ASTM C 1202: Chloride Permeability
Actual ASTM Method

Designation: C1202 – 10

Standard Test Method for Electrical Indication of Concrete's Ability to Resist Chloride Ion Penetration[1]

This standard is issued under the fixed designation C1202; 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:*[3]

C31/C31M Practice for Making and Curing Concrete Test Specimens in the Field

C42/C42M Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete

C192/C192M Practice for Making and Curing Concrete Test Specimens in the Laboratory

C670 Practice for Preparing Precision and Bias Statements for Test Methods for Construction Materials

2.2 *AASHTO Standard:*

T 259 Method of Test for Resistance of Concrete to Chloride Ion Penetration[4]

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 T 259, 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 Sample age has 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.

4.4 This test method was developed originally for evaluations of alternative materials, but in practice its use has evolved to applications such as quality control and acceptance testing.

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[1] This test method is under the jurisdiction of ASTM Committee C09 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] For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

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

*A Summary of Changes section appears at the end of this standard.

In such cases it is imperative that the curing procedures and the age at time of testing be clearly specified.

4.5 Table 1 provides a qualitative relationship between the results of this test and the chloride ion penetrability of concrete.

4.6 Numerical results of this test (total charge passed, in coulombs) can be used as a basis for determining the acceptability of a concrete mixture. Factors such as the ingredient materials used and method and duration of curing of test specimens affect results of this test. (See Note 1)

NOTE 1—When using this test for determining acceptability of concrete mixtures, statistically-based criteria and test age for prequalification, or for acceptance based on jobsite samples, should be stated in project specifications. Acceptance criteria for this test should consider the sources of variability affecting the results and ensure balanced risk between supplier and purchaser. The anticipated exposure conditions and time before a structure will be put into service should be considered. One approach to establishing criteria is discussed in Ref **6**.

4.7 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.

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

4.8.1 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.

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 2—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.

TABLE 1 Chloride Ion Penetrability Based on Charge Passed (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

6. Apparatus

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

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 or Aspirator*—Capable of maintaining a pressure of less than 50 mm Hg (6650 Pa) in desiccator.

NOTE 3—Since vacuum will be drawn over water, a vacuum 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 ± 5 mm Hg (± 665 Pa) over range 0–100 mm Hg (0–13300 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*.

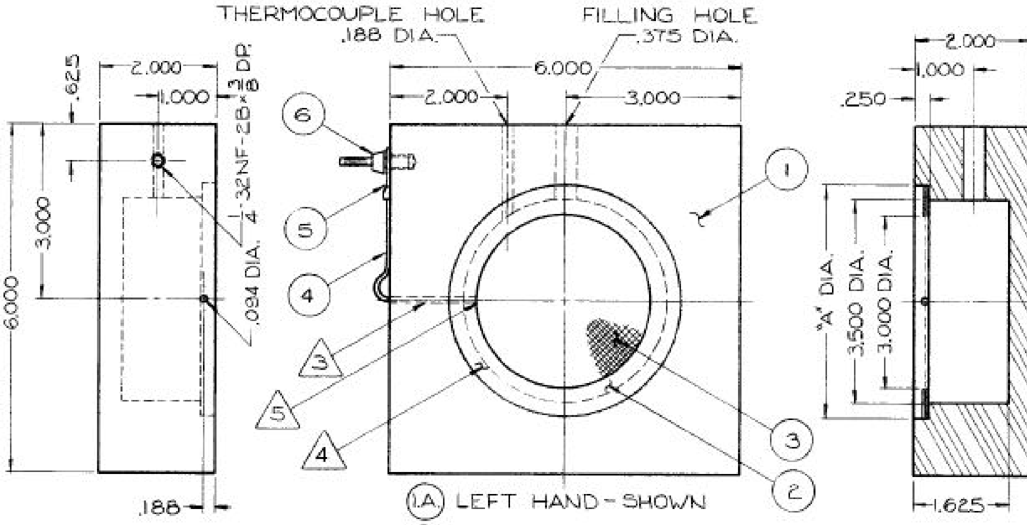
7. Reagents, Materials, and Test Cell

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 caulkings, 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.

7.3.1 **Warning**—Before using NaOH, review: (*1*) the safety precautions for using NaOH; (*2*) first aid for burns; and (*3*) the emergency response to spills, as described in the manufacturer's Material Safety Data Sheet or other reliable safety literature. NaOH can cause very severe burns and injury to unprotected skin and eyes. Suitable personal protective equipment should always be used. These should include full-face shields, rubber aprons, and gloves impervious to NaOH. Gloves should be checked periodically for pin holes.



M.M. = IN. × 25.4

NOTES:

1.) DIAMETER "A" SHOULD BE 1/8" LARGER THAN OUTSIDE DIA. OF SPECIMEN.
2.) NOT TO SCALE.
3.) SEAL WIRE IN HOLE WITH SILICONE RUBBER CAULK.
4.) SCREEN SOLDERED BETWEEN SHIMS.
5.) SOLDER WIRE TO BRASS SHIM.
6.) POLYMETHYLMETHACRYLATE, e.g., PLEXIGLAS.

ITEM	QTY.	NOMENCLATURE	SPECIFICATION
6	2	BANANA PLUG	1/4 MALE, INSULATED
5	2	TERMINAL	12-10-1/4
4	2	WIRE, COPPER	#14, SOLID NYLCLAD
3	2	SCREEN, BRASS	#20 MESH, "A" DIA.
2	4	SHIM, BRASS	0.02 THK.
I.B. I.A.	1 1	CELL BLOCK END	PMMA SHEET (6)

FIG. 1 Applied Voltage Cell (construction drawing)

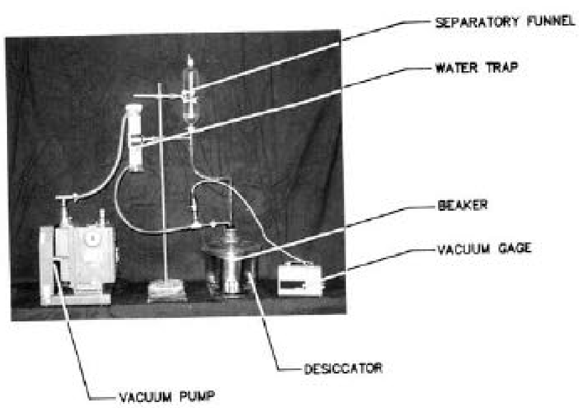


FIG. 2 Vacuum Saturation Apparatus

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

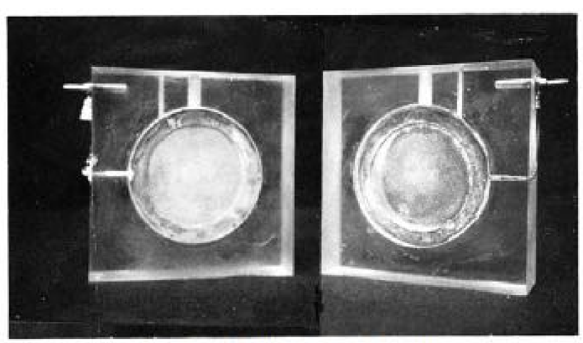


FIG. 3 Applied Voltage Cell-Face View

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 C42/C42M. Cylinders cast in the laboratory shall be prepared following procedures in Practice C192/C192M. When cylinders are cast in the field to evaluate a structure, care must be taken that the cylinders receive the same treatment as the structure, for example, similar degree of consolidation, curing, and temperature history during curing.

NOTE 4—The maximum allowable aggregate size has not been established for this test. Users have indicated that test repeatability is satisfactory on specimens from the same concrete batch for aggregates up to 25.0 mm (1 in.) nominal maximum size.

8.2 When results of this test method are used for evaluation of materials or mixture proportions based on cast specimens for purposes of quality control, mixture submittals, or acceptance of concrete, prepare 4-in (102-mm) diameter cylindrical specimens in accordance with Practice C192/C192M for concrete mixtures prepared in the laboratory or Practice C31/C31M from samples of fresh concrete obtained in the field. Unless otherwise specified, moist cure specimens in accordance with 8.2.1 for concrete mixtures containing only portland cement and in accordance with 8.2.2 for concrete mixtures containing supplementary cementitious materials. Use the same method and duration of curing test specimens when comparing two or more mixtures. The accelerated moist curing procedure in 8.2.3 is permitted as an alternative to the extended moist curing procedure for concrete mixtures containing supplementary cementitious materials (See Note 6).

8.2.1 *Moist Curing*—Cure test specimens for at least 28 days in accordance with Practice C192/C192M or in accordance with the standard curing procedure of Practice C31/C31M for specimens prepared in the field.

8.2.2 *Extended Moist Curing*—Cure test specimens for at least 56 days in accordance with Practice C192/C192M for specimens prepared in the laboratory or in accordance with the standard curing procedure of Practice C31/C31M for specimens prepared in the field.

8.2.3 *Accelerated Moist Curing*—Provide 7 days of moist curing in accordance with Practice C192/C192M for specimens prepared in the laboratory or in accordance with the standard curing procedure of Practice C31/C31M for specimens prepared in the field. After 7 days of moist curing, immerse the specimens for 21 days in lime-saturated water at 38.0 ± 2.0 °C (100 ± 3 °F).

NOTE 5—The 56-day moist curing period is to allow for some supplementary cementitious materials to develop potential properties because of their slower rate of hydration. Concrete containing supplementary cementitious materials may continue to show reductions in results of this test beyond 56 days, and in some cases, it may be appropriate to test at later ages, such as 3 months.

NOTE 6—The accelerated moist curing procedure has been found useful in providing an earlier indication of potential property development with slower hydrating supplementary cementitious materials (7). Because the two different curing methods may not provide the same results, the specifier of the test may require a correlation between results for extended moist cured and accelerated moist cured specimens and establish appropriate acceptance criteria when the accelerated moist curing procedure is used or permitted. Comparisons between results of moist cured specimens and field performance of concrete are documented in (8).

8.3 Transport the cores or field-cured cylinders to the laboratory in sealed (tied) plastic bags. If specimens must be shipped, they should be packed so as to be properly protected from freezing and from damage in transit or storage.

8.4 Using the water-cooled diamond saw or silicon carbide saw, cut a 2 ± ⅛ in. (51 ± 3 mm) slice from the top of the core or cylinder, with the cut parallel to the top of the core. This slice will be the test specimen. Use a belt sander to remove any burrs on the end of the specimen.

8.5 Special processing is necessary for core samples where the surface has been modified, for example, by texturing or by applying curing compounds, sealers, or other surface treatments, and where the intent of the test is not to include the effect of the modifications. In those cases, the modified portion of the core shall be removed and the adjacent 2 ± ⅛ in. (51 ± 3 mm) slice shall be used for the test.

9. Conditioning

9.1 Vigorously boil a litre or more of tapwater in a large sealable container. Remove container from heat, cap tightly, and allow water to cool to ambient temperature.

9.2 Allow specimen prepared in Section 8 to surface dry in air for at least 1 h. Prepare approximately ½ oz (10 g) of rapid setting coating and brush onto the side surface of specimen. Place the sample on a suitable support while coating to ensure complete coating of sides. Allow coating to cure according to the manufacturer's instructions.

9.3 The coating should be allowed to cure until it is no longer sticky to the touch. Fill any apparent holes in the coating and allow additional curing time, as necessary. Place specimen in beaker or other container (see 6.1.2), then place container in vacuum desiccator. Alternatively, place specimen directly in vacuum desiccator. Both end faces of specimen must be exposed. Seal desiccator and start vacuum pump or aspirator. Pressure should decrease to less than 50 mm Hg (6650 Pa) within a few minutes. Maintain vacuum for 3 h.

9.4 Fill separatory funnel or other container (see 6.1.1) with the de-aerated water prepared in 9.1. With vacuum pump still running, open water stopcock and drain sufficient water into beaker or container to cover specimen (do not allow air to enter desiccator through this stopcock).

9.5 Close water stopcock and allow vacuum pump to run for one additional hour.

9.6 Close vacuum line stopcock, then turn off pump. (Change pump oil if a water trap is not being used.) Turn vacuum line stopcock to allow air to re-enter desiccator.

9.7 Soak specimen under water (the water used in steps 9.4-9.6) in the beaker for 18 ± 2 h.

10. Procedure

10.1 Remove specimen from water, blot off excess water, and transfer specimen to a sealed can or other container which will maintain the specimen in 95 % or higher relative humidity.

10.2 Specimen mounting (all sealants other than rubber gaskets; use 10.2.2 or 10.2.3, as appropriate):

10.2.1 If using two-part specimen-cell sealant, prepare approximately 0.7 to 1.4 oz (20 to 40 g).

10.2.2 *Low Viscosity Specimen-Cell Sealant*—If filter paper is necessary, center filter paper over one screen of the applied voltage cell. Trowel sealant over brass shims adjacent to applied voltage cell body. Carefully remove filter paper. Press specimen onto screen; remove or smooth excess sealant which has flowed out of specimen-cell boundary.

10.2.3 *High Viscosity Specimen-Cell Sealant*—Set specimen onto screen. Apply sealant around specimen-cell boundary.

10.2.4 Cover exposed face of specimen with an impermeable material such as rubber or plastic sheeting. Place rubber stopper in cell filling hole to restrict moisture movement. Allow sealant to cure per manufacturer's instructions.

10.2.5 Repeat steps 10.2.2 (or 10.2.3) and 10.2.4 on second half of cell. (Specimen in applied voltage cell now appears as shown in Fig. 4.)

10.3 Specimen mounting (rubber gasket alternative): Place a 4-in. outside diameter by 3-in. inside diameter by ¼-in. (100 mm outside diameter by 75 mm inside diameter by 6 mm) circular vulcanized rubber gasket in each half of the test cell. Insert sample and clamp the two halves of the test cell together to seal.

10.4 Fill the side of the cell containing the top surface of the specimen with 3.0 % NaCl solution. (That side of the cell will be connected to the negative terminal of the power supply in 10.5.) Fill the other side of the cell (which will be connected to the positive terminal of the power supply) with 0.3 N NaOH solution.

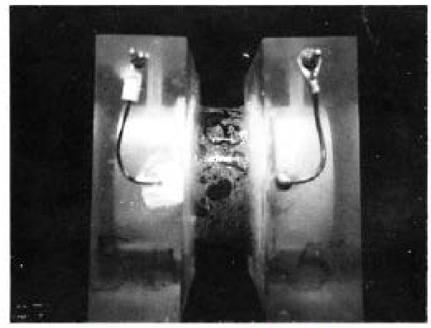


FIG. 4 Specimen Ready for Test

10.5 Attach lead wires to cell banana posts. Make electrical connections to voltage application and data readout apparatus as appropriate; for example, for system listed in 7.7.1-7.7.5, connect as shown in Fig. 5. Turn power supply on, set to 60.0 ± 0.1 V, and record initial current reading. Temperatures of the specimen, applied voltage cell, and solutions shall be 68 to 77 °F (20 to 25 °C) at the time the test is initiated, that is, when the power supply is turned on.

10.6 During the test, the air temperature around the specimens shall be maintained in the range of 68 to 77 °F (20 to 25 °C).

10.7 Read and record current at least every 30 min. If a voltmeter is being used in combination with a shunt resistor for the current reading (see Fig. 5), use appropriate scale factors to convert voltage reading to amperes. Each half of the test cell must remain filled with the appropriate solution for the entire period of the test.

NOTE 7—During the test, the temperature of the solutions should not be allowed to exceed 190 °F (90 °C) in order to avoid damage to the cell and to avoid boiling off the solutions. Although it is not a requirement of the method, the temperature of the solutions can be monitored with thermocouples installed through the ⅛-in. (3-mm) venthole in the top of the cell. High temperatures occur only for highly penetrable concretes. If a test of a 2-in. (51-mm) thick specimen is terminated because of high temperatures, this should be noted in the report, along with the time of

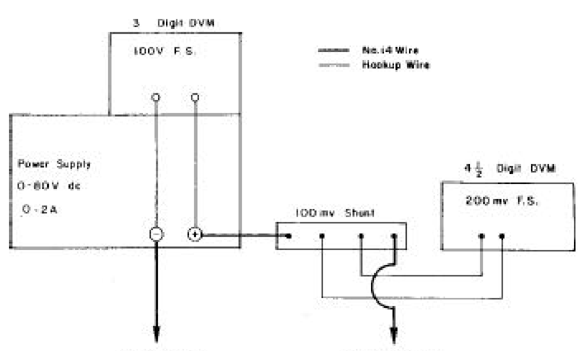


FIG. 5 Electrical Block Diagram (example)

termination, and the concrete rated as having very high chloride ion penetrability (see 12.1.9).

