



Designation: C1582/C1582M – 24

Standard Specification for Admixtures to Inhibit Chloride-Induced Corrosion of Reinforcing Steel in Concrete¹

This standard is issued under the fixed designation C1582/C1582M; 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 specification covers material for use as chloride-corrosion-inhibiting admixtures for concrete.

1.2 Results of the tests conducted to meet this specification are not to be used to rank the expected field performance of various chloride-corrosion-inhibiting admixtures.

1.3 The values stated in either SI units or inch-pound units are to be regarded separately as standard. The values stated in each system are not necessarily exact equivalents; therefore, to ensure conformance with the standard, each system shall be used independently of the other, and values from the two systems shall not be combined.

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, health, and environmental practices and determine the applicability of regulatory limitations prior to use. (Warning—Fresh hydraulic cementitious mixtures are caustic and may cause chemical burns to skin and tissue upon prolonged exposure.²)*

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:³

C39/C39M Test Method for Compressive Strength of Cylindrical Concrete Specimens

C78/C78M Test Method for Flexural Strength of Concrete (Using Simple Beam with Third-Point Loading)

C125 Terminology Relating to Concrete and Concrete Aggregates

C143/C143M Test Method for Slump of Hydraulic-Cement Concrete

C150/C150M Specification for Portland Cement

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

C231/C231M Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method

C260/C260M Specification for Air-Entraining Admixtures for Concrete

C403/C403M Test Method for Time of Setting of Concrete Mixtures by Penetration Resistance

C494/C494M Specification for Chemical Admixtures for Concrete

C595/C595M Specification for Blended Hydraulic Cements

C666/C666M Test Method for Resistance of Concrete to Rapid Freezing and Thawing (Withdrawn 2024)⁴

C1152/C1152M Test Method for Acid-Soluble Chloride in Mortar and Concrete

G15 Terminology Relating to Corrosion and Corrosion Testing (Withdrawn 2010)⁴

G109 Test Methods for Determining Effects of Chemical Admixtures on Corrosion of Embedded Steel Reinforcement in Concrete Exposed to Chloride Environments

G180 Test Method for Corrosion Inhibiting Admixtures for Steel in Concrete by Polarization Resistance in Cementitious Slurries

2.2 American Concrete Institute Standard:⁵

ACI 211.1 Practice for Selecting Proportions of Normal, Heavyweight, and Mass Concrete

¹ This specification is under the jurisdiction of ASTM Committee C09 on Concrete and Concrete Aggregates and is the direct responsibility of Subcommittee C09.23 on Chemical Admixtures.

Current edition approved Aug. 1, 2024. Published September 2024. Originally approved in 2004. Last previous edition approved in 2017 as C1582/C1582M – 11(2017)^ε. DOI: 10.1520/C1582_C1582M-24.

² Section on Safety Precautions, Manual of Aggregate and Concrete Testing, *Annual Book of ASTM Standards*, Vol 04.02.

³ For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at www.astm.org/contact. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

⁴ The last approved version of this historical standard is referenced on www.astm.org.

⁵ Available from American Concrete Institute (ACI), P.O. Box 9094, Farmington Hills, MI 48333-9094, <http://www.concrete.org>.

3. Terminology

3.1 *Definitions*—Refer to Terminologies C125 and G15 for definitions of terms used in this specification.

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



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3.2 Definitions of Terms Specific to This Standard:

3.2.1 *chloride-ion content, n* —the acid-soluble chloride-ion content, measured according to Test Method **C1152/C1152M**, of a powder sample taken at a depth equal to the depth of reinforcement.

3.2.2 *completion of testing, n* —for Test Method **G109**, when the following conditions are satisfied: (1) the mean integrated macrocell current in the control beams is greater than or equal to 150 coulombs (C); and (2) the mean chloride-ion content of the test beams is greater than or equal to the critical chloride-ion content.

3.2.2.1 *Discussion*—Refer to the Appendix for additional explanation of the methodology used to evaluate the performance of a chloride-corrosion-inhibiting admixture.

3.2.3 *control beams, n* —beams subjected to the treatment in Test Method **G109** that are made from concrete without the chloride-corrosion-inhibiting admixture.

3.2.4 *critical chloride-ion content, n* —the mean chloride-ion content in the unreinforced control beams at t_{50} plus the standard deviation.

3.2.5 *reinforced beams, n* —beams used to measure macrocell corrosion current according to Test Method **G109**.

3.2.6 t_{50} , n —time when the mean integrated macrocell current of the control beams reaches 50 C.

