



Designation: C 1202 – 97

Standard Test Method for Electrical Indication of Concrete's Ability to Resist Chloride Ion Penetration¹

This standard is issued under the fixed designation C 1202; 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 of the electrical conductance of concrete to provide a rapid indication of its resistance to the penetration of chloride ions. This test method is applicable to types of concrete where correlations have been established between this test procedure and long-term chloride ponding procedures such as those described in AASHTO T 259. Examples of such correlations are discussed in Refs 1-5.²

1.2 The values stated in inch-pound units are to be regarded as the standard, except where SI units are given first followed by inch-pound units in parentheses. The values given in parentheses are for information only.

1.3 *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 practices and determine the applicability of regulatory limitations prior to use.*

2. Referenced Documents

2.1 ASTM Standards:

- C 31 Practice for Making and Curing Concrete Test Specimens in the Field³
- C 42 Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete³
- C 192 Practice for Making and Curing Concrete Test Specimens in the Laboratory³
- C 670 Practice for Preparing Precision and Bias Statements for Test Methods for Construction Purposes³

2.2 AASHTO Standard:

- T 259 Method of Test for Resistance of Concrete to Chloride Ion Penetration⁴

ride Ion Penetration⁴

3. Summary of Test Method

3.1 This test method consists of monitoring the amount of electrical current passed through 2-in. (51-mm) thick slices of 4-in. (102-mm) nominal diameter cores or cylinders during a 6-h period. A potential difference of 60 V dc is maintained across the ends of the specimen, one of which is immersed in a sodium chloride solution, the other in a sodium hydroxide solution. The total charge passed, in coulombs, has been found to be related to the resistance of the specimen to chloride ion penetration.

4. Significance and Use

4.1 This test method covers the laboratory evaluation of the electrical conductance of concrete samples to provide a rapid indication of their resistance to chloride ion penetration. In most cases the electrical conductance results have shown good correlation with chloride ponding tests, such as AASHTO T259, on companion slabs cast from the same concrete mixtures (Refs 1-5).

4.2 This test method is suitable for evaluation of materials and material proportions for design purposes and research and development.

4.3 The numerical results (total charge passed, in coulombs) from this test method must be used with caution, especially in applications such as quality control and acceptance testing. The qualitative terms in the right-hand column of Table 1 should be used in most cases.

4.4 Care should be taken in interpreting results of this test when it is used on surface-treated concretes, for example, concretes treated with penetrating sealers. The results from this test on some such concretes indicate low resistance to chloride ion penetration, while 90-day chloride ponding tests on companion slabs show a higher resistance.

4.5 The details of the test method apply to 4-in. (102-mm) nominal diameter specimens. This includes specimens with actual diameters ranging from 3.75 in. (95 mm) to 4.0 in. (102

¹ This test method is under the jurisdiction of ASTM Committee C-9 on Concrete and Concrete Aggregates and is the direct responsibility of Subcommittee C09.66 on Concrete's Resistance to Fluid Penetration.

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² The boldface numbers in parentheses refer to the list of references at the end of this standard.

³ *Annual Book of ASTM Standards*, Vol 04.02.

⁴ *Methods of Sampling and Testing*, 1986, American Association of State Highway and Transportation Officials, 444 N. Capitol St., NW, Washington, DC 20001.

TABLE 1 Chloride Ion Penetrability Based on Charge Passed (1)1

Charge Passed (coulombs)	Chloride Ion Penetrability
>4,000	High
2,000-4,000	Moderate
1,000-2,000	Low
100-1,000	Very Low
<100	Negligible

mm). Other specimen diameters may be tested with appropriate changes in the applied voltage cell design (see 7.5 and Fig. 1).

4.5.1 For specimen diameters other than 3.75 in. (95 mm), the test result value for total charge passed must be adjusted following the procedure in 11.2. For specimens with diameters less than 3.75 in. (95 mm), particular care must be taken in coating and mounting the specimens to ensure that the conductive solutions are able to contact the entire end areas during the test.

