

PROOVE'it

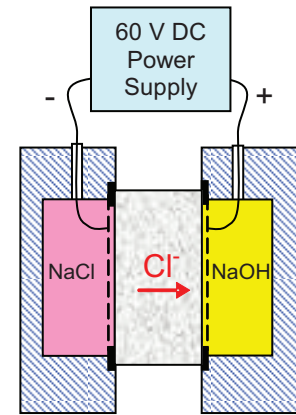
Purpose

The **PROOVE'it** system is used to evaluate the resistance of concrete to the ingress of chloride ions in two ways:

- By determining how easy it is to force chloride ions into saturated concrete by applying an electrical potential across a test specimen in accordance with AASHTO T 277 or ASTM C1202. This is known as the “Coulomb Test” or the “Rapid Chloride Permeability Test (RCPT).”
- By measuring the penetration depth of chloride ions, after an electric potential has been applied to the specimen in accordance with NORDTEST BUILD 492 (Chloride Migration Coefficient from Non-Steady State Migration Experiments) to determine the “Chloride Migration Coefficient,” which can be used to estimate the chloride diffusion coefficient for service life calculations.

Principle

A water-saturated concrete specimen, 100 mm diameter and 50 mm thick, is positioned in a cell (right and page 104) containing fluid reservoirs on both sides. For the RCPT or Coulomb Test, one reservoir is filled with a 3 % NaCl solution and the other with a 0.3N NaOH solution. A potential of 60 VDC is applied across the cell. The negative terminal is connected to the electrode in the reservoir with the NaCl solution and the positive terminal is connected to the electrode in the NaOH solution. The negatively charged chloride ions will migrate towards the positive terminal.



The more permeable is the concrete, the more chloride ions will migrate through the specimen, and a higher current will be measured. The current is measured for 6 hours. The area under the curve of current versus time is determined, which represents the total charge or Coulombs passed across the specimen. The Coulomb values are used for classifying the concrete as follows (ASTM C1202):

Coulombs	Permeability Class	Typical of
>4000	High	$w/c^* > 0.5$
4000-2000	Moderate	$w/c = 0.4$ to 0.5
2000-1000	Low	$w/c < 0.4$
1000-100	Very Low	Latex-modified concrete
<100	Negligible	Polymer concrete

* w/c = water-cement ratio

Alternatively, for the NT BUILD 492 migration test, the reservoir surrounding the negative terminal contains a 10 % NaCl solution and the reservoir surrounding the positive terminal contains a 0.3N NaOH solution. A 30 VDC potential is applied across the specimen, and the initial current is measured. Based on the initial current, the test voltage and test duration are selected accordingly. For example, if the initial current is between 120 and 180 mA, the test voltage is reduced to 15 VDC and the test duration is 24 h, but if the initial current is less than 5 mA, the test voltage is 60 VDC and test duration is 96 h. After the test is completed, the specimen is split, and the chloride ion penetration is measured by spraying the split surface with a 0.1 M silver nitrate solution. From the penetration depth and test conditions, the chloride ion migration coefficient is calculated.

The chloride diffusion coefficient can be determined directly by profile grinding (page 99) and testing for chloride ion content after ponding with a NaCl solution, in accordance with NT BUILD 443 “Concrete, Hardened: Accelerated Chloride Penetration” or ASTM C1556 “Test Method for Determining the Apparent Chloride Diffusion Coefficient of Cementitious Mixtures by Bulk Diffusion.” The required ponding period is at least 35 days. A correlation can be developed between the chloride ion migration coefficient and the diffusion coefficient.

Accuracy and Variability

At 60 VDC, the accuracy of the **PROOVE'it** microprocessor power supply is within ± 0.1 mA for a current between 30 mA and 300 mA. The repeatability of the RCPT or Coulomb Test is reported to

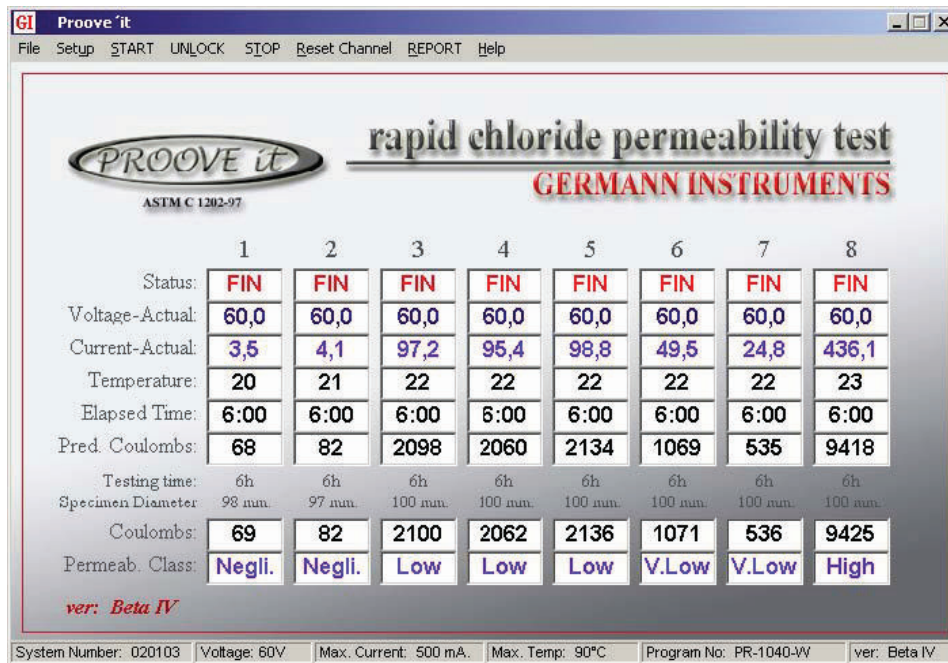
be about 12 % (ASTM C1202), and the repeatability of the migration test is reported to be about 9 % (NT BUILD 492).

