

State of Nevada  
Department of Transportation  
Materials Division

**METHOD OF TEST FOR RELATIVE COMPACTION OF PLANTMIX  
BITUMINOUS BASE AND SURFACE USING CONTROL STRIPS AND  
TEST SECTIONS WITH A NUCLEAR GAUGE**

**SCOPE**

This test is designed to measure the degree of compaction of plantmix base and surface using a portable nuclear density testing device. Results may be obtained rapidly during the compaction process allowing time for additional compactive effort, if required.

Control of compaction is obtained by first determining the density of a "control strip" which has been compacted to a maximum density by standard rolling equipment. "Test sections" are then constructed and tested with the density values compared to the control strip density. Using established acceptance criteria the compaction in the test section is accepted or rejected.

**PART I. APPARATUS and STANDARDIZATION**

**A. APPARATUS**

See Test Method Nev. T335 - Section A.

**B. STANDARDIZATION OF NUCLEAR GAUGE**

See Test Method Nev. T335 - Section B.

**PART II. METHOD OF DETERMINING PERCENT RELATIVE COMPACTION FROM  
CONTROL STRIPS AND TEST SECTIONS**

**A. IN-PLACE DENSITY MEASUREMENTS FOR CONTROL STRIPS**

1. Select a site for testing.
2. Take and record one, one-minute reading; turn the gauge 180 degrees; take and record a second one-minute reading. Use NDOT form 040-048.
3. Determine and record the average of the above two readings as the Average Test Site Density.

## B. TESTING CONTROL STRIPS FOR DENSITY

1. General - Control strips are to be rolled with specified rolling equipment until "no appreciable increase in density is obtained by additional roller coverages". Do not allow excessive rolling as this may result in cracking or other damage to the mat. In order to determine the number of roller passes required, density tests are made after each pass of the rollers at three (3) preselected locations. The average density for the three (3) locations is plotted on a chart of density versus number of roller passes. Rolling is discontinued when the curve levels off. Tests are then taken at seven (7) additional locations throughout the control strip. The average density at these ten test locations is the Mean Control Strip Density.
2. Tests during rolling - In order to assure that material throughout the entire control strip is effectively represented, divide the control strip into three (3) subsections of equal length, taking tests diagonally across the mat. Mark the outline of the gauge on the hot asphalt so that the gauge may be returned to the same spot after each roller pass. Make each density measurement in accordance with instructions in Part II-A, above. After each pass of the roller, average the three density values and plot on the Nuclear Gauge Operator's Worksheet for Control Strip Density-Part 1 (NDOT form 040-048), Density Plot. An example worksheet is shown in Figure 1. Refer to project specifications for the size of the control strip.
3. Tests after completion of rolling - Take seven additional density tests at various locations chosen at random throughout the control strip. Average these seven test results together with the three tests taken after optimum number of roller passes, and record this average as the Mean Control Strip Density on the Nuclear Gauge Operator's Worksheet for Control Strip Density-Part 2 (NDOT form 040-048). An example worksheet is shown in Figure 2.
4. A new control strip should be constructed 1) at the beginning of work on each lift of each roadway course, 2) every ten test sections, 3) if results from compaction tests become erratic or 4) significant change in composition of material.
5. The optimum number of roller passes should be noted from results of each control strip.

C. TESTING TEST SECTIONS AND COMPUTING PERCENT RELATIVE COMPACTION

See Test Method Nev. T335 - Section C.

1. Example:

Assume the Contractor will place a 3.5 m wide spread of plantmix base in a test section which is to be 1280 m in length, beginning at station 60+96.

$$\text{Length of each subsection} = \frac{1280}{5} = 256 \text{ meters}$$

Select a block from the table of random numbers.

