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Information on the Hazards of Aluminum Wiring and what it can mean to you.

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What Owners Need to Know About Wiring Dangers

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By Sandra Fleishman
Washington Post Staff Writer
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David Hannemann and his wife were aware when they bought their Ellicott City home 18 years ago that it had aluminum electrical wiring, a known fire hazard.

But they waited until this February to make the fix that has long been recommended by the Consumer Product Safety Commission.

It wasn't the safety consideration that made them act. It was their belief that insurance companies will soon crack down on people who own homes such as theirs, wired in part with aluminum rather than copper.

"My wife worked in insurance, and she suggested we'd better do it," said Hannemann, a federal employee in Washington. The underwriter at his wife's former agency "told her he wouldn't write the line anymore" unless a house had been repaired as the CPSC recommends, Hannemann said.

About 2 million U.S. homes are believed to have been built with aluminum branch-circuit wiring, which for three decades has been a widely publicized fire hazard. The CPSC is more anxious than ever because Americans are loading up on high-tech appliances and products that draw more current. That's exacerbating the basic problem of overloaded circuits, which can result in overheated plugs and outlets that catch fire.

Tens of thousands of houses in the Washington area have such wiring, according to estimates by local home inspectors and real estate agents.

Insurers say they haven't moved industry-wide to limit coverage of aluminum-wired houses or to require the recommended fixes. Some local real estate and insurance agents say, however, that they're seeing signs that insurers are taking a harder look at such houses, especially if other red flags pop up during home inspections and appraisals.

Officials at Nationwide Mutual Insurance Co., State Farm Insurance Co. and Allstate Insurance Co., for example, say aluminum wiring could trigger a requirement for an electrical inspection before a policy is issued. Two local Nationwide agents last week were blunter, saying they wouldn't write a policy on

an aluminum-wired house unless their underwriter cleared it based on additional information.

Those familiar with the issue here say houses with aluminum wiring are concentrated in Bowie, Columbia, Rockville, Reston, Dale City, Woodbridge and Laurel, all communities that were developed during the mid-1960s and early 1970s when aluminum wiring briefly dominated the homebuilding market.

Local real estate agents say they have almost never heard of aluminum wiring being a deal-breaker in a home sale. But they acknowledge that it can cause concern if it comes up on the home inspection report. Some also said they worry that these days, when people are increasingly waiving home inspections because of the competitive real estate market, buyers don't even know about the potential hazard and the need for repairs.

Discovery Kills House Sale

The discovery of aluminum wiring during a recent home inspection played a considerable role in killing one \$800,000 sale in Bethesda, said W.C. & A.N. Miller agent Liz Smith.

Her clients were already nervous about spending that much money, she said. When the wiring was found during the home inspection and the would-be buyers learned that replacing it would cost \$15,000 to \$25,000 while the CPSC-approved repair would cost \$5,000, they became more rattled. After phone calls to local insurance agents suggested other possible hurdles, the buyers bolted.

Heather Mayeaux, a first-time buyer in Bowie who learned during a home inspection in October that her dream house had aluminum wiring, also said she was taken aback by the discovery and by the roughly \$3,500 cost to make the repairs the CPSC recommends.

The sellers had not disclosed any electrical problems with the 37-year-old, three-bedroom rambler. The inspector indicated that about half of the wiring was aluminum.

"But what was more of a surprise was when the electrician really went in to do the work," Mayeaux said. "With the extent of damage that was there, it was surprising that the house had not burnt down."

She said, "When I saw that, let's just say that I was really glad we had it addressed right away." She and the sellers split the repair cost, Mayeaux said.

The CPSC has been warning since the early 1970s that homes built or renovated from 1965 to 1973 with aluminum branch-circuit wiring are a fire risk.

Branch-circuit wires are those that distribute electricity to each room from the service panel. In other words, they're the wires that run to lights, switches and most outlets. They're much smaller versions of the heavier, high-voltage aluminum wires that typically run to the house from the street or that run inside the house from the service panel to major appliances.

