ITEM P-304 CEMENT-TREATED AGGREGATE BASE COURSE (CTB)

DESCRIPTION

304-1.1 This item shall consist of a cement-treated base (CTB) course composed of mineral aggregate and cement, uniformly blended and mixed with water. The mixed material shall be spread and shaped with a mechanical spreader, and compacted with rollers in accordance with these specifications and in conformance to the lines, grades, dimensions, and cross-sections shown on the plans. The base course shall be built in a series of parallel lanes using a plan of processing that reduces longitudinal and transverse joints to a minimum.

MATERIALS

304-2.1 Aggregate. The aggregate shall be select granular materials, comprised of crushed or uncrushed gravel and/or stone, or recycled cement concrete. The material shall be free of roots, sod, and weeds. The crushed or uncrushed aggregate shall consist of hard, durable particles meeting the requirements in the table below. Coarse or fine aggregate containing or consisting of slag shall not be permitted.

Cement Treated Aggregate Base Material Requirements

<table>
<thead>
<tr>
<th>Material Test</th>
<th>Requirement</th>
<th>Standard</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coarse Aggregate Portion (retained on the No. 4 (4.75 mm) sieve)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Resistance to Degradation</td>
<td>Loss: 40% maximum</td>
<td>ASTM C131</td>
</tr>
<tr>
<td>Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate</td>
<td>Loss after 5 cycles:</td>
<td>ASTM C88</td>
</tr>
<tr>
<td></td>
<td>10% maximum using Sodium sulfate - or - 15% maximum using magnesium sulfate</td>
<td></td>
</tr>
<tr>
<td>Flat Particles, Elongated Particles, or Flat and Elongated Particles¹</td>
<td>10% maximum, by weight, for fraction retained on the ½ inch (12.5mm) sieve and 20% maximum, by weight, for the fraction passing the 1/2-inch (12.5 mm) sieve</td>
<td>ASTM D4791</td>
</tr>
<tr>
<td>Clay lumps and friable particles</td>
<td>Less than or equal to 3 percent</td>
<td>ASTM C142</td>
</tr>
<tr>
<td>Fine Aggregate Portion (Passing the No. 40 (425µm) sieve)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Liquid limit</td>
<td>Less than or equal to 25</td>
<td>ASTM D4318</td>
</tr>
<tr>
<td>Plasticity Index</td>
<td>Not more than 6</td>
<td>ASTM D4318</td>
</tr>
</tbody>
</table>

¹ A flat particle is one having a ratio of width to thickness greater than three (3); an elongated particle is one having a ratio of length to width greater than three (3).

304-2.2 Gradation Requirements. The aggregate shall conform to the gradation(s) shown in the table below per ASTM C136. A dense, well-graded aggregate blend that meets the requirements of the table shall be selected by the Contractor and used in the final mix design. The final aggregate blend shall be well graded from coarse to fine within the limits designated in the table and shall not vary from the low limit on one sieve to the high limit on adjacent sieves, or vice versa.
Aggregate Gradation for CTB Material

<table>
<thead>
<tr>
<th>Sieve Size</th>
<th>Design Range Percentage by Weight Passing</th>
<th>Contractor’s Final Gradation</th>
<th>Job Control Grading Band Tolerances for Contractor’s Final Gradation Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 inch (50 mm)</td>
<td>100</td>
<td></td>
<td>±0</td>
</tr>
<tr>
<td>1 inch (25.0 mm)</td>
<td>90-100</td>
<td></td>
<td>±5</td>
</tr>
<tr>
<td>No. 4 (4.75 mm)</td>
<td>45-95</td>
<td></td>
<td>±8</td>
</tr>
<tr>
<td>No. 10 (2.00 mm)</td>
<td>37-80</td>
<td></td>
<td>±8</td>
</tr>
<tr>
<td>No. 40 (425 µm)</td>
<td>15-50</td>
<td></td>
<td>±5</td>
</tr>
<tr>
<td>No. 200 (75 µm)</td>
<td>0–15</td>
<td></td>
<td>±3</td>
</tr>
</tbody>
</table>

For Contractor quality control, sample the aggregate stockpile in accordance with ASTM D75 and perform gradation tests in accordance with ASTM C136 a minimum of once per week during production of CTB.

