



RISK RESILIENT

Storage of Flammable and Combustible Liquids

The use of flammable and combustible liquids is common in industrial operations. For example, paint, stain, varnish, thinner, cleaning solvent, fuel, and oil are just a few of the common types of liquids found in industrial plants, woodworking shops, and automotive shops. Understanding the exposure and safe storage of these liquids is critical to help limit potential losses.

Know the Risks

Liquids labeled 'flammable' and 'combustible' present a potentially serious fire and safety hazard – especially if they're not stored properly and in accordance with building code, and fire and safety codes. As their labels and Material Safety Data Sheet (MSDS) suggest, these liquids can easily catch and quickly spread fire. Fire involving flammable and combustible liquids is especially difficult to extinguish. At ambient temperature, flammable liquids could give off enough vapours to fuel an explosion.

Classifying Flammable and Combustible Liquids

Flammable and combustible liquids are categorized based on their flash points, which is a measure of how easily they will ignite. The lower the flash point the higher the hazard. Even though they're called flammable and combustible liquids, it's actually the vapours they give off so readily that are dangerous.

Flammable liquids, or Class I liquids, have flash points below 37,8 °C [100 °F] and are further subdivided¹:

- **Class IA:** Flash point below 22,8 °C [73 °F], boiling point below 37,8 °C [100 °F]
Examples: ethylene oxide, methyl chloride, ethyl ether, and pentane
- **Class IB:** Flash point below 22,8 °C [73 °F], boiling point at or above 37,8 °C [100 °F]
Examples: acetone, benzene, ethyl alcohol, gasoline, hexane, methanol, toluene, and isopropyl alcohol
- **Class IC:** Flash point at or above 22,8 °C [73 °F] and below 37,8°C [100 °F]
Examples: butyl alcohol, diethyl glycol, styrene, xylene, and turpentine

¹ This classification is applied by the National Fire Code of Canada (NFCC) and the National Fire Protection Association (NFPA). Other organizations may have other definitions. For example, according to the Transportation of Dangerous Goods Regulation (TDG), a flammable liquid has a flashpoint less than or equal to 60 °C [14 °F]¹. Therefore, a liquid not defined as a dangerous good for the TDG may be a combustible liquid of class III according to the NFCC and NFPA).

Combustible liquids, or Class II and III liquids, have flash points at or above 37,8 °C [100 °F] and are further subdivided:

- **Class II:** Flash point at or above 37,8 °C [100 °F] and below 60 °C [140 °F]
Examples: diesel fuel, pine tar, kerosene, mineral spirits, naphtha, and most oil-based paints
- **Class IIIA:** Flash point at or above 60 °C [140 °F] and below 93 °C [200 °F]
Examples: creosote oil, fuel oil #1, formic acid, used motor oil, and formaldehyde
- **Class IIIB:** Flash point at or above 93 °C [200 °F]
Examples: Various types of vegetable oils, motor oil, antifreeze, brake fluid, power steering fluid, water-based paints, transformer oil, peanut oil, hydraulic fluid, lubricating oils, transmission fluid, and grease

According to the Canadian Center for Occupational Health and Safety², for a flammable or combustible liquid fire to start, a mixture of vapor and air must be ignited.

Ignition sources may include:

- Sparks from electrical tools and equipment
- Sparks, arcs, and hot metal surfaces from welding and cutting
- Tobacco smoking
- Open flames from portable torches and heating units, boilers, pilot lights, ovens, and driers
- Hot surfaces such as boilers, furnaces, steam pipes, electric lamps, hot plates, irons, hot ducts and flues, electric coils and hot bearings
- Embers and sparks from incinerators, foundry cupolas, fireboxes, and furnaces
- Sparks from grinding and crushing operations
- Sparks caused by static electricity from rotating belts, mixing operations or improper transfer of flammable or hot combustible liquids



U.S. municipal fire departments responded to an estimated average of

160,910 fires per year

involving ignition of a flammable or combustible liquid as the type of material first ignited. These fires caused estimated losses of

454 civilian deaths per year, 3,910 civilian injuries per year, and \$1.5 billion in direct property damage per year.

