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, access roads, haul roads, 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. This excludes removal of cement stabilized soil bases and subbases. Suitable material shall be used in fill areas and shaped and compacted as specified herein. All excess material shall be removed from the airport property.

Unclassified Excavation shall include, as incidental, the placement of the excavated material as embankment as needed or at a waste area designated by the Program Manager, in successive lifts, and at the compaction requirement specified in Section 152-2.8.

b. Undercut Excavation. This item shall consist of the removal and disposal of deposits of mixtures of soils not suitable for use as subgrade material, as determined by the Program Manager. This shall also include excavation and disposal of material soft spots encountered in the subgrade observed during the performance of proofrolling operations. Such over-excavation of material soft spots shall not include over-saturated material resulting from the Contractor’s failure to properly drain the grade or due to over application of water during subgrade preparation. This item shall also include, as incidental, the replacement of the over-excavated material with excess Unclassified Excavation materials obtained from grading operations or granular backfill as approved by the Program Manager, compacted and brought to grade as required in this specification.

c. Unsuitable Material Excavation. This item shall consist of the removal and disposal of contaminated soils, unsuitable material for use in subgrade construction, embankment fill, or topsoil. Unsuitable material excavations shall include any materials containing vegetative or organic matter such as muck, peat, organic silt, sod, and/or garbage; materials containing rubbish, trash and/or debris; materials containing waste such as bulky waste, commercial solid waste, construction and demolition waste, domestic waste, farming waste, industrial waste, landscaping waste, and/or land clearing waste. Unsuitable material excavation shall also include petroleum impacted soils and other such hazardous waste. Petroleum impacted soils and hazardous waste shall be disposed of off airport property at the Contractor’s expense. This item shall also include, as incidental, the replacement of the excavated unsuitable material with excess Unclassified Excavation materials obtained from grading operations or granular backfill as approved by the Program Manager, compacted and brought to grade as required in this specification. Materials designated by the Program Manager as petroleum impacted oils or as hazardous waste will be handled by the MSCAA Environmental Department.

The Tennessee Department of Environment and Conservation (TDEC) defines some of the above listed waste materials in accordance with Chapter 0400-11-01, as follows:

Bulky Waste: large items of solid waste such as white goods, furniture, autos or large auto parts, trees, branches, stumps, and other oversize waste whose large size precludes or otherwise complicates their handling by normal collection, processing or disposal methods.
Commercial Solid Waste: all types of solid waste generated by stores, offices, restaurants, warehouses, and other manufacturing activities, excluding domestic and industrial waste.

Construction/Demolition Waste: waste other than special waste resulting from construction, remodeling, repair and demolition of structures and/or road construction. Such waste includes, but is not limited to, bricks, concrete, masonry materials, rock, lumber, road spoils, rebar, asphalt and other such paving materials. These types of waste are not associated with, and shall not be paid for as, demolition of pavements otherwise identified for demolition as a part of this project unless otherwise directed by the Engineer.

Domestic Waste: any solid waste, including garbage and trash, derived from single and multiple residence households, hotels, motels, bunkhouses, ranger stations, crew quarters, campgrounds, picnic grounds, and day-use recreational areas.

Farming Waste: means the wastes from the customary and generally accepted activities, practices, and procedures that farmers adopt, use, or engage in during the production and preparation for market of poultry, livestock, and associated farm products; and in the production and harvesting of agricultural crops which include agronomic, horticultural, and silvicultural crops and wastes resulting from aquaculture activities. However, the term does not include special wastes such as waste oils or other lubricants, unused fertilizers, or pesticide containers or residues.

Hazardous Waste: hazardous waste shall be as defined in subparagraph (1)(c) of Rule 0400-12-01-.02.

Industrial Waste: solid waste produced in, or generated by, industrial or manufacturing processes. The term does not include commercial, domestic, mining, or hazardous waste regulated under and subject to the Resource Conservation and Recovery Act (RCRA) Subtitle C), or oil and gas waste.

Landscaping and Land Clearing Waste: trees, stumps, brush, dirt, branches, leaves, clippings, etc. from landscaping and land clearing activities.

Mixed Solid Waste: a mixture of organic and inorganic discards and may contain household and other municipal solid wastes that are excluded from regulation as hazardous wastes.

Special Waste: are solid wastes that are either difficult or dangerous to manage and may include sludges, bulky wastes, pesticide wastes, medical wastes, industrial wastes, hazardous wastes which are not subject to regulations under Rules 0400-12-01-.03 through 0400-12-01-.07, liquid wastes, friable asbestos wastes, and combustion wastes.

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 by the Program Manager within the limits of the airport property but outside the normal limits of necessary grading, or from areas outside the airport boundaries. The use of borrow material and the need for borrow excavation is not anticipated under this project.

152-1.3 Granular backfill. Granular backfill shall consist of material meeting the requirement of Item P-209 Crushed Aggregate Base Course or P-219 Recycled Concrete Aggregate Base Course.

152-1.4 Subgrade preparation. Subgrade preparation shall consist of the preparation of the underlying subgrade directly below any overlying base or subbase. Subgrade preparation shall occur and subsequent acceptance by the Program Manager shall be obtained prior to the placement of any overlying materials. The subgrade areas designated under pavement shall be prepared in accordance with this specification to meet compaction, grade, and smoothness acceptance criteria.
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.

The suitability of material to be placed in embankments shall be subject to approval by the Program Manager. All unsuitable material shall be disposed in Contractor furnished disposal areas off airport property. 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 Program Manager.

When the Contractor’s excavating operations encounter artifacts of historical or archaeological significance, the operations shall be temporarily discontinued and the Program Manager notified per Section 70, paragraph 70-20. At the direction of the Program Manager, 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, to loosen and pulverize the soil. Stones or rock fragments larger than 4 inches in their greatest dimension will not be permitted in the top 6 inches 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 Program Manager, 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.

The Contractor shall maintain positive drainage at the project site at all times. When drainage pipes cross project phase lines, the Contractor shall take those steps necessary to maintain temporary positive drainage of the affected system. Temporary drainage shall be required and, unless otherwise specified, shall be considered incidental to those operations requiring it’s use in order to complete the work.

Lime may be allowed at the Program Manager’s discretion for the sole purpose of drying soils with high moisture contents where aeration and manipulation of the soil have failed to reduce the moisture content to within tolerance of optimum. Lime shall also be allowed, at the Program Manager’s discretion, to protect the Contractor’s progress by acceleration of compaction efforts in advance of anticipated rain events. Code “L”, Hydrated, or Quicklime are acceptable for use. Use of agricultural lime shall not be allowed.

152-2.2 Excavation. No excavation shall be started until the work has been staked out by the Contractor on a maximum 50’ x 50’ grid for both horizontal and vertical control and the Program Manager has obtained from the Contractor, the survey notes of the elevations and measurements of the ground surface. The Contractor and Program Manager 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. Prior to disturbing original grade, Contractor shall 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 Program Manager 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 Program Manager. All suitable excavated material shall be used in the formation of embankment, subgrade, or other purposes as shown on the plans. All unsuitable material, as defined in paragraph 152-1.2, shall be disposed of in approved disposal areas located off airport property.

The Contractor shall perform all bracing, sheathing, or shoring necessary to implement and protect all excavations as required for safety, conformance to governing laws, or to prevent damage to surrounding items or features. The cost of said bracing, sheathing, and shoring shall be included in the unit price bid for the item requiring excavation.

Excavation of non-stabilized (unbound) pavement bases and subbases such as granular bases and sub-bases will be paid for as Unclassified Excavation. Removal of stabilized (bound) pavement bases and subbases such as Porous Bituminous Base Courses and Soil-Cement Subbase Courses shall be paid for under P-101 Preparation/Removal of Existing Pavements.

The grade shall be maintained so that the surface is well drained at all times.

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 Program Manager. 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 Program Manager.

a. Selective grading. When selective grading is indicated on the plans, the more suitable material designated by the Program Manager 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 be stockpiled in approved areas until it can be placed. 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 below the subgrade or to the depth specified by the Program Manager. Muck, peat, matted roots, or other yielding material, unsatisfactory for subgrade foundation, shall be removed to the depth specified.

Excavation of unsuitable material shall be paid for as Undercut Excavation at the contract unit price per cubic yard as measured in its original position. The excavated areas shall be refilled with suitable material, obtained from the grading operations or, if approved by the Program Manager, replaced with

**ADDENDUM NO. 2**
compacted granular backfill. Granular material used to backfill undercut areas will be measured for payment, if the undercut and use of granular backfill has been authorized by the Program Manager. Backfilling of undercut areas with material obtained from grading operations (unclassified excavation) will not be measured for additional payment but shall be considered incidental to grading operations.

Excessive moisture content alone shall not constitute a reason for classifying any material as unsuitable and performing Undercut Excavation. Material that is too wet for compaction but otherwise suitable as determined by the Program Manager shall be aerated, dried and compacted at the Contractor’s expense. Soils which become oversaturated from percolation of ground water after drying shall be considered for Undercut Excavation, dependent on approval from the Program Manager. The Contractor shall take all reasonable steps necessary to protect subgrade and embankment areas from excessive moisture. Such protection may include, but is not limited to, providing positive temporary drainage, sealing off of embanked or subgrade soils with a smooth drum wheeled roller prior to rain events, limiting disturbed soil areas, and/or constructing diversion ditches or berms. The cost of said protection will be incidental to the contract cost of subgrade preparation or embankments constructed under this project. Soils excavated due to percolation of ground water shall be dried and reused in the embankment or stockpiled on airport property, as directed by the Program Manager.

Unsuitable materials shall be disposed of off the airport. The cost of disposal is incidental to this item. This excavated material shall be paid for at the contract unit price per cubic yard for Undercut Excavation. The excavated area shall be backfilled with suitable material obtained from the grading operations or borrow areas and compacted to specified densities. 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.

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 Program Manager. All over-break shall be graded or removed by the Contractor and disposed of as directed by the Program Manager. The Program Manager 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 Program Manager determines as avoidable. Unavoidable over-break will be classified as “Unclassified 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 below the top of subgrade or as indicated on the plans, and the material disposed of as directed by the Program Manager. 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 are not required.

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 off airport property or as directed by the Program Manager. 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. There shall be no separate measurement or payment for drainage excavation which shall be considered incidental to the drainage items requiring its use.

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 **24 inches** of subgrade shall be scarified and
compacted to not less than **95%** of maximum density for both non-cohesive and cohesive soils as determined by **ASTM D1557**. The subgrade shall then be proof rolled in accordance with P 152-2.9.

**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 depth of 24 inches and shall then be compacted per paragraph 152-2.10.

The stability of the prepared area shall be evaluated by proof rolling, as described under 152-2.9. Soils displaying elastic behavior under proof rolling evaluation shall be deemed stable and ready for embankment construction. Soils may be described as exhibiting elastic behavior when they are firm, unyielding, and exhibiting a stable surface under proof rolling. Soils may be described as exhibiting plastic behavior when they are yielding, not firm, and exhibit undulating and/or rutting under proof rolling. Such plastic soils shall be rejected. The distinction as to whether said soils are elastic or plastic shall be at the discretion of the Program Manager.

If the soils display plastic behavior and are determined by the Program Manager to be unstable, the unstable soils shall be removed as directed by the Program Manager to a maximum depth of 36 inches. This newly exposed subgrade shall be prepared in accordance with this specification to produce a stable subgrade. Proof rolling shall be performed as described under 152-2.9. If the subgrade is determined to be stable, the removed soils may be placed in accordance with 152-2.8. This work will be measured and paid for under the initial effort only. There will be no separate measurement and payment for subsequent efforts of stabilization for preparation of embankment areas. Subgrade Preparation for areas directly beneath pavement sections shall be paid for under the initial effort only. If the subgrade at this lower elevation continues to display plastic behavior and is determined by the Program Manager to be unstable, the Program Manager may direct that a bridge lift be constructed approved methods and materials.

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 and compacted as specified for the adjacent fill.

No direct payment shall be made for the work performed under this section. The necessary clearing and grubbing, the quantity of excavation removed, and quantity of subgrade preparation will be paid for under the respective items of work.

**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 Program Manager, 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 upon the Contractor’s demonstration that approved equipment and operations will uniformly compact the lift to the specified density. The Program Manager 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 Program Manager. 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 Program Manager.

**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 nor more than 12 inches 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 Program Manager. Materials such as brush, hedge, roots, stumps, grass and other organic matter, shall not be incorporated or buried in the embankment.

Existing soil cement base and subbase materials identified for demolition may be utilized in the formation of embankments provided that the material is broken into 4-inch (max) clods, meets requirements for the construction of subgrade and infield surfaces, and the Contractor has obtained approval from the Program Manager. If approval is not provided, the Contractor shall dispose of the soil cement materials off-site or stockpile the material on airport property as directed by the Program Manager.

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 Program Manager will take samples of excavated materials which will be used in embankment for testing to obtain a Moisture-Density Relations of Soils Report (Proctor) in accordance with ASTM D1557. A new Proctor shall be obtained for each soil type based on visual classification.

Density tests will be taken for quality acceptance purposes for every 1,000 square yards of compacted embankment for each lift which is required to be compacted, or other appropriate frequencies as determined by the Program Manager.

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 95% of maximum density for non-cohesive soils, and cohesive soils as determined by ASTM D1557. Under all areas to be paved, the embankments shall be compacted to a depth of 24 inches and to a density of not less than 95 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 in accordance with Item T-904.

The in-place field density shall be determined in accordance with 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 Program Manager's presence and provide the test results upon completion to the Program Manager for acceptance. If the specified density is not attained, the area represented by the test or as designated by the Program Manager shall be reworked and/or re- compacted and additional random tests made. This procedure shall be followed until the specified density is reached.

ADDENDUM NO. 2
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 in their greatest dimensions will not be allowed in the top 12 inches of the subgrade. Rockfill shall be brought up in lifts as specified or as directed by the Program Manager 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 Program Manager.

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 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 of 4 feet below the finished subgrade.

Backfill of utility structures, drainage and utility trenches, and jacking and boring pits, whether resulting from new construction or demolition of existing, that are not under proposed pavements, and outside any runway or taxiway safety area will be compacted to a dry density of not less than 90 percent of the maximum dry density as determined by ASTM D 1557 (Modified Proctor) at +/- 3 percent optimum moisture. The Contractor will backfill and compact any settlement in such trenches, either during construction or the warranty period, as described in this paragraph, at no additional compensation.

