SECTION 33 52 43.24 - FUEL SYSTEM INSPECTION, TESTING, AND FLUSHING

PART 1 - GENERAL

1.1 DESCRIPTION:

A. This Section of the specifications describes inspection of all fabrication, assembly and installation performed to construct the hydrant system and isolation valve vaults..

B. Testing of all fuel system controls, operations, equipment and systems.

C. Flushing of all piping and equipment within the system.

1.2 RELATED DOCUMENTS:

A. American Society for Testing and Materials (ASTM):

1. D1655 - Standard Specification for Aviation Turbine Fuels

B. American Society of Mechanical Engineers (ASME)

1. B31.3 – Process Piping.
2. PCC-2-2015 - Repair of Pressure Equipment and Piping

C. American Petroleum Institute (API):

1. Spec 5L - Line Pipe.
2. API RP 1110 – Recommended Practice for the Pressure Testing of Steel Pipelines for the Transportation of Gas, Petroleum Gas, Hazardous Liquids, Highly Volatile Liquids, or Carbon Dioxide.
3. Std. 2015, Safe Entry and Cleaning of Petroleum Storage Tanks.

D. American Welding Society

E. Energy Institute Standards (EI)

1. EI 1581 - Specifications and Laboratory Qualification Procedures for Aviation Fuel Filter-Water Separators
2. EI 1590 - Specifications and Qualification Procedures for Aviation Fuel Microfilters
3. EI 1596 - Design and Construction of Aviation Fuel Filter Vessels

F. National Electrical Manufacturer's Association (NEMA)

G. Laboratory listing services for specific methods of construction, fabrication and assemblies shall be as specified in Section 33 52 43.00 - Fuel System General Provisions.

H. American National Standards Institute (ANSI)

1.3 RELATED SECTIONS

A. Section 09 97 13.00 - Fuel System Coatings

B. Section 33 52 43.00 - Fuel System General Provisions

C. Section 33 52 43.24 - Fuel System Inspection, Testing, and Flushing

D. Section 33 52 43.13 - Aviation Fuel Pipe, Fittings, and Installation

E. Section 33 52 43.15 - Fuel System General Valves

F. Section 33 52 43.25 - Fuel System Service Pits and Access Covers

1.4 QUALITY ASSURANCE:

A. All tests shall be performed in accordance with the applicable codes, standards, and Contract Documents.

B. All Work, as specified herein, shall be observed by the Engineer's Representative.

1.5 SUBMITTALS:

A. The Contractor shall develop, submit for review and approval, written plans for all testing and flushing.

B. The testing and flushing plans shall include but, not be limited to the following:

1. Identification of system or component
2. Temporary pipes pumps, and filtration equipment to be used during Event
3. Date and time to be performed
4. Method and Description of Event
5. Coordination of approvals
6. Event results
    a. Weld integrity test results
    b. Pneumatic test results
    c. Hydrostatic test results
    d. NACE coating inspection and test results
7. Conclusions and recommendations

C. The Contractor shall submit for examination by the Engineer's Representative, qualifications of the personnel to be utilized in testing and flushing prior to proceeding.

D. All inspections, testing and flushing tasks shall be recorded and certified by the Contractor and shall include the signatures of the personnel involved.

PART 2 - MATERIALS

2.1 EQUIPMENT:

A. The Contractor shall provide all necessary devices to test the completed piping system. Items shall include but, not be limited to the following:

