Insulation resistance measurement

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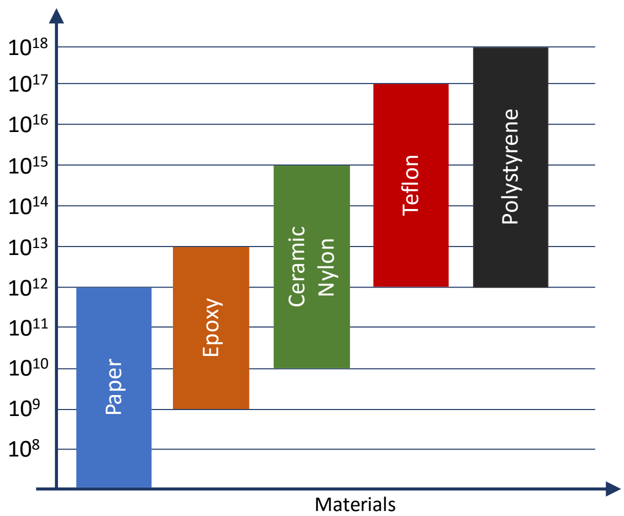
Introduction

The purpose of measuring insulation resistance is to verify that the various components and sub-assemblies constituting electrical equipment have an insulation resistance such that the leakage currents do not reach a level higher than the standard values.
In pratice, a stable and specified DC voltage (chosen from among the standard values) is applied between the defined points, set for a specific imposed duration, and to measure the current flowing through the material under test.
When simply applying Ohm's law (Resistance = Voltage / Current), we express the result by giving the value of the insulation resistance. This value is then compared to the minimum threshold value, specified by the standard used for the test.



Insulation values of materials commonly used in Industry

Cautions

It is important to connect the element to be measured, taking into account the parasitic leaks that could be generated by the measurement environment or method. The supplied accessories have a shield which is connected to a guard potential. This ensures a good immunity of the measurement against parasitic leakage currents and AC residual voltages.

When using extensions from the basic accessories, it is important to avoid introducing a measurement error (short leads, leads that do not touch a metal part or even an insulating part, etc.). When measuring high values resistance (> 100 GΩ), an operator approaching the hand of the test sample can disturb or make the measurement unstable. It is important to avoid nylon clothes or objects made of insulating material which may generate strong electrostatic fields and may disturb the measurement of high resistance values. (100 GΩ at 100 volts = 1 nA measured current).

Capacitor insulation measurement

Many actual electrical devices are equiped with input filters including capacitors to comply with EMC standards.
When measuring insulation resistance on a capacitor, it is recommanded to use the CAPACITOR mode on the megohmmeter in order to make stable measurement :

A) Disturbances:

In fact, on capacitors, even small variations in the measurement voltage, as well as interference, are fully transferred to the very high gain input of the current measurement system. The input circuit will therefore significantly amplify these disturbances. The CAPACITY mode uses circuits which will limit the instability of the measured values due to this kind of interferences.

B) Measurement voltage:

Insulation resistance measurements on capacitive circuits cannot be performed by decreasing the measurement voltage between each test, but always increasing it. The hysteresis ans polarization phenomena presented by the dielectric would affect the results. In this case, the device tends to indicate a maximum value and takes a very long time to come down to the real measurement value.

C) Measurement cycles: Ramp-up, dwell and fall:

The value of the insulation resistance of a capacitor varies according to an exponential law as a function of time. It is important to give a meaning to the evaluated value, to also indicate the duration of the test. The SEFELEC 5X series devices satisfy this requirement, offering operators to program rise, dwell and fall times of the measurement voltage.

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D) Discharge relay circuit:

Operator should never disconnect a capacitive sample from test without pressing first on STOP button in order to stop the measurement. All devices from SEFELEC 5x series are equiped with a discharge relay circuit that automatically control sample discharge through a 2,2 kΩ internal resistor (consider 1 seconde per 100 µF). A new test is not possible as long as STOP button is not pressed and sample is not discharge.

Measurements on cables

Measurement on cables is similar to measurement on capacitive samples.

Cable measurement configurations are very diverse. The measurements must be carried out either between conductors for multi-conductor cables, or between core and shielding for shielded cables, or between the cable and its environment for single-conductor cables.

A) Immersion in water:

In this case, the method generally used is to immerse the cable drum in a water tank (called a Pool), to allow the water to penetrate to the core of the cable drum, then to measure the insulation resistance between the conductor and water. Due to construction and safety reasons, the tank is connected to earth. The insulation resistance measuring device must therefore be able to measure a sample where one of its points is earthed. The devices of the SEFELEC 5x series make it possible to carry out this type of measurement very easily since the high point of the voltage generator is connected to the earth. It is therefore sufficient to connect the measurement input of the device (with the high voltage accessory) to the conductor to be measured and start the measurement.

B) Thresholds and measurement unit MΩ per km:

Another peculiarity of insulation resistance measurements on cables is that the manufacturer's specifications give resistance values for a standard cable length of 1 km (kilometer).

On the platform when inspecting cable drums, they never exactly measure the standardized length, which forces operators to perform a calculation according to the length of the cable and the number of conductors in parallel for multi-cables. conductors. On the other hand, the comparators incorporated in the measuring devices can no longer be used, since they compare against the overall insulation value and not against the standardized value.

The SEFELEC 1500-M Megohmmeter / Picoammeter can display insulation resistance measurements reduced to a length of 1 km and to 1 conductor, which also allows the use of built-in comparators. The operator can enter the length of the cable under test and also the number of conductors. These instructions are available through the configuration screen.

The result is then displayed in MΩ per km.

For example: the device measures a value of 10 MΩ for a single-conductor cable 10 km long. Its value reduced to 1 km will therefore be: (Rtotal / km) x Length = 100 MΩ per km. For the same cable with 10 conductors, the value for 1 conductor will be 1000 MΩ per km.

Choosing measurement voltage

When insulation resistance measurements make it possible to verify if materials or equipment meet standard requirements, it is important to refer to these standards when choosing the measurement voltage. The normalized voltage values are generally: 50, 100, 250 and 500 volts DC. If there is no recommendation, choose a voltage of 100 volts to perform the measurements.

In the case of measurements on capacitive samples and when studying the influence of the voltage on the insulation resistance values, it is important to always start from the lowest voltage and to continue the measurements by increasing voltage. A test procedure in another way could give false results.

SEFELEC 56-S during an insulation test under 45V

Insulation resistance measurement with SEFELEC 5x series

The SEFELEC 5x range of single or multifunction devices, offers insulation measurement function under voltages up to 1500V with its built-in generator.

Performances for each model are described in the table hereafter:

Model	Type	Voltage Range	Measurement Range
SEFELEC 1000-M	Megohmmeter	20 Vdc - 1000 Vdc	1 kΩ - 200 GΩ (2 TΩ in option)
SEFELEC 1500-M	Tera-Ohmmeter / Pico-Ammeter	1Vdc- 1500 Vdc	1 kΩ - 2000 TΩ
SEFELEC 56-D SEFELEC 506-D	Dielectrimeter	20 Vdc - 1000Vdc	1 kΩ - 200 GΩ (2 TΩ in option)
SEFELEC 56-S SEFELEC 506-S	LVD tester	20 Vdc - 1000Vdc	1 kΩ - 200 GΩ (2 TΩ in option)

Functions such as rise duration programmation measurement display in or MΩ per km direct measurement are available for on SEFELEC5X range.

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