# Safe Usage of Flammable Liquids in Cleaning Operations

Nearly every place of business has occasion to use flammable or combustible liquids. Often times solvents are used in cleaning operations or at point-of-use in production lines. OSHA regulations require that flammable liquids be kept in covered containers. Fulfillment of this requirement is met in great part by the use of several types of Justrite FM approved specialty containers.

**Plunger Cans for Moistening Cleaning Rags**
FM approved plunger cans provide the safest method of wetting cloths with flammable liquids for cleaning parts and equipment. The cans are constructed with a spring-loaded pedestal on which a dispensing tray with a perforated metal flame arrester is mounted. A cloth placed in the tray is pressed down to pump liquid from the can into the tray, wetting the cloth. When the cloth is picked up, any excess liquid safely drains back into the can. Can bodies are galvanized steel or polyethylene, come in different sizes, and are offered in red or yellow to help differentiate liquids or for use by different work shifts.

**Bench Cans for Cleaning**
FM approved bench cans are recommended for dipping and rinsing of small parts and also for wetting of large cloths with flammable liquids.

A perforated, spring-loaded dasher tray covers the opening of the wide, shallow can. Flammable liquid in the can is below the tray level and the tray itself serves as a flame arrester screen. Large cleaning cloths put onto the tray and pressed down are wetted with liquid, the excess of which will drain off safely when the dasher is allowed to return to its upper position above the liquid level.

Small parts put onto the dasher tray and lowered into the liquid are also drained automatically when the dasher is allowed to rise. For convenience in handling, a parts basket that fits into the dasher tray permits immersing small parts. A variety of sizes are available.

**FM approved Rinse and Cleaning Tanks**
Tanks for dipping or washing parts in flammable liquids are available in floor and bench styles. Justrite floor-type 11 gallon (42 Litre) and 22 gallon (84 Litre) rinse tanks have self-closing lids which are opened by a foot bar. A pneumatic check prevents lid banging and hand injuries when the lid opener is released.

Justrite bench-style wash and dip tanks are manufactured in round configurations up to 8 gallon (30 Litre) capacity. Both types have manually operated lids which remain open while the tank is in use. In the event of fire in the tank, a fusible link which melts at 165°F (74°C) causes the lid to close automatically to snuff out the flame.

Drain baskets facilitate washing quantities of small parts quickly. The operator simply places parts in the drain basket, agitates the basket in the solvent to clean away dirt and grease and lifts the basket to the drain position.

All parts being cleaned in tanks of flammable liquids, whether small parts in drain baskets or larger workpieces that are individually washed, should be thoroughly drained before being taken away from the tanks.

Filling and draining of rinse and dip tanks must be done with safety containers. Regular safety cans may be used to fill and replenish tanks while safety drain cans should be used to empty contents.

**Dispensing Containers**
Dispensing containers are a convenient way to apply small amounts of flammables. A polyethylene dispensing bottle with a stainless steel wire allows the stem to be shaped to reach "hard-to-get-at" areas. A simple squeeze can target liquids directly onto parts or cleaning cloths.

FM approved nonmetallic dispenser cans permit easy, one-hand application of liquid onto work surface or into a small vessel such as a laboratory beaker. Brass dispenser valve is leakproof and self closes when released to minimize spills and control excess.





# Safe Waste Accumulation

Waste disposal equipment and methods are as important in fire prevention programs as safety procedures in supply and use of fresh materials. Flammable liquids may actually become more hazardous when contaminated and oily and combustible wastes present hazards that are not present in unused rags and paper stocks.

Flammable liquid waste must be collected, transferred and stored with approved safety containers and procedures. Use of unapproved containers, such as open pans or cans for intermediate containment between waste collection and disposal points, is an invitation to flaming disaster, as well as a valid cause for OSHA citations and fines.

**Flammable Liquids Disposal**

Waste disposal drums used for collection of flammable liquids require proper grounding of the drum and bonding of the container being emptied to the receiving funnel. Use of a specially designed safety funnel provides a safe, convenient way of filling disposal drums. It has a flame arrester tube that absorbs and dissipates heat, preventing any external ignition sources (like sparks from power tools, static electricity, cigarettes) from reaching the drum's flammable contents. A hinged lid remains open for convenient filling and can be closed to reduce the spread of vapors. If left unattended and open, a fusible link in the self-closing lid will melt at 165°F (74°C), triggering a shutting mechanism to automatically close the lid to extinguish the flames.

*Large diameter safety drum funnels come in different tube lengths for easy collection of waste solvents without spills and mess.*

Justrite large steel safety funnels are FM approved and accept a padlock for security. Flame arrester tube lengths are 6" (152mm) or 32" (813mm) for greater liquid flow. For viscous flammable or nonflammable liquids, a 33" (838mm) open end solid brass tube directs liquid flow inside drum. A small capacity funnel is also available for 5 gallon (19 Litre) pails.

**Safety disposal cans** have a large diameter spout to minimize the chance of spills during filling. The lid locks open for filling convenience and has a built-in flame arrester to prevent fire intrusion. Lid closes with a touch of the finger and will automatically vent to protect against rupture or explosion.

Justrite nonmetallic safety disposal cans should be bonded to metal containers being drained or filled and they can be used for corrosive as well as flammable liquids. Both 2 and 5 gallon (8 and 19 Litre) sizes are FM approved.

**Safety disposal cans with quick disconnect fittings** are ideal for collection of waste from HPLC (high performance liquid chromatography) machines. They are FM approved and safeguard against knock-over spills and broken glass common with fragile bottles and carboys, and provide a "closed" system from the HPLC machine directly to the safety can. Quick disconnect coupling (made of stainless steel or polyethylene) offers a fast and safe means of detaching can from the HPLC process without having to disengage any tubing already connected to the HPLC machine. Both coupling and disconnect are valved to prevent vapor release or solvent leakage during the collection and disposal processes. Justrite "HPLC cans" are FM approved in 1, 2, and 5 gallon (4, 8, and 19 Litre) sizes and can be customized with additional fittings to suit specific applications.

*HPLC can accessories offer added convenience and protection. A manifold option safely collects waste from multiple machines; an accessory filter provides important hazardous vapor and odor control.*

## Disposal of Solvent Soaked Rags

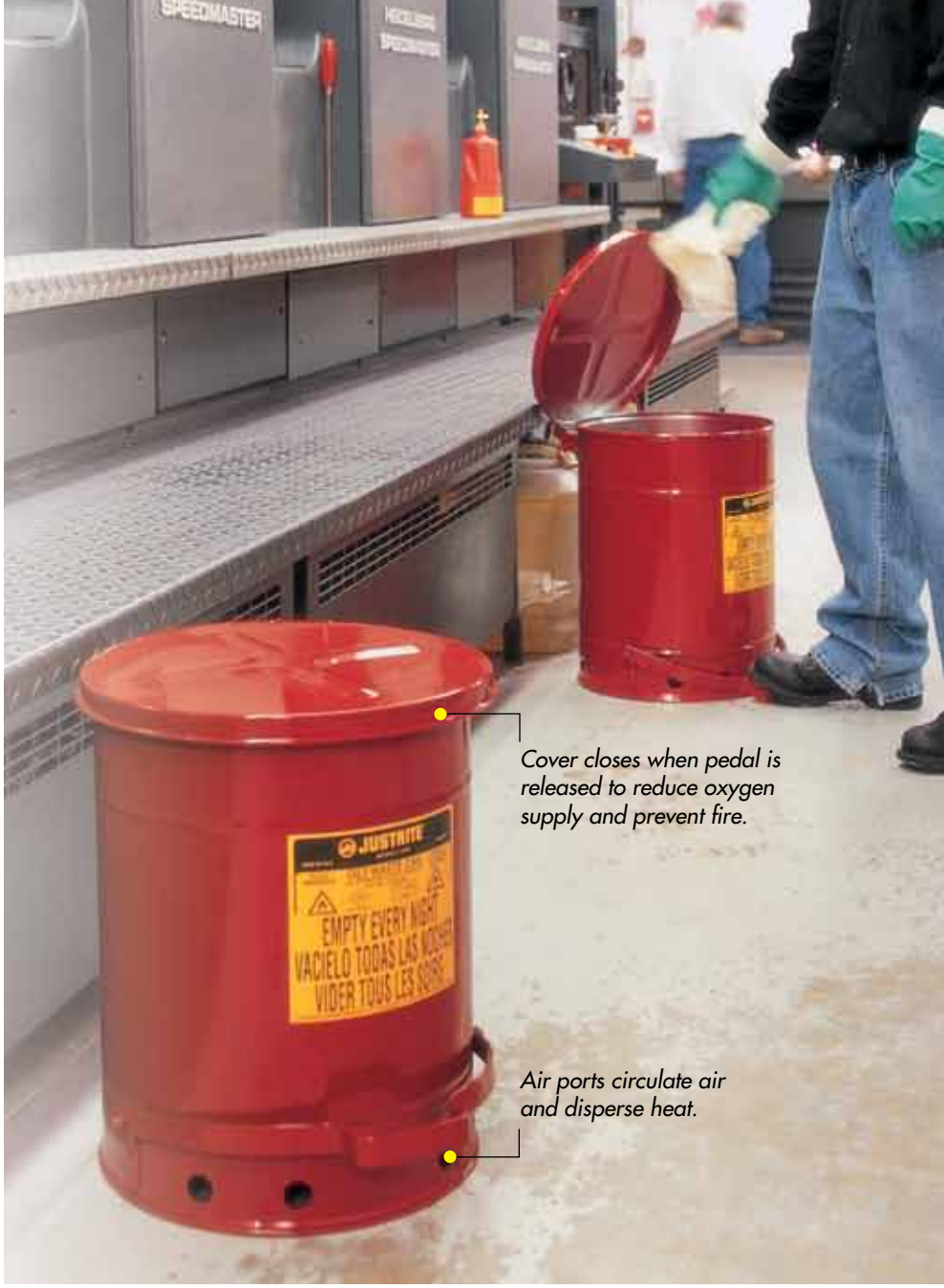
**Oily Waste Cans** are essential whenever cloths, wipes, and cleaning rags are used. Rags containing solvents, thinners, linseed oil, combustible adhesives, and other flammable liquids present a serious fire risk when improperly discarded. Specially designed steel oily waste cans protect a facility from fires that can start due to spontaneous combustion, sparks, or careless use of smoking material.

