

PRACTICAL INSTRUCTIONS FOR PROPER GROUNDING

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This application note offers straightforward, hands-on advice for the proper grounding of the electrical systems involved with your vacuum processing operation, including your power supplies. The advice provided is intended to help you improve system performance and factory safety.

Introduction

Improper grounding puts your manufacturing operation and personnel at risk. Its possible effects include interference with neighboring electrical systems, such as the circuits powering nearby offices. There are actual cases in which such interference has caused overhead lights to blink on and off. Likewise, incorrect grounding can underlie such phenomena as EMI and erroneous instrument readings, which can negatively impact your process and film quality. Most important to note is that improper grounding puts personnel at risk of electric shock. With such potential costs, it's important to be fully informed about proper grounding practices.

Please note that grounding is a complex topic. While the information here is designed to provide essential principles and guidance, it is in no way an exhaustive discussion.

Products

- All AE power supplies

Applications

- Industrial coating

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Grounding must be done in accordance with local codes and regulations. Before working on your systems, refer to applicable standards for your location and take all necessary safety precautions. Improper grounding poses serious hazards to personnel and equipment.



Equipment Grounding

Choose Appropriate Materials.

Copper strap, litz wire, and flat wire braid are the most common materials used for grounding. The material you choose depends upon your particular equipment/system requirements.

Use Sufficiently Wide Copper Straps.

When using copper straps for grounding, make sure they are sufficiently wide. High-frequency power and AC low-frequency power travel only on the surface of the strap. This is commonly referred to as the "skin effect." Due to this phenomenon, your grounding strap should have as much surface area as possible. Figure 1 shows a ground strap of recommended width.

