Incident Summary posse file 5565801 (UW-320027-2015)

SUPPORTING INFORMATION	Incident Date			November 29, 2015
	Location			Mission
	Regulated industry sector			Electrical – Low voltage electrical system
	Impact	Injury	Qty Injuries	0
			Injury description	n/a
			Injury rating	n/a
		Damage	Damage description	Melting, charring and discoloration of a receptacle at the conductor terminations
			Damage rating	Moderate
	Incident rating			Moderate
DESCRIPTION	Incident overview			The Mission Fire Department reported an incident involving electrical that was attended by first responders on November 29, 2015. The incident involved a receptacle in the living room of a single family dwelling unit. The tenant first reported hearing popping and crackling noises but was unable to pin point where the noises were coming from. A few hours later the tenants smelled burning which seemed to be coming from near a receptacle. They contacted the fire department who subsequently attended the scene. The fire department scanned the wall with their thermal imaging device which showed a hot spot around the electrical outlet box. They located the circuit breaker in the electrical panel and turned it off. One of the fire fighters was an electrician. The fire fighter removed the receptacle from the outlet box to observe where the hot spot was and to confirm it was cool enough not cause a fire. The fire fighter put the receptacle back in the outlet box and re-installed the cover plate. The investigation revealed that the receptacle was changed at some point to one not compatible with aluminium wiring. An inspection of the electrical system identified other similar situations where aluminum wiring was terminated onto devices that are only intended to have copper conductor terminations.

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	Site, system and components	The house is a single family dwelling unit, approximately 40 - 45 years old, two story, wood framed structure, approximately 2000 - 3000 square feet in area (see photo log #2). The house contains a secondary suite in the basement and a second laundry facility in an addition at the back of the house. The electrical work completed for these alterations would not have been installed at the time the house was built. (see photo #1) The house has a 100 Amp , 120/240 Volt rated, overhead electrical service that appears to be original equipment. The receptacle involved in the incident was a 15 Amp, 120 Volt rated, ground fault circuit interrupter (GFCI) duplex receptacle in the living room of a house. (see photo #2) Some of the receptacles, switches and light fixtures have been upgraded or replaced from the ones originally installed.
conclusions	Failure scenario(s)	Original house branch circuit wiring installed was #12 awg aluminium as is typical for many houses of that age. The outlet box (retrofit type box), wiring and receptacle were likely altered at some point by an unqualified person. The installed receptacle was not compatible with aluminium wiring. With time and normal use, the electrical connection between the aluminium wiring and the receptacle became loose, contributing to local heating. Heating at the connection progressed with continued use until detected by the tenant as a smoke smell and popping sounds.
	Facts and Evidence	*Receptacle* • The receptacle was a 15 Amp, 120 Volt rated, ground fault circuit interrupter (GFCI) receptacle. • There was no evidence of damage looking at the front of the receptacle. • The receptacle was not energized and the branch circuit (circuit #15) was turned off in the electrical panel (by the fire department at the time of the incident). • Removal of the receptacle showed thermal damage to the side and back of the device. (see photo #3, 4 and 5) • The connection on the line (energized) conductor termination was thermally damaged. This caused the plastic body of the receptacle to melt, deform and discolor, as well as melting the insulation of the conductor. Internal electronic components also appeared to be damaged. • The receptacle had a manufacturer's name "EAGLE" embossed on the back of it, and had the CSA approval logo embossed on the front of the mounting strap. • The receptacle had the words "USE COPPER WIRE ONLY FOR ALL CONNECTIONS" embossed on the back of it as well as "CU" inside a circle (without a line through it), and "AL" inside a circle with a line through it. (see photo #5) • The conductors terminated onto the receptacle were aluminum #12 awg conductors. • Receptacles that are tested and certified for copper terminations are only approved for copper terminations. • The tenant indicated that the only thing plugged into the receptacle at the time of the incident was a small Christmas light string. The lights were approved and

