
Test Procedure for

LABORATORY COMPACTION CHARACTERISTICS AND MOISTURE-DENSITY RELATIONSHIP OF BASE MATERIALS



TxDOT Designation: Tex-113-E

Effective Date: June 2011

1 SCOPE

- 1.1 This method determines the relationship between water content and the dry unit mass (density) of base materials. Base materials are compacted in a 6-in. diameter × 8-in. tall mold with a 10-lb. rammer. The test is performed on prepared materials passing the 1-3/4 in. (45 mm) sieve. Follow Tex-114-E to determine moisture-density relationships of untreated subgrade and embankment soils.
- 1.2 The values given in parentheses (if provided) are not standard and may not be exact mathematical conversions. Use each system of units separately. Combining values from the two systems may result in nonconformance with the standard..
- 1.3 Instructional videos are available using the following links.
- [Definitions](#)
 - [Apparatus](#)
 - [Procedure](#)
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2 DEFINITIONS

- 2.1 *Maximum Dry Density (D_A)*—Maximum dry density is the maximum value obtained from the compaction curve using the specified compactive effort.
- 2.2 *Optimum Water Content (W_{OPT})*—Optimum water content is the water content at which the soil can be compacted to the maximum dry density.
- 2.3 *Compactive Effort (C.E.)*—Compactive effort is the total energy, expressed as foot-pounds per cubic inch (kilo-Newton-meters per cubic meter), used to compact the specimen.
- 2.3.1 Calculate compactive effort as follows:

$$C.E. = \frac{Ht.of\ Drop(m\ or\ ft) \bullet Wt.of\ Hammer(k\ Nor\ lb) \bullet \#Drops \bullet \#Layers}{Volume\ of\ Mold(m^3\ or\ in.^3)}$$

2.3.2 This procedure requires 15 ft-lb per drop (13.26 ft-lb /in.³).

Note 1—In the metric system, the units for weight and mass are not the same. In order to convert the mass of the hammer to the metric "weight," you must multiply the mass by the force of gravity, g , which in the metric system is 9.8 m/sec^2 . The resulting unit is a Newton. Divide that number by 1,000 to get kilo-Newtons (kN).

3 APPARATUS

- 3.1 *Automatic tamper (compaction) device*, with base plate to hold 6-in. (152.4 mm) inside diameter (I.D.) molds, equipped with a $10 \pm 0.02 \text{ lb.}$ ($4.54 \pm 0.01 \text{ kg}$) rammer and adjustable height of fall.
- 3.1.1 Striking face of the rammer should conform to a $43 \pm 2^\circ$ segment of a $2.9 \pm 0.1 \text{ in.}$ ($74 \pm 2.5 \text{ mm}$) radius circle.
- 3.1.2 Bolt the base plate of the tamper to a rigid foundation, such as a concrete block, with a mass of not less than 200 lb. (91 kg). Use an alternate foundation support, such as a rigid stand or table, only if the D_A produced is within 2% of that produced by an automatic tamper bolted to a concrete floor.
- 3.2 *Rigid metal compaction mold*, with a 6 in., $+1/16$, or $-1/64 \text{ in.}$ (152.4 mm, $+1.59$ or -0.40 mm) I.D. and $8.5 \pm 1/16 \text{ in.}$ ($215.9 \pm 1.6 \text{ mm}$) height, with removable collar.
- 3.3 *Metal stand*, with a set of standard spacer blocks 1, 4, 6, and 11 in. (25.4, 101.6, 152.4, and 279.4 mm) accurate to 0.025 mm (0.001 in.), and a micrometer dial assembly with 2 in. (50 mm) travel for determining height of specimens.
- 3.4 *Balance*, Class G2 in accordance with Tex-901-K, with a minimum capacity of 35 lb. (16 kg).
- 3.5 *Extra base plate*, secured on a rigid, level stand to hold the mold.
- 3.6 *Hydraulic press*, to extrude compacted specimens from mold.
- 3.7 *Drying oven*, maintained at $230 \pm 9^\circ\text{F}$ ($110 \pm 5^\circ\text{C}$).
- 3.8 *Metal pans with lids*, wide and shallow for mixing and drying materials.
- 3.9 *Non-absorptive bowls with lids*.
- 3.10 *Set of standard U.S. sieves*, meeting the requirements of Tex-907-K, in the following sizes:
- 1-3/4 in. (44.5 mm)
 - 1-1/4 in. (31.7 mm)
 - 7/8 in. (22.2 mm)
 - 5/8 in. (16 mm)
 - 3/8 in. (9.5 mm)

