# Volume Resistivity Measurement

The "standard" test method for volume resistivity of conductive elastomers is ASTM D991. While useful and accurate for measuring anti-static products (such as carbon-filled elastomers), this method has serious shortcomings when used for EMI gasket materials. For example:

a. ASTM D991 cannot be used to measure actual molded parts (such as O-rings). It requires flat sheet samples.

b. Pressure is critical in ASTM D991 measurements.

c. The probe and meter setup of ASTM D991 is not sufficiently portable to make measurements outside a laboratory.

d. The ASTM D991 procedure assumes that surface resistivity is very high (ref. para. 1.2). For EMI gasket materials, whose surfaces must be very conductive, the method cannot distinguish between samples with high and low surface resistivity.

To reduce or eliminate these shortcomings, a modified ASTM D991 procedure has been developed which uses the surface probe and calculation shown in Figure 35. Tests using this probe have been shown to correlate well with ASTM D991 and other 4-point probe methods of measuring volume resistivity. Using this 2-point probe, measured resistance values for EMI gaskets in the 0.002 to 0.02 ohm-cm range are typically 0.01 to 1.0 ohm (depending on cross section). These values can be easily measured on small, under-$500 ohmmeters sensitive down to 10 milliohms. The probe can be used to make accurate volume resistivity measurements on actual gaskets such as molded rings, extruded strips, or custom cross sections. The weight of the probe (200-500 gm) is sufficient to produce accurate and reproducible measurements after a stabilization period of about 15-60 seconds.The addition of 1-2 lbs (450-900 gm) manual force will allow a stabilized resistance value to be reached more quickly.

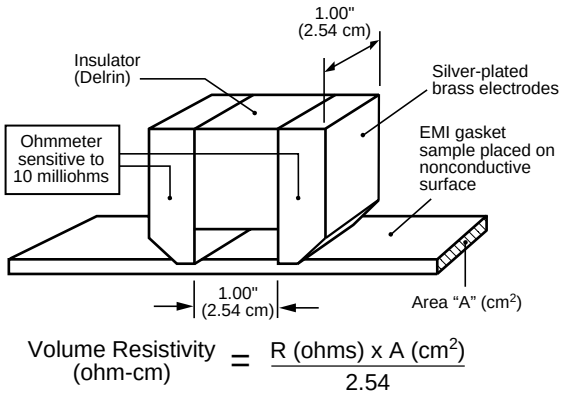


**Figure 35** Modified ASTM D991 test probe for measuring volume resistivity of conductive elastomers.

Although the test electrodes shown in Figure 35 are only in contact with one surface of the part or sample being measured, it can be easily shown that in fact a *volume* resistivity is being measured. Start by measuring a flat sheet sample 2 in. x 4 in. x 0.062 in. in size (5.08 cm x 10.16 cm x 1.51 mm). Then cut the sample into two pieces, each 2 in. (5.08 cm) long, and ply them up into one double-thickness sample 0.125 in. (3.02 mm) thick. This plied-up sample will result in a resistance measurement almost exactly half the first measurement. By doubling the cross sectional area "A" (Figure 35), the resistance "R" is halved.

It can also be shown that for materials with one side substantially more conductive than the other, measurement with the probe of Figure 35 will clearly show the difference. Since this is a common problem with poorly-manufactured conductive elastomers ("resin-rich" on one side), it is recommended that random measurements be made on *both* sides of parts during QC or Acceptance testing.

For extremely small gaskets, shorter electrode spacing may be required – such as 0.50 in. (1.27 cm). For a probe with 1.27 cm separation, change the denominator in the equation shown in Figure 35 to 1.27.

The probe of Figure 35 has been specified as the method of measuring volume resistivity of finished parts in MIL-G-83528.



CHOMERICS
*US Headquarters* **TEL** +(1) 781-935-4850 **FAX** +(1) 781-933-4318 • ***www.chomerics.com***
*Europe* **TEL** +(44) 1628 404000 **FAX** +(44) 1628 404090
*Asia Pacific* **TEL** +(852) 2 428 8008 **FAX** +(852) 2 423 8253
*South America* **TEL** +(55) 11 3917 1099 **FAX** +(55) 11 3917 0817
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