

Residential Aluminum Wiring For Electricians



Milestone Electric, Dallas/Ft. Worth
<http://www.milestoneelectricdfw.com/>

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https://inspectapedia.com/aluminum/Aluminum_Wiring_Hazards.php

Flickering Lights to House Fires & Deaths



Flames engulf the home at 10 Curtis Drive after fire erupted ...North Middleton Township 2004. *A family of five is homeless but uninjured this morning after a fire swept through their North Middleton Township home.* - **Aluminum-SEC**

TOPIC: Aluminum Wiring

- **Problem:** overheating connections, fires
- **Cause:** oxidation, contact resistance, microfretting at connections & splices, more resistance. Not simply “Loose Connections” or “Expansion/Contraction”
- **Cure:** Re-wire or COPALUM or AlumiConn?
- **Mistakes:** Twist-on connectors, CU-AL, doing nothing



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Residential Aluminum Wiring Inspection

- Identify solid aluminum conductors
- Identify multi-strand aluminum conductors?
Fewer connections, less risk, failures do occur
- Look for signs of overheating? Unreliable if none found
- Test circuit resistance? (NO) Unreliable
- Evidence of prior “repairs” May be worse than before
- Signs of trouble: See Advice to Homeowners



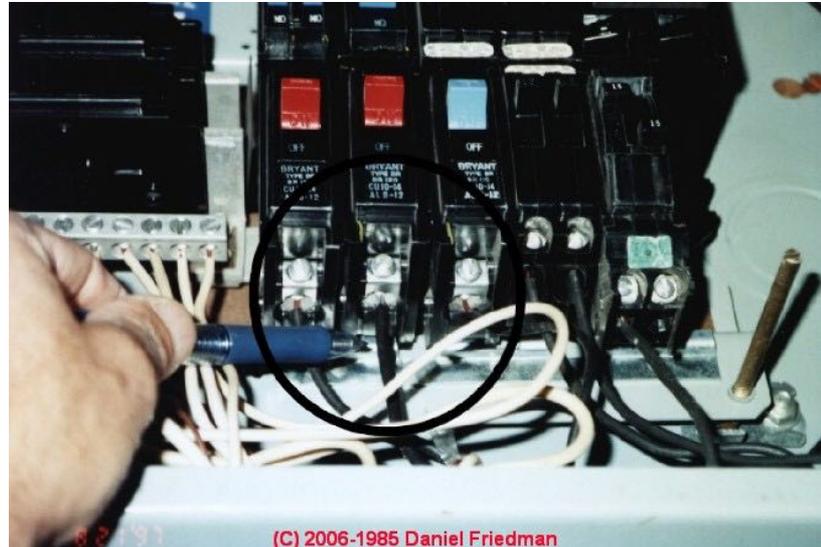
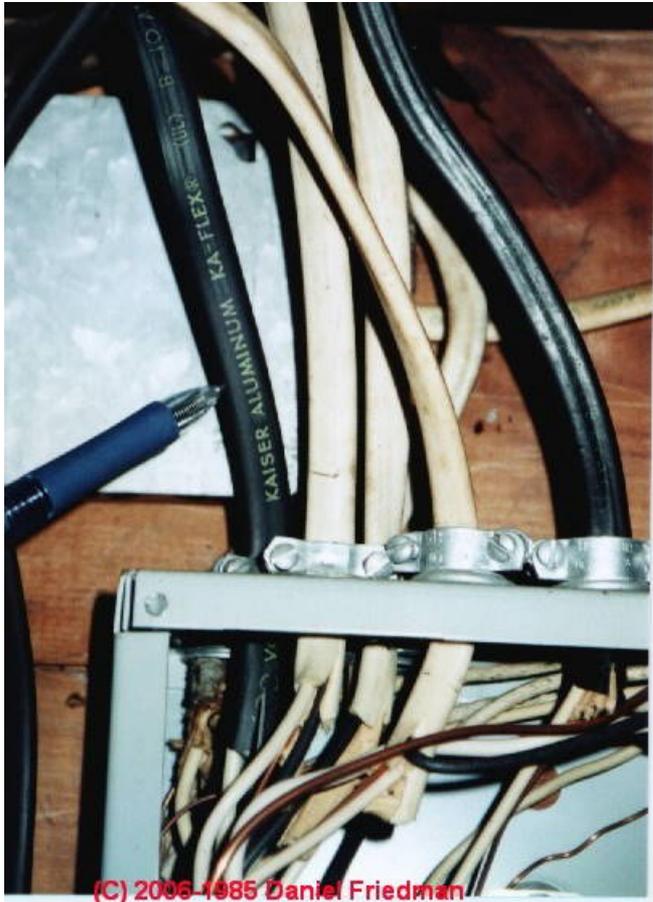
Where to Spot Aluminum Wiring

