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## Test Procedure for

# MINIMUM STANDARDS FOR ACCEPTANCE OF A LABORATORY FOR HOT MIX TESTING



TxDOT Designation: **Tex-237-F**

Effective Date: **July 2021**

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## 1. SCOPE

- 1.1 Use this procedure to determine if a laboratory meets the minimum standard for hot mix testing. In addition to requirements shown below, each piece of apparatus required to perform each test method must be available in the laboratory.
- 1.2 The values given in parentheses (if provided) are not standard and may not be exact mathematical conversions. Use each system of units separately. Combining values from the two systems may result in nonconformance with the standard.
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## 2. DOCUMENTATION

- 2.1 Laboratories are required to maintain calibration records for all calibrated or verified equipment in electronic format in conjunction with SiteManager. Miscellaneous or general items such as trowels, pans, scoops, spatulas, funnels, brushes, and containers are excluded.

**Note 1**—The Materials and Tests Division (MTD) maintains equipment calibration worksheet templates and checklists. To request copies, contact MTD at (512) 506-5802.

- 2.1.1 Records must include the following information for each piece of equipment:

- description of equipment,
  - serial number or other ID,
  - frequency of calibration,
  - calibrating technician,
  - date of calibration,
  - date of last calibration,
  - date of next calibration,
  - procedure used to calibrate equipment, and
  - detailed results of calibration work.
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## 3. REQUIREMENTS

- 3.1 *Moved Equipment:*
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3.1.1 In addition to the intervals specified below, the following equipment must be re-calibrated or verified each time it is moved before being used again: balances and scales, gyratory presses, compression machines, thermometers (check for broken mercury column), and ovens.

Table 1—[Tex-200-F](#), “Sieve Analysis of Fine and Coarse Aggregates”

Equipment	Requirements	Procedure	Interval (Mo.)
Balance, Class G2, Min capacity of 10,000 g	Verify calibration records	<a href="#">Tex-901-K</a>	12
Oven, capable of attaining a temperature of at least 225°F (107°C), or suitable microwave oven	Verify temperature settings	<a href="#">Tex-927-K</a>	12
Mechanical sieve shaker	Verify sieving thoroughness	2	12
Set of standard U.S. sieves	<ul style="list-style-type: none"> <li>▪ Check physical condition</li> <li>▪ Check accuracy</li> </ul>	<a href="#">Tex-907-K</a>	<ul style="list-style-type: none"> <li>▪ 12</li> <li>▪ 12</li> </ul>

Table 2—[Tex-201-F](#), “Bulk Specific Gravity and Water Absorption of Aggregate”

Equipment	Requirements	Procedure	Interval (Mo.)
Balance, Class G2, Min capacity of 10,000 g	Verify calibration records	<a href="#">Tex-901-K</a>	12
Oven, capable of attaining a temperature of at least 225°F (107°C)	Verify temperature settings	<a href="#">Tex-927-K</a>	12
Mercury thermometer capable of measuring the temperature specified in the test procedure and marked in 1°F (0.5°C) divisions	Verify accuracy	3	12
Set of standard U.S. sieves	<ul style="list-style-type: none"> <li>▪ Check physical condition</li> <li>▪ Check accuracy</li> </ul>	<a href="#">Tex-907-K</a>	<ul style="list-style-type: none"> <li>▪ 12</li> <li>▪ 12</li> </ul>
Metal cone	Verify critical dimensions	21	12
Sample Container, wire basket of No.8 (2.36 mm) or finer mesh, or a bucket of approximately equal breadth and height, with a capacity of 4–7 L (1–1-3/4 gal.) for 38 mm (1-1/2 in.) nominal Max size or smaller, and a larger container as needed for testing larger Max size aggregate	Check physical condition	---	12
Tamper	Verify critical dimensions and weight	22	12
Water bath, for immersing specimen in water while suspended, equipped with an overflow outlet for maintaining a constant water level	Verify availability	1	---

Table 3—[Tex-202-F](#), “Apparent Specific Gravity of Material Finer than No. 50 (300 μm) Sieve”

Equipment	Requirements	Procedure	Interval (Mo.)
Balance, Class G1, Min capacity of 1,000 g	Verify calibration records	<a href="#">Tex-901-K</a>	12
Drying oven, capable of attaining a temperature of at least 200°F ± 9°F (93°C ± 5°C) or more	Verify temperature settings	<a href="#">Tex-927-K</a>	12

Equipment	Requirements	Procedure	Interval (Mo.)
Mercury thermometer, marked in 1°F (0.5°C) divisions or less, or digital thermometer capable of measuring the temperature in the test procedure	Verify accuracy	3	12
Aspirator or vacuum pump	Verify vacuum	7	12
Desiccator	Verify availability	---	---
Constant temperature water bath at 73°F (23°C) or other selected temperature	Verify temperature settings	1	4

Table 4—[Tex-203-F](#), “Sand Equivalent Test”

Equipment	Requirements	Procedure	Interval (Mo.)
Set of standard U.S. sieves	<ul style="list-style-type: none"> <li>▪ Check physical condition</li> <li>▪ Check accuracy</li> </ul>	<a href="#">Tex-907-K</a>	<ul style="list-style-type: none"> <li>▪ 12</li> <li>▪ 12</li> </ul>
Drying oven, capable of maintaining 60 ± 3°C (140 ± 5°F) and 110 ± 5°C (230 ± 9°F)	Verify temperature settings	<a href="#">Tex-927-K</a>	12
Agitator tube—brass, stainless steel, or copper, with 1/4 in. (6.4 mm) outside diameter and approximately 20 in. (508 mm) long, with one end closed to form a wedge-shaped tip. Two holes (drill size 60) are drilled laterally through the flat side of the wedge near the tip.	Verify hole sizes	---	---
Weighted foot assembly with a total weight of 35 ± 0.175 oz. (1,000 ± 5 g)	Verify weight	4	12

Table 5—[Tex-205-F](#), “Laboratory Method of Mixing Bituminous Mixtures”