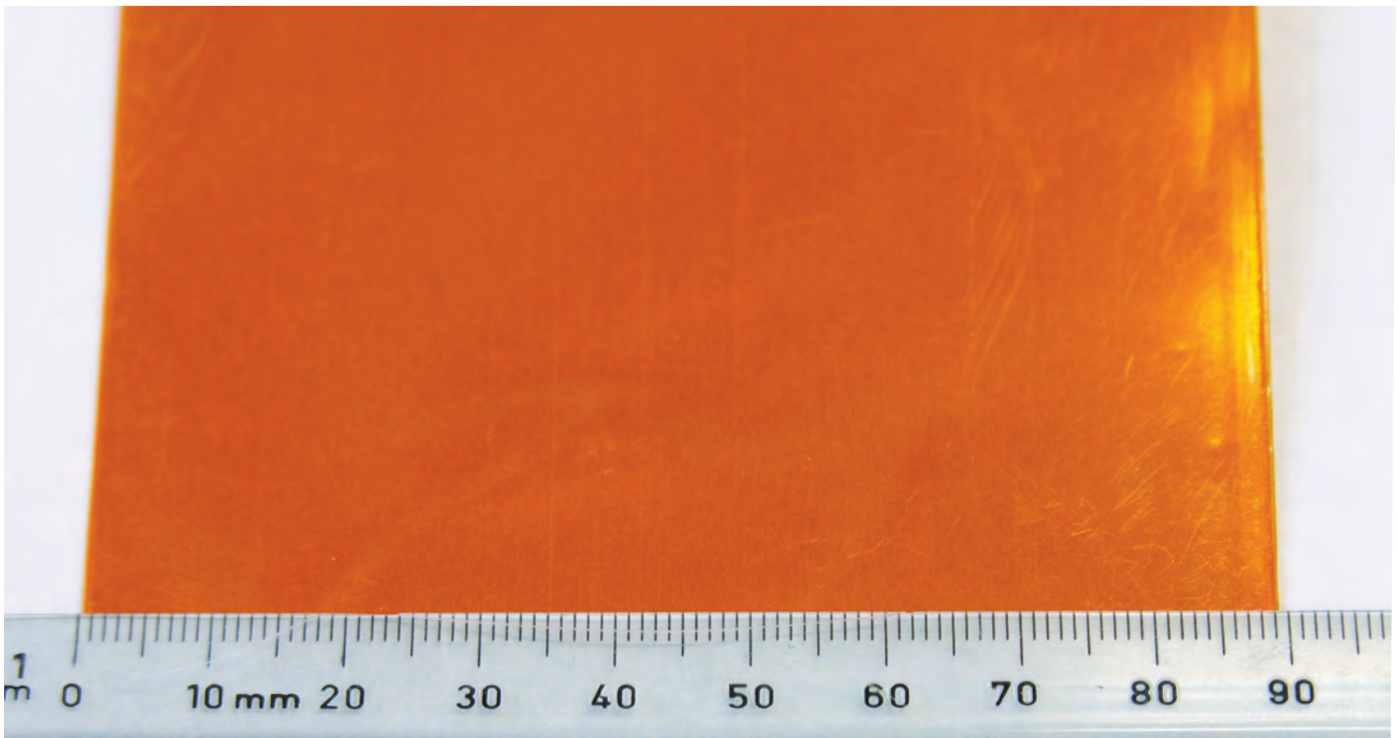


Figure 1. A copper ground strap of recommended width (90 mm, 3.5")

Crimp and Solder Your Grounds.

Crimping alone is not adequate for output cables because copper tends to oxidize. This oxidation compromises your ground connection so that eventually, without both soldering and crimping, the connection may break completely. Figure 2, on page 3, shows a flat braid crimped and soldered to a ring lug, creating a secure connection to the ground stud on the DC power supply.

Make Metal-to-Metal Ground Connections.

Do not allow paint or any other insulating material to come between one side of your ground connection and the other. Either make your connection to an unpainted surface (Figure 2), connect your ground before painting (Figure 3), or remove paint or other insulating coatings before grounding to metal beams, poles, or pipes (Figure 4). Please note that painting over a proper ground connection helps prevent oxidation and therefore protects the connection.



Figure 2. Crimped and soldered ground connection, made to unpainted surface



Figure 3. Ground connection made to metal beam before painting

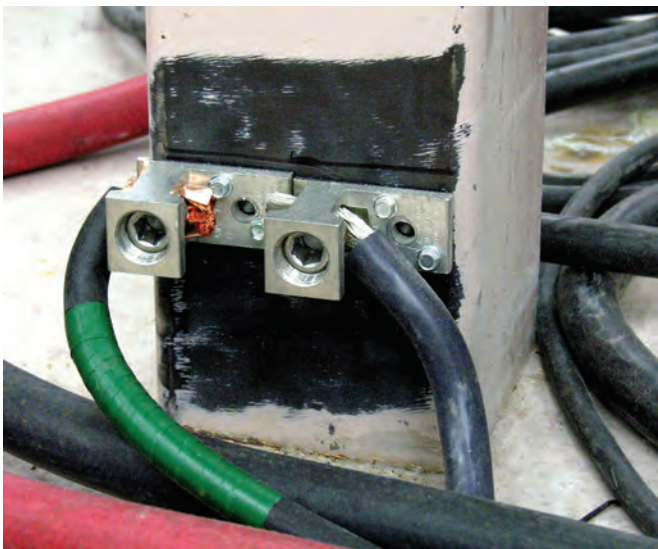


Figure 4. Ground connection made after paint removed from metal beam

Always Ground the Power Supply Chassis.

This particular connection is often overlooked or deemed unnecessary. However, it is always an important connection to make to your power supply.

Assemble the Ground Connection Correctly at the Power Supply Chassis.

Figure 5 shows a correctly assembled power supply ground connection. The star washer between the end of the flat braid and the power supply chassis resists oxidation and therefore helps maintain the ground connection over the long term.