10.8 Terminate test after 6 h, except as discussed in Note 7.

10.9 Remove specimen. Rinse cell thoroughly in tapwater; strip out and discard residual sealant.

11. Calculation and Interpretation of Results

11.1 Plot current (in amperes) versus time (in seconds). Draw a smooth curve through the data, and integrate the area underneath the curve in order to obtain the ampere-seconds, or coulombs, of charge passed during the 6-h test period. (See Note 8) Alternatively, use automatic data processing equipment to perform the integration during or after the test and to display the coulomb value. The total charge passed is a measure of the electrical conductance of the concrete during the period of the test.

NOTE 8—*Sample Calculation*—If the current is recorded at 30 min intervals, the following formula, based on the trapezoidal rule, can be used with an electronic calculator to perform the integration:

$$Q = 900\,(I_0 + 2I_{30} + 2I_{60} + \ldots + 2I_{300} + 2I_{330} + I_{360}) \qquad (1)$$

where:

Q = charge passed (coulombs),
I_o = current (amperes) immediately after voltage is applied, and
I_t = current (amperes) at t min after voltage is applied.

11.2 If the specimen diameter is other than 3.75 in. (95 mm), the value for total charge passed established in 11.1 must be adjusted. The adjustment is made by multiplying the value established in 11.1 by the ratio of the cross-sectional areas of the standard and the actual specimens. That is:

$$Q_s = Q_x \times \left(\frac{3.75}{x}\right)^2 \qquad (2)$$

where:

Q_s = charge passed (coulombs) through a 3.75-in. (95-mm) diameter specimen,
Q_x = charge passed (coulombs) through x in. diameter specimen, and
x = diameter (in.) of the nonstandard specimen.

11.3 Use Table 1 to evaluate the test results. These values were developed from data on slices of cores taken from laboratory slabs prepared from various types of concretes.

11.3.1 Factors which are known to affect chloride ion penetration include: water-cement ratio, the presence of polymeric admixtures, sample age, air-void system, aggregate type, degree of consolidation, and type of curing.

12. Report

12.1 Report the following, if known:

12.1.1 Source of core or cylinder, in terms of the particular location the core or cylinder represents,

12.1.2 Identification number of core or cylinder and specimen,

12.1.3 Location of specimen within core or cylinder,

12.1.4 Type of concrete, including binder type, water-cement ratio, and other relevant data supplied with samples,

12.1.5 Description of specimen, including presence and location of reinforcing steel, presence and thickness of overlay, and presence and thickness of surface treatment,

12.1.6 Curing history of specimen; indicate moist curing, extended moist curing, or accelerated moist curing as defined in this test method, as applicable,

12.1.7 Unusual specimen preparation, for example, removal of surface treatment,

12.1.8 Test results, reported as the total charge passed over the test period (adjusted per 11.2), and

12.1.9 The qualitative chloride ion penetrability equivalent to the calculated charge passed (from Table 1).

13. Precision and Bias [5]

13.1 *Precision*:

13.1.1 *Single-Operator Precision*—The single operator coefficient of variation of a single test result has been found to be 12.3 % (Note 9). Therefore the results of two properly conducted tests by the same operator on concrete samples from the same batch and of the same diameter should not differ by more than 42 % (Note 9).

13.1.2 *Multilaboratory Precision*—The multilaboratory coefficient of variation of a single test result has been found to be 18.0 % (Note 9). Therefore results of two properly conducted tests in different laboratories on the same material should not differ by more than 51 % (Note 9). The average of three test results in two different laboratories should not differ by more than 42 % (Note 10).

NOTE 9—These numbers represent, respectively, the (1s %) and (d2s %) limits as described in Practice C670. The precision statements are based on the variations in tests on three different concretes, each tested in triplicate in eleven laboratories. All specimens had the same actual diameters, but lengths varied within the range 2 ± ⅛ in. (51 ± 3 mm).

NOTE 10—Although the test method does not require the reporting of more than one test result, testing of replicate specimens is usually desirable. The precision statement for the averages of three results is given since laboratories frequently will run this number of specimens. When averages of three results are established in each laboratory, the multilaboratory coefficient of variation, s_{ML} is calculated as:

$$s_{ML} = \sqrt{\frac{s_{WL}^2}{3} + s_{BL}^2} \qquad (3)$$

where:

s_{WL}^2 = within-laboratory variance and
s_{BL}^2 = between-laboratory variance.

The percentage cited represents the (d2s %) limit based on the value for the multilaboratory coefficient of variation.

13.2 *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.

14. Keywords

14.1 chloride content; corrosion; deicing chemicals; resistance-chloride penetration

[5] Supporting data have been filed at ASTM International Headquarters and may be obtained by requesting Research Report RR:C09-1004.

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SUMMARY OF CHANGES

Committee C09 has identified the location of selected changes to this test method since the last issue, C1202 – 09, that may impact the use of this test method. (Approved February 1, 2010)

(*1*) Revised Sections 4, 8, and 12.

Committee C09 has identified the location of selected changes to this test method since the last issue, C1202 – 08, that may impact the use of this test method. (Approved May 1, 2009)

(*1*) Revised 4.4.

Committee C09 has identified the location of selected changes to this test method since the last issue, C1202 – 07, that may impact the use of this test method. (Approved December 15, 2008)

(*1*) Revised 4.4.

ASTM C 1202-97 Rapid Chloride Permeability Test

Instruction and Maintenance Manual

PR-1090

PROOVE'it© software Version 1.1.1

May 15th, 2003

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1. Introduction

The **PROOVE'it**© equipment is designed to perform a rapid and automated electrical indication of the concrete's ability to resist chloride ion penetration in accordance with the standards ASTM C 1202-97 (ref.1) or AASHTO T 277-831 (ref.2).

The test measures the electrical current passing through a concrete specimen for a period of standard 6 hours at a standard voltage of 60 VDC.

The current (in milliamps) is measured over 6 hours and the ampere-seconds are achieved by integration of the curve in order to obtain the Coulombs. This is done automatically. The Coulombs are, according to ASTM C 1202-97, an indication of the concrete's ability to resist chloride ion penetration at 60 VDC and 6 hours of testing, and for a specimen with a diameter of 95 mm (3 ¾"), 50 mm long, as shown in table 1:

Coulombs	Chloride Ion Permeability	Typical of
>4000	High	High w/c-ratio
4000-2000	Moderate	0.4-0.5 w/c-ratio
2000-1000	Low	w/c-ratio < 0.4
1000-100	Very low	Latex modif. concrete
<100	Negligible	Polymer concrete

Table 1. Chloride ion penetrability based on charge passed (ref.1)

Alternatively, the **PROOVE'it**© system allows testing at 10, 20, 30, 40 and 50 VDC and the testing time can be altered as required.

The **PROOVE'it**© permits in this manner also the chloride diffusion coefficient by the CTH Rapid Method (ref.3) to be evaluated. According to this method the voltage selected is 30 VDC at times varying between 168 hours to 4 hours depending on the initial current (<5 mA to >120 mV). After the test has been completed, the specimen is split, the penetration depth of the chlorides is determined by a silver nitrate solution on the split surface and the diffusion coefficient calculated by an equation stated in ref.3. Should temperature regulation of the **PROOVE'it**© cell be needed in this test, it is recommended to use the PR-1100 **PROOVE'it**© cell. This cell contains cooling ribs allowing cooling of the liquids to made during testing by a fan placed adjacent to the cell.

The software permits specimens with diameters other than 95 mm diameter to be tested. The **PROOVE'it**© software will automatically adjust the coulombs for the actual diameter of the specimen to coulombs for 95 mm diameter specimens according to ASTM C 1202-97.

NOTE: The specimen diameter is with the **PROOVE'it**© recommended to be 100 mm in diameter, 50 mm long, to ensure quick and trouble-free watertight assembling of the cells. The cells allows, however, testing of specimens with diameters from 93 mm to 104 mm and specimens with diameters between 75 mm and 78 mm, all of them 50 mm long by using gaskets with matching diameters.

The specimen is positioned in the **PROOVE'it**© measuring cell, containing a fluid reservoir at each face of the specimen. For the ASTM / AASHTO test one reservoir is filled with a sodium chloride (3.0% NaCl) solution, the other with a sodium hydroxide (0.3 N NaOH) solution. For testing effectiveness of membranes, the face of the specimen containing the membrane is placed in the NaCl reservoir.

The reservoir containing the NaCl is connected to the negative terminal, the NaOH reservoir to the positive terminal of the **PROOVE'it**© Microprocessor Power Supply unit.

The **PROOVE'it**© software is installed in an IBM-compatible PC with Windows and the test is run after the required parameters have been entered.

If desired the temperature can be monitored with a probe inserted in the NaCl reservoir. Should the temperature of the solution exceed 90°C (default), the test will be interrupted to avoid boiling.

The **PROOVE'it**© allows up to 8 cells to be tested simultaneously. The voltage, once selected, has to be the same for all eight channels. However, the cells may be started up at different times and the time of testing may also be chosen individually.

The **PROOVE'it**© software in this manual is the latest developed software as of May 15th, 2003. The designation of the software is Version 1.1.1 The software can be used with earlier produced **PROOVE'it**© Microprocessor Power Supply units from serial number 973901 and higher (produced from August 1997 and onwards).

*Fig.1. The main components of the **PROOVE'it**© system.*
*Front: The **PROOVE'it**© PR-1000 cell with concrete sample (100 mm dia., 50 mm long) and the **PROOVE'it**© Microprocessor Power Supply Unit (the **PROOVE'it**© software is not illustrated)*
Back: The drill machine and the CORECASE CEL-100 units with coring rig and the diamond saw for producing the specimens, together with the vacuum desiccator and the vacuum pump

2. PROOVE'it© System Parts List

The components and optional parts of the **PROOVE'it©** System are:

Part Number	**Item**
PR-1050	**PROOVE'it©** Microprocessor Power Supply unit for testing of maximum 8 cells, requires an IBM-compatible PC with Windows operating system (not supplied)
PR-1040	**PROOVE'it©** software
PR-1090	**PROOVE'it©** Manual
PR-1000	**PROOVE'it©** Measuring cell with two rubber gaskets (sealing rings) Specify either PR-1010A, 99 mm inner dia. gaskets, outer dia. 127 mm PR-1010B, 93 mm inner dia. gaskets, outer dia. 126 mm (standard) PR-1010C, 90 mm inner dia. Gaskets, outer dia. 126 mm PR-1010-75, 75 mm inner diam. Gaskets
Alternatively:	
PR-1100	***PROOVE'it©*** *Measuring cell with cooling ribs*
PR-1001	Red connecting cord from cell to Microprocessor Power Supply unit
PR-1002	Black connecting cord from cell to Microprocessor Power Supply unit
PR-1005	Temperature probe, one per channel
PR-1006	Two 17 mm wrenches for tightening bolts of cells.
PR-1020	300 ml bottle of 3.0 % NaCl solution
PR-1030	300 ml bottle of 0.3 N NaOH solution
PR-1064	Main cable for 220 VAC
Or	
PR-1065	*Main cable for 110 VAC*
PR-1066	RS-232C serial cable for connecting PC to the Microprocessor Power Supply unit
PR-1069	Vacuum desiccator for humidifying 8 samples, plastic
Or	
PR-1070	*Vacuum desiccator for humidifying 16 samples, glass*
PR-1081	Vacuum pump with hose for desiccator, < 1 mmHg vacuum, 110 or 220V

For coring and slicing of 100 mm diameter specimens, 50 mm long, the following equipment is needed:

CEL-100	Corecase 100 mm Extra Long, core bit 100 mm inner diameter and 210 mm long
CC-129	Drill machine, 1150 W, type GSB-90-2E for CEL-100 (Specify 110 or 220 VAC)
PR-1060	Diamond saw for slicing of cores to 50 mm thickness, 110 or 220VAC

Optional parts

PR-930	Tube of epoxy for specimen coating and epoxying of gaskets to specimen
PR-940	Brush for epoxy
PR-950	Bottle of silicone oil
PR-1055	Calibration unit
PR-1003	Spare mesh for PR-1000 **PROOVE'it©** Measuring cell

The instructions for testing that follows in this manual are a supplement to he ASTM C 1202-97 Standard. This standard has to be adhered to as well before testing.

3. Producing the concrete specimen.

In the laboratory the specimens may be cast in a 100 mm diameter mold, 50 mm high, or produced by coring. For cored specimens, the CEL-100 Corecase coring rig is recommended to be used. The rig produces accurately the correct 100 mm +/-1 mm core diameter.

For sampling on the structure the same CEL-100 Corecase coring rig is recommended as well. Drill to a minimum depth of 200 mm. Then break the core using a hammer and chisel and extract it. If ones own coring rig is to be used, make sure the diamond drill bit has an inner diameter of 100 mm. Otherwise, it is recommended to acquire the diamond drill (type CCB-100/210) used with the CEL-100 coring rig.

The specimen is saw-cut to a length of 50 mm +/-1 mm by using the PR-1060 saw cutting equipment that aligns the core end ensures a slice cut perpendicular to the axis with a thickness of 50 mm. Be careful to avoid breaking of the edge when the saw-cutting is close to termination.

If the sample is cut too long or unevenly, the cell will not be properly tightened or the mesh of the **PROOVE'it**© may get damaged.

The cell is designed to test the specimen without resorting to epoxy coating provided the specimen diameter is 100 mm +/-1 mm using the PR-1010 B gaskets. However, the operator may choose to use epoxy on the circumferential surface to eliminate any possible stray current and/or to enlarge the diameter of the specimen.

For such applications mix the epoxy in a pot (about 10 grams are needed for each specimen). With a brush, apply a thin layer to the circumference face of the specimen. Make sure no epoxy is applied to the end faces. Allow the epoxy to dry on a tabletop with a piece of paper in between. Turn the specimen up side down after 5 minutes to ensure that the epoxy is equally distributed along the surface.

4. Conditioning the specimen

10 liters (2 gallons) of distilled water is needed to moisten 8 specimens. Boil the water for half an hour to make sure the water is free of air. De-aerated water will permeate the concrete specimen more easily. Allow the water to cool off.

Place the specimen(s) in the vacuum desiccator's bowl. A maximum of 6 specimens can be placed in one PR-1069 plastic desiccator and 16 in the PR-1070 glass desiccator. Clean the edge of the lid and oil it slightly with silicone oil. Make sure stopcock is closed, see fig.2. Place the lid on the bowl. Connect the hose from the vacuum pump to the valve below the vacuum gauge and turn on the vacuum pump. Open the valve. Maintain the vacuum for 3 hours. Close the valve adjacent to the gauge. Turn off the vacuum pump.

Attach the supplied hose to the stopcock on the side of the desiccator and place the other end in the container with the boiled water. Allow the de-aerated water to flow into the desiccator by opening the stopcock slowly. The water must completely cover the specimens. No air should be allowed to enter the desiccator.

Close the stopcock, start the vacuum pump and open the valve. Run the vacuum pump for another hour.

Turn off the vacuum pump and remove the hose from the water container. Open the stopcock slowly to allow air to enter into the desiccator. When water starts running back through stopcock, close the stopcock.

Let the specimens soak in the container water for another 18 hours. Remove the lid together with the moistened specimens. Blot the specimens dry with a cloth.

Fig. 2 illustrates the setup of the vacuum pump, desiccator with stopcock, vacuum gauge and valve, and the deaerated water container after the water has filled the desiccator.

