



## WSDOT SOP 733

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

#### 1. Scope

This test method describes the procedure for locating and testing areas of suspected low cyclic density. Lower pavement density has been related to temperature differentials and areas of “spots, streaks” or visual pavement irregularities. This method uses infrared detection devices and visual inspection to identify areas of potentially low cyclic density.

#### 2. Definitions

- a. Temperature Differential Area- Any area where the temperature of the newly placed HMA pavement is greater than 25° F different than the surrounding area.
- b. Aggregate segregation- “Spots, streaks” or visual pavement irregularities in the newly placed HMA pavement that has a significant difference in texture when compared to the surrounding material.
- c. Systematic Density Testing - the testing of temperature differential areas or areas of aggregate segregation to determine if there is a pattern of low cyclic density.

#### 3. 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 moisture-density gauge.
- c. Tape measure.
- d. A can of spray paint for marking test locations.
- e. Required report form.

#### 4. Testing Criteria

- a. Where temperature differentials are 25° F or greater a systematic HMA compaction test is required.
- b. Where temperature differentials are less than 25° F a systematic HMA compaction test is not required unless, an area shows signs of visual pavement irregularities, surface segregation or a significantly different texture.

#### 5. Determination of Systematic Density Testing Locations

Use either an infrared camera or a handheld non-contact infrared device to locate temperature differential areas as follows:

## 5.1 Infrared Camera

- a. Delineate a 500 ft section of pavement and systematically check the area for temperature differentials within one minute of HMA placement and prior to any compaction of the pavement.
- b. 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.
- c. Focus the camera on the freshly placed HMA pavement prior to compaction. Adjust the camera to show the high and low temperatures.
- d. Viewing should occur from the side of the paved lane approximately 15 to 20 feet back from the paver looking toward the paver.
- e. The “spot” function on the camera should be used to obtain the temperature of the cool area and the surrounding HMA to assess for temperature differentials.
- f. 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 HMA compaction 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 on DOT form 350-170 and in the MATS database.
- g. 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.

## 5.2 Handheld Noncontact Infrared Device

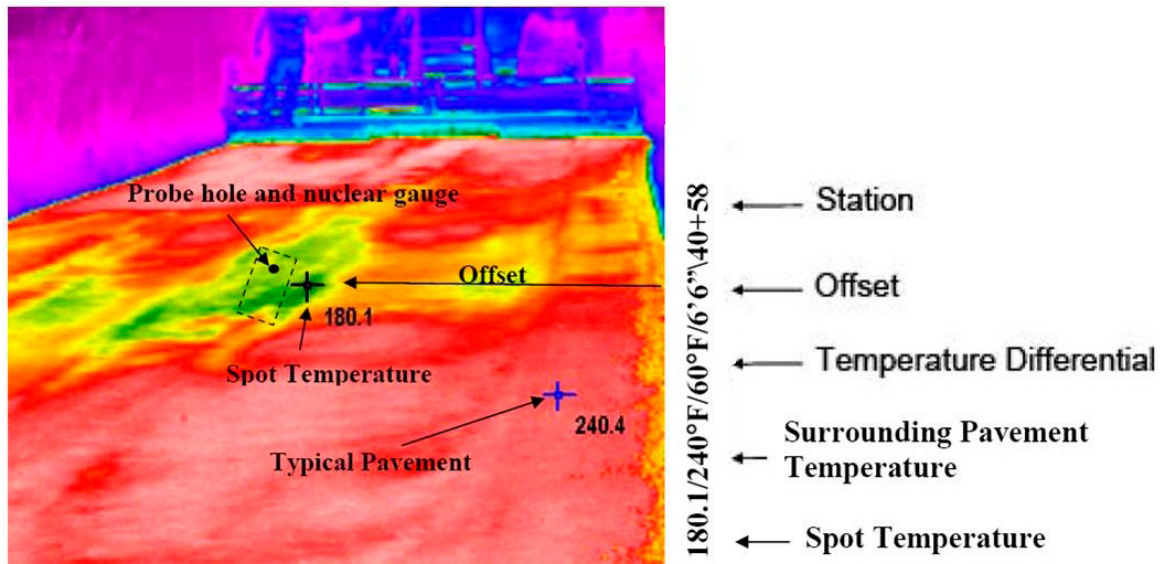
- a. Delineate a 500 ft section of pavement and systematically check the area for temperature differentials within one minute of HMA placement and prior to any compaction of the pavement.
- b. No temperature profiles shall be performed within the first or last 25 tons of production each day or within 25 feet of any transverse joint.
- c. Perform a longitudinal scan of the pavement by standing 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 500 ft of HMA placement.
- d. 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 can be captured with the longitudinal scan.

- e. 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.
- f. 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 testing 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 on DOT form 350-170 or in the MATS database.
- g. 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.

## 6. Systematic Density Testing Procedure

- a. Systematic density testing shall begin after finish rolling is completed.
- b. All systematic density testing shall be performed in accordance with WSDOT FOP for WAQTC T 355.
- c. Systematic density testing shall be performed at all the locations recorded in 5.1f and 5.2f of this procedure. Gauge probe shall be placed at the station and offset determined above as the center of the temperature differential area.
- e. If any temperature differentials are found in the initial assessment of the paving operations, at least one temperature profile shall be taken for every subsequent 500 ft of paving operation.
- d. If no temperature differentials or streaks greater than 25° F are found or if there are no more than 2 density readings lower than 90 percent found in a 500 ft section, the testing frequency may be reduced. Random checks however, should continue to be made throughout the day and the results recorded.
- e. 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.
- f. If it is found that the paving machine is creating areas that are significantly different in texture from the surrounding pavement, systematic density tests should be performed to determine if these are areas of low cyclic density.



Marking Location of Temperature Differential  
Figure 1