

# Grounding and Bonding

Overview

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# What We'll Cover

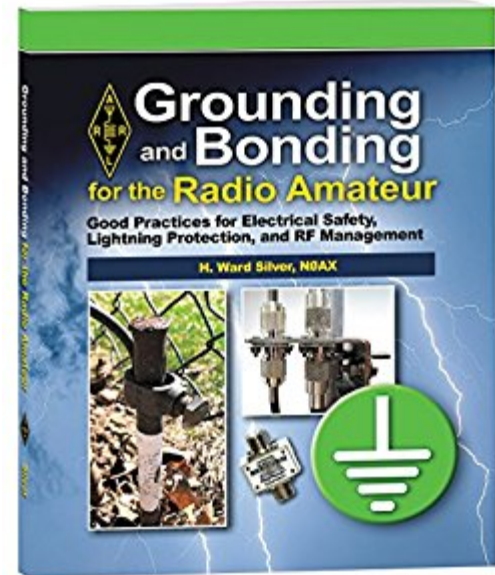
- Grounding & Bonding News
- Hints and Kinks for Exothermic Welding
- Photos of Process (Paul's Station)

# Recent ARRL Publication

## Grounding and Bonding for the Radio Amateur

By: **H. Ward Silver, N0AX**

- Six chapters, eleven appendices
- Lots of links and references
- More than just “how to hook up a ground wire”
- Does have to “manage his liability” Do your own research
- **Should be on every Ham’s Must Read list**

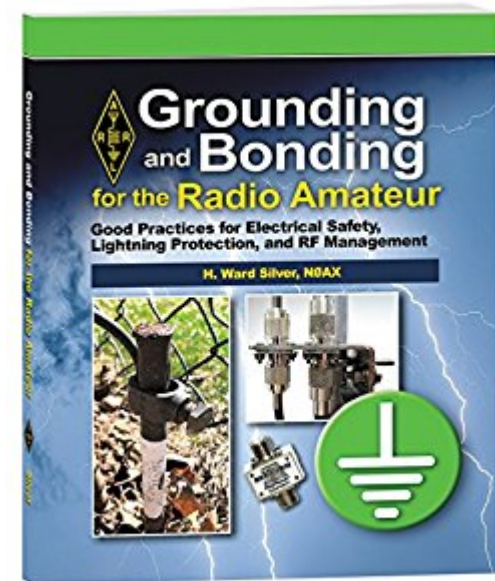


<https://www.arrl.org/shop/Grounding-and-Bonding-for-the-Radio-Amateur>

# Ward's Hi-Lites

## Major Thrusts

- **AC Safety:** "...Protect against shock hazards..."
- **Lightning Protection:** Keep equipment near the same voltage and dissipate charge to Earth during event
- **RF Management:** Keep unwanted RF from adversely affecting your equipment



<https://www.arrl.org/shop/Grounding-and-Bonding-for-the-Radio-Amateur>

# Ground and Grounding

**Ward, N0AX, defines Grounding as:** "... A connection to the Earth ..."

- **“Article 100 of the NEC** (National Electrical Code) **defines Grounding as:** "Establishing a connection, whether intentional or accidental, between an electrical circuit or equipment and the earth or to some conducting body that serves in place of the earth." Sep 1, 2004
- Nearly every profession and trade has their own “definition” of Ground and/or Grounding

<https://www.arrl.org/shop/Grounding-and-Bonding-for-the-Radio-Amateur>  
NFPA 70: National Electrical Code (NEC), 2017 Edition

# Bonding

**Ward, N0AX, defines Bonding as:** “... simply means “to connect together” so that voltage differences...are minimized.”

- **Article 100 of the NEC** (National Electrical Code) **defines Bonding as:** The permanent joining of metal parts together to form an electrically conductive path that has the capacity to conduct safely any fault current likely to be imposed on it.
- Again, nearly every profession and trade has their own “definition” of Bonding

<https://www.arrl.org/shop/Grounding-and-Bonding-for-the-Radio-Amateur>  
NFPA 70: National Electrical Code (NEC), 2017 Edition

# So What Does This Mean?

Like most topics in Life and Ham Radio, it means:

**It depends, and you have to make your own decisions!**

- **It depends on (just to name a few):**
  - The laws you live under
  - Your regard for these laws
  - Your risk tolerance
  - Your finances
- **You have to do your own research and make a choice**
- **My slides are NOT directive in nature.**

# What's New with PolyPhasor



**On 2 May 2017, Infinite Electronics, Irvine CA, purchased PolyPhasor Corp** in a deal for Smiths Interconnect's Microwave Telecoms business (SMT) from Smiths Group plc from London

**Infinite Electronics** now operates under the **PolyPhasor, Transtector Systems, Pasternack, Fairview Microwave, L-com, RadioWaves, MilesTek, KP Performance Antenna, Aiconics, and Kaelus** brand names

<https://www.polyphaser.com>

# What's New with PolyPhasor

With many of these companies heavily tied to India and China, I called PolyPhasor to ask where they were building their lightning arrestors

Turns out PolyPhasor manufactured products in Hayden ID; Minden, NV; and in their company-owned China and India facilities since around 1992.

