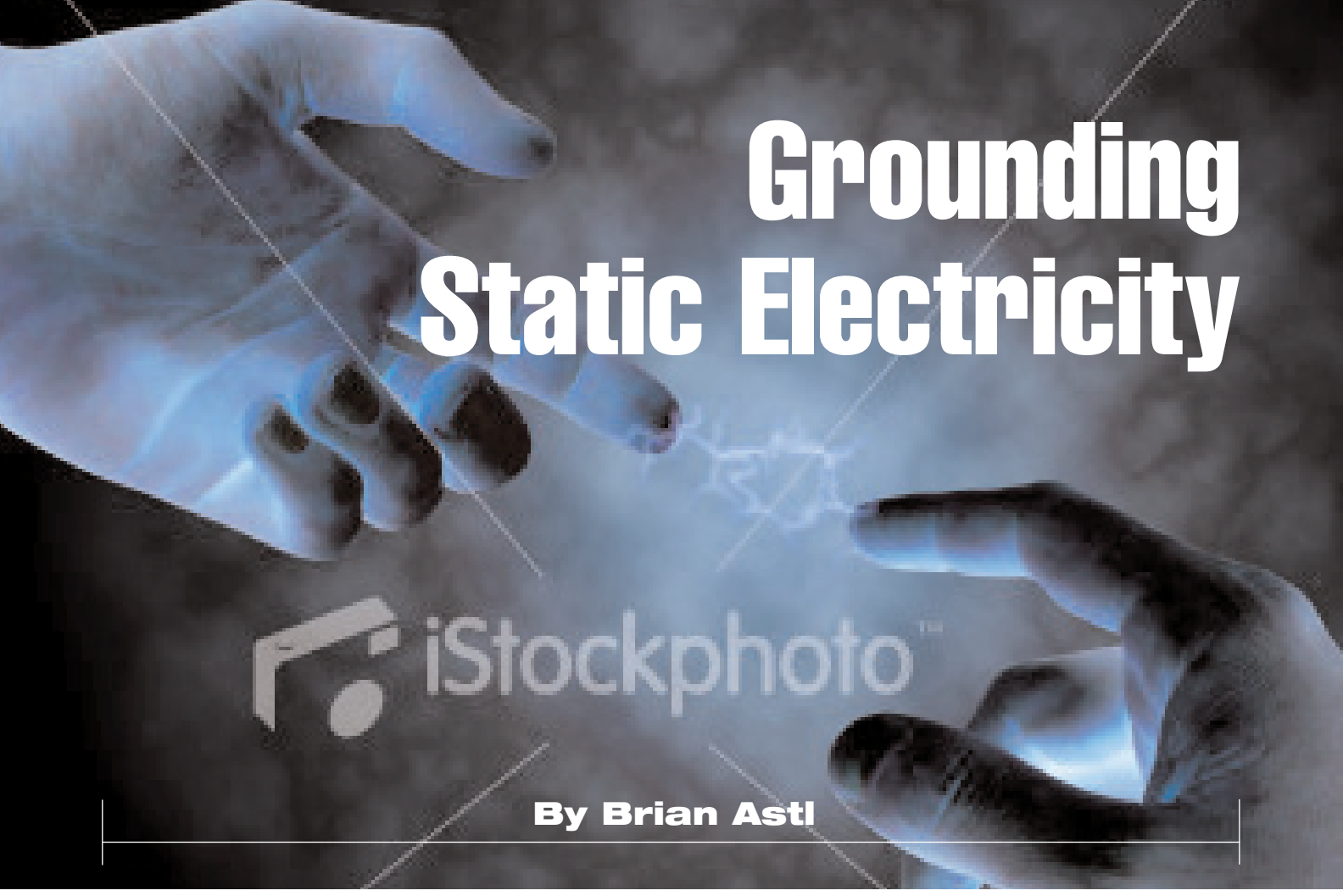

Grounding Static Electricity

By Brian Astl

Static grounding is a form of electrical grounding that is often overlooked. While not as high profile as electrical current grounding, if it is not done properly the results could be catastrophic. Electricians should understand the basics of static electricity and how to design and maintain a static grounding system to mitigate the dangers, as it is often the plant electrician (whether contract or on-staff) that is asked to do this work.

