



# Ger Mann Instruments, Inc.

*Test Smart – Build Right*



User Manual – v4.0



For:

ASTM C 1202

AASHTO T 277-832

ASTM C 1760

NT BUILD 492

& French Standards XP P 18-461 or XP P 18-462

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## 1. Introduction

### 1.1 Prove'it® Classic

The **Proove'it**® Classic Microprocessor Power Supply Unit is capable to perform testing with up to 8 channels simultaneously at one set voltage (*See figure 1*). The voltage range is 0 to 60 V, adjustable in 5 V steps. Therefore, the Proove'it Classic can be used for testing in accordance with:

- ASTM C 1202 "Standard Test Method for Electrical Indication of Concretes Ability to Resist Chloride Ion Penetration" (so called The Rapid Chloride Permeability Test or RCPT).
- ASTM C 1760 "Standard Test Method for Bulk Electrical Conductivity of Hardened Concrete".
- NT BUILD 492 "Nordtest Method for concrete, mortar and cement-based repair materials: Chloride Migration Coefficient from Non-Steady State Migration Experiments".
- XP P 18-462 "Accelerated Migration Test of Chloride Ions under Non-Steady State".
- XP P 18-461 "Accelerated Migration Test of Chloride Ions under Stationary State".

The software and all testing cells are compatible with the microprocessor power supply unit.

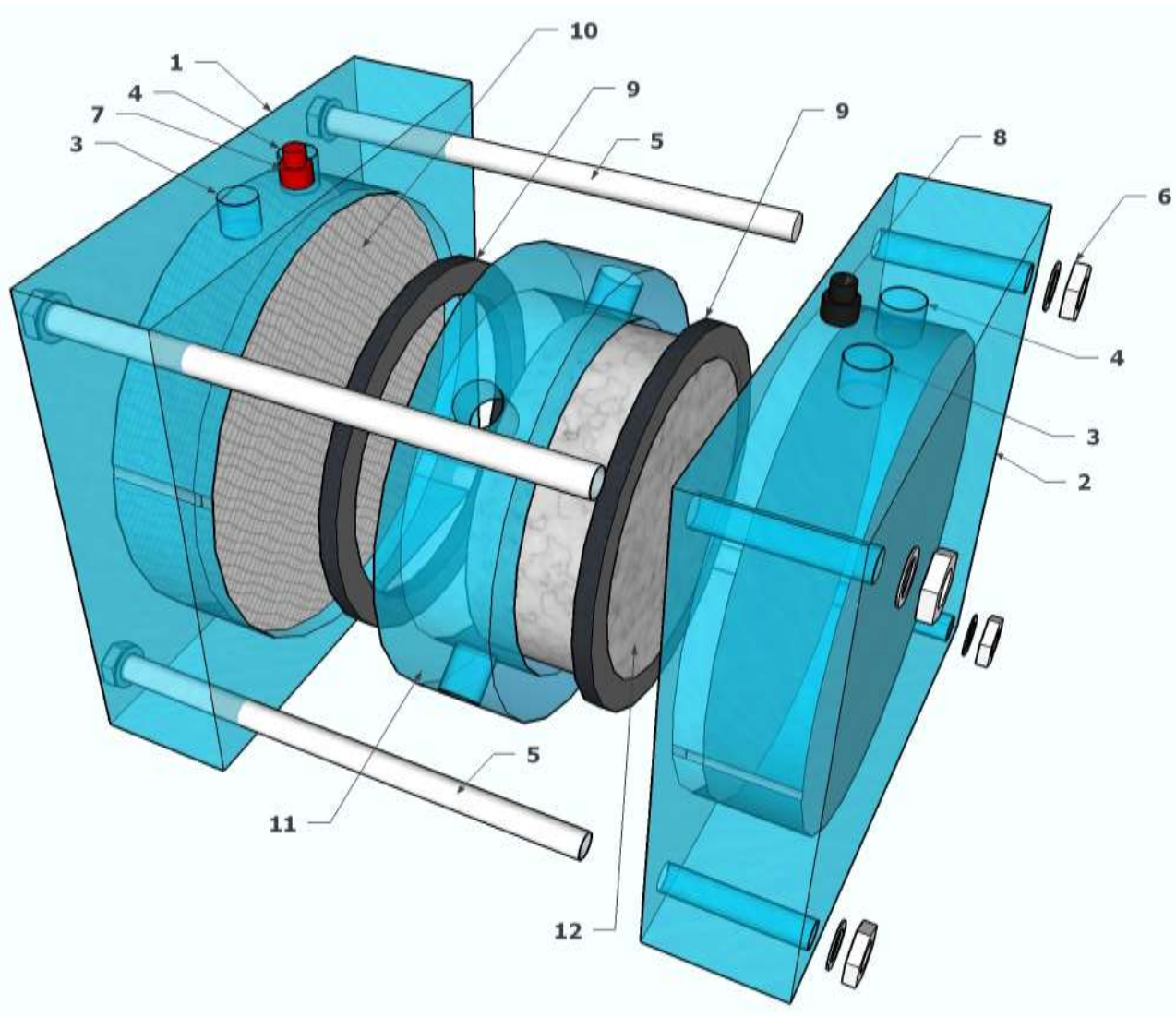


**Figure 1** The PR-1050 Prove'it Classic for up to 8 cells.

### 1.2 Prove'it Cell

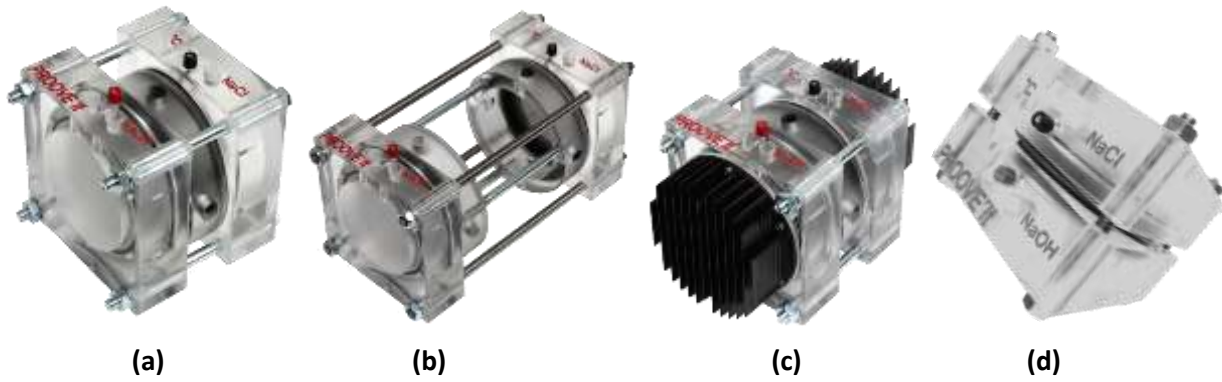
The cell is the accessory that holds the concrete specimen, the NaCl and the NaOH solutions in order to perform the test (*See figure 2*).

The standard cell might have some variations depending on the test standard to be run, such as: ASTM C1202, ASTM C1760, NT Build 492, etc. (*See figure 3*).



**Figure 2** The schematic of a standard Prove'it cell.

- |  |                               |
|--|-------------------------------|
| <b>1.</b> Reservoir for NaCl solution. | <b>7.</b> Red banana jack.    |
| <b>2.</b> Reservoir for NaOH solution. | <b>8.</b> Black banana jack.  |
| <b>3.</b> Solution filling inlet.      | <b>9.</b> Sealing gasket.     |
| <b>4.</b> Solution filling inlet.      | <b>10.</b> Wire mesh.         |
| <b>5.</b> Steel bolt.                  | <b>11.</b> Spacer.            |
| <b>6.</b> Washer and nut.              | <b>12.</b> Concrete specimen. |



**Figure 3** The Proove'it testing cells.

- (a)** The standard PR-1000 cell for ASTM C 1202.
- (b)** The PR-1200 cell for ASTM C 1760.
- (c)** The PR-1100 cell with cooling ribs for NT BUILD 492, and RCPT with optional heat reduction.
- (d)** The PR-1000-113-20 modified for the French standard XP P 18-461 for 113 mm diameter and 20 mm thick specimens (cooling ribs can also be mounted here).

