

## Tack Rate Problem #1

CRS-2 Tack (Specific Gravity=1.00) was applied to the roadway. The temperature measured from the tack distributor was 125° F. The length of the application was 1000 feet. The width of the roadway was 12 feet. 175 gallons of tack were used to cover this section. What is the adjusted tack rate? Does this meet the SCDOT specifications?

Tack application rate is NOT calculated using residual asphalt content.

Answer – Gals. / Sq. Yd. of emulsified asphalt at 60 °F  
Answer: Yes or No

Step 1 – Calculate the square feet of roadway covered with tack  
 $1,000 \text{ ft.} \times 12 \text{ ft.} = 12,000 \text{ square feet}$

Step 2 – Calculate the square yards  
 $12,000 \text{ square feet} \div 9 \text{ sq. ft./sq. yd.} = 1333.33 \text{ sq. yd.}$

Step 3 – Correct number of gals. for temperature  
Reference CRS-2 (from table in SC-T-86) from a temperature of 125 ° F to 60 ° F  $M = 0.98375$   
 $175 \text{ Gallons} \times 0.98375 = 172.2 \text{ gallons of tack @ } 60 \text{ ° F}$

Step 4 – Calculate the application rate – gals./sq. yd.  
 $172.2 \div 1333.33 \text{ sq. yds.} = \underline{0.129 \text{ gals./sq. yd.}}$

Now, round off to 0.13 gals. sq. yd. Meet specs? Yes

## Tack Rate Problem #2

CRS-2 Tack will be applied to 12 foot wide roadway. The application will begin at Station 14+20 and end at Station 31+00. The temperature of the tack distributor is 140° F. How many gallons of CRS-2 are needed for an application rate of 0.05 gals/sq yd? Express answer in gallons to be applied by distributor.

Answer – Gallons @ 140° F

Step 1 – Calculate the square feet of roadway covered with tack  
 $(3100 - 1420 \text{ ft.}) \times 12 \text{ ft.} = 20,160 \text{ square feet}$

Step 2 – Calculate the square yards  
 $20,160 \text{ square feet} \div 9 \text{ sq. ft./sq. yd.} = 2240 \text{ sq. yd.}$

Step 3 – Calculate number of gallons needed for 0.05 gals/sq yd application rate  
 $0.05 \times 2240 \text{ sq. yds.} = 112 \text{ gallons (this is @ } 60 \text{ ° F)}$

Step 4 – Correct number of gals. for temperature  
Reference CRS-2 (from table in SC-T-86) from a temperature of 60 ° F to 140 ° F  $M = 0.98000$   
 $112 \text{ gallons} \div 0.98000 = \underline{114.29 \text{ gallons}}$

Now: Round off to 114.3 gals of tack @ 140 ° F

**HOMEWORK PROBLEM**  
**Tack Application Rate and Quantity**

**Determine the tack application rate and the number of tons of tack used on this project.** Use the following project information:

- 1) Type of emulsion - SS-1
- 2) Starting gallons – 4,251
- 3) Ending gallons - 964
- 4) Length of roadway covered in tack – 2.1 miles @ 26 feet wide
- 5) Temperature of tack - 140° F
- 7) Unit weight of SS-1 - 8.35 lbs./gals.

**(Round application rate to nearest 0.01 gals./sq. yd.  
and tons to 0.01 tons)**

**Tack Application Rate and Quantity  
SOLUTION**

**Step 1. Calculate # gals. of emulsified asphalt used**

$$4,251 - 964 = 3,287 \text{ gals.}$$

**Step 2. Convert gals. to 60° F**

$$3,287 \times 0.98 = 3,221.3 \text{ gals.}$$

**Step 3. Calculate sq. yds. of roadway tacked**

$$[2.1 (5280) \times 26] / 9 = 32,032 \text{ sq. yd.}$$

**Step 4. Calculate application rate (gals./sq. yd.)**

$$3,221 / 32,032 = 0.1006 \text{ or } \underline{\underline{0.10 \text{ gals. / sq. yd.}}}$$

**Step 5. Calculate total tons of emulsified asphalt used**

$$\begin{aligned} & \text{(gals. used} \times \text{unit wt.)} / 2000 \text{ lbs./ ton} \\ & (3,221 \times 8.35) / 2000 = \underline{\underline{13.45 \text{ tons}}} \end{aligned}$$

### Asphalt Mix Rate # 1

Asphalt mix was placed from station 0+00 to station 10+00. The lane width is 12 feet. How many tons of mix are needed to cover this section of roadway if the mix is placed at a rate of 150 pounds per square yard?

**Answer: Tons of mix**

Step 1 – Calculate the number of linear feet

$$1,000.0 - 0.00 = 1000 \text{ linear feet}$$

Step 2 – Calculate the sq. yds. of roadway

$$(1,000 \text{ ft.} \times 12 \text{ ft.}) \div 9 \text{ sq. ft./sq. yd.} = 1333.33 \text{ sq. yd.}$$

Step 3 – Calculate the pounds of asphalt mix needed to cover

$$1,333.33 \text{ sq. yd.} \times 150 \text{ lbs./sq. yd.} = 199,999.5 \text{ lbs. of mix}$$

Step 4 – Calculate the tons of asphalt mix

$$199,999.5 \text{ lbs.} \div 2000 \text{ lbs./ton} = \mathbf{99.99975}$$

**round off = 100.0 Tons**

### Asphalt Mix Quantity # 2

#### Taper Section

A lane that is 800 feet in length is 10 feet wide at the beginning and goes to 14 feet in width at the end. If you ran a rate of 125 pounds per square yard, how many tons would be needed to cover this section?

**Answer: Tons of mix**

Step 1 – Calculate the average width of the roadway

$$(10 \text{ ft.} + 14 \text{ ft.}) \div 2 = 12 \text{ ft. average width}$$

Step 2 – Calculate the sq. yds. of roadway

$$(800 \text{ ft.} \times 12 \text{ ft.}) \div 9 \text{ sq. ft./sq. yd.} = 1,066.67 \text{ sq. yd.}$$

Step 3 – Calculate the pounds of asphalt mix needed to cover

$$1,066.67 \text{ sq. yd.} \times 125 \text{ lbs./sq. yd.} = 133,337.5 \text{ lbs. of mix}$$

Step 4 – Calculate the tons of asphalt mix

$$133,337.5 \text{ lbs.} \div 2000 \text{ lbs./ton} = \mathbf{66.7 \text{ Tons}}$$

### Asphalt Mix Rate #3

You have determined that you have placed 115.7 tons of mix from Station 36+50 to Station 46+50. The width of paving is 12 feet. Your contract shows that the specified mix application rate is 150 pounds/sq. yd. What is your calculated mix application rate? What changes, if any, should be made to the paving operation?