Assume you select the block in the upper left-hand corner, and will use Column A within that block for selecting the station to be sampled, and Column B to determine the distance in from the right edge of the spread.

| Test Site | Random Number Col. A   | Station | Random Number Col. B | Distance in from Right edge of spread |
|-----------|------------------------|---------|----------------------|---------------------------------------|
| 1         | .576x256 m+6096 m=6243 | 62+40   | .730 x 3.5 m         | 2.5 m                                 |
| 2         | .892x256 m+6352 m=6580 | 65+80   | .948 x 3.5 m         | 3 m                                   |
| 3         | .669x256 m+6608 m=6779 | 67+80   | .726 x 3.5 m         | 2.5 m                                 |
| 4         | .609x256 m+6864 m=7020 | 70+20   | .482 x 3.5 m         | 1.5 m                                 |
| 5         | .971x256 m+7120 m=7368 | 73+70   | .824 x 3.5 m         | 3 m                                   |

D. DENSITY TESTING - NORMAL MODE

See Test Method Nev. T335 - Section D.

E. IN PLACE DENSITY MEASUREMENTS

See Test Method Nev. T335 - Section E.

F. COMPUTING PERCENT RELATIVE COMPACTION

1. Calculate the percent relative compaction at each of the five (5) test sites from the following formula:

$$\text{Percent Relative Compaction} = \frac{\text{Average Test Site Density}}{\text{Mean Control Strip Density}} \times 100$$

Record the percent relative compaction to the nearest percent.

2. Mean Percent Relative Compaction - Average the five (5) densities determined above and compute the Mean Percent Relative Compaction from the following formula:

$$\text{Mean Percent Relative Compaction} = \frac{\text{Average Test Section Density}}{\text{Mean Control Strip Density}} \times 100$$

Record to the nearest percent.

#### G. RETESTING PROCEDURES

See Test Method Nev. T335D - Section H.

Material Type TYPE 3 PLANTMIX Contract No. 3800  
 & Pad Number Bottom 40mm; NB # 2 Lane Date 7-25-97  
 Width of Spread 3.5m Station (M) X 70+00 - (M) X 71+00  
 Nuclear Set No. 15

