



# THOR SYSTEMS, INC.

## **SURGE APPS SA-008: SURGE PROTECTION GROUNDING/BONDING** (Guidelines and application tools to promote improved Power Quality)

3621 Saunders Avenue  
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### *Grounding and Bonding for Effective Surge Protection*

Included in almost any Surge Protective Device (SPD) installation manual will be the requirements of short and straight multi-stranded conductors, appropriately sized and coordinated overcurrent system, and connection to a *low impedance grounding system*. But what is a low impedance grounding system for an SPD?

The concept of a low impedance grounding system is especially important during a lightning event. A lightning strike being dissipated through a high impedance grounding system can cause a substantial rise in the voltage potential leading to a flashover event and damage to equipment as well as the nearby structure; this holds true for the operation of an SPD as well. The lower the impedance on the grounding system, the easier it is for the SPD to work as intended during a transient event.



The IEEE Standard for the application of SPDs, C62.72-2007 [IEEE Guide for the Application of Surge-Protective Devices for Low-Voltage (1000V or Less) AC Power Circuits], clearly states “the existence of a low-impedance grounding system and the connections of the SDPs to the ground system will have a direct effect on the SPD operation and coordination.” Without a low impedance grounding system, the highest performing SPD will not suppress a lightning or transient event as anticipated.

#### **Ref. Standards:**

UL 1449 4<sup>th</sup> Ed.  
UL 1283 5<sup>th</sup> Ed.  
C62.41.1: 2002 IEEE  
C62.41.2: 2002 IEEE  
C62.45: 2002 IEEE  
C62.62: 2010 IEEE  
C62.72: 2007 IEEE  
NEC 2014  
NFPA 70  
MIL-STD 220A

#### **WHY DO WE GROUND?**

- The first and foremost reason for grounding is Safety. A ground connection provides a path for the fault current conducted when a phase conductor comes in contact with a metal enclosure. Without a grounding system causing the operation of an overcurrent protective device (circuit breaker or fuse) in a fault condition, that path could be completed by a person making unintended contact with the metal enclosure - resulting in an electrical shock.
- The second reason for grounding is to remove the possibility of different voltage potentials, as differences in voltage potentials can create circulating ground currents and excessive noise on sensitive circuits. This noise can lead to system lock-ups, reboots, and data loss.
- Finally, the grounding system provides a path for current dispersion during a lightning event. A lightning strike is always seeking a path to ground and an effective grounding system will quickly and effectively disperse lightning currents *away* from the electrical system.

#### **WHAT IS THE DIFFERENCE BETWEEN BONDING AND GROUNDING?**

- The difference between bonding and grounding is the actual connection--or bonding--of the metallic infrastructure (building steel, metal water pipes, encased electrodes, etc.) between the metal electrical equipment cases and grounding conductors. Grounding is the connection to earth of this bonded network.
- Both connections play an important part in the effective operation of SPDs. A higher impedance in the earth to ground connection could cause a substantial rise in voltage at the current levels encountered in lightning events and high energy transient impulses. This rise in voltage could cause a flashover to other conductors within the electrical system. A higher impedance grounding system will also limit the ability of an SPD to divert the conducted energy away from the protected load during a transient or lightning event.
- Bonding not only includes the connection of the metallic infrastructure, cases, and grounding systems; it also includes the connection of other utilities as mentioned in Sections 800, 810, 820, and 830 of the National Electrical Code (NEC). To have bonding for effective surge protection there must be connections to the incoming electrical service and the incoming phone, cable, antenna and internet services as well. (Today's broadband environment has bundled many of these services together in one input). Failure to bond these services can create an unwanted ground path through sensitive electronics connected to more than one service (i.e. computers, phones, printers, TVs, etc.) leading to damage during a lightning or transient event.
- Grounding and bonding for effective surge protection is not static. The connections cannot be made and the ground rods put in the ground with the expectation the system will continue to be as effective as it is in that moment in time. Corrosion occurs, connections



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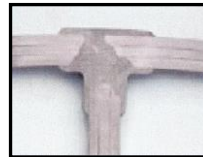
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loosen, and degradation happens over time. (Shown is a residential ground rod that was accidentally unearthed after 13 years of use. A nominal diameter 5/8" rod has many areas with a diameter of less than 1/4". Many grounds rods have been installed many years beyond this installation and have even less earth contact only to go unchecked.)