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		unlikely to have been a factor in the incident other than providing a small load on the receptacle. *Conductors and branch circuit wiring* • The conductors were from the 2 x 2 conductor, #12 awg, non-metallic sheathed cable (NMSC), branch circuit wiring cables that entered the single gang metal outlet box that the receptacle was mounted to. • The bonding conductors of the NMSC's were connected to each other to maintain the branch circuit bonding path. However, the bonding conductor of the branch circuit wiring was not connected to the receptacle and the outlet box was not bonded. This may indicate the altered outlet box, wiring and receptacle were installed by an unqualified person. • The conductors of both cables where terminated to the receptacle on the "Line" and "Load" terminals. This means that current from other receptacles or lights on the downstream side of this receptacle and branch circuit would have been passing through this receptacle which may have contributed to the heating effect on the terminations of the receptacle. • The aluminum conductor termination on the receptacle failed thermally damaging the receptacle and conductor insulation. • Terminating aluminum conductors on devices that are not designed and constructed for aluminum conductors can cause loose or high resistance connections due to dissimilar metals in contact with each other and expansion and contraction of current carrying conductors. • Over time high resistance connections cause heat which leads to a higher resistance connection. Eventually this condition can reach a point where the temperature of the termination exceeds the material's ability to dissipate the heat and damage to the equipment and wiring occurs. • Although other receptacles and light switches were inspected and found to contain aluminium wiring directly connected to receptacles and switches not rated for aluminium wiring, no other thermal damage was observed at device terminations. (see photo #6)
	Causes and Contributing Factors	The cause of this incident was an incompatible receptacle installed on aluminum wiring likely by an unqualified person. The BC Electrical Code rule 2-024 requires electrical equipment to be of a kind or type and rating approved for the specific purpose for which it is to be employed.

Photos or diagrams (if necessary)

Photo 1: Front of the house where incident occurred.

Photo 2: failed receptacle as installed – no evidence of damage when viewed.

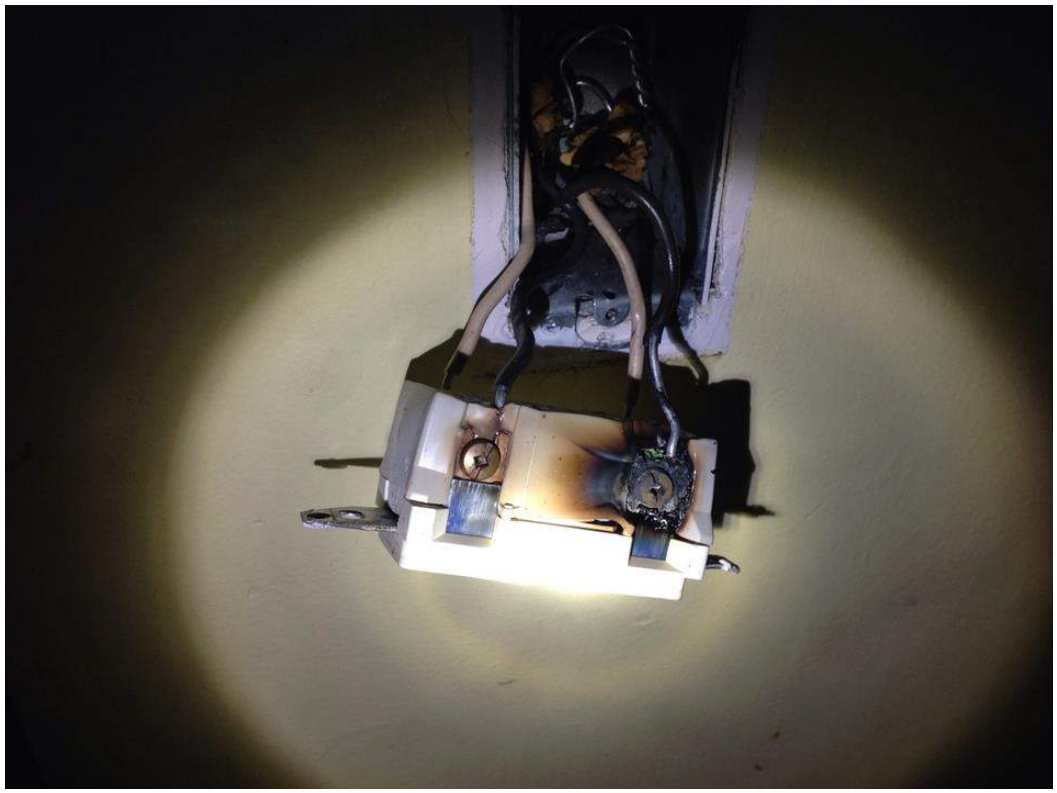

Photo 3: Heat damaged receptacle removed from outlet box. Discoloration at thermally damaged conductor termination.

