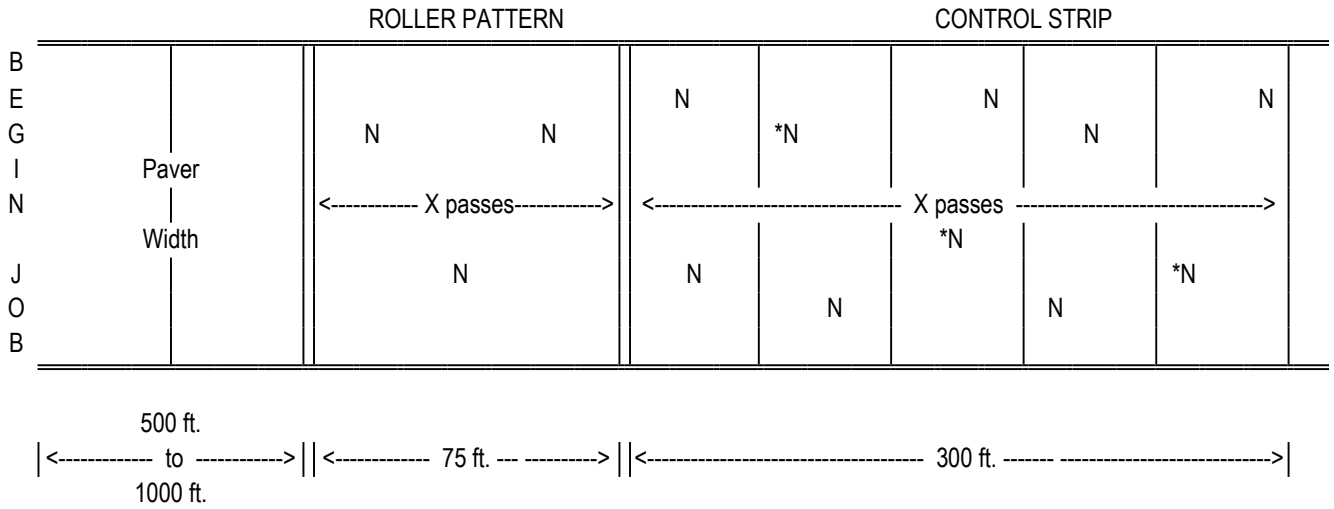
CHAPTER 8
DENSITY TESTING WITH THE THIN LIFT NUCLEAR DENSITY GAUGE

The Department of Transportation (VDOT) requires density testing of the asphalt mat in order to determine whether or not it meets the specifications set for that mix. The procedure explained here is used by VDOT and its Contractors to; 1) determine the compaction required for the mix with the **Roller Pattern**, 2) determine the density achieved by the roller pattern with the **Control Strip**, and then 3) to divide up and test the asphalt mixture into **Test Sections** for the rest of the project. The thin lift nuclear gauge is used for testing all asphalt courses. *It is the responsibility of the Contractor to furnish and operate the thin lift nuclear gauge.*

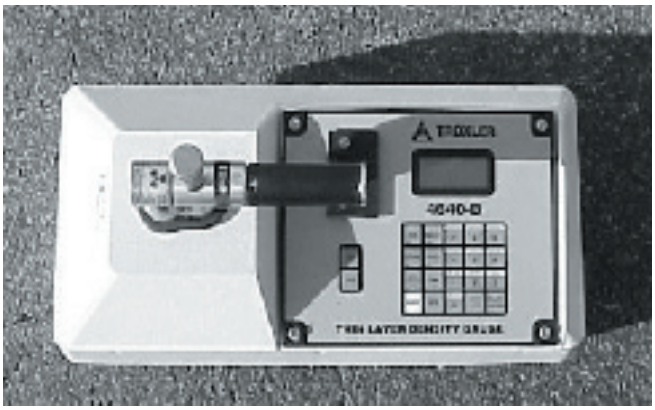
A test strip of 500 tons is required at the beginning of production for each new job mix to verify the design and the ability to achieve specified density.

The Roller Pattern Procedure can be found in VTM-76.

This is an illustration of the roller pattern and control strip, end to end. This is the way you will usually see them in the field. Place the material for the roller pattern first, then place the material for the control strip.



Standard Count Using The 4640 B Nuclear Gauge



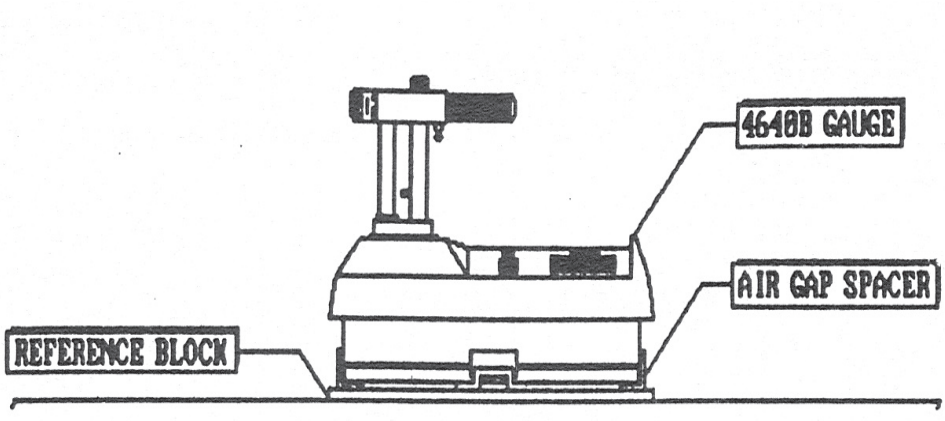
The standard count is taken daily to check the gauge operation, naturally occurring background radiation, and allow the gauge to compensate for natural source decay. The gauge is equipped with a reference block and an air gap spacer to take the standard count.

Standard Count Procedure:

- Establish an area at least 10 feet from any structure and 33 feet from other radioactive sources (such as another gauge) to take the standard count. This should be a dry flat area of concrete or asphalt at least 4 inches thick. Do not use truck beds, tailgates, or tabletops.

- Place the air gap spacer on the reference block.

- Then place the gauge on the air gap spacer. The gauge must be in the "safe" position. The air gap spacer has three legs, two on one end and one on the other. For stability, set the handle side of the gauge on the two-legged side of the air gap spacer. A stable gauge is critical for obtaining accurate readings.



4640B Gauge on Spacer and Reference Block

Taking the Standard Count

Press **< STD >** for the display:

- Standard Count-
xxxx.xxxx
Take a new
Standard Count

Press **< YES >** for the display:

Place Gauge on Spacer & both on Block, Put Rod in Safe, Press ENTER

Check the gauge position.
Press **< ENTER>** for the display:

Taking
Standard Count
xxx seconds
remaining

At the end of the count, the gauge beeps. Enter the count in the standard log and accept the count by pressing **< YES >** .

Test readings may be taken when the gauge is in the **"Ready"** mode.

Note: If the count fails, refer to the gauge's "Manual of Operation and Instruction Guide " for further instructions or contact your District Materials Section for assistance.

Roller Pattern

The purpose of the roller pattern is to determine the number of passes required to get the maximum density for that mix. Since so many things can affect the compaction of an asphalt mat, it is critical that everything - the source of materials, the equipment and the way it is used, and the underlying pavement structure be consistent. If any one of these things changes, a new roller pattern should be constructed.

When an asphalt mix is compacted, density is increased with each pass of the roller until maximum density is achieved. At this point, additional passes may cause the mat to decompact, or lose density. This is what is called the "break" in the curve.

