LOSS CONTROL TECHINCAL BULLETIN

Reducing the Fire Hazards of Aluminum Wiring

The Problem with Aluminum Wiring: aka "Old Technology Wiring"

Aluminum wiring is typically found in 15 and 20 amp wiring connections in businesses, homes, and apartments that were built between 1965 and 1975. Aluminum was used because the cost of copper had increased dramatically. In 1972, manufacturers modified both aluminum wire and switches and outlets to improve the performance of aluminum wired connections.

There are problems associated with this wiring due to its brittleness, expansion properties, oxidation issues, and deformity when under stress, known and cold flow.

Because of these problems, the connections can become loose, causing electrical arc and ignition of nearby combustibles which may lead to fires. The Commission has also conducted research that shows that buildings wired with aluminum wire manufactured before 1972 ("old technology" aluminum wire) are **55 times more likely** to have one or more connections reach "fire hazard conditions" than a building wired with copper.

Reducing the Hazard

Currently Philadelphia Insurance Companies recognizes only **three** permanent solutions retrofitting Aluminum wiring. All repairs must be completed by a **licensed Electrician**:

In order of preference:

1. **Discontinue the use of the aluminum circuit and rewire with copper wire. This is the preferred method.**

2. **Use of COPALUM connectors-** Refer to figure 3. Install additional copper connecting "splice assembly" wires between the aluminum wire and the wired device (receptacle, switch, or other device). The connection must be made using only a special connector and special crimping tool licensed by TYCO /AMP Corporation (COPALUM Crimp Method).
   Permanent repairs using TYCO Electronics / AMP COPALUM Crimp Method must be conducted by authorized electricians. These electricians are thoroughly trained by the manufacturer. This method, based on extensive testing, is the only method considered by the CPSC to be a permanent repair.

3. **Use of ALUMICONN Connectors** – Refer to figure 4. This product was introduced in mid 2006 by King Innovation. If not adequately tightened, there is the possibility that connections could degrade. The manufacturer may be introducing a new holding tool for the field that will assist the installer in proper tightening.

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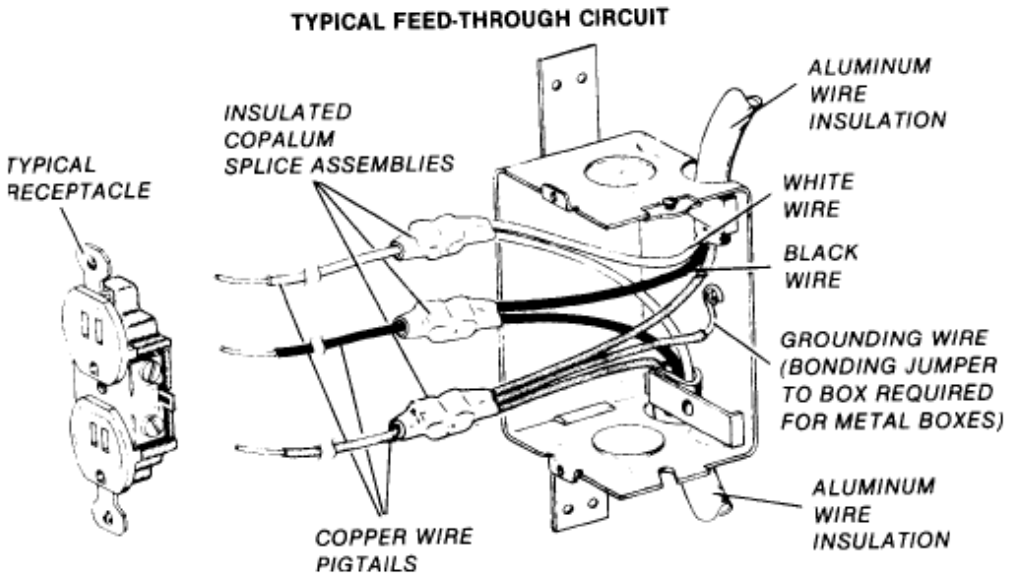

FIGURE 3 - Illustration of copper wire pigtails spliced to aluminum circuit wires using AMP* (Tyco) COPALUM connectors (Source: U.S. Consumer Product Safety Commission)

FIGURE 4 - King Innovation "AlumiConn" Connector

Connections not approved by PIC Loss Control:

The Ideal #65 connector has had poor field results. CPSC has requested the UL withdraw its listing, thus this connector is no longer acceptable by PIC Loss Control.

