



Test Method for Measurement of Excess Asphalt In Bituminous Mixtures by Use of a Loaded Wheel Tester and Sand Adhesion

1.0 Scope

- 1.1 The loaded wheel test is intended to compact fine aggregate bituminous mixtures such as slurry seal by means of a loaded, rubber tired reciprocating wheel. The test may be used for design purposes to establish maximum limits for asphalt content to avoid severe asphalt flushing under heavy traffic loads.
- 1.2 Various accessory measurements may also be made during this test to study compaction rates and plastic deformation of mono and multiple layered bituminous mixture specimens. Refer to ISSA TB No. 147, "Test Method for Measurement of Stability and Resistance to Compaction, Vertical and Lateral Displacement of Multilayered Fine Aggregate Cold Mixes."

2.0 Apparatus and Materials

- 2.1 Loaded Wheel Testing machine as shown in Figures 1 and 2 consisting of the following main components:
- Frame of steel channel.
 - 1/3 HP, 1750 RPM flanged motor.
 - 40:1 horizontal double output shaft gear reducer.
 - Drive cranks, 6-inch (15.24 cm) radius.
 - Driven connecting arms of steel channel.
 - Weight box, centrally positioned over the wheel.
 - Soft (60-70 durometer) rubber wheel, 3 ± 0.0125 " (76 ± 3 mm) diameter by 1 ± 0.0625 " (25.4 ± 1.5 mm) mounted at a sufficient horizontal distance between the drive crank and the caster axle for the travel path of the wheel on the specimen to be $12" \pm 0.5"$.
 - Resettable revolution counter.
 - Sufficient solid weights as necessary to meet the defined total load requirement in section 4.3, fixed in such a manner as to prevent weight shift during testing.
 - Specimen mounting plates, made of 24 gauge galvanized steel, with measurements of 3 ± 0.0125 " x 16 ± 0.0125 " (0.70 mm x 76 ± 3 mm x 406 ± 3 mm).
 - Various specimen molds, measuring .125, .188, .250, .313, .375 and .500 inches thick (3.2, 4.8, 6.4, 8.0, 9.5, 12.7mm), x 3"(76.2 mm) x 16"(406.4 mm) outside and 2" (50.8 mm) x 15" (381 mm) inside dimensions. Mold dimension tolerances shall be $\pm 5\%$.
 - 1" (25.4 mm) dia. X 6"(152.4 mm) long wood strike-off dowel or "U"-shaped screed. Dimension tolerances shall be $\pm 5\%$.
 - Steel sand frame, with .188" x 2.5" x 15" (4.76 mm x 63.5mm x 381 mm) outside and 1.5" x 14" (38.1 mm x 355.6 mm) inside dimensions. Completely line the bottom of the frame with 1/2" x

1/2"(12.7 x 12.7mm) adhesive-backed foam rubber insulation. Mold and foam dimension tolerances shall be $\pm 5\%$.

- Hold-down clamps.
 - Metal strip, such that the gap between the outside width dimensions of the strip and the inside width dimensions of the sand frame are no greater than 0.0625".
 - Platform scale or load cell capable of weighing a minimum of 200 lbs to within 1.0 lb.
- 2.2 Sample Preparation Apparatus:
Balance of 2000 grams or more capacity and sensitive to 0.1 gram, forced draft oven thermostatically controlled at $60^{\circ}\text{C}(140^{\circ}\text{F}) \pm 3^{\circ}\text{C}(5^{\circ}\text{F})$, 600 to 1000 ml. mixing bowl or beaker, suitable mixing spoon or spatula of sufficient size to accomplish mixing, specimen mounting plates (see 2.1.k) and strike-off dowel or "U"-shaped screed (see 2.1.m), and specimen molds (see 2.1.l).
- 2.3 Sand Adhesion Apparatus and Materials:
Fine Ottawa Sand -30 (600 μm), +100 (150 μm) mesh (ASTM Designation C-109-graded standard), hot plate or oven for heating sand $82.2^{\circ}\text{C}(180^{\circ}\text{F}) \pm 1.1^{\circ}\text{C}(2^{\circ}\text{F})$, 1000-5000 ml. Metal bowl, household vacuum cleaner, thermometer for measuring sand temperature, steel sand frame with foam rubber strips (2.1 n).
- 2.4 Optional compaction and distortion measuring apparatus such as a suitable profilograph and calipers.

