

Method of Test for Unit Weight and Voids in Aggregate

1. Scope:

This test covers the determination of unit weight and the percent of voids in fine, coarse or mixed aggregates.

2. Apparatus:

- 2.1 Scale or balance having the capacity to weigh any sample which may be tested utilizing this procedure and readable to the nearest 0.1 lb.
- 2.2 Tamping rod: A round, straight steel rod, 5/8" in diameter and approximately 24" in length, having one end rounded to a hemispherical tip of the same diameter of the rod.
- 2.3 Measure: A cylindrical metal measure. It shall be watertight, with the top and bottom true and even, and sufficiently rigid to retain its form under rough usage. The top rim shall be parallel to the bottom within 0.5 degrees. The capacity of the measure shall conform to the limits of Table 1.

Table 1

Nominal maximum size of aggregate	Capacity of measure
Inches	ft ³
½	1/10
1	1/3
1 ½	½
3	1
4	2 ½
5	3 ½

- 2.4 Drying oven capable of maintaining a temperature of 230° ± 9°F.
- 2.5 Straightedge, scoop, or shovel.

3. Procedure:

- 3.1 Obtain samples in accordance with SD 201.
- 3.2 Dry the sample to a constant weight in an oven or in accordance with SD 108.

- 3.3 Calibrate the measure.
- A. Weigh the measure and glass cover plate and record to the nearest 0.1 lb.
 - B. Weigh the water, plate and measure and record to the nearest 0.1 lb.
 - C. Calculate the volume of the measure.

$$\text{Volume ft}^3 = (B - A) / D$$

- D. Measure the temperature of the water to the nearest 1° F and determine its density from Table 2. Interpolate, if necessary.

Table 2

Temperature F°	lb./ft ³
60	62.366
65	62.336
70	62.301
75	62.261
80	62.216
85	62.166

- E. Calculate the factor for the measure to the nearest 0.01 by dividing the unit weight of the water by the weight required to fill the measure. Factor = $D / (B - A)$
- 3.4 Compacted weight determination.
- A. Rodding: This procedure is applicable to aggregates having a maximum size of 1 ½" or less.
 - (1) Fill the measure 1/3 full and level the surface. Rod the aggregate with 25 strokes. The strokes shall be distributed uniformly. The measure shall be filled 2/3 full and again level and rod as before. Fill the measure to overflowing and repeat the rodding. Level the surface of the aggregate with the fingers and straightedge. Any slight projections of the larger pieces of the coarse aggregate should approximately balance the larger voids in the surface below the top of the measure.
 - (2) When rodding the first layer, do not allow the rod to forcibly strike the bottom of the measure. When rodding

the remaining layers, use only enough force to cause tamping rod to penetrate the previous layer.

- (3) Weigh the aggregates required to fill the measure to the nearest 0.1 lb. Multiply this weight by the factor of the unit.

B. Jigging: This procedure is applicable to aggregates having a maximum size greater than 1 1/2" and not exceeding 4".

- (1) Fill the measure in 3 approximately equal layers, compacting each layer by placing the measure on a firm base, raising the opposite sides alternately about 2" and allowing the measure to drop, hitting with a sharp, slapping blow. Compact each layer by dropping the measure 25 times on each side. Level the surface of the aggregate with the fingers and a straightedge. Any slight projections of the larger pieces of the coarse aggregate should approximately balance the larger voids in the surface below the top of the measure.

- (2) Weigh the aggregate required to fill the measure to the nearest 0.1 lb. Multiply this weight by the factor of the unit.

3.5 Loose weight determination.

A. Shoveling: This procedure is applicable to aggregates having a maximum size of 4" or less.

- (1) Fill the measure to overflowing by means of a shovel, discharging the aggregate from a height not to exceed 2" above the measure. Exercise care to prevent segregation. Level the surface of the aggregate with the fingers and a straightedge. Any slight projections of the larger pieces of the coarse aggregate should approximately balance the larger voids in the surface below the top of the measure.

- (2) Weigh the aggregate required to fill the measure to the nearest 0.1 lb. Multiply this weight by the factor of the measure.

4. Report:

4.1 Record the unit weight to the nearest pound.

4.2 Calculate the void content in aggregate using the unit weight measured by rodding, jigging, or the shoveling procedure.

$$\text{Voids, \%} = \frac{(A \times W) - B}{(A \times W)} \times 100$$

A = Bulk specific gravity of the aggregate as determined in accordance with SD 209 or SD 210

B = Unit weight of the aggregates

W = Unit weight of the water

4.3 Report the results to the nearest 0.1%.

5. References:

AASHTO T19
SD 108
SD 201
SD 209
SD 210