Designation: C 672/C 672M – 03

Standard Test Method for Scaling Resistance of Concrete Surfaces Exposed to Deicing Chemicals[1]

This standard is issued under the fixed designation C 672/C 672M; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

1. Scope

1.1 This test method covers the determination of the resistance to scaling of a horizontal concrete surface exposed to freezing-and-thawing cycles in the presence of deicing chemicals. It is intended for use in evaluating this surface resistance qualitatively by visual examination.

1.2 The values stated in either SI units or inch-pound units are to be regarded separately as standard. Within the text, the inch-pound units are shown in brackets. The values stated in each system are not exact equivalents; therefore, each system shall be used independently of the other.

1.3 *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.*

2. Referenced Documents

2.1 *ASTM Standards:* [2]

C 143/C 143M Test Method for Slump of Hydraulic Cement Concrete

C 156 Test Method for Water Retention by Concrete Curing Materials

C 173/C 173M Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method

C 192/C 192M Practice for Making and Curing Concrete Test Specimens in the Laboratory

C 231 Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method

C 233 Test Method for Air-Entraining Admixtures for Concrete

C 511 Specification for Mixing Rooms, Moist Cabinets, Moist Rooms, and Water Storage Tanks Used in the Testing of Hydraulic Cements and Concretes

3. Significance and Use

3.1 This test method can be used to evaluate the effect of mixture proportioning, surface treatment, curing, or other variables on resistance to scaling.

3.2 This test method is not intended to be used in determining the durability of aggregates or other ingredients of the concrete.

3.3 No relationship has been established between the frost immunity of specimens cut from hardened concrete and specimens prepared in the laboratory.

4. Apparatus

4.1 *Freezing Equipment*—A chest or room of sufficient size to hold the specimens and capable of lowering the temperature of the specimens to −18 ± 3°C [0 ± 5°F] within 16 to 18 h and maintaining this temperature with a full load of specimens.

4.2 *Molds*, of the proper size for the test specimens to be used, and conforming to the requirements of Practice C 192/C 192M.

4.3 *Tamping Rod*, conforming to the requirements of Test Method C 143/C 143M.

4.4 *Small Tools*—Wood strike-off board, steel trowel, and moderately stiff bristle brush suitable for providing the desired texture of the test surface.

4.5 *Slump Cone*, conforming to the requirements of Test Method C 143/C 143M.

4.6 *Air Meter*, conforming to the requirements of Test Method C 173/C 173M or Test Method C 231.

4.7 *Scales*, conforming to the requirements of Practice C 192/C 192M.

4.8 *Concrete Mixer*, conforming to the requirements of Practice C 192/C 192M.

5. Proportioning and Mixing

5.1 *Proportioning*—The air content, cement factor, slump, water-to-cement ratio, and other characteristics of the concrete and its ingredients shall be those appropriate for the purposes for which the tests are to be made. Concrete with the following characteristics has been found useful for the purposes for which this test method is generally used, such as evaluation of a surface treatment for prevention of scaling: (*a*) non-air-entrained; (*b*) cement content, 335 ± 5 kg/m^3[565 ± 10 lb/yd^3]; (*c*) slump, 75 ± 15 mm [3 ± 0.5 in.]; and (*d*) durable

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[2] For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

aggregate (Note 1) of 25-mm [1-in.] maximum size. If air-entrained concrete is to be used for comparative purposes, it shall have the same proportions as that with which it is being compared and the air content shall be 6 ± 1 % (Note 2).

NOTE 1—Care should be taken to use an aggregate which has a good performance record in freezing and thawing exposure.

NOTE 2—For additional information pertaining to air-entrained concrete proportions, see Test Method C 233.

5.2 *Mixing and Testing of Freshly Mixed Concrete*—Machine mix and test in conformance with the applicable provisions of Practice C 192/C 192M.

6. Specimens

6.1 Specimens shall have a surface area of at least 0.045 m^2[72 $in.^2$] and be at least 75 mm [3.0 in.] in depth. At least two duplicate specimens for each combination of variables to be tested shall be made.

6.2 *Fabrication of Specimens*:

6.2.1 Coat the inside surface of the mold with a light coat of mineral oil or a suitable nonreactive release material just prior to fabrication of the specimens.

6.2.2 Fill the mold in one layer. Rod one time for each 1400 mm^2[2 $in.^2$] of surface, leaving a slight excess of material after the final rodding. Tap the mold to close any voids and spade around the periphery with a flat trowel. Level the surface with several passes of a wood strike-off board.

6.2.3 After the concrete has stopped bleeding, finish the surface with three sawing-motion passes of a wood strike-off board. Brush the surface with a medium-stiff brush as a final finishing operation unless another method of surface finishing such as steel-troweled surface, burlap drag, or a troweled-in surface treatment is to be evaluated.

6.2.4 After the finishing operation, place a dike about 25 mm [1 in.] wide and 20 mm [¾ in.] high along the perimeter of the top surface of the specimens. The dike may be made of any material that will adhere to the specimen and serve to maintain the brine pond on top of the specimen throughout the period of the test. If the dike is of mortar, it shall be applied immediately after the final finishing operation, and the surface where the mortar is to be applied shall be roughened to provide a mechanical bond. If an epoxy mortar dike is to be formed or a proven satisfactory bonding material is used to bond the dike to the surface, the dike may be applied after the concrete has set. Any pre-applied coating shall be removed from the bond area prior to the application of the dike.