Equipment	Requirements	Procedure	Interval (Mo.)
Balance, Class G2, Min capacity of 10,000 g	Verify calibration records	<a href="#">Tex-901-K</a>	12
Oven, capable of attaining a temperature of at least 325 ± 5°F (163 ± 3°C)	Verify temperature settings	<a href="#">Tex-927-K</a>	12
Mercury thermometer, marked in 5°F (3°C) divisions or less, or digital thermometer capable of measuring the temperature in the test procedure	Verify accuracy	3	12

Table 6—[Tex-206-F](#), “Compacting Specimens Using the Texas Gyrotory Compactor (TGC)”

Equipment	Requirements	Procedure	Interval (Mo.)
Balance, Class G2, Min capacity of 10,000 g	Verify calibration records	<a href="#">Tex-901-K</a>	12
Motorized gyrotory-shear molding press	Verify pressure and measure gyration angle	<a href="#">Tex-914-K</a>	12
Molding assembly, consisting of gyrotory-shear mold, base plate, and wide-mouthed funnel	Check for wear and verify calibration sticker	11	4

Mercury thermometer, marked in 5°F (3°C) divisions or less, or digital thermometer capable of measuring the temperature in the test procedure	Verify accuracy	3	12
Oven, capable of attaining a temperature of at least 325 ± 5°F (163 ± 3°C)	Verify temperature settings	<a href="#">Tex-927-K</a>	12

Table 7—[Tex-207-F](#), “Determining Density of Compacted Bituminous Mixtures”

Equipment	Requirements	Procedure	Interval (Months)
Balance, Class G2, Min capacity of 10,000 g, equipped with suitable apparatus to permit weighing specimen while suspended in water	Verify calibration records	<a href="#">Tex-901-K</a>	12
Water bath with a tank heater and circulator, for immersing specimen in water while suspended, equipped with an overflow outlet for maintaining a constant water level	Verify availability	1	---
Vacuum device, such as Coredryer (optional)	Verify pressure	7	12
Mercury thermometer, marked in 2°F (1°C) divisions or less, or digital thermometer capable of measuring the temperature in the test procedure	Verify accuracy	3	12
Drying oven, capable of attaining the temperature specified in the test procedure	Verify temperature settings	<a href="#">Tex-927-K</a>	12
Nuclear density gauge	Verify availability	Performed by licensed vendor	12
Electrical impedance (nonnuclear) density measurement gauge (optional)	Verify availability	Performed by licensed vendor	12

Table 8—[Tex-208-F](#), “Test for Stabilometer Value of Bituminous Mixtures”

Equipment	Requirements	Procedure	Interval (Months)
Hveem stabilometer, with adjustable stage	Verify calibration records	12	12
Compression testing machine, with a Min capacity of 10,000 lb. (45,000 N) capable of applying a vertical load at a rate of 0.05 in. (1.27 mm) per minute	Verify calibration records	<a href="#">Tex-902-K</a>	12
Oven, capable of attaining a temperature of at least 140 ± 5°F (60 ± 3°C)	Verify temperature settings	<a href="#">Tex-927-K</a>	12
Follower	Verify critical dimensions	18	12
Calibration cylinder	Verify critical dimensions	19	12

Table 9—[Tex-210-F](#), “Determining Asphalt Content of Bituminous Mixtures by Extraction”

Equipment	Requirements	Procedure	Interval (Months)
<b>Part I—Centrifuge Extraction Method Using Chlorinated Solvent</b>			
Balance, Class G1, Min capacity of 4,000 g	Verify calibration records	<a href="#">Tex-901-K</a>	12
Balance, Class G2, Min capacity of 4,000 g	Verify calibration records	<a href="#">Tex-901-K</a>	12
Drying oven, capable of attaining a temperature of at least 200°F ± 9°F (93°C ± 5°C), and vented to the outside	Verify temperature settings	<a href="#">Tex-927-K</a>	12
Ventilation system for asphalt mix control laboratories	Check for compliance	5	---
Centrifugal extractor, motorized, with explosion-proof features, consisting of a bowl mounted in an assembly so that the bowl revolves at a controlled speed	Verify availability	---	---
Filter paper to fit the rim of the bowl with a 20–25 µm retention factor	Verify retention by calling Flexible Pavements Section or manufacturer	6	---
Extraction Solvent: 1,1,1 Trichlorethylene or methylene chloride	Verify availability	---	---
<b>Part II—Vacuum Extraction Method</b>			
Balance, Class G2, Min capacity of 4,000 g	Verify calibration records	<a href="#">Tex-901-K</a>	12
Oven, capable of attaining a temperature of at least 200°F ± 9°F (93°C ± 5°C), and vented to the outside	Verify temperature settings	<a href="#">Tex-927-K</a>	12
Ventilation system for asphalt mix control laboratories	Check for compliance	5	---
Vacuum extractor complete with vacuum pump, extractor O-rings, tubing, filter support plate, tank, and funnel ring. A vane-type vacuum pump is recommended. An exhaust hose is required for the vacuum pump to carry fumes to immediately in front of the exhaust fan of the ventilation system.	Verify availability	7	---
Filter paper, size 13 in. (331 mm), with a 20–25 µm retention factor	Verify retention by calling Flexible Pavements Section or manufacturer.	6	---
Extraction Solvent: 1,1,1 Trichlorethylene or methylene chloride	Verify availability	---	---
<b>Part III—Centrifuge Extraction Method Using Non-Chlorinated Solvent</b>			
Balance, Class G1, Min capacity of 4,000 g	Verify calibration records	<a href="#">Tex-901-K</a>	12
Balance, Class G2, Min capacity of 4,000 g	Verify calibration records	<a href="#">Tex-901-K</a>	12
Oven, capable of attaining a temperature of at least 200°F (93°C), and vented to the outside	Verify temperature settings	<a href="#">Tex-927-K</a>	12
Ventilation system for asphalt mix control laboratories	Check for compliance	5	---
Centrifugal extractor, motorized, with explosion-proof features, consisting of a bowl mounted in an assembly so that the bowl revolves at a controlled speed	Verify availability	---	---
Filter paper to fit the rim of the bowl with a 20–25 µm retention factor	Verify retention by calling Flexible Pavements Section or manufacturer	6	---

