

## Incident Summary #II-723226-2018 (#8084) (FINAL)

SUPPORTING INFORMATION	Incident Date	July 25, 2018	
	Location	Abbotsford, BC	
	Regulated industry sector	Boilers, PV & refrigeration - Refrigeration system	
	Impact	Qty injuries	0
		Injury description	None
		Injury rating	None
	Damage	Damage description	A rubber gasket failed in a packaged ammonia compression refrigeration unit. Approximately 15 pounds of ammonia released into machinery room.
		Damage rating	Minor
	Incident rating	Minor	
Incident overview	Ammonia vapors leaked from a damaged mechanical seal gasket at the manhole cover of an oil separator inside the machinery room. The ammonia leak detector in the engine room triggered an audio-visual alarm and high speed ventilation intended to exhaust the ammonia from the room . The building was evacuated immediately.		
INVESTIGATION CONCLUSIONS	Site, system and components	<p>Ammonia is an ideal industrial refrigerant for large plants such as cold storages, ice plants, packing plants, skating rinks and breweries because it is inexpensive, operates at low temperatures, and is very efficient. Ammonia used for refrigeration is essentially pure ammonia without water and is known as anhydrous ammonia. "Anhydrous" is a Greek word meaning "without water". Ammonia is toxic and can be a hazard to human health. At higher concentrations, it can cause death.</p> <p>The refrigeration system containing ammonia is almost entirely installed inside a separate machinery room which is self-contained and of tight construction. To get desired low temperatures, a packaged compression refrigeration system comprising of a screw compressor, a prime mover three phase electric motor, and a metallic pressure vessel called an oil separator, is used. An electric motor runs a compressor. The compressor compresses ammonia vapor. The oil separator is a horizontal round shaped pressure vessel which is provided with a manhole opening at one end for inspection and maintenance purposes. A gasket and a metallic cover is provided to make a tight seal between the manhole opening and the body of the vessel to prevent gas from escaping. The manhole cover is elliptical in shape and is held in place with two yokes and nuts/bolts.</p> <p>In an ammonia refrigeration system, low temperature low pressure ammonia vapor is compressed by a screw compressor to high temperature high pressure gas. Lubricating oil is provided to prevent overheating of the compressor as it comes in contact with ammonia vapor. Ammonia vapor is partially soluble in lubricating oil. The hot compressed vapor, carrying some oil enters an oil separator where the ammonia vapor and oil are separated so that oil is not carried over with the ammonia gas to other components of the refrigeration system. The hot ammonia vapor is directed to the coils where the refrigerant vapor dissipates its heat. The ammonia vapor condenses into ammonia liquid at high temperature. The high pressure liquid flows through the expansion valve where the ammonia immediately boils and vaporizes which causes the refrigeration effect. The low temperature low pressure ammonia vapor is directed back to the compressor to complete and repeat the cycle over and over again.</p>	

## Incident Summary #II-723226-2018 (#8084) (FINAL)

	<p>Ammonia vapours leak from the pressure boundary whenever a breach takes place. A leak can be a result of a damaged seal due to over-tightening or a pin hole in metallic piping.</p> <p>If ammonia vapor escapes from a refrigeration system or a storage container in dry air, it will tend to rise to high areas or ceilings. Ammonia sensors are installed at a higher location in the machinery room to detect leaking ammonia vapor. Upon detection of leaking ammonia vapor, these sensors activate an audio-visual alarm and initiate a high speed ventilation fan.</p>
<p>Failure scenario(s)</p>	<p>In 2017, a new packaged compression refrigeration system was installed. The gasket was replaced 3 months prior to the incident. A leak developed at the lower half of the manhole opening from the gasket.</p> <ul style="list-style-type: none"> <li>• The chief engineer heard the ammonia release alarm. An ammonia release in the south machinery room activated the audio-visual alarm. The building was evacuated immediately.</li> <li>• Time of alarm noted was 3:05 pm with 900 parts per million (ppm).</li> <li>• Maintenance supervisor called the licensed refrigeration contractor, who arrived at site and located the leak in the packaged refrigeration unit. The compressor was isolated and the oil separator was depressurized. The yoke assembly was opened and the damaged gasket was found.</li> <li>• The damaged gasket on the oil separator manhole was replaced.</li> <li>• The building was vented with fresh air for 2 hours and the ammonia sensor recorded 0 ppm after 2 hours of ventilation and then personnel were allowed to go inside again.</li> </ul>
<p>Facts and evidence</p>	<p>Chief engineer and maintenance supervisor were interviewed and their statements are as follows;</p> <ul style="list-style-type: none"> <li>• The seal was damaged/ruptured at the 6 o'clock position.</li> </ul> <p>Licensed contractor and refrigerant parts supplier was contacted, points are as follows;</p> <ul style="list-style-type: none"> <li>• Licensed contractor is aware this is second similar recorded incident in industrial ammonia plants.</li> <li>• The equipment manufacture is currently investigating possible causes of gasket failure.</li> <li>• Gasket material is rubber compound and compatible with ammonia, however it deteriorates when placed in service.</li> <li>• Contractor and parts supplier ruled out possibility of gasket failure due to incorrect installation practice.</li> <li>• In rare cases, gasket failed before recommended service life.</li> <li>• When removed, gasket was found damaged – damage patterns showed failure and rupture of gasket material at bottom portion from where ammonia leaked.</li> </ul> <p>Refer to photographs attached:</p> <ul style="list-style-type: none"> <li>• Packaged compression refrigeration unit</li> <li>• Ammonia leak detector</li> <li>• Manhole assembly.</li> </ul>
<p>Causes and contributing factors</p>	<p>It is likely that the rubber gasket deteriorated while in service and provided a path for ammonia release. Evidence was not available to rule out faulty installation as a possible cause or contributing factor.</p>

