Standard Method of Test for

Resistance of Concrete to Rapid Freezing and Thawing

AASHTO Designation: T 161-21

Technically Revised: 2021 **Editorially Revised: 2021**

Technical Subcommittee: 3c, Hardened Concrete

ASTM Designation: C666/C666M-15

AASHTO

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 method covers the determination of the resistance of concrete specimens to rapidly repeated cycles of freezing and thawing in the laboratory by two different procedures: Procedure A, Rapid Freezing and Thawing in Water, and Procedure B, Rapid Freezing in Air and Thawing in Water. Both procedures are intended for use in determining the effects of variations in the properties of concrete on the resistance of the concrete to the freezing and thawing cycles specified in the particular procedure. Neither procedure is intended to provide a quantitative measure of the length of service that may be expected from a specific type of concrete.

1.2. 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.

1.3. All material in this test method not specifically designated as belonging to Procedure A or Procedure B applies to either procedure.

1.4. *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.*

1.5. *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 194M/M 194, Chemical Admixtures for Concrete
- 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 70M/R 70, Use of Apparatus for the Determination of Length Change of Hardened Cement Paste, Mortar, and Concrete
- T 157, Air-Entraining Admixtures for Concrete

2.2. *ASTM Standards*:

- C215, Standard Test Method for Fundamental Transverse, Longitudinal, and Torsional Frequencies of Concrete Specimens
- C295/C295M, Standard Guide for Petrographic Examination of Aggregates for Concrete
- C341/C341M, Standard Practice for Preparation and Conditioning of Cast, Drilled, or Sawed Specimens of Hydraulic-Cement Mortar and Concrete Used for Length Change Measurements
- C670, Standard Practice for Preparing Precision and Bias Statements for Test Methods for Construction Materials
- C823/C823M, Standard Practice for Examination and Sampling of Hardened Concrete in Constructions
- Klieger, P., and J. Lamond, eds. *Significance of Tests and Properties of Concrete and Concrete-Making Materials*. STP169C and STP169D. ASTM International, West Conshohocken, PA, 1994. Available at https://doi.org/10.1520/STP169C-EB and https://doi.org/10.1520/STP169D-EB

3. SIGNIFICANCE AND USE

3.1. As noted in the scope, the two procedures described in this method are intended to determine the effects of variations in both properties and conditioning of concrete in the resistance to freezing and thawing cycles specified in the particular procedure. Specific applications include specified use in M 194M/M 194, T 157, and ranking of coarse aggregates as to their effect on concrete freeze–thaw durability, especially where soundness of the aggregate is questionable.

3.2. It is assumed that the procedures will have no significantly damaging effects on frost-resistant concrete that may be defined as (1) any concrete not critically saturated with water (that is, not sufficiently saturated to be damaged by freezing) and (2) concrete made with frost-resistant aggregates and having an adequate air-void system that has achieved appropriate maturity and thus will prevent critical saturation by water under common conditions.

3.3. If, as a result of performance tests as described in this method, concrete is found to be relatively unaffected, it can be assumed that it was either not critically saturated or was made with “sound” aggregates, a proper air-void system, and allowed to mature properly.

3.4. No relationship has been established between the resistance to cycles of freezing and thawing of specimens cut from hardened concrete and specimens prepared in the laboratory.

Note 1—There is no apparent reason to expect a difference in performance in these two procedures if the concrete properties are fundamentally the same. However, the fact that these two conditions may have been executed with different consolidation procedures or other procedures could affect the number and size of empty, and possibly water-filled voids, which could affect test results.

3.5. There is no specific guidance in this standard on choosing between Procedure A and Procedure B for a given application, except when contained in another standard. Standards T 157 and M 194M/M 194 both stipulate Procedure A.