Incident Summary #II-1534829-2023 (#34432) (FINAL)

SUPPORTING INFORMATION	Incident Date		April 13, 2023
	Location		Castlegar
	Regulated industry sector		Gas - Natural gas system
	Impact – Injury	Qty injuries	1
		Injury description	The owner experienced smoke inhalation while extinguishing the fire.
		Injury rating	Minor
	Impact – Damage	Damage description	Fire caused high heat and melting damage to internal wiring, circuit boards and other internal components inside an on-demand water heater. Fire melted the attached venting and combustion air piping attached to the appliance and caused smoke damage to the mechanical room.
		Damage rating	Moderate
	Incident rating		Moderate
	Incident overview		A three-year-old natural gas on-demand water heater used to supply domestic hot water in a residential home had been experiencing operational issues. After service by an apprentice technician, a fire occurred inside the appliance causing damage to internal components and the attached venting and combustion air piping.
INVESTIGATION CONCLUSIONS	Site, system and components		On-demand gas water heaters use high input gas burners to heat water as it flows through the appliance. The combustion products of the gas pass around primary then secondary heat exchanger tubes that transfer the heat to the flowing water contained inside. The flue gasses are then conveyed through a flue gas collector duct to a flue gas piping system that transfers the flue gas safety outdoors. Apprentice gasfitters are required to only do regulated work if they are under the direct supervision of a person specifically authorised to perform that type of work under the Safety Standards Act. Regulated work includes installation, alteration, testing, maintenance, and repair of a regulated product such as a gas fired water heater.
	Failure scenario(s)		The water heater was originally installed in September 2019 by a gas contractor. Two weeks prior to the incident the water heater had been experiencing operational issues. An apprentice technician working for a different gas contractor attended the scene two days prior to the incident to diagnose and repair the issue without the supervision of an authorised person. The technician contacted the manufacturer's technical support for guidance. While following instructions sent by the technical support representative, the technician adjusted the appliance programming and calibration then began disassembling the appliance to gain access to the gas burners for cleaning. Part way through disassembly the technician realized they did not have the required tools to continue the disassembly and decided to forgo the cleaning process and reassembled the appliance. After the unit was reassembled it was tested for operation and returned to service. An internal water leak may have occurred during recent operation of the water heater resulting in scale buildup which restricted the flue passages through the heat exchanger. The scale and additional heat from the restricted heat exchanger resulted in corrosion that created a hole in the rear of the combustion chamber. The hole, which was not visible from the front of the appliance, allowed products of combustion

Incident Summary #II-1534829-2023 (#34432) (FINAL)

	to escape the combustion chamber and burn several non-metallic components including the wiring insulation, control board, the flue gas collector duct, and attached external vent and combustion air piping. The owner smelled smoke and found flames coming out of the water heater. He doused the flames with water to extinguish the fire.
Facts and evidence	Interview Statements: Gas contractor: • The technician that attended the site and worked on the water heater was an apprentice gasfitter and did not hold a gas fitter certificate of qualification, and they were doing regulated work while unsupervised. Technician: • When the appliance was first started, it backfired a few times before it began operating properly. • They called Bosch technical support and were instructed on the reprograming and calibration process. • Technical support sent him video instructions on how to disassemble the unit to gain access to the burners for cleaning. • He removed the gas pipe, gas valve, control board, and water piping but then realised he didn't have the proper screwdriver to continue the disassembly. • He decided to abandon cleaning the burner and see how the adjusted calibration affected the unit. • He reassembled the unit, ran hot water to test its operation and returned it to service. Owner: • He was in bed on the evening of the incident when he and his partner smelled smoke. He went to downstairs to the mechanical room and witnessed smoke and flames shooting out of the water heater vent and combustion air openings. • He doused the flames with water to extinguish the fire. • He experienced smoke inhalation when extinguishing the fire and received medical attention. • The hot water had been running for a bath and for the dishwasher prior to the fire. • The water heater had not been working right for the past two weeks and causing temperature swings in the water, shutdowns and restarts, and loud squealing noises while operating. • He contracted the gas contractor to diagnose and repair the heater. • The technician removed many internal components attempting to inspect and clean the burners but reassembled them when he realised, he did not have the correct tools to continue. • The technician informed him to monitor the heater after it was returned to service to see if the reprogramming and calibration corrected the water heater operation. Site examination: • Original installation of the water heater only had one observable deficiency, a a slightly undersized gas appliance connector which would have restricted the gas flow at the appliances maximum rated input. • The room the water heater was installed in had no visible direct fire damage but had smoke damage.