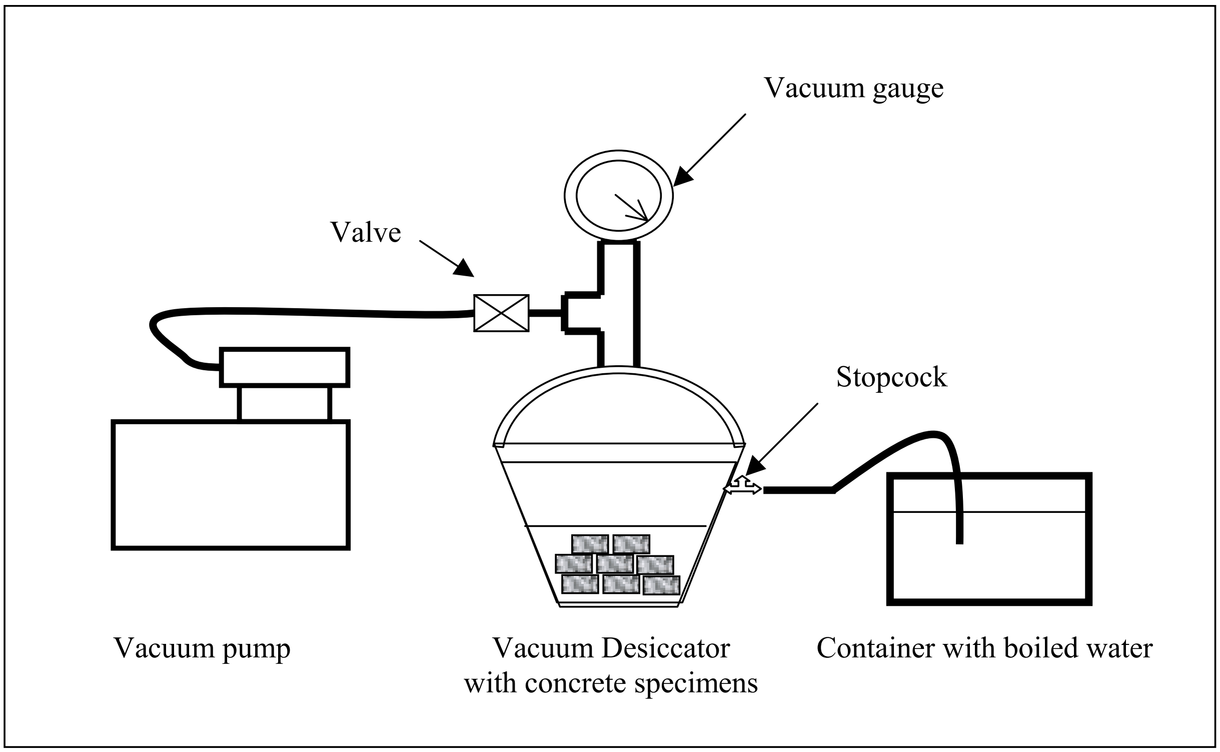


Fig. 2. The vacuum pump, desiccator with specimens and a container with de-aerated water

5. Choosing the correct rubber gasket for the PROOVE'it© cell.

Four rubber gaskets are available, type PR-1010A, PR-1010B, PR-1010C or PR-1010-75, to be used for specimens with different diameters.

Figure 3, page 9, illustrate the gaskets installed in the **PROOVE'it©** cell. Tightening of the four bolts will cause the spacer to compress the rubber gaskets against the stainless steel rings holding the wire mesh and seal the gaskets against the specimen surface. The maximum sealing between the rubber gaskets and the specimen is achieved if the outer circumference of the gaskets fits closely the groove of the cell part, 130 mm in diameter, after the gasket has been mounted the specimen and inserted in the groove. The sealing is eased if the faces between the gasket and the spacer, respectively between the gasket and the stainless steel ring holding the wire mesh, have been applied a thin coat of silicone oil.

In table 2 the specimen diameter is related to the recommended gasket type, and whether or not it is recommended to epoxy the gaskets to the specimen.

Specimen diameter	**Gasket type**	**Gasket dimensions** (inner diameter, outer diameter & thickness)	**Epoxy recommended between gasket and specimen**
104 mm – 102 mm	PR-1010A	99 mm x 127 mm x 10 mm	No
101 mm – 97 mm	PR-1010B	93 mm x 126 mm x 10mm	No
96 mm – 93 mm	PR-1010C	90 mm x 126 mm x 10mm	No
78 mm –75 mm	PR-1010-75	75 mm x 127 mm x 10 mm	Yes

Table 2. Specimen diameter related to the required type of gasket, gasket dimensions and recommendation for applying epoxy between the gasket and the specimen

Sealing without epoxy between the gasket and the specimen eases the testing procedure considerably.

Efficient sealing is partly achieved by regularly shaped specimens, partly by constant diameters of the specimens, partly by choosing the correct sized rubber gasket for the specimen in question that fits closely the 130 mm groove diameter of the cell part after installation on the specimen, and finally, by applying a thin coat of silicone oil between the gasket side faces and the spacer and stainless steel ring in the cell groove.

The **PROOVE'it**© cell is as standard supplied with the PR-1010B gaskets with inner diameter of 93 mm, outer diameter 126 mm and 10 mm thickness, requiring the specimen diameter to be between 97 mm to 101 mm as shown in table 2.

6. Installing gaskets without epoxy between gaskets and specimen

Choose the gasket type according to the specimen diameter as indicated in table 2.

Clean the gaskets, the spacer faces and the stainless steel ring in the 130 mm diameter cell grooves holding the wire meshes of both cell parts.

Oil slightly the end faces of the gaskets with silicone oil.

The gasket is pressed on the moistened and prepared specimen at one end. The initial tight squeezing around the specimen will further improve the sealing. Position the gasket on the specimen on a table. Place the spacer centrally on the gasket and press the other gasket on the other end of the specimen. Make sure equal distances are present between the specimen end and the gasket at both end faces.

Place one cell part on the table with the groove upwards. Insert the installed gasket on the specimen in the groove. Govern the other cell part on the upper gasket on the specimen to a fully engaged position.

Make sure the black and the red terminal posts of the cell parts points in the same direction of the cell parts.

Insert the four tightening bolts with washers in the cell holes and turn the cell to a vertical position. Attach the washers/nuts and tighten opposite bolts/nuts using two 17 mm wrenches.

Finally, tighten the bolts/nuts **firmly**. NOTICE: Do not tighten the bolts/nuts excessively. This will only damage the cell.

Pour de-aerated water in the cell parts using a funnel to the top surface of the filling tubes. Blot dry the cell and place it on a piece of paper. Observe if the level is stable and/or if the paper has leakage spots.

Should leakage occur after assembling, the cell is disassembled in a sink, the parts blotted dry and a thin layer of silicone is applied to the inner circumference of the gasket prior to installation on the specimen. Reassemble, fill in de-aerated water again and make sure the cell is watertight.

Before testing commence, empty the watertight cell completely for water and fill in the proper liquids (3.0% NaCl and 0.3 N NaOH solutions) in the two cell reservoirs. The level of the liquids has to be 2-3 mm below the filling tubes of the cell parts.

7. Installing gaskets with epoxy between gaskets and specimen

Epoxy between the gaskets and the specimen has to be applied if the concrete surface is rough or not cylindrical, of if notches are present from saw cutting, or otherwise, if the cell cannot be made watertight after assembling.

The PR-1010-75 gaskets for 75 mm diameter specimens always need to be epoxied to the specimen.

Blot the moistened specimen dry with a piece of cloth and apply the prepared two-component epoxy in a thin layer to the specimen circumferential surface, 10 mm from the end. While the epoxy is still wet, govern the rubber gasket over the end of the specimen in a rotary motion until it is flush with the specimen end face. Remove as much as possible of the excess epoxy collected on the rubber gasket by means of a spatula and cloth.

Apply a thin layer of silicone oil to the end faces and inner surfaces of the spacer. Position the spacer centrally on the specimen for it to rest against the gasket. Govern the other rubber gasket over the end of the specimen, again with a rotary motion until the gasket is resting against the spacer. Remove any excess epoxy. Wait 5 minutes and turn the unit upside down. To avoid water evaporation from the ready made moistened specimen, cover the specimens with a plastic wrap or sheet and allow the epoxy to harden.

Oil with silicone oil slightly the side faces of the gaskets prior to mounting the gaskets in the cell.

Place one cell part on the table with the groove upwards. Insert the installed gasket on the specimen in the groove. Govern the other cell part on the upper gasket on the specimen to a fully engaged position.

Make sure the black and the red terminal posts of the cell parts points in the same direction of the cell parts.

Insert the four tightening bolts with washers in the cell holes and turn the cell to a vertical position. Attach the washers/nuts and tighten opposite bolts/nuts using two 17 mm wrenches.

Finally, tighten the bolts/nuts **firmly**. NOTICE: Do not tighten the bolts/nuts excessively. This will only damage the cell.

Pour de-aerated water in the cell parts using a funnel to the top surface of the filling tubes. Blot dry the cell and place it on a piece of paper. Observe if the level is stable and/or if the paper has leakage spots.

Should leakage occur after assembling, the cell is disassembled in a sink and the parts blotted dry. The leakage spot is applied a thin layer of epoxy. Cover the specimen with a plastic wrap of sheet during hardening of the epoxy. Reassemble, fill in de-aerated water again and make sure the cell is watertight.

Before testing commence, empty the watertight cell completely for water and fill in the proper liquids (3.0% NaCl and 0.3 N NaOH solutions) in the two cell reservoirs. The level of the liquids has to be 4-5 mm below the filling tubes of the cell parts.

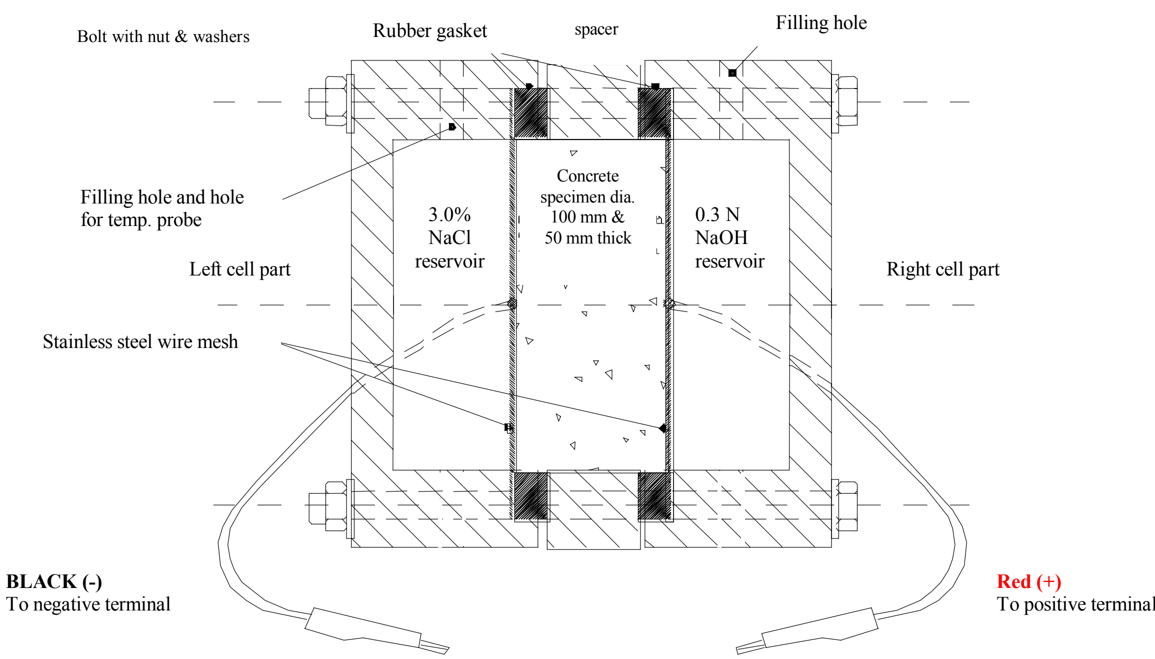


*Fig. 3. The assembled PR-1000 **PROOVE'it**© cell, see also fig.6 page 31*

8. The assembled PROOVE'it© cell

The sealed, leak-free and surface-dry cell is now ready for testing.

9. Connecting the cells to the PROOVE'it© Microprocessor Power Supply unit

Cell #1 is connected to channel #1 of the power supply unit, cell #2 to channel #2, etc. A maximum of 8 cells can be tested simultaneously.

It is imperative that each cell is connected only to each channels power supply binding posts. In other words, red jack to red binding post and black jack to black binding post.

NOTE: *The power supply will suffer irreversible damage if the cords from one cell are crossed with another channels cell. The **PROOVE'it**© does not have a common ground, appendix 4 page 29.*

*Every cell used must be hooked to the Microprocessor unit **before turning on** the unit. Otherwise, attaching the cell after turning on the unit can cause a surge in current that will damage the internal control circuitry. Intermittent current readings on any channel can also cause internal unit damage.*

If the operator wishes to use the supplied temperature probes, place each temperature probe in one of the holes in the cell half with the black jack, also marked with "**°C**". This safeguards the cell if the temperature of the liquids gets close to 90°C.

The power supply is connected to electricity with the appropriate main cords, 110VAC or 220VAC.

The RS-232C cable is hooked-up between the power supply and a Com-port of an IBM-compatible computer. The software will automatically detect the port used.

A printer can be connected as well to the computer.

10. Installing the PROOVE'it© software

The software is made for Windows and is installed on the hard drive. The minimum requirements for the computer to be used is: 120 MHZ Pentium, 16 MB Ram, 10 MB Hard disc and Windows 98, Second Edition

Installation:

1. Turn on the computer.
2. Insert the CD-supplied with the equipment in the CD-drive.
3. The installation will automatically start
4. If the installation is not started automatically press the **Start** button
5. Chose **Run** and type **d:\ ProoInst.exe**, (D being the name of the CD-drive) and press **Enter**.
6. Follow the instructions on the screen. If updating of software on the computer is required the software on the CD will automatically do it and restart the computer.
7. After installation a shortcut is made for the PROOVE'it© program in the folder **Programs** with the name **PROOVE'it**. Also a shortcut is made to a program called **PROOVE'it Report Manager**.

NOTE: A copy of the manual is also installed on the computer to ensure it is available all the time. The program Adobe Acrobat Reader is required to be able to read the manual. This software is enclosed on the CD. Run the **ACRS4ENU.EXE** from the CD to install the Adobe Reader program.

The manual can be opened by clicking on the icon **PROOVE'it manual** located in the same folders as the PROOVE'it program and the PROOVE'it Report Manager.

11. Turning on and running the system

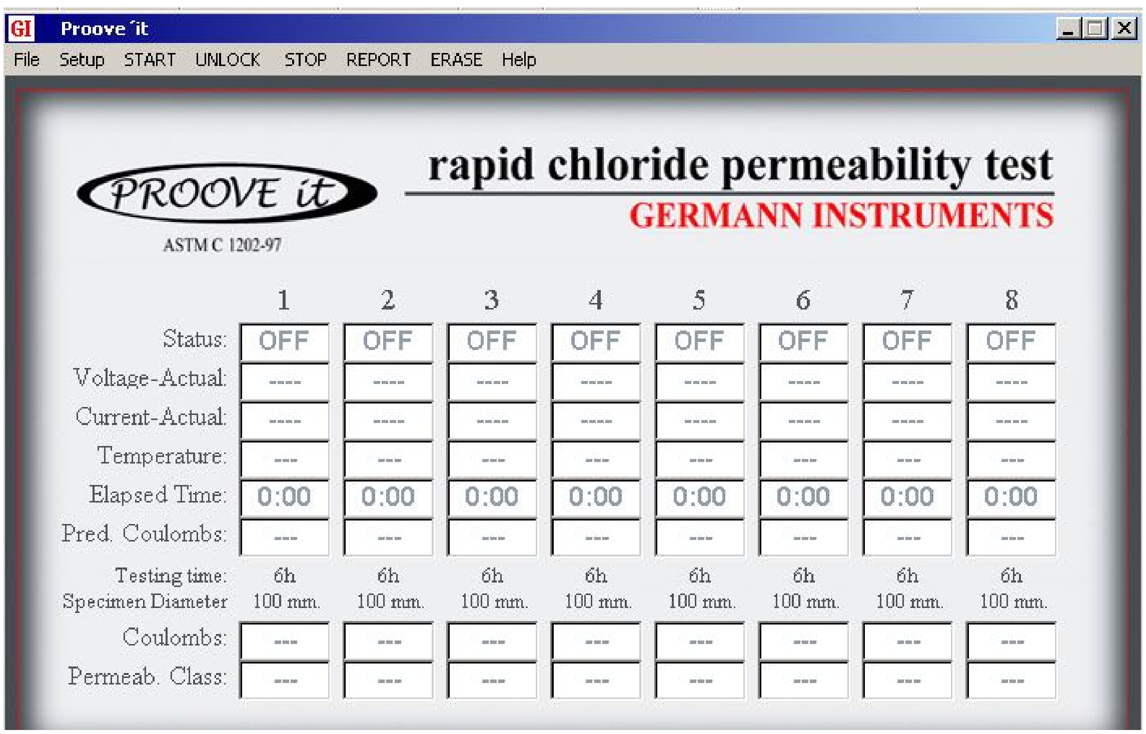
Connect the measuring cells to the **PROOVE'it**© microprocessor power supply as described in section 9, page 9.