304-2.3 Sampling and testing.

a. Aggregate base materials. The Contractor shall take samples of the aggregate base in accordance with ASTM D75 to verify initial aggregate base requirements and gradation in the presence of the Program Manager. Material shall meet the requirements in paragraphs 304-2.1 and 304-2.2. This sampling and testing will be the basis for approval of the aggregate base quality requirements. In lieu of aggregate sample testing, the Program Manager may accept certified State Department of Transportation test results indicating that the aggregates meet specification requirements. The results must be for tests performed within the last six months at the time of submittal. No aggregates shall be used in production of mixtures without prior acceptance.

b. Gradation requirements. The Contractor shall take at least two aggregate base samples per day in the presence of the Program Manager to check the final gradation. Sampling shall be per ASTM D75. Material shall meet the requirements in paragraph 304-2.2. The samples shall be taken from the in-place, un-compacted material at sampling points and intervals designated by the Program Manager.

304-2.4 Cement. Cement shall conform to the requirements of ASTM C150 Type I/II, low alkali.

304-2.5 Cementitious additives. Not applicable.

304-2.6 Water. Water used in mixing or curing shall be from potable water sources. Other sources shall be tested in accordance with ASTM C1602 prior to use.

304-2.7 Curing materials. Curing material shall be an emulsified asphalt conforming to ASTM D977.

304-2.8 Sand blotter. Sand shall be applied, when required, to prevent tracking of the emulsion curing materials. The sand material shall be clean, dry, and non-plastic.

COMPOSITION OF MIXTURE

304-3.1 General. The CTB material shall be composed of a mixture of aggregate, cementitious material, and water.

304-3.2 Mix design. The mix design shall use a cement content that shall not be less than 3% by weight of dry aggregate and, when tested in the laboratory per ASTM D1633, produces a 7-day compressive strength.
a minimum 750 psi with the following exceptions in testing procedures: The compressive strength specimen shall be soaked in water for 4 hours immediately prior to testing; cap and break specimens in compression in accordance with ASTM D1633.

Wet-dry and/or freeze-thaw tests shall be performed in accordance with ASTM D559 and ASTM D560 respectively. The weight loss for each type of test shall not exceed 14% after 12 cycles.

The mix design shall include a complete list of materials, including type, brand, source, and amount of cement, fine aggregate, coarse aggregate, water, and cementitious additives.

Should a change be made in aggregate sources or type of cement, or if cementitious additives are added or deleted from the mix, production of the CTB mix shall be stopped and a new mix design shall be submitted.

**304-3.3 Submittals.** At least 30 days prior to the placement of the CTB, the Contractor shall submit certified test reports to the Program Manager for those materials proposed for use during construction, as well as the mix design information for the CTB material. Tests older than six (6) months shall not be used. The certification shall show the ASTM or AASHTO specifications or tests for the material, the name of the company performing the tests, the date of the tests, the test results, and a statement that the material did or did not comply with the applicable specifications. The submittal package shall include the following:

a. Source(s) of materials, including aggregate, cement, cementitious additives, curing, and bond-breaking materials.

b. Physical properties of the aggregates, cement, cementitious additives, curing, and bond-breaking materials.

c. Mix design:
   - Mix identification number
   - Aggregate gradation
   - Cement content
   - Water content
   - Cementitious materials content
   - Compaction and strength results
   - Laboratory compaction characteristics (maximum dry density and optimum moisture content)
   - Compressive strength at seven (7) days
   - Wet-dry and/or freeze-thaw weight loss

No CTB material shall be placed until the submittal is accepted in writing by the Program Manager.

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

**EQUIPMENT**

**304-4.1 Mixing.** The mixer shall be a batch or continuous-flow type stationary mixer that produces a well-blended, uniform mixture of aggregate, cement, water, and pozzolan. The mixer shall be equipped with calibrated metering and feeding devices that introduce the aggregate, cement, water, and cementitious additives (if used) into the mixer in the specified quantities.

The Program Manager shall have free access to the plant at all times for inspection of the plant’s equipment and operation and for sampling the CTB mixture.
304-4.2 **Hauling.** The CTB material shall be transported from the plant to the job site in trucks or other hauling equipment having beds that are smooth, clean, and tight. Truck bed covers shall be provided and used to protect the CTB from weather. CTB material that becomes wet during transport shall be rejected.

304-4.3 **Placing.** CTB material shall be placed with a mechanical spreader capable of receiving, spreading, and shaping the mixture without segregation into a uniform layer or lift. The equipment shall be equipped with a strike-off plate and end gates capable of being adjusted to the layer thickness and width. The spreaders shall be automatically controlled by sensors operating off acceptable methods of control, as established in the construction of the Control Strip identified under Section 304-4.4, and shall be capable of placing and finishing the base course within the tolerances specified. Spreading of the base material by motor grader or bulldozer shall not be permitted except for small or irregularly shaped areas as approved by the Program Manager.

304-4.4 **Compaction.** The number, type, and weight of rollers and/or compactors shall be sufficient to compact the mixture to the required density.

