Test Procedure for

TEST FOR STABILOMETER VALUE OF BITUMINOUS MIXTURES

TxDOT Designation: Tex-208-F

Effective Date: February 2005

1. SCOPE

1.1 Use this test method to determine the Hveem stability value of a laboratory compacted bituminous mixture.

1.2 Read the complete procedure carefully, including Section 10, before attempting to use the stabilometer.

1.3 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.

2. DEFINITIONS

2.1 *Hveem Stabilometer*—an instrument designed to subject a specimen 4 in. (102 mm) in diameter and approximately 2 in. (51 mm) high to triaxial compression. The instrument measures the lateral pressure transmitted through the specimen by the applied vertical load, and indicates the relative ability of the pavement to resist plastic deformation under the action of traffic. The test determines the shearing resistance of the material, which results primarily from the internal friction of the aggregate. It consists of a cylindrical metal shell and flexible rubber diaphragm, which serves as a cell for the hydraulic fluid. It also includes a pressure gauge, a screw-type hand pump assembly and an air chamber fitted with a needle valve (relief valve) and air-in valve for adjusting the quantity of air in the system.

2.2 *Stability Value*—the ratio of a given applied unit compression stress to the transmitted lateral pressure; indicates the ability of the material to resist deformation. The stability index is expressed in percent ranging from 0 to 100, where 0 represents a fluid that will transmit laterally the full amount of an applied vertical load, and 100 represents a rigid body that will transmit practically none of the load in a lateral direction.

3. APPARATUS

3.1 *Hveem stabilometer*, with adjustable stage. (See Figure 1.) It consists of a cylindrical metal shell and flexible rubber diaphragm, which serves as a cell for the hydraulic fluid. It also includes a pressure gauge, a screw-type hand pump assembly, and an air chamber

fitted with a needle valve (relief valve) and air-in valve for adjusting the quantity of air in the system.

3.2 *Initial displacement cylinder.*

3.3 *Load transfer ram.*

3.4 *Compression testing machine*, with a minimum capacity of 10,000 lb. (45,000 N), calibrated according to the latest revision of ASTM E 4.

3.5 *Electric oven*, convection type, thermostatically controlled to 140 ± 5°F (60 ± 3°C).

3.6 *Measuring device*, dial indicator assembly to determine the rate of travel of the testing machine, graduated in increments of 0.001 in. (0.025 mm) or 0.0100 in. (0.254 mm).

