TEST METHOD FOR RAPID EARTHWORK COMPACTION ASSURANCE

GEOTEchnical TEST METHOD
GTM-6
Revision #3
AUGUST 2015
GEOTECHNICAL TEST METHOD:
TEST METHOD FOR RAPID EARTHWORK COMPACTION ASSURANCE

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Revision #3

STATE OF NEW YORK
DEPARTMENT OF TRANSPORTATION

GEOTECHNICAL ENGINEERING BUREAU

AUGUST 2015
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1. **SCOPE**

This test method describes the procedure for determining, potentially quickly, whether the level of soil densification obtained by the compaction operations meets the requirements of the New York State Department of Transportation Standard Specifications.

This method can only be used for soils where the NYS Statewide Compaction Curves are valid.

2. **SUMMARY OF METHOD**

The test consists of these steps:

1. Determining the Field Wet Density

2. Determining the weight of a 1/30 ft.$^3$ (944 cm$^3$) volume of the soil after compacting it (in a mold in accordance with AASHTO T-99 Method C).

3. Reading off the *Highest Required* and the *Lowest Allowable* Wet Densities from the Compaction Assurance Tables in Appendix D.

4. Determining whether a test passes or fails by comparing the Field Wet Density against the *Highest Required* and the *Lowest Allowable* Wet Densities.

In some cases, the moisture content of the soil must be determined to ascertain whether a test passes or fails.

3. **EQUIPMENT**

The compaction assurance testing equipment is supplied to NYS Inspectors by the Regional Geotechnical Engineer. Each test kit consists of these items:

3.1 **Volumeter (calibrated sand cone apparatus – See Figure 1 and Appendix A):**

The volumeter consists of:

- a tube-like container for testing (silica) sand;
- a double-conical, valve-controlled outlet; and
- a base plate.

The top of the conical outlet shall have a nominal interior diameter of 6 in. (150 mm), and shall be flared flat to fit the base plate. The base plate and volumeter assembly are calibrated as a unit and are labeled accordingly; they must not be interchanged with other units. The sand container shall be capable of holding no less than 8 lbs. (3.6 kg) or 0.1 ft.$^3$ (0.0028 m$^3$) of silica sand.
The Volumeter has been calibrated to read the volume of the excavated test hole directly (note scale on unit), as opposed to a sand cone apparatus, which requires a conversion from weight to volume.

**Figure 1** Volumeter and known Volume Cylinder with Sand Cone Base Plate.
3.2 **Compaction Cylinder (Figure 2):** 1/30 ft.\(^3\) (944 cm\(^3\)) volume, in accordance with AASHTO Standard Density Test T-99 or Geotechnical Engineering Bureau Drawing No. SM 1563AR-2 (Appendix A).

3.3 **Rammer (Figure 2):** Refer to AASHTO T-99 or T-180.

---

**Figure 2**  
5 ½ lb. (2.5 kg) Rammer and 1/30 ft.\(^3\) (944 cm\(^3\)) Density Cylinder
3.4 **Scale:** Minimum of 36 lb. (13.6 kg) capacity; readable and accurate to 0.01 lb. (5 g).
3.5 **Balance:** Minimum 1600 g capacity; readable and accurate to 0.1 g.
3.6 **Steel Straight Edge:** Approx. 1.5 in. x 12 in. x ⅛ in. (38 mm x 300 mm x 3 mm) with machine square edges. One edge can be beveled.
3.7 **¾ in. Sieve:** ¾ in. (19 mm) opening.
3.8 **Pail:** 10 qt. (9.5 L) size or larger.
3.9 **Knife:** Butcher.
3.10 **Hammer:** 1 lb. (0.5 kg) minimum weight.
3.11 **Cold Chisel:** 1 in. (25 mm) blade width by 9 in. (230 mm) length.
3.12 **Skillet:** 12 in. (300 mm) diameter.
3.13 **Spoon:** Basting type.
3.14 **Spatula:** 6 in. (150 mm) length of blade.
3.15 **Cans:** Friction top with covers, 1 gal (3.7 L) size.
3.16 **Pans:** 24 in. (600 mm) square and 3 to 4 in. (75 mm to 100 mm) high.
3.17 **Tares:** Numbered cake pans or pie plates for moisture content determinations.
3.18 **Paint Brush:** 2 in. (50 mm) size.
3.19 **Silica Sand:** Supplied by NYSDOT Geotechnical Group. Sufficient quantity to perform required testing must be available at all times in the project laboratory building.

