

## NICK'S NICHE

Guest Column

# Finding solid ground

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It's surprising the number of times people ask me: "How do I measure ground on a part?" or "What is considered good ground on a part?" Occasionally, they ask the question in a backdoor fashion like: "How often should I clean my hangers?" or "Why is the part arcing in the booth?" In any case, they all are trying to find solid ground, like Lewis and Clark were trying to find a commercial water route across the continent to further trade. Fortunately, the quest for finding solid ground is easier than walking a couple of thousand miles through wilderness.

### What is proper ground?

Let's start out with the definition of part ground. The National Fire Protection Association (NFPA) guidelines state that parts must have less than 1.0 megohm resistance to electrical ground. One megohm is equal to 1 million ohms, a sizeable amount of resistance. This stated recommendation from NFPA in their Guideline Bulletin Number 33 has a safety factor to ensure that sources of igniting the atomized powder are nonexistent. In fact I have seen numerous operations successfully applying powder coatings at much higher levels of resistance to ground (20.0 megohms and higher).

This is because current electrostatic application equipment is capable of coating parts whose resistance to ground can far exceed this limit. However, it's very unsafe to operate an electrostatic process under these conditions, and it's strongly discouraged.

An uncoated metal part, clean hanger, and clean conveyor have little resistance to ground because they are excellent conductors. What degrades this ideal path to ground is powder buildup on the contact points of the part hanger and the conveyor. Dirty swivel assemblies on the conveyor, as well as dirt and contaminants in the conveyor wheels, will also impede the path to solid ground. All these contact points in total must be able to conduct ground with less than 1.0 megohm resistance to meet the NFPA safety guidelines.

### How do you measure proper ground?

The device that is used to measure continuity to ground is an ohm meter that has a megohm scale. This device can be a volt-ohm meter (VOM) or a megohm meter (Megger). The VOM typically uses a low voltage power source (around 9 volts) to check resistance. This is adequate for checking electrical circuits but, because of its low voltage, isn't well-suited for checking

ground in a powder coating system. The megohm meter, originally designed to check motor windings and wire insulation, is the better device because its power source is typically 250, 500, or 1,000 volts. This higher voltage provides the needed current required to measure resistance to ground in a powder coating system and provide an instant reading.

Before using your ohm meter, read and follow all instructions carefully to avoid electric shock and ensure you are obtaining valid resistance measurements. Using long test leads is helpful if you want to verify part ground through the entire coating area within the powder booth. You can make extensions for the test leads that came with your ohm meter by using an appropriate length of 16 gauge, or heavier, wire, and a couple of "alligator" clips.

Verifying the building ground is important to ensure that you have a proper ground circuit. To verify your test ground connection point, connect one lead on an electrical outlet ground lug or conductive cold water pipe and the other lead to your test ground location. The test ground location should be close to the powder booth and can be a conveyor's support steel, electrical conduit or panel, the booth itself (providing the booth is metal), or any metal device that is connected to ground. Energize this test circuit in accordance with the meter's instruction and read the resistance value on the meter scale. A verified building ground won't have more than a couple of ohms resistance between your test ground location and a known electrical ground. Now you can have complete confidence that all future ground measurements taken from this more convenient test ground location are verified building ground.

To check resistance to ground, connect one test lead to the verified building ground test locations and the other test lead to the part on the line, and read the resistance value on the meter scale. To comply with NFPA guidelines, this reading must be 1.0 megohm or less resistance to ground. This ground test will include all items in the circuit, including the

part, hangers, swivels, and all conveyor components and their total resistance to ground.

If the resistance to ground exceeds 1.0 megohm, then move the test lead from the part and touch the next part of the circuit (the hanger contact). If this reading is still higher than 1.0 megohm resistance, then continue up the circuit to test each contact point (swivel, conveyor wheel, conveyor chain, conveyor track, etc.) until proper ground is measured. By starting at the part and working backwards, you'll determine exactly where ground is lost and which device requires attention.

