GDT 48

A. Scope

For a complete list of GDTs, see the Table of Contents.

Use this test method to determine the relation between moisture content and density of soils compacted with a 10 lbs (4.5 kg) rammer in a mold that has a volume of 1/30 cu ft (0.0009 mm). This method establishes the theoretical or laboratory maximum dry density.

B. Apparatus

The apparatus consists of the following:

1. Mold Figure 48-1. Use a cylindrical metal mold approximately 4 in (101.6 mm) diameter and 4.6 in (116.84 mm) high with a volume of 1/30 ft^3 (0.0009 m^3). This mold is fitted with a detachable base plate and a removable extension approximately 2.5 in (63.5 mm) high (WM-07).
2. Rammer: Use a metal rammer with a 2 in (50.4 µm) diameter, flat circular face and weighing 10 lbs (4.5 kg). The rammer must be able to control the height of drop to a free fall of 18 in (450 mm) above the soil (WR-1-1).
3. Extruder (optional): Use a cylindrical piston slightly less than 4 in (101.6 mm) diameter or similar device for removing compacted specimens from mold.
4. Scales and Balances: Use a scale of 45 lb (20 kg) capacity sensitive to and graduated in 0.0002 lb (0.1 g), and a 1.1 lb (500 g) capacity balance sensitive to 0.0002 lb (0.1 g).
5. Drying Device: Use a stove or oven capable of rapidly drying the moisture determination samples.
6. Straightedge: Use a steel straightedge 12 in (305 mm) long (WS-13-1).
7. Pans or Dishes: Use pie pans or evaporating dishes suitable for drying soil samples (WP-01 or WD-3).
8. Sieve: Use a No. 10 (2.00 mm) sieve that conforms to the "Standard Specifications for Sieves for Testing Purposes," AASHTO M 92 (WS-4) (WS-08-#010).
9. Graduated Cylinder: Use a glass (Bit-04-100) or plastic (WC-P100) graduate of 3.4 oz (100 ml) capacity used for measuring the mixing water.
10. Mallet: Use a wooden mallet or rubber-covered pestle of suitable size (WM-01).

C. Sample Size and Preparation

1. Thoroughly break up the aggregations in the soil sample without reducing the natural size of individual particles.
2. By quartering or with a sampler, select a representative test sample of the amount required, approximately 10 lb (4.5 kg), to perform the compaction test.
3. Dry the selected sample only enough to sift over a No. 10 (2.00 mm) sieve.
4. Weigh the sample and record the weight as the weight of the total sample.
5. Separate the test sample into two portions with a No. 10 (2.00 mm) sieve.
6. Grind the fraction retained on the No. 10 (2.00 mm) sieve with a rubber-covered pestle or wooden mallet until the aggregations of soil particles are broken up into separate grains.
7. Sift the ground soil again with the No. 10 (2.00 mm) sieve, letting the material that passes through the No. 10 (2.00 mm) sieve the second to mix with the material that passed the first time.
8. Weigh the fraction retained on the No. 10 (2.00 mm) sieve and record as the weight of material retained on the No. 10 (2.00 mm) sieve.

D. Procedures

1. Thoroughly mix the two fractions that passed the No. 10 (2.00 mm) sieve in both sifting operations in Sample Size and Preparation.
2. Use quartering or a sampler to select a portion weighing approximately 6 lbs (3000 g).
3. Rest the mold on a uniform, rigid foundation, like a concrete block weighing more than 200 lbs (90.7 kg).

4. Compact the sample in the cylinder (with the extension attached) in five equal layers.
   a. Compact each layer with 25 blows from the rammer dropped from 18 inches (450 mm) above the soil.
   b. Uniformly distribute the blows over the surface of the compacted layer.
   c. After compacting each layer, remove any soil adhering to the face of the rammer.
5. After compacting all five layers, remove the extension and base plate.
6. Carefully level the compacted soil to the top and bottom of the cylinder with the straightedge.
7. Weigh the cylinder.
8. Record the wet weight of the compacted soil in lbs per ft^3 (kg per m^3) as follows:
   Wet weight, lbs per ft^3 (kg per m^3) = (Weight of the compacted sample and cylinder – Weight of the cylinder) x (30).

NOTE: If the weights are in grams, convert to kilograms per cubic meter by dividing the number of grams per kilogram (454 g) into the wet weight expressed in grams per cubic meter.

9. Remove the compacted soil from the cylinder and slice it vertically through its center.
10. Take an approximate 0.22 lb (100 g) sample from the center of the mass and weigh it immediately.
11. Dry the sample to a constant weight.
12. Determine the moisture content as follows:

$$\% \text{ Moisture} = \frac{A-B}{B} \times 100$$

where:

A = weight of the wet soil

B = weight of the dry soil

13. Thoroughly pulverize the remainder of the compacted material.
14. Add water to increase the moisture content of the soil in predetermined increments (1 percent to 2 percent for sandy soils, 2 percent to 3 percent for clayey soils).
    For example, on a 6lb (3 kg) sample, add 30 cm^3 of water to increase the moisture content by 1 percent.
15. Repeat Procedures, steps 1 through 14 for each increment of water added.
16. Continue the procedure until the soil becomes very wet and the wet weight of the compacted soil substantially decreases.
17. Take a moisture sample after each determination.