Builders started substituting aluminum for copper branch wiring in homes in the mid-1960s when copper prices soared. In addition to the 2 million homes that the CPSC estimates were built or modified with aluminum during the eight years when it was the cheaper alternative to copper, other homes built or updated later might have some of the material because it remained on dealers' shelves.

The percentage of homes involved, though, is small -- there are about 107 million housing units in the United States.

The CPSC started raising alarms after a 1974 home fire in Hampton Bays, N.Y., in which two people died. Fire officials blamed the fire on a faulty aluminum wire connector at an outlet.

Numerous complaints from homeowners about overheated outlets and switches led to a commission research project. The research showed that homes wired with aluminum wire made before 1972 are 55 times more likely to have one or more connections reach "fire hazard conditions" than is a home wired with copper. Modified wire, switches and outlets that were made after 1972 still didn't pass muster, according to the federal agency.

Hazard Not Always Recognized

The problem, the researchers said, is not the wire itself or the insulating cable, but the connections where the splices are. "That is where the burnouts occur," said Jesse Aronstein, a longtime CPSC research consultant.

The CPSC tried to get the material recalled, but lost in court, Aronstein said. The commission was able only to conduct a public-information campaign, warning homeowners of potential danger.

The product, however, sank under the weight of the criticism, Aronstein said.

"By the mid-'70s electricians would have had to be crazy or desperate to put it in" because of the publicity, he said. "Basically it died by its own reputation."

Agency officials say that what's upsetting is that many homeowners still don't recognize the hazard. Although the agency estimates that "tens of thousands" of homeowners have heeded its advice and installed a specific repair system called a COPALUM crimp connector, many more have not.

"All fires are of concern to us, but electrical fires concern us more because they occur behind the drywall and are hard to detect and to react to. When it comes through the wall, it is a fully involved fire," said Scott Wolfson, an agency spokesman.

Statistics on fires caused by aluminum wiring aren't kept, but the possibility still frightens federal officials and consumer advocates. An estimated 40,000 electrical fires of all kinds occur in homes each year, causing about \$2 billion in property damage and killing three people each day, the agency said.

Wolfson said his agency's fears about consumer inaction have grown recently because the COPALUM system's manufacturer had at one point indicated it might drop the product at the end of this year.

A press release issued by the CPSC in May 2003 praised Tyco Electronics Corp. for agreeing to continue production of the device and to continue licensing and training of installers until at least 2005. Tyco bought the original manufacturer, AMP Inc., in 1999.

Over the past year, Wolfson said, the agency "has been trying to get the word out to consumers about COPALUM, to let them know that there is this excellent resource out there before it is too late."

Last week, however, Tyco representative Paul Lavenberg said, "The intention right now is not to discontinue in 2005. . . . We expect it will continue on indefinitely."

Wolfson said the agency is pleased with that, but still encourages homeowners to act quickly to prevent fires.

While electricians over the years have recommended different devices to address the problem, Wolfson said the COPALUM system remains the only repair CPSC endorses.

The system sounds like a combination of copper and aluminum -- and it is. Its proponents, however, contend it's a much stronger combination than other connectors.

The Tyco product attaches a copper wire to the aluminum wire leading to each junction box using a crimping power tool that applies about 10,000 pounds of force.

The "cold weld" that's formed as a result is "a permanent bond that eliminates electrical arcing or glowing connections and creates a safer electrical connection

at outlets, switches, lights, circuit breakers and panelboard terminals," the CPSC said.

Other connectors and devices made by other manufacturers are cheaper, but the CPSC says they're not as reliable. That includes "pigtail" repairs that use twist-on connectors and CO/ALR switches and outlets marketed specifically to handle aluminum wire.

"Some 'pigtail' repairs made with twist-on connectors may be even more prone to failure than the original wire connection," the CPSC's consumer booklet says.

