
Standard Method of Test for

Time of Setting of Concrete Mixtures by Penetration Resistance

AASHTO Designation: T 197M/T 197-23

Technically Revised: 2023

Technical Subcommittee: 3b, Fresh Concrete

ASTM Designation: C403/C403M-16



American Association of State Highway and Transportation Officials
555 12th Street NW, Suite 1000
Washington, DC 20004

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1. SCOPE

- 1.1. This test method covers the determination of the time of setting of concrete, with slump greater than zero, by means of penetration resistance measurements on mortar sieved from the concrete mixture.
- 1.2. This test method is suitable for use only when tests of the mortar fraction will provide the information required.
- 1.3. This test method may also be applied to prepared mortars and grouts.
- 1.4. This test method is applicable under controlled laboratory conditions, as well as under field conditions.
- 1.5. The values stated in either SI units or inch-pound units are to be regarded separately as standard. The values stated in each system may not be exact equivalents; therefore, each system shall be used independently of the other. Combining values from the two systems may result in nonconformance with the standard.
- 1.6. *This standard does not purport to address all of the safety concerns 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.*
- 1.7. *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 DOCUMENTS

- 2.1. *AASHTO Standards:*
 - < M 201, Mixing Rooms, Moist Cabinets, Moist Rooms, and Water Storage Tanks Used in the Testing of Hydraulic Cements and Concretes

- < 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
- < R 60M/R 60, Sampling Freshly Mixed Concrete
- < T 119M/T 119, Slump of Hydraulic Cement Concrete
- < T 152, Air Content of Freshly Mixed Concrete by the Pressure Method
- < T 196M/T 196, Air Content of Freshly Mixed Concrete by the Volumetric Method

2.2. *ASTM Standards:*

- < C125, Standard Terminology Relating to Concrete and Concrete Aggregates
- < C143/C143M, Standard Test Method for Slump of Hydraulic-Cement Concrete
- < C172/C172M, Standard Practice for Sampling Freshly Mixed Concrete
- < C173/C173M, Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method
- < C192/C192M, Standard Practice for Making and Curing Concrete Test Specimens in the Laboratory
- < C231/C231M, Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method
- < C670, Standard Practice for Preparing Precision and Bias Statements for Test Methods for Construction Materials
- < D1558, Standard Test Method for Moisture Content Penetration Resistance Relationships of Fine-Grained Soils (withdrawn 2019; no replacement)
- < E1, Standard Specification for ASTM Liquid-in-Glass Thermometers
- < E11, Standard Specification for Woven Wire Test Sieve Cloth and Test Sieves
- < E230/E230M, Standard Specification for Temperature-Electromotive Force (emf) Tables for Standardized Thermocouples
- < E2251, Standard Specification for Liquid-in-Glass ASTM Thermometers with Low-Hazard Precision Liquids
- < E2877, Standard Guide for Digital Contact Thermometers

2.3. *International Electrotechnical Commission Standard:*

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

3. TERMINOLOGY

3.1. *Definitions:*

- 3.1.1. *time of initial setting*—the elapsed time, after initial contact of cement and water, required for the mortar sieved from the concrete to reach a penetration resistance of 3.5 MPa (500 psi).
- 3.1.2. *time of final setting*—the elapsed time, after initial contact of cement and water, required for the mortar sieved from the concrete to reach a penetration resistance of 27.6 MPa (4000 psi).

4. SUMMARY OF TEST METHOD

- 4.1. A mortar sample is obtained by sieving a representative sample of fresh concrete. The mortar is placed in a container and stored at a specified ambient temperature. At regular time intervals, the resistance of the mortar to penetration by standard needles is measured. From a plot of penetration resistance versus elapsed time, the times of initial and final setting are determined.



5. SIGNIFICANCE AND USE

- 5.1. Since the setting of concrete is a gradual process, any definition of time of setting must necessarily be arbitrary. In this test method, the times required for the mortar to reach specified values of resistance to penetration are used to define times of setting.
- 5.2. This test method can be used to determine the effects of variables, such as brand, type, and content of cementitious material; water content; and admixtures, upon the time of setting of concrete. This test method may also be used to determine compliance with specified time of setting requirements.
- 5.3. This test method may also be applied to prepared mortars and grouts. However, when the setting time of concrete is desired, the test shall be performed on mortar sieved from the concrete mixture and not on a prepared mortar intended to simulate the mortar fraction of the concrete; it has been shown that the initial and final setting times may be increased when using the prepared mortar.

6. APPARATUS

- 6.1. *Containers for Mortar Specimens*—The containers shall be rigid, watertight, nonabsorptive, free of oil or grease, and either cylindrical or rectangular in cross section. Mortar surface area shall be provided for 10 undisturbed readings of penetration resistance in accordance with Section 9.2 for clear distance requirements. The lateral dimension shall be at least 150 mm (6 in.) and the height at least 150 mm (6 in.).
- 6.2. *Penetration Needles*—Needles shall be provided that can be attached to the loading apparatus and that have the following bearing areas: 645, 323, 161, 65, 32, and 16 mm² (1, 1/2, 1/4, 1/10, 1/20, and 1/40 in.²). Each needle shank shall be scribed circumferentially at a distance 25 mm (1 in.) from the bearing area. The length of the 16-mm² (1/40-in.²) needle shall not be more than 90 mm (3 1/2 in.).
- 6.3. *Loading Apparatus*—A device shall be provided to measure the force required to cause penetration of the needles. The device shall be capable of measuring the penetration force with an accuracy of ±10 N (2 lbf) and shall have a capacity of at least 600 N (130 lbf).
Note 1—Suitable loading apparatus can be of the spring-reaction type as described in ASTM D1558, or of other types with a calibrated force measuring device, such as an electronic load cell or a hydraulic pressure gauge.
- 6.4. *Tamping Rod*—The tamping rod shall be a round, straight, steel rod 16 mm (5/8 in.) in diameter and approximately 600 mm (24 in.) in length, having the tamping end or both ends rounded to a hemispherical tip, the diameter of which is 16 mm (5/8 in.).
- 6.5. *Pipet*—A pipet or other suitable instrument shall be used for drawing off bleeding water from the surface of the test specimen.
- 6.6. *Thermometer*—The thermometer for measuring the temperature of fresh mortar shall meet the requirements of M 339M/M 339 with a temperature range of at least −18 to 50°C (0 to 120°F) and a tolerance range of ±0.5°C (±1°F) or smaller (see Note 2).
Note 2—Thermometer types suitable for use include ASTM E1 mercury thermometer or ASTM E2251 Low Hazard Precision Liquid-in-glass thermometer; ASTM E2877 digital metal stem thermometer; or thermocouple thermometer ASTM E230/E230M, Type T Special or IEC 60584 Type T, Class 1.

7. SAMPLING, TEST SPECIMENS, AND TEST UNITS

- 7.1. For tests under field conditions, three specimens shall be prepared from each sample of concrete.