Incident Summary #II-970401-2020 (#16429) (FINAL)

SUPPORTING INFORMATION	Incident Date		January 22, 2020
	Location		Surrey
	Regulated industry sector		Gas - Natural gas system
	Impact – Injury	Qty injuries	0
		Injury description	NA
		Injury rating	None
	Impact – Damage	Damage description	An explosion blew the doors and vent stack off of a gas fired rooftop appliance. The explosion resulted in a large uncontrolled release of natural gas outdoors.
		Damage rating	Major
	Incident rating		Major
	Incident overview		A natural gas fired make-up air appliance installed on the rooftop of a strip mall experienced a failure that resulted in an explosion within the appliance. The explosion damaged the appliance and caused a large release of natural gas outdoors that resulted in the area and adjacent businesses to be evacuated.
INVESTIGATION CONCLUSIONS	Site, system and components		A make-up air appliance is designed to be installed on buildings where exhaust fans are utilised. As an exhaust fan removes air from the building space, a make-up air appliance uses a blower fan to replace the same amount of air so the ambient pressure in the building remains balanced. An indirect gas fired make-up air unit uses the heat from gas combustion to warm the air being replaced into the building. It warms the air through the use of a heat exchanger which allows the products of combustion to exit safety to the outdoors and not enter the airstream to the building. These appliances are not used to heat the space but to temper the incoming air so as not to cool the space when outdoor temperatures are low. When the appliance involved in the incident receives a call for heat from the thermostat, the control board opens the pilot gas valve and energises the electronic ignitor. Once the pilot burner ignites, a flame sensor detects the flame and allows the control board to open the main gas valve. The pilot valve is positioned to ignite the gas as it exits the main gas burners. Clean burners allow the flame to smoothly transfer across the burners igniting all of the released gas. Appliance manufactures outline required inspection and maintenance procedures in their installation and service manuals to allow for the safe operation of the appliance throughout its lifecycle.

Failure scenario(s)	A natural gas fired make-up air appliance was installed on the rooftop of a strip mall for a small restaurant's exhaust system. Inspection and servicing of the appliance by qualified individuals had not been done at the manufacturer's required intervals. The seals around the ducting and venting had deteriorated allowing water to enter through the top of the appliance cabinet. This contributed to accelerated corrosion of the internal surfaces and components of the appliance **(Image #2)** and allowed debris from corrosion to accumulated on top of the appliances gas burners **(Image #3)**. When the appliance began an ignition sequence, the pilot light lit, but when the main gas valve opened, the gas burners did not immediately light off from the pilot and unburnt gas was able to accumulate inside the appliance. The unburnt gas eventually found an ignition source from the pilot light and ignited. The ignition caused an explosion which blew the vent cap and side doors off the appliance **(Image #1)** and also damaged the gas system which resulted in a large uncontrolled release of natural gas on the rooftop. The leaking natural gas was detected by its odour and first responders were called to the scene who evacuated the area and adjacent businesses. The leak continued until a gas utility technician was able to isolate the leak and stop the flow of gas.
Facts and evidence	The property manager for the complex stated that the property management company is responsible for the repair and maintenance of only the general heating ventilation and air conditioning (HVAC) equipment for the complex. The lease agreement specifies that the tenants are responsible for the repair and maintenance of HVAC equipment that is provided exclusively for the benefit of the premises. This includes the restaurants rooftop make-up air unit. The restaurant owner stated that they have been a tenant in the building since 2000-2001 and were aware of their responsibility to repair and maintain the make-up air unit for their restaurant. They had hired a qualified contractor a few years prior to repair it when it quit working. The contractor informed them the appliance was "pretty beat up" and should be serviced." The owner was not informed by the contractor of any potential hazards or specific technical issues with the appliance and the contractor allowed for its continued operation after the repair. The owner did not hire any qualified contractors to perform regular service on the appliance but only to repair it when it quit working and stated that the cost of regular service was too high. The owner instead payed a friend cash to replace the fan belt and air filters on the appliance. The friend was not a qualified technician and did not inspect, adjust or maintain any of the gas system components within the appliance. The contractor who had repaired the appliance for the owner a few years prior, stated that the owner had already purchased the part required to repair the appliance from a supplier to save money and only hired them to install it. The contractor did inform the owner the appliance was old and in disrepair but did not identify any potential hazards or specific repairs that needed to be done before the appliance could continue operating. The contractor had done other work in the past on the owners refrigeration system but due to difficulties collecting payment, hadn't done any work for them since. The gas utility technician stated that he was called to the site in the morning for an odour of gas call. He found the dial on the gas meter for the restaurant "spinning wildly" indicating a leak in the system. After shutting off the valve at the meter he tested for gas inside the restaurant but found none. When he went on the roof he observed the vent cap and doors where blown off the makeup air unit. While on the

