

SPEEDIE AND ASSOCIATES

Geotechnical ▪ Environmental ▪ Materials Engineers

INTERNAL PROCEDURES MANUAL

Calibration and Verification Intervals

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Internal Procedures

The procedures included herein are to be used for calibration and/or verification of equipment not calibrated in accordance with NIST or other nationally recognized standards organizations. All equipment used during these internal procedures has certificates of traceability located in the Quality Assurance electronic file.

PROCEDURE #1: MECHANICAL SHAKERS

Equipment:

- Timer, readable to 1 second
- Calibrated Balance, readable to 1 gram
- Coarse nest of sieves (1" to #4)
- Fine nest of sieves (#4 to #200)

Prepare a test sample for sieving as instructed in AASHTO T27, Section 7; or ASTM C136, Section 6. For purposes of determining minimum sieving time it is preferred that the sample be washed and dried to constant weight. Using the Speedie Calibration Worksheet for Mechanical Sieve Shaker and a calibrated balance, record the total weight of the sample. Place the sample into the nest of sieves (coarse or fine depending on which sieving time is being checked) and place the nest of sieves into the shaker. Agitate the sieves for a desired minimum sieve time. After the agitation is completed, remove the nest from the shaker. Hand shake each sieve for one minute. For AASHTO, weigh and record the fraction passing each sieve by hand shaking. Compare it to the total weight of the sample. If any of these fractions exceed 0.5% of the total weight, the length of shaking time is insufficient, and the test shall be repeated using a longer shaking time. For ASTM, weigh and record the fraction passing each sieve by hand shaking. Compare it to the weight of the material retained on that sieve. If any of these fractions exceed 1.0% of the weight of the material retained on that sieve, the length of shaking time is insufficient, and the test shall be repeated using a longer shaking time. Repeat this process using a longer shaking time until these conditions are met. Record this time on both the calibration form and the shaker itself as the minimum sample shaking time. The verification frequency shall be once every twelve months or sooner if necessary.

PROCEDURE #2: OVEN TEMPERATURE

Equipment:

- Calibrated Electronic Thermometer, readable to 0.1 °C

Place the thermocouple probe into a small pan of sand in the oven. Set the oven to the temperature most likely to be used during testing. Allow the temperature of sand to stabilize. Record the actual temperature from the thermocouple and the indicated temperature from the oven on the calibration worksheet. Move the sand to another shelf of the oven and repeat the process until actual and indicated readings have been taken on all shelves. Repeat the entire procedure for all temperature ranges at which the oven is likely to be used. If the actual temperature varies from the indicated temperature by more than 5° C then either post the offset on the oven or call an external agency to calibrate the display. The standardization frequency is once every twelve months or sooner if necessary. For soil ovens the standardization frequency will be once every four months or sooner if necessary.

PROCEDURE #3: COARSE SIEVES

Equipment:

Calipers, readable to 0.001 inches

Sieves are checked visibly for torn and/or clogged screens, and loose welds. The #4 and larger sieves are checked by randomly measuring ten openings with calipers, and recording them to the nearest 0.001 in. If any of the openings are found to be greater than the maximum individual opening allowed (AASHTO M92, Table 1, Column 6; or ASTM E11, Table 1, Column 6) for that particular sieve size, or if the average of the opening sizes is larger than the maximum average opening allowed; then the sieve is deemed unacceptable for use. The verification frequency shall be once every six months or sooner if necessary.

PROCEDURE #4: FINE SIEVES

Equipment:

Eye Glass

Sieves are checked visibly for torn and/or clogged screens, and loose welds. The sieves smaller than #4 will be checked visually for defects. The verification frequency shall be once every six months or sooner if necessary.

PROCEDURE #5: SPECIMEN MOLDS

AASHTO T99, T134, T180, T190, T193, T245, T167 - ASTM D698, D558, D1557, D2844, D1883, D1559, D1074, D4829

Equipment:

Calipers, readable to 0.001 inches

Determine the number of diameter and height measurements to be taken for the type of mold being calibrated. Use the calipers to measure the inside diameter of the mold. Repeat this process, taking one half of the total number of required measurements from each end of the mold. Record each of the measurements on the calibration form to the nearest 0.001-inch. Stand the mold on end, measure and record the height of the mold for the required number of measurements. Record the height to the nearest 0.001-inch. Use the average values of the diameter and height to calculate the volume of the mold, if necessary. Determine if the mold is in compliance with the applicable specifications. The verification frequency is once every twelve months or sooner if necessary.

MOLD TYPE	TEST PROCEDURE	REQUIRED NUMBER OF MEASUREMENTS	
		Diameter	Height
R-VALUE	AASHTO T190, ASTM D2844	4	5
CBR	AASHTO T193, ASTM D1883	6	3
Marshall	AASHTO T245, ASTM D1559	4	1
IMC	AASHTO T167, ASTM D1074	4	1
PROCTOR	AASHTO T99, ASTM D698	12	3
EXPANSION INDEX	ASTM D4829	6	3

PROCEDURE #6: GENERAL PURPOSE BALANCES AND MASSES

Equipment:

Calibrated Masses, accurate to 0.1 grams

Calibrated Balance, readable to 0.1 grams

For general purpose masses, use a calibrated balance, precise to 0.1 g to verify the mass. If the indicated mass deviates from the actual mass by more than 0.1% either note the actual mass or submit the mass to an outside agency for re-certification. For general purpose balances, use calibrated masses to verify the balance. If the indicated mass deviates from the actual mass by more than 0.1% calibrate the balance using according to the manufacturer's instructions or submit the balance to an outside agency for calibration. The standardization frequency shall be once every twelve months or sooner if necessary.

