

Considerations for Aging Solar PV System Components

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Training Outline

- Purpose
 - What we know about aging PV systems
 - How issues can be addressed by the inspector at the time of initial installation inspection
- Breakdown by component
 - Structural
 - Grounding
 - Racking
 - Wiring/wire management

About the Trainer: Matt Piantedosi

- BS Electrical Engineering
 - Western New England College
- Cadmus Senior Associate Engineer and Solar PV Inspector
- Inspected over 500 residential/commercial PV systems
- Licensed Master Electrician in MA and NH
- Licensed Journeyman Electrician in MA, RI, and CT
- Working in the trade for over 15 years
 - B. A. Piantedosi Jr. Master Electrician
 - Logan Electrical Company
- IAEI – Boston Paul Revere Chapter
 - Executive Board Member



About The Cadmus Group

- Energy consulting firm with renewable energy technical and economic expertise
 - 13+ years of experience
 - Assisting clients to develop and support renewable energy in the Northeast
- Cadmus has conducted quality assurance inspections for more than 20 MW of solar PV installations



About The Cadmus Group

Supporting clean energy programs since
2002

Technical Due Diligence

- Inspections
- Design Reviews
- Feasibility Studies

Policy and Financial Analysis

- Power purchase agreements
- Net Metering
- Program Design & Evaluation

Training

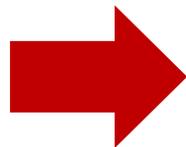
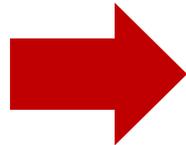
- Code Officials
- Installers
- First Responders



The Ravages of Time

A PV system is expected to last 20-30 years, but a lot can change in that amount of time:

- Water/rain penetration
- Freezing/thawing cycles
- Corrosion
- Wind/snow loading
- Electrical surges
- Other wear & tear



Weatherproofing on the Roof

- Flashing required per most roofing manufacturers as well as 780 CMR 5903.2
 - Attachment points
 - Conduit penetrations
 - Screwholes
 - Lag bolts

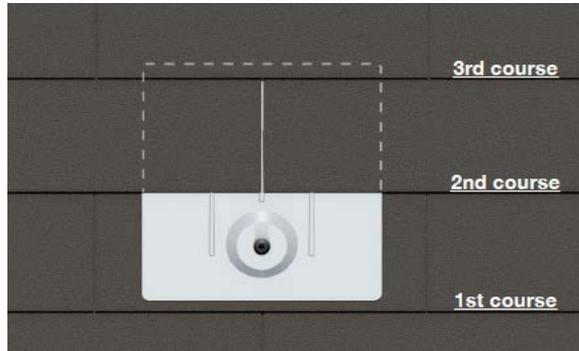
Insufficient Flashing/Poor Materials



Poorly Flashed Penetrations Provide Remodeling “Opportunities”



How Flashing Should Look



Hardware Considerations

- Hardware used must be rated for outdoor environment:
 - Grounding hardware
 - Conductor insulation
 - Screws
 - Conduit fittings
 - Enclosures

