Incident Summary #II-1722974-2024 (#47637) (FINAL)

SUPPORTING INFORMATION	Incident Date		June 14, 2024
	Location		Summerland
	Regulated industry sector		Gas - Natural gas system
	Impact – Injury	Qty injuries	2
		Injury description	One individual received singed hair on their face and arms and a second individual experienced pain in their ears from the explosion concussion.
		Injury rating	Minor
	Impact – Damage	Damage description	The explosion caused the metal panels on the dryer to bend, deform and the top to blow off and collapse back into the machine. The drywall on the ceiling above the machine was damaged with cracks and puncture holes from the flying debris from items placed on the top of the machine. Flexible tubing for the exhaust hood fans started on fire and burnt leaving only the spiral wire left. A door frame on the building was pushed out.
		Damage rating	Moderate
	Incident rating		Moderate
	Incident overview		An explosion occurred inside a gas fired textile dryer while in use at a commercial print shop. The explosion damaged the appliance and surrounding area inside the building.
INVESTIGATION CONCLUSIONS	Site, system and components		The textile dryer is a natural gas fired commercial type clothes dryer with a conveyor belt used for the purpose of curing/drying textile inks on textile substrates such as printed designs on clothing apparel. Apparel with freshly printed ink designs is placed on the conveyer inlet feed and travels through the dryer while hot air from a fan and gas burner cures/dries the fresh textile ink until the finished product exits the machine on the other side. When the dryer is turned on, the combustion and exhaust fans start and go through a timed purge cycle to ensure there are no combustible gasses inside the machine. Then a gas burner is ignited to provide the heat needed for the drying process. With the dryer on, it achieves and maintains a set temperature by modulating the gas burner between low and high input settings. The burner continually stays on and modulates and does not extinguish until the dryer is turned off at which time the burner is extinguished and the fans continue to run until the temperate drops to a safe range before shutting off completely. Once the burner has been extinguished, the appliance needs to go through another purge cycle before it will attempt to ignite the burner again. Multiple safeties including pressure switches, electrical limit switches, flame detectors, and control modules are implemented into the system to ensure safe starting, operation and shutdown of the dryer. The manufacturers installation and operating instructions provide guidance for safe installation, scheduled maintenance and operation of the appliance including: • Provisions for adequate combustion and make-up air supply. • A requirement to conform with the gas installation code CSA B149.1. • No allowance of appliance modifications without written consent from the manufacturer.

Incident Summary #II-1722974-2024 (#47637) (FINAL)

	• Recommended scheduled maintenance including only using certified technicians to adjust, repair or replace any gas or combustion related components. The CSA B149.1 Natural gas and propane installation code states that a commercial type clothes dryer shall have provision made for make-up air where the dryer is installed to replace the air being exhausted from the building by the appliance, and also, when it is determined that conditions created by equipment including exhaust fans, adversely affects the venting, combustion, or burning characteristics of a gas appliance that either the condition shall be corrected, or the fuel supply to the affected appliance shall be discontinued.
Failure scenario(s)	The textile dryer was purchased used and installed in the commercial print shop. The owner did not have a copy of the dryer manufacturers installation and operating manual. The dryer was installed by a licenced contractor under an appropriate installation permit in 2015. After the initial installation, no routine maintenance had been performed by qualified technicians on the gas system. The dryer was typically operated until failure when the gas system shut down and alarmed. The owner or employees who where not certified to work on gas equipment, would then remove, clean and reinstall the flame detecting rod on the gas burner in order to get the equipment operational again. After the dryer's installation, a custom auxiliary ventilation hood was added by the owner to the top of the inlet and outlet of the dryer's conveyer feed to aid in the removal of unpleasant fumes the workers were experiencing indoors during the dryer's operation. Multiple other custom exhaust fans and fume extractor systems were installed in the building to exhaust air with no means of supplying adequate make-up air to the building to replace the exhausted air. The morning of the incident, the dryer was turned on and set to the typical setting of 340°F. It reached this temperature and remained on as the gas burner modulated between low and high fire to maintain the set temperature for normal daily operation. The operation of the exhaust fans combined with the lack of a make-up air system created a negative pressure environment inside the building that drew air in from any available building openings. The back drafting combined with the imbalanced air conditions inside the building likely led to incomplete combustion of the gas at the gas burner allowing unburnt gas to travel through the appliance and up the dryer exhaust vent and custom ventilation ducting. The unburnt gas accumulated to a combustible air-fuel ratio and contacted a source or ignition creating an explosion inside the appliance forcing out the appliance panels causing damage and minor injuries to employees.
Facts and evidence	Owner Statements • The dryer was purchased used and was installed by a licenced contractor in 2015. • They did not have the manufactures manual for the dryer. • Since it's installation, they had never had maintenance or repairs done to the gas system by a certified technician. • "We don't, unfortunately, do regular maintenance to it (Dryer) because it's working". • Every couple of years the dryer would stop operating, and they themselves would remove, clean and reinstall the flame rod for the gas burner and had printed out an instruction list to inform the employees how to do it (Image 6).