Equipment	Requirements	Procedure	Interval (Months)
Glass fiber filter paper, Whatman GF/F 5-in. (12.5-cm) glass micro fiber filters or equivalent	Verify retention	6	---
Buchner filter funnel, Coors porcelain Buchner funnel, 5 in. (126 mm) internal diameter	Verify availability	---	---
Vacuum pump, with an exhaust hose to carry fumes to immediately in front of the exhaust fan of the ventilation system	Verify availability	7	---
Biodegradable extraction solvent meeting the requirements of the Department's specification for non-chlorinated extraction solvent for bituminous mixtures NOTE: See Section 5.	Verify availability	---	---
<b>Part IV—Vacuum Extraction Method Using Non-Chlorinated Solvent</b>			
Balance, Class G2, Min capacity of 4,000 g	Verify calibration records	---	12
Oven, capable of attaining a temperature of at least 200°F (93°C), and vented to the outside	Verify temperature settings	<a href="#">Tex-927-K</a>	12
Ventilation system for asphalt mix control laboratories	Check for compliance	5	---
Vacuum extractor complete with vacuum pump, extractor O-rings, tubing, filter support plate, tank, and funnel ring. A vane-type vacuum pump is recommended. An exhaust hose is required for the vacuum pump to carry fumes to immediately in front of the exhaust fan of the ventilation system.	Verify availability	7	---
Filter paper, size 13 in. (33 mm), 20–25 µm retention factor.	Verify retention, by calling Flexible Pavements Section or manufacturer	6	---
Diatomaceous silica filtering aid (Celite 110 or equivalent) (Optional)	Verify availability	---	---
Biodegradable extraction solvent meeting the requirements of the Department's specification for non-chlorinated extraction solvent for bituminous mixtures NOTE: See Section 5.	Verify availability	---	---
<b>Part V—Automatic Binder Extraction Method</b>			
Balance, Class G2, Min capacity of 4,000 g	Verify calibration records	<a href="#">Tex-901-K</a>	12
Oven, capable of attaining a temperature of at least 200°F (93°C), and vented to the outside	Verify temperature settings	<a href="#">Tex-927-K</a>	12
Ventilation system for asphalt mix control laboratories	Check for compliance	5	---
Automated binder extractor, with washing drum, insulated washing chamber, sealing cap for washing chamber, centrifuge filler cup, insulated centrifuge chamber, internal vacuum extraction device, stabilize solvent and case for alkalinity test of extraction solvent	Verify availability	---	---
Filter paper, size 15 x 8-1/8 in. (381 x 206 mm)	Verify retention by calling Flexible Pavements Section or manufacturer	6	---
Extraction Solvent meeting the requirements of the Department's specification for chlorinated bituminous mixtures extraction solvent	Verify availability	---	---

Table 10—[Tex-211-F](#), “Recovery of Asphalt from Bituminous Mixtures by the Abson Process”

Equipment	Requirements	Procedure	Interval (Mo.)
Balance, Class G2	Verify calibration records	<a href="#">Tex-901-K</a>	12
Centrifuge, capable of handling two 8-oz. (237-mL) wide-mouth bottles at 770 times gravity at approximately 2,200 rpm	Verify speed	13	12
Two distillation assemblies, consisting of: heating mantle on ring stands, three-neck distillation flasks with 17 oz. (500 mL) capacity, glass boiling flask with 101 oz. (3,000 mL) capacity, and tin cans with 3 oz. (89 mL) capacity	Verify availability	---	---
Condenser, glass-tube type, with a condenser jacket approximately 16 in. (400 mm) long	Verify availability	---	---
Mercury thermometer marked in 1°F (0.5°C) divisions, or digital thermometer, capable of measuring the temperature in the test procedure	Verify accuracy	3	12
Aeration tube assembly for primary and final distillation to insert Carbon Dioxide Gas for the test procedure	Verify availability	---	---
Gas flow meter capable of indicating a gas flow up to 34 oz. (1,000 mL) per minute	Verify flow	14	12
Rubber or plastic system of tubing for passing water continuously through condenser	Verify availability	---	---

Table 11—[Tex-212-F](#), “Determining Moisture Content of Bituminous Mixtures”

Equipment	Requirements	Procedure	Interval (Mo.)
<b>Part I—Moisture Content by Distillation</b>			
Balance, Class G2	Verify calibration record	<a href="#">Tex-901-K</a>	12
Metal still, consisting of a vertical cylindrical container approximately 5 in. (127 mm) in diameter and 6 in. (152 mm) deep, with removable lid, fiber gasket or O-ring, and clamping system. There must be two holes in the lid, each approximately 1 in. (25 mm) in diameter, to provide for entrance of the water trap-condenser assembly and a safety valve	Verify availability	---	---
Moisture trap, 0.85 oz. (25 mL) capacity, graduated in 0.0034-fl. oz. (0.1-mL) divisions and equipped with cork or rubber stoppers	Verify availability	---	---
Condenser, Liebig glass-tube type, with a condenser jacket approximately 16 in. (400 mm) long	Verify availability	---	---
System of tubing for passing water continuously through condenser	Verify availability	---	---
<b>Part II—Moisture Content by Drying Oven</b>			
Balance, Class G2	Verify calibration records	<a href="#">Tex-901-K</a>	12
Oven, capable of attaining a temperature of at least 200°F (93°C), or suitable microwave oven	Verify temperature setting	<a href="#">Tex-927-K</a>	12