Turn on the microprocessor power supply unit by activating the switch on the back panel. When switched on, the front panel's on/off lamp will go from red to yellow after a few seconds. If it stays red, the voltage supplied to the unit is either not stable or out of range of the needed voltage supply to the unit (more of than +/- 15 VAC for 115 VAC mains or more of than +/- 30 VAC for 220 VAC mains). The unit is not able to operate properly in such cases. A proper line or main voltage has been found to solve the problem.

Make sure no programs in the computer used are occupying the COM-port.

To start up the software, select the **PROOVE'it**© icon from the folder **Programs** and then the sub-folder **PROOVE'it**© in the **Start**-menu.

The following start screen will appear:



The display illustrates the 8 channels. Each channel shows Status, Voltage-actual, Current-actual in milli-Amps, Temperature in ºC, Elapsed time, Predicted Coulombs, Testing time, Coulombs till now and Permeability Class.

The Predicted Coulombs are shown after 5 minutes of test and will be upgraded after each consecutive 5 minute.

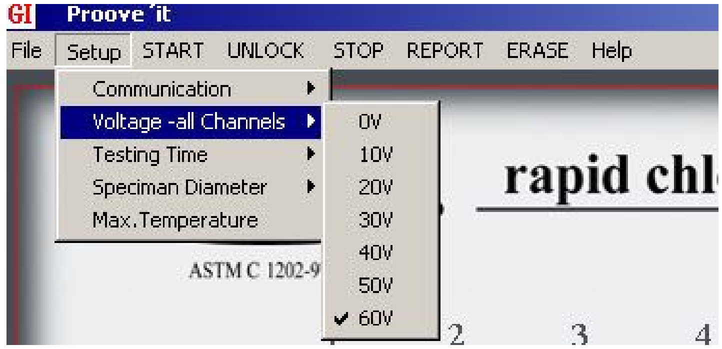
Once the setup has been set the selected values will be default until changed again.

To start a test the steps below has to be followed. Once a selection is made, the selection will be the default value until changed by the user.

Menu Options Screen

Setup

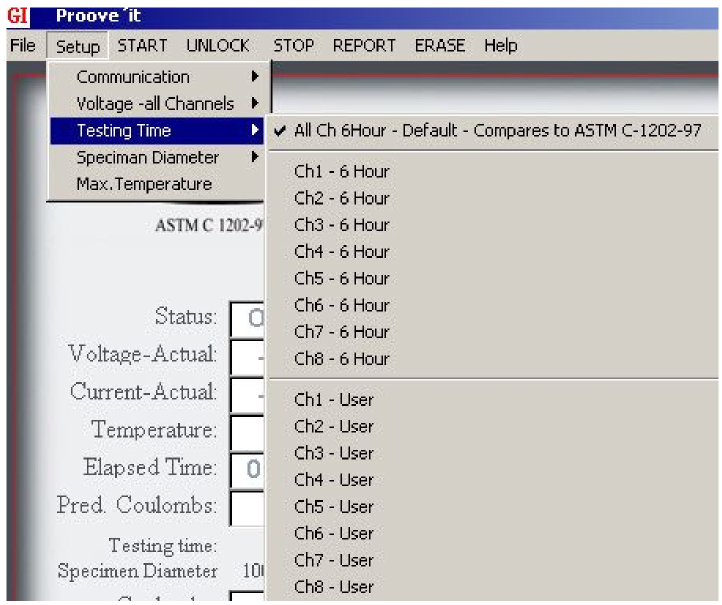
Voltage of Channels:
The voltage choices are 10, 20, 30, 40, 50 or 60 VDC. Once selected, all the channels will use the same voltage.



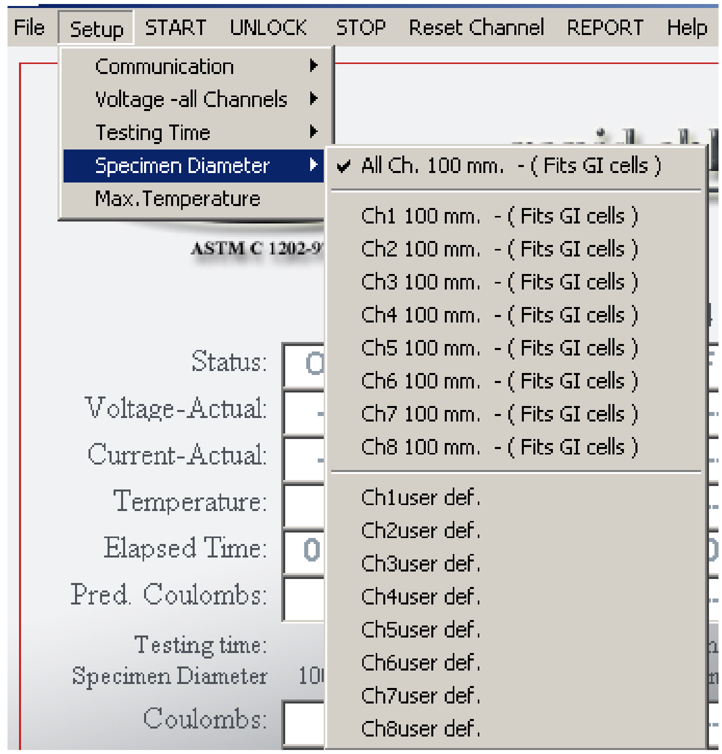
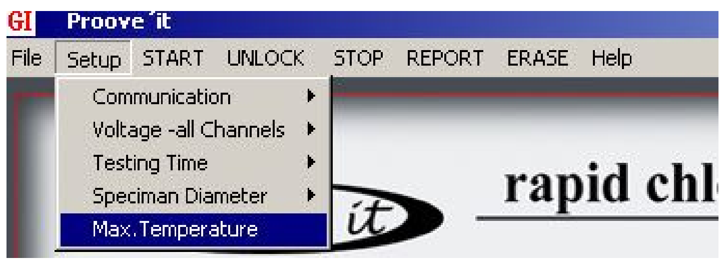
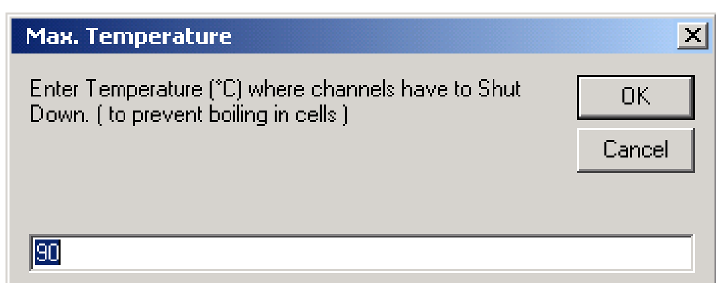
Setup

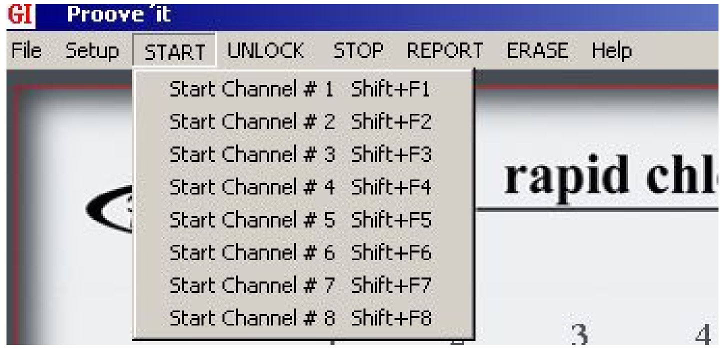
Testing Time:
For each channel a testing time can be set. Either the default 6 hours for all channels or individual time can be chosen for each channel.

NOTE: if any other time than 6 hours is chosen the permeability class cannot be estimated according to ASTM C 1202-97 for the sample in question.



To change the testing time select Ch"x"- user and enter the time the test should run in minutes, “x” being the number of channel.

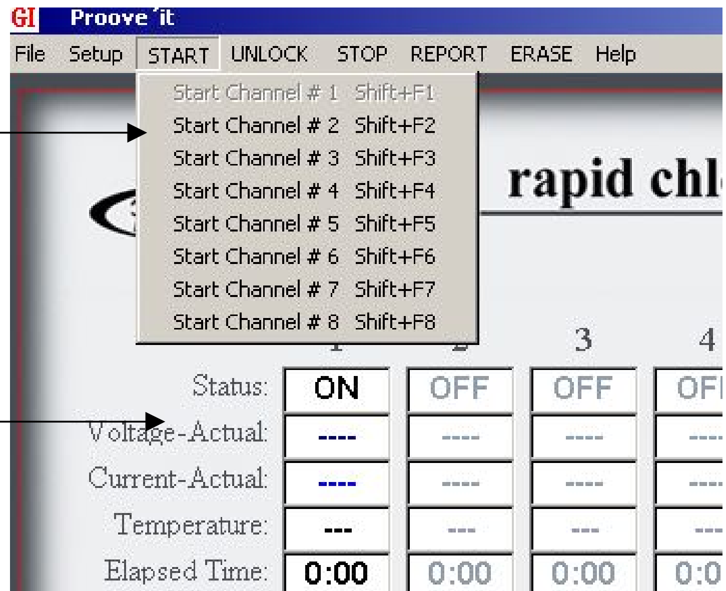
Menu	Options	Screen
Setup	*Specimen Diameter:* For each sample the diameter has to be entered enabling the software to calculate the correct Permeability Class. The program will automatically adjust the corrections to the ASTM standard's 95 mm specimen size. The default is 100 mm diameter for all channels. Alternatively, actual diameters can be entered for each specimen.	
Setup	*Max. Temperature:* This option allows entering of a maximum temperature. The system will automatically turn of the channel, where the temperature exceeds the selected temperature.	
	The default value is 90°C.	

Menu	Options	Screen
START	*Start Channel:* To start the channels select the channel in question with the mouse or press the Shift F-keys for each channel.	

Once a channel is started the text will change to be gray.

The **Status** of the channel will change from **OFF** to **ON.**

The clock for **Elapsed Time** will start, indicated by the black color of the clock.

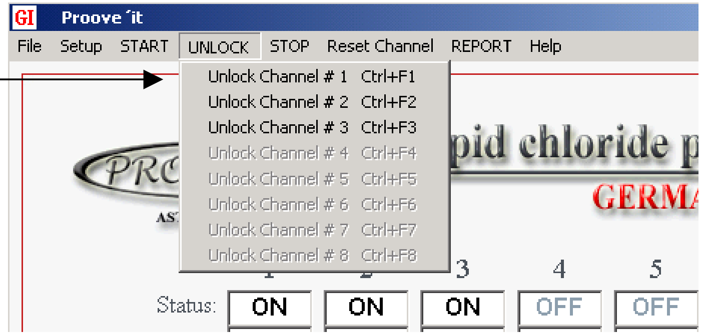


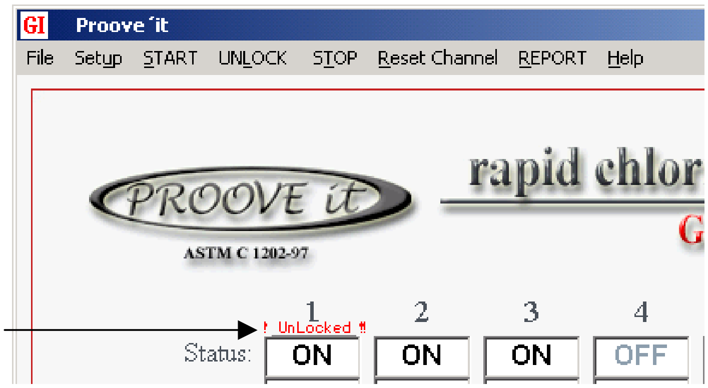
Testing will proceed until the selected duration of time has been reached, the technician stops the test or if the temperature of the liquid in the measuring cells exceed the maximum temperature.

To avoid stopping the testing by an accident the channels are locked. Therefore the channels has to be unlocked if it has to be stopped by the user.

Menu Options Screen

Unlock *Unlock Channel:*
The active channels are shown with black letters. To unlock a channel select the channel in question with the mouse or press the Ctrl + F-keys for each channel.

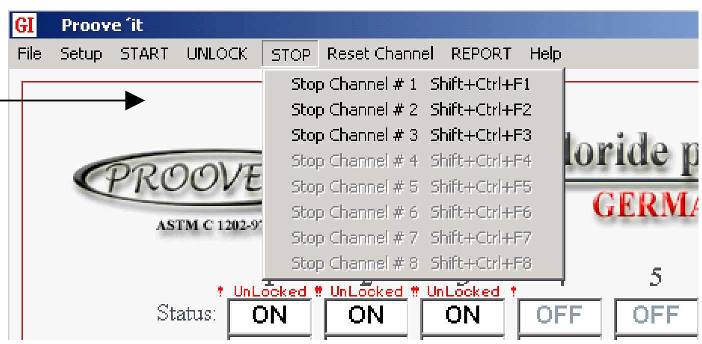




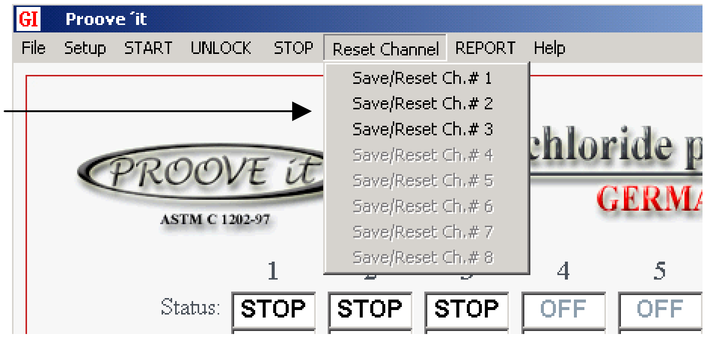
When a channel is unlocked "Unlocked" will be indicated below the channel number.
The channel test continues but now it can be stopped either for interrupting the test or to prepare to print the data.

After unlocking the channel can be stopped.

