QUICK FACTS: LEVEL 1B

TEX-207-F, PART III

Determining In-Place Density (Nuclear Method)

Why

Determine the in-place density of compacted hot mix asphalt using a nuclear density testing gauge.

Accurate measurement of density will ensure adequate density of hot mix asphalt will be acheived. This will produce a less permeable, smooth, and stable roadway .

When

Measure in-place density to establish rolling patterns at the start of placement, anytime during roller compaction, or whenever there is a change in production or thickness of the mat or roadway conditions.

How

Equipment

- Nuclear Density Gauge
  - *Lift thickness two inches or less*
    - Thin layer or thin lift gauge
    - Backscatter Mode
  - *Lift thickness greater than two inches*
    - Direct transmission Mode
  - *Ensure all applicable regulatory certifications are current and requirements are met.*
  - *Follow the manufacturer's instructions and recommendations for calibration, operation, maintenance, and standardization procedures.*
- Portable Reference Standard (Standard Block Supplied with the Gauge)
- Scraper Plate and Drill Rod Guide
- Drill Rod and Driver or Hammer
- Shovel, Sieve, Trowel, Straightedge, Miscellaneous Hand Tools.
- Construction Marker Paint or Crayon
- Gauge Logbook

Standardization

- Perform daily when the gauge is used.
  - This will determine if the gauge is working properly.
- Turn on the nuclear density gauge and allow it to warm up and stabilize.
- Allow at least 10 minutes.
- Perform at least 25 feet away from other sources of radioactivity on a smooth and dry asphalt surface.
  - *The preferred area is the roadway location. This is best to determine day-to-day variability of the gauge.*
- Take a minimum of four repetitive readings of four minutes for each reading.

QUICK FACTS: LEVEL 1B

Standardization Results

- When the values from the standardization count are within acceptable limits.
  - *Gauge is considered to be in satisfactory operating condition and may be used for the day of use.*
- When the values from the standardization count are outside of acceptable limits.
  - *Allow additional time for the gauge to stabilize, make sure area is clear of sources of interference, then conduct another standardization.*
- When the values from the second standardization count are within limits.
  - *Gauge may be used.*
- When the values from the second standardization count also fails the test.
  - *Gauge may not be used and must be adjusted or repaired as recommended by manufacturer.*

Procedure

1. Select an area free of loose material, voids, or depressions.
   - *Select an area at least 12 inches away from obstructions, such as curbing.*
   - *It is optional to use fine sand to fill any voids or minor depressions.*
2. Firmly seat the gauge on the selected area so it is in full contact with the surface.
   - *When the surface is hot, do not leave the gauge on the mat for a long time as erratic readings may result from the hot surface.*
3. When thickness is greater than two inches, use a gauge in direct transmission mode.
   - *Use the drive pin and guide plate to make a hole into the mat. It may be necessary to drill the hole.*
   - *Make a hole as close as possible to 90 degrees from the plane surface.*
   - *Make the hole two inches deeper than the lift thickness.*
   - *Lower the handle to the bottom of the lift.*
4. Measure the density of the compacted mat.
5. Determine the density of the tested area.
   - *Models are programmable to provide direct readings of density or percent compaction (air voids).*
   - *Divide the field counts by the standard counts.*
   - *When necessary, use appropriate calibration curves.*
6. Hydrocarbons from the asphalt may influence results and not produce accurate values compared with the actual density measured from roadway cores.
7. When more accurate results are needed, determine a correlation factor for gauge readings using the bulk specific gravity of roadway cores.
   - *Use a minimum of seven core densities and seven nuclear gauge readings.*

QUICK FACTS: LEVEL 1B

TEX-207-F, PART IV

Establishing Roller Patterns (Control Strip Method)

Why

Determine the number of passes from each roller to achieve the maximum density of the compacted mat.

Adequate density of hot mix asphalt will provide a less permeable, smooth, and stable roadway.

When

Contractor establishes a rolling pattern at the start of placement. It is recommended to establish a new rolling pattern when there is a change in the job mix formula (JMF), temperature, thickness, rollers, or subgrade/base support.

