

Incident Summary #II-1293154-2021 (#25200) (FINAL)

SUPPORTING INFORMATION	Incident Date	October 7, 2021	
	Location	Port Alberni, BC	
	Regulated industry sector	Electrical - Low voltage electrical system (30V to 750V)	
	Impact	Qty injuries	0
		Injury description	N/A
		Injury rating	None
	Damage	Damage description	A cable, a receptacle, and a cord for a piece of electric vehicle supply equipment were damaged beyond repair.
		Damage rating	Minor
	Incident rating	Minor	
	Incident overview	A receptacle, cord end, and cable providing power to electric vehicle supply equipment were damaged when an accumulation of thermal energy at and around the receptacle caused temperatures high enough to melt the plastic components of the equipment.	
INVESTIGATION CONCLUSIONS	Site, system and components	<ul style="list-style-type: none"> In the attached garage of a single-family dwelling, a 50-amp receptacle supplied by a 40A branch circuit breaker was provided for cord connection of a piece of electric vehicle supply equipment (EVSE). 8/3 Teck 90 cable was run exposed approximately 10m through the garage to a metallic outlet box, on which a NEMA 14-50R receptacle was installed. The nameplate rating of the output of the EVSE is 40A. EVSE designed and approved for connection to a receptacle was plugged in to the receptacle and regularly charged an electric vehicle belonging to the homeowner. The charger had been in use for several months prior to the incident and on one other occasion, the homeowner though they detected a burning smell briefly. 	
	Failure scenario(s)	A homeowner connected his electrical vehicle to the EVSE and left his vehicle to charge. As the vehicle was charging, the receptacle and inserted plug began to heat up at a high resistance connection. When the homeowner returned to the garage, he identified a burning smell which he traced to the receptacle supplying the EVSE. He immediately disconnected the EVSE cord from the receptacle, both of which had been damaged by exposure to the heat.	

Incident Summary #II-1293154-2021 (#25200) (FINAL)

Facts and evidence	<p>Visual inspection of the damaged equipment showed:</p> <ul style="list-style-type: none">• The damage was highly localized and confined to the female contact of the plug/receptacle interface (Figure 1), the termination point of the conductor to the receptacle (Figure 2 and 3) and on the blade/prong of the plug (Figure 4 and 5).• Heat conducted by the copper cable supplying the receptacle caused the insulation and jacket of the cable to melt progressively away from the failure point (Figure 4 and 5). <p>Statements from the homeowner indicated the following:</p> <ul style="list-style-type: none">• The damage ceased once the plug was removed from the receptacle.• The circuit breaker did not trip during the event.• The vehicle was charging at the time of the event.• The plug of the charging equipment had only been inserted into the receptacle once, it was not routinely inserted and removed.• The receptacle had been installed while the home was owned by prior occupant(s). <p>Further investigation of the site and associated records showed:</p> <ul style="list-style-type: none">• Construction of the dwelling was completed under an electrical permit closed in 2016.• Based on the wiring route and method, as well as conversation with the constructing electrical contractor, the receptacle was added after the permit was finalized.• No permit could be found for the addition of an EVSE receptacle to this dwelling.
Causes and contributing factors	<p>While the vehicle was charging, heat began to build up at the receptacle. Vehicle charging is a significant and sustained load, and it is likely that this failure had been worsening over time.</p> <p>Given the localization of the damage, it is highly likely the cause of the heat production was a high resistance electrical connection at the receptacle socket/ plug prong interface. There are several locations where this could occur, including:</p> <ol style="list-style-type: none">1) Where the branch circuit conductor is terminated to the receptacle.2) In the pressure connection where the blade of the plug is wedged between the female contacts of the receptacle.3) In the plug where the conductor of the cord is terminated on pressure contact where the prong of the plug is pressed between the female contacts of the receptacle.

Incident Summary #II-1293154-2021 (#25200) (FINAL)

Given that all the above locations were in close proximity and arranged in such a way as to allow for rapid heat transfer between them, it was not possible to determine the precise location of the failure for certain.

It seems slightly more likely that the fault occurred at a termination point rather than the factory terminations in the plug or receptacle, or the plug/receptacle interface itself, but no exclusion of these other possibilities could be made.

Contributing Factors:

Research conducted by Technical Safety BC has shown that unpermitted work is significantly more hazardous than permitted work¹.

A loose field installed connection would be exposed to long periods of high current draw due to the nature of electric vehicle charging.

¹ https://www.technicalsaftybc.ca/sites/default/files/6-13_understanding_safety_risks_in_bc_0.pdf (pg 11)



Figure 1 - Front of receptacle



Figure 2 - Rear of receptacle



Figure 3 - Receptacle termination side with conductor openings



Figure 4 - Damage to conductor in enclosure



Figure 5 - Damage to plug