Answer: lbs./sq. yd. of mix

- Step 1 – Calculate the number of linear feet  
 $4,650.0 - 3,650.0 = 1,000$  linear feet
- Step 2 – Calculate the sq. yds. of roadway  
 $(1,000 \text{ ft.} \times 12 \text{ ft.}) \div 9 \text{ sq. ft./sq. yd.} = 1333.33 \text{ sq. yd.}$
- Step 3 – Calculate the pounds of asphalt mix placed  
 $115.7 \times 2,000 = 231,400 \text{ lbs.}$
- Step 4 – Calculate the mix application rate  
 $231,400 \text{ lbs.} \div 1,333.33 \text{ sq. yd.} = \mathbf{173.55 \text{ lbs./sq.yd.}}$

Changes should be made to the paving operation since mix application rate is too high. Reduce thickness of mix placed by paver until calculated mix application rate is equal to 150 lbs./sq. yd.

### Roller Pattern 1<sup>st</sup> 100-ft Section (300 - 400 ft):

- Passes with Breakdown Roller until the mat breaks
  - If more than 4, contact AME unless it is pneumatic rubber tire roller
- 3 passes each with Intermediate and Finish Rollers

Form 400.02 Field Determination Of Target Density For Asphalt  
 Unique ID: \_\_\_\_\_ Date: 5/25/2012  
 Status: \_\_\_\_\_  
 File No.: \_\_\_\_\_  
 Road No.: \_\_\_\_\_  
 Road In to: \_\_\_\_\_ Southbound  
 Contractor: Quality Pavers  
 Inspector: R.J. Goode  
 Operator: Tess Wright  
 Offset: \_\_\_\_\_ Distance: \_\_\_\_\_ Station No: 3+00 to 4+00  
 Type of Mix: \_\_\_\_\_ Surface Type B Thickness: 2" (220 psy)  
 Lift: 1 Standard Count: \_\_\_\_\_  
 Control Strip No: 1 SCDOT Gauge No: \_\_\_\_\_

Roller / Mode	Passes	Density						Average Density	Remarks
		Site 1		Site 2		Site 3			
		Density	Temp.	Density	Temp.	Density	Temp.		
Vibratory Steel	1	139.4		138.6		140.2		139.4	
Vibratory Steel	2	140.9		140.1		141.7		140.9	
Vibratory Steel	3	141.5		140.7		142.3		141.5	Use
Vibratory Steel	4	141.4		140.6		142.2		141.4	Broke
Pneumatic	1								
Pneumatic	2								
Pneumatic	3								
Static Steel	1								
Static Steel	2								
Static Steel	3								

Twelve Random Readings:

1 \_\_\_\_\_  
 2 \_\_\_\_\_  
 3 \_\_\_\_\_  
 4 \_\_\_\_\_  
 5 \_\_\_\_\_  
 6 \_\_\_\_\_

Note: Omit highest and lowest reading when calculating Target Density

Established Target Density: \_\_\_\_\_  
 Roller Pattern: \_\_\_\_\_  
 Remarks: \_\_\_\_\_

Form 400.02

Field Determination Of Target Density For Asphalt

Unique ID: \_\_\_\_\_  
 Status: \_\_\_\_\_ Date: 5/25/2012  
 File No.: \_\_\_\_\_  
 Road No.: \_\_\_\_\_  
 Road Info: \_\_\_\_\_ Southbound  
 Contractor: \_\_\_\_\_ Quality Pavers  
 Inspector: \_\_\_\_\_ R.U. Goode  
 Operator: \_\_\_\_\_ Tess Wright  
 Offset: \_\_\_\_\_ Distance: \_\_\_\_\_ Station No: 3+00 to 4+00  
 Type of Mix: \_\_\_\_\_ Surface Type B Thickness: 2" (220 psy)  
 Lift: 1 Standard Count: \_\_\_\_\_  
 Control Strip No: 1 SCDOT Gauge No: \_\_\_\_\_

Roller / Mode	Passes	Density						Average Density	Remarks
		Site 1		Site 2		Site 3			
		Density	Temp.	Density	Temp.	Density	Temp.		
Vibratory Steel	1	139.4		138.6		140.2		139.4	
Vibratory Steel	2	140.9		140.1		141.7		140.9	
Vibratory Steel	3	141.5		140.7		142.3		141.5	Use
Vibratory Steel	4	141.4		140.6		142.2		141.4	Broke
Pneumatic	1								
Pneumatic	2								
Pneumatic	3								
Static Steel	1								
Static Steel	2								
Static Steel	3								

Twelve Random Readings:

1 \_\_\_\_\_  
 2 \_\_\_\_\_  
 3 \_\_\_\_\_  
 4 \_\_\_\_\_  
 5 \_\_\_\_\_  
 6 \_\_\_\_\_

Note: Omit highest and lowest reading when calculating Target Density

Established Target Density: \_\_\_\_\_

Roller Pattern: \_\_\_\_\_

Remarks: \_\_\_\_\_

**Roller Pattern 2<sup>nd</sup>  
100-ft Section (400 –  
500 ft):**

- # Passes for Breakdown Roller determined on previous 100-ft section
- Passes with Intermediate Roller until the mat breaks
  - If more than 4, contact AME unless it is pneumatic rubber tire roller
- 3 passes with Finish Roller

Form 400.02 Field Determination Of Target Density For Asphalt

Unique ID: \_\_\_\_\_ Date: 5/25/2012

Status: \_\_\_\_\_ File No.: \_\_\_\_\_

Road No.: \_\_\_\_\_ Road Info: \_\_\_\_\_ Southbound

Contractor: Quality Pavers

Inspector: R.U. Goode

Operator: Tess Wright

Offset: \_\_\_\_\_ Distance: \_\_\_\_\_ Station No: 4+00 to 5+00

Type of Mix: Surface Type B Thickness: 2" (220 ppy)

Lift: 1 Standard Count: \_\_\_\_\_

Control Strip No: 1 SCDOT Gauge No: \_\_\_\_\_

Roller / Mode	Passes	Density						Average Density	Remarks
		Site 1		Site 2		Site 3			
		Density	Temp.	Density	Temp.	Density	Temp.		
Vibratory Steel	1	140.4		139.8		141.2		140.4	
Vibratory Steel	2	141.9		141.1		142.7		141.9	
Vibratory Steel	3	142.5		141.7		143.3		142.5	
Pneumatic	1	143.2		142.4		144.0		143.2	
Pneumatic	2	143.9		143.1		144.7		143.9	
Pneumatic	3	144.6		143.8		145.4		144.6	Use
Pneumatic	4	144.4		143.8		145.2		144.4	Broke
Static Steel	1								
Static Steel	2								
Static Steel	3								

Twelve Random Readings:

1 \_\_\_\_\_

2 \_\_\_\_\_

3 \_\_\_\_\_

4 \_\_\_\_\_

5 \_\_\_\_\_

6 \_\_\_\_\_

Note: Omit highest and lowest reading when calculating Target Density

Established Target Density: \_\_\_\_\_

Roller Pattern: \_\_\_\_\_

Remarks: \_\_\_\_\_

**Roller Pattern 3<sup>rd</sup>  
100-ft Section (500 –  
600 ft):**

- # Passes for Breakdown and Intermediate Rollers determined on previous two 100-ft sections
- Passes with Finish Roller until the mat breaks
  - If more than 4, contact AME unless it is pneumatic rubber tire roller