**NOTE:** For stabilization of the temperature of the liquids, the PR-1100 cell with cooling ribs has to be used. A fan can be positioned in the vicinity of the ribs. Should the temperature measured in the liquids start rising above a required temperature level, the fan is turned on to enhance the airflow around the cooling ribs to release the heat from the cells.

### 1.3 ASTM C 1202 using the Proove'it Cell PR-1000 (See figure 3.a)

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 ASTM C 1202-12<sup>[1]</sup> or AASHTO T 277-831<sup>[2]</sup>. The unit measures the electrical current passing through a concrete specimen for a period of standard 6 hours at a standard voltage of 60 V-DC.

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, an indication of the concrete's ability to resist chloride ion penetration for a specimen with a diameter of 95 mm (3 ¾"), 50 mm long (See table 1).

**Table 1** Chloride ion penetrability based on charge passed<sup>[1]</sup>.

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 modified concrete
<100	Negligible	Polymer modified concrete

The software permits specimens with diameters other than 95 mm 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.

**NOTE:** To ensure quick, trouble-free and watertight assembling of the cells, the recommended size of the specimens for the Proove'it is 100 mm in diameter by 50 mm thickness and use the B-Gasket. For other diameters, ranging from 93 mm to 104 mm, matching gaskets are available for the Proove'it cells (See table 2).

The specimen is positioned in the PR-1000 standard 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 and the NaOH reservoir to the positive terminal of the Proove'it® Microprocessor Power Supply unit.

The Proove'it® software (ProovePC) is installed in a PC or laptop with Windows 10, 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, the test will be automatically interrupted to avoid boiling. The PR-1100 cell will avoid heating effects with its cooling ribs. The consequence of overheating is that the relative Coulombs measures will be higher.

The cells may be started up at different times and its time of testing may also be chosen individually.

#### **1.4 ASTM C 1760 using the Proove'it Cell PR-1200 (See figure 3.b)**

The Proove'it® system can also be used as specified in ASTM C 1760 for measuring the bulk electrical conductivity of hardened concrete, which has a theoretical relationship to the diffusion coefficient of chloride ions in the concrete<sup>[17][18]</sup>. Experimental data<sup>[19][20]</sup> confirm that there is a correlation between the bulk electrical conductivity and the apparent chloride diffusion coefficient as measured by the non-electrical methods ASTM C 1556 "Test Method for Determining the Apparent Chloride Diffusion of Cementitious Mixtures by Bulk Diffusion" or NT BUILD 443 "Concrete, Hardened: Accelerated Chloride Penetration". These two methods require, however, a minimum ponding period of the specimen of at least 35 days for natural diffusion to take place. The apparent chloride diffusion coefficient allows service life estimation using Fick's Second Law of Diffusion.

With the ASTM C 1760, water saturated cylindrical specimens, 100 mm in diameter by 200 mm length, are used as a standard. For cores, the trimmed core length has to be between 100 and 200 mm. A 3% NaCl solution is used in both chambers of the testing cell and the testing takes place at 60 V-DC. The current is recorded on the screen after 1 minute of test to the nearest 0.1 mA.

The part number of the cell required to perform this test is PR-1200. For this testing procedure, the cells are mounted with two spacer rings with appropriate holes, spacer distance pieces (for 200 mm long specimens) and four threaded rods with nuts and washers (See figure 3.b).

The bulk electrical conductivity is finally calculated as:

$$\sigma = K \times I_1 \times L / (V \times D^2)$$

Where:

$\sigma$  = bulk electrical conductivity, mS/m (miliSiemens per meter)

K = conversion factor = 1273.2

$I_1$  = current at 1 min, mA

L = average length of specimen, mm

V = Voltage, V.

D = average diameter of specimen, mm

For concretes with Coulomb values (ASTM C 1202) ranging from 500 to 4000, the values of bulk electrical conductivity should be in the range of 3 mS/m to 20 mS/m.

**NOTE: An alternative to the ASTM C 1760** method is the **MERLIN<sup>®</sup>** system produced by Germann Instruments, measuring the bulk electrical conductivity (or the inverse – the resistivity) in a matter of seconds without using cells (*See figure 4*). Most importantly, the conductivity or resistivity can be measured on any sized specimens, not only 100 mm diameter x 200 mm long specimens. For larger specimens the **MERLIN GRANDE** is available.



**Figure 4** The MERLIN<sup>®</sup> system shown with the verification cylinder.

Testing takes 2 to 3 seconds and no cells are needed as with the Proove'it<sup>®</sup> system. For checking the system the verification cylinder is used to make sure the whole system is working properly with an accuracy of  $\pm 0.1\%$  in the range from 0.0255 MS/m to 254.65 mS/m.



### 1.5 NT BUILD 492 using the Proove´it Cell PR-1100 (See figure 3.c)

For performing the NT BUILD 492 using the **Proove´it**<sup>®</sup> Classic system, the PR-1100 cell with cooling ribs is needed in order to avoid the influence from heating.

The specimen for this test, a 100 mm in diameter, 50 mm long, is water saturated and positioned in the PR-1100 cell. After checking the cell for water-tightness, the NaCl chamber of the cell is filled up with a 10% NaCl solution (negative – black terminal) and a 0.3 M NaOH solution in the NaOH chamber (positive – red terminal) according to the NT BUILD 492.

First, the current is measured at a voltage of 30 V-DC then, as specified by the NT BUILD 492 standard, the voltage and the testing time is chosen independent of the initial measured current. The voltage settings can be set in increments of 5 V-DC in the range from 5 V-DC to 60 V-DC.

After the test has been completed, the specimen is removed from the cell and split. Then the penetration depth of the chlorides is determined by a 0.1 M silver nitrate solution on the freshly split surface and the Migration Coefficient calculated by the equation provided in the NT BUILD 492 standard<sup>[4]</sup>.

The calculated Migration Coefficient in units of  $10^{-12}$  m<sup>2</sup>/s is in the literature often named “Diffusivity”<sup>[13]</sup><sup>[14]</sup>. Note that this is not the “Diffusion Coefficient” obtained by NT BUILD 443 using the Fick’s Second Law of Diffusion for service life calculations, or by the Nernst-Einstein equation, although good correlations between them have been found.

Other standards like the French XP P 18-462 or XP P 18-461 specifies a similar procedure; however, a different cell arrangement may be needed (see figure 3.d). For example, for the XP P 18-461, stationary migration of chlorides, the PR-1000-113-20 is a modified cell available for 113 mm diameter by 20 mm thick specimens where cooling ribs can also be mounted.

## 2. Parts List

Below are listed all the items available for the **Proove'it**® system.

