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Aluminum wiring in residential installations

Issues with aluminum wiring

The Electrical Safety Authority has received an increasing number of questions about the safety of aluminum wiring. In particular, purchasers or owners of homes built from the mid 1960's until the late 1970's with aluminum wiring are finding that many insurers will not provide or renew insurance coverage on such properties unless the wiring is inspected and repaired or replaced as necessary and this work is inspected by ESA and a copy of the certificate of inspection is provided to the insurer. In some cases the insurer may require replacement of the aluminum wiring with copper wiring. Check with your insurance company for their requirements.

Some homes may have a mixture of aluminum and copper wiring.

Reported problems with aluminum wiring have been related to the overheating and failure of aluminum wiring terminations. This is due to aluminums tendency to oxidize and its incompatibility with devices designed for use with copper wiring. Warm cover plates or discolouration of switches or receptacles, flickering lights, or the smell of hot plastic insulation may evidence these problems.

Each home will be different and must be assessed on its own. It is highly recommended the homeowner hire a licensed electrical contractor who is knowledgeable in the special techniques required for working with and repairing aluminum wiring. The contractor should do an assessment, make the necessary repairs, and have the work inspected by ESA. The homeowner should obtain a copy of the Certificate of Inspection for their records and for their insurance company (if requested).

As mentioned above, where problems exist with aluminum wiring they are usually found at termination points. This necessitates the opening of all outlets (receptacles, switches, fixtures, appliance connections, and in the panelboard) and visually inspecting terminations for signs of failure and overheating without removing or disturbing the devices or wiring. There should be no signs of overheating such as darkened or discoloured connections, melted insulation, etc.

Where problems are found the damaged aluminum conductor should be cut back to remove the damaged portion and then the necessary repairs made.

Required markings for devices used with aluminum wiring

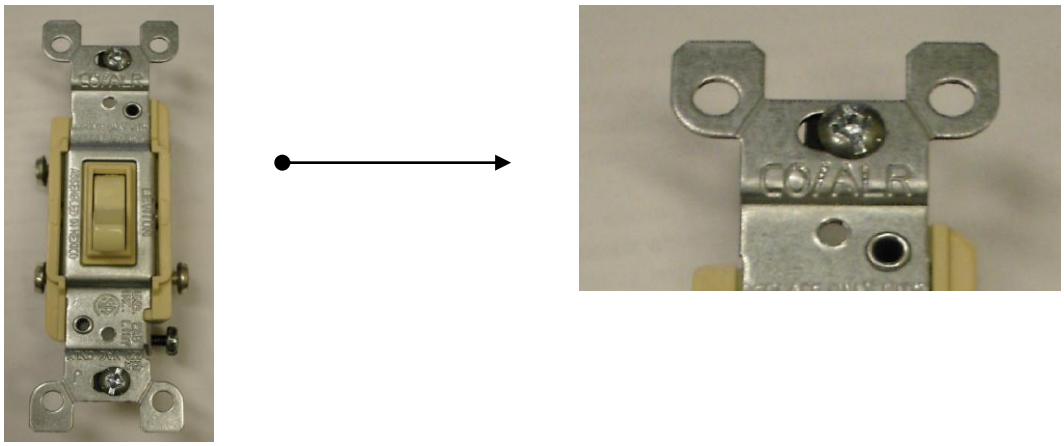
Replacement receptacles and switches shall be installed in compliance with the Ontario Electrical Safety Code and marked as per Table F1.

Table F1 – Required markings for devices used with aluminum wiring

Electrical Device	Required Marking
Receptacle (rated 20 amps or less)	“CO/ALR” or “AL–CU”
Receptacle (rated greater than 20 amps)	“AL–CU” Or “CU–AL”
Switch (rated 20 amps or less)	“CO/ALR”
Wire Connectors [intended for use with combinations of either an aluminum conductor(s), a copper conductor(s), or both]	“AL–CU” Or “CU–AL”
Luminaire (Lighting fixture or lampholder)	No required marking on fixture, however approved wire nuts are required.
Electric Heater	No required marking on heater, however approved wire nuts are required.