- Visible in electrical panel eg at ground bar
- Circuit amperage vs. wire size – AL 15A=No.12 vs CU 15A=No.14
- Wire jacket markings
- During electrical renovations/repairs [http://](http://inspectapedia.com/aluminum/recogniz.htm)

inspectapedia.com/aluminum/recogniz.htm



How to Spot Aluminum Wire



Aluminum Wire Examples



Aluminum Electrical Wire Safety Advice for Homeowners

- Fire hazard, potential injury, property loss
- Failure can be subtle: overheating may not occur just where something is plugged-in
- Improper “repairs” may make wiring *less safe than before*
- Use only CPSC recommended repair methods; other methods *increase* risk
- Don’t *panic*, just fix promptly.

Temporary Safety Steps where Aluminum Wiring is Installed

- Install & test working smoke detectors
- Watch for flickering lights, smoke, odors
- Turn off any misbehaving circuits
- Provide written & online information
 - http://inspectapedia.com/aluminum/Aluminum_Wiring_Summary.html - summary page (current)
 - <http://inspectapedia.com/aluminum/awrepair.htm> - CPSC info (older)

Signs of Aluminum Wiring Trouble

- Warm-to-the-touch outlet face or switch plates
- Flickering Lights, Circuits that don't work
- Plastic or burning smells/ odors
- Charred, sparking receptacles
- Possibly no trouble signs



