# Refrigeration Plant Room Safety – Identification of Hazards and Risks

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This guide is intended for awareness and general information purposes only. It should not be considered a substitute for a thorough review of applicable government Acts, Regulations, Codes and Standards.

***Definition***

*"Refrigeration plant" means an installation comprised of one or more refrigeration compressors, prime movers, equipment, pressure vessels and any associated piping.*

**Introduction**

A clean, well lit refrigeration plant room that is properly labelled and painted is the first step towards plant room operational competency. An ice arena's refrigeration plant room is the heart of the operation and much like the any vital organ it must be kept in top form through regular maintenance and upkeep. Government officials who attend the refrigeration plant room for inspection purposes can quickly form an opinion on the dedication of the facilities staff toward maintaining the safe operation of the plant by its general appearance. While worker risk of injury can be greatly reduced through identification of known hazards, risks and some basic, scheduled housekeeping practices within the plant room.

**Out of Sight - Out of Mind**

The plant room is out of sight of the general public and is often neglected by facility staff. It is an area that can have liquids (oil/brine) collect on the floor which creates a slip hazard while leaks of secondary refrigerant can cause decay to the equipment which reduces its overall life expectancy. Often the plant room has not been cleaned since its installation; such neglect will cause dirt, dust and grime build-up. Health and safety of plant rooms should be a priority for facility operators. Dirt, film, dust, grime and other contaminants should be removed to allow easy, ongoing, visual inspection of all equipment in the room. A clean room is a "fire proofed" room. Remember, this is a "Non-Smoking" area.

Protecting workers from hazardous working conditions is a primary step towards a safe and healthy work environment. This includes providing workers with awareness training on the risks of the area, assurances for adequate ventilation, personal protective equipment and proper labeling and identification of pipes, valves and electrical systems.

**Legal Obligations for Maintaining Your Plant Room**

The Operating Engineer Regulation (OER) Is considered the primary legislation that controls refrigeration plant operations in Ontario. Although the OER does not specify an detailed obligation for maintenance and upkeep, there is a general duty for the owner to maintain the plant room in a safe condition while in the Occupational Health and Safety Act (OHSA) there is a general requirement for all workplaces to be safe through regular, ongoing housekeeping activities. The B52 Section 7.4.1.1 is more direct as it states "the owner is required to maintain all refrigeration systems in a clean and accessible condition".

The level of cleanliness and repair is left up to the owner/operators under the *Internal Responsibility System (IRS)*. There must be assurances in place that any individual that enters or works in the area are safe. Your final housekeeping and maintenance plan may only be questioned should an incident or accident occur in the plant room.

### The B52 Mechanical Refrigeration Code

The B52 Mechanical Refrigeration Code provides guidance to owners of plant rooms on the design and maintenance of a safe environment. Selected highlights of the Code as well as sections of the OER are found throughout this guide. It is important that owners and operators have both a current copy of the Operating Engineer Regulation and B52 Mechanical Refrigeration Code on site for reference.

Section 4.11.1 - Indicates that a permanent, securely attached, legible and readily accessible signage identifying the installer, refrigeration amount, lubricant amount, horsepower rating and tonnage capability and field test pressure must be installed.

Section 4.11.5 - Indicates the owner's responsibility to post a card in the plant giving operational and emergency instructions that include emergency and service contact information and contact information for the nearest "regulatory authority".

### Occupational Health and Safety Acts (OHSA)

The industry is also governed by both the Industrial and Construction health and safety Acts. Generally, the Acts require all workplace parties to work safely and maintain a safe working culture and environment. It is a known fact that proactive housekeeping practices will reduce injuries.

### Excerpts from the OHSA (Industrial)

11. A floor or other surface used by any worker shall, (a) be kept free of, obstructions, hazards, and accumulations of refuse, snow or ice; and (b) not have any finish or protective material used on it that is likely to make the surface slippery. R.R.O. 1990, Reg. 851, s. 11.