Form 400.02 Field Determination Of Target Density For Asphalt

Unique ID: \_\_\_\_\_ Date: 5/25/2012

Status: \_\_\_\_\_ File No.: \_\_\_\_\_

Road No.: \_\_\_\_\_ Road Info: \_\_\_\_\_ Southbound

Contractor: Quality Pavers

Inspector: R.U. Goode

Operator: Tess Wright

Offset: \_\_\_\_\_ Distance: \_\_\_\_\_ Station No: 5+00 to 6+00

Type of Mix: Surface Type B Thickness: 2" (220 ppy)

Lift: 1 Standard Count: \_\_\_\_\_

Control Strip No: 1 SCDOT Gauge No: \_\_\_\_\_

Roller / Mode	Passes	Density						Average Density	Remarks
		Site 1		Site 2		Site 3			
		Density	Temp.	Density	Temp.	Density	Temp.		
Vibratory Steel	1	139.9		139.1		140.7		139.9	
Vibratory Steel	2	141.4		140.6		142.2		141.4	
Vibratory Steel	3	142.0		141.2		142.8		142.0	
Pneumatic	1	142.7		141.9		143.5		142.7	
Pneumatic	2	143.4		142.6		144.2		143.4	
Pneumatic	3	144.1		143.3		144.9		144.1	
Static Steel	1	144.5		143.7		145.3		144.5	
Static Steel	2	144.9		144.1		145.7		144.9	Use
Static Steel	3	144.8		144		145.6		144.8	Broke

Twelve Random Readings:

1 \_\_\_\_\_

2 \_\_\_\_\_

3 \_\_\_\_\_

4 \_\_\_\_\_

5 \_\_\_\_\_

6 \_\_\_\_\_

Note: Omit highest and lowest reading when calculating Target Density

Established Target Density: \_\_\_\_\_

Roller Pattern: \_\_\_\_\_

Remarks: \_\_\_\_\_

Form 400.02

Field Determination Of Target Density For Asphalt

Unique ID: \_\_\_\_\_  
 Status: \_\_\_\_\_ Date: 5/25/2012  
 File No.: \_\_\_\_\_  
 Road No.: \_\_\_\_\_  
 Road Info: \_\_\_\_\_ Southbound \_\_\_\_\_  
 Contractor: \_\_\_\_\_ Quality Pavers \_\_\_\_\_  
 Inspector: \_\_\_\_\_ R.U. Goode \_\_\_\_\_  
 Operator: \_\_\_\_\_ Tess Wright \_\_\_\_\_  
 Offset: \_\_\_\_\_ Distance: \_\_\_\_\_ Station No: 4+00 to 5+00  
 Type of Mix: \_\_\_\_\_ Surface Type B \_\_\_\_\_ Thickness: 2" (220 psy)  
 Lift: 1 Standard Count: \_\_\_\_\_  
 Control Strip No: 1 SCDOT Gauge No: \_\_\_\_\_

Roller / Mode	Passes	Density						Average Density	Remarks
		Site 1		Site 2		Site 3			
		Density	Temp.	Density	Temp.	Density	Temp.		
Vibratory Steel	1	140.4		139.6		141.2		140.4	
Vibratory Steel	2	141.9		141.1		142.7		141.9	
Vibratory Steel	3	142.5		141.7		143.3		142.5	
Pnuematic	1	143.2		142.4		144.0		143.2	
Pnuematic	2	143.9		143.1		144.7		143.9	
Pnuematic	3	144.6		143.8		145.4		144.6	Use
Pnuematic	4	144.4		143.6		145.2		144.4	Broke
Static Steel	1								
Static Steel	2								
Static Steel	3								

Twelve Random Readings:

1 \_\_\_\_\_  
 2 \_\_\_\_\_  
 3 \_\_\_\_\_  
 4 \_\_\_\_\_  
 5 \_\_\_\_\_  
 6 \_\_\_\_\_

Note: Omit highest and lowest reading when calculating Target Density

Established Target Density: \_\_\_\_\_  
 Roller Pattern: \_\_\_\_\_

Remarks: \_\_\_\_\_  
 \_\_\_\_\_

Form 400.02

Field Determination Of Target Density For Asphalt

Unique ID: \_\_\_\_\_  
 Status: \_\_\_\_\_ Date: 5/25/2012  
 File No.: \_\_\_\_\_  
 Road No.: \_\_\_\_\_  
 Road Info: \_\_\_\_\_ Southbound \_\_\_\_\_  
 Contractor: \_\_\_\_\_ Quality Pavers \_\_\_\_\_  
 Inspector: \_\_\_\_\_ R.U. Goode \_\_\_\_\_  
 Operator: \_\_\_\_\_ Tess Wright \_\_\_\_\_  
 Offset: \_\_\_\_\_ Distance: \_\_\_\_\_ Station No: 5+00 to 6+00  
 Type of Mix: \_\_\_\_\_ Surface Type B \_\_\_\_\_ Thickness: 2" (220 psy)  
 Lift: 1 Standard Count: \_\_\_\_\_  
 Control Strip No: 1 SCDOT Gauge No: \_\_\_\_\_

Roller / Mode	Passes	Density						Average Density	Remarks
		Site 1		Site 2		Site 3			
		Density	Temp.	Density	Temp.	Density	Temp.		
Vibratory Steel	1	139.9		139.1		140.7		139.9	
Vibratory Steel	2	141.4		140.6		142.2		141.4	
Vibratory Steel	3	142.0		141.2		142.8		142.0	
Pnuematic	1	142.7		141.9		143.5		142.7	
Pnuematic	2	143.4		142.6		144.2		143.4	
Pnuematic	3	144.1		143.3		144.9		144.1	
Static Steel	1	144.5		143.7		145.3		144.5	
Static Steel	2	144.9		144.1		145.7		144.9	Use
Static Steel	3	144.8		144		145.6		144.8	Broke

Twelve Random Readings:

1 \_\_\_\_\_  
 2 \_\_\_\_\_  
 3 \_\_\_\_\_  
 4 \_\_\_\_\_  
 5 \_\_\_\_\_  
 6 \_\_\_\_\_

Note: Omit highest and lowest reading when calculating Target Density

Established Target Density: \_\_\_\_\_  
 Roller Pattern: \_\_\_\_\_

Remarks: \_\_\_\_\_

**Setting Target Density (600 – 900 ft):**

- Use roller pattern just established
- 12 random density gauge readings
- Discard highest and lowest reading
- Target density is average of remaining 10 readings

Form 400.02 Field Determination Of Target Density For Asphalt

Unique ID: \_\_\_\_\_ Date: 5/25/2012

Status: \_\_\_\_\_

File No.: \_\_\_\_\_

Road No.: \_\_\_\_\_

Road Info: \_\_\_\_\_ Southbound

Contractor: Quality Pavers

Inspector: R.U. Goode

Operator: Tess Wright

Offset: \_\_\_\_\_ Distance: \_\_\_\_\_ Station No: 6+00 to 9+00

Type of Mix: \_\_\_\_\_ Surface Type B Thickness: 2" (220 ppy)