PROOVE'it System Features

- Windows®-based software for testing and report preparation
- Computer controlled microprocessor power supply
 - Testing up to 8 cells simultaneously
 - Voltage settings of 10, 20, 30, 40, 50, and 60 VDC
 - Programmable testing time as required
 - Temperature measurement and recording
 - Cyclic testing option for effect of curing duration
 - Measure concrete conductivity at 60 VDC in 1 minute
 - Predicted 6-h Coulomb value every 5 minutes
 - Documentation of each test result
 - Easy to assemble, simple to maintain, watertight cells

A complete system composed of coring and slicing equipment, vacuum desiccator, vacuum pump, watertight test cells, microprocessor power supply, and software are shown on the following page.

Testing Example



	1	2	3	4	5	6	7	8
Status:	FIN	FIN	FIN	FIN	FIN	FIN	FIN	FIN
Voltage-Actual:	60,0	60,0	60,0	60,0	60,0	60,0	60,0	60,0
Current-Actual:	3,5	4,1	97,2	95,4	98,8	49,5	24,8	436,1
Temperature:	20	21	22	22	22	22	22	23
Elapsed Time:	6:00	6:00	6:00	6:00	6:00	6:00	6:00	6:00
Pred. Coulombs:	68	82	2098	2060	2134	1069	535	9418
Testing time:	6h	6h	6h	6h	6h	6h	6h	6h
Specimen Diameter:	98 mm.	97 mm.	100 mm.	100 mm.	100 mm.	100 mm.	100 mm.	100 mm.
Coulombs:	69	82	2100	2062	2136	1071	536	9425
Permeab. Class:	Negli.	Negli.	Low	Low	Low	V.Low	V.Low	High

ver: Beta IV

System Number: 020103 | Voltage: 60V | Max. Current: 500 mA. | Max. Temp: 90°C | Program No: PR-1040-WV | ver: Beta IV

PROOVE'it screen-shot after completion of 8 simultaneous tests according to ASTM C1202

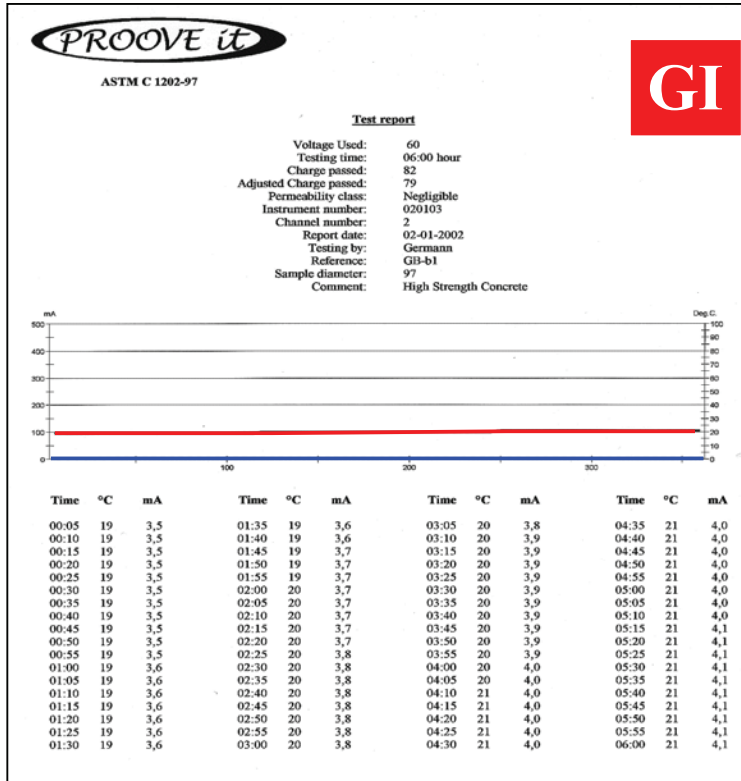
Pointing with the mouse arrow on any of the windows will produce a pop-out window with explanatory notes for that window. The “Status” line for the eight cells is either OFF, ON or FIN, as shown after the tests have been completed. The “Voltage-Actual” line indicates the test voltage, and the “Current-Actual” line indicates the instantaneous current during testing. The “Temperature” line indicates the instantaneous temperature in the reservoir solutions during testing, and “Elapsed Time” indicates the time since start-up of each cell. The “Pred. Coulombs” line indicates the predicted Coulombs at 6 hours, which are estimated after every 5 minutes of testing. The “Testing time” indicates the selected testing time, and the “Specimen Diameter” indicates the actual diameter of the specimen. The “Coulombs” line indicates the measured Coulombs at any time during testing.

