Incident Summary (5613497 #) Final

SUPPORTING INFORMATION	Incident Date			*March 10th, 2017*
	Location			*2 Townhouses in the same complex in Abbotsford B.C*
	Regulated industry sector			*Natural Gas*
	Impact	Injury	Qty injuries	*1*
			Injury description	*Elderly woman started to feel the effects of exposure to carbon monoxide and was taken to hospital for minor treatment (Put on oxygen). Occupants in another suite also noticed unusual odour from boiler room.*
			Injury rating	*Minor*
		Damage	Damage description	*No damage to equipment*
			Damage rating	*None*
	Incident rating			*Minor*
	Incident overview			*Two residential boilers produced higher than normal levels of carbon monoxide that began to spill into the living area of the homes, through open boiler room doors. Occupants felt the negative effects of exposure to carbon monoxide (slight headaches, uncomfortable feelings). Carbon monoxide is odorless, however the other by products of incomplete combustion can be noticed by sense of smell.* *Utilities were called to respond and upon arrival reported a reading of 127 parts per million carbon monoxide in the living areas.*
INVESTIGATION CONCLUSIONS	Site, system and components			*Townhouses in this complex use boilers to heat water to feed in floor slab heating throughout the rooms. The piping installed in these homes 25+ years ago, is called "polybutylene" a grey coloured plastic piping that is no longer used in this application today.* *These types of boilers are referred to as either atmospheric or natural draft appliances because they do not use fans or blowers to assist in the combustion or venting process. They rely on set gas pressures flowing through a manifold which simultaneously draw in air to achieve combustion. The difference in pressure between the combustion chamber and venting creates a draft and the products of combustion (flue gases) make their way through the venting system and to the outdoors safely.* *Boilers of this type are designed to operate at a certain temperature (typically 180 degrees Fahrenheit). If the water is maintained at this temperature, than the flue gases will also achieve the designed temperature (212 degrees Fahrenheit minimum) and ensure that the moisture in the flue gases are boiled and stay in a gaseous state until they reach the outdoors where steam is sometimes visible leaving the chimneys. The appliances have mechanical controls that can be adjusted and are sensing the water temperatures at all times.* *If for various reasons the flue gases drop in temperature, moisture will begin to condense into water droplets inside the venting system and can also accumulate on the boiler coil.*
	Failure scenario(s)			- *100,000 BTU residential style boilers were operating below the required design temperature (180F supply temp, 135F return temp. minimum.)*

		- *This led to the flue gases not reaching high enough temperature and moisture in flue beginning to condense.* - *Over a period of time dissolved solids began to accumulate within the fins of the coil causing increased restriction of the flue gases.* - *Flue gases could no longer make their way through the coil and up the venting system.* - *Flue gases started to spill from the combustion chamber (directly below coil) into the boiler rooms and living spaces.*
	Facts and evidence	- *Checked temperature gauges on boilers and witnessed operating temperatures of water in boiler loops. Found 1 boiler gauge displaying a temperature of 150F and the other displaying 142F leaving water temperature. . Infra-red thermometer was used to double check temperatures leaving boilers, found to be close to gauge read outs (147F and 158F)* - *Noticed 1 of the boilers was "short-cycling" (too short of a burner run time to achieve efficiencies and proper loop temperature.)* - *water leaving at approximately 150F and flowing through in floor piping grid exchanges heat from the water to the concrete slab and room and returns to the boiler 20-30 degrees lower , causing condensation of flue products.* - *Atmospheric/ natural draft boiler piping loops are typically installed in a manner that allows for the 180F water temperature to be maintained through the boiler. Engineered drawings and specifications must also be followed. These boilers were piped and set up in a manner that did not guarantee proper minimum water temperatures returning to boiler.* - *An interview with a gas fitter who serviced one of the boilers about 5 months before the incident occurred showed that a lack of knowledge on how these systems operate as well as proper servicing procedures and techniques probably played a major role in this particular incident. The coil was not inspected and cleaned at the time of servicing and led to an excessive amount of solids accumulating within the fins of the coil.* - *Occupants had boilers serviced and cleaned immediately after the incidents happened. They reported seeing the technicians brushing and vacuuming large amounts of white powdery substance from boiler coils. This typically points to the solids left behind from condensation.*
	Causes and contributing factors	*These types of boilers are 25-30 years old and require regular servicing, maintenance and calibration/checking of mechanical temperature controllers and settings. Differential can be adjusted to reduce short cycling of burners and accuracy of set-points must be confirmed.*