Backfill of utility structures, drainage and utility trenches, and jacking and boring pits, whether resulting from new construction or demolition of existing, under proposed pavements, shoulders, inside runway, or taxiway safety areas will be compacted as per Section 152-2.8, regardless of depth. The cost of compaction of trenches shall be incidental to the item for which it is constructed. At Contractor’s option, CLSM (Item P-153) may be used to backfill trenches, but no measurement and payment will be made if P-153 is utilized.

There will be no separate measurement of payment for compacted embankment. 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 excavation, borrow, or other items.

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. Before start of embankment, and after compaction is completed, the subgrade area shall be proof rolled with a 20 ton Proof Roller Tandem axle Dual Wheel Dump Truck loaded to the legal limit with tires inflated to 100 psi in the presence of the Program Manager. Apply a minimum of 1 coverage, or as specified by the Program Manager, 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 or show permanent deformation greater than 1 inch shall be removed and replaced with suitable material or reworked to conform to the moisture content and compaction requirements in accordance with these specifications. Under Program Manager direction, removal and replacement of soft areas up to a maximum depth of 3 feet shall be measured and paid for as undercut.
152-2.10 Compaction requirements. The subgrade under areas to be paved shall be scarified and compacted to a depth of 24 inches and to a density of not less than 95 percent 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 90 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 test per 1,000 square yards of subgrade per each lift. All quality assurance testing shall be done by the Contractor’s laboratory in the presence of the Program Manager, and density test results shall be furnished upon completion to the Program Manager for acceptance determination.

The in-place field density shall be determined in accordance with 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.

Density tests will be taken for quality acceptance purposes for every 500 square yards of completed subgrade which shall be paid for under Subgrade Preparation. If a nuclear gage is used for density determination, two random readings shall be made for each 500 square yards.

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 re-worked 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 Program Manager and the finished subgrade shall be maintained.

152-2.11 Finishing and protection of subgrade. Finishing and protection of the subgrade is incidental to Subgrade Preparation. 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 Program Manager.

152-2.12 Haul. All hauling within the work area or to/from the identified staging and storage areas 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 within the project limits or to/from the identified staging and storage areas. The Contractor will be paid for the hauling off-site of “Unclassified Excavation – Excess”.

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, reshaped and re-compacted to grade until the required smoothness and accuracy are obtained and approved by the Program Manager. The Contractor shall perform all final smoothness and grade checks in the presence of the Program Manager. 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 +/- 0.5 inch when tested with a Contractor supplied 12-foot 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 straightedge for the full length of each line on a 50-foot grid.

b. Grade. The grade and crown shall be measured on a 25-foot grid and shall be within +/-0.05 feet 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 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 Program Manager, 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 specified by the cubic yard shall be computed by the comparison of digital terrain model (DTM) surfaces for computation of neat line quantities. The end area is that bound by the original ground line established by field cross-sections and the final theoretical pay line established by contours shown on the plans, subject to verification by the Program Manager. After completion of all earthwork operations, the final grade shall be verified by the Program Manager by means of field elevations.

152-3.2 Unclassified Excavation - Embankment. The quantity of unclassified excavation placed as embankment to be paid for shall be the number of cubic yards measured in its original position. 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 Over-excavation (Undercut Excavation). The quantity of undercut excavation shall be the number of cubic yards measured for the undercut areas as designated by the Program Manager in its original position.
152-3.4 Unsuitable Material Excavation and Disposal. Unsuitable material, as defined in Section 152-1.2(c), will be paid on the basis of the number of cubic yards measured in its original position, excavated and disposed of off-site. Unsuitable material not designated as petroleum impacted soils and/or hazardous wastes will be disposed according to the state solid waste disposal control regulations outlined in Chapter 0400-11-01. Materials designated by the Program Manager as petroleum impacted soils or hazardous waste, not generated by the Contractors activities, equipment, storage or facilities, will be handled by the MSCAA environmental consultant. Petroleum impacted soils or hazardous waste generated by the Contractor, whether intentionally, accidentally or by vandalism, shall be hauled off airport property at the Contractors expense.

152-3.5 Subgrade Preparation. The quantity for subgrade preparation shall be the number of square yards in "plan view" of exposed subgrade in embankment areas and the constructed subgrade in excavation areas underneath full-strength airfield pavements and shoulders that is scarified, manipulated, compacted and proofrolled in accordance with Section 152-2.9 and 152-2.10. No separate measurement will be made for subsequent subgrade preparation work in embankments constructed under this contract in the same "plan view" area if the initial effort at a higher elevation does not produce a stable subgrade. Each "plan view" area shall be measured once. (For example: If after proofrolling, unstable material must be removed to a lower elevation, the Contractor will provide subgrade preparation at this lower elevation at no additional expense to the Owner.) Subgrade preparation includes the processing of the top 24 inches, per 152-2.10, including blading, shaping, aerating, and compacting.

152-3.6 Granular Backfill. The quantity of granular backfill shall be the neat theoretical number of cubic yards of granular material placed in the embankment. Measurement shall be made in its final position from field measurements taken prior to and immediately after placement of granular materials into the embankment. Only those areas authorized by the Program Manager for granular backfill will be considered for payment.

152-3.7 Lime. The quantity of lime shall be the actual tons placed in the embankment. Only those areas authorized by the Program Manager for lime treatment will be considered for payment. The quantity of lime indicated in the plans or proposal is an estimate only. Unused quantities of lime shall not be the basis of a claim or adjustment of unit costs under GP-50.

152-3.8 Unclassified Excavation - Excess. The quantity of unclassified excavation hauled off-site to be paid for shall be the number of cubic yards measured in its original position. Measurement shall not include the quantity of materials excavated without authorization beyond normal slope lines, quantity of material affected by swell, or the quantity of material used for purposes other than those directed.

**BASIS OF PAYMENT**

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

152-4.2 “Undercut Excavation” payment shall be made at the contract unit price per cubic yard. This price shall be full compensation for all materials, equipment, labor, tools and incidentals necessary to complete the item regardless of the depth encountered. Only the undercut authorized by the Program Manager shall be paid for.

152-4.3 “Unsuitable Material Excavation and Disposal” payment shall be made at the contract unit price per cubic yard. This price shall be full compensation for furnishing all materials, labor, equipment, tools and incidentals necessary to excavate, load, transport and dispose of the material off site, including any tipping or dump fees.
152-4.4 “Subgrade Preparation” payment shall be made at the contract unit price per square yard. This price shall be full compensation for furnishing all materials, labor, surveying, equipment, tools and incidentals necessary to complete the item. This price includes the scarifying, moisture adjustment, proof rolling and compaction in accordance with the plans and specifications. For embankments constructed under this project, no payment shall be made for subsequent subgrade preparation work in the same "plan view" area if the initial effort at a higher elevation does not produce a stable subgrade. Each "plan view" area shall be measured once.

152-4.5 “Granular Backfill” payment shall be made at the contract unit price per cubic yard. This price shall be full compensation for furnishing all materials, placement of the materials into the embankment as specified, and furnishing all equipment, labor, surveying, tools, filter fabric, and incidentals necessary to complete the item.

152-4.6 “Lime” payment shall be made at the contract unit price per ton. This price shall be full compensation for furnishing all materials, placement of the material into the embankment and furnishing all equipment, labor and incidentals necessary to complete the item as described under this specification.

152-4.7 “Undercut Excavation - Excess” payment shall be made at the contract unit price per cubic yard. This price shall be full compensation for all materials, equipment, labor, tools and incidentals necessary to complete the item regardless of the depth encountered. Only the undercut authorized by the Program Manager shall be paid for.

Payment will be made under:

Item P-152-4.1 Unclassified Excavation – per cubic yard
Item P-152-4.2 Undercut Excavation – per cubic yard
Item P-152-4.3 Unsuitable Material Excavation and Disposal – per cubic yard
Item P-152-4.4 Subgrade Preparation – per square yard
Item P-152-4.5 Granular Backfill – per cubic yard
Item P-152-4.6 Lime – per ton
Item P-152-4.7 Unclassified Excavation - Excess – per cubic 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/ft³ (600 kN·m/m³))

ASTM D1556 Standard Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method

ADDENDUM NO. 2
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
ITEM G-200 DEICE AND ANTI-ICE SYSTEM PIPE, CONNECTIONS, AND INSTALLATION

DESCRIPTION

200-1.1 Related Documents.
   a. Drawings and general provisions of the Contract, including General and Supplementary Conditions and DIVISION 01 Specification Sections, apply to this Section.

200-1.2 Summary.
   a. This Section covers Type I deice fluid, non-potable water, and Type IV anti-ice system piping, fittings, welded and screwed connections, qualification procedures, welding procedures, materials, radiographing and other nondestructive testing requirements, and construction requirements.
   b. All piping shall be of single-wall construction with pipe and fittings as specified herein for each type of "CARRIER PIPE".
   c. All materials, items, and components specified herein shall be suitable for use within a Type I deice fluid, non-potable water, or Type IV anti-ice system with a maximum operating condition of 150 psig, -20°F to 100°F and a specific gravity of 1.00 to 1.05.
   d. All end connections on piping and fittings to be welded shall be prepared for butt welding, without backing ring. Butt welding end preparation shall conform to ANSI B16.25.
   e. Contractor or any Subcontractor or Supplier shall not supply, furnish, or install any pipe flanges, fittings, bolts, or nuts of foreign manufacture. All pipe flanges, fittings, bolts, and nuts shall be manufactured in the United States of America and Contractor shall warrant the U.S.A. origin of all such items. Pipe flanges and fittings shall bear a stamp attesting to their place of origin. Contractor shall provide written certification from the manufacturer as to the origin of all flanges, fittings, bolts, and nuts installed on the Project. If at any time Owner determines that any flanges, fittings, bolts, or nuts are not of U.S.A. origin, Owner shall be entitled to replace all flanges, and/or fittings, and/or bolts and/or nuts (as the case may be) without the need for individual testing for conformance to technical Specifications, or for proof of non-U.S.A. origin of the other items. Contractor shall be responsible for all labor, materials, and consequential costs connected with such replacement.

200-1.3 Related Work.
   a. G-100 – Deice and Anti-ice System General Requirements.
   b. G-300 - Deice and Anti-ice System Coatings for Corrosion Protection.
   c. G-400 - Deice and Anti-ice System Valves.
   d. G-500 - Deice and Anti-ice and System Equipment and Accessories.
   e. G-600 - Deice and Anti-ice System Inspection, Testing, and Commissioning.
   f. G-700 – Deice and Anti-Ice Aboveground Storage Tank
   g. G-800 – Vibration and Seismic Controls for Piping Equipment
   h. G-900 – Glycol Control System
   i. G-902 - Cathodic Protection
   j. G-903 - Heat Tracing for Freeze Protection

200-1.4 Quality Assurance.
   a. All pipe and piping materials shall be produced by a manufacturer acceptable to Owner.
PRODUCTS

200-2.1 Aboveground and Underground Non-Potable Water Distribution Piping:

a. Non-potable water pipe shall be carbon steel pipe: ASTM A53, Grade A or B black steel. NPS 2-inch and smaller shall be seamless Schedule 80 steel pipe, NPS 2 ½-inch and larger shall be Schedule 40 steel pipe. All pipe fittings shall be welded unless connecting to valves and or equipment which is flanged or threaded.

b. Joints:

1. All buried carrier piping shall have welded connections.
2. Flanges shall be standard weldneck type Class 150 forged steel, ASTM A105, and conforming to ASME B16.5. Inside diameter of flanges shall be bored to match the inside diameter of the mating piping.

c. Fittings:

1. Socket welding 3000-lb forged steel, ASTM A105, conforming to B16.11, for sizes 2 inches and smaller. Butt weld fittings conforming to ASME B16.9 in lieu of socket weld are acceptable for 2 inch and smaller.
2. Threads of threaded jointed piping shall be full, clean, sharp, and true.
3. Bushings shall not be used except as noted on the Drawings.
4. Fittings shall have a pressure rating at least equal to that specified for adjoining pipe.

d. Backflow Preventer - Reduced Pressure

200-2.2 Deice and Anti-ice Carrier Piping Materials

a. All pipe fittings shall be welded unless connecting to valves and or equipment which is flanged or threaded.

b. Type IV anti-ice pipe shall be stainless steel ASTM A312, Type 304L, seamless when available. Wall thickness shall be 10S or greater. Stamp all pipe with specification and grade. Shop-coated pipe shall be stenciled with specification and grade. Material certificates and mill test reports shall be provided. If seamless pipe in certain sizes is not available ASTM 358 Class 1 grade 304L welded stainless pipe can be used. It must be double welded and completely radiographed. Perform S1, S2, and S3 examinations per ASTM 358. Testing reports shall be submitted to the owner for approval.

c. Type I deice pipe shall be carbon steel pipe: ASTM A53, Grade A or B black steel. NPS 2-inch and smaller, shall be seamless Schedule 80 steel pipe. NPS 2 ½-inch and larger shall be Schedule 40 steel pipe.

d. All buried carrier piping shall have welded connections. Pipe or fittings in the piping systems shall not be galvanized.

e. Mill Cleaning and Coating of Pipe:

1. All buried deice (carbon steel) and anti-ice (stainless steel) pipe and fittings shall be externally coated as specified in Section G-300 with fusion-bonded epoxy. Above ground stainless steel pipe shall not be coated.
2. Clean inside and outside of pipe and fittings by sand or grit blasting or pickling to remove all mill scale.
3. The ends of the pipe shall be capped at the factory using suitable galvanized metal or plastic caps, secured with a double wrap of 2-inch-wide pressure sensitive tape.

200-2.3 Fittings For Welded Deice and Anti-ice Carrier Pipe:

a. Type I deice fittings shall be butt welding type carbon steel, ASTM A234 Grade WPB, ASME B16.9 for sizes 2-1/2 inches and larger. Wall thicknesses shall match pipe.

b. Type IV anti-ice fittings shall be butt welding type stainless steel, ASTM A403 ,Type 304L, conforming to ANSI B16.9 for sizes 2 inches and larger. Wall thicknesses shall match pipe.