Lift: 1 Standard Count \_\_\_\_\_

Control Strip No: 1 SCDOT Gauge No: \_\_\_\_\_

Roller / Mode	Passes	Density						Average Density	Remarks
		Site 1		Site 2		Site 3			
		Density	Temp.	Density	Temp.	Density	Temp.		
Vibratory Steel	1	140.2		139.4		141.0		140.2	
Vibratory Steel	2	141.7		140.9		142.5		141.7	
Vibratory Steel	3	142.3		141.5		143.1		142.3	
Pneumatic	1	143.0		142.2		143.8		143.0	
Pneumatic	2	143.7		142.9		144.5		143.7	
Pneumatic	3	144.4		143.6		145.2		144.4	
Static Steel	1	144.8		144.0		145.6		144.8	
Static Steel	2	145.2		144.4		146.0		145.2	

**Twelve Random Readings:**

1	145.9	144.8
2	144.9	145.5
3	144.2	145.8
4	145.2	145.6
5	145.6	144.4
6	143.9	145.2

Note: Omit highest and lowest reading when calculating Target Density

Established Target Density: 145.1

Roller Pattern: 3 - 3 - 2

Remarks: \_\_\_\_\_

**Example 2: Setting Target Density (600 – 900 ft):**

- Between 300 and 600 feet, you just set a 3-4-3 roller pattern
- For 600 to 900 feet, use roller pattern you just determined

Form 400.02 Field Determination Of Target Density For Asphalt

Unique ID: \_\_\_\_\_ Date: 5/25/2012

Status: \_\_\_\_\_

File No.: \_\_\_\_\_

Road No.: \_\_\_\_\_

Road Info: \_\_\_\_\_ Northbound

Contractor: Quality Pavers

Inspector: R.U. Goode

Operator: Tess Wright

Offset: \_\_\_\_\_ Distance: \_\_\_\_\_ Station No: 6+00 to 9+00

Type of Mix: \_\_\_\_\_ Surface Type B Thickness: 2" (220 ppy)

Lift: 1 Standard Count 2568

Control Strip No: 1 SCDOT Gauge No: \_\_\_\_\_

Roller / Mode	Passes	Density						Average Density	Remarks
		Site 1		Site 2		Site 3			
		Density	Temp.	Density	Temp.	Density	Temp.		
Vibratory Steel	1	139.2		138.8		139.4		139.4	
Vibratory Steel	2	140.6		140.1		140.8		140.8	
Vibratory Steel	3	140.6		140.2		140.9		140.9	
Pneumatic	1	141.3		140.9		141.6		141.6	
Pneumatic	2	141.9		141.5		142.2		142.2	
Pneumatic	3	142.5		141.9		142.6		142.6	
Pneumatic	4	142.6		142.2		142.9		142.9	
Static Steel	1	143.6		143.2		143.8		143.8	
Static Steel	2	144.2		143.8		144.4		144.4	
Static Steel	3	144.3		144.9		144.4		144.4	

**Twelve Random Readings:**

1	144.1	7	144.5
2	144.5	8	145.2
3	143.9	9	144.1
4	144.2	10	143.8
5	144.9	11	144.2
6	144.3	12	144.4

Note: Omit highest and lowest reading when calculating Target Density

Established Target Density: \_\_\_\_\_

Roller Pattern: \_\_\_\_\_

Remarks: \_\_\_\_\_

Form 400.02

Field Determination Of Target Density For Asphalt

Unique ID: \_\_\_\_\_  
 Status: \_\_\_\_\_ Date: 5/25/2012  
 File No.: \_\_\_\_\_  
 Road No.: \_\_\_\_\_  
 Road Info: \_\_\_\_\_ Southbound \_\_\_\_\_  
 Contractor: \_\_\_\_\_ Quality Pavers \_\_\_\_\_  
 Inspector: \_\_\_\_\_ R.U. Goode \_\_\_\_\_  
 Operator: \_\_\_\_\_ Tess Wright \_\_\_\_\_  
 Offset: \_\_\_\_\_ Distance: \_\_\_\_\_ Station No: 6+00 to 9+00  
 Type of Mix: \_\_\_\_\_ Surface Type B \_\_\_\_\_ Thickness: 2" (220 psy)  
 Lift: 1 Standard Count: \_\_\_\_\_  
 Control Strip No: 1 SCDOT Gauge No: \_\_\_\_\_

Roller / Mode	Passes	Density						Average Density	Remarks
		Site 1		Site 2		Site 3			
		Density	Temp.	Density	Temp.	Density	Temp.		
Vibratory Steel	1	140.2		139.4		141.0		140.2	
Vibratory Steel	2	141.7		140.9		142.5		141.7	
Vibratory Steel	3	142.3		141.5		143.1		142.3	
Pnuematic	1	143.0		142.2		143.8		143.0	
Pnuematic	2	143.7		142.9		144.5		143.7	
Pnuematic	3	144.4		143.6		145.2		144.4	
Static Steel	1	144.8		144.0		145.6		144.8	
Static Steel	2	145.2		144.4		146.0		145.2	

Twelve Random Readings:

1	<u>145.9</u>	<u>144.8</u>
2	<u>144.9</u>	<u>145.5</u>
3	<u>144.2</u>	<u>145.8</u>
4	<u>146.2</u>	<u>144.6</u>
5	<u>145.6</u>	<u>144.4</u>
6	<u>143.9</u>	<u>145.2</u>

Note: Omit highest and lowest reading when calculating Target Density

Established Target Density: \_\_\_\_\_ 145.1 \_\_\_\_\_  
 Roller Pattern: \_\_\_\_\_ 3 - 3 - 2 \_\_\_\_\_

Remarks: \_\_\_\_\_  
 \_\_\_\_\_

Form 400.02

Field Determination Of Target Density For Asphalt

Unique ID: \_\_\_\_\_  
 Status: \_\_\_\_\_ Date: 4/25/2012  
 File No.: \_\_\_\_\_  
 Road No.: \_\_\_\_\_  
 Road Info: \_\_\_\_\_ Northbound \_\_\_\_\_  
 Contractor: \_\_\_\_\_ Quality Pavers \_\_\_\_\_  
 Inspector: \_\_\_\_\_ R.U. Goode \_\_\_\_\_  
 Operator: \_\_\_\_\_ Tess Wright \_\_\_\_\_  
 Offset: \_\_\_\_\_ Distance: \_\_\_\_\_ Station No: 6+00 to 9+00  
 Type of Mix: \_\_\_\_\_ Surface Type B \_\_\_\_\_ Thickness: 2" (220 psy)  
 Lift: 1 Standard Count: 2568  
 Control Strip No: 1 SCDOT Gauge No: \_\_\_\_\_

		Density						Average Density	Remarks
		Site 1		Site 2		Site 3			
Roller / Mode	Passes	Density	Temp.	Density	Temp.	Density	Temp.		
Vibratory Steel	1	139.2		138.8		139.4			
Vibratory Steel	2	140.6		140.1		140.8			
Vibratory Steel	3	140.6		140.2		140.9			
Pnuematic	1	141.3		140.9		141.6			
Pnuematic	2	141.9		141.5		142.2			
Pnuematic	3	142.5		141.9		142.6			
Pnuematic	4	142.6		142.2		142.9			
Static Steel	1	143.6		143.2		143.8			
Static Steel	2	144.2		143.8		144.4			
Static Steel	3	144.3		144.9		144.4			