The self-closing lid on the can is an effective block to fire transmission from outside the can. Any fire transmitted to can contents while the lid is open is immediately snuffed out when the lid closes.

The volume of waste in the can, air availability and the length of time the waste has been allowed to remain in the can are factors in heat generation that precede spontaneous combustion. The first and most obvious safety precaution is frequent emptying – "at least once daily at the end of each shift" as specified by OSHA.

To help prevent temperature build-up, the cans are designed with the bottom elevated above the floor so that there is air circulation to dissipate heat.

Justrite oily waste cans are built in a range of sizes and all are FM approved.




*Cover closes when pedal is released to reduce oxygen supply and prevent fire.*

*Air ports circulate air and disperse heat.*

*Different color cans help segregate waste rags.*

*Self-closing drum cover with fusible link.*

**Safety Drum Covers** provide a cost effective way to convert ordinary open head drums into fire-safe receptacles for combustible trash or solvent soaked rags. A self-closing cover stays open during use and is equipped with a fusible link to automatically slam the cover shut under fire conditions. A variety of FM approved Justrite drum covers are available including a self-latching, gasketed cover to control VOC emissions to meet EPA and NESAM (National Emissions Standards for Aerospace Manufacturing).

## Disposal of Non-Oily Waste

**Cease-Fire® Waste Receptacles** are designed to self-extinguish accidental fires in waste paper and other solvent-free waste. Justrite FM approved receptacles in a range of sizes and colors are equipped with tops or heads having a large center opening for receiving the waste and a domed rim surrounding the opening. Smoke and gas from a fire inside the receptacle rise under the head rim and are directed back into the combustion area, cutting off outside oxygen supply and extinguishing the fire in a matter of seconds.

**How "Cease-Fire" extinguishes fire**

1. Fire starts and combustion vapors rise.
2. Baffle reverses flow.
3. Oxygen is cut off and fire dies.

## Flammable Waste Collection

**Safety Drain Cans** have wide-mouth funnels to collect waste solvents from cleaning tanks and bench cans with minimum spillage or splash. A perforated metal flame arrester in the base of the funnel lets solvents drain into can freely, protecting contents from ignition sources. Drain cans are FM approved in both 3 and 5 gallon (11 and 19 Litre) sizes.

*Safely store hazardous materials outdoors. Best practices include grounding when necessary.*

Smokers Cease-Fire® innovative self-extinguishing design reduces the risk of fire.

**Outdoor Hazardous Material Storage**

Regulations require that hazardous material containers, such as pails and 55 gallon (200 Litre) drums accumulated outdoors, be protected from direct sunlight, rain, snow and other weather conditions that cause rusting or deterioration. A containment system must be provided to ensure no possibility of leaks which can contaminate the environment.

Because requirements can vary from the Environmental Protection Agency, the National Fire Protection Association, or other local fire codes, it is critical to consult with the local authority having jurisdiction to ensure proper protection from hazardous conditions. Outdoor storage units are available in either steel construction or chemically resistant, rustproof polyethylene. Environmental advancements include outdoor sheds made of recycled polyethylene.

**Cigarette Litter**

For safe collection of cigarette butts outdoors, specially designed receptacles keep areas clean looking while reducing the risk of fire. A self-extinguishing design restricts oxygen to suffocate a lit cigarette and quickly put it out. Butts collected in the internal, removable steel pail or urn should be emptied regularly. For added convenience, a fire resistant disposal liner bag can be added to the pail, making cleaning easier. When these bags are used with Justrite FM approved receptacles, the entire system is FM approved. Receptacles are available in a range of colors and styles, including a green choice made of recycled polyethylene.

# Fire Facts You Need to Know

Fire is perhaps the most useful phenomenon ever discovered by mankind. Early man learned to make productive use of fires engendered naturally by lightning, material ejected by volcanoes and other natural occurrences. Today, fire is vital to civilization. Food, energy, transportation, industrial processing, health care, agriculture and our space program, all are dependent on the combustion process.

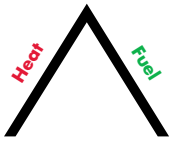
Practically every human alive recognizes fire's extraordinary usefulness and at the same time is all too aware of the extraordinary dangers it presents. Industrial and residential fires alike, present huge problems. Over 1-1/2 million fires were reported in 2006 in the U.S.; and nearly 20,000 deaths and injuries were reported. That's one fire nearly every 3 minutes. To understand how to prevent these catastrophes, following are some basic fire principles.

## What is fire?

Fire has been defined as the visible heat energy being released from rapid oxidation of a fuel. Something is "on fire" when the exothermic release of heat from the oxidation reaction reaches the visible light level.

The classic fire triangle illustrates the three components, that when combined, will result in a fire. The three legs of the fire triangle represent fuel, oxygen, and heat. Air provides oxygen for combustion. The amount of heat required for ignition varies with the characteristics of the fuel and may be introduced by a variety of sources including electric or friction sparks, open flame or heating elements. Fuel is any substance that will sustain combustion after the initial application of heat to start it. It may be paper, wood or other Class A combustible, natural or bottled gas, or the vapors from gasoline, kerosene, diesel fuel, etc. The practical emphasis is on preventing a fire from starting by prohibiting the formation of the triangle.


**The Fire Triangle**




**All three legs of the triangle must be present for a fire to start.**

Examples:

**Heat**
Mechanical sparks, static electric discharge, open flame, smoking, frictional heat, lightning

**Fuel**
A. Solids: paper, wood, plastic, fabric
B. Liquids: flammable liquids, vapor such as gasoline, cooking oil, nail polish remover
C. Gases: natural gas, propane, butane

**Oxygen** Air

**Removing any one leg of the fire triangle stops a fire from starting.**

This book deals with flammable liquids. What is it that makes them dangerous? What are the characteristics to be controlled? We must recognize, first, that it is not the liquid itself that causes the difficulty. It is vapor that forms, mixes with air and burns when the liquid is heated to its' flashpoint or above and ignited. Flammable liquid vapors form the fuel leg of the triangle. Flammable liquid vapor ignitions occur so rapidly that they are frequently described as explosions. They generate extraordinary and frightening heat and light in an instant.

## How Flammable Liquids Safety Equipment Separates the Fire Triangle

Safety equipment in use for storing, transporting or dispensing flammable liquids is designed to control one or more legs of the fire triangle.

Containment of the liquid fuel to prevent it from spreading in the event of fire is a primary function of all flammables safety equipment, including safety cans, safety cabinets, plunger and bench cans, rinse and wash tanks, waste containers and others.

Dissipation of heat to prevent flammable liquid vapor from reaching its ignition temperature is built in to certain types of safety equipment. The flame arrester is common to safety cans, faucets, bench cans, plunger cans and other equipment described earlier in this handbook. In the form of a wire mesh screen or perforated baffle plate, it permits escaping vapor to burn but dissipates heat so that vapor inside the container will not ignite or explode.

Closing out oxygen is another function of safety containers. When the lids of self-closing rinse tanks shut, they snuff out fire by closing off the oxygen supply. Self-closing lids on funnels and safety cans do the same. Oily waste cans are also designed with self-closing covers.

## Characteristics of Flammable Liquids

In order to best understand the hazards of flammable liquids, control procedures, and to interpret the tables on pages 32 to 37, a familiarity with the following terms will prove useful.

**Classifications, flammable and combustible liquids.** A flammable liquid is one having a flash point below 100°F (37.8°C) and having a vapor pressure not exceeding 40 pounds per square inch absolute at 100°F. A combustible liquid is one having a flash point at or above 100°F (37.8°C). For classifications and details, see Chart 1.

**Vapor.** In any liquid there is a constant movement of molecules. As temperature increases, molecules speed up, some acquiring enough energy to escape from the liquid surface as a vapor.

When vapor escapes from a flammable liquid into the air, a flammable or explosive situation can occur, depending upon the air/vapor mixture.

**Flash point** is the lowest temperature in any liquid at which it gives off vapors sufficient to form an ignitable mixture with the air near the surface of the liquid or within the vessel used. See Chart 2 for examples of typical flammable/combustible liquids.

**Ignition temperature** is the minimum temperature to which flammable liquid vapor in air must be heated in order to initiate or cause self-sustained combustion independent of the original heat source. An extremely small area and duration of temperature contact is all that's needed to set the flammable vapor aflame. A static spark with a duration of a few thousandths of a second, contacting a few molecules of the vapor/air mixture is enough to raise the temperature above the ignition point.

**Flammable (explosive) range** of flammable liquids is the percentage range of liquid vapor in air, by volume, within which ignition can occur, see Chart 3. Gasoline, for example, has an explosive range between 1.4% and 7.6 %. This indicates that any concentration of gasoline vapor in air between these percentage limits will ignite at any temperature at or above its flash point when an ignition source provides a contact temperature in the range of 500° to 800°F (260 to 426.6°C) (ignition temperature).

Explosive range figures are based on normal atmospheric pressures and temperatures. There may be considerable variation in the explosive range where other pressures and temperatures are present. Increases in temperature will widen the explosive range. Pressure differences depend on the flammable liquid involved; but substantial pressure decreases will generally narrow the explosive range.