3.2.7 t_{150} , n —time when the mean integrated macrocell current of the control beams reaches 150 C.

3.2.8 *test beams, n* —beams subjected to the treatment in Test Method **G109** that are made from concrete with the chloride-corrosion-inhibiting admixture.

3.2.9 *unreinforced beams, n* —beams without reinforcement that are subjected to the cyclic ponding and drying treatment in Test Method **G109** and used to determine chloride-ion content.

4. General Requirements

4.1 For initial compliance with this specification, test-concrete made with the chloride-corrosion-inhibiting admixture shall conform to the requirements prescribed in **Table 1**.

4.2 The purchaser is allowed to require a limited retesting to confirm current compliance of the admixture to specification requirements. The limited retesting covers physical and chemical properties and performance of the admixture.

4.2.1 The physical properties retesting shall consist of uniformity and equivalence tests for infrared analysis, residue by oven drying, and specific gravity as described in Specification **C494/C494M**.

4.2.2 The performance property retesting shall consist of time of setting and compressive strength at 3, 7, and 28 days. Purchasers having special requirements are allowed to require additional tests currently in this standard.

4.3 At the request of the purchaser, the manufacturer shall state in writing that the admixture supplied for use in the project is identical in all essential respects, including concentration, to the admixture tested under this specification and found to comply therewith.

TABLE 1 Physical Requirements of Concrete Containing a Chloride-Corrosion-Inhibiting Admixture

Time of setting, allowable deviation from control, h:min		
Initial: not more than 3:30 earlier or later		
Final: not more than 3:30 earlier or later		
Strength:		
Age	Compressive strength, min. % of control: ^{A,B}	Flexural strength, min. % of control: ^{A,B}
3 days	80	80
7 days	80	80
28 days	80	80
6 months	80	
1 year	80	
Length change, max. shrinkage (alternative requirements) ^C		
Percent of control: 135		
Increase over control, percentage points: 0.010		
Relative durability factor, minimum %: 80		

^A The values in the table include allowance for normal variation in test results. The objective of the 80 % relative strength is to require a level of performance comparable to that of the control concrete. Reinforced concrete, subjected to brackish water, salt spray and/or deicers, requires a water-cement ratio of 0.40 or less for long-term durability. This durability requirement results typically in compressive strengths in excess of what is required structurally. If high-strength concrete is needed for structural purposes, mixture proportions may need to be adjusted when using a chloride-corrosion-inhibiting admixture.

^B The compressive and flexural strength of the concrete containing the admixture under test at any test age shall not be less than 90 % of that attained at any previous test age. The objective of this limit is to require that the compressive or flexural strength of the concrete containing the admixture under test shall not decrease with age.

^C For the alternative requirements (see Specification **C494/C494M**), the percent of control limit applies when length change of the control concrete is 0.030 % or greater, and the increase over control limit applies when length change of the control concrete is less than 0.030 %.

4.4 Tests for uniformity and equivalence shall be made on the initial sample in accordance with Specification **C494/C494M**, and the results retained for reference and comparison with the results of tests of samples taken from elsewhere within the lot or subsequent lots of admixture supplied for use in the project.

5. Corrosion-Inhibiting Performance

5.1 In addition to producing concrete that meets the requirements in **Table 1**, the test admixture must show corrosion-inhibiting performance as summarized in **Table 2** when tested in accordance with Test Method **G109** with reinforcing bar depths and mixture proportions as specified in Sections 10 and 11 of this specification, or in accordance with Test Method **G180** using 0.5 M NaCl as specified in Section 15.

TABLE 2 Corrosion-Inhibiting Requirements

When evaluated using Test Method G109	
Mean integrated macrocell current of test beams, C ^A	≤ 50
Mean corroded area of test beams, fraction of control ^A	≤ 1/3
When evaluated using Test Method G180	
Mean 1/Rp compared to control ^B	≤ 1/3

^A At completion of testing using Test Method **G109** and based on a minimum of three specimens of control and test concrete, and discarded specimens are not included.

^B Test Method **G180** at 0.5 M NaCl with four control and four test specimens.

5.2 The following requirements must be attained when Test Method **G109** is used:

5.2.1 At completion of testing (see **3.2.2**), the mean integrated macrocell current of the test beams must be less than or equal to 50 C.

5.2.2 At completion of testing, the mean corroded area of the top reinforcing steel in the test beams must be less than or equal to $\frac{1}{3}$ of the mean corroded area of the top steel in the control beams.

5.2.3 At the completion of testing, the mean chloride-ion content of the test beams must be greater than or equal to the critical chloride-ion content.

