

WSDOT FOP for WAQTC TM 8

In-Place Density of Bituminous Mixes Using the Nuclear Moisture-Density Gauge

Scope

This test method describes a test procedure for determining the density of Hot Mix Asphalt (HMA) by means of a nuclear density gauge employing either direct transmission or backscatter (thin layer only) methods. Correlation with densities determined under SOP 730 is required.

Apparatus

- Nuclear density gauge with the factory matched standard reference block.
- Drive pin, guide, scraper plate, and hammer for testing in direct transmission mode.
- Transport case for properly shipping and housing the gauge and tools.
- Instruction manual for the specific make and model of gauge.
- Radioactive materials information and calibration packet containing:
 - Daily Standard Count Log
 - Factory and Laboratory Calibration Data Sheet
 - Leak Test Certificate
 - Shippers Declaration for Dangerous Goods
 - Procedure Memo for Storing, Transporting and Handling Nuclear Testing Equipment
 - Other radioactive materials documentation as required by local regulatory requirements.

Material

WSDOT does not use filler material

Radiation Safety

This method does not purport to address the safety concerns, if any, associated with its use. This test method involves potentially hazardous materials. The gauge utilizes radioactive materials that may be hazardous to the health of the user unless proper precautions are taken. Users of this gauge must become familiar with the applicable safety procedures and governmental regulations. All operators will be trained in radiation safety prior to operating nuclear density gauges. Some agencies require the use of personal monitoring devices such as a thermoluminescent dosimeter or film badge. Effective instructions together with routine safety procedures such as source leak tests, recording and evaluation of personal monitoring device data, etc., are a recommended part of the operation and storage of this gauge.

Calibration

WSDOT performs calibrations according to the manufacturer's Operators Manual.

Standardization

1. Turn the gauge on and allow it to stabilize (approximately 10 to 20 minutes) prior to standardization. Leave the power on during the day's testing.
2. Standardize the gauge at the construction site at the start of each day's work and as often as deemed necessary by the operator or agency. Daily variations in standard count shall not exceed the daily variations established by the manufacturer of the gauge. If the daily variations are exceeded after repeating the standardization procedure, the gauge should be repaired and or recalibrated.
3. Record the standard count for both density and moisture in the Daily Standard Count Log. The exact procedure for standard count is listed in the manufacturer's Operators Manual.

Test Site Location

1. Select a test location(s) randomly and in accordance with WSDOT Test Method T 716. Test sites should be relatively smooth and flat and meet the following conditions:
 - a. At least 33 ft (10 m) away from other sources of radioactivity.
 - b. At least 10 ft (3 m) away from large objects (i.e., vehicles).
 - c. No closer than 24 in (600 mm) to any vertical mass, or less than 6 in (152.0 mm) from a vertical pavement edge.

Overview

There are two methods for determining in-place density of HMA.

- Direct Transmission – The standard for WSDOT when the depth of Hot Mix Asphalt is 0.15 foot or greater.
- Backscatter – Optional standard for WSDOT when the depth of Hot Mix Asphalt is 0.10 foot or greater. Only gauges with two sets of photon detectors operating in “Thin Layer Mode” will be allowed.

Note: When a density lot is started in thin layer mode it must remain in thin layer mode until the lot is completed. If a density lot is started in direct transmission the lot must be completed in direct transmission unless the pavement depth falls below 0.15 feet.

Procedure

Direct Transmission

1. Maintaining maximum contact between the base of the gauge and the surface of the material under test is critical.
2. Use the guide and scraper plate as a template and drill a hole to a depth of at least ¼ in (7 mm) deeper than the measurement depth required for the gauge.
3. Place the gauge on the prepared surface so the source rod can enter the hole. Insert the probe in the hole and lower the source rod to the desired test depth using the handle and trigger mechanism. Position the gauge with the long axis of the gauge parallel to the direction of paving. Pull the gauge so that the probe is firmly against the side of the hole.

WSDOT Note: For alignment purposes, the user may expose the source rod for a maximum of 10 seconds.