E. Calculations

1. Calculate the density (dry weight) of the soil, in pounds per cubic foot (kilograms per cubic meter), as follows:

$$\text{Density -pcf } (kg/m^3) = \frac{Ww}{M + 100} \times 100$$

where:

Ww = wet weight, in pounds per cubic foot (kilograms per cubic meter) of compacted soil (Procedures, step 8)

M = moisture content, in percent, at which wet weight was determined (Procedures, step 12)

2. Calculate the percent moisture and density for each determination in the series.
   a. If using the moisture-density relationship as compaction control, plot a moisture-density curve.
      1) Plot the densities as ordinates and their respective moisture contents as abscissas.
      2) Draw a smooth curve through the resulting points.
      3) Read the results from the curve. The peak of the curve corresponds to the optimum moisture content and the theoretical maximum dry density.

3. Correction for No. 10 (2.00 mm) Material
   a. If the Specifications require density measurements on the total sample, and if the soil contains material retained on the No. 10 (2.00 mm) sieve, correct the maximum dry density to reflect the percentage of Plus No. 10 (2.00 mm) material.
   b. If using maximum densities for compaction control, always correct the densities for the percentage of Plus No. 10 (2 mm) material. Conversion factors are given in the density tables of GDT-7.

F. Report

Record the moisture content and the dry density on Form 386.

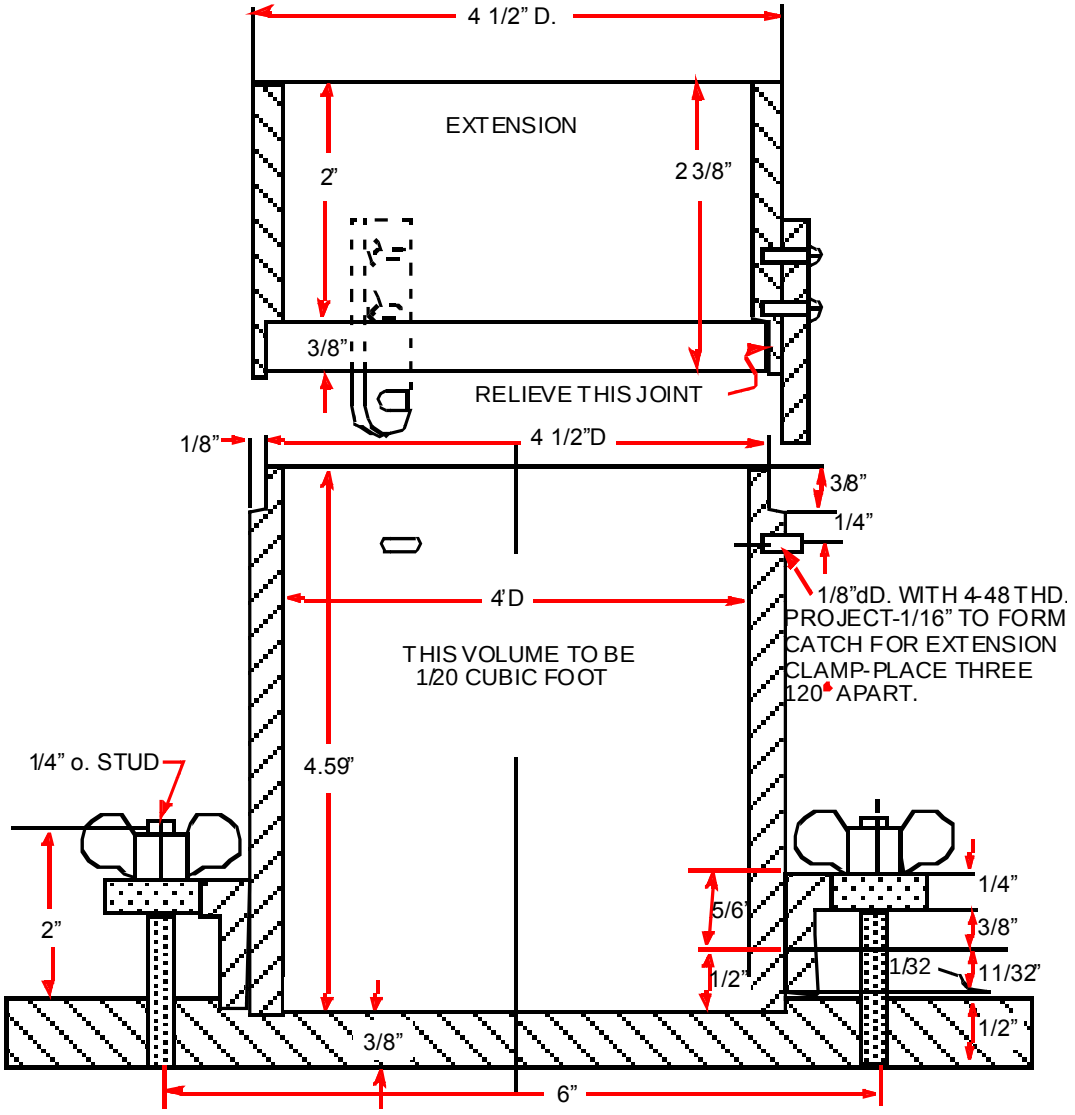

Figure 48-1