The CO/ALR products, which are specifically listed by Underwriters Laboratories Inc. for use with aluminum wire, do "perform better with aluminum wire when installed carefully and according to best electrical practices" than the original switches and outlets, says the booklet. But because the connectors aren't available for all parts of the wiring system, the agency advisory says the device is "an incomplete repair." It notes that CO/ALR devices have also failed in lab tests.

Because of the cost, some electricians and home inspectors contacted recently said they recommend the cheaper alternatives despite the consumer agency's insistence on COPALUM. Others back the COPALUM recommendation. "The CPSC says the only fix that they . . . [recommend] is the COPALUM system, and as home inspectors we go with the most authoritative source," said Mark Dewey, home inspector at HomePro Services Inc. in Falls Church,

Inspector J.D. Grewell of J.D. Grewell & Associates in Silver Spring also advocates the COPALUM repair. Some electricians "will say that pigtail is as good as a COPALUM splice, but it makes it worse," he said.

Seeing Is Believing

Ellicott City homeowner Hannemann, who just made the repairs after 18 years, said the cost put him off for a long time. "People are funny about this kind of thing," he said. "It's a lot of money to spend on something you can't see."

When he finally saw some of the burnt wire nuts, he said, he thought the six-day retrofit was time and money well spent.

The COPALUM connectors, which have to be installed at every junction box in a house, cost about \$35 to \$62 per junction, according to local authorized installers. The average single-family house has about 100 junction boxes.

The CPSC would be happiest if homeowners eliminated all the aluminum wiring and replaced it with copper. But the regulators recognize that the cost of doing so is considered prohibitive in most cases.

Because the national electrical code requires that aluminum wire be stapled every few feet inside the drywall, it can't just be pulled out and replaced, said Brian Smith, owner of All Things Electric in Dickerson. Replacing the wiring means not only a hefty price tag for the electrical work but also thousands more for new drywall.

Rewiring might work in houses where major renovations are already planned or where the wires are easily accessible, local electricians said.

"If you have a rambler with an unfinished basement, for instance, that would be ideal to rewire," said Jeff Smith of Electrical Wiring Limited in Kensington, a COPALUM installer. But he said most homes don't have that kind of access.

"A lot of times people ask me for an estimate on rewiring," said Bob Krebs, vice president of Hawkins Electric Services in Hyattsville, another authorized COPALUM installer. "But I won't even give them one 'cause you might as well tear the whole house down."

Not all homes built during the period when aluminum was used are automatic candidates for a problem, said home inspector Stephanie Bowman of HouseMaster Inc. of Rockville. Some builders never abandoned copper.

"I've seen it the most in Bowie," Bowman said of aluminum wire. "There's like a 50-50 chance that we'll see it there" when the company inspects houses built in that time frame.

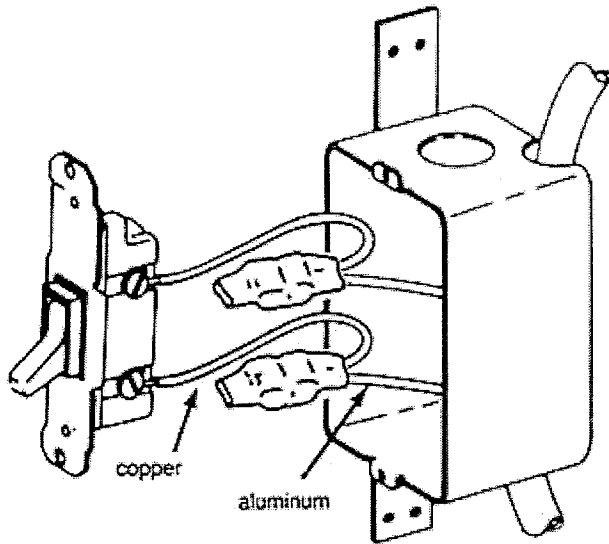
Bowman said most homebuyers are surprised when she mentions the aluminum wiring, and some seem to be interested in remediation. But she thinks "quite a few just live with it, and every couple years have it reinspected to see if the connections are tight."