Roller Pattern Construction (VTM -76) -

The following items are needed before beginning the Roller Pattern/Control Strip:

- ► Approved Mix Design
- ► Approved paving equipment
- ► Nuclear gauge template and white or other approved spray paint
- ► Thin-lift nuclear density gauge with printer, meeting requirements of VTM-81
- ► Magnesium nuclear gauge calibration block
- ► Measuring device that will measure from 1 to 1000 feet
- ► Rotary saw or coring machine for sawing core/ or plug by a dry method.
- ► Equipment to weigh cores or plugs (VTM-6)
- ► Maximum specific gravity of the mix as determined by VTM-22

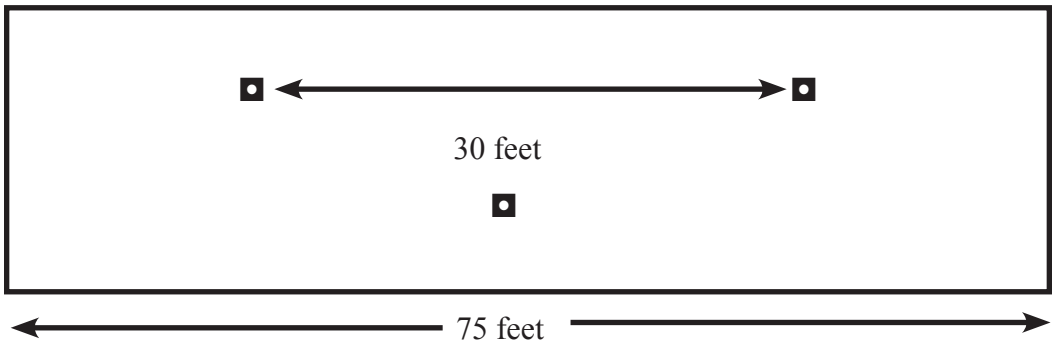
A roller pattern is required at the beginning of each course on the roadway and shoulder. If there is a significant change in the mix, a different job-mix is used, the compaction equipment changes, or the surface that the mix is being placed on changes, a new roller pattern must be established.

- Make sure that the thickness placed for the roller pattern is the same as the course it represents.
- Place enough asphalt to construct the roller pattern. Allow 25 to 50 feet on either end of the roller pattern section for the roller to maneuver.
- It is recommended that the paving train stop while the roller pattern is being constructed.
- Begin the roller pattern by making (2) two passes of the roller over the 75-foot roller pattern area. Make the 2 passes over the entire width of the pavement. (one pass is "up", two passes is "up and back")

Note: Use judgment and experience to make the maximum number of passes before beginning the nuclear gauge readings. (If a mix has historically taken 6 passes of the roller to achieve compaction, make 4 passes before taking the first readings.)

- Select three locations to be tested in the 75-foot roller pattern. Two locations should be approximately 30-feet apart on one side of the lane and the third location on the opposite side of the lane between the first two locations.

- Mark the test site locations after the first 2 passes of the roller. This is necessary since the same test site location must be used for each reading.
- To take the test, the gauge should be positioned so that it is parallel with the centerline of the roadway and set in the 30-second mode. It is important that the gauge is always oriented in the same direction so the same location is being tested. To do this, always position the gauge with the source rod towards the paving train.



▣ Test Location

Roller Pattern Test Locations

- Test the 3 locations after the first two passes of the roller. Record the readings on the **Asphalt Nuclear Density Thin-Lift Roller Pattern Worksheet TL-56 .** Calculate the average density of the 3 locations and plot the average density in pounds per cubic foot versus the number of roller passes on the **Asphalt Nuclear Density Thin-Lift Roller Pattern Graph, TL-57. (See pages 9-6 and 9-7 for TL forms)**
- Continue this procedure - rolling and testing of the section until the roller pattern reaches its maximum density. To achieve maximum density, the mat shall be rolled until the average density decreases. After the first decrease in density, make one additional pass, in the static mode, over the entire width of the mat to ensure that there is not a false break. If the mat continues to decrease in density, then the maximum density will be the density achieved one roller pass before the initial decrease in density.

  A false break occurs when the density increases after a decrease in density. If this happens, continue to make passes with the roller in the static mode until the density decreases a second time. Then make one additional pass to verify the break. The maximum density will be the greatest density achieved at the least number of passes.

Note: Typically a decrease of 0.5 lb/ft^3 will indicate maximum density has been achieved.

- Record the densities measured and averages on the TL-56 form and graph the averages on the TL-57 form.
- At this point the Roller Pattern is complete, maximum density has been attained. You can begin laying the asphalt for the Control Strip.

TL-56(Rev- 4/05)

ASPHALT NUCLEAR DENSITY THIN ROLLER PATTERN - LIFT WORKSHEET

Control Strip No: 1

Project or Schedule: PM-2D-05 Item No. _____ Date: 6/21/05

Route: 81 From: 13.76 To: 11.04

Directional Lane (NBL, SBL, etc.): SBL Lane (inside, center, etc.): PASSING

Mix Type: SM-12.5D Application Rate: 165 lbs/yd² (_____ kg/m²)

Producer: Asphalt, Inc Location: Ketchum, VA

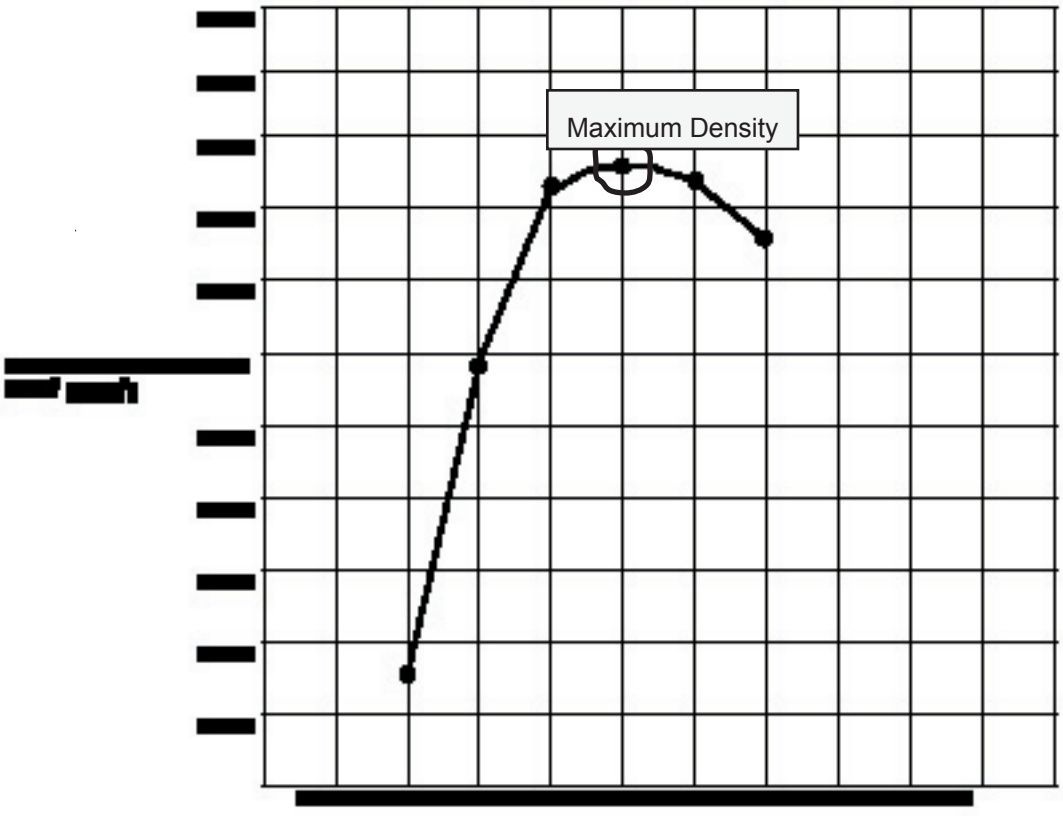
Roller Type: Roller 1: DD-130 Roller 2: DD-110 Roller 3: _____

Roller Pattern Data

Gauge Model: 4640B Serial No: 401 Calibration Date: 4/24/05 Depth Setting: 1.5 in. (mm)

Pass No	Nuclear Density	Pass No	Nuclear Density
2 v		6 (3s)	
Site 1	135.5	Site 1	142.7
Site 2	136.6	Site 2	143.9
Site 3	134.8	Site 3	140.2
AVERAGE	**135.6**	AVERAGE	**142.3**
Pass No 3 v	Nuclear Density	Pass No 7(4s)	Nuclear Density
Site 1	139.5	Site 1	142.3
Site 2	142.4	Site 2	143.0
Site 3	137.9	Site 3	139.5
AVERAGE	**139.9**	AVERAGE	**141.6**
Pass No 4 (1s)	Nuclear Density	Pass No	Nuclear Density
Site 1	142.6	Site 1	
Site 2	144.0	Site 2	
Site 3	139.9	Site 3	
AVERAGE	**142.2**	AVERAGE	
Pass No 5 (2s)	Nuclear Density	Pass No	Nuclear Density
Site 1	142.7	Site 1	
Site 2	144.4	Site 2	
Site 3	140.5	Site 3	
AVERAGE	**142.5**	AVERAGE	

Testing Performed by: J. M. Jones Observed by: C. C. Smith
VDOT Inspector


Maximum Density

Control Strip

In Virginia, the stratified random sampling method is used to determine the locations for density testing in the contol strip. Stratified random sampling is "sampling from equal portions of a lot at locations that have been selected solely by chance". Any statistically acceptable method of randomization may be used to determine the location of the stratified random sample to be taken; however, the method must be approved by the Engineer prior to beginning testing. All random locations shall be determined for each test site prior to the beginning of the paving operation. Below is the procedure for one of several acceptable methods of stratified random sampling for a control strip.