Twelve Random Readings:

1	<u>144.1</u>	7	<u>144.5</u>
2	<u>144.5</u>	8	<u>145.2</u>
3	<u>143.9</u>	9	<u>144.1</u>
4	<u>144.2</u>	10	<u>143.8</u>
5	<u>144.9</u>	11	<u>144.2</u>
6	<u>144.3</u>	12	<u>144.4</u>

Note: Omit highest and lowest reading when calculating Target Density

Established Target Density: \_\_\_\_\_  
 Roller Pattern: \_\_\_\_\_

Remarks: \_\_\_\_\_

Example 2 Solution:  
Setting Target  
Density (600 – 900  
ft):

- Take 12 random density gauge readings
- Discard highest and lowest reading
- Target density is average of remaining 10 readings

Form 400.02 Field Determination Of Target Density For Asphalt

Unique ID: \_\_\_\_\_ Date: 4/25/2012

Status: \_\_\_\_\_

File No.: \_\_\_\_\_

Road No.: \_\_\_\_\_

Road Info: \_\_\_\_\_ Northbound

Contractor: Quality Pavers

Inspector: R.U. Goode

Operator: Tessa Wright

Ormet: \_\_\_\_\_ Distance: \_\_\_\_\_ Station No: 0+00 to 9+00

Type of Mix: \_\_\_\_\_ Surface Type B Thickness: 2" (220 ppy)

Lift: 1 Standard Count: 2568

Control Strip No: 1 SCDOT Gauge No: \_\_\_\_\_

Roller / Mode	Passes	Density						Average Density	Remarks
		Site 1		Site 2		Site 3			
		Density	Temp.	Density	Temp.	Density	Temp.		
Vibratory Steel	1	139.2		138.8		139.4		139.1	
Vibratory Steel	2	140.6		140.1		140.8		140.5	
Vibratory Steel	3	140.6		140.3		140.9		140.6	
Pneumatic	1	141.3		140.9		141.6		141.3	
Pneumatic	2	141.9		141.5		142.2		141.9	
Pneumatic	3	142.5		141.9		142.6		142.3	
Pneumatic	4	142.6		142.2		142.9		142.6	
Static Steel	1	143.6		143.2		143.8		143.5	
Static Steel	2	144.2		143.8		144.4		144.1	
Static Steel	3	144.3		144.9		144.4		144.5	

Twelve Random Readings:

1	144.1	7	144.5
2	144.5	8	145.2
3	143.9	9	144.1
4	144.2	10	143.8
5	144.9	11	144.2
6	144.3	12	144.4

Note: Omit highest and lowest reading when calculating Target Density

Established Target Density: 144.3

Roller Pattern: 3 - 4 - 3

Remarks: \_\_\_\_\_

## Nuclear Gauge Locations

You are placing Surface Course Type D in mainline paving at a width of 12 feet. At the beginning of the day, paving begins at Station 13+75 and ends at Station 47+05. The SCDOT Inspector randomly chooses to use the 1<sup>st</sup> set of random numbers. Determine the locations of your nuclear gauge readings in each subplot in accordance to SC-T-101 procedures.

**Step 1. Determine paving distance: 47+05 – 13+75 = 3,330 feet**

**Step 2. Sublot size is 500 ft. Take one nuclear gauge reading for every 500 ft paved.**

**3,330 ft ÷ 500 ft = 6.66, so at least 6 nuclear gauge readings required; may need to take 7**

**Step 3. Determine the random locations of nuclear gauge readings in each subplot based on the selected random number table in SC-T-101**

Form 400.02

Field Determination Of Target Density For Asphalt

Unique ID: \_\_\_\_\_  
 Status: \_\_\_\_\_ Date: 4/25/2012  
 File No.: \_\_\_\_\_  
 Road No.: \_\_\_\_\_  
 Road Info: \_\_\_\_\_ Northbound \_\_\_\_\_  
 Contractor: \_\_\_\_\_ Quality Pavers \_\_\_\_\_  
 Inspector: \_\_\_\_\_ R.U. Goode \_\_\_\_\_  
 Operator: \_\_\_\_\_ Tess Wright \_\_\_\_\_  
 Offset: \_\_\_\_\_ Distance: \_\_\_\_\_ Station No: 0+00 to 9+00  
 Type of Mix: \_\_\_\_\_ Surface Type B \_\_\_\_\_ Thickness: 2" (220 psy)  
 Lift: 1 Standard Count: 2568  
 Control Strip No: 1 SCDOT Gauge No: \_\_\_\_\_

Roller / Mode	Passes	Density						Average Density	Remarks
		Site 1		Site 2		Site 3			
		Density	Temp.	Density	Temp.	Density	Temp.		
Vibratory Steel	1	139.2		138.8		139.4		139.1	
Vibratory Steel	2	140.6		140.1		140.8		140.5	
Vibratory Steel	3	140.6		140.3		140.9		140.6	
Pnuematic	1	141.3		140.9		141.6		141.3	
Pnuematic	2	141.9		141.5		142.2		141.9	
Pnuematic	3	142.5		141.9		142.6		142.3	
Pnuematic	4	142.6		142.2		142.9		142.6	
Static Steel	1	143.6		143.2		143.8		143.5	
Static Steel	2	144.2		143.8		144.4		144.1	
Static Steel	3	144.3		144.9		144.4		144.5	

