Chapter Two Knowledge Check (Ch.2 – p.17)

1. A prime coat on aggregate base is required on all state jobs regardless of the thickness of the asphalt mat to be put down.
   a. True
   b. False

2. The purpose of a tack coat is to ensure a bond between the existing pavement surface and the new asphalt overlay.
   a. True
   b. False

3. The material taken off the roadway when milling may not be used again.
   a. True
   b. False
Chapter Three Knowledge Check (Ch.3 – p.21)

1. When an “end dump” truck raises its bed to deliver mix into the hopper of the paver, the bed should not be in contact when the hopper and should not press down on or ride on the paver.
   a. True
   b. False

2. Contact between the hauling truck bed and the paver is never a problem.
   a. True
   b. False

3. In Virginia, haul trucks are required to be equipped with tarps __________________________
   a. Only during rain storms.
   b. Only when the roadway temperature goes below 40F.
   c. All the time.
   d. Only when your supervisor tells you to put one on.

4. The bed of the haul truck should be free of all deleterious materials before mix is placed in it.
   a. True
   b. False

5. When using diesel fuel as a release agent the residue must be dumped:
   a. In a container listed on the Departments approved list.
   b. Onto the ground in a well drained area.
   c. Diesel fuel should never be used as a release agent.
   d. Only at a VDOT Residency.

6. Some mixes are more prone to segregation than others and special care must be taken to ensure the mix load is as uniform as possible.
   a. True
   b. False

7. When a semi-tractor trailer is to be loaded, the mix should first be deposited at the___________
   a. Back of a trailer.
   b. Middle of the trailer.
   c. Front of the trailer.
   d. Middle and work towards the back.

8. When using an end dump or live bottom truck to deliver mix to the paver, the truck driver should back the truck up to the laydown machine but stop just short of the push rollers on the front of the paver.
   a. True
   b. False

9. The crust that forms on an asphalt mixture is acceptable if the temperature of the mix is greater than 225F.
   a. True
   b. False

10. Too much breaking force from the haul truck may cause the paver to slip and affect the mat.
    a. True
    c. False
Chapter Four Knowledge Check (Ch.4 – p.28)

1. The paver consists of two primary parts: the tractor unit and the screed unit.
   a. True
   b. False

2. The proper depth of material on the augers should be at the______________________________.
   a. Fill mark on the auger shaft.
   b. Top of the auger shaft
   c. Two inch mark of the auger shaft.
   d. Center of the auger shaft.

3. The primary key to the placement of a smooth pavement layer is the use of the new material feed system to keep a constant head (level) of material in front of the screed.
   a. True
   b. False

4. The screed unit is attached to the tractor at:
   a. One point on each side of the paver.
   b. Two points on each side of the paver.
   c. Three points on each side of the paver.

5. The amount of density obtained by the paver screed is also a function of the speed of the paver.
   a. True
   b. False

6. The primary purpose of the heater or burner on the screed is to assist in reheating the asphalt mix to make up for heat loss during transit.
   a. True
   b. False

7. When changing the thickness control screws or tow point position, it takes ________________ before an adjustment is completed.
   a. 15 minutes
   b. One tow length of the paver
   c. Five tow lengths of the paver

8. When changing trucks during paving, it is best if the transfer is accomplished without slowing down or stopping the paver.
   a. True
   b. False

9. Auger operation and conveyor operation should be adjusted to keep them running as close to __________ percent of the time as possible.
   a. 80
   b. 90
   c. 95
   d. 100
Chapter Five Knowledge Check (Ch.5 – p.27)

1. A ____________________________ joint occurs when one lane of asphalt mix is constructed adjacent to a previously placed lane of mix.
   a. Longitudinal
   b. Conventional
   c. Transverse
   d. Uniform

2. One key to the construction of a good longitudinal joint between lanes of asphalt mix is the amount of overlap between the new mat and the previously placed mat.
   a. True
   b. False

3. When the placement of the asphalt mix is to be suspended for a period of time and traffic is going to be passing over the end of the paving, a vertical butt joint may be constructed.
   a. True
   b. False

4. Constructing a temporary tapered joint using sand or dirt as the bond-breaking medium is not an acceptable VDOT paving practice.
   a. True
   b. false
Chapter Six Knowledge Check (Ch.6 – p.27)

1. The density of a material is simply the weight of the material that occupies a certain volume of space.
   a. True
   b. False
   c.

2. A pass is defined as the entire roller moving over _____ point(s) in the mat at one time.
   a. One
   b. Two
   c. Three
   d. Four

3. A dense-graded aggregate may be easier to compact than a mixture with any other aggregate gradation.
   a. True
   b. False

4. A thin layer of mix will cool more quickly in a strong wind than when there is little or no wind.
   a. True
   b. False

5. The primary compaction variables for all types of rollers that can be controlled using the rolling process are:
   a. Roller speed
   b. Number of roller passes
   c. Rolling zone
   d. Rolling pattern
   e. All of the above

6. Compactive effort is significantly improved at slower roller speeds.
   a. True
   b. False
Chapter Eight Knowledge Check (Ch8 – p.13)

1. What are important qualifications for an Inspector?
   a. Knowledge, common sense
   b. Diplomacy, observation skills
   c. All of the above

2. The most effective learning tool for an Inspector is on-the-job training.
   a. True
   b. False

3. What is the minimum placement temperature for PG-64-22 mix type A?
   a. 375°F
   b. 200°F
   c. 250°F
   d. 270°F

4. The Paving Inspector must keep a daily diary.
   a. True
   b. False

5. What is the purpose of inspection?
   a. Control the quantity of work
   b. Inspector to act as foreman for the Contractor
   c. Ensure the quality of work
   d. All of the above

6. Each load arrives on the job site accompanied by a ____________.
   a. TL-52A
   b. Weigh ticket
   c. TL-102A
   d. Daily diary

7. In order to accept asphalt concrete the Department must have:
   a. An approved mix design
   b. A producer who is under VDOT’s Quality Assurance Program
   c. A good water source
   d. Both A and B

8. It is important for an Inspector to have an understanding of what tests are required both on the road and at the plant.
   a. True
   b. False
Specification Practice

Below is an exercise in looking up specifications. All answers can be found in VDOT Road and Bridge Specifications Section 315 – Asphalt concrete Pavement and Special Provisions.