Photo, aluminum-wired receptacle – James Simmons

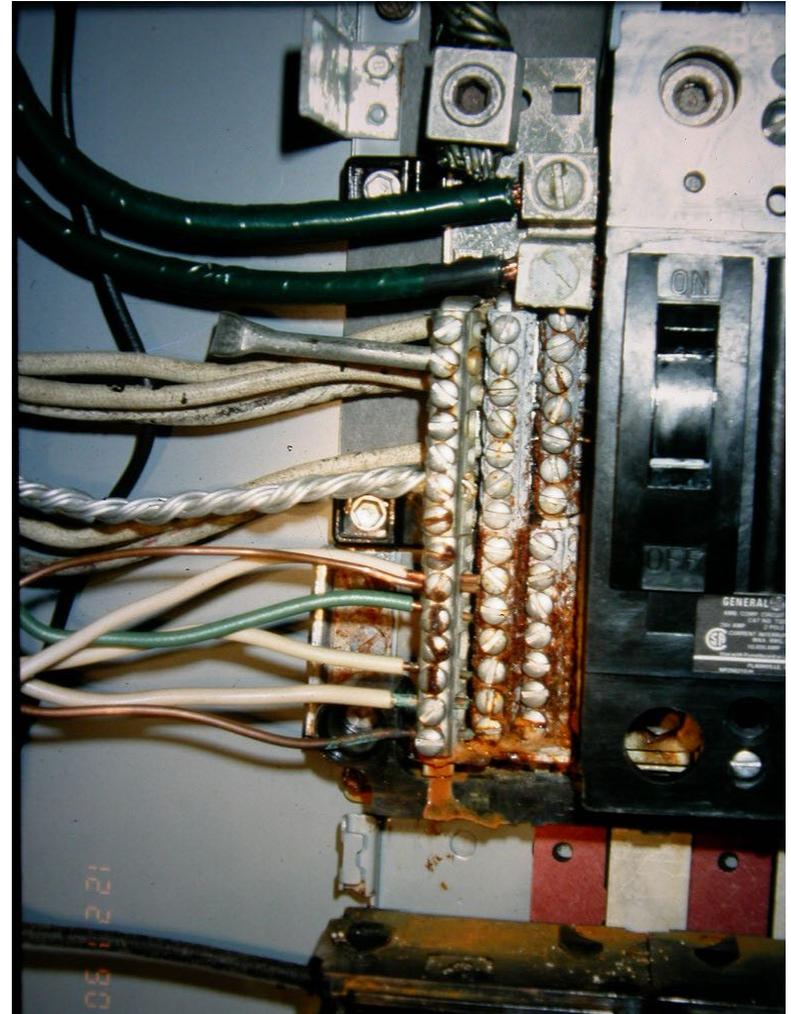
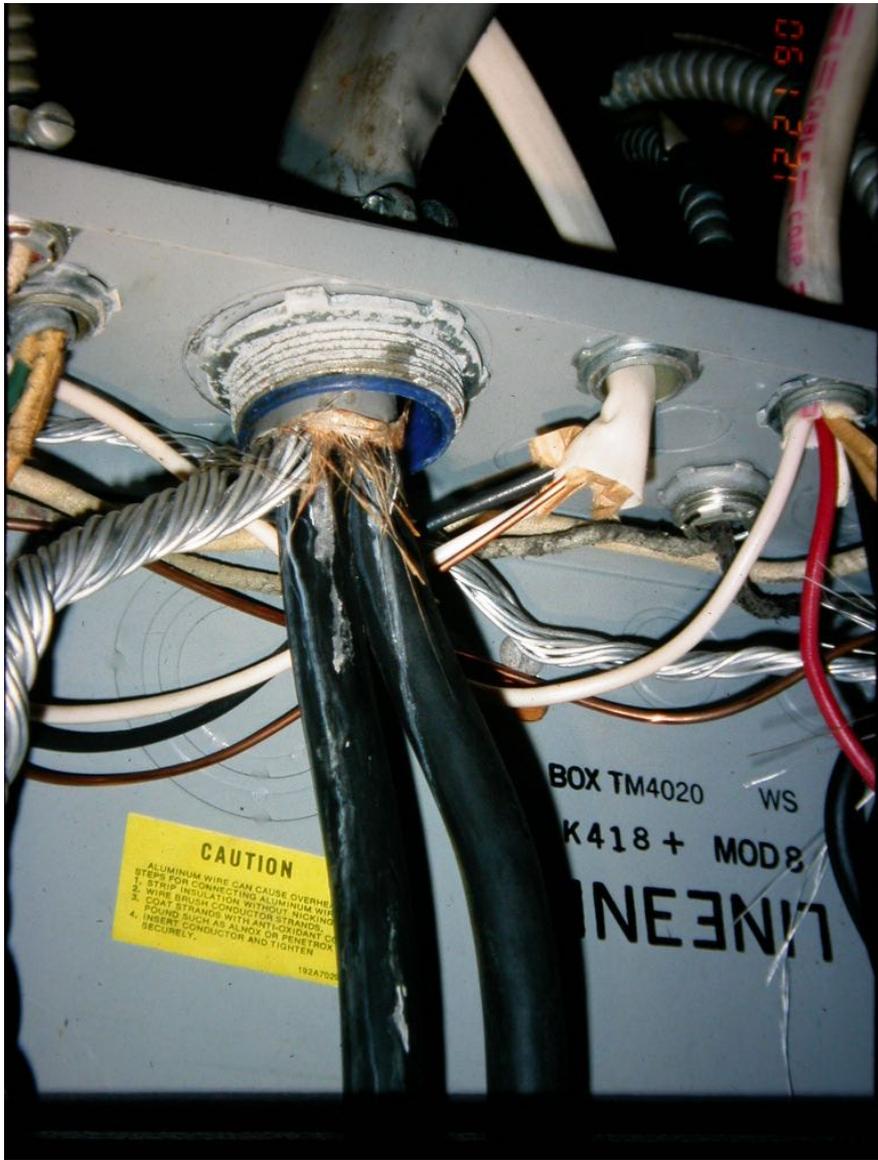
• <http://inspectapedia.com/aluminum/awrepair.htm>

Hidden Aluminum Wire Trouble

- Overheating occurs at *any* connection in circuit
- Heavily-used, high-current circuits
- Mechanically-disturbed receptacles, switches
- Back-wired Receptacles with AL Wire!!
- Confusion: *old technology vs post-1972 new technology* wire –
failures are essentially the same
repairs are the same
- Aluminum SECs, A/C circuits, Ranges, Heaters



