

# RED BOOK

**YOUR GUIDE TO  
HANDLING FLAMMABLE LIQUIDS SAFELY**  
INCLUDES THE LATEST INFORMATION ON OSHA AND FIRE CODES

 **Justrite**  
Safety Group

*Start with the Essential™*



# HOW TO HANDLE FLAMMABLE AND COMBUSTIBLE LIQUIDS **SAFELY**

Backed by over a century of experience, Justrite Manufacturing Company has been providing workplaces with compliant, protective solutions for managing hazardous materials. Our expertise and equipment offers ways to safely *store*, *transfer*, *use*, and *dispose* of flammable liquids. The *STUD-E* system has been recognized as a vital part of environmental, health, and safety programs worldwide. To learn more, visit us at [www.justrite.com](http://www.justrite.com).



## Be Safe











Except in rare cases of natural catastrophes, every fire is preventable. That's why there's RedBook.

Inside you'll find explanations of the equipment and methods you can use to help minimize the chance of fires caused or spread by ignition of flammable and combustible liquids. The information will help you prevent disastrous fires and crushing losses of lives and property.

There is a technical distinction between "flammable" and "combustible" liquids (see page 30). However, both classes burn readily and intensively, are explosive under certain conditions, and if not properly contained, can spread fire rapidly and uncontrollably. In this guide the term "flammable liquids" will be used to cover both flammable and combustible classes.

Safe handling and storage of these flammable liquids require the use of approved equipment and practices. These have been established by the National Fire Protection Association (NFPA), International Fire Code (IFC), FM Approvals (FM), Underwriters Laboratories Inc. (UL), state and local safety codes, and are what the Occupational Safety and Health Administration (OSHA) standards require. All the safety equipment featured in this guide is cataloged in Justrite® product literature available upon request.

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Grounding Wire

Safety Drum Vent

Self-close Safety  
Drum Faucet

Drum Cradle

Faucet Extension

Bonding Wire

Safety Can

Spill Tray

## Safe Drum Storage and Dispensing



Indoor rooms for bulk storage of flammable liquids are subject to construction, arrangement, and outfitting requirements, as well as capacity limitations, which are beyond the scope of this publication. Specifications for acceptable storage rooms can be found in NFPA and IFC publications as well as local fire codes. OSHA Standards also refer to storage.

Assuming a properly constructed room, the following discussion covers recommended practices and equipment required for safe storage and withdrawal of liquids for in-plant use.

Two methods are acceptable for drawing off hazardous liquids from drums: Gravity Flow Method or Pump Method.

### The Gravity Flow Method

utilizes a self-closing\* safety faucet that requires the drum to be in a horizontal position for dispensing. A device such as a drum cradle or drum caddy provides an easy way to move drums into position and support them for storage. Gravity flow method requires the use of a safety drum vent in the drum, a spill tray under the faucet, bonding wire between the drum and the container being filled, and a grounding wire between the drum and an earth ground such as a cold water pipe.

\* Approved self-closing faucet as required by OSHA.

**The Pump Method** utilizes a pump to draw the contents out of a vertically stored drum. A safety pump transfers flammable and combustible liquids from bulk to intermediate containers. Justrite FM-approved, hand-operated piston pumps are stainless steel or electro-zinc plated and include flame arresters and pre-assembled grounding and bonding wires.

If a drum is to be stored temporarily prior to installing a faucet or pump, grounding and venting are recommended. A safety drum vent helps you maintain your drum as a safe, closed container as required by law. It allows vacuum relief for dispensing operations, and provides emergency pressure venting in the event of a fire. Without a safety drum vent, a fire can turn a drum of flammable liquids into a bomb.

In dispensing flammable or combustible liquids from one container to another, it is important to either bond or ground the containers to prevent static discharge which can ignite vapor. For complete information on recommended practices on static electricity, refer to NFPA 77, *Recommended Practice on Static Electricity*.

For details on safety faucets and safety drum vents, see pages 6 and 7.

### Grounding and Bonding

Buildup of static electricity charges on containers and people is a dangerous source of sparks that can touch off flash fires wherever flammable liquids are being transferred or used. It is important that proper grounding and bonding practices be followed to prevent static discharge from igniting vapors.

**Grounding.** Grounding all containers to an earth source is the recommended method to prevent the build up of static electricity. Grounding cables should be attached to each drum to the earth source and left in place as long as the drum is in the room. Grounding, in effect, drains the static charge to the earth.

**Bonding** is simply connecting a bond wire between the dispensing container and the receiving container. This gives both containers the same static potential thus eliminating the chance of static discharge. Before a container is filled from a drum faucet, a bonding wire fastened to the drum must be attached to the container.

It is critical that a metal-to-metal connection be made between a container and the bonding and grounding cables. The area of connection should be clean from dirt, rust, and paint for proper bare metal contact. It is important to make all connections (see example on opposite page), and to discharge oneself before opening any container. This can be done by touching the ground or bond wire first before opening any container.

### Spill Control

Whenever transferring liquids, the potential for leaks or spills exist. To prevent slip and fall injuries as well as protect against contamination to factory floors, drains, and outside groundwater, a variety of spill control devices help reduce risks. A safety spill tray should be positioned below each drum faucet to catch leaks from a worn or damaged faucet. These lidless cans have a perforated fire baffle over the opening to guard against outside ignition sources.

For protection against larger spills, EPA compliant pallets and caddies safely hold pails or drums in 30 or 55 gallon (110 or 200 Liter) capacities.





*Above: Approved self-closing safety faucets incorporate an internal flame arrester which prevents flashback of fire into the drum.*



*Above: Vacuum relief is manually controlled on a drum vent installed on a horizontally-positioned drum. Pressure relief is automatic.*

### **Drum Faucets**

Approved safety faucets for dispensing flammable liquids from horizontal drums are self-closing and equipped with drip-proof seals. The self-closing feature, required by OSHA, prevents unattended dispensing that can result in overflows and spills. Built-in flame arresters rapidly dissipate heat to prevent fire from reaching the drum's vapor space.

Several types of Justrite safety faucets are available. One is a standard rigid type made of brass. The other two are swivel-connection faucets of brass or stainless steel. These can be screwed into the drum tightly, then the spout adjusted independently to the required vertical position. This feature prevents the possibility of dangerous leakage due to overtightening and stripping threads or undertightening in order to position the faucet spout vertically. All  $\frac{3}{4}$ " NPT Justrite faucets carry FM approval and can be padlocked to prevent unauthorized withdrawal of drum contents.

Flexible hose faucet extensions, brass or stainless steel, which screw into the faucet are available to reduce the possibility of spills and provide an electrical bonding path to the container being filled, providing metal to metal contact is made.

Viscous flammables too thick for standard  $\frac{3}{4}$ " NPT safety faucets can be dispensed through the 2" bung opening using a safety drum gate valve. These brass valves are FM approved for non-corrosive liquids 2000 SSU or higher viscosity (about 30W motor oil).

**Antistatic wires** for drums reduce fire risks from static electricity. Available in flexible wire or insulated flexible wire, and end connection styles include alligator clips, hand clamps, C clamps, or pipe clamps.

### Drum Venting

Drums of flammable liquids require venting to relieve pressure buildup due to heat and also to prevent creation of a vacuum when dispensing liquid or the drum is subjected to sudden cooling. Either pressure or vacuum can cause failure of the container. In event of fire, the hazards of drum leakage or explosion due to excessive pressure buildup are frightening to consider.

A safety drum vent helps you maintain your drum as a safe, closed container as required by law. It allows vacuum relief for dispensing operations, and provides emergency pressure venting in the event of a fire.

When a drum is equipped with a safety faucet, both pressure and vacuum relief must be provided by an approved vent installed in the drum bung opening. Relief begins when internal pressure reaches approximately 5 pounds per square inch (0.35 bar) and stops when pressure drops to a safe level below that.

Vacuum relief is necessary to permit smooth flow of liquid from the drum as well as to prevent possible drum collapse and leakage.

There are two types of Justrite drum vents, both FM approved. One provides automatic relief of both pressure and vacuum. The other provides automatic pressure relief with quick, easy manual operation of vacuum relief.



Above: Vent on a vertically stored drum provides automatic relief of both pressure and vacuum. A brass nonsparking drum wrench safely opens tight bungs.

### Drum Accessories

Moving filled drums up to 600 lbs (272 kg) can be difficult and the use of powered handling equipment is often impossible due to space limitations. Effective solutions for easy drum portability include a steel drum cradle or a polyethylene spill containment caddy which offers the added protection of spill control.

Other types of drum accessories offer added convenience. To maximize drainage from a horizontally stored drum, a drum siphon adaptor is useful. To determine the liquid level in a vertically stored drum, use a polyethylene pop-up gauge. Another handy drum accessory for opening drum bung caps is a brass drum bung wrench.



Drum caddy makes it easy to move heavy drums.



Handy accessories: drum cradle, siphon adaptor with faucet spill tray.



Drum wrench fits many 2" or 3/4" bung styles.



Pop-up gauge warns when drum is nearly full.



Antistatic wires for use in bonding and grounding

## Safety Cabinets for Compliant Safekeeping of Hazardous Liquids

Virtually every place of business has occasion to use flammable or combustible liquids. Whether it is a manufacturing or processing plant, laboratory, or commercial institution, fire risks can be reduced by storing hazardous liquids in flammable liquid safety storage cabinets.