3.20 **Field Wet Density Calculator (Figure 3):** The Field Wet Density Calculator is used to determine the compacted density of the minus ¾ in. (19 mm) fraction (See Fig. 3). The Field Wet Density Calculator gives the wet density of the minus ¾ in. (19 mm) fraction by the following formula:

\[
FWD_{(-\frac{3}{4})} = \frac{W_{(-\frac{3}{4})}}{V - \frac{W_{(+\frac{3}{4})}}{SG \times 62.4}}
\]

Where:
- \(FWD_{(-\frac{3}{4})}\) = Field wet density of the minus ¾ in. (19 mm) fraction in lbs/ft\(^3\)
- \(W_{(-\frac{3}{4})}\) = Weight of the minus ¾ in. (19 mm) fraction in lbs.
- \(V\) = Volume of the hole in ft\(^3\).
- \(W_{(+\frac{3}{4})}\) = Weight of the plus ¾ in. (19 mm) fraction in lbs.
- \(SG\) = Specific gravity of solids (2.65 used)

3.21 **Compaction Assurance Tables (Tables 1 & 2):** The compaction assurance tables are used for finding required wet densities.
3.22 **Calibrated Volume Cylinder:** Used to check volumeter accuracy (See Figure 1).
3.23 **Stove:** Described in the specifications for equipment to be supplied by the Contractor for laboratory buildings, is required for drying samples.
Figure 3  Examples of Field Wet Density Calculators
4. EQUIPMENT CALIBRATION

The Sand Cone Apparatus Volume Correction (AVC) and Sand Calibration Factor (SCF) shall be used if a calibrated volumeter is unavailable, or whenever the supply of silica sand changes. Use Form SM 85 R1 – Sand Density Calibration (Appendix B) to determine the AVC and the SCF.

4.1 Sand Cone Apparatus Volume Correction (AVC)

During a field density test, a portion of the sand released from the sand cone apparatus during the test remains in the upper cone; it does not enter the excavated hole so it should not be used to determine the hole’s volume. The AVC is the weight of this material. It is determined by the following procedure:

1. Fill the Sand Cone Apparatus with silica sand, in accordance with Section 5.
2. Weigh the filled Sand Cone Apparatus.
3. Invert the sand cone apparatus and place it on a matching base plate, which must be on a smooth and level surface such as a table.
4. Open the valve and allow the sand to flow, uninterrupted and undisturbed, out of the apparatus. Do not allow any sand to spill outside of the cone during this operation. Care should be taken to prevent vibration to apparatus while valve is open.
5. Close the valve after the flow of sand has stopped.
6. Weigh the Sand Cone Apparatus and remaining sand.
7. Calculate the AVC as the difference between initial and final weights.

The Apparatus Volume Correction will remain constant for each apparatus. If the base plate or calibrated sand changes, the AVC must be re-calculated.

NOTE: If the cone becomes dented or the apparatus experiences any other damage, do not use it. Exchange it for an undamaged, calibrated, and fully-operational unit.

4.2 Sand Calibration Factor (SCF)

The sand calibration factor is the loose unit weight of the calibrated sand. It is determined by the following procedure:

1. Fill the Sand Cone Apparatus with silica sand in accordance with Section 5.1. Weigh the filled Sand Cone Apparatus (Initial Weight).
2. Place the matched base plate over a calibrated volume cylinder. Invert the filled sand cone apparatus on the base plate.
3. Open the valve and allow the sand to flow, uninterrupted and undisturbed, out of the apparatus. Do not allow any sand to spill outside of the cone during this operation. Care should be taken to prevent vibration to apparatus while valve is open.
4. Close the valve after the flow of sand has stopped.
5. Weigh the Sand Cone Apparatus and remaining sand (Final Weight).
6. Subtract the final weight from Step 4.2.5 and the AVC from Step 4.1.7 from the initial weight (Weight of Sand in Container).
7. Divide the weight of sand in container by the known volume of the calibrated container. This value is the Sand Calibration Factor.
The sand calibration factor (SCF) and the apparatus volume correction (AVC) must be for the calibrated sand actually being used for the test. Any time the sand supplied changes or there is any reason to suspect a difference in material, then both the AVC and SCF must be re-established.