Recently, they have moved their remaining US production to India and China

They maintain strict engineering and manufacturing control over their overseas facilities

<https://www.polyphaser.com>

# Tips from PolyPhasors' Chief Surge Protection Engineer

- The “IS-50” series products do not bleed off static charges
  - Best for use with “DC-grounded” antennas
  - They charge up an internal capacitor to around 600 VDC, then fire a gas cartridge.
  - *BTW, this a similar design to the DX Engineering units – ALSO made in China*
- Cartridge isn't replaceable - PolyPhasor doesn't repair units
- Place units close to the equipment you want to protect.
  - Just before the coax makes a turn
  - Can place at base of a tower if protecting a long hardline run and again at station. Just adds minor insertion loss.



<https://www.polyphaser.com>

# What About Non-Grounded Antennas

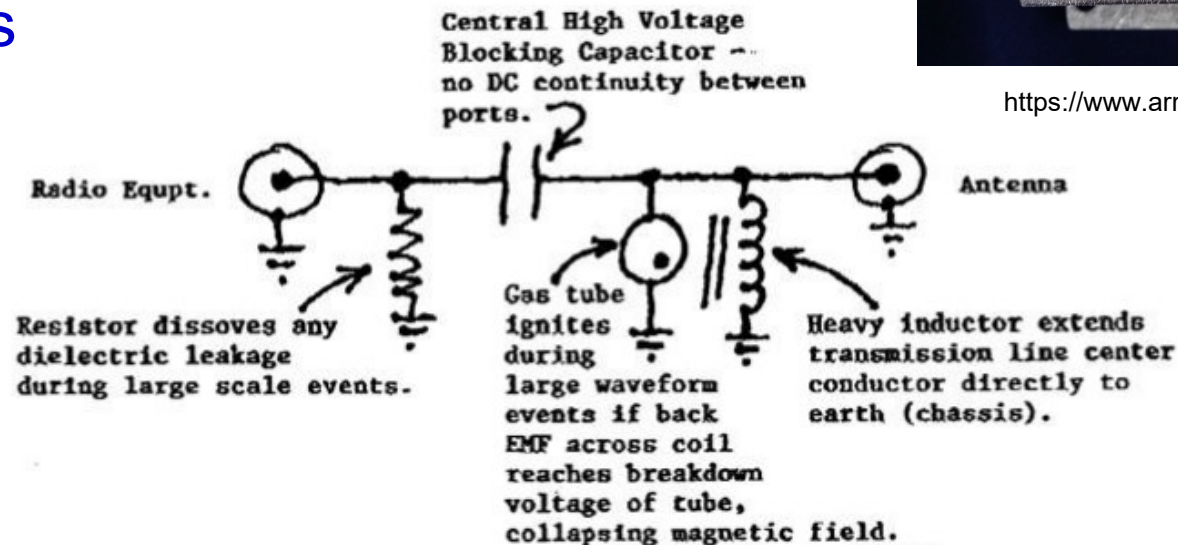


ARRAY SOLUTIONS

Array Solutions sells the old I.C.E. products



<https://www.arrayolutions.com>



# Array Solutions' Arrestor Upgrades

- **Built in Dallas, TX**
  - Manufactures their own cases
  - Assembles the products on site
- **DC grounded – supports all antennas**
  - Yagis, vertical, dipoles
- **User-replaceable gas cartridge**
- **Incorporates JW Miller toroids**



# Select the Proper Rod



# “Drive” Smart

Consider a hammer drill

Avoid forcing the drill

**Harbor Freight #63434**

1-1/8 In. SDS Variable

Speed Pro Rotary

Hammer Kit ~\$80

A clamped hose may help  
hold the drill on rod

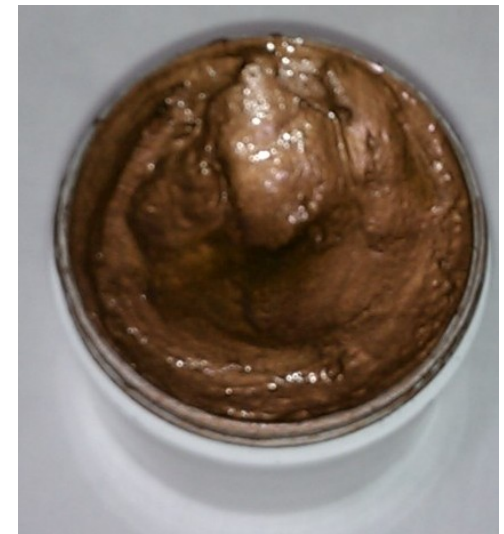


AB8DD at NM8B (driving rod)