Incident Summary #II-1534829-2023 (#34432) (FINAL)

	• Significant fire damage was observed to the connected PVC venting and combustion air piping which were melted to the point they were mostly detached from the appliance. • The water heaters internal wiring and control board was damaged and melted by the fire. Appliance disassembly and examination: • The appliance was taken to a facility to be disassembled and examined by investigators. • The primary heat exchange showed signs of corrosion and scale buildup on the tube fins which would restrict the flow of flue gasses though them. • In the area of the restriction there was a hole in the back of the combustion chamber that was not evident from the front of the appliance. • The area of the hole was covered by the appliance flue gas collector duct which conveys the flue gasses from the bottom of the appliance after the heat exchangers, to the flue gas connection outlet at the top of the appliance. • The flue gas collector duct is made of a fibrous composite material that was damaged and deteriorated originating from the area the hot combustion products would have exited the hole in the combustion chamber. • The corrosion on the heat exchanger fins and combustion chamber suggest water may have been present inside the combustion chamber from a possible leak from one of the heat exchanger tubes. • The stainless-steel secondary heat exchanger tubes did not show any signs of corrosion or restriction.
Causes and contributing factors	The restriction of the heat exchanger passages from a possible internal water leak caused overheating, corrosion, and created a hole in the back of the appliance's combustion chamber. The hole allowed high temperature combustion products to escape the combustion chamber which in turn resulted in the internal damage and fire. The unsupervised, apprentice technician returning the unit to service without being able to complete the disassembly and confirm it would operate safely, was a contributing factor to the incident.

Image 1 – On-demand water heater installed in the mechanical room.

Image 2 – Fire damaged venting and combustion air PVC piping.

Image 3 – Heat and fire damaged internal components inside the water heater.