**CONSTRUCTION METHODS**

304-5.1 **Control Strip.** The first half-day of construction shall be considered the control strip. The Contractor shall demonstrate, in the presence of the Program Manager, that the materials, equipment, and construction processes meet the requirements of the specification. Control strips that do not meet specification requirements shall be removed and replaced at the Contractor’s expense. Full operations shall not continue until the control strip has been accepted by the Program Manager. Upon acceptance of the control strip 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.

304-5.2 **Weather limitations.** The CTB shall not be placed on frozen surfaces or when weather conditions will detrimentally affect quality of the finished course. Apply cement when the ambient temperature is a minimum of 40°F and rising and aggregate are not frozen or contain frost. If ambient temperature falls below 40°F, protect completed CTB areas against freezing. The Contractor should stop operations prior to and during rain allowing time to cover and protect any freshly placed material. Areas damaged by rain shall be replaced at the Contractor’s expense.

304-5.3 **Maintenance.** Completed portions of the cement-stabilized area may be opened to local traffic provided the curing process is not impaired and to other traffic after the curing period has elapsed, provided that the cement-stabilized course has hardened sufficiently to prevent surface marring or distortion by equipment or traffic. Protect finished portions of cement stabilized base from traffic of equipment used in constructing adjoining sections in a manner to prevent marring or damaging completed work. The CTB shall be protected from freezing until covered.

304-5.4 **Preparation of underlying course.** The underlying course shall be checked by the Program Manager before placing and spreading operations are started. Prior to placing the material, the final grade should be firm, moist and free of frost. Use of chemicals to eliminate frost will not be permitted. The underlying course shall be wetted in advance of placing the CTB layer.

304-5.5 **Grade control.** Grade control between the edges of the CTB shall be accomplished at intervals of 50 feet on the longitudinal grade and at 25 feet on the transverse grade.

304-5.6 **Placing.** The CTB mixture shall be deposited on the moistened subgrade or subbase and spread into a uniform layer of specified width and thickness that, when compacted and trimmed, conforms to the required line, grade, and cross-section. The longitudinal joints shall be located so there is no offset from
planned joints in any overlying layer. Placement of the material shall begin along the centerline of the pavement on a crowned section or on the highest elevation contour of a pavement with variable cross slope. The Contractor shall install the CTB layer in single compacted layer no greater than 8 inches thick. In multilift construction, the surface of the compacted lift shall be kept moist until covered with the next lift. Successive lifts shall be placed and compacted so that the required total depth of the CTB layer is completed within 12 hours.

304-5.7 Compaction. All compaction operations shall be completed within 2 hours from the start of mixing. The field density of the compacted mixture shall be at least 98% of the maximum density in accordance with paragraph 304-6.1a. At the start of compaction, the moisture content shall be within ±2 percentage points of the specified optimum moisture. Maximum density refers to maximum dry density at optimum moisture content unless otherwise specified.

304-5.8 Finishing. After compaction, shape the surface of the CTB layer to the specified lines, grades, and cross-section. During the finishing process, the surface shall be kept moist by means of fog-type sprayers. Compaction and finishing shall produce a smooth, dense surface, free of ruts, cracks, ridges, and loose material.

304-5.9 Construction limitations. All placement, compaction, and finishing operations shall be completed within two (2) hours from the start of mixing. Material not completed within the 2-hour time limit shall be removed and replaced at the Contractor’s expense.

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

Completed portions may be opened to light traffic, if approved by the Program Manager, the CTB has achieved a compressive strength of at least 750 psi, and the curing is not impaired.

No construction of subsequent pavement section materials may be placed until the CTB has achieved a compressive strength of at least 750 psi, the Program Manager has provided approval, and acceptance for the area of interest has been obtained.

304-5.10 Curing. The compacted and finished CTB shall be cured with the approved curing agents as soon as possible, but in no case later than two (2) hours after completion of the finishing operations. Curing material(s) shall meet the requirements in paragraph 304-2.7. The layer shall be kept moist using a moisture-retaining cover or a light application of water until the curing material is applied.

The entire surface of the CTB layer shall be uniformly sprayed with an asphalt emulsion at a rate of between 0.15 and 0.30 gallons per square yard; the exact temperature and rate of application being that required to achieve complete and uniform coverage without runoff. Apply sand to treated surfaces requiring protection from traffic.

The curing seal shall be maintained and protected until the pavement is placed. If the surface of the finished CTB and/or the curing seal becomes damaged, additional curing material shall be applied at the time it is damaged or when the damage is first observed.