Module Frame Grounding

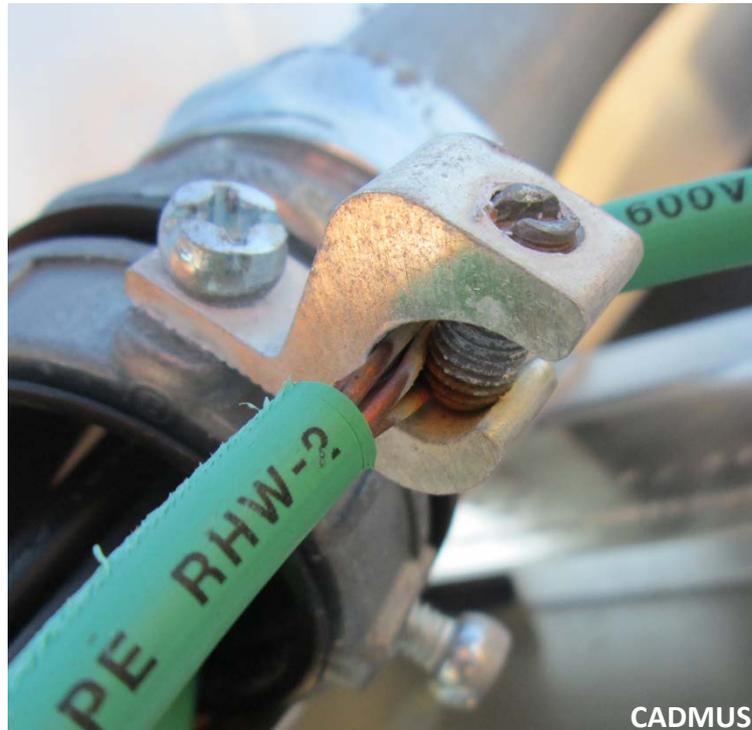
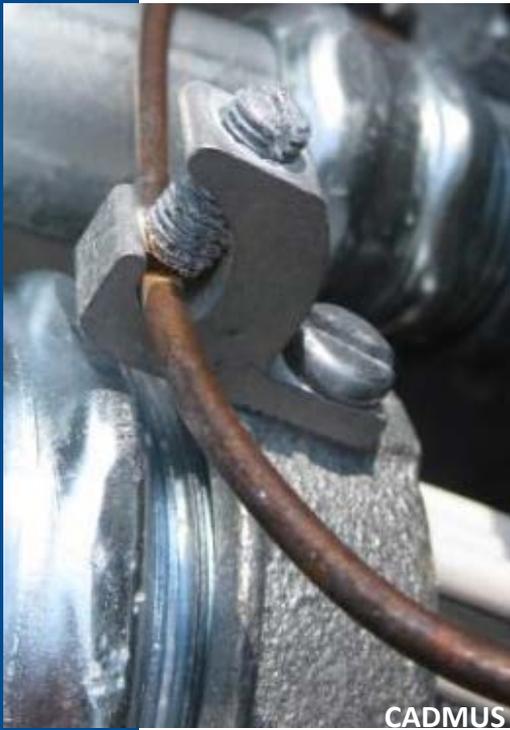
Wrong Lugs – (Copper or Not Listed for Outdoor)



Bonding Bushings

Rated for Outdoor Use?

- Lay-in lug
 - Must be suitable for the environment in which it is installed
 - Outdoor/wet locations (suitable for direct-burial)



Array Equipment Grounding System

NEC Article 110.3(B) / 250.12

- All ground lugs must be suitable and rated for the environment they are used
- How do you know it's indoor rated when you don't see rust?
- Hints:
 - Rust is caused by a non-stainless steel set screw
 - All major manufacturers of lay in lugs share a common standard of stainless steel screws
 - For outdoor rated lay in lugs



