No. 147
Issued 1989
Revision 8/2022

INTERNATIONAL SLURRY SURFACING ASSOCIATION

TECHNICAL BULLETIN

800 Roosevelt Road, Building C-312, Glen Ellyn, IL 60137

Test Method for Measurement of Lateral and Vertical Displacement of Micro Surfacing Systems

1. Scope

1.1 This test method uses a loaded wheel tester to determine the maximum asphalt content of micro surfacing systems by measuring the lateral and vertical displacement characteristics. Excess lateral and vertical displacement characteristics may indicate a mixture's tendency toward rutting/densification under heavy traffic loads.

NOTE 1: The ISSA Recommended Performance Guidelines for Micro Surfacing (A143) provides a specific target value for lateral displacement test results.

NOTE 2: It is acceptable to obtain sand adhesion results (ISSA TB No. 109 Test Method for Measurement of Excess Asphalt in Slurry Surfacing Systems by Use of a Loaded Wheel Tester and Sand Adhesion) on a sample that has been cured and tested according to this method as long as the mold required by TB No. 109 is 12.7 mm (0.5 in) thick.

1.2 Safe equipment operation, proper regulatory compliance, and accepted safe laboratory practices for the associated *laboratory equipment and chemicals presented here are the sole responsibility of the user of this bulletin.*

2. Referenced Documents

2.1 ISSA Recommended Guidelines/Technical Bulletins:

A143 Recommended Performance Guideline for Micro Surfacing

TB No. 109 Test Method for Measurement of Excess Asphalt in Slurry Surfacing Systems by Use of a Loaded Wheel Tester and Sand Adhesion

TB No. 113 Test Method for Determining Mix Time for Slurry Surfacing Systems

2.2 Other Documents:

C.R. Benedict, "Introduction to a Loaded Wheel Test Method for the Measurement of Compaction, Stability and Rutting Resistance of Multilayered, Dense Graded, Fine Aggregate Emulsion Cold Mixes", Proc. 2nd World Congress on Slurry Seal; Geneva, Switzerland, March 1987 (ISSA).

3. Significance

3.1 The loaded wheel test measures the ability of a system to resist deformation due to excess binder content, binder rheology, and aggregate characteristics.

4. Summary of Method

4.1 A mixture of the components identified by TB No. 113 is prepared. The mixture is immediately cast into the specified mold and struck off flush.

4.2 After removal of the mold, the specimen is cured, measured, run on the loaded wheel apparatus, and remeasured to determine the percent lateral and vertical displacement.

5. Apparatus

5.1 **Method A: Single Track Loaded Wheel Tester** consisting of the following main components (see Figures 1, 2 and 3):

5.1.1 Frame of steel channel.

5.1.2 1/3 HP, 1750 RPM flanged motor.

5.1.3 40:1 horizontal, double output shaft gear reducer.

5.1.4 Drive cranks, 15.24 cm (6 in) radius.

5.1.5 Drive connecting arms of steel channel.

5.1.6 60-70 Shore A hardness rubber tread molded onto a wheel with a total diameter of 76.2 ± 3.8 mm (3 ± 0.15 in) and a width of 25.4 ± 1.3 mm (1 ± 0.05 in) mounted at a sufficient horizontal distance between the drive crank and the caster axle traveling 304.8 ± 12.7 mm (12 ± 0.5 in) in a path parallel to the specimen. When the loaded wheel tester is not in use, the wheel shall be stored in a raised position so that the weight (referred to in 5.1.10) doesn't create a flat spot on the wheel.