304-5.11 Surface tolerance. The Contractor shall perform smoothness and grade checks in the presence of the Program Manager. Any area not meeting smoothness and grade shall be corrected by the Contractor at the Contractor’s expense.

   a. Smoothness. The finished surface shall not vary more than ±3/8-inch when tested with a 12-foot straightedge applied parallel with and at right angles to the centerline, and 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 shall be measured on a 50-foot grid and shall be within +/-0.05 feet of the specified grade.

**MATERIAL ACCEPTANCE**

**304-6.1 Acceptance sampling and testing.** Cement Treated Aggregate base course shall be accepted for density and thickness on an area basis. Two tests shall be made for density and thickness for each 1,200 square yards, but not less than four (4) tests per day of production. Sampling locations will be determined on a random basis per ASTM D3665.

a. **Density testing.** CTB samples representing the material placed shall be taken to establish density and moisture requirements in accordance with ASTM D558. Additional CTB samples will be taken as necessary to verify density and moisture requirements. 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.

Each area shall be accepted for density when the field density is at least 98% of the maximum density of laboratory specimens. The in-place field density shall be determined in accordance with ASTM D6938, Procedure A, direct transmission method. The in-place moisture content shall be determined in accordance with ASTM D2216. Perform in-place density test immediately after completion of compaction to determine degree of compaction. If the material fails to meet the density requirements, compaction shall continue or the material shall be removed and replaced at the Contractor's expense. Maximum density refers to maximum dry density at optimum moisture content unless otherwise specified.

b. **Thickness.** Thickness shall be determined by measuring the depth of core holes in the CTB at random locations, per ASTM D3665. The resulting core holes shall be filled by the Contractor with CTB or non-shrink grout.

The Contractor may elect to determine acceptance of thickness by survey before and after placement. Survey intervals shall be no more than 50-foot longitudinally and 25-foot transversely for each proposed lot. Survey data shall be obtained by a state licensed land surveyor.

When the thickness measurement is deficient by more than 1/2 inch, the area represented by the tests shall be removed and replaced at the Contractor’s expense.

**METHOD OF MEASUREMENT**

**304-7.1 Cement-treated base course.** The quantity of cement-treated base course will be determined by measurement of the number of square yards of CTB actually constructed and accepted by the Program Manager as complying with the plans and specifications.

**BASIS OF PAYMENT**

**304-8.1 Cement-treated base course.** Payment shall be made at the contract unit price per square yard for cement-treated base course. This price shall be full compensation for furnishing all materials, including cement; for all preparation, manipulation, placing, and curing of these materials; and for all labor, equipment, tools, and incidentals necessary to complete the item.

Payment will be made under:

Item P-304-8.1 Cement-Treated Aggregate Base Course (8-inch Thick) – per square yard

**ADDENDUM NO. 4**
REFERENCES

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

ASTM International (ASTM)

<table>
<thead>
<tr>
<th>Standard Number</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ASTM C88</td>
<td>Standard Test Method for Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate</td>
</tr>
<tr>
<td>ASTM C150</td>
<td>Standard Specification for Portland Cement</td>
</tr>
<tr>
<td>ASTM C136</td>
<td>Standard Test Method for Sieve or Screen Analysis of Fine and Coarse Aggregate</td>
</tr>
<tr>
<td>ASTM C174</td>
<td>Standard Test Method for Measuring Thickness of Concrete Elements Using Drilled Concrete Cores</td>
</tr>
<tr>
<td>ASTM C309</td>
<td>Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete</td>
</tr>
<tr>
<td>ASTM C595</td>
<td>Standard Specification for Blended Hydraulic Cements</td>
</tr>
<tr>
<td>ASTM C618</td>
<td>Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete</td>
</tr>
<tr>
<td>ASTM C989</td>
<td>Standard Specification for Slag Cement for Use in Concrete and Mortars</td>
</tr>
<tr>
<td>ASTM C1602</td>
<td>Standard Specification for Mixing Water Used in the Production of Hydraulic Cement Concrete</td>
</tr>
<tr>
<td>ASTM D75</td>
<td>Standard Practice for Sampling Aggregates</td>
</tr>
<tr>
<td>ASTM D558</td>
<td>Standard Test Methods for Moisture-Density (Unit Weight) Relations of Soil-Cement Mixtures</td>
</tr>
<tr>
<td>ASTM D559</td>
<td>Standard Test Methods for Wetting and Drying Compacted Soil-Cement Mixtures</td>
</tr>
<tr>
<td>ASTM D560</td>
<td>Standard Test Methods for Freezing and Thawing Compacted Soil-Cement Mixtures</td>
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<tr>
<td>ASTM D977</td>
<td>Standard Specification for Emulsified Asphalt</td>
</tr>
<tr>
<td>ASTM D1556</td>
<td>Standard Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method</td>
</tr>
<tr>
<td>ASTM D1633</td>
<td>Standard Test Methods for Compressive Strength of Molded Soil-Cement Cylinders</td>
</tr>
<tr>
<td>ASTM D2397</td>
<td>Standard Specification for Cationic Emulsified Asphalt</td>
</tr>
<tr>
<td>ASTM D3665</td>
<td>Standard Practice for Random Sampling of Construction Materials</td>
</tr>
<tr>
<td>ASTM D3666</td>
<td>Standard Specification for Minimum Requirements for Agencies Testing and Inspecting Road and Paving Materials</td>
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<td>------------</td>
<td>----------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>ASTM D6938</td>
<td>Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)</td>
</tr>
</tbody>
</table>

