Recommend Approval: Team Leader 8/8/12 Date; Division Chief 8/8/12 Date; Approved: Director 10-02-12 Date	Maryland Department of Transportation State Highway Administration Office of Materials Technology MARYLAND STANDARD METHOD OF TESTS	
	COLD APPLIED DAMPROOFING AND WATERPROOFING MATERIALS	**MSMT 423**

SCOPE:

These procedures are used to test cold applied dampproofing and waterproofing materials. Procedure A is used to test non-emulsified material. Procedure B is used to test asphalt emulsions.

REFERENCES:

D 1227	Specification for Emulsified Asphalt Used as a Protective Coating for Roofing
D 2939	Test Method for Emulsified Bitumens Used as a Protective Coating
D 6690	Specification for Joint and Crack Sealant, Hot Applied, for Concrete and Asphalt Pavements
M 6	Fine Aggregate for Hydraulic Cement Concrete
M 85	Portland Cement
T 48	Flash and Fire Points by Cleveland Open Cup
T 49	Penetration of Bituminous Materials
T 53	Softening Point of Bitumen (Ring and Ball Apparatus)
T 106	Compressive Strength of Hydraulic Cement Mortar (Using 50-mm or 2-in. Cube Specimens)
T 179	Effect of Heat and Air on Asphalt Materials

TERMINOLOGY:

Dampproofing - Treatment of a surface or structure to resist the passage of water in the absence of hydrostatic pressure.

Waterproofing - Treatment of a surface or structure to resist the passage of water in the presence of hydrostatic pressure.

Emulsion - A mixture of bitumen and water, with uniform dispersion of the bitumen and water globules stabilized by an emulsifying agent or system.

SUMMARY OF TEST METHOD:

1. **Ring and Ball Softening Point** ¾ Two horizontal disks of bitumen, cast in shouldered brass rings, are heated at a controlled rate in a liquid bath while each supports a steel ball. The softening point is the means of the temperatures at which the two disks soften enough to allow each ball, enveloped in bitumen, to fall a distance of 1 in.

2. **Penetration** ¾ The specimen is melted and then cooled under controlled conditions. The penetration is measured with a penetrometer by means of a standard needle applied to the sample under specific load, time, and temperature.

3. **Sag Test** ¾ A metal panel is coated with the sample material and allowed to cool at room temperature for 24 hr. The coated panel is then suspended vertically for one hr at room temperature. Movement is measured below a reference line.

4. **Flow Test** ¾ Same as Sag Test except that the coated panel is placed in a 113 F oven for four hr.

5. **Flexibility Test** ¾ Same as Sag Test except the coated panel is placed in a 60 F water bath for one hr and bent over a 2 in. mandrel. The mandrel is examined for peeling or loss of adhesion.

6. **Imperviousness Test** ¾ Same as Sag Test except the coated panel is immersed in chemicals for 24 hr. The material is removed from the panel and the panel is examined for any attack by the chemicals.

7. **Permeability Test** ¾ Previously prepared standard concrete cylinders of known weight are coated with the sample material. Samples are cured, weighed, and placed in a water bath for seven days. Permeability is determined by the weight gained.

SIGNIFICANCE AND USE:

The tests in this method are useful in determining the sample materials consistency, resistance to vertical movement under various temperatures, resistance to loss of adhesion, resistance to attack by chemicals, and resistance to permeability.

MATERIALS AND EQUIPMENT:

1. Five 24 gauge (0.0239 in.) steel panels 4 x 4 in.

2. One 12 gauge (0.1046 in.) steel panel 4 x 4 in.

3. Twenty-four 20 gauge (0.0359 in.) metal strips 2 x 2 in.

4. High vacuum grease.

5. Binder clips.

6. Ointment cans, approximately 3 oz.

7. Three, 1 gal plastic jugs cut in half around the circumference.

8. One quart of 5 percent sulfuric acid solution.

9. One quart of 5 percent sodium hydroxide solution.

10. One quart of sodium chloride saturated solution.

11. Solvent for removing the waterproofing material from the test panel that will not attack the panel.

12. Oven capable of maintaining various temperatures between 95 and 257 F.

13. Steel spatulas.

14. A 3 x 6 in. concrete cylinder.

15. Hot plate capable of heating the samples.

16. Water bath or refrigerated stirred water bath capable of maintaining 60 ±2 F.

17. Galvanized pail large enough to fully contain a 3 x 6 in. concrete cylinder.

PROCEDURE A

RING AND BALL SOFTENING POINT

TEST PROCEDURE:

1. Place 50 "0.5 g of the material to be tested in a thin film oven pan conforming to the dimensions specified in T 179 and allow it to cure for 72 hr at room temperature. During the curing period, stir the sample three times daily at equally spaced intervals throughout each workday. After the curing period, place the sample in the 257 ±2F oven overnight, but not for more than 24 hr. Allow the sample to cool to room temperature. Heat the sample on the hot plate until it reaches pouring consistency, but no more than 72 F above the probable flash point.

2. Pour the material into the ring and ball apparatus and proceed with testing as specified in T 53.

CALCULATIONS:

Perform calculations as specified in T 53.

REPORT:

Report the average of two softening point test results to the accuracy specified in T 53.

PENETRATION TEST

TEST PROCEDURE:

1. Prepare six specimens as described in Step 1 of the ring and ball test.

2. Place the heated material in the ointment can.

3. Conduct the penetration test as specified in T 49. Refer to the Specifications for test time, duration, and test weight to be used.