ADDENDUM NO.2
c. Type I deice socket weld fittings shall be 3000-lb forged carbon steel, ASTM A105, conforming to B16.11, for sizes 2 inches and smaller. Butt weld fittings conforming to ASME B16.9 in lieu of socket weld are acceptable for 2 inches and smaller.

d. Type IV Anti-ice socket weld fittings shall be forged, 2000-lb stainless steel, conforming to ASME B16.11 and ASTM A182, Type F 304L. Butt weld fittings conforming to ASME B16.9 in lieu of socket weld are acceptable for 2 inches and smaller. Where a 90° change in direction is required in Type IV Anti-ice system piping, elbows piping shall be comprised of two 45 degree bends to reduce fluid shear potential.

e. Changes in direction of pipe of other than 45 degrees or 90 degrees shall be as follows:
   1. With long radius weldells cut to the proper angle.
   2. Welded Branch Connections:
      a. Welded branch connections shall be butt welding tees except as described herein and with Owner's approval.
      b. Standard weldolets may be used for welded branch connections for aboveground piping.
   3. Fabricated branch connections for aboveground piping or piping exposed in pits 2 inches and smaller shall be sockolets, elbolets, or threadolets. Field-fabricated half couplings shall not be used.

200-2.4 Flanges and Gaskets:

   a. Type I deice flanges shall be standard weldneck type Class 150 forged carbon steel, ASTM A105, and conforming to ASME B16.5, except where Class 300 or Class 600 flanges are required to correspond to the equipment to which the piping is joined. Inside diameter of flanges shall be bored to match the inside diameter of the mating piping.

   b. NPW flanges shall be standard weldneck type Class 150 forged carbon steel, ASTM A105, and conforming to ASME B16.5, except where Class 300 or Class 600 flanges are required to correspond to the equipment to which the piping is joined. Inside diameter of flanges shall be bored to match the inside diameter of the mating piping.

   c. Type IV anti-ice flanges shall be stainless steel standard weldneck type Class 150 forged steel, ASTM A182, Type 304L, and conforming to ANSI B16.5, except where Class 300 flanges are required to correspond to the equipment to which the piping is joined. Inside diameter of flanges shall be bored to match the inside diameter of the mating piping.

   d. Flange facings shall correspond to the equipment to which the piping is joined, and unless otherwise required, shall be standard 1/16-inch raised face flanges.

   e. Flange gaskets shall be PTFE. Gaskets shall be resistant to the effects of Propylene Glycol.

   f. Full face gaskets shall be used for flat face steel flanged joints.

   g. Ring gaskets shall be used for steel flanged joints with raised face flanges.

   h. Gaskets shall be 1/8 inch in thickness.

   i. All bolted connections (flanges) in SS piping and between SS and carbon steel piping shall have SS bolting as specified below.

200-2.5 Flange Bolts and Nuts:

   a. Machine bolts for NPW and Type I deice piping shall be heavy hexagonal alloy carbon steel conforming to ASTM A193, Grade B7.

   b. Nuts for NPW and Type I deice piping shall be heavy hexagon alloy carbon steel conforming to ASTM A194, Grade 2H.

   c. Machine bolts for Type IV anti-ice piping shall be heavy hexagonal alloy stainless steel conforming to ASTM A193 Grade B8.

   d. Nuts for Type IV anti-ice piping shall be heavy hexagon alloy stainless steel conforming to ASTM A194, Grade B8.

   e. Stud bolts may be used as required for corresponding equipment.
f. All Type I deice and NPW carbon steel bolts and nuts shall be factory coated with fluoropolymer coating as specified in Section G-300.

200-2.6 Flanged Insulating Joints:

a. Joints shall consist of weldneck companion flanges or a weldneck flange with mating valve flange and a package flange insulation assembly.
b. Flange insulation assembly shall be Gask-O-Seal Type "E" by PSI Products, Inc., for full insulation.
c. Assembly shall have full-face thermosetting molded G-10 insulating gasket with Buna-N synthetic rubber sealing element molded in a groove on each side of the phenolic retainer, 1/8 inch thick for series 150 raised face flanges. Minimum dielectric strength shall be 500 VPM conforming to ASTM D229.
d. Insulating washers shall be G-10, 1/8 inch thick (minimum). Dielectric strength shall be compatible with minimum insulating values of insulating sleeves and gaskets. Furnish double quantity of insulating and plated-steel washers for "full" insulation of flanges.
e. Insulating sleeves shall be of G-10, 1/32 inch wall thickness length as required to match thickness of two series 150 raised face flanges plus insulation. Gasket shall provide "full" insulation of studs, minimum dielectric strength shall be 4,000 VPM.
f. Install insulating joints at the locations indicated.
g. Flange assemblies shall provide a minimum resistance of 1,000 ohms measured between each stud and both flanges (when dry).

200-2.7 Pipe Supports:

a. Support design and location shall be as indicated. Suspended pipe supports shall be seismically restrained and designed and stamped by installing contractor. G-800.
b. Provide complete assemblies adequately rated for the applied loads.
c. Install all required inserts and anchors prior to concrete placement.
d. Expansion bolts shall be Hilti or equal.
e. Spacing and arrangements shall conform to ANSI B31.3.
f. Support locations are indicated on the Drawings for pipe sizes 2-1/2 inches and larger only, based on the pipe routing shown. Contractor shall locate and provide supports for piping smaller than 2-1/2 inches in accordance with specified Codes and Standards.
g. Contractors shall provide additional supports as required due to changes in the pipe routing or equipment supplied.
h. Reduce spacing one-quarter where changes in direction occur.
i. Pipes run parallel in the same plane may be supported on gang supports.
j. Install to prevent sag or vibration and to adequately support the piping without interfering with inherent flexibility.
k. Make adjustments after systems are placed in operation.
l. Explosion or powder driven fasteners shall not be used.

200-2.8 Welding Filler Materials:

a. Welding filler material shall be provided in accordance with the applicable welding procedure specification.
b. Filler materials shall be compatible with the base metal and shall be specified and purchased by ASME or AWS classification and chemical composition.
c. Welding electrodes and filler materials shall be properly stored in suitable regulated temperature enclosures in accordance with manufacturer’s recommendations. The use of wet or moist electrodes will not be permitted.

200-2.9 Threaded Pipe Joint Sealing:

ADDENDUM NO.2
Either of the two materials specified below may be used for sealing of threaded pipe joints unless otherwise specified. All threaded joints shall be sealed.

b. Screwed Pipe Joint Tape: TFE tape applied to male threads. Tape width, number of wraps, and use of additional paste sealant shall be in accordance with tape manufacturer's recommendations.

c. Screwed Pipe Joint Compound: Use compound which is resistant to the effects of aviation grade glycols and Underwriters’ Laboratories approved for the application intended.

200-2.10 Instrument Tubing and Fittings:

a. Tubing:
   1. Material shall be ASTM A269 Type TP316 annealed, seamless stainless steel.
   2. Wall thickness shall be as required by the fittings, but not less than .049 inch.

b. Fittings: Stainless-steel compression type tube fittings for flareless tubes. Fitting connections shall be of four-piece construction including nut, front and back (double) ferrules, and fitting body.

c. Ensure pipe doping used is compatible with type IV and Type I fluid in their respective systems.

200-2.11 Pipe Sleeves:

a. Provide sleeves for all pipes passing through equipment pads, slabs, valve vault walls, airfield pavement and other concrete or masonry structures.

b. Sleeve sizes through 10 inches shall be Schedule 40 steel pipe or standard wall thickness. Sleeve sizes 12 inches and larger shall have 0.375 inch wall thickness or standard wall thickness.

c. Provide an anchor collar of the same type of steel as the sleeve. The collar shall be welded all around on both sides to the sleeve at the point on the sleeve that positions at the mid-point of the structural wall, pad, or pavement when the sleeve is in place.

d. Sleeves shall be 2 inch nominal pipe size larger for pipes less than 4 inch nominal diameter and two pipe sizes larger for pipes 4 inch nominal diameter and larger. Coordinate sleeve dimension with sleeve seal specified herein.

e. Sleeves through walls, pads, and pavement shall be cast in place. Piping shall be installed centered in sleeve.

200-2.12 Pipe Sleeve Sealant:


g. Characteristics: Nonshrink; recommended for interior and exterior applications.

h. Design Mix: 5,000-psi (34.5-MPa), 28-day compressive strength.

i. Packaging: Premixed and factory packaged.

200-2.13 Pipe Sleeve Insulators:

a. Insulator shall be a segmented collar molded of high-density polyethylene with runners.

b. Shoe height of runners shall be as required to center the pipeline in the sleeve.

c. Insulator shall be bolted around the fuel pipe without damaging the pipe coating.

200-2.14 Sleeve Boots:

a. Boot shall be oil, chemical, and water-resistant double-accordion bellows-type molded.

b. Boot shall permit ample movement of the carrier pipe in a lengthwise, side, and vertical direction.

c. The boot shall be a minimum of 3/8 inch thick with circumferential ribs molded in the inner surface where bands are applied to increase the contact pressure for a tighter joint.

d. The bands shall be 1/2-inch-wide stainless-steel thumb-screw type with rounded edges which are easily tightened by hand or by pliers.

ADDENDUM NO. 2
e. The boot shall have an extra thickness at the sleeve edge to protect the booth from damage during backfill.
f. The remainder of the boot shall be a minimum of 3/16 inch thick.
g. The boot shall be slipped on the pipe before any tie weld is made.

200-2.15 BACKFLOW PREVENTERS:

h. Reduced-Pressure-Principle Backflow Preventers:
i. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Ames Fire & Waterworks; a division of Watts Regulator Co.
   2. Conbraco Industries, Inc.
   3. FEBCO; SPX Valves & Controls.
   4. Flomatic Corporation.
   5. Watts Water Technologies, Inc.
   6. Wilkins; a Zurn company.

j. Body:
   1. NPS 2-1/2 (DN 65) and Larger: Cast iron, steel or stainless steel.
   2. Cast iron and steel body backflow preventers shall be provided with interior lining complying with AWWA C550 or that is FDA approved.

k. Standards: ASSE 1013 or AWWA C511.
l. Operation: Continuous-pressure applications.
m. Pressure Loss: 13 psig (83 kPa) maximum, through middle 1/3 of flow range.
n. End Connections: Flangedfor NPS 2-1/2 (DN 65) and larger.
o. Accessories:
   1. OS&Y gate type with flanged ends on inlet and outlet of NPS 2-1/2 (DN 65) and larger.
   3. Strainer

200-2.16 High Point Vent/Low Point Drain Pit Assemblies

a. General Requirements: One-piece molded fiberglass pit assembly complete with valves and piping accessories.
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 glycol from buried glycol 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 sealed bottom consisting of a steel collar to be attached to glycol pipe and a molded flexible synthetic boot.
   4. Boot shall be easily replaceable without disassembly of the valving or piping in the pit.
   5. Boot shall be attached to pit bottom and to steel pipe collar with stainless-steel worm gear clamps.
   6. Cover: Cast-aluminum ring and hinged door, 30 lb., one hand lift weight, 180-degree door opening, both cover pieces removable.
   7. Provide deep dish hand hole in cover to permit opening by gloved hand.
   8. 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

ADDENDUM NO.2
the pit and cover shall be machined flat to a total indicator reading of ±0.010 inch for flatness to ensure uniform weight distribution.

9. Entire cover assembly and pit as installed shall be capable of accommodating wheel loads of any aircraft in commercial service.

10. Pit assemblies shall include the following valves and piping materials. Installation shall be as indicated on the Contract Drawings.
   a. Valves shall be as specified in this specification.
   b. Pipe, fittings and piping materials including flanges, gaskets, bolts, nuts, and related items, shall be as specified in this specification.
   c. Provide a 2-inch diameter Civacon Kamlok adaptor, Model 1611A Dry Break with matching dust cap, or approved equal.

11. The words "GLYCOL LOW POINT DRAIN" or "GLYCOL HIGH POINT VENT" shall be in raised letters in the cover door.
   a. A stainless-steel tag with "Glycol Low Point Drain" or "Glycol High Point Vent" shall be permanently affixed to the riser.

200-2.17 Pipe bedding Material

 a. Pipe embedment material for exterior coated steel pipe shall be clean, natural sand conforming to ASTM C144 (masonry aggregate), ASTM C778 type “20-30 Sand”, or type “Graded Sand”, or equivalent, and the following gradations.

<table>
<thead>
<tr>
<th>Sieve Size</th>
<th>Percent Passing</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. 16</td>
<td>100</td>
</tr>
<tr>
<td>No. 20</td>
<td>85-100</td>
</tr>
<tr>
<td>No. 30</td>
<td>0-5</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Sieve Size</th>
<th>Percent Passing</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. 16</td>
<td>100</td>
</tr>
<tr>
<td>No. 30</td>
<td>96-100</td>
</tr>
<tr>
<td>No. 40</td>
<td>65-75</td>
</tr>
<tr>
<td>No. 50</td>
<td>20-30</td>
</tr>
<tr>
<td>No. 100</td>
<td>0-4</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Sieve Size</th>
<th>Percent Passing</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. 4</td>
<td>100</td>
</tr>
<tr>
<td>No. 8</td>
<td>95-100</td>
</tr>
<tr>
<td>No. 16</td>
<td>70-100</td>
</tr>
<tr>
<td>No. 30</td>
<td>40-75</td>
</tr>
<tr>
<td>No. 50</td>
<td>10-35</td>
</tr>
<tr>
<td>No. 100</td>
<td>2-15</td>
</tr>
<tr>
<td>No. 200</td>
<td>0-5</td>
</tr>
</tbody>
</table>

Sand shall conform to the following:
1. Resistivity: >10,000 OHM-CM in accordance with ASTM G57 or equivalent.
2. PH: 6-8 in accordance with ASTM G51 or equivalent.
3. Chloride: <100 mg/kg in accordance with ASTM D512 or equivalent.

ADDITIONAL NO. 2
4. Sulfate: <200mg/kg in accordance with ASTM D516 or equivalent.

200-2.18 Pete's Plug Test Plugs

a. Description: Test-station fitting made for insertion into piping tee fitting.
b. D. Body: Stainless steel with core inserts and gasketed and threaded cap. Include extended stem on units to be installed in insulated piping.
c. E. Thread Size: NPS 1/4 (DN 8) or NPS 1/2 (DN 15), ASME B1.20.1 pipe thread.
d. F. Minimum Pressure and Temperature Rating: 500 psig at 200°F (3450 kPa at 93°C).
e. G. Core Inserts: Chlorosulfonated polyethylene synthetic and EPDM self-sealing rubber. Make sure insters are compatible with Type I and IV fluids.