- The employees do not hold certifications allowing them to do regulated work on gas systems or appliances.
- The flame rod had last been cleaned approximately a year before the incident.
- There are five different ventilation systems in the building that use fans to extract air and fumes from the building and exhaust them to the outdoors.
- They do not have a make-up-air system to replace the exhausted air.
- They had installed a custom fume extractor system on the dryer that is always used when the dryer is operating.
- If the fume extractor fan is not on, they could smell combustion by products in the building similar to the smell of a natural gas oven or range.
- The dryer was started first thing in the morning and typically remains on the whole working day.
- They were retuning after a break when the explosion occurred, and the dryer was on but had not been drying any products for approximately 20 minutes.
- The ink used for printing on the apparel is not flammable.
- Due to the blast, one employee had pain and ringing in their ears, and another had singed hair on their arms and face.

Dryer installation and operation manual scheduled maintenance

- Yearly – Check and clean the exhaust ductwork or under heavy operation every six months.
- Yearly – Have the flame rod inspected for dirt or carbon by a qualified gas technician.
- Warning: Do not attempt to adjust or replace any gas components. Contact the manufacturer service department of local qualified gas technicians.

On site observations

- The factory B-vent for the dryer was observed to have a dirty sticky coating and lint on the inside indicating it had not been checked or cleaned regularly as outlined by the manufacturer (Image 4 and image 5).
- The force of the explosion appeared to originate from the upper conveyer area of the dryer and not the lower combustion chamber area.
- The majority of the damage was located at the top of the lid of the dryer.
- The unsecured rain cap on the dryer vent outlet had not been dislodged from the explosion (Image 7).

On site testing and measurements

- No leaks were detected on the main gas line from the gas meter to the appliance shut off valves of the dryer and other gas appliances in the building.
- No gas leaks were found between the dryer gas shutoff valve and the gas train of the appliance.
- No gas was found to be leaking through the gas train to the gas burner with the appliance off.
- The supply gas pressure to the dryer was measured at 9.75” WC which was acceptable and between the manufactures specified minimum (5”WC) and maximum (10.5”WC) supply gas pressures.
- A smoke test was conducted using a smoke stick located at the vent outlet for the dryer on the roof of the building and with one of the five ventilation

Incident Summary #II-1722974-2024 (#47637) (FINAL)

	fans operating, smoke was drawn into the building through the disconnected vent identifying a negative pressure environment in the space (Image 8).
Causes and contributing factors	It is likely that the conditions created by building pressure and lack of required combustion led to an accumulation of unburnt natural gas inside the appliance that ignited causing an explosion. Contributing factors to the incident include: • The absence of the manufactures certified installation and operating manual that could have informed the owner of the air-supply and maintenance requirements. • The absence of routine maintenance for the gas systems by a certified technician allowed the dryer to operated under upset conditions for a prolonged period of time. • The modification of the dryer by the addition of the custom auxiliary fume extraction system may have contributed to upset operating conditions of the gas burner system. • The multiple exhaust systems in the building without appropriate make-up-air provisions created negative pressure conditions inside the building that may have contributed to upset operating conditions of the gas burner system.

