PROJECT MANUAL

INCLUDING CONSTRUCTION SPECIFICATIONS

for

BP-S00195
TERMINAL C, PHASE 1X – AIRSIDE CONCOURSE

CONTRACT DOCUMENTS

Addenda Book 4 OF 5
(Addenda Nos. 4 Part 3, 5 and 6)

ORLANDO INTERNATIONAL AIRPORT

Orlando,Florida 32827

GREATER ORLANDO AVIATION AUTHORITY

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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. Hydrant Valve:

1. Eaton.

E. Hydrant Fuel Pit Assembly:

1. Cavotec Dabico, Inc.

F. Low-Point Drain Pit Assemblies:

1. Cavotec Dabico, Inc.

G. High-Point Vent Pit Assemblies:

1. Cavotec Dabico, Inc.

H. Block Valve Pit Assemblies:

1. Cavotec Dabico, Inc.

I. Dry Disconnect Adapters:

1. OPW.
2. Approved equal.

J. Pressure Gauges:

1. Ashcroft (Model 1009).
2. Wika.
3. Approved equal.

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 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.

2.6 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."

2.7 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.

2.8 DRY DISCONNECT ADAPTER.

A. Shall be a Kamvalock dry disconnect adapter with dust cap, size as indicated.

B. Construction of adaptor and cap shall be aluminum.

2.9 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.

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. 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.

4. 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. 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.

I. Make modifications to existing block valve pits and described on the contract drawings.

PART 4 – METHOD OF MEASUREMENT

4.1 METHOD OF MEASUREMENT

Method of Measurement for hydrant pit assemblies shall be per each assembly installed in place, completed and accepted. All pits, pipe, fittings, valves, lids, embedment, backfill and compaction, supports, concrete pads, and any ancillary items necessary for installation shall be included in the contract unit price.

Method of Measurement for high-point vent pit assemblies shall be per each assembly installed in place, completed and accepted. All pits, pipe, fittings, valves, lids, embedment, backfill and compaction, supports, concrete pads, and any ancillary items necessary for installation shall be included in the contract unit price.

Method of Measurement for low-point drain pit assemblies shall be per each assembly installed in place, completed and accepted. All pits, pipe, fittings, valves, lids, embedment, backfill and compaction, supports, concrete pads, and any ancillary items necessary for installation shall be included in the contract unit price.

Method of Measurement for block valve pits shall be per each assembly installed in place, completed and accepted. All pits, pipe, fittings, valves, lids, embedment, backfill and compaction, supports, concrete pads, and any ancillary items necessary for installation shall be included in the contract unit price.

Method of Measurement for modifications to existing block valve pit shall be per each valve pit being modified. All pipe, fittings, equipment, supports, and ancillary items necessary to complete the modifications indicated shall be included in the contract unit price.

PART 5 – BASIS OF PAYMENT

5.1 METHOD OF MEASUREMENT

These contract prices shall fully compensate the Contractor for furnishing all material and for all preparation, excavation, and installation of these items, and for all labor, equipment, tools and incidentals necessary to complete the item.

Bid Item 33 52 47-5.1	Hydrant Pit Assembly	per Each
Bid Item 33 52 47-5.2	Hight Point Vent Pit Assembly	per Each
Bid Item 33 52 47-5.3	Low Point Drain Pit Assembly	per Each
Bid Item 33 52 47-5.4	Block Valve Pits	per Each
Bid Item 33 52 47-5.5	Modifications to Existing Block Valve Pit	per Each

END OF SECTION 33 52 47

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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°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 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”/18” pipe from BV-9 to the end of the pipe loop on the South and the pipe from BV-10B to the end cap on the South.

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 velocity 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 Criteria:

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 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 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 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.

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 performed 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.

PART 4 – METHOD OF MEASUREMENT

4.1 METHOD OF MEASUREMENT

Method of Measurement for jet fuel system testing shall be lump sum for completed and accepted testing and inspection of the system. All pressure testing, weld inspections, coating inspections, testing, soak testing, and any other testing and inspection necessary for completion of the system shall be included in the contract unit price.

Method of Measurement for jet fuel system flushing and pigging shall be lump sum for completed and accepted flushing and pigging the system. All flushing and pigging equipment, materials, rentals, supporting personnel, fuel transportation, laboratory testing, and preparation of a flushing and pigging plan shall be included in the contract unit price.

Method of Measurement for jet fuel system performance testing shall be lump sum for completed and accepted performance testing of the system. All adjustments, inspections, labor and materials necessary to test the jet fuel system, along with preparation of all required testing plans, records, forms, and training materials shall be included in the contract unit price.

PART 5 – BASIS OF PAYMENT

5.1 BASIS OF PAYMENT

These contract prices shall fully compensate the Contractor for furnishing all materials, labor, support and reports for these items, and for all labor, equipment, tools and incidentals necessary to complete the item.

Bid Item 33 52 53-5.1	Fuel System Testing	per Lump Sum
Bid Item 33 52 53-5.2	Fuel System Flushing and Pigging	per Lump Sum
Bid Item 33 52 53-5.3	Fuel System Performance Testing	per Lump Sum

END OF SECTION 33 52 53

Item C-100 Contractor Quality Control Program (CQCP)

100-1 General. Quality is more than test results. Quality is the combination of proper materials, testing, workmanship, equipment, inspection, and documentation of the project. Establishing and maintaining a culture of quality is key to achieving a quality project. The Contractor shall establish, provide, and maintain an effective Contractor Quality Control Program (CQCP) that details the methods and procedures that will be taken to assure that all materials and completed construction required by this contract conform to contract plans, technical specifications and other requirements, whether manufactured by the Contractor, or procured from subcontractors or vendors. Although guidelines are established and certain minimum requirements are specified here and elsewhere in the contract technical specifications, the Contractor shall assume full responsibility for accomplishing the stated purpose.

The Contractor shall establish a CQCP that will:

a. Provide qualified personnel to develop and implement the CQCP.

b. Provide for the production of acceptable quality materials.

c. Provide sufficient information to assure that the specification requirements can be met.

d. Document the CQCP process.

The Contractor shall not begin any construction or production of materials to be incorporated into the completed work until the CQCP has been reviewed and approved by the ~~Resident Project Representative (RPR)~~ **Owner's Authorized Representative (OAR)**. No partial payment will be made for materials subject to specific quality control (QC) requirements until the CQCP has been reviewed and approved.

The QC requirements contained in this section and elsewhere in the contract technical specifications are in addition to and separate from the quality assurance (QA) testing requirements. QA testing requirements are the responsibility of the ~~RPR~~ **OAR** or Contractor as specified in the specifications.

A Quality Control (QC)/Quality Assurance (QA) workshop with the Engineer, ~~Resident Project Representative (RPR)~~ **OAR**, Contractor, subcontractors, testing laboratories, and Owner's representative must be held prior to start of construction. The QC/QA workshop will be facilitated by the Contractor. The Contractor shall coordinate with the Airport and the ~~RPR~~ **OAR** on time and location of the QC/QA workshop. Items to be addressed, at a minimum, will include:

a. Review of the CQCP including submittals, QC Testing, Action & Suspension Limits for Production, Corrective Action Plans, Distribution of QC reports, and Control Charts.

b. Discussion of the QA program.

c. Discussion of the QC and QA Organization and authority including coordination and information exchange between QC and QA.

d. Establish regular meetings to discuss control of materials, methods and testing.

e. Establishment of the overall QC culture.

100-2 Description of program.

a. General description. The Contractor shall establish a CQCP to perform QC inspection and testing of all items of work required by the technical specifications, including those performed by subcontractors. The CQCP shall ensure conformance to applicable specifications and plans with respect to materials, off-site fabrication, workmanship, construction, finish, and functional performance. The CQCP shall be effective for control of all construction work performed under this Contract and shall specifically include surveillance and tests required by the technical specifications, in addition to other requirements of this section and any other activities deemed necessary by the Contractor to establish an effective level of QC.

b. Contractor Quality Control Program (CQCP). The Contractor shall describe the CQCP in a written document that shall be reviewed and approved by the ~~RPR~~ **OAR** prior to the start of any production, construction, or off-site fabrication. The written CQCP shall be submitted to the ~~RPR~~ **OAR** for review and approval at least 10 calendar days before the CQCP Workshop. The Contractor's CQCP and QC testing laboratory must be approved in writing by the ~~RPR~~ **OAR** prior to the Notice to Proceed (NTP).

The CQCP shall be organized to address, as a minimum, the following:

1. QC organization and resumes of key staff
2. Project progress schedule
3. Submittals schedule
4. Inspection requirements
5. QC testing plan
6. Documentation of QC activities and distribution of QC reports
7. Requirements for corrective action when QC and/or QA acceptance criteria are not met
8. Material quality and construction means and methods. Address all elements applicable to the project that affect the quality of the pavement structure including subgrade, subbase, base, and surface course. Some elements that must be addressed include, but is not limited to mix design, aggregate grading, stockpile management, mixing and transporting, placing and finishing, quality control testing and inspection, smoothness, laydown plan, equipment, and temperature management plan.

The Contractor must add any additional elements to the CQCP that is necessary to adequately control all production and/or construction processes required by this contract.

100-3 CQCP organization. The CQCP shall be implemented by the establishment of a QC organization. An organizational chart shall be developed to show all QC personnel, their authority, and how these personnel integrate with other management/production and construction functions and personnel.

The organizational chart shall identify all QC staff by name and function, and shall indicate the total staff required to implement all elements of the CQCP, including inspection and testing for each item of work. If necessary, different technicians can be used for specific inspection and testing functions for different items of work. If an outside organization or independent testing laboratory is used for implementation of all or part of the CQCP, the personnel assigned shall be

subject to the qualification requirements of paragraphs 100-03a and 100-03b. The organizational chart shall indicate which personnel are Contractor employees and which are provided by an outside organization.

The QC organization shall, as a minimum, consist of the following personnel:

a. Program Administrator. The Contractor Quality Control Program Administrator (CQCPA) must be a full-time employee of the Contractor, or a consultant engaged by the Contractor. The CQCPA must have a minimum of five (5) years of experience in QC pavement construction with prior QC experience on a project of comparable size and scope as the contract.

Included in the five (5) years of paving/QC experience, the CQCPA must meet at least one of the following requirements:

(1) Professional Engineer with one (1) year of airport paving experience.

(2) Engineer-in-training with two (2) years of airport paving experience.

(3) National Institute for Certification in Engineering Technologies (NICET) Civil Engineering Technology Level IV with three (3) years of airport paving experience.

(4) An individual with four (4) years of airport paving experience, with a Bachelor of Science Degree in Civil Engineering, Civil Engineering Technology or Construction.

The CQCPA must have full authority to institute any and all actions necessary for the successful implementation of the CQCP to ensure compliance with the contract plans and technical specifications. The CQCPA authority must include the ability to immediately stop production until materials and/or processes are in compliance with contract specifications. The CQCPA must report directly to a principal officer of the construction firm. The CQCPA may supervise the Quality Control Program on more than one project provided that person can be at the job site within two (2) hours after being notified of a problem.

b. QC technicians. A sufficient number of QC technicians necessary to adequately implement the CQCP must be provided. These personnel must be either Engineers, engineering technicians, or experienced craftsman with qualifications in the appropriate field equivalent to NICET Level II in Civil Engineering Technology or higher, and shall have a minimum of two (2) years of experience in their area of expertise.

The QC technicians must report directly to the CQCPA and shall perform the following functions:

(1) Inspection of all materials, construction, plant, and equipment for conformance to the technical specifications, and as required by paragraph 100-6.

(2) Performance of all QC tests as required by the technical specifications and paragraph100-8.

(3) Performance of tests for the ~~RPR~~ **OAR** when required by the technical specifications.

Certification at an equivalent level of qualification and experience by a state or nationally recognized organization will be acceptable in lieu of NICET certification.

c. Staffing levels. The Contractor shall provide sufficient qualified QC personnel to monitor each work activity at all times. Where material is being produced in a plant for incorporation into the work, separate plant and field technicians shall be provided at each plant and field placement location. The scheduling and coordinating of all inspection and testing must match

the type and pace of work activity. The CQCP shall state where different technicians will be required for different work elements.

100-4 Project progress schedule. Critical QC activities must be shown on the project schedule as required by Section 80, paragraph 80-03, *Execution and Progress*.

100-5 Submittals schedule. The Contractor shall submit a detailed listing of all submittals (for example, mix designs, material certifications) and shop drawings required by the technical specifications. The listing can be developed in a spreadsheet format and shall include as a minimum:

a. Specification item number

b. Item description

c. Description of submittal

d. Specification paragraph requiring submittal

e. Scheduled date of submittal

100-6 Inspection requirements. QC inspection functions shall be organized to provide inspections for all definable features of work, as detailed below. All inspections shall be documented by the Contractor as specified by paragraph 100-9.

Inspections shall be performed as needed to ensure continuing compliance with contract requirements until completion of the particular feature of work. Inspections shall include the following minimum requirements:

a. During plant operation for material production, QC test results and periodic inspections shall be used to ensure the quality of aggregates and other mix components, and to adjust and control mix proportioning to meet the approved mix design and other requirements of the technical specifications. All equipment used in proportioning and mixing shall be inspected to ensure its proper operating condition. The CQCP shall detail how these and other QC functions will be accomplished and used.

b. During field operations, QC test results and periodic inspections shall be used to ensure the quality of all materials and workmanship. All equipment used in placing, finishing, and compacting shall be inspected to ensure its proper operating condition and to ensure that all such operations are in conformance to the technical specifications and are within the plan dimensions, lines, grades, and tolerances specified. The CQCP shall document how these and other QC functions will be accomplished and used.

100-7 Contractor QC testing facility.

a. For projects that include Item P-401, Item P-403, and Item P-404, the Contractor shall ensure facilities, including all necessary equipment, materials, and current reference standards, are provided that meet requirements in the following paragraphs of ASTM D3666, *Standard Specification for Minimum Requirements for Agencies Testing and Inspecting Road and Paving Materials*:

8.1.3 Equipment Calibration and Checks;

8.1.9 Equipment Calibration, Standardization, and Check Records;

8.1.12 Test Methods and Procedures

b. For projects that include P-501, the Contractor shall ensure facilities, including all necessary equipment, materials, and current reference standards, are provided that meet requirements in the following paragraphs of ASTM C1077, Standard Practice for Agencies Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Testing Agency Evaluation:

7 Test Methods and Procedures

8 Facilities, Equipment, and Supplemental Procedures

100-8 QC testing plan. As a part of the overall CQCP, the Contractor shall implement a QC testing plan, as required by the technical specifications. The testing plan shall include the minimum tests and test frequencies required by each technical specification Item, as well as any additional QC tests that the Contractor deems necessary to adequately control production and/or construction processes.

The QC testing plan can be developed in a spreadsheet fashion and shall, as a minimum, include the following:

a. Specification item number (e.g., P-401)

b. Item description (e.g., Hot Mix Asphalt Pavements)

c. Test type (e.g., gradation, grade, asphalt content)

d. Test standard (e.g., ASTM or American Association of State Highway and Transportation Officials (AASHTO) test number, as applicable)

e. Test frequency (e.g., as required by technical specifications or minimum frequency when requirements are not stated)

f. Responsibility (e.g., plant technician)

g. Control requirements (e.g., target, permissible deviations)

The QC testing plan shall contain a statistically-based procedure of random sampling for acquiring test samples in accordance with ASTM D3665. The ~~RPR~~ **OAR** shall be provided the opportunity to witness QC sampling and testing.

All QC test results shall be documented by the Contractor as required by paragraph 100-9.

100-9 Documentation. The Contractor shall maintain current QC records of all inspections and tests performed. These records shall include factual evidence that the required QC inspections or tests have been performed, including type and number of inspections or tests involved; results of inspections or tests; nature of defects, deviations, causes for rejection, etc.; proposed remedial action; and corrective actions taken.

These records must cover both conforming and defective or deficient features, and must include a statement that all supplies and materials incorporated in the work are in full compliance with the terms of the contract. Legible copies of these records shall be furnished to the ~~RPR~~ **OAR** daily. The records shall cover all work placed subsequent to the previously furnished records and shall be verified and signed by the CQCPA.

Contractor QC records required for the contract shall include, but are not necessarily limited to, the following records:

a. Daily inspection reports. Each Contractor QC technician shall maintain a daily log of all inspections performed for both Contractor and subcontractor operations. These technician's daily reports shall provide factual evidence that continuous QC inspections have been performed and shall, as a minimum, include the following:

(1) Technical specification item number and description
(2) Compliance with approved submittals
(3) Proper storage of materials and equipment
(4) Proper operation of all equipment
(5) Adherence to plans and technical specifications
(6) Summary of any necessary corrective actions
(7) Safety inspection.
(8) Photographs and/or video

The daily inspection reports shall identify all QC inspections and QC tests conducted, results of inspections, location and nature of defects found, causes for rejection, and remedial or corrective actions taken or proposed.

The daily inspection reports shall be signed by the responsible QC technician and the CQCPA. The ~~RPR~~ **OAR** shall be provided at least one copy of each daily inspection report on the work day following the day of record. When QC inspection and test results are recorded and transmitted electronically, the results must be archived.

b. Daily test reports. The Contractor shall be responsible for establishing a system that will record all QC test results. Daily test reports shall document the following information:

(1) Technical specification item number and description
(2) Test designation
(3) Location
(4) Date of test
(5) Control requirements
(6) Test results
(7) Causes for rejection
(8) Recommended remedial actions
(9) Retests

Test results from each day's work period shall be submitted to the ~~RPR~~ **OAR** prior to the start of the next day's work period. When required by the technical specifications, the Contractor shall maintain statistical QC charts. When QC daily test results are recorded and transmitted electronically, the results must be archived.

100-10 Corrective action requirements. The CQCP shall indicate the appropriate action to be taken when a process is deemed, or believed, to be out of control (out of tolerance) and detail what action will be taken to bring the process into control. The requirements for corrective action shall include both general requirements for operation of the CQCP as a whole, and for individual items of work contained in the technical specifications.

The CQCP shall detail how the results of QC inspections and tests will be used for determining the need for corrective action and shall contain clear rules to gauge when a process is out of control and the type of correction to be taken to regain process control.

When applicable or required by the technical specifications, the Contractor shall establish and use statistical QC charts for individual QC tests. The requirements for corrective action shall be linked to the control charts.

100-11 Inspection and/or observations by the ~~RPR~~ OAR. All items of material and equipment are subject to inspection and/or observation by the ~~RPR~~ **OAR** at the point of production, manufacture or shipment to determine if the Contractor, producer, manufacturer or shipper maintains an adequate QC system in conformance with the requirements detailed here and the applicable technical specifications and plans. In addition, all items of materials, equipment and work in place shall be subject to inspection and/or observation by the ~~RPR~~ **OAR** at the site for the same purpose.

Inspection and/or observations by the ~~RPR~~ **OAR** does not relieve the Contractor of performing QC inspections of either on-site or off-site Contractor's or subcontractor's work.

100-12 Noncompliance.

a. The ~~Resident Project Representative (RPR)~~ **OAR** will provide written notice to the Contractor of any noncompliance with their CQCP. After receipt of such notice, the Contractor must take corrective action.

b. When QC activities do not comply with either the CQCP or the contract provisions or when the Contractor fails to properly operate and maintain an effective CQCP, and no effective corrective actions have been taken after notification of non-compliance, the ~~RPR~~ **OAR** will recommend the Owner take the following actions:

(1) Order the Contractor to replace ineffective or unqualified QC personnel or subcontractors and/or

(2) Order the Contractor to stop operations until appropriate corrective actions are taken.

METHOD OF MEASUREMENT

100-13 Basis of measurement and payment. [Not Used] [Contractor Quality Control Program (CQCP) is for the personnel, tests, facilities and documentation required to implement the CQCP. The CQCP will be paid as a lump sum with the following schedule of partial payments:]

a. With first pay request, 25% with approval of CQCP and completion of the Quality Control (QC)/Quality Assurance (QA) workshop.

b. When 25% or more of the original contract is earned, an additional 25%.

c. When 50% or more of the original contract is earned, an additional 20%.

d. When 75% or more of the original contract is earned, an additional 20%

e. After final inspection and acceptance of project, the final 10%.**]**

BASIS OF PAYMENT

100-14 Payment will be made under:

Item C-100-14.1 Contractor Quality Control Program (CQCP)

REFERENCES

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

National Institute for Certification in Engineering Technologies (NICET)

ASTM International (ASTM)

ASTM C1077	Standard Practice for Agencies Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Testing Agency Evaluation
ASTM D3665	Standard Practice for Random Sampling of Construction Materials
ASTM D3666	Standard Specification for Minimum Requirements for Agencies Testing and Inspecting Road and Paving Materials

END OF ITEM C-100

Item C-102 Temporary Air and Water Pollution, Soil Erosion, and Siltation Control

DESCRIPTION

102-1. This item shall consist of temporary control measures as shown on the plans or as ordered by the ~~Resident Project Representative (RPR)~~ **Owner Authorized Representative (OAR)** during the life of a contract to control pollution of air and water, soil erosion, and siltation through the use of silt fences, berms, dikes, dams, sediment basins, fiber mats, gravel, mulches, grasses, slope drains, and other erosion control devices or methods.

Temporary erosion control shall be in accordance with the approved erosion control plan; the approved Construction Safety and Phasing Plan (CSPP) and AC 150/5370-2, *Operational Safety on Airports During Construction*. The temporary erosion control measures contained herein shall be coordinated with the permanent erosion control measures specified as part of this contract to the extent practical to assure economical, effective, and continuous erosion control throughout the construction period.

Temporary control may include work outside the construction limits such as borrow pit operations, equipment and material storage sites, waste areas, and temporary plant sites.

Temporary control measures shall be designed, installed and maintained to minimize the creation of wildlife attractants that have the potential to attract hazardous wildlife on or near public-use airports.

Contractor shall prepare all required documentation, pay all fees and perform all services and work necessary to obtain all permits from appropriate local, state, and federal regulatory agencies for Contractor's staging, stockpile, blending and batch plant areas and operations. In compliance with the National Pollutant Discharge Elimination System (NPDES) permit issued or approved by U.S. Environmental Protection Agency (EPA) pursuant to 40CFR Part 122.6, the contractor shall prepare a project specific erosion control as part of a Stormwater Pollution Prevention Plan.

Contractor's Pollution Control Plan. The Contractor's pollution control plan shall address all measures to dispose of, control, or prevent discharge of solid, hazardous and sanitary wastes to the waters of the U.S. The plan shall include procedures to control offsite tracking of soil by vehicles and construction equipment; and procedures for cleanup and reporting of non-stormwater discharges (such as accidental spills). The Contractor shall adhere to the requirements set forth by the Florida Department of Environmental Protection (FDEP) document No. 62-621.300(4)(a), Florida Statute Section 403.0885, and Florida Administrative Code (F.A.C.) 62-62-4.050(4)(d). The pollution plan may be part of the Environmental Resource Permit review and approval process required by South Florida Water Management District (SFWMD).

Contractor shall adhere to all requirements set forth in the GOAA Master Water Use Permit No. 48-02319-W and must obtain a letter modification prior to commencement of any dewatering activities.

102-1.2 Coordination and Corrective Requirements. The installation of temporary erosion control features shall be coordinate with the construction of any permanent erosion control features to the extent necessary to assure economical, effective, and continuous control of erosion and water pollution throughout the life of the contract.

In cases of repeated failures on the part of the Contractor to control erosion and pollution, right is reserved by the OAR to employ outside assistance to provide such corrective measures and actions deemed appropriate by the OAR to correct the condition(s) and/or to direct the Contractor to perform other work as required by the circumstances. Such measures which may be ordered by the OAR may consist of reconstruction of berms, dikes, dams, drains, sediment basins, ditches, canals, or the use of fiber mats, woven plastic filter cloths, gravel, mulches, quick growing grasses, sod, bituminous spray, and other erosion control devices or methods deemed appropriate under the circumstance(s). The Contractor will be responsible for all costs associated with this requirement.

~~Such incurred costs, including related Engineering costs, will be charged to the Contractor and appropriate deductions made from the Contractor's progress payments~~.

102-1.3 Control of Water Pollution. The Contractor shall take sufficient precautions to prevent pollution of streams, canals, lakes, reservoirs, and other water bodies with fuels, oils, bitumens, calcium chloride, or other harmful materials.

Contractor shall also conduct and schedule operations in such a manner as to avoid or otherwise minimize pollution or siltation of such streams, lakes, and other water bodies, and to avoid interference with natural movements of migratory fish. No residue from dust collectors or washers shall be dumped into any water body whatsoever.

Contractor shall not cause runoff from water controls to exceed 29 Nephelometric Turbidity Units (NTU) above background values. Contractor shall take all necessary steps to meet this requirement.

Except as necessary for construction, excavated materials shall not be deposited in close proximity to waterways and/or water bodies to be washed away by high water and/or runoff.

The Contractor shall not disturb lands or waters outside of the limits of construction as staked, except as may be found necessary and authorized by OAR.

The location of and method of operation for borrow pits, material pits, staging and plant sites and disposal areas for wasted materials from the project (other than commercial operated sources) shall meet the approval of the OAR as being such that erosion during and after completion of the work will not result in the probability of detrimental siltation and/or water pollution.

MATERIALS

102-2.1 Grass. Grass that will not compete with the grasses sown later for permanent cover per Item T-901shall be a quick-growing species (such as ryegrass, Italian ryegrass, or cereal grasses) suitable to the area providing a temporary cover. Selected grass species shall not create a wildlife attractant.

102-2.2 Mulches. Mulches may be hay, straw, fiber mats, netting, bark, wood chips, or other suitable material reasonably clean and free of noxious weeds and deleterious materials per Item T-908. Mulches shall not create a wildlife attractant.

102-2.3 Fertilizer. Fertilizer shall be a standard commercial grade and shall conform to all federal and state regulations and to the standards of the Association of Official Agricultural Chemists.

102-2.4 Slope drains. Slope drains may be constructed of pipe, fiber mats, rubble, concrete, asphalt, or other materials that will adequately control erosion.

102-2.5 Silt fence. Silt fence shall consist of polymeric filaments which are formed into a stable network such that filaments retain their relative positions. Synthetic filter fabric shall contain ultraviolet ray inhibitors and stabilizers to provide a minimum of six months of expected usable construction life. Silt fence shall meet the requirements of ASTM D6461 ***and FDOT Standard Specifications Section 104-6.4.10.***.

102-2.6 Baled Hay or Straw. Baled hay or straw shall meet the requirements of FDOT Standard Specifications Section 104-6.4.9.

102-2.7 Sand Bags. Sand bagging shall consist of furnishing and placing sand bags in configurations and/or piles so as to effectively control erosion and siltation.

102-2.8 Turbidity Barriers. Turbidity barriers shall meet the requirements of FDOT Standard Specifications Section 104-6.4.11.

102-2.9 Watering and Dust Control. Watering of the site shall be as required to control blowing dust on open excavations, including subgrade and lime rock surfaces. The Contractor shall apply supplemental water to the areas as required and/or directed by the OAR to mitigate blowing dust and debris. This requirement shall be in addition to water required for compaction purposes. The Contractor shall obtain approval from the OAR and make all arrangements to obtain water from suitable sources on the site. ~~Contractor shall also pay all costs for establishing and removing all apparatus required for watering~~

102-2.10 Sock Pipe/Horizontal Wells. Sock Pipe/Horizontal Wells shall include the installation of a pumping system or other approved methods of containing perforated plastic pipes, wrapped twice in filter fabric, in a horizontal fashion along the bottom of the excavation pit to be dewatered, as necessary. The Sock Pipe/Horizontal Well shall be used to remove excess surface water, if necessary. The excess surface water shall be filtered and discharged into the existing catch basins provided no visible sediment is discharged. If, in the opinion of the OAR, an excess of sediment is being discharged into the existing catch basin, pumping shall be halted until additional filtering methods can be exercised. Pumping of the water into existing stormwater treatment ponds will not be allowed without prior approval of the OAR.

102-2.11 Catch Basin Filter Fabric. Catch Basin Filter Fabric protection shall consists of placing approved filter fabric material underneath the grate or covering of existing catch basins, inlets, and manholes, as indicated within the plans. Filter fabric shall be placed in two separate layers, each running perpendicular to each other. The filter fabric layers shall be secured to the bottom of the grate or covering and shall extend at least 12 inches beyond the edge when the grate is placed in its sealed position. The fabric shall be neatly folded over and secured to each other with suitable fasteners.

102-2.12 Other. All other materials shall meet commercial grade standards and shall be approved by the ~~RPR~~ **OAR** before being incorporated into the project.

CONSTRUCTION REQUIREMENTS

102-3.1 General. In the event of conflict between these requirements and pollution control laws, rules, or regulations of other federal, state, or local agencies, the more restrictive laws, rules, or regulations shall apply.

The ~~RPR~~ **OAR** shall be responsible for assuring compliance to the extent that construction practices, construction operations, and construction work are involved. ***Acceptance will be on the basis of visual inspection by the OAR.***

102-3.2 Schedule. Prior to the start of construction, the Contractor shall submit schedules in accordance with the approved Construction Safety and Phasing Plan (CSPP) and the plans for accomplishment of temporary and permanent erosion control work for clearing and grubbing; grading; construction; paving; and structures at watercourses. The Contractor shall also submit a proposed method of erosion and dust control on haul roads and borrow pits and a plan for disposal of waste materials. Work shall not be started until the erosion control schedules and methods of operation for the applicable construction have been accepted by the ~~RPR~~ **OAR**.

The Contractor shall schedule operations such that the area of unprotected erodible earth exposed at any one time is not larger than that of the minimum area necessary for efficient construction operations and the duration of the exposed, uncompleted construction to the elements shall be as short as practicable.

"The erosion control plan identified in the plans is provided as a minimum requirement. Contractor is solely responsible for preventing turbidity and for conforming to SFWMD and NPDES permits. Contractor shall submit their erosion and turbidity control plan to the OAR at the Preconstruction Conference. The Plan shall include a maintenance schedule for rehabilitation of the items contained within the erosion control plan. The submitted plan shall be reviewed by the OAR and the Contractor shall incorporate comments received from the OAR.

102-3.3 Construction details. The Contractor will be required to incorporate all permanent erosion control features into the project at the earliest practicable time as outlined in the plans and approved CSPP. Except where future construction operations will damage slopes, the Contractor shall perform the permanent seeding and mulching and other specified slope protection work in stages, as soon as substantial areas of exposed slopes can be made available. Temporary erosion and pollution control measures will be used to correct conditions that develop during construction that were not foreseen during the design stage; that are needed prior to installation of permanent control features; or that are needed temporarily to control erosion that develops during normal construction practices, but are not associated with permanent control features on the project.

Where erosion may be a problem, schedule and perform clearing and grubbing operations so that grading operations and permanent erosion control features can follow immediately if project conditions permit. Temporary erosion control measures are required if permanent measures cannot immediately follow grading operations. The ~~RPR~~ **OAR** shall limit the area of clearing and grubbing, excavation, borrow, and embankment operations in progress, commensurate with the Contractor's capability and progress in keeping the finish grading, mulching, seeding, and other such permanent control measures current with the accepted schedule. If seasonal limitations make such coordination unrealistic, temporary erosion control measures shall be taken immediately to the extent feasible and justified as directed by the ~~RPR~~ **OAR**.

The Contractor shall provide immediate permanent or temporary pollution control measures to minimize contamination of adjacent streams or other watercourses, lakes, ponds, or other areas of water impoundment as directed by the ~~RPR~~ **OAR**. ~~I~~If temporary erosion and pollution control measures are required due to the Contractor's negligence, carelessness, or failure to install permanent controls as a part of the work as scheduled or directed by the ~~RPR~~ **OAR**, the work shall be performed by the Contractor and the cost shall be incidental to this item.

The ~~RPR~~ **OAR** may increase or decrease the area of erodible earth material that can be exposed at any time based on an analysis of project conditions.

The erosion control features installed by the Contractor shall be maintained by the Contractor during the construction period.

Provide temporary structures whenever construction equipment must cross watercourses at frequent intervals. Pollutants such as fuels, lubricants, bitumen, raw sewage, wash water from concrete mixing operations, and other harmful materials shall not be discharged into any waterways, impoundments or into natural or manmade channels.

Typical methods of controlling dust and other air pollutants may include exposing the minimum of erodible earth, applying temporary mulch with or without seeding, using water sprinkler trucks, using covered haul trucks, using dust palliatives or penetration asphalt on haul roads, and/or using plastic sheet coverings.

102-3.3.1 Details for Temporary Erosion Control Features. Temporary erosion control features shall consist of, but not limited to: sand bagging, slope draining, sediment basins, sediment checks, artificial coverings and berms per Florida Department of Transportation standards. The OAR may direct use of temporary erosion control features or methods other than those included in the original contract.

A. Slope Drains. Slope drains shall consist of constructing slope drains utilizing pipe, fiber mats, rubble, cement concrete, asphaltic concrete sheeting or other acceptable materials as may be approved by the OAR.

B. Sediment Basins. Sediment basins shall consist of constructing basins accordance with the details shown on the drawings or as may be approved by the OAR to adequately perform the intended function. Sediment basins shall be cleaned out whenever they are half full or as directed by the OAR.

C. Sediment Checks, Hay Bales, and Silt Fences. Sediment checks shall consist of constructing checks, dams, bales, and/or silt fences as may be approved by the OAR. Prior to the beginning of construction, the area immediately downstream of construction shall be cross-section surveyed to determine existing conditions. Once construction has been completed and just prior to project acceptance, the area shall be cross-section surveyed again. Any silt and washed materials deposited in these areas shall be removed.

The upstream side of each installation shall be checked periodically throughout construction for siltation and deposits. Unless otherwise directed by the OAR, any sediment or deposits in excess of six (6) inches shall be removed.

The checks shall be maintained by the Contractor for the period of the contract. Just prior to the acceptance of the project, the checks shall be removed by the Contractor unless requested by the OAR that they are to be allowed to remain.

D. Artificial Coverings. Artificial Coverings shall consist of furnishing and applying fiber mats, netting, plastic sheeting or other approved covering to the earth surfaces.

E. Berms. Berms shall consist of the construction of temporary earth berms to divert the flow of water from an erodible surface.

F. Fertilizer. Fertilizer shall be a standard commercial grade material and shall conform to all Federal and State regulations in addition to the standards of the Association of Official Agricultural Chemists.

102-3.4 Installation, maintenance and removal of silt fence. Silt fences shall extend a minimum of 16 inches (41 cm) and a maximum of 34 inches (86 cm) above the ground surface. Posts shall be set no more than 10 feet (3 m) on center. Filter fabric shall be cut from a continuous roll to the length required minimizing joints where possible. When joints are necessary, the fabric shall be spliced at a support post with a minimum 12-inch (300-mm) overlap and securely sealed. A trench shall be excavated approximately 4 inches (100 mm) deep by 4 inches (100 mm) wide on the upslope side of the silt fence. The trench shall be backfilled and the soil compacted over the silt fence fabric. The Contractor shall remove and dispose of silt that accumulates during construction and prior to establishment of permanent erosion control. The fence shall be maintained in good working condition until permanent erosion control is established. Silt fence shall be removed upon approval of the ~~RPR~~ **OAR**.

102-3.5 Local Laws, Rules, and Regulations. In the event of differences between these requirements and pollution control laws, rules or regulations of local agencies, the more restrictive laws, rules, and/or regulations shall apply.

A. The Contractor shall file a Notice of Intent (NOI) for coverage under the State of Florida Generic Permit for Stormwater Discharge from Large and Small Construction Activities issued under the provisions of the National Pollutant Discharge Elimination System (NPDES). Guidance for and requirements of the NOI, Generic Permit and NPDES are available through the Florida Department of Environmental Regulation website at www.dep.state.fl.us .

B. The Contractor shall furnish, as submittals to the OAR and Owner, hardcopy and digital documentation for the NOI, the Contractor's Stormwater Pollution Prevention Plan to be implemented for this project, and the Notice of Termination (NOT) filed upon completion of the project.

C. A Construction Stormwater Pollution Prevention Plan Template is in the Florida Stormwater Erosion and Sedimentation Control Inspector's Manual, dated October 2018, or more current edition, available through the Florida Department of Environmental Protection regulation website at www.dep.state.fl.us .

102-3.6 Maintenance of Erosion Control Features

A. Routine Maintenance. The Contractor, at his/her expense, shall provide routine maintenance of permanent and temporary erosion control features until the project is completed and accepted. If such erosion control features must be reconstructed due to the Contractor's negligence or carelessness or, in the case of temporary erosion control features, failure by the Contractor to install permanent erosion control features as scheduled, such replacement (labor, tools, equipment, materials, fines, etc.) shall be at the Contractor's expense.

Routine Maintenance to control dust and other air pollutants shall include, in addition to other methods mentioned herein, using water sprinkler trucks and covered haul trucks.

B. <u>Mowing.</u> The OAR may direct mowing of areas of permanent or temporary grass constructed on the project. The Contractor shall mow these designated areas within seven (7) days of receiving such order. Mowing of slopes which are steeper than four horizontal to one vertical will not be required.

C. <u>Suspension of Contractor Operations.</u> In the event that is necessary that the construction operations be suspended for any appreciable length of time, the Contractor shall shape the work in such a manner as to permit runoff of stormwater and shall construct earth berms along the top edges of the embankments to intercept runoff water. Temporary slope drains shall be provided to convey runoff from cuts and embankments which are located in the vicinity of rivers, streams, canals, lakes, ditches, improved water bodies, and/or water bodies. The slope drains shall be located at the intervals of approximately five hundred feet (500-FT) and shall be stabilized by paving or covering with water proof materials. Should such preventative measures fail, the Contractor shall immediately take other action necessary to effectively prevent erosion and siltation.

The OAR may direct the Contractor to perform, during such suspensions of time, any other erosion control work deemed necessary. The Contractor shall monitor the project and maintain all erosion control features during any suspension of contract time or work.

102-3.7 Proposed Plan of Operation. At the Pre-Construction Conference, the Contractor shall be prepared to present the proposed plans and schedules for the project in accordance with the requirements of this section. The schedule shall be in written form and approved by the OAR prior to the processing of the first partial pay request. This requirement shall not be waived. This schedule shall specifically indicate the sequence of operations and construction of permanent erosion control features and the proposed uses of temporary erosion control features. It shall also include proposed methods to prevent pollution of the streams, lakes, ditches, canals, tidal waters, reservoirs, and other impoundments as the result of construction operations. The Contractor shall also outline his proposed methods of controlling erosion and preventing pollution on haul roads/routes and in borrow pits, material pits, staging and plant sites, and areas used for disposal of waste materials from the project.

No work shall be started until the aforementioned plans and schedules have been accepted by the OAR. The Contractor will be responsible for the accomplishment of the work in accordance with the accepted plans and schedules. The OAR may approve changes made necessary by unforeseen circumstances or conditions which are beyond the control of the Contractor.

102-3.8 Open Surface Area. The OAR shall limit the surface areas of unprotected erodible earth exposed by excavation operations and shall direct the Contractor to provide immediate permanent or temporary erosion/pollution control measures to prevent contamination of any river, stream, lake, tidal water, reservoir, canal or other impoundment or to prevent detrimental effects on property outside of the project limits and damage to the project. The limitation of area in which operations may be under way shall be commensurate with the Contractor's capability and progress in maintaining erosion control measures current in accordance with the approved schedule.

102-3.9 Coordination with Permanent Construction. Any permanent erosion control features shall be incorporated into the project at the earliest practical time. Except where future construction operations will damage slopes, the Contractor shall perform permanent seeding and mulching and other specific slope protection work in stages, as soon as substantial areas of exposed slopes can be made available. Use of temporary erosion control features will be authorized to correct conditions that develop during construction which were not foreseen at the time of design to control erosion prior to the time it is practical to construct permanent control features or to provide immediate temporary control of erosion that develops during the course of normal construction operations but is not associated with permanent erosion control features of the project. Temporary erosion control features may be authorized for use in controlling erosion in areas where stage construction or other conditions not under the control of the Contractor preclude completion of a section of airfield in a continuous manner and in areas where construction operations which must be performed subsequently will cause damage to permanent erosion control features.

102-3.10 Dewatering / Ground Water Control. The Contractor is completely responsible for the site conditions including but not limited to dewater the project site for groundwater and stormwater runoff conditions. A dewatering plan shall be submitted by the contractor to the OAR for review prior to the start of construction. ~~The Contractor shall file for any dewatering permits required, shall pay for all costs associated with dewatering and dewatering permits, and shall implement dewatering in compliance with local water management district, the Airport's SWPPP plan, and any FDEP and/or NPDES requirements simultaneously~~. Contractor shall adhere to all requirements set forth in the GOAA Master Water Use Permit No. 48-02319-W and must obtain a letter modification prior to commencement of any dewatering activities. The type of methods of site dewatering will be by the Contractor (means and methods), and shall be included in the Contractor's bid. ~~If no specific pay item for dewatering is provided within the bid documentation (plans and specifications), the Contractor shall include enough money in one or more other pay items for dewatering~~. Dewatering shall be deployed for the entire duration of the project. No additional compensation will be made to the Contractor for dewatering the project.

The Contractor's attention is directed to the geotechnical engineering report, the boring logs, the contract documents, and/or the plans for water table information. If no water table information is depicted within the contract documents, it is the Contractor's responsibility to request information during bidding. The Contractor should assume that dewatering will be necessary at all times. The requirements of this section are in addition to the General Provisions and Special Provisions requirements.

METHOD OF MEASUREMENT

~~**102-4.1** Temporary erosion and pollution control work required will be performed as scheduled or directed by the RPR **OAR**. Completed and accepted work will be measured as follows:~~

~~**a.** Temporary seeding and mulching will be measured by the square yard (square meter).~~

~~**b.** Temporary slope drains will be measured by the linear foot (meter).~~

~~**c.** Temporary benches, dikes, dams, and sediment basins will be measured by the cubic yard (cubic meter) of excavation performed, including necessary cleaning of sediment basins, and the cubic yard (cubic meter) of embankment placed as directed by the RPR **OAR**.~~

~~**d.** All fertilizing will be measured by the ton (kg).~~

~~**e.** Installation and removal of silt fence will be measured by the linear foot.~~

102-4.1 Temporary erosion and pollution control work required which is not attributed to the Contractors' negligence, carelessness, or failure to install permanent controls which is performed as scheduled or ordered by the OAR or as required to comply with SFWMD permits shall be measured as a lump sum item. Individual items of work shall not be measured separately but shall be considered subsidiary to the lump sum bid item "Erosion and Turbidity Control".

102-4.2 Control work performed for protection of construction areas outside the construction limits, such as borrow and waste areas, haul roads, equipment and material storage sites, and temporary plant sites, will not be measured and paid for directly but shall be considered as a subsidiary obligation of the Contractor.

BASIS OF PAYMENT

~~**102-5.1** Accepted quantities of temporary water pollution, soil erosion, and siltation control work ordered by the RPR **OAR** and measured as provided in paragraph 102-4.1 will be paid for under:~~

~~Item C-102-5.1a Temporary seeding and mulching - per square yard (square meter)~~

~~Item C-102-5.1b Temporary slope drains - per linear foot (meter)~~

~~Item C-102-5.1c Temporary benches, dikes, dams and sediment basins - per cubic yard (cubic meter)~~

~~Item C-102-5.1d Fertilizing - per ton (kg)~~

~~Item C-102-5.1e Installation and removal of silt fence per linear feet~~

~~Where other directed work falls within the specifications for a work item that has a contract price, the units of work shall be measured and paid for at the contract unit price bid for the various items.~~

~~Temporary control features not covered by contract items that are ordered by the RPR **OAR** will be paid for in accordance with Section 90, paragraph 90-05 *Payment for Extra Work*.~~

102-5.1 Accepted quantities of temporary water pollution, soil erosion, and siltation control work shall be paid for at the contract lump sum price bid for "Erosion and Turbidity Control". Payment will be made under:

Item P-102-5.1 Erosion and Turbidity Control – per lump sum

REFERENCES

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

Advisory Circulars (AC)

AC 150/5200-33 *Hazardous Wildlife Attractants on or Near Airports*

AC 150/5370-2 *Operational Safety on Airports During Construction*

ASTM International (ASTM)

ASTM D6461 *Standard Specification for Silt Fence Materials*

United States Department of Agriculture (USDA)

FAA/USDA Wildlife Hazard Management at Airports, A Manual for Airport Personnel

END OF ITEM C-102

ITEM C-106 SAFETY, SECURITY AND MAINTENANCE OF TRAFFIC

PART 1 - DESCRIPTION

1.1 The work of this item shall consist of all labor, material, equipment, work and operations necessary for Maintenance of Traffic both on, and off airport property. Such items include barricades, signage, pavement sweepers, flagmen, radio operators, gate security, worker and personnel transportation and general site security, etc., as required by the Drawings, these specifications, and State and local laws and regulations. Paramount in this item is that aircraft shall have the Right-of-Way at all times. The Contractor shall include all measures required to maintain the safe and orderly movement of Air Operations Area (AOA) traffic in and around the construction areas as shown on the Plans and as described in the Contract documents. The AOA is defined as all areas, used or intended to be used for aircraft operations including active runways, aprons, taxiways and taxilanes. The AOA is generally bounded on this project by 8’ chain link fence with 3-strand barbed wire top, both on the ground and on jersey barrier defining the AOA limits. Maintenance of Traffic off airport property shall be in accordance with the FDOT Standard Specifications for Road and Bridge Construction, the FDOT Standard Index Drawings, and the Manual of Uniform Traffic Control Devices (MUTCD), most current editions.

1.2 GENERAL

This Section covers the Contractor’s responsibilities for maintaining the optimum level of safety and the operating efficiency of the airport during construction. These responsibilities are based on criteria contained in the latest edition of Federal Aviation Administration Advisory Circulars 150/5370-2 “Operational Safety on Airports During Construction”, and 150/5300-13, “Airport Design”. The Contractor shall be responsible for all activities under his control, as specified in the above referenced Advisory Circulars, and in other referenced documents.

1.3 CONSTRUCTION ACTIVITIES

Construction activity, personnel, equipment, and materials shall be permitted only within the designated work areas as defined on the Plans or directed by the Owner’s Authorized Representative (OAR).

1.4 MARKING AND LIGHTING OF CONSTRUCTION AREAS

The Contractor shall install, maintain, move and remove lighting, markings, lighted barricades, and other measures as shown on the plans, described in the Specifications, or directed by the OAR, to delineate access routes, closed areas, and hazardous areas during construction.

1.5 LOOSE MATERIAL AND DEBRIS

Loose materials shall be removed from the Project Limits on a daily basis to prevent dispersion into active portions of the AOA. The Contractor shall exercise care in the transportation of materials within the AOA to ensure that no material is tracked or spilled onto the AOA. Materials tracked or spilled in these areas shall be removed immediately. When hauling, loading, grading, or when any of the Contractor's activities are likely to cause the deposit of loose materials in the AOA or aircraft parking areas, it shall be immediately removed using powered vacuum sweepers which shall continuously patrol the affected areas. The vacuum sweepers shall be supplemented by power brooms with nylon bristles, hand sweepers, loaders, and trucks as necessary. Power brooms and sweepers with metal bristles shall not be used.

1.6 STOCKPILED MATERIALS

At no time shall materials be stockpiled within the Project Limits of the AOA. All materials that are not to be re-used shall be removed directly from the Project Limits or the AOA and hauled to a legal dump site off airport property.

1.7 VEHICLES AND MOBILE EQUIPMENT

All Contractor vehicles and mobile equipment operating in the AOA shall meet requirements of the Contract requirements.

1.8 RADIO COMMUNICATION

The Contractor shall provide and monitor a radio capable of receiving transmissions from the Air Traffic Control Tower (ATCT) and Airport Ground Control. The number of radios shall be as required for the Contractor's Superintendent and Flagmen to ensure safe and orderly movement of AOA traffic to, in, and around the construction areas. Flaggers shall be required to have a company walkie-talkie to communicate with each other.

1.9 CLOSURES

When the Contractor's operations require the closure of any portion of a runway, taxiway, apron, or taxilane the Contractor shall notify the OAR not less than 72 hours prior to need. No closures may occur without prior permission from the OAR and Airfield Operations.

1.10 LIGHTED BARRICADES AND TEMPORARY PAVEMENT MARKINGS

Temporary pavement markings, lighted barricades and other measures shall be provided, installed, relocated, and maintained as shown on the Plans on a 24-hour basis by the Contractor to delineate construction areas available to the Contractor and limits of aircraft operational areas.

On a daily basis, the Contractor shall verify that the temporary lighted barricades are in proper operating condition. Any necessary maintenance repairs shall be performed immediately by the Contractor. The proposed layout of temporary markings, fencing and other measures for each construction area are shown on the Plans. The actual field installation of lighted barricades, and other measures and attendant operational procedures shall be inspected by the OAR, and any necessary changes or modifications will be promptly implemented by the Contractor as directed at no additional cost to the Contract. The revised installation will be re-inspected and approved by the OAR and Airfield Operations before the Contractor may commence any construction or any other work which revises operational procedures in each affected area.

1.11 OPERATIONS SAFETY INSPECTION

The entire work site shall be inspected daily and more frequently if construction activities have potential to accumulate debris on AOA pavements. Special inspections shall be conducted for each work area prior to return to service for aircraft operation. The purpose of these inspections is to ascertain that areas being returned to aircraft service are in satisfactory condition and that the overall work site and its activities are within the safety criteria set forth in these Contract Documents and as set forth in the FAA Advisory Circulars. Inspections shall be conducted jointly by representatives of the Contractor, Airfield Operations, and the OAR. These inspections shall cover the several safety items noted in and referred by in this Section.

Any violations of the Safety Criteria found during these inspections shall be rectified immediately. If a violation cannot be corrected on an immediate basis by the Contractor, he shall immediately notify the OAR. No area shall be approved for aircraft operations while it is in violation unless specifically authorized in writing by Airfield Operations and the OAR.

1.12 OPERATIONAL EMERGENCIES

During periods of severe weather conditions or other operational emergencies, Airfield Operations or the OAR may direct the Contractor to relinquish areas under construction and to prepare the areas for severe weather or operational emergency. In this event, the OAR will so direct the Contractor to evacuate the area and the OAR will specify the limits of the area to be evacuated, the term of evacuation, and the conditions governing the restoration work necessary to prepare the area for aircraft operations. The Contractor shall promptly and fully comply with the OAR’s directive. Should the directive entail extra work under the Contract, as determined by the OAR, the Contractor will be reimbursed for such extra work in accordance with the General Conditions of this Contract. Should the directive entail a delay in the completion of the Contract or any defined subdivision of the contract, as determined by the OAR, the Contractor may be granted an extension of time in accordance with the provisions of General Conditions of this Contract.

1.13 PROTECTION OF FAA FACILITIES

In areas where Contractor vehicles and equipment cross over FAA facilities, Contractor shall install steel plates to protect underlying utilities from damage as described in the electrical specifications and drawings.

1.14 CONSTRUCTION SAFETY AND PHASING PLANS (CSPP) AND SAFETY PLAN COMPLIANCE DOCUMENT (SPCD)

The Contractor shall review the Construction Safety and Phasing Plan (CSPP) provided by the Engineer. The CSPP has been developed for this project and is mandated by FAA AC 150/5370-2 “Operational Safety on Airports During Construction” (Latest Edition) for any projects funded by the Airport Improvement Plan (AIP) or the Passenger Facility Charge (PFC) Program when located on a Part 139 Airport. All FAA revisions to the CSPP have been incorporated in the CSPP.

The Contractor shall complete the SPCD. The SPCD must be submitted for approval from the Design Team, OAR, ATCT and Airfield Operations, prior to the issuance of the Contractor’s Notice to Proceed (NTP). The SPCD will be used to supplement the CSPP document written to comply with the FAA AC 150/5370-2 “Operational Safety at Airports During Construction” (Latest Edition). The supplemental information in the SPCD should be written to match the format of the CSPP indicating each subject by corresponding CSPP subject number and title, per Chapter 2 of the CSPP. If no supplemental information is necessary for any specific subject, the statement “No supplemental information,” should be written after the corresponding subject title. The SPCD should not supplicate information in the CSPP. All modification to the CSPP, due to construction activities, shall be highlighted in the SPCD.

PART 2 - MATERIALS AND CONSTRUCTION METHODS

2.1 DEACTIVATION OF AIRFIELD LIGHTS, SIGNS AND MARKINGS

The Contractor shall deactivate or cover lights, signs, and markings that lead into a construction zone, are in a construction zone, or are in a closed portion of a runway or taxiway, as directed by the OAR and/or described in the Contract Plans.

2.2 TEMPORARY FENCING AND BARRICADES

The Contractor shall install and maintain temporary fencing, with or without jersey barriers, at the locations shown on the Construction Safety and Phasing Plans, in accordance with the plan details, and as directed by the OAR. All temporary fencing shall be inspected daily and repaired or replaced immediately when damaged or not functioning. All temporary fencing shall include barbed wire as shown in the plan details. The temporary fencing shall be measured by the linear foot of fence or fence and barrier at the locations shown on the Plans and payment shall be made under Item C-106-1 – Temporary Fencing and Item C-106-2 – Temporary Fencing with Jersey Barrier.

2.3 TEMPORARY GATES

The Contractor shall install and maintain temporary double-swing type access gates at the locations shown on the Construction Safety and Phasing Plans. Each gate location shall include a double 15’ wide swing gate to allow for construction traffic or Airfield Operations to pass through safely. All gates shall be inspected daily and repaired or replaced immediately when damaged or not functioning. During non-construction hours, all temporary gates leading to the construction work area shall be in the closed position and securely locked with an approved, Contractor-supplied combination lock. At no time shall the gates be left unattended in an open position. The Contractor shall provide an OAR-Approved gate guard at each gate. Payment shall be made per each 30’ wide double swing gate under the Item C-106-3 – Temporary Swing Gate (30’).

2.4 HAUL ROUTES

The Contractor shall stabilize existing areas that are to be used for haul routes utilizing Contractor provided materials at locations shown on the plan and as approved by the OAR. All haul routes shall be maintained throughout the construction period and shall be restored to original or better than original condition at the completion of the project. Haul routes specified in the Plans to become permanent segments of the Vehicle Service Road are to be constructed per the appropriate Plan Details at the conclusion of the project. Any portions of the permanent Vehicle Service Road that are used as temporary haul routes are to be restored to a “like new” condition at the conclusion of the project. Contractor shall water all unpaved haul routes and maintain paved haul routes as directed by OAR to minimize dust.

2.5 GUARDRAIL

The Contractor shall construct a guardrail with a shallow foundation at the locations shown on the plan in accordance with the plan details. All materials shall conform to the requirements of the plans. The guardrail is a permanent element of construction and shall not be removed at the conclusion of the project. Any defect or damage incurred to the guardrail during construction shall be removed and repaired at the Contractor’s expense and to the satisfaction of the OAR.

2.6 SHALLOW FOUNDATION BOLLARD

The Contractor shall construct a bollard with a shallow foundation at the locations shown on the plans in accordance with the plan details. All materials shall conform to the requirements of the plans. All shallow foundation bollards are permanent elements of construction and shall not be removed at the conclusion of the project. Any defect or damage incurred to the bollards during construction shall be removed and repaired at the Contractor’s expense and to the satisfaction of the OAR.

PART 3 - METHOD OF MEASUREMENT

3.1 TEMPORARY FENCE (WITHOUT JERSEY BARRIER)

The unit of measurement for Temporary Fence (without Jersey Barrier) shall be the total number of linear feet of temporary fence without jersey barrier, including barbed wire, as measured from the Construction Safety and Phasing Plans. No separate measurement shall be made for any fence or portion thereof removed and re-used for future construction phases.

3.2 TEMPORARY FENCE (WITH JERSEY BARRIER)

The unit of measurement for Temporary Fence (with Jersey Barrier) shall be the total number of linear feet of temporary fence with jersey barrier, including barbed wire, as measured from the Construction Safety and Phasing Plans. No separate measurement shall be made for any fence and barrier or portion thereof removed and re-used for future construction phases.

3.3 TEMPORARY SWING GATE

The unit of measurement for Temporary Swing Gates shall be each double swing gate consisting of 15’ wide gate sections. No separate measurement shall be made for any swing gate or portion thereof removed and re-used for future construction phases.

3.4 No other items covered by this Specification section shall be individually measured for payment. Additional Maintenance of Traffic and Safety features include, but are not limited to temporary markings and subsequent removal, temporary haul route construction, sweeping and dust control and shall be considered incidental to other Pay Items. See Construction Safety and Phasing Plans for a detailed Maintenance of Traffic plan and additional requirements.

3.5 GUARDRAIL

The unit of measurement for Guardrail shall be the total number of linear feet of guardrail installed as measured on the Geometry and Joint Layout Plans. This pay item is inclusive of all labor, materials, equipment and incidentals required to construct the guardrail system as defined in the construction plans.

3.6 SHALLOW FOUNDATION BOLLARD

The unit of measurement for Shallow Foundation Bollard shall be each bollard as defined on the Geometry and Joint Layout plans. This pay item is inclusive of all labor, materials, equipment and incidentals required to construct the Shallow Foundation Bollards as defined in the construction plans.

PART 4 - BASIS OF PAYMENT

4.1 GENERAL

Payment for the work covered in this Section and as shown on the Plans shall be made at the unit prices bid for these items. The price and payment shall constitute full compensation for furnishing all labor, materials, equipment and incidentals required to complete the work under this Section.

4.2 PAYMENTS

Payments shall be made under:

Item C-106-4.1	Temporary Fence (without Jersey Barrier)	- per Linear Foot (LF)
Item C-106-4.2	Temporary Fence (with Jersey Barrier)	- per Linear Foot (LF)
Item C-106-4.3	Temporary Swing Gate (30’ Total Width)	- per Each (EA)
Item C-106-4.4	Miscellaneous Maintenance of Traffic and Safety	- Lump Sum (LS)
Item C-106-4.5	Guardrail	- per Linear Foot (LF)
Item C-106-4.6	Shallow Foundation Bollard	- per Each (EA)

END OF ITEM C-106

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Item C-110 Method of Estimating Percentage of Material Within Specification Limits (PWL)

Spreadsheets for PWL calculations are available at the following website: http://www.faa.gov/airports/engineering/design_software/.

Use Engineering Brief (EB) 57 Extended Q-Value Table for Estimating Percent of Lot Within Limits (PWL) and the MS Excel PWL Table when the number of samples (n) is greater than 10. The EBs are available at the following website: http://www.faa.gov/airports/engineering/engineering_briefs/.

110-1 General. When the specifications provide for acceptance of material based on the method of estimating percentage of material within specification limits (PWL), the PWL will be determined in accordance with this section. All test results for a lot will be analyzed statistically to determine the total estimated percent of the lot that is within specification limits. The PWL is computed using the sample average (X) and sample standard deviation (S_n) of the specified number (n) of sublots for the lot and the specification tolerance limits, L for lower and U for upper, for the particular acceptance parameter. From these values, the respective Quality index, Q_L for Lower Quality Index and/or Q_U for Upper Quality Index, is computed and the PWL for the lot for the specified n is determined from Table 1. All specification limits specified in the technical sections shall be absolute values. Test results used in the calculations shall be to the significant figure given in the test procedure.

There is some degree of uncertainty (risk) in the measurement for acceptance because only a small fraction of production material (the population) is sampled and tested. This uncertainty exists because all portions of the production material have the same probability to be randomly sampled. The Contractor's risk is the probability that material produced at the acceptable quality level is rejected or subjected to a pay adjustment. The Owner's risk is the probability that material produced at the rejectable quality level is accepted.

It is the intent of this section to inform the Contractor that, in order to consistently offset the Contractor's risk for material evaluated, production quality (using population average and population standard deviation) must be maintained at the acceptable quality specified or higher. In all cases, it is the responsibility of the Contractor to produce at quality levels that will meet the specified acceptance criteria when sampled and tested at the frequencies specified.

110-2 Method for computing PWL. The computational sequence for computing PWL is as follows:

a. Divide the lot into n sublots in accordance with the acceptance requirements of the specification.

b. Locate the random sampling position within the sublot in accordance with the requirements of the specification.

c. Make a measurement at each location, or take a test portion and make the measurement on the test portion in accordance with the testing requirements of the specification.

d. Find the sample average (X) for all sublot test values within the lot by using the following formula:

$$X = (x_1 + x_2 + x_3 + \ldots x_n) / n$$

Where: X = Sample average of all sublot test values within a lot

$x_1, x_2, \ldots x_n$ = Individual sublot test values

n = Number of sublot test values

e. Find the sample standard deviation (S_n) by use of the following formula:

$$S_n = [(d_1^2 + d_2^2 + d_3^2 + \ldots d_n^2)/(n-1)]^{1/2}$$

Where: S_n = Sample standard deviation of the number of sublot test values in the set

$d_1, d_2, \ldots d_n$ = Deviations of the individual sublot test values $x_1, x_2, \ldots$ from the average value X

that is: $d_1 = (x_1 - X)$, $d_2 = (x_2 - X) \ldots d_n = (x_n - X)$

n = Number of sublot test values

f. For single sided specification limits (i.e., L only), compute the Lower Quality Index Q_L by use of the following formula:

$$Q_L = (X - L) / S_n$$

Where: L = specification lower tolerance limit

Estimate the percentage of material within limits (PWL) by entering Table 1 with Q_L, using the column appropriate to the total number (n) of measurements. If the value of Q_L falls between values shown on the table, use the next higher value of PWL.

g. For double-sided specification limits (i.e., L and U), compute the Quality Indexes Q_L and Q_U by use of the following formulas:

$$Q_L = (X - L) / S_n$$
and
$$Q_U = (U - X) / S_n$$

Where: L and U = specification lower and upper tolerance limits

Estimate the percentage of material between the lower (L) and upper (U) tolerance limits (PWL) by entering Table 1 separately with Q_L and Q_U, using the column appropriate to the total number (n) of measurements, and determining the percent of material above P_L and percent of material below P_U for each tolerance limit. If the values of Q_L fall between values shown on the table, use the next higher value of P_L or P_U. Determine the PWL by use of the following formula:

$$PWL = (P_U + P_L) - 100$$

Where: P_L = percent within lower specification limit

P_U = percent within upper specification limit

EXAMPLE OF PWL CALCULATION

Project: Example Project

Test Item: Item P-401, Lot A.

A. PWL Determination for Mat Density.

1. Density of four random cores taken from Lot A.

A-1 = 96.60
A-2 = 97.55
A-3 = 99.30
A-4 = 98.35
n = 4

2. Calculate average density for the lot.

$X = (x_1 + x_2 + x_3 + \ldots x_n) / n$
$X = (96.60 + 97.55 + 99.30 + 98.35) / 4$
X = 97.95% density

3. Calculate the standard deviation for the lot.

$S_n = [((96.60 - 97.95)^2 + (97.55 - 97.95)^2 + (99.30 - 97.95)^2 + (98.35 - 97.95)^2)) / (4 - 1)]^{1/2}$
$S_n = [(1.82 + 0.16 + 1.82 + 0.16) / 3]^{1/2}$
$S_n = 1.15$

4. Calculate the Lower Quality Index Q_L for the lot. (L=96.3)

$Q_L = (X - L) / S_n$
$Q_L = (97.95 - 96.30) / 1.15$
$Q_L = 1.4348$

5. Determine PWL by entering Table 1 with Q_L= 1.44 and n= 4.

PWL = 98

B. PWL Determination for Air Voids.

1. Air Voids of four random samples taken from Lot A.

A-1 = 5.00
A-2 = 3.74
A-3 = 2.30
A-4 = 3.25

2. Calculate the average air voids for the lot.

$X = (x_1 + x_2 + x_3 \ldots n) / n$
$X = (5.00 + 3.74 + 2.30 + 3.25) / 4$
X = 3.57%

3. Calculate the standard deviation S_n for the lot.

$S_n = [((3.57 - 5.00)^2 + (3.57 - 3.74)^2 + (3.57 - 2.30)^2 + (3.57 - 3.25)^2) / (4 - 1)]^{1/2}$

$S_n = [(2.04 + 0.03 + 1.62 + 0.10) / 3]^{1/2}$

$S_n = 1.12$

4. Calculate the Lower Quality Index Q_L for the lot. (L= 2.0)

$Q_L = (X - L) / S_n$

$Q_L = (3.57 - 2.00) / 1.12$

$Q_L = 1.3992$

5. Determine P_L by entering Table 1 with $Q_L = 1.41$ and $n = 4$.

$P_L = 97$

6. Calculate the Upper Quality Index Q_U for the lot. (U= 5.0)

$Q_U = (U - X) / S_n$

$Q_U = (5.00 - 3.57) / 1.12$

$Q_U = 1.2702$

7. Determine P_U by entering Table 1 with $Q_U = 1.29$ and $n = 4$.

$P_U = 93$

8. Calculate Air Voids PWL

$PWL = (P_L + P_U) - 100$

$PWL = (97 + 93) - 100 = 90$

EXAMPLE OF OUTLIER CALCULATION (REFERENCE ASTM E178)

Project: Example Project

Test Item: Item P-401, Lot A.

A. Outlier Determination for Mat Density.

1. Density of four random cores taken from Lot A arranged in descending order.

A-3 = 99.30

A-4 = 98.35

A-2 = 97.55

A-1 = 96.60

2. From ASTM E178, Table 1, for n=4 an upper 5% significance level, the critical value for test criterion = 1.463.

3. Use average density, standard deviation, and test criterion value to evaluate density measurements.

a. For measurements greater than the average:

If (measurement - average)/(standard deviation) is less than test criterion, then the measurement is not considered an outlier.

For A-3, check if (99.30 - 97.95) / 1.15 is greater than 1.463.

Since 1.174 is less than 1.463, the value is not an outlier.

b. For measurements less than the average:

If (average - measurement)/(standard deviation) is less than test criterion, then the measurement is not considered an outlier.

For A-1, check if (97.95 - 96.60) / 1.15 is greater than 1.463.

Since 1.435 is less than 1.463, the value is not an outlier.

Note: In this example, a measurement would be considered an outlier if the density were:

Greater than (97.95 + 1.463 × 1.15) = 99.63%

OR

less than (97.95 - 1.463 × 1.15) = 96.27%.

Table 1. Table for Estimating Percent of Lot Within Limits (PWL)

Percent Within Limits (P_L and P_U)	Positive Values of Q (Q_L and Q_U)							
	n=3	n=4	n=5	n=6	n=7	n=8	n=9	n=10
99	1.1541	1.4700	1.6714	1.8008	1.8888	1.9520	1.9994	2.0362
98	1.1524	1.4400	1.6016	1.6982	1.7612	1.8053	1.8379	1.8630
97	1.1496	1.4100	1.5427	1.6181	1.6661	1.6993	1.7235	1.7420
96	1.1456	1.3800	1.4897	1.5497	1.5871	1.6127	1.6313	1.6454
95	1.1405	1.3500	1.4407	1.4887	1.5181	1.5381	1.5525	1.5635
94	1.1342	1.3200	1.3946	1.4329	1.4561	1.4717	1.4829	1.4914
93	1.1269	1.2900	1.3508	1.3810	1.3991	1.4112	1.4199	1.4265
92	1.1184	1.2600	1.3088	1.3323	1.3461	1.3554	1.3620	1.3670
91	1.1089	1.2300	1.2683	1.2860	1.2964	1.3032	1.3081	1.3118
90	1.0982	1.2000	1.2290	1.2419	1.2492	1.2541	1.2576	1.2602
89	1.0864	1.1700	1.1909	1.1995	1.2043	1.2075	1.2098	1.2115
88	1.0736	1.1400	1.1537	1.1587	1.1613	1.1630	1.1643	1.1653
87	1.0597	1.1100	1.1173	1.1192	1.1199	1.1204	1.1208	1.1212
86	1.0448	1.0800	1.0817	1.0808	1.0800	1.0794	1.0791	1.0789
85	1.0288	1.0500	1.0467	1.0435	1.0413	1.0399	1.0389	1.0382
84	1.0119	1.0200	1.0124	1.0071	1.0037	1.0015	1.0000	0.9990
83	0.9939	0.9900	0.9785	0.9715	0.9671	0.9643	0.9624	0.9610
82	0.9749	0.9600	0.9452	0.9367	0.9315	0.9281	0.9258	0.9241
81	0.9550	0.9300	0.9123	0.9025	0.8966	0.8928	0.8901	0.8882
80	0.9342	0.9000	0.8799	0.8690	0.8625	0.8583	0.8554	0.8533
79	0.9124	0.8700	0.8478	0.8360	0.8291	0.8245	0.8214	0.8192
78	0.8897	0.8400	0.8160	0.8036	0.7962	0.7915	0.7882	0.7858
77	0.8662	0.8100	0.7846	0.7716	0.7640	0.7590	0.7556	0.7531
76	0.8417	0.7800	0.7535	0.7401	0.7322	0.7271	0.7236	0.7211
75	0.8165	0.7500	0.7226	0.7089	0.7009	0.6958	0.6922	0.6896
74	0.7904	0.7200	0.6921	0.6781	0.6701	0.6649	0.6613	0.6587
73	0.7636	0.6900	0.6617	0.6477	0.6396	0.6344	0.6308	0.6282
72	0.7360	0.6600	0.6316	0.6176	0.6095	0.6044	0.6008	0.5982
71	0.7077	0.6300	0.6016	0.5878	0.5798	0.5747	0.5712	0.5686
70	0.6787	0.6000	0.5719	0.5582	0.5504	0.5454	0.5419	0.5394
69	0.6490	0.5700	0.5423	0.5290	0.5213	0.5164	0.5130	0.5105
68	0.6187	0.5400	0.5129	0.4999	0.4924	0.4877	0.4844	0.4820
67	0.5878	0.5100	0.4836	0.4710	0.4638	0.4592	0.4560	0.4537
66	0.5563	0.4800	0.4545	0.4424	0.4355	0.4310	0.4280	0.4257
65	0.5242	0.4500	0.4255	0.4139	0.4073	0.4030	0.4001	0.3980
64	0.4916	0.4200	0.3967	0.3856	0.3793	0.3753	0.3725	0.3705
63	0.4586	0.3900	0.3679	0.3575	0.3515	0.3477	0.3451	0.3432
62	0.4251	0.3600	0.3392	0.3295	0.3239	0.3203	0.3179	0.3161
61	0.3911	0.3300	0.3107	0.3016	0.2964	0.2931	0.2908	0.2892
60	0.3568	0.3000	0.2822	0.2738	0.2691	0.2660	0.2639	0.2624
59	0.3222	0.2700	0.2537	0.2461	0.2418	0.2391	0.2372	0.2358
58	0.2872	0.2400	0.2254	0.2186	0.2147	0.2122	0.2105	0.2093
57	0.2519	0.2100	0.1971	0.1911	0.1877	0.1855	0.1840	0.1829
56	0.2164	0.1800	0.1688	0.1636	0.1607	0.1588	0.1575	0.1566
55	0.1806	0.1500	0.1406	0.1363	0.1338	0.1322	0.1312	0.1304
54	0.1447	0.1200	0.1125	0.1090	0.1070	0.1057	0.1049	0.1042
53	0.1087	0.0900	0.0843	0.0817	0.0802	0.0793	0.0786	0.0781
52	0.0725	0.0600	0.0562	0.0544	0.0534	0.0528	0.0524	0.0521
51	0.0363	0.0300	0.0281	0.0272	0.0267	0.0264	0.0262	0.0260
50	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

Percent Within Limits (P_L and P_U)	Negative Values of Q (Q_L and Q_U)							
	n=3	n=4	n=5	n=6	n=7	n=8	n=9	n=10
49	-0.0363	-0.0300	-0.0281	-0.0272	-0.0267	-0.0264	-0.0262	-0.0260
48	-0.0725	-0.0600	-0.0562	-0.0544	-0.0534	-0.0528	-0.0524	-0.0521
47	-0.1087	-0.0900	-0.0843	-0.0817	-0.0802	-0.0793	-0.0786	-0.0781
46	-0.1447	-0.1200	-0.1125	-0.1090	-0.1070	-0.1057	-0.1049	-0.1042
45	-0.1806	-0.1500	-0.1406	-0.1363	-0.1338	-0.1322	-0.1312	-0.1304
44	-0.2164	-0.1800	-0.1688	-0.1636	-0.1607	-0.1588	-0.1575	-0.1566
43	-0.2519	-0.2100	-0.1971	-0.1911	-0.1877	-0.1855	-0.1840	-0.1829
42	-0.2872	-0.2400	-0.2254	-0.2186	-0.2147	-0.2122	-0.2105	-0.2093
41	-0.3222	-0.2700	-0.2537	-0.2461	-0.2418	-0.2391	-0.2372	-0.2358
40	-0.3568	-0.3000	-0.2822	-0.2738	-0.2691	-0.2660	-0.2639	-0.2624
39	-0.3911	-0.3300	-0.3107	-0.3016	-0.2964	-0.2931	-0.2908	-0.2892
38	-0.4251	-0.3600	-0.3392	-0.3295	-0.3239	-0.3203	-0.3179	-0.3161
37	-0.4586	-0.3900	-0.3679	-0.3575	-0.3515	-0.3477	-0.3451	-0.3432
36	-0.4916	-0.4200	-0.3967	-0.3856	-0.3793	-0.3753	-0.3725	-0.3705
35	-0.5242	-0.4500	-0.4255	-0.4139	-0.4073	-0.4030	-0.4001	-0.3980
34	-0.5563	-0.4800	-0.4545	-0.4424	-0.4355	-0.4310	-0.4280	-0.4257
33	-0.5878	-0.5100	-0.4836	-0.4710	-0.4638	-0.4592	-0.4560	-0.4537
32	-0.6187	-0.5400	-0.5129	-0.4999	-0.4924	-0.4877	-0.4844	-0.4820
31	-0.6490	-0.5700	-0.5423	-0.5290	-0.5213	-0.5164	-0.5130	-0.5105
30	-0.6787	-0.6000	-0.5719	-0.5582	-0.5504	-0.5454	-0.5419	-0.5394
29	-0.7077	-0.6300	-0.6016	-0.5878	-0.5798	-0.5747	-0.5712	-0.5686
28	-0.7360	-0.6600	-0.6316	-0.6176	-0.6095	-0.6044	-0.6008	-0.5982
27	-0.7636	-0.6900	-0.6617	-0.6477	-0.6396	-0.6344	-0.6308	-0.6282
26	-0.7904	-0.7200	-0.6921	-0.6781	-0.6701	-0.6649	-0.6613	-0.6587
25	-0.8165	-0.7500	-0.7226	-0.7089	-0.7009	-0.6958	-0.6922	-0.6896
24	-0.8417	-0.7800	-0.7535	-0.7401	-0.7322	-0.7271	-0.7236	-0.7211
23	-0.8662	-0.8100	-0.7846	-0.7716	-0.7640	-0.7590	-0.7556	-0.7531
22	-0.8897	-0.8400	-0.8160	-0.8036	-0.7962	-0.7915	-0.7882	-0.7858
21	-0.9124	-0.8700	-0.8478	-0.8360	-0.8291	-0.8245	-0.8214	-0.8192
20	-0.9342	-0.9000	-0.8799	-0.8690	-0.8625	-0.8583	-0.8554	-0.8533
19	-0.9550	-0.9300	-0.9123	-0.9025	-0.8966	-0.8928	-0.8901	-0.8882
18	-0.9749	-0.9600	-0.9452	-0.9367	-0.9315	-0.9281	-0.9258	-0.9241
17	-0.9939	-0.9900	-0.9785	-0.9715	-0.9671	-0.9643	-0.9624	-0.9610
16	-1.0119	-1.0200	-1.0124	-1.0071	-1.0037	-1.0015	-1.0000	-0.9990
15	-1.0288	-1.0500	-1.0467	-1.0435	-1.0413	-1.0399	-1.0389	-1.0382
14	-1.0448	-1.0800	-1.0817	-1.0808	-1.0800	-1.0794	-1.0791	-1.0789
13	-1.0597	-1.1100	-1.1173	-1.1192	-1.1199	-1.1204	-1.1208	-1.1212
12	-1.0736	-1.1400	-1.1537	-1.1587	-1.1613	-1.1630	-1.1643	-1.1653
11	-1.0864	-1.1700	-1.1909	-1.1995	-1.2043	-1.2075	-1.2098	-1.2115
10	-1.0982	-1.2000	-1.2290	-1.2419	-1.2492	-1.2541	-1.2576	-1.2602
9	-1.1089	-1.2300	-1.2683	-1.2860	-1.2964	-1.3032	-1.3081	-1.3118
8	-1.1184	-1.2600	-1.3088	-1.3323	-1.3461	-1.3554	-1.3620	-1.3670
7	-1.1269	-1.2900	-1.3508	-1.3810	-1.3991	-1.4112	-1.4199	-1.4265
6	-1.1342	-1.3200	-1.3946	-1.4329	-1.4561	-1.4717	-1.4829	-1.4914
5	-1.1405	-1.3500	-1.4407	-1.4887	-1.5181	-1.5381	-1.5525	-1.5635
4	-1.1456	-1.3800	-1.4897	-1.5497	-1.5871	-1.6127	-1.6313	-1.6454
3	-1.1496	-1.4100	-1.5427	-1.6181	-1.6661	-1.6993	-1.7235	-1.7420
2	-1.1524	-1.4400	-1.6016	-1.6982	-1.7612	-1.8053	-1.8379	-1.8630
1	-1.1541	-1.4700	-1.6714	-1.8008	-1.8888	-1.9520	-1.9994	-2.0362

REFERENCES

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

ASTM International (ASTM)

ASTM E178 Standard Practice for Dealing with Outlying Observations

END OF ITEM C-110

Item D-701 Pipe for Storm Drains and Culverts

DESCRIPTION

701-1.1 This item shall consist of the construction of pipe culverts and storm drains in accordance with these specifications and in reasonably close conformity with the lines and grades shown on the plans.

MATERIALS

701-2.1 Materials shall meet the requirements shown on the plans and specified below. Underground piping and components used in drainage systems for terminal and aircraft fueling ramp drainage shall be noncombustible and inert to fuel in accordance with National Fire Protection Association (NFPA) 415.

Reinforced Concrete Pipe (Class V)

Poly Vinyl Chloride (PVC – SDR 26)

701-2.2 Pipe. The pipe shall be of the type called for on the plans or in the proposal and shall be in accordance with the following appropriate requirements:

American Association of State Highway and Transportation Officials (AASHTO) M167	Standard Specification for Corrugated Steel Structural Plate, Zinc-Coated, for Field-Bolted Pipe, Pipe-Arches, and Arches
AASHTO M190	Standard Specification for Bituminous-Coated Corrugated Metal Culvert Pipe and Pipe Arches
AASHTO M196	Standard Specification for Corrugated Aluminum Pipe for Sewers and Drains
AASHTO M219	Standard Specification for Corrugated Aluminum Alloy Structural Plate for Field-Bolted Pipe, Pipe-Arches, and Arches
AASHTO M243	Standard Specification for Field-Applied Coating of Corrugated Metal Structural Plate for Pipe, Pipe-Arches, and Arches
AASHTO M252	Standard Specification for Corrugated Polyethylene Drainage Pipe
AASHTO M294	Standard Specification for Corrugated Polyethylene Pipe, 300- to 1500-mm (12- to 60-in.) Diameter
AASHTO M304	Standard Specification for Poly (Vinyl Chloride) (PVC) Profile Wall Drain Pipe and Fittings Based on Controlled Inside Diameter
AASHTO MP20	Standard Specification for Steel Reinforced Polyethylene (PE) Ribbed Pipe, 300- to 900-mm (12- to 36-in.) Diameter
AASHTO R73	Standard Practice for Evaluation of Precast Concrete Drainage Productions
ASTM A760	Standard Specification for Corrugated Steel Pipe, Metallic-Coated for Sewers and Drains

ASTM A761	Standard Specification for Corrugated Structural Steel Plate, Zinc-Coated, for Field-Bolted Pipe, Pipe-Arches, and Arches
ASTM A762	Standard Specification for Corrugated Steel Pipe, Polymer Precoated for Sewers and Drains
ASTM A849	Standard Specification for Post Applied Coatings, Pavings, and Linings for Corrugated Steel Sewer and Drainage Pipe
ASTM B745	Standard Specification for Corrugated Aluminum Pipe for Sewers and Drains
ASTM C14	Standard Specification for Nonreinforced Concrete Sewer, Storm Drain, and Culvert Pipe
ASTM C76	Standard Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe
ASTM C506	Standard Specification for Reinforced Concrete Arch Culvert, Storm Drain, and Sewer Pipe
ASTM C507	Standard Specification for Reinforced Concrete Elliptical Culvert, Storm Drain, and Sewer Pipe
ASTM C655	Standard Specification for Reinforced Concrete D-Load Culvert, Storm Drain, and Sewer Pipe
ASTM C1433	Standard Specification for Precast Reinforced Concrete Monolithic Box Sections for Culverts, Storm Drains, and Sewers
ASTM C1479	Standard Practice for Installation of Precast Concrete Sewer, Storm Drain, and Culvert Pipe Using Standard Installations
ASTM C1577	Standard Specification for Precast Reinforced Concrete Monolithic Box Sections for Culverts, Storm Drains, and Sewers Designed According to AASHTO LRFD
ASTM C1786	Standard Specification for Segmental Precast Reinforced Concrete Box Sections for Culverts, Storm Drains, and Sewers Designed According to AASHTO LRFD
ASTM C1840	Standard Practice for Inspection and Acceptance of Installed Reinforced Concrete Culvert, Storm Drain, and Storm Sewer Pipe
ASTM D3262	Standard Specification for “Fiberglass” (Glass-Fiber-Reinforced Thermosetting-Resin) Sewer Pipe
ASTM D4161	Standard Specification for “Fiberglass” (Glass-Fiber-Reinforced Thermosetting-Resin) Pipe Joints Using Flexible Elastomeric Seals
ASTM F667	Standard Specification for 3 through 24 in Corrugated Polyethylene Pipe and Fittings
ASTM F714	Standard Specification for Polyethylene (PE) Plastic Pipe (DR-PR) Based on Outside Diameter
ASTM F794	Standard Specification for Poly (Vinyl Chloride) (PVC) Profile Gravity Sewer Pipe and Fittings Based on Controlled Inside Diameter

ASTM F894	Standard Specification for Polyethylene (PE) Large Diameter Profile Wall Sewer and Drain Pipe
ASTM F949	Standard Specification for Poly (Vinyl Chloride) (PVC) Corrugated Sewer Pipe with a Smooth Interior and Fittings
ASTM F2435	Standard Specification for Steel Reinforced Polyethylene (PE) Corrugated Pipe
ASTM F2562	Specification for Steel Reinforced Thermoplastic Ribbed Pipe and Fittings for Non-Pressure Drainage and Sewerage
ASTM F2736	Standard Specification for 6 to 30 in. (152 to 762 mm) Polypropylene (PP) Corrugated Single Wall Pipe and Double Wall Pipe
ASTM F2764	Standard Specification for 30 to 60 in. (750 to 1500 mm) Polypropylene (PP) Triple Wall Pipe and Fittings for Non-Pressure Sanitary Sewer Applications
ASTM F2881	Standard Specification for 12 to 60 in. (300 to 1500 mm) Polypropylene (PP) Dual Wall Pipe and Fittings for Non-Pressure Storm Sewer Applications
ASTM D3034	Standard Specification for Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings

701-2.3 Concrete. Concrete for pipe cradles shall have a minimum compressive strength of 2000 psi (13.8 MPa) at 28 days and conform to the requirements of ASTM C94.

701-2.4 Rubber gaskets. Rubber gaskets for rigid pipe shall conform to the requirements of ASTM C443. Rubber gaskets for PVC pipe, polyethylene, and polypropylene pipe shall conform to the requirements of ASTM F477. Rubber gaskets for zinc-coated steel pipe and precoated galvanized pipe shall conform to the requirements of ASTM D1056, for the “RE” closed cell grades. Rubber gaskets for steel reinforced thermoplastic ribbed pipe shall conform to the requirements of ASTM F477.

701-2.5 Joint mortar. Pipe joint mortar shall consist of one part Portland cement and two parts sand. The Portland cement shall conform to the requirements of ASTM C150, Type I. The sand shall conform to the requirements of ASTM C144.

701-2.6 Joint fillers. Poured filler for joints shall conform to the requirements of ASTM D6690.

701-2.7 Plastic gaskets. Plastic gaskets shall conform to the requirements of ASTM C990.

701-2.8. Controlled low-strength material (CLSM). Controlled low-strength material shall conform to the requirements of Item P-153. When CLSM is used, all joints shall have gaskets.

701-2.9 Precast box culverts. Manufactured in accordance with and conforming to ASTM C1433.

701-2.10 Precast concrete pipe. Precast concrete structures shall be furnished by a plant meeting National Precast Concrete Association Plant Certification Program or American Concrete Pipe Association QCast Plant Certification program.

CONSTRUCTION METHODS

701-3.1 Excavation. The width of the pipe trench shall be sufficient to permit satisfactory jointing of the pipe and thorough tamping of the bedding material under and around the pipe, but it shall not be less than the external diameter of the pipe plus 12 inches (300 mm) on each side. The trench walls shall be approximately vertical.

The Contractor shall comply with all current federal, state and local rules and regulations governing the safety of men and materials during the excavation, installation and backfilling operations. Specifically, the Contractor shall observe that all requirements of the Occupational Safety and Health Administration (OSHA) relating to excavations, trenching and shoring are strictly adhered to. The width of the trench shall be sufficient to permit satisfactorily jointing of the pipe and thorough compaction of the bedding material under the pipe and backfill material around the pipe, but it shall not be greater than the widths shown on the plans trench detail.

Where rock, hardpan, or other unyielding material is encountered, the Contractor shall remove it from below the foundation grade for a depth of at least 8 inch (200 mm) or 1/2 inch (12 mm) for each foot of fill over the top of the pipe (whichever is greater) but for no more than three-quarters of the nominal diameter of the pipe. The excavation below grade should be filled with granular material to form a uniform foundation.

Where a firm foundation is not encountered at the grade established, due to soft, spongy, or other unstable soil, the unstable soil shall be removed and replaced with approved granular material for the full trench width. The ~~RPR~~ **OAR** shall determine the depth of removal necessary. The granular material shall be compacted to provide adequate support for the pipe.

The excavation for pipes placed in embankment fill shall not be made until the embankment has been completed to a height above the top of the pipe as shown on the plans.

701-3.2 Bedding. The bedding surface for the pipe shall provide a foundation of uniform density to support the pipe throughout its entire length.

a. Rigid pipe. The pipe bedding shall be constructed uniformly for the full length of the pipe barrel, as required on the plans. The maximum aggregate size shall be 1 in when the bedding thickness is less than 6 inches, and 1-1/2 in when the bedding thickness is greater than 6 inches. Bedding shall be loosely placed uncompacted material under the middle third of the pipe prior to placement of the pipe.

b. Flexible pipe. For flexible pipe, the bed shall be roughly shaped to fit the pipe, and a bedding blanket of sand or fine granular material shall be provided as follows:

Flexible Pipe Bedding

Pipe Corrugation Depth		Minimum Bedding Depth	
inch	**mm**	**inch**	**mm**
1/2	12	1	25
1	25	2	50
2	50	3	75
2-1/2	60	3-1/2	90

c. Other pipe materials. For PVC, polyethylene, polypropylene, or fiberglass pipe, the bedding material shall consist of coarse sands and gravels with a maximum particle size of 3/4 inches (19 mm). For pipes installed under paved areas, no more than 12% of the material shall pass the No. 200 (0.075 mm) sieve. For all other areas, no more than 50% of the material shall pass the No. 200 (0.075 mm) sieve. The bedding shall have a thickness of at least 6 inches (150 mm) below the bottom of the pipe and extend up around the pipe for a depth of not less than 50% of the pipe's vertical outside diameter.

701-3.3 Laying pipe. The pipe laying shall begin at the lowest point of the trench and proceed upgrade. The lower segment of the pipe shall be in contact with the bedding throughout its full length. Bell or groove ends of rigid pipes and outside circumferential laps of flexible pipes shall be placed facing upgrade.

Paved or partially lined pipe shall be placed so that the longitudinal center line of the paved segment coincides with the flow line.

Elliptical and elliptically reinforced concrete pipes shall be placed with the manufacturer's reference lines designating the top of the pipe within five degrees of a vertical plane through the longitudinal axis of the pipe.

701-3.4 Joining pipe. Joints shall be made with (1) cement mortar, (2) cement grout, (3) rubber gaskets, (4) plastic gaskets, or (5) coupling bands.

Mortar joints shall be made with an excess of mortar to form a continuous bead around the outside of the pipe and shall be finished smooth on the inside. Molds or runners shall be used for grouted joints to retain the poured grout. Rubber ring gaskets shall be installed to form a flexible watertight seal.

a. Concrete pipe. Concrete pipe may be either bell and spigot or tongue and groove. Pipe sections at joints shall be fully seated and the inner surfaces flush and even. Joints shall be thoroughly wetted before applying mortar or grout.

b. Metal pipe. Metal pipe shall be firmly joined by form-fitting bands conforming to the requirements of ASTM A760 for steel pipe and AASHTO M196 for aluminum pipe.

c. PVC, Polyethylene, or Polypropylene pipe. Joints for PVC, Polyethylene, or Polypropylene pipe shall conform to the requirements of ASTM D3212 when leak resistant joints are required. Joints for PVC and Polyethylene pipe shall conform to the requirements of AASHTO M304 when soil tight joints are required. Fittings for polyethylene pipe shall conform to the requirements of AASHTO M252 or ASTM M294. Fittings for polypropylene pipe shall conform to ASTM F2881, ASTM F2736, or ASTM F2764.

d. Fiberglass pipe. Joints and fittings shall be as detailed on the plans and in accordance with the manufacturers recommendations.

701-3.5 Embedment and Overfill. Pipes shall be inspected before any fill material is placed; any pipes found to be out of alignment, unduly settled, or damaged shall be removed and re-laid or replaced at the Contractor's expense.

701-3.5-1 Embedment Material Requirements

a. Concrete Pipe. Embedment material and compaction requirements shall be in accordance with the applicable Type of Standard Installation (Types 1, 2, 3, or 4) per ASTM C1479. If a concrete cradle or CLSM embedment material is used, it shall conform to the plan details.

b. Plastic and fiberglass Pipe. Embedment material shall meet the requirements of ASTM D3282, A-1, A-2-4, A-2-5, or A-3. Embedment material shall be free of organic material, stones larger than 1.5 inches in the greatest dimension, or frozen lumps. Embedment material shall extend to 12 inches above the top of the pipe.

c. Metal Pipe. Embedment material shall be granular as specified in the contract document and specifications, and shall be free of organic material, rock fragments larger than 1.5 inches in the greatest dimension and frozen lumps. As a minimum, backfill materials shall meet the requirements of ASTM D3282, A-1, A-2, or A-3. Embedment material shall extend to 12 inches above the top of the pipe.

701-3.5-2 Placement of Embedment Material

The embedment material shall be compacted in layers not exceeding 6 inches (150 mm) on each side of the pipe and shall be brought up one foot (30 cm) above the top of the pipe or to natural ground level, whichever is greater. Thoroughly compact the embedment material under the haunches of the pipe without displacing the pipe. Material shall be brought up evenly on each side of the pipe for the full length of the pipe.

When the top of the pipe is above the top of the trench, the embedment material shall be compacted in layers not exceeding 6 inches (150 mm) and shall be brought up evenly on each side of the pipe to one foot (30 cm) above the top of the pipe. All embedment material shall be compacted to a density required under Item P-152.

Concrete cradles and flowable fills, such as controlled low strength material (CLSM) or controlled density fill (CDF), may be used for embedment provided adequate flotation resistance can be achieved by restraints, weighing, or placement technique.

It shall be the Contractor’s responsibility to protect installed pipes and culverts from damage due to construction equipment operations. The Contractor shall be responsible for installation of any extra strutting or backfill required to protect pipes from the construction equipment.

701-3.6 Overfill

Pipes shall be inspected before any overfill is in place. Any pipes found to be out of alignment, unduly settled, or damaged shall be removed and relaid or replaced at the Contractor’s expense. Evaluation of any damage to RCP shall be evaluated based on AASHTO R73.

Overfill material shall be place and compacted in layers as required to achieve compaction to at least 95 percent standard proctor per ASTM D1557. The soil shall contain no debris, organic matter, frozen material, or stones with a diameter greater than one half the thickness of the compacted layers being placed.

701-3.7 Inspection Requirements

An initial post installation inspection shall be performed by the ~~RPR~~ **OAR** no sooner than 30 days after completion of installation and final backfill. Clean or flush all lines prior to inspection.

Use a camera with lighting suitable to allow a clear picture of the entire periphery of the pipe interior. Center the camera in the pipe both vertically and horizontally and be able to pan and tilt to a 90 degree angle with the axis of the pipe rotating 360 degrees. Use equipment to move the camera through the pipe that will not obstruct the camera’s view or interfere with proper documentation of the pipe’s condition. The video image shall be clear, focused, and relatively free from roll, static, or other image distortion qualities that would prevent the reviewer from evaluating the condition of the pipe.

For pipe sizes larger than 48 inches, a walk-through visual inspection shall be performed.

Reinforced concrete pipe shall be inspected, evaluated, and reported on in accordance with ASTM C1840, “Standard Practice for Inspection and Acceptance of Installed Reinforced Concrete Culvert, Storm Drain, and Storm Sewer Pipe.” Any issues reported shall include still photo and video documentation. The zoom ratio shall be provided for all still or video images that document any issues of concern by the inspection firm.

METHOD OF MEASUREMENT

701-4.1 The length of reinforced concrete pipe shall be measured in linear feet of pipe in place, completed, and accepted. It shall be measured along the centerline of the pipe from end or inside face of structure to the end or inside face of structure, whichever is applicable. The pipes shall be measured separately. All fittings shall be included in the footage as typical pipe sections in the pipe being measured. ***All necessary excavation, shoring, backfill, de-watering, pipe cradles, pipe bedding and other works required to install the pipe shall be considered incidental to the placement of the pipe.***

701-4.2 The length of PVC SDR 26 pipe shall be measured in linear feet of pipe in place, completed, and accepted. It shall be measured along the centerline of the pipe from end or inside face of structure to the end or inside face of structure, including connections to structures and inclusion of cleanouts, whichever is applicable. The pipes shall be measured separately. All fittings shall be included in the footage as typical pipe sections in the pipe being measured. ***All necessary excavation, shoring, backfill, de-watering, pipe cradles, pipe bedding and other works required to install the pipe shall be considered incidental to the placement of the pipe.***

BASIS OF PAYMENT

701-5.0 These prices shall fully compensate the Contractor for furnishing all materials and for all preparation, excavation, and installation of these materials; and for all labor, equipment, tools, and incidentals necessary to complete the item.

701-5.1 Payment will be made at the contract unit price per linear foot for reinforced concrete pipe.

701-5.2 Payment will be made at the contract unit price per linear foot for PVC SDR 26 pipe.

Payment will be made under:

Item D-701-5.1	18-inch Reinforced Concrete Pipe - per linear foot
Item D-701-5.2	24-inch Reinforced Concrete Pipe - per linear foot
Item D-701-5.3	30-inch Reinforced Concrete Pipe - per linear foot
Item D-701-5.4	36-inch Reinforced Concrete Pipe - per linear foot
Item D-701-5.5	42-inch Reinforced Concrete Pipe - per linear foot
Item D-701-5.6	48-inch Reinforced Concrete Pipe - per linear foot
Item D-701-5.7	54-inch Reinforced Concrete Pipe - per linear foot

Item D-701-5.8	60-inch Reinforced Concrete Pipe - per linear foot
Item D-701-5.9	72-inch Reinforced Concrete Pipe - per linear foot
Item D-701-5.10	6” PVC SDR 26 Pipe - per linear foot
Item D-701-5.11	10” PVC SDR 26 Pipe - per linear foot

REFERENCES

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

American Association of State Highway and Transportation Officials (AASHTO)

AASHTO M167	Standard Specification for Corrugated Steel Structural Plate, Zinc-Coated, for Field-Bolted Pipe, Pipe-Arches, and Arches
AASHTO M190	Standard Specification for Bituminous-Coated Corrugated Metal Culvert Pipe and Pipe Arches
AASHTO M196	Standard Specification for Corrugated Aluminum Pipe for Sewers and Drains
AASHTO M219	Standard Specification for Corrugated Aluminum Alloy Structural Plate for Field-Bolted Pipe, Pipe-Arches, and Arches
AASHTO M243	Standard Specification for Field Applied Coating of Corrugated Metal Structural Plate for Pipe, Pipe-Arches, and Arches
AASHTO M252	Standard Specification for Corrugated Polyethylene Drainage Pipe
AASHTO M294	Standard Specification for Corrugated Polyethylene Pipe, 300- to 1500-mm (12- to 60-in.) Diameter
AASHTO M304	Standard Specification for Poly (Vinyl Chloride) (PVC) Profile Wall Drain Pipe and Fittings Based on Controlled Inside Diameter
AASHTO MP20	Standard Specification for Steel Reinforced Polyethylene (PE) Ribbed Pipe, 300- to 900-mm (12- to 36-in.) Diameter

ASTM International (ASTM)

ASTM A760	Standard Specification for Corrugated Steel Pipe, Metallic Coated for Sewers and Drains
ASTM A761	Standard Specification for Corrugated Steel Structural Plate, Zinc Coated, for Field-Bolted Pipe, Pipe-Arches, and Arches
ASTM A762	Standard Specification for Corrugated Steel Pipe, Polymer Precoated for Sewers and Drains
ASTM A849	Standard Specification for Post-Applied Coatings, Pavings, and Linings for Corrugated Steel Sewer and Drainage Pipe
ASTM B745	Standard Specification for Corrugated Aluminum Pipe for Sewers and Drains
ASTM C14	Standard Specification for Nonreinforced Concrete Sewer, Storm Drain, and Culvert Pipe

ASTM C76	Standard Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe
ASTM C94	Standard Specification for Ready Mixed Concrete
ASTM C144	Standard Specification for Aggregate for Masonry Mortar
ASTM C150	Standard Specification for Portland Cement
ASTM C443	Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets
ASTM C506	Standard Specification for Reinforced Concrete Arch Culvert, Storm Drain, and Sewer Pipe
ASTM C507	Standard Specification for Reinforced Concrete Elliptical Culvert, Storm Drain and Sewer Pipe
ASTM C655	Standard Specification for Reinforced Concrete D-Load Culvert, Storm Drain and Sewer Pipe
ASTM C990	Standard Specification for Joints for Concrete Pipe, Manholes, and Precast Box Sections Using Preformed Flexible Joint Sealants
ASTM C1433	Standard Specification for Precast Reinforced Concrete Monolithic Box Sections for Culverts, Storm Drains, and Sewers
ASTM D1056	Standard Specification for Flexible Cellular Materials Sponge or Expanded Rubber
ASTM D3034	Standard Specification for Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings
ASTM D3212	Standard Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals
ASTM D3262	Standard Specification for "Fiberglass" (Glass-Fiber Reinforced Thermosetting Resin) Sewer Pipe
ASTM D3282	Standard Practice for Classification of Soils and Soil-Aggregate Mixtures for Highway Construction Purposes
ASTM D4161	Standard Specification for "Fiberglass" (Glass-Fiber Reinforced Thermosetting Resin) Pipe Joints Using Flexible Elastomeric Seals
ASTM D6690	Standard Specification for Joint and Crack Sealants, Hot Applied, for Concrete and Asphalt Pavements
ASTM F477	Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe
ASTM F667	Standard Specification for 3 through 24 in. Corrugated Polyethylene Pipe and Fittings
ASTM F714	Standard Specification for Polyethylene (PE) Plastic Pipe (DR PR) Based on Outside Diameter
ASTM F794	Standard Specification for Poly (Vinyl Chloride) (PVC) Profile Gravity Sewer Pipe & Fittings Based on Controlled Inside Diameter

ASTM F894	Standard Specification for Polyethylene (PE) Large Diameter Profile Wall Sewer and Drain Pipe
ASTM F949	Standard Specification for Poly (Vinyl Chloride) (PVC) Corrugated Sewer Pipe with a Smooth Interior and Fittings
ASTM F2435	Standard Specification for Steel Reinforced Polyethylene (PE) Corrugated Pipe
ASTM F2562	Specification for Steel Reinforced Thermoplastic Ribbed Pipe and Fittings for Non-Pressure Drainage and Sewerage
ASTM F2736	Standard Specification for 6 to 30 in. (152 to 762 mm) Polypropylene (PP) Corrugated Single Wall Pipe and Double Wall Pipe
ASTM F2764	Standard Specification for 30 to 60 in. (750 to 1500 mm) Polypropylene (PP) Triple Wall Pipe and Fittings for Non-Pressure Sanitary Sewer Applications
ASTM F2881	Standard Specification for 12 to 60 in. (300 to 1500 mm) Polypropylene (PP) Dual Wall Pipe and Fittings for Non-Pressure Storm Sewer Applications

National Fire Protection Association (NFPA)

NFPA 415	Standard on Airport Terminal Buildings, Fueling Ramp Drainage, and Loading Walkways

END ITEM D-701

Item D-705 Pipe Underdrains for Airports

DESCRIPTION

705-1.1 This item shall consist of the construction of pipe drains in accordance with these specifications and in reasonably close conformity with the lines and grades shown on the plans.

MATERIALS

705-2.1 General. Materials shall meet the requirements shown on the plans and specified below.

705-2.2 Pipe. The pipe shall be of the type called for on the plans or in the proposal and shall be in accordance with the following appropriate requirements.

FDOT Standard Index 286 Type 1 Smooth High Density Polyethylene (HDPE)

705-2.3 Joint mortar. Pipe joint mortar shall consist of one part by volume of Portland cement and two parts sand. The Portland cement shall conform to the requirements of ASTM C150, Type I. The sand shall conform to the requirements of ASTM C144.

705-2.4 Elastomeric seals. Elastomeric seals shall conform to the requirements of ASTM F477.

705-2.5 Porous backfill. Porous backfill shall be free of clay, humus, or other objectionable matter, and shall conform to the gradation in Table 1 when tested in accordance with ASTM C136.

Table 1. Gradation of Porous Backfill

Sieve Designation (square openings)	Percentage by Weight Passing Sieves
	Porous Material No. *
1-1/2 inch (37.5 mm)	100
1 inch (25.0 mm)	90-100
3/8 inch (9.5 mm)	25-60
No. 4 (4.75 mm)	5-40
No. 8 (2.36 mm)	0-20
No. 16 (1.18 mm)	-
No. 50 (300 µm)	-
No. 100 (150 µm)	-

When two courses of porous backfill are specified in the plans, the finer of the materials shall conform to particle size tabulated herein for porous material No. 1. The coarser granular material shall meet the gradation given in the tabulation for porous material No. 2.

705-2.6 Granular material. Granular material used for backfilling shall conform to the requirements of ASTM D2321 for Class IA, IB, or II materials.

705-2.7 Filter fabric. The filter fabric shall conform to the requirements of AASHTO M288 Class 2 or equivalent.

Table 2. Fabric Properties

Fabric Property	Test Method	Test Requirement
Grab Tensile Strength, lbs	ASTM D4632	125 min
Grab Tensile Elongation %	ASTM D4632	50 min
Burst Strength, psi	ASTM D3785	125 min
Trapezoid Tear Strength, lbs	ASTM D4533	55 min
Puncture Strength, lbs	ASTM D4833	40 min
Abrasion, lbs	ASTM D4886	15 max loss
Equivalent Opening Size	ASTM D4751	70-100
Permittivity sec^{-1}	ASTM D4491	0.80
Accelerated Weathering (UV Stability) (Strength Retained - %)	ASTM D4355 *(500 hrs exposure)	70

705-2.8 Controlled low-strength material (CLSM). CLSM is not used.

CONSTRUCTION METHODS

705-3.1 Equipment. All equipment required for the construction of pipe underdrains shall be on the project, in good working condition, and approved by the RPR before construction is permitted to start.

705-3.2 Excavation. The width of the pipe trench shall be sufficient to permit satisfactory jointing of the pipe and thorough tamping of the bedding material under and around the pipe, but shall not be less than the external diameter of the pipe plus 6 inches (150 mm) on each side of the pipe. The trench walls shall be approximately vertical.

Where rock, hardpan, or other unyielding material is encountered, it shall be removed below the foundation grade for a depth of at least 4 inches (100 mm). The excavation below grade shall be backfilled with selected fine compressible material, such as silty clay or loam, and lightly compacted in layers not over 6 inches (150 mm) in uncompacted depth to form a uniform but yielding foundation.

Where a firm foundation is not encountered at the grade established, due to soft, spongy, or other unstable soil, the unstable soil shall be removed and replaced with approved granular material for the full trench width. The RPR shall determine the depth of removal necessary. The granular material shall be compacted to provide adequate support for the pipe.

Excavated material not required or acceptable for backfill shall be disposed of by the Contractor as directed by the RPR. The excavation shall not be carried below the required depth; if this occurs, the trench shall be backfilled at the Contractor's expense with material approved by the RPR and compacted to the density of the surrounding material.

The pipe bedding shall be constructed uniformly over the full length of the pipe barrel, as required on the plans. The maximum aggregate size shall be 1 inch when the bedding thickness is less than 6 inches, and 1-1/2 inch when the bedding thickness is greater than 6 inches. Bedding shall be loosely placed, uncompacted material under the middle third of the pipe prior to placement of the pipe.

The Contractor shall do trench bracing, sheathing, or shoring necessary to perform and protect the excavation as required for safety and conformance to federal, state and local laws. Unless otherwise provided, the bracing, sheathing, or shoring shall be removed by the Contractor after the backfill has reached at least 12 inches (300 mm) over the top of the pipe. The sheathing or shoring shall be pulled as the granular backfill is placed and compacted to avoid any unfilled spaces between the trench wall and the backfill material. The cost of bracing, sheathing, or shoring, and the removal of same, shall be included in the unit price bid per foot (meter) for the pipe.

705-3.3 Laying and installing pipe.

a. Concrete pipe. The laying of the pipe in the finished trench shall be started at the lowest point and proceed upgrade. When bell and spigot pipe is used, the bells shall be laid upgrade. If tongue and groove pipe is used, the groove end shall be laid upgrade. Holes in perforated pipe shall be placed down, unless otherwise shown on the plans. The pipe shall be firmly and accurately set to line and grade so that the invert will be smooth and uniform. Pipe shall not be laid on frozen ground.

Pipe which is not true in alignment, or which shows any settlement after laying, shall be taken up and re-laid by the Contractor at no additional expense. Making adjustments in grade by exerting force on the barrel of the pipe with excavating equipment, by lifting and dropping the pipe, or by lifting the pipe and packing bedding material under it shall be prohibited. If the installed pipe section is not to grade, the pipe section shall be completely removed, the grade corrected, and the pipe rejoined."

b. Metal pipe. The metal pipe shall be laid with the separate sections joined firmly together with bands, with outside laps of circumferential joints pointing upgrade, and with longitudinal laps on the sides. Any metal in the pipe or bands that is not protected thoroughly by galvanizing shall be coated with a suitable asphaltum paint.

During installation, the asphalt-protected pipe shall be handled without damaging the asphalt coating. Any breaks in the bitumen or treatment of the pipe shall be refilled with the type and kind of bitumen used in coating the pipe originally.

c. PVC, fiberglass, or polyethylene pipe. PVC or polyethylene pipe shall be installed in accordance with the requirements of ASTM D2321. Perforations shall meet the requirements of AASHTO M252 or AASHTO M294 Class 2, unless otherwise indicated on the plans. The pipe shall be laid accurately to line and grade. Fiberglass per ASTM D3839 Standard Guide for Underground Installation of "Fiberglass" (Glass-Fiber Reinforced Thermosetting-Resin) Pipe.

d. All types of pipe. The upgrade end of pipelines, not terminating in a structure, shall be plugged or capped as approved by the RPR.

Unless otherwise shown on the plans, a 4-inch (100 mm) bed of granular backfill material shall be spread in the bottom of the trench throughout the entire length under all perforated pipe underdrains.

Pipe outlets for the underdrains shall be constructed when required or shown on the plans. The pipe shall be laid with tight-fitting joints. Porous backfill is not required around or over pipe

outlets for underdrains. All connections to other drainage pipes or structures shall be made as required and in a satisfactory manner. If connections are not made to other pipes or structures, the outlets shall be protected and constructed as shown on the plans.

e. Filter fabric. The filter fabric shall be installed in accordance with the manufacturer's recommendations, or in accordance with the AASHTO M288 Appendix, unless otherwise shown on the plans.

705-3.4 Mortar. The mortar shall be of the desired consistency for caulking and filling the joints of the pipe and for making connections to other pipes or to structures. Mortar that is not used within 45 minutes after water has been added shall be discarded. Retempering of mortar shall not be permitted.

705-3.5 Joints in concrete pipe. When open or partly open joints are required or specified, they shall be constructed as indicated on the plans. The pipe shall be laid with the ends fitted together as designed. If bell and spigot pipe is used, mortar shall be placed along the inside bottom quarter of the bell to center the following section of pipe.

The open or partly open joints shall be surrounded with granular material meeting requirements of porous backfill No. 2 in Table 1 or as indicated on the plans. This backfill shall be placed so its thickness will be not less than 3 inches (75 mm) nor more than 6 inches (150 mm), unless otherwise shown on the plans.

When the original material excavated from the trench is impervious, commercial concrete sand or granular material meeting requirements of porous backfill No. 1 shall surround porous backfill No. 2 (Table 1), as shown on the plans or as directed by the RPR.

When the original material excavated from the trench is pervious and suitable, it may be used as backfill in lieu of porous backfill No. 1, when indicated on the plans or as directed by the RPR.

705-3.6 Embedment and Backfill

a. Earth. All trenches and excavations shall be backfilled soon after the pipes are installed, unless additional protection of the pipe is directed. The embedment material shall be select material from excavation or borrow and shall be approved by the RPR. The select material shall be placed on each side of the pipe out to a distance of the nominal pipe diameter and one foot (30 cm) over the top of the pipe and shall be readily compacted. It shall not contain stones 3 inches (75 mm) or larger in size, frozen lumps, chunks of highly plastic clay, or any other material that is objectionable to the RPR. The material shall be moistened or dried, as required to aid compaction. Placement of the embedment material shall not cause displacement of the pipe. Thorough compaction under the haunches and along the sides to the top of the pipe shall be obtained.

The embedment material shall be placed in loose layers not exceeding 6 inches (150 mm) in depth under and around the pipe. Backfill material over the pipe shall be placed in lifts not exceeding 8 inches (200 mm). Successive layers shall be added and thoroughly compacted by hand and pneumatic tampers, approved by the RPR, until the trench is completely filled and brought to the planned elevation. Embedment and backfilling shall be done to avoid damaging top or side of the pipe.

In embankments and other unpaved areas, the backfill shall be compacted per Item P-152 to the density required for embankments in unpaved areas. Under paved areas, the subgrade and any backfill shall be compacted per Item P-152 to the density required for embankments for paved areas.

b. Granular backfill. When granular backfill is required, placement in the trench and about the pipe shall be as shown on the plans. The granular backfill shall not contain an excessive amount of foreign matter, nor shall soil from the sides of the trench or from the soil excavated from the trench be allowed to filter into the granular backfill. When required by the RPR, a template shall be used to properly place and separate the two sizes of backfill. The backfill shall be placed in loose layers not exceeding 6 inches (150 mm) in depth. The granular backfill shall be compacted by hand and pneumatic tampers to the requirements as given for embankment. Backfilling shall be done to avoid damaging top or side pressure on the pipe. The granular backfill shall extend to the elevation of the trench or as shown on the plans.

When perforated pipe is specified, granular backfill material shall be placed along the full length of the pipe. The position of the granular material shall be as shown on the plans. If the original material excavated from the trench is pervious and suitable, it shall be used in lieu of porous backfill No. 1.

If porous backfill is placed in paved or adjacent to paved areas before grading or subgrade operations is completed, the backfill material shall be placed immediately after laying the pipe. The depth of the granular backfill shall be not less than 12 inches (300 mm), measured from the top of the underdrain. During subsequent construction operations, a minimum depth of 12 inches (300 mm) of backfill shall be maintained over the underdrains. When the underdrains are to be completed, any unsuitable material shall be removed exposing the porous backfill. Porous backfill containing objectionable material shall be removed and replaced with suitable material. The cost of removing and replacing any unsuitable material shall be at the Contractor's expense.

If a granular subbase blanket course is used which extends several feet beyond the edge of paving to the outside edge of the underdrain trench, the granular backfill material over the underdrains shall be placed in the trench up to an elevation of 2 inches (50 mm) above the bottom surface of the granular subbase blanket course. Immediately prior to the placing of the granular subbase blanket course, the Contractor shall blade this excess trench backfill from the top of the trench onto the adjacent subgrade where it can be incorporated into the granular subbase blanket course. Any unsuitable material that remains over the underdrain trench shall be removed and replaced. The subbase material shall be placed to provide clean contact between the subbase material and the underdrain granular backfill material for the full width of the underdrain trench.

c. Controlled low-strength material (CLSM). ***CLSM is not used.***

705-3.7 Flexible Pipe Ring Deflection. The flexible pipe shall be inspected by the Contractor during and after installation to ensure that the internal diameter of the pipe barrel has not been reduced by more than 5 percent. For guidance on properly sizing mandrels, refer to ASTM D3034 and ASTM F679 appendices.

705-3.8 Connections. When the plans call for connections to existing or proposed pipe or structures, these connections shall be watertight and made to obtain a smooth uniform flow line throughout the drainage system.

705-3.9 Cleaning and restoration of site. After the backfill is completed, the Contractor shall dispose of all surplus material, soil, and rubbish from the site. Surplus soil may be deposited in embankments, shoulders, or as directed by the RPR. Except for paved areas of the airport, the Contractor shall restore all disturbed areas to their original condition.

METHOD OF MEASUREMENT

705-4.1 The length of 6" perforated or non-perforated pipe shall be the number of linear feet of pipe underdrains in place, completed, and approved; measured along the centerline of the pipe from end or inside face of structure to the end or inside face of structure, whichever is applicable. The several classes, types, and sizes shall be measured separately. All fittings (including cleanouts, frame/lids, concrete pads, wyes, tees, etc.) shall be incidental to the footage of pipeline being measured. The quantity of pipe underdrains shall include porous backfill and filter fabric for perforated sections.

BASIS OF PAYMENT

705-5.1 6-Inch Pipe Underdrains. Payment will be made at the contract unit price per linear foot for pipe underdrains of the type, class, and size designated.

These prices shall be full compensation for furnishing all materials and for all preparation, excavation, and installation of these materials, and for all labor, equipment, tools, and incidentals necessary to complete the item.

Payment will be made under:

Item D-705-5.1 6-inch Smooth High Density Polyethylene (HDPE) Pipe per linear foot

REFERENCES

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

ASTM International (ASTM)

ASTM A760	Standard Specification for Corrugated Steel Pipe, Metallic Coated for Sewers and Drains
ASTM A762	Standard Specification for Corrugated Steel Pipe, Polymer Precoated for Sewers and Drains
ASTM C136	Standard Test Method for Sieve or Screen Analysis of Fine and Coarse Aggregates
ASTM C144	Standard Specification for Aggregate for Masonry Mortar
ASTM C150	Standard Specification for Portland Cement
ASTM C444	Standard Specification for Perforated Concrete Pipe
ASTM C654	Standard Specification for Porous Concrete Pipe
ASTM D2321	Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications
ASTM D3262	Standard Specification for "Fiberglass" (Glass-Fiber Reinforced Thermosetting Resin) Sewer Pipe
ASTM D4161	Standard Specification for "Fiberglass" (Glass-Fiber Reinforced Thermosetting Resin) Pipe Joints Using Flexible Elastomeric Seals

ASTM F477	Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe
ASTM F758	Standard Specification for Smooth Wall Poly (Vinyl Chloride) (PVC) Plastic Underdrain Systems for Highway, Airport, and Similar Drainage
ASTM F794	Standard Specification for Poly (Vinyl Chloride) (PVC) Profile Gravity Sewer Pipe & Fittings Based on Controlled Inside Diameter
ASTM F949	Standard Specification for Poly (Vinyl Chloride) (PVC) Corrugated Sewer Pipe with a Smooth Interior and Fittings
ASTM F2562	Specification for Steel Reinforced Thermoplastic Ribbed Pipe and Fittings for Non-Pressure Drainage and Sewerage

American Association of State Highway and Transportation Officials (AASHTO)

AASHTO M190	Standard Specification for Bituminous - Coated Corrugated Metal Culvert Pipe and Pipe Arches
AASHTO M196	Standard Specification for Corrugated Aluminum Pipe for Sewers and Drains
AASHTO M252	Standard Specification for Corrugated Polyethylene Drainage Pipe
AASHTO M288	Standard Specification for Geotextile Specification for Highway Applications
AASHTO M294	Standard Specification for Corrugated Polyethylene Pipe, 300- to 1500- mm (12- to 60-in.) Diameter
AASHTO M304	Standard Specification for Poly (Vinyl Chloride) (PVC) Profile Wall Drain Pipe and Fittings Based on Controlled Inside Diameter
AASHTO MP20	Standard Specification for Steel-Reinforced Polyethylene (PE) Ribbed Pipe, 300- to 900-mm (12- to 36-in.) diameter
AASHTO	Standard Specifications for Highway Bridges

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Item D-751 Manholes, Catch Basins, Inlets and Inspection Holes

DESCRIPTION

751-1.1 This item shall consist of construction of manholes, catch basins, inlets, and inspection holes, in accordance with these specifications, at the specified locations and conforming to the lines, grades, and dimensions shown on the plans or required by the ~~RPR~~ **OAR**.

MATERIALS

751-2.1 Brick. The brick shall conform to the requirements of ASTM C32, Grade MS.

751-2.2 Mortar. Mortar shall consist of one part Portland cement and two parts sand. The cement shall conform to the requirements of ASTM C150, Type I. The sand shall conform to the requirements of ASTM C144.

751-2.3 Concrete. Plain and reinforced concrete used in structures, connections of pipes with structures, and the support of structures or frames shall conform to the requirements of Item P-610.

751-2.4 Precast concrete pipe manhole rings. Precast concrete pipe manhole rings shall conform to the requirements of ASTM C478. Unless otherwise specified, the risers and offset cone sections shall have an inside diameter of not less than 36 inches (90 cm) nor more than 48 inches (120 cm). There shall be a gasket between individual sections and sections cemented together with mortar on the inside of the manhole. Gaskets shall conform to the requirements of ASTM C443.

751-2.5 Corrugated metal. Corrugated metal shall conform to the requirements of American Association of State Highway and Transportation Officials (AASHTO) M36.

751-2.6 Frames, covers, and grates. The castings shall conform to one of the following requirements:

a. ASTM A48, Class 35B: Gray iron castings

b. ASTM A47: Malleable iron castings

c. ASTM A27: Steel castings

d. ASTM A283, Grade D: Structural steel for grates and frames

e. ASTM A536, Grade 65-45-12: Ductile iron castings

f. ASTM A897: Austempered ductile iron castings

All castings or structural steel units shall conform to the dimensions shown on the plans and shall be designed to support the loadings, aircraft gear configuration and/or direct loading, specified.

Each frame and cover or grate unit shall be provided with fastening members to prevent it from being dislodged by traffic but which will allow easy removal for access to the structure.

All castings shall be thoroughly cleaned. After fabrication, structural steel units shall be galvanized to meet the requirements of ASTM A123.

751-2.7 Steps. The steps or ladder bars shall be gray or malleable cast iron or galvanized steel. The steps shall be the size, length, and shape shown on the plans and those steps that are not galvanized shall be given a coat of asphalt paint, when directed.

751-2.8 Precast inlet structures. Manufactured in accordance with and conforming to ASTM C913.

CONSTRUCTION METHODS

751-3.1 Unclassified excavation.

a. The Contractor shall excavate for structures and footings to the lines and grades or elevations, shown on the plans~~, or as staked by the RPR~~. The excavation shall be of sufficient size to permit the placing of the full width and length of the structure or structure footings shown. The elevations of the bottoms of footings, as shown on the plans, shall be considered as approximately only; and the ~~RPR~~ **OAR** may direct, in writing, changes in dimensions or elevations of footings necessary for a satisfactory foundation.

b. Boulders, logs, or any other objectionable material encountered in excavation shall be removed. All rock or other hard foundation material shall be cleaned of all loose material and cut to a firm surface either level, stepped, or serrated, as directed by the ~~RPR~~ **OAR**. All seams or crevices shall be cleaned out and grouted. All loose and disintegrated rock and thin strata shall be removed. Where concrete will rest on a surface other than rock, the bottom of the excavation shall not be disturbed and excavation to final grade shall not be made until immediately before the concrete or reinforcing is placed.

c. The Contractor shall do all bracing, sheathing, or shoring necessary to implement and protect the excavation and the structure as required for safety or conformance to governing laws. The cost of ***de-watering***, bracing, sheathing, or shoring shall be included in the unit price bid for the structure.

d. All ***de-watering equipment***, bracing, sheathing, or shoring involved in the construction of this item shall be removed by the Contractor after the completion of the structure. Removal shall not disturb or damage finished masonry. The cost of removal shall be included in the unit price bid for the structure.

e. After excavation is completed for each structure, the Contractor shall notify the ~~RPR~~ **OAR**. No concrete or reinforcing steel shall be placed until the ~~RPR~~ **OAR** has **observed and** approved the depth of the excavation and the character of the foundation material.

751-3.2 Brick structures.

a. Foundations. A prepared foundation shall be placed for all brick structures after the foundation excavation is completed and accepted. Unless otherwise specified, the base shall consist of reinforced concrete mixed, prepared, and placed in accordance with the requirements of Item P-610.

b. Laying brick. All brick shall be clean and thoroughly wet before laying so that they will not absorb any appreciable amount of additional water at the time they are laid. All brick shall be laid in freshly made mortar. Mortar not used within 45 minutes after water has been added shall be discarded. Retempering of mortar shall not be permitted. An ample layer of mortar shall be spread on the beds and a shallow furrow shall be made in it that can be readily closed by the laying of the brick. All bed and head joints shall be filled solid with mortar. End joints of stretchers and side or cross joints of headers shall be fully buttered with mortar and a shoved joint made to squeeze

out mortar at the top of the joint. Any bricks that may be loosened after the mortar has taken its set, shall be removed, cleaned, and re-laid with fresh mortar. No broken or chipped brick shall be used in the face, and no spalls or bats shall be used except where necessary to shape around irregular openings or edges; in which case, full bricks shall be placed at ends or corners where possible, and the bats shall be used in the interior of the course. In making closures, no piece of brick shorter than the width of a whole brick shall be used; and wherever practicable, whole brick shall be used and laid as headers.

c. Joints. All joints shall be filled with mortar at every course Exterior faces shall be laid up in advance of backing. Exterior faces shall be plastered or parged with a coat of mortar not less than 3/8 inch (9 mm) thick before the backing is laid up. Prior to parging, all joints on the back of face courses shall be cut flush. Unless otherwise noted, joints shall be not less than 1/4 inch (6 mm) nor more than 1/2 inch (12 mm) wide and the selected joint width shall be maintained uniform throughout the work.

d. Pointing. Face joints shall be neatly struck, using the weather-struck joint. All joints shall be finished properly as the laying of the brick progresses. When nails or line pins are used, the holes shall be immediately plugged with mortar and pointed when the nail or pin is removed.

e. Cleaning. Upon completion of the work all exterior surfaces shall be thoroughly cleaned by scrubbing and washing with water. If necessary to produce satisfactory results, cleaning shall be done with a 5% solution of muriatic acid which shall then be rinsed off with liberal quantities of water.

f. Curing and cold weather protection. The brick masonry shall be protected and kept moist for at least 48 hours after laying the brick. Brick masonry work or pointing shall not be done when there is frost on the brick or when the air temperature is below 50°F (10°C) unless the Contractor has, on the project ready to use, suitable covering and artificial heating devices necessary to keep the atmosphere surrounding the masonry at a temperature of not less than 60°F (16°C) for the duration of the curing period.

751-3.3 Concrete structures. Concrete structures which are to be cast-in-place within the project boundaries shall be built on prepared foundations, conforming to the dimensions and shape indicated on the plans. The construction shall conform to the requirements specified in Item P-610. Any reinforcement required shall be placed as indicated on the plans and shall be approved by the ~~RPR~~ **OAR** before the concrete is placed.

All invert channels shall be constructed and shaped accurately to be smooth, uniform, and cause minimum resistance to flowing water. The interior bottom shall be sloped to the outlet.

751-3.4 Precast concrete structures. Precast concrete structures shall be furnished by a plant meeting National Precast Concrete Association Plant Certification Program or another ~~RPR~~ **OAR** approved third party certification program.

Precast concrete structures shall conform to ASTM C478. Precast concrete structures shall be constructed on prepared or previously placed slab foundations conforming to the dimensions and locations shown on the plans. All precast concrete sections necessary to build a completed structure shall be furnished. The different sections shall fit together readily. Joints between precast concrete risers and tops shall be full-bedded in cement mortar and shall: (1) be smoothed to a uniform surface on both interior and exterior of the structure or (2) utilize a rubber gasket per ASTM C443. The top of the upper precast concrete section shall be suitably formed and dimensioned to receive the metal frame and cover or grate, or other cap, as required. Provision shall be made for any connections for lateral pipe, including drops and leads that may be installed in the structure. The flow lines shall be smooth, uniform, and cause minimum resistance to flow.

The metal or metal encapsulated steps that are embedded or built into the side walls shall be aligned and placed in accordance to ASTM C478. When a metal ladder replaces the steps, it shall be securely fastened into position.

751-3.5 Corrugated metal structures. Corrugated metal structures shall be prefabricated. All standard or special fittings shall be furnished to provide pipe connections or branches with the correct dimensions and of sufficient length to accommodate connecting bands. The fittings shall be welded in place to the metal structures. The top of the metal structure shall be designed so that either a concrete slab or metal collar may be attached to allow the fastening of a standard metal frame and grate or cover. Steps or ladders shall be furnished as shown on the plans. Corrugated metal structures shall be constructed on prepared foundations, conforming to the dimensions and locations as shown on the plans. When indicated, the structures shall be placed on a reinforced concrete base.

751-3.6 Inlet and outlet pipes. Inlet and outlet pipes shall extend through the walls of the structures a sufficient distance beyond the outside surface to allow for connections. They shall be cut off flush with the wall on the inside surface of the structure, unless otherwise directed. For concrete or brick structures, mortar shall be placed around these pipes to form a tight, neat connection.

751-3.7 Placement and treatment of castings, frames, and fittings. All castings, frames, and fittings shall be placed in the positions indicated on the plans or as directed by the ~~RPR~~ **OAR**, and shall be set true to line and elevation. If frames or fittings are to be set in concrete or cement mortar, all anchors or bolts shall be in place before the concrete or mortar is placed. The unit shall not be disturbed until the mortar or concrete has set.

When frames or fittings are placed on previously constructed masonry, the bearing surface of the masonry shall be brought true to line and grade and shall present an even bearing surface so the entire face or back of the unit will come in contact with the masonry. The unit shall be set in mortar beds and anchored to the masonry as indicated on the plans or as directed by the ~~RPR~~ **OAR**. All units shall set firm and secure.

After the frames or fittings have been set in final position, the concrete or mortar shall be allowed to harden for seven (7) days before the grates or covers are placed and fastened down.

751-3.8 Installation of steps. The steps shall be installed as indicated on the plans or as directed by the ~~RPR~~ OAR. When the steps are to be set in concrete, they shall be placed and secured in position before the concrete is placed. When the steps are installed in brick masonry, they shall be placed as the masonry is being built. The steps shall not be disturbed or used until the concrete or mortar has hardened for at least seven (7) days. After seven (7) days, the steps shall be cleaned and painted, unless they have been galvanized.

When steps are required with precast concrete structures they shall meet the requirements of ASTM C478. The steps shall be cast into the side of the sections at the time the sections are manufactured or set in place after the structure is erected by drilling holes in the concrete and cementing the steps in place.

When steps are required with corrugated metal structures, they shall be welded into aligned position at a vertical spacing of 12 inches (300 mm).

~~Instead of steps, prefabricated ladders may be installed. For brick or concrete structures, the ladder shall be held in place by grouting the supports in drilled holes. For metal structures, the ladder shall be secured by welding the top support to the structure and grouting the bottom support into drilled holes in the foundation or as directed by the RPR **OAR**.~~

751-3.9 Backfilling.

a. After a structure has been completed, the area around it shall be backfilled with approved material, in horizontal layers not to exceed 8 inches (200 mm) in loose depth, and compacted to the density required in Item P-152. Each layer shall be deposited evenly around the structure to approximately the same elevation. The top of the fill shall meet the elevation shown on the plans or as directed by the ~~RPR~~ **OAR**.

b. Backfill shall not be placed against any structure until approved by the ~~RPR~~ **OAR**. For concrete structures, approval shall not be given until the concrete has been in place seven (7) days, or until tests establish that the concrete has attained sufficient strength to withstand any pressure created by the backfill and placing methods.

c. Backfill shall not be measured for direct payment. Performance of this work shall be considered an obligation of the Contractor covered under the contract unit price for the structure involved.

751-3.10 Cleaning and restoration of site. After the backfill is completed, the Contractor shall dispose of all surplus material, dirt, and rubbish from the site. Surplus dirt may be deposited in embankments, shoulders, or as approved by the ~~RPR~~ **OAR**. The Contractor shall restore all disturbed areas to their original condition. The Contractor shall remove all tools and equipment, leaving the entire site free, clear, and in good condition.

METHOD OF MEASUREMENT

751-4.1 Manholes catch basins and inlets shall be measured by the unit.

751-4.2 Cleanout shall not be measured and shall be incidental to other applicable elements of work.

751-4.3 The quantity of Adjust Existing Manhole, Inlet, Inspection Hole and Cleanout to grade shall be incidental to specification P-501 Portland Cement Concrete Pavement. This work shall consist of all materials and equipment needed to complete the item as shown on the plans and details.

BASIS OF PAYMENT

751-5.1 The accepted quantities of manholes, catch basins and inlets will be paid for at the contract unit price per each in place when completed. This price shall be full compensation for furnishing all materials and for all preparation, de-watering, excavation, shoring, backfilling and placing of the materials; furnishing and installation of such specials and connections to pipes and other structures as may be required to complete the item as shown on the plans; and for all labor equipment, tools and incidentals necessary to complete the structure.

Payment will be made under:

Item D-751-5.1	Manholes - per each
Item D-751-5.2	Inlets - per each

REFERENCES

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

ASTM International (ASTM)

ASTM A27	Standard Specification for Steel Castings, Carbon, for General Application
ASTM A47	Standard Specification for Ferritic Malleable Iron Castings
ASTM A48	Standard Specification for Gray Iron Castings
ASTM A123	Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A283	Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates
ASTM A536	Standard Specification for Ductile Iron Castings
ASTM A897	Standard Specification for Austempered Ductile Iron Castings
ASTM C32	Standard Specification for Sewer and Manhole Brick (Made from Clay or Shale)
ASTM C144	Standard Specification for Aggregate for Masonry Mortar
ASTM C150	Standard Specification for Portland Cement
ASTM C443	Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets.
ASTM C478	Standard Specification for Precast Reinforced Concrete Manhole Sections
ASTM C913	Standard Specification for Precast Concrete Water and Wastewater Structures.

American Association of State Highway and Transportation Officials (AASHTO)

AASHTO M36	Standard Specification for Corrugated Steel Pipe, Metallic-Coated, for Sewers and Drains

END OF ITEM D-751

Item D-756 Trench Drain and Forming System

DESCRIPTION

756-1.1 This item shall consist of trench drains and trench forming systems constructed in accordance with these specifications, at the specified locations and conforming to the lines, grades, and dimensions shown on the plans or required by the Engineer.

MATERIALS

756-2.1a Forms (12' Trench) – Removable trench forms to be pre-manufactured using non-CFC EPS foam, wood product, FRP and or plastics. Each former segment shall have an 8" wide I.D. with means of deforming and provide a minimum of an 11.5" grate seat width. Appropriate form release for smooth interior walls and easy form removal is to be used. Form segments are to provide trench dimensional accuracy of .0625". Trench slope and depths are to be as specified on the drawings. Deviations from plan of slope, width and depth shall not be allowed as it directly impacts hydraulic capacity, storage capacity & velocity. Forms shall have a radius or square bottom as shown on plans and will allow for a monolithic concrete pour eliminating cold joints and water stop materials from being used in the trench invert. Forms and removal of forms shall not interfere or compromise the structural integrity of the load transfer assembly between the frame and encapsulation concrete. Forms, mounting brackets and liners shall be fully removed, without exception, to allow for 100% inspection of concrete consolidation. Inspection of consolidation below frames shall be 100%, partial inspection points will not be allowed. Formwork assembly must be prevented from floating during concrete placement without penetrating the sub grade. A means to assure constant frame spacing and grate seat dimension shall be provided.

756-2.1b Forms (18" Trench) – Removable trench forms to be pre-manufactured using non-CFC EPS foam, wood product, FRP and or plastics. Each former segment shall have an 18" wide I.D. with means of deforming and provide a minimum of a 22" grate seat width. Appropriate form release for smooth interior walls and easy form removal is to be used. Form segments are to provide trench dimensional accuracy of .0625". Trench slope and depths are to be as specified on the drawings. Deviations from plan of slope, width and depth shall not be allowed as it directly impacts hydraulic capacity, storage capacity & velocity. Forms shall have a radius or square bottom as shown on plans and will allow for a monolithic concrete pour eliminating cold joints and water stop materials from being used in the trench invert. Forms and removal of forms shall not interfere or compromise the structural integrity of the load transfer assembly between the frame and encapsulation concrete. Forms, mounting brackets and liners shall be fully removed, without exception, to allow for 100% inspection of concrete consolidation. Inspection of consolidation below frames shall be 100%, partial inspection points will not be allowed. Formwork assembly must be prevented from floating during concrete placement without penetrating the sub grade. A means to assure constant frame spacing and grate seat dimension shall be provided.

756-2.2 Frames (12' Trench) – Steel and or ductile iron components: Structural steel angle frames shall conform to ASTM A36/A36M-93a. Structural steel frame to be post fabrication hot dipped galvanized conforming to ASTM A123-89a. Ductile iron frames are to be uncoated and conform to ASTM A536-84. Either type of grate frame is to provide a minimum of 2.0 square inches concrete bearing area and a minimum of 4.5 square inches of concrete contact per inch of trench length on each side. Specialty frames are to be used as noted on plans to facilitate radii, intersections, grade changes and expansion, control & construction joints. There shall be a

minimum of four .5” diameter retainers per grate located at each corner of the grate. Grate retainers shall allow for non-rigid grate retention, rigid bolt-down assemblies will not be allowed. Frames shall have at minimum one anchor per side into the encapsulation concrete per 10” of trench. Headed concrete anchors shall have minimum dimensions of .5” diameter and 4” long. Anchored frames shall be made in USA and shall conform to the “Buy American Act” if Federal Aid finances apply.

756-2.2b Frames (18” Trench) - Steel and or ductile iron components: Structural steel angle frames shall conform to ASTM A36/A36M-93a. Structural steel frame to be post fabrication hot dipped galvanized conforming to ASTM A123-89a. Ductile iron frames are to be uncoated and conform to ASTM A536-84. Either type of grate frame is to provide a minimum of 2.25 square inches concrete bearing area and a minimum of 5.25 square inches of concrete contact per inch of trench length on each side. Specialty frames are to be used as noted on plans to facilitate radii, intersections, grade changes and expansion, control & construction joints. There shall be a minimum of four .5” diameter retainers per grate located at each corner of the grate. Grate retainers shall allow for non-rigid grate retention, rigid bolt-down assemblies will not be allowed. Frames shall have at minimum one anchor per side into the encapsulation concrete per 10” of trench. Headed concrete anchors shall have minimum dimensions of .5” diameter and 4” long.

756-2.3 Grating (12’ Trench) - Grates shall have minimum dimension width of 11.38”, ensuring a minimum edge distance of 1.69” each side of grate to the inner trench wall. Grates are to be uncoated ductile iron conforming to ASTM A536-84 with a minimum inlet area of 0.61ft2/Lft. Grates shall meet a minimum vertical proof load of 2496 psi (200,000 lbs) by utilizing a 9” x 9” centered contact area without failure. Grating shall be made in USA and shall conform to the “Buy American Act” if Federal Aid finances apply.

756-2.3b Grating (18” Trench) - Grates shall have a minimum dimension width of 21.8”, ensuring a minimum edge distance of 1.9” each side of grate to the inner trench wall. Grates are to be uncoated ductile iron conforming to ASTM A536-84 with a minimum inlet area of 0.97ft2/Lft. Grates shall meet a minimum vertical proof load of 2496 psi (200,000 lbs) by utilizing a 9” x 9” centered contact area without failure.

PRE-CONSTRUCTION

756-3.1 Submittals - A submittal package consisting of a certificate of specification compliance, trench drain construction drawings, system details, specifications, warranty information, installation guide and independent laboratories grate load test data shall be submitted to the engineer of record for approval. In addition, the material submitted must include a reference list of no less than three projects with a minimum of five-year service in a similar application. A certificate of origin shall be provided for all steel and iron parts if the “Buy American Act” applies.

756-3.2 Training - A Pre-construction meeting with the manufacturer is mandatory for review of the installation process and installation materials. A manufacturer’s representative shall be on site at job start and available for site visits during the construction phase to provide onsite assistance.

POST CONSTRUCTION

756-4.1 Inspection – Formwork, mounting brackets and liners are to be fully removed, without exception, to allow for 100% inspection by the OAR and if needed repair of voids and or concrete consolidation issues below the frame, trench walls and invert. Grate and grate retainer inspection shall be performed to ensure that all grates and retainers are installed and are properly seated in place.

METHOD OF MEASUREMENT

756-5.1 The length of trench drain shall be measured in linear feet of trench drain in place, completed, and approved. It shall be measured along the centerline of the drain from end or inside face of structure to the end or inside face of structure, whichever is applicable. The several classes, types, and sizes shall be measured separately. All fittings shall be included in the footage as typical pipe sections being measured.

BASIS OF PAYMENT

756-6.0 These prices shall fully compensate the Contractor for furnishing all materials and for all preparation, excavation, and installation of these materials; and for all labor, equipment, tools, and incidentals necessary to complete the item.

756-6.1 Payment will be made at the contract unit price per linear foot for reinforced concrete pipe.

Payment will be made under:

Item 756-6.1	12” Trench drain per linear foot
Item 756-6.2	18” Trench drain per linear foot

END OF ITEM D-756

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Item F-162 Chain-Link Fence

DESCRIPTION

162-1.1 This item shall consist of furnishing and erecting a chain-link fence in accordance with these specifications, the details shown on the plans, and in conformity with the lines and grades shown on the plans or established by the ~~RPR~~ **OAR**.

MATERIALS

162-2.1 Fabric. The fabric shall be woven with a 9-gaugegalvanized steel wire in a 2-inch (50 mm) mesh and shall meet the requirements of ASTM A392, Class 2. ***The fabric shall be black vinyl-coated when fence is to be constructed in water.***

162-2.2 Barbed wire. Barbed wire shall be 2-strand 12-1/2 gauge zinc-coated wire with 4-point barbs and shall conform to the requirements of ASTM A121, Class 3, Chain Link Fence Grade.

162-2.3 Posts, rails, and braces. Line posts, rails, and braces shall conform to the requirements of ASTM F1043 or ASTM F1083 as follows:

- Galvanized tubular steel pipe shall conform to the requirements of Group IA, (Schedule 40) coatings conforming to Type A, or Group IC (High Strength Pipe), External coating Type B, and internal coating Type B or D.
- Roll Formed Steel Shapes (C-Sections) shall conform to the requirements of Group IIA, and be galvanized in accordance with the requirements of ASTM F1043, Type A.
- Hot-Rolled Shapes (H Beams) shall meet the requirements of Group III, and be galvanized in accordance with the requirements of ASTM F1043, Type A.
- Aluminum Pipe shall conform to the requirements of Group IB.
- Aluminum Shapes shall conform to the requirements of Group IIB.
- Vinyl or polyester coated steel shall conform to the requirements of ASTM F1043, Paragraph 7.3, Optional Supplemental Color Coating.
- Composite posts shall conform to the strength requirements of ASTM F1043 or ASTM F1083. The strength loss of composite posts shall not exceed 10% when subjected to 3,600 hours of exposure to light and water in accordance with ASTM G152, ASTM G153, ASTM G154, and ASTM G155.
- Posts, rails, and braces furnished for use in conjunction with aluminum alloy fabric shall be aluminum alloy or composite.

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

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

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

162-2.4 Gates. Gate frames shall consist of galvanized steel pipe and shall conform to the specifications for the same material under paragraph 162-2.3. The fabric shall be of the same type material as used in the fence.

162-2.5 Wire ties and tension wires. Wire ties for use in conjunction with a given type of fabric shall be of the same material and coating weight identified with the fabric type. Tension wire shall be 7-gauge marcelled steel wire with the same coating as the fabric type and shall conform to ASTM A824. ***Bottom tension wire shall be attached to the mesh fabric with wire ties at a maximum of twenty-four (24) inch spacing.***

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

162-2.6 Miscellaneous fittings and hardware. Miscellaneous steel fittings and hardware for use with zinc-coated steel fabric shall be of commercial grade steel or better quality, wrought or cast as appropriate to the article, and sufficient in strength to provide a balanced design when used in conjunction with fabric posts, and wires of the quality specified herein. All steel fittings and hardware shall be protected with a zinc coating applied in conformance with ASTM A153. Barbed wire support arms shall withstand a load of 250 pounds (113 kg) applied vertically to the outermost end of the arm.

162-2.7 Concrete. Concrete shall have a minimum 28-day compressive strength of ***3,500 psi***.

162-2.8 Marking. Each roll of fabric shall carry a tag showing the kind of base metal (steel, aluminum, or aluminum alloy number), kind of coating, the gauge of the wire, the length of fencing in the roll, and the name of the manufacturer. Posts, wire, and other fittings shall be identified as to manufacturer, kind of base metal (steel, aluminum, or aluminum alloy number), and kind of coating.

162-2.9 Course Aggregate Bed. Coarse aggregate bed shall consist of a minimum four (4) inch thick layer of Number 57 Stone meeting the gradation requirements of Section 901 of the Florida Department of Transportation Specifications for Road and Bridge Construction, most current edition. Material shall be Natural Stones per Section 901-2, or Reclaimed Portland Cement Concrete per Section 901-5. Bedding shall be placed with an underlayment of Type D-1 or Type D-2 Woven Geotextile Fabric in accordance with the FDOT Standard Index Drawing 199, and FDOT Specification Section 985.

CONSTRUCTION METHODS

162-3.1 General. The fence shall be constructed in accordance with the details on the plans and as specified here using new materials. All work shall be performed in a workmanlike manner satisfactory to the ~~RPR~~ **OAR**. The Contractor shall layout the fence line based on the plans. The Contractor shall span the opening below the fence with barbed wire at all locations where it is not practical to conform the fence to the general contour of the ground surface because of natural or manmade features such as drainage ditches. The new fence shall be permanently tied to the terminals of existing fences as shown on the plans. The Contractor shall stake down the woven wire fence at several points between posts as shown on the plans.

The Contractor shall arrange the work so that construction of the new fence will immediately follow the removal of existing fences. The length of unfenced section at any time shall not exceed 300 feet (90 m). The work shall progress in this manner and at the close of the working day the newly constructed fence shall be tied to the existing fence.

162-3.2 Clearing fence line. Clearing shall consist of the removal of all stumps, brush, rocks, trees, or other obstructions that will interfere with proper construction of the fence. Stumps within

the cleared area of the fence shall be grubbed or excavated. The bottom of the fence shall be placed a uniform distance above ground, as specified in the plans. When shown on the plans or as directed by the ~~RPR~~ **OAR**, the existing fences which interfere with the new fence location shall be removed by the Contractor as a part of the construction work unless such removal is listed as a separate item in the bid schedule. All holes remaining after post and stump removal shall be refilled with suitable soil, gravel, or other suitable material and compacted with tampers.

The cost of removing and disposing of the material shall not constitute a pay item and shall be considered incidental to fence construction.

162-3.3 Installing posts. All posts shall be set in concrete at the required dimension and depth and at the spacing shown on the plans.

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

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

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

162-3.4 Installing top rails. The top rail shall be continuous and shall pass through the post tops. The coupling used to join the top rail lengths shall allow for expansion.

162-3.5 Installing braces. Horizontal brace rails, with diagonal truss rods and turnbuckles, shall be installed at all terminal posts.

162-3.6 Installing fabric. The wire fabric shall be firmly attached to the posts and braced as shown on the plans. All wire shall be stretched taut and shall be installed to the required elevations. The fence shall generally follow the contour of the ground, with the bottom of the fence fabric no less than one inch (25 mm) or more than 4 inches (100 mm) from the ground surface. Grading shall be performed where necessary to provide a neat appearance.

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

162-3.7 Electrical grounds. Electrical grounds shall be constructed at 500 feet (150 m) intervals**.** The ground shall be accomplished with a copper clad rod 8 feet (2.4 m) long and a minimum of 5/8 inches (16 mm) in diameter driven vertically until the top is 6 inches (150 mm) below the ground surface. A No. 6 solid copper conductor shall be clamped ***or welded*** to the rod and to the fence in such a manner that each element of the fence is grounded ***as indicated on the plans***. Installation of ground rods shall not constitute a pay item and shall be considered incidental to fence construction. The Contractor shall comply with FAA-STD-019, Lightning and Surge Protection, Grounding, Bonding and Shielding Requirements for Facilities and Electronic Equipment, paragraph 4.2.3.8, Lightning Protection for Fences and Gates, when fencing is adjacent to FAA facilities.

162-3.8 Cleaning up. The Contractor shall remove from the vicinity of the completed work all tools, buildings, equipment, etc., used during construction. All disturbed areas shall be seeded per T-901.

METHOD OF MEASUREMENT

162-4.1 Chain-link fence will be not be measured for payment. Temporary fencing is addressed in Item C-106.

162-4.2 Gates will be not be measured. Temporary gates are addressed in Item C-106.

BASIS OF PAYMENT

162-5.1 Payment for temporary fencing and gates will be made under Item C-106.

REFERENCES

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

ASTM International (ASTM)

ASTM A121	Standard Specification for Metallic-Coated Carbon Steel Barbed Wire
ASTM A153	Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A392	Standard Specification for Zinc-Coated Steel Chain-Link Fence Fabric
ASTM A491	Standard Specification for Aluminum-Coated Steel Chain-Link Fence Fabric
ASTM A824	Standard Specification for Metallic-Coated Steel Marcelled Tension Wire for Use with Chain Link Fence
ASTM B117	Standard Practice for Operating Salt Spray (Fog) Apparatus
ASTM F668	Standard Specification for Polyvinyl Chloride (PVC), Polyolefin and other Organic Polymer Coated Steel Chain-Link Fence Fabric
ASTM F1043	Standard Specification for Strength and Protective Coatings on Steel Industrial Fence Framework
ASTM F1083	Standard Specification for Pipe, Steel, Hot-Dipped Zinc-Coated (Galvanized) Welded, for Fence Structures
ASTM F1183	Standard Specification for Aluminum Alloy Chain Link Fence Fabric
ASTM F1345	Standard Specification for Zinc 5% Aluminum-Mischmetal Alloy Coated Steel Chain-Link Fence Fabric
ASTM G152	Standard Practice for Operating Open Flame Carbon Arc Light Apparatus for Exposure of Nonmetallic Materials
ASTM G153	Standard Practice for Operating Enclosed Carbon Arc Light Apparatus for Exposure of Nonmetallic Materials

ASTM G154 Standard Practice for Operating Fluorescent Ultraviolet (UV) Lamp Apparatus for Exposure of Nonmetallic Materials

ASTM G155 Standard Practice for Operating Xenon Arc Light Apparatus for Exposure of Nonmetallic Materials

Federal Specifications (FED SPEC)

FED SPEC RR-F-191/3 Fencing, Wire and Post, Metal (Chain-Link Fence Posts, Top Rails and Braces)

FED SPEC RR-F-191/4 Fencing, Wire and Post, Metal (Chain-Link Fence Accessories)

FAA Standard

FAA-STD-019 Lightning and Surge Protection, Grounding, Bonding and Shielding Requirements for Facilities and Electronic Equipment

FAA Orders

5300.38 AIP Handbook

END OF ITEM F-162

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Item P-100 Construction Survey

DESCRIPTION

100-1.1 GENERAL. Under this item, the Contractor shall perform all necessary surveying and project stakeout required to construct all elements of the Project as shown on the Contract Drawings and required by the Specifications. This shall include, but not be limited to; stakeout, layout and elevations for pavements, structures, forms and appurtenances as shown and required, consistent with the current practices and shall be performed by or under the direction of a State of Florida licensed professional land surveyor or OAR approved substitute. The stakeout survey shall proceed immediately following the Notice to Proceed or as soon as authorized by the OAR in accordance with the phasing of the construction and shall be expeditiously progressed to completion in a manner and at a rate satisfactory to the OAR. The Contractor shall keep the OAR fully informed as to the progress of the stakeout survey.

All survey work shall be provided under the direction of a State of Florida licensed professional land surveyor.

Construction survey shall be required for submittal to the OAR at several stages of the project for design verification. At a minimum, survey shall be completed by the Contractor to verify existing conditions, establish a post-grading survey, a post-paving and marking survey, and the required As-Built Survey as described below.

Contractor shall submit baseline survey to the OAR for approval five (5) days prior to any construction.

100-1.2 Contractor shall refer to *The Orlando International Airport Geodetic Control Survey Horizontal and Vertical Control Network* prepared by ZHA Incorporated and Regional Engineerings, Planners, and Surveyors, Inc. (November 1999, Updated December 2000 or latest version) for definition of horizontal and vertical control definition reference.

MATERIALS

100-2.1 All instruments, equipment, stakes, and any other material incidental and/or necessary to perform the work satisfactorily shall be provided by the Contractor.

All stakes, nails, discs, pins, or other markers/monumentation shall be of a type approved by the OAR. It shall be the Contractor's responsibility to maintain these artifacts in their proper position and location at all times. All costs associated with repair and/or replacement of artifacts will be the responsibility of the Contractor should damages be sustained.

CONSTRUCTION METHODS

100-3.1 The Contractor shall trim trees, brush and other interfering objects, not inconsistent with the Contract Drawings, from survey lines in advance of all survey work to permit accurate and unimpeded work by stakeout crews. Incidental clearing of any permitted wetland area shall be withheld pending issuance of the required permits unless otherwise approved in writing by the Owner.

The exact position of all work shall be established from control points, baseline transit points or other points of similar nature which are depicted on the Contract Drawings and/or modified by the

OAR. Prior to any layout of work to be constructed, the Contractor shall verify the location and accuracy of all survey points provided within the plans. Any error, apparent discrepancy or absence in or of data shown or required for accurately accomplishing the stakeout survey shall be referred to the OAR for interpretation or furnishing when such is observed or required.

The Contractor shall place two offset stakes or references at each centerline station and at such intermediate locations as the OAR may direct. From computations and measurements made by the Contractor, these stakes shall be clearly and legibly marked with the correct centerline station number, offset, and cut or fill as to permit the establishment of the exact centerline location and elevation during construction. If markings become faded or blurred for any reason, the markings shall be restored by the Contractor at the request of the OAR. Contractor shall locate and place all cut, fill, slope, finegrade, or other stakes and/or points, as the OAR may direct, for the proper progress of the work. All control points shall be properly guarded and flagged for easy identification.

Drainage structures shall be staked out by the Contractor at the locations and elevations shown on the Contract Drawings or as specified by the OAR.

Reference points, baselines, stakes, and benchmarks for stockpiles shall be established by the Contractor.

The Contractor shall be responsible for the accuracy of his work and shall maintain all refence points, stakes, etc., throughout the life of the Contract. Damage or destroyed points, benchmarks, stakes, monumentation, or any reference points made inaccessible by the progress of the construction, shall be replaced or transferred by the Contractor before they are damaged or destroyed. All control points shall be referenced by ties to acceptable objects and recorded. Any alterations or revisions in the ties shall be so noted and the information furnished to the OAR immediately. All stakeout survey work shall be referenced to the centerlines shown on the Contract Drawings. All computations necessary to establish the exact position of the work from control points shall be made and preserved by the Contractor. All computations, survey notes, and other records shall be made available to the OAR upon request and shall become property of the Owner and delivered to the OAR no later than the date of acceptance of the Contract.

The Contractor shall furnish, at his/her expense, all horizontal and vertical control, all staking and layout of construction work called for on the Contract Drawings. The OAR and Owner shall not be responsible for such work. However, the Owner and OAR reserve the right to check all said lines, grades, and measurements with their appointed surveyor. Should the Owner/OAR’s surveyor detect errors and/or discrepancies in said lines, grades, and measurements, the Contractor shall pay for all said surveying costs and subsequent surveying costs performed to verify correction of errors found in said lines, grades, and measurements. Definition of an error shall be a discrepancy of ¼-inch or more. In the case of a discrepancy between the technical specifications and this defined tolerance, the more severe tolerance shall govern.

During the progress of the construction work, the Contractor shall be required to furnish all of the surveying and stakeout incidental to the proper location by line and grade for all work. For paving and any other operation requiring defined accuracy with tolerances, the Contractor shall re-stake with pins or other acceptable hubs located directly adjacent to the work at a spacing acceptable to the OAR.

Any existing stakes, iron pins, survey monuments, or other artifact markers defining property lines which may be disturbed during construction shall be properly tied into fixed referenced points prior to being disturbed and accurately re-set in their proper position upon completion of the work.

Just prior to completion of the Contract, the Contractor shall re-establish, if necessary, and re-tie all control points as permanently as possible and to the satisfaction of the OAR.

100-3.2 AS-BUILT SURVEY. ***The Contractor shall maintain a set of as-built contract documents (plans and specification) in their field office that are available for review by the OAR, Engineer and Owner at all times during the project. The as-buit documents shall be continuously updated to reflect the built condition of the project and any changes made to the project.*** Upon completion of the work, after Substantial Completion and before Final Acceptance, the Contractor shall supply to the OAR a complete as-built survey of the entire project site including, but not limited to: drainage structures, utilities (above ground and subsurface), and all contract improvements. All survey points, including horizontal and vertical control, property corners and references (hereinafter referred to as “survey point”) shall be clearly marked and referenced prior to construction. These survey points must be sufficiently referenced so that they can be re-established after construction if they are disturbed. All survey data shall be in State Plane Coordinates, Florida North American Datum (NAD) 1983 US Foot.

This as-built survey will be a complete topographic and physical feature survey of the entire project site surrounded by the limits of construction plus an additional ten (10) feet beyond limits of construction in all directions. If any work is done outside the limits of construction for any reason, this limit of survey will be increased to include the additional area plus twenty-five (25) feet beyond in all directions.

This survey shall be certified by a State of Florida Licensed Professional Land Surveyor and meets the minimum requirements set forth by the Technical Standards for topographic surveys set forth in 5J-17.052 Standards of Practice: Specific Survey, Map, and Report Requirements., Florida Administrative Code (F.A.C.). This survey data must be supplied as a compilation of signed and sealed drawings (42” by 30” maximum size) at a minimum scale as the Contract Drawings and be submitted in electronic format as PDF and AutoCAD Civil 3D 2020 or later. AutoCAD Civil 3D file must contain all utilized survey point data and breakline information. Signed and sealed copies of all field notes, sketches, and calculations must be submitted concurrently with the as-built survey. Larger scale details shall be provided to clarify any complicated or complex areas. A separate point database file shall be electronically submitted in .TXT (text) or ASCII format, with each point on a single row with comma delimited columns with data orders as follows: *point number, northing, easting, elevation, and description*. Contractor shall provide any electronic surface TIN model data utilized in the development of the as-built.

The as-built survey is to be supplied to the OAR for review and approval not more than thirty (30) calendar days after substantial completion for the project has been issued. If the acceptable as-built survey is not supplied within the required time, the Owner/OAR reserves the right to perform the required survey at the expense of the Contractor.

METHOD OF MEASUREMENT

100-4.1 The work specified in this item consist of the requirements in the plans and remaining Contract Documents and Special Provisions for certified topographic land surveys before, during, and after construction, including by not limited to the staged mass earthwork grading surface surveys, base surveys, and final paving surveys.

BASIS OF PAYMENT

162-5.1 Payment for Construction Survey items shall be made at the lump sum price for all Construction Survey. The price shall be full compensation for furnishing all materials and for all layout, preparation, and installation of these materials and for all labor, equipment, tools, and incidentals necessary to complete the items per the Contract Documents.

Payment will be made under:

Item P-100-5.1	Construction Survey	per Lump Sum (LS)

MATERIAL REQUIREMENTS

F.A.C. 5J-17.052 Standards of Practice: Specific Survey, Map, and Report Requirements

END OF ITEM P-100

SECTION P-101 - PREPARATION/REMOVAL OF EXISTING PAVEMENTS

PART 1 - DESCRIPTION

1.1 This item shall consist of preparation of existing pavement surfaces for overlay, surface treatments, removal of existing pavement, and other miscellaneous items. The work shall be accomplished in accordance with these specifications and the applicable plans.

PART 2 - EQUIPMENT AND MATERIALS

2.1 All equipment and materials shall be specified here and in the following paragraphs or approved by the ~~Resident Project Representative (RPR)~~ ***Owner's Authorized Representative (OAR)***. The equipment shall not cause damage to the pavement to remain in place.

PART 3 - CONSTRUCTION

3.1 REMOVAL OF EXISTING PAVEMENT

The Contractor's removal operation shall be controlled to not damage adjacent pavement structure, and base material, cables, utility ducts, pipelines, or drainage structures which are to remain under the pavement.

A. Concrete pavement removal. Full depth saw cuts shall be made perpendicular to the slab surface. The Contractor shall saw through the full depth of the slab including any dowels at the joint, removing the pavement and installing new dowels as shown on the plans and per the specifications. Where the perimeter of the removal limits is not located on the joint and there are no dowels present, the perimeter shall be saw cut the full depth of the pavement. The pavement inside the saw cut shall be removed by methods which will not cause distress in the pavement which is to remain in place. If the material is to be wasted on the airport site, it shall be reduced to a maximum size of 3 inches. Concrete slabs that are damaged by under breaking shall be repaired or removed and replaced as directed by the ~~RPR~~ ***OAR***.

The edge of existing concrete pavement against which new pavement abuts shall be protected from damage at all times. Spall and underbreak repair shall be in accordance with the plans. Any underlaying material that is to remain in place, shall be recompacted and/or replaced as shown on the plans. Adjacent areas damaged during repair shall be repaired or replaced at the Contractor's expense.

B. Asphalt pavement removal. Asphalt pavement to be removed shall be cut to the full depth of the asphalt pavement around the perimeter of the area to be removed. If the

material is to be wasted on the airport site, it shall be broken to a maximum size of 3 inches (mm).

C. Repair or removal of Base, Subbase, and/or Subgrade. All failed material including surface, base course, subbase course, and subgrade shall be removed and repaired as shown on the plans or as directed by the ~~RPR~~ ***OAR***. Materials and methods of construction shall comply with the applicable sections of these specifications. Any damage caused by Contractor's removal process shall be repaired at the Contractor's expense.

3.2 PREPARATION OF JOINTS AND CRACKS PRIOR TO OVERLAY/SURFACE TREATMENT

Remove all vegetation and debris from cracks to a minimum depth of 1 inch (25 mm). If extensive vegetation exists, treat the specific area with a concentrated solution of a water-based herbicide approved by the ~~RPR~~ ***OAR***. Fill all cracks greater than 1/4 inch (6 mm) wide) with a crack sealant per ASTM D6690. The crack sealant, preparation, and application shall be compatible with the surface treatment/overlay to be used. To minimize contamination of the asphalt with the crack sealant, underfill the crack sealant a minimum of 1/8 inch (3 mm), not to exceed ¼ inch (6 mm). Any excess joint or crack sealer shall be removed from the pavement surface.

3.3 REMOVAL OF FOREIGN SUBSTANCES/CONTAMINATES PRIOR TO REMARKING

Removal of foreign substances/contaminates from existing pavement that will affect the bond of the new treatment shall consist of removal of rubber, fuel spills, oil, crack sealer, at least 90% of paint, and other foreign substances from the surface of the pavement. Areas that require removal are designated on the plans and as directed by the ~~RPR~~ ***OAR*** in the field during construction.

High-pressure water, rotary grinding, or sandblasting may be used. If chemicals are used, they shall comply with the state's environmental protection regulations. Removal methods used shall not cause major damage to the pavement, or to any structure or utility within or adjacent to the work area. Major damage is defined as changing the properties of the pavement, removal of asphalt causing the aggregate to ravel, or removing pavement over 1/8 inch (3 mm) deep. If it is deemed by the ~~RPR~~ ***OAR*** that damage to the existing pavement is caused by operational error, such as permitting the application method to dwell in one location for too long, the Contractor shall repair the damaged area without compensation and as directed by the ~~RPR~~ ***OAR***.

Removal of foreign substances shall not proceed until approved by the ~~RPR~~ ***OAR***. Water used for high-pressure water equipment shall be provided by the Contractor at the Contractor's expense. No material shall be deposited on the pavement shoulders. All wastes shall be disposed of in areas indicated in this specification or shown on the plans.

3.4 CONCRETE SPALL OR FAILED ASPHALTIC CONCRETE PAVEMENT REPAIR

~~A. Repair of concrete spalls in areas to be overlaid with asphalt. The Contractor shall repair all spalled concrete as shown on the plans or as directed by the RPR. The perimeter of the repair shall be saw cut a minimum of 2 inches (50 mm) outside the affected area and 2 inches (50 mm) deep. The deteriorated material shall be removed to a depth where the existing material is firm or cannot be easily removed with a geologist pick. The removed area shall be filled with asphalt mixture with aggregate sized appropriately for the depth of the patch. The material shall be compacted with equipment approved by the RPR until the material is dense and no movement or marks are visible. The material shall not be placed in lifts over 4 inches (100 mm) in depth. This method of repair applies only to pavement to be overlaid.~~

~~B. Asphalt pavement repair. The Contractor shall repair all spalled concrete as shown on the plans or as directed by the RPR. The failed areas shall be removed as specified in paragraph 101-3.1b. All failed material including surface, base course, subbase course, and subgrade shall be removed. Materials and methods of construction shall comply with the applicable sections of these specifications.~~

3.5 COLD MILLING

Milling shall be performed with a power-operated milling machine or grinder, capable of producing a uniform finished surface. The milling machine or grinder shall operate without tearing or gouging the underlaying surface. The milling machine or grinder shall be equipped with grade and slope controls, and a positive means of dust control. All millings shall be removed and disposed off Airport property. If the Contractor mills or grinds deeper or wider than the plans specify, the Contractor shall replace the material removed with new material at the Contractor's Expense.

A. Patching. The milling machine shall be capable of cutting a vertical edge without chipping or spalling the edges of the remaining pavement and it shall have a positive method of controlling the depth of cut. The ~~RPR~~ ***OAR*** shall layout the area to be milled with a straightedge in increments of 1-foot (30 cm) widths. The area to be milled shall cover only the failed area. Any excessive area that is milled because the Contractor doesn't have the appropriate milling machine, or areas that are damaged because of his negligence, shall be repaired by the Contractor at the Contractor's Expense.