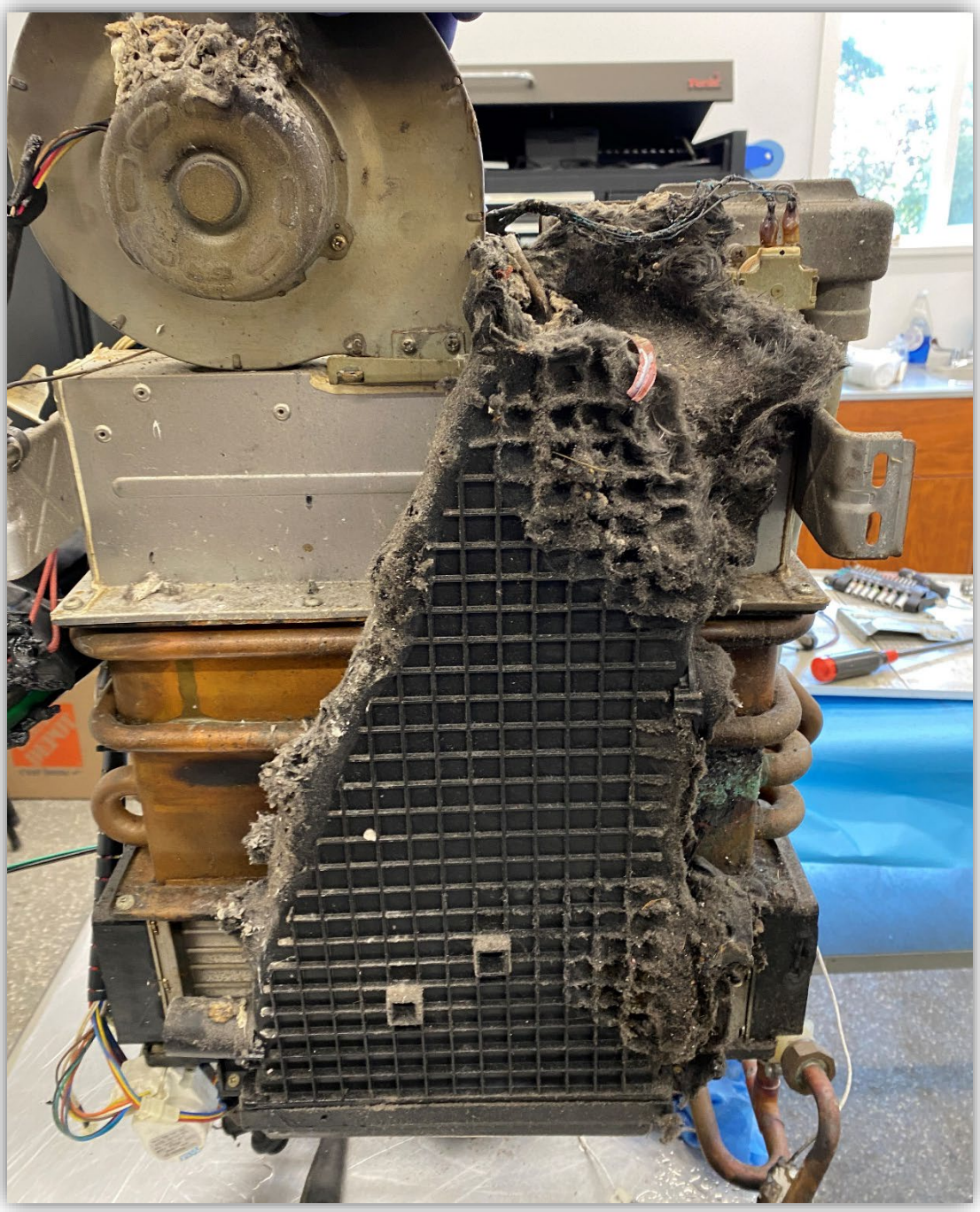

Image 4 – Damaged composite flue gas collector duct at rear of appliance after removal from appliance case.

Image 5 – Damaged flue gas collector duct and rear of combustion chamber.

Image 6 – Closeup of damage and hole in the combustion chamber.

Image 7 – Damaged composite flue gas collector duct.

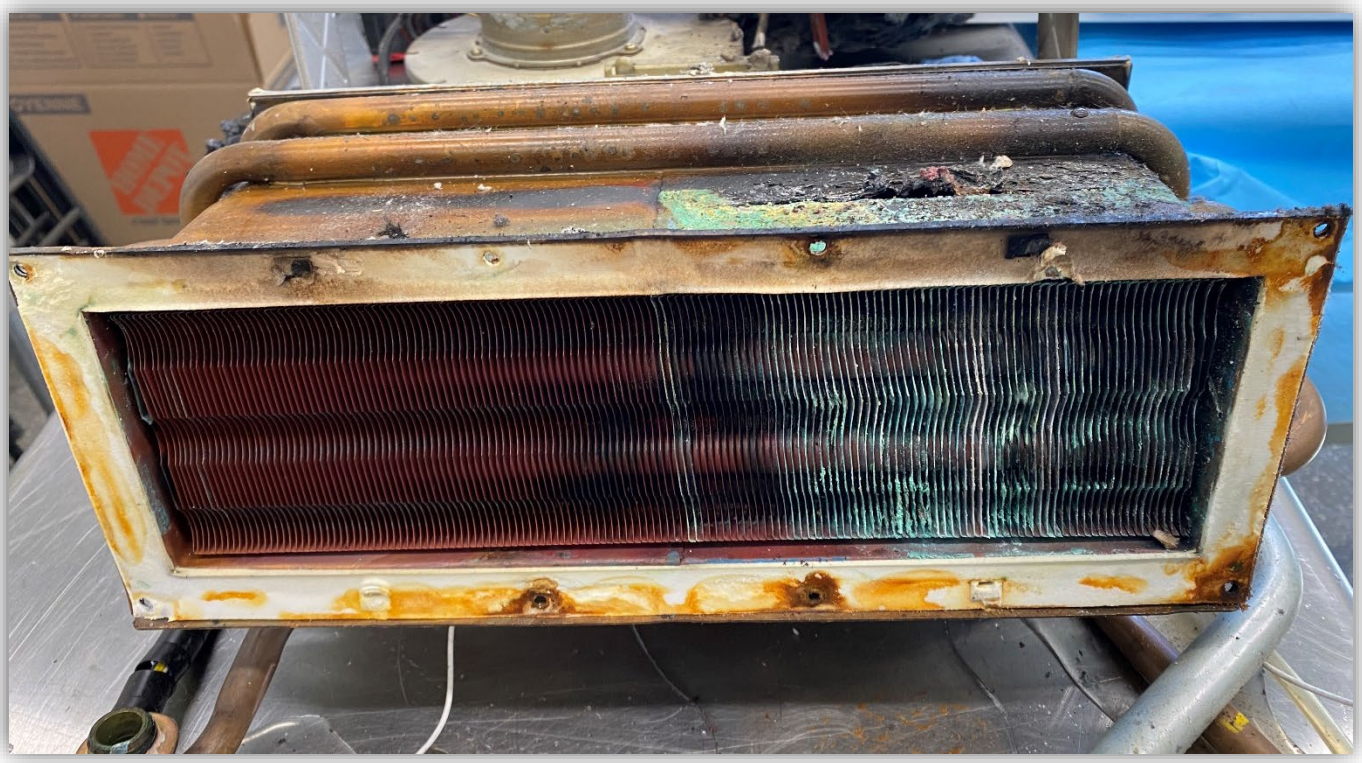

Image 8 – Combustion chamber with primary heat exchanger finned tubing.

Image 9 – Corrosion and scale buildup on the internal primary heat exchanger tube fins restricting flue gas flow.

Image 10 – Primary heat exchange tubes with light shining through the hole in the combustion chamber.