Designation: C 671 – 94

Standard Test Method for Critical Dilation of Concrete Specimens Subjected to Freezing[1]

This standard is issued under the fixed designation C 671; 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 test period of frost immunity of concrete specimens as measured by the length of time of water immersion required to produce critical dilation when subjected to a prescribed slow-freezing procedure.

1.2 The values stated in SI units are to be regarded as the standard.

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:*

C 192 Practice for Making and Curing Concrete Test Specimens in the Laboratory[2]

C 490 Practice for Use of Apparatus for Determination of Length Change of Hardened Cement Paste, Mortar, and Concrete[3]

C 682 Practice for Evaluation of Frost Resistance of Coarse Aggregates in Air Entrained Concrete by Critical Dilation Procedures[2]

2.2 ASTM Adjuncts:

Adjunct C 671 Two detailed drawings of a strain frame, 1 drawing of gage point installation, and a table of metric equivalents.[4]

3. Significance and Use

3.1 This test method is suitable for ranking concretes according to their resistance to freezing and thawing for defined curing and conditioning procedures. The significance of the results in terms of potential field performance will depend upon the degree to which field conditions can be expected to correlate with those employed in the laboratory.

3.2 This test method is suitable for estimating the frost susceptibility of aggregates in concrete as described in Practice C 682.

3.3 This test method is also suitable for use by those people engaged in research and development in the field of concrete durability. It is believed that a fundamental understanding of length change of concrete subjected to freezing will lead to more durable concrete.

4. Apparatus

4.1 *Cooling Bath*, of sufficient size and depth to completely immerse the test specimens in silicone oil or water-saturated kerosine (Note 1). The bath shall have a sufficient volume of kerosine per specimen and shall be provided with controls so as to permit lowering its temperature and that of the test specimens uniformly from 1.7 to − 9.4°C (35 to 15°F) at the rate of 2.8 ± 0.5°C/h (5 ± 1°F/h). Suitable bath temperature recording facilities shall be provided.

NOTE 1—Very little water is required to saturate kerosine. Excess water should be avoided as it will form ice crystals in the bath. As an alternative to kerosine, the use of silicone oil may be preferable to reduce odors and fire hazards.

4.2 *Constant-Temperature Water Bath*— A refrigerated water bath capable of containing the specimens completely immersed, and equipped with control facilities capable of maintaining the temperature of the specimens at 1.7 ± 0.9°C (35 ± 2°F) before and between test cycles.

4.3 *Strain-Measuring and Recording Facilities*, (Note 2) and a supply of strain frames to support the specimens in the cooling bath and to provide alignment for the strain-measuring apparatus (Fig. 1).[3] The strain-measuring apparatus shall have a capability for measuring 2 millionths or less.

NOTE 2—Linear variable differential transformers (LVDT) with the appropriate associated electronic actuating and indicating apparatus appear to give the best results with respect to stability, sensitivity, and reliability. Multichannel recording of outputs has been found to be practical and efficient (see Fig. 2). As an alternate to the recording apparatus shown in Fig. 2, a data logger[5] can be used to excite the LVDT and record the LVDT both temperature and time outputs. The data can be stored directly in a personal computer for graphing of test results.

4.4 *Room or Cabinet*, for storing specimens at the desired temperature and relative humidity with provision for constant circulation of air in the immediate vicinity of the specimens.

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[1] This test method is under the jurisdiction of ASTM Committee C-9 on Concrete and Concrete Aggregatesand is the direct responsibility of Subcommittee C09.67on Resistance of Concrete to Its Environment.