16. A door, (b) leading to a hazardous, restricted or unsafe area, shall be identified by a warning sign posted on it. R.R.O. 1990, Reg. 851, s. 16.
21. Where natural lighting is inadequate to ensure the safety of any worker, artificial lighting shall be provided and shadows and glare shall be reduced to a minimum. R.R.O. 1990, Reg. 851, s. 21.
46. Machinery, equipment or material that may tip or fall and endanger any worker shall be secured against tipping or falling. R.R.O. 1990, Reg. 851, s. 46.

123. (2) The requirements of the Fire Code respecting keeping egress doorways, public corridors and exits free from obstruction apply at industrial establishments. 1990, Reg. 851, s. 123 (2).

139. (10) A clearly visible warning sign shall be posted at every approach to an area in the workplace where the sound level, measured as described in subsection (5), regularly exceeds 85 dBA. O. Reg. 565/06, s. 2.

### OHSA (Construction)

35. (1) Waste material and debris shall be removed to a disposal area and reusable material shall be removed to a storage area as often as is necessary to prevent a hazardous condition arising and, in any event, at least once daily. O. Reg. 213/91, s. 35 (1).
Identification of Refrigeration System Components

(Excerpts from the ORFA Refrigeration Manual)
There are a number of ways to identify components within a refrigeration system and piping systems. For example, the Canadian Standards Association requires natural gas components to be identified in bright yellow. For Refrigeration systems, there are two generally accepted piping identification schemes specified by system engineers. The ANSI/ASME Standard A13.1 provides for such a colour-coding scheme for pipe identification. This allows for immediate awareness of potential hazards within a piping system. Oftentimes, a lettered legend giving the name of the pipe contents in full or abbreviated form is the primary method of identifying pipe contents. Ideally, arrows can be used to indicate the normal direction of flow. Additional details such as temperature or pressure could also be shown to identify more details of the piping system. This standard recommends black lettering on yellow colour coded markers or white lettering on other colour coded markers. The use of alternate existing identification schemes is acceptable if such schemes are described in writing and accompanied by proper employee training.

An identification colour and marking system should be developed which becomes the known safety image standard for your particular plant. Overtime there has been some acceptable basic application standards developed. They include but are not limited to:

- **Piping Systems** - Painting all piping systems in a solid range of specific colour identification creates an attractive image in the plant. Consider painting piping in a

neutral standard colour such as a light beige/gray at specific and reasonable distances; apply colour bands for the specific pipe content. Arrows for direction of flow can also be considered.

- **Valve wheels** - Coloured to image the content as per the colour band on the pipe.
- **Butterfly valve levers** - Coloured to image the content as per the colour band on the pipe.
- **All machinery (boilers, compressors, motors, etc.)** - Painted the same attractive standard colour on a contrasting but relatable base colour. A member of the green family of colours goes well with a dark green base. (Lighter greens have a known psychological calming effect).
- **Walls** painted an attractive light relatable but contrast colour to the machinery. The very light green colours are considered attractive.
- **Floors** - Floors that are not pre finished in tile etc. should be painted a light colour such as grey.
- **Electrical control boxes** - painted in a light colour relatable to the machinery and pipe colour.
- **Valve and pipe content / service colours** should be image relatable to the risk / service. Reds, oranges and yellow are a higher risk danger image than blue or green.