Image 1 – Front of the building housing the textile dryer that exploded.

Image 2 – The textile dryer after the explosion showing the pushed-out dryer panels and explosion debris.

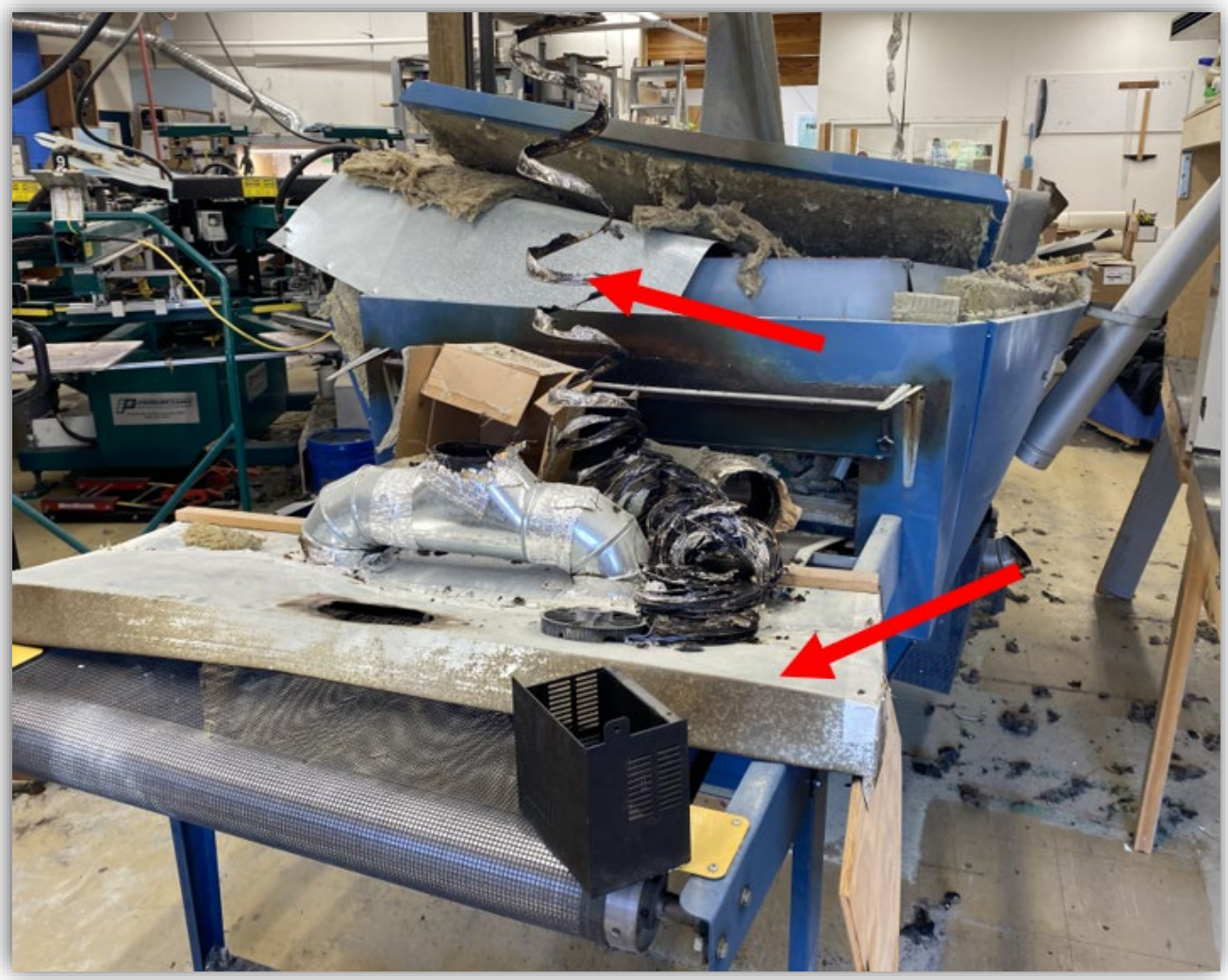

Image 3 –The arrows showing sheet metal hood and burnt flexible ducting for the custom exhaust ventilation system that was installed above the dryer inlet and outlet feeds for fume extraction.

