
Standard Method of Test for Early Stiffening of Hydraulic Cement (Paste Method)

AASHTO Designation: T 186-22¹

Technically Revised: 2022

Technical Subcommittee: 3a, Cement, Lime, and Concrete Materials

ASTM Designation: C451-19



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

- 1.1. This test method covers the determination of early stiffening in hydraulic cement paste.
- 1.2. The values stated in SI units are to be regarded as the standard. No other units of measure are included in this standard.
- 1.3. *This standard does not purport to address all the safety concerns, 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.*
Warning—Fresh hydraulic-cementitious mixtures are caustic and may cause chemical burns to skin and tissue on prolonged exposure.
- 1.4. The text of this standard references notes and footnotes that provide explanatory material. These notes and footnotes (excluding those in tables and figures) shall not be considered as requirements of the standard.
- 1.5. *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
 - R 18, Establishing and Implementing a Quality Management System for Construction Materials Testing Laboratories
 - R 71, Sampling and Amount of Testing of Hydraulic Cement
 - T 129, Amount of Water Required for Normal Consistency of Hydraulic Cement Paste
 - T 162, Mechanical Mixing of Hydraulic Cement Pastes and Mortars of Plastic Consistency

- 2.2. *ASTM Standards:*
- C219, Standard Terminology Relating to Hydraulic or Other Inorganic Cements
 - C670, Standard Practice for Preparing Precision and Bias Statements for Test Methods for Construction Materials
 - C1005, Standard Specification for Reference Masses and Devices for Determining Mass and Volume for Use in the Physical Testing of Hydraulic Cements
 - D1193, Standard Specification for Reagent Water
- 2.3. *NCHRP Report:*
- Azari, H. and R. Lutz. *NCHRP Web-Only Document 140: Precision Estimates for AASHTO Test Methods T 186, T 154, and T 22, Determined Using CCRL Proficiency Sample Data*. National Cooperative Highway Research Program (NCHRP), Transportation Research Board, National Research Council, Washington, DC, 2009, 48 pp. Available from http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_w140.pdf

3. TERMINOLOGY

- 3.1. *Definitions:*
- 3.1.1. *early stiffening, n*—the early development of stiffness in the working characteristics of a hydraulic cement paste, mortar, or concrete. Varieties include false set and flash set.
- 3.1.2. *false set, n*—the early development of stiffness in the working characteristics of a hydraulic cement paste, mortar, or concrete without the evolution of much heat. This stiffness can be dispelled and plasticity regained by further mixing without addition of water. Also known as “grab set,” “premature stiffening,” “hesitation set,” and “rubber set.”
- 3.1.3. *flash set, n*—the early development of stiffness in the working characteristics of a hydraulic cement paste, mortar, or concrete, usually with the evolution of considerable heat. This stiffness cannot be dispelled nor can the plasticity be regained by further mixing without addition of water. Also known as “quick set.”
- 3.1.4. Refer to ASTM C219 for definitions of other terms.

4. SUMMARY OF TEST METHOD

- 4.1. A paste is prepared with the cement to be tested, using sufficient water to give a required initial penetration as measured by the Vicat apparatus at a stipulated time after completion of mixing. A second penetration, termed the “final penetration,” is measured at a later stipulated time. The ratio of final penetration to initial penetration is calculated as a percentage.

5. SIGNIFICANCE AND USE

- 5.1. The purpose of this test method is to determine the degree to which a cement paste develops early stiffening or establish whether a cement complies with a specification limit on early stiffening.
- 5.2. When used for establishing compliance with a specification limit, the specification requirement is customarily stated in terms of the minimum allowable final penetration, in percent, calculated in accordance with Section 11. When used for estimating the relative tendency of a cement to manifest early stiffening, additional information of value may be obtained if the remix procedure described in Section 10 is employed. Under some conditions, a judgment may be made by