4.6 Sample age may have significant effects on the test results, depending on the type of concrete and the curing procedure. Most concretes, if properly cured, become progressively and significantly less permeable with time.

5. Interferences

5.1 This test method can produce misleading results when calcium nitrite has been admixed into a concrete. The results from this test on some such concretes indicate higher coulomb values, that is, lower resistance to chloride ion penetration, than from tests on identical concrete mixtures (controls) without calcium nitrite. However, long-term chloride ponding tests indicate the concretes with calcium nitrite were at least as resistant to chloride ion penetration as the control mixtures.

NOTE 1—Other admixtures might affect results of this test similarly. Long term ponding tests are recommended if an admixture effect is suspected.

5.2 Since the test results are a function of the electrical resistance of the specimen, the presence of reinforcing steel or other embedded electrically conductive materials may have a significant effect. The test is not valid for specimens containing reinforcing steel positioned longitudinally, that is, providing a continuous electrical path between the two ends of the specimen.

6. Apparatus

6.1 Vacuum Saturation Apparatus (see Fig. 2 for example):

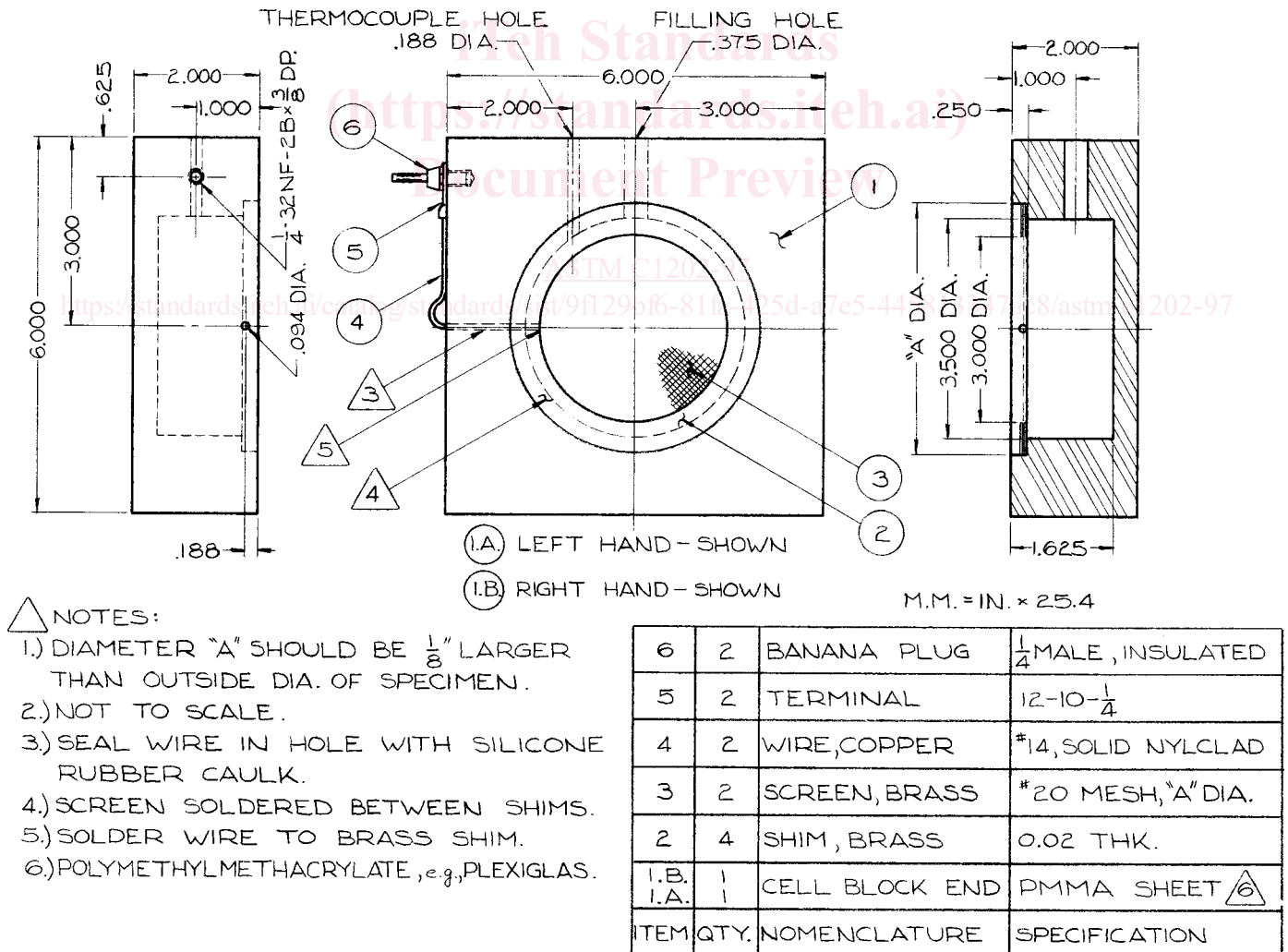


FIG. 1 Applied Voltage Cell (construction drawing)

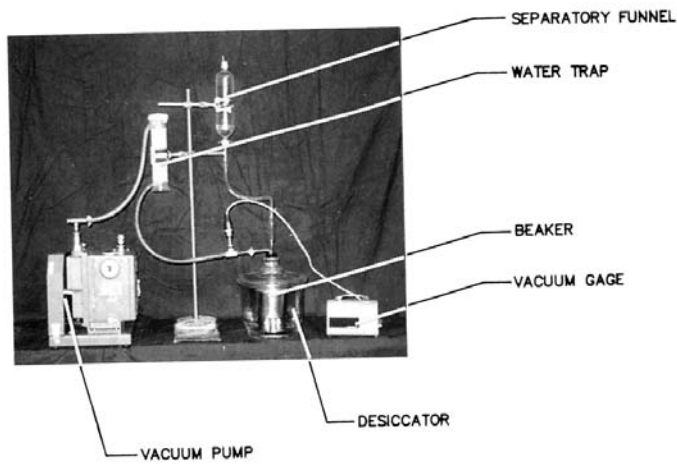


FIG. 2 Vacuum Saturation Apparatus

6.1.1 *Separatory Funnel*, or other sealable, bottom-draining container with a minimum capacity of 500 mL.