Stratified Random Sampling for Control Strip:

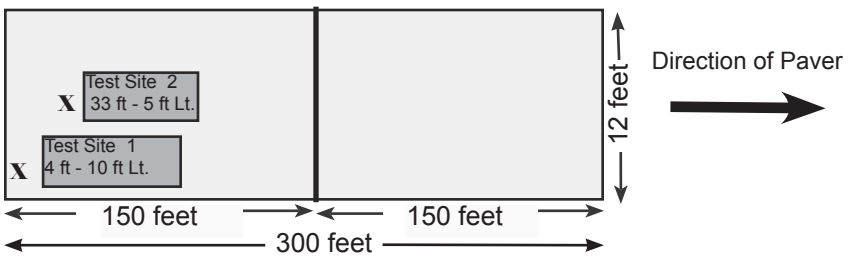
To determine test site locations, select ten numbers from the Random Numbers Table (see example below) under "Distance from beginning of Control Strip" and the corresponding numbers under "Paving Width - Distance From Reference Line".
Make sure to choose the correct width of the pavement to select proper distance from the reference line.

For this example, the pavement width is 12 feet and the reference line is on the left. The first test site location will be 4 feet from the start of the control strip and 10 feet from the reference line. (See the Table below and the TL-58 on the next page.)

Random NumbersTable

Distance From beginning of Control Strip	Distance from Sublot Start	Paving Width / Distance From Reference Line						
Control Strip	Test Section	8 ft. width	9 ft. width	10 ft. width	11 ft. width	12 ft. width	13 ft. width	14 ft. width
4	73	Test Site 1 location			7	10	10	6
33	653	Test Site 2 location			7	5	3	1
89	955	Test Site 3 location			3	10	4	9
110	583	Test Site 4 location			6	10	9	6
120	351	Test Site 5 location			7	7	11	11
155	715	Test Site 6 location			8	5	7	8
203	49	Test Site 7 location			3	10	8	1
219	11	Test Site 8 location			6	9	6	4
254	358	Test Site 9 location			7	2	5	5
282	239	Test Site 10 location			7	8	8	10

X = Test Location



TL-58 (Rev. 4/05)

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

Control Strip Number 1

Project or Schedule PM-2D-05 Item Number _____ Date 6/21/05

Route 81 From 8.23 To 16.25

Directional Lane SBL (NBL, SBL, etc) Lane Passing (Inside, Center, etc.)

Mix Type SM-12.5D Application Rate 165 lbs/yd² (kg/m²)

Producer Asphalt, Inc Location Ketchum, VA

CONTROL STRIP TARGET DENSITY DETERMINATION

Gauge Model 4640B Serial Number 401 Calibration Date 4/24/05 Depth Setting 1.5 in (mm)

TEST SITE	DISTANCE	OFFSET	ENTER GAUGE READING			
Site 1	4 ft.	10 ft. Lt	141.1	lb/ft³	(	kg/m³)
Site 2	33 ft.	5 ft. Lt	137.4	lb/ft³	(	kg/m³)
Site 3	89 ft.	10ft. Lt	141.9	lb/ft³	(	kg/m³)
Site 4	110 ft.	10 ft. Lt	144.1	lb/ft³	(	kg/m³)
Site 5	120 ft.	7 ft. Lt	142.8	lb/ft³	(	kg/m³)
Site 6	155 ft.	5 ft. Lt	143.8	lb/ft³	(	kg/m³)
Site 7	203 ft.	10 ft. Lt	143.0	lb/ft³	(	kg/m³)
Site 8	219 ft.	9 ft. Lt	138.0	lb/ft³	(	kg/m³)
Site 9	254 ft.	2 ft. Lt	144.1	lb/ft³	(	kg/m³)
Site 10	282 ft.	8 ft. Lt	137.9	lb/ft³	(	kg/m³)
		Total	1414.1	lb/ft³	(	kg/m³)
		Average	141.4	lb/ft³	(	kg/m³)

Numbers selected from the Random Numbers Table

Remarks:

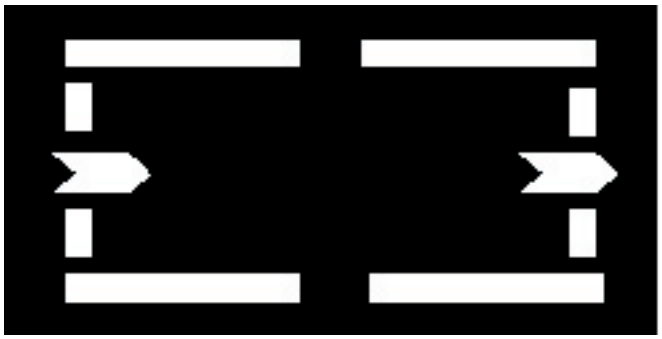
Testing Performed by _____ Observed by _____

VDOT Inspector

Control Strip Procedure:

1) Lay Hot Mix Asphalt (HMA) for the 300-foot control strip and compact the mat using the number of passes determined in the roller pattern. Stratify (divide into equal sections) the 300-foot control strip in a manner approved by the Engineer. Using the nuclear gauge template (see figure below), mark the ten stratified random locations that will be used to determine the target density. Do not take readings within 12 inches of an unconfined edge for surface and intermediate mixes, or within 18 inches of an unconfined edge for base mixes.

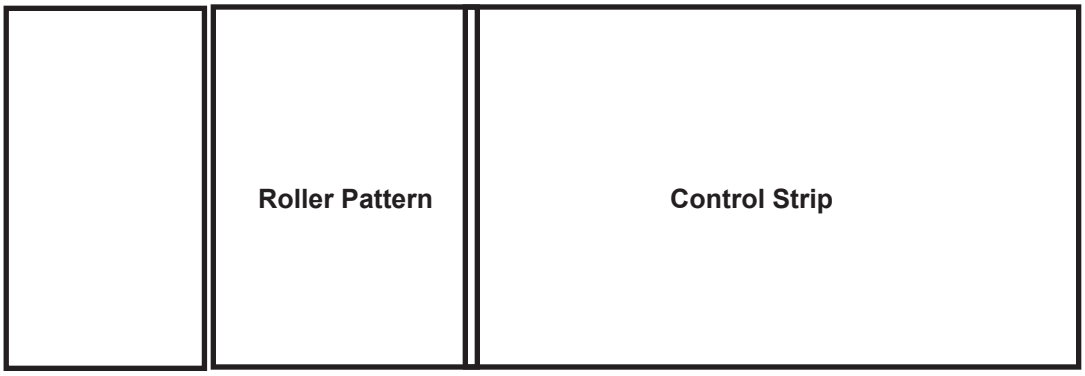
Place the template on the mat and position it parallel to the roadway with the arrows pointing in the direction of the paver. Spray paint the template with white or other approved paint such that the underlying pavement is marked with paint through the cutouts in the template. These locations should be clearly visible when the template is removed. Once the gauge location is marked, remove the template.



Nuclear Gauge Template

2) Place the nuclear gauge within the area marked by the template with the source rod toward the paver. Take the nuclear density readings in lb/ft^3 using the one-minute mode at the ten (10) stratified random locations marked in the 300 -foot control strip section. Record the locations and density readings on the Asphalt Nuclear Density Thin-Lift Worksheet, Control Strip Target Density, form TL-58 (see page 9-9). The average of these 10 readings is the Target Density.

The density for acceptance of the rest of the project (Test Sections) is measured against this "Target Density".



3) Cores/plugs are cut to verify that the specified density has been achieved in the control strip. Two cores/plugs shall be taken for density determination from each of three (3) of the ten (10) nuclear gauge reading locations in the 300-foot control strip section. **The sites for the three sets of cores should be the three sites closest to the target density (average of the ten readings).**

Dry cut the cores/plugs for density testing. The cores/plugs are to be 4"x 4" square if sawn or 4" in diameter if taken with a drill. If a drill is used to obtain the cores, no water shall be used. Mark the location of the core. Freeze the roadway using CO_2, dry ice, or another approved method. Cut the core using the saw or drill. Freeze the road a second time after cutting. Then gently pry around the core/plug to break it loose from the underlying layer. Take care not to damage the core/plug or break off any corners. If the core/plug is damaged, it must be discarded and another core/plug taken from the same area. Measure the thickness of the core/plug and record on the **TL-60** form (see page 9-13).