PROCEDURE #7: THERMOMETER

Equipment:

Calibrated Thermometer, readable to 0.1 °C

Fill a beaker with distilled water. Heat or cool the water to a temperature which is in the range of the intended use of the thermometer being calibrated. Place the calibrated thermometer and the thermometer being calibrated in the water. Allow enough time for both thermometers to stabilize. Record the temperature of both thermometers on the appropriate calibration worksheet. Repeat the above procedure until you have achieved at least three readings for each thermometer. The standardization frequency shall be once every 12 months or sooner if necessary.

PROCEDURE #8: UNIT WEIGHT MEASURES

AASHTO T19 – ASTM C29

Equipment:

Satin Rule, readable to 0.1 inches

Calipers, readable to 0.001 inches

Glass Plate, capable of covering the complete surface of the bucket

Feeler Gauge, 0.01 inches thick

Calibrated Balance, readable to 0.01 pounds

Use the satin rule to measure the diameter in two locations. Measure the inside and outside height in three locations. Record these measurements to the nearest 0.1 inch on the calibration form. The difference between the inside and outside height measurements is equal to the thickness of the bottom. Record the thickness on the calibration form. Use the calipers to measure the thickness of the upper 1.5 inches of the sidewall. Record these on the calibration form to the nearest 0.001 inch. Place a glass plate on the rim of the bucket and use a feeler gauge to check that the rim of the bucket is plane within 0.01 inches. Measure the volume using the procedure given in AASHTO T19, Section 7; or ASTM C29, Section 8. Weigh the bucket to the nearest 0.01 pounds and record the weight on the bucket. Record the volume and date of standardization on the bucket. The standardization frequency shall be once every twelve months or sooner if necessary.

PROCEDURE #9: SULFATE OVEN

AASHTO T104 – ASTM C28

Equipment:

Calibrated Thermometer, readable to 1 °C

Griffin low-form beaker (5), 1 liter

Calibrated Balance, readable to 1 gram

Verify the oven temperature by placing the thermocouple probe into a small pan of sand in the oven. Set the oven so as to maintain a temperature of 230 ± 9 °F (110 ± 5 °C). Allow the temperature of sand to stabilize. Record the actual temperature from the thermocouple and the indicated temperature from the oven on the calibration worksheet. If the actual temperature is outside the acceptable range, adjust the oven settings, wait for the oven and sand to stabilize and take another reading. Repeat until the oven is able to maintain 230 ± 9 °F. If the oven is not able to maintain 230 ± 9 °F, submit the oven to an outside agency for calibration or repair.

Once the oven temperature has been verified, empty the oven of all samples. Fill five Griffin low-form beakers with 500 g of water at a temperature of 70 ± 3 °F and place the beakers in the oven at the center and each corner of the oven. Close the oven doors and keep them close for four hours. At the end of four hours, remove the four beakers, allow them to cool, and weigh the amount of water remaining in each beaker. Divide the amount of water lost by four. If the amount of water lost per hour is less than 25 g/h, remove the oven from service and submit it to an outside agency for calibration or repair. The verification frequency shall be once every twelve months or sooner if necessary.

PROCEDURE #10: SULFATE SOUNDNESS CONTAINERS

AASHTO T104 – ASTM C28

Equipment:

Eye Glass

Check containers for visibly torn and/or clogged screens, loose welds, any other visible defects by which the container might be compromised. If a container is found to have some defect, it shall be removed from service. The verification frequency shall be once every twelve months or sooner if necessary.

PROCEDURE #11: L. A. ABRASION MACHINE

AASHTO T96 - ASTM C131

Equipment:

Tape Measure, readable to 0.001 inches

Timer, readable to 0.1 second

Using a measuring tape, measure the diameter at the right and left edges of the steel drum. Measure the width and height of the opening. Measure the wall thickness at the left and right edge. Determine if the cylinder is horizontal using a steel ball to check left-to-right roll. Measure the depth of the interior shelf. Measure the distance from the shelf to the opening along the outside circumference in the direction of travel. Record these measurements to the nearest 0.001-inch. Using a stopwatch, and with a charge and sample loaded in the machine, count and record the number of rotations turned in five minutes. Check that the number of revolutions is 500 by looking at the counter on the machine. Compare the measured dimensions

to those specified in AASHTO T96, Figure 1; or ASTM C131, Figure 1. The verification frequency shall be once every twenty-four months or sooner if necessary.