**Chart 1: Classification By Flash Point**

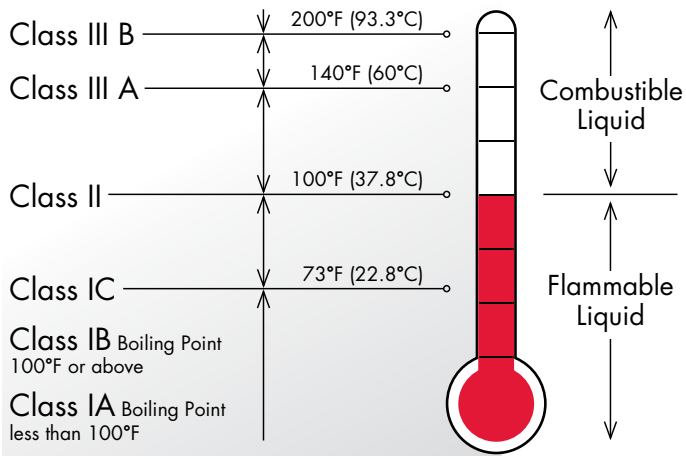
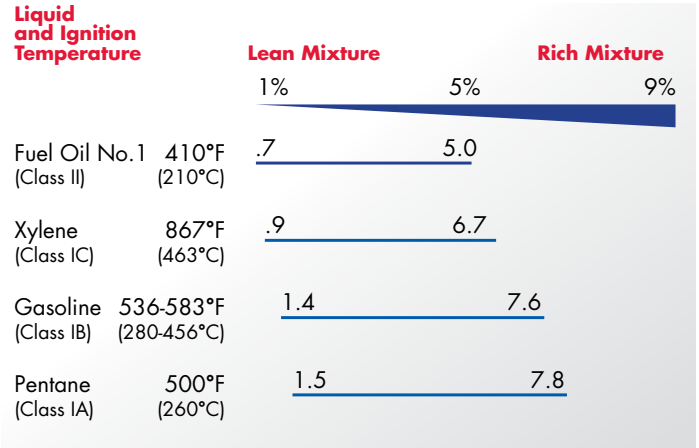



**Chart 2: Typical Flammable/Combustible Liquids**

| Classification | Chemical | Flash Point | Boiling Point |
|---|---|---|---|
| Class IIIB (at or above 200°F) | Lubricating Oil, Turbine, Hydraulic Brake/Trans Fluid | 400°F (204°C) 250-450°F (121-232°C) | |
| Class IIIA (at or above 140°F) | Heavy Fuel Oil No. 6 Aniline | 150-270°F (66-132°C) 158°F (70°C) | 364°F (184°C) |
| Class II (at or above 100°F) | Mineral Spirits Kerosene (Fuel Oil No.1) | 104°F (40°C) 100-162°F (38-72°C) | 300°F (149°C) 304-574°F (151-304°C) |
| Class IC (at or above 73°F) | Xylene Turpentine | 63°F (17°C) 95°F (35°C) | 292°F (144°C) 300°F (149°C) |
| Class IB (below 73°F) (boils at or above 100°F) | Methyl ethyl ketone Acetone Gasoline | 16°F (-9°C) -4°F (-20°C) -45 - -36°F (-43 - -38°C) | 176°F (80°C) 133°F (56°C) 100-400°F (38-204°C) |
| Class IA (below 73°F) (boils below 100°F) | Pentane Ethyl Ether | <-40°F (<-40°C) -49°F (-45°C) | 97°F (36°C) 95°F (35°C) |

**Chart 3: Explosive Range of Flammables**



**Specific gravity** of flammable liquids is important in fire prevention planning to anticipate the behavior of hazardous materials where water or other liquids are present under fire conditions. Many flammable liquids with a specific gravity below 1 (lighter than water) are also insoluble in water. In the event of fire with such liquids present, water may be ineffective as an extinguishing agent.

**Vapor pressure** is the pressure exerted by vapor above the surface of a liquid in a closed container. It is caused by evaporation and is stabilized by confinement in a closed container to a pressure characteristic of a specific liquid. Vapor pressures of flammable liquids are an important consideration in fire prevention. They give the relative speed of evaporation: the higher the vapor pressure, the greater the evaporation rate and the more vapor escape potential every time a container is opened. Vapor pressure of liquids is below 40 pounds per square inch absolute, at 100°F (37.8°C), by definition. Materials with higher vapor pressure are considered gases at 100°F (37.8°C).

**Boiling point** of a liquid is the temperature of the liquid at which its vapor pressure equals the atmospheric pressure.

**Vapor density**, as commonly used in fire protection, is the weight of a volume of pure gas compared to the weight of an equal volume of dry air at the same temperature and pressure. A figure greater than 1 indicates that a gas is heavier than air. This means that any escaped vapors will settle downward onto floors and flow with air currents, around corners and down stairs or elevator shafts to pool in low spots. If the source liquid is open and a continuous supply of vapor is flowing, a spark anywhere along the vapor trail will set off an explosion and fire that may envelop an entire building almost instantly.

### Definitions
### Relating to Flammable Liquids Safety Procedures and Equipment

**Approved:** Unless otherwise indicated, approved or listed by at least one of the following nationally recognized testing laboratories: Underwriters Laboratories Inc., FM Global.

**Bonding:** Provision of metal to metal contact, usually by wire, between two containers to prevent generation of static electrical sparks.

**Control Area:** A building or portion of a building within which flammable and combustible liquids are allowed to be stored, dispensed, and used or handled in quantities that do not exceed the maximum allowable quantity.

**FM Global (FM):** A nationally recognized independent testing laboratory established by the insurance industry to which manufacturers submit their products for evaluation of ability to meet safety requirements under intended use. Products meeting these requirements are "FM approved."

**Grounding:** Provision of contact between container and the earth, usually by wire, to prevent generation of static electric sparks.

**Inside Liquid Storage Area:** A room or building used for the storage of liquids in containers or portable tanks, separated from other types of occupancies.

**Listed:** Equipment, materials, or services included in a list published by an organization that is acceptable to the authority having jurisdiction and concern with the evaluation of products or services, that maintains periodic inspection of production of listed equipment or materials or periodic evaluation of services, and whose listing states that either the equipment, material, or service meets appropriate designated standards or has been tested and found suitable for a specified purpose.

**Maximum Allowable Quantity (MAQ):** For the purposes of NFPA 30, the quantity of flammable and combustible liquid permitted in a control area. See NFPA 30 Table 9.6.1.

**NFPA Code 30:** The code developed by NFPA to cover the safe storage and handling of flammable and combustible liquids.

**OSHA 1910.106 Standards:** Requirements established by the Department of Labor, Occupational Safety and Health Administration for conformance to the Occupational Safety and Health Act in 1970.

**Spontaneous Combustion:** Self-ignition resulting from a chemical reaction and temperature buildup in waste material.

**Underwriters Laboratories (UL):** A nationally recognized independent testing laboratory to which manufacturers submit their products for evaluation of ability to meet safety requirements under intended use. Products meeting requirements are "UL Listed."

**MAQ of Flammable and Combustible Liquids per Control Area**

| | Liquid Class(es) | Quantity gal | Quantity L | Notes |
|---|---|---|---|---|
| Flammable liquids | IA | 30 | 115 | 1,2 |
| | IB & IC | 120 | 460 | 1,2 |
| | IA, IB, IC combined | 120 | 460 | 1,2,3 |
| Combustible liquids | II | 120 | 460 | 1,2 |
| | IIIA | 330 | 1,265 | 1,2 |
| | IIIB | 13,200 | 50,600 | 1,4 |

**Table 9.6.1 from NFPA 30, 2008 edition***
Source: Table 34.1.3.1 of NFPA 5000, 2006 edition.)
Notes:
(1) Quantities are permitted to be increased 100 percent where stored in approved flammable liquids storage cabinets or in safety cans in accordance with the fire code. Where Note 2 also applies, the increase for both notes is permitted to be applied accumulatively.
(2) Quantities are permitted to be increased 100 percent in buildings equipped throughout with an automatic sprinkler system installed in accordance with NFPA 13, *Standard for the Installation of Sprinkler Systems*. Where Note 1 also applies, the increase for both notes is permitted to be applied accumulatively.
(3) Containing not more than the maximum allowable quantity per control area of Class 1A, Class 1B, or Class 1C flammable liquids, individually.
(4) Quantities are not limited in a building equipped throughout with an automatic sprinkler system installed in accordance with NFPA 13, *Standard for the Installation of Sprinkler Systems*

*see page 39

# Abstracts from Regulations and Standards

## OSHA 29 CODE OF FEDERAL REGULATION

**■ 1910.106(a)(5)**

Boiling point shall mean the boiling point of a liquid at a pressure of 14.7 pounds per square inch absolute (p.s.i.a.) (760 mm.). Where an accurate boiling point is unavailable for the material in question, or for mixtures which do not have a constant boiling point, for purposes of this section the 10 percent point of a distillation performed in accordance with the Standard Method of Test for Distillation of Petroleum Products, ASTM D-86-62, which is incorporated by reference as specified in Sec. 1940.6, may be used as the boiling point of the liquid.

**■ 1910.106(a)(12)**

Fire area shall mean an area of a building separated from the remainder of the building by construction having a fire resistance of at least 1 hour and having all communicating openings properly protected by an assembly having a fire resistance rating of at least 1 hour.

**■ 1910.106(a)(14)**

"Flashpoint" means the minimum temperature at which a liquid gives off vapor within a test vessel in sufficient concentration to form an ignitable mixture with air near the surface of the liquid, and shall be determined as follows:

*(i)* For a liquid which has a viscosity of less than 45 SUS at 100 deg. F. (37.8 deg. C.), does not contain suspended solids, and does not have a tendency to form a surface film while under test, the procedure specified in the Standard Method of Test for Flashpoint by Tag Closed Tester (ASTM D-56-70), which is incorporated by reference as specified in Sec. 1910.6, shall be used.

*(ii.)* For a liquid which has a viscosity of 45 SUS or more at 100 deg. F. (37.8 deg. C.) or contains suspended solids, or has a tendency to form a surface film while under test, the Standard Method of Test for Flashpoint by Pensky-Martens Closed Tester (ASTM D-93-71) shall be used, except that the methods specified in Note 1 to section 1.1 of ASTM 0-93-71 may be used for the respective materials specified in the Note. The preceding ASTM standards are incorporated by reference as specified in Sec. 1910.6.

*(iii)* For a liquid that is a mixture of compounds that have different volatilities and flashpoints, its flashpoint shall be determined by using the procedure specified in paragraph (a)(14) (i) or (ii) of this section on the liquid in the form it is shipped. If the flashpoint, as determined by this test, is 100 deg. F. (37.8 deg. C.), or higher, an additional flashpoint determination shall be run on a sample of the liquid evaporated to 90 percent of its original volume, and the lower value of the two tests shall be considered the flashpoint of the material.

*(iv)* Organic peroxides, which undergo auto accelerating thermal decomposition, are excluded from any of the flashpoint determination methods specified in this subparagraph.

**■ 1910.106(a)(18)**

"Combustible liquid" means any liquid having a flashpoint at or above 100 deg. F. (37.8 deg. C.) Combustible liquids shall be divided into two classes as follows:

*(i)* "Class II liquids" shall include those with flashpoints at or above 100 deg. F (37.8 deg. C.), and below 140 deg. F. (60 deg. C.), except any mixture having the components with flashpoints of 200 deg. F. (93.3 deg. C.) or higher, the volume of which make up 99 percent or more of the total volume of the mixture.