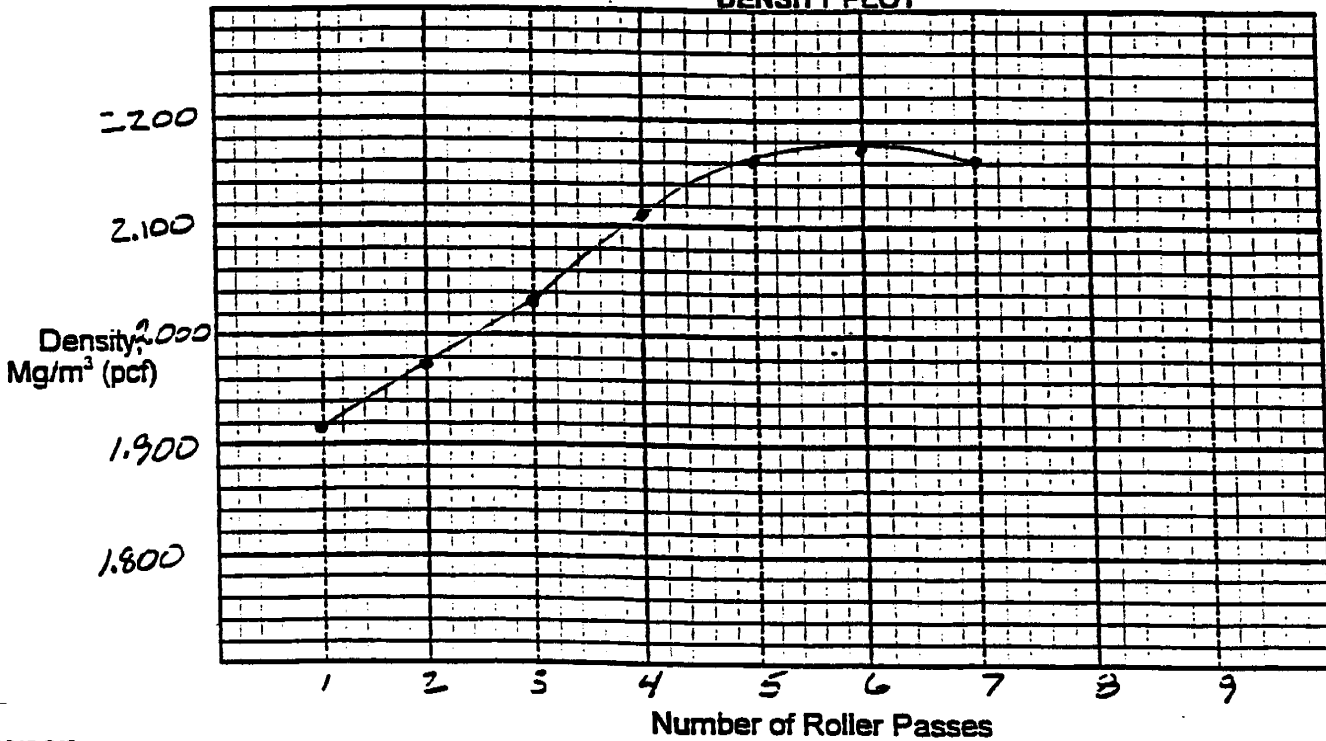
**TESTS DURING ROLLING**

| No. of Roller Passes             | 1     |       |       | 2     |       |       | 3     |       |       |
|----------------------------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
|                                  | 1     | 2     | 3     | 1     | 2     | 3     | 1     | 2     | 3     |
| Density, Mg/m <sup>3</sup> (pcf) | 1.843 | 1.924 | 1.968 | 2.003 | 1.900 | 2.008 | 2.024 | 2.005 | 2.060 |
|                                  | 1.821 | 1.963 | 1.946 | 1.955 | 2.010 | 1.982 | 2.062 | 1.985 | 2.074 |
| Average Test Site Density        | 1.832 | 1.944 | 1.957 | 1.979 | 1.955 | 1.995 | 2.043 | 1.995 | 2.067 |
| Average Density                  | 1.911 |       |       | 1.976 |       |       | 2.035 |       |       |

| No. of Roller Passes             | 4     |       |       | 5     |       |       | 6     |       |       |
|----------------------------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
|                                  | 1     | 2     | 3     | 1     | 2     | 3     | 1     | 2     | 3     |
| Density, Mg/m <sup>3</sup> (pcf) | 2.180 | 2.121 | 2.057 | 2.152 | 2.221 | 2.175 | 2.150 | 2.143 | 2.170 |
|                                  | 2.050 | 2.111 | 2.093 | 2.110 | 2.171 | 2.135 | 2.226 | 2.183 | 2.160 |
| Average Test Site Density        | 2.115 | 2.116 | 2.075 | 2.131 | 2.196 | 2.155 | 2.188 | 2.163 | 2.165 |
| Average Density                  | 2.102 |       |       | 2.161 |       |       | 2.172 |       |       |

| No. of Roller Passes             | 7     |       |       |   |   |   |   |   |   |
|----------------------------------|-------|-------|-------|---|---|---|---|---|---|
|                                  | 1     | 2     | 3     | 1 | 2 | 3 | 1 | 2 | 3 |
| Density, Mg/m <sup>3</sup> (pcf) | 2.177 | 2.156 | 2.164 |   |   |   |   |   |   |
|                                  | 2.143 | 2.186 | 2.126 |   |   |   |   |   |   |
| Average Test Site Density        | 2.160 | 2.171 | 2.145 |   |   |   |   |   |   |
| Average Density                  | 2.159 |       |       |   |   |   |   |   |   |