*Table 2 Parts list for the Proove'it system.*

	Ordering number
Proove'it® Classic Microprocessor Power Supply unit .....	PR-1050
ProovePC software, version 4.0 .....	PR-1040
Proove'it® Manual .....	PR-1090
Proove'it® Standard measuring cell for ASTM C 1202 with two rubber gaskets .....	PR-1000
*The PR-1010B gaskets are the standard if there is no specification.	
*Order should specify gaskets' size.	
Gaskets for specimen diameter of 104 - 102 mm (99 mm inner dia, outer dia. 127 mm).	PR-1010A
Gaskets for specimen diameter of 101 - 97 mm (93 mm inner dia, outer dia. 126 mm)...	PR-1010B
Gaskets for specimen diameter of 96 - 93 mm (90 mm inner dia, outer dia. 126 mm) ....	PR-1010C
Proove'it® Measuring cell for NT BUILD 492 with cooling ribs and two rubber gaskets ...	PR-1100
*The PR-1010B gaskets are the standard if there is no specification.	
*Order should specify gaskets' size.	
Proove'it® Measuring cell for ASTM C 1760 with two rubber gaskets .....	PR-1200
*The PR-1010B gaskets are the standard if there is no specification.	
*Order should specify gaskets' size.	
Proove'it® Measuring cell for the XP P 18-461 .....	PR-1000-113-20
Proove'it® Measuring cell with cooling ribs for the XP P 18-461 .....	PR-1001-113-20
Red connecting cord .....	PR-1001
Black connecting cord .....	PR-1002
Spare mesh for cells .....	PR-1003
Temperature probe for Proove'it® Classic, one per channel .....	PR-1005
Two 17 mm wrenches .....	PR-1006
300 ml bottle of 3.0 % NaCl solution (only for ASTM C 1202) .....	PR-1020
300 ml bottle of 0.3 N NaOH solution (only for ASTM C 1202) .....	PR-1030
Cable for power supply 220 V-AC .....	PR-1064
Cable for power supply 110 V-AC .....	PR-1065
RS-232C serial cable (Classic version) .....	PR-1066
USB cable .....	PR-1067
Verification unit .....	PR-1055
 <b>For saturating the specimens with water</b>	
Vacuum desiccator for humidifying 8 samples .....	PR-1069
Vacuum desiccator for humidifying 16 samples .....	PR-1070
Vacuum pump with hose for < 50 mm Hg vacuum (specify 110 or 220 V-AC) .....	PR-1080
Vacuum pump with hose for < 10 mm Hg vacuum (specify 110 or 220 V-AC) .....	PR-1081
 <b>For coring and slicing of 100 mm diameter specimens, 50 mm long</b>	
Corecase with core bit 100 mm inner diameter and 210 mm long .....	CEL-100
Precision steel mould, reusable, for casting of 100 mm x 200 mm specimens .....	MRLN-1009
Drill machine, 1150 W, for CEL-100 (specify 110 or 220 V-AC) .....	CC-129
Diamond saw for slicing of cores, (specify 110 or 220V-AC) .....	PR-1060

### 3. Preparing and producing the specimens

In laboratory, specimens may be cast in a 100 mm diameter steel moulds, 200 mm high (see figure 5), with the MRLN-1009 precision steel mould, reusable, 100 mm diameter, 200 mm high (internal dimensions), with an accuracy of 0.02 mm on the dimensions.

Prior to stripping of the cast specimen the top and bottom lids are removed and the container opened slightly axially by applying a pressure with the screws in the welded-on studs. The mould allows specimens to be produced with totally plane end-faces perpendicular to the circular specimen. The specimens may be also used for the MERLIN Bulk Conductivity Systems as well as for ASTM C 1760 Bulk Electrical Conductivity of Hardened Concrete.

Alternatively, the specimens may be produced in the lab by coring. For cored specimens, the CEL-100 CORECASE coring rig is recommended to be used (see figure 6). The rig produces accurately the correct 100 mm +/-0.5 mm core diameter.

For sampling on the structure, the same CEL-100 CORECASE coring rig is also recommended. Drill to a minimum depth of 210 mm. Then break the core using a hammer and chisel and extract it. If a different coring rig is to be used, make sure the diamond drill bit has an inner diameter of 100 mm.

The specimens for ASTM C 1202 or NT BUILD 492 are saw cut to a length of 50 mm +/-1 mm, e.g. by using the PR-1060 saw that aligns the core end faces and ensure 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 tighten properly or the mesh of the **Proove'it**® cells may get damaged.

The cells are designed to test the specimens without resorting to epoxy coating provided the specimen diameter is regular and the correct gaskets' size has to be selected (See Table 2). However, the technician may choose to use epoxy on the circumferential surface to eliminate any possible stray current.

For such applications, the epoxy is mixed 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 table with a piece of paper in between. Turn the specimen upside down after 5 minutes to ensure that the epoxy is equally distributed along the surface.



**Figure 5** The precision steel mould for 100 mm in diameter, 200 mm high specimens.



**Figure 6** The drill machine and the CORECASE CEL-100 with coring rig and the diamond saw for producing the specimens.

#### 4. Conditioning the specimens

For moistening the samples, boiled (cooled down) or de-aerated tap water is required. Boil the required amount of water for half an hour to make sure the water is free of air. De-aerated water will permeate the concrete specimen more easily. Should the tap-water contain chlorides it is recommended to use distilled or de-ionized water. Allow the water to cool off before pouring it into a separate container or bucket.

Place the specimen(s) in the empty vacuum desiccator (see figure 7), preferably positioned on a floor close to a water drainage outlet. Keep the desiccator at this same position all the time, also during final drainage of the solutions. A maximum of 6 specimens can be placed in one PR-1069 plastic desiccator and 18 in the PR-1070 desiccator. Clean the edge of the lid and oil slightly with silicone oil. Make sure the valves are closed and place the top lid on the desiccators. Connect the hose from the vacuum pump to one of the valve nipples in the lid. Open the valve and turn on the pump. After running the vacuum pump for the required 3 hours, close the valve and then turn off the pump.



**Figure 7** The PR-1070 Vacuum desiccator for saturating 16 specimens (dia. 100 mm x 50 mm) and the PR-1081 vacuum pump with hose with <10 mm Hg vacuum.

Attach another hose to the second valve of the desiccator's lid and place the end of the hose in the container with the prepared boiled water (make sure that the amount is enough for all the specimens to be fully submerged). For NT BUILD 492, a saturated CaOH solution is needed. Allow the water or solution to flow into the desiccator by opening the valve slowly until the specimens are completely covered. No air should be allowed to enter the desiccator.

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

Turn off the vacuum pump, close the valve to the pump and then remove the hoses from the valve nipples. Open one of the valves slowly, allowing air to enter the desiccator. Let the specimens soak in the container for another 18 hours. Remove the lid together with the moistened specimens and blot them dry.

Finally, a hose is connected to the bottom (red) valve and the water or solution is drained completely from the desiccator.

When moulded cylinders are required (e.g. for ASTM C1760), cure them in a moist room or in water storage tanks for 28 days.

**NOTE:** Do not lift the desiccators containing the samples and water. The water or solution has to be drained prior to removing the top lid and the samples; otherwise, the desiccator may separate at the bottom.

The PR-1081 vacuum pump has to be operated and maintained according to its instructions. Fill in the oil as prescribed for operation of the pump and empty the oil from the pump after a test series has been performed.

## 5. Choosing the correct rubber gasket

Three rubber gaskets are available type PR-1010A, PR-1010 and PR-1010C, to be used for specimens with different diameters (*See Table 3*).

Tightening of the four bolts will cause the in-between spacer to compress the rubber gaskets against the stainless steel rings.

The maximum sealing between the rubber gaskets and the specimen is achieved if the outer circumference of the gaskets mounted the concrete specimen fits closely the 130 mm in diameter groove parts of the cell, after the gasket mounted specimen has been inserted in the groove.

When compressing the gaskets with the spacer ring in between the gasket will not be allowed to expand, but will only be compressed against the specimen. In this manner epoxying will not be needed.

The filling holes are threaded for attachments to nipples and hoses. The hoses can be connected to a pump or bucket with the solutions to flush the reservoirs during testing, partly to maintain the concentration of the solutions and partly to maintain a required temperature, if needed.

Always, apply a thin coat of silicone oil to both faces of each gasket (contacting the spacer and the steel ring portion of each mesh) eases assembly of the cell.

Tightening of the four bolts/nuts/washers is performed in a cross between two bolts, more and more.