The last line shows the “chloride ion permeability” classification according to ASTM C1202, as indicated on page 101. In arriving at the classification, the displayed Coulomb values are adjusted to a standard specimen diameter of 95 mm, as required by ASTM C1202. As an example, cell number 3 containing a specimen with a diameter of 100 mm has been measured to have 2100 Coulombs. Adjusted for a diameter of 95 mm, the Coulomb value is 1898 and, according ASTM C1202, the permeability class is LOW and not MODERATE as evaluated from the measured Coulomb value.

PROOVE'it

Sample Test Report

The following figure shows an example test report. In this case, the report is for Cell #2 shown on the previous page. The top of the report summarizes the test result. The graph shows the measured solution temperature (—) and current (—), and the table shows the temperature and current at 5-min intervals.



The PROOVE'it System



The **PROOVE'it** system is shown with its main components: At the front is the **PROOVE'it** microprocessor power supply connected to one **PROOVE'it** test cell.

Optional Items: At the back is the **CEL-100 CORECASE** for coring with an electric drill, a diamond saw for trimming the core, a vacuum desiccator, and a vacuum pump.

Note: A computer is also required with the following minimum requirements: 75 MHz Pentium, 32 MB RAM, 1.0 GB hard drive, and Windows 95, 98, NT, 2000 or XP.

The PROOVE'it Cells

Two types of cells are available, the PR-1000 cell and the PR-1100 cell, shown below. The PR-1000 cell is the standard cell. The PR-1100 is supplied with cooling fins, which are needed if the temperature is required to be kept constant, as for example, for chloride ion migration testing using the NT BUILD 492 test method.

The cell is sealed by tightening the four corner bolts, which squeezes the gaskets against the specimen.

The following gaskets are available for different specimen diameters:

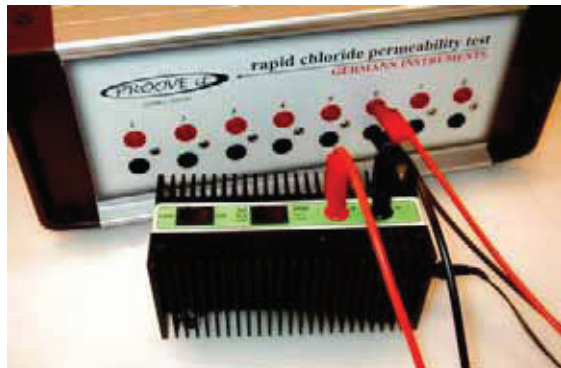
Specimen Diameter	Ordering #
104 to 102 mm	PR-1010A
101 to 97 mm	PR-1010B
96 to 93 mm	PR-1010C



Two types of PROOVE'it cells: standard PR-1000 cell (left) and PR-1100 cell with cooling ribs (right)

The cells are supplied with PR-1010B gaskets, unless otherwise specified. The PR-1010B gaskets match the 100-mm core diameter produced by the CEL-100 coring equipment (see page 29).

The PR-1055 Verification Unit



The PR-1055 verification unit is used to verify that the microprocessor controlled power supply is working properly. The unit is connected to line power, 110 VAC or 220 VAC. Each channel of the PROOVE'it power supply is set up for testing at a selected voltage and connected to the verification unit. When the PROOVE'it system is operating properly, the "Current-Actual" indicated on the computer screen (see page 102) should be within 30 mA ± 0.1 mA or 300 mA ± 0.1 mA for the two switch settings on the verification unit.

PROOVE'it Ordering Numbers*

Item	Order #
PROOVE'it cell, standard	PR-1000
PROOVE'it cell, with cooling ribs	PR-1100
Red connecting cord	PR-1001
Black connecting cord	PR-1002
Spare mesh for PROOVE'it cell	PR-1003
Temperature probe	PR-1005
17 mm (2) wrenches for bolts	PR-1006
300 mL bottle of 3.0 % NaCl solution	PR-1020
300 mL bottle of 0.3N NaOH solution	PR-1030
PROOVE'it software for Windows®	PR-1040
PROOVE'it power supply for 8 cells	PR-1050

Item	Order #
Power cable for power supply 230 VAC	PR-1064
Power cable for power supply 110 VAC	PR-1065
RS-232C serial cable for power supply	PR-1066
PROOVE'it manual	PR-1090
Verification unit	PR-1055
Vacuum desiccator for max.16 specimens	PR-1070
Vacuum pump, < 10 mm Hg (1.3 kPa)	PR-1081
CORECASE for 100 mm cores	CEL-100
Drilling machine, 1150W	CC-29
Diamond saw for trimming cores	PR-1060

*These items can be selected as needed to assemble a system to meet the purchaser's requirements.

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