- No. 4 (4.75 mm)
 - No. 40 (0.425 mm).
- 3.11 *Sprinkling jar and wash bottle.*
- 3.12 *Clean, circular, porous stones, slightly less than 6 in. (152.4 mm) in diameter and 2 in. (51 mm) high.*
- 3.13 *Non-porous paper discs, 6-in. (150 mm) diameter, Gilson MSA-121 or equivalent.*
- 3.14 *Supply of small tools, including a level, putty knife, spatula, horsehair bristle brush, plastic mallet, open-ended wrenches (7/16 in. and 9/16 in.), crescent wrenches (12 in. and 16 in.), Allen wrenches (1/8 in., 3/16 in., and 9/64 in.), and feeler gauges.*
- 3.15 *Soil Compactor Analyzer (SCA) approved by TxDOT, with sensor rod assembly, control box, computer, and compaction device analysis system software capable of turning the automatic tamper off once the required compactive energy has been delivered to the layer being compacted.*
- 3.15.1 *Sensor rod assembly consists of sensing rod, magnetostrictive linear displacement transducer, frame (powder coated), circular magnet, magnet mount, cable, and miscellaneous mounting hardware.*
- 3.15.2 *Control box consists of enclosure, power supply, data acquisition card, miscellaneous electronics, and emergency stop.*
- 3.15.3 *Computer with system software, TxDOT SCA V8.1.10, maintained by the Construction Division, Materials and Pavements Section.*
- 3.15.4 [SCA Reference Guide.](#)
- 3.16 *Slide finishing hammer, meeting the dimensions in Figure 1. The drop weight will be 10 ± 0.02 lb. (4.55 ± 0.01 kg), and drop height will be 18 in. along a vertical, fixed shaft. The finishing tool will have a smooth, flat surface. Weight of entire slide finishing hammer will be 23.4 ± 0.1 lb.*