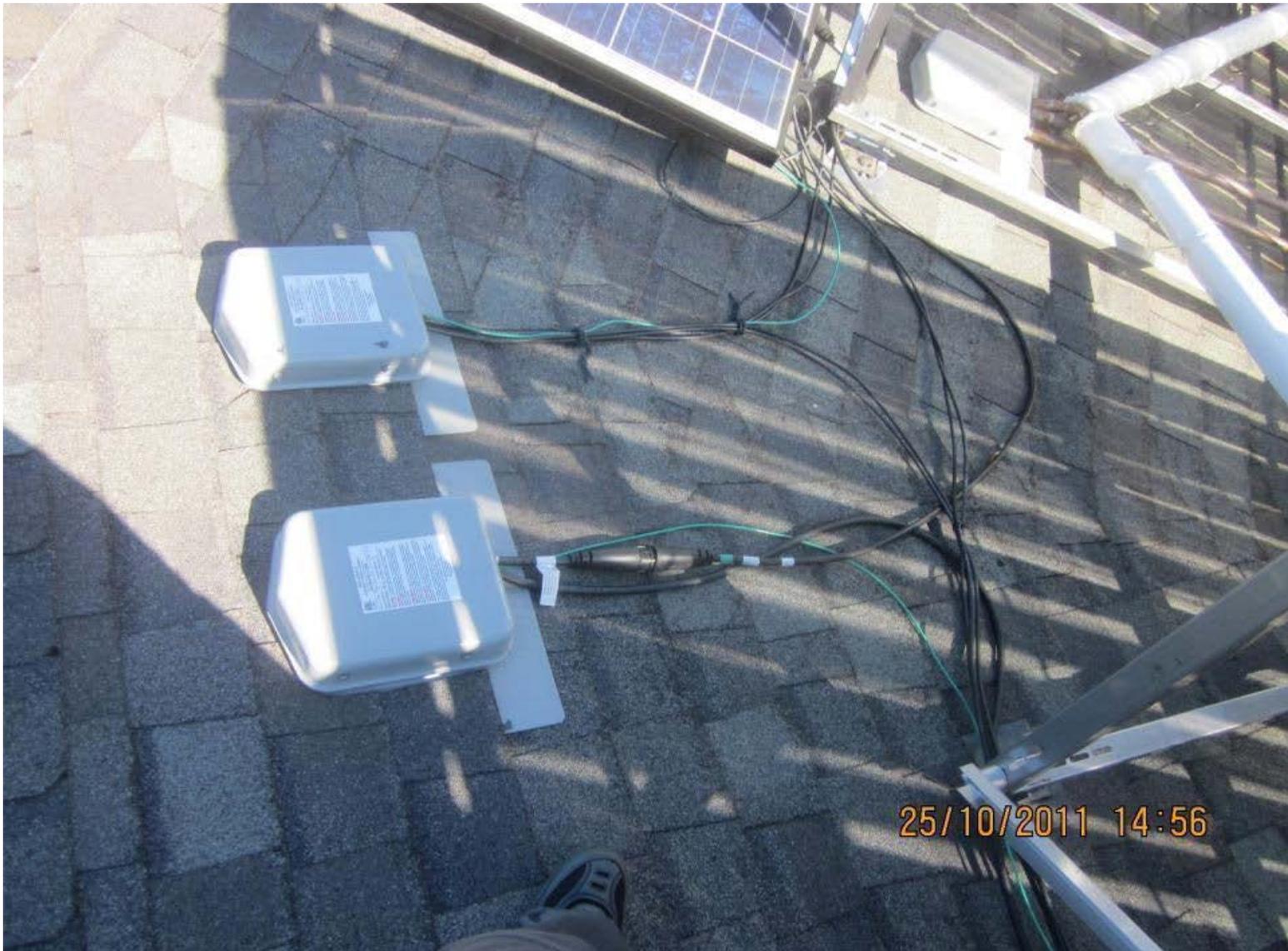
Protecting Conductors

- Required by NEC 300.4, 334.30, and other NEC Articles
- Common Sense = keep wires away from:
 - Abrasive surfaces
 - Sharp edges
 - Debris
 - Animals
- Protecting conductors is still an issue in almost 1 out of every 4 PV installations











Courtesy of Sirois Electric

The Right Way...



PV output conductors installed in conduit.

The Right Way...



Not the “Reaction” You Want to a New PV System

- Galvanic reactions occur between common materials found in PV systems and should be avoided:
 - Copper-Zinc (remember that zinc is used in galvanized steel)
 - Copper-Aluminum (most module frames are aluminum)
- Allowing galvanic reaction means rapid degradation of key system connections