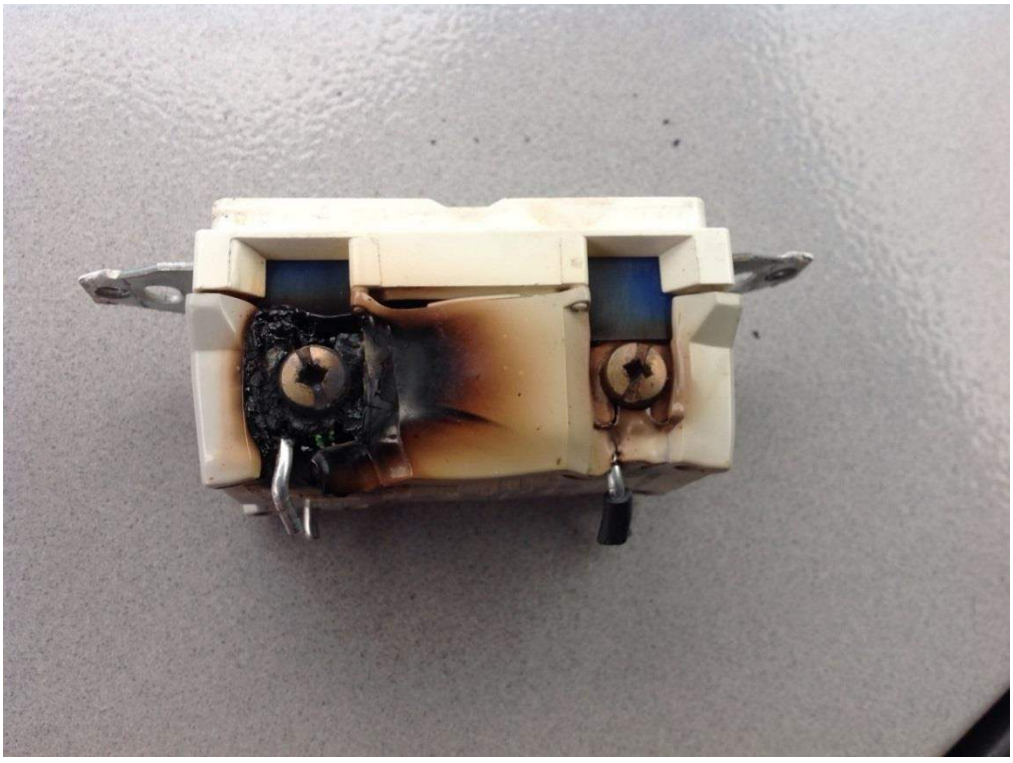

Photo 4: Damaged receptacle cut from house #12 awg aluminium wiring.