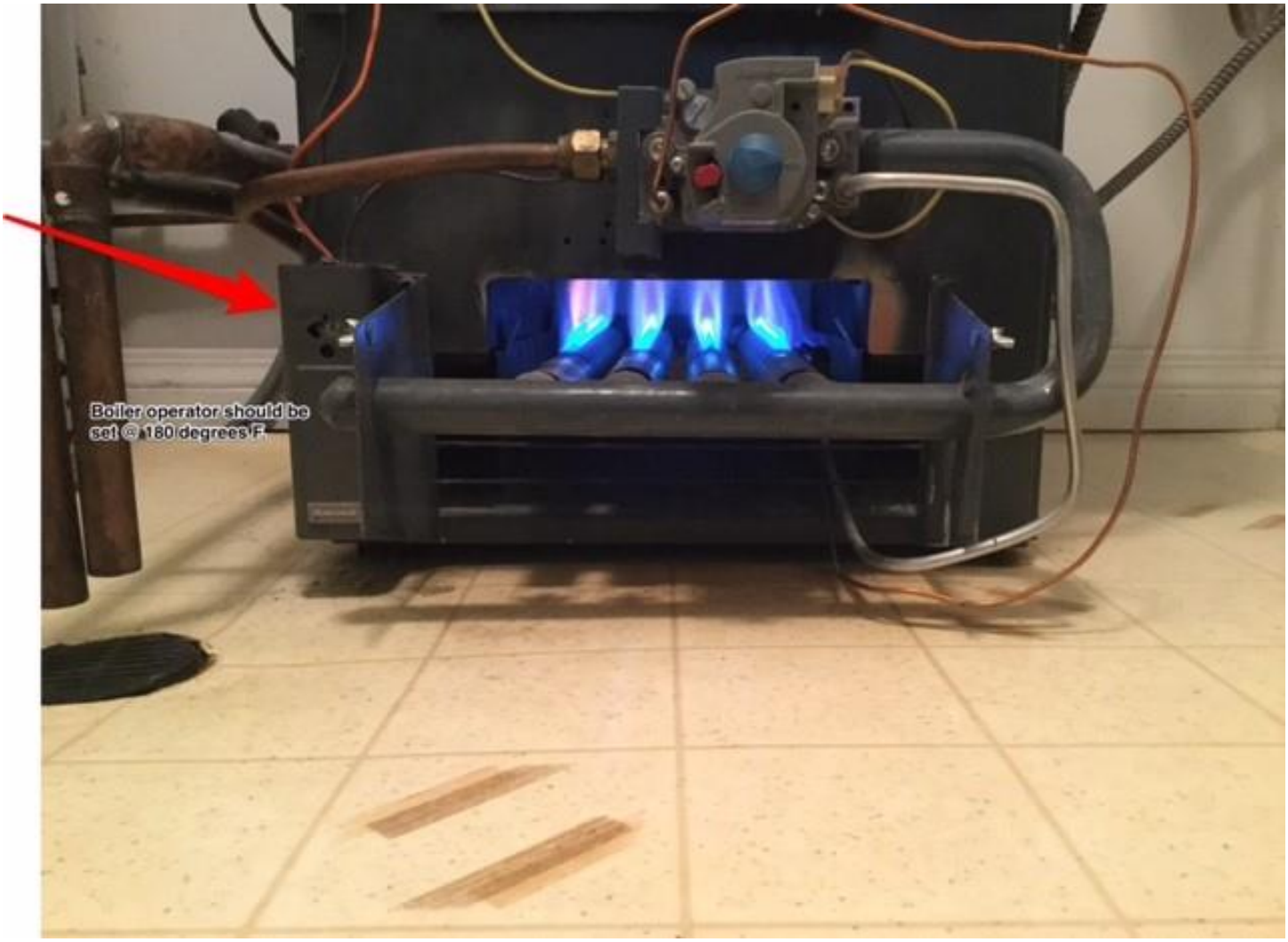
		It is likely that the controls on these boilers may no longer be accurately cycling the boilers to maintain the correct temperatures. The incorrect piping configurations of these systems will also make it very difficult for the loops to maintain the correct design temperature to avoid condensing. *It is also likely that the temperature controllers were left set below 180F because in floor slabs and piping cannot handle these high temperatures. Radiant in-floor system design temperatures can vary dependant on the equipment involved, therefore these systems are to be designed and installed to not effect or alter the boiler manufacturer's design, installation and operating requirements.*

Front of the townhouse complex where one of the incidents occurred.