Water damage inside the electrical panel



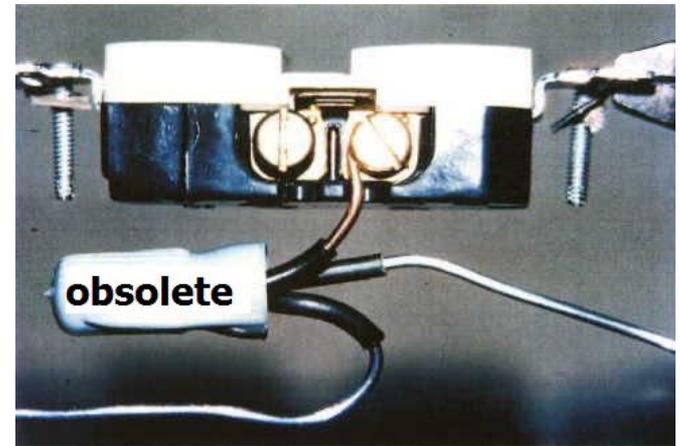
Repair Methods for Aluminum Wiring

- Recommended by US CPSC

- Re-wire the home
- AL to CU pigtails using
AMP/TYCO

COPALUM

not the twist-on connector in this photo



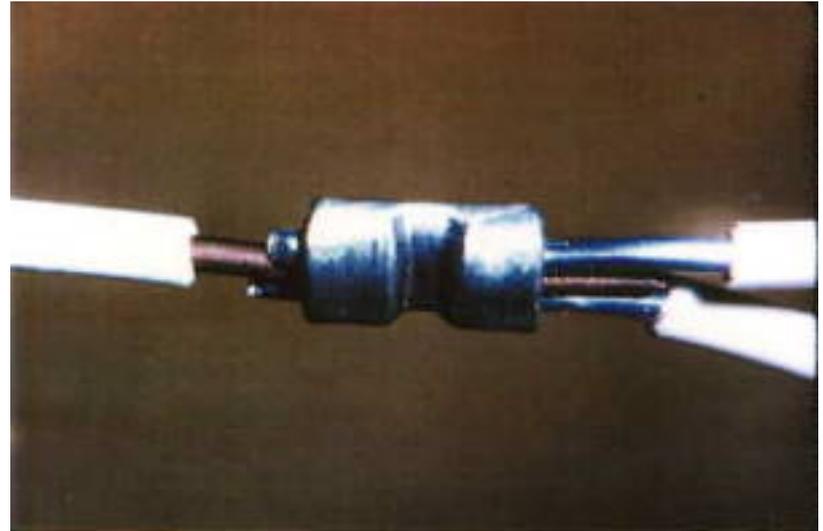
- AlumiConn - works, anticipate recommended soon, care in installation

Re-Wiring

- Be sure *ALL* solid conductor AL circuits are replaced
- Consider CU for high-amp multi-strand circuits as well - *OPINION by DF*
 - Not addressed in the CPSC recommendations
 - Less risk, fewer connections
 - Reports of failure reports at A/C units, electric stoves, dryers, water heaters
 - Reports of failures, fires, at SECs

COPALUM Connectors

- Special crimp tool
- Special connectors
- Cold-weld formed
- Space limitations in electrical boxes
- Hard to get the tool into the work space
- Reluctance of AMP/TYCO to support
- Remains available - <http://inspectapedia.com/aluminum/CPSC03120.htm>



AlumiConn

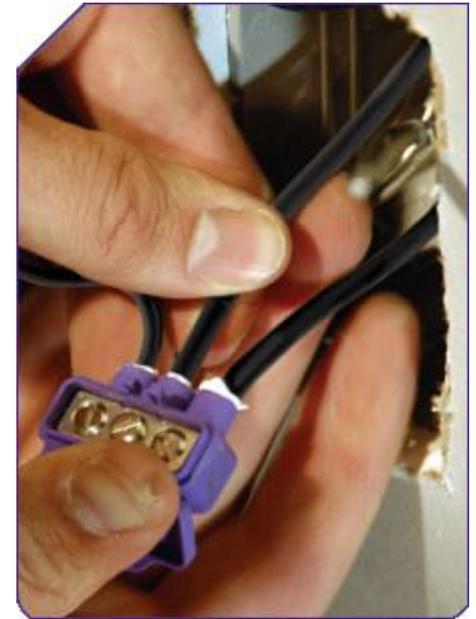


- **UL Listed, not yet CPSC**
 - Anticipate CPSC-recommended soon
- **Space limitations**
- **Torque screwdriver:** SK® 73004 4-22 in.lb. - \$100.
 - Strip back 5/16” of insulation
 - Fully seat stripped end into the device
 - #12-#10 (solid conductor) AL: 10 in.lb. of torque
 - #18-#10 (solid conductor) AL: 15 in.lb. “
 - All (solid or stranded) CU: 15 in.lb. “
 - Do not over-torque
 - Do not re-use the connectors
 - *OPINION-DF*: minimize bending/manipulating the assembly during push-back into the electrical box

AlumiConn

Manufacturer's Alternative *No Torque* Method

- This Method is NOT Approved for UL-Listing
- Procedure:
 - #12-#10 AL: (solid conductor) “contact” + 1 turn of the screw (no torque)
 - #18-#10 : (solid conductor) “contact” + 1/2 turn of the screw (no torque)
 - All CU: (solid conductor) – no guidance
- Testing of This Method is Planned (DJF)



Aluminum Wire Repairs *NOT RECOMMENDED*

- Twist-on connectors
 - Ideal 65 Purple Twister
 - Marrette B-Cap ACS#63 AL/CU
 - Wago Wall Nut
 - Scotchlok 3M Twist-On – obsolete
 - Other twist-on connectors – though UL Listed up to 1985
- CU-AL devices, CO/ALR devices
- Harbor-Freight Al-CU Crimping Tool



