

Aluminum Wiring

Hazards and Controls

Risk Control Services

Aluminum wiring was listed by Underwriters Laboratories for interior wiring applications in 1946; however, it was not used heavily until 1965. Due to the rising cost of copper, builders of homes, apartments and businesses began using aluminum wire for electrical branch circuits as a more economical substitute to copper wire from 1965 to 1973. Numerous complaints about overheated outlets, switches and fires drew attention and public scrutiny, thereby initiating research to identify the causes and corrective measures. This research combined with UL's efforts resulted in manufacturing changes for the electrical industry to improve the safety of aluminum wire and connectors.

However there remains considerable controversy and confusion over the safety of aluminum wiring today. Critical to clarification of the hazards, the reader should avail himself/herself of the differences between "Old Technology" and "New Technology" aluminum wiring.

"Old Technology" Aluminum Wiring (circa 1965 to 1973)

Problems associated with aluminum wiring are largely limited to 15 and 20 amp connections found in homes, apartments, and businesses. Aluminum wiring can be found in



wall receptacles, switches and cable connections (e.g., fans, furnaces, light fixtures, etc.) which were installed from 1965 to 1973. Wiring that was installed during this time period is referred to as "**old technology**" wiring. This "old" technology wiring has 5 potential deficiencies including:

- **Brittleness:** Aluminum wiring is considerably more brittle than copper wiring. The point of connection or termination is where most breaks occur.
- **Cold flow (creep):** Aluminum wire deforms at a higher rate than copper under heat stress.
- **Expansion:** Aluminum may expand up to 30% more than copper when heated.
- **Oxidation:** The aluminum wire may more readily corrode from oxidation than copper thereby reducing the ability to conduct electricity well.
- **Workmanship:** Due to the physical properties listed above, greater care is needed during installation to prevent damaging the conductor.

As a result, old technology aluminum wiring can cause loose connections that can lead to over-heating, arcing and sparking which may ignite dust, insulation or other surrounding combustible materials causing building fire. Since most receptacles, switches, and cable connections are concealed within the walls, floor or ceiling, fire may grow undetected for some duration.

More on reverse

Old Technology Aluminum Wire Repairs (1965 to 1973)

Where possible, replace the aluminum wire. When replacement is not feasible there are 3 methods for repair of old technology aluminum wiring:

- **Pig-tailing:** This involves attaching a short piece of copper wire to the aluminum wire with a twist-on connector (wire nut). The copper wire is then connected to the switch, outlet etc. The Consumer Product Safety Commission (CPSC) does not endorse this method as it performed very poorly in laboratory tests and in some cases may even worsen the hazard. This method however is the least expensive.
- **CO/ALR Devices:** This method consists of replacing receptacles and switches with types designed to be compatible with aluminum conductors. This hardware, called CO/ALR devices, is available only for 15-20 amp receptacles and switches (not available for permanently wired appliances, ceiling mounted light fixtures etc.). Therefore, in order for an aluminum wiring system to be completely repaired, wire connections for ceiling-mounted light fixtures, appliances, etc. would need to employ one of the other two repair methods. The CPSC indicates that CO/ALR devices appear to perform better with old technology aluminum wire than the original equipment, but they have still failed in laboratory tests.
- **COPALUM Crimp Connector Repair:** This consists of attaching a piece of copper wire to the existing aluminum branch circuit wire by a special crimping tool. The tool makes a permanent connection and installs an insulating sleeve around the connector to complete the repair. The connector is manufactured only by AMP and the special connector can only be installed by using the matching AMP crimping tool (AMP, Inc. was purchased by Tyco in 1999). Distributors and electricians utilizing the Amp/Tyco crimping tool must be authorized and complete a training program (thus this method may be more expensive and difficult to obtain). For additional information contact <http://www.tycoelectronics.com> or 800-522-6752. This is the only method endorsed by the CPSC. There are other brands of crimp connectors at hardware stores, but the CPSC warns that they may not be as reliable.

“New Technology” Aluminum Wiring (after 1973)

Due to the fire hazards associated with Old Technology wiring, the electrical industry responded to correct the physical deficiencies by requiring new wire to be made of aluminum alloy instead of nearly pure aluminum. The New

Technology wire (known as AA-8000 series aluminum alloy) has been produced since 1973. It is fully annealed, strong and flexible and can be used in standard installations provided it is used in conjunction with CO/ALR devices and aluminum compatible cable connectors. Since circa 1973, installation of UL listed CO/ALR devices became standard practice when New Technology wire was installed. The CO/ALR devices should be installed for receptacles and switches, and aluminum wire should have aluminum or aluminum/copper compatible wire connectors.

Guidelines for Receptacles and Switch Devices for Aluminum Wiring



- All wire connectors, receptacles, switches and associated devices should be listed by Underwriter's Laboratories, Inc. to ensure that the products have been tested for this application by a nationally recognized agency.
- Devices marked CO/ALR may be installed using copper, copper clad aluminum, or aluminum wire. CO/ALR devices are limited to 15-20 amp devices.
- Devices rated 15-20 amp and not marked CO/ALR should be installed only when using copper or copper-clad aluminum wire.
- Devices with screw-less or push-in terminals are for use only with copper and copper-clad aluminum wire.
- Devices rated 30 amps and above, not marked AL-CU should only be used with copper wire.
- Devices rated 30 amps and above, marked AL-CU may be installed using copper, copper-clad aluminum, or aluminum wire.

REFERENCE

IAEI Magazine, January 2006, Aluminum Building Wire Installation and Terminations, by Christel Hunter.
NFPA 70B, Recommended Practice for Electrical Equipment Maintenance
U.S. Consumer Product Safety Commission, Repairing Aluminum Wiring, CPSC #516
The National Electrical Code Handbook