

**DEPARTMENT OF TRANSPORTATION**  
**ENGINEERING SERVICE CENTER**  
 Transportation Laboratory  
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## METHOD OF TEST FOR UNIT WEIGHT OF AGGREGATE

**CAUTION:** Prior to handling test materials, performing equipment setups, and/or conducting this method, testers are required to read “**SAFETY AND HEALTH**” in Section H of this method. It is the responsibility of the user of this method to consult and use departmental safety and health practices and determine the applicability of regulatory limitations before any testing is performed.

### A. SCOPE

This method of test, which is a modification of AASHTO Designation: T 19, covers the procedure for determining the compacted or loose mass per cubic meter of both fine and coarse aggregates.

### B. APPARATUS

1. Square-point shovel.
2. Quartering canvas (2 by 2 m).
3. A balance or scale sensitive to 0.5 % of the mass of the sample to be weighed.
4. Tamping rod: A round, straight, steel rod, 16 mm in diameter and approximately 600 mm in length having one end rounded to a hemispherical tip of the same diameter as the rod.
5. Measure: A cylindrical metal measure preferably provided with handles, having the capacity required in Table 1 for the nominal size of the aggregate being tested. The measure shall be watertight, with the top and bottom true and even, preferably machined to accurate dimensions on the inside, and of sufficient rigidity to retain its form under rough usage. Measures with capacities of 0.014 and 0.028 m<sup>3</sup> and having a metal thickness less than 5.3 mm shall be reinforced around the upper 38 mm with a steel band to provide a minimum thickness of 5.3 mm.

**TABLE 1**  
**Dimensions of Measures**

Approx. Volume m <sup>3</sup>	Inside Diameter, mm	Inside Height, mm	Minimum Thickness of Metal, mm		Maximum Nominal Size of Aggregate, mm
			Bottom	Wall	
0.0028	152 ± 2	155 ± 2	5	2.5	12.5
0.0094	203 ± 2	292 ± 2	5	2.5	25.0
0.014	254 ± 2	279 ± 2	5	3.0	37.5
0.028	355 ± 2	284 ± 2	5	3.0	100.0

### C. CALIBRATION OF MEASURE

1. Fill the measure with water at room temperature and cover with a piece of plate glass in such a way as to eliminate bubbles and excess water.
2. Determine the net mass of water in the measure to an accuracy of ± 0.1 %.
3. Measure the temperature of the water and determine its unit mass from Table 2, interpolating if necessary.
4. Calculate the factor F, for the measure by dividing the unit mass of the water by the mass required to fill the measure.

**TABLE 2**  
**Unit Mass of Water**

Temperature °C	Unit Mass kg/m <sup>3</sup>
17	998.77
18	998.59
19	998.41
20	998.23
21	998.01
22	997.79
23	997.57
24	997.32
25	997.06
26	996.81
27	996.53
28	996.25
29	995.97

**D. SAMPLE PREPARATION**

The aggregate to be tested shall be oven dried to constant mass at  $110 \pm 5^\circ\text{C}$ .

**E. TEST PROCEDURE**

1. Fill the measure with aggregate using the appropriate procedure described below.

a. Compacted Method (by Rodding).

This procedure is applicable to aggregates having a maximum size of 37.5 mm or less.

- (1) Place the measure on a level surface.
- (2) Fill the measure one-third full and level the surface with the fingers.
- (3) Rod the layer of aggregate with 25 strokes of the tamping rod evenly distributed over the surface. Do not allow the rod to strike the bottom of the measure forcibly.
- (4) Fill the measure two-thirds full and repeat the leveling and rodding described above. Use only enough force to cause the tamping rod to just penetrate the previous layer.

- (5) Fill the measure to overflowing and repeat the rodding. Use only enough force to just penetrate the previous layer.
- (6) Level the surface of the aggregate with the fingers or a straightedge in such a way that any slight projections of the larger pieces of the coarse aggregate approximately balance the larger voids in the surface below the top of the measure.

b. Compacted Method (by Jigging).

This procedure is applicable to aggregates having a maximum size greater than 37.5 mm and not exceeding 100 mm.

- (1) Place the measure on a level, firm base such as a concrete floor.
- (2) Fill the measure one-third full and level the surface with the fingers.
- (3) Consolidate the material by alternately raising opposite sides of the measure about 50 mm and allowing the vessel to drop in such a manner as to hit with a sharp slapping blow. Repeat this raising and dropping action 50 times.
- (4) Fill the measure two-thirds full and repeat the leveling and consolidation procedure described above.
- (5) Fill the measure to overflowing and repeat the consolidation procedure described above.
- (6) Level the surface of the aggregate with the fingers or a straightedge in such a way that any slight projections of the larger pieces of coarse aggregate approximately balance the larger voids in the surface below the top of the measure.

c. Loose Method (by Shoveling).

The shoveling is applicable to aggregate having a maximum size of 100 mm or less.

- (1) Place the measure on a level surface.

- (2) Fill a square-point shovel from the thoroughly mixed sample pile. Walk slowly around the measure, pouring aggregate from the shovel at a height not to exceed 50 mm above the top of the measure. Repeat until the measure is filled.
  - (3) Level off the surface of the aggregate with the fingers or a straightedge in such a way that any slight projections of the larger pieces of the coarse aggregate shall balance the larger voids in the surface below the top of the measure.
2. Weigh the measure full of aggregate, and subtract the tare mass of the empty measure to obtain the net mass of the aggregate required to fill the measure.
  3. Repeat the above steps until a total of three mass determinations are obtained which do not differ by more than 1 %.

#### F. CALCULATIONS

1. Calculate the average net mass of aggregate required to fill the measure.
2. Calculate the unit mass of the aggregate from the following formula:

Unit mass per cubic meter =  $FA$

Where:

$F$  = Factor obtained as specified in Section C, Calibration of Measure; and

$A$  = Average net mass of aggregate required to fill measure.

#### G. PRECAUTIONS

Avoid segregation of coarse and fine aggregate particles by mixing the material thoroughly on a quartering canvas, and by pressing the shovel tip down firmly enough to pick up fines from quartering canvas.

#### H. SAFETY AND HEALTH

Aggregates may contain bacteria and/or organisms that can be harmful to one's health. The wearing of dust masks and protective gloves when handling materials is advised.

Dust and lifting are encountered in this testing procedure. It is not possible to completely eliminate these risks, but steps should be taken to minimize them as much as possible. The use of table-high carts to move materials can eliminate much of the lifting. Also, personnel should be instructed in proper lifting methods.

The use of dust collection units and the spraying of workroom floors with dust palliatives are very effective methods of reducing dust conditions.

The use of heat resistant gloves/mitts or potholders is recommended for removing samples from the ovens.

Prior to handling, testing or disposing of any waste materials, testers are required to read: Part A (Section 5.0), Part B (Sections: 5.0, 6.0 and 10.0) and Part C (Section 1.0) of Caltrans Laboratory Safety Manual. Users of this method do so at their own risk.

#### REFERENCE:

AASHTO Designation: T 19

End of Text (California Test 212 contains 3 pages)