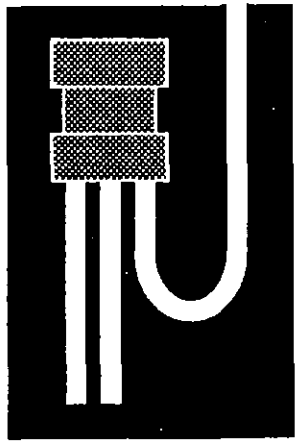
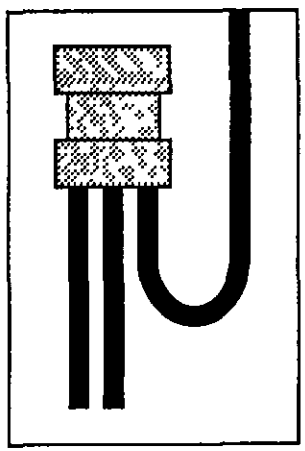
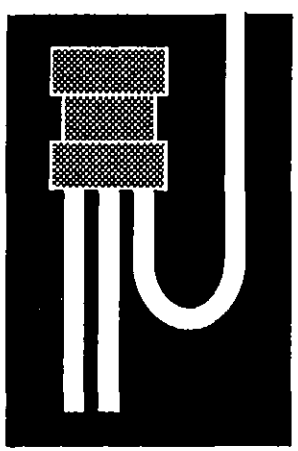






Repairing Aluminum Wiring

CPSC #516

U S Consumer Product
Safety Commision
Washington, D C 20207

ALUMINUM WIRING

◆ On April, 28, 1974, two persons died in a home fire in Hampton Bays, New York Fire officials determined that the fire was caused by a faulty aluminum wire connection at an outlet

◆ Since that tragic accident, the U S Consumer Product Safety Commission staff and other government officials have investigated numerous complaints from homeowners throughout the nation who have had trouble with small gauge aluminum branch circuit wiring The Commission has also had research conducted that shows that homes 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" [1] than is a home wired with copper

◆ The hazard investigated by the Commission staff occurs at connections to old technology aluminum wire, such as at outlets or switches or at major appliances such as dishwashers, furnaces, etc Corrosion of the metals in the connection, particularly the aluminum wire itself, causes increased resistance to the flow of electric current and that resistance causes overheating

◆ Homes built before 1965 are unlikely to have aluminum branch circuit wiring Homes built, rooms added, and circuits rewired or added between 1965 and 1973 may contain aluminum wiring

◆ In 1972, manufacturers modified both aluminum wire and switches and outlets to improve the performance of aluminum wired connections Sale of the old style wire, switches and outlets still on dealers' shelves however, continued after 1972

TROUBLE SIGNS

◆ Signs of trouble in aluminum wire systems include warm-to-the-touch face plates on outlets or switches, flickering lights, circuits that don't work, or the smell of burning plastic at outlets or switches Unfortunately, not all failing aluminum wired connections provide such easily detected warning signs, aluminum wired connections have been reported to fail without any prior indications or problems

[1] The survey conducted by the Franklin Research Institute defined "Fire Hazard Conditions" to occur when receptacle coverplate mounting screws reached 149°C (300°F), or sparks were emitted from the receptacle, or materials around the receptacle were charred

WHAT THE HOMEOWNER CAN DO

◆ If you have noticed any of the trouble signs, have a qualified electrician determine whether the problem is caused by deteriorating connections to aluminum wiring DO NOT TRY TO DO IT YOURSELF You could be electrocuted or you could make the connections worse by disturbing them. If you are not certain whether your home has aluminum branch circuit wiring, you may be able to tell by looking at the markings on the surface of the electric cables which are visible in unfinished basements, attics or garages Aluminum wiring will have "Al" or "Aluminum" marked every few feet along the length of the cable. (Note - the marking "CU-clad" or "Copper-clad" in addition to the "Al" or "Aluminum" means that the cable uses copper-coated aluminum wire and is not covered by this message)

◆ If you do have aluminum branch circuit wiring, the Commission suggests that you have a qualified electrician check the system for impending trouble Remember, you may not have noticed any of the warning signs, but research shows that trouble may develop over time and an electrician may spot potential problems before you notice them

CAN THE PROBLEM BE FIXED?