Safety cabinets serve several critical functions. First and foremost, they provide heat resistant enclosure of flammable liquid containers which helps protect both personnel and property from devastating fires. Cabinets help identify, organize, and segregate dangerous liquids. Often times they can be located near points-of-use, saving time and effort by eliminating frequent trips to a central storage room.

To clearly identify contents, safety cabinets include a visible warning label: "Flammable – Keep Fire Away." Labels that are reflective in nature offer an extra measure of safety. When illuminated with a flashlight during power outages or under smoky conditions, the reflective warning label bursts with high visibility, alerting firefighters or employees to the location of hazardous materials.

Lastly, safety cabinets improve security against unauthorized use of their potentially destructive contents. Justrite cabinets can be padlocked allowing security to be keyed different, keyed alike, or master keyed for employee convenience.

### Safety Cabinet Design

Construction and design requirements for safety cabinets are spelled out in NFPA 30, *Flammable and Combustible Liquids Code* and various OSHA regulations. Cabinets must be made of double-walled, 18 gauge (1mm) steel with 1½" (38mm) of insulating air space in the bottom, top, doors, and sides of the cabinet.

Additional requirements are that joints shall be welded, riveted, or made tight by some equally effective means and that the door shall be provided with a three-point latching arrangement. Further, the door sill shall be raised at least 2" (51mm) above the bottom of the cabinet and be labeled "Flammable – Keep Fire Away."

In response to the criteria set forth by NFPA and OSHA, independent testing agencies such as FM and UL have established procedures to test the effectiveness of a flammable liquid storage cabinet. A cabinet is considered acceptable if the internal temperature is limited to not more than 325°F (163°C) when subjected to a 10-minute fire test using the standard time temperature curve as set forth in NFPA 251, *Standard Methods of Fire Resistance of Building Construction and Materials*.

In addition to design requirements for flammable liquid safety cabinets, fire codes have also recognized the need to address the storage of hazardous materials — not because they are flammable, but because they are highly reactive. Example liquids are acids, bases, organic peroxides, oxidizers, and pyrophoric, toxic, and water reactive materials. NFPA 1, the IFC, and NFPA 400 *Hazardous Material Code* specify that these safety cabinets must be made of 18 gauge double-walled steel with 1½" air space, have a 3-point latching system with self-closing doors, a 2" sump, and be labeled HAZARDOUS KEEP FIRE AWAY. Justrite hazardous material safety cabinets also include polyethylene trays to line steel shelves for corrosion resistance and content-specific labels which should be affixed to the cabinet for proper identification of contents.

Note: if a hazardous liquid exhibits a flammable characteristic, such as concentrated acetic acid, the rules of flammable liquid safety apply, i.e. stored in a cabinet labeled Flammable—Keep Fire Away.

### Venting

Safety cabinets include dual vents with built-in flame arresters with bungs, usually located on the sides of a cabinet: one high and one low and they typically accommodate a two-inch NPT threaded rigid steel pipe. However, NFPA 30 does not require a cabinet be ventilated for fire protection purposes. Further, the code states that if not vented, the vent openings should be sealed with the bung caps provided. It goes on to say that if the cabinet is ventilated for any reason, "the vent openings should be ducted directly to a safe location outdoors or to a treatment device designed to control volatile organic compounds (VOCs) and ignitable vapors 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."

To determine if a cabinet should be vented, it is critical the local Fire Marshal/Fire Inspector be contacted for a determination based upon local or state regulations. It is also recommended to retain the services of a professional engineer to design a vent system following the guidelines below. The designer/installer should consult the local building codes, fire code, and the authority having jurisdiction to understand the laws and to look for recommendations or interpretations prior to the installation. It might also be helpful to contact the local EHS (Environmental Health and Safety) Officer, an Industrial Hygienist, the covering insurance company, or a corporate manager who is responsible for a company's overall safety directives.

## Venting (cont.)

If a cabinet is vented, some guidelines include: Blower(s) should be specified as safe for handling flammable fumes (explosion-proof) and installed in a manner to evacuate fumes from the cabinet using negative pressure (suction) to avoid dispersing fumes into the room itself.

- Blower(s) should shut down in the event of a fire to avoid drawing hot air and flame into the cabinet.
- Use of thermally actuated vent dampers on each vent opening, in conjunction with rigid steel pipe ducting, is the most effective way to vent a safety cabinet and to ensure the performance of a safety cabinet in a fire.
- Since flammable vapors are usually heavier than air, it is important to draw from the bottom vent and provide fresh air from the top vent.

## Seismic Protection

For earthquake regions, or simply where an added measure of stability is needed, a seismic bracket kit allows for either floor or wall mounting. A mounting kit that does not involve drilling into the cabinet is required so as to not violate the double-walled design, maintaining the fire protection properties of the cabinet and FM approval.

## Grounding

Although not required by federal regulations, steel safety cabinets include a built-in grounding lug, generally located at the bottom right side. For safe storage of flammables, it makes good safety sense to ground a cabinet when possible. If dispensing or collection processes are taking place within the cabinet, such as pumping out of a drum or pouring waste into a drum funnel, it is critical the cabinet be connected to an earth ground and proper bonding techniques between containers are followed.



To protect people and property from fire risks associated with volatile liquids, store flammable fuels, solvents, and chemicals in specially designed fire resistant safety cabinets. All Justrite safety cabinets meet OSHA and NFPA specifications, and most are independently tested and approved by FM Approvals.



Justrite Safe-T-Vent™ Thermally-Actuated Safety Cabinet Damper, used in conjunction with a Justrite safety cabinet and properly designed ventilation system, is a safe, reliable, and compliant way to ventilate a safety cabinet and still maintain the cabinet's performance in a fire.

## What Makes a Safety Cabinet Safe?

Complies with OSHA 29  
CFR 1910.106,  
NFPA Code 30,  
NFPA 1 and IFC

Fire tested and  
approved by  
FM Approvals.



- 1 18-gauge (1mm) double wall steel with 1-1/2" (38mm) of insulating air space for fire resistance.
  - 2 Fully welded construction holds squareness for longer life, offering greater protection in a fire since air gaps are reduced.
  - 3 Highly reflective "Flammable – Keep Fire Away" label warns of contents and provides greater visibility when illuminated with a flashlight during fire conditions. Lower reflective label alerts firefighters when rising smoke might obscure higher points.
  - 4 Rounded corners on doors reduce accidental nicks.
  - 5 On self-close style of cabinet, doors are held open by means of a fusible link. If inadvertently left open, under fire conditions the link will melt at 165°F (74°C) and automatically close the doors to protect the contents. Two-door cabinets are designed to be self-indexing, so both doors close in the correct sequence.
  - 6 Stainless steel, 3-point bullet self-latching system provides fail-safe, positive door closure with increased heat resistance.
  - 7 Flush handle accepts padlock or keys to secure contents from unauthorized use; reduces "catches" from passing traffic.
  - 8 Shelves are slightly sloped to direct hazardous spills to back and bottom of leak proof sump. They meet ANSI standards with a 350 lb. (159kg) safe allowable load.
  - 9 Welded shelf hangers interlock for safe, "no-slip" stability and adjust on 3" (76 mm) centers.
  - 10 Built-in grounding lug accepts optional antistatic wire to safely ground cabinet to earth ground. Optional seismic brackets secure cabinet to floor or wall for an extra measure of security when increased stability is needed.
  - 11 Dual vents with built-in flame arresters sealed with bung caps.
  - 12 2" (51mm) liquid-tight sump safely contains dangerous leaks or spills.
  - 13 Adjustable leveling feet for stability on uneven surfaces.
- Indicates location of 3-point latching system.

## Important Considerations When Selecting a Safety Cabinet

Safety cabinets come in a wide selection of colors, sizes, shapes and door arrangements. Beyond choosing a cabinet that meets the requirements of NFPA, OSHA, and carries an FM approval, other factors must be considered.

### Chemical Characteristics

It is important to identify and inventory all chemicals to be stored. A review of the Safety Data Sheet (SDS) will determine characteristics and recommended storage practices. To avoid generating toxic explosions and to prevent fires, it is critical to segregate incompatible chemicals. Chemical labeling and training is covered under regulations and the Right-to-Know Act (or Hazard Communication Standard). For easy access to SDS sheets, Document Storage Boxes are available which adhere directly on a safety cabinet for point-of-use availability and to avoid modifying safety cabinets.

An easy way to organize chemicals or fuels and segregate incompatible liquids is to store them in different color safety cabinets for quick identification and visibility to workers. It is also helpful to fire department personnel in recognizing hazards when responding to emergency situations. Per regulatory codes, safety cabinets must be correctly labeled to represent hazards found in an area. While codes do not mandate the specific color, industry has customarily observed certain colors for defined liquids (see chart below).

Safety cabinet construction varies. For *flammable* liquid storage, OSHA, NFPA, and the IFC specify design criteria for either steel or wood construction. The most popular and widely used flammable liquid safety cabinets are made of steel.

See page 8 for construction criteria. For *corrosive liquids that exhibit a flammable characteristic*, rules of flammable liquid storage must be followed with the same design criteria as above. The addition of polyethylene trays should be added to a flammable storage cabinet to help resist the aggressive nature of corrosive chemicals. The cabinet must also be labeled "Flammable—Keep Fire Away."

