Colorado Procedure 81-13

Standard Method of Test for

Density and Percent Relative Compaction of HMA Pavement by the Nuclear Method

(This procedure is based upon AASHTO T 310-01. AASHTO T 310-01or any subsequent revision may not be used in place of this procedure.)

1. SCOPE

1.1   This method covers the determination of the total density of hot mix asphalt pavement in-place by use of nuclear gauges. The test method used to determine the density of in-place hot mix asphalt pavements is the backscatter method, whereby the source is lowered into near contact with the compacted roadway surface. The direct transmission and air gap methods are not used to test the in-place density of bituminous pavements..

1.2   The nuclear equipment referenced in this method is the Surface Moisture/Density (M/D) Gauge and the Thin Layer Density Gauge. This procedure applies equally to both types of gauges, except as noted.

1.3   The following applies to all specified limits in this standard: For the purposes of determining conformance with these specifications, an observed value or a calculated value shall be rounded off "to the nearest unit" in the last right-hand place of figures used in expressing the limiting value, in accordance with the rounding-off method of AASHTO R 11, Recommended Practice For Indicating Which Places Of Figures Are To Be Considered Significant In Specified Limiting Values.

2. REFERENCED DOCUMENTS

2.1   *Colorado Procedures:*
  CP 15   Certification of Consultant Nuclear Moisture / Density Gauges
  CP 75   Stratified Random Sampling of Materials
  CP 82   Field Correction of the In-Place Measurement of Density of Bituminous Pavement by the Nuclear Method

  CP-L 5302 Calibration of CDOT Nuclear Moisture/Density Gauges
  CP-L 5304 Calibration of CDOT Nuclear Thin Layer Density Gauges

3. SIGNIFICANCE

3.1   The method described is used for the in-place determination of density of HMA.

3.2   This method is used for acceptance testing of HMA.

3.3   Test results may be affected by chemical composition, sample heterogeneity, and the surface texture of the material being tested. The techniques also exhibit spatial bias in that the apparatus is more sensitive to certain regions of the material under test.

4. APPARATUS

4.1   *Nuclear Moisture/Density (M/D) or Thin Lift Gauge* - The M/D or Thin-Layer gauge shall meet the requirements of CP 15 or CP-L 5302.

5. HAZARDS

5.1   The gauge utilizes radioactive material that may be hazardous to the health of the user unless proper precautions are taken. Users of the gauge must become familiar with applicable safety procedures and government regulations.

6. CALIBRATION / CERTIFICATION

6.1   Calibration / Certification of M/D gauges shall be in accordance with CP-L 5302 or CP 15.

6.2   Calibration / Certification of Thin Layer Density shall be accordance with CP-L 5304 or CP 15.

7. STANDARDIZATION

7.1 All Nuclear Gauges are subject to long-term aging of the radioactive sources, detectors, and electronic systems, which may change the relationship between count rates and the material density and water content. To offset this aging, gauges are calibrated as a ratio of the measurement count rate to a count rate made on a reference standard.

7.2 Standardization of the gauge on the reference standard is required at the start of each day's use, after the gauge has been turned off, or when a gauge's readings are in question. A permanent record of this data shall be retained. The standardization shall be performed with the gauge at least 33 ft away from other nuclear gauges and clear of large masses of water, hydrogenous material, or other items which may affect the reference count rates. Standard counts should be taken in the same environment as the actual measurement counts.

7.3 Turn the gauge on and allow it to stabilize according the manufacturers recommendations.

7.4 Place the gauge on the reference standard as recommended by the gauge manufacturer, and perform a four-minute standard count.

7.5 Compare the standard count obtained in Subsection 7.4 to the average of the previous 4 days standard counts. If the density standard count is not within 1% of the density 4-day average, rerun the standard count. If the above conditions are not met contact your On-site Radiation Safety Officer, follow your company's procedures, or contact the gauge manufacturer for further guidance. Record the standard counts on CDOT Form #746 and #428.

8. PROCEDURE

8.1 Using CP 75, select both longitudinal and transverse test locations where the gauge in test position will be at least 6 in. away from any vertical projection. Mark these test locations using a pavement marking pen. The gauge test site shall be an area 8 in. by 13 in. centered over the marked test location. The long axis of the test site must be parallel to the direction of the paver and rollers.

NOTE 1: When selecting a test location, include all areas 1 foot or more away from confined or unconfined longitudinal joints. Do not include locations closer than 1 foot to longitudinal joints.

8.2 Prepare the gauge test site in the following manner:

8.2.1 Remove all loose and disturbed material from the roadway surface.

8.2.2 Prepare the gauge test site to accommodate the gauge so that the gauge remains level and steady. "Rocking of the gauge may be caused by a non-level surface or by asphaltic aggregate particles becoming cemented to the bottom of the gauge. Obtain maximum contact between the gauge and material being tested. If rocking cannot be corrected, the test site may be moved a few centimeters to level the gauge.

8.2.3 The maximum void beneath the gauge shall not exceed 1/8 in. If necessary, use the minimum possible amount of native fines or fine sand to fill these voids and smooth the surface with a rigid plate or other suitable tool.

NOTE 2: The placement of the gauge on the surface of the material to be tested is critical to the successful determination of density. The optimum condition is total contact between the bottom surface of the gauge and the surface of the material being tested. This is not possible in all cases and to correct surface irregularities use of sand or similar material as a filler will be necessary. The depth of the filler should not exceed 1/8 in. and the total area filled should not exceed 10 percent of the bottom area of the gauge. Several trial seatings may be required to achieve these conditions.

8.3 Proceed with the test in the following manner:

8.3.1 Place the gauge on the 8 in. by 13 in. gauge test site. Mark two corners of the gauge test site using a pavement marking pen.

8.3.2 Keep all other radioactive sources at least 33 ft. away from the gauge to avoid affecting the measurement.

8.3.3 Tilt the gauge away from the operator slightly. Extend the source rod from the "SAFE" position to the "Backscatter" position, which is the position in which the tip of the source rod attains near contact with the pavement surface.

Tilting the gauge will ensure that the index handle trigger of the source rod is securely engaged in the notch on the index rod. Ensure that the source rod is firmly seated against the bottom of the notch, which places the source into near contact with the roadway surface.

8.3.4   Seat the gauge firmly, keeping the base in contact with the prepared gauge test site.

8.3.5   Set the count time to one-minute. Perform two one-minute readings and record the wet density on CDOT Form #428. Turn the gauge 180 degrees and align the gauge over the gauge test site. Perform and record two additional one-minute readings.

NOTE 3: Most gauges report both wet and dry density. It is important to record the correct reading from the gauge.

8.3.6   If a core sample is required, follow CP 82. Obtain the core or cores for CP 82 from the central longitudinal axis of the gauge test site.

NOTE 4:   If the entire bituminous pavement, that is the old existing asphalt roadway plus the planned overlay, will be less than 4 inches thick, underlying subgrade density variations can cause nuclear gauge test inconsistencies.

9. CALCULATIONS

9.1   Average the four nuclear gauge readings obtained in Subsection 8.3.5.

9.2   Calculate the adjusted wet density value by adding the field density to the correction factor derived through CP 82. Calculate the percent density by dividing the adjusted field density by the laboratory maximum mixture density (i.e. the maximum specific gravity multiplied by 62.4).

10. REPORT

10.1   CDOT Form #746, Nuclear Moisture/Density Gauge Log (Example in Chapter 800).

10.2   CDOT Form #428, Nuclear Asphalt-Density Test (Example in Chapter 800).

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