Method of Test for

CALIBRATION OF MEASURES USED TO DETERMINE UNIT WEIGHTS

DOTD Designation: TR 640

I. Scope

This method covers the procedure for determining the calibrated volume of a unit weight measure.

Note 1: *Determine the volume of the measure upon initial use and subsequently at a frequency not to exceed twelve months, or whenever there is reason to question the accuracy of the volumetric capacity of the measure.*

II. Reference Documents

A. AASHTO T 19 – Method of Test for Unit Weight and Voids in Aggregate
B. ASTM C29 – Standard Test Method for Bulk Density ("Unit Weight") and Voids in Aggregate

III. Apparatus

A. Scale – A scale readable to 0.01 pounds capable of a weight measurement at any point within the range of use. The range of use shall extend from the weight of the empty measure to the weight of the measure plus its contents.
B. Measure – a cylindrical container made from steel or other suitable metal that complies with this section. It shall be watertight and sufficiently rigid to retain its form and calibrated volume under rough usage. Measures shall be machined to accurate dimensions on the inside and provided with handles. The top rim shall be smooth and plane within 0.01 inches and shall be parallel to the bottom within 0.5 degrees. The capacity and dimensions of the measure shall conform to the requirements of the test for which the measure is being calibrated.
C. Glass Plate – Minimum 1/4 inch thick and at least 1 inch larger than the diameter of the measure to be calibrated.
D. Grease – A supply of water-pump, chassis, or similar grease
E. Thermometer – Capable of measuring temperature to the nearest 0.5˚F.
F. Containers – Suitable for transporting water and filling the measure for calibration and testing purposes.

IV. Procedure

Determine the calibrated volume of the measure following the procedure outlined below:

A. Weigh the empty measure and glass plate together and record as (B) on the worksheet accompanying this procedure and labeled (Figure 1).
B. Place a thin layer of grease on the rim of the measure to prevent leakage of water from the measure.
C. Fill the measure with water and cover with the glass plate to eliminate bubbles and excess water. Clean and dry any water that has spilled or overflowed from the exterior of the measure during this process.
D. Weigh the filled measure and the glass plate together and record the weight as (A) on the worksheet.

E. Determine the net weight of water in the measure by subtracting the empty weight of the measure and glass plate as determined in paragraph IV.A (denoted as (B) on the worksheet) from the gross weight of the filled measure plus the glass determined in paragraph IV.C (denoted as (A) on the worksheet) and record this net weight on the worksheet as (C).
F. Determine the temperature of the water and record on the worksheet.
G. Determine the unit weight of the water from Table 1 (interpolating if necessary), and record as (D) on the worksheet.

Table 1
Unit Weight of Water

Temperature (˚F)	Unit Weight (lbs/ft³)
60	62.366
65	62.336
70	62.301
(73.4)	(62.274)
75	62.261
80	62.219
85	62.166

H. Calculate the calibrated volume of the measure, in cubic feet, using the following formula:

$$V = \frac{C}{D}$$

Where: V = Calibrated Volume (ft³)
C = Net Weight (lbs)
D = Unit Weight of Water (lbs/ft³)

V. Example - Determination of the Unit Weight of Water using Interpolation:
Recorded temperature of water = 76 ˚F
From Table 1:
Unit Weight of Water at 75 ˚F = 62.261 lbs/ft³
Unit Weight of Water at 80 ˚F = 62.216 lbs/ft³
Difference in Temperature = 80˚F – 75 ˚F = 5 ˚F
Difference in Unit Weight = 62.261 lbs/ft³ – 62.216 lbs/ft³ = 0.045 lbs/ft³
0.045 lbs/ft³ is distributed proportionally over the 5 ˚F range and is equivalent to 0.009 lbs/ft³ per 1 ˚F. Therefore, the unit weight of water decreases by 0.009 lbs/ft³ for every 1˚F increase in temperature.

Solution: At 76 ˚F the unit weight of water is 62.252 lbs/ft³ = 62.261 lbs/ft³ - 0.009 lbs/ft³

Note 2: *Normal testing time is 2 hours.*

CALIBRATED VOLUME FOR UNIT WEIGHT MEASURES
LA DOTD TR 640

DATE: _____ CALIBRATED BY: _____

MEASURE IDENTIFICATION: _____ CHECKED BY: _____

TEMPERATURE OF WATER (˚F)	T	
WEIGHT OF MEASURE + GLASS PLATE + WATER (lb)	A	
WEIGHT OF MEASURE + GLASS PLATE (lb.)	B	
NET WEIGHT OF WATER (lb.)	C = A - B	
UNIT WEIGHT OF WATER (lb./ft³)	D = Table 1 or Interpolation	
CALIBRATED VOLUME OF MEASURE (ft³)	V = C / D	

(Figure 1)

CALIBRATED VOLUME FOR UNIT WEIGHT MEASURES
LA DOTD TR 640

DATE: 03/27/2019 CALIBRATED BY: ABC

MEASURE IDENTIFICATION: 22-XX CHECKED BY: ML

TEMPERATURE OF WATER (˚F)	T	76 ˚F
WEIGHT OF MEASURE + GLASS PLATE + WATER (lb)	A	58.24 lb.
WEIGHT OF MEASURE + GLASS PLATE (lb.)	B	35.47 lb.
NET WEIGHT OF WATER (lb.)	C = A - B	22.77 lb.
UNIT WEIGHT OF WATER (lb./ft³)	D = Table 1 or Interpolation	62.252 (lb./ft³)
CALIBRATED VOLUME OF MEASURE (ft³)	V = C / D	0.366 (ft³)

(Example 2)