B. Profiling, grade correction, or surface correction. The milling machine shall have a minimum width of 7 (2 m) and it shall be equipped with electronic grade control devices that will cut the surface to the grade specified. The tolerances shall be maintained within +0 inch and -1/4 inch (+0 mm and -6mm) of the specified grade. The machine must cut vertical edges and have a positive method of dust control. The machine must have the ability to remove the millings or cuttings from the pavement and load them into a truck. All millings shall be removed and disposed of off the airport.

C. Clean-up. The Contractor shall sweep the milled surface daily and immediately after the milling until all residual materials are removed from the pavement surface. Prior to paving, the Contractor shall wet down the milled pavement and thoroughly sweep and/or

blow the surface to remove loose residual material. Waste materials shall be collected and removed from the pavement surface and adjacent areas by sweeping or vacuuming. Waste materials shall be removed and disposed off Airport property.

3.6. PREPARATION OF ASPHALT PAVEMENT SURFACES PRIOR TO SURFACE TREATMENT

Existing asphalt pavements to be treated with a surface treatment shall be prepared as follows:

A. Patch asphalt pavement surfaces that have been softened by petroleum derivatives or have failed due to any other cause. Remove damaged pavement to the full depth of the damage and replace with new asphalt pavement similar to that of the existing pavement in accordance with paragraph 101-3.4b.

B. Repair joints and cracks in accordance with paragraph 101-3.2.

C. Remove oil or grease that has not penetrated the asphalt pavement by scrubbing with a detergent and washing thoroughly with clean water. After cleaning, treat these areas with an oil spot primer.

D. Clean pavement surface immediately prior to placing the surface treatment so that it is free of dust, dirt, grease, vegetation, oil or any type of objectionable surface film.

3.7 MAINTENANCE

The Contractor shall perform all maintenance work necessary to keep the pavement in a satisfactory condition until the full section is complete and accepted by the ~~RPR~~ ***OAR***. The surface shall be kept clean and free from foreign material. The pavement shall be properly drained at all times. If cleaning is necessary or if the pavement becomes disturbed, any work repairs necessary shall be performed at the Contractor's expense.

3.8 PREPARATION OF JOINTS IN RIGID PAVEMENT PRIOR TO RESEALING

Prior to application of sealant material, clean and dry the joints of all scale, dirt, dust, old sealant, curing compound, moisture and other foreign matter. The Contractor shall demonstrate, in the presence of the ~~RPR~~ ***OAR***, that the method used cleans the joint and does not damage the joint.

3.8.1 Removal of Existing Joint Sealant. All existing joint sealants will be removed by plowing or use of hand tools. Any remaining sealant and or debris will be removed by use of wire brushes or other tools as necessary. Resaw joints removing no more than 1/16 inch (2 mm) from each joint face. Immediately after sawing, flush out joint with water and other tools as necessary to completely remove the slurry.

3.8.2 Cleaning prior to sealing. Immediately before sealing, joints shall be cleaned by removing any remaining laitance and other foreign material. Allow sufficient time to dry out joints prior to sealing. Joint surfaces will be surface-dry prior to installation of sealant.

3.8.3 Joint sealant. Joint material and installation will be in accordance with Item P-605 and Item P-604.

3.9 ~~PREPARATION OF CRACKS IN FLEXIBLE PAVEMENT PRIOR TO SEALING~~

~~Prior to application of sealant material, clean and dry the joints of all scale, dirt, dust, old sealant, curing compound, moisture and other foreign matter. The Contractor shall demonstrate, in the presence of the RPR, that the method used cleans the cracks and does not damage the pavement.~~

~~3.9.1 Preparation of Crack. Widen crack with [router] [random crack saw] by removing a minimum of 1/16 inch (2 mm) from each side of crack. Immediately before sealing, cracks will be blown out with a hot air lance combined with oil and water-free compressed air.~~

~~3.9.2 Removal of Existing Crack Sealant. Existing sealants will be removed by [routing] [random crack saw]. Following [routing] [sawing] any remaining debris will be removed by use of a hot lance combined with oil and water-free compressed air.~~

~~3.9.3 Crack Sealant. Crack sealant material and installation will be in accordance with [Item P-605]~~

~~3.9.4 Removal of Pipe and other Buried Structures~~

~~A. Removal of Existing Pipe Material. Remove the types of pipe as indicated on the plans. The pipe material shall be legally disposed of off-site in a timely manner following removal. Trenches shall be backfilled with material equal to or better in quality than adjacent embankment. Trenches under paved areas must be compacted to 100% of ASTM D1557.~~

B. ~~Removal of Inlets/Manholes. Where indicated on the plans or as directed by the RPR~~ ***~~OAR~~***~~, inlets and/or manholes shall be removed and legally disposed of off-site in a timely fashion after removal. Excavations after removal shall be backfilled with material equal or better in quality than adjacent embankment. When under paved areas must be compacted to 100% of ASTM D1557, when outside of paved areas must be compacted to 95% of ASTM D698.~~

PART 4 - METHOD OF MEASUREMENT

4.1 PAVEMENT REMOVAL

The unit of measurement for pavement removal shall be the number of square yards (square meters) removed by the Contractor. Any pavement removed outside the limits of removal because the pavement was damaged by negligence on the part of the Contractor shall not be included in the measurement for payment. No direct measurement or payment shall be made for saw cutting. Saw cutting shall be incidental to pavement removal. ~~***Dowel bar installation shall be incidental to pavement removal.***~~

~~4.2 REMOVAL OF PIPE AND OTHER BURIED STRUCTURES~~

~~The unit of measurement for removal of pipe and other buried structures will be made at the contract unit price for each completed and accepted item. This price shall be full compensation for all labor, equipment, tools, and incidentals necessary to complete this item in accordance with paragraph 101-3.9.4.~~

PART 5 - BASIS OF PAYMENT

5.1 PAYMENT

Payment shall be made at contract unit price for the unit of measurement as specified above. This price shall be full compensation for furnishing all materials and for all preparation, hauling, and placing of the material and for all labor, equipment, tools, and incidentals necessary to complete this item.

~~***Item P-101-5.1 Asphalt Pavement Removal (8" Total Depth) - per Square Yard (SY)***~~

~~***Item P-101-5.2 BP-S196 Landside Civil Demolition - Lump Sum (LS)***~~

Item P-101-5.1 Concrete Pavement Removal (Variable Depth) - per Square Yard (SY)

PART 6 - REFERENCES

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

Advisory Circulars (AC)

AC 150/5380-6 Guidelines and Procedures for Maintenance of Airport Pavements.

ASTM International (ASTM)

ASTM D6690	Standard Specification for Joint and Crack Sealants, Hot Applied, for Concrete and Asphalt Pavements

END OF SECTION P-101

Item P-151 Clearing and Grubbing

DESCRIPTION

151-1.1 This item shall consist of clearing or clearing and grubbing, including the disposal of materials, for all areas within the limits designated on the plans or as required by the ~~Resident Project Representative (RPR)~~ **Owner Authorized Representative (OAR)**.

a. Clearing shall consist of the cutting and removal of all trees, stumps, brush, logs, hedges, the removal of fences and other loose or projecting material from the designated areas, **which in the opinion of the ~~RPR~~ OAR is unsuitable for the foundation of pavements, or other required structures,** ~~The grubbing of stumps and roots will not be required.~~

b. Clearing and grubbing shall consist of clearing the surface of the ground of the designated areas of all trees, stumps, down timber, logs, snags, brush, undergrowth, hedges, heavy growth of grass or weeds, fences, ***rip rap, pavements***, structures, debris, ***abandon utilities***, and rubbish of any nature, natural obstructions or such material which in the opinion of the ~~RPR~~ **OAR** is unsuitable for the foundation of strips, ***rip rap***, pavements, or other required structures, including the grubbing of stumps, roots, matted roots, ***abandoned utilities***, foundations, and the disposal from the project of all spoil materials resulting from clearing and grubbing.

~~**c. Tree Removal.** Tree Removal shall consist of the cutting and removal of isolated single trees or isolated groups of trees, and the grubbing of stumps and roots. The removal of all the trees of this classification shall be in accordance with the requirements for the particular area being cleared.~~

CONSTRUCTION METHODS

151-2.1 General. The areas denoted on the plans to be cleared or cleared and grubbed shall be staked on the ground by the Contractor as indicated on the plans **and approved by the OAR**.

The removal of existing structures and utilities required to permit orderly progress of work shall be accomplished by local agencies, unless otherwise shown on the plans. Whenever a telephone pole, pipeline, conduit, sewer, roadway, or other utility is encountered and must be removed or relocated, the Contractor shall advise the ~~RPR~~ **OAR** who will notify the proper local authority or owner to secure prompt action.

151-2.1.1 Disposal. All materials removed by clearing or by clearing and grubbing shall be disposed of in the designated waste disposal area, except when otherwise directed by the ~~RPR~~ **OAR**. ~~As far as practicable, waste concrete and masonry shall be placed on slopes of embankments or channels. When embankments are constructed of such material, this material shall be placed in accordance with requirements for formation of embankments.~~ **Waste concrete or asphalt shall not be used for construction of embankments and shall be disposed of by the Contractor off of Airport property at an approved County or State dump site.** Any broken concrete or masonry that cannot be used in construction and all other materials not considered suitable for use elsewhere, shall be disposed of by the Contractor. In no case, shall any discarded materials be left in windrows or piles adjacent to or within the airport limits. The manner and location of disposal of materials shall be subject to the approval of the ~~RPR~~ **OAR** and shall not create an unsightly or objectionable view. When the Contractor is required to locate a disposal area outside the airport property limits, the Contractor shall obtain and file with the ~~RPR~~ **OAR** permission in writing from the property owner for the use of private property for this purpose.

151-2.1.2 Blasting. Blasting shall not be allowed.

151-2.2 Clearing. The Contractor shall clear the staked or indicated area of all materials as indicated on the plans. Trees unavoidably falling outside the specified clearing limits must be cut up, removed, and disposed of in a satisfactory manner. To minimize damage to trees that are to be left standing, trees shall be felled toward the center of the area being cleared. The Contractor shall preserve and protect from injury all trees not to be removed. The trees, stumps, and brush shall be cut flush with the original ground surface. The grubbing of stumps and roots will not be required.

Fences shall be removed and disposed of as directed by the ~~RPR~~ **OAR**. Fence wire shall be neatly rolled and the wire and posts stored on the airport if they are to be used again, or stored at a location designated by the ~~RPR~~ **OAR** if the fence is to remain the property of a local owner or authority.

151-2.3 Clearing and grubbing. In areas designated to be cleared and grubbed, all stumps, roots, buried logs, brush, grass, and other unsatisfactory materials as indicated on the plans, shall be removed, except where embankments exceeding 3-1/2 feet (105 cm) in depth will be constructed outside of paved areas. For embankments constructed outside of paved areas, all unsatisfactory materials shall be removed, but sound trees, stumps, and brush can be cut off flush with the original ground and allowed to remain. Tap roots and other projections over 1-1/2 inches (38 mm) in diameter shall be grubbed out to a depth of at least 18 inches (0.5 m) below the finished subgrade or slope elevation.

Any buildings, ***rip rap, pavements, abandoned utilities,*** ~~and~~ miscellaneous structures ***and other debris*** that are ~~shown~~ ***defined*** on the plans ***or directed by the OAR*** to be removed shall be demolished or removed, and all materials shall be disposed of by removal from the site. The cost of removal is incidental to this item. ~~The remaining or existing foundations, wells, cesspools, and like structures shall be destroyed by breaking down the materials of which the foundations, wells, cesspools, etc., are built to a depth at least 2 feet (60 cm) below the existing surrounding ground.~~ Any broken concrete, blocks, or other objectionable material that cannot be used in backfill shall be removed and ***properly*** disposed of ***off the site.*** ~~at the Contractor's expense~~. The holes or openings shall be backfilled with acceptable material and ~~properly~~ compacted ***in accordance with the provision of Item P-152***.

All holes in embankment areas remaining after the grubbing operation shall have the sides of the holes flattened to facilitate filling with acceptable material and compacting as required in Item P-152. The same procedure shall be applied to all holes remaining after grubbing in areas where the depth of holes exceeds the depth of the proposed excavation.

METHOD OF MEASUREMENT

151-3.1 The quantities of clearing and grubbing as shown by the limits on the plans shall be the number of acres or fractions thereof, of land specifically cleared.

151-3.2 The quantities of BP-S196 Landside Civil Demolition as shown by the limits on the plans or directed by the OAR shall not be measured separately.

BASIS OF PAYMENT

151-4.1 Payment shall be made at the contract unit price per acre or fractions thereof for clearing. This price shall be full compensation for furnishing all materials and for all labor, equipment, tools, and incidentals necessary to complete the item.

151-4.2 Payment shall be made at the lump sum (LS) price for BP-S196 Landside Civil Demolition. This price shall be full compensation for furnishing all materials and for all labor, equipment, tools, and incidentals necessary to complete the item.

Payment will be made under:

Item P-151-4.1	Clearing and grubbing - per lump sum (LS)
Item P-151-4.2	BP-S196 Landside Civil Demolition – per lump sum (LS)

END OF ITEM P-151

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Item P-152 Excavation, Subgrade, and Embankment

DESCRIPTION

152-1.1 This item covers excavation, disposal, placement, and compaction of all materials within the limits of the work required to construct safety areas, runways, taxiways, aprons, and intermediate areas as well as other areas for drainage, building construction, parking, or other purposes in accordance with these specifications and in conformity to the dimensions and typical sections shown on the plans.

152-1.2 Classification. All material excavated shall be classified as defined below:

a. Unclassified excavation. Unclassified excavation shall consist of the excavation and disposal of all material, regardless of its nature which is not otherwise classified and paid for under one of the following items.

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 Excavation shall consist of the removal and disposal of deposits of soils with an organic content of 5 percent (by weight) or higher which is unsuitable as subgrade and embankment construction 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 for incorporation in the embankment.

c. **Drainage excavation**. Drainage excavation shall consist of all excavation made for the primary purpose of drainage and includes drainage ditches, such as intercepting, inlet or outlet ditches; temporary levee construction; or any other type as shown on the plans.

d. Borrow excavation. Borrow excavation shall consist of approved material required for the construction of embankments or for other portions of the work in excess of the quantity of usable material available from required excavations. Borrow material shall be obtained from areas ~~designated~~ ***approved*** by the ~~Resident Project Representative (RPR)~~ **Owner Authorized Representative (OAR)** ~~within the limits of the airport property but outside the normal limits of necessary grading, or~~ from areas outside the airport boundaries. ***No borrow areas have been identified on the airport for this project.***

152-1.3 Unsuitable excavation. Unsuitable material shall be disposed in designated waste areas as shown on the plans. Materials containing vegetable or organic matter ***in excess of 5 percent (by weight)***, such as muck, peat, organic silt, or sod shall be considered unsuitable for use in embankment construction. Material suitable for topsoil may be used on the embankment slope ***as topsoil*** when approved by the ~~RPR~~ **OAR**.

CONSTRUCTION METHODS

152-2.1 General. ~~Before beginning excavation, grading, and embankment operations in any area, the area shall be cleared or cleared and grubbed in accordance with Item P-151.~~ ***Before beginning excavation, grading, and embankment operations in existing pervious areas, the area shall have topsoil stripped to a minimum depth of 6 inches.***

The suitability of material to be placed in embankments shall be subject to approval by the ~~RPR~~ **OAR**. All unsuitable material shall be disposed ***of as directed by the OAR***. All waste areas shall

be graded to allow positive drainage of the area and adjacent areas. The surface elevation of waste areas shall be specified on the plans or approved by the ~~RPR~~ **OAR**.

When the Contractor's excavating operations encounter artifacts of historical or archaeological significance, the operations shall be temporarily discontinued and the ~~RPR~~ **OAR** notified per Section 70, paragraph 70-20. At the direction of the ~~RPR~~ **OAR**, the Contractor shall excavate the site in such a manner as to preserve the artifacts encountered and allow for their removal. Such excavation will be paid for as extra work.

Areas outside the limits of the pavement areas where the top layer of soil has become compacted by hauling or other Contractor activities shall be scarified and disked to a depth of 4 inches (100 mm), to loosen and pulverize the soil. Stones or rock fragments larger than 4 inches (100 mm) in their greatest dimension will not be permitted in the top 6 inches (150 mm) of the subgrade.

If it is necessary to interrupt existing surface drainage, sewers or under-drainage, conduits, utilities, or similar underground structures, the Contractor shall be responsible for and shall take all necessary precautions to preserve them or provide temporary services. When such facilities are encountered, the Contractor shall notify the ~~RPR~~ **OAR**, who shall arrange for their removal if necessary. The Contractor, at their own expense, shall satisfactorily repair or pay the cost of all damage to such facilities or structures that may result from any of the Contractor's operations during the period of the contract.

a. Blasting. Blasting shall not be allowed.

152-2.2 Excavation. No excavation shall be started until the work has been staked out by the Contractor and the ~~RPR~~ **OAR** has obtained from the Contractor, the survey notes of the elevations and measurements of the ground surface. The Contractor and ~~RPR~~ **OAR** shall agree that the original ground lines shown on the original topographic mapping are accurate, or agree to any adjustments made to the original ground lines.

~~Digital terrain model (DTM) files of the existing surfaces, finished surfaces and other various surfaces were used to develop the design plans.~~

~~Volumetric quantities were calculated by comparing DTM files of the applicable design surfaces and generating Triangle Volume Reports. Electronic copies of DTM files and a paper copy of the original topographic map will be issued to the successful bidder.~~

~~Existing grades on the design cross sections or DTM's, where they do not match the locations of actual spot elevations shown on the topographic map, were developed by computer interpolation from those spot elevations.~~ ***The existing ground surface has been defined based on the best available information available at the time of the design. The project site and associated quantities may vary from the conditions defined in the plans.*** Prior to disturbing original grade, Contractor shall ***survey the existing site to establish the original ground surface to be used for calculation of earthwork quantities to be paid under this project. The Contractor's survey shall be reviewed and accepted by the OAR before it can be used as a basis for quantities determination.*** ~~verify the accuracy of the existing ground surface by verifying spot elevations at the same locations where original field survey data was obtained as indicated on the topographic map. Contractor shall recognize that, due to the interpolation process, the actual ground surface at any particular location may differ somewhat from the interpolated surface shown on the design cross sections or obtained from the DTM's. Contractor's verification of original ground surface, however, shall be limited to verification of spot elevations as indicated herein, and no adjustments will be made to the original ground surface unless the Contractor demonstrates that spot elevations shown are incorrect. For this purpose, spot elevations which are within 0.1 foot of the stated elevations for ground surfaces, or within 0.04~~

~~foot for hard surfaces (pavements, buildings, foundations, structures, etc.) shall be considered "no change". Only deviations in excess of these will be considered for adjustment of the original ground surface. If Contractor's verification identifies discrepancies in the topographic map, Contractor shall notify the RPR~~ **OAR** ~~in writing at least two weeks before disturbance of existing grade to allow sufficient time to verify the submitted information and make adjustments to the design cross sections or DTM's. Disturbance of existing grade in any area shall constitute acceptance by the Contractor of the accuracy of the original elevations shown on the topographic map for that area.~~

All areas to be excavated shall be stripped of vegetation and topsoil. Topsoil shall be stockpiled for future use in areas designated on the plans or by the ~~RPR~~ **OAR**. All suitable excavated material shall be used in the formation of embankment, subgrade, or other purposes **as** shown on the plans ***or directed by the OAR***.

The grade shall be maintained so that the surface is well drained at all times. ***Effective surface water control shall be required to prevent the disturbance to previously prepared or freshly exposed surfaces.***

When the volume of the excavation exceeds that required to construct the embankments to the grades as indicated on the plans, the excess shall be used to grade the areas of ultimate development or disposed as directed by the ~~RPR~~ **OAR**. ***When the material can be utilized for another area within the project, the Contractor shall stockpile the material and shall provide erosion control measures completely around stockpiles.*** When the volume of excavation is not sufficient for constructing the embankments to the grades indicated, the deficiency shall be obtained from borrow areas ***approved by the OAR***.

a. Selective grading. When selective grading is indicated on the plans, the more suitable material designated by the ~~RPR~~ **OAR** shall be used in constructing the embankment or in capping the pavement subgrade. If, at the time of excavation, it is not possible to place this material in its final location, it shall ***become property of the Owner and shall be properly placed in approved areas as directed by the OAR***. The more suitable material shall then be placed and compacted as specified. Selective grading shall be considered incidental to the work involved. The cost of stockpiling and placing the material shall be included in the various pay items of work involved.

b. Undercutting. Rock, shale, hardpan, loose rock, boulders, or other material unsatisfactory for safety areas, subgrades, roads, shoulders, or any areas intended for turf shall be excavated to a minimum depth of 12 inches (300 mm) below the subgrade or to the depth specified by the ~~RPR~~ **OAR**. Muck, peat, matted roots, or other yielding material, unsatisfactory for subgrade foundation, shall be removed to the depth specified. Unsuitable materials shall be disposed off the airport ***or at the direction of the OAR***. The cost is incidental to this item. This excavated material shall be paid for at the contract unit price per cubic yard (per cubic meter) for ~~Unclassified~~ ***Unsuitable*** Excavation. The excavated area shall be backfilled with suitable material obtained from the grading operations or borrow areas and compacted to specified densities ***in accordance with the provisions of Item P-152***. The necessary backfill will constitute a part of the embankment. Where rock cuts are made, backfill with select material. Any pockets created in the rock surface shall be drained in accordance with the details shown on the plans. Undercutting will be paid as ~~unclassified~~ "***Unsuitable*** Excavation".

c. Over-break. Over-break, including slides, is that portion of any material displaced or loosened beyond the finished work as planned or authorized by the ~~RPR~~ **OAR**. All over-break shall be graded or removed by the Contractor and disposed of as directed by the ~~RPR~~ **OAR**. The ~~RPR~~ **OAR** shall determine if the displacement of such material was unavoidable and their own

decision shall be final. Payment will not be made for the removal and disposal of over-break that the ~~RPR~~ **OAR** determines as avoidable. Unavoidable over-break will be classified as "~~Unclassified~~ Unsuitable Excavation."

d. Removal of utilities. The removal of existing structures and utilities required to permit the orderly progress of work will be accomplished by the Contractor as indicated on the plans. All existing foundations shall be excavated at least 2 feet (60 cm) below the top of subgrade or as indicated on the plans, and the material disposed of as directed by the ~~RPR~~ **OAR**. All foundations thus excavated shall be backfilled with suitable material and compacted as specified for embankment or as shown on the plans.

152-2.3 Borrow excavation. ~~Borrow areas within the airport property are indicated on the plans. Borrow excavation shall be made only at these designated locations and within the horizontal and vertical limits as staked or as directed by the RPR.~~ ***No borrow locations are identified on the Airport for this Project.*** All unsuitable material shall be disposed of by the Contractor as shown on the plans ***or directed by the OAR***. All borrow pits shall be opened to expose the various strata of acceptable material to allow obtaining a uniform product. Borrow areas shall be drained and left in a neat, presentable condition with all slopes dressed uniformly. Borrow areas shall not create a hazardous wildlife attractant.

There are no borrow sources within the boundaries of the airport property. ***If borrow material is necessary to construct the project,*** the Contractor shall locate and obtain borrow sources ***and any environmental permits, hauling fees or other required incidental items to satisfy the requirements of the project***, subject to the approval of the ~~RPR~~ **OAR**. The Contractor shall notify the ~~RPR~~ **OAR** at least 15 days prior to beginning the excavation so necessary measurements and tests can be made by the ~~RPR~~ **OAR**. All borrow pits shall be opened to expose the various strata of acceptable material to allow obtaining a uniform product. Borrow areas shall be drained and left in a neat, presentable condition with all slopes dressed uniformly. Borrow areas shall not create a hazardous wildlife attractant.

All materials designated as borrow material shall meet the following criteria to be accepted:

Unified Soil Classification	***SP, SP-SM*** ***Fine Sand, Fine Sand with Silt***	***SM*** ***Silty Fine Sand***
% Passing No. 200 Sieve	***Less than 12% by weight***	***Less than 18% by weight***
Liquid Limit	***Less than 20***	***Less than 20***
Plasticity Index	***Less than 4***	***Less than 4***
Organic Content	***Less than 3% by weight***	***Less than 3% by weight***

All borrow material to be used for the project must have laboratory tests on file with OAR demonstrating aforementioned criteria prior to material being accepted onto airport property for incorporation as borrow material.

Any change in the sources or composition of borrow material will be discussed with OAR and laboratory test results must be approved prior to any change of material.

152-2.4 Drainage excavation. Drainage excavation shall consist of excavating drainage ditches including intercepting, inlet, or outlet ditches; or other types as shown on the plans. The work shall be performed in sequence with the other construction. Ditches shall be constructed prior to starting adjacent excavation operations. All satisfactory material shall be placed in embankment fills; unsuitable material shall be placed in designated waste areas or as directed by the ~~RPR~~ **OAR**. All necessary work shall be performed true to final line, elevation, and cross-section. The Contractor shall maintain ditches constructed on the project to the required cross-section and shall keep them free of debris or obstructions until the project is accepted.

No direct payment shall be made for the work performed under this section.

152-2.5 Preparation of cut areas or areas where existing pavement has been removed. In those areas on which a subbase or base course is to be placed, the top 12 inches of subgrade shall be compacted to not less than 100 % of maximum density for non-cohesive soils, and 95% of maximum density for cohesive soils as determined by ASTM D1557. As used in this specification, "non-cohesive" shall mean those soils having a plasticity index (PI) of less than 3 as determined by ASTM D4318.

No direct payment shall be made for the work performed under this section. The work shall be incidental to P-101 Pavement Removal and P-152 Subgrade Preparation.

152-2.6 Preparation of embankment area. All sod and vegetative matter shall be removed from the surface upon which the embankment is to be placed. The cleared surface shall be broken up by plowing or scarifying to a minimum depth of 6 inches (150 mm) and shall then be compacted per paragraph 152-2.10.

Sloped surfaces steeper than one (1) vertical to four (4) horizontal shall be plowed, stepped, benched, or broken up so that the fill material will bond with the existing material. When the subgrade is part fill and part excavation or natural ground, the excavated or natural ground portion shall be scarified to a depth of 12 inches (300 mm) and compacted as specified for the adjacent fill.

Where embankments are to be placed on natural slopes steeper than 1 vertical and 3 horizontal, horizontal benches shall be constructed.

No direct payment shall be made for the work performed under this section. The work shall be incidental to P-152 Subgrade Preparation.

152-2.7 Control Strip. The first half-day of construction of subgrade and/or embankment shall be considered as a control strip for the Contractor to demonstrate, in the presence of the ~~RPR~~ **OAR**, that the materials, equipment, and construction processes meet the requirements of this specification. The sequence and manner of rolling necessary to obtain specified density requirements shall be determined. The maximum compacted thickness may be increased to a maximum of 12 inches (300 mm) upon the Contractor's demonstration that approved equipment and operations will uniformly compact the lift to the specified density. The ~~RPR~~ **OAR** must witness this demonstration and approve the lift thickness prior to full production.

Control strips that do not meet specification requirements shall be reworked, re-compacted, or removed and replaced at the Contractor's expense. Full operations shall not begin until the control strip has been accepted by the ~~RPR~~ **OAR**. The Contractor shall use the same equipment, materials, and construction methods for the remainder of construction, unless adjustments made by the Contractor are approved in advance by the ~~RPR~~ **OAR**.

152-2.8 Formation of embankments. The material shall be constructed in lifts as established in the control strip, but not less than 6 inches (150 mm) nor more than 12 inches (300 mm) of compacted thickness.

When more than one lift is required to establish the layer thickness shown on the plans, the construction procedure described here shall apply to each lift. No lift shall be covered by subsequent lifts until tests verify that compaction requirements have been met. The Contractor shall rework, re-compact and retest any material placed which does not meet the specifications.

The lifts shall be placed, to produce a soil structure as shown on the typical cross-section or as directed by the ~~RPR~~ **OAR**. Materials such as ***concrete and masonry debris, crushed concrete, pavement,*** brush, hedge, roots, stumps, grass and other organic matter, shall not be incorporated or buried in the embankment.

Earthwork operations shall be suspended at any time when satisfactory results cannot be obtained due to rain, freezing, or other unsatisfactory weather conditions in the field. Frozen material shall not be placed in the embankment nor shall embankment be placed upon frozen material. Material shall not be placed on surfaces that are muddy, frozen, or contain frost. The Contractor shall drag, blade, or slope the embankment to provide surface drainage at all times.

The material in each lift shall be within ±2% of optimum moisture content before rolling to obtain the prescribed compaction. The material shall be moistened or aerated as necessary to achieve a uniform moisture content throughout the lift. Natural drying may be accelerated by blending in dry material or manipulation alone to increase the rate of evaporation.

The Contractor shall make the necessary corrections and adjustments in methods, materials or moisture content to achieve the specified embankment density.

The contractor will take samples of excavated materials which will be used in embankment for testing and develop a Moisture-Density Relations of Soils Report (Proctor) in accordance with ASTM D1557. A new Proctor shall be developed for each soil type based on visual classification.

Density tests will be taken by the contractor for every 3,000 square yards of compacted embankment for each lift which is required to be compacted, or other appropriate frequencies as determined by the ~~RPR~~ **OAR**.

If the material has greater than 30% retained on the 3/4-inch (19.0 mm) sieve, follow AASHTO T-180 Annex Correction of maximum dry density and optimum moisture for oversized particles.

Rolling operations shall be continued until the embankment is compacted to not less than 100%of maximum density for non-cohesive soils, and 95% of maximum density for cohesive soils as determined by ASTM D1557. Under all areas to be paved, the embankments shall be compacted to a depth of 12 inches and to a density of not less than 100 percent of the maximum density as determined by ASTM D1557. As used in this specification, "non-cohesive" shall mean those soils having a plasticity index (PI) of less than 3 as determined by ASTM D4318.

On all areas outside of the pavement areas, no compaction will be required on the top 4 inches which shall be prepared for a seedbed in accordance with Item T-901.

The in-place field density shall be determined in accordance with ASTM D1556 or ASTM 6938 using Procedure A, the direct transmission method, and ASTM D6938 shall be used to determine the moisture content of the material. The machine shall be calibrated in accordance with ASTM D6938.The Contractor’s laboratory shall perform all density tests in the ~~RPR’s~~ **OAR’s** presence and provide the test results upon completion to the ~~RPR~~ **OAR** for acceptance. If the specified density is not attained, the area represented by the test or as designated by the ~~RPR~~ **OAR** shall

be reworked and/or re-compacted and additional random tests made. This procedure shall be followed until the specified density is reached.

Compaction areas shall be kept separate, and no lift shall be covered by another lift until the proper density is obtained.

During construction of the embankment, the Contractor shall route all construction equipment evenly over the entire width of the embankment as each lift is placed. Lift placement shall begin in the deepest portion of the embankment fill. As placement progresses, the lifts shall be constructed approximately parallel to the finished pavement grade line.

When rock, concrete pavement, asphalt pavement, and other embankment material are excavated at approximately the same time as the subgrade, the material shall be incorporated into the outer portion of the embankment and the subgrade material shall be incorporated under the future paved areas. Stones, fragmentary rock, and recycled pavement larger than 4 inches (100 mm) in their greatest dimensions will not be allowed in the top 12 inches (300 mm) of the subgrade. Rockfill shall be brought up in lifts as specified or as directed by the ~~RPR~~ **OAR** and the finer material shall be used to fill the voids forming a dense, compact mass. Rock, cement concrete pavement, asphalt pavement, and other embankment material shall not be disposed of except at places and in the manner designated on the plans or by the ~~RPR~~ **OAR**.

When the excavated material consists predominantly of rock fragments of such size that the material cannot be placed in lifts of the prescribed thickness without crushing, pulverizing or further breaking down the pieces, such material may be placed in the embankment as directed in lifts not exceeding 2 feet (60 cm) in thickness. Each lift shall be leveled and smoothed with suitable equipment by distribution of spalls and finer fragments of rock. The lift shall not be constructed above an elevation 4 feet (1.2 m) below the finished subgrade.

Following placement of embankment the Contractor shall survey the site to establish the surface to be used for determination of the quantities of placed embankment. The survey will be reviewed by the OAR for approval prior to determination of the quantity of embankment to be paid.

All costs incidental to placing in lifts, compacting, discing, watering, mixing, sloping, and other operations necessary for construction of embankments will be included in the contract price for embankment.

152-2.9 Proof rolling. The purpose of proof rolling the subgrade is to identify any weak areas in the subgrade and not for compaction of the subgrade. After compaction is completed, the subgrade area shall be proof rolled with a 20 ton (18.1 metric ton) Tandem axle Dual Wheel Dump Truck loaded to the legal limit with tires inflated t**o** 80/100/150 psi (0.551 MPa/0.689 MPa/1.034 MPa) in the presence of the ~~RPR~~ **OAR**. Apply a minimum of 100% coverage, or as specified by the ~~RPR~~ **OAR**, under pavement areas. A coverage is defined as the application of one tire print over the designated area. Soft areas of subgrade that deflect more than 1 inch (25 mm) or show permanent deformation greater than 1 inch (25 mm) shall be removed and replaced with suitable material or reworked to conform to the moisture content and compaction requirements in accordance with these specifications. Removal and replacement of soft areas is incidental to this item.

152-2.10 Compaction requirements. The subgrade under areas to be paved shall be compacted to a depth of 12 inches and to a density of not less than 100percent of the maximum dry density as determined by ASTM D1557. The subgrade in areas outside the limits of the pavement areas shall be compacted to a depth of 12 inches and to a density of not less than 95 percent of the maximum density as determined by ASTM D1557.

The material to be compacted shall be within ±2% of optimum moisture content before being rolled to obtain the prescribed compaction (except for expansive soils). When the material has greater than 30 percent retained on the ¾ inch (19.0 mm) sieve, follow the methods in ASTM D1557 Tests for moisture content and compaction will be taken at a minimum of 1,000 S.Y. of subgrade. All quality assurance testing shall be done by the Contractor's laboratory in the presence of the ~~RPR~~ **OAR**, and density test results shall be furnished upon completion to the ~~RPR~~ **OAR** for acceptance determination.

Under all areas to be paved, the embankments shall be compacted to the depths and densities as specified below:

Depth Below Finished Subgrade (in.)	***Compaction for P-152 per ASTM D 1557***	***Required Soil Type***
0 to 25 (fill and cut areas)	***100%***	***SP and SP-SM only (<12% by weight)***
25 to 44 (fill and cut areas)	***95%***	***SP and SP-SM only (<12% by weight)***
Below 44 (fill areas only)	***95%***	***SP, SP-SM, and SM only (<18% by weight)***

Contractor shall provide (by digging) test pits on each 1,000 square yard area under proposed full strength pavement (or per each isolated area of construction) for OAR testing firm to perform density tests. Tests shall be taken at these locations at the various depths for density specified. All testing for excavation and backfilling of test pits shall be included as part of P-152-1.

The in-place field density shall be determined in accordance with ASTM D1556 or ASTM D6938 using Procedure A, the direct transmission method, and ASTM D6938 shall be used to determine the moisture content of the material. The machine shall be calibrated in accordance with ASTM D6938 within 12 months prior to its use on this contract. The gage shall be field standardized daily.

Maximum density refers to maximum dry density at optimum moisture content unless otherwise specified.

If the specified density is not attained, the entire lot shall be reworked and/or re-compacted and additional random tests made. This procedure shall be followed until the specified density is reached.

All cut-and-fill slopes shall be uniformly dressed to the slope, cross-section, and alignment shown on the plans or as directed by the ~~RPR~~ **OAR** and the finished subgrade shall be maintained.

152-2.11 Finishing and protection of subgrade. Finishing and protection of the subgrade is incidental to this item. Grading and compacting of the subgrade shall be performed so that it will drain readily. All low areas, holes or depressions in the subgrade shall be brought to grade. Scarifying, blading, rolling and other methods shall be performed to provide a thoroughly

compacted subgrade shaped to the lines and grades shown on the plans. All ruts or rough places that develop in the completed subgrade shall be graded, re-compacted, and retested. The Contractor shall protect the subgrade from damage and limit hauling over the finished subgrade to only traffic essential for construction purposes.

The Contractor shall maintain the completed course in satisfactory condition throughout placement of subsequent layers. No subbase, base, or surface course shall be placed on the subgrade until the subgrade has been accepted by the ~~RPR~~ **OAR**.

152-2.12 Haul. All hauling, ***both on and off Airport property,*** will be considered a necessary and incidental part of the work. The Contractor shall include the cost in the contract unit price for the pay of items of work involved. No payment will be made separately or directly for hauling on any part of the work.

The Contractor's equipment shall not cause damage to any excavated surface, compacted lift or to the subgrade as a result of hauling operations. Any damage caused as a result of the Contractor's hauling operations shall be repaired at the Contractor's expense.

The Contractor shall be responsible for providing, maintaining and removing any haul roads or routes within or outside of the work area, and shall return the affected areas to their former condition, unless otherwise authorized in writing by the Owner. No separate payment will be made for any work or materials associated with providing, maintaining and removing haul roads or routes.

152-2.13 Surface Tolerances. In those areas on which a subbase or base course is to be placed, the surface shall be tested for smoothness and accuracy of grade and crown. Any portion lacking the required smoothness or failing in accuracy of grade or crown shall be scarified to a depth of at least 3 inches (75 mm), reshaped and re-compacted to grade until the required smoothness and accuracy are obtained and approved by the ~~RPR~~ **OAR**. The Contractor shall perform all final smoothness and grade checks in the presence of the ~~RPR~~ **OAR**. Any deviation in surface tolerances shall be corrected by the Contractor at the Contractor's expense.

a. Smoothness. The finished surface shall not vary more than +/- ½ inch (12 mm) when tested with a 12-foot (3.7-m) straightedge applied parallel with and at right angles to the centerline. The straightedge shall be moved continuously forward at half the length of the 12-foot (3.7-m) straightedge for the full length of each line on a 50-foot (15-m) grid.

b. Grade. The grade and crown shall be measured on a 50-foot (15-m) grid and shall be within +/-0.05 feet (15 mm) of the specified grade.

On safety areas, turfed areas and other designated areas within the grading limits where no subbase or base is to placed, grade shall not vary more than 0.10 feet (30 mm) from specified grade. Any deviation in excess of this amount shall be corrected by loosening, adding or removing materials, and reshaping.

152-2.14 Topsoil. When topsoil is specified or required as shown on the plans or under Item T-905, it shall be salvaged from stripping or other grading operations. The topsoil shall meet the requirements of Item T-905. If, at the time of excavation or stripping, the topsoil cannot be placed in its final section of finished construction, the material shall be stockpiled at approved locations. Stockpiles shall be located as shown on the plans and the approved CSPP, and shall not be placed on areas that subsequently will require any excavation or embankment fill. If, in the judgment of the ~~RPR~~ **OAR**, it is practical to place the salvaged topsoil at the time of excavation or stripping, the material shall be placed in its final position without stockpiling or further re-handling.

Upon completion of grading operations, stockpiled topsoil shall be handled and placed as shown on the plans and as required in Item T-905. Topsoil shall be paid for as provided in Item T-905. No direct payment will be made for topsoil under Item P-152.

METHOD OF MEASUREMENT

152-3.1 Measurement for payment for embankment, specified by the cubic yard (cubic meter) shall be computed ***from the comparison of surveyed original and final surface approved by the OAR. The volume computed by a DTM model of the original and final surfaces established by the Contractor surveys and approved be the OAR shall be the basis of measurement.***

152-3.2 The quantity of unsuitable excavation to be paid for shall be the number of cubic yards measured in its original position as approved by the OAR. Measurement shall not include the quantity of materials excavated without authorization beyond normal slope lines, or the quantity of material used for purposes other than those directed.

152-3.3 The quantity of subgrade preparation to be paid for shall be the number of square yards measure in its final place and accepted by the OAR. Measurement shall not include the quantity subgrade preparation perform outside the limits of work defined on the plans without authorization.

BASIS OF PAYMENT

152-4.1 Embankment payment shall be made at the contract unit price per cubic yard (cubic meter). This price shall be full compensation for furnishing all materials, labor, equipment, tools, and incidentals necessary to complete the item.

152-4.1 Unsuitable excavation payment shall be made at the contract unit price per cubic yard (cubic meter). This price shall be full compensation for furnishing all materials, labor, equipment, tools, and incidentals necessary to complete the item.

152-4.1 Subgrade preparation payment shall be made at the contract unit price per square yard (square meter). This price shall be full compensation for furnishing all materials, labor, equipment, tools, and incidentals necessary to complete the item.

Payment will be made under:

Item P-152-4.1	Embankment - per cubic yard
Item P-152-4.2	Unsuitable Excavation - per cubic yard
Item P-152-4.3	Subgrade Preparation - per square yard

REFERENCES

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

American Association of State Highway and Transportation Officials (AASHTO)

AASHTO T-180	Standard Method of Test for Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18-in.) Drop

ASTM International (ASTM)

ASTM D698	Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft^3 (600 kN-m/m^3))
ASTM D1556	Standard Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method
ASTM D1557	Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft^3 (2700 kN-m/m^3))
ASTM D6938	Standard Test Methods for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)

Advisory Circulars (AC)

AC 150/5370-2	Operational Safety on Airports During Construction Software

Software

FAARFIELD – FAA Rigid and Flexible Iterative Elastic Layered Design

U.S. Department of Transportation

FAA RD-76-66	Design and Construction of Airport Pavements on Expansive Soils

END OF ITEM P-152

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SECTION P-153 - CONTROLLED LOW-STRENGTH MATERIAL (CLSM)

PART 1 - DESCRIPTION

1.1 This item shall consist of furnishing, transporting, and placing a controlled low-strength material (CLSM) as flowable backfill in trenches or at other locations shown on the plans or as directed by the ~~Resident Project Representative (RPR)~~ ***Owner's Authorized Representative (OAR)***.

PART 2 - MATERIALS

2.1 MATERIALS.

A. Cement. Cement shall conform to the requirements of ASTM C150 Type I/II or ASTM C595 Type IL.

B. Fly ash. Fly ash shall conform to ASTM C618, Class C or F.

C. Fine aggregate (sand). Fine aggregate shall conform to the requirements of ASTM C33 except for aggregate gradation. Any aggregate gradation which produces the specified performance characteristics of the CLSM and meets the following requirements, will be accepted.

Sieve Size	Percent Passing by weight
3/4 inch (19.0 mm)	100
No. 200 (75 µm)	0 - 12

D. Water. Water used in mixing or curing shall be from potable water sources. Other sources shall be tested in accordance with ASTM C1602 prior to use.

PART 3 - MIX DESIGN

3.1 PROPORTIONS

The Contractor shall submit, to the ~~RPR~~ ***OAR***, a mix design including the proportions and source of aggregate, fly ash, cement, water, and approved admixtures. No CLSM mixture shall be produced for payment until the ~~RPR~~ ***OAR*** has given written approval of the proportions. The proportions shall be prepared by a laboratory and shall remain in effect for the duration of the project. The proportions shall establish a single percentage or weight for aggregate, fly ash, cement, water, and any admixtures proposed. Laboratory costs are incidental to this item.

A. Compressive strength. CLSM shall be designed to achieve a 28-day compressive strength of 100 to 200 psi (690 to 1379 kPa) when tested in accordance with ASTM D4832, with no significant strength gain after 28 days.

B. Consistency. Design CLSM to achieve a consistency that will produce an approximate 8-inch (200 mm) diameter circular-type spread without segregation. CLSM consistency shall be determined per ASTM D6103.

PART 4 - CONSTRUCTION METHODS

4.1 PLACEMENT

A. Placement. CLSM may be placed by any reasonable means from the mixing unit into the space to be filled. Agitation is required during transportation and waiting time. Placement shall be performed so structures or pipes are not displaced from their final position and intrusion of CLSM into unwanted areas is avoided. The material shall be brought up uniformly to the fill line shown on the plans or as directed by the ~~RPR~~ ***OAR***. Each placement of CLSM shall be as continuous an operation as possible. If CLSM is placed in more than one lift, the base lift shall be free of surface water and loose foreign material prior to placement of the next lift.

B. Contractor Quality Control. The Contractor shall collect all batch tickets to verify the CLSM delivered to the project conforms to the mix design. The Contractor shall verify daily that the CLSM is consistent with 3.1a and 3.1b. Adjustments shall be made as necessary to the proportions and materials as needed. The Contractor shall provide all batch tickets to the ~~RPR~~ ***OAR***.

C. Limitations of placement. CLSM shall not be placed on frozen ground. Mixing and placing may begin when the air or ground temperature is at least 35°F (2°C) and rising. Mixing and placement shall stop when the air temperature is 40°F (4°C) and falling or when the anticipated air or ground temperature will be 35°F (2°C) or less in the 24-hour period following proposed placement. At the time of placement, CLSM shall have a temperature of at least 40°F (4°C).

4.2 CURING AND PROTECTION

A. Curing. The air in contact with the CLSM shall be maintained at temperatures above freezing for a minimum of 72 hours. If the CLSM is subjected to temperatures below 32°F (0°C), the material may be rejected by the ~~RPR~~ ***OAR*** if damage to the material is observed.

B. Protection. The CLSM shall not be subject to loads and shall remain undisturbed by construction activities for a period of 48 hours or until a compressive strength of 15 psi (105 kPa) is obtained. The Contractor shall be responsible for providing evidence to the ~~RPR~~ ***OAR*** that the material has reached the desired strength. Acceptable evidence shall be based upon compressive tests made in accordance with paragraph 3.1a.

4.3 QUALITY ASSURANCE (QA) ACCEPTANCE

CLSM QA acceptance shall be based upon batch tickets provided by the Contractor to the ~~RPR~~ ***OAR*** to confirm that the delivered material conforms to the mix design.

PART 5 - METHOD OF MEASUREMENT

5.1 MEASUREMENT

No separate measurement for payment shall be made for controlled low strength material (CLSM). CLSM shall be considered necessary and incidental to the work of this Contract.

PART 6 - BASIS OF PAYMENT

6.1 PAYMENT

No payment will be made separately or directly for controlled low strength material (CLSM). CLSM shall be considered necessary and incidental to the work of this Contract.

PART 7 - REFERENCES

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

ASTM International (ASTM)

ASTM C33	Standard Specification for Concrete Aggregates
ASTM C150	Standard Specification for Portland Cement
ASTM C618	Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete
ASTM C595	Standard Specification for Blended Hydraulic Cements
ASTM C1602	Standard Specification for Mixing Water Used in the Production of Hydraulic Cement Concrete
ASTM D4832	Standard Test Method for Preparation and Testing of Controlled Low-Strength Material (CLSM) Test Cylinders

ASTM D6103 Flow Consistency of Controlled Low Strength Material (CLSM)

END OF SECTION P-153

SECTION P-211 - LIME ROCK BASE COURSE

PART 1 - DESCRIPTION

1.1 This item shall consist of a base course composed of lime rock constructed on the prepared underlying course per these specifications and shall conform to the dimensions and typical cross-section shown on the plans.

PART 2 - MATERIALS

2.1 MATERIALS

The lime rock base course material shall consist of fossiliferous limestone of uniform quality. The material shall not contain hard or flinty pieces that will cause a rough surface containing pits and pockets. The rock shall show no tendency to “air slake” or undergo chemical change when exposed to the weather. The material when watered and rolled shall be capable of compacting to a dense and well-bonded base.

Lime Rock Base Course Material Properties[2]

	Oolitic	Non-Oolitic
Carbonates of calcium and magnesium[1]	70% minimum	75% minimum
Oxides of iron and aluminum[1]	Less than or equal to 2%	Less than or equal to 2%
Liquid limit	NA	Not greater than 35
Plasticity Index	NA	Not greater than 6
Organic or foreign matter	Not more than 0.5%	Not more than 0.5%
Lime Bearing Ratio (LBR)[3] at 0 to +1.5% optimum	125	125

[1] The combined amount of carbonates, oxides, and silica shall be at least 97%. The material shall be non-plastic.

[2] The chemical analysis of lime rock shall consist of determining the insoluble silica, iron oxide, and alumina by solution of the sample in hydrochloric (HCl) acid, evaporating, dehydrating, re-dissolving the residue, and neutralizing with ammonium hydroxide, filtering, washing, and igniting the residue lime rock. The difference between the percentage of insoluble matter and 100% is reported as carbonates of calcium and magnesium.

[3] FM 5-515, Florida Method of Test for Lime Rock Bearing Ratio

Lime Rock Base Course Gradation

Sieve Designation (square openings)	Percentage by Weight Passing Sieves
3-1/2 inch (87.5 mm)	100
3/4 inch (19.0 mm)	50-100

All fine material shall consist entirely of dust of fracture (fine portion passing the No. 10 (2.00 mm) sieve).

2.2 SAMPLING AND TESTING

A. Aggregate base materials. The Contractor shall take samples of the aggregate base in accordance with ASTM D75 to verify initial aggregate base requirements and gradation. Material shall meet the requirements in paragraph 2.1. This sampling and testing will be the basis for approval of the aggregate base quality requirements.

B. Gradation requirements. The Contractor shall take at least two aggregate base samples per day in the presence of the ~~Resident Project Representative (RPR)~~ ***Owner's Authorized Representative (OAR)*** to check the final gradation. Sampling shall be per ASTM D75. Material shall meet the requirements in paragraph 209-2.1. The lot will be consistent with the lot size used for density. The samples shall be taken from the in-place, un-compacted material at sampling points and intervals designated by the ~~RPR~~ ***OAR***.

2.3 SEPARATION GEOTEXTILE

Not used.

PART 3 - CONSTRUCTION METHODS

3.1 CONTROL STRIP

The first half-day of construction shall be considered the control strip. The Contractor shall demonstrate, in the presence of the ~~RPR~~ ***OAR***, that the materials, equipment, and construction processes meet the requirements of the specification. The sequence and manner of rolling necessary to obtain specified density requirements shall be determined. Control strips that do not meet specification requirements shall be removed and replaced at the Contractor's expense. Full operations shall not continue until the control strip has been accepted by the ~~RPR~~ ***OAR***. Upon acceptance of the control strip by the ~~RPR~~ ***OAR***, the Contractor shall use the same equipment, materials, and construction methods for the remainder of construction, unless adjustments made by the Contractor are approved in advance by the ~~RPR~~ ***OAR***.

3.2 PREPARING UNDERLYING COURSE

The ~~RPR~~ ***OAR*** shall check and accept the underlying course before placing and spreading operations are started. Any ruts or soft yielding places caused by improper drainage conditions, hauling, or any other cause shall be corrected at the Contractor's expense before the base course is placed. Material shall not be placed on frozen subgrade.

3.3 PLACEMENT

The material shall be placed and spread on the prepared underlying layer by spreader boxes or other devices as approved by the ~~RPR~~ ***OAR***, to a uniform thickness and width. The equipment shall have positive thickness controls to minimize the need for additional manipulation of the material. Dumping from vehicles that require re-handling shall not be permitted. Hauling over the uncompacted base course shall not be permitted.

The material shall meet gradation and moisture requirements prior to compaction. The layer shall be constructed in lifts as established in the control strip, but not less than 4 inches (100 mm) nor more than 12 inches (300 mm) of compacted thickness.

When more than one lift is required to establish the layer thickness shown on the plans, the construction procedure described here shall apply to each lift. No lift shall be covered by subsequent lifts until tests verify that compaction requirements have been met. The Contractor shall rework, re-compact and retest any material placed which does not meet the specifications.

3.4 COMPACTION

Immediately upon completion of the spreading operations, compact each layer of the base course, as specified, with approved compaction equipment. The number, type, and weight of rollers shall be sufficient to compact the material to the required density within the same day that the aggregate is placed on the subgrade. The field density of each compacted lift of material shall be at least 100% of the maximum density of laboratory specimens prepared from samples of the subbase material delivered to the jobsite. The moisture content of the material during placing operations shall be within ±2 percentage points of the optimum moisture content as determined by ASTM D1557. Maximum density refers to maximum dry density at optimum moisture content unless otherwise specified.

3.5 FINISHING

After the watering and rolling of the base course, the entire surface shall be scarified to a depth of at least 3 inches (75 mm) and shaped to the exact crown and cross-section with a blade grader. The scarified material shall be rewetted and thoroughly rolled. Rolling shall continue until the base is bonded and compacted to a dense, unyielding mass, true to grade and cross-section. Scarifying and rolling of the surface of the base shall follow the initial rolling of the lime rock by not more than four (4) days. When the lime rock base is constructed in two layers, the scarifying of the surface shall be to a depth of 2 inches (50 mm).

If cracks or checks appear in the base before the surface course is laid, the Contractor shall rescarifying, reshaping, watering, add lime rock where necessary, and recompact. If the underlying material becomes mixed with the base course material, the Contractor shall, without additional compensation, remove, reshape, and recompact the mixture.

3.6 WEATHER LIMITATIONS

Material shall not be placed unless the ambient air temperature is at least 40°F (4°C) and rising. Work on base course shall not be conducted when the subgrade or subbase is wet or frozen or the base material contains frozen material.

3.7 MAINTENANCE

The base course shall be maintained in a condition that will meet all specification requirements until the work is accepted by the ~~RPR~~ ***OAR***. When material has been exposed to excessive rain, snow, or freeze-thaw conditions, prior to placement of additional material, the Contractor shall verify that materials still meet all specification requirements. Equipment may be routed over completed sections of base course, provided that no damage results and the equipment is routed over the full width of the completed base course. Any damage resulting to the base course from routing equipment over the base course shall be repaired by the Contractor at the Contractor's expense.

3.8 SURFACE TOLERANCE

After the course has been compacted, the surface shall be tested for smoothness and accuracy of grade and crown. Any portion lacking the required smoothness or failing in accuracy of grade or crown shall be scarified to a depth of at least 3 inches (75 mm), reshaped and recompacted to grade. until the required smoothness and accuracy are obtained and approved by the ~~RPR~~ ***OAR***. Any deviation in surface tolerances shall be corrected by the Contractor at the Contractor's expense. The smoothness and accuracy requirements specified here apply only to the top layer when base course is constructed in more than one layer.

A. Smoothness. The finished surface shall not vary more than 3/8-inch (9 mm) when tested with a 12-foot (3.7-m) straightedge applied parallel with and at right angles to the centerline. The straightedge shall be moved continuously at half the length of the 12-foot (3.7-m) straightedge for the full length of each line on a 50-foot (15-m) grid.

B. Grade. The grade and crown shall be measured on a 50-foot (15-m) grid and shall be within +0 and -1/2 inch (12 mm) of the specified grade.

3.9 ACCEPTANCE SAMPLING AND TESTING

Lime rock base course shall be accepted for density on an area basis. Two tests shall be made for density and thickness for each 1200 square yds (1000 m^2). Sampling locations will be determined on a random basis per ASTM D3665.

A. Density. The Contractor's laboratory shall perform all density tests in the ~~RPR's~~ ***OAR's*** presence and provide the test results upon completion to the ~~RPR~~ ***OAR*** for acceptance.

Each area shall be accepted for density when the field density is at least 100% of the maximum density of laboratory specimens compacted and tested per ASTM D1557. The in-place field density shall be determined per ASTM D6938 using Procedure A, the direct transmission method, and ASTM D6938 shall be used to determine the moisture content of the material. The machine shall be calibrated in accordance with ASTM D6938. If the specified density is not attained, the entire area shall be reworked and/or recompacted and two additional random tests made. This procedure shall be followed until the specified density is reached. Maximum density refers to maximum dry density at optimum moisture content unless otherwise specified.

B. Thickness. Depth tests shall be made by test holes or cores at least 3 inches (75 mm) in diameter that extend through the base. The thickness of the base course shall be within +0 and -1/2 inch (12 mm) of the specified thickness as determined by depth tests taken by the Contractor in the presence of the ~~RPR~~ ***OAR*** for each area. Where the thickness is deficient by more than 1/2-inch (12 mm), the Contractor shall correct such areas at no additional cost by scarifying to a depth of at least 3 inches (75 mm), adding new material of proper gradation, and the material shall be blended and recompacted to grade. The Contractor shall replace, at his expense, base material where depth tests have been taken.

Alternately the Contractor may request the OAR to permit the thickness determination by survey. Survey shall be required before and after placement of the base. The survey interval shall be no greater than a 50' X 50' grid across the project.

PART 4 - METHOD OF MEASUREMENT

4.1 The quantity of lime rock base course shall be the number of square yards (square meters) of base material placed, bonded, and accepted in the completed base course. The quantity of base course material shall be measured in final position based upon depth tests taken as directed by the ~~RPR~~ ***OAR***. On individual depth measurements, thicknesses more than 1/2 inch (12 mm) in excess of that shown on the plans shall be considered as the specified thickness plus 1/2 inch (12 mm) in computing the yardage for payment.

PART 5 - BASIS OF PAYMENT

5.1 Payment shall be made at the contract unit price per square yards for lime rock base course. This price shall be full compensation for furnishing all materials and for all preparation, hauling, and placing of these materials, and for all labor, equipment, tools, and incidentals necessary to complete the item.

The cost of removing cracks and checks including the labor, and the additional lime rock necessary for crack elimination, will not be paid for separately but shall be included in the contract price per square yard for lime rock base course.

Payment will be made under:

Item P-211-5.1 6" Lime rock base course - per Square Yard (SY)

Item P-211-5.2	13” Lime rock base course	- per Square Yard (SY)
Item P-211-5.3	14” Lime rock base course	- per Square Yard (SY)
Item P-211-5.4	24” Lime rock base course	- per Square Yard (SY)

REFERENCES

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

ASTM International (ASTM)

ASTM C136	Standard Test Method for Sieve or Screen Analysis of Fine and Coarse Aggregates
ASTM D75	Standard Practice for Sampling Aggregates
ASTM D698	Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft^3 (600 kN-m/m^3))
ASTM D1556	Standard Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method
ASTM D1557	Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft^3 (2700 kN-m/m^3))
ASTM D3665	Standard Practice for Random Sampling of Construction Materials
ASTM D4318	Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils
ASTM D4491	Standard Test Methods for Water Permeability of Geotextiles by Permittivity
ASTM D4751	Standard Test Methods for Determining Apparent Opening Size of a Geotextile

American Association of State Highway and Transportation Officials (AASHTO)

M288	Standard Specification for Geosynthetic Specification for Highway Applications

END OF SECTION P-211

SECTION P-306 LEAN CONCRETE BASE COURSE

PART 1 - DESCRIPTION

1.1 This item shall consist of a lean concrete subbase material that is composed of aggregate and cement uniformly blended together and mixed with water. The mixture may also include approved cementitious additives, in the form of fly ash or slag, and chemical admixtures. The mixed material shall be spread, shaped, and consolidated using concrete paving equipment in accordance with these specifications and in conformity to the lines, grades, dimensions, and typical cross-sections shown on the plans.

PART 2 - MATERIALS

2.1 AGGREGATE

The coarse aggregate fraction shall be crushed stone, crushed or uncrushed gravel, crushed and adequately seasoned, air-cooled, iron blast furnace slag, crushed recycled concrete, or a combination thereof. The fine aggregate fraction may be part of the natural aggregate blend as obtained from the borrow source or it may be natural sand that is added at the time of mixing. The aggregate shall meet the gradation and material requirements in the tables below.

Aggregate Material Requirements

Material Test	Requirement	Standard
Coarse Aggregate Portion (retained on the No. 4 (4.75 mm) sieve)		
Resistance to Degradation	Loss: 40% maximum	ASTM C131
Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate	Loss after 5 cycles: 10% maximum using Sodium sulfate - or - 15% maximum using magnesium sulfate	ASTM C88
Flat Particles, Elongated Particles, or Flat and Elongated Particles[1]	10% maximum, by weight, for fraction retained on the ½ inch (12.5mm) sieve and 10% maximum, by weight, for the fraction passing the 1/2-inch (12.5 mm) sieve	ASTM D4791
Clay lumps and friable particles	Less than or equal to 3 percent	ASTM C142
Fine Aggregate Portion (passing the No. 40 (425µm) sieve)		
Clay lumps and friable particles	Less than or equal to 3 percent	ASTM C142
Soundness of Aggregates	Loss after 5 cycles: 10% maximum using Sodium sulfate - or -	ASTM C88

Material Test	Requirement	Standard
by Use of Sodium Sulfate or Magnesium Sulfate	15% maximum using magnesium sulfate	

[1] A flat particle is one having a ratio of width to thickness greater than five (5); an elongated particle is one having a ratio of length to width greater than five (5).

Aggregate Gradation for Lean Concrete

Sieve Size (square openings)	Percentage by Weight Passing Sieves	
	Gradation A	Gradation B
1-1/2 inch (37.5 mm)	100	--
1 inch (25.0 mm)	70 - 95	100
3/4 inch (19.0 mm)	55 - 85	70 - 100
No. 4 (4.75 mm)	30 - 60	35 - 65
No. 40 (425 µm)	10 - 30	15 - 30
No. 200 (75 µm)	0 - 15	0 - 15

2.2 SAMPLING AND TESTING

A. Aggregate base materials

The Contractor shall take samples of the aggregate base stockpile in accordance with ASTM D75 to verify initial aggregate base requirements and gradation. Material shall meet the requirements in paragraphs 2.1 and 2.2. This sampling and testing will be the basis for approval of the aggregate base quality requirements.

2.3 CEMENT

Cement shall conform to the requirements of ASTM C150, Type I or II or ASTM C595, Type IL.

2.4 CEMENTITIOUS ADDITIVES

Pozzolanic and slag cement may be added to the lean concrete mix. If used, each material must meet the following requirements:

A. Pozzolan. Pozzolanic materials must meet the requirements of ASTM C618, Class F, or N with the exception of loss of ignition, where the maximum shall be less than 6%.

B. Slag cement (ground granulated blast furnace (GGBF) slag). Slag shall conform to ASTM C989, Grade 100 or 120.

2.5 CHEMICAL ADMIXTURES

The Contractor shall submit certificates indicating that the material to be furnished meets all the requirements listed below. In addition, the ~~RPR~~ ***Owner's Authorized Representative (OAR)*** may require the Contractor to submit complete test data showing that the material to be furnished meets all the requirements of the cited specification.

A. Air-entraining admixtures. Air-entraining admixtures shall meet the requirements of ASTM C260.

B. Water-reducing admixtures. Water-reducing, set-controlling admixtures shall meet the requirements of ASTM C494, Type A, D, E, F, or G. Water-reducing admixtures shall be added at the mixer separately from air-entraining admixtures in accordance with the manufacturer's printed instructions. The air entrainment agent and the water-reducing admixture shall be compatible.

C. Retarding admixtures. Retarding admixtures shall meet the requirements of ASTM C494, Type B or D.

D. Accelerating admixtures. Accelerating admixtures shall meet the requirements of ASTM C494, Type C.

2.6 WATER

Water used in mixing or curing shall be from potable water sources. Other sources shall be tested in accordance with ASTM C1602 prior to use.

2.7 CURING MATERIALS

For curing lean concrete, use white-pigmented, liquid membrane-forming compound conforming to ASTM C309, Type 2, Class B, or clear or translucent Type 1-D, Class B with white fugitive dye.

2.8 BOND BREAKER

Choke stone shall be an ASTM C33 Number 89 stone.

PART 3 - COMPOSITION OF MIXTURE

3.1 MIX DESIGN

The lean concrete mix design shall be based on trial batch results conducted in the laboratory. The lean concrete shall be designed to meet the criteria in this section.

Compressive strength shall not be less than 500 pounds per square inch (3,445 kPa) nor greater than 800 pounds per square inch (5,516 kPa) at seven (7) days. Compressive strengths shall be taken as the average of two compressive strength test results. All compressive strength specimens shall be prepared and tested in accordance with ASTM C192 and ASTM C39, respectively.

The percentage of air entrainment shall be 6%, ±1/2%. Air content shall be determined by testing in accordance with ASTM C231 for gravel and stone coarse aggregate and ASTM C173 for slag and other highly porous coarse aggregate.

If there is a change in aggregate sources, type of cement used, or pozzolanic materials, a new mix design must be submitted

3.2 SUBMITTALS

At least 30 days prior to the placement of the lean concrete, the Contractor shall submit certified test reports to the ~~RPR~~ ***OAR*** for those materials proposed for use during construction, as well as the mix design information for the lean concrete material. The certification shall identify the specifications and test standard, the name of the testing laboratory, the date of the tests, and a statement that the materials comply with the applicable specifications. Tests older than six (6) months shall not be used. The submittal package shall include the following:

A. Sources of materials, including aggregate, cement, admixtures, and curing and bond breaking materials.

B. Physical properties of the aggregates, cement, admixtures, curing and bond breaking materials.

C. Mix design:

- Mix identification number
- Weight of saturated surface-dry aggregates (fine and coarse)
- Combined aggregate gradation
- Cement factor
- Water content
- Water-cementitious material ratio (by weight)
- Volume of admixtures and yield for one cubic yard (cubic meter) of lean concrete
- Laboratory test results:
- Slump
- Unit weight
- Air content
- Compressive strength at 3, 7, and 28 days (average values)

Where applicable, the Contractor shall submit a jointing plan for transverse joints in the lean concrete layer for approval by the ~~RPR~~ ***OAR***.

During production, the Contractor shall submit batch tickets for each delivered load.

PART 4 - EQUIPMENT

4.1 All equipment necessary to mix, transport, place, compact, and finish the lean concrete material shall be furnished by the Contractor and is subject to inspection and approval by the ~~RPR~~ ***OAR***. The Contractor shall provide certification that all equipment conforms to the requirements of ASTM C94.

4.2 FORMS

Straight side forms shall be made of steel and shall be furnished in sections not less than 10 feet (3 m) in length. Forms shall have a depth equal to the pavement thickness at the edge. Flexible or curved forms of proper radius shall be used for curves of 100 feet (30 m) radius or less. Forms shall be provided with adequate devices for secure settings so that when in place they will withstand, without visible spring or settlement, the impact and vibration of the consolidating and finishing equipment. Forms with battered top surfaces and bent, twisted or broken forms shall not be used. Built-up forms shall not be used, except as approved by the ~~RPR~~ ***OAR***. The forms shall contain provisions for locking the ends of abutting sections together tightly for secure setting. Wood forms may be used under special conditions, when accepted by the ~~RPR~~ ***OAR***.

4.3 CONCRETE PAVERS

A fixed form or slip-form concrete paver may be used to place lean concrete. The paver shall be fully energized, self-propelled and capable of spreading, consolidating, and finishing the lean concrete material, true to grade, tolerances, and cross-sections. The paver shall be of sufficient weight and power to construct the maximum specified concrete paving lane width, at adequate forward speed, without transverse, longitudinal or vertical instability or without displacement. Slip-form pavers shall be equipped with electronic or hydraulic horizontal and vertical control devises. Bridge deck pavers are approved as paver-finishing machines for lean concrete, provided they are capable of handling the amount of lean concrete required for the full-lane width specified, and capable of spreading, consolidating, and finishing the lean concrete material, true to grade, tolerances, and cross-sections.

4.4 VIBRATORS

For fixed-form construction, vibrators may be either the surface pan type or internal type with either immersed tube or multiple spuds for the full width of the slab. They may be attached to the spreader, the finishing machine, or mounted on a separate carriage. They shall not come in contact with the subgrade or forms.

For slip-form construction, the paver shall be accomplished by internal vibrators for the full width and depth of the pavement being placed. The number, spacing, frequency, and eccentric weights of vibrators shall be provided to achieve acceptable consolidation without segregation and finishing quality. Internal vibrators may be supplemented by vibrating screeds operating on the surface of the lean concrete. Vibrators and screeds

shall automatically stop operation when forward motion ceases. An override switch shall be provided.

Hand held vibrators may be used in irregular areas.

4.5 JOINT SAWS

The Contractor shall provide a sufficient number of saws with adequate power to cut contraction or construction joints to the required dimensions as shown on the plans. The Contractor shall provide at least one standby saw in good working order.

PART 5 - CONSTRUCTION METHODS

5.1 CONTROL STRIP

The first half-day of construction shall be considered the control strip. The Contractor shall demonstrate, in the presence of the ~~RPR~~ ***OAR***, that the materials, equipment, and construction processes meet the requirements of the specification. Control strips that do not meet specification requirements shall be removed and replaced at the Contractor's expense. Full operations shall not continue until the control strip has been accepted by the ~~RPR~~ ***OAR***. Upon acceptance of the control strip by the ~~RPR~~ ***OAR***, the Contractor shall use the same equipment, materials, and construction methods for the remainder of construction, unless adjustments made by the Contractor are approved in advance by the ~~RPR~~, ***OAR***.

5.2 WEATHER LIMITATIONS

The Contractor shall follow the recommended practices in American Concrete Institute (ACI) 306R, Guide to Cold Weather Concreting. The temperature of the mixed lean concrete shall not be less than 50°F (10°C) at the time of placement. The lean concrete shall not be placed when the ambient temperature is below 40°F (4°C) or when conditions indicate that the temperature may fall below 35°F (2°C) within 24 hours. The lean concrete shall not be placed on frozen underlying courses.

The Contractor shall follow the recommended practices in ACI 305R, Guide to Hot Weather Concreting. The lean concrete temperature from initial mixing through final cure shall not exceed 90°F (32°C). When the maximum daily air temperature exceeds 85°F (30°C), the forms and/or the underlying material shall be sprinkled with water before placing the lean concrete.

The Contractor should stop operations prior to and during rain allowing time to cover and protect any plastic lean concrete. Areas damaged by rain shall be refinished or replaced at the Contractor's expense.

5.3 MAINTENANCE

The Contractor shall protect the lean concrete from environmental or mechanical damage. Traffic shall not be allowed on the pavement until test specimens made per ASTM C31 have attained a compressive strength of 500 psi (3445 kPa) when tested per ASTM C39. The Contractor shall maintain continuity of the applied curing method for the entire curing period.

5.4 FORM SETTING

Form sections shall be tightly locked and shall be free from play or movement in any direction. The forms shall not deviate from true line by more than 1/4 inch (6 mm) at any joint. The top face of the form shall not vary from a true plane more than 1/8 inch (3 mm) in 10 feet (3 m), and the upstanding leg shall not vary more than 1/4 inch (6 mm). Forms shall be cleaned and oiled prior to the placing of lean concrete.

5.5 PREPARATION OF UNDERLYING COURSE

The underlying course shall be checked and accepted by the ~~RPR~~ ***OAR*** before placing operations begin. Prior to placing the material, the final grade should be firm, moist and free of frost. Use of chemicals to eliminate frost will not be permitted. The underlying course shall be wetted in advance of placing the lean concrete base course.

5.6 GRADE CONTROL

Grade control shall be as necessary to construct the layer to the profile and cross-sections as shown on the plans.

5.7 MIXING

The batch plant site, layout, equipment, and provisions for transporting material shall assure a continuous supply of material to the work. Stockpiles shall be constructed in a manner that prevents segregation and intermixing of deleterious materials.

All lean concrete shall be mixed and delivered to the site per the requirements of ASTM C94. The mixing time should be adequate to produce lean concrete that is uniform in appearance, with all ingredients evenly distributed. Mixing time shall be measured from the time all materials are emptied into the drum (provided all the water is added before one-fourth the preset mixing time has elapsed) and continues until the time the discharge chute is opened to deliver the lean concrete.

If mixing in a batch plant, the mixing time shall not be less than 50 or greater than 90 seconds. If mixing in a truck mixer, the mixing time shall not be less than 70 or more than 125 truck-drum revolutions at a mixing speed of not less than six (6) or more than 18 truck-drum revolutions per minute.

The elapsed time from the addition of cementitious material to the mix until the lean concrete is deposited in place at the work site shall not exceed 45 minutes when the concrete is hauled in non-agitating trucks, or 90 minutes when it is hauled in truck mixers or truck agitators.

Re-tempering lean concrete will not be permitted, except when delivered in truck mixers. With truck mixers, additional water may be added to the batch materials if the addition of water is added within 45 minutes after the initial mixing operations and the water/cement ratio specified in the mix design is not exceeded.

5.8 PLACING

The lean concrete material shall be placed continuously at a uniform rate on the underlying course minimizing segregation and handling of the mix. Rakes shall not be allowed for spreading the lean concrete.

5.9 FINISHING

Shape the finished surface of the lean concrete base layer to the specified lines, grades, and cross-section. Hand finishing will not be permitted except in areas where the mechanical finisher cannot operate.

The surface of the lean concrete shall not be textured.

5.10 CONSTRUCTION LIMITATIONS

All placement and finishing operations shall be completed within two (2) hours from the start of mixing. Material not completed within the 2-hour time limit shall be removed and replaced at the Contractor’s expense.

At the end of each day’s construction and/or when operations are interrupted for more than 30 minutes, a straight transverse construction joint shall be formed by a header or by cutting back into the compacted material to form a true vertical face.

Completed portions may be opened to light traffic when it has achieved its 7-day strength and the curing is not damaged.

5.11 JOINTS

Locate all longitudinal and transverse construction joints as shown on the plans. Longitudinal joints shall be within 6 inches (150 mm) of planned joints in the overlaying concrete pavement and transverse joints shall be within 3 inches (75 mm) the planned joints of the overlying concrete surface. Joints shall be sawn as soon as the base can support the saws without damage to the lean concrete base. Joints shall be constructed by sawing the hardened lean concrete to a depth of at least one-third the thickness of the

lean concrete base, or 1/5th the depth of the lean concrete base when constructed using early entry saws.

5.12 CURING

Immediately after the finishing operations are complete and within two (2) hours of placement of the lean concrete, the entire surface and edges of the newly placed lean concrete shall be sprayed uniformly with [white pigmented, liquid membrane forming curing compound conforming to ASTM C309, Type 2, Class B or clear or translucent Type 1-D, Class B with white fugitive dye] in accordance with paragraph 2.7. The layer should be kept moist using a moisture-retaining cover or a light application of water until the curing material is applied. The curing compound shall not be applied during rainfall.

The curing material shall be applied at a maximum coverage of 200 square feet per gallon (5.0 m^2/l) using pressurized mechanical sprayers. The spraying equipment shall be a fully atomizing type equipped with a tank agitator. At the time of use, the curing compound in the tank shall be thoroughly and uniformly mixed with the pigment. During application, the curing compound shall be continuously stirred by mechanical means. Edges of the lean concrete layer shall be sprayed with curing compound immediately following placement with slip-form pavers or when side-forms are removed. Hand spraying of odd widths or shapes and lean concrete surfaces exposed by the removal of forms is permitted.

The lean concrete temperature during curing shall be in accordance with paragraph 5.2.

If the curing material becomes damaged from any cause, including sawing operations, within the required 7-day curing period or until the overlying course is constructed, the Contractor shall immediately repair the damaged areas by application of additional curing compound or other means approved by the ~~RPR~~ ***OAR***.

5.13 SURFACE TOLERANCE

The Contractor shall perform smoothness and grade checks daily. Any area not meeting smoothness and grade shall be corrected by the Contractor at the Contractor's expense. The Contractor shall provide smoothness and grade data to the ~~RPR~~ ***OAR*** on a daily basis.

A. Smoothness. The finished surface shall not vary more than ±3/8-inch (9 mm) when tested with a 12-foot (3.7-m) straightedge applied parallel with and at right angles to the centerline, and. moved continuously forward at half the length of the 12-foot (3.7-m) straightedge for the full length of each line on a 50-foot (15-m) grid. The Contractor shall correct any high spots more than 3/8 inch (9 mm) in 12-foot (3.7-m) with a grinding machine or remove and replace the material at the Contractor's expense. Any areas that have been ground shall have curing compound reapplied.

B. Grade. The grade shall be measured on a 50-foot (15-m) grid and shall be within +/-0.05 feet (15 mm) of the specified grade. When the surface is more than 1/2 inch (12 mm) above the grade shown in the plans, the surface shall be corrected at the Contractor's expense to an elevation that falls within a tolerance of 1/4 inch (6 mm).

5.14 BOND-BREAKER

Choke stone per paragraph 2.8 shall be placed on the surface of the lean concrete to prevent bonding. The choke stone shall be placed in a layer approximately 1/4-inch (6 mm) thick. ***After application of the bond breaker, traffic will be limited to that required for placement of the PCC surface course.***

PART 6 - MATERIAL ACCEPTANCE

6.1 SAMPLING AND TESTING

Acceptance sampling and testing to determine conformance with the requirements specified in this section will be performed by the ~~RPR~~ ***OAR*** for each 1200 square yards (1000 square meters). Sampling locations will be determined by the ~~RPR~~ ***OAR*** on a random basis per ASTM D3665.

A. Compressive Strength. One sample of freshly delivered lean concrete will be taken for compressive strength for each 1200 square yards (1000 square meters) in accordance with ASTM C172 and air content tests in accordance with ASTM C231. Two test cylinders will be made and cured from the sample per ASTM C31 and the 7-day compressive strength of each cylinder determined per ASTM C39. The compressive strength will be computed by averaging the two 7-day compressive strengths.

The Contractor shall provide for the initial curing of cylinders in accordance with ASTM C31 during the 24 hours after molding.

B. Thickness. Cores shall be drilled by the Contractor at two different sampling locations for thickness determination for each 1200 square yards (1000 square meters). Thickness will be determined by measuring the depth of core holes and computed by averaging the thickness determination of the two locations.

Core holes shall be filled by the Contractor with lean concrete base or non-shrink grout.

Thickness will be determined by survey on a ~~25-foot by 25-foot grid~~ ***50-foot by 50-foot grid.***

6.2 ACCEPTANCE

A. Strength. If the lean concrete fails to meet the minimum compressive strength requirements, the Contractor shall remove and replaced the material at the Contractor’s expense.

B. Thickness. If the average thickness is not deficient by more than 1/2 inch (12 mm) from the plan thickness, full payment shall be made. When such measurement is deficient by more than 1/2 inch (12 mm) but less than one inch (25 mm) from the plan thickness, the area represented by the test shall be removed and replaced at the Contractor’s expense

or shall be permitted to remain in-place at an adjusted payment of 75% of the contract unit price.

PART 7 - METHOD OF MEASUREMENT

7.1 The quantity of lean concrete base course will be determined by the number of square yard ~~(m^2)~~ of lean concrete actually constructed and accepted by the ~~RPR~~, ***OAR*** as complying with the plans and specifications.

PART 8 - BASIS OF PAYMENT

8.1 The accepted quantities of lean concrete will be paid for at the contract unit price per square yard ~~(m^2)~~ for lean concrete base. The price and payment shall be full compensation for furnishing and placing all materials, provided; however, for any pavement found deficient in thickness as specified in paragraph 6.2b, the reduced unit price shall be paid.

Item P-306-8.1	6” Lean Concrete Base Course	- per Square Yard (SY)

PART 9 - REFERENCES

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

ASTM International (ASTM)

ASTM C31	Standard Practice for Making and Curing Concrete Test Specimens in the Field
ASTM C33	Standard Specification for Concrete Aggregates
ASTM C39	Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens
ASTM C94	Standard Specification for Ready-Mixed Concrete
ASTM C136	Standard Test Method for Sieve or Screen Analysis of Fine and Coarse Aggregates
ASTM C150	Standard Specification for Portland Cement
ASTM C172	Standard Practice for Sampling Freshly Mixed Concrete
ASTM C173	Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method

ASTM C174	Standard Test Method for Measuring Thickness of Concrete Elements Using Drilled Concrete Cores
ASTM C192	Standard Practice for Making and Curing Concrete Test Specimens in the Laboratory
ASTM C231	Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method
ASTM C260	Standard Specification for Air-Entraining Admixtures for Concrete
ASTM C1260	Standard Test Method for Potential Alkali Reactivity of Aggregates (Mortar-Bar Method)
ASTM C309	Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete
ASTM C494	Standard Specification for Chemical Admixtures for Concrete
ASTM C595	Standard Specification for Blended Hydraulic Cements
ASTM C618	Specification for Coal Fly Ash and Raw and Calcined Natural Pozzolans for Use in Concrete
ASTM C989	Standard Specification for Slag Cement for Use in Concrete and Mortars
ASTM C1567	Standard Test Method for Determining the Potential Alkali-Silica Reactivity of Combinations of Cementitious Materials and Aggregates (Accelerated Mortar-Bar Method)
ASTM C1602	Standard Specification for Mixing Water Used in the Production of Hydraulic Cement Concrete

American Association of State Highway and Transportation Officials (AASHTO)

AASHTO T136	Standard Method of Test for Freezing-and-Thawing Tests of Compacted Soil-Cement Mixtures
ASTM D3665	Standard Practice for Random Sampling of Construction Materials

American Concrete Institute (ACI)

ACI 305R	Guide to Hot Weather Concreting
ACI 306R	Guide to Cold Weather Concreting

END OF ITEM P-306

SECTION P-403 - ASPHALT MIX PAVEMENT SURFACE COURSE

PART 1 - DESCRIPTION

1.1 This item shall consist of pavement courses composed of mineral aggregate and asphalt binder mixed in a central mixing plant and placed on a prepared course in accordance with these specifications and shall conform to the lines, grades, thicknesses, and typical cross-sections shown on the plans. Each course shall be constructed to the depth, typical section, and elevation required by the plans and shall be rolled, finished, and approved before the placement of the next course.

PART 2 - MATERIALS

2.1 AGGREGATE

Aggregates shall consist of crushed stone, crushed gravel, crushed slag, screenings, natural sand and mineral filler, as required. The aggregates should have no known history of detrimental pavement staining due to ferrous sulfides, such as pyrite. Coarse aggregate is the material retained on the No. 4 (4.75 mm) sieve. Fine aggregate is the material passing the No. 4 (4.75 mm) sieve.

A. Coarse aggregate

Coarse aggregate shall consist of sound, tough, durable particles, free from films of matter that would prevent thorough coating and bonding with the asphalt material and free from organic matter and other deleterious substances. Coarse aggregate material requirements are given in the table below.

Coarse Aggregate Material Requirements

Material Test	Requirement	Standard
Resistance to Degradation	Loss: 40% maximum for surface, asphalt binder, and leveling course Loss: 50% maximum for base course	ASTM C131
Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate	Loss after 5 cycles: 12% maximum using Sodium sulfate - or - 18% maximum using magnesium sulfate	ASTM C88
Clay lumps and friable particles	1.0% maximum	ASTM C142
Percentage of Fractured Particles	For pavements designed for aircraft gross weights of 60,000 pounds (27200 kg) or more:	ASTM D5821

Material Test	Requirement	Standard
	Minimum 75% by weight of particles with at least two fractured faces and 85% with at least one fractured face[1]	
	For pavements designed for aircraft gross weights less than 60,000 pounds (27200 kg): Minimum 50% by weight of particles with at least two fractured faces and 65% with at least one fractured face[1]	
Flat, Elongated, or Flat and Elongated Particles	8% maximum, by weight, of flat, elongated, or flat and elongated particles with a value of 5:1 [2]	ASTM D4791
Bulk density of slag[3]	Weigh not less than 70 pounds per cubic foot (1.12 Mg/cubic meter)	ASTM C29.

[1] The area of each face shall be equal to at least 75% of the smallest mid-sectional area of the piece. When two fractured faces are contiguous, the angle between the planes of fractures shall be at least 30 degrees to count as two fractured faces.

[2] A flat particle is one having a ratio of width to thickness greater than five (5); an elongated particle is one having a ratio of length to width greater than five (5).

[3] Only required if slag is specified.

B. Fine aggregate

Fine aggregate shall consist of clean, sound, tough, durable, angular shaped particles produced by crushing stone, slag, or gravel and shall be free from coatings of clay, silt, or other objectionable matter. Natural (non-manufactured) sand may be used to obtain the gradation of the aggregate blend or to improve the workability of the mix. Fine aggregate material requirements are listed in the table below.

Fine Aggregate Material Requirements

Material Test	Requirement	Standard
Liquid limit	25 maximum	ASTM D4318
Plasticity Index	4 maximum	ASTM D4318
Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate	Loss after 5 cycles: 10% maximum using Sodium sulfate - or - 15% maximum using magnesium sulfate	ASTM C88
Clay lumps and friable particles	1.0% maximum	ASTM C142
Sand equivalent	45 minimum	ASTM D2419
Natural Sand	15% maximum by weight of total aggregate	ASTM D1073

C. Sampling

ASTM D75 shall be used in sampling coarse and fine aggregate, and ASTM C183 shall be used in sampling mineral filler.

2.2 MINERAL FILLER

Mineral filler (baghouse fines) may be added in addition to material naturally present in the aggregate. Mineral filler shall meet the requirements of ASTM D242.

Mineral Filler Requirements

Material Test	Requirement	Standard
Plasticity Index	4 maximum	ASTM D4318

2.3 ASPHALT BINDER

Asphalt binder shall conform to ASTM D6373 Performance Grade (PG) 76-22.

Asphalt Binder PG Plus Test Requirements

Material Test	Requirement	Standard
Elastic Recovery	75% minimum	ASTM D6084[1]

[1]Follow procedure B on RTFO aged binder.

2.4 ANTI-STRIPPING AGENT

Any anti-stripping agent or additive (anti-strip) shall be heat stable and shall not change the asphalt binder grade beyond specifications. Anti-strip shall be an approved material of the Department of Transportation of the State in which the project is located.

2.5 BOND BREAKER

Choke stone shall be an ASTM C33 Number 89 stone.

PART 3 - COMPOSITION

3.1 COMPOSITION OF MIXTURE

The asphalt plant mix shall be composed of a mixture of well-graded aggregate, filler and anti-strip agent if required, and asphalt binder. The several aggregate fractions shall be

sized, handled in separate size groups, and combined in such proportions that the resulting mixture meets the grading requirements of the job mix formula (JMF).

3.2 JOB MIX FORMULA (JMF) LABORATORY

The laboratory used to develop the JMF shall possess a current certificate of accreditation, listing D3666 from a national accrediting authority and all test methods required for developing the JMF, and listed on the accrediting authority's website. A copy of the laboratory's current accreditation and accredited test methods shall be submitted to the ~~RPR~~ ***OAR*** prior to start of construction.

3.3 JOB MIX FORMULA (JMF)

No asphalt mixture shall be placed until an acceptable mix design has been submitted to the ~~RPR~~ ***OAR*** for review and accepted in writing. The ~~RPR's~~ ***OAR's*** review shall not relieve the Contractor of the responsibility to select and proportion the materials to comply with this section.

When the project requires asphalt mixtures of differing aggregate gradations and/or binders, a separate JMF shall be submitted for each mix. Add anti-stripping agent to meet tensile strength requirements.

The JMF shall be prepared by an accredited laboratory that meets the requirements of paragraph 3.2. The asphalt mixture shall be designed using procedures contained in Asphalt Institute MS-2 Mix Design Manual, 7th Edition. Samples shall be prepared and compacted using the gyratory compactor in accordance with ASTM D6925.

Should a change in sources of materials be made, a new JMF must be submitted to the ~~RPR~~ ***OAR*** for review and accepted in writing before the new material is used. After the initial production JMF has been approved by the ~~RPR~~ ***OAR*** and a new or modified JMF is required for whatever reason, the subsequent cost of the new or modified JMF, including a new control strip when required by the ~~RPR~~ ***OAR***, will be borne by the Contractor.

The ~~RPR~~ ***OAR*** may request samples at any time for testing, prior to and during production, to verify the quality of the materials and to ensure conformance with the applicable specifications.

The JMF shall be submitted in writing by the Contractor at least 30 days prior to the start of paving operations. The JMF shall be developed within the same construction season using aggregates proposed for project use.

The submitted JMF shall be dated, and stamped or sealed by the responsible professional Engineer of the laboratory and shall include the following items as a minimum:

- Manufacturer's Certificate of Analysis (COA) for the asphalt binder used in the JMF in accordance with paragraph 2.3. Certificate of asphalt performance grade is with modifier already added, if used and must indicate compliance with ASTM D6373. For plant modified asphalt binder, certified test report indicating grade certification of modified asphalt binder.

- Manufacturer's Certificate of Analysis (COA) for the anti-stripping agent if used in the JMF in accordance with paragraph 2.4.

- Certified material test reports for the course and fine aggregate and mineral filler in accordance with paragraphs 2.1 and 2.2.

- Percent passing each sieve size for individual gradation of each aggregate cold feed and/or hot bin; percent by weight of each cold feed and/or hot bin used; and the total combined gradation in the JMF.

- Specific Gravity and absorption of each course and fine aggregate.

- Percent natural sand.

- Percent fractured faces.

- Percent by weight of flat particles, elongated particles, and flat and elongated particles (and criteria).

- Percent of asphalt.

- Number of blows or gyrations.

- Laboratory mixing and compaction temperatures.

- Supplier recommended mixing and compaction temperatures.

- Plot of the combined gradation on the 0.45 power gradation curve.

- Graphical plots of air voids, voids in the mineral aggregate (VMA), and unit weight versus asphalt content. To achieve minimum VMA during production, the mix design needs to account for material breakdown during production.

- Tensile Strength Ratio (TSR).

- Type and amount of Anti-strip agent when used.

- Asphalt Pavement Analyzer (APA) results.

- Date the JMF was developed. Mix designs that are not dated or which are from a prior construction season shall not be accepted.

Table 1. Asphalt Design Criteria

Test Property	Value	Test Method
Number of blows/gyrations	75	
Air voids (%)	3.5	ASTM D3203
Percent voids in mineral aggregate (VMA), minimum	See Table 2	ASTM D6995
TSR[1]	not less than 80 at a saturation of 70-80%	ASTM D4867
Asphalt Pavement Analyzer (APA)[2,3]	Less than 10 mm @ 4000 passes	AASHTO T340 at 250 psi hose pressure at 64°C test temperature

[1] Test specimens for TSR shall be compacted at 7 ± 1.0 % air voids. In areas subject to freeze-thaw, use freeze-thaw conditioning in lieu of moisture conditioning per ASTM D4867.

[2] AASHTO T340 at 100 psi hose pressure at 64°C test temperature may be used in the interim. If this method is used, the required Value shall be less than 5 mm @ 8000 passes.

[3] Where APA not available, use Hamburg wheel test (AASHTO T 324) 10 mm @ 20,000 passes at 50ºC.

The mineral aggregate shall be of such size that the percentage composition by weight, as determined by laboratory sieves, will conform to the gradation or gradations specified in Table 2 when tested in accordance with ASTM C136 and ASTM C117.

The gradations in Table 2 represent the limits that shall determine the suitability of aggregate for use from the sources of supply, be well graded from coarse to fine and shall not vary from the low limit on one sieve to the high limit on the adjacent sieve, or vice versa.

Table 2. Aggregate - Asphalt Pavements

Sieve Size	Percentage by Weight Passing Sieve
1 inch (25.0 mm)	--
3/4 inch (19.0 mm)	100
1/2 inch (12.5 mm)	90-100
3/8 inch (9.5 mm)	72-88
No. 4 (4.75 mm)	53-73
No. 8 (2.36 mm)	38-60
No. 16 (1.18 mm)	26-48
No. 30 (600 µm)	18-38
No. 50 (300 µm)	11-27

Sieve Size	Percentage by Weight Passing Sieve
No. 100 (150 µm)	6-18
No. 200 (75 µm)	3-6
Voids in Mineral Aggregate (VMA)[1]	15
Asphalt Percent:	
Stone or gravel	5.0-7.5
Slag	6.5-9.5
Recommended Minimum Construction Lift Thickness	2 inch

[1] To achieve minimum VMA during production, the mix design needs to account for material breakdown during production.

The aggregate gradations shown are based on aggregates of uniform specific gravity. The percentages passing the various sieves shall be corrected when aggregates of varying specific gravities are used, as indicated in the Asphalt Institute MS-2 Mix Design Manual, 7th Edition.

3.4 RECLAIMED ASPHALT PAVEMENT (RAP)

RAP shall not be used.

3.5 CONTROL STRIP

Full production shall not begin until an acceptable control strip has been constructed and accepted in writing by the ~~RPR~~ ***OAR***. The Contractor shall prepare and place a quantity of asphalt according to the JMF. The underlying grade or pavement structure upon which the control strip is to be constructed shall be the same as the remainder of the course represented by the control strip.

The Contractor will not be allowed to place the control strip until the Contractor quality control program (CQCP), showing conformance with the requirements of paragraph 5.1, has been accepted, in writing, by the ~~RPR~~ ***OAR***.

The control strip will consist of at least 250 tons (227 metric tons) or 1/2 sublot, whichever is greater. The control strip shall be placed in two lanes of the same width and depth to be used in production with a longitudinal cold joint. The cold joint must be cut back in accordance with paragraph 4.13 using the same procedure that will be used during production. The cold joint for the control strip will be an exposed construction joint at least four (4) hours old or when the mat has cooled to less than 160°F (71°C). The equipment used in construction of the control strip shall be the same type, configuration and weight to be used on the project.

The control strip shall be evaluated for acceptance as a single lot in accordance with the acceptance criteria in paragraph 6.1 and 6.2. The control strip shall be divided into equal sublots. As a minimum, the control strip shall consist of three (3) sublots.

The control strip will be considered acceptable by the ~~RPR~~ ***OAR*** if the gradation, asphalt content, and VMA are within the action limits specified in paragraph 5.5a; and Mat density, air voids, and joint density meet the requirements specified in paragraphs 6.2, and Mat density greater than or equal to 94%, air voids 3.5% ± 1%, and joint density greater than or equal to 92%.

If the control strip is unacceptable, necessary adjustments to the JMF, plant operation, placing procedures, and/or rolling procedures shall be made and another control strip shall be placed. Unacceptable control strips shall be removed at the Contractor's expense.

The control strip will be considered one lot for payment based upon the average of a minimum of 3 samples (no sublots required for control strip). Payment will only be made for an acceptable control strip in accordance with paragraph 8.1.

PART 4 - CONSTRUCTION METHODS

4.1 WEATHER LIMITATIONS

The asphalt shall not be placed upon a wet surface or when the surface temperature of the underlying course is less than specified in Table 4. The temperature requirements may be waived by the ~~RPR~~ ***OAR***, if requested; however, all other requirements including compaction shall be met.

Table 4. Surface Temperature Limitations of Underlying Course

Mat Thickness	Base Temperature (Minimum)	
	Degrees F	Degrees C
3 inches (7.5 cm) or greater	40	4
Greater than 2 inches (50 mm) but less than 3 inches (7.5 cm)	45	7

4.2 ASPHALT PLANT

Plants used for the preparation of asphalt shall conform to the requirements of American Association of State Highway and Transportation Officials (AASHTO) M156 including the following items:

A. Inspection of plant

The ~~RPR~~ ***OAR***, or ~~RPR's~~ ***OAR's*** authorized representative, shall have access, at all times, to all areas of the plant for checking adequacy of equipment; inspecting operation of the plant: verifying weights, proportions, and material properties; and checking the temperatures maintained in the preparation of the mixtures.

B. Storage bins and surge bins

The asphalt mixture stored in storage and/or surge bins shall meet the same requirements as asphalt mixture loaded directly into trucks. Asphalt mixture shall not be stored in storage and/or surge bins for a period greater than twelve (12) hours. If the ~~RPR~~ ***OAR*** determines there is an excessive heat loss, segregation or oxidation of the asphalt mixture due to temporary storage, temporary storage shall not be allowed.

4.3 AGGREGATE STOCKPILE MANAGEMENT

Aggregate stockpiles shall be constructed in such a manner that prevents segregation and intermixing of deleterious materials. Aggregates from different sources shall be stockpiled, weighed and batched separately at the concrete batch plant. Aggregates that have become segregated or mixed with earth or foreign material shall not be used.

A continuous supply of materials shall be provided to the work to ensure continuous placement.

4.4 HAULING EQUIPMENT

Trucks used for hauling asphalt shall have tight, clean, and smooth metal beds. To prevent the asphalt from sticking to the truck beds, the truck beds shall be lightly coated with a minimum amount of paraffin oil, lime solution, or other material approved by the ~~RPR~~ ***OAR***. Petroleum products shall not be used for coating truck beds. Each truck shall have a suitable cover to protect the mixture from adverse weather. When necessary, to ensure that the mixture will be delivered to the site at the specified temperature, truck beds shall be insulated or heated and covers shall be securely fastened.

4.4.1 Material transfer vehicle (MTV)

Material transfer Vehicles shall be required due to the improvement in smoothness and decrease in both physical and thermal segregation. To transfer the material from the hauling equipment to the paver, use a self-propelled, material transfer vehicle with a swing conveyor that can deliver material to the paver without making contact with the paver. The MTV shall be able to move back and forth between the hauling equipment and the paver providing material transfer to the paver, while allowing the paver to operate at a constant speed. The Material Transfer Vehicle will have remixing and storage capability to prevent physical and thermal segregation.

4.5 ASPHALT PAVERS

Asphalt pavers shall be self-propelled with an activated heated screed, capable of spreading and finishing courses of asphalt that will meet the specified thickness, smoothness, and grade. The paver shall have sufficient power to propel itself and the hauling equipment without adversely affecting the finished surface. The asphalt paver shall be equipped with a control system capable of automatically maintaining the specified screed grade and elevation.

If the spreading and finishing equipment in use leaves tracks or indented areas, or produces other blemishes in the pavement that are not satisfactorily corrected by the scheduled operations, the use of such equipment shall be discontinued.

The paver shall be capable of paving to a minimum width specified in paragraph 401-4.11.

4.6 ROLLERS

The number, type, and weight of rollers shall be sufficient to compact the asphalt to the required density while it is still in a workable condition without crushing of the aggregate, depressions or other damage to the pavement surface. Rollers shall be in good condition, capable of operating at slow speeds to avoid displacement of the asphalt. All rollers shall be specifically designed and suitable for compacting asphalt concrete and shall be properly used. Rollers that impair the stability of any layer of a pavement structure or underlying soils shall not be used.

4.6.1 Density device

The Contractor shall have on site a density gauge during all paving operations in order to assist in the determination of the optimum rolling pattern, type of roller and frequencies, as well as to monitor the effect of the rolling operations during production paving. The Contractor shall also supply a qualified technician during all paving operations to calibrate the density gauge and obtain accurate density readings for all new asphalt. These densities shall be supplied to the ~~RPR~~ ***OAR*** upon request at any time during construction. No separate payment will be made for supplying the density gauge and technician.

4.7 PREPARATION OF ASPHALT BINDER

The asphalt binder shall be heated in a manner that will avoid local overheating and provide a continuous supply of the asphalt material to the mixer at a uniform temperature. The temperature of the unmodified asphalt binder delivered to the mixer shall be sufficient to provide a suitable viscosity for adequate coating of the aggregate particles, but shall not exceed 325°F (160°C) when added to the aggregate. The temperature of modified asphalt binder shall be no more than 350°F (175°C) when added to the aggregate.

4.8 PREPARATION OF MINERAL AGGREGATE

The aggregate for the asphalt shall be heated and dried. The maximum temperature and rate of heating shall be such that no damage occurs to the aggregates. The temperature of the aggregate and mineral filler shall not exceed 350°F (175°C) when the asphalt binder is added. Particular care shall be taken that aggregates high in calcium or magnesium content are not damaged by overheating. The temperature shall not be lower than is required to obtain complete coating and uniform distribution on the aggregate particles and to provide a mixture of satisfactory workability.

4.9 PREPARATION OF ASPHALT MIXTURE

The aggregates and the asphalt binder shall be weighed or metered and introduced into the mixer in the amount specified by the JMF. The combined materials shall be mixed until the aggregate obtains a uniform coating of asphalt binder and is thoroughly distributed throughout the mixture. Wet mixing time shall be the shortest time that will produce a satisfactory mixture, but not less than 25 seconds for batch plants. The wet mixing time for all plants shall be established by the Contractor, based on the procedure for determining the percentage of coated particles described in ASTM D2489, for each individual plant and for each type of aggregate used. The wet mixing time will be set to achieve 95% of coated particles. For continuous mix plants, the minimum mixing time shall be determined by dividing the weight of its contents at operating level by the weight of the mixture delivered per second by the mixer. The moisture content of all asphalt upon discharge shall not exceed 0.5%.

4.10 APPLICATION OF PRIME AND TACK COAT

Immediately before placing the asphalt mixture, the underlying course shall be cleaned of all dust and debris.

A prime coat in accordance with Item P-602 shall be applied to aggregate base prior to placing the asphalt mixture.

A tack coat shall be applied in accordance with Item P-603 to all vertical and horizontal asphalt and concrete surfaces prior to placement of the first and each subsequent lift of asphalt mixture.

4.11 LAYDOWN PLAN, TRANSPORTING, PLACING, AND FINISHING

Prior to the placement of the asphalt, the Contractor shall prepare a laydown plan with the sequence of paving lanes and width to minimize the number of cold joints; the location of any temporary ramps; laydown temperature; and estimated time of completion for each portion of the work (milling, paving, rolling, cooling, etc.). The laydown plan and any modifications shall be approved by the ~~RPR~~ ***OAR***.

Deliveries shall be scheduled so that placing and compacting of asphalt is uniform with minimum stopping and starting of the paver. Hauling over freshly placed material shall not be permitted until the material has been compacted, as specified, and allowed to cool to approximately ambient temperature. The Contractor, at their expense, shall be responsible for repair of any damage to the pavement caused by hauling operations.

Contractor shall survey each lift of asphalt surface course and certify to ~~RPR~~ ***OAR*** that every lot of each lift meets the grade tolerances of paragraph 401-6.2e before the next lift can be placed.

Edges of existing asphalt pavement abutting the new work shall be saw cut and the cut off material and laitance removed. Apply a tack coat in accordance with P-603 before new asphalt material is placed against it.

The speed of the paver shall be regulated to eliminate pulling and tearing of the asphalt mat. Placement of the asphalt mix shall begin along the centerline of a crowned section or on the high side of areas with a one way slope unless shown otherwise on the laydown plan as accepted by the ~~RPR~~ ***OAR***. The asphalt mix shall be placed in consecutive adjacent lanes having a minimum width of 15 feet (m) except where edge lanes require less width to complete the area. Additional screed sections attached to widen the paver to meet the minimum lane width requirements must include additional auger sections to move the asphalt mixture uniformly along the screed extension.

The longitudinal joint in one course shall offset the longitudinal joint in the course immediately below by at least 1 foot (30 cm); however, the joint in the surface top course shall be at the centerline of crowned pavements. Transverse joints in one course shall be offset by at least 10 feet (3 m) from transverse joints in the previous course. Transverse joints in adjacent lanes shall be offset a minimum of 10 feet (3 m).On areas where irregularities or unavoidable obstacles make the use of mechanical spreading and finishing equipment impractical, the asphalt may be spread and luted by hand tools.

The ~~RPR~~ ***OAR*** may at any time, reject any batch of asphalt, on the truck or placed in the mat, which is rendered unfit for use due to contamination, segregation, incomplete coating of aggregate, or overheated asphalt mixture. Such rejection may be based on only visual inspection or temperature measurements. In the event of such rejection, the Contractor may take a representative sample of the rejected material in the presence of the ~~RPR~~ ***OAR***, and if it can be demonstrated in the laboratory, in the presence of the ~~RPR~~ ***OAR***, that such material was erroneously rejected, payment will be made for the material at the contract unit price.

Areas of segregation in the surface course, as determined by the ~~RPR~~ ***OAR***, shall be removed and replaced at the Contractor's expense. The area shall be removed by saw cutting and milling a minimum of the construction lift thickness as specified in paragraph 401-3.3, Table 2 for the approved mix design. The area to be removed and replaced shall be a minimum width of the paver and a minimum of 10 feet (3 m) long.

4.12 COMPACTION OF ASPHALT MIXTURE

After placing, the asphalt mixture shall be thoroughly and uniformly compacted by self-propelled rollers. The surface shall be compacted as soon as possible when the asphalt has attained sufficient stability so that the rolling does not cause undue displacement, cracking or shoving. The sequence of rolling operations and the type of rollers used shall be at the discretion of the Contractor. The speed of the roller shall, at all times, be sufficiently slow to avoid displacement of the hot mixture and be effective in compaction. Any surface defects and/or displacement occurring as a result of the roller, or from any other cause, shall be corrected at the Contractor's expense.

Sufficient rollers shall be furnished to handle the output of the plant. Rolling shall continue until the surface is of uniform texture, true to grade and cross-section, and the required field density is obtained. To prevent adhesion of the asphalt to the roller, the wheels shall be equipped with a scraper and kept moistened with water as necessary.

In areas not accessible to the roller, the mixture shall be thoroughly compacted with approved power tampers.

Any asphalt that becomes loose and broken, mixed with dirt, contains check-cracking, or in any way defective shall be removed and replaced with fresh hot mixture and immediately compacted to conform to the surrounding area. This work shall be done at the Contractor's expense. Skin patching shall not be allowed.

4.13 JOINTS

The formation of all joints shall be made in such a manner as to ensure a continuous bond between the courses and obtain the required density. All joints shall have the same texture as other sections of the course and meet the requirements for smoothness and grade.

The roller shall not pass over the unprotected end of the freshly laid asphalt except when necessary to form a transverse joint. When necessary to form a transverse joint, it shall be made by means of placing a bulkhead or by tapering the course. The tapered edge shall be cut back to its full depth and width on a straight line to expose a vertical face prior to placing the adjacent lane. In both methods, all contact surfaces shall be coated with an asphalt tack coat before placing any fresh asphalt against the joint.

Longitudinal joints which are have been left exposed for more than four (4) hours; the surface temperature has cooled to less than 175°F (80°C); or are irregular, damaged, uncompacted or otherwise defective shall be cut back with a cutting wheel or pavement saw a maximum of 3 inches (75 mm) to expose a clean, sound, uniform vertical surface for the full depth of the course. All cutback material and any laitance produced from cutting joints shall be removed from the project. An asphalt tack coat or other product approved by the ~~RPR~~ ***OAR*** shall be applied to the clean, dry joint prior to placing any additional fresh asphalt against the joint. The cost of this work shall be considered incidental to the cost of the asphalt.

4.14 SAW-CUT GROOVING

Saw-cut grooving is not required.

4.15 DIAMOND GRINDING

Diamond grinding shall be completed prior to pavement grooving. Diamond grinding shall be accomplished by sawing with saw blades impregnated with industrial diamond abrasive.

Diamond grinding shall be performed with a machine designed specifically for diamond grinding capable of cutting a path at least 3 feet (0.9 m) wide. The saw blades shall be 1/8-inch (3-mm) wide with a minimum of 55 to 60 blades per 12 inches (300 mm) of cutting head width; grooves between 0.090 and 0.130 inches (2 and 3.5 mm) wide; and peaks and ridges approximately 1/32 inch (1 mm) higher than the bottom of the grinding cut. The actual number of blades will be determined by the Contractor and depend on the hardness of the aggregate. Equipment or grinding procedures that causes ravels, aggregate fractures, spalls or disturbance to the pavement will not be permitted.

Grinding will be tapered in all directions to provide smooth transitions to areas not requiring grinding. The slurry resulting from the grinding operation shall be continuously removed and the pavement left in a clean condition. The Contractor shall apply a surface treatment per P-608 to all areas that have been subject to grinding.

4.16 NIGHTTIME PAVING REQUIREMENTS

The Contractor shall provide adequate lighting during any nighttime construction. A lighting plan shall be submitted by the Contractor and approved by the ~~RPR~~ ***OAR*** prior to the start of any nighttime work. All work shall be in accordance with the approved CSPP and lighting plan.

PART 5 - CONTRACTOR QUALITY CONTROL (CQC)

5.1 GENERAL

The Contractor shall develop a CQCP in accordance with Item C-100. No partial payment will be made for materials that are subject to specific QC requirements without an approved CQCP.

5.2 CONTRACTOR QUALITY CONTROL (QC) FACILITIES

The Contractor shall provide or contract for testing facilities in accordance with Item C-100. The ~~RPR~~ ***OAR*** shall be permitted unrestricted access to inspect the Contractor's QC facilities and witness QC activities. The ~~RPR~~ ***OAR*** will advise the Contractor in writing of any noted deficiencies concerning the QC facility, equipment, supplies, or testing personnel and procedures. When the deficiencies are serious enough to be adversely

affecting the test results, the incorporation of the materials into the work shall be suspended immediately and will not be permitted to resume until the deficiencies are satisfactorily corrected.

5.3 QUALITY CONTROL (QC) TESTING

The Contractor shall perform all QC tests necessary to control the production and construction processes applicable to these specifications and as set forth in the approved CQCP. The testing program shall include, but not necessarily be limited to, tests for the control of asphalt content, aggregate gradation, temperatures, aggregate moisture, field compaction, and surface smoothness. A QC Testing Plan shall be developed as part of the CQCP.

A. Asphalt content

A minimum of two tests shall be performed per day in accordance with ASTM D6307 or ASTM D2172 for determination of asphalt content. When using ASTM D6307, the correction factor shall be determined as part of the first test performed at the beginning of plant production; and as part of every tenth test performed thereafter. The asphalt content for the day will be determined by averaging the test results.

B. Gradation

Aggregate gradations shall be determined a minimum of twice per lot from mechanical analysis of extracted aggregate in accordance with ASTM D5444 and ASTM C136, and ASTM C117.

C. Moisture content of aggregate

The moisture content of aggregate used for production shall be determined a minimum of once per lot in accordance with ASTM C566.

D. Moisture content of asphalt

The moisture content of the asphalt shall be determined once per lot in accordance with AASHTO T329 or ASTM D1461.

E. Temperatures

Temperatures shall be checked, at least four times per lot, at necessary locations to determine the temperatures of the dryer, the asphalt binder in the storage tank, the asphalt at the plant, and the asphalt at the job site.

F. In-place density monitoring

The Contractor shall conduct any necessary testing to ensure that the specified density is being achieved. A nuclear gauge may be used to monitor the pavement density in accordance with ASTM D2950.

G. Smoothness for Contractor Quality Control

The Contractor shall perform smoothness testing in transverse and longitudinal directions daily to verify that the construction processes are producing pavement with variances less than ¼ inch in 12 feet, identifying areas that may pond water which could lead to hydroplaning of aircraft. If the smoothness criteria is not met, appropriate changes and corrections to the construction process shall be made by the Contractor before construction continues

The Contractor may use a 12-foot (3.7 m) straightedge, a rolling inclinometer meeting the requirements of ASTM E2133 or rolling external reference device that can simulate a 12-foot (3.7m) straightedge approved by the ~~RPR~~ ***OAR***. Straight-edge testing shall start with one-half the length of the straightedge at the edge of pavement section being tested and then moved ahead one-half the length of the straightedge for each successive measurement. Testing shall be continuous across all joints. The surface irregularity shall be determined by placing the freestanding (unleveled) straightedge on the pavement surface and allowing it to rest upon the two highest spots covered by its length, and measuring the maximum gap between the straightedge and the pavement surface in the area between the two high points. If the rolling inclinometer or external reference device is used, the data may be evaluated using the FAA profile program, ProFAA, or FHWA ProVal, using the 12-foot straightedge simulation function.

Smoothness readings shall not be made across grade changes or cross slope transitions. The transition between new and existing pavement shall be evaluated separately for conformance with the plans.

(1) Transverse measurements. Transverse measurements shall be taken for each day's production placed. Transverse measurements will be taken perpendicular to the pavement centerline each 50 feet (15 m) or more often as determined by the ~~RPR~~ ***OAR***. The joint between lanes shall be tested separately to facilitate smoothness between lanes.

(2) Longitudinal measurements. Longitudinal measurements shall be taken for each day's production placed. Longitudinal tests will be parallel to the centerline of paving; at the center of paving lanes when widths of paving lanes are less than 20 feet (6 m); and at the third points of paving lanes when widths of paving lanes are 20 ft (6 m) or greater. When placement abuts previously placed material the first measurement shall start with one half the length of the straight edge on the previously placed material.

Deviations on the final surface course in either the transverse or longitudinal direction that will trap water greater than 1/4 inch (6 mm) shall be corrected with diamond grinding per paragraph 4.15 or by removing and replacing the surface course to full depth. Grinding shall be tapered in all directions to provide smooth transitions to areas not requiring grinding. All areas in which diamond grinding has been performed shall be subject to the final pavement thickness tolerances specified in paragraph 401-6.1d(3) Areas that have been ground shall be sealed with a surface treatment in accordance with Item P-608. To avoid the surface treatment creating any conflict with runway or taxiway markings, it may be necessary to seal a larger area.

Control charts shall be kept to show area of each day's placement and the percentage of corrective grinding required. Corrections to production and placement shall be initiated when corrective grinding is required. If the Contractor's machines and/or methods produce significant areas that need corrective actions in excess of 10 percent of a day's production, production shall be stopped until corrective measures are implemented by the Contractor.

H. Grade. Grade shall be evaluated daily to allow adjustments to paving operations when grade measurements do not meet specifications. As a minimum, grade shall be evaluated prior to the placement of the first lift and then prior to and after placement of the surface lift.

Measurements will be taken at appropriate gradelines (as a minimum at center and edges of paving lane) and longitudinal spacing as shown on cross-sections and plans. The final surface of the pavement will not vary from the gradeline elevations and cross-sections shown on the plans by more than 1/2 inch (12 mm) vertically and 0.1 feet (30 mm) laterally. The documentation will be provided by the Contractor to the ~~RPR~~ ***OAR*** within 24 hours.

Areas with humps or depressions that exceed grade or smoothness criteria and that retain water on the surface must be ground off provided the course thickness after grinding is not more than 1/2 inch (12 mm) less than the thickness specified on the plans. Grinding shall be in accordance with paragraph 4.15.

The Contractor shall repair low areas or areas that cannot be corrected by grinding by removal of deficient areas to the depth of the final course plus ½ inch and replacing with new material. Skin patching is not allowed.

5.4 SAMPLING

When directed by the ~~RPR~~ ***OAR***, the Contractor shall sample and test any material that appears inconsistent with similar material being sampled, unless such material is voluntarily removed and replaced or deficiencies corrected by the Contractor. All sampling shall be in accordance with standard procedures specified.

5.5 CONTROL CHARTS

The Contractor shall maintain linear control charts both for individual measurements and range (i.e., difference between highest and lowest measurements) for aggregate gradation, asphalt content, and VMA. The VMA for each day shall be calculated and monitored by the QC laboratory.

Control charts shall be posted in a location satisfactory to the ~~RPR~~ ***OAR*** and kept current. As a minimum, the control charts shall identify the project number, the contract item number, the test number, each test parameter, the Action and Suspension Limits applicable to each test parameter, and the Contractor's test results. The Contractor shall use the control charts as part of a process control system for identifying potential problems and assignable causes before they occur. If the Contractor's projected data during production indicates a problem and the Contractor is not taking satisfactory corrective action, the ~~RPR~~ ***OAR*** may suspend production or acceptance of the material.

A. Individual measurements

Control charts for individual measurements shall be established to maintain process control within tolerance for aggregate gradation, asphalt content, and VMA. The control charts shall use the JMF target values as indicators of central tendency for the following test parameters with associated Action and Suspension Limits:

Control Chart Limits for Individual Measurements

Sieve	Action Limit	Suspension Limit
3/4 inch (19.0 mm)	±6%	±9%
1/2 inch (12.5 mm)	±6%	±9%
3/8 inch (9.5 mm)	±6%	±9%
No. 4 (4.75 mm)	±6%	±9%
No. 16 (1.18 mm)	±5%	±7.5%
No. 50 (300 µm)	±3%	±4.5%
No. 200 (75 µm)	±2%	±3%
Asphalt Content	±0.45%	±0.70%
Minimum VMA	-0.5%	-1.0%

B. Range

Control charts for range shall be established to control process variability for the test parameters and Suspension Limits listed below. The range shall be computed for each lot as the difference between the two test results for each control parameter. The Suspension Limits specified below are based on a sample size of n = 2. Should the Contractor elect to perform more than two tests per lot, the Suspension Limits shall be adjusted by multiplying the Suspension Limit by 1.18 for n = 3 and by 1.27 for n = 4.

Control Chart Limits Based on Range
(n = 2)

Sieve	Suspension Limit
1/2 inch (12.5 mm)	11%
3/8 inch (9.5 mm)	11%
No. 4 (4.75 mm)	11%
No. 16 (1.18 mm)	9%
No. 50 (300 µm)	6%
No. 200 (75 µm)	3.5%
Asphalt Content	0.8%

C. Corrective action

The CQCP shall indicate that appropriate action shall be taken when the process is believed to be out of tolerance. The Plan shall contain sets of rules to gauge when a process is out of control and detail what action will be taken to bring the process into control. As a minimum, a process shall be deemed out of control and production stopped and corrective action taken, if:

(1) One point falls outside the Suspension Limit line for individual measurements or range;

or

(2) Two points in a row fall outside the Action Limit line for individual measurements.

5.6 QUALITY CONTROL (QC) REPORTS.

The Contractor shall maintain records and shall submit reports of QC activities daily, in accordance with the CQCP described in Item C-100.

PART 6 - MATERIAL ACCEPTANCE

6.1 QUALITY ASSURANCE ACCEPTANCE SAMPLING AND TESTING

Unless otherwise specified, all acceptance sampling and testing necessary to determine conformance with the requirements specified in this section will be performed by the ~~RPR~~ ***OAR*** at no cost to the Contractor except that coring as required in this section shall be completed and paid for by the Contractor.

A. Quality Assurance (QA) testing laboratory

The QA testing laboratory performing these acceptance tests will be accredited in accordance with ASTM D3666. The QA laboratory accreditation will be current and listed

on the accrediting authority's website. All test methods required for acceptance sampling and testing will be listed on the lab accreditation.

B. Lot Size

A standard lot will be equal to one day's production divided into approximately equal sublots of between 400 to 600 tons. When only one or two sublots are produced in a day's production, the sublots will be combined with the production lot from the previous or next day.

Where more than one plant is simultaneously producing asphalt for the job, the lot sizes will apply separately for each plant.

C. Asphalt air voids

Plant-produced asphalt will be tested for air voids on a sublot basis.

(1) Sampling. Material from each sublot shall be sampled in accordance with ASTM D3665. Samples shall be taken from material deposited into trucks at the plant or at the job site in accordance with ASTM D979. The sample of asphalt may be put in a covered metal tin and placed in an oven for not less than 30 minutes nor more than 60 minutes to maintain the material at or above the compaction temperature as specified in the JMF.

(2) Testing. Air voids will be determined for each sublot in accordance with ASTM D3203 for a set of three compacted specimens prepared in accordance with ASTM D6925.

D. In-place asphalt mat and joint density

Each sublot will be tested for in-place mat and joint density as a percentage of the theoretical maximum density (TMD).

(1) Sampling. The Contractor will cut minimum 5 inches (125 mm) diameter samples in accordance with ASTM D5361. The Contractor shall furnish all tools, labor, and materials for cleaning, and filling the cored pavement. Laitance produced by the coring operation shall be removed immediately after coring, and core holes shall be filled within one day after sampling in a manner acceptable to the ~~RPR~~ ***OAR***.

(2) Bond. Each lift of asphalt shall be bonded to the underlying layer. If cores reveal that the surface is not bonded, additional cores shall be taken as directed by the ~~RPR~~ ***OAR*** to determine the extent of unbonded areas. Unbonded areas shall be removed by milling and replaced at no additional cost as directed by the ~~RPR~~ ***OAR***.

(3) Thickness. Thickness of each lift of surface course will be evaluated by the ~~RPR~~ ***OAR*** for compliance to the requirements shown on the plans after any necessary corrections for grade. Measurements of thickness will be made using the cores extracted for each sublot for density measurement. The maximum allowable deficiency at any point will not be more than 1/4 inch (6 mm) less than the thickness indicated for the lift. Average thickness of lift, or combined lifts, will not be less than the indicated thickness. Where the thickness tolerances are not met, the lot or sublot shall be corrected by the

Contractor at his expense by removing the deficient area and replacing with new pavement. The Contractor, at his expense, may take additional cores as approved by the ~~RPR~~ ***OAR*** to circumscribe the deficient area.

(4) Mat density. One core shall be taken from each sublot. Core locations will be determined by the ~~RPR~~ ***OAR*** in accordance with ASTM D3665. Cores for mat density shall not be taken closer than one foot (30 cm) from a transverse or longitudinal joint. The bulk specific gravity of each cored sample will be determined in accordance with ASTM D2726. The percent compaction (density) of each sample will be determined by dividing the bulk specific gravity of each sublot sample by the TMD for that sublot.

(5) Joint density. One core centered over the longitudinal joint shall be taken for each sublot which contains a longitudinal joint. Core locations will be determined by the ~~RPR~~ ***OAR*** in accordance with ASTM D3665. The bulk specific gravity of each core sample will be determined in accordance with ASTM D2726. The percent compaction (density) of each sample will be determined by dividing the bulk specific gravity of each joint density sample by the average TMD for the lot. The TMD used to determine the joint density at joints formed between lots will be the lower of the average TMD values from the adjacent lots.

6.2 ACCEPTANCE CRITERIA

A. General

Acceptance will be based on the implementation of the Contractor Quality Control Program (CQCP) and the following characteristics of the asphalt and completed pavements: air voids, mat density, joint density and grade. ***Test results for air voids, mat density and joint density shall be documented and delivered to the OAR within 24 hours of each lot's placement.***

B. Air voids

Acceptance of each lot of plant produced material for air voids will be based upon the average air void from the sublots. If the average air voids of the lot are equal to or greater than 2% and equal to or less than 5%, then the lot will be acceptable. If the average is below 2% or greater than 5%, the lot shall be removed and replaced at the Contractor's expense.

C. Mat density

Acceptance of each lot of plant produced material for mat density will be based on the average of all of the densities taken from the sublots. If the average mat density of the lot so established equals or exceeds 94%, the lot will be acceptable. If the average mat density of the lot is below 94%, the lot shall be removed and replaced at the Contractor's expense.

D. Joint density

Acceptance of each lot of plant produced asphalt for joint density will be based on the average of all of the joint densities taken from the sublots. If the average joint density of the lot so established equals or exceeds 92%, the lot will be acceptable. If the average joint density of the lot is less than 92%, the Contractor shall stop production and evaluate the method of compacting joints. Production may resume once the reason for poor compaction has been determined and appropriate measures have been taken to ensure proper compaction.

E. Grade

The final finished surface of the pavement of the completed project shall be surveyed to verify that the grade elevations and cross-sections shown on the plans do not deviate more than 1/2 inch (12 mm) vertically or 0.1 feet (30 mm) laterally.

Cross-sections of the pavement shall be taken at a minimum 50-foot (15-m) longitudinal spacing and at all longitudinal grade breaks. Minimum cross-section grade points shall include grade at edge of taxiway pavement and edge of shoulder pavement.

The survey and documentation shall be stamped and signed by a licensed surveyor. Payment for sublots that do not meet grade for over 25% of the sublot shall not be more than 95%.

6.3 RESAMPLING PAVEMENT FOR MAT DENSITY

A. General

Resampling of a lot of pavement will only be allowed for mat density and then, only if the Contractor requests same in writing, within 48 hours after receiving the written test results from the ~~RPR~~ ***OAR***. A retest will consist of all the sampling and testing procedures contained in paragraphs 6.1. Only one resampling per lot will be permitted.

(1) A redefined mat density will be calculated for the resampled lot. The number of tests used to calculate the redefined mat density will include the initial tests made for that lot plus the retests.

(2) The cost for resampling and retesting shall be borne by the Contractor.

B. Payment for resampled lots

The redefined mat density for a resampled lot will be used to evaluate the acceptance of that lot in accordance with paragraph 6.2.

C. Outliers

Check for outliers in accordance with ASTM E178, at a significance level of 5%. Outliers will be discarded and density determined using the remaining test values.

PART 7 - METHOD OF MEASUREMENT

7.1 MEASUREMENT

Plant mix asphalt mix pavement shall be measured by the number of tons (kg) of asphalt pavement used in the accepted work. Recorded batch weights or truck scale weights will be used to determine the basis for the tonnage.

PART 8 - BASIS OF PAYMENT

8.1 PAYMENT

Payment for a lot of asphalt mixture meeting all acceptance criteria as specified in paragraph 6.2 shall be made at the contract unit price per ton (kg) for asphalt. The price shall be compensation for furnishing all materials, for all preparation, mixing, and placing of these materials, and for all labor, equipment, tools, and incidentals necessary to complete the item.

Payment will be made under:

Item P-403-8.1	Asphalt Mixture Surface Course	- per Ton (TN)

PART 9 - REFERENCES

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

ASTM International (ASTM)

ASTM C29	Standard Test Method for Bulk Density (“Unit Weight”) and Voids in Aggregate
ASTM C88	Standard Test Method for Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate
ASTM C117	Standard Test Method for Materials Finer than 75-µm (No. 200) Sieve in Mineral Aggregates by Washing
ASTM C127	Standard Test Method for Density, Relative Density (Specific Gravity), and Absorption of Coarse Aggregate
ASTM C131	Standard Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine

ASTM C136	Standard Test Method for Sieve or Screen Analysis of Fine and Coarse Aggregates
ASTM C142	Standard Test Method for Clay Lumps and Friable Particles in Aggregates
ASTM C183	Standard Practice for Sampling and the Amount of Testing of Hydraulic Cement
ASTM C566	Standard Test Method for Total Evaporable Moisture Content of Aggregate by Drying
ASTM D75	Standard Practice for Sampling Aggregates
ASTM D242	Standard Specification for Mineral Filler for Bituminous Paving Mixtures
ASTM D946	Standard Specification for Penetration-Graded Asphalt Cement for Use in Pavement Construction
ASTM D979	Standard Practice for Sampling Bituminous Paving Mixtures
ASTM D1073	Standard Specification for Fine Aggregate for Bituminous Paving Mixtures
ASTM D1074	Standard Test Method for Compressive Strength of Bituminous Mixtures
ASTM D1461	Standard Test Method for Moisture or Volatile Distillates in Bituminous Paving Mixtures
ASTM D2041	Standard Test Method for Theoretical Maximum Specific Gravity and Density of Bituminous Paving Mixtures
ASTM D2172	Standard Test Method for Quantitative Extraction of Bitumen from Bituminous Paving Mixtures
ASTM D2419	Standard Test Method for Sand Equivalent Value of Soils and Fine Aggregate
ASTM D2489	Standard Practice for Estimating Degree of Particle Coating of Bituminous-Aggregate Mixtures
ASTM D2726	Standard Test Method for Bulk Specific Gravity and Density of Non-Absorptive Compacted Bituminous Mixtures
ASTM D2950	Standard Test Method for Density of Bituminous Concrete in Place by Nuclear Methods
ASTM D3203	Standard Test Method for Percent Air Voids in Compacted Dense and Open Bituminous Paving Mixtures

ASTM D3381	Standard Specification for Viscosity-Graded Asphalt Cement for Use in Pavement Construction
ASTM D3665	Standard Practice for Random Sampling of Construction Materials
ASTM D3666	Standard Specification for Minimum Requirements for Agencies Testing and Inspecting Road and Paving Materials
ASTM D4125	Standard Test Methods for Asphalt Content of Bituminous mixtures by the Nuclear Method
ASTM D4318	Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils
ASTM D4552	Standard Practice for Classifying Hot-Mix Recycling Agents
ASTM D4791	Standard Test Method for Flat Particles, Elongated Particles, or Flat and Elongated Particles in Coarse Aggregate
ASTM D4867	Standard Test Method for Effect of Moisture on Asphalt Concrete Paving Mixtures
ASTM D5444	Standard Test Method for Mechanical Size Analysis of Extracted Aggregate
ASTM D5581	Standard Test Method for Resistance to Plastic Flow of Bituminous Mixtures Using Marshall Apparatus (6 inch-Diameter Specimen)
ASTM D5821	Standard Test Method for Determining the Percentage of Fractured Particles in Coarse Aggregate
ASTM D6307	Standard Test Method for Asphalt Content of Hot-Mix Asphalt by Ignition Method
ASTM D6373	Standard Specification for Performance Graded Asphalt Binder
ASTM D6752	Standard Test Method for Bulk Specific Gravity and Density of Compacted Bituminous Mixtures Using Automatic Vacuum Sealing Method
ASTM D6925	Standard Test Method for Preparation and Determination of the Relative Density of Hot Mix Asphalt (HMA) Specimens by Means of the SuperPave Gyratory Compactor
ASTM D6926	Standard Practice for Preparation of Bituminous Specimens Using Marshall Apparatus
ASTM D6927	Standard Test Method for Marshall Stability and Flow of Bituminous Mixtures

ASTM D6995	Standard Test Method for Determining Field VMA based on the Maximum Specific Gravity of the Mix (Gmm)
ASTM E11	Standard Specification for Woven Wire Test Sieve Cloth and Test Sieves
ASTM E178	Standard Practice for Dealing with Outlying Observations
ASTM E2133	Standard Test Method for Using a Rolling Inclinometer to Measure Longitudinal and Transverse Profiles of a Traveled Surface

American Association of State Highway and Transportation Officials (AASHTO)

AASHTO M156	Standard Specification for Requirements for Mixing Plants for Hot-Mixed, Hot-Laid Bituminous Paving Mixtures
AASHTO T329	Standard Method of Test for Moisture Content of Hot Mix Asphalt (HMA) by Oven Method
AASHTO T 340	Standard Method of Test for Determining the Rutting Susceptibility of Hot Mix Asphalt (APA) Using the Asphalt Pavement Analyzer (APA)

Asphalt Institute (AI)

MS-2	Mix Design Manual, 7th Edition
MS-26	Asphalt Binder Handbook AI State Binder Specification Database

FAA Orders

5300.1	Modifications to Agency Airport Design, Construction, and Equipment Standards

Federal Highway Administration (FHWA)

Long Term Pavement Performance Binder program

Software

FAARFIELD

END OF SECTION P-403

SECTION P-501- CEMENT CONCRETE PAVEMENT

PART 1 - DESCRIPTION

1.1 This work shall consist of pavement composed of cement concrete without reinforcement constructed on a prepared underlying surface in accordance with these specifications and shall conform to the lines, grades, thickness, and typical cross-sections shown on the plans. The terms cement concrete, hydraulic cement concrete, and concrete are interchangeable in this specification.

PART 2 - MATERIALS

2.1 AGGREGATES

A. Reactivity

Fine and Coarse aggregates to be used in PCC on this project shall be tested and evaluated by the Contractor for alkali-aggregate reactivity in accordance with both ASTM C1260 and ASTM C1567. Tests must be representative of aggregate sources which will be providing material for production. ASTM C1260 and ASTM C1567 tests may be run concurrently.

1. Coarse aggregate and fine aggregate shall be tested separately in accordance with ASTM C1260, however, the length of test shall be extended to 28 days (30 days from casting). Tests must have been completed within 6 months of the date of the concrete mix submittal.

2. The combined coarse and fine aggregate shall be tested in accordance with ASTM C1567, modified for combined aggregates, using the proposed mixture design proportions of aggregates, cementitious materials, and/or specific reactivity reducing chemicals. If the expansion does not exceed 0.10% at 28 days, the proposed combined materials will be accepted. If the expansion is greater than 0.10% at 28 days, the aggregates will not be accepted unless adjustments to the combined materials mixture can reduce the expansion to less than 0.10% at 28 days, or new aggregates shall be evaluated and tested.

3. If lithium nitrate is proposed for use with or without supplementary cementitious materials, the aggregates shall be tested in accordance with Corps of Engineers (COE) Concrete Research Division (CRD) C662 in lieu of ASTM C1567. If lithium nitrate admixture is used, it shall be nominal 30% ±0.5% weight lithium nitrate in water. If the expansion does not exceed 0.10% at 28 days, the proposed combined materials will be accepted. If the expansion is greater than 0.10% at 28 days, the aggregates will not be accepted unless adjustments to the combined materials mixture can reduce the expansion to less than 0.10% at 28 days, or new aggregates shall be evaluated and tested.

B. Fine aggregate

Grading of the fine aggregate, as delivered to the mixer, shall conform to the requirements of ASTM C33 and the parameters identified in the fine aggregate material requirements below. Fine aggregate material requirements and deleterious limits are shown in the table below.

Fine Aggregate Material Requirements		
Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate	Loss after 5 cycles: 10% maximum using Sodium sulfate - or - 15% maximum using magnesium sulfate	ASTM C88
Sand Equivalent	45 minimum	ASTM D2419
Fineness Modulus (FM)	2.50 ≤ FM ≤ 3.40	ASTM C136
Limits for Deleterious Substances in Fine Aggregate for Concrete		
Clay lumps and friable particles	1.0% maximum	ASTM C142
Coal and lignite	0.5% using a medium with a density of Sp. Gr. of 2.0	ASTM C123
Total Deleterious Material	1.0% maximum	

C. Coarse aggregate

The maximum size coarse aggregate shall be 1.5-inch.

Aggregates delivered to the mixer shall be clean, hard, uncoated aggregates consisting of crushed stone, crushed or uncrushed gravel, air-cooled iron blast furnace slag, crushed recycled concrete pavement, or a combination. The aggregates shall have no known history of detrimental pavement staining. Steel blast furnace slag shall not be permitted. Coarse aggregate material requirements and deleterious limits are shown in the table below; washing may be required to meet aggregate requirements.

Coarse Aggregate Material Requirements

Material Test	Requirement	Standard
Resistance to Degradation	Loss: 40% maximum	ASTM C131
Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate	Loss after 5 cycles: 12% maximum using Sodium sulfate - or - 18% maximum using magnesium sulfate	ASTM C88

Material Test	Requirement	Standard
Flat, Elongated, or Flat and Elongated Particles	8% maximum, by weight, of flat, elongated, or flat and elongated particles at 5:1 for any size group coarser than 3/8 (9.5 mm) sieve [1]	ASTM D4791
Bulk density of slag [2]	Weigh not less than 70 pounds per cubic foot (1.12 Mg/cubic meter)	ASTM C29
D-cracking (Freeze-Thaw)[3]	Durability factor ≥ 95	ASTM C666

[1] A flat particle is one having a ratio of width to thickness greater than five (5); an elongated particle is one having a ratio of length to width greater than five (5).

[2] Only required if slag is specified.

[3] Coarse aggregate may only be accepted from sources that have a 20-year service history for the same gradation to be supplied with no history of D-Cracking. Aggregates that do not have a 20-year record of service free from major repairs (less than 5% of slabs replaced) in similar conditions without D-cracking shall not be used unless the material currently being produced has a durability factor greater than or equal to 95 per ASTM C666. The Contractor shall submit a current certification and test results to verify the aggregate acceptability. Test results will only be accepted from a State Department of Transportation (DOT) materials laboratory or an accredited laboratory. Certification and test results which are not dated or which are over one (1) year old or which are for different gradations will not be accepted.

The amount of deleterious material in the coarse aggregate shall not exceed the following limits:

Limits for Deleterious Substances in Coarse Aggregate

Deleterious material	ASTM	Percentage by Mass
Clay Lumps and friable particles	ASTM C142	1.0
Material finer than No. 200 sieve (75 µm)	ASTM C117	1.0[1]
Lightweight particles	ASTM C123 using a medium with a density of Sp. Gr. of 2.0	0.5
Chert[2] (less than 2.40 Sp Gr.)	ASTM C123 using a medium with a density of Sp. Gr. of 2.40)	1.0[3]

[1] The limit for material finer than 75-µm is allowed to be increased to 1.5% for crushed aggregates consisting of dust of fracture that is essentially free from clay or shale. Test results supporting acceptance of increasing limit to 1.5% with statement indicating material is dust of fracture must be submitted with Concrete mix. Acceptable techniques to characterizing these fines include methylene blue adsorption or X-ray diffraction analysis.

[2] Chert and aggregates with less than 2.4 specific gravity.

[3] The limit for chert may be increased to 1.0 percent by mass in areas not subject to severe freeze and thaw.

D. Combined aggregate gradation

This specification is targeted for a combined aggregate gradation developed following the guidance presented in United States Air Force Engineering Technical Letter (ETL) 97-5: Proportioning Concrete Mixtures with Graded Aggregates for Rigid Airfield Pavements. Base the aggregate grading upon a combination of all the aggregates (coarse and fine) to be used for the mixture proportioning. Three aggregate sizes may be required to achieve an optimized combined gradation that will produce a workable concrete mixture for its intended use. Use aggregate gradations that produce concrete mixtures with well-graded or optimized aggregate combinations. The Contractor shall submit complete mixture information necessary to calculate the volumetric components of the mixture. The combined aggregate grading shall meet the following requirements:

1. The materials selected and the proportions used shall be such that when the Coarseness Factor (CF) and the Workability Factor (WF) are plotted on a diagram as described in paragraph 2.1d(4) below, the point thus determined shall fall within the parallelogram described therein.

2. The CF shall be determined from the following equation:

   CF = (cumulative percent retained on the 3/8 in. (9.5 mm) sieve)(100) / (cumulative percent retained on the No. 8 (2.36 mm) sieve)

3. The WF is defined as the percent passing the No. 8 (2.36 mm) sieve based on the combined gradation. However, WF shall be adjusted, upwards only, by 2.5 percentage points for each 94 pounds (42 kg) of cementitious material per cubic meter yard greater than 564 pounds per cubic yard (335 kg per cubic meter).

4. A diagram shall be plotted using a rectangular scale with WF on the Y-axis with units from 20 (bottom) to 45 (top), and with CF on the X-axis with units from 80 (left side) to 30 (right side). On this diagram a parallelogram shall be plotted with corners at the following coordinates (CF-75, WF-28), (CF-75, WF-40), (CF-45, WF-32.5), and (CF-45, WF-44.5). If the point determined by the intersection of the computed CF and WF does not fall within the above parallelogram, the grading of each size of aggregate used and the proportions selected shall be changed as necessary. The point determined by the plotting of the CF and WF may be adjusted during production ±3 WF and ±5 CF. Adjustments to gradation may not take the point outside of the parallelogram.

E. Contractors combined aggregate gradation. The Contractor shall submit their combined aggregate gradation using the following format:

Contractor's Combined Aggregate Gradation

Sieve Size	Contractor's Concrete mix Gradation (Percent passing by weight)
2 inch (50 mm)	*
1-1/2 inch (37.5 mm)	*
1 inch (25.0 mm)	*
3/4 inch (19.0 mm)	*
1/2 inch (12.5 mm)	*
3/8 inch (9.5 mm)	*
No. 4 (4.75 mm)	*
No. 8 (2.36 mm)	*
No. 16 (1.18 mm)	*
No. 30 (600 µm)	*
No. 50 (300 µm)	*
No. 100 (150 µm)	*

2.2 CEMENT

Cement shall conform to the requirements of ASTM C150 Type I/II or ASTM C595 Type IL.

2.3 CEMENTITIOUS MATERIALS

A. Fly ash

Fly ash shall meet the requirements of ASTM C618, with the exception of loss of ignition, where the maximum shall be less than 6%. Fly ash shall have a Calcium Oxide (CaO) content of less than 15% and a total alkali content less than 3% per ASTM C311. The Contractor shall furnish the previous three most recent, consecutive ASTM C618 reports for each source of fly ash proposed in the concrete mix, and shall furnish each additional report as they become available during the project. The reports can be used for acceptance or the material may be tested independently by the ~~Resident Project Representative (RPR)~~ ***Owner's Authorized Representative (OAR)***.

B. Slag cement (ground granulated blast furnace (GGBF))

Slag cement shall conform to ASTM C989, Grade 100 or Grade 120. Slag cement shall be used only at a rate between 25% and 55% of the total cementitious material by mass.

C. Raw or calcined natural pozzolan

Natural pozzolan shall be raw or calcined and conform to ASTM C618, Class N, including the optional requirements for uniformity and effectiveness in controlling Alkali-Silica reaction and shall have a loss on ignition not exceeding 6%. Class N pozzolan for use in mitigating Alkali-Silica Reactivity shall have a total available alkali content less than 3%.

D. Ultrafine fly ash and ultrafine pozzolan

UltraFine Fly Ash (UFFA) and UltraFine Pozzolan (UFP) shall conform to ASTM C618, Class F or N, and the following additional requirements:

1. The strength activity index at 28 days of age shall be at least 95% of the control specimens.

2. The average particle size shall not exceed 6 microns.

2.4 JOINT SEAL

The joint seal for the joints in the concrete pavement shall meet the requirements of Item P-604 or P-605 and shall be of the type specified in the plans.

2.5 ISOLATION JOINT FILLER

Premolded joint filler for isolation joints shall conform to the requirements of ASTM D1751 or ASTM D1752 and shall be where shown on the plans. The filler for each joint shall be furnished in a single piece for the full depth and width required for the joint, unless otherwise specified by the ~~RPR~~ ***OAR***. When the use of more than one piece is required for a joint, the abutting ends shall be fastened securely and held accurately to shape by stapling or other positive fastening means satisfactory to the ~~RPR~~ ***OAR***.

2.6 STEEL REINFORCEMENT

Reinforcing shall consist of #4 Bars conforming to the requirements of ASTM A615.

2.7 DOWEL AND TIE BARS

Dowel bars shall be plain steel bars conforming to ASTM A615 and shall be free from burring or other deformation restricting slippage in the concrete.

A. Dowel Bars

Before delivery to the construction site each dowel bar shall be epoxy coated per ASTM A1078, Type 1, with a coating thickness after curing greater than 10 mils. Patched ends are not required for Type 1 coated dowels. The dowels shall be coated with a bond-

breaker recommended by the manufacturer. Dowel sleeves or inserts are not permitted. Grout retention rings shall be fully circular metal or plastic devices capable of supporting the dowel until the grout hardens.

B. Tie Bars

Tie bars shall be deformed steel bars and conform to the requirements of ASTM A615. Tie bars designated as Grade 60 in ASTM A615 or ASTM A706 shall be used for construction requiring bent bars.

2.8 WATER

Water used in mixing or curing shall be potable. If water is taken from other sources considered non-potable, it shall meet the requirements of ASTM C1602.

2.9 MATERIAL FOR CURING CONCRETE

Curing materials shall conform to one of the following specifications:

A. Liquid membrane-forming compounds for curing concrete shall conform to the requirements of ASTM C309, Type 2, Class A, or Class B.

B. White polyethylene film for curing concrete shall conform to the requirements of ASTM C171.

C. White burlap-polyethylene sheeting for curing concrete shall conform to the requirements of ASTM C171.

D. Waterproof paper for curing concrete shall conform to the requirements of ASTM C171.

2.10 ADMIXTURES

Admixtures shall conform to the following specifications:

A. Air-entraining admixtures. Air-entraining admixtures shall meet the requirements of ASTM C260 and shall consistently entrain the air content in the specified ranges under field conditions. The air-entraining agent and any water reducer admixture shall be compatible.

B. Water-reducing admixtures. Water-reducing admixture shall meet the requirements of ASTM C494, Type A, B, or D.

C. Other admixtures. The use of set retarding and set-accelerating admixtures shall be approved by the ~~RPR~~ ***OAR*** prior to developing the concrete mix. Retarding admixtures shall meet the requirements of ASTM C494, Type A, B, or D and set-accelerating admixtures shall meet the requirements of ASTM C494, Type C. Calcium chloride and admixtures containing calcium chloride shall not be used.

D. Lithium Nitrate. The lithium admixture shall be a nominal 30% aqueous solution of Lithium Nitrate, with a density of 10 pounds/gallon (1.2 kg/L), and shall have the approximate chemical form as shown below:

Lithium Admixture

Constituent	Limit (Percent by Mass)
LiNO3 (Lithium Nitrate)	30 ±0.5
SO4 (Sulfate Ion)	0.1 (max)
Cl (Chloride Ion)	0.2 (max)
Na (Sodium Ion)	0.1 (max)
K (Potassium Ion)	0.1 (max)

The lithium nitrate admixture dispensing and mixing operations shall be verified and certified by the lithium manufacturer's representative.

2.11 EPOXY-RESIN

All epoxy-resin materials shall be two-component materials conforming to the requirements of ASTM C881, Class as appropriate for each application temperature to be encountered, except that in addition, the materials shall meet the following requirements:

A. Material for use for embedding dowels and anchor bolts shall be Type IV, Grade 3.

B. Material for use as patching materials for complete filling of spalls and other voids and for use in preparing epoxy resin mortar shall be Type III, Grade as approved.

C. Material for use for injecting cracks shall be Type IV, Grade 1.

D. Material for bonding freshly mixed Portland cement concrete or mortar or freshly mixed epoxy resin concrete or mortar to hardened concrete shall be Type V, Grade as approved.

2.12 BOND BREAKER

Choke stone shall be an ASTM C33 Number 89 stone.

2.13 RAISED SIDEWALK PAVEMENT

A. All materials for 6" Raised Sidewalk Concrete Pavement shall meet the material requirements of Specification P-610.

2.14 HURRICANE TIE-DOWNS

A. Hurricane tie-downs shall consist of a mooring device cast into the pavement in accordance with the plans and details at locations selected by the OAR. The mooring device shall be Neenah Model No. R-3490-A or approved equal and consist of Ductile Cast Iron (ASTM A-536). Reinforcing shall consist of #4 Bars conforming to the requirements of ASTM A615. Concrete shall conform to the requirements of this specification.

PART 3 - CONCRETE MIX

3.1. GENERAL

No concrete shall be placed until an acceptable concrete mix has been submitted to the ~~RPR~~ ***OAR*** for review and the ~~RPR~~ ***OAR*** has taken appropriate action. The ~~RPR's~~ ***OAR's*** review shall not relieve the Contractor of the responsibility to select and proportion the materials to comply with this section.

3.2 CONCRETE MIX LABORATORY

The laboratory used to develop the concrete mix shall be accredited in accordance with ASTM C1077. The laboratory accreditation must be current and listed on the accrediting authority's website. All test methods required for developing the concrete mix must be included in the lab accreditation. A copy of the laboratory's current accreditation and accredited test methods shall be submitted to the ~~RPR~~ ***OAR*** prior to start of construction.

3.3 CONCRETE MIX PROPORTIONS

Develop the mix using the procedures contained in Portland Cement Association (PCA) publication, "Design and Control of Concrete Mixtures." Concrete shall be proportioned to achieve a 28-day flexural strength that meets or exceeds the acceptance criteria contained in paragraph 6.6 for a flexural strength of 620 psi per ASTM C78.

The minimum cementitious material shall be adequate to ensure a workable, durable mix. The minimum cementitious material (cement plus fly ash, or slag cement) shall be 470 pounds per cubic yard (280 kg per cubic meter). The ratio of water to cementitious material, including free surface moisture on the aggregates but not including moisture absorbed by the aggregates shall be between 0.38 – 0.45 by weight.

Flexural strength test specimens shall be prepared in accordance with ASTM C192 and tested in accordance with ASTM C78. At the start of the project, the Contractor shall determine an allowable slump as determined by ASTM C143 not to exceed 2 inches (50 mm) for slip-form placement. For fixed-form placement, the slump shall not exceed 3 inches (75 mm). For hand placement, the slump shall not exceed 4 inches (100 mm).

The results of the concrete mix shall include a statement giving the maximum nominal coarse aggregate size and the weights and volumes of each ingredient proportioned on a one cubic yard (meter) basis. Aggregate quantities shall be based on the mass in a saturated surface dry condition.

If a change in source(s) is made, or admixtures added or deleted from the mix, a new concrete mix must be submitted to the ~~RPR~~ ***OAR*** for approval.

The ~~RPR~~ ***OAR*** may request samples at any time for testing, prior to and during production, to verify the quality of the materials and to ensure conformance with the applicable specifications.

3.4 CONCRETE MIX SUBMITTAL

The concrete mix shall be submitted to the ~~RPR~~ ***OAR*** at least 30 days prior to the start of operations. The submitted concrete mix shall not be more than 180 days old and must use the materials to be used for production for the project. Production shall not begin until the concrete mix is approved in writing by the ~~RPR~~ ***OAR***.

Each of the submitted concrete mixes (i.e, slip form, side form machine finish and side form hand finish) shall be stamped or sealed by the responsible professional Engineer of the laboratory and shall include the following items and quantities as a minimum:

- Certified material test reports for aggregate in accordance with paragraph 2.1. Certified reports must include all tests required; reporting each test, test method, test result, and requirement specified (criteria).
- Combined aggregate gradations and analysis; and including plots of the fine aggregate fineness modulus.
- Reactivity Test Results.
- Coarse aggregate quality test results, including deleterious materials.
- Fine aggregate quality test results, including deleterious materials.
- Mill certificates for cement and supplemental cementitious materials.
- Certified test results for all admixtures, including Lithium Nitrate if applicable.
- Specified flexural strength, slump, and air content.
- Recommended proportions/volumes for proposed mixture and trial water-cementitious materials ratio, including actual slump and air content.
- Flexural and compressive strength summaries and plots, including all individual beam and cylinder breaks.

- Correlation ratios for acceptance testing and Contractor QC testing, when applicable.

- Historical record of test results documenting production standard deviation, when applicable.

3.5 CEMENTITIOUS MATERIALS

A. Fly ash

When fly ash is used as a partial replacement for cement, the replacement rate shall be determined from laboratory trial mixes, and shall be between 20 and 30% by weight of the total cementitious material. If fly ash is used in conjunction with slag cement the maximum replacement rate shall not exceed 10% by weight of total cementitious material.

B. Slag cement (ground granulated blast furnace (GGBF))

Slag cement may be used. The slag cement, or slag cement plus fly ash if both are used, may constitute between 25 to 55% of the total cementitious material by weight.

C. Raw or calcined natural pozzolan

Natural pozzolan may be used in the concrete mix. When pozzolan is used as a partial replacement for cement, the replacement rate shall be determined from laboratory trial mixes, and shall be between 20 and 30% by weight of the total cementitious material. If pozzolan is used in conjunction with slag cement the maximum replacement rate shall not exceed 10% by weight of total cementitious material.

D. Ultrafine fly ash (UFFA) and ultrafine pozzolan (UFP)

UFFA and UFP may be used in the concrete mix with the ~~RPR's~~ ***OAR's*** approval. When UFFA and UFP is used as a partial replacement for cement, the replacement rate shall be determined from laboratory trial mixes, and shall be between 7% and 16% by weight of the total cementitious material.

3.6 ADMIXTURES

A. Air-entraining admixtures

Air-entraining admixture are to be added in such a manner that will ensure uniform distribution of the agent throughout the batch. The air content of freshly mixed air-entrained concrete shall be based upon trial mixes with the materials to be used in the work adjusted to produce concrete of the required plasticity and workability. The percentage of air in the mix shall be 3.5%. Air content shall be determined by testing in accordance with ASTM C231 for gravel and stone coarse aggregate and ASTM C173 for slag and other highly porous coarse aggregate.

B. Water-reducing admixtures

Water-reducing admixtures shall be added to the mix in the manner recommended by the manufacturer and in the amount necessary to comply with the specification requirements. Tests shall be conducted with the materials to be used in the work, in accordance with ASTM C494.

C. Other admixtures

Set controlling, and other approved admixtures shall be added to the mix in the manner recommended by the manufacturer and in the amount necessary to comply with the specification requirements. Tests shall be conducted with the materials to be used in the work, in accordance with ASTM C494.

D. Lithium nitrate

Lithium nitrate shall be added to the mix in the manner recommended by the manufacturer and in the amount necessary to comply with the specification requirements in accordance with paragraph 2.10d.

3.7 RAISED SIDEWALK PAVEMENT

The concrete mix design for 6" Raised Sidewalk Concrete Pavement shall meet the requirements of this Specification or Specification P-610. The Contractor shall clearly indicate on the mix design submittal the Specification to which the mix is designed.

PART 4 - CONSTRUCTION METHODS

4.1 CONTROL STRIP

The control strip(s) shall be to the next planned joint after the initial 250 feet (75 m) of each type of pavement construction (slip-form pilot lane, slip-form fill-in lane, or fixed form). The Contractor shall demonstrate, in the presence of the ~~RPR~~ ***OAR***, that the materials, concrete mix, equipment, construction processes, and quality control processes meet the requirements of the specifications. The concrete mixture shall be extruded from the paver meeting the edge slump tolerance and with little or no finishing. Pilot, fill-in, and fixed-form control strips will be accepted separately. Minor adjustments to the mix design may be required to place an acceptable control strip. Minor adjustments to the mix design may be required to place an acceptable control strip. The production mix will be the adjusted mix design used to place the acceptable control strip. Upon acceptance of the control strip by the ~~RPR~~ ***OAR***, the Contractor must use the same equipment, materials, and construction methods for the remainder of concrete paving. Any adjustments to processes or materials must be approved in advance by the ~~RPR~~ ***OAR***. Acceptable control strips will meet edge slump tolerance and surface acceptable with little or no finishing, air content within action limits, strength equal or greater than requirements of P3.3. The control strip

will be considered one lot for payment (no sublots required for control strip). Payment will only be made for an acceptable control strip in accordance with paragraph 8.1 using a lot pay factor equal to 100.

4.2 EQUIPMENT

The Contractor is responsible for the proper operation and maintenance of all equipment necessary for handling materials and performing all parts of the work to meet this specification.

A. Plant and equipment

The plant and mixing equipment shall conform to the requirements of ASTM C94 and/or ASTM C685. Each truck mixer shall have attached in a prominent place a manufacturer's nameplate showing the capacity of the drum in terms of volume of mixed concrete and the speed of rotation of the mixing drum or blades. The truck mixers shall be examined daily for changes in condition due to accumulation of hard concrete or mortar or wear of blades. The pickup and throwover blades shall be replaced when they have worn down 3/4 inch (19 mm) or more. The Contractor shall have a copy of the manufacturer's design on hand showing dimensions and arrangement of blades in reference to original height and depth.

Equipment for transferring and spreading concrete from the transporting equipment to the paving lane in front of the finishing equipment shall be provided. The equipment shall be specially manufactured, self-propelled transfer equipment which will accept the concrete outside the paving lane and will spread it evenly across the paving lane in front of the paver and strike off the surface evenly to a depth which permits the paver to operate efficiently.

B. Finishing equipment

1. Slip-form. The standard method of constructing concrete pavements shall be with an approved slip-form paving equipment designed and operated to spread, consolidate, screed, and finish the freshly placed concrete in one complete pass of the machine so that the end result is a dense and homogeneous pavement which is achieved with a minimum of hand finishing. The paver-finisher shall be a heavy duty, self-propelled machine designed specifically for paving and finishing high quality concrete pavements.

2. Fixed-form. On projects requiring less than 10,000 cubic yards (7650 cubic meters) of concrete pavement or irregular areas at locations inaccessible to slip-form paving equipment, concrete pavement may be placed with equipment specifically designed for placement and finishing using stationary side forms. Methods and equipment shall be reviewed and accepted by the ~~RPR~~ ***OAR***. Hand screeding and float finishing may only be used on small irregular areas as allowed by the ~~RPR~~ ***OAR***.

C. Vibrators

Vibrator shall be the internal type. The rate of vibration of each vibrating unit shall be sufficient to consolidate the pavement without segregation or voids. The number, spacing, and frequency shall be as necessary to provide a dense and homogeneous pavement and meet the recommendations of American Concrete Institute (ACI) 309R, Guide for Consolidation of Concrete. Adequate power to operate all vibrators shall be available on the paver. The vibrators shall be automatically controlled so that they shall be stopped as forward motion ceases. The Contractor shall provide an electronic or mechanical means to monitor vibrator status. The checks on vibrator status shall occur a minimum of two times per day or when requested by the ~~RPR~~ ***OAR***.

Hand held vibrators may only be used in irregular areas and shall meet the recommendations of ACI 309R, Guide for Consolidation of Concrete.

D. Concrete saws

The Contractor shall provide sawing equipment adequate in number of units and power to complete the sawing to the required dimensions. The Contractor shall provide at least one standby saw in good working order and a supply of saw blades at the site of the work at all times during sawing operations.

E. Fixed forms

Straight side fixed forms shall be made of steel and shall be furnished in sections not less than 10 feet (3 m) in length. Forms shall be provided with adequate devices for secure settings so that when in place they will withstand, without visible spring or settlement, the impact and vibration of the consolidating and finishing equipment. Forms with battered top surfaces and bent, twisted or broken forms shall not be used. Built-up forms shall not be used, except as approved by the ~~RPR~~ ***OAR***. The top face of the form shall not vary from a true plane more than 1/8 inch (3 mm) in 10 feet (3 m), and the upstanding leg shall not vary more than 1/4 inch (6 mm). The forms shall contain provisions for locking the ends of abutting sections together tightly for secure setting. Wood forms may be used under special conditions, when approved by the ~~RPR~~ ***OAR***. The forms shall extend the full depth of the pavement section.

4.3 FORM SETTING

Forms shall be set to line and grade as shown on the plans, sufficiently in advance of the concrete placement, to ensure continuous paving operation. Forms shall be set to withstand, without visible spring or settlement, the impact and vibration of the consolidating and finishing equipment. Forms shall be cleaned and oiled prior to the concrete placement.

4.4 BASE SURFACE PREPARATION PRIOR TO PLACEMENT

Any damage to the prepared base, subbase, and subgrade shall be corrected full depth by the Contractor prior to concrete placement. The underlying surface shall be entirely free of frost when concrete is placed. The prepared grade shall be moistened with water, without saturating, immediately ahead of concrete placement to prevent rapid loss of moisture from concrete. Bond breaker shall be applied in accordance with 2.12.

4.5 HANDLING, MEASURING, AND BATCHING MATERIAL

Aggregate stockpiles shall be constructed and managed in such a manner that prevents segregation and intermixing of deleterious materials. Aggregates from different sources shall be stockpiled, weighed and batched separately at the concrete batch plant. Aggregates that have become segregated or mixed with earth or foreign material shall not be used. All aggregates produced or handled by hydraulic methods, and washed aggregates, shall be stockpiled or binned for draining at least 12 hours before being batched. Store and maintain all aggregates at a uniform moisture content prior to use. A continuous supply of materials shall be provided to the work to ensure continuous placement.

4.6 MIXING CONCRETE

The concrete may be mixed at the work site, in a central mix plant or in truck mixers. The mixer shall be of an approved type and capacity. Mixing time shall be measured from the time all materials are placed into the drum until the drum is emptied into the truck. All concrete shall be mixed and delivered to the site in accordance with the requirements of ASTM C94 or ASTM C685.

Mixed concrete from the central mixing plant shall be transported in truck mixers, truck agitators, or non-agitating trucks. The elapsed time from the addition of cementitious material to the mix until the concrete is discharged from the truck should not exceed 30 minutes when the concrete is hauled in non-agitating trucks, nor 90 minutes when the concrete is hauled in truck mixers or truck agitators. In no case shall the temperature of the concrete when placed exceed 90°F (32°C). Retempering concrete by adding water or by other means will not be permitted. With transit mixers additional water may be added to the batch materials and additional mixing performed to increase the slump to meet the specified requirements provided the addition of water is performed within 45 minutes after the initial mixing operations and provided the water/cementitious ratio specified is not exceeded.

4.7 WEATHER LIMITATIONS ON MIXING AND PLACING

No concrete shall be mixed, placed, or finished when the natural light is insufficient, unless an adequate and approved artificial lighting system is operated.

A. Cold weather

Unless authorized in writing by the ~~RPR~~ ***OAR***, mixing and concreting operations shall be discontinued when a descending air temperature in the shade and away from artificial heat reaches 40°F (4°C) and shall not be resumed until an ascending air temperature in the shade and away from artificial heat reaches 35°F (2°C).

The aggregate shall be free of ice, snow, and frozen lumps before entering the mixer. The temperature of the mixed concrete shall not be less than 50°F (10°C) at the time of placement. Concrete shall not be placed on frozen material nor shall frozen aggregates be used in the concrete.

When concreting is authorized during cold weather, water and/or the aggregates may be heated to not more than 150°F (66°C). The apparatus used shall heat the mass uniformly and shall be arranged to preclude the possible occurrence of overheated areas which might be detrimental to the materials.

Curing during cold weather shall be in accordance with paragraph 4.13d.

B. Hot weather

During periods of hot weather when the maximum daily air temperature exceeds 85°F (30°C), the following precautions shall be taken.

The forms and/or the underlying surface shall be sprinkled with water immediately before placing the concrete. The concrete shall be placed at the coolest temperature practicable, and in no case shall the temperature of the concrete when placed exceed 90°F (32°C). The aggregates and/or mixing water shall be cooled as necessary to maintain the concrete temperature at or not more than the specified maximum.

The concrete placement shall be protected from exceeding an evaporation rate of 0.2 psf (0.98 kg/m^2 per hour) per hour. When conditions are such that problems with plastic cracking can be expected, and particularly if any plastic cracking begins to occur, the Contractor shall immediately take such additional measures as necessary to protect the concrete surface. If the Contractor's measures are not effective in preventing plastic cracking, paving operations shall be immediately stopped.

Curing during hot weather shall be in accordance with paragraph 4.13e.

C. Temperature management program. Prior to the start of paving operation for each day of paving, the Contractor shall provide the ~~RPR~~ ***OAR*** with a Temperature Management Program for the concrete to be placed to assure that uncontrolled cracking is avoided. (Federal Highway Administration HIPERPAV 3 is one example of a temperature management program.) As a minimum, the program shall address the following items:

1. Anticipated tensile strains in the fresh concrete as related to heating and cooling of the concrete material.

2. Anticipated weather conditions such as ambient temperatures, wind velocity, and relative humidity; and anticipated evaporation rate using Figure 19-9, PCA, Design and Control of Concrete Mixtures.

3. Anticipated timing of initial sawing of joint.

4. Anticipated number and type of saws to be used.

D. Rain

The Contractor shall have available materials for the protection of the concrete during inclement weather. Such protective materials shall consist of rolled polyethylene sheeting at least 4 mils (0.1 mm) thick of sufficient length and width to cover the plastic concrete slab and any edges. The sheeting may be mounted on either the paver or a separate movable bridge from which it can be unrolled without dragging over the plastic concrete surface. When rain appears imminent, all paving operations shall stop and all available personnel shall begin covering the surface of the unhardened concrete with the protective covering.

4.8 CONCRETE PLACEMENT

At any point in concrete conveyance, the free vertical drop of the concrete from one point to another or to the underlying surface shall not exceed 3 feet (1 m). The finished concrete product must be dense and homogeneous, without segregation and conforming to the standards in this specification. Backhoes and grading equipment shall not be used to distribute the concrete in front of the paver. Front end loaders will not be used. All concrete shall be consolidated without voids or segregation, including under and around all load-transfer devices, joint assembly units, and other features embedded in the pavement. Hauling equipment or other mechanical equipment can be permitted on adjoining previously constructed pavement when the concrete strength reaches a flexural strength of 550 psi (3.8 MPa), based on the average of four field cured specimens per 2,000 cubic yards (1,530 cubic meters) of concrete placed. The Contractor must determine that the above minimum strengths are adequate to protection the pavement from overloads due to the construction equipment proposed for the project.

The Contractor shall have available materials for the protection of the concrete during cold, hot and/or inclement weather in accordance with paragraph 4.7.

A. Slip-form construction

The concrete shall be distributed uniformly into final position by a self-propelled slip-form paver without delay. The alignment and elevation of the paver shall be regulated from outside reference lines established for this purpose. The paver shall vibrate the concrete for the full width and depth of the strip of pavement being placed and the vibration shall be adequate to provide a consistency of concrete that will stand normal to the surface with

sharp well-defined edges. The sliding forms shall be rigidly held together laterally to prevent spreading of the forms. The plastic concrete shall be effectively consolidated by internal vibration with transverse vibrating units for the full width of the pavement and/or a series of equally placed longitudinal vibrating units. The space from the outer edge of the pavement to longitudinal unit shall not exceed 9 inches (23 cm) for slipform and at the end of the dowels for the fill-in lanes. The spacing of internal units shall be uniform and shall not exceed 18 inches (0.5 m).

The term internal vibration means vibrating units located within the specified thickness of pavement section.

The rate of vibration of each vibrating unit shall be sufficient to consolidate the pavement without, segregation, voids, or vibrator trails and the amplitude of vibration shall be sufficient to be perceptible on the surface of the concrete along the entire length of the vibrating unit and for a distance of at least one foot (30 cm). The frequency of vibration or amplitude should be adjusted proportionately with the rate of travel to result in a uniform density and air content. The paving machine shall be equipped with a tachometer or other suitable device for measuring and indicating the actual frequency of vibrations.