**Table 12—[Tex-213-F](#), “Determining Hydrocarbon-Volatile Content of Bituminous Mixtures”**

Equipment	Requirements	Procedure	Interval (Months)
Balance, Class G2	Verify calibration records	<a href="#">Tex-901-K</a>	12
Metal still, consisting of a vertical cylindrical container approximately 5 in. (127 mm) in diameter and 16 in. (52 mm) deep, with removable lid, fiber gasket, or O-ring, and clamping system. There must be two holes in the lid, each approximately 1 in. (25 mm) in diameter, to provide for entrance of the water trap-condenser assembly and a safety valve	Verify availability	---	---
Volatile trap, 0.2 oz. (5 mL) capacity, graduated in 0.0034-fl. oz. (0.1-mL) divisions and equipped with cork or rubber stoppers	Verify availability	---	---
Condenser, Liebig glass-tube type, with a condenser jacket approximately 16 in. (400 mm) long	Verify availability	---	---
System of tubing for passing water continuously through condenser	Verify availability	---	---

**Table 13—[Tex-215-F](#), “Determining Asphalt Content of Rock Asphalt by Hot Solvent Extraction”**

Equipment	Requirements	Procedure	Interval (Months)
Balance, Class G1	Verify calibration records	<a href="#">Tex-901-K</a>	12
Oven, capable of maintaining 140–230°F (60–110°C)	Verify temperature setting	<a href="#">Tex-927-K</a>	12

**Table 14—[Tex-217-F](#), “Determining Deleterious Material and Decantation Test for Coarse Aggregates (Bituminous Mixtures)”**

Equipment	Requirements	Procedure	Interval (Months)
<b>Part I—Determining Deleterious Material in Coarse Aggregates</b>			
Balance, Class G2, Min capacity of 4,000 g	Verify calibration records	<a href="#">Tex-901-K</a>	12
Oven, capable of attaining a temperature of at least 200 ± 5°F (93 ± 3°C)	Verify temperature setting	<a href="#">Tex-927-K</a>	12
Set of standard U.S. sieves in the following sizes: 3/8 in. (9.5 mm), No. 4 (4.75 mm), and No. 8 (2.36 mm)	<ul style="list-style-type: none"> <li>▪ Check physical condition</li> <li>▪ Check accuracy</li> </ul>	<a href="#">Tex-907-K</a>	<ul style="list-style-type: none"> <li>▪ 12</li> <li>▪ 12</li> </ul>
<b>Part II—Decantation Test for Coarse Aggregates</b>			
Balance, Class G2, Min capacity of 4,000 g	Verify calibration records	<a href="#">Tex-901-K</a>	12
Oven, capable of attaining a temperature of at least 200 ± 5°F (93 ± 3°C)	Verify temperature setting	<a href="#">Tex-927-K</a>	12
Mechanical sieve shaker	Verify sieving thoroughness	2	12



Equipment	Requirements	Procedure	Interval (Months)
Set of standard U.S. sieves, in the following sizes: 3/8 in. (9.5 mm), No. 4 (4.75 mm), No. 8 (2.36 mm), and No. 200 (75 μm)	<ul style="list-style-type: none"> <li>▪ Check physical condition</li> <li>▪ Check accuracy</li> </ul>	<a href="#">Tex-907-K</a>	<ul style="list-style-type: none"> <li>▪ 12</li> <li>▪ 12</li> </ul>
<b>Part III—Determining Deleterious Material in Recycled Asphalt Shingles (RAS)</b>			
Equipment	Requirements	Procedure	Interval (Months)
Balance, Class G2, Min capacity of 5,000 g	Verify calibration records	<a href="#">Tex-901-K</a>	12
Oven, capable of attaining a temperature of at least 140 ± 5°F (60 ± 3°C)	Verify temperature setting	<a href="#">Tex-927-K</a>	12
Mechanical sieve shaker	Verify sieving thoroughness	2	12
Set of standard U.S. sieves, in the following sizes: 3/8 in. (9.5 mm), No. 4 (4.75 mm), No. 8 (2.36 mm), and No. 30 (0.6 mm)	<ul style="list-style-type: none"> <li>▪ Check physical condition</li> <li>▪ Check accuracy</li> </ul>	<a href="#">Tex-907-K</a>	<ul style="list-style-type: none"> <li>▪ 12</li> <li>▪ 12</li> </ul>

**Table 15—Tex-220-F, “Determining Percentages of White Rock Contained in Native Rock Asphalt”**

Equipment	Requirements	Procedure	Interval (Months)
Balance, Class G2	Verify calibration records	<a href="#">Tex-901-K</a>	12
Oven, capable of attaining a temperature range of 105–230°F (40–100°C)	Verify temperature setting	<a href="#">Tex-927-K</a>	12
Standard U.S. sieve, 4.75 mm (No. 4)	<ul style="list-style-type: none"> <li>▪ Check physical condition</li> <li>▪ Check accuracy</li> </ul>	<a href="#">Tex-907-K</a>	<ul style="list-style-type: none"> <li>▪ 12</li> <li>▪ 12</li> </ul>

**Table 16—Tex-224-F, “Determining Flakiness Index”**

Equipment	Requirements	Procedure	Interval (Months)
Oven, capable of attaining a temperature of at least 100°F (38°C)	Verify temperature setting	<a href="#">Tex-927-K</a>	12
Set of standard U.S. sieves, in the following sizes: 7/8 in. (22.4 mm), 5/8 in. (16.0 mm), 3/8 in. (9.5 mm), and 1/4 in. (6.3 mm)	<ul style="list-style-type: none"> <li>▪ Check physical condition</li> <li>▪ Check accuracy</li> </ul>	<a href="#">Tex-907-K</a>	<ul style="list-style-type: none"> <li>▪ 12</li> <li>▪ 12</li> </ul>
Metal Thickness Gauge, made of 12-gauge carbon steel sheet, with three sized slots cut into it	Verify physical condition	15	12

**Table 17—Tex-226-F, “Indirect Tensile Strength Test”**

Equipment	Requirements	Procedure	Interval (Months)
Temperature Chamber or Heating Oven, capable of maintaining 77 ± 2°F (25 ± 1°C)	Verify temperature setting	<a href="#">Tex-927-K</a>	12
Load Cell with capacity of at least 6,000 lb.	Verify load	<a href="#">Tex-902-K</a>	12
Loading press capable of applying compressive load at a controlled deformation rate of 2 in. (51 mm) per minute	Verify calibration records	---	---
Loading strips consisting of 0.75 × 0.75 in. (19 × 19 mm) square steel bars. Machine the surface in contact with the specimen to the curvature of the test sample.	Verify conformity of loading strips	---	---