1. What section is equipment for asphalt concrete pavement found?
   315.03 Equipment

2. What is the equipment and application requirement for tacking joints? What section is this found in?
   Tack at joints applied with a hand wand or spray bar at the rate of 0.2 gal/yd².
   Special Provision Section 315.05 (b) 1.b.

3. In section 315.05(d) the compacting sub-section of Procedures states, “Rolling shall not cause ____________________________”.
   “undue displacement, shoving or cracking.”

4. The variation of the surface from the testing edge of the straightedge between any two contacts with the surface shall not be more than ___________________. This is found in Section ____________________________.
   “1/4 inch”
   “315.07(a) Surface Tolerance”

5. How much should a longitudinal joint in one layer be offset form the layer immediately below? What section is this found in?
   6”
   Section 315.05 (c)

6. What is the pay unit for asphalt concrete material? This is found in what section?
   Tons
   Section 315.08
Chapter Nine Knowledge Check (Ch. 9 – p.26)

1. Before a roller pattern is constructed:
   a. The number of roller passes should be established
   b. Three hundred feet must be measured off
   c. The roller operator must be Asphalt Field certified
   d. A minimum of 500 feet of mix should be placed

2. A roller pattern compares compactive effort vs. density?
   a. True
   b. False

3. To mark the locations for the roller pattern density testing:
   a. Marking is not necessary
   b. Use the nuclear gauge template and spray paint
   c. Place the gauge in position and spray paint around the edges
   d. First select numbers from the random number table

4. Who has the responsibility of furnishing and operating the thin-lift nuclear gauge?
   a. VDOT furnishes and operates the gauge.
   b. The Contractor furnishes the gauge and it must be operated by an Asphalt Field Certified Technician
   c. The Research Council furnishes the gauge and must be operated by the Engineer.
   d. VDOT furnishes the gauge, but it must be operated by the Contractor.

5. What determines whether the control strip passes?
   a. The average of the ten readings in the control strip meets or exceeds the minimum density requirement
   b. The average of 6 plugs/cores meets or exceeds the minimum density requirement
   c. One plug/core meets or exceeds the minimum density requirement
   d. The average of the ten readings in the control strip is between 98% and 102% of the job-mix density
6. Readings for the ten locations selected in the control strip are to be taken with the thin-lift nuclear gauge in the:
   a. 15 second mode
   b. 30 second mode
   c. **1 minute mode**
   d. 2 minute mode

7. The density value to be entered in the thin lift gauge for the test sections must come from:
   e. **The average of 10 readings in the control strip**
   f. The average density of 3 plugs/cores from the control strip
   g. 92.5% of maximum theoretical density from the job mix
   h. The maximum density obtained in the roller pattern

8. How should the stratified reading locations be selected to determine the target nuclear control strip density?
   i. Daily
   j. Visually
   k. Professionally
   l. **Randomly**
**Chapter 9 Practice Exercise #1**

**ASPHALT NUCLEAR DENSITY THIN LIFT ROLLER PATTERN - WORKSHEET**

<table>
<thead>
<tr>
<th>Control Strip No</th>
<th>Item No.</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>9/15/13</td>
</tr>
</tbody>
</table>

**Project or Schedule** PM-2D-13

**Route Direction** (NBL, SBL, etc.)

**Mix Type** SM-12.5D

**Application** 165 lbs/yd (66 kg/m²)

**Producer** Brand X

**Location** Loafers Glory, VA

**Roller Type:**
- Roller 1 DD-130
- Roller 2 DD-110
- Roller 3

---

**Roller Pattern Data**

<table>
<thead>
<tr>
<th>Gauge Model</th>
<th>Serial No</th>
<th>Calibration Date</th>
<th>Depth Setting</th>
</tr>
</thead>
<tbody>
<tr>
<td>4640B</td>
<td>1212</td>
<td>7/18/13</td>
<td>1.5 in. (mm)</td>
</tr>
</tbody>
</table>

**Site 1**

Pass No 2V Nuclear Density 144.6 Site 1 147.8

Site 2 145.8 Site 2 148.0

Site 3 144.9 Site 3 147.3

AVERAGE 145.1 AVERAGE 147.7

Pass No 3 V Nuclear Density 146.5 Site 1 146.5

Site 2 147.6 Site 2 147.6

Site 3 146.8 Site 3 146.8

AVERAGE 147.0 AVERAGE

Pass No 4 (1S) Nuclear Density 148.4 Site 1 148.4

Site 2 149.2 Site 2 149.2

Site 3 148.4 Site 3 148.4

AVERAGE 148.7 AVERAGE

Pass No 5(2S) Nuclear Density 147.9 Site 1 148.1

Site 2 148.5 Site 2 148.5

Site 3 147.8 Site 3 147.8

AVERAGE 148.1 AVERAGE

---

Testing Performed by

Observed by
TL-57

ASPHALT NUCLEAR DENSITY THINLIFT
ROLLER PATTERN GRAPH

Control Strip No 1

Project or Schedule PM-2D-13 Item No 1 Date 9/15/13
Route 81 From 13.76 To 11.04
Directional Lane SBL (NBL, SBL, etc) Lane Inside