1. Air compressors
    a. Air compressors shall be equipped with condensate dryer system and filter capable of generating oil-free air at -20 degrees F dew point.
    b. Air compressors shall have sufficient capacity to bring the system pressure in a maximum of 60 minutes.
2. Pressure and temperature recorders
    a. Provide certified and calibrated test instruments capable of recording direct temperature, pressure and time in the same scale and chart.
    b. Submit data for test instruments and certificates of calibration. Calibration certificates must be dated within one year of test date.
    c. In lieu of circle chart recorders, calibrated transmitters can be used and the electronic data collected can be submitted in tabular. Provide a certified copy of test data.
3. Deadweight Tester
    a. A calibrated deadweight tester shall be used along with the circle chart recorder or transmitters, to provide continuous calibration.
    b. Submit literature and calibration certificate on deadweight testers. Calibration certificates must be dated within one year of test date.
4. Temporary piping
    a. Provide all piping, fittings, valves, gauges, hoses, pumps, filters, tanker vehicles and equipment required to test and flush and inspect all segments of the system.
5. Pumps
    a. Pumping capability shall be provided by the contractor to flush the system as described in this specification.
6. Electronic Holiday Detectors
7. Temporary Filtration
    a. Filter vessels complying to Energy Institute Specifications

2.2 FUELS:

A. The Contractor shall perform hydrostatic testing of the new Jet-A pipe. The Owner will provide the Jet A fuel required for the hydrostatic testing. The fuel shall meet ASTM D1655, latest revision specification for Jet A Type Aviation Turbine Fuel.

PART 3 - EXECUTION

3.1 GENERAL:

A. The Contractor shall be responsible for completing all inspection, testing, and flushing procedures as outlined in this specification for the complete fueling system as a whole.

B. The Contractor shall be responsible for the operation of all permanent and temporary equipment and systems and conduct all performance tests in a safe and effective manner. The Contractor shall provide all the necessary equipment, tools, media and labor required for the proper performance of the tests.

C. The Owner shall be responsible for the procurement and delivery of all fuel required for testing and flushing. The fuels to be purchased shall be Jet-A per ASTM D1655.

D. Water shall not be used for the testing and flushing of any aboveground fuel piping or components.

E. The Contractor shall be responsible for establishing all testing procedures and shall demonstrate operation completed “system” to the Owner and Engineer at the time of commissioning.

F. Upon completion of system testing and flushing, the fuel shall be tested to determine cleanliness and adherence to ASTM D1655 for Jet-A. The fuel that is determined acceptable for use, shall be retained in storage. In the event the fuel is unacceptable for use, it must be removed from the system and site at the Contractor’s expense. The contractor shall observe diligent care not to waste, spill, or contaminate the fuel. The cost of fuel spilled, wasted, or contaminated shall be paid for by the Contractor at the Owners purchase rate times a 1.20 multiplier. The Contractor shall also be responsible for any and all required clean up caused by their spill at no additional cost. The Contractor will receive a credit for this fuel on the final payment of this Contract.

3.2 WELD INTEGRITY TESTING

A. All butt welds for field and shop fabricated piping for belowground installation (including those welds within a pit/vault) shall be 100 percent radiographed. All carbon steel socket welds for field and shop fabricated piping for installation within a pit or vault, shall be 100 percent magnetic particle inspected. Ten percent (10%) of all aboveground piping welds shall be inspected by a third party inspector using the following methods: butt welds shall be radiographed and all remaining welds, including socket welds and O'lets, shall be magnetic particle inspected. Stainless steel piping shall be dye penetrant tested in lieu of magnetic particle testing.

B. All fillet welds on hot tap weldolets or fittings and on Plidco couplings shall be magnetic particle tested.

C. Piping where factory welds have been performed, must also be radiographed or tested by an approved testing laboratory with results provided to the Contractor upon delivery and receipt of the piping. Forward results of the testing to the Owner and Engineer.

D. All weld integrity-testing costs, including test reports and interpretation, are the responsibility of the Contractor. An independent testing laboratory employed by the Contractor, and subject to approval by the Owner and Engineer, shall perform the weld integrity testing. All testing shall be performed in accordance with ASME B31.3.

E. All welds shall be left exposed until radiographed, processed, and certified. Any weld that is determined to be defective by the testing laboratory shall be repaired in accordance with ASME B31.3. The Contractor shall be responsible for all costs associated with the weld repair.