**Table 3** Specimen diameter related to the required type of gasket.

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

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

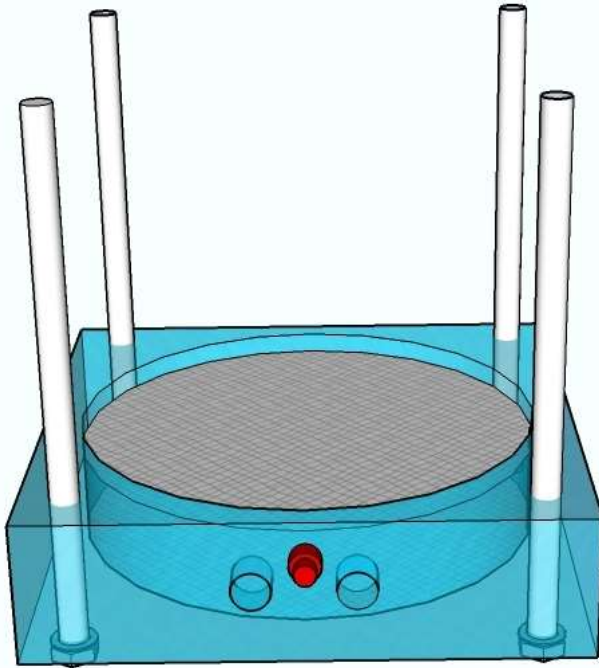
Efficient sealing is partly achieved by regularly shaped specimens, partly by constant diameters of the specimens, partly by choosing the correct sized rubber gasket for the specimen in question that fits closely the 130 mm groove diameter of the cell parts after installation on the specimen, and, finally,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

Unless other gaskets are specified when placing an order, all Prove'it<sup>®</sup> cells are delivered with the PR-1010B gaskets, inner diameter of 93 mm, outer diameter 126 mm and 10 mm thick, as standard. This requires that the specimen diameter be between 97 mm to 101 mm (See table 3).

## 6. Installing the gaskets without epoxy

After disassembling the measuring cell when received from Germann Instruments, leave the bolts in one cell half and have it sitting with the bolts straight up (See figure 8).

Place a sealing gasket over one end of the specimen (previously moistened and prepared). Using a small brush, apply a light coat of silicon oil on the face of the spacer that will touch the sealing gasket. Put the spacer over the specimen and against the first sealing gasket. Now, apply a light coat of silicone oil to the other face of the spacer and place the second sealing gasket over the specimen and against the spacer (See figure 9). Squeeze the gaskets and spacer together and center the specimen in this subassembly.



**Figure 8** Half of the cell with the bolts straight up.    **Figure 9** Position of the gaskets in the spacer.

Apply a light coat of silicon oil on the gasket face that you choose to sit on the metal ring of the mesh of the cell half that has the bolts pointing straight up. Place the subassembly into the recess against the mesh, making sure it is sitting flat (See figure 10).

Apply a light coat of silicon oil to the face of the second gasket (which is now pointing upwards) and insert the second cell half through the bolts. Make sure that the black and the red terminal posts of the cell parts point to the same direction and add the washers and hex nuts (See figure 11).

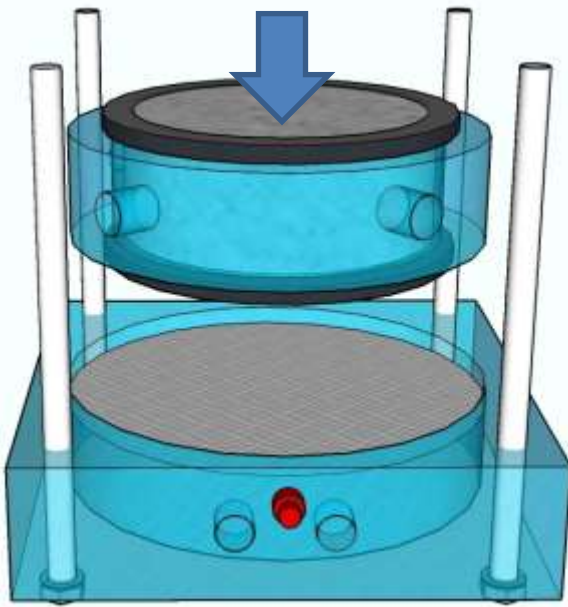


Figure 10

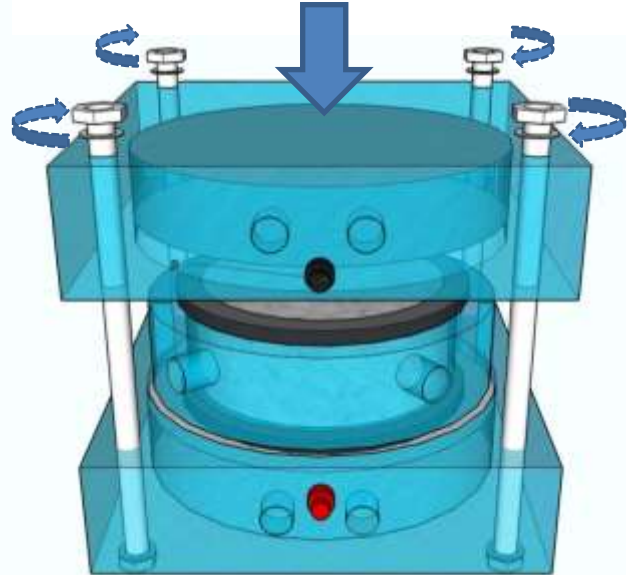


Figure 11

Tighten each hex nut fingertip tight, going from one bolt to another diagonally. Then, tight the nuts diagonally a little further with the 17 mm hex keys in the same order so that the cell half is squeezed evenly and that all the parts are parallel to each other. Tighten until the nuts cannot turn any further but do not over tighten as it is possible to crack the acrylic body of the cells.

**NOTE:** 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 and place the cell on a piece of paper on a table. Observe if the level is stable in the filling holes 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 in the two cell reservoirs: 3.0 % NaCl and 0.3 N NaOH solutions for the ASTM C 1202. The level of the liquids has to be 4-5 mm below the filling holes of the cell parts. The sealed, leak-free and surface-dry cell is now ready for testing.

## 7. Installing the gaskets with epoxy

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

Preferably, use a two component, moisture tolerant, fast curing epoxy, methacrylate, epoxy-methacrylate or a similar formulation to avoid long times waiting the adhesive to harden. A creamy consistency is desirable so that the adhesive is not absorbed by the concrete surface and the sealing effect is lost.

Blot the moistened specimen dry with a piece of cloth and apply the prepared epoxy in a thin layer to the specimen circumferential surface, up to 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/or cloth.

Apply a thin layer of silicone oil to the end faces of the spacer. Position the spacer centrally on the specimen for it to rest against the gasket. Govern, in the same way with epoxy, the other rubber gasket over the remaining end of the specimen, again with a rotary motion until the gasket is resting against the spacer. Remove any excess epoxy and wait until the adhesive has hardened enough to turn this subassembly 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 according to its specifications.

Oil with silicone oil slightly the side faces of the gaskets prior to mounting the gaskets in the cell and follow the same procedure described in section 6 to complete the cell assembling and fill the chambers with the testing solutions.

## 8. 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, and so on. A maximum of 8 cells can be tested simultaneously with the Proove'it® Classic.

**WARNING:** The power supply will suffer irreversible damage if the cords from one cell are crossed with another channel's cell.

It is imperative that each cell is connected only to each channel of the power supply binding posts. In other words, the red jack to the red binding post and the black jack to the black binding post of the same channel of the power supply unit.

Every cell must be connected to the control unit before turning it on. Otherwise, it might cause a surge in current that will damage the internal control circuitry. Intermittent current readings on any channel can also cause the unit internal damage.

If the operator wish 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 by which the system is automatically turned off.



## 9. Installing the Proove'it<sup>®</sup> Software (ProovePC v4.0)

1. Turn on the PC or laptop.
2. Insert the CD with the PR-1040 **ProovePC<sup>®</sup>** software in the CD-drive and open the ProovePC folder.
  - Alternatively, open the ProovePC folder if it's downloaded from a Dropbox (*See figure 12*).