The procedure for taking the cores/plugs is found in VTM-22. The apparatus and procedure for determining the bulk specific gravity of the cores/plugs is in VTM-6. (See Appendix A for these test methods.)

4) Determine the density calculations on the two (2) cores from each of the three (3) sites. Record the weights and calculations for the cores/plugs on the **TL-60** form. Compute the average bulk specific gravity of the cores/plugs using VTM-6. If the average bulk specific gravity of the six cores/plugs meets the minimum specified density for that mix, the roller pattern is accepted and the target density will then be used to determine acceptance in the test sections.

When the same job mix is used on a roadway other than the one for which the cores/plugs were taken for density determination, no cores/plugs are needed unless directed by the Engineer. However, the 375-foot roller pattern/control strip shall be constructed to determine the roller pattern and target density for this roadway.

Always consult the Materials Section in the District in which you are paving for guidance as to when roller patterns and cores/plugs should be taken.

The percent density of the cores/plugs is determined by dividing the Average SSD Bulk Specific Gravity, as calculated on the TL-60, by the Current Maximum Specific Gravity* (G_{mm}) of the mix, and multiplying by 100. The equation for this calculation is:

(Avg. SSD BSG/G_{mm}) x 100 = Avg % Density

The average percent density is then compared to the Minimum Control Strip Density listed in the Road and Bridge Specifications - Section 315.05(e)1. Table III-3

Table III-3 Density Requirements	
Mix Type	**Min. Control Strip Density %**
SM-9.5A, SM-12.5A	92.5
SM-9.5D, SM-12.5D	92.2
SM-9.5E, SM-12.5E	92.2
IM-19.0A	92.2
IM-19.0D	92.0
BM-25.0A, BM-25.0D	91.5

**A current maximum specific gravity is defined in VTM-22 as:*
The theoretical maximum specific gravity (G_{mm}) used for this calculation is determined by a moving average of five (5) values. On the first day of production of a mix, the producer's lab should have a G_{mm} from the sample taken that morning by the time you are ready to determine the density of the cores/plugs on the road.

After taking the ten readings in the contol strip, verifing the density with the cores/plugs, and establishing the target density, divide the rest of the project into Test Sections.

TL 60 (Rev.4/05)

VIRGINIA DEPARTMENT OF TRANSPORTATION
ASPHALT NUCLEAR DENSITY WORKSHEET
ROLLER PATTERN/SAWN PLUGS & CONTROL STRIP TARGET DENSITY

Control Strip No. 1

Schedule PM-2D-04 Item No. _____ Date 6/21/05

Route 81 From: 13.76 To: 11.04

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

Mix Type SM12.5D 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 Topping, VA

NUCLEAR CALIBRATION CHECK

	A	B	C	D	E	F		G		H	
Sawed Spec. Number	Weight in Air (g)	Weight in Water (Total g)	Basket Tare Weight (g)	Weight in Water (g) B - C	SSD Weight In Air (g)	Volume E-D	SSD Bulk Specific Gravity A ÷ F	Average SSD Bulk Per Site	Sawed Specimen Thickness In. (mm)	Target Test Site Nuclear (from TL-58)	
1	1125	626	xxx	626	1131	505	2.23	2.26	1.5	141.1	1
2	1121	639	xxx	639	1129	490	2.29		1.5	137.4	2
										141.9	3
3	1123	631	xxx	631	1130	499	2.25		1.5	144.1	4
								2.24		142.8	5
4	1126	625	xxx	625	1132	507	2.22	3 sites closest to target nuclear density		143.8	6
										143.0	7
5	1120	619	xxx	619	1126	507	2.21	2.23	1.5	138.0	8
										144.1	9
6	1123	632	xxx	632	1131	499	2.25		1.5	137.9	10
										1414.4	Total

Average 2.24 (Sum of G/3) 141.4 (Sum of H/10)

Max Specific Gravity (G_{mm}) 2.424

A. Sawed Specimen Average % Density 92.4 % (avg. SSD Bulk Sp. Gr. /G_{mm} x 100)

B. Minimum Design Density (Table III – 3 of sec. 315) 92.2 %
*(A must equal or exceed B)

C. Target Nuclear Density 141.4 lb/ft³

Gauge Model 4640B Serial No. 401 Calibration Date 4/24/05 Depth Setting 1.5 In (mm)

Pay Quantity _____ Ton (Metric Ton)
Lot length x width x application rate/ 18000

Testing Performed by G.O. Strait Observed by T.F. Baker

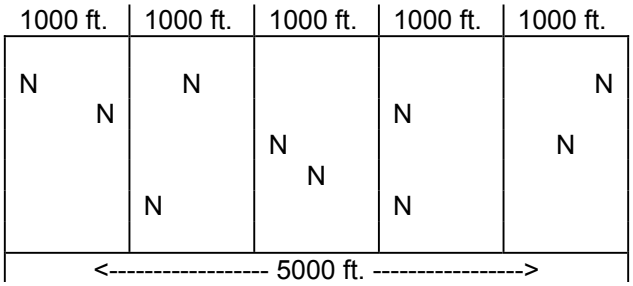
Test Sections

After the roller pattern has been approved and the target density is set, the rest of the project is divided up into test sections. The density of the test sections is measured to determine the percent of payment for the asphalt mixture.

The standard size of a lot is 5000 feet, regardless of width or thickness. The tonnage of each lot varies as it is based on width and appication rate as shown in the contract or revised by the Engineer.

Test Sections

N = Test Location



Each lot is divided into 5 sublots of 1000 feet each. Take two readings in each sublot, for a total of ten readings per lot. See page 15 for example of stratified random sampling for determination of test section reading locations.

5000 Linear Feet	Sublot
1 - 1000	1
1001 - 2000	2
2001 - 3000	3
3001 - 4000	4
4001 - 5000	5

If at the end of a day a partial lot is left, redefine the lot as follows:

- If the partial lot is 1-2000 feet (1 or 2 sublots), add it to the previous lot. This lot will then have 6 or 7 sublots.
- If the partial lot has 2001 – 5000 feet (3 or 4 sublots), make it a lot on its own with 3 or 4 sublots.

Procdedure for Statified Randsom Sampling for Test Sections:

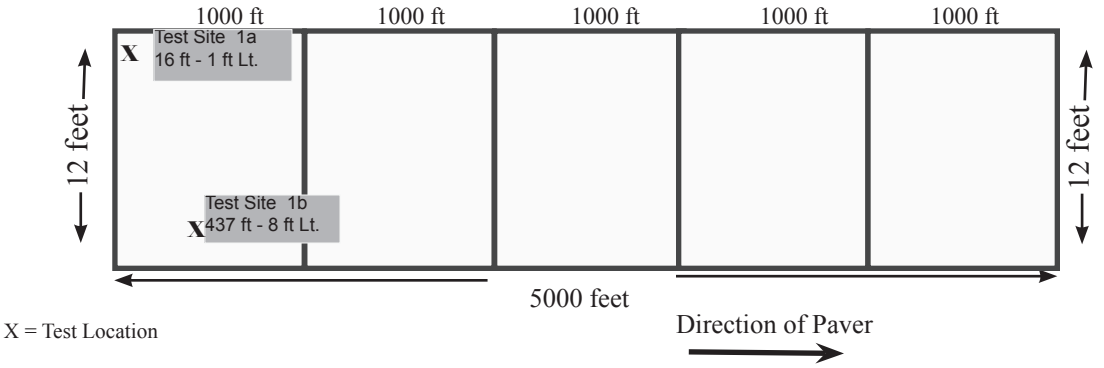
Any statistically acceptable method of randomization may be used to determine the location of the stratified random sample to be taken; however, the method must be approved by the Engineer prior to beginning testing. All random locations shall be determined for each test section prior to the beginning of the paving operation. Listed below is the procedure for one of several acceptable methods of stratified random sampling for a test section.

- Select ten numbers from the Random Numbers Table (see example below) under **"Distance from Sublot Start"**
- Then select the corresponding numbers under **"Paving Width - Distance From Reference Line"**.

Make sure to choose the correct width of the pavement to select proper distance from the reference line.

