

Guideline for In-Service Assessment of Ammonia Refrigeration Plants

This communication is intended to be used by plant owners and operators to provide guidance in preparation for an assessment of the plant by a Technical Safety BC boiler safety officer. It can also serve as audit criteria for internal audits of plant operations to evaluate conformance to regulatory, code and standards requirements. As the facility representative you may also wish to contact the boiler safety officer directly to seek additional clarification of the assessment requirements or to review any aspect of the process and ask questions.

Technical Safety BC conducts assessments, including physical inspections, of regulated equipment to verify that plants are in compliance with the *Safety Standards Act*. Periodic inspection of pressure equipment is intended to assess the condition of the equipment and its fitness for continued safe operation.

Scope of Assessment

In general the scope of the assessment will review all regulated equipment, its operation and maintenance. This typically includes an assessment of supervision requirements, employee qualifications, training, logbooks, supporting documentation and an onsite inspection of the plant. Other items, specific to the individual plant may also be considered.

On completion of the assessment the BSO will review the findings and indicate either compliance or non-compliance with the assessment criteria. The BSO will also review any areas for improvements based on recommended best practice. The BSO will complete a Certificate of Inspection and issue it to the ammonia refrigeration plant's operating permit holder.

For the owner's awareness, a checklist describing typical assessment criteria is attached.

Occupational Health and Safety Requirement

Prior to the site assessment, please verify and inform the BSO that the ammonia detection system and alarms have been calibrated in the last 12 months and that the ammonia equipment machinery room ventilation system is fully operational. An assessment may be terminated at any time if there are safety issues. The assessment cannot continue until controls have been put in place to adequately address any safety issue.

Owner's Responsibilities

Owners and operators of ammonia refrigeration plants must comply with the requirements of the Safety Standards Act (SSA), Safety Standards General Regulation, Power Engineers, Boiler, Pressure Vessel and Refrigeration Safety Regulation (the Regulation), CSA B52 and other adopted codes pertaining to ammonia refrigeration plants. General requirements include:

1. Cooperate with safety officers during a plant assessment, and provide to them any equipment or assistance that is reasonably necessary (SSA section 19)
2. Prepare equipment in the refrigeration plant for inspection as required by a safety officer – this may include removal of insulation, access to or operation of any regulated component of the system.



3. Produce plans or specifications considered necessary for inspection of regulated equipment – this includes applicable operating manuals, maintenance records, log books, training documents, testing reports or service records. Where inspection and maintenance operations are carried out according to documented procedures, the procedures and documents shall be acceptable to the authority having jurisdiction.
4. Provide inspection assistance for any regulated product by starting, turning on, putting in motion, testing, using, operating, stopping or turning off equipment as requested by a safety officer

In-Service Inspections – Owner’s Requirements

Periodic inspection of pressure equipment is intended to determine the condition of the equipment and its fitness for continued safe operation.

In-service inspection of systems shall be performed as required for the specific installation in accordance with the code and standards adopted by the Power Engineers, Boiler, Pressure Vessel and Refrigeration Safety Regulation. The equipment manufacturer’s testing and maintenance recommendations must also be carried out. Personnel performing in-service inspection shall be trained and competent in the duties for which they are responsible.

Where inspection and maintenance operations are carried out according to documented procedures, the procedures and documents may be assessed by the safety officer to verify they are adequate.

The Owner or Owner’s representative may be required to produce evidence that In-service inspection of systems and pressure vessels have been performed as required for the specific installation in accordance with the adopted codes and standards.

Ammonia Refrigeration Plant In-Service Assessment

A guideline for preparation for an ammonia refrigeration plant assessment

The list below is intended to provide initial guidance and clarification to the facility representative about items that may be inspected during a refrigeration plant assessment. The items below describe a list of typical assessment criteria employed. Assessments may include additional items specific to the type and complexity of the plant. In preparation for the assessment, the facility representative may also contact the Boiler Safety Officer directly to seek additional clarification of the assessment requirements or to review any aspect of the process and ask questions.