PROCEDURE #12: LOS ANGELES ABRASION CHARGES

AASHTO T96 - ASTM C131

Equipment:

- Calipers, readable to 0.001 inches
- Calibrated Balance, readable to 0.1 gram

Using a balance and set of calipers, measure and record the weight and diameter of each of the steel spheres. The weight should be measured to the nearest 0.1-gram, and the diameter to the 0.001-inch. The total charge weight is then taken using the specified number of spheres for each grading as specified in AASHTO T96, Table 1; and ASTM C136, Table 1. The verification frequency shall be once every twenty-four months or sooner if necessary.

PROCEDURE #13: FINE AGGREGATE SPECIFIC GRAVITY CONE

AASHTO T84 - ASTM C128

Equipment:

- Calipers, readable to 0.001 inches

Use the calipers to measure the diameter of the top opening of the cone two times 90° apart. Measure the bottom opening of the cone the same way. Use the calipers to measure the height of the cone. Measure the thickness of the cone two times 90° apart at the top and two times 90° apart at the bottom. Record these dimensions on the calibration form to the nearest 0.001-inch. Compare the measured dimensions to those specified in AASHTO T84, Section 4; or ASTM C128, Section 4. The verification frequency shall be once every twenty-four months or sooner if necessary.

PROCEDURE #14: FINE AGGREGATE SPECIFIC GRAVITY TAMPER

AASHTO T84 - ASTM C128

Equipment:

- Calipers, readable to 0.001 inches
- Calibrated Balance, readable to 0.1 gram

Weigh the tamper on the balance. Record the weight on the calibration form to the nearest 0.1 gram. Use a set of calipers to measure the diameter of the face of the tamper two times 90° apart. Compare the measured dimensions and weight to those specified in AASHTO T84, Section 4; or ASTM C128, Section 4. The verification frequency shall be once every twenty-four months or sooner if necessary.

PROCEDURE #15: TIMING DEVICES

AASHTO T49 - ASTM D5

Equipment:

- Calibrated Reference Timing Device, readable to 0.1 seconds

OR

Landline telephone

NIST Hotline, (303) 499-7111

Method A – Calibrated Reference Timer: Set both the timing device to be standardized and the calibrated timing device to the same start time. Start both devices simultaneously. Stop the timing device being standardized once the calibrated timing device reaches 1, 15, and 60 minutes (3 separate instances). If the reading on the timing device being standardized deviates from 1, 15, or 60 minutes by more than the allowable range indicated on the standardization form, remove the timer from service and replace with an acceptable timer or submit it to an outside agency for calibration or repair. The standardization frequency shall be once every 12 months or sooner if necessary.

Method B – NIST Hotline: Call the NIST Hotline at (303) 499-7111. Listen for the tone marking the beginning of a minute and start the timing device to be standardized at the tone. If standardizing at 1 minute, remain on the line and stop the timer at the next tone marking the beginning of the minute. If standardizing for 15 or 60 minutes, hang up the phone and record the time of day (to the minute) that the timing device to be standardized was started – call back a couple minutes before the 15 or 60 minute mark, and stop the timer at the appropriate tone marking the beginning of the 15th or 60th minute since having started the timer. For all 3 times, record the reading on the timing device as it compares to 1, 15, and 60 minutes marked by the NIST hotline tones. If the reading on the timing device being standardized deviates from 1, 15, or 60 minutes by more than the allowable range indicated on the standardization form, remove the timer from service and replace with an acceptable timer or submit it to an outside agency for calibration or repair. The standardization frequency shall be once every 12 months or sooner if necessary.

PROCEDURE #16: PENETROMETER NEEDLE

AASHTO T49 - ASTM D5

Equipment:

Calibrated Balance, readable to 0.001 gram

Calipers, readable to 0.001 inches

Using a balance readable to 0.001 g, the total weight of the needle and spindle assembly shall be 50.0 ± 0.05 g. The weight of the spindle shall be 47.5 ± 0.05 g. Using dial calipers readable to 0.001 inches, the length of the penetration needle should be measured. A standard penetration needle shall be approximately 50 mm in length and a long needle shall be approximately 60 mm in length. The diameters of both the standard and the long needle shall be 1.00 mm to 1.02 mm. The dial calipers shall be used to determine the metal ferrules diameter and length. The metal ferrule shall have a diameter of 3.2 ± 0.05 mm and a length of 38 ± 1 mm. The weight of the metal ferrule needle assembly shall be 2.50 ± 0.05 g. Run-out of the needle tip shall be determined by rolling the ferrule on a flat surface. Run-out is not to exceed 1.0mm. A visual inspection of the ferrule tip under magnification is to be done to verify that the tip is free of burrs. The verification frequency shall be once every six months or sooner if necessary.

PROCEDURE #17: PENETROMETER

AASHTO T49 - ASTM D5

Equipment:

Calipers, readable to 0.001 inches

Use the calipers to adjust the penetrometer until the calipers read 0.800 inches. Read and record the penetrometer reading. Use the calipers to adjust the penetrometer until the calipers read 1.000 inches. Read and record the penetrometer reading. If the penetrometer reading differs from 20.3 mm for the 0.800 inch reading or 25.4 mm for the 1.000 inch reading, submit the penetrometer to an outside agency for calibration or repair. The verification frequency shall be once every twelve months or sooner if necessary.

