



**Dr. Zap**

## Electrical Resistance and Resistivity

Written by: David E. Swenson, Affinity Static Control Consulting

Interpreting a data sheet for a static-control product requires a certain level of knowledge and experience. Often, you must wade through a myriad of specifications, test methods, and claims without fully understanding what is actually stated. It also is possible that the supplier of the product has used incorrect test methods to substantiate the properties of interest.

The ESD Association provides standards and information regarding the application of test methods for various static-control products to help educate the industry. Without question, the most important attributes of a static-control product pertain to electrical resistance in some way. In almost every case, the fundamental function of a static-control product relates to the electrical property that controls the rate of current flow, specifically electrical resistance.

Basically, there are four ways to express electrical resistance:

- Resistance to ground (ohms)
- Resistance point to point (ohms)
- Resistance (ohms)
- Resistivity (ohm-meter)

Each of these forms has an appropriate and acceptable application. Each form also is misused, perhaps more frequently than used correctly. You may notice that the often-used resistivity term ohms/square is not listed. This article supports the internationally accepted technical convention that ohms is the correct term for surface resistance.

### Resistance to Ground

Resistance to ground is a measurement that indicates the capability of an item to conduct an electrical charge (current flow) to an attached ground connection. The higher the resistance in the path, the more slowly the charge will move through that defined path.

Many static-control items are evaluated for functionality by measuring electrical resistance through the intended primary path to ground. Wrist straps and static-control footwear, while worn, are evaluated by a loop-resistance measurement that is conceptually the same sort of measurement (Figure 1, right).



Figure 1.

Items such as conductive and dissipative floors and worksurfaces also fit into this category but require a standardized contacting electrode. A 5-lb, 2.5" dia. electrode attaches to an instrument that

Continued on Page 2



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## Product

### 41000 - Survey Kit



The ESD Systems.com Item 41000 Survey Kit contains everything needed to conduct an ESD Control Program survey, per ANSI/ESD S20.20. The contents of the Survey Kit are (1) 42755 Ionization Test Kit, (1) 42722 HBM Test Fixture, (1) 41290 Surface Resistance Test Kit, (1) Fluke 10 Meter, (1) 41110 AC Outlet Analyzer, (1) 36080 Training Paddles, (1) 22025 Wrist Strap, (2) 24010 Foot Grounders, (1) Heavy duty carrying case.

#### Features

- ESD Survey Kit 15"x19"x7"
- Heavy duty carrying case with protective foam
- All tools required to audit or survey per ANSI/ESD S20.20
- Protects test equipment during transport or storage

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will make the resistance measurement at 10 V for conductive items and 100 V for dissipative items. The second measurement lead from the instrument goes to either the grounding point or the static ground.

Most often, the measurement is a loop resistance between the electrode and the grounding point of the floor or worksurface. In most cases, the resistance from the grounding point to actual ground, such as the equipment grounding conductor bus bar at the main service entrance to the facility, is measured using a specialized ground tester. An example of a loop-resistance measurement or resistance to a grounding point is the system wrist-strap test shown in Figure 1.

Another example of loop resistance comes from the ANSI/ESD S4.1-1997: *Worksurfaces-Resistance Measurements*. For this test, the standard electrode is placed on the tabletop surface. One wire from the test instrument attaches to the electrode and the other to the grounding point. The single electrode is moved to multiple locations on the worksurface to monitor variations of resistance to the grounding point.

### Resistance Point to Point

A point-to-point measurement used during the qualification process evaluates floor and worksurface materials, garments, chair elements, some packaging items, and many other static-control materials. Two electrodes contact the item-under-test at some prescribed spacing. As in the resistance-to-ground test, the measurement voltage depends on the material: 10 V for conductive items and 100 V for dissipative ones. **Figure 2** shows the point-to-point concept for a worksurface. So then you should get the wires and connected them to the right side of the connectros. Then it will attract electricity from tester.

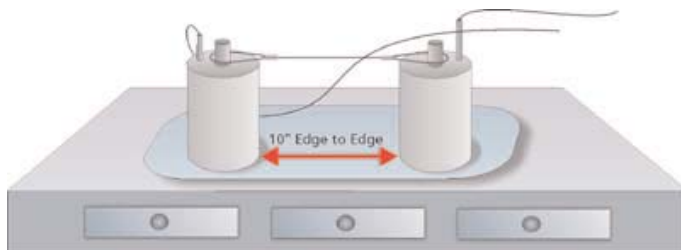


Figure 2. Measurement of Worksurface Resistance Point-to-Point

Point-to-point measurements are important during the qualification process for proper evaluation of flooring and worksurface materials. After installation, the resistance-to-ground measurement is more applicable since it emulates how the material really behaves in practice.

At this time, a single electrode containing two small probes is under evaluation by the ESD Association's Two Point Resistance (Packaging) WG-11.13. This probe, intended to measure packaging materials, is sure to find many other applications.

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## Product

### 41222 - Dual Operator Continuous Monitor



The ESD Systems.com Item 41222 Dual Operator Continuous Monitor with Satellites continuously monitors the grounding integrity of two operators, and two ESD worksurfaces' path to ground.

#### Features

- Control unit LEDs continuously indicates proper grounding of two mats and two operators; includes mounting so that control unit is at eye level, off the work surface area
- Two satellite remote monitors include monitored wrist strap ground, parking stud, and unmonitored ground for guest or equipment. Versatile design allows placement where desired up to 7 feet from control unit.
- standards. Important for users to maintain NIST calibration at their facility.
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**Q:398** An untreated cement flooring may measure no static voltage even when attempting to tribocharge it. Would it be safe to assume that since the concrete absorbs moisture from the ground it would be safe to use untreated in an ESD controlled area?

[see ANSWER 398](#)

**Q:1175** What happens if you staple ESD Bags shut? Does that damage the ESD Bag's effectiveness? What if the ESD Bag is heat sealed shut & a staple on the seam is used to attach paperwork?

[see ANSWER 1175](#)

**Q:1178** My ESD shoes are failing, what's wrong with the Tester?

[see ANSWER 1178](#)

**Q:1171** Is a combo tester limited to testing Wrist Straps and Foot Grounders, or can it test ESD smocks?

[see ANSWER 1171](#)

**Q:1180** Is it OK to not ground an ESD Smock when at an ESD protective workstation where all conductors should be grounded?

[see ANSWER 1180](#)

[Find more ESD Q&As here](#)

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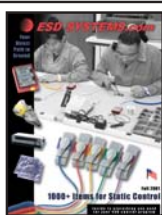
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