*(ii)* "Class III liquids" shall include those with flashpoints at or above 140 deg. F. (60 deg. C.). Class III liquids are subdivided into two subclasses:

(ii)(a) "Class IIIA liquids" shall include those with flashpoints at or above 140 deg. F. (60 deg. C.) and below 200 deg. F. (93.3 deg. C.), except any mixture having components with flashpoints of 200 deg. F. (93.3 deg. C.), or higher, the total volume of which make up 99 percent or more of the total volume of the mixture.

(ii)(b) "Class IIIB liquids" shall include those with flashpoints at or above 200 deg. F. (93.3 deg. C.). This section does not cover Class IIIB liquids. Where the term "Class III liquids" is used in this section, it shall mean only Class IIIA liquids.

*(iii)* When a combustible liquid is heated for use to within 30 deg. F. (16.7 deg. C.) of its flashpoint, it shall be handled in accordance with the requirements for the next lower class of liquids.

**■ 1910.106(a)(19)**

"Flammable liquid" means any liquid having a flashpoint below 100 deg. F. (37.8 deg. C.), except any mixture having components with flashpoints of 100 deg. F. (37.8 deg. C.) or higher, the total of which make up 99 percent or more of the total volume of the mixture. Flammable liquids shall be known as Class I liquids. Class I liquids are divided into three classes as follows:

*(i)* Class IA shall include liquids having flashpoints below 73 deg. F. (22.8 deg. C.) and having a boiling point below 100 deg. F. (37.8 deg. C.).

*(ii)* Class IB shall include liquids having flashpoints below 73 deg. F. (22.8 deg. C.) and having a boiling point at or above 100 deg. F. (37.8 deg. C.).

*(iii)* Class IC shall include liquids having flashpoints at or above 73 deg. F. (22.8 deg. C.) and below 100 deg. F. (37.8 deg. C.).

**■ 1910.106(a)(35)**

Approved unless otherwise indicated, approved, or listed by a nationally recognized testing laboratory. Refer to 1910.7 for definition of nationally recognized testing laboratory.

**■ 1910.106(d)**

"Container and portable tank storage" –

*(i)* "General" This paragraph shall apply only to the storage of flammable or combustible liquids in drums or other containers (including flammable aerosols, not exceeding 60 gallons individual capacity and those portable tanks not exceeding 660 gallons individual capacity.

*(ii)* "Exceptions" This paragraph shall not apply to the following:

*(ii)(a)* Storage of containers in bulk plants, service stations, refineries, chemical plants, and distilleries;

*(ii)(b)* Class I or Class II liquids in the fuel tanks of a motor vehicle, aircraft, boat, or portable or stationary engine;

*(ii)(c)* Flammable or combustible paints, oils, varnishes, and similar mixtures used for painting or maintenance when not kept for a period in excess of 30 days;

*(ii)(d)* Beverages when packaged in individual containers not exceeding 1 gallon in size.

**■ OSHA 29 CFR 1910.106(e)(2)(iii):**

Separation and protection. Areas in which flammable or combustible liquids are transferred from one tank or container to another container shall be separated from other operations in the building by adequate distance or by construction having adequate fire resistance. Drainage or other means shall be provided to control spills. Adequate natural or mechanical ventilation shall be provided.

**■ OSHA 29 CFR 1910.106(d)(4)(v):**

Storage in inside storage rooms. In every inside storage room there shall be maintained one clear aisle at least 3 feet wide. Containers over 30 gallons capacity shall not be stacked one upon the other. Dispensing shall be by approved pump or self-closing faucet only.

**■ OSHA 29 CFR 1910.106(e)(2)(iv)(d):**

Flammable or combustible liquids shall be drawn from or transferred into vessels, containers, or portable tanks within a building only through a closed piping system, from safety cans, by means of a device drawing through the top, or from a container or portable tanks by gravity through an approved self-closing valve. Transferring by means of air pressure on the container or portable tanks shall be prohibited.

**■ OSHA 29 CFR 1910.106(d)(2)(ii):**

Emergency venting. Each portable tank shall be provided with one or more devices installed in the top with sufficient emergency venting capacity to limit internal pressure under fire exposure conditions to 10 psig, or 30 percent of the bursting pressure of the tank, whichever is greater. The total venting capacity shall be not less than that specified in paragraphs (b)(2)(v)(c) or (e) of this section. At least one pressure-activated vent having a minimum capacity of 6,000 cubic feet of free air (14.7 psia and 60°F) shall be used. It shall be set to open at not less than 5 psig. If fusible vents are used, they shall be actuated by elements that operate at a temperature not exceeding 300°F.

**■ OSHA 29 CFR 1910.106(e)(6)(ii):**

Grounding. Class I liquids shall not be dispensed into containers unless the nozzle and container are electrically interconnected. Where the metallic floorplate on which the container stands while filling is electrically connected to the fill stem or where the fill stem is bonded to the container during filling operations by means of a bond wire, the provisions of this section shall be deemed to have been complied with.

**■ OSHA 29 CFR 1910.106(e)(2)(ii)(b): Incidental storage or use of flammable and combustible liquids.**

(b) The quantity of liquid that may be located outside of an inside storage room or storage cabinet in a building or in any one fire area of a building shall not exceed:

(1) 25 gallons of Class IA liquids in containers

(2) 120 gallons of Class IB, IC, II or III liquids in containers
(3) 660 gallons of Class IB, IC, II or III liquids in a single portable tank

■ **OSHA 29 CFR 1910.106(d)(3)(i&ii): Design, construction, and capacity of storage cabinets - (i) Maximum capacity.**
Not more than 60 gallons of Class I or Class II liquids, nor more than 120 gallons of Class III liquids may be stored in a storage cabinet.
**(ii)(a) Fire resistance.** Storage cabinets shall be designed and constructed to limit the internal temperature to not more than 325°F. when subjected to a 10-minute fire test using the standard time-temperature curve as set forth in Standard Methods of Fire Tests of Building Construction and Materials, NFPA 251-1969. All joints and seams shall remain tight and the door shall remain securely closed during the fire test. Cabinets shall be labeled in conspicuous lettering, "Flammable – Keep Fire Away."
(a) Metal cabinets constructed in the following manner shall be deemed to be in compliance. The bottom, top, door, and sides of cabinet shall be at least No. 18 gauge sheet iron and double walled with 1½" air space. Joints shall be riveted, welded, or made tight by some equally effective means. The door shall be provided with a three-point lock, and the door sill shall be raised at least 2" above the bottom of the cabinet.
**(ii)(b) Wooden cabinets** constructed in the following manner shall be deemed in compliance. The bottom, sides, and top shall be constructed of an approved grade of plywood at least 1 inch in thickness, which shall not break down or delaminate under fire conditions. All joints shall be rabbeted and shall be fastened in two directions with flathead woodscrews. When more than one door is used, there shall be a rabbeted overlap of not less than 1 inch. Hinges shall be mounted in such a manner as not to lose their holding capacity due to loosening or burning out of the screws when subjected to the fire test.

■ **International Fire Code^:**
**3404.3.2 Liquid storage cabinets.**
Where other sections of this code require that liquid containers be stored in storage cabinets, such cabinets and storage shall be in accordance with Sections 3404.3.2.1 through 3404.3.2.3.
**3404.3.2.1.1 Materials.** Cabinets shall be listed in accordance with UL 1275, or constructed of approved wood or metal in accordance with the following:
1. Unlisted metal cabinets shall be constructed of steel having a thickness of not less than 0.044 inch (1.12 mm) (18 gage). The cabinet, including the door, shall be double walled with 1-1/2 inch (38 mm) airspace between the walls. Joints shall be riveted or welded and shall be tight fitting.
**3404.3.2.1.2 Labeling.** Cabinets shall be provided with a conspicuous label in red letters on contrasting background which reads:
FLAMMABLE–KEEP FIRE AWAY.
**3404.3.2.1.3 Doors.** Doors shall be well fitted, self-closing and equipped with a three-point latch.
**3404.3.2.1.4 Bottom.** The bottom of the cabinet shall be liquid tight to a height of at least 2 inches (51 mm).

■ **NFPA 1 The Uniform Fire Code – 2006 Edition**:**
**60.1.2.23 Hazardous Materials Storage Cabinets.**
(d.) Doors shall be well fitted, self-closing, and equipped with a self-latching device.

^,*, ** See page 39.

■ **NFPA Code 30 – 2008 Edition*:**
**9.5.1** The volume of Class I, Class II, and Class IIIA liquids stored in an individual storage cabinet shall not exceed 120 gal (460 L).

**9.5.2** The total aggregate volume of Class I, Class II, and Class IIIA liquids in a group of storage cabinets shall not exceed the maximum allowable quantity of flammable and combustible liquids per control area based on the occupancy where the cabinets are located.

**9.5.4** Storage cabinets shall not be required by this code to be ventilated for fire protection purposes.

**9.5.4.1** If not ventilated, storage cabinet vent openings shall be sealed with the bungs supplied with the cabinet or with bungs specified by the cabinet manufacturer.

**9.5.4.2** If ventilated for any reason, the storage cabinet vent openings shall be ducted directly to outdoors in such a manner that will not compromise the specified performance of the cabinet and in a manner that is acceptable to the authority having jurisdiction.

**The National Fire Code of Canada (NFC) 1995 Edition, section 4.2.10.5 references storage Cabinets must conform to ULC-C1275.**

■ **ULC/ORD-C1275-84**
**1.1** These requirements cover storage cabinets for flammable liquid containers which are intended for the storage of flammable liquid and permitted by the relevant sections of the National Fire Code of Canada.

**1.2** The cabinets are tested to determine their ability to withstand a standard fire exposure for a period of 10 minutes without developing an internal temperature rise in excess of 139°C above ambient.

■ **OSHA 29 CFR 1910.1200(g)(8):**
The employer shall maintain in the workplace copies of the required material safety data sheets for each hazardous chemical, and shall ensure that they are readily accessible during each work shift to employees when they are in their work area(s). (Electronic access, microfiche, and other alternatives to maintaining paper copies of the material safety data sheets are permitted as long as no barriers to immediate employee access in each workplace are created by such options.)