EXECUTION

200-3.1 Hauling and Stringing Pipe.

a. Perform the hauling and stringing of pipe and other materials in such a manner as to prevent damage to pipe and material. If damage is sustained, Contractor shall be responsible for repair or replacement cost.
b. Galvanized metal or plastic caps covering the ends of the pipe shall remain in place until the welding of the pipe. If any caps are discovered to be not in place, pipe shall be flushed or swabbed to remove all foreign material and then the cap shall be resecured to the pipe ends to prevent dirt, water, and other foreign material from entering. Under no circumstances during the entire project shall there be an unattended pipe without galvanized metal or plastic caps covering the ends of the pipe.
c. String pipe on right-of-way in such a manner as to cause the least interference with the normal use of the land crossed. Leave gaps at intervals to permit use of land and passage of equipment.
d. Contractor shall promptly repair, at his own expense, all roads, fences, building, or other property damaged by him in the progress of the Work.

200-3.2 Laying Underground Pipe.

a. Lay, embed, and maintain all underground pipelines to the flow-line elevation and grades shown on the Drawings.
b. The full length of each section of pipe shall rest solidly upon the pipe bed of compacted sand with depth as indicated.
c. Any pipe that has the grade or joint disturbed after being laid shall be taken up and relaid.
d. Do not lay pipe in water or when trench conditions are unsuitable except by written permission of Owner.
e. Anchor pipe during installation to prevent flotation prior to placement in service.
f. When work is not in progress, securely close open ends of pipe or fittings so that no trench water, earth, or other substance will enter the pipe or fittings.
g. Install pipe to be clear of contacts with other pipes, pipe sleeves, casings, reinforcing steel, conduits, cables, or other metallic structures.
h. Where glycol and non-potable water pipes cross other pipes, conduits or metallic or structures with a separation of less than 6 inches, install an insulating separator.
i. Insulating separators shall be minimum 36-inch by 36-inch by 1/2-inch thick UHMW polyethylene sheets or of a size that will span/overlap the crossing by 1 foot in any direction. No wood shall be used.

200-3.3 Installation of Aboveground Pipe.

a. Install complete with valves, fittings, and accessories and make all necessary connections.
b. Provide offsets, fittings, and accessories required to eliminate interferences and to match actual equipment connection locations and arrangements.

c. All fabrication and installation shall conform to ANSI B31.3.

d. Verify all measurements, and location of existing facilities and underground piping, before commencing work. Submit discrepancies for clarification before proceeding with the installations.

e. Arrange all piping with proper slopes, true to line, without sags, traps, or pockets, and pitched to drain at the lowest points so that entire systems can be emptied.

f. Provide high point vents, pump outs, and low point drains as required or indicated on the Drawings.

g. Provide threaded unions where indicated and as required elsewhere to permit satisfactory disassembly of small-bore piping for threaded valve and equipment maintenance.

200-3.4 Handling Coated Pipe.

a. Storage Racks:
   1. Storage rack material shall be 4 to 6 inches in bearing width and placed not less than 10 feet apart.
   2. Do not rack pipe 8 inches and under not more than 4 sections in height.
   3. Protect all racked pipe by use of suitable padded material between sections.
   4. All coated pipe shall be protected from ultraviolet deterioration.

b. Handling Operation:
   1. All trucks handling coated pipe shall have properly padded bolsters, chains, and binders to not damage the coating.
   2. Pipe shall not be rolled off the truck but shall be carefully lowered onto the skids by mechanical equipment.
   3. Coated and wrapped sections of pipe must be lifted with slings of approved width and are not to be dragged or pulled into position.

200-3.5 Pipe Cleaning.

a. Clean each joint before welding into the system, to remove all loose debris.

b. To minimize the amount of flushing each segment of pipe shall be thoroughly cleaned and swabbed prior to installation to remove any dirt or debris.

c. Remove materials such as welding byproducts, dirt, and similar materials, left inside after completion of the lines. Expense incurred by Owner for removal of such objects shall be reimbursed by Contractor.

200-3.6 Permits.

a. Provide special permits required for any work under the various sections of this Section of the Specifications and pay all permit fees.

200-3.7 Welded Joints.

a. Process: Welding shall be accomplished using the TIG welding the root and hot pass process with and shall be in strict accordance with ANSI B31.3. Shielded metallic arc welding process will not be allowed.

b. Procedure: Upon award of the Contract, submit for review the welding procedures and qualifications that are intended to be used on the job in accordance with section G-100.
1. Owner reserves the right to request qualification tests to be performed at the jobsite for each welder and welding operator on the job, such tests being made in strict compliance with the above code.

c. Costs: Costs incident to these procedures and the welder's qualification tests shall be assumed by Contractor.

d. Inspectors: Shop welding and fabrication shall be subject to the right of Owner to maintain one or more inspectors in the shop or to visit the shop at any time this work is in progress.

e. Identification:
   1. Each welder shall identify his weld with specific code marking signifying his name and assigned number.
   2. Contractor shall maintain a code listing assigned to each welder.
   3. Stamp on the pipe using "low stress" steel stamp, or other approved method, not closer than 4 inches to a weld.

f. Butt Welding End Preparation on all Pipe:
   2. Shop and field bevels shall be machine cut; manual flame cutting (without machine guide) shall not be permitted.

   g. All welds shall have full penetration and fusion and shall conform to ANSI B31.3.

   h. Backing rings shall not be used.

   i. Align pipe joints with pipe clamps prior to welding. Clamps or other alignment devices shall not reduce the internal pipe diameter.

   j. Defective welds shall be repaired in accordance with ANSI B31.3 at Contractor's expense.

   k. Repairs to defective welds shall not be made prior to authorization. Owner will determine based on the testing laboratory report if repairs may be made or if the entire joint must be cut out and welded again.

   l. No weld metal shall project within the piping at completion of the welding.

   m. If welding operations produce slag in the interior of the pipe, then entire pipe section and pipe joint shall be swabbed using denatured alcohol and then visually inspected by Owner’s quality representative. Repeat swabbing until entire pipe interior surface is clean and free of foreign debris.

200-3.8 Radiographing.

   a. Contractor shall coordinate and arrange for radiography by an approved testing laboratory of all welds on all the underground deice and anti-ice carrier pipe and a minimum of 10% of selected aboveground or exposed welded joints. This shall include all circumferential butt welds and all fabricated branch connections.

   b. Testing laboratory shall be selected by and employed by Contractor subject to Owner's approval.

   c. The radiographing shall be coordinated by Contractor and conducted at the Project Site such that Owner and the testing laboratory are provided with adequate notice that welds are available for radiographing and all the work required of Contractor in connection with the radiographing is properly completed at no additional cost to Owner. Factory welds of the final carrier pipe shall be radiographed by an approved testing laboratory. Radiography of factory welds may be conducted at the factory site.

   d. Reports for both factory and field welds shall be submitted throughout the progress of the Work as described below.

   e. All radiographing and subsequent reports shall be in accordance with the requirements of ANSI B31.3.

   f. Each weld shall be assigned a number. Contractor shall maintain a marked-up copy of piping drawings identifying the location and number of each radiographed weld. Upon completion of the Work, these drawings shall be submitted with as-constructed drawings.

ADDENDUM NO.2
Radiograph exposure records shall be kept by the testing laboratory which show date, location, area, film number, serial number, film combination, time, source-film distance, angulation, weld number and other pertinent information for each weld radiographed.

A summary of this record and an expert interpretation by the testing laboratory shall be submitted in report form for each weld to Owner and Contractor. Test reports and weld test films shall be submitted in a digital format.

All joints shall be left exposed until radiographing and other testing is completed.

Welds which do not meet the standards of acceptability as outlined in the above mentioned ANSI B31.3, will be judged unacceptable and shall be repaired or cut out and rewelded by Contractor as directed by the testing laboratory, all at no additional cost to Owner. Repaired and rewelded joints will then be reradiographed.

Inspection stamps, code symbol stamps, and other required information shall be stamped on the pipe by using "low stress" steel stamps, or other approved method.

All the costs of the radiographing at each weld and the accompanying reports and interpretation shall be paid by Contractor and shall be included in the Contract Price. Contractor shall be responsible for coordination and scheduling of the work.

200-3.9 Magnetic Particle and Dye Penetrant Testing.

Contractor shall coordinate and arrange for dye penetrant or magnetic particle testing by an approved testing laboratory of all new buried socket-weld connections and 10% of aboveground socket-weld connections.

The dye penetrant or magnetic particle tests shall be conducted on the entire 360-degree circumference of each socket weld.

Testing laboratory shall be selected by and employed by Contractor subject to Owner’s approval.

The dye penetrant or magnetic particle testing shall be coordinated by Contractor and conducted at the Project Site such that the Owner and the testing laboratory are provided with adequate notice that welds are available for testing and all the Work required of Contractor in connection with the testing is properly completed at no additional cost to Owner.

Reports for field welds shall be submitted throughout the progress of the Work as described below.

All dye penetrant or magnetic particle testing and subsequent reports will be in accordance with the requirements of ASME B31.3 and Section V of the ASME Boiler and Pressure Vessel Code.

Each weld shall be assigned a number. Contractor shall maintain a marked up copy of piping drawings identifying the location and number of each weld. Upon completion of the Work, these drawings shall be submitted with as-constructed drawings.

Dye penetrant or magnetic particle testing records shall be kept by the testing laboratory and shall show date, location, area, weld number, and other pertinent information for each weld tested.

A summary of this record, and an expert interpretation by the testing laboratory shall be submitted in report form for each weld to Owner, Engineer, and Contractor.

All fittings shall be left exposed until testing is completed.

Welds which do not meet the standards of acceptability as outlined in the above mentioned ASME B31.3 will be judged unacceptable and shall be repaired or cut out and rewelded by Contractor as directed by the testing laboratory, all at no additional cost to Owner. Repaired and rewelded joints will then be retested.

Inspection stamps, code symbol stamps, and other required information shall be stamped on the pipe by using "low stress" steel stamps, or other approved method.

All the costs of the testing at each weld and the accompanying reports and interpretation shall be paid by Contractor and shall be included in the Contract Price. Contractor shall be responsible for coordination and scheduling of the testing work.
200-3.10 FLUSHING:

a. The installing Contractor shall be responsible for all flushing requirements. A flushing and calibration procedure shall be submitted to the owner for approval prior to any work. The amount of glycol required shall be proposed to the owner prior to any work being performed. The contractors shall coordinate a flushing plan and schedule with the owner, engineer, deicing equipment supplier before any flushing is to occur. Flushing and calibration of the systems will occur subsequently. Glycol equipment supplier shall be on site for flushing and calibration.

b. All general service valves and adapters shall be in place throughout the flushing procedure.

c. After flushing has been completed and approved, Contractor shall remove all temporary cross connections and related items, and install control valves, metering elements, strainer baskets, and other system components. Strainer baskets shall be in place on all positive displacement pumps. Contractor shall also be responsible for cleaning the interior of aboveground storage tanks after flushing, so that the entire facility may be received in a new and clean condition as described previously.

d. Smaller segments of pipe should be flushed by mobile pumps or tanker trucks before equipment is connected.

e. To minimize the amount of flushing each segment of pipe shall be thoroughly cleaned and swabbed prior to installation to remove any dirt or debris. TIG welding is required to minimize the amount of slag in the welding process.

f. Flushing shall be completed after project substantial completion and prior to project commissioning.

g. Desired flow rate of flush is 5 feet per second minimum unless a lesser rate is agreed upon by Owner quality assurance representative. The NPW will flushed with water from the DCW line.

h. All temporary cross connections or special fabrication of adapters required shall be provided by Contractor.

i. Contractor shall supply any temporary manifolds plus sufficient number of single compartment tanks or tank trucks and hoses to allow the desired flow rates to be achieved in a safe manner. Hoses and couplings shall have a minimum 300 psig rating and shall be hydrostatically tested. All glycol used during flushing operations shall be discharged to the project glycol collection system.

j. Flushing Procedures:

1. Contractor shall submit for approval start-up strainer piping assembly. Start-up strainer assembly shall be temporarily installed in front of load stand inlet.

2. Flush the non-potable water system with the domestic cold water (DCW) first and make sure entire piping system is clean. Install clean strainers on NPW system.

3. Flush offload lines and clean tank of all debris using NPW. Clean tanks of all debris. Use NPW to fill the Type I tanks with enough fluid to thoroughly flush system and perform calibrations. Run the Type I systems to flush the lines from tank to the load stands with water. It is critical that coordination of the flushing coincides the startup of the equipment. NPW will be used to calibrate the mixing equipment before Type I fluid is used. Purge the offload lines of water and pump type I into the tanks until pure Type I is entering the tanks. Remove all water/Type I fluids and clean tanks. Ensure that the tanks are dry before introducing Type I fluid into the system. Ensure the strainers are clean before introducing Type I fluid into the system.

4. Use the system pumps to push type I fluid through the system all the way to the load stands until pure type I fluid is at each load stand. Ensure quality of type I fluid via testing for purity.

ADDENDUM NO.2
5. Repeat the process for the Type IV system. Test Type IV fluid for purity and viscosity. Chlorinated water shall not set in any stainless-steel pipe for longer than 5 days.

6. Flushing shall be performed with Type I or Type IV glycol for a duration of 15 minutes minimum at each load stand and have no debris larger than a 40 mesh. If at the end of final flushing, debris larger than a 40 mesh is present, contractor shall repeat final flushing until debris is no longer present.

7. Contractor is responsible for disposal of spent flushing agent to the project glycol collection system in accordance with all applicable federal and local environmental laws and regulations.

8. After flushing has been completed and approved, Contractor shall remove the 40 mesh start up strainer. Notify Owner’s representative prior to 40 mesh start up strainer removal and provide used strainer to Owner’s representative for visual observation if requested.

Caution: For safety, all persons not involved in the flushing operation shall be kept a minimum of 100 feet away from tank truck and load stand.

