GDT 28

A. Scope

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

Use this test method to determine the weight per cubic foot (meter) of freshly mixed concrete and to calculate:

- The yield
- The actual cement factor
- The air content of the concrete

Yield is defined as the volume of concrete produced from a mixture of known quantities of the component materials.

Use this method of calculating air content when equipment is not available for making the air test in GDT 26, or when making field determinations of yield-per-batch.

B. Apparatus

The apparatus consists of the following:

1. Scale: Use a scale of at least 150 lbs (70 kg) capacity and sensitive to 0.1 lb (0.045 kg).
2. Tamping Rod: Use a round, straight metal rod, 5/8 in (16 mm) diameter and approximately 24 in (600 mm) long, with one end rounded to a hemispherical tip with a 5/8 in (16 mm) diameter (WR-7).
3. Measure: Use a cylindrical metal measure, preferably with handles. The measure must be watertight, preferably machined to accurate dimensions on the inside. It must be reinforced around the top with No. 10 to No. 12 (2.77 to 3.51 mm) U.S. gauge steel and 1-l/2 in (38 mm) wide.

   Depending upon the maximum nominal size of the coarse aggregate in the concrete, the measures required must have capacities of 1/2 or 1 ft^3 (0.0141 or 0.0283 m^3) and shall conform to the requirements prescribed in the following table (WM-02):

Dimensional Requirements for Cylindrical Measures —English				
Capacity (ft^3)	**Inside Dia., inches**	**Inside Height, inches**	**Thickness, U.S. Gauge**	**Max. Nominal Size of Coarse Aggregate**
1/2	10.00	11.00	No. 10 to No. 12	Up to 2" inclusive
1	14.00	11.23	No. 10 to No. 12	Over 2"

Dimensional Requirements for Cylindrical Measures—metric				
Capacity (m^3)	**Inside Dia., mm**	**Inside Height, mm**	**Thickness of Metal, mm**	**Max. Nominal Size of Coarse Aggregate**
0.0141	254	279	2.77 to 3.51	Up to 51 mm inclusive
0.0283	356	285	2.77 to 3.51	Over 51 mm

4. Calibration of the Measure
   a. Accurately calibrate the measure by determining the weight of water at 62 °F (16.7 °C) required to fill it.

NOTE: Ensure the measure is properly full by using a glass cover plate.

   b. Obtain the factor for any measure by dividing the unit weight of water at 62 °F (16.7 °C) (62.4 lbs/ft^3 [1000 kg/m^3]) by the weight required to fill the measure (in pounds [kilograms] of water at 62 °F [16.7 °C]).

C. Sample Size and Preparation

Obtain the sample of freshly mixed concrete according to GSP 17 or ASTM C172, whichever is applicable.

D. Procedures

1. Fill the measure to capacity in three layers.
2. Rod each layer evenly over the cross section of the measure as follows:
   a. While rodding the first layer, make sure the rod does not forcibly strike the bottom of the measure.
   b. In rodding the second and final layers, use only enough force to cause the rod to penetrate the surface of the previous layer.
   c. When using the 1/2 ft^3 (0.0141 m^3) measure, rod each layer with 25 strokes. When using the 1 ft^3 (0.0283 m^3) measure, rod each layer with 50 strokes.
   d. Tap the exterior surface of the measure 10 to 15 times after rodding each layer, or until large bubbles of air appear on the surface of the rodded layer.
3. After consolidating the concrete, strike off the top surface and finish it smoothly with a flat cover plate. Be sure to leave the measure exactly full.
4. Clean all excess concrete from the exterior.
5. Weigh the filled measure to the nearest 0.1 lbs (0.045 kg).

E. Calculations

1. Weight per Cubic Foot (meter)
   The net weight of the concrete shall be calculated by subtracting the weight of the measure from the gross weight. The weight per cubic foot (meter) shall be calculated by multiplying the new weight by the factor for the measure used, determined as described in Section B, "Apparatus".

2. Yield
   The yield of concrete produced per batch shall be calculated as follows:

$$Y = \frac{W_{cem} + W_f + W_c + W_w}{W}$$

   Where:
   Y = yield of concrete produced per batch, in cubic feet (meters)
   W_{cem} = total weight of cementitious material (cement, fly ash or slag) in batch, in pounds (kilograms)
   W_f = total weight of fine aggregate in batch in condition used, in pounds (kilograms)
   W_c = total weight of coarse aggregate in batch in condition used, in pounds (kilograms)
   W_w = total weight of mixing water added to batch, in pounds (kilograms), and
   W = weight of concrete, in pounds per cubic foot (kilograms per cubic meter)

3. Cement Content
   The "actual" cement content shall be calculated as follows:

$$C = \frac{27C_w}{Y} \quad \text{or} \quad C = Cw \div Y \text{ (SI units)}$$

   Where:
   C = actual cement content, in pounds per cubic yard (kilograms per cubic meter)
   C_w = weight of cement in the batch, in pounds (kilograms)
   Y = yield of concrete produced per batch, in cubic feet (meter)

4. Air Content
The air content shall be calculated as follows:

$$A = \frac{T - W}{T} \times 100$$

or by the formula:

$$A = \frac{Y - V}{Y} \times 100$$

Where:

A = air content (percentage of voids) in the concrete
T = theoretical weight of the concrete, in pounds per cubic foot (kilograms per cubic meter), computed on air-free basis*
W = weight of concrete, in pounds per cubic foot (kilograms per cubic meter)
Y = yield of concrete produced per batch, in cubic feet (meters), and
V = Total absolute volume of the component ingredients in the batch in cubic feet (meters)

*NOTE: The theoretical weight per cubic foot (meter) is customarily a laboratory determination, the value for which is assumed to remain constant for all batches made, using identical component ingredients and proportions. It is calculated from the formula:

$$T = \frac{W_1}{V}$$

Where:

T = theoretical weight of the concrete, in pounds per cubic foot (kilograms per cubic meter), computed on an air-free basis
W_1 = total weight of the component ingredients in the batch, in pounds (kilograms), and
V = total absolute volume of the component ingredients in the batch, in cubic feet (meters)

NOTE:

The absolute volume of each ingredient in cubic feet is equal to the quotient of the mass of that ingredient divided by the product of its specific gravity times 62.4. The absolute volume of each ingredient in cubic meters is equal to the mass of the ingredient in kilograms divided by 1000 times its specific gravity.

For the aggregate components, the bulks specific gravity and weight should be based on the saturated surface-dry condition. For cement, use a value of 3.15.

F. Report

Report the weight per cubic foot (meter), the yield, and the air content of the concrete on Form 319 and Form 525.