■ **OSHA 29 CFR 1910.106(a)(29):**
**Safety Can** shall mean an approved container, of not more than 5 gallons capacity, having a spring-closing lid and spout cover and so designed that it will safely relieve internal pressure when subjected to fire exposure.

■ **1910.106 (d)(2)(iii)(b)**
Table H-12 – Maximum Allowable Size of Containers and Portable Tanks

| | Flammable Liquids | | | Combustible Liquids | |
|---|---|---|---|---|---|
| Container Type | Class IA | Class IB | Class IC | Class II | Class III |
| Glass or approved plastic | 1pt | 1qt | 1 gal | 1 gal | 1 gal |
| Metal (other than DOT drums) | 1 gal | 5 gal | 5 gal | 5 gal | 5 gal |
| Safety cans | 2 gal | 5 gal | 5 gal | 5 gal | 5 gal |
| Metal drums (DOT specs) | 60 gal | 60 gal | 60 gal | 60 gal | 60 gal |
| Approved portable tanks | 660 gal | 660 gal | 660 gal | 660 gal | 660 gal |

Note: Container exemptions: (a) Medicines, beverages, foodstuffs, cosmetics, and other common consumer items, when packaged according to commonly accepted practices, shall be exempt from the requirement of 29 CFR 1910.106(d)(2)(i) and (ii).

**California Air Resources Board (CARB) Title 13 of the California Code of Regulations:**
**2467.2** Performance Standards for Portable Fuel Containers and Spill-Proof Spout
**(2)** Automatically closes and seals when removed from the target fuel tank and remains completely closed when not dispensing fuel.

**2467.3** Exemptions
**(c)** This Article does not apply to safety cans meeting the requirements of Chapter 17, Title 29, Subpart F, of the Code of Federal Regulations.

■ **DOT 49 CFR Parts 100 to 177:**
All Justrite DOT Cans carry UN designation-1A1/Y1.2/100

■ **OSHA 29 CFR 1910.106(e)(2)(ii): Incidental storage or use of flammable and combustible liquids:**
**Containers.** Flammable or combustible liquids shall be stored in tanks or closed containers.

■ **OSHA 29 CFR 1910.106(a)(9):**
**Closed container** shall mean a container as herein defined, so sealed by means of a lid or other device that neither liquid nor vapor will escape from it at ordinary temperatures.

■ **OSHA 29 CFR 1910.106 (e)(2)(iv)(a):**
Flammable liquids shall be kept in covered containers when not actually in use.

■ **OSHA 29 CFR 1926.252(e):**
(e) All solvent waste, oily rags, and flammable liquids shall be kept in fire resistant covered containers until removed from worksite.

■ **OSHA 29 CFR 1910.125(e)(4)(ii&iii):**
Rags and other material contaminated with liquids from dipping or coating operations are placed in approved waste cans immediately after use; and waste can contents are properly disposed of at the end of each shift.

■ **OSHA 29 CFR 1910.106(e)(9)(iii):**
**Waste and residue.** Combustible waste material and residues in a building or unit operating area shall be kept to a minimum, stored in covered metal receptacles and disposed of daily.

■ **OSHA 29 CFR 1910.144: Safety Color Code for Marking Physical Hazards**
**(a)Color identification – (1) Red.** Red shall be the basic color for the identification of ... (ii) Danger. Safety cans or other portable containers of flammable liquids having a flash point at or below 80°F, table containers of flammable liquids (open cup tester), excluding shipping containers, shall be painted red with some additional clearly visible identification either in the form of a yellow band around the can or the name of the contents conspicuously stenciled or painted on the can in yellow.

■ **OSHA 29 CFR 1910.123(d):**
Dip tank means a container holding a liquid other than water and that is used for dipping or coating. An object may be immersed (or partially immersed) in a dip tank or it may be suspended in a vapor coming from the tank.

■ **OSHA 29 CFR 1910.125(f)(3)(i):**
You may substitute a cover that is closed by an approved automatic device for the automatic fire-extinguishing system if the cover can also be activated manually.

**■ EPA 40 CFR 63:**
National Emission Standards for Hazardous Air Pollutants (NESHAP) are regulated by the Environmental Protection Agency as a result of the Clean Air Act of 1990, Section 112(d) – which created standards to protect the public health by requiring sources to control emissions from hazardous air pollutants.
**Subpart GG: National Emission Standards for Aerospace Manufacturing and Rework Facilities (NESAM).**
**Section 63.741 – Designation of Affected Sources:**
(1)(i) All hand wipe cleaning operations constitute an affected source.

**Section 63.742 – Definitions:**
Cleaning operation means collectively hand wipe, spray gun, and flush-cleaning operations.
Hand wipe cleaning operation means the removal of contaminants such as dirt, grease, oil, and coatings from an aerospace vehicle or component by physically rubbing it with a material such as a rag, paper, or cotton swab that has been moistened with a cleaning solvent.
Cleaning solvent means a liquid material used for hand wipe, spray gun, or flush-cleaning.
Aerospace facility means any facility that produces, reworks, or repairs in any amount any commercial, civil, or military aerospace vehicle or component.
**Section 63.744 – Cleaning Operations Standards:**
(a) Housekeeping measures. (1) Place solvent-laden cloth, paper, or any other absorbent applicators used for cleaning aerospace vehicles or components in bags or other closed containers immediately after use. Ensure that these bags and containers are kept closed at all times except when depositing or removing these materials from the container. Use bags and containers of such design so as to contain the vapors of the cleaning solvent. (2) Store fresh and spent cleaning solvents used in aerospace cleaning operations in closed containers.

**The Clean Air Act Amendments of 1990** have mandated Hazardous Organic National Emission Standards for Hazardous Air Pollutants, known as the HON Rule. EPA encourages control of these "fugitive emissions."

**■ EPA 40 CFR 264.173: Management of containers.**
(a) A container holding hazardous waste must always be closed during storage, except when it is necessary to add or remove waste.
(b) A container holding hazardous waste must not be opened, handled, or stored in a manner which may rupture the container or cause it to leak.

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## NFPA Code 30 – 2008 Edition*
## Chapter 14 Hazardous Materials Storage Lockers.

**■ 14.1 Scope.** This chapter shall apply to the storage of liquids in movable, modular, prefabricated storage lockers, specifically designed and manufactured for storage of hazardous materials, in the following:
**(1)** Containers that do not exceed 119 gal (450 L) individual capacity
**(2)** Portable tanks that do not exceed 660 gal (2500 L) individual capacity
**(3)** Intermediate bulk containers that do not exceed 793 gal (3000 L) individual capacity.

* See page 39.

**■ 14.2 Definitions Specific to Chapter 14. (Reserved)**

**■ 14.3 General Requirements.**

**14.3.1** Hazardous materials storage lockers that are used as liquid storage rooms shall meet the requirements of Chapter 9.

**14.3.2** Sections 14.4 and 14.5 shall apply to storage of flammable and combustible liquids in hazardous materials storage lockers (hereinafter referred to as lockers) that are located outside.

**■ 14.4 Design and Construction of Hazardous Materials Storage Lockers.**

**14.4.1** The design and construction of a locker shall meet all applicable local, state, and federal regulations and requirements and shall be subject to the approval of the authority having jurisdiction.

**14.4.2** Movable prefabricated structures that have been examined, listed, or labeled by an organization acceptable to the authority having jurisdiction for use as a hazardous materials storage facility shall be acceptable.

**14.4.3** Lockers shall not exceed 1500 ft² (140 m²) gross floor area.

**14.4.4** Vertical stacking of lockers shall not be permitted.

**14.4.5** Where electrical wiring and equipment are required, they shall comply with Chapter 7 and Section 9.12.

**14.4.6** Where dispensing or filling is permitted inside a locker, operations shall comply with the provisions of Chapter 18.

**14.4.7** Ventilation shall be provided in accordance with Section 9.14.

**14.4.8** Lockers shall include a spill containment system to prevent the flow of liquids from the structure under emergency conditions.

**14.4.8.1** The containment system shall have sufficient capacity to contain 10 percent of the volume of containers allowed in the locker or the volume of the largest container, whichever is greater.

**■ 14.5 Designated Sites for Hazardous Materials Storage Lockers.**

**14.5.1** Lockers shall be located on a designated approved site on the property.

**14.5.2** The designated site shall be arranged to provide the minimum separation distances specified in Table 14.5.2 between individual lockers, from locker to property line that is or can be built upon, and from locker to nearest side of public ways or to important buildings on the same property.

Table 14.5.2.2 Designated Sites

| Area of Designated Site[a] (ft²) | Minimum Separation Distance (ft) | | |
|---|---|---|---|
| | Between Individual Lockers | From Locker to Property Line that Is or Can Be Built Upon[b] | From Locker to Nearest Side of Public Ways or to Important Buildings on Same Property[b,c] |
| ≤ 100 | 5 | 10 | 5 |
| >100 and ≤500 | 5 | 20 | 10 |
| >500 and ≤1,500[d] | 5 | 30 | 20 |

For SI units, 1 ft = 0.3 m; 1 ft² = 0.09 m².
Note: If the locker is provided with a fire resistance rating of not less than 4 hours and deflagration venting is not required in accordance with Section 9.15, all distances required by Table 14.5.2 are permitted to be waived.

[a] Site area limits are intended to differentiate the relative size and thus the number of lockers that are permitted in one designated site.
[b] Distances apply to properties that have protection for exposures, as defined in 3.3.42 of NFPA 30. If there are exposures and such protection for exposures does not exist, the distances shall be doubled.
[c] When the exposed building has an exterior wall facing the designated site that has a fire resistance rating of at least 2 hours and has no openings to above grade areas within 10 ft (3 m) horizontally and no openings to below grade areas within 50 ft (15 m) horizontally of the designated area, the distances can be reduced to half of those shown in the table, except they should never be less than 5 ft (1.5 m).
[d] When a single locker has a gross single story floor area that will require a site area limit of greater than 1500 ft² (140 m²) or when multiple units exceed the area limit of 1500 ft² (140 m²), the authority having jurisdiction shall be consulted for approval of distances.

**14.5.3** Once the designated site is approved, it shall not be changed without the approval of the authority having jurisdiction.