- Hoses shall be secured in a manner to prevent whipping during flush.
- Bond truck or tanks to system piping.
- Start product flow slowly before reaching flushing velocity to check for leaks and system tightness.
- Location of test personnel:
  (1) One person per each tank or truck to monitor level in tank.
  (2) One person at each load stand to control flow into tank or truck.
  (3) One person at main pump control station to shut down pumps in emergency.
  (4) One person removed from manual tasks in command of flushing operation.

**k. Final Acceptance:**

1. Contractor shall be responsible to hire an independent, third party testing laboratory.

2. Following completion of the glycol de-icing system in its entirety, Type I and Type IV glycol samples shall be pumped through the system and samples collected at every dispenser.

3. Samples shall be submitted to the independent testing laboratory and shall meet the following standards.
   a. Type I Glycol:
      (1) Refractive Index: 1.387 – 1.390
      (2) pH: 8.0 – 9.0
   b. Type IV Glycol
      (1) Refractive Index: 1.390 – 1.393
      (2) pH: 6.4 – 7.4
      (3) viscosity 0.3 rpm: 8,000 – 16,000 mPas.s (20°C)

**200-3.11 Video Inspection:**

- Use of video equipment through a pipeline to determine compliance to cleanliness requirements. Video inspection is required as a baseline assessment for the internal cleanliness of the piping, and is required for all new piping. Whether permanent or temporary, including laterals. All video inspection shall be recorded on electronic media in MPEG2 or higher format, and named and indexed with location data for later retrieval. All video inspection files shall be submitted on DVD to the Program Manager for record keeping. A report of any water, debris and/or obstructions identified within the piping system shall be provided with the video inspection.

The camera shall have adjustable focus and adjustable lighting features, auto-focus and auto-exposure features, and the ability to pan 360 degrees and tilt 90 degrees up and down from

ADDENDUM NO. 2
horizontal. The camera speed through the pipe shall be 30 feet per minute or less. The installing Contractor shall be responsible for all flushing requirements. A flushing and calibration

METHOD OF MEASUREMENT

200-4.1 Carbon steel and stainless steel pipe shall be measured by the linear foot (LF).
200-4.2 Underground HPV and LPD are measured on a per unit basis (EA).
200-4.3 Underground Valve Vaults are measured on a per unit basis (EA).

BASIS OF PAYMENT

200-5.1 Payment for pipe and pipe accessories meeting all acceptance criteria identified as a pay item below shall be based on the contract unit price per linear foot as indicated. These prices shall be full compensation for furnishing all materials and for all preparation, delivery and installation of these materials, and for all labor, equipment, tools, and incidentals necessary to complete the item.

The cost of all accessories including but not limited to fittings, elbows, tees, 45 elbows, reducers, welding materials, flanges, gaskets, flange bolt and nut sets, insulating joints, insulating flanges, pipe supports, instrument fittings, pipe sleeves, valves, check valves, automatic air vents, instrument valves, solenoid valves, pressure reducing valves, high point vents for above ground piping, backflow preventers, low point drains for above ground piping, PT ports, thermal relief piping, thermal relief valve and thermal check valves, **best-trace**, factory and field coatings shall be considered incidental to all other items of work requiring pipe and included in the linear foot price of the pipe. Its payment shall be included in the cost of the pipe and considered incidental to that item requiring its use.

The cost of all materials, accessories, and labor needed to complete underground pipe installation shall be considered incidental to the unit cost for underground pipe and shall be included in the linear foot price of pipe. These items include but are not limited to pipe embedment material, backfill material, trenching, shoring, and earthwork operations meeting all acceptance criteria as specified in the contract documents. These prices shall be full compensation for furnishing all materials and for all preparation, delivery and installation of these materials, and for all labor, equipment, tools, and incidentals necessary to complete the item.

The cost of all materials, accessories, and labor required to complete underground low point drains and high point vents installation shall be considered incidental to the unit cost for low point drains and high point vents and shall be included in the per each cost. These prices shall be full compensation for furnishing all materials and for all preparation, delivery and installation of these materials, and for all labor, equipment, tools, and incidentals necessary to complete the item.

Payment will be made under:

| G-200-5.1 | Underground Carbon Steel Pipe – 10” Diameter - LF |
| G-200-5.2 | Underground Carbon Steel Pipe – 8” Diameter - LF |
| G-200-5.3 | Underground Carbon Steel Pipe – 6” Diameter - LF |
| G-200-5.4 | Underground Carbon Steel Pipe – 4” Diameter - LF |
| G-200-5.5 | Underground Stainless Steel Pipe – 10” Diameter - LF |
| G-200-5.6 | Underground Stainless Steel Pipe – 6” Diameter - LF |

ADDENDUM NO.2
G-200-5.7 Underground Stainless Steel Pipe – 4” Diameter - LF
G-200-5.8 Above Ground Carbon Steel Pipe – 12” Diameter - LF
G-200-5.9 Above Ground Carbon Steel Pipe – 10” Diameter - LF
G-200-5.10 Above Ground Carbon Steel Pipe – 8” Diameter - LF
G-200-5.11 Above Ground Carbon Steel Pipe – 6” Diameter - LF
G-200-5.12 Above Ground Carbon Steel Pipe – 4” Diameter - LF
G-200-5.13 Above Ground Carbon Steel Pipe – 2” Diameter - LF
G-200-5.14 Above Ground Stainless Steel Pipe – 10” Diameter - LF
G-200-5.15 Above Ground Stainless Steel Pipe – 6” Diameter - LF
G-200-5.16 Above Ground Stainless Steel Pipe – 4” Diameter - LF
G-200-5.17 Above Ground Stainless Steel Pipe – 3” Diameter - LF
G-200-5.18 Underground Low point drain (LPD) or High Point Vent (HPV) - EA
G-200-5.19 Underground Valve Vault – EA
G-200-5.20 Flushing of NPW pipe systems – LF
G-200-5.21 Flushing of Deicing pipe systems – LF
G-200-5.22 Flushing of Anti-icing pipe systems - LF
G-200-5.23 Above Ground Carbon Steel Pipe – 3” Diameter - LF
G-200-5.24 Above Ground Stainless Steel Pipe – 8” Diameter - LF

REFERENCES

a. American Water Works Association (AWWA):
   1. C606 - Grooved and Shouldered Joints.

   1. A47 - Ferritic Malleable Iron Castings.
   2. A53 - Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless.
   3. A105 - Carbon Steel Forgings for Piping Applications.
   4. A139 - Electric-Fusion (Arc) - Welded Steel Pipe (NPS 4 and Over).
   5. A193 - Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service.
   6. A194 - Carbon and Alloy Steel Nuts for Bolts for High-Pressure and High-Temperature Service.
   7. A269 - Seamless and Welded Austenitic Stainless Steel Tubing for General Service.
   8. A733 - Welded and Seamless Carbon Steel and Austenitic Stainless Steel Pipe Nipples.
   10. C144 - Aggregate for Masonry Mortar
   11. C778- Standard Sand

c. American Society of Mechanical Engineers:
   2. B16.11 - Forged Steel Fittings, Socket-Welding and Threaded.
   4. B16.5 - Pipe Flanges and Flanged Fittings.
   5. B31.3 - Process Piping.

ADDENDUM NO. 2

END OF ITEM G-200

PAGE INTENTIONALLY LEFT BLANK
ITEM G-500 DEICE AND ANTI-ICE SYSTEM EQUIPMENT AND ACCESSORIES

DESCRIPTION

500-1.1 Summary.

a. This Section covers special Equipment and mechanical accessories applicable to the Type I deice, non-potable water and type IV anti-ice systems.

b. Related Work Specified Elsewhere:
   1. For general requirements of fueling system: G-100 – Deice and Anti-ice System General Requirements.
   2. DIVISION 26 "Electrical Work".

c. Extent of Work shall be as follows:
   1. All special valves, pilots, fittings, equipment, and related items shall meet the following requirements:
      a. Be furnished, installed, tested, and put into successful operation.
      b. Be complete with all necessary miscellaneous pipe, valves, unions, fittings, auxiliaries, and other items, whether shown on the Drawings or not, but required.
      c. Meet the requirements of applicable codes and standards as specified.

   2. Piping connected to Equipment which must vary from the Drawings shall be furnished and installed as required to make a complete and workable installation without additional cost to Owner. This requirement includes changes due to the selection of a different Equipment manufacturer than what is indicated on the Drawings, specified, or a design change made by the manufacturer between the time the piping system was designed and the time of installation.

   3. Spare, Replacement, or Additional Parts:
      a. Where spare, replacement, or additional parts are required for the equipment specified herein, these items shall be delivered to the Owner immediately upon receipt at the Site.
      b. Parts shall be packaged and sealed for long storage and be securely and visibly labeled as to part, function, and name of Equipment to which they apply.
      c. Contractor shall prepare an inventory list of the items delivered to Owner.

d. This Section covers fittings, meters, and accessories related to the Type I deice fluid, non-potable water and type IV anti-ice systems for this project. All items, materials, and components specified herein shall be suitable for use within a deice, anti-ice or non-potable water system with a maximum operating condition of 150 psig, -20°F to 100°F, and having a specific gravity of 1.00 to 1.05.

e. Lightning Protection:
   1. All field inputs and power inputs shall have lightning protection devices installed on them.

500-1.2 Quality Assurance.

a. Manufacturer's Qualification: Firms regularly engaged in manufacture of valves and Equipment, of types and capacities required, whose products have been in satisfactory use in similar service for not less than 5 years.
PRODUCTS

500-2.1 Manufacturers.

a, Subject to compliance with requirements, provide products by one of the following:

1. Type I Deice Fluid and Water Blending System
   a. Liquid Automation Systems, LLC - DeiceCube™250
   b. Approved equal.

2. Reblend System
   a. Liquid Automation Systems, LLC
   b. Approved equal

3. Type I Deice Fluid Load Stands:
   a. Liquid Automation Systems, LLC.
   b. Approved equal.

4. Type IV Anti-ice Fluid Load Stands:
   a. Liquid Automation Systems, LLC.
   b. Approved equal.

5. Type I Deice Fluid Issue Pump:
   a. Taco
   b. Grundfos
   c. Approved equal

6. Type I Deice Fluid Offload Pump and Type I Reclaim Offload Pump:
   a. Blackmer
   b. Dixon
   c. Parker
   d. Approved equal.

7. NPW Issue Pump:
   a. Taco
   b. Grundfos
   c. Approved equal.

8. Type IV Anti-ice Fluid Primary Issue Pump:
   a. Moyno
   b. Seepex
   c. Approved equal.

9. Type IV Anti-ice Fluid Secondary Issue Pump:
   a. Blackmer
   b. Dixon
   c. Approved equal

10. Type IV Anti-ice Fluid Offload Pump:
    a. Moyno
    b. Seepex
    c. Dixon
    d. Approved Equal

500-2.2 Blending System.

a. Type I deice fluid and non-potable water blenders shall mix the two fluids at controlled ratios and flow rates in order to make deicing fluid to meet current weather condition requirements. The deicing fluid will then be directed to a load stand.

b. Blender manufacturer shall have at least five (5) years' experience in the design, construction and installation of deice fluid and non-potable water blenders and service personnel to provide after
sale support. All performance of the blenders shall be in accordance with FAA standards and requirements.

c. Blender Construction:
   1. Blending systems shall be self-contained, modular with all controls, actuators, meters, valves, microprocessors, and instrumentation required to blend Type I deice fluid with non-potable water at a ratio selected by the operator.
   2. Blender and all internals shall operate on 120VAC, 1 phase, 60 Hz power.
      a. Current load 40 Amperes
         (1) 8.5A on 1,000 W heater
         (2) 5A on controls
         (3) 15A on auxiliary power receptacle
         (4) 120VAC single phase 10A load stand
   3. Provide control panel for selection of de-ice fluid/non-potable water blend ratio. Blend ratio shall be adjustable in 1% increments.
   4. At a minimum, touchscreens will be protected from UV and other weather related elements by a stainless steel hinged cover.
   5. All internal piping shall be stainless steel.
   6. High Accuracy Flow Meters 0.25% of reading
   7. 3" Stainless Steel Pipe Male NPT inbound Type I connection
   8. 3" Stainless Steel Pipe Male NPT inbound water connection
   9. 3" Stainless Steel Pipe Male NPT outbound connection
   10. Freeze prevention for the water lines must be provided.
   11. Insulation packed walls
   12. Internal temperature control to stay above 40ºF/4ºC in ambient conditions down to -40ºC.
   13. Latching/Lockable door on front.
   14. Door can be opened from inside in case of entrapment.
   15. Fork lift slots allow for easy movement.
   16. LED light illuminates internal components.
   17. Provide NEMA 4x rated controls for alarm silence and reset.
   18. NEMA 4x enclosure shall be constructed of 304 SS with a hinged access panel for ease of maintenance.

d. Blender Operation:
   1. Blenders shall be capable of mixing Type I deice fluid and non-potable water at any mix ratio between 0% deice fluid / 100% non-potable water and 100% deice fluid / 0% non-potable water, in 1% increments between 20% and 65%. Mix ratio shall be adjustable from the blender control pane and remotely.
   2. Blending accuracy shall be ± 2% of setpoint.
   3. The deicing fluid flow rate at 20% deice fluid / 65% non-potable water shall not be less than 250 gpm.
   4. The blended deicing fluid flow rate at a 50% mix ratio shall not be less than 250 gpm.
   5. The deicing fluid flow rate at 65% deice fluid / 35% non-potable water shall not be less than 250 gpm.

e. Blender Controls:
   1. 8" Touch Screen Interface
   2. Emergency Stop Push Button Operator
   3. Blend Set Point Adjustment 20% - 65% in 1% increments
   4. Freeze point display for selected Type I fluid
   5. Alarm Indication and Acknowledgement
   6. Instantaneous Blend Percentage Indicator
   7. Accumulated meter totals

ADDENDUM NO. 2
8. Process Pump Status Indication
9. Supervisor Password Protected for Event Staging
10. Start/Stop Control
11. Deadman Switch Operation
13. The system shall allow for automatic adjustment of the current truck mix ratio
14. Provide internal valves, meters, motor speed control system, and feedback control system via microprocessor in order to regulate blend ratio.
15. Provide meters with pulse transmitters for Type I deice fluid inventory control. Pulse rate shall be 100 pulses/gallon. Transmit type I deice fluid meter pulses to card reader for inventory control.
16. Provide automatic shutdown with a selectable deviation range from 2-5%. and alarm if the mix ratio is more than % (adjustable) in error of the desired setpoint.
17. Provide heater to prevent freezing of above grade non-potable water piping.