Items of inspection include:

Equipment Data

Equipment Data	Reference: CSA B52-13 cl.5.11.1	A permanent sign shall be posted for the refrigeration system that indicates the following: a) name and address of installer; b) refrigerant type; c) lubricant type and amount; d) total weight of refrigerant required for normal operation; e) field test pressures applied; f) refrigeration capacity at design or nominal conditions; and g) for prime mover(s), the rating in kilowatts (hp) or full-load current and voltage
Machinery Room Data	Reference: CSA B52-13 cl.4.5.2	When a refrigeration system is located indoors, a machinery room shall be provided and comply with CSA B52-13 Clause 4.5. as required.
Ammonia Vapor Detectors Data	Reference: CSA B52-13 cl.6.3(i)	A vapour detector shall automatically start the ventilation system and actuate an alarm at the lowest practical detection levels not exceeding the concentration limits specified in Item (c)(iii) of Clause 4.5.2 or 300 ppm for ammonia. The vapour detector shall also initiate a supervised alarm so that corrective action can be initiated.
Licensed Contractor Data	Reference: BC Reg. 104/ 2004 s.81	The owner of a plant in which the holder of a refrigeration safety awareness certificate of qualification is employed must obtain, and keep



		at the premises an annual service report from a licensed refrigeration contractor stating that any work that has been carried out has been done in accordance with the manufacturers' specifications and as required under this regulation.
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Staffing / Training

Plant Staffing	Reference: BC Reg. 104/ 2004 s.44(2.1)	A refrigeration plant requires a refrigeration operator or a power engineer with a fourth class or higher certification of qualification to be in charge of the plant.
	Reference: BC Reg. 104/ 2004 s.45	Unless a plant is registered under section 54 or is exempted under section 6, the person in charge of the plant must be present at all times in the plant boiler room, refrigeration machinery room, engine turbine room or in the immediate vicinity within the plant premises while the plant is in operation. Compliance with supervision requirements must be reflected in the logbook. Supervision requirements must consider back up for sickness, holidays or other emergency.
	Reference: BC Reg. 104/ 2004 s.69.1(c)	Within the plant there must be a list of all power engineers, operators and safety awareness certificate holders employed at the plant, including (A) their certificate numbers, classes and expiry dates, and (B) a description of their tasks and where and when they perform those tasks
Posting of Certificates	Reference: BC Reg. 104/ 2004 s.43	When the holder of a certificate of qualification issued under this regulation is employed in a plant, the original certificate must be posted in a conspicuous, clean and safe place in the plant premises. A holder of a certificate of qualification issued under this regulation must carry, at all times



		while performing regulated work, proof acceptable to a provincial safety manager of the holder's certification.
Training	Applicable to Registered Special Plant. Reference: TSBC MAN-4000	A written training program for all plant related tasks (ex: oil pot draining, adding oil to the compressor) and emergency response must be available.
	Applicable to Registered Special Plant. Reference: TSBC MAN-4000	All plant operating personnel must be trained and documentation made available to verify the training.
Log Book	Reference: CSA B52-13 cl.8.4.5 & SSGR BC Reg. 105/ 2004 s.19	The plant must be monitored using daily logs to record process parameters, (e.g., pressure and temperature levels). The log must be reviewed on a regular basis by the person in charge. Supervision requirements shall be reflected in the log book.
Other Certificates of Qualification	Reference: BC Reg. 104/ 2004 s.5(2)	Documents must be available to verify that all persons performing regulated work (including contractors) in the plant are qualified.