3.7 *Stopwatch.*

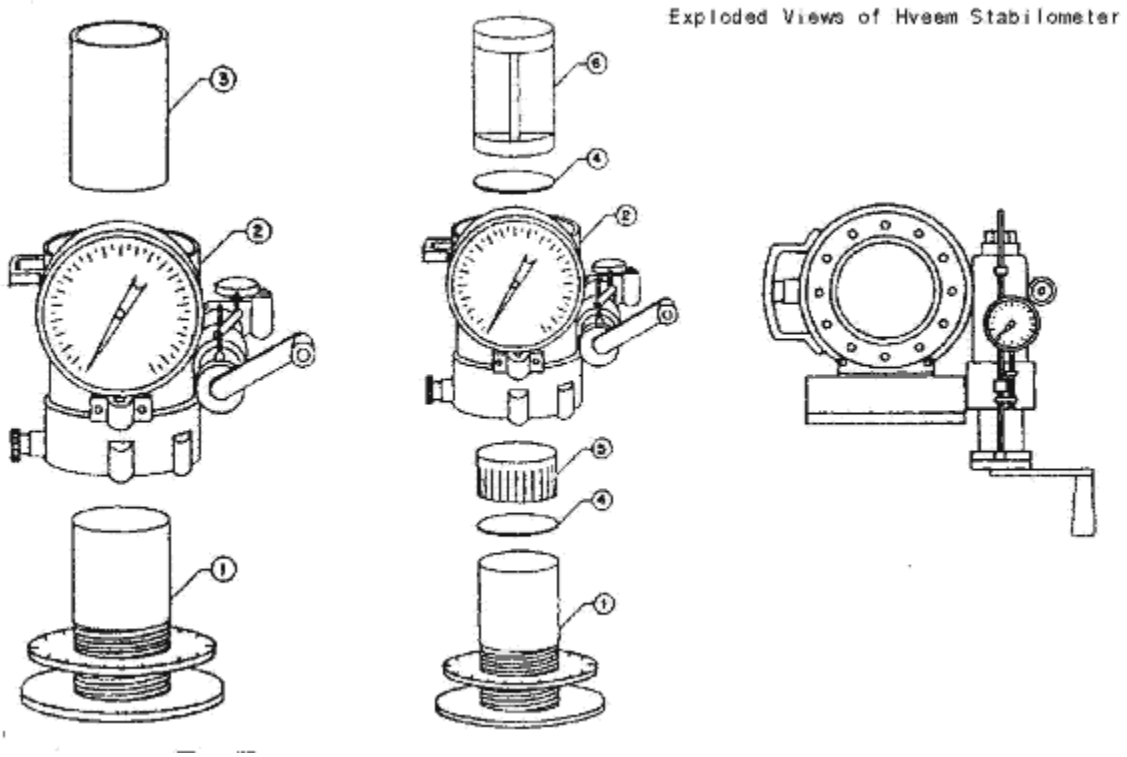

Figure 1—Hveem Stabilometer

4. MATERIALS

4.1 *Heavy bond paper tape*, 2 in. (51 mm) wide with glue applied to one side; 2 in- (51 mm-) wide masking tape may be used as an option.

4.2 *Small rubber bands.*

4.3 *Gaskets*, 4 in. (102 mm) in diameter cut from heavy paper.

4.4 *Powdered talc.*

4.5 *1 qt. (1 L) Shell Tellus Oil No. 15*, for the Soiltest Stabilometer, or 1 qt. (1 L) transmission fluid with Dextron II for the Rainhart Stabilometer.

4.6 *Naphtha.*

5. REPORT FORMS

5.1 Use the Hveem Stability Worksheet in Excel.

6. ADJUSTING INITIAL DISPLACEMENT OF STABILOMETER

6.1 *Stabilometer*—Follow these steps to perform the initial calibration of the stabilometer for the Hveem test:

6.1.1 Set the adjustable stage so that when placing the stabilometer cell in position for testing, 1-13/16 in. (46 mm) of a 2 in. (51 mm) specimen will be exposed to the rubber diaphragm. The adjustable stage should be calibrated so the height reading on the adjustable stage is set to the same height as the measured specimen.

6.1.1.1 This adjustment will permit 3/16 in. (4.8 mm) of the specimen to extend into the metal ring in the top of the stabilometer cell.

6.1.1.2 Verify this calibration by setting the adjustable stage to 2 in. (51 mm) and placing the stabilometer cell on the adjustable stage. Measure from the inside to ensure the 2 in. (51 mm) mark will extend onto the metal ring by 3/16 in. (4.8 mm).

6.1.2 Turn the pump handle counterclockwise to retract the flexible rubber membrane, and lower the stabilometer cell squarely over the specimen platform.

6.1.3 Place the initial displacement cylinder in the stabilometer cell and make certain it rests firmly against the specimen platform.

6.1.4 Turn the pump handle clockwise to exert a lateral pressure of exactly 5 psi (34.5 kPa).

6.1.4.1 In making all gauge readings, tap the gauge gently to prevent the needle from sticking.

6.1.4.2 When applying pressure by means of the pump, always obtain the desired amount while turning the handle in a clockwise direction.

6.1.5 If the pressure exceeds the required amount, reduce it below 5 psi (34.5 kPa) and make the final adjustment by again turning the pump handle clockwise.

6.1.6 With the lateral pressure set on 5 psi (34.5 kPa), adjust the dial indicator in such a position the needle from the dial indicator will be in direct contact with the stem on the displacement rod. Set the dial indicator to zero.