PROCEDURE #18: BRASS RINGS AND ASSEMBLIES

AASHTO T53 - ASTM D36

Equipment:

Calibrated Balance, readable to 0.01 grams

Calipers, readable to 0.001 inches

Using the diagrams shown in figure 1 (a) and figure 1 (b) of AASHTO T53, measure both the shoulder ring and the ring holder critical dimensions using the calipers. Using the balance, record the weight of each steel sphere. The calibration tolerances for the shoulder rings, the ring holders and the steel spheres can be found on the calibration worksheet or in AASHTO T53. The verification frequency shall be once every twelve months or sooner if necessary.

PROCEDURE #19: PYCNOMETER

AASHTO T228 - ASTM D70

Equipment

Calipers, readable to 0.001 inches

Beaker, 0.6 liters

Water Bath

Calibrated Balance, readable to 0.001 grams

Calibrated Thermometer, readable to 0.1 °C

Use the calipers to measure and verify the critical dimensions of the glass stopper according to figure 1 in ASTM D70. Fill a 600ml beaker with freshly boiled and cooled distilled water to a level that will allow the top of the pycnometer to be immersed to a depth of not less than 40 mm. Immerse the beaker in a water bath to a depth not less than 100 mm. Clamp the beaker in place while ensuring that the top of the beaker is still above the water level in the water bath. The temperature in the water bath must be maintained to within 0.1 °C of the desired test temperature (calibration must be done for each test temperature that will be used). Obtain the weight of a clean and dry pycnometer (and stopper). Fill the pycnometer with freshly boiled and cooled distilled water. Place the stopper on the pycnometer and place the pycnometer in the beaker. The pycnometer should remain in the water for a minimum of thirty minutes. After the thirty-minute period, remove the pycnometer and dry the top of the stopper with one stroke (expansion may result in the formation of small droplets of water, do not re-dry the stopper). Quickly dry the outside area of the pycnometer and obtain the weight of the pycnometer filled with water. Inspect the pycnometer for any cracks. The calibration frequency shall be once every twelve months or sooner if necessary.

PROCEDURE #20: ROTATIONAL VISCOMETER

AASHTO T316 - ASTM D4402

Equipment:

Traceable Brookfield Standard Solution

Calibrated Thermometer, readable to 0.1 °C

Using the manufacturer's system manual, perform calibrations to obtain digital readout to compare against known viscosity of Brookfield Standard Solution. Partially fill a disposable chamber with viscosity standard. Place the thermocouple probe in the fluid in the sample chamber. Compare the temperature readings between the calibrated thermocouple and the two digital readouts on the Brookfield device. The standardization frequency shall be once every six months or sooner if necessary.

PROCEDURE #21: MECHANICAL COMPACTOR

AASHTO T245

Equipment:

Mechanical Compactor

Hand Compactor

Calibrated Balance, readable to 0.1 grams

Split out six representative samples from a thoroughly blended asphalt sample. Place the samples into molds and bring the samples up to compaction temperature. Compact three of the specimens using the mechanical compactor. Compact the other three specimens using hand compactor. Extrude the specimens, and after cooling, run unit weight measurements. Average the unit weights from the two sets of plugs and compare. The standardization frequency shall be once every thirty-six months or sooner if necessary.

PROCEDURE #22: FOLLOWER

AASHTO T246, T247 - ASTM D1560, D1561

Equipment:

Calipers, readable to 0.001 inches

Using the calipers, measure the outside diameter and the length of the solid wall metal follower. Record each of the measurements to the nearest 0.001 inch. The verification frequency shall be once every twelve months or sooner if necessary.

PROCEDURE #23: CALIBRATION CYLINDER

AASHTO T246, T247 - ASTM D1560, D1561

Equipment:

Calipers, readable to 0.001 inches

Using the calipers, measure the outside diameter and the height of the hollow metal cylinder. Record each of the measurements to the nearest 0.001 inch. The verification frequency shall be once every twelve months or sooner if necessary.

PROCEDURE #24: MANUAL COMPACTION HAMMERS

AASHTO T245 - ASTM D6926, D6927

Equipment:

- Calipers, readable to 0.001 inches
- Satin Rule, readable to 0.01 inches
- Calibrated Balance, readable to 0.1 grams

Disassemble the hammer apparatus and clean the components. Weigh the sliding weight and record the mass of the weight to the nearest 0.1 gram. Use the calipers to measure the diameter of the hammer face at three equally spaced points around the circumference. Record the diameters to the nearest 0.001 inch. Average the three measurements and record. Reassemble the hammer. Using a satin rule, measure the distance from the bottom of the handle to the top of the sliding weight. Record this as the height of drop to the nearest 0.01 inch. The verification frequency shall be once every twelve months or sooner if necessary.

PROCEDURE #25: BREAKING HEADS

AASHTO T245 - ASTM D6926, D6927

Equipment:

- Marshall breaking head verification device

Place the device in the Marshall breaking head. Position the verification device in such a way that the inscribed lines are parallel with the top of the Marshall breaking head. Visually verify the dimensions will fit inside the inscribed lines. The verification frequency shall be once every twelve months or sooner if necessary.