**Table 18—Tex-227-F, “Theoretical Maximum Specific Gravity of Bituminous Mixtures”**

Equipment	Requirements	Procedure	Interval (Months)
<b>Part II—Using a Metal Vibratory Pycnometer</b>			
Balance, Class G2, Min capacity of 2,500 g	Verify calibration records	<a href="#">Tex-901-K</a>	12
Mercury thermometer, marked in 2°F (1°C) divisions or less, or a digital thermometer capable of measuring the temperature used in the test procedure	Verify calibration records	3	12

Equipment	Requirements	Procedure	Interval (Months)
Vacuum pump or water aspirator to evacuate air from the assembly, able to reduce residual pressure to 2.0 in. Hg or less before completion of the evacuation process of the procedure. This equates to a vacuum gauge reading of 27.9 in. Hg or more at normal sea level atmospheric pressure.	Verify vacuum	7	12
Manometer or vacuum gauge, able to determine the level of pressure (vacuum) within the assembly	Verify gauge reading	9	12
Vacuum hoses, connections, tapered stoppers, and valves, suitable to apply and control the specified vacuum level within the assembly	Verify setup	8	---
Metal vacuum pycnometer, 150 fl. oz. (4500 mL), with a clear poly (methyl methacrylate) (PMMA) lid for applying vacuum, (Humbolt H-1750, Gilson SG-16A, or equal)	Verify availability	---	---
Vibrating table, Humbolt H-1755, Gilson SGA-5RT, or equal	Verify availability	---	---
Water bath with a tank heater and circulator, for calibration of metal pycnometer and for immersing the metal pycnometer and sample in water, while suspended, and equipped with an overflow outlet for maintaining a constant water level	Verify availability	---	---

Table 19—[Tex-228-F](#), “Determining Asphalt Content of Bituminous Mixtures by the Nuclear Method”

Equipment	Requirements	Procedure	Interval (Months)
Balance, Class G2, capable of weighing 44 lb. (20 kg)	Verify calibration records	<a href="#">Tex-901-K</a>	12
Oven, capable of heating to at least 350 ± 5°F (177 ± 3°C)	Verify temperature setting	<a href="#">Tex-927-K</a>	12
Thermometer capable of measuring 10–300°C (50–500°F)	Verify calibration records	3	12
Nuclear asphalt content gauge (with manufacturer's instruction manual and sample pans), able to determine the asphalt content of a sample containing between 0% and 14% asphalt cement	Verify availability	---	---
Plywood, 0.75 in. (19 mm) or thicker, or metal plate, 0.375 in. (9.5 mm) or thicker, with an area slightly larger than the top of the gauge sample pans	Verify availability	---	---

Table 20—[Tex-229-F](#), “Combined Bituminous Mixture Cold-Belt Sampling and Testing Procedure”

Equipment	Requirements	Procedure	Interval (Months)
Balance, Class G2, Min capacity of 10,000 g	Verify calibration records	<a href="#">Tex-901-K</a>	12
Oven capable of heating to at least 350 ± 5°F (177 ± 3°C), or microwave oven	Verify temperature setting	<a href="#">Tex-927-K</a>	12
Mechanical sieve shaker	Verify sieving thoroughness	2	---
Set of standard U.S. sieves	<ul style="list-style-type: none"> <li>▪ Check physical condition</li> <li>▪ Check accuracy</li> </ul>	<a href="#">Tex-907-K</a>	<ul style="list-style-type: none"> <li>▪ 12</li> <li>▪ 12</li> </ul>
Sample template	Verify availability	---	---

Equipment	Requirements	Procedure	Interval (Months)
Source of potable water, with pressurized (Min 20 psi [137.9 kPa]) spray attachment. Example—standard sink with spray head attachment	Verify availability	---	---

**Table 21—Tex-235-F, “Determining Draindown Characteristics in Bituminous Materials”**

Equipment	Requirements	Procedure	Interval (Months)
Balance, Class G2	Verify calibration records	<a href="#">Tex-901-K</a>	12
Oven, capable of heating to at least 100–302°F (38–150°C)	Verify temperature setting	<a href="#">Tex-927-K</a>	12
Wire basket assembly, constructed with 0.25 in. (6.3 mm) sieve cloth	Verify availability	---	---

**Table 22—Tex-236-F, “Determining Asphalt Content from Asphalt Paving Mixtures by the Ignition Method”**

Equipment	Requirements	Procedure	Interval (Months)
Ignition furnace with internal balance	Verify calibration records for balance	<a href="#">Tex-901-K</a>	12
Tempered stainless steel No. 8 (2.36 mm) mesh basket, otherwise perforated basket, or combination of baskets.	Verify physical condition	---	--
Balance, Class G2, Min capacity of 17.6 lb. (8 kg)	Verify calibration records	<a href="#">Tex-901-K</a>	12
Oven, capable of heating to at least 325 ± 5°F (163 ± 3°C)	Verify temperature setting	<a href="#">Tex-927-K</a>	12

**Table 23—Tex-241-F, “Compacting Bituminous Specimens using the Superpave Gyratory Compactor (SGC)”**

Equipment	Requirements	Procedure	Interval (Months)
Balance, Class G2, Min capacity of 10,000 g	Verify calibration records	<a href="#">Tex-901-K</a>	12
Oven, capable of heating to at least 325 ± 5°F (163 ± 3°C)	Verify temperature setting	<a href="#">Tex-927-K</a>	12
Mercury thermometer, marked in 5°F (3°C) divisions or less, or digital thermometer capable of measuring the temperature in the test procedure	Verify calibration records	3	12
Superpave gyratory compactor, able to maintain a ram pressure of 87 ± 2 psi (600 ± 18 kPa) at an internal angle of 1.16 ± 0.02°, and with molds that have an inside diameter of 149.90–150.20 mm (reference 2011 AASHTO Specification T 312-2, 4.2)	Check for wear and verify calibration records	16	12
Verification of Superpave gyratory compactor	Check force and height	20	3