Mix Type SM-12.5D Application Rate 165 lbs/yd² (kg/m²)
Producer Brand X Location Loafers Glory, VA
Gauge Model 4640B Serial No 1212 Calibration Date 7/18/13
Depth Setting 1.5 in. (mm)

Optimum Density

148.7 lbs/ft³ (kg/m³)
(from peak of roller pattern curve)

Optimum Number of Passes: 4

Number of Roller Passes Roller 1 3 V Roller 2 1 S Roller 3

Testing Performed by
Observed By

This density was selected because it is the highest density reading before a decrease in density.
Chapter 9 Practice Exercise #1

VIRGINIA DEPARTMENT OF TRANSPORTATION
ASPHALT NUCLEAR DENSITY THIN LIFT WORKSHEET
CONTROL STRIP TARGET DENSITY

<table>
<thead>
<tr>
<th>Control Strip Number</th>
<th>1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Project or Schedule</td>
<td>PM-2D-13</td>
</tr>
<tr>
<td>Route</td>
<td>81</td>
</tr>
<tr>
<td>Directional Lane</td>
<td>SBL</td>
</tr>
<tr>
<td>Mix Type</td>
<td>SM-12.5D</td>
</tr>
<tr>
<td>Date</td>
<td>9/15/13</td>
</tr>
<tr>
<td>To</td>
<td>11.04</td>
</tr>
</tbody>
</table>

**Remarks:**
REFERENCE LINE IS ON THE RIGHT

<table>
<thead>
<tr>
<th>TEST SITE</th>
<th>DISTANCE</th>
<th>OFFSET</th>
<th>ENTER GAUGE READING</th>
</tr>
</thead>
<tbody>
<tr>
<td>Site 1</td>
<td>23 ft</td>
<td>2 ft. Lt</td>
<td>148.3 lb/ft³ (kg/m³)</td>
</tr>
<tr>
<td>Site 2</td>
<td>44 ft</td>
<td>9 ft. Lt</td>
<td>147.2 lb/ft³ (kg/m³)</td>
</tr>
<tr>
<td>Site 3</td>
<td>81 ft</td>
<td>2 ft. Lt</td>
<td>148.1 lb/ft³ (kg/m³)</td>
</tr>
<tr>
<td>Site 4</td>
<td>141 ft</td>
<td>6 ft. Lt</td>
<td>149.2 lb/ft³ (kg/m³)</td>
</tr>
<tr>
<td>Site 5</td>
<td>149 ft</td>
<td>10 ft. Lt</td>
<td>150.2 lb/ft³ (kg/m³)</td>
</tr>
<tr>
<td>Site 6</td>
<td>176 ft</td>
<td>3 ft. Lt</td>
<td>148.7 lb/ft³ (kg/m³)</td>
</tr>
<tr>
<td>Site 7</td>
<td>187 ft</td>
<td>9 ft. Lt</td>
<td>147.5 lb/ft³ (kg/m³)</td>
</tr>
<tr>
<td>Site 8</td>
<td>213 ft</td>
<td>4 ft. Lt</td>
<td>149.4 lb/ft³ (kg/m³)</td>
</tr>
<tr>
<td>Site 9</td>
<td>239 ft</td>
<td>2 ft. Lt</td>
<td>147.4 lb/ft³ (kg/m³)</td>
</tr>
<tr>
<td>Site 10</td>
<td>275 ft</td>
<td>3 ft. Lt</td>
<td>147.6 lb/ft³ (kg/m³)</td>
</tr>
</tbody>
</table>

Total: 1483.6 lb/ft³ (kg/m³)
Average: 148.4 lb/ft³ (kg/m³)

Testing Performed by Isaac Clive
Observed by S.F. Miles
VDOT Inspector
## VIRGINIA DEPARTMENT OF TRANSPORTATION
### ASPHALT NUCLEAR DENSITY WORKSHEET
#### ROLLER PATTERN/SAWN PLUGS & CONTROL STRIP TARGET DENSITY

<table>
<thead>
<tr>
<th>Control Strip No.</th>
<th>Date</th>
<th>Route</th>
<th>Item No.</th>
<th>From:</th>
<th>To:</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>9/15/13</td>
<td>81</td>
<td>13.76</td>
<td></td>
<td>11.04</td>
</tr>
</tbody>
</table>

**Nuclear Calibration Check**

<table>
<thead>
<tr>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
<th>G</th>
<th>H</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sawed Spec. Number</td>
<td>Weight in Air</td>
<td>Weight in Water</td>
<td>Basket Tare Weight</td>
<td>SSD Weight in Air</td>
<td>Volume E-D</td>
<td>SSD Bulk Specific Gravity</td>
<td>Averag e SSD Bulk Specimen Thickness</td>
</tr>
<tr>
<td>1</td>
<td>1215</td>
<td>730</td>
<td>xxx</td>
<td>720</td>
<td>1224</td>
<td>494</td>
<td>2.46</td>
</tr>
<tr>
<td>2</td>
<td>1218</td>
<td>732</td>
<td>xxx</td>
<td>722</td>
<td>1227</td>
<td>495</td>
<td>2.46</td>
</tr>
<tr>
<td>3</td>
<td>1223</td>
<td>734</td>
<td>xxx</td>
<td>734</td>
<td>1232</td>
<td>498</td>
<td>2.46</td>
</tr>
<tr>
<td>4</td>
<td>1220</td>
<td>728</td>
<td>xxx</td>
<td>728</td>
<td>1228</td>
<td>500</td>
<td>2.44</td>
</tr>
<tr>
<td>5</td>
<td>1210</td>
<td>728</td>
<td>xxx</td>
<td>728</td>
<td>1222</td>
<td>494</td>
<td>2.45</td>
</tr>
<tr>
<td>6</td>
<td>1214</td>
<td>729</td>
<td>xxx</td>
<td>729</td>
<td>1225</td>
<td>496</td>
<td>2.45</td>
</tr>
</tbody>
</table>

**Average**

<table>
<thead>
<tr>
<th>Averag e SSD Bulk Specimen Thickness</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.45</td>
</tr>
</tbody>
</table>

**Max Specific Gravity (Gmm)**

| 2.644 |

### What three sites would you core? Is this control strip acceptable? Why or why not?

Yes, the average percent density exceeds the minimum design density for an SM-12.5D. Core sites - 1, 3, 6

Lot length x width x application rate/ 18000
Calculations for the TL-60 on the previous page.