4.3 **Volumeter**

The volumeter assembly and matching base plate have been calibrated. No additional calibration is required unless the supply of sand changes.

Damaged volumeters and/or base plates must be immediately removed from service. Volumeters which have been supplied by the Geotechnical Engineering Bureau and become damaged should be returned to the Regional Geotechnical Group.
5. TEST PROCEDURE

Use Form SM 384a (Appendix C). US Customary units (lbs) are used for recording the larger weights (Plus ¾ in. (19 mm) material, weight of cylinder & soil, etc.) on Lines A through N. International System of Units (g) are used for recording the smaller weights (soil & tare, tare, etc.) on Lines T through X.

5.1 Filling the Volumeter
1. Make sure the Volumeter is in good working condition, and is empty.
2. Set the volumeter on a firm level area, free from vibration, with the cone end up and the valve closed.
3. With the valve closed, fill the cone with sand.
4. Open the valve, allowing sand to begin to flow into the container. Taking care not to let the cone empty, continue to add sand to the cone until the sand stops flowing into the container.
5. Close the valve carefully and pour off the excess sand remaining in the cone.

NOTE: If the volumeter is subject to movement or vibration during the filling operation or while closing the valve, empty all of the sand from the apparatus and start over at Step 1.

NOTE: Do not attempt to disassemble any part of the volumeter apparatus. Doing so will affect the calibration.

5.2 Test Location Data
1. Choose a test location in accordance with the following procedure:

   Single Test Area
   a. Plan out area to be tested (1 test location required).
   c. Multiple the 1st number by the test area width for the X coordinate, multiply the 2nd number by the test area length for the Y coordinate.
   d. Test location is located by the X, Y coordinate within the test area.

   Sub-lots
   a. Determine number of test locations required.
   b. Divide total area to be tested by required number of test locations to determine Number of Sub-lots.
   c. Using ASTM D3665 Standard Practice for Random Sampling of Construction Materials (or equivalent), generate two random numbers.
   d. Multiple the 1st number by the sub-lot width for the X coordinate, multiply the 2nd number by the sub-lot length for the Y coordinate.
   e. Repeat until all test locations for all sub-lots are determined.
   f. Test location is located by the X, Y coordinate within the sub-lot.
General:
If an area to be tested has a location of a suspected compaction deficiency, no Random Numbers are needed. Perform the test at the suspect location.

2. Enter the information required in the top section of Form SM 384a.

5.3 Sampling and Testing
1. Line A (for the Weight Method only): Weigh the Sand Cone Apparatus (this step is not necessary when using the Volumeter Method).
   - **NOTE**: Assure that scales and balances are leveled on a stable surface before mass measurements are taken.
2. Choose a test location in accordance with Section 5.2 Test Location Data.
3. Remove all loose and disturbed material at the test location. Level a small area for the base plate.
4. Set base plate firmly in place. Be sure it has intimate contact with the ground surface and that there are no gaps present.
   - **NOTE**: Nails can be used to prevent base plate movement while following Step 5.
5. Dig a hole of approximately 0.1 ft$^3$ (2832 cm$^3$) through the opening in the base plate. Place the excavated soil in a friction-top container. Follow these tips:
   - Wear eye protection while performing this Step.
   - Protect the test area from direct sunlight.
   - Dig as rapidly as practical. Loosen the soil with a hammer, chisel and knife. Transfer loosened soil into the friction-top can with a large spoon. Keep the top on the can to preserve the soil moisture, removing it only when placing soil into the can.
   - The diameter of the hole should be close to the diameter of the center hole in the base plate. Do not undercut the base plate; doing so will invalidate the test.
   - The Depth of the hole should be about 6 in (150 mm).
   - The volume of the hole must not be less than 0.06 ft$^3$ (1700 cm$^3$).
     - Tip: Completely fill the friction-top can with soil. This typically will ensure that the minimum volume will be met.
   - Remove and place in the can, any loose material from inside the hole and on top of the base plate (use the paintbrush as a broom for this).
6. Properly seat the Sand Cone Apparatus or Volumeter on the base plate over the hole.
7. Open the valve to permit sand to flow into the hole.
   - **NOTE**: Heavy equipment in the vicinity of the test area must be stopped while the valve is open. Vibrations will compact the sand flowing in the test hole, resulting in an incorrect test value and invalidating the test.
8. When the sand stops flowing from the apparatus into the test hole, close the valve tightly.
9. Line B (for the Weight Method only):
   - Weigh the apparatus and remaining sand and record this value.
10. Complete **Line C** through **Line G** to calculate the volume of the hole.
11. If a volumeter is used, skip Lines A through G and proceed as follows:
   - Turn the closed volumeter upside down.
   - Upturn the volumeter *very slowly*, tipping it slightly past vertical to semi-level the sand in the container.
   - **NOTE**: Do not shake the volumeter to level the sand. Doing so will densify the sand, resulting in an incorrect value for volume. The sand does not need to be perfectly level; the three scales on the side of the Volumeter will give a correct average value.
   - From the 3 scale indicators, read the top surface of the sand to the nearest 0.001 ft$^3$.
   - Repeat Step 11 two additional times, for a total of 9 values.
12. **Line H**. Record the average of the 3 sets of readings.
   - No individual set of readings should deviate by more than 0.001 ft$^3$ from the average.

