

Incident Summary #II-1655748-2024 (#42919) (FINAL)

SUPPORTING INFORMATION	Incident Date	December 21, 2023	
	Location	Penticton, BC	
	Regulated industry sector	Gas - Natural gas system	
	Impact	Qty injuries	0
		Injury description	N/A
		Injury rating	None
	Damage	Damage description	Melted boiler controls, Melted insulation on adjoining piping
		Damage rating	Minor
	Incident rating	Minor	
Incident overview	An atmospheric boiler overheated causing it to overheat and melt its controls and the insulation on the piping connected to it.		
INVESTIGATION CONCLUSIONS	Site, system and components	<p>When a boiler receives a call for heat it begins an ignition sequence where gas is supplied to burners through a metering orifice in an open-air venturi where it is entrained with air and burnt. The products of combustion pass over a collection of tightly interconnected, finned pipes called a heat exchanger. This flow of hot products of combustion heats the heating medium within to provide space or process heating down the line. The products of combustion then exit the boiler and building through the venting system. This flow of products of combustion over the heat exchanger and out the venting system maintains a constant temperature in the boiler, keeping it from overheating. Over time initial start up of the boiler can cause products of combustion to accumulate on the boiler in the form of soot which can cause blockages of the fins on the heat exchanger. Regular annual inspection and servicing of boilers should be performed on all heating equipment to identify areas of blockage on the heat exchangers and when blockages are identified boilers are often stripped and cleaned to remove these blockages and ensure longevity of the boiler.</p>	
	Failure scenario(s)	<ul style="list-style-type: none"> • Due to a lack of maintenance the heat exchanger in the boiler became plugged with soot. Upon ignition a flame rollout condition occurred, and flames spilled from the combustion chamber igniting gas at a burner orifice on the right side of the boiler, sending flame rolling up underneath the control panel, melting the ignition control box. • The flames became trapped in a void space in the sheet metal of the boiler causing the side of the boiler to become red hot, pyrolyzing and melting the insulation next to the boiler causing it to smoke. • A custodian onsite noticed the smell and presence of smoke in the building. • At roughly 9:30 pm the fire department was called. • The fire department arrived on scene and found flames exiting the boiler, contained only to the piece of equipment. • A fire fighter turned off the gas to the boiler and the flames gradually dulled and went out. 	

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Facts and evidence	<ul style="list-style-type: none">• Fire personnel noted that flames were seen exiting the front of the boiler.• Hot spots were found on the front and side of the boiler, these hot spots aligned directly with areas where the controls and insulation were melted as well as the burner orifice and venturi. Although no direct sign of burning could be found on the burner tray or connected piping.• The interior of the boiler and venting system was very sooty, which is consistent with poor combustion caused by blockage of the heat exchanger.• Metallizing surfaces on rear of the burner tray which hold the burners in place were deformed and, in some areas, destroyed by heat, indicating that these surfaces were subjected to abnormally high temperatures.• Assessment of the combustion chamber found that roughly 75% of the heat exchanger was completely blocked with soot.• At the time of assessment, a second boiler which was disconnected from the gas supply and de-energized was found showing the same signs of lack of maintenance.• An interview with the past building maintenance contractors indicated that the boiler had not been stripped and cleaned in the past five years.
Causes and contributing factors	It is highly probable that a lack of maintenance to the boiler's heat exchanger allowed the boiler's heat exchanger to soot up, causing flames to roll out of the combustion chamber.



Image 1 - Scene when Safety Officer arrived on site. Arrow indicates hot spot found on side of boiler.