500-2.3 Re-Blending System.
a. Type I deice fluid concentrate, Type I deice reclaim and non-potable water blenders shall mix the two fluids at controlled ratios and flow rates in order to make deicing fluid to meet current weather condition requirements. The deicing fluid will then be directed to a load stand.
b. Blender manufacturer shall have at least five (5) years' experience in the design, construction and installation of deice fluid and non-potable water blenders and service personnel to provide after sale support. All performance of the blenders shall be in accordance with FAA standards and requirements.
c. Blender Construction:
   1. Blending systems shall be self-contained, modular with all controls, actuators, meters, valves, microprocessors, and instrumentation required to blend Type I deice fluid with non-potable water at a ratio selected by the operator.
   2. Blender and all internals shall operate on 120VAC, 1 phase, 60 Hz power.
      a. Current load 40 Amperes
         (1) 8.5A on 1,000 W heater
         (2) 5A on controls
         (3) 15A on auxiliary power receptacle
         (4) 120VAC single phase 10A load stand
   3. Provide control panel for selection of de-ice fluid/non-potable water blend ratio. Blend ratio shall be adjustable in 1% increments.
   4. At a minimum, touchscreens will be protected from UV and other weather related elements by a stainless steel hinged cover.
   5. All internal piping shall be stainless steel.
   6. High Accuracy Flow Meters 0.25% of reading
   7. 3” Stainless Steel Pipe Male NPT inbound Type I connection
   8. 3” Stainless Steel Pipe Male NPT inbound Reclaim connection
   9. 3” Stainless Steel Pipe Male NPT inbound water connection
   10. 3” Stainless Steel Pipe Male NPT outbound Type I/Reclaim connection
   11. 3” Stainless Steel Pipe Male NPT outbound Reclaim/NPW connection
   12. Freeze prevention for the water lines must be provided.
   13. Insulation packed walls. Minimum 4” thick metal encased closed cell foam.
   14. Internal temperature control to stay above 40°F/4°C in ambient conditions down to -40°C.
   15. Latching/Lockable door on front.
   16. Door can be opened from inside in case of entrapment.

ADDENDUM NO. 2
17. Fork lift slots allow for easy movement.
18. LED light illuminates internal components.
19. Provide NEMA 4x rated controls for alarm silence and reset.
20. NEMA 4x enclosure shall be constructed of 304 SS with a hinged access panel for ease

d. Blender Operation:
   1. Blenders shall be capable of mixing Type I deice fluid and non-potable water at any mix
      ratio between 0% deice fluid / 100% non-potable water and 100% deice fluid / 0% non-
      potable water, in 1% increments between 20% and 65%. Mix ratio shall be adjustable
      from the blender control pane and remotely.
   2. Blending accuracy shall be ± 2% of setpoint.
   3. The deicing fluid flow rate at 30% deice fluid / 70% non-potable water shall not be less
      than 250 gpm.
   4. The blended deicing fluid flow rate at a 50% mix ratio shall not be less than 250 gpm.
   5. The deicing fluid flow rate at 70% deice fluid / 30% non-potable water shall not be less
      than 250 gpm.

e. Blender Controls:
   1. 8" Touch Screen Interface
   2. Emergency Stop Push Button Operator
   3. Blend Set Point Adjustment 20% - 65% in 1% increments
   4. Freeze point display for selected Type I fluid
   5. Alarm Indication and Acknowledgement
   6. Instantaneous Blend Percentage Indicator
   7. Accumulated meter totals
   8. Process Pump Status Indication
   9. Supervisor Password Protected for Event Staging
   10. Start/Stop Control
   11. Deadman Switch Operation
   12. Manual Mode - The system allows for manual operation in the event of a controls
       malfunction.
   13. The system shall allow for automatic adjustment of the current truck mix ratio
   14. Provide internal valves, meters, motor speed control system, and feedback control system
       via microprocessor in order to regulate blend ratio.
   15. Provide meters with pulse transmitters for Type I deice fluid inventory control. Pulse
       rate shall be 100 pulses/gallon. Transmit type I deice fluid meter pulses to card reader for
       inventory control.
   16. Provide automatic shutdown and alarm if the mix ratio is more than 2% in error of the
       desired setpoint.
   17. Provide heater to prevent freezing of above grade non-potable water piping.
   18. Blending up or blending down of reblend fluid is to be automated.

500-2.4 Load Stands.
   a. Type I and Type IV load stand to issue to fluid de-icing trucks.
   b. Inbound:
      1. ADF Type I blend -2" NPT
      2. AAF Type IV -2" NPT
   c. Outbound:
      1. ADF Type I blend -10' of 2" hose and camlock style SS adapter
      2. AAF Type IV -10' of 2" hose and camlock style SS adapter
      3. All pipe work to be 304 stainless steel
      4. Fluid test port on each line

ADDENDUM NO. 2
5. Provide breakaway couplings on piping outlet to protect against drive offs with hoses connected.

d. Hose Management
   1. Counterweight balanced hose retractors
   2. Breakaway connectors to protect loadstand from drive offs with hoses connected to truck.
   3. Breakaway connector on hose retriever to prevent damage from drive offs
   4. Provide deadman control which will signal motor starter relays to start a Type I deice fluid and non-potable water pump.
   5. Provide 3-inch dry break coupling truck connection.

e. Controls
   a. Simple Operator Interface
   b. ADF Type I blend Start/Stop Push Button Operators
   c. AAF Type IV Start/Stop Push Button Operators
   d. Deadman switch for Type I and Type IV
   e. Load stand solenoid valve should have a slow acting closure rate to avoid surge issues.

f. Power Requirements
   1. 120VAC single phase 15A. Powered by blending system. A light is required

500-2.5 Type I Deice Fluid Issue Pump.
   a. Type I Glycol issue pump shall distribute glycol to blending cube.
   b. Pump Construction:
      1. Pump shall have flanged connections to connect to 6” flanged pipe. Verify pipe size on plans.
      2. Pumps shall be positive displacement, sliding vane or centrifugal horizontal split case.
      3. Pumps shall be split coupled.
      4. Provide components that are compatible with propylene glycol.
      5. Provide pumps complete with gear reducer (if required), motor, Variable Frequency Drive as specified in Section G-901, coupling, baseplate, anchors and all accessories required for operation.
      6. Provide ¾” drain connection with valve and hose connection.

500-2.6 Type I Deice Fluid Offload Pump And Type I Reclaim Offload Pump.
   a. Type I Glycol offload pump shall off load Type I Glycol from delivery transport trucks and transfer Glycol to the aboveground Glycol tanks.
   b. Type I Glycol reclaim offload pump shall off load Type I Glycol from glycol trucks and transfer Glycol to the aboveground Glycol reclaim tanks.
   c. Pump Construction:
      1. Pump shall have flanged connections to connect to 3” flanged pipe. Verify pipe size on plans.
      2. Pumps shall be positive displacement.
      3. Provide components that are compatible with propylene glycol.
      4. Provide pumps complete with gear reducer (if required), motor, Variable Frequency Drive as specified in Section G-901, coupling, baseplate, anchors and all accessories required for operation.
      5. Provide ¾” drain connection with valve and hose connection.

500-2.7 Non-Potable Water Issue Pump and Type I Reclaim Issue Pump.
   a. Non-Potable Water Issue Pump shall distribute Non-Potable Water to blending cube.
b. Type I Reclaim Issue Pump shall distribute fluid from reclaim tanks to reclaim blending cube to fill a glycol truck.

c. Pump Construction:
   1. Pump shall have flanged connections to connect to 6” flanged pipe. Verify pipe size on plans.
   2. Pumps shall be positive displacement, sliding vane or rotary gear type design or centrifugal vertical inline.
   3. Pumps shall be split coupled.
   4. Provide pumps complete with gear reducer (if required), motor, Variable Frequency Drive as specified in Section G-901, coupling, baseplate, anchors and all accessories required for operation.
   5. Provide ¾” drain connection with valve and hose connection.

500-2.8 Type IV Anti-ice Fluid Issue Primary Pump.
   a. Type IV Glycol issue primary pumps shall transfer Type IV Glycol from the centralized tanks to the primary glycol loop.
   b. Pump Construction:
      1. Pump shall have flanged connections to connect to 8” suction and 6” discharge flanged pipe. Verify pipe size on plans.
      2. Pumps shall be positive displacement, progressive cavity type design.
      3. Stainless steel internal construction
      4. Provide components that are compatible with propylene glycol.
      5. Provide pumps complete with gear reducer (if required), motor, Variable Frequency Drive as specified in SECTION G-901, coupling, baseplate, anchors and all accessories required for operation.
      6. Provide ¾” drain connection with valve and hose connection.

500-2.9 Type IV Anti-ice Fluid Issue Secondary Pump.
   a. Type IV Glycol issue secondary pump shall pull from primary glycol loop and distribute to load stand.
   b. Pump Construction:
      1. Pump shall have flanged connections to connect to 3” flanged pipe. Verify pipe size on plans.
      2. Pumps shall be positive displacement.
      3. Stainless steel internal construction
      4. Provide pumps complete with gear reducer (if required), motor, motor starter, coupling, baseplate, anchors and all accessories required for operation.
      5. Pump shall have integral bypass.
      6. Provide ¾” drain connection with valve and hose connection.

500-2.10 Type IV Anti-ice Fluid Offload Pump.
   a. Type IV Glycol offload secondary pumps shall transfer Glycol from Delivery trucks to the storage tanks.
   b. Pump Construction:
      1. Pump shall have flanged connections to connect to a 4” flanged pipe. Verify pipe size on plans.
      2. Pumps shall be positive displacement.
      3. Stainless steel internal construction

ADDENDUM NO. 2
4. Provide pumps complete with gear reducer (if required), motor, Variable Frequency Drive as specified in Section G-901, coupling, baseplate, anchors and all accessories required for operation.

500-2.11 Deice, Anti-ice And Non-Potable Water Loading Hose.
   a. Hose shall be 2-inch or 3-inch diameter as required and capable of 150 psi working pressure to full vacuum.
   b. Tube shall be nitrile with single ply, high-tensile nylon cord reinforcement interwoven hard wall construction. Cover shall be black neoprene.

500-2.12 Deice, Anti-ice And Non-Potable Water Hose Swivel Joint.
   a. Swivel Joint shall match hose diameter.
   b. Swivel joint shall be capable of 150 psi working pressure to full vacuum.
   c. Provide stainless steel ball bearings and raceway.
   d. End connections shall be flanged body with female threaded sleeve.
   e. Breakaway couplers shall be installed on the load stand outlet piping to protect against drive offs.

500-2.13 Deice and Anti-ice Truck Unloading Hose Coupler.
   a. Shall be a quick dry disconnect coupling adaptor and dust cap, size as indicated.
   b. Construction of adaptor and cap shall be aluminum.
   c. 2” Type I
   d. 3” Type IV

500-2.14 Spill Containment Box.
   a. Shall be a weatherproof containment box to house unloading connections.
   b. Construction of containment box shall be stainless steel.
   c. Containment box shall house the truck unloading hose adapters with dust caps, 3” ball valves, and piping.
   d. Shall be designed with a lid that can be locked closed when not in use and will stay open during unloading.
   e. Containment box shall also include a 3/4” NPT drain.
   f. Containment box size shall be a minimum of 24 inches wide by 16-1/2 to 30 inches tall by 24 inches deep. Size shall allow for acceptable operation of coupler and valve and shall be confirmed by Contractor. Coupler may be installed offset within the containment box without interfering with unloading connection and operation.

500-2.15 Deicing Truck Loading Hose Dry Break Coupler.
   a. Coupler shall mate with adapters as provided on existing vehicles. Size as indicated.
   b. All wetted parts shall be aluminum or stainless steel.
   c. Shall have an interlock such that coupler cannot be opened unless coupled to adaptor; unit cannot be uncoupled from an adaptor while in the open position.
   d. Provide dust cap.

500-2.16 Surge Tank
   a. Bladder type surge tank with bladder compatible with glycol (PTFE, Viton, EPDM, Hypalon)
   b. All wetted parts are stainless steel.
   c. 10 gallon capacity
   d. Pressure shall be set for 80% of the system design pressure.
   e. Surge tank shall have isolation valve for service and replacement.
   f. ASME Coded Section VIII DIV 1.

ADDENDUM NO. 2
500-2.17 Air Separator
   a. Air separation tank shall have an internal design constructed of stainless steel and suitable for creating the required vortex and subsequent air separation. Tank shall be steel, constructed for, and tested to pressure-temperature rating of 125 psi at 150 degrees F.
   b. Tank shall have tangential inlets and outlets connections, threaded for 2 inches and smaller and flanged for sizes 2-1/2 inches and larger. Air released from a tank shall be to the atmosphere.
   c. Tank shall be provided with a blow-down connection.
   d. Design to separate air from water and to direct released air to automatic air vent.
   e. Unit shall be of one-piece cast-iron construction with internal baffles and two air chambers at top of unit; one air chamber shall have outlet to expansion tank and other air chamber shall be provided with automatic air release device.
   f. Tank shall be steel, constructed for, and tested to a ANSI Class 125 pressure-temperature rating.

500-2.18 Suction Diffuser
   a. Angle pattern.
   b. 175-psig (1204-kPa) pressure rating, cast-iron body and end cap, pump-inlet fitting.
   c. Bronze startup and bronze or stainless-steel permanent strainers.
   d. Bronze or stainless-steel straightening vanes.
   e. Drain plug.
   f. Factory-fabricated support.

500-2.19 Y-Strainer
   a. Install Type Y strainers with removable strainer element. Use flanged body end connections. Body materials are cast steel conforming to ASTM A216/A216M, Grade.
   b. Ensure minimum free-hole area of strainer element is equal to not less than 3.4 times the internal area of connecting piping. Strainer screens perforation size is not to exceed 0.51 millimeter 0.020 inch. Strainer screens have finished ends fitted to machined screen chamber surfaces to preclude bypass flow.
   c. Strainer element material is AISI Type 304 corrosion-resistant steel and fitted with backup screens where necessary to prevent collapse.