### 5.4 Field Wet Density Determination

The range of allowable field wet densities has been developed from Statewide Compaction Assurance Curves (Appendix C). These curves are expressed in terms of the dry density of the minus ¾ in (19 mm) portion of the material at given moisture contents. To accurately compare soil densities, the Field Wet Density of the total sample must be corrected to give the Field Wet Density of the minus ¾ in (19 mm) portion of the sample.

1. **Line I**: Sieve the material removed from the test hole through a ¾ in (19 mm) sieve. Weigh the material retained on the sieve to the nearest 0.01 lb.
2. **Line J**: Weigh the material passing the ¾ in. (19 mm) sieve to the nearest 0.01 lb.
   - Place approximately 500 g of this material in a covered container to be used if it is later necessary to determine the moisture content.
3. **Line K**: Using the Field Wet Density Calculator in accordance with the instructions printed on the calculator, determine the corrected field wet density ($\frac{3}{4}$ in. (19 mm) fraction) to the nearest lb/ft$^3$.
4. **Line L**: Weigh a 1/30 ft. $^3$ (944 cm$^3$) Compaction Cylinder and base, but without the collar, to the nearest 0.01 lb.
5. **Line M**:
   - Install the collar on the Compaction Cylinder. Place the Compaction Cylinder assembly on a flat, level and rigid foundation.
   - Place the material passing the ¾ in. (19 mm) sieve into the Compaction Cylinder in three equal layers. Compact each layer with 25 well-distributed blows of the 5.5 lb (2.5 kg) Rammer.
   - **Note**: Hold the Rammer sleeve plumb, and allow the Rammer to drop freely from its full height of 12 in (300 mm).
   - **Note**: The last compacted layer should extend at least ¼ in. (6.3 mm), but no more than 1 in. (25 mm), into the collar.
   - Remove the collar. Screed the top of the cylinder with a steel straight edge so that the compacted soil is level with the top of the cylinder.
• **Note:** Care should be exercised to assure a smooth and level sample surface.

• **Tips:**
  - Hold the screed at a 45 degree angle to the soil. Screed around the outside edge first, gradually working toward the center until you can screed across the entire top of the sample.
  - Some larger particles may be pulled out of the sample with the screed, leaving a small depression. Fill these depressions with finer soil that had been screeded off. Exert a reasonable effort with the screed to densify this filler to match the density of the sample.

• Weigh the sample, cylinder and base to the nearest 0.01 lb.

6. **Line N:** Subtract Line L from Line M. Round the value to the nearest 0.1 lb.

• **Note:** Rounding Rule – The Geotechnical Engineering Bureau’s laboratory utilizes a simplified version of the rounding rule described in ASTM E29 *Standard Practice for Using Significant Digits in Test Data to Determine Conformance with Specifications*. The procedure is as follows:

  **Significant Number Rounding:**
  When the next digit beyond the last place to be retained is:
  - Less than 5. Drop that number and leave the remainder unchanged.
  - Greater than 5. Increase the last digit to be retained by 1.
  - Equal to 5. Round to the nearest even number or zero (e.g. if the last place to be retained is an even number, that digit remains unchanged. If the last place to be retained is an odd number, increase the last digit by 1).