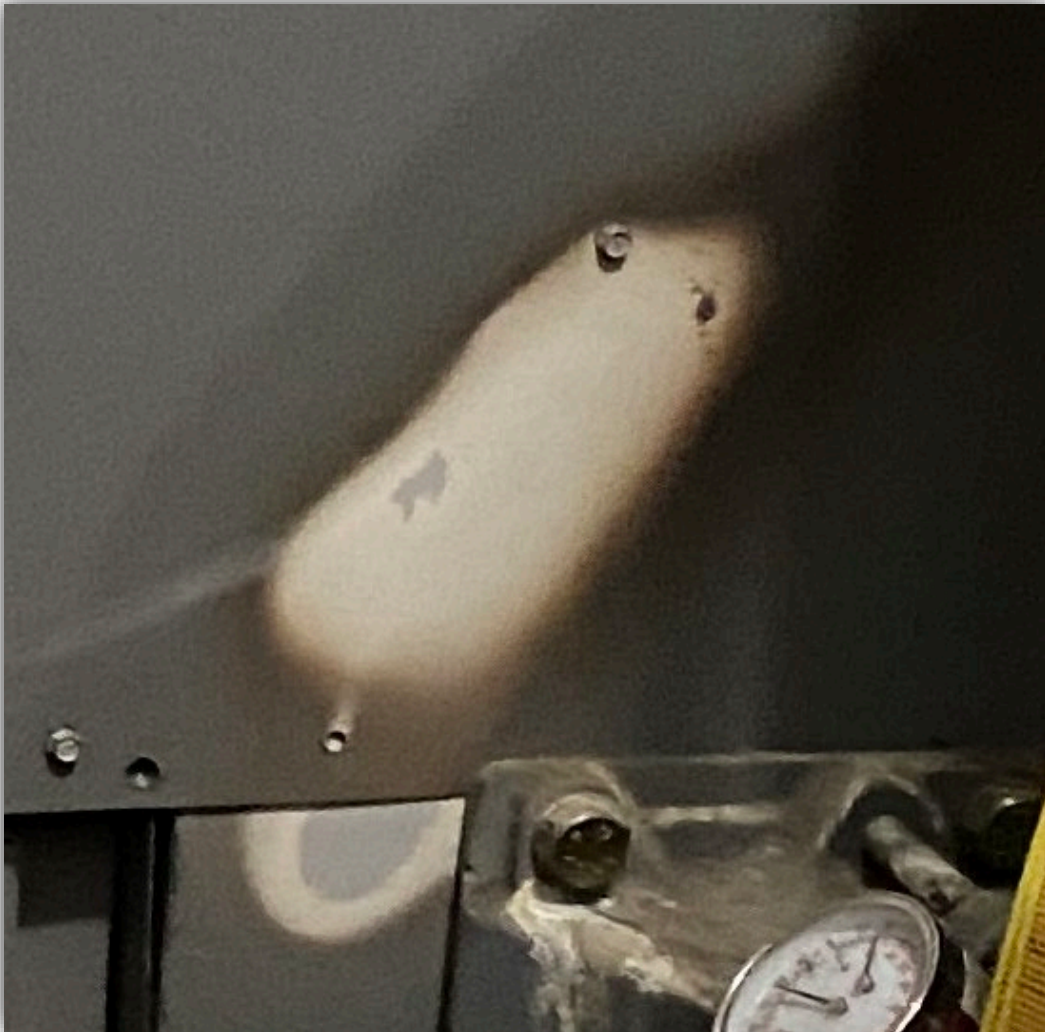


Image 2 – Close up of hot spot on the side of the boiler where flames became trapped in boiler sheet metal.