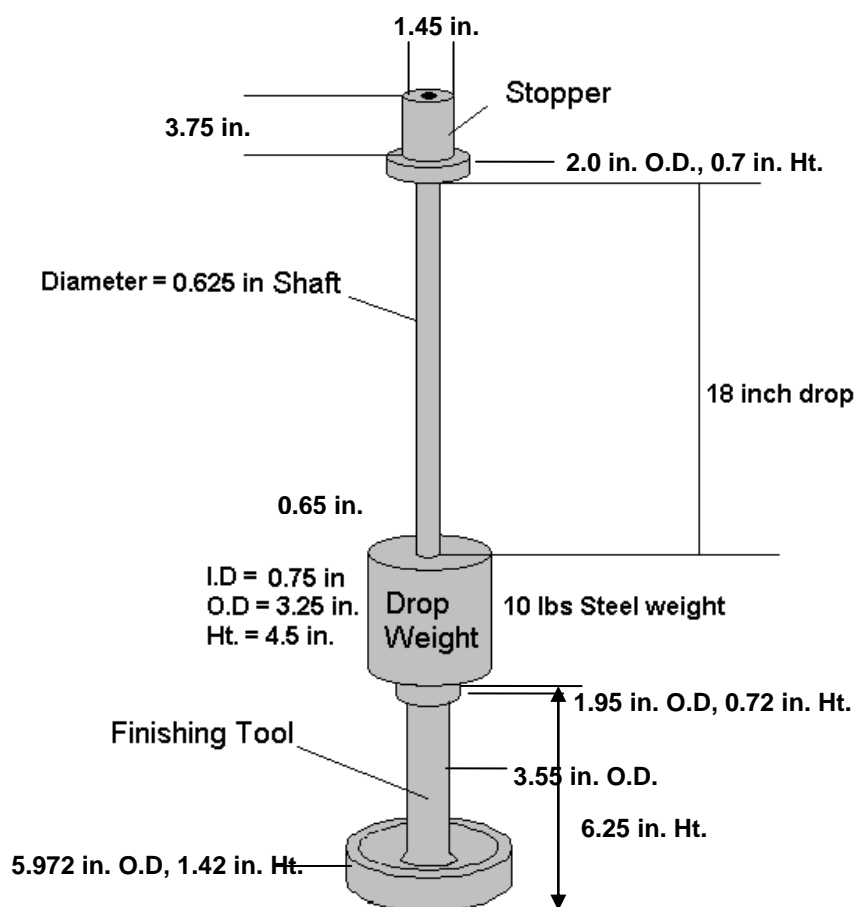


Figure 1—Slide Finishing Hammer

4 CALIBRATING EQUIPMENT

- 4.1 Calibrate and maintain all equipment required by this procedure in accordance with Tex-198-E.
- 4.2 Perform the following additional activities to properly maintain the automatic tamper:
 - 4.2.1 Wipe the guide rods and disc with a wet rag after each use.
 - 4.2.2 Wipe the guide rods and disc with alcohol weekly to ensure that no oil or residue begins to build up on them.
 - 4.2.3 Lubricate the guide disc prior to compaction with a graphite pencil. The rods will become lubricated by picking up a bit of the graphite from the edge of the disc during compaction.

- 4.2.4 Check the guide bushing located on top of the compactor weekly. There should be very little play between the shaft and the guide bushing. The acceptable clearance between the shaft and the guide bushing is 0.007–0.013 in. Replace the guide bushing if the clearance is outside these limits.
- 4.2.5 Check the guide rod brackets weekly. There should be very little to no play between the rods and the brackets. If the play is excessive, replace the brackets.
- 4.2.6 Check the spacing between the guide disc and rods weekly by pushing the shaft/disc towards two of the guide rods and measuring for a total clearance of 0.016 in. with feeler gauges. If the total clearance exceeds 0.016 in., adjust the spacing until it meets the tolerance.
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5 MATERIAL SAMPLING AND PREPARATION

- 5.1 Obtain a representative sample in accordance with Tex-400-A.
- 5.2 Check specifications for maximum aggregate size.
- 5.3 Spread sample on a clean floor to air dry or use a forced draft of warm air not to exceed 230°F (110°C) and dry to constant weight. Constant weight will be considered achieved when the weight loss is less than 0.1% of the sample weight in four hours of drying.
- 5.4 Separate flexible base by dry sieving into the following sizes.
- 1-3/4 in. (44.5 mm)
 - 1-1/4 in. (31.7 mm)
 - 7/8 in. (22.2 mm)
 - 5/8 in. (16 mm)
 - 3/8 in. (9.5 mm)
 - No. 4 (4.75 mm)
 - No. 40 (0.425 mm)
- Note 2**—Do not overload the screens. The material passing the No. 4 and retained on the No. 40 sieve may need to be shaken separately and in several small batches to avoid overloading the screen.
- 5.5 When material contains aggregate retained on the 1-3/4 in. (44.5 mm) sieve, add the material passing the 1-3/4 in. (44.5 mm) sieve and retained on the 1-1/4 in. (31.7 mm) sieve for recombining individual specimens.
- Note 3**—Do not use particles larger than 1-3/4 in. (44.5 mm) in the compacted specimens.
- 5.5.1 When aggregate between 1-3/4 in. (44.5 mm) and 1-1/4 in. (31.7 mm) is needed, crush particles larger than 1-3/4 in. (44.5 mm) or obtain additional material from the project.
- Note 4**—Do not crush the material if it is an uncrushed gravel.
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5.6 Weigh each size of material to the nearest 0.1 lb. (5 g).

5.7 Calculate the cumulative percentages retained on each sieve:

$$\text{Percent Retained} = 100(\text{Mass Retained} / \text{Total Mass of Sample})$$

Note 5—These values are to be used in recombining the sample for compaction specimens.

