

# MOISTURE AND DENSITY DETERMINATION

## NUCLEAR METHOD

Clear Form

**DISTRIBUTION:** ORIGINAL – Construction Engineer, COPIES – Area Density Specialist, Density Technology Unit (Lansing).

\* SEE REVERSE SIDE

|                                                          |                             |                                 |                                                      |                                                         |
|----------------------------------------------------------|-----------------------------|---------------------------------|------------------------------------------------------|---------------------------------------------------------|
| DATE<br>05/20/20                                         | CONTROL SECTION ID<br>82000 | JOB NUMBER<br>205935A, 207914A  | ROUTE NO. or STREET<br>Major Fed-Aid HMA Resurfacing | GAUGE NO.<br>2411                                       |
| DENSITY INSPECTOR<br>Ryan Castillo                       |                             | CERTIFICATION NO.<br>31927-0522 | DENSITY INSPECTOR PHONE NO.<br>(313) 680-3222        | CONSTRUCTION ENG. (MDOT)<br>Andrea Wilcox - Detroit TSC |
| ASST. CON. ENG. / CONSULTANT ENG.<br>Kevin Surhigh (HRC) |                             |                                 |                                                      |                                                         |

| TEST     |         |                    | DETERMINATION OF IN-PLACE DENSITY |                |                    |                    |                      |                    |                    |                               | LOCATION OF TEST |                                    |       |                                       |                         |
|----------|---------|--------------------|-----------------------------------|----------------|--------------------|--------------------|----------------------|--------------------|--------------------|-------------------------------|------------------|------------------------------------|-------|---------------------------------------|-------------------------|
| ORIGINAL | RECHECK | TEST DEPTH<br>inch | COUNTS<br>(MC)                    | COUNTS<br>(DC) | DRY DENSITY<br>PCF | WET DENSITY<br>PCF | MOIS-<br>TURE<br>PCF | MOIS-<br>TURE<br>% | MAX DENSITY<br>PCF | PERCENT<br>OF COM-<br>PACTION | STATION          | DISTANCE FROM C <sub>L</sub><br>ft |       | DEPTH<br>BELOW<br>PLAN<br>GRADE<br>ft | ITEM<br>OF<br>WORK<br>* |
|          |         |                    |                                   |                |                    |                    |                      |                    |                    |                               |                  | LEFT                               | RIGHT |                                       |                         |
| 1        | 2       | 3                  | 4                                 | 5              | 6                  | 7                  | 8                    | 9                  | 10                 | 11                            | 12               | 13                                 | 14    | 15                                    | 16                      |
| 13       |         | BS                 | 69                                | 787            |                    | 146.5              | 8.4                  | 6.1                | 158.1              | 92.7                          | Remarks          | 21                                 |       | 0.2                                   | BB                      |
| 14       |         | BS                 | 61                                | 798            |                    | 145.5              | 7.3                  | 5.3                | 158.1              | 92.0                          | Remarks          | 14                                 |       | 0.2                                   | BB                      |
| 15       |         | BS                 | 65                                | 777            |                    | 147.5              | 7.9                  | 5.6                | 158.1              | 93.3                          | Remarks          | 9                                  |       | 0.2                                   | BB                      |
| 16       |         | BS                 | 64                                | 770            |                    | 148.2              | 7.7                  | 5.5                | 158.1              | 93.7                          | Remarks          | 20                                 |       | 0.2                                   | BB                      |
| 17       |         | BS                 | 65                                | 794            |                    | 145.8              | 7.9                  | 5.7                | 158.1              | 92.2                          | Remarks          | 11                                 |       | 0.2                                   | BB                      |
| 18       |         | BS                 | 69                                | 790            |                    | 146.2              | 8.4                  | 6.1                | 158.1              | 92.5                          | Remarks          | 21                                 |       | 0.2                                   | BB                      |
| 19       |         | BS                 | 61                                | 780            |                    | 147.2              | 7.3                  | 5.2                | 158.1              | 93.1                          | Remarks          | 13                                 |       | 0.2                                   | BB                      |
| 20       |         | BS                 | 65                                | 783            |                    | 146.9              | 7.9                  | 5.7                | 158.1              | 92.9                          | Remarks          | 9                                  |       | 0.2                                   | BB                      |
| 21       |         | BS                 | 50                                | 797            |                    | 145.6              | 5.8                  | 4.2                | 158.1              | 92.1                          | Remarks          | 4                                  |       | 0.2                                   | BB                      |
| 22       |         | BS                 | 63                                | 772            |                    | 148.0              | 7.6                  | 5.4                | 158.1              | 93.6                          | Remarks          |                                    | 3     | 0.2                                   | BB                      |
| 23       |         | BS                 | 62                                | 794            |                    | 145.9              | 7.5                  | 5.4                | 158.1              | 92.3                          | Remarks          | 7                                  |       | 0.2                                   | BB                      |
| 24       |         | BS                 | 62                                | 799            |                    | 145.4              | 7.5                  | 5.4                | 158.1              | 92.0                          | Remarks          | 2                                  |       | 0.2                                   | BB                      |