How

Equipment

- Nuclear Density Gauge
- Electrical Impedance Gauge (Non-Nuclear)
- Construction Marker Paint or Crayon

Control Strip

- Approximately 300 feet long
- At least 12 feet wide or width of paver
- Two coverages of the entire strip before testing
- Three test sites

Procedure

1. Refer to the manufacturer's instructions to operate and, when applicable, to standardize the density testing gauge.
   - *When using a nuclear density gauge ensure all applicable regulatory certifications are current and requirements are met.*
2. Choose three test sites, one in each 100-foot area within the control strip.
3. After two coverages are completed, place the gauge on the hot mat and outline the gauge with paint or crayon so all readings are taken from the same position.
4. Measure the density of the compacted mat as quickly as possible.
   - *One reading only, as erratic readings may result from the hot surface.*
   - *Nuclear gauge is used in backscatter mode or thin lift and in the 30-second mode of testing.*
   - *Impedance gauge is used in continuous mode.*
5. Record the density and make note of the type of roller used and the number of coverages.
6. Allow the rollers to complete additional coverage.
7. Repeat the density tests at the marked positions and make note of the number of roller coverages.
8. Continue this process of rolling and testing until there is no significant increase in density.
   - *Generally a decrease of 0.5 pcf will indicate maximum density has been achieved.*
9. Construct another section using the rolling pattern from the control strip without interruption.
10. Take random density tests to verify the results from the control strip.

QUICK FACTS: LEVEL 1B

TEX-207-F, PART V

Determining Mat Segregation Using a Density-Testing Gauge

Why

Identify segregation of a compacted mat.

Segregation may be the cause of low density/high air voids, which may lead to premature cracking, raveling, and roughness of hot mix asphalt pavements.

When

After Compaction

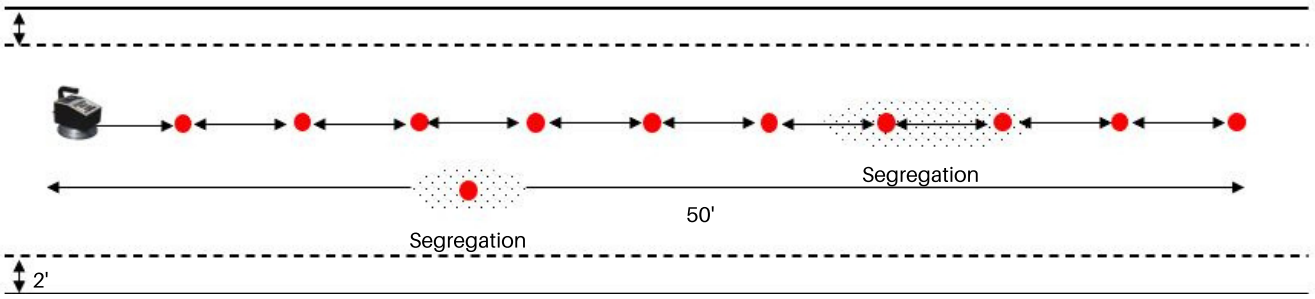
1. Engineer one per project.
2. Contractor one per sublot.
3. Moderate or severe thermal segregation.
4. Paver stops from lack of material **and** low uncompacted mat temperature.
5. Visible segregation.

Not required when thermal imaging system is used.

How

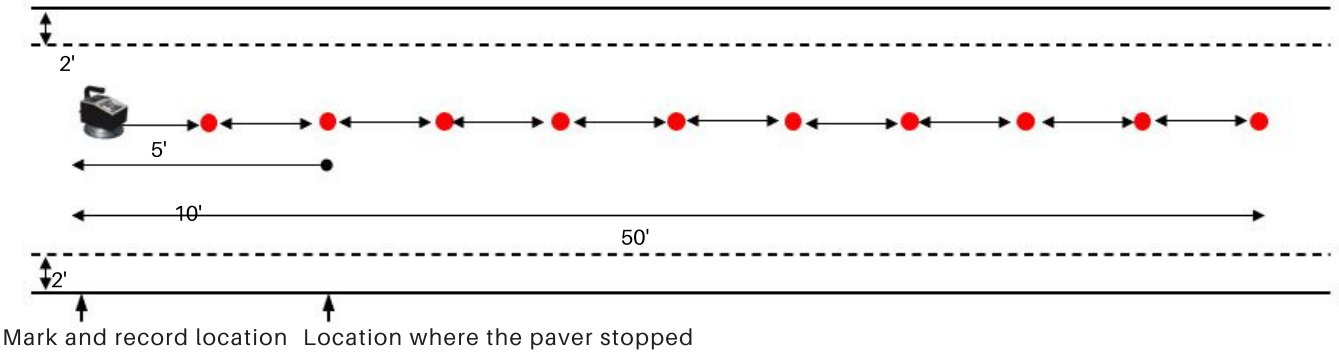
Random Location

1. Randomly select a location.
2. Choose an area with visible segregation, if possible.
3. Stay two feet or more from the pavement edge.
4. Start your 50-foot profile and take readings every 5 ft.
5. Take additional reading(s) from areas with visible segregation. Include in the profile.