Table 24—[Tex-242-F](#), “Hamburg Wheel-Tracking Test”

Equipment	Requirements	Procedure	Interval (Months)
Wheel Tracking device and stainless-steel sample tray assemblies	Verify physical condition	--	--
Steel wheels, with an applied load of 158 ± 5 lb. (705 ± 22.2 N)	Verify calibration records	--	12
Linear Variable Differential Transducer (LVDT) device, capable of measuring the rut depth induced by the steel wheel within 0.0004 in. (0.01 mm), over a range of 0.8 in. (20 mm)	Verify calibration records	--	12
Wheel passes per minute of 52 ± 2 passes per minute	Verify speed	17	12
Circulating water bath, capable of controlling the test temperature within ± 4°F (2°C) over a range of 77–158°F (25–70°C)	Verify temperature settings	1	4

Table 25—[Tex-244-F](#), “Thermal Profile of Hot Mix Asphalt”

Equipment	Requirements	Procedure	Interval (Months)
Thermal camera, hand-held, using a LCD viewing screen with a Min diagonal dimension of 3.0 in., and capable of: variable emissivity from 0.1 to 1.0 and thermal sensitivity less than 0.11°F; measuring from 32°F–475°F with an accuracy of ± 4°F or ± 2% of reading (whichever is greater); producing an IR image with a Min resolution of 19,200 pixels, and storing a Min of 500 images	Verify calibration records	Tex-928-K	12
Thermal imaging system, paver-mounted, capable of: using infrared sensors to measure from 32°F–475°F with an accuracy of ± 4.0°F or ± 2.0% of reading (whichever is greater) when the object temperature exceeds 32°F and the ambient temperature is 73 ± 9°F; measuring at a Max transverse spacing of 12 ± 1 in.; with temperature measurement repeatability of ± 0.9°F or ± 0.5% of reading (whichever is greater); measuring spots with a Max size of 10 in. at the installed operating height; profiling the entire pavement width (up to at least 12-ft. wide); measuring distance using a DMI, and equipped with a GPS; determining the low and high temperatures within each profile using the statistical one percentile and 98.5 percentile; and providing software capable of collecting, displaying, saving and analyzing temperature readings, and developing and analyzing thermal profiles for the entire project	Verify calibration records	Performed by licensed vendor	12

Table 26—[Tex-248-F](#), “Overlay Test”

Equipment	Requirements	Procedure	Interval (Months)
Overlay tester	Verify calibration records	--	12
Base plates and mounting jig	Verify physical condition	--	12
Temperature Chamber or Heating Oven (optional), capable of maintaining 77 ± 1°F (25 ± 0.5°C)	Verify temperature setting	<a href="#">Tex-927-K</a>	12
Vacuum device, such as Coredryer (optional)	Verify pressure	7	12

Table 27—[Tex-249-F](#), “Shear Bond Strength Test”

Equipment	Requirements	Procedure	Interval (Months)
Interlayer Shear Strength Device, equipped with a fixed and sliding sleeve, and capable of: holding the test specimen horizontally, and applying compressive load (range of 200-5,000 lb. with an accuracy of 1%) at a controlled deformation rate of 0.2 ± 0.02 in. per minute	Verify calibration records Verify loading rate	--	--
Temperature Chamber or Heating Oven, capable of maintaining 77 ± 2°F (25 ± 1°C)	Verify temperature setting	<a href="#">Tex-927-K</a>	12

Table 28—[Tex-250-F](#), “IDEAL Cracking Test”

Equipment	Requirements	Procedure	Interval (Months)
Temperature Chamber or Heating Oven, capable of maintaining 77 ± 2°F (25 ± 1°C)	Verify temperature setting	<a href="#">Tex-927-K</a>	12
Load Cell with capacity of at least 6,000 lb.	Verify load	<a href="#">Tex-902-K</a>	12
Loading press capable of applying compressive load at a controlled deformation rate of 2 in. (51 mm) per minute	Verify calibration records	---	---
Loading strips consisting of 0.75 × 0.75 in. (19 × 19 mm) square steel bars. Machine the surface in contact with the specimen to the curvature of the test sample.	Verify conformity of loading strips	---	---
Displacement measuring device, capable of measuring the displacement with a resolution of ± 0.4 mils (± 0.01mm)	Verify calibration records	---	12

Table 29—[Tex-252-F](#), “Determining the Presence of Harmful Clays Using Methylene Blue”

Equipment	Requirements	Procedure	Interval (Months)
Balance, Class G1	Verify calibration records	<a href="#">Tex-901-K</a>	12
Balance, Class B	Verify calibration records	<a href="#">Tex-901-K</a>	12

Equipment	Requirements	Procedure	Interval (Months)
Oven, capable of heating to at least 230 ± 9°F (110 ± 5°C)	Verify temperature setting	<a href="#">Tex-927-K</a>	12
Set of standard U.S. sieves	<ul style="list-style-type: none"> <li>▪ Check physical condition</li> <li>▪ Check accuracy</li> </ul>	<a href="#">Tex-907-K</a>	<ul style="list-style-type: none"> <li>▪ 12</li> <li>▪ 12</li> </ul>

Table 30—[Tex-280-F](#), “Determining Flat and Elongated Particles”

Equipment	Requirements	Procedure	Interval (Months)
Proportional caliper device, consisting of a base plate with two fixed vertical posts and a swinging arm mounted between them so that the openings between the arms and the posts maintain a constant ratio	Verify ratios using machined block, micrometer	--	12
Balance, Class G2, Min capacity of 2,000 g	Verify calibration records	<a href="#">Tex-901-K</a>	12
Machined blocks, micrometer	Verify dimensions to meet 2:1, 3:1, 4:1, 5:1 ratio requirements	--	12

Table 31—[Tex-530-C](#), “Effect of Water on Bituminous Paving Mixtures”