### Industry Recognized Pipe Colour Coding System

As indicated earlier, there is not one specific pipe colour code system to comply with. The following colour coding system should be considered specific to the piping and valves in a typical plant room:

- **High Pressure Steam** - red band on pipes and red covering entire valve wheel.
- **Low pressure Steam** - red and orange band on pipes and red on valve wheel rim with orange valve spokes.
- **Potable water** - blue band on pipes and blue covering entire blue valve wheel or handle (the blue colour used for water is the base colour for all water; the secondary colour indicates what kind of water).
- **Cooling water** - blue and green band on pipes and blue on valve wheel rim with green valve spokes. Blue and green valve handle.
- **Boiler feed water** - blue and red band on pipes and blue on valve wheel rim with red valve spokes.
- **Hot water** - blue and orange band on pipes and blue on valve wheel rim with orange on valve spokes. Blue and orange valve handle.
- **Waster/Sewage water** - blue and black band on pipes and blue on valve wheel rim with black valve spokes. Blue and black valve handle. (**Any other water** can be imaged by applying a mental image relatable colour with the base water blue).
- **Fuel oil** - brown band on pipes and total brown valve wheel.
- **Compressed air** - white band on pipes and white covering entire valve wheel.
- **Natural gas** - yellow band on pipes and yellow covering entire valve wheel.
- **Brine or glycol** - green labels with arrows indicating the direction of flow.
- **Liquid Anhydrous Ammonia** - Yellow
- **Vapour Anhydrous Ammonia** - Yellow
- **Aqua Ammonia** - Yellow
- **Fire Protection** - Red
- **Compressed Air** - Blue
- **Water** - Green
- **Fuel Gas** - Yellow
- **Fuel Oil** - Yellow

Remember that refrigeration plant room pipes are often under extreme pressure and/or temperature and that failure of the pipe is a significant cause for safety concern. NEVER place a ladder or hang anything from any pipe or conduit in your plant room.

### Maintaining Refrigeration Plant Room Piping Systems

Refrigeration pipes are metal and as such they are prone to rust. If left unchecked, the rust will slowly destroy the pipe. Rust should be regularly removed and the pipe repainted to maintain its original strength and integrity. The same level of maintenance, responsibility and commitment should be applied to all other metal parts in the plant room.

Removing the rust from a metal plumbing pipe can usually be completed by facility staff. Staff will need to be properly informed on the risks of such a process and need to be provided with the right tools and personal protection. Avoid power tools such as grinders and power wired brushes. This task is always best performed by hand. Discussing how best

to maintain your plants piping system with your refrigeration contractor is strongly recommended. The steps will include removing all existing rust off from the pipe, and then treating it with a rust-dissolving product. Here are some proven steps on how to remove rust.

**You will need:**

1. Fine grit sandpaper
2. Naval jelly
3. Clean cloth
4. Paint brush
5. Wire brush
6. Protective gloves
7. Water
8. Primer paint

**Steps:**

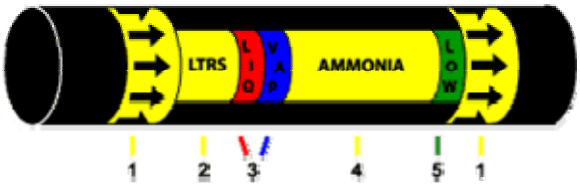
- Prepare the pipe surface with a wire brush to remove any loose rust flakes. Use "fine-grit" sandpaper to sand over the surface of the pipe with a small circle movement. The sandpaper will remove the rust that is too stuck for the wire brush to loosen.
- Using protective gloves apply a light coat of naval jelly to the surface of the pipe and let it soak for 30 minutes. The purpose of using naval jelly is to dissolve the rust. Rinse the surface with clean water after 30 minutes, and dry the pipes with a clean towel. Allow to dry.
- Apply a thin even primer paint for plumbing pipes or any similar product. Leave the primer overnight to dry.
- Paint may not adhere well to the mill scale on the pipe so you need to decide how to clean the piping so that the paint will fully adhere to it.
- Once completely dry apply another coat of the selected pipe paint colour.
- The time spent on preparing your surface will greatly affect how long the paint adheres.
- Record the work in the plant room log book.

**Pipe Markings**

Section 4.11.1 of the B52 Mechanical Refrigeration Code specifically deals with marking and labeling requirements for an Ontario refrigeration plant rooms.

