
Standard Method of Test for

Measuring Early-Age Compression Strength and Projecting Later-Age Strength

AASHTO Designation: T 276-22

Technically Revised: 2022

Technical Subcommittee: 3c, Hardened Concrete

ASTM Designation: C918-20



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1. SCOPE

- 1.1. This test method covers a procedure for making and curing concrete specimens and for testing them at an early age. The specimens are stored under standard curing conditions and the measured temperature history is used to compute a maturity index that is related to strength gain.
- 1.2. This test method also covers a procedure for using the results of early-age compressive-strength tests to project the potential strength of concrete at later ages.
- 1.3. The values stated in 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.
- 1.4. 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. *This standard does not purport to address all of 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.*
- 1.6. *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 205M/M 205, Molds for Forming Concrete Test Cylinders Vertically
 - 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 39, Making and Curing Concrete Test Specimens in the Laboratory
- < R 60, Sampling Freshly Mixed Concrete
- < R 100, Making and Curing Concrete Test Specimens in the Field
- < T 22M/T 22, Compressive Strength of Cylindrical Concrete Specimens
- < T 231, Capping Cylindrical Concrete Specimens

2.2.

ASTM Standards:

- < C125, Terminology Relating to Concrete and Concrete Aggregates
- < C1074, Standard Practice for Estimating Concrete Strength by the Maturity Method
- < C1231/C1231M, Standard Practice for Use of Unbonded Caps in Determination of Compressive Strength of Hardened Cylindrical Concrete Specimens
- < C1768/C1768M, Standard Practice for Accelerated Curing of Concrete Cylinders
- < 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

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.

For definitions of terms used in this test method, refer to ASTM C125.

3.2.

Definition of Terms Specific to This Standard:

3.2.1.

potential strength—the strength of a test specimen that would be obtained at a specified age under standard curing conditions.

3.2.2.

prediction equation—the equation representing the straight-line relationship between compressive strength and the logarithm of the maturity index.

3.2.2.1.

Discussion—The prediction equation is used to project the strength of a test specimen based upon its measured early-age strength. The general form of the prediction equation used in this test method is:

$$S_M = S_m + b (\log M - \log m) \quad (1)$$

where:

- S_M = predicted strength at maturity index, M ;
- S_m = measured compressive strength at maturity index, m ;
- b = slope of the line;
- M = maturity index under standard curing conditions; and
- m = maturity index of the specimen tested at early age.

The prediction equation is developed by performing compressive strength tests at various ages, computing the corresponding maturity indices at the test ages, and plotting the compressive strength as a function of the logarithm of the maturity index. A best-fit line is drawn through the data and the slope of this line is used in the prediction equation.

- 3.2.3. *projected strength, n* —the potential strength estimated by using the measured early-age strength and the previously established prediction equation.

4. SUMMARY OF TEST METHOD

- 4.1. Cylindrical test specimens are prepared and cured in accordance with the appropriate sections of R 100, R 39, or ASTM C1768/C1768M. The temperature of a representative specimen is monitored during the curing period. Specimens are tested for compressive strength at an early age beyond 24 h, and the concrete temperature history is used to compute the maturity index at the time of test.
- 4.2. A procedure is presented for acquiring a series of compressive strength values and the corresponding maturity indices at different ages. These data are used to develop a prediction equation that is used subsequently to project the strengths at later ages based upon measured early-age strengths.

5. SIGNIFICANCE AND USE

- 5.1. This test method provides a procedure to estimate the potential strength of a particular test specimen based on its measured strength at an age as early as 24 h. The early-age test results provide information on the variability of the concrete production process for use in process control.
- 5.2. The relationship between early-age strength of a test specimen and strength achieved at some later age under standard curing depends upon the materials comprising the concrete. In this test method, it is assumed that there is a linear relationship between strength and the logarithm of the maturity index. Experience has shown that this is an acceptable approximation for test ages between 24 h and 28 days under standard curing conditions. The user of this method shall verify that the test data used to develop the prediction equation are represented correctly by the linear relationship. If the underlying relationship between strength and the logarithm of the maturity index cannot be approximated by a straight line, the principle of this test method is applicable provided an approximate equation is used to represent the nonlinear relationship.
- 5.3. Strength projections are limited to concretes using the same materials and proportions as the concrete used to establish the prediction equation.
- Note 1**—Confidence intervals developed in accordance with Section 10.2 are helpful in evaluating predictions.
- 5.4. This test method is not intended for estimating the in-place strength of concrete. ASTM C1074 provides procedures for using the measured in-place maturity index to estimate in-place strength.

6. APPARATUS

- 6.1. *Equipment and Small Tools*—For fabricating specimens and measuring the characteristics of fresh concrete; shall conform to the applicable requirements of R 39 or R 100.
- 6.2. *Molds*—Shall conform to the requirements for cylinder molds in M 205M/M 205.