The concrete shall be held at a uniform consistency. The slip-form paver shall be operated with as nearly a continuous forward movement as possible and all operations of mixing, delivering, and spreading concrete shall be coordinated to provide uniform progress with stopping and starting of the paver held to a minimum. If for any reason, it is necessary to stop the forward movement of the paver, the vibratory and tamping elements shall also be stopped immediately. No tractive force shall be applied to the machine, except that which is controlled from the machine.

When concrete is being placed adjacent to an existing pavement, that part of the equipment which is supported on the existing pavement shall be equipped with protective pads on crawler tracks or rubber-tired wheels on which the bearing surface is offset to run a sufficient distance from the edge of the pavement to avoid breaking the pavement edge.

Not more than 15% of the total free edge of each 500-foot (150 m) segment of pavement, or fraction thereof, shall have an edge slump exceeding 1/4 inch (6 mm), and none of the free edge of the pavement shall have an edge slump exceeding 3/8 inch (9 mm). (The total free edge of 500 feet (150 m) of pavement will be considered the cumulative total linear measurement of pavement edge originally constructed as nonadjacent to any existing pavement; that is, 500 feet (150 m) of paving lane originally constructed as a separate lane will have 1,000 feet (300 m) of free edge, 500 feet (150 m) of fill-in lane will have no free edge, etc.). The area affected by the downward movement of the concrete along the pavement edge shall be limited to not more than 18 inches (0.5 m) from the edge.

When excessive edge slump cannot be corrected before the concrete has hardened, the area with excessive edge slump will be removed the full width of the slip form lane and replaced at the expense of the Contractor as directed by the ~~RPR~~ ***OAR***.

B. Fixed-form construction

Forms shall be drilled in advance of being placed to line and grade to accommodate tie bars / dowel bars where these are specified.

Immediately in advance of placing concrete and after all subbase operations are completed, side forms shall be trued and maintained to the required line and grade for a distance sufficient to prevent delay in placing.

Side forms shall remain in place at least 12 hours after the concrete has been placed, and in all cases until the edge of the pavement no longer requires the protection of the forms. Curing compound shall be applied to the concrete immediately after the forms have been removed.

Side forms shall be thoroughly cleaned and coated with a release agent each time they are used and before concrete is placed against them.

Concrete shall be spread, screed, shaped and consolidated by one or more self-propelled machines. These machines shall uniformly distribute and consolidate concrete without segregation so that the completed pavement will conform to the required cross-section with a minimum of handwork.

The number and capacity of machines furnished shall be adequate to perform the work required at a rate equal to that of concrete delivery. The equipment must be specifically designed for placement and finishing using stationary side forms. Methods and equipment shall be reviewed and accepted by the ~~RPR~~ ***OAR***.

Concrete for the full paving width shall be effectively consolidated by internal vibrators. The rate of vibration of each vibrating unit shall be sufficient to consolidate the pavement without segregation, voids, or leaving vibrator trails.

Power to vibrators shall be connected so that vibration ceases when forward or backward motion of the machine is stopped.

C. Consolidation

Concrete shall be consolidated with the specified type of lane-spanning, gang-mounted, mechanical, immersion type vibrating equipment mounted in front of the paver, supplemented, in rare instances as specified, by hand-operated vibrators. The vibrators shall be inserted into the concrete to a depth that will provide the best full-depth consolidation but not closer to the underlying material than 2 inches (50 mm). Vibrators shall not be used to transport or spread the concrete. For each paving train, at least one additional vibrator spud, or sufficient parts for rapid replacement and repair of vibrators shall be maintained at the paving site at all times. Any evidence of inadequate consolidation (honeycomb along the edges, large air pockets, or any other evidence) or over-consolidation (vibrator trails, segregation, or any other evidence) shall require the immediate stopping of the paving operation and adjustment of the equipment or procedures as approved by the ~~RPR~~ ***OAR***.

If a lack of consolidation of the hardened concrete is suspected by the ~~RPR~~ ***OAR***, referee testing may be required. Referee testing of hardened concrete will be performed by the ~~RPR~~ ***OAR*** by cutting cores from the finished pavement after a minimum of 24 hours curing. The ~~RPR~~ ***OAR*** shall visually examine the cores for evidence of lack of consolidation. Density determinations will be made by the ~~RPR~~ ***OAR*** based on the water content of the core as taken. ASTM C642 shall be used for the determination of core density in the saturated-surface dry condition. When required, referee cores will be taken at the minimum rate of one for each 500 cubic yards (382 m^2) of pavement, or fraction. The Contractor shall be responsible for all referee testing cost if they fail to meet the required density.

The average density of the cores shall be at least 97% of the original concrete mix density, with no cores having a density of less than 96% of the original concrete mix density. Failure to meet the referee tests will be considered evidence that the minimum requirements for vibration are inadequate for the job conditions. Additional vibrating units or other means of increasing the effect of vibration shall be employed so that the density of the hardened concrete conforms to the above requirements.

4.9 STRIKE-OFF OF CONCRETE AND PLACEMENT OF REINFORCEMENT

Following the placing of the concrete, it shall be struck off to conform to the cross-section shown on the plans and to an elevation that when the concrete is properly consolidated and finished, the surface of the pavement shall be at the elevation shown on the plans. When reinforced concrete pavement is placed in two layers, the bottom layer shall be struck off to such length and depth that the sheet of reinforcing steel fabric or bar mat may be laid full length on the concrete in its final position without further manipulation. The reinforcement shall then be placed directly upon the concrete, after which the top layer of the concrete shall be placed, struck off, and screed. If any portion of the bottom layer of concrete has been placed more than 30 minutes without being covered with the top layer or if initial set has taken place, it shall be removed and replaced with freshly mixed concrete at the Contractor's expense. When reinforced concrete is placed in one layer, the reinforcement may be positioned in advance of concrete placement or it may be placed in plastic concrete by mechanical or vibratory means after spreading.

Reinforcing steel, at the time concrete is placed, shall be free of mud, oil, or other organic matter that may adversely affect or reduce bond. Reinforcing steel with rust, mill scale or a combination of both will be considered satisfactory, provided the minimum dimensions, weight, and tensile properties of a hand wire-brushed test specimen are not less than the applicable ASTM specification requirements.

4.10 JOINTS

Joints shall be constructed as shown on the plans and in accordance with these requirements. All joints shall be constructed with their faces perpendicular to the surface of the pavement and finished or edged as shown on the plans. Joints shall not vary more than 1/2-inch (12 mm) from their designated position and shall be true to line with not more than 1/4-inch (6 mm) variation in 10 feet (3 m). The surface across the joints shall be

tested with a 12-foot (3 m) straightedge as the joints are finished and any irregularities in excess of 1/4 inch (6 mm) shall be corrected before the concrete has hardened. All joints shall be so prepared, finished, or cut to provide a groove of uniform width and depth as shown on the plans.

A. Construction. Longitudinal construction joints shall be slip-formed or formed against side forms as shown in the plans.

Transverse construction joints shall be installed at the end of each day's placing operations and at any other points within a paving lane when concrete placement is interrupted for more than 30 minutes or it appears that the concrete will obtain its initial set before fresh concrete arrives. The installation of the joint shall be located at a planned contraction or expansion joint. If placing of the concrete is stopped, the Contractor shall remove the excess concrete back to the previous planned joint.

B. Contraction

Contraction joints shall be installed at the locations and spacing as shown on the plans. Contraction joints shall be installed to the dimensions required by forming a groove or cleft in the top of the slab while the concrete is still plastic or by sawing a groove into the concrete surface after the concrete has hardened. When the groove is formed in plastic concrete the sides of the grooves shall be finished even and smooth with an edging tool. If an insert material is used, the installation and edge finish shall be according to the manufacturer's instructions. The groove shall be finished or cut clean so that spalling will be avoided at intersections with other joints. Grooving or sawing shall produce a slot at least 1/8 inch (3 mm) wide and to the depth shown on the plans.

C. Isolation (expansion)

Isolation joints shall be installed as shown on the plans. The premolded filler of the thickness as shown on the plans, shall extend for the full depth and width of the slab at the joint. The filler shall be fastened uniformly along the hardened joint face with no buckling or debris between the filler and the concrete interface, including a temporary filler for the sealant reservoir at the top of the slab. The edges of the joint shall be finished and tooled while the concrete is still plastic.

D. Dowels and Tie Bars for Joints

1. Tie bars

Tie bars shall consist of deformed bars installed in joints as shown on the plans. Tie bars shall be placed at right angles to the centerline of the concrete slab and shall be spaced at intervals shown on the plans. They shall be held in position parallel to the pavement surface and in the middle of the slab depth and within the tolerances in paragraph 4.10(f.). When tie bars extend into an unpaved lane, they may be bent against the form at longitudinal construction joints, unless threaded bolt or other assembled tie bars are specified. Tie bars shall not be painted, greased, or enclosed in sleeves. When slip-form operations call for tie bars, two-piece hook bolts can be installed.

2. Dowel bars

Dowel bars shall be placed across joints in the proper horizontal and vertical alignment as shown on the plans. The dowels shall be coated with a bond-breaker or other lubricant recommended by the manufacturer and approved by the ~~RPR~~ ***OAR***. Dowels bars at longitudinal construction joints shall be bonded in drilled holes.

3. Placing dowels and tie bars

Horizontal spacing of dowels shall be within a tolerance of ±3/4 inch (19 mm). The vertical location on the face of the slab shall be within a tolerance of ±1/2 inch (12 mm). The method used to install dowels shall ensure that the horizontal and vertical alignment will not be greater than 1/4 inch per feet (6 mm per 0.3 m), except for those across the crown or other grade change joints. Dowels across crowns and other joints at grade changes shall be measured to a level surface. Horizontal alignment shall be checked perpendicular to the joint edge. The portion of each dowel intended to move within the concrete or expansion cap shall be wiped clean and coated with a thin, even film of lubricating oil or light grease before the concrete is placed. Dowels shall be installed as specified in the following subparagraphs.

(a) Contraction joints. Dowels and tie bars in longitudinal and transverse contraction joints within the paving lane shall be held securely in place by means of rigid metal frames or basket assemblies of an approved type. The basket assemblies shall be held securely in the proper location by means of suitable pins or anchors. Do not cut or crimp the dowel basket tie wires.

At the Contractor's option, dowels and tie bars in contraction joints may be installed by insertion into the plastic concrete using approved equipment and procedures per the paver manufacturer's design. Approval of installation methods will be based on the results of the control strip showing that the dowels and tie bars are installed within specified tolerances as verified by cores or non-destructive rebar location devices approved by the ~~RPR~~ ***OAR***.

(b) Construction joints. Install dowels and tie bars by the cast-in- place or the drill-and-dowel method. Installation by removing and replacing in preformed holes will not be permitted. Dowels and tie bars shall be prepared and placed across joints where indicated, correctly aligned, and securely held in the proper horizontal and vertical position during placing and finishing operations, by means of devices fastened to the forms.

(c) Joints in hardened concrete. Install dowels in hardened concrete by bonding the dowels into holes drilled into the concrete. The concrete shall have cured for seven (7) days or reached a minimum flexural strength of 450 psi (3.1 MPa) before drilling begins. Holes 1/8 inch (3 mm) greater in diameter than the dowels shall be drilled into the hardened concrete using rotary-core drills. Rotary-percussion drills may be used, provided that excessive spalling does not occur. Spalling beyond the limits of the grout retention ring will require modification of the equipment and operation. Depth of dowel hole shall be within a tolerance of ±1/2 inch (12 mm) of the dimension shown on the drawings. On completion of the drilling operation, the

dowel hole shall be blown out with oil-free, compressed air. Dowels shall be bonded in the drilled holes using epoxy resin. Epoxy resin shall be injected at the back of the hole before installing the dowel and extruded to the collar during insertion of the dowel so as to completely fill the void around the dowel. Application by buttering the dowel will not be permitted. The dowels shall be held in alignment at the collar of the hole by means of a suitable metal or plastic grout retention ring fitted around the dowel.

E. Sawing of joints

Sawing shall commence, without regard to day or night, as soon as the concrete has hardened sufficiently to permit cutting without chipping, spalling, or tearing and before uncontrolled shrinkage cracking of the pavement occurs and shall continue without interruption until all joints have been sawn. All slurry and debris produced in the sawing of joints shall be removed by vacuuming and washing. Curing compound or system shall be reapplied in the initial saw-cut and maintained for the remaining cure period.

Joints shall be cut in locations as shown on the plans. The initial joint cut shall be a minimum 1/8 inch (3 mm) wide and to the depth shown on the plans. Prior to placement of joint sealant or seals, the top of the joint shall be widened by sawing as shown on the plans.

4.11 FINISHING

Finishing operations shall be a continuing part of placing operations starting immediately behind the strike-off of the paver. Initial finishing shall be provided by the transverse screed or extrusion plate. The sequence of operations shall be transverse finishing, longitudinal machine floating if used, straightedge finishing, edging of joints, and then texturing. Finishing shall be by the machine method. The hand method shall be used only on isolated areas of odd slab widths or shapes and in the event of a breakdown of the mechanical finishing equipment. Supplemental hand finishing for machine finished pavement shall be kept to an absolute minimum. Any machine finishing operation which requires appreciable hand finishing, other than a moderate amount of straightedge finishing, shall be immediately stopped and proper adjustments made or the equipment replaced. Equipment, mixture, and/or procedures which produce more than 1/4 inch (6 mm) of mortar-rich surface shall be immediately modified as necessary to eliminate this condition or operations shall cease. Compensation shall be made for surging behind the screeds or extrusion plate and settlement during hardening and care shall be taken to ensure that paving and finishing machines are properly adjusted so that the finished surface of the concrete (not just the cutting edges of the screeds) will be at the required line and grade. Finishing equipment and tools shall be maintained clean and in an approved condition. At no time shall water be added to the surface of the slab with the finishing equipment or tools, or in any other way. Fog (mist) sprays or other surface applied finishing aids specified to prevent plastic shrinkage cracking, approved by the ~~RPR~~ ***OAR***, may be used in accordance with the manufacturers requirements.

A. Machine finishing with slipform pavers

The slipform paver shall be operated so that only a very minimum of additional finishing work is required to produce pavement surfaces and edges meeting the specified tolerances. Any equipment or procedure that fails to meet these specified requirements shall immediately be replaced or modified as necessary. A self-propelled non-rotating pipe float may be used while the concrete is still plastic, to remove minor irregularities and score marks. Only one pass of the pipe float shall be allowed. Equipment, mixture, and/or procedures which produce more than 1/4 inch (6 mm) of mortar-rich surface shall be immediately modified as necessary to eliminate this condition or operations shall cease. Remove excessive slurry from the surface with a cutting straightedge and wipe off the edge. Any slurry which does run down the vertical edges shall be immediately removed by hand, using stiff brushes or scrapers. No slurry, concrete or concrete mortar shall be used to build up along the edges of the pavement to compensate for excessive edge slump, either while the concrete is plastic or after it hardens.

B. Machine finishing with fixed forms

The machine shall be designed to straddle the forms and shall be operated to screed and consolidate the concrete. Machines that cause displacement of the forms shall be replaced. The machine shall make only one pass over each area of pavement. If the equipment and procedures do not produce a surface of uniform texture, true to grade, in one pass, the operation shall be immediately stopped and the equipment, mixture, and procedures adjusted as necessary.

C. Other types of finishing equipment

Clary screeds, other rotating tube floats, or bridge deck finishers are not allowed on mainline paving, but may be allowed on irregular or odd-shaped slabs, and near buildings or trench drains, subject to the ~~RPR's~~ ***OAR's*** approval.

Bridge deck finishers shall have a minimum operating weight of 7500 pounds (3400 kg) and shall have a transversely operating carriage containing a knock-down auger and a minimum of two immersion vibrators. Vibrating screeds or pans shall be used only for isolated slabs where hand finishing is permitted as specified, and only where specifically approved.

D. Hand finishing

Hand finishing methods will not be permitted, except under the following conditions: (1) in the event of breakdown of the mechanical equipment, hand methods may be used to finish the concrete already deposited on the grade and (2) in areas of narrow widths or of irregular dimensions where operation of the mechanical equipment is impractical.

E. Straightedge testing and surface correction

After the pavement has been struck off and while the concrete is still plastic, it shall be tested for trueness with a 12-foot (3.7-m) finishing straightedge swung from handles capable of spanning at least one-half the width of the slab. The straightedge shall be held

in contact with the surface in successive positions parallel to the centerline and the whole area gone over from one side of the slab to the other, as necessary. Advancing shall be in successive stages of not more than one-half the length of the straightedge. Any excess water and laitance in excess of 1/8 inch (3 mm) thick shall be removed from the surface of the pavement and wasted. Any depressions shall be immediately filled with freshly mixed concrete, struck off, consolidated, and refinished. High areas shall be cut down and refinished. Special attention shall be given to assure that the surface across joints meets the smoothness requirements. Straightedge testing and surface corrections shall continue until the entire surface is found to be free from observable departures from the straightedge and until the slab conforms to the required grade and cross-section. The use of long-handled wood floats shall be confined to a minimum; they may be used only in emergencies and in areas not accessible to finishing equipment.

4.12 SURFACE TEXTURE

The surface of the pavement shall be finished as designated below for all newly constructed concrete pavements. It is important that the texturing equipment not tear or unduly roughen the pavement surface during the operation. The texture shall be uniform in appearance and approximately 1/16 inch (2 mm) in depth. Any imperfections resulting from the texturing operation shall be corrected to the satisfaction of the ~~RPR~~ ***OAR***.

A. Brush or broom finish

Shall be applied when the water sheen has practically disappeared. The equipment shall operate transversely across the pavement surface. ***All 6" raised sidewalk pavement sections shall receive a brush or broom finish.***

B. Burlap drag finish

Not used.

C. Artificial turf finish

Not used.

4.13 CURING

Immediately after finishing operations are completed and bleed water is gone from the surface, all exposed surfaces of the newly placed concrete shall be cured for a 7-day cure period in accordance with one of the methods below. Failure to provide sufficient cover material of whatever kind the Contractor may elect to use, or lack of water to adequately take care of both curing and other requirements, shall be cause for immediate suspension of concreting operations. The concrete shall not be left exposed for more than 1/2 hour during the curing period.

When a two-saw-cut method is used to construct the contraction joint, the curing compound shall be applied to the saw-cut immediately after the initial cut has been made. The sealant reservoir shall not be sawed until after the curing period has been completed. When the one cut method is used to construct the contraction joint, the joint shall be cured with wet rope, wet rags, or wet blankets. The rags, ropes, or blankets shall be kept moist for the duration of the curing period.

A. Impervious membrane method

Curing with liquid membrane compounds should not occur until bleed and surface moisture has evaporated. All exposed surfaces of the pavement shall be sprayed uniformly with white pigmented curing compound immediately after the finishing of the surface and before the set of the concrete has taken place. The curing compound shall not be applied during rainfall. Curing compound shall be applied by mechanical sprayers under pressure at the rate of one gallon (4 liters) to not more than 150 square feet (14 sq m). The spraying equipment shall be of the fully atomizing type equipped with a tank agitator. At the time of use, the compound shall be in a thoroughly mixed condition with the pigment uniformly dispersed throughout the vehicle. During application, the compound shall be stirred continuously by mechanical means. Hand spraying of odd widths or shapes and concrete surfaces exposed by the removal of forms will be permitted. When hand spraying is approved by the ~~RPR~~ ***OAR***, a double application rate shall be used to ensure coverage. Should the film become damaged from any cause, including sawing operations, within the required curing period, the damaged portions shall be repaired immediately with additional compound or other approved means. Upon removal of side forms, the sides of the exposed slabs shall be protected immediately to provide a curing treatment equal to that provided for the surface.

B. White burlap-polyethylene sheets

The surface of the pavement shall be entirely covered with the sheeting. The sheeting used shall be such length (or width) that it will extend at least twice the thickness of the pavement beyond the edges of the slab. The sheeting shall be placed so that the entire surface and both edges of the slab are completely covered. The sheeting shall be placed and weighted to remain in contact with the surface covered, and the covering shall be maintained fully saturated and in position for seven (7) days after the concrete has been placed.

C. Water method

The entire area shall be covered with burlap or other water absorbing material. The material shall be of sufficient thickness to retain water for adequate curing without excessive runoff. The material shall be kept wet at all times and maintained for seven (7) days. When the forms are stripped, the vertical walls shall also be kept moist. It shall be the responsibility of the Contractor to prevent ponding of the curing water on the subbase.

D. Concrete protection for cold weather

Maintain the concrete at a temperature of at least 50°F (10°C) for a period of 72 hours after placing and at a temperature above freezing for the remainder of the 7-day curing period. The Contractor shall be responsible for the quality and strength of the concrete placed during cold weather; and any concrete damaged shall be removed and replaced at the Contractor's expense.

E. Concrete protection for hot weather

Concrete should be continuous moisture cured for the entire curing period and shall commence as soon as the surfaces are finished and continue for at least 24 hours. However, if moisture curing is not practical beyond 24 hours, the concrete surface shall be protected from drying with application of a liquid membrane-forming curing compound while the surfaces are still damp. Other curing methods may be approved by the ~~RPR~~ ***OAR***.

4.14 REMOVING FORMS

Unless otherwise specified, forms shall not be removed from freshly placed concrete until it has hardened sufficiently to permit removal without chipping, spalling, or tearing. After the forms have been removed, the sides of the slab shall be cured in accordance with paragraph 4.13.

If honeycombed areas are evident when the forms are removed, materials, placement, and consolidation methods must be reviewed and appropriate adjustments made to assure adequate consolidation at the edges of future concrete placements. Honeycombed areas that extend into the slab less than approximately 1 inch (25 mm), shall be repaired with an approved grout, as directed by the ~~RPR~~ ***OAR***. Honeycombed areas that extend into the slab greater than a depth of 1 inch (25 mm) shall be considered as defective work and shall be removed and replaced in accordance with paragraph 4.19.

4.15 SAW-CUT GROOVING

~~If shown on the plans, grooved surfaces shall be provided in accordance with the requirements of Item P-621~~.

4.16 SEALING JOINTS

The joints in the pavement shall be sealed in accordance with Items P-604 and P-605.

4.17 PROTECTION OF PAVEMENT

The Contractor shall protect the pavement and its appurtenances against both public traffic and traffic caused by the Contractor's employees and agents until accepted by the ~~RPR~~ ***OAR***. This shall include watchmen to direct traffic and the erection and maintenance of warning signs, lights, pavement bridges, crossovers, and protection of unsealed joints from intrusion of foreign material, etc. Any damage to the pavement occurring prior to final acceptance shall be repaired or the pavement replaced at the Contractor's expense.

Aggregates, rubble, or other similar construction materials shall not be placed on airfield pavements. Traffic shall be excluded from the new pavement by erecting and maintaining barricades and signs until the concrete is at least seven (7) days old, or for a longer period if directed by the ~~RPR~~ ***OAR***.

In paving intermediate lanes between newly paved pilot lanes, operation of the hauling and paving equipment will be permitted on the new pavement after the pavement has been cured for seven (7) days, the joints are protected, the concrete has attained a minimum field cured flexural strength of 450 psi (3100 kPa), and the slab edge is protected.

All new and existing pavement carrying construction traffic or equipment shall be kept clean and spillage of concrete and other materials shall be cleaned up immediately.

Damaged pavements shall be removed and replaced at the Contractor's expense. Slabs shall be removed to the full depth, width, and length of the slab.

4.18 OPENING TO CONSTRUCTION TRAFFIC

The pavement shall not be opened to traffic until test specimens molded and cured in accordance with ASTM C31 have attained a flexural strength of 450 pounds per square inch (3100 kPa) when tested in accordance with ASTM C78. If such tests are not conducted, the pavement shall not be opened to traffic until 14 days after the concrete was placed. Prior to opening the pavement to construction traffic, all joints shall either be sealed or protected from damage to the joint edge and intrusion of foreign materials into the joint. As a minimum, backer rod or tape may be used to protect the joints from foreign matter intrusion.

4.19 REPAIR, REMOVAL, OR REPLACEMENT OF SLABS

New pavement slabs that are broken or contain cracks or are otherwise defective or unacceptable as defined by acceptance criteria in paragraph 6.6 shall be removed and replaced or repaired, as directed by the ~~RPR~~ ***OAR***, at the Contractor's expense. Spalls along joints shall be repaired as specified. Removal of partial slabs is not permitted. Removal and replacement shall be full depth, shall be full width of the slab, and the limit of removal shall be normal to the paving lane and to each original transverse joint. The ~~RPR~~ ***OAR*** will determine whether cracks extend full depth of the pavement and may require cores to be drilled on the crack to determine depth of cracking. Such cores shall

be have a diameter of 2 inches (50 mm) to 4 inches (100 mm), shall be drilled by the Contractor and shall be filled by the Contractor with a well consolidated concrete mixture bonded to the walls of the hole with a bonding agent, using approved procedures. Drilling of cores and refilling holes shall be at no expense to the Owner. Repair of cracks as described in this section shall not be allowed if in the opinion of the ~~RPR~~ ***OAR*** the overall condition of the pavement indicates that such repair is unlikely to achieve an acceptable and durable finished pavement. No repair of cracks shall be allowed in any panel that demonstrates segregated aggregate with an absence of coarse aggregate in the upper 1/8 inch (3 mm) of the pavement surface.

A. Shrinkage cracks

Shrinkage cracks which do not exceed one-third of the pavement depth shall be cleaned and either high molecular weight methacrylate (HMWM) applied; or epoxy resin (Type IV, Grade 1) pressure injected using procedures recommended by the manufacturer and approved by the ~~RPR~~ ***OAR***. Sandblasting of the surface may be required following the application of HMWM to restore skid resistance. Care shall be taken to ensure that the crack is not widened during epoxy resin injection. All epoxy resin injection shall take place in the presence of the ~~RPR~~ ***OAR***. Shrinkage cracks which exceed one-third the pavement depth shall be treated as full depth cracks in accordance with paragraphs 4.19b and 19c.

B. Slabs with cracks through interior areas

Interior area is defined as that area more than 6 inches (150 mm) from either adjacent original transverse joint. The full slab shall be removed and replaced at no cost to the Owner, when there are any full depth cracks, or cracks greater than one-third the pavement depth, that extend into the interior area.

C. Cracks close to and parallel to joints

All full-depth cracks within 6 inches (150 mm) either side of the joint and essentially parallel to the original joints, shall be treated as follows.

1. Full depth cracks and original joint not cracked. The full-depth crack shall be treated as the new joint and the original joint filled with an epoxy resin.

   i. Full-depth crack. The joint sealant reservoir for the crack shall be formed by sawing to a depth of 3/4 inches (19 mm), ±1/16 inch (2 mm), and to a width of 5/8 inch (16 mm), ±1/8 inch (3 mm). The crack shall be sawed with equipment specially designed to follow random cracks. Any equipment or procedure which causes raveling or spalling along the crack shall be modified or replaced to prevent raveling or spalling. The joint shall be sealed with sealant in accordance with P-605 or as directed by the ~~RPR~~ ***OAR***.

   ii. Original joint. If the original joint sealant reservoir has been sawed out, the reservoir and as much of the lower saw cut as possible shall be filled with epoxy resin, Type IV, Grade 2, thoroughly tooled into the void using approved procedures.

If only the original narrow saw cut has been made, it shall be cleaned and pressure injected with epoxy resin, Type IV, Grade 1, using approved procedures.

Where a parallel crack goes part way across paving lane and then intersects and follows the original joint which is cracked only for the remained of the width, it shall be treated as specified above for a parallel crack, and the cracked original joint shall be prepared and sealed as originally designed.

2. Full depth cracks and original joint cracked. If there is any place in the lane width where a parallel crack and a cracked portion of the original joint overlap, the entire slab containing the crack shall be removed and replaced.

D. Removal and replacement of full slabs

Make a full depth cut perpendicular to the slab surface along all edges of the slab with a concrete saw cutting any dowels or tie-bars. Remove damaged slab protecting adjacent pavement from damage. Damage to adjacent slabs may result in removal of additional slabs as directed by the ~~RPR~~ ***OAR*** at the Contractor's expense.

The underlying material shall be repaired, re-compacted and shaped to grade.

Dowels of the size and spacing specified for other joints in similar pavement on the project shall be installed along all four (4) edges of the new slab in accordance with paragraph 4.10d.

Placement of concrete shall be as specified for original construction. The joints around the new slab shall be prepared and sealed as specified for original construction.

E. Spalls along joints

1. Spalls less than one inch wide and less than the depth of the joint sealant reservoir, shall be filled with joint sealant material.

2. Spalls larger than one inch and/or deeper than the joint reservoir, but less than ½ the slab depth, and less than 25% of the length of the adjacent joint shall be repaired as follows:

(a) Make a vertical saw cut at least one inch (25 mm) outside the spalled area and to a depth of at least 2 inches (50 mm). Saw cuts shall be straight lines forming rectangular areas surrounding the spalled area.

(b) Remove unsound concrete and at least 1/2 inch (12 mm) of visually sound concrete between the saw cut and the joint or crack with a light chipping hammer.

(c) Clean cavity with high-pressure water jets supplemented with compressed air as needed to remove all loose material.

(d) Apply a prime coat of epoxy resin, Type III, Grade I, to the dry, cleaned surface of all sides and bottom of the cavity, except any joint face.

(e) Fill the cavity with low slump concrete or mortar or with epoxy resin concrete or mortar.

(f) An insert or other bond-breaking medium shall be used to prevent bond at all joint faces.

(g) A reservoir for the joint sealant shall be sawed to the dimensions required for other joints, or as required to be routed for cracks. The reservoir shall be thoroughly cleaned and sealed with the sealer specified for the joints.

3. Spalls deeper than 1/2 of the slab depth or spalls longer than 25% of the adjacent joint require replacement of the entire slab.

F. Diamond grinding of Concrete surfaces

Diamond grinding shall be completed prior to pavement grooving. Diamond grinding of the hardened concrete should not be performed until the concrete is at least 14 days old and has achieved full minimum strength. Equipment that causes ravels, aggregate fractures, spalls or disturbance to the joints will not be permitted. The depth of diamond grinding shall not exceed 1/2 inch (13 mm) and all areas in which diamond grinding has been performed will be subject to the final pavement thickness tolerances specified.

Diamond grinding shall be performed with a machine specifically designed for diamond grinding capable of cutting a path at least 3 feet (0.9 m) wide. The saw blades shall be 1/8-inch (3-mm) wide with sufficient number of flush cut blades that create grooves between 0.090 and 0.130 inches (2 and 3.5 mm) wide; and peaks and ridges approximately 1/32 inch (1 mm) higher than the bottom of the grinding cut. The Contractor shall determine the number and type of blades based on the hardness of the aggregate. Contractor shall demonstrate to the ~~RPR~~ ***OAR*** that the grinding equipment will produce satisfactory results prior to making corrections to surfaces.

Grinding will be tapered in all directions to provide smooth transitions to areas not requiring grinding. The slurry resulting from the grinding operation shall be continuously removed and the pavement left in a clean condition. All grinding shall be at the expense of the Contractor.

4.20 RAISED SIDEWALK CONCRETE PAVEMENT

The Contractor shall adhere to all Construction Methods in this specification as is practicable. The OAR shall approve the use of methods included in Specification P-610 as applicable during construction.

4.21 Raising Existing Structures to Grade

Adjustments of existing structures to grade shall be completed according to the requirements of this Specification. The Contractor shall take appropriate measures to protect existing structures prior to raising to grade. Any damage to existing structures shall be repaired to the OAR's satisfaction at the Contractor's expense.

4.22 HURRICANE TIE-DOWNS

Hurricane tie-downs shall be installed in accordance with the manufacturer's recommendations. Mooring devices shall be cast in place with the pavement in accordance with the plans and details. The Contractor shall take appropriate measures to protect the mooring device during construction.

PART 5 - CONTRACTOR QUALITY CONTROL (CQC)

5.1 QUALITY CONTROL PROGRAM

The Contractor shall develop a Quality Control Program in accordance with Item C-100. No partial payment will be made for materials that are subject to specific quality control requirements without an approved quality control program.

5.2 CONTRACTOR QUALITY CONTROL (CQC)

The Contractor shall provide or contract for testing facilities in accordance with Item C-100. The ~~RPR~~ ***OAR*** shall be permitted unrestricted access to inspect the Contractor's QC facilities and witness QC activities. The ~~RPR~~ ***OAR*** will advise the Contractor in writing of any noted deficiencies concerning the QC facility, equipment, supplies, or testing personnel and procedures. When the deficiencies are serious enough to be adversely affecting the test results, the incorporation of the materials into the work shall be suspended immediately and will not be permitted to resume until the deficiencies are satisfactorily corrected.

5.3 CONTRACTOR QC TESTING

The Contractor shall perform all QC tests necessary to control the production and construction processes applicable to this specification and as set forth in the CQCP. The testing program shall include, but not necessarily be limited to, tests for aggregate gradation, aggregate moisture content, slump, and air content. A QC Testing Plan shall be developed and approved by the ~~RPR~~ ***OAR*** as part of the CQCP.

The ~~RPR~~ ***OAR*** may at any time, notwithstanding previous plant acceptance, reject and require the Contractor to dispose of any batch of concrete mixture which is rendered unfit for use due to contamination, segregation, or improper slump. Such rejection may be based on only visual inspection. In the event of such rejection, the Contractor may take a representative sample of the rejected material in the presence of the ~~RPR~~ ***OAR***, and if it can be demonstrated in the laboratory, in the presence of the ~~RPR~~ ***OAR***, that such material was erroneously rejected, payment will be made for the material at the contract unit price.

A. Fine aggregate

1. Gradation. A sieve analysis shall be made at least twice daily in accordance with ASTM C136 from randomly sampled material taken from the discharge gate of storage bins or from the conveyor belt.

2. Moisture content. If an electric moisture meter is used, at least two direct measurements of moisture content shall be made per week to check the calibration. If direct measurements are made in lieu of using an electric meter, two tests shall be made per day. Tests shall be made in accordance with ASTM C70 or ASTM C566.

3. Deleterious substances. Fine aggregate as delivered to the mixer shall be tested for deleterious substances in fine aggregate for concrete as specified in paragraph 2.1b, prior to production of the control strip, and a minimum of every 30-days during production or more frequently as necessary to control deleterious substances.

B. Coarse Aggregate

1. Gradation. A sieve analysis shall be made at least twice daily for each size of aggregate. Tests shall be made in accordance with ASTM C136 from randomly sampled material taken from the discharge gate of storage bins or from the conveyor belt.

2. Moisture content. If an electric moisture meter is used, at least two direct measurements of moisture content shall be made per week to check the calibration. If direct measurements are made in lieu of using an electric meter, two tests shall be made per day. Tests shall be made in accordance with ASTM C566.

3. Deleterious substances. Coarse aggregate as delivered to the mixer shall be tested for deleterious substances in coarse aggregate for concrete as specified in paragraph 2.1c, prior to production of the control strip, and a minimum of every 30-days during production or more frequently as necessary to control deleterious substances.

C. Slump

One test shall be made for each sublot. Slump tests shall be performed in accordance with ASTM C143 from material randomly sampled from material discharged from trucks at the paving site. Material samples shall be taken in accordance with ASTM C172.

D. Air content

One test shall be made for each sublot. Air content tests shall be performed in accordance with ASTM C231 for gravel and stone coarse aggregate and ASTM C173 for slag or other porous coarse aggregate, from material randomly sampled from trucks at the paving site. Material samples shall be taken in accordance with ASTM C172.

E. Unit weight and Yield

One test shall be made for each sublot. Unit weight and yield tests shall be in accordance with ASTM C138. The samples shall be taken in accordance with ASTM C172 and at the same time as the air content tests.

F. Temperatures

Temperatures shall be checked at least four times per lot at the job site in accordance with ASTM C1064.

G. Smoothness for Contractor Quality Control

The Contractor shall perform smoothness testing in transverse and longitudinal directions daily to verify that the construction processes are producing pavement with variances less than ¼ inch in 12 feet, identifying areas that may pond water which could lead to hydroplaning of aircraft. If the smoothness criteria is not met, appropriate changes and corrections to the construction process shall be made by the Contractor before construction continues**.**

The Contractor may use a 12-foot (3.7 m) straightedge, a rolling inclinometer meeting the requirements of ASTM E2133 or rolling external reference device that can simulate a 12-foot (3.7m) straightedge approved by the ~~RPR~~ ***OAR***. Straight-edge testing shall start with one-half the length of the straightedge at the edge of pavement section being tested and then moved ahead one-half the length of the straightedge for each successive measurement. Testing shall be continuous across all joints. The surface irregularity shall be determined by placing the freestanding (unleveled) straightedge on the pavement surface and allowing it to rest upon the two highest spots covered by its length, and measuring the maximum gap between the straightedge and the pavement surface in the area between the two high points. If the rolling inclinometer or external reference device is used, the data may be evaluated using the FAA profile program, ProFAA, or FHWA profile program ProVal, using the 12-foot straightedge simulation function.

Smoothness readings shall not be made across grade changes or cross slope transitions. The transition between new and existing pavement shall be evaluated separately for conformance with the plans.

1. Transverse measurements. Transverse measurements shall be taken for each day's production placed. Transverse measurements shall be taken perpendicular to the pavement centerline each 50 feet (15 m) or more often as determined by the ~~RPR~~ ***OAR***. The joint between lanes shall be tested separately to facilitate smoothness between lanes.

2. Longitudinal measurements. Longitudinal measurements shall be taken for each day's production placed. Longitudinal tests shall be parallel to the centerline of paving; at the center of paving lanes when widths of paving lanes are less than 20 feet (6 m); and at the third points of paving lanes when widths of paving lanes are 20 ft (6 m) or greater. When placement abuts previously placed material the first measurement shall start with one half the length of the straight edge on the previously placed material.

Deviations on the final surface course in either the transverse or longitudinal direction that will trap water greater than 1/4 inch (6 mm) shall be corrected with diamond grinding per paragraph 4.19f or by removing and replacing the surface course to full depth. Grinding shall be tapered in all directions to provide smooth transitions to areas not requiring grinding. All areas in which diamond grinding has been performed shall be subject to the final pavement thickness tolerances specified in paragraph 6.6.

Control charts shall be kept to show area of each day's placement and the percentage of corrective grinding required. Corrections to production and placement shall be initiated when corrective grinding is required. If the Contractor's machines and/or methods produce significant areas that need corrective actions in excess of 10 percent of a day's production, production shall be stopped until corrective measures are implemented by the Contractor.

H. Grade

Grade will be evaluated prior to and after placement of the concrete surface.

Measurements will be taken at appropriate gradelines (as a minimum at center and edges of paving lane) and longitudinal spacing as shown on cross-sections and plans. The final surface of the pavement will not vary from the gradeline elevations and cross-sections shown on the plans by more than 1/2 inch (12 mm) vertically and 0.1 feet (30 mm) laterally. The documentation will be provided by the Contractor to the ~~RPR~~ ***OAR*** within 48 hours.

Areas with humps or depression that that exceed grade or smoothness and that retain water on the surface must be ground off provided the course thickness after grinding is not more than 1/2 inch (12 mm) less than the thickness specified on the plans. If these areas cannot be corrected with grinding then the slabs that are retaining water must be removed and replaced in accordance with paragraph 4.19d. Grinding shall be in accordance with paragraph 4.19f. All corrections will be at the Contractors expense.

5.4 CONTROL CHARTS

The Contractor shall maintain linear control charts for fine and coarse aggregate gradation, slump, and air content. The Contractor shall also maintain a control chart plotting the coarseness factor/workability factor from the combined gradations in accordance with paragraph 2.1d.

Control charts shall be posted in a location satisfactory to the ~~RPR~~ ***OAR*** and shall be kept up to date at all times. As a minimum, the control charts shall identify the project number, the contract item number, the test number, each test parameter, the Action and suspension Limits, or Specification limits, applicable to each test parameter, and the Contractor's test results. The Contractor shall use the control charts as part of a process control system for identifying potential problems and assignable causes before they occur. If the Contractor's projected data during production indicates a potential problem and the Contractor is not taking satisfactory corrective action, the ~~RPR~~ ***OAR*** may halt production or acceptance of the material.

A. Fine and coarse aggregate gradation

The Contractor shall record the running average of the last five gradation tests for each control sieve on linear control charts. Superimposed on the control charts shall be the action and suspension limits. Gradation tests shall be performed by the Contractor per ASTM C136. The Contractor shall take at least two samples per lot to check the final gradation. Sampling shall be per ASTM D75 from the flowing aggregate stream or conveyor belt.

B. Slump and air content

The Contractor shall maintain linear control charts both for individual measurements and range (that is, difference between highest and lowest measurements) for slump and air content in accordance with the following Action and Suspension Limits.

C. Combined gradation. The Contractor shall maintain a control chart plotting the coarseness factor and workability factor on a chart in accordance with paragraph 2.1d.

Control Chart Limits[1]

Control Parameter	Individual Measurements	
	Action Limit	Suspension Limit
Gradation[2]	*[3]	*[3]
Coarseness Factor (CF)	±3.5	±5
Workability Factor (WF)	±2	±3
Slump	+0.5 to -1 inch (+13 to -25 mm)	+1 to -1.5 inch (+25 to -38 mm)
Air Content	±1.5%	±2.0%

[1] Control charts shall developed and maintained for each control parameter indicated.

[2] Control charts shall be developed and maintained for each sieve size.

[3] Action and suspension limits shall be determined by the Contractor.

5.5 CORRECTIVE ACTION AT SUSPENSION LIMIT

The CQCP shall indicate that appropriate action shall be taken when the process is believed to be out of control. The CQCP shall detail what action will be taken to bring the process into control and shall contain sets of rules to gauge when a process is out of control. As a minimum, a process shall be deemed out of control and corrective action taken if any one of the following conditions exists.

A. Fine and coarse aggregate gradation. When two consecutive averages of five tests are outside of the suspension limits, immediate steps, including a halt to production, shall be taken to correct the grading.

B. Coarseness and Workability factor. When the CF or WF reaches the applicable suspension limits, the Contractor, immediate steps, including a halt to production, shall be taken to correct the CF and WF.

C. Fine and coarse aggregate moisture content. Whenever the moisture content of the fine or coarse aggregate changes by more than 0.5%, the scale settings for the aggregate batcher and water batcher shall be adjusted.

D. Slump. The Contractor shall halt production and make appropriate adjustments whenever:

1. one point falls outside the Suspension Limit line for individual measurements

OR

2. two points in a row fall outside the Action Limit line for individual measurements.

E. Air content. The Contractor shall halt production and adjust the amount of air-entraining admixture whenever:

1. one point falls outside the Suspension Limit line for individual measurements

OR

2. two points in a row fall outside the Action Limit line for individual measurements.

PART 6 - MATERIAL ACCEPTANCE

6.1 QUALITY ASSURANCE (QA) ACCEPTANCE SAMPLING AND TESTING

All acceptance sampling and testing necessary to determine conformance with the requirements specified in this section, with the exception of coring for thickness determination, will be performed by the ~~RPR~~ ***OAR***. The Contractor shall provide adequate facilities for the initial curing of beams. The Contractor shall bear the cost of providing initial curing facilities and coring and filling operations, per paragraph 6.5b(1).

The samples will be transported while in the molds. The curing, except for the initial cure period, will be accomplished using the immersion in saturated lime water method. During the 24 hours after molding, the temperature immediately adjacent to the specimens must be maintained in the range of 60° to 80°F (16° to 27°C), and loss of moisture from the specimens must be prevented. The specimens may be stored in tightly constructed wooden boxes, damp sand pits, temporary buildings at construction sites, under wet burlap in favorable weather, or in heavyweight closed plastic bags, or using other suitable methods, provided the temperature and moisture loss requirements are met.

6.2 QUALITY ASSURANCE (QA) TESTING LABORATORY

Quality assurance testing organizations performing these acceptance tests will be accredited in accordance with ASTM C1077. The quality assurance laboratory accreditation must be current and listed on the accrediting authority's website. All test methods required for acceptance sampling and testing must be listed on the lab accreditation. A copy of the laboratory's current accreditation and accredited test methods will be submitted to the ~~RPR~~ ***OAR*** prior to start of construction.

6.3 LOT SIZE

Concrete will be accepted for strength and thickness on a lot basis. A lot will consist of a day's production not to exceed 2,000 cubic yards (1530 cubic meters). This is the equivalent of 4,000 square yards of 18-inch thick PCC or 6,000 SY of 12-inch thick PCC. Each lot will be divided into approximately equal sublots with individual sublots between 400 to 600 cubic yards. Where three sublots are produced, they will constitute a lot. Where one or two sublots are produced, they will be incorporated into the previous or next lot. Where more than one plant is simultaneously producing concrete for the job, the lot sizes will apply separately for each plant.

6.4 PARTIAL LOTS

When operational conditions cause a lot to be terminated before the specified number of tests have been made for the lot or for overages or minor placements to be considered as partial lots, the following procedure will be used to adjust the lot size and the number of tests for the lot.

Where three sublots have been produced, they will constitute a lot. Where one or two sublots have been produced, they will be incorporated into the next lot or the previous lot and the total number of sublots will be used in the acceptance criteria calculation, that is, n=5 or n=6.

6.5 ACCEPTANCE SAMPLING AND TESTING

A. Strength

1. Sampling. One sample will be taken for each sublot from the concrete delivered to the job site. Sampling locations will be determined by the ~~RPR~~ ***OAR*** in accordance with random sampling procedures contained in ASTM D3665. The concrete will be sampled in accordance with ASTM C172.

2. Test Specimens. The ~~RPR~~ ***OAR*** will be responsible for the casting, initial curing, transportation, and curing of specimens in accordance with ASTM C31. Two (2) specimens will be made from each sample and slump, air content, unit weight, and temperature tests will be conducted for each set of strength specimens. Within 24 to 48 hours, the samples will be transported from the field to the laboratory while in the molds. Samples will be cured in saturated lime water.

   The strength of each specimen will be determined in accordance with ASTM C78. The strength for each sublot will be computed by averaging the results of the two test specimens representing that sublot.

3. Acceptance. Acceptance of pavement for strength will be determined by the ~~RPR~~ ***OAR*** in accordance with paragraph 6.6b(1). All individual strength tests within a lot will be checked for outliers in accordance with ASTM E178, at a significance level of 5%. Outliers will be discarded and the remaining test values will be used to determine acceptance in accordance with paragraph 6.5b.

B. Pavement thickness

1. Sampling. One core will be taken by the Contractor for each sublot in the presence of the ~~RPR~~ ***OAR***. Sampling locations will be determined by the ~~RPR~~ ***OAR*** in accordance with random sampling procedures contained in ASTM D3665. Areas, such as thickened edges, with planned variable thickness, will be excluded from sample locations.

   Cores shall be a minimum 4 inch (100 mm) in diameter neatly cut with a core drill. The Contractor will furnish all tools, labor, and materials for cutting samples and filling the cored hole. Core holes will be filled by the Contractor with a non-shrink grout approved by the ~~RPR~~ ***OAR*** within one day after sampling.

2. Testing. The thickness of the cores will be determined by the ~~RPR~~ ***OAR*** by the average caliper measurement in accordance with ASTM C174. Each core shall be photographed and the photograph included with the test report.

3. Acceptance. Acceptance of pavement for thickness will be determined by the ~~RPR~~ ***OAR*** in accordance with paragraph 6.6.

6.6 ACCEPTANCE CRITERIA

A. General

Acceptance will be based on the following characteristics of the completed pavement discussed in paragraph 6.5b:

1. Strength

2. Thickness

3. Grade

4. ~~Profilograph smoothness~~

5. Adjustments for repairs

Acceptance for strength, thickness, and grade, will be based on the criteria contained in accordance with paragraph 6.6b(1), 6.6b(2), and 6.6b(3), respectively. Acceptance for profilograph smoothness will be based on the criteria contained in paragraph 6.6b(4).

Production quality must achieve 90 PWL or higher to receive full payment.

Strength and thickness will be evaluated for acceptance on a lot basis using the method of estimating PWL. Production quality must achieve 90 PWL or higher to receive full pavement. The PWL will be determined in accordance with procedures specified in Item C-110.

The lower specification tolerance limit (L) for strength and thickness will be:

Lower Specification Tolerance Limit (L)

Strength	0.93 × strength specified in paragraph 3.3
Thickness	Lot Plan Thickness in inches, - 0.50 in

B. Acceptance criteria

1. Strength. If the PWL of the lot equals or exceeds 90%, the lot will be acceptable. Acceptance and payment for the lot will be determined in accordance with paragraph 8.1.

2. Thickness. If the PWL of the lot equals or exceeds 90%, the lot will be acceptable. Acceptance and payment for the lot will be determined in accordance with paragraph 8.1.

3. Grade. The final finished surface of the pavement of the completed project will not vary from the gradeline elevations and cross-sections shown on the plans by more than 1/2 inch (12 mm) vertically [or 0.1 feet (30 mm) laterally]. The documentation, stamped and signed by a licensed surveyor shall be in accordance with paragraph 5.3h. Payment for sublots that do not meet grade for over 25% of the sublot shall reduced by 5% and not be more than 95%.

~~4. Profilograph roughness for QA Acceptance. The final profilograph shall be the full length of the project to facilitate testing of roughness between lots. The Contractor, in the presence of the RPR shall perform a profilograph roughness test on the completed project with a profilograph meeting the requirements of ASTM E1274 or a Class I inertial profiler meeting ASTM E950. Data and results shall be provided within 48 hrs of profilograph roughness tests.~~

~~The pavement shall have an average profile index less than 15 inches per mile per 1/10 mile. The equipment shall utilize electronic recording and automatic computerized reduction of data to indicate "must grind" bumps and the Profile Index for the pavement using a 0.2-inch (5 mm) blanking band. The bump template must span one inch (25 mm) with an offset of 0.4 inches (10 mm). The profilograph must be calibrated prior to use and operated by a factory or State DOT approved, trained operator. Profilograms shall be recorded on a longitudinal scale of one inch (25 mm) equals 25 feet (7.5 m) and a vertical scale of one inch (25 mm) equals one inch (25 mm). Profilograph shall be performed one foot right and left of project centerline and 15 feet (4.5 m) right and left of project centerline. Any areas that indicate "must grind" shall be corrected with diamond grinding per paragraph 4.19f or by removing and replacing full depth of surface course. as directed by the RPR. Where corrections are necessary, a second profilograph run shall be performed to verify that the corrections produced an average profile index of 15 inches per mile per 1/10 mile or less.~~

5. Adjustments for repair. Sublots with spall repairs, crack repairs, or partial panel replacement, will be limited to no more than 95% payment.

6. Adjustment for grinding. For sublots with grinding over 25% of a sublot, payment will be reduced 5%.

6.7 ***RAISED SIDEWALK CONCRETE PAVEMENT***

Concrete for each day's placement will be accepted on the basis of the compressive strength as specified in Specification P-610, Section 4.1. The OAR will sample the concrete in accordance with ASTM C172; test the slump in accordance with ASTM C143; test air content in accordance with ASTM C231; make and cure compressive strength specimens in accordance with ASTM C31; and test in accordance with ASTM C39. The QA testing agency will meet the requirements of ASTM C1077.

The Contractor shall provide adequate facilities for the initial curing of cylinders.

PART 7 - METHOD OF MEASUREMENT

7.1 Concrete pavement shall be measured by the number of square yards ~~(square meters)~~ of plain or reinforced pavement as specified in-place, completed and accepted.

7.2 Raised sidewalk concrete pavement shall be measured by the number of square yards of plain reinforced pavement as specified in-place, completed and accepted.

7.3 Adjustment of structures to grade shall be measured and paid for individually within the Airside Concourse work area. Adjustment of structures to grade is incidental to associated items of work within the Airfield Civil work area.

7.4 Hurricane tie-downs shall be measured by each number (EA) of mooring devices installed as specified, completed and accepted by the OAR.

PART 8 - BASIS OF PAYMENT

8.1 PAYMENT

Payment for concrete pavement meeting all acceptance criteria as specified in paragraph 6.6. Acceptance Criteria shall be based on results of strength, smoothness, and thickness tests. Payment for acceptable lots of concrete pavement shall be adjusted in accordance with paragraph 8.1a for strength and thickness; 8.1b for repairs; 8.1c for grinding; and 8.1d for smoothness, subject to the limitation that:

The total project payment for concrete pavement shall not exceed 100 percent of the product of the contract unit price and the total number of square yards (square meters) of concrete pavement used in the accepted work (See Note 1 under the Price Adjustment Schedule table below).

Payment shall be full compensation for all labor, materials, tools, equipment, and incidentals required to complete the work as specified herein and on the drawings.

A. Basis of adjusted payment

The pay factor for each individual lot shall be calculated in accordance with the Price Adjustment Schedule table below. A pay factor shall be calculated for both strength and thickness. The lot pay factor shall be the higher of the two values when calculations for both strength and thickness are 100% or higher. The lot pay factor shall be the product of the two values when only one of the calculations for either strength or thickness is 100% or higher. The lot pay factor shall be the lower of the two values when calculations for both strength and thickness are less than 100%.

Price Adjustment Schedule[1]

Percentage of Materials Within Specification Limits (PWL)	Lot Pay Factor (Percent of Contract Unit Price)
96 – 100	106
90 – 95	PWL + 10
75 – 90	0.5 PWL + 55
55 – 74	1.4 PWL – 12
Below 55	Reject[2]

[1] Although it is theoretically possible to achieve a pay factor of 106% for each lot, actual payment in excess of 100% shall be subject to the total project payment limitation specified in paragraph 8.1.

[2] The lot shall be removed and replaced unless, after receipt of FAA concurrence, the Owner and Contractor agree in writing that the lot will remain; the lot paid at 50% of the contract unit price; and the total project payment limitation reduced by the amount withheld for that lot.

For each lot accepted, the adjusted contract unit price shall be the product of the lot pay factor for the lot and the contract unit price. Payment shall be subject to the total project payment limitation specified in paragraph 8.1. Payment in excess of 100% for accepted lots of concrete pavement shall be used to offset payment for accepted lots of concrete pavement that achieve a lot pay factor less than 100%; except for rejected lots which remain in place and/or sublots with adjustments for repairs.

B. Adjusted payment for repairs

The PWL lot pay factor shall be reduced by 5% and be no higher than 95% for sublots which contain repairs in accordance with paragraph 4.19 on more than 20% of the slabs within the sublot. Payment factors greater than 100 percent for the strength and thickness cannot be used to offset adjustments for repairs.

C. Adjusted payment for grinding

The PWL lot pay factor shall be reduced by 5% and be no higher than 95% for sublots with grinding over 25% of a sublot.

~~D. Profilograph Roughness~~

~~The Contractor will receive full payment when the profilograph average profile index is in accordance with paragraph 6.6b(4). When the final average profile index for the entire length of pavement does not exceed 15 inches per mile per 1/10 mile, payment will be made at the contract unit price for the completed pavement.~~

E. ***Raised sidewalk concrete pavement***

No PWL lot pay factors shall be applied to concrete placed as raised sidewalk concrete pavement.

F. Payment

Payment shall be made under:

Item P-501-8.1	18” Aircraft Rated Concrete Pavement	- per Square Yard (SY)
Item P-501-8.2	12” Non-Aircraft Rated Concrete Pavement	- per Square Yard (SY)
Item P-501-8.3	6” Raised Sidewalk Concrete Pavement	- per Square Yard (SY)

Item P-501-8.4	Raise Existing Structures to Grade	- per Each (EA)
Item P-501-8.5	Hurricane Tie-Down	- per Each (EA)

REFERENCES

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

ASTM International (ASTM)

ASTM A184	Standard Specification for Welded Deformed Steel Bar Mats for Concrete Reinforcement
ASTM A615	Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
ASTM A704	Standard Specification for Welded Steel Plain Bar or Rod Mats for Concrete Reinforcement
ASTM A706	Standard Specification for Low-Alloy Steel Deformed and Plain Bars for Concrete Reinforcement
ASTM A775	Standard Specification for Epoxy-Coated Steel Reinforcing Bars
ASTM A884	Standard Specification for Epoxy-Coated Steel Wire and Welded Wire Reinforcement
ASTM A934	Standard Specification for Epoxy-Coated Prefabricated Steel Reinforcing Bars
ASTM A996	Standard Specification for Rail-Steel and Axle-Steel Deformed Bars for Concrete Reinforcement
ASTM A1035	Standard Specification for Deformed and Plain, Low-Carbon, Chromium, Steel Bars for Concrete Reinforcement
ASTM A1064	Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete
ASTM A1078	Standard Specification for Epoxy-Coated Steel Dowels for Concrete Pavement
ASTM C29	Standard Test Method for Bulk Density (“Unit Weight”) and Voids in Aggregate

ASTM C31	Standard Practice for Making and Curing Concrete Test Specimens in the Field
ASTM C33	Standard Specification for Concrete Aggregates
ASTM C39	Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens
ASTM C70	Standard Test Method for Surface Moisture in Fine Aggregate
ASTM C78	Standard Test Method for Flexural Strength of Concrete (Using Simple Beam with Third-Point Loading)
ASTM C88	Standard Test Method for Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate
ASTM C94	Standard Specification for Ready-Mixed Concrete
ASTM C114	Standard Test Methods for Chemical Analysis of Hydraulic Cement
ASTM C117	Standard Test Method for Materials Finer than 75-µm (No. 200) Sieve in Mineral Aggregates by Washing
ASTM C123	Standard Test Method for Lightweight Particles in Aggregate
ASTM C136	Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates
ASTM C131	Standard Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
ASTM C136	Standard Test Method for Sieve or Screen Analysis of Fine and Coarse Aggregates
ASTM C138	Standard Test Method for Density (Unit Weight), Yield, and Air Content (Gravimetric) of Concrete
ASTM C142	Standard Test Method for Clay Lumps and Friable Particles in Aggregates
ASTM C143	Standard Test Method for Slump of Hydraulic-Cement Concrete
ASTM C150	Standard Specification for Portland Cement
ASTM C171	Standard Specification for Sheet Materials for Curing Concrete
ASTM C172	Standard Practice for Sampling Freshly Mixed Concrete

ASTM C173	Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method
ASTM C174	Standard Test Method for Measuring Thickness of Concrete Elements Using Drilled Concrete Cores
ASTM C227	Standard Test Method for Potential Alkali Reactivity of Cement-Aggregate Combinations (Mortar-Bar Method)
ASTM C231	Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method
ASTM C260	Standard Specification for Air-Entraining Admixtures for Concrete
ASTM C295	Standard Guide for Petrographic Examination of Aggregates for Concrete
ASTM C309	Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete
ASTM C311	Standard Test Methods for Sampling and Testing Fly Ash or Natural Pozzolans for Use in Portland Cement Concrete
ASTM C494	Standard Specification for Chemical Admixtures for Concrete
ASTM C566	Standard Test Method for Total Evaporable Moisture Content of Aggregates by Drying
ASTM C595	Standard Specification for Blended Hydraulic Cements
ASTM C618	Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete
ASTM C642	Standard Test Method for Density, Absorption, and Voids in Hardened Concrete
ASTM C666	Standard Test Method for Resistance of Concrete to Rapid Freezing and Thawing
ASTM C685	Standard Specification for Concrete Made by Volumetric Batching and Continuous Mixing
ASTM C881	Standard Specification for Epoxy-Resin-Base Bonding Systems for Concrete
ASTM C989	Standard Specification for Slag Cement for Use in Concrete and Mortars

ASTM C1017	Standard Specification for Chemical Admixtures for Use in Producing Flowing Concrete
ASTM C1064	Test Method for Temperature of Freshly Mixed Hydraulic-Cement Concrete
ASTM C1077	Standard Practice for Agencies Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Testing Agency Evaluation
ASTM C1157	Standard Performance Specification for Hydraulic Cement
ASTM C1260	Standard Test Method for Potential Alkali Reactivity of Aggregates (Mortar-Bar Method)
ASTM C1365	Standard Test Method for Determination of the Proportion of Phases in Portland Cement and Portland-Cement Clinker Using X-Ray Powder Diffraction Analysis
ASTM C1567	Standard Test Method for Determining the Potential Alkali-Silica Reactivity of Combinations of Cementitious Materials and Aggregate (Accelerated Mortar-Bar Method)
ASTM C1602	Standard Specification for Mixing Water Used in the Production of Hydraulic Cement Concrete
ASTM D75	Standard Practice for Sampling Aggregates
ASTM D1751	Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types)
ASTM D1752	Standard Specification for Preformed Sponge Rubber and Cork and Recycled PVC Expansion Joint Fillers for Concrete Paving and Structural Construction
ASTM D2419	Standard Test Method for Sand Equivalent Value of Soils and Fine Aggregate
ASTM D3665	Standard Practice for Random Sampling of Construction Materials
ASTM D4791	Standard Test Method for Flat Particles, Elongated Particles, or Flat and Elongated Particles in Coarse Aggregate
ASTM E178	Standard Practice for Dealing with Outlying Observations
ASTM E1274	Standard Test Method for Measuring Pavement Roughness Using a Profilograph

ASTM E2133	Standard Test Method for Using a Rolling Inclinometer to Measure Longitudinal and Transverse Profiles of a Traveled Surface

American Concrete Institute (ACI)

ACI 305R	Guide to Hot Weather Concreting
ACI 306R	Guide to Cold Weather Concreting
ACI 309R	Guide for Consolidation of Concrete

Advisory Circulars (AC)

AC 150/5320-6	Airport Pavement Design and Evaluation

Federal Highway Administration (FHWA)

HIPERPAV 3, version 3.2

Portland Concrete Association (PCA)

PCA	Design and Control of Concrete Mixtures, 16th Edition

U.S. Army Corps of Engineers (USACE) Concrete Research Division (CRD)

CRD C662	Determining the Potential Alkali-Silica Reactivity of Combinations of Cementitious Materials, Lithium Nitrate Admixture and Aggregate (Accelerated Mortar-Bar Method)

United States Air Force Engineering Technical Letter (ETL)

ETL 97-5	Proportioning Concrete Mixtures with Graded Aggregates for Rigid Airfield Pavements

END OF SECTION P-501

ITEM P-602 - EMULSIFIED ASPHALT PRIME COAT

PART 1 - DESCRIPTION

1.1 This item shall consist of an application of emulsified asphalt material on the prepared base course in accordance with these specifications and in reasonably close conformity to the lines shown on the plans.

PART 2 - MATERIALS

2.1 EMULSIFIED ASPHALT MATERIAL

The emulsified asphalt material shall be as specified in ASTM D3628 for use as a prime coat appropriate to local conditions. The Contractor shall provide a copy of the manufacturer's Certificate of Analysis (COA) for the emulsified asphalt material. The COA shall be provided to and approved by the ~~Resident Project Representative (RPR)~~ ***Owner's Authorized Representative (OAR)*** before the emulsified asphalt material is applied. The furnishing of the COA for the emulsified asphalt material shall not be interpreted as a basis for final acceptance. The manufacturer's COA may be subject to verification by testing the material delivered for use on the project.

PART 3 - CONSTRUCTION METHODS

3.1 WEATHER LIMITATIONS

The emulsified asphalt prime coat shall be applied only when the existing surface is dry; the atmospheric temperature is 50°F (10°C) or above, and the temperature has not been below 35°F (2°C) for the 12 hours prior to application; and when the weather is not foggy or rainy. The temperature requirements may be waived when directed by the ~~RPR~~ ***OAR***.

3.2 EQUIPMENT

The equipment shall include a self-powered pressure asphalt material distributor and equipment for heating asphalt material.

Provide a distributor with pneumatic tires of such size and number that the load produced on the base surface does not exceed 65.0 psi (4.5 kg/sq cm) of tire width to prevent rutting, shoving or otherwise damaging the base, surface or other layers in the pavement structure. Design and equip the distributor to spray the asphalt material in a uniform coverage at the specified temperature, at readily determined and controlled rates from 0.05 to 1.0 gallons per square yard (0.23 to 4.5 L/square meter), with a pressure range of 25 to 75 psi (172.4 to 517.1 kPa) and with an allowable variation from the specified rate of not more than ±5%, and at variable widths. Include with the distributor equipment a separate power unit for the bitumen pump, full-circulation spray bars, tachometer,

pressure gauges, volume-measuring devices, adequate heaters for heating of materials to the proper application temperature, a thermometer for reading the temperature of tank contents, and a hand hose attachment suitable for applying asphalt material manually to areas inaccessible to the distributor. Equip the distributor to circulate and agitate the asphalt material during the heating process. If the distributor is not equipped with an operable quick shutoff valve, the prime operations shall be started and stopped on building paper.

A power broom and power blower suitable for cleaning the surfaces to which the asphalt coat is to be applied shall be provided.

Asphalt distributors must be calibrated annually in accordance with ASTM D2995. The Contractor must furnish a current calibration certification for the asphalt distributor truck from any State or other agency as approved by the ~~RPR~~ ***OAR***.

3.3 APPLICATION OF EMULSIFIED ASPHALT MATERIAL

Immediately before applying the prime coat, the full width of the surface to be primed shall be swept with a power broom to remove all loose dirt and other objectionable material.

The asphalt emulsion material shall be uniformly applied with an asphalt distributor at the rate of 0.15 to 0.30 gallons per square yard (0.68 to 1.36 liters per square meter) depending on the base course surface texture. The type of asphalt material and application rate shall be approved by the ~~RPR~~ ***OAR*** prior to application.

Following application of the emulsified asphalt material and prior to application of the succeeding layer of pavement, allow the asphalt coat to cure and to obtain evaporation of any volatiles or moisture. Maintain the coated surface until the succeeding layer of pavement is placed, by protecting the surface against damage and by repairing and recoating deficient areas. Allow the prime coat to cure without being disturbed for a period of at least 48 hours or longer, as may be necessary to attain penetration into the treated course. Furnish and spread sand to effectively blot up and cure excess asphalt material. The Contractor shall remove blotting sand prior to asphalt concrete lay down operations at no additional expense to the Owner. Keep traffic off surfaces freshly treated with asphalt material. Provide sufficient warning signs and barricades so that traffic will not travel over freshly treated surfaces.

3.4 TRIAL APPLICATION RATES

The Contractor shall apply a minimum of three lengths of at least 100 feet (30 m) for the full width of the distributor bar to evaluate the amount of emulsified asphalt material that can be satisfactorily applied with the equipment. Apply three different application rates of emulsified asphalt materials within the application range specified in paragraph 3.3. Other trial applications can be made using various amounts of material as directed by the ~~RPR~~ ***OAR***. The trial application is to demonstrate the equipment can uniformly apply the emulsified asphalt material within the rates specified and determine the application rate for the project.

3.5 FREIGHT AND WAYBILLS

The Contractor shall submit waybills and delivery tickets during the progress of the work. Before the final estimate is allowed, file with the ~~RPR~~ ***OAR*** certified waybills and certified delivery tickets for all emulsified asphalt materials used in the construction of the pavement covered by the contract. Do not remove emulsified asphalt material from storage until the initial outage and temperature measurements have been taken. The delivery or storage units will not be released until the final outage has been taken.

PART 4 - METHOD OF MEASUREMENT

4.1 The emulsified asphalt material for prime coat shall be measured by the gallon (liter). Volume shall be corrected to the volume at 60°F (16°C) in accordance with ASTM D4311. The emulsified asphalt material paid for will be the measured quantities used in the accepted work, provided that the measured quantities are not 10% over the specified application rate. Any amount of emulsified asphalt material more than 10% over the specified application rate for each application will be deducted from the measured quantities, except for irregular areas where hand spraying of the emulsified asphalt material is necessary. Water added to emulsified asphalt will not be measured for payment.

Application rates shall be determined using before and after readings of volume, in gallons, provided by the Contractor, for each work areas. The OAR shall determine the application rate by recording the volume provided over the area applied, in square yards. Application rates and an exhibit demonstrating the area of work shall be provided to the Engineer by the OAR at the end of the day's work.

PART 5 - BASIS OF PAYMENT

5.1 Payment shall be made at the contract unit price per gallon (liter) for emulsified asphalt prime coat. This price shall be full compensation for furnishing all materials and for all preparation, delivering, and applying the materials, and for all labor, equipment, tools, and incidentals necessary to complete this item.

Payment will be made under:

Item P-602-5.1	Emulsified Asphalt Prime Coat	- per Gallon (GAL)

PART 6 - REFERENCES

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

ASTM International (ASTM)

ASTM D2995	Standard Practice for Estimating Application Rate and Residual Application Rate of Bituminous Distributors
ASTM D3628	Standard Practice for Selection and Use of Emulsified Asphalts

END OF ITEM P-602

ITEM P-603 - EMULSIFIED ASPHALT TACK COAT

PART 1 - DESCRIPTION

1.1 This item shall consist of preparing and treating an asphalt or concrete surface with asphalt material in accordance with these specifications and in reasonably close conformity to the lines shown on the plans.

PART 2 - MATERIALS

2.1 ASPHALT MATERIALS

The asphalt material shall be an emulsified asphalt as specified in ASTM D3628 as an asphalt application for tack coat appropriate to local conditions. The emulsified asphalt shall not be diluted. The Contractor shall provide a copy of the manufacturer's Certificate of Analysis (COA) for the asphalt material to the ~~Resident Project Representative (RPR)~~ ***Owner's Authorized Representative (OAR)*** before the asphalt material is applied for review and acceptance. The furnishing of COA for the asphalt material shall not be interpreted as a basis for final acceptance. The manufacturer's COA may be subject to verification by testing the material delivered for use on the project.

PART 3 - CONSTRUCTION METHODS

3.1 WEATHER LIMITATIONS

The tack coat shall be applied only when the existing surface is dry and the atmospheric temperature is 50°F (10°C) or above; the temperature has not been below 35°F (2°C) for the 12 hours prior to application; and when the weather is not foggy or rainy. The temperature requirements may be waived when directed by the ~~RPR~~ ***OAR***.

3.2 EQUIPMENT

The Contractor shall provide equipment for heating and applying the emulsified asphalt material. The emulsion shall be applied with a manufacturer-approved computer rate-controlled asphalt distributor. The equipment shall be in good working order and contain no contaminants or diluents in the tank. Spray bar tips must be clean, free of burrs, and of a size to maintain an even distribution of the emulsion. Any type of tip or pressure source is suitable that will maintain predetermined flow rates and constant pressure during the application process with application speeds under eight (8) miles per hour (13 km per hour) or seven (700) feet per minute (213 m per minute).

The equipment will be tested under pressure for leaks and to ensure proper set-up before use to verify truck set-up (via a test-shot area), including but not limited to, nozzle tip size appropriate for application, spray-bar height and pressure and pump speed, evidence of

triple-overlap spray pattern, lack of leaks, and any other factors relevant to ensure the truck is in good working order before use.

The distributor truck shall be equipped with a minimum 12-foot (3.7-m) spreader spray bar with individual nozzle control with computer-controlled application rates. The distributor truck shall have an easily accessible thermometer that constantly monitors the temperature of the emulsion, and have an operable mechanical tank gauge that can be used to cross-check the computer accuracy. If the distributor is not equipped with an operable quick shutoff valve, the prime operations shall be started and stopped on building paper.

The distributor truck shall be equipped to effectively heat and mix the material to the required temperature prior to application as required. Heating and mixing shall be done in accordance with the manufacturer's recommendations. Do not overheat or over mix the material.

The distributor shall be equipped with a hand sprayer.

Asphalt distributors must be calibrated annually in accordance with ASTM D2995. The Contractor must furnish a current calibration certification for the asphalt distributor truck from any State or other agency as approved by the ~~RPR~~ ***OAR***.

A power broom and/or power blower suitable for cleaning the surfaces to which the asphalt tack coat is to be applied shall be provided.

3.3 APPLICATION OF EMULSIFIED ASPHALT MATERIAL

The emulsified asphalt shall not be diluted. Immediately before applying the emulsified asphalt tack coat, the full width of surface to be treated shall be swept with a power broom and/or power blower to remove all loose dirt and other objectionable material.

The emulsified asphalt material shall be uniformly applied with an asphalt distributor at the rates appropriate for the conditions and surface specified in the table below. The type of asphalt material and application rate shall be approved by the ~~RPR~~ ***OAR*** prior to application.

Emulsified Asphalt

Surface Type	Residual Rate, gal/SY (L/square meter)	Emulsion Application Bar Rate, gal/SY (L/square meter)
New asphalt	0.02-0.05 (0.09-0.23)	0.03-0.07 (0.13-0.32)
Existing asphalt	0.04-0.07 (0.18-0.32)	0.06-0.11 (0.27-0.50)
Milled Surface	0.04-0.08 (0.18-0.36)	.0.06-0.12 (0.27-0.54)
Concrete	0.03-0.05 (0.13-0.23)	0.05-0.08 (0.23-0.36)

After application of the tack coat, the surface shall be allowed to cure without being disturbed for the period of time necessary to permit drying and setting of the tack coat. This period shall be determined by the ~~RPR~~ ***OAR***. The Contractor shall protect the tack

coat and maintain the surface until the next course has been placed. When the tack coat has been disturbed by the Contractor, tack coat shall be reapplied at the Contractor's expense.

3.4 FREIGHT AND WAYBILLS

The Contractor shall submit waybills and delivery tickets, during progress of the work. Before the final statement is allowed, file with the ~~RPR~~ ***OAR*** certified waybills and certified delivery tickets for all emulsified asphalt materials used in the construction of the pavement covered by the contract. Do not remove emulsified asphalt material from storage until the initial outage and temperature measurements have been taken. The delivery or storage units will not be released until the final outage has been taken.

PART 4 - METHOD OF MEASUREMENT

4.1 The emulsified asphalt material for tack coat shall be measured by the gallon (liter). Volume shall be corrected to the volume at 60°F (16°C) in accordance with ASTM D1250. The emulsified asphalt material paid for will be the measured quantities used in the accepted work, provided that the measured quantities are not 10% over the specified application rate. Any amount of emulsified asphalt material more than 10% over the specified application rate for each application will be deducted from the measured quantities, except for irregular areas where hand spraying of the emulsified asphalt material is necessary. Water added to emulsified asphalt will not be measured for payment.

Application rates shall be determined using before and after readings of volume, in gallons, provided by the Contractor, for each work area. The OAR shall determine the application rate by recording the volume provided over the area applied, in square yards. Application rates and an exhibit demonstrating the area of work shall be provided to the Engineer by the OAR at the end of the day's work.

PART 5 - BASIS OF PAYMENT

5-1 Payment shall be made at the contract unit price per gallon (liter) of emulsified asphalt material. This price shall be full compensation for furnishing all materials, for all preparation, delivery, and application of these materials, and for all labor, equipment, tools, and incidentals necessary to complete the item.

Payment will be made under:

Item P-603-5.1 Emulsified Asphalt Tack Coat	- per Gallon (GAL)

PART 6 - REFERENCES

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

ASTM International (ASTM)

ASTM D1250	Standard Guide for Use of the Petroleum Measurement Tables
ASTM D2995	Standard Practice for Estimating Application Rate and Residual Application Rate of Bituminous Distributors
ASTM D3628	Standard Practice for Selection and Use of Emulsified Asphalts

END OF ITEM P-603

ITEM P-604 - COMPRESSION JOINT SEALS FOR CONCRETE PAVEMENTS

PART 1 - DESCRIPTION

1.1 This item shall consist of preformed polychloroprene compression seals used for sealing joints of rigid pavements.

PART 2 - MATERIALS

2.1 COMPRESSION SEALS

Compression joint seal materials shall be a vulcanized elastomeric compound using polychloroprene as the only base polymer. The material and the manufactured seal shall conform to ASTM D2628.

The joint seal shall be a labyrinth type seal. The uncompressed depth of the face of the compression seal (that is to be bonded to the joint wall) shall be greater than the uncompressed width of the seal, except that for seals one inch (25 mm) or greater in width, the depth need be only one inch (25 mm) or greater. The actual width of the uncompressed seal shall be as recommended by the joint seal manufacturer for the type and width of joints as shown on the plans. The tolerance on the seal shall be +1/8 inch or -1/16 inch (+3 mm or -2 mm), below the top of the pavement surface or bottom of groove for grooved pavement.

The Contractor shall provide a copy of the manufacturer's Certificate of Analysis (COA) for the joint seal material delivered to the project. The COA shall be provided to and approved by the ~~RPR~~ *OAR* before the material is installed. The furnishing of the vendor's certified test report shall not be interpreted as a basis for final acceptance. The manufacturer's COA may be subject to verification by testing the material delivered for use on the project.

Materials delivered to the job site shall be inspected for defects, unloaded, and stored with a minimum of handling to avoid damage. Storage facilities shall be provided at the job site to protect materials from weather and maintain materials at temperatures recommended by the manufacturer.

Representative sample of joint seal material will be sampled and retained by the ~~RPR~~ *OAR* for possible testing.

2.2 LUBRICANT/ADHESIVE

Lubricant/adhesive used for the compression elastomeric joint seal shall be a one-component compound conforming to ASTM D2835.

PART 3 - CONSTRUCTION METHODS

3.1 EQUIPMENT

Machines, tools, and equipment used in the performance of the work required by this section shall be approved by the ~~RPR~~ *OAR* before the work starts and shall be maintained by the Contractor in satisfactory condition at all times.

A. Joint cleaning equipment

1. Concrete saw. A self-propelled power saw with water-cooled diamond saw blades shall be provided for cutting joints to the depths and widths specified and for removing filler, existing old joint seal or other material embedded in the joints or adhered to the joint faces.

2. Waterblasting equipment. Waterblasting equipment shall include a trailer-mounted water tank, pumps, high-pressure hose, a wand with safety release cutoff controls, nozzle, and auxiliary water resupply equipment. The water tank and auxiliary water resupply equipment shall be of sufficient capacity to permit continuous operations. The pumps, hoses, wand, and nozzle shall be of sufficient capacity to permit the cleaning of both walls of the joint and the pavement surface for a width of at least 1/2 inch (12 mm) on either side of the joint. The pump shall be capable of supplying a pressure of at least 3,000 psi (20.7 MPa). A pressure gauge mounted at the pump shall show at all times the pressure in pounds per square inch (psi) (kPa) at which the equipment is operating.

3. Sandblasting equipment. Sandblasting equipment shall include an air compressor, hose, and a long-wearing venturi-type nozzle of proper size, shape, and opening. The maximum nozzle opening should not exceed 1/4 inch (6 mm). The air compressor shall be portable and shall be capable of furnishing not less than 150 cubic feet (4200 liters) per minute and maintaining a line pressure of not less than 90 psi (620 kPa) at the nozzle while in use. The compressor shall be equipped with traps that will maintain the compressed air free of oil and water. The nozzle shall have an adjustable guide that will hold the nozzle aligned with the joint about one inch (25 mm) above the pavement surface and will direct the blast to clean the joint walls. The height, angle of inclination, and the size of the nozzle shall be adjusted as necessary to ensure satisfactory results.

B. Sealing equipment. Equipment used to install the compression seal shall place the compression seal to the prescribed depths within the specified tolerances without cutting, nicking, twisting, or otherwise damaging the seal. The equipment shall not stretch or compress the seal more than 2.0% longitudinally during installation. The machine shall be an automatic self-propelled joint seal application equipment and shall be engine powered. The machine shall include a reservoir for the lubricant/adhesive, a device for conveying the lubricant/adhesive in the proper quantities to the sides the preformed seal or the sidewalls of the joint, a reel capable of holding one full spool of compression seal, and a power-driven apparatus for feeding the joint seal through a compression device and inserting the seal into the joint. The equipment shall also include a guide to maintain the

proper course along the joint being sealed. The machine shall at all times be operated by an experienced operator.

Hand operated joint seal application equipment may be used for localized areas and for projects less than 500 square yards (450 square meters). The equipment shall be a two-axle, four-wheel machine that includes means for compressing and inserting the compression seal into the joint and a reel capable of holding one full spool of compression seal material.

PART 4 - CONSTRUCTION METHODS

4.1 ENVIRONMENTAL CONDITIONS

The ambient temperature and the pavement temperature within the joint wall shall be at least 35°F (2°C) and rising at the time of installation of the materials. Sealant application will not be permitted if moisture or any foreign material is observed in the joint.

4.2 TRIAL JOINT SEAL AND LUBRICANT/ADHESIVE INSTALLATION

Prior to the cleaning and sealing of the joints for the entire project, a control strip at least 200 feet (69 meters) long shall be prepared at a location designated by the ~~RPR~~ *OAR* using the specified materials and the approved equipment, to demonstrate the materials and construction processes for joint preparation and sealing of all types of joints included in the project. No other joints shall be sealed until the test installation has been approved by the ~~RPR~~ *OAR*.

If materials or installation do not meet requirements, the materials shall be removed, and the joints shall be cleaned and a new trial joint seal installation shall be performed at the Contractor's expense. The ~~RPR~~ *OAR* approved trial section will be incorporated into the permanent work.

4.3 PREPARATION OF JOINTS

Immediately before installation of the compression joint seal, the joints shall be thoroughly cleaned to remove all laitance, filler, existing sealer, foreign material and protrusions of hardened concrete from the sides and upper edges of the joint space to be sealed. Cleaning shall extend along pavement surfaces at least 1/2 inch (12 mm) on either side of the joint. After final cleaning and immediately prior to sealing, the joints shall be blown out with compressed air and left free of debris and water. Any irregularity in the joint face that would prevent uniform contact between the joint seal and the joint face shall be corrected prior to the installation of the joint seal.

A. Sawing. Joints shall be sawed to clean and to open them to the full specified width and depth. Immediately following the sawing operation, the joint faces and opening shall be thoroughly cleaned using a water jet to remove all saw cuttings or debris remaining on the faces or in the joint opening. Compression seal shall be installed within three (3) calendar

days of the time the joint cavity is sawed. Depth of the joint cavity shall be in accordance with manufacturer's instructions. Submit printed copies of manufacturers' instructions 60 days prior to use on the project. The saw cut for the joint seal cavity shall at all locations be centered over the joint line. The nominal width of the sawed joint seal cavity shall be as follows; the actual width shall be within a tolerance of ±1/16 inch (2 mm):

1. If a nominal 13/16 inch (21 mm) wide compression seal is furnished, the nominal width of the saw cut shall be 1/2 inches (12.5 mm) when the pavement temperature at the time of sawing is between 30 and 110°F (-1 and 43°C). If the pavement temperature at the time of sawing is above this range, the nominal width of the saw cut shall be decreased 1/16 inch (2 mm). If the pavement temperature at the time of sawing is below this range, the nominal width of the saw cut shall be increased 1/16 inch (2 mm).

2. If a nominal one inch (25 mm) wide compression seal is furnished, the nominal width of the saw cut shall be 9/16 inches (14 mm) when the pavement temperature at the time of sawing is between 30 and 170°F (-1 and 77°C). If the pavement temperature at the time of sawing is above this range, the nominal width of the saw cut shall be decreased 1/16 inch (2 mm). If the pavement temperature at the time of sawing is below this range, the nominal width of the saw cut shall be increased 1/16 inch (2 mm).

3. The pavement temperature shall be measured and recorded in the presence of the ~~RPR~~ *OAR*. Measurement shall be made each day before commencing sawing and at any other time during the day when the temperature appears to be moving out of the allowable sawing range.

B. Waterblast cleaning. The concrete joint faces and pavement surfaces extending at least 1/2 inch (12 mm) from the joint edges shall be waterblasted clean. A multiple pass technique shall be used until the surfaces are free of dust, dirt, curing compound, or any residue that might prevent ready insertion or uniform contact of the seal and bonding of the lubricant/adhesive to the concrete. After final cleaning and immediately prior to sealing, the joints shall be blown out with compressed air and left completely free of debris and water.

C. Sandblast cleaning. The concrete joint faces and pavement surfaces extending at least 1/2 inch (12 mm) from the joint edges shall be sandblasted clean. A multiple pass technique shall be used until the surfaces are free of dust, dirt, curing compound, or any residue that might prevent ready insertion or uniform contact of the seal and bonding of the lubricant/adhesive to the concrete. After final cleaning and immediately prior to sealing, the joints shall be blown out with compressed air and left completely free of debris and water.

D. Rate of progress. Cleaning of the joint faces shall be limited to the linear footage of joint that can be sealed during the same workday.

4.4 INSTALLATION OF THE COMPRESSION SEAL

A. Time of installation. Joints shall be sealed within 3 calendar days of sawing the joint seal cavity and the final cleaning of the joint walls, or a temporary seal shall be installed to prevent infiltration of foreign material. If rain interrupts the sealing operations, the joints shall be washed, cleaned with air and be dry before proceeding with installing of the lubricant/adhesive and compression seal.

B. Installation Sequence. Longitudinal joints shall be sealed first, then seal the transverse joints. Transverse joint seals will be continuous from edge to edge of the pavement. Intersections shall be made monolithic by use of joint seal adhesive and care in fitting the intersection parts together. Seals which do not reach an intersection shall be removed and replaced with new seal as directed by the ~~RPR~~ *OAR* at the Contractor's Expense. Seal extender pieces shall not be used at intersections.

C. Sealing joints. The sides of the joint seal or the sides of the joint shall be covered with a coating of lubricant/adhesive and the seal installed as specified. Butt joints and seal intersections shall be coated with liberal applications of lubricant/adhesive. Lubricant/adhesive spilled on the pavement shall be removed immediately to prevent setting on the pavement.

The joint seal shall be placed at a uniform depth within the tolerances specified. The compression joint seal shall be placed to a depth of 3/16 inch (5 mm), ±1/8 inch (3 mm), below the pavement surface or below the depth of the groove unless otherwise directed by the ~~RPR~~ *OAR*.

The seal shall be installed in the longest practicable lengths in longitudinal joints and shall be cut at the joint intersections to provide continuous installation of the seal in the transverse joints. The joint seal shall be installed in an upright position, free from twisting, distortion, and cuts. If stretch of installed joint seal exceeds 1%, adjustments shall be made to the installation equipment and procedure. Stretch of installed joint seals exceeding 2% stretch shall be removed and replaced.

After installation of the longitudinal joint seals, it shall set for a minimum of one (1) hour prior to cutting the seal at the joint intersections. For all transverse joints, the minimum length of the preformed joint seal shall be the pavement width from edge to edge.

4.5 CLEAN-UP

Upon completion of the project, all unused materials shall be removed from the site, all lubricant/adhesive on the pavement surface shall be removed, and the pavement shall be left in clean condition.

4.6 QUALITY CONTROL AND QUALITY ASSURANCE

A. Quality Control. The application equipment shall be inspected to assure uniform application of lubricant/adhesive to the sides of the compression joint seal or the walls of the joint. Equipment causing cutting, twisting, nicking, excessive stretching or

compressing of the compression seal, or improper application of the lubricant/adhesive, shall not be used until causes of the deficiencies are determined and corrected by the Contractor.

The seal shall be inspected by the Contractor a minimum of once per 400 feet (120 m) of seal for compliance to the shrinkage or compression requirements. Measurements shall be made at the same interval to determine conformance with depth and width installation requirements.

B. Quality Assurance. Cleaned joints shall be approved by the ~~RPR~~ *OAR* prior to installation of the lubricant/adhesive and compression joint seal.

Conformance to stretching and compression limitations shall be determined by the ~~RPR~~ *OAR* using the following procedures:

1. Mark the top surface of the compression seal at one foot (30 cm) intervals in a manner clear and durable to enable length determinations of the seal.

2. After installation, the distance between the marks on the seal shall be measured by the Contractor.

3. If the stretching or compression exceeds the specified limit, the seal shall be removed and replaced with new joint seal at the Contractor's Expense. The seal shall be removed up to the last correct measurement.

4.7 ACCEPTANCE

The joint sealing system (compression seal and lubricant/adhesive) shall be inspected by the ~~RPR~~ *OAR* for proper rate of cure and bonding to the concrete, cuts, twists, nicks, and other deficiencies. Seals exhibiting any defects prior to final acceptance of the project, shall be removed from the joint, wasted, and replaced with new material in a satisfactory manner, at the Contractor's expense, as determined by the ~~RPR~~ *OAR*.

PART 5 - METHOD OF MEASUREMENT

5.1 MEASUREMENT

Compression joint seals shall be considered incidental and no separate measurement shall be made.

PART 6 - BASIS OF PAYMENT

6.1 PAYMENT

Compression joint seals shall be considered incidental and no separate payment shall be made.

PART 7 - REFERENCES

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

ASTM International (ASTM)

ASTM D2628	Standard Specification for Preformed Polychloroprene Elastomeric Joint Seals for Concrete Pavements
ASTM D2835	Standard Specification for Lubricant for Installation of Preformed Compression Seals in Concrete Pavements

Corps of Engineers

CRD C548	Standard Specification for Jet-Fuel and Heat Resistant Preformed Polychloroprene Elastomeric Joint Seals for Rigid Pavements

Unified Facilities Criteria (UFC)

UFC 3-250-08FA	Standard Practice for Sealing Joints and Cracks in Rigid and Flexible Pavements

END OF ITEM P-604

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ITEM P-605 JOINT SEALANTS FOR PAVEMENTS

PART 1 - DESCRIPTION

1.1 This item shall consist of providing and installing a resilient and adhesive joint sealing material capable of effectively sealing joints in pavement; joints between different types of pavements; and cracks in existing pavement.

PART 2 - MATERIALS

2.1 JOINT SEALANTS

Joint sealant materials shall meet the requirements of D6690.

Each lot or batch of sealant shall be delivered to the jobsite in the manufacturer's original sealed container. Each container shall be marked with the manufacturer's name, batch or lot number, the safe heating temperature, and shall be accompanied by the manufacturer's certification stating that the sealant meets the requirements of this specification.

2.2 BACKER ROD

The material furnished shall be a compressible, non-shrinking, non-staining, non-absorbing material that is non-reactive with the joint sealant in accordance with ASTM D5249. The backer-rod material shall be 25% ± 5 % larger in diameter than the nominal width of the joint.

2.3 BOND BREAKING TAPES

Provide a bond breaking tape or separating material that is a flexible, non-shrinkable, non-absorbing, non-staining, and non-reacting adhesive-backed tape. The material shall have a melting point at least 5°F (3°C) greater than the pouring temperature of the sealant being used when tested in accordance with ASTM D789. The bond breaker tape shall be approximately 1/8 inch (3 mm) wider than the nominal width of the joint and shall not bond to the joint sealant.

PART 3 - CONSTRUCTION METHODS

3.1 TIME OF APPLICATION

Joints shall be sealed as soon after completion of the curing period as feasible and before the pavement is opened to traffic, including construction equipment. The pavement temperature shall be 50°F (10°C) and rising at the time of application of the poured joint sealing material. Do not apply sealant if moisture is observed in the joint.

3.2 EQUIPMENT

Machines, tools, and equipment used in the performance of the work required by this section shall be approved before the work is started and maintained in satisfactory condition at all times. Submit a list of proposed equipment to be used in performance of construction work including descriptive data, 30 days prior to use on the project.

A. Tractor-mounted routing tool. Provide a routing tool, used for removing old sealant from the joints, of such shape and dimensions and so mounted on the tractor that it will not damage the sides of the joints. The tool shall be designed so that it can be adjusted to remove the old material to varying depths as required. The use of V-shaped tools or rotary impact routing devices will not be permitted. Hand-operated spindle routing devices may be used to clean and enlarge random cracks.

B. Concrete saw. Provide a self-propelled power saw, with water-cooled diamond or abrasive saw blades, for cutting joints to the depths and widths specified.

C. Sandblasting equipment. The Contractor must demonstrate sandblasting equipment including the air compressor, hose, guide and nozzle size, under job conditions, before approval in accordance with paragraph 3.3. The Contractor shall demonstrate, in the presence of the ~~Resident Project Representative (RPR)~~ ***Owner's Authorized Representative (OAR)***, that the method cleans the joint and does not damage the joint.

D. Waterblasting equipment. The Contractor must demonstrate waterblasting equipment including the pumps, hose, guide and nozzle size, under job conditions, before approval in accordance with paragraph 3.3. The Contractor shall demonstrate, in the presence of the ~~RPR~~ ***OAR***, that the method cleans the joint and does not damage the joint.

E. Hand tools. Hand tools may be used, when approved, for removing defective sealant from a crack and repairing or cleaning the crack faces. Hand tools should be carefully evaluated for potential spalling effects prior to approval for use.

F. Hot-poured sealing equipment. The unit applicators used for heating and installing ASTM D6690 joint sealant materials shall be mobile and shall be equipped with a double-boiler, agitator-type kettle with an oil medium in the outer space for heat transfer; a direct-connected pressure-type extruding device with a nozzle shaped for inserting in the joint to be filled; positive temperature devices for controlling the temperature of the transfer oil and sealant; and a recording type thermometer for indicating the temperature of the sealant. The applicator unit shall be designed so that the sealant will circulate through the delivery hose and return to the inner kettle when not in use.

3.3 PREPARATION OF JOINTS

Pavement joints for application of material in this specification must be dry, clean of all scale, dirt, dust, curing compound, and other foreign matter. The Contractor shall demonstrate, in the presence of the ~~RPR~~ ***OAR***, that the method cleans the joint and does not damage the joint.

A. Sawing. All joints shall be sawed in accordance with specifications and plan details. Immediately after sawing the joint, the resulting slurry shall be completely removed from joint and adjacent area by flushing with a jet of water, and by use of other tools as necessary.

B. Sealing. Immediately before sealing, the joints shall be thoroughly cleaned of all remaining laitance, curing compound, filler, protrusions of hardened concrete, old sealant and other foreign material from the sides and upper edges of the joint space to be sealed. Cleaning shall be accomplished by sandblasting, tractor-mounted routing equipment, concrete saw or waterblaster as specified in paragraph 3.2. The newly exposed concrete joint faces and the pavement surface extending a minimum of 1/2 inch (12 mm) from the joint edge shall be sandblasted clean. Sandblasting shall be accomplished in a minimum of two passes. One pass per joint face with the nozzle held at an angle directly toward the joint face and not more than 3 inches (75 mm) from it. After final cleaning and immediately prior to sealing, blow out the joints with compressed air and leave them completely free of debris and water. The joint faces shall be surface dry when the seal is applied.

C. Backer Rod. When the joint opening is of a greater depth than indicated for the sealant depth, plug or seal off the lower portion of the joint opening using a backer rod in accordance with paragraph 2.2 to prevent the entrance of the sealant below the specified depth. Take care to ensure that the backer rod is placed at the specified depth and is not stretched or twisted during installation.

D. Bond-breaking tape. Where inserts or filler materials contain bitumen, or the depth of the joint opening does not allow for the use of a backup material, insert a bond-separating tape breaker in accordance with paragraph 2.3 to prevent incompatibility with the filler materials and three-sided adhesion of the sealant. Securely bond the tape to the bottom of the joint opening so it will not float up into the new sealant.

3.4 INSTALLATION OF SEALANTS

Joints shall be inspected for proper width, depth, alignment, and preparation, and shall be approved by the ~~RPR~~ ***OAR*** before sealing is allowed. Sealants shall be installed in accordance with the following requirements:

Immediately preceding, but not more than 50 feet (15 m) ahead of the joint sealing operations, perform a final cleaning with compressed air. Fill the joints from the bottom up to 1/4 inch (6 mm) ±1/16 inch (2 mm) below the top of pavement surface; or bottom of groove for grooved pavement. Remove and discard excess or spilled sealant from the pavement by approved methods. Install the sealant in such a manner as to prevent the formation of voids and entrapped air. In no case shall gravity methods or pouring pots be used to install the sealant material. Traffic shall not be permitted over newly sealed pavement until authorized by the ~~RPR~~ ***OAR***. When a primer is recommended by the manufacturer, apply it evenly to the joint faces in accordance with the manufacturer's instructions. Check the joints frequently to ensure that the newly installed sealant is cured to a tack-free condition within the time specified.

3.5 INSPECTION.

The Contractor shall inspect the joint sealant for proper rate of cure and set, bonding to the joint walls, cohesive separation within the sealant, reversion to liquid, entrapped air and voids. Sealants exhibiting any of these deficiencies at any time prior to the final acceptance of the project shall be removed from the joint, wasted, and replaced as specified at no additional cost to the airport.

3.6 CLEAN-UP.

Upon completion of the project, remove all unused materials from the site and leave the pavement in a clean condition.

PART 4 - METHOD OF MEASUREMENT

4.1 Joint sealing shall be considered incidental and no separate measurement shall be made.

PART 5 - BASIS OF PAYMENT

5.1 Joint sealing shall be considered incidental and no separate payment shall be made.

PART 6 - REFERENCES

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

ASTM International (ASTM)

ASTM D789	Standard Test Method for Determination of Relative Viscosity of Polyamide (PA)
ASTM D5249	Standard Specification for Backer Material for Use with Cold- and Hot-Applied Joint Sealants in Portland-Cement Concrete and Asphalt Joints
ASTM D6690	Standard Specification for Joint and Crack Sealants, Hot Applied, for Concrete and Asphalt]

Advisory Circulars (AC)

AC 150/5340-30	Design and Installation Details for Airport Visual Aids

END OF ITEM P-605

ITEM P-606 ADHESIVE COMPOUNDS, TWO-COMPONENT FOR SEALING WIRE AND LIGHTS IN PAVEMENT

PART 1 - DESCRIPTION

1.1 This specification covers two types of material; a liquid suitable for sealing electrical wire in saw cuts in pavement and for sealing light fixtures or bases in pavement, and a paste suitable for embedding light fixtures in the pavement. Both types of material are two-component filled formulas with the characteristics specified in paragraph 2.4. Materials supplied for use with asphalt and/or concrete pavements must be formulated so they are compatible with the asphalt and/or concrete.

PART 2 - MATERIALS

2.1 CURING

When pre-warmed to 77°F (25°C), mixed, and placed in accordance with manufacturer's directions, the materials shall cure at temperatures of 45°F (7°C) or above without the application of external heat.

2.2 STORAGE

The adhesive components shall not be stored at temperatures over 86°F (30°C), unless otherwise specified by the manufacturer.

2.3 CAUTION

Installation and use shall be in accordance with the manufacturer's recommended procedures. Avoid prolonged or repeated contact with skin. In case of contact, wash with soap and flush with water. If taken internally, call doctor. Keep away from heat or flame. Avoid vapor. Use in well-ventilated areas. Keep in cool place. Keep away from children.

2.4 CHARACTERISTICS

When mixed and cured in accordance with the manufacturer's directions, the materials shall have the following properties shown in Table 1.

Table 1. Property Requirements

Physical or Electrical Property	Minimum	Maximum	ASTM Method
Tensile			
Portland cement concrete	1,000 psi (70 kg/sq cm)		D 638
Asphalt concrete	500 psi (35 kg/sq cm)		
Elongation			
Portland cement concrete		See note [1]	D 638
Asphalt concrete	50%		D 638
Coef. of cub. exp. cu. cm/cu. cm/°C	0.00090	0.00120	D 1168
Coef. of lin. exp. cm/cm/°C	0.000030	0.000040	D 1168
Dielectric strength, short time test	350 volts/mil.		D 149
Arc resistance	125 sec		
Pull-off			
Adhesion to steel	1,000 psi (70 kg/sq cm)		
Adhesion to Portland cement concrete	200 psi (14 kg/sq cm)		
Adhesion to asphalt concrete	No test available.		
Adhesion to aluminum	250 psi		

[1] 20% or more (without filler) for formulations to be supplied for areas subject to freezing.

PART 3 - SAMPLING, INSPECTION, AND TEST PROCEDURES

3.1 TENSILE PROPERTIES

Tests for tensile strength and elongation shall be conducted in accordance with ASTM D638.

3.2 EXPANSION

Tests for coefficients of linear and cubical expansion shall be conducted in accordance with, Method B, except that mercury shall be used instead of glycerine. The test specimen shall be mixed in the proportions specified by the manufacturer, and cured in a glass tub approximately 2 inch (50 mm) long by 3/8 inch (9 mm) in diameter. The interior of the tube shall be precoated with a silicone mold release agent. The hardened sample shall be

removed from the tube and aged at room temperature for one (1) week before conducting the test. The test temperature range shall be from 35°F (2°C) to 140°F (60°C).

3.3 TEST FOR DIELECTRIC STRENGTH

Test for dielectric strength shall be conducted in accordance with ASTM D149 for sealing compounds to be furnished for sealing electrical wires in pavement.

3.4 TEST FOR ARC RESISTANCE

Test for arc resistance shall be conducted for sealing compounds to be furnished for sealing electrical wires in pavement.

3.5 TEST FOR ADHESION TO STEEL

The ends of two smooth, clean, steel specimens of convenient size (1 inch by 1 inch by 6 inch) (25 mm by 25 mm by 150 mm) would be satisfactory when bonded together with adhesive mixture and allowed to cure at room temperature for a period of time to meet formulation requirements and then tested to failure on a Riehle (or similar) tensile tester. The thickness of adhesive to be tested shall be 1/4 inch (6 mm).

3.6 ADHESION TO PORTLAND CEMENT CONCRETE

A. Concrete test block preparation. The aggregate grading shall be as shown in Table 2.

The coarse aggregate shall consist of crushed rock having a minimum of 75% of the particles with at least one fractured face and having a water absorption of not more than 1.5%. The fine aggregate shall consist of crushed sand manufactured from the same parent rock as the coarse aggregate. The concrete shall have a water-cement ratio of 5.5 gallons (21 liters) of water per bag of cement, a cement factor of 6, ±0.5, bags of cement per cubic yard (0.76 cubic meter) of concrete, and a slump of 2-1/2 inch (60 mm), ±1/2 inch (60 mm ±12 mm). The ratio of fine aggregate to total aggregate shall be approximately 40% by solid volume. The air content shall be 5.0%, ±0.5%, and it shall be obtained by the addition to the batch of an air-entraining admixture such as Vinsol® resin. The mold shall be of metal and shall be provided with a metal base plate.

Means shall be provided for securing the base plate to the mold. The assembled mold and base plate shall be watertight and shall be oiled with mineral oil before use. The inside measurement of the mold shall be such that several one inch (25 mm) by 2-inch (75 mm) by 3-inch (25 mm by 50 mm by 75 mm) test blocks can be cut from the specimen with a concrete saw having a diamond blade. The concrete shall be prepared and cured in accordance with ASTM C192.

Table 2. Aggregate for Bond Test Blocks

Type	Sieve Size	Percent Passing
Coarse Aggregate	3/4 inch (19.0 mm)	97 to 100
	1/2 inch (12.5 mm)	63 to 69
	3/8 inch (9.5 mm)	30 to 36
	No. 4 (4.75 mm)	0 to 3
Fine Aggregate	No. 4 (4.75 mm)	100
	No. 8 (2.36 mm)	82 to 88
	No. 16 (1.18 mm)	60 to 70
	No. 30 (600 µm)	40 to 50
	No. 50 (300 µm)	16 to 26
	No. 100 (150 µm)	5 to 9

B. Bond test. Prior to use, oven-dry the test blocks to constant weight at a temperature of 220°F to 230°F (104°C to 110°C), cool to room temperature, 73.4°F ±3°F (23°C ±1.6°C), in a desiccator, and clean the surface of the blocks of film or powder by vigorous brushing with a stiff-bristled fiber brush. Two test blocks shall be bonded together on the one inch by 3 inch (25 mm by 75 mm) sawed face with the adhesive mixture and allowed to cure at room temperature for a period of time to meet formulation requirements and then tested to failure in a Riehle (or similar) tensile tester. The thickness of the adhesive to be tested shall be 1/4 inch (6 mm).

3.7 COMPATIBILITY WITH ASPHALT MIX

Test for compatibility with asphalt in accordance with ASTM D5329.

3.8 ADHESIVE COMPOUNDS - CONTRACTOR'S RESPONSIBILITY

The Contractor shall furnish the vendor's certified test reports for each batch of material delivered to the project. The report shall certify that the material meets specification requirements and is suitable for use with concrete and asphalt concrete pavements. The report shall be provided to and accepted by the ~~Resident Project Representative (RPR)~~ ***Owner's Authorized Representative (OAR)*** before use of the material. In addition, the Contractor shall obtain a statement from the supplier or manufacturer that guarantees the material for one year. The supplier or manufacturer shall furnish evidence that the material has performed satisfactorily on other projects.

3.9 APPLICATION

Adhesive shall be applied on a dry, clean surface, free of grease, dust, and other loose particles. The method of mixing and application shall be in strict accordance with the manufacturer's recommendations. When used with Item P-605, such as light can installation, Item P-605 shall not be applied until the Item P-606 has fully cured.

PART 4 - METHOD OF MEASUREMENT

4.1 ~~The adhesive compound shall be measured by the gallon (l) of adhesive as specified, in place, complete and accepted.~~ When required in the installation of an ~~in-runway~~ in-pavement lighting system or portion thereof, no measurement will be made for direct payment of adhesive, as the cost of furnishing and installing shall be considered as a subsidiary obligation in the completion of the installation.

PART 5 - BASIS OF PAYMENT

5.1 No payment shall be made for the adhesive. This item shall be considered as a subsidiary obligation in the completion of the installation of the in-pavement lighting system. This includes furnishing all materials, and all preparation, delivering, and application of these materials, and all labor, equipment, tools, and incidentals necessary to complete the item.

PART 6 - REFERENCES

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

ASTM International (ASTM)

ASTM C192	Standard Practice for Making and Curing Concrete Test Specimens in the Laboratory
ASTM D149	Standard Test Method for Dielectric Breakdown Voltage and Dielectric Strength of Solid Electrical Insulating Materials at Commercial Power Frequencies
ASTM D638	Standard Test Method for Tensile Properties of Plastics
ASTM D5329	Standard Test Methods for Sealants and Fillers, Hot-applied, for Joints and Cracks in Asphaltic and Portland Cement Concrete Pavements

END OF ITEM P-606

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ITEM P-608 EMULSIFIED ASPHALT SEAL COAT

PART 1 - DESCRIPTION

1.1 This item shall consist of the application of a emulsified asphalt surface treatment composed of an emulsion of natural and refined asphalt materials, water and a polymer additive, for taxiways and runways with the application of a suitable aggregate to maintain adequate surface friction; and airfield secondary and tertiary pavements including low-speed taxiways, shoulders, overruns, roads, parking areas, and other general applications with or without aggregate applied as designated on the plans. The terms seal coat, asphalt sealer, and asphalt material are interchangeable throughout this specification. The term emulsified asphalt means an emulsion of natural and refined asphalt materials.

PART 2 - MATERIALS

2.1 AGGREGATE

The aggregate material shall be a dry, clean, dust and dirt free, sound, durable, angular shaped manufactured specialty sand, such as that used as an abrasive, with a Mohs hardness of 6 to 8. The Contractor shall submit the specialty sand manufacturer's technical data and a manufacturer's Certificate of Analysis (COA) indicating that the specialty sand meets the requirements of the specification to the ~~RPR~~ ***Owner's Authorized Representative (OAR)*** prior to start of construction. The sand must be approved for use by the ~~RPR~~ ***OAR*** and shall meet the following gradation limits when tested in accordance with ASTM C136 and ASTM C117:

Aggregate Material Gradation Requirements[1]

Sieve Designation (square openings)	Individual Percentage Retained by Weight
No. 10 (2.00 mm)	0
No. 14 (1.41 mm)	0-4
No. 16 (1.18 mm)	0-8
No. 20 (850 µm)	0-35
No. 30 (600 µm)	20-50
No. 40 (425 µm)	10-45
No. 50 (300 µm)	0-20
No. 70 (212 µm)	0-5
No. 100 (150 µm)	0-2
No. 200 (75 µm)	0-2

[1] Locally available sand or abrasive material that is slightly outside of the gradation requirements may be approved by the RPR with concurrence by the seal coat manufacturer for the use of locally available sand or abrasive material. The ~~RPR~~ ***OAR***

and manufacturer's field representative should verify acceptance during application of Control strips indicated under paragraph 3.2.

The Contractor shall provide a certification showing particle size analysis and properties of the material delivered for use on the project. The Contractor's certification may be subject to verification by testing the material delivered for use on the project.

2.2 ASPHALT EMULSION

The asphalt emulsion shall meet the properties in the following table:

Concentrated Asphalt Emulsion Properties

Properties	Specification	Limits
Viscosity, Saybolt Furol at 77°F (25°C)	ASTM D7496	20 – 100 seconds
Residue by Distillation or Evaporation	ASTM D6997 or ASTM D6934	57% minimum
Sieve Test	ASTM D6933	0.1% maximum
24-hour Stability	ASTM D6930	1% maximum
5-day Settlement Test	ASTM D6930	5.0% maximum
Particle Charge [1]	ASTM D7402	Positive 6.5 maximum pH

[1] pH may be used in lieu of the particle charge test which is sometimes inconclusive in slow setting, asphalt emulsions.

The asphalt material base residue shall contain not less than 20% gilsonite, or uintaite and shall not contain any tall oil pitch or coal tar material and shall contain no less than one percent (1%) polymer.

Tests on Residue from Distillation or Evaporation

Properties	Specification	Limits
Viscosity at 275°F (135°C)	ASTM D4402	1750 cts maximum
Solubility in 1, 1, 1 trichloroethylene	ASTM D2042	97.5% minimum
Penetration	ASTM D5	50 dmm maximum
Asphaltenes	ASTM D2007	15% minimum
Saturates	ASTM D2007	15% maximum
Polar Compounds	ASTM D2007	25% minimum
Aromatics	ASTM D2007	15% minimum

The asphalt emulsion, when diluted in the volumetric proportion of two parts concentrated asphalt material to one part hot water shall have the following properties:

~~One-to-One Dilution Emulsion Properties~~

~~Properties~~	~~Specification~~	~~Limits~~
~~In Ready-to-Apply Form, one part concentrate to one part water, by volume~~		
~~Viscosity, Saybolt Furol at 77°F (25°C)~~	~~ASTM D7496~~	~~5 – 50 seconds~~
~~Residue by Distillation or Evaporation~~	~~ASTM D6997 or ASTM D6934~~	~~28.5% minimum~~
~~Pumping Stability [1]~~		~~Pass~~

~~[1] Pumping stability is tested by pumping one pint (475 ml) of seal coat diluted one (1) part concentrate to one (1) part water, at 77°F (25°C), through a 1/4-inch (6 mm) gear pump operating 1750 rpm for 10 minutes with no significant separation or coagulation.~~

Two-to-One Dilution Emulsion Properties

Properties	Specification	Limits
In Ready-to-Apply Form, two parts concentrate to one part water, by volume		
Viscosity, Saybolt Furol at 77°F (25°C)	ASTM D7496	5 – 50 seconds
Residue by Distillation or Evaporation	ASTM D6997 or ASTM D6934	38% minimum
Pumping Stability [1]		Pass

[1] Pumping stability is tested by pumping one pint (475 ml) of seal coat diluted one (1) part concentrate to one (1) part water, at 77°F (25°C), through a 1/4-inch (6 mm) gear pump operating 1750 rpm for 10 minutes with no significant separation or coagulation.

The Contractor shall provide a copy of the manufacturer's Certificate of Analysis (COA) for the emulsified asphalt delivered to the project. If the asphalt emulsion is diluted at other than the manufacturer's facility, the Contractor shall provide a supplemental COA from an independent laboratory verifying the asphalt emulsion properties.

The COA shall be provided to and approved by the ~~RPR~~ ***OAR*** before the emulsified asphalt is applied. The furnishing of the vendor's certified test report for the asphalt material shall not be interpreted as a basis for final acceptance. The manufacturer's COA may be subject to verification by testing the material delivered for use on the project.

The asphalt material storage and handling temperature shall be between 50°F - 160°F (10°C - 70°C) and the material shall be protected from freezing, or whenever outside temperature drops below 40°F (4°C) for prolonged time periods.

Contractor shall provide a list of airport pavement projects, exposed to similar climate conditions, where this product has been successfully applied within at least 5 years of the project.

2.3 WATER

Water used in mixing or curing shall be from potable water sources. Other sources shall be tested in accordance with ASTM C1602 prior to use. Water used in making and diluting the emulsion shall be potable, with a maximum hardness of 90ppm calcium and 15ppm magnesium; deleterious iron, sulfates, and phosphates maximum 7ppm, and less than 1ppm of organic byproducts. Water shall be a minimum of 140°F (60°C) prior to adding to emulsion.

2.4 POLYMER

The polymer shall meet the properties in the following table:

Polymer Properties

Properties	Limits
Solids Content	47% to 65%, Percent by Weight
Weight	8.0 to 9.0 pounds/gallon (1.07 to 1.17 kg/L)
pH	3.0 to 8.0
Particle Charge	Nonionic/Cationic
Mechanical Stability	Excellent
Film Forming Temperature, °C	+5°C, minimum
Tg, °C	22°C, maximum

The manufacturer shall provide a copy of the Certificate of Analysis (COA) for the polymer used in the seal coat; and the Contractor shall include the COA with the emulsified asphalt COA when submitting to the ~~RPR~~ ***OAR***.

2.5 SEAL COAT WITH AGGREGATE

The Contractor shall submit friction test data from no less than one of the airport projects identified under 2.2. The test data must be from the same project and include technical details on application rates, aggregate rates, and point of contact at the airport to confirm use and success of sealer with aggregate.

Friction test data in accordance with AC 150/5320-12, at 40 or 60 mph (65 or 95 km/h) wet, must include as a minimum; the friction value prior to sealant application; two values, between 24 and 96 hours after application, with a minimum of 24 hours between tests; and one value between 180 days and 360 days after the application. The results of the tests between 24 and 96 hours shall indicate friction is increasing at a rate to obtain similar friction value of the pavement surface prior to application, and the long-term test shall indicate no apparent adverse effect with time relative to friction values and existing pavement surface.

Seal coat material submittal without required friction performance will not be approved. Friction tests performed on this project cannot be used as a substitute of this requirement.

PART 3 - COMPOSITION AND APPLICATION RATE

3.1 APPLICATION RATE

The approximate amounts of materials per square yard (square meter) for the asphalt surface treatment shall be as provided in the table for the treatment area(s) at the specified dilution rate(s) as noted on the plans. The actual application rates will vary within the range specified to suit field conditions and will be recommended by the manufacturer's representative and approved by the ~~RPR~~ ***OAR*** from the test area/sections evaluation.

Application Rate

Dilution Rate	Quantity of Emulsion gal/yd^2 (l/m^2)	Quantity of Aggregate lb/yd^2 (kg/m^2)
~~1:1~~	~~0.10-0.17 (0.45-0.77)~~	~~0.20-0.50 (0.11-0.27)~~
2:1	0.08-0.17 (0.36-0.77)	0.20-0.50 (0.11-0.27)

3.2 CONTROL AREAS AND CONTROL STRIPS

Prior to full application, the control strip must be accepted by the ~~RPR~~ ***OAR***. The surface preparation, personnel, equipment, and method of operation used on the test area(s) and control strip(s) shall be the same as used on the remainder of the work.

A qualified manufacturer's representative shall be present in the field to assist the Contractor in applying control areas and/or control strips to determine the appropriate application rate of both emulsion and aggregate to be approved by the RPR.

A test area(s) and control strip(s) shall be applied for each differing asphalt pavement surface identified in the project. The test area(s) and control strip(s) shall be used to determine the material application rate(s) of both emulsion and sand prior to full production.

A. For taxiway, taxilane and apron surfaces. Prior to full application, the Contractor shall place test areas at varying application rates as recommended by the Contractor's manufacturer's representative to determine appropriate application rate(s). The test areas will be located on representative section(s) of the pavement to receive the asphalt surface treatment designated by the ~~RPR~~ ***OAR***.

~~B. For runway and high-speed exit taxiway surfaces. Prior to full application, the Contractor shall place a series of control strips a minimum of 300 feet (90 m) long by 12 feet (3.6 m) wide, or width of anticipated application, whichever is greater, at varying application rates as recommended by the manufacturer's representative and acceptable to the RPR ***OAR*** to determine appropriate application rate(s). The control strips should be separated by a minimum of 200 feet between control strips. The area to be tested will be located on a representative section of the pavement to receive the asphalt surface treatment designated by the RPR ***OAR***. The control strips should be placed under similar field conditions as anticipated for the actual application. The skid resistance of the existing pavement shall be determined for each control strip with a continuous friction measuring equipment (CFME). The skid resistance of existing pavement can be immediately adjacent to the control strip or at the same location as the control strip if testing prior to application. The Contractor may begin testing the skid resistance of runway and high-speed exit taxiway control strips after application of the asphalt surface treatment has fully cured, generally 8 to 36 hours after application of the control strips depending on site and environmental conditions. Aircraft shall not be permitted on the runway or high speed exit taxiway control strips until such time as the Contractor validates that its surface friction meets the maintenance planning friction levels in AC 150/5320-12, Table 3-2 when tested at speeds of 40 and 60 mph (65 and 95 km/h) wet with approved CFME.~~

If the control strip should prove to be unsatisfactory, necessary adjustments to the application rate, placement operations, and equipment shall be made. Additional control strips shall be placed and additional skid resistance tests performed and evaluated. Full production shall not begin without the RPR's approval of an appropriate application rate(s). Acceptable control strips shall be paid for in accordance with paragraph 8.1.

PART 4 - CONSTRUCTION METHODS

4.1 WORKER SAFETY

The Contractor shall obtain a Safety Data Sheet (SDS) for both the asphalt emulsion product and sand and require workmen to follow the manufacturer's recommended safety precautions.

4.2 WEATHER LIMITATIONS

The asphalt emulsion shall be applied only when the existing pavement surface is dry and when the weather is not foggy, rainy, or when the wind velocity will prevent the uniform application of the material. No material shall be applied in strong winds that interfere with the uniform application of the material(s), or when dust or sand is blowing or when rain is anticipated within eight (8) hours of application completion. The atmospheric temperature and the pavement surface temperature shall both be at, or above 60°F (16°C) and rising. Seal coat shall not be applied when pavement temperatures are expected to exceed 130ºF within the subsequent 72 hours if traffic will be opened on pavement within those 72 hours. During application, account for wind drift. Cover existing buildings, structures, runway edge lights, taxiway edge lights, informational signs, retro-reflective marking and in-pavement duct markers as necessary to protect against overspray before applying the emulsion. Should emulsion get on any light or marker fixture, promptly clean the fixture.

If cleaning is not satisfactory to the ~~RPR~~ ***OAR***, the Contractor shall replace any light, sign or marker with equivalent equipment at no cost to the Owner.

4.3 EQUIPMENT AND TOOLS

The Contractor shall furnish all equipment, tools, and machinery necessary for the performance of the work.

A. Pressure distributor. The emulsion shall be applied with a manufacturer-approved computer rate-controlled asphalt distributor. The equipment shall be in good working order and contain no contaminants or diluents in the tank. Spray bar tips must be clean, free of burrs, and of a size to maintain an even distribution of the emulsion. Any type of tip or pressure source is suitable that will maintain predetermined flow rates and constant pressure during the application process with application speeds under eight (8) miles per hour (13 km per hour) or seven hundred (700) feet per minute (213 m per minute). The equipment will be tested under pressure for leaks and to ensure proper set-up before use. The Contractor will provide verification of truck set-up (via a test-shot area), including but not limited to, nozzle tip size appropriate for application per nozzle manufacturer, spray-bar height and pressure and pump speed appropriate for the viscosity and temperature of sealer material, evidence of triple-overlap spray pattern, lack of leaks, and any other factors relevant to ensure the truck is in good working order before use.

The distributor truck shall be equipped with a 12-foot (3.7-m), minimum, spray bar with individual nozzle control. The distributor truck shall be capable of specific application rates in the range of 0.05 to 0.25 gallons per square yard (0.15 to 0.80 liters per square meter). These rates shall be computer-controlled rather than mechanical. The distributor truck shall have an easily accessible thermometer that constantly monitors the temperature of the emulsion, and have an operable mechanical tank gauge that can be used to cross-check the computer accuracy.

The distributor truck shall effectively heat and mix the material to the required temperature prior to application in accordance with the manufacturer's recommendations.

The distributor shall be equipped with a hand sprayer to spray the emulsion in areas not accessible to the distributor truck.

B. Aggregate spreader. The asphalt distributor truck will be equipped with an aggregate spreader mounted to the distributor truck that can apply sand to the emulsion in a single pass operation without driving through wet emulsion. The aggregate spreader shall be equipped with a variable control system capable of uniformly distributing the sand at the specified rate at varying application widths and speeds. The aggregate spreader must be adjusted to produce an even and accurate application of specified aggregate. Prior to any seal coat application, the aggregate spreader will be calibrated onsite to ensure acceptable uniformity of spread. The ~~RPR~~ ***OAR*** will observe the calibration and verify the results. The aggregate spreader will be re-calibrated each time the aggregate rate is changed either during the application of test strips or production. The Contractor may consult the seal coat manufacturer representative for procedure and guidance. The sander shall have a minimum hopper capacity of 3,000 pounds (1361 kg) of sand. Push-

type hand sanders will be allowed for use around lights, signs and other obstructions, if necessary.

C. Power broom/blower. A power broom and/or blower shall be provided for removing loose material from the surface to be treated.

D. Equipment calibration. Asphalt distributors must be calibrated within the same construction season in accordance with ASTM D2995. The Contractor must furnish a current calibration certification for the asphalt distributor truck from any State or other agency as approved by the ~~RPR~~ ***OAR***.

4.4 PREPARATION OF ASPHALT PAVEMENT SURFACES

Clean pavement surface immediately prior to placing the seal coat so that it is free of dust, dirt, grease, vegetation, oil or any type of objectionable surface film. Remove oil or grease from the asphalt pavement by scrubbing with a detergent, washing thoroughly with clean water, and then treat these areas with a spot primer. Any additional surface preparation, such as crack repair, shall be in accordance with Item P-101, paragraph 101-3.6.

A. New asphalt pavement surfaces. Allow new asphalt pavement surfaces to cure so that there is no concentration of oils on the surface.

Perform a water-break-free test to confirm that the surface oils have degraded and dissipated. (Cast approximately one gallon (4 liters) of clean water out over the surface. The water should sheet out and wet the surface uniformly without crawling or showing oil rings.) If signs of crawling or oil rings are apparent on the pavement surface, additional time must be allowed for additional curing and retesting of the pavement surface prior to treatment.

4.5 EMULSION MIXING

The application emulsion shall be obtained by blending asphalt material concentrate, water and polymer, if specified. Always add heated water to the asphalt material concentrate, never add asphalt material concentrate to heated water. Mix one part heated water to two parts asphalt material concentrate, by volume.

Add 1% polymer, by volume, to the emulsion mix. If the polymer is added to the emulsion mix at the plant, submit weight scale tickets to the RPR. As an option, the polymer may be added to the emulsion mix at the job site provided the polymer is added slowly while the asphalt distributor truck circulating pump is running. The mix must be agitated for a minimum of 15 minutes or until the polymer is mixed to the satisfaction of the ~~RPR~~ ***OAR***.

4.6 APPLICATION OF ASPHALT EMULSION

The asphalt emulsion shall be applied using a pressure distributor upon the properly prepared, clean and dry surface at the application rate recommended by the manufacturer's representative and approved by the ~~RPR~~ ***OAR*** from the test area/sections evaluation for each designated treatment area. The asphalt emulsion should be applied

at a temperature between 130°F (54°C) and 160°F (70°C) or in accordance with the manufacturer's recommendation.

If low spots and depressions greater than 1/2 inch (12 mm) in depth in the pavement surface cause ponding or puddling of the applied materials, the pavement surface shall be lightly broomed with a broom or brush type squeegee until the pavement surface is free of any pools of excess material.

During all applications, the surfaces of adjacent structures shall be protected to prevent their being spattered or marred.

4.7 APPLICATION OF AGGREGATE MATERIAL

Immediately following the application of the asphalt emulsion, friction sand at the rate recommended by the manufacturer's representative and approved by the ~~RPR~~ ***OAR*** from the test area/sections evaluation for each designated application area, shall be spread uniformly over the asphalt emulsion in a single-pass operation simultaneous with the sealer application. The aggregate shall be spread to the same width of application as the asphalt material and shall not be applied in such thickness as to cause blanketing.

Sprinkling of additional aggregate material, and spraying additional asphalt material over areas that show up having insufficient cover or bitumen, shall be done by hand whenever necessary. In areas where hand work is necessitated, the sand shall be applied before the sealant begins to break.

Minimize aggregate from being broadcast and accumulating on the untreated pavement adjacent to an application pass. Prior to the next application pass, the Contractor shall clean areas of excess or loose aggregate and remove from project site.

PART 5 - QUALITY CONTROL (QC)

5.1 MANUFACTURER'S REPRESENTATION

The manufacturer's representative knowledgeable of the material, procedures, and equipment described in the specification is responsible to assist the Contractor and ~~RPR~~ ***OAR*** in determining the appropriate application rates of the emulsion and aggregate, as well as recommendations for proper preparation and start-up of seal coat application. Documentation of the manufacturer representative's experience and knowledge for applying the seal coat product shall be furnished to the ~~RPR~~ ***OAR*** a minimum of 10 work days prior to placement of the control strips. The cost of the manufacturer's representative shall be included in the Contractor's bid price.

5.2 CONTRACTOR QUALIFICATIONS

The Contractor shall provide documentation to the ~~RPR~~ ***OAR*** that the seal coat Contractor is qualified to apply the seal coat, including personnel, and equipment, and has made at least three (3) applications similar to this project in the past two (2) years.

PART 6 - MATERIAL ACCEPTANCE

6.1 APPLICATION RATE

The rate of application of the asphalt emulsion shall be verified at least twice per day.

6.2 FRICTION TESTS

Friction tests in accordance with AC 150/5320-12, Measurement, Construction, and Maintenance of Skid-Resistant Airport Pavement Surfaces, shall be performed on all runway and high-speed taxiways that received a seal coat. Each test includes performing friction tests at 40 mph and 60 mph (65 or 95 km/h) both wet, 15 feet (4.5 m) to each side of runway centerline with approved continuous friction measuring equipment (CFME). The Contractor shall coordinate testing with the ~~RPR~~ ***OAR*** and provide the ~~RPR~~ ***OAR*** a written report of friction test results. The ~~RPR~~ ***OAR*** shall be present for testing.

PART 7 - METHOD OF MEASUREMENT

7.1 ASPHALT SURFACE TREATMENT

The quantity of asphalt surface treatment shall not be measured for individual payment.

~~The Contractor must furnish the RPR ***OAR*** with the certified weigh bills when materials are received for the asphalt material used under this contract. The Contractor must not remove material from the tank car or storage tank until initial amounts and temperature measurements have been verified.~~

PART 8 - BASIS OF PAYMENT

8.1 No separate payment shall be made for asphalt surface treatment. All costs associated with surface preparation, furnishing all materials, delivery and application of these materials, for all labor, equipment, tools, and incidentals necessary to complete the item, including the friction testing and all work required to meet AC 150/5320-12, and any costs associated with furnishing a qualified manufacturer's representative to assist with control strips shall be considered incidental.

PART 9 **-** REFERENCES

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

ASTM International (ASTM)

ASTM C117	Standard Test Method for Materials Finer than 75-µm (No. 200) Sieve in Mineral Aggregates by Washing
ASTM C136	Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates
ASTM C1602	Standard Specification for Mixing Water Used in the Production of Hydraulic Cement Concrete
ASTM D5	Standard Test Method for Penetration of Asphalt Materials
ASTM D244	Standard Test Methods and Practices for Emulsified Asphalts
ASTM D2007	Standard Test Method for Characteristic Groups in Rubber Extender and Processing Oils and Other Petroleum-Derived Oils by the Clay-Gel Absorption Chromatographic Method
ASTM D2042	Standard Test Method for Solubility of Asphalt Materials in Trichloroethylene
ASTM D2995	Standard Practice for Estimating Application Rate of Bituminous Distributors
ASTM D4402	Standard Test Method for Viscosity Determination of Asphalt at Elevated Temperatures Using a Rotational Viscometer
ASTM D5340	Standard Test Method for Airport Pavement Condition Index Surveys

Advisory Circulars (AC)

AC 150/5320-12	Measurement, Construction, and Maintenance of Skid-Resistant Airport Pavement Surfaces
AC 150/5320-17	Airfield Pavement Surface Evaluation and Rating (PASER) Manuals
AC 150/5380-6	Guidelines and Procedures for Maintenance of Airport Pavements

END OF ITEM P-608

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ITEM P-610 - CONCRETE FOR MISCELLANEOUS STRUCTURES

PART 1 - DESCRIPTION

1.1 This item shall consist of concrete and reinforcement, as shown on the plans, prepared and constructed in accordance with these specifications. This specification shall be used for all concrete other than airfield pavement which are cast-in-place.

PART 2 - MATERIALS

2.1 GENERAL

Only approved materials, conforming to the requirements of these specifications, shall be used in the work. Materials may be subject to inspection and tests at any time during their preparation or use. The source of all materials shall be approved by the ~~Resident Project Representative (RPR)~~ ***Owner's Authorized Representative (OAR)*** before delivery or use in the work. Representative preliminary samples of the materials shall be submitted by the Contractor, when required, for examination and test. Materials shall be stored and handled to ensure preservation of their quality and fitness for use and shall be located to facilitate prompt inspection. All equipment for handling and transporting materials and concrete must be clean before any material or concrete is placed in them.

The use of pit-run aggregates shall not be permitted unless the pit-run aggregate has been screened and washed, and all fine and coarse aggregates stored separately and kept clean. The mixing of different aggregates from different sources in one storage stockpile or alternating batches of different aggregates shall not be permitted.

A. Reactivity. Fine aggregate and coarse aggregates to be used in all concrete shall have been tested separately within six months of the project in accordance with ASTM C1260. Test results shall be submitted to the ~~RPR~~ ***OAR***. The aggregate shall be considered innocuous if the expansion of test specimens, tested in accordance with ASTM C1260, does not exceed 0.08% at 14 days (16 days from casting). If the expansion either or both test specimen is greater than 0.08% at 14 days, but less than 0.20%, a minimum of 25% of Type F fly ash, or between 40% and 55% of slag cement shall be used in the concrete mix.

If the expansion is greater than 0.20% the aggregates shall not be used, and test results for other aggregates must be submitted for evaluation; or aggregates that meet P-501 reactivity test requirements may be utilized.

2.2 COARSE AGGREGATE

The coarse aggregate for concrete shall meet the requirements of ASTM C33 and the requirements of Table 4, Class Designation 5S; and the grading requirements shown below, as required for the project.

Coarse Aggregate Grading Requirements

Maximum Aggregate Size	ASTM C33, Table 3 Grading Requirements (Size No.)
1 1/2 inch (37.5 mm)	467 or 4 and 67
1 inch (25 mm)	57
¾ inch (19 mm)	67
½ inch (12.5 mm)	7

2.2.1 Coarse Aggregate susceptibility to durability (D) cracking. Not used.

2.3 FINE AGGREGATE

The fine aggregate for concrete shall meet all fine aggregate requirements of ASTM C33.

2.4 CEMENT

Cement shall conform to the requirements of ASTM C150 Type I/II or ASTM C595 Type IL.

2.5 CEMENTITIOUS MATERIALS

A. Fly ash. Fly ash shall meet the requirements of ASTM C618, with the exception of loss of ignition, where the maximum shall be less than 6%. Fly ash shall have a Calcium Oxide (CaO) content of less than 15% and a total available alkali content less than 3% per ASTM C311. Fly ash produced in furnace operations using liming materials or soda ash (sodium carbonate) as an additive shall not be acceptable. The Contractor shall furnish the previous three most recent, consecutive ASTM C618 reports for each source of fly ash proposed in the concrete mix, and shall furnish each additional report as they become available during the project. The reports can be used for acceptance or the material may be tested independently by the ~~RPR~~ ***OAR***.

B. Slag cement (ground granulated blast furnace (GGBF)). Slag cement shall conform to ASTM C989, Grade 100 or Grade 120. Slag cement shall be used only at a rate between 25% and 55% of the total cementitious material by mass.

2.6 WATER

Water used in mixing or curing shall be from potable water sources. Other sources shall be tested in accordance with ASTM C1602 prior to use.

2.7 ADMIXTURES

The Contractor shall submit certificates indicating that the material to be furnished meets all of the requirements indicated below. In addition, the ~~RPR~~ ***OAR*** may require the Contractor to submit complete test data from an approved laboratory showing that the material to be furnished meets all of the requirements of the cited specifications. Subsequent tests may be made of samples taken by the ~~RPR~~ ***OAR*** from the supply of the material being furnished or proposed for use on the work to determine whether the admixture is uniform in quality with that approved.

A. Air-entraining admixtures. Air-entraining admixtures shall meet the requirements of ASTM C260 and shall consistently entrain the air content in the specified ranges under field conditions. The air-entrainment agent and any water reducer admixture shall be compatible.

B. Water-reducing admixtures. Water-reducing admixture shall meet the requirements of ASTM C494, Type A, B, or D. ASTM C494, Type F and G high range water reducing admixtures and ASTM C1017 flowable admixtures shall not be used.

C. Other chemical admixtures. The use of set retarding, and set-accelerating admixtures shall be approved by the ~~RPR~~ ***OAR***. Retarding shall meet the requirements of ASTM C494, Type A, B, or D and set-accelerating shall meet the requirements of ASTM C494, Type C. Calcium chloride and admixtures containing calcium chloride shall not be used.

2.8 PREMOLDED JOINT MATERIAL

Premolded joint material for expansion joints shall meet the requirements of ASTM 1751.

2.9 JOINT FILLER

The filler for joints shall meet the requirements of Item P-605, unless otherwise specified.

2.10 STEEL REINFORCEMENT

Reinforcing shall consist of reinforcing steel conforming to the requirements of ASTM A615 or welded steel wire fabric conforming to ASTM A1064.

2.11 MATERIALS FOR CURING CONCRETE

Curing materials shall conform to ASTM C309 White-pigmented Liquid Membrane-Forming Compound, Type 2, Class B.

PART 3 - CONSTRUCTION METHODS

3.1 GENERAL

The Contractor shall furnish all labor, materials, and services necessary for, and incidental to, the completion of all work as shown on the drawings and specified here. All machinery and equipment used by the Contractor on the work, shall be of sufficient size to meet the requirements of the work. All work shall be subject to the inspection and approval of the ~~RPR~~ ***OAR***.

3.2 CONCRETE MIXTURE

The concrete shall develop a compressive strength of 4000 psi (28 MPa) in 28 days as determined by test cylinders made in accordance with ASTM C31 and tested in accordance with ASTM C39. The concrete shall contain not less than 470 pounds of cementitious material per cubic yard (280 kg per cubic meter). The water cementitious ratio shall not exceed 0.45 by weight. The air content of the concrete shall be 5% +/- 1.2% as determined by ASTM C231 and shall have a slump of not more than 4 inches (100 mm) as determined by ASTM C143.

3.3 MIXING

Concrete may be mixed at the construction site, at a central point, or wholly or in part in truck mixers. The concrete shall be mixed and delivered in accordance with the requirements of ASTM C94 or ASTM C685.

The concrete shall be mixed only in quantities required for immediate use. Concrete shall not be mixed while the air temperature is below 40°F (4°C) without the ~~RPRs~~ ***OAR's*** approval. If approval is granted for mixing under such conditions, aggregates or water, or both, shall be heated and the concrete shall be placed at a temperature not less than 50°F (10°C) nor more than 100°F (38°C). The Contractor shall be held responsible for any defective work, resulting from freezing or injury in any manner during placing and curing, and shall replace such work at his expense.

Retempering of concrete by adding water or any other material is not permitted.

The rate of delivery of concrete to the job shall be sufficient to allow uninterrupted placement of the concrete.

3.4 FORMS

Concrete shall not be placed until all the forms and reinforcements have been inspected and approved by the ~~RPR~~ ***OAR***. Forms shall be of suitable material and shall be of the type, size, shape, quality, and strength to build the structure as shown on the plans. The forms shall be true to line and grade and shall be mortar-tight and sufficiently rigid to prevent displacement and sagging between supports. The surfaces of forms shall be

smooth and free from irregularities, dents, sags, and holes. The Contractor shall be responsible for their adequacy.

The internal form ties shall be arranged so no metal will show in the concrete surface or discolor the surface when exposed to weathering when the forms are removed. All forms shall be wetted with water or with a non-staining mineral oil, which shall be applied immediately before the concrete is placed. Forms shall be constructed so they can be removed without injuring the concrete or concrete surface.

3.5 PLACING REINFORCEMENT

All reinforcement shall be accurately placed, as shown on the plans, and shall be firmly held in position during concrete placement. Bars shall be fastened together at intersections. The reinforcement shall be supported by approved metal chairs. Shop drawings, lists, and bending details shall be supplied by the Contractor when required.

3.6 EMBEDDED ITEMS

Before placing concrete, all embedded items shall be firmly and securely fastened in place as indicated. All embedded items shall be clean and free from coating, rust, scale, oil, or any foreign matter. The concrete shall be spaded and consolidated around and against embedded items. The embedding of wood shall not be allowed.

3.7 CONCRETE CONSISTENCY

The Contractor shall monitor the consistency of the concrete delivered to the project site; collect each batch ticket; check temperature; and perform slump tests on each truck at the project site in accordance with ASTM C143.

3.8 PLACING CONCRETE

All concrete shall be placed during daylight hours, unless otherwise approved. The concrete shall not be placed until the depth and condition of foundations, the adequacy of forms and falsework, and the placing of the steel reinforcing have been approved by the ~~RPR~~ ***OAR***. Concrete shall be placed as soon as practical after mixing, but in no case later than one (1) hour after water has been added to the mix. The method and manner of placing shall avoid segregation and displacement of the reinforcement. Troughs, pipes, and chutes shall be used as an aid in placing concrete when necessary. The concrete shall not be dropped from a height of more than 5 feet (1.5 m). Concrete shall be deposited as nearly as practical in its final position to avoid segregation due to rehandling or flowing. Do not subject concrete to procedures which cause segregation. Concrete shall be placed on clean, damp surfaces, free from running water, or on a properly consolidated soil foundation.

3.9 VIBRATION

Vibration shall follow the guidelines in American Concrete Institute (ACI) Committee 309R, Guide for Consolidation of Concrete.

3.10 JOINTS

Joints shall be constructed as indicated on the plans.

3.11 FINISHING

All exposed concrete surfaces shall be true, smooth, and free from open or rough areas, depressions, or projections. All concrete horizontal plane surfaces shall be brought flush to the proper elevation with the finished top surface struck-off with a straightedge and floated.

3.12 CURING AND PROTECTION

All concrete shall be properly cured in accordance with the recommendations in American Concrete Institute (ACI) 308R, Guide to External Curing of Concrete. The concrete shall be protected from damage until project acceptance.

3.13 COLD WEATHER PLACING

When concrete is placed at temperatures below 40°F (4°C), follow the cold weather concreting recommendations found in ACI 306R, Cold Weather Concreting.

3.14 HOT WEATHER PLACING

When concrete is placed in hot weather greater than 85ºF (30 ºC), follow the hot weather concreting recommendations found in ACI 305R, Hot Weather Concreting.

PART 4 - QUALITY ASSURANCE (QA)

4.1 QUALITY ASSURANCE SAMPLING AND TESTING

Concrete for each day's placement will be accepted on the basis of the compressive strength specified in paragraph 3.2. The ~~RPR~~ ***OAR*** will sample the concrete in accordance with ASTM C172; test the slump in accordance with ASTM C143; test air content in accordance with ASTM C231; make and cure compressive strength specimens in accordance with ASTM C31; and test in accordance with ASTM C39. The QA testing agency will meet the requirements of ASTM C1077.

The Contractor shall provide adequate facilities for the initial curing of cylinders.

4.2 DEFECTIVE WORK

Any defective work that cannot be satisfactorily repaired as determined by the ~~RPR~~ ***OAR***, shall be removed and replaced at the Contractor's expense. Defective work includes, but is not limited to, uneven dimensions, honeycombing and other voids on the surface or edges of the concrete.

PART 5 - METHOD OF MEASUREMENT

5.1 Concrete shall be considered incidental and no separate measurement shall be made.

PART 6 - BASIS OF PAYMENT

6.1 Concrete shall be considered incidental and no separate payment shall be made.

PART 7 - REFERENCES

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

ASTM International (ASTM)

ASTM A184	Standard Specification for Welded Deformed Steel Bar Mats for Concrete Reinforcement
ASTM A615	Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
ASTM A704	Standard Specification for Welded Steel Plain Bar or Rod Mats for Concrete Reinforcement
ASTM A706	Standard Specification for Low-Alloy Steel Deformed and Plain Bars for Concrete Reinforcement
ASTM A775	Standard Specification for Epoxy-Coated Steel Reinforcing Bars
ASTM A884	Standard Specification for Epoxy-Coated Steel Wire and Welded Wire Reinforcement
ASTM A934	Standard Specification for Epoxy-Coated Prefabricated Steel Reinforcing Bars
ASTM A1064	Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete

ASTM C31	Standard Practice for Making and Curing Concrete Test Specimens in the Field
ASTM C33	Standard Specification for Concrete Aggregates
ASTM C39	Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens
ASTM C94	Standard Specification for Ready-Mixed Concrete
ASTM C136	Standard Test Method for Sieve or Screen Analysis of Fine and Coarse Aggregates
ASTM C114	Standard Test Methods for Chemical Analysis of Hydraulic Cement
ASTM C136	Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates
ASTM C143	Standard Test Method for Slump of Hydraulic-Cement Concrete
ASTM C150	Standard Specification for Portland Cement
ASTM C171	Standard Specification for Sheet Materials for Curing Concrete
ASTM C172	Standard Practice for Sampling Freshly Mixed Concrete
ASTM C231	Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method
ASTM C260	Standard Specification for Air-Entraining Admixtures for Concrete
ASTM C309	Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete
ASTM C311	Standard Test Methods for Sampling and Testing Fly Ash or Natural Pozzolans for Use in Portland-Cement Concrete
ASTM C494	Standard Specification for Chemical Admixtures for Concrete
ASTM C618	Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete
ASTM C666	Standard Test Method for Resistance of Concrete to Rapid Freezing and Thawing
ASTM C685	Standard Specification for Concrete Made by Volumetric Batching and Continuous Mixing
ASTM C989	Standard Specification for Slag Cement for Use in Concrete and Mortars

ASTM C1017	Standard Specification for Chemical Admixtures for Use in Producing Flowing Concrete
ASTM C1077	Standard Practice for Agencies Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Testing Agency Evaluation
ASTM C1157	Standard Performance Specification for Hydraulic Cement
ASTM C1260	Standard Test Method for Potential Alkali Reactivity of Aggregates (Mortar-Bar Method)
ASTM C1365	Standard Test Method for Determination of the Proportion of Phases in Portland Cement and Portland-Cement Clinker Using X-Ray Powder Diffraction Analysis
ASTM C1602	Standard Specification for Mixing Water Used in the Production of Hydraulic Cement Concrete
ASTM D1751	Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Asphalt Types)
ASTM D1752	Standard Specification for Preformed Sponge Rubber Cork and Recycled PVC Expansion Joint Fillers for Concrete Paving and Structural Construction

American Concrete Institute (ACI)

ACI 305R	Hot Weather Concreting
ACI 306R	Cold Weather Concreting
ACI 308R	Guide to External Curing of Concrete
ACI 309R	Guide for Consolidation of Concrete

END OF ITEM P-610

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ITEM P-620 - RUNWAY AND TAXIWAY MARKING

PART 1 - DESCRIPTION

1.1 This item shall consist of the preparation and painting of numbers, markings, and stripes on the surface of runways, taxiways, and aprons, in accordance with these specifications and at the locations shown on the plans, or as directed by the ~~Resident Project Representative (RPR)~~ ***Owner's Authorized Representative (OAR)***. The terms "paint" and "marking material" as well as "painting" and "application of markings" are interchangeable throughout this specification.

PART 2 - MATERIALS

2.1 MATERIALS ACCEPTANCE

The Contractor shall furnish manufacturer's certified test reports, for materials shipped to the project. The certified test reports shall include a statement that the materials meet the specification requirements. This certification along with a copy of the paint manufacturer's surface preparation; marking materials, including adhesion, flow promoting and/or floatation additive; and application requirements must be submitted and approved by the ~~Resident Project Representative (RPR)~~ ***Owner's Authorized Representative (OAR)*** prior to the initial application of markings. The reports can be used for material acceptance or the ~~RPR~~ ***OAR*** may perform verification testing. The reports shall not be interpreted as a basis for payment. The Contractor shall notify the ~~RPR~~ ***OAR*** upon arrival of a shipment of materials to the site. All material shall arrive in sealed containers that are easily quantifiable for inspection by the ~~RPR~~ ***OAR***.

2.2 MARKING MATERIALS

Table 1. Marking Materials

Paint[1]				Glass Beads[2]	
Type	Color	Fed Std. 595 Number	Application Rate Maximum	Type	Application Rate Minimum
Waterborne Type III	White	37925	90 ft^2/gal	Type III	10 lb/gal
Waterborne Type III	Yellow	33538	90 ft^2/gal	Type III	10 lb/gal
Waterborne Type III	Red	31136	90 ft^2/gal	Type I	8 lb/gal
Waterborne Type III	Black	37038	90 ft^2/gal	n/a	n/a

[1] See paragraph 2.2a

[2] See paragraph 2.2b

A. Paint. Paint shall be waterborne in accordance with the requirements of this paragraph. Paint colors shall comply with Federal Standard No. 595.

Waterborne. Paint shall meet the requirements of Federal Specification TT-P-1952F, Type III. The non-volatile portion of the vehicle for all paint types shall be composed of a 100% acrylic polymer as determined by infrared spectral analysis. ***Paint shall be furnished with a biocide compatible with manufacturer when tested in accordance with ASTM D 711 (not required for black paint).***

B. Reflective media. Glass beads for white and yellow paint shall meet the requirements for Federal Specification TT-B-1325D Type III.

Glass beads for red and pink paint shall meet the requirements for Type I, Gradation A.

Glass beads shall be treated with all compatible coupling agents recommended by the manufacturers of the paint and reflective media to ensure adhesion and embedment.

Glass beads shall not be used in black and green paint.

Type III glass beads shall not be used in red and pink paint.

PART 3 - CONSTRUCTION METHODS

3.1 WEATHER LIMITATIONS

Painting shall only be performed when the surface is dry, and the ambient temperature and the pavement surface temperature meet the manufacturer's recommendations in accordance with paragraph 2.1. Painting operations shall be discontinued when the ambient or surface temperatures does not meet the manufacturer's recommendations. Markings shall not be applied when the wind speed exceeds 10 mph unless windscreens are used to shroud the material guns. Markings shall not be applied when weather conditions are forecasts to not be within the manufacturers' recommendations for application and dry time. ***The weather shall not be excessively gusty, dusty, or foggy and the suitability of the weather will be determined by the OAR.***

3.2 EQUIPMENT

Equipment shall include the apparatus necessary to properly clean the existing surface, a mechanical marking machine, a bead dispensing machine, and such auxiliary hand-painting equipment as may be necessary to satisfactorily complete the job.

The mechanical marker shall be an atomizing spray-type or airless type marking machine with automatic glass bead dispensers suitable for application of traffic paint. It shall produce an even and uniform film thickness and appearance of both paint and glass beads at the required coverage and shall apply markings of uniform cross-sections and clear-cut edges without running or spattering and without over spray. The marking equipment for both paint and beads shall be calibrated daily.

The Contractor shall provide vacuum type equipment capable of removing excess or loose beads from the pavement surface.

3.3 PREPARATION OF SURFACES

Immediately before application of the paint, the surface shall be dry and free from dirt, grease, oil, laitance, or other contaminates that would reduce the bond between the paint and the pavement. Use of any chemicals or impact abrasives during surface preparation shall be approved in advance by the ~~RPR~~ ***OAR***. After the cleaning operations, sweeping, blowing, or rinsing with pressurized water shall be performed to ensure the surface is clean and free of grit or other debris left from the cleaning process.

A. Preparation of new pavement surfaces. The area to be painted shall be cleaned by broom, blower, water blasting, or by other methods approved by the ~~RPR~~ ***OAR*** to remove all contaminants, including PCC curing compounds, minimizing damage to the pavement surface.

B. Preparation of pavement to remove existing markings. Existing pavement markings shall be removed by rotary grinding, water blasting, or by other methods approved by the ~~RPR~~ ***OAR*** minimizing damage to the pavement surface. The removal area may need to be larger than the area of the markings to eliminate ghost markings. After removal of markings on asphalt pavements, apply a fog seal or seal coat to 'block out' the removal area to eliminate 'ghost' markings.

C. Preparation of pavement markings prior to remarking. Prior to remarking existing markings, loose existing markings must be removed minimizing damage to the pavement surface, with a method approved by the ~~RPR~~ ***OAR***. After removal, the surface shall be cleaned of all residue or debris.

Prior to the application of markings, the Contractor shall certify in writing that the surface is dry and free from dirt, grease, oil, laitance, or other foreign material that would prevent the bond of the paint to the pavement or existing markings. This certification along with a copy of the paint manufactures application and surface preparation requirements must be submitted to the ~~RPR~~ ***OAR*** prior to the initial application of markings.

3.4 LAYOUT OF MARKINGS

The proposed markings shall be laid out in advance of the paint application. The locations of markings to receive glass beads shall be shown on the plans.

3.5 APPLICATION

A period of 28 days shall elapse between placement of surface course or seal coat and application of the permanent paint markings. Paint shall be applied at the locations and to the dimensions and spacing shown on the plans. Paint shall not be applied until the layout and condition of the surface has been approved by the ~~RPR~~ ***OAR***.

SECTION SP-100 - GENERAL PROVISIONS AND REQUIREMENTS FOR ELECTRICAL WORK

PART 1 - GENERAL

1.1 SPECIAL REQUIREMENTS FOR ELECTRICAL WORK

A. This item shall apply to all electrical work contained within the Contract Documents. Where the contract general conditions, special provisions or other parts of the Contract Documents also apply, the stricter of the documents shall govern.

1.2 AUXILIARIES AND ACCESSORIES

A. Include all auxiliaries and accessories for a complete, fully functional and properly operating system in accordance with the Contract Documents.

B. Provide and install all electrical systems and any necessary appurtenances as per Federal Aviation Administration (FAA) Advisory Circulars and FAA Orders, NFPA 70 - National Electrical Code (NEC), federal, state and local codes whether specified or shown in the Contract Documents or not. The content of the Contract Documents in general only refers to work required above and beyond the requirements of the FAA, NEC and applicable federal, state and local codes.

1.3 PROJECT PAY ITEMS

A. The project pay items are provided to be inclusive of all work to be performed as shown in the Contract Documents. All work not identified with a specific pay item shall be considered required work to complete the project and shall be considered subsidiary to the cost of the project pay items provided.

1.4 CONTRACTOR EXPERIENCE

A. All Contractors used to perform work of this contract shall be licensed to perform electrical work in the state in which the project is located at the time bids are submitted. At least one member (qualifier) of the electrical contracting firm shall hold a state certified (unlimited, unrestricted) electrical contractor’s license.

1.5 EXPERIENCE AND SUPERVISION OF CONTRACTOR PERSONNEL

A. Provide a resident on-site electrical supervisor to manage work at the job site whenever electrical work is being performed or affected. Electrical work is defined as any work described, included, depicted or contained within the Construction Specifications Institute (CSI) Division 16, 26, 27, 28, 33 or 34 specifications, L-XXX specification series, SP-XXX specification series, E- series drawings, ED-series drawings, and all other work within the Contract Documents dealing with the distribution of electrical power/light, electrical/electronic/light monitoring, communication and control.

ITEM P-620 - RUNWAY AND TAXIWAY MARKING

PART 1 - DESCRIPTION

1.1 This item shall consist of the preparation and painting of numbers, markings, and stripes on the surface of runways, taxiways, and aprons, in accordance with these specifications and at the locations shown on the plans, or as directed by the ~~Resident Project Representative (RPR)~~ ***Owner's Authorized Representative (OAR)***. The terms "paint" and "marking material" as well as "painting" and "application of markings" are interchangeable throughout this specification.

PART 2 - MATERIALS

2.1 MATERIALS ACCEPTANCE

The Contractor shall furnish manufacturer's certified test reports, for materials shipped to the project. The certified test reports shall include a statement that the materials meet the specification requirements. This certification along with a copy of the paint manufacturer's surface preparation; marking materials, including adhesion, flow promoting and/or floatation additive; and application requirements must be submitted and approved by the ~~Resident Project Representative (RPR)~~ ***Owner's Authorized Representative (OAR)*** prior to the initial application of markings. The reports can be used for material acceptance or the ~~RPR~~ ***OAR*** may perform verification testing. The reports shall not be interpreted as a basis for payment. The Contractor shall notify the ~~RPR~~ ***OAR*** upon arrival of a shipment of materials to the site. All material shall arrive in sealed containers that are easily quantifiable for inspection by the ~~RPR~~ ***OAR***.

2.2 MARKING MATERIALS

Table 1. Marking Materials

Paint[1]				Glass Beads[2]	
Type	Color	Fed Std. 595 Number	Application Rate Maximum	Type	Application Rate Minimum
Waterborne Type III	White	37925	90 ft²/gal	Type III	10 lb/gal
Waterborne Type III	Yellow	33538	90 ft²/gal	Type III	10 lb/gal
Waterborne Type III	Red	31136	90 ft²/gal	Type I	8 lb/gal
Waterborne Type III	Black	37038	90 ft²/gal	n/a	n/a

[1] See paragraph 2.2a
[2] See paragraph 2.2b

A. Paint. Paint shall be waterborne in accordance with the requirements of this paragraph. Paint colors shall comply with Federal Standard No. 595.

Waterborne. Paint shall meet the requirements of Federal Specification TT-P-1952F, Type III. The non-volatile portion of the vehicle for all paint types shall be composed of a 100% acrylic polymer as determined by infrared spectral analysis. ***Paint shall be furnished with a biocide compatible with manufacturer when tested in accordance with ASTM D 711 (not required for black paint). Temporary markings shall be applied at a half application rate and shall not include reflective media.***

B. Reflective media. Glass beads for white and yellow paint shall meet the requirements for Federal Specification TT-B-1325D Type III.

Glass beads for red and pink paint shall meet the requirements for Type I, Gradation A.

Glass beads shall be treated with all compatible coupling agents recommended by the manufacturers of the paint and reflective media to ensure adhesion and embedment.

Glass beads shall not be used in black and green paint.

Type III glass beads shall not be used in red and pink paint.

PART 3 - CONSTRUCTION METHODS

3.1 WEATHER LIMITATIONS

Painting shall only be performed when the surface is dry, and the ambient temperature and the pavement surface temperature meet the manufacturer's recommendations in accordance with paragraph 2.1. Painting operations shall be discontinued when the ambient or surface temperatures does not meet the manufacturer's recommendations. Markings shall not be applied when the wind speed exceeds 10 mph unless windscreens are used to shroud the material guns. Markings shall not be applied when weather conditions are forecasts to not be within the manufacturers' recommendations for application and dry time. ***The weather shall not be excessively gusty, dusty, or foggy and the suitability of the weather will be determined by the OAR.***

3.2 EQUIPMENT

Equipment shall include the apparatus necessary to properly clean the existing surface, a mechanical marking machine, a bead dispensing machine, and such auxiliary hand-painting equipment as may be necessary to satisfactorily complete the job.

The mechanical marker shall be an atomizing spray-type or airless type marking machine with automatic glass bead dispensers suitable for application of traffic paint. It shall produce an even and uniform film thickness and appearance of both paint and glass beads at the required coverage and shall apply markings of uniform cross-sections and clear-cut edges without running or spattering and without over spray. The marking equipment for both paint and beads shall be calibrated daily.

The Contractor shall provide vacuum type equipment capable of removing excess or loose beads from the pavement surface.

3.3 PREPARATION OF SURFACES

Immediately before application of the paint, the surface shall be dry and free from dirt, grease, oil, laitance, or other contaminates that would reduce the bond between the paint and the pavement. Use of any chemicals or impact abrasives during surface preparation shall be approved in advance by the ~~RPR~~ ***OAR***. After the cleaning operations, sweeping, blowing, or rinsing with pressurized water shall be performed to ensure the surface is clean and free of grit or other debris left from the cleaning process.

A. Preparation of new pavement surfaces. The area to be painted shall be cleaned by broom, blower, water blasting, or by other methods approved by the ~~RPR~~ ***OAR*** to remove all contaminants, including PCC curing compounds, minimizing damage to the pavement surface.

B. Preparation of pavement to remove existing markings. Existing pavement markings shall be removed by rotary grinding, water blasting, or by other methods approved by the ~~RPR~~ ***OAR*** minimizing damage to the pavement surface. The removal area may need to be larger than the area of the markings to eliminate ghost markings. After removal of markings on asphalt pavements, apply a fog seal or seal coat to ‘block out’ the removal area to eliminate ‘ghost’ markings.

C. Preparation of pavement markings prior to remarking. Prior to remarking existing markings, loose existing markings must be removed minimizing damage to the pavement surface, with a method approved by the ~~RPR~~ ***OAR***. After removal, the surface shall be cleaned of all residue or debris.

Prior to the application of markings, the Contractor shall certify in writing that the surface is dry and free from dirt, grease, oil, laitance, or other foreign material that would prevent the bond of the paint to the pavement or existing markings. This certification along with a copy of the paint manufactures application and surface preparation requirements must be submitted to the ~~RPR~~ ***OAR*** prior to the initial application of markings.

3.4 LAYOUT OF MARKINGS

The proposed markings shall be laid out in advance of the paint application. The locations of markings to receive glass beads shall be shown on the plans.

3.5 APPLICATION

A period of 28 days shall elapse between placement of surface course or seal coat and application of the permanent paint markings. Paint shall be applied at the locations and to the dimensions and spacing shown on the plans. Paint shall not be applied until the layout and condition of the surface has been approved by the ~~RPR~~ ***OAR***.

The edges of the markings shall not vary from a straight line more than 1/2 inch (12 mm) in 50 feet (15 m), and marking dimensions and spacing shall be within the following tolerances:

Marking Dimensions and Spacing Tolerance

Dimension and Spacing	Tolerance
36 inch (910 mm) or less	±1/2 inch (12 mm)
greater than 36 inch to 6 feet (910 mm to 1.85 m)	±1 inch (25 mm)
greater than 6 feet to 60 feet (1.85 m to 18.3 m)	±2 inch (50 mm)
greater than 60 feet (18.3 m)	±3 inch (76 mm)

The paint shall be mixed in accordance with the manufacturer's instructions and applied to the pavement with a marking machine at the rate shown in Table 1. The addition of thinner will not be permitted.

Glass beads shall be distributed upon the marked areas at the locations shown on the plans to receive glass beads immediately after application of the paint. A dispenser shall be furnished that is properly designed for attachment to the marking machine and suitable for dispensing glass beads. Glass beads shall be applied at the rate shown in Table 1. Glass beads shall not be applied to black paint or green paint. Glass beads shall adhere to the cured paint or all marking operations shall cease until corrections are made. Different bead types shall not be mixed. Regular monitoring of glass bead embedment and distribution should be performed.

3.6 APPLICATION--PREFORMED THERMOPLASTIC AIRPORT PAVEMENT MARKINGS

Preformed thermoplastic pavement markings not used.

3.7 CONTROL STRIP

Prior to the full application of airfield markings, the Contractor shall prepare a control strip in the presence of the ~~RPR~~ ***OAR***. The Contractor shall demonstrate the surface preparation method and all striping equipment to be used on the project. The marking equipment must achieve the prescribed application rate of paint and population of glass beads (per Table 1) that are properly embedded and evenly distributed across the full

width of the marking. Prior to acceptance of the control strip, markings must be evaluated during darkness to ensure a uniform appearance.

3.8 RETRO-REFLECTANCE

Reflectance shall be measured with a portable retro-reflectometer meeting ASTM E1710 (or equivalent). A total of 6 reading shall be taken over a 6 square foot area with 3 readings taken from each direction. The average shall be equal to or above the minimum levels of all readings which are within 30% of each other.

Minimum Retro-Reflectance Values

Material	Retro-reflectance mcd/m^2/lux		
	White	Yellow	Red
Initial Type I	300	175	35
Initial Type III	600	300	35
Initial Thermoplastic	225	100	35
All materials, remark when less than[1]	100	75	10

[1] 'Prior to remarking, determine if removal of contaminants on markings will restore retro-reflectance.

3.9 PROTECTION AND CLEANUP

After application of the markings, all markings shall be protected from damage until dry. All surfaces shall be protected from excess moisture and/or rain and from disfiguration by spatter, splashes, spillage, or drippings. The Contractor shall remove from the work area all debris, waste, loose reflective media, and by-products generated by the surface preparation and application operations to the satisfaction of the ~~RPR~~ ***OAR***. The Contractor shall dispose of these wastes in strict compliance with all applicable state, local, and federal environmental statutes and regulations.

PART 4 - METHOD OF MEASUREMENT

4.1A The quantity of surface preparation shall not be measured directly for payment.

4.1B The quantity of markings shall be paid for shall be measured by the number of square feet of painting.

4.1C The quantity of reflective media shall not be measured directly for payment.

4.1D Temporary markings ***may be required and shall not be measured directly for payment. Temporary markings, and their removal shall be considered incidental to the C-106-4.4.***

4.1E The quantity of markings removal (excluding those temporary markings applied by the Contractor) shall be paid for shall be measured by the number of square feet of painting removal.

PART 5 - BASIS OF PAYMENT

5.1 This price shall be full compensation for furnishing all materials and for all labor, equipment, tools, and incidentals necessary to complete the item complete in place and accepted by the ~~RPR~~ ***OAR*** in accordance with these specifications.

~~5.1A Payment for surface preparation shall be made at the contract price for.~~

5.2B Payment for markings shall be made at the contract price for the number of square feet of painting.

~~5.3C Payment for reflective media shall be made at the contract unit price for [the number of pounds (km) of reflective media] [lump sum].~~

5.4D ***Temporary markings shall be performed in accordance with the specifications and accepted by the RPR and payment shall be included in the lump sum bid item C-106-4.4. Temporary marking includes surface preparation, application and complete removal of the temporary marking.***

5.4E Payment for markings removal (excluding those temporary markings applied by the Contractor) shall be made at the contract price for the number of square feet of painting removal.

Item P-620-5.1	Markings - Yellow	- per Square Foot (SF)
Item P-620-5.2	Markings – White	- per Square Foot (SF)
Item P-620-5.3	Markings - Red	- per Square Foot (SF)
Item P-620-5.4	Markings - Black	- per Square Foot (SF)
Item P-620-5.5	***Marking Removal***	***-per Square Foot (SF)***

PART 6 - REFERENCES

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

ASTM International (ASTM)

ASTM D476	Standard Classification for Dry Pigmentary Titanium Dioxide Products
ASTM D968	Standard Test Methods for Abrasion Resistance of Organic Coatings by Falling Abrasive
ASTM D1652	Standard Test Method for Epoxy Content of Epoxy Resins
ASTM D2074	Standard Test Method for Total, Primary, Secondary, and Tertiary Amine Values of Fatty Amines by Alternative Indicator Method
ASTM D2240	Standard Test Method for Rubber Property - Durometer Hardness
ASTM D7585	Standard Practice for Evaluating Retroreflective Pavement Markings Using Portable Hand-Operated Instruments
ASTM E303	Standard Test Method for Measuring Surface Frictional Properties Using the British Pendulum Tester
ASTM E1710	Standard Test Method for Measurement of Retroreflective Pavement Marking Materials with CEN-Prescribed Geometry Using a Portable Retroreflectometer
ASTM E2302	Standard Test Method for Measurement of the Luminance Coefficient Under Diffuse Illumination of Pavement Marking Materials Using a Portable Reflectometer
ASTM G154	Standard Practice for Operating Fluorescent Ultraviolet (UV) Lamp Apparatus for Exposure of Nonmetallic Materials

Code of Federal Regulations (CFR)

40 CFR Part 60, Appendix A-7, Method 24	Determination of volatile matter content, water content, density, volume solids, and weight solids of surface coatings
29 CFR Part 1910.1200	Hazard Communication

Federal Specifications (FED SPEC)

FED SPEC TT-B-1325D	Beads (Glass Spheres) Retro-Reflective
FED SPEC TT-P-1952F	Paint, Traffic and Airfield Marking, Waterborne
FED STD 595	Colors used in Government Procurement

Commercial Item Description

A-A-2886B	Paint, Traffic, Solvent Based

Advisory Circulars (AC)

AC 150/5340-1	Standards for Airport Markings
AC 150/5320-12	Measurement, Construction, and Maintenance of Skid Resistant Airport Pavement Surfaces

END OF ITEM P-620

B. When work is being performed within the Aircraft Operations Area, the on-site supervisor shall also be within the Aircraft Operations Area, except for incidental absences. Incidental absences shall not exceed 45 minutes in length. The Contractor is encouraged to keep the same on-site supervisor(s) from commencement to completion of work.