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The use of electrical receptacles and switches marked **COALR, CO/ALR, AL-CU or CU-AL <u>have not</u>** been recommended at this time by the US CPSC for aluminum wiring repairs. For that reason, PIC Loss Control does not recommend the use of these connectors.

What Should be Modified?

Every connection of aluminum-to-aluminum or aluminum-to-copper wire in your building should be repaired in order to obtain the maximum benefit of the repair work. Appliances connected directly to #12 and #10 AWG aluminum branch circuit wiring (i.e. dishwashers, cooking equipment, heaters, air conditioners and light fixtures) must be repaired in addition to wall outlets, switches, junction boxes, and panel boxes. Aluminum wiring is still permitted and used for certain applications, including residential service entrance wiring and single-purpose higher amperage circuits such as 240V air conditioning or electric range circuits.

All electrical modifications and additions must be in accordance with local regulations and inspected by municipal authorities.

Identifying the Hazard

Identifying the aluminum-wiring hazard is the first step towards fixing the problem. The following simple steps can be taken to assist you in determining if aluminum wiring is present: (It is recommended that a licensed electrician make the determination)

1. **Determine when was the building or house built or re-wired, or when new circuits added?** Buildings built, rooms added, circuits rewired or added between 1965-1973 may contain aluminum wiring.

2. **Don't assume that there's no aluminum wire** if your building was *not* built during these years. Circuits may have been added, extended, or modified using aluminum wiring. Or an installer may have had leftover aluminum wire and used it after these dates.

3. **Don't assume there's no aluminum wire** just because you find none in the panel. Aluminum may have been used for part of circuits or for some but not other circuits in the building.

4. **At outlets and switches, look at stripped wire ends**. Oftentimes, simply removing the cover plate will give sufficient view. Be especially cautious if you see back-wired receptacles. It may be difficult to see if the wire is aluminum, but if it is, the smaller wire contact surface when this method was used may increase the risk of overheating or other failures.

5. **Look at wire at circuit breakers in the electric panel for aluminum wire.** (See Figure #1). The pen in the circled area points to bare silver-colored wire visible at the circuit breaker. Notice that the aluminum wire in this photo is a single circuit installed between two copper wires (on adjacent breakers).

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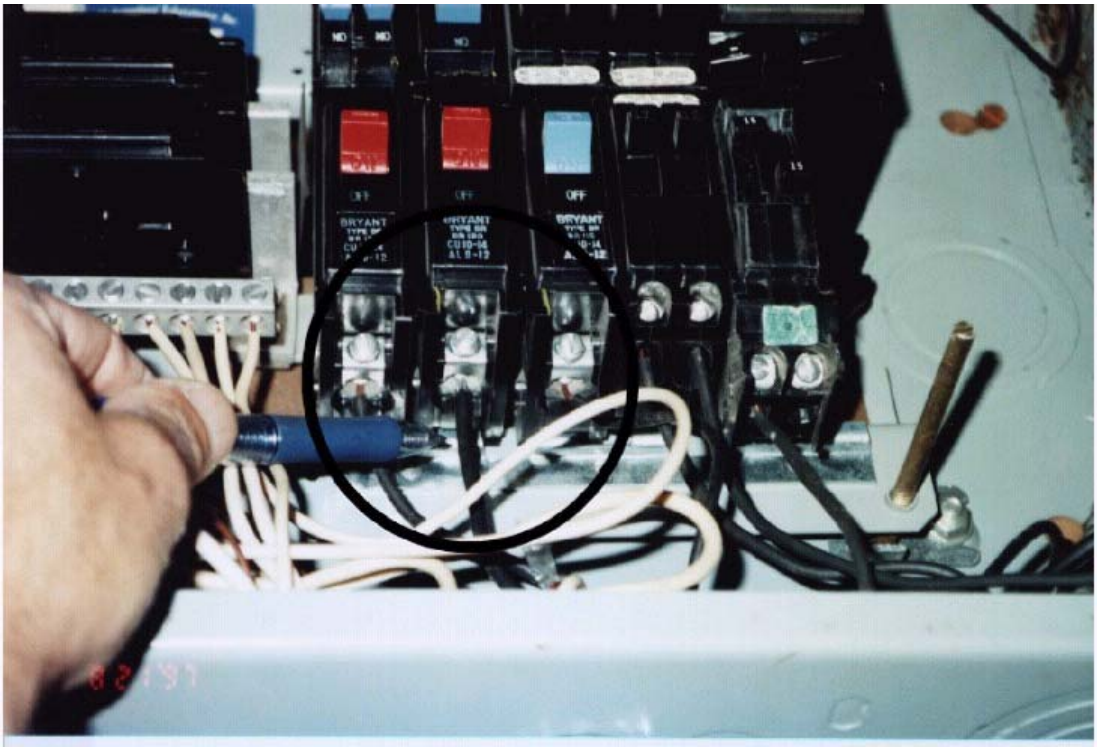
FIGURE #1