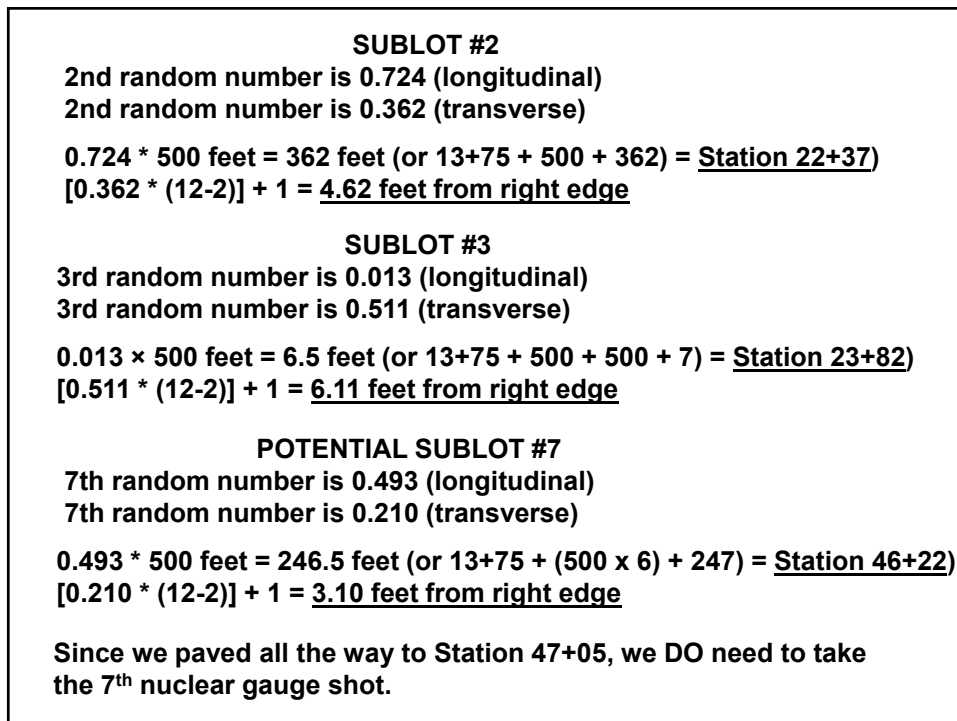
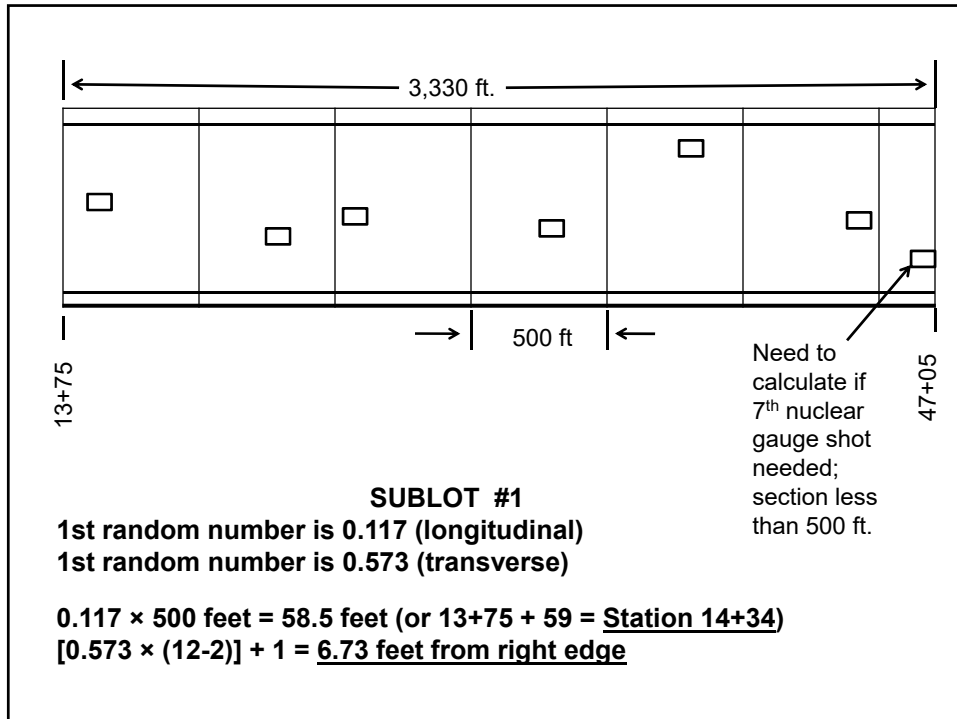
Twelve Random Readings:

1	<u>144.1</u>	7	<u>144.5</u>
2	<u>144.5</u>	8	<u>145.2</u>
3	<u>143.9</u>	9	<u>144.1</u>
4	<u>144.2</u>	10	<u>143.8</u>
5	<u>144.9</u>	11	<u>144.2</u>
6	<u>144.3</u>	12	<u>144.4</u>

Note: Omit highest and lowest reading when calculating Target Density

Established Target Density: \_\_\_\_\_ 144.3 \_\_\_\_\_  
 Roller Pattern: \_\_\_\_\_ 3 - 4 - 3 \_\_\_\_\_

Remarks: \_\_\_\_\_  
 \_\_\_\_\_



**CORE & DENSITY READING LOCATION WORK SHEET**

4/18/19

Date July 17 2025

Random Number Set 1 Core/Gauge? Gauge

Jane Doe  
Inspector

File # 32B

Sublots Length 500

Lane Width 12

Type Mix Surface D

SUBLOT	STA #	RANDOM #'S	FEET TO SAMPLE	SAMPLE LOCATION
1 rt or left lane	13+75 Begin STA	0.117 a	( 0.117 ) ( 500 ft ) = 58.5 a Sublot length c	13+75 + 59 = <u>14+34</u> Begin STA c Core STA Location
	18+75 End STA	0.573 b	( 0.573 ) ( 12-2 ) + 1 = 6.73 b (lane width - 2) d	<u>6.73 ft</u> From Right Edge or Center Line d
2 rt or left lane	18+75 Begin STA	0.724 a	( 0.724 ) ( 500 ft ) = 362 a Sublot length c	18+75 + 362 = <u>22+37</u> Begin STA c Core STA Location
	23+75 End STA	0.362 b	( 0.362 ) ( 12-2 ) + 1 = 4.62 b (lane width - 2) d	<u>4.62 ft</u> From Right Edge or Center Line d
3 rt or left lane	23+75 Begin STA	0.013 a	( 0.013 ) ( 500 ft ) = 6.5 a Sublot length c	23+75 + 7 = <u>23+82</u> Begin STA c Core STA Location
	24+25 End STA	0.511 b	( 0.511 ) ( 12-2 ) + 1 = 6.11 b (lane width - 2) d	<u>6.11 ft</u> From Right Edge or Center Line d

7 rt or left lane	43+75 Begin STA	0.493 a	( 0.493 ) ( 500 ft ) = 246.5 a Sublot length c	43+75 + 247 = <u>46+22</u> Begin STA c Core STA Location
	47+05 End STA	0.210 b	( 0.210 ) ( 12-2 ) + 1 = 3.10 b lane width - 2 d	<u>3.10 ft</u> From Right Edge or Center Line d

<b>Cores</b>	Requirements apply to <b>Intermediate B Special at rates ≤ 300 psy; Intermediate A and B; Surface A and B</b>	1 per 1,500-ft subplot
<b>Nuclear Gauge</b>	Requirements apply to <b>Base A, B, C and D; Intermediate B Special at rates &gt; 300 psy; Intermediate C; Surface C and D</b>	1 per 500-ft subplot

Shawn Salley, SCDOT Resident Maintenance Engineer; Saluda County

Revised 1/5/18

## Core Locations (QA Specifications)

You are placing Surface B in mainline paving at a width of 12 feet. Paving begins at Station 36+75 and ends at Station 90+90. The SCDOT Inspector randomly chooses to use the 21<sup>st</sup> set of random numbers. Determine the locations of your roadway cores in accordance to SC-T-101 procedures.