◆ One method of eliminating the risks associated with old *technology aluminum wiring terminations is to eliminate the primary* cause the aluminum wire itself Depending upon the architectural style of your home and the number and locations of unfinished spaces (e g , basements and attics), it may be relatively easy to rewire your home A new copper wire branch circuit system would be installed, and the existing aluminum wire would be abandoned inside the walls This is the most expensive method of repairing an aluminum wired home, but if you can afford the cost, it is also the best method available

◆ Since it may be impractical to rewire some types of aluminum wired homes (e g , condominium units), or since rewiring may be prohibitively expensive for some homes (e g , split-levels with no unfinished areas), the Commission staff attempted to find a repair method which would permit the continued use of existing old technology aluminum wire The main criteria to be met by such a repair method are

◇ It must permit the repair of *every* connection to, or splice between, aluminum wire in the home,

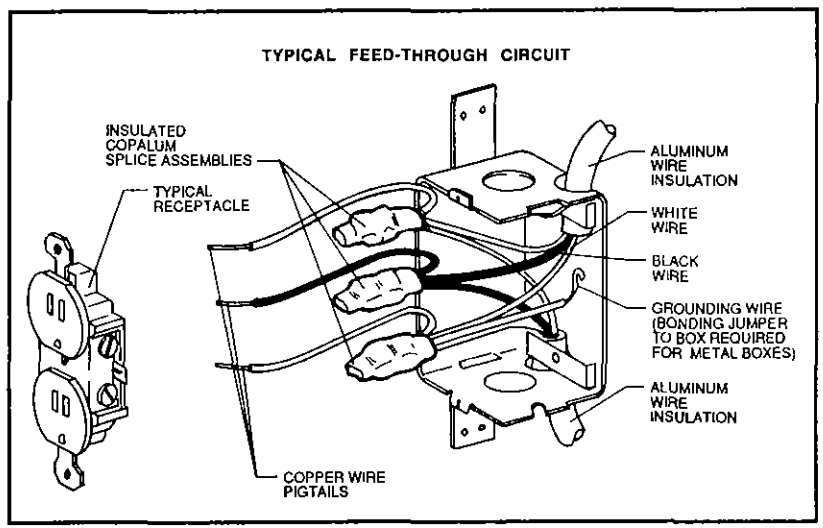
◇ The repaired connections must be permanent but must result in a system that can be maintained without the need for special switches, wall outlets or other connectors,

◇ The repair technique must be practical for use in an occupied and furnished home

◆ *The CPSC-sponsored research, laboratory tests, and* demonstration projects identified only one method of repairing existing aluminum wire circuits which meet these criteria That repair is known as the crimp connector repair

◆ The crimp connector repair consists of attaching a piece of copper wire to the existing aluminum wire branch circuit with a specially designed metal sleeve and powered crimping tool The metal sleeve is called a COPALUM parallel splice connector and is manufactured only by AMP Incorporated This special connector can be properly installed only with the matching AMP tool This tool makes a permanent connection that is, in effect, a cold weld An insulating sleeve is placed around the crimp connector to complete the repair