C. Each on-site supervisor shall have a minimum of 5 years (2,000 hours per year) of successful supervisory experience either constructing or maintaining airfield lighting systems. At least 3 of these years of experience shall have occurred in the last 5 years on projects of comparable size and complexity. On-site supervisor shall be certified as a "Qualified Person". The definition of a Qualified Person is defined in OSHA 1910.399 and NFPA 70E (Article 100 & 110.2(1)). The certification shall be signed by the Contractor's Electrical License qualifier. Equivalent experience and training may be considered by the Engineer. On-Site supervisor may substitute one year of education in qualified electrical curriculum for one-half year electrical experience for a maximum of 2,000 hours of the required 10,000 hours of experience. Records of on-site supervisor's experience demonstrating compliance with these requirements shall be submitted to the Engineer for verification and review prior to starting work. Experience records shall include contact information for references (name, title and phone number) from airports where the proposed on-site supervisor has completed the required electrical experience. Only on-site supervisors whose experience records have been confirmed by the Engineer shall supervise work. Work shall not start prior to approval of the on-site supervisor, unless under the direct supervision of the Contractor's Electrical License qualifier. Multiple certified on-site supervisors may be required to support multiple shifts or around the clock activities.

D. If at any time the Owner Authorized Representative (OAR) believes that work is being performed without the presence of an on-site supervisor, the OAR will request that the workman in question demonstrate that the on-site supervisor is present. If the on-site supervisor's presence cannot be verified within 45 minutes the OAR may direct the Contractor to suspend work until proper supervision is made available. The Contractor shall not be remunerated for costs associated with suspension of work under these conditions.

E. It is agreed and understood that, if requested in writing by the OAR, the Contractor shall replace any on-site supervisor with another meeting the required qualifications within seven (7) days of receipt of request.

F. Electricians are tasked with installing raceways and fittings; electrical distribution and supply equipment, pulling, splicing and terminating wire/cable; grounding, lightning protection, installing light bases, light fixtures; connecting signs; performing electrical testing or other work contained in the Contract Documents or as described in 1.5(A) above. Electricians performing work shall have a minimum of 4 years (2,000 hours per year) of successful experience either constructing or maintaining airfield lighting systems and shall be certified a "Qualified Person". A copy of each Electrician's experience shall be submitted to the OAR. Each electrician's experience submittal shall comply with the above requirements. An apprentice/helper/laborer may assist the electrician with the above tasks as directed by the on-site supervisor. An electrician may supervise a maximum of four apprentices/helpers/laborers.

G. Electrical apprentices, helpers, laborers, shall be qualified persons for the work they are performing and shall be under the supervision of the on-site supervisor or electrician.

H. Other helpers, laborers, equipment operators, concrete workers and other crafts persons (skilled or unskilled) shall be qualified persons for the work they are performing and shall be under the supervision of the on-site supervisor and are not subject to the four person limitation in 1.5.f.

I. Any person who does not have the required experience or who demonstrates a lack of knowledge appropriate for the task they are performing shall be dismissed from the project for remainder of the contract.

PART 2 - SUMMARY OF WORK

2.1 GENERAL

A. In support of this project this contract includes installation of airfield lighting, counterpoise, signage, power distribution, standby generator, lightning protection and other electrical work as shown in the Contract Documents. The above is not intended to be all inclusive but is provided as an aid to the Contractor. It is the intent of the Contract Documents that the Contractor is to furnish and install all materials and provide the necessary supervision, transportation, preparation, assembly, survey and installation of these materials, and for all labor, equipment, tools, incidentals, and appurtenances necessary to provide a fully functional and operational system as described by these Contract Documents. All items are new and unused unless specifically noted otherwise.

2.2 RECORD DOCUMENTS

A. The Contractor shall maintain the Contract Documents, Shop Drawings and samples at the site, in good order and annotated daily to show all changes made during the construction process per Item SP-106. These shall be available to the OAR for examination.

2.3 ENGINEERING OBSERVATIONS

A. Items noted by Engineer during construction and before final acceptance, which does not comply with the Contract, will be listed in accordance with the general conditions. These items will be sent to the Contractor for action. The Contractor shall have these items corrected.

B. The Contractor shall check items noted after acceptance during the warranty/guarantee period in the same manner as above.

2.4 EXISTING CONDITIONS

A. Investigate site thoroughly and reroute all conduit/duct and wiring in area of new construction in order to maintain continuity of existing circuitry. Existing conduit/duct shown in the Contract Documents show approximate locations only. Contractor must verify and coordinate existing site conduit/ducts, wiring and piping. The bids shall include hand digging and all required rerouting in areas of existing conduit/ducts and/or pipes.

B. Check site and existing conditions thoroughly before bidding. Advise Engineer of discrepancies or questions noted. If any difference is discovered between the existing conditions and the Contract Documents, the Engineer shall be notified in writing immediately.

C. The Electrical Contractor shall investigate all existing systems within the construction limits and complete the performance verification prior to the beginning of any work, which could affect these existing systems.

D. Advise Engineer in writing of all deficiencies in existing system(s) prior to work. All systems will be assumed to be fully operational if written notification is not received by Engineer prior to work on system.

E. The work involved is in connection with existing systems/facilities, which must remain in operation while work is being performed. Work must be done in accordance with the schedule specified in the Contract Documents. Schedule all work to minimize the period when systems are inoperable. Request written permission and receive written approval from Engineer a minimum of 2 weeks in advance of any shutdown of existing systems. (FAA requires 45 days minimum notice.) Perform work required at other than standard working hours where outages cannot be accepted during regular working hours. Protect existing buildings and equipment during construction as required.

F. There may be piping, fixtures or other items, which must be removed or relocated in order to perform the alteration work. All conduit/duct, wiring, boxes, etc. that do not comply with the Contract Documents shall be removed or corrected to comply with the Contract Documents. All unused conduit/duct not removed shall be identified and a pull line shall be installed. Bid shall include all removal and relocation required for completion of the alterations and the new construction.

G. Special attention is directed to relocation of the existing power conduits and duct bank and communication systems. Cable counts, location, and function must be field verified before starting work.

H. The Contractor shall verify the areas, conditions, and features necessary to tie into existing construction. This verification shall be done prior to submittal of shop drawings, fabrication or erection, construction or installation. The Contractor shall be responsible for the accurate tie-in of the new work to existing facilities. This requirement assumes that existing items comply with current codes and standards.

2.5 SYSTEMS WARRANTY

A. The work required under this division shall include a one (1) year warranty from the date of final acceptance unless required otherwise by the Contract Documents. This warranty shall be by the Contractor/Manufacturer to the Owner for any defective workmanship or material, which has been furnished under this contract. The Contractor/Manufacturer at no cost to the Owner shall perform replacement of defective workmanship or material for a period of one (1) year (or greater if noted in the Contract Documents) from the date of final acceptance of the system. This warranty shall not include light bulbs in service after one (1) month from date of substantial completion of the system. Explain the provisions of the warranty to the Owner during project close out.

B. In accordance with EB-67D, Light Sources Other Than Incandescent and Xenon for Airport and Obstruction Lighting Fixtures; all LED light fixtures with the exception of obstruction lighting (AC 150/5345-43) shall be warranted by the manufacturer for a minimum of four (4) years after date of installation inclusive of all electronics. This warranty shall be by the Contractor/Manufacturer to the Owner for any defective workmanship or material, which has been furnished under this contract. The Contractor/Manufacturer at no cost to the Owner shall perform replacement of defective LED fixture workmanship or material for a period of four (4) years after date of installation.

2.6 SUBSTANTIAL COMPLETION

A. All specified work shall be complete prior to final observation of work, and all forms and other information requested, including Operation and Maintenance Manuals, shall be submitted to the Engineer for approval one (1) week before the request for substantial completion of the work.

2.7 CONTRACTORS RESPONSIBILITIES

A. Provide necessary layout, labor, material, equipment, tools, transportation, full time supervision and services required for the satisfactory and timely completion of the work in accordance with the Contract Documents.

B. Unload, store, protect and re-handle the materials required for this Contract until such time that material is in place. Provide protection of materials required of this contract after installation.

C. Provide all required transportation, erection, maintenance, dismantling and removal of temporary facilities and equipment required by this contract.

D. Provide all transportation, unloading, distribution, hoisting, rigging, material handling and scaffolding required installing the work of this contract.

E. Provide all engineering and layout required to perform the work from established base lines and benchmarks.

F. The Electrical Contractor shall coordinate the work of all the Electrical Contractors vendors and subcontractors to provide a fully functional and operating system.

G. Provide temporary electrical power and temporary water and sanitary sewer for this Contractor's field office, if required. Pay all utility company charges. Provide temporary power required for this Contractor's work.

H. Prior to start of work this Contractor is to inspect work performed by others on which this work is to be placed on or adjacent to, and report in writing to the Engineer, any condition found to be unacceptable. Failure to make said report shall constitute acceptance of the conditions found and any claims made thereafter due the unacceptable conditions will not be considered by the Engineer.

I. Provide all required coordination and supervision where work connects to or is affected by work of others and comply with all requirements affecting this work. Work required under other items of the Contract Documents to be performed by this Contractor shall be coordinated with the respective Contractor, and such work performed at no additional cost to the Owner including but not limited to electrical work in support of other trades as shown in the Contract Documents.

J. It is the responsibility of the Contractor to coordinate the exact required location of any electrical or electronic equipment, system, or cabinets to be installed or relocated. No existing equipment may be relocated without prior coordination and with approval of the Engineer.

K. Provide and pay for all permits, licenses, fees and inspections required for the performance of the work. The Contractor shall pay all sales, consumer, use and other taxes required in accordance with the law of the place of the project.

L. Provide all tests as required, per the Contract Documents and submit all test reports to the Engineer.

M. Provide all excavation, backfill, compaction, shoring and dewatering required for performance of the work.

N. Provide sleeves for all conduit/duct required as specified.

O. Protect all work of this Contract from damage and intrusion of dirt and foreign objects. Close off open ends of conduit/duct and sleeves on work, which is to be completed at a later date. Remove closure material prior to continuance of work.

P. Prior to Final Inspection, submit to the Engineer, all Record Drawings and Operation and Maintenance Manuals as specified. Instruct Owner's maintenance personnel in the operation and maintenance of the systems as required by the Contract Documents.

Q. The above is not all inclusive of the work described by the Contract Documents, which form the basis for this Contract, but is presented for the Contractor's convenience.

2.8 EXISTING UTILITIES

A. The Contractor is solely responsible for the location of all existing utilities within the project limits. Please refer to SP-104 for additional requirements.

B. The Contractor is solely responsible for the protection of all existing utilities within the project limits. All manholes, hand holes, light bases, conduits and ducts shall be kept tightly closed and sealed during all phases of construction. The items may be opened in support of the work but shall be resealed or closed or covered immediately upon completion of the specific task that required them to be opened.

PART 3 - BASIC MATERIAL & METHODS

3.1 REQUIREMENTS OF BASIC MATERIALS AND METHODS

A. The work shall include the furnishing of the systems, equipment and material specified in this Division and as called for in the Contract Documents, to include supervision, operations, methods and labor for the fabrication, installation, start-up and tests for the complete electrical installation. Provide the necessary inter-trade/Contractor coordination for the installation to be in a neat and work person like manner.

B. Drawings for the work are diagrammatic, intended to convey the Scope of the Work and to indicate the general arrangement and locations of the work. The drawings shall not be scaled for exact sizes or locations. Because of the scale of the drawings, certain basic items such as: conduit/duct fittings, access panels, sleeves, pull and junction boxes may not be shown. Where such items are required by Code or by other items or where they are required for proper installation of the work, such items shall be included. Coordinate final equipment locations with governing architectural, civil and structural drawings as applicable. Layout equipment before installation so that all trades may install equipment in the space available.

C. Equipment Specifications may not deal with minute items such as components, parts, controls and devices, which may be required to produce the equipment performance specified, or as required to meet the equipment warranties. Where such items are required, the Contractor/Supplier of the equipment shall include them, whether specifically called for or not.

D. Conduit/duct routed through the building/structure that interferes with other equipment and construction shall not constitute a reason for an extra charge. Equipment, conduit/duct, and fixtures shall fit into available spaces in the building/structure; do not introduce these into the building/structure at such times or in such manner as to cause damage to the structure. Equipment that requires servicing shall be readily accessible.

E. Locate all openings required for work performed under this item. Provide sleeves, guards or other acceptable methods to allow passage of items installed under this item.

F. Keep cutting and patching to a minimum. Insofar as possible, determine in advance the proper chase size and openings necessary for the work.

G. Where cutting and patching are required due to an error of the Contractor, or where the Contractor has not given enough advance notice of the need for holes, recesses, and chases, patching shall be performed by those trades skilled in the use of the materials involved and shall be done at the Contractor's expense.

H. Any cutting of work in place shall be patched and decorated by such mechanics and in such a manner that the quality of workmanship and finish shall be compatible with that of adjacent construction.

I. The location of electrical work is indicated on the drawings. The Engineer may adjust exact locations of new work as work progresses. Before any item is installed, the indicated location may be changed by twenty-five (25) feet in any direction without additional cost.

J. All penetrations through roof, wall or floor shall maintain structure fire rating and environmental barriers. Any roof penetrations shall be made by a state licensed roofing Contractor and shall maintain any in place roofing warranty.

K. Surface mounted fixtures, outlets, cabinets, conduit/duct, panels, etc., shall have finish or shall be painted as directed by Engineer. Paint shall be in accordance with other applicable items of the Contract Documents.

L. All materials utilized shall be suitable for the environment encountered. No combination of materials shall be used that forms an electrolytic coupling of such nature that in the presence of moisture corrosion is accelerated.

M. In general, all relays, contactors, panelboards, dry type transformers, disconnect switches, and circuit breakers are to be supplied and manufactured by the same manufacturer and shall be submitted and accepted equivalent to that specified.

N. Where the requirements of another division, item, or part of these Contract Documents exceed the requirements of this division, those requirements shall govern.

O. Make electrical connections to regulators, transformers, instruments, mechanical equipment, controls and at other locations as required with approximately 3 feet (12" minimum) of liquid tight flexible metal conduit. Grounding type liquid tight flexible metallic conduit connectors shall be used. Determine the requirements from the Contract Documents and the accepted manufacturer drawings.

P. Provide inserts, hangers, supports, braces, and anchor bolts as necessary for all work called for under the Contract Documents.

Q. Provide equipment grounding conductor in all conduit/ducts, for all circuits, except series airfield lighting.

R. All galvanized materials shall be hot-dip galvanized after fabrication, conforming to ASTM A-386 and/or A-153, unless noted otherwise (UNO).

S. Unless noted otherwise, all panelboards, junction boxes, wire ways, etc., shall be spaced off the concrete structure by using a Unistrut P-1060 series square washer or accepted equivalent between the mounting surface and the equipment at each mounting point. Equipment as listed above, mounted on Unistrut or accepted equivalent shall have

Unistrut P-1060 series square washer, Unistrut P-28XX flat plate fitting or accepted equivalent installed between the Unistrut channel or accepted equivalent and the equipment at each mounting point.

T. All bolted connections and equipment mountings shall utilize two flat washers, lock washer and hex head bolting hardware, unless noted otherwise.

U. Unless noted otherwise, all wire sizes are based on a 90 Deg. C., THWN-2, 600-volt insulation, copper conductors, not more than three single insulated conductors, in raceway, in free air. The conduit/duct sizes are based on the use of THWN-2, 600-volt insulated conductors. The Contractor shall make the necessary increase in conduit/duct sizes for other types of wire insulation. In no case shall the conduit/duct size be reduced. The minimum power circuit wire size shall be #12 AWG.

V. Conductor sizes may have been adjusted due to voltage drop or other engineering considerations. Equipment provided by the Contractor shall be capable of accepting the quantity and sizes of conductors shown in the Contract Documents. All conductor pigtails, cable step-down adapters, cable step-up adapters, terminal blocks and splicing materials necessary to complete the cable termination/splice shall be considered incidental to the respective pay items provided.

W. All equipment enclosures, junction boxes, wire ways, pull boxes, etc. utilized in damp, wet or exterior locations shall be NEMA 4X stainless steel. All mounting channel, hardware, nuts, bolts, lock washers, etc. utilized in damp, wet or exterior locations shall be stainless steel.

X. All electrical conductors, windings, bus bars, etc. shall be high conductivity (98% conductivity) copper.

Y. This Contractor shall furnish and install all required overcurrent protection required by the NEC and the Contract Documents. The overcurrent protection shall be sized according to the equipment nameplate data.

Z. Powder-actuated fasteners will not be allowed without express written approval of the Engineer. No fasteners shall pierce the structure until accepted by the Engineer.

AA. Use Ideal NOALOX antioxidant compound or accepted equivalent on all aluminum to aluminum mechanical or electrical connections. Use Thomas and Betts KOPR-SHIELD or accepted equivalent on all rigid galvanized steel conduit connections and all copper grounding connections using mechanical lugs. Use an approved anti-seize compound on all bolted connections.

3.2 ELECTRICAL REFERENCE SYMBOLS

A. Symbols used in the Contract Documents are defined in the Electrical Legend. Not necessarily will all symbols defined be applicable to the project.

3.3 ACTIVE SERVICES

A. Existing active services, water, gas, sewer, electric, communication, jet fuel, etc. when encountered, shall be protected against damage. Do not prevent or disturb operation of active services, which are to remain. If active services are encountered which require relocation, make request to Authorities Having Jurisdiction (AHJ) for determination of procedures. Where existing services are to be abandoned, they shall be terminated in conformance with requirements of the AHJ, Utility or Municipality having jurisdiction.

3.4 CODES AND STANDARDS

A. Install in accordance with latest edition of the National Electrical Code and the regulations of governing Federal, State, County, local and other applicable codes, including the Utility Companies. Where a conflict in code requirements occurs the most stringent requirement shall govern. The Contractor shall be responsible to obtain and pay for all required licenses, fees and inspections including meter installation fee. The cost for such shall be included in the bid price.

B. The work shall meet the requirements and recommendations of applicable portions of the latest editions of these laws, codes and standards:

1. OSHA 1910 & 1926
2. NFPA 70, National Electrical Code
3. NFPA 70E, Standard for Electrical Safety in the Workplace
4. NFPA 101, Life Safety Code
5. NFPA 409, Standard on Aircraft Hangars
6. NFPA 780, Standard for the Installation of Lightning Protection Systems (UL 96, UL 96A)
7. FAA Advisory Circulars, Engineering Briefs and Orders
8. Applicable local building code
9. Florida Building Code Project State Specific
10. ANSI C2, National Electrical Safety Code
11. NEMA Standards (NEMA)
12. Underwriter's Laboratories (UL)
13. Institute of Electrical and Electronics Engineers (IEEE)
14. FDOT - Standard Specifications for Road and Bridge Construction Project State Specific

15. FDOT – Design Standards Index Project State Specific

16. AWS D1.1, Structural Welding Code – Steel

17. Merriam-Webster Dictionary

The above is not all inclusive of applicable codes and standards but is presented for the Contractors convenience.

The advisory circulars are available online at:

https://www.faa.gov/regulations_policies/advisory_circulars/index.cfm/go/document.list?display=current&q=

3.5 LISTED AND LABELED

A. All materials shall be new and free of defects and shall be U.L. listed, bear the U.L. label or be labeled or listed with an accepted, nationally recognized Electrical Testing Agency. Where no labeling or listing service is available for certain types of equipment, test data shall be submitted to prove to the Engineer that equipment meets or exceeds available standards. All U.L. listed material shall be used only for the intended purpose.

3.6 UTILITY COMPANY FEES, CHARGES, AND COSTS

A. It is the Contractor's responsibility to contact the applicable Utility Company(s) to determine if any fees, charges or costs will be due the Utility Company(s) as required by the Utility Company(s) for temporary power, installations, hook-ups, etc. This fee, charge or cost shall be included in this Contractor's price.

3.7 TESTING – QUALITY CONTROL

A. Systems shall be tested by the Contractor, in the presence of the OAR, and placed in proper working order prior to demonstrating systems to the Owner. Refer to the requirements in each item for other applicable standards.

B. Provide all tests as required, per the Contract Documents and submit all test reports to the OAR. Costs of all testing shall be borne by the Contractor and shall be considered incidental to the respective pay item of the tested item. The Contractor shall perform all Quality Control in accordance with the Contract Documents and the Contractor’s Quality Control Plan General Conditions. The Owner will perform Quality Assurance/Acceptance.

C. After work is completed a load balance test shall be made to demonstrate that with full lighting and mechanical load the balance between phases is within 5%. Unbalance beyond this limit shall be corrected.

D. Perform such tests as required by AHJ over the site.

E. Testing methods shall be acceptable to the Engineer and shall be submitted to the OAR for review, a minimum of thirty (30) days prior to the scheduled test.

3.8 LAMINATED PHENOLIC PLASTIC NAMEPLATES

A. Contractor shall provide nameplates for wiring systems and equipment as called for herein. All nameplates shall have beveled edges and one-half inch (1/2") lettering. If equipment is smaller than ten inches by six inches (10"x 6"), one-quarter inch (1/4") lettering may be used. Smaller lettering may be used with permission of the OAR.

B. Nameplates shall be laminated phenolic plastic, black front and back with white core, with lettering etched through the outer covering. White engraved letters on black background. Emergency systems shall use red front and back with white core for nameplates. Attach nameplates with stainless steel pop rivets, sealed with clear silicon caulk. Adhesive may be used only on panelboard interiors. Where conditions do not warrant piercing the enclosure "LOCTITE" brand adhesive or accepted equivalent may be used with permission of the OAR.

C. Coordinate nameplates with Contract Documents and submit 1 to 1 scale detail of all nameplates to OAR for review.

D. All electrical equipment, enclosures, pull boxes and all similar items in the sole opinion of the OAR shall be equipped with nameplates. Examples are all constant current regulators, motors, pushbutton stations, hand holes, pull boxes, junction boxes, manholes, control panels, system cabinets, terminal cabinets, time switches, disconnect switches, panelboards, circuit breakers, contactors, relays, high voltage boxes and cabinets. Special electrical systems shall be identified at junction and pull boxes, terminal cabinets and equipment racks.

E. Nameplates shall adequately describe the function of the particular equipment involved. Where nameplates are detailed in the Contract Documents, inscription and size of letters shall be as shown. Nameplates for panelboards and switchboards shall include the panel designation, panel name, source(s) of power and voltage and phase of the supply. For example, "Equip YY, Panel A, fed from Panel XYZ, 480/277V, 3-phase, 4-wire." The unique name of a particular piece of equipment shall be used consistently on all nameplates referencing that particular piece of equipment. Equipment name/numbers utilized shall be consistent throughout the entire system. When equipment has multiple sources of power, all sources of power shall appear on the nameplate. Power source descriptions shall contain as a minimum the information listed above. Nameplates shall include as a minimum the following.

1. Equipment Number

2. Equipment Name

3. Power Source(s)

4. Voltage Level and number of phases (for each power source)

F. Panelboard and distribution panels shall have each breaker position identified with phenolic labels.

G. All major pull and junction boxes in service areas, tunnels, above accessible ceilings and in accessible chases shall have nameplates identifying the feeder or system. This shall include the access cover on lighting pole bases.

H. Systems with conductors exceeding 100 volts to ground shall have voltage identification nameplates with one-half inch (1/2") high letters on all panels, switches, pull boxes and junction boxes.

3.9 CONCRETE WORK

A. Concrete bases and pads for all equipment furnished by Contractor shall be the responsibility of Contractor unless noted otherwise.

B. Furnish and install reinforced concrete pads for transformers, switchgear, and motor control centers, etc. of size as shown in the Contract Documents. Chamfer the top edges 1". Trowel all surfaces smooth, provide broom finish where noted. Reinforce the pads as shown in the Contract Documents.

C. Concrete equipment pads shall be installed by tradespersons skilled in concrete work. Equipment pads shall be level within one-eighth inch (1/8”) in 10 feet (10’). Equipment pads not meeting the previous requirements shall be removed and replaced at the Contractor’s expense.

D. The Contractor shall furnish all equipment anchor bolts and shall be responsible for their proper installation and accurate location.

3.10 EXCAVATING, TRENCHING AND BACKFILLING

A. This Contractor shall do excavating necessary for light bases, underground wiring, conduit, duct banks and other underground work and shall backfill trenches and excavations after work has been inspected. Care shall be taken in excavating that walls and footings and adjacent load bearing soils are not disturbed in any way, except where lines must cross under a footing, pad or other structural item. Where a line must pass under a footing, pad or other structural item the crossing shall be made by the smallest possible trench to accommodate the conduit/duct. Excavations shall be kept free from water. No greater length of trench shall be left open in advance of conduit/duct installation than that, which is authorized or directed by the OAR.

B. Roots shall be removed to a level of eighteen (18") below finished grades and deeper as required for conduit/duct runs, manholes and light pole bases. No roots shall be allowed to remain under the work.

C. Backfill about the work shall be placed, where practical, as the work of construction progresses. Backfilling on or against concrete work shall be done only when directed. Backfilling of conduit/duct lines shall progress as rapidly as the testing and acceptance of the finished items of the work will permit and shall be carried to a crown approximately six

inches (6") above the existing grades. In backfilling around conduit/duct lines, selected material shall be compacted firmly around the conduit/duct. Fill and backfill shall be clean and free from vegetable matter and refuse.

D. All loose materials shall be removed from all excavations for electrical items. The bottom of the excavation shall be compacted to the following criteria:

SOIL TYPE	DESIGN AIRCRAFT GROSS WEIGHT	TEST STANDARD	UNDER PAVEMENT	IN TURF
<30% RETAINED ON ¾" SIEVE	>60,000 LBS	ASTM D1557	100%	95%
<30% RETAINED ON ¾" SIEVE	≤60,000 LBS	ASTM D698	100%	98%
>30% RETAINED ON ¾" SIEVE	>60,000 LBS	AASHTO T-180	100%	95%
>30% RETAINED ON ¾" SIEVE	≤60,000 LBS	AASHTO T-99	100%	95%

Backfill shall comply with the same compaction requirements.

E. All trenches and other excavation left open by necessity shall be barricaded and guarded as required by OSHA or applicable codes and regulations.

3.12 WELDING

A. All welding and weld procedures shall be in accordance with AWS D1.1, Latest Edition. Qualifications of welders and welding operators shall be in accordance with AWS D1.1, Latest Edition. The welder qualification test shall be performed on a 1" A-36 Test Coupon in the 3G and 4G positions. The welder qualification shall be current within 12 months of the work being performed. Weld inspections shall be per the criteria set forth in AWS D1.1 for visual weld inspection.

3.13 ELECTRONIC DRAWING FILES

A. Electronic versions of the Contract Documents may be available for the Contractors use. Please be advised that Engineer cannot be held responsible for third party use of this information, and furthermore, that this information is supplied as a professional courtesy. This applies to all electronic data files transmitted on behalf of Engineer to third parties.

B. The files are without warranty as to performance, accuracy, or freedom from error, or as to any results generated through their use at any time. Written dimensions in file, details, specifications take precedence.

C. The files being transmitted are the intellectual property of Engineer and as such are protected by the copyright laws of the United States. The files are being transmitted for the single use on this project only.

D. The electronic files provided are non-sealed and unofficial versions of the Contract Documents that have been created by the Engineer. The electronic files are provided only for the convenience of explicitly authorized users.

E. The hard copy Conformed Documents that have been provided are the only official documents that may be relied upon for accurate presentation. The electronic files provided will be at the authorized user's risk and does not pose any risk or liability to the Owner or Engineer.

F. Engineer does not guarantee or warrant the authenticity of electronic files. The authorized users agree and recognize that the electronic files may unintentionally become corrupted or modified without the authorization of the Engineer.

G. Written dimensions will govern over scaled values.

H. AutoCAD files were developed using base files provided by others.

I. Variations in printer drivers may cause the electronic file presentation to vary considerably.

PART 4 - DESIGNATION OF MATERIALS

4.1 DESIGNATION OF MATERIALS

A. Where equipment or materials are specified using the name and catalog number of one manufacturer, that equipment or material specified shall set the quality and functionality of the item. Equivalents accepted by the Engineer will be acceptable.

B. Where equipment or materials are specified using the name and catalog number of more than one manufacturer, that equipment or material shall be one of those specified. No alternative will be acceptable.

C. Where no brand name is specified, the source and quality shall be subject to the Engineer's review and acceptance.

D. When a product is specified to be in accordance with a trade association or government standard, at the request of Engineer, Contractor shall furnish a certificate that the product complies with the referenced standard. Upon request of the Engineer, the Contractor shall submit supporting test data to substantiate compliance.

E. The Engineer shall be the sole judge of whether the proposed "equivalent" is suitable for use in the work.

F. The Engineer reserves the right to reject any and all equipment, materials or procedures, which, in the Engineer's opinion, does not meet the system design and the standards and codes, shown in the Contract Documents.

G. Each Bidder represents their bid is based upon the materials and equipment described in the Contract Documents.

PART 5 - PROTECTION OF MATERIALS, EQUIPMENT AND WORK

5.1 PROTECTION OF MATERIALS, EQUIPMENT AND WORK

A. Materials shall be stored to assure the preservation of their quality and fitness for the work. Stored materials, even though accepted before storage, shall be subject to reinspection prior to their use in the work. The Contractor shall coordinate the storage of all materials with the OAR.

B. The Contractor shall protect electrical raceway, cable, lighting fixtures, associated support systems, and all other electrical items against damage from movement of equipment and material, welding, flame cutting, and other construction damage. Raceways and supporting structures for raceway and lighting fixtures shall not be used as access scaffolding at any time. Whenever welding or flame cutting operations occur above or near raceways, cables lighting fixtures, etc not shielded from such operations by concrete floor or other protective covers, the Contractor shall protect the items from damage by means of fireproof boards or blankets. Damaged materials shall be repaired or replaced, by and at the Contractor's expense, subject to the OAR's direction and acceptance.

C. Surfaces of most equipment, such as panels, switchgear, transformers, constant current regulators (CCR) and circuit breakers, are finished at the factory. Great care shall be exercised to prevent damage to this original finish during installation of the equipment and during construction work.

D. If the factory finish is damaged during construction, the entire surface of the damaged component shall be refinished by and at the expense of the Contractor.

E. The refinished surface shall be equivalent in every respect to the original surface, including color, texture and smoothness. Refinishing paint, if furnished with the equipment, may be used; otherwise, the paint shall be obtained from the equipment manufacturer.

F. All cut edges of galvanized materials and marred or scratched galvanized surfaces shall be repaired using LPS-1G cold galvanizing compound or accepted equivalent.

PART 6 - GENERAL CONSTRUCTION REQUIREMENTS

6.1 GENERAL CONSTRUCTION REQUIREMENTS

A. Provide the bracing, shoring, rails, guards, and covers necessary to prevent damage or injury. Do not leave energized electrical items exposed or unprotected. Protect personnel from exposure to contact with electricity. Deliver equipment and materials to the job site in their original, unopened, labeled containers. Store ferrous materials to prevent rusting. Store finished materials and equipment to prevent staining and discoloring.

B. Maintain separation between stainless steel items and carbon steel items to prevent contamination of stainless-steel item and subsequent rust stains on stainless steel item.

C. All sheeting, shoring, dewatering and cleaning necessary to keep trenches and their grades in proper condition for the work to be continued, including the removal of water by mechanical means, shall be the Contractor's responsibility.

PART 7 - METHOD OF MEASUREMENT

7.1 METHOD OF MEASUREMENT

A. The items described in Item SP-100 are incidental to other pay items and shall not be measured for payment.

PART 8 - BASIS OF PAYMENT

8.1 BASIS OF PAYMENT

A. No direct payment shall be made for the work described in Item SP-100. The work described in Item SP-100 is incidental to other items and shall be paid for in the respective bid item of which it is a component part.

END OF ITEM SP-100

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SECTION SP-104 - GENERAL ELECTRICAL SAFETY REQUIREMENTS AND TEMPORARY AIRFIELD LIGHTING

PART 1 - DESCRIPTION

1.1 PURPOSE

A. The purpose of this item is to assist in establishing the proper safety guidelines necessary to protect aircraft, passengers, crews, the general public, Owner, Engineer, all workers and vehicles involved in their daily tasks.

B. The Contractor is solely responsible for all issues related to the safety program and guidelines and implementation of such programs and guidelines necessary to protect aircraft, passengers, crews, the general public, Owner, Engineer, all workers and vehicles involved in their daily tasks.

C. The Contractor shall comply with FAA Advisory Circulars, FAA Engineering Bulletins, specific airport requirements, OSHA 29CFR1910, OSHA 29CFR1926 and NFPA 70E as minimum requirements.

1.2 REFERENCED STANDARDS AND CODES

A. All applicable requirements of the below listed advisory circulars, codes, standards and related reading, as a minimum, shall be compiled with:

1. AC 150/5200-18, Airport Safety Self-Inspection
2. AC 150/5210-5, Painting, Marking and Lighting of Vehicles
3. AC 150/5340-1, Standards for Airport Markings
4. AC 150/5340-18, Standards for Airport Sign Systems
5. AC 150/5340-26, Maintenance of Airport Visual Aid Facilities
6. AC 150/5340-30, Design and Installation Details for Airport Visual Aids
7. AC 150/5370-2, Operational Safety On Airports During Construction
8. 29 CFR Part 1926/1910, Occupational Safety and Health Standards
9. NFPA 70, National Electrical Code
10. NFPA 70E, Standard for Electrical Safety in the Workplace
11. ANSI C2, National Electrical Safety Code

The Contractor is responsible for obtaining and using the latest edition of the referenced documents. This list is not all inclusive but is offered as a convenience to the Contractor. The advisory circulars are available online at:

https://www.faa.gov/regulations_policies/advisory_circulars/index.cfm/go/document.list?display=current&q=

1.3 GENERAL SAFETY PROVISIONS

A. Contractor shall take safety and health measures in performing work under this contract. Contractor shall meet with the Engineer and Owner to develop a mutual understanding relative to administration of the safety plan. The Contractor is subject to and shall comply with all applicable federal, state and local laws, regulations, ordinances, codes and orders relating to safety and health in effect on the date of this contract. Where the contract general conditions, special provisions or other parts of the Contract Documents also apply, the stricter of the documents shall govern.

B. As a minimum workplace safety shall comply with NFPA 70E, Standard for Electrical Safety in the Workplace, OSHA, federal, state and local requirements. Where a conflict in requirements occurs the most stringent requirement shall govern.

C. During the performance of work under this contract, the Contractor shall comply with procedures prescribed for control and safety of persons visiting the project site.

D. Contractor is responsible for the Contractor's personnel and for familiarizing each of the Subcontractors with safety requirements.

E. Contractor shall advise the Engineer of any special safety restrictions established so that Owner and Engineer personnel can be notified of these restrictions.

F. The Contractor shall be solely and completely responsible for initiating, maintaining and supervising all safety precautions and programs in connection with the work. The Contractor shall take all necessary precautions for the safety of, and shall provide the necessary protection to prevent damage, injury or loss to:

1. All employees on the work and all other persons (including but not limited to the general public) who may be affected thereby,

2. All the work and all materials or equipment to be incorporated therein, whether in storage on or off the site,

3. Other property at the site, adjacent thereto, or utilized by the Contractor including but not limited to trees, shrubs, lawns, walks, pavements, structures, underground facilities, and other utilities not designated for removal, relocation or replacement in the course of construction regardless of whether or not such other property is indicated in the Contract Documents.

G. The installation and/or removal of lighting equipment may be critical to airport operations; therefore, the Contractor shall follow work schedules established in the Contract Documents or as directed by the OAR. The system shall be installed in accordance with the Contract Documents, FAA criteria, the National Electrical Code and/or federal, state, or local code requirements.

H. The Contractor shall generate and submit for approval A Maintenance of Power Plan for all electrical services impacted by this project. The Contractor shall always maintain power (permanent or temporary) to all FAA and airport owned facilities during this project. Power outages may be scheduled at the FAA and Owners convenience. Scheduling and duration of any power outage is at the sole discretion of the power system owner. Cost of maintenance of power and all necessary materials, labor transportation, supervision, coordination and all appurtenances shall be considered incidental to the SP-1 or SP-2 pay items.

I. The Contractor shall provide temporary wiring as required to reconnect existing circuits to provide guidance for aircraft to pass through the construction areas on those taxiways/runways, which must remain open. The Contractor, in conjunction with the Owner's Maintenance Department, shall perform a visual lighting check of all lighting circuits within the Contractor's area of responsibility before dark each day (or at additional times as designated by the OAR) to assure that they are fully functional. In the event of failure, the Contractor shall immediately take steps to restore operation.

1.4 FIRE PREVENTION AND PROTECTION

A. All tools producing sparks or heat, open-flame heating devices, operations utilizing such devices, etc. shall be in accordance with the airport fire department and airport "Burn Permit Procedures". Work shall not start until all requirements of the burn permit procedures are met

B. Open fires, salamanders and open-flame heating devices will not be permitted except by special approval in writing. Such permission will not be granted unless the Contractor has taken reasonable precautions to make such devices safe. Burning trash, brush or wood on the project site will not be permitted. Approval for open fires and open-flame heating devices will in no way relieve the Contractor from the responsibility for any damage incurred because of fires.

C. Flammable liquids shall be stored and handled in accordance with NFPA and OSHA requirements.

D. Smoking shall not be permitted within the AOA or in areas such as paint storage, fuel storage, and posted no smoking areas.

E. Welding, flame cutting, melting and other such operations in all operating areas, shall not be permitted until approved at the beginning of each workday by the OAR. The OAR may approve longer periods of time for welding and burning in some operating areas if the detailed safety procedures are established beforehand. Operating open flame devices shall not be left unattended in any area.

F. Contractor shall provide the necessary firefighting equipment, fire prevention methods and fire watch.

G. A Contractor's employee shall be assigned as fire watch for every welding and burning operation. The fire watch shall be properly trained in firefighting techniques and the operation of the fire extinguishers. The fire watch shall be equipped with two full 15-pound Class A, B & C fire extinguishers and shall check all areas around and below the welding or burning operation for fires. The fire watch shall continue this check for at least 60 minutes after the completion of the welding or burning operation.

H. Contractor shall discontinue all burning, welding, or cutting operations, one hour prior to the end of the normal workday. Contractor shall provide a fire watch to remain at the site for one hour after discontinuing these operations. This fire watch shall make a thorough inspection of the area for possible sources of latent combustion. Any unsafe conditions shall be corrected.

I. During operations involving possible fire hazard, the Contractor shall notify the OAR and not proceed until clearance is obtained in writing. The OAR may request a standby from the Fire Station. However, this does not relieve the Contractor of responsibility for welding and cutting safety.

J. Clean up of scrap materials and waste of this Contractor shall be completed as a minimum daily or more often as required to maintain airport operations.

1.5 TEMPORARY EXITS AND ENTRANCES

A. Such passageways shall provide adequate fire protection and safety of Owner personnel and representatives.

1.6 SWITCHING

A. Electrical switching required for clearance to work on equipment operating from electrical circuits will be performed only by Owner personnel authorized as safety operators for the specific equipment or as specifically authorized by the Owner.

1.7 REMOVAL OF EQUIPMENT

A. When permanently removing equipment, the electrical wiring, conduit/duct and control boxes shall be removed to the source of feed, unless otherwise specified or indicated.

B. After equipment has been removed, the electrical wiring diagrams, schematics, etc., shall be marked to show the change.

C. Conduit/duct not removed shall have a pull string installed.

1.8 OTHER SAFETY REQUIREMENTS

A. Temporary wiring shall comply with NEC. Indiscriminate use of extension cords, portable cable or junction boxes creating tripping hazards as well as overloaded circuits will not be permitted.

B. Unplug or disconnect energy source of power tools when not in use.

C. Before maintaining or repairing any electrical equipment, it shall be disconnected from the power source.

D. Do not use any equipment that has frayed cords or three-wire plugs that have had the grounding prongs removed. Faulty equipment and tools shall be repaired by a qualified person.

E. Do not use metal ladders when working on electrical equipment.

1.9 EXISTING UTILITIES

A. The Contractor is solely responsible for the location of all existing utilities within the project limits. Prior to initiation of any construction in the field, the Contractor shall provide a written notice (return receipt requested) to each of the utility companies, along with the various airport departments and Florida Sunshine One Call as prescribed by state law. The Contractor shall provide the Owner and Engineer with a copy of the receipt of said written notification to each of the utility companies or airport departments. This requirement is in addition to any other state laws regarding public notification prior to excavation.

PART 2 - EXCAVATION

2.1 EXCAVATION OPERATIONS

A. Prior to any excavation or demolition, the Contractor shall obtain an “Airport Dig Permit”.

B. Methods of excavation, means of earth support, and manner of backfill shall be conducted with consideration for the safety of persons and work, and prevention of damage to adjacent pavement, utilities, structures and other facilities, due to settlement, lateral movement, undermining and washout. Minimum requirements for trench shoring and bracing shall be in accordance with OSHA, State and local requirements. Excavation shall be performed in a manner to prevent surface water and subsurface or groundwater from flowing into excavations, and to prevent water from flooding conduit/duct trench and adjacent or surrounding area.

PART 3 - PROTECTION OF WORK

3.1 PROTECTION OF WORK

A. Provide adequate stand-by mechanical equipment for emergency use.

B. Excavations shall have substantial barricades and be posted with warning signs for the safety of persons. Warning lights shall be provided during hours of darkness.

C. Barricades shall be erected immediately around manhole openings when covers are opened/removed.

D. Prior to performing any excavation work or any surface penetrations 6 inches or deeper (such as driving stakes more than 6 inches in the ground) on any ground surface, for personnel safety and to prevent possible interruption of major utility services encountered during excavation, the following procedures shall be followed:

1. Refer to 1.9.

2. The Contractor shall obtain from the OAR, local utilities, etc., the current up-to-date subsurface utility drawing of the particular area to be worked on.

3. All agencies/utilities, etc. that may be affected by the excavating shall be contacted by the Contractor so that all lines, pipes, etc. can be marked/staked. The Contractor shall be responsible to maintain the utility locate markings.

4. The Contractor shall stake out subsurface high voltage cables, communication cables, pipelines, all subsurface utilities, etc., indicated within the scope of the work contemplated. All subsurface utilities shall be located by hand digging; hand digging shall extend for 5 feet on both sides of the subsurface utility. Hand digging and protection of existing systems shall not be paid for separately but shall be considered incidental to the item being installed.

5. After hand exposure of cable or pipelines, the Contractor shall obtain agreement from the OAR, AHJ, Agency/Utility on how much closer to cable or pipe the excavations can be permitted.

6. Detectable printed mylar foil warning tape, color coded, printed with the words “CAUTION ELECTRIC LINE BELOW,” red, “CAUTION COMMUNICATION LINE BELOW,” orange, “CAUTION WATER LINE BELOW,” blue, “CAUTION FUEL LINE BELOW,” yellow, etc., shall be installed over the buried utilities. Material and installation of detectable tape shall be in accordance with L-110.

7. Contractor shall notify the OAR, 72 hours prior to the start of excavation work or surface penetration, to enable the OAR to review measures being taken to prevent hazard to employees and to prevent possible damage to subsurface utilities. Where emergency conditions preclude the 72 hours advance notification, Contractor shall nevertheless inform the OAR of the Contractor’s intention to initiate work prior to actual start of activity.

8. After all underground utilities have been located and staked, the Contractor shall proceed with excavating work, or other surface penetration work. The Contractor, however, shall temporarily halt any machine excavation work or other surface penetration when approaching within 5 feet of the staked-out cable or pipeline, until Contractor has hand excavated down to expose the underground utility to exactly fix its location.

9. No digging, dirt moving, or other heavy equipment shall physically enter any construction area before all FAA utilities, airport utilities and all other underground utilities have been located and properly staked out. It is the Contractor's responsibility to locate all utilities before digging, sawing, coring, boring, etc. Any damage caused by digging, sawing, boring coring, etc., is the Contractor's responsibility for repair. Any damage must be reported immediately to the OAR. No repair shall be attempted without approval.

10. All electrical cables shall be disconnected before excavation is attempted.

11. Provide minimum of 48” undisturbed earth cover or 1” thick steel plate over electrical conduit/duct, cables or other utilities when heavy equipment is being used in the area to protect underground systems/utilities. In addition, protect utilities in accordance with AHJ requirements.

12. The requirements listed above shall be considered incidental to the item for which the excavation is required.

13. A written description of the utility protection measures shall be submitted to the OAR for review by the Owner, FAA and AHJ.

PART 4 - SAFETY TAGGING AND LOCKOUT

4.1 SAFETY WITH ELECTRICAL CIRCUITS AND EQUIPMENT:

A. No one may work on an energized circuit without written permission from the Contractor's On-Site Supervisor. The Contractor’s On-Site Supervisor shall review the circumstances and the necessary safety precautions with the OAR, prior to giving permission for the energized work. The Contractor assumes all liability in connection with any work on energized circuits.

B. No one may disconnect or cause to be disconnected any electrical circuit before permission is requested from and granted by the Owner or authorized representative through the OAR.

C. Identification markings on light and power circuits shall not be relied on for establishing electrically safe work conditions. Always verify the proper safe "deenergized" conditions with properly operating test equipment.

D. Before any circuit supplying radar, ILS, weather, VORTAC, airport beacon, runway/taxiway lighting equipment or any other equipment is disconnected, permission

must first be granted by the systems Owner or authorized representative, and, if applicable, FAA Sector Field Office and the Airport's Air Traffic Control Tower. After permission is granted, the following requirements must be compiled with. THE FAA REQUIRES 45 DAY NOTICE PRIOR TO WORKING ON OR DISTURBING FAA CABLES OR EQUIPMENT.

E. As a minimum the LOCK OUT/TAG OUT (LOTO) procedure shall comply with the Owner's requirements, OSHA1910.147, OSHA1910.147 Appendix A and NFPA 70E. If conflicts between standards arise the stricter requirement shall apply.

F. Comply with OSHA 1910.333, Selection and Use of Work Practices.

G. A qualified person shall perform a hazard risk assessment, job safety plan, and job briefing in accordance with NFPA 70E.

H. A qualified person shall create an Electrically Safe Work Condition in accordance with NFPA 70E.

I. Restoration shall be accomplished in a safe manner and locks/tags removed only by the Electrical Contractor's qualified person who placed the locks and tags in the presence of the Owner or authorized representative. Should the qualified person who placed the lock/tag not be available, see OSHA 1910.333(b)(2)(v)(C).

J. The Owner or authorized representative shall record time, date and operational status of circuit after restoration.

K. Electrical circuits and apparatus shall be operated at these facilities only by qualified persons and authorized personnel.

L. The OAR shall be provided contact names and phone numbers for two qualified persons (one as primary, one as backup) to provide for removal or addition of any Contractor LOTO work during off hours. The qualified person(s) shall respond onsite within one hour of initial contact.

4.2 TEMPORARY AIRFIELD LIGHTING AND SIGNAGE

A. Temporary airfield electrical fixtures and conductors are allowable when necessary, but shall be installed as follows:

1. Temporary lights shall be bolted to the pavement in a manner rendering the light stationery and allowing space for conductors to enter or exit and to be spliced.

2. When the above is not practical, lights shall be fastened to a weighted object adaptable for the purpose and of sufficient weight to inhibit movement by jet engine blast.

3. Temporary conductors supplying temporary lights shall be installed in a rigid galvanized steel conduit system and secured every five feet to prevent movement by jet engine blast. See temporary airfield lighting details.

4. All joints or splices in temporary conductors shall have heat shrink tubing with integral sealant or tape applied to secure mechanical and electrical connection and prevent water entry.

5. All temporary plug-in connections shall comply with the permanent wiring detailed in L-108 and the wiring details.

6. Temporary lights and signage shall conform as closely as possible to permanent locations normally on the taxiway or runway but shall guide aircraft in a safe path. Please refer to the temporary airfield lighting details provided in the Contract Documents for additional requirements.

B. Closed taxiways and runways shall be blacked out in a manner acceptable to FAA, OAR and Airport Operations and said black/out/marking/lighting shall be kept in acceptable condition.

1. The required method of temporarily bypassing a fixture is to unplug and bypass the primary side of the L-830 isolation transformer.

2. Alternately, pipe sleeves may be used to obscure the elevated edge lights. Pipe sleeve length shall be of sufficient length to block all light output and to prevent any light leakage.

3. In extreme circumstances and with written permission of the Engineer, no more than 5% of the fixtures in each airfield lighting circuit may be unplugged from the L-830 isolation transformer secondary or have the lamp removed. If at any time a larger number of fixtures are required to be bypassed (or have the lamp removed); the L-830 isolation transformer secondary shall have a shorting device installed.

4. During runway closures the respective runway's mandatory signs shall remain operational.

5. During runway closures the respective runway's approach lighting systems (PAPI, REIL, MALSR, ALSF, etc.) shall be turned off.

6. Airfield signs providing directions to closed areas shall be covered (black out). No stray light may be emitted from the covered portions of the sign. The signs shall be covered with 3/8" thick exterior plywood panels. The plywood panels shall be painted black and shall be banded to the sign. Please refer to the temporary airfield lighting details provided in the Contract Documents for additional requirements.

7. Areas closed to aircraft shall not be lighted (black out). The Contractor shall ensure that lighting in the closed areas cannot be inadvertently energized.

8. Adequate lighting in the opinion of the Engineer or Airport Operations shall be provided to delineate the active and closed areas of the AOA.

C. CAUTION: The series lighting circuit must always be complete before a regulator is energized. Normal circuit voltage is less than 5,000 volts; open circuit voltage can approach 10,000 volts. All personnel shall be instructed to protect the integrity of the

lighting circuit. Turn off and lock out/tag out the regulator at the vault before opening the circuit. Continuity of the circuit shall be checked before the regulator is reconnected and reenergized.

D. The installation and/or removal of lighting equipment is critical to airport operations; therefore, the Contractor shall follow work schedules established in the Contract Documents or as directed by the OAR. The Contractor shall attend weekly coordination meetings with Airport Operations for the duration of the contract. The system shall be installed in accordance with applicable FAA Advisory Circulars, the National Electrical Code and/or other federal, state or local requirements.

E. The Contractor shall provide temporary wiring as required to reconnect existing circuits to provide guidance for aircraft to pass through the construction areas on those taxiways/runways, which must remain open. The Contractor shall bypass or otherwise render inoperative those portions of the runway/taxiway lighting circuits in closed areas of the airfield.

F. All runways/taxiways not closed for construction shall have fully operable airfield lighting systems using the airport airfield lighting control system. The Contractor shall coordinate the temporary airfield lighting requirements for each phase with the OAR. The Contractor shall submit a temporary airfield lighting plan to the OAR two weeks prior to the need for the temporary airfield lighting. The OAR will coordinate the plan with the airport and FAA. The Contractor shall make revisions/corrections to the temporary airfield lighting plan as required by the OAR.

G. Existing conditions may vary from the existing information shown in the Contract Documents. The Contractor’s means and methods and sequence of construction within a specific phase is determined by the Contractor. Therefore, the temporary airfield lighting plan in 4.2.f above is the Contractor’s responsibility. The Owner and Engineer will provide reasonable assistance to the Contractor.

H. It shall be the Contractor's responsibility to determine that all airfield lighting circuits, except those that are serving closed taxiways or runways, are fully functional, using tower controls, at the end of each work shift and shall so certify to the OAR at the end of each shift. The Contractor shall not leave the work area until the OAR has confirmed circuit operation. The certification shall be provided to the OAR at 4:00 PM and one hour before sunset. Second shift report shall report one hour before sunset. Any other shift shall report one hour prior to the need for airfield lighting or as determined by the OAR. Should bad weather cause poor visibility the OAR may require additional status reports of system operability and may call for the operation of the airfield lighting system at any time. In the event of airfield lighting system failure, the Contractor shall immediately take the necessary steps to restore proper operation of the airfield lighting system.

I. During runway closures the respective runway’s mandatory signs shall remain operational.

J. It shall be the Contractor's responsibility to determine that all airfield lighting and signage circuits serving closed taxiways or runways (except runway mandatory signs) are turned off, bypassed as previously described or completely obscured at the end of each work shift and shall so certify to the OAR at the end of each shift. The Contractor shall not leave the work area until the OAR has confirmed the closed area is properly blacked out.

K. The Contractor shall check the status of the temporary airfield lighting/signage and black out equipment on a daily basis. The Contractor shall provide temporary airfield lighting/signage and black out maintenance and support on a 24 hour a day, seven days a week basis for the duration of the project. The OAR shall be provided contact names and phone numbers for two persons (one as primary, one as backup) to provide maintenance or to meet temporary airfield lighting/signage and black out needs during off hours. The designated person shall respond onsite within one hour of initial contact.

L. Whenever the scope of work requires connection to an existing circuit, or should the scope of work involve working adjacent to or near an existing circuit, and the work could have any impact on the existing circuit, the circuit's insulation resistance shall be tested, in the presence of the OAR. The test shall be performed in accordance with Item SP-111 and prior to any activity affecting or impacting the respective circuit. The Contractor shall record the results on forms included in SP-111. When the work affecting the circuit is complete (or at end of shift prior to energization), the circuit's insulation resistance shall be checked again, in the presence of the OAR. The Contractor shall record the results on forms included in SP-111. The second reading shall be equal to or greater than the first reading or the Contractor shall make the necessary repairs to the circuit to bring the second reading above the first reading. All repair costs including a complete replacement of the L-823 connectors, L-830 transformers and L-824 cable, if necessary, shall be borne by the Contractor. The Contractor shall measure and record the insulation resistance of ALL airfield lighting circuits prior to starting any work. All test results shall be submitted in the Operation and Maintenance (O&M) Manual.

M. Should the Contractor fail to perform the tests prior to starting work, the Contractor shall be responsible to bring the impacted circuits to a minimum 50 megohm insulation resistance value or higher value in conformance with any previous airport test records.

N. Provide temporary wiring to permit operation of lighting circuits associated with each phase of construction. Temporary cable connections shall be made in airfield lighting circuits when permanent wiring cannot be completed during daylight hours.

O. The Contractor shall furnish, install and maintain hazard marking and lighting to identify closure areas, open manholes, small areas under repair, stockpiles, and other construction related areas hazardous to aircraft or personnel.

P. The Contractor is responsible for operating all temporary circuits within their rated capacity.

Q. The cost of temporary and reconnected airfield lighting/power shall be considered incidental to the pay items provided within the Contract Documents.

4.3 TEMPORARY ELECTRICAL AND LIGHTING INSTALLATION

A. Temporary electrical and/or lighting fixtures shall be provided in operational areas of buildings where required to maintain public safety and continued airport operations.

B. Provide temporary roadway lighting on airport roads and detours during construction. Design installation and removal of temporary systems shall be the responsibility of the Contractor. Light levels shall be 1.0 maintained foot-candles on the traveled part of the roadway. Lighting under the bridges during construction shall have a metal halide or other white light source, providing a maintained light level of 2.0 foot-candles. Maximum to minimum uniformity ratios shall be 10:1.

C. Temporary lighting must be installed to ANSI/OSHA standards for impacted area. Light levels shall also meet the requirements of the Illuminating Engineering Society for the type of task being performed.

D. Temporary installations shall comply with the NEC and shall be acceptable to the Owner, OAR or authorized representative.

E. The cost of temporary and reconnected area/building lighting/power shall be considered incidental to the pay items provided within the Contract Documents.

4.4 MISCELLANEOUS REGULATIONS

A. Electrical main distribution panels, branch circuits panels, control panels, etc., may have their front covers removed for access to live parts. Access to live parts shall be guarded/barricaded in accordance with NFPA 70E.

B. Draw-out type breakers, regardless of operating voltage must be drawn completely out to open position and tagged and locked out per 4.1.

C. In hazardous locations, regardless of class, all electrical tools and extension cords shall be of a type accepted for use in such areas.

D. No counterpoise/grounding conductors may be joined, connected, or affixed to any terminal, grounding electrode, or other point of attachment by any method except exothermic welding, or accepted equivalent. See Item L-108.

E. All counterpoise or grounding systems, when damaged, shall be immediately reported to the OAR. Once the repair/replace procedure has been accepted by the OAR the Contractor shall immediately repair/replace the counterpoise or grounding components.

F. No high voltage switch shall be engaged or disengaged under load.

G. All backhoes, cranes, etc., shall be enclosed by safety pylon or other markers and rope festooned by accepted safety tapes.

H. All security gates in use by Contractors are the responsibility of the Contractor and must be used in a fully secure manner. Any damage to a security gate shall be reported immediately to the OAR.

4.5 TEMPORARY COMMUNICATIONS/CONTROL

A. Temporary communication and control systems shall be provided in operational areas of buildings where required to maintain public safety and continued airport operations. Temporary communication and control systems shall be as described in the Contract Documents.

B. The cost of temporary and reconnected communication and control shall be considered incidental to the pay items provided within the Contract Documents.

PART 5 - METHOD OF MEASUREMENT

5.1 METHOD OF MEASUREMENT

A. Except for the pay item described below all other items shall be considered incidental to other items and shall be included with its applicable system.

B. Temporary Power & Temporary Airfield Lighting/Signage/Navigational Facilities shall be measured as a lump sum item.

PART 6 - BASIS OF PAYMENT

6.1 BASIS OF PAYMENT

A. Except for the pay item, as described below, no direct payment shall be made for the work described in this section. The work described in this section is incidental to other items and shall be paid for the respective bid item of which it is a component part.

B. Temporary Power & Temporary Airfield Lighting/Signage/Navigational Facilities payment shall be made at the contract lump sum price for the required work. This item shall include all testing, troubleshooting, maintenance and other consequential work required to maintain the temporary power, and temporary airfield lighting, signage, and Navigational Facilities as impacted by this Contract. This price shall be full compensation for all planning, supervision, furnishing all material, labor, transportation, services, equipment, utility company fees and for all preparation, removal of the temporary materials and equipment and for all labor, equipment, tools and all incidentals required to furnish and install Temporary Power and Temporary Airfield Lighting, Signage, and Navigational Facilities in accordance with the Contract Documents. This item includes all excavation, backfill, cable, conduit and other materials and appurtenances necessary to complete these items.

Payment will be made under:

Item SP-104-6.1	Temporary Power & Temporary Airfield Lighting/Signage/Navigational Facilities	-- Lump Sum (LS)

END OF SECTION SP-104

ITEM SP-105 - ALTERATIONS, REMOVAL AND DEMOLITION

PART 1 - GENERAL

1.1 GENERAL

A. This item shall apply to all electrical work contained within the Contract Documents. Where the contract general conditions, special provisions or other parts of the Contract Documents also apply, the stricter of the documents shall govern.

B. Alterations shall mean any change or rearrangement in the component parts, including structural, mechanical, and electrical systems, or internal or external arrangements of an existing item, component, system or structure.

C. Removal shall mean the dismantling and disposal of existing materials, components, equipment, and utilities. Removed items shall be handled, prepared for storage, transported to storage areas, or disposed of as specified.

D. Demolition shall mean abandonment, removal and disposal, or salvage and delivery to the Owner as required by the Contract Documents.

E. The installation and/or removal of lighting equipment may be critical to airport operations; therefore, the Contractor shall follow work schedule established in the Contract Documents or as directed by the Engineer.

F. Temporary power and lighting shall be accomplished in accordance with the Contract Documents.

1.2 CONDITION OF EXISTING FACILITIES

A. The Contractor shall verify the areas, conditions, and features necessary to tie into existing construction. This verification shall be done prior to submittal of shop drawings, fabrication or erection, construction or installation. The Contractor shall be responsible for the accurate tie-in of the new work to existing facilities.

B. The Contractor shall protect all existing utilities from damage resulting from alteration, removal and demolition activities.

C. Any hazardous waste issue shall be immediately reported to the Engineer.

D. Whenever the scope of work requires, connection to an existing circuit, or should the scope of work involve working adjacent or near to an existing circuit and the work could have an adverse impact on the existing circuit, the circuit's insulation resistance shall be tested, in the presence of the Engineer. The test shall be performed in accordance with Item SP-111 and prior to any activity affecting or impacting the respective circuit. The Contractor shall record the results on forms included in Item SP-111. When the work affecting the circuit is complete (or at end of shift prior to energization), the circuit's insulation resistance shall be checked again, in the presence of the Engineer. The

Contractor shall record the results on forms included in Item SP-111. The second reading shall be equal to or greater than the first reading or the Contractor shall make the necessary repairs to the circuit to bring the second reading above the first reading. All repair costs including a complete replacement of the L-823 connectors, L-830 transformers and L-824 cable, if necessary, shall be borne by the Contractor. The Contractor shall measure and record the insulation resistance of ALL airfield lighting circuits prior to starting any work. All test results shall be submitted in the Operation and Maintenance (O&M) Manual.

E. Should the Contractor fail to perform the insulation resistance tests prior to starting work, the Contractor shall be responsible to bring the impacted circuits to a minimum 50 megohm earth resistance value or higher value in conformance with any previous airport test records.

1.3 OCCUPANCY AND USE OF EXISTING FACILITIES

A. The Owner will occupy and use the facilities within the areas of work during the entire construction period. The Contractor shall be required to plan and coordinate the Contractor's activities in order to provide all necessary controls for the abatement of dust, noise, and inconvenience to Owner personnel during all phases of the work.

1.4 VACATING OCCUPIED AREAS

A. The Owner will remove all portable items of furniture, equipment, and fixtures prior to the start of work.

1.5 SAFETY REQUIREMENTS

A. The Contractor shall conduct all operations in a manner that will ensure the safety of persons and property in accordance with the OSHA requirements of CFR 29 Part 1926/1910.

B. The Contractor shall comply with the Airport Maintenance Department's LOCK OUT/TAG OUT (LOTO) procedure and NFPA 70E.

1.6 CLASSIFICATION OF REMOVED ITEMS

A. Existing materials and equipment indicated to be removed will be classified as "salvageable" and shall remain the property of the Owner or will be classified as "demolition or debris" and shall be legally disposed.

B. Salvageable Items:

1. Salvaged materials and equipment shall be reused in the work only in construction of temporary electrical facilities, unless noted otherwise.

2. Properly box, protect and ready for transport salvageable items. Retained salvaged items shall be stored on Owner property.

3. Salvaged materials and equipment to be retained by the Owner but not reused in the work shall be turned over to the Owner at a site at the facility to be determined by the Owner.

4. Airfield lighting fixtures, signs and isolation transformers designated to be removed and reinstalled by the Contractor shall be stored indoors in a conditioned space. The indoor conditioned space shall be provided by the Contractor and considered incidental to the pay items provided. As each item designated for removal and reinstallation is removed the Contractor and Engineer shall immediately inspect the item for appropriateness for reinstallation. Any damage not reported in writing to the Engineer within two hours of removal shall become the Contractor's responsibility for replacement/repair of the material as directed by the Engineer. The Contractor is asked to pay special attention to the protection of the semiflush fixture leads. The semiflush fixture lead insulation is easily damaged which results in water infiltration into the fixture.

C. Demolition or Debris

1. Items classified as demolition or debris shall be legally disposed of off the Owner's property. The cost of such disposal shall be included in the bid price.

1.7 TEMPORARY PROTECTION

A. Contractor shall protect persons and property throughout the progress of the work in accordance with the Contract Documents.

1.8 DEMOLITION TASK PLAN AND SCHEDULE

A. The Contractor shall submit to the Engineer a Demolition Task Plan and Schedule for all existing utility relocation(s) and demolition work. The task plan shall be submitted within 30 days of notice to proceed but no later than 30 days prior to the start of the relocation/demolition work.

B. The task plan and schedule shall detail the phasing of the utility relocation(s) and demolition activities with the balance of the project phasing plan. The task plan and schedule shall detail the Contractor's plan for protection of the existing utilities.

C. The task plan and schedule shall demonstrate preliminary coordination has taken place with the FAA, Airport, communications and power utilities and also demonstrates compliance with the Contract Documents.

D. No work shall be initiated until the task plan and schedule has been submitted to the Engineer and accepted by the utilities. No demolition, alteration or relocation work shall be started until the permanent work replacing the demolition, alteration or relocation is

complete, in place, accepted and ready for operation; or until other temporary means have been approved and accepted by the Engineer.

PART 2 - EXECUTION

2.1 DISCONNECTING UTILITIES

A. Prior to the start of work, the Contractor shall coordinate with the Owner and effected utility companies to have each utility placed in a safe work condition.

B. Each utility effected shall be locked out and tagged by the Contractor. Proper safety grounds or equivalent shall be placed for personnel protection.

2.2 TEMPORARY UTILITY SERVICES

A. Contractor shall install temporary utility services in satisfactory operating condition before disconnecting existing utilities. Such temporary services shall be maintained during the period of construction and removed only after new permanent services have been tested and are in operation. Please refer to Item SP-104.

2.3 REMOVAL WORK

A. The Contractor shall not disturb the existing construction beyond that indicated or necessary for installation of new work. Temporary shoring and bracing for support of building components to prevent settlement or other movement shall be as required to protect the work and existing facilities.

B. The Contractor shall provide protective measures to control accumulation and migration of dust and dirt in all areas of work, particularly those adjacent to occupied areas. The Contractor shall remove dust, dirt, and debris from the areas of work daily.

2.4 SALVAGEABLE MATERIALS AND EQUIPMENT

A. The Contractor shall remove all salvageable materials and equipment in a manner that will cause the least possible damage thereto. Salvageable items, which are to be retained by the Owner, shall be carefully handled, stored, and protected.

B. The Contractor shall provide identification tags on all salvageable items boxed or placed in containers, indicating the type, size, and quantity of materials.

C. The Contractor shall exercise extreme care when removing airfield lighting bolting hardware. The existing bolting hardware may have been installed in excess of twenty-five years. The Contractor shall be responsible for the proper removal/repair/replacement of all stripped/broken/damaged fixture bolts or light base bolts or tapped holes in light bases and/or appurtenances encountered during

construction. Contractor shall use drilling/tapping/inserts fixture/jigs/tooling and methods approved by the light base manufacturer or an accepted equivalent. Payment for this work shall be considered incidental to the respective fixture and light base pay items provided in the Contract Documents.

2.5 ELECTRICAL EQUIPMENT AND FIXTURES

A. Wiring systems and components shall be salvaged. Loose items shall be boxed and tagged for identification.

B. Primary, secondary, control, communication, and signal circuits shall be disconnected at the point of attachment to their distribution system.

C. The Contractor shall remove and salvage electrical fixtures. Incandescent lamps, mercury-vapor lamps, and fluorescent lamps shall be salvaged, boxed and tagged for identification, and protected from breakage. The fixtures shall be turned over to the Owners Maintenance Department. This Contractor shall legally dispose of concrete bases, etc. off the Airport property.

D. The Contractor shall remove and salvage switches, receptacles, fixtures, transformers, regulators, meters, instruments, cover plates, circuit breakers, panelboards, outlet boxes, and similar items; these items shall be boxed, and tagged for identification according to type and size.

E. The Contractor shall remove and salvage cable tray, wiring ducts and troughs.

F. The Contractor shall remove and dispose of conductors, including insulated wire, nonmetallic sheathed and flexible armored cable.

G. All removed or demolished items not identified for reuse in the work or to be turned over to the Owner, unless noted otherwise, shall be properly and legally disposed of off the airport site.

2.6 DEMOLITION OPERATIONS

A. Demolition operations shall be conducted to ensure the safe passage of persons to and from facilities occupied and used by the Owner.

B. The sequence of operations shall be such that maximum protection from inclement weather will be provided for materials and equipment in partially dismantled state.

2.7 MAINTAINING TRAFFIC

A. Demolition operations and removal of debris to disposal areas shall be conducted to ensure minimum interference with roads, streets, walks, and other facilities occupied and used by the Owner.

B. Streets, walks, runways, taxiways and other facilities occupied and used by the Owner shall not be closed or obstructed without written permission.

2.8 UTILITY ADJUSTMENTS

A. The Contractor shall adjust utility elevations and or locations as described in the Contract Documents.

PART 3 - DISPOSAL OF REMOVED/DEMOLISHED MATERIALS

3.1 GENERAL

A. The Contractor shall dispose of debris, rubbish, scrap, and other non-salvageable materials resulting from demolition/removal operations. Removed/demolished materials shall not be stored or disposed of on the project site.

B. Removed/demolished materials shall be properly and legally disposed of off airport property.

C. Removed/demolished debris shall be transported from Owner property and legally disposed at no additional cost to the Owner. The Contractor shall pay permits and fees for disposal.

3.2 RACEWAY DEMOLITION

A. Pull wire out of existing raceways. Underground conduit/duct may be abandoned in place when not in an area of excavation. When abandoned in place install waterproof caps/plugs and concrete end of duct markers.

B. Raceways that interfere with new work shall be completely removed.

C. Install 200 pound test pull rope in all conduits/ducts to remain in place. Conduit/duct banks may be abandoned in place if they are not within 24” of any new subgrade material.

D. Dispose of raceway as debris.

3.3 AIRFIELD LIGHTING AND SIGNS

A. Carefully remove existing airfield lighting, signs, etc. as noted in the Contract Documents. Properly store all signs, fixtures, base plates and spacer rings for reinstallation or turn over to Owner as noted in the Contract Documents.

B. There may be concrete foundations (anchors) around light bases that extend into the existing asphalt surface as well as concrete backfilled trenches, conduits and duct banks within the asphalt paved areas that may be encountered during the required milling process. To the extent known, these duct banks and conduits are shown on the Contract Documents under/within the paved areas. The milling of any such concrete around the light bases, or over trenches, ducts and conduits shall be considered incidental to the milling pay item.

C. Existing concrete sign pads, light bases, and raceways shall be demolished, transported from Owner property and legally disposed.

D. If required by the Contract Documents reinstall signs and fixtures.

E. Turn over to the Owner all signs, fixtures, base plates and spacer rings not reinstalled as a part of this contract.

F. Remove existing light bases, L-824 cable, L-830 isolation transformers and associated foundations and legally dispose.

3.4 MANHOLE/HAND HOLE DEMOLITION

A. Manholes, hand holes, pull boxes, etc. shall be removed and disposed of as demolition debris.

B. Demolished manholes, hand holes, pull boxes, etc. below the new full strength pavement shall be completely removed.

C. Demolished manholes, hand holes, pull boxes, etc. below shoulder pavement or in turfed areas shall be cut down to a depth of 48” min. below finished grade, filled and compacted in accordance with the Contract Documents.

3.5 GENERAL – CUTTING AND PATCHING

A. Cutting, patching, repairing, and other alteration work shall be done by mechanics skilled in the particular trade or work required.

B. Salvaged items for reuse shall be as accepted by the Engineer.

C. Where required to patch or extend existing construction, or both, such alteration work shall match existing exposed surface materials in finish, color, texture, and pattern.

PART 4 - METHOD OF MEASUREMENT

4.1 METHOD OF MEASUREMENT

A. All Electrical Demolition covered by this item will be paid for at the contract lump sum price, as set forth below, for demolition, alteration and removal complete and in accordance with the Contract Documents.

PART 5 - BASIS OF PAYMENT

5.1 BASIS OF PAYMENT

A. Payment will be made at the contract lump sum price for the required demolition, alteration and removal. This price shall be full compensation for furnishing all material, equipment and for all preparation, removal of the demolished materials and equipment and for all materials, labor, equipment, tools, services and incidentals necessary or required for the electrical demolition as shown in the Contract Documents. It is the intent of the demolition pay item that all equipment, devices, raceway, pull boxes, manholes, fixtures, wiring, materials, systems, appurtenances, etc., which are no longer required as a result of the project be removed. All waste materials shall be removed from the airport property and legally disposed of by the Contractor. This item includes all backfill, P-610, sod and other materials and appurtenances not specifically identified, but necessary to complete these items in accordance with the Contract Documents. This price shall include the required demolition and removal of VRC A1 Type manholes.

Payment will be made under:

Item SP-105-5.1	Electrical Demolition	-- Lump Sum (LS)

END OF ITEM SP-105

SECTION SP-106 - SUBMITTALS, RECORD DOCUMENTS AND MAINTENANCE MANUALS

PART 1 - DESCRIPTION

1.1 GENERAL

A. The items described in this item are applicable to all electrical work. Electrical work is defined as any work described, included, depicted or contained within the L-XXX specification series, SP-XXX, L- series drawings, E- series drawings, ED- series drawings and all other work within the Contract Documents dealing with the distribution of electrical power/light, electrical/electronic/light monitoring, communication and control.

B. Only Third Party Certified manufacturers, listed in AC 150/5345-53, Appendix 3 Addendum (as required) and meeting the BUY AMERICAN preference requirements can provide equipment and materials specified in the Contract Documents. Documentation certifying compliance with the BUY AMERICAN preference rules for AIP (in accordance with Title 49, United State Code [USC], 1990; later designated as 49 USC §50101) shall be included with each equipment and material submittal.

C. The requirements for submittals, record drawings and Operation and Maintenance (O&M) Manuals supplement the requirements and are in addition to the requirements of the general conditions, special provisions or other parts of the Contract Documents. Where the contract general conditions, special provisions or other parts of the Contract Documents also apply, the stricter of the documents shall govern.

1.2 SCOPE

A. This item includes the requirements for submittals, record documents and operation and maintenance (O&M) manuals. All submittals and O & M Manuals shall be submitted in book form as described by this item.

PART 2 - REQUIREMENTS FOR SUBMITTALS

2.1 DATA, SHOP DRAWINGS AND SAMPLES

A. Shop drawings are drawings, diagrams, illustrations, schedules, performance charts, brochures and other data which are prepared by the Contractor or any subcontractor, manufacturer, supplier or distributor, and which illustrate some portion of the work.

B. Submittal data for electrical materials and equipment shall consist of shop drawings and/or catalog cuts showing technical data as necessary to evaluate the material or equipment, to include dimensions, wiring diagrams, performance curves, ratings, control sequence and other descriptive data necessary to describe fully the item proposed and its operating characteristics.

C. Prior to the installation of any material or equipment and within 30 days of notice to proceed, the Contractor shall provide to the Engineer all submittals as required by the Contract Documents. The submittals shall be complete and made in ONE submission in the format required by this item. Partial submission will only be considered under special circumstances.

D. The Contractor shall perform no portion of the work, nor purchase any materials, requiring submission until the Engineer has accepted the relevant submittal/shop drawing/sample. Should the Contractor commence any work or install any materials prior to the receipt of an accepted submittal/shop drawing/sample the Contractor is deemed to be proceeding at the Contractor's own risk.

E. Samples are physical examples furnished by the Contractor to illustrate materials, equipment or workmanship, and to establish standards by which the work will be judged. Each sample shall be accompanied by the manufacturer's instructions regarding installation, operation and maintenance and shall be identified by item number, and specification.

F. By approving and submitting Shop Drawings and Samples, the Contractor thereby represents that the Contractor has determined and verified all field measurements, field construction criteria, materials, catalog numbers and similar data and that the Contractor, has checked and coordinated each Shop Drawing and Sample with the requirements of the work of the Contract Documents.

G. Unless otherwise stated in the Contract Documents the Engineer will review Data, Shop Drawings and Samples within thirty (30) days after receipt, but only for general conformance with the design concept of the project and general compliance with the information given in the Contract Documents. The Engineer's review of a separate item shall not indicate approval of an assembly in which the item functions.

H. The Engineer reserves the right to reject any and all equipment, materials and procedures, which, in the Engineer's opinion, does not comply with the system design and the standards and codes specified herein.

I. The Engineer shall be the sole judge of whether the proposed "acceptable equivalent" is suitable for use in the work.

J. The Contractor shall make any corrections required by the Engineer and shall resubmit the required number of corrected shop drawings or new samples until accepted. The Contractor shall direct specific attention in writing on resubmitted shop drawings to revisions other than the corrections requested by the Engineer on previous submissions.

K. If the Contractor desires to substitute materials or deviate from the requirements of the Contract Documents, the Contractor shall separately submit all substitute materials and deviations to the Contract Documents. Such submittals shall be clearly and boldly marked "SUBSTITUTION" or "DEVIATION TO CONTRACT DOCUMENTS". If the substitution or deviation is accepted, the Contractor will not be excused from producing work in conformity with the Contract Documents. If a trial use establishes the work does not comply with the Contract Documents, the Contractor shall take such action as the Engineer determines necessary.

L. The Engineer's approval of shop drawings or samples shall not relieve the Contractor of responsibility for any deviation from the requirements of the Contract Documents unless the Contractor has informed the Engineer in writing of such deviation at the time of submission and the Engineer has provided written acceptance to the specific deviation. The Engineer's approval shall not relieve the Contractor from responsibility for errors or omissions in the shop drawings or samples.

M. The submittals will be checked only for general conformance with the design concept of the project and general compliance with the information given in the Contract Documents. Any action noted by the Engineer on the submittal is subject to the requirements of the Contract Documents.

N. The Contractor is responsible for dimensions, quantities, fabrication processes and methods of construction, coordination of the Contractors work with that of all trades. The Contractor shall be responsible for satisfactory performance of the Contractor's work and supplying a complete and fully functional system. The Contractor shall confirm and correlate dimensions at the jobsite.

O. Samples shall be submitted upon request or as required by the Contract Documents.

P. The Contractor shall maintain an accurate updated "SUBMITTAL REGISTER" containing the status of all submittals. The log shall be updated on a weekly basis. The Contractor shall bring the submittal register to each progress meeting. The submittal register shall contain the following information:

1. Submittal description and number assigned.
2. Contract Document required submittal date.
3. Submittal electrical system type; airfield lighting or airfield lighting control or airfield lighting vault power system.
4. Reference Item # (L-108, 26 05 33.13, etc).
5. Date sent to Engineer.
6. Date returned to Contractor from Engineer.
7. Submittal status.
8. Date of resubmittal and return – as applicable.
9. Date material released for fabrication.
10. Projected date of fabrication.
11. Projected date of delivery to site.

2.2 ELECTRONIC SUBMITTAL

A. Electronic submittal shall consist of a single PDF document separated and book marked per each electrical system, per specification section as described in section 2.2.d. containing all materials for each item to be installed in the project.

B. Electronic submittals larger than 10 megabyte shall be separated into smaller PDF files for transmission to make up a single PDF document. Each separate PDF shall be book marked per specification section containing all materials for each item to be installed in the project.

C. Each PDF for electronic transmission shall be clearly labeled as transmittal X of Y per submittal section.

D. Provide separate submittal PDF's for each of the following electrical system types:

1. One PDF submittal set for the Airfield Lighting System. All components to be included in the contract for lighting, conduit, grounding and miscellaneous systems shall be included.

2. One PDF submittal set for the Airfield Lighting Control System.

3. One PDF submittal set for the Airfield Lighting Vault Modifications,

2.3 SUBMITTAL CONTENTS

A. First sheet(s) in shall be a cover sheet containing the project information and location. See appendix A at the end of SP-106 specification.

B. The second sheet shall be a table of contents identifying the specification section(s) being submitted.

C. Third sheet shall be prepared and filled out by Contractor and shall list project address of airport, Engineer, Contractor & subcontractor(s).

D. Fourth sheet shall also be filled out by Contractor and list project schedule information.

E. Submittals consisting of marked catalog sheets or shop drawings shall be inserted in the PDF in specification number/section order. Submittal data shall be presented in a clear and thorough manner. Original PDF catalog sheets are preferred. Scans of catalog sheets are acceptable provided they are equivalent in quality to the original document.

F. Clearly and boldly mark each page to identify pertinent products or models applicable to this project. Indicate all optional equipment and delete non-pertinent data. Markings shall be boldly and clearly made with arrows or circles (highlighting is not acceptable).

G. All sheets within the submittal shall be oriented in a portrait setting. Mixing of portrait and landscape oriented standard 8.5 X 11 sheets shall not be permitted.

H. All sheets contained within the PDF shall be straight. Sheets scanned on a drastic angle making the submittal page difficult to read shall not be permitted and shall result in the submittal being rejected.

I. Some catalog sheets have colored backgrounds or colored text. When scanned these items appear black and obscure the printed text and markings by the contractor. For this reason, all scans of sheets with colored backgrounds or text shall be made in color. Sheets that are not readable due to obscured information shall be rejected.

J. Submittals for components of electrical equipment and systems shall identify the equipment for which they are a component part on each submittal sheet.

K. Shop Drawings: Drawings to include identification of project and names of Engineer(s), General Contractor, subcontractor and supplier, data, number sequentially and indicate the following:

1. Fabrication and erection dimensions.

2. Arrangements and sectional views.

3. Necessary details, including complete information for making connections with other work.

4. Kinds of materials and finishes.

5. Descriptive names of equipment.

6. Modifications and options to standard equipment required by the work.

7. Leave blank area, size approximately 5 x 5 inches, near title block for the Engineer’s stamp imprint.

8. Point-to-point wiring diagrams.

9. Conduit/duct/raceway rough-in drawings.

10. See specific items of the Contract Documents for further requirements.

L. Submittal Product Data - Technical data is required for all items as called for in the Contract Documents, regardless, if item furnished is as specified.

1. Submit technical data verifying that the item submitted complies with the requirements of the Contract Documents. Technical data shall include manufacturer's name and model number, dimensions, weights, electrical characteristics, and clearances required. Indicate all optional equipment and changes from the standard item as called for in the Contract Documents. Furnish drawings, or diagrams, dimensioned and in correct scale, covering equipment, showing arrangement of components and overall coordination.

2. In order to facilitate review of product data, insofar as practicable, they shall be noted, indicating by cross reference the Contract Documents, note, drawing number and/or specification number and item paragraph numbers where item(s) occur in the Contract Documents.

3. See specific items in Contract Documents for further requirements.

2.4 PROCESSING SUBMITTALS

A. Submit the PDF submittal and shop drawings per Specification section

B. The Contractor shall review, stamp with the Contractor's approval and submit to the Engineer, eight (8) prints of shop drawings, eight (8) copies of submittal books and three (3) sets of samples where required, as described in this item,

C. The General Contractor shall review the submittal books before submitting to the Engineer. No request for payment will be considered until the submittal book has been reviewed and submitted for review by the Engineer.

D. Product Data: For standard manufactured materials, products and items, submit one (1) copy or sets of data (per book).

E. Shop Drawings for custom fabricated items and systems:

1. Initially submit a transparency (suitable for reproduction) together with four (4) prints made the transparency.

2. When submittal is acceptable, furnish one (1) print per book made from the accepted transparency.

F. Acceptance: When returned to Contractor, the front of each submittal will be marked with the Engineer's stamp. If box marked "Submit Specified Item", or "Rejected" or "Revise and Resubmit" is checked, submittal is not accepted and Contractor is to correct and resubmit as noted. If submittal is marked "Make Correction Noted" Contractor may begin construction utilizing the submitted item with corrections made. However, the corrected submittal must be resubmitted for record keeping purposes. Contractor is to comply with notation making necessary corrections on submittal and resubmit for final record.

G. If the submittal is marked "No Exception Taken" the Engineer took no exceptions to the submitted items.

H. Corrections or comments made on the shop drawings during this review do not relieve Contractor from compliance with requirements of the Contract Documents. This check is only for review of the general conformance with the design concept of the project and general compliance with the information given in the Contract Documents. The Contractor is responsible for; confirming and correlating all quantities and dimensions; selecting fabrication processes and techniques of construction; coordinating the

Contractor's work with that of all other trades and performing all work in a safe and satisfactory manner.

I. Note that the acceptance of shop drawings or other information submitted in accordance with the requirements contained in this item, does not assure that the Engineer or any other Owner's Representative attests:

1. To the dimensional accuracy or dimensional suitability of the material or equipment involved.

2. The ability of the material or equipment involved to perform as designed.

3. The mechanical or electrical performance of equipment.

J. Approval of shop drawings does not invalidate the Contract Documents if in conflict; unless a letter requesting such a change is submitted and accepted on the Engineer's letterhead.

2.5 DELAYS

A. Contractor is responsible for delays in job progress accruing directly or indirectly from late submissions or resubmissions of shop drawings, or product data.

2.6 RE-SUBMITTALS

A. The Engineer shall be reimbursed for engineering costs to review resubmittals subsequent to the second submittal.

PART 3 – RECORD DOCUMENTS

3.1 PROGRESS AND RECORD DRAWINGS

A. Keep two sets of blue line prints on the job and neatly mark up design drawings each day as components are installed. Red pencil shall be used for additions and green pencil for deletions. Use of "white out" or similar products is not permitted.

B. All items on record drawings shall be shown in actual location installed. Drawings shall be inspected weekly, by the Engineer, for compliance and accuracy. Project payments shall be withheld if the marked-up drawings are not current.

C. Change the equipment schedules to agree with items actually furnished.

D. All hand holes, pull boxes, junction can plazas, manholes, underground ducts, conduits, force mains, drains, ground grids, etc. (all underground utilities) installed by this Contractor or located by this Contractor during the construction of this project shall be surveyed and recorded on the record documents. Record utility locations in state plane grid coordinates. Provide north-south, east-west coordinate and elevation.

E. At the end of the project, all changes shall be reviewed by the Electrical Contractor. The drawings shall be marked "As Built" and dated and signed by the Electrical Contractor's Superintendent.

F. Prior to request for final payment, furnish a set of "As Built" prints to the Engineer for review. The final prints shall be professionally drafted to indicate "As Built" conditions to the Engineer. The prints shall be stamped "As Built" signed and dated by the Contractor. The Contractor's signature shall certify to the Engineer that the "As Built" drawings are accurate and complete.

G. The Contractor's failure to produce representative "As Built" drawings in accordance with requirements of this item, shall be cause for the Engineer to produce such "As-built" drawings and the Contractor shall reimburse Engineer for all costs to produce a representative set of "As Built" drawings.

PART 4 - PERATION AND MAINTENANCE MANUALS

4.1 REQUIREMENTS FOR OPERATION AND MAINTENANCE MANUALS:

A. Two (2) CD's shall be provided with all O & M Manual information included in PDF format. The Operation and Maintenance Manual shall be submitted as a PDF document. As a minimum, the Operation and Maintenance Manual shall contain the following:

1. Safety precautions used while maintaining the equipment.
2. Theory of circuit and system operation.
3. Complete schematic and interconnecting wiring diagrams.
4. Complete parts list with each circuit component keyed to designations assigned on schematics and wiring diagrams. Complete information shall be given for each part to permit ordering for replacement purposes. This information shall include the components rating, name of manufacturer and the manufacturer's part number.
5. Recommended preventative maintenance, including care, cleaning lubrication, service intervals, etc.
6. Troubleshooting procedures.
7. Physical characteristics (weight, size, mounting dimensions, etc.).
8. Installation instructions.
9. Operating instruction.
10. Recommended spare parts and usage for a one (1) year period.

11. Submit for checking purposes a specific set of written operating instructions on each item, which requires instructions to operate. After acceptance, provide one copy for insertion in each Operation and Maintenance Manual.

12. Submit for acceptance maintenance information consisting of manufacturer's printed instructions and parts list for each major item of equipment. After acceptance, insert information in each Operations and Maintenance Manual. Detailed schematic diagrams shall be furnished for all electrical/electronic equipment.

13. Bill of materials.

14. Physical layout plans.

15. Equipment supplier list.

16. Panel schedules shall be submitted with the respective panel data.

17. Special instructions

18. Service maintenance contracts including the name, address and 24 hour phone number and contact of manufacturer’s authorized Repair Company.

There shall be no "Black Boxes" for which there are no schematic/wiring diagrams.

4.2 OPERATION AND MAINTENANCE MANUALS

A. O & M Manuals shall consist of a PDF document. The manual shall be bookmarked into sections by Table of Contents, Project Contacts, and each technical specification section. Shop drawings, product data and/or catalog sheets shall be inserted into the O & M PDF by technical specification.

B. Provide correct designation of project on first page of each technical specification submittal section. Description sheet shall be white with black letters, minimum of 11” high and full width of page. Description shall describe project and match project Contract Document description. Description to include submittal type.

C. All documents inserted into the O & M Manual PDF, including but not limited to catalog cut sheets, theory of operation, and all other related product data, shall be the original documentation from the manufacturer.

D. Any scanned documentation shall be legible, and have the correct orientation in the pdf so the document can be read horizontally, from left to right, in line with all other pages in the O & M Manual. Failure to meet these requirements will result in the O & M Manual’s rejection. Upon rejection any errata shall be fixed and resubmitted to the engineer for approval.

E. Provide one O & M Manual for the electrical system required by the contract documents.

4.3 OPERATION AND MAINTENANCE MANUAL CONTENTS

A. Operation & Maintenance Manuals shall include:

1. First sheet in PDF shall be the cover sheet.

2. The second sheet shall be a table of contents.

3. The third sheet shall be filled out by Contractor and shall list project address of airport, Engineer, Contractor & subcontractor(s).

4. The fourth sheet shall also be filled out by Contractor and list project schedule information showing project “as completed”.

5. Shop Drawings: Shop drawings shall be a copy of the final and accepted shop drawings submitted. These shall be inserted into the PDF in specification number/section order. Each catalog sheet shall clearly identify where the product is used and the Contract Document identification for equipment.

6. Product data and/or catalog sheets shall be a copy of the final and accepted submittal. These shall be inserted into the PDF in specification number/section order. Each catalog sheet shall clearly identify where the product is used and the Contract Document identification for equipment.

7. Warranty/Guarantee: Provide copy of warranty/guarantee and letters of certification, in respective location in O & M Manual PDF. Original warranty/guarantee shall be incorporated into separate project warranty PDF with warranty/guarantees provided for other items and submitted for Engineer review.

4.4 PROCESSING OPERATION AND MAINTENANCE MANUALS

A. The General Contractor shall review the manuals before submitting to the Engineer. Submit one CD containing the PDF set of O& M Manuals to the owner and one CD containing the PDF set to the Engineer.

4.5 DELAYS

A. Contractor is responsible for delays in job progress accruing directly or indirectly from late submissions or resubmissions of the Operation and Maintenance Manuals.

4.6 RE-SUBMITTALS

A. The Engineer shall be reimbursed the cost to review Operation and Maintenance Manual re-submittals subsequent to the second submittal.

PART 5 - METHOD OF MEASUREMENT

5.1 METHOD OF MEASUREMENT

A. The items described in Item SP-106 are incidental to other pay items and shall not be measured for payment.

PART 6 - BASIS OF PAYMENT

6.1 BASIS OF PAYMENT

A. No direct payment shall be made for the work described in Item SP-106. The work described in Item SP-106 is incidental to other items and shall be paid for in the respective bid item of which it is a component part.

PART 7 - SUBMITTAL LIST

7.1 SUBMITTAL LIST

A. The following is a list of materials expected by the Engineer to be incorporated within the project. This list is not all inclusive as the Contractor's chosen means and methods will have a direct impact on the materials used.

B. It is the intent of this item that all materials used or incorporated into this project is submitted to the Engineer for review.

C. The Contractor shall maintain a submittal register in accordance with Part 2 of this item. The Submittal register shall include all items used or incorporated into the project.

LIST TO FOLLOW:

Spec. Section Number	**Spec Paragraph Number**	**Submittal Description**
SP-100	1.4-A	CERTIFICATION OF ELECTRICAL CONTRACTOR'S EXPERIENCE
SP-100	1.4-A	COPY OF ELECTRICAL CONTRACTOR'S STATE ELECTRICAL LICENSE
SP-100	1.5-C	CERTIFICATION OF ELECTRICAL SUPERINTENDENT'S EXPERIENCE
SP-100	1.5-C	ELECTRICAL SUPERINTENDENT'S RESUME' AND COPY OF JOURNEYMAN ELECTRICIAN LICENSE

SP-100	1.5-C	ELECTRICAL SUPERINTENDENT'S REFERENCES, AIRPORT NAME, CONTACT AND PHONE NUMBER
SP-100	1.5-F	COPY OF EACH JOURNEYMAN ELECTRICIAN'S LICENSE
SP-100	2.4-B	EXISTING FACILITIES INVESTIGATION MEMO
SP-100	2.4-E	SCHEDULED SHUTDOWNS
SP-100	2.5-A	WARRANTIES
SP-100	2.6-A	O&M MANUALS
SP-100	2.7-O	RECORD DOCUMENTS
SP-100	3.1-A	GENERAL LIGHTING PROVISIONS SUPERVISION & ATTENDANCE (SD-08)
SP-100	3.1-K	COLOR CODE PAINT
SP-100	3.7-D	LOAD BALANCE TEST
SP-100	3.8-C	PHENOLIC NAMEPLATES 1 TO 1 SCALE DETAIL OF EACH NAMEPLATE
SP-100	3.9	ADHESIVE BACKED CLOTH MARKERS
SP-100	3.12-A	WELDER QUALIFICATIONS
SP-100	3.12-A	WELDING PROCEDURES
SP-100	3.12-A	WELDER QUALIFICATION TEST
SP-100	GENERIC REQUIREMENT	PERMANENT BLACK MARKER
SP-100	GENERIC REQUIREMENT	SELF-ADHESIVE CLEAR PRINTED LABELS W/ BLACK TYPED LETTERS
SP-104	1.3-A	SAFETY PLAN (SD-01)
SP-104	1.9-A	WRITTEN VERIFICATION PROVIDING PROOF OF CORRESPONDENCE WITH REPRESENTATIVES OF ALL UTILITIES/AGENCIES TO LOCATE ALL EXISTING UTILITIES/SYSTEMS WITHIN THE PROJECT LIMITS
SP-104	4.1-A	TAGGING AND LOCKOUT PROCEDURE
SP-104	4.1-D	FAA 45 DAY WRITTEN NOTICE OF WORK
SP-104	4.2-F	TEMPORARY AIRFIELD LIGHTING/POWER PLAN
SP-104	4.2-J	INSULATION RESISTANCE TESTS ON EXISTING CIRCUITS TO BE MODIFIED BY CONTRACTOR
SP-105	1.2-A	VERIFICATION OF EXISTING CONDITIONS (SD-21)
SP-105	1.2-D	INSULATION RESISTANCE TESTS ON EXISTING CIRCUITS TO BE MODIFIED BY CONTRACTOR
SP-105	1.8-A	DEMOLITION TASK PLAN

SP-105	1.8-B	EXISTING CABLE PROTECTION PLAN
L-108	2.1 - D	ALL MATERIALS AND EQUIPMENT USED TO CONSTRUCT THIS ITEM SHALL BE SUBMITTED TO THE ENGINEER
L-108	2.1 - F	WARRANTY
L-108	2.1 - G	CREW MIX
L-108	2.2 - A	#8 AWG, 5KV L-824 AIRFIELD LIGHTING CABLE (6.6A)
L-108	2.2 - A	L-824 SECONDARY CONDUCTORS, EXTENSION CORDS, ETC.
L-108	2.2 - B	CERTIFIED COPY OF FACTORY TEST REPORTS FOR ALL CABLE PROVIDED
L-108	2.2 - F	THWN-2 WIRE FOR CIRCUITS UP TO 600V
L-108	2.2 - F	COPPER BUS BAR BY SIZE, TYPE AND USE
L-108	2.2 - G	CONTROL CABLE
L-108	2.2 - H	FIBER OPTIC CABLE
L-108	2.2 - I	ALCS CONTROL CABLE
L-108	2.3 - A	#2 AWG SOLID COPPER COUNTERPOISE
L-108	2.3 - B	4/0 AWG GROUND GRID WIRE
L-108	2.3 - C	#6 AWG, GREEN THWN-2 INSULATED BONDING JUMPER
L-108	2.3 - D	#2 AWG, GREEN THWN-2 INSULATED BONDING JUMPER
L-108	2.3 - F	¾” DIAMETER BY 10’ LONG COPPER CLAD STEEL SECTIONAL GROUND ROD
L-108	2.3 - F	GROUND ROD COUPLINGS
L-108	2.3 - F	GROUND ROD DRIVING STUDS
L-108	2.3 - I	GROUNDING CONDUCTORS FOR VOLTAGE CIRCUITS
L-108	2.4 - B	CAST SPLICE INCLUDING BLOCKING COMPOUND, CONNECTORS, SPLICE AND CRIMPING TOOL
L-108	2.4 - C	FIELD-ATTACHED PLUG-IN SPLICE
L-108	2.4 - E	TAPED OR HEAT-SHRIINKED SPLICE METHODS
L-108	2.4 - F	LIST OF APPROVED CRIMP CONNECTORS AND CRIMPING TOOLS
L-108	2.4 - F	COMPRESSION BUTT SPLICES INCLUDING MANUFACTURER'S INSTRUCTIONS
L-108	2.4 - F	COMPRESSION LUGS INCLUDING MANUFACTURER'S INSTRUCTIONS

L-108	2.4 - F	C-TAPS INCLUDING MANUFACTURER'S INSTRUCTIONS
L-108	2.4 - F	COMPRESSION TOOLING, CALIBRATION CERTIFICATE, PROCEDURES AND MANUFACTURER'S RECOMMENDED PRACTICES
L-108	2.4 - G	EXOTHERMIC CONNECTIONS INCLUDING ALL MOLDS, SHOTS AND MANUFACTURER'S INSTRUCTIONS
L-108	2.4 - G	BASE CAN GROUND CLAMPS
L-108	2.5 - A	AIRFIELD LIGHTING CABLE SPLICER QUALIFICATIONS
L-108	2.5 - B	AIRFIELD LIGHTING CABLE SPLICING DEMONSTRATIONS
L-108	2.5 - B	LIST OF APPROVED AIRFIELD LIGHTING CABLE SPLICERS AND ASSIGNED SPLICER IDENTIFICATION NUMBER.
L-108	2.5 - C	EXOTHERMIC WELDER QUALIFICATIONS
L-108	2.5 - C	SAMPLE EXOTHERMIC WELD DEMONSTRATIONS
L-108	2.5 - C	LIST OF APPROVED EXOTHERMIC WELDERS.
L-108	2.5 - D	ALL GROUNDING AND BONDING TOOLS AND EQUIPMENT
L-108	2.5 - D	GROUNDING AND BONDING QUALIFICATIONS
L-108	2.5 - D	SAMPLE CONNECTOR/LUG DEMONSTRATIONS
L-108	2.5 - D	LIST OF APPROVED GROUNDING AND BONDING PERSONNEL
L-108	2.8 - A	CABLE IDENTIFICATION TAGS AND TYRAP
L-108	2.8 - A	CABLE ID TAG STAMPED SAMPLES
L-108	2.9 - A	ALL ELECTRICAL TAPES
L-108	2.9 - A	HEAT SHRINK TUBING
L-108	2.10	ELECTRICAL COATING
L-108	2.11	INSULATION RESISTANCE TESTS OF EXISTING CIRCUITS
L-108	2.12	FIELD LIGHTING ARRESTOR ASSEMBLY CONNECTIONS
L-108	2.13	DETECTABLE WARNING TAPE
L-108	3.1 - G	L-823 CONNECTORS INCLUDING MANUFACTURER'S INSTRUCTIONS
L-108	3.1 - K	ADDITIONAL L-823 CONNECTORS TURNED OVER TO OWNER

L-108	3.2 - C	PULL ROPE
L-108	3.2 - D	MOISTURE-SEAL TAPE
L-108	3.2 - D	CABLE PULLING LUBRICANT
L-108	3.2 - E	CABLE PULLING TENSION VALUES
L-108	3.4 - A	WIRE/CABLE MARKERS
L-108	3.5 - F	CABLE STRIPPING AND PENCILING TOOLS
L-108	3.7 - H	EXOTHERMIC WELD PHOTOGRAPHIC LOG AND CD
L-108	3.7 - I	EXOTHERMIC WELD MANUFACTURER'S INSPECTION / ACCEPTANCE CRITERIA
L-108	3.8-D	LIGHTING AND POWER CIRCUIT CONTINUOUS OPERATION TEST
L-108	3.8-D	COUNTERPOISE CONTINUITY TEST
L-108	4.3	GROUND ROD INSPECTION PITS
L-108	GENERIC REQUIREMENT	MECHANICAL LUGS AND TORQUING REQUIREMENTS
L-108	GENERIC REQUIREMENT	TORQUE WRENCH, CALIBRATION CERTIFICATE AND MANUFACTURER’S RECOMMENDED PRACTICES
L-108	GENERIC REQUIREMENT	WIRE NUTS
L-108	GENERIC REQUIREMENT	TERMINAL BLOCKS
L-108	GENERIC REQUIREMENT	SS WIRE MESH STRAIN RELIEF BASKETS FOR 5 KV CABLES
L-108	GENERIC REQUIREMENT	ELECTRICAL JOINT COMPOUND
L-110	2.1	UNDERGROUND DUCT (SD-01, -09)
L-110	2.2	RIGID GALVANIZED STEEL (RGS) CONDUIT
L-110	2.3-B	SCHEDULE 40 PVC CONDUIT (2",3",4")
L-110	2.3-B	SCHEDULE 40 PVC END BELLS, FITTINGS, TERMINATIONS, CLEANER AND SOLVENT CEMENT (2",3",4")
L-110	2.4	SPLIT CONDUIT (4")
L-110	2.5	CONDUIT SPACERS AND DUCT PLUGS
L-110	2.6	CONCRETE
L-110	2.7	FLOWABLE BACKFILL
L-110	2.8	DETECTABLE MARKER TAPE

L-110	2.9	LONG RADIUS RGS BENDS
L-110	2.10	DIRECTIONAL BORE DUCT
L-110	2.10	DIRECTIONAL BORE WORK PLAN, SCHEDULE, PROCEDURE, METHODS AND EQUIPMENT
L-110	2.10	DIRECTIONAL BORE DRILLING FLUID MIXING AND DELIVERY SYSTEM
L-110	2.10	DIRECTIONAL BORE GUIDANCE SYSTEM
L-110	2.12	PAVEMENT REINFORCEMENT MESH
L-110	3.9	CONDUIT PITTING LUBRICANT
L-110	3.10	RACEWAY DRAIN
L-110	GENERIC REQUIREMENT	WEATHER PROOF CONDUIT HUBS
L-110	GENERIC REQUIREMENT	LOCKNUTS
L-110	GENERIC REQUIREMENT	GROUNDING BUSHINGS W/ INSULATED THROAT
L-110	GENERIC REQUIREMENT	BUSHINGS W/ INSULATED THROAT
L-110	GENERIC REQUIREMENT	CONDULETS, COVERS AND GASKETS
L-110	GENERIC REQUIREMENT	EXPANSION FITTINGS
L-110	GENERIC REQUIREMENT	CABLE RACKS, SUPPORTS, TIES AND STRAPS
L-110	GENERIC REQUIREMENT	CONDUIT THREAD COMPOUND
L-110	GENERIC REQUIREMENT	COLD GALVANIZING COMPOUND
L-110	GENERIC REQUIREMENT	ASPHALTUM PAINT
L-110	GENERIC REQUIREMENT	EXPANSION FITTINGS
SP-111	2.1-A	SUBMIT ALL MATERIALS, TEST EQUIPMENT, WRITTEN PROCEDURES, EQUIPMENT CALIBRATION CERTIFICATES FOR PERFORMING THE FOLLOWING TESTS:
SP-111	2.1-C, 2.3	QUALIFICATION OF FIRM PERFORMING HI-POT TESTING
SP-111	2.1-D	FIELD TEST PLAN

SP-111	2.3-A	QUALIFICATIONS OF TESTING PERSONNEL
SP-111	2.3-E	QUALIFICATIONS OF CALIBRATION LAB
SP-111	2.3-G	QUALIFICATION OF FIRM PERFORMING AIRFIELD LIGHTING PHOTOMETRIC TESTING
SP-111	3.1	COUNTERPOISE TESTING
SP-111	3.1	EXOTHERMIC WELD TESTS
SP-111	3.2	GROUND ROD TESTING
SP-111	3.3	FIELD LIGHTNING ARRESTOR ASSEMBLY TESTING
SP-111	3.4	EXISTING AIRFIELD LIGHTING CIRCUIT INSULATION RESISTANCE TESTING
SP-111	3.5	NEW AIRFIELD LIGHTING CIRCUIT CONTINUITY TESTING
SP-111	3.6	NEW AIRFIELD LIGHTING CIRCUIT INSULATION RESISTANCE TESTING
SP-111	3.7	NEW AIRFIELD LIGHTING CIRCUIT HIGH POTENTIAL TESTING
SP-111	3.8	CONCLUDING AIRFIELD LIGHTING CIRCUIT TESTS
SP-111	3.9	CONSTANT CURRENT REGULATOR CALIBRATION AND PERFORMANCE TEST PROCEDURE AND TEST EQUIPMENT
SP-111	3.10	CONTROL SYSTEM TESTS
SP-111	3.11	FIXTURE WIRING SEQUENCE TESTING
SP-111	3.12	AIRFIELD LIGHTING PHOTOMETRIC TESTING PROCEDURE AND EQUIPMENT
SP-111	3.13	AIRFIELD SIGN PHOTOMETRIC TESTING
SP-111	3.14	SHIRT CIRCUIT/COORDINATION/DEVICE EVALUATION/ARC FLASH ANALYSIS
SP-111	GENERIC REQUIREMENTS	TESTING REQUIRED BY EQUIPMENT MANUF.
SP-111	GENERIC REQUIREMENTS	TORQUING OF ELECTRICAL TERMINATIONS
SP-111	GENERIC REQUIREMENTS	TORQUING OF ANCHOR BOLTS
L-115	2.1-C,2.2	ELECTRICAL MANHOLES AND JUNCTION STRUCTURES
L-115	2.1-C, 2.2	STRUCTURAL SLAB
L-115	2.6, 2.18	FRAMES AND COVERS
L-115	2.16	MOWING APRONS

L-115	2.17	TRANSITIONAL APRONS
L-125	1.1	INSTALLATION OF AIRPORT LIGHTING SYSTEMS (SD-01, -09, -20)
L-125	1.2-A	SHOP DRAWINGS OF EACH AIRFIELD LIGHTING COMPONENT, INDICATING FAA APPROVAL, SHALL BE SUBMITTED TO THE OAR FOR REVIEW AND APPROVAL AND BE APPROVED PRIOR TO ORDERING ANY MATERIALS FOR THIS ITEM. THIS SUBMITTAL SHALL INCLUDE THE PROPOSED METHOD OF INSTALLATION FOR ALL AIRFIELD LIGHTING COMPONENTS. THE SUBMITTAL SHALL INCLUDE DATA ON ALL COMPONENT PARTS OF THE ITEM OR SYSTEM, AND SHALL INLCUDE THE MANUFACTURERS LIST OR RECOMMENDED SPARE PARTS FOR ONE YEARS USE.
L-125	1.2-B	THE MANUFACTURER OF THE LIGHTING FIXTURES AND SIGNS PROPOSED SHALL PROVIDE DATA, CERTIFICATION, AND FIVE (5) AIRPORT REFERENCES THAT EACH TYPE OF PROPOSED FIXTURE, AS CURRENTLY DESIGNED UNLESS A NEW DESIGN THAT HAS NOT BEEN REQUIRED IN THE UNITED STATES HERETOFORE, HAS BEEN IN OPERATION UNDER NORMAL AIRFIELD CONDITIONS FOR A MINIMUM OF 3 YEARS WITH A CERTIFIED REPAIR REQUIREMENT RATE OF NO MORE THAN THREE (3) PERCENT.
L-125	1.2-B	AIRFIELD LIGHTING FIXTURE MANUFACTURER QUALIFICATIONS
L-125	1.3-A	SPARE PARTS GUARANTEE
L-125	1.4-A(6)	SURVEY OF EXISTING FIXTURES, BASE CANS, ETC
L-125	2.2	GUARANTEE
L-125	2.7	L-852C(L) BI-DIRECTIONAL GREEN LED TAXIWAY CENTERLINE LIGHT - INCLUDING AS APPLICABLE: LIGHT BASES (BASE CANS), EXTENSIONS AND TOP SECTIONS, COVERS, GASKETS, GROUND LUGS, LOAD RINGS, ANTI-ROTATIONAL FINS, SPACER RINGS, CONCRETE RINGS, ADAPTER RINGS, SS BOLTING HARDWARE, L-830 ISOLATION TRANSFORMERS, FRANGIBLE COUPLINGS, LAMPS, INSTALLATION DETAIL, ALL COMPONENTS , ACCESSORIES AND INCIDENTALS.

L-125	2.7	L-852D(L) BI-DIRECTIONAL GREEN LED TAXIWAY CENTERLINE LIGHT - INCLUDING AS APPLICABLE: LIGHT BASES (BASE CANS), EXTENSIONS AND TOP SECTIONS, COVERS, GASKETS, GROUND LUGS, LOAD RINGS, ANTI-ROTATIONAL FINS, SPACER RINGS, CONCRETE RINGS, ADAPTER RINGS, SS BOLTING HARDWARE, L-830 ISOLATION TRANSFORMERS, FRANGIBLE COUPLINGS, LAMPS, INSTALLATION DETAIL, ALL COMPONENTS , ACCESSORIES AND INCIDENTALS.
L-125	2.7	L-852T(L), OMNIDIRECTIONAL, RED, LED, STYLE 3, T/W EDGE LIGHT, MOUNTED ON AN L-868B, 2 PIECE, DEEP LIGHT BASE WITH A PROPERLY SIZED SPACER RING (W/CONCRETE RING) AND PROPERLY SIZED L-830 TRANSFORMER, L-823 CONNECTORS, AND ALL INCIDENTALS. ALIGN AND LEVEL AS REQUIRED.
L-125	2.7	L-861T(L) OMNI-DIRECTIONAL BLUE LED TAXIWAY EDGE LIGHT - INCLUDING AS APPLICABLE: LIGHT BASES (BASE CANS), EXTENSIONS AND TOP SECTIONS, COVERS, GASKETS, GROUND LUGS, LOAD RINGS, ANTI-ROTATIONAL FINS, SPACER RINGS, CONCRETE RINGS, ADAPTER RINGS, SS BOLTING HARDWARE, L-830 ISOLATION TRANSFORMERS, FRANGIBLE COUPLINGS, LAMPS, INSTALLATION DETAIL, ALL COMPONENTS , ACCESSORIES AND INCIDENTALS.
L-125	2.8	L-858(L) Y, R, L SIGN 2 MODULE SIGN - INCLUDING AS APPLICABLE: LIGHT BASES (BASE CANS), EXTENSIONS AND TOP SECTIONS, COVERS, GASKETS, GROUND LUGS, LOAD RINGS, ANTI-ROTATIONAL FINS, SPACER RINGS, CONCRETE RINGS, SIGN TETHERS, SS ANCHOR BOLTS, SS BOLTING HARDWARE, L-830 ISOLATION TRANSFORMERS, FRANGIBLE COUPLINGS, LAMPS, INSTALLATION DETAIL, ALL COMPONENTS , ACCESSORIES AND INCIDENTALS.
L-125	2.8	L-858(L) Y, R, L SIGN 3 MODULE SIGN - INCLUDING AS APPLICABLE: LIGHT BASES (BASE CANS), EXTENSIONS AND TOP SECTIONS, COVERS, GASKETS, GROUND LUGS, LOAD RINGS, ANTI-ROTATIONAL FINS, SPACER RINGS, CONCRETE RINGS, SIGN TETHERS, SS ANCHOR BOLTS, SS BOLTING HARDWARE, L-830 ISOLATION TRANSFORMERS, FRANGIBLE COUPLINGS, LAMPS, INSTALLATION DETAIL, ALL COMPONENTS , ACCESSORIES AND INCIDENTALS.

L-125	2.8	L-858(L) Y, R, L SIGN 4 MODULE SIGN - INCLUDING AS APPLICABLE: LIGHT BASES (BASE CANS), EXTENSIONS AND TOP SECTIONS, COVERS, GASKETS, GROUND LUGS, LOAD RINGS, ANTI-ROTATIONAL FINS, SPACER RINGS, CONCRETE RINGS, SIGN TETHERS, SS ANCHOR BOLTS, SS BOLTING HARDWARE, L-830 ISOLATION TRANSFORMERS, FRANGIBLE COUPLINGS, LAMPS, INSTALLATION DETAIL, ALL COMPONENTS , ACCESSORIES AND INCIDENTALS.
L-125	PLAN DETAILS	MISC SIGN ITEMS
L-125	PLAN DETAILS	L-858 SIGN MESSAGE SCHEDULE
L-125	PLAN DETAILS	SIGN LOAD CALCULATION OR TEST RESULTS SUPPORTING 200MPH REQUIREMENT PER AC 150/5345-44F
L-125	PLAN DETAILS	VINYL DIE CUT LABELS AND SAMPLE
L-125	PLAN DETAILS	CONCRETE SIGN PAD - 1 TO 4 MODULE
L-125	PLAN DETAILS	SIGN STYLE CONVERSIONS
L-125	PLAN DETAILS	REINFORCING STEEL
L-125	2.12	L-867/L-868 BASE CANS AND ACCESSORIES
L-125	2.16	JUNCTION CAN PLAZA - (XX CAN), INCLUDING ALL INCIDENTALS
L-125	5.1	¾” GALVANIZED STEEL BLANK COVER – INCLUDING ALL INCIDENTALS AND SECURED WITH STAINLESS STEEL BOLTS.
L-125	2.13	L-830 ISOLATION TRANSFORMERS
L-125	PLAN DETAILS	FRANGIBLE CONNECTIONS
L-125	PLAN DETAILS	FIXTURE AND BASE CAN BOLTING HARDWARE
L-125	PLAN DETAILS	ANTI-SEIZE COMPOUND
L-125	PLAN DETAILS	IDENTIFICATION/NUMBER MARKERS
L-125	PLAN DETAILS	24 EACH SAMPLES OF ID MARKERS L-125.32
L-125	5.1	FIELD LIGHTNING ARRESTOR ASSEMBLY – INCLUDING ALL COMPENENTS, ACCESSORIES, AND INCIDENTALS.
L-125	PLAN DETAILS	FIXTURE AND SIGN BONDING JUMPER AND LUG
L-125	PLAN DETAILS	SPARE PARTS
L-125	5.1	EACH COMPONENT SHALL BE IDENTIFIED WITH THE SPECIFIC PAY ITEM OF WHICH IT IS A COMPONENT PART. COMPLETE ASSEMBLIES SHALL BE SUBMITTED FOR EACH PAY ITEM.

APPENDIX 1

"EXAMPLE OF COVER SHEET"

AIRPORT NAME

AIRPORT OWNER

PROJECT NAME

AIRPORT PROJECT NUMBER

AIP#

DOT#

AIRFIELD LIGHTING SYSTEM

OPERATION AND MAINTENANCE MANUAL

OWNER MANUAL #1

Note:

Submittal books and spline information similar.

END OF SECTION SP-106

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SECTION L-108 - UNDERGROUND POWER CABLE FOR AIRPORTS

PART 1 - DESCRIPTION

1.1 This item shall consist of furnishing and installing power cables that are direct buried and furnishing and/or installing power cables within conduit or duct banks per these specifications at the locations shown on the plans. It includes excavation and backfill of trench for direct-buried cables only. Also included are the installation of counterpoise wires, ground wires, ground rods and connections, cable splicing, cable marking, cable testing, and all incidentals necessary to place the cable in operating condition as a completed unit to the satisfaction of the ***OAR*** ~~RPR~~. This item shall not include the installation of duct banks or conduit, trenching and backfilling for duct banks or conduit, or furnishing or installation of cable for FAA owned/operated facilities.

PART 2 - EQUIPMENT AND MATERIALS

2.1 GENERAL

A. Airport lighting equipment and materials covered by advisory circulars (AC) shall be approved under the Airport Lighting Equipment Certification Program per AC 150/5345-53, current version.

B. All other equipment and materials covered by other referenced specifications shall be subject to acceptance through manufacturer's certification of compliance with the applicable specification, when requested by the ***OAR*** ~~RPR~~.

C. Manufacturer's certifications shall not relieve the Contractor of the responsibility to provide materials per these specifications. Materials supplied and/or installed that do not comply with these specifications shall be removed (when directed by the ***OAR*** ~~RPR~~) and replaced with materials that comply with these specifications at the Contractor's cost.

D. All materials and equipment used to construct this item shall be submitted to the ***OAR*** ~~RPR~~ for approval prior to ordering the equipment. Submittals consisting of marked catalog sheets or shop drawings shall be provided. Submittal data shall be presented in a clear, precise and thorough manner. Original catalog sheets are preferred. Photocopies are acceptable provided they are as good a quality as the original. Clearly and boldly mark each copy to identify products or models applicable to this project. Indicate all optional equipment and delete any non-pertinent data. Submittals for components of electrical equipment and systems shall identify the equipment to which they apply on each submittal sheet. Markings shall be made bold and clear with arrows or circles (highlighting is not acceptable). The Contractor is solely responsible for delays in the project that may accrue directly or indirectly from late submissions or resubmissions of submittals.

E. The data submitted shall be sufficient, in the opinion of the ***OAR*** ~~RPR~~, to determine compliance with the plans and specifications. The Contractor's submittals shall be neatly electronically submitted in pdf format. The ***OAR*** ~~RPR~~ reserves the right to reject any and all equipment, materials, or procedures that do not meet the system design and the standards and codes, specified in this document.

F. All equipment and materials furnished and installed under this section shall be guaranteed against defects in materials and workmanship for at least twelve (12) months from the date of final acceptance by the Owner. The defective materials and/or equipment shall be repaired or replaced, at the Owner's discretion, with no additional cost to the Owner. The Contractor shall maintain a minimum insulation resistance in accordance with paragraph 3.10e with isolation transformers connected in new circuits and new segments of existing circuits through the end of the contract warranty period when tested in accordance with AC 150/5340-26, *Maintenance Airport Visual Aid Facilities*, paragraph 5.1.3.1, Insulation Resistance Test.

2.2 CABLE

Underground cable for airfield lighting facilities (runway and taxiway lights and signs) shall conform to the requirements of AC 150/5345-7, Specification for L-824 Underground Electrical Cable for Airport Lighting Circuits latest edition. Conductors for use on 6.6 ampere primary airfield lighting series circuits shall be single conductor, seven strand, #8 American wire gauge (AWG), L-824 Type C, 5,000 volts, non-shielded, with cross-linked polyethylene insulation. Conductors for use on 20 ampere primary airfield lighting series circuits shall be single conductor, seven strand, #6 AWG, L-824 Type C, 5,000 volts, non-shielded, with cross-linked polyethylene insulation. L-824 conductors for use on the L-830 secondary of airfield lighting series circuits shall be sized in accordance with the manufacturer's recommendations. All other conductors shall comply with FAA and National Electric Code (NEC) requirements. Conductor sizes noted above shall not apply to leads furnished by manufacturers on airfield lighting transformers and fixtures.

Wire for electrical circuits up to 600 volts shall comply with Specification L-824 and/or Commercial Item Description A-A-59544A and shall be type THWN-2, 75°C for installation in conduit and RHW-2, 75°C for direct burial installations. Conductors for parallel (voltage) circuits shall be type and size and installed in accordance with NFPA-70, National Electrical Code.

Unless noted otherwise, all 600-volt and less non-airfield lighting conductor sizes are based on a 75°C, THWN-2, 600-volt insulation, copper conductors, not more than three single insulated conductors, in raceway, in free air. The conduit/duct sizes are based on the use of THWN-2, 600-volt insulated conductors. The Contractor shall make the necessary increase in conduit/duct sizes for other types of wire insulation. In no case shall the conduit/duct size be reduced. The minimum power circuit wire size shall be #12 AWG.

Conductor sizes may have been adjusted due to voltage drop or other engineering considerations. Equipment provided by the Contractor shall be capable of accepting the quantity and sizes of conductors shown in the Contract Documents. All conductors,

pigtails, cable step-down adapters, cable step-up adapters, terminal blocks and splicing materials necessary to complete the cable termination/splice shall be considered incidental to the respective pay items provided.

Cable type, size, number of conductors, strand and service voltage shall be as specified in the Contract Document.

2.3 BARE COPPER WIRE (COUNTERPOISE, BARE COPPER WIRE GROUND AND GROUND RODS).

Wire for counterpoise or ground installations for airfield lighting systems shall be No. 2 AWG bare solid copper wire for counterpoise and/or No. 2 AWG insulated stranded for grounding bond wire per ASTM B3 and ASTM B8 and shall be bare copper wire. For voltage powered circuits, the equipment grounding conductor shall comply with NEC Article 250.

Ground rods shall be copper-clad steel. The ground rods shall be of the length and diameter specified on the plans, but in no case be less than 10 feet (2.54 m) long and 3/4 inch (19 mm) in diameter.

2.4 CABLE CONNECTIONS

In-line connections or splices of underground primary cables shall be of the type called for on the plans, and shall be one of the types listed below. No separate payment will be made for cable connections.

A. The cast splice. A cast splice, employing a plastic mold and using epoxy resin equivalent to that manufactured by 3M™ Company, “Scotchcast” Kit No. 82-B, or an approved equivalent, used for potting the splice is acceptable.

B. The field-attached plug-in splice. Field attached plug-in splices shall be installed as shown on the plans. The Contractor shall determine the outside diameter of the cable to be spliced and furnish appropriately sized connector kits and/or adapters. Tape or heat shrink tubing with integral sealant shall be in accordance with the manufacturer’s requirements. Primary Connector Kits manufactured by Amerace, "Super Kit", Integro "Complete Kit", or approved equal is acceptable.

C. The factory-molded plug-in splice. Specification for L-823 Connectors, Factory-Molded to Individual Conductors, is acceptable.

D. The taped or heat-shrink splice. Taped splices employing field-applied rubber, or synthetic rubber tape covered with plastic tape is acceptable. The rubber tape should meet the requirements of ASTM D4388 and the plastic tape should comply with Military Specification MIL-I-24391 or Commercial Item Description A-A-55809. Heat shrinkable tubing shall be heavy-wall, self-sealing tubing rated for the voltage of the wire being spliced and suitable for direct-buried installations. The tubing shall be factory coated with a thermoplastic adhesive-sealant that will adhere to the insulation of the wire being spliced forming a moisture- and dirt-proof seal. Additionally, heat shrinkable tubing for

multi-conductor cables, shielded cables, and armored cables shall be factory kits that are designed for the application. Heat shrinkable tubing and tubing kits shall be manufactured by Tyco Electronics/ Raychem Corporation, Energy Division, or approved equivalent.

In all the above cases, connections of cable conductors shall be made using crimp connectors using a crimping tool designed to make a complete crimp before the tool can be removed. All L-823/L-824 splices and terminations shall be made per the manufacturer's recommendations and listings.

All connections of counterpoise, grounding conductors and ground rods shall be made by the exothermic process or approved equivalent, except that a light base ground clamp connector shall be used for attachment to the light base. All exothermic connections shall be made per the manufacturer's recommendations and listings.

2.5 SPLICER QUALIFICATIONS

Every airfield lighting cable splicer shall be qualified in making airport cable splices and terminations on cables rated at or above 5,000 volts AC. The Contractor shall submit to the ***OAR*** ~~RPR~~ proof of the qualifications of each proposed cable splicer for the airport cable type and voltage level to be worked on. Cable splicing/terminating personnel shall have a minimum of three (3) years continuous experience in terminating/splicing medium voltage cable.

2.6 CONCRETE

Concrete shall be proportioned, placed, and cured per Item P-610, Concrete for Miscellaneous Structures.

2.7 FLOWABLE BACKFILL

Flowable material used to backfill trenches for power cable trenches shall conform to the requirements of Item P-153, Controlled Low Strength Material.

2.8 CABLE IDENTIFICATION TAGS

Cable identification tags shall be made from a non-corrosive material with the circuit identification stamped or etched onto the tag. The tags shall be of the type as detailed on the plans.

2.9 TAPE

Electrical tapes shall be Scotch™ Electrical Tapes –Scotch™ 88 (1-1/2 inch (38 mm) wide) and Scotch™ 130C® linerless rubber splicing tape (2-inch (50 mm) wide), as

manufactured by the Minnesota Mining and Manufacturing Company (3M™), or an approved equivalent.

2.10 ELECTRICAL COATING

Electrical coating shall be Scotchkote™ as manufactured by 3M™, or an approved equivalent.

2.11 EXISTING CIRCUITS

Whenever the scope of work requires connection to an existing circuit, the existing circuit's insulation resistance shall be tested, in the presence of the ***OAR*** ~~RPR~~. The test shall be performed per this item and prior to any activity that will affect the respective circuit. The Contractor shall record the results on forms acceptable to the ***OAR*** ~~RPR~~. When the work affecting the circuit is complete, the circuit's insulation resistance shall be checked again, in the presence of the ***OAR*** ~~RPR~~. The Contractor shall record the results on forms acceptable to the ***OAR*** ~~RPR~~. The second reading shall be equal to or greater than the first reading or the Contractor shall make the necessary repairs to the existing circuit to bring the second reading above the first reading. All repair costs including a complete replacement of the L-823 connectors, L-830 transformers and L-824 cable, if necessary, shall be borne by the Contractor. All test results shall be submitted in the Operation and Maintenance (O&M) Manual.

2.12 DETECTABLE WARNING TAPE

Plastic, detectable, American Public Works Association (APWA) Red (electrical power lines, cables, conduit and lighting cable) with continuous legend tape shall be polyethylene film with a metalized foil core and shall be 3-6 inches (75-150 mm) wide. Detectable tape is incidental to the respective bid item. Detectable warning tape for communication cables shall be orange. Detectable warning tape color code shall comply with the APWA Uniform Color Code.

PART 3 - CONSTRUCTION METHODS

3.1 GENERAL

The Contractor shall install the specified cable at the approximate locations indicated on the plans. Unless otherwise shown on the plans, all cable required to cross under pavements expected to carry aircraft loads shall be installed in concrete encased duct banks. Cable shall be run without splices, from fixture to fixture.

Cable connections between lights will be permitted only at the light locations for connecting the underground cable to the primary leads of the individual isolation transformers. The Contractor shall be responsible for providing cable in continuous

lengths for home runs or other long cable runs without connections unless otherwise authorized in writing by the ***OAR*** ~~RPR~~ or shown on the plans.

In addition to connectors being installed at individual isolation transformers, L-823 cable connectors for maintenance and test points shall be installed at locations shown on the plans. Cable circuit identification markers shall be installed on both sides of the L-823 connectors installed and on both sides of slack loops where a future connector would be installed.

Provide not less than 3 feet (1 m) of cable slack on each side of all connections, isolation transformers, light units, and at points where cable is connected to field equipment. Where provisions must be made for testing or for future above grade connections, provide enough slack to allow the cable to be extended at least one foot (30 cm) vertically above the top of the access structure. This requirement also applies where primary cable passes through empty light bases, junction boxes, and access structures to allow for future connections, or as designated by the ***OAR*** ~~RPR~~.

Primary airfield lighting cables installed shall have cable circuit identification markers attached on both sides of each L-823 connector and on each airport lighting cable entering or leaving cable access points, such as manholes, hand holes, pull boxes, junction boxes, etc. Markers shall be of sufficient length for imprinting the cable circuit identification legend on one line, using letters not less than 1/4 inch (6 mm) in size. The cable circuit identification shall match the circuits noted on the construction plans.

3.2 INSTALLATION IN DUCT BANKS OR CONDUITS

This item includes the installation of the cable in duct banks or conduit per the following paragraphs. The maximum number and voltage ratings of cables installed in each single duct or conduit, and the current-carrying capacity of each cable shall be per the latest version of the National Electric Code, or the code of the local agency or authority having jurisdiction.

The Contractor shall make no connections or splices of any kind in cables installed in conduits or duct banks.

Unless otherwise designated in the plans, where ducts are in tiers, use the lowest ducts to receive the cable first, with spare ducts left in the upper levels. Check duct routes prior to construction to obtain assurance that the shortest routes are selected and that any potential interference is avoided.

Duct banks or conduits shall be installed as a separate item per Item L-110, Airport Underground Electrical Duct Banks and Conduit. The Contractor shall run a mandrel through duct banks or conduit prior to installation of cable to ensure that the duct bank or conduit is open, continuous and clear of debris. The mandrel size shall be compatible with the conduit size. The Contractor shall swab out all conduits/ducts and clean light bases, manholes, etc., interiors immediately prior to pulling cable. Once cleaned and swabbed, the light bases and all accessible points of entry to the duct/conduit system shall be kept closed except when installing cables. Cleaning of ducts, light bases, manholes, etc., is incidental to the pay item of the item being cleaned. All raceway

systems left open, after initial cleaning, for any reason shall be re-cleaned at the Contractor's expense. The Contractor shall verify existing ducts proposed for use in this project as clear and open. The Contractor shall notify the ***OAR*** ~~RPR~~ of any blockage in the existing ducts.

The cable shall be installed in a manner that prevents harmful stretching of the conductor, damage to the insulation, or damage to the outer protective covering. The ends of all cables shall be sealed with moisture-seal tape providing moisture-tight mechanical protection with minimum bulk, or alternately, heat shrinkable tubing before pulling into the conduit and it shall be left sealed until connections are made. Where more than one cable is to be installed in a conduit, all cable shall be pulled in the conduit at the same time. The pulling of a cable through duct banks or conduits may be accomplished by hand winch or power winch with the use of cable grips or pulling eyes. Maximum pulling tensions shall not exceed the cable manufacturer's recommendations. A non-hardening cable-pulling lubricant recommended for the type of cable being installed shall be used where required.

The Contractor shall submit the recommended pulling tension values to the ***OAR*** ~~RPR~~ prior to any cable installation. If required by the ***OAR*** ~~RPR~~, pulling tension values for cable pulls shall be monitored by a dynamometer in the presence of the ***OAR*** ~~RPR~~. Cable pull tensions shall be recorded by the Contractor and reviewed by the ***OAR*** ~~RPR~~. Cables exceeding the maximum allowable pulling tension values shall be removed and replaced by the Contractor at the Contractor's expense.

The manufacturer's minimum bend radius or NEC requirements (whichever is more restrictive) shall apply. Cable installation, handling and storage shall be per manufacturer's recommendations. During cold weather, particular attention shall be paid to the manufacturer's minimum installation temperature. Cable shall not be installed when the temperature is at or below the manufacturer's minimum installation temperature. At the Contractor's option, the Contractor may submit a plan, for review by the ***OAR*** ~~RPR~~, for heated storage of the cable and maintenance of an acceptable cable temperature during installation when temperatures are below the manufacturer's minimum cable installation temperature.

Cable shall not be dragged across base can or manhole edges, pavement or earth. When cable must be coiled, lay cable out on a canvas tarp or use other appropriate means to prevent abrasion to the cable jacket.

3.3 INSTALLATION OF DIRECT-BURIED CABLE IN TRENCHES. Not used.

3.4 CABLE MARKERS FOR DIRECT-BURIED CABLE. Not used.

3.5 SPLICING

Connections of the type shown on the plans shall be made by experienced personnel regularly engaged in this type of work and shall be made as follows:

A. Cast splices. These shall be made by using crimp connectors for jointing conductors. Molds shall be assembled, and the compound shall be mixed and poured per the manufacturer's instructions and to the satisfaction of the ***OAR*** ~~RPR~~.

B. Field-attached plug-in splices. These shall be assembled per the manufacturer's instructions. These splices shall be made by plugging directly into mating connectors. The joint where the connectors come together shall be finished by one of the following methods: (1) wrapped with at least one layer of rubber or synthetic rubber tape and one layer of plastic tape, one-half lapped, extending at least 1-1/2 inches (38 mm) on each side of the joint (2) Covered with heat shrinkable tubing with integral sealant extending at least 1-1/2 inches (38 mm) on each side of the joint or (3) On connector kits equipped with water seal flap; roll-over water seal flap to sealing position on mating connector.

C. Factory-molded plug-in splices. These shall be made by plugging directly into mating connectors. The joint where the connectors come together shall be finished by one of the following methods: (1) Wrapped with at least one layer of rubber or synthetic rubber tape and one layer of plastic tape, one-half lapped, extending at least 1-1/2 inches (38 mm) on each side of the joint. (2) Covered with heat shrinkable tubing with integral sealant extending at least 1-1/2 inches (38 mm) on each side of the joint. or (3) On connector kits so equipped with water seal flap; roll-over water seal flap to sealing position on mating connector.

D. Taped or heat-shrink splices. A taped splice shall be made in the following manner:

Bring the cables to their final position and cut so that the conductors will butt. Remove insulation and jacket allowing for bare conductor of proper length to fit compression sleeve connector with 1/4 inch (6 mm) of bare conductor on each side of the connector. Prior to splicing, the two ends of the cable insulation shall be penciled using a tool designed specifically for this purpose and for cable size and type. Do not use emery paper on splicing operation since it contains metallic particles. The copper conductors shall be thoroughly cleaned. Join the conductors by inserting them equidistant into the compression connection sleeve. Crimp conductors firmly in place with crimping tool that requires a complete crimp before tool can be removed. Test the crimped connection by pulling on the cable. Scrape the insulation to assure that the entire surface over which the tape will be applied (plus 3 inches (75 mm) on each end) is clean. After scraping, wipe the entire area with a clean lint-free cloth. Do not use solvents.

Apply high-voltage rubber tape one-half lapped over bare conductor. This tape should be tensioned as recommended by the manufacturer. Voids in the connector area may be eliminated by highly elongating the tape, stretching it just short of its breaking point. The manufacturer's recommendation for stretching tape during splicing shall be followed. Always attempt to exactly half-lap to produce a uniform buildup. Continue buildup to 1-1/2 times cable diameter over the body of the splice with ends tapered a distance of approximately one inch (25 mm) over the original jacket. Cover rubber tape with two layers of vinyl pressure-sensitive tape one-half lapped. Do not use glyptol or lacquer over vinyl tape as they react as solvents to the tape. No further cable covering or splice boxes are required.

Heat shrinkable tubing shall be installed following manufacturer's instructions. Direct flame heating shall not be permitted unless recommended by the manufacturer. Cable

surfaces within the limits of the heat-shrink application shall be clean and free of contaminates prior to application.

E. Assembly. Surfaces of equipment or conductors being terminated or connected shall be prepared in accordance with industry standard practice and manufacturer's recommendations. All surfaces to be connected shall be thoroughly cleaned to remove all dirt, grease, oxides, nonconductive films, or other foreign material. Paints and other nonconductive coatings shall be removed to expose base metal. Clean all surfaces at least 1/4 inch (6.4 mm) beyond all sides of the larger bonded area on all mating surfaces. Use a joint compound suitable for the materials used in the connection. Repair painted/coated surface to original condition after completing the connection.

3.6 BARE COUNTERPOISE WIRE INSTALLATION FOR LIGHTNING PROTECTION AND GROUNDING

If shown on the plans or included in the job specifications, bare solid #2 AWG copper counterpoise wire shall be installed for lightning protection of the underground cables. The ***OAR*** ~~RPR~~ shall select one of two methods of lightning protection for the airfield lighting circuit based upon sound engineering practice and lightning strike density.

A. Equipotential. The counterpoise size is as shown on the plans. The equipotential method is applicable to all airfield lighting systems; i.e. runway, taxiway, apron – touchdown zone, centerline, edge, threshold and approach lighting systems. The equipotential method is also successfully applied to provide lightning protection for power, signal and communication systems. The light bases, counterpoise, etc. – all components - are bonded together and bonded to the vault power system ground loop/electrode.

Counterpoise wire shall be installed in the same trench for the entire length of buried cable, conduits and duct banks that are installed to contain airfield cables. The counterpoise is centered over the cable/conduit/duct to be protected.

The counterpoise conductor shall be installed no less than 8 inches (200 mm) minimum or 12 inches (300 mm) maximum above the raceway or cable to be protected, except as permitted below:

(1) The minimum counterpoise conductor height above the raceway or cable to be protected shall be permitted to be adjusted subject to coordination with the airfield lighting and pavement designs.

(2) The counterpoise conductor height above the protected raceway(s) or cable(s) shall be calculated to ensure that the raceway or cable is within a 45-degree area of protection, (45 degrees on each side of vertical creating a 90 degree angle).

The counterpoise conductor shall be bonded to each metallic light base, mounting stake, and metallic airfield lighting component.

All metallic airfield lighting components in the field circuit on the output side of the constant current regulator (CCR) or other power source shall be bonded to the airfield lighting counterpoise system.

All components rise and fall at the same potential; with no potential difference, no damaging arcing and no damaging current flow.

See AC 150/5340-30, Design and Installation Details for Airport Visual Aids and NFPA 780, Standard for the Installation of Lightning Protection Systems, Chapter 11, for a detailed description of the Equipotential Method of lightning protection.

Reference FAA STD-019E, Lightning and Surge Protection, Grounding Bonding and Shielding Requirements for Facilities and Electronic Equipment, Part 4.1.1.7.

B. Isolation. Not used.

C. Common Installation requirements. Grounding electrodes may be rods, ground dissipation plates, radials, or other electrodes listed in the NFPA 70 (NEC) or NFPA 780.

Where raceway is installed by the directional bore, jack and bore, or other drilling method, the counterpoise conductor shall be permitted to be installed concurrently with the directional bore, jack and bore, or other drilling method raceway, external to the raceway or sleeve.

The counterpoise wire shall also be exothermically welded to ground rods installed as shown on the plans but not more than 500 feet (150 m) apart around the entire circuit. The counterpoise system shall be continuous and terminate at the transformer vault or at the power source. It shall be securely attached to the vault or equipment external ground ring or other made electrode-grounding system. The connections shall be made as shown on the plans and in the specifications.

Where an existing airfield lighting system is being extended or modified, the new counterpoise conductors shall be interconnected to existing counterpoise conductors at each intersection of the new and existing airfield lighting counterpoise systems.

D. Parallel Voltage Systems. Provide grounding and bonding in accordance with NFPA 70, National Electrical Code.

3.7 COUNTERPOISE INSTALLATION ABOVE MULTIPLE CONDUITS AND DUCT BANKS

Counterpoise wires shall be installed above multiple conduits/duct banks for airfield lighting cables, with the intent being to provide a complete area of protection over the airfield lighting cables. When multiple conduits and/or duct banks for airfield cable are installed in the same trench, the number and location of counterpoise wires above the conduits shall be adequate to provide a complete area of protection measured 45 degrees each side of vertical.

Where duct banks pass under pavement to be constructed in the project, the counterpoise shall be placed above the duct bank. Reference details on the construction plans.

3.8 COUNTERPOISE INSTALLATION AT EXISTING DUCT BANKS

When airfield lighting cables are indicated on the plans to be routed through existing duct banks, the new counterpoise wiring shall be terminated at ground rods at each end of the existing duct bank where the cables being protected enter and exit the duct bank. The new counterpoise conductor shall be bonded to the existing counterpoise system.

3.9 EXOTHERMIC BONDING

Bonding of counterpoise wire shall be by the exothermic welding process or equivalent method accepted by the ***OAR*** ~~RPR~~. Only personnel experienced in and regularly engaged in this type of work shall make these connections.

Contractor shall demonstrate to the satisfaction of the ***OAR*** ~~RPR~~, the welding kits, materials and procedures to be used for welded connections prior to any installations in the field. The installations shall comply with the manufacturer's recommendations and the following:

A. All slag shall be removed from welds.

B. Using an exothermic weld to bond the counterpoise to a lug on a galvanized light base is not recommended unless the base has been specially modified. Consult the manufacturer's installation directions for proper methods of bonding copper wire to the light base. See AC 150/5340-30 for galvanized light base exception.

C. If called for in the plans, all buried copper and weld material at weld connections shall be thoroughly coated with 6 mm of 3M™ Scotchkote™, or approved equivalent, or coated with coal tar Bitumastic® material to prevent surface exposure to corrosive soil or moisture.

3.10 TESTING

The Contractor shall furnish all necessary equipment and appliances for testing the airport electrical systems and underground cable circuits before and after installation. The Contractor shall perform all tests in the presence of the ***OAR*** ~~RPR~~. The Contractor shall demonstrate the electrical characteristics to the satisfaction of the ***OAR*** ~~RPR~~. All costs for testing are incidental to the respective item being tested. For phased projects, the tests must be completed by phase. The Contractor must maintain the test results throughout the entire project as well as during the warranty period that meet the following:

A. Earth resistance testing methods shall be submitted to the ***OAR*** ~~RPR~~ for approval. Earth resistance testing results shall be recorded on an approved form and testing shall be performed in the presence of the ***OAR*** ~~RPR~~. All such testing shall be at the sole expense of the Contractor.

B. Should the counterpoise or ground grid conductors be damaged or suspected of being damaged by construction activities the Contractor shall test the conductors for continuity with a low resistance ohmmeter. The conductors shall be isolated such that no parallel path exists and tested for continuity. The ***OAR*** ~~RPR~~ shall approve of the test method selected. All such testing shall be at the sole expense of the Contractor.

After installation, the Contractor shall test and demonstrate to the satisfaction of the ***OAR*** ~~RPR~~ the following:

C. That all affected lighting power and control circuits (existing and new) are continuous and free from short circuits.

D. That all affected circuits (existing and new) are free from unspecified grounds.

E. That the insulation resistance to ground of all new non-grounded high voltage series circuits or cable segments is not less than 500 megohms. Verify continuity of all series airfield lighting circuits prior to energization.

F. That the insulation resistance to ground of all new non-grounded conductors of new multiple circuits or circuit segments is not less than 100 megohms.

G. That all affected circuits (existing and new) are properly connected per applicable wiring diagrams.

H. That all affected circuits (existing and new) are operable. Tests shall be conducted that include operating each control not less than 10 times and the continuous operation of each lighting and power circuit for not less than 1/2 hour.

That the impedance to ground of each ground rod does not exceed 10 ohms prior to establishing connections to other ground electrodes. The fall-of-potential ground impedance test shall be used, as described by American National Standards Institute/Institute of Electrical and Electronic Engineers (ANSI/IEEE) Standard 81, to verify this requirement. As an alternate, clamp-on style ground impedance test meters may be used to satisfy the impedance testing requirement. Test equipment and its calibration sheets shall be submitted for review and approval by the ***OAR*** ~~RPR~~ prior to performing the testing.

Two copies of tabulated results of all cable tests performed shall be supplied by the Contractor to the ***OAR*** ~~RPR~~. Where connecting new cable to existing cable, insulation resistance tests shall be performed on the new cable prior to connection to the existing circuit.

There are no approved “repair” procedures for items that have failed testing other than complete replacement.

PART 4 - METHOD OF MEASUREMENT

4.1 The cost of all excavation, backfill, dewatering and restoration regardless of the type of material encountered shall be included in the unit price bid for the work.

4.2 Counterpoise wire installed in above conduit or duct bank, and cable installed in duct bank or conduit shall be measured by the number of linear feet (meters) installed and grounding connectors, and trench marking tape ready for operation, and accepted as satisfactory. Separate measurement shall be made for each counterpoise wire installed above conduit or duct bank, and cable installed in duct bank or conduit. The measurement for this item shall include additional quantities required for slack.

4.3 Ground rods shall be measured by each 10-foot section installed complete, ***including the earth resistance readings of each completed installation being tested and recorded for the engineer per 3.10. See specification SP-111 "AIRFIELD ELECTRICAL INSTALLATION TESTING" for ground rod testing method and "EARTH RESISTANCE TEST"***

PART 5 - BASIS OF PAYMENT

5.1 Payment will be made at the contract unit price for bare counterpoise wire installed above duct bank or conduit, or cable and equipment ground installed in duct bank or conduit, in place by the Contractor and accepted by the ***OAR*** ~~RPR~~. This price shall be full compensation for furnishing all materials and for all preparation and installation of these materials, and for all labor, equipment, tools, and incidentals, including ground rods and ground connectors and trench marking tape, necessary to complete this item.

Payment will be made under:

Item L-108-5.1	1/C L-824-Type C Unshielded #8 AWG 5 KV Stranded Copper Cable, Installed in Duct or Conduit	-- per Linear Foot (LF)
Item L-108-5.2	1/C #2 AWG Solid Copper Counterpoise Cable, Installed over Duct or Conduit	-- per Linear Foot (LF)
Item L-108-5.3	3/4" Diameter by 10.00' Long Copper Clad Steel Sectional Ground Rod	-- per Each (EA)

PART 6 - REFERENCES

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

Advisory Circulars (AC)

AC 150/5340-26	Maintenance of Airport Visual Aid Facilities
AC 150/5340-30	Design and Installation Details for Airport Visual Aids
AC 150/5345-7	Specification for L-824 Underground Electrical Cable for Airport Lighting Circuits
AC 150/5345-26	Specification for L-823 Plug and Receptacle, Cable Connectors
AC 150/5345-53	Airport Lighting Equipment Certification Program

Commercial Item Description

A-A-59544A	Cable and Wire, Electrical (Power, Fixed Installation)
A-A-55809	Insulation Tape, Electrical, Pressure-Sensitive Adhesive, Plastic

ASTM International (ASTM)

ASTM B3	Standard Specification for Soft or Annealed Copper Wire
ASTM B8	Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft
ASTM B33	Standard Specification for Tin-Coated Soft or Annealed Copper Wire for Electrical Purposes
ASTM D4388	Standard Specification for Nonmetallic Semi-Conducting and Electrically Insulating Rubber Tapes

Mil Spec

MIL-PRF-23586F	Performance Specification: Sealing Compound (with Accelerator), Silicone Rubber, Electrical
MIL-I-24391	Insulation Tape, Electrical, Plastic, Pressure Sensitive

National Fire Protection Association (NFPA)

NFPA-70	National Electrical Code (NEC)
NFPA-780	Standard for the Installation of Lightning Protection Systems

American National Standards Institute (ANSI)/Institute of Electrical and Electronics Engineers (IEEE)

ANSI/IEEE STD 81	IEEE Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System

Federal Aviation Administration Standard

FAA STD-019E Lightning and Surge Protection, Grounding Bonding and Shielding Requirements for Facilities and Electronic Equipment

END OF SECTION L-108

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SECTION L-110 - AIRPORT UNDERGROUND ELECTRICAL DUCT BANKS AND CONDUITS

PART 1 - DESCRIPTION

1.1 This item shall consist of underground electrical conduits and duct banks (single or multiple conduits encased in concrete or buried in sand) installed per this specification at the locations and per the dimensions, designs, and details shown on the plans. This item shall include furnishing and installing of all underground electrical duct banks and individual and multiple underground conduits. It shall also include all turfing trenching, backfilling, removal, and restoration of any paved or turfed areas; concrete encasement, mandrelling, pulling lines, duct markers, plugging of conduits, and the testing of the installation as a completed system ready for installation of cables per the plans and specifications. This item shall also include furnishing and installing conduits and all incidentals for providing positive drainage of the system. Verification of existing ducts is incidental to the pay items provided in this specification.

PART 2 - EQUIPMENT AND MATERIALS

2.1 GENERAL

A. All equipment and materials covered by referenced specifications shall be subject to acceptance through manufacturer's certification of compliance with the applicable specification when requested by the ***OAR*** ~~RPR~~.

B. Manufacturer's certifications shall not relieve the Contractor of the responsibility to provide materials per these specifications and acceptable to the ***OAR*** ~~RPR~~. Materials supplied and/or installed that do not comply with these specifications shall be removed, when directed by the ***OAR*** ~~RPR~~ and replaced with materials, that comply with these specifications, at the Contractor's cost.

C. All materials and equipment used to construct this item shall be submitted to the ***OAR*** ~~RPR~~ for approval prior to ordering the equipment. Submittals consisting of marked catalog sheets or shop drawings shall be provided. Submittal data shall be presented in a clear, precise and thorough manner. Original catalog sheets are preferred. Photocopies are acceptable provided they are as good a quality as the original. Clearly and boldly mark each copy to identify products or models applicable to this project. Indicate all optional equipment and delete non-pertinent data. Submittals for components of electrical equipment and systems shall identify the equipment for which they apply on each submittal sheet. Markings shall be made bold and clear with arrows or circles (highlighting is not acceptable). The Contractor is solely responsible for delays in project that accrue directly or indirectly from late submissions or resubmissions of submittals.

D. The data submitted shall be sufficient, in the opinion of the ***OAR*** ~~RPR~~, to determine compliance with the plans and specifications. The Contractor's submittals shall be electronically submitted in pdf format, tabbed by specification section. The ***OAR*** ~~RPR~~

reserves the right to reject any and all equipment, materials or procedures that do not meet the system design and the standards and codes specified in this document.

E. All equipment and materials furnished and installed under this section shall be guaranteed against defects in materials and workmanship for a period of at least twelve (12) months from final acceptance by the Owner. The defective materials and/or equipment shall be repaired or replaced, at the Owner's discretion, with no additional cost to the Owner.

2.2 STEEL CONDUIT

Rigid galvanized steel (RGS) conduit and fittings shall be hot dipped galvanized inside and out and conform to the requirements of Underwriters Laboratories Standards 6, 514B, and 1242. All RGS conduits or RGS elbows installed below grade, in concrete, permanently wet locations or other similar environments shall be painted with a 10-mil thick coat of asphaltum sealer or shall have a factory-bonded polyvinyl chloride (PVC) cover. Any exposed galvanizing or steel shall be coated with 10 mils of asphaltum sealer. When using PVC coated RGS conduit, care shall be exercised not to damage the factory PVC coating. Damaged PVC coating shall be repaired per the manufacturer's written instructions. In lieu of PVC coated RGS, corrosion wrap tape shall be permitted to be used where RGS is in contact with direct earth."

2.3 PLASTIC CONDUIT

Plastic conduit and fittings-shall conform to the following requirements:

- UL 514B covers W-C-1094-Conduit fittings all types, classes 1 thru 3 and 6 thru 10.
- UL 514C covers W-C-1094- all types, Class 5 junction box and cover in plastic (PVC).
- UL 651 covers W-C-1094-Rigid PVC Conduit, types I and II, Class 4.
- UL 651A covers W-C-1094-Rigid PVC Conduit and high-density polyethylene (HDPE) Conduit type III and Class 4.

Underwriters Laboratories Standards UL-651 and Article 352 of the current National Electrical Code shall be one of the following, as shown on the plans:

A. Type I–Schedule 40 and Schedule 80 PVC suitable for underground use either direct-buried or encased in concrete.

B. Type II–Schedule 40 PVC suitable for either above ground or underground use.

C. Type III – Schedule 80 PVC suitable for either above ground or underground use either direct-buried or encased in concrete.

D. Type III –HDPE pipe, minimum standard dimensional ratio (SDR) 11, suitable for placement with directional boring under pavement.

The type of solvent cement shall be as recommended by the conduit/fitting manufacturer.

2.4 SPLIT CONDUIT

Split conduit shall be pre-manufactured for the intended purpose and shall be made of steel or plastic.

2.5 CONDUIT SPACERS

Conduit spacers shall be prefabricated interlocking units manufactured for the intended purpose. They shall be of double wall construction made of high grade, high density polyethylene complete with interlocking cap and base pads. They shall be designed to accept No. 4 reinforcing bars installed vertically.

2.6 CONCRETE

Concrete shall be proportioned, placed, and cured per Item P-610, Concrete for Miscellaneous Structures.

2.7 PRECAST CONCRETE STRUCTURES

Precast concrete structures shall be furnished by a plant meeting National Precast Concrete Association Plant Certification Program or another ***OAR*** ~~RPR~~ approved third party certification program. Precast concrete structures shall conform to ASTM C478.

2.8 FLOWABLE BACKFILL

Flowable material used to back fill conduit and duct bank trenches shall conform to the requirements of Item P-153, Controlled Low Strength Material.

2.9 DETECTABLE WARNING TAPE

Plastic, detectable, American Public Works Association (APWA) red (electrical power lines, cables, conduit and lighting cable), orange (telephone/fiber optic cabling) with continuous legend magnetic tape shall be polyethylene film with a metallized foil core and shall be 3-6 inches (75-150 mm) wide. Detectable tape is incidental to the respective bid item.

PART 3 - CONSTRUCTION METHODS

3.1 GENERAL

The Contractor shall install underground duct banks and conduits at the approximate locations indicated on the plans. The ***OAR*** ~~RPR~~ shall indicate specific locations as the work progresses, if required to differ from the plans. Duct banks and conduits shall be of the size, material, and type indicated on the plans or specifications. Where no size is indicated on the plans or in the specifications, conduits shall be not less than 2 inches (50 mm) inside diameter or comply with the National Electrical Code based on cable to be installed, whichever is larger. All duct bank and conduit lines shall be laid so as to grade toward access points and duct or conduit ends for drainage. Unless shown otherwise on the plans, grades shall be at least 3 inches (75 mm) per 100 feet (30 m). On runs where it is not practicable to maintain the grade all one way, the duct bank and conduit lines shall be graded from the center in both directions toward access points or conduit ends, with a drain into the storm drainage system. Pockets or traps where moisture may accumulate shall be avoided. Under pavement, the top of the duct bank shall not be less than 18 inches (0.5 m) below the subgrade; in other locations, the top of the duct bank or underground conduit shall be not less than 18 inches (0.5 m) below finished grade.

The Contractor shall mandrel each individual conduit whether the conduit is direct-buried or part of a duct bank. An iron-shod mandrel, not more than 1/4 inch (6 mm) smaller than the bore of the conduit shall be pulled or pushed through each conduit. The mandrel shall have a leather or rubber gasket slightly larger than the conduit hole.

The Contractor shall swab out all conduits/ducts and clean base can, manhole, pull boxes, etc., interiors immediately prior to pulling cable. Once cleaned and swabbed the light bases, manholes, pull boxes, etc., and all accessible points of entry to the duct/conduit system shall be kept closed except when installing cables. Cleaning of ducts, base cans, manholes, etc., is incidental to the pay item of the item being cleaned. All raceway systems left open, after initial cleaning, for any reason shall be recleaned at the Contractor's expense. All accessible points shall be kept closed when not installing cable. The Contractor shall verify existing ducts proposed for use in this project as clear and open. The Contractor shall notify the ***OAR*** ~~RPR~~ of any blockage in the existing ducts.

For pulling the permanent wiring, each individual conduit, whether the conduit is direct-buried or part of a duct bank, shall be provided with a 200-pound (90 kg) test polypropylene pull rope. The ends shall be secured and sufficient length shall be left in access points to prevent it from slipping back into the conduit. Where spare conduits are installed, as indicated on the plans, the open ends shall be plugged with removable tapered plugs, designed for this purpose.

All conduits shall be securely fastened in place during construction and shall be plugged to prevent contaminants from entering the conduits. Any conduit section having a defective joint shall not be installed. Ducts shall be supported and spaced apart using approved spacers at intervals not to exceed 5 feet (1.5 m).

Unless otherwise shown on the plans, concrete encased duct banks shall be used when crossing under pavements expected to carry aircraft loads, such as runways, taxiways, taxilanes, ramps and aprons. When under paved shoulders and other paved areas, conduit and duct banks shall be encased using flowable fill for protection.

All conduits within concrete encasement of the duct banks shall terminate with female ends for ease in current and future use. Install factory plugs in all unused ends. Do not cover the ends or plugs with concrete.

Where turf is well established and the sod can be removed, it shall be carefully stripped and properly stored.

Trenches for conduits and duct banks may be excavated manually or with mechanical trenching equipment unless in pavement, in which case they shall be excavated with mechanical trenching equipment. Walls of trenches shall be essentially vertical so that a minimum of shoulder surface is disturbed. Blades of graders shall not be used to excavate the trench.

When rock is encountered, the rock shall be removed to a depth of at least 3 inches (75 mm) below the required conduit or duct bank depth and it shall be replaced with bedding material of earth or sand containing no mineral aggregate particles that would be retained on a 1/4-inch (6.3 mm) sieve. Flowable backfill may alternatively be used

Underground electrical warning (Caution) tape shall be installed in the trench above all underground duct banks and conduits in unpaved areas. Contractor shall submit a sample of the proposed warning tape for approval by the ***OAR*** ~~RPR~~. If not shown on the plans, the warning tape shall be located 6 inches above the duct/conduit or the counterpoise wire if present.

Joints in plastic conduit shall be prepared per the manufacturer's recommendations for the particular type of conduit. Plastic conduit shall be prepared by application of a plastic cleaner and brushing a plastic solvent on the outside of the conduit ends and on the inside of the couplings. The conduit fitting shall then be slipped together with a quick one-quarter turn twist to set the joint tightly. Where more than one conduit is placed in a single trench, or in duct banks, joints in the conduit shall be staggered a minimum of 2 feet (60 cm).

Changes in direction of runs exceeding 10 degrees, either vertical or horizontal, shall be accomplished using manufactured sweep bends.

Whether or not specifically indicated on the drawings, where the soil encountered at established duct bank grade is an unsuitable material, as determined by the ***OAR*** ~~RPR~~, the unsuitable material shall be removed per Item P-152 and replaced with suitable material. Additional duct bank supports shall be installed, as approved by the ***OAR*** ~~RPR~~.

All excavation shall be unclassified and shall be considered incidental to Item L-110. Dewatering necessary for duct installation, and erosion per federal, state, and local requirements is incidental to Item L-110.

Unless otherwise specified, excavated materials that are deemed by the ***OAR*** ~~RPR~~ to be unsuitable for use in backfill or embankments shall be removed and disposed of offsite.

Any excess excavation shall be filled with suitable material approved by the ***OAR*** ~~RPR~~ and compacted per Item P-152.

It is the Contractor's responsibility to locate existing utilities within the work area prior to excavation. Where existing active cables) cross proposed installations, the Contractor shall ensure that these cables are adequately protected. Where crossings are unavoidable, no splices will be allowed in the existing cables, except as specified on the plans. Installation of new cable where such crossings must occur shall proceed as follows:

A. Existing cables shall be located manually. Unearthed cables shall be inspected to assure absolutely no damage has occurred

B. Trenching, etc., in cable areas shall then proceed with approval of the ***OAR*** ~~RPR~~, with care taken to minimize possible damage or disruption of existing cable, including careful backfilling in area of cable.

In the event that any previously identified cable is damaged during the course of construction, the Contractor shall be responsible for the complete repair.

3.2 DUCT BANKS

Unless otherwise shown in the plans, duct banks shall be installed so that the top of the concrete envelope is not less than 18 inches (0.5 m) below the bottom of the base or stabilized base course layers where installed under runways, taxiways, aprons, or other paved areas, and not less than 18 inches (0.5 m) below finished grade where installed in unpaved areas.

Unless otherwise shown on the plans, duct banks under paved areas shall extend at least 3 feet (1 m) beyond the edges of the pavement or 3 feet (1 m) beyond any under drains that may be installed alongside the paved area. Trenches for duct banks shall be opened the complete length before concrete is placed so that if any obstructions are encountered, provisions can be made to avoid them. Unless otherwise shown on the plans, all duct banks shall be placed on a layer of concrete not less than 3 inches (75 mm) thick prior to its initial set. The Contractor shall space the conduits not less than 3 inches (75 mm) apart (measured from outside wall to outside wall). All such multiple conduits shall be placed using conduit spacers applicable to the type of conduit. As the conduit laying progresses, concrete shall be placed around and on top of the conduits not less than 3 inches (75 mm) thick unless otherwise shown on the plans. All conduits shall terminate with female ends for ease of access in current and future use. Install factory plugs in all unused ends. Do not cover the ends or plugs with concrete.

Conduits forming the duct bank shall be installed using conduit spacers. No. 4 reinforcing bars shall be driven vertically into the soil a minimum of 6 inches (150 mm) to anchor the assembly into the earth prior to placing the concrete encasement. For this purpose,

the spacers shall be fastened down with locking collars attached to the vertical bars. Spacers shall be installed at 5-foot (1.5-m) intervals. Spacers shall be in the proper sizes and configurations to fit the conduits. Locking collars and spacers shall be submitted to the ***OAR*** ~~RPR~~ for review prior to use.

When specified, the Contractor shall reinforce the bottom side and top of encasements with steel reinforcing mesh or fabric or other approved metal reinforcement. When directed, the Contractor shall supply additional supports where the ground is soft and boggy, where ducts cross under roadways, or where shown on the plans. Under such conditions, the complete duct structure shall be supported on reinforced concrete footings, piers, or piles located at approximately 5-foot (1.5-m) intervals.

All pavement surfaces that are to have ducts installed therein shall be neatly saw cut to form a vertical face. All excavation shall be included in the contract with price for the duct.

Install a plastic, detectable, color as noted, 3 to 6 inches (75 to 150 mm) wide tape, 8 inches (200 mm) minimum below grade above all underground conduit or duct lines not installed under pavement. Utilize the 3-inch (75-mm) wide tape only for single conduit runs. Utilize the 6-inch (150-mm) wide tape for multiple conduits and duct banks. For duct banks equal to or greater than 24 inches (600 mm) in width, utilize more than one tape for sufficient coverage and identification of the duct bank as required.

When existing cables are to be placed in split duct, encased in concrete, the cable shall be carefully located and exposed by hand tools. Prior to being placed in duct, the ***OAR*** ~~RPR~~ shall be notified so that he may inspect the cable and determine that it is in good condition. Where required, split duct shall be installed as shown on the drawings or as required by the ***OAR*** ~~RPR~~.

3.3 CONDUITS WITHOUT CONCRETE ENCASEMENT. Not used.

3.4 MARKERS

The location of each end and of each change of direction of conduits and duct banks shall be marked by a concrete slab marker 2 feet (60 cm) square and 4 - 6 inches (100 - 150 mm) thick extending approximately one inch (25 mm) above the surface. The markers shall also be located directly above the ends of all conduits or duct banks, except where they terminate in a junction/access structure or building. Each cable or duct run from a line of lights and signs to the equipment vault must be marked at approximately every 200 feet (61 m) along the cable or duct run, with an additional marker at each change of direction of cable or duct run.

The Contractor shall impress the word “DUCT” or “CONDUIT” on each marker slab. Impression of letters shall be done in a manner, approved by the ***OAR*** ~~RPR~~, for a neat, professional appearance. All letters and words must be neatly stenciled. After placement, all markers shall be given one coat of high-visibility orange paint, as approved by the ***OAR*** ~~RPR~~. The Contractor shall also impress on the slab the number and size of conduits beneath the marker along with all other necessary information as

determined by the ***OAR*** ~~RPR~~. The letters shall be 4 inches (100 mm) high and 3 inches (75 mm) wide with width of stroke 1/2 inch (12 mm) and 1/4 inch (6 mm) deep or as large as the available space permits. Furnishing and installation of duct markers is incidental to the respective duct pay item.

3.5 BACKFILLING FOR CONDUITS

For conduits, 8 inches (200 mm) of sand, soft earth, or other fine fill (loose measurement) shall be placed around the conduits ducts and carefully tamped around and over them with hand tampers. The remaining trench shall then be backfilled and compacted per Item P-152 except that material used for back fill shall be select material not larger than 4 inches (100 mm) in diameter.

Flowable backfill may alternatively be used.

Trenches shall not contain pools of water during back filling operations.

The trench shall be completely backfilled and tamped level with the adjacent surface; except that, where sod is to be placed over the trench, the backfilling shall be stopped at a depth equal to the thickness of the sod to be used, with proper allowance for settlement.

Any excess excavated material shall be removed and disposed of per instructions issued by the ***OAR*** ~~RPR~~.

3.6 BACKFILLING FOR DUCT BANKS

After the concrete has cured, the remaining trench shall be backfilled and compacted per Item P-152 “Excavation and Embankment” except that the material used for backfill shall be select material not larger than 4 inches (100 mm) in diameter. In addition to the requirements of Item P-152, where duct banks are installed under pavement, one moisture/density test per lift shall be made for each 250 linear feet (76 m) of duct bank or one work period’s construction, whichever is less.