Image 4 – Inside of dryer exhaust vent showing dust, lint and debris from the operations process.

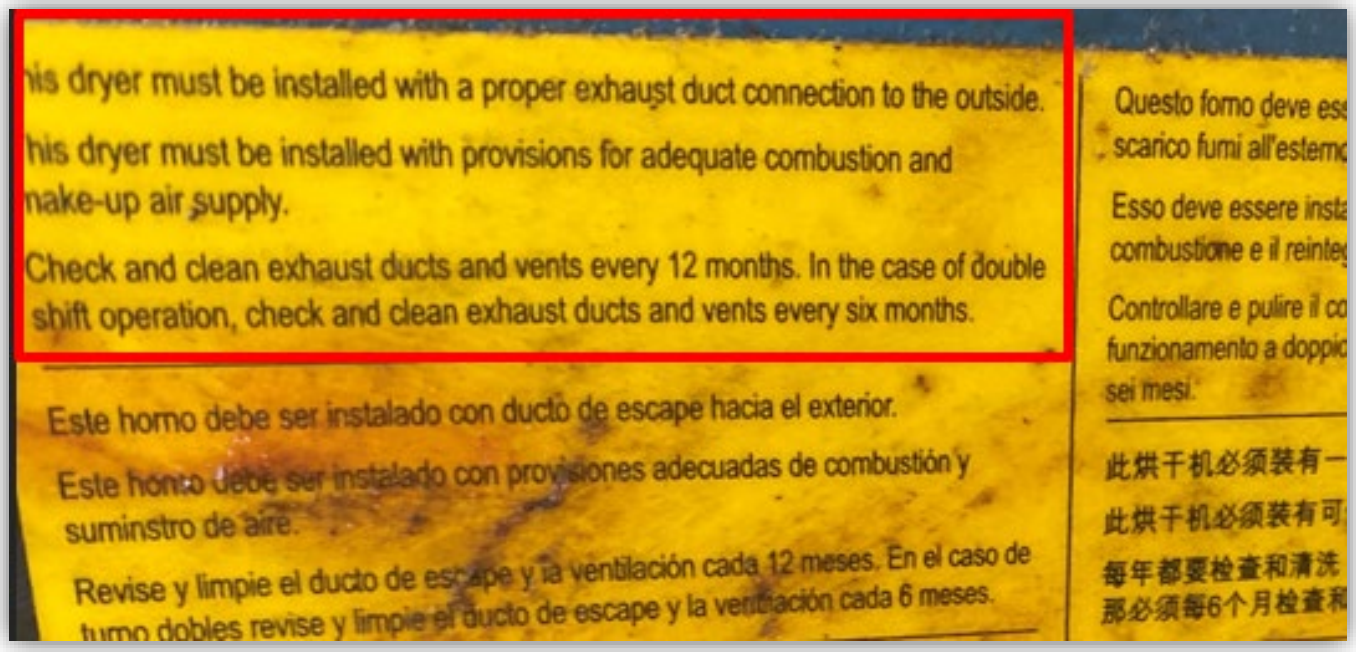

Image 5 – Warning label of dryer. Box identifies the requirement for adequate combustion and make-up-air supplies.