7. **Line O:** The percent of Maximum Dry Density as required by the Specifications for the item being tested.

8. **Line P:** From the soil type, determine the proper Compaction Assurance Table to use.

• **Note:** If the value recorded on Line N is greater than 4.6, Table 2 should be used regardless of the soil description.

9. **Line Q:** Using the table listed on Line P, locate on the vertical axis the Weight of Soil (Line N) and the Percent of Maximum Density (Line O). On the adjacent horizontal row, find the highest value and record it.

10. **Line R:** On the adjacent horizontal row, find the lowest value and record it.

11. **Determine Pass/Fail/Run Moisture Content**

• **PASS:** Compare **Line K** with **Line Q:** If Field Wet Density (Line K) is equal to or greater than the Highest Field Wet Density Required (Line Q), then the test passes with no additional analysis needed.

• **FAIL:** Compare **Line K** with **Line R:** If Field Wet Density (Line K) is lower than the lowest Field Wet Density Required (Line R), than the test fails with no additional analysis needed.

• **RUN MOISTURE:** If the value recorded on **Line K** is **between** the values
shown on Line Q and Line R it is necessary to determine the moisture content of the excavated soil.

5.5 **Moisture Content Determination**

1. **Line S**: Tare ID.
2. **Line T**: Weight of the empty tare.
3. **Line U**: Place a 500 - 1000g portion of the minus ¾ (19mm) material (from Step 5.4.2) in the tare and record the weight of tare and soil.
4. **Line V**: Dry soil to a constant weight and record the value.
   - Tips:
     - Good drying results are obtained if the tare containing the sample is placed in a skillet on a bed of sand. The sand distributes the heat more uniformly and will prevent burning the sample.
     - Occasional stirring will hasten the drying process, but care should be taken not to lose any of the sample.
5. **Line W**: Calculate the weight of water (Line U - Line V) and record the value.
6. **Line X**: Calculate the weight of Dry Soil (Line V - Line T) and record the value.
7. **Line Y**: Calculate the Moisture Content and record it as a whole number percentage.

\[
\% M.C. = \frac{\text{weight of water}}{\text{weight of dry soil}} \times 100
\]

8. **Line Z**: Using the table recorded on Line P, locate on the vertical axis the Weight of Soil (Line N) and the Percent of Maximum Density (Line O). Find the value located at the intersection of the moisture content column and the indicated horizontal row and record the value.
9. Determine Pass/Fail:
   - **PASS**: Line K \( \geq \) Line Z.
   - **FAIL**: Line K < Line Z.
6. FAILURE OF COMPACTATION ASSURANCE TEST

If a Compaction Assurance Test fails, the compaction effort on the soil layer is not achieving results in conformance with the specifications. The Contractor must adjust or revise the compaction methods and/or equipment in order to meet the requirements of the specifications. Retested areas should be referenced in “Remarks” to previously failing tests.

7. REPORTS

Follow instructions found in MURK Part 1B, and in SiteManager.

All Compaction Assurance tests must be reported, including:

- Tests which indicated that the material did not meet specification requirements for the percent Maximum Dry Density, and
- Retests conducted after corrective measures were taken by the Contractor.
- Note: Sufficient notes should be included on the form to identify the individual test and field conditions.
Sand Cone Assembly - Geotechnical Engineering Bureau Drawing No. SM 1685
Compaction Cylinder - Geotechnical Engineering Bureau Drawing No. SM 1563A
APPENDIX B

BACKGROUND AND THEORY

This method utilizes a computational system based on Statewide Compaction Assurance Curves that permits a majority of compaction tests to be performed without requiring moisture content determinations. The computational system, as well as the special equipment used in this method, was originated by William H. Peak, Assistant Civil Engineer, Region 1 Geotechnical Group.

As shown in Figure B-1, the Statewide Curves are developed on a Dry Density vs. Moisture Content basis. Using an assumed Laboratory Dry Density (113 pcf (17.75 kN/m³)) and a moisture content (6%), a point can be plotted on the graph. Through this point a curve is drawn parallel and similar to the adjacent curves. The Maximum Dry Density (117 pcf (18.38 kN/m³)) is obtained from the point where this curve intercepts the Locus of Maximum Density. Since the moisture content for the laboratory and the field dry density is identical, the intersection of this moisture content value and the maximum dry density value is the point where the Field Dry Density would plot to be equivalent to the Maximum Dry Density. In Figure B-1 this point is called the Field Dry Density required.