4. The same penetration specimen may be reheated, stirred, and used again for further penetration testing.

CALCULATIONS:

Perform calculations as specified in T 49.

REPORT:

Report the average of three penetration test results to the accuracy specified in T 49.

SAG TEST

TEST PROCEDURE:

1. Coat one side and one edge of four metal strips with high vacuum grease.

2. Assemble the specimens, placing four of the coated strips around the perimeter of the 24 gauge steel panel with the greased side down and the greased edge facing the inside, thus creating a 3 x 3 in. test area.

3. Cover the steel panel and the metal strips with the test specimen to a depth of 1 mm. The specimen may be poured or placed with a spatula.

4. Place the specimens horizontally at 68 to 86 F for 24 hr allowing for initial set prior to continuing the test.

5. Remove the metal strips from the specimen.

6. Draw a reference line across the panel at the edge of the coating.

7. Immediately suspend the panel vertically so the reference line is at the bottom of the panel parallel to the floor for one hr at room temperature.

8. Inspect the panel for movement.

CALCULATIONS:

Measure the movement below the reference line.

REPORT:

Report the Sag Test as "Pass" or "Fail."

FLOW TEST

TEST PROCEDURE:

1. Prepare the test specimens as specified in Steps 1 through 6 of the Sag Test described above.

2. When the material appears to be cured or the appearance doesn't change within 48 hr, continue testing. If the material still does not cure it shall be rejected. The time period shall not exceed 14 days.

3. After curing, suspend the panel vertically with the reference line parallel to the floor in an oven maintained at 113 ±2F for four hr ±5 minutes.

CALCULATIONS:

Measure the movement below the reference line.

REPORT:

Report the maximum flow from the reference line to the nearest 1 mm.

FLEXIBILITY TEST

TEST PROCEDURE:

1. Prepare the test specimens as specified in Steps 1 through 5 of the Sag Test, except use the 12 gauge steel panel.

2. Immerse the specimen in the 60 ±2 F water bath for one hr ±1 minute.

3. Remove the specimen from the bath and immediately bend the panel over a 2 in. mandrel.

4. The specimens shall show no evidence of peeling or loss of adhesion at the completion of the test.

CALCULATIONS:

Not applicable.

REPORT:

Report the Flexibility Test as "Pass" or "Fail."

IMPERVIOUSNESS TEST

TEST PROCEDURE:

1. Prepare the specimens as specified in Steps 1 through 5 of the Sag Test.

2. Immerse one panel in each of the sulfuric acid, sodium hydroxide, and the sodium chloride solutions for 24 hr ±5 minutes.

3. Remove the panels and rinse with water to remove the solution.

4. Remove the waterproofing material with the cleaning solvent.

5. Inspect the face of the metal panel that contained the test specimen and note any pitting, rusting or discoloration.

NOTE: The chemicals used in this procedure are considered hazardous.

CALCULATIONS:

Not applicable.

REPORT:

Report any pitting, rusting, or discoloration caused by any of the solutions.

PERMEABILITY TEST

TEST PROCEDURE:

1. Prepare the concrete cylinder using one part Type III, portland cement conforming to M 85 to two parts by weight and conforming to M 6. Use sufficient water to produce a flow of 100 ±5 when tested as specified in T 106. Allow the cylinders to cure for 14 days in lime water. The cylinders may be stored in a dry condition prior to use.

2. Prior to testing, place a cylinder in a 140 ±7F oven until it attains a constant weight. Constant weight is defined as a loss of less than 0.1 percent of the sample weight after one hr of oven drying time.

3. Record the weight of the dry concrete cylinder to the nearest 0.1 g.

4. Place the cylinder vertically in a 12 x 12 in. sample tray covered with paper towels.

5. Coat the side and one end of the cylinder with the material to be tested. When applying the material, use the smallest amount that will cover the cylinder, while not allowing any of the cylinder to show through the coating. Allow to dry overnight at room temperature and recoat using the procedure specified above.

6. Allow to cure at 68 to 86 F. When the material appears to be cured or the appearance does not change in two consecutive days, continue testing. If the material does not cure it shall be rejected. The time period shall not exceed 14 days.

7. Weigh the coated cylinder to the nearest 0.1 g and record.

8. Place the cylinder, coated end down, in the galvanized pail and fill with water to a level 1 in. below the top of the cylinder. The cylinder shall not come in contact with the sides of the pail.

9. Check the height of the water daily and maintain at 1 in. below the top of the cylinder for the entire 7 days.

10. After 7 days, remove the specimen from the water, pat dry, weigh the specimen, and record the weight to the nearest 0.1 g.

CALCULATIONS:

Determine the permeability using the following formula:

$$P = \frac{(A-C) - (B-C)}{\pi R^2 H}$$

where:

P = Permeability, g/cm^3,

A = weight of cylinder after the 7 day water immersion, g,

B = total weight of cylinder after coating and curing, g,

C = weight of uncoated cylinder, g,

R = radius of cylinder, cm, and

H = height of cylinder below water line, cm.

REPORT:

Report the permeability to the nearest 0.01 g/cm^3.

PROCEDURE B

Asphalt emulsions shall be tested as specified in D 2939, except as modified below for the Wet Flow, Heat, Flexibility, and Resistance to Water tests.

TEST PROCEDURE:

1. Prepare the test specimens as described in Procedure A, Steps 1 through 4 of the Sag Test.
2. Continue testing as specified in D 2939.
3. Test for Resistance to Water using Alternative B.

CALCULATIONS:

As specified in D 2939.

REPORT:

As specified in D 2939.