6.2.5 Test specimens may also be slabs meeting the test area requirements cut from hardened concrete in a structure. In this case, the specimens shall not be cut or damaged on the surface to be tested and should not be allowed to dry to a moisture condition below that of the structure from which they have been taken. This may be accomplished by wrapping the specimens in some waterproof material or by other suitable means.

7. Curing

7.1 Except where the method of curing is an element of study or is otherwise specified, cover the specimens with a polyethylene sheet immediately after finishing. The sheet shall not be permitted to contact the concrete surface.

7.2 Remove the specimens from the molds at an age of 20 to 24 h after addition of water to the mix and place in moist storage as provided for in Specification C 511.

7.3 If concretes with differing rates of strength gain are to be compared, maintain the specimens in moist storage until such time as the desired strength level has been obtained. When the desired strength level has been reached, remove the specimens from moist storage and store in air for 14 days at 23.0 ± 2.0°C [73.5 ± 3.5°F] and 45 to 55 % relative humidity.

7.4 For all other concretes, remove the specimens from moist storage at the age of 14 days and store in air for 14 days at 23.0 ± 2.0°C [73.5 ± 3.5°F] and 45 to 55 % relative humidity.

8. Protective Coatings

8.1 If protective coatings are to be evaluated, apply them in accordance with the manufacturer's recommendations regarding quantity and method of application at the age of 21 days. When a material proposed as dual-purpose curing compound/protective coating is being evaluated, apply it at the proper time of application for curing compounds, as described in Test Method C 156.

NOTE 3—When evaluating penetration-type coatings for application to pavement surfaces subject to traffic wear, it may be desirable to abrade the treated surface of the test specimens by sufficient wire brushing to break any films remaining on the surface after drying.

9. Procedure

9.1 After completion of moist and air curing, cover the flat surface of the specimen with approximately 6 mm (¼ in.) of a solution of calcium chloride and water, having a concentration such that each 100 mL of solution contains 4 g of anhydrous calcium chloride.

NOTE 4—Other chemical deicers and different concentrations may be used when there is a need to evaluate their specific effect. In addition, a variation in the procedure may be adopted whereby the deicer is added directly to the ice produced by freezing a 6 mm (¼ in.) layer of fresh water during the freezing portion of the cycle, discarding and flushing the resulting solution off the surface at the end of the thawing portion of the cycle and then repeating the cycle. If this procedure is adopted, it should be recognized that about 100 cycles or more will be required to evaluate a surface treatment.

9.2 Place specimens in a freezing environment for 16 to 18 h. At the end of this time remove them from the freezer and place them in laboratory air at 23 ± 2.0°C [73.5 ± 3.5°F] and a relative humidity of 45 to 55 % for 6 to 8 h. Add water between each cycle as necessary to maintain the proper depth of solution. Repeat this cycle daily, flushing off the surface thoroughly at the end of each 5 cycles. After making a visual examination, replace the solution and continue the test.

NOTE 5—Generally, 50 cycles are sufficient to evaluate a surface or surface treatment. However, where comparative tests are being made, it is recommended that the tests be continued beyond the recommended minimum number of cycles if differences have not developed.

9.3 Either keep specimens frozen during any interruption in the daily cycling or maintain them in a damp condition after removal of solution and flushing surfaces.

10. Report

10.1 Report the following:

10.1.1 Cement content, water-cement ratio, the kind and amount of any admixture, slump, and air content of mix,

10.1.2 Curing and drying if other than standard,

10.1.3 Type of surface treatment, time of application, and rate of application,

10.1.4 Type of deicer, whether solution or solid, concentration of the solution if used, rate of application, and time of application,

10.1.5 Visual rating of the surface after 5, 10, 15, 25, and every 25 cycles thereafter in accordance with the following scale:

Rating	Condition of Surface
0	no scaling
1	very slight scaling (3 mm [⅛ in.] depth, max, no coarse aggregate visible)
2	slight to moderate scaling
3	moderate scaling (some coarse aggregate visible)
4	moderate to severe scaling
5	severe scaling (coarse aggregate visible over entire surface)

10.1.6 If the test specimens are cut from hardened concrete, the size, shape, orientation of the specimens in the structure, and any other pertinent information available shall be included in the report, and

10.1.7 Photographs or a word description of the surface, or both, also should be included where possible.

11. Precision and Bias

11.1 In statistical analyses of data obtained by the use of this test method, it is necessary to recognize that the ratings are ranks, and as such, may not be appropriately subjected to analyses based on the calculation of averages and standard deviations nor to other techniques that assume continuous distribution of measurement on at least an interval scale. If groups of similar specimens are to be reported or compared with other groups, such nonparametric quantities as the median and the range may be used.

12. Keywords

12.1 concrete-weathering tests; deicing chemicals; freezing and thawing; resistance-frost; resistance-scaling