6 PROCEDURE

6.1 Estimate the mass of air-dry material that will fill the mold when wetted and compacted.

6.2 Using this estimated mass and the percentages of the various sizes of particles obtained in the preparation of the sample, compute the cumulative masses for each size to be combined to mold a specimen.

$$\text{Cumulative Weight Retained} = \left(\frac{\text{Cumulative Percent Retained}}{100} \right) \times \text{Estimated Mass of Material}$$

EXAMPLE: Estimated Mass of Material = 18.250 lb.

Sieve Size (in.)	Cumulative Percent Retained (%)	Cumulative Weight Retained (lb.)
1-3/4	0.0	$\left(\frac{0.0}{100} \right) \times 18.25 = 0.000$
1-1/4	2.6	$\left(\frac{2.6}{100} \right) \times 18.25 = 0.475$
7/8	10.6	$\left(\frac{10.6}{100} \right) \times 18.25 = 1.935$
5/8	20.6	$\left(\frac{20.6}{100} \right) \times 18.25 = 3.760$
3/8	35.7	$\left(\frac{35.7}{100} \right) \times 18.25 = 6.515$
No. 4	52.8	$\left(\frac{52.8}{100} \right) \times 18.25 = 9.636$
No. 40	82.1	$\left(\frac{82.1}{100} \right) \times 18.25 = 14.983$
(-)No. 40	100.0	$\left(\frac{100.0}{100} \right) \times 18.25 = 18.250$

- 6.3 Weigh a trial sample as calculated in Section 6.2.
- 6.3.1 Estimate the percent moisture at optimum and calculate the weight of water to add based on the mass of the air-dried material.

$$\text{Weight of Water} = \left(\frac{\text{Estimated Moisture at Optimum}}{100} \right) \times \text{Estimated Mass of Material}$$

EXAMPLE:

Estimated Mass of Material = 18.250 lb., Estimated Moisture at Optimum = 5.2 %

$$\text{Weight of Water} = \left(\frac{5.2}{100} \right) \times 18.250 = 0.949 \text{ lb}$$

- 6.3.2 Weigh the water calculated in Section 6.3.1 in a tared sprinkling jar.
- 6.3.3 Mold the trial sample in accordance with Sections 6.7–6.32.
- 6.4 Using the height and mass of the trial sample, calculate the corrected mass of material required to mold samples with a height of 8 ± 0.250 in. (203.2 ± 6.4 mm):
- $$\text{Corrected mass} = (8.000 \text{ in.}) \times (\text{trial mass/trial height})$$
- 6.5 Weigh four samples for the moisture-density curve using the corrected mass of material calculated in Section 6.4 and the percentages of the various sizes of particles obtained in the preparation of the sample.
- 6.6 Determine the moisture content of each specimen.
- 6.6.1 Estimate the optimum moisture content and calculate the water content of the first specimen at 2 percentage points below this estimate.
- 6.6.2 Calculate the water content of the other three specimens, increasing each in increments of one percentage point.
- 6.6.3 Calculate the weight of water to add to each specimen based on the mass of the air-dried material.
- 6.6.4 Weigh each of these water contents in a tared sprinkling jar.
- 6.7 Place the total sample in the mixing pan, mix thoroughly, and wet with all of the mixing water by sprinkling water in increments onto the sample during mixing.
- 6.7.1 Mix thoroughly, breaking up soil lumps. Do not break any aggregate particles in the sample.
- 6.7.2 Turn the wet material over with the mixing trowel to allow the aggregate particles to absorb water.

