

Flammables and Combustibles

Flammable and combustible liquids vaporize and form flammable mixtures with air when in open containers, when leaks occur or when heated. To prevent fires, special precautions need to be taken when storing, handling and using flammable and combustible liquids.

References

1. Flammable and Combustible Liquids Code Handbook, National Fire Protection Association, 4th Edition, 2000, Benedetti, Robert P.
2. OSHA, 29 CFR 1910.106
3. Flammable and Combustible Liquids Code, NFPA 30, 2000 Edition

Definition

Understanding the differences between liquids is important when meeting the OSHA requirements for the safe storage and handling of these liquids.

Flammable and combustible liquids are defined and classified by their flash point and boiling point. A flammable liquid is any liquid that has a flash point below 100 degrees F (37.8 degrees C). Flammable liquids are known as Class I liquids. A combustible liquid is any liquid with a flash point at or above 100 degrees F (37.8 degrees C). Combustible liquids are known as Class II and Class III liquids.

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FLAMMABLE AND COMBUSTIBLE LIQUID CLASSES			
	Class	Flash Point	Boiling Point
Flammables	IA IB IC	<73°F <73°F >73°F and <100°F	<100°F >100°F –
Combustibles	II IIIA IIIB	>100°F and <140°F >140°F and <200°F >200°F	–

NOTE: • The class of a liquid can change due to contamination. • Classifications do not apply to mixtures. • Volatility of liquids increases when heated.

STORAGE OF FLAMMABLE AND COMBUSTIBLE LIQUIDS

Flammable and combustible liquids should be stored only in approved containers. Approval for containers is based on specifications developed by the U.S. Department of Transportation (DOT), OSHA, the National Fire Protection Association (NFPA),

Underwriters Laboratory (UL) or Factory Mutual (FM). Containers used by manufacturers of flammable and combustible liquids usually meet these specifications.
Safety Cans and Containers

All flammable or combustible liquids must be stored in an approved container. A “safety can” by OSHA definition is “an approved container of not more than five 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.” An “approved container” by OSHA definition is a can that is approved by an NRTL (nationally recognized testing laboratory) such as FM (Factory Mutual), UL (Underwriters Laboratory) or other recognized laboratory. All cans or containers must have an NRTL approval. NOTE: OSHA has determined that it is acceptable to store flammable/combustible liquids in plastic containers if the containers are approved by an NRTL.

In addition to the storage of flammable and combustible liquids in safety containers, 29 CFR 1910.106 limits the amount of liquid in a single container. The following chart lists the allowable amount of liquid for each class of liquid.

Flammable Liquid Storage Cabinets

A flammable liquid storage cabinet is an approved cabinet that has been designed and constructed to protect the contents from external fire. In accordance with NFPA requirements, the storage cabinet shall not be vented for fire protection purposes, and vent openings shall be sealed with the bungs supplied by the cabinet manufacturer. Storage cabinets shall be labeled “FLAMMABLE — KEEP FIRE AWAY,” and the doors shall be self-closing.

MAXIMUM ALLOWABLE SIZE OF CONTAINERS AND METAL PORTABLE TANKS					
Container Type	Flammable Liquids			Combustible Liquids	
	CLASS IA	CLASS IB	CLASS IC	CLASS II	CLASS III
Glass	1 pt.	1qt.	1 gal.	1 gal.	1 gal.
Metal (other than DOT drums) or approved plastic	1 gal.	5 gal.	5 gal.	5 gal.	5 gal.
Safety Cans	2 gal.	5 gal.	5 gal.	5 gal.	5 gal.
Metal Drum (DOT Spec)	60 gal.	60 gal.	60 gal.	60 gal.	60 gal.
Approved Metal Portable Tanks	660 gal.	660 gal.	660 gal.	660 gal.	660 gal.

The amount of liquid storage and location of cabinets is regulated by OSHA and NFPA. No more than 60 gallons of Class I or Class II liquids, nor more than 120 gallons of Class III liquids, may be stored in a storage cabinet. No more than three (3) cabinets shall be located in any one fire area. Additional cabinets shall be permitted to be located

in the same fire area if a minimum separation of 100 feet is maintained between each group of not more than three cabinets.