F. One film negative of each radiograph shall be made. Each negative shall be identified as to location. Negatives shall be turned over to the Owner at the end of the project. An expert interpretation by a recognized testing laboratory shall be submitted in report form for every weld to the Owner and the Engineer throughout the progress of the work. The report shall show date of test, location, area, film number, weld number and other pertinent information. Weld numbers and weld location shall be clearly indicated on final As-Built fabrication layout drawings for future identification.

G. Temporary radiographic identification markings shall be located on the piping near the welds. Do not use identification stamps. Contractor shall temporary identify welds with a paint pen or permanent marker. This identification shall be removed in the final coating process after acceptance testing.

H. The Independent Laboratory making the tests shall interpret test results and any defects found shall be repaired by the Contractor and a new radiograph taken of the repair. The cost for inspection of defective welds shall be the responsibility of the Contractor at no cost to the Owner.

I. The Contractor shall coordinate the weld integrity testing with the testing lab, making certain that adequate notices are given that the welds are available for testing.

J. Backfilling of the piping shall not commence until tests have been approved by the Engineer and pressure tests have been completed.

3.3 PNEUMATIC PRESSURE TESTING OF FUEL PIPING

A. General: The entire newly installed, fuel distribution piping shall be pneumatically pressure tested after all joints are completed, in accordance with ASME B31.3. Contractor shall perform test at the completion of each phase prior to backfilling belowgrade piping operations where feasible. Sections of the system may be tested and accepted in order to expedite the work or are required due to phasing requirements. These sections shall be tagged by the Contractor to indicate compliance with the tests.

B. Contractor shall submit testing plan which includes the following:

1. Identify the test segments inlcuding length and volume of piping.
2. For underground piping installations, identify if piping will be in the pipe trench during the test or if it will be staged aboveground next to piping trench. Identify all surrounding hazards or safety precautions to be taken. The following link may be used to determine the safe distance per ASME PCC-2. https://www.piping-world.com/safe-distance-and-stored-energy-calculator-pneumatic-test3.
3. Identify the proposed test pressure to ensure the test segment results in a maximum stored energy equating to a safe distance of 100 ft or 30m per ASMEPCC-2-2018

Section 501-III-1(a) and ASME PCC-2-2018 Section 501-III-1(b) with a maximum test pressure not to exceed 25 psig.

C. Install temporary closures or other fittings, including plugs, weld caps, blind flanges, etc., as necessary to facilitate the testing process.

D. Equipment, which is not rated by the manufacturer for the test pressure, shall be removed or isolated prior to testing. Install temporary connections as necessary. All permanent butterfly and plug valves and equipment, which are rated at the test pressure or greater, shall be in place during the pneumatic tests.

E. Test Procedure: Tests shall be made with clean dry-filtered and oil-free compressed air (-20 degrees F pressure dew point) or compressed nitrogen gas and shall be made in accordance with all applicable codes particularly with regard to safety precautions and the following:

1. A preliminary check of the fuel distribution piping at a test pressure of approximately 25% of the final test pressure shall be made.
2. The pressure shall be increased gradually in steps, providing sufficient time to allow the piping to equalize strains during the test, and to be checked for leaks. Final test pressure shall be as calculated per ASME PCC-2-2018 methods identified above.
3. Test duration shall be minimum of 1 hour.

F. The Contractor shall provide certified and calibrated temperature and pressure instruments and chart recorders and a deadweight tester to provide continuous calibration and direct readings of time, temperature, and pressure on the same scale and chart during the tests. Test Certifications and recorder charts shall be submitted to the Engineer for approval prior to final acceptance of the piping. Calibrated thermocouples may be surface applied to the piping but must be placed in the shade to eliminate the heating effects of direct sunlight. When testing buried piping, the thermocouple shall be placed in the backfill of the piping to obtain a representative temperature of the piping. In lieu of circle chart recorders, electronic data can be submitted using calibrated transmitters. Provide a certified copy of test data.