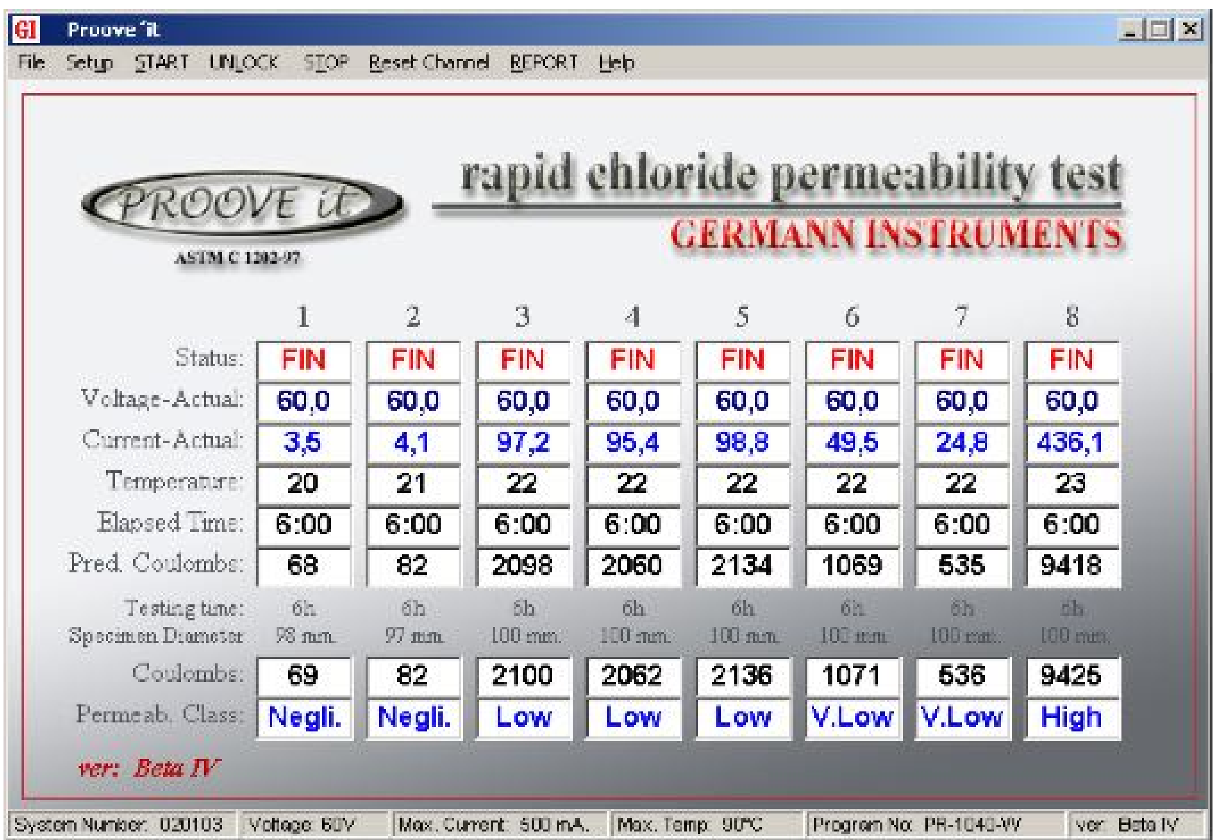
STOP *STOP Channel:*
To stop a test the channel in question has to be stopped.
Once a channel is stopped it cannot be started again before resetting the channel.



When a channel is stopped it is possible to save the data and reset the channel. The data will be saved in a database in Access (Office 2000 is required to open the database with Access) with the name **prooveit.mdb** in the directory where the software is installed. The default directory is C:\Program Files\Prooveit\.

Menu	Options	Screen
Reset Channel	*Reset Channel:* To save the data from a test and/or reset the channel select the channel in question.	

If the channels are not stopped, testing will proceed for the testing time selected. An example of a screen picture is given below for 60 VDC and 6 hours of testing on 8 channels:

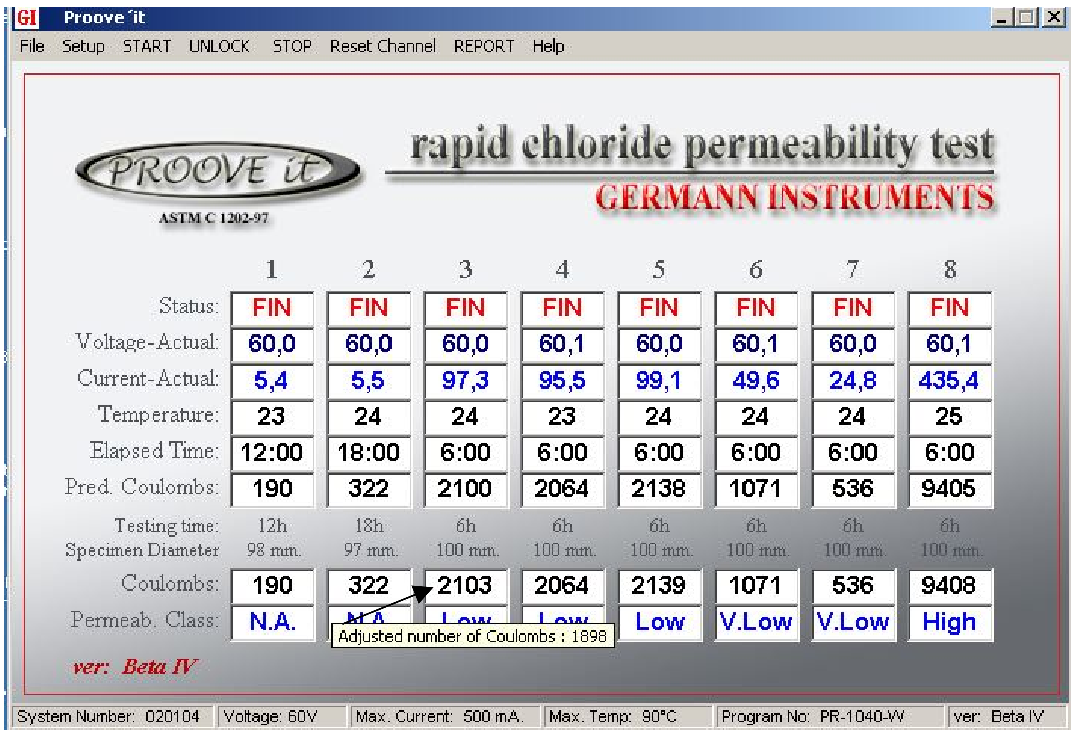


The status of the channels is FIN (finish) and the permeability class for each sample is shown at the bottom row. As will be noticed, the coulombs measured on channel #3, #4, #5 and #6 are not matching the permeability classes indicated in table 1, page 2. The reason is that the specimen diameters used are 100 mm, by which the coulombs re-calculated for a specimen diameter of 95 mm

– according to ASTM C 1202-97 – are lower, and it is these coulombs values that are classified in the permeability classes indicated.

To read the coulombs adjusted to 95 mm specimen diameters, point with the mouse arrow on the coulombs window and a pop-out window will appear with the adjusted coulombs according to ASTM C 1202-97 indicated.

An example in shown in the figure below.

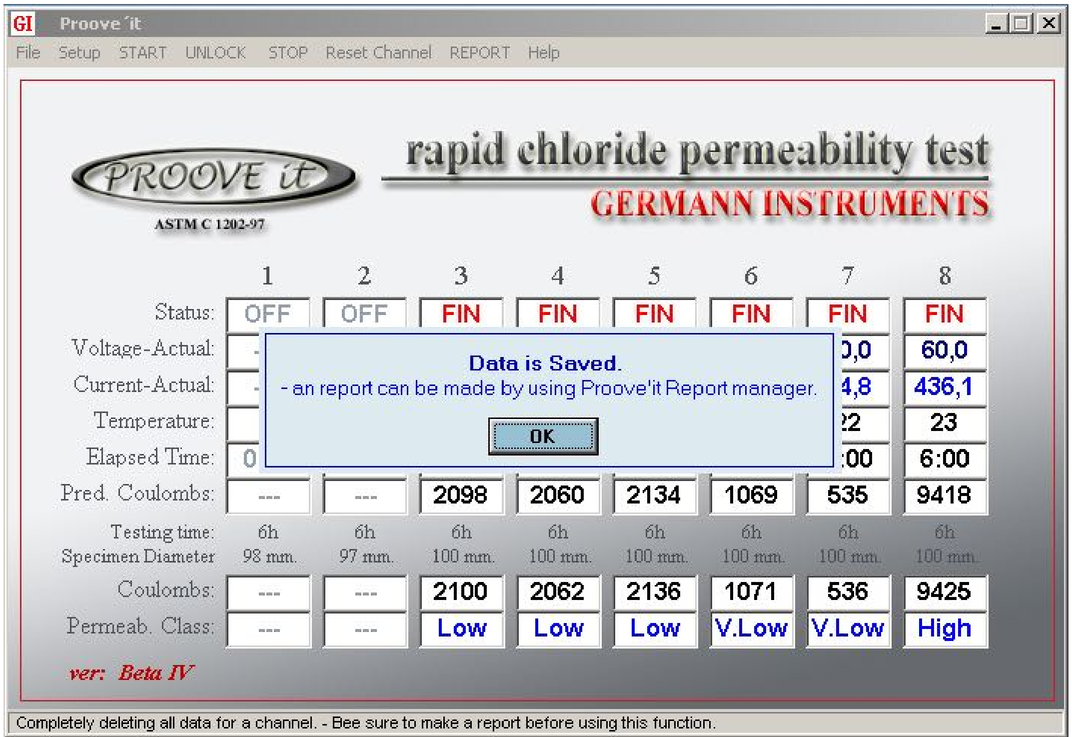


Only for 95 mm in diameter specimens the coulombs indicated will be the same as the adjusted ones.

Pointing with the mouse arrow on any of the windows on the screen picture will produce pop-out windows with explanatory notes for each window.

To save the data and reset the channels follow the instructions at the top of this screen.

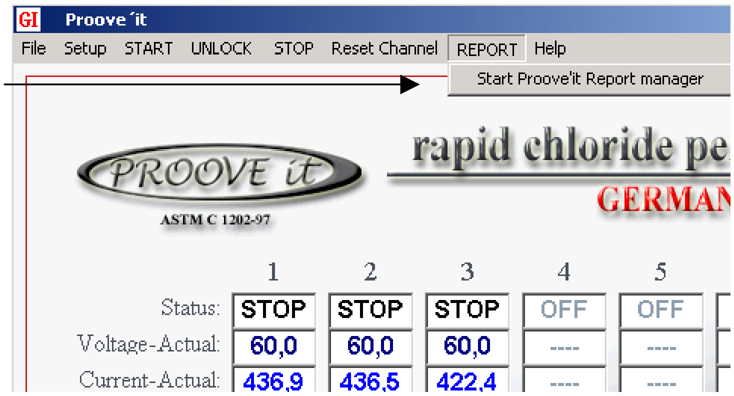
Once the results are saved for a channel the screen shown below will appear with a confirmation.



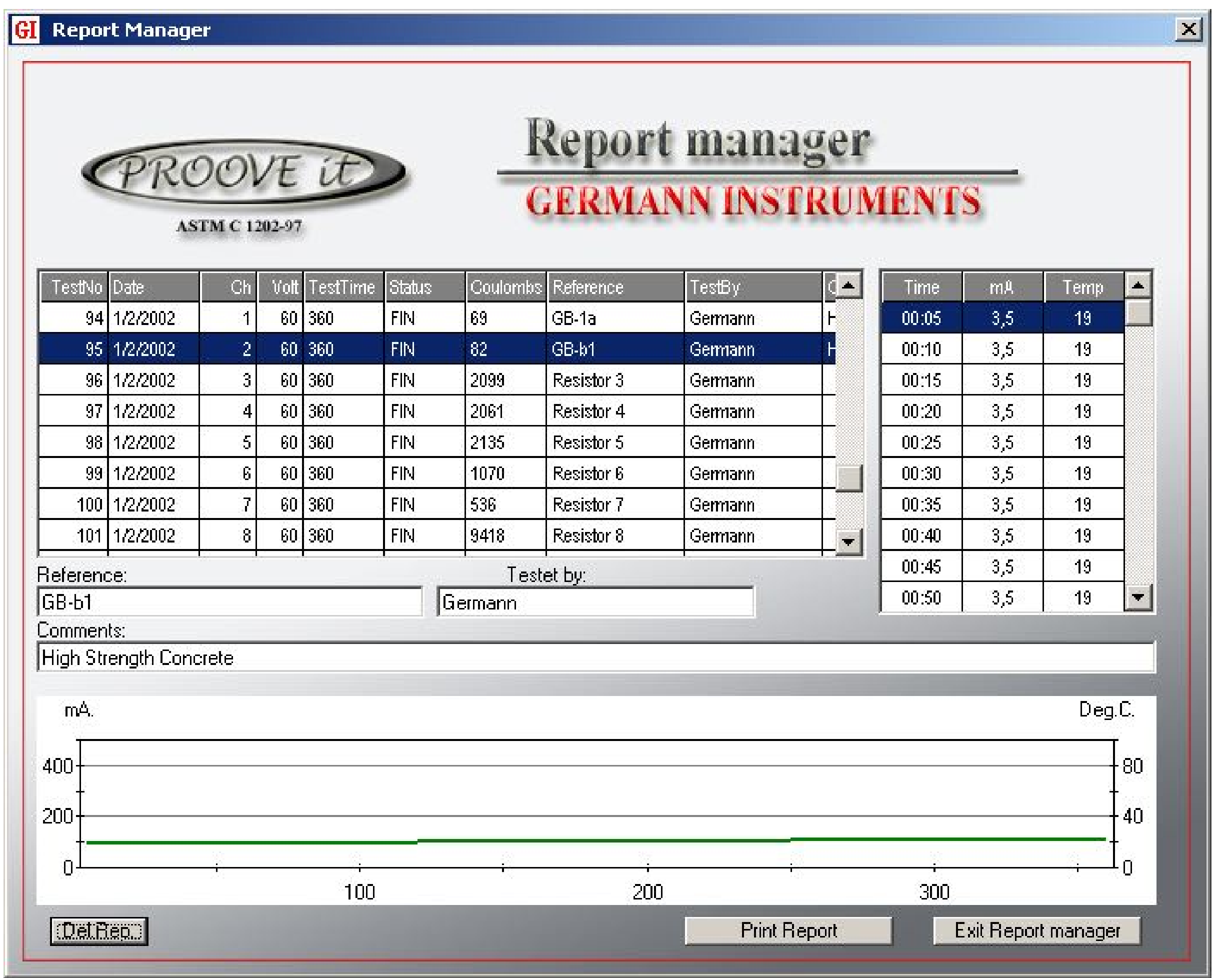
If the Stop-option has been used, the software asks if the data has to be saved.

12. Report

To print a report with test data the **PROOVE'it Report Manager** utility is used. It can be started either from using the REPORT in the menu shown below. Alternatively the **PROOVE'it Report Manager** can be started from the folder **Programs** and then the subfolder **PROOVE'it** in the **Start**-menu

Menu	Options	Screen
Report	*Report:* To print a report of the data the **PROOVE'it Report Manager** has to be started.	

The **Report Manager** is shown below.



For each test made there is a Test No., Date of testing, channel number, status (if it was interrupted or completed), Coulombs measured, Reference, Test By and comments. See figure below:

TestNo	Date	Ch	Volt	TestTime	Status	Coulombs	Reference	TestBy	Com
2	12/7/2001	3			AFBRUDT	N.A.	testref	Kaj	Tets
12	10/12/2001	1	60	360	OFF	1020	Development	Kaj Jørgensen	ssss
26	12/16/2001	1	60	600	FIN	16893	Test Run		
27	12/16/2001	1	60	600	OFF	16893			
28	12/20/2001	1	60	360	OFF	654	Test run on resist	KSO	
29	12/20/2001	2	60	360	OFF	654			
30	12/20/2001	3	60	360	OFF	634			

A Test No. is opened by clicking at the test no. in the left column in the table shown above. The data for the channel selected is shown on the right side of the screen. For every 5 minutes the readings of the mA and temperature measured is saved in the database. See adjacent figure with a test running for 25 minutes:

Time	mA	Temp
00:05	433,8	18
00:10	436,9	20
00:15	436,8	21
00:20	436,8	22
00:25	436,9	22

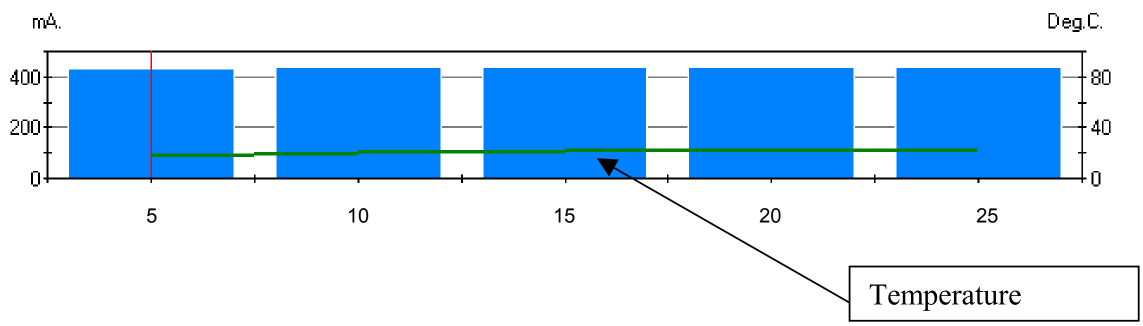
Below the tables it is possible to enter information about each sample tested such as reference number, ID of the technician who tested the specimen and comments, see the figure below:

Reference: Test run on resistors

Testet by: KSO

Comments: Test interrupted after 25 minutes

Finally at the bottom of the **Report Manager** the data is presented in graphics. Each blue column represents 5 minutes. The X-axis is automatically adjusted depending of the number of readings. The temperature readings are indicated with the green line. A specific reading can be chosen and the values for that reading is displayed in the table at the right side of the **Report Manager.**



Deleting data can be done by clicking on the button located in the lower left part of the Report Manager Windows with the name “Del. Rep.” Activating this button deletes the test data highlighted. E.g. Test no. 28, which is highlighted at the top of this page.