Name	Date modified	Type	Size
DevCalibData.sdf	7/22/2018 9:23 PM	SQL Server Comp...	832 KB
dotnetfx45_full_x86_x64.exe	5/7/2018 3:23 AM	Application	49,173 KB
Measuring details.pdf	8/1/2018 3:19 AM	Adobe Acrobat D...	521 KB
ProovePC_V4.exe	7/20/2018 7:32 AM	Application	8,758 KB
ProovePCdata.sdf	7/11/2018 12:27 PM	SQL Server Comp...	168 KB
ProoveSettings.xml	5/7/2018 3:23 AM	XML File	5 KB
User Manual.pdf	1/16/2018 11:30 AM	Adobe Acrobat D...	3,377 KB

*Figure 12 ProovePC installation files.*

3. The installation wizard will automatically start. If the computer does not support autorun, click on the ProovePC\_V4.exe file that in the CD's folder.
4. Follow the instructions on the screen.
5. If updating of software on the PC or laptop is required, the software in the CD will automatically do it and restart the laptop.
6. After installation, shortcuts on the Desk are made for the program itself and for the two Report Managers.
7. A PDF copy of the manual will be also installed in the same folder as the **ProovePC<sup>®</sup>** program.

The software is compatible with Windows (Vista/Win 7/Win 8/Win 10).

## 10. Turning on and running the system

The power supply is connected to electricity with the appropriate line cord, 110 V-AC or 220 V-AC. The RS-232 serial cable is hooked-up between the control unit and an USB port of a laptop or PC. A RS232 to USB converter is required. Make sure that the drivers for the converter are installed from the dedicated software and that Windows recognizes it well. Go to the Windows Device manager to check. Once the converter cable has been correctly installed, the software will automatically detect the USB port assigned.

Turn on the Proove'it control unit by activating the switch on the backside of the panel.

When switched on, the on/off indicator lamp on the front panel 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 (more than +/- 15 V-AC for 115 V-AC mains or more than +/- 30 V-AC for 220 V-AC 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.

The yellow lamp will subsequently turn green and a clicking sound will be heard when the system is ready to test.

**NOTE: Disable the sleeping mode in the PC.** The operator has to make sure that the PC or laptop power settings are always ON when testing with the instrument. If the computer goes to sleeping or hibernating mode, it will temporarily disconnect the computer from the Proove’it unit, causing an extension of the running time to include the time the computer was in sleeping, hibernating or power saving mode and therefore, an increase of the readings of charged passed as well.

To start up the software, select the **ProovePC** icon from the folder or from the shortcut on the Desk. The following start screen will appear, illustrating the 8 channels status:



- **Actual Voltage (V):** The testing voltage being used. It is not possible to set individual values for each channel.
- **Actual Current (mA):** The current passing through the specimen in milliamps.
- **Temperature (°C):** The temperature measured by the probe in centigrade.
- **Elapsed time:** The time reckoned from the beginning of the test in hours:minutes format.
- **Predicted Coulombs (adjusted):** From the first minutes of measurements, the program predicts in advance the Coulombs passed after 6 hours as a quick orientation (adjusted to a 95 mm diameter specimen). The predicted Coulombs will be updated continuously during testing.
- **Testing time:** The total time selected for testing in hours:minutes format.
- **Specimen diameter:** The actual diameter of the specimen in millimeters.
- **Coulombs (adjusted):** The Coulombs calculated up to the elapsed time value.
- **Permeability Class:** The specimen classification according to the Coulombs value.

All readings are updated every 5 seconds during testing indicated by a moving blinking cursor.

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

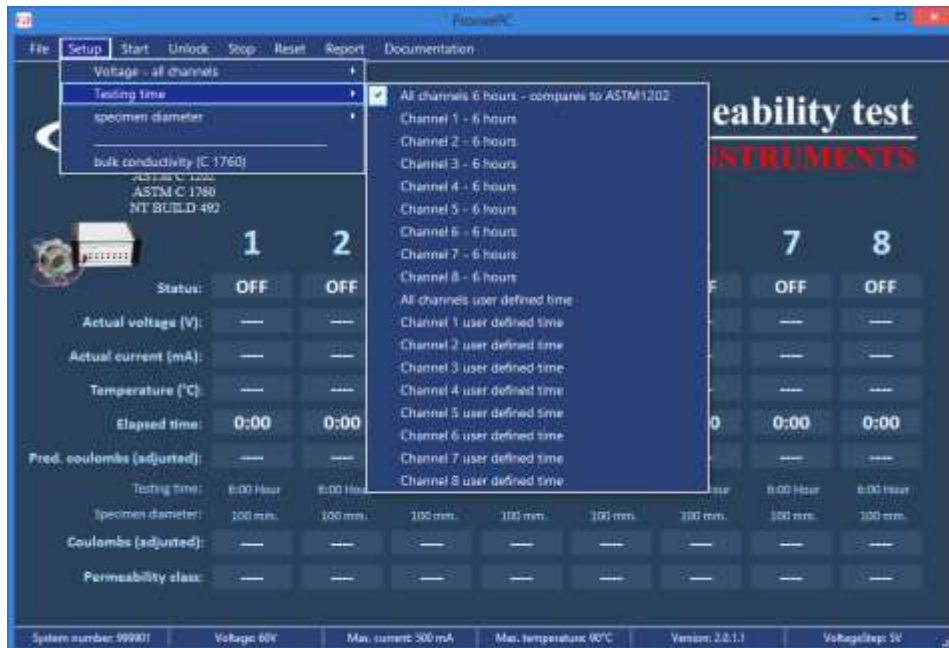
## 10.1 Running the test for ASTM C 1202 and NT BUILD 492

### Setup → Voltage - all channels



The ASTM C 1202 standard specifies the voltage to be at 60 V. For the NT BUILD 492 the start-up voltage is 30 V and, depending on the initial current measured, the final testing voltage and the time tested over are selected according to what is stated in the NT BUILD 492 standard requirements.

### Setup → Testing time



Testing time can be set whether to be the default 6-hours period (ASTM C 1202), or any other testing time (NT Build 492) for each channel.

If channels are not stopped, testing will proceed until the selected testing time is achieved. Then, the status of the channels turns “FIN” (finished) and the corresponding permeability class for each sample will be shown at the bottom row.

**NOTE:** If any other time than 6 hours is chosen, the permeability class cannot be estimated according to ASTM C 1202.

**Setup → Specimen diameter**



The default selected option is 100 mm diameter for all channels. For each sample the actual diameter has to be entered, enabling the software to calculate the correct Permeability Class according to the ASTM C 1202 classification system. The program will automatically apply the corrections to the ASTM standard’s 95 mm specimen size.

If the Coulombs for the 100 mm diameter specimen needs to be known, point with the mouse arrow on the coulombs window and a pop-up window will appear with the coulombs for the 100 mm diameter specimen.

**Start → Start channel**



To start a channel, select the channel in question with the mouse or press the combination Shift + the Function key for the desired channel, e.g. keys Shift + F4 for channel 4.

Once a channel is started up, the text in the pop-up menu will change to a gray color, the Status of the channel will change from OFF to ON and the clock in the Elapsed Time field will start. The values for voltage, actual current, temperature, elapsed time, predicted Coulombs and the actual measured Coulombs, are updated for every channel in a matter of seconds, running all the time until the test finishes.

Testing will proceed until the selected duration of time has been reached or before if the user stops the test.

**NOTES:** When starting more than one channel at the same time, start the channels with 10 to 15 seconds intervals. Doing it quicker may lead to miss readings. Should this happens to a channel, unblock, stop, reset and restart the channel.

A test will stop if the temperature of the liquid in the measuring cells exceeds the maximum temperature of 90°C or if the current measured reaches 500 mV which is the maximum capacity of the electronic circuits for each channel. A status of OVFL (overflow) will be shown if this happens.

To avoid stopping a test by accident, the channels are locked. Therefore a channel has to be unlocked before being stopped by the user.

**Unlock → Unlock channel**



To unlock a channel, select the channel in question with the mouse or press the combination Ctrl + the Function key for the desired channel, e.g. keys Ctrl + F4 for channel 4.



When a channel is unlocked, a yellow unlock symbol will be shown beside the channel number. The test continues as usual but can be stopped either for interrupting the test or to prepare and print the data.