6.1.7 Raise the lateral gauge pressure smoothly with a continuous movement of the pump handle from 5 psi (34.5 kPa) to 100 psi (689.5 kPa). The value on the dial is the initial displacement. Repeat this procedure until two consecutive readings agree within 0.002 in. (0.05 mm). The desired average value for initial displacement is between 0.06 in. (1.52 mm.) and 0.100 in. (2.54 mm). To achieve this range, follow the procedures outlined in Sections 6.2 and 6.3.

6.2 *Soiltest Stabilometer:*

6.2.1 If the initial value is below 0.06 in. (1.52 mm), turn the displacement pump handle counterclockwise about three turns to create a negative pressure in the system.

6.2.2 Introduce a little air into the chamber to raise the displacement by opening the needle valve only slightly and quickly closing it.

6.2.3 If the displacement is more than 0.100 in. (2.54 mm), turn the pump handle to set the pressure in the hydraulic cell at 10 psi (68.9 kPa) to 20 psi (137.9 kPa) and open the needle valve momentarily to remove excess air in the system.

6.2.3.1 Do not open the needle valve when the cell is under high pressure, or the instrument will release oil.

6.2.3.2 When the pressure is less than 5 psi (34.5 kPa), do not allow the valve to remain open long enough to introduce excess air.

6.2.4 When not in use, store the stabilometer with standard metal cylinder in place and under a gauge pressure of approximately 20 psi (137.9 kPa).

6.3 *Rainhart Stabilometer:*

6.3.1 If the initial displacement is below 0.06 in. (1.52 mm), release the pressure until able to turn the 4 in. (101.6 mm) initial displacement cylinder freely in the diaphragm.

6.3.2 Turn the pump handle counterclockwise one dial indicator revolution 2.54 mm (0.100 in.) to create a negative pressure in the system.

6.3.3 With a finger, press upward and immediately release the valve core stem to open the air-in valve momentarily. Check the progress by rerunning the air calibration test. More than one stroke of the valve core stem may be necessary.

6.3.4 Repeat process until initial displacement is between 0.06 in. (1.52 mm) and 0.100 in. (2.54 mm).

6.3.5 If the initial displacement is over 0.100 in. (2.54 mm), wrap the relief valve with a rag or tissue and turn pump handle clockwise until the relief valve opens. (Approximately 200 psi [1379 kPa] on gauge.) Check the progress by rerunning the air calibration test.

6.3.6 If initial displacement is still over 0.100 in. (2.54 mm), repeat this process until the initial displacement is between 0.06 in. (1.52 mm) and 0.100 in. (2.54 mm).

7. PREPARING TEST SPECIMENS

7.1 Compact test specimens 4 in. (102 mm) in diameter and 2 ± 0.06 in. (51 ± 1.52 mm) in height in accordance with Tex-206-F, and record the height of each specimen on the Hveem Stability Worksheet.

7.2 Obtain a strip of heavy bond paper tape or masking tape, 2 in. (51 mm) wide and approximately 13.25 in. (337 mm) long, and slit the tape transversely every 3/8 in. (9.5 mm) to within 0.5 in. (13 mm) of the edge.

7.3 Moisten the glued side of the paper tape, and place it around the circumference of the specimen so that the slit portion is at the bottom. Use a rubber band to hold tape in place until glue has dried. Place the rubber band near the bottom of the specimen to prevent curling of the paper tape.

7.4 Place the test specimen in a 140 ± 5°F (60 ± 3°C) constant temperature convection type oven and allow to remain for a minimum of 3-1/2 hours before testing.

8. PROCEDURE

8.1 Check the initial displacement of the instrument immediately before each series of consecutive tests as described under Section 6.

8.2 Turn the pump handle counterclockwise to release pressure and retract rubber membrane.

8.3 Disassemble the stabilometer by removing the initial displacement cylinder and the stabilometer cell from the specimen platform.

8.4 Adjust the adjustable stage so that when the stabilometer cell is placed in position for testing, 3/16 in. (4.8 mm) of the top of the specimen will extend into the top metal ring of the stabilometer cell. When the adjustable stage is properly calibrated, the height reading on the adjustable stage is the same as the specimen height.