5.1.7 Resettable cycle counter. One back and forth pass is considered a cycle.

5.1.8 Securing mechanism for the galvanized plate/specimen.

5.1.9 Securing mechanism for the sand frame.

5.1.10 Weights centrally positioned over the wheel and secured directly over the axle (see Appendix A.1 – A.2).

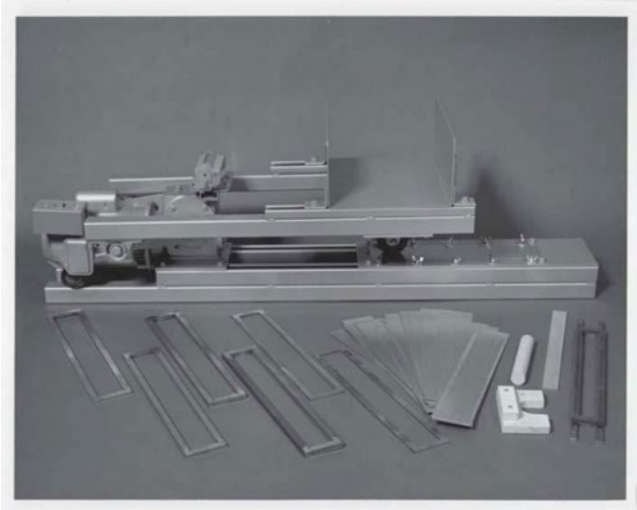

Figure 1 - Single Track Loaded Wheel Tester

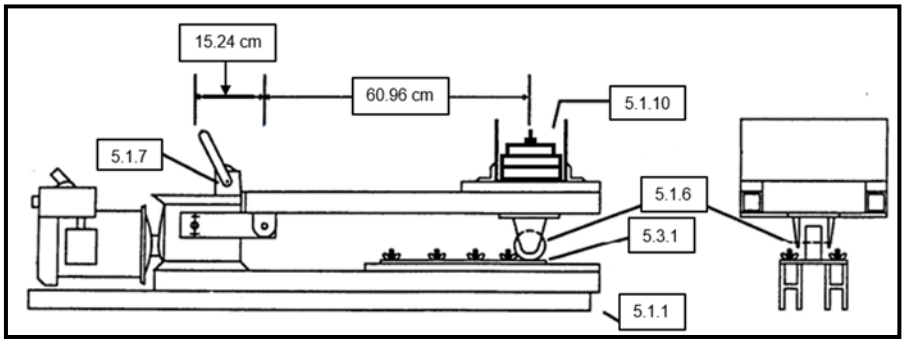

Figure 2 - Single Track Loaded Wheel Tester - Side and End Views

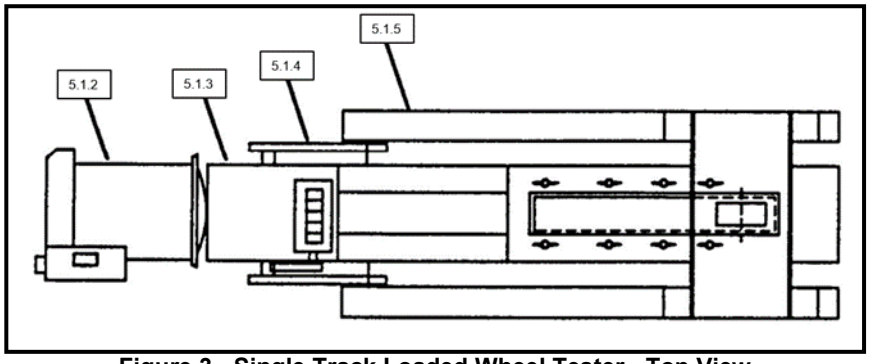

Figure 3 - Single Track Loaded Wheel Tester - Top View

5.2 **Method B: Triple Track Loaded Wheel Tester** consisting of the following main components (see Figures 4 and 5):

5.2.1 Frame of steel channel.

5.2.2 ¾ HP motor and reciprocating table providing 40-50 cycles/minute.

5.2.3 Stroke of 304.8 ± 12.7 mm (12 ± 0.5 in).

5.2.4 Pneumatically controlled pressure system for adjustment of applied load for each wheel (see Appendix A.3 – A.4).

5.2.5 70-80 Shore A hardness rubber tread molded onto a wheel with a total diameter of 203.2 ± 4.1 mm (8 ± 0.16 in) and a width of 40-45 mm at the contact point with the sample. When the loaded wheel tester is not in use, the wheels shall be stored in a raised position so that the load (referred to in 5.2.4) doesn't create a flat spot on the wheel.

NOTE 3: A rubber covered wheel that meets these requirements is Part # 3G269. One supplier of this wheel is Grainger.