Storage Outside of Flammable Cabinets

In accordance with OSHA requirements, the quantity of liquid that may be stored outside of an inside storage room or cabinet in any one fire area of a building shall not exceed the following:

- 25 gallons of Class IA liquids in safety cans.
- 120 gallons of Class IB, IC, II or III liquids in approved containers.
- 660 gallons of Class IB, IC, II or III liquids in a single approved portable tank.

Storage and Handling Precautions

- Quantities of flammable and combustible liquids should be limited to the amount necessary for work in progress.
- Storage of flammable/combustible liquids shall not obstruct any exit.
- Flammable liquids shall be stored separately from strong oxidizers or other incompatible materials, and away from direct sunlight and other heat sources.
- All ignition sources shall be controlled in areas where flammable liquids are used. Smoking, open flames and spark-producing equipment shall not be used.
- Spark-free, intrinsically safe motors and equipment shall be used. This equipment must meet National Electric Code (NEC) requirements for explosion-proof equipment.
- Minimize the production of vapors and the risk of ignition. Vapors from flammable liquids are heavier than air and tend to settle at floor level, where they can spread over a large area.
- Electrically bond metal containers when transferring flammable liquids from one to another. Bonding can be direct, by wire attached to both containers, or indirect through a common ground system.
- When grounding non-metallic containers, contact must be made directly to the liquid rather than to the container.
- Portable fire extinguisher(s) and control equipment in quantities and types needed shall be provided for the hazards of operation and storage.
- All fire equipment shall be maintained and periodically inspected and tested by a competent person to ensure they are in satisfactory operating condition and ready in case of an emergency.

- Rags soaked with flammable or combustible liquids shall be disposed of in an approved oil waste can. The cans shall be emptied daily and the contents disposed of properly, in accordance with all environmental regulations.

Compressed gases can be toxic, flammable, oxidizing, corrosive, inert or a combination of hazards. In addition to the chemical hazards, compressed gases are under very high pressure. The amount of energy in a compressed gas cylinder makes it a potential rocket. Appropriate care in the handling and storage of compressed gas cylinders is crucial.

References

1. 29 CFR 1910.101
2. The Compressed Gas Association (CGA)

Hazards

The following is a list of the hazards to be avoided during the handling and storing of compressed gases:

- *Asphyxiation:* Asphyxiation is the primary hazard associated with inert gases. Because inert gases are colorless and odorless, they can escape into the atmosphere undetected and quickly reduce the concentration of oxygen below safe levels. Oxygen-monitoring equipment should be used when inert gases are being used in enclosed areas.
- *Fire and Explosion:* Fire and explosion are the primary hazards associated with flammable gases, oxygen and other oxidizing gases. Flammable gases can be ignited by static electricity or a heat source. Oxygen and oxidizing gases do not burn but will support combustion of organic materials. Increasing the concentration of an oxidizer accelerates the rate of combustion. Materials that are ordinarily nonflammable may burn in an oxygen-enriched atmosphere.
- *Chemical Burns:* Corrosive gases can chemically attack various materials, including fire-resistant clothing. Some gases are not corrosive in their pure form, but can become extremely corrosive if a small amount of moisture is added. Corrosive gases can cause rapid destruction of skin, mucous membranes and eye tissue.
- *Chemical Poisoning:* Chemical poisoning is the primary hazard of toxic gases. Even in very small concentrations, brief exposure to a toxic gas can result in a serious poisoning injury. Symptoms of exposure can be delayed.
- *High Pressure:* All compressed gases are potentially dangerous because of the high pressure stored inside the cylinder. A sudden release of pressure can cause injuries or serious property damage by propelling a cylinder or whipping a line.

- Cylinder Weight: A full-size cylinder can weigh more than 130 pounds. Moving a cylinder manually may cause a serious back or muscular injury. Dropping or dragging a cylinder could also cause a serious injury.

Handling Requirements

- A suitable hand truck or cart equipped with a chain or belt for securing the cylinder to the cart shall be used when moving cylinders, even for short distances.
- Cylinders shall not be lifted by the cap.
- Cylinders shall not be lifted with a lifting magnet. Slings, ropes or chains shall not be used unless the cylinder is equipped with appropriate lifting attachments, (i.e., lugs). Cranes shall not be used unless a safe cradle or platform has been provided to hold the cylinder(s).
- Do not permit cylinders to strike each other violently. Cylinders shall not be used as rollers for moving material or other equipment.
- Cylinder caps shall be kept on the cylinders at all times, except when in use.
- Never tamper with pressure-relief devices in valves or cylinders.
- Only wrenches or tools provided by the cylinder supplier shall be used to remove a cylinder cap or to open a valve. Never use a screwdriver or pliers.
- The cylinder valve shall be kept closed at all times except during use.
- The cylinder shall be positioned so that the valve is accessible at all times.