- 6.8 After it is thoroughly mixed, scrape all material off the mixing trowel into the pan. Weigh the sample and pan, and record the weight.
- 6.9 Cover the mixture with a non-absorptive lid to prevent moisture evaporation and allow to stand for 18–24 hours.
Note 6—Allow the trial sample to stand for a minimum of 2 hours before compaction.
- 6.10 Prior to compaction, weigh the sample (without the lid), replace evaporated water, and thoroughly mix to ensure even distribution of water throughout the sample. Scrape material off mixing tools and into pan.
- 6.11 Cover and allow the samples to stand 1–2 hours before molding.
Note 7—For the trial sample, this step can be eliminated.
- 6.12 Weigh the compaction mold and record on [Form Tx113.4](#), “Moisture-Density Relations of Base Material and Sand or Subgrade and Embankment Soils.”
- 6.13 Place one non-porous paper disc in the bottom of the mold.
- 6.14 Separate the sample using a 7/8 in. (22.6 mm) sieve.
- 6.14.1 Distribute the material retained on the 7/8 in. (22.6 mm) sieve equally, based on size, shape, and number of particles, into four separate non-absorptive bowls.
- 6.14.2 Cover each bowl to prevent loss of moisture.
- 6.14.3 Using the horsehair bristle brush, brush the material stuck to the 7/8 in. (22.6 mm) sieve back into the pan containing the material passing the 7/8 in. (22.6 mm) sieve.
- 6.14.4 Divide the material passing the 7/8 in. sieve into four equal, homogeneous portions.
- 6.15 Estimate the mass needed for one 2-in. (51-mm) layer of compacted material (approximately one-quarter of the total material for the specimen). Weigh one of the portions of material retained on the 7/8 in. sieve with one of the portions of material passing the 7/8 in. sieve, adjusting the amount of material as needed to attain the estimated weight for one layer.
- 6.16 Construct the layer.
- 6.16.1 Cover the bottom of the mold with approximately 1/4 in. of material passing the 7/8 in. sieve and level with a spatula.
- 6.16.2 Hand place all of the aggregate particles retained on the 7/8 in. (22.6 mm) sieve that are contained in one of the non-absorptive containers, minimizing contact with the edges of the mold.
- 6.16.3 Place aggregates in their most stable position. Aggregates may be placed on top of each other in order to make them all fit, but they must also fill the entire diameter of the mold.

- 6.16.4 Use a scoop held slightly above the top of the mold to pour the remaining weighed portion of material passing the 7/8 in. (22.6 mm) sieve into the mold.
- 6.16.5 Use a spatula to move the material passing the 7/8 in. sieve around to fill voids between the aggregate particles retained on the 7/8 in. sieve. Do not rearrange the aggregate particles retained on the 7/8 in. sieve.
- 6.16.6 Completely cover the aggregate particles retained on the 7/8 in. sieve with material passing the 7/8 in. sieve.
- 6.16.7 Use a spatula to spade around the inside perimeter of the mold to allow some of the material passing the 7/8 in. sieve to fill cavities around the edge.
- 6.16.8 Level the surface with the spatula. Do not push this layer down by hand or other means than those described above.
- 6.17 Lower the hammer and allow it to rest on the surface of the uncompacted lift.
- 6.18 Prepare the SCA for data collection in accordance with the SCA Reference Guide. Use the option that allows the SCA to shut the automatic tamper off when the required compactive energy is attained.
- 6.19 Use the SCA to start the compactor. Compact the layer by dropping the 10-lb. (4.55-kg) rammer from a height of $18 \pm 1/2$ in. (457 ± 12.7 mm) until the SCA indicates the total energy delivered to the lift equals 750 ± 15.0 ft-lb. The number of blows needed to achieve 750 ft-lb must be a minimum of 50 and a maximum of 60. If the number of blows is outside this range, discard the sample and adjust the compactor so that the specified energy is attained within the allowable number of blows.
- Note 8**—The SCA will turn the compactor off when the correct energy has been delivered to the lift.
- 6.20 Remove material sticking to the ram face after completing compaction of each lift.
- 6.21 Use the sample mass and compacted thickness of the first layer (measured by the SCA) to adjust the mass of the subsequent lifts.
- 6.22 Weigh one of the portions of material retained on the 7/8 in. sieve with one of the portions of material passing the 7/8 in. sieve. Adjust the amount of material to attain the mass for one layer determined in Section 6.21.
- 6.23 Use a spatula to scarify the surface of the lift just compacted. Do not dislodge aggregates from the previously compacted lift.
- 6.24 Repeat Sections 6.16.2–6.23 for each of the remaining lifts. Use all material to mold the sample. The surface of the fourth lift should be as free as possible from large aggregates.
- Note 9**—Use a flexible collar to extend the height of the mold collar on the fourth lift to prevent loss of material, if needed.
- 6.25 After the fourth layer has been compacted, fasten the mold containing the material on top of the extra base plate.

