Montana Procedure MT 334

Method of Test For

Hamburg Wheel-Track Testing of Compacted Bituminous Mixtures

This document is a description of the test method used by the Montana Department of Transportation to test samples in the Hamburg Wheel-Tracking Device.

1. SCOPE

This method describes the testing of submersed, compacted bituminous mixtures in a reciprocating rolling wheel device. This test provides information about the total deformation from a moving, concentrated load and about the rate of deformation by comparing the number of load cycles to the resultant deformation. In addition the potential for moisture damage effects are evaluated since the specimens are submerged in a temperature-controlled water bath during the loading and testing sequence.

Samples compacted in the field laboratory using the gyratory compactor are tested on the wheel-tracker. A pair of samples with the same AC content, height, and N design Air voids are used as a single composite sample for the test. The samples are cut to fit the mounting forms of the testing apparatus. The paired samples are held together at the interface of a cut chord. The wheel of the tester rolls over the face of the sample produced by the pairing.

Field cores that are nominally 10 inches in diameter and 2.5 inches – 4 inches thick are also tested. These are sized by separating the sample on the lift line or by sawing. The voids in the bituminous mixture are determined and reported.

Laboratory compacted slabs prepared according to MT 335 may also be tested following this procedure. These samples are prepared with voids of 6% $\pm$ 2 %.

2. REFERENCED DOCUMENTS

MT 303 Reducing Field Samples of Hot-Mix Bituminous Pavements to Testing Size
MT 314 Bulk Specific Gravity of Compacted bituminous mixtures
MT 321 Maximum specific Gravity of Bituminous Mixtures
MT 332 Gyratory Compaction of Bituminous Mixtures
MT 335 Linear Kneading Compaction of Bituminous Mixtures

3. SUMMARY OF METHOD

A sample of plant mix; a pair of laboratory gyratory compacted samples, a laboratory-compacted slab or a ten-inch core taken from a compacted pavement, is repetitively loaded using a reciprocating steel wheel. The specimen is submerged in a temperature controlled water bath at a temperature of 50°C. The maximum amount of deformation (rutting) of the specimen, caused by the wheel loading, is measured and the assessment of the performance of the plant mix is decided on the basis of the maximum value obtained.
The procedure is a pass or fail test. If the rutting is excessive; more than permitted by the contract the material fails the test, and the contractor will redesign the bituminous mixture or take the steps that will increase the mixture performance.

APPARATUS

Wheel-Tracking Machine - An electrically powered machine capable of moving a 203.6 mm (8 in.) diameter, 47 mm (1.85 in.) wide steel wheel over a test slab. The load on the wheel is 158 Ibs. (705 N). The wheel shall reciprocate over the slab, with the position varying sinusoidally over time. The wheel unidirectionally travels approximately 50 passes across the slab per minute. The speed of the wheel is approximately 0.305 m/s (1.1 ft/sec). The wheel load is maintained ± 5% for the duration of the test excluding the cycles that are interrupted by stopping the procedure.

Temperature Control System - a water bath capable of controlling the temperature within ± 2.0 °C over a range of 35° to 60°C. This bath has a mechanical circulating system to stabilize the water temperature.

Impression Measurement System - A Linear Variable Differential Transducer (LVDT) device capable of measuring the depth of the impression of the wheel within 0.5 mm, over a minimum range of 20 mm. The system shall be mounted to measure the depth of the impression at several points in the path of the wheel and at the midpoint of the wheel's path on the slab. The impression is measured at intervals of 400 passes of the wheel without stopping the wheel.

Wheel Pass Counter- a non-contacting device that counts each wheel pass over the slab. The signal from this counter is coupled to the wheel impression measurement, allowing for the rut depth to be correlated with the number of wheel passes.

Sample Mounting System - a stainless steel tray is mounted to the machine so that movement of the sample less than 0.5 mm during testing. The system supports the sample, The mounting system provides a minimum of 2 cm of free circulating water on all sides of the tray or sample.

FIELD SAMPLES The top lift or lifts of plant mix are tested**.** Samples for testing should have a thickness that is more than three times the nominal maximum aggregate size.

Field Compacted gyratory samples

Two gyratory samples produced to the same requirements are paired and tested or One sample of 115 mm may be cut to yield two samples that are 55mm in height. The gyratory specimens are fabricated with air voids in the range of N design. The air voids (VTM) for all current bituminous mixtures is 3.4% - 4.0%. Each sample is cut to fit the form. The height is adjusted and each sample is cut on a chord that is at least 35 mm longer than the width of the test wheel and parallel to the vertical axis of the specimen The two samples are mounted so that the chords are together and the wheel rolls on the faces of the specimens. The wheel path follows the diameter of each half of the sample through the center of the chords.
A tolerance of ± 5 mm offset from the center is allowed.

Ten inch cores. Cut field cores with a bit with a nominal 10 inch diameter. Complete the preparation of the cores for testing by removing the bottom lift/s of plant mix to achieve a height of two and one-half inches to four inches. Separate the plant mix lifts by chilling the core and splitting the sample on the lift line with a metal wedge. The wedge is successively placed at points on the lift line around the circumference of the specimen and tapped with a hammer. The core will cleanly cleave on the lift line. An alternative is cut the core with a diamond saw at the desired point, taking care to orient the cut perpendicular to the axis of the vertical core.