**Stop → Stop channel**



To stop a channel, select the channel in question with the mouse or press the combination Ctrl + Shift + the Function key for the desired channel, e.g. keys Ctrl + Shift + F4 for channel 4.

Once a channel is stopped, it cannot be started again before resetting the data. After stopping a channel, it is possible to save the data obtained and reset the channel. All data will be saved in a database in SQL format located in C:\provePCdata.

**Reset → Save / Reset channel**

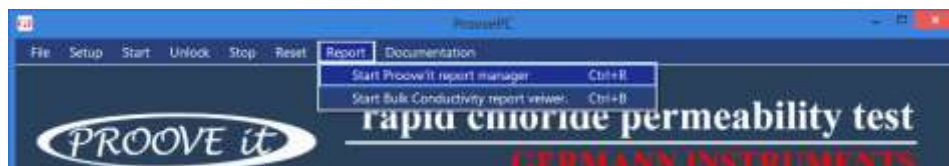


To save the data from a test and/or reset the channel, select the channel in question with the mouse or press the combination Alt + Shift + the Function key for the desired channel, e.g. keys Alt + Shift + F4 for channel 4. After selecting a channel to save and/or reset the channels, enter the information in the pop-up window “SaveData”.



Once the results are saved for a channel, a confirmation will be given. If the Stop option has been selected, the software will ask if the data has to be saved.

**Report → Reporting the data**



Use the Proove’it Report Manager to print a report with test data. It can be started either by selecting the Report in the ProovePC menu or by clicking on the icon “ProoveReport” of the shortcut created during the installation.



The Report Manager will show the table below which will contain every test that has been ran:

SysTestNo	CustTestID	TimeSaved	Channel	VoltageChosen	TestTimeChosen	Status	CoulombsAdj
10042		3/18/2013 10:32 AM	1	60	60	_FIN	80.44
10041		2/10/2013 6:27 AM	2	60	360	_FIN	7677.65
10040		2/10/2013 6:19 AM	7	60	360	_FIN	1166.34
10039		2/10/2013 6:19 AM	6	60	360	_FIN	7663.02
10038		2/10/2013 6:19 AM	5	60	360	_FIN	5224.78

A specific Test can be opened by clicking on the left column in the table shown above. The data for the channel selected is shown on the right side of the screen. The readings of current (mA) and temperature are saved in the database every 5 minutes.

ChannelNo	TimeSaved	mA	Volt	DegC
0	3/18/2013 9:37 AM	24.8	60.0	16.9
0	3/18/2013 9:42 AM	24.8	60.0	16.3
0	3/18/2013 9:47 AM	24.8	60.0	16.2
0	3/18/2013 9:52 AM	24.8	60.0	16.1
0	3/18/2013 9:57 AM	24.8	60.0	16.1
0	3/18/2013 10:02 AM	24.8	60.0	16.2
0	3/18/2013 10:07 AM	24.8	60.0	16.2
0	3/18/2013 10:12 AM	24.8	60.0	16.3
0	3/18/2013 10:17 AM	24.8	60.0	16.2
0	3/18/2013 10:22 AM	24.8	60.0	16.3
0	3/18/2013 10:27 AM	24.8	60.0	16.2
0	3/18/2013 10:32 AM	24.8	60.0	16.3

More information can be entered for each sample tested as shown below:

<a href="#">Main information</a>	<a href="#">Comments 1</a>	<a href="#">Comments 2</a>	<a href="#">Comments 3</a>
----------------------------------	----------------------------	----------------------------	----------------------------

System ID:	10038	<b>Penetrability class: High</b>
Channel:	5	
Time saved:	10. februar 2013 06:19	
Selected voltage:	60 V.	
Test time:	6:00	
Instrument status:	_FIN	
Coulombs adjusted:	5224,78	
Cylinder diameter:	100	
Instrument number:	999901	
User ID:	<input style="width: 100%;" type="text"/>	
Reference:	<input style="width: 100%;" type="text"/>	
Test performed by:	<input style="width: 100%;" type="text"/>	
Cylinder length:	<input style="width: 50px;" type="text" value="50"/> mm.	

The test data is presented in a graphic at the bottom of the Report Manager. The X-axis will be automatically adjusted depending on the number of readings. The temperature is indicated with the blue line and the current with the light blue columns. Each blue column represents results every 5 minutes.



Once all information about a sample is entered, a report for each specimen tested can be printed out by activating the “Print Report” button at the bottom. An example of a report is shown below:



Test report

Voltage used: 60 V.  
 Testing time: 1.00 hour  
 Charge passed (adjusted): 80.44 coulomb  
 Penetrability class: N.A.  
 Instrument number: 130105  
 Channel number: 1  
 Report saved: Monday, March 18, 2013 10:33 AM  
 Testing by:  
 Reference:  
 Sample diameter: 100 mm.  
 Sample length: 50 mm.  
 Instrument status: FIN  
 System ID: 10042  
 Test ID:



Time	°C	mA	Time	°C	mA	Time	°C	mA	Time	°C	mA
00:05	17	24.8	00:20	16	24.8	00:35	16	24.8	00:50	16	24.8
00:10	16	24.8	00:25	16	24.8	00:40	16	24.8	00:55	16	24.8
00:15	16	24.8	00:30	16	24.8	00:45	16	24.8	01:00	16	24.8

**NOTE:** A company's logo or address can be inserted in 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.

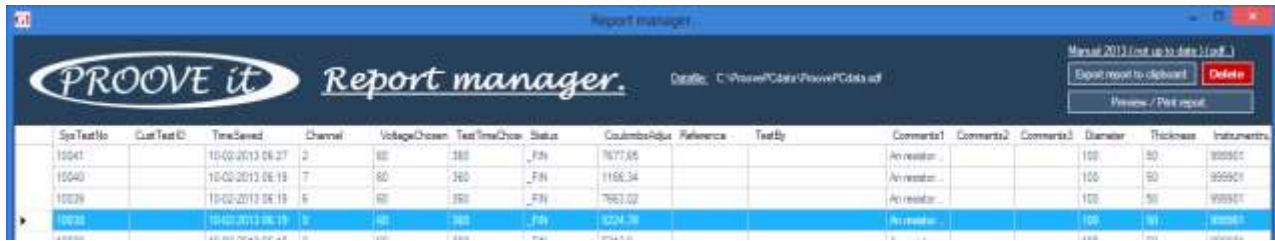
In the data directory where the software is installed, C:....\provePCdata, a file with the name **Prooveit User Logo.jpg** is located. By default this logo will appear on the report. The logo looks as follows:



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**.

**Delete → Deleting data**



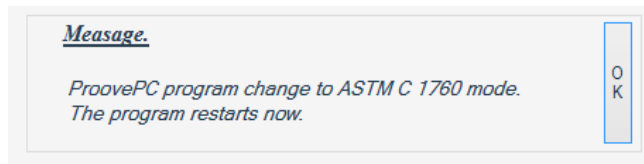
The test data highlighted can be deleted by clicking on the red button “Delete” located in the upper right side of the Report Manager Window.

**10.2 Running the test for ASTM C 1760**

For using the Prove’it for the Bulk Conductivity test, the program mode has to be changed by clicking on “bulk conductivity (C 1760)” from the Setup menu in the main screen.



When changing the mode from the setup menu, a message like this is shown:



After pressing the OK-button, the program restarts in the new program mode. Make sure that all data has been saved in the mode that operator intends to leave.

Once the main screen of the bulk conductivity mode appears, the specimen diameter and length can be set in the setup menu but the test time is always 1 minute, and cannot be changed. Although the standard voltage for ASTM C1760 is 60V, it is allowed to change it.

