

FIRE PROTECTION AND PREVENTION

DEFINITIONS APPLICABLE TO THIS SUBPART - §1926.155

"Approved" means equipment that has been listed or approved by a nationally recognized testing laboratory such as Factory Mutual Engineering Corp., or Underwriters' Laboratories, Inc., or Federal agencies such as Bureau of Mines, or U.S. Coast Guard, which issue approvals for such equipment.

"Closed container" means a container so sealed by means of a lid or other device that neither liquid nor vapor will escape from it at ordinary temperatures.

"Combustible liquid" means any liquid having a flash point at or above 140 deg. F (60 deg. C), and below 200 deg. F (93.4 deg. C).

"Combustion" means any chemical process that involves oxidation sufficient to produce light or heat.

"Fire brigade" means an organized group of employees that are knowledgeable, trained, and skilled in the safe evacuation of employees during emergency situations and in assisting in fire fighting operations.

"Fire resistance" means so resistant to fire that, for specified time and under conditions of a standard heat intensity, it will not fail structurally and will not permit the side away from the fire to become hotter than a specified temperature. For purposes of this part, fire resistance shall be determined by the *Standard Methods of Fire Tests of Building Construction and Materials*, NFPA 251-1969.

"Flammable" means capable of being easily ignited, burning intensely, or having a rapid rate of flame spread.

"Flammable liquid" means any liquid having a flash point below 140 deg. F and having a vapor pressure not exceeding 40 pounds per square inch (absolute) at 100 deg. F.

"Flash point" of the liquid means the temperature at which it gives off vapor sufficient to form an ignitable mixture with the air near the surface of the liquid or within the vessel used as determined by appropriate test procedure and apparatus as specified below.

(1) The flash point of liquids having a viscosity less than 45 Saybolt Universal Second(s) at 100 deg. F (37.8 deg. C) and a flash point below 175 deg. F (79.4 deg. C) shall be determined in accordance with the *Standard Method of Test for Flash Point by the Tag Closed Tester*, ASTM D-56-69.

(2) The flash point of liquids having a viscosity of 45 Saybolt Universal Second(s) or more at 175 deg. F. (79.4 deg. C) or higher shall be determined in accordance with the *Standard Method of Test for Flash Point by the Pensky Martens Closed Tester*, ASTM D-93-69.

"Liquefied petroleum gases," "LPG" and "LP Gas" mean and include any material which is composed predominantly of any of the following hydrocarbons, or mixtures of them, such as propane, propylene, butane (normal butane or iso-butane), and butylenes.

"Portable tank" means a closed container having a liquid capacity more than 60 U.S. gallons, and not intended for fixed installation.

"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.

"Vapor pressure" means the pressure, measured in pounds per square inch (absolute), exerted by a volatile liquid as determined by the *Standard Method of Test for Vapor Pressure of Petroleum Products (Reid Method)*, ASTM D-323-58.

FIRE PROTECTION - §1926.150

General Requirements

The employer shall be responsible for the development of a fire protection program to be followed throughout all phases of the construction and demolition work, and shall provide for the firefighting equipment as specified in this subpart. As fire hazards occur, there shall be no delay in providing the necessary equipment.

Access to all available firefighting equipment shall be maintained at all times. All firefighting equipment, provided by the employer, shall be conspicuously located.

All firefighting equipment shall be periodically inspected and maintained in operating condition. Defective equipment shall be immediately replaced.

As warranted by the project, the employer shall provide a trained and equipped firefighting organization (Fire Brigade) to assure adequate protection to life.

Water Supply

A temporary or permanent water supply, of sufficient volume, duration, and pressure, required to properly operate the firefighting equipment shall be made available as soon as combustible materials accumulate.

Where underground water mains are to be provided, they shall be installed, completed, and made available for use as soon as practicable.

Portable Firefighting Equipment

Fire Extinguishers and Small Hose Lines

A fire extinguisher, rated not less than 2A, shall be provided for each 3,000 square feet of the protected building area, or major fraction thereof. Travel distance from any point of the protected area to the nearest fire extinguisher shall not exceed 100 feet.

One 55-gallon open drum of water with two fire pails may be substituted for a fire extinguisher having a 2A rating.

A ½-inch diameter garden-type hose line, not to exceed 100 feet in length and equipped with a nozzle, may be substituted for a 2A-rated fire extinguisher, providing it is capable of discharging a minimum of 5 gallons per minute with a minimum hose stream range of 30 feet horizontally. The garden-type hose lines shall be mounted on conventional racks or reels. The number and location of hose racks or reels shall be such that at least one hose stream can be applied to all points in the area.

One or more fire extinguishers, rated not less than 2A, shall be provided on each floor. In multistory buildings, at least one fire extinguisher shall be located adjacent to stairway.

Extinguishers and water drums, subject to freezing, shall be protected from freezing.

A fire extinguisher, rated not less than 10B, shall be provided within 50 feet of wherever more than 5 gallons of flammable or combustible liquids or 5 pounds of flammable gas are being used on the jobsite. This requirement does not apply to the integral fuel tanks of motor vehicles.

Carbon tetrachloride and other toxic vaporizing liquid fire extinguishers are prohibited.

Portable fire extinguishers shall be inspected periodically and maintained in accordance with *Maintenance and Use of Portable Fire Extinguishers*, NFPA No. 10A-1970. Fire extinguishers which have been listed or approved by a nationally recognized testing laboratory, shall be used to meet the requirements of this subpart.

Table F-1 in §1926.150(c)(1)(x) may be used as a guide for selecting the appropriate portable fire extinguishers.

Where the employer has provided portable fire extinguishers for employee use in

the workplace, the employer shall also provide an educational program to familiarize employees with the general principles of fire extinguisher use and the hazards involved with incipient stage fire fighting.

The employer shall provide the education required in paragraph (c)(1)(xi) of this section upon initial employment and at least annually thereafter.

The employer shall assure that portable fire extinguishers are maintained in a fully charged and operable condition and kept in their designated places at all times except during use.

The employer shall assure that portable fire extinguishers are subjected to an annual maintenance check. Stored pressure extinguishers do not require an internal examination. The employer shall record the annual maintenance date and retain this record for one year after the last entry or the life of the shell, whichever is less. The record shall be available to the Assistant Secretary upon request.

Fire Hose and Connections

One hundred feet, or less, of 1½-inch hose, with a nozzle capable of discharging water at 25 gallons or more per minute, may be substituted for a fire extinguisher rated not more than 2A in the designated area provided that the hose line can reach all points in the area.

If fire hose connections are not compatible with local firefighting equipment, the contractor shall provide adapters, or equivalent, to permit connections.

