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Standard Test Method for Length Change of Concrete Due to Alkali-Carbonate Rock Reaction¹

This standard is issued under the fixed designation C1105; 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, by measurement of length change of concrete prisms, the susceptibility of cement-aggregate combinations to expansive alkali-carbonate reaction involving hydroxide ions associated with alkalies (sodium and potassium) and certain calcitic dolomites and dolomitic limestones.

1.2 The text of this standard refers to notes and footnotes that provide explanatory material. These notes and footnotes (excluding those in tables and figures) shall not be considered as requirements of the standard.

1.3 Units—The values stated in SI units are to be regarded as the standard. No other units of measurement are included in this standard. When combined standards are cited, the selection of measurement system is at the user's discretion subject to the requirements of the referenced standard.

1.4 *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~~safety, health, and environmental practices and determine the applicability of regulatory limitations prior to use.*

1.5 *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:²

~~C33~~C33/C33M Specification for Concrete Aggregates

C125 Terminology Relating to Concrete and Concrete Aggregates

~~C150~~C150/C150M Specification for Portland Cement

C157/C157M Test Method for Length Change of Hardened Hydraulic-Cement Mortar and Concrete

~~E233~~C233/C233M Test Method for Air-Entraining Admixtures for Concrete

C294 Descriptive Nomenclature for Constituents of Concrete Aggregates

~~E295~~C295/C295M Guide for Petrographic Examination of Aggregates for Concrete

C490 Practice for Use of Apparatus for the Determination of Length Change of Hardened Cement Paste, Mortar, and Concrete

¹ 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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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.

*A Summary of Changes section appears at the end of this standard

[C511 Specification for Mixing Rooms, Moist Cabinets, Moist Rooms, and Water Storage Tanks Used in the Testing of Hydraulic Cements and Concretes](#)

[C586 Test Method for Potential Alkali Reactivity of Carbonate Rocks as Concrete Aggregates \(Rock-Cylinder Method\)](#)

[C595C595/C595M Specification for Blended Hydraulic Cements](#)

[C670 Practice for Preparing Precision and Bias Statements for Test Methods for Construction Materials](#)

[C702C702/C702M Practice for Reducing Samples of Aggregate to Testing Size](#)

[D75D75/D75M Practice for Sampling Aggregates](#)

3. Terminology

3.1 Terminology used in this standard is defined in Terminology [C125](#) or Descriptive Nomenclature [C294](#).

4. Significance and Use

4.1 Two types of alkali reactivity of aggregates have been described in the literature: the alkali-silica reaction involving certain siliceous rocks, minerals, and artificial glasses (1),³ and the alkali-carbonate reaction involving dolomite in certain calcitic dolomites and dolomitic limestones (2). This test method is not recommended as a means to detect combinations susceptible to expansion due to alkali-silica reaction since it was not evaluated for this use in the work reported by Buck (2). This test method is not applicable to aggregates that do not contain or consist of carbonate rock (see Descriptive Nomenclature [C294](#)).

4.2 This test method is intended for evaluating the behavior of specific combinations of concrete-making materials to be used in the work. However, provisions are made for the use of substitute materials when required. This test method assesses the potential for expansion of concrete caused by alkali-carbonate rock reaction from tests performed under prescribed laboratory curing conditions that will probably differ from field conditions. Thus, actual field performance will not be duplicated due to differences in wetting and drying, temperature, other factors, or combinations of these (see [Appendix X1](#)).

4.3 Use of this test method is of particular value when samples of aggregate from a source have been determined to contain constituents that are regarded as capable of participation in a potentially deleterious alkali-carbonate rock reaction either by petrographic examination, Guide [C295C295/C295M](#), by the rock cylinder test, Test Method [C586](#), by service record; or by a combination of these.

4.4 Results of tests conducted as described herein should form a part of the basis for a decision as to whether precautions be taken against excessive expansion due to alkali-carbonate rock reaction. This decision should be made before a particular cement-aggregate combination is used in concrete construction (see [Note 1](#)).

NOTE 1—Other elements that may be included in the decision-making process for categorizing an aggregate or a cement-aggregate combination with respect to whether precautions are needed, and examples of precautions that may be taken, are described in [Appendix X1](#).

