

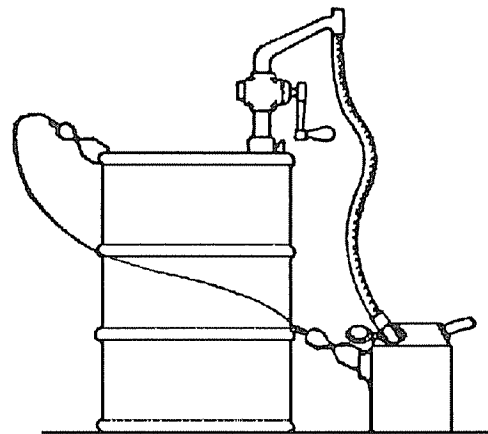


HAZARDOUS MATERIALS SUBPART H

FLAMMABLE AND COMBUSTIBLE LIQUIDS - 1910.106

Introduction

The primary basis of this standard is the National Fire Protection Association's publication NFPA 30, *Flammable and Combustible Liquids Code*. This standard applies to the handling, storage, and use of flammable and combustible liquids with a flash point below 200°F. There are two primary hazards associated with flammable and combustible liquids: explosion and fire. In order to prevent these hazards, this standard addresses the primary concerns of: design and construction, ventilation, ignition sources, and storage.



Definitions

There are a number of definitions included in 1910.106. These definitions were derived from consensus standards, and were not uniquely developed for OSHA regulations. Some of the more important definitions are discussed below.



Aerosol shall mean a material which is dispensed from its container as a mist, spray, or foam by a propellant under pressure.

Approved shall mean approved or listed by a nationally recognized testing laboratory.

Boiling point shall mean the boiling point of a liquid at a pressure of 14.7 pounds per square inch absolute (psia). This pressure is equivalent to 760 millimeters of mercury (760 mm Hg).

At temperatures above the boiling point, the pressure of the atmosphere can no longer hold the liquid in the liquid state and bubbles begin to form. The lower the boiling point, the greater the vapor pressure at normal ambient temperatures and consequently the greater the fire risk.

Container shall mean any can, barrel, or drum.

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

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.

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. The flash point is normally an indication of susceptibility to ignition.

The flash point is determined by heating the liquid in test equipment and



measuring the temperature at which a flash will be obtained when a small flame is introduced in the vapor zone above the surface of the liquid.

A standard closed container is used to determine the closed-cup flash point and a standard open-surface dish for the open-cup flash point temperature, as specified by the American Society for Testing and Materials (ASTM). These methods are referenced in OSHA's 1910.106 standard.

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

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

Class III liquids shall include those with flash points at or above 140°F (60°C). Class III liquids are subdivided into two subclasses:

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

Class IIIB liquids shall include those with flash points at or above 200°F (93.3°C). This section does not regulate Class IIIB liquids. Where the term "Class III liquids" is used in this section, it shall mean only Class IIIA liquids.

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



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

Class IA shall include liquids having flash points below 73°F (22.8°C) and having a boiling point below 100°F (37.8°C).

Class IB shall include liquids having flash points below 73°F (22.8°C) and having a boiling point at or above 100°F (37.8°C).

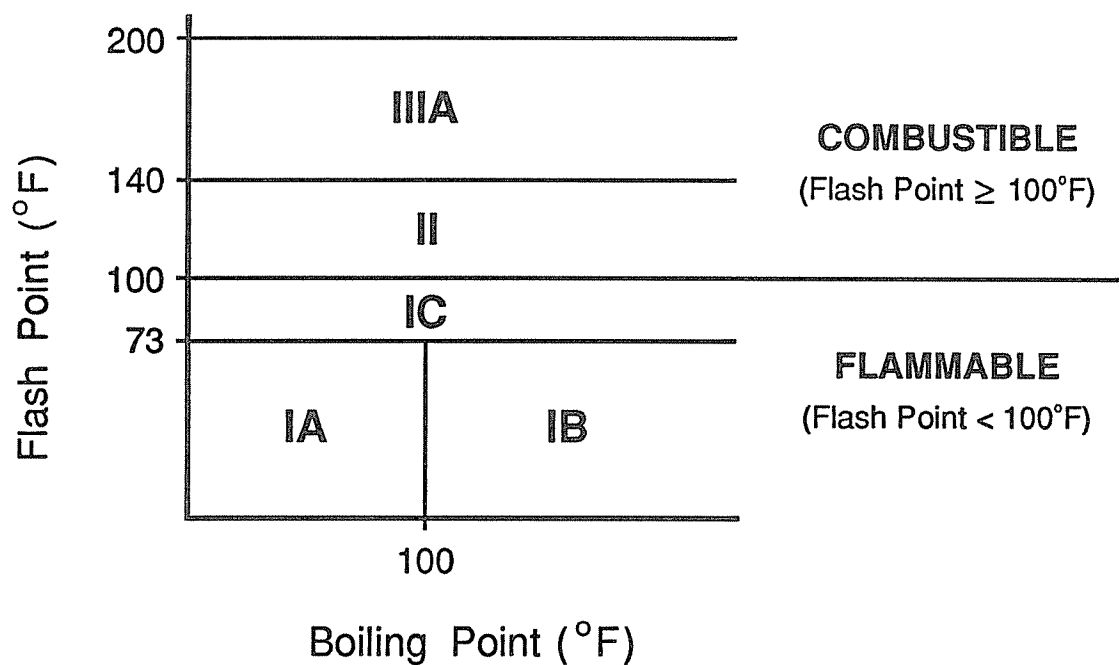
Class IC shall include liquids having flash points at or above 73°F (22.8°C) and below 100°F (37.8°C).