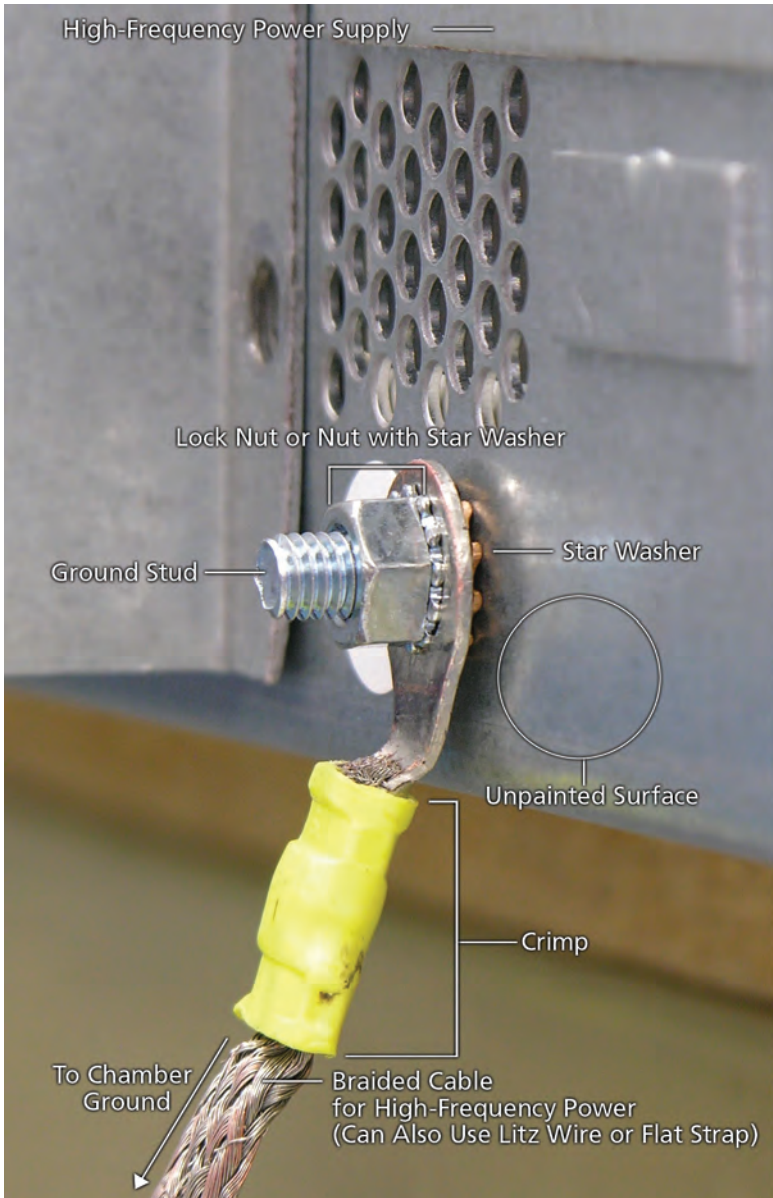


Figure 5. Close-up view of correct assembly of ground connection to Pinnacle® chassis

Connect Your AC Power Supply's Output Cables to Ground at Both Ends.

For power usage of the magnitude used in industrial sputtering applications, grounding at one end is not sufficient. A length of cable has a certain amount of resistance that can allow a high amount of voltage at the ungrounded end, putting equipment and personnel at risk.

Connect Grounds from the Chamber to the Power Supply and Ultimately to the Building.

This ensures that your system ground terminates securely in the earth. An earth ground is more effective than a reference ground, and greatly helps prevent EMI, noise, electric shock to personnel, and all of the other problems associated with improper grounding. Figure 5, on page 4, shows a flat braid ground cable leading from the power supply to the vacuum chamber. Figures 6 and 7, below, show a flat copper strap connected to the chamber and power supply.