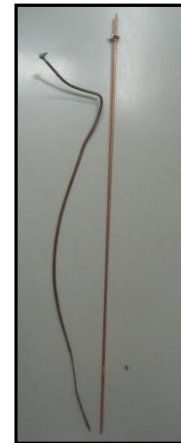
- Grounding systems, especially grounding systems with surge protection, need to be routinely checked for evidence degradation to assure proper operation of the SPDs.

### **ENSURING EFFECTIVE SURGE PROTECTION GROUNDING AND BONDING SYSTEM**

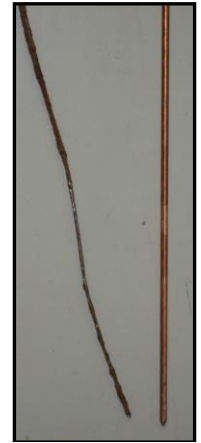
- Use the methods listed below to ensure an effective grounding system connection:
  - Exothermally weld the connections, or at least use approved mechanical connections, not "acorn nuts."
  - Make sure the ground rods and connections are below the surface level to reduce possible contact with lawn care equipment.
  - Make the evaluation of the grounding system part of the regular maintenance routine.



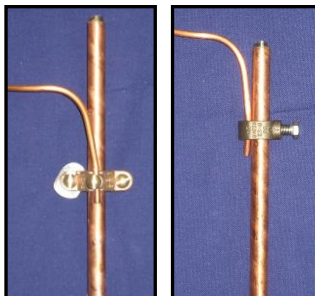
**Exothermic Weld  
Cross-section**



**New 5/8" Ground Rod  
Vs. 13-Yr Old  
5/8" Ground Rod**



**Inset Depicting  
Degradation to <1/4"  
dia. On 13-Yr Old  
Ground Rod**



**Mechanical  
Connection**

**Acorn Nut  
Connection**

- Provide a low impedance earth ground. The NEC requires 25 Ohms or less; THOR SYSTEMS recommends 5 Ohms or less for critical installations.
- Bond all metallic infrastructure, equipment cases, ground connections, and utility services.
- Inspect the grounding system regularly using a Ground Resistance Meter to assure a low resistance ground level is maintained.

Thank you for your interest in THOR SYSTEMS. We would like to become an information resource for surge protection applications. THOR SYSTEMS offers products and services that provide protection from the more *obvious external* to the more *frequent internal* transient voltage sources.

Our consistent focus on improved product performance and increased value to the customer is conveyed by our products' transparent cover enclosures, showcasing the TILE Architecture, unique component configurations, and providing per mode status indication.

Should you have any questions, please feel free to contact us (804.355.1100) or visit our Web site, [www.ThorSystems.us](http://www.ThorSystems.us).

#### **Ref. Documents:**

<b>SA-001</b>	<b>Introduction: Why Thor Systems?</b>
<b>TSI 068</b>	<b>Product Overview</b>
<b>TSI 107</b>	<b>Design/Build Spec</b>
<b>3G TSr</b>	<b>Product Spec Sheet</b>
<b>3G TSn</b>	<b>Product Spec Sheet</b>

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Ray, Larry, and S. Frank Waterer, PE. "Understanding the Differences Between Bonding, Grounding, and Earthing." *Electrical Construction & Maintenance (EC&M) Magazine Home Page*. Electrical Constructions and Maintenance, n.d. Web. 20 Nov. 2009.

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