6.1.2 *Beaker* (1000 mL or larger) or other container—Capable of holding concrete specimen(s) and water and of fitting into vacuum desiccator (see 6.1.3).

6.1.3 *Vacuum Desiccator*—250-mm (9.8-in.) inside diameter or larger. Desiccator must allow two hose connections through a rubber stopper and sleeve or through a rubber stopper only. Each connection must be equipped with a stopcock.

6.1.4 *Vacuum Pump*—Capable of maintaining a pressure of less than 1 mm Hg (133 Pa) in desiccator.

NOTE 2—Since vacuum will be drawn over water, pump should be protected with a water trap, or pump oil should be changed after each operation.

6.1.5 *Vacuum Gage or Manometer*—Accurate to ± 0.5 mm Hg (± 66 Pa) over range 0–10 mm Hg (0–1330 Pa) pressure.

6.2 *Coating Apparatus and Materials:*

6.2.1 *Coating*—Rapid setting, electrically nonconductive, capable of sealing side surface of concrete cores.

6.2.2 *Balance or Scale, Paper Cups, Wooden Spatulas, and Disposable Brushes*—For mixing and applying coating.

6.3 *Specimen Sizing Equipment* (not required if samples are cast to final specimen size).

6.3.1 *Movable Bed Water-Cooled Diamond Saw or Silicon Carbide Saw.*

7. Reagents, Materials, and Test Cell

7.1 *Specimen-Cell Sealant*—Capable of sealing concrete to poly (methyl methacrylate), for example, Plexiglas, against water and dilute sodium hydroxide and sodium chloride solutions at temperatures up to 200°F (90°C); examples include RTV silicone rubbers, silicone rubber caulking, other synthetic rubber sealants, silicone greases, and rubber gaskets.