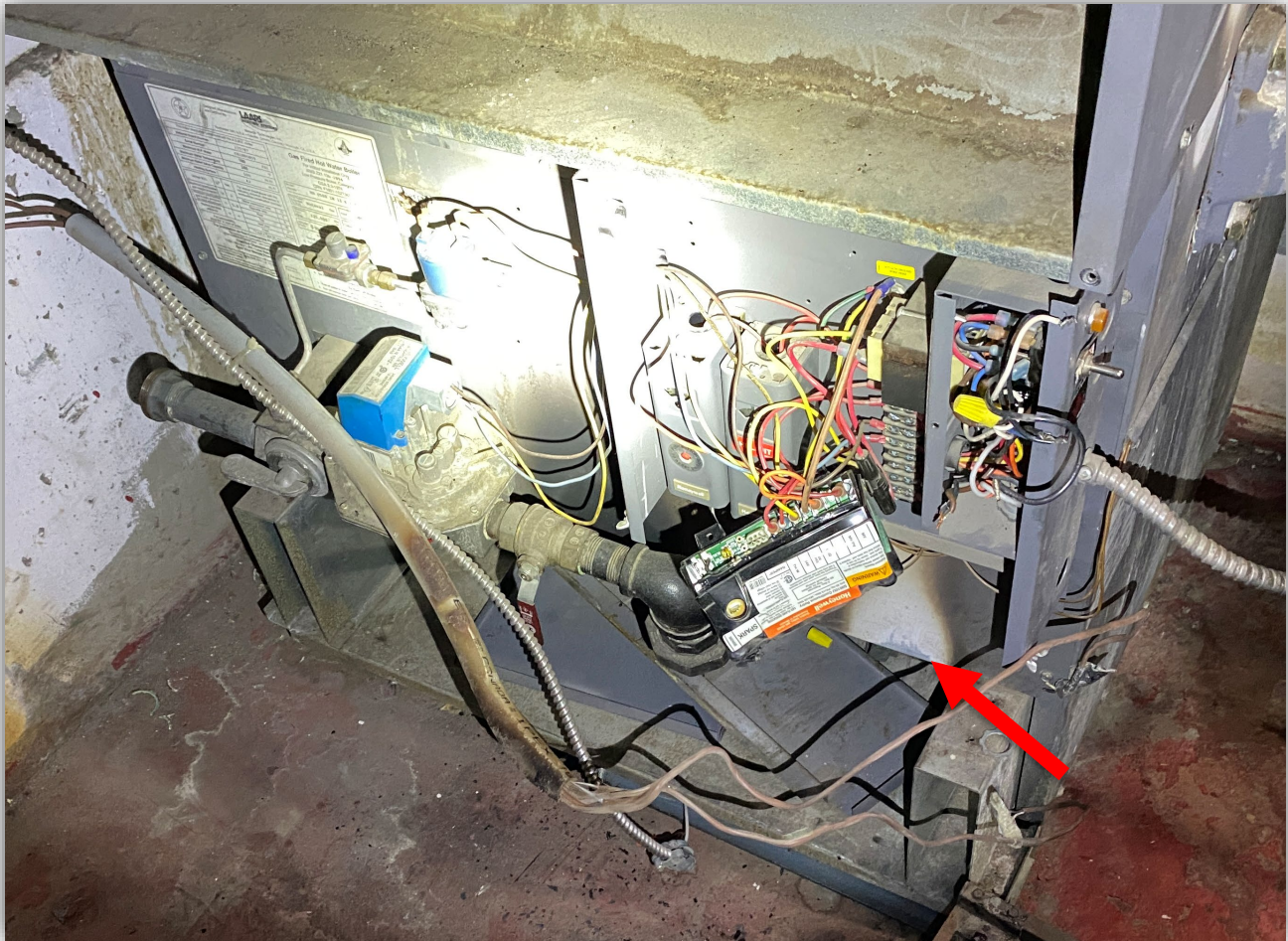


Image 3 - Front of boiler at time of investigation. Arrow indicates area where flames were found exiting the boiler.



Image 4 - Boiler gas valve and combustion chamber at time of investigation. **[A]** Area where flame rollout was occurring. **[B]** Area where flames were seen exiting boiler.



Image 5 - Boiler combustion chamber showing burn path where flames were found exiting the boiler.

