

Florida Method of Test For Concrete Resistivity as an Electrical Indicator of its Permeability

Designation: FM 5-578

1. SCOPE

1.1 This non-destructive laboratory test method measures the electrical resistivity of water-saturated concrete and provides an indication of its permeability. The test result is a function of the electrical resistance of the specimen.

2. APPLICABILITY

2.1 This test method is applicable to concretes formulated with various combinations of cementitious materials (fly ash, slag, silica fume, or metakaolin), but can produce misleading results when calcium nitrite, reinforcing steel, conductive fibers or other embedded electrically conductive materials are present in the concrete. This test method is not applicable to cores, as these can be contaminated with conductive chloride ions.

3. APARATUS

3.1 Surface Resistivity meter with a Wenner linear four-probe array. The meter should have a range of 0 to 100 KOhm-cm, with a resolution of 0.1 KOhm-cm and an Accuracy of +/- 2% of reading. The Wenner probe array spacing should be set at 1.5 inches (38.1 mm).

3.2 Test Specimen Molds - 4.0 x 8.0 inches (100 x 200 mm) cylindrical molds meeting the requirements of ASTM C-470.

4. SAMPLE PREPARATION

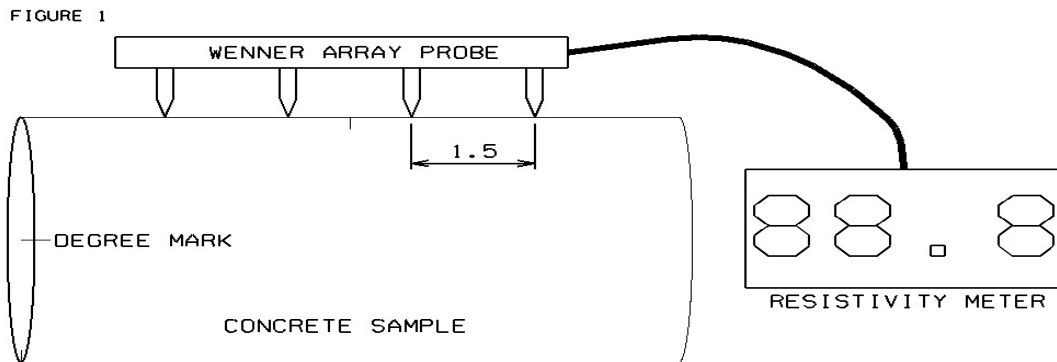
4.1 Cast three 4.0 x 8.0 inches concrete cylinder specimens, as identified in 3.2, in accordance with ASTM C192 or ASTM C31.

4.2 All specimens shall be moist cured in accordance with ASTM C-192, except as noted below, from the time of molding to testing in a moist room. The specimens should not be cured in a saturated lime water tank, as this curing condition decreases the resistivity of the concrete.

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- 4.3 Allow the specimens to cure in the molds for approximately 24 +/- 8 hours at 73 +/- 3°F (23 +/- 2°F) before removing from the molds. Immediately after demolding, make four indelible marks on the top circular face of the specimen marking the 0, 90, 180, and 270 degree points of the circumference of the circle. Extend the marks into the longitudinal sides of the specimens. The marks serve as visual aids during the resistivity readings.

5. PROCEDURE

- 5.1 Place Wenner array probe longitudinally on the side of the specimen at the 0 degree mark. Ensure the probe is centered on the side of the specimen (Figure 1). Make sure all the points of the array probe are in contact with the concrete. Wait 3 to 5 seconds or until a stable reading is obtained, record the resistivity measurement on the form shown in Table 1. Negative, unstable or obviously erroneous readings are indicative of problems with the instrument or the probe array, which need to be addressed before proceeding. A reading is considered unstable if it drifts by more than 1 kOhm-cm.
- 5.2 Repeat step 5.1 for the 90, 180, and 270 degree marks.
- 5.3 Repeat steps 5.1 and 5.2 for the same specimen.
- 5.4 Average all eight readings obtained in steps 5.1 to 5.3 for this specimen. Record this value on the form shown in Table 1.
- 5.5 Repeat steps 5.1 to 5.4 for the remaining two specimens.
- 5.6 Calculate average resistivity for the set of samples by averaging the average resistivity of the three specimens. Record this value on the form shown in Table 1. Use table 2 to characterize the permeability of the concrete.



6. Report

Mix Description:

Cast Date:

Test Date:

Age:

Technician Name:

Table 1 Surface Resistivity Readings									
Sample	0°	90°	180°	270°	0°	90°	180°	270°	Average
A									
B									
C									
									Set Average

Table 2 Surface Resistivity - Permeability	
Chloride Ion Permeability	Surface Resistivity Test kΩ-cm
High	< 12
Moderate	12 – 21
Low	21 – 37
Very Low	37 – 254
Negligible	> 254

Permeability Based on Surface Resistivity:

7. REFERENCE

- 7.1 Chini, A., ““Determination of Acceptance Permeability Characteristics for Performance-Related Specifications for Portland Cement Concrete,” BC 354-41, School of Building Construction, University of Florida, 2003. Table 5.9 from this report is partially reproduced here for information purposes only.

Table 5.9 Equivalent Surface Resistivity Values Rounded for Utilization

Chloride Ion Permeability	RCP Test Charged Passed (coulombs)	Surface Resistivity Test 28 day test k Ω -cm
High	> 4,000	< 12
Moderate	2,000-4,000	12 - 21
Low	1,000-2,000	21 - 37
Very Low	100-1,000	37 - 254
Negligible	< 100	> 254

8. PRECISION AND BIAS

- 8.1 Single-Operator Precision – the single operator coefficient of variation of a single test result has been found to be 8.2%. Therefore, the results of two properly conducted tests by the same operator on concrete samples from the same batch and the same diameter should not differ by more than 23.1%.
- 8.2 Bias – The procedure of this test method for measuring the resistance of concrete to chloride ion penetration has no bias because the value of this resistance can be defined only in terms of a test method.