Laboratory Produced Mix

Before mixing bituminous mixtures for testing all of the pans and implements should be “buttered. Buttering is performed by adding a mix with the same aggregate, asphalt and asphalt content as the mix that will be tested into a container and stirring it so that the surfaces to which asphalt mix would normally adher to are

covered. The material used for the buttering process is discarded. Heat materials to be mixed in the laboratory to the mixing temperature in a forced draft or convection oven. Do not overheat the samples.

Combine the aggregate and asphalt with filler or additive if required. Stir the sample using a mechanical mixer until complete coating of the aggregate is achieved or for a maximum of 3 minutes. If a mechanical mixer is not available stir the mixture by hand using a narrow spatula; spading and turning until the aggregate is coated and all materials are dispersed into the mixture. Recheck the temperature before compacting if mixing is done by hand.

The size of the sample to prepare is determined by calculating the number of grams of mix needed to attain an air void target. Multiply the volume the sample will occupy by the rice gravity of the plant mix. This is the mass a sample with zero air voids. Multiply this mass by .94 to determine the mass of a sample occupying the same volume with 6% air voids.

Gyratory specimens

The height of a compacted gyratory specimen is 115mm. $\pm$ 3 mm. And the diameter is 150 mm. Compact each specimen to N design with the number of gyrations shown on the mix design. Field compacted samples produced to specification parameters are used Using a diamond saw Cut two specimens the same height in the range of 55mm to 63 mm.

Slabs

The formula for the volume of a slab is length X width x thickness. The amount of material to batch for each slab with 6% air voids is determined by multiplying the sample width x length x height in cubic centimeters by the sample's maximum specific gravity x .94. **Mass for sample = 5283 cm^3 x 1 gm/cm^3 x R.G x.94.**

Compact plant mix into slabs using the Linear Compactor (refer to MT 335). Slabs 12.5 in. (320 mm) long and 10.25 in. (260 mm) wide are produced. Select a slab thickness of 2.5 in. (63 mm). – 3 in. (76.00 mm.). Place a compacted slab on a clean, flat surface at normal room temperature until the sample is cool to the touch.

6.1.5 *Bulk gravity* – Perform the bulk specific gravity in accordance with MT. 314.

Specimen Mounting - Samples are mounted so the track of the wheel follows the axis of the specimen and so the movement range of the wheel passes through the center of the specimen. The range of the movement of the wheel is on the specimen. Restrict movement of the mounted sample to less than 0.5 mm. Use Plaster-of-Paris, a stabilizing frame or a combination of the two to mount the specimen or specimens in the mounting tray. Do not use a device that clamps or applies pressure to the sample. Level the sample and positioned it so it is same height as the outside frame when you are mounting it.

If plaster is needed, mix it according to the directions. The plaster we are using requires approximately a 2:1 volume ratio of plaster and water. Seat the sample in a thin layer of plaster. Insure that the plaster layer underneath the slab does not exceed 0.10 in. If there are gaps between the form and the sample fill them with plaster to the top of the forms. Do not test plaster-mounted samples until at least one hour after the plaster has been poured.

8. TEST

Position the frame holding the sample into the wheel-tracker so that the loading arm of the wheel is horizontal when it rests on the slab. Insure that the setting for the machine is the same as those required for the

specification. These are wheel force, temperature of environment stroke length and speed and the other variables described in the procedure. Enter the number of test passes required by the specification.

When the water has been at test temperature for 30 minutes, lower the wheels onto the slab and make ten passes with the loaded wheel. Measure the height of the specimen to establish the zero position. Continue with the test; Record the amount of rutting of the specimen at 400 cycle intervals until the test sequence is complete. If the rutting exceeds the preset limit the test will conclude and the cycles to failure will be reported. If the specimen cycles the number of times required by the contract and does not reach the rut depth defined as failure; record the rut depth at the conclusion of the testing.

REPORTING OF RESULTS

The report for the results of testing samples using the wheel tracker must contain the following information.

Cover Sheet: Date sampled, Project Number, Project Name, Binder Content (How % AC was obtained), Binder Grade, Sample type,
Configuration settings: Conditioning Time; Maximum number of Passes, Wheel Travel, and maximum velocity of wheel, force setting, water temperature, maximum depth of rut, sample frequency,

Output; Log of configuration parameter values during the testing; Graph; of number of passes on X axis and the rut depth on the Y axis.

Report if the sample passed requirements of the contract for not exceeding the specified maximum rut depth.

A detailed report of the data is generated as part of the testing. The deformation (rutting) is plotted as a function of the number of wheel passes. There is no contractual requirement for this information but it is invaluable if the sample fails and there is excessive deformation of the plant mix. The slope of the curve of the deformation yields information about the cause of the rutting. If the slope is uniform this is consistent with a mixture that is rutting as a result of load related deformation. This is characteristic of a bituminous mixture with an unstable aggregate configuration or a mixture that was formulated with asphalt that lacked elastic properties. If an abrupt increase in the rate of deformation (the slope) is recorded; this coincides with stripping of the asphalt from the aggregate. It is characteristic of bituminous mixtures that are susceptible to moisture damage. These mixtures require the inclusion of asphalt additives, improvements in the lime delivery system or checks for other asphalt problems.

CALIBRATION / EQUIPMENT VERIFICATION

Verify that the water bath temperature is within 1.0 °C of the temperature readout every 6 months.

Verify that the LVDT height is within 0.1 mm at each height tested with each of three calibration blocks that span the range of the test.

Verify the accuracy of the force application to the specimens within 2 kilograms.