### **How do I attain a solid ground?**

Uncoated parts inherently are conductive as long as they're entirely constructed of metal. The most common culprits of bad grounding are poorly maintained hanger contacts. The entire hanger can be coated, but the contact points (at each end) must be clean enough to conduct ground. Obviously, the more contact points a hanging system has the more difficult it is to maintain solid ground. If flexible hangers are necessary to safely transport your parts, consider using cable instead of chain to minimize contact points that can go bad. Contact points will remain clean for quite some time, as long as the contacts are protected by the part and conveyor connection. Coating hangers or contact points without parts is a surefire way to lose ground quickly.

After part hangers, the next area that requires attention for proper grounding is the conveyor components. Swivels can be cleaned or replaced to ensure proper ground. Conveyor wheels or trolleys can be cleaned or in rare circumstances replaced to conduct proper ground. If you suspect the conveyor rail or track, the simple fix here is to attach the conveyor rail or track to a known and verified building ground.

Some people insist on using grounding rods driven into the dirt under the plant floor to attain solid ground. For ground rods to be effective, they must reach the base water table height. This can be more than 12 feet under-

ground in some parts of the country, making this approach impractical. Attaching the conveyor, and other booth devices, to the building's electrical ground system is much more convenient and all that is required for a connection to known ground.

### **What conditions are caused by improper grounding?**

The most prevalent issue with poor grounding is inconsistent and inadequate coating thickness. When you have improper ground, film build will vary from part to part, and Faraday areas will be more difficult to cover. Edge build may also be affected. Recoats will be very difficult to coat, as well. All in all, it will be very difficult to control film thickness within a reasonable range in such a process.

Second to coating thickness with a bad ground is poor transfer efficiency. Because the powder won't be attracted to the part at an efficient rate, the amount of overspray will increase compared with a process that has a well-managed ground. If your system is spray-to-waste, then your coating cost will undoubtedly increase as you scrap more of this overspray. Even in an all-reclaim system, the poor powder transfer efficiency will play havoc with particle size, adding to transfer efficiency and film thickness control problems.

Coating smoothness will be impacted, as poor ground often results in more back ionization problems and orange peel. Moreover, you can forget about applying film builds above 3.0 mils with a poor ground, as most of the powder will reject from the part surface.

### **What are the safety issues with poor grounding?**

The paramount issue with poor part grounding is safety. Ungrounded, or poorly grounded, parts will store the electrostatic charge emitted from the powder guns. When this charge attains sufficient energy, the stored electrostatic charge will discharge to the nearest ground. When this happens, the discharge often jumps the airspace between the part and the target ground causing an arc. For you non-technical readers, this is how lightning occurs. The energy released

in this arc is sufficient to ignite powder that is above the lower explosion concentration of the powder formula. The powder density at the end of the gun typically is above this lower explosion limit, which is why most booth fires occur between the gun and the part. We all know that a fire in a powder booth is a bad thing.

### **Besides the part, what else should be grounded?**

NFPA guidelines are clear that all equipment in and around the powder coating area must be grounded. This means feed hoppers, gun pumps, guns, gun controls, booths, ductwork, operators, oscillators, reciprocators, electrical cabinets...everything. If the equipment is conductive, it must be grounded. Touch-up sprayers are grounded by holding the gun handle, unless they wear gloves. If they must wear gloves, purchase conductive gloves from your equipment supplier for the best results. A personnel grounding strap works, but most people find these too cumbersome and they restrict mobility.

### **Summary**

Finding solid ground in powder systems can be difficult if the system was improperly grounded by the installer or you performed inadequate ground maintenance. Running a powder coating operation that doesn't have a solid ground is like standing on quicksand. Eventually, you'll be very uncomfortable. However, there's nothing like standing on solid ground when operating a powder coating process. It sure beats sinking up to your neck in the quicksand of poorly coated products and unsafe working conditions. **PC**

### **Editor's note**

For further reading, see the "Index to Articles and Authors 1990-2010," Reference and Buyer's Resource Issue, *Powder Coating*, vol. 21 no. 7 (December 2010), or click on the Article Index at [www.pcoating.com]. Article can be bought online. Have a question? Click on Problem Solving to submit one.

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