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High Resistance Ohmmeters – Voltage Measurements

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High Resistance Ohmmeter Measurements

Introduction

High Resistance Meters are one of the most commonly used meters for the measurement of materials used to control ESD. From work surfaces to floors, evaluators use these meters to qualify materials and audit workstations and ESD safe areas. There are a number of parameters that can cause different readings from these meters when improper instrumentation and techniques are used. These techniques and precautions will be discussed in this Technical Report (TR) in order that the measurement will be as accurate and repeatable as possible for high resistance measurement of materials. Several orders of magnitude differences in measured resistance values have been observed and reported to the ESD Technical Advisory and Services (TAS) committee. Materials that may have a non-linear resistance for various levels of applied voltages. Also, measurement may vary because of materials used in the electrodes, but these issues are beyond the scope of the investigation conducted for this TR.

Measurement Considerations

The following are some considerations that need to be kept in mind while making resistance measurements using these meters.

1. Careful attention must be paid to test lead and instrument (high resistance meter or megohmmeter) selection and setup especially when measuring grounded items. The equipment grounding conductor (chassis ground) must be isolated from the instrument (signal sensing) terminals. A high resistance megohmmeter test lead may require a connection to the ground side of the item under test. (Consult the manufacturers instructions for proper test lead setup for grounded items.)
2. Resistance meter output voltage may vary with load resistance. This can cause a wide variation of measurements between two different models of meters. Although the open circuit test voltage is usually specified as 10 or 100 volts, the voltage under load can drop to levels that may produce errors in measurements. Variations in measurements will occur when the internal source resistance of the meter approaches or is greater than that of the item under test. The item under test's resistance pulls down or "loads" the meter's output voltage. The reduced output voltage will not always affect the measurement. This depends on the non-linearity of a material's resistance with applied voltage. Generally when non-linear materials are measured, the less the "load" pulls down the open circuit output voltage of the measuring instrument, the more accurate the measurement.
3. Measurement of the open circuit output voltage of a megohmmeter or high resistance meter requires that the input impedance of the voltage meter used to make measurement be at least two orders of magnitude higher than the source resistance of the megohmmeter. The two orders of magnitude will allow for a reading of at least 99% of the open circuit test voltage.

It has been reported that the output voltage drops for some instruments when measuring a wide range of resistance. This Technical Report gives the results for a wide range of resistance measurements made with several different meters