<table>
<thead>
<tr>
<th>Specimen 1 &amp; 2</th>
<th>Specimen 3 &amp; 4</th>
<th>Specimen 5 &amp; 6</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Column F Volume</strong></td>
<td><strong>Column F Volume</strong></td>
<td><strong>Column F Volume</strong></td>
</tr>
<tr>
<td>E / D</td>
<td>E / D</td>
<td>E / D</td>
</tr>
<tr>
<td>Specimen 1</td>
<td>Specimen 3</td>
<td>Specimen 5</td>
</tr>
<tr>
<td>1224 - 730 = 494</td>
<td>1232 - 734 = 498</td>
<td>1222 - 728 = 494</td>
</tr>
<tr>
<td>Specimen 2</td>
<td>Specimen 4</td>
<td>Specimen 6</td>
</tr>
<tr>
<td>1227 - 732 = 495</td>
<td>1228 - 728 = 500</td>
<td>1225 - 729 = 496</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>SSD Bulk Specific Gravity</th>
<th>SSD Bulk Specific Gravity</th>
<th>SSD Bulk Specific Gravity</th>
</tr>
</thead>
<tbody>
<tr>
<td>A / F</td>
<td>A / F</td>
<td>A / F</td>
</tr>
<tr>
<td>Specimen 1</td>
<td>Specimen 3</td>
<td>Specimen 5</td>
</tr>
<tr>
<td>1215 / 494 = 2.46</td>
<td>1223 / 498 = 2.46</td>
<td>1210 / 494 = 2.45</td>
</tr>
<tr>
<td>Specimen 2</td>
<td>Specimen 4</td>
<td>Specimen 6</td>
</tr>
<tr>
<td>1218 / 495 = 2.46</td>
<td>1220 / 500 = 2.44</td>
<td>1214 / 496 = 2.45</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Average SSD Bulk Per Site</th>
<th>Average SSD Bulk Per Site</th>
<th>Average SSD Bulk Per Site</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.46 + 2.46 = 4.92 / 2 = 2.46</td>
<td>2.46 + 2.44 = 4.90 / 2 = 2.45</td>
<td>2.45 + 2.45 = 4.90 / 2 = 2.45</td>
</tr>
</tbody>
</table>

Average SSD Bulk Specific Gravity
2.46 + 2.45 + 2.45 = 7.36 / 3 = 2.45

Column H Target Test Site Nuclear Density

\[ \text{Sum of H/10} = 148.3 + 147.2 + 148.1 + 149.2 + 150.2 + 148.7 + 147.5 + 149.4 + 147.4 + 147.5 = 1483.6 / 10 = 148.4 \]

Sawed Specimen Average % Density

\[ \text{Avg. SSD Bulk Sp. Gr./ G}_{\text{mm}} \times 100 = 2.45 / 2.644 = 0.927 \times 100 = 92.7 \]
## Chapter 9 Practice Exercise #1

### Asphalt Concrete Density Quality Control (QC) Test Report – Nuclear

<table>
<thead>
<tr>
<th>Project/Schedule Number:</th>
<th>PM-2D-13</th>
<th>Item Number:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Route Number:</td>
<td>81</td>
<td>County: Mitchell</td>
</tr>
<tr>
<td>From (Station, MP, Int., etc.):</td>
<td></td>
<td>To (Station, MP, Int., etc.):</td>
</tr>
<tr>
<td>Direction (e.g. NB, SB, etc.)</td>
<td>SBL</td>
<td>Lane (Inside, Center, Right, Inside)</td>
</tr>
<tr>
<td>QC Lot #:</td>
<td>2</td>
<td>Application Rate (lbs/sy): 165</td>
</tr>
<tr>
<td>Asphalt Mix Type:</td>
<td>SM-12.5D</td>
<td>Asphalt Job Mix Number: 2041-2010-12</td>
</tr>
<tr>
<td>Nuclear Gauge Model</td>
<td>4640 B</td>
<td>Gauge Calibration Date: 7/18/13</td>
</tr>
<tr>
<td>Nuclear Gauge Serial</td>
<td>1212</td>
<td>Depth Setting (in/mm): 1.5 in</td>
</tr>
</tbody>
</table>

### Control Strip Information:

1. Control Strip Number and Date 1 9/15/13
2. Target Density from Control Strip 148.4 lbs/ft³ (kg/m³)
3. Minimum Density (98% Of Control Strip Target) 145.4 lbs/ft³ (kg/m³)
4. Maximum Density (102% Of Control Strip Target) 151.4 lbs/ft³ (kg/m³)