Flowable backfill may alternatively be used.

Trenches shall not contain pools of water during backfilling operations.

The trench shall be completely backfilled and tamped level with the adjacent surface; except that, where sod is to be placed over the trench, the backfilling shall be stopped at a depth equal to the thickness of the sod to be used, with proper allowance for settlement.

Any excess excavated material shall be removed and disposed of per instructions issued by the ***OAR*** ~~RPR~~.

3.7 RESTORATION

Where sod has been removed, it shall be replaced as soon as possible after the backfilling is completed. All areas disturbed by the work shall be restored to its original condition. The restoration shall include sodding ***per the Contract Documents*** ~~shown on the plans~~. The Contractor shall be held responsible for maintaining all disturbed surfaces and replacements until final acceptance. All restoration shall be considered incidental to the respective L-110 pay item. Following restoration of all trenching near airport movement surfaces, the Contractor shall thoroughly visually inspect the area for foreign object debris (FOD), and remove any such FOD that is found. This FOD inspection and removal shall be considered incidental to the pay item of which it is a component part.

3.8 OWNERSHIP OF REMOVED CABLE. Not used.

PART 4 - METHOD OF MEASUREMENT

4.1 Underground conduits and duct banks shall be measured by the linear feet (meter) of conduits and duct banks installed, including encasement, locator tape, trenching and backfill with designated material, and restoration, and for drain lines, the termination at the drainage structure, all measured in place, completed, and accepted. Separate measurement shall be made for the various types and sizes.

PART 5 - BASIS OF PAYMENT

5.1 Payment will be made at the contract unit price per linear foot for each type and size of conduit and duct bank completed and accepted, including trench and backfill with the designated material, and, for drain lines, the termination at the drainage structure. This price shall be full compensation for removal and disposal of existing duct banks and conduits as shown on the plans, furnishing all materials and for all preparation, assembly, and installation of these materials, and for all labor, equipment, tools, and incidentals necessary to complete this item per the provisions and intent of the plans and specifications.

Payment will be made under:

Item L-110-5.1	1 Way 2" Schedule 40 PVC Concrete Encased Duct	- per Linear Foot (LF)
Item L-110-5.2	8 Way 2" Schedule 40 PVC Concrete Encased Duct	- per Linear Foot (LF)
Item L-110-5.3	2 Way 4" Schedule 40 PVC Concrete Encased Duct	- per Linear Foot (LF)

Item L-110-5.4	4 Way 4" Schedule 40 PVC Concrete Encased Duct	- per Linear Foot (LF)
Item L-110-5.5	1 Way 4” Split Duct	- per Linear Foot (LF)

REFERENCES

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

Advisory Circular (AC)

AC 150/5340-30	Design and Installation Details for Airport Visual Aids
AC 150/5345-53	Airport Lighting Equipment Certification Program

ASTM International (ASTM)

ASTM A615	Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement

National Fire Protection Association (NFPA)

NFPA-70	National Electrical Code (NEC)

Underwriters Laboratories (UL)

UL Standard 6	Electrical Rigid Metal Conduit - Steel
UL Standard 514B	Conduit, Tubing, and Cable Fittings
UL Standard 514C	Nonmetallic Outlet Boxes, Flush-Device Boxes, and Covers
UL Standard 1242	Electrical Intermediate Metal Conduit Steel
UL Standard 651	Schedule 40, 80, Type EB and A Rigid PVC Conduit and Fittings
UL Standard 651A	Type EB and A Rigid PVC Conduit and HDPE Conduit

END OF SECTION L-110

ITEM SP-110S-02310 INSTALLATION OF UNDERGROUND ELECTRICAL DIRECTIONAL BORE DUCT

PART 1 – GENERAL

1.1 SECTION INCLUDES

A. The work specified in this section consists of furnishing and installing underground utilities using the method of installation commonly referred to as directional boring. This work shall include all supervision, services, equipment, materials, labor, area restoration, environmental protection and incidentals for the complete and functional installation of the directional bore duct as shown in the Contract Documents. A copper counterpoise conductor, in accordance with the details, shall be installed with and external to the directional bore duct. Quantity of counterpoise shall be per the details. 2 AWG solid copper counterpoise shall be paid for by the linear foot in accordance with Item L-108. 4/) AWG OUC bare stranded copper counterpoise shall be considered incidental to the OUC duct pay item.

1.2 RELATED DOCUMENTS AND SECTIONS

A. Item L-110; Airport Underground Electrical Duct Banks and Conduits.

B. Section 555; Directional Bore - FDOT *Specifications for Road and Bridge Construction*, latest edition.

1.3 SUBMITTALS

A. Work Plan: Prior to beginning work, the Contractor shall submit to the Engineer a general work plan outlining the procedure and schedule to be used to execute the work task. Plan shall document the thoughtful planning required to successfully complete the work.

B. Demonstration of compliance with Item L-110 and State DOT requirements.

C. Equipment: Contractor shall submit specifications on directional drilling equipment to be used in the work to ensure that the equipment will be adequate to complete the project.

D. Material: Specifications on material to be used shall be submitted to Engineer. Material shall include the pipe, conduit, fittings, splicing/coupling method, means of transition from HDPE to PVC and any other item, which is to be an installed component of the project.

1.4 WARRANTY

A. All equipment and materials furnished and installed under this section shall be guaranteed against defects in materials and workmanship for a period of twelve (12) months from final acceptance by the Owner. The defective materials and/or equipment shall be repaired or replaced, at the Owner's discretion, with no additional cost to the Owner.

PART 2 – EQUIPMENT REQUIREMENTS

2.1 GENERAL

A. The directional drilling equipment shall consist of a directional drilling rig of sufficient capacity to perform the bore and pullback the pipe, a drilling fluid mixing and delivery system of sufficient capacity to successfully complete the crossing, a guidance system to accurately guide boring operations and 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 the project.

2.2 GUIDANCE SYSTEM

A. The guidance system shall be of a proven type and shall be setup and operated by personnel trained and experienced with this system. The Operator shall be aware of any magnetic anomalies and shall consider such influences in the operation of the guidance system if using a magnetic system.

B. The locating and tracking system must provide information on:

1. Clock and pitch information.
2. Depth.
3. Transmitter temperature.
4. Battery status.
5. Position (X,Y).
6. Azimuth, where direct overhead readings (walkover) are not possible (i.e. subaqueous or limited access transportation facility).
7. Ensure proper calibration of all equipment before commencing directional drilling operation.

C. Take and record alignment readings or plot points such that elevations on top of and offset dimensions from the center of the product to a permanent fixed feature are provided. Such permanent fixed feature must have prior approval of the Engineer. Provide elevations and dimensions at all bore alignment corrections (vertical and horizontal) with a maximum distance of 5 feet between points. Provide additional points when requested by the Engineer. Provide a sufficient number of elevations and offset distances to accurately plot the vertical and horizontal alignment of the installed product.

2.3 CONDUIT/DUCT

A. The directional bore conduit/duct shall be UL Listed Schedule 80 HDPE electrical conduit as described in NFPA 70, Article 353 suitable for placement with directional boring systems or accepted equivalent. HDPE conduit shall comply with UL Category EAZX and ANSI/UL 651A.

B. Orlando Utilities Commission requires the use of restrained joint schedule 40 PVC conduit system. The restrained joint schedule 40 PVC conduit directional bore duct for Orlando Utility Commission (OUC) use shall be Carlon Bore-Gard (Prime Conduit) or Certainteed; Certa-Com, no equivalents accepted. See Specification 26 05 12, *OUC Underground Electric*.

C. Conduit to meet all applicable ASTM testing and be UL listed. Conduit to be chamfered on inside diameter male ends to minimize cable damage. The bending radius for 4" PVC pipe should be no less than 100' as recommended by the PVC Pipe Industry. Installation bend radius should be kept at a minimum to reduce the tensile pull forces displaced onto the pipe. Pipe installation and joint assembly shall be per manufacturer recommendations.

2.4 CONCRETE

A. Concrete shall conform to item P-610, Structural Portland Cement Concrete or FDOT *Standard Specification for Road and Bridge Construction* specification Section 346, latest edition, concrete mix with Type I/II cement using 1-inch maximum size course aggregate (#57 stone) with a minimum 28 day compressive strength of 4,000 psi. Where reinforced duct banks are specified, reinforcing steel shall conform to ASTM A 615 grade 60. Concrete and reinforcing steel are incidental to the respective pay item of which they are a component part.

B. High early strength P-610 concrete will be required for use with ducts, conduits, base cans and other work as directed by the Engineer, in existing operational areas and within the safety areas of operational pavement to comply with the project phasing and scheduling requirements and where the pavement is required to open to aircraft at the end of the designated work period. The extra cost for the high early strength P-610 concrete shall be considered incidental to the respective pay item of which it is a component part.

2.5 COPPER COUNTERPOISE WIRE

A. The copper counterpoise wire shall comply with Item L-108 and/or Specification 26 05 12 as applicable. The copper counterpoise wire shall be installed with and externally to the directionally bored duct.

PART 3 – EXECUTION

3.1 GENERAL

A. The Engineer shall be notified 48 hours in advance of starting work. The Directional Bore shall not begin until the Engineer is present at the job site and agrees that proper preparations for the operation have been made. The Engineer's approval for beginning the installation shall in no way relieve the Contractor of the ultimate responsibility for the satisfactory completion of the work as authorized under the Contract.

3.2 BORING PATH REPORT

A. Furnish a bore path report to the Engineer within seven days of the completion of each bore path. Include the following in the report:

1. Location of project and financial project number including the permit number when assigned.

2. Name of person collecting data, including title, position and company name.

3. Investigation site location (Contract plans station number or reference to a permanent structure within the project right-of-way).

4. Identification of the detection method used.

5. Elevations and offset dimensions as required in 2.2.

B. Provide the Engineer a complete set of as-built plans showing all bores (successful and failed) within 30 calendar days of completing the work. As-built plans shall be PDF files or AutoCAD files, in the same scale as the Contract Plans, and formatted on 22 inch by 34 inch sheets. Ensure that the plans are dimensionally correct copies of the Contract Plans and include pavement/area plan and profile, cross-section, boring location and subsurface conditions as directed by the Engineer. The plans must show elevations referenced to a permanent feature (edge of pavement, manhole, mast arm foundation, manhole inlet cover, head wall, etc). Specific plans content requirements include but may not be limited to the following:

1. Provide a horizontal plan and a profile plan for each bore path at 5 foot intervals, to an accuracy of 1 inch. Horizontal and vertical plan dimensions shall be referenced to fixed permanent monuments/references at the bore location.

2. In addition to the directional bore duct information, show the ground or pavement surface and crown elevation of each position along the bore path to an accuracy of 1 inch and at the ends and other exposed locations. Profile plans for bore paths crossing the runway, taxiway or roadway shall denote stationing of the crossing on the Contract Plans.

3. If, during boring, an obstruction is encountered which prevents completion of the installation in accordance with the design location and specification, and the product is left in place and taken out of service, show the failed bore path along with the final bore path on the plans. Note the failed bore path as “Failed Bore Path - Taken Out of Service”. Also show the name of the utility owner, location and length of the drill head and any drill stems not removed from the bore path.

4. Show the top elevation, diameter and material type of all utilities encountered and physically observed during the work. For all other obstructions encountered during a subsoil investigation or the installation, show the type of material, horizontal and vertical location, top and lowest elevation observed, and note if the obstruction continues below the lowest point observed.

5. Include bore notes on each plan stating the final bore path diameter, product diameter, drilling fluid composition, composition of any other materials used to fill the annular void between the bore path and the product, or facility placed out of service. Note if the product is a casing as well as the size and type of carrier pipes placed within the casing as part of the Contract work.

3.3 SPLICING, COUPLING AND TERMINATION

A. The HDPE duct shall “relax” for 48 hours after installation prior to splicing, coupling or termination.

B. Only Engineer accepted methods shall be used to splice, couple or terminate the HDPE duct.

1. Dura-line Shur-Lok II Couplings,
2. Carlon HDPE to PVC Couplings
3. 8 inch minimum length Morris Compression Couplings
4. Fusion couplings
5. OUC use: Carlon or Certainteed Restrained Joint.

C. All splicing, coupling and termination of HDPE or PVC ducts shall be performed and completed in strict accordance with the manufacturer’s instructions and recommendations.

D. Splices and couplings shall be permitted only where connection to conventionally installed ducts or manholes are required. Fusion coupling is the only method of splicing ducts subject to installation pull tensions.

E. The duct shall be properly reamed in accordance with the applicable specification or details. prior to assembly.

F. All HDPE and PVC duct/conduit splicing, coupling and termination fittings and materials shall be listed or approved.

3.4 GROUND MOVEMENT

A. Before excavation, establish control points for measuring vertical movement of the runway, taxiway, roadway bore path under obstruction at 10 feet intervals along the centerline and 10 feet each side of the pipeline. A land surveyor licensed in the state in which the project is located shall monitor these points daily until construction is complete.

B. Cease trenchless operations when measured movement exceeds 0.02 feet. Determine cause of settlement and repair as necessary. Modify trenchless methods as needed.

3.5 BORE DEPTH MINIMUM COVER

A.

Bore Diameter	Minimum Cover
>2 inches to 6 inches	6 feet
>6 inches up to 14 inches	12 feet
>14 inches up to 24 inches	15 feet
>24 inches up to 48 inches	25 feet

B. Contractor shall survey to verify bottom elevation of ditches, swales, ponds, rivers etc. to determine bottom of obstruction. Bottom is considered natural earth less any settlement or sludge.

C. Contractor shall maintain 25-foot minimum cover between the bottom (not including sediments) of the pond, river or other body of water.

D. Proposed bore alignment shall maintain a minimum clearance of 10 foot horizontal and 5 foot vertical between bore and any obstruction.

E. Blow-out of any drill mud shall be immediately corrected and cleaned up by the Contractor at no additional expense to the Owner.

PART 4 – METHOD OF MEASUREMENT

4.1 METHOD OF MEASUREMENT

A. The items described in this item are incidental to other items and shall not be measured for payment.

PART 5 – BASIS OF PAYMENT

5.1 BASIS OF PAYMENT

A. No direct payment shall be made for the work described in this item. All directional bore costs shall be considered incidental to the respective L-108, L-110 or 26 05 12 pay items.

END OF ITEM SP-110S-02310

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SECTION SP-111 - AIRFIELD ELECTRICAL INSTALLATION TESTING

PART 1 - DESCRIPTION

1.1 GENERAL

A. This item shall consist of performing all tasks necessary to prove proper performance of electrical and airfield lighting systems. Airfield lighting systems include airfield signage systems, approach lighting systems and other associated NAVAIDS.

B. Drawings, general provisions and special provisions of the Contract Documents, including Contractual Conditions and Division 1 Specification sections apply to this Item.

C. This section describes the electrical quality control testing furnished by the Contractor. The Contractor shall provide all testing as required by this item, including retesting of failed items. All items furnished and/or installed by the Contractor shall be tested in accordance with this item.

D. The Contractor shall provide for all electrical testing to confirm that the installations associated with this project comply with the Contract Documents. Contractor shall engage an independent organization to perform the Hi-Pot Testing and to perform specified Photometric Testing with the Contractor providing all testing assistance.

E. The Contractor shall furnish all equipment, labor, supervision, transportation, materials and appliances necessary or required for testing the airport lighting systems before and after installation. The Contractor shall perform all tests in the presence of the Engineer. The Contractor shall demonstrate the electrical characteristics to the satisfaction of the Engineer. All costs for testing are incidental to the pay item for the respective item being tested.

F. Any system installation errors or discrepancies of installation not in conformance with the Contract Documents shall be corrected at no additional cost to the Owner. Equipment, cables and other components which do not satisfy the test requirements of this Item shall be removed and replaced with new equipment, cables and other components which do satisfy the requirements of this item with no additional cost to the Owner. Any necessary retesting shall be performed at no additional cost to the Owner.

G. There are no approved "repair" procedures for items that have failed testing other than complete replacement. The Contractor shall replace all items that may be damaged during testing at no additional cost to the Owner.

H. Weather information necessary to complete the testing forms may be obtained from the listed website http://www.faa.gov/air_traffic/weather/asos/ by double clicking on the respective state and airport ID.

PART 2 - EQUIPMENT AND MATERIALS

2.1 SUBMITTALS

A. Materials and equipment covered by this item shall be subject to acceptance through manufacturer's certification of compliance with the applicable specification when requested by the Engineer. All equipment, materials, methods and record keeping procedures shall be submitted to the Engineer for review.

B. The submittal shall include a list of the proposed test and measurement equipment to be used, the test and measurement equipment serial number, the current calibration certificate for each piece of equipment and a written description of the proposed test. A copy of the test and measurement equipment manufacturer's recommended test procedure is acceptable as a written description of the proposed test.

C. The Contractor shall submit the qualifications of the organization performing the Hi-Pot and Photometric testing. The submittal shall include:

1. The organizations name and address.

2. References for the organization from five previous air carrier airports with similar jobs to include names and phone numbers.

3. A complete list of all test, measurement equipment and all accessories proposed for use including the serial numbers of the equipment and a copy of the respective calibration certificates.

4. Test procedures and safety precautions required during testing.

5. Qualifications and experience of persons performing the testing.

6. References for the person designated to perform the testing from five previous similar jobs to include names and phone numbers.

D. Submit a proposed field test plan, 60 days prior to testing the installed system. No field test shall be performed until the test plan is approved. The test plan shall consist of complete field test procedures including tests to be performed, test equipment required, and tolerance limits. The Contractor shall submit a complete list of required tests and a proposed schedule and duration of the tests. The schedule shall be integrated with the overall project schedule. The Contractor shall update the testing schedule on a monthly basis for the duration of the project.

E. All test results shall be submitted in the Operation and Maintenance (O&M) Manual. See Item SP-106 for submittal requirements.

F. The Engineer reserves the right to reject any and all equipment, materials or procedures, which, in the Engineer's opinion, does not meet the system design and the standards and codes, specified herein.

2.2 SAFETY

A. Dangerous voltages are present during the system testing. The Contractor is solely responsible for the safety of all personnel involved in the testing activities and shall ensure that all testing areas are secured to prevent the entry of unqualified personnel.

B. Observe all safety instructions or precautions recommended by testing equipment manufacturer.

C. The Contractor shall perform a “Hazard/Risk Evaluation” of each test site and procedure. The Contractor shall provide a job briefing and install the necessary barriers and barricades at the respective approach boundaries prior to starting the testing.

D. The Contractor shall provide and use safety devices such as rubber gloves, protective barriers, and danger signs to protect and warn personnel in the test vicinity. The Contractor shall replace any device or equipment which is damaged due to improper test procedures or handling.

E. In addition to compliance with the Contractors safety program, the Contractor shall comply with the following documents/programs:

1. OSHA, 29CFR1910 Occupational Safety and Health Standards
2. OSHA 29CFR1926 Safety and Health regulations for Construction
3. NFPA 70B Recommended Practice for Electrical Equipment Maintenance
4. NFPA 70E Standard for Electrical Safety in the Workplace
5. AC 150/5340-26 Maintenance of Airport Visual Aid Facilities
6. Owner’s safety program.

2.3 QUALIFICATIONS

A. Each person performing testing shall have a minimum of 5 years (2,000 hours per year) of successful testing experience either constructing or maintaining airfield lighting systems. At least 3 of these years of experience shall have occurred in the last 5 years on projects of comparable size and complexity. Person performing testing shall be certified as a “Qualified Person”. The definition of a Qualified Person is defined in OSHA 1910.399 and NFPA 70E (Article 100 & 110.2(1)). The certification shall be signed by the Contractor’s Electrical License qualifier. Equivalent experience and training may be considered by the Engineer. Person performing testing may substitute one year of education in qualified electrical curriculum for one-half year electrical experience for a maximum of 2,000 hours of the required 10,000 hours of experience. Records of person performing testing experience demonstrating compliance with these requirements shall be submitted to the Engineer for verification and review prior to starting work. Experience records shall include contact information for references (name, title and phone number) from airports where the proposed person performing testing has completed the required electrical experience. Work shall not

start prior to approval of the person performing testing, unless under the direct supervision of the Contractor's Electrical License qualifier.

B. The person performing the tests shall be a "qualified person" as defined in NFPA 70E and OSHA 29 CFR 1926.32(l).

C. The person performing the tests shall be thoroughly familiar with the test equipment used in the test performed and shall be sufficiently experienced to detect equipment abnormalities or questionable data obtained during the test procedure.

D. Each piece of test and measurement equipment utilized to demonstrate compliance with the Contract Documents shall be calibrated. The level of calibration shall be *"NIST traceable, Z540 Calibration with Data*". The test and measurement equipment calibration shall be valid for one year. At any time, the Engineer may require the Contractor to have a piece of test and measurement equipment recalibrated. Should the Engineer have any reason to doubt the accuracy of a piece of test and measurement equipment, even within current calibration, the test and measurement equipment shall be removed from the project. The Engineer shall determine which tests shall be redone due to the malfunctioning equipment.

E. The test and measurement equipment calibration lab as a minimum shall meet the requirements of ANSI/NCSL Z-540 and shall be A2LA accredited.

F. The High Potential (Hi-Pot) tests shall be performed by an independent agency certified by the National Electrical Testing Association (NETA) with certified technicians using properly calibrated equipment and standard procedures.

G. Electrical and photometric testing of airfield lighting systems shall be performed by a firm with demonstrated capability for field measurement of electrical characteristics of airfield lighting circuits and regulators and of the photometric performance of airfield lighting fixtures and signs. Because of the correlation between the electrical performance of airfield lighting circuits and the photometric performance of the airfield lighting fixtures, all work shall be done by a single firm. The firm shall have experience in evaluating the test results against FAA standards and manufacturers' performance criteria. See below for listed firms or approved equivalent.

H. Two possible electrical and photometric testing firms are listed below:

Lean Photometrics, LLC
113 S. 25th Street
Phoenix, Arizona 85034
Contact: Doron Lean
(602) 244-1076
dlean@leanphotometrics.com

MALMS Navaid
481 Pleasant Hill Road
Rutherfordton, NC 28139
Contact: Bryan Fountain
(855) 440-0541
bfountain@malms.aero

2.4 TESTING COORDINATION

A. After installation of all required components and before final acceptance, in accordance with project phasing and schedule make required tests to determine proper function of all circuits.

B. Ten days prior to any testing the Contractor shall notify the Engineer of the need to perform testing. A mutually agreed upon time and date for each test will be set. All requirements under this item shall be coordinated with the Engineer.

C. The Contractor shall perform the necessary inspection and tests for some items concurrently with the installation because of subsequent inaccessibility of some components.

D. Photometric testing of a runway lighting system shall occur prior to opening the runway. Photometric testing of a taxiway lighting system may occur after all fixtures have been installed, provided the lighting system passes a visual inspection prior to opening to air traffic.

E. The Contractor shall ensure that all test and measurement equipment, accessories and qualified personnel are available prior to scheduling tests.

F. Forty-eight (48) hours prior to each test the Contractor shall send the Engineer a written confirmation that the scheduled test will occur at the proposed date and time. Any rescheduling of the test shall be coordinated with the Engineer.

G. The Engineer shall be provided reasonable opportunity to observe all tests. Testing shall not proceed until the Engineer or designated representative is present to observe the testing, or until the Engineer has provided written instruction to proceed with the testing in the Engineer's absence.

H. All test results shall be recorded by the Contractor and witnessed by the Engineer. Test results shall be submitted in the O&M Manuals in accordance with Item SP-106.

I. The Contractor is reminded that due to phasing constraints the HI-POT testing organization, photometric testing organization or any other testing organization/groups may have multiple mobilizations required to test airfield lighting systems as each area is complete. For projects completed in phases, the respective required testing must be completed by phase.

2.5 TEST AND MEASUREMENT EQUIPMENT

A. Electrical test and measurement equipment shall be an off the shelf item, not a one of a kind prototype. The test and measurement equipment shall be manufactured by a firm regularly engaged in the manufacture of precision electrical test and measurement equipment for the industrial, commercial and utility marketplace. Typical accuracy for test equipment shall be $\pm$ 2% of instrument reading and shall be TRUE RMS.

B. The Engineer shall confirm that the test and measurement equipment proposed for use by the Contractor is suitable for the intended use. The Engineer shall have sole discretion to determine if the test and measurement equipment is suitable for the intended use.

C. The airfield lighting photometric test and measurement equipment is utilized in a specific airfield lighting application and is not required to meet Item A. above.

D. The ground point for the cable test equipment shall be the vault ground bus. The vault ground bus, vault ground system, airport ground grid and counterpoise system shall be complete prior to cable testing.

PART 3 - CONSTRUCTION METHODS

3.1 COUNTERPOISE TESTING

A. Continuity of counterpoise system shall be checked by visual inspection as construction progresses, prior to work being covered up.

B. Verification of counterpoise system continuity shall be checked by visual inspection at accessible locations during normal inspections.

C. Verification of counterpoise system continuity to the vault grounding system shall be tested with a micro-ohmmeter. Micro-Ohmmeter shall be Megger Ductor DLRO-10 or accepted equivalent. Resistance readings shall be corrected to standard temperature.

D. Should the counterpoise or ground grid conductors be damaged or are suspected to be damaged by construction activities (in the opinion of the Engineer) the Contractor shall test the conductors for continuity with a micro-ohmmeter. The conductors shall be isolated such that there is no parallel path. Alternatively, the Contractor may conduct tests and through mathematical computations prove the continuity of the conductors.

E. Investigate unsatisfactory results and make necessary corrections or replacements as required by the Contract Documents.

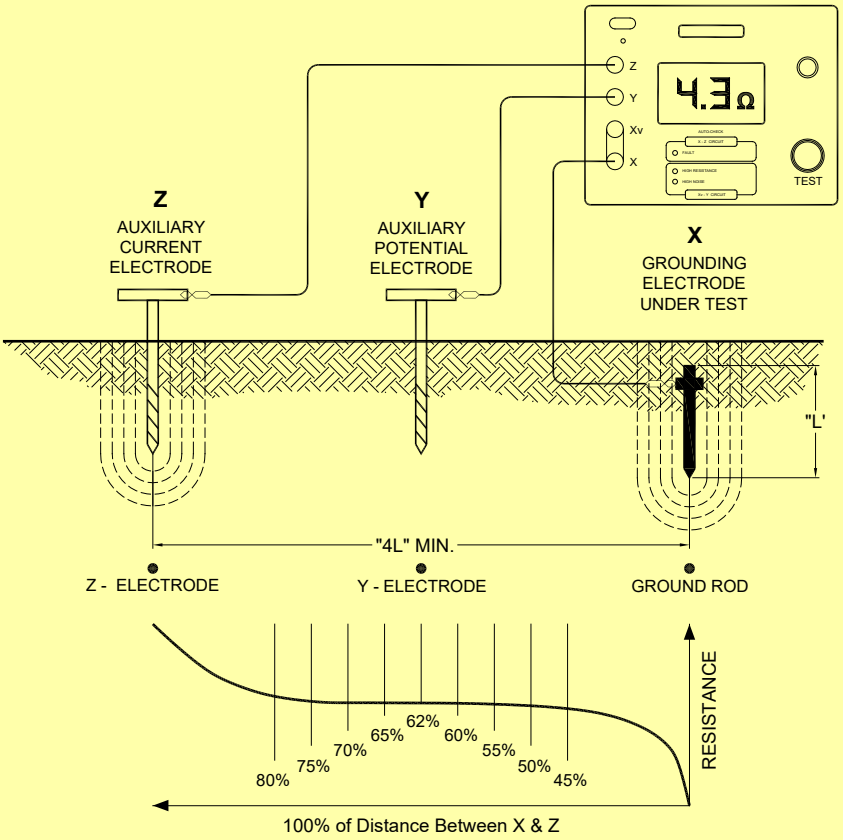
F. Record test results on the record drawing set indicating point to point readings.

3.2 GROUND ROD TESTING

A. Contractor shall provide equipment and personnel to measure the resistance to earth of each ground rod installed. Earth resistance measurement tests shall adhere to recommendations of IEEE Standard 142, latest edition.

B. Earth resistance measurements shall be made in normally dry conditions not less than 48 hours after the last rainfall.

C. Initially the Contractor shall test each ground rod in accordance with the following instructions. The horizontal distance between the Ground Electrode Under Test (Electrode X) and the Auxiliary Current Electrode (Electrode Z) shall be 4 times the depth (length) of the ground electrode under test.



D. The three electrodes shall be installed in a straight line in a direction away from other underground metallic items. The test leads shall be separated.

E. The first test shall be conducted with the Auxiliary Potential Electrode (Electrode Y) at 45% of the distance between the X and Z electrodes. The earth resistance shall be measured and recorded at the 45% position. The Y electrode will then be moved 5% closer to the Z electrode to the 50% position and the earth resistance shall be measured and recorded. The previous steps will be repeated at 5% distance intervals through the 80% position. Graph the resultant points on the form provided at the end of this item.

F. The above test method shall be utilized at each new ground rod installation until otherwise determined by the Engineer. The Engineer will use the acquired data to establish a revised distance ratio between the X and Z electrode.

G. Once the new electrode distance ratio is set by the Engineer, the Contractor may perform the tests with a single test position for electrode Y.

H. Earth resistance tests shall be performed as each ground rod is installed. Earth resistance tests shall be conducted prior to the connection of any grounded, grounding or counterpoise conductors. Ground rods not in compliance with the not to exceed maximum earth resistance shall have an additional 10' section(s) added until the required earth resistance is achieved.

I. Should the Contractor install 100 feet of sectional ground rod (ten rods) at a single location and not achieve the required earth resistance, the Contractor shall stop installing rods at this specific location and contact the Engineer for resolution.

3.3 FIELD LIGHTNING ARRESTOR ASSEMBLY TESTING

A. Each field lightning arrestor assembly (FLA) shall receive an inspection upon receipt by the Contractor.

B. The Contractor shall group the FLAs by circuit. Mark each FLA with circuit designation and unique number.

C. Each FLA shall be tested for continuity between the airfield lighting series circuit L-823 connectors. A reading of 200 milliohms or less is acceptable.

D. Each FLA shall have its internal resistance tested between the airfield lighting series circuit L-823 connector and the grounding screw. A reading of less than 10 gigohms is cause for rejection. Any FLA testing less than 10 gigohms shall be rejected.

E. The FLA internal resistance test shall be performed with a megohmmeter providing a test voltage of 1,000 volts DC. The output of the megohmmeter shall be direct reading in megohms and shall have an upper range limit in excess of 10 gigohms.

F. The Contractor shall then interconnect each FLA within that circuit to the other. The Contractor shall interconnect the ground screws on each unit with a #12AWG bare copper conductor. The Contractor shall then megger test the FLA circuit assembly and record the reading.

G. The Contractor shall repackage the FLA units, maintaining the circuit designations. The FLA shall be stored in a clean dry location until installation in the base cans.

H. Record data on insulation resistance test form provided at the end of this item.

3.4 EXISTING AIRFIELD LIGHTING CIRCUIT INSULATION RESISTANCE TESTING

A. Whenever the scope of work requires connection to an existing circuit, or should the scope of work involve working adjacent to or near an existing circuit, and the work could have any impact on the existing circuit, the existing circuit's insulation resistance shall be tested. The test shall be performed prior to any activity which could possibly affect or impact the respective circuit. The Contractor shall record the results on forms included at the end of this item.

B. The existing airfield lighting circuit insulation resistance test shall be performed with a megohmmeter providing a test voltage of 1,000 volts DC. The output of the megohmmeter shall be direct reading in megohms and shall have an upper range limit in excess of 10 gigohms.

C. Observe required safety precautions.

D. Connect the test instrument in accordance with the manufacturer's recommendations. The insulation resistance test shall be conducted for two (2) minutes). Record data at 30 second intervals on the form provided at the end of this Item. The insulation resistance measurement results shall be corrected to 20^0 Centigrade (68^0 Fahrenheit).

E. When the work effecting the circuit is complete (or at end of shift prior to energization), the circuit's insulation resistance shall be checked again, in the presence of the Engineer. The Contractor shall record the results on forms included at the end of this item. The second reading shall be equal to or greater than the first reading or the Contractor shall make the necessary repairs to the circuit to bring the second reading above the first reading.

F. All repair costs including a complete replacement of the L-823 connectors, L-830 transformers and L-824 cable, if necessary, shall be borne by the Contractor.

G. Should the Contractor fail to perform the tests prior to starting work, the Contractor shall be responsible to bring the impacted circuits to a minimum 50 megohm insulation resistance value or higher value in conformance with any previous airport test records.

3.5 NEW AIRFIELD LIGHTING CIRCUIT CONTINUITY TESTING

A. After new cable installation and before the operating test or connection to an existing system, the airfield lighting series circuit cable system shall be given a circuit internal resistance (continuity) test.

B. This test shall be conducted at the proposed point of connection to the Constant Current Regulator and shall be used to prove continuity of the entire circuit. The Contract Documents shall be reviewed to confirm proper circuit routing, connection and installation of necessary components prior to testing.

C. No Field Lighting Arrestor Assemblies shall be installed in the circuit during the internal resistance (continuity) test. No airfield lighting fixtures or signs shall be connected to the secondary of the L-830 isolation transformers internal resistance (continuity) test.

D. The L-824C series circuit cable, complete with all L-823 connectors and L-830 isolation transformers installed, shall be tested for continuity. The cable, connectors and transformers shall be in their final configuration, ready for connection to the constant current regulator (CCR).

E. Observe required safety precautions.

F. The circuit's internal resistance (continuity) test shall be performed using an ohmmeter with sufficient output to measure the circuit's internal resistance. The expected internal circuit resistance should be between 20 ohms and 70 ohms.

G. Investigate unsatisfactory results and make necessary corrections or replacements as required by the Contract Documents.

H. Upon successful completion of circuit's internal resistance (continuity) test, record the measured circuits internal resistance on the cable test form included at the end of this item.

3.6 NEW AIRFIELD LIGHTING CIRCUIT INSULATION RESISTANCE TESTING

A. Upon successful completion of the airfield lighting circuit's internal resistance (continuity) test perform an airfield lighting circuit insulation resistance test.

B. In addition to successfully completing the airfield lighting circuit internal resistance (continuity) test, all prerequisite conditions required prior to performing the airfield lighting circuit internal resistance (continuity) test shall be performed prior to starting the airfield lighting circuit insulation resistance test.

C. Airfield lighting circuit insulation resistance tests shall be made in normally dry conditions not less than 48 hours after the last rainfall.

D. The airfield lighting circuit insulation resistance test shall be performed with a megohmmeter providing a test voltage of 1,000 volts DC. The output of the megohmmeter shall be direct reading in megohms and shall have an upper range limit in excess of 10 gigohms.

E. Observe required safety precautions.

F. Ground all other conductors within the conduits or ducts containing the conductor under test.

G. Connect the test instrument in accordance with the manufacturer's recommendations. The insulation resistance test shall be conducted for ten (10) minutes). Record data at the required intervals on the form provided at the end of this Item. The insulation resistance measurement results shall be corrected to 20^0 Centigrade (68^0 Fahrenheit).

H. The expected insulation resistance for the completed circuit should be in excess of 500 megohms.

I. Investigate unsatisfactory results and make necessary corrections or replacements as required by the Contract Documents.

J. Upon successful completion of circuit's insulation resistance test, record the measured circuits internal resistance on the cable test form included at the end of this item.

3.7 NEW AIRFIELD LIGHTING CIRCUIT HIGH POTENTIAL TESTING

A. Upon successful completion of the airfield lighting circuit's insulation resistance test perform an airfield lighting circuit High Potential (Hi-Pot) test.

B. In addition to successfully completing the airfield lighting circuit insulation resistance test, all prerequisite conditions required prior to performing the airfield lighting circuit insulation resistance test shall be performed prior to starting the airfield lighting circuit Hi-Pot testing.

C. Airfield lighting circuit Hi-Pot tests shall be made in normally dry conditions not less than 48 hours after the last rainfall.

D. The airfield lighting circuit Hi-Pot test shall be performed with a suitable high voltage test set which has steady, filtered direct current output voltage. The high voltage test set shall include an accurate voltmeter and microammeter for reading the voltage applied to the circuit and resultant insulation leakage current.

E. Observe required safety precautions.

F. Ground all other conductors within the conduits or ducts containing the conductor under test.

G. Connect the Hi-Pot test instrument in accordance with the manufacturer's recommendations. Clean and dry the cable for a distance of 1 foot from the ends. Connect both ends of the circuit together and to the high voltage test set.

H. The Hi-Pot test shall be conducted for fifteen (15) minutes). Step the voltage up, hold and down in accordance with the test form included at the end of this item. Record data at the required intervals on the form provided at the end of this Item. The insulation resistance measurement results shall be corrected to 20^0 Centigrade (68^0 Fahrenheit).

I. Insulation leakage current shall be measured and recorded for each circuit after a 1 minute application of the test voltage. If leakage current exceeds values specified below, the circuit shall be sectionalized and retested and the defective parts shall be repaired or replaced. Leakage current limits include allowances for the normal number of connectors and splices for each circuit as follows:

   1. Three microamperes for each (300m) 1000 feet of cable.

   2. Two microamperes for each 200 watt and each 500 watt 5,000-volt series transformer.

   3. Two microamperes for each 30/45-Watt 5,000 volt series transformer.

J. If the measured value of insulation leakage current exceeds calculated value, the circuit shall be sectionalized and tested as specified for each section. Defective components shall be corrected or replaced until repeated tests indicate an acceptable value of leakage current for the entire circuit. Investigate unsatisfactory results and make necessary corrections or replacements as required by the Contract Documents.

3.8 CONCLUDING AIRFIELD LIGHTING CIRCUIT TESTS

A. Upon successful completion of the airfield lighting circuit and High Potential (Hi-Pot) test install and connect all airfield lighting fixtures, signs and perform an airfield lighting circuit insulation resistance test. Conduct test similar to test performed above (3.6).

B. Airfield lighting circuit insulation resistance tests shall be made in normally dry conditions not less than 48 hours after the last rainfall.

C. The airfield lighting circuit insulation resistance test shall be performed with a megohmmeter providing a test voltage of 1,000 volts DC. The output of the megohmmeter shall be direct reading in megohms and shall have an upper range limit in excess of 10 gigohms.

D. Observe required safety precautions.

E. Ground all other conductors within the conduits or ducts containing the conductor under test.

F. Connect the test instrument in accordance with the manufacturer's recommendations. The insulation resistance test shall be conducted for ten (10) minutes). Record data at the required intervals on the form provided at the end of this Item. The insulation resistance measurement results shall be corrected to 20^0 Centigrade (68^0 Fahrenheit).

G. The expected insulation resistance for the completed circuit should be in excess of 500 megohms.

H. Investigate unsatisfactory results and make necessary corrections or replacements as required by the Contract Documents.

I. Upon successful completion of circuit's insulation resistance test, record the measured circuits internal resistance on the cable test form included at the end of this item.

J. Install respective circuit designated FLA assemblies. Use the sum of reciprocals rule to calculate the final circuit insulation resistance. Perform insulation resistance test on completed circuit in accordance with above criteria. Record final circuit insulation resistance value on form provided at the end of this Item.

3.9 CONSTANT CURRENT REGULATOR (CCR) TESTS

A. Each constant current regulator shall be examined to ensure that porcelain bushings are not cracked, no shipping damage has occurred, internal and external connections are correct, switches and relays operate freely and are not tied or blocked, fuses, if required, are correct, and liquid level of liquid-filled regulators is correct. Relay panel covers shall be removed only for this examination; it is not necessary to open the main tank of liquid-filled regulators. The Contractor shall comply with the manufacturer's startup and operational instructions. Covers shall be replaced tightly after completing examinations and tests.

B. Verify the supply voltage and nameplate input voltage are the same. Verify CCR is properly grounded. With the loads disconnected, regulator shall be energized and the open circuit protector observed to ensure that it de-energizes the regulator within 2 seconds.

C. Comply with the manufacturer's recommendation for calibration and set up of each new CCR and each existing CCR connected to a new or modified airfield lighting circuit. The regulator output current and voltage shall be calibrated using a true RMS meter. The CCR calibration shall be complete prior to making any other CCR measurements.

D. Verify all airfield lighting fixtures and loads are operational.

E. Complete an Airfield Lighting Circuit Data Sheet for each new CCR and each existing CCR connected to a new or modified airfield lighting circuit.

F. A sample Airfield Lighting Circuit Data Sheet is included at the end of this Item.

G. Record notable current, voltage or power wave forms of the circuits tested to demonstrate and identify normal operation and any unusual circuit characteristics.

H. Comply with the manufacturer's recommendation for calibration and set up of each new CCR and each existing CCR connected to a new or modified airfield lighting circuit. The regulator output current and voltage shall be calibrated using a true RMS meter. The CCR calibration shall be complete prior to opening the lighted pavement to aircraft and prior to performing photometric testing.

I. Investigate unsatisfactory results and make necessary corrections or replacements as required by the Contract Documents.

J. Perform required testing to complete information requested on the Airfield Lighting Circuit Data Sheet.

3.10 CONTROL SYSTEM TESTS

A. The equipment shall be demonstrated to operate in accordance with the requirements of the Contract Documents. Each applicable control device in the air traffic control tower (ATCT) airfield lighting control panel and other control locations shall be operated so that each control device position is engaged at least ten times. During this process, all lights and associated equipment shall be observed to determine that each control device/switch/indicator properly operates the corresponding component. Radio communication between the operator and the observers shall be provided by the Contractor.

B. The above tests shall be repeated for each individual circuit from the local control switches on the regulators. Each installed or revised lighting circuit shall be tested by operating the lamps throughout the range of applicable steps and shall be operated separately at step 3 or step 5 as appropriate for full intensity for not less than 4 hours. Visual examination shall be made at the beginning and at the end of this test to determine that the installed airfield light fixtures are illuminating at full intensity.

C. Investigate unsatisfactory results and make necessary corrections or replacements as required by the Contract Documents.

D. Systems tests shall confirm by demonstration that all airfield lighting circuits are in required operating condition in accordance with the Contract Documents.

3.11 FIXTURE WIRING SEQUENCE TEST

A. The fixture wiring sequence testing shall be performed at night with minimum interference to airport operations.

B. The Contract Documents require all centerline lighting fixtures be wired in numerical order. Touch down zone and edge lights shall be wired in numerical sequence without zig-zagging back and forth across the runway or taxiway.

C. The 5 kV L-824 airfield lighting series circuit cables shall be supplied with factory imprinted numbers.

1. Odd numbered circuits shall utilize:

Wire #1 Routed from the constant current regulator (CCR) output terminal S1 to the lowest numbered fixture in the circuit.

Wire #3 Routed from the lowest numbered fixture to the highest numbered fixture in the circuit. The fixtures shall be connected in numerical sequence. When the series circuit loops back in the same raceway, all fixtures shall be connected into the same leg of the circuit conductor. The return portion of the loop shall not have any fixtures installed into that portion of the conductor.

Wire #5 Routed from the highest numbered fixture in the circuit to the CCR output terminal S2.

2. Even numbered circuits shall use numbers 2, 4 and 6.

D. To verify proper wiring sequence from fixture to fixture temporary intentional grounds shall be inserted into the 5 kV airfield lighting series circuits. The temporary intentional grounds shall be inserted in sequence, one location at a time, at each PC, PT or PI where the cable returns (loops in the same conduit) with the fixture conductor. The Engineer shall designate each point as circuiting is completed.

E. The Contractor is solely responsible for the safety of all personnel, materials and equipment within the construction area. In addition to the Contractor's requirements each temporary intentional ground location shall be barricaded. The barricade shall extend a minimum of twenty-five (25) feet in all directions around the temporary intentional ground. No one shall be allowed within the barricaded area during the test.

F. All wiring for the 5 kV airfield lighting series circuits shall be complete prior to the sequence testing. The test circuit shall consist of the #1 conductor connected between the constant current regulator (CCR) output terminal S1 and the lowest numbered airfield lighting fixture. The #3 conductor connected from fixture to fixture to the first test point noted in the Contract Documents. A temporary intentional ground shall be inserted at this point. The constant current regulator (CCR) output terminal S2 shall be connected to a temporary intentional ground. Each temporary intentional ground shall be barricaded. All personnel shall be outside the barricade. The CCR shall be energized remotely. A visual inspection of the airfield lighting fixtures shall be made to determine proper wiring sequence.

G. The temporary intentional ground shall be moved to the next test point and this procedure shall be repeated for each temporary intentional ground.

H. The final temporary intentional ground for each circuit shall test proper routing of the #1 wire from the CCR output terminal S1 to the lowest numbered fixture. The temporary intentional grounds shall be placed at the output terminal S1 of the CCR and on the #1 wire side of the lowest numbered fixture. Each temporary intentional ground shall be barricaded. All personnel shall be outside the barricade. The CCR shall be energized remotely. A visual inspection of the airfield lighting fixtures shall be made to determine proper wiring sequence.

I. Investigate unsatisfactory results and make necessary corrections or replacements as required by the Contract Documents and retest.

J. Once proper wiring sequence has been verified remove all intentional temporary grounds and place 5 kV airfield lighting series circuits in proper working order.

K. Systems tests shall confirm by demonstration that all airfield lighting circuits are in required operating condition in accordance with the Contract Documents.

3.12 AIRFIELD LIGHTING FIXTURE PHOTOMETRIC TESTING

A. Photometric testing shall be performed at night with minimum interference to airport operations. Not more than 24 hours prior to starting the test, the Contractor shall clean all the light fixture lens to assure that the system is ready for the photometric testing.

B. The photometric report shall include test results, general quality of installation in terms of photometric performance, identification of deficient lights, analysis to identify the cause of any deficient lights (e.g., fixture alignment, light fixture or specific primary circuit segment), and recommendation for correcting any deficiencies found. The test data shall be presented in the form of a log book with the first readings entered in the log book, and with provisions for entering future readings for each light.

C. The photometric test and measurement equipment shall have an array of sensors capable of taking simultaneous readings along the horizontal axis of the light output. (Reference FAA Advisory Circular (AC) 150/5345-46, Latest Edition). Photometric testing shall include the measurement at each light fixture of the light distribution along the horizontal axis. The measurements shall be compared with FAA standards presented in the AC for each type of light fixture.

D. The highest sensor reading, together with the two adjacent readings, will be averaged, and the calculated average shall be at least 20% greater than the minimum average intensity specified in the AC or in the project specifications, whichever is greater, in order for that fixture to be considered acceptable.

E. In addition, all other readings within the specified ellipse shall be at least 50 percent of the specified minimum average intensity in order for the fixture to be considered acceptable. Results shall also be compared with the requirements set forth in FAA AC 150/5345-46.

F. The photometric equipment system software shall be capable of recording the data and analyzing that data to calculate:

1. The average photometric output of the main beam of the fixture,

2. The location of the maximum reading,

3. The location of the minimum reading,

4. The ratio of the maximum reading to the average output,

5. The ratio of the minimum reading to the average output, and

6. Comparisons of these values with FAA specified values.

G. In every group of fixtures, that is, touchdown zone, centerline, or other such group, ten percent (10%) of the fixtures shall be evaluated at three (3) different vertical angles, on the centerline of the light beam, and at two (2) degrees above and below the centerline of the beam.

H. All sensor readings for the light fixture being evaluated shall be displayed simultaneously for operator and Engineer review and evaluation. All sensor readings shall be recorded automatically through the computer and shall be printed out via a computer controlled printer. Hand written data will not be accepted.

I. For minimum impact on airport operations, the taking of photometric data at any one fixture shall be completed within thirty seconds.

J. Interim reports will be submitted periodically during the progress of the work so that corrective measures may be taken as required by test results.

K. Investigate unsatisfactory results and make necessary corrections or replacements as required by the Contract Documents.

L. Retesting shall be performed by the testing agency to verify that the deficient condition has been corrected.

M. The documented test results of each fixture’s photometric condition shall be graded as:

1. Passes/Meets FAA Requirements - This classification includes those new light fixtures which exceed the FAA requirement, or, in the case of existing lighting systems, those fixtures which exceed 70 percent of FAA requirements. (FAA specifies that airfield lights must be replaced when the outputs are less than 70 percent of the required output.) In such cases, no further action is necessary other than periodic monitoring by the Owner. When nothing is indicated in the “Remarks” column of the photometric data, the light fixture is satisfactory.

2. Fail/Investigate - These light fixtures have not met the FAA required photometric output for their particular type of light fixture. These fixtures shall be investigated by the Contractor to determine the cause of unacceptable performance. Appropriate corrective measures shall be taken to bring the performance of the fixtures to FAA standards, and the fixtures shall then be retested to assure that the repairs/replacements are satisfactory.

N. Photometric test data shall be tabulated with the following minimum information:

Fixture Number	From the Identification sheets of the Contract Documents
Light Direction	Direction of light beam
Max CD	Maximum candela output in a point along the main beam
Avg CD	Average candela output of the main beam
Min Level (70%)	70 Percent of FAA specified output for type of fixture
Lens Color	Color of lens on fixture being tested
Con for 70%	Condition compared with 70 percent of FAA standard (blank if fixture is acceptable).
Remarks	Notes pertaining to the fixture being tested.
Corrective Action	Notes action taken to correct deficiency.

3.13 AIRFIELD SIGN PHOTOMETRIC TESTING

A. All signs shall be tested in accordance with specification 150/5345-44. The photometric testing of the signs shall evaluate the performance of signs with respect to the following FAA criteria:

1. Luminance: The background of Type L-858Y signs and the legends of Type L-858R and L-858L signs shall have an average luminance of 10 to 30 ft lamberts.

2. Uniformity: Photometric measurements shall be made on a 3 inch (76 mm) grid over the entire face of the sign, with no measurement being closer than 3 inches (76 mm) to the sign frame. Adjacent measurements shall not exceed a 1.5:1 ratio.

3. The sign shall be discernable from eight hundred (800') away.

B. All new airfield guidance panels or signs installed on this project shall be tested at night. Style 2 and Style 3 signs shall be tested at each input current throughout the range on which the sign is to operate. Style 5 signs shall be tested at the highest rated input current (5.5 amperes). The photometric performance of the signs shall be evaluated using digital color images. These images shall be converted to gray-scale images that can be analyzed directly for photometric output. To provide calibration and control for the evaluation of the gray-scale image, direct photometric readings of the light output in foot-lamberts (FL) shall be taken at several locations on the face of the sign using a calibrated photometer. Light emitted only from the sign shall be permitted to reach the photometer.

C. To document compliance with FAA requirements, the final report shall present the following information and data for each color for each sign tested:

1. Sign Designation & Date Sign was tested.

2. Digital & Gray-Scale Image of Sign.

3. Step - The step intensity of the regulator controlling the sign.

4. Arithmetic average of illumination levels (FL).

5. Maximum illumination level on sign face and/or message (FL).

6. Minimum illumination level sign face and/or message (FL).

7. Ratio of Maximum illumination to Minimum illumination.

8. Uniformity. The maximum ratio of the average illumination levels of adjacent 3-inch areas over the face of the sign.

9. Visual Discernability of the Sign including comments.

10. Statements whether or not sign meets FAA criteria.

D. Photometric measurements shall also be taken of the red background on mandatory signs (white message on red background) to evaluate the signs red to white contrast. (FAA does not have criteria for contrast).

E. Interim reports will be submitted periodically during the progress of the work so that corrective measures may be taken as required by test results.

F. The documented test results of each signs photometric condition shall be graded as Passes/Meets FAA Requirements or Fail/Investigate.

G. Investigate unsatisfactory results and make necessary corrections or replacements as required by the Contract Documents.

H. Retesting shall be performed by the testing agency to verify that the deficient condition has been corrected.

PART 4 - METHOD OF MEASUREMENT

4.1 METHOD OF MEASUREMENT

A. The items described in this section are incidental to other items and shall not be measured for payment.

PART 5 - BASIS OF PAYMENT

5.1 BASIS OF PAYMENT

A. No direct payment shall be made for the work described in this item.

END OF SECTION SP-111

AIRFIELD LIGHTING CIRCUIT DATA SHEET

Circuit Designation:

Date:

Circuit Description:

Ph. Wire Size/Type:

Source Panel/Ckt

GND. Wire Size/Type:

Panel ∅; CB Size:

Conduit Size/Type:

CCR Size:

CCR Output Amps:

CCR Manufacturer:

Yr. Manufactured:

CCR Type No.:

Part No.:

Output Amp Steps: / / / /

Input Volts: Ph.: Hz.:

Input Amps:

Control Voltage:

Serial Number:

Oil Capacity: **Gal.** Oil Test Date:

Weight: **lbs.**

CCR Insp./Calib.: Date:

Circuit Age: **Years**

Insul. Resist. at 1 min.: **Ω @ 1000 V**

Weather:

Lamps in Ckt.: Lamp Watts:

Lamps Out:

Manufacturer's Set up and Calibration Completed by: _____

	Calibration	LOAD TEST							
Step	Output Amps	Output Amps	Output Voltage	Output KVA	Output PF	Input Amps	Input Volts	Input KVA	Input PF
B1/B10									
B2/B30									
B3/B100									
B4									
B5									

Comments:

Earth Resistance Test

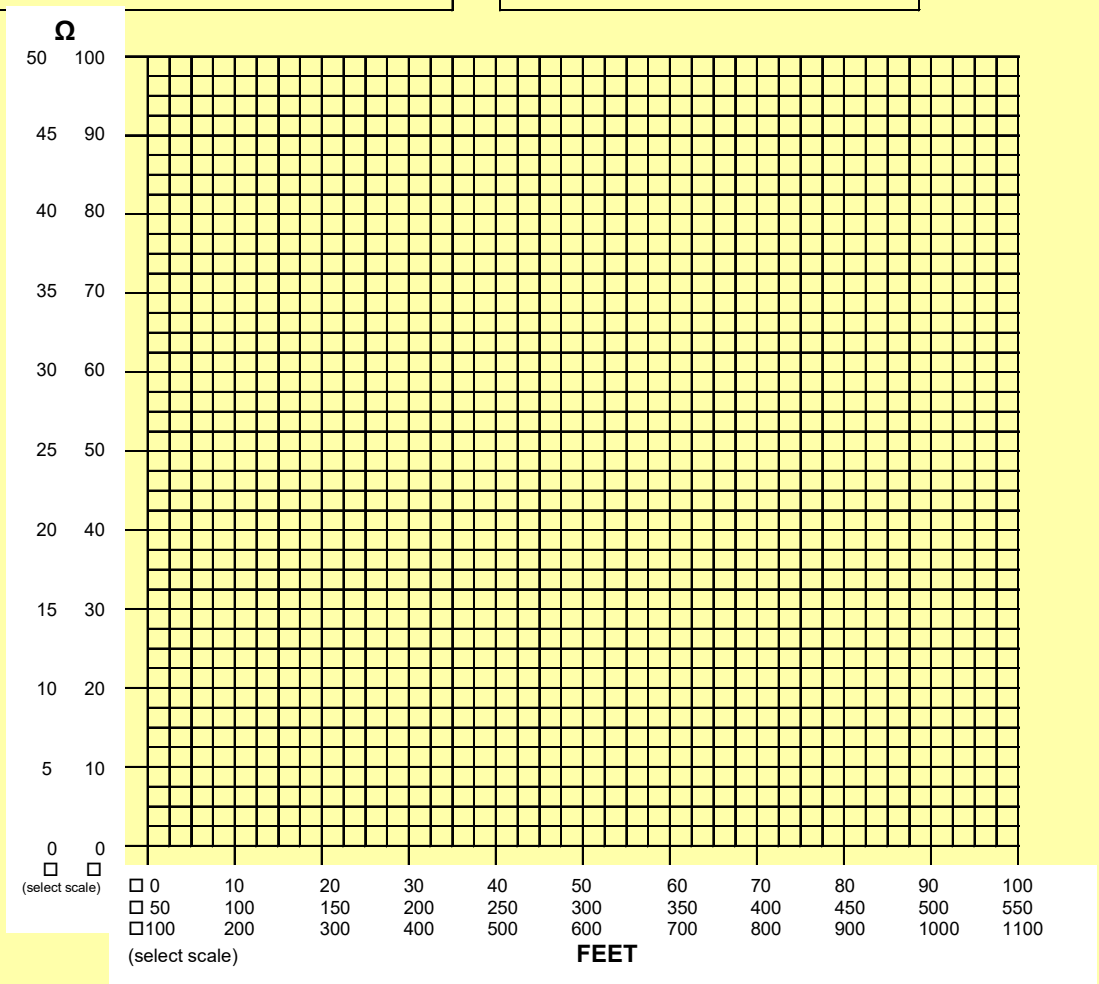
Instrument Mfg. _____ Test Date _____

Model _____ Operator Name _____

Serial Number _____ Test Location _____

Test Conditions				Weather Conditions
Soil Condition:	☐ Moist	☐ Dry	Temperature _____ °F °C	Relative Humidity: _____
				Precipitation Accumulation: _____
				Sky Conditions: _____
Soil Type: (choose one)	☐ Clay	☐ Limestone	☐ Sand & Gravel	**Grounding System**
	☐ Granite	☐ Shale	☐ Sandstone	☐ Single Rod
	☐ Loam	☐ Slate	☐ Other _____	Rod Depth _____ft

%	Voltage Electrode (Y) distance from Ground rod under test (X) FEET	Measured Resistance OHMS
100	_____	_____
90	_____	_____
80	_____	_____
70	_____	_____
60	_____	_____
50	_____	_____
40	_____	_____
30	_____	_____
20	_____	_____
10	_____	_____
0	_____	_____



Comments:

HIGH POTENTIAL TEST REPORT

Date: _____ Start Time: _____ / Stop Time _____

Circuit Designation: _____	Circuit Description _____	Circuit Length _____
Circuit Operating Voltage _____	Circuit Isolation Transformers Qty/Size: _____	
Hazard Risk Evaluation Performed? Yes No	Ambient Temperature: _____ Relative Humidity: _____ Sky Conditions.: _____ Rain last 48hrs: _____	

Test Equipment:	Manufacturer	Model #	Serial#	Upper Range Limit:
	_____	_____	_____	_____

Associated Equipment included in test:_____

_____

Circuit Continuity: _____	Test Voltage: _____	Cable Manufacturer: _____

VISUAL/MECHANICAL INSPECTION

CHECK POINT	*COND	NOTES	CHECK POINT	*COND	NOTES
GROUNDS PROPERLY TERMINATED			ACCEPTABLE BENDING RADIUS		
PHYSICAL DAMAGE			TIGHTNESS CABLE CONNECTION		

ELECTRICAL TESTS

MEGGER @ 2500 VDC (1 MINUTE) = >50 KMΩ

TEST VOLTAGE (KV)	LEAKAGE CURRENT (MICRO-AMPS)	TIME HELD AT TEST VOLTAGE (MINUTES)
3		1
6		1
9		1
12		1
15		1
15		15 sec
15		30 sec
15		45 sec
15		60 sec
15		15 sec
15		30 sec
15		45 sec
15		60 sec
15		3 min
15		4 min
15		5 min
15		6 min
15		7 min
15		8 min
15		9 min
15		10 min

DECAYING VOLTAGE = @ 30 SECONDS = KV @1 MINUTE = KV

NOTES:

*CONDITION: A=ACCEPTBLE R=NEEDS REPAIR , REPLACEMENT OR ADJUSTMENT C=CORRECTED NA-NOT APPLICABLE

Engineer: _____

Witness: _____

Tested by: _____

Airfield Lighting Circuit Continuity and Insulation Resistance Testing

Date: _____ Start Time: _____ / Stop Time _____

Circuit Designation: _____ Circuit Description _____ Circuit Length _____

Circuit Operating Voltage _____ Circuit Isolation Transformers Qty/Size: _____

Hazard Risk Evaluation Performed? Yes No Ambient Temperature: _____ Relative Humidity: _____

Sky Conditions.: _____ Rain last 48hrs: _____

Test Equipment: Manufacturer _____ Model # _____ Serial# _____ Upper Range Limit: _____

Associated Equipment included in test: _____

Circuit Continuity: _____ Test Voltage: _____ Cable Manufacturer: _____

Tested by: _____ Witness: _____

Minutes	0.25	0.5	1.0	2.0	3.0	4.0	5.0	6.0	7.0	8.0	9.0	10.0
Reading												
Correction												

Megohms: Infinity, 10,000, 5,000, 3,000, 2,000, 1,000, 800, 600, 400, 300, 200, 150, 100, 80, 60, 40, 30, 20, 15, 10, 6, 4, 2, 1, 0.6, 0.2, 0.1, 0.06, 0.02, Zero

Comments: _____

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SECTION L-115 - ELECTRICAL MANHOLES AND JUNCTION STRUCTURES

PART 1 - DESCRIPTION

1.1 This item shall consist of electrical manholes and junction structures (hand holes, pull boxes, junction cans, etc.) installed per this specification, at the indicated locations and conforming to the lines, grades and dimensions shown on the plans or as required by the ***OAR*** ~~RPR~~. This item shall include the installation of each electrical manhole and/or junction structures with all associated excavation, backfilling, sheeting and bracing, concrete, reinforcing steel, ladders, appurtenances, testing, dewatering and restoration of surfaces to the satisfaction of the ***OAR*** ~~RPR~~.

PART 2 - EQUIPMENT AND MATERIALS

2.1 GENERAL

A. All equipment and materials covered by referenced specifications shall be subject to acceptance through manufacturer's certification of compliance with the applicable specification when so requested by the ***OAR*** ~~RPR~~.

B. Manufacturer's certifications shall not relieve the Contractor of the responsibility to provide materials per these specifications. Materials supplied and/or installed that do not comply with these specifications shall be removed (when directed by the ***OAR*** ~~RPR~~) and replaced with materials that comply with these specifications at the Contractor's cost.

C. All materials and equipment used to construct this item shall be submitted to the ***OAR*** ~~RPR~~ for approval prior to ordering the equipment. Submittals consisting of marked catalog sheets or shop drawings shall be provided. Submittal data shall be presented in a clear, precise and thorough manner. Original catalog sheets are preferred. Photocopies are acceptable provided they are as good a quality as the original. Clearly and boldly mark each copy to identify products or models applicable to this project. Indicate all optional equipment and delete any non-pertinent data. Submittals for components of electrical equipment and systems shall identify the equipment to which they apply on each submittal sheet. Markings shall be made bold and clear with arrows or circles (highlighting is not acceptable). The Contractor is solely responsible for delays in the project that may accrue directly or indirectly from late submissions or resubmissions of submittals.

D. d. The data submitted shall be sufficient, in the opinion of the ***OAR*** ~~RPR~~, to determine compliance with the plans and specifications. The Contractor's submittals shall be electronically submitted in pdf format, tabbed by specification section. The ***OAR*** ~~RPR~~ reserves the right to reject any and all equipment, materials or procedures that do not meet the system design and the standards and codes, specified in this document.

E. All equipment and materials furnished and installed under this section shall be guaranteed against defects in materials and workmanship for a period of at least twelve (12) months from the date of final acceptance by the Owner. The defective materials and/or equipment shall be repaired or replaced, at the Owner's discretion, with no additional cost to the Owner.

2.2 CONCRETE STRUCTURES

Concrete shall be proportioned, placed, and cured per Item P-610, Concrete for Miscellaneous Structures. Cast-in-place concrete structures shall be as shown on the plans.

2.3 PRECAST CONCRETE STRUCTURES

Precast concrete structures shall be furnished by a plant meeting National Precast Concrete Association Plant Certification Program or another engineer approved third party certification program. Provide precast concrete structures where shown on the plans.

Precast concrete structures shall be an approved standard design of the manufacturer. Precast units shall have mortar or bitumastic sealer placed between all joints to make them watertight. The structure shall be designed to withstand 100,000 lb aircraft loads, unless otherwise shown on the plans. Openings or knockouts shall be provided in the structure as detailed on the plans.

Threaded inserts and pulling eyes shall be cast in as shown on the plans.

If the Contractor chooses to propose a different structural design, signed and sealed shop drawings, design calculations, and other information requested by the ***OAR*** ~~RPR~~ shall be submitted by the Contractor to allow for a full evaluation by the ***OAR*** ~~RPR~~. The ***OAR*** ~~RPR~~ shall review per the process defined in the General Provisions.

2.4 JUNCTION BOXES

Junction boxes shall be L-867 Class 1 (non-load bearing) or L-868 Class 1 (load bearing) airport light bases that are encased in concrete. The light bases shall have a L-894 blank cover, gasket, and stainless steel hardware. All bolts, studs, nuts, lock washers, and other similar fasteners used for the light fixture assemblies must be fabricated from 316L (equivalent to EN 1.4404), 18-8, 410, or 416 stainless steel. If 18-8, 410, or 416 stainless steel is utilized it shall be passivated and be free from any discoloration. Covers shall be 3/8-inch (9-mm) thickness for L-867 and 3/4-inch (19-mm) thickness for L-868. All junction boxes shall be provided with both internal and external ground lugs.

2.5 MORTAR

The mortar shall be composed of one part of cement and two parts of mortar sand, by volume. The cement shall be per the requirements in ASTM C150, Type I. The sand shall be per the requirements in ASTM C144. Hydrated lime may be added to the mixture of sand and cement in an amount not to exceed 15% of the weight of cement used. The hydrated lime shall meet the requirements of ASTM C206. Water shall be potable, reasonably clean and free of oil, salt, acid, alkali, sugar, vegetable, or other substances injurious to the finished product.

2.6 CONCRETE

Concrete shall be proportioned, placed and cured per Item P-610, Concrete for Miscellaneous Structures.

2.7 FRAMES AND COVERS

The frames shall conform to one of the following requirements:

A.	ASTM A48	Gray iron castings
B.	ASTM A47	Malleable iron castings
C.	ASTM A27	Steel castings
D.	ASTM A283, Grade D	Structural steel for grates and frames
E.	ASTM A536	Ductile iron castings
F.	ASTM A897	Austempered ductile iron castings

All castings specified shall withstand a maximum tire pressure of 250 psi and maximum load of 100,000 lbs.

All castings or structural steel units shall conform to the dimensions shown on the plans and shall be designed to support the loadings specified.

Each frame and cover unit shall be provided with fastening members to prevent it from being dislodged by traffic, but which will allow easy removal for access to the structure.

All castings shall be thoroughly cleaned. After fabrication, structural steel units shall be galvanized to meet the requirements of ASTM A123.

Each cover shall have the word “ELECTRIC” or other approved designation cast on it. Each frame and cover shall be as shown on the plans or approved equivalent. No cable notches are required.

Each manhole shall be provided with a “DANGER -- PERMIT-REQUIRED CONFINED SPACE, DO NOT ENTER” safety warning sign as detailed in the Contract Documents and in accordance with OSHA 1910.146 (c)(2).

2.8 LADDERS Not used.

2.9 REINFORCING STEEL

All reinforcing steel shall be deformed bars of new billet steel meeting the requirements of ASTM A615, Grade 60.

2.10 BEDDING/SPECIAL BACKFILL

Bedding or special backfill shall be as shown on the plans.

2.11 FLOWABLE BACKFILL

Flowable material used to backfill shall conform to the requirements of Item P-153, Controlled Low Strength Material.

2.12 CABLE TRAYS Not used.

2.13 PLASTIC CONDUIT

Plastic conduit shall comply with Item L-110, Airport Underground Electrical Duct Banks and Conduits.

2.14 CONDUIT TERMINATORS

Conduit terminators shall be pre-manufactured for the specific purpose and sized as required or as shown on the plans.

2.15 PULLING-IN IRONS

Pulling-in irons shall be manufactured with 7/8-inch (22 mm) diameter hot-dipped galvanized steel or stress-relieved carbon steel roping designed for concrete applications (7 strand, 1/2-inch (12 mm) diameter with an ultimate strength of 270,000 psi (1862 MPa)). Where stress-relieved carbon steel roping is used, a rustproof sleeve shall be installed at the hooking point and all exposed surfaces shall be encapsulated with a polyester coating to prevent corrosion.

2.16 GROUND RODS

Ground rods shall be one piece copper clad steel. The ground rods shall be of the length and diameter specified on the plans, but in no case shall they be less than 10 feet long nor less than 3/4 inch in diameter.

PART 3 - CONSTRUCTION METHODS

3.1 UNCLASSIFIED EXCAVATION

It is the Contractor's responsibility to locate existing utilities within the work area prior to excavation. Damage to utility lines, through lack of care in excavating, shall be repaired or replaced to the satisfaction of the ***OAR*** ~~RPR~~ without additional expense to the Owner.

The Contractor shall perform excavation for structures and structure footings to the lines and grades or elevations shown on the plans or as staked by the ***OAR*** ~~RPR~~. The excavation shall be of sufficient size to permit the placing of the full width and length of the structure or structure footings shown.

All excavation shall be unclassified and shall be considered incidental to Item L-115. Dewatering necessary for structure installation and erosion per federal, state, and local requirements is incidental to Item L-115.

Boulders, logs and all other objectionable material encountered in excavation shall be removed. All rock and other hard foundation material shall be cleaned of all loose material and cut to a firm surface either level, stepped or serrated, as directed by the ***OAR*** ~~RPR~~. All seams, crevices, disintegrated rock and thin strata shall be removed. When concrete is to rest on a surface other than rock, special care shall be taken not to disturb the bottom of the excavation. Excavation to final grade shall not be made until just before the concrete or reinforcing is to be placed.

The Contractor shall provide all bracing, sheeting and shoring necessary to implement and protect the excavation and the structure as required for safety or conformance to governing laws. The cost of bracing, sheeting and shoring shall be included in the unit price bid for the structure.

Unless otherwise provided, bracing, sheeting and shoring involved in the construction of this item shall be removed by the Contractor after the completion of the structure. Removal shall be effected in a manner that will not disturb or mar finished masonry. The cost of removal shall be included in the unit price bid for the structure.

After each excavation is completed, the Contractor shall notify the ***OAR*** ~~RPR~~. Structures shall be placed after the ***OAR*** ~~RPR~~ has approved the depth of the excavation and the suitability of the foundation material.

Prior to installation the Contractor shall provide a minimum of 6 inches (150 mm) of sand or a material approved by the ***OAR*** ~~RPR~~ as a suitable base to receive the structure. The base material shall be compacted and graded level and at proper elevation to receive the structure in proper relation to the conduit grade or ground cover requirements, as indicated on the plans.

3.2 CONCRETE STRUCTURES

Concrete structures shall be built on prepared foundations conforming to the dimensions and form indicated on the plans. The concrete and construction methods shall conform to the requirements specified in Item P-610. Any reinforcement required shall be placed as indicated on the plans and shall be approved by the ***OAR*** ~~RPR~~ before the concrete is placed.

3.3 PRECAST UNIT INSTALLATIONS

Precast units shall be installed plumb and true. Joints shall be made watertight by use of sealant at each tongue-and-groove joint and at roof of manhole. Excess sealant shall be removed and severe surface projections on exterior of neck shall be removed.

3.4 PLACEMENT AND TREATMENT OF CASTINGS, FRAMES AND FITTINGS

All castings, frames and fittings shall be placed in the positions indicated on the Plans or as directed by the ***OAR*** ~~RPR~~ and shall be set true to line and to correct elevation. If frames or fittings are to be set in concrete or cement mortar, all anchors or bolts shall be in place and position before the concrete or mortar is placed. The unit shall not be disturbed until the mortar or concrete has set.

Field connections shall be made with bolts, unless indicated otherwise. Welding will not be permitted unless shown otherwise on the approved shop drawings and written approval is granted by the casting manufacturer. Erection equipment shall be suitable and safe for the workman. Errors in shop fabrication or deformation resulting from handling and transportation that prevent the proper assembly and fitting of parts shall be reported immediately to the ***OAR*** ~~RPR~~ and approval of the method of correction shall be obtained. Approved corrections shall be made at Contractor’s expense.

Anchor bolts and anchors shall be properly located and built into connection work. Bolts and anchors shall be preset by the use of templates or such other methods as may be required to locate the anchors and anchor bolts accurately.

Pulling-in irons shall be located opposite all conduit entrances into structures to provide a strong, convenient attachment for pulling-in blocks when installing cables. Pulling-in irons shall be set directly into the concrete walls of the structure.

3.5 INSTALLATION OF LADDERS

Ladders shall be installed such that they may be removed if necessary. Mounting brackets shall be supplied top and bottom and shall be cast in place during fabrication of the structure or drilled and grouted in place after erection of the structure.

3.6 REMOVAL OF SHEETING AND BRACING

In general, all sheeting and bracing used to support the sides of trenches or other open excavations shall be withdrawn as the trenches or other open excavations are being refilled. That portion of the sheeting extending below the top of a structure shall be withdrawn, unless otherwise directed, before more than 6 inches (150 mm) of material is placed above the top of the structure and before any bracing is removed. Voids left by the sheeting shall be carefully refilled with selected material and rammed tight with tools especially adapted for the purpose or otherwise as may be approved.

The ***OAR*** ~~RPR~~ may direct the Contractor to delay the removal of sheeting and bracing if, in his judgment, the installed work has not attained the necessary strength to permit placing of backfill.

3.7 BACKFILLING

After a structure has been completed, the area around it shall be backfilled in horizontal layers not to exceed 6 inches (150 mm) in thickness measured after compaction to the density requirements in Item P-152. Each layer shall be deposited all around the structure to approximately the same elevation. The top of the fill shall meet the elevation shown on the plans or as directed by the ***OAR*** ~~RPR~~.

Backfill shall not be placed against any structure until approval is given by the ***OAR*** ~~RPR~~. In the case of concrete, such approval shall not be given until tests made by the laboratory under supervision of the ***OAR*** ~~RPR~~ establish that the concrete has attained sufficient strength to provide a factor of safety against damage or strain in withstanding any pressure created by the backfill or the methods used in placing it.

Where required, the ***OAR*** ~~RPR~~ may direct the Contractor to add, at his own expense, sufficient water during compaction to assure a complete consolidation of the backfill. The Contractor shall be responsible for all damage or injury done to conduits, duct banks, structures, property or persons due to improper placing or compacting of backfill.

3.8 CONNECTION OF DUCT BANKS

To relieve stress of joint between concrete-encased duct banks and structure walls, reinforcement rods shall be placed in the structure wall and shall be formed and tied into duct bank reinforcement at the time the duct bank is installed.

3.9 GROUNDING

A ground rod shall be installed in the floor of all concrete structures so that the top of rod extends 6 inches (150 mm) above the floor. The ground rod shall be installed within one foot (30 cm) of a corner of the concrete structure. Ground rods shall be installed prior to casting the bottom slab. Where the soil condition does not permit driving the ground rod into the earth without damage to the ground rod, the Contractor shall drill a 4-inch (100 mm) diameter hole into the earth to receive the ground rod. The hole around the ground rod shall be filled throughout its length, below slab, with Portland cement grout. Ground rods shall be installed in precast bottom slab of structures by drilling a hole through bottom slab and installing the ground rod. Bottom slab penetration shall be sealed watertight with Portland cement grout around the ground rod.

A grounding bus of 4/0 bare stranded copper shall be exothermically bonded to the ground rod and loop the concrete structure walls. The ground bus shall be a minimum of one foot (30 cm) above the floor of the structure and separate from other cables. No. 2 American wire gauge (AWG) bare copper pigtails shall bond the grounding bus to all cable trays and other metal hardware within the concrete structure. Connections to the grounding bus shall be exothermic. If an exothermic weld is not possible, connections to the grounding bus shall be made by using connectors approved for direct burial in soil or concrete per UL 467. Hardware connections may be mechanical, using a lug designed for that purpose.

3.10 CLEANUP AND REPAIR

After erection of all galvanized items, damaged areas shall be repaired by applying a liquid cold-galvanizing compound per MIL-P-21035. Surfaces shall be prepared and compound applied per the manufacturer’s recommendations.

Prior to acceptance, the entire structure shall be cleaned of all dirt and debris.

3.11 RESTORATION

After the backfill is completed, the Contractor shall dispose of all surplus material, dirt and rubbish from the site. The Contractor shall restore all disturbed areas equivalent to or better than their original condition. All sodding, grading and restoration shall be considered incidental to the respective Item L-115 pay item.

The Contractor shall grade around structures as required to provide positive drainage away from the structure.

Areas with special surface treatment, such as roads, sidewalks, or other paved areas shall have backfill compacted to match surrounding areas, and surfaces shall be repaired using materials comparable to original materials.

Following restoration of all trenching near airport movement surfaces, the Contractor shall thoroughly visually inspect the area for foreign object debris (FOD), and remove any such FOD that is found. This FOD inspection and removal shall be considered incidental to the pay item of which it is a component part.

After all work is completed, the Contractor shall remove all tools and other equipment, leaving the entire site free, clear and in good condition.

3.12 INSPECTION

Prior to final approval, the electrical structures shall be thoroughly inspected for conformance with the plans and this specification. Any indication of defects in materials or workmanship shall be further investigated and corrected. The earth resistance to ground of each ground rod shall not exceed 10 ~~25~~ ohms. Each ground rod shall be tested using the fall-of-potential ground impedance test per American National Standards Institute / Institute of Electrical and Electronic Engineers (ANSI/IEEE) Standard 81. This test shall be performed prior to establishing connections to other ground electrodes.

3.13 MANHOLE ELEVATION ADJUSTMENTS Not used**.**

3.14 DUCT EXTENSION TO EXISTING DUCTS

Where existing concrete encased ducts are to be extended, the duct extension shall be concrete encased plastic conduit. The fittings to connect the ducts together shall be standard manufactured connectors designed and approved for the purpose. The duct extensions shall be installed according to the concrete encased duct detail and as shown on the plans.

PART 4 - METHOD OF MEASUREMENT

4.1 Electrical junction structures shall be measured by each unit completed in place and accepted. The following items shall be included in the price of each unit: All required excavation and dewatering; sheeting and bracing; all required backfilling with on-site materials; restoration of all surfaces and finished grading and turfing; all required connections; temporary cables and connections; and ground rod testing

PART 5 - BASIS OF PAYMENT

5.1 The accepted quantity of junction structures will be paid for at the Contract unit price per each, complete and in place. This price shall be full compensation for furnishing all materials and for all preparation, excavation, backfilling and placing of the materials, furnishing and installation of appurtenances and connections to duct banks and other

structures as may be required to complete the item as shown on the plans and for all labor, equipment, tools and incidentals necessary to complete the structure.

Payment will be made under:

Item L-115-5.1	Junction Can Plaza – Eight L-867D Cans	-- per Each (EA)
	This item includes all materials, labor, transportation, supervision, services and all incidentals required to provide and install a junction can plaza with L-867D, 24" deep light bases. Conduit, ground rods and counterpoise wire are paid under their respective pay items. This item includes all concrete, rebar, excavation, forming, backfill, sod, light bases, cover plates, hardware, identification tags, etc., and all appurtenances to construct a junction can plaza with eight light bases in accordance with the Contract Documents and to the satisfaction of the Engineer.	
Item L-115-5.2	Aircraft Rated Electrical Manhole Type A-1	-- per Each (EA)
	This item includes all materials, labor, transportation, supervision, services, ground rods and all incidentals required to provide and install an aircraft rated electrical manhole type A-1. This item includes all concrete, rebar, excavation, forming, backfill, sod, light bases, cover plates, hardware, identification tags, etc., and all appurtenances to construct an aircraft rated electrical manhole type A-1 in accordance with the Contract Documents and to the satisfaction of the Engineer.	
Item L-115-5.3	Aircraft Rated Electrical Manhole Type A-2	-- per Each (EA)
	This item includes all materials, labor, transportation, supervision, services, ground rods and all incidentals required to provide and install an aircraft rated electrical manhole type A-2. This item includes all concrete, rebar, excavation, forming, backfill, sod, light bases, cover plates, hardware, identification tags, etc., and all appurtenances to construct an aircraft rated electrical manhole type A-2 in accordance with the Contract Documents and to the satisfaction of the Engineer.	
Item L-115-5.4	Existing Aircraft Rated Electrical Manhole/Handhole/Junction Structure Elevation Adjustment up to and Including 5'x5' Inside Dimension	-- per Each (EA)

REFERENCES

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

American National Standards Institute / Insulated Cable Engineers Association (ANSI/ICEA)

ANSI/IEEE STD 81	IEEE Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System

Advisory Circular (AC)

AC 150/5345-7	Specification for L-824 Underground Electrical Cable for Airport Lighting Circuits
AC 150/5345-26	Specification for L-823 Plug and Receptacle, Cable Connectors
AC 150/5345-42	Specification for Airport Light Bases, Transformer Housings, Junction Boxes, and Accessories
AC 150/5340-30	Design and Installation Details for Airport Visual Aids
AC 150/5345-53	Airport Lighting Equipment Certification Program

Commercial Item Description (CID)

A-A 59544	Cable and Wire, Electrical (Power, Fixed Installation)

ASTM International (ASTM)

ASTM A27	Standard Specification for Steel Castings, Carbon, for General Application
ASTM A47	Standard Specification for Ferritic Malleable Iron Castings
ASTM A48	Standard Specification for Gray Iron Castings
ASTM A123	Standard Specification for Zinc (Hot Dip Galvanized) Coatings on Iron and Steel Products
ASTM A283	Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates
ASTM A536	Standard Specification for Ductile Iron Castings
ASTM A615	Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
ASTM A897	Standard Specification for Austempered Ductile Iron Castings

ASTM C144 Standard Specification for Aggregate for Masonry Mortar

ASTM C150 Standard Specification for Portland Cement

ASTM C206 Standard Specification for Finishing Hydrated Lime

FAA Engineering Brief (EB)

EB #83 In Pavement Light Fixture Bolts

Mil Spec

MIL-P-21035 Paint High Zinc Dust Content, Galvanizing Repair

National Fire Protection Association (NFPA)

NFPA-70 National Electrical Code (NEC)

END OF SECTION L-115

SECTION L-125 - INSTALLATION OF AIRPORT LIGHTING SYSTEMS

PART 1 - DESCRIPTION

1.1 This item shall consist of airport lighting systems furnished and installed in accordance with this specification, the referenced specifications, and the applicable advisory circulars (ACs). The systems shall be installed at the locations and in accordance with the dimensions, design, and details shown in the plans. This item shall include the furnishing of all equipment, materials, services, and incidentals necessary to place the systems in operation as completed units to the satisfaction of the ***OAR*** ~~RPR~~.

PART 2 - EQUIPMENT AND MATERIALS

2.1 GENERAL

A. Airport lighting equipment and materials covered by Federal Aviation Administration (FAA) specifications shall be certified under the Airport Lighting Equipment Certification Program in accordance with AC 150/5345-53, current version. FAA certified airfield lighting shall be compatible with each other to perform in compliance with FAA criteria and the intended operation. If the Contractor provides equipment that does not performs as intended because of incompatibility with the system, the Contractor assumes all costs to correct the system for to operate properly.

B. Manufacturer's certifications shall not relieve the Contractor of their responsibility to provide materials in accordance with these specifications and acceptable to the ***OAR*** ~~RPR~~. Materials supplied and/or installed that do not comply with these specifications shall be removed, when directed by the ***OAR*** ~~RPR~~ and replaced with materials, which do comply with these specifications, at the sole cost of the Contractor.

C. All materials and equipment used shall be submitted to the ***OAR*** ~~RPR~~ for approval prior to ordering the equipment. Submittals consisting of marked catalog sheets or shop drawings shall be provided. Clearly mark each copy to identify pertinent products or models applicable to this project. Indicate all optional equipment and delete non-pertinent data. Submittals for components of electrical equipment and systems shall identify the equipment for which they apply on each submittal sheet. Markings shall be clearly made with arrows or circles (highlighting is not acceptable). The Contractor shall be responsible for delays in the project accruing directly or indirectly from late submissions or resubmissions of submittals.

D. The data submitted shall be sufficient, in the opinion of the ***OAR*** ~~RPR~~, to determine compliance with the plans and specifications. The Contractor's submittals shall be submitted in electronic PDF format, tabbed by specification section. The ***OAR*** ~~RPR~~ reserves the right to reject any or all equipment, materials or procedures, which, in the ***OAR's*** ~~RPR's~~ opinion, does not meet the system design and the standards and codes, specified herein.

E. All equipment and materials furnished and installed under this section shall be guaranteed against defects in materials and workmanship for a period of at least twelve (12) months from final acceptance by the Owner. The defective materials and/or equipment shall be repaired or replaced, at the Owner's discretion, with no additional cost to the Owner.

All LED light fixtures, with the exception of obstruction lighting (AC 150/5345-43) must be warranted by the manufacturer for a minimum of 4 years after date of installation inclusive of all electronics." Obstruction lighting warranty is set by the individual manufacturer.

2.2 CONDUIT/DUCT

Conduit shall conform to Specification Item L-110 Airport Underground Electrical Duct Banks and Conduits.

2.3 CABLE AND COUNTERPOISE

Cable and Counterpoise shall conform to Item L-108 Underground Power Cable for Airports.

2.4 TAPE

Rubber and plastic electrical tapes shall be Scotch Electrical Tape Numbers 23 and 88 respectively, as manufactured by 3M Company or an approved equal.

2.5 CABLE CONNECTIONS

Cable Connections shall conform to Item L-108 Installation of Underground Cable for Airports.

2.6 RETROREFLECTIVE MARKERS

Retroreflective markers shall be type L-853 and shall conform to the requirements of AC 150/5345-39.

2.7 RUNWAY AND TAXIWAY LIGHTS

Runway and taxiway lights shall conform to the requirements of AC 150/5345-46. Lamps shall be of size and type indicated, or as required by fixture manufacturer for each lighting fixture required under this contract. Filters shall be of colors conforming to the specification for the light concerned or to the standard referenced.

Lights

Type	Class	Mode	Style	Option	Base	Filter	Transformer	Notes
L-852C(L)	2	1	3		L-868B	BI-GREEN/GREEN	L-830	
L-852D(L)	2	1	3		L-868B	BI-GREEN/GREEN	L-830	
L-852T(L)	2	1	3		L-868B	BI-RED	L-830	
L-861T(L)		1			L-867B/D	BI-BLUE	L-830	14” MAX
L-861T(L)		1			L-868B	BI-BLUE	L-830	14” MAX

2.8 RUNWAY AND TAXIWAY SIGNS

Runway and Taxiway Guidance Signs should conform to the requirements of AC 150/5345-44.

Signs

Type	Size	Style	Class	Mode	Notes
L-858Y,R, L(L)	3	*5* ~~3~~	1	2	

2.9 RUNWAY END IDENTIFIER LIGHT (REIL) Not required.

2.10 PRECISION APPROACH PATH INDICATOR (PAPI) Not required.

2.11 CIRCUIT SELECTOR CABINET Not required.

2.12 LIGHT BASE AND TRANSFORMER HOUSINGS

Light Base and Transformer Housings should conform to the requirements of AC 150/5345-42. Light bases shall be Type L-867 or L-868, Class 1A, Size B or D, shall be provided as indicated or as required to accommodate the fixture or device installed thereon. Base plates, cover plates, and adapter plates shall be provided to accommodate various sizes of fixtures.

2.13 ISOLATION TRANSFORMERS

Isolation Transformers shall be Type L-830, size as required for each installation. Transformer shall conform to AC 150/5345-47.

PART 3 - INSTALLATION

3.1 INSTALLATION

The Contractor shall furnish, install, connect and test all equipment, accessories, conduit, cables, wires, buses, grounds and support items necessary to ensure a complete and operable airport lighting system as specified here and shown in the plans.

The equipment installation and mounting shall comply with the requirements of the National Electrical Code and state and local code agencies having jurisdiction.

The Contractor shall install the specified equipment in accordance with the applicable advisory circulars and the details shown on the plans.

3.2 TESTING

All lights shall be fully tested by continuous operation for not less than 24 hours as a completed system prior to acceptance. The test shall include operating the constant current regulator in each step not less than 10 times at the beginning and end of the 24-hour test. The fixtures shall illuminate properly during each portion of the test.

3.3 SHIPPING AND STORAGE

Equipment shall be shipped in suitable packing material to prevent damage during shipping. Store and maintain equipment and materials in areas protected from weather and physical damage. Any equipment and materials, in the opinion of the ***OAR*** ~~RPR~~, damaged during construction or storage shall be replaced by the Contractor at no additional cost to the owner. Painted or galvanized surfaces that are damaged shall be repaired in accordance with the manufacturer's recommendations.

3.4 ELEVATED AND IN-PAVEMENT LIGHTS

Water, debris, and other foreign substances shall be removed prior to installing fixture base and light.

A jig or holding device shall be used when installing each light fixture to ensure positioning to the proper elevation, alignment, level control, and azimuth control. Light fixtures shall be oriented with the light beams parallel to the runway or taxiway centerline and facing in the required direction. The outermost edge of fixture shall be level with the surrounding pavement. Surplus sealant or flexible embedding material shall be removed. The holding device shall remain in place until sealant has reached its initial set.

PART 4 - METHOD OF MEASUREMENT

4.1 Taxiway lights will be measured by the number of each type installed as completed units in place, ready for operation, and accepted by the ***OAR*** ~~RPR~~. Guidance signs will be measured by the number of each type and size installed as completed units, in place, ready for operation, and accepted by the ***OAR*** ~~RPR~~.

PART 5 - BASIS OF PAYMENT

5.1 Payment will be made at the Contract unit price for each complete taxiway light or guidance sign installed by the Contractor and accepted by the ***OAR*** ~~RPR~~. This payment will be full compensation for furnishing all materials and for all preparation, assembly, and installation of these materials, and for all labor, equipment, tools and incidentals necessary to complete this item.

Payment will be made under:

Item L-125-5.1	L-852C(L) Bidirectional Green LED Taxiway Centerline Light (NE) L-852C(L), Bidirectional, green, LED, style 3, T/W centerline light, mounted on an existing L-868B deep light base utilizing existing spacer ring(s) (w/concrete ring), properly sized L-830 transformer, L-823 connectors, and all incidentals. Align and level as required.	-- per Each (EA)
Item L-125-5.2	L-852C(L) Bidirectional Green LED Taxiway Centerline Light (N) L-852C(L), Bidirectional, green, LED, style 3, T/W centerline light, mounted on a L-868B deep light base with ¾" nominal spacer ring (w/concrete ring), properly sized L-830 transformer, L-823 connectors, and all incidentals. Align and level as required.	-- per Each (EA)
Item L-125-5.3	L-852D(L) Bidirectional Green LED Taxiway Centerline Light (NE) L-852D(L), Bidirectional, green, LED, style 3, T/W centerline light, mounted on an existing L-868B deep light base utilizing existing spacer ring(s) (w/concrete ring), properly sized L-830 transformer, L-823 connectors, and all incidentals. Align and level as required.	-- per Each (EA)

Item L-125-5.4	L-852D(L) Bidirectional Green LED Taxiway Centerline Light (N) L-852D(L), Bidirectional, green, LED, style 3, T/W centerline light, mounted on a L-868B deep light base with ¾" nominal spacer ring (w/concrete ring), properly sized L-830 transformer, L-823 connectors, and all incidentals. Align and level as required.	-- per Each (EA)
Item L-125-5.5	L-852T(L) Omnidirectional, Red, LED In-Pavement, Taxiway Edge Light L-852T(L), Omnidirectional, red, LED, style 3, T/W edge light, mounted on an L-868B, 2 piece, deep light base with a properly sized spacer ring (w/concrete ring) and properly sized L-830 transformer, L-823 connectors, and all incidentals. Align and level as required.	-- per Each (EA)
Item L-125-5.6	L-858(L) Sign – Single/Double Face, LED, Size 3 - 2 Module L-858(L), Y,R,L sign, size 3 with LED Light Source installed on a concrete base with a L-867D 24" deep light base, with 1/2" thick galvanized steel cover plate and gasket, properly sized L-830 transformer(s), L-823 connectors, and all incidentals. Align and level as required.	-- per Each (EA)
Item L-125-5.7	L-858(L) Sign – Single/Double Face, LED, Size 3 - 3 Module L-858(L) Y,R,L sign, size 3 with LED Light Source installed on a concrete base with a L-867D 24" deep light base, with 1/2" thick galvanized steel cover plate and gasket, properly sized L-830 transformer(s), L-823 connectors, and all incidentals. Align and level as required.	-- per Each (EA)
Item L-125-5.8	L-858(L) Sign – Single/Double Face, LED, Size 3 - 4 Module L-858(L) Y,R,L sign, size 3 with LED Light Source installed on a concrete base with a L-867D 24" deep light base, with 1/2" thick galvanized steel cover plate and gasket, properly sized L-830 transformer(s), L-823 connectors, and all incidentals. Align and level as required.	-- per Each (EA)

Item L-125-5.9	L-861T(L) Omnidirectional, Blue, LED, Taxiway Edge Light (NE) L-861T(L), omnidirectional, blue, LED, MITL, T/W edge light, column mounted on an existing L-867B/D deep light base installed with a “corten” or accepted equivalent base plate with gasket, properly sized L-830 transformer, L-823 connectors, and all incidentals. The overall height shall be 14”. Align and level as required.	-- per Each (EA)
Item L-125-5.10	L-861T(L) Omnidirectional, Blue, LED, Taxiway Edge Light (N) L-861T(L), Omni-directional, blue, LED, MITL T/W edge light, column mounted on a L-867B/D deep light base with a "corten" or accepted equivalent base plate with gasket and properly sized L-830 transformer, L-823 connectors, and all incidentals. Align and level as required. The overall height shall be 14".	-- per Each (EA)
Item L-125-5.11	L-861T(L) Omnidirectional, Blue, LED, Taxiway Edge Light on L-868B Light base L-861T(L), Omni-directional, blue, LED, MITL T/W edge light, column mounted on a L-868B deep light base with a "corten" or accepted equivalent base plate with gasket and properly sized L-830 transformer, L-823 connectors, and all incidentals. Align and level as required. The overall height shall be 14".	-- per Each (EA)
Item L-125-5.12	L-868B Light base (N) L-868B 12" diameter 21" deep light base with a properly sized spacer ring (w/concrete ring) and a 3/4" galvanized steel blank cover and gasket secured with stainless steel bolts, and all incidentals. For use as light base for future in-pavement fixture. Align and level as required.	-- per Each (EA)
Item L-125-5.13	Field Lightning Arrestor Assembly This item includes all materials, labor, transportation, supervision and all incidentals to furnish and install a field lightning arrestor assembly in accordance with the Contract Documents.	-- per Each (EA)
Item L-125-5.14	Airfield Lighting Control System Modifications: Vendor	-- Allowance (AL)

This item includes vendor coordination and planning with contractor schedule for system upgrade and verify proper installation of A-RMS module and connection to existing A-RMS module. The vendor shall provide support as necessary to ensure scope is met and proper system operation. Vendor shall perform final System Acceptance Test (SAT) remotely with OAR and contractor.

Item L-125-5.15 Airfield Lighting Control System Modifications: Contractor -- Lump Sum (LS)

This item includes all coordination, materials, labor, supervision, and all incidentals required to modify the existing Airfield Lighting Control System (ALCS) including the L-821 control panel modifications in the Air Traffic Control Tower (ATCT), interconnection of the existing tower, vault computers and new Constant Current Regulators (CCR) and monitors, provide and install all controls and monitoring and all modifications necessary for a complete and operational Airfield Lighting Control System to provide a fully functional system in accordance with the Contract Documents. As a part of this pay item the Contractor shall furnish to the Owner a 1,000 foot reel of Beldon 9842 cable. The Contractor may use a portion of this cable for the connection of the new CCRs with the balance of the cable being turned over to the Owner.

Item L-125-5.16 RFID Fixture Association and Database: Vendor -- Allowance (AL)

This item includes RFID tags, the vendor being on site and associating each fixture in the project into the MALMS database, update the database in the GOAA Tablets and provide the SQL database for GOAA IT. Documentation, meeting time and commissioning of the MALMS updates are also included. Payment shall be made in accordance with completed vendor invoices.

Item L-125-5.17 RFID Fixture Association and Database: Contractor -- Lump Sum

This item includes escort and support for the RFID work.

REFERENCES

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

Advisory Circulars (AC)

AC 150/5340-18	Standards for Airport Sign Systems
AC 150/5340-26	Maintenance of Airport Visual Aid Facilities
AC 150/5340-30	Design and Installation Details for Airport Visual Aids
AC 150/5345-5	Circuit Selector Switch
AC 150/5345-7	Specification for L-824 Underground Electrical Cable for Airport Lighting Circuits
AC 150/5345-26	Specification for L-823 Plug and Receptacle, Cable Connectors
AC 150/5345-28	Precision Approach Path Indicator (PAPI) Systems
AC 150/5345-39	Specification for L-853, Runway and Taxiway Retroreflective Markers
AC 150/5345-42	Specification for Airport Light Bases, Transformer Housings, Junction Boxes, and Accessories
AC 150/5345-44	Specification for Runway and Taxiway Signs
AC 150/5345-46	Specification for Runway and Taxiway Light Fixtures
AC 150/5345-47	Specification for Series to Series Isolation Transformers for Airport Lighting Systems
AC 150/5345-51	Specification for Discharge-Type Flashing Light Equipment
AC 150/5345-53	Airport Lighting Equipment Certification Program

Engineering Brief (EB)

EB No. 67	Light Sources Other than Incandescent and Xenon for Airport and Obstruction Lighting Fixtures

END OF SECTION L-125

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Item T-901 Seeding

DESCRIPTION

901-1.1 This item shall consist of soil preparation, seeding **and/or hydroseeding** the areas shown on the plans or as directed by the ~~RPR~~ OAR in accordance with these specifications. ***Contractor is to adhere to FDOT SECTION 981 TURF MATERIALS.***

MATERIALS

901-2.1 Seed. The species and application rates of grass, legume, and cover-crop seed furnished shall be those stipulated herein. Seed shall conform to the requirements of Federal Specification JJJ-S-181, Federal Specification, Seeds, Agricultural.

Seed shall be furnished separately or in mixtures in standard containers labeled in conformance with the Agricultural Marketing Service (AMS) Seed Act and applicable state seed laws with the seed name, lot number, net weight, percentages of purity and of germination and hard seed, and percentage of maximum weed seed content clearly marked for each kind of seed. The Contractor shall furnish the RPR duplicate signed copies of a statement by the vendor certifying that each lot of seed has been tested by a recognized laboratory for seed testing within six (6) months of date of delivery. This statement shall include: name and address of laboratory, date of test, lot number for each kind of seed, and the results of tests as to name, percentages of purity and of germination, and percentage of weed content for each kind of seed furnished, and, in case of a mixture, the proportions of each kind of seed. Wet, moldy, or otherwise damaged seed will be rejected.

Seeds shall be applied as follows:

Seed Properties and Rate of Application

Seed	Minimum Seed Purity (Percent)	Minimum Germination (Percent)	Rate of Application lb/acre (or lb/1,000 S.F.)
Pensacola Bahia Seed	95% Live	80%	75 lb/acre
Bermuda Seed	95% Live	85%	75 lb/acre
Annual Ryegrass	95% Live	90%	50 lb/acre

Seeding shall be performed during the period between **April 1st** and **November 15th** inclusive, unless otherwise approved by the RPR.

901-2.1.1 Hydroseeding

Equipment shall have a built-in agitation system and operating capacity sufficient to agitate, suspend, and homogeneously mix a slurry containing organic mulching amendment plus fertilizer, chemical additives and solids.

a.	***GeoPerm Bonded Fiber Matrix (100% virgin wood fibers)***	***4,000 lbs/AC***
b.	***Aqua-pHix™ Hydro Formula– (for soils in excess of 8.5pH)***	***10 gal/AC***
c.	***JumpStart™ - soluble growth stimulant.***	***1.25 gal/AC***
d.	***BioPrime ™ - nitrogen rich biostimulant.***	***40 lbs/AC***
e.	***Pensacola Bahia seed – AOSCA certified, blue tag***	***75 lbs/AC***
f.	***Annual Ryegrass seed – AOSCA certified, blue tag***	***50 lbs/AC***
g.	***Bermuda seed – AOSCA certified, blue tag***	***75 lbs/AC***

Water

a. ***Apply hydroseeding when no rainfall is expected for 12 hours after application.***

b. ***Use clean, water free from substances which might inhibit plant growth. Water is to be provided or arranged for by the Contractor.***

Soils Test

The Contractor shall test soils for determining pH factor of soil. Submit results to Owner along with written plan to amend soil to pH suitable for selected seed mix design and designated amendments.

901-2.2 Lime. Lime shall be ground limestone containing not less than 85% of total carbonates, and shall be ground to such fineness that 90% will pass through a No. 20 (850 µm) mesh sieve and 50% will pass through a No. 100 (150 µm) mesh sieve. Coarser material will be acceptable, providing the rates of application are increased to provide not less than the minimum quantities and depth specified in the special provisions on the basis of the two sieve requirements above. Dolomitic lime or a high magnesium lime shall contain at least 10% of magnesium oxide. Lime shall be applied at the rate of **1,750 lbs. to 6,500 lbs. per acre**. All liming materials shall conform to the requirements of ASTM C602.

901-2.3 Fertilizer. Fertilizer shall be standard commercial fertilizers supplied separately or in mixtures containing the percentages of total nitrogen, available phosphoric acid, and water-soluble potash. They shall be applied at the rate and to the depth specified, and shall meet the requirements of applicable state laws. They shall be furnished in standard containers with name, weight, and guaranteed analysis of contents clearly marked thereon. No cyanamide compounds or hydrated lime shall be permitted in mixed fertilizers.

The fertilizers may be supplied in one of the following forms:

a. A dry, free-flowing fertilizer suitable for application by a common fertilizer spreader;

b. A finely-ground fertilizer soluble in water, suitable for application by power sprayers; or

c. A granular or pellet form suitable for application by blower equipment.

Fertilizers shall be ***in compliance with FDOT Section 982*** commercial fertilizer and shall be spread at the rate of ***no more than 0.25 lbs P_2O_5/1,000 square feet per application prior to planting or as directed by OAR***.

901-2.4 Soil for repairs. The soil for fill and topsoiling of areas to be repaired shall be at least of equal quality to that which exists in areas adjacent to the area to be repaired. The soil shall be relatively free from large stones, roots, stumps, or other materials that will interfere with subsequent sowing of seed, compacting, and establishing turf, and shall be approved by the RPR before being placed.

901.-2.4 Hydroseed Mix Design

The hydroseeding mix shall consist of a slurry combination of seed, mulch, fertilizer, tackifier, green dye, and other additives that will remain under rainy conditions and reduce erosion problems and seal the soil moisture. The mix design and application rates shall be as follow:

1. GeoPerm Bonded Fiber Matrix	***4,000 lbs/AC***
2. Aqua-pHix™ Hydro Formula	***10 gal/AC (if necessary)***
3. JumpStart™	***1.25 gal/AC***
4. BioPrime ™	***40 lbs/AC***
5. Pensacola Bahia seed	***75 lbs/AC***
6. Annual Ryegrass seed	***50 lbs/AC***
7. Bermuda seed	***75 lbs/AC***

Seeding shall be performed during the period between April 1 and November 15 inclusive, unless otherwise approved by the OAR.

CONSTRUCTION METHODS

901-3.1 Advance preparation and cleanup. After grading of areas has been completed and before applying fertilizer and ground limestone, areas to be seeded shall be raked or otherwise cleared of stones larger than 2 inches (50 mm) in any diameter, sticks, stumps, and other debris that might interfere with sowing of seed, growth of grasses, or subsequent maintenance of grass-covered areas. If any damage by erosion or other causes has occurred after the completion of grading and before beginning the application of fertilizer and ground limestone, the Contractor shall repair such damage include filling gullies, smoothing irregularities, and repairing other incidental damage.

An area to be seeded shall be considered a satisfactory seedbed without additional treatment if it has recently been thoroughly loosened and worked to a depth of not less than 5 inches (125 mm) as a result of grading operations and, if immediately prior to seeding, the top 3 inches (75 mm) of soil is loose, friable, reasonably free from large clods, rocks, large roots, or other undesirable matter, and if shaped to the required grade.

When the area to be seeded is sparsely sodded, weedy, barren and unworked, or packed and hard, any grass and weeds shall first be cut or otherwise satisfactorily disposed of, and the soil then scarified or otherwise loosened to a depth not less than 5 inches (125 mm). Clods shall be broken and the top 3 inches (75 mm) of soil shall be worked into a satisfactory seedbed by discing, or by use of cultipackers, rollers, drags, harrows, or other appropriate means.

901-3.2 Dry application method.

a. Liming. Lime shall be applied separately and prior to the application of any fertilizer or seed and only on seedbeds that have previously been prepared as described above. The lime shall then be worked into the top 3 inches (75 mm) of soil after which the seedbed shall again be properly graded and dressed to a smooth finish.

b. Fertilizing. Following advance preparations and cleanup fertilizer shall be uniformly spread at the rate that will provide not less than the minimum quantity stated in paragraph 901-2.3.

c. Seeding. Grass seed shall be sown at the rate specified in paragraph 901-2.1 immediately after fertilizing. The fertilizer and seed shall be raked within the depth range stated in the special provisions. Seeds of legumes, either alone or in mixtures, shall be inoculated before mixing or sowing, in accordance with the instructions of the manufacturer of the inoculant. When seeding is required at other than the seasons shown on the plans or in the special provisions, a cover crop shall be sown by the same methods required for grass and legume seeding.

d. Rolling. After the seed has been properly covered, the seedbed shall be immediately compacted by means of an approved lawn roller, weighing 40 to 65 pounds per foot (60 to 97 kg per meter) of width for clay soil (or any soil having a tendency to pack), and weighing 150 to 200 pounds per foot (223 to 298 kg per meter) of width for sandy or light soils.

901-3.3 Wet application method.

a. General. The Contractor may elect to apply seed and fertilizer (and lime, if required) by spraying them on the previously prepared seedbed in the form of an aqueous mixture and by using the methods and equipment described herein. The rates of application shall be as specified in the special provisions.

b. Spraying equipment. The spraying equipment shall have a container or water tank equipped with a liquid level gauge calibrated to read in increments not larger than 50 gallons (190 liters) over the entire range of the tank capacity, mounted so as to be visible to the nozzle operator. The container or tank shall also be equipped with a mechanical power-driven agitator capable of keeping all the solids in the mixture in complete suspension at all times until used.

The unit shall also be equipped with a pressure pump capable of delivering 100 gallons (380 liters) per minute at a pressure of 100 lb / sq inches (690 kPa). The pump shall be mounted in a line that will recirculate the mixture through the tank whenever it is not being sprayed from the nozzle. All pump passages and pipe lines shall be capable of providing clearance for 5/8 inch (16 mm) solids. The power unit for the pump and agitator shall have controls mounted so as to be accessible to the nozzle operator. There shall be an indicating pressure gauge connected and mounted immediately at the back of the nozzle.

The nozzle pipe shall be mounted on an elevated supporting stand in such a manner that it can be rotated through 360 degrees horizontally and inclined vertically from at least 20 degrees below to at least 60 degrees above the horizontal. There shall be a quick-acting, three-way control valve connecting the recirculating line to the nozzle pipe and mounted so that the nozzle operator can control and regulate the amount of flow of mixture delivered to the nozzle. At least three different types of nozzles shall be supplied so that mixtures may be properly sprayed over

distance varying from 20 to 100 feet (6 to 30 m). One shall be a close-range ribbon nozzle, one a medium-range ribbon nozzle, and one a long-range jet nozzle. For case of removal and cleaning, all nozzles shall be connected to the nozzle pipe by means of quick-release couplings.

In order to reach areas inaccessible to the regular equipment, an extension hose at least 50 feet (15 m) in length shall be provided to which the nozzles may be connected.

c. Mixtures. Lime, if required, shall be applied separately, in the quantity specified, prior to the fertilizing and seeding operations. Not more than 220 pounds (100 kg) of lime shall be added to and mixed with each 100 gallons (380 liters) of water. Seed and fertilizer shall be mixed together in the relative proportions specified, but not more than a total of 220 pounds (100 kg) of these combined solids shall be added to and mixed with each 100 gallons (380 liters) of water.

All water used shall be obtained from fresh water sources and shall be free from injurious chemicals and other toxic substances harmful to plant life. The Contractor shall identify to the RPR all sources of water at least two (2) weeks prior to use. The RPR may take samples of the water at the source or from the tank at any time and have a laboratory test the samples for chemical and saline content. The Contractor shall not use any water from any source that is disapproved by the RPR following such tests.

All mixtures shall be constantly agitated from the time they are mixed until they are finally applied to the seedbed. All such mixtures shall be used within two (2) hours from the time they were mixed or they shall be wasted and disposed of at approved locations.

d. Spraying. Lime, if required, shall be sprayed only upon previously prepared seedbeds. After the applied lime mixture has dried, the lime shall be worked into the top 3 inches (75 mm), after which the seedbed shall again be properly graded and dressed to a smooth finish.

Mixtures of seed and fertilizer shall only be sprayed upon previously prepared seedbeds on which the lime, if required, shall already have been worked in. The mixtures shall be applied by means of a high-pressure spray that shall always be directed upward into the air so that the mixtures will fall to the ground like rain in a uniform spray. Nozzles or sprays shall never be directed toward the ground in such a manner as might produce erosion or runoff.

Particular care shall be exercised to ensure that the application is made uniformly and at the prescribed rate and to guard against misses and overlapped areas. Proper predetermined quantities of the mixture in accordance with specifications shall be used to cover specified sections of known area.

Checks on the rate and uniformity of application may be made by observing the degree of wetting of the ground or by distributing test sheets of paper or pans over the area at intervals and observing the quantity of material deposited thereon.

On surfaces that are to be mulched as indicated by the plans or designated by the RPR, seed and fertilizer applied by the spray method need not be raked into the soil or rolled. However, on surfaces on which mulch is not to be used, the raking and rolling operations will be required after the soil has dried.

901-3.4 Maintenance of seeded areas. The Contractor shall protect seeded areas against traffic or other use by warning signs or barricades, as approved by the RPR. Surfaces gullied or otherwise damaged following seeding shall be repaired by regrading and reseeding as directed. The Contractor shall mow, water as directed, and otherwise maintain seeded areas in a satisfactory condition until final inspection and acceptance of the work.

When either the dry or wet application method outlined above is used for work done out of season, it will be required that the Contractor establish a good stand of grass of uniform color and density to the satisfaction of the RPR. A grass stand shall be considered adequate when bare spots are one square foot (0.01 sq m) or less, randomly dispersed, and do not exceed 3% of the area seeded. ***If at the time when the contract has been otherwise completed it is not possible to make an adequate determination of the color, density, and uniformity of such stand of grass, payment for the unaccepted portions of the areas seeded out of season will be withheld until such time as these requirements have been met.***

The Contractor will provide detailed, typewritten instructions and recommendations to be followed by the Owner for properly maintaining hydroseeding work for one full year following installation and maintenance period.

Begin maintenance as soon as each plant is in place and continue maintenance until all planting has passed final acceptance of the total facility by the Owner's Representative. Maintenance includes the following: spraying for insect control; watering; weeding; cultivating; removal of dead material; restoration of bare spots larger than one square foot; and other operations to keep seeded areas healthy while providing 100% coverage over bare soil.

Acceptance: Upon acceptance of hydroseeding operations, maintain all hydroseeded areas for a period of 90 calendar days as follows:

1. ***Germination Stage Irrigation: Approximately 25 hours after hydroseeding, initiate the watering sequence. Irrigate for a period of time that sufficiently moistens the soil to the depth of the slurry mulch, taking care not to wash away the slurry and seed. Perform frequent, light irrigation sessions until the seed has germinated. Repair all seed washings and erosion caused by irrigation.***
2. ***Establishment Stage Irrigation: After germination is visible over the entire hydroseeded area, begin to reduce the number of light irrigation sessions. The specific watering program must be approved by the Owner and Owner's representative.***

Fertilization: As allowed by the Owner, fertilize hydroseeded areas with an approved commercial fertilizer, 30 calendar days from the start of the maintenance period and continuing once every 60 calendar days until the completion of the 90 calendar day maintenance period.

Weeding: All concentrated developments of weed growth appearing in the hydroseeded planting areas during the maintenance period shall be removed at two (2) week intervals. The Contractor may elect to remove such concentrations of weeds manually or by an Owner-approved herbicide program.

Minimum Coverage and Acceptance:

1. ***Minimum Coverage: Final acceptance may be given at the end of the 90 calendar day maintenance period if an acceptable germination of turf and adequate plant establishment has been achieved, as determined by the Owner's Representative.***
2. ***Acceptance: Final approval and acceptance will be given in writing by the Owner's Representative following a final acceptance inspection. The Owner reserves the option to extend the maintenance period to achieve complete germination of all hydroseed areas with a uniform height, color, and density throughout.***

Site Layout

Stake out proposed hydroseeding locations and obtain approval of the Owner's Representative before beginning seeding operations.

Testing

a. ***Test soil as often as necessary to determine pH factor of untreated soil.***

b. ***Where test indicates adjustment of pH factor is required, adjust hydroseed amendments, as necessary, to adjust to proper pH factor. Submit final hydroseed mix design for approval prior to application.***

c. ***Keep record of:***

i) Locations where tests are made.

ii) Readings before corrections are made.

Soil Preparation

a. ***Apply specified herbicide at rates specified on product packaging.***

d. ***Surface preparation: Mix soil and additives to a depth of not less than 5 inches, rake smooth, and leave clean and ready for seeding.***

e. ***Water all hydroseed-designated areas thoroughly to saturate upper layers of soil prior to hydroseeding application.***

f. ***Allow the hydroseed-designated areas' surface to dry for one day only prior to the hydroseeding application. Drying period should allow for residual moisture within the first 1/4 inch of the soil surface. There shall be no standing water on the soil's surface at the time of the hydroseeding application.***

Protect areas outside of designated hydroseeded areas, but within the Owner's property during this work.

METHOD OF MEASUREMENT

901-4.1 The quantity of seeding to be paid for shall be the number of units acre measured on the ground surface, completed and accepted.

BASIS OF PAYMENT

901-5.1 Payment shall be made at the contract unit price per acre or fraction thereof, which price and payment shall be full compensation for furnishing and placing all material and for all labor, equipment, tools, and incidentals necessary to complete the work prescribed in this item.

Payment will be made under:

Item 901-5.1 Seeding - per acre

REFERENCES

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

ASTM International (ASTM)

ASTM C602 Standard Specification for Agricultural Liming Materials

Federal Specifications (FED SPEC)

FED SPEC JJJ-S-181, Federal Specification, Seeds, Agricultural

Advisory Circulars (AC)

AC 150/5200-33 Hazardous Wildlife Attractants on or Near Airports

FAA/United States Department of Agriculture

Wildlife Hazard Management at Airports, A Manual for Airport Personnel

END OF ITEM T-901

Item T-904 Sodding

DESCRIPTION

904-1.1 This item shall consist of furnishing, hauling, and placing approved live sod on prepared areas in accordance with this specification at the locations shown on the plans or as directed by the ~~RPR~~ **OAR**.

MATERIALS

904-2.1 Sod. Sod furnished by the Contractor shall have a good cover of living or growing grass. This shall be interpreted to include grass that is seasonally dormant during the cold or dry seasons and capable of renewing growth after the dormant period. All sod shall be obtained from areas where the soil is reasonably fertile and contains a high percentage of loamy topsoil. Sod shall be cut or stripped from living, thickly matted turf relatively free of weeds or other undesirable foreign plants, large stones, roots, or other materials that might be detrimental to the development of the sod or to future maintenance. At least 70% of the plants in the cut sod shall be composed of ~~the species stated in the special provisions~~ ***Pensacola Bahia grass***, and any vegetation more than 6 inches (150 mm) in height shall be mowed to a height of 3 inches (75 mm) or less before sod is lifted. Sod, including the soil containing the roots and the plant growth showing above, shall be cut uniformly to a thickness not less than that stated in the special provisions.

904-2.2 Lime. Lime shall be ground limestone containing not less than 85% of total carbonates, and shall be ground to such fineness that 90% will pass through a No. 20 (850 µm) mesh sieve and 50% will pass through a No. 100 (150 µm) mesh sieve. Coarser material will be acceptable, providing the rates of application are increased to provide not less than the minimum quantities and depth specified in the special provisions on the basis of the two sieve requirements above. Dolomitic lime or a high magnesium lime shall contain at least 10% of magnesium oxide. Lime shall be applied at the rate ~~of~~ ***conforming to the requirements of 901-2.2***. All liming materials shall conform to the requirements of ASTM C602.

904-2.3 Fertilizer. Fertilizer shall be standard commercial fertilizers supplied separately or in mixtures containing the percentages of total nitrogen, available phosphoric acid, and water-soluble potash. They shall be applied at the rate and to the depth specified, and shall meet the requirements of applicable state laws. They shall be furnished in standard containers with name, weight, and guaranteed analysis of contents clearly marked thereon. No cyanamide compounds or hydrated lime shall be permitted in mixed fertilizers.

The fertilizers may be supplied in one of the following forms:

a. A dry, free-flowing fertilizer suitable for application by a common fertilizer spreader;

b. A finely-ground fertilizer soluble in water, suitable for application by power sprayers; or

c. A granular or pellet form suitable for application by blower equipment.

Fertilizers ~~shall be commercial fertilizer and shall be spread at the rate of~~ ***conform to the requirements of 901-2.3***.

904-2.4 Water. The water shall be sufficiently free from oil, acid, alkali, salt, or other harmful materials that would inhibit the growth of grass.

904-2.5 Soil for repairs. The soil for fill and topsoiling of areas to be repaired shall be at least of equal quality to that which exists in areas adjacent to the area to be repaired. The soil shall be relatively free from large stones, roots, stumps, or other materials that will interfere with subsequent sowing of seed, compacting, and establishing turf, and shall be approved by the ~~RPR~~ **OAR** before being placed.

CONSTRUCTION METHODS

904-3.1 General. ~~Areas to be solid, strip, or spot sodded shall be shown on the plans.~~ ***All sod shall be laid solid and shall be done so in locations of disturbance as depicted in Contract Drawings.*** Areas requiring special ground surface preparation such as tilling and those areas in a satisfactory condition that are to remain undisturbed shall also be shown on the plans.

Suitable equipment necessary for proper preparation of the ground surface and for the handling and placing of all required materials shall be on hand, in good condition, and shall be approved by the ~~RPR~~ **OAR** before the various operations are started. The Contractor shall demonstrate to the ~~RPR~~ **OAR** before starting the various operations that the application of required materials will be made at the specified rates.

904-3.2 Preparing the ground surface. After grading of areas has been completed and before applying fertilizer and limestone, areas to be sodded shall be raked or otherwise cleared of stones larger than 2 inches (50 mm) in any diameter, sticks, stumps, and other debris which might interfere with sodding, growth of grasses, or subsequent maintenance of grass-covered areas. If any damage by erosion or other causes occurs after grading of areas and before beginning the application of fertilizer and ground limestone, the Contractor shall repair such damage. ~~This may include filling gullies, smoothing irregularities, and repairing other incidental damage.~~

904-3.3 Applying fertilizer and ground limestone. Following ground surface preparation, fertilizer shall be uniformly spread at a rate which will provide not less than the minimum quantity of each fertilizer ingredient, as stated in the special provisions. If use of ground limestone is required, it shall then be spread at a rate that will provide not less than the minimum quantity stated in the special provisions. These materials shall be incorporated into the soil to a depth of not less than 2 inches (50 mm) by discing, raking, or other suitable methods. Any stones larger than 2 inches (50 mm) in any diameter, large clods, roots, and other litter brought to the surface by this operation shall be removed.

904-3.4 Obtaining and delivering sod. After inspection and approval of the source of sod by the ~~RPR~~ **OAR**, the sod shall be cut with approved sod cutters to such a thickness that after it has been transported and placed on the prepared bed, but before it has been compacted, it shall have a uniform thickness of not less than 2 inches (50 mm). Sod sections or strips shall be cut in uniform widths, not less than 10 inches (250 mm), and in lengths of not less than 18 inches (0.5 m), but of such length as may be readily lifted without breaking, tearing, or loss of soil. Where strips are required, the sod must be rolled without damage with the grass folded inside. The Contractor may be required to mow high grass before cutting sod.

The sod shall be transplanted within 24 hours from the time it is stripped, unless circumstances beyond the Contractor’s control make storing necessary. In such cases, sod shall be stacked, kept moist, and protected from exposure to the air and sun and shall be kept from freezing. Sod shall be cut and moved only when the soil moisture conditions are such that favorable results can be expected. Where the soil is too dry, approval to cut sod may be granted only after it has been watered sufficiently to moisten the soil to the depth the sod is to be cut.

904-3.5 Laying sod. Sodding shall be performed only during the seasons when satisfactory results can be expected. Frozen sod shall not be used and sod shall not be placed upon frozen soil. Sod may be transplanted during periods of drought with the approval of the ~~RPR~~ **OAR**, provided the sod bed is watered to moisten the soil to a depth of at least 4 inches (100 mm) immediately prior to laying the sod.

The sod shall be moist and shall be placed on a moist earth bed. Pitch forks shall not be used to handle sod, and dumping from vehicles shall not be permitted. The sod shall be carefully placed by hand, edge to edge and with staggered joints, in rows at right angles to the slopes, commencing at the base of the area to be sodded and working upward. The sod shall immediately be pressed firmly into contact with the sod bed by tamping or rolling with approved equipment to provide a true and even surface, and ensure knitting without displacement of the sod or deformation of the surfaces of sodded areas. ***All sod shall be rolled within twenty-four (24) hours of placement.*** Where the sod may be displaced during sodding operations, the workmen, when replacing it, shall work from ladders or treaded planks to prevent further displacement. Screened soil of good quality shall be used to fill all cracks between sods. The quantity of the fill soil shall not cause smothering of the grass. Where the grades are such that the flow of water will be from paved surfaces across sodded areas, the surface of the soil in the sod after compaction shall be set approximately one inch (25 mm) below the pavement edge. Where the flow will be over the sodded areas and onto the paved surfaces around manholes and inlets, the surface of the soil in the sod after compaction shall be placed flush with pavement edges.

On slopes steeper than one (1) vertical to 2-1/2 horizontal and in v-shaped or flat-bottom ditches or gutters, the sod shall be pegged with wooden pegs not less than 12 inches (300 mm) in length and have a cross-sectional area of not less than 3/4 sq inch (18 sq mm). The pegs shall be driven flush with the surface of the sod.

904-3.6 Watering. Adequate water and watering equipment must be on hand before sodding begins, and sod shall be kept moist until it has become established and its continued growth assured. In all cases, watering shall be done in a manner that will avoid erosion from the application of excessive quantities and will avoid damage to the finished surface.

904-3.7 Establishing turf. The Contractor shall provide general care for the sodded areas as soon as the sod has been laid and shall continue until final inspection and acceptance of the work. All sodded areas shall be protected against traffic or other use by warning signs or barricades approved by the ~~RPR~~ **OAR**. The Contractor shall mow the sodded areas with approved mowing equipment, depending upon climatic and growth conditions and the needs for mowing specific areas. Weeds or other undesirable vegetation shall be mowed and the clippings raked and removed from the area.

904-3.8 Repairing. When the surface has become gullied or otherwise damaged during the period covered by this contract, the affected areas shall be repaired to re-establish the grade and the condition of the soil, as directed by the ~~RPR~~ **OAR**, and shall then be sodded as specified in paragraph 904-3.5.

904-3.9 Warranty. All new sod shall be warranted through the end of the construction period and for sixty (60) days following final acceptance.

METHOD OF MEASUREMENT

904-4.1 This item shall be measured on the basis of the area in square yards of the surface covered with sod and accepted.

BASIS OF PAYMENT

904-5.1 This item will be paid for on the basis of the contract unit price per square yard for sodding, which price shall be full compensation for all labor, equipment, material, staking, and incidentals necessary to satisfactorily complete the items as specified.

Payment will be made under:

Item T-904-5.1	Sodding - per square yard

REFERENCES

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

ASTM International (ASTM)

ASTM C602	Standard Specification for Agricultural Liming Materials

Advisory Circulars (AC)

AC 150/5200-33	Hazardous Wildlife Attractants on or Near Airports

FAA/United States Department of Agriculture

Wildlife Hazard Management at Airports, A Manual for Airport Personnel

END OF ITEM T-904

Item T-905 Topsoil

DESCRIPTION

905-1.1 This item shall consist of preparing the ground surface for topsoil application, removing topsoil from designated stockpiles or areas to be stripped on the site or from approved sources off the site, and placing and spreading the topsoil on prepared areas in accordance with this specification at the locations shown on the plans or as directed by the ~~RPR~~ **OAR**.

MATERIALS

905-2.1 Topsoil. Topsoil shall be the surface layer of soil with no admixture of refuse or any material toxic to plant growth, and it shall be reasonably free from subsoil and stumps, roots, brush, stones (2 inches (50 mm) or more in diameter), and clay lumps or similar objects. Brush and other vegetation that will not be incorporated with the soil during handling operations shall be cut and removed. Ordinary sod and herbaceous growth such as grass and weeds are not to be removed, but shall be thoroughly broken up and intermixed with the soil during handling operations. Heavy sod or other cover, which cannot be incorporated into the topsoil by discing or other means, shall be removed. The topsoil or soil mixture, unless otherwise specified or approved, shall have a pH range of approximately 5.5 pH to 7.6 pH, when tested in accordance with the methods of testing of the Association of Official Agricultural Chemists in effect on the date of invitation of bids. The organic content shall be not less than 3% nor more than 20% as determined by the wet-combustion method (chromic acid reduction). There shall be not less than 20% nor more than 80% of the material passing the 200 mesh (75 µm) sieve as determined by the wash test in accordance with ASTM C117.

Natural topsoil may be amended by the Contractor with approved materials and methods to meet the above specifications.

905-2.2 Inspection and tests. Within 10 days following acceptance of the bid, the ~~RPR~~ **OAR** shall be notified of the source of topsoil to be furnished by the Contractor. The topsoil shall be inspected to determine if the selected soil meets the requirements specified and to determine the depth to which stripping will be permitted. At this time, the Contractor may be required to take representative soil samples from several locations within the area under consideration and to the proposed stripping depths, for testing purposes as specified in paragraph 905-2.1.

CONSTRUCTION METHODS

905-3.1 General. Areas to be topsoiled shall be shown on the plans. If topsoil is available on the site, the location of the stockpiles or areas to be stripped of topsoil and the stripping depths shall be shown on the plans.

Suitable equipment necessary for proper preparation and treatment of the ground surface, stripping of topsoil, and for the handling and placing of all required materials shall be on hand, in good condition, and approved by the ~~RPR~~ **OAR** before the various operations are started.

905-3.2 Preparing the ground surface. Immediately prior to dumping and spreading the topsoil on any area, the surface shall be loosened by discs or spike-tooth harrows, or by other means approved by the ~~RPR~~ **OAR**, to a minimum depth of 2 inches (50 mm) to facilitate bonding of the topsoil to the covered subgrade soil. The surface of the area to be topsoiled shall be cleared of

all stones larger than 2 inches (50 mm) in any diameter and all litter or other material which may be detrimental to proper bonding, the rise of capillary moisture, or the proper growth of the desired planting. Limited areas, as shown on the plans, which are too compact to respond to these operations shall receive special scarification.

Grades on the area to be topsoiled, which have been established by others as shown on the plans, shall be maintained in a true and even condition. Where grades have not been established, the areas shall be smooth-graded and the surface left at the prescribed grades in an even and compacted condition to prevent the formation of low places or pockets where water will stand.

905-3.3 Obtaining topsoil. Prior to the stripping of topsoil from designated areas, any vegetation, briars, stumps and large roots, rubbish or stones found on such areas, which may interfere with subsequent operations, shall be removed using methods approved by the ~~RPR~~ **OAR**. Heavy sod or other cover, which cannot be incorporated into the topsoil by discing or other means shall be removed.

When suitable topsoil is available on the site, the Contractor shall remove this material from the designated areas and to the depth as directed by the ~~RPR~~ **OAR**. The topsoil shall be spread on areas already tilled and smooth-graded, or stockpiled in areas approved by the ~~RPR~~ **OAR**. Any topsoil stockpiled by the Contractor shall be rehandled and placed without additional compensation. Any topsoil that has been stockpiled on the site by others, and is required for topsoil purposes, shall be removed and placed by the Contractor. The sites of all stockpiles and areas adjacent thereto which have been disturbed by the Contractor shall be graded if required and put into a condition acceptable for seeding.

When suitable topsoil is secured off the airport site, the Contractor shall locate and obtain the supply, subject to the approval of the ~~RPR~~ **OAR**. The Contractor shall notify the ~~RPR~~ **OAR** sufficiently in advance of operations in order that necessary measurements and tests can be made. The Contractor shall remove the topsoil from approved areas and to the depth as directed. The topsoil shall be hauled to the site of the work and placed for spreading, or spread as required. ~~Any topsoil hauled to the site of the work and stockpiled shall be rehandled and placed without additional compensation.~~

905-3.4 Placing topsoil. The topsoil shall be evenly spread on the prepared areas to a uniform depth of 2 inches (50 mm) after compaction, unless otherwise shown on the plans or stated in the special provisions. Spreading shall not be done when the ground or topsoil is frozen, excessively wet, or otherwise in a condition detrimental to the work. Spreading shall be carried on so that turfing operations can proceed with a minimum of soil preparation or tilling.

After spreading, any large, stiff clods and hard lumps shall be broken with a pulverizer or by other effective means, and all stones or rocks (2 inches (50 mm) or more in diameter), roots, litter, or any foreign matter shall be raked up and disposed of by the Contractor. after spreading is completed, the topsoil shall be satisfactorily compacted by rolling with a cultipacker or by other means approved by the ~~RPR~~ **OAR**. The compacted topsoil surface shall conform to the required lines, grades, and cross-sections. Any topsoil or other dirt falling upon pavements as a result of hauling or handling of topsoil shall be promptly removed.

METHOD OF MEASUREMENT

905-4.1 Topsoil obtained on the site shall be measured by the number of cubic yards (cubic meters) of topsoil measured in its original position and stripped or excavated. Topsoil stockpiled by others and removed for topsoil by the Contractor shall be measured by the number of cubic

yards (cubic meters) of topsoil measured in the stockpile. Topsoil shall be measured by volume in cubic yards (cubic meters) computed by the method of end areas.

905-4.2 Topsoil obtained off the site shall be measured by the number of cubic yards (cubic meters) of topsoil measured in its original position and stripped or excavated. Topsoil shall be measured by volume in cubic yards (meters) computed by the method of end areas.

BASIS OF PAYMENT

905-5.1 Payment will be made at the contract unit price per cubic yard (cubic meter) for topsoil (obtained on the site). This price shall be full compensation for furnishing all materials and for all preparation, placing, and spreading of the materials, and for all labor, equipment, tools, and incidentals necessary to complete the item.

905-5.2 Payment will be made at the contract unit price per cubic yard (cubic meter) for topsoil (obtained off the site). This price shall be full compensation for furnishing all materials and for all preparation, placing, and spreading of the materials, and for all labor, equipment, tools, and incidentals necessary to complete the item.

Payment will be made under:

Item T-905-5.1	Topsoil (Obtained on Site or Removed from Stockpile - per cubic yard (cubic meter)
Item T-905-5.2	Topsoil (Furnished from Off the Site) - per cubic yard (cubic meter)

REFERENCES

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

ASTM International (ASTM)

ASTM C117	Materials Finer than 75 μm (No. 200) Sieve in Mineral Aggregates by Washing

Advisory Circulars (AC)

AC 150/5200-33	Hazardous Wildlife Attractants on or Near Airports

FAA/United States Department of Agriculture

Wildlife Hazard Management at Airports, A Manual for Airport Personnel

END OF ITEM T-905

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GREATER ORLANDO AVIATION AUTHORITY

ADDENDUM NO. 02

(Issued July 8, 2022)

TO THE BID DOCUMENTS FOR
BP-S196, TERM C, PH 1X – AIRFIELD CIVIL, APRON & TAXIWAY PAVING

ORLANDO INTERNATIONAL AIRPORT

July 8, 2022

ADDENDUM NO. 2

TO ALL HOLDERS OF CONTRACT DOCUMENTS

1. Your attention is directed to the following interpretations of, changes in, and/or additions to the contract documents for the above-named project
2. This addendum is part of the Contract Documents
3. Bidders are required to acknowledge receipt of this Addendum in the space provided on the Bid Form Section 00 41 13

Revised Specifications

The following Specifications have been modified by this Addendum:

- None

Revised Drawings

The following drawings have been revised by this Addendum and are included as attachments to this Addendum:

- None

BP-S196 Airfield Civil, Apron & Taxiway Paving: Pre-Bid Conference Minutes

The following has been included in this Addendum:

- BP-S196 Pre-Bid Presentation
- BP-S196 Pre-Bid Conference Attendance Sheet
- BP-S196 Pre-Bid Conference Questions/Answers
- Geotechnical Report
- WS110 Landside Civil Demo Plans
- Available Inventory List
- BP-S196 Airside Concourse Plan Holder's List

BP-S196 Pre-Bid Conference Questions/Answers

Question: Demolition shows utilities, lighting, etc, but is shown as lump sum?
Answer: Contractor means/methods. Demolish anything in the way of construction. Some material is available for reuse. Additional existing utility information provided in this addendum.

Question: Temporary pavement quantities seem to be incidental?
Answer: There is a small amount related to temporary roads during construction. Permanent roads are separate.

Question: Phase 1 shows 90 days, Phase 2 shows 365 days?
Answer: Updates to phasing sheets are being provided in this addendum. Phasing is up to contractor; finish the project within 365 days.

Question: When is NTP anticipated?
Answer: December 6, 2022. As stated in the bid documents, the bid guarantee period is 93 days, which means bids must stay valid through 10/27/22. Federal funding is anticipated in October. If funding is available earlier, an earlier NTP is possible.

Question: Can submittals be provided early to help meet schedule (specifically RON equipment?)
Answer: Yes.

Question: What utilities are available for contractor?
Answer: Near the previous project batch plant area, south of the proposed apron, water and power are available.

Question: Are there as-builts of utilities?
Answer: Utility as-builts are no longer relevant. Some utilities exist near the former trailer complex. Contractor can set up south of the former trailer complex if desired.

Question: Can the contractor use an empty trailer in the current trailer complex?
Answer: GOAA can provide trailer space for up to 20 personnel in an existing trailer.

Question: What are the milestone dates for utilities on the building side of the demarcation line?
Answer: Sanitary and water are installed. Contractor to install roof drain laterals, inlets, electrical fiber ducts, manholes, RON infrastructure.

Question: Is there a milestone date to install, to avoid impact to ASC contractor?
Answer: Coordination between contractors will be required to avoid impacts. The ASC project will still be under construction after the AFC project is complete.

Question: What is the budget?
Answer: $50 million for an all-in Program cost that includes all soft costs and owner-furnished items.

Question: Is the fuel system currently charged with fuel?
Answer: Yes, it is active and serving the existing adjacent apron. The existing fuel system was installed by Cherokee Enterprises and the tie-in must be coordinated.

Question: Is geotechnical information available?
Answer: The 2016 geotechnical investigation report will be issued in [Addendum 1]

Question: Is this project require only DBE?
Answer: Just DBE.

Question: Is there a civil component to the adjacent building jobs?
Answer: Yes, for both building jobs

Question: Is Virtual Ramp Control in this contract?
Answer: No, it is in the building contract.

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GREATER ORLANDO AVIATION AUTHORITY

BP-S196
TERM C, PH 1X AIRFIELD CIVIL, APRON & TAXIWAY PAVING

PRE-BID CONFERENCE

July 7th, 2022
11:00 AM EST

Agenda

- Owner / Introduction of Participants
- Project Requirements
  - Scope of Work
  - Safety Requirements
  - Time of Completion
  - Liquidated Damages
- Construction Document Package
- Bid Procedures and Requirements
  - Insurance Requirements
  - Bid Submittals / Bid Opening / Addenda

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Introduction of Participants

- **Davin Ruohomaki** Senior Director Engineering and Construction
- **Mark Birkebak** Director of Engineering
- **Scott Shedek** Director of Construction
- **Kathy Anderson** Manager Contracts and Grants
- **Edelis Molina** Senior Small Business Administrator
- **Ross Spence** Program Director
- **Christina Taylor** Project Manager
- **Bill Brooks** Design Program Director
- **JC Arteaga** Architect of Record
- **Erik Lange** Manager Design
- **Gunther Zurstadt** Design CA

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Project Requirements

Scope of Work

- Underground utilities on the ramp and airfield, including drainage, sanitary mains, water, and power
- Construction of all grading, base and pavement for ramp areas, remain overnight areas, taxiway extensions, construction of all pavement markings, taxiway signage, and airfield lighting
- Maintain the function of the current airfield as coordinated with Airfield Operations; provide all maintenance of traffic to phase the work and maintain access needed for airfield operations; maintain the integrity of the secure fence at all times and everything required by design intent to complete the project.

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Project Requirements (cont.)

Scope of Work (cont.)

- Safety Requirements
  - Contractor is required to be knowledgeable of all safety and security requirements, including employee badging requirements, outlined in the Contract Documents.

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Project Location

Airfield Civil, Apron & Taxiway Paving

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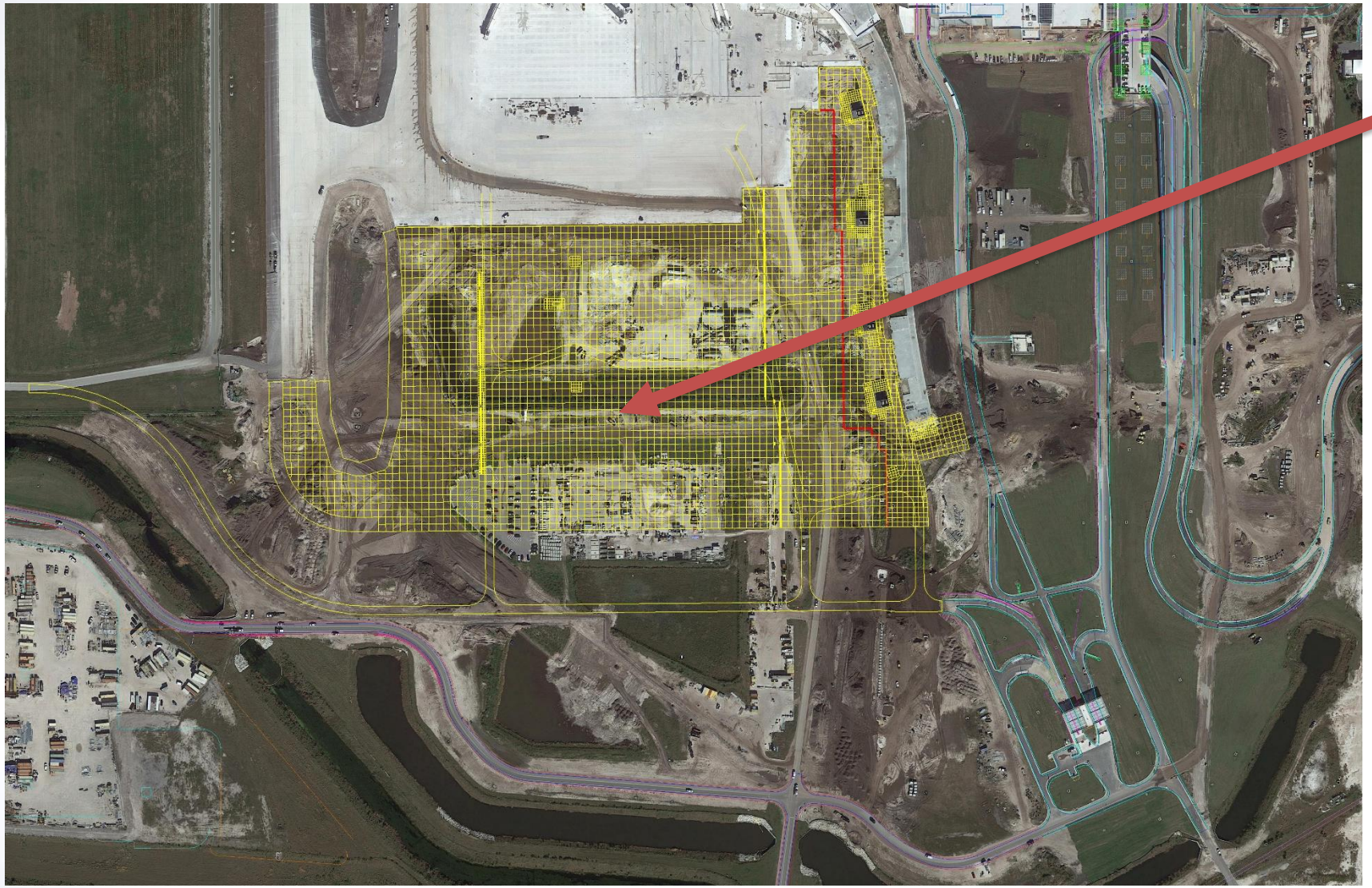
Project Location (cont.)



Apron & Taxiway Paving Project Limits

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Demarcation Line AFC vs ASC

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Project Requirements (cont.)

- Time of Completion
  - Base Bid will be **365** calendar days to Substantial Completion from the issuance of the Notice to Proceed.
  - Final Completion shall be achieved **120** calendar days from the date of actual Substantial Completion.

- Liquidated Damages
  - **$7,130** per calendar day past Substantial Completion Date, until actual Substantial Completion is achieved.
  - **$0** per calendar day past Final Completion Date, until Final Completion is achieved.

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Construction Documents

- Bid Documents available on **June 29, 2022**
- Documents available by emailing a request to Matthew Granlund at mgranlund@hntb.com. A link will be provided to download the Construction Documents & Specifications.
- Questions must be submitted in writing by:
  - Emailing the question(s) to **mgranlund@hntb.com**
  - Written questions must be received nine (9) calendar days prior to the bid date
  - Addendum will be issued (if necessary) five (5) calendar days prior to bid date

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DBE
GOOD FAITH EFFORTS (GFE)
49 CFR § 26.53

Project: BP-S196

TERM C, PH 1X AIRFIELD CIVIL, APRON & TAXIWAY PAVING

GREATER ORLANDO AVIATION AUTHORITY

Small Business Development Department

DBE Programs - Directories

Please visit the following for certified DBE requirements:

1. Greater Orlando Aviation Authority **(DBE):**
https://www.orlandoairports.net/airport-business/

2. FDOT **(DBE)**
http://www3b.dot.state.fl.us/EqualOpportunityOfficeBusinessDirectory/

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DBE Business Programs

- GOAA reciprocates DBE certification from FDOT-UCP, Orange County, City of Orlando and State of Florida
- The Bidder is responsible to ensure that the DBE firm is currently certified

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Goal and Potential Work Items

- All Bidders, including DBE Prime Bidders, must meet the goal or provide Good Faith Efforts documents (Self-Performance does not count towards the goal)
- **Goals:**
  - **DBE: 20% of Total Bid Price**

- Questions concerning the Small Business Programs or GFE can be addressed to:

- **George Morning**, Director of Small Business Development
  Phone: (407) 825-7130, Email: **george.morning@goaa.org**
- **Edelis Molina**, Sr. Small Business Administrator
  Phone: (407) 825-7135, Email: **edelis.molina@goaa.org**

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Good Faith Efforts - Examples

- Active engagement/contract negotiations
- Follow-up calls
- Furnish information regarding bid
- Maintain call records and call logs
- Receive and evaluate bids
- Furnish copies of bids from both DBE and non-DBE subs for GFE evaluation if the DBE bid is rejected

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Good Faith Efforts - Examples

- In those instances where a majority subcontractor is selected for a scope of work for which DBE bids were submitted, the Prime Contractor shall submit documentation to evidence “good faith” negotiations with the DBE subcontractors.
- Documentation shall include but not limited to records of all quotations received from DBE and from the selected majority subcontractor, and an explanation why the DBE quotations were unacceptable. It is the responsibility of the Prime Contractor to demonstrate that the DBE bid was not rejected as unqualified without a thorough and documented investigation of its capability

Insurance Requirements

Type of Insurance Policy	Amount
Commercial General Liability: Maximum Deductible or Self-insured Retention: Coverage shall also include Products & Completed Operations and Contractual liability, and naming Owner as additional insured.	$10,000,000, each Occurrence $1,000,000
Automobile Liability: Maximum Deductible or Self-insured Retention: Naming Owner as Additional Insured	$5,000,000, Combined Single Limit $1,000,000
Workers Compensation And Employers' Liability	Statutory Limit $1,000,000 each accident $1,000,000 disease-policy limit $1,000,000 disease-each employee
Pollution Liability Coverage: Maximum Deductible or Self-insured Retention: Naming Owner as Additional Insured. If written on a claims-made basis, coverage shall apply for 3 years from completion of project/scope of work.	$10,000,000, each Claim $1,000,000

Any deductible or self-insurance retention must be indicated on the Certificate of Insurance.

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Bid Requirements Summary

- Bid Submittal and Bid Opening
  - Sealed bids will be received in the Project Controls Office, Greater Orlando Aviation Authority, 11312 Terminal C Service Road, Bldg. 16, Orlando, FL 32824, up to **2:00 p.m., local time, July 26, 2022**, at which time all bids received will be publicly opened the contents noted and read aloud.
- Addenda
  - Any changes or clarification to the drawings or specifications will be issued via addenda
  - Any questions pertaining to the drawings or specifications must be submitted in writing by **Sunday, July 17, 2022 by 2PM EST** to **mgranlund@hntb.com**
  - Deadline for last issued addendum will be **Thursday, July 21, 2022**

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GREATER ORLANDO AVIATION AUTHORITY

QUESTIONS

BP-S196
TERM C, PH 1X AIRFIELD CIVIL, APRON & TAXIWAY PAVING

HNTB

SIGN IN SHEET

SOUTH TERMINAL C – PHASE 1X

Subject: BPS196 AFC Pre-Bid Conference
When: Thursday, July 7th, 2022 11:00am-12:00pm
Where: 11344 Terminal C Service Road, Orlando, FL 32824 – Conference Room Alpha

NAME	COMPANY	E-MAIL
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ERIK LANGE	HNTB	elange@hntb.com
Gunther Zurstadt	HNTB	gzurstadt@hntb.com
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NICK SOSA	KIEWIT	NICK.SOSA@KIEWIT.com
Chris Beaudoin	Kiewit	Chris.Beaudoin@kiewit.com
Jeff Stuckey	SEMA	JStuckey@Sema.inc
GREG MORO	Independence Recycling	GMORO@INDREC.com
Mike Thomas	Chinchor Electric	MThomas@chinchorelectric.com
BILL CAPEHART	IPC PAVING	wcapehart@ipcpaving.com
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ED WARMOTH	McCREE	EDWARD.WARMOTH@MCCREE.COM
JC ARTEAGA	HNTB CORPORATION	JCARTEAGA@HNTB.COM
MATT GRANLUND	HNTB	Mgranlund@hntb.com
CLIFFORD HUGHLEY		

Report of Geotechnical Engineering Investigation

WS-110 SOUTH TERMINAL C - PHASE 1X

Airfield Civil Apron Expansion

Orlando, Florida

GEC Project No. 4221G

Geotechnical and Environmental Consultants, Inc.
At the very foundation of our community

November 15, 2018

Kimley-Horn and Associates, Inc.
3660 Maguire Boulevard
Suite 200
Orlando, Florida 32803

Attention: Mr. Mark Manning, P.E.
Project Manager

Subject: Report of Geotechnical Engineering Investigation
WS-110 SOUTH TERMINAL C - PHASE 1X
Airfield Civil Apron Expansion
Orlando, Florida
GEC Project No. 4221G

Dear Mr. Manning:

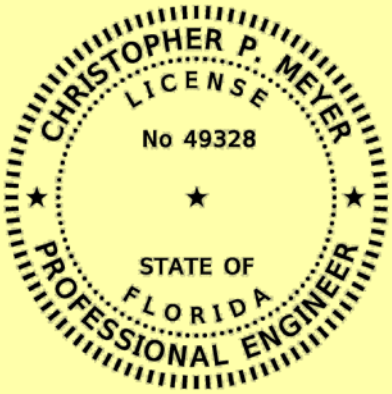
Geotechnical and Environmental Consultants, Inc. (GEC) is pleased to present this Report of Geotechnical Engineering Investigation for the above-referenced project. The purpose of our investigation was to explore subsurface conditions at the apron/taxiway expansion site and to provide geotechnical engineering recommendations to aid in design and construction of the proposed pavements. This report presents the results of our field and laboratory investigations and includes our analyses and recommendations.

The analyses and recommendations in this report are based on design information provided to us and data collected by GEC during the current design phase and are subject to change as project plans develop.

GEC appreciates the opportunity to be of service to Kimley-Horn and GOAA on this project. If you should have any questions concerning the contents of this report, please contact us.

Very truly yours,

GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS, INC.
919 Lake Baldwin Lane
Orlando, Florida 32814
Certificate of Authorization No. 5882



V. Eugene Williford IV, P.E.
Geotechnical Engineer
Florida License No. 82275

Christopher P. Meyer, P.E.
Geotechnical Services Manager
Florida License No. 49328

This Report has been digitally signed and sealed by Christopher P. Meyer, P.E. on the date adjacent to the seal. Printed copies of this document are not considered signed and sealed and the signature must be verified on any electronic copies.

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Figures 4 - 11:	SPT Boring Results for Apron/Taxiway
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Figure 13:	Muck Probe Location Plan with Results

1.0 SITE AND PROJECT DESCRIPTION

Due to the site being an active construction site, conditions at the project site frequently change.

The project is the area of the proposed OIA South Terminal C (Phase 1/1X) located south of the Mid-Cross Field Taxiway. The project site is approximately 180 acres in area. The majority of the site is currently under construction in association with the Phase 1 airside and landside development. Due to the site being an active construction site, conditions at the project site frequently change. The southern portion of the project site is developed with the existing temporary access road and Site Logistics Compound.

GEC understands that the project will consist of multiple phases. Phase I includes the construction of the main section of concrete apron and taxiway, the new terminal building, enplane/deplane structure access roadways and other associated buildings/structures, which are all currently under construction. Phase 1X includes the expansion of the apron/taxiway to the south and west. In addition, a new taxiway is proposed and will be located east of Taxiway Charlie and will connect to Taxiway Foxtrot. The apron and taxiway expansion will have an approximate 75 acre footprint. In addition, an approximately 840-foot long double 8' by 8' box culvert extension will be added on the southwest end of the project and will connect to the existing box culvert adjacent to Taxiway Charlie.

Phase 1X includes the expansion of the apron/taxiway…

Based on review of existing data, we understand that the existing grades range from about +80 to +85 feet NAVD88. We understand that fill will be brought in to raise grades to +85 to +90. We anticipate that the majority of the site will require fill to bring the site to final grades.

2.0 REVIEW OF AVAILABLE DATA

To obtain general information on soil and groundwater conditions in the project area, GEC reviewed available data including USGS Quadrangle Maps, the Natural Resources Conservation Service (NRCS) Soil Survey of Orange County and other published sources. A summary of this information is presented in the following report sections.

2.1 USGS Quadrangle Map

Based on our review of the USGS Pine Castle, Florida Quadrangle map and other existing information the existing ground surface at the project site ranges from approximately +80 to +90 feet NGVD. According to the Quadrangle map, areas of the northern and southwestern airfield apron are located within low-lying depressional areas. This low-lying depressional area may contain organic soils not suitable for the proposed construction as well as ponded water for 8

months of the year. The project site is depicted on an excerpt of the U.S. Geological Survey (USGS) Pine Castle, Florida Quadrangle map (**Figure 1**) in the **Appendix**.

2.2 NRCS Soil Survey

The Natural Resources Conservation Service (NRCS) Soil Survey of Orange County was reviewed to obtain near-surface soils information in the vicinity of the site. According to the NRCS map, the soils in the vicinity of the site are summarized below. The NRCS Soil Survey map of the project area is shown on **Figure 1** in the **Appendix**.

Table 1
NRCS Soil Survey Classifications

Unit No.	Soil Name	Depth (inches)	Soil Description	Unified Classification Symbol	Depth to Seasonal High Groundwater (feet)	Hydrologic Group
1	Arents, nearly level	0 - 80	Sand	SP, SP-SM	2.0 - 3.0	A
3	Basinger fine sand, frequently ponded, 0 to 5 percent slopes	0 - 36 36 - 80	Fine sand Fine sand, sand	SP-SM, SM SP-SM, SM	+2.0 - 0.0	A/D
34	Pomello fine sand, 0 to 5 percent slopes	0 - 65 65 - 80	Fine sand Fine sand	SP-SM SP	2.0 - 3.5	A
37	St. Johns fine sand	0 - 12 12 - 24 24 - 44 44 - 80	Fine sand Sand, fine sand Sand, fine sand Sand, fine sand	SP, SP-SM SP, SP-SM SM, SP-SM SP, SP-SM	0.5 - 1.0	B/D
44	Smyrna fine sand, 0 to 2 percent slopes	0 - 4 4 - 17 17 - 27 27 - 80	Fine sand Fine sand Loamy fine sand, fine sand Fine sand	SP, SM, SP-SM SP, SP-SM SP-SM, SM SP, SP-SM	0.5 - 3.5	A/D
99	Water	---	---	---	---	---

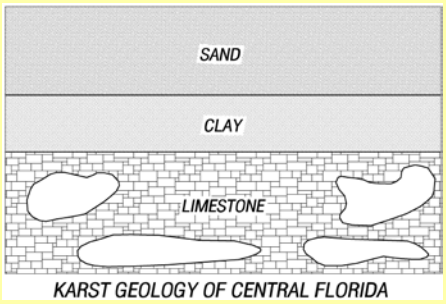
The NRCS Soil Survey map depicts St. Johns and Smyrna fine sands (Soil Unit Nos. 37 and 44) as the predominate soil types at the project site. These soils are generally classified as sand with varying amounts of silt fines (SP, SP-SM, SM). The NRCS Soil Survey predicts seasonal high groundwater levels in the majority of the site to range from 0.5 to 1.5 feet below the natural ground surface.

The NRCS Soil Survey map also depicts sporadic areas of Basinger fine sand (Soil Unit No. 3) which is typically associated with lowland/wetland depressional areas and can have shallow surficial muck. In addition to the muck soils, another limitation of this soil for site development is the estimated seasonal high groundwater level. Ponded water should be anticipated in the portions of the site encompassed by soil group 3.

In addition, the NRCS soil survey map depicts Arents soils (Soil Unit 1) within the area adjacent to the existing taxiway/runway. Arents soils are the result of numerous earthmoving and filling activities, which result in non-indigenous soils with high variability in physical and chemical properties. Arents soils are typically used to fill such areas as sloughs, marshes, and other low-lying areas.

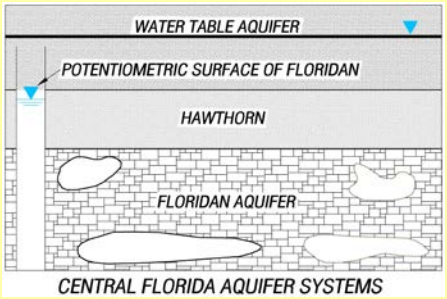
Information contained in the NRCS Soil Survey is very general and may be outdated. It may not therefore be reflective of actual soil and groundwater conditions, particularly if recent development in the site vicinity has modified soil conditions or surface/subsurface drainage. The NRCS seasonal high groundwater levels, summarized in **Table 1**, do not account for changes in groundwater due to development and are only relevant for the natural, undisturbed condition of the soils. The soils and groundwater data collected as part of this study should be considered a more accurate representation of soil conditions at the site.

2.3 Regional Geology



KARST GEOLOGY OF CENTRAL FLORIDA

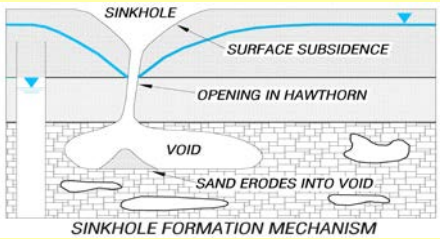
Due to its prevalent geology, referred to as karst, Central Florida is prone to the formation of sinkholes, or large, circular depressions created by local subsidence of the ground surface. The nature and relationship of the three sedimentary layers typical of Central Florida geology cause sinkholes. The deepest, or basement, layer is a massive cavernous limestone formation known as the Floridan aquifer. The Floridan aquifer limestone is overlain by a silty or clayey sand, clay, phosphate, and limestone aquitard (or flow-retarding layer) ranging in thickness from nearly absent to greater than 100 feet and locally referred to as the Hawthorn formation. The Hawthorn formation is in turn overlain by a 40 to 70-foot thick surficial layer of sand, bearing the water table aquifer. The likelihood of sinkhole occurrence at a given site within the region is determined by the relationship among these three layers, specifically by the water (and soil)-transmitting capacity of the Hawthorn formation at that location.



CENTRAL FLORIDA AQUIFER SYSTEMS

The water table aquifer is comprised of Recent and Pleistocene sands and is separated from the Eocene limestone of the Floridan aquifer by the Miocene sands, clays and limestone of the Hawthorn formation. Since the thickness and consistency of the Hawthorn layer is variable across Central Florida, the likelihood of groundwater flow from the upper to the lower aquifer (known as aquifer

recharge) will also vary by geographical location. In areas where the Hawthorn formation is absent, water table groundwater (and associated sands) can flow downward to cavities within the limestone aquifer, like sand through an hourglass, recharging the Floridan aquifer, and sometimes causing the formation of surface sinkholes. This process of subsurface erosion associated with recharging the Floridan aquifer is known as raveling. Thus, in Central Florida, areas of effective groundwater recharge to the Floridan aquifer have a higher potential for the formation of surface sinkholes.



SINKHOLE FORMATION MECHANISM

No method of geological, geotechnical, or geophysical exploration is known that can accurately predict the occurrence of sinkholes. It is common geotechnical practice in Central Florida to make a qualitative prediction of sinkhole risk on the basis of local geological conditions in the vicinity of a particular site.

Based on our review of the U.S. Geological Survey Map entitled "Recharge and Discharge Areas of the Floridan Aquifer in the St. Johns River Water Management District and Vicinity, Florida," 1984, the project alignment lies in a known low to moderate recharge area and, therefore, we can conclude based solely on this data that the site is located in an area where the relative risk of sinkhole formation is low to moderate compared to the overall risk across Central Florida.

> …the site is located in an area where the relative risk of sinkhole formation is low to moderate…

3.0 SUBSURFACE EXPLORATION

> GEC's scope …includes …a total of 175 Standard Penetration Test (SPT) borings …to depths of 10 feet

In addition to consulting the sources of information previously discussed for regional and site-specific soils data, GEC conducted a subsurface exploration to evaluate soil and groundwater conditions. GEC's scope at the airfield apron/taxiway pavement expansion includes performing a total of 175 Standard Penetration Test (SPT) borings (AP-348 through AP-523) to depths of 10 feet below the ground surface. The borings were performed on an approximate 100-foot square grid through the apron expansion footprint and on an approximate 200-foot grid along the taxiways.

The boring locations were established in the field using project plans and a handheld, sub-meter accuracy, Global Positioning Satellite (GPS) unit (Trimble 7X). The boring were then surveyed by Shannon Surveying, Inc. for horizontal and vertical control. The boring locations are presented on **Figures 2A** through **2C** in the **Appendix**.

GEC has completed 142 SPT borings to depths ranging from 10 to 14 feet below the existing ground surface. Various borings are located in areas affected by the current construction activities (e.g.; large fill piles, stormwater retention areas, temporary canals, etc.) and were unable to be completed at the time of this report, as documented on **Figures 4** through **11** in the **Appendix**, and could not be conducted at this time.

GEC's scope of work also included performing 5 Standard Penetration Test (SPT) borings to a depth of 40 feet at the proposed box culvert extension location, as documented in **Figure 12** in the **Appendix**. At the time of this report, GEC has completed 4 SPT borings (BCX-2 through BCX-5) to depths ranging from 40 to 60 feet below the existing ground surface. Boring BCX-1 is located within an existing box culvert excavation and temporary drainage channel and could not be completed at this time.

In addition, manual probes were completed at the north end of the new taxiway alignment where the taxiway will cross the existing canal adjacent to Taxiway Foxtrot. The manual probes were completed on an approximate 50-foot grid and are presented on **Figure 13** in the **Appendix**.

3.1 SPT Borings

SPT borings were drilled in general accordance with ASTM Procedure D-1586. The boreholes were advanced by the rotary wash method with bentonite-based mud used as the circulating fluid to stabilize the borehole. GEC's field crew obtained SPT samples continuously in the borings to a depth of 10 feet and at 5-foot depth intervals thereafter. However, some boring locations were hand augered to a depth of 6 feet to avoid damage to underground utilities. A GEC engineering technician monitored the drilling operation, and collected, examined and visually classified each sample. He then packaged representative portions of each sample for transport to our laboratory for further examination and laboratory testing.

3.2 Groundwater Measurement

A GEC engineering technician measured the depth to the groundwater in the boreholes at the time of drilling and again after approximately 24 hours. Once the groundwater measurements were recorded, the boreholes were backfilled with soil cuttings to prevailing ground surface. However, due to current construction activities some of the boreholes were backfilled upon completion or prior to being able to record the 24 hour stabilized water table. Therefore, some of the water tables were only estimated at the time of drilling.

4.0 LABORATORY TESTING

Selected soil samples obtained from the borings were tested in accordance with Florida Standard Testing Methods (FM) and AASHTO test methods. Florida Standard Testing Methods are adaptations of recognized standard methods, e.g., ASTM and AASHTO, which have been modified to accommodate Florida's geological conditions. The GEC laboratory is reviewed annually by the Construction Materials Engineering Council, Inc. (CMEC) to verify compliance with FM, AASHTO and ASTM. Our laboratory testing program is summarized in the following table:

Table 2
Summary of Laboratory Testing Program

Type of Test	Number of Tests
Percent Fines (AASHTO T 88)	147
Atterberg Limits (AASHTO T 89 / T 90)	4
Natural Moisture Content (AASHTO T 265)	13
Organic Content (FM 1-T 267)	9

The results of our laboratory tests are shown adjacent to the soil profiles on **Figures 4** through **12** in the **Appendix**.

5.0 SUBSURFACE CONDITIONS

The results of the subsurface investigation are shown on the Report of SPT Borings sheets in the **Appendix**. The boring logs describe the soil layers using the Unified Soil Classification System (USCS) symbol (e.g., SP-SM) and ASTM soil descriptions (e.g., sand with silt). We based our soil classifications and descriptions on visual examination and the limited laboratory testing shown adjacent to the boring profiles.

The boring logs indicate subsurface conditions only at the specific boring locations at the time of our field exploration. Subsurface conditions, including groundwater levels, at other locations of the subject site may differ from conditions we encountered at the boring locations. Moreover, conditions at the boring locations can change over time. Groundwater levels fluctuate seasonally, and soil conditions can be altered by earthmoving operations.

The depths and thicknesses of the subsurface strata indicated on the boring logs were interpolated between samples obtained at different depths in the borings. The actual transition between soil layers may be different than indicated. *These stratification lines were used for our analytical purposes. Quantity estimates based on the results of the borings will vary from the actual quantities measured during construction.*

5.1 SPT Boring Results for Airfield Apron/Taxiways

The subsurface profile in the apron area is mainly comprised of loose to medium dense fine sand with silt (SP-SM) in the top 4 to 6 feet from existing ground, underlain by medium dense fine sand with silt and silty fine sand (SP-SM, SM) to the typical boring termination depths of 10 to 12 feet below the existing ground surface.

No clayey fine sands, sandy clays or fat clays (SC, CL and CH) were encountered in the 10-foot deep borings conducted. No significant layers of mucky sands to muck (PT) were encountered other than the 3 areas described below.