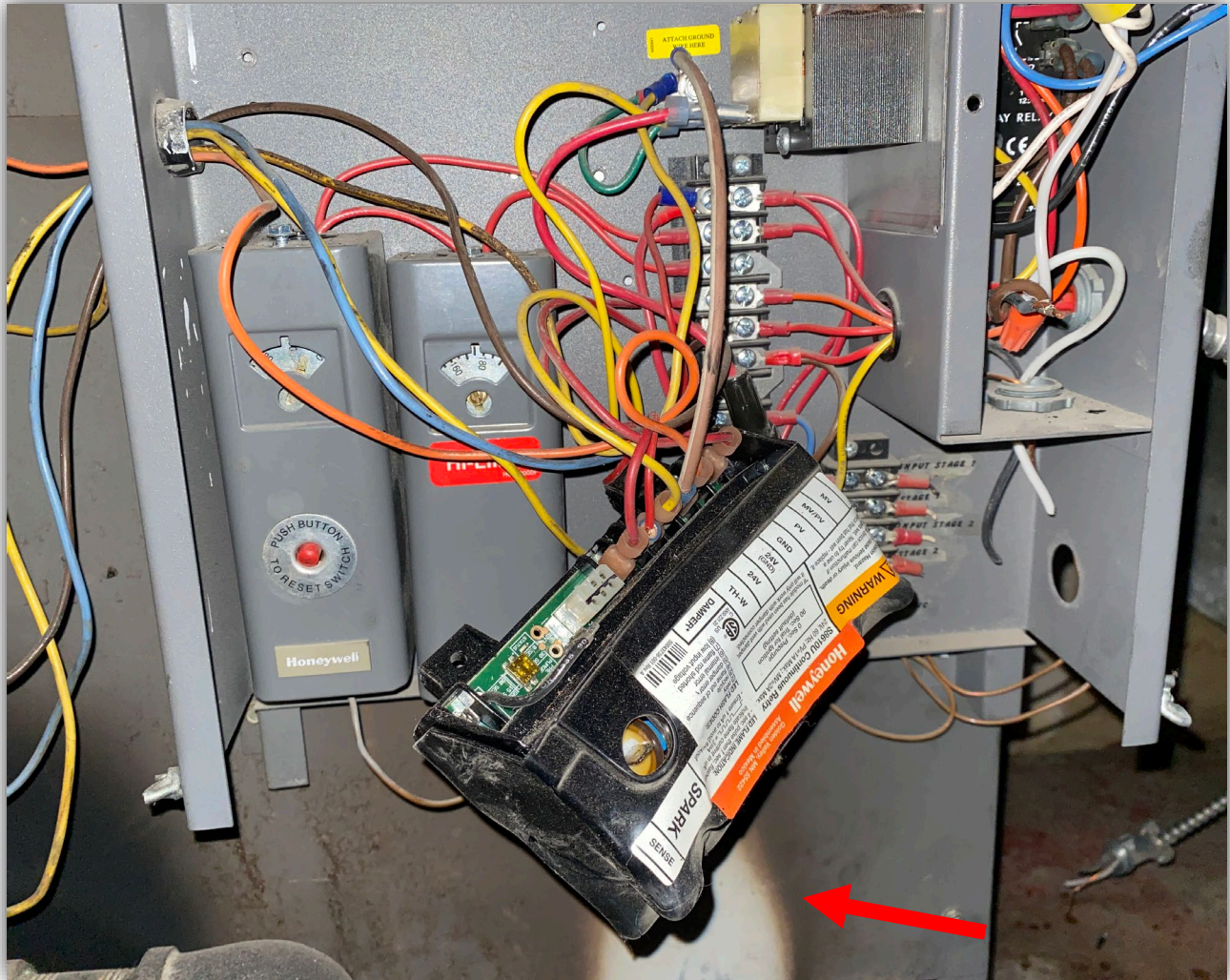


Image 6 - Melted ignition control box, arrow indicates where flames were exiting boiler travelling behind control panel.