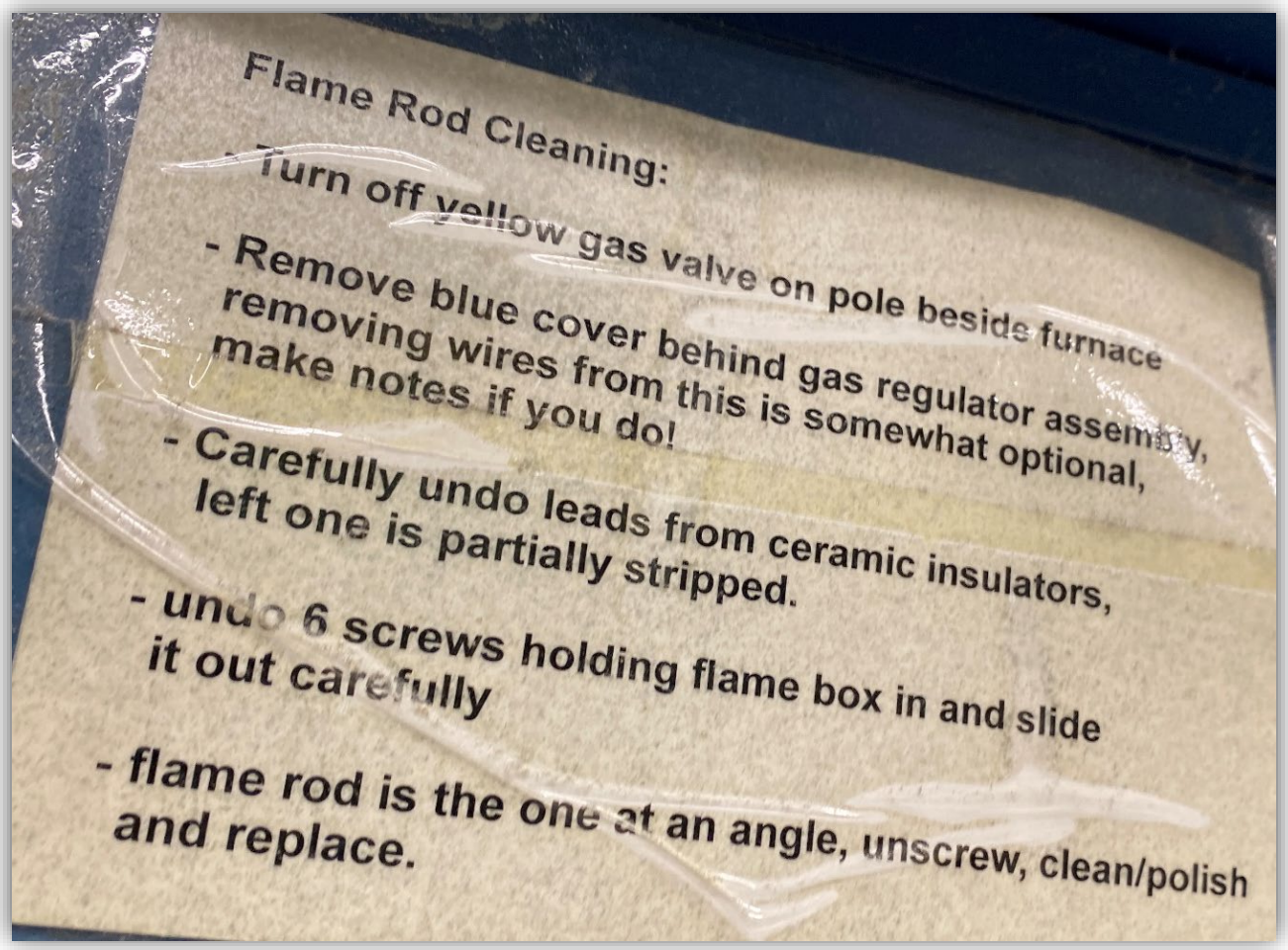

Image 6 – Directions created by the owner detailing how to remove, clean and reinstall the flame rod for the gas burner system of the dryer.

Image 7 – The b-vent termination for the dryer with the unsecured rain cap still attached after the explosion.

Image 8 – Smoke from a smoke stick test being drawn into the building from the roof through the disconnected dryer vent due to a negative pressure condition in the building created by one exhaust fan operating.