5.2.6 Resettable cycle counter. One back and forth pass is considered a cycle.

5.2.7 Securing mechanism for the galvanized plate/specimen.

5.2.8 Securing mechanism for the sand frame.

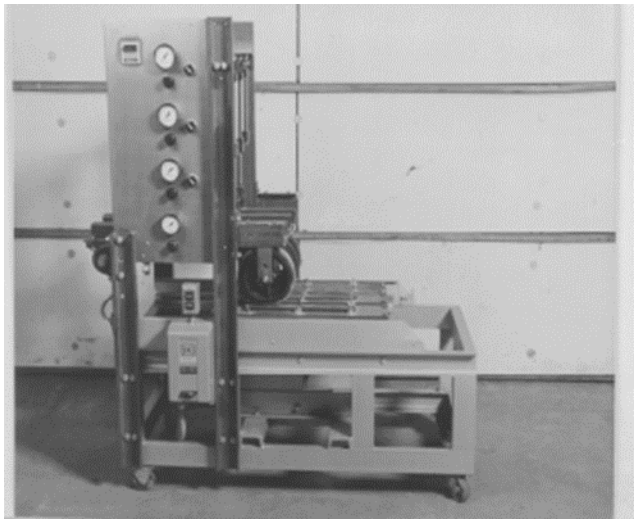

Figure 4 - Triple Track Loaded Wheel Tester

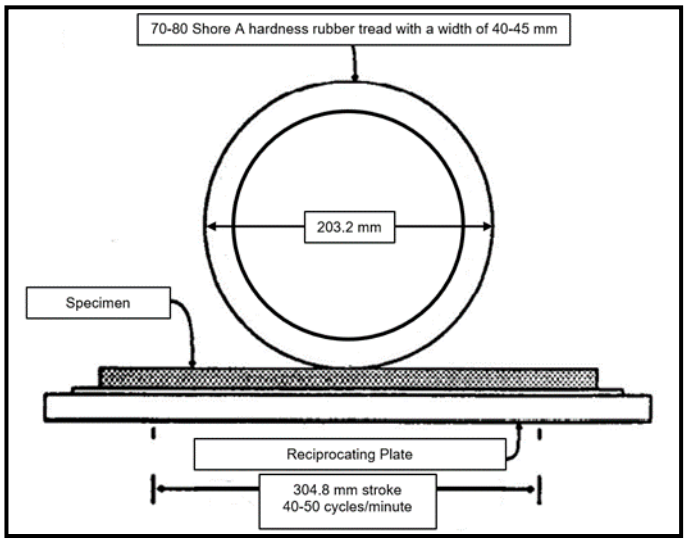

Figure 5 - Triple Track Wheel and Reciprocating Plate

5.3 **Equipment for Sample Preparation and Testing**

5.3.1 Specimen mounting plate, as shown in Figure 6, made of 24-gauge galvanized steel, with measurements of 76.2 ± 1.6 mm x 406.4 ± 3.2 mm (3 ± 0.0625 in x 16 ± 0.125 in).

