



ALUMINUM WIRING

History

During the mid 60's and into the mid 70's and throughout the Vietnam War era, copper was at an all-time high price level, which made it cost prohibitive for use in residential wiring. (Actually, it was nowhere near as expensive as it is today.) Copper mining and processing was not what it is today, production could not keep up with demand, and the copper was being bought up at a rapid pace to provide jacketing for ballistics in the military and for other military purposes. People in the home building industry were looking for an alternative product that could be used safely for residential wiring and it was determined that aluminum would suffice, if it was installed correctly. Underwriters Laboratories had previously approved aluminum for interior wiring purposes as early as 1945.

There were some issues that needed to be considered by the industry if it was going to use aluminum for circuits in homes. Aluminum was much softer than copper wiring, it couldn't withstand as much stress when it was being pulled, it was subject to breaking if it was nicked and bent at radical angles, and it had to be at least one wire gauge larger than copper for each current rating. But, despite all of the downfalls of aluminum, it was much cheaper to use at the time and it would have been an acceptable product for the purpose if it were installed correctly. Not much emphasis was put on aluminum wiring's creep rating (rate of expansion and contraction) and very little information was disseminated to the end users about the proper installation of aluminum wiring. Builders and electrical contractors were just happy to have a cheaper product to use that would enable them to continue building. During that time there was widespread use of 12 AWG and 10 AWG type NM-C sheathed aluminum cable in the interior wiring of homes. Local building inspection departments and code enforcement agencies were very scarce during this era and probably had even less information than the electrical contractors did about the installation of aluminum wire.

Current Use

As much as you may have heard about the problems with aluminum wiring in homes, aluminum wiring remains the preferred choice on larger circuits that don't require as many terminations to various devices. Many electrical contractors still use aluminum for large-gauge feeder wires to panels and for high amp circuits to large appliances such as electric furnaces. Design engineers still specify aluminum wiring on large feeders and branch circuits in commercial buildings as well. These circuits are commonly terminated in disconnects and electrical panels with lugs that are rated and suitable for aluminum wiring. The continued use of aluminum wiring occurs where termination of the aluminum



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wire can be more precisely secured and controlled and where those connections don't require any bending or repetitive movement of the wire during servicing.

Aluminum must be terminated with lugs, crimp sleeves, screw terminals, and other devices that are made of materials that are compatible with aluminum and it must be treated with an oxide inhibitor that is intended for aluminum wiring. Most of the homes that were built during the residential aluminum era were not installed with aluminum wiring terminated any differently than the practice used with copper wiring. In many cases, the receptacles, switches, and other devices that were installed on the wiring were not of the correct type and oxide inhibitor wasn't in widespread use. The devices that were installed in most of the homes with aluminum wiring were rated only for copper and are not compatible with aluminum due to the composition of the screws and terminals. In short, the metal on the screw terminals caused oxidation, heating, expansion, and contraction, which made the terminals become loose on the receptacles and switches. That is primarily because aluminum expands and contracts at a different rate than copper, and the switches and receptacles were designed for copper's rate of expansion and contraction.

The other long-term issue with aluminum wiring has been cracking of the wire at bends, particularly at bends in the wire that are flexed several times over as outlets and switches were installed, pulled out and reinstalled during painting, remodeling or servicing. This repeated bending or flexing of the wire results in fractures of the wire and intermittent connections.

How does aluminum wiring catch fire?

Whether the aluminum wiring fractures from flexing and bending, or if the wire connection loosens at a terminal or connection from thermal expansion and contraction, both conditions result in tiny gaps in the wire or connection that cause small electrical arcs to occur as the current jumps across the tiny void. These arcs leave behind carbon deposits. Although they arcs may be extremely small and the initial carbon deposits almost microscopic in nature, over time these carbon deposits accumulate and heat up due to continued arcing and wire heating from high current demand. Eventually, these carbon deposits ignite, or the available plastic or other combustibles adjacent to the wire ignite and cause a fire. In the case of fractured wiring at bends, it is usually invisible to the naked eye as the wire sheathing conceals the fracture or break of the actual aluminum conductor inside of the sheathing.