Machinery Room & Safety Devices

Piping	Reference: CSA B52-13 cl. 6.8.1	Consideration shall be given to the location of refrigerant piping, to minimize the danger of the piping being struck from any direction (such as by falling objects, material handling equipment, or general traffic). Should such a hazard exist, appropriate protection shall be provided.
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<p>Labelling</p>	<p>Reference: CSA B52-13 cl. 5.11.3</p>	<p>All refrigeration system lines and valves shall be adequately identified. Signs for systems containing more than 45 kg (100 lb) of refrigerant. Systems containing more than 45 kg (100 lb) of refrigerant shall be provided with durable signs with letters not less than 13 mm (1/2 in) in height designating the following:</p> <ul style="list-style-type: none"> a) the main electrical disconnect switch(es); b) any remote control switch(es); c) any pressure-limiting device(s); d) each pressure vessel; e) the main shut-off to each vessel; and f) the refrigerant piping (indicating whether it is at the high-side or low-side pressure and whether it is normally in the liquid or vapour state).
<p>Over Pressure Protection safety devices</p>	<p>Reference: CSA B52-13 cl. 8.4.2(a)</p>	<p>Pressure-relief valves shall be replaced or recertified at intervals no longer than five years. Recertification of relief valves shall be conducted in accordance with the requirements of the regulatory authority having jurisdiction and CSA B51.</p>
<p>Compressor Safety Devices</p>	<p>Reference: CSA B52-13 cl. 8.4.2(c)</p>	<p>Pressure-limiting devices shall be tested at least once every 12 months for set point accuracy and for their ability to properly stop the affected equipment.</p>
	<p>Reference: CSA B52-13 cl. 8.4.2(d)</p>	<p>Other safety devices shall be tested at least once every 12 months for set point accuracy and for their ability to properly stop the affected equipment.</p>



	Reference: CSA B52-13 cl. 5.6.3.1	All systems that are not critically charged and that use compressors and a liquid/vapour separation pressure vessel that has an internal diameter greater than 300 mm (12 in), and is located on the low side of the compressor(s), shall have a high-liquid-level sensing device fitted to that vessel. This device shall be installed to stop the compressor(s) before damaging quantities of liquid refrigerant enter the compressor(s).
Refrigerant Vapor Detection	Reference: CSA B52-13 cl. 8.4.2(e)	Permanent space leak detectors shall be tested for function at the specified refrigerant concentration in accordance with the manufacturer's instructions. The maximum interval between tests shall not exceed one year. The leak detector, in the simulated leak test, shall initiate an audible and visible alarm and begin ventilation at a rate not less than that specified in Clause 6.2.5.5. Failure of any of the three functions shall require corrective action.
Emergency Discharge	Reference: CSA B52-13 Annex B	Systems designed for operation over 103 kPa (15 psig) and containing 182 kg (400 lb) or more of Group A1 or 91 kg (200 lb) or more of all other refrigerants shall be constructed so that, in an emergency, the refrigerant can be safely and rapidly discharged into the atmosphere. The system shall comply with the requirements of CSA B52-13 Annex B.
Machinery Room	Reference: CSA B52-13 cl. 4.5.2	The room housing compressors and related equipment shall comply with the requirements of CSA B52 Clause 6.2 and special machinery room requirements of Clause 6.3 as required by cl. 4.5.2.



<p>Refrigerated Work Area</p> <p>(only applicable to industrial refrigeration plants)</p>	<p>Reference: CSA B52-13 cl. 4.5.2(d)</p>	<p>The refrigerated work area shall have:</p> <ol style="list-style-type: none"> i. Area is separated from rest of building with tight construction with tight fitting doors ii. Access is restricted to authorized personnel iii. Detectors located in areas where refrigerant vapor from a leak will be concentrated. Detector provide a warning at a concentration not exceeding 300 ppm iv. No flame producing device or hot surface over 425 °C(800 °F) shall be permitted.
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Ammonia Leaks and / or Releases

<p>Ammonia Leaks</p>	<p>Reference: CSA B52-13 cl. 8.4.2(i)</p>	<p>Testing for refrigerant leaks shall be carried out</p> <ol style="list-style-type: none"> i) periodically as per regulations; ii) as required by the manufacturer; iii) if there is physical evidence that may indicate a leak; iv) if the system operating conditions indicate a loss of refrigerant; and v) if the vapour detector alarm is activated
<p>Ammonia Releases</p>	<p>Reference: SSA s.36 & BC Reg. 104/ 2004 s.66 &72</p>	<p>The owner must conduct, or cause to be conducted, an investigation of an incident and submit a written report of the findings to a provincial safety manager within 30 days of the incident. A record must be kept of all accidental ammonia releases.</p>



