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MADE IN JAPAN

APPLICATION NOTE

Super Megohm Meter SM7110

Measurement of Various Materials Surface Resistance

Super Megohm Meter SM7110

Static electricity is an imbalance between negative and positive charges in objects. Charge remains until it is able to move away through electric current or discharge through another object. One nature spectacular example is lightning. Static electricity has contributed to the invention of products used daily such as supercapacitors, laser printers and paint spray gun. While static is useful, it can also be a nuisance, causing painful shock and damage of delicate electronics. In extreme cases, it can result in danger such as an explosion in hazardous zones.

Hazardous zone is defined as an area where flammable liquids, gases or vapors or combustible dusts exist in sufficient quantities to produce an explosion or fire. A tiny spark may be emitted from the simple act of toggling the power switch. In an ordinary atmosphere, the spark is harmless. However, it will be a concern if flammable vapor is present as it could ignite an explosion. Examples of these locations are chemical factory, oil refinery and marine. Measures are put in place to reduce the risk factor. One of the simplest methods is to minimize the amount of electrical equipment installed in the hazardous area by not allowing the equipment in the area totally or making the area less hazardous by process improvements. The equipment used in the area are designed to be intrinsic safe or explosion proof by limiting energy, electrical and thermal available by ignition.

The IEC 60079 – 0 (Explosive atmosphere standards) specifies the general requirements for construction, testing and making of electrical equipment and Ex Components [1] intended for use in explosive atmosphere.

[1] Definition of EN 60079-0:2012 for Ex Component part of electrical equipment or a module, marked with symbol "U", which is not intended to be used alone and requires additional consideration when incorporated into electrical equipment or systems for use in explosive atmosphere

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One of the design considerations is the material selection for equipment casing which is critical. For example, magnesium is prohibited within the explosive areas. Common materials such as aluminum must go through metallurgical effort to allow it to have specific properties. Polymers generally are not used. The materials used have to satisfy anti-static properties which is difficult to achieve. Anti-static agent is also used to treat materials to have a conducting layer, hence reducing the buildup of static electricity.

According to the IEC standards, equipment that has non-metallic material as enclosures is required to have the material surface resistance tested. The test is conducted on parts of the enclosures or a test piece in accordance to the specified dimensions. The test object has to be conditioned at least 24 hours at 23°C and 50 % relative humidity and also tested in the same ambient conditions. A direct 500 V will be applied for 65 seconds between 2 electrodes. The surface resistance will then be measured. The typical value of the surface resistance is between 10^6 to 10^{12} Ω. With a high surface resistance value, the material is more insulative.

In critical environment such as hospital operating theatre where sensitive electronics equipment are being used, it requires stringent static control.

Furthermore, compressed oxygen are often being used in the operating theatre. A small discharge is able to disturb the sensitive electronics components resulting in the malfunction of equipment and cause of fire hazard due to the compressed oxygen. Electrostatic discharge (ESD) measures are put in place to prevent the build-up for static electricity. Static dissipative ESD flooring is being used. Other preventive measures practice includes humidity control of operating theatre and use of static-controlled clothing and footwear. In order to be ESD safe, the flooring material is being tested in accordance to IEC61340-2-3 (Part 2-3: Methods of test for determining the resistance and resistivity of solid materials used to avoid electrostatic charge accumulation).

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A super megohm meter (commonly known in the industry as electrometer and picoammeter) such as Hioki SM7110 is used to measure the surface resistance of materials. The SM7110 is able to perform simultaneous measurement of temperature and humidity. This is important when conducting measurement and management of new materials as changes in either can affect the insulation resistance. The sequence mode feature allows the setting of time for “Discharge – Recharge – Measurement – Discharge” flow to perform repeated measurements without the use of computer. Various electrodes and shield box are available to cater to different application.

For example, the SM9001 electrode (Figure 1) is built in compliant to IEC61340-2-3 standards which is suitable to be used to measure anti-static flooring materials. Measurements can be conducted easily as no cutting of samples is required. This is because the electrode uses a conductive rubber where the size conforms to standards. Hence, only the electrode needs to be place on the desired point for stable measurements under the load of 2.5 kg.

- **Main body**
  SURFACE/VOLUME RESISTANCE MEASUREMENT ELECTRODE SM9001
  (With integrated low resistance [500 kΩ]/high resistance [1 TΩ] test surfaces)

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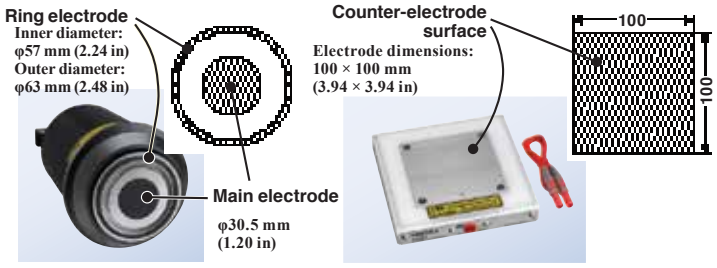
The SM7110 has strong resistance against noise, giving a high stability which is crucial for high resistance measurement. It has a management range up to 2 x 10^{19} Ω. With capability to give reliable readings and availability of various accessories, the SM7110 is suitable to accomplish the task of material surface resistance measurement.

Measure without cutting samples

● **Electrode Shapes Compliant with Standards**



Main body electrode (Bottom view of the SM9001)

Counter-electrode with integrated stand (SM9001 accessory)

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