

FLAMMABLE LIQUIDS STORAGE

Introduction

This guideline is designed to help you store flammable liquids safely. It is based on the requirements of the Ontario Fire Code, Part 4, and of the Regulations for Industrial Establishments (R.R.O. 851/90), for storing flammable liquids in **industrial workplaces*** under the following conditions. They are:

- For incidental use
- In closed containers

If you are storing flammable liquids in storage tanks, or if storage is your principal activity, consult the Ontario Fire Code, Part 4, for applicable requirements.

*Note: some words or phrases are defined in the glossary at the back of this guideline.

Storing Flammable Liquids

To store flammable liquids safely, or if you are designing a flammable liquids storage area, consider the following:

- Design and construction of storage containers
- The class of flammable liquids
- The quantity to be stored
- Your storage location
- How it will be used
- Ventilation
- Fire protection
- Control of ignition sources

Storage Containers

Containers used to store flammable or combustible liquids, having a capacity of not more than 230 litres, must conform to one of the following:

- The “Transportation of Dangerous Goods Regulations”
- CSA B376-M (R2003) “Portable containers for Gasoline and Other Petroleum Fuels” (up to 5 gallons/25 litres)
- ULC/ORDC30 “Safety Containers”
- CSA-B306, “Portable Fuel Tanks for Marine Use”
- Section 6 of CSA-B620, “Highway Tanks and Portable Tanks for the Transportation of Dangerous Goods”

Containers of not more than 1 litre capacity used for flammable liquids (5 litres for combustible liquids) are exempt from the above requirement. Ensure that all containers, in storage, have WHMIS supplier labels affixed to them.

Never use plastic or glass containers for storing flammable liquids unless storage in metal containers would affect the required liquid purity or if the liquid would cause excessive corrosion of the metal container.

Class

What is the class of the flammable liquid?

Flammable liquids have flash points below 37.8°C, and include solvents such as acetone, ethyl alcohol and xylene. They are classified according to their flash points and boiling points as follows:

	Flash Point	Boiling Point
Class 1A	below 22.8°C	below 37.8°C
Class 1B	below 22.8°C	at or above 37.8°C
Class 1C	at or above 22.8°C but below 37.8°C	

Source: Section 4.1.2.1 (2), Ontario Fire Code (O. Reg. 213/07)

The lower the flash and boiling points, the more hazardous the liquid; therefore, the storage restrictions are greater. If liquids with flash points at or above 37.8°C are stored at temperatures above their flash points, they must be stored as Class 1 liquids. To determine the flash and boiling points of the liquids you will be storing, consult your suppliers' material safety data sheets (MSDSs).

Quantity

What is the quantity to be stored?

Small quantities, up to 250 litres* of flammable liquids (or 600 litres of flammable and combustible liquids), in closed containers, may be stored outside of fire-separated rooms or storage cabinets, in anyone fire compartment. Of this, **not more than 100 litres shall be Class 1A liquids**. Greater quantities may be stored but must not exceed one day's normal requirements.

*Note: the Fire Code does not have the 250 L restriction for flammable liquids.

It is advisable not to store any quantity of flammable liquids in basement areas*.

*Note: the Fire Code permits up to 5L of flammable liquid in safety containers in the basement (see Ontario Fire Code, 4.1.5.9).

Do not store containers in or near exits (either inside the building or outside), elevators or access routes to exits.

What about quantities above 250 Litres?

For quantities greater than 250 litres, in closed containers, you have the following storage options:

- In metal cabinets
- In a general storage area in the workplace (Note: as Section 4.2.8.4 outlines requirements if quantities exceed 4.2.8.2(1))
- In a fire-separated room in the workplace
- Outdoors
- Flammable liquid warehouse (see Ontario Fire Code, 4.2.7)

Storage Options

Metal Cabinets

Up to 250 litres of flammable liquids (500 litres of flammable and combustible liquids), in closed containers, may be stored in a metal cabinet. A total quantity of 750 litres of Class 1 liquids (1,500 litres of flammable or combustible liquids) may be stored in a group of cabinets in a single fire compartment.