Fire codes address the storage of *hazardous materials including acids* — not because they are flammable, but because they are highly reactive. See page 8 for regulations, examples of hazardous materials, and steel design criteria. These cabinets can be used to increase Maximum Allowable Quantities (MAQs) per code.

For situations not dictated by fire codes, such as for *non-flammable acids and corrosives* where quantities are below the MAQ, suitable cabinet construction includes low-density polyethylene, laminated wood, or high-density solid polyethylene. To increase MAQs, cabinet construction options include steel with poly shelf liners, or steel with a thermoplastic coating on all interior surfaces.

No matter what type of liquid is being stored, it's important to properly maintain a safety or storage cabinet. Always store chemicals in closed containers, neutralize acid spills, and promptly clean up spills and residue on cabinet surfaces and containers. Be sure the cabinet is level and located indoors in a well ventilated, low humidity environment.

### Regulatory and Safety Considerations

As covered earlier, construction criteria must conform to specifications set forth

by NFPA and OSHA. In some areas of the country where the International Fire Code (IFC) is followed, it is further required that the doors of a flammable liquid cabinet shall be well fitted and *self-closing*.

Safety cabinets come in single or two door closure styles: manual or self-closing. Economical manual close doors permit doors to open a full 180 degrees and require the user to physically shut the doors. Self-close, self-indexing doors incorporate a mechanism that automatically shuts doors upon release. Fusible links hold the doors open during use, but if inadvertently left open, will melt at 165°F (74°C) in the event of a fire to automatically close the doors.

Whereas self-closing doors are required in states that adopt a specific fire code, it is recommended that local jurisdictions always be contacted for specific requirements. Self-closing doors ensure closure by taking away the "human element" of potentially forgetting to shut the doors. It is often, therefore, considered the preferred door choice for a good overall safety program. Additionally, self-close mechanisms that are concealed within the top wall of the cabinet are an added benefit, maximizing available storage space.

Whether manual or self-closing, a self-latching door and handle is critical as it does not require the user to manually rotate a handle to ensure the mandatory three-point latch is properly engaged. A stainless steel bullet-type latching system offers positive closure and optimum longevity with increased heat resistance.

All Justrite cabinets have a 3-pt. stainless steel bullet self-latching system, meet OSHA and NFPA, and most are FM approved.



Yellow for flammable liquids



Green for pesticides and insecticides



Red for paints, inks, and other combustible liquids



Silver or neutral colors for laboratory settings



Blue for corrosives and hazardous liquids



White, beige or gray for waste or outdoor lockers



### Capacity Factors

OSHA limits the amount of liquid kept outside of a flammable storage cabinet or inside storage room. Local authorities or insurance companies may require the use of safety cabinets for quantities less than that of OSHA. It is simply a good safety practice to store even the smallest amount of flammables in cabinets rather than on or under benches or in other locations where carelessness could contribute to fire hazards and possible inspection citations.

When choosing a safety cabinet, identify how much chemical capacity is needed for both existing as well as future needs. Justrite flammable liquid storage cabinets are available in sizes ranging from 4 to 120 gallons (15 to 454 liters).

To determine the volume limit of flammable liquid to be stored in a single cabinet, it's important to understand if someone is referencing labor law (OSHA) or the fire codes (NFPA 30, NFPA 1, and IFC). Starting in 2012, their classifications of flammable liquids became different. The fire codes refer to a "Class" of liquid, whereas OSHA refers to a "Category" of liquid. Another difference is the fire codes define combustible liquids, whereas OSHA has eliminated the reference to "combustible" entirely and defines all flammable liquids by flash point with notations about liquids heated within 30°F (16.7° C) of their flash point.

OSHA changed to the "Category" classification to align their Hazard Communication Standard (HCS) with the United Nation's Globally Harmonized System of Classification and Labeling of Chemicals (GHS). See the chart at right for classification of liquids by flash point. OSHA states that not more than 60 gallons (227 liters) of Category 1, 2, or 3 flammable liquids, nor more than 120 gallons (454 liters) of Category 4 flammable liquids may be stored in a single cabinet.

For the classification of liquids and maximum allowable quantities (MAQs) according to the fire codes, see pages 28-29.

Because MAQs are complex and can be different between fire codes and labor law, it is critical to always consult the authority having jurisdiction (AHJ) for final determinations.

Beyond code issues, thought should be given to the type of containers being stored and location placement. There are a variety of sizes and shapes available, accommodating

safety cans and smaller containers up to storage for large drums, stored either vertically or horizontally.

### Security and other Safety Considerations

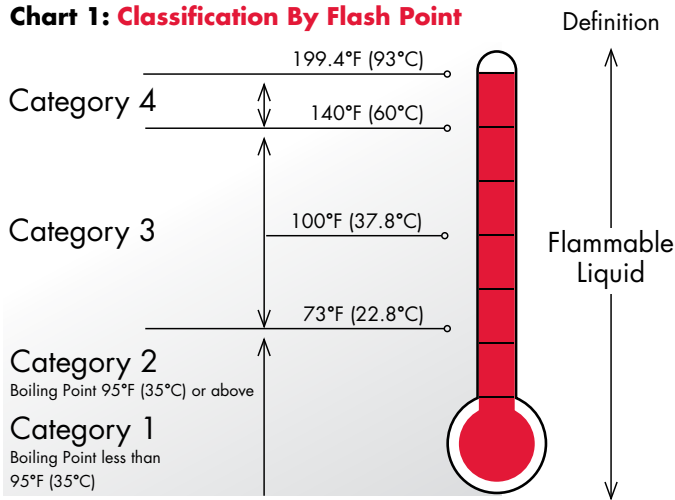
To secure hazardous contents from unauthorized use, all safety cabinets are lockable. Justrite cabinet's U-Loc™ handles include a double key set and are also designed to accept a padlock which offers a clearly visible deterrent. It also allows an economical way to control access to contents, can be keyed differently for security, master keyed, or keyed alike for employee convenience. The padlockable feature eliminates the desire to drill into the cabinet to attach a padlock hasp which would violate its FM approval and the cabinet's fire protection property.

To identify flammable contents and alert employees, safety cabinets carry a large, "Flammable – Keep Fire Away" warning label. Trilingual warning labels on Justrite cabinets are reflective in nature. When illuminated with a flashlight during dark conditions, they burst with high visibility and can be seen at a great distance. Strategically placed in high and low zones, their firefighter friendly design allows emergency personnel to locate a cabinet during an investigative walk through, or when crawling in a smoke filled area.

Other things to look for in selecting a cabinet include shelves that meet ANSI standards for safe loading. The ability to direct spills and leaks into the leak proof cabinet sump is a plus. Lastly, choosing a cabinet with quality craftsmanship ensures cabinets will work properly for a long time. Justrite cabinets come with a 10-year limited warranty.

### Liquid Classification Per OSHA

**Chart 1: Classification By Flash Point**



**Notes**

- 1) When a Category 4 flammable liquid is heated for use to within 30 °F (16.7 °C) of its flash point, it shall be handled in accordance with the requirements for a Category 3 liquid with a flash point at or above 100 °F (37.8 °C).
- 2) When a Category 3 liquid with a flash point at or above 100 °F (37.8 °C) is heated for use to within 30 °F (16.7 °C) of its flash point, it shall be handled in accordance with the requirements for a Category 3 liquid with a flash point below 100 °F (37.8 °C).
- 3) When liquid with a flash point greater than 199.4 °F (93 °C) is heated for use to within 30 °F (16.7 °C) of its flash point, it shall be handled in accordance with the requirements for a Category 4 flammable liquid.

## Transfer – Safety Cans for Liquid Transfer

### Safety Cans for Storage and Transfer

Approved safety cans (required by OSHA) are the most familiar safety equipment seen in many plants and probably among the least understood as to what they are and what they must do.

The basic purpose of a safety can is to control flammable vapors, while providing a safe and convenient means of carrying, dispensing and storing up to 5 gallons (19 Litres) of flammable liquid.

This requires that the can must:

1. Be leak tight;
2. Automatically vent vapor between 3 and 5 psig (0.2 and 0.35 bar) internal pressure to prevent rupture (or explosion in event of fire);
3. Prevent flame from reaching the flammable liquid contents through the spout;
4. Automatically close after filling or pouring (self-closing lid).

For more details on what makes a safety can "safe," see page 15.

Beyond guarding against possible fire and explosion, safety cans must be able to resist damage and wear in normal usage, permit ready, convenient use in pouring, filling and carrying and be properly marked to identify their contents. OSHA standards for portable safety containers for flammable liquids having a flash point at or below 80°F (27°C) require the safety can be red with a yellow band around the container or stenciling of identification of the can contents. All Justrite safety cans carry a yellow

band with a large area on the band for the user to identify contents to reduce misuse. Justrite safety cans offer a 10-year limited warranty.

Several different types of safety cans as well as a full range of can capacities are needed for most convenient, efficient service in various use situations. These include Type I and Type II safety cans, galvanized steel and nonmetallic can bodies, faucet and tilt-rack laboratory cans and wide-mouth disposal cans. All Justrite safety cans are FM approved and/or UL listed.

To provide information necessary to put the right safety cans to their best uses, brief design and application data for each type follows.