	roof he shut off the gas valve to the appliance and then returned to the gas meter. When he turned the gas back on, the dial on the gas meter no longer spun identifying the gas leak had been isolated and had been occurring from the gas system on the appliance. Another gas technician was hired by the property management company to inspect the appliance after the incident. The technician stated that he observed the appliance as being “ridiculously neglected”. Pictures show a recent attempt to re-seal the leaking duct connections and vent collar with weatherproof tape and silicone **(Image #1)** The gas pressure regulator that was installed just outside of the appliance was removed and disassembled for examination. A significant amount of debris from corrosion was found on top of the regulator diaphragm. **(Images 5-6)** The installation and service manual for the appliance states: • The appliance is a weatherproof duct furnace designed for outdoor installation and can be used for make-up air systems • All duct connections MUST be weathertight to prevent rain and snow from entering • The serial number of the appliance identifies its manufacture date of 1995 • Servicing of the appliance must be done by a qualified installation and service agency • The maintenance instructions in the manual must be followed to provide safe operation • General maintenance service must be done annually • The gas burners and orifices must be kept clean from dust, dirt and foreign matter • The manufacturer will void their warranty if the appliance is subject to negligence contrary to their printed instructions The CSA B149.1-15 Natural gas and propane installation code states that a qualified individual who services or repairs a gas appliance (Installer) is responsible to ensure, before they leave, that the appliance is in safe working order and they have instructed the user of its safe and correct operation. (4.3.1,4.3.2)
Causes and contributing factors	It is very likely that the owner not hiring a qualified contractor to perform the required service and maintenance on their appliance was the cause of the incident. The lack of service and maintenance allowed debris from corrosion to accumulate on top of the burners. This allowed unburnt gas to collect inside the appliance leading to the explosion. It is possible that the contractor not informing the owner of the potential hazards associated with not maintaining and servicing their appliance may have been a contributing factor.