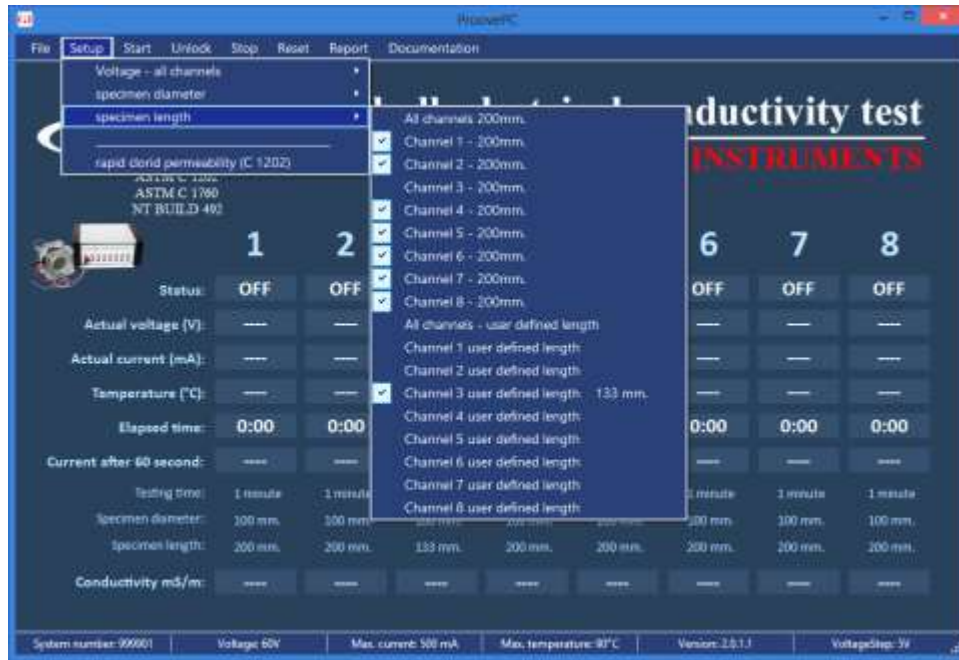


**Setup → Specimen diameter**



Select one of the default 100 mm diameter options from the menu or input the actual diameter for the desired channel.

**Setup → Specimen Length**



Select one of the default 200 mm length options from the menu or input the actual length for the desired channel.

**Setup → Voltage – all channels**



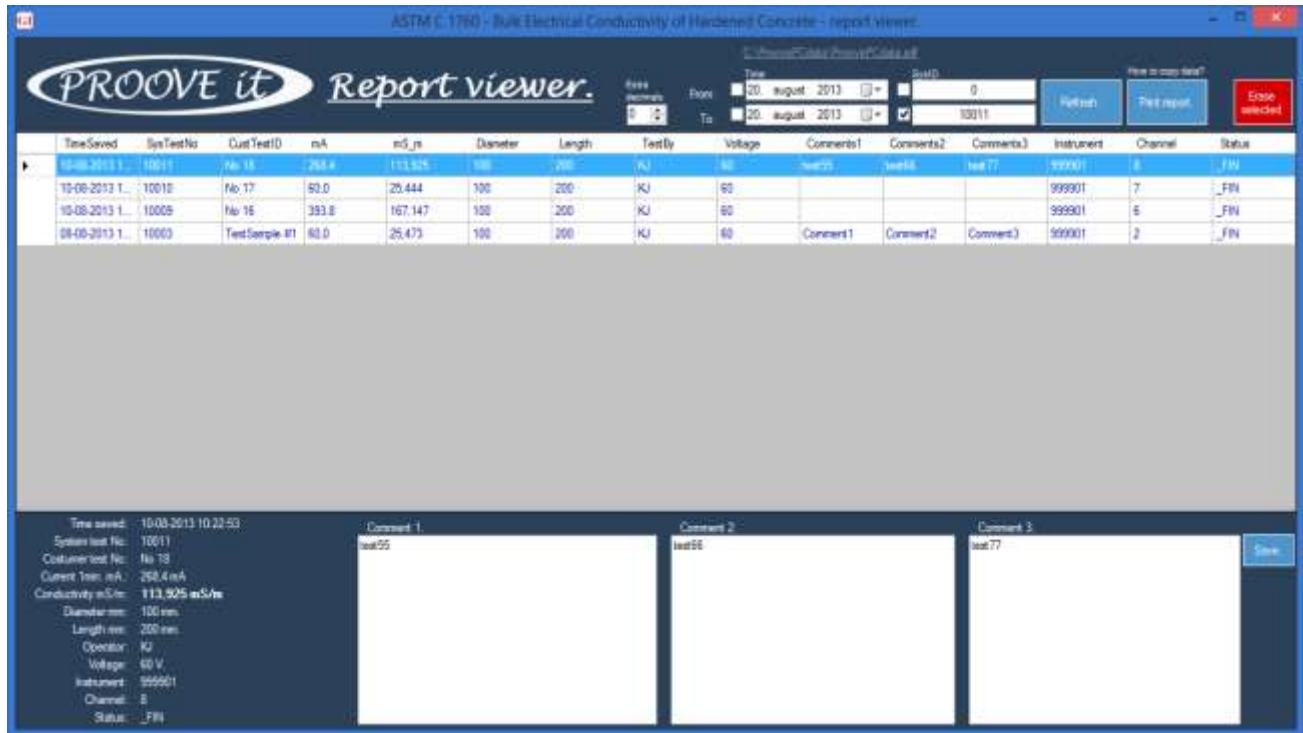
Select the testing voltage for the channels; however, the standard voltage according to ASTM C 1760 is 60 V.

To start, unlock or stop a channel, the same instructions applied as mentioned in section 10. Refer to that section for details. Screen shots of a test running and after finishing are shown below. Note that the testing time is always one minute.

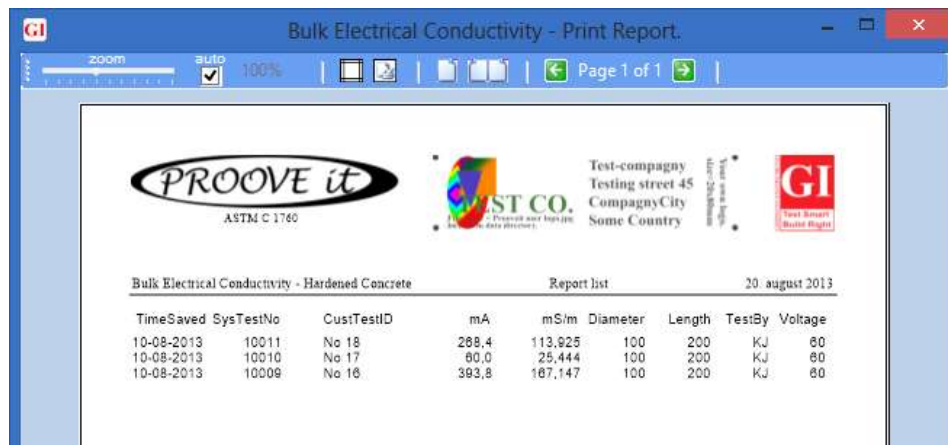


When the tests stop, the channels can be reset and data saved as explained in section 10.

**Report → Reporting the data**



Report Viewer is the application to report data after performing tests under ASTM C1760. It can be started either by selecting the REPORT menu or by clicking on the icon “Bulk Conductivity Report Viewer” of the shortcut created during the installation. The Report Viewer is shown below with an example of a file ready to print.



To suppress data that will not be printed, use the filters on the top of the Report Viewer. Alternatively, some lines can be selected and by pressing the <DEL> key, they will be removed from the list. The information will not be deleted from the database, just from the report. Deleting data from the database can only be done with the red “erase” button located on the top.



To **copy data to Excel**, follow the next steps:

1. Start an Excel file.
2. Place the cursor somewhere in the data area of the Report.
3. Press <CTRL> + A to select the data.
4. Press <CTRL> + C to copy the data.
5. Place the cursor in a cell of the Excel worksheet.
6. Press <CTRL> + V to paste the data.

Now the data, including the headers, is copied to Excel.



## 11. Turning off the system

To turn off the **ProovePC**® software, make sure all channels are in the OFF-Status. Then select **File** in the menu and then select **Quit Program**. The green indicator light on the Power Supply Unit will turn into yellow.