**Step 1. Determine paving distance:  $90+90 - 36+75 = \underline{5,415 \text{ feet}}$**

**Step 2. Determine subplot distance. For mainline paving with Surface B mixes, the subplot distance is 1,500 feet, so there will be at least three cores taken, possibly four.**

**Step 3. Determine the core locations based on random numbers.**

### CORE #1

1st random number is 0.853 (longitudinal)

1st random number is 0.611 (transverse)

$0.853 * 1,500 \text{ feet} = 1,280 \text{ feet (or } 36+75 + 1,280 = \underline{\text{Station } 49+55})$   
 $[0.611 * (12-2)] + 1 = \underline{7.11 \text{ feet from right edge}}$

### CORE #2

2nd random number is 0.489 (longitudinal)

2nd random number is 0.547 (transverse)

$0.489 * 1,500 \text{ feet} = 734 \text{ feet (or } 36+75 + 1,500 + 734 = \underline{\text{Station } 59+09})$   
 $[0.547 * (12-2)] + 1 = \underline{6.47 \text{ feet from right edge}}$

### CORE #3

3rd random number is 0.800 (longitudinal)

3rd random number is 0.371 (transverse)

$0.800 * 1,500 \text{ feet} = 1,200 \text{ feet (or } 36+75 + 1,500 + 1,500 + 1,200 = \underline{\text{Station } 78+75})$   
 $[0.371 * (12-2)] + 1 = \underline{4.71 \text{ feet from right edge}}$

**CORE & DENSITY READING LOCATION WORK SHEET**

4/18/19

**Date** July 16 2015

**Random Number Set** 21

**Inspector** Joe Blow

**File #** 1A

**Sublots Length** 1,500

**Lane Width** 12

**Type Mix Surface** B

SUBLOT	STA #	RANDOM #'S	FEET TO SAMPLE	SAMPLE LOCATION
1 rt or left lane	36+75 Begin STA	0.853 a	( 0.853 ) (1,500 ft) = 1,280 a Sublot length c	36+75 + 1,280 = <b>49+55</b> Begin STA c Core STA Location
	51+75 End STA	0.611 b	(0.611)(12 - 2) + 1 = 7.11 b lane width - 2 d	<b>7.11 ft</b> From Right Edge or Center Line d
2 rt or left lane	51+75 Begin STA	0.489 a	(0.489) (1,500 ft) = 734 a Sublot length c	51+75 + 734 = <b>59+09</b> Begin STA c Core STA Location
	66+75 End STA	0.547 b	(0.547)( 12-2 ) + 1 = 6.47 b lane width - 2 d	<b>6.47 ft</b> From Right Edge or Center Line d
3 rt or left lane	66+75 Begin STA	0.8 a	(0.800) (1,500 ft) = 1,200 a Sublot length c	66+75 + 1,200 = <b>78+75</b> Begin STA c Core STA Location
	81+75 End STA	0.371 b	( 0.371 ) ( 12-2 ) + 1 = 4.71 b lane width - 2 d	<b>4.71 ft</b> From Right Edge or Center Line d
4 rt or left lane	81+75 Begin STA	0.643 a	(0.643)(1,500 ft) = 965 a Sublot length c	<b>Station 91+40 past end of paving NO CORE</b> Begin STA c Core STA Location
	96+75 End STA	0.85 b	( _____ ) ( _____ ) + 1 = _____ b lane width - 2 d	<b>NO CORE</b> d

<b>Cores</b>	Requirements apply to <b>Intermediate B Special at rates ≤ 300 psy; Intermediate A and B; Surface A and B</b>	1 per 1,500-ft subplot
<b>Nuclear Gauge</b>	Requirements apply to <b>Base A, B, C and D; Intermediate B Special at rates &gt; 300 psy; Intermediate C; Surface C and D</b>	1 per 500-ft subplot

Shawn Salley, SCDOT Resident Maintenance Engineer; Saluda County

Revised 1/5/18

**CORE #4**

4th random number is 0.643 (longitudinal)

4th random number is 0.850 (transverse)

$$0.643 * 1,500 \text{ feet} = 965 \text{ feet (or } 36+75 + (1,500 \times 3) + 965 \\ = \text{Station } 91+40)$$

$$[0.850 * (12-2)] + 1 = \underline{9.50 \text{ feet from right edge}}$$

Fourth core will NOT be taken. However, if the station number for the fourth core had been before the ending station, the fourth core WOULD have been taken.

### Number of Cores (QA Specifications)

The table below shows mainline paving distances for a given week. The type of mixture is Intermediate Type A. For each day, determine the number of cores required.

Monday 43 <sup>rd</sup> set	Tuesday 16 <sup>th</sup> set	Wednesday 37 <sup>th</sup> set	Thursday 4 <sup>th</sup> set	Friday 22 <sup>nd</sup> set
7,215 feet	11,360 feet	4,295 feet	975 feet	2,475 ft

**Step 1. Determine subplot distance:** For mainline paving with Intermediate A mixes, the subplot distance is 1,500 feet. So, for every 1,500 feet, you are guaranteed to cut a core.

**Step 2. Determine the number of cores required for each day in accordance with SC-T-101.**

**Monday**

$$7,215 / 1,500 = 4.81$$

So, you are guaranteed to cut 4 cores required for each day in accordance with SC-T-101. Possibly cut 5<sup>th</sup> core.

Find the 5<sup>th</sup> random number for longitudinal distance for the 43<sup>rd</sup> set of random numbers.

5<sup>th</sup> random number is 0.147

$0.147 * 1,500 = 220.5$  feet (meaning that you would have paved 220.5 feet into the 5<sup>th</sup> subplot in order to cut the 5<sup>th</sup> core.

Check to see if a fifth core is needed.

$(4 * 1,500) + 220.5$  feet = 6,220.5 feet from the beginning Station; Since  $6,220.5 < 7,215$ , 5<sup>th</sup> core will be taken.

5 cores will be taken on Monday

**Tuesday**

$$11,360 / 1,500 = 7.57$$

So, you are guaranteed to cut 7 cores required for each day in accordance with SC-T-101. Possibly cut 8<sup>th</sup> core.

Find the 8<sup>th</sup> random number for longitudinal distance for the 16<sup>th</sup> set of random numbers.

8<sup>th</sup> random number is 0.575

$0.575 * 1,500 = 862.5$  feet (meaning that you would have paved 862.5 feet into the 8<sup>th</sup> subplot in order to cut the 5<sup>th</sup> core.)

Check to see if an eighth core is needed.

$(7 * 1,500) + 862.5$  feet = 11,362.5 feet from the beginning Station; Since  $11,362.5 > 11,360$ , 8<sup>th</sup> core will not be taken.

7 cores will be taken on Tuesday

**Wednesday**

$$4,295 / 1,500 = 2.86$$

So, you are guaranteed to cut 2 cores required for each day in accordance with SC-T-101. Possibly cut 3rd core.

Find the 3<sup>rd</sup> random number for longitudinal distance for the 37<sup>th</sup> set of random numbers.

3<sup>rd</sup> random number is 0.310

$0.310 * 1,500 = 465.0$  feet (meaning that you would have paved 465.0 feet into the 3<sup>rd</sup> subplot in order to cut the 3<sup>rd</sup> core.)

Check to see if a third core is needed.

$(2 * 1,500) + 465.0$  feet = 3,465.0 feet from the beginning Station; Since  $3,465.0 < 4,295$ , 3<sup>rd</sup> core will be taken.

3 cores will be taken on Wednesday

**Thursday**

Since 975 ft is less than 1,500 ft, no cores will be taken.