4.11.3 - Systems containing more than 110lbs (45kg) of refrigerant require signage of specific size lettering identifying main disconnect and control switches, pressure limiting switches, and each pressure vessel and their shutoffs, and all refrigeration piping and whether the refrigerant is at high or low pressure state or vapour.


*Another commonly used piping identification system that has been used widely within the industrial refrigeration systems throughout North America is often used. This established engineered guideline is often used to identify ammonia refrigeration piping and system components and is defined through IIAR Bulletin 114. This bulletin attempts to create a uniform identification system for such piping and components. Errors and risks of the misidentification of piping system can be minimized if commonly used hazardous communications markers are used and recognized everywhere. These Safety Yellow coloured piping markers identify the direction of flow, the physical state of the substance within the pipe under normal operating conditions, the location of the piping system with respect to the refrigeration system, and provide a quick reference to the expected operating pressure of the system.*
***In all cases of piping identification, workers should be aware of the system in place and a legend should be established with the workplace.***




NOTE: For the final colour and marking scheme to be an effective safety tool it must have a large posted framed chart that will image the pipe and valve wheel colour standards with a word legend.

**(IIAR) International Institute of Ammonia Refrigeration** https://www.iiar.org

**IIAR Bulletin 114.Guidelines for Identification of Ammonia Refrigeration Piping and System**

**Components. IIAR Ammonia Refrigeration Library, (1991, September).** Provides a comprehensive ammonia labeling scheme for companies in need of an identification system that "covers it all." Offers recommendations on label sizes, colors, installation locations and label material requirements.
**Pipe Labels**

### Identifying Valves

Marking pipes with pipe markers and valve tags is critical to an effective facility identification and safety program. The numbered or named tag system is not effective as the tags get ripped off overtime and require a chart, which is never available, to identify the number.


A proven system is to apply a brass or stainless disc / washer in the centre of the valve wheel that is retained by the valve wheel nut. The content / service of the valve can then be stamped on the circumference of the disc. These can be professionally produced at low cost and are very effective. Lever valves can have a marked plate screwed to the valve handle.

Pipes that are wrapped in insulation should not be left uninspected. Temperature and humidity inside the room needs to be maintained and controlled as indicated in Section 6.2.5.7 Minimum Temperature B52 Mechanical Refrigeration Code. Water and moisture that is allowed to enter or collect in any mechanical room will promote rusting of metal. Insulation that becomes wet will often be hidden while impacting the pipe inside. Be sure to add a regular detailed inspection of all piping insulation to your ongoing maintenance plan.

Natural gas lines are always to be painted bright yellow. The important thing to remember about colour coding in the refrigeration room, particularly in municipalities that have more than one arena, is that it must be consistent from one arena to another and not be subject to the likes or dislikes of the staff working in the different facilities. The last thing you want to have is confusion over what a specific colour represents. Also, emergency response agencies such as the fire department should be provided with an explanation of the colour code in the arena.

The colours relate to the similar colours found on the actual pipe substance directional markers used in refrigeration systems and recognized by the IIAR (International Institute of Ammonia Refrigeration). This applies to the ammonia identifiers specifically. The yellow colour identifies hazardous substances, of which refrigerants are not considered. All other colours have developed over the course of time. It is important that each community maintain a similar coding arrangement so as not to confuse internal staff that may be working in the various facilities.

### A Virtual Tour of a Typical Plant Room

Let's take a virtual tour through a typical refrigeration plant room and identify some of the items we have reviewed as well as the other items that should be found in or proximate to the room. Consider each item and whether it might apply to your refrigeration plant room?

