

Colorado Procedure – Laboratory 5114-20

Standard Method of Test for

French Rut Testing of Compacted Bituminous Mixtures

(This document is a description of the test method used by the Colorado Department of Transportation to test samples in the French Rutting Tester.)

1. SCOPE

- 1.1 This method describes the testing of compacted bituminous mixtures in a rolling wheel device. This test provides information about the rate of permanent deformation from a moving, concentrated load. A special laboratory compactor has been designed to prepare slab specimens. Alternatively, saw-cut field slabs may be tested.

2. REFERENCED DOCUMENTS

- 2.1 Colorado Procedures:

CP 44 Bulk Specific Gravity of Compacted Bituminous Mixtures Using Saturated Surface-Dry Specimens

CP 55 Reducing Field Samples of Hot Mix Asphalt to Testing Size

3. SIGNIFICANCE AND USE

- 3.1 This test may simulate traffic loading that occurs in the field. The load is concentrated to produce measurable deformations after a single day of testing.

4. SUMMARY OF METHOD

- 4.1 A laboratory-compacted slab of a bituminous mixture, or a saw-cut field slab taken from a compacted pavement, is repetitively loaded with an 1,124 lb. (5,000 N) force while a rubber tire inflated to 87 psi (0.6 MPa) rolls across the slab for 10,000 cycles (20,000 passes). Test temperatures can range from 40° to 60°C. The deformation of the slab is first measured at 1,000 cycles at room temperature before heat is applied to obtain an initial testing surface ("zero"). The slab is heated for 12 hours for 100 mm samples or 4 hours for 50 mm samples. At the end of 10,000 cycles, the deformation of the slab is again measured.
- 4.2 The depth of deformation is reported in mm as an average of the fifteen measurements after 10,000 cycles.

5. APPARATUS

- 5.1 *French Rutting Tester* - A self contained chamber with a temperature regulation device, a table platform that can lift the sample to the tire with a predetermined amount of force, and a motor to move the tires across the slabs at a rate of one cycle per second.
- 5.2 *Sample Securing Molds* - With dimensions of 19.7x 7.1x 3.9in. (500 x 180 x 100 mm) or 19.7 x 7.1 x 2 in. (500 x 180 x 50 mm).
- 5.3 *Depth Gauge and Support System* - Accurate to 0.01 mm.
- 5.4 *Tire Pressure Gauge* - To check the air pressure in the contact tires.
- 5.5 *Temperature Probe* - Which shall be placed in a compacted asphalt core stored inside of the testing chamber. As an alternative, the probe can be placed directly into one of the asphalt slabs by drilling a hole in the slab 1.2 in. (30 mm) from the side of the slab and 2.75 in. (70 mm) from the end of the slab.

6. SAMPLE PREPARATION

6.1 Laboratory Produced Mix

- 6.1.1 *Mixing* - Material mixed in the laboratory shall be brought to mixing temperature (Table 1) in a forced draft oven and mixed in a mechanical mixer for 3 to 5 minutes or until complete coating of the aggregates is achieved.
- 6.1.2 *Splitting* - Materials mixed in the laboratory shall be placed in open pans. The amount (weight) of material is determined by calculating the number of grams of mix needed to attain an air void target of 6% (\pm 2%). To do this, multiply the volume of the sample (width x length x height) in cubic centimeters by the sample's maximum specific gravity, and then remove a percentage of the mix equal to the targeted air voids. Note: The volume of the 50 mm slab is 4,500 cc and the 100 mm slab is 9,000 cc.
- 6.1.3 *Aging* - The mixed material shall be short term aged by placing the open pans in a forced draft oven at the compaction temperature (Table 1) for 3 hours. If it is known that the material being designed will stay at elevated temperature in the field for longer than 3 hours, then the aging time can be increased.
- 6.1.4 *Compacting* - Material shall be compacted into slabs. The slabs must be compacted to 6% \pm 2% voids such that the void distribution is consistent throughout the sample. Samples shall be 19.7 in. (500 mm) long and 7.1 in. (180 mm) wide. A slab thickness of 2 in. (50 mm) or 4 in. (100 mm) can be used. The slab thickness shall be at least twice the maximum nominal aggregate size. Compacted slabs shall be cooled at normal room temperature on a clean, flat surface until the sample is cool to the touch.
- 6.1.5 *Bulking* - The bulk specific gravity shall be performed in accordance with CP 44.
- 6.1.6 *Slab Mounting* - Compacted slabs are secured in the molds used for the French Rutting Tester. They must fit snugly and should be the approximate height of the molds.

6.2 Field Produced Mix

6.2.1 Field Loose Mix

6.2.1.1 *Splitting* - The mix received from the field shall be heated for 3 hours (± 0.5) in a forced draft oven at compaction temperature (Table 1) and then separated into pans for compaction. The amount of material is determined by calculating the number of grams of mix needed to attain an air void target of 6% ($\pm 2\%$). To do this, multiply the volume of the sample (width x length x height) in cubic centimeters by the sample's maximum specific gravity, and then remove a percentage of the mix equal to the targeted air voids. Note: The volume of the 50 mm slab is 4,500 cc and the 100 mm slab is 9,000 cc.

