
Standard Method of Test for Soundness of Aggregates by Freezing and Thawing

AASHTO Designation: T 103-22

Technically Revised: 2022

Technical Subcommittee: 1c, Aggregates



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

- 1.1. This method describes three procedures to be followed in testing aggregates to determine their resistance to disintegration by freezing and thawing. It furnishes information helpful in judging the soundness of aggregates subjected to weathering, particularly when adequate information is not available from service records of the behavior of the aggregate.
- 1.2. The following applies to all specified limits in this standard: For the purpose of determining conformance with these specifications, an observed value or a calculated value shall be rounded off “to the nearest unit” in the last right-hand place of figures used in expressing the limiting value, in accordance with the rounding-off method of ASTM E29.
- 1.3. The values stated in SI units are to be regarded as the standard.
- 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.*
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2. REFERENCED DOCUMENTS

- 2.1. *AASHTO Standards:*
- M 231, Weighing Devices Used in the Testing of Materials
 - 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
 - T 27, Sieve Analysis of Fine and Coarse Aggregates
- 2.2. *ASTM Standards:*
- E1, Standard Specification for ASTM Liquid-in-Glass Thermometers
 - E11, Standard Specification for Woven Wire Test Sieve Cloth and Test Sieves
 - E29, Standard Practice for Using Significant Digits in Test Data to Determine Conformance with Specifications

- E230/E230M, Standard Specification for Temperature-Electromotive Force (emf) Tables for Standardized Thermocouples
- 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. APPARATUS

3.1. *The apparatus shall consist of the following:*

- 3.1.1. *Freezing and Thawing Equipment*—No specific requirements for the type or size of the freezing equipment are given, as many laboratories have adequate equipment that is variable in type and size. The freezing and thawing apparatus shall consist of a suitable chamber or chambers in which the sample may be subjected to the specified freezing and thawing cycle, together with the necessary refrigerating and heating equipment and controls to continuously and automatically produce reproducible cycles within the specified temperature requirements. In the event that the equipment does not operate automatically, provision shall be made for either its continuous manual operation on a 24-hour-a-day basis or for the storage of all samples in a thawed condition when the equipment is not in operation. All equipment shall be capable of being operated at temperatures between -30 to 25°C (-22 to 77°F) and maintaining temperature within $\pm 3^{\circ}\text{C}$ ($\pm 5.4^{\circ}\text{F}$) at any point in the freezing chamber. The equipment shall be equipped with an automatic temperature-recording device capable of operation at the temperatures required, between -40 to 50°C (-40 to 122°F), within $\pm 0.75^{\circ}\text{C}$ ($\pm 1.4^{\circ}\text{F}$), as corrected, if necessary, by standardization. The thermometer for measuring the temperature within the test chamber and specimens shall meet the requirements of M 339M/M 339 with a temperature range of at least -40 to 50°C (-40 to 122°F) and an accuracy of $\pm 0.75^{\circ}\text{C}$ ($\pm 1.4^{\circ}\text{F}$) (see Note 1).

Note 1—Thermometer types suitable for use include ASTM E1 mercury thermometers; ASTM E230/E230M thermocouple thermometer, Type T, Special Class; or IEC 60584 thermocouple thermometer, Type T, Class 1.

- 3.1.2. *Sample Containers*—The sample containers shall be of plastic, rubber, or other materials suitable for the procedure to be followed. The containers shall be flexible so as not to cause undue stress on the aggregate being tested in water in the freezing cycle. The sample containers shall be of sufficient size to hold the required sample and solution, as well as being compatible with the freeze/thaw apparatus.

- 3.1.3. *Sieves*—The sieves used shall meet the requirements of ASTM E11.

- 3.1.4. *Balance*—The balance shall have sufficient capacity, be readable to 0.1 percent of the sample mass or better, and conform to the requirements of M 231.

- 3.1.5. *Drying Oven*—The drying oven shall provide a free circulation of air through the oven and shall be capable of maintaining a temperature of $110 \pm 5^{\circ}\text{C}$ ($230 \pm 9^{\circ}\text{F}$). Oven(s) for heating and drying shall be capable of operation at the temperatures required, between 100 to 120°C (212 to 248°F), within $\pm 5^{\circ}\text{C}$ ($\pm 9^{\circ}\text{F}$), as corrected, if necessary, by standardization. More than one oven may be used, provided each is used within its proper operating temperature range. The thermometer for measuring the temperature, regardless of drying apparatus used, shall meet the requirements of M 339M/M 339 with a temperature range of at least 90 to 130°C (194 to 266°F), and an accuracy of $\pm 1.25^{\circ}\text{C}$ ($\pm 2.25^{\circ}\text{F}$) (see Note 2).

Note 2—Thermometer types suitable for use include ASTM E1 mercury thermometers; ASTM E2877 digital metal stem thermometer; ASTM E230/E230M thermocouple thermometer, Type J or K, Special Class, Type T any Class; IEC 60584 thermocouple thermometer, Type J or K, Class 1, Type T any Class; or dial gauge metal stem (bi-metal) thermometer.