**14.5.4** More than one locker shall be permitted on a designated site, provided that the separation distance between individual lockers is maintained in accordance with Table 14.5.2.

**14.5.5** Where the approved designated storage site is accessible to the general public, it shall be protected from tampering or trespassing.

# Fire Hazard Properties of Flammable Liquids, Gases, and Volatile Solids Table

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(see pg 39). References to extinguishing methods and hazard identification can be found in the original material.

| Chemical Name<br>Formula<br>(Synonym)<br>CAS No. | NFPA 30/ OSHA Class | Flash Point °F(°C) | Ignition Temp. °F(°C) | Flammable Limits % by Vol. Lower | Upper | Sp.Gr. (Water =1) | Vapor Density Air=1) | Boiling Point °F(°C) | Water Soluble | Extin-guishing Methods | Hazard Identification Health | Flamma-bility | Insta-bility |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Acetaldehyde**<br>$CH_3CHO$<br>(Acetic Aldehyde)<br>(Ethanal)<br>**75-07-0** | IA | -38 (-39) | 347 (175) | 4.0 | 60 | 0.8 | 1.5 | 70 (21) | Yes | 1<br>5 | 2 | 4 | 2 |
| | *Note: Polymerizes. See NFPA 49 contained in Fire Protection Guide to Hazardous Materials.* | | | | | | | | | | | | |
| **Acetone**<br>$CH_3COCH_3$<br>(Dimethyl Ketone)-<br>(2-Propanone)<br>**67-64-1** | IB | -4 (-20) | 869 (465) | 2.5 | 12.8 | 0.8 | 2.0 | 133 (56) | Yes | 1<br>5 | 1 | 3 | 0 |
| **Acetonitrile**<br>$CH_3CN$<br>(Methyl Cyanide)<br>**75-05-8** | | 42 (6) (oc) | 975 (524) | 3.0 | 16.0 | 0.8 | 1.4 | 179 (82) | Yes | 1<br>5 | 2 | 3 | 0 |
| | *See NFPA 49 contained in Fire Protection Guide to Hazardous Materials.* | | | | | | | | | | | | |
| **Acrolein**<br>$CH_2$:CHCHO<br>(Acrylic Aldehyde)<br>**107-02-8** | IB | -15 (-26) | 428 (220)<br>Unstable | 2.8 | 31 | 0.8 | 1.9 | 125 (52) | Yes | 1<br>5 | 4 | 3 | 3 |
| | *Note: May polymerize explosively. See NFPA 49 contained in Fire Protection Guide to Hazardous Materials.* | | | | | | | | | | | | |
| **Allylamine**<br>$CH_2$:$CHCH_2NH_2$<br>(2-Propenylamine)<br>**107-11-9** | IB | -20 (-29) | 705 (374) | 2.2 | 22 | 0.8 | 2.0 | 128 (53) | Yes | 1<br>5 | 4 | 3 | 1 |
| | *See NFPA 49 contained in Fire Protection Guide to Hazardous Materials.* | | | | | | | | | | | | |
| **Amyl Acetate**<br>$CH_3COOC_5H_{11}$<br>(1-Pentanol Acetate)<br>Comm.<br>**628-63-7** | IB | 60 (16)<br>70 (21) | 680 (360) | 1.1 | 7.5 | 0.9 | 4.5 | 300 (149) | Slight | 1<br>5 | 1 | 3 | 0 |
| **Aniline**<br>$C_6H_5NH_2$<br>(Aminobenzene)<br>(Phenylamine)<br>**62-53-3** | IIIA | 158 (70) | 1139<br>(615) | 1.3 | 11 | 1.0+ | 3.2 | 364 (184) | Slight | 5 | 2 | 2 | 0 |
| | *See NFPA 49 contained in Fire Protection Guide to Hazardous Materials.* | | | | | | | | | | | | |
| **Benzene**<br>$C_6H_6$<br>(Benzol)<br>**71-43-2** | IB | 12 (-11) | 928 (498) | 1.2 | 7.8 | 0.9 | 2.8 | 176 (80) | No | 1 | 1 | 3 | 0 |
| | *See NFPA 49 contained in Fire Protection Guide to Hazardous Materials.* | | | | | | | | | | | | |
| **Butadiene Monoxide**<br>$CH_2$:$CHCHOCH_2$<br>(Vinylethylene Oxide)<br>**930-22-3** | IB | <-58<br>(<-50) | | | | 0.9 | 2.4 | 151 (66) | | 1 | | 3 | 2 |
| **2-Butanone** | *See Methyl Ethyl Ketone.* | | | | | | | | | | | | |
| **Butyl Alcohol**<br>$CH_3(CH_2)_2CH_2OH$<br>(1-Butanol)<br>(Propyl Carbinol)<br>(Propyl Methanol)<br>**71-36-3** | IC | 98 (37) | 650 (343) | 1.4 | 11.2 | 0.8 | 2.6 | 243 (117) | No | 1<br>5 | 2 | 3 | 0 |
| **Butyl Chloride**<br>$C_4H_9Cl$<br>(1-Chlorobutane)<br>**109-69-3** | IB | 15 (-9) | 464 (240) | 1.8 | 10.1 | 0.9 | 3.2 | 170 (77) | No | 1 | 1 | 3 | 0 |
| **Carbon Disulfide**<br>$CS_2$<br>(Carbon Bisulfide)<br>**75-15-0** | IB | -22 (-30) | 194 (90) | 1.3 | 50.0 | 1.3 | 2.6 | 115 (46) | No | 4 | 3 | 4 | 0 |
| | *See NFPA 49 contained in Fire Protection Guide to Hazardous Materials.* | | | | | | | | | | | | |

# Fire Hazard Properties of Flammable Liquids, Gases, and Volatile Solids Table

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(see pg 39). References to extinguishing methods and hazard identification can be found in the original material.