During demolition involving combustible materials, charged hose lines, supplied by hydrants, water tank trucks with pumps, or equivalent, shall be made available.

Fixed Firefighting Equipment

Sprinkler Protection

If the facility being constructed includes the installation of automatic sprinkler protection, the installation shall closely follow the construction and be placed in

service as soon as applicable laws permit following completion of each story.

During demolition or alterations, existing automatic sprinkler installations shall be retained in service as long as reasonable. The operation of sprinkler control valves shall be permitted only by properly authorized persons. Modification of sprinkler systems to permit alterations or additional demolition should be expedited so that the automatic protection may be returned to service as quickly as possible. Sprinkler control valves shall be checked daily at close of work to ascertain that the protection is in service.

Standpipes

In all structures in which standpipes are required, or where standpipes exist in structures being altered, they shall be brought up as soon as applicable laws permit, and shall be maintained as construction progresses in such a manner that they are always ready for fire protection use. The standpipes shall be provided with Siamese fire department connections on the outside of the structure, at the street level, which shall be conspicuously marked. There shall be at least one standard hose outlet at each floor.

Fire Alarm Devices

An alarm system, e.g., telephone system, siren, etc., shall be established by the employer whereby employees on the site and the local fire department can be alerted for an emergency. The alarm code and reporting instructions shall be conspicuously posted at phones and at employee entrances.

Fire Cutoffs

Fire walls and exit stairways, required for the completed buildings, shall be given construction priority. Fire doors, with automatic closing devices, shall be hung on openings as soon as practicable.

Fire cutoffs shall be retained in buildings undergoing alterations or demolition until operations necessitate their removal.

FIRE PREVENTION - §1926.151

Ignition Hazards

Electrical wiring and equipment for light, heat, or power purposes shall be installed in compliance with the requirements of Subpart K, *Electrical*.

Internal combustion engine powered equipment shall be so located that the exhausts are well away from combustible materials. When the exhausts are piped to outside the building under construction, a clearance of at least 6 inches shall be maintained between such piping and combustible material.

Smoking shall be prohibited at or in the vicinity of operations which constitute a fire hazard, and shall be conspicuously posted: "No Smoking or Open Flame."

Portable battery powered lighting equipment, used in connection with the storage, handling, or use of flammable gases or liquids, shall be of the type approved for the hazardous locations.

The nozzle of air, inert gas, and steam lines or hoses, when used in the cleaning or ventilation of tanks and vessels that contain hazardous concentrations of flammable gases or vapors, shall be bonded to the tank or vessel shell. Bonding devices shall not be attached or detached in hazardous concentrations of flammable gases or vapors.

Temporary Buildings

No temporary building shall be erected where it will adversely affect any means of exit.

Temporary buildings, when located within another building or structure, shall be of either noncombustible construction or of combustible construction having a fire resistance of not less than 1 hour.

Temporary buildings, located other than inside another building and not used for

the storage, handling, or use of flammable or combustible liquids, flammable gases, explosives, or blasting agents, or similar hazardous occupancies, shall be located at a distance of not less than 10 feet from another building or structure. Groups of temporary buildings, not exceeding 2,000 square feet in aggregate, shall, for the purposes of this part, be considered a single temporary building.

Open Yard Storage

Combustible materials shall be piled with due regard to the stability of piles and in no case higher than 20 feet.

Driveways between and around combustible storage piles shall be at least 15 feet wide and maintained free from accumulation of rubbish, equipment, or other articles or materials. Driveways shall be so spaced that a maximum grid system unit of 50 feet by 150 feet is produced.

The entire storage site shall be kept free from accumulation of unnecessary combustible materials. Weeds and grass shall be kept down and a regular procedure provided for the periodic cleanup of the entire area. When there is a danger of an underground fire, that land shall not be used for combustible or flammable storage.

Method of piling shall be solid wherever possible and in orderly and regular piles. No combustible material shall be stored outdoors within 10 feet of a building or structure.

Portable fire extinguishing equipment, suitable for the fire hazard involved, shall be provided at convenient, conspicuously accessible locations in the yard area. Portable fire extinguishers, rated not less than 2A, shall be placed so that maximum travel distance to the nearest unit shall not exceed 100 feet.

Indoor Storage

Storage shall not obstruct, or adversely affect, means of exit. All materials shall be stored, handled, and piled with due regard to their fire characteristics.

Noncompatible materials, which may create a fire hazard, shall be segregated by a barrier having a fire resistance of at least 1 hour.

Material shall be piled to minimize the spread of fire internally and to permit convenient access for firefighting. Stable piling shall be maintained at all times. Aisle space shall be maintained to safely accommodate the widest vehicle that may be used within the building for firefighting purposes.

Clearance of at least 36 inches shall be maintained between the top level of the stored material and the sprinkler deflectors.

Clearance shall be maintained around lights and heating units to prevent ignition of combustible materials.

A clearance of 24 inches shall be maintained around the path of travel of fire doors unless a barricade is provided, in which case no clearance is needed. Material shall not be stored within 36 inches of a fire door opening.

FLAMMABLE AND COMBUSTIBLE LIQUIDS - §1926.152

General Requirements

Only approved containers and portable tanks shall be used for storage and handling of flammable and combustible liquids. Approved metal safety cans shall be used for the handling and use of flammable liquids in quantities greater than one gallon, except that this shall not apply to those flammable liquid materials which are highly viscous (extremely hard to pour), which may be used and handled in original shipping containers. For quantities of one gallon or less, only the original container or approved metal safety cans shall be used for storage, use, and handling of flammable liquids.

Flammable or combustible liquids shall not be stored in areas used for exits, stairways, or normally used for the safe passage of people.

Indoor Storage of Flammable and Combustible Liquids

No more than 25 gallons of flammable or combustible liquids shall be stored in a room outside of an approved storage cabinet. For storage of liquefied petroleum gas, see §1926.153.

Quantities of flammable and combustible liquid in excess of 25 gallons shall be stored in an acceptable or approved cabinet meeting the following requirements:

- (i) Acceptable wooden storage cabinets shall be constructed in the following manner, or equivalent: The bottom, sides, and top shall be constructed of an exterior grade of plywood at least 1 inch in thickness, which shall not break down or delaminate under standard fire test conditions. All joints shall be rabbeted and shall be fastened in two directions with flathead wood screws. When more than one door is used, there shall be a rabbeted overlap of not less than 1 inch. Steel hinges shall be mounted in such a manner as to not lose their holding capacity due to loosening or burning out of the screws when subjected to fire. Such cabinets shall be painted inside and out with fire retardant paint.

- (ii) Approved metal storage cabinets will be acceptable.
- (iii) Cabinets shall be labeled in conspicuous lettering, "Flammable-Keep Fire Away."