Static electricity is generated through the movement of one type of material against another. This movement transfers electrons, leaving the items with an electrical potential different from ground. Bringing the item back to a neutral electrical state can involve a static discharge – a spark. Most people have felt the shock of a static discharge from getting out of their car, or shuffling their feet on a carpet and then touching a door knob.

While these sparks are annoying in an office environment, they are highly unlikely to injure anyone directly. That is because static electricity is a very low amperage event. The amount of actual electricity that is transferred is quite low. However, static electricity is a very high voltage event, hence its ability to arc through the air to complete the discharge. This high voltage in a static discharge has more than enough energy and heat to ignite flammable gases and dusts that are present in the air. So for workers in industrial areas that work with flammable liquids, gases, dusts and grains, static electricity is a real problem that must be addressed. Several high profile explosions happen every year from uncontrolled static discharge. The Chemical Safety Board routinely finds a static discharge to be the root cause of industrial explosions in the U.S., and the issue even attracted the attention of the news program 60 Minutes.

The build up of static electricity in many industrial processes is unavoidable. The movement of fuel from a pump into an airplane, for example, is bound to generate static. What is important to do is to take steps to limit the accumulation of static electricity and to safely drain the static electricity to ground. The goal is to avoid the static discharge 'spark' that comes as a result of an uncontrolled static charge.

Static Bonding & Grounding Regulation

In Canada and the U.S., the state, provincial and country level fire codes control the regulation for static bonding and grounding. Unlike most 'electrical' issues that are handled by the Electrical Codes, the dangers of static electricity are recognized in the fire codes, since a static discharge around flammables is an explosion and fire hazard.

For this reason, electricians are often not fully aware of the intricacies of static bonding and grounding. However, they are often the ones responsible for the control of static electricity, since it is 'electricity' that is at issue.

The Canadian Fire Code (and its provincial counterparts) requires anyone who is transferring flammables to safely discharge the static electricity. Examples of this include fuel transfer, mixing/breaking bulk on chemicals, mixing paint,

and drumming operations. However, the Fire Code does not tell you how to do this, what equipment to use, what standards to adhere to, or how to evaluate a system to know if it is effective. This lack of information causes poor system design, the use of inadequate equipment, and poorly maintained systems.

Each static grounding application and system is going to be different and require some thought and planning, and it's always best to engage experts in the field to help where there are difficult issues or questions. However, there are some general guidelines that electricians can use when called upon to take the lead on static grounding.

Process Improvements To Minimize Static

Before you even start designing the static grounding system, look at the processes involved and see how they could be changed to minimize the generation of the static electricity in the first place. Static electricity is generated when two different materials rub against each other, such as your shoes and the carpet or a flammable liquid flowing through a metal pipe. Faster flow, flow over a larger surface area, and higher impact of flow all increase the rate at which static electricity is generated.

As such, tactics like reducing the flow rate, splashing of liquids, and other measures can be used to decrease the surface area of materials rubbing together. For example, all containers should be bottom-filled using a slow rate of flow, especially if a filter is employed.

Another key process improvement is to store and mix flammables only in metal drums, as plastic drums cannot be properly grounded.

Static Grounding System Design

A good static grounding system will safely and effectively move any generated static electricity to ground through a verified system of clamps and cables.

Systems can be designed to be permanent (e.g. wiring between joints on a pipe), semi-permanent (e.g. screw-type c-clamps on drums that are not moved on a regular basis), and portable (e.g. hand held clamps and assemblies that are used regularly in a process like drumming). The systems can also be designed for areas where there is a consistent location for the activity that needs grounding or where there needs to be some variability. An example of the latter case would be when a bulk chemical truck pulls into an unloading facility. Typically a static grounding reel would be mounted on the truck or at the loading area with 50 to 100 feet of cable that can reach a ground point regardless of where the truck is parked.

What all these systems have in common is that they provide a relatively low-resistance path for the static electricity to move from the equipment used to a known ground point. Typically static grounding assemblies are connected to a bus bar on the wall that has continuity to ground, such as a ground rod installed outside the facility. Static grounding systems should be on their own dedicated ground. Connecting the static ground point to the facility's electrical ground can cause serious problems if the ground is energized for some reason.

A typical grounding assembly would involve a specially designed static grounding clamp, a length of steel cable, and a connection (lug, c-clamp, etc.) to the known ground point. Each component of the static grounding system is worth examining on its own to understand some of the intricacies of static grounding.