- 6.25.1 Ensure that the mold sits level on the base plate.
- 6.25.2 Use a spatula or other suitable hand tool to dislodge material from the side of the mold that extends above the compacted surface. Press this material into the surface.
- 6.26 Use a small level to check the levelness of the specimen's surface.
- 6.26.1 If needed, level the surface by placing the slide hammer on top of the specimen's surface and tap the bottom edge of the slide hammer with the plastic mallet. Repeat until the top of the specimen is level.
- Note 10**—Do not trim the compacted material with a straight edge. The compacted material should not completely fill the mold after compaction.
- 6.26.2 After the surface is level, apply ten blows to the top of the specimen with the slide hammer.
- Note 11**—Ensure that the shaft of the slide hammer is maintained perpendicular to the specimen surface when dropping the 10 lb. weight.
- 6.26.3 Repeat Sections 6.26.1–6.26.2 a second time.
- 6.26.4 Use a small level to check the levelness of the specimen's surface and tap the edge of the slide hammer if needed to level the sample one final time.
- 6.27 Remove the mold from the base plate.
- 6.28 Weigh the specimen in the mold to the nearest 0.001 lb. (0.5 g) and measure the sample height with the micrometer dial assembly to the nearest 0.001 in. (0.03 mm). The height of the finished specimen should be 8 ± 0.250 in. (203.2 ± 6.4 mm).
- 6.29 Record data on Form Tx113,4.
- 6.30 Turn the specimen over and carefully center it over a porous stone. Place a non-porous paper disc between the stone and the specimen to prevent moisture from traveling from the specimen into the porous stone.
- 6.31 Place in the hydraulic press and extrude the specimen from the mold.
- 6.32 If unconfined compressive strengths are desired, proceed to Section 6.33; otherwise proceed to Section 6.34.
- 6.33 Immediately after extruding the specimen from the mold, enclose the specimen in a triaxial cell, with top and bottom porous stones in place, and allow it to remain undisturbed at room temperature until the entire set of test specimens has been molded.
- 6.33.1 After the entire test set has been molded, break the specimens at 0 psi lateral pressure in accordance with Tex-117-E, Section 5.19 when using an automated load frame or Section 5.20 when using a screw jack press.
- 6.33.2 Remove the triaxial cell from each specimen just before testing.

- 6.33.3 Place a drying pan under the sample to catch the material as it breaks.
- 6.33.4 Plot the test results in accordance with Section 8.2 to establish the effect of moisture content and density on strength characteristics of the material.
- 6.34 Record the weight of a flat drying pan. Remove the porous stones and place the specimen in the flat drying pan.
- 6.35 Break up the specimen and place the identification tag with the loose material in the tared drying pan.
- 6.36 Weigh the tared pan and wet sample to the nearest 0.001 lb. (0.5 g) and record on Form Tx113,4.
- 6.37 Place the drying pan with wet material in an oven at a temperature of 230°F (110°C) until a constant mass is reached.
- 6.38 Weigh the tared pan and oven-dried material to the nearest 0.001 lb. (0.5 g) and record on Form Tx113,4.
Note 12—Do not reuse material from compacted sample(s) for preparation of other compaction specimens.
- 6.39 Repeat Sections 6.6–6.38 for each sample.
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7 CALCULATIONS

- 7.1 Use [Form Tx113,4](#) to calculate and record the following:
- 7.1.1 Calculate the wet density of the compacted specimens, lb./ft.³ (kg/m³):

$$D_{WET} = (W_T - W_M) / V_M$$

Where:

W_T = mass of the mold and the compacted sample, lb. (kg)

W_M = mass of the mold, lb. (kg)

V_M = volume of the mold, ft.³ (m³).

- 7.1.2 Calculate the percent water content:

$$WC = 100[(W_w - W_d) / W_d]$$

Where:

W_w = wet mass of the sample, lb. (kg)

W_d = oven dried mass of the molded sample, lb. (kg).