**Cap operating mechanisms** on safety cans are spring-loaded and self-closing to provide a leakproof spout seal, and pressure relief venting. Either attached to or integral with the cap operating mechanism is a can carrying handle. Design of the handle will greatly affect the convenience of carrying and using safety cans. The best design will swing to distribute weight evenly and protect the cap when not in use. It will also enable the user to open the cap without any awkward secondary linkages.

Spring pressure is applied to the self-aligning cap and its sealing gasket to make a leakproof seal with the rim of the can spout. The spring tension that seals the cap is also designed to allow the cap to lift to relieve excessive internal pressures.

**Flame arrester screens** inside the cap spout are essential to prevent fire flashback to the can contents.

Flame arresters in Justrite safety cans are long length and stainless steel construction with large surface area to permit full-flow filling and pouring.

A flame arrester works by providing rapid dissipation of heat from a flame, quenching the flame, to prevent flame propagation to the vapor space inside the safety can. Employees must be instructed not to remove or damage flame arrester screens. Any holes punched in the screens change the heat-absorption characteristics of the area involved and may nullify the effectiveness of the unit.

**Capacity ratings.** Safety cans must not be filled above their rated capacity, which is up to the seam that joins a metal can top to the body or to a fill level mark on a nonmetallic can. Overfilling can result in dangerous liquid overflow from the spout as pressure builds from an increase in temperature.

**Approvals.** Safety cans are designed to meet specifications set forth by the Occupational Safety and Health Administration (OSHA) and the National Fire Protection Association (NFPA). Additionally, most have earned certification from nationally recognized testing laboratories such as FM Approvals (FM), Underwriters Laboratories (UL/ULC), and TÜV SÜD.



ACCEPTED UNDER CARB TITLE 13

## TRANSFER

**Styles of safety.** The various types of safety cans are often defined by the lid design and methods of filling and pouring.



*Type I Safety Can One opening from which to fill and pour into larger receiving vessels.*

**Type I and Type II Safety Cans** are required by OSHA when used by any business or commercial enterprise.



*Type II Safety Can Two openings: top opening with lift lever for filling, and a second one with flexible metal hose attached for controlled, plug-free dispensing into smaller openings.*



*Type II D.O.T. Safety Can Two openings: top opening with lift lever for filling, and a second one with flexible metal hose attached for accurate, plug-free dispensing into smaller openings. Additional safety features include roll-bar construction and a fusible-link protected hold-down bracket for protection during over-the-road transport.*

**Type II D.O.T. Safety Cans** are required by the Department of Transportation and OSHA for use in any commercial vehicle when transporting flammables on public roads and highways (some exceptions may apply).

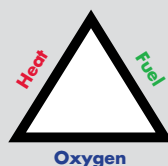


**Colors.** When working with flammable or combustible liquids, using the wrong fluid could result in equipment damage or even present a potential disaster. Using color in your storage practices helps identify, organize and segregate liquids to avoid accidents.

OSHA requires flammables with a flash point below 80°F (27°C) be in a red can with yellow band. Typical industry convention is red = gasoline, yellow = diesel, blue = kerosene, and green = oil.

**Type I safety cans** are the typical, single-spout safety cans in widest use for transfer, storage and dispensing of flammable liquids in capacities from 1 pint (.5 Litre) to 5 gallons (19 Litres). Justrite manufactures Type I cans with galvanized steel bodies in many sizes and with nonmetallic bodies in the most commonly used sizes.

Type I safety cans are designed primarily for filling of containers having large receiving openings, such as rinse or cleaning tanks. However they can be equipped with accessory funnel attachments for filling containers with smaller openings.



**Triangle Leg:**

**Heat**  
**Fuel**  
**Oxygen**

Is Controlled by:

Flame Arrester, Self-close Lid  
Self-close Lid, Leaktight Gasketed Lid  
Leaktight Gasketed Lid

The fire triangle demonstrates the three basic elements that must be present simultaneously to support a fire. These elements are the "legs" of a fire triangle. A safety can is designed to specifically eliminate one or more of the elements needed for a fire to start: heat, oxygen and fuel.

## What makes a safety can safe?

TRANSFER

*Self-closing, leakproof, gasketed lid*  
Protects vapors from escaping and guards against dangerous spillage if the can is accidentally dropped or knocked over. Spring loaded, it closes automatically after filling or pouring to keep it a safe, closed container as required by law.

*Positive pressure relief cap*  
Allows the container to automatically vent to prevent rupture or explosion in the event of a fire.

*Flame arrester within the fill/pour spout*  
Guards against outside heat sources, such as a spark, from entering the container—thereby protecting the volatile vapor space on the inside of the container from igniting.

*100% leak tested*  
Every safety can is tested under pressure to ensure it will not leak.

*Yellow band around can body*  
Warns of danger and includes large area for content identification.

*Carry handle*  
Rounded handle design doesn't cut into hand and makes it easy to carry heavy loads. Free-swinging style on Type I cans pulls back to open lid. Rigid carry handle on Type II cans include easy trigger mechanism for controlled pouring.

*Reinforcing rings*  
Strengthens can walls and reduces denting.

*Approved container*  
Independently tested and approved by FM, UL/ULC Listed, TÜV Certified



Cutaway view of a Type I safety can.



Proper grounding and bonding techniques safely prevent static discharge and the potential for explosion and fire.



**Type II safety cans** offer additional convenience with two openings; top opening with lift lever for filling, and a second opening equipped with a flexible metal hose for accurate, controlled pouring into small apertures. A special manifold design incorporates an air displacement vent for smooth, slug-free liquid flow. A leakproof, self-closing lid controls spills and auto vents to prevent pressure build-up. Like the Type I can, an internal stainless steel flame arrester stops flashback ignition to reduce fire risks.

Justrite metal body Type II safety cans are manufactured in a variety of capacities. They meet OSHA, NFPA, and IFC and are FM approved, UL/ULC listed and TÜV certified. All models are well suited for controlled pouring of fuel or other flammable liquids into containers with small openings, such as small motor fuel tanks and dispenser cans.

**Metal laboratory cans** are safety cans with self-closing faucets, designed for dispensing flammable liquids into smaller containers. Justrite models are available in both shelf and tilt-rack types. The shelf dispensing can has a safety faucet near its base for gravity flow draining and a top spout for filling and pressure relief. The tilt-rack laboratory can is mounted in a sturdy tilt frame with the pouring spout on the can top opposite the fill and pressure-relief spout. Where test tubes, small flasks and other small-opening containers are to be filled, these cans are recommended. Shelf models are manufactured in 1, 3 and 5 gallon (4, 11, 19 Litre) sizes; the tilt-rack lab can has a 5 gallon (19 Litre) capacity. Flexible metal safety hoses may be threaded into the faucets for complete control.



*Antistatic wires with alligator clips are a popular choice when grounding containers. Clips with their sharp teeth can be "wiggled" to ensure metal to metal contact on painted surfaces.*



### Nonmetallic Safety Cans

Nonmetallic safety cans are an original Justrite development in safety containment for flammable liquids. They have special applications and advantages over metal safety cans that fill important gaps in the overall flammable liquids handling picture. They are tested to the same rigors as steel safety cans and they meet OSHA requirements for an approved container.

The can bodies are molded from dense, thick polyethylene that is highly resistant to corrosive chemicals. Justrite nonmetallic cans have a unique current-carrying carbon insert embedded in the ribbing which facilitates proper bonding or grounding.

Nonmetallic safety cans also are much more resistant to rough usage than conventional metal cans. They have higher dent, puncture and drop resistance than metal and retain good appearance longer because their bright red color is molded into the can material instead of painted on. Their durability has made them ideal on construction sites as well as in manufacturing plants. Because they can accommodate corrosive or high-purity liquids, they are a popular choice among laboratory professionals.



*To properly ground when using nonmetallic containers, an antistatic wire connects the poly can's cover assembly (with special internal insert) to the receiving vessel. A second antistatic wire connects the receiving vessel to a ground pipe.*



*The conductive, current-carrying carbon insert is embedded in the rib of the container creating a grounding path between the cover assembly and the flame arrester in the spout to aid in proper grounding.*

Nonmetallic safety cans include internal stainless steel flame arresters to stop flashback ignition. External hardware is also stainless steel for optimum protection against corrosives.

Under extreme fire exposure, the top of a nonmetallic can will soften, melt and collapse inward. The vapor released from the surface of the exposed liquid then burns off, just as vapor escaping from any safety can spout will burn off in the presence of flame. However, the nonmetallic can body does not melt nor rupture below the level of the contained liquid. Thus, no liquid escapes to spread fire.

For corrosive liquid applications in the laboratory or plant, the nonmetallic safety cans are an ideal replacement for more expensive stainless steel safety cans or relatively fragile porcelain and glass bottles.

Justrite Type I nonmetallic safety cans are available in capacities of 2½ and 5 gallons (9 and 19 Litre) in the round shape, and in ½ gallon and 1 gallon (2 and 4 Litre) oval shape. The latter are popular for laboratory use, with five oval cans occupying no more space than three round cans of the same capacity. All models are FM approved.

Nonmetallic waste disposal cans in 2 gallon and 5 gallon (8 and 19 Litre) sizes, designed with wide mouth openings for collection of flammable wastes, are discussed on page 23 of this handbook.