3.0 Test Specimens

- 3.1 Slurry Seal mixtures are prepared with formulations selected for test using project materials.
- 3.2 Mold thickness is selected that will result in a specimen of desired thickness for testing, e.g., 25% thicker than the coarsest particle thickness.
- 3.3 25 to 35% more material than required to fill the mold is mixed.
(Normally, 300 grams of aggregate fills the 1/4" (6.4 mm) mold.)
- 3.4 Trial mixes are made to determine the consistency characteristics of the selected formulation. (See ISSA TB No. 106). Notation of the exact percentage formulation to be used is made listing the quantity of aggregate, filler, water, emulsion and the consistency obtained; e.g., 100-2-10-18-3 cm.
- 3.5 The materials are carefully weighed into the mixing container. Mixing should proceed rapidly and thoroughly so that the specimen is cast 30 seconds after the addition of the emulsion.
- 3.6 The selected mold is centered over a previously

weighed specimen mounting plate and uniformly over-filled with the mixture. Using a horizontal sawing motion with the strike-off bar held in a vertical position, the specimen is struck off level with the specimen frame. When the specimen has set sufficiently to prevent displacement, the mold is removed. The specimen is dried for a minimum of 12 hours to constant weight in a 60°C(140°F) ± 3°C(5°F) oven. The specimen is removed from the oven and cooled to room temperature.

4.0 Adjustment and Weight of the Loaded Wheel Tester

- 4.1 The travel path of the wheel on the specimen shall be 12" ± 0.5". The wheel assembly must be aligned so the wheel runs true and parallel with the specimen.
- 4.2 The weight box is centered and secured directly over the wheel axle.
- 4.3 The wheel is placed on a platform scale so that the connecting arms are parallel with the frame. The total load should be adjusted using the weights described in 2.1.j until the weight measured by the load cell or platform scale is 125 ± 1 lb.

5.0 Mounting the Specimen

- 5.1 The specimen is then placed on the mounting plate firmly against the locating pins and clamped in position with the clamp washer and wing nuts provided.

6.0 Procedure

- 6.1 Temperature is maintained at 72 ± 5°F (22 ± 3°C) unless otherwise specified or noted.
- 6.2 The wheel is inspected and thoroughly cleaned. The wheel is then placed on the specimen. **Note:** In time, solvents may saturate the rubber tire and give false tack point and sand adhesion values. A fine disc sander mounted onto a 1/4"(6.4 mm) or 3/8"(9.5 mm) drill is recommended to clean the rubber tire.
- 6.3 The counter is returned to zero and compaction is started with the electrical switch. The cycles per minute should be 44 at the stated drive ratios. (Caution: Care should be taken to guard the machine against personal contact with the moving parts. Careless, unguarded operation can result in serious injury.)
- 6.4 At some point during the compaction, an audible tackiness and visible shine may be noted. At this point, sufficient water to prevent adhesion of the specimen to the wheel must be added from the wash bottle. (With certain aggregates, it may become necessary to liberally flush the wheel path with water to prevent abraded fines from impacting the specimen.) Notation of the cycles required to reach the tack point is made.
- 6.5 After 1000 cycles, the machine is stopped, unloaded, and loose particles are removed from the specimen. If water is used in 6.4, the specimen must be dried at 60°C(140°F) ± 3°C(5°F) to constant weight.
- 6.6 The weight of the specimen is recorded. It is mounted in its original position. The sand frame is centered, with the foam rubber against the specimen, and secured to prevent loss of sand.
- 6.7 Weigh 200 grams of sand. Heat the sand to 180° ± 2 F (82.2°C). Uniformly spread it in the frame and cover with the metal strip. Sand application must be completed within two minutes. Operate the machine for 100 cycles.

Note: Another option is to weigh 300 grams of sand, heated and applied in the same manner as in 6.7 but

without the use of the metal strip.

- 6.8 Remove the assembly as a unit. Disassemble over a waste container and gently tap the specimen to remove the loose sand.
- 6.9 Record the final weight of the specimen with adhered sand.