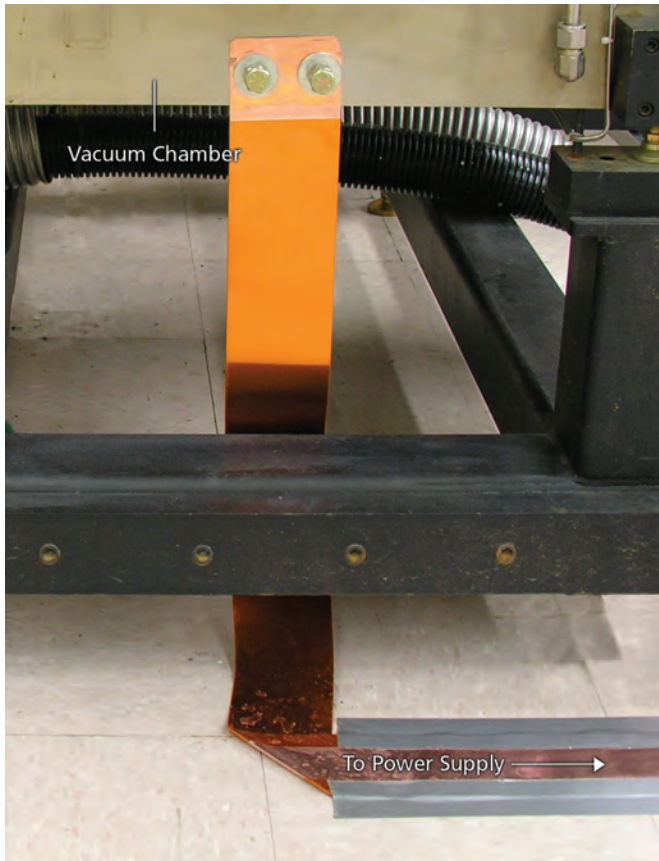


Figure 6. Flat copper ground strap connected to the chamber from the power supply



Figure 7. Copper ground strap leading to the power supply from the vacuum chamber

System Grounding

Good system grounding starts in the very foundations of your buildings. The following diagrams show a properly grounded industrial coating system inside a room constructed with grounding in mind. The ground wire, ground rods, and other structural elements allow the coater to be grounded properly.