*Nonmetallic oval-shaped safety cans require less storage space and are a popular choice in laboratories where high-purity liquids are used.*



## Justrite Safety Can Compatibility Chart

▼ Chemical	Can Material ►	Galvanized Steel	Polyethylene	Stainless Steel
Acetic Acid		NR	Good	Good
Acetone		Poor	Fair	Good
Acetonitrile		Fair	Good	Fair
Aniline		Good	Good	Good
Benzene		Fair	Fair	Good
Cyclohexane		Good	Fair	Poor
Cyclohexanone		Good	NR	Poor
Ethanol		Good	Good	Good
Ethyl Acetate		Good	Fair	Good
Ethyl Ether		Good	Fair	Good
Ethylene Glycol		Good	Good	Good
Fuel Oil		Good	NR	Good
Gasoline		Good	Fair	Good
Heptane		Good	Poor	Good
Hexane		Good	NR	Good
Hydrochloric Acid 37%		NR	Good	NR
Isopropyl Alcohol 70%		NR	Good	Good
Kerosene		Good	NR	Good
Methanol		Good	Good	Good
Methyl Ethyl Ketone		Good	Fair	Good
Methyl Isobutyl Ketone		Good	Fair	Poor
Methylene Chloride		NR	NR	Good
Pentane		Good	NR	Good
Petroleum Ether		Good	Poor	Good
Toluene		Good	Fair	Good
Trichloroethylene		NR	NR	Good
Turpentine		Poor	Poor	Good
Xylene		Good	Fair	Good

NR = Not Recommended



 **Justrite®**

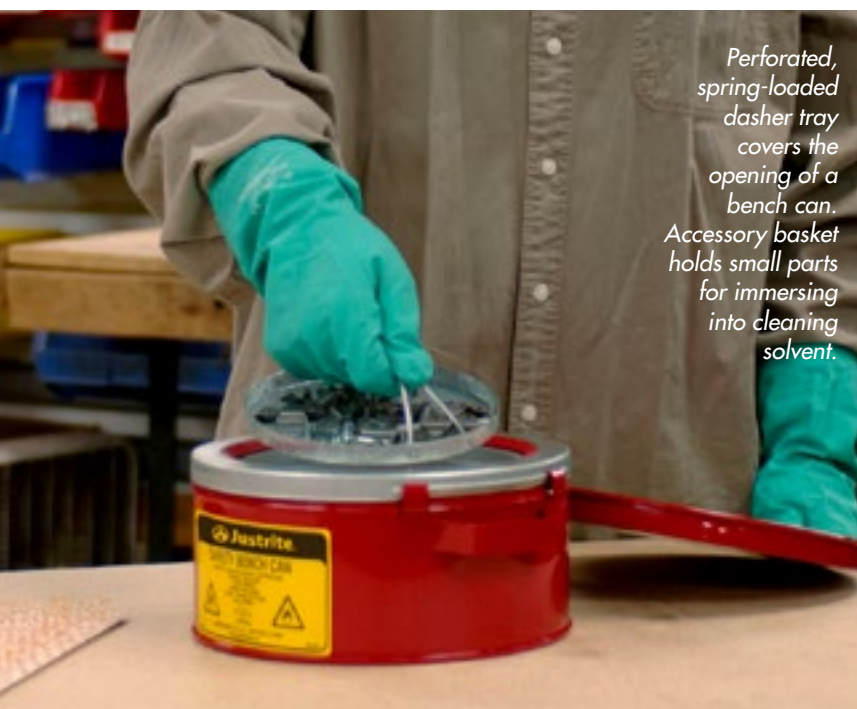
**Warning:** This chart is offered as a guide for convenience and is not a substitute for the user clearly understanding the nature and proper use of the chemicals being used, area hygiene and environmental conditions, and the laws governing use. Check with the chemical manufacturer for more information. Mixing of different chemicals and chemical concentrations may impact suitability and compatibility. This chart is not a guarantee, express or implied, of fitness of use and Justrite assumes no responsibility for the use or misuse of this information.



*The dispensing tray top of a plunger can incorporates a perforated metal flame arrester. Pressing down pumps liquid up from the can for safe moistening of cleaning rags.*



*Self-closing, foot-operated lid on a Justrite rinse tank contains flammable vapors, snuffs out flash fire.*



*Perforated, spring-loaded dasher tray covers the opening of a bench can. Accessory basket holds small parts for immersing into cleaning solvent.*



*Round bench-style wash tank has fusible link device to close lid in case of fire.*

## Safe Usage of Combustible Liquids in Cleaning Operations



Often times solvents are used in cleaning operations or at point-of-use in production lines. NFPA 30B 9.7.6 indicates that cleaning of all parts shall be performed with a nonflammable solvent. The exception noted is a combustible liquid with a flash point above 100°F (37.8°C) (closed cup) is permitted to be used for cleaning provided adequate ventilation is supplied and no sources of ignition are present in the cleaning area.

OSHA requires that rinse and dipping operations be covered or one "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."

Fulfillment of OSHA and NFPA requirements are met in great part by the use of Justrite FM-approved containers that have gravity closing lids, fusible link activated spring closing lids, or dasher plates.

### Plunger Cans for Moistening Cleaning Rags

FM approved plunger cans provide the safest method of wetting cloths with combustible 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 combustible liquids.

A perforated, spring-loaded dasher tray covers the opening of the wide, shallow can. Combustible 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 combustible 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 combustible 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 combustible solvents. 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.



## DISPOSAL

Fusible link melts under fire conditions to close cover.

Bonding wire connects can to funnel.

Grounding wire connects drum to earth ground.

Safety vent provides automatic pressure and vacuum relief.

Spill platform keeps drum off floor and catches incidental drips. For EPA compliant spill control, larger sump capacity pallets are available.

## 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.

Built-in flame arrester prevents fire intrusion.

*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 are approved safety cans,** with 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, made of non-combustible steel, 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.

A closed lid also robs oxygen from any internal combustion that can occur as a result of spontaneous combustion.

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.



*Foot operated cover closes by gravity when pedal is released to reduce oxygen supply and prevent fire. Hand operated styles also available.*

*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, UL listed 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 thereceptacle rise under the head rim and are directed back into the combustion area, cutting off outsideoxygen 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 spill 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.

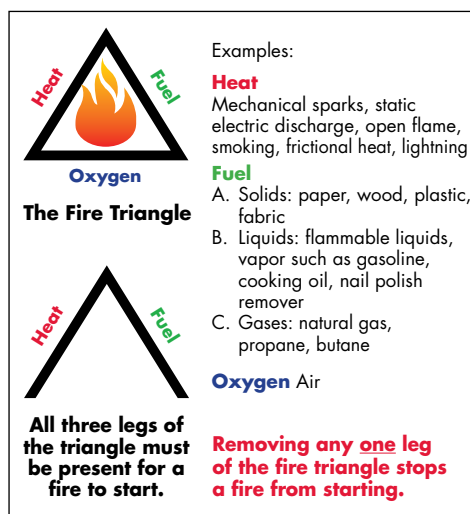
Practically every human alive recognizes fire's extraordinary usefulness and at the same time is all too aware of the extraordinary dangers it presents. Industrial and residential fires alike, present huge problems. NFPA statistics show that 1,3750,000 fires were reported in the U.S. during 2012. A fire department responded to a fire every 23 seconds. One civilian death occurred every 3 hours and 4 minutes and property damage amounted to \$12.4 billion. 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.



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 flash point 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 33 to 37, a familiarity with the following terms will prove useful.

*Note: Liquid classifications as shown on pages 28-29 and the charts on pages 33-37 reflect definitions according to fire and flammable liquid codes (NFPA 30, NFPA 1, IFC). Labor law (OSHA) defines flammable liquids differently than the fire codes —refer to page 12 for specifics.*

**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. It is not the liquid that burns, it is the vapor and its mixture with air that burns.

**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.

**Fire point** is a temperature above the flash point of a liquid, which after the initial combustion, sustained combustion can occur. Sustained combustion occurs when there is enough oxygen, enough fuel, and enough heat to feed it. Then the concern is how to put the fire out.

**(Auto) ignition temperature** is 1) the minimum temperature of a heat source to ignite flammable liquid vapor with air in the flammable range (as relates to safety cabinet performance in a fire), or 2) the lowest temperature at which a mass will spontaneously combust (as relates to oily rags).

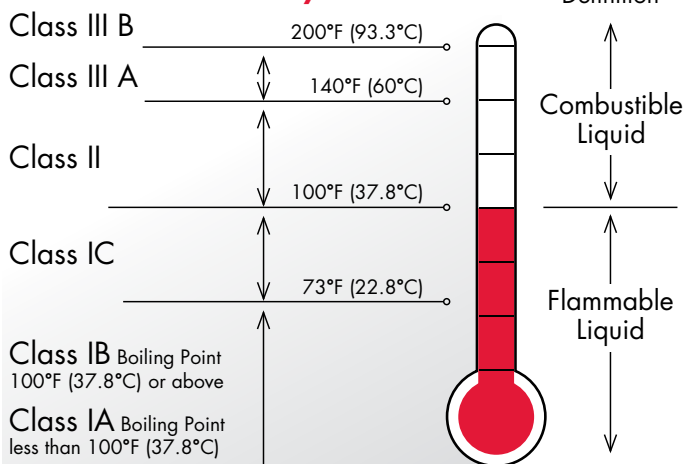
**Flammable (explosive) range** of flammable liquids is the ratio of liquid vapor in air, by volume, within which ignition can occur, see Chart 3. Gasoline, for example, has an explosive range between 1.4% and 7.6 %. This indicates that any ratio of gasoline vapor in air between these percentage limits 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) (auto 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.