**END OF ITEM P-304**
ITEM S-401

PLANT MIX BITUMINOUS PAVEMENT (TDOT)

DESCRIPTION

401-1 ROAD AND SHOULDER PAVEMENT SPECIFICATIONS
All asphalt paving for access roads and shoulder pavements shall be in conformance with the Tennessee Department of Transportation (TDOT), "Standard Specification for Road and Bridge Construction," dated January 1, 2015, and all Supplemental Provisions and subsequent updates to these specifications and Supplemental Provisions.
Asphaltic concrete surface course for airfield shoulders shall conform to TDOT Section 411, Grading E, PG 70-22.
Asphaltic concrete surface course for roadways shall conform to TDOT Section 411, Grading D, PG 70-22.
Bituminous subbase course (intermediate course) for roadways shall conform to TDOT Section 307, Grading B-M2, PG 70-22.
Bituminous base course for roadways shall conform to TDOT Section 307, Grading A, PG 70-22.
Density requirements for both mixes shall be ADT 3000 or greater per TDOT Section 407.15 Compaction.
The Contractor shall follow Quality Control testing procedures as set forth in GP-100, Contractor Quality Control Program and SC-150 Quality Control. The Owner shall provide Quality Assurance Testing as set forth in SC-160, Testing Laboratory Services.
All Quality Control Testing, per TDOT Specifications, shall be performed at the Contractor’s testing facility. All Quality Assurance Testing, per TDOT Specifications, shall be performed at the Owner’s onsite testing facility.
Methods of Measurement and Basis of Payment for these items shall be made in accordance with Special Provisions No. 307 and No. 411 provided under this Technical Specification below.

401-2 SPECIAL PROVISIONS
The following Special Provisions supplement the Tennessee Department of Transportation "Standard Specifications for Road Bridge Construction", dated January 1, 2015 and any Supplemental Provisions issued to date. In case of conflict with the "Standard Specifications", these Special Provisions shall take precedence and shall govern.

Testing Procedures

Test Sections:

Test sections for TDOT mixes (307-BM2, 307-A, 411-D and 411-E) are to be handled in the following manner. The test section shall be 300 feet long by 20 feet wide, and will consist of two paving lanes. Three (3) random samples will be taken at the plant. These three (3) samples will be used to test for stability, flow, and air voids as well as two tests for gradation and asphalt content. The Program Manager is to randomly select twelve (12) core locations to be taken from the pavement mat. The testing lab will discard the two (2) cores that produce the high and low density results and will use the remaining ten (10) for calibrating the nuclear gauge and reporting the average density. The Program Manager is also to randomly select three (3) core locations to be
taken from the longitudinal joint. These will be used to report joint density information.

**Full Production:**

Regular production of 307-BM2, 307-A, 411-D and 411-E will be tested in accordance with the most recent publication of the TDOT Specifications
S-401 - SPECIAL PROVISION NO. 307

BITUMINOUS PLANT MIX BASE AND SUBBASE (HOT MIX)

Modify subsection 307.07, 307.08 and 307.09 of the TDOT Standard Specification for Road and Bridge Construction as noted below:

307.07 – Thickness and Surface Requirements. Add the following:
Areas of deficient thickness, as determined in accordance with the following paragraph, shall not be measured for payment. A lot will consist of either 2,000 square yards or one day’s production. Each lot will consist of four equal sublots. Thickness shall be evaluated for compliance by the Program Manager to the requirements shown on the plans. Measurements of thickness shall be made by the Program Manager using the cores extracted by the Contractor for each sublot for thickness measurement. The maximum allowable deficiency at any point shall not be more than ¼ inch less than the thickness indicated for the lift. Average thickness of lift, or combined lifts, shall not be less than the indicated thickness.