4.5 While the basic intent of this test method is to develop information on a particular cement-aggregate combination, it will usually be very useful to conduct control tests in parallel using the aggregate of interest with other cements or the cement of interest with other aggregates.

5. Apparatus

5.1 The molds, the associated items for molding test specimens, and the length comparator for measuring length change shall conform to the applicable requirements of Test Method [C157/C157M](#) and Practice [C490](#), and the molds shall have nominal 75-mm square cross sections.

6. Materials

6.1 *Maximum Size of Coarse Aggregate*—Coarse-aggregate fractions larger than the 19.0-mm sieve shall not be tested as such. When petrographic examination using Guide [C295C295/C295M](#) reveals that the material making up the size fractions larger than the 19.0-mm sieve is of such a composition and lithology that no differences should be expected compared with the smaller size material to be tested, or when tests, made in accordance with Test Method [C586](#), of material in such sizes reveal no significant

³ The boldface numbers in parentheses refer to the list of references at the end of this test method.

differences from the sizes to be tested, then no further attention need be paid to the larger sizes. If results of petrographic examination or tests made in accordance with Test Method **C586** suggest that the larger size material should be studied for its effects in concrete, one or the other of two alternative procedures described herein may be used.

6.1.1 *Proportional Testing*—Material larger than the 19.0-mm sieve shall be crushed to pass the 19.0-mm sieve and material larger than the 4.75-mm sieve shall be proportioned to include the same proportion by mass of the crushed material originally retained on the 19.0-mm sieve and that originally passing this sieve, as may be expected to be used in the field concrete.

6.1.2 *Separated Size Testing*—Material larger than the 19.0-mm sieve shall be crushed to pass this sieve and shall be used in concrete as a second aggregate.

6.1.2.1 In the case of construction where several size ranges coarser than the 19.0-mm sieve are contemplated, each of these may, if desired, be separately crushed to pass this sieve and may be tested separately.

6.2 *Job Cement*—When it is desired to evaluate a particular cement-aggregate combination for use in particular work, the cement or cements used shall meet the requirements for the work and shall be from the source or sources and in the amounts expected to be used in the work. If several cements may be used in the work, it is desirable that tests be made using each cement separately.

6.3 *Reference Cements*—When it is desired to evaluate aggregates for general use or to compare aggregates for investigational purposes, the cement used shall be of the highest alkali content representative of the general use intended, or available to the laboratory making the tests. The cement or cements selected should comply with Specification **C150/C150M** or Specification **C595/C595M**. Additional information of value may be obtained by conducting parallel tests with cements of different alkali content, of different sodium oxide to potassium oxide ratio, or blended with pozzolan or ground blast-furnace slag, or both.

6.4 *Substitute Fine Aggregate*—If the test aggregate is to be used only as coarse aggregate and the fine aggregate that it will be used with is not available, a fine aggregate that is not expected to participate in an expansive reaction with alkalis (see **Note 2**) shall be used.

NOTE 2—Advice on judging the expansive reactivity of aggregate is given in Appendix XI of Specification **C33/C33M**.

7. Sampling

7.1 Obtain the sample in accordance with Practice **D75/D75M** and reduce it to test portion size in accordance with Practice **C702/C702M**.

8. Test Specimens

8.1 Prepare six specimens, of the type required for concrete Test Method **C157/C157M**, from one batch of concrete. The concrete mixture shall be the mixture in which the aggregates are proposed for use. In the event that no specific concrete mixture is being considered, that described in Test Method **C233/C233M** shall be used.

8.2 If control or comparison mixtures are made, specimens shall be made from those mixtures as described in **8.1**.

9. Conditioning

9.1 Cure, store, and remove molds in accordance with Test Method **C157/C157M**. Thereafter, keep the specimens in moist storage in accordance with Specification **C511** but do not immerse in water.

10. Procedure

10.1 Follow the procedure of Test Method **C157/C157M**, except that the specimens shall be stored in a moist room or moist cabinet meeting the requirements of Specification **C511** and length measurements shall be made at ages 7, 28, and 56 days, and 3, 6, 9, and 12 months.

11. Calculation

11.1 Calculate the change in length of each of the prisms at each of the ages at which determinations are made and express as a