



Designation: **C1218/C1218M – 17** **C1218/C1218M – 20**

Standard Test Method for Water-Soluble Chloride in Mortar and Concrete¹

This standard is issued under the fixed designation C1218/C1218M; 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 provides procedures for the sampling and analysis of hydraulic-cement mortar or concrete for chloride that is water soluble under the conditions of test.

1.2 The text of this standard references notes and footnotes that provide explanatory information. These notes and footnotes shall not be considered as requirements of this standard.

1.3 The values stated in either SI units or inch-pound units are to be regarded separately as a standard. Within the text, the inch-pound units are shown in brackets. The values stated in each system are not exact equivalents; therefore, each system shall be used independently of the other.

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.*

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

[C42/C42M Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete](#)

[C114 Test Methods for Chemical Analysis of Hydraulic Cement](#)

[C125 Terminology Relating to Concrete and Concrete Aggregates](#)

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

~~E823~~[C823/C823M Practice for Examination and Sampling of Hardened Concrete in Constructions](#)

[C1084 Test Method for Portland-Cement Content of Hardened Hydraulic-Cement Concrete](#)

[D1193 Specification for Reagent Water](#)

[E11 Specification for Woven Wire Test Sieve Cloth and Test Sieves](#)

[E832 Specification for Laboratory Filter Papers](#)

3. Terminology

3.1 *Definitions:*

3.1.1 For definitions of terms used in this test method, refer to Terminology [C125](#).

4. Significance and Use

4.1 Water-soluble chloride, if present in sufficient amount, is capable of initiating or accelerating the corrosion of some metallic materials embedded in or contacting cementitious mixtures such as mortar and concrete. Chloride content, along with other factors, can be indicators for the possibility of corrosion of embedded metallic materials. This test method is used to determine the water-soluble chloride content in cementitious mixtures, either in new construction or existing structures.

NOTE 1—Water-soluble chloride content can vary with time. For example, water-soluble chloride content could increase due to additional chloride

¹ This test method is under the jurisdiction of ASTM Committee C09 on Concrete and Concrete Aggregates and is the direct responsibility of Subcommittee C09.69 on Miscellaneous Tests.

Current edition approved May 1, 2017; June 1, 2020. Published July 2017; July 2020. Originally approved in 1992. Last previous edition approved in 2015 as ~~C1218/C1218M – 15~~ C1218/C1218M – 17. DOI: ~~10.1520/C1218-C1218M-17~~ 10.1520/C1218_C1218M-20.

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

ingress. Alternatively, water-soluble chloride content could decrease due to chloride-binding or leaching.

4.1.1 Test conditions are capable of affecting water-soluble chloride determinations. Take caution when comparing results from this test method with those from other test methods.

4.2 Sulfides are known to interfere with the determination of chloride content. Blast-furnace slag aggregates and cements contain sulfide sulfur in concentrations that are capable of such interference and produce erroneously high test results. Treatment with hydrogen peroxide, as discussed in Test Methods **C114**, is used to eliminate such interference.

4.3 There are aggregates that contain chloride that is not available for corrosion. Such chloride will be detected by use of this test method.³

5. Apparatus

5.1 Sampling Equipment:

5.1.1 The apparatus required for obtaining samples by coring or sawing is described in Test Method **C42/C42M**.

5.1.2 Use the following apparatus for sampling by drilling (pulverization):

5.1.2.1 Rotary impact drill or drill with pulverizing bits.

5.1.2.2 Spoon or other suitable means to collect without contamination pulverized sample material produced by drilling.

5.1.2.3 Sample containers capable of maintaining samples in an uncontaminated state.

5.2 *Sample Processing Apparatus*—The apparatus required for processing samples shall be chosen for its suitability for the purposes of the investigation, and frequently includes a concrete saw and one or more pulverizers.

5.2.1 Samples more than 25 mm [1 in.] in maximum dimension shall be reduced in size by use of a jaw crusher or broken into smaller pieces by hammering carefully to avoid loss of smaller pieces.

5.2.2 Crush particles less than 25 mm [1 in.] in maximum dimension using a rotating-puck grinding apparatus, or by using a disc pulverizer, or mortar and pestle operated to restrict to negligible levels the loss of fine particles.

5.2.3 The 850- μm [~~No. 20~~](No. 20) sieve shall comply with Specification **E11**.

5.3 The apparatus required for the chloride determination step is given as the reference test method for chloride in Test Methods **C114**.

5.4 Glazed paper to minimize adherence of fine particles for use as described in ~~7-18.1~~.

6. Reagents

6.1 The reagents required for the chloride determination are given in the reference test method for chloride of Test Methods **C114**.

7. Sampling

7.1 Select the sample as required for the purpose of the investigation (**Note 2**).

NOTE 2—Because of the small nominal maximum size of the aggregate in a mortar, pieces of mortar having a mass of at least 10 g will be more representative of a much larger volume of mortar than would an equivalently sized sample of concrete. Practice **E823/C823/C823M** may be used as a guide for sampling.

7.1.1 Take concrete cores in accordance with Test Method **C42/C42M** unless otherwise specified (**Note 3**):

NOTE 3—Concrete cores taken in accordance with Test Method **C42/C42M** may be cut longitudinally to provide a 12-mm [$\frac{1}{2}$ -in.] thick section generally representative of the core, or cut laterally into 12-mm [$\frac{1}{2}$ -in.] thick discs representative of the concrete core at various depths. Experience has shown that the cooling water from core cutting will not dissolve a significant amount of the chloride.