For this example, the pavement width is 12 feet. The reference line is on the left for this example. The first test site location will be 16 feet from the start of the control strip and 1 foot from the reference line.

Distance From beginning of Control Strip	Distance from Sublot Start	Paving Width						
		Distance From Reference Line						
Control Strip	Test Section	8 ft. width	9 ft. width	10 ft. width	11 ft. width	12 ft. width	13 ft. width	14 ft. width
17	16	2	Test Site 1a location		2	1	2	4
57	437	6	Test Site 1b location		9	8	11	11
63	412	5	4	8	2	3	7	11
118	964	5	3	8	6	10	6	8
129	113	3	7	7	10	9	2	11
157	834	3	4	3	3	2	9	7
192	92	1	6	5	9	7	5	1
237	959	3	3	6	4	6	4	5
246	716	6	8	8	2	3	4	7
280	402	1	4	2	3	4	8	9



TL-59(Rev. 4/05)

ASPHALT NUCLEAR DENSITY TEST SECTION

Project or Schedule: PM-2D-05 | Item No. | Date: 6/21/05
Route: 81 | Mile Post From: 13.76
Directional Lane: SBL (NBL, SBL, etc.) | Mile Post To: 11.04 | Lane: Passing (inside, center, etc.)

Mix Type: SM-12.5D | Application Rate: 165 lbs/yd² (kg/m²)

Mix Producer: ASPHALT, INC | Plant Location: Blacktop, VA

Lot No: 1 | Width of Application: 12 | Lot Length: 5000 ft (m)

Gauge Model: 4640 | Serial Number: 401 | Calibration Date: 5/16/05 | Depth Setting: 1.5 in. (mm)

Sublot Number	Lane (Inside, Center, etc.)	Test Site Location: Distance	Test Site Location: Offset	Nuclear Density lb/ft³ (kg/m³)	Sublot Average lb/ft³ (kg/m³)
1a	PASSING	16 ft.	1 ft. Lt.		
1b	PASSING	437 ft.	8ft. Lt.		
2a	PASSING	412 ft.	3 ft. Lt.		
2b	PASSING	964 ft.	10 ft. Lt.		
3a	PASSING	113 ft	9ft. Lt.		
3b	PASSING	834 ft	2 ft. Lt.		
4a	PASSING	92 ft.	7 ft. Lt.		
4b	PASSING	959 ft.	6 ft. Lt.		
5a	PASSING	716 ft.	3 ft. Lt.		
5b	PASSING	402 ft.	4 ft. Lt.		
6a					
6b					
7a					
7b					

Numbers selected from the Random Numbers Table

Average: lb/ft³ (kg/m³)

Target Nuclear control Strip Density: 141.4 lb/ft³ (kg/m³)

Control Strip No: 1 | % of Target Nuclear Control Strip Density: (Average/Target*100) | 98 – 102 (Acceptance Range)

Pay Quantity: Ton (Metric Ton)
Lot length x width x application rate / 18000

Remarks:

Testing Performed by: J. M. Jones | Observed by: C. C. Smith VDOT Inspector

Random Number Table

Distance From Beginning of Control Strip	Distance From Sublot Start	Paving Width						
		Distance From Reference Line						
Control Strip	Test Section	8 ft. width	9 ft. width	10 ft. width	11ft. width	12 ft. width	13 ft. width	14 ft. width
4	73	2	2	3	7	10	10	6
33	653	4	8	7	7	5	3	1
89	955	5	7	5	3	10	4	9
110	583	6	4	2	6	10	9	6
120	351	2	4	7	7	7	11	11
155	715	2	7	3	8	5	7	8
203	49	3	7	8	3	10	8	1
219	11	1	7	2	6	9	6	4
254	358	5	2	2	7	2	5	5
282	239	1	6	6	7	8	8	10
17	16	2	4	5	2	1	2	4
57	437	6	4	8	9	8	11	11
63	412	5	4	8	2	3	7	11
118	964	5	3	8	6	10	6	8
129	113	3	7	7	10	9	2	11
157	834	3	4	3	3	2	9	7
192	92	1	6	5	9	7	5	1
237	959	3	3	6	4	6	4	5
246	716	6	8	8	2	3	4	7
280	402	1	4	2	3	4	8	9
18	81	7	7	2	4	2	8	4
59	142	1	4	5	5	7	2	6
83	67	6	5	2	3	2	2	12
93	569	2	4	6	3	5	3	1
120	728	2	6	7	5	4	12	12
151	902	1	3	5	4	4	1	12
192	726	2	3	2	5	8	5	6
210	242	2	7	3	9	6	5	13
267	172	6	3	1	5	4	6	4
286	82	6	7	4	9	2	9	5
22	481	4	1	4	7	5	7	1
41	40	3	7	2	4	8	5	6
74	871	5	6	8	4	9	6	12
111	414	7	5	3	5	6	3	13
144	528	6	4	2	6	10	9	6
152	982	3	4	3	3	2	9	7
205	9	5	3	8	6	10	6	8
229	889	1	4	2	3	4	8	9
255	448	3	3	6	4	6	4	5
288	872	4	1	4	7	5	7	1

After the stratified random density test locations have been determined, the sites will be marked in the sublot with the nuclear gauge template described in VTM –76. The template shall be placed on the mat and positioned parallel to the roadway with the arrows pointing in the direction of the paver. The template shall be spray painted with white or other approved paint such that the underlying pavement is marked with paint through the cutouts in the template. These locations must be clearly visible when the template is removed. After marking the location with paint the gauge template can be removed. The nuclear gauge shall then be placed within the area marked by the gauge template with the source toward the direction of the paver.

Test the density for each lot by taking density readings, using the one-minute mode, from two random locations within each sublot. The readings for the test section are recorded on Form TL-59. Remember that even though the test location should be random, don't take a test within 1 foot of an unconfined edge.

Compare the sublot readings to the "target density" to determine the acceptability of the lot. If two consecutive sublots have density readings less than 98% or more than 102% of the target density, notify the Engineer and take corrective action. The final pay quantity for density is determined by averaging all the tests contained within each lot. Then compare this average to the payment guidelines shown in the following chart. A separate pay factor is determined for each lot.

Payment Schedule for Lot Densities

Percent of Target Nuclear Control Strip Density	Percent of Payment
Greater than 102.0	95
98.0 to 102.0	100
97.0 to 97.9	95
96.0 to 96.9	90
Less than 96.0	75

The Contractor shall submit density worksheets and printouts for each test section to the Inspector upon completion of each day's testing.

TL-59(Rev. 4/05)

ASPHALT NUCLEAR DENSITY TEST SECTION

Project or Schedule: PM-2D-05 | Item No. | Date: 6/21/05

Route: 81 | Mile Post From: 13.76

Directional Lane: SBL (NBL, SBL, etc.) | Mile Post To: 11.04 | Lane: Passing (inside, center, etc.)

Mix Type: SM-12.5D | Application Rate: 165 lbs/yd² (kg/m²)

Mix Producer: ASPHALT, INC | Plant Location: Blacktop, VA

Lot No: 1 | Width of Application: 12 | Lot Length: 5000 ft (m)

Gauge Model: 4640 | Serial Number: 401 | Calibration Date: 5/16/05 | Depth Setting: 1.5 in. (mm)

Sublot Number	Lane (Inside, Center, etc.)	Test Site Location: Distance	Test Site Location: Offset	Nuclear Density lb/ft³ (kg/m³)	Sublot Average lb/ft³ (kg/m³)
1a	PASSING	16 ft.	1 ft. Lt.	141.3	
1b	PASSING	437 ft.	8ft. Lt.	145.2	143.3
2a	PASSING	412 ft.	3 ft. Lt.	144.6	
2b	PASSING	964 ft.	10 ft. Lt.	140.5	142.6
3a	PASSING	113 ft	9ft. Lt.	142.0	
3b	PASSING	834 ft	2 ft. Lt.	139.4	140.7
4a	PASSING	92 ft.	7 ft. Lt.	138.0	
4b	PASSING	959 ft.	6 ft. Lt.	140.8	139.4
5a	PASSING	716 ft.	3 ft. Lt.	144.2	
5b	PASSING	402 ft.	4 ft. Lt.	141.0	142.6
6a					
6b					
7a					
7b					

Average: 141.7 lb/ft³ (kg/m³)

Target Nuclear control Strip Density: 141.4 lb/ft³ (kg/m³)

Control Strip No: 1 | % of Target Nuclear Control Strip Density: 100.2 (Average/Target*100) | 98 – 102 (Acceptance Range)