Notable exceptions to the general profile are as follows:

- Boring AP-348 encountered a 2-foot thick surficial layer of muck with sand (PT).
- Boring AP-418 encountered a 2-foot thick surficial layer of mucky fine sand (PT).
- Boring AP-465 encountered wood/thick roots from 6 to 10 feet below the existing ground surface.
- Intermittent layers of sands with traces of organic material were encountered at various boring locations and at varying depths. The organic content of these samples typcially ranged from 2% to 5%.
- Multiple borings encountered sands with trace to abundant limerock at varying depths.
- Some intermittent borings encountered dense sands (N-Values greater than 24).
- Some borings encountered an occasional medium dense to dense hardpan-type soil layer.

For detailed subsurface profiles encountered at each of the boring locations see the SPT Boring Results for Apron/Taxiway sheets (**Figures 4** through **11**) in the **Appendix**.

The manual probes performed within the canal located at the north end of the proposed new taxiway adjacent to Taxiway Charlie and connecting to Taxiway Foxtrot were completed on an approximate 50-foot grid. The probes generally encountered 0.1 to 0.5 feet of deleterious soft/organic material around the perimeter of the existing canal. Within the center of the canal, the probes encountered 9 to 11 feet of water underlain by 0 to 1 feet of deleterious soft/organic material. See **Figure 13** in the **Appendix** for details at each probe location.

5.2 SPT Boring Results for Box Culvert

In general, the SPT borings performed for the proposed box culvert extension encountered the generalized subsurface profile summarized in the following table:

Table 3
Generalized Subsurface Profile
Borings BCX-2 through BCX-5

Approximate Soil Layer Depths* (feet bls)	Soil Description	Typical Range of N-Values (blows/foot)
0 to 18-22	Loose to medium dense fine sand with silt to silty fine sand (SP-SM, SM)	4 - 23
18-22 to 23-32	Loose to medium dense clayey fine sand (SC) (Borings BCX-4 and BCX-5 only) or silty fine sand (SM/Borings BCX-2 and BCX-3)	6 - 11
23-32 to 50	Loose to medium dense fine sand to fine sand with silt (SP, SP-SM)	4 - 12

* Soil layers and approximate depths are provided as a general summary only. The individual soil boring profiles should be used to evaluate layer properties at each boring.

Notable exceptions to the general profile are as follows:

- Boring BCX-2 encountered soft to firm sandy lean clay (CL) to sandy fat clay (CH) from 37 to 58 feet below the existing ground surface.
- Boring BCX-3 did not encounter the clayey fine sand (SC) layer.

For detailed subsurface profiles encountered at each of the boring locations see the SPT Boring Results for Box Culvert sheet (**Figure 12**) in the **Appendix**.

5.3 Groundwater Levels

The encountered groundwater table ranged widely from approximately 1 foot to 8 feet below the existing ground surface in our borings conducted. However, standing water was also encountered in at a few locations across portions of the site. Based on field observations, this standing water and some of the shallow groundwater tables are likely due to on-going construction activities (discharging of dewatering effluent to this site) and the relatively dense consistency of the shallow sands encountered in our borings. The deeper groundwater tables were likely deep due to nearby dewatering efforts and do not reflect normal stabilized conditions.

Groundwater levels can vary seasonally and with changes in subsurface conditions between boring locations. Alterations in surface and/or subsurface drainage brought about by site development can also affect groundwater levels. *Therefore, groundwater depths measured at different times or at different locations along the project alignment can be expected to vary from those measured by GEC during this investigation.*

For the purposes of this report, estimated seasonal high groundwater levels are defined as groundwater levels that are anticipated at the end of the wet season of a “normal rainfall” year

under current site conditions. We define a "normal rainfall" year as a year in which rainfall quantity and distribution were at or near historical rainfall averages.

It is anticipated that estimated seasonal high groundwater levels will range from approximately 1 to 5 feet below the existing ground surface…

Significant changes to these groundwater levels could occur due to future artificial controls such as new stormwater retention areas and/or new drainage canal control levels. Seasonal high groundwater table estimates will depend on final site grades and nearby stormwater control elements. It is anticipated that estimated seasonal high groundwater levels will range from approximately 1 to 5 feet below the existing ground surface at the boring locations.

We anticipate that the majority of the site will require fill to bring the site to final grades. GEC will submit our seasonal high groundwater table estimates upon review of the existing and proposed site grades and discussion with the drainage/civil engineer.

6.0 GEOTECHNICAL ANALYSES AND RECOMMENDATIONS

The following recommendations are based on the structure design elements previously described and the subsurface conditions encountered in our borings. If the project design requirements change or if subsurface conditions are different from those described in this report, GEC should be retained to review and modify, if necessary, the following recommendations in light of such changes.

We… recommend that GEC be allowed to review the construction plans prior to contractor pricing…

We also recommend that GEC be allowed to review the construction plans prior to contractor pricing so that we can verify that our recommendations were properly interpreted and incorporated into the plans and specifications. The recommendations in this report are not written in specification language and are not intended to be used verbatim as a part of the plans and specifications. This report should not be wholly incorporated into the project contract documents.

All …construction shall be conducted in accordance with the Project Specifications…

All excavations, subgrade and embankment construction shall be conducted in accordance with the Project Specifications as briefly discussed herein.

6.1 Airfield Apron/Taxiway Sub-Soil Preparation

The results of this investigation indicate that with proper site preparation, the encountered subsurface soils are appropriate to support the proposed fill material and apron/taxiway pavement.

…borings AP-348 and AP-418 encountered a 2-foot thick surficial layer of mucky fine sand to muck with sand (PT) with organic contents of 35% and 8%, respectively.

Based on our SPT borings conducted to date, there are a few sporadic areas where surficial and buried soil layers containing traces of organic material exist. These layers have low organic contents (5% or less) and are acceptable to remain in-place. However, borings AP-348 and AP-418 encountered a 2-foot thick surficial layer of mucky fine sand to muck with sand (PT) with organic contents of 35% and 8%, respectively. Stripping and grubbing operations will likely remove this deleterious material; however, the mucky sands in this general area may extend down deeper. GEC is in the process of conducting several additional borings to better delineate the horizontal extent of this area.

We recommend that a geotechnical engineering technician provide on-site visual inspection during stripping and grubbing operations to ensure that the contractor removes all the surficial deleterious soils, yet does not remove acceptable soils. It is our experience that acceptable soils are sometimes conservatively removed by the contractor because the soils are dark brown in color and appear similar to the unsuitable mucky fine sands. A geotechnical engineering technician proficient in soil classification can easily determine which soils can remain and thereby save unsuitable soil removal and backfill costs.

…boring AP-465, we encountered buried wood/thick roots from 6 to 10 feet …and we recommend this area be investigated with a test pit…

In addition, at boring AP-465, we encountered buried wood/thick roots from 6 to 10 feet below existing ground, and we recommend this area be investigated with a test pit and all deleterious wood/root organic soils removed.

The site should be stripped, grubbed and proof-rolled per the Project Specifications. Any areas requiring unsuitable soil removal (PT soils) should be addressed as described above. Thereafter, filling should take place in accordance with the Project Specifications and as discussed below. In addition, the proposed apron/taxiway expansion pavements extend into the existing access road and site logistics compound. In this area, all existing concrete, asphalt, buried utilities, etc. and deleterious materials should be removed from beneath the proposed pavements prior to fill being placed.

…all existing concrete, asphalt, buried utilities, …etc. and deleterious materials should be removed from beneath the proposed pavements...

6.2 Airfield Apron/Taxiway Grading/Filling

We anticipate that the majority of the site will require fill to bring the site to final grades. The following tables are excerpts from the Project Specifications for fill material and compaction of fill.

All materials designated as borrow material shall meet the following criteria to be accepted:

Unified Soil Classification	*SP, SP-SM Fine Sand, Fine Sand with Silt*	*SM Silty Fine Sand*
% Passing No. 200 Sieve	*Less than 12% by weight*	*Less than 18% by weight*
Liquid Limit	*Less than 20*	*Less than 20*
Plasticity Index	*Less than 4*	*Less than 4*
Organic Content	*Less than 3% by weight*	*Less than 3% by weight*

Under all areas to be paved, the embankments shall be compacted to *the depths and densities as specified below.*

Depth Below Finished Subgrade (in.)	*Compaction for P-152 per ASTM D 1557*	*Required Soil Type*
0 to 25	*100%*	*SP and SP-SM only (<12% by weight)*
25 to 44	*95%*	*SP and SP-SM only (<12% by weight)*
>44	*95%*	*SP, SP-SM, and SM only (<18% by weight)*

The use of greater compactive effort in the 2 to 4 feet immediately below the apron pavement is essential to handling the greater stresses/loads applied to the pavement surface. Additionally, using a cleaner fine sand soil (SP and SP-SM with percent fines content less than 12%) is essential to achieving adequate internal soil drainage immediately beneath the pavement section.

Fill shall be placed in horizontal layers of not more than 8 inches in loose thickness. Compaction should be tested for each lift every 1,000 square yards or per isolated area of construction. The material to be compacted should be within +/- 2% of optimum moisture content before being compacted.

Due to the stringent compaction requirements for airfield pavement, the contractor should be advised to pay extremely close attention to the moisture content at the time of compaction. Thinner lifts may be needed in addition to moisture content manipulation depending on soil and current weather conditions.

Apron/taxiway pavement design(s), including drainage layers and edge drains (if any), are prepared by KHA and are presented in the plans and specifications.

6.3 Airfield Apron/Taxiway Modulus of Subgrade Reaction

…a modulus of subgrade reaction (k) of 200 pounds per cubic inch

We anticipate that the majority of the site will require fill to bring the site to final grades. CBR testing of the existing soil subgrade will only provide usable design values for the pavement subgrade where less than two feet of fill is needed. During the Phase 1 investigation, GEC tested 1 CBR test within the apron area where less than 2 feet of fill is needed and 5 CBR tests on representative samples collected from the Lake Gillooly borrow pit site. Based on the previously performed CBR tests, we recommend that apron pavement design should be conducted by KHA using a modulus of subgrade reaction (k) of 200 pounds per cubic inch (pci).

6.4 Box Culvert

It is our understanding that approximately 840 feet of new box culvert extension (double 8' by 8') is proposed to facilitate the apron/taxiway expansion. The results of this investigation indicate that with proper site preparation as detailed further below, most of the encountered soils are generally appropriate to support the proposed box culvert on a shallow mat foundation system (the bottom of the culvert structure). The endwalls/wingwalls may be supported on spread footings. The structure areas and foundation subsoils should be prepared in accordance with the FDOT Design Standards and the FDOT Standard Specifications for Road and Bridge Construction.

Any soft sediments or organic soils should be removed if encountered within 5 feet laterally of the footing bottoms.

This …clayey fine sand may affect …compaction and dewatering efforts

We recommend that the clayey fine sand (SC) be over-excavated to at least …2 feet below the bottom of the box culvert foundation...

Soft to firm sandy clay (CL) was encountered at 37 feet deep in Boring BCX-2 which should be well below the bottom of the box culvert. However, loose to medium dense clayey fine sand (SC) was encountered in borings BCX-4 and BCX-5 at depths of 18 and 22 feet, respectively. This layer of clayey fine sand may affect some site preparation, compaction and dewatering efforts. We recommend that the clayey fine sand (SC) be over-excavated to at least a depth of 2 feet below the bottom of the box culvert foundation and backfilled with clean sands (SP, SP-SM).

GEC conducted settlement analyses of box culvert structure to calculate total and long term differential settlement using the box culvert borings, soil profiles, box culvert plans provided and the computer program WINSAF-I (results included in the **Appendix**). The results of the settlement analyses are summarized in the following table:

Table 4
Box Culvert Settlement Estimates

Box Culvert	Short Term Settlement (in.)	Long Term Settlement (in.)	Total Settlement (in.)	Maximum Long-Term Differential Settlement (in.)	Effective Length for Settlement (ft.)
P1X - Dual 8' x 8'	0.4	0.5	0.9	0.5	40

The following parameters are recommended for design of the box culvert. These parameters are provided assuming the foundation and backfill soils are prepared in accordance with the recommendations in this report and project specifications.

Table 5
Recommended Soil Parameters for Box Culvert Design

Box Culvert	Soil Type	Nominal Bearing Capacity* (psf)	Saturated Unit Weight (pcf)	Effective (Buoyant) Unit Weight (pcf)	Angle of Internal Friction, ϕ (degrees)	Modulus of Subgrade Reaction (pci)
---	Backfill Sands (SP, SP-SM)	N/A	110	50	30	N/A
P1X - Dual 8' x 8'	SP, SP-SM, SM	14,500	115	55	31	70

* NBR calculated using a Phi Factor of 0.45 per AASHTO LRFD guidelines. Endwall/wingwall footings should be designed with a Nominal Bearing Resistance of 3,000 psf and should be designed by the structural engineer to resist the anticipated loading.

6.5 Lateral Earth Pressure

This section is for use in design of any buried vaults, pits or other structures. These recommendations are applicable for excavations that will penetrate the surficial sandy soils classified as SP, SP-SM, and SM on the boring logs included with this report.

Lateral earth pressures for design of below grade and/or earth retaining structures can be calculated using a hydrostatic pressure distribution from an equivalent fluid having varying densities for various conditions. These values assume sandy soil (SP, SP-SM, SM) with an angle of internal friction of about 30 degrees and a moist unit weight of 110 pcf and a saturated unit weight of 115 pcf. **Table 4** below summarizes the recommended equivalent fluid densities for active, passive and at-rest conditions and drained or undrained conditions. The actual lateral earth pressure will be a function of both the soil unit weight (submerged or moist) and the depth below ground surface.

Table 4
Lateral Earth Pressure

Lateral Earth Pressure Condition	Equivalent Fluid Density Drained (pcf)
Active	37
Passive	330
At-rest	55

Drained conditions assume hydrostatic (water) pressure cannot develop due to positive drainage behind the structure, and includes only the moist soil earth pressure. All buried or partially buried structures at this site should be designed using the "At-Rest Lateral Earth Pressure Condition" and the "Equivalent Fluid Density" for drained conditions and an appropriate Factor of Safety.

6.6 Temporary Dewatering

Depending on groundwater levels at the time of construction and final design grades, temporary dewatering may be required to facilitate stable excavations. The contractor should be required to provide a dewatering system which maintains groundwater levels at least 2 feet below compaction surfaces, including the bottom of excavations. A system of ditches and sumps may be sufficient in some instances to achieve adequate dewatering for shallow excavations less than 10 feet.

An experienced dewatering contractor should be retained to evaluate specific dewatering system requirements.

However, for deeper excavations such as for pipe lines and box culverts, the contractor should be prepared to install wellpoint, sock drain, or other dewatering systems designed to lower the groundwater in the soil types encountered. Where cemented soils (hardpan-type) are present, the dewatering system design will need to consider the relatively impervious and dense characteristics of these soils. Well-point screens and/or socks may need to be placed above and below the cemented soils. An experienced dewatering contractor should be retained to evaluate specific dewatering system requirements.

Additionally, the contractor must provide positive site drainage during site preparation and fill placement. Surface runoff should not be allowed to accumulate on compaction surfaces. Temporary rim ditches may be required to facilitate site preparation by routing drainage away from active construction operations.

…the contractor should be made aware …dewatering will be required …and that the use of gravel in excavation bottoms is not allowed.

We do not recommend allowing the contractor to use gravel (e.g.; #57 stone) in excavation bottoms when soils are too wet to achieve the required compaction. Gravel contains small voids that may allow soil raveling to occur, resulting in ground subsidence. Instead the contractor should be made aware, in the plans and again at the pre-construction meeting, that adequate dewatering will be required where groundwater levels are within 2 feet of compaction surfaces and that the use of gravel in excavation bottoms is not allowed.

6.7 Temporary Excavations

The owner and the contractor should be familiar with local, state and federal safety regulations, including current Occupational Safety and Health Association (OSHA) excavation and trench safety standards. Construction site safety is the responsibility of the contractor. The contractor should also be responsible for the means, methods, techniques, sequences, and operations of the construction. Care should be taken to protect adjacent utilities, structures or pavements from loss of support due to excavation activities.

The contractor should be aware that slope height, slope inclination, and excavation depths (including utility trench excavations) should not exceed those specified in local, state, or federal safety regulations; e.g., OSHA Health and Safety Standards for Excavations, 29 CFR Part 1926. *OSHA regulations are strictly enforced and, if not followed, the owner, contractor, earthwork subcontractor or utility subcontractor could be liable for substantial penalties.*

Cemented sand (hardpan-type) was encountered in the borings at various depths. These soils may be undetectable in some SPT borings. Sometimes, their presence can be inferred by high "N" values (often greater than 30 bpf) in SPT borings. However, cementation can also be present in layers with blow counts less than 30 bpf. These soils may be difficult to excavate and may require special consideration from the Contractor in choosing the proper equipment for excavation. A note alerting the Contractor that difficult excavation and special equipment/procedures may be required should be added to the plans.

The soils encountered in the borings performed by GEC at this site are primarily sand with varying amounts of silt. We anticipate that OSHA will classify these materials as Type C. OSHA recommends a maximum temporary slope inclination of 1.5 horizontal to 1 vertical for this soil type. Soils encountered in the construction excavations may vary significantly across the site. Our soil classifications are based on the materials encountered in widely-spaced borings. The contractor should verify that similar conditions exist throughout the proposed excavation area. If

different subsurface conditions are encountered at the time of construction, GEC should be contacted immediately to evaluate the conditions encountered.

7.0 USE OF THIS REPORT

GEC has prepared this report for the exclusive use of our client, Kimley-Horn, and GOAA, and for specific application to our client's project. GEC will not be held responsible for any other party's interpretation or use of this report's subsurface data or engineering analysis without our written authorization.

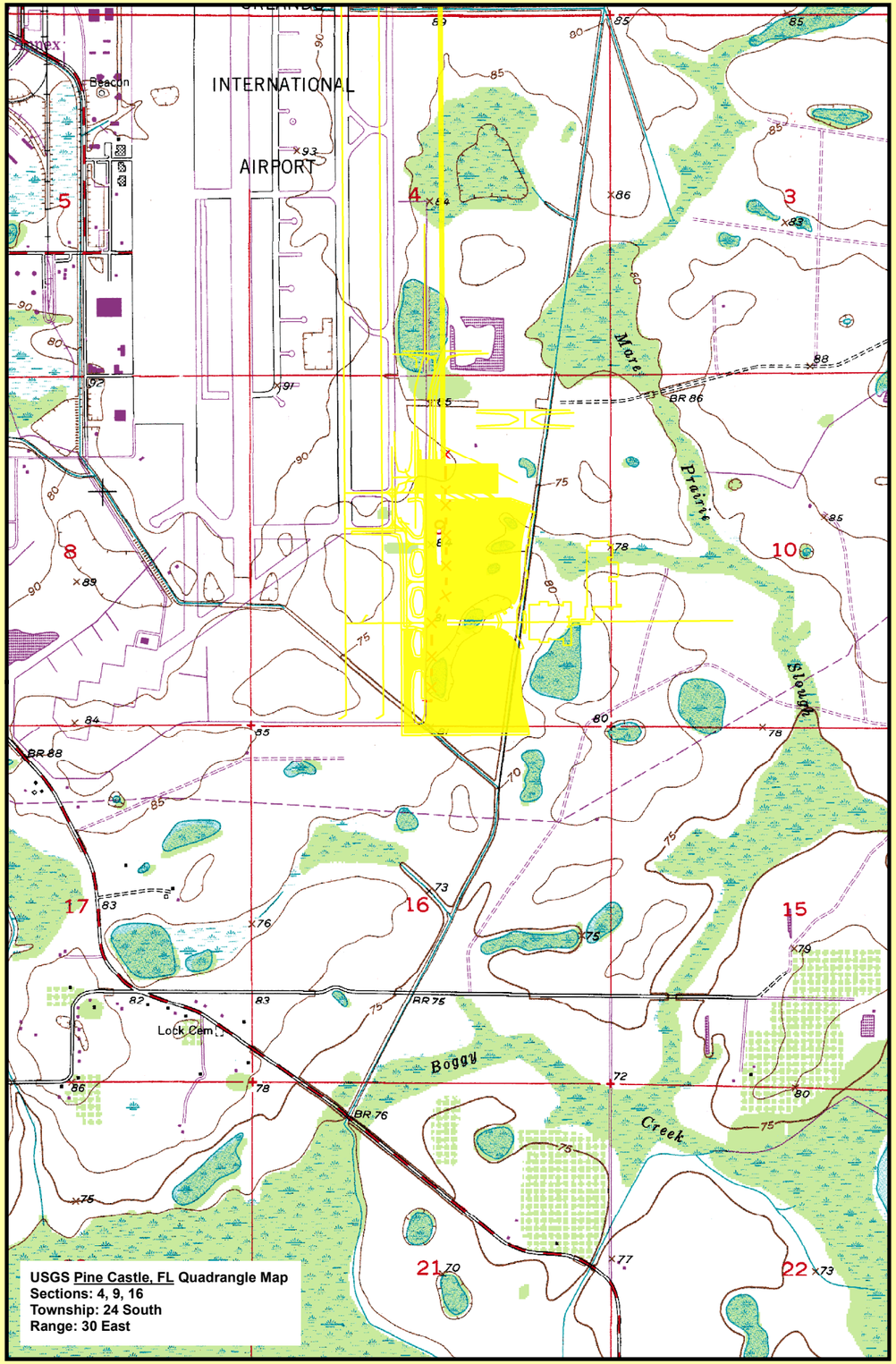
The sole purpose of the borings performed by GEC at this site was to obtain indications of subsurface conditions as part of a geotechnical exploration program. GEC has not subjected any soil samples to analysis for contaminants.

GEC has strived to provide the services described in this report in a manner consistent with that level of care and skill ordinarily exercised by members of our profession currently practicing in Central Florida. No other representation is made or implied in this document.

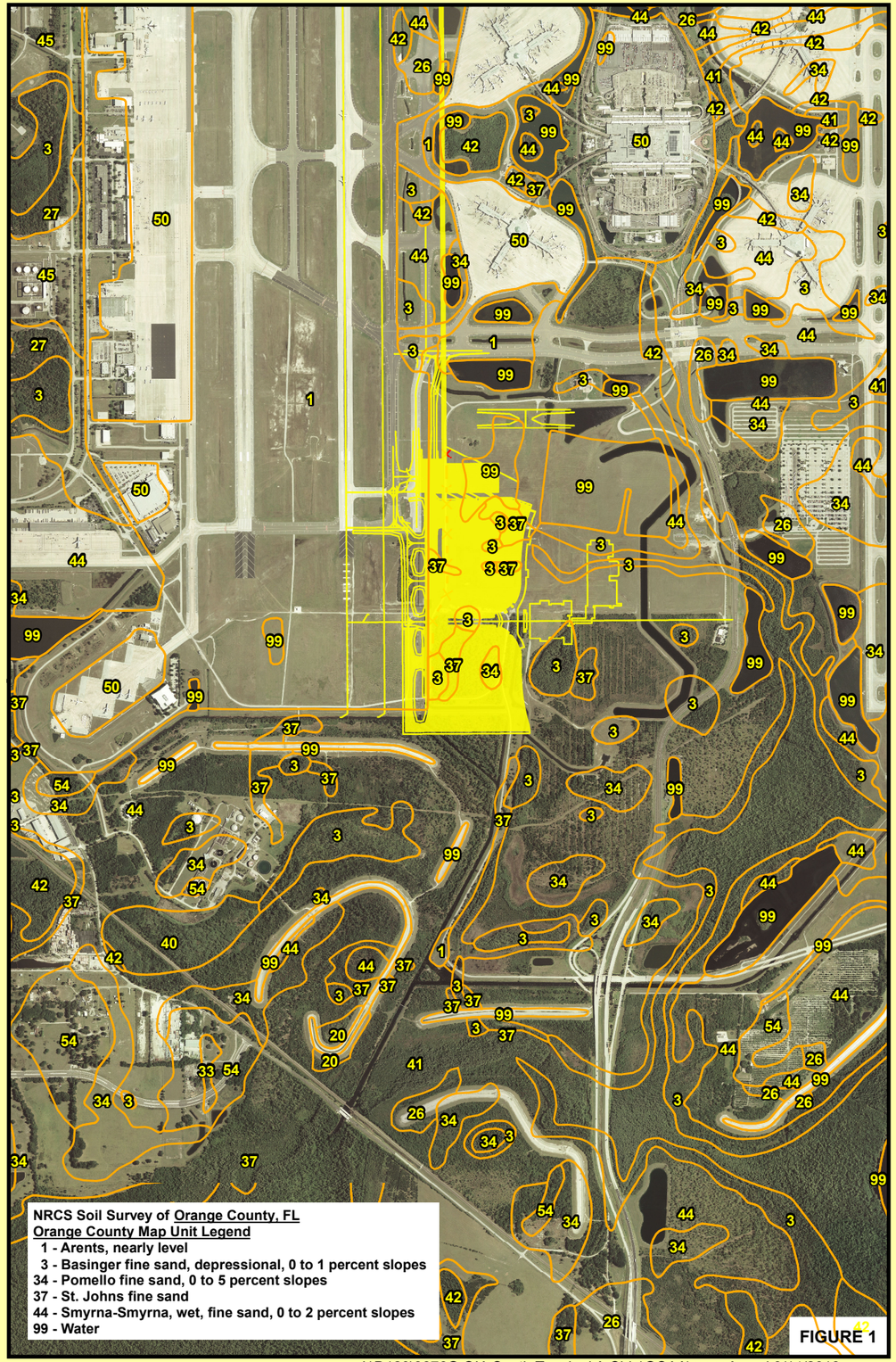
The conclusions or recommendations of this report should be disregarded if the nature, design, or location of the facilities is changed. If such changes are contemplated, GEC should be retained to review the new plans to assess the applicability of this report in light of proposed changes.

APPENDIX

USGS QUADRANGLE AND
NRCS SOIL SURVEY MAPS



USGS Pine Castle, FL Quadrangle Map
Sections: 4, 9, 16
Township: 24 South
Range: 30 East



NRCS Soil Survey of Orange County, FL
Orange County Map Unit Legend
1 - Arents, nearly level
3 - Basinger fine sand, depressional, 0 to 1 percent slopes
34 - Pomello fine sand, 0 to 5 percent slopes
37 - St. Johns fine sand
44 - Smyrna-Smyrna, wet, fine sand, 0 to 2 percent slopes
99 - Water

FIGURE 1

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GREATER ORLANDO AVIATION AUTHORITY

WS110 SOUTH TERMINAL C-PHASE 1X AIRFIELD CIVIL

ORLANDO INTERNATIONAL AIRPORT

N
W E
S

0 1,000 2,000
Feet

Revisions

Project No.:	Date	Description

Key Plan

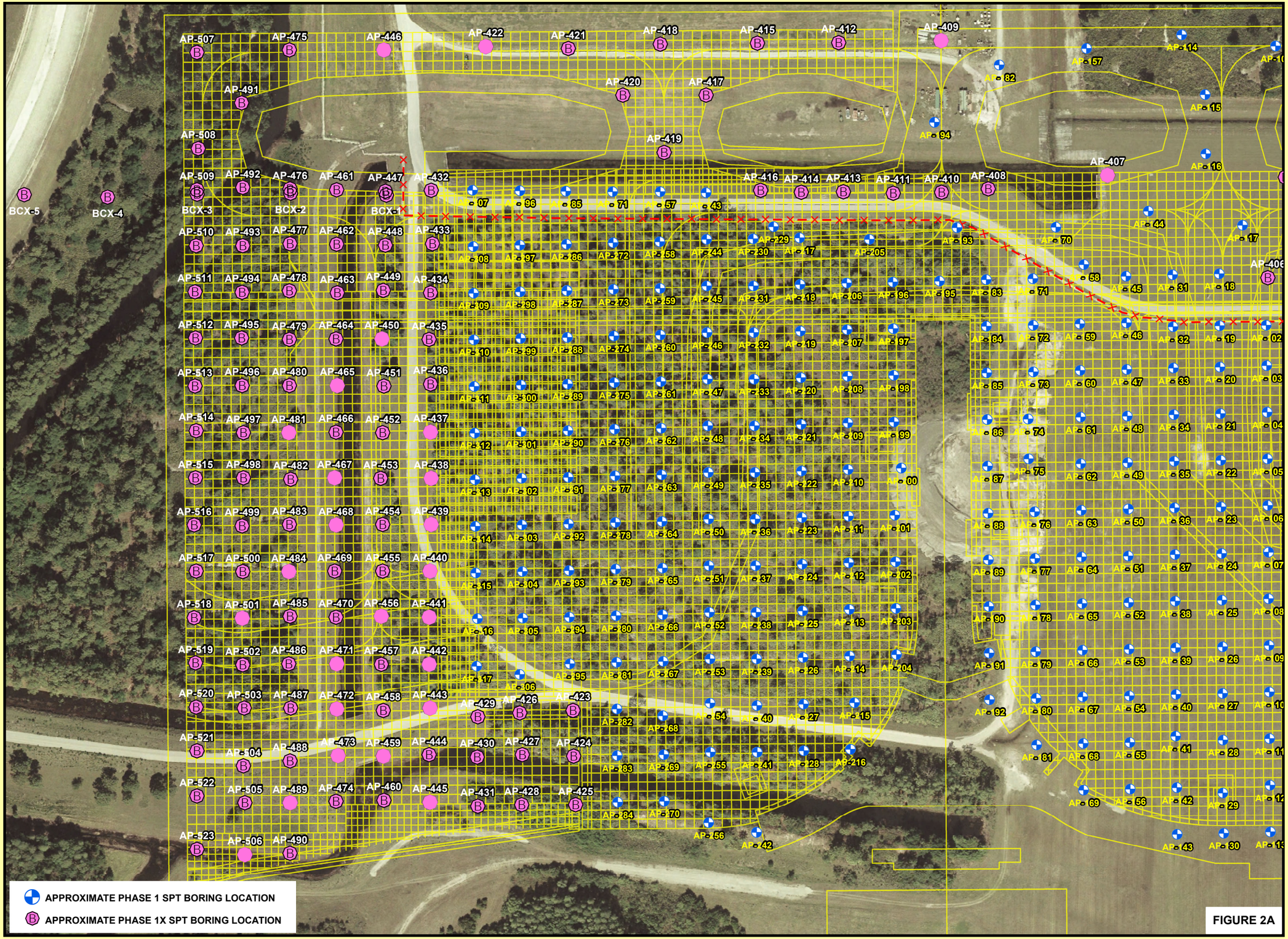
Project No.:	4221G
Designed By:	VEW
Drawn By:	SKR
Checked By:	VEW
Issue Date:	September 2018
Drawing Scale:	

Drawing Titles:

USGS QUADRANGLE AND NRCS SOIL SURVEY MAPS

Drawing No.

BORING LOCATION PLAN



J:\D120\3876G OIA South Terminal A-Side\GOAA\4221G FIG2A.mxd 11/15/2018

GREATER ORLANDO AVIATION AUTHORITY

WS110 SOUTH TERMINAL C-PHASE 1 AIRFIELD CIVIL

ORLANDO INTERNATIONAL AIRPORT

GEC

N
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Feet

Revisions

Project No.:	Date	Description

Key Plan

Project No.:	3876G
Designed By:	VEW
Drawn By:	SKR
Checked By:	VEW
Issue Date:	November 2016
Drawing Scale:	

Drawing Titles:

BORING LOCATION PLAN

Drawing No.

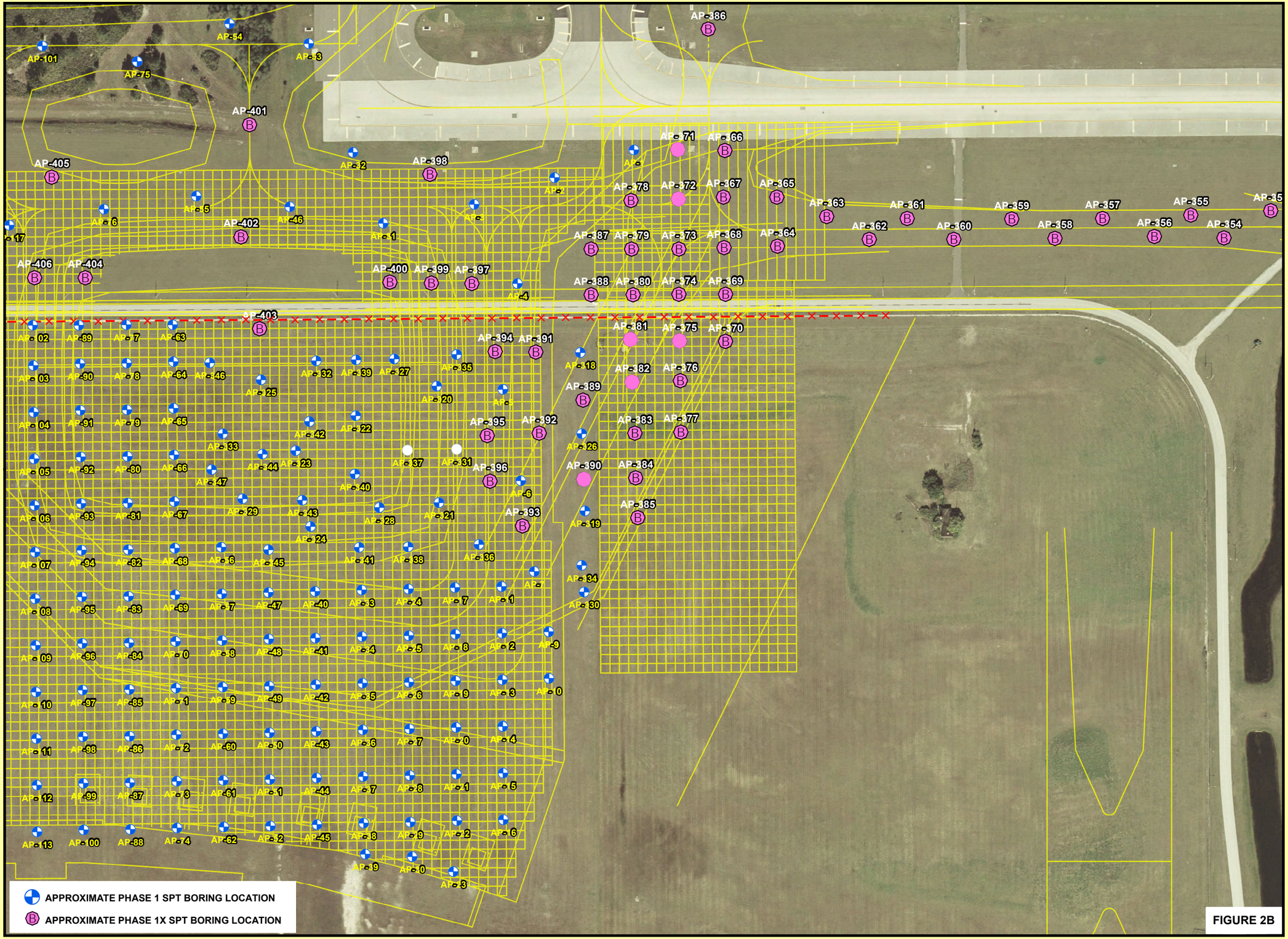


FIGURE 2B

GREATER ORLANDO AVIATION AUTHORITY

WS110 SOUTH TERMINAL C-PHASE 1 AIRFIELD CIVIL

ORLANDO INTERNATIONAL AIRPORT

GEC

0 100 200
Feet

Revisions

Project No.:	Date	Description

Key Plan

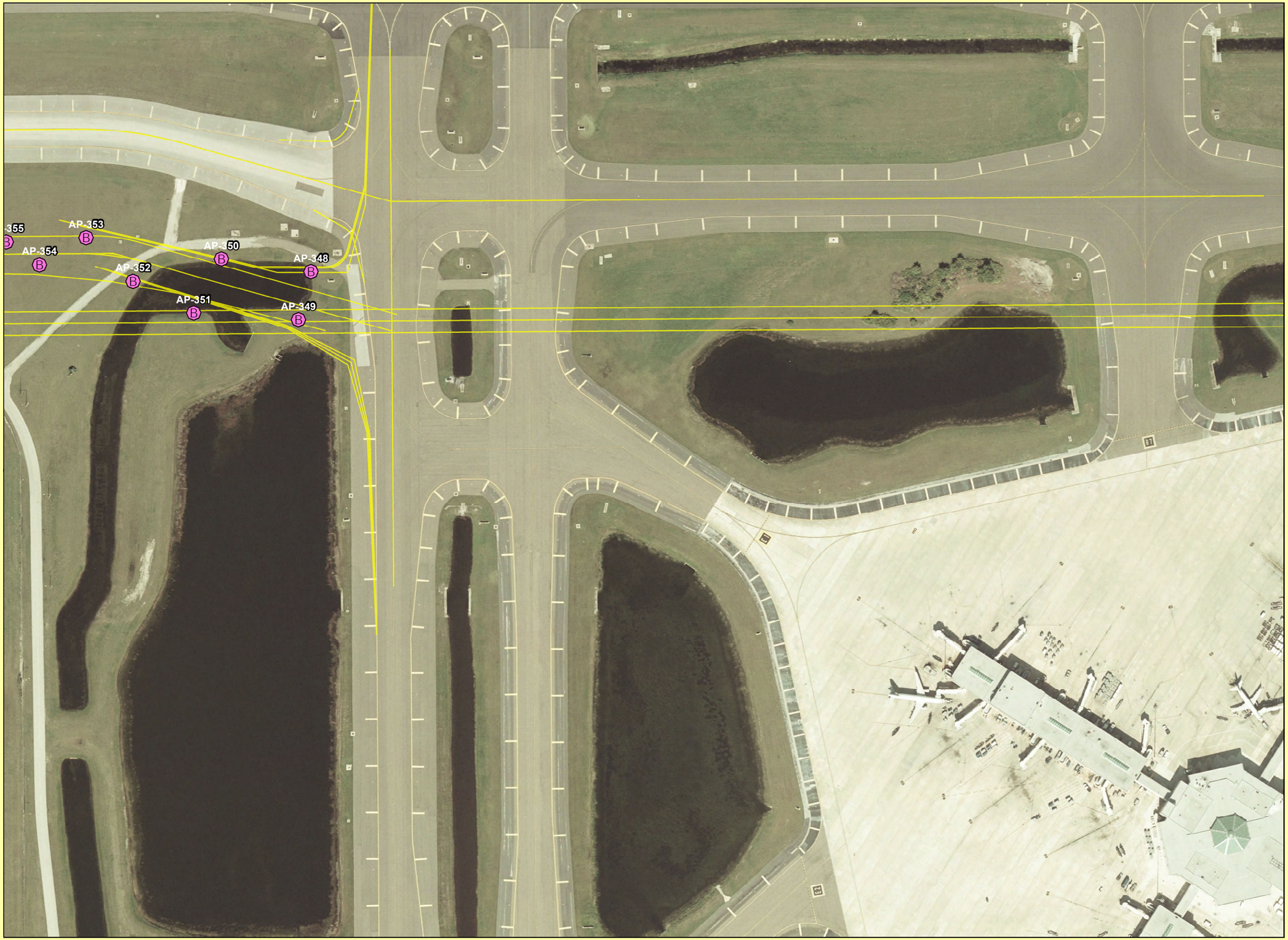
Project No.:	3876G
Designed By:	VEW
Drawn By:	SKR
Checked By:	VEW
Issue Date:	November 2016
Drawing Scale:	

Drawing Titles:

BORING LOCATION PLAN

Drawing No.

J:\D120\3876G OIA South Terminal A-Side\GOAA\4221G FIG2B.mxd 11/15/2018



GREATER ORLANDO AVIATION AUTHORITY

WS110 SOUTH TERMINAL C-PHASE 1 AIRFIELD CIVIL

ORLANDO INTERNATIONAL AIRPORT

GEC

W S N E

0 100 200

Feet

Revisions

Project No.:	Date	Description

Key Plan

Project No.:	3876G
Designed By:	VEW
Drawn By:	SKR
Checked By:	VEW
Issue Date:	November 2016
Drawing Scale:	

Drawing Titles:

BORING LOCATION PLAN

Drawing No.

J:\D120\3876G OIA South Terminal A-Side\GOAA\4221G FIG2C.mxd 11/15/2018

GEOTECH SOIL BORING LEGEND AND NOTES

LEGEND

GSE	GROUND SURFACE ELEVATION (FT. NAVD88)
N	STANDARD PENETRATION RESISTANCE, BLOWS PER FOOT
50/6"	NUMBER OF BLOWS FOR 6 INCHES OF PENETRATION
▼ +80.0+	ENCOUNTERED STANDING WATER ELEVATION (FT. NAVD88)
▼ +72.4	ENCOUNTERED GROUNDWATER ELEVATION (FT. NAVD88) 24 HOURS AFTER DATE DRILLED
* ▼ +72.6	ENCOUNTERED GROUNDWATER ELEVATION (FT. NAVD88) AT TIME OF DRILLING
BT	BORING TERMINATED AT DEPTH INDICATED
-200=	PERCENT PASSING NO. 200 U.S. STANDARD SIEVE
MC=	PERCENT NATURAL MOISTURE CONTENT
OC=	PERCENT ORGANIC CONTENT

SAND

SAND AND SILT

WOOD / THICK ROOTS

LIMEROCK

SAND AND MUCK

GENERAL NOTES

SUBSURFACE CONDITIONS SHOWN ON THE BORINGS REPRESENT THE CONDITIONS ENCOUNTERED AT THE BORING LOCATIONS. ACTUAL CONDITIONS BETWEEN THE BORINGS MAY VARY FROM THOSE SHOWN. UNIFIED SOIL CLASSIFICATIONS SHOWN ON THE BORINGS ARE BASED ON VISUAL EXAMINATION AND THE LABORATORY TESTING SHOWN.

STANDARD PENETRATION TEST BORINGS WERE PERFORMED IN ACCORDANCE WITH ASTM D-1586. STANDARD PENETRATION RESISTANCES ARE SHOWN ON THE BORINGS AT THE TEST DEPTHS IN IN BLOWS PER FOOT UNLESS OTHERWISE NOTED.

BORINGS LOCATIONS WERE ESTABLISHED IN THE FIELD USING A SUB-METER ACCURACY GPS UNIT (TRIMBLE 7X). THE BORING LOCATIONS WERE SURVEYED FOR HORIZONTAL AND VERTICAL CONTROL BY SHANNON SURVEYING, INC.

BASED ON REVIEW OF THE U.S. GEOLOGICAL SURVEY MAP ENTITILED "POTENTIOMETRIC SURFACE OF THE UPPER FLORIDAN AQUIFER IN THE ST. JOHNS RIVER WATER MANAGEMENT DISTRICT AND VICINITY, FLORIDA, SEPTEMBER 2008" FOR THE PROJECT AREA, THE ELEVATION OF THE ARTESIAN HEAD IS ESTIMATED TO BE APPROXIMATELY +48 FT. NGVD. THE CONTRACTOR SHALL BE PREPARED TO HANDLE ARTESIAN HEAD LEVELS UP TO +48 FT. NGVD.

STABILIZED GROUNDWATER DEPTHS WERE NOT OBTAINED AT BORING LOCATIONS AP-494, AP-497 THROUGH AP-500, AND AP-511 THROUGH AP-517 DUE TO THE BORING BEING COMPLETED WITH EXISTING PAVEMENTS AND BEING BACKFILLED UPON COMPLETION.

SPLIT SPOON SAMPLER:
- INSIDE DIAMETER: 1.375 IN.
- OUTSIDE DIAMETER: 2.0 IN.
- AVERAGE HAMMER DROP: 30 IN.
- HAMMER WEIGHT: 140 LBS.
- HAMMER TYPE: AUTOMATIC

CORRELATION OF STANDARD PENETRATION RESISTANCE WITH RELATIVE DENSITY AND CONSISTENCY OF SOIL

GRANULAR SOILS	AUTOMATIC HAMMER N VALUE (blows per foot)	RELATIVE DENSITY
SANDS	0-3	VERY LOOSE
	3-8	LOOSE
	8-24	MEDIUM DENSE
	24-40	DENSE
	OVER 40	VERY DENSE

NON-GRANULAR SOILS	AUTOMATIC HAMMER N VALUE (blows per foot)	CONSISTENCY
SILTS, CLAYS, MUCK, PEAT	0-1	VERY SOFT
	1-3	SOFT
	3-6	FIRM
	6-12	STIFF
	12-24	VERY STIFF
	OVER 24	HARD

FIGURE 3

GREATER ORLANDO AVIATION AUTHORITY

WS110 SOUTH TERMINAL C PHASE 1X AIRFIELD CIVIL

ORLANDO INTERNATIONAL AIRPORT

GEC

Revisions

No.	Date	Description

Key Plan

Project No: 4221G

Designed By: VEW

Drawn By: SKR

Checked By: VEW

Issue Date: September 2018

Drawing Scale:

Drawing Title:

GEOTECH SOIL BORING LEGEND AND NOTES

Drawing No.

SPT BORING RESULTS
FOR APRON/TAXIWAY

FIGURE 4

GREATER ORLANDO AVIATION AUTHORITY

WS110 SOUTH TERMINAL C PHASE 1X AIRFIELD CIVIL

ORLANDO INTERNATIONAL AIRPORT

GEC

Revisions

No.	Date	Description

Key Plan

Project No.: 4221G

Designed By: VEW

Drawn By: SKR

Checked By: VEW

Issue Date: September 2018

Drawing Scale:

Drawing Title:

SPT BORING RESULTS FOR APRON/ TAXIWAY

Drawing No.

AP-370
GSE: +87.1
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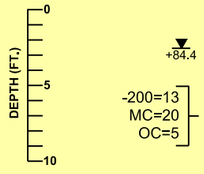

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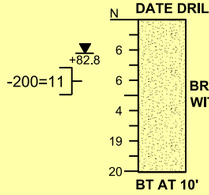

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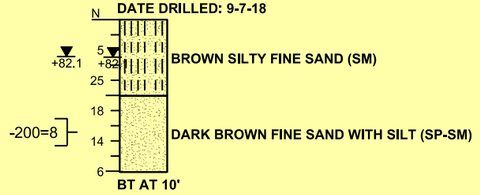

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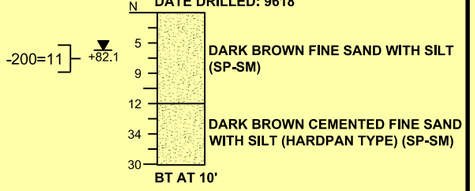

AP-374
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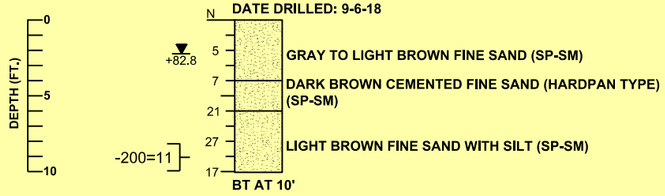

AP-375
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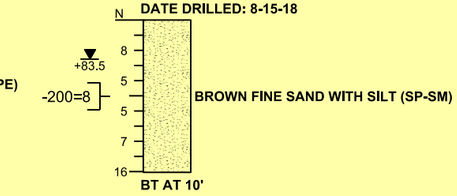


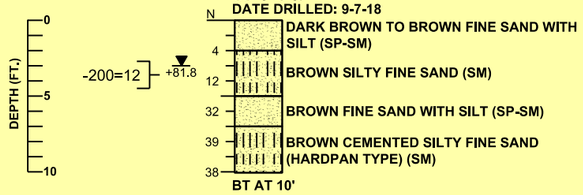
AP-376

FALLS ON TOP OF 20 FT.
TALL STOCK PILE

AP-377

FALLS ON TOP OF 20 FT.
TALL STOCK PILE

AP-378
GSE: +84.8
DATE DRILLED: 9-7-18



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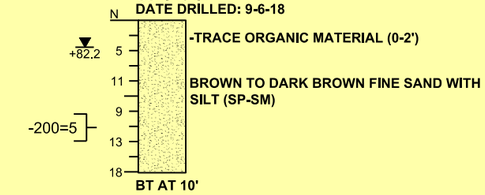

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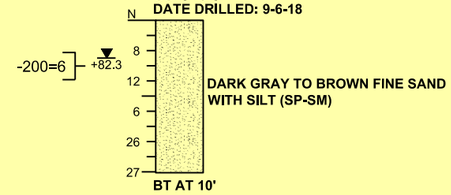

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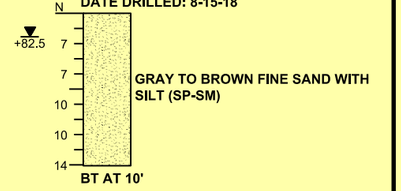

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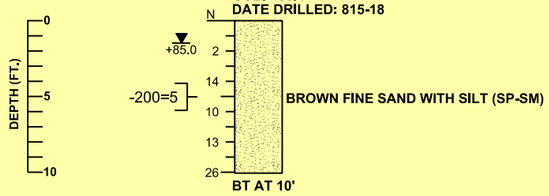

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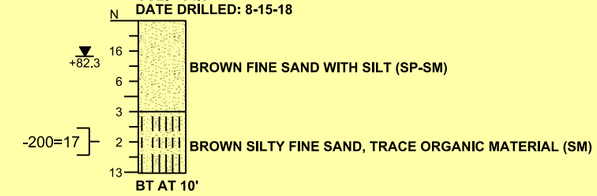


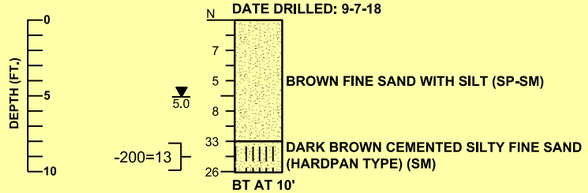
AP-384

FALLS ON TOP OF 20 FT.
TALL STOCK PILE

AP-385

FALLS ON TOP OF 20 FT.
TALL STOCK PILE

AP-386
GSE: NOT SURVEYED
DATE DRILLED: 9-7-18



AP-387
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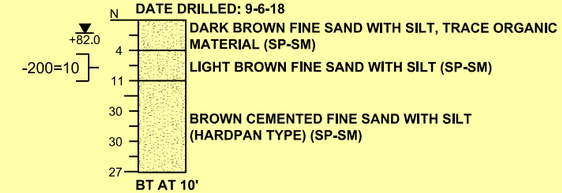
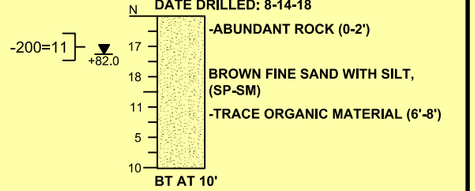


AP-388

FALLS IN STORMWATER
HOLDING POND

AP-389
GSE: +84.7
DATE DRILLED: 8-14-18



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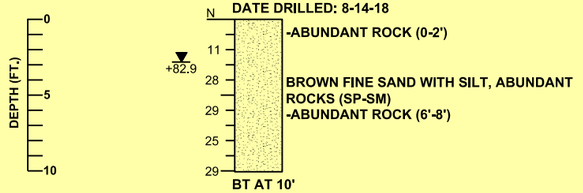

AP-391
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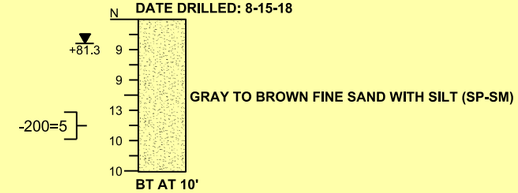

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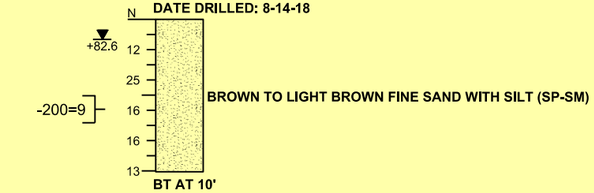

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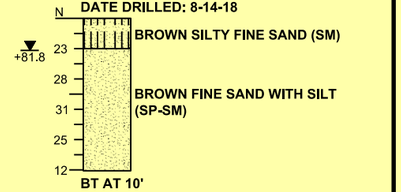


FIGURE 5

GREATER ORLANDO AVIATION AUTHORITY

WS110 SOUTH TERMINAL C PHASE 1X AIRFIELD CIVIL

ORLANDO INTERNATIONAL AIRPORT

GEC

Revisions

No.	Date	Description

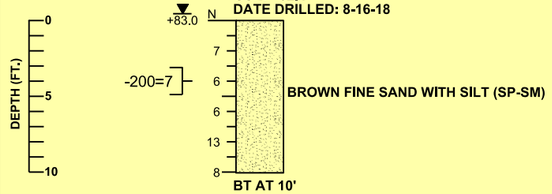
Key Plan

Project No.: 4221G
Designed By: VEW
Drawn By: SKR
Checked By: VEW
Issue Date: September 2018
Drawing Scale:

Drawing Title:
SPT BORING RESULTS FOR APRON/ TAXIWAY

Drawing No.

AP-394
GSE: +82.4
DATE DRILLED: 8-16-18



AP-395
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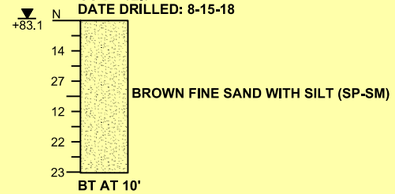

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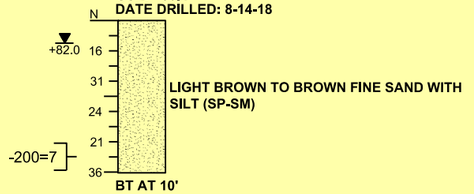
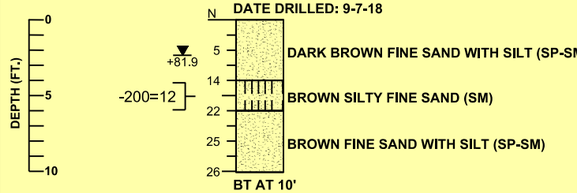


AP-397

FALLS IN STORMWATER HOLDING POND

AP-398
GSE: +84.2
DATE DRILLED: 9-7-18



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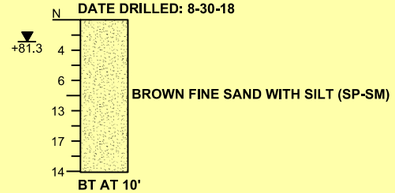

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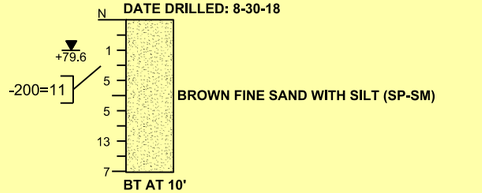

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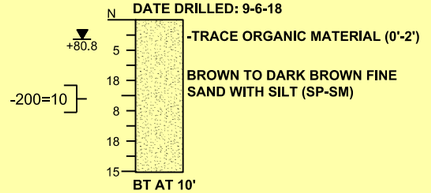

AP-402
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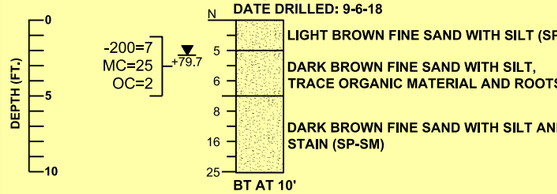

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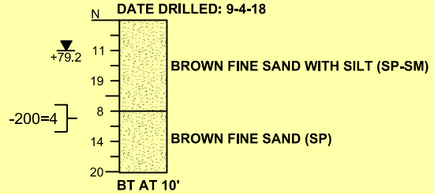
DATE DRILLED: 9-4-18



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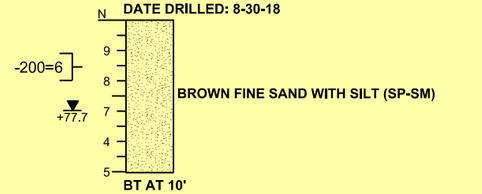

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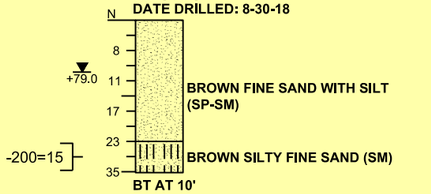

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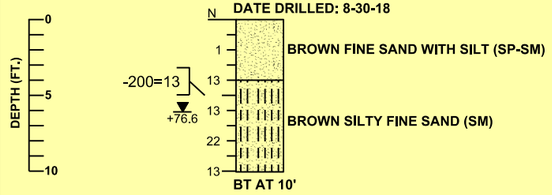

AP-407
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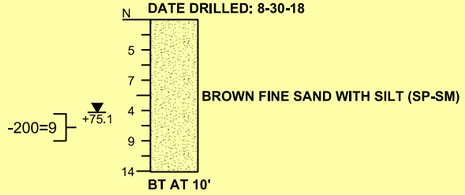

AP-408

FALLS IN BOX CULVERT EXCAVATION

AP-409

FALLS IN SOIL SPOIL PILE

AP-410

FALLS IN BOX CULVERT EXCAVATION

AP-411

FALLS IN BOX CULVERT EXCAVATION

AP-412

FALLS IN SOIL SPOIL PILE

AP-413

FALLS IN BOX CULVERT EXCAVATION

AP-414

FALLS IN BOX CULVERT EXCAVATION

AP-415

FALLS IN SOIL SPOIL PILE

AP-416

FALLS IN BOX CULVERT EXCAVATION

AP-417

FALLS IN CONSTRUCTION LAYDOWN YARD

FIGURE 6

GREATER ORLANDO AVIATION AUTHORITY

WS110 SOUTH TERMINAL C PHASE 1X AIRFIELD CIVIL

ORLANDO INTERNATIONAL AIRPORT

GEC

Revisions

No.	Date	Description

Key Plan

Project No.: 4221G
Designed By: VEW
Drawn By: SKR
Checked By: VEW
Issue Date: September 2018
Drawing Scale:

Drawing Title:

SPT BORING RESULTS FOR APRON/ TAXIWAY

Drawing No.

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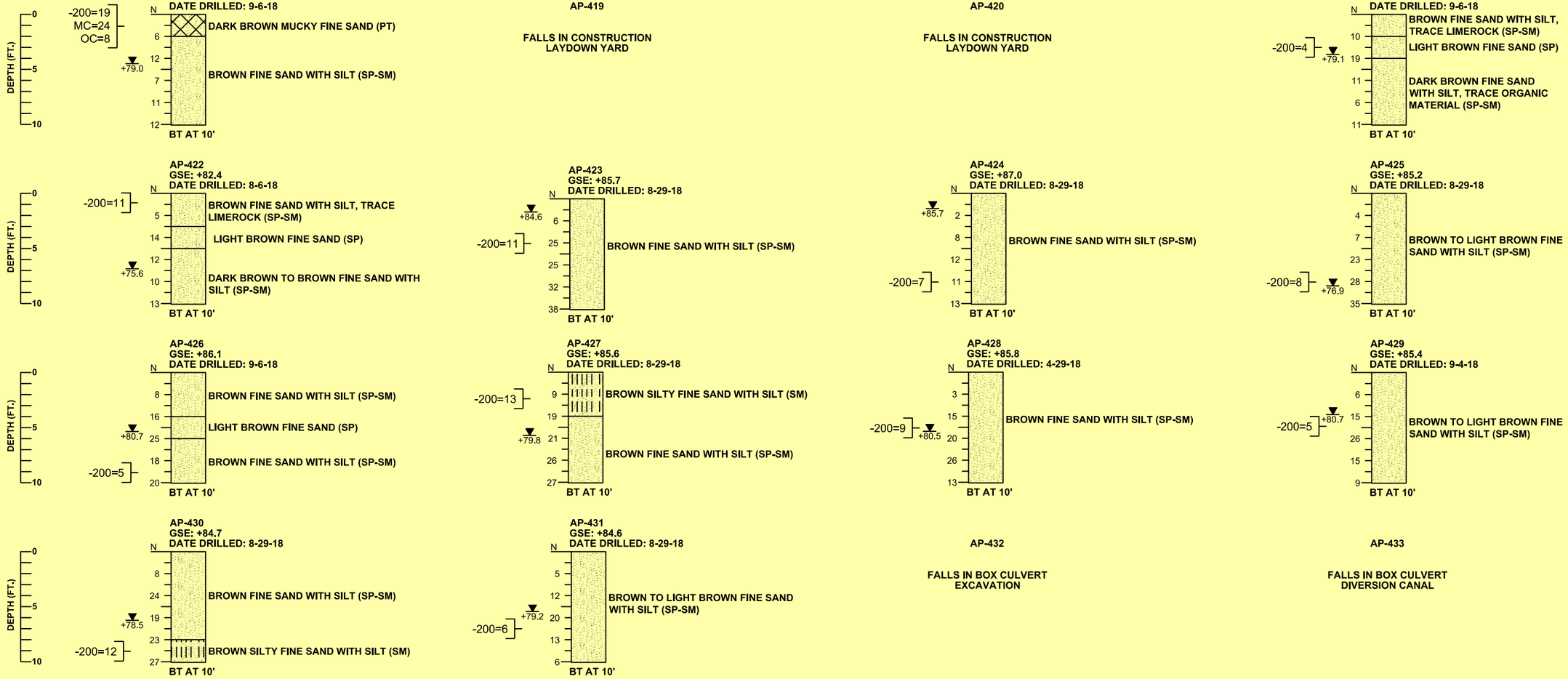

FIGURE 7

GREATER ORLANDO AVIATION AUTHORITY

WS110 SOUTH TERMINAL C PHASE 1X AIRFIELD CIVIL

ORLANDO INTERNATIONAL AIRPORT

GEC

Revisions

No.	Date	Description

Key Plan

Project No.: 4221G

Designed By: VEW

Drawn By: SKR

Checked By: VEW

Issue Date: September 2018

Drawing Scale:

Drawing Title:

SPT BORING RESULTS FOR APRON/ TAXIWAY

Drawing No.

Scott 10/5/2018 1:32:06 PM J:\Jobs - Drafting\4221G OIA\b1boring01.dgn

GREATER ORLANDO AVIATION AUTHORITY

WS110 SOUTH TERMINAL C PHASE 1X AIRFIELD CIVIL

ORLANDO INTERNATIONAL AIRPORT

GEC

Revisions

No.	Date	Description

Key Plan

Project No.: 4221G

Designed By: VEW

Drawn By: SKR

Checked By: VEW

Issue Date: September 2018

Drawing Scale:

Drawing Title:

SPT BORING RESULTS FOR APRON/ TAXIWAY

Drawing No.

FIGURE 8

Scott 10/5/2018 1:32:34 PM J:\Jobs - Drafting\4221G OIA\b1boring01.dgn

FIGURE 9

GREATER ORLANDO AVIATION AUTHORITY

WS110 SOUTH TERMINAL C PHASE 1X AIRFIELD CIVIL

ORLANDO INTERNATIONAL AIRPORT

GEC

Revisions

No.	Date	Description

Key Plan

Project No.: 4221G

Designed By: VEW

Drawn By: SKR

Checked By: VEW

Issue Date: September 2018

Drawing Scale:

Drawing Title:

SPT BORING RESULTS FOR APRON/ TAXIWAY

Drawing No.

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GREATER ORLANDO AVIATION AUTHORITY

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FIGURE 10

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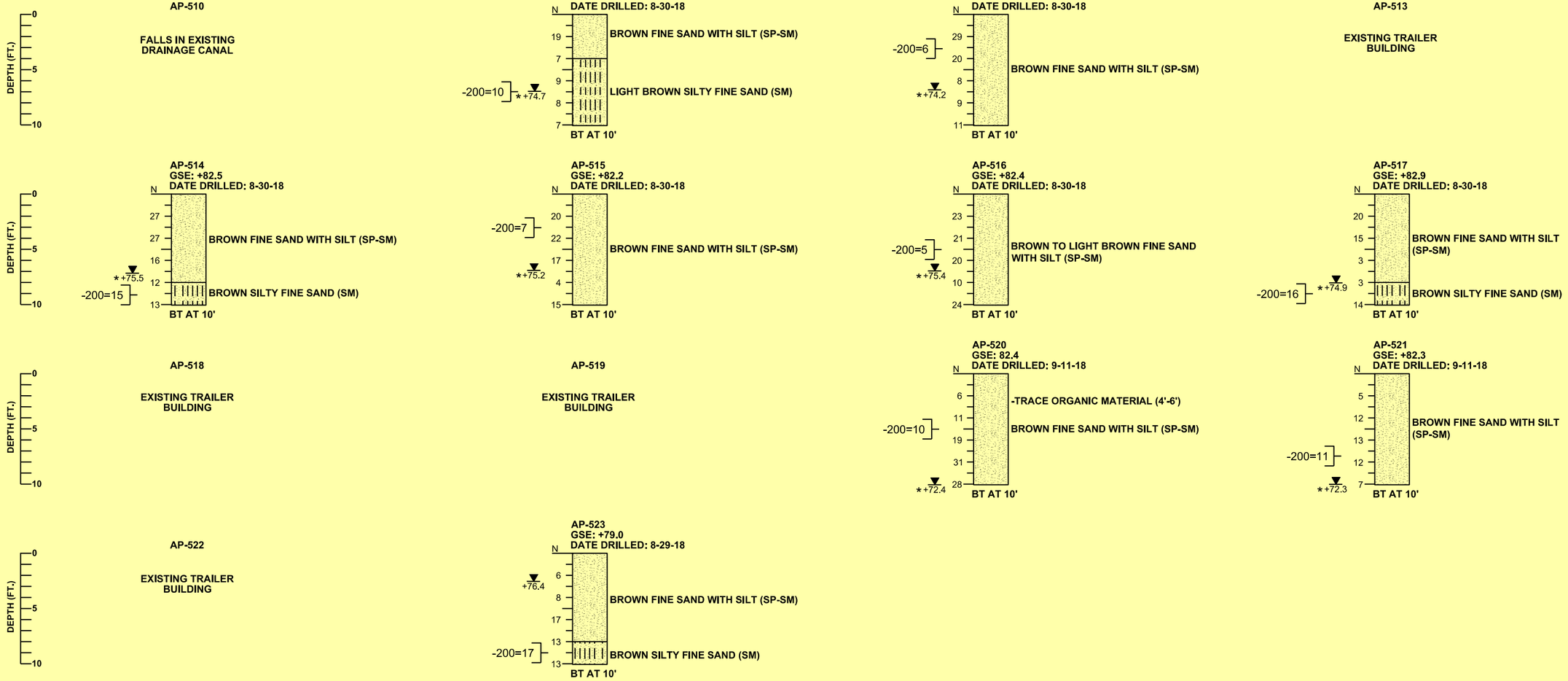

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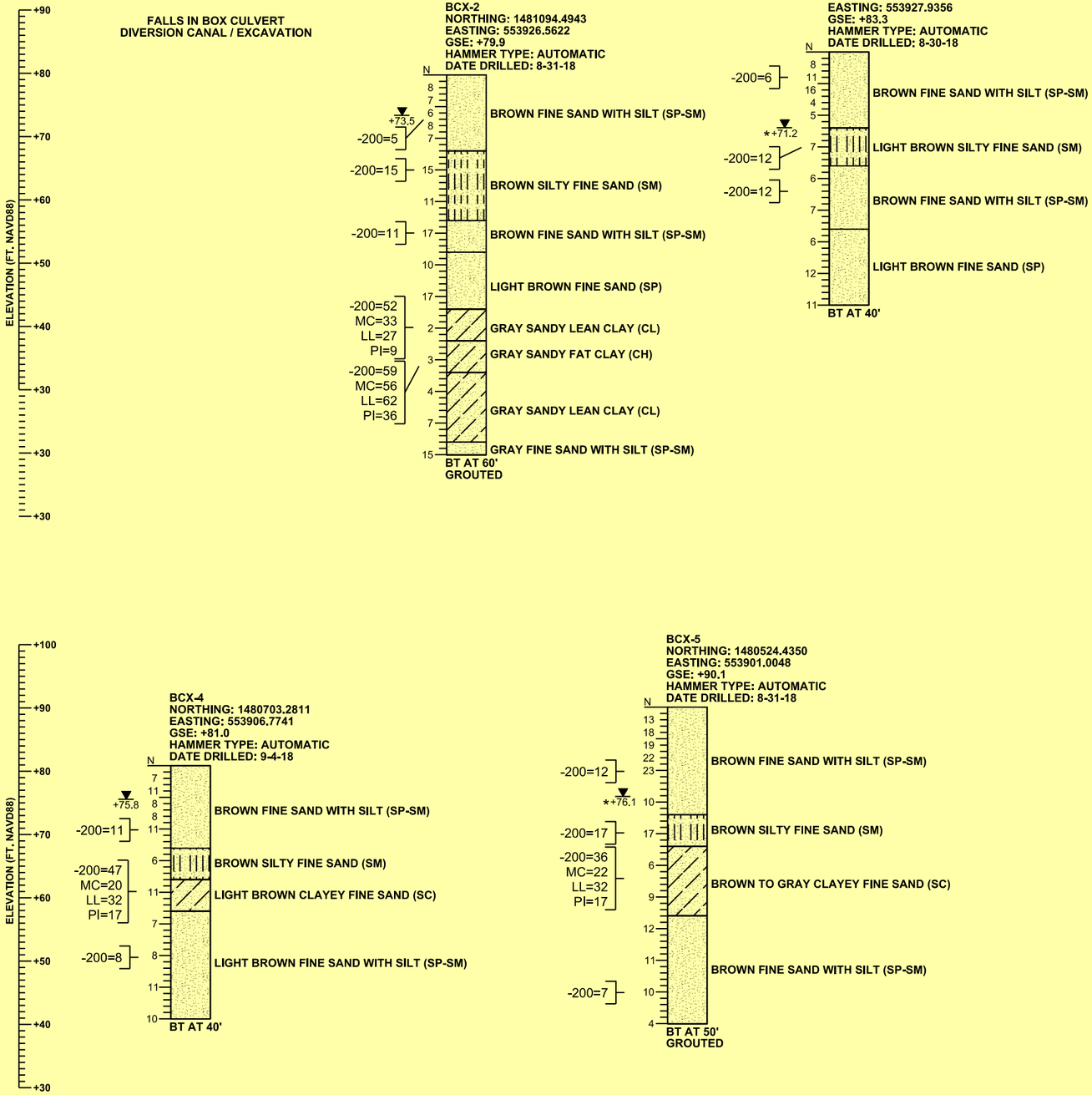
FIGURE 11

SPT BORING RESULTS
FOR BOX CULVERT



LEGEND

GSE	GROUND SURFACE ELEVATION (FT. NAVD88)
N	STANDARD PENETRATION RESISTANCE, BLOWS PER FOOT
*+71.2	ENCOUNTERED GROUNDWATER ELEVATION (FT. NAVD88) AT TIME OF DRILLING
+73.5	ENCOUNTERED GROUNDWATER ELEVATION (FT. NAVD88)
BT	BORING TERMINATED AT DEPTH INDICATED
-200=	PERCENT PASSING NO. 200 U.S. STANDARD SIEVE
MC=	PERCENT NATURAL MOISTURE CONTENT
LL=	LIQUID LIMIT
PI=	PLASTICITY INDEX

SAND

SAND AND SILT

SAND AND CLAY

GENERAL NOTES

SUBSURFACE CONDITIONS SHOWN ON THE BORINGS REPRESENT THE CONDITIONS ENCOUNTERED AT THE BORING AND SOUNDING LOCATIONS. ACTUAL CONDITIONS BETWEEN THE BORINGS MAY VARY FROM THOSE SHOWN. UNIFIED SOIL CLASSIFICATIONS SHOWN ON THE BORINGS ARE BASED ON VISUAL EXAMINATION AND THE LABORATORY TESTING SHOWN.

STANDARD PENETRATION TEST BORINGS WERE PERFORMED IN ACCORDANCE WITH ASTM D-1586. STANDARD PENETRATION RESISTANCES ARE SHOWN ON THE BORINGS AT THE TEST DEPTHS IN IN BLOWS PER FOOT UNLESS OTHERWISE NOTED.

BORING LOCATIONS WERE SURVEYED BY SHANNON SURVEYING FOR HORIZONTAL AND VERTICAL CONTROL. BORING LOCATIONS WERE ESTABLISHED IN THE FIELD USING A SUB-METER ACCURACY GPS UNIT (TRIMBLE 7X).

SEASONAL HIGH GROUNDWATER TABLES ARE HEAVILY DEPENDENT ON THE SITE DRAINAGE CONTROL. PRIOR TO 2017 NEARBY DRAINAGE CANALS / PONDS WERE TYPICALLY CONTROLLED AT NORMAL WATER LEVELS OF +78 FEET NAVD88.

BASED ON REVIEW OF THE U.S. GEOLOGICAL SURVEY MAP ENTITILED "POTENTIOMETRIC SURFACE OF THE UPPER FLORIDAN AQUIFER IN THE ST. JOHNS RIVER WATER MANAGEMENT DISTRICT AND VICINITY, FLORIDA, SEPTEMBER 2008" FOR THE PROJECT AREA, THE ELEVATION OF THE ARTESIAN HEAD IS ESTIMATED TO BE APPROXIMATELY +49 FT. NAVD88. THE CONTRACTOR SHALL BE PREPARED TO HANDLE ARTESIAN HEAD LEVELS UP TO +49 FT. NAVD88.

* STABILIZED GROUNDWATER LEVELS WERE NOT OBTAINED AT BORING LOCATIONS BCX-3 AND BCX-5 DUE TO THE INTRODUCTION OF DRILLING FLUID ABOVE THE GROUNDWATER TABLE.

SPLIT SPOON SAMPLER:
INSIDE DIAMETER: 1.375 IN.
OUTSIDE DIAMETER: 2.0 IN.
AVERAGE HAMMER DROP: 30 IN.
HAMMER WEIGHT: 140 LBS.

CORRELATION OF STANDARD PENETRATION RESISTANCE WITH RELATIVE DENSITY AND CONSISTENCY OF SOIL

GRANULAR SOILS	AUTOMATIC HAMMER N VALUE (blows per foot)	RELATIVE DENSITY
SANDS	0-3	VERY LOOSE
	3-8	LOOSE
	8-24	MEDIUM DENSE
	24-40	DENSE
	OVER 40	VERY DENSE

NON-GRANULAR SOILS	AUTOMATIC HAMMER N VALUE (blows per foot)	CONSISTENCY
SILTS, CLAYS, MUCK, PEAT	0-1	VERY SOFT
	1-3	SOFT
	3-6	FIRM
	6-12	STIFF
	12-24	VERY STIFF
	OVER 24	HARD

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Drawing Title:

SPT BORING RESULTS FOR BOX CULVERT

Drawing No.

FIGURE 12

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MUCK PROBE LOCATION PLAN WITH RESULTS

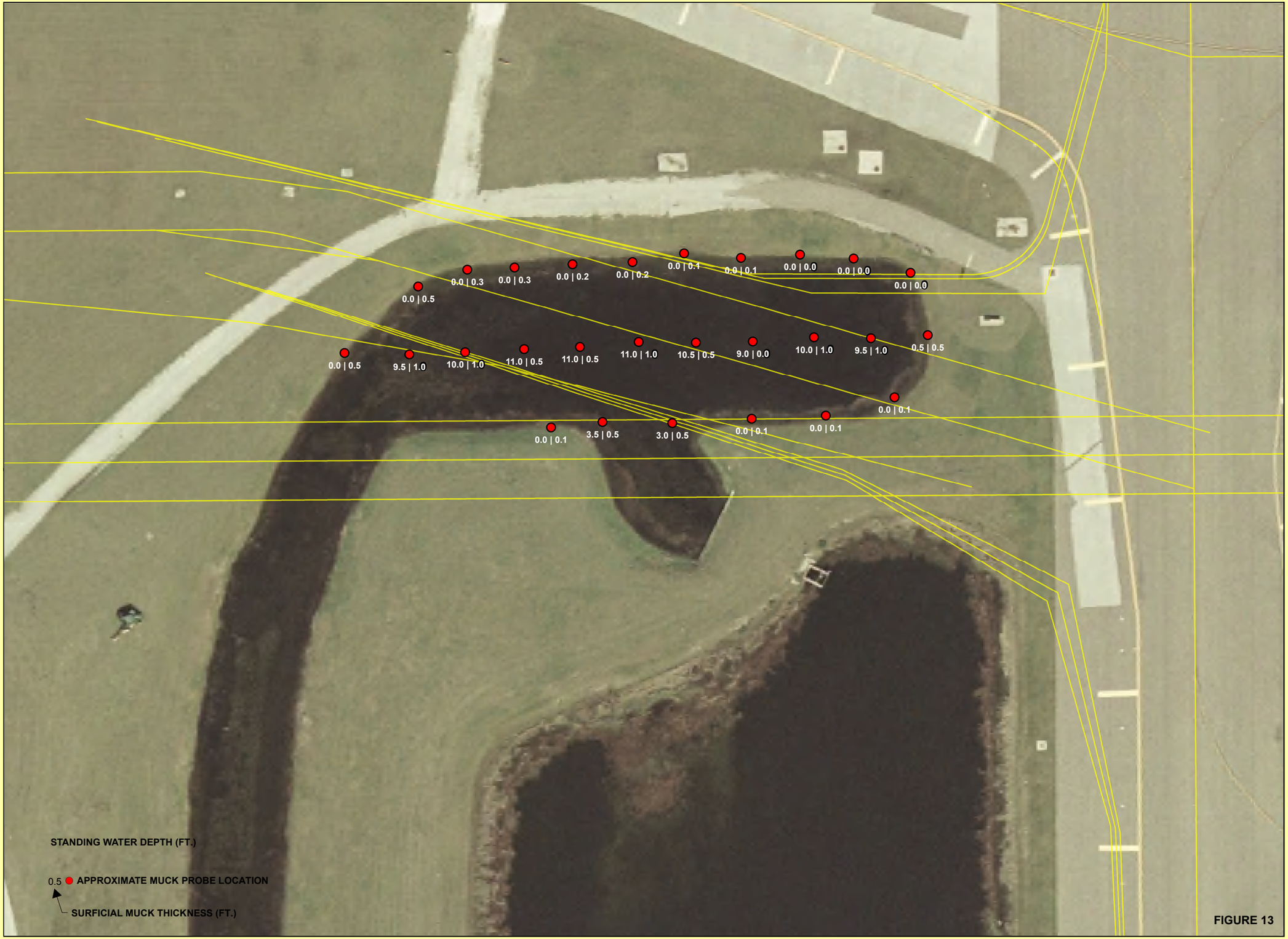

FIGURE 13

J:\D120\3876G OIA South Terminal A-Side\GOAA\4221Gmuck.mxd 10/5/2018

GREATER ORLANDO AVIATION AUTHORITY

WS110 SOUTH TERMINAL C-PHASE 1 AIRFIELD CIVIL

ORLANDO INTERNATIONAL AIRPORT

GEC

W N S E

0 30 60

Feet

Revisions

Project No.:	Date	Description

Key Plan

Project No.: 4221D

Designed By: VEW

Drawn By: SKR

Checked By: VEW

Issue Date: October 2018

Drawing Scale:

Drawing Titles:

MUCK PROBE LOCATION PLAN WITH RESULTS

Drawing No.

Material to remain property of Owner and moved to off site GOAA warehouse by CEI.

STC P1X Material Matrix

GMP	Subcontractor	Specification Section	Specification Title	Material Description	Storage	Quantities
			DIVISION 10 - SPECIALTIES			
11S	Cherokee Enterprises	33 52 45	Fuel System Pipe, Connections & Installation	12" JFP in 16" Casing Pipe Spool - Spool 174	Indoor on dunnage	1 piece of 12"/16" JFP - 16'3" in length with Tee
11S	Cherokee Enterprises	33 52 45	Fuel System Pipe, Connections & Installation	12" JFP in 16" Casing Pipe Spool - Spool 175	Indoor on dunnage	1 piece of 12"/16" JFP - 19' 0" in length with Tee
11S	Cherokee Enterprises	33 52 45	Fuel System Pipe, Connections & Installation	12" JFP in 16" Casing Pipe Spool - Spool 176	Indoor on dunnage	1 piece of 12"/16" JFP - 23' 0" in length with 45*
11S	Cherokee Enterprises	33 52 45	Fuel System Pipe, Connections & Installation	12" JFP in 16" Casing Pipe Spool - Spool 177	Indoor on dunnage	1 piece of 12"/16" JFP - 14' 7" in length with 45*
11S	Cherokee Enterprises	33 52 45	Fuel System Pipe, Connections & Installation	12" JFP in 16" Casing Pipe Spool - Spool 178	Indoor on dunnage	1 piece of 12"/16" JFP - 17' 0" in length with Tee
11S	Cherokee Enterprises	33 52 45	Fuel System Pipe, Connections & Installation	12" JFP in 16" Casing Pipe Spool - Spool 179	Indoor on dunnage	1 piece of 12"/16" JFP - 17' 6" in length with Tee
11S	Cherokee Enterprises	33 52 45	Fuel System Pipe, Connections & Installation	12" JFP in 16" Casing Pipe Spool - Spool 180	Indoor on dunnage	1 piece of 12"/16" JFP - 14' 6" in length with Tee
11S	Cherokee Enterprises	33 52 45	Fuel System Pipe, Connections & Installation	12" JFP in 16" Casing Pipe Spool - Spool 181	Indoor on dunnage	1 piece of 12"/16" JFP - 9' 0" in length with Tee
11S	Cherokee Enterprises	33 52 45	Fuel System Pipe, Connections & Installation	12" JFP in 16" Casing Pipe Spool - Spool 182	Indoor on dunnage	1 piece of 12"/16" JFP - 11' 11" in length with Tee
11S	Cherokee Enterprises	33 52 45	Fuel System Pipe, Connections & Installation	12" JFP in 16" Casing Pipe Spool - Spool 183	Indoor on dunnage	1 piece of 12"/16" JFP - 6' 10" in length with Tee
11S	Cherokee Enterprises	33 52 45	Fuel System Pipe, Connections & Installation	12" JFP in 16" Casing Pipe Spool - Spool 184	Indoor on dunnage	1 piece of 12"/16" JFP - 5' 6" in length with Tee
11S	Cherokee Enterprises	33 52 45	Fuel System Pipe, Connections & Installation	12" JFP in 16" Casing Pipe Spool - Spools 185	Indoor on dunnage	2 pieces of 12"/16" JFP - 17' 2" in length with 45*
11S	Cherokee Enterprises	33 52 45	Fuel System Pipe, Connections & Installation	12" JFP in 16" Casing Pipe Spool - Spool 186	Indoor on dunnage	1 piece of 12"/16" JFP - 39' 0" in length
11S	Cherokee Enterprises	33 52 45	Fuel System Pipe, Connections & Installation	12" JFP in 16" Casing Pipe Spool - Spool 201	Indoor on dunnage	1 piece of 12"/16" JFP - 11' 9" in length with Tee
11S	Cherokee Enterprises	33 52 45	Fuel System Pipe, Connections & Installation	12" JFP in 16" Casing Pipe Spool - Spool 202	Indoor on dunnage	1 piece of 12"/16" JFP - 11' 11" in length with Tee
11S	Cherokee Enterprises	33 52 45	Fuel System Pipe, Connections & Installation	12" JFP in 16" Casing Pipe Spool - Spool 203	Indoor on dunnage	1 piece of 12"/16" JFP - 11' 9" in length with Tee
11S	Cherokee Enterprises	33 52 45	Fuel System Pipe, Connections & Installation	12" JFP in 16" Casing Pipe Spool - Spool 204	Indoor on dunnage	1 piece of 12"/16" JFP - 23' 0" in length with 45*
11S	Cherokee Enterprises	33 52 45	Fuel System Pipe, Connections & Installation	12" JFP in 16" Casing Pipe Spool - Spool 205	Indoor on dunnage	1 piece of 12"/16" JFP - 14' 8" in length with Tee
11S	Cherokee Enterprises	33 52 45	Fuel System Pipe, Connections & Installation	12" JFP in 16" Casing Pipe Spool - Spool 206	Indoor on dunnage	1 piece of 12"/16" JFP - 25' 6" in length with Tee
11S	Cherokee Enterprises	33 52 45	Fuel System Pipe, Connections & Installation	12" JFP in 16" Casing Pipe Spool - Spool 207	Indoor on dunnage	1 piece of 12"/16" JFP - 24' 0" in length with 45*
11S	Cherokee Enterprises	33 52 45	Fuel System Pipe, Connections & Installation	12" JFP in 16" Casing Pipe Spool - Spool 208	Indoor on dunnage	1 piece of 12"/16" JFP - 21' 10" in length with Tee
11S	Cherokee Enterprises	33 52 45	Fuel System Pipe, Connections & Installation	12" JFP in 16" Casing Pipe Spool - Spool 209	Indoor on dunnage	1 piece of 12"/16" JFP - 9' 6" in length with Tee
11S	Cherokee Enterprises	33 52 45	Fuel System Pipe, Connections & Installation	12" JFP in 16" Casing Pipe Spool - Spool 210	Indoor on dunnage	1 piece of 12"/16" JFP - 20' 10" in length with Tee
11S	Cherokee Enterprises	33 52 45	Fuel System Pipe, Connections & Installation	12" JFP in 16" Casing Pipe Spool - Spool 211	Indoor on dunnage	1 piece of 12"/16" JFP - 20' 4" in length
11S	Cherokee Enterprises	33 52 45	Fuel System Pipe, Connections & Installation	12" JFP in 16" Casing Pipe Spool - Spool 212	Indoor on dunnage	1 piece of 12"/16" JFP - 18' 4" in length with Tee
11S	Cherokee Enterprises	33 52 45	Fuel System Pipe, Connections & Installation	12" JFP in 16" Casing Pipe Spool - Spool 213	Indoor on dunnage	1 piece of 12"/16" JFP - 18' 0" in length with Tee
11S	Cherokee Enterprises	33 52 45	Fuel System Pipe, Connections & Installation	12" JFP in 16" Casing Pipe Spool - Spool 214	Indoor on dunnage	1 piece of 12"/16" JFP - 17' 6" in length
11S	Cherokee Enterprises	33 52 45	Fuel System Pipe, Connections & Installation	12" JFP in 16" Casing Pipe Spool - Spool 215	Indoor on dunnage	1 piece of 12"/16" JFP - 9' 1" in length with Tee & Cap
11S	Cherokee Enterprises	33 52 45	Fuel System Pipe, Connections & Installation	6" JFP in 10" Casing Pipe Spool - Spool 190	Indoor on dunnage	1 piece of 6"/10" JFP - 14'9" in length
11S	Cherokee Enterprises	33 52 45	Fuel System Pipe, Connections & Installation	6" JFP in 10" Casing Pipe Spool - Spool 191	Indoor on dunnage	1 piece of 6"/10" JFP - 26'6" in length
11S	Cherokee Enterprises	33 52 45	Fuel System Pipe, Connections & Installation	6" JFP in 10" Casing Pipe Spool - Spool 192	Indoor on dunnage	1 piece of 6"/10" JFP - 14'10" in length
11S	Cherokee Enterprises	33 52 45	Fuel System Pipe, Connections & Installation	6" JFP in 10" Casing Pipe Spool - Spool 193	Indoor on dunnage	1 piece of 6"/10" JFP - 20' 3" in length with Tee
11S	Cherokee Enterprises	33 52 45	Fuel System Pipe, Connections & Installation	6" JFP in 10" Casing Pipe Spool - Spool 194	Indoor on dunnage	1 piece of 6"/10" JFP - 13'2" in length
11S	Cherokee Enterprises	33 52 45	Fuel System Pipe, Connections & Installation	6" JFP in 10" Casing Pipe Spool - Spool 195	Indoor on dunnage	1 piece of 6"/10" JFP - 28'3" in length
11S	Cherokee Enterprises	33 52 45	Fuel System Pipe, Connections & Installation	6" JFP in 10" Casing Pipe Spool - Spool 196	Indoor on dunnage	1 piece of 6"/10" JFP - 17'2" in length with 45*
11S	Cherokee Enterprises	33 52 45	Fuel System Pipe, Connections & Installation	6" JFP in 10" Casing Pipe Spool - Spool 197	Indoor on dunnage	1 piece of 6"/10" JFP - 20'6" in length with 45*
11S	Cherokee Enterprises	33 52 45	Fuel System Pipe, Connections & Installation	6" JFP in 10" Casing Pipe Spool - Spool 220	Indoor on dunnage	1 piece of 6"/10" JFP - 12'6" in length
11S	Cherokee Enterprises	33 52 45	Fuel System Pipe, Connections & Installation	6" JFP in 10" Casing Pipe Spool - Spool 221	Indoor on dunnage	1 piece of 6"/10" JFP - 6'8" in length

11S	Cherokee Enterprises	33 52 45	Fuel System Pipe, Connections & Installation	6" JFP in 10" Casing Pipe Spool - Spool 222	Indoor on dunnage	2 pieces of 6"/10" JFP - 40'0" in length
11S	Cherokee Enterprises	33 52 45	Fuel System Pipe, Connections & Installation	6" JFP in 10" Casing Pipe Spool - Spool 223	Indoor on dunnage	1 piece of 6"/10" JFP - 16'6" in length with 45*
11S	Cherokee Enterprises	33 52 45	Fuel System Pipe, Connections & Installation	6" JFP in 10" Casing Pipe Spool - Spool 224	Indoor on dunnage	1 piece of 6"/10" JFP - 10'8" in length with 45*
11S	Cherokee Enterprises	33 52 45	Fuel System Pipe, Connections & Installation	6" JFP in 10" Casing Pipe Spool - Spool 225	Indoor on dunnage	1 piece of 6"/10" JFP - 21'0" in length
11S	Cherokee Enterprises	33 52 45	Fuel System Pipe, Connections & Installation	6" JFP in 10" Casing Pipe Spool - Spool 226	Indoor on dunnage	1 piece of 6"/10" JFP - 17'5" in length with 45*
11S	Cherokee Enterprises	33 52 45	Fuel System Pipe, Connections & Installation	6" JFP in 10" Casing Pipe Spool - Spool 227	Indoor on dunnage	1 piece of 6"/10" JFP - 17'11" in length with 45*
11S	Cherokee Enterprises	33 52 45	Fuel System Pipe, Connections & Installation	2" JFP in 8" Casing Pipe Spool - Spool 228	Indoor on dunnage	1 piece of 2"/8" JFP - 13'8" in length with 48*
11S	Cherokee Enterprises	33 52 45	Fuel System Pipe, Connections & Installation	2" JFP in 8" Casing Pipe Spool - Spool 229	Indoor on dunnage	1 piece of 2"/8" JFP - 5' 1" in length with 45*
11S	Cherokee Enterprises	33 52 47	Fuel System Valves & Equipment	HP-236A - Fiberglass Fuel Hydrant Pit	Indoor on 3'x5' Pallet	1 Fiberglass Pit on 3'x5' Pallet - 4' High
11S	Cherokee Enterprises	33 52 47	Fuel System Valves & Equipment	HP-236L - Fiberglass Fuel Hydrant Pit	Indoor on 3'x5' Pallet	1 Fiberglass Pit on 3'x5' Pallet - 4' High
11S	Cherokee Enterprises	33 52 47	Fuel System Valves & Equipment	HP-236R - Fiberglass Fuel Hydrant Pit	Indoor on 3'x5' Pallet	1 Fiberglass Pit on 3'x5' Pallet - 4' High
11S	Cherokee Enterprises	33 52 47	Fuel System Valves & Equipment	HP-236 - Fiberglass Fuel Hydrant Pit	Indoor on 3'x5' Pallet	1 Fiberglass Pit on 3'x5' Pallet - 4' High
11S	Cherokee Enterprises	33 52 47	Fuel System Valves & Equipment	HP-235A - Fiberglass Fuel Hydrant Pit	Indoor on 3'x5' Pallet	1 Fiberglass Pit on 3'x5' Pallet - 4' High
11S	Cherokee Enterprises	33 52 47	Fuel System Valves & Equipment	HP-235L - Fiberglass Fuel Hydrant Pit	Indoor on 3'x5' Pallet	1 Fiberglass Pit on 3'x5' Pallet - 4' High
11S	Cherokee Enterprises	33 52 47	Fuel System Valves & Equipment	HP-235R - Fiberglass Fuel Hydrant Pit	Indoor on 3'x5' Pallet	1 Fiberglass Pit on 3'x5' Pallet - 4' High
11S	Cherokee Enterprises	33 52 47	Fuel System Valves & Equipment	HP-236B - Fiberglass Fuel Hydrant Pit	Indoor on 3'x5' Pallet	1 Fiberglass Pit on 3'x5' Pallet - 4' High
11S	Cherokee Enterprises	33 52 47	Fuel System Valves & Equipment	HP-234L - Fiberglass Fuel Hydrant Pit	Indoor on 3'x5' Pallet	1 Fiberglass Pit on 3'x5' Pallet - 4' High
11S	Cherokee Enterprises	33 52 47	Fuel System Valves & Equipment	HP-234A - Fiberglass Fuel Hydrant Pit	Indoor on 3'x5' Pallet	1 Fiberglass Pit on 3'x5' Pallet - 4' High
11S	Cherokee Enterprises	33 52 47	Fuel System Valves & Equipment	HP-234R - Fiberglass Fuel Hydrant Pit	Indoor on 3'x5' Pallet	1 Fiberglass Pit on 3'x5' Pallet - 4' High
11S	Cherokee Enterprises	33 52 47	Fuel System Valves & Equipment	HP-234B - Fiberglass Fuel Hydrant Pit	Indoor on 3'x5' Pallet	1 Fiberglass Pit on 3'x5' Pallet - 4' High
11S	Cherokee Enterprises	33 52 47	Fuel System Valves & Equipment	HP-233L - Fiberglass Fuel Hydrant Pit	Indoor on 3'x5' Pallet	1 Fiberglass Pit on 3'x5' Pallet - 4' High
11S	Cherokee Enterprises	33 52 47	Fuel System Valves & Equipment	HP-233A - Fiberglass Fuel Hydrant Pit	Indoor on 3'x5' Pallet	1 Fiberglass Pit on 3'x5' Pallet - 4' High
11S	Cherokee Enterprises	33 52 47	Fuel System Valves & Equipment	HP-233R - Fiberglass Fuel Hydrant Pit	Indoor on 3'x5' Pallet	1 Fiberglass Pit on 3'x5' Pallet - 4' High
11S	Cherokee Enterprises	33 52 47	Fuel System Valves & Equipment	HP-233B - Fiberglass Fuel Hydrant Pit	Indoor on 3'x5' Pallet	1 Fiberglass Pit on 3'x5' Pallet - 4' High
11S	Cherokee Enterprises	33 52 47	Fuel System Valves & Equipment	HPV-4A Fiberglass High Poing Vent Pit	Indoor on 3'x5' Pallet	1 Fiberglass Pit on 3'x5' Pallet - 4' High
11S	Cherokee Enterprises	33 52 47	Fuel System Valves & Equipment	HPV-4B Fiberglass High Poing Vent Pit	Indoor on 3'x5' Pallet	1 Fiberglass Pit on 3'x5' Pallet - 4' High
11S	Cherokee Enterprises	33 52 47	Fuel System Valves & Equipment	HPV-252 Fiberglass High Poing Vent Pit	Indoor on 3'x5' Pallet	1 Fiberglass Pit on 3'x5' Pallet - 4' High
11S	Cherokee Enterprises	33 52 47	Fuel System Valves & Equipment	LPD-4B Fiberglass Low Point Drain Pit	Indoor on 3'x5' Pallet	1 Fiberglass Pit on 3'x5' Pallet - 4' High
11S	Cherokee Enterprises	34 52 47	Fuel System Valves & Equipment	LPD-251 Fiberglass Low Point Drain Pit	Indoor on 3'x5' Pallet	1 Fiberglass Pit on 3'x5' Pallet - 4' High
11S	Cherokee Enterprises	33 52 47	Fuel System Valves & Equipment	LPD-253 Fiberglass Low Point Drain Pit	Indoor on 3'x5' Pallet	1 Fiberglass Pit on 3'x5' Pallet - 4' High

GMP 19S Attic Stock Inventory

Collected By: Sarah Schultz (Kiewit), Lindsay Antoine (OAR), Rich Dobbyn (OAR)

Date Inventoried: 4/5/2022 4/6/2022 4/8/2022

Item Description	Size (L)	Size (W)	Size (H)	Quantity	Location	Manufacturer	Comment	Spec
RCP	8 ft	72" dia		14	NW square lot	Forterra		33 39 00
Manhole top		5'-6" dia	2'6"	1	NW square lot	Unknown	Ss7	33 39 00
Structure bottom	7'-4"	9'-5"	4'-8"	1	NW square lot	Lindsay precast	A205	33 39 00
Structure top	7'-4"	9'-5"	3'-9"	1	NW square lot	Lindsay precast	A205	33 39 00
Structure riser	7,-11"	4'-4"	2'	1	NW square lot	Lindsay precast	A205	33 39 00
Timber Poles	30'	12" dia		34	NW square lot	Unkown		33 39 00
RCP 72"	8 ft	72" dia		2	NW square lot	County materials	C76	33 39 00
RCP 42"	8 ft	42" dia		4	W square lot	Forterra	C 5	33 39 00
RCP 48"	8 ft	48" dia		17	W square lot	Forterra	C5	33 39 00
RCP 30"	8 ft	30" dia		12	W square lot	County materials		33 39 00
RCP 72"	8 ft	72" dia		4	W square lot	County materials		33 39 00
RCP miter 24"	8 ft	24" dia		1	W square lot	Forterra		33 39 00
PPDB 42" x 6" riser round	8 ft	58" dia	6"	1	W square lot	Lindsay precast		33 39 00
RCP 54"	8 ft	54" dia		8	W square lot	Forterra		33 39 00
RCP 30"	8 ft	30" dia		2	W square lot	Forterra		33 39 00
RCP 36"	8 ft	36" dia		13	SWSquare lot	Forterra		33 39 00
RCP 60"	8 ft	60" dia		49	SW square lot	County materials		33 39 00
RCP 18"	8 ft	18" dia		6	SW square lot	Forterra		33 39 00
OUC ELectric metal hatch	3'-6"	3'-6"	4"	3	S Square lot	Neenah Goundry		26 05 12
OUC Electric precast box top with hatch	8'	6'	2'-9"	1	S Square lot	Lindsay precast	Eden 5' x 7' OUC primary pull box top	26 05 12
OUC electric precast pull box bottom	8'	6'	4'	1	S square lot	Lindsay precast		26 05 12
Precast riser box	3'- 9"	3'-9"	3'-2"	2	S Square lot	Lindsay precast		33 39 00
60"x60" aircraft rated flattop	5'	5'	1'-2"	11	S Square lot	Lindsay precast		33 39 00
4'x4' ARC Hatch riser	5'	5'	1'-1"	3	S Square lot	Lindsay precast		33 39 00
4 x 4 ARC precast manhole	5'	5'	5'	1	S Square lot	Lindsay precast		33 39 00
Precast top with opening comm box lid	8'-6"	9'-2"	10"	5	S Square lot	Lindsay precast		33 39 00
4 x 4 x 48" aircraft rated base		5	5 4'-10"	12	S Square lot	Lindsay precast		33 39 00
4' x 4' x 30" ARC Riser		5	5 30"	1	S Square lot	Lindsay precast		33 39 00
4x4 top with square hatch		5	5 30"	1	S Square lot	Lindsay precast		33 39 00
P1X base slab	11'-8"	21'-8"	10"	3	S Square lot	Lindsay precast	AP 222	33 39 00
P 1. X top slab	11'-8"	21'-8"	11"	3	S Square lot	Lindsay precast	AP 224	33 39 00
10' x 20' riser section ducts 2x6x2	11'-8"	21'-8"	4'	3	S Square lot	Lindsay precast	AC 220	33 39 00
10' x 20' riser section ducts 6x6x6	11'-8"	21'-8"	4'-4"	3	S Square lot	Lindsay precast	AP 224	33 39 00
Metal rip hatch insert	4'-8"	4'-8"	4"	1	S Square lot	Neenah Foundry		33 39 00

Item Description	Size (L)	Size (W)	Size (H)	Quantity	Location	Manufacturer	Comment	Spec
Round manhole cover		2'-3" dia		1	S Square lot			33 39 00
Aluminum C channel box culvert stop plates	24"	10'	3"	10	S Square lot	Unknown		33 39 00
Manhole precast round riser		5' dia	1'	1	S square lot	Lindsay precast		33 39 00
Trench drain grate 14"	2'	14"	2"	181	S Square lot	Dura trench		33 39 00
Trench drain grate 20"	2"	20"	3"	100	S Square lot	Dura trench		33 39 00
Trench drain angle iron embeds	8'	2"	2"	171	S Square lot	Dura trench		33 39 00
Fence barrier wall bases	8'	2'	2'	11	S Square lot	Unknown		33 39 00
Barrier mounted fence section	8'	6'		5	S Square lot	Unknown		33 39 00
Fiberglass wier		8 8'	2'	1	SE square lot	Unknown		33 39 00
Yellow point lights	5'	5"		16	SE square lot	Point lighting corporation		33 39 00
Aluminum LED light pole arms 130	16'			4	SE square lot	Unknown		33 39 00
Aluminum LED light pole arms 140	16'			6	SE square lot	Unknown		33 39 00
HPS bulb 25 light pole arms	16'			9	SE square lot	Unknown		33 39 00
Concrete light pole	45'	13"	13"	18	SE square lot	Unknown		33 39 00
Old barrier wall	8'			9	SE square lot	Unknown		33 39 00
Concrete deadman	6'	33"	32"	6	SE square lot	Unknown		33 39 00
Concrete pile cutoffs	Varies	24"	24"	115	SE square lot	Unknown		33 39 00
OUC electric grounding boxes	13"	19"	13"	8	SE square lot	Unknown		26 05 12
4x4 x27 ACR hatch riser	5'	5'	27"	1	SE square lot	Lindsay precast		33 39 00
Precast drainage top with round riser	9'-4"	8'-4"	5'-7"	2	SE square lot	Lindsay precast	A247 and A109	33 39 00
Precast drainage structure bottom	10'	9'	9'	2	SE square lot	Lindsay precast	A247 and A109	33 39 00
Manhole ring 42" dia	42" dia			1		Neenah Foundry		33 39 00
Steel pipe	7" dia		21'	1		Unknown		33 39 00
Precast drainage box	7'	5'	6'-6"	1	E square lot		A 133; to be incorporated with GTF	33 39 00
Precast drainage box	3'	4'-1"	5'-7"	1	E square lot	Unknown	S7005; to be incorporated with GTF	33 39 00
Precast drainage box	5'	3'	6'	1	E square lot		S711543; to be incorporated with GTF	33 39 00
Precast drainage box	5'	3'	3'6"	1	E square lot		C124; to be incorporated with GTF	33 39 00
Precast drainage box	5-1"	4'1"	5'6"	1	E square lot		C139; to be incorporated with GTF	33 39 00
Curb drop inlet	3'	5'	2'	3	E square lot		To be incorporated with GTF	33 39 00
Precast manhole top cone 4' dia to 2'	4'10' dia	3'4' dia	2	1	E square lot	Old castle	TMC; to be incorporated with GTF	33 39 00
Round box bottom and lid	4'10" dia	2'10"	8" top slab	1	E square lot	Unknown	S3551; to be incorporated with GTF	33 39 00
Precast drainage box	3'	3'	3'11"	1	E square lot	Unknown	To be incorporated with GTF	33 39 00

Item Description	Size (L)	Size (W)	Size (H)	Quantity	Location	Manufacturer	Comment	Spec
Precast drainage box	4'-1"	5'-1"	3'-7"	1	E square lot	Unknown	C122;To be incorporated with GTF	33 39 00
Precast top slab round	7' dia		8"	1	E square lot	Unknown	To be incorporated with GTF	33 39 00
Precast top slab square	5'	5'	7"	1	E square lot	Unknown	To be incorporated with GTF	33 39 00
Precast manhole top round	5' dia		8"	1	E square lot	Old castle	To be incorporated with GTF	33 39 00
Steel ring and cover "storm"	2' dia		7"	1	E square lot	Neenah foundry	To be incorporated with GTF	33 39 00
Rectangle riser insert	3'	4'	1'2"	1	E square lot	Unknown	To be incorporated with GTF	33 39 00
RCP 4' dia	4' dia	2'		1	E square lot	Unknown	To be incorporated with GTF	33 39 00
Round precast top slab	7' OD	5' ID	8"	1	E square lot	Unknown	To be incorporated with GTF	33 39 00
Rectangle riser insert	3'	4'	2'-10"	1	E square lot	Unknown	S7005	33 39 00
Rectangle top slab solid	4'-1"	5'-1"	8"	1	E square lot	Unknown	To be incorporated with GTF	33 39 00
RCP 42"	3'6 " ID	4'2 od	2'	1	E square lot	Unknown	To be incorporated with GTF	33 39 00

Item Description	Size (L)	Size (W)	Size (H)	Quantity	Location	Manufacturer	Comment	Spec
Steel manhole lid 40'	40" dia			1	NE square lot			33 39 00
OUC electric metal hatch	3'6"	3'-6"	4"	1	NE square lot			26 05 12
GOAA communication hatch only	3'-2"	3'-2"	2'	1	NE square lot			26 05 12
Spring assist door	2'	4'2"	2"	2	NE square lot			33 39 00
Manhole lid 30"	30"		2"	1	NE square lot			33 39 00
Metal hatch only	3'2"	3'2"	2"	1	NE square lot			33 39 00
CP test riser	8" dia		20"	2	NE square lot			33 39 00
Water valve riser	8" dia		16"	1	NE square lot			33 39 00
Clean out ring	9" id	16" od	8"	2				33 39 00
Sewer cap	7" dis							33 39 00
Underground enclosure	23" square base	15" square top	25"	3		Ouazite		33 39 00
3" ips sir 11 geothermal water pipe	3" dia			3 bundles				33 39 00
Elliptical pipe 34x53	8	34	53	7		Forterra	C507	33 39 00
72" mitered pipe	72" dia			1		Forterra		33 39 00
72" miter cutoff				1		Forterra		33 39 00
Round sewer bottom	6'6" od	4' id	4'	1		Mack	S-3r	33 39 00
Round sewer riser	6' 6" od	4' id	16"	4		Mack	S6A	33 39 00

Item Description	Size (L)	Size (W)	Size (H)	Quantity	Location	Manufacturer	Comment	Spec
Metal inlet grate	3'	4' 4"	6"	1		Unknown		33 39 00
USF 9151 galv airport frame	2'6"	5'	4"	5		Old castle		33 39 00
Metal rings	10" dia		4"	3				33 39 00
OUC electric cast top with hatch	6'	8'	4'9"	1				26 05 12
Pile cutoffs	24"	24"	Varies	125	Old batch plant			33 39 00
Storm manhole top with round riser	8'-8"	12"-2"	4'-10"			Lindsay precast		33 39 00
Storm structure bottom	9'4"	12'9"	10'					33 39 00
L852C G/G				48	West Vault	ADB Safegate		FAA
L802D G/G				99	West Vault	ADB Safegate		FAA
Taxiway Edge Lights Blue				34	West Vault	ADB Safegate		FAA
L852T R/R				4	West Vault	ADB Safegate		FAA
30/45 W Transformers				109	West Vault	ADB Safegate		FAA
20/25 W Transformers				50	West Vault	ADB Safegate		FAA
10/15 W Transformers				14	West Vault	ADB Safegate		FAA
Sign #35				4	HBJ Warehouse	ADB Safegate		FAA
Sign #36				4	HBJ Warehouse	ADB Safegate		FAA
Sign #37				3	HBJ Warehouse	ADB Safegate		FAA
Sign #38				3	HBJ Warehouse	ADB Safegate		FAA
Sign #39				3	HBJ Warehouse	ADB Safegate		FAA
Sign #40				3	HBJ Warehouse	ADB Safegate		FAA
Sign #41				3	HBJ Warehouse	ADB Safegate		FAA

BP-S195 P1X AIRSIDE CONCOURSE - PLAN HOLDERS LIST

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ADDENDUM NO. 05

(Issued July 11, 2022)

TO THE BID DOCUMENTS FOR
BP-S00195, TERMINAL C, PHASE 1X AIRSIDE CONCOURSE

ORLANDO INTERNATIONAL AIRPORT

ADDENDUM NO. 05

TO ALL HOLDERS OF CONTRACT DOCUMENTS

1. Your attention is directed to the following interpretations of, changes in, and/or additions to the contract documents for the above-named project
2. This addendum is part of the Contract Documents
3. Bidders are required to acknowledge receipt of this Addendum in the space provided on the Bid Form Section 00 41 13

The Bid Due date has been extended to August 2, 2022 @ 2:00 p.m. Please revise Volume 1 of the Project Manual, Page 7 of 461, 3rd paragraph, (Section 00 11 14 – Advertisement for Bids) with the following:

"Sealed bids will be received in the Project Controls Office, Greater Orlando Aviation Authority, 11312 Terminal C Service Road, Bldg. 16, Orlando, FL 32824, up to 2:00 p.m., local time, August 2, 2022, at which time all bids received will be publicly opened, the contents noted and read aloud."

Revised Drawings

The following drawings have been revised by this Addendum and are included as attachments to this Addendum:

- S1.37.37 ADDED ROOF ATENNA

ADDENDUM NO. 06

(Issued July 13, 2022)

TO THE BID DOCUMENTS FOR
BP-S00195, TERMINAL C, PHASE 1X AIRSIDE CONCOURSE

ORLANDO INTERNATIONAL AIRPORT

ADDENDUM NO. 06

TO ALL HOLDERS OF CONTRACT DOCUMENTS

1. Your attention is directed to the following interpretations of, changes in, and/or additions to the contract documents for the above-named project
2. This addendum is part of the Contract Documents
3. Bidders are required to acknowledge receipt of this Addendum in the space provided on the Bid Form Section 00 41 13

Revised Specifications

The following Specifications have been revised by this Addendum and are included as attachments to this Addendum:

- 14 21 00 TRACTION ELEVATOR
- 14 31 00 ESCALATORS
- 27 10 00 PREMISE DISTRIBUTION SYSTEM
- 27 41 33 IP MASTER ANTENNA TELEVISION SYSTEM
- 27 53 10 DISTRIBUTED ANTENNA SYSTEM – CELLULAR
- 27 51 13 EMERGENCY COMMUNICATION SYSTEM
- 28 13 00 PHYSICAL ACCESS CONTROL SYSTEM
- 28 31 00 ADDRESSABLE FIRE DETECTION AND ALARM

Revised Drawings

The following drawings have been revised by this Addendum and are included as attachments to this Addendum:

- A1.12.35 MODIFIED GOAA IDF TO INCLUDE VENDOR IDF AND ADDED WIRE MESH PARTITION AND SWING GATE/DOOR
- A1.12.36 MODIFIED GOAA IDF TO INCLUDE VENDOR IDF AND ADDED WIRE MESH PARTITION AND SWING GATE/DOOR
- A1.12.38 MODIFIED GOAA IDF TO INCLUDE VENDOR IDF AND ADDED WIRE MESH PARTITION AND SWING GATE/DOOR
- A1.12.39 MODIFIED GOAA IDF TO INCLUDE VENDOR IDF AND ADDED WIRE MESH PARTITION AND SWING GATE/DOOR
- A3.12.21 KEYNOTE DELETED
- A3.12.22 NEW CALLOUT
- A3.13.02 NEW WALL SECTION
- A3.13.03 ADDED DETAIL; MODIFIED WALL SECTION
- A4.12.36 MODIFIED GOAA IDF TO INCLUDE VENDOR IDF AND ADDED WIRE MESH PARTITION AND SWING GATE/DOOR
- A6.11.01 CHANGED DOOR HARDWARE FOR 02.6081, 02.6165, 02.6259, 02.6081, 04.6087A, AND 04.6160A FROM IHC-08A TO IHC-06
- E6.10.01 REVISED PANEL FEEDER SCHEDULES
- E6.10.02 REVISED PANEL FEEDER SCHEDULES
- EC1.01.01 FUTURE TENANT ROOM CALLOUTS ADDED
- EC4.01.04 NEW SHEET FOR FUTURE TENANT IDF
- EC4.02.02 VENDOR IDF ROOM ADDED TO SCOPE
- EC4.02.03 VENDOR IDF ROOM ADDED TO SCOPE
- EC4.02.04 VENDOR IDF ROOM ADDED TO SCOPE
- EC4.02.05 VENDOR IDF ROOM ADDED TO SCOPE
- FA0.01.12 UPDATED FA LEGEND SYMBOL; ADDED RATC LEGEND
- FA1.11.34 ADDED HEX NOTE; ADDED RATC
- FA1.11. 35 ADDED WP TO EXTERIOR FA DEVICES; ADDED HEX NOTES; ADDED FIRE SMOKE DAMPER
- FA1.11.36 ADDED WP TO EXTERIOR FA DEVICES; ADDED FIRE SMOKE DAMPERS; ADDED HEX NOTE
- FA1.11.37 ADDED RATC; RELOCATED STROBE; ADDED HEX NOTE
- FA1.11.38 ADDED ADDRESSABLE RELAY; ADDED DUCT DETECTOR**;** ADDED FIRE SMOKE DAMPER; ADDED HEX NOTE
- FA1.11.39 ADDED WP TO EXTERIOR FA DEVICES; ADDED RATC; ADDED HEX NOTE
- FA1.12.35 ADDED RATC; ADDED HEX NOTE
- FA1.14.35 RELOCATED FA DEVICES

- FA1.14.36 RELOCATED FA DEVICES
- FA1.14.38 RELOCATED FA DEVICES
- FA1.14.39 RELOCATED FA DEVICES
- FA4.01.10 ADDED SHEET
- FA5.01.11 UPDATED DETAIL
- FA5.01.13 ADDED DETAILS
- FAD1.11.34 SHEET INCLUDED
- FAD1.12.34 SHEET INCLUDED
- T1.11.34 TENANT IDF ENLARGED PLAN REFERENCE ADDED
- T1.11.35 FUTURE TENANT IDF ROOMS ADDED; (A135026) ADDED; ADDED DATA OUTLET FOR CAMERA; FUTURE TENANT IDF ROOMS ADDED
- T1.11.38 ITO(A135026) ADDED; ADDED DATA OUTLET FOR CAMERA
- T1.12.34 REFERENCE NOTE ADDED TO EME CONDUITS; PHONE RELOCATED FROM BEHIND DOOR
- T1.12.35 ADDED DATA OUTLET FOR DYNAMIC SIGN; ADDED KEYNOTE TO REFER CONTRACTOR TO QP DRAWINGS FOR VDGS OPERATOR PANEL LOCATIONS AND INCLUSION OF CONDUIT AND CABLING SCOPE FOR OPERATOR PANELS; ADDED DATA OUTLET FOR DYNAMIC SIGN
- T1.12.36 ADDED KEYNOTE TO REFER CONTRACTOR TO QP DRAWINGS FOR VDGS OPERATOR PANEL LOCATIONS AND INCLUSION OF CONDUIT AND CABLING SCOPE FOR OPERATOR PANELS; ADDED DATA OUTLET FOR DYNAMIC SIGN
- T1.12.37 ADDED KEYNOTE TO REFER CONTRACTOR TO QP DRAWINGS FOR VDGS OPERATOR PANEL LOCATIONS AND INCLUSION OF CONDUIT AND CABLING SCOPE FOR OPERATOR PANELS
- T1.12.38 REVISED KEYNOTE 2 ADDED KEYNOTE TO REFER CONTRACTOR TO QP DRAWINGS FOR VDGS OPERATOR PANEL LOCATIONS AND INCLUSION OF CONDUIT AND CABLING SCOPE FOR OPERATOR PANELS; ADDED DATA OUTLET FOR DYNAMIC SIGN
- T1.12.39 ADDED DATA OUTLET FOR DYNAMIC SIGN; ADDED KEYNOTE TO REFER CONTRACTOR TO QP DRAWINGS FOR VDGS OPERATOR PANEL LOCATIONS AND INCLUSION OF CONDUIT AND CABLING SCOPE FOR OPERATOR PANELS
- T1.12.40 ADDED KEYNOTE TO REFER CONTRACTOR TO QP DRAWINGS FOR VDGS OPERATOR PANEL LOCATIONS AND INCLUSION OF CONDUIT AND CABLING SCOPE FOR OPERATOR PANELS
- T1.17.35 ADDITIONAL CONDUIT PATHWAY TO RAMP LEVEL ADDED
- T1.17.37 KEYED NOTE FOR ROOF PENETRATION FOR PATHWAY TO TENANT IDF ADDED; (2) 4" CONDUITS FROM ROOF TO TENANT IDF 026208 ADDED
- T1.31.34 TENANT IDF ENLARGED PLAN REFERENCE ADDED; ADDED WAP AND DATA OUTLET FOR WAP; REVISED NOTES
- T1.31.35 ADDED WAP AND DATA OUTLET FOR WAP; CONDUIT PATHWAYS FOR TENANT SPACES AND FUTURE TENANT IDF ROOMS ADDED; REVISED NOTES; RELOCATED CONDUIT STUBS INTO TRANSFER LEVEL IDF ROOM

- T1.31.36 RELOCATED CONDUIT STUBS INTO TRANSFER LEVEL IDF ROOM; ADDED WAP AND DATA OUTLET FOR WAP; KEYED NOTES REVISED
- T1.31.37 ADDED WAP AND DATA OUTLET FOR WAP; REVISED NOTES
- T1.31.38 ADDED WAP AND DATA OUTLET FOR WAP; RELOCATED CONDUIT STUBS INTO TRANSFER LEVEL IDF ROOM; REVISED NOTES
- T1.31.39 ADDED WAP AND DATA OUTLET FOR WAP; RELOCATED CONDUIT STUBS INTO TRANSFER LEVEL IDF ROOM; REVISED NOTES; ADDED WAP AND DATA OUTLET FOR WAP
- T1.32.35 ADDITIONAL CONDUIT PATHWAY FROM ROOF TO RAMP LEVEL ADDED
- T1.32.39 ADDED WAP AND DATA OUTLET FOR WAP
- T1.34.35 ADDITIONAL CONDUIT PATHWAY FROM ROOF TO RAMP LEVEL ADDED
- T1.34.37 (2) 4" CONDUITS FROM ROOF TO TENANT IDF 026208 ADDED
- T4.21.15 SHEET ADDED TO SHOW ENLAGED FUTURE TENANT IDF ROOMS 010040 & 01606B
- T4.22.00 REVISED IDF ROOM LAYOUT; ITO(A235042) ADDED; ADDED EQUIPMENT CABINET ELEVATION AND SCHEDULE; ADDED EQUIPMENT CABINET ELEVATION AND SCHEDULE; REVISED NOTES; REVISED IDF ROOM LAYOUT
- T4.22.01 REVISED WALL ELEVATION
- T4.22.10 ADDED EQUIPMENT CABINET ELEVATION AND SCHEDULE; REVISED IDF ROOM LAYOUT; REVISED NOTES; ADDED EQUIPMENT CABINET ELEVATION AND SCHEDULE; REVISED IDF ROOM LAYOUT
- T4.22.11 REVISED WALL ELEVATION
- T4.32.00 (2) 4" CONDUITS FROM ROOF TO TENANT IDF 026208 ADDED
- T5.00.02 IT/PD ITO TYPE DETAIL ADDED
- T6.10.01 REVISED PACS DEVICE LOCATIONS AND CONNECTIONS IN PBB CONTROL CONSOLE AND PBB EXIT DOOR
- T7.11.10 ITO SCHEDULE REVISED
- T7.11.11 ITO SCHEDULE REVISED
- T7.11.20 ITO SCHEDULE REVISED
- T7.11.21 ITO SCHEDULE REVISED
- T7.20.01 WAP SCHEDULE REVISED
- TA0.00.01 C41 TYPE INFORMATION REVISED; TYPE INFORMATION REVISED
- TA1.12.35 C41 DISPLAY(A235011) ADDED; C41 DISPLAY(A235006) ADDED
- TA1.12.36 C41 DISPLAY ID REVISED(A236006), C41 DISPLAY(A236007) ADDED; C41 DISPLAY ID REVISED(A236008), C41 DISPLAY(A236009) ADDED
- TA1.12.38 C41 DISPLAY ID REVISED(A238006), C41 DISPLAY(A238007) ADDED; C41 DISPLAY ID REVISED(A238008), C41 DISPLAY(A238009) ADDED
- TA1.12.39 C41 DISPLAY(A239007) ADDED; C101 DISPLAY ID REVISED(A239010); C41 DISPLAY ID REVISED(A239008), C41 DISPLAY(A239009) ADDED
- TA5.00.01 C41 DISPLAY CONNECTIVITY DETAIL REVISED

- TA6.02.01 CABLE TYPE LEGEND REVISED; DIAGRAM KEYED NOTES 11-14 ADDED; SYMBOL LEGEND REVISED; DYNAMIC SIGNAGE BLOCK DIAGRAM REVISED
- TA7.01.01 ITO SCHEDULE REVISED
- TA1.01.42 ADDED NOTE
- TA1.01.52 ADDED NOTE
- TA1.31.35 UPDATED CIRCUIT
- TA1.31.36 UPDATED CIRCUIT
- TA1.31.38 UPDATED CIRCUIT
- TA1.31.39 UPDATED CIRCUIT
- TA1.32.35 REMOVED TYPE 6
- TA1.34.35 RELOCATED SPEAKERS; ADDED HEX NOTE
- TA1.34.36 RELOCATED SPEAKERS; ADDED HEX NOTE
- TA1.34.38 RELOCATED SPEAKERS; ADDED HEX NOTE
- TA1.34.39 RELOCATED SPEAKERS; ADDED HEX NOTE
- TA5.02.24 REVISED HEAD END NOTE
- TS0.00.01 PACS TYPE LEGEND REVISED: TYPE 6J DESCRIPTION REVISED
- TS0.00.03 RESPONSIBILITY MATRIX REVISED: PACS INTERFACES REVISED
- TS1.11.34 PACS DOORS 016060A & 016060B ADDED
- TS1.11.35 KEYED NOTES 8 & 9 ADDED; CAMERA(A135027) ADDED AT EMERGENCY PHONE, KEYED NOTES 8 & 9 ADDED
- TS1.11.37 DOOR(016177) ID CORRECTED
- TS1.11.38 CAMERA(A138019) ADDED AT EMERGENCY PHONE, KEYED NOTES 8 & 9 ADDED; KEYED NOTES 8 & 9 ADDED
- TS1.12.35 KEYED NOTES 3 & 5 REVISED, 8-10 ADDED; PACS ID REVISED; PACS DOOR TAG REMOVED, KEYED NOTE CHANGED TO 10; KEYED NOTES 8 & 9 ADDED; DOOR(026066) AND CAMERA(A235028) ADDED; PACS DOOR TAG REMOVED, KEYED NOTE CHANGED TO 10
- TS1.12.36 PACS DOOR TAG REMOVED, KEYED NOTE CHANGED TO 10; PACS ID REVISED; PACS ID REVISED; KEYED NOTE 8 ADDED; DOOR(026144A) AND CAMERA(A236021) ADDED; PACS DOOR TAG REMOVED, KEYED NOTE CHANGED TO 10; KEYED NOTES 3 & 5 REVISED, 8 & 9 ADDED
- TS1.12.38 PACS DOOR TAG REMOVED, KEYED NOTE CHANGED TO 10; PACS DOOR TAG REMOVED, KEYED NOTE CHANGED TO 10; PACS ID REVISED; KEYED NOTES 8 & 9 ADDED KEYED NOTES 3 & 5 REVISED, 8-10 ADDED; DOOR(026066) AND CAMERA(A235028) ADDED; PACS ID REVISED
- TS1.12.39 PACS ID REVISED; KEYED NOTES 3,5,8 REVISED, 10,11 ADDED PACS ID REVISED; DOOR(026281A) AND CAMERA(A239026) ADDED; PACS DOOR TAG REMOVED, KEYED NOTE CHANGED TO 10; KEYED NOTE 10 ADDED; DOOR TAG REMOVED, KEYED NOTE CHANGED TO 10
- TS1.14.35 KEYED NOTE 1 ADDED; CARD READERS AND VISUAL INDICATORS ADDED, KEYED NOTE 1 ADDED

- TS1.14.36 CARD READERS AND VISUAL INDICATORS ADDED, KEYED NOTE 1 ADDED; KEYED NOTE 1 ADDED; CAMERA(A436009) GOAA CAMERA TYPE CORRECTED
- TS1.14.37 GRAPHICS CLEANUP: CAMERA PLOTTED ON WRONG LEVEL; GRAPHICS CLEANUP: CAMERA PLOTTED ON WRONG LEVEL
- TS1.14.38 CARD READERS AND VISUAL INDICATORS ADDED, KEYED NOTE 1 ADDED
- TS1.14.39 CARD READERS AND VISUAL INDICATORS ADDED, KEYED NOTE 1 ADDED
- TS5.01.02 PACS DOOR TYPE 1JS DETAIL REVISED
- TS5.01.03 PACS DOOR TYPE 2JA DETAIL REVISED; DOOR TYPE 2J DETAIL REVISED; PACS DOOR TYPE 2K DETAIL REVISED
- TS5.01.04 PACS DOOR TYPE 3D DETAIL REVISED; PACS DOOR TYPE 4K DETAIL REVISED; PACS DETAIL E4: PACS/C41 SIGN INTERFACE DETAIL ADDED
- TS5.01.05 PACS DOOR TYPE 6JR DETAIL REVISED; PACS DOOR TYPE 6J DETAIL REVISED; PACS DOOR TYPE JBX DETAIL REVISED; PACS DETAIL E5: PACS/EMERGENCY PHONE INTERFACE DETAIL ADDED
- TS6.01.01 PACS BLOCK DIAGRAM REVISED
- TS6.02.01 VSS BLOCK DIAGRAM REVISED; DIAGRAM KEYED NOTE REVISED
- TS6.02.02 CBP VSS BLOCK DIAGRAM REVISED; DIAGRAM KEYED NOTE 1 REVISED
- TS7.01.01 PACS SCHEDULE REVISED
- TS7.01.02 PACS SCHEDULE REVISED
- TS7.01.03 PACS SCHEDULE REVISED
- TS7.02.01 VSS SCHEDULE REVISED
- TS7.02.02 VSS SCHEDULE REVISED
- TS7.02.03 VSS SCHEDULE REVISED
- X0.00.01 UPDATED QTY FOR B20
- X0.00.05 UPDATED MESSAGE LAYOUTS
- X0.00.06 UPDATED MESSAGE LAYOUTS
- X2.12.36 ADDED B20/2002
- X2.12.37 ADDED B20/2001
- X2.12.39 ADDED B20/2003
- X8.00.12 UPDATED MESSAGE LAYOUTS. UPDATED REFERENCE NOTE. UPDATED GRAPHIC PANEL DIMENSIONS.
- X8.00.13 UPDATED MESSAGE LAYOUTS
- X8.00.24 UPDATED MESSAGE LAYOUTS
- X8.00.25 UPDATED DETAIL REFERENCE NOTE
- X8.00.27 UPDATED MESSAGE SIGN ELEVATIONS

Responses to Bidders Questions

Question: Specification Section 27 51 13 specifies the AtlasIED AT##-PA Local Volume Control to be provided where indicated on the drawings. The TA-Series drawings do not appear to illustrate any local volume controls to be part of the Emergency Communication System. Please confirm the specified local volume controls can be disregarded. If not, please provide updated block diagram and floor plan drawings illustrating all required connectivity and locations.

Response: None are currently shown in plan but may become necessary due to future revisions and/or tenant requests, provide only when shown on plans.

Question: Specification Section 27 51 13 Section 1.12 specifies spare materials that are to be provided as part of the Emergency Communication System. The language appears to mirror the original project specifications and requires spare materials in excess of the spare materials previously provided. Please clarify if additional spare materials are required as part of P1X, or if the specified spare materials can be disregarded. If additional spare materials are required, please clarify the quantities and models that are required.

Response**:** See Revised Spare Material Schedule below

1. *(5) of each style AMP Card used*
2. *(2) AMP Mainframes*
3. *(2) Multifunction IO*
4. *(5) Ambient Sensor Collectors*
5. *(5) of each style Mic stations*
6. *Ceiling Speakers*
    a. *(20) Type 00*
    b. *(5) Type 01*
7. *Wall Speakers*
    a. *(10) Type 01*
    b. *(2) Type 06*

Question: The TA-series drawings illustrate CSTC terminal cabinets in the MDF/IDF rooms. Specification Section 27 51 13 does not specify a manufacturer or model number for the CSTC cabinets. Please provide the manufacturer and model number for the required cabinets.

Response: Shall be per DIV 26 and DIV 27 general specification for terminal cabinets and junction boxes for additional requirements, and detail on drawings.

Question: Specification Section 27 51 13 Section 1.13 specifies additional devices to be provided as part of the Emergency Communication System. The language appears to mirror the original project specifications and requires additional devices in excess of the additional devices previously provided. Please clarify if additional devices are required as part of P1X,

or if the specified additional devices can be disregarded. If additional devices are required, please clarify the quantities and models that are required.

Response: Devices shall be per specifications.

Question: The Head End Fire Alarm Interface block diagram on drawing TA5.02.24 notes that the contractor is to "PROVIDE THIS DETAIL (x2) IN HEAD END. TOTAL OF (2) OF EACH CONNECTION SHOWN BELOW." Please confirm a quantity of four (4) AtlasIED IP116 ECS System Controllers are required to accommodate the illustrated and noted connectivity.

Response: Will remove note requiring detail x2, only (2) total ACS to support additional equipment are required.

Question: The Head End Fire Alarm Interface block diagram on drawing TA5.02.24, as well as the ECS Block Diagrams on drawing TA6.12.20 and TA6.12.21 illustrate connectivity for a Logic Relay Module. Specification Section 275113 specifies the AtlasIED IED1516LI to be the Logic Relay Module. The IED1516LI does not have Relay Outputs as illustrated on the block diagrams. Please confirm the IED1516LI is the required interface module.

Response: Specifications will be revised to indicate correct part number IED: 1522LR 2 Input x 2 Relay Output

Question: Specification Section 27 51 13 Section 1.3.C states that PAS Signal Cabling falls under the scope of work for the Emergency Communication System contractor. Specification Section 27 51 13 Section 2.13.A refers to the Network Cabling requirements to Specification Section 27 10 00 for the Horizontal Cabling that would be required for the Microphone Paging Stations. Please clarify who is to provide the network cabling for the Microphone Paging Stations.

Response: To be coordinated with CM / GC

Question: Specification Section 27 51 13 Section 2.8.A specifies the provision of an "additional twenty-five (25) stations and all associated cable, conduit, labor, programing and materials to be located where directed by GOAA." The language appears to mirror the original project specifications and requires devices in excess of the additional devices previously provided. Please clarify if additional devices are required as part of P1X, or if the specified additional devices can be disregarded.

Response: Will revise specifications, provide additional (5) Type 1 Station only.

Question: Specification Section 27 51 13 Section 2.10.6 specifies the Renkus-Heinz ICL-F-DUAL-RN to be the Type 4 Wall Speaker. The TA-Series drawings do not appear to illustrate any Type 4 Wall Speakers to be part of the Emergency Communication System. Please confirm the specified Type 4 Wall Speakers can be disregarded. If not, please provide updated block diagram and floor plan drawings illustrating all required connectivity and locations.

Response: Will revise specifications and remove type 4 wall speakers as they are not used in this phase.

Question: Specification Section 27 51 13 Section 2.10.6 specifies the AtlasIED ALA5T to be the Type 5 Wall Speaker. The TA-Series drawings do not appear to illustrate any Type 5 Wall Speakers to be part of the Emergency Communication System. Please confirm the specified Type 5 Wall Speakers can be disregarded. If not, please provide updated block diagram and floor plan drawings illustrating all required connectivity and locations.

Response: Will revise specifications and remove type 5 wall speakers as they are not used in this phase.

SECTION 14 21 00 - TRACTION ELEVATORS

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Division includes:

~~1.~~ ASC: Provide **thirteen (13)** MRL gearless service and passenger elevators. ~~Two (2) of the thirty elevators are planned as future elevators.~~

~~2. LSC: Provide twenty-three (23) MRL gearless service and passenger elevators.~~

~~3. PKG: Provide six (6) Overhead Geared passenger elevators.~~

4. ~~GTF: Provide three (3) MRL gearless passenger-shaped and service-shaped passenger elevators~~.

5. Coordinate the work of this Division with work of other Divisions as required to properly execute the work as necessary to maintain satisfactory progress of the work of other Divisions.

B. Related Work (to include but not limited to the following by other trades):

1. Elevator pit, including sump with pump, elevator machine foundation with block- outs in machine room floor slabs and other similar concrete work such as grouting thresholds.
2. Hoistway enclosures, including cutouts for elevator equipment and components penetrating enclosures, building in and grouting hoistway door frames, grouting thresholds.
3. Structural steel work, including intermediate floor framing where floor height exceeds 14 feet, elevator pit ladders, elevator buffer ladders and/or platforms (as required by pit depth), railings, wire mesh partitions, machine room floor grates and hoisting beam(‘s) at top of the elevator machine room, and/or hoistway.
4. Waterproofing of elevator pits.
5. Machine room heating, ventilation and air conditioning and temperature control of the machine rooms, hoistway ventilation and sprinklers to meet applicable Codes.
6. Electrical service to fused lockable main disconnects in elevator machine rooms and/or machine or control spaces or closets; electrical service to fused lockable disconnect for each elevator’s car lighting; electrical power for elevator installation and testing; electrical disconnecting device to elevator equipment prior to activation of the sprinkler system; electrical service for the machine room (spaces, or closet); receptacles with ground-fault current protection in machine room (spaces, or closet), secondary areas, hoistway, and pit; lighting in the machine room (spaces, or closets), secondary areas and pits; wiring for telephone service to the machine room (spaces, or closet).
7. Standby-power supply systems including emergency generators and transfer switches for elevator operation. An electrical control connection needs to be established between

standby power system and elevator controls. Additional control features need to be included in electrical switchboards, and transfer switches.

8. Standby power of normal voltage characteristics via normal electrical feeders to run elevators at full-contract car speed and capacity.
9. Conductor from auxiliary form “C” dry contacts, located in the standby power transfer switch to a designated elevator control panel. Provide a time delay of 30 - 45 seconds for pre-transfer signal in either direction.
10. Standby single-phase power to group controller, and each elevator controller for car lighting, exhaust blower, emergency signaling device, air conditioner unit (if equipped with one).
11. Standby power to machine room, and pit lighting.
12. Standby power to machine room ventilation or air conditioning.
13. Standby power to emergency communications devices.
14. Fire alarm systems including fire initiated devices and interconnecting devices; fire alarm signal lines (main, auxiliary, and machine/control room, space, or closet to contacts in the machine/control room, space, or closet.

1.3 SUBMITTALS

A. Product Data: Submit manufacturer’s product data for each system proposed for use. Include the following:

1. Signal and operating fixtures, operating panels and indicators.
2. Cab design, dimensions and layout.
3. Hoistway door and frame details.
4. Electrical characteristics and connection requirements.
5. Expected heat dissipation of elevator equipment in machine room, control space or closet.

B. Shop Drawings: Submit no less than five copies (unless otherwise directed by the architect) of approval layout drawings. Include the following:

1. Driving machine, controller, governor and other machine or controller room component locations.
2. Car, counterweight, sheaves, guide rails, buffers, suspension means, and other components in hoistway.
3. Rail bracket spacing; maximum loads imposed on guide rails requiring load transfer to building structural framing.
4. Load reactions at all points of support.
5. Location of hoisting beams for machine room equipment.
6. Clearances and over travel of car and counterweight.
7. Locations in hoistway and machine room of traveling cables and connections for car light and telephone.
8. Location and sizes of access doors and frames.
9. Hoistway door and frame details

C. Samples: All exposed materials with finish and all custom fixture fabrications.

1. Omit all logos from exposed finishes or components.
2. All cab finishes.
3. All entrance finishes
4. Of handicapped Braille tags for car and hall buttons
5. Of handicapped Braille plates for hoistway door jamb

D. Maintenance Data: Provide written information necessary for proper maintenance and adjustment of the equipment prior to final acceptance as follows:

1. Straight line wiring diagrams of as-installed elevator circuits with index of location and function of all components. Leave one set in machine rooms. Provide 2 corrected sets for Owner's file 90 days after acceptance.
2. Lubricating instructions and recommended lubricant grade.
3. Parts catalogs and maintenance manuals not limited to repair, diagnostic, parts and service, necessary for the maintenance and repair of the elevator equipment shall be provided to the Aviation Authority.
4. Provide at no additional cost any special tools, laptops, pass words and manuals that are required for maintenance, trouble shooting, adjustments, door operation or performance of safety or code related tests for the Owner's use.
5. If the Contractor requires the Owner to sign any documents for the special trouble-shooting tool(s), a copy of the agreement, shall be submitted with the bid.
6. Provide 5 keys for each elevator switch and function. Match existing key system for the project. WD01 fireman's switches, 501CH Access switch, F315 On / Off, F501 Service panel door.
7. Contractor shall furnish to Aviation Authority any proprietary tools or diagnostic equipment that is required for the maintenance, repair or troubleshooting of the elevator related systems that would prevent an outside elevator company that is not related to the elevator manufacturer from providing maintenance and repair functions / services, or which would prevent the outside elevator company from performing future upgrades or modifications to the elevator or related building systems. (ie, security, fire protection system, etc,)
8. Submit the recommended monthly and annual testing and inspection schedule for each unit, as applicable, to be incorporated into the Service Contract, as Attachment D.

1.4 SUBSTANTIAL COMPLETION SUBMITTALS

A. In addition to all other Contract requirements to achieve Substantial Completion, the Contractor shall, as a condition of Substantial Completion of the construction subcontract and before the effective date of the Service Contract, execute and/or deliver the following to the Authority: the Contract, a copy of the Bidder's valid business or occupational license, a copy of Bidder's W -9 Form (Request for Taxpayer Identification Number and Certification), certificate of insurance, performance bond or letter of credit, final approved staffing plan and inventory list, final approved testing and inspection schedule and all other documents and information required by the Contract Documents or the Owner. All of the above documents and information must be furnished and the Contract Documents executed by Contractor, and delivered to Authority, before the Contract will be executed by the Authority

B. The failure to timely fulfill these obligations shall be just cause for the Authority's withdrawal of such Notice of Intent to Award. In such case, the Contract may be re-advertised and the Authority shall be entitled to receive its damages and costs, including, but not limited to, its attorneys' fees caused by or in connection with the Contractor's failure to fulfill its obligations under this Section.

C. The Contract shall not be binding upon the Authority until it has been executed by the Authority and a copy of such fully executed Contract is delivered to the Contractor. The Authority reserves the right to cancel the award without liability to any Bidder at any time before the Contract has been fully executed by the Authority and delivered to the Contractor. Accordingly, the Contractor is hereby warned that it should not commence performance or incur costs or expenses in connection with the Contract obligations until it has received from the Authority a final, fully executed copy of the Contract.

1.5 PRE-INSTALLATION CONFERENCE

A. Pre-Installation Conference: Before Work begins, conduct conference at Project site.

1. Participants:

a. Architect.
b. OAR.
c. Contractor, including superintendent.
d. Installer, including project manager and supervisor.
e. Manufacturer's qualified technical representative.
f. Installers of other construction interfaced with Work.

2. Minimum Agenda: Installer shall demonstrate understanding of the Work required by describing detailed procedures for preparing, installing, and cleaning the Work. Demonstration shall include, but not be limited to, following topics:

a. Tour representative areas of Work, inspect and discuss condition of substrate, and other preparatory work performed by other trades.
b. Review Contract Document requirements.
c. Review approved submittals.
d. Review inspection and testing requirements.
e. Review environmental conditions and procedures for coping with unfavorable conditions.
f. Resolve deviations or differences between Contract Documents and the manufacturer's specifications.

3. Record discussions, including decisions and agreements, and prepare report.

1.6 REFERENCES

A. Comply with applicable building codes and elevator codes at the project site, including but not limited to the following:

1. ASME A17.1 Safety Code for Elevators and Escalators, current adopted edition or as required by the authority having jurisdiction. In areas not covered by AHJ use latest edition of ASME Code.

a. NFPA 70 National Electrical Code.
b. NFPA 80 Fire Doors and Windows.
c. Americans with Disabilities Act – Accessibility Guidelines (ADAAG).
d. ASME A17.1, Buildings and Facilities, Providing Accessibility and Usability for Physically Handicapped People.
e. ASME UL 10B and ASTM E152 (or approved equal), Fire tests of door assemblies.
f. Model building codes.
g. Florida Building Codes, Statues, Administrative Codes and Safety Guidelines
h. All other local applicable codes.

B. Make application for, secure and pay for all necessary permits and certificates of inspection/operation for all equipment included herein, as required by the various departments of the Local and State Authorities. Furnish the Owner certificates and approval as required by

the local governing authorities having jurisdiction.

C. In addition to the permits, inspections and test specified and the governing codes, the elevator contractor will be required to have performed speed and load carrying capacity and heat tests at his own expense.

D. Make applications for secure and pay for all necessary delays, waivers, or required to obtain certificate of compliance.

E. Any damage of any kind to the car or the adjoining structure which may develop through performance of any tests shall be repaired at no additional costs to the Owner.

1.7 CONTRACTORS RESPONSIBILITY

A. The Elevator Contractor shall coordinate installation and inspection of their work with all trades to ensure timely installation, inspections and overall construction schedule sequencing. Failure of the Elevator Contractor to not coordinate in a timely manner with other trades shall not warrant a delay in schedule or additional costs.

B. In order to discover and resolve conflicts or lack of definition which might create problems, elevator manufacturer must review contract documents for compatibility with its product prior to bidding. Review structural, architectural, electrical, mechanical documents, and elevator specifications.

C. Contractor must review all drawings associated with the project to ensure architectural design intents are full achieved, executed and coordinated as needed with other trades.

D. Submit specific written exception and or clarification with quotation. Compliance with provisions of contract documents is assumed and required in absence of written exception.

E. Owner will not pay for change to structural, mechanical, electrical, or other systems required to accommodate manufacturer’s equipment if not identified before contract award.

F. The electrical and mechanical design is based on the power characteristics and heat releases outlined in the drawings. The Contractor shall submit with bid any power characteristics or heat releases of this equipment that exceeds those listed in the drawings. Any additions or modifications requested at a later date will be at the expense of the Contractor.

Heat release given as BTU/elevator/hour. All amperages based on 480 volt system. Maintain 50 to 90 degrees F temperature with 90% non-condensing humidity.

G. Storage of materials: Store materials in a dry protected area. Handle materials in accordance with manufacturer’s recommendations to prevent damage, soiling, or deterioration.

1.8 WARRANTY

A. Provide warranty to replace, repair, or restore parts or components that fail or do not operate properly due to poor field or factory workmanship, engineering or design for a period of 12 months from the date of Substantial Completion. If turnover for beneficial use occurs prior to Substantial Completion, provide interim warranty/maintenance between turnover and substantial completion, so that 12 month Warranty period is maintained starting at Substantial

completion.

1.9 MAINTENANCE

A. Furnish a preventable maintenance schedule, including all testing and inspection services identified for each elevator for a period of twelve (12) months as a condition of Substantial Condition. The maintenance service shall comprise of regular examinations of the installation by competent and trained mechanics on a routine basis, and shall include all necessary adjustments, greasing, oiling, cleaning, and supply parts and accessories necessary to keep the equipment in good operating condition, except such replacement of parts made necessary by misuse, accidents not attributable to failure of equipment or workmanship, and negligence by the Owner.

B. A list of manufacturers recommended spare parts to be stocked (included in the unit price bid) shall be provided by the contractor for approval by the Owner as a condition of substantial completion of the elevator installation. Substantial deviators between the proposed and final inventory list may justify an adjustment to the bid price, if fully documented and approved by the Owner.

C. Provide in accordance with Section 14 00 00 Escalator, Escalator Maintenance and Repair. Provide bid on a per unit basis with a monthly and annual total outlined in the Contractors bid submittal.

D. In the event there is a conflict between this Specification and the Service Contract, the Service Contract will govern on all matters that arise after Substantial Completion.

E. If turnover for beneficial use occurs prior to Substantial Completion, provide interim warranty/maintenance between turnover and substantial completion, so that 12 month Warranty period is maintained starting at Substantial completion.

1.10 QUALITY ASSURANCE

A. The specific product or material manufactured by any of the following listed manufacturers is “acceptable” only if the specific product or material can evidence exact compliance with the contract documents and governing codes.

1. KONE Elevator Company
2. Otis Elevator Company
3. Schindler Elevator
4. ThyssenKrupp Elevator

B. Elevator Contractor must be able to demonstrate that it is a Manufacturer of similar elevators to those specified and which have given satisfactory service; has been in successful operation for at least ten (10) years; maintains locally, an adequate stock of parts for replacement or emergency purposes; has available qualified persons to do the work. Manufacturer means, for the purpose of this Specification section, a legal entity that is regularly engaged in the business of manufacturing the equipment required by this Specification and does not include independent "assemblers" of component parts.

1.11 PARTS AND PRINTED CIRCUIT BOARDS

A. Contractor guarantees they will sell original manufactured parts and printed circuit boards to the Owner or the Owner's Agent. The same shall not be dependent on an exchange component.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. The following manufacturers and dispatching are acceptable:
   1. KONE Elevator KCM 831
   2. Otis Elevator GCS
   3. Schindler Elevator Miconic TX
   4. ThyssenKrupp Elevator TAC32T

B. For cabs and entrances:
   1. Eklunds
   2. Hauenstein & Burmeister
   3. KONE Elevator
   4. Otis Elevator
   5. Schindler Elevator
   6. ThyssenKrupp Elevator
   7. Travertine
   8. Tyler Elevator Products

C. Type and general characteristics:

   1. Review drawings for more details. In the event of conflict, drawings supersede.

Building	HNTB Tag	Levels	Stops	Doors	Notes
~~ASC~~	~~Elevator 14.1~~	~~1 to 6~~	~~4 Stops~~	~~Front @1, 2, 4, 6~~	~~5,000 MRL Service Car, 350 fpm, Simplex Elevator~~
~~ASC~~	~~Elevator 14.2~~	~~1 to 4~~	~~2 Stops~~	~~Front @ 1, 4~~	~~5,000 MRL Service Car, 350 fpm.~~ ~~**Non-Conveyable, Simplex Elevator**~~
~~ASC~~	~~Elevator 14.3~~	~~- 02 06~~	~~3 Stops~~	~~Front~~	~~4,000 MRL, 350 fpm, glass, passenger~~
~~ASC~~	~~Elevator 15.1~~	~~1 to 4~~	~~3 Stops~~	~~Front~~	~~5,000 MRL Service Car, 200 fpm~~
~~ASC~~	~~Elevator 16.1~~	~~2 to 4~~	~~2 Stops~~	~~Front @2 /Rear @ 4~~	~~4,500 MRL, 200 fpm, "service shape" passenger. Occupied space below pit.~~
~~ASC~~	~~Elevator 16.2~~	~~2 to 4~~	~~2 Stops~~	~~Front @2 /Rear @ 4~~	~~4,500 MRL, 200 fpm, "service shape" passenger. Occupied space below pit.~~
~~ASC~~	~~Elevator 16.3~~	~~2 to 4~~	~~2 Stops~~	~~Front @2 /Rear @ 4~~	~~4,500 MRL, 200 fpm, "service shape" passenger. Occupied space below pit.~~

~~ASC~~	~~Elevator 18.1~~	~~2 & 4~~	~~2 stops~~	~~Front~~	~~4,000 MRL 200 fpm Passenger. Occupied space below pit.~~
~~ACS~~	~~Elevator 21.1~~	~~1 to 2~~	~~2 stops~~	~~Front~~	~~4,000 MRL, Service Shape, 200 fpm~~
~~ASC~~	~~Elevator 24.2~~	~~1, 2, 4~~	~~3 Stops~~	~~Front @ 1,4 Rear @ 1,2, 4~~	~~5,000 MRL Service Car, 350 fpm~~
~~ASC~~	~~Elevator 24.3~~	~~2 to 4~~	~~2 stops~~	~~Front~~	~~FUTURE ELEVATOR 4,000 MRL 200fpm Passenger~~
~~ASC~~	~~Elevator 24.4~~	~~2 to 4~~	~~2 stops~~	~~Front~~	~~FUTURE ELEVATOR 4,000 MRL 200fpm Passenger, Occupied space below pit.~~
~~ASC~~	~~Elevator 25.1~~	~~1 to 6~~	~~4 Stops~~	~~Front 1, 2, 4, 6~~	~~5,000 MRL Service Car, 350 FPM~~
~~ASC~~	~~Elevator 25.2~~	~~1 to 4~~	~~2 Stops~~	~~Front @ 1, 4~~	~~5,000 MRL, Service Car, 350 FPM~~ ~~**Non-Conveyable**~~
~~ASC~~	~~Elevator 25.3~~	~~2, 4, 6~~	~~3 stops~~	~~Front~~	~~4,000 MRL 350 fpm, glass passenger~~
~~ASC~~	~~Elevator 26.1~~	~~1 to 2~~	~~2 stops~~	~~Front~~	~~"JetBlue" elevator. 4,000lb. capacity MRL; passenger-shaped, 200 FPM~~
~~ASC~~	~~Elevator 28.1~~	~~1 to 2~~	~~2 Stops~~	~~Front~~	~~4,000 MRL passenger shaped, 200 fpm. Service Car.~~
~~ASC~~	~~Elevator 31.1~~	~~1 to 2~~	~~2 Stops~~	~~Front~~	~~4,000 MRL passenger shaped, 200 fpm~~
ASC	Elevator 34.1	1 to 2	2 stops	Front	4,000lb. capacity; MRL; passenger-shaped; 200 FPM
ASC	Elevator 35.1	1 to 4	3 stops	Front @ 1, 2 Rear @ 4	4,500lb. capacity; MRL; service-shaped; 200FPM
ASC	Elevator 35.2	1 to 4	3 stops	Front @ 1, 2 Rear @ 4	4,500lb. capacity; MRL; service-shaped; 200FPM
ASC	Elevator 36.1	1 to 4	3 stops	Front @ 1, 2 Rear @ 4	4,500lb. capacity; MRL; service-shaped; 200FPM
ASC	Elevator 36.2	1 to 4	3 stops	Front @ 1, 2 Rear @ 4	4,500lb. capacity; MRL; service-shaped; 200FPM
ASC	Elevator 37.1	1 to 2	2 stops	Front	4,000lb. capacity; MRL; passenger-shaped; 200FPM
ASC	Elevator 37.2	1 to 2	2 stops	Front	4,000lb. capacity; MRL; passenger-shaped; 200FPM

ASC	Elevator 38.1	1 to 4	3 stops	Front @ 1, 2 Rear @ 4	4,500lb. capacity; MRL; service-shaped; 200FPM
ASC	Elevator 38.2	1 to 4	3 stops	Front @ 1, 2 Rear @ 4	4,500lb. capacity; MRL; service-shaped; 200FPM
ASC	Elevator 39.1	1 to 4	3 stops	Front @ 1, 2 Rear @ 4	4,500lb. capacity; MRL; service-shaped; 200FPM
ASC	Elevator 39.2	1 to 4	3 stops	Front @ 1, 2 Rear @ 4	4,500lb. capacity; MRL; service-shaped; 200FPM
ASC (Ramp Loading Connector)	Elevator 39.3	1 to 4	3 stops	Front	4,000lb. capacity; MRL; passenger-shaped; 200FPM
ASC (Ramp Loading Connector)	Elevator 39.4	1 to 4	3 stops	Front	4,000lb. capacity; MRL; passenger-shaped; 200FPM
~~LST~~	~~Elevator 2.1~~	~~1 to 6~~	~~3 Stops (1,2,6)~~	~~Front @ 2, 6 / Rear @ 1~~	~~5,000 MRL Service Cars, 350 fpm Non-Conveyable.~~
~~LST~~	~~Elevator 2.2~~	~~1 to 6~~	~~5 Stops (1,2,3,6,7)~~	~~Front @ 2,3,6,7 / Rear @ 1~~	~~5,000 MRL Service Cars, 350 fpm; Non-Conveyable.~~
~~LST~~	~~Elevator 2.3~~	~~1 to 6~~	~~3 Stops~~	~~Front~~	~~3,000lb passenger car, 200fpm~~
~~LST~~	~~Elevator 5.1~~	~~1 to 4~~	~~4 Stops (1,2,4,6)~~	~~Front~~	~~4,000 MRL Passenger, 350 fpm, Glass Cab~~
~~LST~~	~~Elevator 5.2~~	~~1 to 4~~	~~4 stops (1,2,4,6)~~	~~Front~~	~~4,000 MRL Passenger, 350 fpm, Glass Cab~~
~~LST~~	~~Elevator 5.3~~	~~1 to 4~~	~~4 Stops (1,2,4,6)~~	~~Front~~	~~4,000 MRL Passenger, 350 fpm, Glass Cab~~
~~LST~~	~~Elevator 5.4~~	~~1 to 4~~	~~4 Stops (1,2,4,6)~~	~~Front~~	~~4,000 MRL Passenger, 350 fpm, Glass Cab~~
~~LST~~	~~Elevator 6.1~~	~~1 to 4~~	~~4 Stops (1,2,4,6)~~	~~Front~~	~~4,000 MRL Passenger, 350 fpm, Glass Cab~~
~~LST~~	~~Elevator 6.2~~	~~1 to 4~~	~~4 Stops (1,2,4,6)~~	~~Front~~	~~4,000 MRL Passenger, 350 fpm, Glass Cab~~
~~LST~~	~~Elevator 6.3~~	~~1 to 4~~	~~4 Stops (1,2,4,6)~~	~~Front~~	~~4,000 MRL Passenger, 350 fpm, Glass Cab~~

LST	Elevator 6.4	1 to 4 -	4 Stops (1,2,4,6)	Front	4,000 MRL Passenger, 350 fpm, Glass Cab
LST	Elevator 4.1	1 to 7	5 stops	Front	5,000 MRL Service, 350 fpm **Non-Conveyable**
LST	Elevator 12.1	3 to 6	2 Stops	Front	5,000 MRL, 200 fpm Service, Walk in pit
LST	Elevator 12.2	1 to 7	4 Stops	Front	5,000 MRL, 350 fpm Service
LST	Elevator 10.1	1 to 6	3 Stops	Front @ 2/ Rear @ 1,6	5,000 MRL Service Cars, 350 fpm **Non-Conveyable**
LST	Elevator 10.2	1 to 7	5Stops	Front @ 2, 7 / Rear @ 1,3,6	5,000 MRL Service Cars, 350 fpm **Non-Conveyable**
LST	Elevator 8.1	1 to 3	2 Stops	Front @ 1/ Rear @ 3	5,000 MRL, Service, 200 fpm. **Non-conveyable**
LST	Elevator 8.2	1 to 3	2 Stops	Front @ 1/ Rear @ 3	5,000 MRL, Service, 200 fpm. **Non-conveyable**
LST	Elevator 8.3	1 to 2	2 Stops	Front	3,000 MRL Passenger, 200 fpm.
LST	Elevator 6.5	2 to 6	3 Stops (2,4,6)	Front	4,000 MRL, Passenger, 350 fpm. Occupied space below pit.
LST	Elevator 6.6	2 to 6	3 Stops (2,4,6)	Front	4,000 MRL, Passenger, 350 fpm. Occupied space below pit.
LST	Elevator 6.7	2 to 6	3 Stops (2,4,6)	Front	4,000 MRL, Passenger, 350 fpm. Occupied space below pit.
LST	Elevator 6.8	2 to 6	3 Stops (2,4,6)	Front	4,000 MRL, Passenger, 350 fpm. Occupied space below pit.
GARAGE	Elevator 3.1	1 6	6 Stops	Front Only	Triplex. 7,000lb overhead geared traction. 5' center opening doors. 350 fpm See Drawings.
GARAGE	Elevator 3.2	1 6	6 Stops	Front Only	Triplex. 7,000lb overhead geared traction. 5' center opening doors. 350 fpm See Drawings.
GARAGE	Elevator 3.3	1 6	6 Stops	Front Only	Triplex. 7,000lb overhead geared traction. 5' center opening doors. 350 fpm See Drawings.
GARAGE	Elevator 4.1	1 6	6 Stops	Front @ 1,3 Rear @ 2,3,5,6	Triplex. 7,000lb overhead geared traction. 5' center opening doors. 350 fpm See Drawings.
GARAGE	Elevator 4.2	1 6	6 Stops	Front @ 1,3 Rear @ 2,3,5,6	Triplex. 7,000lb overhead geared traction. 5' center opening doors. 350 fpm See Drawings.
GARAGE	Elevator 4.3	1 6	6 Stops	Front @ 1,3 Rear @ 2,3,5,6	Triplex. 7,000lb overhead geared traction. 5' center opening doors. 350 fpm See Drawings.
GTF	Elevator 5.1	3 to 5	3	Front @ 3, 5 Rear @ 4	4,500lb. capacity; MRL; service shaped; 200FPM; Occupied space below pit.

~~GTF~~	~~Elevator 5.2~~	~~3 to 5~~	~~3~~	~~Front @ 3, 5 Rear @ 4~~	~~4,500lb. capacity; MRL; service-shaped; 200FPM; Occupied space below pit.~~
~~GTF~~	~~Elevator 2.1~~	~~1 to 4~~	~~3~~	~~Front @ 1, 2, 4~~	~~5,000lb.AIA capacity; MRL; service-shaped; 200FPM; Class C platform.~~

2.2 PERFORMANCE

A. Speed: +/- 3% under any loading condition.

B. Capacity: Safely lower, stop and hold up to 125% rated load. As required by ASME A17.1 Code.

C. Leveling: +/- 1/8" under any loading condition.

D. Door Closing Time, Force and Kinetic Energy: Comply with ASME A17.1 Code and ADA requirements.

E. Floor-to-Floor Performance Time: Floor to floor performance time (from time door starts closing at one floor to fully opened and level on next successive typical floor, regardless of loading conditions or direction of travel). Performance requirements are based on 12' 0" typical floor-to-floor heights. Adjust times by .2 seconds for each foot of travel.

1. 200 Feet Per Minute 48" Center Opening Doors: 11.0-11.5 Seconds
2. 200 Feet Per Minute 54" Side Opening Doors: 14.0-14.5 Seconds
3. 350 Feet Per Minute 48" Center Opening Doors: 10.0-10.5 Seconds
4. 350 Feet Per Minute 54" Side Opening Doors: 13.0-13.5 Seconds
5. 350 Feet Per Minute 60" Center Opening Doors: 9.5-10.0 Seconds

F. Ride Quality:

1. The following parameters define the standard for quality elevator ride for the high speed elevators:

Design Speed	Adjacent Peak to Peak	Acceleration
200 FPM	17 mg (mille g's)	3.0 ft./sec2
350 FPM	17 mg (mille g's)	3.0 ft./sec2

2. Recording accelerometer tests shall be conducted on each elevator traveling at design speed between terminal landings without stopping in both the Up and Down directions with a maximum load of 500 pounds placed symmetrically in the car. Recordings shall be taken with the accelerometer on the platform in the plane of the car guide rails and perpendicular to the place of the car guide rails. The accelerometer tests shall be made with the sensing unit placed in the center of the elevator car enclosure mounted directly on top of the car platform. The accelerometer and the recording device shall be calibrated just prior to the test, shall provide continuous direct reading on paper tape at a speed not less than 1 inch per second, shall be sensitive to the accelerations in a band width from 0.25 to 10 hertz and be equipped with an ISO2631 filter or equivalent. One set of recordings for each elevator shall become the property of the Owner as a permanent record.

a. The maximum horizontal acceleration permitted in each plane shall be determined from the charts of "Elevator Motion Measurement" in accordance with the following criteria and evaluation method:

1) If the results exceed the maximum specified, the rail alignment, the rail joints, and the guides shall be adjusted to correct the ride characteristic in each plane separately to this maximum.
2) The instantaneous acceleration recorded for a trip of the full travel of the elevator in both the Up and Down directions shall not exceed the tabulated values. Adjacent peak-to-peak values of instantaneous acceleration shall be used to determine the zero reference line.

2.3 MACHINE ROOM EQUIPMENT

A. Identification: Provide identifying numbers on drive, machine, governor, controller and disconnect switch, and car light disconnect switch.

B. MRL Gearless: Elevators shall have permanent magnet gearless machines located in the overhead of the hoistway. All components shall be located so that safe and efficient access is provided from the top of the elevator car top. Machine shall be effectively isolated from the building structure.

C. Geared Machine: The garage elevator machines shall be of the geared single wrap traction type with the motor, brake, and traction sheave mounted on a continuous bedplate. Sound isolation pads shall be installed beneath the machine bedplate to reduce vibration and noise transmission to the building structure.

D. Motors: The motor shall be designed for elevator service with high starting torque and low starting current and be provided with devices to protect against overloading. The motor shall be of alternating current type. Motor armature shall be dynamically balanced and supported by appropriate ball or roller bearings.

E. Brake: The brake shall be spring applied and electrically released and designed to hold the car at the floor after it has come to rest and provide smooth stops under variable loads.

F. Governor: The car safety shall be operated by a centrifugal speed governor located at the top of the hoistway or the machine room. The governor shall actuate a switch when excessive speed occurs, disconnecting power to the motor and applying the brake application of the safety.

G. Drive System:

1. A variable voltage variable frequency AC drive system shall be provided. Power for the system will be taken from the building 3 phase power supply. The AC voltage will be changed to DC, and a power transistor inverter circuit will change the DC voltage to AC to power the elevator motor. Motor speed and torque will be controlled by varying the frequency and amplitude of the AC. A digital velocity encoder shall be provided on the motor giving feedback to the controller on motor speed and position. Provide line filters, noise spike or notching suppressors on regenerative systems to insure other computer-operated equipment in the building will not be affected.
2. The system shall meet or exceed all requirements of IEEE 519 standard for general systems. The position selector shall be part of the microprocessor system. The car position in the hoistway shall be digitized through a primary position encoder. The microprocessor control system shall store the floor position and slowdown points in memory.
3. The drive control system shall be a dual-loop feedback system based primarily on car position. The velocity profile shall be calculated by the microprocessor control system producing extremely smooth and accurate stops. The velocity encoder shall permit

accurate position/velocity feedback and shall permit a fast and accurate control of acceleration and deceleration. The vertical acceleration rate shall be not less than 3.3 ft./sec.² for speeds through 700 fpm, and 4 ft./sec.² for speeds over 700 fpm.

4. The drive shall be the Contractor's Regenerative Version, and the system shall be designed such that on emergency power there will be no regenerative power returned to the temporary power system.

H. Unintended Motion:

1. Provide a device to stop the car in case of unintended movement with the doors open or overspeed in the up direction.

2.4 AUTOMATIC TWO WAY LEVELING.

A. Each elevator will have two-way leveling to automatically bring the car to a stop level with any floor for which a stop has been initiated, regardless of load, rope stretch of direction of travel.

2.5 NORMAL STOPPING DEVICES

A. Provide slow-down and normal stopping devices on top of each car.

2.6 GUARDS

A. In addition to guards for sheaves and other similar items hereinafter specified, attention is directed to the requirements relative to guarding of exposed gears, counterweights, sprockets, tape or rope sheaves, or devices of selectors, floor controllers, or signal machines, and the ropes, chains, or tapes for driving same in machine rooms, pits, car tops and secondary spaces. Kick angles shall be included around all unprotected openings in the machine room floor.

2.7 OPERATION AND CONTROL SYSTEMS

A. Provide "Simplex Collective" operation for single elevators using a microprocessor- based controller. Operation shall be automatic by means of the car and hall buttons. If all calls in the system have been answered, the car shall park at the last landing served.