7.1.2 Powdered concrete obtained by use of a rotary impact drill is frequently useful in determining chloride concentration with depth in bridge decks and pavements. When the nominal maximum coarse aggregate size is 25 mm [1 in.] or more such samples are unrepresentative. The data must be used with care or several samples combined. Procedures for this method of sampling are as follows:

7.1.2.1 Using the rotary impact drill, drill perpendicular to the concrete surface or parallel to the axis of a cored specimen to a specified depth or a depth sufficient to obtain a representative sample of at least 20 g of powdered material. To prevent sample contamination, avoid contact of sample with hands and other sources of perspiration. Clean all sampling tools prior to each sampling operation (**Note 4**). Do not use lubricants during drilling.

NOTE 4—Sampling tools may be cleaned with a brush, cloth, ethyl alcohol rinse, water rinse, or other method that will not contaminate the sample.

7.1.2.2 Transfer powdered sample into the sample container using a spoon or other suitable means.

³ For more information see “The Determination of the Chloride Content of Concrete,” by Brian B. Hope, John A. Page and John S. Poland, *Cement and Concrete Research*, Volume 15, Number 5, Pergamon Press, New York, September 1985, pp. 863–870. For more information, see Hope, B. B., Page, J. A., and Poland, J. S., “The Determination of the Chloride Content of Concrete,” *Cement and Concrete Research*, Vol 15, No. 5, Pergamon Press, New York, September 1985, pp. 863–870.

8. Sample Preparation

8.1 Pulverize the sample so that all the material will pass a 850- μm [~~No. 20~~](No. 20) sieve. Thoroughly blend the material by transferring it from one glazed paper to another at least ten times.

9. Procedure

9.1 Select a sample having a mass of approximately 10 g. Weigh the sample to the nearest 0.01 g and place it into a 250-mL beaker. Add 50 ± 1 mL of reagent water meeting Specification **D1193**, cover with a watch glass, bring to a boil and boil for 5 min. Allow to stand 24 h. Filter by gravity or suction through a fine-texture, Type II, Class G filter paper of Specification **E832**. Transfer the filtrate to a 250-mL beaker. Add 3 ± 0.1 mL of (1:1) nitric acid and add 3 ± 0.1 mL of hydrogen peroxide (30 % solution) to the filtrate. Cover the beaker with a watch glass and allow to stand for 1 to 2 min. Heat the covered beaker rapidly to boiling. Do not allow to boil for more than a few seconds. Remove from hot plate (**Note 5**). Proceed in accordance with the reference test method for chloride of Test Methods **C114**, starting with the procedure that follows removal of the sample from the hot plate in Test Methods **C114**.

NOTE 5—It is important to keep the beaker covered during heating and digestion to prevent the loss of chloride by volatilization.

10. Calculation

10.1 Calculate percent chloride by mass of mortar or concrete, by the reference test method for chloride given in Test Methods **C114**.

10.2 Other useful measures of chloride concentration can be obtained as follows:

10.2.1 For calculating kilograms of chloride per cubic meter [pounds of chloride per cubic yard] of concrete, multiply percent chloride by $D_1/100$ or $D_2/100$,

where:

D_1 = oven-dry density as determined in the section on Concrete Density in Test Method **C1084**, kg/m^3 [lb/yd^3].

D_2 = saturated-surface-dry density as determined in the section on Concrete Density in Test Method **C1084**, kg/m^3 [lb/yd^3], and

D_2 = saturated-surface-dry density as determined in the section on Concrete Density in Test Method **C1084**, kg/m^3 [lb/yd^3].

The report must state which density is used in the calculation.

10.2.2 For calculating percent chloride by mass of cement, multiply percent chloride by $100/P$,

where:

P = percent cement by mass in the mortar or concrete, as known or determined in accordance with Test Method **C1084**.

11. Precision and Bias

11.1 **Precision**—This precision statement is based on samples passing a 600- μm [No. 30] sieve instead of an 850- μm [No. 20] sieve and on a 1 min boil instead of a 5 min boil.

NOTE 6—It is the opinion of the committee that this difference in procedure should not significantly influence the precision beyond what is presented here.

11.1.1 **Single-Operator Precision**—The single-laboratory single-operator standard deviation has been found to be 0.0013 % chloride by mass of mortar or concrete. Therefore, results of two properly conducted tests in by the same laboratory operator on the same material are not expected to differ by more than 0.0037 %.⁴

11.1.2 **Multilaboratory Precision**—The multilaboratory standard deviation has been found to be 0.0037 % chloride by mass of mortar or concrete. Therefore, results of two properly conducted tests from two different laboratories on samples specimens of the same material are not expected to differ by more than 0.0106 % (Note 76).

NOTE 6—These precision statements apply to tests of samples prepared and ground by a single laboratory. The precision statements are based on samples passing a 600- μm (No. 30) sieve instead of an 850- μm (No. 20) sieve and on a 1 min boil instead of a 5 min boil. It is the opinion of the committee that this difference in procedure should not significantly influence the precision beyond what is presented here. Test results of concrete construction will vary depending upon the method of obtaining the sample and the size of the sample before it is crushed and reduced to pass the 850- μm [~~No. 20~~](No. 20) sieve or pulverized. The effect may be small for large concrete cores or from mortars sectioned vertically to appreciable for large aggregate concrete sampled by rotary impact drilling with small diameter drills. A copy of the research report used to develop the precision statements is available by request.⁵

11.2 **Bias**—The procedure in this test method has no bias because the value of water-soluble chloride is defined by the procedure.

⁴ These numbers represent the difference limits (d2s) as described in Practice **C670**.

⁵ Supporting data have been filed at ASTM International Headquarters and may be obtained by requesting Research Report RR:C09-1003. Contact ASTM Customer Service at service@astm.org.