100V SURFACE RESISTANCE AND RESISTANCE TO GROUND TESTER

Code H700 FEC Code 877657

Description

This surface resistance tester is fitted with a built in square probe electrode that allows a quick test of material surface resistance. Two 4mm plug sockets and a probe selection switch allow the connection of external probes to the tester.

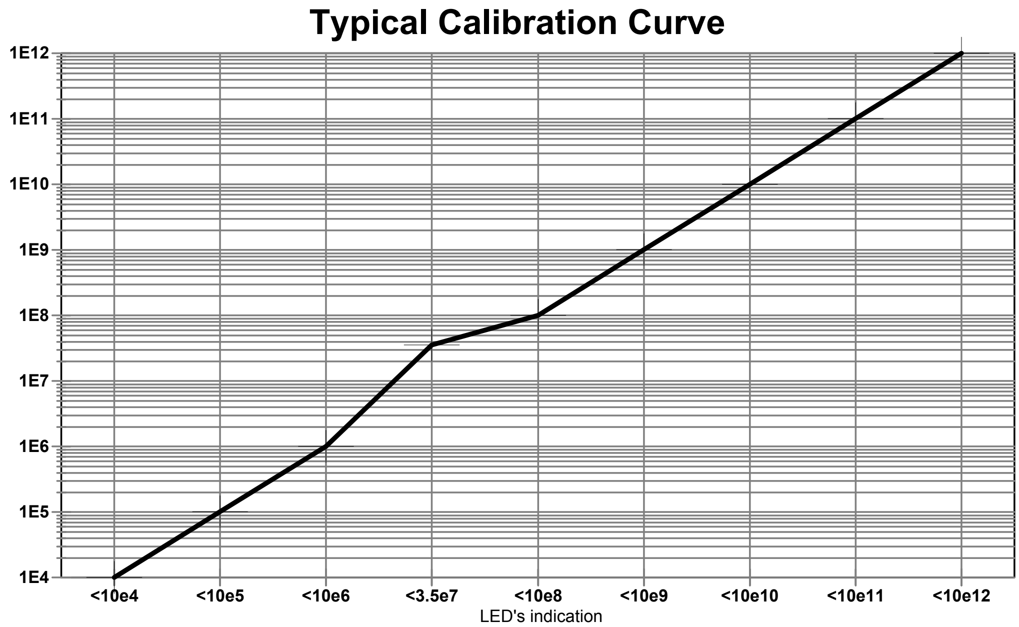
Physical and Electrical specification

Dimensions	145 x 90 x 32mm
Weight	240g
Power Supply	1 x 9 volt PP3 cell, preferably alkaline

Contents	Code	Qty
Tester	H700	1
9 volt PP3 battery	RH2000	1
Certificate of calibration for H700	Verm 100	1
Product Information Sheet	PIS116	1

Resistance Meter Performance:

The instrument accuracy is ±10% (at +20^{O}C). The instrument is calibratable to the NAMAS Standards. Below is the typical calibration curve:



Features of the Resistance Meter

Resistance is indicated via a row of 10 LED's. Thresholds can be deduced from the curve above. As the electrification period is important when measuring surface resistivity, a 15 second timer has been fitted within the meter. The resistance indication LED's will flash during resistance measurement and the correct LED will latch at the end of the timer, giving the tested material resistance.
This unit is fitted with an automatic test voltage selection; the test voltage will switch to 100V should the measured resistance exceed 1×10^6 **Ω.** When the test voltage is of 100V, the LED placed in the centre of the meter will flash, in order to raise the user awareness of the high test voltage.
The meter is fitted with two sockets so that an external probe can be used. To do so, connect the probe to the meter sockets using leads fitted with 4 mm plugs and flick the switch to the position "external probes" At this time the meter's integrated probes are disabled, hence ensuring operator safety and allowing the unit to be laid on any type of surface without influencing the resistance measurement.
A battery low indicator will inform the user when the battery needs replacing. Calibration is not guaranteed when the battery low indicator is on. It is recommended that any battery triggering the battery low indicator is discarded as battery leakage could occur and destroy the unit.
Care must be taken when handling this meter; it is recommended that the meter be lifted off the surface to be tested and placed on the next area for test rather than sliding the meter along the surface. This will considerably reduce wear to the probes.
The instrument is CE compliant (i.e. meets European directive on EMI).