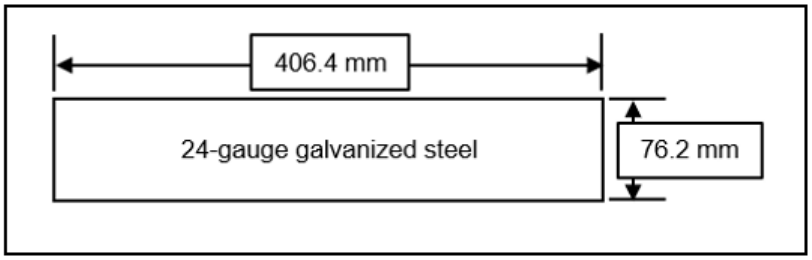

Figure 6 - Specimen Mounting Plate

5.3.2 Specimen mold having the dimensions outlined in Figures 7, 8 and 9.

5.3.2.1 Mold with depth of:
A = 12.7 ± 0.8 mm (0.5 ± 0.03 in).

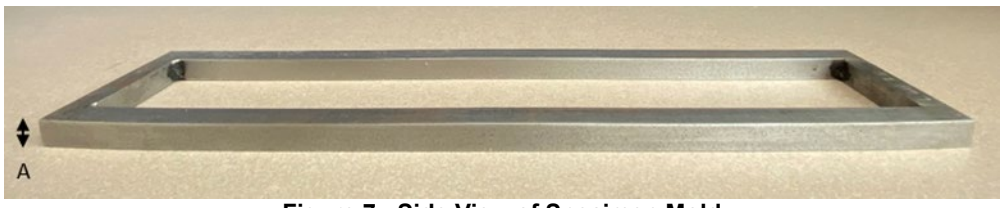

Figure 7 - Side View of Specimen Mold

5.3.2.2 Outside width of:
B = 76.2 ± 1.6 mm (3 ± 0.0625 in) and
outside length of:
C = 406.4 ± 3.2 mm (16 ± 0.125 in).

5.3.2.3 Inside width of:
D = 50.8 ± 1.6 mm (2 ± 0.0625 in) and
inside length of:
E = 381 ± 3.2 mm (15 ± 0.125 in).

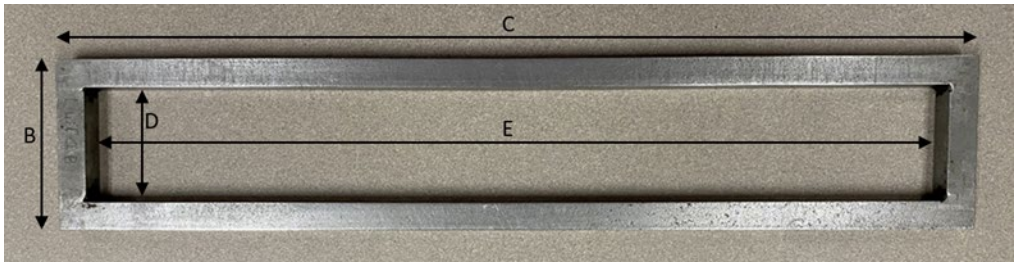

Figure 8 - Top View of Specimen Mold

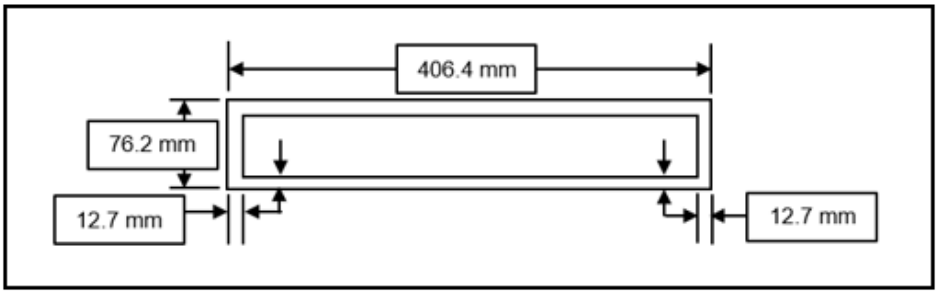

Figure 9 - Specimen Mold Dimensions

5.3.3 Suitable strike-off apparatus such as a 25.4 mm (1 in) diameter x 152 – 203 mm (6 – 8 in) long dowel, a "U"-shaped screed, or a dough scraper.
5.3.4 Platform scale, or load cell, capable of weighing a minimum of 91 kg (200 lb) to within 0.57 kg (1.25 lb).
5.3.5 Balance, capable of weighing 2000 g to within 0.1 g.
5.3.6 Forced draft oven thermostatically controlled at 60 ± 3°C (140 ± 5.4°F).
5.3.7 Suitable smooth surface bowl to contain sample during mixing.
5.3.8 Suitable mixing spoon or spatula of sufficient size to accomplish mixing.
5.3.9 Sieve, 850 µm (No. 20).
5.3.10 Wash bottle filled with water.
5.3.11 Gauge block with approximate measurements of 4.8 x 12.7 x 101.6 mm (0.188 x 0.5 x 4 in) with a 6.4 mm (0.25 in) slot.
5.3.12 Calipers capable of measuring specimen width and depth to within 0.1 mm (0.004 in).

6. Materials

6.1 Aggregate shall be representative of the material to be used on the project. Care should be taken to prevent segregation.
6.2 Emulsified asphalt shall be representative of the material to be used on the project and should be uniformly mixed. Oversized particles of asphalt shall be removed by pouring the sample through the 850 µm (No. 20) sieve.
6.3 Water should be potable.
6.4. Mineral fillers and other liquid and/or solid additives shall be representative of the materials to be used on the project. If required, the type and concentration of liquid additives should be recorded.

7. Procedure for Preparation of Test Specimen

7.1 Mark the specimen mounting plate centrally and at 2 points, one on either side of the center point, where lateral and vertical measurements will be taken. Marks should be made at a distance of 25.4 – 38.1 mm (1.0 - 1.5 in) from the center. Alternatively, the sample can be marked as described in 7.14.
7.2 Measure and record the thickness of the mounting plate.
7.3 Center the 12.7 mm (0.5 in) mold on a specimen mounting plate.
NOTE 4: It may be desirable to coat the inside surfaces of the mold with a thin coating of liquid dish detergent or suitable release agent to prevent the mix from sticking.
7.4 A starting ratio of system components, based on dry aggregate weight, should have been established according to TB No. 113. Make 500 g trial mixes to observe the consistency characteristics of the selected formulation. If changing the sample size from the one used for TB No. 113 adversely affects mix consistency, adjust the water content as necessary. Record the formulation percentages listing the quantity of aggregate, mineral filler, water (and liquid additive, if required) and emulsified asphalt.
NOTE 5: The ratio of system components is mathematically based on dry aggregate weight. To prevent segregation, use of aggregate containing moisture is best practice.
7.5 Weigh at least 500 g aggregate, based on dry aggregate weight, into the mixing container. Using the spoon, or spatula, mix the mineral filler into the aggregate until uniformly distributed. Add the water (and liquid additive, if required) and mix until all the components are uniformly wet. Add the emulsified asphalt, mix for 30 seconds ensuring the components are adequately coated and homogeneous, and then immediately cast.
7.6 To cast, distribute the mixture into the mold starting at one end and working toward the other. Lay the strike-off apparatus across the width of the mold at one end. Move the strike-off in a side-to-side fashion across the width of the mold, completely filling it with the mixture and levelling the mix with the top (see Figure 10). The leveling shall be performed in a single pass and the process of filling and casting should be completed within 30 seconds.

