

Colorado Procedure – Laboratory 5116-15

Standard Method of Test for

Linear Kneading Compaction of Bituminous Mixtures

(This document is a description of a method used by the Colorado Department of Transportation to compact asphalt slabs in the Linear Kneading Compactor.)

1. SCOPE

- 1.1 This method describes the compacting of bituminous mixtures in a linear driven, kneading machine. Slabs can be made for either the French Rutting Tester or the Hamburg Wheel-Tracking Device.

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 The Linear Kneading Compactor easily and safely prepares uniform asphalt specimens in the laboratory that would be representative of those taken from an actual road surface. It simulates the rolling action of paving equipment used in the field.

4. SUMMARY OF METHOD

- 4.1 A mold is filled with a weighed amount of mix calculated from the desired final density and the mold volume. Downward motion of a rolling wheel applies a force to the top of the compacting plates while the mold moves back and forth on a sliding table. A linear compression wave is produced in the mix by the bottom edges of the plates as the roller pushes down on each one successively. This kneading action allows the mix to be compacted without fracturing the aggregate.

5. APPARATUS

- 5.1 *Linear Kneading Compactor* - An electronically powered machine that has a motor which turns a ball screw mechanism, the nut of which is fastened to a specimen table. There is a hydraulic ram and hand pump to move the roller down for compaction of the bituminous mixture. The table has two mold lock levers that clamp down on the mold to hold the mold in place. The Linear Kneading Compactor is totally enclosed and is locked to prevent access to the moving parts during compaction. A digital meter is mounted on the machine to give a constant readout of the height of the roller.

- 5.2 *Molds / Compaction-plates* - There are two sets of molds and compaction-plates for compacting slabs for either the French Rutting Tester or the Hamburg Wheel-Tracking Device.

- 5.2.1 When compacting slabs for the Hamburg Wheel-Tracking Device, a mold 12.5 in. (320 mm) long and 10.25 in. (260 mm) wide is used. There are two bottom-plates inside the Hamburg mold that are 1 in. (25 mm) and 0.5 in. (13 mm) thick. The compaction-plates are 10.1 in. (257 mm) long and 3.5 in. (89 mm) high. Slab thicknesses of 1.5 in. (38 mm) to 3 in. (76 mm) can be obtained by changing the bottom-plates and varying the heights to which the samples are compacted.
- 5.2.2 When compacting slabs for the French Rutting Tester, a mold 19.7 in. (500 mm) long, 7.1 in. (180 mm) wide, and 7.0 in. (178 mm) deep is used. There are two different sets of compaction plates and they can be used to make slabs of either 2 in. (50 mm) in one lift or 4 in. (100 mm) in two lifts.

6. SAMPLE PREPARATION

- 6.1 Prepare the asphalt samples according to either the French Rut Testing Procedure (CP-L 5114) or the Hamburg Wheel-Track Testing Procedure (CP-L 5112).

7. PRE-TEST PROCEDURE

- 7.1 Place the two halves of the appropriate mold together around the bottom plate(s) and hand tighten using the knobs. If compacting a slab for the French Rutting Tester, no rectangular bottom plate is used.
- 7.2 Center the mold using the marks on the table. Tighten the mold lock levers over the mold wings with the large Allen wrench.
- 7.3 Place a 1/8 in. (3 mm) aluminum plate inside the bottom of the mold. The plate will provide additional support for the bottom of the slab while it is being removed following compaction.
- 7.4 Spray the inside of the mold, the surface of the aluminum plate, and the bottom of the compaction-plates with a release agent (PAM™ or lecithin pan spray) to prevent sticking.
- 7.5 Set the black switch (top center of the control panel) to "GERMAN" or "FRENCH", depending on the type of slab that is going to be compacted.
- 7.6 Ensure that the "FAST/SLOW" switch is set to the "FAST" position.

8. TEST PROCEDURE

- 8.1 After the bituminous mixture has reached its compaction temperature (Table 1), carefully pour it from the pan into the mold to minimize any segregation of the mixture. Rod the corners with a metal spatula. Build the corners up slightly, as they will tend to have a high air void content.
- 8.1.1 A 100 mm tall slab for the French Rutting Tester is compacted in two lifts. Half of the material is poured into the mold and is compacted using the larger, 7 in. (178 mm) long and 6.5 in. (165 mm), compaction-plates. The other half of the material is poured into the mold and is compacted using the smaller, 7 in. (178 mm) long and 3.5 in. (89 mm), compaction-plates.
- 8.2 Place the compaction-plates on top of the mixture inside of the mold with the sprayed side down. Make sure that the compaction-plates are placed together tightly and are vertical.

- 8.3 Slide the transparent safety guard to the right until it is completely closed.
- 8.4 Press the green "POWER ON" button. If the power does not come on, make sure that the transparent safety guard is completely closed. After the digital height readout reads 10.28, press the green "START CYCLE" button.
- 8.5 Pump the hand pump on the hydraulic ram until the roller comes into contact with the compaction-plates. Continue to pump until the desired roller height is reached. If the pressure gauge exceeds 6,000 psi, the machine will shut off and you will have to re-perform the procedure in Subsection 8.4.
- 8.5.1 The desired roller height for compacting a Hamburg slab is 6.58 on the digital meter.
- 8.5.2 The desired height for compacting the first lift of a French slab (2 in./50 mm), using the larger compaction-plates, is 8.50 on the digital meter. The desired height for the second lift (4 in./100 mm), using the smaller compaction-plates, is 7.46 on the digital meter.
- 8.6 As the desired roller height is approached, proceed toward the final height slowly. Allow approximately 3 to 5 passes to occur before continuing to lower the roller, as it takes a few passes before the roller settles down to obtain a constant height.
- 8.7 Once the desired roller height is achieved, press the red "**STOP CYCLE**" button. The table will return to its original (home) position. Once the table has stopped, press the "**POWER OFF**" button. This will allow the safety guard to be opened.

Table 1

| Asphalt Grade | Mixing Temperature * | Compaction Temperature* |
|--------------------------|---------------------------------|------------------------------------|
| PG 58-22 | 154° C (310°F) | 138° C (280° F) |
| 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)

9. POST-TEST PROCEDURE

- 9.1 Loosen the mold lock levers with the large Allen wrench.
- 9.2 Turn the knobs so that the mold may be pulled into two halves.
- 9.3 Remove the compaction-plates from the top of the compacted slab and label it with the field sheet number and slab number (1 or 2).
- 9.4 Slide the slab off of the table and place it on a clean, flat surface to allow it to cool. Ensure that the aluminum plate remains on the bottom of the slab while moving it to help support the slab.

10. REPORT

10.1 It is not necessary to record any information for this operation and no calculations are required.

11. MAINTENANCE

11.1 The Linear Kneading Compactor is very low maintenance. The bearings are of a Teflon-like material and are self-lubricating.

11.2 The screw on which the table rides requires only a very light amount of oil. If you touch the screw and there is any oil at all on your finger, it does not need any oil. If it does need lubrication, use light weight machine oil.

11.3 The hydraulic fluid does not need to be changed. There should be enough hydraulic fluid to cover the metal rod within the pump. Leave the cap to the hydraulic pump in the "VENT" position.

11.4 The roller, molds, table, and compaction plates can be cleaned with 140 solvent. To get to the roller, the plexi-glass top must be removed with a small Allen wrench. When replacing the top, do not over tighten the screws, as they can easily be stripped.

12. CALIBRATION / EQUIPMENT VERIFICATION

12.1 There are no calibration procedures necessary for this machine.