| TEST NO. | MOIS-<br>TURE<br>% | VOLUME OF<br>MOLD<br>CU. FT. | DETERMINATION OF MAXIMUM DENSITY (SOIL & HMA) |           |               |                 |                              |                       |                          | NOTE:<br>To convert (g) to (lbs):<br>Wt. (g) ÷ 453.59 = Wt. (lbs) |          |
|----------|--------------------|------------------------------|-----------------------------------------------|-----------|---------------|-----------------|------------------------------|-----------------------|--------------------------|-------------------------------------------------------------------|----------|
|          |                    |                              | WET SOIL<br>+ MOLD<br>g                       | MOLD<br>g | WET SOIL<br>g | WET SOIL<br>lbs | COMPACTED<br>SOIL WET<br>PCF | MAX<br>DENSITY<br>PCF | OPTIMUM<br>MOISTURE<br>% |                                                                   |          |
| A        | B                  | C                            | D                                             | E         | F             | G               | H                            | I                     | J                        | CHART STANDARDS                                                   |          |
| 4E3      |                    |                              |                                               |           |               |                 |                              | 158.1                 |                          | DENSITY                                                           | MOISTURE |
|          |                    |                              |                                               |           |               |                 |                              |                       |                          | 3,023                                                             | 454      |
|          |                    |                              |                                               |           |               |                 |                              |                       |                          | 2,963                                                             | 438      |
|          |                    |                              |                                               |           |               |                 |                              |                       |                          | OPERATING STANDARDS                                               |          |
|          |                    |                              |                                               |           |               |                 |                              |                       |                          | DENSITY                                                           | MOISTURE |
|          |                    |                              |                                               |           |               |                 |                              |                       |                          | 2,994                                                             | 439      |

### REMARKS

Tests were taken on Spinoza Dr from Orangelawn to Joy Rd. Test 13: 42.3652, -83.2489 Test 14: 42.3632, -83.2480 Test 15: 42.3617, -83.2481

Test 16: 42.3611, -83.2489 Test 17: 42.3603, -83.2500 Test 18: 42.3595, -83.2504 Test 19: 42.3584, -83.2504 Test 20: 42.3574, -83.2503

Test 21: 42.3661, -83.2490 Test 22: 42.3654, -83.2492 Test 23: 42.3644, -83.2489 Test 24: 42.3631, -83.2480

|               |     |     |                                                                                                       |                                                            |
|---------------|-----|-----|-------------------------------------------------------------------------------------------------------|------------------------------------------------------------|
| 20/10 Weights | 1st | 2nd | DENSITY INSPECTOR'S SIGNATURE<br><br>Ryan Castillo<br>Jun 11 2020 10:46 AM<br><small>DocuSign</small> | AGENCY / COMPANY<br>Somat Engineering, Inc. (JN. 2019086C) |
| 3rd           | 4th | 5th |                                                                                                       |                                                            |