Once all information about a sample is entered, a report for each specimen can be printed out by activating the Print Report button at the bottom or using the **Report Manager**.

An example of a report is shown below for a very dense, high strength concrete:

PROOVE it

ASTM C 1202-97

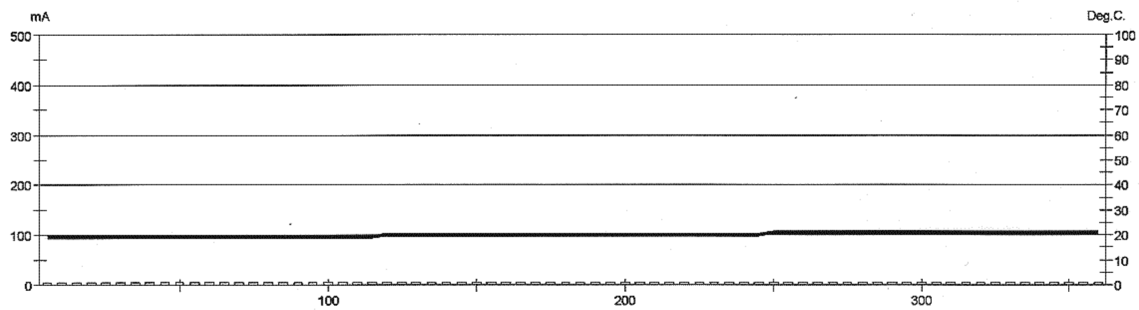
GERMANN INSTRUMENTS

DENMARK
Phone: +45 3967 7117
Fax: +45 3967 xxxx

USA
Phone: (847)329-9999
Fax: (847)329-8888

Test report

Voltage Used:	60
Testing time:	06:00 hour
Charge passed:	82
Adjusted Charge passed:	79
Permeability class:	Negligible
Instrument number:	020103
Channel number:	2
Report date:	02-01-2002
Testing by:	Germann
Reference:	GB-b1
Sample diameter:	97
Comment:	High Strength Concrete



Time	°C	mA	Time	°C	mA	Time	°C	mA	Time	°C	mA
00:05	19	3,5	01:35	19	3,6	03:05	20	3,8	04:35	21	4,0
00:10	19	3,5	01:40	19	3,6	03:10	20	3,9	04:40	21	4,0
00:15	19	3,5	01:45	19	3,7	03:15	20	3,9	04:45	21	4,0
00:20	19	3,5	01:50	19	3,7	03:20	20	3,9	04:50	21	4,0
00:25	19	3,5	01:55	19	3,7	03:25	20	3,9	04:55	21	4,0
00:30	19	3,5	02:00	20	3,7	03:30	20	3,9	05:00	21	4,0
00:35	19	3,5	02:05	20	3,7	03:35	20	3,9	05:05	21	4,0
00:40	19	3,5	02:10	20	3,7	03:40	20	3,9	05:10	21	4,0
00:45	19	3,5	02:15	20	3,7	03:45	20	3,9	05:15	21	4,1
00:50	19	3,5	02:20	20	3,7	03:50	20	3,9	05:20	21	4,1
00:55	19	3,5	02:25	20	3,8	03:55	20	3,9	05:25	21	4,1
01:00	19	3,6	02:30	20	3,8	04:00	20	4,0	05:30	21	4,1
01:05	19	3,6	02:35	20	3,8	04:05	20	4,0	05:35	21	4,1
01:10	19	3,6	02:40	20	3,8	04:10	21	4,0	05:40	21	4,1
01:15	19	3,6	02:45	20	3,8	04:15	21	4,0	05:45	21	4,1
01:20	19	3,6	02:50	20	3,8	04:20	21	4,0	05:50	21	4,1
01:25	19	3,6	02:55	20	3,8	04:25	21	4,0	05:55	21	4,1
01:30	19	3,6	03:00	20	3,8	04:30	21	4,0	06:00	21	4,1

It is possible to attach a company's logo or address to the top of the report. To do so, a file with the size 20 x 80 mm has to be made as a JPEG-file.

In the directory where the software is installed, a file with the name **Prooveit User Logo.jpg** is located. As a standard this logo will appear on the report. The logo looks as follows:

To change the logo the JPEG-file with the company name has to be renamed to **Prooveit User Logo.jpg** and has to overwrite the existing file.

If a report has to be made without a logo, the file "**for a blank logo rename this file to Prooveit User Logo.jpg"** located in the same directory has to be renamed to **Prooveit User Logo.jpg**.

13. Turning off the system

To turn off the **PROOVE'it**© software make sure all channels are in the OFF-Status. Then select **File** in the menu and **Quit Program**. The green indicator light on the power supply unit will turn into yellow.

Turn off the power supply. Disconnect the cells from each channel set of binding posts. Remove the temperature probes.

14. Maintenance of the vacuum pump

For oil exchange adhere to the maintenance manual enclosed with the vacuum pump.

To reach deep vacuum, FastVac pumps need clean, moisture-free oil throughout evacuation. Care should be taken to avoid contact on skin and clothing when changing oil. Used oil should be disposed of in a leak proof corrosive-resistant container.

- After every evacuation while pump is warm and oil is thin, place pump on level surface and open drain oil. Oil can be forced from the pump by opening one intake partially blocking the exhaust with a cloth while the pump is running. **Do not operate the pump for more than 20 seconds using this method.**
- Close drain. Remove oil fill cap and till to top of OIL LEVEL line with FastVac Pump Oil, Replace oil fill cap.

After evacuation, oil contains rust forming water and corrosive acids. Drain immediately while pump is warm.

For refilling, slowly add oil through the oil fill plug until the oil level rises to the top of Oil Level line. Replace the oil fill plug.

15. Disassembling the PROOVE'it© cell and maintenance of the cell

The cell(s) are placed in a sink. Unthread the nuts from the bolts using the two 17 mm wrenches. Allow the solution to be drained into the sink.

Remove the concrete specimen along with the gaskets from the cell and blot dry. For gaskets epoxied to the specimen gently pull off the gaskets. The rubber will be released from the epoxy for reuse. Clean the gaskets completely from epoxy remains. The gaskets may be reused as long as they are intact without cuts and permanents indents.

Clean all parts.

For checking the electrical continuity of the cell parts measure the electrical resistance between the mesh and the red or black jacks on the side face of the cell parts. The electrical resistance has to be less than 0.5 Ohm.

The meshes of the cell parts are inspected. The meshes have to be intact without corrosion damages.

Should such damages have occurred, a new mesh (PR-1003) is installed as follows:

15.1 Unthread the red or the black plastic parts of the banana binding posts.

15.2 Using a pair of pliers, unthread the emerging metal threaded part of the binding post from the cell part. Be careful not to ruin the thread.

15.3 Unthread the six Allen screws holding the stainless steel ring of the wire mesh unit with a 2.5 mm Allen key.

15.4 Remove the damaged mesh.

15.5 Oil the O-ring in the cell part slightly with silicone oil and install a new mesh.

15.6 Thread the six Allen screws back into position.

15.7 Mix a small amount of two component "Conductive Epoxy" and dip the end of the threaded part of the binding post into the conductive epoxy.

15.8 Thread the part into the cell part and tighten it.

15.9 Install the remaining parts of the banana binding post.

15.10 Check the conductivity between the metal part of the binding post and the mesh. The electrical resistance has to be lower than 0.5 Ohm.

16. Remarks

Line (mains) voltage
The voltage for the power supply can be 110 VAC or 220 VAC. The unit itself will sense the voltage and no adjustment has to be made by the operator.

Fuse
The fuse for the AC line (mains) voltage is placed at the back of the power supply. The channel fuses are internally mounted on the printed circuit board near the power transistors that are attached to the black external heat sinks. It is not easy to gain access to these fuses. See Appendix No. 1 for further information.

Predicted Coulombs
The menu will after 5 minutes of testing show the predicted Coulombs for a quick orientation. The predicted Coulombs will be updated every 5 minutes of testing.

Voltage output
The voltage output can only be chosen between 10, 20, 30, 40, 50 and 60 VDC. The testing cannot be performed if the voltage output is zero.

Temperature measurement
If the temperature probe is used and the temperature exceeds 90 degree Celsius the channel(s) will be turned off automatically to avoid boiling. If the temperature probe has not been installed the menu will show "N.A." during measurement.

Regulation of the temperature of the liquids
For regulation of the temperature of the liquids the PR-1100 cell with cooling ribs has to be used. A fan is positioned in the vicinity of the cell. Should the temperature measured in the liquids start rising above a required level the fan is turned on to enhance the airflow around the cooling ribs.

Excessive current (amps)
If any cell draws more than 500 mA of current, the unit will automatically turn off the cell and the status for that cell will show OVFL (overflow). In addition, each channel is short-circuiting protected. Despite this, it is still possible to destroy a channel transistor before the fuse blow if the precautions stated in appendix 4, page 29, are not followed.

17. References

1. ASTM C 1202-97: "Standard Test Method for Electrical Indication of Concretes Ability to Resist Chloride Ion Penetration".

2. AASHTO T 277-832: "Rapid Determination of the Chloride Permeability of Concrete".

3. "Recommended Procedure for Determination of Chloride Diffusion Coefficient by Using CTH Rapid Method", in "Chloride Transport in Concrete – Measurement and Prediction" by Tang Luping, Publication P-96:6, Chalmers University of Technology, Department of Building Materials, Gothenburg, Sweden, pp 75-88

4. Streicher, P.E. & Alexander, M.G.: "A Critical Evaluation of Chloride Diffusion Test Methods for Concrete", Third Canmet/ACI International Conference of Durability of Concrete, Nice, France Supplementary Papers, pp. 517-530.

5. Whitting, D.: "Rapid Determination of the Chloride Permeability of Concrete", Final Report No. FHWA/RD-81/119, Federal Highway Administration, August 1981, NTIS PB82140724.

6. Geiker, M el al: "Assessment of Rapid Chloride Permeability Test of Concrete with and without Mineral Admixtures", Fifth International Conference on Durability of Building Materials and Components, BRE, Brighton, 7-9 Nov. 1990.

7. Feldman, R.F. et al: "Investigation of the Rapid Chloride Permeability Test", ACI Materials Journal, May-June, 1994, pp. 246-255.

8. Scanlon, J.M. & Sherman, M.R.: "Fly Ash Concrete: An Evaluation of Chloride Penetration Testing Methods", Concrete International, June 1996.

Appendix 1

Replacing the fuses in the PROOVE it Microprocessor Power Supply unit

Line (Mains) Fuse

The unit line fuse is located on the back panel adjacent to the power cord receptacle. The fuse rating is 4 amps at 250 VAC. It is a slow-blow T4A/250V, 5 mm x 20 mm fuse.

Channel Fuses

The channel fuses are normally never replaced. If they are defect the reason is most certainly a defect channel. Such a defect channel has to be repaired by Germann Instruments.

The channel fuse type is T1L250, 1 amp at 250 VAC, 5 mm x 20 mm fuse.

Channel fuses are not easily accessible. All fuses are located on the circuit board by the power transistors at the back of the unit.

If fuses have to be replaced, first disconnect the power cord from the wall outlet for safety purposes. Then remove the side covers on the right side of the unit (when looking at the **PROOVE it** from the from panel).

Appendix 2

Calibration of the PR-1050 PROOVE'it© Microprocessor Power Supply unit

For calibration of the PR-1050 PROOVE'it© Microprocessor Power Supply unit the PR-1055 Calibration Unit is available, illustrated below in fig.4.

For 60 VDC the unit has options for the checking the current at 30 mA and at 300 mA. The accuracy on the calibration unit is within ±0.5 mA.

Each channel is at 60 VDC set up for testing after the unit has been connected to the channel in question. The "Current-Actual" indicated on the computer screen, p.16, is checked to be within 30 mA ±0.5 mA, respectively 300 mA ±0.5 mA for the two switch options on the calibration unit.

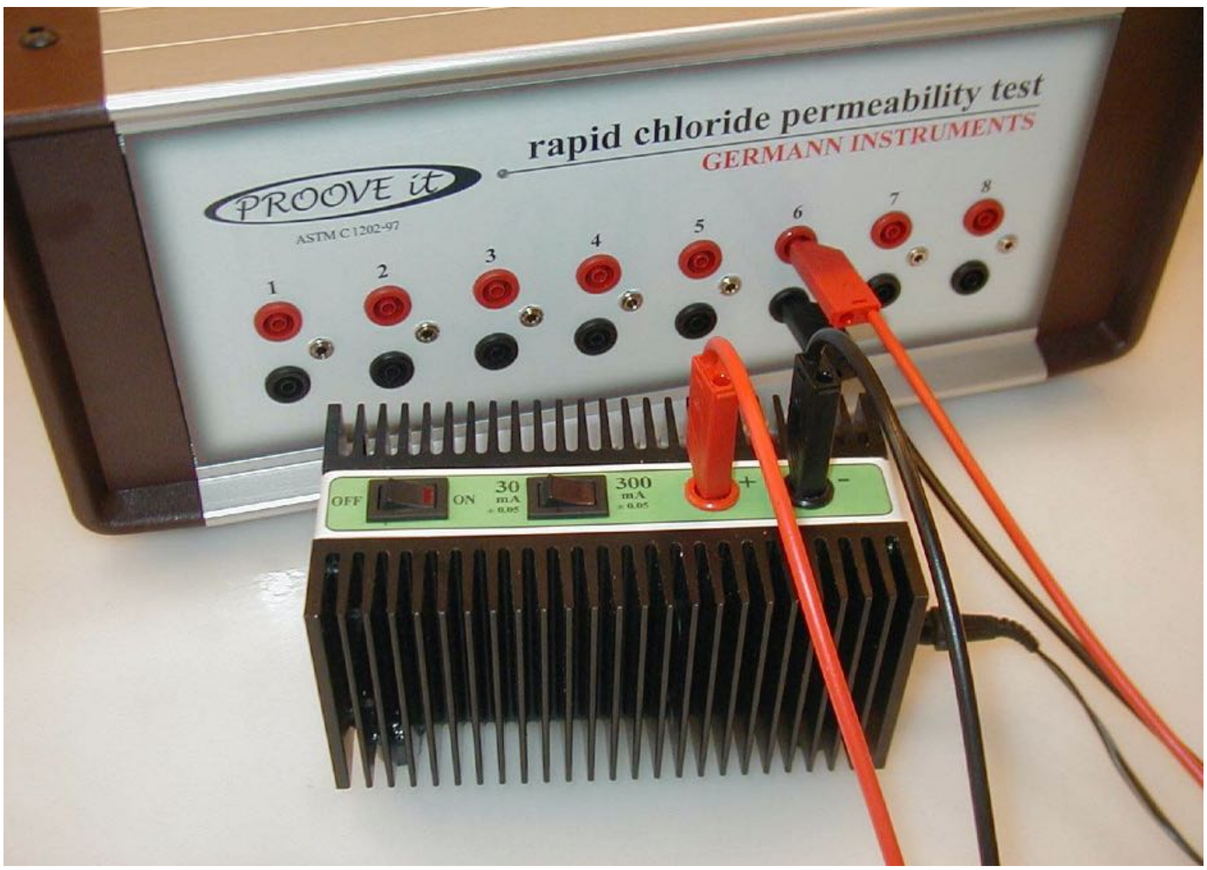


Fig. 4. The PR-1055 Calibration Unit shown hooked up to the PR-1050 PROOVE´it© Microprocessor Power Supply unit

Appendix 3

Comparative Coulomb results for different type of meshes installed in the PROOVE'it© cell

In table 3 and 4 comparative measurements of the Coulombs are reported for different types of meshes used in the PROOVE'it© cell. The meshes are:

Type I Mesh:
Stainless steel mesh with diameter 100 mm attached to a stainless steel ring with outer diameter 129 mm, 100 mm diameter effective conductive area after installment in the PROOVE'it© cell.
(Type of mesh used in PROOVE'it© cells produced before January 1st, 2002)

Type II Mesh:
Stainless steel mesh with diameter 75 mm attached to stainless steel ring with outer diameter 129 mm, 100 mm diameter effective conductive area after installment in the PROOVE'it© cell.
(Type of mesh used in PROOVE'it© cells produced after January 1st, 2002)

Type III Mesh:
Brass mesh with diameter 75 mm attached to brass ring with outer diameter 129 mm, 100 mm diameter effective conductive area after installment in the PROOVE'it© cell.
(Type of mesh recommended in the ASTM C 1202-97 standard)

Testing was conducted on two types of concretes, one with very low (100-1000 Coulombs) and one with moderate (2000-4000 Coulombs) chloride ion penetrability.