Not more than 60 gallons of flammable or 120 gallons of combustible liquids shall be stored in any one storage cabinet. Not more than three such cabinets may be located in a single storage area. Quantities in excess of this shall be stored in an inside storage room.

Inside storage rooms shall be constructed to meet the required fire-resistive rating for their use. Such construction shall comply with the test specifications set forth in *Standard Methods of Fire Test of Building Construction and Material*, NFPA 251-1969.

Where an automatic extinguishing system is provided, the system shall be designed and installed in an approved manner. Openings to other rooms or buildings shall be provided with noncombustible liquid-tight raised sills or ramps at least 4 inches in height, or the floor in the storage area shall be at least 4 inches below the surrounding floor. Openings shall be provided with approved self-closing fire doors. The room shall be liquid-tight where the walls join the floor. A permissible alternate to the sill or ramp is an open-grated trench, inside of the room, which drains to a safe location. Where other portions of the building or other buildings are exposed, windows shall be protected as set forth in the *Standard for Fire Doors and Windows*, NFPA No. 80-1970, for Class E or F openings. Wood of at least 1-inch nominal thickness may be used for shelving, racks, dunnage, scuffboards, floor overlay, and similar installations.

Materials which will react with water and create a fire hazard shall not be stored in the same room with flammable or combustible liquids.

Storage in inside storage rooms shall comply with Table F-2:

TABLE F-2			
Fire Protection Provided	Fire Resistance	Maximum Size	Total Allowable Quantities (gal./sq. ft. floor area)
Yes	2 hrs.	500 sq. ft.	10
No	2 hrs.	500 sq. ft.	4
Yes	1 hr.	150 sq. ft.	5
No	1 hr.	150 sq. ft.	2

NOTE: Fire protection system shall be sprinkler, water spray, carbon dioxide or other system approved by a nationally recognized testing laboratory for this purpose.

Electrical wiring and equipment located in inside storage rooms shall be approved for Class I, Division 1, Hazardous Locations. For definition of Class I, Division 1, Hazardous Locations, see §1926.449.

Every inside storage room shall be provided with either a gravity or a mechanical exhausting system. Such system shall commence not more than 12 inches above the floor and be designed to provide for a complete change of air within the room at least 6 times per hour. If a mechanical exhausting system is used, it shall be controlled by a switch located outside of the door. The ventilating equipment and any lighting fixtures shall be operated by the same switch. An electric pilot light shall be installed adjacent to the switch if flammable liquids are dispensed within the room. Where gravity ventilation is provided, the fresh air intake, as well as the exhausting outlet from the room, shall be on the exterior of the building in which the room is located.

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.

Flammable and combustible liquids in excess of that permitted in inside storage rooms shall be stored outside of buildings in accordance with paragraph "Storage Outside Buildings" of this section.

The quantity of flammable or combustible liquids kept in the vicinity of spraying operations shall be the minimum required for operations and should ordinarily not exceed a supply for 1 day or one shift. Bulk storage of portable containers of flammable or combustible liquids shall be in a separate, constructed building detached from other important buildings or cut off in a standard manner.

Storage Outside Buildings

Storage of containers (not more than 60 gallons each) shall not exceed 1,100 gallons in any one pile or area. Piles or groups of containers shall be separated by a 5-foot clearance. Piles or groups of containers shall not be nearer than 20 feet to a building.

Within 200 feet of each pile of containers, there shall be a 12-foot-wide access way to permit approach of fire control apparatus.

The storage area shall be graded in a manner to divert possible spills away from buildings or other exposures, or shall be surrounded by a curb or earth dike at least 12 inches high. When curbs or dikes are used, provisions shall be made for draining off accumulations of ground or rain water, or spills of flammable or combustible liquids. Drains shall terminate at a safe location and shall be accessible to operation under fire conditions.

Outdoor portable tank storage:

(i) Portable tanks shall not be nearer than 20 feet from any building. Two or more portable tanks, grouped together, having a combined capacity in excess of 2,200 gallons, shall be separated by a 5-foot-clear area. Individual portable tanks exceeding 1,100 gallons shall be separated by a 5-foot-clear area.

(ii) Within 200 feet of each portable tank, there shall be a 12-foot-wide access way to permit approach of fire control apparatus.

Storage areas shall be kept free of weeds, debris, and other combustible material not necessary to the storage.

Portable tanks, not exceeding 660 gallons, shall be provided with emergency venting and other devices, as required by chapters III and IV of NFPA 30-1969, *The Flammable and Combustible Liquids Code*.

Portable tanks, in excess of 660 gallons, shall have emergency venting and other devices, as required by chapters II and III of *The Flammable and Combustible Liquids Code*, NFPA 30-1969.

Fire Control for Flammable or Combustible Liquid Storage

At least one portable fire extinguisher, having a rating of not less than 20-B units, shall be located outside of, but not more than 10 feet from, the door opening into any room used for storage of more than 60 gallons of flammable or combustible liquids.

At least one portable fire extinguisher having a rating of not less than 20-B units shall be located not less than 25 feet, nor more than 75 feet, from any flammable liquid storage area located outside.

When sprinklers are provided, they shall be installed in accordance with the *Standard for the Installation of Sprinkler Systems*, NFPA 13-1969.

At least one portable fire extinguisher having a rating of not less than 20-B:C units shall be provided on all tank trucks or other vehicles used for transporting and/or dispensing flammable or combustible liquids.

Dispensing Liquids

Areas in which flammable or combustible liquids are transferred at one time, in quantities greater than 5 gallons from one tank or container to another tank or container, shall be separated from other operations by 25-foot distance or by construction having a fire resistance of at least 1 hour. Drainage or other means shall be provided to control spills. Adequate natural or mechanical ventilation shall be provided to maintain the concentration of flammable vapor at or below 10 percent of the lower flammable limit.

Transfer of flammable liquids from one container to another shall be done only when containers are electrically interconnected (bonded).

Flammable or combustible liquids shall be drawn from or transferred into vessels, containers, or tanks within a building or outside 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 or pump, through an approved self-closing valve. Transferring by means of air pressure on the container or portable tanks is prohibited.

The dispensing units shall be protected against collision damage. Dispensing devices and nozzles for flammable liquids shall be of an approved type.

Handling Liquids at Point of Final Use

Flammable liquids shall be kept in closed containers when not actually in use.

Leakage or spillage of flammable or combustible liquids shall be disposed of promptly and safely.

Flammable liquids may be used only where there are no open flames or other sources of ignition within 50 feet of the operation, unless conditions warrant greater clearance.

Service and Refueling Areas

Flammable or combustible liquids shall be stored in approved closed containers, in tanks located underground, or in aboveground portable tanks.