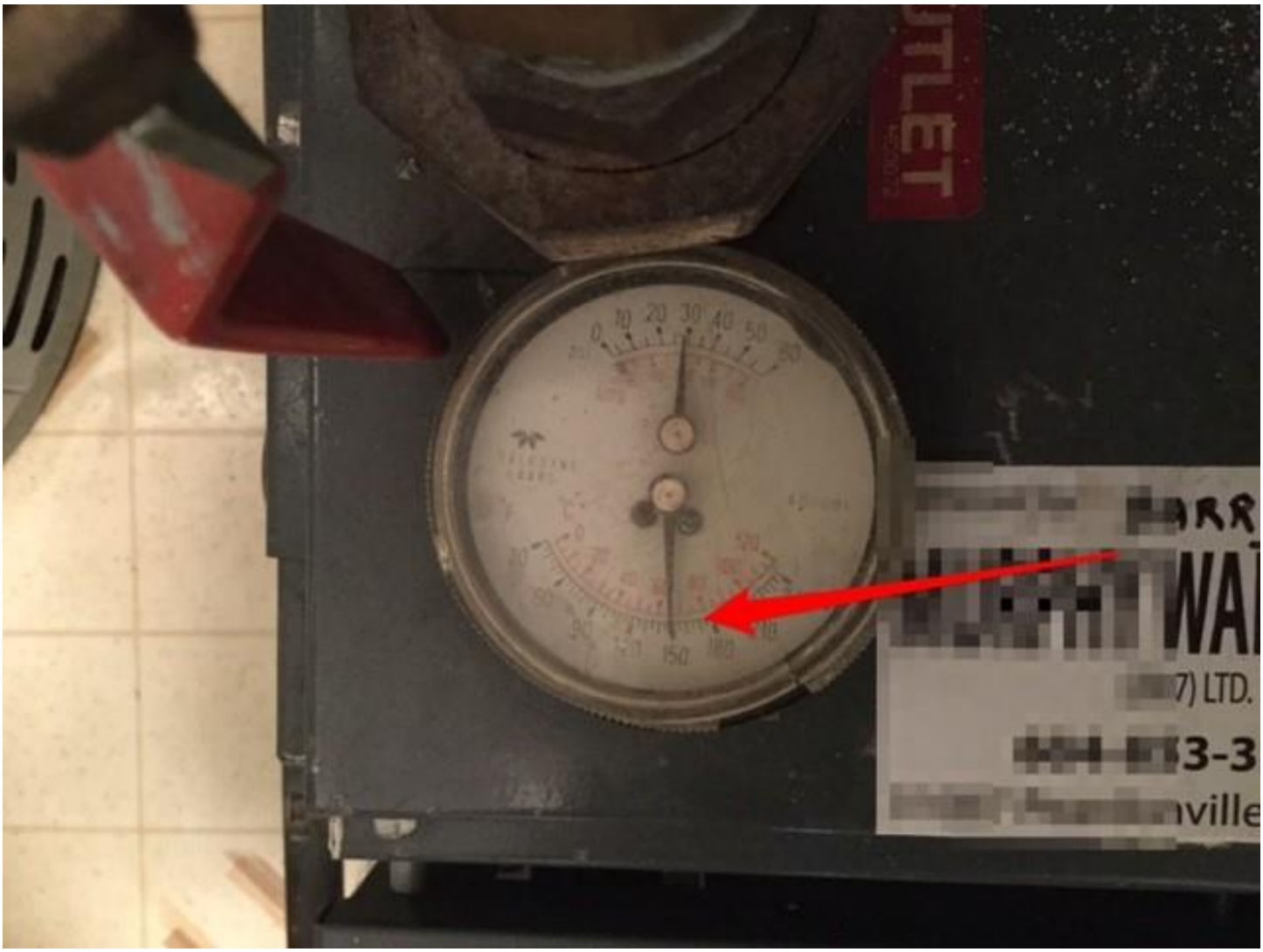
Boiler room/ Laundry room in townhouse unit.

Boiler room and correct venting arrangement.

View of the burners and combustion chamber. Note the arrow pointing to the temperature controller that must be set correctly.



Temperature gauge mounted in well on top of boiler. Note the water temperature at the outlet side of the boiler is around 150F.



In this picture, looking down at top of boiler. Vent is removed for inspection. You can see the coil, fins for heat transfer and the white residue in between fins and on top panel of boiler.