PROCEDURE #26: PLUNGERS

AASHTO T167 - ASTM D1074

Equipment:

- Calipers, readable to 0.001 inches

Use the calipers to measure the outside diameter of the plunger. Repeat this process taking measurements at evenly spaced intervals around the circumference of the plunger. Record each of the measurements to the nearest 0.001 inch. Stand the plunger on end, measure and record the height of the plunger for the required number of measurements to the nearest 0.001 inch. The verification frequency shall be once every twelve months or sooner if necessary.

PROCEDURE #27: GYRATORY COMPACTOR

AASHTO T312 - ASTM D7115

Equipment:

- Gyratory Calibration Kit:
 - Load Cell
 - Gage Blocks
 - LVDT
 - Micrometer

Using manufacturer's procedures in the equipment manual, perform calibration procedures for height, angle, and pressure as well as the verification procedure for rotational speed. The calibration frequency shall be once every 12 months or sooner if necessary.

PROCEDURE #28: RAM FACE, BASE PLATE FACE

AASHTO T312 - ASTM D7115

Equipment:

Calipers, readable to 0.001 inches

Keeping the ram heads perpendicular to their axis, visually inspect the platen side of each mold bottom to confirm that it is flat and parallel to its face. Inspect the smoothness of the inside finish of the molds in accordance with ANSI B 46.1. Use the calipers to measure the height of the molds. Use the calipers to measure the diameters of the ram face and base plate face. Measure each diameter twice with the second measurement at a right angle to the first measurement. Determine the average diameter from the two measurements. Record each of the measurements on the calibration form to the nearest 0.001 inch. The calibration frequency shall be once every twelve months or sooner if necessary.

PROCEDURE #29: IGNITION OVEN INTERNAL BALANCE

AASHTO T308 - ASTM D6307

Equipment:

Calibrated Masses, 8000 grams

Using manufacturer's procedures in the equipment manual, perform the calibration procedure for the ignition oven internal balance. If, for any reason, the calibration fails or cannot be completed, submit the internal balance to an outside agency for repair or calibration. The calibration frequency shall be once every twelve months or sooner if necessary.

PROCEDURE #30: MANUAL HAMMER

AASHTO T99, T180 - ASTM D698, D1557

Equipment:

Calipers, readable to 0.001 inches

Satin Rule, readable to 0.01 inches

Calibrated balance, readable to 0.1 grams

With the calipers, measure and record two diameters of the face of the hammer 90° apart, to the nearest 0.001 inch. Record the average of the two diameters. With the hammer fully retracted, place the satin rule inside the guide sleeve until it makes contact with the face of the hammer. Measure and record the distance from the bottom of the guide sleeve to the bottom of the hammer face to the nearest 0.01 inch. Record the height of drop of the hammer. Disassemble the hammer. Weigh and record the weight of the hammer to the nearest 0.1 gram. Measure and record the diameters of the vent holes near the hammer. The verification frequency shall be once every twelve months or sooner if necessary.

PROCEDURE #31: LIQUID LIMIT DEVICE

AASHTO T89 - ASTM D4318

Equipment:

The verification frequency shall be once every twelve months or sooner if necessary.

PROCEDURE #32: GROOVING TOOL

AASHTO T89 - ASTM D4318

Equipment:

Calipers, Readable to 0.001 inches

Use the calipers to measure the appropriate dimensions as outlined on the calibration sheet. The verification frequency shall be once every twelve months or sooner if necessary.

PROCEDURE #33: HYDROMETER

AASHTO T88 - ASTM D422

Equipment:

Calipers, readable to 0.001 inches

Measure and record the required lengths and diameter of the hydrometer as shown in ASTM E100 figure 2. The verification frequency shall be once every twenty-four months or sooner if necessary.

PROCEDURE #34: STRAIGHTEDGE

AASHTO T99, T134, T135, T136, T180 - ASTM D558, D559, D560, D698, D1557

Equipment:

Feeler Gauge, 0.005 inches

Glass Plate, 12 inch

Satin Rule, 0.01 inches

Measure and record the length of the straightedge to the nearest 0.1". Lay the straightedge on the glass plate. Check for gaps between the glass plate and the straightedge along the entire length of the straightedge using the 0.01" and 0.005" feeler gauges. The verification frequency shall be once every six months or sooner if necessary.

PROCEDURE #35: WEIGHTED FOOT ASSEMBLY

AASHTO T176 - ASTM D2419

Equipment:

Calibrated Balance, readable to 0.1 grams

Measure and record the mass of the weighted Foot Assembly. Measure the diameter of the face of the weighted Foot Assembly. The verification frequency shall be once every twelve months or sooner if necessary.

PROCEDURE #36: CBR ANNULAR & SLOTTED WEIGHTS

AASHTO T193 - ASTM D1883

Equipment:

- Calibrated Balance, readable to 0.1 grams
- Calipers readable to 0.001 inches

Measure and record the mass of the weight. Measure and record the outside diameter of the weight. The verification frequency shall be once every twelve months or sooner if necessary.

PROCEDURE #37: STANDARD METAL SPECIMEN

AASHTO T190 - ASTM D2844

Equipment:

- Calipers, readable to 0.001 inches

Using the diagram shown in figure 8 of the AASHTO T190/ASTM D2844, use the calipers to measure the outside diameter and the height of the standard metal specimen. Record each of the measurements on the calibration form to the nearest 0.001 inch. The verification frequency shall be once every twelve months or sooner if necessary.