The tank trucks shall comply with the requirements covered in the *Standard for Tank Vehicles for Flammable and Combustible Liquids*, NFPA No. 385-1966.

The dispensing hose shall be an approved type, and the dispensing nozzle shall be an approved automatic-closing type without a latch-open device.

Underground tanks shall not be abandoned.

Clearly identified and easily accessible switch(es) shall be provided at a location remote from dispensing devices to shut off the power to all dispensing devices in the event of an emergency.

Heating equipment of an approved type may be installed in the lubrication or service area where there is no dispensing or transferring of flammable liquids, provided the bottom of the heating unit is at least 18 inches above the floor and is protected from physical damage.

Heating equipment installed in lubrication or service areas, where flammable liquids are dispensed, shall be of an approved type for garages, and shall be installed at least 8 feet above the floor.

There shall be no smoking or open flames in the areas used for fueling, servicing fuel systems for internal combustion engines, receiving or dispensing of flammable or combustible liquids. Conspicuous and legible signs prohibiting smoking shall be posted.

The motors of all equipment being fueled shall be shut off during the fueling operation.

Each service or fueling area shall be provided with at least one fire extinguisher

having a rating of not less than 20-B:C located so that an extinguisher will be within 75 feet of each pump, dispenser, underground fill pipe opening, and lubrication or service area.

Scope

This section applies to the handling, storage, and use of flammable and combustible liquids with a flashpoint below 200 deg. F (93.33 deg. C). This section does not apply to: (1) Bulk transportation of flammable and combustible liquids; and (2) Storage, handling, and use of fuel oil tanks and containers connected with oil burning equipment.

Tank Storage

Refer to §1926.152(i) for design, construction, and installation requirements for flammable or combustible liquid storage tanks.

Piping, Valves, and Fittings

Refer to §1926.152(j) for design, fabrication, assembly, test, and inspection requirements for piping systems containing flammable or combustible liquids.

Marine Service Stations

Refer to §1926.152(k) for dispensing, tanks and pumps, and piping service stations where flammable or combustible liquids used as fuels are stored and dispensed.

LIQUEFIED PETROLEUM GAS (LP-GAS) - §1926.153

Approval of Equipment and Systems

Each system shall have containers, valves, connectors, manifold valve assemblies, and regulators of an approved type.

All cylinders shall meet the Department of Transportation specification identification requirements published in 49 CFR Part 178, *Shipping Container Specifications*.

As used in this section, "Containers" are defined as all vessels, such as tanks, cylinders, or drums, used for transportation or storing liquefied petroleum gases.

Welding on LP-Gas Containers

Welding is prohibited on containers.

Container Valves and Container Accessories

Valves, fittings, and accessories connected directly to the container, including primary shut off valves, shall have a rated working pressure of at least 250 p.s.i.g. and shall be of material and design suitable for LP-Gas service.

Connections to containers, except safety relief connections, liquid level gauging devices, and plugged openings, shall have shutoff valves located as close to the container as practicable.

Safety Devices

Every container and every vaporizer shall be provided with one or more approved safety relief valves or devices. These valves shall be arranged to afford free vent to the outer air with discharge not less than 5 feet horizontally away from any opening into a building which is below such discharge.

Shutoff valves shall not be installed between the safety relief device and the container, or the equipment or piping to which the safety relief device is connected, except that a shutoff valve may be used where the arrangement of this valve is such that full required capacity flow through the safety relief device is always afforded.

Container safety relief devices and regulator relief vents shall be located not less than 5 feet in any direction from air openings into sealed combustion system appliances or mechanical ventilation air intakes.

Dispensing

Filling of fuel containers for trucks or motor vehicles from bulk storage containers shall be performed not less than 10 feet from the nearest masonry-walled building, or not less than 25 feet from the nearest building or other construction and, in any event, not less than 25 feet from any building opening.

Filling of portable containers or containers mounted on skids from storage containers shall be performed not less than 50 feet from the nearest building.

Requirements for Appliances

Any appliance that was originally manufactured for operation with a gaseous fuel other than LP-Gas, and is in good condition, may be used with LP-Gas only after it is properly converted, adapted, and tested for performance with LP-Gas before the appliance is placed in use.

Containers shall be upright upon firm foundations or otherwise firmly secured. The possible effect on the outlet piping of settling shall be guarded against by a flexible connection or special fitting.

Containers and Equipment Used Inside of Buildings or Structures

When operational requirements make portable use of containers necessary, and their location outside of buildings or structures is impracticable, containers and equipment shall be permitted to be used inside of buildings or structures in

accordance with paragraphs (h)(2) through (11) of this section.

"Containers in use" means connected for use.

Systems utilizing containers having a water capacity greater than 2½ pounds (nominal 1 pound LP-Gas capacity) shall be equipped with excess flow valves. Such excess flow valves shall be either integral with the container valves or in the connections to the container valve outlets.

Regulators shall be either directly connected to the container valves or to manifolds connected to the container valves. The regulator shall be suitable for use with LP-Gas. Manifolds and fittings connecting containers to pressure regulator inlets shall be designed for at least 250 p.s.i.g. service pressure.

Valves on containers having water capacity greater than 50 pounds (nominal 20 pounds LP-Gas capacity) shall be protected from damage while in use or storage.

Aluminum piping or tubing shall not be used.

Hose shall be designed for a working pressure of at least 250 p.s.i.g. Design, construction, and performance of hose, and hose connections shall have their suitability determined by listing by a nationally recognized testing agency. The hose length shall be as short as practicable. Hoses shall be long enough to permit compliance with spacing provisions of paragraphs (h)(1) through (13) of this section, without kinking or straining, or causing hose to be so close to a burner as to be damaged by heat.

Portable heaters, including salamanders, shall be equipped with an approved automatic device to shut off the flow of gas to the main burner, and pilot if used, in the event of flame failure. Such heaters, having inputs above 50,000 B.t.u. per hour, shall be equipped with either a pilot, which must be lighted and proved before the main burner can be turned on, or an electrical ignition system.

NOTE: The provisions of this subparagraph do not apply to portable heaters under 7,500 B.t.u. per hour input when used with containers having a maximum water

capacity of 2½ pounds.

Container valves, connectors, regulators, manifolds, piping, and tubing shall not be used as structural supports for heaters.

Containers, regulating equipment, manifolds, pipe, tubing, and hose shall be located to minimize exposure to high temperatures or physical damage.

Containers having a water capacity greater than 2½ pounds (nominal 1 pound LP-Gas capacity) connected for use shall stand on a firm and substantially level surface and, when necessary, shall be secured in an upright position.

The maximum water capacity of individual containers shall be 245 pounds (nominal 100 pounds LP-Gas capacity).