5.3 If Test Method **G180** is used, the average polarization resistance, R_p , of the test specimens with the corrosion inhibitor shall be at least 8 times greater than that of the control specimens.

6. Packaging and Package Marking

6.1 When the admixture is delivered in packages or containers, the proprietary name of the admixture and the net mass or volume shall be plainly marked thereon. Similar information shall be provided in the shipping information accompanying packaged or bulk shipments of admixtures.

7. Storage

7.1 Store the admixture so as to permit easy access for proper inspection and identification of each shipment, and in a suitable weather-tight building that will protect the admixture from dampness and freezing.

8. Sampling and Inspection

8.1 Sampling and inspection shall be in accordance with Specification **C494/C494M**.

9. Rejection

9.1 For initial compliance testing, the purchaser is allowed to reject the admixture if it fails to meet any of the applicable requirements for this specification.

9.2 For limited retesting, the purchaser is allowed to reject the admixture if it fails to meet any of the requirements of the Uniformity and Equivalence Section of Specification **C494/C494M** and of the applicable parts of **Table 1** of this standard.

9.3 An admixture stored at the point of manufacture, for more than 6 months prior to shipment, or an admixture in local storage in the hands of a vendor for more than 6 months, after completion of tests, shall be retested before use when requested by the purchaser and is allowed to be rejected if it fails to conform to any of the applicable requirements of this specification.

9.4 Packages or containers varying more than 5 % from the specified mass or volume are allowed to be rejected. If the average mass or volume of 50 packages taken at random is less than that specified, the entire shipment is allowed to be rejected.

9.5 When the admixture is to be used in non-air-entrained concrete, it shall be rejected when the purchaser desires if the

test concrete containing it has an air content greater than 3.5 %; when the admixture is to be used in air-entrained concrete, it shall be rejected when the purchaser desires if the test concrete containing it has an air content greater than 7.0 %.

TEST METHODS

NOTE 1—These tests are based on arbitrary stipulations which make possible highly standardized testing in the laboratory and are not intended to simulate actual job conditions.

10. Test Specimens

10.1 Two types of concrete are used to make test specimens. One, the control concrete, is made without the chloride-corrosion-inhibiting admixture. The other concrete, the test concrete, is made with the chloride-corrosion-inhibiting admixture. Do not use cement that causes the air content of the control concrete made without the subject admixture to exceed 3.0 %.

10.2 Make specimens for measuring compressive strength, flexural strength, resistance to freezing and thawing, and length change in accordance with Specification **C494/C494M**. Prepare three separate batches of each concrete mixture in accordance with Specification **C494/C494M**, and report the mean test results from the three batches.

10.3 When corrosion performance will be determined by Test Method **G109**, make specimens for corrosion testing and chloride-ion analysis from a separate batch of each concrete. For each concrete mixture, make at least three beams with steel reinforcement in accordance with Test Method **G109**, and make at least three beams of the same size without reinforcement (**Note 2**). The reinforcement shall be deformed bars designation No. 4 [13] with a nominal diameter of $\frac{1}{2}$ in. [12.7 mm] and the cover depth shall be 1.0 ± 0.1 in. [25 ± 3 mm]. Subject all beams to the same cyclic ponding and drying treatment described in Test Method **G109**.

NOTE 2—The reinforced beams are used to determine the macrocell corrosion current as a function of time, and the unreinforced beams are used to determine the chloride-ion content at specified times.

11. Specimen Preparation

11.1 *Mixture Proportions*—Proportion all concrete mixtures to conform to the requirements described in **11.1.1** through **11.1.5**. Unless otherwise specified, include the chloride-corrosion-inhibiting admixture with the first increment of mixing water that is added to the mixer.

11.1.1 The water-cement ratio shall be 0.50 ± 0.01 and the cement content shall be between 550 and 650 lb/yd³ [325 and 385 kg/m³]. The test and control mixtures are to have water and cement contents equivalent to within ± 1 % by mass.

11.1.2 Cement shall be Type II cement conforming to Specification **C150/C150M** or Type 1L blended cement conforming to Specification **C595/C595M**.

11.1.3 The grading of the coarse aggregate shall comply with size number 7 or 8 of Specification **C33**, that is, the nominal maximum size is $\frac{1}{2}$ in. [12.5 mm] or $\frac{3}{8}$ in. [9.5 mm]. For the first trial mixture, refer to ACI 211.1 for guidance on the amount of coarse aggregate to use based on the fineness modulus of the fine aggregate.

NOTE 3—Tabulated values of coarse aggregate content given in ACI