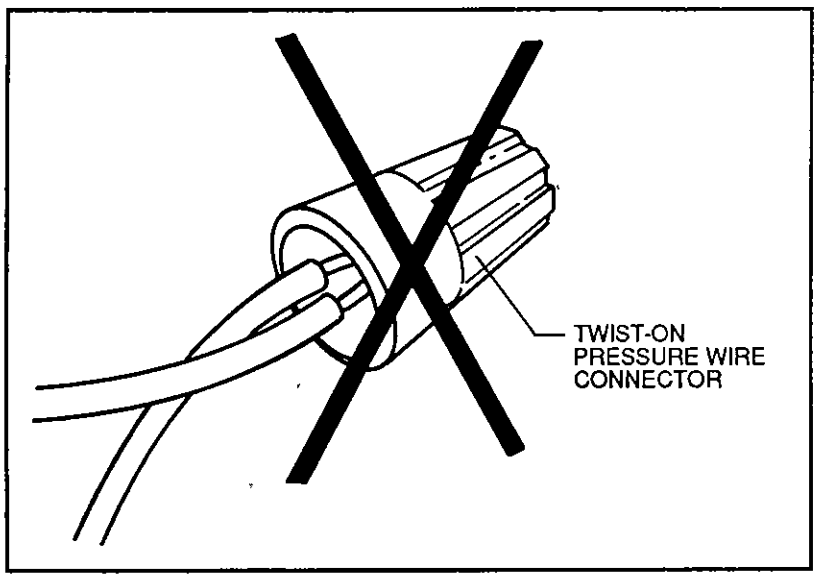
Recommended COPALUM Crimp Connector Repair



◆ Two other repair methods are often recommended by electricians While these repair methods are substantially less expensive than *COPALUM crimp connectors, neither of these repairs is considered* acceptable by the Commission staff

◆ The first repair ("pigtailing") involves attaching a short piece of copper wire to the aluminum wire with a twist-on connector sometimes called a wire nut, the copper wire is connected to the switch, wall outlet or other termination device. The Commission staff has evaluated the effectiveness of "pigtailing" as a repair In CPSC-sponsored laboratory testing some brands of twist-on connectors have performed very poorly Over time, substantial numbers of these connectors have overheated in laboratory tests Surveys of and statements made by electricians and electrical inspectors confirm the highly variable and often poor performance of these connectors when used with old technology aluminum wire It is possible that some pigtailing "repairs" made with twist-on connectors may be even more prone to failure than the original aluminum wire connections Accordingly, the Commission staff believes that this method of repair does not solve the problem of overheating present in aluminum branch circuits

"Pigtailing" Is Not a Recommended Repair



◆ The other repair recommended by the industry uses switches and outlets labeled "CO/ALR". Underwriters Laboratories Inc (UL) lists these devices especially for use with aluminum wire, although they can be used with copper or copper-clad wire CO/ALR devices perform better with aluminum wire when installed carefully and according to best electrical practices than do the types of switches and

outlets usually used in the original installations of old technology aluminum branch circuit wiring However, CO/ALR connectors are not available for all parts of the wiring system (for example, for permanently-wired appliances and ceiling mounted light fixtures) In the opinion of the Commission staff CO/ALR devices must be considered to be, at best, an incomplete repair Further, CO/ALR wiring devices have failed in laboratory tests when connected to aluminum wire typical of that installed in existing homes The test conditions simulated actual use conditions, no "overstress" type of testing was used

◆ Exception If you have an aluminum wire termination in your home which exhibits symptoms of failure, twist-on connector pigtails or CO/ALR devices may be used as an emergency temporary repair for a failed aluminum termination Should such a repair be performed, the Commission staff recommends that you arrange to have your home rewired or the COPALUM crimp connector repair performed as soon as possible

◆ It is important to note that there is only one manufacturer of the special connectors and the tools required to make the repairs as recommended by the CPSC staff

WARNING

◆ There are many other brands and types of crimp connectors - including those intended to be installed with a pliers type of handtool - which are readily available to consumers at hardware stores, lumber yards, hobby supply stores, automotive supply stores, and so forth

THE COMMISSION STAFF DOES NOT BELIEVE THAT THESE COMMON VARIETIES OF CRIMP CONNECTORS CAN BE USED TO RELIABLY REPAIR ALUMINUM WIRING