500-2.20 Flexible connectors
   a. Stainless-Steel Bellow
   c. End Connections: Threaded or flanged to match equipment connected
   d. Performance: Capable of 3/4 inch (20 mm) misalignment.
   e. CWP Rating: 150 psig (1035 kPa)
   f. Maximum Operating Temperature: 250ºF (121ºC).

500-3.1 Gauges.
   a. Install where indicated on the Drawings.
   b. Direct-Mounted, Metal-Case, Dial-Type Pressure Gages:
   d. Case: Liquid-filled,Sealed type(s); cast aluminum or drawn steel 4-1/2 inch (114 mm) nominal diameter.
   e. Pressure-Element Assembly: Bourdon tube, unless otherwise indicated.
   f. 6. Pressure Connection: Brass, with NPS 1/4 (DN 8), ASME B1.20.1 pipe threads and bottom-outlet type, unless back-outlet type is indicated.
   g. 7. Movement: Mechanical, with link to pressure element and connection to pointer.
h. 8. Dial: Non-reflective aluminum with permanently etched scale markings graduated in psi (kPa).
i. 9. Pointer: Dark-colored metal.
j. 10. Window: Glass.
k. 11. Ring: Stainless steel.
l. 12. Accuracy: Grade A, ±1% of middle half of scale range.

EXECUTION

500-3.2 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. Provide coupling alignment records indicating parallel and angular dial indicator readings as well as coupling manufacturer's tolerances. Alignment for blenders, couplings, and drivers requiring "cold" and "hot" settings shall be checked in both conditions and so indicated on the alignment record.
d. Retighten all bolted and threaded connections after installation.

500-3.3 Inspections.

a. The Work will be inspected by Owner at intervals appropriate to the stage of construction during the course of construction.
b. Provide for inspection by all others having jurisdiction over the work performed under the various Sections of these Specifications during the proper phase.
c. At time of final inspection, furnish certificate or certificates of final approval by all others having jurisdiction.

500-3.4 Adjustments and Calibration.

a. Contractor shall adjust all valves for the flows, level settings, and pressure settings indicated and specified.
b. Set rate of closure of control valves to eliminate surges and shocks in the systems as installed. Final adjustments shall be made during system operation prior to final start-up.
c. Final adjustments shall be made during system operation prior to final start-up.
d. Adjust all items at start-up, including flow rates, pressure settings, meter settings, and other variables as required by Owner.

500-3.5 Tubing Installations.

a. Assemble using Hy-Fer-Set presetting device as recommended by manufacturer.
b. Route as required to interconnect the instrumentation provided.
c. Provide an instrument valve and weldolet for all "root" valve locations where instrumentation tubing connections are made to the piping system.

500-3.6 Gauges.

a. Install where indicated on the Drawings.

500-3.7 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.
c. 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.
d. Provide spool pieces or spacers in the piping as necessary to ensure valve parts and operators have sufficient operating clearances.
e. For adapters with integral screens; remove, clean, and reinstall screen after completion of flushing, before putting system into service.

500-3.8 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.

500-3.9 Equipment Test and Checkout.

a. Before Equipment installations will be accepted, Contractor-furnished Equipment shall be tested and demonstrated to be correctly connected and installed.
b. All testing and checkout procedures of manufacturer shall be carried out completely.
c. All tested equipment found to be defective or inoperable to any extent is to be reported to Owner immediately.
d. 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.
e. Protect all Equipment and surrounding areas from damage resulting from testing operations. Clean up any spills or leakage from testing.
f. At a minimum a functional operational test shall be performed by the glycol vendor and mechanical contractor on all equipment and systems to verify operation as intended. Several instances shall be tested based on 1, 4, 8, and 12 blending cubes operating at a time. Offload shall be functionally tested to ensure each above ground storage tank can be filled. Reclaim offload and issues shall be functionally tested and verified. Additional tests could be required to verify all systems are operational. A test procedure shall be submitted to the owner for approval prior to any testing. The owner will provide the glycol for the test.

500-3.10 Maintenance Program and Warranty.

a. The deice/anti-ice contractor shall provide a warranty that guarantees system materials and workmanship against defects for a minimum of five (5) years. The system warranty shall also be inclusive of a comprehensive maintenance and support program for the entire warranty duration. The program shall consist at a minimum of annual pre-season system startup inspection and training, annual post season system inspection and shut down, 24/7 remote on-call system support, and on-site system support. Remote support must include 24/7 on-call access to diagnose, adjust and repair the system. Contractor must also have sufficient personnel and technical resources to effectively carry out on-site support in a timely manner.

500-3.11 Operation and Maintenance Manuals

a. O&M Manual will be prepared for the purpose of assisting the Glycol Storage and Conveyance System personnel operate the overall System. The emphasis of the O&M manual will be for the operators responsible for managing glycol fluid receipt and distribution to the load stands. The O&M manual will include a schedule of preventative maintenance activities for equipment in the deice house, tanks, and recommended actions between the off-season and deicing season. The glycol vendor will provide separate O&M manuals for the individual components (e.g. equipment and control system). Subconsultant will review and compile O&M information provided by the vendor into an overall system O&M manual. The Draft System O&M Manual
will be distributed to Consultant, Owner, and system operators for review and comment prior to Commissioning. Comments will be incorporated in a Final O&M Manual.

b. Commissioning Plan and System Commissioning

1. Prepare a Commissioning Plan for the Glycol Storage and Conveyance System. The Commissioning Plan will include provisions to test individual components and the overall capacity of the Glycol Storage and Conveyance System to deliver glycol and water to the dispensers.

2. Provide Draft Commissioning Plan to Consultant, Owner, and system Operators for review and comment.

3. Provide Final Commissioning Plan

4. Subconsultant will lead and participate in a Commissioning Event with Consultant, Contractor, and Owner. Commissioning Event is assumed to occur over a period of one week.

5. Subconsultant will prepare a brief memorandum summarizing key findings and recommendations (if any).

**METHOD OF MEASUREMENT**

**500-5.1** The glycol vendor to provide equipment including but not limited to all load stands, blending cubes, reblend cubes, all pumps, all pump VFD’s, all motor operated control valves, (no manual or isolation valves are provided by glycol vendor), spill containment boxes, all controls, all startup and commissioning. No install or labor associated with glycol vendor equipment lump sum price and should be provided by the installing contractor. See attachment for glycol equipment quote and inclusions and exclusions.

**500-5.2** The contractor is responsible at a minimum for the install of all glycol vendor equipment and pumps. The contractor is to provide and install all pipe, pipe fittings, pipe accessories, pipe insulation, manual valves, isolation valves, equipment anchoring and pads, vibration and seismic design and apparatuses for equipment interfaces, and any other items to furnish a fully functional glycol system as shown on plans and specifications. The glycol vendor will provide control wiring schedules and verify completeness after contractor has terminated all wires. The cost for pump installs shall also include the purchase and install of all accessories including but not limited to strainers, air separators, surge tanks, isolation valves, suction diffusers, pressure gauges check valves housekeeping pads, vibration and seismic restraints and anything that shall be considered incidental to all other items of a pump and included in the install price.

**BASIS OF PAYMENT**

**500-5.3** Payment for the equipment meeting all acceptance criteria and identified as a pay item below shall be based on the contract lump sum. These prices shall be full compensation for

**ADDENDUM NO. 2**
furnishing all materials necessary to complete the item. Any other items either specified or required that are not specifically mentioned here shall also be included in this price.

500-5.4 Payment for the equipment installation meeting all acceptance criteria and identified as a pay item below shall be based on the contract lump sum. These prices shall be full compensation for furnishing all materials necessary to complete the item. Any other items either specified or required that are not specifically mentioned here shall also be included in this price.

Payment will be made under:

Item G-500-5.1 Glycol Equipment provided by Glycol Vendor – LUMP SUM
Item G-500-5.2 Glycol equipment install, accessories and accessories install – LUMP SUM

REFERENCES

   1. A53 - Pipe, Steel, Blade and Hot-Dipped, Zinc-Coated Welded and Seamless.

d. American Society of Mechanical Engineers (ASME):

e. American Bearing Manufacturers' Association (ABMA).

f. Factory Mutual Engineering Division (FM).

g. National Electrical Manufacturers' Association (NEMA).

h. Local governing code.
Proposal for LAS-USA Supply of Specification Item G-500
Deice and Anti-Ice System Equipment and Accessories
LDQ052019-JG1 REV 4

Glycol Management Program – Deice Facility Airside Construction Rebid
Memphis International Airport
Memphis, Tennessee
MSCAA Project No. 08-1260-03 Specifications Dated 11/11/19
January 6, 2020

Liquid Automation Systems (LAS) appreciates the opportunity to submit our proposal to provide equipment, startup, commissioning, integration and training as noted in project specifications G-500 in support of the Deice Facility Airside Construction Program at Memphis International Airport. In addition to efficiently storing and dispensing glycol, our equipment and systems will serve to reduce costs, increase deicing capacity, improve operational efficiency, reduce storm water pollution and improve safety of deicing operations.

In the sections below, we have identified our proposed cost to supply the specified equipment, controls, integration, system startup, commissioning and training, along with a brief narrative to assist in accurately delineating the interface of effort between LAS and the Contractor. Also, included as Attachment A are the Inclusions/Exclusions for clarification in support of our cost proposal and scoping narrative.

Proposed Cost
The following table represents our proposed costs to supply the equipment and support services as identified in Specifications G-500 (De-Ice and Anti-Ice System Equipment and Accessories) and as also further clarified in Attachment A – Inclusions and Exclusions.

Please note that due to the current uncertainties in the steel markets, steel suppliers are only holding firm pricing for 30 days.

The warranty on the equipment can start on date of commissioning/acceptance provided the system is started up and commissioned within 12 months from date of shipment from the factory.

Lump Sum Line Item Costs

Items G-500-5.1 Glycol Equipment and Glycol Control System Provided by Glycol Vendor Lump Sum:  $ 9,450,210

Exclusions in conjunction with attachment A:

- Electrical
  - Supply and termination of field control and supply power cabling to the Blend Stations.
  - Supply and termination of field control wiring for pump control panels
  - Supply and termination of field control wiring from the blenders to loading stations/dispensers.
MEM Glycol Management Program
Deice Facility Airside Construction

January 6, 2020

- Supply and termination of CAT 6 shielded network cable between LAS equipment.

- Mechanical
  - Supply, installation and connection of all Type I Aircraft Deicing Fluid piping, manual valves and related equipment external to the Blend Stations as required.
  - Supply, installation and connection of all water supply piping, manuals valves, freeze prevention and related equipment external to the Blend Stations as required.
  - Supply, installation and connection of all Type IV Aircraft Anti-icing Fluid piping, manual valves and related equipment external to the pumps and Load Stations as required.
  - Supply, installation and connection of all piping and related equipment connecting to the Load Stations as required.
  - It is assumed that the sites will have sufficient water supply connections with backflow preventers, utility metering equipment and other items as required by local code and authorities.

- Site Preparation and System Installation
  - The Contractor will:
    - Prepare a suitable concrete base for mounting of all systems supplied by LAS
    - Offload, positioning and mounting of all systems supplied by LAS

- The handling, supply and disposal of fluid required for testing
- Client/Contractor to provide wireless or wired network connectivity from pump control panel to MEM LAN for remote access

**Interface with Installing Contractors**

LAS will collaborate with the selected mechanical and electrical contractors to support proper installation of LAS provided equipment within the proposed glycol fluid management system. In general, LAS will provide subject matter expertise for the Contractor to include wiring schedules, shop drawings, field validation of wiring terminations and piping configurations related to the proper installation of LAS provided equipment. LAS will also provide startup, testing, calibration and final commissioning of the glycol fluid management system and well as operator training.

**Electrical**

LAS will provide control wiring schedules for equipment and controls provided by LAS as noted herein. Contractor is to provide all wiring and terminations including installation of conduit and associated wire pulls. LAS will serve as on-site subject matter expert for all LAS provided equipment and verify completeness after Contractor has terminated all wiring. LAS will coordinate with the Contractor during the test and checkout phase to ensure the system is operating as intended.

**Mechanical**

LAS will provide shop drawings as required for changes related to its equipment. In addition to piping, Contractor is responsible for install of all LAS supplied equipment including blending systems, load stands, pumps, and incidental items. LAS will serve as on-site subject matter expert for all LAS provided equipment and verify completeness during the startup and commissioning process. LAS will coordinate with the Contractor during the test and checkout phase to ensure the system is operating as intended.

**Confidential Information**

Some aspects of the pricing contained in this proposal are considered confidential and may not be shared with third parties outside of the Memphis International Airport staff without the written permission of LAS. Specifically, individual line item pricing and any supporting information is to be treated as confidential information. The lump sum total pricing is excluded from this requirement and may be shared as needed in the bid package addendum to potential contractors.
Commercial Terms:

- This proposal is based on the specifications provided in the bid package dated 3/15/19.
- Payment terms:
  - Equipment
    - 25% at order
    - Balance billed monthly on % completion, Net 30 from date of invoice
- Delays on site outside the control of LAS-USA will be for the account of the client
- Daily rate of standing time shall be at LAS standard rates plus expenses
- Standing time of less than one day may be pro-rated
- LAS 1 year Standard warranty on parts and workmanship. The warranty on the equipment can start on date of commissioning/acceptance provided the system is started up and commissioned within 12 months from date of shipment from the factory.”

Please feel free to contact me for any technical or commercial clarification of this proposal.

