
Standard Method of Test for Determining the Total Pore Volume in Hardened Concrete Using Vacuum Saturation

AASHTO Designation: TP 135-22 (2024)¹

Technically Revised: 2022

Reviewed but Not Updated: 2024

Technical Subcommittee: 3c, Hardened Concrete



**American Association of State Highway and Transportation Officials
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1. SCOPE
- 1.1.

This test method covers the procedure for determination of the total pore volume in hardened concrete using vacuum saturation.
- 1.2.

The values stated in SI units are to be regarded as the standard, with exception of the pressure values given in units of Torr, that can be used as standard.
- 1.3.

This standard does not purport to address all of the safety problems, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.
- 1.4.

The quality of the results produced by this standard are dependent on the competence of the personnel performing the procedure and the capability, calibration, and maintenance of the equipment used. Agencies that meet the criteria of R 18 are generally considered capable of competent and objective testing/sampling/inspection/etc. Users of this standard are cautioned that compliance with R 18 alone does not completely assure reliable results. Reliable results depend on many factors; following the suggestions of R 18 or some similar acceptable guideline provides a means of evaluating and controlling some of those factors.

2. REFERENCED STANDARDS

- 2.1.

AASHTO Standards:

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M 231, Weighing Devices Used in the Testing of Materials

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M 339M/M 339, Thermometers Used in the Testing of Construction Materials

■

R 18, Establishing and Implementing a Quality Management System for Construction Materials Testing Laboratories

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R 39M/R 39, Making and Curing Concrete Test Specimens in the Laboratory

■

R 100M/R 100, Making and Curing Concrete Test Specimens in the Field

■

T 24M/T 24, Obtaining and Testing Drilled Cores and Sawed Beams of Concrete

■

T 277, Electrical Indication of Concrete’s Ability to Resist Chloride Ion Penetration
- 2.2.

ASTM Standards:

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C125, Standard Terminology Relating to Concrete and Concrete Aggregates

- C642, Standard Test Method for Density, Absorption, and Voids in Hardened Concrete
- E1, Standard Specification for ASTM Liquid-in-Glass Thermometers
- E230/E230M, Standard Specification for Temperature-Electromotive Force (emf) Tables for Standardized Thermocouples
- E879, Standard Specification for Thermistor Sensors for General Purpose and Laboratory Temperature Measurements
- E2877, Standard Guide for Digital Contact Thermometers

2.3. *International Electrotechnical Commission Standard:*

- IEC 60584-1:2013, Thermocouples - Part 1: EMF Specifications and Tolerances

2.4. *Other Documents and Standards:*

- Bu, Y., R. Spragg, and W. J. Weiss. Comparison of the Pore Volume in Concrete as Determined Using ASTM C642 and Vacuum Saturation. *Advances in Civil Engineering Materials*, Vol. 3, No. 1, 2014, pp. 308–315.

3. SUMMARY OF TEST METHOD

- 3.1. This test method covers the procedure for the quantitative determination of the total pore volume in hardened concrete using vacuum saturation.
- 3.2. This procedure is similar to ASTM C642; however, the pores are saturated with water using vacuum saturation with a controlled absolute pressure of less than 20 Torr (2666 Pa) (see Note 1). This vacuum level is applied to ensure the saturation of all the voids in concrete.
- Note 1**—It has been shown (Bu, Spragg, and Weiss, 2014) that ASTM C642 does not result in filling all the voids in concrete, especially the air entrained voids, so it does not provide a measure of the pore volume at complete saturation. As such, the total void volume is not provided by that test.

4. SIGNIFICANCE AND USE

- 4.1. The test method using vacuum saturation is able to measure the total pore volume including the matrix pore volume and the entrained air volume. This standard produces a consistent measure of total pore volume for use in durability and transport calculations.

5. TERMINOLOGY

- 5.1. For definitions of terms used in this standard, refer to ASTM C125.

6. APPARATUS

- 6.1. *Balance*—Complying with M 231, with a minimum capacity of 3 kg, sensitive and readable to 0.01 g or less, and accurate within 0.025 percent of the testing mass, at any point within the range of use for this test method. The balance shall be equipped with suitable apparatus for suspending the sample container in water from the center of the platform or pan of the balance.
- 6.2. *Oven*—Of sufficient size, shall be capable of operation at the temperatures required, between 100 to 120°C, within $\pm 5^\circ\text{C}$, as corrected, if necessary, by calibration. More than one oven may be used, provided each is used within its proper operating temperature range. The thermometer for