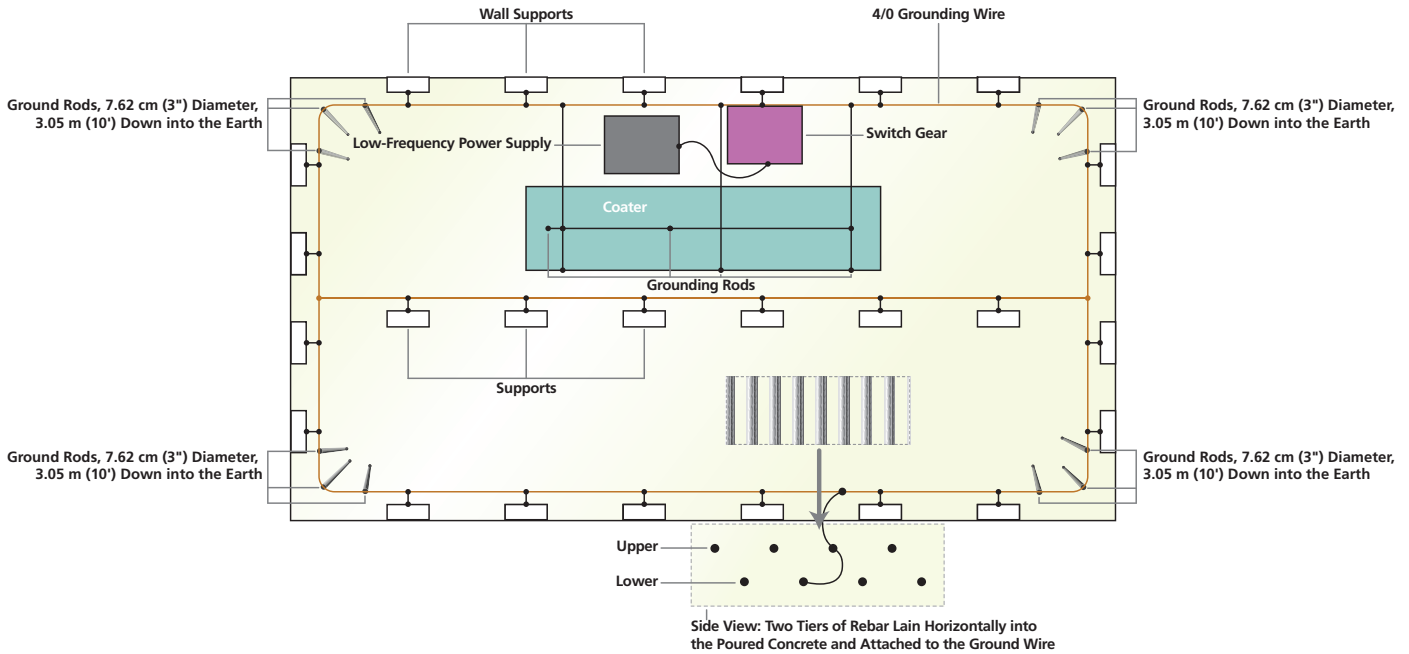


Figure 8. Proper system and factory grounding for an industrial coating operation

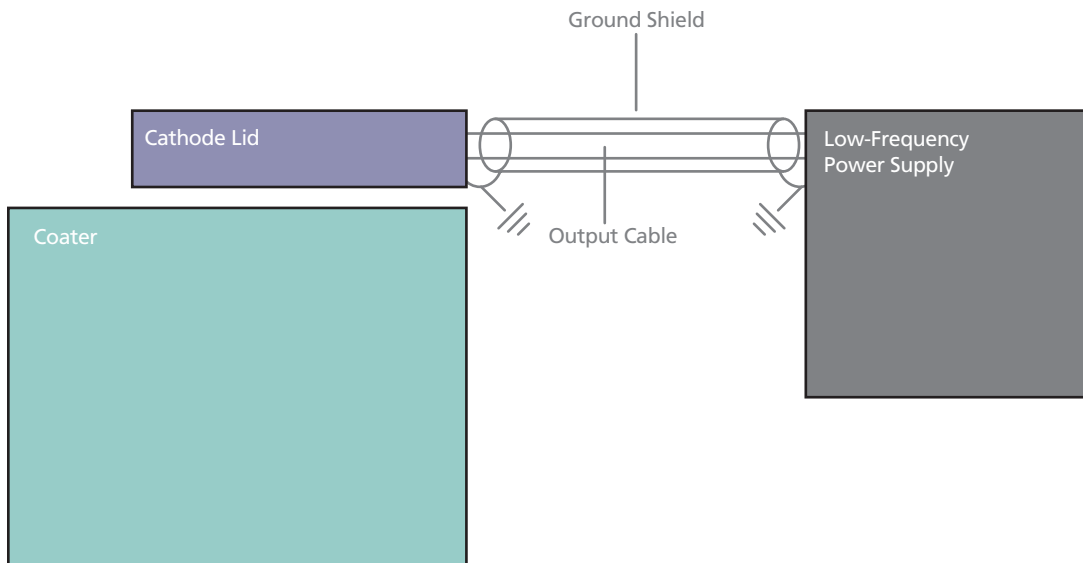


Figure 9. Properly grounded power lines between the low-frequency power supply and cathodes in the coater; The power supply output cable is surrounded by a ground shield that is itself grounded at both ends.

The following photos show a factory under construction that will house an industrial coating system. In this phase, we can clearly see the built-in hardware that will enable proper grounding once the system is installed and operating.