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6. **Look for the word "Aluminum."** (See Figure 2). Look for printed or embossed letters on the plastic wire jacket where wiring is visible or at the electric panel. Some aluminum wire has the word "Aluminum" or a specific brand name such as "Kaiser Aluminum" plainly marked on the plastic wire jacket. This photo shows a dark colored wire jacket with green print indicating "Kaiser Aluminum." Some white colored plastic wire jackets are inked in red; others have embossed letters without ink and are hard to read. Try shining a light along the wire.

FIGURE #2

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7. **In an area where the wire is visible, such as an attic, look at the wire gauge or "size."** Look for #12-gauge wires in the attic or other places where wiring is readily available. If you see only #12 and no #14, look further. Aluminum wire must be one wire gauge size larger for a given circuit than if copper was used. So while #14 copper wire is permitted on a 15-amp electrical circuit, if aluminum wire was used for the same circuit it would have to be #12. Similarly, a 20-amp circuit uses #12 copper wire or #10 aluminum wire. Common residential lighting and electrical-receptacle circuits are 15-amp or possibly 20-amp (e.g., in a kitchen). So if you see only #12 or larger wires in the attic of your house look further to see if it's aluminum. The wire gauge size is printed or embossed on the wire jacket. #12 does not guarantee it's aluminum, it's just more data to point in that direction.

8. **Look at bare wire exposed at the neutral bus.** An easy place to look for aluminum wiring (other than at the circuit breakers) might be at the neutral bus where both white neutral wires and ground wires are connected in a row. At the neutral bus it's easier to see exposed portions of the wire itself.

Loss History Involving Aluminum Wiring

A fundamental principle of electrical safety for wiring in buildings is that high temperatures are hazardous. While some protection is provided by electrical enclosures, high temperatures can develop at failing branch circuit connections can lead to fire in many ways. Aluminum-wired connections have been found to have a very high probability of overheating compared with copper-wired connections. The aluminum-wired connections that fail tend to progressively deteriorate at a slow rate, and after many years can reach very high temperature while still remaining electrically functional in the circuits. A large number of connection burnouts have occurred in aluminum-wired buildings.

There have been many fires caused by aluminum wiring, some involving injury and death. The most well known fire resulting in the loss of life and property occurred 21 years ago on the night of May 28, 1977. A devastating fire swept through the Beverly Hills Supper Club in Southgate, Kentucky. The fire was discovered shortly before 9 p.m. and burned most of the night. It killed 165 people. In the coming weeks, months and years, another horror would become apparent: The deaths could have been prevented.

The official investigation into what caused the fire at the Beverly Hills Supper Club was inconclusive, but the factor most often cited is aluminum wiring. A federal jury in Ashland agreed, ruling in July 1985 that aluminum wiring caused the fire. Attorneys and their experts shifted through the debris at Beverly Hills and found the aluminum wiring, which had been installed in the club in 1970 and 1971. They learned that aluminum wiring could pull away from its connections and ignite nearby materials if it didn't have the proper receptacles. They also produced dozens of documents during the trial in 1985 that indicated aluminum wiring made before 1973 was faulty.

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Further information and Resources:

Reducing the Fire Hazard in Aluminum Wired Homes – Dr. Jesse Aronstein, Revised May 21, 2007

http://www.inspect-ny.com/aluminum/alreduce.pdf

Repairing Aluminum Wiring - US Consumer Product Safety Commission (CPSC) Publication #516
http://www.cpsc.gov/cpscpub/pubs/516.pdf

Information on the AlumiConn connector
http://www.kinginnovation.com/products/alumiconn.html