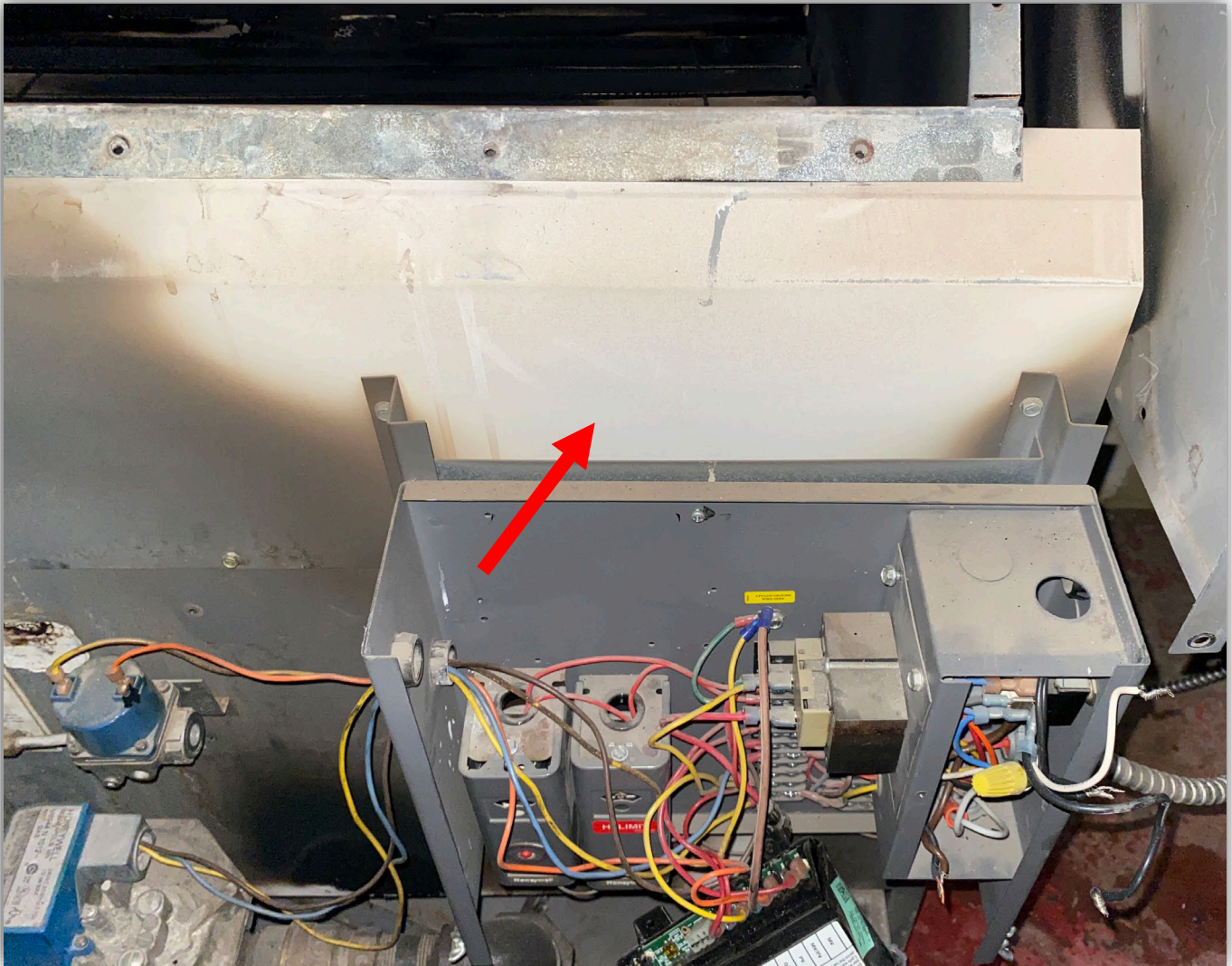


Image 7 - Top side of control panel, arrow indicates where flames came up behind control panel and became trapped in boiler sheet metal.



Image 8 - Boiler burner tray showing sooting from poor combustion. Arrow indicates burner orifice where flames exiting the boiler are believed to have come from.