| Chemical Name<br>Formula<br>(Synonym)<br>CAS No. | NFPA 30/ OSHA Class | Flash Point °F(°C) | Ignition Temp. °F(°C) | Flammable Limits % by Vol. Lower | Upper | Sp.Gr. (Water =1) | Vapor Density Air=1) | Boiling Point °F(°C) | Water Soluble | Extin-guishing Methods | Hazard Identification Health | Flamma-bility | Insta-bility |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Collodion**<br>$C_{12}H_{16}O_6(NO_3)_4$<br>$C_{13}H_{17}O_7(NO_3)_3$<br>Solution of Nitrated Cellulose in Ether-Alcohol<br>**9004-70-0** | IA | <0 (<-18) | 338 (170) | 1.9 | 48 | 0.8 | 2.6 | 95 (35) | | 1<br>5 | 2 | 4 | 0 |
| *See Nitrocellulose and Pyroxylin Solution contained in the Fire Protection Guide to Hazardous Materials.* | | | | | | | | | | | | | |
| **Cyclohexane**<br>$C_6H_{12}$<br>(Hexahydrobenzene)<br>(Hexamethylene)<br>**110-82-7** | IB | -4 (-20) | 473 (245) | 1.3 | 8 | 0.8 | 2.9 | 179 (82) | No | 1 | 1 | 3 | 0 |
| **Cyclohexanone**<br>$C_6H_{10}O$<br>(Pimelic Ketone)<br>**108-94-1** | II | 111 (44) | 788 (420) | 1.1 @212 (100) | 9.4 | 0.9 | 3.4 | 313 (156) | Slight | 5 | 1 | 2 | 0 |
| **Denatured Alcohol** | IB | 60 (16) | 750 (399) | | | 0.8 | 1.6 | 175 (79) | Yes | 1<br>5 | 0 | 3 | 0 |
| Government Formula | | 60-62 | | | | | | | | | | | |
| (CD-5) | | (16-17) | | | | | | | | | | | |
| (CD-5A) | | 60-61 | | | | | | | | | | | |
| | | (15.5-16) | | | | | | | | | | | |
| (CD-10) | | 49-59 | | | | | | | | | | | |
| | | (9-15) | | | | | | | | | | | |
| (SD-1) | | 57 (14) | | | | | | | | | | | |
| (SD-2B) | | 56 (13) | | | | | | | | | | | |
| (SD-3A) | | 59 (15) | | | | | | | | | | | |
| (SD-13A) | | <19 (<-7) | | | | | | | | | | | |
| (SD-17) | | 60 (16) | | | | | | | | | | | |
| (SD-23A) | | 35 (2) | | | | | | | | | | | |
| (SD-30) | | 59 (15) | | | | | | | | | | | |
| (SD-39B) | | 60 (16) | | | | | | | | | | | |
| (SD-39C) | | 59 (15) | | | | | | | | | | | |
| (SD-40M) | | 59 (15) | | | | | | | | | | | |
| **Dibutyl Ether**<br>$(C_4H_9)_2O$<br>(1-Butoxybutane)<br>(Butyl Ether)<br>**142-96-1** | IC | 77 (25) | 382 (194) | 1.5 | 7.6 | 0.8 | 4.5 | 286 (141) | No | 1 | 1<br>5 | 3 | 1 |
| *See NFPA 49 contained in Fire Protection Guide to Hazardous Materials.* | | | | | | | | | | | | | |
| **1,2-Dichloroethylene**<br>ClCH:CHCl<br>(sym-Dichloroethylene)<br>**540-59-0** | IB | 36 (2) | 860 (460) | 5.6 | 12.8 | 1.3 | 3.4 | 119 (48) | No | 4 | 1 | 3 | 2 |
| *Note: Exists as cis and trans isomers.* | | | | | | | | | | | | | |
| **Diesel Fuel Oil No. 1-D**<br>**68334-30-5** | II | 100 (38)<br>Min. or Legal | | | | | | | No | | 1 | 2 | 0 |
| **Diethylamine**<br>$(C_2H_5)_2NH$<br>**109-89-7** | IB | -9 (-23) | 594 (312) | 1.8 | 10.1 | 0.7 | 2.5 | 134 (57) | Yes | 5<br>1 | 3 | 3 | 0 |
| *See NFPA 49 contained in Fire Protection Guide to Hazardous Materials.* | | | | | | | | | | | | | |
| **2,2-Dimethylbutane**<br>$(CH_3)_3CCH_2CH_3$<br>(Neohexane)<br>**75-83-2** | IB | -54 (-48) | 761 (405) | 1.2 | 7.0 | 0.6 | 3.0 | 122 (50) | No | 1 | 2 | 3 | 0 |
| **2,3-Dimethylpentane**<br>$CH_3CH(CH_3)CH(CH_3)CH_2CH_3$<br>**565-59-3** | IB | <20 (<-7) | 635 (335) | 1.1 | 6.7 | 0.7 | 3.5 | 194 (90) | No | 1 | 2 | 3 | 0 |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **p-Dioxane**<br>$OCH_2CH_2OCH_2CH_2$<br>(Diethylene Dioxide)<br>**123-91-1** | IB | 54 (12) | 356 (180) | 2.0 | 22 | 1.0+ | 3.0 | 214 (101) | Yes | 1<br>5 | 2 | 3 | 1 |
| | *See NFPA 49 contained in Fire Protection Guide to Hazardous Materials.* | | | | | | | | | | | | |
| **Divinyl Ether**<br>$(CH_2{:}CH)_2O$<br>(Ethenyloxyethene)<br>(Vinyl Ether)<br>**109-93-3** | IA | <-22 (<-30) | 680 (360) | 1.7 | 27 | 0.8 | 2.4 | 83 (28) | No | 1 | 0 | 4 | 2 |
| | *See NFPA 49 contained in Fire Protection Guide to Hazardous Materials.* | | | | | | | | | | | | |
| **Ethanol** | *See Ethyl Alcohol.* | | | | | | | | | | | | |
| **Ethyl Acetate**<br>$CH_3COOC_2H_5$<br>(Acetic Ester)<br>(Acetic Ether)<br>(Ethyl Ethanoate)<br>**141-78-6** | IB | 24 (-4) | 800 (426) | 2.0 | 11.5 | 0.9 | 3.0 | 171 (77) | Slight | 1<br>5 | 1 | 3 | 0 |
| **Ethyl Alcohol**<br>$C_2H_5OH$<br>(Grain Alcohol, Cologne Spirits, Ethanol)<br>**64-17-5** | IB | 55 (13) | 685 (363) | 3.3 | 19 | 0.8 | 1.6 | 173 (78) | Yes | 1<br>5 | 2 | 3 | 0 |
| | *See also Ethyl Alcohol and Water contained in Fire Protection Guide to Hazardous Materials.* | | | | | | | | | | | | |
| **Ethylamine, 70%**<br>$C_2H_5NH_2$<br>(Aminoethane)<br>**75-04-7** | IA | <0 (<-18) | 725 (385) | 3.5 | 14.0 | 0.8 | 1.6 | 62 (17) | Yes | 1<br>5 | 5<br>3 | 4 | 0 |
| | *See NFPA 49 contained in Fire Protection Guide to Hazardous Materials.* | | | | | | | | | | | | |
| **Ethyl Chloride**<br>$C_2H_5Cl$<br>(Chloroethane)<br>(Hydrochloric Ether)<br>(Muriatic Ether)<br>**75-00-3** | IA | -58 (-50) | 966 (519) | 3.8 | 15.4 | 0.9 | 2.2 | 54 (12) | Slight | 1 | 2 | 4 | 0 |
| **Ethylene Glycol**<br>$HOC_2H_4OH$<br>(1,2-Ethanediol)<br>(Glycol)<br>**107-21-1** | IIIB | 232 (111) | 748 (398) | 3.2 | | 1.1 | | 387 (197) | Yes | 5<br>2 | 2 | 1 | 0 |
| **Ethylene Oxide**<br>$CH_2OCH_2$<br>(Dimethylene Oxide)<br>(1,2-Epoxyethane)<br>(Oxirane)<br>(EO)<br>**75-21-8** | IA | -20 (-29) | 804 (429) | 3.0 | 100 | 0.9 | 1.5 | 51 (11) | Yes | 1 | 3 | 4 | 3 |
| | *Note: Vapors explosive. See NFPA 49 contained in Fire Protection Guide to Hazardous Materials.* | | | | | | | | | | | | |
| **Ethyl Ether**<br>$C_2H_5OC_2H_5$<br>(Diethyl Ether)<br>(Diethyl Oxide)<br>(Ether)<br>(Ethyl Oxide)<br>**60-29-7** | IA | -49 (-45) | 356 (180) | 1.9 | 36.0 | 0.7 | 2.6 | 95 (35) | Slight | 1<br>5 | 1 | 4 | 1 |
| | *See NFPA 49 contained in Fire Protection Guide to Hazardous Materials.* | | | | | | | | | | | | |
| **Fuel Oil No. 1**<br>(Jet Fuel A)<br>(Kerosene)<br>(Range Oil)<br>**8008-20-6** | | 100-162 (38-72) | 410 (210) | 0.7 | 5 | <1 | | 304-574 (151-301) | No | | 2 | 2 | 0 |

# Fire Hazard Properties of Flammable Liquids, Gases, and Volatile Solids Table

Extracted tables reprinted with permission from NFPA *Fire Protection Guide to Hazardous Materials, Thirteenth Edition****
(see pg 39). References to extinguishing methods and hazard identification can be found in the original material.

| Chemical Name<br>Formula<br>(Synonym)<br>CAS No. | NFPA 30/ OSHA Class | Flash Point °F(°C) | Ignition Temp. °F(°C) | Flammable Limits % by Vol. Lower | Flammable Limits % by Vol. Upper | Sp.Gr. (Water =1) | Vapor Density Air=1) | Boiling Point °F(°C) | Water Soluble | Extin-guishing Methods | Hazard Identification: Health | Hazard Identification: Flamma-bility | Hazard Identification: Insta-bility |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Gasoline**<br>$C_5H_{12}$ to $C_9H_{20}$<br>56-60 Octane 73 Octane<br>92 Octane<br>100 Octane<br>**8006-61-9** | IB | -45 (-43)<br>-45 (-43)<br>-36 (-38) | 536 (280)<br>853 (456) | 1.4 | 7.6 | 0.8 | 3.0-4.0 | 100-400 (38-204) | No | 1 | 1 | 3 | 0 |
| | *Note: Values may vary considerably for different grades of gasoline.* | | | | | | | | | | | | |
| **Heptane**<br>$CH_3(CH_2)_5CH_3$<br>**142-82-5** | IB | 25 (-4) | 399 (204) | 1.05 | 6.7 | 0.7 | 3.5 | 209 (98) | No | 1 | 1 | 3 | |
| **1,4-Hexadiene**<br>$CH_3CH{:}CHCH_2CH{:}CH_2$<br>(Allylpropenyl)<br>**592-45-0** | IB | -6 (-21) | | 2.0 | 6.1 | 0.7 | 2.8 | 151 (66) | No | 1 | 1 | 3 | 0 |
| **Hexane**<br>$CH_3(CH_2)_4CH_3$<br>(Hexyl Hydride)<br>**110-54-3** | IB | -7 (-22) | 437 (225) | 1.1 | 7.5 | 0.7 | 3.0 | 156 (69) | No | 1 | | 3 | 0 |
| **Isopropyl Alcohol, 88%**<br>$(CH_3)_2CHOH$<br>(Isopropanol)<br>(Dimethyl Carbinol)<br>(2-Propanol)<br>**67-63-0** | IB | 53 (12)<br>57 (14) | 750 (399) | 2.0 | 12.7 @ 200 (93) | 0.8 | 2.1 | 181 (83) | Yes | 5<br>1 | 1 | 3 | 0 |
| **Jet Fuels**<br>JP-4 | IB | -10 to +30 (-23 to -1) | 464 (240) | 1.3 | 8.0 | 0.75-0.18 | | 140-518 (60-270) | No | 1 | 3 | 3 | 0 |
| **Kerosene** | *See Fuel Oil No. 1.* | | | | | | | | | | | | |
| **Lubricating Oil, Turbine**<br>(Turbine Oil) | | 400 (204) (oc) | 700 (371) | | | ‹1 | | | No | 2 | 0 | 1 | 0 |
| **Methanol** | *See Methyl Alcohol.* | | | | | | | | | | | | |
| **Methyl Alcohol**<br>$CH_3OH$<br>(Methanol)<br>(Wood Alcohol)<br>(Columbian Spirits)<br>**67-56-1** | IB | 52 (11) | 867 (464) | 6.0 | 36 | 0.8 | 1.1 | 147 (64) | Yes | 1<br>5 | 1 | 3 | 0 |
| **Methylcyclohexane**<br>$CH_2(CH_2)_4CHCH_3$<br>(Cyclohexylmethane)<br>(Hexahydroxytoluene)<br>**108-87-2** | IB | 25 (-4) | 482 (250) | 1.2 | 6.7 | 0.8 | 3.4 | 214 (101) | No | 1 | 1 | 3 | 0 |
| **Methylene Chloride**<br>$CH_2Cl_2$<br>(Dichloromethane)<br>**75-09-2** | | None | 1033 (556) | 13 | 23 | 1.3 | 2.9 | 104 (40) | Slight | | 2 | 1 | 0 |
| | *See NFPA 49 contained in Fire Protection Guide to Hazardous Materials.* | | | | | | | | | | | | |
| **Methyl Ethyl Ether**<br>$CH_3OC_2H_5$<br>(Ethyl Methyl Ether)<br>**540-67-0** | IA | -35 (-37) | 374 (190) | 2.0 | 10.1 | 0.7 | 2.1 | 51 (11) | Yes | 1<br>5 | 1 | 4 | 1 |
| | *See NFPA 49 contained in Fire Protection Guide to Hazardous Materials.* | | | | | | | | | | | | |
| **Methyl Ethyl Ketone**<br>$C_2H_5COCH_3$<br>(2-Butanone)<br>(Ethyl Methyl Ketone)<br>**78-93-3** | IB | 16 (-9) | 759 (404) | 1.4 @ 200 (93) | 11.4 @ 200 (93) | 0.8 | 2.5 | 176 (80) | Yes | 1<br>5 | 1 | 3 | 0 |

# Fire Hazard Properties of Flammable Liquids, Gases, and Volatile Solids Table

Extracted tables reprinted with permission from NFPA *Fire Protection Guide to Hazardous Materials, Thirteenth Edition****
(see pg 39). References to extinguishing methods and hazard identification can be found in the original material.