G. An acceptable test shall be one in which the pressure and temperature remain stabilized within 10% of the test pressure. A rise in temperature shall result in a rise in pressure and vice versa. Visually inspect all welds as available.

H. Repair any leaks detected. Retest at four (4) hour pressure cycles, as described above after all leaks have been repaired. Repeat repair and testing cycles until the system is acceptable to Engineer.

I. The recordings shall be made after temperature and pressure have stabilized and shall be conducted in accordance with NFPA Codes and API RP1110 and this specification.

3.4 HYDROSTATIC PRESSURE TESTING OF FUEL PIPING

A. After a successful pneumatic test has been completed, the Contractor shall begin preparation for hydrostatic testing.

B. The Contractor shall remove all control valves, meters, and other equipment, which are not rated by the manufacturer for the test pressure of 275 psig. Piping spools and blind flanges shall be provided and installed by the Contractor.

C. If jet fuel is to be used, then prior to hydrostatic testing, the Contractor shall coordinate with the Fuel System Operator to carefully fill the fuel system piping with the proper grade of fuel. During the filling process care should be taken to properly vent all high points to disperse all air pockets.

D. The Contractor will provide the required amount of fuel for the initial line fill and hydrostatic testing.

E. The hydrostatic testing shall be in accordance with ASME B31.3 (latest edition) and shall include a two-step process. The initial step will be to gradually bring system pressure up to 100 psig and inspect all joints, components and connections. The second step will be to gradually bring system pressure up to 275 psig and recheck all joints, components, and connections.

F. The actual test shall be to hold pressure at 275 psig for two hours, decrease pressure to 50 psig through high point vents, and increase pressure to 275 psig and monitor for 4 hours.

G. During the testing period, if a leak develops, the Contractor shall abort the test, repair the defect and restart the test from the beginning.

H. The Contractor shall provide certified and calibrated temperature and pressure instruments and chart recorders and a deadweight tester to provide continuous calibration and direct readings of time, temperature, and pressure on the same scale and chart during the tests. Test Certifications and recorder charts shall be submitted to the Engineer for approval prior to final acceptance of the piping. Calibrated thermocouples may be surface applied. In lieu of circle chart recorders, electronic data can be submitted using calibrated transmitters. Provide a certified copy of test data.

3.5 INSPECTION OF PIPE COATINGS:

A. The Contractor shall inspect all exterior pipe and joint coatings with a Holiday Tester to locate any damage to the protective coatings during the course of construction.

B. This element of testing shall take place after all welding and radiographing has been completed, but before any section of belowgrade piping is lowered into the trench.

C. The inspection shall be performed by using an approved tester at a voltage recommended by the coating manufacturer.

D. All damaged sections shall be repaired by using the procedures and materials specified in Section 09 97 13.00 - Fuel System Coatings.

3.6 SYSTEM FLUSHING:

A. It shall be the Contractor’s responsibility to provide the Owner with a complete and functional system. One important aspect of this accomplishment is the interior cleanliness of the piping system. Therefore, this becomes a critical part of the Contractor’s responsibility.

B. The Contractor shall be responsible for providing and installing all temporary manifolds, connections and devices to facilitate the flushing process.

C. The Contractor shall provide temporary secondary containment surrounding the temporary flushing equipment, including pumps, filters and portable tanks.

D. The Contractor shall have at minimum one person observing the system for leaks during flushing activities. Equipment shall not be left running and unattended.

E. Prior to starting the flushing process, the Contractor shall develop a detailed procedure, sequence and schedule for approval by the Engineer and Fuel System Operator (DFW Fuel Company LLC c/o Menzies). Flushing procedure may include a combination of the following:

1. A temporary closed loop system for recirculation with Contractor provided temporary piping, pumping, and filtration equipment.
2. A temporary once through method using the existing hydrant system supply through the new piping section and into temporary tanks or transport trucks.
3. A temporary once through system using temporary tanks to supply fuel to temporary pumping and filtration equipment through the new piping segment and into temporary tanks receiving the flushing fuel.
4. By swabbing clean short sections of piping where flushing is not possible.