**DENSITY PLOT**



**FIGURE 1**

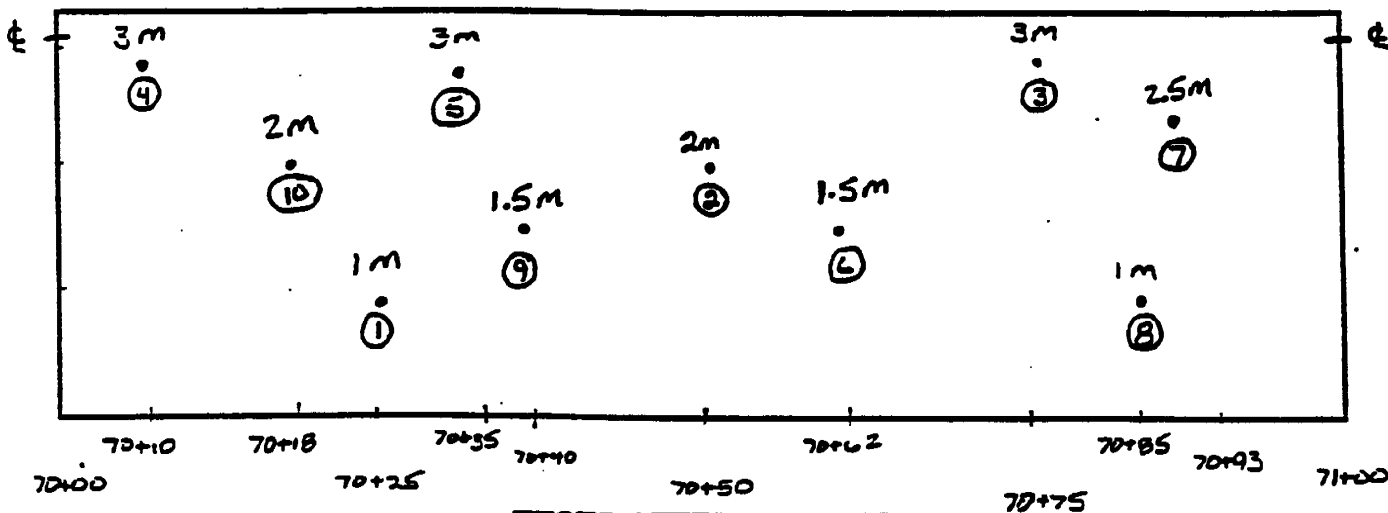
**NUCLEAR GAUGE OPERATOR'S WORKSHEET  
FOR CONTROL STRIP DENSITY - PART 2**

Test Method Nev. T750 C

Material Type TYPE 3 PLANTMIX Contract No. 3800  
 Lift & Pad Number BOTTOM 40 mm; NB #2 LANE Date 7-25-77  
 Width of Spread 35 m Station (M) X "70+00-(M) X" 71+00  
 Nuclear Set No. 15

**DIAGRAM OF CONTROL STRIP**

Show Centerline, Stations at ends of Control Strip, Stations at Test Sites, Site Number, Offset from edge of oil or centerline



**TESTS AFTER ROLLING**

| Site Number                      | 1     | 2     | 3     | 4     | 5     |
|----------------------------------|-------|-------|-------|-------|-------|
| Density, Mg/m <sup>3</sup> (pcf) | 1     |       |       | 2.154 | 2.169 |
|                                  | 2     |       |       | 2.124 | 2.207 |
| Average Test Site Density        | 2.160 | 2.171 | 2.145 | 2.139 | 2.188 |

| Site Number                      | 6     | 7     | 8     | 9     | 10    |       |
|----------------------------------|-------|-------|-------|-------|-------|-------|
| Density, Mg/m <sup>3</sup> (pcf) | 1     | 2.201 | 2.143 | 2.144 | 2.173 | 2.142 |
|                                  | 2     | 2.141 | 2.181 | 2.134 | 2.137 | 2.174 |
| Average Test Site Density        | 2.171 | 2.162 | 2.139 | 2.155 | 2.158 |       |

Mean Control Strip Density, Mg/m<sup>3</sup> (pcf) = 2.159

Rolling Pattern: 2 PASSES BREAKDOWN, 3 PASSES PNEUMATIC, 2 PASSES FINISH (NO VIR.)

Remarks: DISTANCES FROM RIGHT EDGE OF OIL AHEAD ON LINE.

Tested by: Joe Tester Resident Engineer: M. R. ...

FIGURE 2