When the measurement of any one core extracted for thickness testing is less than the minimum allowable thickness, additional cores shall be taken by the Contractor at his expense at 20-foot intervals until the completed bituminous pavement is within such minimum thickness for the sub-unit being tested. Out-of-tolerance areas shall be deducted from the total area of bituminous pavement for payment. If, in the Project Manager’s judgment, such out-of-tolerance areas warrant removal, the bituminous pavement shall be removed, the underlying course shall be cleaned (ready for reconstruction), and the bituminous pavement shall be replaced, all at the Contractor’s expense. The minimum allowable thickness is 0.25 inches less than the design thickness for each lift. Average thickness of lift, or combined lifts, shall not be less than the indicated thickness.

307.08 - Method of Measurement. Bituminous Plant Mix Base (Hot Mix) will be measured by the ton for the nominal thickness course. No direct payment will be made for liquid antistrip additive, hydrated lime, polymer or latex additive.

307.09 - Basis of Payment. Bituminous Plant Mix Base (Hot Mix) nominal courses, complete in place, will be paid for at the contract unit price per ton. Said prices shall include aggregate, asphalt cement, prime coat, tack coat and all materials, labor, plant and equipment necessary to complete this work. No price adjustment will be paid for asphalt cement content, recycled asphalt, antistrip additive, hydrated lime, and polymer or latex additive.

End of Special Provision 307

ADDENDUM NO. 4
Modify subsection 411.09 and 411.10 of the TDOT Standard Specification for Road and Bridge Construction as noted below:

**411.08 – Thickness and Surface Requirements.** The surface shall meet the requirements specified under Subsection 407.18, and when tested in accordance with the provisions of that subsection, the deviation of the surface from the testing edge of a Contractor provided 12 foot straightedge shall not exceed ¼ inches. Areas of deficient thickness, as determined in accordance with the following paragraph, shall not be measured for payment. A lot will consist of either 2,000 square yards or one day’s production. Each lot will consist of four equal sublots. Thickness shall be evaluated for compliance by the Program Manager to the requirements shown on the plans. Measurements of thickness shall be made by the Program Manager using the cores extracted by the Contractor for each sublot for thickness measurement. The maximum allowable deficiency at any point shall not be more than ¼ inch less than the thickness indicated for the lift. Average thickness of lift, or combined lifts, shall not be less than the indicated thickness.

When the measurement of any one core extracted for density testing is less than the minimum allowable thickness, additional cores shall be taken by the Contractor at his expense at 20-foot intervals until the completed bituminous pavement is within such minimum thickness for the sub-unit being tested. Out-of-tolerance areas shall be deducted from the total area of bituminous pavement for payment. If, in the Project Manager’s judgment, such out-of-tolerance areas warrant removal, the bituminous pavement shall be removed, the underlying course shall be cleaned (ready for reconstruction), and the bituminous pavement shall be replaced, all at the Contractor’s expense. The minimum allowable thickness is 0.25 inches less than the design thickness for each lift. Average thickness of lift, or combined lifts, shall not be less than the indicated thickness.

**411.09 - Method of Measurement.** Asphaltic Concrete Surface (Hot Mix) will be measured by the ton. No price adjustment will be made for asphalt cement content. No direct payment will be made for antistrip additive, hydrated lime and polymer or latex additive.

**411.10 - Basis of Payment.** Asphalt Concrete Surface (Hot Mix) complete in place, will be paid for at the contract unit price per ton. Said price shall include aggregate, asphalt cement, prime coat, tack coat and all materials, labor, plant and equipment necessary to complete this work. No price adjustment will be paid for asphalt cement content, recycled asphalt, antistrip additive, hydrate lime, and polymer or latex additive.

**End of Special Provision 411**

**METHOD OF MEASUREMENT**

**401-3.1 Measurement.** Plant mix bituminous concrete pavement shall be measured by the number of tons of either surface, subbase (intermediate), or base course pavements as specified in-place, completed and accepted on a lot basis, in accordance with special provisions No. 307 and No. 411 provided in this specification above.

**BASIS OF PAYMENT**

**401-4.1 Payment.** Payment for a lot of plant mix bituminous concrete pavement meeting all acceptance criteria as specified under this technical specification shall be made at the contract unit price per ton. The

**ADDENDUM NO. 4**
price shall be compensation for furnishing all materials, for all preparation, mixing, and placing of these materials, and for all labor, equipment, tools, and incidentals necessary to complete the item.