Any point on this graph also represents a certain wet density - the product of the dry density value and of one plus the moisture content value. Points of equal wet density arrange in curves trending from the upper left to the lower right. Figure B-2 shows the relationship between the wet density curves, the Compaction Assurance Curves and the points as plotted in Figure B-1.

Using this graph it can be seen that if the Laboratory Wet Density (120 pcf (18.85 kN/m³)) and the moisture content (6%) is known, the Field Wet Density Required (124 pcf (19.48 kN/m³)) to obtain the Maximum Field Dry Density can be established.

Figure B-3 shows that points of equal Laboratory Wet Density (used 120 pcf (18.85 kN/m³)) and varying moisture contents develop different values for the Maximum Dry Density and the Field Wet Density Required. The range of varying moistures and these corresponding values can be limited as follows:

1. A 2% minimum limit for sands and sands containing minor amounts of gravel and silt, and a 4% minimum limit for other soils. Normal embankment material will rarely be found to be drier than these limits.
2. A maximum of 4%+ above Optimum - Embankment material with moistrures approaching this limit will rut excessively and no compaction test will be taken.

Within these limits, Figure B-3 shows that the highest Field Wet Density Required (126 pcf (19.79 kN/m³)) for Laboratory Wet Density of 120 pcf (18.85 kN/m³)) occurs at the minimum moisture content of 2%. Accordingly, if the Field Wet Density is greater than the Field Wet Density Required at 2% moisture content, the compaction test passes regardless of the actual moisture content of the soil.

As the moisture content is increased above the minimum, the Field Wet Density Required to satisfy the specification requirements, decreases until the lowest Field Wet Density Required (120 pcf (18.85 kN/m³)) is reached. This is at the point where the wet density curve crosses the locus of maximum density (or optimum moisture). It then increases on the wet side of the optimum
APPENDIX B

moisture. This means that, if the Field Wet Density is lower than the Field Wet Density required at the optimum moisture content, the test fails regardless of the actual moisture content of the soil.

If the field wet density of the soil is between the highest and the lowest Field Wet Density Required, a moisture content determination is necessary to evaluate the test. From the known Laboratory Wet Density and the Moisture Content, the actual Field Wet Density Required can be obtained and compared with the measured Field Wet Density for a Pass – Fail decision.
APPENDIX B

Figure B-1

This family is to be used on soils identified as:
- Sand, some Gravel, tr. Silt
- Sand, tr. Gravel & Silt
- Sand, some Silt
- Sand, tr. Silt

▲ FIELD DRY DENSITY REQUIRED
○ LABORATORY DRY DENSITY
(PER AASHO T-99 METHOD C)

DRI DENSITY - LBS PER CUBIC FEET

MOISTURE CONTENT - % OF DRY WEIGHT
This family is to be used on soils identified as:
- Sand, some Gravel, tr. Silt
- Sand, tr. Gravel & Silt
- Sand, some Silt
- Sand, tr. Silt

**Figure B-2**
APPENDIX B

Figure B-3
APPENDIX C

PROJECT ____________________________

DISTRICT ___________ COUNTY ____________

SAND SOURCE ____________________________

A Cone Calibration

1. Weight of Jar, Cone and Sand - Before LBS.
2. Weight of Jar, Cone and Sand - After LBS.
3. Weight of Sand in Cone (1 - 2) LBS.

B Weight Sand in Container

4. Weight of Jar, Cone and Sand - Before LBS.
5. Weight of Jar, Cone and Sand - After LBS.
6. Weight of Sand in Cone and Container (4 - 5) LBS.
7. Weight of Sand in Cone (3) LBS.
8. Weight of Sand in Container (6 - 7) LBS.

C Volume of Container

9. Weight of Container Filled with Water LBS.
10. Weight of Container LBS.
11. Weight of Water to Fill Container (9 - 10) LBS.
12. Volume of Container (11 + 12.4) CU.FT.