You may increase the quantities you can store by using additional groups of cabinets, but there must be a minimum distance of 30 metres between groups of cabinets permitted above.

Ensure that cabinets used for container storage:

- Conform to ULC Standards C1275 "Storage Cabinets for Flammable Liquid Containers"
- Are labelled in conspicuous lettering to indicate that the cabinet contains flammable materials and that open flames must be kept away

If the storage cabinet has ventilation openings, make sure that the ventilation openings are sealed or that the cabinet is vented outdoors. The sealant material or the vent piping must provide fire protection equal to that required for the construction of the cabinet.

General Storage Area

Storage in quantities greater than 250 litres of flammable liquids, but not exceeding that specified in Ontario Fire Code, Section 4.2.8.4(4), in closed containers, is permitted in general storage area, provided that:

- The area is sprinklered in accordance with article 3.2.3.3 of the National Fire Code, 2005 – the protection offered must equal that required for Class IV commodities (as defined in NFPA 13) stored to a height of 6 meters;
- Storage height does not exceed those set out in Table 4.2.7A which includes a maximum of 1.5 m for Class 1A liquids and 2.0 meters for Class 1B and 1C liquids;
- When a single class of liquid is stored, not more than 2,500 litres of Class 1B and 1C liquids (5,000 litres of Class II or 10,000 litres of Class IIIA liquids) are stored in a single fire compartment (the above quantity applies to a single fire compartment and not an individual storage area).

If you are storing Class 1B and Class 1C liquids with combustible liquids in the same fire compartment, consult the Ontario Fire Code [article 4.2.8.4(5)] for the formula you must apply to determine if the quantities you are storing fall within the permissible limit of the formula.

If you are storing Class 1B, Class 1C and combustible liquids in the same individual storage area, the total quantity of all classes of liquid storage must not exceed 2,500 litres (which is the maximum permitted for the liquid with the lowest limit).

Fire-separated Room in the Workplace

A room in which flammable liquids, in sealed containers, are stored must:

- Be separated from the rest of the building by partitions which have:
 - A fire resistance rating of at least one hour based on quantity stored (consult the Ontario Fire Code, 4.2.9)
 - Self-closing doors, hinged to swing outwardly on their vertical axes
- Be equipped with:
 - A drain connected to a dry sump or holding tank
 - Liquid-tight seals between interior walls and floor, and a liquid – tight ramped sill at any door opening which is not in an exterior wall
- Be designed to prevent spills from flowing outside the spill areas
- Have continuous mechanical or natural ventilation to the outdoors by upper and lower exterior wall gravity louvers. For this reason, where natural ventilation is provided, the room should be located along an exterior wall or portion of an exterior wall of the building

The following table shows the maximum quantities that you are permitted to store.

The Storage densities are averaged over the total room area.

Max. Total Quantity of Liquid (litres)	Min. Fire Separation around Storage Room, Hr.	Max. Density (litres/sq. metre)
10,000	2 hours	200
1,500	1 hour	100

Source: Table 4.2.9A., Ontario Fire Code (O. Reg. 213/07)

If you are storing Class 1A liquids in sealed containers, any Class 1 liquid in open containers, or if you are dispensing flammable liquids in the room, make sure that the room meets all the above requirements, and that:

- There are no potential sources of ignition in the room
- It is designed in conformance with good engineering practices, to prevent critical structural and mechanical damage from internal explosions
- It has a spark resistant floor*

*Note: the Ontario Fire Code does not have this specific requirement, however, it has requirements to control all sources of ignition, see 4.1.5.3.

If you are dispensing flammable liquids in the room, and its area is greater than 15 square metres or if the distance from any point in the room to an exit door is greater than 4.5 metres, you will need to make sure that:

- The room is located in a floor area that has at least two exits
- The room has at least two exits doorways and distance between doorways is at least three quarters of the length of the diagonal distance of the room
- One exit doorway is located not more than 23 meters from any point in the room
- The doors are self-closing and hinged to swing outwards on their vertical axis

Ensure that the area where flammable liquids are dispensed has mechanical ventilation from floor level to the outdoors at the rate of 18 cubic meters per hour per square metre of floor area*.