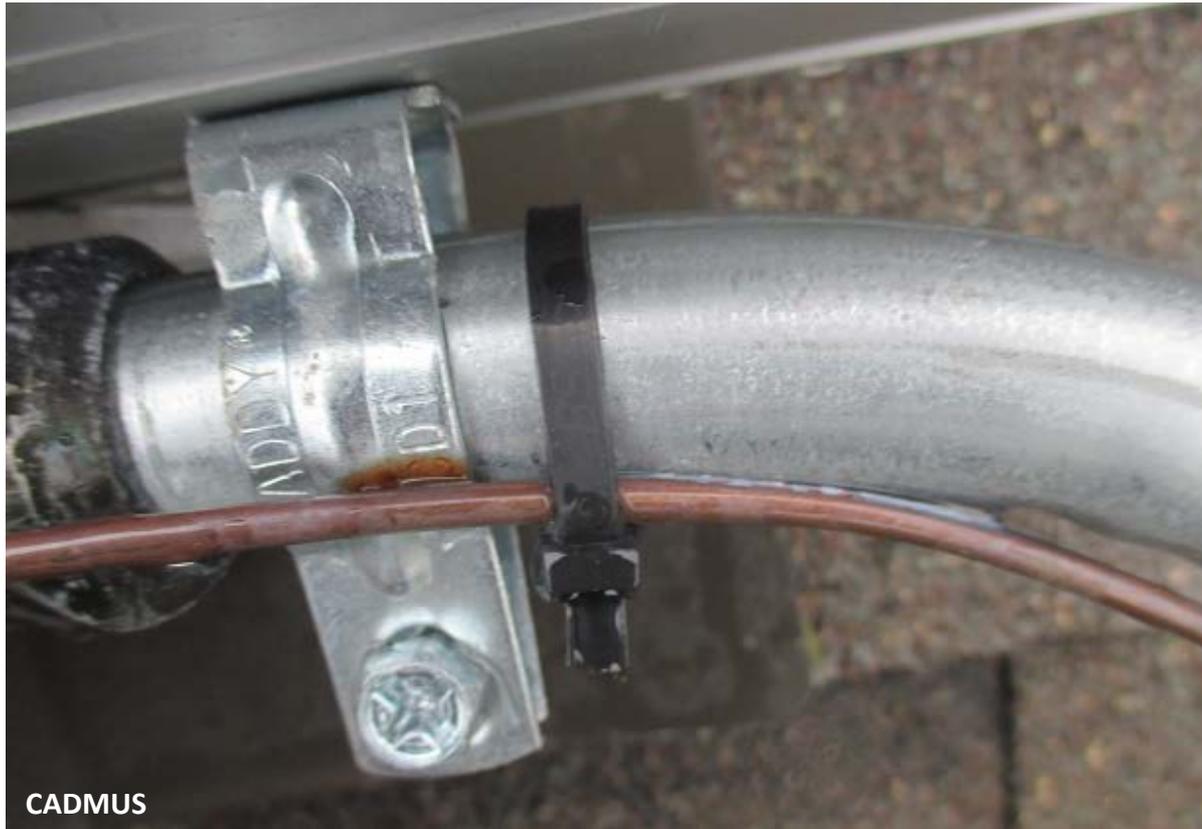
Dissimilar Metals



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Dissimilar Metals

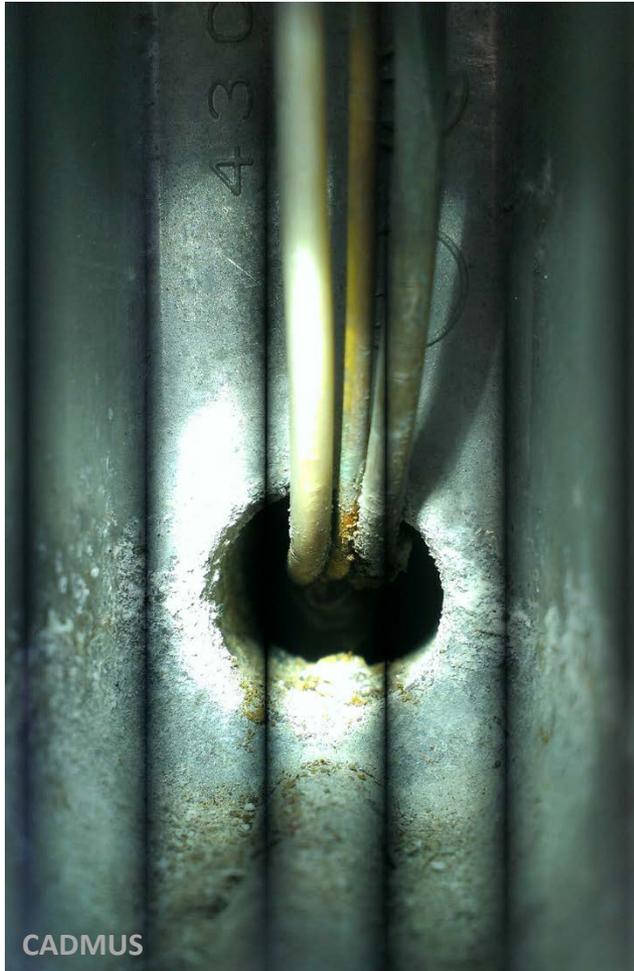
Beyond the lugs...