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# Bonding to the tower

- If you must clamp, consider quality clamps (KF7P)
  - <http://www.kf7p.com/KF7P/Products.html>
- Stop galvanic corrosion by “layering”
- Conductive paste does help
- **Avoid Lead Solder**
- Braze or “Silver Solder” connections work well
- Copper strap or at least #4 solid copper wire
- “Braid” has too much inductance for a lightning stroke



# Exothermic Welding

## What is it?

A welding process for joining two electrical conductors.

Uses superheated copper alloy to permanently join conductors.

Heat from burning of a copper thermite powder.

- Permanent low impedance connection
- Same price as a good clamp
- Clean, degrease, and dry the wires and rod
- Consider buying a few extra welds – stuff happens

# EXOTHERMIC WELDING

Cadweld® or Harger®

Excerpts from ERICO website:

<http://www.erico.com/public/library/fep/LT30323.pdf>

**“NOTE:** Welding material is an exothermic mixture and reacts to produce hot molten material with **temperatures in excess of 2500 degrees** Fahrenheit ... and a localized release of smoke.”

**“Avoid direct eye contact with “flash” of light from ignition of starting material. Avoid inhalation of smoke/fumes.”**

**“Always wear protective safety glasses and gloves while working with CADWELD® exothermic products.”**

# Stuff Happens

- **Cleaning:** You think it's clean enough- clean it again
- **Mold placement:** Each type of mold needs special attention
- **For all molds:** Suggest you ensure they're level and conductors are touching the top of the rod

## To prevent blow by:

- **Cadwelds:** Consider placing a hose clamp and a tight fitting steel washer over rod before installing the weld mold
- **Harger:** Recommends use of their special sealant around conductors and rod