Figure 10 - Levelling the Mix

7.7 Remove the mold when the mixture has set sufficiently to prevent slumping.

NOTE 6: If the mixture slumps so that the sides of the sample are not straight and easily measurable, remake the sample reducing water to adjust the consistency of the mixture.

7.8 Air cure the sample for 24 ± 2 hours at room temperature.

7.9 Place the specimen in a 60 ± 3°C (140 ± 5.4°F) oven.

7.10 Dry the specimen to constant weight for a minimum of 15 hours and for no longer than 30 hours. The sample will be considered at constant weight when the difference in mass between two consecutive measurements, taken 1 hour apart, is less than 0.1% of the previous measurement.

7.11 Remove the sample from the oven once it has reached constant weight.

7.12 Allow the sample to reach room temperature of 22 ± 3°C (72 ± 5°F) and test within 12 hours.

7.13 Measure and record the thickness of the gauge block.

7.14 Align the outer edge of the gauge block with the center of the sample as shown in Figure 11. Measure the specimen at the marks made in 7.1, or mark now according to the instructions given in 7.1 and then measure. Measure without moving the gauge block, using the calipers jaws to take all vertical measurements. When making the lateral measurements, the points of the calipers should touch the mounting plate, as seen in Figure 12.

NOTE 7: Due to sample irregularities, measurements may need to be taken in a slightly different location from the marks made in 7.1. If an adjustment is made, ensure the location of the measurement is marked, so the measurements in 8.8 can be taken in the same spot.

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Figure 11 – Measuring Vertically

Figure 12 – Measuring Laterally

8. Loaded Wheel Test

8.1 Maintain room temperature at 22 ± 3°C (72 ± 5°F).

8.2 Inspect and thoroughly clean the wheel surface with water or by scraping with a spatula taking care not to damage it. Avoid the use of any cleaning agent that may change the Shore A hardness.

8.3 Secure the mounted specimen in position ensuring that the wheel tracks down the center.

8.4 Set the counter to zero.

8.5 Place the wheel on the specimen and begin the test.

NOTE 8: If an audible tackiness or evidence that material is sticking to the wheel is observed, use a wash bottle to add sufficient water to prevent adhesion of the specimen to the wheel.

8.6 Stop the machine at 1000 cycles.

8.7 Unload the specimen and invert to remove any loose particles.

8.8 Record lateral and vertical measurements at the marks, as described in 7.14.

9. Calculation

9.1 The percent lateral displacement (percent increase in original width) is calculated as follows:
Lateral Displacement, % = [(L2 - L1) / L1] x 100 where:
L1=Average of lateral measurements before running
L2=Average of lateral measurements after running

9.2 The percent vertical displacement (rut depth as a percent of the original net thickness) is calculated as follows:
Vertical Displacement, % = [Rut depth / (V1 – Mounting plate thickness – Gauge block thickness)] x 100 where:
Rut depth = V1-V2
V1=Average of vertical measurements before running
V2=Average of vertical measurements after running

10. Report

10.1 Percent lateral displacement

10.2 Optional: Percent vertical displacement

Appendix
Adjusting the Load Applied to the Sample

Single Track Loaded Wheel Tester

A.1 With the connecting arms of the loaded wheel tester parallel to its frame, place the wheel on a platform scale or load cell.

A.2 Add sufficient solid weights as necessary to meet a total load on the sample of 56.75 ± 0.45 kg (125 ± 1 lb). Fix added weights in such a manner as to prevent shifting during testing.

Triple Track Loaded Wheel Tester

A.3 Lower the wheel onto a platform scale or load cell.

A.4 Adjust the air pressure controlling each wheel as necessary to meet a total load on the sample of 56.75 ± 0.45 kg (125 ± 1 lb).