

Incident Summary II-1703922-2024 (#45823) (Final)



SUPPORTING INFORMATION	Incident Date	March 10, 2024	
	Location	Delta, BC	
	Regulated industry sector	Electrical - Low voltage electrical system (30 to 1000V)	
	Impact	Qty injuries	0
		Injury description	N/A
		Injury rating	None
	Damage	Damage description	Hot tub control box burnt.
		Damage rating	Moderate
Incident rating	Moderate		
Incident overview	An electrical hot tub control box burnt causing a loss of power to a homeowner's house.		
INVESTIGATION CONCLUSIONS	Site, system and components	<ul style="list-style-type: none"> The site where the incident occurred was a single-family home with a 100 amp, 120/240V single phase electrical consumer service. The residence had a 32-amp 240 v, single phase hot tub. In 2021, the hot tub was wired to a 2 pole, 40amp ground fault circuit interrupter (GFCI) breaker using 3 conductor #6 AWG aluminum armoured cable. <p>Aluminum conductor shall be utilized with terminals connectors approved for use.</p> <p>The use of aluminum conductors creates the potential for heat to be generated for several reasons:</p> <ol style="list-style-type: none"> Aluminum conductors oxidize and create high resistance connections when not used with appropriate connectors. Aluminum conductors have higher resistance than copper and therefore must be a larger diameter to provide the same current carrying capacity. Aluminum wires are softer than copper, making connections more susceptible to loosening over time from vibrations such as would occur from hot tub motors. 	
	Failure scenario(s)	<p>In 2021 a hot tub was installed at the residence and wired with a new 3 conductor #6 AWG aluminum armoured feeder cable (ACWU). The hot tub was required to be connected with a minimum #6AWG copper conductors only and was not approved for use with aluminum conductors.</p> <p>The connections with the aluminum conductors at the hot tub control box degraded over time and created high resistance connections. During use, the heat generated at the connections was sufficient to ignite the combustible enclosure for the electrical control box.</p>	

<p>Facts and evidence</p>	<p>On the day of the incident the main service breaker at the house tripped resulting in a complete loss of power to the residence. The homeowner was able to restore power to the home after a few hours but noticed the hot tub side cover was distorted and was leaking water.</p> <p>The homeowner removed the hot tub side cover and discovered the electrical control box had been significantly burnt.</p> <p>The hot tub manufactures installation manual requires minimum #6AWG copper conductors only.</p> <p>An armoured (ACWU) cable with aluminum conductors was installed to the hot tub control box.</p> <p>Aluminum conductor shall be utilized with terminals connectors approved for use.</p> <p>The Canadian Electrical code C22.1 2-026, even though approval has previously been granted, the inspection department may reject, at any time, any electrical equipment under any of the following conditions:</p> <ul style="list-style-type: none">a) The equipment is substandard with respect to the sample on which approval was granted.b) The conditions of use indicate that the equipment is not suitable or,c) The terms of the approval agreement are not being carried out.
<p>Causes and contributing factors</p>	<p>The cause of the incident was the use of aluminum conductors to supply power to the hot tub, contrary to manufacturer recommendations. It is highly probably the use of aluminum conductors resulted in high resistance connections, that ignited nearby combustibles when the hot tub was operating.</p>



Image 1 – Damaged hot tub.



Image 2 - Aluminum cable installed to hot tub controller.



Image 3 – Close up of damaged hot tub.



Image 4 – Aluminum conductor used to connect to the hot tub.