Equipment	Requirements	Procedure	Interval (Months)
Balance, Class G2, Min capacity of 2,000 g	Verify calibration records	<a href="#">Tex-901-K</a>	12
Oven, capable of heating to at least 300°F (150°C)	Verify temperature settings	<a href="#">Tex-927-K</a>	12
Mercury thermometer capable of measuring the temperature in the test procedure	Verify calibration records	3	12
Hot oil bath, controllable at 350°F (177°C) and sized to allow a 68-fl. oz. (2,000-mL) beaker to be supported at a Min of 0.25 in. (0.6 cm) from the bottom when submerged to 2/3 of its depth	Verify temperature settings	10	4
Beaker, 68 fl. oz. (2,000 mL), preferably stainless steel	Verify availability	--	--
USP mineral oil for bath, Min flash point of 420°F (215°C)	Verify availability	--	--

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## 4. PROCEDURES

### 4.1 Procedure 1—Water Baths:

4.1.1 Place a calibrated thermometer in the center of the water bath for 1 hr. to verify temperature setting.

**Note 2**—Check setting at which the water bath is used.

### 4.2 Procedure 2—Mechanical Shakers:

4.2.1 Match the sieve and aggregate such that a minimum of 10% of the total sample weight is retained on each sieve. After sieving on the mechanical shaker for a given time, check the thoroughness of sieving by shaking each sieve by hand with a lateral and vertical motion, accompanied by a jarring action, to keep the material moving continuously over the surface of the sieve.

4.2.2 If hand shaking shows more than 1% passing any given sieve, increase shaking time and repeat the check until all screens show less than 1% by weight passing a given sieve.

### 4.3 Procedure 3—Thermometers:

4.3.1 Examine documentation for each thermometer used. Examine documentation for the standard used.

4.3.2 The documentation on thermometers used should include:

- temperature read at each calibration point,
- true temperature read at each calibration point,
- serial or identification number of each thermometer,
- date calibrated or checked, and
- signature of person who read calibration.

4.3.3 The documentation on standard used should include:

- serial or identification of standard used,
- dated standard used, and
- signature of person who ran calibration on standard.

### 4.4 Procedure 4—Sand Equivalents:

4.4.1 The weighted foot assembly must weigh  $1,000 \pm 5$  g. The cap to fit the top of the cylinder, centering the weighted foot assembly, is not considered part of the total weight of the assembly.

4.4.2 Verify that the two drill holes, drilled laterally through the flat side of the wedge near the tip, are drill size 60.

### 4.5 Procedure 5—Ventilation System for Asphalt Mix Control Laboratories:

4.5.1 Ventilation required by current specifications for asphalt mix control laboratories applies, unless tests show that the alternate system lowers solvent vapor to safe levels throughout the testing process.

4.5.2 Refer to Section 5 for a description of ventilation systems and information on electrical equipment.



- 4.6 *Procedure 6—Filters:*
- 4.6.1 Check for size to fit extractor (both centrifuge and vacuum) and retention factor. On the Buchner funnel filter, a Whatman GF/F 12.5 cm glass microfiber filter or equivalent is needed.
- 4.7 *Procedure 7—Vacuum Pumps:*
- 4.7.1 Using a manometer or an analog vacuum verification gauge, verify that the vacuum pump or water aspirator is evacuating the air from the assembly.
- 4.7.2 The vacuum pump or water aspirator must be able to reduce residual pressure to 2 in. Hg or less. This equates to 27.9 in. Hg or more at normal sea level atmospheric pressure.
- 4.8 *Procedure 8—Vacuum Setup:*
- 4.8.1 Check the vacuum setup to comply with [Tex-227-F](#), Figure 1.
- 4.9 *Procedure 9—Vacuum Gauge:*
- 4.9.1 Use a manometer or a vacuum verification gauge to verify the gauge reading.
- 4.9.1.1 Connect a manometer to the vacuum pump with vacuum gauge in line.
- 4.9.1.2 Place the analog vacuum verification gauge inside of the pycnometer bucket.
- 4.9.2 Close the bleed valve very slowly.
- 4.9.3 Take pressure readings with one of the two pressure reading devices.
- 4.9.3.1 Take readings on the two sides of the manometer, subtract the difference between the two readings from 760 mm Hg, and record the result.
- EXAMPLE:*
- $$760 \text{ mm Hg} - (53 \text{ difference between two readings}) = 707 \text{ mm Hg}$$
- Since 1.0 in. Hg = 25.4 mm Hg or absolute, divide the result by 25.4 mm per inch to determine what the vacuum pump is pulling.
- EXAMPLE:*
- $$\frac{707 \text{ mm Hg}}{25.4 \text{ mm / in.}} = 27.83 \text{ in. Hg}$$
- 4.9.3.2 Take a reading from the analog vacuum verification gauge by looking through the lid of the pycnometer bucket. Since 1 torr = 1 mm Hg, subtract the reading from 760 mm Hg, and record the result. Next, divide this result by 25.4 to determine what the vacuum pump is pulling. Follow the example from Section 4.9.3.1.
- 4.9.4 Check the resulting number against the gauge reading. They must be relatively close.
- 4.10 *Procedure 10—Hot Oil Baths:*