### QC Testing Results By Nuclear Gauge:

<table>
<thead>
<tr>
<th>Sublot No.</th>
<th>Location</th>
<th>Nuclear Density lbs/ft³ (kg/m³)</th>
<th>Sublot Average lbs/ft³ (kg/m³)</th>
<th>Joint Density lbs/ft³ (kg/m³)</th>
<th>Left (C or U)*</th>
<th>Right (C or U)*</th>
</tr>
</thead>
<tbody>
<tr>
<td>1a</td>
<td>12 ft</td>
<td>12 ft lt</td>
<td>148.2</td>
<td>148.5</td>
<td>149.6 c</td>
<td>148.0 u</td>
</tr>
<tr>
<td>1b</td>
<td>429 ft</td>
<td>9 ft lt</td>
<td>148.7</td>
<td></td>
<td>150.1 c</td>
<td>147.8 u</td>
</tr>
<tr>
<td>2a</td>
<td>358 ft</td>
<td>2 ft lt</td>
<td>150.1</td>
<td>148.7</td>
<td>152.7 c</td>
<td>147.9 u</td>
</tr>
<tr>
<td>2b</td>
<td>812 ft</td>
<td>6 ft lt</td>
<td>147.3</td>
<td></td>
<td>148.9 c</td>
<td>145.2 u</td>
</tr>
<tr>
<td>3a</td>
<td>105 ft</td>
<td>10 ft lt</td>
<td>149.9</td>
<td>149.7</td>
<td>152.1 c</td>
<td>148.2 u</td>
</tr>
<tr>
<td>3b</td>
<td>620 ft</td>
<td>3 ft lt</td>
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<td>150.0 c</td>
<td>148.4 u</td>
</tr>
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<td>4a</td>
<td>167 ft</td>
<td>9 ft lt</td>
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<td>147.5</td>
<td>147.3 c</td>
<td>146.7 u</td>
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<tr>
<td>4b</td>
<td>589 ft</td>
<td>4 ft lt</td>
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<td></td>
<td>150.7 c</td>
<td>146.7 u</td>
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<td>2 ft lt</td>
<td>148.4</td>
<td>148.1</td>
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<td>147.1 u</td>
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<td>5b</td>
<td>412 ft</td>
<td>3 ft lt</td>
<td>147.7</td>
<td></td>
<td>148.8 c</td>
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</tr>
<tr>
<td>6b</td>
<td></td>
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<td>7a</td>
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<td>7b</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>

**Average:** 148.6

Does the QC Test Section: (circle one) **PASS**  FAIL

* - C = Confined Jt, U = Unconfined Jt

This Test Section passes with a density of 148.6 lb/ft³ which is within the acceptance range of 98-102% (145.4 – 151.4). Also no two consecutive sublot densities are lower than 98% or greater than 102%
## Chapter 9 Practice Exercise #2

**ASPHALT NUCLEAR DENSITY THIN LIFT**

**ROLLE R PATTERN - WORKSHEET**

Complete this worksheet.

Using the information on this worksheet, complete the TL-57 on the next page.

### Control Strip No

1

### Project or Schedule

PM-2D-13

### Item No

Date 6/21/13

### Route

Route 81 From 8.23 To 17.25

### Direction

(SBL, NBL, etc.) inside, center

### Mix Type

SM- 12.5

### Application

165 lbs/yd² (kg/m²)

### Producer

Asphalt, Inc.

### Location

Blacktop, VA

### Roller Type:

Roller 1 DD-130

Roller 2 DD-110

Roller 3

### Roller Pattern Data

<table>
<thead>
<tr>
<th>Gauge Model</th>
<th>Serial No</th>
<th>Calibration Date</th>
<th>Depth Setting</th>
<th>Nuclear Density Site 1</th>
<th>Nuclear Density Site 2</th>
<th>Nuclear Density Site 3</th>
<th>AVERAGE Nuclear Density</th>
</tr>
</thead>
<tbody>
<tr>
<td>4640B</td>
<td>1212</td>
<td>5/18/13</td>
<td>1.5 in. (mm)</td>
<td>149.0</td>
<td>145.1</td>
<td>146.9</td>
<td>147.0</td>
</tr>
<tr>
<td>Pass No 3V</td>
<td>Nuclear Density</td>
<td>Pass No 7 (3S) Nuclear Density</td>
<td></td>
<td></td>
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<tr>
<td>Site 1</td>
<td>149.0</td>
<td>Site 1 151.1</td>
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<td></td>
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<td>Site 2</td>
<td>145.1</td>
<td>Site 2 148.8</td>
<td></td>
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</tr>
<tr>
<td>Site 3</td>
<td>146.9</td>
<td>Site 3 150.9</td>
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<td>AVERAGE</td>
<td>147.0</td>
<td>AVERAGE 150.3</td>
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<td></td>
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<tr>
<td>Pass No 4 V</td>
<td>Nuclear Density</td>
<td>Pass No 6 (2S) Nuclear Density</td>
<td></td>
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<td></td>
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<tr>
<td>Site 1</td>
<td>145.4</td>
<td>Site 1 151.1</td>
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<tr>
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<td>150.2</td>
<td>Site 2 148.8</td>
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<td></td>
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<tr>
<td>Site 3</td>
<td>154.3</td>
<td>Site 3 150.9</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>AVERAGE</td>
<td>150.0</td>
<td>AVERAGE 152.5</td>
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<td></td>
</tr>
<tr>
<td>Pass No 5 (1S) Nuclear Density</td>
<td>Pass No 7</td>
<td>Nuclear Density</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Site 1</td>
<td>153.0</td>
<td>Site 1 151.1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Site 2</td>
<td>152.3</td>
<td>Site 2 148.8</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Site 3</td>
<td>152.1</td>
<td>Site 3 150.9</td>
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<td></td>
<td></td>
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</tr>
<tr>
<td>AVERAGE</td>
<td>152.5</td>
<td>AVERAGE 151.5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pass No 6 (2S) Nuclear Density</td>
<td>Pass No 7</td>
<td>Nuclear Density</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Site 1</td>
<td>152.1</td>
<td>Site 1 151.1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Site 2</td>
<td>150.6</td>
<td>Site 2 148.8</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Site 3</td>
<td>151.7</td>
<td>Site 3 150.9</td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>AVERAGE</td>
<td>151.5</td>
<td>AVERAGE 152.5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Testing Performed by