When the Paver Stops and Low Mat Temperature according to Specification

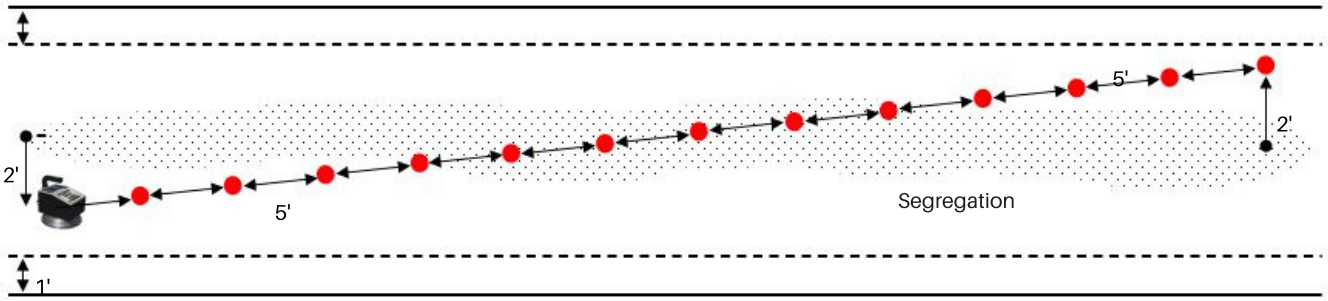
1. Mark where paver stopped.
2. Move back 10 feet.
3. Mark and record this location.
4. Start your 50-foot profile and take readings every five feet, staying two feet or more from the pavement edge.



QUICK FACTS: LEVEL 1B

Longitudinal Streaking Greater than 50 Feet

1. Start the profile with an offset of two feet from the center of the streak.
2. Profile the area at an angle in a diagonal direction.
3. End the profile with an offset of two feet on the opposite side of the streak.
4. Do not start or end a profile less than one foot from the pavement edge.
5. Start your profile and take readings every five feet through the entire length of the streaking.



Gauge Readings

- *Electrical Impedance Gauge (Non-Nuclear)*
  - Two readings in continuous mode
- *Nuclear Density Gauge*
  - Three one-minute readings in backscatter mode

Action

1. Average the readings from each location.
2. Discard any single reading that is more than 1 pcf from the average.
3. Average the readings from all the locations.
4. Determine the difference between the highest and lowest average density.
5. Determine the difference between the average and lowest average density.

SPECIFICATION

- Density profile is considered failing if it exceeds the tolerances found in the specification as shown in the table below.
- Segregation in the testing area is more severe as the density testing range increases.

Mixture Types	Maximum Allowable Density Testing Range	
	Highest to Lowest	Average to Lowest
Base Mixtures	8 pcf	5 pcf
Surface Mixtures	5 pcf	8 pcf

1. Investigate density profile failures and take corrective actions during production and placement to eliminate segregation.
2. Suspend production if two consecutive density profiles fail unless otherwise approved.
3. Resume production after the Engineer approves changes to production or placement methods.

QUICK FACTS: LEVEL 1B

TEX-207-F, PART VII

Determining Longitudinal Joint Density using a Density-Testing Gauge

Why

Evaluate density of longitudinal joints.

Low density/high air voids along the joint will allow water to penetrate. This may lead to premature cracking, raveling, and roughness of hot mix asphalt pavements.

When

After Compaction

1. Engineer one per project.
2. Contractor one per sublot.

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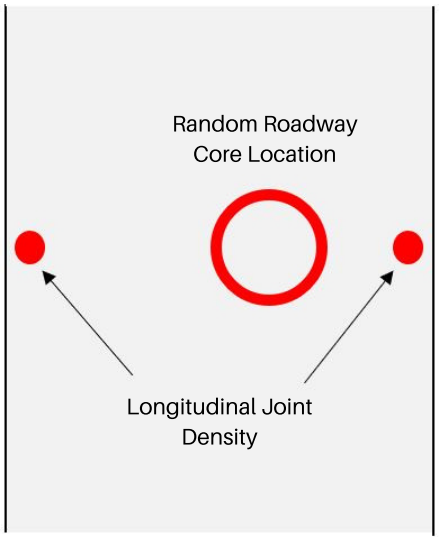
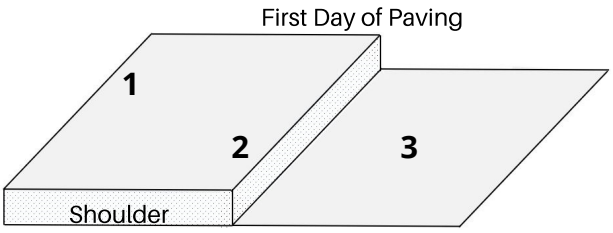
How