Equipment Integrity/ Maintenance

<p>Pressure Vessels & Piping</p>	<p>Reference: NBIC Part-2 s.2.3.5.4</p>	<p>The owner shall have available for review any pressure vessel log, record of maintenance, corrosion rate record, or any other examination results.</p>
	<p>Reference: CSA B52-13 cl. 8.4.2(h)(i)</p>	<p>Periodic visual inspection in conjunction with operational system logging and operating characteristics of the equipment and system components shall be performed to identify existing or pending problems. These inspections shall include, but not be limited to, the following items and time frames:</p> <ul style="list-style-type: none"> i) All refrigerant lines, vent lines, and system components shall be inspected quarterly for vibration, corrosion, and/or physical damage. ii) All lines, including vent lines and outlets, shall be inspected quarterly for blockages and insulation condition. <ul style="list-style-type: none"> Note: <i>This includes inspection of vessel insulation.</i> iii) Ancillary devices, components and fluids integral, external or remote to refrigeration equipment (e.g., indirect systems, hydronic systems, cooling towers, air distribution systems, etc.) shall be inspected for operational performance prior to initial start up and prior to annual start up and monthly thereafter during operation, as ancillary devices operation affects the primary refrigeration equipment. iv) Where visual inspection is not permissible, system operational characteristics and relevant sensors shall be used to assist in identifying existing or pending problems.



	Reference: BC Reg. 104/ 2004 s.86	The owner shall have records regarding repairs or alterations made, if any, since the last internal inspection available for review. The Inspector shall review the records of such repairs or alterations for compliance with applicable requirements.
Maintenance	Reference: CSA B52-13 cl. 8.4 & CSA B51-14 cl. 13	<p>The owner should have a written program which specifies in-service inspection and maintenance requirements of the refrigeration system in accordance with the code of construction, inspection code adopted by the jurisdiction and manufacturers recommendations.</p> <p>Elements of such a program should specify that :</p> <ul style="list-style-type: none">• a person or position be identified responsible for implementation of the program• the person or position have the authority and the resources to effectively implement and carry out maintenance program activities.• the maintenance program identify the maintenance duties and activities required to manage the refrigeration system throughout its life cycle.• the remaining life of the refrigeration system be identified.• such duties and activities be performed by personnel that are adequately qualified or trained.• the maintenance program provide a means for adequately documenting maintenance activities.



		<ul style="list-style-type: none"> the maintenance program make provisions for internal audit and process improvements. the maintenance plan address all the requirements of CSA B52 section 8 "Maintenance of Systems".
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Emergency Preparedness

Emergency Procedures	Applicable to Registered Special Plant. Reference: TSBC MAN-4000	The facility should established written emergency procedures and instructions on what to do in the event of an ammonia release.
King Valve	Applicable to Registered Special Plant. Reference: TSBC MAN-4000	The facility should identify the king valve and other emergency isolation valves with a large placard so that they can easily be identified by emergency responders. These valves should be clearly indicated on the piping and instrumentation diagrams (P&IDs) and/or process flow diagrams
Power Failure	Applicable to Registered Special Plant. Reference: TSBC MAN-4000	The facility should established emergency shutdown procedures and instructions on what to do during and after a power failure.
Emergency Instructions	Applicable to Registered Special Plant. Reference: TSBC MAN-4000	A floor plan should be posted with evacuation procedures for staff to refer to and carry out evacuations or emergencies
		An emergency shut down procedure and emergency contact information should be posted on the mechanical room door.
		A neighborhood call out list with current contact numbers should be available.
Training	Applicable to Registered Special Plant. Reference: TSBC MAN-4000	All staff should be trained in the emergency response for ammonia leaks with duties and responsibilities listed in procedures.



Emergency responder	Applicable to Registered Special Plant. Reference: TSBC MAN-4000	The owner should identify who provides the emergency response and what the response time is.
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Record Retention

Records	Reference: BC Reg. 104/ 2004 s.72	All pertinent plant records listed and maintained (including owner / contractor inspection / testing maintenance records) must be kept for a minimum of 7 years.
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