## Liquid Classification Per Codes

- NFPA 30 Flammable and Combustible Liquids Code
- NFPA 1 Fire Code • International Fire Code

**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**

Liquid and Ignition Temperature	Lean Mixture			Rich Mixture	
	1%	5%		9%	
Fuel Oil No.1 (Class II)	410°F (210°C)	0.7	5.0		
Xylene (Class IC)	867°F (463°C)	0.9	6.7		
Gasoline (Class IB)	536-583°F (280-456°C)	1.4	7.6		
Pentane (Class IA)	500°F (260°C)	1.5	7.8		

**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, so it floats on 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.

**Water miscible** liquids are able to mix completely with water at the molecular level. The volatility of miscible flammable liquids, such as alcohols, may be diluted with water—the higher the percentage of water, the lower the flash point of the compound.

#### 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 Approvals.

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

**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 Approvals (FM):** A nationally recognized 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 by draining the static to earth.

**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 an exothermic chemical reaction creating a 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.”

**Table 9.6.1**

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

	Liquid Class(es)	Quantity		Notes
		gal	L	
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	1,2,4

**Table 9.6.1 from NFPA 30, 2015 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*, and designed in accordance with the protection criteria contained in Chapter 16 of this code.

\*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. 1910.6, 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)

"Flash point" 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 °F (37.8 °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 § 1910.6, or an equivalent test method as defined in Appendix B to § 1910.1200—Physical Hazard Criteria, shall be used.

(ii) For a liquid which has a viscosity of 45 SUS or more at 100 °F (37.8 °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) or an equivalent method as defined by Appendix B to § 1910.1200—Physical Hazard Criteria, shall be used except that the methods specified in Note 1 to section 1.1 of ASTM D-93-71 may be used for the respective materials specified in the Note. The preceding ASTM standard is incorporated by reference as specified in § 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.

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

## ■ 1910.106(a)(19)

Flammable liquid means any liquid having a flash point at or below 199.4 °F (93 °C). Flammable liquids are divided into four categories as follows:

(i) Category 1 shall include liquids having flash points below 73.4 °F (23 °C) and having a boiling point at or below 95 °F (35 °C).

(ii) Category 2 shall include liquids having flash points below 73.4 °F (23 °C) and having a boiling point above 95 °F (35 °C).

(iii) Category 3 shall include liquids having flash points at or above 73.4 °F (23 °C) and at or below 140 °F (60 °C). When a Category 3 liquid with a flash point at or above 100 °F (37.8 °C) is heated for use to within 30 °F (16.7 °C) of its flash point, it shall be handled in accordance with the requirements for a Category 3 liquid with a flash point below 100 °F (37.8 °C).

(iv) Category 4 shall include liquids having flash points above 140 °F (60 °C) and at or below 199.4 °F (93 °C). When a Category 4 flammable liquid is heated for use to within 30 °F (16.7 °C) of its flash point, it shall be handled in accordance with the requirements for a Category 3 liquid with a flash point at or above 100 °F (37.8 °C).

(v) When liquid with a flash point greater than 199.4 °F (93 °C) is heated for use to within 30 °F (16.7 °C) of its flash point, it shall be handled in accordance with the requirements for a Category 4 flammable liquid.

## ■ 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) "Scope"

"Container and portable tank storage" –

(i) "General" This paragraph shall apply only to the storage of flammable 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:

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

(iii)(b) Category 1,2,3 flammable liquids in the fuel tanks of a motor vehicle, aircraft, boat, or portable or stationary engine;

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

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

## Drum Equipment/Handling

## ■ 1910.106(e)(2)(iii):

"Separation and protection." Areas in which flammable 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.

## ■ 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.

## ■ 1910.106(e)(2)(iv):

"Handling liquids at point of final use."

(a) Category 1 or 2 flammable liquids, or Category 3 flammable liquids with a flash point below 100 °F (37.8 °C), shall be kept in covered containers when not actually in use.

(b) Where flammable liquids are used or handled, except in closed containers, means shall be provided to dispose promptly and safely of leakage or spills.

(c) Category 1 or 2 flammable liquids, or Category 3 flammable liquids with a flash point below 100 °F (37.8 °C), may be used only where there are no open flames or other sources of ignition within the possible path of vapor travel.

(d) Flammable 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.

## ■ 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.

## ■ 1910.106(e)(6)(ii):

Grounding. Category 1 or 2 flammable liquids, or Category 3 flammable liquids with a flash point below 100 °F (37.8 °C), 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.

## MAQs and Safety Cabinets

## ■ CFR 1910.106(e)(2):

(i) "Application." This subparagraph shall be applicable to those portions of an industrial plant where the use and handling of flammable liquids is only incidental to the principal business, such as automobile assembly, construction of electronic equipment, furniture manufacturing, or other similar activities.

(ii) "Containers." flammable liquids shall be stored in tanks or closed containers.

(a) Except as provided in subdivisions (b) and (c) of this subdivision, all storage shall comply with paragraph (d) (3) or (4) of this section.

(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 Category 1 flammable liquids in containers

(2) 120 gallons of Category 2, 3, or 4 flammable liquids in containers

(3) 660 gallons of Category 2, 3, or 4 flammable liquids in a single portable tank.

## ■ 1910.106(d)(3):

"Design, construction, and capacity of storage cabinets"

i) **Maximum capacity.** Not more than 60 gallons of Category 1, 2, or 3 flammable liquids, nor more than 120 gallons of Category 4 flammable 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 deg. 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, which is incorporated by reference as specified in Sec. 1910.6. 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 gage sheet iron and double walled with 1 1/2 - inch 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 inches above the bottom of the cabinet.

(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 rabbetted and shall be fastened in two directions with flathead woodscrews. When more than one door is used, there shall be a rabbetted 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 — 2012 Edition<sup>®</sup>:

### 5704.2.2 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 5704.3.2.1 through 5704.3.2.2

**5704.3.2.1.1 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.

2. Unlisted wooden cabinets, including doors, shall be constructed of not less than 1-inch (25 mm) exterior grade plywood. Joints shall be rabbeted and shall be fastened in two directions with wood screws. Door hinges shall be of steel or brass. Cabinets shall be painted with an intumescent-type paint.

**5704.3.2.1.2 Labeling.** Cabinets shall be provided with a conspicuous label in red letters on contrasting background which reads:

FLAMMABLE—KEEP FIRE AWAY.

**5704.3.2.1.3 Doors.** Doors shall be well fitted, self-closing and equipped with a three-point latch.

**5704.3.2.1.4 Bottom.** The bottom of the cabinet shall be liquid tight to a height of at least 2 inches (51 mm).

**■ NFPA Code 30 – 2015 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 a storage cabinet is not ventilated, the 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 a storage cabinet is ventilated for any reason, the vent openings shall be ducted directly to a safe location outdoors or to a treatment device designed to control volatile organic compounds (VOCs) and ignitable vapors 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.

**A.9.5.4\*** Venting of storage cabinets has not been demonstrated to be necessary for fire protection purposes. Additionally, venting a cabinet could compromise the ability of the cabinet to adequately protect its contents from involvement in a fire, because cabinets are not generally tested with any venting. Therefore, venting of storage cabinets is not recommended.

However, it is recognized that some jurisdictions might require storage cabinets to be vented and that venting can also be desirable for other reasons, such as health and safety. In such cases, the venting system should be installed so as to not affect substantially the desired performance of the cabinet during a fire. Means of accomplishing this can include thermally actuated dampers on the vent openings or sufficiently insulating the vent piping system to prevent the internal temperature of the cabinet from rising above that specified. Any make-up air to the cabinet should also be arranged in a similar manner. If vented, the cabinet should be vented from the bottom with make-up air supplied to the top. Also, mechanical exhaust ventilation is preferred and should comply with NFPA 91. Manifolding the vents of multiple storage cabinets should be avoided.

**■ NFPA 1 Fire Code - 2012 Edition\*\***

**66.9.5** Flammable Liquids Storage Cabinets.

**66.9.5.1** The volume of Class I, Class II, and Class IIIA liquids stored in an individual storage cabinet shall not exceed 120 gal (460 L). [30:9.5.1]

**66.9.5.2** 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. [30:9.5.2]

**66.9.5.3** Storage cabinets that meet at least one of the following sets of requirements shall be acceptable

for storage of liquids:

(1) Storage cabinets designed and constructed to limit the internal temperature at the center of the cabinet and 1 in. (25 mm) from the top of the cabinet to not more than 325°F (163°C), when subjected to a 10-minute fire test that simulates the fire exposure of the standard time-temperature curve specified in NFPA 251, Standard Methods of Tests of Fire Resistance of Building and Construction and Materials, shall be acceptable. All joints and seams shall remain tight and the door shall remain securely closed during the test.

(2) Metal storage cabinets constructed in the following manner shall be acceptable:

(a) The bottom, top, door, and sides of the cabinet shall be at least No. 18 gauge sheet steel and shall be double-walled, with 1 1/2 in. (38 mm) air space.

(b) Joints shall be riveted, welded, or made tight by some equally effective means.