Joe Huff, an agent with Llewellyn Realtors in Rockville, said some of the neighborhoods where he works are also filled with aluminum-wired houses. When a home inspector finds the wiring, he said, the sellers will usually pay to fix the problem as the CPSC has urged. If they balk, Huff said he tells them that it might smooth the way to quick settlement, particularly because the issue, now that it has been identified, would have to be disclosed to any other potential buyer.

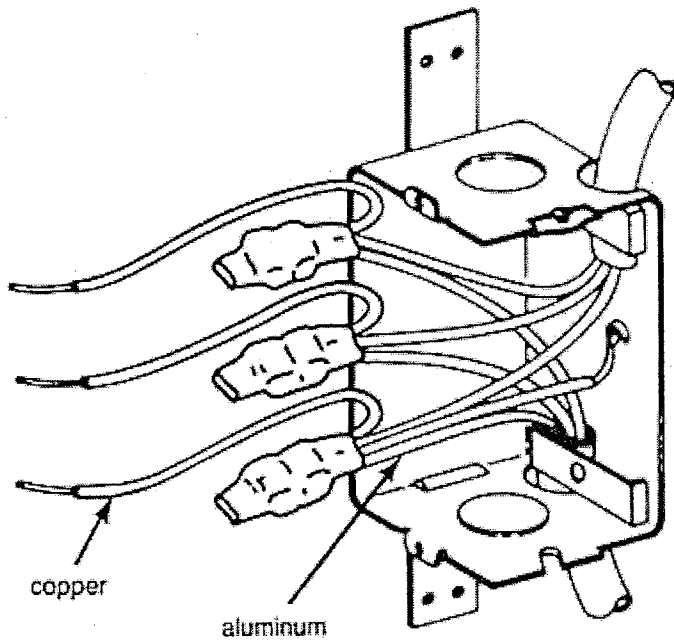
Sellers might insist on splitting the cost or on making the buyer pay for the repairs, but "generally I have persuaded my sellers that it's a pretty small price to pay to make sure a deal goes through," Huff said.

COPALUM Connection Illustration

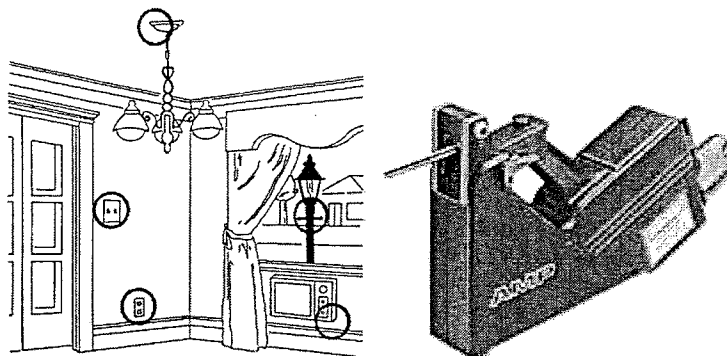
Reconnection for switch or duplex receptacle with AMP COPALUM Connectors.



Reconnection for typical feed-through circuit with AMP COPALUM Connectors.



COPALUM Connectors and Heat Shrink Tubing System



Features and Benefits

Avoids the expense of completely replacing old technology aluminum branch wiring circuits.
Provides an approved splice for permanent reconnections.

The only "repair method" considered acceptable by the U.S. Consumer Product Safety Commission.

COPALUM Connectors have copper body construction with a perforated copper alloy liner for solid 12, 14 AWG CU; and for solid 10, 12 AWG Al wire.