For temporary heating, heaters (other than integral heater-container units) shall be located at least 6 feet from any LP-Gas container. This shall not prohibit the use of heaters specifically designed for attachment to the container or to a supporting standard, provided they are designed and installed so as to prevent direct or radiant heat application from the heater onto the containers. Blower and radiant type heaters shall not be directed toward any LP-Gas container within 20 feet.

If two or more heater-container units, of either the integral or nonintegral type, are located in an unpartitioned area on the same floor, the container or containers of each unit shall be separated from the container or containers of any other unit by at least 20 feet.

When heaters are connected to containers for use in an unpartitioned area on the same floor, the total water capacity of containers, manifolded together for connection to a heater or heaters, shall not be greater than 735 pounds (nominal 300 pounds LP-Gas capacity). Such manifolds shall be separated by at least 20 feet.

Storage of containers awaiting use shall be in accordance with paragraphs (j) and (k) of this section.

Multiple Container Systems

Valves in the assembly of multiple container systems shall be arranged so that replacement of containers can be made without shutting off the flow of gas in the system. This provision is not to be construed as requiring an automatic changeover device.

Heaters shall be equipped with an approved regulator in the supply line between the fuel cylinder and the heater unit. Cylinder connectors shall be provided with an excess flow valve to minimize the flow of gas in the event the fuel line becomes ruptured.

Regulators and low-pressure relief devices shall be rigidly attached to the cylinder valves, cylinders, supporting standards, the building walls, or otherwise rigidly secured, and shall be so installed or protected from the elements.

Storage of LPG Containers

Storage of LPG within buildings is prohibited.

Storage Outside of Buildings

Storage outside of buildings, for containers awaiting use, shall be located from the nearest building or group of buildings, in accordance with the following:

TABLE F-3	
Quantity of LP-Gas Stored	Distance (feet)
500 lbs. or less	0
501 to 6,000 lbs.	10
6,001 to 10,000 lbs.	20
Over 10,000 lbs	25

Containers shall be in a suitable ventilated enclosure or otherwise protected against tampering.

Fire Protection

Storage locations shall be provided with at least one approved portable fire extinguisher having a rating of not less than 20-B:C.

Systems Utilizing Containers Other Than DOT Containers

This paragraph applies specifically to systems utilizing storage containers other than those constructed in accordance with DOT specifications. Paragraph (b) of this section applies to this paragraph unless otherwise noted in paragraph (b) of this section.

Storage containers shall be designed and classified in accordance with Table F-31 of §1926.153(m)(2).

Containers with foundations attached (portable or semiportable containers with suitable steel "runners" or "skids" and popularly known in the industry as "skid tanks") shall be designed, installed, and used in accordance with these rules subject to the following provisions:

- (i) If they are to be used at a given general location for a temporary period not to exceed 6 months they need not have fire-resisting foundations or saddles but shall have adequate ferrous metal supports.
- (ii) They shall not be located with the outside bottom of the container shell more than 5 feet (1.52 m) above the surface of the ground unless fire-resisting supports are provided.
- (iii) The bottom of the skids shall not be less than 2 inches (5.08 cm) or more than 12 inches (30.48 cm) below the outside bottom of the container shell.
- (iv) Flanges, nozzles, valves, fittings, and the like, having communication with the

interior of the container, shall be protected against physical damage.

(v) When not permanently located on fire-resisting foundations, piping connections shall be sufficiently flexible to minimize the possibility of breakage or leakage of connections if the container settles, moves, or is otherwise displaced.

(vi) Skids, or lugs for attachment of skids, shall be secured to the container in accordance with the code or rules under which the container is designed and built (with a minimum factor of safety of four) to withstand loading in any direction equal to four times the weight of the container and attachments when filled to the maximum permissible loaded weight.

Field welding where necessary shall be made only on saddle plates or brackets which were applied by the manufacturer of the tank.

Marking of Gas Cylinders

When LP-Gas and one or more other gases are stored or used in the same area, the containers shall be marked to identify their content. Marking shall be in compliance with American National Standard Z48.1-1954, *Method of Marking Portable Compressed Gas Containers To Identify the Material Contained*.

Damage From Vehicles

When damage to LP-Gas systems from vehicular traffic is a possibility, precautions against such damage shall be taken.

TEMPORARY HEATING DEVICES - §1926.154

Ventilation

Fresh air shall be supplied in sufficient quantities to maintain the health and safety of workers. Where natural means of fresh air supply is inadequate, mechanical ventilation shall be provided.

When heaters are used in confined spaces, special care shall be taken to provide sufficient ventilation in order to ensure proper combustion, maintain the health and safety of workers, and limit temperature rise in the area.

Clearance and Mounting

Temporary heating devices shall be installed to provide clearance to combustible material not less than the amount shown in Table F-4 in §1926.154(b)(1).

Temporary heating devices, which are listed for installation with lesser clearances than specified in Table F-4, may be installed in accordance with their approval.

Heaters not suitable for use on wood floors shall not be set directly upon them or other combustible materials. When such heaters are used, they shall rest on suitable heat insulating material or at least 1-inch concrete, or equivalent. The insulating material shall extend beyond the heater 2 feet or more in all directions.

Heaters used in the vicinity of combustible tarpaulins, canvas, or similar coverings shall be located at least 10 feet from the coverings. The coverings shall be securely fastened to prevent ignition or upsetting of the heater due to wind action on the covering or other material.

Stability

Heaters, when in use, shall be set horizontally level, unless otherwise permitted by the manufacturer's markings.

Solid Fuel Salamanders

Solid fuel salamanders are prohibited in buildings and on scaffolds.

Oil-Fired Heaters

Flammable liquid-fired heaters shall be equipped with a primary safety control to stop the flow of fuel in the event of flame failure. Barometric or gravity oil feed shall not be considered a primary safety control.

Heaters designed for barometric or gravity oil feed shall be used only with the integral tanks.

Heaters specifically designed and approved for use with separate supply tanks may be directly connected for gravity feed, or an automatic pump, from a supply tank.

FIXED EXTINGUISHING SYSTEMS, GENERAL - §1926.156

Scope and Application

This section applies to all fixed extinguishing systems installed to meet a particular OSHA standard except for automatic sprinkler systems which are covered by §1910.159.

This section also applies to fixed systems not installed to meet a particular OSHA standard, but which, by means of their operation, may expose employees to possible injury, death, or adverse health consequences caused by the extinguishing agent. Such systems are only subject to the requirements of paragraphs (b)(4) through (b)(7) and (c) of this section.

Systems otherwise covered in paragraph (a)(2) of this section which are installed in areas with no employee exposure are exempted from the requirements of this section.