Source: National Fire Protection Association. Fires Starting With Flammable Gas Fact Sheet. Retrieved November 16, 2020, from: <https://www.nfpa.org/-/media/Files/News-and-Research/Fire-statisticsand-reports/Fact-sheets/FiresStartingGasFactSheet.pdf>

2 Government of Canada. September 30, 2008. How Do I Work Safely with - Flammable and Combustible Liquids (General). Retrieved December 16, 2020 from: https://www.ccohs.ca/oshanswers/prevention/flammable_general.html

Be Prepared

The following safety guidelines for the safe storage of flammable and combustible liquids are outlined in the National Fire Protection Association - Standard NFPA 30 "Flammable & Combustible Liquids Code".³

Housekeeping

The room where flammable and combustible liquids are kept should be neat and clean and free of any general storage items. It must be restricted to keeping flammable liquids isolated.

Ventilation Systems

Proper ventilation is essential to help remove flammable vapors from the workplace environment, not to mention reduce health risks for employees.

The amount of ventilation required depends on the materials used and the size/layout of the space. These factors will help determine whether your operations require a gravity system or continuous mechanical exhaust ventilation. Mechanical ventilation systems should provide at least 1 cfm³ of exhaust air for each square foot of floor area, but no less than 150 cfm³. Exhaust air should be taken from a point within 300 mm of the floor. For gravity systems, the make-up air should be supplied from outside the building.

Use non-ferrous fan blades and explosion-proof electrical equipment in systems used for ventilating flammable liquids. Regular cleaning of the ducts, filters, plenums, etc. will decrease the severity of any fires and will reduce the likelihood of spontaneous combustion if some self-heating material is present. Ventilation equipment used to handle solvent vapors should meet the relevant fire code requirements.

If the ventilation keeps vapor levels below the occupational exposure limit of a chemical, usually there's little risk of fire or explosion.

³ National Fire Protection Association (NFPA) #30, Classifications of Flammable and Combustible Liquids. Retrieved January 14, 2021 from: <https://www.nfpa.org/codes-and-standards/all-codes-andstandards/list-of-codes-and-standards/detail?code=30>

Electrical Standards

The electrical wiring and equipment in flammable liquid storage areas should be installed to meet requirements of the National Fire Code of Canada (NFCC) and CSA 22.1 standard Canadian Electrical Code. If flammable liquids are dispensed, mixed, or handled in open containers, then the electrical wiring and equipment should be suitable for use in Class I locations. Where only combustible liquids (Class II and Class III) are stored, general usage wiring and equipment are acceptable.

It's also important to be mindful of static electricity. When flammable liquids are mixed, dispensed or transferred, drums and containers in the storage racks must be electrically grounded to a positive ground source. Smaller containers being filled must be properly bonded to the ground connection.

Ignition Sources

Sources of ignition and all other open flames such as sparks, arcs, welding, cigarettes, and matches, must be kept out of, and at least 6 meters [20 ft] away from, the storage room.

Storage

It's critically important to store flammable and combustible liquids in accordance with the Codes that apply to your particular workplace (Building Codes, Fire Codes, Electrical Codes).

These codes detail:

- The types of storage allowed for these liquids, such as cabinets and storage rooms
- How to construct these storage areas
- The amount of flammable/combustible liquids in different types of containers that you can store in each kind of storage area