- 7.1.3 Calculate the dry density of the compacted specimens:

$$D_{DRY} = 100 \bullet D_{WET} / (100 + WC)$$

Where:

WC = water content of the compacted specimen, % (includes hygroscopic moisture).

- 7.1.4 Calculate the zero air voids density:

$$D_{ZAV} = (Specific\ Gravity \bullet 62.5) / \{1 + [Specific\ Gravity \bullet (\%WC / 100)]\}$$

Where the specific gravity is unknown, use a value of 2.65 as an average value.

- 7.2 Use the electronic worksheets contained in [Form Tx117](#), “Triaxial Compression Tests,” to record and calculate unconfined compressive strength results.

8 GRAPHS

- 8.1 Construct the M/D curve.

- 8.1.1 Plot the dry density versus the percent of molding moisture on Form Tx113,4 for each compacted specimen, as shown in Figure 2.

- 8.1.2 To obtain a well-defined compaction curve, provide at least two water content percentages on both sides of optimum.

- 8.1.3 The R-square value for the fit of the data to the curve must be greater than or equal to 0.9500. If it is not, mold additional samples to improve the fit of the data to the curve and to achieve a minimum R-square value of 0.9500.

- 8.1.4 Use the zero air void line as an aid in drawing the moisture-density curve. For materials containing more than 10% fines, the wet leg of the moisture-density curve generally parallels with the zero air void curve. Theoretically, the moisture-density curve cannot plot to the right of the zero air void curve. If it does, there is an error in specific gravity, in measurement, in calculation, in sample preparation, or in plotting.

- 8.2 If strength behavior is required, plot unconfined compressive strength versus the percent of molding moisture on Form Tx113,4 for each compacted specimen, as shown in Figure 3.