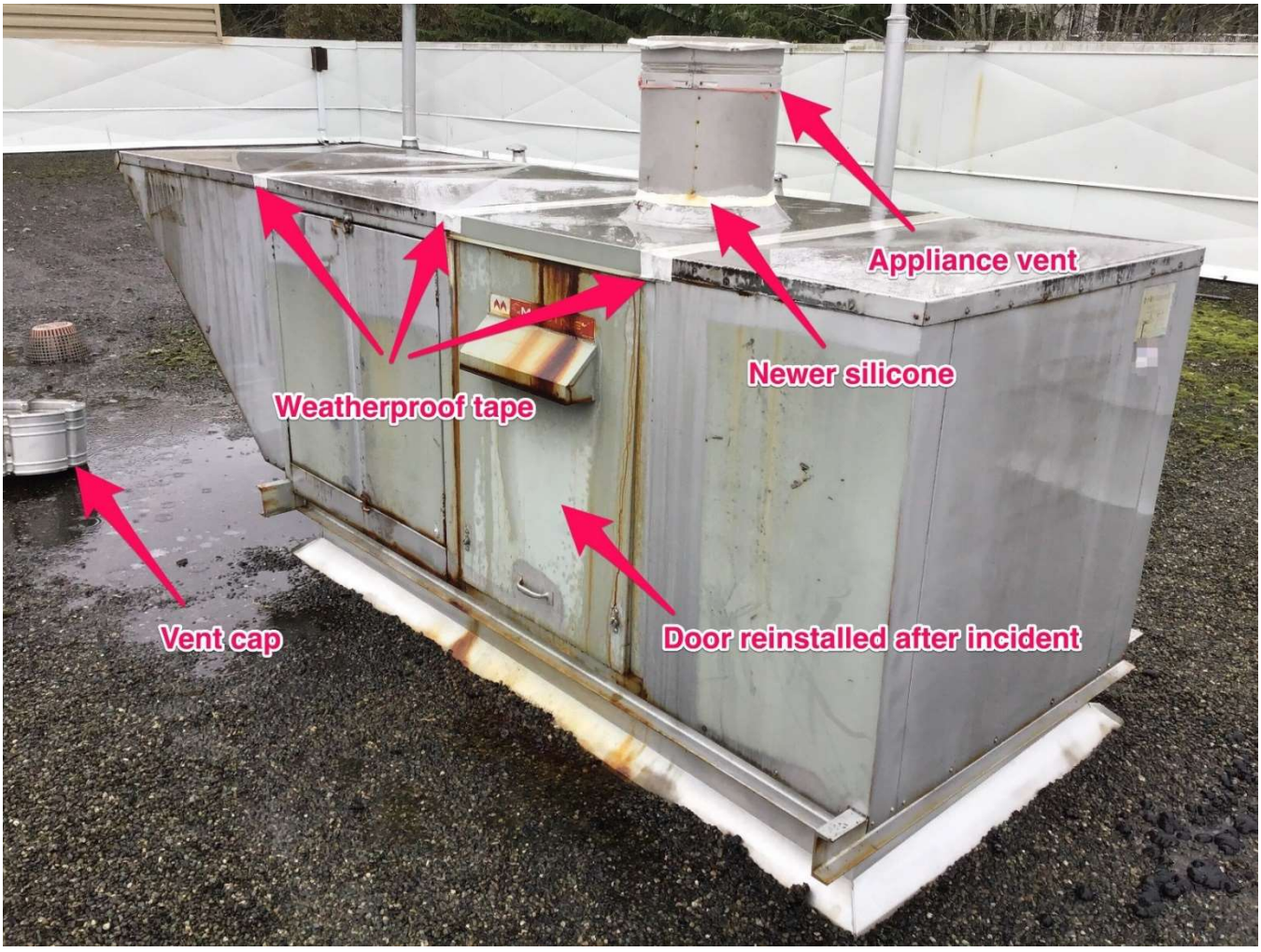

Image #1 Rooftop make-up air appliance showing weatherproofing efforts and location of vent cap after explosion