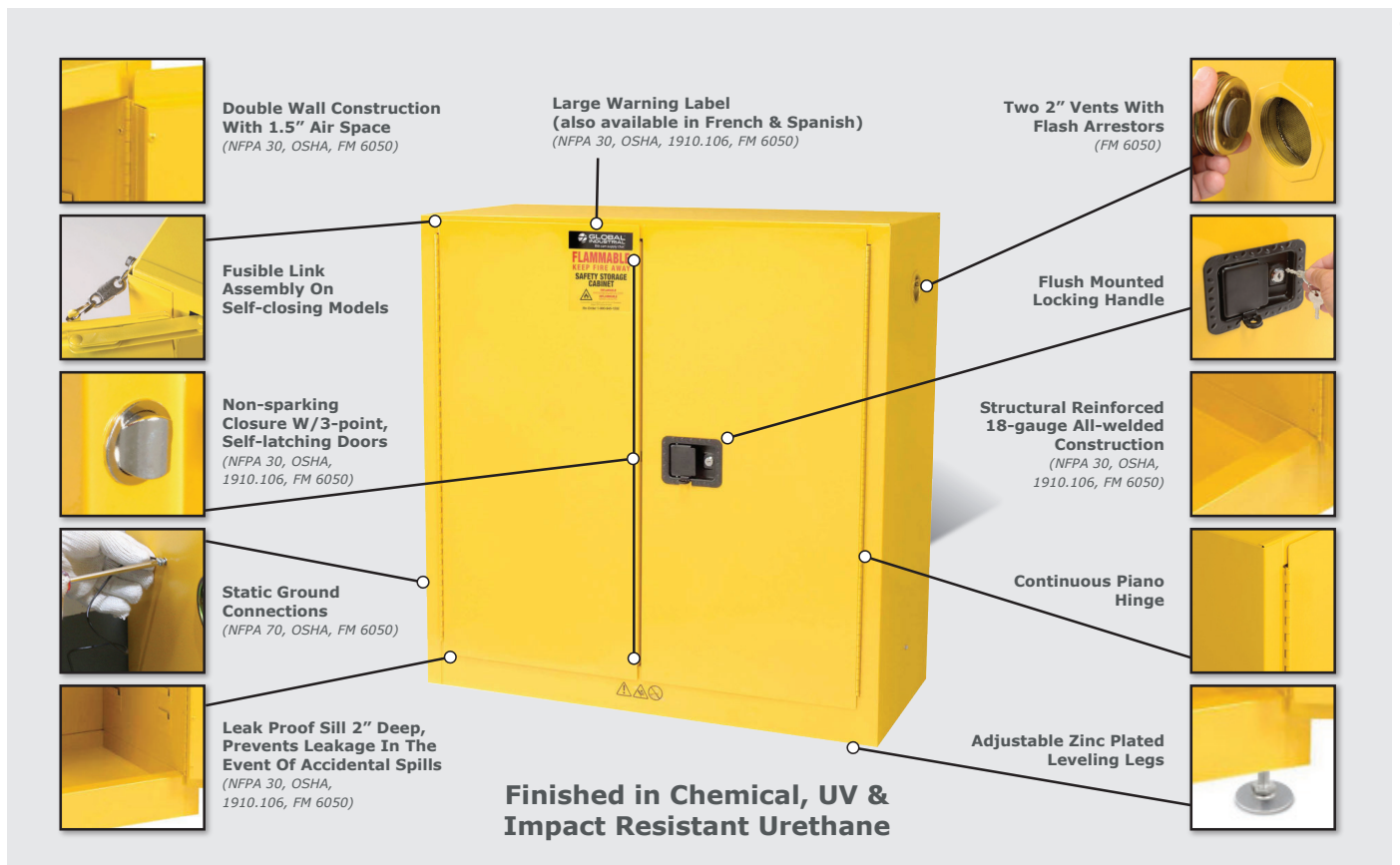
Storage Guidelines

- Keep the storage area neat, clean, and well organized.
- Keep all potential sources of ignition and open flames at least 6 meters [20 feet] away.
- Inspect containers regularly and discard any damaged or leaking containers.
- Install electrical wiring and equipment to meet the requirements for the classification of liquids being stored, according to the Canadian Electrical Code and the National Fire Protection Association.
- Use bonding and grounding devices when transferring flammables from one container to another. Bonding and grounding are essential to overcome the hazard of static electricity.

Storage Cabinet Guidelines

- Use only ULC, UL or FM listed cabinets that are approved and labeled.
- Never store more than a total of 450 L [120 US gallons] of Class I, II or IIIA in a single cabinet. The NFCC may permit up to three flammable liquid cabinets in a single control area.
- Keep cabinet's doors closed and if available, latched.
- Check automatic doors regularly for proper operation including closing hardware (fusible link devices).

