
Standard Method of Test for

Determining Water-Soluble Chloride Ion Content in Soil

AASHTO Designation: T 291-22

Technically Revised: 2022

Technical Subcommittee: 1a, Soil and Unbound Recycled Materials



**American Association of State Highway and Transportation Officials
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1. SCOPE

1.1. This test method describes the procedures for sampling and testing a soil for chloride ion content. This standard is divided into two parts. The first part specifies the procedure for sampling and preparing the sample to size for testing. The second part delineates two test procedures (Methods A or B) for the determination of the water-soluble chloride ion content in soil. Two methods are given as follows:

	Section
Method A: (Mohr Titration Method)	(1 to 7) and (8 to 16)
Method B: (pH/mV Meter Method)	(1 to 7) and (17 to 28)

1.2. Method A is based on the Mohr procedure for determining chloride ion with silver nitrate. Method B utilizes a pH/mV meter. By comparing the mV readings to the calibration curve, determine the chloride ion content.

1.3. The values stated in SI units are to be regarded as the standard.

1.4. *The quality of the results produced by this standard are dependent on the competence of the personnel performing the procedure and the capability, calibration, and maintenance of the equipment used. Agencies that meet the criteria of R 18 are generally considered capable of competent and objective testing/sampling/inspection/etc. Users of this standard are cautioned that compliance with R 18 alone does not completely assure reliable results. Reliable results depend on many factors; following the suggestions of R 18 or some similar acceptable guideline provides a means of evaluating and controlling some of those factors.*

2. REFERENCED DOCUMENTS

- 2.1. AASHTO Standards:
- M 231, Weighing Devices Used in the Testing of Materials
 - M 339M/M 339, Thermometers Used in the Testing of Construction Materials
 - R 18, Establishing and Implementing a Quality Management System for Construction Materials Testing Laboratories

- R 90, Sampling Aggregate Products

2.2. *ASTM Standards:*

- D1129, Standard Terminology Relating to Water
- D1193, Standard Specification for Reagent Water
- E1, Standard Specification for ASTM Liquid-in-Glass Thermometers
- E11, Standard Specification for Woven Wire Test Sieve Cloth and Test Sieves
- E29, Standard Practice for Using Significant Digits in Test Data to Determine Conformance with Specifications
- E230/E230M, Standard Specification for Temperature-Electromotive Force (emf) Tables for Standardized Thermocouples
- E2877, Standard Guide for Digital Contact Thermometers

2.3. *International Electrotechnical Commission Standard:*

- IEC 60584-1: 2013 Thermocouples - Part 1: EMF Specifications and Tolerances

3. TERMINOLOGY

- 3.1. For definitions of terms used in this test method, refer to ASTM D1129.

PART I—INITIAL PREPARATION OF TEST SAMPLES

4. SCOPE

- 4.1. This method covers the dry preparation of soil and soil-aggregate samples, as received from the field, for use in determining the chloride content.
- 4.2. The following applies to all specified limits in this standard: For the purpose of determining conformance with these specifications, an observed value or calculated value shall be rounded off “to the nearest unit” in the last right-hand place of figures used in expressing the limiting value, in accordance with ASTM E29.

5. APPARATUS

- 5.1. *Balance*—The balance shall have sufficient capacity, be readable to 0.1 percent of the sample mass, or better, and conform to the requirements of M 231.
- 5.2. *Drying Apparatus*—Any suitable device capable of drying samples at a temperature not exceeding 60°C (140°F). Oven(s) for heating and drying shall be capable of operation at the temperatures required, between 25 to 120°C (77 to 248°F), within ±5°C (±9°F), as corrected, if necessary, by standardization. More than one oven may be used, provided each is used within its proper operating temperature range. The thermometer used for monitoring the temperature of the oven, or for measuring the temperature of materials, regardless of drying apparatus used, shall meet the requirements of M 339M/M 339 with a temperature range of at least 0 to 130°C (32 to 266°F), and an accuracy of ±1.25°C (±2.25°F) (see Note 1).
- Note 1**—Thermometer types suitable for use include ASTM E1 mercury thermometers; ASTM E2877 digital metal stem thermometer; ASTM E230/E230M thermocouple thermometer, Type J or K, Special Class, Type T any Class; IEC 60584 thermocouple thermometer, Type J or K, Class 1, Type T any Class; or dial gauge metal stem (bi-metal) thermometer.

- 5.3. *Sieves*—A series of sieves of the following sizes: 6.3-mm ($\frac{1}{4}$ -in.), 4.75-mm (No. 4), 2.00-mm (No. 10) sieve, and a pan. The sieve shall conform to ASTM E11 (Note 2).
Note 2—The sieve sizes that have an opening size of 6.3 mm ($\frac{1}{4}$ in.) or larger shall conform to the requirements specified in ASTM E11, excluding Column No. 7. This exclusion permits the use of heavier screens in nonstandard frames that are larger than the 203.2 mm (8 in.) round frames.
- 5.4. *Pulverizing Apparatus*—Either a mortar and rubber-covered pestle or any device suitable for breaking up the aggregations of soil particles without reducing the size of the individual grains (Note 3).
Note 3—Other types of apparatus are satisfactory if the aggregations of soil particles are broken up without reducing the size of the individual grains.
- 5.5. *Sample Splitter*—A suitable riffle sampler or sample splitter for proportional splitting of the sample and capable of obtaining representative portions of the sample without appreciable loss of fines. The width of the container used to feed the riffle sampler splitter should be equal to the total combined width of the riffle chutes. Proportional splitting of the sample on a canvas cloth is also permitted.

6. SAMPLE SIZE

- 6.1. The amount of soil material required to perform the individual test is as follows (see R 90):

Test	Approx. Mass (g)	Sieve Size Finer Than:
Chlorides	250	2.00 mm (No. 10)

7. INITIAL PREPARATION OF TEST SAMPLES

- 7.1. The sample as received from the field may be dried in air or a drying apparatus not exceeding 60°C (140°F) prior to sample selection (Note 4). A representative test sample of the amount required to perform the tests shall then be obtained with the sampler, or by splitting or quartering. The aggregations of soil particles shall then be broken up in the pulverizing apparatus in such a way as to avoid reducing the natural size of the individual particles.
Note 4—Samples dried in an oven or other drying apparatus at a temperature not exceeding 60°C (140°F) are considered to be air dried.
- 7.2. The portion of the sample selected for chloride testing shall be separated into fractions by one of the following methods:
- 7.2.1. *Alternate Method Using 2.00-mm (No. 10) Sieve*—The dried sample shall be separated into two fractions using a 2.00-mm sieve. The fraction retained on this sieve shall be ground with the pulverizing apparatus until the aggregation of soil particles is separated into individual grains. The ground soil shall then be separated into two fractions using the 2.00-mm sieve.
- 7.2.2. *Alternate Method Using 4.75-mm and 2.00-mm (No. 4 and No. 10) Sieves*—The dried sample shall be separated into two fractions using a 4.75-mm sieve. The fraction retained on this sieve shall be ground with the pulverizing apparatus until the aggregation of soil particles is separated into individual grains and again separated on the 4.75-mm sieve. The fraction passing the 4.7-mm sieve shall be mixed thoroughly and, by the use of the sampler or by splitting and quartering, a representative portion adequate for testing shall be obtained. This split-off portion shall then be separated on the 2.00-mm sieve and processed as in Section 7.2.1.