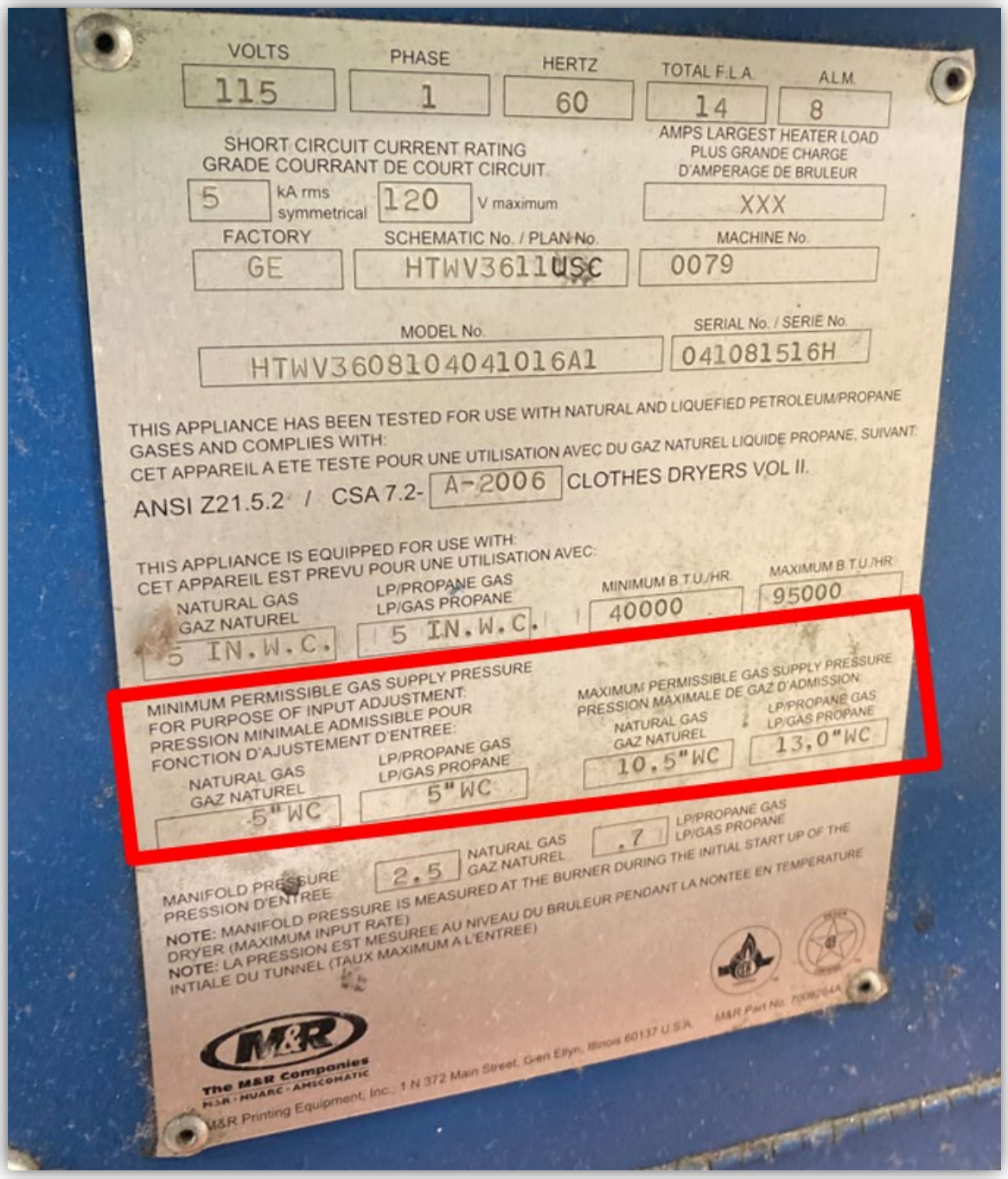

Image 9 – Data tag for the textile dryer showing the acceptable minimum and maximum gas supply pressures.