



Designation: C586 – 11 (Reapproved 2019)

# Standard Test Method for Potential Alkali Reactivity of Carbonate Rocks as Concrete Aggregates (Rock-Cylinder Method)<sup>1</sup>

This standard is issued under the fixed designation C586; 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 ( $\epsilon$ ) indicates an editorial change since the last revision or reapproval.

*This standard has been approved for use by agencies of the U.S. Department of Defense.*

## 1. Scope

1.1 This test method covers the determination of the expansion of a specimen of carbonate rock while immersed in a solution of sodium hydroxide (NaOH) at room temperature. The length changes occurring during such immersion indicate the general level of reactivity of the rock and whether tests should be made to determine the effect of aggregate prepared from the rock upon the volume change in concrete.

1.2 The values stated in SI units are to be regarded as standard. No other units of measurement are included in this 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, health, and environmental practices and determine the applicability of regulatory limitations prior to use.*

1.4 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

## 2. Referenced Documents

2.1 *ASTM Standards:*<sup>2</sup>

[C294 Descriptive Nomenclature for Constituents of Concrete Aggregates](#)

[C295 Guide for Petrographic Examination of Aggregates for Concrete](#)

[C1105 Test Method for Length Change of Concrete Due to Alkali-Carbonate Rock Reaction](#)

[D75 Practice for Sampling Aggregates](#)

[D1248 Specification for Polyethylene Plastics Extrusion Materials for Wire and Cable](#)

[E177 Practice for Use of the Terms Precision and Bias in ASTM Test Methods](#)

## 3. Terminology

3.1 For definitions of terms relating to aggregates used in this test method, refer to Descriptive Nomenclature [C294](#).

## 4. Summary of Test Method

4.1 Small rock cylinders are immersed in a solution of NaOH except when removed for determination of length change. The length change of each specimen is periodically determined.

## 5. Significance and Use

5.1 This test method is intended to give a relatively rapid indication of the potential expansive reactivity of certain carbonate rocks that may be used as concrete aggregates. The test method has been successfully used in (1) research and (2) preliminary screening of aggregate sources to indicate the presence of material with a potential for deleterious expansion when used in concrete.

5.2 The test method is intended as a research and screening method rather than as the basis of a specification requirement. It is intended to supplement data from field service records, petrographic examinations according to Guide [C295](#), and tests of aggregate in concrete according to Test Method [C1105](#).

5.3 Alkalies participating in the expansive reactions with aggregate constituents in concrete usually are derived from the hydraulic cement; under certain circumstances they may be derived from other constituents of concrete or from external sources. Two types of alkali reactivity of aggregates are recognized: (1) alkali-silica reaction involving certain siliceous rocks, minerals, and artificial glasses, and (2) alkali carbonate reaction involving dolomite in certain calcitic dolomites, dolomitic limestones, and dolostones. This test method is not suitable as a means to detect alkali-silica reaction.

<sup>1</sup> This test method is under the jurisdiction of ASTM Committee [C09](#) on Concrete and Concrete Aggregates and is the direct responsibility of Subcommittee [C09.50](#) on Aggregate Reactions in Concrete.

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<sup>2</sup> 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.

## 6. Apparatus and Reagents

6.1 *1 N Sodium Hydroxide Solution*—Dissolve  $40 \pm 1$  g of reagent-grade sodium hydroxide (NaOH) in distilled water, dilute to 1 L and store in a polyethylene bottle.

6.2 *Sawing, Drilling, and Grinding Equipment*, suitable for preparing test specimens of the dimensions given in Section 8. This will require one or more rock saws, depending upon the size of the original sample, a drill press equipped with a small diamond core barrel for removing the cylindrical core, and a lap, grinder, or suitable modified lathe for shaping the ends of the specimens.

6.3 *Storage Bottles*, approximately 50 to 100-mL capacity with caps and openings of sufficient size to facilitate removal of specimens. The polyethylene bottle shall be selected to ensure that the solution will not be modified by reaction with the material composing the container, including pigments or other additives or by transpiration of phases through the walls of the container. Bottles with wall thickness not less than 0.50 mm and composed of high density polyethylene meeting the requirements of Specification D1248 for materials of Type III, Class A, are suitable.