*Note: the Ontario Fire Code requires sufficient ventilation to ensure that flammable vapour concentrations outside the Class 1, Div. 1 zone does not exceed 25% of the lower explosive limit, Ontario Fire Code, 4.1.7.2.(3).

Arrange the contents of storage rooms to provide aisles at least 1 metre wide. If the room is protected by an approved sprinkler system or an equivalent fixed suppression system (as per Ontario Fire Code, 4.2.7.7), the maximum quantities and densities in the above table may be doubled.

However, the maximum quantities of Class 1 liquids that you are permitted to store in a single fire compartment in an unprotected storage room with a fire separation of at least 2 hours is 2,500 litres of Class 1A liquids or 10,000 litres of Class 1B and 1C liquids.

If you are storing Class 1A, 1B and 1C liquids in the same fire compartment, or along with combustible liquids, refer to Table 4.2.7.A. (unprotected storage) and article 4.2.7.5.(4) for the maximums for flammable and combustible liquids and the formula you must use to determine if the quantities you are storing fall within the permissible limit of the formula.

If you are storing liquids with different flash points in the same individual storage area, the maximum quantity you are permitted to store is the maximum allowed for the liquid with the lowest flash point.

Outdoor Storage

If you are storing flammable or combustible liquids outdoors, ensure that:

- Containers are piled away from buildings (especially building exits), employees, and ignition sources
- There are physical separations between areas, storage piles, buildings and property lines to act as a barrier against the spread of fire
- The total quantity of flammable liquid per pile does not exceed 5,000 litres for Class 1A flammable, or 15,000 litres for Class 1B or 1C flammable the total quantity of combustible liquid per pile does not exceed 35,000 liters for Class II, and 85,000 litres for Class IIIA liquids

- Where liquids of different flash points are stored in the same pile, the maximum quantity in the pile does not exceed the maximum for the liquid with the lowest flash point
- The minimum distance between piles is 1.5 metres
- The minimum distance to a property line or to a building on the same property is at least 6 metres
- There are measures in place to accommodate spillage that conforms to section 4.1.6 of the Ontario Fire Code
- A fence at least 1.8 metres high surrounds the facility to discourage climbing and unauthorized entry
- Gates are kept locked when the facility is not staffed

Additional Requirements

The following are some fire prevention and protection measures and precautions that are necessary to ensure the safety of all personnel and of the environment.

Indoor Storage

Locate fire compartments, individual storage areas, and storage rooms away from exits and main aisles leading to exits. Post warning signs identifying flammable and combustible liquid storage locations as hazardous areas. Keep aisles free of obstructions to allow access for firefighting purposes at all times. Ensure that all electrical equipment in flammable liquid storage locations conform to the Ontario Electrical Safety Code.

Indoor and Outdoor Storage

- Ensure that storage areas are cool and dry (flammable and combustible liquids exposed to heat can release vapours causing fire and explosion hazards)
- Keep ignition sources away. Enforce strict “No Smoking” rules

- Store flammable and combustible liquids away from other dangerous goods (e.g., materials known as oxidizers can promote fires and explosions and thus should never be stored with flammable liquids)
- Don't store combustible materials other than those used for the packaging of flammable or combustible liquids in the same individual storage area with these liquids
- Check your supplier's MSDS for any specific storage precautions, and make sure these are followed
- Ensure that storage locations are equipped with Type B fire extinguishers in accordance with Section 6 of the Ontario Fire Code
- Enforce housekeeping measures to keep storage areas free of ground vegetation (outdoor storage) and combustible materials
- Provide approved containers for disposal of cleaning rags and other waste
- Ensure that piles are stable to prevent toppling which can result in containers getting damaged
- Post spill control procedures in locations where flammable and combustible liquids are stored, and ensure that employees are trained in these procedures
- Ensure that your fire safety plan covers all areas where in excess of 250 liters of Class 1 Liquids or a total of 500 litres of combustible and flammable liquids are stored
- Ensure that storage areas are designed to contain spills, including the water used for firefighting purposes
- Ensure an emergency spill kit is readily available for use