8.5 Put a paper gasket on the top and bottom sides of the test specimen, which has been heated to a temperature of 140 ± 5°F (60 ± 3°C), and place the specimen (with top side, as molded, up) on specimen platform.

8.6 Carefully lower the stabilometer cell over the specimen and set it squarely on adjustable stage.

8.7 Place the load transfer ram on top of the specimen and adjust the pump to exert a lateral pressure of 5 psi (34.5 kPa) to the specimen.

8.8 Center the stabilometer in the testing machine and 'zero' the compression machine load reading.

8.9 Start applying vertical load at a rate of 0.05 in. (1.27 mm) per minute, and record the stabilometer pressure gauge reading when the vertical load is 5,000 lb. (22,241 N).

8.10 Stop the vertical loading at approximately 6,000 lb. (26,690 N) and immediately reduce the load on the specimen to 1,000 ± 100 lb. (4448 ± 445 N). Maintain this load.

8.11 Turn the displacement pump handle counterclockwise to lower the lateral pressure slightly below 5 psi (34.5 kPa) but not all the way to zero.

8.12 Turn the pump handle clockwise to adjust the pressure (tap the gauge) such that the gauge registers exactly 5 psi (34.5 kPa). This will result in a further reduction in the vertical load reading which is normal and for which no compensation is made. Set the dial indicator to zero.

8.13 Turn the displacement pump handle with a smooth, continuous motion and raise the stabilometer lateral pressure to exactly 100 psi (689.5 kPa). Read the dial indicator and record this value as the final displacement, using in. (mm).

8.14 Release the vertical load on the compression machine and remove the stabilometer from under the compression head of the testing machine.

8.15 Turn the displacement pump handle counterclockwise until the gauge pressure has dropped to zero, and then turn it about two or three more turns to retract the flexible rubber membrane from the specimen and specimen platform.

8.16 Disassemble the stabilometer by removing the load transfer ram and lift the stabilometer cell from the specimen platform.

8.17 After completing the test, clean the diaphragm of the cell with a rag lightly moistened with naphtha, and heavily powder the diaphragm with talc before storing the instrument.

8.18 Fasten the stabilometer cell on the specimen platform, insert the initial displacement cylinder, and use the pump to apply a gauge pressure of approximately 20 psi (137.9 kPa).

Note 1—A change in temperature will affect the pressure in the cell.

8.19 Keep the instrument in a convenient place where the gauge pressure can be checked often.

9. CALCULATIONS

9.1 Uncorrected Hveem stability value:

$$S_u = \frac{22.2}{\frac{P_h D_2}{P_V - P_h} + 0.222}$$

9.2 The uncorrected Hveem stability needs to be corrected to make height adjustments to the standard 2-5/16 in. according to the following formula:

$$S = S_u - 20.1(2.3125 - H)$$

Where:

S_u = Uncorrected Hveem stability

S = Hveem stability corrected for height

P_v = Vertical pressure (typically 400 psi)

P_h = Horizontal or lateral pressure (stabilometer reading in psi) (P_h taken at the instant P_v = 400 psi or 5,000 lb. on specimen)

D_2 = Final displacement of specimen in inches multiplied by 10

H = Actual height of specimen in inches.

Note 2—Formulas have not been converted to accommodate metric units of measure.

10. PRECAUTIONS

10.1 The Hveem stabilometer is an expensive, sensitive instrument; handle it with care. During testing, the gauge pressure should never exceed the 200-psi (1,379 kPa) maximum value. Should this ever occur, perform an accuracy verification check with a standard resilient specimen, and remove the gauge and check it with a dead weight tester before another test is performed. Check the gauge after any severe jar or if the gauge's operation is questioned.

10.2 The oil-filled stabilometer is extremely sensitive to temperature change. Store the instrument, properly assembled, with metal cylinder in place and under approximately 20 psi (137.9 kPa) lateral pressure to prevent air from entering the hydraulic system. Keep the instrument in a convenient place so that the pressure can be easily checked.