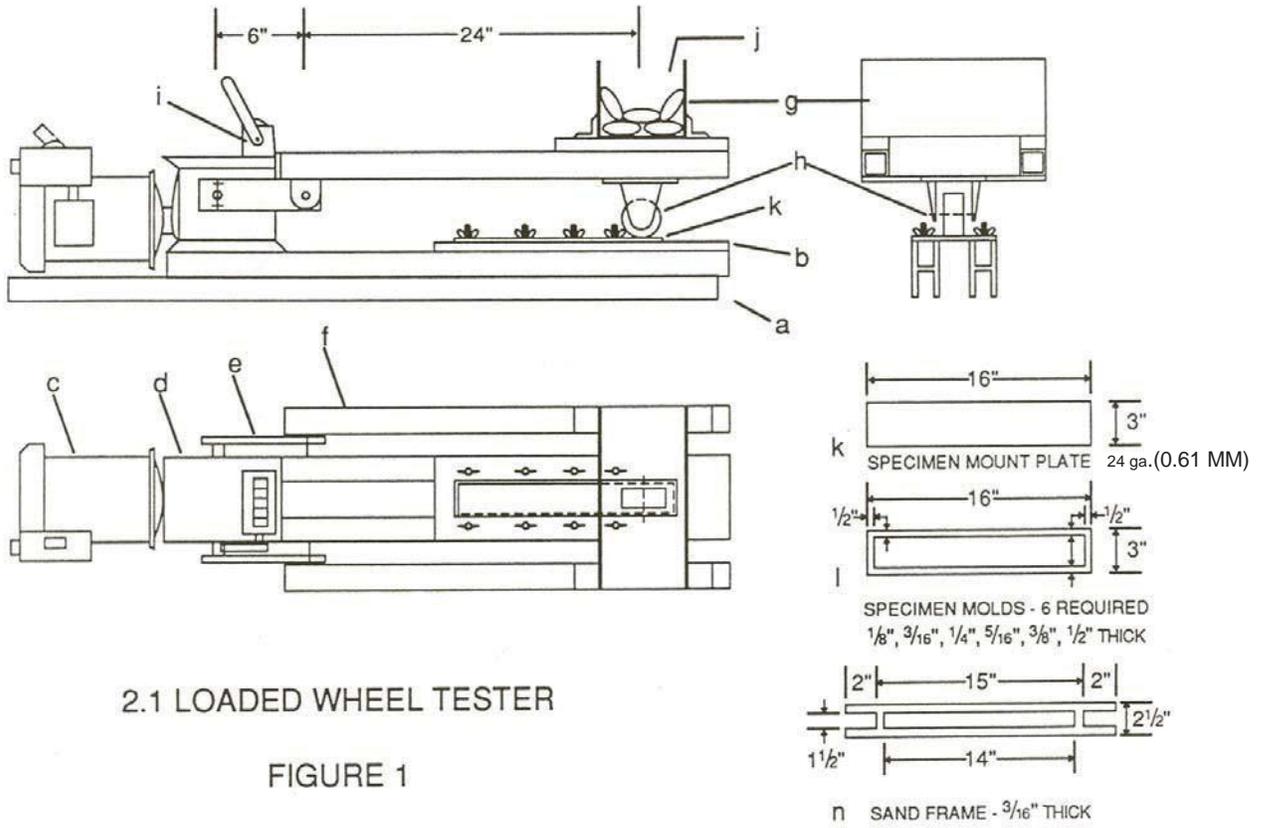
7.0 Calculation

- 7.1 Subtract the original specimen weight (see 6.6) from the final weight of the specimen with adhered sand (see 6.8) to achieve grams of adhered sand.
- 7.2 Divide grams of adhered sand by the area of the metal strip in ft² (m²) to achieve g/ft² (g/m²).

Note: When using the 300 grams of sand option, replace the area of the metal strip with the area of the wheel's travel path.

8.0 Report

- 8.1 Report sand adhered per square foot (square meter).
- 8.2 The tack is reported as _____cycles of _____pound load at _____°F (°C).



1/8"	3/16"	1/4"	5/16"	3/8"	1/2"	1-1/2"	2"	2-1/2"	3"	6"	14"	15"	16"
3.18 mm	4.76 mm	6.4 mm	7.94 mm	9.53 mm	12.7 mm	38.1 mm	50.8 mm	63.5 mm	76.2 mm	15.24 cm	35.56 cm	38.1 cm	40.64 cm

Conversion Table

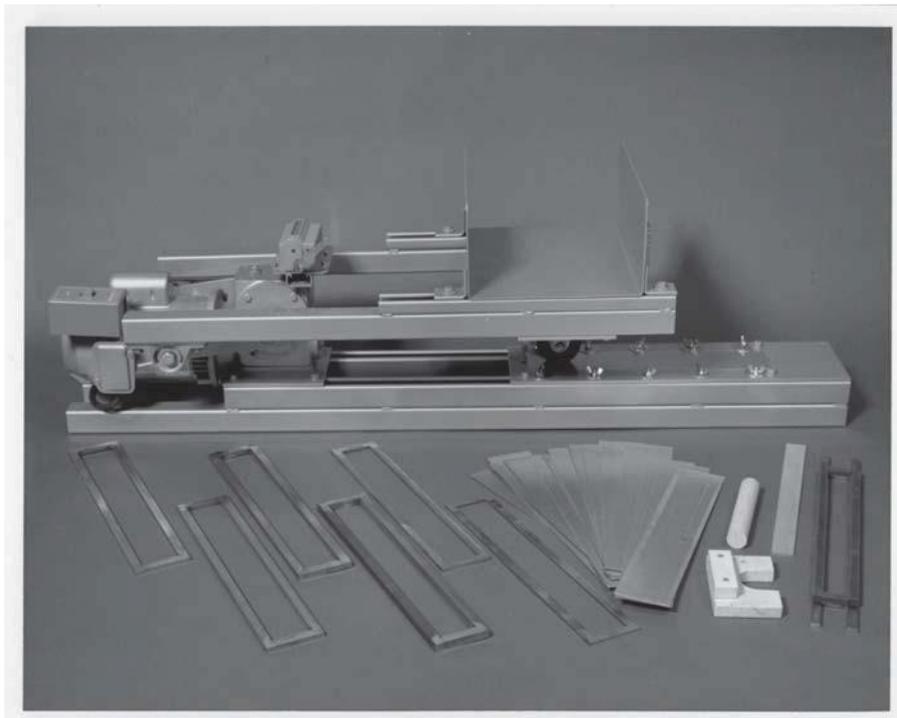


FIGURE 2