(c) The door shall be provided with a three-point latch arrangement, and the door sill shall be raised at least 2 in. (50 mm) above the bottom of the cabinet to retain spilled liquid within the cabinet.

(3) Wooden cabinets constructed in the following manner shall be acceptable:

(a) The bottom, sides, and top shall be constructed of exterior grade plywood that is at least 1 in. (25 mm) thick and of a type that will not break down or delaminate under fire conditions.

(b) All joints shall be rabbetted and shall be fastened in two directions with wood screws.

(c) Where more than one door is used, there shall be a rabbetted overlap of not less than 1 in. (25 mm).

(d) Doors shall be equipped with a means of latching, and hinges shall be constructed and mounted in such a manner as to not lose their holding capacity when subjected to fire exposure.

(e) A raised sill or pan capable of containing a 2 in. (50 mm) depth of liquid shall be provided at the bottom of the cabinet to retain spilled liquid within the cabinet.

(4) Listed storage cabinets that have been constructed and tested in accordance with 66.9.5.3(1) shall be acceptable. [30:9.5.3]

**66.9.5.4\*** Storage cabinets shall not be required by this Code to be ventilated for fire protection purposes. [30:9.5.4]

**66.9.5.4.1** 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. [30:9.5.4.1]

**66.9.5.4.2\*** If a storage cabinet is ventilated for any reason, the vent openings shall be ducted directly to a safe location outdoors or to a treatment device designed to control volatile organic compounds (VOCs) and ignitable vapors 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. [30:9.5.4.2]

**A.66.9.5.4\*** Venting of storage cabinets has not been demonstrated to be necessary for fire protection purposes. Additionally, venting a cabinet could compromise the ability of the cabinet to adequately protect its contents from involvement in a fire, because cabinets are not generally tested with any venting. Therefore, venting of storage cabinets is not recommended. [30: A.9.5.4]

However, it is recognized that some jurisdictions might require storage cabinets to be vented and that venting can also be desirable for other reasons, such as health and safety. In such cases, the venting system should be installed so as to not affect substantially the desired performance of the cabinet during a fire. Means of accomplishing this can include thermally actuated dampers on the vent openings or sufficiently insulating the vent piping system to prevent the internal temperature of the cabinet from rising above that specified. Any make-up air to the cabinet should also be arranged in a similar manner. [30: A.9.5.4]

If vented, the cabinet should be vented from the bottom with make-up air supplied to the top. Also, mechanical exhaust ventilation is preferred and should comply with

NFPA 91, Standard for Exhaust Systems for Air Conveying of Vapors, Gases, Mists, and Noncombustible Particulate Solids. Manifolding the vents of multiple storage cabinets should be avoided.

**66.9.5.5\*** Storage cabinets shall be marked as follows:

WARNING:  
FLAMMABLE  
KEEP FIRE AWAY

[30:9.5.5]

**66.9.5.5.1** The minimum letter height for FLAMMABLE (signal word) shall be 2.0 in. (50 mm) and the minimum letter height for KEEP FIRE AWAY (message) shall be 1.0 in. (25 mm). [30:9.5.5.1]

**66.9.5.5.2** All letters shall be uppercase and in contrasting color to the background. [30:9.5.5.2]

**66.9.5.5.3** The marking shall be located on the upper portion of the cabinet's front door(s) or frame. [30:9.5.5.3]

**66.9.5.5.4** Use of other languages, the international symbol for "flammable" (a flame in a triangle), the international symbol for "keep fire away" (a burning match in "no" circle) shall be permitted. [30:9.5.5.4]

**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.

**Safety Cans/Containers**

**■ 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.)

**■ 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

Container Type	Cat = Category			
	Cat 1	Cat 2	Cat 3	Cat 4
Glass or approved plastic	1pt	1qt	1gal	1gal
Metal (other than DOT drums)	1gal	5 gal	5 gal	5 gal
Safety cans	2 gal	5 gal	5 gal	5 gal
Metal drums (DOT specs)	60 gal	60 gal	60 gal	60 gal
Approved portable tanks	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).

**■ 1926.155(i):**

**Safety Can** means an approved closed container, of not more than 5 gallons capacity, having a flash-arresting screen, spring-closing lid and spout cover and so designed that it will safely relieve internal pressure when subjected to fire exposure.

^, \*, \*\* See page 39.

**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.

### Outdoor Lockers

## NFPA Code 30 - 2015 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, also known as hazardous materials storage lockers (hereinafter referred to as 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.

## 14.2 Definitions Specific to Chapter 14. (Reserved)

## 14.3 General Requirements.

**14.3.1** Lockers that are used as liquid storage rooms shall meet the requirements of Chapter 9 and 12 and Sections 14.4 and 14.6.

**14.3.2** Lockers that are located outside shall meet the requirements of Sections 14.4 through 14.6.

## 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 ft<sup>2</sup> (140 m<sup>2</sup>) gross floor area.

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

**14.4.5** Where electrical wiring and electrical utilization 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 18.6.

**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.

Area of Designated Site* (ft <sup>2</sup> )	Minimum Separation Distance (ft)		
	Between Individual Lockers	From Locker to Property Line that Is or Can Be Built Upon <sup>b</sup>	From Locker to Nearest Side of Public Ways or to Important Buildings on Same Property <sup>b,c</sup>
≤ 100	5	10	5
>100 and ≤500	5	20	10
>500 and ≤1,500 <sup>d</sup>	5	30	20

For SI units, 1 ft = 0.3 m; 1 ft<sup>2</sup> = 0.09 m<sup>2</sup>.  
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 9.16, 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. If there are exposures and such protection for exposures does not exist, the distances should 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 ft<sup>2</sup> (140 m<sup>2</sup>) or when multiple units exceed the area limit of 1500 ft<sup>2</sup> (140 m<sup>2</sup>), 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.

\* See page 39.

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

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				Lower	Upper						Health	Flamma- bility	Insta- bility
<b>Acetaldehyde</b> CH <sub>3</sub> CHO (Acetic Aldehyde) (Ethanal) <b>75-07-0</b>	IA	-38 (-39)	347 (175)	4.0	60	0.8	1.5	70 (21)	Yes	1 5	2	4	2
<i>Note: Polymerizes. See NFPA 49 contained in Fire Protection Guide to Hazardous Materials.</i>													
<b>Acetone</b> CH <sub>3</sub> COCH <sub>3</sub> (Dimethyl Ketone)- (2-Propanone) <b>67-64-1</b>	IB	-4 (-20)	869 (465)	2.5	12.8	0.8	2.0	133 (56)	Yes	1 5	1	3	0
<b>Acetonitrile</b> CH <sub>3</sub> CN (Methyl Cyanide) <b>75-05-8</b>		42 (6) (oc)	975 (524)	3.0	16.0	0.8	1.4	179 (82)	Yes	1 5	2	3	0
<i>See NFPA 49 contained in Fire Protection Guide to Hazardous Materials.</i>													
<b>Acrolein</b> CH <sub>2</sub> :CHCHO (Acrylic Aldehyde) <b>107-02-8</b>	IB	-15 (-26)	428 (220) Unstable	2.8	31	0.8	1.9	125 (52)	Yes	1 5	4	3	3
<i>Note: May polymerize explosively. See NFPA 49 contained in Fire Protection Guide to Hazardous Materials.</i>													
<b>Allylamine</b> CH <sub>2</sub> :CHCH <sub>2</sub> NH <sub>2</sub> (2-Propenylamine) <b>107-11-9</b>	IB	-20 (-29)	705 (374)	2.2	22	0.8	2.0	128 (53)	Yes	1 5	4	3	1
<i>See NFPA 49 contained in Fire Protection Guide to Hazardous Materials.</i>													
<b>Amyl Acetate</b> CH <sub>3</sub> COOC <sub>5</sub> H <sub>11</sub> (1-Pentanol Acetate) Comm. <b>628-63-7</b>	IB	60 (16) 70 (21)	680 (360)	1.1	7.5	0.9	4.5	300 (149)	Slight	1 5	1	3	0
<b>Aniline</b> C <sub>6</sub> H <sub>5</sub> NH <sub>2</sub> (Aminobenzene) (Phenylamine) <b>62-53-3</b>	IIIA	158 (70)	1139 (615)	1.3	11	1.0+	3.2	364 (184)	Slight	5	2	2	0
<i>See NFPA 49 contained in Fire Protection Guide to Hazardous Materials.</i>													
<b>Benzene</b> C <sub>6</sub> H <sub>6</sub> (Benzol) <b>71-43-2</b>	IB	12 (-11)	928 (498)	1.2	7.8	0.9	2.8	176 (80)	No	1	1	3	0
<i>See NFPA 49 contained in Fire Protection Guide to Hazardous Materials.</i>													
<b>Butadiene Monoxide</b> CH <sub>2</sub> :CHCHOCH <sub>2</sub> (Vinylethylene Oxide) <b>930-22-3</b>	IB	<-58 (<-50)				0.9	2.4	151 (66)		1		3	2
<i>See Methyl Ethyl Ketone.</i>													
<b>2-Butanone</b> <b>Butyl Alcohol</b> CH <sub>3</sub> (CH <sub>2</sub> ) <sub>2</sub> CH <sub>2</sub> OH (1-Butanol) (Propyl Carbinol) (Propyl Methanol) <b>71-36-3</b>	IC	98 (37)	650 (343)	1.4	11.2	0.8	2.6	243 (117)	No	1 5	2	3	0
<b>Butyl Chloride</b> C <sub>4</sub> H <sub>9</sub> Cl (1-Chlorobutane) <b>109-69-3</b>	IB	15 (-9)	464 (240)	1.8	10.1	0.9	3.2	170 (77)	No	1	1	3	0
<b>Carbon Disulfide</b> CS <sub>2</sub> (Carbon Bisulfide) <b>75-15-0</b>	IB	-22 (-30)	194 (90)	1.3	50.0	1.3	2.6	115 (46)	No	4	3	4	0
<i>See NFPA 49 contained in Fire Protection Guide to Hazardous Materials.</i>													

