Incident Summary #II-1035781-2020 (#18697) (FINAL)

SUPPORTING INFORMATION	Incident Date		July 1, 2020
	Location		Prince George
	Regulated industry sector		Electrical - Low voltage electrical system (30V to 750V)
	Impact – Injury	Qty injuries	0
		Injury description	None
		Injury rating	None
	Impact – Damage	Damage description	Fire and smoke damage to recreational vehicle. Most structural damage contained to the area where the fridge was located.
		Damage rating	Moderate
	Incident rating		Moderate
	Incident overview		On the day of the incident, the owner of a Jayco recreational vehicle was preparing for a weekend of camping. They were packing the Recreational vehicle and decided to get some items from the store. The recreational vehicle was plugged into the home exterior receptacle and then they turned on the fridge and left. It was at the store they got a call from a neighbour stating the recreational vehicle was on fire. The fire was quickly extinguished.
INVESTIGATION CONCLUSIONS	Site, system and components		The Jayco recreational vehicle was located in the driveway of the owner's single family dwelling. The unit was purchased with a three way refrigerator, meaning it can operate on propane, 12 Volts DC or 120 volts AC. The fridge is a typical recreational vehicle refrigerator permanently mounted in a vented enclosure. The fire was contained to the area behind the fridge. The recreational vehicle is QAI certified. QAI is a certification agency accredited by the standards council of Canada. This allows QAI to certify that mobile homes meet a minimum standard of safety, outside the limits of the accepted code rules for a province. Both low voltage DC and 120 volt conductors are run through the refrigerator enclosure supplying utility and control functions of the recreational vehicle. Rather than the conductors run in approved manner, and close to the wall they were bundled in a single stack and ty-rapped to each other.
	Failure scenario(s)		The configuration of the conductors running through the refrigerator enclosure caused an non-metallic sheathed cable to rest against the tubing for the cooling system. This tubing is hot and over time the non-metallic conductors would heat up and change the characteristics of the insulating material over the cable and over the individual conductors. This damage, if not addressed, would eventually expose the conductors to contact. The cable is energized only when the recreational vehicle is plugged in. On the day of the incident the owner wanted to cool the fridge down as they went shopping. They plugged in the recreational vehicle energizing the non-metallic cable and as the refrigerator cooled the cable heated up due to it touching the tubing. This process degraded the insulation to the point that a conductor in the cable started arcing against the tubing causing a number of pin holes and releasing the gasses in the cooling system causing an explosion and intense fire for a very brief time. After the gasses vacated the cooling system, the fire was quickly extinguished by a neighbour.

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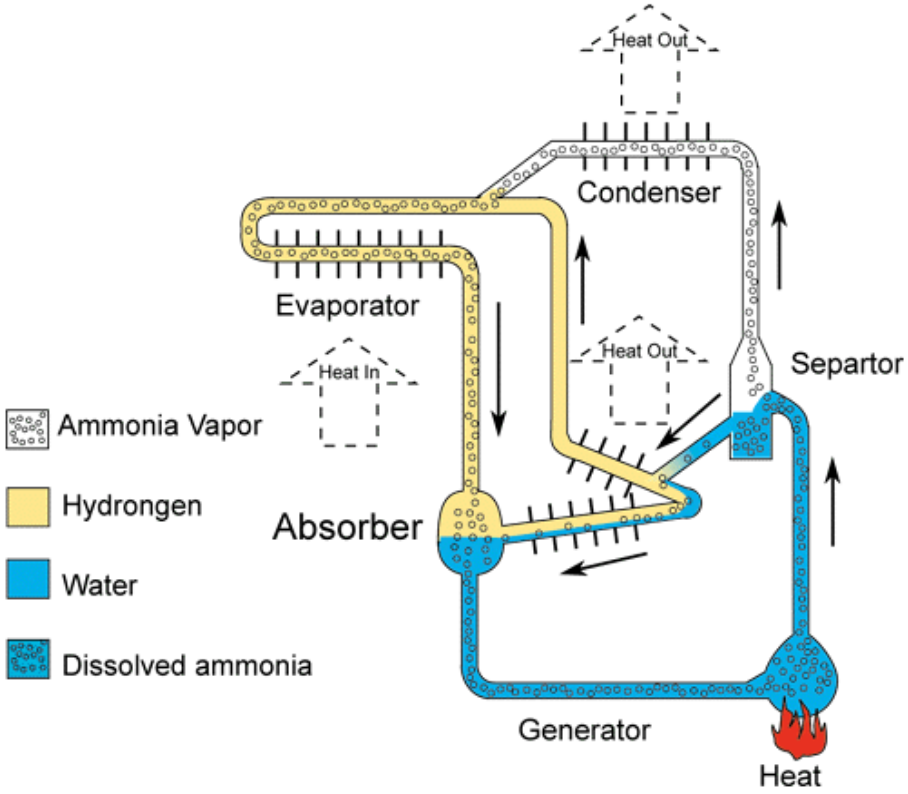
Facts and evidence

The installation instructions are clear that anything in contact with the cooling system would create a fire hazard. This had happened for some time as the cable left a heat transfer image of itself on the tubing. There is a faint “S” curve imprinted on the tubing that matched the bend in the damaged cable.