Note regarding the test voltages

It is difficult to measure resistance of more than 10^6 **Ω** using conventional, low cost methods, as the measuring currents become very small. EN 61340-5 recommends using a 100 volt test voltage, which raises the current and reduces the level of error.

What is Resistance and Resistivity?

The resistance expresses the ability of a material to conduct electricity. It is therefore related to current and voltage. With a pure resistive material, R=U/I where R is the resistance (expressed in Ohm **Ω)**, U the voltage (expressed in Volt) and I the current (expressed in Amp).
The resistance of a material is also the result of the material's dimensions and its resistivity. For example, the resistance of a wire is R = φ x (l / r), where l is the length of the wire, r the section of the wire and φ the resistivity of the material used for making the wire. Therefore, resistivity is a specific resistance and is a property of a material.
A square probe or a concentric ring probe is used to measure the resistivity of the surface of ESD control materials. The measured value used to be expressed in Ohm per square (**Ω/☐**) but today is simply stated in Ω.

Care must be taken in expressing the results

Particular care is needed in interpreting results when measuring non-homogeneous materials such as multi-layer mats or conductive-backed synthetic fibre carpeting containing a small amount of conductive fibre. Buried conductive layers can provide shunt paths. Be clear when stating what you have measured! On large surfaces such as bench-mats, readings will sometimes vary with increasing time of measurement. This is due to the 'electrification' of the mat beyond the area measured. It is therefore important to measure properly and to keep the duration of measurement constant. Fifteen seconds is an arbitrary but practical duration for measurement time.
Moreover, the materials needing to be checked in an EPA are most of the time, non-conductive polymers that have been made conductive or antistatic by addition of conductive particles or by special treatments during manufacture. The resistivity of such materials may vary from one point to another or they may be direction dependent (anisotropic).
EN 61340-5 goes some way to specifying the procedures to be followed and test probes to be used, so that the results can be compared, at least roughly.
Also, the resistance of some materials may vary with humidity level and temperature. It is therefore good practice to take a note of these two parameters when measuring.

Resistance in an EPA according to EN 61340-5:

Resistance below 10^6 **Ω**: the material is conductive.
Resistance between 10^5 **Ω** and 10^{12} **Ω**: the material is static dissipative
Resistance above 10^{12} **Ω**: the material is insulative.
Resistance of a wrist strap: between 0,75 x 10^6 **Ω** and 35 x 10^6 **Ω** using a test voltage > 10 volt < 30 volts.
Resistance of a foot grounder: between 0,1 x 10^6 **Ω** and 35 x 10^6 **Ω** using a test voltage > 10 volt < 30 volts.
Resistance to ground of a bench mat: between 0,75 x 10^6 **Ω** and 10^9 **Ω**.
Resistance to ground of a floor mat: between 1 x 10^4**Ω** and 10^9**Ω**, but 10^6**Ω** to10^8 **Ω** is better.

Resistance conversion chart:

1 Ω (one ohm)
10 Ω
100 Ω

1000 Ω =	**1 x 10^3Ω**	=					**1KΩ**	(one kilohm)
10 000 Ω =	**10 x 10^3Ω**	=	1 x 10^4Ω	=			**10KΩ**	(ten kilohm)
100 000 Ω =	**100 x 10^3Ω**	=	10 x 10^4Ω	=	1 x 10^5Ω	=	**100KΩ**	(one hundred kilohm)
1 000 000 Ω =	**100 x 10^4Ω**	=	10 x 10^5Ω	=	1 x 10^6 Ω	=	**1MΩ**	(one megohm)
10 000 000 Ω =	**10 x 10^6Ω**	=	1 x 10^7Ω	=			**10MΩ**	(ten megohm)
100 000 000 Ω =	**100 x 10^6Ω**	=	10 x 10^7Ω	=	1 x 10^8Ω	=	**100MΩ**	(one hundred megohm)
1000 000 000 Ω =	**1 x10^9Ω**	=					**1GΩ**	(one gigohm)
10 000 000 000 Ω =	**10 x 10^9Ω**	=	1 x 10^{10}Ω	=			**10GΩ**	(ten gigohm)
100 000 000 000 Ω =	**100 x10^9Ω**	=	10x 10^{10}Ω	=	100 x 10^{11}Ω	=	**100GΩ**	(one hundred gigohm)
1000 000 000 000Ω =	**1 x 10^{12}Ω**	=	1000GΩ	=			**1TΩ**	(one teraohm)

