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Aluminum wiring in residential installations

Issues with aluminum wiring

The Electrical Safety Authority (ESA) 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.

Myths

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

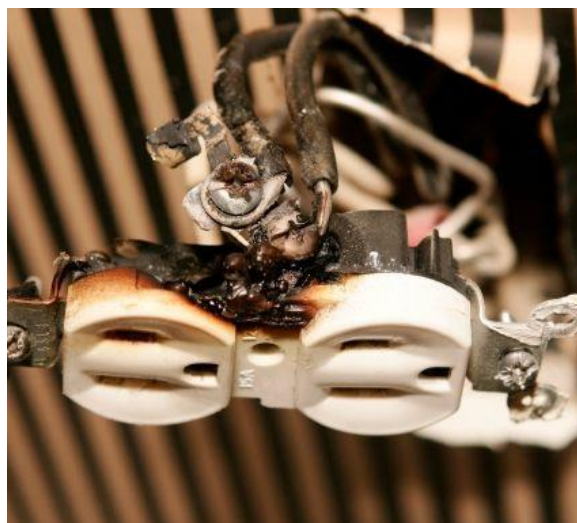
Fact

- The Ontario Electrical Safety Code (OESC) 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 and installed in accordance with the OESC and the manufacturer's instructions.
- 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.

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 the tendency for aluminum to oxidize and its incompatibility with devices designed for use with copper wiring. Warm cover plates or discolouration of switches or receptacles, signs of arcing within switches or receptacles as per photo F1, flickering lights, or the smell of hot plastic insulation may be evidence of these problems.

Photo F1 – Failure of aluminum wiring terminations



Each home is different and must be assessed on its own. It is highly recommended that the homeowner hire a Licensed Electrical Contractor (LEC) 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

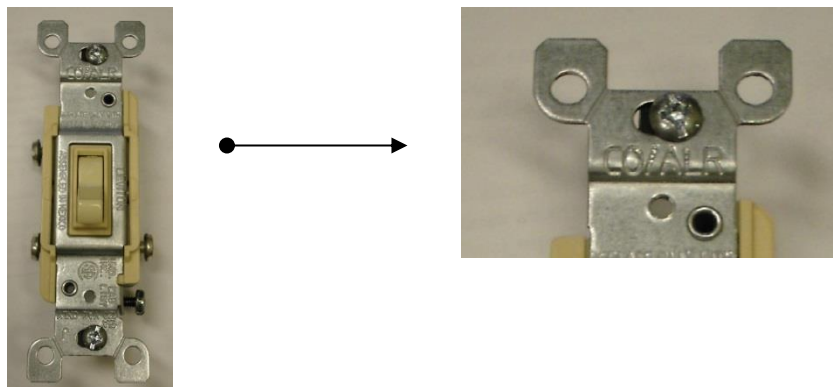
Replacement receptacles and switches shall be installed in compliance with the OESC and marked as per Table F1.

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 F2; this includes the bare bond conductor. OESC 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 F2 – Required marking for devices used with aluminum wiring



Terminations of aluminum conductors

OESC Rule 12-118 6) requires the connection of aluminum conductors to wiring devices having binding- screw terminals around 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 “pig-tail” between the aluminum conductor and the device connection screw of a device approved for copper only connections. Pig-tailing also applies to the bond conductor. The wire connector used for the pigtail joint shall be marked as per Table F1.

OESC 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, 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, OESC Rule 12-3036 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.

Aluminum wiring in existing installations

If an owner is aware or has discovered that the house is wired with aluminum wiring and the original devices are not marked as suitable for aluminum wiring, there is a potential for failure which could lead to a fire, as per Photo F1. Aluminum-wired connections have been known to fail and overheat without any prior indications or problems. Do not wait for signs of overheating of the termination or signs of arcing within switches and receptacles. ESA strongly recommends eliminating a hazard by replacing the original devices with aluminum rated and properly marked devices (or have copper tails installed).

If any of the original devices have been replaced in the past with newer Cu only devices (i.e. Decora), then they are not original and are required to be replaced with a Cu/ AL device.

The use of Oxide Inhibitors

OESC 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, OESC 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