Here are some cabinet features that help ensure proper storage of flammable and combustible materials⁴:

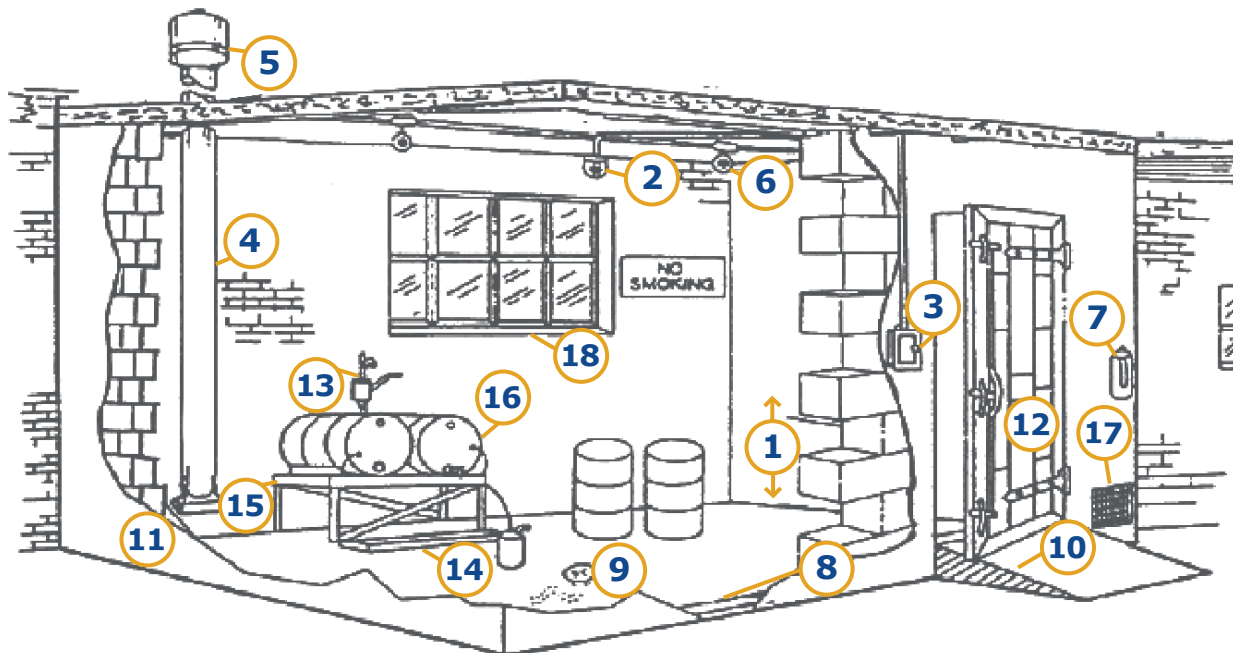


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4 BC Site Service, Commercial Property Supplies. Flammable Liquid Storage Cabinet. Retrieved November 16, 2020 from: <https://www.bcsiteservice.com/product/flammable-liquid-storage-cabinet/>

5 BC Site Service Commercial Property Supplies. Flammable-Storage-Cabinet-Features. Retrieved October 26, 2020 from: <https://www.globalindustrial.ca/c/storage/flammable-osh-a-cabinets>

Storage and Mixing Room Best Practices⁶



1. No electrical or heating equipment below the four-foot level.
2. Explosion-proof electrical equipment must be used inside the room.
3. Install electrical switches and controlling equipment outside the room.
4. Ventilator pipes (8 inches minimum diameter, with screened opening 6 inches above floor).
5. Mechanical ventilation.
6. Automatic sprinklers installed according NFPA 30 criteria.
7. Minimum 4A40BC dry chemical fire extinguisher.
8. Liquid-tight floor pitched to drain.
9. Floor drain (2-inch minimum drainpipe) to safe outside location.
10. Four-inch raised sill with double ramp or grate-covered trench across door.
11. Inside rooms, walls & ceilings must be constructed to meet the fire resistance rating as specified in the National Fire Code.
12. Automatic-closing fire door.
13. Drum pumps or self-closing faucets must be used to dispense flammable liquids.
14. Metal pan to catch flammable/combustible liquid drippings.
15. Grounded steel rack holds drums for dispensing.
16. Drums, racks, and containers being filled must be bonded and grounded.
17. Air inlet; opening protected by fire damper
18. Explosion-venting wire-glass window.

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⁶ National Fire Protection Association (NFPA) #30, Flammable and Combustible Liquids Code. Paragraph 18.6. Retrieved January 14, 2021 from: <https://www.nfpa.org/codes-and-standards/all-codes-and-standards/list-of-codesand-standards/detail?code=30>