Figure 10. Proper ground connection to wall support

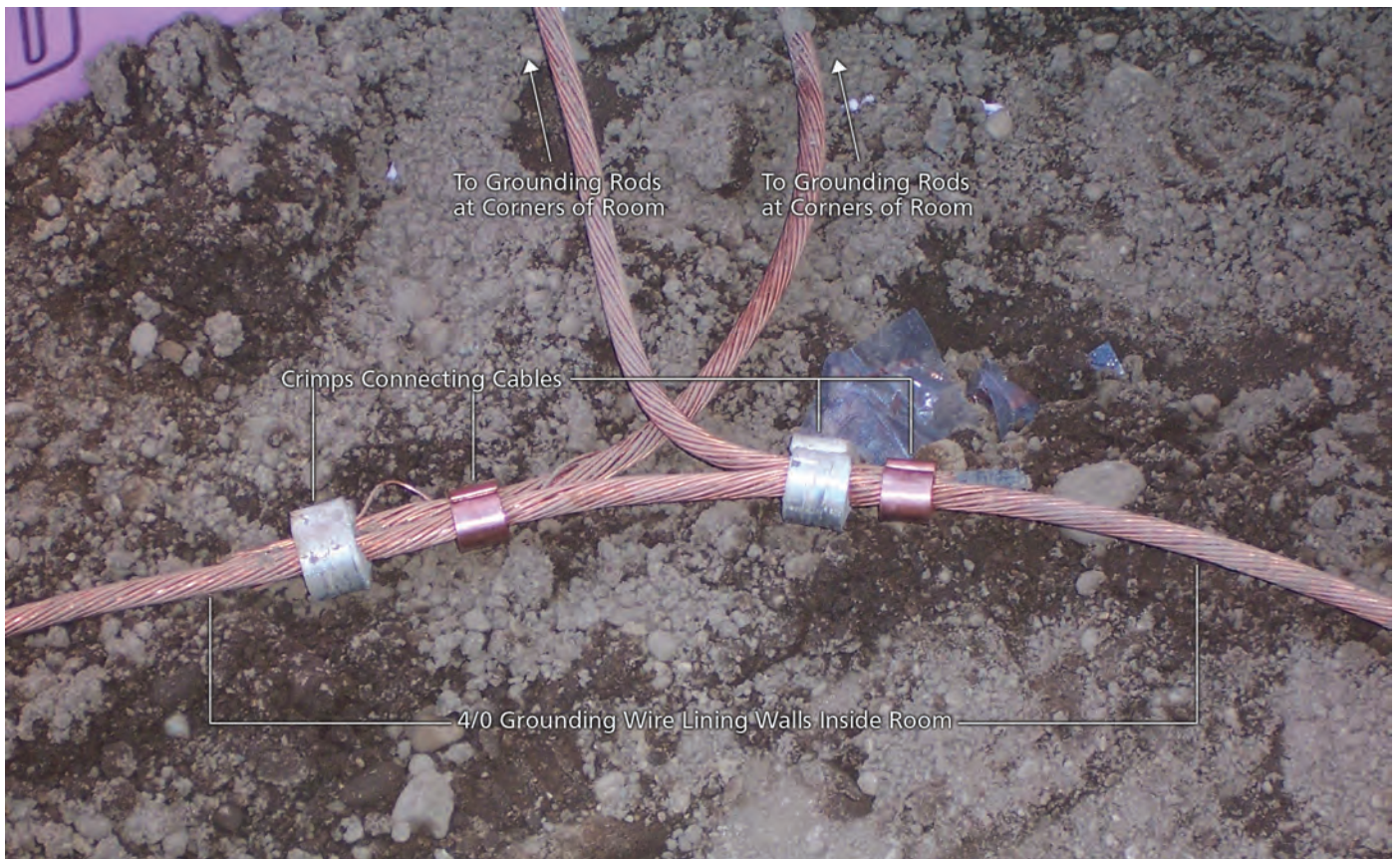


Figure 11. Cables connecting room grounding wire to grounding rods at corners of room



Figure 12. Room grounding wire connections to rebar inside wall



Figure 13. Room grounding wire connections to rebar inside wall



Figure 14. Properly crimped cable connection



Figure 15. Properly crimped cable connection



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