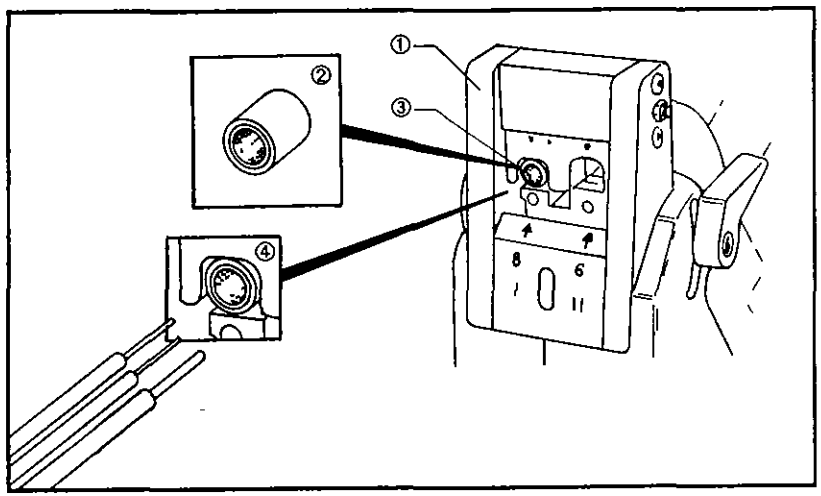
THE COPALUM CRIMP METHOD OF REPAIR

◆ The precision dies in the COPALUM tool squeeze the connector and wires into a particular shape which was determined during the design of the COPALUM wire connector Both the final shape of the connection and the amount that it is squeezed (deformed during crimping) are critical in making a reliable crimp connection Upwards of 10,000 pounds of force is necessary to obtain the amount of deformation for which the connector is designed

◆ In addition, electricians who are authorized to install COPALUM connectors are thoroughly trained by the manufacturer to use the tool properly The Commission staff emphasizes that this training is

necessary to assure that the electrician uses the careful, professional workmanship required to make the crimp connector repair safe and reliable

How the COPALUM Crimp Method Works



CRIMPING PROCEDURE

Follow the procedure below with attention given to steps 1 thru 4

(1) Use the correct tool and dies (recommended by the AMP field representative) for the splice being crimped Ensure that the color coding and marking designation on the splice correspond to the color coding and marking designation on the tool

(2) Be sure the perforated liner is inside the splice The ends of the liner are flared to prevent removal

(3) Load the splice into the dies of the tool

(4) Insert stripped wires into the splice until the ends of wires extend beyond end of the splice Wires should be parallel in the splice Insulation of the wire MUST NOT ENTER the splice

◆ You should request a copy of AMP literature from your electrician prior to his beginning work Discuss with your electrician any information in the literature which you do not understand Remember, every connection of aluminum-to-aluminum or aluminum-to-copper

wire in your home should be repaired in order to obtain the maximum benefit from such repair work

◆ All appliances connected directly to #12 or #10 AWG aluminum branch circuit wiring (for example, dishwashers, cooking equipment, heaters, air conditioners and light fixtures) must be repaired in addition to wall outlets, switches, junction boxes and panel boxes

◆ To determine whether the COPALUM crimp connection method of repair is available in your area, you may wish to write or call the manufacturer of the COPALUM connector for a list of authorized electricians who are doing aluminum branch circuit repair work in your area You may write to

AMP Incorporated
Attn Aluminum Wire Repair Program
Mail Stop 140-13
P O Box 3608
Harrisburg, PA 17105-3608
PHONE 1-800-522-6752

◆ The Commission staff wishes to remind you that all modifications and additions to your wiring system should be done in accordance with local regulations and inspected by municipal authorities You should insist that repairs to your aluminum wiring be inspected

☆ U S GOVERNMENT PRINTING OFFICE 1994 379-211/20004