Applicable Legislation

- Regulation for Industrial Establishments (R.R.O. 851/90), Sections 22, 121 and 122
- The Ontario Fire Code (O. Reg. 213/07), Part 4: Flammable and Combustible Liquids Sections 4.1-4.12
- National Fire Code of Canada, 2005: Subsection 3.2.3: General Indoor Storage, Table 3.2.7.6: Separation Chart for Storage of Dangerous Goods – Classification 3: Flammable and Combustible Liquids
- The Workplace Hazardous Materials Information System Regulation (R.R.O. 860/90)
- Ontario Electrical Safety Code (O. Reg. 10/02)
- The Ontario Building Code (O. Reg. 403/97)
- Technical Standards and Safety Act, Regulation 217/01 – Liquid Fuels
- Technical Standards and Safety Act, Regulation 213/01 – Fuel Oil

Resources

Ontario Ministry of Community Safety and Correctional Services,

- Office of the Fire Marshal: Commentary on Part 4 of the Ontario Fire Code, O. Reg. 388/97, 2001
- Audit Guide to Part 4 of Ontario Fire Code, August 1998

Ministry of Municipal Affairs and Housing:
Supplementary Guidelines to the Ontario Building Code, 1997, SG.2 “Fire Performance Ratings”

National Fire Protection Association Standards,

- NFPA 13: “Standard for Installation of Sprinkler Systems”
- NFPA 68: “Guide for Venting of Deflagrations,”
- NFPA 30: “Flammable and Combustible Liquids Code,”

Glossary

Boiling Point – The temperature at which a liquid usually changes to a vapour at normal atmospheric pressure.

Closed Container – A container sealed by a lid or other device in a way that liquid or vapour will not escape from it at ordinary temperatures

Combustible Liquid – A liquid having a flash point at or above 37.8°C and below 93.3°C. These are subdivided into Class II and Class IIIA liquids.

Combustibles – Any solid, liquid, or gaseous material (e.g., wood, paper, cardboard, cloth) not classified as “flammable” that is capable of catching fire and burning.

Dangerous Goods – Products or substances regulated by the Transportation of Dangerous Goods Act (Canada) and its Regulations.

Fire Compartment – Areas in the workplace where specified quantities of flammable or combustible liquids are stored. Unless the containers are stored in metal cabinets, fire separations must generally be installed between fire compartments.

Fire Resistance Rating – The time in hours that a material will withstand flames or heat passing through when exposed to fire under specified conditions of test and performance criteria.

Fire Separation – A barrier against the spread of fire that may or may not have a fire-resistance rating.

Flammable Liquid – A liquid with a flashpoint below 37.8°C and lowering a vapour pressure not more than 275.8 kPa (absolute) at 37.8°C a flammable liquid, within a container, gives off enough vapour to form an ignitable mixture with air near the surface of the liquid.

General Storage Area – Indoor storage area, as covered in Subsection 3.2.3 of the National Fire Code of Canada, 1995, where commodities or

plastics are stored in piles, on pallets, on shelves or in bin boxes or racks.

Hazardous Room – A room containing a substance which, because of its chemical nature, the form in which it exists or the manner in which it is handled or processed, may explode or become easily ignitable creating a condition of imminent hazard to a person's health or safety.

Incidental Use – Storage and use of flammable liquids is incidental or secondary to the principal activity in the industrial workplace. Manufacturers of electronic equipment and furniture, and automobile plants are some example of locations where the storage and use of flammable liquids is secondary to the principal activity of manufacturing consumer products.

Individual Storage Area – An area occupied by piles, bin boxes, racks or shelves, including aisles providing access to stored product, which is separated from adjacent storage by aisles at least 2.4 metres wide.

Industrial Workplace – A building or part of a building used to assemble, fabricate, manufacture, process, repair or store goods or materials.

Oxidizer – A substance that causes or contributes to the burning of another material by yielding oxygen or any other oxidizing substance.

Pile – Groups of containers (i.e., drums or other prepackaged containers) of flammable liquids that are stacked or piled on floors or pallets.

Sprinklered – Equipped with a system of automatic sprinklers.

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Revised: October 2011