Observed by
Control Strip No: 1

After completing this worksheet, answer the question at the bottom of the page

TL-57

ASPHALT NUCLEAR DENSITY THINLIFT
ROLLER PATTERN GRAPH

Mix Type: SM-12.5D
Application Rate: 165 lbs/yd² (kg/m²)
Producer: Asphalt, Inc
Location: Blacktop, VA
Gauge Model: 4640B
Serial No: 1212
Calibration Date: 5/18/13
Depth Setting: 1.5 in. (mm)

Optimum Density: 152.5 lbs/ft³ (kg/m³) (from peak of roller pattern curve)
Optimum Number of Passes: 5

This density was selected because it is the highest density reading before a decrease in density.
Chapter 9 Practice Exercise #2

VIRGINIA DEPARTMENT OF TRANSPORTATION

ASPHALT NUCLEAR DENSITY THIN LIFT WORKSHEET

CONTROL STRIP TARGET DENSITY

Project or Schedule PM-2D-13
Route 81
Directional Lane NBL
Item Number Date 6/21/13

Route 81 From 8.23 To 17.25
Lane Inside

Mix Type SM-12.5D Application Rate 165 lbs/yd² (kg/m²)
Producer Asphalt, Inc Location Blacktop, VA

Gauge Model 4640B Calibration Date 5/18/13
Serial Number 1212

Depth Setting 1.5 in (mm)

CONTROL STRIP TARGET DENSITY DETERMINATION

<table>
<thead>
<tr>
<th>TEST SITE</th>
<th>DISTANCE</th>
<th>OFFSET</th>
<th>ENTER GAUGE READING</th>
</tr>
</thead>
<tbody>
<tr>
<td>Site 1</td>
<td>8 ft</td>
<td>3 ft lt</td>
<td>153.5 lb/ft³ (kg/m³)</td>
</tr>
<tr>
<td>Site 2</td>
<td>43 ft</td>
<td>4 ft lt</td>
<td>152.4 lb/ft³ (kg/m³)</td>
</tr>
<tr>
<td>Site 3</td>
<td>81 ft</td>
<td>2 ft lt</td>
<td>154.6 lb/ft³ (kg/m³)</td>
</tr>
<tr>
<td>Site 4</td>
<td>99 ft</td>
<td>6 ft lt</td>
<td>157.0 lb/ft³ (kg/m³)</td>
</tr>
<tr>
<td>Site 5</td>
<td>111 ft</td>
<td>3 ft lt</td>
<td>150.2 lb/ft³ (kg/m³)</td>
</tr>
<tr>
<td>Site 6</td>
<td>172 ft</td>
<td>2 ft lt</td>
<td>151.9 lb/ft³ (kg/m³)</td>
</tr>
<tr>
<td>Site 7</td>
<td>192 ft</td>
<td>8 ft lt</td>
<td>152.0 lb/ft³ (kg/m³)</td>
</tr>
<tr>
<td>Site 8</td>
<td>210 ft</td>
<td>6 ft lt</td>
<td>154.1 lb/ft³ (kg/m³)</td>
</tr>
<tr>
<td>Site 9</td>
<td>243 ft</td>
<td>3 ft lt</td>
<td>155.6 lb/ft³ (kg/m³)</td>
</tr>
<tr>
<td>Site 10</td>
<td>278 ft</td>
<td>2 ft lt</td>
<td>153.0 lb/ft³ (kg/m³)</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td></td>
<td>1534.3 lb/ft³ (kg/m³)</td>
</tr>
<tr>
<td>Average</td>
<td></td>
<td></td>
<td>153.4 lb/ft³ (kg/m³)</td>
</tr>
</tbody>
</table>

Remarks:

Testing Performed by Observed by VDOT Inspector
### Appendix A | Answers

**Chapter 9 Practice Exercise #2**

**VIRGINIA DEPARTMENT OF TRANSPORTATION**

**ASPHALT NUCLEAR DENSITY WORKSHEET**

**ROLLER PATTERN/SAWN PLUGS & CONTROL STRIP TARGET DENSITY**

Control Strip No. 1

<table>
<thead>
<tr>
<th>Schedule</th>
<th>Item No.</th>
<th>Date</th>
<th>Route</th>
<th>From:</th>
<th>To:</th>
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</thead>
<tbody>
<tr>
<td>PM-2D-13</td>
<td></td>
<td>6/21/13</td>
<td>81</td>
<td>8.23</td>
<td>17.25</td>
</tr>
</tbody>
</table>

Lane Direction: NBL (inside, center, etc.)

Mix Type: SM-12.5D

Application Rate: 165 lbs/yd² (kg/m²)

Lot No. 2

Width of Application: 12

Lot Length: 5000 ft (m)

Mix Producer: Asphalt, Inc

Plant Location: Blacktop, VA

#### NUCLEAR CALIBRATION CHECK

<table>
<thead>
<tr>
<th>Sawed Spec. Number</th>
<th>Weigh t in Air (g)</th>
<th>Weight in Water (Total g)</th>
<th>Bas ke t Tare Weigh t (g)</th>
<th>SSD Weigh t B - C</th>
<th>SSD Weigh t in Air (g)</th>
<th>SSD Bulk Specific Gravity A ÷ F</th>
<th>Averages of SSD Bulk Per Site</th>
<th>Sawed Specimen Thickness In. (mm)</th>
<th>Target Test Site Nuclear (from TL-58)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1014</td>
<td>641</td>
<td>xxx</td>
<td>641</td>
<td>1021</td>
<td>380</td>
<td>2.67</td>
<td>1.5</td>
<td>1.5</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>1024</td>
<td>618</td>
<td>xxx</td>
<td>618</td>
<td>1031</td>
<td>413</td>
<td>2.48</td>
<td>1.5</td>
<td>1.5</td>
</tr>
<tr>
<td></td>
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</tr>
<tr>
<td>3</td>
<td>1158</td>
<td>691</td>
<td>xxx</td>
<td>691</td>
<td>1167</td>
<td>476</td>
<td>2.43</td>
<td>1.5</td>
<td>1.5</td>
</tr>
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</tr>
<tr>
<td>4</td>
<td>1082</td>
<td>660</td>
<td>xxx</td>
<td>660</td>
<td>1091</td>
<td>431</td>
<td>2.51</td>
<td>1.5</td>
<td>1.5</td>
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<td>699</td>
<td>xxx</td>
<td>699</td>
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<td></td>
</tr>
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<td>6</td>
<td>1099</td>
<td>679</td>
<td>xxx</td>
<td>679</td>
<td>1107</td>
<td>428</td>
<td>2.57</td>
<td>1.5</td>
<td>1.5</td>
</tr>
</tbody>
</table>