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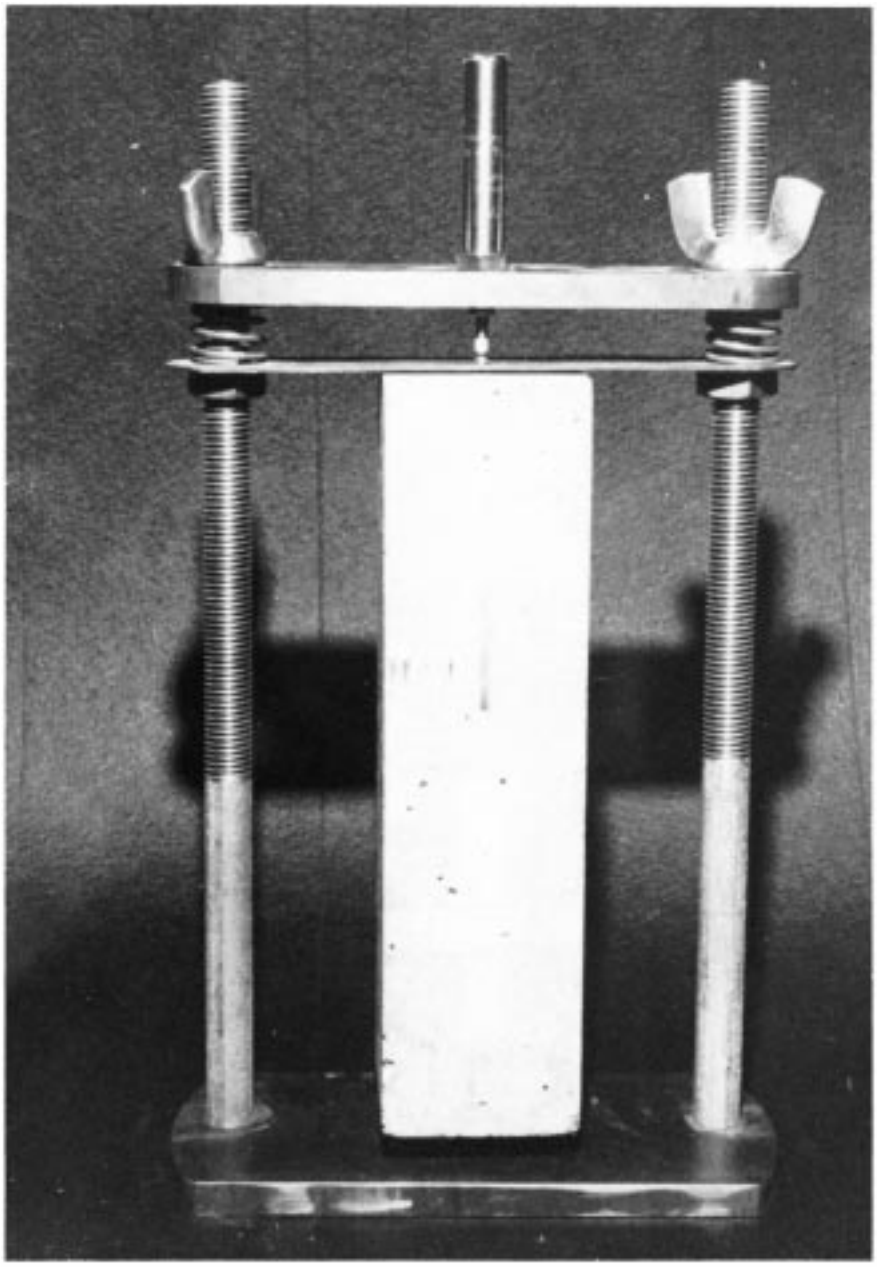
[2] *Annual Book of ASTM Standards*, Vol 04.02.

[3] *Annual Book of ASTM Standards*, Vol 04.01.

[4] Available from ASTM Headquarters, 100 Barr Harbor Drive, West Conshohocken, PA 19428. Request ADJC0671.

[5] A suitable data logger is manufactured by Campbell Scientific Inc., Model 21X, P.O. Box 551, Logan, Utah 84321.



NOTE 1—The drawings in Adjunct C 671 show an experimental setup slightly different from this one.

FIG. 1 Specimen Positioned in Strain Frame

4.5 *Miscellaneous Equipment*—Specimen molds and apparatus specified in applicable sections of Practice C 192.

5. Test Specimens

5.1 Test specimens shall be concrete cylinders mixed, molded, and cured as prescribed in Practice C 192. Specimens shall be 75 mm (3 in.) in diameter by 150 mm (6 in.) high and shall be fitted with axially centered stainless steel gage plugs in both top and bottom. Gage studs shall conform to requirements of Practice C 490. Other sizes and shapes of specimens may be used at some expense of efficiency and convenience. A 1:3 ratio of aggregate to specimen size should be preserved, however. Comparison of concretes must be made on the specimens of the same size.

5.2 Test specimens may also be cores, cubes, or prisms cut from hardened concrete. If so, the specimens should not be allowed to dry to a moisture condition below that of the structure from which they were taken. This may be accomplished by wrapping the specimens in plastic or by other suitable means.

6. Calibration

6.1 Each strain frame and strain-measuring apparatus shall be calibrated using an invar bar with known thermal expansion characteristics.

6.2 With the invar bar in the strain frame, cool the apparatus as described in 8.2 and record the strain with change in temperature.