- 4.10.1 Use a calibrated mercury or digital thermometer with a range of approximately 32–572°F (0–300°C). Place the thermometer in the center of the oil bath about 1 in. (25 mm) off the bottom.
- 4.10.2 After 5 min., check the thermometer reading.
- 4.10.3 Verify that the temperature setting is within 5% of the calibrated thermometer reading.
- 4.11 *Procedure 11—Molding Assembly – Texas Gyro Compactor:*
- 4.11.1 Replace worn or damaged mold ring, base plate, or compression rams.
- 4.11.2 Measure the distance the ram head travels with one stroke of the pump handle.
- 4.11.2.1 Place a dial gauge between the ram and the platen. The gauge must have a minimum travel of 0.2 in. (5 mm) and must be capable of measuring to 0.001 in. (0.023 mm).
- 4.11.2.2 Lower the ram until it depresses the tip of the dial gauge slightly and the distance between the ram and the platen is  $4 \pm 0.1$  in. ( $102 \pm 2$  mm).
- 4.11.2.3 Stop the ram movement and zero the dial gauge. For mechanical dial gauges, zeroing is usually achieved by turning the scale with the outer knurled edge.
- 4.11.2.4 Raise the pump handle up as far as it will go, then make one full, smooth, downward stroke in approximately 1 sec.
- 4.11.2.5 Record the reading. Make the reading the instant the handle hits the bottom.  
**Note 3**—Some drift in the dial reading will usually occur due to the weight of the ram head and air in the hydraulic system. The dial gauge can be mounted to a rectangular metal block with large springs mounted on opposite sides; the springs will support the ram and eliminate the drift problem.
- 4.11.2.6 Repeat Sections 4.11.2.2 through 4.11.2.5 to obtain three readings. Average the results of the three readings and record.
- 4.11.2.7 If the stroke is not within tolerance, adjust the set screw near the pump handle until the ram travel is  $0.023 \pm 0.001$  in. ( $0.58 \pm 0.03$  mm).
- 4.12 *Procedure 12—Hveem Stabilometer with Adjustable Stage:*
- 4.12.1 Check for wear on inner rubber diaphragm.
- 4.12.2 Check Stabilometer for the current calibration records.
- 4.12.3 Calibrate every 12 mo.
- 4.13 *Procedure 13—Centrifuge:*
- 4.13.1 Check speed for approximately 2,200 rpm.
- 4.14 *Procedure 14—Gas Flow Meter:*
- 4.14.1 Check gas flow for 34 oz. (1,000 mL) per minute with a gas flow metering instrument.

- 4.15 *Procedure 15—Metal Thickness Gauge:*
- 4.15.1 Verify that gauge is made of 12-gauge carbon steel sheet  $0.105 \pm 0.002$  in. ( $2.66 \pm 0.05$  mm) with three slots cut at  $5/32$  in. (4 mm),  $1/4$  in. (6.3 mm), and  $3/8$  in. (9.5 mm).
- 4.16 *Procedure 16—Molding Assembly for Superpave Gyratory Compactor:*
- 4.16.1 Verify the load, angle, and height with calibration kit provided with gyratory compactor.
- 4.16.2 If the mold ring, base plate, top plate, or compression rams show wear, rough or worn edges, or warped surfaces, replace them.
- 4.17 *Procedure 17—Hamburg Wheel Tracking Speed:*
- 4.17.1 Using a stopwatch, count the number of wheel passes within a minute.
- 4.18 *Procedure 18—Hveem Follower Dimensions:*
- 4.18.1 Measure and record the height ( $139.70 \pm 6.35$  mm) and the diameter ( $101.219 \pm 0.127$  mm) of the follower using a digital caliper.
- 4.19 *Procedure 19—Hveem Calibration Cylinder Dimensions:*
- 4.19.1 Measure and record the outside diameter ( $101.6 \pm 0.13$  mm) and the height ( $140.0 \pm 6.4$  mm) of the calibration cylinder using a digital caliper.
- 4.20 *Procedure 20—Superpave Gyratory Compactor Force and Height Verification:*
- 4.20.1 The manufacturer, other agencies providing such services, or in-house personnel may perform the verification of the calibration system standardization and quality checks. Verification of force and height must follow manufacturer's recommendations.
- 4.21 *Procedure 21—Metal Cone Dimensions:*
- 4.21.1 Measure and record the inside top diameter ( $1.5 \pm 0.125$  in. [ $40 \pm 3$  mm]), inside bottom diameter ( $3.5 \pm 0.125$  in. [ $90 \pm 3$  mm]), height ( $3 \pm 0.125$  in. [ $75 \pm 3$  mm]), and minimum thickness (0.0313 in. [0.8 mm]) of the metal cone using a digital caliper.
- 4.21.2 Visually inspect the metal cone for roundness and undamaged surface.
- 4.22 *Procedure 22—Tamper Dimensions:*
- 4.22.1 Measure and record the face diameter ( $1 \pm 0.125$  in. [ $25 \pm 3$  mm]) of the tamper using a digital caliper. Weigh and record the mass of the tamper ( $340 \pm 15$  g).
- 4.22.2 Inspect the surface of the tamper to ensure that it is circular and flat.

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## 5. SAFETY CONSIDERATIONS

- 5.1 Bulk storage inside the laboratory building must not exceed 5 gal. (19 L), plus up to 5 gal. (19 L) of used solvent.

- 5.2 Solvent in storage must be kept in closed containers and must not be located under or adjacent to an oven or other heating device.
- 5.3 The storage location must drain away from any known source of ignition.
- 5.4 Means must be available to clean solvent spills.
- 5.5 A portable fire extinguisher for burning liquids is required (outside the room in close proximity) where solvents are stored and used.
- 5.6 The vent fan must have at least a 1,000 CFM (30 cu. m per minute) rating and be able to adequately remove fumes. The fan outlet must be located even with or below the height at which solvents will be poured or used. It is preferable that fans be located beneath a workbench constructed of expanded metal top and enclosed front and sides. The front of the workbench must have a sliding panel, which, when opened, in conjunction with covering the expanded metal top, will cause the exhaust to be pulled through the front opening. This design accommodates both centrifuge and vacuum extraction equipment while providing for exhausting fumes from floor spills. The fan must have an explosion proof (sealed) motor, or the motor must be located so that the solvent vapors are not drawn directly over it. The vent fan and extraction equipment must be wired to a single switch so the vent fan will always be on during extraction. Means for cutting power to the extraction equipment while the ventilation fan is operating is also required.
- 5.7 Ordinary electrical equipment, including switches, may be used in the room where solvents are transferred or used, except in the immediate hazardous area, which must be kept in negative pressure with respect to the rest of the room by a vent fan. The immediate hazardous area is the space immediately above and below the centrifuge extractor, and the air flow space between the centrifuge and the outside exhaust.
- 5.8 Sources of open flame (pilot lights, smoking, Bunsen burners, etc.) will not be permitted in the room where solvents are stored or handled.

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## 6. ARCHIVED VERSIONS

- 6.1 Archived versions are available.