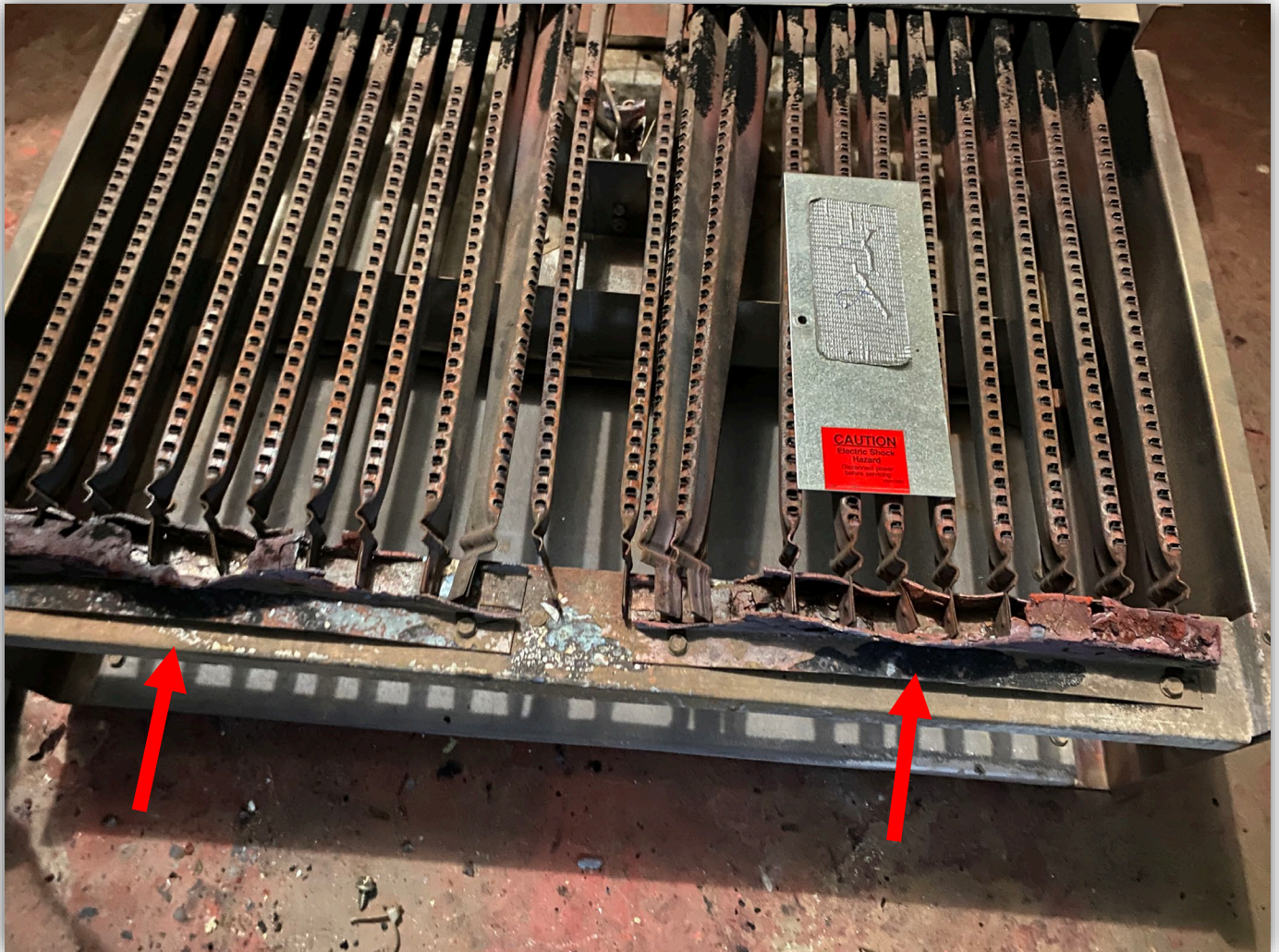


Image 9 - Interior side of burner tray. Arrows indicate where metal was deformed and destroyed by extreme heat within the combustion chamber. *Note: Burner tray was removed from appliance before investigation so burners may not be in the same orientation as when the incident occurred.*



Image 10 - Underside of heat exchanger showing visible sooting and plugging.