| Chemical Name<br>Formula<br>(Synonym)<br>CAS No. | NFPA 30/ OSHA Class | Flash Point °F(°C) | Ignition Temp. °F(°C) | Flammable Limits % by Vol. Lower | Upper | Sp.Gr. (Water =1) | Vapor Density Air=1) | Boiling Point °F(°C) | Water Soluble | Extin-guishing Methods | Hazard Identification Health | Flamma-bility | Insta-bility |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Methyl Isobutyl Ketone**<br>$CH_3COCH_2CH(CH_3)_2$<br>(Hexone)<br>(4-Methyl-2-Pentanone)<br>**108-10-1** | IB | 64 (18) | 840 (448) | 1.2 @ 200 (93) | 8.0 @ 200 (93) | 0.8 | 3.5 | 244 (118) | Slight | 5<br>1 | 1 | 3 | 0 |
| *See NFPA 49 contained in Fire Protection Guide to Hazardous Materials.* | | | | | | | | | | | | | |
| **Naphtha V.M. & P., Regular**<br>**8032-32-4** | IB | 28 (-2) | 450 (232) | 0.9 | 6.0 | <1 | | 212-320 (100-160) | No | 1 | 1 | 3 | 0 |
| *Note: Flash point and ignition temperature will vary depending on the manufacturer.* | | | | | | | | | | | | | |
| **Nitroethane**<br>$C_2H_5NO_2$<br>**79-24-3** | IC | 82 (28) | 778 (414) | 3.4 | | 1.1 | 2.6 | 237(114) | Slight | 4<br>5 | 2 | 3 | 3 |
| *Note: May explode on heating. See NFPA 49 contained in Fire Protection Guide to Hazardous Materials.* | | | | | | | | | | | | | |
| **Paraldehyde**<br>$(CH_3CHO)_3$<br>**123-63-7** | | 96 (36) (oc) | 460 (238) | 1.3 | | 1.0- | 4.5 | 255 (124) | Slight | 1<br>5 | 2 | 3 | 1 |
| *See NFPA 49 contained in Fire Protection Guide to Hazardous Materials.* | | | | | | | | | | | | | |
| **Pentane**<br>$CH_3(CH_2)_3CH_3$<br>**109-66-0** | IA | <-40 (<-40) | 500 (260) | 1.5 | 7.8 | 0.6 | 2.5 | 97 (36) | No | 1 | 1 | 4 | 0 |
| **Petroleum Ether**<br>(Benzine)<br>(Naphtha, Petroleum)<br>**64475-85-0** | | <0 (<-18) | 550 (288) | 1.1 | 5.9 | 0.6 | 2.5 | 95-140 (35-60) | No | 1 | 1 | 4 | 0 |
| **Propionaldehyde**<br>$CH_3CH_2CHO$<br>(Propanal)<br>**123-38-6** | IB | -22 (-30) | 405 (207) | 2.6 | 17 | 0.8 | 2.0 | 120 (49) | Slight | 1<br>5 | 2 | 3 | 2 |
| *See NFPA 49 contained in Fire Protection Guide to Hazardous Materials.* | | | | | | | | | | | | | |
| **Propylene Oxide**<br>$OCH_2CHCH_3$<br>**75-56-9** | IA | -35 (-37) | 840 (449) | 2.3 | 36 | 0.83 | 2.0 | 94 (35) | Yes | 1<br>5 | 3 | 4 | 2 |
| *See NFPA 49 contained in Fire Protection Guide to Hazardous Materials.* | | | | | | | | | | | | | |
| **Toluene**<br>$C_6H_5CH_3$<br>(Methylbenzene)<br>(Phenylmethane)<br>(Toluol)<br>**108-88-3** | IB | 40 (4) | 896 (480) | 1.1 | 7.1 | 0.9 | 3.1 | 231 (111) | No | 1 | 2 | 3 | 0 |
| *See NFPA 49 contained in Fire Protection Guide to Hazardous Materials.* | | | | | | | | | | | | | |
| **Toluol** | *See Toluene.* | | | | | | | | | | | | |
| **Trichloroethylene**<br>$ClHC:CCl_2$<br>**79-01-6** | | None | 788 (420) | 8 @ 25°C 7.8 @ 100°C | 10.5 @ 25°C 52 @ 100°C | 1.5 | 4.5 | 188 (87) | No | | 2 | 1 | 0 |
| *See NFPA 49 contained in Fire Protection Guide to Hazardous Materials.* | | | | | | | | | | | | | |
| **Turpentine**<br>**9005-90-7** | IC | 95 (35) | 488 (253) | 0.8 | | <1 | | 300 (149) | No | 1 | 1 | 3 | 0 |
| **Vinyl Ethyl Ether**<br>$CH_2:CHOC_2H_5$<br>(Ethyl Vinyl Ether)<br>**109-92-2** | IA | <-50 (<-46) | 395 (202) | 1.7 | 28 | 0.8 | 2.5 | 96 (36) | No | 1<br>5 | 2 | 4 | 2 |
| **o-Xylene**<br>$C_6H_4(CH_3)_2$<br>(1,2-Dimethylbenzene)<br>(o-Xylol)<br>**95-47-6** | IC | 63 (17) | 867 (463) | 0.9 | 6.7 | 0.9 | 3.7 | 292 (144) | No | 1 | 2 | 3 | 0 |
| *See NFPA 49 contained in Fire Protection Guide to Hazardous Materials.* | | | | | | | | | | | | | |

# Safety Checklists

This list summarizes the equipment needed to safely store and handle flammable liquids in order to minimize fire hazards and assist with compliance to governing codes and regulations.

## Storage – Drums

- ❑ Safety vent in each drum (vertical and horizontal stored)
- ❑ Grounding wires attached from drum to earth ground
- ❑ Bonding wires used between containers during transfer operations
- ❑ Metal-to-metal contact maintained for proper ground/bond
- ❑ Self-closing faucet on each drum being drained
- ❑ Spill tray or pallet/caddy being used to capture leaks & spills

## Storage – Safety Cabinets

- ❑ Approved cabinets in use in storage and work areas
- ❑ Cabinet material construction appropriate for stored chemical
- ❑ Cabinet size appropriate for current and future storage needs
- ❑ Chemicals properly segregated and stored in correct color cabinet
- ❑ Chemicals inventoried and MSDS sheets readily available
- ❑ Bungs installed on dual vents (unless venting is required by the authority having jurisdiction)
- ❑ Antistatic wires attached from ground lug to earth source
- ❑ Cabinet anchored with seismic bracket as needed
- ❑ Cabinet contents secured with padlock on built-in handle – (drilling into cabinet walls will negate fire resistance approval)
- ❑ Cabinets fully operational: fusible links on self close doors, doors close fully and engage 3-point latching system, leak proof sills intact, shelving stable and not overloaded

## Transfer – Safety Containers

- ❑ Type I safety cans in use for storing and pouring flammables
- ❑ Different colored cans being used to identify different liquids
- ❑ Type II safety cans with hoses for controlled, targeted pouring
- ❑ Bonding and grounding being followed when transferring liquids
- ❑ DOT cans in use for over-the-road transport
- ❑ Nonmetallic safety cans in use for corrosive or high purity liquids
- ❑ Faucet cans in use when dispensing from shelf or bench

## Use – Specialty Containers

- ❑ Plunger cans used to moisten cleaning rags
- ❑ Bench cans in use for wetting small parts
- ❑ Wash and dip tanks in use for cleaning parts
- ❑ Floor and bench style rinse tanks being used for washing large parts
- ❑ One-handed dispensers being used to apply small liquid amounts

## Disposal – Waste Containers

- ❑ Safety drum funnels in use for collection of flammable waste liquids
- ❑ Bonding and grounding practices being followed during liquid transfer
- ❑ Safety disposal cans in use to collect small amounts of waste liquids
- ❑ Disposal cans with quick disconnects in use for HPLC collection
- ❑ Oily waste cans being used for rags/wipes containing solvents
- ❑ Safety drum covers in use to collect combustible trash
- ❑ Cease-Fire® receptacles in use for paper/trash and solvent-free waste
- ❑ Safety drain cans in use to drain solvent waste from rinse tanks

## Outdoor Applications

- ❑ Cigarette litter being safely collected in specially designed receptacles
- ❑ Drums of hazardous material stored in approved outdoor safety lockers

# Guidelines

Below are basic tips to remember when managing flammable liquids.

1. Know your chemical – consult the MSDS sheet
2. Remember it's not the flammable liquid itself that burns, but rather, the invisible vapor
3. Maintain adequate ventilation, avoid confined areas where vapors can accumulate
4. Eliminate potential ignition sources
5. Think "covered" or "closed" for containers
6. Properly bond and ground when transferring liquids
7. Maintain good housekeeping: keep liquids segregated, organized, and safely stored according to fire codes
8. Use approved equipment
9. Never become complacent. Flammables and the fire danger they present are very serious matters.
10. Remember the "Fire Triangle" and ensure your equipment and practices follow established regulations and procedures which reduce fire risks

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## Important Resources

- American National Standards Institute (ANSI) - www.ansi.org
- California Air Resources Board (CARB) Title 13 - www.arb.ca.gov
- Department of Transportation (DOT) - www.dot.gov
- Environmental Protection Agency (EPA) 40 CFR - www.epa.gov
- FM Global (FM) - www.fmglobal.com
- International Code Council (ICC) - www.iccsafe.org
  ^ International Fire Code© Section 3404.3.2
- Justrite Manufacturing Company - www.justritemfg.com
- National Fire Code of Canada (NFC) - www.nationalcodes.ca
- National Fire Protection Association (NFPA) - www.nfpa.org
  * NFPA 30, *Flammable Combustible Liquids Code* – 2008 Edition
  ** NFPA 1, *Uniform Fire Code*™ – 2006 edition
  *** *Fire Protection Guide to Hazardous Materials*, 13th ed.
- National Institute for Occupational Safety & Health (NIOSH) - www.cdc.gov/niosh
- Occupational Safety and Health Administration - www.osha.gov
  (OSHA 29 CFR 1910 (.106, .123, .125, .144, .1200 and 1926.252)
- OSHA/EPA Occupational Chemical Database - www.osha.gov/web/dep/chemicaldata/
- Underwriters Laboratories - www.ul.com
- Underwriters Laboratories of Canada - www.ulc.ca

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