D Sand Density Determination

13. Density of Sand (8 + 12) LBS. PER CU.FT.

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<th>Sieve</th>
<th>% Passing</th>
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# Compaction Assurance Data Sheet

**Pin:**

**Project:**

**Contract No.:**

**County:**

**Inspector:**

**Checked By:**

## Test Information

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<th>Description</th>
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<td>Test Number</td>
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<tr>
<td>Station of Test</td>
<td></td>
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<td>Offset</td>
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</tr>
<tr>
<td>Type of Compactor</td>
<td></td>
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<tr>
<td>Number of Passes Per Layer</td>
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<tr>
<td>Soil Type (Sand)/ (Till-Silt-Clay-Gravel)</td>
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<td>Depth Below Subgrade Surface</td>
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## Test Results

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<th>Value</th>
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<td>WT. Sand Cone Apparatus (Before) - lbs</td>
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<tr>
<td>WT. Sand Cone Apparatus (After) - lbs</td>
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</tr>
<tr>
<td>WT. Sand Used - lbs (A - B)</td>
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<tr>
<td>Apparatus Volume Correction - lbs</td>
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<tr>
<td>WT. Sand in Hole - lbs (C - D)</td>
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<tr>
<td>Sand Calibration Factor - lb/ft³</td>
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<td>Volume of Hole - ft³ (E/F)</td>
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<td>Apparatus Volume (Volumeter)</td>
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</tr>
<tr>
<td>Weight of Plus ¾ lbs</td>
<td></td>
</tr>
<tr>
<td>Weight of Minus ¾ lbs</td>
<td></td>
</tr>
<tr>
<td>Field Wet Density - lb/ft³</td>
<td></td>
</tr>
<tr>
<td>Weight of Cylinder - lbs</td>
<td></td>
</tr>
<tr>
<td>Weight of Cylinder &amp; Soil - lbs</td>
<td></td>
</tr>
<tr>
<td>Weight of Soil - lbs (M - L)</td>
<td></td>
</tr>
<tr>
<td>Specified Density - % of Maximum</td>
<td></td>
</tr>
<tr>
<td>Compaction Assurance Table No.</td>
<td></td>
</tr>
<tr>
<td>Highest Field Wet Density Required - lb/ft³</td>
<td></td>
</tr>
<tr>
<td>Lowest Field Wet Density Required - lb/ft³</td>
<td></td>
</tr>
<tr>
<td>Run Moisture Content</td>
<td></td>
</tr>
<tr>
<td>Tare ID</td>
<td></td>
</tr>
<tr>
<td>WT. of Tare - g</td>
<td></td>
</tr>
<tr>
<td>WT. of Tare &amp; Wet Soil - g</td>
<td></td>
</tr>
<tr>
<td>WT. of Tare &amp; Dry soil - g</td>
<td></td>
</tr>
<tr>
<td>WT. of Water - g (U - V)</td>
<td></td>
</tr>
<tr>
<td>WT. of Dry Soil - g (V - T)</td>
<td></td>
</tr>
<tr>
<td>Moisture Content - % (W/X * 100)</td>
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<tr>
<td>Field Wet Density Required - lb/ft³</td>
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</tbody>
</table>

## Test Results

<table>
<thead>
<tr>
<th>Test Case</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pass (K equal or greater than Q)</td>
<td></td>
</tr>
<tr>
<td>Fail (K lower than R)</td>
<td></td>
</tr>
<tr>
<td>Approximate % of Maximum Density (optional)</td>
<td></td>
</tr>
</tbody>
</table>

**Remarks:**

____________________________________________________________________________________

____________________________________________________________________________________
### APPENDIX D

#### TABLE I

<table>
<thead>
<tr>
<th>Weight of Soil in Pounds</th>
<th>Compaction Assurance Tables</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Moisture Content (%)</td>
</tr>
<tr>
<td></td>
<td>1%</td>
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<tr>
<td></td>
<td>1</td>
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</tbody>
</table>

#### TABLE II

<table>
<thead>
<tr>
<th>Weight of Soil in Pounds</th>
<th>Compaction Assurance Tables</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Moisture Content (%)</td>
</tr>
<tr>
<td></td>
<td>1%</td>
</tr>
<tr>
<td></td>
<td>1</td>
</tr>
</tbody>
</table>

Note: The table values are placeholders for the actual data.