Clamps are very typical devices, but electricians should make sure to use the proper type of clamp. Static grounding clamps have sharp points that cut through paint, dirt and rust, and strong springs that are designed to be used regularly. Often clamps designed for other purposes will be mistakenly used in a static grounding system. For example, battery clips are used extensively by people who have not had proper static bonding and grounding experience. The problem with battery clips is that they have sharp points, but have weak springs that will not withstand regular use. Quite quickly, the spring will cease to provide a strong grip which will mean that there is not good metal-to-metal contact and the clamp may even be prone to falling off during operations.

Another common mistake is to use welding clamps. While welding clamps have stronger springs than battery clips, they are built with flat ends to the clamp that can't assure good metal-to-metal contact. Without strong sharp points on the end, you cannot be sure that the clamp will be able to penetrate paint, rust, dirt, etc.

Only specially designed static grounding clamps should be used. Clamps can be bought for all applications, including new clamps on the market that integrate intrinsically-safe electronic circuits that will warn users if they do not have a proper static ground. These 'intelligent' clamps provide an additional level

of safety that is often requested by industry. While regular static grounding clamps have been designed to achieve all of the parameters listed above, a user will never be certain that there is a proper ground unless the continuity is checked for the entire circuit. The user can attach an ohmmeter, but it is often safer and less cumbersome to employ an 'intelligent' clamp that will flash a bright red LED light if the continuity of the static grounding system is lower than the appropriate levels.

Cables that connect the clamp to the known ground point can be made of a wide variety of materials. The industry standard is to use plated or stainless steel cable, often coated in specially designed plastics to resist chemicals. Copper electrical cord need not be used for static grounding applications. As mentioned before, static electricity is very high voltage but low amperage. The high voltage means that the current can move through materials with a higher resistance than copper cord. The low amperage means that the cable carrying the current does not need to be insulated from contact with people. You can literally hold on to a steel cable that is draining static electricity and never feel any adverse effects from the current. Of course, using copper electrical cord isn't 'wrong' per se, but using a plated steel cable has many advantages. For example, the steel cable is much more durable and light when compared to copper cord, and can be coated in several different high visibility colours to prevent tripping hazards.

When designing a static grounding system, it is important to take into account the application at hand, the location of the work vis-a-vis the known ground point, and the process that will be employed. Installing the right equipment is only the first step; users must be trained on how and when to use the static grounding equipment.

Many firms in this industry can provide consulting help to assist in the design of a static grounding system and user training.

Static Grounding Maintenance

Once a static grounding system is in place, it must be maintained on an ongoing basis to ensure that it is providing the highest level of safety.

Upon initial set-up, the efficacy of the system should be verified. This is achieved by ensuring that there is continuity throughout the system from the tip of the clamps to the known ground point. Industry best practices set the resistance level for a static grounding system at 10 ohms between the item and a known ground point. This can be measured and verified easily using an ohmmeter. As mentioned earlier, this known ground point should be a verified ground (e.g. ground rod or bus bar leading to a ground rod/grid), but it should not be the electrical system ground point.

On an ongoing basis, the continuity of the system should be re-verified regularly. Alternatively, an 'intelligent' clamp system could be employed that will verify continuity with every use, showing the user that they have a proper set up to ground static electricity.

Additionally, the equipment should be maintained. The sharp stainless steel points on static grounding clamps should be checked and sharpened or replaced as they naturally dull over time. Cables and their connections should be physically examined for wear in order to proactively identify potential issues before they become problems.

Despite the lack of easily accessible information about dealing with the hazards of static electricity, electricians can draw on their knowledge of electrical flows to quickly come up to speed on static grounding. It is a topic that should be taken quite seriously, and the proper design, equipment and maintenance should be employed. Often users in industry will remark that they have been working without static grounding or with makeshift equipment such as battery clips for decades without a problem. But given the right humidity, flow of materials and type of materials, and an improperly designed or maintained system that has worked previously will fail catastrophically. A static spark has been blamed for explosions and fires that have literally destroyed entire facilities. Taking the time and effort to design a good system and use the proper equipment can quickly alleviate static concerns and allow the electrician to add value as the expert on both electrical current grounding and static grounding. Ω

Brian Astl is VP Sales/Marketing at Lind Equipment, a leading provider of portable electrical equipment for the toughest workplaces, including static grounding, hazardous location and industrial lighting, cord reels and portable power equipment. Lind Equipment has been working with customers to help them work confidently with their static grounding equipment for over 60 years.