0 cores will be taken on Thursday

**Friday**

$$2,475 / 1,500 = 1.65$$

So, you are guaranteed to cut one core required for this day in accordance with SC-T-101. Possibly cut two cores.

Find the 2<sup>nd</sup> random number for longitudinal distance for the 22<sup>nd</sup> set of random numbers.

2<sup>nd</sup> random number is 0.243

0.243 \* 1,500 = 364.5 feet (meaning that you would have to pave 364.5 feet into the 2<sup>nd</sup> subplot in order to cut the 2<sup>nd</sup> core.)

Check to see if second core is needed.

(1 \* 1500) + 364.5 = 1,864.5 feet from the beginning Station; Since 1,864.5 < 2,475, 2<sup>nd</sup> core will be taken.

2 cores will be taken on Friday

### Calculations on Cores #1

Based on the information given calculate the volume, bulk specific gravity and bulk density. Then calculate the average bulk density of the cores.

Given:	Core #1	Core #2	
Weight in air	1190	Weight in air	1196 <b>A</b>
Weight in air SSD	1191	Weight in air SSD	1198 <b>B</b>
Weight in water	679	Weight in water	682 <b>C</b>

**A**  
**B-C**

Core #1

$$\frac{1190}{1191 - 679} = \frac{1190}{512} = 2.324 \times 62.4 = \underline{\underline{145.02 \text{ lbs./cu. ft.}}}$$

Note: Water = 62.4 lbs./cu. ft.

512 is the volume of core #1 (cu. Cm.)

2.324 is the bulk specific gravity

145.02 is the bulk density

Core #2

$$\frac{1196}{1198 - 682} = \frac{1196}{516} = 2.318 \times 62.4 = \underline{\underline{144.64 \text{ lbs./cu. ft.}}}$$

$$\text{Average Bulk Sp. Gr.} = (2.324 + 2.318) \div 2 = \underline{\underline{2.321}}$$

$$\text{Average Bulk Density} = (145.02 + 144.64) \div 2 = \underline{\underline{144.83 \text{ lbs./cu. ft.}}}$$

## Calculations on Cores

From the information below, calculate the percent of compaction of the roadway cores. The average daily maximum Specific Gravity = 2.445

Given:	Core #1	Core #2	
Weight in air	2158.0	Weight in air	2228.0 A
Weight in air SSD	2164.0	Weight in air SSD	2323.0 B
Weight in water	1227.8	Weight in water	1324.7 C

<b>A</b>
<b>B-C</b>

Core #1

$$\frac{2158}{2164-1227.8} = \frac{2158}{936.2} = 2.305 \text{ Bulk Specific Gravity}$$

$$(2.305 \div 2.445) \times 100 = 94.27 \text{ or } \underline{94.3\% \text{ of average max. Sp. Gr.}}$$

Core #2

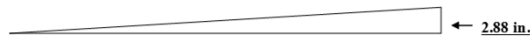
$$\frac{2228}{2323-1324.7} = \frac{2228}{998.3} = 2.232 = \text{Bulk Specific Gravity}$$

$$(2.232 \div 2.445) \times 100 = 91.29 \text{ or } \underline{91.3\% \text{ of average Max. Sp. Gr.}}$$

### Asphalt Roadway Technician Slope Problems: Examples

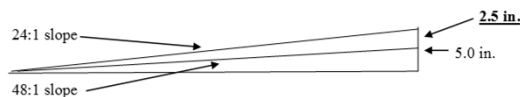
- 1) You are resurfacing a roadway that currently has 0% slope and a width of 12 feet. You are going to make a slope correction to 2%. Calculate the difference in elevation from the lower edge of the pavement to the upper edge.

Step One: Convert feet to inches  $12 \times 12 = 144$  inches  
 Step Two: Calculate 2% of 144 inches  $.02 \times 144 = \underline{2.88 \text{ inches}}$



- 2) The current roadway has a slope of 48:1, but needs to be corrected for a curve section that needs to be 24:1. The width of the pavement is 10 feet. Calculate the necessary elevation change for this section.

Step One: Convert feet to inches  $12 \times 10 = 120$  inches  
 Step Two: Calculate elevation at 48:1  $[(1/48) \times 120] = 2.5$  inches  
 Step Three: Calculate elevation at 24:1  $[(1/24) \times 120] = 5.0$  inches  
 Step Four: Calculate elevation change:  $5.0 \text{ in.} - 2.5 \text{ in.} = \underline{2.5 \text{ inches}}$



- 3) The roadway is 14 feet in width, and the road requires a 48:1 slope, what should be the change in elevation (height)?

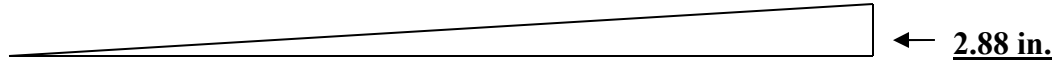
Step One: Convert feet to inches  $14 \times 12 = 168$  in.  
 Step Two: Calculate elevation at 48:1  $[(1/48) \times 168] = \underline{3.5 \text{ inches}}$



## Asphalt Roadway Technician Slope Problems: Examples

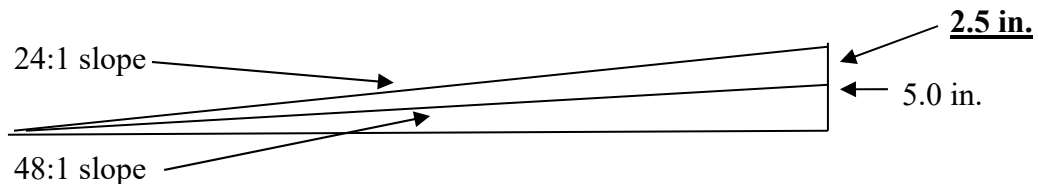
- 1) You are resurfacing a roadway that currently has 0% slope and a width of 12 feet. You are going to make a slope correction to 2%. Calculate the difference in elevation from the lower edge of the pavement to the upper edge.

Step One: Convert feet to inches       $12 \times 12 = 144$  inches  
 Step Two: Calculate 2% of 144 inches     $.02 \times 144 = \underline{\mathbf{2.88 \text{ inches}}}$



- 2) The current roadway has a slope of 48:1, but needs to be corrected for a curve section that needs to be 24:1. The width of the pavement is 10 feet. Calculate the necessary elevation change for this section.

Step One: Convert feet to inches       $12 \times 10 = 120$  inches  
 Step Two: Calculate elevation at 48:1     $[(1/48) \times 120] = 2.5$  inches  
 Step Three: Calculate elevation at 24:1    $[(1/24) \times 120] = 5.0$  inches  
 Step Four: Calculate elevation change:    $5.0 \text{ in.} - 2.5 \text{ in.} = \underline{\mathbf{2.5 \text{ inches}}}$



- 3) The roadway is 14 feet in width, and the road requires a 48:1 slope, what should be the change in elevation (height)?

Step One: Convert feet to inches       $14 \times 12 = 168$  in.  
 Step Two: Calculate elevation at 48:1     $[(1/48) \times 168] = \underline{\mathbf{3.5 \text{ inches}}}$