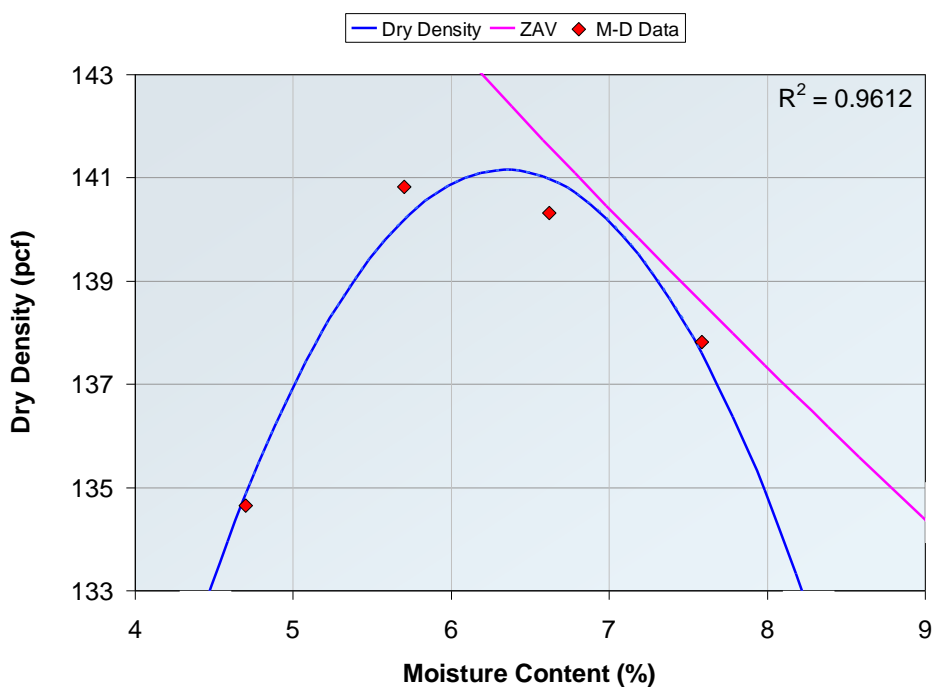


Figure 2—Example of Moisture-Density Curve

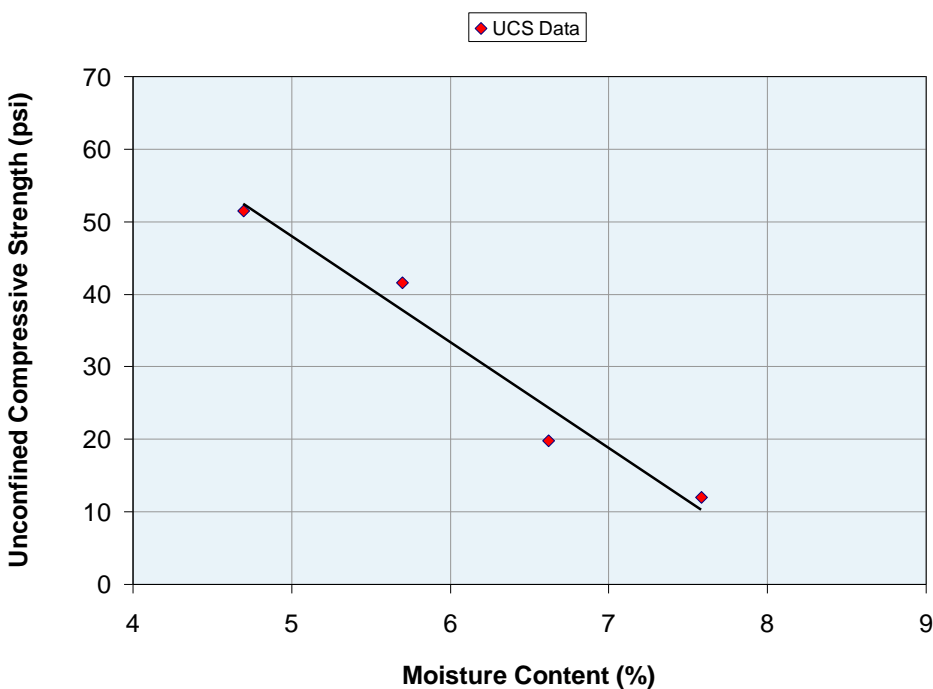


Figure 3—Example of Unconfined Compressive Strength versus Percent Molding Moisture

9 GENERAL NOTES

- 9.1 When determining the M/D curve for lime treated subgrade and base materials, determine the percent lime needed to achieve a pH of 12.4 in accordance with Tex-121-E, Part III.
- 9.2 For wetted stabilized materials taken from the roadway, see appropriate test method for preparation procedure for specification compliance, density, and/or strength:
- Cement Stabilization: Tex-120-E
 - Lime Stabilization: Tex-121-E
 - Lime-Fly Ash Stabilization: Tex-127-E
- 9.3 *Materials Difficult to Compact:*
- 9.3.1 Materials that are difficult to compact are an exception and require special attachments to the compaction apparatus.
- *Rammer*, 10 lb. \pm 0.02 (4.54 \pm 0.01 kg), with twin striking face.
 - *Neoprene pad*, 0.5 in. (12.7 mm) thick, Type A Shore durometer 65 ± 3 . The 6-in. (152.4-mm) diameter neoprene pad should just slide into the mold on top of the sand layer and will divert some of the impact to vibrations.
- 9.3.2 Compact the material in eight 1-in. (25.4-mm) layers using the neoprene pad and 100 ram blows of the 10-lb. (4.55-kg) rammer for each layer.
- 9.3.3 Use the rammer with a twin striking face when the material—wetted to slightly below optimum water content, mixed thoroughly, and molded in two 2-in. (51 mm) lifts—is sheared or torn by the ram in excess of 1 in. (25.4 mm) on the last blow.
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10 REPORTING TEST RESULTS

- 10.1 Record test data on [Form Tx113,4](#) and [Form Tx117](#).
- 10.2 Record the following SCA data on Form Tx113,4 for each lift compacted for each molded specimen:
- total energy,
 - average drop height,
 - average energy per blow, and
 - number of blows per lift.
- 10.3 Report all test data recorded in Sections 6, 7, and 8.
- 10.4 Report maximum dry density (D_A) to the nearest 0.1 lb./ft.³ (kg/m³).
- 10.5 Report optimum moisture content (W_{OPT}) to the nearest 0.1%.
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11 ARCHIVED VERSIONS

11.1 Archived versions are available.