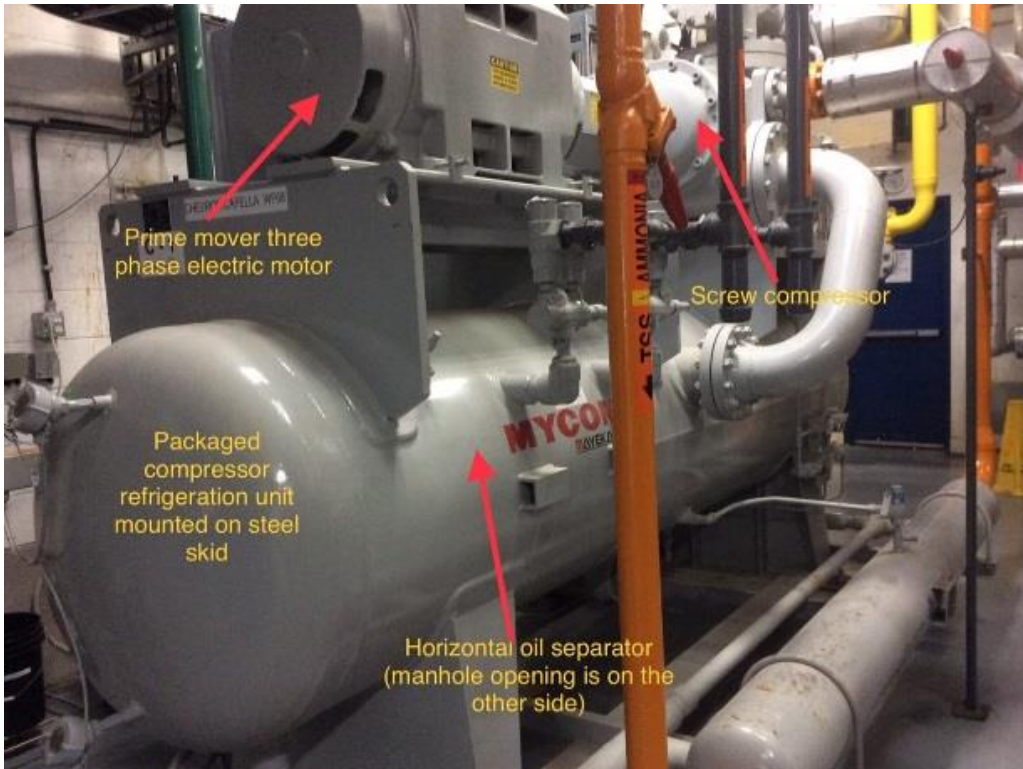


Photo 1: Packaged Refrigeration System

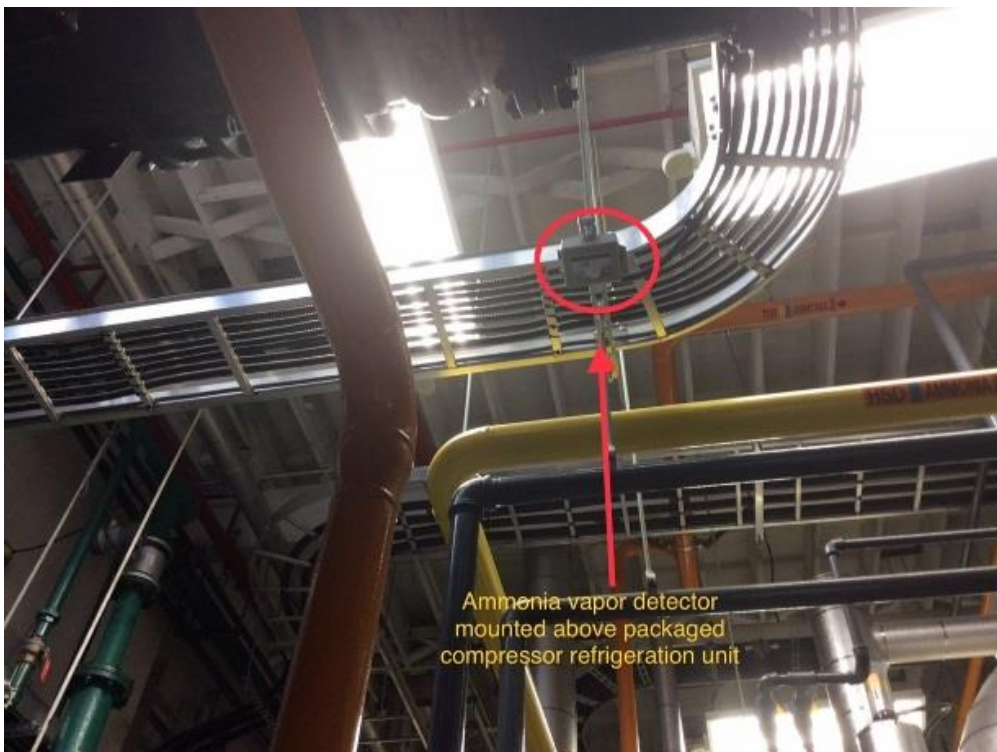