Measurement of Resistance and Resistivity using the H700

Measurement of surface resistivity Rs

Surface resistivity is measured when the properties of a material need to be determined. The surface resistivity meter can be used directly on the material, with its probe selection switch flicked to the "internal probe" position. Each electrode of this hand held meter has a length of 65mm and is fitted with a conductive rubber shoe 4mm in diameter. The electrodes are spaced 65mm apart, so that they form two sides of a square. Due to the square configuration of the electrodes, the resistivity of the test surface in ohm per square can be read directly from the ohmmeter without the use of conversion factors. However, the test specimen must extend beyond the electrodes on all four sides. The surface onto which the test material is laid for measuring must be insulated so that it does not provide a shunt path and give a false reading. Before a measurement is taken, the measurement sites should be determined. These should be chosen to obtain a suitable idea of any variations over the test surface. For working surfaces it is recommended that at lease nine sites per square metre are used, each equidistant from one another and not less than 10 cm away from the surface boundary. The hand held meter is then placed on the first site so that the direction of current flow between the electrodes is parallel to the long edge of the test surface. Observe the meter readings and record the lowest value occurring in the first 15 seconds. Then turn the meter through 90^o and again record the lowest value observed in the first 15 seconds. Repeat this procedure at the other sites. Then calculate the average resistivity along and across the surface.
More accurate measurements can be obtained from a concentric ring probe H107. Please refer to page 2 of this document, "What is resistance and resistivity?"

Measurement of point to point resistance RP

As it may not always be convenient to measure surface resistivity on a material, it is possible to measure the resistance from one point to another. This can be done using two cylindrical probes H116 and flicking the probe selection switch to “external”. Connect the probes to the hand held meter as described in “features of H700". To proceed, place the two probes on the mat and check the resistance indication. Note that the reading may be different from that on the same mat with a square probe.
The result will be expressed in Ohm, and it gives an indication of resistance, which is very often more interesting than the surface resistivity. Point to point measurement would be used to check an EPA, whereas resistivity measurements are more useful for testing materials.

Measurement of volume resistance Rv

To measure volume resistance, use two cylindrical probes. Put the first probe upside down and 'sandwich' the test sample between it and the second probe placed on top. Usually, volume resistance should not be greater than 10^{11} ohm, if it is greater than 10^{10} ohm, check the charge decay time. It should be less than 2 seconds according to EN 61340, but for most EPAs, <6 seconds will suffice.

Measurement of resistance to ground RG

The resistance to ground expresses the resistance from one point of the material to be tested to its earth grounding point. This is certainly one of the most useful measurements in an EPA. To proceed, place a cylindrical probe in the centre of a mat and connect the second tester lead to the ground point (stud on a mat, for example). It is also possible to use this method to check the resistance from the mat to earth, and this way check all the connections and bonding points. To proceed, place a probe in the middle of a mat and connect the second tester lead to a different earthing socket to that to which the mat is connected (or to a metal part of the building infrastructure, such as central heating pipe, metal framework, etc.). Take care when doing this not to add too many resistances on the second earth connection as it will introduce an error to the reading. Ideally, you should use an earth plug with a one megohm resistor in the earth reference socket, and subtract the one megohm from the reading.

RG of matting should not exceed 10^9 ohm. It must lie between $0{,}75 \times 10^6$ and 35×10^6 ohm if used for grounding of personnel to comply with EN 61340-5.

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