# CADWELD® Blow-by



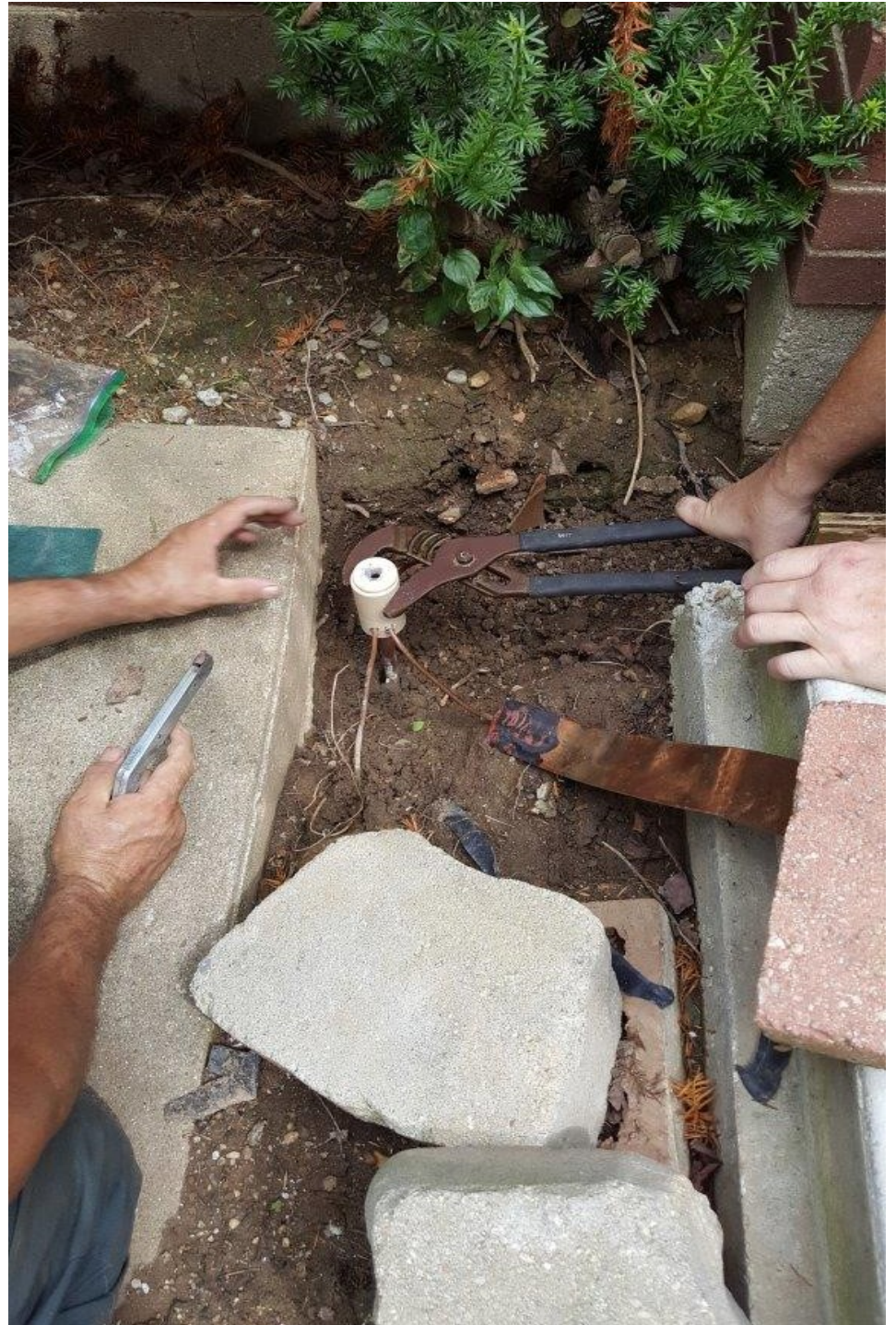
# Real Life

- Paul and Chris installed new ground system at Paul's QTH
- All new Cadwelds®
- BARC's new exothermic welding experts
- Fantastic job!
- *All pictures are property of Paul Sharp*

# Align Mold

- When you think you have is clean – clean it again!
- Use washer/clamp (CadWeld) or Sealant putty (Harger) to prevent blowout
- Ensure wires and thimbles are fully inside mold
- Don't Move!

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# Spark Time



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# Flame

- **Caution!** Up To 2500 Degrees
- Flying Molten Metal
- Smoke
- Don't look at the flame if possible

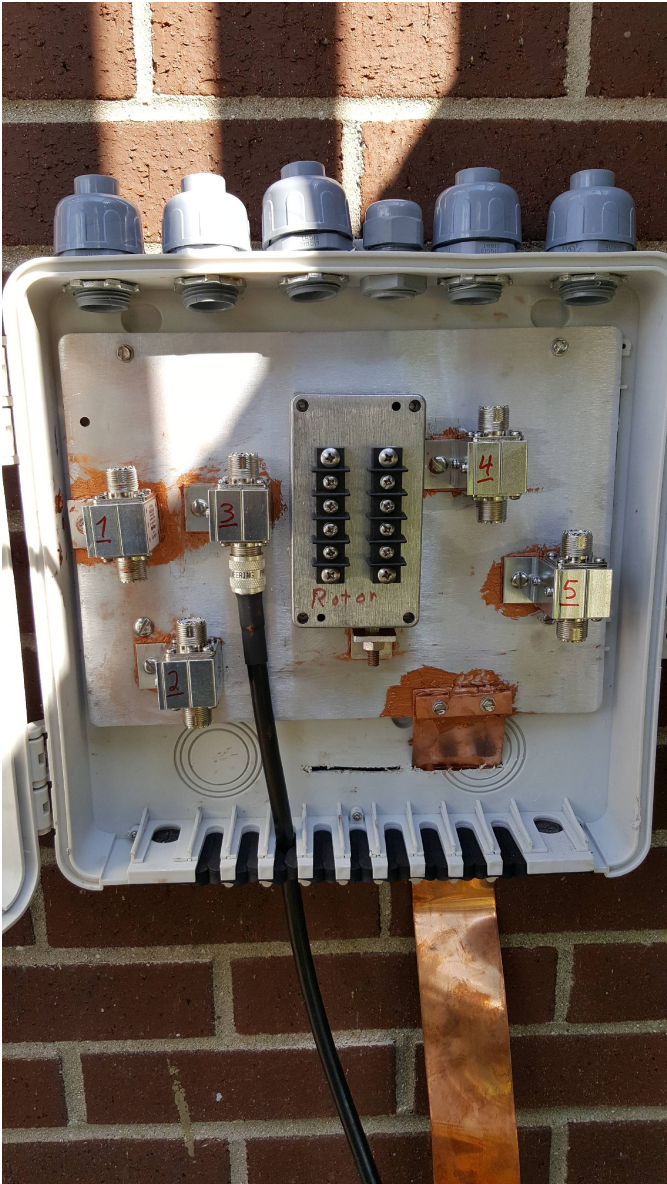
# Glowing



Complete !



# Junction Box



- DX Engineering Junction Box
  - Weather Tight
  - Solid Grounding Plate
  - 2" Copper Strap to Ground Matrix
  - Conductive Paste Used
  - Drains on Bottom for Condensation

Questions ?