

## **WSDOT SOP 733**

### ***Determination of Pavement Density Differentials Using the Nuclear Density Gauge***

#### INTRODUCTION

This test method explains how to locate and test for cyclic density. WSDOT field personnel are to systematically measure the locations where the new hot mix asphalt (HMA) pavement density may vary due to “spots, streaks” or visual pavement irregularities that may be related to temperature differentials or aggregate surface segregation. The described test method will identify density variations due to both causes.

#### 1. GENERAL SCOPE

- a. Temperature differentials is defined as any area where the surrounding new HMA pavement temperature is 25°F or greater.
- b. Temperature differentials shall be determined when the new HMA pavement has been on the roadway for less than 1 minute, and no compaction has been applied.
- c. aggregate segregation “Spots, streaks” or visual pavement irregularities is defined as areas of new HMA pavement that has a significantly different texture than the surrounding material.
- d. A systematic density reading shall be performed on locations where a temperature differential exists or where the HMA pavement shows spots, streaks, or has a significantly different texture after then finished rolling.
- e. Only systematic density readings located within the compaction lot should be marked and tested for density.
- f. Hot Mix Asphalt density measurements are made in accordance with WSDOT FOP for WAQTC TM-8 using a nuclear moisture density gauge in direct transmission mode.
- g. A density measurement shall be the result of a single four minute reading taken at the described location.
- h. Gauge-core correlation shall be in accordance with WSDOT SOP 730 is required for the systematic density testing.
- i. Normal Quality Assurance Testing will be performed throughout the entire job, asdescribed in WSDOT SOP 729, in addition to any systematic density readings.

#### 2. EQUIPMENT

- a. An approved infrared camera OR a handheld noncontact infrared thermometer (features for both should include continuous reading, minimum, maximum, and average readings, laser sighting, and a minimum distance to spot size ratio (D:S) of 30:1.

- b. Nuclear density gauge and standardizing block (reference standard).
  - c. Tape measure.
  - d. A can of spray paint for marking test locations.
  - e. Required report form.
3. GAUGE CALIBRATION
- a. Shall be in accordance with WSDOT FOP for WAQTC TM-8. Follow the gauge calibration as outlined in FOP for WAQTC TM 8.
4. TEMPERATURE CRITERIA
- a. If the new HMA pavement temperature differentials are 25°F or greater than the surrounding new pavement, then a systematic density test is required.
  - b. If the new HMA pavement temperature differentials are less than 25°F, then there is no need to perform testing unless an area shows signs of visual pavement irregularities, surface segregation or a significantly different texture.
5. USE OF INFRARED CAMERA
- a. View at least five consecutive truckloads of HMA (as described in steps b, c, d, e, and f) being placed and observe the location and temperature of any cool spots within the compaction lot. These observations should allow the operator to become familiar with the location and extent of the temperature differentials, if any, and if the temperature differentials are occurring in a cyclic manner.
  - b. Viewing should occur from the side of the paved lane approximately 15 to 20 feet back from the paver looking toward the paver.
  - c. The camera should be focused on the freshly placed HMA pavement prior to rolling. The camera should be adjusted to show the high and low temperatures.
  - d. One truckload of HMA begins when the truck starts to dump into the paver or material transfer device and ends when another truck starts to dump.
  - e. The “spot” function on the camera should be used to obtain the temperature of the cool area and the surrounding HMA to assess the temperature differential.
  - f. Only temperature differentials located within the compaction lot should be marked for density testing.
  - g. If the temperature differential is 25°F or more, locate the approximate center of the temperature differential area with the camera. The offset is from the center of the temperature differential area to the edge of the lane. Mark the location to be tested for systematic density by placing a paint mark at the edge of the lane corresponding to the center of the temperature differential. Record the HMA surface temperature, temperature differential, offset, and station as shown in Figure 1.
  - h. If the temperature differential is less than 25°F, there is no need to mark the location unless an area within the paved lane has a significantly different texture. If testing is performed because of a significantly different textured area, locate the center of the affected area and mark the location as described in step g and as shown in Figure 1 with an (S) after the temperature differential.

## 6. USE OF HANDHELD NONCONTACT INFRARED THERMOMETER

- a. View at least five consecutive truckloads of HMA (as described in steps b, c, d, e, and f) being placed at varying offsets and observe the location and temperature of any cool spots within the compaction lot. These observations should allow the operator to become familiar with the location and extent of the temperature differentials, if any, and if the temperature differentials are occurring in a cyclic manner.
- b. Begin the longitudinal scan when a truck starts to dump into the paver or material transfer device and continue until the paver stops (discontinuous mix delivery) or until another truck starts to dump (continuous mix delivery).
- c. To perform the longitudinal scan, stand at the edge of the paving lane about 5 to 10 feet back from the paver. Scan the mat with the handheld noncontact thermometer continuously in a longitudinal manner by walking behind the paver in the direction of paving, staying the same distance away from the paver for one truckload of HMA. The offset for the longitudinal profile should be anywhere from 18 inches from the edge to no more than half the width of the paved lane. (The need to vary the longitudinal offset will be necessary to get an accurate representation of the whole mat.) Scanning temperatures for the other half of the paved lane should be performed from the other side.