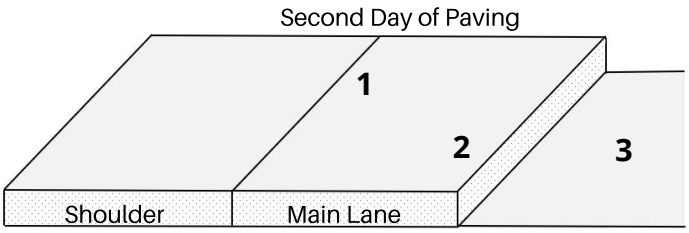
1. Identify the random sample location for in-place air void testing (roadway core location).
2. Mark and record this location.
3. Identify the pavement edge that will become a longitudinal joint.
4. Take density-testing gauge readings at each location.
5. Identify each joint type as 'Confined' or 'Unconfined'.



Confined or Unconfined

- Confined - Pavement edge is next to another pavement or structure, curb & gutter.
- Unconfined - Pavement edge is open and another lane will be paved next to it.





First Day of Paving

1. Unconfined joint, will not become a longitudinal joint, no testing required.
2. Unconfined joint, testing required.
3. Main lane, next day paving, no testing required.

Second Day of Paving

1. Confined joint, testing required.
2. Unconfined joint, testing required.
3. Main lane, next day paving, no testing required.

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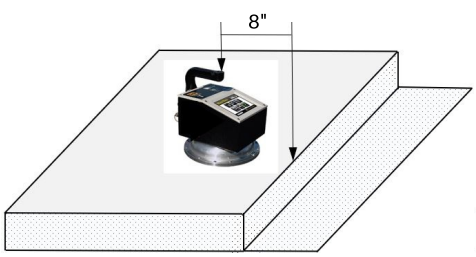
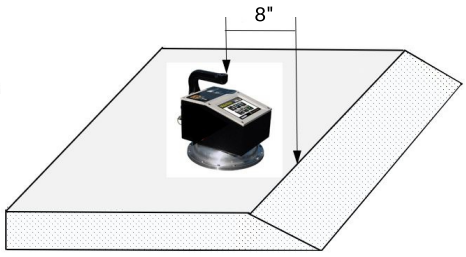
Density-Testing Gauge Readings

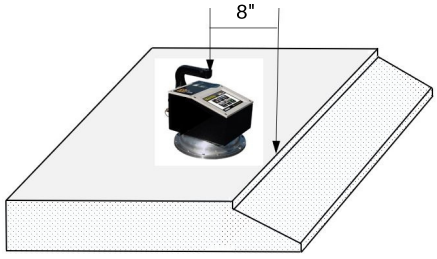
- Position gauge with center placed eight inches from longitudinal joint.
- *Electrical Impedance Gauge (Non-Nuclear)*
  - 2 readings in continuous mode.
- *Nuclear Density Gauge*
  - Three one-minute readings in backscatter mode.
  - Longer dimension of gauge is parallel to joint.



Longitudinal Butt Joint



Longitudinal Tapered Joint



Notched Wedge Longitudinal Joint

Action

1. Record the readings from each location.
2. Determine the difference in density between the readings taken at the random roadway core location and the readings taken at the longitudinal joint.
3. Determine a Correlated Joint Density for each longitudinal joint.
   - Record the average Bulk Specific Gravity (Ga) of the roadway cores.
   - Record the Theoretical Maximum Specific Gravity (Gr) for the sublot from where the cores were taken.
   - Use equation in the test procedure to calculate the Correlated Joint Density for each longitudunal joint.

SPECIFICATION

1. Longitudinal joint density is failing when:
   - Reading at the joint is more than 3.0 pcf below the density reading taken at the random core location **and**
   - Correlated Joint Density is less than 90.0%.
2. Suspend production when the joint density evaluation for two consecutive sublots do not meet this criteria.
3. Resume production after the Engineer approves changes to production or placement methods.

- When the difference in readings between the core location and the joint increases, the density at the joint decreases having higher air voids.
- When the correlated joint density decreases, falls below 90%, the density at the joint decreases having higher air voids.
- Under these circumstances, water is more likely to drain into the joint and lead to cracking and raveling.