All terminations of aluminum conductors shall be to devices marked as per Table F1 and Photo F1; this includes the bare bond conductor as well. Rule 12-118(3) provides two exceptions to this requirement. The first exception is for devices or fixtures with wire leads, in which case the joint between the wire lead and the aluminum conductor shall be made with a wire connector approved for copper to aluminum connections and marked as per Table F1. The second exception is the outlet box bonding screw, which does not require approval for connection of the aluminum bonding conductor.

Photo F1 – Required marking for devices used with aluminum wiring



Terminations of aluminum conductors

Rule 12-118(6) of the Code requires the connection of aluminum conductors to wiring devices having wire binding terminal screws, about which the conductors can be looped under the head of the screw, shall be made by forming the conductor in a clockwise direction around the screw into three-fourths of a complete loop and only one conductor shall be connected to any one screw.

Devices with “push-in” terminations shall not be used with aluminum conductors.

An alternative to using copper/aluminum approved devices is to connect a copper wire “pigtail” between the aluminum conductor and the device connection screw of a device approved for copper only connections. Pigtailing also applies to the bond conductor, which is often overlooked. The wire connector used for the pigtail joint shall be marked as per Table F1.

Rule 12-118(1) states that adequate precaution shall be given to the termination and splicing of aluminum conductors, including the removal of insulation, the cleaning of the bared conductor, and the compatibility and installation of fittings.

Aluminum conductors are softer than copper and care must be taken that they are not nicked or cut, or crushed during termination. Nicks, cuts, or crush spots at terminations result in a weak spot that may result in breakage of the conductor or a hot spot.

Where pig tailing is used, Rule 12-3034 must be considered with respect to the minimum volume of box required to contain the existing as well as the new conductors and connections. Where there is not enough room in the existing outlet box, a surface mounted extension box may be required to contain the extra volume necessary to safely accommodate everything.

The use of oxide inhibitors

Rule 12-118(2) requires that a joint compound be used with stranded aluminum conductor connections.

It has been brought to the attention of ESA that the excess use of **non-petroleum** based inhibitors may result in the failure of approved wire connectors. Figure F2 shows an example of a failure when non-petroleum based inhibitor was used for copper to aluminum connections. The “Oxide Inhibiting compound” and connector manufacturers’ shall be consulted to ensure the compound used is appropriate for the application.

Unless the termination or splice is approved and so marked for use without Oxide Inhibitors, Rule 12-118(2) requires a joint compound, capable of penetrating the oxide film and preventing its reforming, be used with **stranded** aluminum conductor connections.

Note:
The compound is conductive and should be used sparingly and any excess compound should be removed.

Figure F2 – Non-Petroleum based inhibitor failures

General inspection

Question
If ESA completes a general inspection, does the OESC require an older house that is wired with aluminum wiring to have all non-CU/AL devices replaced with devices approved for connection to aluminum wiring (or have copper tails installed as per information included in this Bulletin (12-28-*).

Answer
No, If the devices are the original ones installed and show no visible signs of overheating or other damage, then they are not required to be replaced (it is recommended only). If a device shows any visible signs of overheating or other damage, then replacement is required. If any of the devices have been replaced in the past with newer devices (ie: Decora style), then they are not original and are required to be replaced with a Code compliant installation.

Rationale
Rule 2-300 requires that operating electrical equipment be kept in safe and proper working condition and that defective equipment shall either be put in good order or permanently disconnected. Where there is no evidence of deterioration of the wire, the termination, or the device, then the Code does not require that repairs be made.

Myths
- Aluminum wiring was recalled because it is known to be a fire hazard.
- Aluminum wiring is no longer used for interior wiring systems.

Fact
- The Ontario Electrical Safety Code permits the installation of aluminum wiring.
- Adequate precautions shall be given to the terminations and splicing of aluminum conductors;
- Aluminum wiring itself is safe if proper connections and terminations are made, without damaging the wire and devices approved for use with aluminum wire are employed.
- Aluminum wiring is widely used today for larger commercial and industrial feeders. Electrical distribution companies use it widely throughout their distribution systems including the supply

service cable to most residences; in fact it may still be used today for interior wiring systems in residential homes as well as other structures.

Aluminum wiring itself is safe and if proper connections and terminations are made without damaging the wire and using approved materials installed in accordance with the Ontario Electrical Safety Code and the manufacturer's instructions, there should be no problems with the aluminum wiring installation.