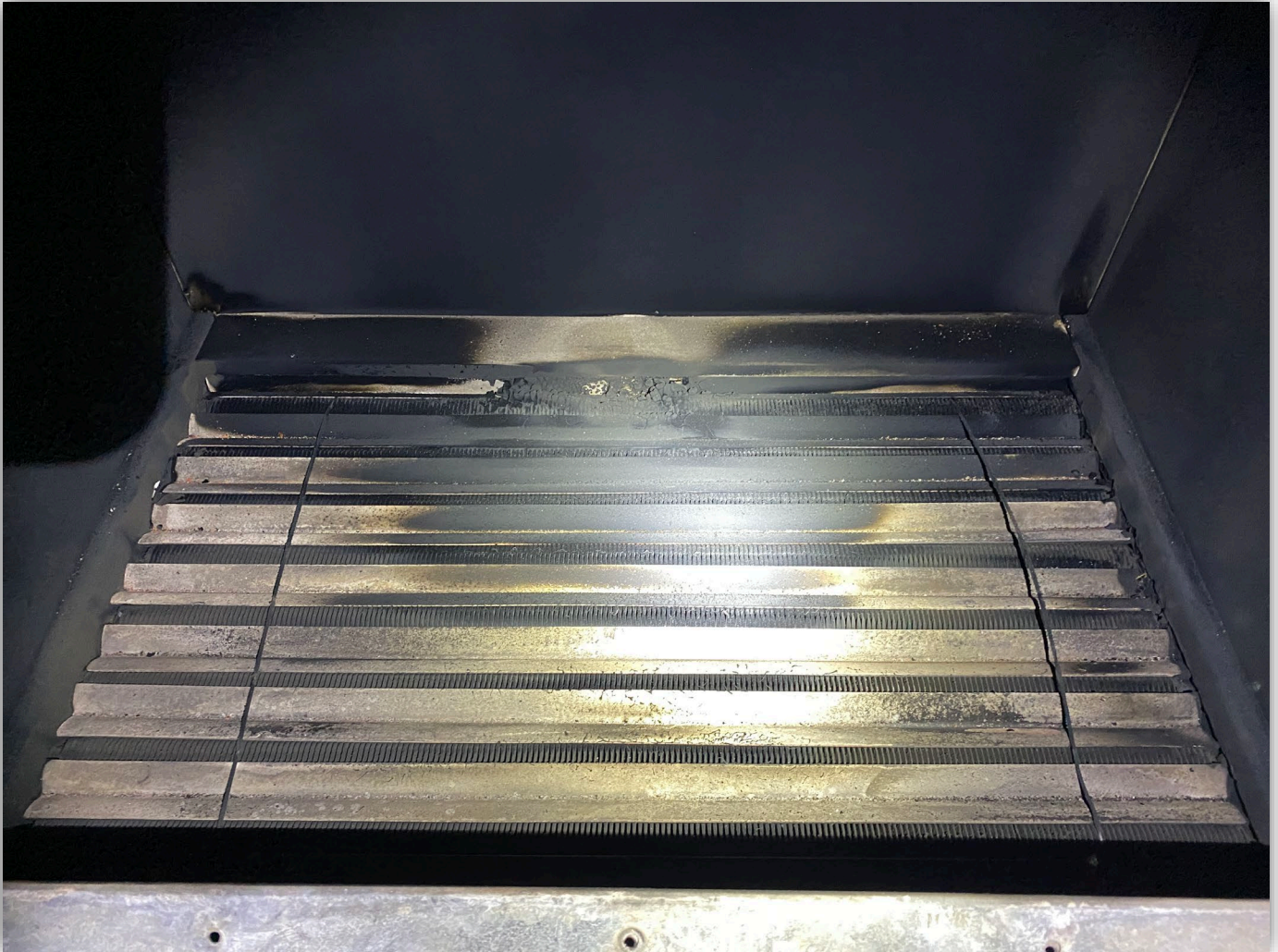


Image 11 - Top side of heat exchanger showing visible accumulations of soot causing plugging of the heat exchanger.



Image 12 - Boiler breeching where vent connects to the boiler showing signs of heavy sooting due to poor combustion.



Image 13 - Interior of boiler venting showing heavy sooting due to poor combustion.



Image 14 - Boiler piping insulation, melted from heat radiated by hot spots on boiler sheet metal.



Image 15 - Boiler piping insulation melted by heat radiated from hot spots on boiler sheet metal.