*Note:* Typically, temperature differentials or surface segregation at the beginning or end of a truckload can be captured with the longitudinal scan.

- d. Perform a transverse scan after completion of the longitudinal scan, making sure to scan the entire width of the paved lane excluding the outer 18 inches on each side. It should be performed approximately 5 to 10 feet behind the paver (to check for streaking of the mat).

*Note:* Typically, streaking caused by temperature differentials or surface segregation will be captured by the transverse scan.

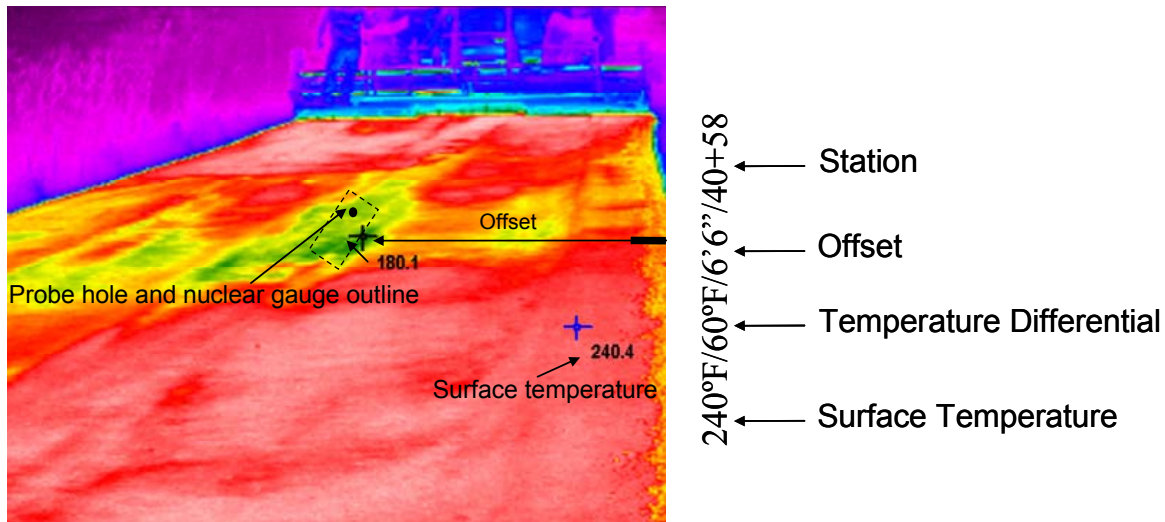
- e. The temperature scan can be stopped as soon as a temperature differential greater than 25°F has been located.
- f. Only temperature differentials located within the compaction lot should be marked for density testing.
- g. If the temperature differential is 25°F or more, locate the approximate center of the temperature differential area by scanning that specified location. The offset is from the center of the temperature differential area to the edge of the paved lane. Mark the location to be tested for systematic density by placing a paint mark at the edge of the lane corresponding to the center of the temperature differential. Record the HMA surface temperature, temperature differential, offset, and station as shown in Figure 1.
- h. If the temperature differential is less than 25°F, there is no need to mark the location unless an area within the paved lane has visual pavement irregularities, surface segregation or a significantly different texture. If testing is performed because of a significantly different textured area, locate the center of the affected area and mark the location as described in step g and as shown in Figure 1 with an (S) after the temperature differential.

## 7. SYSTEMATIC DENSITY PROCEDURE

- a. Testing shall be performed after the Contractor has finished compaction of the paved lane.
- b. Locate the mark (Figure 1) and record the information as listed.
- c. The probe of the gauge shall be placed at the offset listed and perform the testing according to WSDOT FOP for WAQTC TM 8 (direct transmission mode).
- d. Record the data on the Hot Mix Asphalt Concrete Pavement Compaction Report for Cyclic Density Form.

## 8. NUMBER AND LOCATION OF TEMPERATURE PROFILES AND SYSTEMATIC DENSITY TESTS

- a. If any temperature differentials were found in the initial assessment of paving operations (as described in 5a or 6a), the Engineer or Inspector shall take at least one temperature profile for every 5 trucks delivered to the paving operation.
- b. If the operation is not producing temperature differentials greater than 25°F in a cyclic pattern or the Engineer is not able to find 4 or more locations to be tested per compaction lot, the testing frequency can be reduced, but should be checked randomly throughout the day and the results recorded.
- c. If any significant equipment or weather changes occur, temperature profiles should be performed to determine if the new operation is capable of producing uniform HMA temperatures. If the paving machine in use is causing surface segregation, spotting or streaking that creates a finish that has a significantly different texture than the surrounding HMA, density tests should be performed in accordance with section 7 of this SOP.
- d. No temperature profiles shall be performed within the first or last 25 tons of production each day or within 25 feet of any transverse joint.
- e. Systematic density testing shall be performed on any location marked for testing.



Marking Location of Temperature Differential.

Figure 1