PROCEDURE #38: METAL FOLLOWER

AASHTO T190 - ASTM D2844

Equipment:

- Calipers, readable to 0.001 inches

Using the calipers, measure the outside diameter and the length of the solid wall metal follower. Record each of the measurements on the calibration form to the nearest 0.001 inch. The verification frequency shall be once every twelve months or sooner if necessary.

PROCEDURE #39: UNIT WEIGHT MEASURE

AASHTO T121 - ASTM C138

Equipment:

- Satin Rule, readable to 0.1 inches
- Calipers, readable to 0.001 inches
- Glass Plate, capable of covering the complete surface of the bucket
- Feeler Gauge, 0.01 inches thick
- Calibrated Balance, readable to 0.01 pounds

Use the satin rule to measure the diameter in two locations. Measure the inside and outside height in three locations. Record these measurements to the nearest 0.1 inch on the calibration form. The difference between the inside and outside height measurements is equal to the thickness of the bottom. Record the thickness on the calibration form. Use the calipers to measure the thickness of the upper 1.5 inches of the sidewall. Record these on the calibration form to the nearest 0.001 inch. Place a glass plate on the rim of the bucket and use a feeler gauge to check that the rim of the bucket is plane within 0.01 inches. Measure the volume using the procedure given in AASHTO T19, Section 7; or ASTM C29, Section 8. Weigh the bucket to the nearest 0.01 pounds and record the weight on the bucket. Record the volume and date of standardization on the bucket. The standardization frequency shall be once every twelve months or sooner if necessary.

PROCEDURE #40: AIR METER (PRESSURE)

AASHTO T152 - ASTM C231

Equipment:

- Calipers, readable to 0.1 inches
- Calibrated Balance, readable to 0.1 % of the weight of the filled calibration vessel
- Calibrated Balance, readable to 0.1 % of the weight of the filled measuring bowl
- Glass Plate, capable of covering the complete surface of the calibration vessel
- Glass Plate, capable of covering the complete surface of the measuring bowl

Measure the weight of the filled calibration vessel by filling the vessel, sliding the glass plate on top of the vessel to ensure it is completely full, and weighing the amount of water contained within the vessel. Measure the weight of the filled measuring bowl by filling the bowl, sliding the glass plate on top of the bowl to ensure it is completely full, and weighing the amount of water contained within the bowl. Determine the effective volume of the calibration vessel using the formula $R = w/W$; where R is the effective volume of the calibration vessel, w is weight of water contained in the filled calibration vessel, and W is the weight of water contained in the filled measuring bowl. To calibrate the gauge graduations, screw the short tubing into the underside of the measuring bowl cover. Fill the measuring bowl with water. Clamp the cover to the measuring bowl. Using a syringe, inject water into petcock attached to the short tubing until it is expelled through the opposite petcock. Once all the air from inside the measuring bowl has been removed, pump the meter until the gauge reads slightly beyond the initial pressure line. Wait several seconds for the air temperature to stabilize, then pump or bleed off air to adjust the gauge to the initial pressure line. Close both petcocks and press the needle valve to release air into the bowl. Wait for the gauge to stabilize. The gauge should read 0.0 % air. If it does not, adjust the initial pressure line until two tests verify the position of the new initial pressure line.

Screw the curved tube into the petcock attached to the short tubing. Open the petcock and allow water to fill the calibration vessel. Open the opposite petcock allowing water to flow back into the measuring bowl. The bowl now contains 5.0 % air. Pump the meter until the gauge reads slightly beyond the initial pressure line. Wait several seconds for the air temperature to stabilize, then pump or bleed off air to adjust the gauge to the initial pressure line. Close both petcocks and press the needle valve to release air into the bowl. Wait for the gauge to stabilize. Press the needle valve again to release any additional air. The gauge should read 5.0 % air. If in two or more tests the gauge deviates from the actual air percentage by more than 0.2 %, the gauge will be reset using the calibration screw on the gauge hand such that two or more subsequent trials will produce readings within 0.2 % of the actual air percentage. The calibration frequency shall be once every three months or sooner if necessary.

PROCEDURE #41: AIR METER (VOLUMETRIC)

ASTM C173

Equipment:

- Satin Rule, readable to 0.1 inches
- Calipers, readable to 0.001 inches
- Glass Plate, capable of covering the complete surface of the bucket
- Feeler Gauge, 0.01 inches thick
- Calibrated Balance, readable to 0.01 pounds

Use the satin rule to measure the diameter in two locations. Measure the inside and outside height in three locations. Record these measurements to the nearest 0.1 inch on the calibration form. The difference between the inside and outside height measurements is equal to the thickness of the bottom. Record the thickness on the calibration form. Use the calipers to measure the thickness of the upper 1.5 inches of the sidewall. Record these on the calibration form to the nearest 0.001 inch. Place a glass plate on the rim of the bucket and use a feeler gauge to check that the rim of the bucket is plane within 0.01 inches. Measure the volume using the procedure given in AASHTO T19, Section 7; or ASTM C29, Section 8. Weigh the bucket to the nearest 0.01 pounds and record the weight on the bucket. Record the volume and date of standardization on the bucket.