Unfortunately, there are a number of subdivisions in our region that consist almost entirely of homes that were wired with aluminum wiring. These subdivisions mostly lie in a "belt" around St. Louis where development occurred between approximately 1965 and 1975. On the Missouri side of St. Louis, these areas include Black Jack, Florissant, Hazelwood, Bridgeton, Maryland Heights, Creve Coeur, Ladue, Manchester, Ballwin, Chesterfield,

Valley Park, Fenton, Sunset Hills and Mehlville. While nowhere near every home in those communities has aluminum wiring, the conversion of large tracts of prior farmland into subdivisions in the mid to late 1960s thru the mid 1970's mostly occurred in these communities.

As time has gone by, many of these homes have had some level of remediation work performed on their aluminum wiring, but few have had the wiring replaced entirely. Ever since Geraldo Rivera's 60-Minutes sensational exposure of "aluminum wiring fires" in the early 80's, the insurance companies have been gunning for those of us that have homes that are wired with aluminum wiring. Now that the wiring and the devices have been in the homes for approximately 35 to 45 years, the insurance companies have really gotten serious about aluminum wiring. Some of them will not insure your home with aluminum wiring, and others will insure your home only if you take the proper steps to make it safe but with elevated annual premiums to make it worth their risk to insure your home.



Are there any indications of failed aluminum wiring?

Yes. Signs of a failed or failing aluminum wiring circuit include the following:

1. Outlets, switches or lights with wisps of smoke discoloration on the walls or ceilings around the outlet, switch or fixture.
2. Intermittent outages of one or more outlets or lights in your home
3. Melted receptacle plates
4. Melted receptacles or switches
5. Burned or discolored wiring inside of junction boxes
6. Circuit breakers that are warm to the touch regardless of being tripped or not




Are there any solutions for aluminum wiring?

Yes, there are a few solutions to consider but they may no longer be acceptable to your home insurance carrier due to the age of the aluminum and the receptacles and switches to which it is installed. Historically, there have been three options to correct the issue with the aluminum wiring:



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1. Electricians employ a method called “Pig tailing” which involved adding a short piece of copper wiring on to the aluminum wiring with an approved, but very expensive, special wire nut that contains an oxide inhibitor and terminate the short piece of copper on to the receptacle or switch. This “pig tailing” can also be done with an approved crimp sleeve, but our experience has led us away from that method for a number of reasons. The advantage to pig-tailing is that once performed, the aluminum wiring doesn’t move if the switch or outlet is pulled out of the receptacle, with the copper pig tail incurring the flex required. The disadvantage is that the electrical gang boxes of this era of construction were often metal and typically very small by today’s standards. The boxes often are not large enough to contain the additional connectors and pig tailed wire. Currently, the only widely accepted connector is called an “AlumiConn” which is a proprietary product and rather expensive.
2. Another solution was to remove all of the switches and receptacles in the residence and replace them with Co/Alr receptacles and switches. This has often been done in most of the houses we have seen in our District over time, but we have seen a noticeable re-emergence of Copper-only outlets being installed on aluminum wiring. This typically is due to non-qualified individuals switching out switches or outlets and selecting the cheaper “\$0.99” Copper-only outlet instead of paying for the similar looking \$3.99” Copper-Aluminum rated outlets. There has also been a concerning number of installations of GFCI outlets installed on aluminum wiring. To date, there has not been an aluminum-rated GFCI outlet offered. Use of a GFCI in an aluminum-wired house requires pig-tailing to copper before the outlet.
3. The remaining solution is to completely rewire the home. This option is by far the most expensive and intrusive resolution. Many of the homes that were built during the same era when aluminum was being used are ranch style homes that have low pitched roofs and horizontal fire bracing in the walls. This is a very difficult combination when trying to rewire an existing home with finished walls. It is very hard to determine how long it would take to rewire a home under the circumstances and it is equally as hard to find someone willing to give a firm quotation on the rewiring of the home.

In summary, homes with aluminum wiring have and will continue to exist safely with proper maintenance and care of its aluminum wiring. Particular attention should be paid to any additions, remodels or maintenance work that has involved the wiring system to ensure that proper techniques were used. For home purchases, qualified inspectors will be able to determine the condition of the home’s aluminum wiring.

Significant portions of text in this document were sourced from Gulf Coast Electric’s website www.gcedestin.com which had the most concise and comprehensive explanation of aluminum wiring’s history we could research.