Photo 2: Ammonia Leak Detector Installed

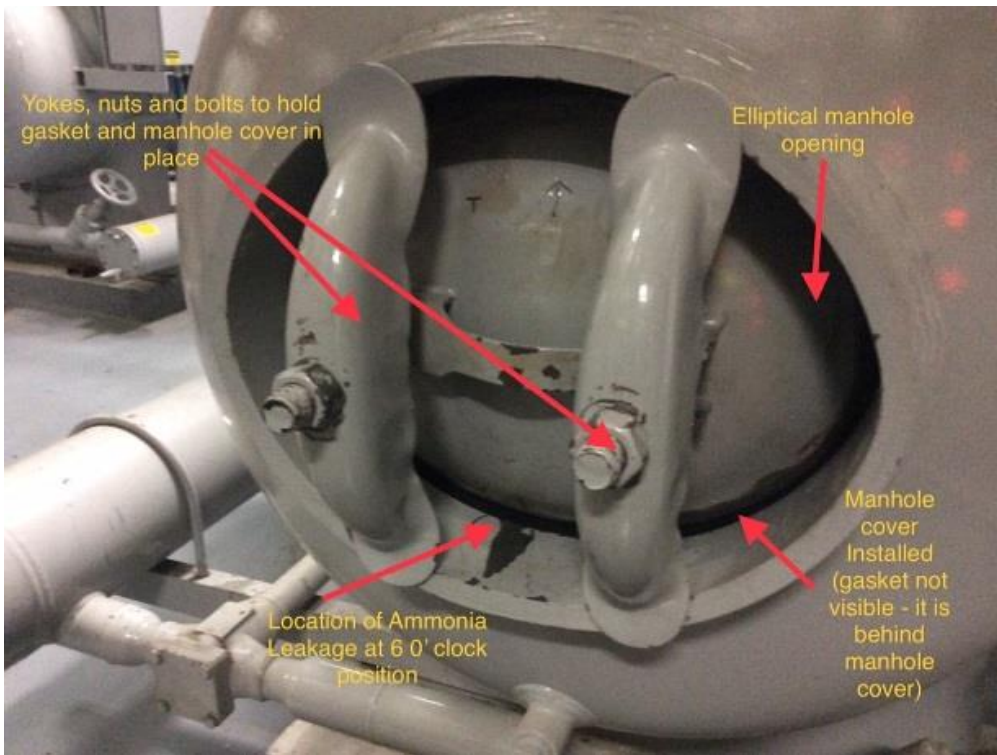


Photo 3: Manhole Assembly