General Requirements

Fixed extinguishing system components and agents shall be designed and approved for use on the specific fire hazards they are expected to control or extinguish. If for any reason a fixed extinguishing system becomes inoperable, the employer shall notify employees and take the necessary temporary precautions to assure their safety until the system is restored to operating order. Any defects or impairments shall be properly corrected by trained personnel.

The employer shall provide a distinctive alarm or signaling system which complies with §1926.159 and is capable of being perceived above ambient noise or light levels, on all extinguishing systems in those portions of the workplace covered by the extinguishing system to indicate when the extinguishing system is discharging. Discharge alarms are not required on systems where discharge is immediately recognizable.

The employer shall provide effective safeguards to warn employees against entry

into discharge areas where the atmosphere remains hazardous to employee safety or health.

The employer shall post hazard warning or caution signs at the entrance to, and inside of, areas protected by fixed extinguishing systems which use agents in concentrations known to be hazardous to employee safety and health.

The employer shall assure that fixed systems are inspected annually by a person knowledgeable in the design and function of the system to assure that the system is maintained in good operating condition.

The employer shall assure that the weight and pressure of refillable containers is checked at least semi-annually. If the container shows a loss in net content or weight of more than 5 percent, or a loss in pressure of more than 10 percent, it shall be subjected to maintenance.

The employer shall assure that factory charged nonrefillable containers which have no means of pressure indication are weighed at least semi-annually. If a container shows a loss in net weight or more than 5 percent it shall be replaced.

The employer shall assure that inspection and maintenance dates are recorded on the container, on a tag attached to the container, or in a central location. A record of the last semi-annual check shall be maintained until the container is checked again or for the life of the container, whichever is less.

The employer shall train employees designated to inspect, maintain, operate, or repair fixed extinguishing systems and annually review their training to keep them up-to-date in the functions they are to perform.

The employer shall not use chlorobromomethane or carbon tetrachloride as an extinguishing agent where employees may be exposed.

The employer shall assure that systems installed in the presence of corrosive atmospheres are constructed of non-corrosive material or otherwise protected against corrosion.

Automatic detection equipment shall be approved, installed and maintained in accordance with §1926.158.

The employer shall assure that all systems designed for and installed in areas with climatic extremes shall operate effectively at the expected extreme temperatures.

The employer shall assure that at least one manual station is provided for discharge activation of each fixed extinguishing system. The employer shall assure that manual operating devices are identified as to the hazard against which they will provide protection.

The employer shall provide and assure the use of the personal protective equipment needed for immediate rescue of employees trapped in hazardous atmospheres created by an agent discharge.

Total Flooding Systems With Potential Health and Safety Hazards to Employees

The employer shall provide an emergency action plan in accordance with §1926.35 for each area within a workplace that is protected by a total flooding system which provides agent concentrations exceeding the maximum safe levels set forth in paragraphs (b)(5) and (b)(6) of §1926.157.

Systems installed in areas where employees cannot enter during or after the system's operation are exempt from the requirements of this paragraph.

On all total flooding systems the employer shall provide a pre-discharge employee alarm which complies with §1926.159, and is capable of being perceived above ambient light or noise levels before the system discharges, which will give employees time to safely exit from the discharge area prior to system discharge.

The employer shall provide automatic actuation of total flooding systems by means of an approved fire detection device installed and interconnected with a pre-discharge employee alarm system to give employees time to safely exit from the discharge area prior to system discharge.

FIXED EXTINGUISHING SYSTEMS, GASEOUS AGENT - §1926.157

Scope

This section applies to all fixed extinguishing systems, using a gas as the extinguishing agent, installed to meet a particular OSHA standard. These systems shall also comply with §1926.156. In some cases, the gas may be in a liquid state during storage.

Specific Requirements

Agents used for initial supply and replenishment shall be of the type approved for the system's application. Carbon dioxide obtained by dry ice conversion to liquid is not acceptable unless it is processed to remove excess water and oil.

The employer shall assure that employees are not exposed to toxic levels of gaseous agent or its decomposition products.

The following requirements shall apply only to total flooding systems:

Except during overhaul, the employer shall assure that the designed concentration of gaseous agents is maintained until the fire has been extinguished or is under control.

The employer shall assure that the designed extinguishing concentration is reached within 30 seconds of initial discharge except for Halon systems which must achieve design concentration within 10 seconds.

The employer shall provide a distinctive pre-discharge employee alarm capable of being perceived above ambient light or noise levels when agent design concentrations exceed the maximum safe level for employee exposure. A pre-discharge employee alarm for alerting employees before system discharge shall be provided on Halon 1211 and carbon dioxide systems with a design concentration of 10 percent or greater. The pre-discharge employee alarm shall provide employees time to safely exit the discharge area prior to system discharge.

Where egress from an area cannot be accomplished within one minute, the employer shall not use Halon 1301 in concentrations greater than 7 percent.

Where egress takes greater than 30 seconds but less than one minute, the employer shall not use Halon 1301 in a concentration greater than 10 percent.

Halon 1301 concentrations greater than 10 percent are only permitted in areas not normally occupied by employees provided that any employee in the area can escape within 30 seconds. The employer shall assure that no unprotected employees enter the area during agent discharge.

FIRE DETECTION SYSTEMS - §1926.158

Scope and Application

This section applies to all automatic fire detection systems installed to meet the requirements of a particular OSHA standard.

Installation and Restoration

The employer shall assure that all devices and equipment constructed and installed to comply with this standard are approved for the purpose for which they are intended.

The employer shall restore all fire detection systems and components to normal operating condition as promptly as possible after each test or alarm. Spare detection devices and components which are normally destroyed in the process of detecting fires shall be available on the premises or from a local supplier in sufficient quantities and locations for prompt restoration of the system.

Maintenance and Testing

The employer shall maintain all systems in an operable condition except during repairs or maintenance.

The employer shall assure that fire detectors and fire detection systems are tested and adjusted as often as needed to maintain proper reliability and operating condition except that factory calibrated detectors need not be adjusted after installation.

The employer shall assure that pneumatic and hydraulic operated detection systems installed after January 1, 1981, are equipped with supervised systems.

The employer shall assure that the servicing, maintenance and testing of fire detection systems, including cleaning and necessary sensitivity adjustments are performed by a trained person knowledgeable in the operation and functions of the

system.

The employer shall also assure that fire detectors that need to be cleaned of dirt, dust, or other particulates in order to be fully operational are cleaned at regular periodic intervals.

Protection of Fire Detectors

The employer shall assure that fire detection equipment installed outdoors or in the presence of corrosive atmospheres be protected from corrosion. The employer shall provide a canopy, hood, or other suitable protection for detection equipment requiring protection from the weather.