Payment will be made under:

<table>
<thead>
<tr>
<th>Item S-401-4.1</th>
<th>Hot Mix Asphalt (HMA) Pavement 411-D, PG70-22 (Surface Course 1.25” Thick) – per Ton</th>
</tr>
</thead>
<tbody>
<tr>
<td>Item S-401-4.2</td>
<td>Hot Mix Asphalt (HMA) Pavement 307-BM2, PG70-22 (Subbase Course 2” Thick) – per Ton</td>
</tr>
<tr>
<td>Item S-401-4.3</td>
<td>Hot Mix Asphalt (HMA) Pavement 307-A, PG70-22 (Base Course 3” Thick) – per Ton</td>
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END OF ITEM S-401

ADDENDUM NO. 4
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.

ADDENDUM NO. 4
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.
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. 4
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.

**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.

**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.

### 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.

#### e. The boot shall have an extra thickness at the sleeve edge to protect the booth from damage during backfill.

**ADDENDUM NO. 4**
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: Flanged for 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 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.

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<th>Percent Passing</th>
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**Type Graded Sand**

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**ASTM C144, Natural Sand**

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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.
4. Sulfate: <200mg/kg in accordance with ASTM D516 or equivalent.

ADDENDUM NO. 4
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.

ADDENDUM NO. 4
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.

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

i. Backing rings shall not be used.

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

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

l. Repair 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.

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

200-3.8 Radiographing.

a. Contractor shall coordinate and arrange for radiography by an approved testing laboratory of all welds on all the underground device 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.

g. Radiograph exposure records shall be kept by the testing laboratory which show date, location, area, film number, serial number, film combination, time, source-film distance, angulation, weld number and other pertinent information for each weld radiographed.

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

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

j. Welds which do not meet the standards of acceptability as outlined in the above mentioned 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.
k. Inspection stamps, code symbol stamps, and other required information shall be stamped on the pipe by using "low stress" steel stamps, or other approved method.

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

200-3.9 Magnetic Particle and Dye Penetrant Testing.

a. 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.

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

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

d. 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.

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

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

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

h. 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.

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

j. All fittings shall be left exposed until testing is completed.

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

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

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

200-3.10 FLUSHING:

a. 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.

b. The first part of this specification is applicable to all methods of fuel system flushing, retain

c. The installing Contractor shall be responsible for all flushing requirements.

d. Flushing shall be completed after project substantial completion and prior to project commissioning, prior to back-filling

e. Desired flow rate of flush is 5 feet per second minimum unless a lesser rate is agreed upon by Owner quality assurance representative.
f. All temporary cross connections or special fabrication of adapters required shall be provided by Contractor.

g. The system shall be flushed with Type I and Type IV glycol for each system. Owner will provide the glycol material. 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.

h. 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. 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.

3. 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.

4. 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.

a. Hoses shall be secured in a manner to prevent whipping during flush.

b. Bond truck or tanks to system piping.

c. Start product flow slowly before reaching flushing velocity to check for leaks and system tightness.

d. 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.

i. 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 (20C)
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

300-5.1 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, pipe supports, instrument fittings, pipe sleeves, valves, check valves, instrument valves, solenoid valves, pressure reducing valves, air separators, high point vents for above ground piping, low point drains for above ground piping, PT ports, thermal relief piping, thermal relief valve and thermal check valves, 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

ADDENDUM NO. 4
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
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

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.

END OF ITEM G-200
ITEM G-600 DEICE AND ANTI-ICE SYSTEM INSPECTION, TESTING, AND COMMISSIONING

DESCRIPTION

600-1.1 This Section includes the inspection, testing, and/or flushing of all system piping, testing of corrosion protection coatings, and Equipment performance.

600-1.2 References.
   a. American Society of Mechanical Engineers (ASME):  

600-1.3 Submittals.
   a. Submit detailed procedures for testing methods for approval before proceeding with pipe fabrication. This includes all radiographing and other pipe welding NDE, pressure testing, holiday testing, and flushing.
   b. Submit examination personnel qualifications before proceeding with any testing method.
   c. Submit completed examination procedures with actual testing data (readings) and signatures of examination personnel.

600-1.4 Quality Assurance.
   a. All tests (radiographing and other welding NDE, pressure testing, holiday testing) shall be performed in accordance with ASME B31.3.

PRODUCTS

600-2.1 Not applicable.