## DENSITY REQUIREMENTS

|                                                                                                                         | MINIMUM %<br>OF COMPACTION | ITEM OF<br>WORK | DEPTH |
|-------------------------------------------------------------------------------------------------------------------------|----------------------------|-----------------|-------|
| <b>Original Ground</b>                                                                                                  |                            |                 |       |
| Road Embankment Areas (if specified on the plans) .....                                                                 | 90.0                       | OG              | 9"    |
| Bridges – as shown on the plans .....                                                                                   | 95.0                       | OG              | 9"    |
| <b>Cut Areas</b>                                                                                                        |                            |                 |       |
| Cuts requiring Sand Subbase .....                                                                                       | 95.0                       | CS              | 9"    |
| Cuts not requiring Sand Subbase .....                                                                                   | 95.0                       | CN              | 12"   |
| Subgrade for HMA Base, Aggregate Base and Concrete Widening .....                                                       | 95.0                       | SG              | 9"    |
| <b>Embankments</b>                                                                                                      |                            |                 |       |
| Regular .....                                                                                                           | 95.0                       | E               |       |
| Abutments with Piling .....                                                                                             | 95.0                       | AP              |       |
| Abutments without Piling – within the limits for Structure Embankment<br>as shown on the plans .....                    | 100.0                      | AN              |       |
| <b>Backfill</b>                                                                                                         |                            |                 |       |
| Foundation Undercut Backfill for Retaining Walls, Grade Separation or<br>Bridges .....                                  | 100.0                      | FB              |       |
| Backfill for Bridges, Culverts, Sewers, Water Main, Manholes, Catch Basins,<br>Edge Drains and Subgrade Undercuts ..... | 95.0                       | B               |       |
| <b>Pavement Structure</b>                                                                                               |                            |                 |       |
| Subbase .....                                                                                                           | 95.0                       | S               |       |
| Subbase for Slope Paving .....                                                                                          | 90.0                       | SP              |       |
| Aggregate Base-used under Concrete Pavement .....                                                                       | 95.0                       | SS              |       |
| Aggregate Base-used under HMA Pavement .....                                                                            | 98.0                       | AB              |       |
| OGDC – used under Concrete and HMA Pavement .....                                                                       | 95.0                       | OGDC            |       |
| OGDC – used under Concrete and HMA Pavement (recycled material) .....                                                   | 95.0                       | OGR             |       |
| HMA Aggregate Base (pulverized HMA used as Aggregate Base) .....                                                        | 98.0                       | BAB             |       |
| Aggregate Base – used under Concrete Pavement (recycled material) .....                                                 | 95.0                       | CAC             |       |
| Aggregate Base – used under HMA Pavement (recycled material) .....                                                      | 98.0                       | CAB             |       |
| OGDC – Sleeper slab footprint and approach area .....                                                                   | 95.0                       | SLO             |       |
| OGDC – Sleeper slab footprint and approach area (recycled material) .....                                               | 95.0                       | SLOR            |       |
| Aggregate Base – Sleeper slab footprint and approach area .....                                                         | 98.0                       | SLA             |       |
| Trenching – under concrete pavement .....                                                                               | 95.0                       | TC              |       |
| Trenching – under HMA pavement .....                                                                                    | 98.0                       | TB              |       |
| Shoulders – Class I .....                                                                                               | 98.0                       | SAA             |       |
| Shoulders – Class II and III .....                                                                                      | 95.0                       | SA              |       |
| HMA Stabilization .....                                                                                                 | 98.0                       | BS              |       |
| HMA Paving – Base Course .....                                                                                          | 92.0*                      | BB              |       |
| HMA Paving – Leveling Course .....                                                                                      | 92.0*                      | BL              |       |
| HMA Paving – Top Course .....                                                                                           | 92.0*                      | BT              |       |

See JMF (form 1911) for  $G_{mm}$  value for target density value.  $TMD = G_{mm} \times 62.4$

\*Minimum % compaction of JMF TMD