The employer shall locate or otherwise protect detection equipment so that it is protected from mechanical or physical impact which might render it inoperable.

The employer shall assure that detectors are supported independently of their attachment to wires or tubing.

Response Time

The employer shall assure that fire detection systems installed for the purpose of actuating fire extinguishment or suppression systems shall be designed to operate in time to control or extinguish a fire.

The employer shall assure that fire detection systems installed for the purpose of employee alarm and evacuation be designed and installed to provide a warning for emergency action and safe escape of employees.

The employer shall not delay alarms or devices initiated by fire detector actuation for more than 30 seconds unless such delay is necessary for the immediate safety of employees. When such delay is necessary, it shall be addressed in an emergency action plan meeting the requirements of §1926.35.

Number, Location and Spacing of Detecting Devices

The employer shall assure that the number, spacing and location of fire detectors is based upon design data obtained from field experience, or tests, engineering surveys, the manufacturer's recommendations, or a recognized testing laboratory listing.

EMPLOYER ALARM SYSTEMS - §1926.159

Scope and Application

This section applies to all emergency employee alarms installed to meet a particular OSHA standard. This section does not apply to those discharge or supervisory alarms required on various fixed extinguishing systems or to supervisory alarms on fire suppression, alarm or detection systems unless they are intended to be employee alarm systems.

The requirements in this section that pertain to maintenance, testing and inspection shall apply to all local fire alarm signaling systems used for alerting employees regardless of the other functions of the system.

All pre-discharge employee alarms installed to meet a particular OSHA standard shall meet the requirements of paragraphs (b)(1) through (4), (c), and (d)(1) of this section.

General Requirements

The employee alarm system shall provide warning for necessary emergency action as called for in the emergency action plan, or for reaction time for safe escape of employees from the workplace or the immediate work area, or both.

The employee alarm shall be capable of being perceived above ambient noise or light levels by all employees in the affected portions of the workplace. Tactile devices may be used to alert those employees who would not otherwise be able to recognize the audible or visual alarm.

The employee alarm shall be distinctive and recognizable as a signal to evacuate the work area or to perform actions designated under the emergency action plan.

The employer shall explain to each employee the preferred means of reporting emergencies, such as manual pull box alarms, public address systems, radio or telephones. The employer shall post emergency telephone numbers near

telephones, or employee notice boards, and other conspicuous locations when telephones serve as a means of reporting emergencies. Where a communication system also serves as the employee alarm system, all emergency messages shall have priority over all non-emergency messages.

The employer shall establish procedures for sounding emergency alarms in the workplace. For those employers with 10 or fewer employees in a particular workplace, direct voice communication is an acceptable procedure for sounding the alarm provided all employees can hear the alarm. Such workplaces need not have a back-up system.

Installation and Restoration

The employer shall assure that all devices, components, combinations of devices or systems constructed and installed to comply with this standard are approved. Steam whistles, air horns, strobe lights or similar lighting devices, or tactile devices meeting the requirements of this section are considered to meet this requirement for approval.

The employer shall assure that all employee alarm systems are restored to normal operating condition as promptly as possible after each test or alarm. Spare alarm devices and components subject to wear or destruction shall be available in sufficient quantities and locations for prompt restoration of the system.

Maintenance and Testing

The employer shall assure that all employee alarm systems are maintained in operating condition except when undergoing repairs or maintenance.

The employer shall assure that a test of the reliability and adequacy of non-supervised employee alarm systems is made every two months. A different actuation device shall be used in each test of a multi-actuation device system so that no individual device is used for two consecutive tests.

The employer shall maintain or replace power supplies as often as is necessary to

assure a fully operational condition. Back-up means of alarm, such as employee runners or telephones, shall be provided when systems are out of service.

The employer shall assure that employee alarm circuitry installed after January 1, 1981, which is capable of being supervised is supervised and that it will provide positive notification to assigned personnel whenever a deficiency exists in the system. The employer shall assure that all supervised employee alarm systems are tested at least annually for reliability and adequacy.

The employer shall assure that the servicing, maintenance and testing of employee alarms are done by persons trained in the designed operation and functions necessary for reliable and safe operation of the system.

Manual Operation

The employer shall assure that manually operated actuation devices for use in conjunction with employee alarms are unobstructed, conspicuous and readily accessible.

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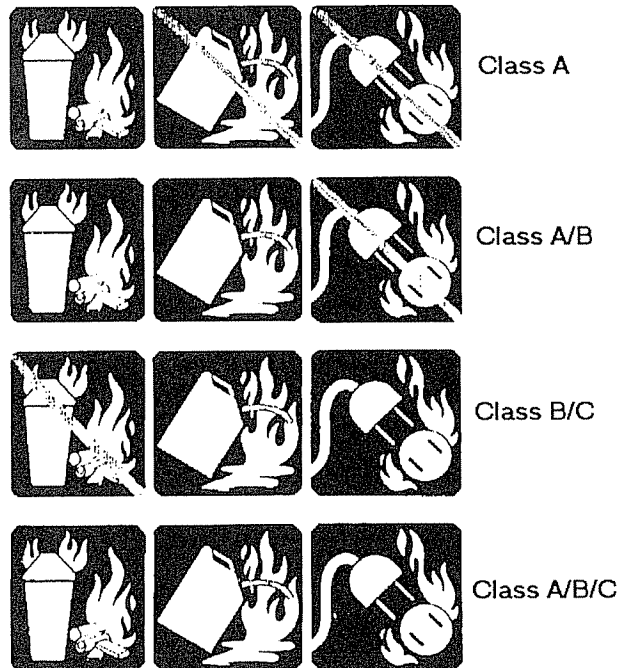
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CLASSIFICATION OF PORTABLE FIRE EXTINGUISHERS

Portable fire extinguishers are classified to indicate their ability to handle specific classes and sizes of fires. Labels on extinguishers indicate the class and relative size of fire that they can be expected to handle.

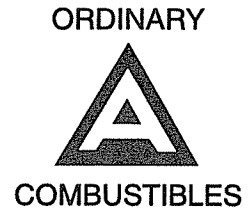
Class A extinguishers are used on fires involving ordinary combustibles, such as wood, cloth, and paper. Class B extinguishers are used on fires involving liquids, greases, and gases. Class C extinguishers are used on fires involving energized electrical equipment. Class D extinguishers are used on fires involving metals such as magnesium, titanium, zirconium, sodium, and potassium.