Average SSD Bulk Specific Gravity: 2.51 (Sum of G/3)

Max Specific Gravity (Gmm): 2.653

A. Sawed Specimen Average % Density

B. Minimum Design Density (Table III – 3 of sec. 315)

*(A must equal or exceed B)*

C. Target Nuclear Density

Gauge Model: 4640B

Serial No.: 1212

Calibration Date: 7/18/13

Depth Setting: 1.5 In (mm)

Pay Quantity: Lot length x width x application rate/ 18000

Testing Performed by

Observed by

---

**What three sites would you core? Is this control strip acceptable? Why or why not?**

Yes, the average percent density exceeds the minimum design density for an SM-12.5D Core sites - 1, 8, 10

---

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Appendix A | page 19
These are the calculations for the TL-60 on the previous page.

<table>
<thead>
<tr>
<th>Specimens 1 &amp; 2</th>
<th>Specimens 3 &amp; 4</th>
<th>Specimens 3 &amp; 4</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Column F Volume</strong></td>
<td><strong>Column F Volume</strong></td>
<td><strong>Column F Volume</strong></td>
</tr>
<tr>
<td>E - D</td>
<td>E - D</td>
<td>E - D</td>
</tr>
<tr>
<td>Specimen 1</td>
<td>1021 - 641 = 380</td>
<td>Specimen 3</td>
</tr>
<tr>
<td>Specimen 2</td>
<td>1031 - 618 = 413</td>
<td>Specimen 4</td>
</tr>
<tr>
<td><strong>SSD Bulk Specific Gravity</strong></td>
<td><strong>SSD Bulk Specific Gravity</strong></td>
<td><strong>SSD Bulk Specific Gravity</strong></td>
</tr>
<tr>
<td>A / F</td>
<td>A / F</td>
<td>A / F</td>
</tr>
<tr>
<td>Specimen 1</td>
<td>1014 / 380 = 2.67</td>
<td>Specimen 3</td>
</tr>
<tr>
<td>Specimen 2</td>
<td>1024 / 413 = 2.48</td>
<td>Specimen 4</td>
</tr>
<tr>
<td><strong>Average SSD Bulk Per Site</strong></td>
<td><strong>Average SSD Bulk Per Site</strong></td>
<td><strong>Average SSD Bulk Per Site</strong></td>
</tr>
<tr>
<td>2.67 + 2.48 = 5.15/2 = 2.58</td>
<td>2.43 + 2.51 = 4.94/2 = 2.47</td>
<td>2.39 + 2.57 = 4.96/2 = 2.48</td>
</tr>
</tbody>
</table>

Average SSD Bulk Specific Gravity
2.58 + 2.47 + 2.48 = 7.53/3 = 2.51

Column H Target Test Site Nuclear Density
Sum of H/10
153.5 + 152.4 + 154.6 + 157.0 + 150.2 + 151.9 + 152.0 + 154.1 + 155.6 + 153.0 = 1534.0 / 10 = 153.4

Sawed Specimen Average % Density
Avg. SSD Bulk Sp. Gr / Gm X 100
2.51 / 2.653 = 0.946 x 100 = 94.6
Chapter Practice Exercise #2

Asphalt Concrete Density Quality Control (QC) Test Report – Nuclear

TL-59A (12/08)

Complete this work sheet. Then answer the question at the bottom of the page.

<table>
<thead>
<tr>
<th>Sublot No.</th>
<th>Location</th>
<th>Nuclear Density lbs/ft³ (kg/m³)</th>
<th>Sublot Average lbs/ft³ (kg/m³)</th>
<th>Joint Density lbs/ft³ (kg/m³)</th>
</tr>
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<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Left (C or U)*</td>
</tr>
<tr>
<td>1a</td>
<td>8 ft</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1b</td>
<td>142 ft</td>
<td>150.6</td>
<td>150.9</td>
<td>151.4 c</td>
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<tr>
<td>2a</td>
<td>67 ft</td>
<td>152.5</td>
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</tr>
<tr>
<td>2b</td>
<td>569 ft</td>
<td>153.1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3a</td>
<td>728 ft</td>
<td>153.8</td>
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<td>153.8 c</td>
</tr>
<tr>
<td>3b</td>
<td>902 ft</td>
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<td></td>
</tr>
<tr>
<td>4a</td>
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<td>155.7c</td>
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<tr>
<td>4b</td>
<td>242 ft</td>
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<td>5a</td>
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<td>6a</td>
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</tr>
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<td>6b</td>
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</tr>
<tr>
<td>7b</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Average:** 153.4

Does the QC Test Section: (circle one) **PASS**  **FAIL**

* - C = Confined Jt, U = Unconfined Jt

This Test Section passes with a density of 153.4 lb/ft³ which is within the acceptance range of 98-102% (150.3 – 156.5). Also no two consecutive sublot densities are lower than 98% or greater than 102%.
Chapter Ten (Ch. 10 – questions begin on p. 4)
Paving Math Problems

1. Using the information below:
   a. Calculate the linear feet this truckload of HMA should cover at the specified application rate.
   b. How many linear feet will each ton of HMA pave?