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

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				Lower	Upper						Health	Flammability	Instability
<b>p-Dioxane</b> <chem>OCH2CH2OCH2CH2</chem> (Diethylene Dioxide) <b>123-91-1</b>	IB	54 (12)	356 (180)	2.0	22	1.0+	3.0	214 (101)	Yes	1 5	2	3	1
See NFPA 49 contained in Fire Protection Guide to Hazardous Materials.													
<b>Divinyl Ether</b> <chem>(CH2:CH)2O</chem> (Ethenyloxyethene) (Vinyl Ether) <b>109-93-3</b>	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.													
<b>Ethanol</b>	See Ethyl Alcohol.												
<b>Ethyl Acetate</b> <chem>CH3COOC2H5</chem> (Acetic Ester) (Acetic Ether) (Ethyl Ethanoate) <b>141-78-6</b>	IB	24 (-4)	800 (426)	2.0	11.5	0.9	3.0	171 (77)	Slight	1 5	1	3	0
<b>Ethyl Alcohol</b> <chem>C2H5OH</chem> (Grain Alcohol, Cologne Spirits, Ethanol) <b>64-17-5</b>	IB	55 (13)	685 (363)	3.3	19	0.8	1.6	173 (78)	Yes	1 5	2	3	0
See also Ethyl Alcohol and Water contained in Fire Protection Guide to Hazardous Materials.													
<b>Ethylamine, 70%</b> <chem>C2H5NH2</chem> (Aminoethane) <b>75-04-7</b>	IA	<0 (<18)	725 (385)	3.5	14.0	0.8	1.6	62 (17)	Yes	1 5	5 3	4	0
See NFPA 49 contained in Fire Protection Guide to Hazardous Materials.													
<b>Ethyl Chloride</b> <chem>C2H5Cl</chem> (Chloroethane) (Hydrochloric Ether) (Muriatic Ether) <b>75-00-3</b>	IA	-58 (-50)	966 (519)	3.8	15.4	0.9	2.2	54 (12)	Slight	1	2	4	0
<b>Ethylene Glycol</b> <chem>HOC2H4OH</chem> (1,2-Ethanediol) (Glycol) <b>107-21-1</b>	IIIB	232 (111)	748 (398)	3.2		1.1		387 (197)	Yes	5 2	2	1	0
<b>Ethylene Oxide</b> <chem>CH2OCH2</chem> (Dimethylene Oxide) (1,2-Epoxyethane) (Oxirane) (EO) <b>75-21-8</b>	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.													
<b>Ethyl Ether</b> <chem>C2H5OC2H5</chem> (Diethyl Ether) (Diethyl Oxide) (Ether) (Ethyl Oxide) <b>60-29-7</b>	IA	-49 (-45)	356 (180)	1.9	36.0	0.7	2.6	95 (35)	Slight	1 5	1	4	1
See NFPA 49 contained in Fire Protection Guide to Hazardous Materials.													
<b>Fuel Oil No. 1</b> (Jet Fuel A) (Kerosene) (Range Oil) <b>8008-20-6</b>		100-162 (38-72)	410 (210)	0.7	5	<1		304-574 (151-301)	No		2	2	0

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

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				Lower	Upper						Health	Flammability	Instability
<b>Methyl Isobutyl Ketone</b> <chem>CH3COCH2CH(CH3)2</chem> (Hexone) (4-Methyl-2-Pentanone) <b>108-10-1</b>	IB	64 (18)	840 (448)	1.2 @ 200 (93)	8.0 @ 200 (93)	0.8	3.5	244 (118)	Slight	5 1	1	3	0
See NFPA 49 contained in Fire Protection Guide to Hazardous Materials.													
<b>Naphtha V.M. &amp; P., Regular</b> <b>8032-32-4</b>	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.													
<b>Nitroethane</b> <chem>C2H5NO2</chem> <b>79-24-3</b>	IC	82 (28)	778 (414)	3.4		1.1	2.6	237(114)	Slight	4 5	2	3	3
Note: May explode on heating. See NFPA 49 contained in Fire Protection Guide to Hazardous Materials.													
<b>Paraldehyde</b> <chem>(CH3CHO)3</chem> <b>123-63-7</b>		96 (36) (oc)	460 (238)	1.3		1.0-	4.5	255 (124)	Slight	1 5	2	3	1
See NFPA 49 contained in Fire Protection Guide to Hazardous Materials.													
<b>Pentane</b> <chem>CH3(CH2)3CH3</chem> <b>109-66-0</b>	IA	<40 (<40)	500 (260)	1.5	7.8	0.6	2.5	97 (36)	No	1	1	4	0
<b>Petroleum Ether</b> (Benzine) (Naphtha, Petroleum) <b>64475-85-0</b>		<0 (<18)	550 (288)	1.1	5.9	0.6	2.5	95-140 (35-60)	No	1	1	4	0
<b>Propionaldehyde</b> <chem>CH3CH2CHO</chem> (Propanal) <b>123-38-6</b>	IB	-22 (-30)	405 (207)	2.6	17	0.8	2.0	120 (49)	Slight	1 5	2	3	2
See NFPA 49 contained in Fire Protection Guide to Hazardous Materials.													
<b>Propylene Oxide</b> <chem>OCH2CHCH3</chem> <b>75-56-9</b>	IA	-35 (-37)	840 (449)	2.3	36	0.83	2.0	94 (35)	Yes	1 5	3	4	2
See NFPA 49 contained in Fire Protection Guide to Hazardous Materials.													
<b>Toluene</b> <chem>C6H5CH3</chem> (Methylbenzene) (Phenylmethane) (Toluol) <b>108-88-3</b>	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.													
<b>Toluol</b>	See Toluene.												
<b>Trichloroethylene</b> <chem>ClHC:CCl2</chem> <b>79-01-6</b>		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.													
<b>Turpentine</b> <b>9005-90-7</b>	IC	95 (35)	488 (253)	0.8		<1		300 (149)	No	1	1	3	0
<b>Vinyl Ethyl Ether</b> <chem>CH2:CHOC2H5</chem> (Ethyl Vinyl Ether) <b>109-92-2</b>	IA	<50 (<46)	395 (202)	1.7	28	0.8	2.5	96 (36)	No	1 5	2	4	2
<b>o-Xylene</b> <chem>C6H4(CH3)2</chem> (1,2-Dimethylbenzene) (o-Xylol) <b>95-47-6</b>	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
- ☐ Safety drum pump for safe, compliant dispensing from vertical drums
- ☐ Use approved self-closing faucet for horizontal drum dispensing as required by OSHA
- ☐ 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 SDS 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 SDS sheet
2. Remember it's not the flammable liquid itself that burns, but rather, the invisible vapor with air
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



**Justrite Safety Group** is a growing family of leading industrial safety companies. We are united by deep safety knowledge, long experience, and a commitment to protecting people, property and the planet.

We cover every facet of the industrial safety landscape—from the storage, containment and clean-up of hazardous materials to motion safety and emergency showers.



## Important Resources

American National Standards Institute (ANSI) - [www.ansi.org](http://www.ansi.org)

California Air Resources Board (CARB) Title 13 - [www.arb.ca.gov](http://www.arb.ca.gov)

Department of Transportation (DOT) - [www.dot.gov](http://www.dot.gov)

Environmental Protection Agency (EPA) 40 CFR - [www.epa.gov](http://www.epa.gov)

FM Approvals (FM) - [www.fmaprovals.com](http://www.fmaprovals.com)

International Code Council (ICC) - [www.iccsafe.org](http://www.iccsafe.org)

^ International Fire Code® 2012 Edition

Justrite Manufacturing Company - [www.justrite.com](http://www.justrite.com)

National Fire Code of Canada (NFC) - [www.nationalcodes.ca](http://www.nationalcodes.ca)

National Fire Protection Association (NFPA) - [www.nfpa.org](http://www.nfpa.org)

\* NFPA 30, *Flammable Combustible Liquids Code* – 2015 Edition

\*\* NFPA 1, *Fire Code*™ – 2012 edition

\*\*\* *Fire Protection Guide to Hazardous Materials*, 13th ed.

National Institute for Occupational Safety & Health (NIOSH)  
[www.cdc.gov/niosh](http://www.cdc.gov/niosh)

Occupational Safety and Health Administration - [www.osha.gov](http://www.osha.gov)  
(OSHA 29 CFR 1910 (.106, .123, .125, .144, .1200 and 1926.252)

OSHA/EPA Occupational Chemical Database  
<https://www.osha.gov/chemicaldata/>

Underwriters Laboratories - [www.ul.com](http://www.ul.com)

Underwriters Laboratories of Canada - [www.ulc.ca](http://www.ulc.ca)

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