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Dissimilar Metals

Beyond the lugs...



Keeping the Water Out

- Outdoor equipment WILL get wet:
 - Conduit
 - Combiner Boxes
 - Junction Boxes
 - Conductors
 - Splices
- Equipment must be properly rated and installed in order to last under these conditions



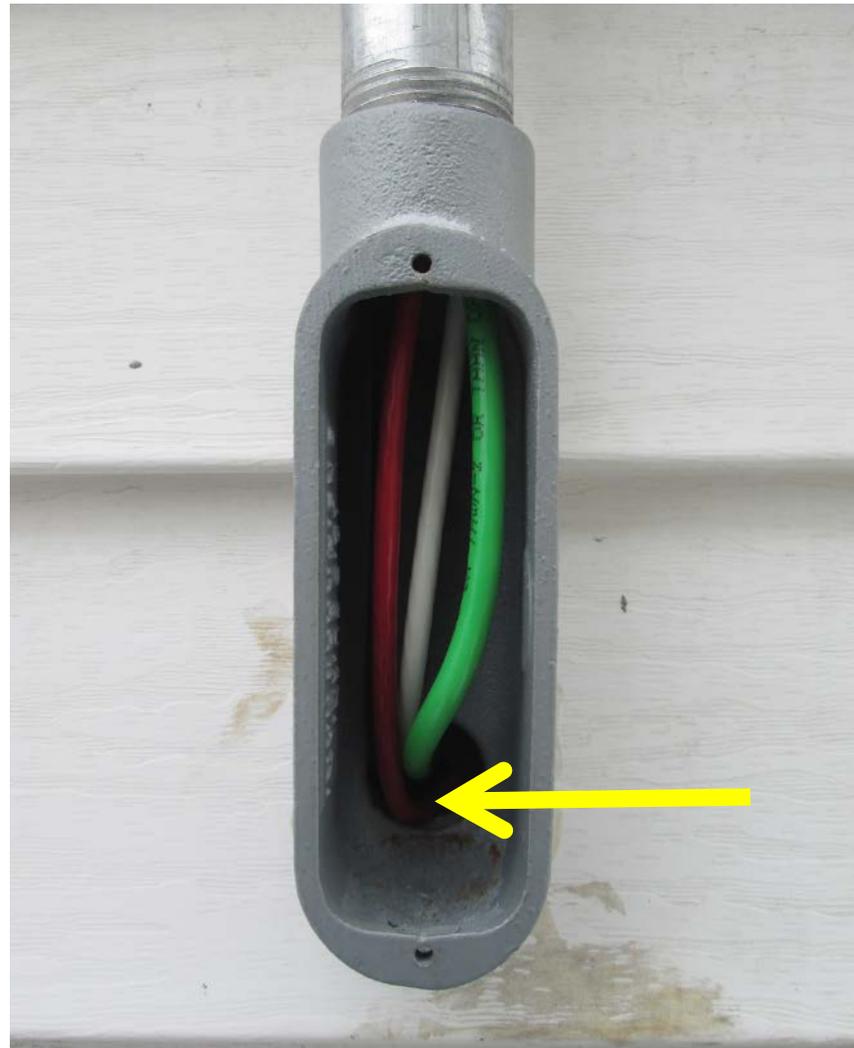
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Enclosures must be installed “so as to prevent moisture from entering or accumulating...” in accordance with NEC 314.15.



Raceway must be sealed when passing between the interior and exterior of a building per NEC 300.7(A).

Type NM Cable

NEC Article 334.12

- Prohibited in wet/damp locations
 - Article 334.12(B)(4)
- Outdoor raceways are wet locations!
 - Article 300.9



Making It Last

- To survive harsh outdoor environments for 25+ years, PV system components must be properly rated and installed.
- Imagine 25 years of wind, rain, sun, snow, ice, rodents, and debris
- Focus on:
 - Good flashing/sealing
 - Wire management
 - Wet-rated equipment
 - Avoiding galvanic reactions
 - Sealing raceway and enclosures

Questions?

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<http://www.mass.gov/eea/energy-utilities-clean-tech/renewable-energy/solar/solar-permitting-and-structural-review-rsc2.html>