   Application Rate = 185 lb./yd²
   Total weight shipped = 33,135 lb.
   Pavement width = 11 feet

   a. Coverage of truckload in linear feet:

   \[ L = \frac{9 \times T}{W \times R} = \frac{9 \times 33,135}{11 \times 185} = \frac{298,215}{2035} = 146.54 \text{ or } 146.5 \text{ linear feet} \]

   b. Coverage per ton in linear feet:

   \[ L = \frac{9 \times T}{W \times R} = \frac{9 \times 2000}{11 \times 185} = \frac{18,000}{2035} = 8.84 \text{ or } 8.8 \text{ linear ft/ton} \]

2. Using the information below:
   a. Calculate the linear feet this truckload of HMA should cover at the specified application rate.
   b. How many linear feet will each ton of HMA pave?

   Application Rate = 165 lb./yd²
   Total weight shipped = 127,580 lb.
   Pavement width = 24 feet

   a. Coverage of truckload in linear feet:

   \[ L = \frac{9 \times T}{W \times R} = \frac{9 \times 127,580}{24 \times 165} = \frac{1,148,220}{3960} = 289.95 \text{ OR } 290 \text{ linear feet} \]

   b. Coverage per ton in linear feet:

   \[ L = \frac{9 \times T}{W \times R} = \frac{9 \times 2000}{24 \times 165} = \frac{18,000}{3960} = 4.54 \text{ or } 4.5 \text{ linear ft/ton} \]
3. Using the information below:
   a. Calculate the linear feet this truckload of HMA should cover at the specified application rate.
   b. How many linear feet will each ton of HMA pave?

Application Rate = 158 lb./yd^2
Total weight shipped = 46,778 lb.
Pavement width = 12 feet

   a. Coverage of truckload in linear feet:

\[
L = \frac{9 \times T}{W \times R} = \frac{9 \times 46,778}{12 \times 158} = \frac{421,002}{1896} = 222.04 \text{ OR } 222 \text{ linear feet}
\]

   b. Coverage per ton in linear feet:

\[
L = \frac{9 \times T}{W \times R} = \frac{9 \times 2000}{12 \times 158} = \frac{18000}{1896} = 9.49 \text{ or } 9.5 \text{ linear ft/ton}
\]
4. The Contractor has uniformly applied 610 gallons of undiluted CRS-1 emulsion to a section of roadway for a tack coat. The tack covers 5250 linear feet in length at a width of 11 feet.
   a. What is the application rate of the tack coat? _____________gal/yd².
   b. Does this meet specification?

   **What is the application rate of the tack coat?** 0.1 gal/yd²
   **Does this meet specification?** Yes

   \[
   R = \frac{9 \times T}{W \times L} = \frac{9 \times 610}{11 \times 5250} = \frac{5490}{57750} = 0.095 = 0.1 \text{ gal/yd}^2
   \]

   Spec for undiluted: 0.05-0.10 gal/yd²
   Spec for diluted: 0.10-0.15 gal/yd² (Section 310.03)

5. The Contractor has uniformly applied 2154 gallons of undiluted CRS-1 emulsion to a section of roadway for a tack coat. The tack covers 38,016 linear feet in length at a width of 12 feet.
   a. What is the application rate of the tack coat? _____________gal/yd².
   b. Does this meet specification?

   **What is the application rate of the tack coat?** 0.04 gal/yd²
   **Does this meet specification?** No

   \[
   R = \frac{9 \times T}{W \times L} = \frac{9 \times 2154}{12 \times 38,016} = \frac{19,386}{456,192} = 0.042 = 0.04 \text{ gal/yd}^2
   \]

   Spec for undiluted: 0.05-0.10 gal/yd²
   Spec for diluted: 0.10-0.15 gal/yd² (Section 310.03)

6. The Contractor has uniformly applied 3320 gallons of undiluted CRS-1 emulsion to a section of roadway for a tack coat. The tack covers 29,040 linear feet in length at a width of 12 feet.
   a. What is the application rate of the tack coat? _____________gal/yd².
   b. Does this meet specification?

   **What is the application rate of the tack coat?** 0.09 gal/yd²
   **Does this meet specification?** Yes

   \[
   R = \frac{9 \times T}{W \times L} = \frac{9 \times 3320}{12 \times 29,040} = \frac{29880}{348,480} = 0.085 = 0.09 \text{ gal/yd}^2
   \]

   Spec for undiluted: 0.05-0.10 gal/yd²
   Spec for diluted: 0.10-0.15 gal/yd² (Section 310.03)
7. A load of IM-19.0A arrived at the project to be placed at 220 lb./yd.² with one breakdown roller on the job and a base temperature of 50°F, what is the minimum laydown temperature?
   a. 250°F  
   b. 304°F  
   c. 295°F  
   d. 353°F

8. A load of SM-12.5A arrived at the project to be placed at 175 lb./yd.² with two breakdown rollers on the job and a base temperature of 40°F, what is the minimum laydown temperature?
   a. 330°F  
   b. 338°F  
   c. 250°F  
   d. 289°F

9. A load of SM-12.5A arrived at the project to be placed at 185 lb./yd.² with one breakdown roller on the job and a base temperature of 45°F, what is the minimum laydown temperature?
   a. 300°F  
   b. 318°F  
   c. 287°F  
   d. 307°F

10. A load of IM-19.0A arrived at the project to be placed at 190 lb./yd.² with two breakdown rollers on the job and a base temperature of 52°F, what is the minimum laydown temperature?
    a. 308°F  
    b. 338°F  
    c. 281°F  
    d. 274°F

11. The 8 minute maximum breakdown rolling time is specified when 2 or more rollers are used in breakdown rolling.
    a. True  
    b. False
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