Fill the air meter with water, which is at 70 °F, to the 7 % mark on the neck. Using a known mass of water, which is at 70 °F, fill the meter to the zero mark. Calculate the amount of water which was added to fill the meter to the zero mark. Using the volume calculation shown in AASHTO T19, section 8, determine the volume of water required to fill the air meter to the zero mark. Next, calculate the volume percent of the bowl by the following equation. (volume of water required to fill the air meter to the zero line/volume of the bowl)*100. Repeat this procedure by filling the meter to the 5 % mark initially, then repeat the procedure by filling to the 3 % mark. The verification frequency shall be once every twelve months or sooner if necessary.

PROCEDURE #42: AIR METER (VOLUMETRIC)

AASHTO T196

Equipment:

- Satin Rule, readable to 0.1 inches
- Calipers, readable to 0.001 inches
- Glass Plate, capable of covering the complete surface of the bucket
- Feeler Gauge, 0.01 inches thick
- Calibrated Balance, readable to 0.01 pounds

Use the satin rule to measure the diameter in two locations. Measure the inside and outside height in three locations. Record these measurements to the nearest 0.1 inch on the calibration form. The difference between the inside and outside height measurements is equal to the thickness of the bottom. Record the thickness on the calibration form. Use the calipers to measure the thickness of the upper 1.5 inches of the sidewall. Record these on the calibration form to the nearest 0.001 inch. Place a glass plate on the rim of the bucket and use a feeler gauge to check that the rim of the bucket is plane within 0.01 inches. Measure the volume using the procedure given in AASHTO T19, Section 7; or ASTM C29, Section 8. Weigh the bucket to the nearest 0.01 pounds and record the weight on the bucket. Record the volume and date of standardization on the bucket.

Fill the air meter with water, which is at 70 °F, to the 7 % mark on the neck. Using a known mass of water, which is at 70 °F, fill the meter to the zero mark. Calculate the amount of water which was added to fill the meter to the zero mark. Using the volume calculation shown in AASHTO T19, section 8, determine the volume of water required to fill the air meter to the zero mark. Next, calculate the volume percent of the bowl by the following equation. (volume of water required to fill the air meter to the zero line/volume of the bowl)*100. Repeat this procedure by filling the meter to the 5 % mark initially, then repeat the procedure by filling to the 3 % mark. The verification frequency shall be once every twelve months or sooner if necessary. The verification frequency shall be once every thirty-six months or sooner if necessary.

PROCEDURE #43: CAPPING MATERIAL

Equipment:

Steel Cube Molds

Compression Machine

Prepare test specimens using a cube mold and base plate conforming to the requirements of Test Method C 109/C 109M and a metal cover plate conforming in principle to the design shown in ASTM C617 Fig. 1. Bring the various parts of the apparatus to a temperature of 68 to 86 °F (20 to 30 °C), lightly coat the surfaces that will be in contact with the sulfur mortar with mineral oil, and assemble near the melting pot. Bring the temperature of the molten-sulfur mortar in the pot within a range of 265 to 290 °F (129 to 143 °C), stir thoroughly, and begin casting cubes. Using a ladle, or other suitable pouring device, quickly fill each of the three compartments until the molten material reaches the top of the filling hole. Allow sufficient time for maximum shrinkage, due to cooling, and solidification to occur (approximately 15 min) and refill each hole with molten material. After solidification is complete, remove the cubes from the mold without breaking off the knob formed by the filling hole in the cover plate. Remove oil, sharp edges, and fins from the cubes and check the planeness of the bearing surfaces in the manner described ASTM C109. After storage at room temperature to the desired age, but not less than 2 h, test cubes in compression following the procedure described in Test Method C109, and calculate the compressive strength. The verification frequency shall be once every three months or sooner if necessary.

PROCEDURE #44: SLUMP CONE

AASHTO T119 - ASTM C143

Equipment:

Calipers, readable to 0.001 inches

Satin Rule, readable to 0.01 inches

Use the calipers to measure the diameter of the top opening of the slump cone at four locations equally spaced around the circumference. Repeat this procedure for the diameter of the bottom opening. Measure the height of the cone at four equally spaced locations. Measure the thickness of the metal used in the cone at four random locations. Record these measurements, and their averages to the nearest 0.001 inch. Measure the diameter of the tamping rod to the nearest 0.001 inch. Use a tape measure to measure the length of the tamping rod. Record the length to the nearest 1/16th of an inch. Verify that all the measurements satisfy the requirements of AASHTO T119, Section 2 or ASTM C143, Section 5. The verification frequency shall be once every twelve months or sooner if necessary.