A total of 18 samples, 9 from each permeability class, were tested. The testing was performed with each sample tested first with one type of mesh, then another mesh type with the same sample, and finally, the third type of mesh. The numbers in parenthesis in the tables below indicates the sequence of testing.

Sample	Type I Mesh (Coulombs)	Type II Mesh (Coulombs)	Type III Mesh (Coulombs)
1	(1) 181	(2) 180	(3) 205
2	(3) 166	(1) 156	(2) 186
3	(2) 148	(3) 156	(1) 140
4	(1) 298	(2) 299	(3) 315
5	(3) 260	(1) 241	(2) 255
6	(2) 191	(3) 201	(1) 170
7	(1) 170	(2) 162	(3) 182
8	(3) 204	(1) 185	(2) 196
9	(2) 186	(3) 205	(1) 179
Ave.	***200***	***198***	***203***

Table 3. Low Chloride Ion Penetrability Class test results

Sample	Type I Mesh (Coulombs)	Type II Mesh (Coulombs)	Type III Mesh (Coulombs)
10	(1) 2435	(2) 2896	(3) 3155
11	(3) 2989	(1) 2234	(2) 2655
12	(2) 2490	(3) 2710	(1) 2265
13	(1) 2296	(2) 2675	(3) 3002
14	(3) 2988	(1) 2353	(2) 2699
15	(2) 2661	(3) 2954	(1) 2312
16	(1) 2208	(2) 2461	(3) 2846
17	(3) 3199	(1) 2430	(2) 2705
18	(2) 2801	(3) 3009	(1) 2430
Ave.	***2696***	***2636***	***2674***

Table 4. Moderate Chloride Ion Permeability Class test results

The conclusion is that the different types of meshes classify the concretes tested in the same permeability classes.

Appendix 4

How to avoid fatal errors with the PROOVE´it power supply unit

As a general rule, the current running from one channels red jack of the power supply unit has to run back through the same channels black jack (the green current path on the sketch page 30).

If there, for the same channel, is a difference in the current being transmitted and being received, the power supply will suffer severe damage (e.g. as illustrated by the two red current paths on the sketch page 30).

Also, the unit will suffer irreversible damage if the cords from one channel are short-circuited or cross-circuited between different channels.

NOTE, please:

The **BLACK JACK** on each channel is **NOT A COMMON GROUND.**

EACH CHANNEL of the 8 channels of the power supply unit is an **INDIVIDUAL CHANNEL.**

NEVER CROSS-CONNECT CHANNELS.

CONNECTION **and** DISCONNECTION **of the cords has** ALWAYS **to be made with the power supply** TURNED OFF.

For proper operation:

1. Make sure the cell containing the concrete sample and the solutions is watertight before testing.
2. Make sure the exterior of the cell is dry.
3. The power supply is turned off.
4. Connect then the **red jack** from one channel to the **red terminal** of the cell with the **red cord**. Similarly, connect the same channels **black jack** to the **black terminal** of the cell with the **black cord**.
5. **Never** place the cell on top of the power supply unit.
6. **Never** place the power supply unit and the cell(s) on a grounded steel table as illustrated on the enclosed sketch.
7. **Always** place an **insulation material** between the cell(s) / power supply and the table being used, e.g. a heavy plastic sheet or a dry wooden plate.
8. Once all the connections have been made, check the connections again as instructed above, and then turn on the power supply.
9. **Never** touch the cords during testing.
10. Turn off the power supply before disconnecting the cords.
11. If the testing has to be interrupted, first turn off the power supply, then disconnect the cords.

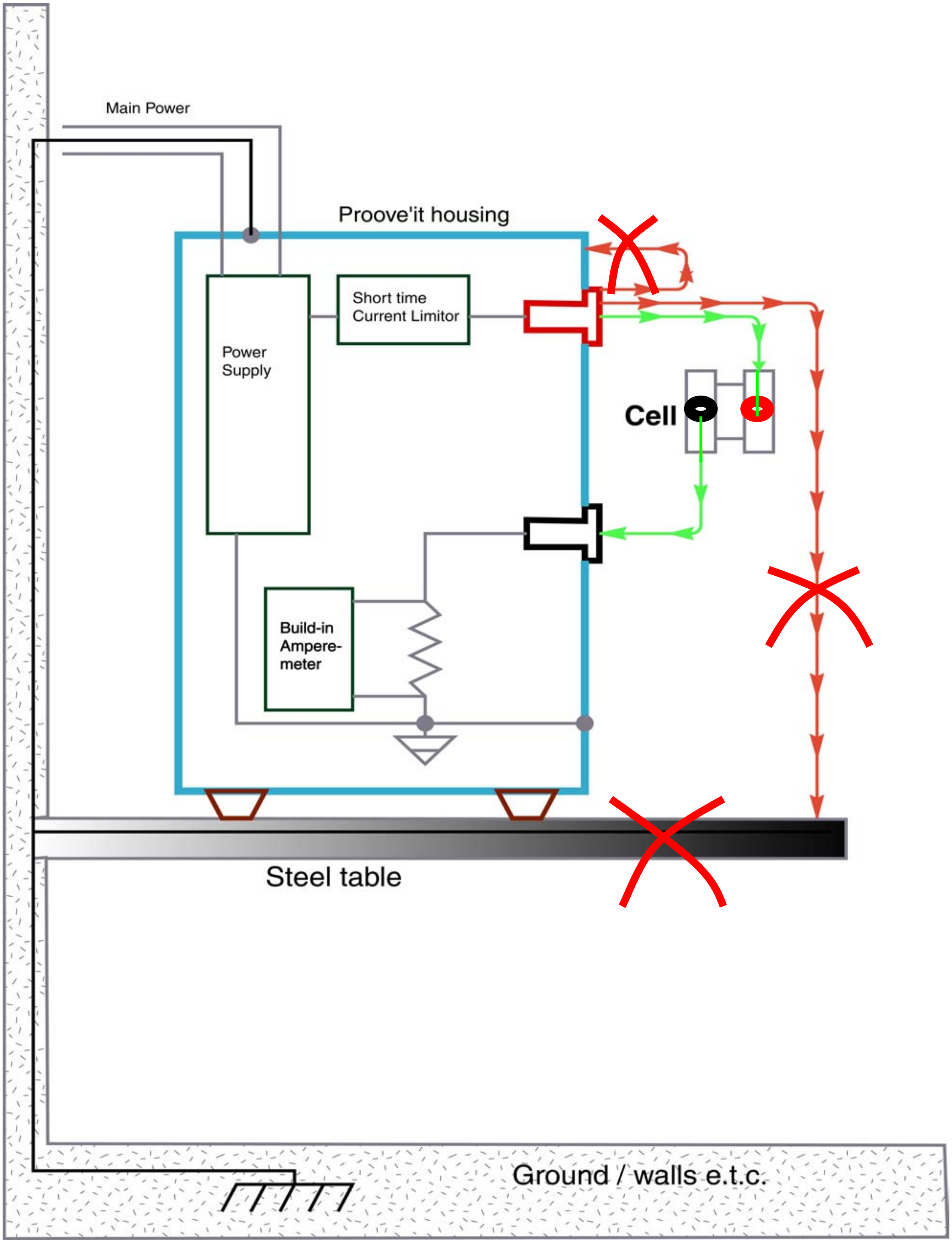


Fig.5. Correct current path (→) and incorrect current paths (→) for one channel of the PROOVE´it power supply. Note: The black jacks of the power supply are NOT common ground. Never cross-connect different channels.

Appendix 5

The PROOVE'it© Cells illustrated

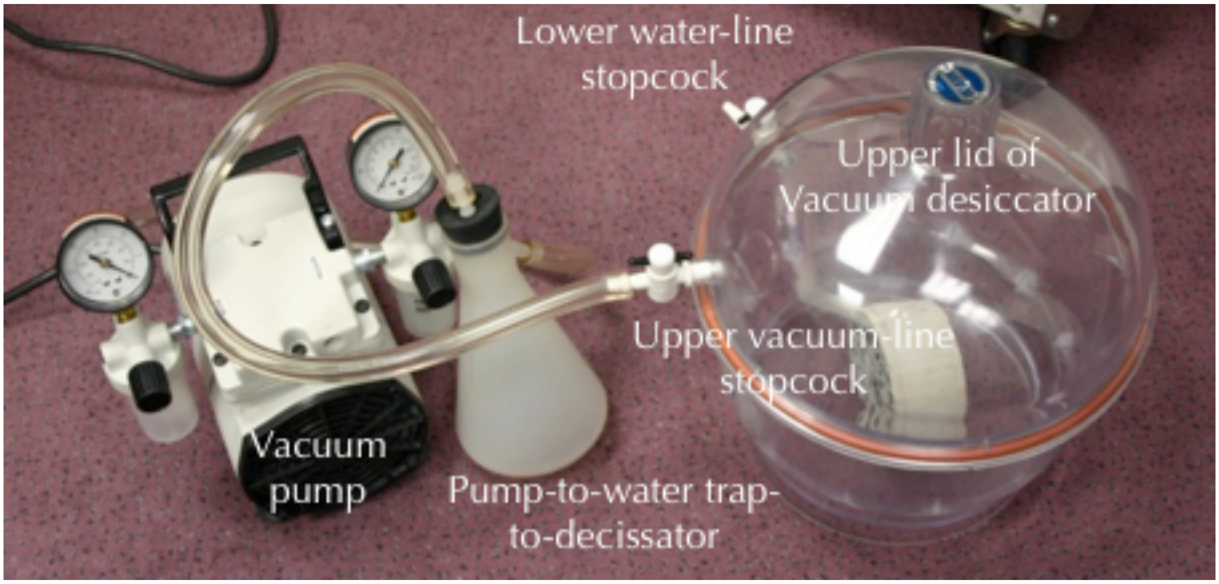
Fig.6. The two types of ***PROOVE'it©*** *Cells, the PR-1000 Standard Cell (left) and the PR-1100 Cell with Cooling Ribs (right)*

ASTM C1202-10: Chloride Permeability
[A] Sample Preparation & Conditioning

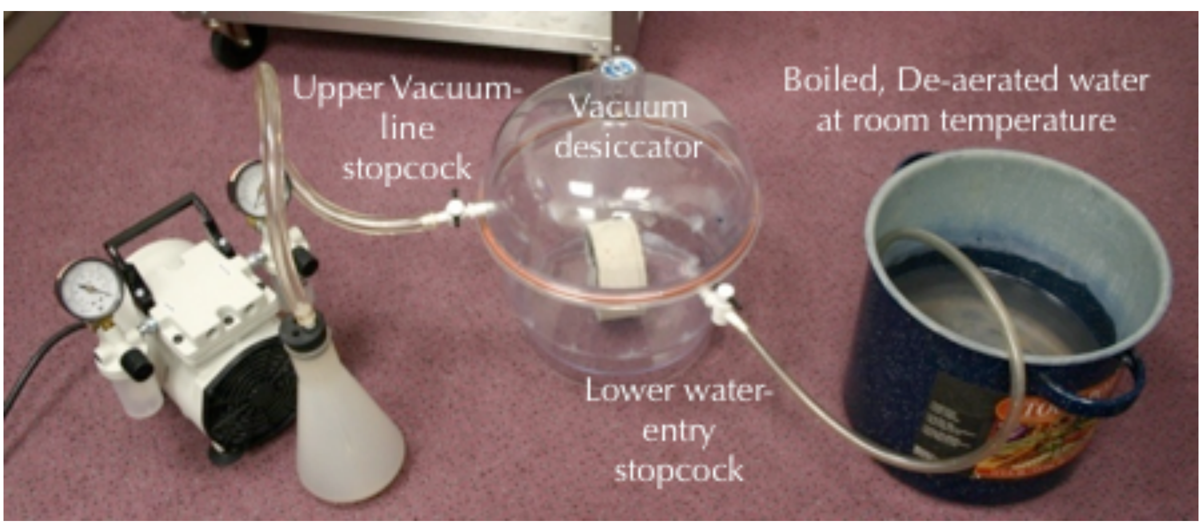
Conditioning:

1) **De-Aerated Boiled, Sealed, and Air-Cooled wate**r - Vigorously boil a liter (2-gallon) or more of tap water in a large sealable container to remove air. Remove container from heat, cap tightly, and allow water to cool to room temperature.
2) **Sample Sectioning & Air-Drying** - Cores and cylinders must be 100mm (4-in.) diameter. Cut the core or cylinder to 2-inch length and grind the sectioned ends down to 1 7/8in. length (50mm) by light lapping on a coarse metal-bonded lapping plate. Allow the core or cylinder samples (prepared to 1 7/8 in. thickness by sectioning and lapping) to surface dry in air for at least 1 hour.
3) **Sample Coating (for Cores only)** - Prepare approximately ½ oz. (10 grams) of rapid-setting coating or epoxy and brush as a thin layer onto the side (i.e. cylindrical) surface of specimen. Place the sample on a suitable support white coating to ensure complete coating of sides. Turn sample up side down after 5 minutes to reduce dripping and ensure epoxy is evenly distributed along surface. Make sure NO epoxy is applied to sectioned ends. Grind off any epoxy that gets on sectioned ends. Allow coating to cure according to manufacturer's instruction. The coating should be allowed to cure until it is no longer sticky to the touch. Fill any apparent holes in the coating and allow additional curing time, as necessary. For cylinders it is not necessary to coat the cylindrical surface.
4) **Repair of Spalled Cylinders and Cores** - Beuler Vardur Powder and Hardener Ratio-Approximately 2:1, 2 parts powder to 1 part liquid (should be the consistency of cake batter). Use clear packing tape to build up around the top/bottom of sample where spalling has occurred. Apply patch only in spalled area. Let it dry for 10 minutes. Grind down excess patch close to original surface.
5) **3-hr Vacuuming** - Place above-prepared samples in the large chloride permeability vacuum desiccator that has an upper lid with the vacuum-line upper stopcock valve, and, the sealable lower container (with an O-ring) with the water-entry stopcock valve. Place samples vertically i.e. on their end sides exposed to maximize vacuuming and water penetration. Place the upper lid on desiccator. Connect vacuum line to the stopcock at the upper lid of the bowl and open valve. Close the opposite stopcock valve at the lower half of the desiccator. Seal the desiccator, turn on the vacuum pump, and pressure should decrease to less than 50 mm Hg (6650 Pa) within a few minutes. Maintain the vacuum for three (3) hours.
6) **1-hr Water Immersion of Samples in Vacuum** - Attach hose to the lower water-entry stopcock and place the other end of hose deep into the container with the boiled, de-aerated water After three (3) hours in vacuum, with vacuum pump still running, open water stopcock valve at the bottom half of the desiccator and drain sufficient water into the desiccator to cover the sample completely (do not allow air to enter desiccator through this stopcock). Allow the de-aerated water

to flow slowly into the desiccator by opening the water-entry stopcock only slightly. Don't let water splash, no air should enter the desiccator. Close the lower water-entry stopcock value when the samples are completely covered. Run the vacuum pump for another one (1) hour.