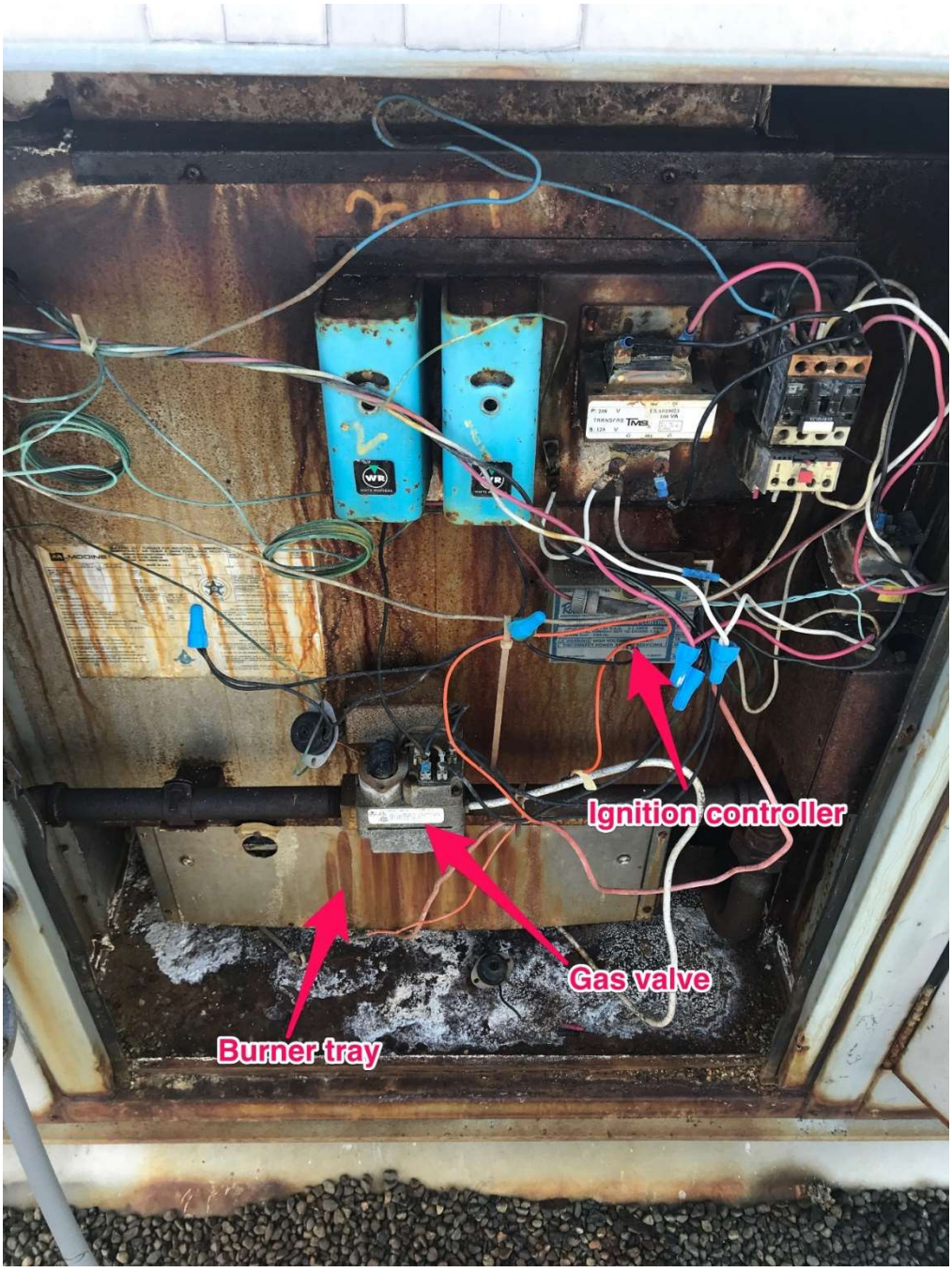

Image #2 Control cabinet section of appliance showing corrosion and disrepair

Image #3 Burner tray after removal from appliance

Image #4 Location of burner box after removal from appliance

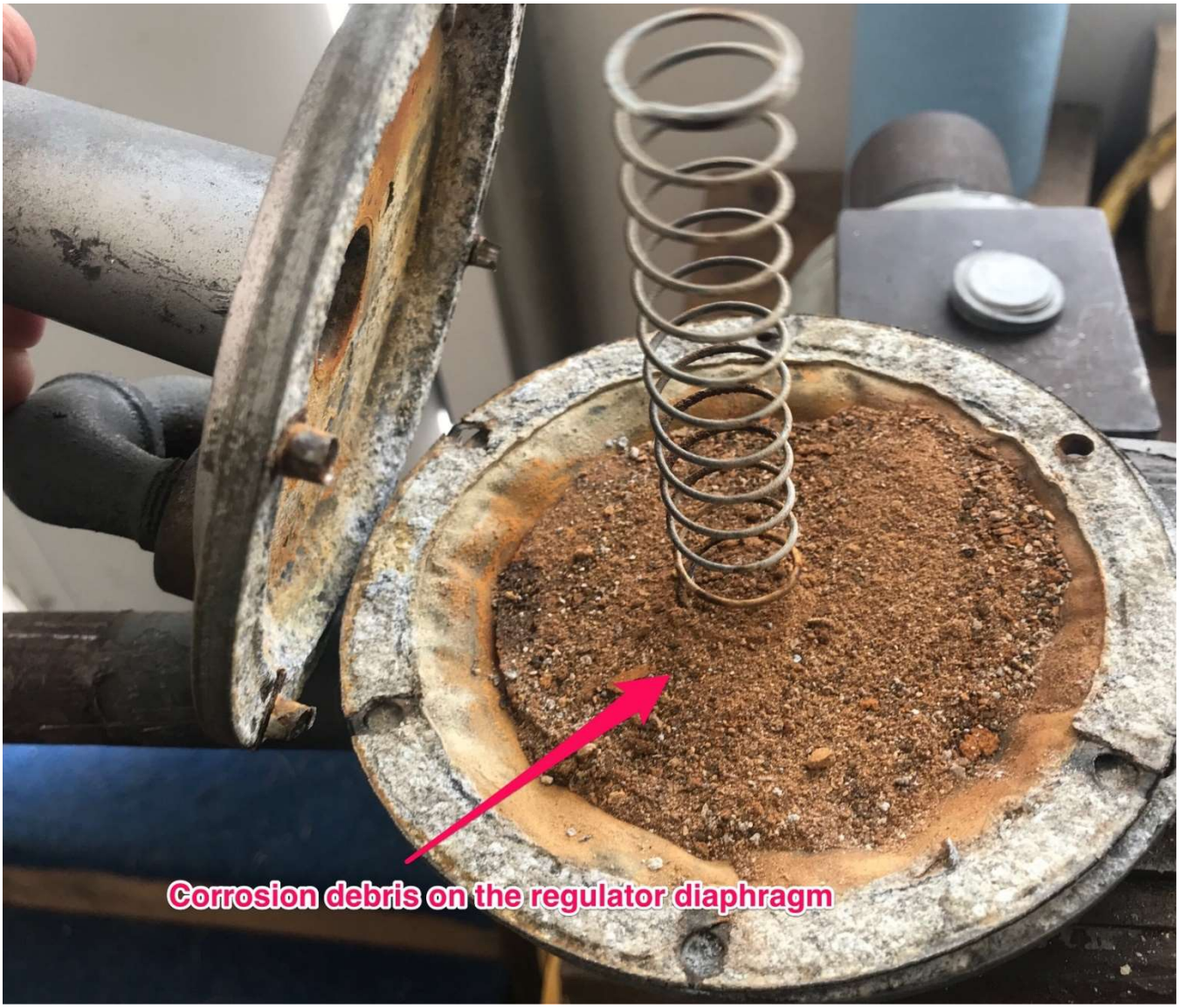

Image #5 Gas pressure regulator

Image #6 Corrosion debris removed from regulator diaphragm