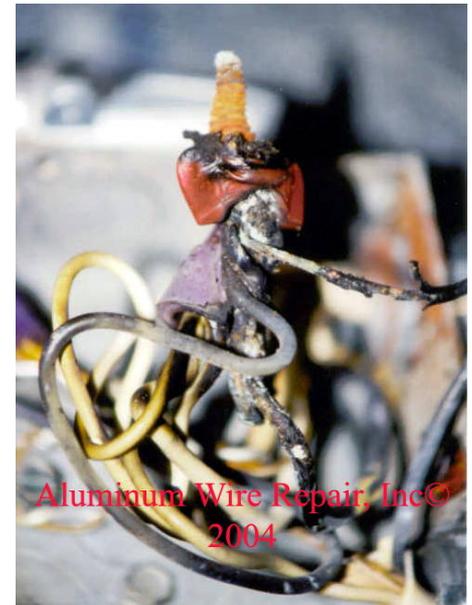
Twist-On Connector Field Failures



- Some current flows wire-to-wire through increasing resistance at wire surfaces – time to failure depends on initial oxide level (initial resistance)
- Increasingly current flows from 1st hot wire to connector's internal spring to 2nd wire - spring cuts into the wires make lower-resistance connection spring-to-wire than the wire-to-wire contact
- Spring becomes the conductor, overheats

Twist-On Connectors

- *Not Recommended* for AL wire
- Failures confirmed in field data
- 4,531 connections from 102 Dallas apartments, on-site failures traced to connectors, not due to installation practices; not due to unusual AL wire conditions.
- Comments from CPSC meeting – temp. repair?
- <http://inspectapedia.com/aluminum/i65debat.htm> - full info
- <http://inspectapedia.com/aluminum/twistcpsc.htm> - CPSC recommends against



Twist-on Connectors

- Failures confirmed in lab tests
- Ideal-65 Purple “Twister”
- Other twist-ons used up to '85



Wago Wall Nut & Other Products

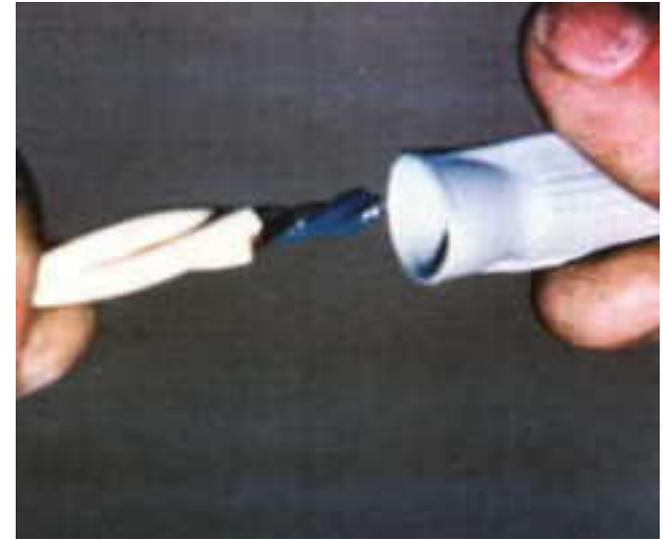


- Wago Wall Nut (left)
- Marrette B-Cap ACS#63 AL/CU Twist-On (right)

Also not recommended for AL Wire Repair

Scotchlok 3M Connector

- Obsolete – *not recommended.*
- Performed well
- Labor Intensive
 - Strip
 - Abrade under antioxidant
 - Twist
 - Assemble
 - Non-flammable Penetrox antioxidant



CO/ALR Devices for AL Wire?

- CU-AL Not Recommended for AL Wire
- CO/ALR perform better than CU-AL, Not Recommended
- Listed but not tested
- Failures reported
- Cannot handle splices
- <http://inspectapedia.com/aluminum/COALR.htm>



Aluminum Wire References

- Aluminum Wire Info <http://inspectapedia.com/aluminum/aluminum.htm> - website http://inspectapedia.com/aluminum/Aluminum_Wiring_Summary.html
- US CPSC
<http://inspectapedia.com/aluminum/awrepair.htm> - Booklet
- Reducing the Hazard in AL Wired Homes
<http://inspectapedia.com/aluminum/alreduce.pdf> - detailed paper
- Repair AL ground wire?
http://inspectapedia.com/aluminum/Aluminum_Ground_Wires.htm
- Repair AL Multi-Strand Circuits?
<http://inspectapedia.com/electric/ElecAmps6.htm>
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