This a diagram showing the
Basic operation of the recreational vehicle refrigerator.
The refrigerator has a sealed network of tubes and chambers holding water, ammonia and hydrogen gas. A heating source heats a chamber holding a solution of water and ammonia until the liquid boils. The ammonia gas rises to another chamber, the condenser, where it cools back into a liquid. When ammonia encounters hydrogen gas, the chemical reaction between the two absorbs heat. That's how the propane fridge produces its cooling action -- by pulling heat from the interior of the refrigerator into the ammonia-hydrogen mix.



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The damaged cable had a “S” bend that matched the faint heat image on the tubing.

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This fire did not burn hot enough to melt copper, and there was one conductor that had been severed. Here is arcing damage to the conductor. This must have been exposed to the bonded tubing of the refrigerator cooling system.

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Causes and contributing factors	This close up of the severed conductor shows the arcing damage 

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Close-up of the arcing damage and the holes in the tube.

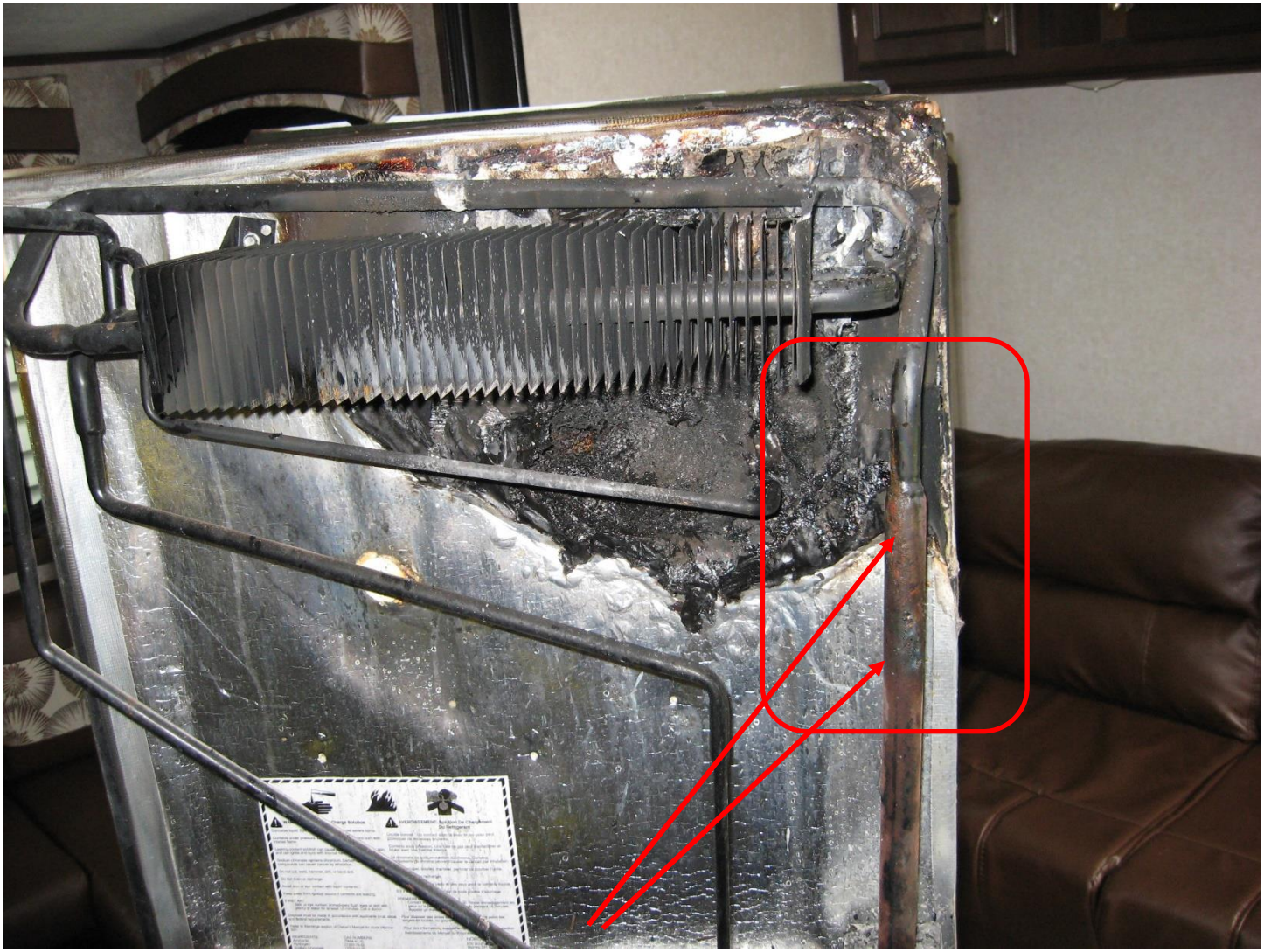
It is very likely that the wiring methods used in the manufacturer of this recreational vehicle contributed to the cable touching the cooling system. The cables were bundled into a single stack rather than spread out over the space beside the fridge. Over time the insulation on the NMD 90 cable would degrade and expose the conductors the bonded tubing causing arcing to occur. This would allow the cooling gasses to vent and ignite due to the high temperature of the electrical arc.

There was no damage to the receptacle or plug for the RV.

This is a picture of the cover for the hot water tank

RV certification Label

This is the data that can be used to find out which factory made the unit



Cover shot of the back of the fridge showing the tubing and the cable “S” image and the arcing damage.