1. Approaching the room an ammonia sensor system may be required depending on the primary refrigerant being used. *Section 6.2.3 B52 Mechanical Refrigeration Code*

2. The primary entry door should be secured permitting only qualified competent persons to enter. The second fire rated vestibule door should be closed. The doors fire rating plate should be visible, in good condition and readable on the hinge side of the doors when opened. The doors and all entry points for piping, electrical wires etc. must be sealed and tight. The door should be posted as a staff entry only area; hearing protection requirements; ammonia (if applicable); electrical risk area; danger equipment may start without warning, and; No

Smoking signage may be required. *Section 5.2 - B52 Mechanical Refrigeration Code, Section 16 OHSA*

3. A room ventilation start switch is to be outside the primary main entry door. *Section 6.2.5 - B52 Mechanical Refrigeration Code*

4. Additional egresses need to be clear and functional during all seasons with hardware being in proper working order. *Section 6.2.2 B52 Mechanical Refrigeration Code*

5. Eyewash and deluge shower system should be clear and functional. Applicable/required PPE such as an ammonia canister mask may need to be accessible outside the room. *Section 8 - B52 Mechanical Refrigeration Code*

6. Proper general housekeeping practices should be in place resulting in a plant room that is neat and clean. Liquids should be immediately cleaned away, leaks recorded in the log book and repairs scheduled or made. *Section 7.4.1.1 - B52 Mechanical Refrigeration Code*

7. Name of installer, refrigerant amount, lubricant amount, horsepower rating and tonnage capability and field test pressure must be posted. *Section 4.11.1 - B52 Mechanical Refrigeration Code.*

8. Operational and emergency instructions including emergency service contact information and nearest regulatory authority information must be posted. *Section 4.11.5 - B52 Mechanical Refrigeration Code.*

9. All liquids, canisters and chemicals are to be safely and properly marked and stored. *Section 4.11.1 - B52 Mechanical Refrigeration Code.*

10. Maximum of 300lbs is allowed to be stored on site outside of the plant room. *Section 7.3 - B52 Mechanical Refrigeration Code.*

11. Unrelated mechanical systems such as water heating tanks should not be installed in the plant room unless the installation conforms to all applicable Acts, codes and regulations. *Section 6.2.4.3 - B52 Mechanical Refrigeration Code*

12 All relevant documents including logbook, operational manual, MSDS, Standard Operational Procedures, piping scheme chart and emergency procedures should be readily available to the plant operators. Operating Engineer Regulation (OER)

13. Electrical panels require proper lock out and access by qualified competent personnel only. *Ontario Electrical Code and OHSA*

14. All moving equipment parts require proper guarding. *OHSA*

15. Lighting switches should be within easy access at plant room entrances upon entering the room. Lighting should be adequate and properly maintained. *OHSA*

16. All required fire suppression equipment must be in proper working order. *Ontario Fire Code*

17. There should be NO storage of unrelated plant room operational items (light bulbs, paper products, cleaning supplies etc.) *Ontario Fire Code*

18. Posting of the typical safe operating temperature ranges and pressures is considered an industry best practice. *ORFA*

**Checks and Balances**

- Is your refrigeration plant room on your internal housekeeping schedule of activities?
- Is there a general maintenance plan in place to deal with rust and aging paint conditions?
- Does staff play a key role in the ongoing general maintenance and upkeep activities of the plant room and surrounding areas?
- Does the plant room feel safe, secure and welcoming?

## Conclusion

Government agencies can be a valuable resource and are there to help ensure your personal and the general public's safety. Working with your Joint Health and Safety Committee, refrigeration contractor, Ministry of Labour Inspector and TSSA Inspector is the best way to stay compliant.

The ORFA has compiled this guide as awareness for to assist you the plant operator in being aware of the variety of legislative operational requirements that may impact your operation. One design scheme that would work in any refrigeration plant there are too many variables from facility to facility and is beyond

our expertise. Ensuring compliance to all applicable legislation is the responsibility of plant owners and operators, one which should not be taken lightly.

All too often poor operational habits become the norm. A dirty, poorly lit mechanical room that has no or little ongoing housekeeping activity is unacceptable and not the way business should be conducted.

***The refrigeration room is the "heart" of the operation. The staff is the "lifeblood". Remember when the heart fails there is no further need for the lifeblood.***

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