6.2.1.2 *Compacting* - Prior to compaction, the material shall be heated in a forced-draft oven at the temperature specified in Table 1, until at least 15 minutes after the specimens have been brought to compaction temperature, not exceeding 4 hours. The slabs must be compacted to $6\% \pm 2\%$ voids such that the void distribution is consistent throughout the sample. The samples shall be 19.7 in. (500 mm) long and 7.1 in. (180 mm) wide. A slab thickness of 2 in. (50 mm) or 4 in. (100 mm) can be used. The slab thickness shall be at least twice the maximum nominal aggregate size. Compacted slabs shall be cooled at normal room temperature on a clean, flat surface until the sample is cool to the touch.

6.2.1.3 *Bulking* - The bulk specific gravity shall be performed in accordance with CP 44.

6.2.1.4 *Slab Mounting* - Compacted slabs are secured in the molds used for the French Rutting Tester. They must fit snugly and should be the approximate height of the molds.

6.2.2 Field Compacted Slab

6.2.2.1 *Cutting* - Slabs taken from pavements shall be cut to approximately 19.7 in. (500 mm) long and 7.1 in. (180 mm) wide. The height of a slab is typically 4 in. (100 mm), but may be cut to fit the 2 in. (50 mm) molds if there is not enough material.

6.2.2.2 *Bulking* - The bulk specific gravity is typically not performed on field slabs, however, it can be performed in accordance with CP 44.

6.2.2.3 *Slab Mounting* - The saw-cut field slabs are secured in the molds used for the French Rutting Tester. They must fit snugly and should be the approximate height of the molds. If the slab does not fit the mold snugly, use Plaster-of-Paris to fill in the space between the mold and the slab. The plaster shall be mixed at approximately a 1: 1 ratio of plaster to water.

Table 1

| <u>Asphalt Grade</u> | <u>Mixing Temperature</u> | <u>Compaction Temperature</u> |
|----------------------|---------------------------|-------------------------------|
| PG 58-28 | 154° C (310° F) | 138° C (280° F) |
| PG 58-34 | 154° C (310° F) | 138° C (280° F) |
| PG 64-22 | 163° C (325° F) | 149° C (300° F) |
| PG 64-28 | 163° C (325° F) | 149° C (300° F) |
| PG 70-28 | 163° C (325° F) | 149° C (300° F) |
| PG 76-28 | 163° C (325° F) | 149° C (300° F) |

± 2.8° C (5°F)

7. PRE-TEST PROCEDURE

- 7.1 Place the mold/slab on the table surface and secure it.
- 7.2 Check and/or inflate the tires to 87 psi (0.6 Mpa).
- 7.3 Record the following items on the French Data Recording Sheet: slab number (field sheet number), mold number, test temperature, and test date (tomorrow's date).
- 7.4 Close and fasten the doors on each side of the French Rutting Tester.
- 7.5 The "zero" reading is determined by loading the slab with 1,000 cycles at room temperature.
- 7.6 Take the rut measurement and record it on the Data Recording Sheet to the nearest 0.01 mm.
- 7.7 The environment that the pavement will be exposed to establishes the test temperature. It is determined from the 7-day high air temperature within the proximity of the nearest weather station from the project. The corresponding test temperatures are:

| <u>Environment</u> | <u>7- day mean</u> | <u>Test Temperature</u> |
|--------------------|--------------------|-------------------------|
| Cool | 27.0- 30.9 | 50° C |
| Moderate | 31.0- 36.0 | 55° C |
| Hot | > 36.0 | 60° C |
| Very Cool | < 27.0 | 40° C or 45° C |

- 7.8 Turn on the heater. The 4-inch slab(s) must be at test temperature for 12 hours prior to testing. The 2-inch slabs must be at test temperature for 4 hours prior to testing.

8. TEST PROCEDURE

- 8.1 Check and/or inflate the tires to 87 psi (0.6 Mpa). The tire pressure will need to be decreased due to the higher air temperature in the tire that comes from the increased temperature in the chamber.
- 8.2 Run 10,000 cycles.

9. POST-TEST PROCEDURE

- 9.1 After testing has been completed, take the final measurement per Subsection 7.6.

10. REPORT

- 10.1 The report shall include the following parameters:

- Maximum Impression, mm
- Number of Passes
- Test Temperature
- Sample Air voids

11. CALIBRATION / EQUIPMENT VERIFICATION

- 11.1 The French Rutting Tester shall be calibrated semi-annually, at a minimum, with a calibrated proving ring.
- 11.2 Check the accuracy of the temperature readout with a calibrated thermometer at a minimum of every 3 months, or whenever the temperature appears to be incorrect.

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