6.4 *Length Comparator*, for convenient and rapid measurement of lengths of specimens, the comparator shall be of such design as to provide, permit, or include the following characteristics. One type of comparator which has been found satisfactory is shown in Fig. 1.

6.4.1 A positive means of contact with the conical ends of the specimen to ensure reproducible measurement of length. A variety of contact points have been used successfully. Care should be exercised to ensure that when using specimens with conical ends as described in 8.3, contact is made on the end along a circle which is concentric about the long axis of the specimen. If the measuring device is a barrel micrometer, it shall have a ratchet stop to produce a constant pressure on the specimen.

6.4.2 A high-grade barrel or dial micrometer graduated to read in 0.001 or 0.002-mm units, and accurate within 0.002 mm in any 0.020-mm range, and within 0.004 mm in any 0.200-mm range. The measuring device should be calibrated throughout its range to determine both periodic and cumulative errors for proper correction of observed data.

6.4.3 A sufficient range to allow for small differences among gage lengths of various specimens. If care is taken in the fabrication of the specimens, a measuring device with a travel of not less than 7.5 mm provides ample range in the instrument, and

6.4.4 A standard or reference shall be used for checking the measuring device at regular intervals. The bar that serves as a reference for the length comparator shall have an over-all length of  $35 \pm 2$  mm. The length of the bar shall be known to an accuracy of 0.002 mm. The bar shall be fused silica or a steel alloy having a coefficient of thermal expansion not greater than  $1.0 \times 10^{-6}/^{\circ}\text{C}$ . Each end shall be machined to the same shape as that of the rock specimens. If a steel alloy is used, it shall be polished (see Note 1). The reference bar shall be placed in the instrument in the same position each time a length measurement is made. The micrometer setting of the measur-

ing device shall be checked by use of the reference bar at least at the beginning and end of the readings made within a half day when the apparatus is kept in a room maintained at constant temperature. It shall be checked more often when kept in a room where temperature is not constant.

NOTE 1—Steel alloys with low thermal expansion coefficient should not be heat treated because they lose their low coefficient of thermal expansion when so treated.

## 7. Sampling

7.1 Sample the rock in accordance with the applicable requirements of Practice D75, except that the sample mass of each discernable stratum shall be at least 1 kg, and individual pieces shall be not less than  $75 \times 75 \times 75$  mm in size.

7.2 Sampling should be under the direction of an individual capable of distinguishing differences in lithology, and the sample of rock should be taken to represent only the particular lithology under consideration bearing in mind the limitations and significance of this method as stated in Section 5. Each sample of rock should be in one piece of sufficient size for preparing the necessary test specimens.

7.3 One test specimen will sufficiently represent the sample of rock unless shale seams or other discontinuities are present or the bedding is not discernible. In these cases, prepare and test 3 mutually perpendicular specimens. Of these three specimens, testing shall be continued on that one showing the greatest calculated length change after 28 days of immersion in alkali solution. Discard the remaining two.

## 8. Test Specimens

8.1 Test specimens shall be in the form of right circular cylinders or square prisms with conical or plane parallel ends, unless otherwise specified.

8.2 The specimen shall have an over-all length of  $35 \pm 5$  mm and a diameter or sides of  $9 \pm 1$  mm for cylinders and prisms respectively. Care shall be exercised in the preparation of the specimens to avoid alteration of the cylindrical surface by polishing or with materials which will affect the rate of entry of alkali solution into the rock.

8.3 The included angle of the conical ends shall be approximately  $120^{\circ}$ .

8.4 Fabricate specimens having flat-end faces in such a manner as to ensure that the faces are parallel to each other and perpendicular to the major axis of the specimen (see Note 2).

NOTE 2—End faces parallel to each other and perpendicular to the major axis of the specimen can be made by turning the specimen in a small lathe and using tool steel to cut the ends.

## 9. Procedure

9.1 Place a position mark on the specimen to permit placing the specimen in the comparator in the same position during subsequent measurements.

9.2 Measure the length of the test specimen.

9.3 Immerse the specimen in distilled water at a room temperature in the range of 20 to  $27.5^{\circ}\text{C}$ .