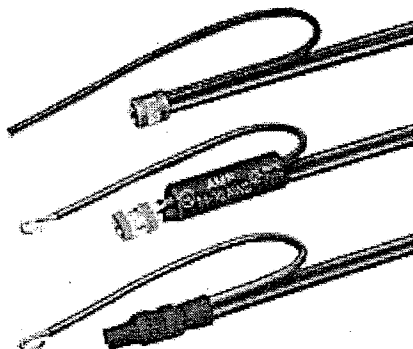
COPALUM Connectors provide a good aluminum-to-copper termination for reconnecting branch wiring circuits.



LISTED File No. E13288 Tested to Spec. # 486C



Certified File No. LR 7189

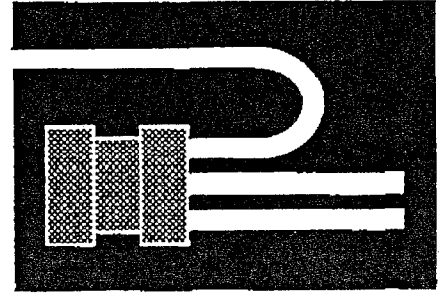
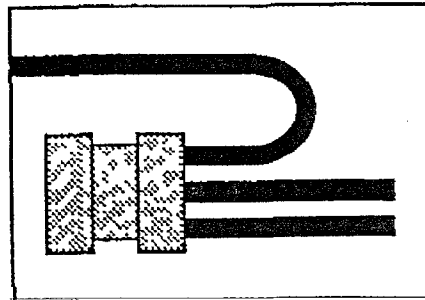
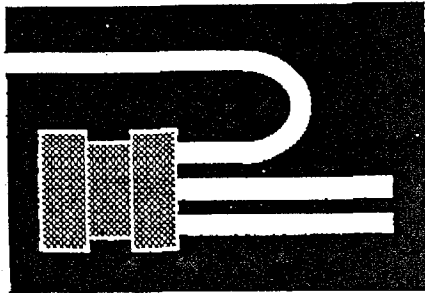


For Reconnecting Old Technology Aluminum Branch Circuit Wiring Systems

Between 1965 and 1973, one and one-half million homes were wired with old technology aluminum branch circuit wiring. The U.S. Consumer Product Safety Commission (CPSC) had research conducted which 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"* than is a home wired with copper. The CPSC-sponsored research, laboratory testing, and demonstration projects identified only one method of "repairing" existing aluminum wire circuits which meets their criteria... the AMP COPALUM Connector. By Use of the COPALUM Connector, old technology aluminum wire is permanently connected to a short length of copper wire. The copper wire is then terminated to outlets, fixtures and appliances by use of approved methods.

The application procedure is fast and efficient. The COPALUM Connector uses a perforated copper alloy liner for optimum mechanical and electrical performance. Using AMP tooling, the relatively soft, old technology aluminum conductor is forced into the perforated liner, allowing oxide-free aluminum to be brought into solid contact with the connector. AMP heat shrink tubing insulates the connection to complete the termination.

*The survey conducted by the Franklin Research Institute defined "Fire Hazard Condition" to occur when receptacle cover plate mounting screw reached 149°C (300°F) or sparks were emitted from the receptacles, or materials around the receptacle were charred.



Repairing Aluminum Wiring

CPSC #516

U.S. Consumer Product
Safety Commission
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