EXECUTION

600-3.1 General.
   a. Contractor will furnish all water for testing and commissioning except as otherwise specified.
   b. Contractor shall furnish and operate all equipment required, including pumps, trucks, gauges, instruments, hoses, connections, temporary pumps, and other items specified or required.
   c. Procedures:
      1. Perform holiday testing of coating systems on all underground piping including joints.
      2. Hydrostatically test piping.
      3. Flush piping with water at a velocity of at least 5 ft/sec.
      4. Perform hydrostatic testing before piping joints are concealed with other construction. Variances from this may be allowed but must be approved by Owner.
      5. Electrically test all insulating flanges and joints.
   d. Responsibility of Contractor:
      1. Notify the proper authorities and Owner that items are ready for inspection and testing. Twenty-four hours' notice shall be given for all inspection and tests.
      2. Furnish and install all necessary equipment, materials, and personnel including pumps, compressors, gauges, and valves. Valves shall be approved by Owner and shall be suitable to hold test pressure for the specified time without leakage.
      3. Conduct the tests of all systems in a safe manner and correct all deficiencies.

ADDENDUM NO. 4
4. Apply the specified test pressures by means of a pump or compressor connected to the piping of highest elevation and plug tightly afterwards.

5. Be fully responsible for operating trucks and equipment throughout the testing and flushing operations.

6. Obtain and pay for all necessary approvals, acceptances, and permits.

7. Contractor shall make provisions to conduct all tests during inclement weather, if necessary.

600-3.2 Piping Hydrostatic Pressure Test.

a. Apply a liquid pressure test with water to all the Non-Potable water pipe.
b. Apply a liquid pressure test with Type I deice fluid to all the Type I pipe.
c. Apply a liquid pressure test with Type IV anti-ice fluid to all the Type IV pipe.
d. The pressure shall be gradually increased until a gauge pressure which is one-half the test pressure (135 psig for Deice and Anti-ice piping; NPW) is attained, at which time a preliminary check shall be made, including examination of exposed joints in accordance with ASME B31.3. Thereafter, the pressure shall be gradually increased in steps until the test pressure is reached (265 psig for Deice and Anti-ice piping), holding the pressure at each step long enough to equalize piping strains.
e. The test pressure shall be maintained for at least 8 hours.
f. Repair any leaks in a manner approved by Owner.
g. Provide calibrated temperature and pressure instruments and chart recorders to provide continuous temperature and pressure readings variations during the tests. Instruments shall be calibrated for temperature and pressure immediately prior to each test. Recorder charts shall be submitted to Owner for review prior to final acceptance of the piping.
h. Permanent valves and adapters which are rated for the test pressure shall be in place for the liquid pressure test. Equipment which is not rated by the manufacturer for the test pressure shall be removed prior to testing. Install temporary connections as necessary.

600-3.3 Inspection of Coatings.

a. Contractor shall make a detailed inspection with a holiday tester of all pipe coating and joint coating for below ground pipe preceding the lowering of the pipe.
b. Holiday-tester voltage shall not be higher than the manufacturer's recommended voltage for the coating tested. Testing shall be for holidays only and not to test the dielectric strength of the coating materials.
c. All holidays and damaged or broken places in the coating shall be repaired in a workmanlike manner at Contractor's expense.
d. All holidays shall be patched using the methods specified for field-applied external protective pipe coating and procedure in SECTION 33 52 46.

600-3.4 Testing of Insulating Flanges and Joints.

a. Each insulating flange and joint assembly shall be tested with an approved ohmmeter.
b. Ohmmeter used shall have at least 20 megohms, full-scale deflection when using the meter's highest dc resistance multiplier setting.
c. Ohmmeter tests shall be made when flange assembly is dry using the highest multiplier setting and shall indicate infinity measured between each stud and both flanges.
d. Each insulating flange assembly shall be field tested after installation and shall be tested not higher than the manufacturer's recommended voltage.

600-3.5 FLUSHING.

a. The installing contractor shall be responsible for all flushing requirements.
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. 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.

**600-3.6 Performance Testing/Commisioning.**

a. Contractor shall subject the entire system to such operating tests as required by Owner, to demonstrate satisfactory functioning and operating efficiency.

b. Tests shall include checks to determine that all control valves and switches are properly adjusted.

c. Testing shall include the functions of the complete electrical system.

d. All instruments required to conduct the tests shall be furnished by Contractor.

e. All tests may be witnessed by a representative of Owner.

f. Submit typed samples of test reports to Owner for approval.

g. Submit completed test reports.

**METHOD OF MEASUREMENT**

**600-4.1 Measurement.** No separate measurement for payment shall be made for inspection, testing and commissioning. This shall be considered necessary and incidental to the work of this Contract and covered in the linear foot price of the pipe under G-200.

**BASIS OF PAYMENT**

**600-5.1 Payment.** No payment shall be made for inspection, testing and commissioning. Valves shall be considered necessary and incidental to the work of this Contract and covered in the linear foot price of the pipe under G-200.

**END OF ITEM G-600**