The recommended marking system to indicate the extinguisher suitability according to class of fire is a pictorial concept that combines the uses and non-uses of extinguishers on a single label. This system is illustrated in the accompanying figure. The first set (row) of symbols illustrated in the figure is a label for use on a Class A extinguisher. The symbol at the left (which depicts a Class A fire) is blue. Since the extinguisher is not recommended for use on Class B or C fires, the remaining two symbols (which depict Class B and Class C fires) are black, with a diagonal red line through them. The second set (row) of symbols illustrated in the figure is a label for use on a Class A/B extinguisher. The two left symbols are blue. Since the extinguisher is not recommended for use on Class C fires, the symbol on the far right (which depicts a Class C fire) is black, with a diagonal red line through it. The third set of symbols is a label for use on Class B/C extinguishers. The two right symbols are blue. Since the extinguisher is not recommended for use on Class A fires, this symbol is black, with a diagonal red line through it. The fourth set of symbols is a label for use on Class A/B/C extinguishers. All symbols on this label are blue.

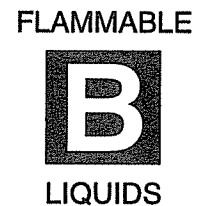


Letter-shaped symbol markings are also used to indicate extinguisher suitability according to class of fire.

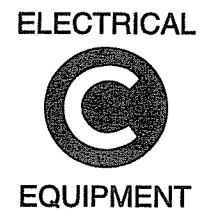
Extinguishers suitable for Class A fires should be identified by a triangle containing the letter "A." If colored, the triangle should be green.



Extinguishers suitable for Class B fires should be identified by a square containing the letter "B." If colored, the square shall be colored red.



Extinguishers suitable for Class C fires should be identified by a circle containing the letter "C." If colored, the circle should be colored blue.



Extinguishers suitable for fires involving metals should be identified by a five-pointed star containing the letter "D." If colored, the star shall be colored yellow.



Extinguishers suitable for more than one class of fire should be identified by multiple symbols placed in a horizontal sequence.

Class A and Class B extinguishers carry a numerical rating to indicate how large a fire an experienced person can put out with the extinguisher. The ratings are based on reproducible physical tests conducted by Underwriters' Laboratories, Inc. Class C extinguishers have only a letter rating because there is no readily measurable quantity for Class C fires which are essentially Class A or B fires involving energized electrical equipment. Class D extinguishers likewise do not have a numerical rating. Their effectiveness is described on the faceplate.

Class A Ratings

An extinguisher for Class A fires could have any one of the following ratings: 1-A, 2-A, 3-A, 4-A, 6-A, 10-A, 20-A, 30-A, and 40-A. A 4-A extinguisher, for example, should extinguish about twice as much fire as a 2-A extinguisher.

Class B Ratings

An extinguisher for Class B fires could have any one of the following ratings: 1-B, 2-B, 5-B, 10-B, 20-B, 30-B, 40-B, and up to 640-B.

Class C Ratings

Extinguishers rated for Class C fires are tested only for electrical conductivity. However, no extinguisher gets a Class C rating without a Class A and/or Class B rating.

Class D Ratings

Class D extinguishers are tested on metal fires. The agent used depends on the metal for which the extinguisher was designed. Check the extinguisher faceplate for the unit's effectiveness on specific metals.

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COMMON FIRE EXTINGUISHING AGENTS

- Water
- Carbon dioxide
- Dry chemical
- Multipurpose dry chemical
- Halon 1301
- Halon 1211

WATER

- Removes heat
- Effective on Class A fires
- Inexpensive
- Plentiful
- Non-toxic

Disadvantages:

- Conducts electricity
- May spread Class B fires
- Freezes in cold climates
- May carry pollutants as run-off water

CARBON DIOXIDE (CO₂)

- Reduces oxygen to less than 15%
- Effective on Class B and C fires
- No residue
- Relatively inert

Disadvantages:

- Generally >35% concentration by volume required for total flooding systems
- Toxic to humans at >4% by volume
- Not the best agent for smoldering deep-seated fires (maintain concentration for >20 minutes)
- Dissipates rapidly - allows reflash
- Has a cooling/chilling effect on some electronic components
- Vapor density = 1.5 (collects in pits and low areas)

DRY CHEMICAL

- Interrupts chemical reactions
- Sodium bicarbonate (baking soda)
- Very effective on Class B and C fires
- Not considered toxic

Disadvantages:

- Leaves a residue
- Obscures vision
- Not good on deep-seated Class A fires
- Absorbs moisture and may "cake" within container
- May be irritating
- Nozzle pressure may cause burning liquids to splash

MULTIPURPOSE DRY CHEMICAL

- Interrupts chemical reactions
- Ammonium phosphate
- Effective on Class A, B, and C fires
- Non-conductive

Disadvantages:

- Obscures vision
- More irritating than ordinary dry chemical
- Nozzle pressure may cause burning liquids to splash

HALON TERMINOLOGY

Halon 104: Carbon tetrachloride (CCl₄)

Halon 1211: Bromochlorodifluoromethane (CBrClF₂)

Halon 1301: Bromotrifluoromethane (CBrF₃)

C	F	Cl	Br
1	0	4	-
1	2	1	1
1	3	0	1

HALON 1301

- Interrupts chemical reactions
- Bromotrifluoromethane
- Effective on Class A, B, and C fires
- Not acutely toxic at <10% by volume
- Generally used at <7% by volume
- No residue
- No chilling effect on electronic parts and components

Disadvantages:

- Acutely toxic at >10% by volume (anesthetic and cardiac effects)
- Delayed effects and effects of chronic exposure not well known
- Toxic decomposition products are generated by fire
- Vapor density = 5 (collects in pits and low areas)
- Production restricted per Montreal Protocol due to depletion of ozone layer

HALON 1301

DECOMPOSITION PRODUCTS

- Hydrogen fluoride (HF)
- Hydrogen bromide (HBr)
- Bromine (Br₂)
- Carbonyl Fluoride (COF₂)
- Carbonyl Bromide (COBr₂)

HALON 1211

- Interrupts chemical reactions
- Bromochlorodifluoromethane
- Effective on Class A, B, and C fires
- No residue
- May be sprayed (Boiling Point = 25°F)
- Used in portable fire extinguishers

Disadvantages:

- Acutely toxic at >4% by volume (dizziness, impaired coordination and cardiac effects)
- Must be used at >5% by volume
- Toxic decomposition products are generated by fire
- Vapor density = 5.7 (collects in pits and low areas)
- Production restricted per Montreal Protocol due to depletion of ozone layer

HALON 1211

DECOMPOSITION PRODUCTS

- Hydrogen bromide (HBr)
- Hydrogen chloride (HCl)
- Hydrogen fluoride (HF)
- Bromine (Br₂)
- Chlorine (Cl₂)
- Fluorine (F₂)
- Carbonyl bromide (COBr₂)
- Carbonyl chloride (COCl₂)
- Carbonyl fluoride (COF₂)