Respectfully submitted,

Jef Gaskill
+1 205-378-1060
### Inclusion/Exclusion Schedule

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
<th>Quantity</th>
<th>Type</th>
<th>Shipping to site</th>
<th>Installation</th>
<th>Power</th>
<th>Cooma</th>
<th>Item</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-01</td>
<td>Load Stands</td>
<td>26</td>
<td>Equipment</td>
<td>Included</td>
<td>Supplied by others</td>
<td>Supplied by others</td>
<td>Supplied by others</td>
<td>e-01</td>
<td>Valves, manual</td>
</tr>
<tr>
<td>1-02</td>
<td>Blending Cubes</td>
<td>24</td>
<td>Equipment</td>
<td>Included</td>
<td>Supplied by others</td>
<td>Supplied by others</td>
<td>Supplied by others</td>
<td>e-02</td>
<td>Valves, isolation</td>
</tr>
<tr>
<td>1-04</td>
<td>Spill boxes with dump bock</td>
<td>4</td>
<td>Equipment</td>
<td>Included</td>
<td>Supplied by others</td>
<td>Supplied by others</td>
<td>Supplied by others</td>
<td>e-03</td>
<td>Piping</td>
</tr>
<tr>
<td>1-05</td>
<td>Cardlock terminals</td>
<td>30</td>
<td>Equipment</td>
<td>Included</td>
<td>Supplied by others</td>
<td>Supplied by others</td>
<td>Supplied by others</td>
<td>e-04</td>
<td>Fittings</td>
</tr>
<tr>
<td>1-06</td>
<td>Rust management system software</td>
<td>as required</td>
<td>Software</td>
<td>Included</td>
<td>Included</td>
<td>Not applicable</td>
<td>Not applicable</td>
<td>e-05</td>
<td>Pipe accessories</td>
</tr>
<tr>
<td>1-07</td>
<td>All Type I Glycol Pumps</td>
<td>11</td>
<td>Equipment</td>
<td>Included</td>
<td>Supplied by others</td>
<td>Supplied by others</td>
<td>Supplied by others</td>
<td>e-06</td>
<td>Piping installation</td>
</tr>
<tr>
<td>1-08</td>
<td>All Type IV Glycol Pumps</td>
<td>29</td>
<td>Equipment</td>
<td>Included</td>
<td>Supplied by others</td>
<td>Supplied by others</td>
<td>Supplied by others</td>
<td>e-07</td>
<td>Used stand installation</td>
</tr>
<tr>
<td>1-09</td>
<td>All Water Pumps servicing the glycol blenders</td>
<td>4</td>
<td>Equipment</td>
<td>Included</td>
<td>Supplied by others</td>
<td>Supplied by others</td>
<td>Supplied by others</td>
<td>e-08</td>
<td>Blending cube installation</td>
</tr>
<tr>
<td>1-10</td>
<td>All motor operated control valves</td>
<td>28</td>
<td>Hardware</td>
<td>Included</td>
<td>Supplied by others</td>
<td>Supplied by others</td>
<td>Supplied by others</td>
<td>e-09</td>
<td>Re-Blend cube installation</td>
</tr>
<tr>
<td>1-11</td>
<td>All VFDs, including cabinets, for the pumps listed above in (1-07), (1-08), and (1-09)</td>
<td>as required</td>
<td>Equipment</td>
<td>Included</td>
<td>Supplied by others</td>
<td>Supplied by others</td>
<td>Supplied by others</td>
<td>e-10</td>
<td>All-pump installations</td>
</tr>
<tr>
<td>1-12</td>
<td>Main Network Cabinet (with 24 fiber, and 12 ethernet connections)</td>
<td>1</td>
<td>Equipment</td>
<td>Included</td>
<td>Supplied by others</td>
<td>Supplied by others</td>
<td>Supplied by others</td>
<td>e-11</td>
<td>Control / Instrumentation equipment installation</td>
</tr>
<tr>
<td>1-13</td>
<td>Main PLC control panel</td>
<td>1</td>
<td>Equipment</td>
<td>Included</td>
<td>Supplied by others</td>
<td>Supplied by others</td>
<td>Supplied by others</td>
<td>e-12</td>
<td>Control / Instrumentation wiring and connection</td>
</tr>
<tr>
<td>1-14</td>
<td>Controls system hardware for glycol management system</td>
<td>as required</td>
<td>Hardware</td>
<td>Included</td>
<td>Supplied by others</td>
<td>Supplied by others</td>
<td>Supplied by others</td>
<td>e-13</td>
<td>Fiber optic wiring</td>
</tr>
<tr>
<td>1-15</td>
<td>Controls system software for glycol management system</td>
<td>as required</td>
<td>Software</td>
<td>Included</td>
<td>Included</td>
<td>Supplied by others</td>
<td>Supplied by others</td>
<td>e-14</td>
<td>Ethernet wiring</td>
</tr>
<tr>
<td>1-16</td>
<td>All flow sensors</td>
<td>As required on drawings M-PD-01, 02, 03, 04, 05</td>
<td>Hardware</td>
<td>Included</td>
<td>Supplied by others</td>
<td>Supplied by others</td>
<td>Supplied by others</td>
<td>e-15</td>
<td>Pump Control cabinet anchoring.</td>
</tr>
<tr>
<td>1-17</td>
<td>All level sensors</td>
<td>As required on drawings M-PD-01, 02, 03, 04, 05</td>
<td>Hardware</td>
<td>Included</td>
<td>Supplied by others</td>
<td>Supplied by others</td>
<td>Supplied by others</td>
<td>e-16</td>
<td>IMF display mounting hardware</td>
</tr>
<tr>
<td>1-18</td>
<td>All flow transmitters</td>
<td>As required on drawings M-PD-01, 02, 03, 04, 05</td>
<td>Hardware</td>
<td>Included</td>
<td>Supplied by others</td>
<td>Supplied by others</td>
<td>Supplied by others</td>
<td>e-17</td>
<td>Seismic design</td>
</tr>
<tr>
<td>1-19</td>
<td>All level transmitters</td>
<td>As required on drawings M-PD-01, 02, 03, 04, 05</td>
<td>Hardware</td>
<td>Included</td>
<td>Supplied by others</td>
<td>Supplied by others</td>
<td>Supplied by others</td>
<td>e-18</td>
<td>Vibration and seismic devices</td>
</tr>
<tr>
<td>1-20</td>
<td>Load and offload hoses</td>
<td>58 (total, size may vary)</td>
<td>Hardware</td>
<td>Included</td>
<td>Supplied by others</td>
<td>Not applicable</td>
<td>Not applicable</td>
<td>e-19</td>
<td>Power wiring and connection</td>
</tr>
<tr>
<td>1-21</td>
<td>Load and Off-road couplings</td>
<td>58 (total, size may vary)</td>
<td>Hardware</td>
<td>Included</td>
<td>Supplied by others</td>
<td>Not applicable</td>
<td>Not applicable</td>
<td>e-20</td>
<td>Power wiring schedules</td>
</tr>
<tr>
<td>1-22</td>
<td>System Start up testing</td>
<td>as required</td>
<td>Resources</td>
<td>Included</td>
<td>Included</td>
<td>Not applicable</td>
<td>Not applicable</td>
<td>e-21</td>
<td>Power supply panels</td>
</tr>
<tr>
<td>1-23</td>
<td>System calibration</td>
<td>as required</td>
<td>Resources</td>
<td>Included</td>
<td>Included</td>
<td>Not applicable</td>
<td>Not applicable</td>
<td>e-22</td>
<td>Equipment interfaces</td>
</tr>
<tr>
<td>1-24</td>
<td>System training</td>
<td>as required</td>
<td>Training</td>
<td>Included</td>
<td>Included</td>
<td>Not applicable</td>
<td>Not applicable</td>
<td>e-23</td>
<td>Consult</td>
</tr>
<tr>
<td>1-25</td>
<td>Spare parts for all above items</td>
<td>as required</td>
<td>Hardware</td>
<td>Included</td>
<td>Not applicable</td>
<td>Not applicable</td>
<td>Not applicable</td>
<td>e-24</td>
<td>Consult Installation</td>
</tr>
<tr>
<td>1-26</td>
<td>All installation manuals for all fluid blending, dispensing, and pumping equipment</td>
<td>as required</td>
<td>Documentation</td>
<td>Included</td>
<td>Included</td>
<td>Not applicable</td>
<td>Not applicable</td>
<td>e-25</td>
<td>Heat tracing</td>
</tr>
<tr>
<td>1-27</td>
<td>Documentation and manuals for the control system</td>
<td>as required</td>
<td>Documentation</td>
<td>Included</td>
<td>Included</td>
<td>Not applicable</td>
<td>Not applicable</td>
<td>e-26</td>
<td>Site preparation including concrete pads, forms, and bases</td>
</tr>
<tr>
<td>1-28</td>
<td>Documentation and manuals for all fluid blending, dispensing, and pumping equipment</td>
<td>as required</td>
<td>Documentation</td>
<td>Included</td>
<td>Included</td>
<td>Not applicable</td>
<td>Not applicable</td>
<td>e-27</td>
<td>Equipment anchorage hardware</td>
</tr>
<tr>
<td>1-29</td>
<td>Documentation and manuals for all fluid blending, dispensing, and pumping equipment</td>
<td>as required</td>
<td>Documentation</td>
<td>Included</td>
<td>Included</td>
<td>Not applicable</td>
<td>Not applicable</td>
<td>e-28</td>
<td>Glycol wiper equipment interconnection- electrical and control wiring, piping</td>
</tr>
<tr>
<td>1-30</td>
<td>Warranty for equipment supplied</td>
<td>as required</td>
<td>Contract</td>
<td>Included</td>
<td>Included</td>
<td>Not applicable</td>
<td>Not applicable</td>
<td>e-29</td>
<td>Cathodic protection</td>
</tr>
<tr>
<td>1-31</td>
<td>Warranty for systems supplied</td>
<td>as required</td>
<td>Contract</td>
<td>Included</td>
<td>Included</td>
<td>Not applicable</td>
<td>Not applicable</td>
<td>e-30</td>
<td>Surge tanks</td>
</tr>
</tbody>
</table>

### Exclusions

Note: The Glycol Vendor will provide all equipment as defined in Item G-500 Section 5.1 page 10.

- Air Separators
- Blending Cubes
- Controls system hardware for glycol management system
- Controls system software for glycol management system
- Equipment anchorage hardware
- Glycol vendor equipment interconnection- electrical and control wiring, piping
- Heat tracing
- Site preparation including concrete pads, forms, and bases
- Spill boxes with dump bock
- System Start up testing
- System calibration
- System training
- Spill boxes with adapter boot
- System Start up testing
- System calibration
- System training
- Spill boxes with adapter boot
- System Start up testing
- System calibration
- System training

---

**Project**: MSCAA Project No. 08-1260-03  
**Revision**: 3

**Liquid Automation Systems, LLC**  
916 Belcher Drive Pelham, AL 35124  
205 378 1060  
customerservice@las-usallc.com

**G-500** Page 17
## Attachment A

### Exclusion/Inclusion Schedule

#### Proposal Line Item List

**Project**: D002  
**Date**: 1/2/2020  
**Rev #**: 2

<table>
<thead>
<tr>
<th>Line</th>
<th>Item</th>
<th>Qty</th>
<th>Selling Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Load Stand, Dual</td>
<td>24</td>
<td>$1,064,385</td>
</tr>
<tr>
<td>2</td>
<td>Load Stand, Single</td>
<td>2</td>
<td>$34,235</td>
</tr>
<tr>
<td>3</td>
<td>Blending Cube250</td>
<td>26</td>
<td>$3,303,121</td>
</tr>
<tr>
<td>4</td>
<td>Re-Blend Module</td>
<td>2</td>
<td>$173,097</td>
</tr>
<tr>
<td>5</td>
<td>Pump Skid, Type IV Secondary Issue</td>
<td>24</td>
<td>$643,452</td>
</tr>
<tr>
<td>6</td>
<td>Pump Skid, Type I Reclaim Issue</td>
<td>2</td>
<td>$44,473</td>
</tr>
<tr>
<td>7</td>
<td>Pump Skid, Reclaim Offload</td>
<td>2</td>
<td>$59,337</td>
</tr>
<tr>
<td>8</td>
<td>Fluid/Inventory Management System</td>
<td>1</td>
<td>$536,294</td>
</tr>
<tr>
<td>9</td>
<td>Pump House Pumps</td>
<td>16</td>
<td>$374,607</td>
</tr>
<tr>
<td>10</td>
<td>Spill Boxes</td>
<td>4</td>
<td>$20,743</td>
</tr>
<tr>
<td>11</td>
<td>Motor Operated Valves</td>
<td>28</td>
<td>$418,654</td>
</tr>
<tr>
<td>12</td>
<td>Pump Panel, Type I</td>
<td>1</td>
<td>$192,412</td>
</tr>
<tr>
<td>13</td>
<td>Pump Panel, Type IV</td>
<td>1</td>
<td>$181,311</td>
</tr>
<tr>
<td>14</td>
<td>Pump Panel, Water</td>
<td>1</td>
<td>$125,498</td>
</tr>
<tr>
<td>15</td>
<td>Main Network Cabinet</td>
<td>1</td>
<td>$89,143</td>
</tr>
<tr>
<td>16</td>
<td>Main PLC Cabinet</td>
<td>1</td>
<td>$250,033</td>
</tr>
<tr>
<td>17</td>
<td>Controls System Integration</td>
<td>1</td>
<td>$508,548</td>
</tr>
<tr>
<td>18</td>
<td>Instrumentation</td>
<td>1</td>
<td>$366,397</td>
</tr>
<tr>
<td>19</td>
<td>System Startup, Calibration</td>
<td>1</td>
<td>$464,071</td>
</tr>
<tr>
<td>20</td>
<td>Training</td>
<td>1</td>
<td>$18,462</td>
</tr>
<tr>
<td>21</td>
<td>Spare Parts (minimum)</td>
<td>1</td>
<td>$25,025</td>
</tr>
<tr>
<td>22</td>
<td>System Documentation</td>
<td>1</td>
<td>$146,559</td>
</tr>
<tr>
<td>23</td>
<td>Project Management and Collaboration</td>
<td>1</td>
<td>$320,000</td>
</tr>
<tr>
<td>24</td>
<td>Annual Support Package, 1 year</td>
<td>1</td>
<td>$39,847</td>
</tr>
<tr>
<td>25</td>
<td>Shipping / Freight</td>
<td>1</td>
<td>$50,505</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td></td>
<td></td>
<td><strong>$9,450,210</strong></td>
</tr>
</tbody>
</table>

### OPTIONAL ADDERS

<table>
<thead>
<tr>
<th>Line</th>
<th>Item</th>
<th>Qty</th>
<th>Selling Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>1a</td>
<td>Spare Parts (maximum)</td>
<td>1</td>
<td>$625,000</td>
</tr>
<tr>
<td>2a</td>
<td>Extended Warranty, 4 years</td>
<td>1</td>
<td>$600,000</td>
</tr>
<tr>
<td>3a</td>
<td>Annual Support Package, 4 year</td>
<td>1</td>
<td>$159,384</td>
</tr>
</tbody>
</table>