Pay Quantity: Ton (Metric Ton)

Lot length x width x application rate / 18000

Remarks:

LOT IS WITHIN THE 100% PAY RANGE

Testing Performed by: J. M. Jones | Observed by: C. C. Smith VDOT Inspector

CHAPTER 8
ROLLER PATTERN/CONTROL STRIP/TEST SECTIONS & NUCLEAR DENSITY TESTING
Study Questions

1. Before a roller pattern can be set:

   A. the subgrade must be prepared
   B. compaction equipment must be approved
   C. the thickness of placed material should be the same depth as the course it represents
   D. all of the above

2. A roller pattern compares compactive effort vs. density?

   A. True
   B. False

3. A new roller pattern must be set up if:

   A. the material comes from a new source
   B. a different roller is used
   C. a new nuclear device is being used
   D. all of the above

4. Who has the responsibility of furnishing and operating the thin-lift nuclear gauge?

   A. VDOT
   B. Contractor
   C. Research Council
   D. None of the above

CHAPTER 8
ROLLER PATTERN/CONTROL STRIP/TEST SECTIONS & NUCLEAR DENSITY TESTING
Study Questions

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:

   A. the average of 10 readings in the control strip
   B. the average density of 3 plugs/cores from the control strip
   C. 92.5% of maximum theoretical density from the job mix
   D. 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?

   A. Daily
   B. Visually
   C. Professionally
   D. Randomly

TL-56(Rev- 4/05)

Problem No. 1

ASPHALT NUCLEAR DENSITY THIN
ROLLER PATTERN - LIFT WORKSHEET

Control Strip No 1

1. Average the density readings for each set of test site readings.
2. For the last pass - select the pass number and roller mode.
3. Then plot and graph the densities on the TL-57 on the next page.

Date 9/15/05

To 37

Directional Lane (NBL, SBL, etc.) NBL

Lane Inside (inside, center, etc.)

Mix Type SM.9.5A Application Rate: 165 lbs/yd² ( ) kg/m²)

Producer Brand X Location Loafers Glory, VA

Roller Type: DD-130 Roller DD-110 Roller 3

Roller Pattern Data

Gauge Model 4640B Serial No 1212 Calibration Date 7/18/05 Depth Setting 1.5 in. (mm)

Pass No 2V	Nuclear Density	Pass No	Nuclear Density
Site 1	144.6	Site 1	147.8
Site 2	145.8	Site 2	148.0
Site 3	144.9	Site 3	147.3
AVERAGE		AVERAGE	

Pass No 3V	Nuclear Density	Pass No	Nuclear Density
Site 1	146.5	Site 1	
Site 2	147.6	Site 2	
Site 3	146.8	Site 3	
AVERAGE		AVERAGE	

Pass No 4 (1s)	Nuclear Density	Pass No	Nuclear Density
Site 1	148.4	Site 1	
Site 2	149.2	Site 2	
Site 3	148.4	Site 3	
AVERAGE		AVERAGE	

Pass No 5 (2s)	Nuclear Density	Pass No	Nuclear Density
Site 1	147.9	Site 1	
Site 2	148.5	Site 2	
Site 3	147.8	Site 3	
AVERAGE		AVERAGE	

Testing Performed by

Observed by
VDOT Inspector

TL-57 (Rev. 4/05)

Problem No. 1 (continued)

ASPHALT NUCLEAR DENSITY THIN LIFT ROLLER PATTERN -GRAPH

Control Strip No 1

Project or Sch

1. Plot and graph the densities.
2. Fill in answers the shaded areas below.
3. Answer the question at the bottom of the page.

Date 9/15/05

Route

To 37

Directional Lar (NBL, SBL, etc)

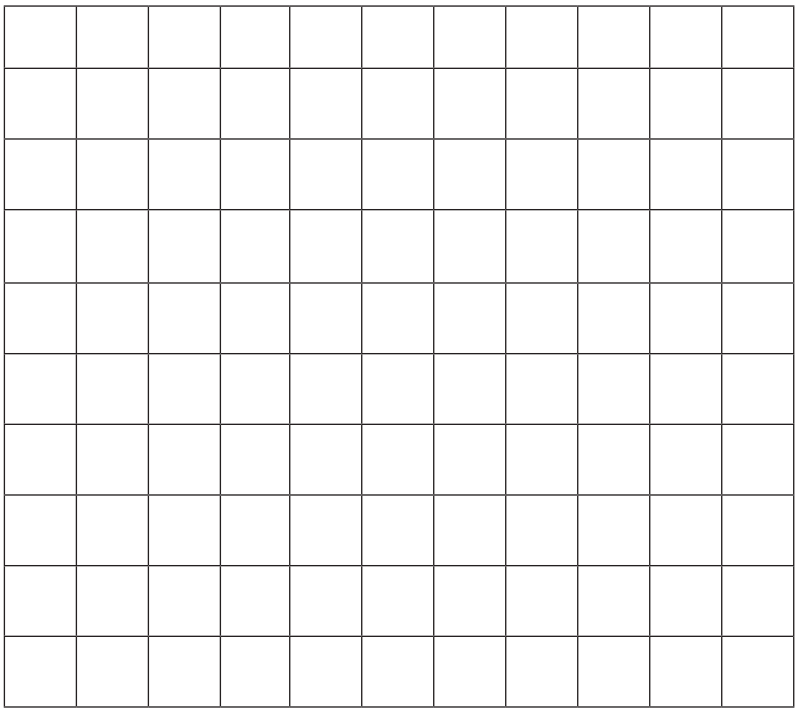
Lane Inside (Inside, Center, etc.)

Mix Type SM-9.5A Application Rate 165 lbs/yd² (kg/m²)

Producer Brand X Location Loafers Glory, VA

Gauge Model 4640B Serial No 1212 Calibration Date 7/18/05 Depth Setting 1.5 in. (mm)

DENSITY lbs/ft³ (kg/m³)



NUMBER OF ROLLER PASSES

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

Optimum Number of Passes:

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

Testing Performed By Observed By
VDOT Inspector

Why did you select this point for optimum (maximum) density?

Problem No. 1(continued)

Use the random number table below, determine the test site locations for the control strip shown on the next page. The lane width is 11 feet. The reference line is on the left. Complete the TL-58, listing the test site locations and averaging the density readings.

Distance From Beginning of Control Strip	Distance From Sublot Start Test Section		Paving Width Distance From Reference Line						
			8 ft. width	9 ft. width	10 ft. width	11ft. width	12 ft. width	13 ft. width	14 ft. width
23	12		2	4	5	2	1	2	4
44	429		6	4	8	9	8	11	11
81	358		5	4	8	2	3	7	11
141	812		5	3	8	6	10	6	8
149	105		3	7	7	10	9	2	11
176	620		3	4	3	3	2	9	7
187	167		1	6	5	9	7	5	1
213	589		3	3	6	4	6	4	5
239	726		6	8	8	2	3	4	7
275	412		1	4	2	3	4	8	9

TL-58 (Rev. 4/05)

Problem No.1 (continued)

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

Control Strip Number _____

Project or Schedule _____ Item Number _____ Date 9/15/05

1. Using the random numbers on the previous page, fill in the distance and offset.
2. Average the densities

Route _____ To _____

Directional Lane _____ (NBL, SBL, etc) Lane Inside (Inside, Center, etc.)

Mix Type SM-9.5A Application Rate 165 lbs/yd² (kg/m²)

Producer Brand X Location Loafers Glory, VA

Gauge Model 4640B Serial Number 1212 Calibration Date 7/18/05 Depth Setting 1.5 in (mm)

CONTROL STRIP TARGET DENSITY DETERMINATION

TEST SITE	**DISTANCE**	**OFFSET**	**ENTER GAUGE READING**			
Site 1			148.3	lb/ft³ (		kg/m³)
Site 2			147.2	lb/ft³ (		kg/m³)
Site 3			148.1	lb/ft³ (		kg/m³)
Site 4			149.2	lb/ft³ (		kg/m³)
Site 5			150.2	lb/ft³ (		kg/m³)
Site 6			148.7	lb/ft³ (		kg/m³)
Site 7			147.5	lb/ft³ (		kg/m³)
Site 8			149.4	lb/ft³ (		kg/m³)
Site 9			147.4	lb/ft³ (		kg/m³)
Site 10			147.6	lb/ft³ (		kg/m³)
		Total		lb/ft³ (		kg/m³)
		Average		lb/ft³ (		kg/m³)

Remarks:

Application Width is 11 feet / Reference Line is on the left.