F. Components such as control valves, strainer baskets, hydrant valves and control devices shall not be in place during flushing.

G. The desired velocity rate for flushing is 10 feet per second to satisfy Airline QA Standards. To accomplish this, the Contractor must provide temporary pumps and filter/separators to supplement the permanent system in order to obtain the desired flow rate and velocity.

H. A two-test minimum is required to ensure piping cleanliness. The system being flushed must be displaced with clean fuel prior to taking second test.

I. Acceptance Specifications:

1. Visual - All fuel samples must be clear and bright. Other visual clues must be observed and acted upon accordingly, i.e.; feel, color, odor, etc. This test shall be performed with a minimum of 1 gallon of each fuel used in the system.
2. Perform a membrane test per ASTM D2276 for the Jet-A system. A minimum of 1 gallon of jet fuel shall be used for this test. Membrane shall be dried and visually compared with a color rating booklet. The color shall be a maximum of A2, B2, or G2 with a particulate contamination not exceeding the B scale on the shell particle assessment guide. Flushing shall continue and the membrane test repeated, until a sample is obtained which meets these requirements. 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.
3. Water - 15 ppm maximum.
4. Water Separation (MSEP) Rating - 85 WSIM minimum.

J. Final Acceptance:

1. It shall be the responsibility of the fuel system operator(Menzies), or his designee, to have final decision on system cleanliness and acceptance before aircraft fuel servicing is permitted.

K. After flushing has been completed and approved, the Contractor shall remove all temporary cross connections, spool pieces, etc., and install control valves, metering elements, strainer baskets, etc. The Contractor shall also be responsible for replacing all filter media and cleaning the interior of aboveground fuel storage tanks and filter vessels after flushing has been completed so that the entire facility may be received in a new and clean condition. Additionally, the tanks shall be inspected visually following the flush. The Contractor shall be responsible for cleaning the tank if deem required by the Fuel System Operator.

3.7 SYSTEM TESTING:

A. After all individual devices and components have been tested and after the piping system has been tested and flushed, the Contractor shall perform overall operational system tests. It shall be the responsibility of the Contractor to debug, test and verify operation of the installed systems in complete conformance to itemized functions of each component and system as identified throughout Division 9, 26 and 33.

B. The Contractor shall be responsible for establishing all testing procedures and shall demonstrate operation of each completed “system” to the Engineer, Fuel System Operator and the Owner. Each demonstration may be video recorded by the Owner at his discretion.

C. All tests shall be witnessed by representatives of the Engineer. The Contractor shall notify the Engineer at least 7 days in advance of the approximate proposed date of test followed by no less than 48 hours advance notice.

D. All instruments required to conduct the tests shall be furnished and operated by the Contractor using experienced and qualified personnel.

E. At a minimum, the following tests must be completed:

1. Hydrant Valve Pit operation
2. Emergency Shutdown
    a. With one fueling pump circulating fuel through the system, test each “Emergency Stop” pushbutton station to verify that terminal entrance isolation valves close and that appropriate notification and alarm annunciation is received at the fuel farm control panel.

3.8 LEAK DETECTION SYSTEM:

A. The Airport utilizes a leak detection system manufactured by Hansa Consult of North America, LLC (HCNA). The existing leak detection system shall be modified to incorporate the new fuel work into the leak testing protocols. Contractor shall coordinate with HCNA to secure and perform testing and re-certification as required to integrate the new work into the existing system.

HCNA

HANSA CONSULT OF NORTH AMERICA, LLC

200 INTERNATIONAL DRIVE

BLDG. 120

PORTSMOUTH, NH 03801

603.422.8833

END OF SECTION 33 52 43.24