10.3 Clean the flexible rubber membrane and cover with talc before storing the stabilometer and as often as needed. Always remember to turn the pump handle to retract the diaphragm before inserting or removing specimens, to prevent damage to the rubber diaphragm. Never test a specimen that is deeply pitted or has sharp pieces of stone protruding from the side. Avoid damage to the rubber membrane, as membrane replacement requires considerable time.

11. HVEEM STABILOMETER ACCURACY VERIFICATION USING A STANDARD RESILIENT SPECIMEN

11.1 *Procedure:*

11.1.1 Gauge pressure should never exceed the 200-psi (1379 kPa) maximum value. If this happens or a problem occurs during testing, follow these steps to perform an accuracy verification check with a standard resilient specimen:

11.1.2 The resilient specimen must develop a horizontal pressure of less than 200 psi (1379 kPa) while carrying a 5,000 lb. (22,241 N) vertical load.

11.1.3 The resilient specimen should be at 77 ± 2°F (25 ± 1°C) or at any other selected temperature ±2°F (±1°C) as long as the same specimen temperature is used each time, due to the temperature susceptibility of the specimen.

11.1.4 The stabilometer should be at room temperature and not used within the past three hours.

11.1.5 Set initial displacement on the stabilometer between 0.085 in. (2.16 mm) and 0.095 in. (2.41 mm) and record this value.

11.1.6 Set the adjustable stage at 2 in. (51 mm), regardless of resilient specimen height, and place the specimen inside the stabilometer.

11.1.7 Before beginning actual verification tests, load the resilient specimen in the stabilometer up to approximately 5,000 lb. (22,241 N) several times to flex the specimen.

11.1.8 Test the resilient specimen using the standard test procedure for asphaltic concrete specimens with the following exceptions:

- Do not heat the resilient specimen.
- Do not place a paper skirt on the resilient specimen.

11.1.9 Make three tests as above, removing and reinserting the resilient specimen into the stabilometer between tests.

11.1.10 Calculate Uncorrected Hveem stability at 5,000 lb. (22,241 N) load. Use the equation under Section 9.1.

11.1.11 Record the resulting Uncorrected Hveem Stability values for comparison to values from other stabilometers and to values from earlier and later test runs on the same equipment.

11.1.12 Record the specimen temperature and the specimen ID number if applicable.

11.2 *Calculation:*

11.2.1 The following calculation determines uncorrected Hveem stability:

$$S_H = \frac{22.2}{\frac{P_h D_2}{400 - P_h} + 0.222}$$

Where:

S_H = Uncorrected Hveem stability value

P_h = Lateral pressure reading in psi

D_2 = Final displacement of resilient specimen multiplied by 10.

11.3 *Procedure:*

11.3.1 Follow this procedure to check the diaphragm tension of the Hveem stabilometer.

11.3.2 Use the steel initial displacement cylinder with a 0.75 in. (19 mm) diameter hole near one end to check the evenness and level of tension of the diaphragm.

11.3.3 The Allen head screw setting should be set at a depth of 0.220 in. (5.59 mm) from the outside diameter of the steel initial displacement cylinder.

11.3.4 The stabilometer base must be adjusted so that distance from the bottom of the upper tapered ring to the top of the base is 1-13/16 in. (46 mm).

11.3.5 Place the steel initial displacement cylinder in the stabilometer on its stage with a white filter paper covering the stage top.

11.3.6 Turn the pump handle on the stabilometer until the diaphragm just contacts the tip of the screw.

11.3.6.1 At this point, the stabilometer horizontal pressure is read and recorded. This is repeated at the four-quarter points in the diaphragm circumference.

11.3.6.2 The readings should be between 20 psi (137.9 kPa) and 60 psi (413.7 kPa) and the readings at the quarter points should show even tension by varying no more than 3 psi (20.7 kPa) from each other.

11.3.7 If readings fall below 20 psi (137.9 kPa), diaphragm replacement is required.

12. ARCHIVED VERSIONS

12.1 Archived versions are available.