Testing Performed by _____ Observed by _____

VDOT Inspector

TL 60 (Rev.4/05)

Problem No. 1 (continued)

VIRGINIA DEPARTMENT OF TRANSPORTATION
ASPHALT NUCLEAR DENSITY WORKSHEET
ROLLER PATTERN/SAWN PLUGS & CONTROL STRIP TARGET DENSITY

Control Strip No. 1

Schedule PM-3D-05 Item No. Date 9/15/05

1. Calculate and then fill in the missing information on this form.
2. Answer the questions at the bottom of the page.

(NBL, SBL, etc.) (inside, center, etc.)

Mix Type SM -9.5A Application Rate: 165 lbs/yd² (kg/m²)

Lot No 1 Width of Application 11 Lot Length 5000 ft (m)

Mix Producer Brand X Plant Location Loafers Glory, VA

NUCLEAR CALIBRATION CHECK

Sawed Spec. Number	A Weight in Air (g)	B Weight in Water (Total g)	C Basket Tare Weight	D Weight in Water (g) B - C	E SSD Weight In Air (g)	F Volume E-D	SSD Bulk Specific Gravity A ÷ F	G Average SSD Bulk Per Site	Sawed Specimen Thickness In. (mm)	H Target Test Site Nuclear (from TL-58)	
1	1215	730	xxx	730	1224				1.5		1
2	1218	732	xxx	732	1227				1.5		2
											3
3	1223	734	xxx	734	1232				1.6		4
											5
4	1220	728	xxx	728	1228				1.6		6
											7
5	1210	728	xxx	728	1222				1.5		8
											9
6	1214	729	xxx	729	1225				1.5		10
											Total

Average (Sum of G/3) (Sum ofH/10)

Max Specific Gravity (G_{MM}) 2.644

A. Sawed Specimen Average % Density _____ % (avg. SSD Bulk Sp. Gr. /G_{MM} x 100)

B. Minimum Design Density (Table III – 3 of sec. 315) _____ %
*(A must equal or exceed B)

C. Target Nuclear Density _____ lb/ft³

Gauge Model 4640B Serial No. 1212 Calibration Date 7/18/05 Depth Setting 1.5 In (mm)

Pay Quantity _____ Ton (Metric Ton)
Lot length x width x application rate/ 18000

Testing Performed by _____ Observed by _____

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Problem No. 1(continued)
Test Section

Using the random number table below, determine the test site locations for the test section shown on the next page. The lane width is 11 feet. It is an inside lane. The reference line is on the left.

Complete the TL-59.

Distance From Beginning of Control Strip	Distance From Sublot Start		Paving Width						
			Distance From Reference Line						
	Test Section		8 ft. width	9 ft. width	10 ft. width	11ft. width	12 ft. width	13 ft. width	14 ft. width
18	81		7	7	2	4	2	8	4
59	142		1	4	5	5	7	2	6
83	67		6	5	2	3	2	2	12
93	569		2	4	6	3	5	3	1
120	728		2	6	7	5	4	12	12
151	902		1	3	5	4	4	1	12
192	726		2	3	2	5	8	5	6
210	242		2	7	3	9	6	5	13
267	172		6	3	1	5	4	6	4
286	82		6	7	4	9	2	9	5

TL-59(Rev. 4/05)

Problem No. 1 (continued)
ASPHALT NUCLEAR DENSITY TEST SECTION

1. Fill in lane location.
2. Using the random number table on the previous page, fill in the distance and offset.
3. Average the sublot densities.
4. Average the density for this Test Section.
5. Calculate percent density.
6. Fill in the Target Density
7. Answer the questions at the bottom of the page.

Pr(9/15/05

Ro

Dir Inside
nside, center, etc.)

Mi kg/m²)

Mi

Lot No 1 Width of Application 11 Lot Length 5000 ft (m)

Gauge Model 4640B Serial Number 1212 Calibration Date 7/18/05 Depth Setting 1.5 in. (mm)

Sublot Number	Lane (Inside, Center, etc.)	Test Site Location Distance	Offset	Nuclear Density lb/ft³ (kg/m³)	Sublot Average lb/ft³ (kg/m³)
1a				148.2	
1b				148.7	
2a				150.1	
2b				147.3	
3a				149.9	
3b				149.5	
4a				147.5	
4b				148.3	
5a				148.4	
5b				147.7	
6a					
6b					
7a					
7b					

Average _____ lb/ft³ (kg/m³)

Target Nuclear Control Strip Density _____ lb/ft³ (kg/m³)

Control Strip No 1 % of Target Nuclear Control Strip Density _____ (Average/Target∗100) 98 – 102 (Acceptance Range)

Pay Quantity _____ Ton (Metric Ton)
Lot length x width x application rate / 18000

Remarks:

Testing Performed by _____ Observed by _____
VDOT Inspector

Does this test section pass? Why or why not?

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Problem No. 2

ASPHALT NUCLEAR DENSITY THIN
ROLLER PATTERN - LIFT WORKSHEET

Control Strip No 1

1. Average the density readings for each set of test site readings.
2. For the last pass - select the pass number and roller mode.
3. Then plot and graph the densities on the TL-57 on the next page.

Date 8/21/05

To 16.25

Lane Passing (inside, center, etc.)

(NBL, SBL, etc.) EBL

Mix Type SM-9.5D Application Rate: 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

Gauge Model 4640B Serial No 1502 Calibration Date 7/18/05 Depth Setting 1.5 in. (mm)

Pass No	Nuclear Density	Pass No	Nuclear Density
3V		_____	
Site 1	149.0	Site 1	151.1
Site 2	145.1	Site 2	148.8
Site 3	146.9	Site 3	150.9
AVERAGE		AVERAGE	

Pass No	Nuclear Density	Pass No	Nuclear Density
4V		_____	
Site 1	145.4	Site 1	
Site 2	150.2	Site 2	
Site 3	154.3	Site 3	
AVERAGE		AVERAGE	

Pass No	Nuclear Density	Pass No	Nuclear Density
5 (1s)		_____	
Site 1	153.0	Site 1	
Site 2	152.3	Site 2	
Site 3	152.1	Site 3	
AVERAGE		AVERAGE	

Pass No	Nuclear Density	Pass No	Nuclear Density
6 (2s)		_____	
Site 1	152.1	Site 1	
Site 2	150.6	Site 2	
Site 3	151.7	Site 3	
AVERAGE		AVERAGE	

Testing Performed by _____ Observed by _____ VDOT Inspector

TL-57 (Rev. 4/05)

Problem No. 2 (continued)

ASPHALT NUCLEAR DENSITY THIN LIFT
ROLLER PATTERN -GRAPH

Control Strip No 1

1. Plot and graph the densities.
2. Fill in answers the shaded areas below.
3. Answer the question at the bottom of the page.

From _____ Date 8/21/05

Route _____ To 16.25

Directional Lane EBL (NBL, SBL, etc)

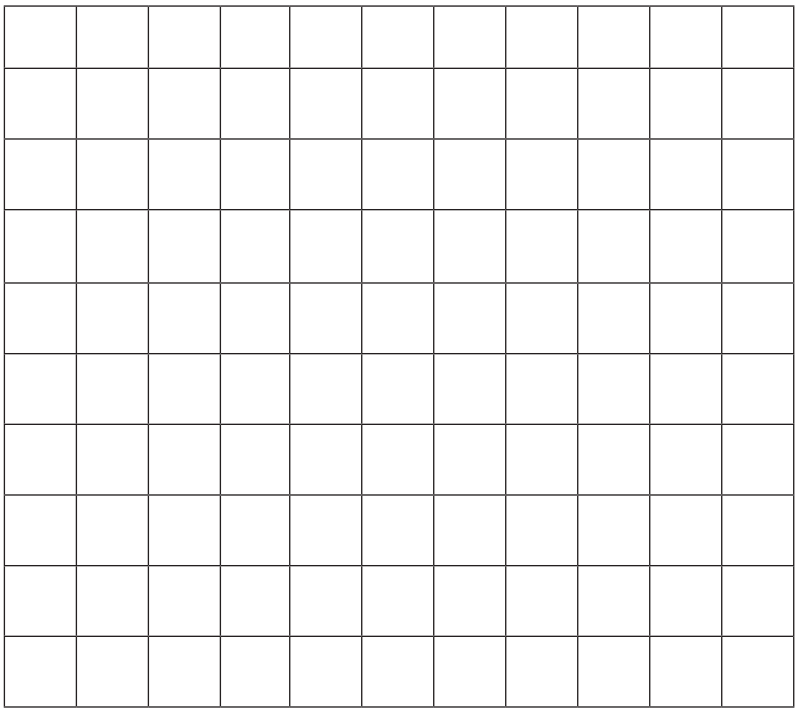
Lane Passing (Inside, Center, etc.)