Storage Requirements

- Cylinder storage areas shall be posted with the types of gases stored.
- All cylinders shall be properly labeled as to their contents.
- All cylinders shall be secured to a wall, bench or fixed support using a chain or strap placed two-thirds of the way up. Cylinder stands may be used as an alternative to straps. Cylinders shall be strapped individually.
- Where gases of different types are stored at the same location, cylinders shall be grouped by types of gas and arranged so that oxidizers and flammable gases are not stored together.

- When oxygen and a fuel gas (acetylene) are to be stored, they shall be separated by a distance of 20 feet or by a non-combustible barrier at least 5 feet high and having a fire resistance rating of 30 minutes. (Two layers of 5/8" sheetrock or 1/2"-thick metal separation.
- Never place acetylene cylinders on their side.
- Do not store empty and full cylinders together.
- Cylinders shall not be stored near flammable or combustible substances.
- Cylinders shall not be placed where they could become part of an electric circuit. When cylinders are used in conjunction with electric welding, precautions must be taken against accidentally grounding the compressed gas cylinders and allowing them to be burned by the electric welding arc.
- Cylinders shall not be stored at temperatures above 125°F or near other sources of heat.
- If cylinders are stored outdoors, they shall be protected from weather extremes and damp ground to prevent corrosion. Cylinders shall be protected from direct sunlight. If snow or ice accumulates on a cylinder, it should be thawed at room temperature or with water at a temperature not exceeding 125°F.
- Cylinders shall be protected from objects that may produce a cut or other abrasion in the surface of the metal. Do not store cylinders in locations where heavy moving objects could strike or fall on them.
- The number of cylinders shall be kept to the minimum necessary to reduce fire and toxicity hazards.

Use Requirements

- Before using cylinders, read all label information and material safety data sheets (MSDS) associated with the gas being used.
- Use compressed gases only in a well-ventilated area. Toxic, flammable and corrosive gases must be carefully handled.
- Where more than one type of gas is in use, label gas lines. This is especially important when the gas supply is not in the same room or area as the operation using the gases.
- Cylinder valves should be opened slowly. Never direct high-pressure gas streams toward the body.

- Never use wrenches or tools to open a cylinder valve except those provided or approved by the gas manufacturer. Never hammer the valve wheel in an attempt to close the valve.
- Do not attempt to open valves or caps that are hard to open or are frozen because of corrosion. Return these cylinders to the vendor.
- Connections to piping, regulators and other equipment should always be kept tight to prevent leakage. Where hoses or metal coils are used, they shall be maintained in good condition. Use soap or a similar material to check for leaks. A flame should never be used for leak detection.
- Before a cylinder is removed from service, determine that the cylinder valve is securely closed and that all pressure is released from the connected system.
- Use Teflon tape or thread lubricant for assembly.
- Do not force threads that do not fit exactly.
- Do not use oil or lubricants on equipment with oxygen.
- Do not use copper piping for acetylene.
- When the cylinder is empty, remove the regulator and replace the cylinder cap. Tag the cylinder as empty (MT) and store in a designated area for return to the vendor.
- Do not empty cylinders to a pressure below 25 psi. The residual contents may become contaminated with air.
- Compressed gas cylinders shall be inspected by the user prior to and during use to determine that they are in safe condition for use. Such an inspection should look for corrosion, valve damage or leaks, evidence of tampering, etc. Most compressed gas cylinders are required to be retested periodically. The last test date is stamped on the shoulder. Those cylinders requiring tests shall be returned to the vendor. Hydrostatic pressure tests are to be performed in order to determine whether the cylinders are in good condition for use.

National Park Service Construction Safety Policy

All National Park Service units shall implement Construction Safety programs to protect NPS employees, volunteer workers, contract employees and visitors from hazards associated with construction, demolition, renovation or historical restoration projects. Construction activities that include scaffolds, excavations or fall hazards of six feet or more are responsible for approximately 40 percent of the construction fatalities nationally, and, due to the higher than normal level of risk inherent in these activities, receive special attention within this Reference Manual.