7.2 *Sodium Chloride Solution*—3.0 % by mass (reagent grade) in distilled water.

7.3 *Sodium Hydroxide Solution*—0.3 N (reagent grade) in distilled water.

7.4 *Filter Papers*—No. 2, 90-mm (3.5-in.) diameter (not required if rubber gasket is used for sealant (see 7.1) or if sealant can be applied without overflowing from shim onto mesh).

7.5 *Applied Voltage Cell* (see Fig. 1 and Fig. 3)—Two symmetric poly (methyl methacrylate) chambers, each containing electrically conductive mesh and external connectors. One design in common use is shown in Fig. 1 and Fig. 3. However, other designs are acceptable, provided that overall dimensions (including dimensions of the fluid reservoir) are the same as shown in Fig. 1 and width of the screen and shims are as shown.

7.6 *Temperature Measuring Device* (optional)—30 to 250°F (0 to 120°C) range.

7.7 *Voltage Application and Data Readout Apparatus*—Capable of holding 60 ± 0.1 V dc across applied voltage cell over entire range of currents and of displaying voltage accurate to ± 0.1 V and current to ± 1 mA. Apparatus listed in 7.7.1-7.7.5 is a possible system meeting this requirement.

7.7.1 *Voltmeter*—Digital (DVM), 3 digit, minimum 0–99.9 V range, rated accuracy ± 0.1 %.

7.7.2 *Voltmeter*—Digital (DVM), 4½ digit, 0–200 mV range, rated accuracy ± 0.1 %.

7.7.3 *Shunt Resistor*—100 mV, 10A rating, tolerance ± 0.1 %. Alternatively, a 0.01 Ω resistor, tolerance ± 0.1 %, may be used, but care must be taken to establish very low resistance connections.

7.7.4 *Constant Voltage Power Supply*—0–80 V dc, 0–2 A, capable of holding voltage constant at 60 ± 0.1 V over entire range of currents.

7.7.5 *Cable*—Two conductor, No. 14 (1.6 mm), insulated, 600 V.

8. Test Specimens

8.1 Sample preparation and selection depends on the purpose of the test. For evaluation of materials or their proportions, samples may be (a) cores from test slabs or from large diameter cylinders or (b) 4-in. (102-mm) diameter cast cylinders. For evaluation of structures, samples may be (a) cores from the structure or (b) 4-in. (102-mm) diameter cylinders cast and cured at the field site. Coring shall be done with a drilling rig equipped with a 4-in. (102-mm) diameter diamond-dressed core bit. Select and core samples following procedures in Test Method C 42. Cylinders cast in the laboratory shall be prepared following procedures in Practice C 192. When cylinders are cast in the field to evaluate a structure, care must be taken that the cylinders receive the same treatment as the

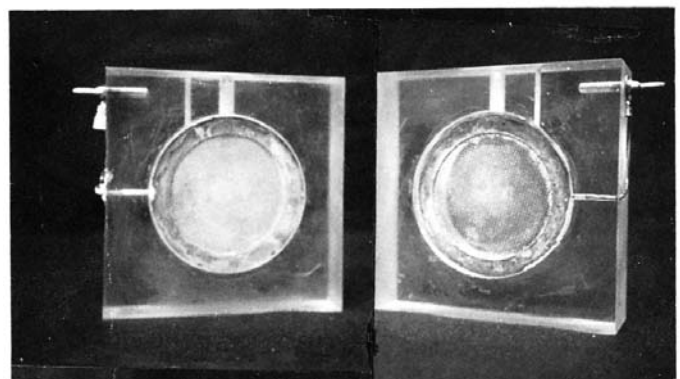


FIG. 3 Applied Voltage Cell-Face View