B. Provide "Group Automatic" operation and control systems for each group of elevators.

2.8 OPERATION

A. General Operation and Control: A microprocessor based control system shall be provided to perform all of the functions of safe elevator motion and elevator door control. This shall include all of the hardware required to connect, transfer and interrupt power, and protect the motor against overloading. The system shall also perform car operational and group supervisory control. Each controller cabinet containing memory equipment shall be properly shielded from line pollution. Micro- computer system shall be designed to accept reprogramming with minimum system down time.

B. Anticipated in Rush Device: To maintain sufficient lobby elevator capacity to handle anticipated

heavy in rush traffic the system shall include a device to call all of the cars in the group to the lobby without waiting for a lobby call. The device shall only operate predetermined heavy rush periods. During these periods, cars shall be automatically dispatched from the lobby when they become loaded nearly to capacity or, if not loaded to capacity, on a variable time interval calculated on the basis of the number of cars at the lobby and other data representative of traffic in the system. The cars shall continue to operate in this manner until the end of the pre-determined period.

C. Off Peak Geographical Spacing: When the cars are at rest, they shall be assigned throughout the building to pre-determined zones. The first car entering a zone shall become assigned to that zone. A car may run through an occupied, assigned zone in search of an occupied zone in which to park. While there are no calls registered the cars shall remain in a zone parked with door closed. The lowest zone shall consist of the main floor and adjacent floor, above or below, as required to suit design requirements. The remaining floors shall be divided into equal zones with one car randomly assigned to each zone. Optimized response to hall calls shall be below, as required to suit design requirements. The remaining floors shall be divided into equal zones with one car randomly assigned to each zone. Optimized response to hall calls shall be achieved by computing a relative system response (RSR) time for each registered hall call. The computation of each car's (RSR) time to a hall call shall be based on, but not limited to, such relevant factors as distance, service to previously assigned car, and hall calls, car load, direction, door and car motion status, and coincidence of car and hall calls. The car with the least RSR shall have this call assigned to it. RSR computations for each hall call are repeated several times a second and the hall call assignment might be changed if a more suitable car is found.

D. Moderate Up and Moderate Down Traffic programs: When incoming traffic at the lobby floor increases as indicated by two cars leaving the lobby in the up direction, filled to capacity with a predetermined adjustable time period, cars assigned to upper zones shall be called to the lobby without waiting for a lobby call. Calls shall be automatically dispatched from the lobby when they become loaded nearly to capacity or, if not loaded to capacity, on a variable time interval calculated on the basis of the number of cars at the lobby and other data representative of traffic in the system. The cars shall continue to operate in this manner until the lobby traffic has been reduced to a predetermined level. When down calls above the lobby increases to a predetermined level, assignment of a car to the lobby ceases and the lobby car shall travel up to assist the other cars. Cars arriving at the lobby, after discharging passenger shall be dispatched upward. The cars shall continue to operate in this manner until the down traffic has been reduced to a pre-determined level.

E. Anticipated Exit Device: To prepare the system for heavy outgoing traffic, operation shall be such that upon arrival at the lobby of any car, loaded more than a pre- determined capacity during a regularly anticipated exit period, assignment of a car to the lobby ceases and the lobby car shall travel up to assist the other cars. Cars arriving at the lobby, after discharging passengers, shall be dispatched upward. The cars shall continue to operate in this manner until the end of the regularly anticipated exit period.

F. Load Weighing Dispatching: A load weighing device shall be provided which shall dispatch the cars away from the main lobby floor when the load in the car reaches a pre-determined capacity. The load dispatch weight shall be adjustable.

G. Load Weighing Bypass: A load weighing device shall be provided which shall be set to operate at a pre-determined percentage of the load in the car. The car shall bypass hall calls when this device is actuated. The bypass load weight shall be adjustable and separate from the load weighing dispatch weight.

H. Anti-nuisance: A system shall be provided so that when the number of car calls is greatly

disproportionate with the weight of the car all car calls shall be canceled without making any stops. The ratio of calls to weight shall be adjustable.

I. Car Button Independent Service all Elevators: A Switch shall be provided in the car operating station which, when actuated, shall disconnect the elevator from the hall buttons, and permit operation from the car buttons only.

J. Car Reversal Operation: A car without registered car call arriving at a floor where both up and down hall calls are registered shall initially respond to the hall call in the direction that the car was traveling. If no car call or hall call is registered for further travel in that direction, the car shall close its doors and immediately reopen them in response to the hall call in the opposite direction.

K. Car Delay Operation: If, for any reason, the doors are prevented from closing and the car is unable to respond to a call, the calls shall be transferred to another car.

2.9 GENERAL OPERATIONS AND CONTROL

A. Control of the elevator shall be automatic in operation by means of pushbuttons in the car numbered to correspond to floors served, for registering car stops and by up/down push buttons at each intermediate landing and call pushbuttons at terminal landings.

B. The momentary pressing of one or more buttons shall dispatch the car to designated landings in the order in which the landings are reached by the car, irrespective of the sequence in which buttons are pressed.

C. Each landing call shall be canceled when answered.

D. When the car is traveling in the up direction, it shall stop at all floors for which car buttons or up hall buttons have been pressed. It shall not stop at floors where down buttons only have been pressed unless the stop for the floor has been registered by a car button, or unless the down call is at the highest floor for which any buttons have been pressed.

E. The pressing of an up button when the car is traveling in the down direction shall not interrupt the travel unless the stop for that floor has been registered by a car button, or unless the up call is the lowest for which any button has been pressed.

F. When the car has responded to high or lowest stop, and stops are registered for the opposite direction, its travel shall reverse automatically and it shall then clear the calls registered for that direction.

G. Should both up and down call be registered at an intermediate floor, only the call corresponding to the direction in which the car is traveling shall be canceled upon the stopping of the car at the landing.

H. An adjustable time delay shall be provided so that after the car has stopped in response to a hall button, the entering passenger may register his car button before the car will reverse to answer calls in opposite direction.

I. Car station shall contain a key operated toggle switch for the car light, a fan switch and a door open button for stopping the closing motion of the doors and causing them to return automatically to their position.

J. The buttons in the car and hall stations shall be of the light-up type and shall indicate that a call has been registered for that landing.

K. Elevators shall have car button independent service. When a key operated switch in the car panel is activated the car shall be disconnected from the hall buttons and shall only respond to car buttons. Car doors shall be closed by pressing the door close button.

L. Elevator Successive Starting. After all drives in a group have been shut down, only a single drive shall be allowed to start up at one time.

M. Contractor must review elevator drawings and inventory to ensure control system's have proper operation design and functionality based on the intended use and floors served. Elevators appearing to share the same general location may or may not be grouped together.

2.10 AUXILIARY OPERATION AND CONTROLS

A. General: In addition to primary control system features, provide the following controls or operational features for the passenger and service elevators, except where otherwise indicated.

B. Special Emergency Service – Phase I: The activation of a key switch in a lobby level hall station shall return all cars in the group express to the designated floor and by- pass all car and hall calls. The cars shall park at the designated floor with the doors open and will not respond to car or hall calls unless the SES-II switch in the car is activated. This system shall be in conformance with the applicable ASME code. The key switch shall comply with local code requirements.

C. Special Emergency Service – Phase II: In-car control of each elevator during the emergency operation, by means of a key switch in each car shall be provided. Operation shall be per ASME A17.1. The key switch shall comply with local code requirements.

D. Emergency Lighting and alarm Bell (Power to Car): Remote emergency alarm bell, located where directed, so it can be heard outside the hoistway, to be arranged to sound automatically in response to activation of alarm button.

E. Emergency lighting and Alarm Bell (No Electrical Power to Car): Car mounted 12 volt battery unit including solid state charger and testing means enclosed in common metal container rechargeable lead acid or nickel cadmium battery with 10 year minimum life expectancy. When normal power to the car fails the system shall automatically provide power to the car emergency light and to the alarm bell circuit. Operation shall be in accordance with ASME A17.1.

F. Emergency power operation: Elevators shall be designed to operate from the stand by power system. Coordinate with MEP provider to determine the number of elevators in the group that can be run at any given time. Provide a manual key switch for selection of elevators after automatic selection occurs.

G. Emergency Exhaust Fan: Any glass elevators located where direct sunlight can reach the cab must be equipped with a battery backup exhaust fan, three speed. Provide industry standard three speed ventilation fan elsewhere capable of providing code compliant operation based on the size of the cab.

H. Hoistway Access Switches: Hoistway access switches shall be provide at the top and bottom landings in the hoistway door jamb as required by local code.

I. Liftnet system: Provide Liftnet system components and all connections to communicate with the

Owners existing system. Include sensor for pit water level monitoring.

J. Auto light / fan shutdown: Provide auto shut down function for car lights and fans. Time to be field programmable.

K. Provide door hold function in all service elevators. Activation will hold doors open for 20-30 seconds or until a door close or floor registration occurs.

2.11 GUIDE RAILS

A. Car and counterweight guide rails, brackets and bracket spacing shall conform to ASME A17.1 Code requirements. Design brackets to accommodate offsets or variations in hoistway walls. Include ladder brackets where necessary. Rail alignment shall be within 1/16 inch. Provide rail backing and intermediate counterweight tie brackets. Provide structural steel or supports to achieve code-required rail deflection limits, as required by manufacturer’s design and system. Provide intermediate structural supports as required for manufacturer’s design and system. Any vertical structural members spanning between hoistway divider beams must be included in the scope of execution, if required by the selected manufacturer's design. No additional structural points of attachment other than those shown on the Contract Documents will be provided.

2.12 MACHINE AND EQUIPMENT SUPPORT BEAMS

A. Provide structural steel beams required for direct support of and attachment to building structure of hoist machine, governor, and hoist rope dead-end hitch assemblies.

B. Provide bearing plates, anchors, shelf angles, blocking, embedment, etc. for support and fastening of hoisting beams, machine beams, or equipment to the building structure.

C. Isolate machine beams to prevent noise and vibration transmission to building structure.

D. A suspension by means that cannot be physically examined shall be provided with a tool that allows inspection of the suspension means.

2.13 PIT SWITCH

A. Provide a lockable pit switch adjacent to the pit ladder. Provide an additional pit stop switch where the pit depth exceeds 66 inches.

2.14 SUSPENSION MEANS

E. Suspension means and their connections shall conform to ASME A17.1.

F. A suspension by means that cannot be physically examined shall be provided with a tool that allows inspection of the suspension means.

G. Provide all tools required by local codes to inspect the means of inspection

2.15 ELEVATOR COUNTERWEIGHTS

A. A counterweight shall be provided for each elevator equal in weight to approximately the weight of the car plus a minimum of 40 to 45 percent of the rated load. Counterweight fillers shall be fabricated of precision flame cut steel plates. They shall lay flat in the weight frame and not rattle when the car is in motion. They shall be sized in a way to facilitate accurate balance of the elevator car,

B. Provide Counterweight Guard where compensation is not provided and where counterweights are adjacent to other elevators.

C. Counterweight safeties shall be provided if there is occupied space below the pit level.

2.16 CAR AND COUNTERWEIGHT BUFFERS

A. Suitable oil buffers with necessary blocking and extensions shall be provided under the elevator car and counterweight. Oil buffers shall be provided with a switch that prevents the car from moving if the plunger is not in it's fully extended position.

2.17 OVERHEAD SWITCHES

A. One emergency stop switch shall be located beside top access door of elevators without overhead machine location.

2.18 HOISTWAY DOOR INTERLOCK

A. Each elevator hoistway door shall be equipped with a hoistway unit system hoistway door interlock. The interlock shall prevent the operation of the elevator driving machine by the normal operating device unless the hoistway is locked in the closed position. The interlock shall also prevent the opening of the hoistway door from the landing side unless the car is either stopped or being stopped. Provide door restrictors.

2.19 HOISTWAY DOOR UNLOCKING DEVICES

A. Unlocking devices shall be provided at all floors where allowed by code. Escutcheons shall be provided in all openings; finish of escutcheons shall be metal and match door finish.

2.20 ELEVATOR COMPENSATION

A. Compensation, when required by drive design, shall be provided for the weight of hoisting ropes and unbalanced portion of traveling cables. Such compensation shall consist of iron or steel wire ropes or Whisperflex at duties below 500 fpm attached to the underside of the car and counterweight.

2.21 ELECTRICAL WIRING

A. Electrical wiring shall comply with the ASME A17.1 and NFPA 70, National Electrical Codes and

all applicable local codes. Wiring shall be included for all devices installed.

1. Furnish and install complete insulated wiring to connect all parts of the equipment. Properly ground all components as required by NFPA 70, National Electric Code.
2. Insulated wiring shall have a flame retarding and moisture resisting outer cover and shall be run in a metal conduit, metallic tubing, or wire ducts.
3. Provide 10 percent spare wires between each controller, leveling device, hoistway junction box, and control panel, also, provide 10 percent spare conductors in each trail cable; all spares shall be properly tagged or otherwise identified with clear and indelible markings.
4. Tag code all field wiring at junction points; control wiring in traveling cables at their terminals in the machine room: elevator car junction box and connections within the car. Test entire wiring system for insulation to ground.
5. Provide total of six (6) shielded pairs for security use in the traveling cables for each elevator. The shielded pairs shall be located in a cable which is not used to carry alternating current circuits. The shielded wiring shall extend from the top of the elevator to a junction box in the elevator machine room.
6. Provide two seperate stranded Coaxial Cable for camera usage. Assist in camera installation with security camera contractor, both inside elevator, on top of elevator and in control room. Coax cables shall be ran separate from elevator traveling cable and be a home run from the elevator machine room to the top of the elevator in order to reach the top back corner of the elevator with a 6 foot extra loop. The security camera contractor intends on housing converter for security wiring within the car operating panels, elevator contractor to open car operating panels to assist security provider with safe access.

2.22 TOP OF CAR OPERATING DEVICE

A. Each elevator shall be provided with an operation device mounted from or on the car cross-head which will permit slow speed (150 fpm or less) operation for purposes of adjustment, inspection, maintenance, and repair. A transfer switch shall be provided in the top of the car operating device fixture, which will permit the disconnection of hoistway switch or switches and render the top of car operating device operative. The operating device shall be mounted in a metal box and shall be rigidly secured in a position conveniently accessible to workmen on top of the car and accessible from the landing side without getting on the car top.

2.23 LUBRICATION

A. Suitable means shall be provided for lubrication, with oil or grease, for all bearing surfaces in connection with the elevator installation.

2.24 CAR TOP LIGHTS

A. Electric light with wire guard and GFCI convenience outlet fixture on car top, which shall meet the requirements of ASME A17.1.

2.25 DOOR OPERATOR

A. A heavy duty, master door operator capable of opening door at not less than 1½" fps and accomplishing reversal in 2½" maximum door movement. Doors shall open automatically when

car arrives at floor to permit transfer of passengers; after timed interval, door shall automatically close. Arrange operator so doors can be opened by hand from inside car in case of power failure, if car is within leveling zone.

B. Door operation shall be “closed loop” system which gives constant feedback of the position and velocity of the elevator doors. System shall automatically overcome door resistance by increasing the power supply to the motor and increasing the torque required to maintain velocity. If a service tool is needed to make digital adjustments, provide the Owner with the service tool and all required manuals.

2.26 DOOR OPENING AND DOOR CONTROL DEVICE

A. Provide Tri Tronics proximity type door protection for all elevators.

B. Door open timing feature.

1. Operate in conjunction with proximity devices to provide adjustable, reduced, hold open time once beams are broken and re-established.
2. When doors are held open beyond an adjustable time, buzzer sounds and doors shall close at reduced speed.
3. The door hold open times between car and hall calls shall be separately adjustable. Door speed, thrust and kinetic energy shall comply with the ASME A17.1 Code. Door hold open times for both car and hall shall comply with “Handicapped Requirements”.

2.27 FINAL LIMIT SWITCHES

A. In addition to the normal limit switches, a hoistway final limit switch shall be installed at the top and at the bottom of each hoistway.

B. Final limit switches shall be so located that they open at or about the time the buffer is engaged by the time the buffer is engaged by the car or counterweight.

2.28 CAR FRAME AND SAFETY

A. Car frame shall be fabricated from formed or structural steel members and shall have adequate bracing to support the platform and car enclosure. The car safety shall be an integral part of the car frame with safety blocks located in the bottom members of the car frame. The safety shall be flexible guide clamp type. Car frame shall be designed for Class A loading for all passenger use elevators and Class C loading for all service elevators.

2.29 PLATFORM

A. The car platform shall be constructed of steel with ¾: plywood sub-floor and fire proofing on the underside. The platform shall rest on rubber pads designed to form an isolating cushion between the car and car frame. Coordinate sill height with flooring. Design platform for Class A loading for all passenger use elevators and Class C loading for all service elevators.

2.30 ROLLER GUIDES

A. Rubber synthetic tired roller spring guides, set in adjustable castings, shall be mounted on the top and bottom of the car and counterweight to engage the guide rails.

2.31 CAR DOOR HANGERS AND TRACKS

A. Hang doors on sheave type hangers with polyurethane rollers that roll on a polished steel track and guided at the bottom by non-metallic shoes sliding in a smooth threshold groove. Minimum two shoes per door panel.

2.32 CAR DOOR ELECTRICAL CONTACT

A. Shall operate in conjunction with car door so elevator cannot operate unless doors are closed or within the tolerance allowed by Code.

B. A car door interlock shall be provided for all glass elevators to prevent car door from being opened out of the locking zone given there is no fascia requirement.

2.33 HOISTWAY ENTRANCES

A. Entrances shall be complete with frames, doors, sight guards, sills, fascia plates, toe guards, headers, struts, hanger covers, tracks, hangers, miscellaneous hardware and related parts. Entrances shall carry UL label for Class “B” 1 ½ hour fire rating (or approved equal). Entrance profiles, finishes and details as shown on the drawings.

B. Frames: Frame finish for all entrances shall be satin stainless steel, see architectural drawings.

C. Doors and Sight Guards: Provide horizontal sliding doors of flush construction and sound deadened. Doors shall be fabricated from a minimum of #16 gauge satin stainless steel, unless the cab is specified to be a glass cab with glass cab doors, at which point the hoistway doors shall have a portion of glass with a stainless trim extending at least 4 inches around the entire door. Glass shall adhere to ASME A17.1 requirements, and meet design requirements shown in Contract documents.

D. Sills: Extruded nickel silver at all floors. Sills shall be level with finished floor.

E. Sill Supports: Any support angles required shall be furnished and installed by the elevator contractor.

F. Hanger Supports: Hanger supports or headers shall be formed sections securely bolted to the strut angles.

G. Fascia Plates: Concealed fascia plates shall be steel, material reinforced to insure a flat even surface throughout, and shall be securely fastened to hanger housings and sill above. Fascia plates shall be finish painted with one coat of rust inhibitive prime paint or of galvanized material.

H. Struts and Closers: Structural steel angles and other similar methods shall be furnished of sufficient size to accommodate the door closers. Angles shall be continuous and be securely bolted to the sills and building beams above.

1. Hoistway door closers for all elevators shall utilize Smart-Tork reel closures to ensure

varying building air pressure does not impact the elevator door closing performance.

I. Header: 3/16” thick steel formed to provide stiffening flanges.

J. Door Hangers and Tracks: Hangers for each hoistway entrance shall be of the sheave type arranged for two point suspension of the doors, and shall have brackets integral with door, or applied. Sheave and rollers shall be of steel with sealed ball bearings and there shall be adjustable ball bearings rollers to take up thrust of doors. Tracks shall be cold drawn or cold rolled steel of smooth surface and working section and shall be oiled with wick type lubrication. All hanger assemblies must have door retainer devices at top and bottom of hoistway doors.

K. Hanger Cover Plates: Shall be made of steel and shall be removable type. Cover plates shall be arranged to assure hanger accessibility from within the car. Cover plates shall be finish painted with one coat of rust-inhibitive prime paint.

L. Floor Numbers: Provide floor numbers within the hoistway in compliance with ASME A17.1 Code.

M. Guides: Each door panel shall contain two gibs with fire tabs.

N. Jamb and Plates: Provide cast plates on each elevator entrance jamb in compliance with requirements of A.D.A. Submit sample for approval.

2.34 PASSSENGER CAR ENCLOSURE

A. Passenger Car interiors as shown in the Architect’s drawings and standards described further herein. Provide custom cab interior finishes, custom cab shells, as required to comply with design shown in Contract documents.

B. Provide self-contained roof top air conditioners for parking garage elevators. Place thermostat and controls in cab service cabinet. Include top mounted condensate boiler system to vaporize condensation water.

C. Ventilation: Morrison Products, Inc. three-speed model or pre-approved equal that meets the noise and vibration requirements as well as air flow volume requirements dictated by code. Provide auxiliary power for ventilation on glass observation elevators.

D. Cab shells shall be constructed of a minimum of 14-gauge re-enforced satin finish stainless steel formed panels. Elevators feature Glass walls shall include glass that meets ASME 17.1 requirements.

E. Canopy: Reinforced 12-gauge furniture steel formed panels with lockable, contacted, hinged emergency exit. Interior finish white reflective baked enamel.

F. Front and Rear Return Panels: Reinforced 14-gauge furniture steel clad with minimum 16-gauge satin stainless steel.

G. Entrance Columns and Transom: Reinforced 14-gauge furniture steel clad with minimum 16-gauge satin stainless steel.

H. Canopy: Reinforced 12-gauge furniture steel formed panels with lockable, contacted, hinged emergency exit.

I. All materials must meet applicable code requirements, including but not limited material flame spread application and glass enclosure code requirements.

J. See Architectural drawings and material specifications for additional details.

2.35 SERVICE CAR ENCLOSURE

A. Flooring: ¼" stainless steel checker plate over 3/4" thick marine plywood sub-floor.

B. Canopy: Reinforced 12-gauge furniture steel formed panels with lockable, contacted, hinged emergency exit. Interior finish white reflective baked enamel.

C. Front and Rear Return Panels: Reinforced 14-gauge furniture steel clad with minimum 16-gauge satin finish stainless steel.

D. Entrance Columns and Transom: Reinforced 14-gauge furniture steel clad with minimum 16-gauge satin finish stainless steel.

E. Shell/Side/Rear Wall Finish: Heavily Reinforced 14-gauge satin finish stainless steel formed panels no more than 18" wide with light-proof joints. There shall not be any flex to the panels if reinforced sufficiently. Apply sound deadening mastic to exterior.

F. Lighting: LED flat lighting fixtures flush mounted in canopy with expanded metal protective diffuser and steel guard over fixtures on car top. Provide protective covers. Lighting shall not be impacted by cab extension provisions that may exist. Lighting shall achieve 200lx at floor of interior.

G. Handrails/Guardrails: Two lines. Top handrail line minimum 1½" diameter stainless steel grab bar with backing plates and captive nuts. Lower guardrail line 4" x 3/8" solid stainless steel flatstock bars mounted on both sides and rear of the car. Locate bottom guardrail line at 8" above car floor and handrail line at 32" above the car floor. Bolt rails through car walls from back and mount on 1½" deep solid round stainless steel standoff spacers no more than 18" O.C. Return handrail/guardrail ends to car walls. Note: for rear opening elevators, rear hand and guardrails not required.

H. Ventilation: Provide inconspicuous ventilation means to comply with Code.

I. Pads and Permanently Mounted Hooks: Removable pads. Two pads covering side walls and adjacent front returns and one covering rear wall. Provide cutouts to access main car operating panel and fire service panel. Color to be determined by Facility.

J. Cab Interior and Door Opening Dimensions per Architectural Drawings.

2.36 CAR DOORS

A. Car doors shall be 1 inch thick, of flush design metal construction, with interior reinforcing and sound deadening insulation. They shall be adequately reinforced to withstand operational stresses and as required to accept hangers, interlocks and other accessories.

1. The finish of the car doors shall be as detailed in the architectural drawings.

B. The car door system shall be designed so that the car doors may not be opened more than 4” from the inside of the car if the car is outside the unlocking zone of a landing.

C. Car door guides: Car doors shall have a minimum of two gibs per panel.

D. Car sills: Car sills shall be extruded nickel silver.

E. Infrared door protection: The contractor shall furnish and install only Tri-Tronics model infrared safety edges. Interruption of one or more of the beams shall cause the doors tom stop and reopen.

2.35 EMERGENCY EXITS

A. All cars shall have ceiling emergency exits. Including interlocks as required by ASME A17.1 Code.

2.36 HALL BUTTON FIXTURES

A. Elevators shall have two (2) flush mounted pushbutton fixtures at each floor when more than one elevator is present, otherwise where single (simplex) elevators are present, provide one (1) flush mounted pushbutton fixture at each floor level Where designated by architectural drawings, provide custom fixture, fixture housing, fixture location and or fixture installation coordination with other trades.

B. Passenger Elevators: Provide EPCO WA-9PC or pre-approved equal. Include up and down arrow integral with button face. Illumination shall be white.

C. Service Elevators: Provide buttons as specified in the car operating panel

D. Include rated boxes and wiring as required.

E. Including phase I key with, Phase I engraved instructions and emergency power jewel in first floor hall station. Coordinate key switch with existing switches.

F. Provide emergency communication phone line monitoring device in accordance with code requirements in first floor hall station.

G. Provide engraved “flame” emergency signage integral with hall pushbutton fixtures in accordance with code requirements.

2.37 HALL LANTERN FIXTURES

A. Provide a hall lantern with an audible signal at each landing entrance for each elevator. The lanterns, when illuminated, shall indicate which elevator car will stop at the landing and in which direction the car is set to travel. When the car reaches a predetermined distance from the floor where it is going to stop, the corresponding hall lantern shall illuminate and the gongs sound once for up and twice for down. The hall lantern shall remain illuminated until the car doors close in preparation for leaving the floor. Provide on all floors.

1. Faceplates shall have a satin stainless steel finish.

2. Provide LED bulbs arrow indications.
3. Shall be easily visible from anywhere in the corridor area.
4. Fixtures design shall be pre-approved by GOAA and in accordance with the ITF and PDL elevators as well as in accordance with the architectural drawings.
5. Illumination shall be green in the up direction and red in the down direction.
6. Fixture shall be vandal resistant for service elevators, 7 jewel type design arrows.
7. Fixture shall be digital type lantern for passenger elevators.
8. Fixture shall have flush design.
9. Hall Lanterns must be designed with gongs/chimes that can be heard clearly within a noisy airport corridor space. Volumes must be set to the maximum level.

2.38 CAR POSITION INDICATOR

A. The elevators shall have one digital readout fixture, with 2" high characters, above each car operating panel.

B. Fixtures shall be LED type and include floor sounding adjustable electronic chime of no less than 20 Decibels at not more than 1500 hertz, shall sound as the car is passing or stopping at a floor.

C. Electronic Voice Annunciator shall have a selectable voice male or female and be able to announce floor, floor selection and direction of travel.

D. Illumination of LED digital fixture shall be red.

2.39 CAR OPERATING PANELS

A. The elevators shall have the following quantity of custom car operating panels:
1. Center Opening, Front Only Doors: Two (2) Car Operating Panels
2. Side Opening, Front Only Doors: One (1) Car Operating Panel
3. Center Opening, Front and Rear Doors: Four (4) Car Operating Panels
4. Side Opening, Front and Rear Doors: Two (2) Car Operating Panels
5. Glass Enclosure Elevators to utilize an applied car operating panel with 45 degree angled metal edge with security fasteners, positioned on the side walls in between glass panels as shown in architectural drawings.
6. Remaining car operating panels are to be full swing car operating panels.
7. All car operating panels to have satin stainless finish.

B. The car operating panels shall include the following:
1. Passenger Elevators: Self-illuminating floor registration elongated metal faced bar buttons. Match design of current GOAA ITF & PDL elevators. Buttons shall have floor designation engraved. Buttons shall illuminate white. Provide EPCO RB-9 button or pre-approved equal. Alarm, door control buttons shall be EPCO SSL-PC button or pre-approved equal.
2. Service Elevators: Self-illuminating floor registration vandal resistant metal buttons. Match design of current GOAA ITF & PDL elevators. Buttons shall have floor designation engraved to the side of the button in 1" letters. Buttons shall illuminate white. Provide EPCO SURVPL-SPC button or pre-approved equal. Alarm, door control buttons shall be EPCO SURVPL-SPC button or pre-approved equal.
3. Firefighter's key switch, pilot light, call cancel and buzzer in a locked cabinet with graphics as required by local code. Key cabinet to match existing units.
4. All buttons shall be designated by raised markings with Braille, applied with concealed fasteners to meet ADA requirements. Stick-on markings are not acceptable.
5. Engraved elevator number, Phase II fireman's instructions, no smoking sign and elevator

capacity on each faceplate or return panel as required by local code.

6. Lockable service cabinet containing controls for fan switch, car light switch, light rheostat, independent service, inspection service, 120 volt convenience outlet and incorporate an Emergency light test button. Cabinet lockset to be Illinois type F315 keyed.
7. ADA hands free phone compatible with Owners existing systems shall be flush mounted in the swing front return.
8. Logos or manufacturer's name are not permitted on exposed surfaces.
9. Certificate holder compatible with the certificate furnished by the AHJ.

2.40 COMMUNICATIONS SYSTEMS

A. The emergency communication system shall be mounted behind the main car operating panel and be designed to provide two-way communication between the elevator and a point outside the hoistway. Audio and visual two-way communication is required. System shall automatically dial a programmable number to a point outside hoistway.

B. Visual messages shall be provided to indicate the status of an emergency call. The visual message will illuminate and shall read: "Message Received" when the emergency call button is pressed.

C. Raised letter and Braille shall be integrated and permanently marked on the faceplate identifying the device as a speech independent emergency telephone. Surface painted or applied graphics shall not be acceptable.

D. Emergency communication system must be able to provide receiving agent with information identifying building and elevator number whenever an emergency call is placed.

E. Emergency communication system shall comply with Federal Communication Commission (FCC) regulations and Americans with Disabilities Act (ADA).

F. When the party called by someone in the cab hangs up, the telephone shall disconnect immediately without giving a busy signal in the cab.

G. The instruments shall be designed in a way that up to six (6) instruments can operate on a single telephone line and provide connection to all six (6) cars at the same time.

H. The system shall have the ability to communicate from Machine room to each individual car.

I. System shall be compatible with Owner's existing systems.

2.41 SMOKE SENSOR TIE-IN

A. System to interface with smoke sensors, including alternate level refuge. (Others will run wiring from the smoke sensors to the elevator machine room interface where the elevator contractor connects to their controls).

B. Elevator contract to provide all necessary interface equipment with their submittal drawings.

2.42 SECURITY INTERFACE FOR ELEVATORS WITH CARD READERS

A. Elevator contractor shall provide cut-out in the COP faceplate (including mounting studs) with a tinted non-scratch flush mounted window and space behind within each elevator that requires a security cardholder. Refer to the security section. The security contractor shall furnish the card reader or key pad to the elevator contractor for mounting. The elevator contractor shall provide all required mounting accessories and shall mount the card reader within the elevator cab. Brackets to hold the card reader in place shall be durable and non-metallic.

B. The security contractor shall co-ordinate with the elevator contractor to connect the traveling cable provided by the elevator contractor within the elevator cab to the mounted card reader. The elevator contractor shall provide and mount glass panel to cover the mounted card reader. Mount the card reader so the window panel is flush to the front of the swing front return.

C. The security contractor shall connect the traveling cable provided by the elevator contractor within the elevator machine room to the security remote field panel.

D. The security contractor shall provide an interface panel within the elevator machine room. This panel shall contain two terminal strips. The security contractor shall label the terminal strips with the required connections from the elevator controller. The elevator contractor shall wire from the elevator controller to these terminal strips. Coordinate with the security contractor to provide all required connections and compatible low voltage contact closures from the elevator controller to this terminal strip to allow the following operation:

1. Signal from the security system to initiate elevator control by the card reader.
2. On card reader mode: The security system shall indicate to the elevator controller which floors are selectable by the cardholder within that elevator. The elevator controller shall enable those floor selection buttons only. When a floor is selected, the elevator controller should disable all other floors from being selected and signal the security system that a selection has been made.
3. Signal from the security system to remove the elevator from under card reader control to normal operation.

E. Submit an alternate price at bid if this interface can be accomplished via an RS-32 protocol interface.

2.43 ELEVATOR MANAGEMENT SYSTEM

A. For all of the vertical transportation herein, a Lift-Net Elevator Monitoring and Management system shall be provided. The system shall comply with the requirement's set forth herein and shall include a monitoring system in each machine room and connected to existing Lift-Net system in central command.

B. General: Provide an interactive system to monitor and manage the elevator equipment ("units") hereinafter called "system." Data collection, data storage, and real-time monitoring portion of the system shall be based on Microsoft Windows and be able to run on Windows 2000 Pro, XP Pro, or later operating systems. Provide the following features:
   A. Network based, capable of interfacing with control systems via either serial data link or hardwired interface connections.
   B. Operate on any TCP/IP based network system including but not limited to an Ethernet, Token Ring, Arc-Net, Lift-Net, etc.
   C. Expansion capability to add unlimited number of monitoring terminals on the network.

D. Monitoring terminals shall operate peer-to peer or with a single client server. Failure of a single network device shall not affect the operation of the remainder of the system.
E. Complete backup of system data shall be accomplished at any single terminal/server location.
F. Display multiple banks, including multiple buildings, on a single monitoring terminal screen.

C. Monitoring Display: The system shall be capable of simultaneous monitoring of at least five hundred units on a single monitoring station utilizing a graphical representation of a plan view of the facility. Each elevator shown on the plan view shall be individually displayed and shall be visible on the monitoring system display terminal without the need to scroll. Each individual unit, when operating "normally," shall be displayed in green. In the event of a malfunction of any individual unit, the unit shall be displayed by a red blinking light on the monitoring system display. Units which are intentionally placed out of service shall be shown as yellow in the display mode. When malfunctioning units, or units intentionally placed out of service are returned to normal operation the graphical representation for that unit(s) shall automatically return to green. The user shall have the ability to display additional information, such as the cause of fault/alarm, for all units by selecting the unit with a "mouse click" from the plan view of the facility. All monitored units shall be visible from any monitoring terminal on the network. Entry into the network shall be multi-level password protected.

D. System Capabilities:
A. The system shall be capable of real time display of all monitored status points on all monitored equipment. Fault and event notification screens and audible alarms shall be immediately displayed on selected monitoring stations. Different fault and event tables shall be defined on a per-bank basis. The system shall collect and store all status, fault, and event information for later reporting and analysis. The system shall provide statistical analysis of hall call response times, traffic patterns, fault conditions, service logs, and security usage in graphical and tabular format.
B. The system shall maintain a record of every status point change occurring on the monitored equipment and provide the ability to replay these events in a simulation at a later time in real time, slow speed, single step, reverse, or fast forward. This information shall be retained for a period of at least twenty-six weeks and a mechanism shall be provided whereby this information may be archived.
C. The system shall store traffic fault and statistical data for a period of at least three (3) years. The system shall log error type, car number, floor position, and major system status points whenever a fault or logged event occurs.
D. The system shall provide interactive control of certain features provided in the elevator control system. These features may be revised as the requirements of the building change. Some of these interactive controls may include, but are not limited to: Security floor lockouts, entering car and hall calls, Firefighters' service, lobby recall, VIP service, up/down peak service, etc.
E. In the case of a power failure the system shall be capable of connecting to emergency power back-up unit. The loss of power shall not affect any stored data. The system shall have the capability to detect the loss (disconnect) of any individual unit from the monitoring system by periodically polling all units to ensure that normal communications between the unit(s) and the terminals/server are maintained.
F. The system will automatically re-boot the program and continue to operate after a power loss or other system malfunction.

E. Monitoring Equipment: The monitoring equipment shall have these minimum characteristics:
   A. Monitoring Station Hardware: Provide a monitoring station in each machine room and on for each facility in central command.
      a. Central Processing Unit: IBM compatible microcomputer – desk top or mini-tower (multiple machine rooms or lobby displays)
      b. Type: Pentium or most current high-performance processor
      c. Speed: Most current high-performance
      d. Internal Hard Drive: Adequate storage for three years data for entire system
      e. Modem: Most current high-performance
      f. Display Monitor: 19" – 20" LCD flat panel, color, capable of simultaneous display of all monitored units
      g. Printer: Current HP Color Desk Jet Series
      h. Keyboard: MS Windows compatible
      i. Mouse: MS Windows compatible
      j. Power Requirements: 90-230 Volts AC, 50-60Hz @ 8A
   B. Monitoring Station Operating System Software
      a. MS Windows 2000 Pro, XP Pro, or later
      b. MS Windows 2000 Server or later

F. Network requirements:
   A. Maximum local network rated distance (2-20 gauge shielded TP): > 10 miles
   B. Elevator Contractor shall provide assistance to Network Contractor with installation of network system in elevator equipment spaces at no additional cost.
   C. Elevator Contractor is responsible for material and labor required for the connectivity and testing of all elevator management
   D. Refer to Division 28 for Network information.

G. Monitoring Requirements: The system shall display and record the following information for each monitored unit. Serial data links may include many more points. Items listed below are minimum requirements.
   A. Group status:
      a. Group operational mode
      b. All units to be monitored on the same screen in a graphical format
      c. In/out of service
      d. Standby power
      e. Supervisory failure
      f. Location and direction of hall calls
      g. Shunt Trip status.
   B. Individual car status, expandable menus:
      a. Direction of travel
      b. Independent service
      c. Inspection service
      d. Firefighters' service
      e. Position of elevator
      f. Door status (open, opening, closing, closed)
      g. Door dwell time
      h. Load by-pass
      i. Standby power
      j. Power on/off
      k. Door detector
      l. Safety circuit
      m. Door zone

n. Stop switch
o. Alarm button
p. Registered car calls
q. Out of level
r. Machine room temperature exceeds 95 degrees
s. Stop counter (number of starts)
t. Car speed
u. Door open times
v. Door close time
w. Start to stop motion time
x. Emergency 2-way communication device
y. Air conditioner/heater

C. Keyboard, mouse, and time clock control capabilities:
a. Floor lockouts (car or hall)
b. Lobby recall
c. VIP service
d. Firefighters' service
e. Up/down peak

D. Faults monitored with visual and audible alarm, triggered by combinations of any of the above status points:
a. Safety circuit
b. Alarm bell
c. Stop switch
d. Emergency 2-way communication device
e. Door reversal device
f. At least six (6) user selectable faults or events (i.e. water in pit, high machine room/cab temperature)

H. Reporting Requirements: System shall provide reports in color graphical format both on-screen and in printed form capability to conveniently switch from one report type to another and from one bank to another using minimal mouse clicks and key strokes. Reports shall be displayed after minimal waiting time. Data for all reports shall be continuously recorded and stored. Reports shall be displayed by simply selecting a date and time range, bank of equipment and report type. Date and time range selections shall carry forward from one report selection to the next. Reporting functions shall be sub-divided into the following categories:

A. Traffic Reports:
a. Number of hall calls per floor (hall call distribution on a per floor basis)
b. Number of hall calls per hour (24 hour time-line)
c. Hall call waiting times per floor (hall call waiting time distribution on a per floor basis)
d. Hall call waiting times per hour (24 hour time-line)
e. Distributed hall call response graph (24 hour time-line)
f. Detailed hall call response graph (% calls / n seconds)
g. Longest wait times including floor #, wait time, date, time and direction

B. Fault Reports:
a. Ten most recent faults (most recent faults listed per bank)
b. Fault Log: Displays the entire fault log for a given time period
c. Faults per car (fault distribution on a per car basis)
d. Faults per floor (fault distribution on a per floor basis)
e. Faults per day/week/month (fault distribution on a per unit or group basis)

C. Car Use Statistics:
a. Car use by hour (24 hour time-line of car calls, car starts, door cycles, delayed car, load by pass)

b. Car use statistics (same as above, shown for an entire bank)

D. Group Service Log:
   a. Cars in service (24 hour time-line with text log of group availability of each car)
   b. Group functions (24 hour time-line with text log of actuation of group functions – Up peak, down peak, fire service, emergency power, etc.

I. Interactive Features: The control system shall be capable where desired of operating interactive control features provided in the elevator control system. These features may be revised as the requirements of the building change. Some of these interactive controls may include but are not limited to: security floor lockouts, entering car and hall calls, Firefighters' return service, lobby recall, VIP service, up/down peak or hospital Code Blue service. Local codes may affect the availability or operation of these features.

A. Security Access Features: The monitoring system shall be capable of providing security enable/disable of all hall and car calls through on-screen menus at a minimum. The monitoring system shall also be capable of interfacing directly with card readers and security keypads in stand-alone mode, and indirectly through a serial interface with a third party security system. When in stand-alone mode, the monitoring system shall maintain a database of elevator users and security pass codes. When on secure mode the use of each elevator will be recorded in a file together with the time, authorized pass code and destination for each call.

B. Elevator Control Features: Each elevator shall be capable of being controlled through the monitoring system. All control points shall be capable of seven-day twenty-four hour time clock automatic operation or manual operation from the mouse and keyboard. The control points shall include, but not be limited to, the following (where allowed by local codes):
   a. Lobby recall
   b. Car call security lockout
   c. Hall call security lockout
   d. Independent service

C. Paging Feature: The monitoring system shall be capable of paging a service technician or other personnel based on pre-defined parameters of elevator faults or conditions. The paging system shall provide the ability to page multiple numbers determined by the type of event triggering the notification and shall be able to page different numbers based on preset times of day (i.e. different shifts). The system shall be capable of sending text messages to full text pagers in addition to supporting standard DTMF pagers.

D. Remote Access Feature: The monitoring system shall be capable of allowing approved individuals under multi-level password control to access all system features via the local area network, internet, or via modem over the public telephone network to review the performance of the equipment or to evaluate a fault condition. The remote access feature shall be integrated into the monitoring system and shall not use third party "remote control" software products.

J. Elevators to be integrated into existing Lift Net monitoring system and communicate to the Central Control room of the facility. Coordinate use of LAN with the Owner. For non LAN functions provide wiring and conduit for all components furnished.

K. Lift-net system shall be connected to a new USP power back up system furnished fully by Elevator Contractor.

PART 3 – EXECUTION

3.1 SCOPE

A. Installation shall meet all of the standard requirements outlined herein and inspection, tolerances, and qualifications. All work required for completion of a first-class installation is the responsibility of the Contractor, even if not included in this specification.

B. Labeling of disconnects with feed location information and shunt trip locations to be by the elevator contractor.

3.2 HOISTWAYS

A. Entire front of hoistway will be left open until the hoistway entrances have been installed. After the guide rails have been erected and aligned, install frames in alignment with the guide rails, after which the wall may be completed. Coordinate this phase of the work to provide minimum delay in completion.

3.3 PAINTING

A. All elevator equipment not painted, located within the machine room or hoistway, shall be given a finish coat of paint. Material that has factory finish paint shall have all scratches or mars re-painted after installation. Any galvanized finishes do not need to be painted.

B. Finish coat shall have hard, tough semi-gloss surface.

C. Elevator machine room and pit floors shall be painted with an oil resistant polyurethane high gloss enamel paint or approved equivalent. Color shall be terra cotta (Tough Shield #1231-108) or approved equivalent.

3.4 CLEAN UP

A. Remove trash daily from hoistways, pits, and machine rooms including all packing material and debris resulting from this work. Leave all elevator spaces broom clean.

3.5 ACCEPTANCE TESTING

A. Tests shall be performed by the Elevator Contractor at his expense in the presence of the Owner’s representative. The elevators shall be subjected to the following acceptance inspection and tests:

1. Inspection and tests required by applicable portions of Requirements, 1.03.
2. Inspection and tests required by Federal, State, and Local codes and ordinances.
3. Test safety circuit, loop circuit, and the drive circuits at 500 volts. Minimum resistance to ground shall be one megohm.
4. General riding quality, leveling accuracy, and quietness of operation shall be acceptable to the Owner’s representative.

3.6 USE OF ELEVATORS

A. The elevators shall not be used for construction purposes or during the period prior to turning over the project to the Owner, without Owner's written authorization. Should the elevators be authorized for temporary use, the following conditions shall apply:

1. The Elevator Contractor shall provide a temporary acceptance form for the user to sign.
2. The Warranty period commences upon Substantial Completion and GOAA receives and approves the recommended spare parts list and staffing plan, regardless of any temporary use agreement.
3. The user shall provide, if job conditions require, all temporary enclosures, guards or other projection of the hoistway openings, power, signal devices, car lights, protection of any elevator entrances, cars, fixtures, and any other equipment that is installed.
4. The user shall return the elevators in the same condition they were in when placed on temporary service and shall pay the Elevator Contractor for repairs or clean up.
5. The user shall allow the Elevator Contractor to perform routine maintenance or repairs.
6. The cost of temporary service shall be worked out between the Elevator Contractor and the user.

B. As elevators are completed, the Owner shall have the prerogative of accepting and using them, shutting them down, or accepting them under an Interim Service Agreement described below:

1. The Owner shall have the prerogative of continuing the Interim Service Agreement until all elevators in the group (or building or APM/ITF Programs) are completed.
2. The Warranty period commences upon Substantial Completion and GOAA receives and approves the recommended spare parts list and staffing plan, regardless of any Interim Use Agreement.
3. Cost of interim service shall not exceed the prorated unit price for Year One included on the Bid Form.

3.7 INSTRUCTIONS TO OWNER

A. Before final acceptance, Contractor shall instruct Owner's personnel how to use elevator during automatic operation, independent service, secured mode and fireman's service.

3.8 ACCEPTANCE

A. Final acceptance of the installation shall be made only after all field inspections and tests are complete, punch list items are complete, all Owner's information items listed in 1.4 have been furnished, and the Owner's representative is satisfied that the installation has been satisfactorily completed.

END OF SECTION 14 21 00

SECTION 14 31 00 – ESCALATORS

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. Escalator Technical Specifications.
2. Performance criteria.
3. Provide Escalators per drawings.

B. Related Requirements:

1. Structural work to support escalator truss.
2. Pit at bottom. Division 03
3. Completion of finished floor to the level of floor plates. Division 09.
4. Enclose sides of truss. Division 09.
5. Temporary power for starting, testing and adjusting. Division 26.
6. Electrical power to machine room including correct sized circuit breakers, lighting and convenience outlets. Division 26.

1.3 SUBMITTALS

A. Product Data: Submit manufacturer’s product data for each system proposed for use. Include the following:

1. Indicators.
2. Dimensions and layout.
3. Motor data.
4. Balustrade details.
5. Step details.
6. Walk on plate details.
7. Skirt details
8. Decking details.
9. Electrical characteristics and connection requirements.
10. Expected heat dissipation of Escalator equipment in equipment space.

B. Shop Drawings:Submit no less than five copies (unless otherwise directed by the architect) of approval layout drawings. Include the following:

1. Design information, including equipment lists and compliance with applicable agencies.
2. Escalator layout in plan and section.
3. Details of escalator controls including but not limited to emergency stop switches, key switches and access panels.
4. Control plate complete with exact representation of graphics.

5. Dimensioned layout of escalator pit showing escalator equipment, mechanical, electrical and structural elements and all accessories required to complete the work in compliance with Contract Documents.

C. Samples: All exposed materials with finish and all custom fabrications.

1. Omit all logos from exposed finishes or components.
2. Glass. Provide three (3) 8” x 8” samples
3. Stainless Steel. Provide three (3) 8” x 8” samples

D. Maintenance Data: Provide written information necessary for proper maintenance and adjustment of the equipment prior to final acceptance as follows:

1. Straight line wiring diagrams of as-installed Escalator circuits with index of location and function of all components. Leave one set in machine rooms. Provide 2 corrected sets for Owner’s file 90 days after acceptance.
2. Lubricating instructions and recommended lubricant grade.
3. Parts catalogs and maintenance manuals not limited to repair, diagnostic, parts and service, necessary for the maintenance and repair of the Escalator equipment shall be provided to the Aviation Authority.
4. Provide at no additional cost any special tools, laptops, pass words and manuals that are required for maintenance, trouble shooting, adjustments, door operation or performance of safety or code related tests for the Owner’s use.
5. If the Contractor requires the Owner to sign any documents for the special trouble- shooting tool(s), a copy of the agreement, shall be submitted with the bid.
6. Provide 5 keys for each escalator switch and function. Match existing key system for the project.
7. Contractor shall furnish to Aviation Authority any proprietary tools or diagnostic equipment that is required for the maintenance, repair or troubleshooting of the Escalator related systems that would prevent an outside Escalator company that is not related to the Escalator manufacturer from providing maintenance and repair functions / services, or which would prevent the outside Escalator company from performing future upgrades or modifications to the Escalator or related building systems. (ie, security, fire protection system, etc,)
8. Submit the recommended monthly and annual testing and inspection schedule for each unit, as applicable, to be incorporated into the Service Contract.

1.4 SUBSTANTIAL COMPLETION SUBMITTALS

A. In addition to all other Contract requirements to achieve Substantial Completion, the Contractor shall, as a condition of Substantial Completion of the construction subcontract and before the effective date of the Service Contract, execute and/or deliver the following to the Authority: the Contract, a copy of the Bidder's valid business or occupational license, a copy of Bidder's W -9 Form (Request for Taxpayer Identification Number and Certification), certificate of insurance, performance bond or letter of credit, final approved staffing plan and inventory list, final approved testing and inspection schedule and all other documents and information required by the Contract Documents or the Owner. All of the above

documents and information must be furnished and the Contract Documents executed by Contractor, and delivered to Authority, before the Contract will be executed by the Authority

B. The failure to timely fulfill these obligations shall be just cause for the Authority's withdrawal of such Notice of Intent to Award. In such case, the Contract may be re-advertised and the Authority shall be entitled to receive its damages and costs, including, but not limited to, its attorneys' fees caused by or in connection with the Contractor's failure to fulfill its obligations under this Section.

C. The Contract shall not be binding upon the Authority until it has been executed by the Authority and a copy of such fully executed Contract is delivered to the Contractor. The Authority reserves the right to cancel the award without liability to any Bidder at any time before the Contract has been fully executed by the Authority and delivered to the Contractor. Accordingly, the Contractor is hereby warned that it should not commence performance or incur costs or expenses in connection with the Contract obligations until it has received from the Authority a final, fully executed copy of the Contract.

1.5 PRE-INSTALLATION CONFERENCE

A. Pre-installation Conference: Conduct conference at Project site.

B. Minimum Agenda: Installer shall demonstrate understanding of the Work required by describing detailed procedures for preparing, installing, and cleaning the Work. Demonstration shall include, but not be limited to, following topics:

1. Tour representative areas of work, inspect and discuss condition of substrate, and other preparatory work performed by other trades.
2. Review Contract Document requirements.
3. Review approved submittals.
4. Review inspection and testing requirements.
5. Review environmental conditions and procedures for coping with unfavorable conditions.
6. Resolve deviations or differences between Contract Documents and the manufacturer's specifications.

C. Record discussions, including decisions and agreements, and prepare report.

1.6 REFERENCES

A. Comply with applicable building codes and Escalator codes at the project site, including but not limited to the following:

1. ASME A17.1 Safety Code for Elevators and Escalators, current adopted edition or as required by the authority having jurisdiction. In areas not covered by AHJ use latest edition of ASME Code.
   a. NFPA 70 National Electrical Code.
   b. NFPA 80 Fire Doors and Windows.
   c. Americans with Disabilities Act – Accessibility Guidelines (ADAAG).
   d. ASME A17.1, Buildings and Facilities, Providing Accessibility and Usability for Physically Handicapped People.

e. ASME UL 10B and ASTM E152 (or approved equal), Fire tests of door assemblies.
f. Model building codes.
g. Florida Building Codes, Statues, Administrative Codes and Safety Guidelines.
h. All other local applicable codes.

B. Make application for, secure and pay for all necessary permits and certificates of inspection/operation for all equipment included herein, as required by the various departments of the Local and State Authorities. Furnish the Owner certificates and approval as required by the local governing authorities having jurisdiction.

C. In addition to the permits, inspections and test specified and the governing codes, the escalator contractor will be required to have performed speed and load carrying capacity and heat tests at his own expense.

D. Make applications for secure and pay for all necessary delays, waivers, or required to obtain certificate of compliance.

E. Any damage of any kind to the car or the adjoining structure which may develop through performance of any tests shall be repaired at no additional costs to the Owner.

1.7 CONTRACTORS RESPONSIBILITY

A. The Escalator Contractor shall coordinate installation and inspection of their work with all trades to ensure timely installation, inspections and overall construction schedule sequencing. Failure of the Elevator Contractor to not coordinate in a timely manner with other trades shall not warrant a delay in schedule or additional costs.

B. In order to discover and resolve conflicts or lack of definition which might create problems, escalator manufacturer must review contract documents for compatibility with its product prior to bidding. Review structural, architectural, electrical, mechanical documents, and escalator specifications.

C. Contractor must review all drawings associated with the project to ensure architectural design intents are full achieved, executed and coordinated as needed with other trades.

D. Submit specific written exception and or clarification with quotation. Compliance with provisions of contract documents is assumed and required in absence of written exception.

E. Owner will not pay for change to structural, mechanical, electrical, or other systems required to accommodate manufacturer’s equipment if not identified before contract award.

F. The electrical and mechanical design is based on the power characteristics and heat releases outlined in the drawings. The Contractor shall submit with bid any power characteristics or heat releases of this equipment that exceeds those listed

in the drawings. Any additions or modifications requested at a later date will be at the expense of the Contractor.

G. Heat release given as BTU/escalator/hour. All amperages based on 480 volt system. Maintain 50 to 90 degrees F temperature with 90% non-condensing humidity.

H. Storage of materials: Store materials in a dry protected area. Handle materials in accordance with manufacturer's recommendations to prevent damage, soiling, or deterioration

1.8 WARRANTY

A. Provide warranty to replace, repair, or restore parts or components that fail or do not operate properly due to poor field or factory workmanship, engineering or design for a period of 12 months from the date of Substantial Completion. If turnover for beneficial use occurs prior to Substantial Completion, provide interim warranty/maintenance between turnover and substantial completion, so that 12 month Warranty period is maintained starting at Substantial completion.

1.9 MAINTENANCE

A. Furnish a preventable maintenance schedule, including all testing and inspection services identified for each escalator for a period of twelve (12) months as a condition of Substantial Condition. The maintenance service shall comprise of regular examinations of the installation by competent and trained mechanics on a routine basis, and shall include all necessary adjustments, greasing, oiling, cleaning, and supply parts and accessories necessary to keep the equipment in good operating condition, except such replacement of parts made necessary by misuse, accidents not attributable to failure of equipment or workmanship, and negligence by the Owner.

B. A list of manufacturers recommended spare parts to be stocked (included in the unit price bid) shall be provided by the contractor for approval by the Owner as a condition of substantial completion of the escalator installation. Substantial deviators between the proposed and final inventory list may justify an adjustment to the bid price, if fully documented and approved by the Owner.

C. Provide in accordance with Section 14 00 00 Escalator, Escalator Maintenance and Repair. Provide bid on a per unit basis with a monthly and annual total outlined in the Contractors bid submittal.

D. In the event there is a conflict between this Specification and the Service Contract, the Service Contract will govern on all matters that arise after Substantial Completion.

E. If turnover for beneficial use occurs prior to Substantial Completion, provide interim warranty/maintenance between turnover and substantial completion, so that 12 month Warranty period is maintained starting at Substantial completion.

1.10 QUALITY ASSURANCE

A. The specific product or material manufactured by any of the following listed manufacturers is “acceptable” only if the specific product or material can evidence exact compliance with the contract documents and governing codes.

1. KONE Escalator Company – Heavy Duty Grade Escalator
2. Otis Escalator Company - Heavy Duty Grade Escalator
3. Schindler Escalator - Heavy Duty Grade Escalator
4. ThyssenKrupp Escalator - Heavy Duty Grade Escalator

B. Escalator Contractor must be able to demonstrate that it is a Manufacturer of similar Escalators to those specified and which have given satisfactory service; has been in successful operation for at least ten (10) years; maintains locally, an adequate stock of parts for replacement or emergency purposes; has available qualified persons to do the work. Manufacturer means, for the purpose of this Specification section, a legal entity that is regularly engaged in the business of manufacturing the equipment required by this Specification and does not include independent "assemblers" of component parts.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. The following manufacturers are acceptable:

1. Heavy Duty Escalators:
   a. Kone
   b. Otis
   c. Schindler
   d. ThyssenKrupp

B. Type and General Characteristics:

Bldg.	Type/HNTB Tag	Levels	Step Size	Notes
~~ASC~~	~~Escalator 16.1~~	~~2 to 3~~	~~40”~~	~~Three Flat Steps, 100 FPM, Step Loading Rating minimum 245lbs per step. See Drawings~~
~~ASC~~	~~Escalator 16.2~~	~~2 to 3~~	~~40”~~	~~Three Flat Steps, 100 FPM, Step Loading Rating minimum 245lbs per step. See Drawings~~
~~ASC~~	~~Escalator 16.3~~	~~Future~~	~~Future~~	~~Future~~
ASC	Escalator 33.2	1 to 2	40”	15’-6” travel. Three Flat Steps, 100 FPM, Step Loading Rating minimum 245lbs per step. See Drawings

ASC	Escalator 35.1	2 to 4	40”	17’-6” travel. Three Flat Steps, 100 FPM, Step Loading Rating minimum 245lbs per step. See Drawings
ASC	Escalator 36.1	2 to 4	40”	17’-6” travel. Three Flat Steps, 100 FPM, Step Loading Rating minimum 245lbs per step. See Drawings
ASC	Escalator 38.1	2 to 4	40”	17’-6” travel. Three Flat Steps, 100 FPM, Step Loading Rating minimum 245lbs per step. See Drawings
ASC	Escalator 39.1	2 to 4	40”	17’-6” travel. Three Flat Steps, 100 FPM, Step Loading Rating minimum 245lbs per step. See Drawings
ASC (Ramp Loading Connector)	Escalator 39.2	1 to 2	40”	15’-6” travel. Three Flat Steps, 100 FPM, Step Loading Rating minimum 245lbs per step. See Drawings
ASC (Ramp Loading Connector)	Escalator 39.3	2 to 4	40”	16’-0” travel. Three Flat Steps, 100 FPM, Step Loading Rating minimum 245lbs per step. See Drawings
~~LST~~	~~Escalator 5.1~~	~~1 to 2~~	~~40”~~	~~Three Flat Steps, 100 FPM, Step Loading Rating minimum 245lbs per step. See Drawings~~
~~LST~~	~~Escalator 5.2~~	~~1 to 2~~	~~40”~~	~~Three Flat Steps, 100 FPM, Step Loading Rating minimum 245lbs per step. See Drawings~~
~~LST~~	~~Escalator 5.3~~	~~1 to 2~~	~~40”~~	~~Three Flat Steps, 100 FPM, Step Loading Rating minimum 245lbs per step. See Drawings~~
~~LST~~	~~Escalator 5.4~~	~~1 to 2~~	~~40”~~	~~Three Flat Steps, 100 FPM, Step Loading Rating minimum 245lbs per step. See Drawings~~

~~LST~~	~~Escalator 5.5~~	~~1 to 2~~	~~40”~~	~~Three Flat Steps, 100 FPM, Step Loading Rating minimum 245lbs per step. See Drawings~~
~~LST~~	~~Escalator 5.6~~	~~1 to 2~~	~~40”~~	~~Three Flat Steps, 100 FPM, Step Loading Rating minimum 245lbs per step. See Drawings~~
~~LST~~	~~Escalator 5.7~~	~~2 to 4~~	~~40”~~	~~Three Flat Steps, 100 FPM, Step Loading Rating minimum 245lbs per step. See Drawings~~
~~LST~~	~~Escalator 5.8~~	~~2 to 4~~	~~40”~~	~~Three Flat Steps, 100 FPM, Step Loading Rating minimum 245lbs per step. See Drawings~~
~~LST~~	~~Escalator 5.9~~	~~2 to 4~~	~~40”~~	~~Three Flat Steps, 100 FPM, Step Loading Rating minimum 245lbs per step. See Drawings~~
~~LST~~	~~Escalator 5.10~~	~~2 to 4~~	~~40”~~	~~Three Flat Steps, 100 FPM, Step Loading Rating minimum 245lbs per step. See Drawings~~
~~LST~~	~~Escalator 5.11~~	~~2 to 4~~	~~40”~~	~~Three Flat Steps, 100 FPM, Step Loading Rating minimum 245lbs per step. See Drawings~~
~~LST~~	~~Escalator 5.12~~	~~2 to 4~~	~~40”~~	~~Three Flat Steps, 100 FPM, Step Loading Rating minimum 245lbs per step. See Drawings~~
~~LST~~	~~Escalator 5.13~~	~~4 to 6~~	~~40”~~	~~Three Flat Steps, 100 FPM, Step Loading Rating minimum 245lbs per step. See Drawings~~
~~LST~~	~~Escalator 5.14~~	~~4 to 6~~	~~40”~~	~~Three Flat Steps, 100 FPM, Step Loading Rating minimum 245lbs per step. See Drawings~~
~~LST~~	~~Escalator 5.15~~	~~4 to 6~~	~~40”~~	~~Three Flat Steps, 100 FPM, Step Loading Rating minimum 245lbs per step. See Drawings~~
~~LST~~	~~Escalator 5.16~~	~~4 to 6~~	~~40”~~	~~Three Flat Steps, 100 FPM, Step Loading Rating minimum 245lbs per step. See Drawings~~

~~LST~~	~~Escalator 5.17~~	~~4 to 4~~	~~40”~~	~~Three Flat Steps, 100 FPM, Step Loading Rating minimum 245lbs per step. See Drawings~~
~~LST~~	~~Escalator 5.18~~	~~4 to 6~~	~~40”~~	~~Three Flat Steps, 100 FPM, Step Loading Rating minimum 245lbs per step. See Drawings~~
~~LST~~	~~Escalator 6.1~~	~~4 to 6~~	~~40”~~	~~Three Flat Steps, 100 FPM, Step Loading Rating minimum 245lbs per step. See Drawings~~
~~LST~~	~~Escalator 6.2~~	~~4 to 6~~	~~40”~~	~~Three Flat Steps, 100 FPM, Step Loading Rating minimum 245lbs per step. See Drawings~~
~~LST~~	~~Escalator 6.3~~	~~Future~~	~~Future~~	~~Future~~
-	-	-		
~~GTF/PG~~	~~Escalator 3.1~~	~~4 to PG 2~~	~~40”~~	~~Three Flat Steps, 100 FPM, Step Loading Rating minimum 245lbs per step See Drawings~~
~~GTF/PG~~	~~Escalator 3.2~~	~~4 to PG 2~~	~~40”~~	~~Three Flat Steps, 100 FPM, Step Loading Rating minimum 245lbs per step. See Drawings~~
~~GTF/PG~~	~~Escalator 3.3~~	~~4 to PG 2~~	~~40”~~	~~Three Flat Steps, 100 FPM, Step Loading Rating minimum 245lbs per step. See Drawings~~
~~GTF/PG~~	~~Escalator 3.4~~	~~4 to PG 2~~	~~40”~~	~~Three Flat Steps, 100 FPM, Step Loading Rating minimum 245lbs per step. See Drawings~~
~~GTF~~	~~Escalator 3.5~~	~~4 to Prom~~	~~40”~~	~~Three Flat Steps, 100 FPM, Step Loading Rating minimum 245lbs per step. See Drawings~~
~~GTF~~	~~Escalator 3.6~~	~~4to Prom~~	~~40”~~	~~Three Flat Steps, 100 FPM, Step Loading Rating minimum 245lbs per step. See Drawings~~
~~GTF~~	~~Escalator 3.7~~	~~4 to Prom~~	~~40”~~	~~Three Flat Steps, 100 FPM, Step Loading Rating minimum 245lbs per step. See Drawings~~

~~GTF~~	~~Escalator 3.8~~	~~4 to Prom~~	~~40”~~	~~Three Flat Steps, 100 FPM, Step Loading Rating minimum 245lbs per step. See Drawings~~
~~GTF~~	~~Escalator 3.1~~	~~3 to 4~~	~~40”~~	~~10’-2” travel. Three Flat Steps, 100 FPM, Step Loading Rating minimum 245lbs per step. See Drawings~~
~~GTF~~	~~Escalator 3.2~~	~~3 to 4~~	~~40”~~	~~10’-2” travel. Three Flat Steps, 100 FPM, Step Loading Rating minimum 245lbs per step. See Drawings~~
~~GTF~~	~~Escalator 3.3~~	~~Pkg Lvl 2 to 4~~	~~40”~~	~~25’-4” travel. Three Flat Steps, 100 FPM, Step Loading Rating minimum 245lbs per step. See Drawings~~
~~GTF~~	~~Escalator 3.4~~	~~Pkg Lvl 2 to 4~~	~~40”~~	~~25’-4” travel. Three Flat Steps, 100 FPM, Step Loading Rating minimum 245lbs per step. See Drawings~~
~~GTF~~	~~Escalator 5.1~~	~~4 to 5~~	~~40”~~	~~13’-10” travel. Three Flat Steps, 100 FPM, Step Loading Rating minimum 245lbs per step. See Drawings~~
~~GTF~~	~~Escalator 5.2~~	~~4 to 5~~	~~40”~~	~~13’-10” travel. Three Flat Steps, 100 FPM, Step Loading Rating minimum 245lbs per step. See Drawings~~
~~GTF~~	~~Escalator 5.3~~	~~3 to 4~~	~~40”~~	~~10’-2” travel. Three Flat Steps, 100 FPM, Step Loading Rating minimum 245lbs per step. See Drawings~~
~~GTF~~	~~Escalator 5.4~~	~~3 to 4~~	~~40”~~	~~10’-2” travel. Three Flat Steps, 100 FPM, Step Loading Rating minimum 245lbs per step. See Drawings~~
~~PKG~~	~~Escalator E122~~	~~1-2~~	~~40”~~	~~Three Flat Steps, 100 FPM, Step Loading Rating minimum 245lbs per step. See Drawings~~

~~PKG~~	~~Escalator E123~~	~~1-2~~	~~40”~~	~~Three Flat Steps, 100 FPM, Step Loading Rating minimum 245lbs per step. See Drawings~~

2.2 DESIGN AND FABRICATION

A. Escalators shall be heavy duty design, capable of operating in a 24 hour facility with heavy usage. The escalators shall be designed and manufactured to include all energy saving/reduction methods and means (see alternates also). Moisture resistant design shall be incorporated for vertical transportation that is exposed to outside air. Vandal resistant design shall be incorporated for all vertical transportation on this project.

B. The escalators shall also comply with applicable wind load standards if escalators are designated for outside exposure.

2.3 PERFORMANCE REQUIREMENTS

A. Speed shall be +/- 3% under any loading condition

B. The escalator shall not make any objectionable noise during operation such as grinding, squeaking and or noise that exceed 60dB measured from 3’ from the step or landing plate.

2.4 TRUSS

A. Type: Truss shall be designed and constructed of structural steel, ASTM A36, to safely carry the entire load of the escalator including all parts of same, together with the full capacity load and including the weight of the balustrade and truss covering as detailed on the drawings.

1. Top end of truss shall carry the drive machine and controller.
2. Trusses shall be designed to support the cladding over the exterior of truss.
3. Trusses shall have a safety factor in accordance with the requirements of the Safety Code and other codes having jurisdiction.
4. Clad any exposed portion of truss in satin stainless steel, grade 308.

2.5 INTERMEDIATE STRUCTURAL SUPPORT FOR TRUSSES

A. Provide intermediate structural support for escalator truss as required based on manufacturer’s requirements. Due to travel length intermediate structural supports will be required for some escalators, including Escalators 3.3 and 3.4, Escalators 6.7 – 6.12, and PKG Garage Escalators. Escalator scope must include all required intermediate supports as part of complete installation scope.

2.6 STEPS

A. Step Design:

1. Steps shall be of the horizontal tread formation.
   a. Vertical Rise Between Steps: 8-1/8" maximum.
   b. Horizontal Distance Between Noses of Steps: 13-3/4" minimum.

c. Clearance Between Steps: 1/8” maximum.

2. Step Frames: Cast aluminum reinforced and braced to carry step threads and maximum load per stop under eccentric loading conditions without distortion.
3. Step Wheels: Shall be designed for quiet operation and must be of a type which will ensure rotation and prevention of flat spots, complete with bearings and provisions for retention of ample lubricant to ensure satisfactory operation without frequent lubrication.
4. Design of steps and required attachments shall permit the steps to be removed without disturbing the balustrades or dismantling any part of the chains.
5. Design of stairway shall permit chain to run without the steps for convenience in cleaning and inspection.
6. Exposed Gearing, Sprockets, Chains: Shall be covered with guards.
7. Side Panels or Guards: Removable type for inspection and maintenance.
8. Provide 3 flat steps at the entrance of each escalator landing.
9. Steps shall be 40” wide.
10. Step loading capabilities should be equal to or greater than 245lbs per step.

B. Step Treads:

1. Type: One-piece cast aluminum cleat type, with square edges, designed to ensure a secure foothold and comfortable tread surface, mill finish, black in color.
2. Cleats: 1/8” wide maximum, spaced so that ends are flush with step riser.
3. Grooves: 1/4" wide maximum, 7/16" deep minimum.
4. Sides: To be located with minimum clearance at adjustable curtain boards.

C. Step Risers:

1. Cleat type constructed of aluminum.

D. Step Drive Units:

1. Top Member of Step Driving Unit: Shall be carried on two brackets rigidly attached to truss to ensure and maintain proper alignment of the unit, and shall be removable intact from the truss.
2. Lower Member of Step Driving Unit: Shall be removable intact from the truss, and be mounted on supporting brackets or pedestals provided with rollers which operate on tracks located at each side of truss, and be designed and installed to automatically maintain proper tension on the step chains by means of either tension weights or compression springs.
3. Bearings: Ball or roller type, dustproof and self-aligning, complete with ample means for lubricating and adjustment for wear.
4. Chain Sprockets for Step Drive Units: Shall be designed for smooth operation, and be accurately machined to distribute load evenly on sprocket teeth and on chain rollers.
5. Contractor's Option: Instead of step drive units specified above, provide a step driving arrangement utilizing laminating plates secured to each other by means of step axles to drive the step wheels.

E. Step Chains:

1. Type: Endless roller type, one located on each side of steps made of high grade steel links with hardened pins and rollers designed to accurately engage the drive sprockets to ensure smooth operation.
2. Provision shall be made to prevent sagging or buckling of chains and to prevent the steps from coming in contact with each other and to also maintain substantially constant distances between step axles of all exposed steps.
3. Step chain shall be provided with a tension device at lower landing to maintain proper tension.
4. Safety Factor: Not less than ten and shall consist of hardened steel links throughout.

2.7 HANDRAIL AND BALUSTRADE ASSEMBLY

A. Type: Traction or positive handrail drive complete with balustrade and interior panels.

B. Handrails: Fabricated of laminated canvas and black rubber, spliced and vulcanized to create a strong and smooth splice.

1. Handrail shall operate on brass, bronze or steel guides of sealed type, complete with provisions for lubrication.
2. Canvas shall not be exposed.
3. The extended newel shall be designed and fabricated so that the handrail will disappear into the balustrade at a point difficult to reach.
4. Where adjacent escalators share a common landing, newels must align. Top end newels must align with bottom end newels where adjacent escalators share a common landing.

C. Balustrades: Tempered glass complete with covers, moldings, skirt panels and all accessories required for complete installations, fabricated of stainless steel with No. 4 satin finish.

1. Glass Panels: 3/8" clear tempered glass, ASTM C1048, Condition A (uncoated) without vertical metal mullions at interior panels, with glass joints vertical to landing not to truss.
2. Skirt Panels: 16 gauge stainless steel No. 4 finish laminated to fire-retardant rubberized sound-deadening board. Provide temporary strippable factory applied protective coating on exposed surfaces.

D. Balustrade Lighting: Provide continuous LED lighting strips under handrail guides at structural glass interior panels consisting of key-operated switch to control lighting. Color shall be white. Provide integral 3500°K LED balustrade lighting to target a minimum illuminance of 10 fc.

2.8 MISCELLANEOUS COMPONENTS

A. Exterior Quality:

1. Contractor shall ensure that all measures are taken to include exterior escalator quality components, design and construction to withstand temperature, humidity, water, appropriate wind load conformance requirements and direct sunlight impact. Contractor must detail these

inclusions in their bid submittal. This applies to any escalator designated for exterior building installation per the architectural drawings.

B. Landing and Floor Plates:

1. Type: Cast aluminum of slip-resistant design, removable for access to drive machines and pits.
2. Design of landing and floor plates shall harmonize with steps and comb plates.
3. Transition at landing shall have 3 flat steps

C. Drip Pans: Oil-tight construction is required for entire length and width of each truss.

D. Tracks:

1. Type: "Closed", smooth for continuous support of chain wheels from sprocket to sprocket, constructed of drawn steel or other alloy, of proper rigidity, and installed and supported to ensure perfect alignment and smooth operation of the running gear under all conditions.
2. All tracks shall have a smooth finish track surface.
3. Carriages and curved tracks for guiding the steps at the upper and lower landings shall be provided with machined guiding surfaces, or formed from cold rolled steel bars.
4. Curved chain wheel tracks at upper landing shall be made easily removable and replaceable.
5. Tracks at lower landing shall be designed to accommodate movement of carriage unit.
6. Transition between incline and upper landing shall be accomplished by a curved track system with a minimum of 70" radius.
7. Transition between incline and lower landing, a minimum of 48" radius.

E. Comb Plates:

1. Type: Shall have yellow metal surfaces, with comb teeth spaced so that cleats of step treads will pass between combs with minimum clearance.
2. Comb teeth shall be made in sections so that damaged or worn section can be readily replaced without disturbing balance of comb.
3. Comb teeth shall be formed to correspond to form of treads to obtain uniform side clearance.

F. Deck Covers and Moldings: Constructed of metal and finished to match skirt panels, adequately reinforced.

G. Barrier Panels: Clear, tempered glass panels, cantilevered from deck cover between adjacent, parallel escalators.

H. Where required by code, anti-slide devices shall be provided.

I. Fault Indicator: Provide upper and lower end of truss with fault indicator to display source of fault without removal of equipment access plate. Locate indicator in handrail inlet box or deck board visible from landing plate.

J. Pit Flood Detector: Provide a high level water alarm switch in the escalator pits, interconnected to the control system as required to stop the escalator in the event water is detected in the pits. The escalator shall stop “gently” to prevent harm to passengers. The device shall be able to be turned off and reset via a key switch external to the escalator.

2.9 OPERATION

A. Driving Machine:

1. Type: Worm gear type especially designed for escalator service, provided with accurately machined worm and gear driven by a moderate speed motor.
2. Motors: Shall be designed to operate on 460-480 volt, 3 phase, 60 hertz electric current.
3. Driving Machine: Shall be located at upper end of truss.
4. Contractor's Option: Machines may be located along the incline provided easy access is provided for maintenance and inspection.
5. Units shall operate at 100 feet per minute (FPM) and shall have the ability to be field adjusted to normally operate <80 FPM should GOAA elect to have a normal slower operating speed than industry standard.

B. Controller:

1. Type: Full magnetic, continuous duty and reversing type designed to protect the motor against overload.
2. Control Transformers: Provide in each controller to reduce control voltage to pushbutton circuit, etc., 110-120 volt single phase, 60 hertz, AC.
3. Should power failure occur, or any safety device operate, the controller shall automatically cut off power to the motor and apply the service brake to bring the escalator to a quick and smooth stop.
4. Controllers and all wiring for outside units to be NEMA 4 or equivalent and rated for exterior operation including temperature and humidity conditions.
5. Provide Contractor’s Variable Voltage Variable Frequency Drive.
6. Alternate (If not standard in Contractor’s product line, list as separate cost for all escalators in package as part of bid submittal): Provide escalator power feedback drive units. Provide a regenerative drive system. The system shall produce clean power with harmonic distortion within the guidelines of IEEE 519.
7. Alternate (If not standard in Contractor’s product line, list as separate cost for all escalators in package as part of bid submittal): Standby Speed Operation: Provide inverter control that will run the escalator at reduced speed when no passengers are on the step band.
    a. Speed shall change from the Owner specified speed to no less than 10fpm. Passenger detection means shall be provided at both landings of the escalator. Detection of any approaching passenger shall occur sufficiently in advance of boarding to cause the escalator to reach full operating speed before a passenger walking at 270 feet per minute reaches the comb plate.
    b. Passenger detection shall remain active at the egress landing to detect a passenger approaching against the direction of escalator travel and shall cause the escalator to accelerate to full speed and

sound the alarm at the approaching landing before the passenger reaches the comb plate.

c. Automatic deceleration shall not occur at less than three times the time it takes to transfer a passenger between landings. A means shell be provided to detect failure of the passenger detection means and shall cause the escalator to operate at owner specified speed not to exceed rated speed

C. Emergency Stop Buttons:

1. Shall be located at top and bottom landings and on controller and shall be designed, on momentary pressure of either button, to cut off the current supply to the motor and bring the escalator to rest. All controls and switches to be NEMA 4 rated or equivalent for units located outside air conditioned spaces.

D. Safety Brake:

1. Shall be of a type which is positive in operation and shall be brought into action each time the escalator is stopped, and shall automatically stop the escalator whenever the power is interrupted from any cause or by any of the safety devices, and shall hold the escalator stationary with full load.
2. If the escalator shall be operated by main drive chain and sprocket driving chains, a broken chain safety shall be provided which will set an emergency brake mounted on the upper sprocket shaft, and will stop the escalator.
3. Units outside air condition spaces to have shrouds or means to protect brake from water intrusion.

E. Overspeed Governor:

1. Shall be designed to cut off current supply to motor and bring escalator to rest, should it attain a speed in excess of 140 percent of rated speed.

F. Non-Reversing Device:

1. Shall be designed to stop escalator automatically should the direction of travel be accidentally reversed while escalator is operating in ascending direction.

G. Control Buttons and Key-Operated Switches:

1. Shall be provided in the lower ends of the upper and lower newels of escalator to control the following.
   a. The stopping of all motion of escalator - pushbuttons (both at top and bottom).
   b. The direction of travel of escalator - key switches (at top and bottom).
   c. The starting of escalators (at top and bottom).
2. Plates shall be of matching material, flush mounted, and suitably inscribed with letters, figures and direction arrows which are readily visible from a standing position.
3. Bottom plate, at the bottom and top of escalator, shall contain a stop button and key switch which will permit the operation of the escalator in either up or down direction.
4. Stop button and the key switch shall be interconnected so that the escalator can be brought to rest before the direction of travel can be changed.

5. Contractor shall connect with approved type conduit and wiring all of the above buttons and switches to the controller which shall be located in the machine space at the top of escalator.
6. Escalators that are located outside in non-air conditioned spaces shall have NEMA 4 or equivalent components.
7. Provide 5 keys for each function, match all keys to Owners standard key system.

H. Safety Devices:

1. Safety devices shall consist of a broken chain device, overspeed governor, non-reversing device, safety brake, emergency stop buttons, and such other safety devices as may be included in applicable safety codes.
2. Contractor shall furnish and install a step skirt safety device on each escalator.
3. Device shall consist of safety switches so mounted alongside the steps that they will effectively stop the escalator should the steps be forced out of line due to the introduction of an object between the escalator and step riser.

I. Broken Chain Device:

1. Shall be provided with electric contacts which will be opened and cause the brake to be applied when step chains break or should the tension on the chains drop below or exceed a predetermined value.

2.10 ESCALATOR MANAGEMENT SYSTEMS

A. For all of the vertical transportation herein, a Lift-Net Elevator Monitoring and Management system shall be provided. The system shall comply with the requirement's set forth herein and shall include a monitoring system in each machine room and connected to existing Lift-Net system in central command.

B. General: Provide an interactive system to monitor and manage the elevator equipment ("units") hereinafter called "system." Data collection, data storage, and real-time monitoring portion of the system shall be based on Microsoft Windows and be able to run on Windows 2000 Pro, XP Pro, or later operating systems. Provide the following features:
1. Network based, capable of interfacing with control systems via either serial data link or hardwired interface connections.
2. Operate on any TCP/IP based network system including but not limited to an Ether-net, Token Ring, Arc-Net, Lift-Net, etc.
3. Expansion capability to add unlimited number of monitoring terminals on the network.
4. Monitoring terminals shall operate peer-to peer or with a single client server. Failure of a single network device shall not affect the operation of the remainder of the sys-tem.
5. Complete backup of system data shall be accomplished at any single terminal/server location.
6. Display multiple banks, including multiple buildings, on a single monitoring terminal screen.

C. Monitoring Display: The system shall be capable of simultaneous monitoring of at least five hundred units on a single monitoring station utilizing a graphical representation of a plan view of the facility. Each elevator shown on the plan view shall be individually displayed and shall be visible on the monitoring system display terminal without the need to scroll. Each individual unit, when operating "normally," shall be displayed in green. In the event of a malfunction of any individual unit, the unit shall be displayed by a red blinking light on the

monitoring system display. Units which are intentionally placed out of service shall be shown as yellow in the display mode. When malfunctioning units, or units intentionally placed out of service are returned to normal operation the graphical representation for that unit(s) shall automatically return to green. The user shall have the ability to display additional information, such as the cause of fault/alarm, for all units by selecting the unit with a "mouse click" from the plan view of the facility. All monitored units shall be visible from any monitoring terminal on the network. Entry into the network shall be multi-level password protected.

D. System Capabilities:
   1. The system shall be capable of real time display of all monitored status points on all monitored equipment. Fault and event notification screens and audible alarms shall be immediately displayed on selected monitoring stations. Different fault and event tables shall be defined on a per-bank basis. The system shall collect and store all status, fault, and event information for later reporting and analysis. The system shall provide statistical analysis of hall call response times, traffic patterns, fault conditions, service logs, and security usage in graphical and tabular format.
   2. The system shall maintain a record of every status point change occurring on the monitored equipment and provide the ability to replay these events in a simulation at a later time in real time, slow speed, single step, reverse, or fast forward. This information shall be retained for a period of at least twenty-six weeks and a mechanism shall be provided whereby this information may be archived.
   3. The system shall store traffic fault and statistical data for a period of at least three (3) years. The system shall log error type, car number, floor position, and major system status points whenever a fault or logged event occurs.
   4. The system shall provide interactive control of certain features provided in the elevator control system. These features may be revised as the requirements of the building change. Some of these interactive controls may include, but are not limited to: Security floor lockouts, entering car and hall calls, Firefighters' service, lobby recall, VIP service, up/down peak service, etc.
   5. In the case of a power failure the system shall be capable of connecting to emergency power back-up unit. The loss of power shall not affect any stored data. The system shall have the capability to detect the loss (disconnect) of any individual unit from the monitoring system by periodically polling all units to ensure that normal communications between the unit(s) and the terminals/server are maintained.
   6. The system will automatically re-boot the program and continue to operate after a power loss or other system malfunction.

E. Monitoring Equipment: The monitoring equipment shall have these minimum characteristics:
   1. Monitoring Station Hardware: Provide a monitoring station in each machine room and on for each facility in central command.
      a. Central Processing Unit: IBM compatible microcomputer – desk top or mini-tower (multiple machine rooms or lobby displays)
      b. Type: Pentium or most current high-performance processor
      c. Speed: Most current high-performance
      d. Internal Hard Drive: Adequate storage for three years data for entire system
      e. Modem: Most current high-performance
      f. Display Monitor: 19" – 20" LCD flat panel, color, capable of simultaneous display of all monitored units
      g. Printer: Current HP Color Desk Jet Series
      h. Keyboard: MS Windows compatible
      i. Mouse: MS Windows compatible
      j. Power Requirements: 90-230 Volts AC, 50-60Hz @ 8A
   2. Monitoring Station Operating System Software

a. MS Windows 2000 Pro, XP Pro, or later
b. MS Windows 2000 Server or later

F. Network requirements:
1. Maximum local network rated distance (2-20 gauge shielded TP): > 10 miles
2. Elevator Contractor shall provide assistance to Network Contractor with installation of network system in elevator equipment spaces at no additional cost.
3. Elevator Contractor is responsible for material and labor required for the connectivity and testing of all escalator management.
4. Refer to Division 28 for Network information.

G. Monitoring Requirements: The system shall display and record the following information for each monitored unit. Serial data links may include many more points. Items listed below are minimum requirements.
1. Group status:
a. Group operational mode
b. All units to be monitored on the same screen in a graphical format
c. In/out of service
d. Standby power
e. Supervisory failure
f. Location and direction of hall calls
g. Shunt Trip status.
2. Individual car status, expandable menus:
a. Direction of travel
b. Independent service
c. Inspection service
d. Firefighters' service
e. Position of elevator
f. Door status (open, opening, closing, closed)
g. Door dwell time
h. Load by-pass
i. Standby power
j. Power on/off
k. Door detector
l. Safety circuit
m. Door zone
n. Stop switch
o. Alarm button
p. Registered car calls
q. Out of level
r. Machine room temperature exceeds 95 degrees
s. Stop counter (number of starts)
t. Car speed
u. Door open times
v. Door close time
w. Start to stop motion time
x. Emergency 2-way communication device
y. Air conditioner/heater
3. Keyboard, mouse, and time clock control capabilities:
a. Floor lockouts (car or hall)
b. Lobby recall
c. VIP service
d. Firefighters' service
e. Up/down peak

4. Faults monitored with visual and audible alarm, triggered by combinations of any of the above status points:
   a. Safety circuit
   b. Alarm bell
   c. Stop switch
   d. Emergency 2-way communication device
   e. Door reversal device
   f. At least six (6) user selectable faults or events (i.e. water in pit, high machine room/cab temperature)

H. Reporting Requirements: System shall provide reports in color graphical format both on-screen and in printed form capability to conveniently switch from one report type to another and from one bank to another using minimal mouse clicks and key strokes. Reports shall be displayed after minimal waiting time. Data for all reports shall be continuously recorded and stored. Reports shall be displayed by simply selecting a date and time range, bank of equipment and report type. Date and time range selections shall carry forward from one report selection to the next. Reporting functions shall be sub-divided into the following categories:
   1. Traffic Reports:
      a. Number of hall calls per floor (hall call distribution on a per floor basis)
      b. Number of hall calls per hour (24 hour time-line)
      c. Hall call waiting times per floor (hall call waiting time distribution on a per floor basis)
      d. Hall call waiting times per hour (24 hour time-line)
      e. Distributed hall call response graph (24 hour time-line)
      f. Detailed hall call response graph (% calls / n seconds)
      g. Longest wait times including floor #, wait time, date, time and direction
   2. Fault Reports:
      a. Ten most recent faults (most recent faults listed per bank)
      b. Fault Log: Displays the entire fault log for a given time period
      c. Faults per car (fault distribution on a per car basis)
      d. Faults per floor (fault distribution on a per floor basis)
      e. Faults per day/week/month (fault distribution on a per unit or group basis)
   3. Car Use Statistics:
      a. Car use by hour (24 hour time-line of car calls, car starts, door cycles, delayed car, load by pass)
      b. Car use statistics (same as above, shown for an entire bank)
   4. Group Service Log:
      a. Cars in service (24 hour time-line with text log of group availability of each car)
      b. Group functions (24 hour time-line with text log of actuation of group functions – Up peak, down peak, fire service, emergency power, etc.

I. Interactive Features: The control system shall be capable where desired of operating interactive control features provided in the elevator control system. These features may be revised as the requirements of the building change. Some of these interactive controls may include but are not limited to: security floor lockouts, entering car and hall calls, Firefighters' return service, lobby recall, VIP service, up/down peak or hospital Code Blue service. Local codes may affect the availability or operation of these features.
   1. Security Access Features: The monitoring system shall be capable of providing security enable/disable of all hall and car calls through on-screen menus at a minimum. The monitoring system shall also be capable of interfacing directly with card readers and security keypads in stand-alone mode, and indirectly through a serial interface with a third party security system. When in stand-alone mode, the monitoring system

shall maintain a database of elevator users and security pass codes. When on secure mode the use of each elevator will be recorded in a file together with the time, authorized pass code and destination for each call.

2. Elevator Control Features: Each elevator shall be capable of being controlled through the monitoring system. All control points shall be capable of seven-day twenty-four hour time clock automatic operation or manual operation from the mouse and keyboard. The control points shall include, but not be limited to, the following (where allowed by local codes):
   a. Lobby recall
   b. Car call security lockout
   c. Hall call security lockout
   d. Independent service
3. Paging Feature: The monitoring system shall be capable of paging a service technician or other personnel based on pre-defined parameters of elevator faults or conditions. The paging system shall provide the ability to page multiple numbers determined by the type of event triggering the notification and shall be able to page different numbers based on preset times of day (i.e. different shifts). The system shall be capable of sending text messages to full text pagers in addition to supporting standard DTMF pagers.
4. Remote Access Feature: The monitoring system shall be capable of allowing approved individuals under multi-level password control to access all system features via the local area network, internet, or via modem over the public telephone network to review the performance of the equipment or to evaluate a fault condition. The remote access feature shall be integrated into the monitoring system and shall not use third party “remote control” software products.

J. Elevators to be integrated into existing Lift Net monitoring system and communicate to the Central Control room of the facility. Coordinate use of LAN with the Owner. For non LAN functions provide wiring and conduit for all components furnished.

K. Lift-net system shall be connected to a new USP power back up system furnished fully by Elevator Contractor.

PRODUCT DATA SHEET 1 - PART 3 – EXECUTION

3.1 SCOPE

A. Installation shall meet all of the standard requirements of paragraph 1.03 for installation and inspection, tolerances, and qualifications. All work required for completion of a first-class installation is the responsibility of the Contractor, even if not included in this specification.

B. Performance of the Escalator shall meet requirements outlined in Division 14 documents.

C. Labeling of disconnects with feed location information and shunt trip locations to be by Escalator contractor.

3.3 PAINTING

A. All escalator equipment not painted, located within the machine room or hoistway, shall be given a finish coat of paint. Material that has factory finish paint, shall have all scratches or mars re-painted after installation. Any galvanized finishes do not need to be painted.

B. Finish coat shall have hard, tough semi-gloss surface.

C. Escalator machine room and pit floors shall be painted with an oil resistant polyurethane high gloss enamel paint or approved equivalent. Color shall be terra cotta (Tough Shield #1231-108) or approved equivalent.

3.4 CLEAN UP

A. Remove trash daily from hoistways, pits, and machine rooms including all packing material and debris resulting from this work. Leave all Escalator spaces broom clean.

3.5 ACCEPTANCE TESTING

A. Tests shall be performed by the Escalator Contractor at his expense in the presence of the Owner's representative. The Escalators shall be subjected to the following acceptance inspection and tests.

1. Inspection and tests required by applicable portions the Construction Documents.
2. Inspection and tests required by Federal, State, and Local codes and ordinances.
3. Test safety circuit, loop circuit, and the drive circuits at 500 volts. Minimum resistance to ground shall be one megohm.
4. General riding quality, leveling accuracy, and quietness of operation shall be acceptable to the Owner's representative.

B. The Escalators shall not be used for construction purposes, or during the period prior to turning over the project to the Owner, without Owner written authorization. Should the Escalators be authorized for temporary use, the following conditions shall apply:

C. The Escalator Contractor shall provide a temporary acceptance form for the user to sign.

D. The Warranty period commences upon Substantial Completion, regardless of any temporary use agreement.

E. The user shall provide, if job conditions require, all temporary enclosures, guards or other project of the hoistway openings, power, signal devices, car lights, protection of any Escalator equipment that is installed.

F. The user shall return the Escalators in the same condition they were in when placed on temporary service and shall pay the Escalator Contractor for repairs or clean up.

G. The user shall allow the Escalator Contractor to perform routine maintenance or repairs.

H. The cost of temporary service shall be worked out between the Escalator Contractor and the user.

2.2 I. As Escalators are completed, the Owner shall have the prerogative of accepting and using them, shutting them down, or accepting them under an interim Service Agreement described below:

2.3 1. The Owner shall have the prerogative of continuing the Interim Service Agreement until all Escalators in the group (or building or APM/ITF Programs) are completed.

2.4 2. The Warranty period commences upon Substantial Completion, regardless of any Interim Use Agreement.

2.5 3. Cost of Interim Service shall not exceed the prorated unit price for Year One included on the Bid Form.

2.6 3.6 INSTRUCTIONS TO OWNER

2.7 A.Before final acceptance, Contractor shall instruct Owner's personnel hot to use Escalator during automatic operation, independent service, secured mode and fireman's service.

2.8 3.7 ACCEPTANCE

2.9 A.Final acceptance of the installation shall be made only after all field inspections and tests are complete, punch list items are complete, all Owner's representative is satisfied that the installation has been satisfactorily completed.

END OF SECTION 14 31 00

SECTION 27 10 00 – PREMISE DISTRIBUTION SYSTEMS

PART 1 – GENERAL

1.1 STIPULATIONS

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

B. Drawings and general provisions of the Contract, including Division 00 and Division 01 Specification sections apply to this Section.

C. Related Specification Sections:

1. Refer to Specification Section 27 05 00 for a complete list of related specification sections.

D. ~~The GOAA Standard Voice and Data Infrastructure Cable and Pathways Labeling Format document in its entirety.~~The GOAA Telecommunications Infrastructure Administration Standard (TIAS) in its entirety. This document is included as an attachment in this section, and it applies for all ~~cables and pathways installed~~telecommunications components installed, including but not limited to used conduits, spare conduits, inner-ducts, manholes, and underground duct-bank. Any references made to cable and pathway labeling directives for inside Premise Distribution Systems or Outside Plant installations include all components of this document.

1.2 SUMMARY

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

B. This section includes the requirements for provision and installation of a complete Premise Distribution System~~s~~ (PDS) including Outside Plant (OSP) backbone cabling and pathways.

1.3 SCOPE OF WORK

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

B. Refer to drawing sheet T0.00.03 for the work responsibility matrix for the scope of work required for the Premise Distribution System.

C. Where listed on the Premise Distribution System portion of the drawing responsibility matrix, the following components shall be defined as follows:

1. Headend and Software: Contractor shall be responsible for providing information in the GOAA PDS Administration Database Refer to related specification sections for additional information.
2. Integration to Existing System: All wiring, cabling, interface devices and appurtenances as required to extend the physical or logical scope of an existing system, or to incorporate a new or disparate system into an existing system. This shall include fiber channeling – refer to Backbone Cable below for additional information. Refer to related specification sections for additional information.
3. Interfaces: All hardware, software, wiring, cabling, programming, interface devices and appurtenances as required for communication between systems, or between a given system and an operator, to provide the specified functionality. Refer to related specification sections for additional information.

4. Network Switch: Refer to specification section 27 05 00 for additional information. Contractor shall provide patch cables and coordinate patching into the network with GOAA and GOAA Vendor.
5. Backbone Cable: The segment of the premises distribution system that provides inter-building and intra-building connectivity between entrance facilities, equipment rooms and other telecommunications spaces including telecommunications rooms and telecommunications enclosures. Contractor shall furnish and install all backbone cabling, pathways, conduit, termination equipment, communication room fittings, grounding, bonding, testing, labeling, and all other work included in this specification section. Contractor shall provide fiber channeling in order to achieve required connectivity to the NTC and all other portions of Airport and this project in support of all telecommunications systems. Fiber Channeling is defined as the required cross connections of fiber circuits through multiple communications spaces, enclosures, IDF and MDF rooms across the campus in order to establish a communications link over fiber between two end points. Channeling also includes additional testing, per Division 27 and related specifications, of the length of fiber channels across all cross connects from end to end, and the documentation of said channel testing per GOAA IT standards. Contractor shall provide fiber channeling by hiring the services of a GOAA Continuing Contractor.
6. Horizontal Cable: The segment of the premises distribution system that provides connectivity from communications spaces to field devices. Contractor shall furnish and install all horizontal cabling, pathways, conduit, termination equipment, communication room fittings, grounding, bonding, testing, labeling, and all other work included in this specification section. Furnish all copper and fiber patch cables required for all network-connected systems and to support all spare patch panel connections within communications spaces (IDFs/MDF). Refer to related specifications for information regarding responsibility for installation of patch cables.
7. Field Devices: Components of a system which are served by the system headend and are the network endpoint or “edge” device. Contractor shall furnish and install data outlets, premise distribution system testing, labeling, and all other work included in this specification section. Furnish all copper and fiber patch cables required to connect field devices to the network. Refer to related specifications for information regarding responsibility for installation of patch cables.

1.4 REFERENCES

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

1.5 SYSTEM DESCRIPTION

A. Furnish and install a complete Premise Distribution System (PDS) including Outside Plant (OSP) backbone cabling system, including all necessary tools, materials, equipment, labor, and testing, to create a dynamic multi-product, vendor-agnostic environment including all cable, equipment, materials, and labor as required to provide, install and test a complete system. This system shall enable all GOAA low voltage systems to be fully operational according to design specifications at project

completion, complying with these specifications and all regulatory requirements. The system shall include but not be limited to:

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

13. Surge suppression shall be provided on all cables entering or leaving the footprint of the building or exterior device subject to surge. See below section for additional surge suppression requirements.
14. Fireproofing equivalent to ~~a one-hour rating~~the fire rating of the barrier penetrated shall be provided on all communications room penetrations.
15. Systems rooms overhead cable trays: all cable trays shall be mounted per manufacturers specifications complete with all hardware and rubber boots on ends. Corner or T-sections shall be provided with corner bracket sweep or a bend section. Corner bracket sweeps shall only be used whee the use of a bent swept section is impractical.
16. All cable trays shall be a minimum of 12 inches from any source of EMI or other sources of electrical interference. The Contractor shall follow industry standards and best practices in maintaining proper separation from EMI and other sources of electrical interference.
17. All racks or cabinets shall be installed with overhead fiber optic trough system with an open channel design to protect and route fiber optic patch cords. Trough shall have downspouts and drop-outs over each rack side, cabinet, and other areas within the telecommunications space as designated. Refer to drawings for side of ladder rack that fiber optic trough system shall be installed on.
18. All locations that have ~~Fiber Optic (FO) or copper cabling~~telecommunications equipment mounted on Communication Room walls or any wall within a telecommunications space with a telecommunications backboard installed to accommodate the future installation of telecommunications equipment shall have overhead cable ladder rack and overhead fiber optic trough system with an open channel design to protect and route fiber optic patch cords installed from any new racks or cabinets to the wall or other existing rack(s) or cabinets to create cable pathways. In addition, Communications Room walls shall have ~~D-rings and/or other~~ vertical and horizontal cable management to support cabling. Zip ties shall not be used as cable management.
19. All under floor cable pathways shall be completed as described above providing cable pathways between components, using under-floor system.
20. Transition pans with dividing fingers shall be furnished and installed on ladder rack above racks and equipment cabinets and any place on the tray where cabling lays over a side rail or drops through the tray in quantities and locations as necessary to properly support and route fiber and copper cables and patch cords, including patch cords installed by GOAA or GOAA Vendor(s). Transition pans shall match racks (black) in color and be provided by the same manufacturer as the rack.
21. Backbone cable shall be secured by hook-and-loop (Velcro) cable ties on overhead rack and into LIUs (fiber).
22. Backbone cables shall not be broken out of the cable jacket except within enclosures designed to protect and support cable breakouts.
23. All horizontal fiber and copper, and patch cords cable shall be secured by black Velcro wrap as necessary.
    a. Velcro wrap shall be cut from 1 inch by 10 yard roll (industry standard supply) for cable bundles.
    b. Individual black Velcro cable ties may be used where appropriate.

c. Velcro cable ties shall be solid black without any manufacturers name, logo, or other imprinted on wrap.

B. Coordinate all work related to equipment provided by the Owner and/or Owner's vendor(s).

1. Where new telephone, network, and other systems equipment provided by Owner (GOAA) is to be installed as a requirement in project, a systems meeting is required with GOAA Information Technology Department no longer than three (3) weeks after Notice To Proceed is issued and thereafter on a monthly basis.
2. Monthly Systems meetings are required as necessary for successful coordination and completion of Owner provided equipment.

C. Provide all power, grounding, bonding, plywood backboards and complete raceway system. Refer to Division 26 for power and grounding requirements.

D. Complete Telecommunication Infrastructure element labeling according to ANSI/TIA 606 and GOAA requirements as specified in this document.

1. Labeling format samples and required Telecommunication Infrastructure Record Administration forms are included in this specification document.
2. All Infrastructure Element labeling shall be complete and Telecommunications Infrastructure Administration Records shall be submitted prior to the infrastructure being put into use, at the same time all cable test records are submitted.

E. Completion of the PDS and OSP cabling system in its entirety is required by Substantial Completion inspection, including submission of system test report documents.

1. If Owner provided or Contractor provided equipment requires the use of systems cabling infrastructure to have any Electronic Systems operational for the project to meet Substantial Completion inspection requirements the cabling infrastructure shall be complete and tested in its entirety according to a previously coordinated schedule providing reasonable and adequate time for Electronic Systems to be installed, tested and commissioned or made operational.
2. No cabling infrastructure is to be put into use without being complete and fully tested according to these and Project Engineering specifications.

F. Where any active Electronic Systems are installed by any party requiring installation of fiber or copper patch cords, all patch cords shall be permanently and properly routed in the pathway created for same, and the patch cords shall be labeled on each end with source/destination according to GOAA Labeling Specification. All patch panel or LIU User Identification tables shall be filled out as to use/user.

1.6 SUBMITTALS

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

B. Product data shall be submitted on all products used to complete the scope of work of this project, including but not limited to:

1. Catalog cut sheets.
2. Roughing-in diagrams

3. Proof of UL Listing. Indicate the UL listing, the UL classification, and NEC insulation type used for each type of cable to be used in installation of the Premise Distribution System. Provide a complete copy of the UL Test report substantiating that the cable meets ANSI/TIA requirements.
4. UL Verification of Category 6 and 6A equipment and material.
5. Installation instructions. Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation.
6. Manufacturers Certificate: Certify that products meet or exceed specified requirements.
7. Test results from manufacturer showing product has passed quality control tests at factory (specifically fiber optic cabling, as well as other applicable products.
8. Submit test reports from manufacturers', specifications and any other information necessary to determine compliance with material and equipment specified.
9. Operation and maintenance manuals.

C. Shop Drawings: Submit plan of building(s) and site showing pathways with all installed cables and pathways noted.

1. Shop Drawings for enclosures shall include plans, elevations, sections, and attachment details indicating sizes of equipment, their relationship, and clear space within the enclosure. The Contractor shall submit cabinet and rack elevation drawings that are coordinated between all Contractors and GOAA Vendors and show all equipment that will be installed by all Contractors and GOAA Vendors in a combined, comprehensive submission..
2. Detailed floor plan layouts and riser diagrams showing system components and their location, interconnections, wiring/cabling, and interface and connection with other disciplines.
3. Coordination Drawings in accordance with the requirements of Division 01.
4. Detailed data as requested by designer/OAR.
5. Point to point wiring diagrams and block diagrams of system to be installed, including the telecommunications bonding system.
6. Submit a detailed step by step testing procedure for any active components, component/ system functional checkout and test.
7. Coordination: Shop drawing plans shall include pathway routing, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of items involved:
   a. Structural members in paths of pathway groups with common supports.
   b. HVAC and plumbing items and architectural features in paths of conduit groups with common supports.

D. Detail drawings of each of the facilities terminal boards/cabinets, and equipment rack elevations for all MDF and IDF locations.

E. Qualifications: Submit qualifications of system installer including but not limited to:

1. Contractor’s license.
2. A list of a minimum of three (3) recently completed PDS projects of similar type and size with contact names and telephone numbers for each that the Contractor has performed within the last two (2) years.

3. Documentation of the Contractor's staff member(s) who are BICSI Certified Installation Technicians. The documentation shall be current copies of the certificate issued by BICSI.
4. A letter certifying the Contractor maintains an office within fifty (50) miles of the project location.
5. Proof of certification by the manufacturer(s): Documentation that the Contractor is an authorized and designated installer for the equipment manufacturers whose products he intends to install.
6. Technical resume of the Contractor's Project Manager and Field Supervisor documenting a minimum of five (5) years' experience installing Premise Distribution Systems.
7. Technical resume for any sub-contractor who will assist the PDS Contractor in performance of this work. Sub-contractors used on the project by the Contractor must meet the same qualifications requirements as the Contractor.
8. A list of test equipment proposed for use.
   a. For testing copper or metallic cabling components.
   b. For testing fiber optic cabling components.
   c. Include test certificate verifying that all test instruments have been calibrated by a factory authorized service agent within 12 calendar months immediately preceding the date of submittal.
   d. All testing equipment/instruments shall be manufactured by a company engaged in the manufacturing of test equipment specifically designed for the purposes specified herein. Test equipment required to satisfy the testing requirements of this project shall have been available for purchase from the submitted manufacturer for at least five consecutive years immediately preceding the submittal date.
   e. All test equipment/instruments submitted and used to satisfy the testing requirements of this project shall be current models manufactured by the submitted manufacturer. The equipment/instruments shall be currently in production at the time of submittal and fully supported by the manufacturer.

1.7 QUALITY ASSURANCE

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

1.8 DELIVERY, STORAGE, AND HANDLING

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

1.9 RECORD DOCUMENTS

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

B. As-Built documents shall include updating and revising contract documents to record actual locations (as-installed) of all equipment, pull boxes, devices, IDF's, raceways, cabling, Telecommunication Outlets, and all Premise Distribution and all Outside Plant cable infrastructure components.

C. As-Built PDS and OSP riser diagrams shall be submitted. As-Built Telecommunications Bonding System riser diagram shall be submitted.

D. All drawings required herein shall be in AutoCAD Latest Release or format required by Division 01 specifications.

E. Drawings required herein are in addition to those required under "OPERATION AND MAINTENANCE DATA."

F. Telecommunication Outlet label information sheet: An E size sheet(s) copy of the Electrical, Power or Systems project plan sheet that shows all Telecommunication outlets in office/building spaces with all TO final label information typed in by each TO symbol in each room shall be submitted to GOAA OAR and GOAA Information Technology department. This document shall be submitted by Substantial Completion Inspection or earlier. This sheet is required a minimum of three weeks prior to any need to have any voice/data jacks to be made active for any purpose.

~~F.~~G. Update the Comprehensive Cable Management Form and other forms provided by the OAR as cable installation progresses. Contractor shall provide updated copies of these reports to the OAR as requested throughout the project duration for coordination purposes.

1.10 OPERATION AND MAINTENANCE

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

B. O & M Manuals shall include:

1. A complete as-installed equipment list of active (powered) components, including Owner Furnished Equipment. Equipment shall be listed by room, with manufacturers' names, model numbers, serial numbers, and quantities of each item.
2. A complete and correct system schematic, showing detailed connections for all parts of the system, including cable numbers, terminal block numbers and layouts, and other designations and coding's (point-to-point wiring diagrams). System performance measurements shall be documented as noted elsewhere in this specification.
3. Riser diagrams showing as-installed conduit with pull boxes, outlet boxes, physical cable layouts, part numbers of cable types used, and number of ~~circuits~~ cables in each conduit.
4. Repair parts list for each major equipment item furnished.
5. A list of spare repair parts provided by the Project with a copy of the Transmittal Sheet showing who took receipt of and where the spare parts are stored.
6. Service manuals for each major equipment item furnished.
   a. Manual(s) shall be bound separately and labeled appropriately.
   b. Include instructions for adjusting, operating, and extending the system
   c. Manufacturer's warranties and operating instructions for each active equipment item furnished.
   d. Recommended preventive maintenance procedures.
7. Test Data: record of results for all copper, metallic, and fiber optic cables installed and tested, or tested.
   a. Test data shall be formatted according to GOAA Standard and ANSI/TIA 606 Administration Standards.
   b. Test results shall be submitted in hard copy in three (3) ring binder and in electronic form (CD).

c. Include all fiber tests with performance graph from OTDR. Single Mode and Multi-Mode shall be OTDR and OLTS tested. All fiber utilized for the installation of Project Systems required by the project scope shall be tested whether or not the cable was installed by the Contractor.

8. Data sheets showing all field labeling used for ~~termination blocks~~all components, and cable (outside plant, backbone, riser and horizontal) runs.
9. Cable Data for all backbone (riser) and horizontal fiber and copper indicating type and use of cable installed by Contractor and to include:
   a. Manufacturer's specification sheet.
   b. Manufacturers performance and warranty sheet.
   c. Date manufactured.
   d. Part number.
   e. Serial number.
   f. Reel number.
   g. Description.
   h. Attenuation specifications.
   i. Bandwidth specifications.
   ~~i.~~j. Index of Refraction (IOR).
10. Complete equipment rack/cabinet layouts showing ~~locations of all rack mounted patch panels, and equipment items~~size and location of all empty spaces and components, including but not limited to: Patch Panels, LIUs, Cable and jumper management, and active components, components mounted on the back side of a cabinet shall be included in the layout as well in a manner that makes it clear that it is located in the rear of the cabinet.

1.11 SOFTWARE AGREEMENT

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

1.12 SPARE MATERIAL

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

B. Patch Cables – Category 6 Copper: Furnish spare CAT6 patch cables in a quantity equal to the number of terminated CAT6 patch panel ports in communications spaces (MDF/IDFs/Zone Enclosures). ~~Furnish an equal number of each of the following lengths (in meters): 1, 2, 3, 4, 5, 6, 7, 8 9, 10.~~Coordinate with the Authority and OAR to determine the various lengths required. Refer to HORIZONTAL CABLING AND TERMINATION for additional patch cable specifications.

C. Patch Cables – Singlemode Fiber: Furnish spare fiber patch cables in a quantity equal to the number of terminated fiber patch panel ports in communications spaces (MDF/IDFs/Zone Enclosures). ~~Furnish an equal number of each of the following lengths (in meters): 1, 2, 3, 4, 5, 6, 7, 8 9, 10.~~ Coordinate with the Authority and OAR to determine the various lengths required. Refer to BACKBONE CABLING AND TERMINATION – FIBER OPTIC CABLE for additional patch cable specifications.

1.13 ENVIRONMENTAL CONDITIONS

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

1.14 SUBSTANTIAL COMPLETION INSPECTION REQUIREMENTS

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

B. These Substantial Completion requirements are additional to Drawings and general provisions of the Contract, including Division 00 and Division 01. These ~~Specification~~ specification sections apply to this Section.

C. The Substantial Completion inspection shall cover all locations where PDS components and/or Systems have been installed and/or modified.

D. The Substantial Completion inspection shall be coordinated by the Technical Project Manager with the Contractor, Project Manager, and GOAA Telecom/IT Representative attending.

E. A separate PDS and Systems inspection may be requested by GOAA OAR or GOAA Information Technology Department.

F. All cabling testing and labeling shall be completed by Substantial Completion Inspection, or prior to being put into service, whichever comes first.

G. All cabling test results' documents shall be submitted to the Technical Project Manager, GOAA OAR, with a copy to GOAA Information Technology Department by Substantial Completion inspection or prior to being put into service, whichever comes first.

H. All labeling documents shall be submitted to the Technical Project Manager, GOAA OAR, with a copy to GOAA Information Technology Department.

I. If Owner provided or Contractor provided equipment requires the use of systems cabling infrastructure to have any Electronic Systems operational for the project to meet Substantial Completion inspection requirements the cabling infrastructure shall be complete and tested in its entirety according to a previously coordinated schedule providing reasonable and adequate time for Electronic Systems to be installed, tested and commissioned in time to prevent an impact to the scheduled opening date.

J. Where any active Electronic Systems are installed by any party requiring use of new or existing fiber or copper backbone or horizontal cables, the installation of fiber or copper patch cords shall be complete; all patch cords shall be permanently and properly routed in the pathway created for same, and the patch cords shall be labeled on each end with source/destination according to GOAA Labeling Specifications. All patch panel or LIU User Identification tables shall be filled out as to use/user. This must be demonstrated as complete by Substantial Completion inspection.

K. Where new or expansion Systems are installed using new or existing backbone or horizontal fiber strands, and other new or existing fiber strands becomes unused, all strands that became unused shall have their corresponding patch cords removed along the entire fiber cable route. All User ID cards information shall be erased or covered with white adhesive paper to indicate those strands are no longer in use. Marking out fields in User ID cards is prohibited. This shall be demonstrated during Substantial Completion inspection.

L. Telecommunication Outlet-to-Label space information sheet shall be provided:

1. An E size sheet(s) copy of the Power or Systems project plan sheet that shows all Telecommunication Outlets (TO) in office/building spaces, that has all TO final label information typed in by each TO symbol in each room is to be submitted to GOAA OAR and GOAA Information Technology Department.
2. Two copies shall be submitted to GOAA Information Technology Department.
3. This document shall be submitted by Substantial Completion Inspection or earlier. This sheet is required a minimum of three weeks prior to any need to have any voice/data jacks, dry pairs, or any outlet to be made active for any purpose.

PART 2– PRODUCTS

2.1 GENERAL

A. All equipment shall be new and unused. All components and systems shall be designed for uninterrupted duty. All equipment, materials, accessories, devices, and other facilities covered by this specification or noted on the contract drawings shall be the best suited for the intended use and a single manufacturer shall provide component assemblies.

B. Provide all components, equipment, parts, accessories and associated quantities required for complete installations and according to Manufacturers installation specifications or requirements. All components may not be specified herein.

C. All devices/components/products shall be suitable for use intended, and meet all stated performance requirements for PDS, OSP and Systems configurations specified in this document.

2.2 PATHWAYS/CONDUIT/RACEWAYS

A. General:

1. All pathways (conduit, raceways, wireways, pullboxes, outlet boxes, etc.) shall comply with applicable requirements of sections within these specifications.
2. All pathways (conduit, raceways, wireways, pull boxes, outlet boxes, etc.) shall comply with all requirements of ANSI/TIA-569~~D-2015~~.
3. Size: All horizontal pathways shall be minimum 1” conduit. Pathways shall be increased in size to properly accommodate number of cables to a maximum of 24 cables. Backbone conduits shall have at least 20% of installed innerduct pathways spare at the completion of the project.
4. All conduits shall be sized and installed per NEC and ANSI/TIA specifications for intended use.
5. Size: All backbone conduit shall be a minimum 2” conduit.
6. Long Radius (sweep) bends shall be used for all fiber optic cable pathways, sized per NEC and ANSI/TIA specifications for intended use.
7. No pathway components shall be installed that force cables to exceed manufacturer’s recommended bend radius during installation or when pulling of cable is complete.
8. For all horizontal pathways, there shall be no more than 180-degrees of total bend between any two pull points.
9. Pull-boxes shall not be used as direction changes but be used to pull straight through.
10. Where a pull-box is required with raceway(s) smaller than 1-1/4 trade size, an outlet box may be used as a pull-box.

11. Where a pullbox is used with raceway(s) of 1-1/4 trade size or larger, the pull box shall:
    a. Have a length of at least 8 times the trade size diameter of the largest raceway.
    b. Be individually labeled and installation location marked on As-Builts.
12. Metal flexible conduit shall not be used for PDS system.
13. Protective bushings: All backbone and horizontal conduits shall have plastic/nylon insulating bushings installed on all ends to protect cable.
14. All backbone and horizontal conduits shall have ground bonding bushings with lugs installed on ends that terminate in a communications room and be bonded to the Systems Ground Bus Bar with an insulated #6 AWG wire.
15. All conduit shall be labeled with source/destination at each end, and each main pull box. See GOAA Cable and Pathways specifications.
16. Pull Cords/Pull Tape: Install pull cords in all raceway runs including conduit and inner-ducts that are installed without cable (empty). Install a pull string or pull rope in all horizontal and backbone conduits and inner-ducts that have cable installed (used).
17. Boxes:
    a. All outlet boxes, junction boxes, pull boxes, etc. shall comply with applicable sections of these specifications.
    b. Outlet boxes shall be deep with a minimum size of 4-11/16” by 4-11/6” by 2-1/8” deep with a single gang sheetrock ring.
    c. Boxes shall be sized as required by ANSI/TIA and NEC for cables, both fiber and copper (metallic), conduit and/or device installed.

B. Rigid Steel Conduit:

1. Conduit shall be seamless, hot dipped galvanized rigid steel.
2. Threads shall be cut and ends chamfered prior to galvanizing.
3. Galvanized to provide zinc coating fused to inside and outside walls of conduit.
4. Provide an enamel lubricating coating on the inside of the conduit.
5. Conduit shall conform to ANSI C80.1 and listed and labeled under UL 6.

C. Rigid Aluminum Conduit:

1. Conduit shall be seamless, 6063 alloy, T-1 temper.
2. Conduit shall conform to FS WW-C-581d, ANSI C80.1, and UL 6.
3. Pass bending, ductility, and thickness of zinc coating in ANSI C80.1.

D. Intermediate Metal Conduit:

1. Conduit shall be seamless, hot dipped galvanized rigid steel.
2. Threads shall be cut and ends chamfered prior to galvanizing.
3. Galvanizing shall provide zinc coating fused to outside walls of conduit.
4. Provide an enamel lubricating coating on the inside of the conduit.
5. Conduit shall be listed and labeled under UL 1242.

E. Electrical Metallic Tubing (EMT):

1. EMT fittings shall be formed steel compression ring type. Die cast fittings are not allowed.
2. EMT shall be UL listed and conform to NEC Article 300.22.
3. Shall be used inside buildings only.

4. Only manufactured fittings, transition adapters, terminators and fixed bends shall be used.
5. All transition junction and pull boxes, fittings terminators and adapters shall be a metallic material.

F. Raintight Sealing Hubs:

1. Two piece type with outer internally-threaded hub to receive conduit, inner locking ring with bonding screw, insulated throat, and V shaped ring or O-ring.
2. Manufacturers: Thomas & Betts H series or Bridgeport.

G. Conduit Bodies: Not Permitted.

H. Conduit Fittings:

1. All fittings shall be compression or threaded.
2. Fittings shall provide a secure connection for pulling communications cables.
3. Setscrew fittings are not permitted.
4. ANSI/NEMA FB 1; material to match conduit.
5. Couplings for rigid steel conduit and IMC to be single piece threaded, cadmium plated malleable iron.
6. Couplings for rigid aluminum conduit to be of aluminum construction, 6063 alloy.
7. Hubs for box connection to be two-piece with outer internally threaded hub to receive conduit and inner locking ring with bonding screw.
8. Expansion fittings shall allow for a minimum of four inches of movement and shall be similar to O-Z Gedney AX series, complete with bonding jumpers and hardware.

I. Non-metallic conduits are not permitted in above ground installations. Conversion fittings are required for non-metallic (below ground) to metallic (above ground) transitions.

J. Innerduct:

1. Application: Suitable for an indoor or duct bank installation within a riser system or backbone conduit for the support of telecommunications fiber optic cables.
2. Material, as specified on drawings for each application:
   a. Multi-cell flexible fabric.
   b. 3-cell flexible fabric or greater, as indicated on the drawings, for duct bank installation.
   c. 3-cell flexible fabric, riser rated, for indoor installation.

K. Pull Cord / Pull Tape:

1. Pre-lubricated, woven polyester, low friction, and high abrasion resistant yarn.
2. Minimum average tensile strength shall be 1250 lbs. for 2 inch and smaller conduits and innerduct.
3. Minimum average tensile strength shall be 1800 lbs. for conduits larger than 2 inches.

L. Pull Boxes, Junction Boxes, and Gutters:

1. All junction boxes, gutters and pull boxes shall comply with NEC Article 314.

2. All junction boxes, gutters and pull boxes shall meet the following minimum material requirements:
   a. 16-gauge steel or heavier.
   b. Seams shall be continuously welded and grounded smooth.
   c. External screws and clamps.
   d. External mounting feet (where possible).
   e. Oil-resistant gasket and adhesive.
   f. ANSI 61 gray polyester powder coating inside and out over phosphatized surface.
   g. UL 50 type 12.
3. All junction boxes, gutters and pull boxes shall be provided with bushings for conduits and/or cabling.
4. All junction boxes shall be provided with a hinged cover. Where clearances do not allow full opening of hinged cover, bolt on covers with captive nuts shall be provided.
5. All junction boxes, gutters and pull boxes shall be securely installed.
6. All junction boxes, gutters and pull box configurations and sizes for single and multiple conduit runs shall comply with ANSI/TIA 569.

M. Metal Wireways and Auxiliary Gutters:

1. Description: Sheet metal, complying with UL 870 and NEMA 250, Type 1 unless otherwise indicated, and sized according to NFPA 70.
   a. Metal wireways installed outdoors shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
   b. Comply with TIA-569~~-B~~.
2. Fittings and Accessories: Include couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.
3. Wireway Covers: Hinged type unless otherwise indicated.
4. Finish: Manufacturer's standard enamel finish.

N. Boxes, Enclosures, and Cabinets:

1. General Requirements for Boxes, Enclosures, and Cabinets:
   a. Comply with TIA-569~~-B~~.
   b. Boxes, enclosures and cabinets installed in wet locations shall be listed for use in wet locations.
2. Sheet-Metal Outlet and Device Boxes: Comply with NEMA OS 1 and UL 514A.
3. Box extensions used to accommodate new building finishes shall be of same material as recessed box.
4. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.
5. Device Box Dimensions: 4-11/16” inches by 4-11/16” inches by 2-1/8 inches deep with mud ring.
6. Gangable boxes are not allowed.
7. Nonmetallic Outlet and Device Boxes: Comply with NEMA OS 2 and UL 514C.
8. Cabinets:
   a. NEMA 250, Type 1, galvanized-steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel.

b. Hinged door in front cover with flush latch and concealed hinge.
c. Key latch to match panelboards.
d. Metal barriers to separate wiring of different systems and voltage.
e. Accessory feet where required for freestanding equipment.
f. Nonmetallic cabinets shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

O. Handholes and Maintenance Holes for Exterior Underground Cabling:

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

2.3 TERMINATION BACKBOARDS

A. Material: 3/4" A/C grade, Class A Flame Spread plywood, LEED compliant, A side shall face out.

B. Size: 8’ high by 4’ wide with multiple sections as shown on drawings, unless otherwise noted or required in these specifications.

C. Finish: Paint terminal board with gray paint having a flame spread rating of Class A as a minimum. Do not paint over Class A flame spread information on plywood, this information shall face out.

D. ~~Install label on backboard with TTB# and Room#~~Lavel backboards per the GOAA Telecommunications Infrastructure Administration Standard (TIAS) document.

2.4 "SYSTEMS" AND "LOCAL" GROUND BUS

A. Ground Bus shall be copper and comply with applicable sections of these specifications.

B. Install minimum one copper ground bus with qty (12) pre-drilled 1/4” holes on isolating stand-offs of TTB backboard. Holes shall be configured to accept two-hole lugs.

C. Basis of Design: ~~Chatsworth #10622-012 or approved substitution~~Harger GBI144xxTMGB or approved equal.

2.5 COMMUNICATION ROOMS AND SIMILAR SPACES

A. With the exception of cable management devices and rack/cabinet equipment below, devices shall be installed per requirements determined in the field by the Project Engineer and Contractor as required to neatly dress/organize cables in and out of rack/cabinets.

B. No metallic or fiber cables shall be unsupported, or potential patch cord routes be without a supported pathway.

C. Fiber optic patch cable pathways shall be routed and specifically constructed for protective fiber cable routing.

2.6 FLOOR MOUNT EQUIPMENT RACKS/CABINETS

A. Standard open racks (2-post):

1. Universal self-supporting all aluminum rack 84" H. x 19" W. x 3" D.
2. Standard for 19" rack mounted equipment.
3. Standard 3" x 1.25" aluminum upright channels, .125" thick.
4. Have mounting holes both sides (front and rear) of upright channels.
5. Panel Mounting Holes: #12-24 rolled threads in 5/8" - 5/8" x 1/2" hole pattern meeting ANSI/TIA-568 mounting space requirements.
6. Use heavy-duty assembly hardware.
7. Provide isolation pad between rack and floor.
8. Base Angles: 3-1/2" x 6" x 3/8" thick (pair) for bolting to floor with 3/8” expansion anchors.
9. Top Cross-Angles: 1-1/2" x 1-1/2" x 1/4" (pair).
10. Finish: Black.
11. All rack equipment mounting screws to be black clean thread type.
12. Rack Basis of Design: Chatsworth.
13. Acceptable substitutions:
    a. Homaco.
    b. Hubbell.

B. Cabinets:

1. Cabinets shall be sized according to Project design to meet the requirements of active and passive equipment that may be installed inside each cabinet.
2. Cabinets shall house all active electronics and meet the following minimum requirements:
    a. All cabinets, if installed in a contiguous fashion, shall have an inter-cabinet pathway installed at the top of cabinets for patch cables following ANSI/TIA guidelines for patch cord cable management.
    b. All cabinets shall have internal vertical and horizontal cable management panels.
    c. Cabinet installations shall have overhead cable tray installed.

d. ~~All cabinets shall have vented front and rear doors and side panels shall be solid for adequate airflow for proposed equipment to be installed.~~All cabinets shall have vented front and rear doors for adequate airflow for proposed equipment being installed. Side panels shall be solid.
e. All cabinets shall have locking front and rear ~~covers~~doors. Locks shall be independently keyed to GOAA PDS cabinet key.
f. Cabinets shall be provided with a full height ground bar. Refer to additional cabinet grounding requirements below.
g. Cabinets shall be secured to the floor and bayed together per manufacturer's requirements.

3. Cabinets shall be full height.
4. All co-locating cabinets shall have same construction and keying characteristics of full height cabinets.
5. Cabinet Basis of Design: HP Pallet Intelligent Cabinet 842, 1075mm #BW917A.
6. Acceptable substitutions:
   a. Approved substitutions.

C. Rack and Cabinet Equipment

1. All rack equipment, wire managers, PDUs (power distribution units), etc. shall be black.
2. All racks/cabinets shall be provided with black equipment mounting screws. Provide (50) fifty cage nuts and (50) fifty rack screws per equipment cabinet and turn over to Owner upon installation of the cabinet.
3. Provide cable management devices (clamps, guides, supports, etc. as required to neatly dress/organize cables in and out of rack (or enclosure).
4. Provide horizontal and vertical (full rack height) cable management. Cable management fill rate shall not exceed 50% condition when all provided jacks are in use.
5. All Rack/Cabinet equipment shall be provided by the same manufacturer as the racks/cabinets with the following exceptions:
   a. Horizontal wire management.
   b. PDU.

D. Horizontal Cable Managers:

1. Horizontal wire managers shall have both front and rear channels with covers.
2. Horizontal wire manager Basis of Design: Panduit WMPH3, or approved substitution.

E. Vertical Cable Managers:

1. Racks:
   a. Each rack shall have one full-height double sided vertical cable manager on each side of each rack, 6" wide.
   b. Racks may share a vertical cable manager mounted between them when co-located.
   c. Basis of Design for rack vertical cable managers: Chatsworth 11729 series.
2. Cabinets:
   a. Each cabinet shall have one full-length vertical cable manager installed internally on each side.

b. Vertical cable management shall be installed in rear of cabinet and provided by same manufacturer as the cabinet.

F. Jumper Tray:

1. Each rack shall have a jumper tray installed in the uppermost position.
2. Each cabinet shall have a jumper tray installed in the uppermost position.
3. Basis of Design for Jumper Tray: Chatsworth 12183 series.

G. Power Distribution Unit (PDU):

1. Refer to cabinet elevation drawings for PDU requirements at each equipment cabinet.
2. Surge protection to comply with UL 1449. For 330/400vac clamping voltage.
3. Basis of Design for PDU: Dynamic Signage cabinets: HPE P9S15A WITH HPE P9Q66A extension bars; PON system ang Public Safety DAS cabinets: APC AP8830, cabinets for other systems: APC 8832. Contractor shall confirm power requirements for each cabinet, including equipment provided by GOAA Vendors, prior to procuring PDUs. Each cabinet shall contain a minimum of (2) two PDUs.

H. Ground Bar:

1. Racks:
   a. Provide vertical full height grounding ~~strip~~ busbar for all rack mounted equipment.
   b. Racks shall have factory installed studs for crimp on ground lug at top and bottom of vertical rails. Lugs shall be 2-hole with long barrel and inspection window. Crimping tool shall impress the die number into the terminal.
   c. Connect to communication room TMGB/TGB with minimum #6 THHN stranded wire; increase size of bonding cable to accommodate cable installations of excessive lengths per ANSI/TIA 607.
   d. All grounding connections shall utilize non reversible connectors and lugs.
2. Cabinets:
   a. Provide full height minus 6” ground bar.
   b. Mount in rear of cabinet ~~and provide compression 2-hole lug with long barrel and inspection window on top for connection to grounding system. Crimping tool shall impress the die number into the terminal.~~. Do not use equipment mounting screw holes to mount the busbar. Mount busbar outside of rail mounting screw holes to avoid impeding the installation of equipment.
   c. Connect to communication room TMGB/TGB with minimum #6 THHN stranded wire; increase size of grounding cable to accommodate any ground cable installations of excessive lengths.
   d. All grounding connections shall utilize non reversible connectors and lugs.

I. Miscellaneous: Provide all necessary accessories including, but not limited to equipment shelves as required to support the placement of non-rack mountable equipment (e.g. termination blocks, fiber optic extenders, audio codecs, etc.) into cabinets. Coordinate with the Authority and Authority Vendors to determine type,

size, and quantity of such accessories required to accommodate Owner and Vendor provided equipment.

2.7 LABELS

A. All PDS components, including but not limited to, Fiber Optic, metallic cable, TTBs (Telecom Spaces), Ground points, racks, cabinets, rack/cabinet-~~moutned~~mounted equipment and equipment power cords; and cross-connects shall be identified and labeled per ~~Attachment One: GOAA Standard Voice and Data Infrastructure Cable and Pathways Labeling Format document~~the GOAA Telecommunications Infrastructure Administration Standard (TIAS) in its entirety, and according to ANSI/TIA 606 Administration Standards for Telecommunication Infrastructure of Commercial Buildings.

1. All label material shall be suitable for intended usage and environment, meeting the legibility, defacement and general exposure requirements listed in UL 969 for indoor and outdoor use. Where insert labels are used the insert label shall be covered with clear cover and shall be securely held in place under the normal operating conditions and usage to which the labeled infrastructure element is applied.
2. All items to be identified and labeled as listed above shall be labeled at the time they are installed.

B. Label printer shall be of the thermal transfer type capable of printing self-laminating labels of various size up to and including 1.5 inch by 1.5 inch printable area with a 4.5 inch self-laminating tail.

C. Label Printer Basis of Design: Brady BMP61 or approved equal.

D. In addition to color coding requirements specified in Division 26, Pathways, backbone fiber optic cables, and backbone metallic cable labels shall have a 1.5 inch by 1.5 inch printable area white in color with a 4.5 inch self-laminating clear tail.

1. Font shall be Arial Alt Mono 7 font size (11 point size).
2. Label shall have the ability to have 15 characters per line and 8 lines for a total of 120 characters.
3. Label Basis of Design: Brady P/N PTL-34-427 or approved equal, for inside use. For exterior use label shall follow the same character format, and meet the legibility, defacement, and general exposure requirements listed in UL 969.
4. GOAA reserves the right to modify the label characters and character layout providing label materials do not change, up to the point at which the Contractor applies the labels to the PDS components, at no cost.
5. For all conduit or other pathways that have a diameter too large for the self-laminating label to over-wrap itself and fully laminate the printable area the label shall be changed to an insert type (tie-on is acceptable) and meet the exposure requirements in UL 969 for indoor and outdoor use. The insert label shall be covered with clear cover and shall be securely held in place under the normal operating conditions and usage to which the labeled infrastructure element is applied.

E. Cables which shall be labeled include, but are not limited to, backbone, horizontal, patch cords, line cords, and jumpers.

F. Contractor shall install all pathway and cable labels so they are visible and able to be read by a person standing on floor without moving cables., and if conduitConduit/pathway, labels shall not be obscured by other conduit, or components. Any additional types of labeling materials necessary to keep labels visible shall be provided by the Contractor and installed by the Contractor.

G. All metallic and fiber patch cords installed by Contractor or at direction of Contractor shall be labeled.

H. Pathways are defined but not limited to; any conduit, inner-duct, underground duct-bank, cabling troughs, pull boxes, and any materials or systems used to enclose cabling of any type.

1. Any pathways or cablesPDS components whose label format is not specifically mentioned in the GOAA Standard Voice and Data Infrastructure Cable and Pathways Labeling Format documentGOAA Telecommunications Infrastructure Administration Standard (TIAS) shall still be labeled in a similar format as directed by GOAA OAR/Telecom.

I. All metallic/fiber horizontal cable and metallic/fiber patch cord labels shall have a 1 inch by 5 inch printable area white in color with a 1 inch self-laminating clear tail, labeled at each end.

1. Font shall be Arial Alt Mono, 7 font size (11 point size).
2. Label shall have the ability to have 15 characters per line and 2 lines for a total of 30 characters.
3. Label Basis of Design is Brady P/N PTL-31-427 or approved equal, for inside use. For exterior use label shall follow the same character format, and meet the legibility, defacement, and general exposure requirements listed in UL 969.

J. Equipment cabinet / Rack labeling

1. Provide phenolic nameplate fastenendfastened to top of racks and cabinets indicating rack / cabinet designation. Min 1” white text on black laminate. Labels shall be sized to fit label holders affixed to the front door of each cabinet.

2.8 CABLE TRAY/LADDER RACK

A. Ladder Rack (inside Communications Rooms):

1. Upper ladder rack shall be populated with horizontal and backbone copper and fiber cables and shall be mounted at 9’ A.F.F., unless otherwise noted on communication room enlarged plans.
2. Lower ladder rack shall be populated with copper patch cables only and shall be mounted at 8’ A.F.F., unless otherwise noted on communication room enlarged plans. No service loops are permitted inside ladder rack system.
3. Ladder rack shall be spaced off the wall 4” minimum to allow for cabling to pass vertically on wall. Ensure minimum code required spacing is provided for wall-mounted electrical equipment.
4. Ladder rack width shall be 18” unless otherwise noted, refer to enlarged room plans.
5. 1-1/2” x 0.0625” wall rectangular tubing.
6. Cross members welded at maximum 12” intervals, ½” x 1”.

7. Side mounted 6” cable guide/cable fence shall be mounted every other cross member, from same manufacturer as ladder rack.
8. Provide all accessories to support ladder rack from above and wall. Ladder rack shall not be supported from racks or cabinets. Supports shall be minimum 5/8” threaded rod.
9. Install ceiling supports as required, eliminating lateral movement.
10. All ladder rack mounted adjacent to walls shall be supported from the wall using wall mount brackets from the same manufacturer~~brackets~~.
11. Supports shall be used as specified by the cable tray manufacturer for maximum loading characteristics of ~~cable~~ ladder rack.
12. Provide supports as required by the manufacturer’s installation guidelines.
13. Edges, fittings and hardware shall be finished free from burrs and sharp edges. Ends shall have rubber boots.
14. Fittings shall have not less than the load-carrying ability of straight tray sections and shall have manufacturer's minimum standard radius unless otherwise indicated.
15. Furnish swept elbows for all direction changes.
16. Bond together to form an electrically continuous path.
17. Provide grounding kit to bond together sections of cable tray.
18. Provide transition pans to be installed where required on cable tray.
19. Transition pans with dividing fingers shall be installed on ladder racks above racks, cabinets and all locations required for ~~routing copper patch cords~~proper routing of all cable supported by the ladder rack. Transition pans shall match racking (black) in color and provided by the same manufacturer as the ~~cable~~ ladder rack.
20. Provide all warning labels as required by UL, NEC and NEMA.
21. Finish: Black, including all accessories.
22. Basis of Design: Chatsworth.
23. Approved Substitutions:
    a. Legrand.
    b. B-Line.
    c. Homaco.

2.9 FIBER OPTIC OPEN TROUGH SYSTEM (FIBER GUIDE/FIBER TRAY)

A. All overhead ladder rack shall have installed an overhead fiber optic trough system with an open channel design to protect and route fiber optic patch cords. Troughs shall have removable top covers. All components shall be yellow in color.

B. Fiber trough shall be configured to provide a pathway between all 2-post racks, all cabinets, wall mounted equipment, and backboards installed for future equipment in same communications room.

C. Trough shall have rounded flair downspouts and drop outs over each rack corner and vertical cable manager of sufficient length to enter top rung of vertical cable manager.

D. Fiber Trough width shall be 6 inch minimum.

E. Fiber Trough system shall be supported by manufacturer provided support kit of threaded rod/single support arm method, whether supported by ladder rack or unistrut.

F. Fiber Trough system shall have all end caps and protective bushings.

G. Fiber Trough systems shall be sized to not exceed manufacturer recommended patch cord fill rate based on area fiber ports.

H. Fiber Optic Open Trough Basis of Design: Panduit Fiber Runner series.

I. Acceptable substitutions: None.

2.10 CABLE TESTER

A. Copper cable tester technology required: basis of design: Fluke DSX-8000, or approved equivalent.

1. Copper cable tester shall be manufactured by a company engaged in the manufacturing of copper cable testing/certification equipment, and such equipment shall have been available for purchase from the chosen manufacturer for at least five consecutive years immediately preceding any test conducted to satisfy the requirements of this project.
2. Copper cable tester shall be a current model as manufactured by the chosen manufacturer and shall be currently in production, and fully supported by the manufacturer at the time any test is conducted to satisfy the requirements of this project.
3. Copper cable tester shall be calibrated by a factory authorized service provider within the 12 calendar months immediately preceding any test conducted to satisfy the requirements of this project. A Certificate of Calibration from the factory authorized service provider, identifying the specific unit calibrated, the date it was calibrated and that the specified unit is approved for service, shall be made immediately available to the Owner, OAR or field inspectors upon request. The last calibration date of the testing equipment/instrument used shall be documented in the test results provided to the Owner at any time such results are provided.
4. Any test results submitted to the Owner, OAR or inspectors that were conducted by a copper cable tester that does not meet the requirements specified herein will be rejected by the Owner. The Contractor will be required to repeat the necessary tests on the impacted cables with an approved tester at no additional cost to the owner and without impacting the project schedule or the Owner’s operations.

B. Fiber cable tester technology required: basis of design: Fluke Versiv, or approved equivalent.

1. Fiber cable tester shall be manufactured by a company engaged in the manufacturing of fiber cable testing/certification equipment, and such equipment shall have been available for purchase from the chosen manufacturer for at least five consecutive years immediately preceding any test conducted to satisfy the requirements of this project.
2. Fiber cable tester shall be a current model as manufactured by the chosen manufacturer and shall be currently in production, and fully supported by the manufacturer at the time any test is conducted to satisfy the requirements of this project.

3. Fiber cable tester shall be calibrated by a factory authorized service provider within the 12 calendar months immediately preceding any test conducted to satisfy the requirements of this project. A Certificate of Calibration from the factory authorized service provider, identifying the specific unit calibrated, the date it was calibrated and that the specified unit is approved for service, shall be made immediately available to the Owner, OAR or field inspectors upon request. The last calibration date of the testing equipment/instrument used shall be documented in the test results provided to the Owner at any time such results are provided.
4. Any test results submitted to the Owner, OAR or inspectors that were conducted by a fiber cable tester that does not meet the requirements specified herein will be rejected. The Contractor will be required to repeat the necessary tests on the impacted cables with an approved tester at no additional cost to the owner and without impacting the project schedule or the Owner's operations.

2.11 HORIZONTAL CABLING AND TERMINATION

A. Patch Panels:

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

c. Configuration: Modular Shielded RJ-45 non-keyed 8-position jack port to 110 printed circuit board, factory pre-wired, Category 6A.
d. Wire Plan: ANSI/TIA T568B.
e. Active Pins: 1 through 8.
f. Must be backward compatible in all characteristics to Category 6 specifications.
g. Individual patch panel size not to exceed 48 ports.
    1) One horizontal wire manager shall be installed for every 24 ports in patch panel configuration, between each patch panel(s).
h. Connection Hardware: IDC PCB (printed circuit board) mounted connector for 22-26 AWG.
i. Include strain relief bar. All cables terminating at a patch panel shall be secured to the strain relief bar for that patch panel.
j. UL listed and labeled.
k. Quick Grounding bar design.
l. Provide strain relief on all cabling terminated in patch panel.
m. Provide shielded panel kit including bonding jumper.
n. Finish: Black.
o. Basis of Design: Optical Cable Corporation.
p. Approved Substitution:
    1) None.

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

B. Telecommunications Outlets:

1. Telecommunication Outlet (TO):
   a. Provide all copper, metallic, and fiber optic cable as designed for Telecommunication Outlets indicated on the drawings.
   b. Provide Communication Outlet faceplates and jack modules for all type of cable media installed.
   c. Jacks/ports/faceplates shall be provided from the same manufacturer.
   d. All jacks installed in TO shall have colored bezel and dust shutter.
   e. The TO faceplate shall have six port positions and be white or as specified by design to match surrounding area décor.
      1) Faceplate shall have a recessed label area covered by a clear plastic lens, at top and bottom covering screws.
      2) Exception: when face plate is stainless steel.
   f. Refer to Attachment One in this specification document for GOAA Telecommunication Outlet ~~label~~, Jack, and wiring configuration. “Data” and “LAN” nomenclature is interchangeable in this reference.
   g. All Work Areas shall have GOAA Standard Telecommunication Outlets installed.
   h. Basis of design: Optical Cable Corporation UMJ faceplate #FPSR06xx xx=color.
   i. Approved substitution:
      1) Hubbell.
      2) Berk-Tek.
2. Wall Phone Outlet:
   a. Single port stainless steel wall plates with mounting studs for wall telephone installed with 8P8C jack as specified and served by one (1) Category 6 cable.
   b. Basis of design: Optical Cable Corporation.
   c. Approved Substitution:
      1) Hubbell.
      2) Berk-Tek.
3. Floor Outlets:
   a. Shall be designed with separate chambers for voice/data/electrical per NEC and ANSI/TIA specifications for dual service use.
   b. Voice and data jacks and mounting hardware shall meet ANSI/TIA Category 6 requirements for intended use.
   c. Voice and data jacks shall be recessed to protect cable ends when in use.
   d. Floor boxes shall have retractable covers to protect debris from entering voice and data jacks. Cover shall be capable of closing while jacks are in use.
   e. Floor box basis of design: Legrand Evolution Series.
   f. Approved Substitution:
      1) Hubbell.

C. Telecommunications Modular Jacks:

1. Jacks and faceplates shall be by same manufacturer.
2. Jacks and modular patch panels shall be by same manufacturer.
3. Category 6 UTP Jacks:

a. Meets ANSI/TIA-568-C.2 Category 6 specifications for all components including but not limited to specifications within this document and as follows:
   1) IEEE 802.3AF (POE).
   2) IEEE 802.3AT (POE+).
   3) IEEE 802.3BT (POE++ 60W).
b. Supports IEEE 1000GBASE-T Ethernet.
c. Tool-less design allows for simple, consistent, reliable terminations.
d. Provide colored bezel for all jacks in accordance with Attachment 1 within this specification section.
e. Accommodates 22-24 AWG conductors.
f. Modular interface: 750 mating cycles.
g. 50µ-inch gold-plated contacts.
h. Zinc alloy housing.
i. 1000 VDC Dielectric withstand.
j. 500 MΩ insulation resistance.
k. UL 1863 Listed.
l. Basis of Design: Optical Cable Corporation UMJ Series.
m. Acceptable substitution:
   1) Hubbell.
   2) Berk-Tek.

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

5. Fiber Optic Jacks:
   a. Shall be modular style.
   b. Shall be provided for MM or SM fiber cabling where required.
   c. Dual LC or SC connector, as required by application.

d. Provide colored bezel for all jacks in accordance with Attachment 1 within this specification section.
e. Basis of Design: Optical Cable Corporation UMJ Series.
f. Acceptable substitution:
1) Hubbell.
2) Berk-Tek.

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

D. Horizontal Cable:

1. All cable shall be installed, terminated, and tested by Contractor.
2. All cable jacket and construction shall be applicable for the intended installation environment to maintain full manufacturer's warranty and industry standard expected life cycle, including but not limited to specifications within this document section.
3. All cable shall include additional accessories such as clamps, supports, mounting hardware, straps, anchoring structures, termination hardware, etc. necessary to provide an industry standard installation in all environments. Accessories to include but are not limited to specifications within this document section.
4. Terminate all horizontal cabling on rack mounted patch panels.
5. Horizontal Copper CAT6 UTP Data Cable.
a. Cable shall meet the following minimum requirements:
1) Support for Power-over-ethernet including:
a) IEEE 802.3AF (POE).
b) IEEE 802.3AT (POE+).
c) IEEE 802.3BT (POE++ 60W).

b. Cable shall be four (4) pair copper unshielded twisted pair cable 23 gauge copper.
c. Cable shall exceed Cat 6 performance requirements and have guaranteed performance to 400MHz.
d. Certified to UL Category 6.
e. Certified to ANSI/TIA Category 6 specifications.
f. Shall meet ANSI/TIA-568-C~~.2–2009+A1:2010~~, Balanced Twisted-Pair Telecommunications Cabling and Components Standard, and current performance specifications for Category 6 rated cable.
g. The cable shall have surface markings: Verified UL Category 6.
h. Cable color: Continuous green jacket.
i. Plenum rating: Where required cable shall be plenum rated and marked CMP or Plenum (UL) and meet UL-910 standards.
j. Cable may be non-plenum rated only in spaces or areas not subject to the requirement for plenum rated cables~~where installed in non-plenum spaces/areas~~.
k. Basis of Design: Superior Essex DataGain, Category 6 4 pair UTP cable.
l. Approved Substitution:
    1) Mohawk - 6 LAN Plus.
    2) Berk-Tek – Lanmark 1000.

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

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

6) The cable shall have surface markings: Verified UL Category 6A.
7) Cable color: Continuous orange jacket.
8) Plenum rating: Where required cable shall be plenum rated and marked CMP or Plenum (UL) and meet UL-910 standards.
9) Cable may be non-plenum rated only in spaces or areas not subject to the requirement for plenum rated cables~~where installed in non-plenum spaces/areas~~.
10) Basis of Design: Superior Essex 10Gain, Category 6A 4 pair UTP cable.
11) Approved Substitution:
    a) Mohawk – GigaLAN 10.
    b) Berk-Tek.

E. Lightning / Surge Suppression for Horizontal Copper Cables:

1. Lightning protection assembly shall be comprised of Chassis and Modules and shall be provided for all cabling terminating outside the building envelope or otherwise susceptible to surge.
2. Chassis shall be installed directly above or below the patch panel being protected.
3. Surge Protection Chassis:
    a. Shall be high density, min ports per RU shall be 24.
    b. All modules shall be serviceable from the front.
    c. Modules shall be individual and field replaceable.
    d. Chassis Basis of Design: APC #PRM24.
4. Surge Protection Modules:
    a. Modules shall be selected based on CATx cable being protected and/or signal type.
    b. Modules shall be POE compliant and shall match required POE power requirement of cable being protected (30W, 60W or 100W).
    c. Model Basis of Design: APC #PNETR6.

F. Patch Cables:

1. Factory assembled patch cables shall be provided in all communications spaces (MDF, IDFs, & Zone Enclosures) for each patch panel termination. Length shall be as required to reach any LAN switch, OLT, ONT, active electronics component, or any other cabinet or rack within the same telecommunications space.~~Provide factory assembled patch cords sized to routing requirements.~~
2. Additional patch cables for specialty systems and equipment shall be provided as required to facilitate ~~a~~ complete and operational systems.
3. Patch cords shall be constructed and provided by the same manufacturer that provided the data patch panels/termination hardware.
4. Patch cables shall match color and performance specifications of corresponding horizontal cable.
~~4.~~5. All patch cables shall be provided by the Contractor.

2.12 BACKBONE CABLING AND TERMINATION – FIBER OPTIC CABLE

A. Termination:

1. No service loops shall be permitted in overhead ladder rack for backbone

cable.

2. Rack Mounted Modular Fiber Optic Patch Panels – Light Interface Unit (LIU):
   a. LIU shall be stackable, with modular connector bulkhead panels.
   b. Single Mode bulkhead connectors shall be designed strictly for single mode fiber.
   c. Multi-mode fiber bulkhead connectors shall be designed strictly for multi-mode fiber use.
   d. No high density panels will be allowed.
   e. Other sizes' fiber connector bulkheads shall be designed for specified fiber size and type only.
   f. Side or rear cable entry.
   g. Storage area designed internally to neatly store slack cable.
   h. Hinge out patch/connector panels.
   i. Each connector to have covers: single-mode shall be yellow, multi-mode shall be black.
   j. Patch panel to consist of connectors as indicated on the project drawings:
      1) LIU bulkhead connectors for work in Parking Garage and trailer complex shall be ST.
      2) LIU bulkhead connectors for work in South Terminal facilities including Airside Concourse, Landside Terminal, Ground Transportation Facility, Central Energy Plant, Checkpoint Delta, Emergency Standby Power Generation Plant, and Ground Support Equipment Facility shall be LC-APC type. Vendor specific requirements may supersede for Passive Optical Network connections.
      3) South Terminal 400/800 MHz DAS shall have LC-APC LIU bulkhead connectors in IDF Rooms and fusion splices at MDF Rooms and other locations between IDF Rooms and the 400/800 MHz DAS Headend location.
      4) LIUs shall have a metal frame door with pad locking hinged front cover.
      5) LIU's shall have metal pad locking rear cover. LIUs shall have a locking bar that interconnects the rear cover with the front cover.
   k. Provide a clear separation between horizontal and backbone fiber optic cables. Backbone fiber shall be in separate LIUs than horizontal fiber.
   l. Provide a clear separation between multi-mode and single-mode fiber optic cables, terminate in grouped connector panels segmented by cable type.
   m. When splice trays are required for termination of fiber they shall be of same manufacturer as LIU and have brackets / provisions to securely and neatly stack inside the rear compartment of the LIU. Trays shall be installed to allow future work in LIU and serviceability of fiber cable.
   n. Provide with all required cable management and accessories for a complete installation.
   o. Terminate all fiber cable with factory terminated pigtail assembly; splices shall be made in splice tray. Refer to additional Splice trays requirements below.
   p. Basis of Design: Optical Cable Corporation RTC-LM Series.

q. Approved Substitution:
1) None.

3. Fiber Splice Trays:
a. Install fan out kits and splice trays where incoming or outgoing fiber optic cables are loose tube, gel-filled type OSP cables. All loose tube, gel-filled, OSP cables shall be spliced to pigtails prior to connection to patch panel.
b. Fiber cable splice trays shall be used for all fiber cable terminations requiring spliced pigtails.
c. Splice cases installed without splice trays designed are prohibited.
d. Splice trays shall be tray type.
e. Splice trays shall be provided by same manufacture as LIU(s) installed.
f. All splices in tray shall be fusion type.

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

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

6. Fire Resistant Single Mode Fiber Optic Cable Requirements:
a. Single mode 9 micron core diameter/125 micron cladding diameter.
b. LSZH Fire Resistive outer jacket.
c. Cable shall meet the following standards:
1) Upgraded IEC 60331-25 (1000 °C, 3 hours)

2) UL 1666
3) UL 1685
4) UL 1651

d. Cable shall be riser rated and marked OFCR.
e. Jacket color shall be red.
~~k.~~f. Basis of Design: Draka Lifeline

C. Inter-Building Backbone/Riser Fiber Optic Cable (OSP):

1. Inter Building cable shall be used where cable is required to leave the building or be installed below grade or in wet location.
2. Backbone/Riser Inter-Building Fiber Optic Cable shall be Single-mode.
3. Refer to drawings for fiber strand count as specified.
4. Installed cables found to have defective strands are not acceptable and shall be replaced by the Contractor. Cables that provide additional fibers to replace defective fibers in the cable shall not be permitted.
5. Single-Mode Fiber Optic Cable Requirements:
   a. Single mode 9 micron core diameter/125 micron cladding diameter.
   b. Meet all applicable specifications for FDDI physical media.
   c. Fiber used in cable shall:
      1) Support applications using a bandwidth in excess of 10 Gbps.
      2) Meet EIA/TIA 492 AAAA standard.
   d. Underground and exterior cables shall be loose tube, gel-filled design.
   e. Loose Tube, gel-filled cables shall be Loose Tube, gel-filled cables shall be cleaned and terminated according to Cable Manufacturer and specifications within this document. The use of fan-out kits are required. The use of splice cases shall include splice trays.
   f. Backbone single mode OSP cable basis of design: Corning.
   g. Acceptable substitution:
      1) AFL.
      2) Prysmian.

D. Patch Cables:

1. Factory assembled patch cables shall be provided in all communications spaces (MDF, IDFs & Zone Enclosures) for each LIU panel termination. Length shall be as required to reach any LAN switch, OLT, ONT, active electronics component, or any other cabinet or rack within the same telecommunications space. Additional patch cables for systems and specialty equipment shall be provided as required to facilitate complete and operational systems.~~Patch cables shall be provided in communications rooms for each LIU panel termination, length shall be as required to reach any LAN switch, active electronic device, and/or cabinet in same communications room.~~
2. The fiber optic cladding shall be covered by aramid yarn and an OFNR jacket. Specialty use patch cords shall have a jacket suitable for intended use.
3. Provided factory assembled patch cords with SC or LCAPC style connectors, coordinated with LIU connector types, with ceramic ferrules length as required for routing.
4. Provide simplex or duplex type patch cables as required. Coordinate with Authority or OAR to determine types, configurations, and quantities before ordering.~~Provide one (1) duplex patch cord for each Fiber Optic Patch Panel termination pair.~~ Refer to Spare Material for additional information.

5. Patch cords shall be constructed and provided by the same manufacturer that provided the fiber patch panels/termination hardware.
6. Patch cable shall match color and performance specifications of corresponding backbone cable.
7. ~~Patch~~ All patch cables shall be provided by the contractor.

2.13 ZONE ENCLOSURE

A. Description: Wall-mounted cabinets manufactured from steel sheet. Maximum equipment weight of 100 lb (45.4 kg) when secured to the structural wall with standard anchors.

B. Equipment Mounting Rails: Two pairs of equipment mounting rails shall provide 6U of rack-mount space.

C. Front Door: Solid and keyed.

D. Sides: Louvered near the top for inlet airflow with four ~~3/4~~¾ inch and 1-1/2 inch conduit knockouts for network cable access.

E. Bottom Panel: Vented for an exhaust fan with two ~~3/4~~¾ inch and 1-1/2 inch conduit knockouts for network cable access.

F. Top Panel: Solid removable top panel to provide access to internal equipment.

G. Rear Panel: 4 inches by 6 inches opening located near the bottom center of the cabinet for through-the-wall network cable access.

H. Electrical Connection: Single-gang 2 inch by 4 inch duplex electrical junction box for a single duplex electrical outlet

I. Color: Powder coat Black.

J. Accessories:

1. Fan Kit: Solid state temperature control variable fan speed with a 115 VAC, 60 Hz to 12 VDC power supply.
   a. Size: 4U, 65 CFM – 120 CFM (110 CMH – 204 CMH).
2. Power Outlet: Surge-suppressed duplex receptacle rated for 125 Volt, 15 Amps with two NEMA 5-15R outlets.
3. Fiber Slack Manager Panel: 19 inches wide rack-mount, 4U high and 2 inches deep in black.

K. Accessibility: Zone enclosures shall be mounted so as to be accessible for maintenance without requiring the use of a step ladder or lift. Ceiling-mounted zone enclosures shall be unacceptable. Unless notified otherwise in the Contracto Drawings. Refer to specification section 27 05 00 for additional information regarding accessibility of equipment.

L. Acceptable Manufacturers

~~9.~~1. Chatsworth (CPI) – Thinline II
~~10.~~2. Middle Atlantic – HDR
~~11.~~3. Hubbell – ReBox
~~12.~~4. Or approved equal.

PART 3– EXECUTION

3.1 COORDINATION

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

3.2 EQUIPMENT PROTECTION

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

3.3 WORK PERFORMANCE

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

3.4 EQUIPMENT INSTALLATION

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

B. General Installation Requirements:

1. Provide any necessary screws, anchors, clamps, Velcro ties, raceway, grounding or other support hardware required to facilitate the proper installation of the Premise Distribution System.
2. All cable, terminating hardware, cabinets, racks, and all PDS components shall include additional accessories such as clamps, supports, mounting hardware, straps, anchoring structures, termination hardware, etc. necessary to provide an industry standard installation in intended environments. Accessories include but are not limited to specifications within this document section.
3. Locate, install, and test the Premise Distribution System in accordance with the equipment manufacturer's written instructions; the latest editions of the National Electrical Code; the National Electrical Contractors' Association publication "Standard of Installation," according to Regulatory and Reference Documents section of this document, and all applicable codes and standards referenced in this specification.
4. Furnish any special installation equipment or tools necessary to properly complete the Work. This may include, but not be limited to, testing equipment, communication devices, jack stands, cable winches, etc.
   a. Furnish to the Owner any specialty hand tools needed to access any covers, access hatches, or other Contractor installed enclosures.
   b. Provide above hand tools by Substantial Completion Inspection or earlier if deemed necessary by Owner or Project Manager.
   c. Label all Comm Room outer doors "Communication Room ###" per GOAA door labeling standards ~~for Electrical Rooms~~.
5. Install equipment, cables, raceways and outlets as required to comply with all applicable requirements within this specification document as minimum installation requirements. Exceed this minimum requirement when called for herein or as required to ensure a fully operational PDS.
6. Install all ~~electrical~~ telecommunications basic materials per applicable sections of these specifications.
7. Install all rack mountable equipment in equipment rack, except that furnished and installed by GOAA and GOAA Vendors.
8. Install system cabinets/racks in locations shown; arrange to provide adequate cooling, ventilation and access.
9. Properly bond system per applicable sections of these specifications.
10. Support raceways, backboards, and cabinets under the provisions of these

specifications and as required by manufacturer's instructions.

11. Install raceways and pathways to conform to applicable sections of these specifications.
12. Install PDS system wiring and raceways away from any surface that may become hot, including and not limited to, hot water piping and heating ducts.
13. Install PDS system wiring with at least 12 inches of separation from line voltage power wiring on parallel runs. Wiring crossing power circuits shall be at right angles. For metal enclosed electric light or power or Class 1 circuits, separation may be reduced as described in NEC 800-52 (a) (1). Increase separation if so required to comply with ANSI/TIA referenced standards.
14. Maintain proper separation between PDS system cables and all power and unshielded cables, as required to prevent noise, crosstalk, etc.
15. All horizontal voice and data cables shall be splice-free and homerun to the patch panel in the associated ~~GOAA~~ Telecommunications ~~Room or zone enclosure~~space (MDF/IDFs or Zone Enclosure) as shown on the drawings.

3.5 EQUIPMENT RACKS/CABINETS:

A. Equipment Racks/Cabinets shall be installed where shown on the drawings and in accordance with the manufacturer's instructions.

B. Whether or not specifically shown on the drawings, all racks and cabinets shall be installed as specified within this document as GOAA Standard Rack/Cabinet configuration.

1. Each equipment rack shall have one full-length vertical wire manager installed on each side of the equipment rack.
2. Each row of ~~terminating frames and cable racks~~cabinets and/or equipment racks shall be bonded to ground with a minimum #6 stranded THHN copper cable with a continuous green jacket.
3. Remove paint from grounding lug attachment points on each rack. Each grounding lug to be attached to rack via nut and bolt method.
   a. Bonding cables within Communications Room to be installed separate route from all horizontal and backbone cabling, back to Telecommunications Grounding Busbar.
   b. This separate pathway shall hang from ladder rack.
4. When mounting any equipment in enclosure, provide width, height, hardware, etc. as required for complete and coordinated installation.
5. Horizontal wire managers are to be installed qty (1) for each 24 ports of modular copper cable patch panels.
6. For the maximum size allowed patch panel (48 ports) one horizontal wire manager to be installed above and one horizontal wire manager to be installed below.
7. Furnish and install blank plate covers in all empty equipment cabinet spaces.

3.6 TELECOMMUNICATION OUTLETS (TO)

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

B. Install cable to outlets for PDS where indicated on the drawings.

C. Install per applicable section of these specifications (i.e., outlet boxes, indoor service poles, floor boxes, wall phones, etc.).

D. Terminate all voice, data, and fiber optic cable on jacks wired per jack wiring details in Attachment One.

E. Install face plate on single-gang sheet rock ring. Label face plate per Attachment One.

F. All required cabling, outlet and faceplate labeling shall be completed at the time of installation.

G. All cable testing shall be complete before any cabling is put into use.

3.7 PATHWAYS

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

B. General:

1. All raceways shall meet the applicable requirements of all of Divisions 26, 27, 28 Specifications, and all requirements within this specification document.
2. All raceways at terminal boards shall turn 90 degrees down and terminate at a point within 6 inches of termination board with appropriate plastic bushing, and grounding hardware.
3. Raceway shall not be shared by power or any other electrical wiring that is not part of the low voltage PDS systems. PDS system cabling may be installed in underground pull boxes with other low-voltage systems provided:
   a. Installation meets/complies with all applicable codes and standards.
   b. PDS system cables shall be separated by at least 12 inches from any non-shielded wire/cable.
4. Raceway Bends:
   a. Bend raceway with minimum inside radius of 6 times the internal diameter.
   b. Increase bend radius to 10 times for raceway larger than 2 inch size. Provide proper bend for all changes of direction.
   c. Pull and splice boxes shall not be used in lieu of a direction change in raceway.
   d. Install raceways so no more than 180-degrees of total bend are present between any two pull points in any raceway section without pull box.
      1) Install additional pull boxes as required to maintain maximum of 180-degrees in total bend between pull boxes and/or termination points.
      2) Label all raceway at both ends to indicate destination and PDS source room.
         a) Length of raceway and labeling/identification shall be fully documented in as-built drawings.
         b) As-built conduit/raceway marking nomenclature shall match exactly Identification Label format according to ~~GOAA Standard Voice and Data Infrastructure Cable and Pathways Labeling Format document~~the GOAA Telecommunications Infrastructure Administration Standard (TIAS) document.
         c) Label PDS Conduits per ~~GOAA Standard Voice and Data Infrastructure Cable and Pathways Labeling Format document~~the GOAA Telecommunications Infrastructure Administration Standard (TIAS) document.

3) Install polyester pull cord/pull tape in each conduit whether used or empty.

5. Pathways/raceways at terminal board locations shall be racked on a c-channel / strut channel (e.g. Unistrut / Kindorf) type rack secured to wall above and below terminal boards.

C. Penetrations/Fire Stop:

1. Make no penetration in floors, walls or ceilings without the prior consent of the Authority/OAR. It is the responsibility of the Contractor to firestop all rated walls, penetrations, and conduits affected to code compliant condition.
2. Where penetrations through acoustical walls or other walls for cable-ways have been provided, such penetrations shall be sealed in compliance with applicable code requirements and the Contract Documents.
3. Where penetrations through fire-rated walls for cableways have been provided, such penetrations shall be as required by code and the Contract Documents. Submit details of any special systems to be used.
4. Where conduit penetrates a fire rated wall, floor, etc., firestopping shall be provided and installed.
5. Provide permanent firestopping seals after cable installers have pulled risers and distribution cables.
6. Meet all requirements for UL assembly involved. Provide firestopping UL listed for assembly, conduit, and/or cable involved.
7. Attach UL Label to wall adjacent to each instance of firestopping.

D. Sleeves:

1. Install rigid steel conduit sleeves with bushings on both ends at penetration of all walls above ceilings. Stub-out each side of wall a minimum of 8 inches or as per design.
2. Install firestopping at sleeves and all rated firewall/smoke wall penetrations. Stub-out wall as required for routing. Firestopping assembly must comply with UL for wall routing, material and cable used.
3. Size sleeves as required by the NEC for cable installed, but in no case shall sleeve be less than 2 inch diameter, nor smaller than that required by "4)" below.
~~4. Sleeve size shall not be smaller than that required by ANSI/TIA-569, Table 4.1-1, "Conduit Sizing."~~

E. Cable Support:

1. Cable shall be supported in raceways according to this specification document.

F. Termination Locations:

1. Install vertical wireway to point within six (6) inches of each side of ceiling to facilitate ceiling penetrations.

2. Size wireway as required for cables and meet percent fill requirements of applicable codes/standards.
3. Provide bushings on each end of wireway, including grounding hardware, ground.