4. Take one 4-minute test and record the wet density (WD) reading.

Thin Layer Gauge or Mode

1. A thin layer gauge (i.e., Troxler 4640) or a moisture density & thin layer gauge that has a thin layer mode setting (i.e., Troxler 3450) is required to perform this testing.
2. Take tests in accordance with manufacturer's recommendation.
3. Take one 4-minute test and record the wet density (WD) reading.

Calculation of Percent of Compaction

The percent compaction is determined by comparing the in-place wet density, as determined by this method, to the Average Theoretical Maximum Density of the HMA as determined by the WSDOT SOP 729.

The density gauge operator will receive a new average Theoretical Maximum Density from the tester at the HMA plant each day that production requires a mix test. The density gauge operator will continue to use the previous moving average until a new moving average is received from the tester at the HMA plant.

Each gauge shall be correlated in accordance with WSDOT SOP 730. A correlation factor will be provided to the density gauge operator for each gauge.

Use the following equations to calculate the percent of compaction:

1. Calculate the corrected gauge reading to the nearest tenth of a percent as follows:

$$\text{Corrected Gauge Reading} = \text{WD} \times \text{CF}$$

WD = moisture density gauge wet density reading

CF = gauge correlation factor (WSDOT SOP 730)

2. Calculate the percent compaction as follows.

$$\text{Percent Compaction} = \frac{\text{Corrected Gauge Reading}}{\text{Average Theoretical Maximum Density}} \times 100$$

Correlation With Cores

WSDOT has deleted this section, refer to WSDOT SOP 730.

Report

Report the results using one of the following:

- Materials Testing System (MATS)
- WDOT Form 350-092 and 350-157
- Form approved in writing by the State Materials Engineer

Report the percent compaction to the nearest tenth of a percent (0.1 percent)

Tester Qualification Practical Exam Checklist

In-place Density of Hot Mix Asphalt (HMA) Using the Nuclear Moisture-Density Gauge FOP for WAQTC TM 8

Participant Name _____ Exam Date _____

Procedure Element	Yes	No
1. The tester has a copy of the current procedure on hand?	<input type="checkbox"/>	<input type="checkbox"/>
2. All equipment is functioning according to the test procedure, and if required, has the current calibration/verification tags present?	<input type="checkbox"/>	<input type="checkbox"/>
3. Gauge turned on?	<input type="checkbox"/>	<input type="checkbox"/>
4. Gauge standardized and standard count recorded?	<input type="checkbox"/>	<input type="checkbox"/>
5. Test location selected appropriately?	<input type="checkbox"/>	<input type="checkbox"/>
6. Direct Transmission Mode:		
a. Hole made a minimum of 1/4 inch deeper than measurement depth?	<input type="checkbox"/>	<input type="checkbox"/>
b. Gauge placed parallel to direction of paving, probe extended, gauge pulled back so probe against hole?	<input type="checkbox"/>	<input type="checkbox"/>
c. For alignment purposes did not expose the source rod for more than 10 seconds.	<input type="checkbox"/>	<input type="checkbox"/>
d. One four-minute test made?	<input type="checkbox"/>	<input type="checkbox"/>
e. Wet density recorded?	<input type="checkbox"/>	<input type="checkbox"/>
7. Thin Layer Gauge or Gauge in Thin Layer Mode:		
a. Gauge placed, probe extended to backscatter position?	<input type="checkbox"/>	<input type="checkbox"/>
b. One four-minute test made; gauge placed as described in the manufacture recommendations?	<input type="checkbox"/>	<input type="checkbox"/>
c. Wet Densities recorded?	<input type="checkbox"/>	<input type="checkbox"/>
8. All calculations performed correctly?	<input type="checkbox"/>	<input type="checkbox"/>
9. Nuclear Gauge secured in a manner consistent with current DOH requirements?	<input type="checkbox"/>	<input type="checkbox"/>

First Attempt: Pass Fail

Second Attempt: Pass Fail

Signature of Examiner

Comments:

