Designation: C1105 – 23a

Standard Test Method for Length Change of Concrete Due to Alkali-Carbonate Rock Reaction[1]

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 a coarse aggregate or cementitious materials 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 Results of tests conducted as described herein should form a part of the basis for a decision as to whether or not the coarse aggregate or specific combinations of concrete-making materials under test can be used in portland cement concrete construction. Interpretation of results can be found in Guide C1778.

1.3 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.

1.4 *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.

1.5 *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.*

1.6 *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/C33M Specification for Concrete Aggregates
C125 Terminology Relating to Concrete and Concrete Aggregates
C150/C150M Specification for Portland Cement
C157/C157M Test Method for Length Change of Hardened Hydraulic-Cement Mortar and Concrete
C294 Descriptive Nomenclature for Constituents of Concrete Aggregates
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
C494 Specification for Chemical Admixtures for Concrete
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)
C595/C595M Specification for Blended Hydraulic Cements
C670 Practice for Preparing Precision and Bias Statements for Test Methods for Construction Materials
C702/C702M Practice for Reducing Samples of Aggregate to Testing Size
C856/C856M Practice for Petrographic Examination of Hardened Concrete
C1260 Test Method for Potential Alkali Reactivity of Aggregates (Mortar-Bar Method)
C1778 Guide for Reducing the Risk of Deleterious Alkali-Aggregate Reaction in Concrete
D75/D75M Practice for Sampling Aggregates

3. Terminology

3.1 Terminology used in this standard is defined in Terminology C125 or Descriptive Nomenclature C294.

[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.

Current edition approved Dec. 15, 2023. Published April 2024. Originally approved in 1989. Last previous edition approved in 2023 as C1105 – 23. DOI: 10.1520/C1105-23A.

[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

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 contains two methods. Method A is used to evaluate the susceptibility of a coarse aggregate to alkali-carbonate reaction. Method B is to evaluate the behavior of specific combinations of concrete-making materials to be used in concrete construction. 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.

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 C295/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 or not the aggregate under test can be used in portland cement concrete construction. Interpretation of results can be found in Guide C1778.

4.5 At the conclusion of the test it may be useful to conduct petrographic examination on the concrete following Practice C856/C856M and the aggregate following Guide C295/C295M to confirm that the aggregate causing expansive behaviour of the concrete, if any, is comparable to the petrography and chemistry of known deleteriously expansive alkali-carbonate reactive rocks. It is important to check the presence of potentially reactive silica that may not necessarily be visible at the scale of conventional transmitted light optical microscopy examination.

4.6 The research, evaluation, and precision and bias statement for this test method were done on crushed quarried carbonate coarse aggregate (**3**). Therefore, the results of evaluating alkali-carbonate reactive expansion of manufactured fine aggregate or natural sand containing crusher screenings derived from quarried carbonate rocks is unknown. Further, the applicability of this test to gravels containing carbonate rocks suspected of being alkali-carbonate reactive is unknown and as far as is known has not been evaluated.

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 and nominal 285 mm length.

6. Materials for Method A – Aggregate Reactivity Determination

6.1 *Materials:*

6.1.1 To evaluate the potential alkali-carbonate reactivity of a coarse aggregate, use an alkali-silica nonreactive fine aggregate. An alkali-silica nonreactive fine aggregate is defined as an aggregate that develops an expansion in the accelerated mortar bar, (see Test Method C1260) of less than 0.10 % at 14 days (see Guide C1778 for interpretation of expansion data). Use a fine aggregate meeting Specification C33/C33M.

6.1.2 Sieve the coarse aggregate and recombine in accordance with the requirements in Table 1. Select the Table 1 grading based on the as-received grading of the sample. Coarse aggregate fractions larger than 19.0 mm sieve are not to be tested as such. When petrographic examination using Guide C295/C295M reveals that the material making up the size fraction larger than the 19.0 mm sieve is of such a composition and lithology that no difference should be expected compared with the smaller size material, then no further attention need be paid to the larger sizes. If petrographic examination suggests the larger size material to have a different reactivity, the material should be studied for its effect in concrete according to one of the other alternative procedures described herein:

6.1.2.1 *Proportional Testing*—Crush material larger than the 19.0 mm sieve to pass the 19.0 mm sieve. The crushing operation shall be performed in a manner that minimizes production of material passing the 4.75 mm sieve. Grade this crushed material in accordance with the Table 1 grading and add to the original mass of graded aggregate produced in 6.1.2 such that the ratio of crushed, graded, oversize aggregate to total graded aggregate equals the ratio of material retained on the 19.0 mm sieve to the total material retained above the 4.75 mm sieve (see Note 1).

NOTE 1—For example, if the material retained on the 19 mm sieve formed 25 % of the total material retained above the 4.75 mm sieve, then the mass of crushed and returned oversize material shall form 25 % of the total graded aggregate.

TABLE 1 Gradation Requirement for Coarse Aggregate in Procedure A

Sieve Size		Mass Fraction	
Passing	Retained	Coarse	Intermediate
19.0 mm	12.5 mm	⅓	...
12.5 mm	9.5 mm	⅓	½
9.5 mm	4.75 mm	⅓	½

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