7) **__18-hr Immersion__** - Close the upper vacuum-line stopcock and turn off the pump. (Change pump oil if a water trap is not being used). We use a water trap in between the vacuum pump and the desiccator, as shown. Open the vacuum-line stopcock to allow air to re-enter the desiccator. Soak the samples under water for 18 ± 2 hrs.



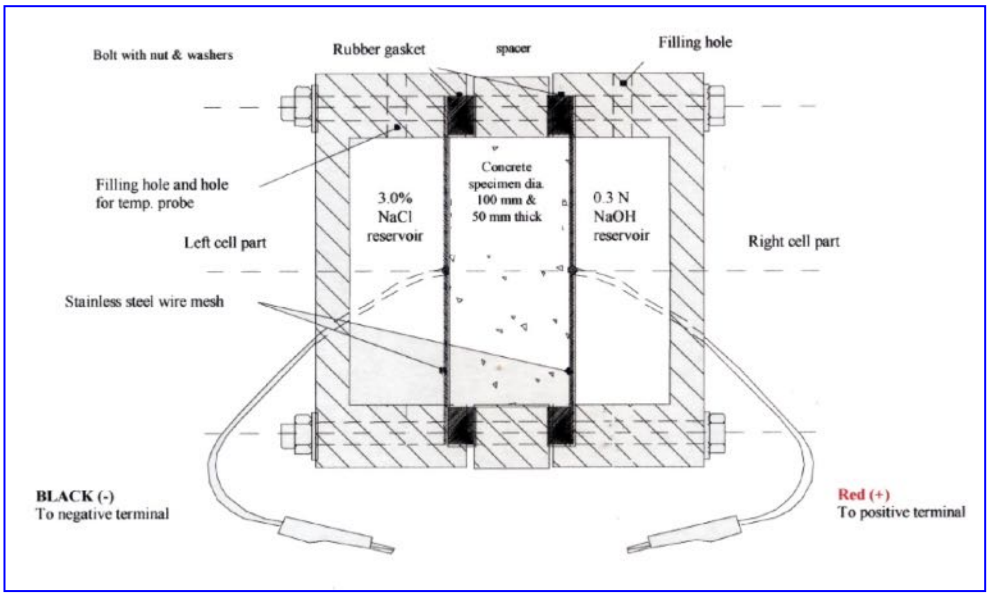
After soaking for 18 ± 2 hours remove specimen from water, blot off excess water, and transfer to a sealed container that will maintain the specimen in 95% or higher relative humidity unless the specimen is reading for mounting with rubber gaskets for the permeability cells.

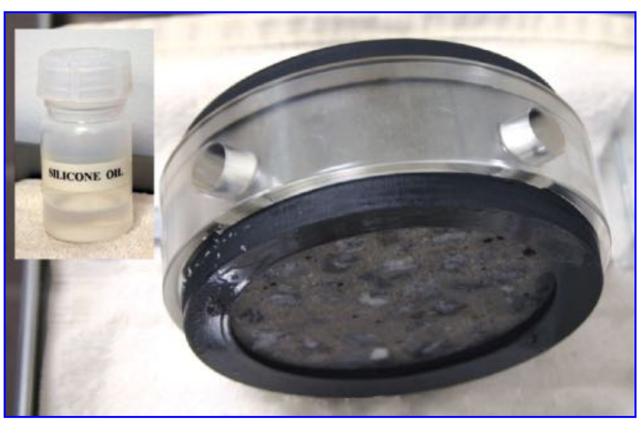
ASTM C1202-10: Chloride Permeability
[B] PROOVE'it Procedures

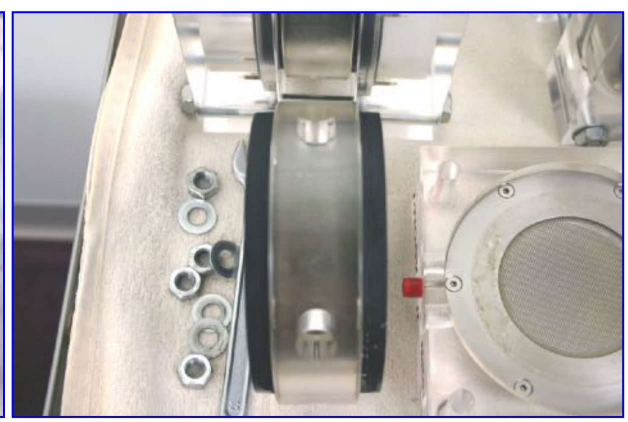
Proove it Cells:

Sample Assembly

1) Disassemble empty PROOVE'it cell.
2) Choose correct rubber gasket for cores/cylinders. (Cylinder gaskets are slightly larger.)
3) Lubricate one side of gasket with liquid silicon.
4) Place gasket around sample with oiled side facing toward the center of the sample.
5) Place spacer over sample and centrally on the gasket.
6) Oil another gasket and press on other end of sample with the oiled side facing toward the sample. Make sure the sample is centrally located in spacer with equal spacing of the gaskets at the ends.
7) Oil outside faces of both gaskets.







8) Reassemble cells making sure the black and the red terminal posts point in the same direction.

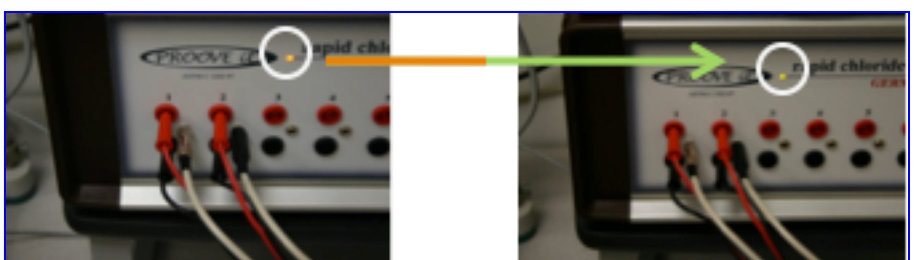
9) Tighten bolts in an alternating pattern. Do not over tighten bolts as to crack the cell.

Filling Reservoirs

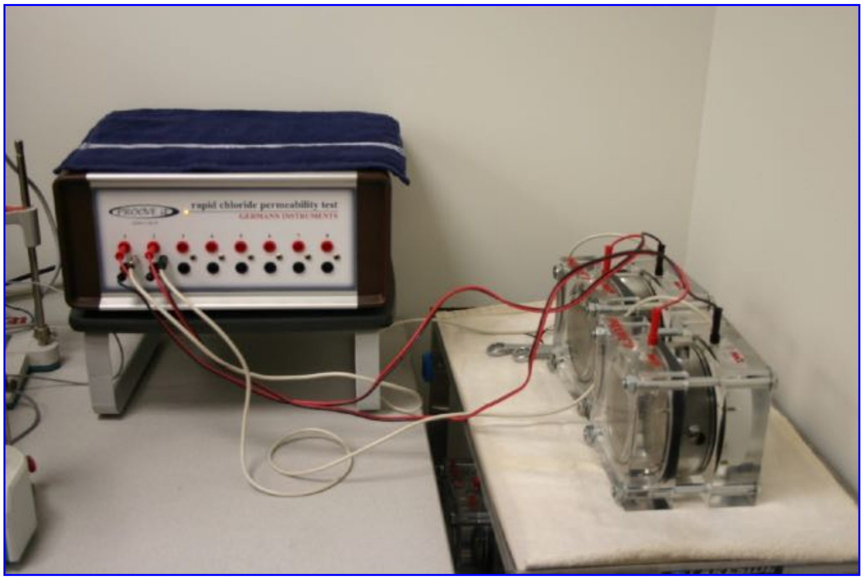
1) Add distilled water in the NaCl and NaOH reservoirs and set on dry paper to check for leaks. Tighten bolts if necessary.
2) Empty out distilled water and add the .3N NaOH and 3%NaCl to their respective reservoirs. Fill to 2-3mm **below** filling tubes of cell to allow for expansion of solutions.
   a) 0.3N NaOH 12g NaOH per 1 liter distilled water
   b) 3% NaCl 30g NaCl per 1 liter distilled water

Connections

1) Turn on Chloride Permeability computer - In this order:
2) Plug in cells to PROOVE'it apparatus. Black jack of #1 cell to black jack of #1 channel and red to red…
3) Connect temperature gage to PROOVE'it and place probe in ºC hole in corresponding cell.
4) Turn on switch located on back of PROOVE'it. Amber light should come on.
5) Turn on PROOVE'it Program. Amber light should turn to green along with a clicking sound as the PROOVE'it program recognizes the PROOVE'it hardware.
6) Red light means check connection.
7) **Note:** The Power supply will suffer irreversible damage if the cords from one cell are crossed with another channels cells. Also, attaching the cell after turning on the unit can cause a surge in current that will damage the internal control circuitry.



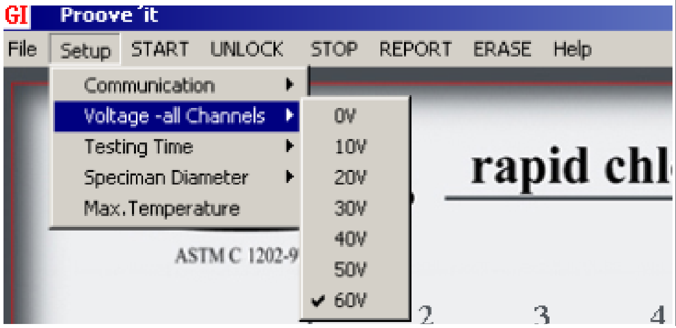
Amber to green

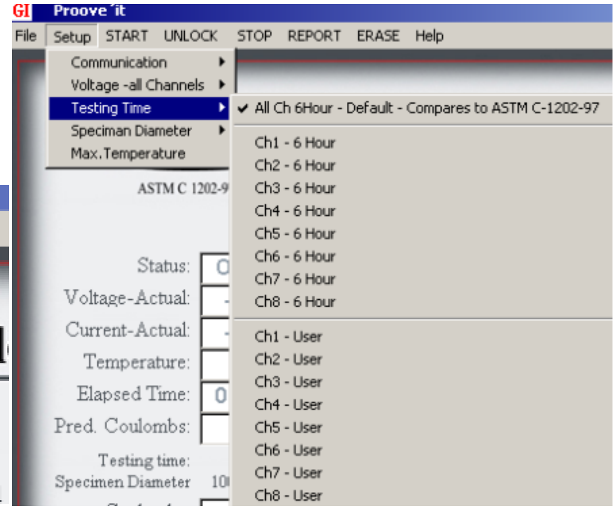


Set up

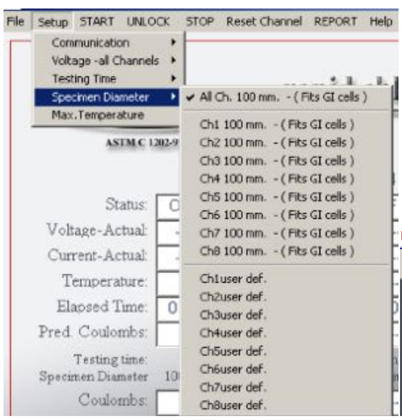
Proove it Program Setup

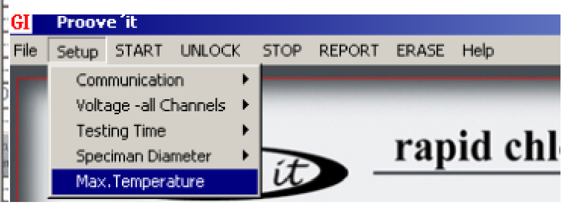
In Setup dropdown menu:



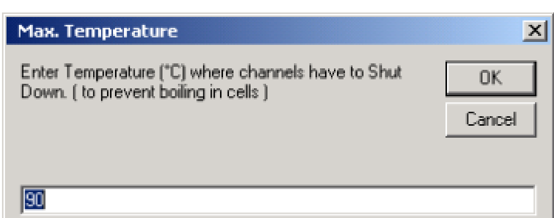


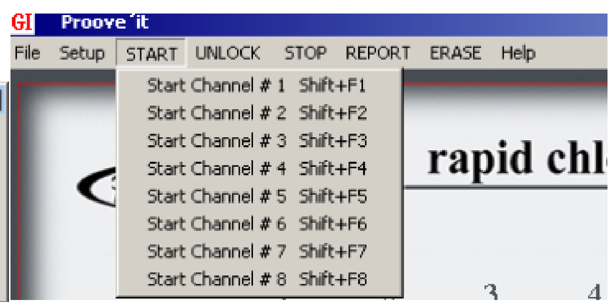
Voltage-all channels-60V; **Testing Time**-6 hours.





Specimen Diamter-100mm

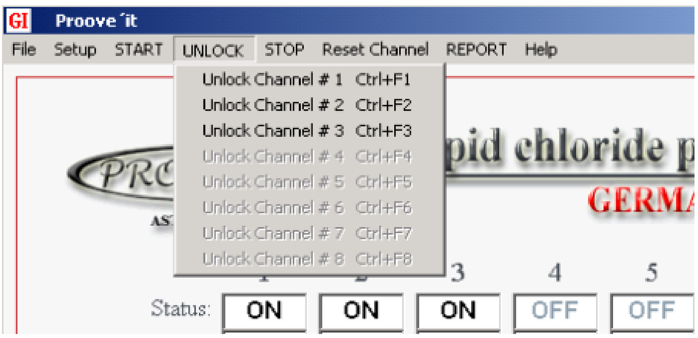




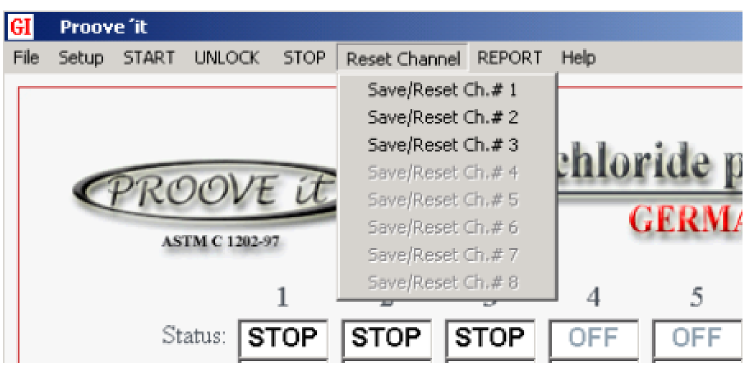
Max Temperature -90°; Select **Start Channel** number corresponding to cell connections.

Test/Program End

1) Test will stop automatically after 6 hours.
2) If temperature probes record a temperature above 90º before the 6 hours, test will stop.
3) If it is necessary to stop test before the 6 hours is up, first go to Unlock then Stop.
4) Unlock will not interrupt the test.
5) Stop will end the test and it cannot be started again from that point. Resetting the channel will start the test over from the beginning.



6) If it is necessary to stop test before the 6 hours is up, first go to Unlock then Stop.
7) Unlock will not interrupt the test.
8) Stop will end the test and it cannot be started again from that point. Resetting the channel will start the test over from the beginning.
9) Select Save - Reset from Reset Channel for each channel/cell.



10) For Report – Start Proove it Report Manager – Select the Test No. in the manager for the present runs. Insert CMC Project No. under the Reference, then Tested by…., and Sample ID in the Comment Section. Then select Print Report – Adobe PDF – create a CMC Project Folder under Proove it Reports folder and save the files for each run under the project folder.