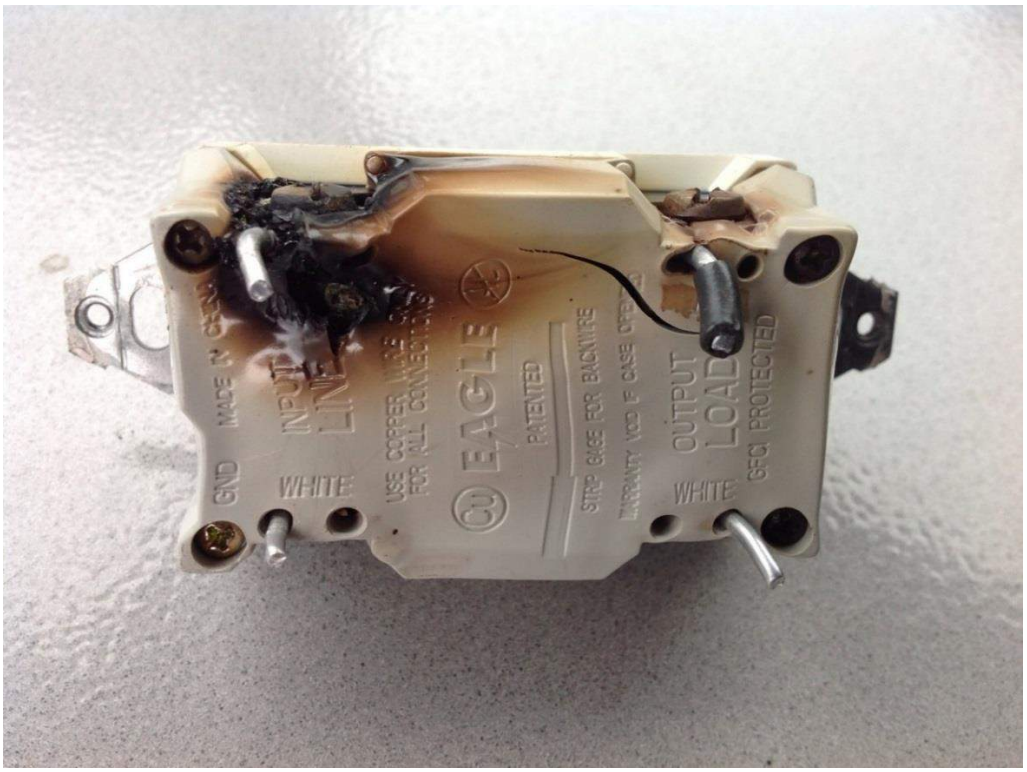

Photo 5: Back of damaged receptacle cut from #12 awg aluminium house wiring. Note the statement “USE COPPER WIRE ONLY FOR ALL CONNECTIONS” and the Cu (copper) symbol and the ‘no AL (Aluminium)’ symbol.

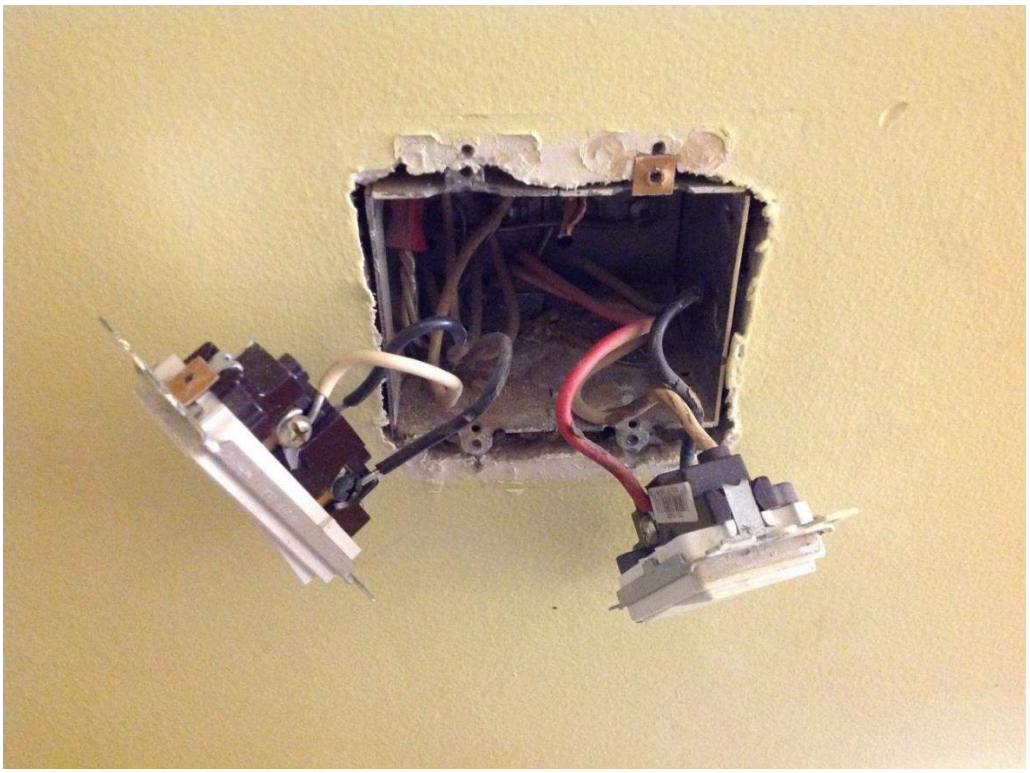

Photo 6: Other devices containing aluminum wiring directly connected to switches rated for copper wiring only.