Mix Type SM-9.5D Application Rate 165 lbs/yd² (_____ kg/m²)

Producer Asphalt, Inc Location Blacktop, VA

Gauge Model 4640B Serial No 1502 Calibration Date 7/18/05 Depth Setting 1.5 in. (mm)

DENSITY
lbs/ft³ (kg/m³)



NUMBER OF ROLLER PASSES

Optimum Density _____ lbs/ft³ (kg/m³)
(from peak of roller pattern curve)

Optimum Number of Passes: _____

Number of Roller Passes Roller 1 _____ Roller 2 _____ Roller 3 _____

Testing Performed By _____ Observed By _____
VDOT Inspector

Why did you select this point for optimum (maximum) density?

Problem No. 2(continued)
Control Strip

Using the random number table below, determine the test site locations for the Control Strip shown on the next page. The lane width is 12 feet. It is a passing lane. The reference line is on the right.

Complete the TL-58.

Distance From Beginning of Control Strip	Distance From Sublot Start		Paving Width						
			Distance From Reference Line						
	Test Section		8 ft. width	9 ft. width	10 ft. width	11ft. width	12 ft. width	13 ft. width	14 ft. width
8	81		7	7	2	4	3	8	4
43	142		1	4	5	5	4	2	6
81	67		6	5	2	3	2	2	12
99	569		2	4	6	3	6	3	1
111	728		2	6	7	5	3	12	12
172	902		1	3	5	4	2	1	12
192	726		2	3	2	5	8	5	6
210	242		2	7	3	9	6	5	13
243	172		6	3	1	5	3	6	4
278	82		6	7	4	9	2	9	5

TL-58 (Rev. 4/05)

Problem No. 2 (continued)

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

Control Strip Number

1. Using the random numbers on the previous page, fill in the distance and offset.
2. Average the densities

Date 8/21/05
To 16.25

Directional Lane EBL (NBL, SBL, etc) Lane Passing (Inside, Center, etc.)

Mix Type SM-9.5D Application Rate 165 lbs/yd² (kg/m²)

Producer Asphalt, Inc Location Blacktop, VA

Gauge Model 4640B Serial Number 1502 Calibration Date 7/18/05 Depth Setting 1.5 in (mm)

CONTROL STRIP TARGET DENSITY DETERMINATION

TEST SITE	**DISTANCE**	**OFFSET**	**ENTER GAUGE READING**			
Site 1			153.5	lb/ft³ (		kg/m³)
Site 2			152.4	lb/ft³ (		kg/m³)
Site 3			154.6	lb/ft³ (		kg/m³)
Site 4			157.0	lb/ft³ (		kg/m³)
Site 5			150.2	lb/ft³ (		kg/m³)
Site 6			151.9	lb/ft³ (		kg/m³)
Site 7			152.0	lb/ft³ (		kg/m³)
Site 8			154.1	lb/ft³ (		kg/m³)
Site 9			155.6	lb/ft³ (		kg/m³)
Site 10			153.0	lb/ft³ (		kg/m³)
		Total		lb/ft³ (		kg/m³)
		Average		lb/ft³ (		kg/m³)

Remarks:

Application Width is 12 feet and Reference Line is on right.

Testing Performed by _____ Observed by _____
VDOT Inspector

TL 60 (Rev.4/05)

Problem No. 2 (continued)

VIRGINIA DEPARTMENT OF TRANSPORTATION
ASPHALT NUCLEAR DENSITY WORKSHEET
ROLLER PATTERN/SAWN PLUGS & CONTROL STRIP TARGET DENSITY

Control Strip No. 1

Sche 1. Calculate and then fill in the missing information on this form.
Rout 2. Answer the questions at the bottom of the page.
Lane Direction: EBL (NBL, SBL, etc.)

Date 8/21/05

To: 16.25

Lane Passing (inside, center, etc.)

Mix Type SM -9.5D Application Rate: 165 lbs/yd² (kg/m²)

Lot No 1 Width of Application 12 Lot Length 5000 ft (m)

Mix Producer Asphalt, Inc Plant Location Blacktop, VA

NUCLEAR CALIBRATION CHECK

	A	B	C	D	E	F		G		H	
Sawed Spec. Number	Weight in Air (g)	Weight in Water (Total g)	Basket Tare Weight	Weight in Water (g) B - C	SSD Weight In Air (g)	Volume E-D	SSD Bulk Specific Gravity A ÷ F	Average SSD Bulk Per Site	Sawed Specimen Thickness In. (mm)	Target Test Site Nuclear (from TL-58)	
1	1014	641	xxx	641	1021				1.5		1
2	1024	618	xxx	618	1031				1.5		2
											3
3	1158	691	xxx	691	1167				1.6		4
											5
4	1082	660	xxx	660	1091				1.5		6
											7
5	1190	699	xxx	699	1196				1.5		8
											9
6	1099	679	xxx	679	1107				1.5		10
											Total

Average _____ (Sum of G/3) _____ (Sum ofH/10)

Max Specific Gravity (G_{mm}) 2.653

A. Sawed Specimen Average % Density _____ (avg. SSD Bulk Sp. Gr. /G_{mm} x 100) %

B. Minimum Design Density (Table III – 3 of sec. 315) _____ %
*(A must equal or exceed B)

C. Target Nuclear Density _____ lb/ft³

Gauge Model 4640B Serial No. 1212 Calibration Date 7/18/05 Depth Setting 1.5 In (mm)

Pay Quantity _____ Ton (Metric Ton)
Lot length x width x application rate/ 18000

Testing Performed by _____ Observed by _____

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

Problem No. 2(continued)
Control Strip

Using the random number table below, determine the test site locations for the Test Section shown on the next page. The lane width is 12 feet. It is an inside lane. The reference line is on the right.

Complete the TL-59.

Distance From Beginning of Control Strip	Distance From Sublot Start		Paving Width						
			Distance From Reference Line						
	Test Section		8 ft. width	9 ft. width	10 ft. width	11ft. width	12 ft. width	13 ft. width	14 ft. width
8	13		7	7	2	4	6	8	4
43	112		1	4	5	5	8	2	6
81	262		6	5	2	3	2	2	12
99	467		2	4	6	3	3	3	1
111	419		2	6	7	5	7	12	12
172	845		1	3	5	4	4	1	12
192	626		2	3	2	5	7	5	6
210	237		2	7	3	9	6	5	13
243	936		6	3	1	5	8	6	4
278	592		6	7	4	9	2	9	5

TL-59(Rev. 4/05)

Problem No. 2 (continued)

ASPHALT NUCLEAR DENSITY TEST SECTION

1. Fill in lane location.
2. Using the random number table on the previous page, fill in the distance and offset.
3. Average the sublot densities.
4. Average the density for this Test Section.
5. Calculate percent density.
6. Fill in the Target Density
7. Answer the questions at the bottom of the page.

8/21/05

Passing
(inside, center, etc.)

_____ kg/m²)

Mix Producer Asphalt, Inc Plant Location Blacktop, VA

Lot No 1 Width of Application 12 Lot Length 5000 ft (m)

Gauge Model 4640B Serial Number 1502 Calibration Date 7/18/05 Depth Setting 1.5 in. (mm)

Sublot Number	Lane (Inside, Center, etc.)	Test Site Location Distance	Test Site Location Offset	Nuclear Density lb/ft³ (kg/m³)	Sublot Average lb/ft³ (kg/m³)
1a				150.6	
1b				151.2	
2a				152.5	
2b				153.1	
3a				153.8	
3b				152.4	
4a				155.7	
4b				156.5	
5a				154.4	
5b				153.9	
6a					
6b					
7a					
7b					

Average _____ lb/ft³ (kg/m³)

Target Nuclear Control Strip Density _____ lb/ft³ (kg/m³)

Control Strip No 1 % of Target Nuclear Control Strip Density _____ (Average/Target∗100) 98 – 102 (Acceptance Range)

Pay Quantity _____ Ton (Metric Ton)
Lot length x width x application rate / 18000

Remarks:

Testing Performed by _____ Observed by _____
VDOT Inspector

Does this test section pass? Why or why not?