Standard Method of Test for

Predicting Chloride Penetration of Hydraulic Cement Concrete by the Rapid Migration Procedure

AASHTO Designation: T 357-15 (2019)¹ Technical Subcommittee: 3c, Hardened Concrete Release: Group 1 (April)



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1. SCOPE

1.1. This procedure is for the rapid evaluation of chloride penetration resistance of concrete, from nonsteady-state migration experiments.

2. REFERENCED DOCUMENTS

2.1. *AASHTO Standards*:

- R 39, Making and Curing Concrete Test Specimens in the Laboratory
- T 23, Making and Curing Concrete Test Specimens in the Field
- T 24M/T 24, Obtaining and Testing Drilled Cores and Sawed Beams of Concrete
- T 277, Electrical Indication of Concrete's Ability to Resist Chloride Ion Penetration

2.2. *ASTM Standard*:

■ D1193, Standard Specification for Reagent Water

3. TERMINOLOGY

- 3.1. *Definitions*:
- 3.1.1. *chloride penetration depth*—the distance between the surface exposed to chloride solution and the chloride penetration front where the color changes from white to brown after spraying of 0.1N silver nitrate solution.
- **3.1.2.** *diffusion*—the movement of molecules or ions under a gradient of concentration, or more strictly speaking, chemical potential, from a high concentration zone to a low concentration zone.
- 3.1.3. *migration*—the movement of ions under the action of an external electrical field.

4. SUMMARY OF TEST METHOD

4.1. This test method uses electrical migration to accelerate the movement of chloride ions into a concrete specimen and a colorimetric indicator to measure the extent of chloride penetration. An

external potential is applied axially across the specimen to force the chloride ions to migrate into the specimen. After a defined test duration, the specimen is axially split and a silver nitrate solution (colorimetric indicator for chloride) is sprayed on one of the fresh split surfaces. The chloride penetration depth is measured from the extent of the visible white silver chloride precipitate. From this penetration depth, the rate of chloride ion penetration is determined and used to rate the concrete.

5. SIGNIFICANCE AND USE

5.1. The results of this test can be used to rate concrete according to the relative ease with which chloride ions can penetrate into the concrete. This in turn gives an indication of the potential for corrosion of reinforcing steel due to chloride intrusion.

6. APPARATUS

- 6.1. Water-cooled diamond saw, capable of making cuts perpendicular to the axis of 100-mm diameter concrete cylinders or cores.
- 6.2. *Conditioning Equipment:*
- 6.2.1. *Vacuum Desiccator*—250-mm diameter or larger (capable of containing at least three specimens), allowing two hose connections, each of which must be equipped with a stopcock.
- 6.2.2. *Vacuum Pump*—Capable of maintaining a pressure of less than 5 kPa (37 mmHg) in the desiccator.

Note 1—Because the vacuum will be drawn over water, the pump should be protected with a cold trap, or the pump oil should be changed after each use.

- 6.2.3. *Vacuum Gauge or Manometer*—Capable of reading vacuum levels as low as 1 kPa (5 mmHg).
- 6.3. Migration apparatus shown schematically in Figure 1 (Note 1). Detailed drawings may be found in Annex A1.



Figure 1—Schematic of Migration Apparatus

6.3.1. Silicon Rubber Sleeve—Inner/outer diameter 100/115 mm, about 150 mm long.