Turn off the power supply at the back of the unit and disconnect the cells from each channel's set of jacks. Finally, remove the temperature probes from the cells and disconnect them from the Power Supply Unit.

## 12. Disassembling a Proove'it© cell and maintenance

Place the cells in a proper sink. Unthread the nuts from the bolts using the two 17 mm wrenches. Allow the solutions to be drained into the sink and remove the concrete specimen along with the gaskets from the cell and blot them dry.

For gaskets bonded with epoxy to the specimen, gently remove the rubber gaskets from the epoxy so that they can be reused. Clean the gaskets of all remaining epoxy. The gaskets may be reused as long as they are intact, without cuts and permanent indentations.

Use clean water to wash the cell halves and stop any chemical reaction of the solutions with the mesh. Use finally a clean cotton cloth to dry the 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 should be inspected. The meshes have to be intact without any damage from corrosion. Should the mesh be damaged, install a new mesh (PR-1003) as follows:

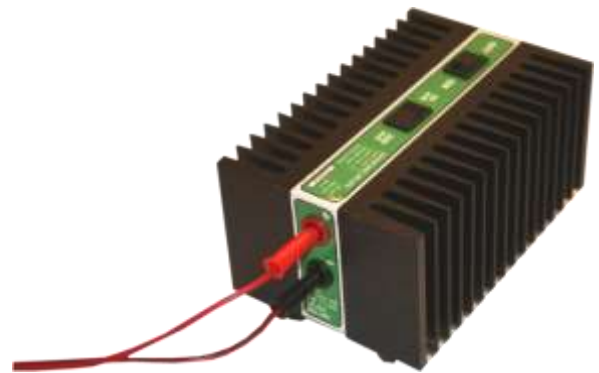
- Use a pair of gas pliers to unthread the banana jack from the acrylic, taking care not to crack the plastic heads.
- Unthread the six Allen screws holding the stainless steel ring of the wire mesh unit with a 2.5 mm Allen key and remove the damaged mesh.
- Oil the O-ring in the cell part slightly with silicone oil and install a new mesh.
- Thread the six Allen screws back into position without tightening too much. The acrylic cell body may break if the screws are tightened too much.
- Thread the jack part into the cell part and tighten it, firmly.
- Install the remaining parts of the banana binding post.
- Check the conductivity between the metal part of the binding post and the metal ring of the mesh with a multimeter. The electrical resistance has to be the same as when the meter probes are touched together. Otherwise, tighten the banana jack post more.

### 13. Verification of the Proove'it® Unit

For verification of a Proove'it® Microprocessor Power Supply unit, the PR-1055 Verification Unit is available.

For 60 V, the unit has options for checking the accuracy of a current measurement at 30 mA and at 300 mA in a desired channel. The accuracy on the calibration unit is within  $\pm 0.5$  mA.

The unit is connected to a power source and to the channel in question and turned on. Then the channel is set up at 60 V for testing. Once the testing starts, the "actual current" indicated on the screen is checked to be within 30 mA  $\pm 0.5$  mA and 300 mA  $\pm 0.5$  mA respectively, for the two switch options on the calibration unit.



**Figure 13** The PR-1055 Verification Unit.

**NOTES: DO NOT SWITCH** between 30 mA and 300 mA while the verification unit is on. This may damage both the Proove'it unit and the verification unit. Turn off the verification unit and the Proove'it before switching to a different current setting.



## 14. Remarks on proper operation of the Proove'it<sup>®</sup> Unit

As a general rule, the current running from one channel's red jack of the Power Supply Unit has to run back through the same channel's black jack.

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

**NOTES:** The **black jack** on each channel is **not a common ground**. **Each channel** of the Power Supply Unit is an **individual channel**, **never cross-connect the channels**.

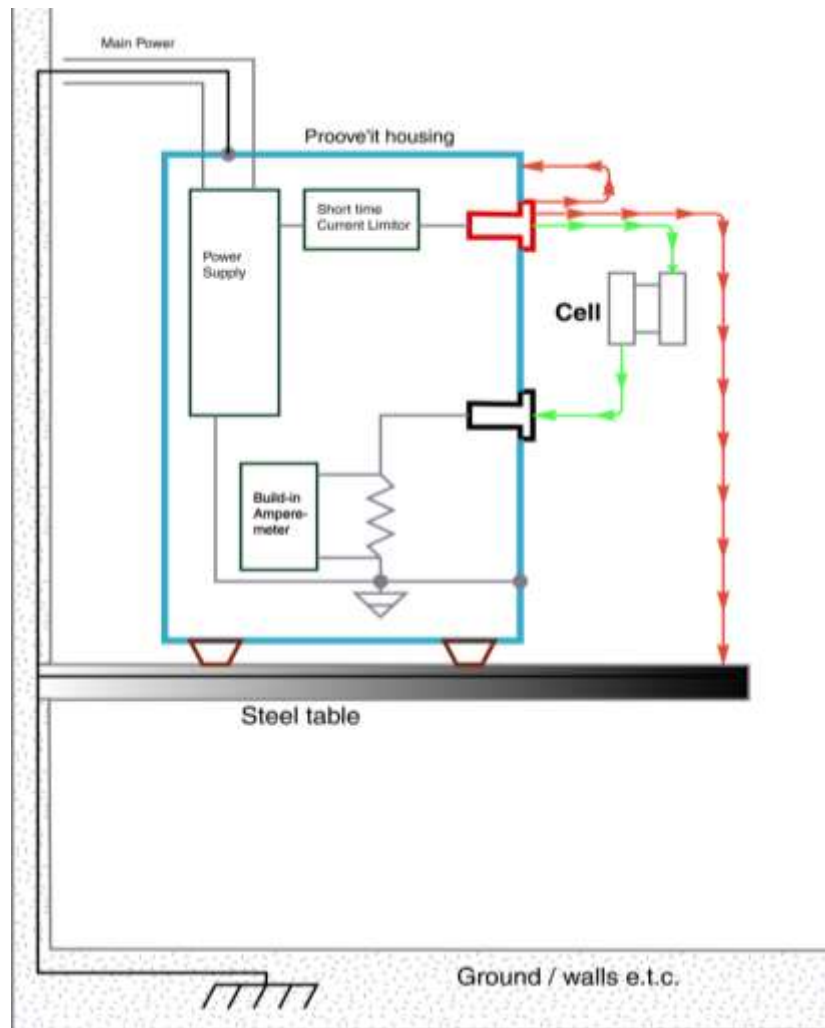
Connection and disconnection of the cords has always to be made with the Power Supply Unit **turned off**.

The voltage for the power supply can be 110 V-AC or 220 V-AC. The unit itself will sense the voltage and no adjustment has to be made by the operator.

The fuse for the AC line (mains) voltage is located on the back panel adjacent to the power cord receptacle. The fuse rating is 4 amps at 250 V-AC. It is a slow-blow T4A/250V, 5 mm x 20 mm fuse. Other internal fuses can only be replaced by personnel of Germann Instruments.

For proper operation:

- Make sure the cell containing the concrete sample and the solutions is watertight before testing.
- Make sure the exterior of the cell is dry.
- The power supply is turned off when connecting or disconnecting.
- Connect 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.
- Never place the cell on top of the Power Supply Unit.
- Never place the Power Supply Unit or the cells on a grounded steel table (*See figure 14*).
- Always place an insulation material between the cell or Power Supply Unit and the table being used, e.g. a heavy plastic sheet or a dry wooden plate.
- Once all the connections have been made, check the connections again as instructed above, and then turn on the Power Supply Unit.
- Never touch the cords during testing.
- If the testing has to be interrupted, first turn off the Power Supply Unit and then disconnect the cords.



**Figure 14** Correct current path (green) and incorrect current paths (red) for one channel of the Proove'it Power Supply Unit. The black jacks are NOT common ground. Never cross-connect different channels.

## 15. 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 the pump on a 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 the 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.

## 16. References

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