PROCEDURE #45: SINGLE USE MOLD

AASHTO T22, T23 - ASTM C31, C39

Equipment:

- Calipers, readable to 0.001 inches
- Satin Rule, readable to 0.1 inches
- Slump Rod, 3/8 inch or 5/8 inch diameter

Use the satin rule to measure the outside height of the mold at two evenly spaced points around the circumference. Record the two measurements and the average to the nearest 0.1 inch. Use the calipers to measure the thickness of the wall at four equally spaced locations around the circumference. Record the individual measurements and the average to the nearest 0.001 inch. Measure the diameter in two locations. Record the individual measurements and the average to the nearest 0.001 inch. When making measurements, care must be used to avoid flexing the mold as this could generate erroneous results. Subject the mold to the dry Roding test as described in AASHTO M205; and ASTM C470, Section 7.3.2. A sampling of molds shall be tested in each shipment; those that do not meet the requirements of this specification will be returned to the manufacturer. The verification frequency shall be once every for every shipment received or sooner if necessary.

PROCEDURE #46: RECORDING THERMOMETER

ASTM C31, C39

Equipment:

- Calibrated Thermometer, readable to 0.1 °C

Fill a beaker with distilled water. Heat or cool the water to a temperature which is in the range of the intended use of the thermometer being calibrated. Place the calibrated thermometer and the thermometer being calibrated in the water. Allow enough time for both thermometers to stabilize. Record the temperature of both thermometers on the appropriate calibration worksheet. Repeat the above procedure until you have achieved five readings for each thermometer. The verification frequency shall be once every six months or sooner if necessary.

PROCEDURE #47: MOIST CABINET/WATER TANK RECORDING THERMOMETER

AASHTO T106 - ASTM C109

Equipment:

- Calibrated Thermometer, readable to 0.1 °C

Fill a beaker with distilled water. Heat or cool the water to a temperature which is in the range of the intended use of the thermometer being calibrated. Place the calibrated thermometer and the thermometer being calibrated in the water. Allow enough time for both thermometers to stabilize. Record the temperature of both thermometers on the appropriate calibration worksheet. Repeat the above procedure until you have achieved five readings for each thermometer. The verification frequency shall be once every six months or sooner if necessary. The verification frequency shall be once every six months or sooner if necessary.

PROCEDURE #48: STORAGE WATER

AASHTO T106 - ASTM C109

Equipment:

The verification frequency shall be once every six months or sooner if necessary.

PROCEDURE #49: BEARING BLOCKS

AASHTO T106 - ASTM C109

Equipment:

Feeler Gauge, 0.001 inches thick

Using the feeler gauge, check the planes of the bearing blocks. If the blocks are out of compliance, submit them to be machined. The verification frequency shall be once every six months or sooner if necessary.

PROCEDURE #50: FLAKINESS INDEX SLOTTED PLATE

ARIZ 233

Equipment:

Calipers, readable to 0.001 inches

Use the calipers to measure the width of each slot in the plate three times at evenly spaced intervals. Record these dimensions on the calibration form to the nearest 0.001 inch. Compare the measured dimensions to those specified in ARIZ 233, Section 2. The calibration frequency shall be once every twelve months or sooner if necessary.

PROCEDURE #51: CONSOLIDOMETERS/SWELL ARM DEFORMATION

AASHTO T216 – ASTM D2435, D4546

ARIZ 249

Equipment:

Weights with a total mass of 11,000 g, capable of applying specified loads

Assemble the consolidometer with a hard steel disk of approximately the same height as the test specimen and 1 mm smaller diameter than the ring in place of a sample. Moisten the porous stones, if filter papers are to be used they should be moistened also. Sufficient time shall be allowed for the moisture to be squeezed from them during the calibration process. Load and unload the consolidometer as in the test and measure the deformation for those loads. On graph paper, plot the corrections to be applied to the deformation of the test specimen.

PROCEDURE #52: CBR PISTON

AASHTO T193, ASTM D1883

Equipment:

Calipers

Using calipers, record at least 4 measurements at the bottom of the piston to determine an average diameter and at least one measurement to determine the length of the piston.

PROCEDURE #53: SAYBOLT VISCOMETER

AASHTO T59, ASTM D244

Equipment:

Viscosity Reference Standard - Preferably Cannon S600

Calibrated Stop Watch

ASTM 19C or 19F Thermometer

Power on Saybolt bath and set bath temperature controller to 50^oC and allow bath time to stabilize once temp has been reached. Obtain a representative sample of certified reference standard oil and pour 100-ml into a

125-ml Erlenmeyer flask, place cork or rubber stopper loosely on top of flask. Immerse the flask in a heated bath no greater than 53^oC making sure the sample is heated throughout while stirring the sample without incorporating bubbles. Place rubber stopper at end of viscometer and pour oil from flask into viscometer until oil is at least ¼" above the overflow rim. Insert appropriate ASTM glass thermometer (19C or 19F) into the thermometer support and stir the oil until the temperature remains constant within 0.05F of the test temperature during 1 min of continuous stirring at 60r/min avoiding bubble formation. Once the temperature has remained constant for 1 minute, remove the thermometer from the sample and quickly remove the oil from the gallery until its level is below the overflow rim using withdrawal tube or pipet. Place the receiving flask where the stream of oil from the bottom of the viscometer will just strike the neck of the flask. Snap the cork from the viscometer using the attached cord, at the same instant start the timer. Stop the timer the instant the bottom of the meniscus reaches the graduation mark. Record the efflux time in seconds.

For reporting, multiply the efflux time by the calibration correction factor the viscometer used.