G. Telecommunication Outlet (TO) Horizontal Pathway:

1. Minimum size to be 1” C. Increase size of raceway to properly accommodate number of cables.

H. Backbone Conduit and Pathways (Intra-building or Inter-building):

1. Install raceways as required above under "General."
2. Minimum size: 2" C.
3. Increase size of conduit/raceway/pathway called for above if larger size is called for on drawings or larger size is required.
4. ~~Conduit/raceway/pathway size shall not be smaller than that required by ANSI/TIA-569, Table 5.2-1, "Conduit Fill for Backbone Cable."~~ Conduit size shall be based on type of cable and quantity of cables.
5. Install per applicable sections of these specifications and all applicable codes/standards.

I. Pull-boxes, Splice (Junction) Boxes, Outlet Boxes, Termination Enclosures:

1. Boxes shall be placed above accessible ceilings and in an exposed manner and location, and readily accessible. Boxes shall not be placed in a fixed false ceiling space unless immediately above a suitably marked and rated hinged access panel.
2. Where cables can be exposed in pull boxes, label the cables per the ~~GOAA Labeling Plan~~GOAA Telecommunications Infrastructure Administration Standard (ITAS) document.
3. All pull boxes installed to serve more than two 1” conduits shall be labeled and marked on as-built drawings.
4. All backbone and horizontal pathways (no exception unless in writing from Owner) pull boxes shall be placed in conduit run where:
   a. The length is over 100 feet.
   b. Total of all bends exceeds 180 degrees.
   c. There is a reverse bend.
   d. Boxes shall be placed in a straight section of conduit and not used in lieu of a bend.
      1) Every pull box shall have a hinged cover:
         a) Install appropriate access panel to allow cover to open.
         b) No backbone cabling shall rest on hinged cover when cover is closed. All cable shall have its own service loop coil support. No stick-on cable anchors are allowed.
      2) The corresponding conduit ends shall be aligned with each other.
      3) Conduit fittings shall not be used in place of pull boxes.
      4) Backbone cable pull-boxes shall have kindorf strut or equivalent secured to inside top to support cables’ service loops.
      5) No cable is to be supported by or strapped to another.

J. Horizontal Conduit and Pathways:

1. Size: Minimum pathway size to be 1” C.
2. Flexible conduit is not allowed.
3. Conduit type for location within Airport Property is per GOAA requirements, Codes, and Regulatory and Reference documents specified within this document.

4. Outlet boxes shall be installed at locations shown on drawings per applicable codes/standards.
5. Where a pull box is required with raceway(s) smaller than 1-1/4 trade size, an outlet box may be used as a pull box.
6. Where a pull box is used with raceway(s) of 1-1/4 trade size or larger, the pull box shall:
   a. For straight pull through, have a length of at least 8 times the trade size diameter of the largest raceway.
   b. Have a distance between the nearest edges of each raceway entry enclosing the same conductor of at least: six times the trade size diameter of the raceway; or six times the trade size diameter of the larger raceway if they are of different sizes.
   c. For a raceway entering the wall of a pullbox opposite to a removable cover, have a distance from the wall to the cover of not less than the trade size diameter of the largest raceway plus 6 times the diameter of the largest conductor.

~~7. Where a splice box is used with raceway, it shall be sized per ANSI/TIA-569, Table 4.4-2, "Splice Box Sizing".~~

~~8.~~7. No box shall be smaller than that required by NEC 370-28 (a), (1) and (2).

3.8 TERMINATION BACKBOARDS

A. Terminal Boards:

1. Terminal boards shall be installed secure to wall with bottom of board at 6" above floor.
2. ~~Install termination backboards plumb, and attach securely to building wall at each corner.~~Install and support backboards as required by the manufacturer per the current version of the BICSI Information Technology Systems Installation Methods Manual (ITSIMM)
3. Finish paint termination backboards with durable gray paint having flame spread rating of Class A prior to installation of any equipment on termination boards.
4. ~~Mark all TTBs with TTB#.~~ Label all TBBs per the GOAA Telecommunications Infrastructure Administration Standard (TIAS) document.

3.9 COMMUNICATIONS CABLING REQUIREMENTS

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

B. All cable shall include additional accessories such as clamps, supports, mounting hardware, straps, anchoring structures, termination hardware, etc. necessary to provide an industry standard installation in intended environments. Accessories to include but are not limited to specifications within this document.

C. All cable shall be kept on reels until it is installed. Do not roll or store cable reels without an appropriate underlay and the prior approval of the OAR. Cable on reels shall be handled, loaded, unloaded and transported by approved machinery equipped specifically for these operations.

D. Replace any cable found to be defective.

E. Do not install any Premise Distribution System cabling alongside any power circuit or device. Premise Distribution System cabling shall not share the same raceway, channel or sleeve with electrical circuits or devices.

F. Ensure, during installation, that the maximum pulling tensions and bend radii of the Premise Distribution System cabling (both backbone and horizontal) are not exceeded.

G. Install cables in accordance with manufacturer's instructions and ~~ANSI/TIA 568~~all referenced standards.

H. All cables shall be installed as illustrated on the drawings except where necessary to avoid EMI sources or other obstacles.

1. The Authority/OAR must approve major deviations from the illustrated path in advance.
2. No splices unless specifically noted otherwise.
3. Provide adequate cable size and length for each backbone/riser run.
4. All backbone cable shall be labeled per ~~GOAA Standard Labeling Plan~~the GOAA Telecommunications Infrastructure Administration Standard (TIAS) document at every location where the cable could be exposed.
   a. This includes all pull boxes and pull through locations.
5. Provide and install riser/backbone cable that meets performance requirements specified, and links all systems room locations indicated on Contract Documents.
6. Spare Cable (During Installation):
   a. The following spare cable lengths are to be left at termination ends of conduits after termination is completed:
      1) Main Distribution Frame (MDF) Rooms: Fiber and copper cables terminating MDF Rooms shall have enough spare cable length left to be routed to any point in the room from point of entrance to the room.
      2) Intermediate Distribution Frame (IDF) Rooms: Fiber and copper cables terminating in the IDF Rooms shall have enough spare cable length left to be routed in industry standard workman like manner, from the point of entry into the systems room, to the farthest equipment rack or backboard, then down to the floor plus three (3) feet.
7. Telecommunications Outlets: At the TO's, cables shall terminate with a minimum of twelve (12) inches of spare cable length for copper and twenty-four (24) inches of spare cable length for fiber.
8. Install all cables no closer than 12" from any cable installed for Premise Distribution System, power system cable/raceway, or fluorescent/ballasted light fixtures.
9. All PDS cable shall be installed in the appropriate raceway.
10. Provide protection for exposed cables where subject to damage.
11. All cables in systems rooms shall be routed in overhead cable ladder racks and dropped into the appropriate racks utilizing transition pans. All cables shall be properly secured to the cable tray, racks, or cabinets.
    a. All fiber cable shall be routed in raceway specifically designed for fiber, and separate from copper cables.

12. Cables shall be terminated to preserve wiring order consistently across all termination (jacks, patch panels, connector blocks and patch cords).

I. Ensure consistency. Corrections shall be made at no additional cost to the Owner.

J. Install appropriate cable to match application, i.e., plenum, riser, etc. All cables shall bear CMP and/or appropriate marking for the application in which they are installed.

K. Cables/raceways routed through rated walls; floors and assemblies shall be routed via appropriate fireproofing system as approved by UL.

L. Label cable per ~~GOAA Standard Voice and Data Infrastructure Cable and Pathways Labeling Format document~~the GOAA Telecommunications Infrastructure Administration (TIAS) document. This labeling/identification shall be fully documented in as-built drawings.

M. Horizontal Cables Copper and Fiber:

1. Provide and install adequate number cables and cable lengths for each horizontal run.
2. Horizontal cables shall be terminated on patch panels in rack(s) or fiber LIU.
   a. Install one horizontal wire manager directly above or below every 24 ports of patch panel(s).
   b. Terminate all cabling in designate system patch panel where applicable. (i.e. WiFi, CCTV, DS, VMS). Refer to specific labeling requirements for dedicated patch panels.
3. Shall be labeled per ~~GOAA Standard Voice and Data Infrastructure Cable and Pathways Labeling Format document~~the GOAA Telecommunications Infrastructure Administration Standard (TIAS) document.
4. Horizontal cables shall be installed in a neat and orderly manner.
5. Horizontal cables shall be dressed in ~~MFD~~ MDFs and IDFs without tangle or inter-wrapping.
6. Termination of all horizontal station copper cables shall be by PDS contractor and shall be according to ANSI/TIA 568~~B~~ wiring configuration, all fiber cables by termination methods specified within this document.

N. Backbone Fiber Optic Cable:

1. Install fiber optic cable from each IDF to MDF in innerduct within conduit.
2. Termination in respective fiber optic patch panel shall be via connectors as described in Part 2 and labeled per ~~GOAA Standard Voice and Data Infrastructure Cable and Pathways Labeling Format document~~the GOAA Telecommunications Infrastructure Administration (TIAS) document.
3. Provide minimum 15FT feet of slack (service loop) on both ends of each fiber optic cable.
4. Observe all manufacturer's specifications relative to cable bend radius and pulling tension.
   a. All fiber cables to be installed without splices except at pigtails in LIU or at outlets.

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

3.10 ELECTRICAL POWER DISTRIBUTION

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

3.11 TRANSIENT VOLTAGE SURGE SUPRESSION

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

3.12 GROUNDING AND BONDING

A. Refer to Division 26 and Specification Section 27 05 00 in addition to the following. All telecommunications grounding and bonding shall comply with Division 27, regardless ~~fo~~of the Contractor performing the work.

B. Provide and install complete bonding system as required to comply with all sections of these specifications and applicable codes and referenced standards.

C. Connect all rows of racks and cabinets to Telecommunications Ground Bus (TGB) or Telecommunications Main Ground Bus (TMGB) with AWG #6 THHN green jacket.

1. Each row shall have its own ground cable as described above.

D. Connect all horizontal and backbone metal conduit (via grounding bushing) to TGB or TMGB.

E. Connect cable shields to Rack Grounding Busbar (RGB).

F. Connect surge suppression equipment to TGB or TMGB.

3.13 EQUIPMENT IDENTIFICATION

A. Refer to Specification Section 27 05 00 and Attachments to this section in addition to the following.

B. Labeling – General:

1. Cables, pathways, significant Junction Boxes, PDS components etc. shall be labeled at each exposed and termination point and as detailed below at the time of installation. All Unique Cable Identifiers (UCI), Unique Pathway Identifiers (UPI), Unique LIU Identifier (ULI), and similar field characters shall be provided by GOAA to the Installer for use in completing label structure field data.
2. All PDS components, including but not limited to ~~All~~ conduit, pathways, innerducts, enclosures, pull boxes and wireways shall be labeled.
3. Provide and install printed labels for all PDS components, including but not limited to conduit, pathways, cables, patch cords, frames racks, enclosures, pull boxes etc. See ~~Attachment One: GOAA Standard Voice and Data Infrastructure Cable and Pathways Labeling Format document~~the GOAA Telecommunications Infrastructure Administration Standard (TIAS).
4. All labeling shall be in accordance with ANSI/TIA-606. UL and NEMA requirements.
5. All physical location and network identifiers shall be derived from MCO standard GIS fields and characters.
6. All PDS components must be easily identifiable for any person that may need to locate telecommunications equipment, facilities, or circuit information.
7. Cable and equipment management shall be performed using PDS

Administration Database program that track all telecommunications circuit components. Coordinate requirements for adding cable and equipment management information to the GOAA PDS Administration Database with GOAA.

8. All copper and fiber test results must be exportable into format to allow importing into Telecommunications PDS Administration Database.
9. Hand written labels shall not be acceptable.

C. Patch Panels:

1. Provide ~~Permanente~~ permanent ~~phenoloc~~phenolic label on each “dedicated patch panel~~s~~” located in the upper left hand side indicating patch panel designation, system designation, and warning; see below example:
   a. PP-01 CCTV ONLY (PP-xx yyyy ONLY) x=patch panel number, y=System type.

D. Racks / Cabinets:

1. All Racks and cabinets shall have phenolic label mounted to the top of each rack or cabinet.
2. Labels shall be ¾” MIN letters and White lettering on black label.

E. Telecommunication Outlets (TOs):

1. All Telecommunication Outlets (TO) are to be labeled (with appropriate designation labels per ~~GOAA Standard Voice and Data Infrastructure Cable and Pathways Labeling Format document see Attachment One for details~~the GOAA Telecommunications Infrastructure Administration Standard (TIAS) document.

F. Cables and Pathways:

1. Cables that shall be labeled include but are not limited to backbone, horizontal, patch cords, line cords, and jumpers.
2. Labels shall be installed for all pathway and cable so they are visible and able to be read by a person standing on floor without moving cables, and if conduit/pathway, labels shall not be obscured by other conduit, or components. Any additional types of labeling materials necessary to keep labels visible shall be provided by the Contractor and installed by the Contractor.
3. All installed metallic and fiber patch cords shall be labeled.
4. Pathways are defined but not limited to; any conduit, inner-duct, underground duct-bank, wiring troughs, pull boxes, and any wiring systems used to enclose cabling of any type.
5. Any pathways or cables whose label format is not specifically mentioned in the ~~GOAA Standard Voice and Data Infrastructure Cable and Pathways Labeling Format document~~GOAA Telecommunications Infrastructure and Administration Standard (TIAS) document shall still be labeled in a similar format as directed by GOAA OAR/Telecom.
6. Cable and Pathway Labels shall be electronically generated by thermal transfer printer. All labels with all fields shall be delivered to GOAA electronically.
7. Cable and Pathway Labels shall be printed in ALL CAPITAL LETTERS. All components follow “End One” / “End Two” format and named for Inventory

format following MCO standard GIS fields' structured labels. GOAA has the right to change field data and label structure without additional costs.

8. Cable and Pathway Labels shall be printed on adhesive tags no less than 2" in height and permanently placed, longitudinally or flagged. ALL LABELS MUST BE VISIBLE WHEN INSTALLED.
9. Cable and Pathway Labels shall be made of polyester or similar durable material with permanent adhesive characteristics typically found in telecommunication labels. Cable labels to be self-laminating. PER-PROJECT PRODUCTS USED ONLY AFTER SUBMITTALS ARE APPROVED BY GOAA.
10. Cable Labeling - Attached for easy access and visibility to the cable within 12" of entering the LIU or terminating at Patch Panel.
11. Cable Labeling - Attached for easy access and visibility to the cable 12" – 16" before entering conduit or inner-duct pathway.
12. Cable Labeling - Attached for easy access and visibility to the cable on service loop on TTB for backbone cables.
13. When printing labels no line break shall fall in a data field. All line breaks to be after nearest field separating character.
14. Pathway Labeling - Attached for easy access and visibility to conduit (occupied with cable or inner-duct). Shall be visible without movement.
15. Pathway Labeling - Attached for easy access and visibility to inner-duct (empty or occupied with cable) 12" – 16" before inner-duct enters conduit pathway.
16. Inner-duct and cables shall be labeled any time the inner-duct or cable is/can be exposed i.e. pull/junction boxes, manholes, and similar conditions.
17. Inner-ducts and cables shall be labeled in all pull-boxes, manholes, junction boxes. Labels to be minimum 4IN x 2IN, rated for outdoor use and permanently secured by one tie wrap at each end of label or as approved by GOAA.

G. The labeling scheme is to enable tracing data/circuit information flow between devices without physically tracing each cable, and will be used to identify the following communications infrastructure components and paths:

1. Where any active Electronic Systems are installed by any party requiring use of new or existing fiber or copper backbone or horizontal cables, the installation of fiber or copper patch cords shall be complete; all patch cords shall be permanently and properly routed in the pathway created for same, and the patch cords shall be labeled on each end with source/destination according to GOAA Labeling Specifications. All patch panel or LIU User Identification tables shall be filled out as to use/user. This must be demonstrated as complete by Substantial Completion inspection.
2. Each active device and its rack location.
3. Each patch panel, row and the associated active device.
4. Each active device cable and the device it is attached to at the other end.
5. Each dormant cable and its other end.
6. Each systems room cable and the systems room located at the other end.

H. All horizontal media (cable) shall be labeled at both ends indicating exact origination and destination information, using basis of design labeling method.

I. Any patch cords installed in MDFs, IDFs, or other rooms shall be labeled according to GOAA Format as provided by GOAA Information Technology Department at both ends.

J. Passenger Boarding Bridge (PBB) Connectivity Infrastructure

1. The ~~Technology Master~~ Contractor shall label all cable provided by the PBB manufacturer as an extension of building premise distribution to technology and security devices located on the passenger boarding bridge in accordance with the Contract Documents. All points of PBB cabling transition and/or interface to building premise distribution shall be labeled per the PBB cable's identification.

K. Telecommunications Infrastructure Administration Records:

1. Example Telecommunications Infrastructure Administration Records tables shall be provided by GOAA Information Technology Department.
2. Installing Contractor shall complete all infrastructure element labeling and Telecommunications Infrastructure Administration Records tables/forms.
3. Above forms shall be submitted filled out by installing Contractor in their entirety prior to Project Substantial Completion, at the same time all cable test records are submitted.
   a. Tables shall be submitted in Hardcopy and electronic format.
      1) Hardcopy to be submitted in 3 ring binder at same time as cable test records.
      2) Electronic file to be submitted in Excel most current version using Arial 10 font size using layout in example provided by GOAA.

3.14 MAINTENANCE AND SERVICE

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

3.15 WARRANTY

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

3.16 FIELD SERVICES

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

B. No fiber optic or copper cable shall be put into use without being successfully tested and the test results approved as submitted to the Authority and OAR.

1. All telecommunications cable provided by the passenger boarding bridge manufacturer as an extension of building premise distribution to technology and security devices located on the passenger boarding bridge shall be tested and submitted by the Technology Master Contractor.

C. Perform all testing where necessary or specified to assure a fully functional system. Repair or replace and retest components that fail performance standards.

D. Test all cables:

1. Provide all cable test results in both hardcopy and CD format.
2. The CD shall contain test results in tester native format and exported in comma delimited file.
3. All Test results shall be submitted in 3 ring binder with Project #, title, date, indicated on spine and front in no less than 24 font size Arial font.

4. All Binder labeling to be machine printed.
5. Multiple binders shall also be labeled as volume of total volume set, I.E. 1-3, 2-3, 3-3, etc.
6. Test instrument data fields shall exactly match PDS component labeling, I.E. Telecommunication Outlets, fiber LIUs, etc., provide exact source/destination information for all media tested.
7. All copper backbone testing shall be in its own binder.
   a. A divider shall be placed between each cable's test results.
8. All backbone fiber test results shall be in its own binder.
   a. A divider shall be placed between each cable's test results.
9. All horizontal copper voice and data cable test results shall be together in a binder, with each Telecommunication Outlet's test results pages together and sequential.
10. Each volume/binder shall have Installing/Testing Contractors company information and warranty phone numbers to call for service.
11. Test results submittal shall include calibration certification, within twelve months of the test date, for the test equipment used by the Contractor.

E. Provide system verification and acceptance documentation signed and dated by the installer.

1. This documentation shall include test measurements and system calibrations performed for the entire system.
2. Sample system operations shall also be performed with actual hardware or using Contractor provided test equipment and documented to verify that the system is operational and ready for acceptance.
3. This shall also establish the baseline performance of the system.

F. Fiber Optic Cable Testing:

1. Each fiber in every backbone inter-building and intra-building cable and every horizontal cable run shall undergo testing in accordance with Annex E of ANSI/TIA-568-C, including Tier 1 testing for length, polarity and Optical Return Loss (ORL), using an Optical Loss Test Set (OLTS), and the additional steps required for Tier 2 testing using an Optical Time Domain Reflectometer (OTDR). The test methods and configuration of equipment and test cords for both Tier 1 and Tier 2 tests shall be as detailed in ANSI/TIA-526-7-A.
2. Test results shall include a record of:
   a. Wavelength.
   b. Fiber type.
   c. Fiber and cable number.
   d. Measurement direction.
   e. Test equipment model and serial numbers
   f. Date.
   g. Reference setup.
   h. Operator (crew members).

G. Copper Category 6 or higher, UTP & STP Cable Testing:

1. Every cable and connector pin for each horizontal cable run from an MDF or IDF to a Telecommunication Outlet (TO) shall be tested up to 250 MHz for Category 6 rated operation:
   a. Continuity on each pin.

b. Correct pin-pair orientation (wiremap).
c. Propagation Delay (100 m).
d. Skew (100 m).
e. Near end crosstalk (NEXT value).
f. Power Sum Near End Crosstalk (PSNEXT).
g. dB loss (attenuation).
h. Equal Level Far End Crosstalk (ELFEXT).
i. Power Sum Equal Level Far End Crosstalk (PSELFEXT).
j. Return loss.
k. Cable length.
l. Presence of AC voltage.
m. The Category 6 cable shall be tested for the conformance to the specifications of ANSI/TIA 568~~-D~~ Category 6.
n. Should UTP cable type in project be changed to make use of updated cable technologies, testing of cable shall conform to latest industry standard and manufacturer's testing requirements to ensure cable has been correctly installed and is operating to specification.
o. STP cabling shall include the following additional test requirements:
   1) Cable shield continuity
   2) Power Sum Alien Near-End Crosstalk (PSANEXT) test
   3) Power Sum Attenuation-to-Alien-Crosstalk Ratio at the Far End (PSAACRF) test
p. Category 6A rated cable shall include the following additional requirements:
   1) Perform all testing required for Category 6 rated cable up to a frequency of 500MHz for all Category 6A rated cable.

3.17 TRAINING

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

B. Training and orientation of installed PDS and OSP components and active equipment shall be provided to the Owner.

1. Training instruction shall include any additional active Systems as required by Project.
2. Training shall cover all locations where PDS and/or Systems have been installed and or modified.

3.18 PROJECT CLOSEOUT REQUIREMENTS

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

B. Upon completion of the aforementioned tests and before system commissioning and final acceptance, actual voice and data testing shall be performed.

C. The tests may be performed with existing equipment, if in place, or using contractor provided equipment or test equipment.

D. The tests shall be performed at Owner's discretion and on a sample basis (10% of installed Telecommunication Outlets, copper pairs, and fiber strands) on various portions of the network as determined by the Authority/OAR.

1. The tests shall be witnessed by the Contractor, the Authority/OAR.

E. Demonstrate system to designated Owner personnel as required by applicable sections of these specifications.

1. Conduct walking tour of project.
2. Briefly describe function, operation, and maintenance of each component.
3. All pull-box covers shall be removed so Owner can inspect for proper installation of cable and labels.
4. Provide detailed operation and maintenance instruction and training.
5. Use submitted operation and maintenance manual as reference during demonstration and training.

3.19 ATTACHMENTS

~~A. Attachment 0 – General Guidelines – Labeling Cable and Pathways (1 page)~~

~~B.~~A. Attachment 1 – MCO Information Technology Outlets (ITO) Wiring Detail REV 12

~~C. Attachment 2 – Labeling Backbone Fiber Optic Cables – Data Field Definitions~~

END OF SECTION 27 10 00

ATTACHMENT 0 - GENERAL GUIDELINES – LABELING CABLE AND PATHWAYS

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

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

- ~~Inner-ducts and cables to be labeled in all pull-boxes, manholes, junction boxes. Labels to be minimum 4IN x 2IN, rated for outdoor use and permanently secured by one tie wrap at each end of label or as approved by GOAA.~~

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

THIS ATTACHMENT CONTAINS TWO DIAGRAMS;
1. WIRING / JACK DETAILS
2. FACE-PLATE LABELING DETAILS

1. Standard GOAA ITO Requirements: Each Information Technology Outlet (ITO) shall be installed with Category Cat 6 cable and hardware. All Category 6 products shall be Category 6 component compliant unless specifically noted otherwise. Each GOAA Standard Outlet is served by three (3) Cat 6 UTP cables to the local GOAA communications room and where applicable an additional three (3) Cat 6 UTP cables to local tenant communication room.

2. GOAA offices ITO requirements: GOAA office ITO shall be installed with L4, L5 and L6 cables. All cables are installed back to a GOAA Communications Room (CR) and to a rack mounted patch panel. L1, L2 and L3 are blanked. Cables may be added in location(s) per project design. If L1, L2 or L3 are added to a GOAA ITO, the bezels are to be blue.

3. Tenant ITO requirements: Tenant ITO shall be installed with *L1, *L2, *L3, L4, L5 and L6 cables. Tenant ITO shall use L1, L2 and L3 as Tenant only cables and shall be cabled to Tenant space, where typically a Tenant has assigned space within their leased locations to place their private LAN or Point of Sale (POS) network electronics.*Cables L1, L2 and L3 (all with green bezels) may be eliminated if Tenant does not require them. If an ITO is installed without cables L1, L2 or L3, blanks shall be placed in each unused faceplate positions. If Tenant requires higher “L” density, Information Technology Outlet Plus (ITOP) can be used.

4. Non-Tenant, non-GOAA office ITO requirements: such as CUTE, CUPPS, counters, bag make-up floor areas, bag make-up controllers/stations, etc.); shall be installed with L4, L5 and L6 cables. All cables are installed back to a GOAA CR and to a rack mounted patch panel. L1, L2 and L3 are blanked. If increased L densities are required, Information Technology Outlet Plus (ITOP) can be used.

5. All GOAA ITO cables shall be installed unbroken back to a GOAA CR as indicated on the drawings, or as directed by the Owner’s Authorized Representative (OAR) and shall be punched down on a GOAA Information Technology patch panel mounted in an open rack. 110 blocks are not to be used for termination. Patch panel locations are to be in accordance with the rack elevations, or as directed by the OAR. All Tenant wiring shall also be installed unbroken end to end.

6. For L1, L2 and L3 jacks / cabling / associated components for Tenant Premise Distribution System (PDS) wiring that has cable staying within Tenant Space and terminated only to Tenant Equipment in Tenant Space; L1, L2 and L3 components specifications are at the Tenants discretion, however it is recommended that GOAA standards be followed.

7. Outlet wire management: all outlet wiring shall have cable management products installed in Work Areas and Communications Rooms; no horizontal wiring shall be self-supporting or supported by tie-wraps to other cables.

8. Cable testing: all cables / jacks installed shall be fully tested in accordance to TIA-568-C.2 and TIA 1152-A requirements by field test devices. Test results SHALL be saved and submitted to Greater Orlando Aviation Authority in a GOAA approved electronic format. GOAA reserves the right to update the electronic format without cost. Testing shall be completed after fiber and copper cabling are in place and secure. Testing shall be submitted to GOAA by Substantial Completion or prior to being put into use, whichever comes first.

9. Information Technology Outlet Plus (ITOP): in some conditions, to increase Tenant LAN jack densities, such as in training rooms, call centers, or similar, (ITOP) may be added to supplement areas served by ITOs. Such applications shall be approved in writing prior to installation. ITOPs shall supplement ITOs, not replace ITOs. Labeling Information Technology Outlet Plus (ITOP) shall follow DIAGRAM TWO in this attachment. Under counter Information Technology Outlets (ITOs) may be side access multi-media outlets in specific designs authorized by Information Technology department.

10. Information Technology Outlet Plus (ITOP): in some conditions the exact configuration of Information Technology Outlets (ITO) fiber and copper connectivity shall vary to accommodate the design intent, such as; Flight Information Displays (FIDs) monitors, Training Centers, multi-purpose kiosks, etc. It’s not the intent of this Information Technology Outlet ITO configuration meet all requirements. In SPECIAL CONDITIONS refer to the Contract Documents or consults with the OAR to obtain written authorization to deviate from this ITO configuration.

11. Cables shall be in hard-wall metallic conduit following GOAA construction specifications section Division 27 or per Project written design requirements. Conduit can be trunk/branch system, following TIA / EIA conduit sizing and maximum degree of bends allowed.

12. For GOAA complete copper and fiber infrastructure design requirements and connectivity components performance specifications see GOAA Master Design Guideline sections 27 10 00 Structured Cabling.

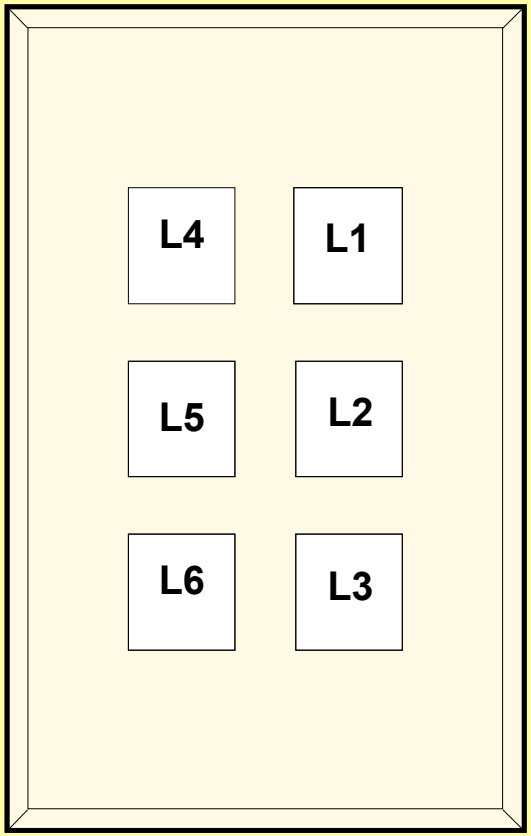
13. Any single wall phone height telephone jacks called for shall have type Cat 6 cable and matching components, and a single position wall phone jack.

DIAGRAM ONE: REQUIRED JACK POSITIONS IN FACE PLATE

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

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

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



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

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

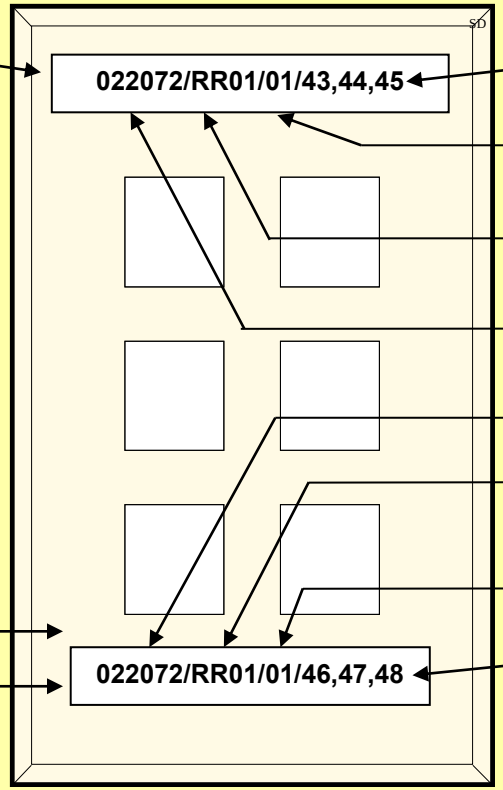
L3 - LAN JACK 568B
- CATEGORY 6
- RJ45
- GREEN BEZEL

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

DIAGRAM TWO: LABELING OF FACE PLATE

No handwritten labels are allowed. Do not remove adhesive backing from typical label printers for under lenses' labels. Insert labels under clear lens top and bottom of outlet as shown below. Do remove backing for L1 and L2 label. See the GOAA Telecommunications Infrastructure Administration Standard (TIAS) for more information on labeling of ITO plates.

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



WHITE LABEL BLACK TYPE ALL CAPS

WHITE LABEL BLACK TYPE ALL CAPS

"L1", "L2", and "L3" Patch Panel

"L1", "L2", and "L3" Patch Panel #

(RR) Relay Rack #, or (CA) Cabinet #, (WM) Wall Mount Rack #, (WO) Wall Mount Outlet #

Cable "L1, L2, L3" Originating Floor and Comm Rm

Cable "L4, L5, L6" Originating Floor and Comm Rm

(RR) Relay Rack #, or (CA) Cabinet #, (WM) Wall Mount Rack #, (WO) Wall Mount Outlet #

"L4, "L5", and "L6" Patch Panel #

"L4", "L5", and "L6" Patch Panel Position #s

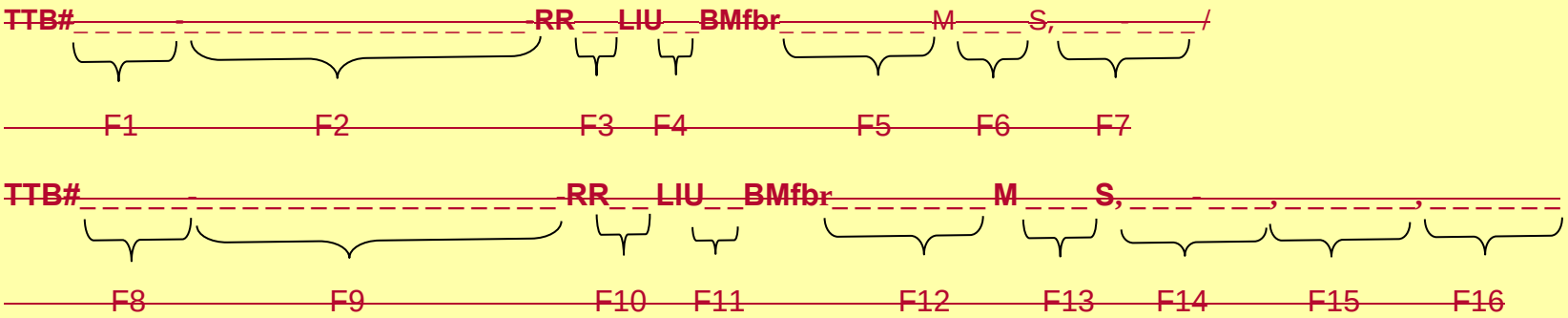
Duplicates of all three labels with adhesive backing removed to be placed side by side on the suspended ceiling metal support runner ("T bar") above the ITO. If the ceiling is higher than normal office space these labels shall be placed on millwork or other above the (ITO) or (SDO) clearly visible without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

012072/RR01/01/46,47,48

012072/RR01/01/44,45

LABELING BACKBONE FIBER OPTIC CABLES – DATA FIELD DEFINITIONS

Physical Layer Administration - Attachment Two R3



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

F1: End 1 TTB# provided by Project and/or GOAA Information Technology Department 5 characters
F2: End 1 Building Area Room Number (Space Designation) provided by GOAA and/or Project, 16 characters
F3: Relay Rack Number (**RR**) 2 characters. If a Cabinet is used, (**RR**) is to be replaced by (**CA**). If LIU being installed for cable is Wall Mount use (**WM**).
F4: Light Interface Unit (**LIU**) 2 characters
F5: Backbone Multi-mode (**BMFBR**), Single Mode (**BSFBR**) or Composite **(BCFBR)** and **U**nique **C**able **I**dentifier (**UCI**) 4 characters. UCI provided by GOAA Information Technology Department.
F6: Fiber strand qty of each type under this one jacket. “3 characters M 3 characters S”. 096M000S denotes 96MM zero SM. 072M096S denotes a Composite cable.
F7: Bulkhead Position Range 3 characters – 3 characters
F8: End 2 TTB# provided by Project and/or GOAA Information Technology Department 5 characters
F9: End 2 Building Area Room Number (Space Designation), provided by GOAA and/or Project, 16 characters
F10: Relay Rack Number (**RR**) 2 characters. If a Cabinet is used, (**RR**) is to be replaced by (**CA**). If LIU being installed for cable is **W**all **M**ount use (**WM**).
F11: Lightguide Interface Unit (**LIU**) 2 characters

~~F12: Backbone Multimode or Single-Mode Fiber (**BMFbr**) or (**BSFbr**) Unique Cable Identifier (UCI) 4 characters. This number provided by GOAA Information Technology Department.~~
~~F13: Fiber strand qty of each type under this one jacket. 096M000S denotes 96MM zero SM. 072M096S denotes a Composite cable. "3 characters M 3 characters S".~~
~~F14: Bulkhead Position Range 3 characters – 3 characters~~
~~F15: Length in feet 6 characters, no commas in number.~~
~~F16: Date Installed 6 characters, date format to be month, day, last two digits of year; "012218".~~

Actual Basis of Design riser label with sample text, printable section. Label is still on backing, ready to be peeled. Line breaks to be as shown.
Brady label p/n PTL-34-427, top margin –0.02460in, left margin +0.01476in, font #6 (point size 10), horiz justify center, vert justify bottom.
Clear laminating tail extends below printable section another 4.5in.

SECTION 27 41 33 - IP MASTER ANTENNA TELEVISION SYSTEM

PART 1 - GENERAL

1.1 STIPULATIONS

A. Project drawings and general provisions of the Contract, including but not limited to all; General and Supplementary Conditions, Division 01 Specification Sections and stipulated Specification Sections shall apply to this and all related Division 27 Specification Sections.

B. Related Sections:

1. Refer to Specification Section 27 05 00 for a complete list of related specification sections.

C. Reference Symbols:

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. The IPTV System shall be an extension of the existing South Terminal C IPTV System.

C. The intent of this specification is to establish a standard of quality, functionality, and features for the installation of an IP-based Master Antenna Television (IPTV) system throughout the STC airside concourse expansion as indicated on the Contract Drawings and specified herein. The IPTV system shall distribute and display broadcast television content obtained from the Authority's service provider, Summit Broadband, on video display monitors throughout the terminal.

D. It is the responsibility of the contractor to ensure that the installed system meets or exceeds every standard set forth in these specifications. The contractor shall provide all fiber/copper outlets, conduits, fiber optic cabling and category 6 cabling as necessary to provide a complete and fully operational IP Master Antenna Broadcast Television (IPTV) distribution system.

1. Refer to Specification Sections 27 05 00 and 27 10 00 and for all TCP/IP based system cabling requirements.

E. The Contractor shall be responsible for providing all cabling, cable terminations, conduits/raceways, racks, cabinets, programming, commissioning, and testing of all network communications cabling in accordance with all related Division 27 Specification Sections.

F. Definitions

1. Refer to Specification Section 27 05 00 for requirements.

1.3 SCOPE OF WORK

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

B. Refer to drawing Sheet TA0.00.03 for the work responsibility matrix for the scope of work required for the IPTV System.

1. Where listed on the responsibility matrix, the following line items shall be defined as follows:
   a. Headend and Software: The IPTV system requires connectivity to the public internet in order to obtain the required video data. The Authority and Authority Vendor shall furnish and install all required active network equipment. The Contractor shall coordinate with the Authority and Authority Vendor to furnish end-to-end cabling connectivity to service IPTV outlets. The Contractor shall also furnish and install all head end audio/visual equipment including fiber optic extender transmitters, networks a/v media players, A/V control system equipment, A/V matrix switchers, and A/V distribution amplifiers.
   b. Integration to Existing System: The Authority will perform all required tasks in order to document and manage the IPTV in the North and South Terminals as a single system. The Contractor shall provide fiber channeling with all materials required to connect the STC airside concourse expansion to the existing NTC and STC systems. The Contractor shall coordinate with the Authority and the Authority Vendor to ensure fiber channeling completion complies with the project schedule. Refer to Backbone Cable below for additional information.
   c. Interfaces: The Authority shall furnish and Authority Vendor shall install all hardware, software, programming, interface devices and appurtenances as required for communication between the IPTV and the Authority Passive Optical LAN (POL) / Local Area Network (LAN) and all terminal systems which require connectivity.
   d. Network Components: Refer to specification section 27 10 05 for requirements. The Authority shall furnish and Authority Vendor shall install all Passive Optical Network components required to support the IPTV system except for passive optical splitters. Refer to Horizontal Cable below.
   e. Backbone Cable: The contractor shall furnish and install all backbone cable, including fiber channeling to achieve the required connectivity to the NTC and STC Phase 1. Contractor shall perform fiber channeling as described in section 27 10 00 and furnish and install all patch cables required for channeling. Coordinate with the Authority and the Authority Vendor to ensure fiber channeling completion complies with the project schedule. Refer to specification section 27 10 00 for additional information.
   f. Horizontal Cable: The contractor shall furnish and install all horizontal cabling and associated raceways/pathways, boxes, fittings and appurtenances. Furnish patch cables for connection of all IPTV set-top boxes at display locations and in communications spaces (IDFs/MDF). Install patch cables at each set-top box location. Includes fiber optic cabling and copper cabling to support ONTs. Contractor shall install patch cable onto patch panel and route cable back to ONTs with the appropriate lengths, and label per GOAA standards. Provide patch panel port and patch panel labeling information to the Authority to perform patching onto the ONTs. Refer to specification section 27 10 00 for additional information.

g. Field Devices: The Authority will furnish and Contractor shall install Set-Top Boxes and Flat Panel Displays. The Contractor shall furnish and install standard off-the-shelf mounts, A/V touchscreen controllers, A/V control cables, audio amplifiers, audio speakers, A/V media panels, fiber optic extender receivers, A/V cables and connectors and all appurtenances. The Contractor shall provide all field patch cables with the appropriate lengths required for field device connection to field outlets

1.4 REFERENCES

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

1.5 SYSTEM DESCRIPTION

A. The IPTV system shall provide the display of broadcast/cable television channel feeds on selected flat panel display monitors in the South Terminal Complex airside concourse expansion. The system shall consist of IPTV tuner modules (“set top boxes”) located at each IPTV display. Set top box make and model shall be as required by the Authority’s service provider. Set top boxes shall obtain television content through the Local Area Network / Passive Optical Network from the content provider’s utility connection.

B. The South Terminal Local Area Network / Passive Optical Network shall be configured to provide the appropriate routing and switching paths from the existing network service provider public wide area network (WAN) connection in the NTC to the set top boxes to be installed in the STC airside concourse expansion.

C. The IPTV system shall receive an initiation signal from the Fire Alarm System (FAS) through the ECS and playback a preset message on the IPTV displays. Refer to Division 27 51 13 and 28 31 00 for more information in addition to the requirements listed below.

1. The Contractor shall coordinate the interface with the FAS through the ECS to provide the functionality.
2. The Contractor shall coordinate with GOAA and create images for multiple emergency announcements. Those may include Weather Event 1, 2, X, evacuation, and similar.

1.6 SUBMITTALS

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

1. Submit a channel plan listing channel numbers and corresponding broadcast network or content.

1.7 QUALITY ASSURANCE

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

1.8 DELIVERY STORAGE AND HANDLING

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

1.9 RECORD DOCUMENTS

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

1.10 OPERATIONS AND MAINTENANCE

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

1.11 SOFTWARE AGREEMENT

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

1.12 SPARE MATERIAL

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

1.13 ENVIRONMENTAL CONDITIONS

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

PART 2 - PRODUCTS

2.1 MANUFACTURED PRODUCTS

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

2.2 SYSTEM REQUIREMENTS

A. The IPTV system shall support all channels made available by the service provider as part of the Authority's subscription, with the capability to support additional channels in the future (minimum of 64 channels).

B. The IPTV system shall meet the following audio/visual formatting requirements

1. Support a minimum of 1920x1080-pixlel full HD resolution at 60Hz refresh rate, as well as other standard resolutions including 480i, 480p, 720p, and 1080i.
2. Support for standard compression formats including, but not limited to MPEG-1, MPEG-2, MPEG-4 Part 10 (AVC/H.264), and others as specified by the service provider.

C. Images and audio shall be free from pixilation, artifacts, noise and other undesirable audible and visual aberrations.

D. All system components shall be fully interoperable and permit future upgrades via software or firmware update.

2.3 FIELD DEVICES

A. Flat Panel Displays

1. Authority shall furnish and Contractor shall install LED-backlit LCD flat displays as shown on the contract documents. Displays shall be commercial/professional-grade, rated for 24/7 use and meet the following requirements:

a. Panel Size: 55" Class Diagonal – 16:9 widescreen aspect ratio.
b. Bezel: 0.9mm or less
c. Panel Technology: In-Plane Switching (IPS)
d. Native Resolution: 1920 x 1080 pixels (Full HD)
e. Brightness: 700 cd/m2
f. Contrast Ratio: 1400:1
g. Dynamic Contrast Ratio: 500,000:1
h. Viewing Angle (Degrees): 178H x 178V

i. Color Depth: 1.06 Billion colors
j. Response Time (Gray-To-Gray, Black & White): 8ms
k. Duty Cycle: 24-7 Continuous Use
l. Orientation: Portrait or Landscape
m. Inputs: HDMI, DisplayPort, DVI-D, OPS, Analog RGB, RS-232C, RJ-45, USB3.0/2.0
n. HDTV Formats: 720p, 1080i, 1080p
o. Outputs: DisplayPort (1.2a/HDCP 1.3), audio, RS-232C, RJ-45
p. Integrated Network/USB Media Player
q. Remote Monitoring and Control GUI

2. Owner Furnished Display is the NEC P555.

B. Set-Top Boxes

1. Authority shall furnish and Contractor shall install an IPTV set-top box tuner for each LCD television monitor. IPTV tuners shall meet the following requirements:
   a. AES 128/256 decryption capable.
   b. Support of network video-on-demand.
   c. Support for MPEG-1/2/4, H.264 and HD IPTV streams.
   d. IR remote control.
   e. Serial RS-232 control.
   f. HDMI video output.
   g. All service provider / carrier requirements.
2. Contractor shall coordinate with the Authority and OAR for exact mounting locations of all LCD television monitors. Furnish and install mounts listed for the application and with sufficient load-bearing capacity to support the selected television monitors. Refer to the Contract Drawings for additional information.
3. Contractor shall provide mounting brackets, hardware and fasteners required to securely mount the set-top box within the monitor mount/housing.

C. Standard Mounts

1. Mounts shall meet the following requirements at a minimum:
   a. Support 40” – 65” displays
   b. Back-to-back mounting for (2) displays
   c. Concealed mounting area for media player / set-top box equipment
   d. Maximum Capacity: 300lb / 136kg
   e. Mount shall be Peerless-AV model #DST965 or approved equal.

D. Hold Room IPTV Sound Bar

1. At each hold room display used to transmit IPTV provide UL listed Sound Bar connected to display and Fiber Optic Extender – Receiver with all required cabling, power, mounting hardware and all other required appurtenances to complete the installation per the contract documents. Audio level of sound bar shall be adjusted and tested by Contractor to 10dB above ambient noise level for the application.
   a. Basis of Design: EXTRON Sound Bar Model #SB 33A 46-55 or approved substitution.
   b. Physical Characteristics

1) Adjustable Dimensions: 6”H x 40”W x 3.9”D to 6”H x 49”W x 3.9”D
2) Weight: 13.1 lbs
3) Enclosure type: Black metal and plastic
4) Mounting: Mount to display with VESA compliant Sound Bar Mounting Kit, Basis of Design is SMK V SB 33. Spacers shall be used as required to provide clearance off of pole/pedestal.
5) Provide with cover p/n SAK BCG SB 33

c. Integrated Audio Amplifier
1) Class D
2) Stereo channel separation: >60dB @1kHz
3) Common Mode Rejection Ratio (CMMR): 74dB @ 1 kHz
4) Signal to noise ratio: >90 dB

d. Audio Input Connections
1) (1) 3.5 mm captive screw connector, 5 pole (main input)
2) (1) 3.5 mm mini audio jack (tip, ring, sleeve)
3) 1 pair female RCA

e. Control Input Connections
1) (1) 3.5 mm captive screw connector, 3 pole
a) +10 VDC, Volume/mute, GND
2) Power Supply
a) Input 100-240 VAC, 50-60 Hz, 4.2A

E. Fiber Optic Extender - Transmitter

1. The fiber optic extender with metal enclosure shall receive an input video signal and extend it over fiber optic cabling to a receiver. The extender shall be High-bandwidth Digital Content Protection (HDCP) compliant using DVI and HDMI standards. Video signals shall achieve pixel for pixel performance. It shall also extend stereo audio signals either via HDMI, or audio embedding and HDMI de-embedding. It shall transmit bidirectional RS-232 control signals. The unit shall manage EDID communication between connected devices.
a. Fanless, convection cooled
b. Video Processing
1) Maximum data rate: 4.25 Gbps
c. Resolution range: 640x480 to 1920x1200, 480p, 576p, 1080i, 1080p at 60 Hz, 2048x1080 at 60 Hz (undersampled)
d. EDID and DDC: Supports Extended Display Identification Data (EDID) and Display Data Channel (DDC) data using DVI and HDMI standards with user selectable factory or custom EDID tables
e. Standards: DVI 1.0, HDMI 1.4, HDCP 1.4
f. Audio:
1) 18 bits per channel sampled at 48 Hz
2) Distortion: <0.1% THD at 1kHz, >80dB S/N from 20 Hz to 20kHz
3) Response: +1 dB/-3dB 80 Hz to 20 kHz at 1W
g. Inputs
1) Audio Video: (1) female Type A HDMI
2) Audio:
a) Signal: (1) unbalanced stereo or (2) unbalanced mono

b) Connectors: 3.5mm mini audio jack
3) Control
a) Signals: bi-directional serial RS-232
b) Connectors: 2.5mm mini stereo jack
4) Control pass through
a) Signals: bi-directional serial RS-232
b) Connectors: 3.5mm 5-pole captive screw
h. Outputs: (2) singlemode fiber optic cables with LC connectors
i. Mounting: 1 RU, quarter width compatible with EIA 310-D standard, 19-inch wide panel mounting. Include all necessary mounting hardware.
j. Power Supply: 100-240 VAC, 50-60 Hz
k. Basis of Design: Extron Foxbox Tx HDMI or approved substitution.

F. Fiber Optic Extender – Receiver

1. The fiber optic extender with metal enclosure shall receive an input video signal from a transmitter and convert it to a standard AV signal. The extender shall be High-bandwidth Digital Content Protection (HDCP) compliant using DVI and HDMI standards. Video signals shall achieve pixel for pixel performance. It shall also extend stereo audio signals either via HDMI, or audio embedding and HDMI de-embedding. It shall transmit bidirectional RS-232 control signals. The unit shall manage EDID communication between connected devices.
a. Fanless, convection cooled
b. Video Processing
1) Maximum data rate: 4.25 Gbps
c. Resolution range: 640x480 to 1920x1200, 480p, 576p, 1080i, 1080p at 60 Hz, 2048x1080 at 60 Hz (undersampled)
d. EDID and DDC: Supports Extended Display Identification Data (EDID) and Display Data Channel (DDC) data using DVI and HDMI standards with user selectable factory or custom EDID tables
e. Standards: DVI 1.0, HDMI 1.4, HDCP 1.4
f. Audio:
1) 18 bits per channel sampled at 48 Hz
2) Distortion: <0.1% THD at 1kHz, >80dB S/N from 20 Hz to 20kHz
3) Response: +1 dB/-3dB 80 Hz to 20 kHz at 1W
g. Inputs: (2) singlemode fiber optic cables with LC connectors
h. Outputs:
1) Audio Video: (1) female Type A HDMI
2) Audio:
a) Signal: (1) stereo/mono balanced/unbalanced
b) Connectors: 3.5mm mini audio jack
3) Control
a) Signals: bi-directional serial RS-232
b) Connectors: 3.5mm 3-pole captive screw connector
4) Control pass through
a) Signals: bi-directional serial RS-232
b) Connectors: 3.5mm 5-pole captive screw

i. Mounting: 1 RU, quarter width compatible with EIA 310-D standard, 19-inch wide panel mounting. Include all necessary mounting hardware.
j. Power Supply: 100-240 VAC, 50-60 Hz
k. Basis of Design: Extron Foxbox Rx HDMI or approved substitution.

G. Networked AV Media Player

1. Provide a commercial network based AV media player to display static images and video on IPTV flat panel displays. The player shall receive updates from the network and retain local files and playback schedule.
2. The media player shall initiate playback based on a signal from the control system with the intent that the FAS will trigger the system through the ECS to display a message on the displays.
   a. Fanless, convection cooled
   b. Media Storage and Playback Formats:
      1) Video:
         a) Codecs: MPEG-1, MPEG-2, H.264 MPEG-4 Part 10, H.265
         b) Containers for FHD content: .ts, .mpg, .vob, .mov, .mP4, .m2ts, .wmv
         c) Containers for 4K content: .ts, .mov, .mP4, .mkv
      2) Images: BMP, JPEG, PNG
      3) Audio: MP2, MP3, AAC, FLAC, OGG, WAV
      4) HTML5
   c. Resolution range: 640x480 to 1920x1200, 480p, 576p, 1080i, 1080p at 60 Hz
   d. Standards: DVI 1.0, HDMI 1.4, HDCP 1.4
   e. Hardware Interface:
      1) Micro SDHC/SDXC slot
      2) (2) Type A USB High Speed
      3) 12-pin bi-directional phoenix GPIO port
      4) 3.5 mm bi-directional serial RS-232
   f. Network: RJ-45 Gigabit Ethernet
   g. Outputs:
      1) Audio Video: (1) female Type A HDMI
      2) Audio:
         a) Signal: (1) stereo/mono balanced/unbalanced
         b) Connectors: 3.5mm mini audio jack
      3) Control
         a) Signals: bi-directional serial RS-232
         b) Connectors: 3.5mm 3-pole captive screw connector
      4) Control pass through
         a) Signals: bi-directional serial RS-232
         b) Connectors: 3.5mm 5-pole captive screw
   h. Mounting: 1 RU, quarter width compatible with EIA 310-D standard, 19-inch wide panel mounting. Include all necessary mounting hardware.
   i. Power Supply: 100-240 VAC, 50-60 Hz

3. Provide fully capable network based software designed to create, publish, and manage media players including. The software shall allow multiple content types to be played in zones on a single display. The software shall include the following.
   a. WYSIWYG drag and drop capabilities and generate live content previews.
   b. Publish updates to groups of media players in batches.
   c. Playlist editor including video, images, audio, HTML5, IP streams, live feeds.
   d. An intuitive calendar including day parting.
   e. Publish with update capabilities and dynamic playlists.
   f. Secure logon with account capability based on user assigned permissions.
   g. Monitor status of players remotely.
   h. Easily distribute presentations to single players, user defined groups of players, or all players at once.
   i. Remotely host and manage content.
   j. Acceptable Manufacturers:
      1) Extron
      2) Crestron
      3) FSR
      4) Or approved substitution.

H. AV Control System

1. Control system processor shall be provided with the required COM ports, IR, serial, relays, inputs and outputs to provide for the control and interface of the IPTV flat panel displays, media players, switches, set top boxes, and other equipment indicated on the block diagram. The units shall be a solid state device. The units shall provide the following:
   a. Interface and programming control of IPTV displays and content selection from the media player from a remote location over the Local Area Network.
   b. Enable all system components to perform remote control operations, programming functions, and interface functions as detailed throughout this Specification with respect to equipment and operational controls.
   c. Ethernet and serial ports with the ability for all ports to operate simultaneously. Infrared receivers shall only be utilized as a last resort when required interface cannot be achieved using a network or RS232 interface.
   d. All required remote power control modules, required relays and I/O ports.
   e. Software to provide system configuration during installation and operations by end users.
   f. The controller shall be capable of the following interface types:
      1) Ethernet
      2) Bidirectional RS-232
      3) Bidirectional RS-422
      4) Bidirectional RS-485
      5) Infrared-serial
      6) Voltage Relay
      7) Other manufacturer specific protocols for submitted devices

g. The AV Controller shall allow the user to manage and maintain the system via a Graphical User Interface. This application shall be able to allow the user to query the available layouts, define new layouts, save the layouts, switch current layouts, preview sources, drag and drop sources, launch applications, and perform other configuration functions.
h. Mounting: one RU, compatible with EIA 310-D standard, 19-inch wide panel mounting. Include all necessary mounting hardware.
i. Power Supply: 100-240 VAC, 50-60 Hz
j. Acceptable Manufacturers:
    1) Extron
    2) Crestron
    3) FSR
    4) Or approved substitution.

I. AV Switch

1. Provide an HDCP compliant AV switch to receive, process, and distribute audio video signals. The switch shall include 1 digital authentication key per physical input and output port to minimize HDCP authentication time.
2. The switcher shall support individual input and output video resolutions up to 4K (4096 x 2160) at 60Hz.
3. The switcher shall include dedicated audio output using built in audio de-embedders.
4. The switch shall include AV control capabilities and be compatible with the specified user control interface.
5. Routing: 2 x 1 switching
6. Video Processing
    a. Maximum data rate: 10.2 Gbps (3.4 Gbps per color)
    b. Digital sampling:
        1) 8 bits per color, 4:4:4 color sampling at 4096x2160 at 30 Hz
        2) 8 bits per color, 4:2:0 color sampling at 4096x2160 at 60 Hz
    c. Colors: 16.78 million
    d. Resolution range: 640x480 to 1920x1200, 480p, 576p, 1080i, 1080p at 60 Hz, 4096x2160 at 30 Hz, 3840x2160 at 30 Hz
    e. EDID and DDC: Supports Extended Display Identification Data (EDID) and Display Data Channel (DDC) data using DVI and HDMI standards. Factory or custom EDID tables are user selectable.
    f. Standards: DVI 1.0, HDMI 1.4, HDCP 1.3
7. Inputs:
    a. Audio Video: (2) female Type A HDMI
    b. Audio: Signal: (1) stereo/mono balanced/unbalanced 3.5mm mini audio jack
8. Outputs:
    a. Audio Video: (1) female Type A HDMI
9. Mounting: two RU, compatible with EIA 310-D standard, 19-inch wide panel mounting. Include all necessary mounting hardware.
10. Power Supply: 100-240 VAC, 50-60 Hz.
11. Acceptable Manufacturers

a. Extron
b. Crestron
c. FSR
d. Or approved substitution.

J. AV Distribution Amplifier (DA)

1. The video distribution amplifier shall process an input AV signal and rebroadcast an identical signal to multiple outputs. The amplifier shall have a user-selectable HDCP authorization option to allow for automatic source signal encryption management. The unit shall allow the AV system to control AV mute of individual outputs.
   a. Routing: 1 x 4 distribution
   b. Video Processing
      1) Maximum data rate: 10 Gbps (3.4 Gbps per color)
      2) Digital sampling:
      3) 8 bits per color, 4:4:4 color sampling at 4096x2160 at 30 Hz
      4) 8 bits per color, 4:2:0 color sampling at 4096x2160 at 60 Hz
      5) Resolution range: 640x480 to 1920x1200, 480p, 576p, 1080i, 1080p at 60 Hz, 4096x2160 at 30 Hz, 3840x2160 at 30 Hz
      6) EDID and DDC: Supports Extended Display Identification Data (EDID) and Display Data Channel (DDC) data using DVI and HDMI standards. Factory or custom EDID tables are user selectable.
      7) Standards: DVI 1.0, HDMI 1.4, HDCP 1.4
   c. Inputs:
      1) Audio Video: (1) female Type A HDMI
   d. Outputs:
      1) Audio Video: (4) female Type A HDMI
   e. Control:
      1) Bi-directional serial RS-232
   f. Mounting: one RU one quarter wide, compatible with EIA 310-D standard, 19-inch wide panel mounting. Include all necessary mounting hardware.
   g. Power Supply: 100-240 VAC, 50-60 Hz
2. Acceptable Manufacturers:
   a. Extron
   b. Crestron
   c. FSR
   d. Or approved substitution.

K. AV Touchscreen Controller

1. 10” color touch screen shall be provided. The units shall offer two-way operation to allow for visual control feedback of system status. The units shall be provided with sufficient internal memory and light and motion sensors to sense activity and illuminate buttons/screen. The screen shall upload and download touch panel pages and graphical objects using supplied control system software. The screen shall include all jacks, adapters and panels required to install and mount the unit and its control interfaces.

2. The design of the color touch panel “pages” and menu system shall be coordinated with and approved by the Employer. The Contractor shall include cost to create unique touch panel pages for each touch screen location. Refer to attachments at the end of this Section for additional Employer requirements. Control functions shall be programmed and stored for simplified operations including, but not limited to:
   a. System power on/off.
   b. Video, computer and audio source selection and routing.
   c. Media Player transport controls (play, stop, fast forward, etc.).
   d. Flat Panel display controls (on/off, source select, volume control, etc.).
   e. Multi Window Processor presets
   f. Video projector controls (on/off, standby, source select, etc.).
   g. Video blanking/mute
   h. Projector screen and lift control.
   i. Audio teleconferencing external RS-232 controller.
   j. Lighting control functions.
   k. More detailed controls including direct and breakaway routing switcher controls shall also be made available for technical personnel at the color touch panel.
3. Assembly, installation and setup shall be done according to instructions provided by the manufacturer.
4. All cables, adapters, and converters to connect the touch screen to the AV controller shall be provided as part of this project.
5. Mounting: Freestanding tilting table dock with locking features.
6. Power supply: low voltage cabling routed to power supply located in the AV Cabinet
7. Control: Dock shall utilize manufacturer specific control over Ethernet (RJ45 connector).
8. Finish: matte black.
9. Acceptable Manufacturers:
   a. Extron
   b. Crestron
   c. FSR
   d. Or approved substitution.

L. Cables and Connectors

1. HDMI Cables
   a. Provide professional grade HDMI cable with cable equalizer for all HDMI cables routed over 25 feet.
   b. Maximum data rate: 18.0 Gbps (6.0 Gbps per color)
   c. Digital sampling:
      1) 8 bits per color, 4:4:4 color sampling at 4096x2160 at 60 Hz
   d. Colors: 16.78 million
   e. Resolution range: 640x480 to 1920x1200, 480p, 576p, 1080i, 1080p at 60 Hz, 4096x2160 at 30 Hz, 3840x2160 at 30 Hz

f. EDID and DDC: Supports Extended Display Identification Data (EDID) and Display Data Channel (DDC) data using DVI and HDMI standards. Factory or custom EDID tables are user selectable.
g. Standards: DVI 1.0, HDMI 2.0b, HDCP 2.2
h. Skew: <200 ps per 8m for 25' cable construction
i. Connectors: pre-manufactured cable with male to male single link HDMI HDCP compliant Type A.
j. Attenuation:
   1) 2.465-4.125 GHz, <20 dB per 6m
   2) 4.125-5.1 GHz, <25 dB per 6m
k. Material: gold plated connectors, tinned copper conductors with tinned copper drain wire and overall PVC jacket with aluminum/mylar and tinned copper braid shielding.
l. Minimum conductors and drain wire 22 AWG.
m. Minimum UL listed CM cable.
n. Connectors: 2.46" x 0.80" x 0.60", coordinate all installation locations and pathways prior to construction to ensure sufficient space and pathway sizes to pull the manufacturer terminated cables. Bend radius shall be 4.5".
o. Cable Equalizer: Provide equalizer from the cable manufacturer.
   1) The equalized shall ensure full video signal at the distances required by the final installation.
   2) The equalizer shall ensure clear, reliable signals by actively equalizing poor or marginal signals, and reducing jitter and skew.
   3) Equalizer shall be compact, rack mounted 1 RU tall, 1/8 RU wide.
   4) Provide all mounting, power, and connectivity required for the equalizer.

2. Audio Signal Cables: Balanced Mono
   a. Cable shall be used to distribute balanced mono audio signals from field input devices to the audio processing headend.
   b. Rating: UL 725, Listed for plenum applications
   c. Conductor: (2) min. #20 AWG, solid tinned copper conductors, overall shield, drain wire, and insulated as required for application.
3. Audio Signal Cables: 70V Mono
   a. Cable shall be used to distribute amplified audio signals to 70.7 V speakers.
   b. Rating: UL 725, Listed for plenum applications
   c. Conductor: (2) min. #18 AWG, solid tinned copper, insulated as required for application.

PART 3 - EXECUTION

3.1 COORDINATION

A. In addition to the requirements of Specification Section 27 05 00, comply with the following.

B. Coordinate Work of this Section with the requirements of the Authority's television service provider.

C. Coordinate the work of this contract with the work of the Authority and all Authority Vendors. Schedule all work to ensure that the work of the Authority and all Authority Vendors can proceed in accordance with the Project Schedule.

D. Site Preparation

1. In addition to the Shop Drawing Requirements in section 27 05 00, the Contractor shall present a field mockup for approval to the OAR prior to installing the remaining IPTV locations. The field mockup shall include all power and data outlet locations, cable management and routing, component placement, and display mounting.
2. Any work performed onsite regarding conduit and cable installation, floor penetrations, display mounting, component placement etc. related to the IPTV display deployment performed before the shop drawing and field mockup approval will be at the sole risk of the Contractor.

3.2 EQUIPMENT PROTECTION

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

3.3 WORK PERFORMANCE

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

1. Refer to related specification sections for additional project coordination requirements. In addition to the requirements defined in this specification section, the contractor shall coordinate and meet all requirements addressed in Division 26, Division 27 and Division 28 specification sections.
2. The Contractor shall provide all end-user cabling and connectivity components for interconnection of system equipment. This shall consist of, but not be limited to:
   a. The installation of fiber optic/copper cabling from communications rooms (IDFs/MDFs) to all ONTs supporting IPTV set top boxes.
   b. The installation of Category 6 UTP patch cords for interconnection from ONTs to set top boxes.
   c. The installation of single mode fiber optic and Category 6 UTP patch cords in communications rooms to connect equipment associated with the IPTV system.
   d. The installation of video cables from Set-Top Boxes to Video Displays.
   e. The installation of all AV control cabling.

3.4 EQUIPMENT INSTALLATION

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

3.5 COMMUNICATIONS CABLING REQUIREMENTS

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

3.6 ELECTRICAL POWER DISTRIBUTION

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

3.7 TRANSIENT VOLTAGE SUPPRESSION

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

3.8 GROUNDING AND BONDING

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

3.9 EQUIPMENT IDENTIFICATION

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

3.10 MAINTENANCE & SERVICE

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

3.11 WARRANTY

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

3.12 FIELD SERVICES

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

3.13 TRAINING

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

3.14 PROJECT CLOSEOUT REQUIREMENTS

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

END OF SECTION 27 41 33

SECTION 27 53 10 - DISTRIBUTED ANTENNA SYSTEM CELLULAR

PART 1 - GENERAL

1.1 STIPULATIONS

A. Project drawings and general provisions of the Contract, including but not limited to all; General and Supplementary Conditions, Division 01 Specification Sections and stipulated Specification Sections shall apply to this and all related Division 27 Specification Sections.

B. Related to Specification Section 27 05 00 for referenced related specification sections.

C. Reference Symbols:

1. All device symbols are defined by the appropriate symbol schedule on the symbols and abbreviations sheet in the systems drawing package. Not all device symbols indicated may be required for the project.
2. Because of the scale of the drawings, symbols are shown on drawings as close as possible to the mounting location. Coordinate exact locations with all drawings and affected trades prior to submittal of shop drawings.
    a. Coordinate exact locations with all security and telecommunications drawings and site plan drawings as well as all affected trades prior to submittal of any shop drawings.

D. Abbreviations:

1. Refer to Specification Section 27 05 00 for requirements.

E. Definitions:

1. Refer to Specification Section 27 05 00 in addition to the following:
    a. Acceptance: Expressed approval by the customer
    b. Active: DAS components that require AC/DC power for operation
    c. Carrier Approval: Expressed approval to interconnect to the WSP macro network
    d. Channel: A path for an RF transmission between two points
    e. Component: A main system element of the DAS
    f. Contractor: The prime contractor bidding the project
    g. Passive: DAS components that do not require AC/DC power for operation

1.2 SUMMARY

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

B. This Section describes the technical and performance criteria for deploying an independent Distributed Antenna System (DAS) for Wireless Service Providers (WSP) for Cellular Telephones. This system will make use of a collection of omni directional and directional antennas to provide coverage throughout the STC airside concourse expansion and in all applicable private and public areas and service passages. The system will make use of RF over fiber which digitizes the RF signal and passes it over the fiber optic backbone cabling. This configuration will allow for the signal to be passed further without amplification and will reduce the interference suffered in the application radio bands.

1. The intent of this document is to establish the design criteria which shall be adhered to by Authority's Cellular Distributed Antenna System designer and all contractor's responsible for the delivery and proper installation of the DAS.
   a. The Authority's Cellular DAS vendor shall be responsible for the application, design and configuration of the system and shall be based on an extension of the DAS system installed as part of the STC Phase 1 project procured under a separate contract.
   b. The Contractor shall be responsible for coordination with the Authority's DAS vendor for final placement of all elements as well as coordination with any other wireless systems.

C. This Section includes the following:

1. The DAS components specified in this document shall include but not limited to:
   a. Donor Antennas
   b. Coaxial Cabling, Connectors, Attenuators and Loads.
   c. RF Circulators, Splitters, Combiners, Couplers, RF Switches, Filters and Diplexers,
   d. Fiber-Optic Cable, Fiber-Optic Connectors, Fiber-Optic Jumpers,
   e. Bi-Directional Amplifiers (BDA),
   f. Fiber-Optic Cable, Fiber-Optic Connectors, Fiber-Optic Jumpers,
   g. Fiber-Optic Master Unit and Fiber-Optic Remote Units.

1.3 SCOPE OF WORK

A. Comply with the requirements of Specification Section 27 05 00 in addition to the following:

1. Requirements set forth by Orlando first-responder radio communications requirements, and/or the Authority's shall supersede the requirements described herein and shall be met in their entirety. It is the Authority Vendor's responsibility to ensure that the DAS complies with local code, ordinances or requirements established by the Authority.
2. The following Standards contain provisions, which, through reference in this text, constitute provisions of this Standard. All standards are subject to revision, and parties to agreements based on this standard are encouraged to investigate the possibility of applying the most recent editions of the standards referenced below. Included with all references to Regulatory Documents within this document, the most recent editions are required to be adhered to for all Scopes of Work.
   a. RUS Standards (formerly REA)
   b. Local State Uniform Fire Prevention and Building Code.
   c. Local State Department of Labor Rules and Regulations
   d. Association of Public Safety Communications Officers (APCO) "Avoiding Interference Between Public Safety Wireless Communications Systems and Commercial Wireless Communications Systems at 800 MHz"
   e. Code of Federal Regulations (CFR) [Telecommunications] Title 47 Part 90
   f. Code of Federal Regulations (CFR) [Telecommunications] Title 47 Part 15
   g. Wireless Communications Principles and Practice, current edition
   h. Motorola R-56

B. Refer to contract drawing sheet T0.00.03 for the work responsibility matrix for the scope of work and responsibilities required for the Distributed Antenna System.

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

1. Headend and Software: Authority Vendor shall furnish, install, and program all required headend equipment and software including, but not limited to any servers, management/administrative software, software licenses, and components which serve the purpose of performing system-wide coordination, monitoring, data processing, control and other global functions. This includes but is not limited to: base station interface, head end units, remote units, donor antennas, and radio consoles.
2. Integration to Existing System: Authority Vendor shall provide all hardware, software, wiring, cabling, programming, protocol converters, interface devices and appurtenances as required to extend the physical or logical scope of an existing system, or to incorporate a new or disparate system into an existing system. This includes but is not limited to interfaces to base stations or extensions of existing connectivity to extend DAS coverage.
3. Interfaces: Authority Vendor shall provide all system interfaces including, but not limited to 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. This includes but is not limited to: FAS, UPS/BMS and power monitoring if not done through the FAS.
4. Network Switch: Refer to specification section 27 05 00 for requirements. Coordinate network programming requirements with GOAA IT when required. Contractor shall coordinate patching into the network with GOAA.
5. Backbone Cable: Refer to specification section 27 10 00 for requirements. Contractor shall furnish and install all conduit boxes, fittings, pathways and raceways. The Authority Vendor shall furnish and install intra-building cable and fiber. The DAS requires dedicated fiber optic backbone cabling between headend units and remote end units. The furnishing and installation of the dedicated fiber optic cabling in support of the Cellular DAS shall include the following:
   a. Fusion splices will be required by the Contractor Vendor in the Airside Concourse MDF. The Contractor Vendor shall be responsible to test DAS Fiber from the Airside Concourse IDF rooms to termination point in the South APM Cellular Radio Room.
   b. Fusion splices will be required by the Contractor Vendor in the Landside Terminal MDF. The Contractor Vendor shall be responsible to test DAS Fiber from the Landside IDF rooms to termination point in the South APM Radio Room.
6. Horizontal Cable: Contractor shall furnish and install all pathways, conduit, access hatches, termination equipment, communication room fittings, grounding and labeling included in this specification section. Horizontal cabling shall be furnished and installed by the GOAA Vendor. Horizontal cable includes the segment of the premises distribution system that provides connectivity from communications rooms to field devices. This includes all conduit, access hatches, and coaxial cable to connect to field devices. Antenna locations noted on the drawings must be confirmed by the Contractor and conduit must be installed prior to any antenna being mounted.

7. Field Devices: Authority Vendor shall furnish and install data outlets, testing, labeling, and all other work included in this specification section. This includes but is not limited to: omni or directional antenna, coaxial splitters, combiners, and filters as required. Contractor shall ensure the final location of all field devices is coordinated will all other wireless disciplines and proper coverage studies are conducted by the Authority Vendor for final mounting locations. Contractor is responsible for all conduit as required for the connection of field devices.

1.4 REFERENCES

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

1.5 SYSTEM DESCRIPTION

A. The Distributed Antenna System specified herein provides coverage throughout the terminal and other public areas for cellular frequencies via a system of spatially separated antenna nodes. The system will consist of a Head End Unit (HEU) which connects to Remote End Units (REUs) via fiber optic cabling. The REUs will feed antenna placed throughout the terminal and related public areas providing cellular coverage while mitigating interference.

1.6 SUBMITTALS

A. Refer to Specification Section 27 05 00 in addition to the following requirements:
   1. Contractor shall coordinate with Authority Vendor to obtain all submittal documents prior to final submittal.
   2. Submittals shall include, but not be limited to:
      a. Product Data: Submit manufacturer datasheets for the following components:
         1) Donor and Coverage Antennas
         2) Coaxial Cable and Connectors
         3) Coaxial Attenuators and Loads
         4) RF Circulators
         5) Splitters, Combiners and Couplers
         6) RF Switches
         7) RF Filters and Diplexers
         8) Bi-Directional Amplifiers (BDA)
         9) Master Unit
         10) Remote Units
      b. Shop Drawings: Submit the following items:
         1) Overlay of system Components on floor plans
         2) RF Propagation Analysis and Link Budget
         3) Drawings for Donor Antenna and Grounding
         4) Drawings for Rack Elevations
         5) Bill-of-Material (BOM)
      c. Submittal Requirements Prior to Start of Construction
         1) Final RF link budget
         2) Overlay of system Components on floor plans
         3) Drawings for Donor Antenna and grounding
         4) Drawings for Rack Elevations

5) RF propagation modeling
6) Signal to Noise Interference Ratio (SNIR) Map
7) In-band Interference Analysis
8) Bill-of-Material (BOM)
9) Maintenance Service Contract
10) Statement of Work (SOW): The contractor shall submit a SOW that has been accepted by the customer or customer's designated representative.
11) Acceptance Test Plan (ATP): The contractor shall submit an ATP that has been accepted by the customer or customer's designated representative.

d. Submittal Requirements at Close Out
1) Drawings: Submit as-built drawings indicating:
2) Donor antenna, grounding and lighting protection details
3) Cable routing, splitters, couplers and coverage antenna locations
4) Active component locations, layout and configuration

e. Test Reports
1) WSP DAS: Submit accepted ATP reports confirming the requirements have been met.
2) Field Reports: Submit testing results for all cable runs.
3) Field Reports: Submit OTDR test results for all fiber runs.
4) Operation and Maintenance Data: Submit hardware and software manuals for all Active Components.
5) Warranty Documents:
a) Submit for all manufactured components specified in this Section.
b) Submit Vendor's System Warranty.
c) Submit Manufacturer's Extended Warranty

f. Antenna location shop drawings: Antenna locations indicated on the drawings are approximate and final determination shall be made by the Authority Vendor based on calculations using the performance characteristics of the Authority Vendor's proposed system. In addition coordination must be done with all providers of the Public Safety DAS and 460 MHz DAS systems (if kept separate) to ensure antenna locations do not create interference with other systems operating in the same frequency range. This includes coordination with WiFi design for WAP locations. All coordination must be done before shop drawings are submitted. Coordination includes identifying required conduit for all field devices and horizontal and vertical cabling. Contractor shall be responsible for coordination between DAS Vendors. Contractor shall submit revised antenna location shop drawings.

g. DAS coverage prediction maps: Authority Vendor must perform an analysis of the coverage offered by the DAS in-building antenna locations submitted in the antenna shop drawings. DAS coverage prediction maps should account for all other DAS devices including (but not limited to) Public Safety DAS antenna, and 460 MHz antenna (if designed separately from the Public Safety DAS). The coverage prediction maps must ensure the required isolation is achieved to ensure proper operation of the both the public safety DAS system as well as any other DAS system. Coverage prediction maps shall be submitted prior to the start of system installation, including any conduit installation to antenna locations. Installation shall not proceed until submittal has been approved by the Authority and Owner Authorized Representative (OAR). Contractor shall ensure all conduit required to support field devices is installed prior to device installation.

B. Submit system documentation:

1. This Section requires complete documentation of the DAS for the purpose of system operation and maintenance during and after the Warranty period. It is intended that the operation and maintenance manuals be exhaustive in the coverage of the system to the extent that they may be used as the sole guide to the troubleshooting, identification, and repair of defective parts. All documentation, as described here-in shall be submitted to the Authority and OAR for approval sixty (60) days prior to final submission. Authority Vendor shall supply all required documentation to the Contractor prior to submittal deadlines. The Contractor shall be responsible for coordination with the Authority Vendor to obtain necessary documentation as well as submitting all documents to the Authority.
2. These manuals shall include basic wiring diagrams, schematics, and functional details such that any component, wire, or piece of equipment in the system may be easily identified by going to the actual equipment and making reference to this manual. It is required that everything in the system be neatly labeled and easily identifiable. Every terminal, wire, component, or piece of equipment, and other such items shall have a number or letter designation. All of these identification characteristics shall be included in the maintenance and operation manuals.
3. The maintenance manual requirement of this Section is in addition to Shop Drawing requirements. Maintenance manuals and Drawing sets shall be compiled after system fabrication and testing, and shall incorporate any changes made after Shop Drawing submittal. The maintenance manuals and drawing books shall be permanently bound in hard plastic covers.
4. Maintenance Manuals, Manufacturer's Literature: Provide manufacturer's standard literature, covering all equipment included in the system. The maintenance manuals shall contain specifications, adjustment procedures, circuit schematics, component location diagrams, and replacement parts identification. All references to equipment not supplied on this Project shall be crossed out.

5. As Built Documentation: The as built documents shall be produced with current version of AutoCAD and the electronic files shall be provided to the Authority at the completion of the Project on CD-ROM. Provide component identification and cross reference on the Drawings to allow the Authority and (OAR) to understand the function of each item (the block diagram), find the room where the device is mounted (Contract Document plans), find its location in a rack (Arrangement Drawings), find how it is wired (wiring diagrams), and its detailed Specifications (vendor data sheets), and how to repair it (spare part lists). Include the following drawings as a minimum:
   a. System Block Diagram: This drawing shall depict the final DAS overview, including equipment types, location, and any special information. Final gain settings on all amplifiers in the system shall be recorded.
   b. System Riser Diagram(s): These drawings shall show all DAS components, wire numbers, color codes, pin numbers, component locations and connections, depicting the "as-built", final configuration.
   c. Rack / Wall Elevation and Wiring Diagram(s): The elevation diagrams shall depict the front views of the equipment racks and wall fields identifying all equipment installed within. Complete wiring diagrams of the rack / wall equipment shall also be included.
   d. Floor plans of the communications room showing the location of all equipment affected as a part of this contract within the telecommunications room and throughout the building.
   e. Wiring Diagrams: Provide wiring diagrams showing all field installed interconnecting wiring. Wire identification on the diagrams shall agree with the wire markers installed on the equipment.
6. System Administrator Documentation: Supply three (3) hardcopies of administrator documentation and one (1) copy of the documentation in PDF format on CD-ROM that detail the operation of the system. This documentation shall provide complete information on the configuration, business rules, operation, maintenance, and trouble-shooting of the system.

C. Submit a list of test equipment proposed for use in verifying installed performance of the system. Submit factory documentation showing test equipment has been calibrated within the last 12 months.

D. Submit test report documentation.
   1. Electronic and hardcopy versions of test reports shall be submitted together.
   2. Acceptance testing documentation showing the received signal strength index as well as signal-to-noise ratio at predefined locations.

E. Warranty: Copy of the hardware and software warranty certifying that the final as-built installation is fully warranted by the manufacturer. See Section 1.11 for warranty requirements.

F. Training materials: Submit training materials for review and approval at least two weeks before the start of scheduled training.

1.7 QUALITY ASSURANCE

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

B. Contractor and Authority Vendor Qualifications: Submit written proof that the following experience requirements are being met.

1. The Authority Vendor shall be certified by the manufacturer of the products, adhere to the engineering, installation and testing procedures and utilize the authorized manufacturer components and distribution channels in provisioning this Project.
2. All members of the installation team shall be certified by the manufacturer as having completed the necessary training to complete their part of the installation. Resumes of the entire team shall be provided along with documentation of completed training courses. Testing must be performed by an FCC licensed technician. Submit resume and copy of technician's license.
3. A Technical resume of the Authority Vendor and Contractor's Project Manager and Field Supervisor documenting a minimum of five (5) years' experience installing similar size projects.
4. Matching documentation for any Sub-Contractor who will assist the Contractor or Authority Vendor in performance of this work.

C. Manufacturer: The manufacturing company specializing in producing products specified in this Section shall have a minimum of five years' experience in producing the products.

1.8 DELIVERY STORAGE AND HANDLING

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

1.9 RECORD DOCUMENTS

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

1.10 OPERATIONS AND MAINTENANCE

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

1.11 SOFTWARE AGREEMENT

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

1.12 SPARE MATERIAL

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

PART 2 - PRODUCTS

2.1 MANUFACTURED PRODUCTS

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

2.2 SYSTEM REQUIREMENTS

A. The Contractor shall be responsible for coordination with Authority Preferred DAS Vendor to ensure the system meets all requirements listed below.

B. The DAS shall deliver usable signal over the coverage areas defined in the Drawings.

C. Coverage is defined as providing 99% coverage for talk-out and talk-in reliability for all elevator shafts, egress stairways, electrical/mechanical rooms, and baggage handling areas, fire department command center areas surrounding fire standpipes arrival and departure drop-off areas, as well as all apron and aircraft operations areas. All public access areas such as airline operations rooms, airline club lounges, restrooms, departure and arrival halls, baggage claim areas etc. shall be provided with coverage of 97% for both talk-out and talk-back reliability.

D. Reliability for voice radio is defined as a usable signal level as defined below and Delivered Audio Quality (DAQ) of 3.4 at 97% or 99% of the samples taken within the above defined coverage areas.

E. Usable signal is defined as receive signal strength 10dB greater than receive sensitivity of the mobile device or the minimum downlink receive signal levels (RSL) and reference signal receive power (RSRP) levels defined within this section, whichever is greater.

F. WSP DAS:

1. On a per channel basis, the WSP DAS downlink RSL and RSRP for each frequency band shall meet or exceed the criteria in Table 1.

Table 1. System Parameters

Parameters	**Unit**	**700 MHz LTE**	**Cellular, PCS, AWS**
Minimum downlink receive signal level (RSL), non-LTE	dBm	**N/A**	**-85**
Minimum Reference Signal Receive Power (RSRP), LTE only	dBm	**-95**	**-105**

2. S state the assumed channel loading and frequency bands for the proposed WSP in-building coverage. Prior to installation, contractors shall confirm the channel loading and frequency use in the serving area, and shall guarantee coverage for these channels per the criteria in Table 1.
3. Provide an In-band Isolation Analysis that describes the design methods used to avoid downlink and uplink interference.
4. The DAS shall be capable of upgrade, without additional hardware or software, to allow for changes to system frequencies within the deployed frequency band in order to maintain radio system coverage as originally designed.
5. WSP Approval: P provide the WSP with information each WSP requires to approve interconnection of the DAS to the WSP's macro network.
6. All remote amplifiers shall be powered with a minimum of 30 minutes of backup power in the event of an outage.

7. All active components and UPS units shall be monitored by an SNMP based Network Management system.
8. The WSP DAS shall be designed with consideration of future growth and integrating emerging technologies (e.g. 5G).

2.3 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

B. DAS Equipment

1. Commscope (Andrew)
2. TE Connectivity
3. Corning MobileAccess
4. SOLiD Technologies

C. Repeaters

1. Commscope (Andrew)
2. Corning MobileAccess
3. Or approved substitution

D. Antennas

1. Andrew
2. MaxRad
3. Cellmax
4. Mars
5. Huber-Shuner

E. Feeder and Distribution Coaxial Cable

1. Andrew, or approved substitution

2.4 DAS EQUIPMENT

A. Donor Antennas: Donor Antennas shall feature a multi-band design where possible, accommodating the applicable service frequencies in a single small antenna.

1. Electrical:
   a. Frequency bands: As proposed by the DAS designer to meet the performance specifications in this Section.
   b. Gain: As proposed by the DAS designer to meet the performance specifications in this Section.
   c. Maximum input power: Minimum 6 dB margin over composite broadband power levels proposed to meet the performance specifications in this Section.
   d. Polarization: As determined by WSP AHJ base stations
   e. Front-to-back ratio: As proposed by the DAS designer to meet the performance specifications in this Section.
   f. Impedance: 50 Ω
   g. Azimuth Pattern: As proposed by the designer to meet the performance specifications in this Section.
2. Mechanical:

a. Radom material: UV-protected ABS
b. Pigtail cable: RG58, plenum rated
c. Connector: 50 Ω N Type Female
d. Mounting: Pole

3. Environmental:
a. Temperature: -40 °C to +60 °C
b. Lighting protection: Direct ground
c. Waterproof level: IP 66
d. Wind Speed, maximum: 125 mph

4. Approved Manufacturer: Andrew DB498-PS or approved substitution.

B. Omni-Directional Coverage: Omni-Directional Coverage antennas shall feature a multiband design, accommodating multiple frequency bands in a single small antenna.

1. WSP Frequency Band:
a. Frequency Band: 698 – 894 MHz, 1710 – 1755 MHz, 1850 – 1990 MHz, 2110 – 2155 MHz
b. Gain: ≥ 1.5 dBi
c. Maximum input power: Minimum 6 dB margin over composite broadband power levels proposed to meet the performance specifications in this Section.
d. Impedance: 50 Ω
e. Beamwidth, Horizontal: 360° omnidirectional

2. Mechanical:
a. Connector: 50 Ω N Type Female
b. Mounting: Thru-hole ceiling mount
c. Radome material: ABS, UV resistant
d. Pigtail cable: KSR195, plenum rated

3. Environmental:
a. Application: Indoor
b. Operating Temperature: 40 °C to +60 °C (40 °F to +140 °F)
c. Relative Humidity: Up to 100%

4. Regulatory Compliance/Certifications: RoHS 2002/95/EC
5. Approved Manufacturer: SOLiD/Commscope/or approved substitution.

C. Directional Coverage Antennas: Directional coverage antennas shall feature a multiband design, accommodating multiple frequency bands in a single small antenna. Specifications are identical to those for Omni-Directional indoor antennas with the exception of Gain and Beam-width.

D. Fiber-Optic Cable and Connectors:

1. General Specifications:
a. Fiber optic cable shall be Single-mode, type OS2 and use standard colored tight-buffered construction.
b. Designed for point-to-point applications as well as mid-span access, and shall provide a high-level of protection for optical fiber installed in interior building environments.
c. Higher optical fiber count cables shall utilize a sub-unitized design with color-coded subunits for easy identification.

d. The single-mode optical fiber shall be dispersion-unshifted optical fiber that meets ITU-T G.652c standards.
e. Cable shall provide optimum performance over entire wavelength range from 1260 to 1625 nanometers.
f. Cable shall support new and emerging applications that utilize extended E band, 1360 to 1460 nanometers.
g. Cable shall also support existing and legacy single-mode applications that traditionally operate in 1310 and 1550 nanometer regions.
h. Cable shall deliver a cost-effective upgrade path by expanding available wavelengths by 50 percent supporting 16 Channels of coarse wave division multiplexing (CWDM) on a single optical fiber and up to 400 Channels of dense wave division multiplexing (DWDM) on a single cable.
i. Fire ratings: Plenum

E. Fiber-Optic Pigtails:

1. General Specifications:
a. To maintain channel integrity, optical fiber patch cords and pigtails shall be fabricated to meet the performance parameters corresponding to the optical fiber cable approved product type specified below.
b. Patch cord and pigtail plug connectors shall be equipped with boots, and shall have same colors as related optical fiber backbone cables, unless specified or indicated otherwise.
c. Pigtails shall be fusion spliced to incoming backbone cables; mechanical splices shall not be acceptable. All connectors shall be factory-connectorized with pigtails; field-connectorized terminations shall not be acceptable.
d. Optical fiber patch cords and pigtails shall be available with the following options as specified or indicated:
1) Termination types: SC-APC
2) Connector/cable configuration: Simplex
3) Fire ratings: Riser, plenum and/or LSZH
4) Pigtails: Ruggedized and tight-buffered optical fiber—0.9 millimeters (0.035 inches) outside diameter
5) Lengths: As specified or indicated
6) Approved Manufacturer: CommScope RFT-01RF09-8W-SCA-XX, single reinforced buffered 900 µm, LightScope ZWP single-mode fiber, angled polished connector or equivalent.

F. Air Dielectric, Plenum Rated Coaxial Cable:

1. Material Characteristics:
a. Jacket: Halogenated, Fire-Retardant
b. Outer Conductor Material: Corrugated Aluminum or Corrugated Copper
c. Inner Conductor Material: Copper-Clad Aluminum Wire
2. Electrical Characteristics:
a. Impedance: 50 ± 2.0 Ω
b. Frequency Band: 1 - 8800 MHz
c. Peak Power Rating: ≥ 40.0 kW
3. Mechanical Characteristics:
a. Diameter Over Jacket: ≤ .627 in
b. Minimum Bending Radius: ≤ 5 in
c. One Time Minimum Bending Radius: ≤ 3 in

4. Attenuation Characteristics:

Frequency (MHz)	Attenuation (dB/100ft)
150	≤ 0.848
450	≤ 1.53
800	≤ 2.105
2000	≤ 2.105

Standard Conditions: VSWR 1.0, ambient temperature 20 °C (68 °F)

5. Approved Manufacturer: Andrew HL4RP-50A, AL4RPV-50A or equivalent.

G. Foam Dielectric Coaxial Cable:

1. Material Characteristics:
   a. Jacket: Non-halogenated, Fire-Retardant Polyolefin
   b. Outer Conductor Material: Corrugated Copper
   c. Inner Conductor Material: Copper-Clad Aluminum Wire or Copper Tube
2. Electrical Characteristics:
   a. Impedance: 50 ± 1.0 Ω
   b. Frequency Band: 1/2” Nominal: 1 - 8800 MHz, 7/8” Nominal: 1 - 5000 MHz
   c. Peak Power Rating: ≥ 40.0 kW
3. Mechanical Characteristics:
   a. Diameter Over Jacket: 1/2” Nominal: ≤ .630 in, 7/8” Nominal: ≤ 1.1 in
   b. Minimum Bending Radius: 1/2” Nominal: ≤ 5 in, 7/8” Nominal: ≤ 10 in
   c. One Time Minimum Bending Radius: 1/2” Nominal: ≤ 2 in, 7/8” Nominal: ≤ 5 in
4. Attenuation Characteristics: 1/2” Nominal

Frequency (MHz)	Attenuation (dB/100ft)
150	≤ 0.815
450	≤ 1.447
800	≤ 1.968
2000	≤ 3.251

Standard Conditions: VSWR 1.0, ambient temperature 20 °C (68 °F)

5. Attenuation Characteristics: 7/8” Nominal:

Frequency (MHz)	Attenuation (dB/100ft)
150	≤ 0.417
450	≤ .744
800	≤ 1.014
2000	≤ 1.683

Standard Conditions: VSWR 1.0, ambient temperature 20 °C (68 °F)

6. Approved Manufacturer: SOLiD/Commscope/ or Equal.

H. Splitters, Combiners, Couplers, Coax Jumpers and Connectors:

1. Electrical:
   a. WSP Frequency Band: 698 – 894 MHz, 1710 – 1755 MHz, 1850 – 1990 MHz, 2110 – 2155 MHz

b. Maximum input power: Minimum 6 dB margin over composite broadband power levels proposed to meet the performance specifications in this Section.
c. Impedance: 50 Ω

2. Environmental:
   a. Operating Temperature Range: -33 °C to +50 °C
   b. Relative Humidity up to 100%
3. Mechanical Connector: 50 Ω N-Type
4. Compliance:
   a. FCC: Shall be FCC type certified.
5. Approved Manufacturer: SOLiD/Commscope or approved substitution.

I. WSP BDA: When the WSP dictates a BDA drive the DAS, the BDA shall be of modular design and use digital filtering to mitigate interference and accommodate multiple services for WSPs..

1. Characteristics:
   a. Operating Temperature Range: -33 °C to +50 °C
   b. Chassis: Shall be of modular design
   c. Filtering: Digital
   d. Separate Control: Each RF amplifier shall be capable of adjusting and controlling power levels for each WSP when multiple WSPs share a single amplifier.
   e. Alarming: Shall support SNMP
   f. Mounting Options: shall support rack, wall and pole mounting
   g. Frequency Bands Supported: 698 – 894 MHz Cellular, 1710 - 1755 MHz AWS, 1850 – 1990 MHz PCS and 2110 – 2155 MHz AWS
2. Compliance:
   a. FCC: Shall be FCC type certified.
3. Approved Manufacturer: SOLiD/Commscope or approved substitution.

J. Fiber-Optic Master Unit: When building size dictates an Active fiber DAS, the Fiber-Optic Master Unit shall convert radio over coax to Radio-Over-Fiber (RoF) for distribution to Fiber-Optic Remote Units.

1. Characteristics:
   a. Transmission Media: Single-mode fiber at 1310 nm
   b. Operating Temperature Range: +5 °C to +40 °C
   c. Impendence: 50 Ω
   d. Chassis:
      1) Shall be of modular design capable of supporting ≥ 32 Remote Units per 19," 4 RU chassis.
      2) Shall support redundant power supplies.
      3) Shall have the capability to remotely power the Remote Units via composite fiber-optic cable.
   e. Automatic Gain Control (AGC): Shall provide AGC for optical loss compensation
   f. Optical Budget: Shall support ≤ 3 dB optical budget (~3 km or 2 miles)
   g. Auxiliary Channel: Shall provide an input to support 400 to 2700 MHz for future expandability
   h. Interlink: Shall support one fiber or two fibers bi-directional optical link for distances up to 20 km with a 10 dB optical budget

i. Remote Supervision:
1) Shall support the TCP/IP protocol, SNMPv2, FTP, HTTP, Telnet, and be fully compatible with general purpose SNMP managers.
2) Remote access shall be available via Point-to-Point Protocol (PPP), over circuit-switched/packet data and wired/wireless modems.
3) Each Active device shall be manageable via a Web GUI.
4) Auto Mapping: Each board position shall be automatically mapped during system turn-up.

2. Frequency Bands Supported:
a. WSP Units: 698 – 894 MHz Cellular, 1710 - 1755 MHz AWS, 1850 – 1990 MHz PCS and 2110 – 2155 MHz AWS

3. Approved Manufacturer: SOLiD/Commscope/ or approved substitution.

K. Fiber-Optic Remote Units: The Fiber-Optic Remote Unit converts the RoF signal back to radio over coax, as well as provides filtering so that multiple frequency bands can reside over the same passive cable and antenna infrastructure.

1. Characteristics:
a. Operating Temperature Range: +5 °C to +40 °C
b. Impendence: 50 Ω
c. Alarming: Shall support SNMP
d. MTBF (excluding external power supply): ≥ 160,000 hours
e. Physical: The Remote Unit shall consist of the following:
1) Ingress Protection: IP31 or equivalent
2) Frequency Bands supported:
a) WSP Units: 698 – 894 MHz Cellular, 1710 - 1755 MHz AWS, 1850 – 1990 MHz PCS and 2110 – 2155 MHz AWS
1) Optical Port: 2xSC-APC connector (separated uplink/downlink)
2) Antenna Port: Single 50 Ω N type female connector
3) Auxiliary Ports: Two SMA female for future add-on modules

2. Approved Manufacturer: SOLiD/Commscope or approved substitution.

2.5 RF CONNECTORS

A. All connectors shall be low intermodulation (IM) connectors. Typically, this is a gold center conductor with silver-plating on the connector. Connectors using dissimilar metal contacts or ferrous materials (e.g., nickel plating) are not allowed. The connector shall use a silver plated body with gold plated inner conductor. Brass bodies and silver or brass inner conductors are also authorized. N-type connectors shall be used.

2.6 LIGHTNING ARRESTORS

A. Lightning Arrestors shall provide surge path to ground with minimal degradation to RF performance over the full bandwidth of services identified within this section.

2.7 GENERATOR

A. All DAS equipment shall be backed up on the facility's emergency generator.

2.8 LABELS

A. In addition to all “Submittal” requirements specified in Division 01, Specification Section 270500 and all requirements by related specification sections, the Contractor shall also conform to all requirements of this section

1. All DAS components, areas, and cables shall be labeled; including but not limited to fiber cables, metallic cable, ground points, cross-connect fields, relay racks, patch panels, cabinets, and patch cords/jumpers shall be labeled following Authority’s-established labeling format. As-built to contain matching label information.
2. Labeling guidelines are ANSI/TIA/EIA-606-A Administration Standards for Telecommunication Infrastructure of Commercial Buildings with Authority specific asset nomenclature.
3. All label material shall be suitable for intended usage and environment, meeting the legibility, defacement and general exposure requirements listed in UL 969 for indoor and outdoor use. Where insert labels are used the insert label shall be covered with clear cover and securely held in place.

PART 3 - EXECUTION

3.1 COORDINATION

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

B. In addition to the Cellular DAS specified herein, this project will also install a Public Safety Radio 800MHz DAS and a 460 MHz DAS within the same building spaces. The contractor shall coordinate with the Vendors providing these systems to ensure proper installation and performance of each DAS.

C. Coordination items shall include, but not be limited to:

1. Coordination of antenna placement within the building to minimize or eliminate radio frequency interference (RFI), intermodulation, and other undesirable effects or performance degradation within any DAS as a result of antenna placement. Performance of the system is the responsibility of the Authority Vendor.
2. Coordination of Conduit Routing with Authority Vendors.
3. Coordination of communications room space requirements, grounding requirements, electrical power requirements, and all other requirements with Authority Vendors.

D. This coordination shall occur at all phases of the project to ensure proper functionality of all DAS systems as well as sufficient fiber optic cable, appropriate conduit placement, appropriate antenna placement, access hatch placement where necessary, and all other functional requirements of the various DAS systems are met as specified in the Contract Documents.

E. In addition to coordination with additional DAS vendors the Contractor must perform a walkthrough with the Cellular DAS Vendor prior to any equipment installation. This walkthrough will be for the purposes of final conduit and device placement prior to any installation activities.

3.2 EQUIPMENT PROTECTION

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

3.3 WORK PERFORMANCE

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

3.4 EQUIPMENT INSTALLATION

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

B. The installation of all components is the responsibility of the Authority Vendor. Contractor will coordinate with the vendor to ensure the locations of the devices are compatible with other systems.

C. Install all system components including furnished equipment, and appurtenances in accordance with the manufacturer's instructions, furnish all cables, connectors, terminators, interconnections, services, and adjustments required for a complete and operable system.

D. Grounding shall be installed as necessary to preclude ground loops, noise, and surges from adversely affecting system operation.

E. Adhere to the following during installation of the system:

1. Underwriters Laboratories (UL) listing for restricted access installations in business and customer premises applications. This listing is required by the National Electric Code for customer premise installations.
2. Fire resistance requirements specified by Underwriters Laboratories in UL 1459, 2nd edition.
3. System installation and construction methods shall conform to the requirements of the Federal Communications Commission (FCC).

F. Where undefined by codes and standards, apply a safety factor of at least two (2) times the rated load to all fastenings and supports of system components.

G. Adhere to the installation schedule of the general contractor and should attend all construction meetings scheduled by the General Contractor.

H. Install and configure all software required in this Specification in accordance with the software manufacturer's installation instructions. Apply the latest patches and security updates.

I. Final configuration of the DAS and associated equipment shall be performed by the Authority Vendor. This includes, but is not limited to software installation and configuration, uplink and downlink gain configuration, splitter/combiner installation, and antenna placement. These final details must be coordinated with other DAS vendors to ensure the proper functionality of the Public Safety DAS, Cellular, and 460MHz DAS system(s) as well as the WiFi system. Coordination between various DAS Vendors shall be the responsibility of the Contractor.

J. Place materials only in those locations that have been previously approved. Any other locations shall be approved, in writing, by the Authority and OAR.

K. All wiring and cables shall be properly dressed and/or bundled with tie-wraps or cable ties with excess cut close to the barbs. Twisted wire, tape, rope, twine, phone wire and similar bits of debris usually available on site are not acceptable substitutes for proper securing hardware. All inter-rack cables and wiring must be properly routed, and where available, in cable trays. Overhead cables must be easily removed or re-worked within the cable trays. Proper care must be taken to ensure that new cables added to the trays are not stressed or intertwined with existing cables. Overhead cables may not cross perpendiculars or be suspended in mid-air without supports. No supports may be installed without prior approval from the Authority and OAR. All long cable runs must be properly identified at each end and every 100 feet indicating the carried frequency and communication room of origin. All cabling within the building must be cut to proper length.

L. Obtain written permission from the Authority and OAR before proceeding with any work which requires cutting into or through any part of the building structures such as, but not limited to, girders, beams, concrete, carpeted or tiled floors, partitions or ceilings. Consult with the General Contractor before cutting into or through any part of the building structures where fireproofing or moisture proofing could be impaired.

3.5 COMMUNICATIONS CABLING REQUIREMENTS

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

B. Conduit shall be installed in all areas. Antenna locations noted on the drawings must be confirmed by the Contractor and conduit must be installed prior to any antenna being mounted. 2” Rigid Metal Conduit is required for Cellular DAS coaxial pathways. 2” Rigid Metal Conduit must stub with bushing 12-18” from the IDF cable tray. 2” Rigid Metal Conduit must stub with bushing at Cellular DAS locations 24-36” from the antenna or ceiling hatch.

C. Ceiling hatches are required to access above the hard ceiling locations. If the antenna is to be mounted on the hatch, the hatch must be plastic.

3.6 ELECTRICAL POWER DISTRIBUTION

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

3.7 TRANSIENT VOLTAGE SUPPRESSION

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

1. Each lightning suppression device shall have its own home run ground cable. External ground busbar shall be connected to the building lightning protection system

3.8 GROUNDING AND BONDING

A. Refer to Specification Section 27 05 00 for requirements

3.9 EQUIPMENT IDENTIFICATION

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

3.10 MAINTENANCE & SERVICE

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

B. Authority Vendor will be responsible for all maintenance and service of DAS equipment as detailed in this section.

C. General

1. Provide maintenance and support of all components associated with this system at no additional charge during the warranty period.
2. Supply a list of special tools, test equipment, and outside inventory required for this Project. The Contractor may recommend specific items to facilitate long-term support of the system as an option.
3. All lead technicians performing installation and maintenance shall have a minimum of two (2) years' experience on the proposed system and be manufacturer certified on all hardware/software applications. All maintenance technicians shall be provisioned to attend a one (1) week manufacturer training class each year. Pre-assigned backup technicians shall be available to backfill for onsite technicians who are on vacation, in training or who are out sick.
4. Provide twenty-four (24) hours/seven (7) days a week telephone support as a minimum maintenance and support agreement. Respond to non-emergency service requests between 8am to 5pm, the next business day after a support call is placed.

D. Network Hardware and Software Support

1. Network Hardware and Software support shall be supplied by the Authority Vendor. Support shall cover all equipment and systems referenced in this Specification.
2. All software shall be delivered with an installable backup.

E. Requirements

1. Preventive and Routine Maintenance: Preventive and routine maintenance services shall be provided in accordance with the provisions of the maintenance manual for each component during the warranty period. Preventative maintenance services shall include inspection, test, necessary adjustment, lubrication, parts cleaning, and upgrades. Routine maintenance services shall include scheduled overhauls as recommended by the equipment manufacturer.
2. Emergency Failure: A system failure is considered an emergency if any of the key components are inoperative to the extent the system cannot function in a normal manner. Emergency services shall include inspections and necessary tests to determine the causes of equipment or software malfunction or failure during the warranty period. The emergency services shall include furnishing and installing components, parts, or software changes required to replace malfunctioning system elements. Provide telephone support twenty-four (24) hours a day, seven (7) days a week. Provide support on-site within eight (8) hours of request.

3.11 WARRANTY

A. Authority Vendor will be responsible for all warranty requirements for the DAS system.

B. In addition to all “Warranty” requirements specified in Division 01, Specification Section 270500 and all requirements by related specification sections, the Contractor shall also conform to all requirements of this section.

C. Provide a joint written warranty of the manufacturer(s) and the installer(s), on a single document. The document shall warrant complete installation of the radio equipment, cabling, antennas, connectors, and software to be free from defects in materials and workmanship for a period of no less than one (1) year, starting with the date of Final System Acceptance.

D. Hardware Warranty:

1. Warrant that all components meet or exceed the specifications provided in the product data submittal.
2. Warrant that the proposed merchandise will conform to its description and any applicable specifications, and shall be of good quality for the known purpose for which it is intended.
3. The product warranty shall cover material and labor for the replacement or repair of defective products.

E. Software Warranty:

1. The warranty shall allow for replacement or repair at the discretion of the Authority. All software necessary to compile, modify, and maintain software developed for this specification shall be included in this warranty.
2. The warranties shall include the price of all software upgrades during the warranty period. If a new version of the system software becomes available during the warranty period, it shall be upgraded as part of the warranty.

3.12 FIELD SERVICES

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

B. Authority Vendor will be responsible for all field services for the DAS system components.

C. In addition to all “Field Services” requirements specified in Division 01, Specification Section 270500 and all requirements by related specification sections, conform to all requirements of this section.

1. Remove all unnecessary tools and equipment, unused materials, packing materials, and debris from each area where work has been completed unless designated for storage.

D. Acceptance will be withheld until the following have been completed successfully:

1. Acceptance of all submittals
2. Delivery of final documentation
3. Successful testing
4. Completion of training
5. Demonstrate system to designated Authority personnel as required by applicable sections of these specifications. Use submitted operation and maintenance manual as reference during demonstration and training. Demonstrate as-built records are in format required and can lead troubleshooting technicians to port level of detail in field.

E. Project Testing: The overall DAS project shall not be considered complete until On-Site Testing is completed on the entire DAS test results have been approved. The purpose is to test the complete system and demonstrate that all specified features and performance criteria are met. All requirements of the specification shall be tested, including:

1. Functionality, including signal coverage and audio quality test. Radio signal coverage, shall consist of testing a minimum of 100 points on each level of the Terminal. Audio quality test shall consist of making radio test call from each test point and recording both the received and transmitted audio quality on a scale of 1 to 5. A minimum audio quality of 3 at 95% of the test points is required.
2. System capacity
3. Hardware and software interaction
4. Failure Recovery
5. Report generation

F. Test Plan/Procedure: Provide a copy of the proposed test plan/procedures for each testing phase for review by the Authority and OAR. The test plan for each phase of testing shall detail the objectives of all tests. The tests shall clearly demonstrate that the system and its components fully comply with the requirements specified herein. The submission of Test Plans shall adhere to the following:

1. A draft test plan shall be presented to the Authority and OAR at least forty-five (45) days prior to the scheduled start of each test.
2. A workshop for reviewing comments shall be conducted with the Authority and OAR at least thirty (30) days prior to the scheduled start of each test.
3. A final test plan shall be submitted to the Authority and OAR at least fourteen (14) days prior to the scheduled start of each test.

G. Test plans shall contain at a minimum:

1. Functional procedures including use of any test or sample data.
2. Test equipment is to be identified by manufacturer and model including spectrum analyzers and power meters.
3. Interconnection of test equipment and steps of operation shall be defined.
4. Expected results required to comply with specifications.
5. Testing matrix referencing Specification requirements with specific test procedures.
6. Record of test results with witness initials or signature and date performed.
7. Pass or fail evaluation with comments.

H. The test procedures shall provide conformity to all Specification requirements. Satisfactory completion of the test procedure is necessary as a condition of system acceptance.

I. All Test plans must be reviewed by the Authority and OAR. To successfully complete a test, the test document must be signed and dated by the Contractor AHJ and Authority.

J. The AHJ, Authority and OAR will review, witness and validate the execution of all formal test procedures prepared by the Authority Vendor and Contractor and deliverable under the contract to assure the tests cover all requirements and that there is a conformity between the conducted test, the test results and Specification requirements.

K. Documentation verification both interconnects and operationally, shall be part of the test. Where documentation is not in accordance with the installed system interconnect and operating procedures, the system shall not be considered accepted until the system and documentation correlate.

L. Provide the AHJ, Authority and OAR the opportunity(s) to participate in any or all of tests.

M. Test Reports: Prepare, for each test, a test report document that shall certify successful completion of that test. Test reports shall be submitted to the Authority's representative for review and acceptance within seven (7) days following each test. The test report shall contain, at a minimum:

1. Commentary on test results.
2. A listing and discussion of all discrepancies between expected and actual results and of all failures encountered during the test and their resolution.
3. Complete copy of test procedures and test data sheets with annotations showing dates, times, initials, and any other annotations entered during execution of the test.
4. Signatures of persons who performed and witnessed the test.

N. Test Resolution: Any discrepancies or problems discovered during these tests shall be corrected by the Contractor at no cost to the Authority. The problems identified shall be corrected and the percentage of the entire system re-tested as determined by the Authority and OAR before any subsequent testing is performed.

3.13 TRAINING

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

B. Contractor shall coordinate with Authority Vendor to obtain training materials for the DAS system.

C. In addition to all "Training" requirements specified in Division 01, Specification Section 270500 and all requirements by related specification sections, conform to all requirements of this section.

1. Provide the Authority specified trainees with detailed as-built information. The training shall provide trainees with a working knowledge of the system design and layout, ability to configure and monitor the system, and troubleshooting methods and techniques. In addition, the training shall cover testing, maintenance, and repair procedures for all equipment and applications, which are provided under this Specification.
2. Course materials shall be delivered to the Authority. Final delivery of the course materials shall include a master hard copy of all materials and an electronic copy in a format reviewed in advance by the Authority. Supply a videotape of each training course.
3. All training shall be completed a minimum of two weeks prior to the system becoming operational and utilized by the Authority. Training schedule subject to the Authority's review.

3.14 PROJECT CLOSEOUT REQUIREMENTS

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

END OF SECTION 27 53 10

SECTION 27 51 13 – EMERGENCY COMMUNICATION SYSTEM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. General provisions of the Contract, including Contractual Conditions and Division 0 and Division 01 specifications 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 includes the requirements for provision and installation of the extension of existing emergency communications/paging system (ECS).

C. The Emergency Communications System (ECS) shall provide code compliant emergency voice evacuation and airport operational public address functions. The headend and amplifiers shall be capable of performing voice evacuation announcements as required by NFPA 72. Programming and installation of speaker circuits and related circuit monitoring equipment shall be provided as required by NFPA 72. The ECS shall interface to the South Terminal Complex Fire Alarm System to provide code compliant voice evacuation. Refer to Section 28 31 00, Addressable Fire Detection and Alarm for additional requirements.

D. The ECS shall be installed in compliance with FBC 907

E. Provide a complete and operational system throughout project area in accordance with current codes, standards, manufacturer’s recommendations and available guidelines.

F. Work will included updates and expansion to the existing STC System, NTC Comm Center head end, and associated ECS LAN to provide connectivity between new system and existing Head-End.

1.3 SCOPE OF WORK

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

B. Refer to drawing sheet TA0.00.03 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 amplifiers, 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: Contractor shall provide all hardware, software, programming, licenses, wiring, cabling, protocol converters, interface devices and appurtenances as required to extend the physical or logical scope of the existing system.
3. Interfaces: Contractor shall provide all system interfaces including, but not limited to all hardware, software, wiring, cabling, programming, 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: Refer to specification section 27 05 00 for requirements. Coordinate network programming requirements with GOAA IT for ECS 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 PAS signal cabling as described in this section.
7. Field Devices: Contractor shall provide all field devices including, but not limited to power supplies, microphones, speakers, mounting hardware, and similar equipment or appliances.

1.4 DESCRIPTION

A. Contractor to rework the existing paging system to facilitate additional devices and modifications to the existing system to increase functionality as shown on drawings and included in these specifications. Contractor shall submit to GOAA for approval for all modifications to the existing system. These items shall include but not be limited to:

1. Updating of existing GUI to indicate additional zones and areas
2. Updating of existing messages as required for new areas being served
3. Rework and/or update of NTC/STC system programming and firmware
4. Providing and scheduling new area specific messages.

B. The ECS is an extension of the existing IED GlobalCommACS system utilizing Cobranet network audio protocol which is located thru-out the South Terminal Complex main communications room and communicates with the North Terminal Complex (NTC) Comm. Center. All devices, equipment, and software shall be compatible with this existing system.

C. All control and supervision of the ECS system shall be from Comm Center in NTC. Rework NTC interface to support additional devices and areas.

D. The ECS shall be interfaced with the EME control system to reproduce dedicated audio channels in areas around multimedia displays. This audio will be overridden during an airport paging of emergency message. The system shall provide a warning trigger prior to airport page to the EME controller to soft mute (fade out) the audio prior to paging message.

E. Contractor shall include in his bid all required components and labor to support the extension of the existing STC/NTC ECS system. This shall include but not be limited to:

1. Head end equipment
2. Power Amplifiers
3. Ambient Sensing Microphones
4. Paging Microphone Stations
5. All Wire and Cable
6. Programming / Firmware / Software / Licenses
7. GUI
8. Speakers and Speaker mounting hardware
9. Terminal cabinets
10. Labeling
11. Testing and Tuning of system
12. Interface with third party systems
13. Interface with Fire Alarm system to perform Emergency Voice Messaging
14. Visual Paging Interface for all way finding monitors.

F. Parking Garage: Match existing NTC /STC parking garage configuration and messaging for ECS system and include all additional requirements indicated in these drawing and specifications.

G. LST/ASC/GTF: Match existing NTC / STC messaging for ECS system and include all additional requirements indicated in these drawing and specifications.

1. Configure system to page by ZONE as indicated in ECS zone plans, with the additional capability to create on demand paging zones which may include ADS areas as well as ECS ZONES.

H. Contractor shall provide an ECS paging workstation and local desktop paging station in the Fire Command Room for local override and control of the ecs system in the event of an emergency. This shall be provided at each building (ASC and LST)

I. Provide interface with existing FIDS database to incorporate Automated Announcements with flight information. Use FAS and T-CAS to provide this functionality, coordinate with GOAA and provide messaging required. Upgrade existing STC APM ACS as required to provide this capability between existing and new building ACS’s.

J. Contractor shall interface with owners Weather alert / lighting warning system vendor to provide interface for activation of dedicated weather alert visual notification devices and warning speakers at ASC.

K. System shall provide a “MUTE” trigger to IPTV controllers where indicated on drawings and be configured to provide audio / video mute to selected local TV’s during an airport page or emergency notification.

1.5 REFERENCES AND REGULATORY REQUIREMENTS

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

1. All requirements of Federal Communications Commission.
2. UL 6 Rigid Metal Conduit
3. UL 797 Safety Electrical Metallic Tubing
4. EIA-219: Audio Facilities for Radio Broadcast Standards
5. EIA-310-D: Cabinets, Racks, Panels and associated equipment
6. Supplementary References: The publications listed are listed as they contain design and technical criteria that are pertinent to the project and they shall be used as minimum standards governing work performed on the project.
   a. System installation and construction practices shall conform to standard industry practices as defined by the National Association of Broadcasters Engineering Handbook (latest edition), Sound System Engineering (Don and Carolyn Davis, Howard W. Sams, publisher.

B. Contractor shall coordinate with other divisions required for complete functionality of this system these shall be included but not be limited to the following:

1. Fire Alarm Systems
2. PON communications infrastructure
3. EME Multimedia Systems
4. Horizontal Network Cabling System

1.6 SUBMITTALS

A. Submit in accordance with Section 27 05 00 Common Work Results for Communications Systems and Section 01 33 23 Shop Drawings, Product Data, and Samples.

1.7 PROJECT RECORD DOCUMENTS

A. Submit in accordance with Section 27 05 00 Common Work Results for Communications Systems and Section 01 78 00 Closeout Submittals .

1.8 O & M MANUALS

A. Submit in accordance with Section 27 05 00 Common Work Results for Communications Systems and Section 01 78 00 Closeout Submittals .

1.9 QUALITY ASSURANCE

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

B. Work performed as part of this contract shall be in accordance with relative sections of the Electrical Code.

C. Standards of workmanship shall meet or exceed accepted audio/video systems industry installation practices.

D. Specific reference in Specifications to codes, rules, regulations, standards, manufacturer's instructions or requirements of regulatory agencies shall mean the latest printed edition of each in effect at date of contract unless the Document is shown dated.

E. Conflicts

1. Between referenced requirements: Comply with the one establishing the more stringent requirements.
2. Between referenced requirements and contract documents: Comply with the one establishing the more stringent requirements.

F. Provide documentation for any sub-Contractor who will assist the Contractor in performance of this work shall be required.

G. Contractor personal shall have been to factory training and received a certificate of completion within 18 months of project start.

1.10 QUALIFICATIONS

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

B. Manufacturer: Company specializing in manufacturing the products specified in this section with minimum five years documented experience.

C. Supplier: Authorized distributor of specified manufacturer with five years documented experience.

D. Quality Assurance: Contractor shall be experienced in all aspects of this work and shall be required to demonstrate direct experience on recent systems of similar type and size. The Contractor shall own and maintain tools and equipment necessary for successful installation and testing of audio and visual systems and have personnel who are adequately trained in the use of such tools and equipment.

1. A resume of qualification shall be submitted with the Contractor's bid indicating the following:
   a. A list of five completed SPS projects over the past five years of similar type with an audio system scope over $1,000,000 with contact names and telephone numbers for each. One of the five projects must have included a LAN based networked audio system
   b. A list of test equipment proposed for use in testing and verifying the systems on this project.

c. A technical resume of experience for the Contractor's Engineer and on-site installation foreman who will be assigned to this project.

E. Installer: Authorized installer of specified manufacturer with five years documented experience and service facilities within 50 miles of Project.

1.11 EQUIPMENT WARRANTY

A. Refer to Specification Section 27 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 Owner, 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 trouble call within twenty-four (24) hours after receipt of such a call.

1.12 SPARE MATERIAL

A. Contractor shall provide the following spare equipment and turn over to GOAA electronics shop:

1. (~~10~~5) of each style AMP Card used
2. (~~5~~2) AMP Mainframes
3. (~~5~~2) Multifunction IO
4. (5) Ambient Sensor Collectors
5. (5) of each style Mic stations
6. Ceiling Speakers
   a. (20) Type 00
   b. (15 5) Type 01
   ~~c.~~ (5) Type 02
7. Wall Speakers
   a. (20 10) Type 01
   ~~b.~~ (2) Type 05
   ~~c.~~b. (2) Type 06

1.13 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 ECS 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 20 additional audible notification devices wall mount Type 01 (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 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 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 ECS issues identified during the first annual safety inspection are resolved.

1.14 TRAINING

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

B. System orientation: Contractor shall conduct a walking tour for the Owner, tenants, and host organizations (separate from the systems testing) of the system to demonstrate the scope of the work and the completeness of the systems.

1.15 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.
      1) NFPA 72: Chapter 24 Emergency Communications System
      2) NFPA 72: Chapter 24.3.3 Required Emergency Communications Systems
      3) NFPA 72: Chapter 24.3.5.2 Loudspeakers for ECS
   c. NFPA 101 - Life Safety Code.

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 1480: Speakers.
   b. UL 1424: Cables.
   c. UL 1711: Amplifiers for Fire Protective Signaling Systems.
4. Florida Building Code: Latest adopted edition.
5. General: The system shall comply with all applicable Codes, Ordinances and Standards as interpreted and enforced by the local authority having jurisdiction.
6. 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 components, equipment, parts, accessories and associated quantities required for complete extension of existing system. All components may not be specified herein.

B. All devices/components/products shall be suitable for use intended, and meet all stated performance requirements for Sound/Paging system specified in this section.

2.2 PATHWAYS

A. All pathways (conduit, raceways, and wireways, pullboxes, and outlet boxes) shall comply with applicable requirements of Division 27.

2.3 ECS EQUIPMENT PDU

A. Provide (2) PDU’s minimum at each ECS cabinet location and connect to Life Safety branch UPS power. Provide additional PDU’s where required due to power consumption.

B. Basis of Design: APC# AP9626

2.4 SOFTWARE

A. Update existing Globalcom ACS software and licenses

B. Update existing GCK – Advanced notification software

C. Update existing FAS - Automated Announcement System

1. T-CAS – Text-to-speech Announcement System (Client and Server)Include Text to speech engine and language pack

D. Coordinate with GOAA for configurations required for software setup and installation.

2.5 ANNOUNCEMENT CONTROL SYSTEM

A. IED GLOBALCOM.IP ACS (ANNOUNCEMENT CONTROL SYSTEM)

1. The ACS shall be provided at each Head end (LST/ASC/GTF) and shall have a parallel secondary ACS configured for backup if the primary ACS fails.
2. Contractor shall provide additional ACS's with backup as required to support total device counts per manufacture recommendation.
3. The ACS shall manage announcements and messages using dynamically routed data on a standard Ethernet Network. It shall include an integral multi-channel message server providing simultaneous record and playback capability for up to 16 play and 16 record channels in multiple languages.
4. The ACS shall manage AtlasIED GLOBALCOM® Series peripherals including Digital Communications Stations, Network Power Amplifier Systems, Input/Output Devices, Zone Controllers and IP End Points.
5. The ACS shall include internal support for (8) logic inputs, (8) relay outputs, and (2) balanced audio inputs.
6. The ACS shall manage dynamic requests for live and delayed announcements, pre-recorded and assembled messages, actions, defined events, and two-way full duplex intercom connections.
7. An integrated visual paging server shall deliver visual messaging to supported visual displays that shall be synchronized to the audio regardless of message length.
8. Announcements and messages shall be initiated by contact closures, microphone paging stations, DIRECTOR® software, open standard IP network commands, and VoIP.
   a. The ACS shall include an integral interface for VoIP telephones via SIP and PBX trucking as well as standard 3rd party FXO gateways.
   b. The interface shall support standards G.711, G.722 and RTP protocols.
   c. Operating modes shall provide for both direct dial zone paging access and well as voice prompted actions for announcements and messages.
9. The ACS shall support CobraNet® and Dante™ Audio-over-Ethernet protocols with VoIP, RTP, and RTCP.
10. The ACS shall supervise all associated end-point devices, report system abnormalities, and log faults to be reported via SMNP, E-mail, and SMS via E-mail notifications.

11. The ACS shall be designed for high reliability with no moving parts including an Intel® 64-bit Quad Core™ low power processor, solid state hard drive, and available hot swap redundant power supply.
12. The ACS shall fit into 1 RU of 19" rack space and weigh 3.0 kg.
13. The ACS shall be safety listed to UL Standard 60950.
14. The ACS shall include GLOBALCOM®.IP system configuration and management software and shall include internally hosted web page for configuration and monitoring the System Management Console.
15. Provide additional ACS controllers with backup as required to support number of devices / amplifiers at head end.
16. Basis of Design: IED Globalcom.IP Model - IP116

2.6 INPUT/OUTPUT MODULES

A. Logic Relay Module

1. Provide where indicated on plans and where required for interface with 3rd part equipment
2. 2 electro-mechanical relays
3. 2 optically isolated inputs
4. Communication shall be via RJ-45 LAN connection.
5. Power shall be via PoE from LAN
6. DIN rail mounted. Provide rack mounted DIN rail for installation of modules in ECS cabinets.
7. Basis of Design: IED 1516LI

B. Input Module

1. Provide where indicated on plans and where required for interface with 3rd part equipment
2. 16 optically isolated inputs (expandable to 32 using expansion module
3. Communication shall be via RJ-45 LAN connection.
4. Power shall be via PoE from LAN
5. DIN rail mounted. Provide rack mounted DIN rail for installation of modules in ECS cabinets.
6. Basis of Design: IED 1516LI

2.7 POWER AMPLIFIERS

A. ECS Amplifier Mainframe (AMP FRAME)

1. General:
   a. Provide power amp frames in ECS equipment cabinets shown on drawings as required to support all local speaker circuits.
   b. Provide additional 25% spare capacity in amp mainframe at each IDF room location (for additional amp cards in the future).
   c. Provide backup amp card in each mainframe sized to match the largest amp card in use in same mainframe

2. The Smart Mainframe Power Amplifier shall house, supply power to, and control up to seven (7) TitanONE Series amplifier cards and a DSP/CPU card. In addition, the Smart Mainframe Power Amplifier shall have a provision to provide digital audio connections via a CobraNET audio distribution.
3. Local program or BGM (background music) inputs shall connect via (12) analog inputs at the rear panel via provided connectors.
4. The integrated NIC (Network Interface Card) shall include dual ports for redundant network connections.
5. The Smart Mainframe Power Amplifier shall house six (6) active single or dual channel amplifier cards (150W, 300W or 600W 70.7V/100V load) and a seventh (7th) active spare that is automatically engaged should a failure condition be reported. The system shall detect a failure in any of the primary amplifier cards and replace the effected amplifier without loss of service.
6. The integrated digital signal processor shall provide up to 12 channels of processing to include level control of individual circuits, up to 8 bands of parametric equalization, high pass filter, signal delay, compression (on analog inputs) and ambient analysis control.
7. All setup, monitoring, configuration, testing and control shall be under software control.
8. The Smart Mainframe Power Amplifier shall be capable of live or delayed paging, pre-recorded message playback, and muting of individual amplifier channels, zones and zone groups in any combination when used with optional GCK software deployment. Ambient analysis and control shall be accomplished via an adjustment of signal levels via external noise sensing and/or computer commands.
9. Connections for 24 ambient sensors shall be incorporated via rear panel connections and allow for single or dual sensor control of desired zones. Ambient analysis and control shall be in real time.
10. The Smart Mainframe Power Amplifier shall include internal audio bus monitoring and provide for visual as well as audio monitoring of the internal signal chain. Testing of the Smart Mainframe Power Amplifier shall be automatic or manually on demand and allow selection of the monitor points in the signal chain internal to the amplifiers and current level to the speaker lines and report with a resolution of 0.5dB.
11. The Smart Mainframe Power Amplifier shall require 4 rack units of vertical space in a 19 inch rack and all connections shall be in on the rear panel. The front panel shall provide for slide in cards and a visual indicator of amplifier status.
12. Basis of Design: AtlasIED T112 TitainONE with DSP and Processor

B. ECS Amplifier Cards

1. General:
   a. Provide amp card as required per drawings schedules. All power amp cards shall be 1200W 2ch cards unless specifically noted on drawings.
   b. Contractor may not load any amp card more than 80% rate power handling once final tap values are set.
2. Line Driver Card

a. 2-Channed Line Level Driver for long distance audio feeds.
b. Utilized to support power line array speakers.
c. The 2-channel line driver has two low impedance, balanced, floating, active outputs which are designed to drive very long lines. Its transformer less output design provides wider bandwidth while minimizing distortion at all frequencies.
d. Basis of Design: IED T2LD-120V-T1

3. Modular Amp Card (300W)
   a. 2-Channed amplifier card providing 150W per ch.
   b. Shall be rated for 70V distribution
   c. The card shall have LED indicators for power and signal.
   d. Each card shall be provided with a front accessible power switch
   e. Basis of Design: IED T302-120V–T1
4. Modular Amp Card (600W)
   a. 2-Channed amplifier card providing 300W per ch.
   b. Shall be rated for 70V distribution
   c. The card shall have LED indicators for power and signal.
   d. Each card shall be provided with a front accessible power switch
   e. Basis of Design: IED T602-120V–T1
5. Modular Amp Card (1200W)
   a. 2-Channed amplifier card providing 600W per ch.
   b. Shall be rated for 70V distribution
   c. The card shall have LED indicators for power and signal.
   d. Each card shall be provided with a front accessible power switch
   e. Basis of Design: IED T1202-120V–T1

C. POE IP AMP (Elevators)

1. Amp shall have 2 channels, each with 4 watt @ 8 ohms
2. Provide NEMA enclosure and DIN mounting rail for installation
3. Shall integrate with Globalcom via CobraNET Audio.
4. Basis of Design: IED1542NA-C

2.8 MICROPHONE PAGING STATIONS

A. Microphone Paging Station (Type 1)

1. Provide where shown on drawings.
2. Provide rack mounted paging station in ECS cabinet in each IDF room with associated paging equipment.
3. Provide additional ~~25~~ 5 stations and all associated cable, conduit, labor, programing and materials to be located where directed by GOAA. Contractor shall coordinate programing functions and locations with GOAA.
4. Shall be a network device used for initiating audio/visual announcements, messages, and pages with the IED family of Announcement Control Systems via CobraNET audio.
5. It is a network appliance with its own unique IP address, which simplifies its installation and configuration.
6. Shall have fully customizable LCD touch screen interface.

a. Screen layout and button function Shall be coordinated with GOAA prior to installation

7. The Digital Communication Station uses a single Ethernet interface for audio and control data. The station is fully compatible with IEEE 802.3af standard for Power Over Ethernet (PoE), allowing the station to be powered directly from any standard off-the-shelf PoE switch.
8. Provide with back box and all required installation accessories.
9. For desktop / counter top paging stations, provide handheld microphone with desktop mounting base with rubber feet. Connect to LAN outlet with patch cable.
10. Where specifically noted on drawings, provide paging station with recessed wall mounted enclosure
11. Manufacturer:
    a. LCD Touch Screen Paging Station: IED IED550CS-H Series

B. Microphone Paging Station (Type 2)

1. Shall be a network device used for initiating audio/visual announcements, messages, and pages with the IED family of Announcement Control Systems.
    a. It is a network appliance with its own unique IP address, which simplifies its installation and configuration.

    A 4 button full function keypad shall be provided for user shortcuts.
2. Magnetically held replaceable handheld paging microphone.
3. The Digital Communication Station uses a single Ethernet interface for audio and control data. The station is fully compatible with IEEE 802.3af standard for Power Over Ethernet (PoE), allowing the station to be powered directly from any standard off-the-shelf PoE switch.
4. Provide with back box and all required installation accessories.
5. Where noted on drawings provide paging station with recessed wall mounted enclosure
6. Manufacturer:
    a. 4 Button Paging Station: IED IEDA524 Series

2.9 AMBIENT SENSING MICROPHONE

A. Flush Ambient Sensing Microphone

1. Condenser microphone for monitoring of ambient audio levels.
2. Omnidirectional condenser microphone, preamplifier, and an analog conversion module.
3. Provide with 2-Gang powder coated mounting plate to match wall color. Coordinate with architect for exact paint color code by location..
4. Mount in standard flush 4S box
5. Basis of Design: IED IED0540S

2.10 ECS SPEAKERS: ASC/LST/GTF

1. Ceiling Speaker (Type 0)
    a. System shall include a high performance 6.5" coaxial loudspeaker, ported bass reflex enclosure and press-fit grille for conventional ceiling installation.

b. Frequency response for the system shall be 50Hz – 20kHz. Sensitivity shall be 90dB.
c. Loudspeaker shall be comprised of a 6.5" cone type driver. Cone shall be constructed of composite cone with polymer coated cloth surround.
d. Magnet shall be a minimum of 10 oz (264 g) and the voice coil diameter shall be 1" (25 mm).
e. The silk dome tweeter is 20mm and utilizes a Neodymium magnet.
f. Transformer shall be a 70.7V / 100V type with 4, 8, 16, and 32 watt primary taps (@70.7V) with a front mounted tap selector switch to include transformer bypass setting for 8Ω direct coupled operation.
g. The speaker shall be equipped with a universal line matching transformer for a 70V output line with taps at 2, 4, 8, 16, & 32 watts.
h. Mounting: Speaker shall be recessed mounted, and provided with Tile Bridge and all required mounting hardware.
i. Color: White
j. Where mounted outside building envelope, provide additional Hyfidrophobic™ Treatment from manufacturer to prevent moisture intrusion.
1) Basis of Design: Atlas Sound FAP63T-W or approved substitution

2. Ceiling Speaker (Type 1)
a. System shall include an 8” coaxial loud speaker, ported bass reflex enclosure and press fit grille.
b. Frequency response shall be 60Hz to 15Khz with a sensitivity of 92db average.
c. Loud speaker shall be rated at 150W, and be constructed with a polypropylene cone and a 1.25” titanium diaphragm compression driver. Woofer magnet shall be minimum of 25oz.
d. Two transducer section shall be coupled thru a built in 2000Hz crossover network.
e. Shall include a 70V transformer rated at 1.9, 3.8, 7.5, 15, 30, and 60 watt primary taps with front mounted selector switch.
f. Mounting: Speaker shall be recessed mounted, and provided with Tile Bridge and all required mounting hardware.
g. Color: White
h. Where mounted outside building envelope, provide additional Hyfidrophobic™ Treatment from manufacturer to prevent moisture intrusion.
i. Basis of Design: Atlas Sound FAP8CXT or approved substitution

3. Ceiling Speaker (Type 2)
a. Systems shall include a 250 watt loudspeaker that combines a 12" diameter, low frequency transducer and a 1" exit, true compression driver.
b. Frequency response range shall be 58 Hz to 15 kHz, ±3dB. Sensitivity shall be 99dB at 1 watt, 1 meter.
c. Voice coil impedance shall be 8 ohms (nominal). Low frequency voice coil diameter shall be 2.5" (63.5mm).
d. The maximum depth of the loudspeaker shall not exceed 8" (203mm).

e. The low frequency reproducer cone shall be a full 12" (305mm) in diameter and the high frequency reproducer diaphragm shall be 2.5" (65mm) in diameter. The woofer shall have a 70 oz. (1984g) ceramic magnet. The tweeter shall have a 20 oz. (567g) ceramic magnet.
f. The two reproducer sections shall be coupled through a built-in crossover network. The crossover frequency shall be at 1800 Hz. Conical dispersion shall be 90 degrees at 2kHz.
g. System shall be provided with an internal transformer with primary voltage of 70.7V with a frequency response range of 33Hz to 21kHz (±2dB) and power taps at 7.5, 15, 30 & 60 watts. Insertion loss shall not exceed 1dB.
h. Mounting: Speaker shall be recessed mounted, and provided with a Q series enclosure with a internal volume of 3cu/ft. provide speaker grille cover and mounting channels.
i. Color: White
j. Where mounted outside building envelope, provide additional Hyfidrophobic™ Treatment from manufacturer to prevent moisture intrusion.
1) Basis of Design: Atlas Sound 12CXT60 or approved substitution

4. Ceiling Speaker (Type 3)
a. System shall consist of a two-way woofer and tweeter assembly within an pendant mount environmental-resistant housing.
b. The 150 Watts system shall have an 8.25" (310 mm) woofer constructed with a polypropylene cone and a 1" (25 mm) titanium diaphragm compression driver.
c. Each system shall be complete with a built-in, 60 Watts 70.7/100V transformer with taps of 1.9, 3.8, 7.5, 15, 30, & 60 Watts (70.7V) and a transformer bypass position for 8 Ω direct coupled operation on a 8 position terminal block.
d. The frequency response for the system shall be 60 Hz – 15 kHz (±5 dB). The loudspeaker shall be the Atlas Sound PM8CX.
e. Mounting: Speaker shall be pendant mounted from structure above, refer to mounting detail on drawings for additional requirements. Install per manufactures recommendation.
f. Color: White
g. Where mounted outside building envelope, provide additional Hyfidrophobic™ Treatment from manufacturer to prevent moisture intrusion.
1) Basis of Design: Atlas Sound PM8CX or approved substitution

5. Wall Speaker (Type 1)
a. Shall consist of a semi recessed horn driver.
b. Continuous power rating shall be (15, 8, 4, 2, 1, 1/2, 1/4 watts) at
c. 70V.
d. Frequency response shall be 600 to 5500 Hz (± 5dB).
e. Sensitivity shall be 96.9dB (at 1 watt, 1 meter).
f. Dispersion shall be greater than 190° (-6dB point, 1 and 2 kHz octave bands).

g. Model shall be water/moisture sealed and constructed of die-cast zinc.
h. Unit shall operate within the temperature range of 150°F (66°C) to -30°F (-35°C).
i. Mounting: Speaker shall be semi recessed mounted with the Semi-flush adapter plate mounted behind VT Series to cover any recessed 4" SQ x
j. 1 1⁄2" D (102mm x 38mm) outlet box. CRS wall plate is stamped and painted.
k. Color: Shall be Grey
l. Basis of Design: Atlas Sound VT-157UC or approved substitution

~~6. Wall Speaker (Type 4)~~
~~a. Systems shall be self powered steerable vertical line array~~
~~b. Frequency Range: 80 Hz to 20 kHz~~
~~c. Max SPL:~~
~~1) 102 dB pgm, 105 dB peak @ 100 Ft. (30.5 meters), 105 dB pgm, 108 dB peak when stacked (3-octave bandwidth centered at 2 kHz)~~
~~d. Coverage:~~
~~1) Horizontal: 150° up to 3 kHz; 120° above 3 kHz~~
~~2) Vertical: 20°, 25° and 30° (5°, 10°, 15° and 20° when stacked)~~
~~3) Aiming Angle: Adjustable from -30° to +30° 66 Ft. (20 m) 132 Ft. (40 m) when stacked Effective down to 800 Hz (400 Hz when stacked)~~
~~e. Loudspeakers:~~
~~1) Five 6.5-inch cone transducers with neodymium magnets Three 1-inch HF titanium nitride compression drivers per module~~
~~2) 8 Amp Channels (per module) 48" H x 8" W x 11.3" D (121.5 cm x 20. cm x 28.7 cm) 61 Lbs (27.7 Kg)~~
~~f. I/O Connectors:~~
~~1) Analog Audio Inputs: Looping Phoenix 6-pin (looping 3-in, 3-out)~~
~~2) Dual RJ45 connectors~~
~~3) AES/EBU: Phoenix connector~~
~~g. Provide full software suite for remote control and configuration.~~
~~h. Mounting: Speaker shall be surface mounted utilizing manufacturers provided mounting hardware inside recessed cavity. Refer to architectural specs and drawings foir additional mounting information~~
~~i. Color: White~~
~~j. Basis of Design: Renkus-Heinz ICL-F-DUAL-RN or approved substitution~~

~~7. Wall Speaker (Type 5)~~
~~a. The loudspeaker system shall be a two way, full range column array system with five 3" LF transducers and two 22mm dome tweeter HF transducers.~~
~~b. The paintable enclosure shall be constructed of extruded aluminum. The back of the enclosure shall incorporate vertical channels that accept an included wall mount and allow the loudspeaker to slide up or down the mount for desired vertical aiming. The mounting system shall provide at least ±10° vertical tilt capability.~~

~~c.~~ The system shall have a frequency response of 137Hz to 20kHz (-5 dB) and a low impedance (8Ω) input capability of 27.4V RMS. The sensitivity at 1W/1m shall be 92dBSPL with a max SPL of 116.8 dBSPL at 1m.

~~d.~~ The loudspeaker system shall have a vertical coverage of 45° (800Hz - 4kHz) and a horizontal coverage of 135° average (800Hz - 4kHz).

~~e.~~ The system shall be equipped with a 60W high performance transformer for use in 70.7V distributed audio systems. In 70V operation, it shall provide 60W, 30W, 15W and 7.5W taps.

~~f.~~ Mounting: Speaker shall be surface mounted utilizing manufacturers provided mounting hardware.

~~g.~~ Color: White

~~h.~~ Where mounted outside building envelope, provide additional Hyfidrophobic™ Treatment from manufacturer to prevent moisture intrusion.

~~1) Basis of Design: Atlas Sound ALA5T or approved substitution~~

~~8.~~6. Wall Speaker (Type 6)

a. The Speaker assemblies shall consist of 2-way, woofer and tweeter, within environment-resistant housings. Enclosure shall be constructed of paintable UV-resistant, talc impregnated, polypropylene, injection molded plastic finished.

b. Each unit shall include a stamped, powder coated, aluminum grille and removable C-shaped mounting bracket. All hardware inserts shall be brass and threaded 1⁄4"-20.

c. The 100-Watt RMS system shall have a 5 1⁄4" (133mm) woofer, constructed of reinforced polypropylene, and a 1" (25mm) Ferrofluid cooled tweeter. The dividing network crossover frequency shall be 5kHz. The dividing network shall include protection circuits for the high-frequency component.

d. Each unit shall include an internally mounted 30 Watt 70.7V line matching transformer for use in distributed sound applications wattage taps shall be screwdriver selectable via a sealed switch located near the input section. Wattage taps shall be 0.94, 1.9, 3.7, 7.5, 15, 30 @ 70.7V plus transformer bypass setting for direct coupled 8Ω operation.

e. The loudspeaker system shall meet the following performance criteria:
   1) Power handling: 100 Watts RMS; Frequency response: 85Hz – 20kHz (±3dB); Pressure sensitivity, 90dB SPL at one watt, 100Hz – 10kHz measured at a distance of one meter on axis.

f. Input connectors shall include a two-pole barrier strip capable of accepting up to two #16AWG cables.

g. A tongue-in-groove cover with rubber wire exit grommet shall be provided to protect the input connectors from corrosion.

h. Mounting: Speaker shall be surface mounted in a horizontal configuration utilizing manufacturers provided mounting hardware.

i. Color: White

j. Where mounted outside building envelope, provide additional Hyfidrophobic™ Treatment from manufacturer to prevent moisture intrusion.
k. Basis of Design: Atlas Sound SM52T or approved substitution

~~9.~~7. Surface Speaker (Type S1)
a. Speaker Shall be a constant-directivity paging loudspeakers for use in public address or paging applications.
b. Speaker shall be rated at 40 watts at 70V.
c. Speaker shall be environment-resistant and feature a 60° x 40° (±10˚) constant-dispersion pattern across the controlled frequency band of 1.25-10 kHz.
d. Mounting shall be via a rotating bell which pivots in precise 15° increments for exact on-site positioning of projection angles. Shall include a triple lock security mounting method.
e. The Horn shall be equipped with an internal 25/70.7/100 volt transformer with screw terminal connections made beneath the rear cap. Rear cap shall facilitate armored cable.
f. Loudspeaker mounts to die-cast zinc base. Pre-mount the base to a standard 4” sq. E.O. box.
g. Basis of Design: Atlas Sound APX40TN or approved substitution

~~10.~~8. Surface Speaker (Type S4)
a. Shall consist of (2) voice tone compression drivers mounted in opposite direction utilizing a two way ceiling mount.
b. Continuous power rating shall be (15, 8, 4, 2, 1, 1/2, 1/4 watts) at
c. 70V.
d. Frequency response shall be 600 to 5500 Hz (± 5dB).
e. Sensitivity shall be 96.9dB (at 1 watt, 1 meter).
f. Dispersion shall be greater than 190° (-6dB point, 1 and 2 kHz octave bands).
g. Model shall be water/moisture sealed and constructed of die-cast zinc.
h. Unit shall operate within the temperature range of 150°F (66°C) to -30°F (-35°C).
i. Color: Shall be Grey
j. Mounting:
1) Twin housing for bi-directional mounting of two independently powered VT Series models. Unit is recommended for wall or ceiling installation in corridors and walkways.
2) Each unit includes 2 3⁄4" D (70mm) housing with base and adapter plate for parallel mounting to any 4" SQ or single-gang electrical backbox for distortion-free, bi-directional projection.
k. Basis of Design: Atlas Sound VT-158UC or approved substitution

2.11 HIGH POWERED SPEAKER ARRAY (HPSA WEATHER ALERT SYSTEM)

A. HPSA (Speaker)

1. Provide where indicated on floor plans with all require mounting hardware and adapters

2. NEMA 3R Rated enclosure
3. Provide with pole mounting kit
4. 113db peak output
5. 250W Power Handling @ 70V
6. Color: Grey
7. Basis of Design: EST Hyperpike Series #MN-HSMG25P5N

B. Visual Device (Strobe)

1. Double Flash Dual Strobe, provide at all HPSA locations with all required mounting hardware and adapters
2. Color: Amber
3. Type 4X / IP69K
4. 120VAC Operation
5. Basis of Design: Federal Signal #371DST-120A

C. HPSA-PS (Power Supply)

1. Provide power supply on TTB in each local IDF room supporting a HPSA
2. Provide Power Controller and low voltage Power Supply boards
3. Four (4) independently controlled fuse protected outputs. These power outputs can be converted to dry form “C” contacts.
4. Outputs are activated by an open collector sink or normally open (NO) dry trigger input from an external trigger. Outputs will operate in both Fail-Safe and/or Fail-Secure modes.
5. Units are designed to be powered by two (2) totally independent power sources, one (1) providing power for board operation and the other for
6. lock / accessory power.
7. Enclosure shall be as recommended by manufacturer.
8. Basis of Design: Altronix ACM4CB

2.12 LOCAL VOLUME CONTROL

A. Local volume control with a 3db per step attenuator.

1. Provide with single gang SS faceplate.
2. Wattage rating shall be as required based on load supported (10W, 35W, 100W)
3. Removable terminal strip for all wiring connections
4. Shall be rated at 70V
5. Shall be provided with a priority page relay option, relay shall be an SPDT, 24 VDC type securely mounted to the attenuator assembly wired at the factory
6. Basis of Design: AtlasIED AT##-PA (## = wattage rating)

2.13 WIRES/CABLES

A. Network Cabling - Refer to Division 27 10 00 for all cabling requirements.

B. Ambient Sensing Microphones shall be sized to allow no greater than 5 percent loss from source to head end. Lines shall be stranded twisted pair, jacketed with shield and drain wire.

1. Minimum conductor strand count: 2
2. UM type CMR/CMP as required based on application.
3. Low capacitance
4. Manufacturer
   a. Belden or EQUAL

C. Loudspeaker signal lines shall be sized to allow no greater than 5 percent loss from source to first speaker. Lines shall be stranded twisted pair, jacketed with no shield.

1. Minimum conductor strand count: 2
2. Cable size as noted on drawings or as required above. Maximum cable size: 12AWG
3. UM type CMR/CMP as required based on application.
4. Low capacitance
5. Manufacturer
   a. Belden or EQUAL

PART 3 - EXECUTION

3.1 INSTALLATION

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

B. General

1. Install equipment and cable/wires in accordance with manufacturer's instructions.
2. Install equipment, cables, and speakers as required to comply with all applicable requirements of the references and/or regulatory requirements and performance called for under PART 1 of this section of specifications, as a minimum installation requirement. Exceed this minimum requirement when called for herein.
3. Install all electrical basic materials per applicable sections of these specifications.
4. Install system cabinets/racks in locations shown; arrange to provide adequate ventilation and access.
5. Properly ground system per applicable sections of these specifications.
6. Support raceways, backboards, and cabinets under the provisions of Division 26, or, if more restrictive as required by manufacturer's instructions.
7. Install raceways to conform to applicable sections of Division 26.
8. Install sound/paging system wiring and/or raceways away from any surface that may become hot, including and not limited to, hot water piping and heating ducts.
9. Install sound/paging system wiring with at least 12 inches of separation from line voltage power wiring on parallel runs. Wiring crossing power circuits shall be at right angles. For metal enclosed electric light or power or Class 1 circuits, separation may be reduced as described in 1990 NEC 800-52 (a) (1). Increase separation if so required to comply with EIA/TIA referenced standards.

10. Raceway for sound/paging system wiring shall not be shared by power or any other electrical wiring that is not part of the low-voltage sound/paging systems.
11. Final connections, balancing, adjustments, testing, etc. Shall be factory trained technicians. When system is complete, it shall be demonstrated to owner's representative who shall be given complete instructions, part, manuals and maintenance information.
12. Make cable shields continuous at splices and connect speaker circuit shield to equipment ground only at amplifier.
13. Install input circuits in separate cables and raceways from output circuits.
14. Provide protection for exposed cables where subject to damage.
15. Use suitable cable fittings and connectors.
16. Install equipment racks in location shown; arrange to provide adequate ventilation and access.
17. All cables shall be cut to the length dictated by the run. No splices shall be permitted in any pull boxes. For equipment mounted in drawers or on slides, the interconnecting cables shall be provided with a service loop of appropriate length.

C. Pathway

1. General
   a. All raceways shall meet requirement for raceway per section, in addition to applicable requirement of sections within Division 27 of these Specifications.
   b. Raceway shall not be shared by power or any other electrical wiring that is not part of the low voltage Sound/Paging systems. Sound/Paging system wiring may be installed in underground pull boxes with other low-voltage systems provided:
      1) Installation meets/complies with all applicable codes and standards.
      2) Sound/Paging system cables are separated by at least 12 inches from any non-shielded voice/telephone/PDS wire/cable.
   c. Bend raceway with minimum inside radius of 6 times the internal diameter. Increase bend radius to 10 times for raceway larger than 2 inch size. Provide proper bend for all changes of direction. Pull and splice boxes shall not be used in lieu of a bend.
   d. Install raceways so no more than two 90o bends are in any raceway section without pullbox. Install additional pullboxes as required to maintain maximum of two 90o bends between pullboxes and/or termination points.
   e. Label all raceway at both ends to indicate destination and Sound/Paging source room. Also indicate length of raceway and this labeling/identification shall be fully documented in as-built drawings.
   f. Install polyethylene pulling string in each empty conduit over 10 feet in length or containing a bend.
   g. Properly support cables/wire not installed in raceways.

h. Special Raceway Systems: Special raceway systems may be specified for some portions of the Sound/Paging system. Refer to other sections of these specifications to determine where or if such systems are used.
i. Pathways/raceways at terminal board locations shall be neatly racked on a Kindorf type rack secured to wall above and below terminal boards.
j. Fire Stop
k. Where conduit penetrates a fire rated wall, floor, etc., firestopping shall be provided.
1) Meet all requirements for UL assembly involved. Provide firestopping UL listed for assembly and/or conduit involved.

D. Grounding

1. Equipment grounds: Grounding methods used shall be dependent upon individual equipment interconnection of chassis ground, circuit common, and power supply common within the units. Ground methods shall vary with type as follows:
a. Type A: Equipment having a 3-wire power cord with green wire of the power cord connected to chassis and where signal common is not internally connected to chassis. Make no connection from chassis ground to primary systems ground busbar in Equipment Rack.
b. Type B: Equipment having a 3-wire power cord with green wire of the power cord connected to chassis and signal common can be connected to chassis ground at the user's option.
c. Make no connection from chassis ground to primary system busbar, but do make connection with 14 AWG insulated wire from circuit common to primary system ground busbar in equipment rack. Be sure to separate circuit common from chassis ground.
d. Type C: Equipment having a 2-wire power cord, no green wire, neutral is not tied to chassis, and circuit common is tied to chassis. Make connection from chassis to primary system ground busbar using 14 AWG insulated wire.
e. Audio cable shields shall be grounded at one point only, without exception. For inter- and intra-rack wiring this requires that the shield be connected at one end only, this shall be at the input to a device. The shield shall be lifted at the device output. For ungrounded portable equipment, such as microphones, the shield shall be connected at both ends but grounded at only one end.
2. Contractor shall not deviate from the above, except if necessary to minimize crosstalk and to maximize signal-to-noise ratios.

E. Speakers

1. Mount ceiling speakers in pattern acceptable to architect in coordination with lights, sprinkler heads, etc and as directed by ceiling system contractor, manufacturer, and installer. Provide all required mounting hardware and/or accessories. In general, all speakers shall be recessed mounted in the ceiling system.
a. Speakers mounted in acoustical tile ceilings shall have Support Bridge.

F. Microphone Stations

1. Install microphone station where indicated on drawings.
2. Mic station shall be programmed to provide paging to all required areas based on installation location. Match existing configuration of north terminal paging stations and coordinate with GOAA operations prior to programing to confirm exact paging requirements at each location.

G. Elevators

1. Provide dedicated speaker circuit for each elevator shaft and connect to in cab speaker via elevator travel cable.
2. Coordinate exact interface requirements with elevator installers prior to installation to ensure they are providing correct follower cable to support in cab speaker.
3. Interface shall be made between paging system and elevator equipment in elevator control room. No connection allowed in shaft.

H. Cable/Wire

1. Splice cable only at terminal block units located in terminal cabinets.
2. Speaker cabling may not be “T” tapped and shall be supervised with EOL device. All speaker circuits shall be installed per IED manufacturer recommendations.
3. Make cable shields continuous at splices and connect speaker circuit shield to equipment ground only at building surge protection devices and at amplifier and/or as otherwise required by applicable codes.
4. Install input circuits in separate cables and raceways/pathways from output circuits.
5. Install all cables no closer than 12" from any wire/cable installed for Premise Distribution System, power system cable/raceway, or fluorescent/ballasted light fixtures.
6. Leave 12 inches excess cable at each termination at speaker and termination blocks.
7. Leave 12 feet excess cable at the central system equipment/rack.
8. Provide protection for exposed cables where subject to damage.
9. Use suitable cable fittings and connectors.
10. Label cable at both ends indicating the originating and terminating location of each end. This labeling/identification shall be fully documented in as-built drawings.
11. Cables shall not be installed with bend radium less than that specified by the cable manufacturer.

I. Weather Alert System

1. Owners Vendor to provide PLC and Annunciators (Primary / Secondary) to be located in the ECS head end at ASC and provide inputs into the ECS system for the following alert conditions:
   a. Level 1
   b. Level 2
   c. Level 3

d. All Clear

2. Contractor shall install vendor provided equipment into rack mounted panel in ECS Head End. Refer to details.
3. System shall activate visual devices under all Levels, and deactivate once all clear is received
4. Audible Notification shall be via pre-recorded message alerts
   a. Coordinate with OAR for exact message content
5. Contractor shall coordinate with OAR to confirm final sequence of operation
6. Provided in ECS IDF rooms:
   a. Provide Logic Relay with output to trigger wall mounted power supply for visual notification device.
   b. Provide HPSA-PS (Visual device power supply) where indicated on drawings or as required to support local HPSA strobe.
   c. Connect local HPSA to dedicated amplifier circuit in ECS cabinet
7. Contractor shall provide surge protection on both speaker and visual device circuits supporting the HPSA's
8. Mounting:
   a. Coordinate all mounting with architect and structural engineer. Contractor to provide Signed and Sealed engineered shop drawings indicating exact mounting condition and wind loading calculation as required by local codes and standards.
   b. Contractor shall fabricate mount using all SS hardware.

J. IPTV Interface

1. Interface with IPTV payers located in adjacent IDF room from ECS equipment cabinets. Each IDF shall be provided with a relay output to trigger the local video players / controller to mute audio / video signals.
2. Local relay shall be configured to activate when an airport page or emergency message is routed thru a local amplifier

K. Room Volume Control

1. Where indicated on drawings provide a priority page override volume control for the local room speaker/s.
2. Where required to support local volume control devices, install additional Logic Relay Module in ECS cabinet to provide trigger output to activate the priority page relay in all local volume controls.
3. Provide power supply in ECS cabinet sized as required to handle local paging relays connected, as recommended by the manufacture.
4. Priority Page relay shall activate when an emergency / fire page is made

L. Ambient Sensors

1. Route all sensors to same amplifier as corresponding speaker circuit.

3.2 FIELD QUALITY CONTROL

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

B. Provide services of service representative to supervise the field assembly and connection of components and the pre-testing, testing, and adjustment of the system.

C. Pre-testing: upon completing installation of the system, align, adjust, and balance the system and perform complete pre-testing. Determine, through pre-testing, the conformance of the system to the requirements of the specifications. Correct deficiencies observed in pre-testing. Replace malfunctioning or damaged items with new and retest until satisfactory performance and conditions are achieved. Prepare forms for systematic recording of acceptance test results.

D. Report of pre-testing: after pre-testing is complete, provide a letter certifying the installation is complete and fully operable, including the names and titles of the witnesses to the preliminary tests.

E. Final test notice: provide a 10-day minimum notice in writing when the system is ready for final acceptance testing.

F. Verify the absence of unwanted voltages between circuit conductors and ground.

G. Megger test all conductors other than those intentionally and permanently grounded with electronic components disconnected. Test for resistance to ground. Report readings less than 1-megohm for evaluation.

H. Test all conductors for short circuits utilizing an insulation-testing device.

I. With each circuit pair, short circuit at the far end of the circuit and measure the circuit resistance with an ohmmeter. Record the circuit resistance of each circuit on the record drawings.

J. Verify the ACS control unit is in the normal condition as detailed in the manufacturer's operating and maintenance manual.

K. Test the system for all specified functions according to the manufacturer's operating and maintenance manual.

L. Re-testing: correct deficiencies indicated by tests and completely retest work affected by such deficiencies. Verify by the system test that the total system meets the specifications and complies with applicable standards.

3.3 TESTS AND ADJUSTMENTS

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

B. The Contractor shall perform all tests and adjustments prior to the system demonstration and acceptance test.

C. The Contractor will provide the test instrumentation such as, precision sound level meter, real time, audio frequency analyzer, dual trace oscilloscope, random noise generator, Impedance Bridge, etc. And as previously submitted and approved.

D. Provide permanent staff - trained personnel to perform the tests and to adjust and equalize the systems, there will be no exceptions.

E. Measure and record the input impedance of any active device used to terminate passive devices and record the total impedance of all such devices. Record the dc resistance of any terminating resistor used.

F. Measure and record the frequency response of each mixer preamplifier and power amplifier in the system. Adjust as required.

G. The documentation of tests, measurements and adjustments performed will include a list of personnel and the list of certified test equipment used.

H. All information recorded from all testing is to be shown on the as-built documents.

I. Speaker Circuits:

1. Measure and record the impedance of each loudspeaker line before connecting the line to the output of its respective amplifier. Adjust, so that the load impedance will be equal to or greater than the rated impedance. Record the total impedance.
2. Provide ground fault test on all speaker circuits before connecting to amplifier outputs.
3. Perform polarity check on all speaker circuits prior to connection to amplifier outputs.
4. Contractor to adjust speaker tap values and amplifier settings to achieve a target SPL of 90db and configure ambient sensors to maintain 15db above ambient up to 95db max

J. Steerable line array aiming requirements:

1. Contractor shall level, balance, and adjust the digitally steerable speakers for optimal levels, speech intelligibility, and overall sound quality.
2. The Contractor shall coordinate a walk through with the Authority, OAR, and Engineer to demonstrate options for the steerable array software beam patterns.
3. The Contractor shall validate the horizontal aiming angle on site.
4. The Contactor shall engage an entity experienced in adjusting public address emergency communications systems in large atrium environments.

K. Messaging:

1. Test message playback thru out buildings including message request from Mic Stations, NTLS Comm Center, and Automated FIDS messages.
2. Test interface between FIDS (AIDB) and ECS system controller for purpose of automated flight information messages.
3. Test curtesy message playback and automated schedule

L. Contractor shall adjust all speaker tap values, amplifier power setting, DSP (EQ, Limiters, Compressors) as required to provide a NFPA compliant ECS audio system meeting all intelligibility and audibility requirements

M. Configure all ambient audio sensors for each speaker circuit being controller to allow for a 15db over ambient SPL. Adjustments and demonstration shall be made when building is empty and occupied to simulate daytime and nighttime ambient levels and prove system functionality. Testing shall be with AHJ, Owner, and EOR.

1. Contractor shall include all additional time required to make all requested adjustments after demonstration.

N. Test function of ALL fire alarm supervision and control relays during fire alarm activation and for system supervision.

3.4 SYSTEM DEMONSTRATION AND ACCEPTANCE TEST.

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

B. The demonstration and acceptance test will be performed after the system test and adjustments have been completed.

C. The demonstration of the system shall be by the contractor.

D. All final "as-built" drawings, run sheets, manuals, and other required documents, as detailed herein, shall be on hand. Two complete sets of these documents shall be delivered to the owner at this time. (One complete set shall have been delivered to the consultant prior to the scheduling of acceptance tests).

E. In the event further adjustment is required, or defective equipment must be repaired or replaced, tests may be suspended or continued at the option of the consultant.

3.5 OWNER PERSONNEL TRAINING

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

B. During training Use submitted operation and maintenance manual as reference. Supplement with training materials as required.

END OF SECTION 27 51 13

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
2. Refer to Specification Section 01 81 13.14 “Sustainable Design Requirements - LEED v4 BD+C” for additional 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 located thru ought the 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 throughout the STC. 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 of all equipment over 2000CFM.
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, and clean agent 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. Two Way Radio System Supervision - Provide all code required supervision of entire TWRS and indicate status via FAAP and Fireworks Workstations. Refer to 27 53 19 For additional information and requirements

1. Contractor shall provide local supervision modules where TWR Equipment is indicated on drawings for required monitoring of TWRS status.
2. TWRA shall be located where shown on plans and shall provide required indication of TWRS status. Refer to NFPA 72 Chapter 24.9 and NFPA 1221 for all additional requirements.
3. Systems shall supervise the following parameters for all TWRS equipment; Master Station, BDA, FDU, RDU, UPS/Battery etc.
   a. Normal AC Power Available
   b. Signal Booster Trouble/Failure
   c. Antenna Malfunction
   d. Loss of Normal AC Power
   e. Failure of Battery Charger
   f. Low Battery Capacity – Indicate when Generator Fuel Tank and/or Battery Capacity's at 70% of the 12hr Run time.

~~P.~~Q. 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.

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. 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 the following additional 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. The following shall be included with all required raceway, cable, programming, power supplies, modules, etc. required for them to be completely operational.

1. (40) Additional Visual notification strobes
2. (20) Connections to Fire / Smoke Dampers with associated duct detectors
3. (20) Additional smoke detectors
4. (10) Relays for AHU shutdown
5. (10) Manual Pull Stations

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.
      1) NFPA 72: Chapter 24 Emergency Communications System
      2) NFPA 72: Chapter 24.3.3 Required Emergency Communications Systems
      3) NFPA 72: Chapter 24.3.5.2 Loudspeakers for ECS
   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.
   n. UL 1224
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.

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. Existing Fireworks PC Workstation and graphics to be updated to include the additional areas being added and/or modified.

B. Panel shall indicate 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.

D. Shall be extension of existing EST3 FA System and compatible with all existing equipment

E. Basis of Design: EST3

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, 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. Supervision: Provide local EST3 motherboard and required modules to supervise the VESDA control panels at all locations. Shall report trouble, supervisory, and alarm conditions at a minimum.
21. Manufacturer: VESDA-E #VEU-A10

2.8 NOTIFICATION APPLIANCES

A. General:

1. All notification devices shall be white in color

B. Interior Visual Alarm Devices: Xenon strobe lights with clear 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. Exterior Visual Alarm Devices: Xenon strobe lights with clear polycarbonate lens. Mount lenses on a Red 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. Provide gasket and SS hardware
7. Comply with UL 1971.
8. Manufacturer: EST3
   a. Exterior Locations: CS405 Series

D. 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.”

E. 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.

F. 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 shall be provided with MFC-A enclosure
6. Manufacturer: EST3 #UIO6/R

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. Calculations shall be submitted at time of sop drawings review.

G. Piping and detections shall be configured for cross zone detections as indicated on drawings. Provide all required equipment to accommodate this requirement.

H. Contractor shall provide test point in a readily accessible location for annual system testing.

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.

3.12 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.

3.13 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.

3.14 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.

3.15 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.

3.16 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.)

3.17 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.
   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.

3.18 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.

3.19 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