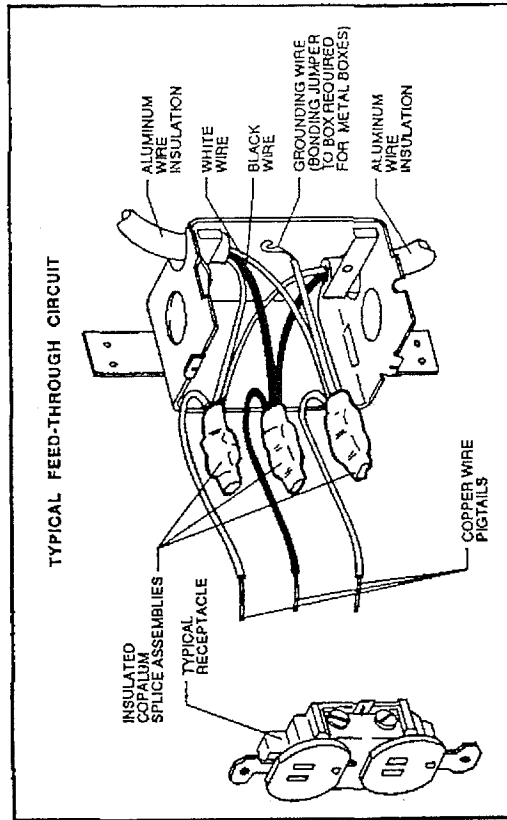
- ◆ If you have noticed any of the trouble signs, have a qualified electrician determine whether the problem is caused by deteriorating connections to aluminum wiring. **DO NOT TRY TO DO IT YOURSELF.** You could be electrocuted or you could make the connections worse by disturbing them. If you are not 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.

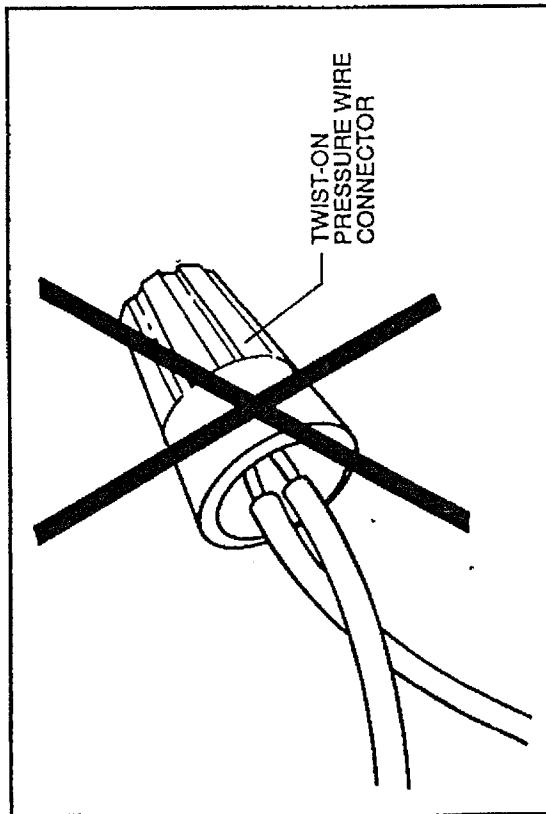
Recommended COPALUM Crimp Connector Repair



- ◆ 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 ("pigtail") 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 "pigtail" 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 pigtail "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.

"Pigtail" 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.

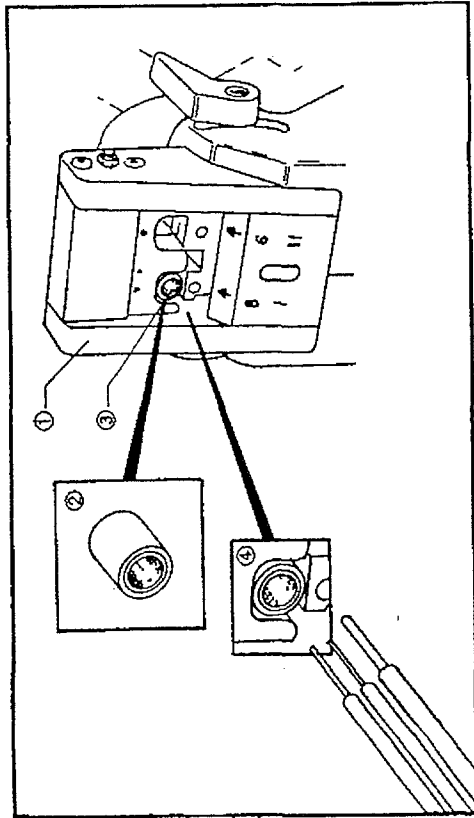
THE COPALUM CRIMP METHOD OF REPAIR

◆ 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