It should be mentioned that flash point was selected as the basis for classification of flammable and combustible liquids because it is directly related to a liquid's ability to generate vapor, i.e., its volatility. Since it is the vapor of the liquid, not the liquid itself, that burns, vapor generation becomes the primary factor in determining the fire hazard. The expression "low flash - high hazard" applies. Liquids having flash points below ambient storage temperatures generally display a rapid rate of flame spread over the surface of the liquid, since it is not necessary for the heat of the fire to expend its energy in heating the liquid to generate more vapor.

The above definitions for classification of flammable and combustible liquids are quite complex. The diagram below should aid in their understanding.



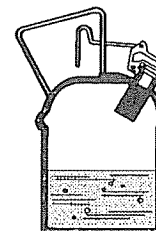
Classes of Flammable and Combustible Liquids as Defined in 29 CFR 1910.106





Portable tank shall mean a closed container having a liquid capacity over 60 U.S. gallons and not intended for fixed installation.

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.



Vapor pressure shall mean 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)*, American Society for Testing and Materials ASTM D323-68.

Vapor pressure is a measure of a liquid's propensity to evaporate. The higher the vapor pressure, the more volatile the liquid and, thus, the more readily the liquid gives off vapors.

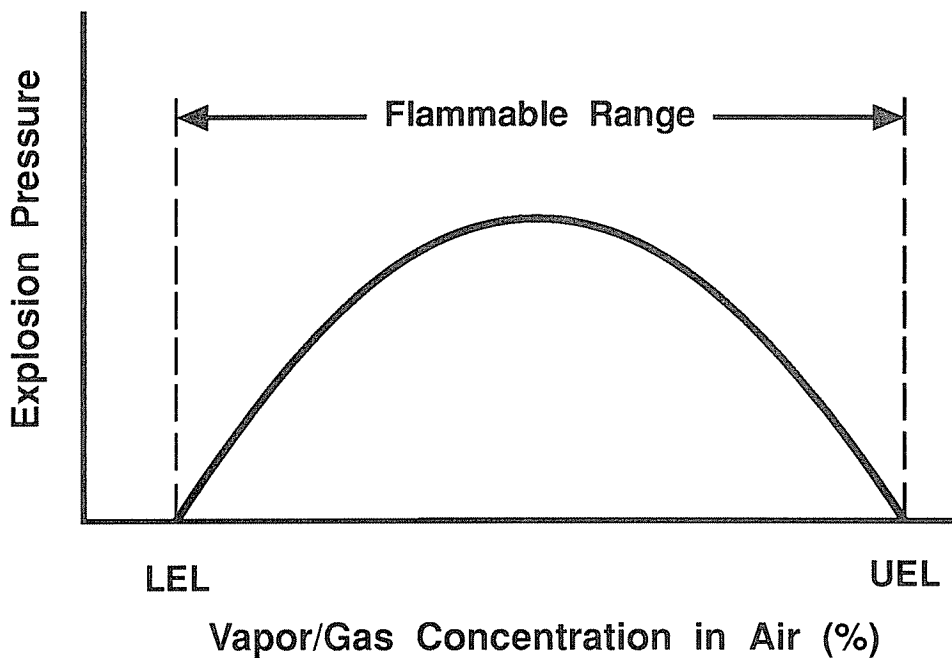
Ventilation as specified in this section is for the prevention of fire and explosion. It is considered adequate if it is sufficient to prevent accumulation of significant quantities of vapor-air mixtures in concentration over one-fourth of the lower flammable limit.

Flammable (Explosive) Limits

When vapors of a flammable or combustible liquid are mixed with air in the proper proportions in the presence of a source of ignition, rapid combustion or an explosion can occur. The proper proportion is called the *flammable range* and is also often referred to as the *explosive range*. The flammable range includes all concentrations of flammable vapor or gas in air, in which a flash will occur or a flame will travel if the mixture is ignited. There is a minimum concentration of vapor or gas in air below which propagation of flame does not occur on



contact with a source of ignition. There is also a maximum proportion of vapor in air above which propagation of flame does not occur. These boundary-line mixtures of vapor with air are known as the *lower* and *upper flammable* or *explosive limits* (LEL or UEL) respectively, and they are usually expressed in terms of percentage by volume of vapor in air. See figure below.



In popular jargon, a vapor/air mixture below the flammable limit is too "lean" to burn or explode, and a mixture above the upper flammable limit is too "rich" to burn or explode. No attempt is made to differentiate between the terms *flammable* and *explosive* as applied to the lower and upper limits of flammability.



Container and Portable Tank Storage

Scope

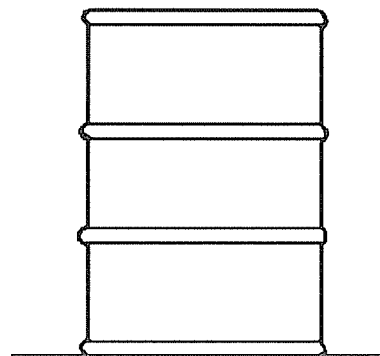
This section applies only to the storage of flammable or combustible liquids in drums or other containers (including flammable aerosols) not exceeding 60 gallons individual capacity and portable tanks of less than 660 gallon individual capacity. A portable tank is a closed container which has a liquid capacity of over 60 gallons and is not intended for fixed installations.

This section does not apply to the following:

- Storage of containers in bulk plants, service stations, refineries, chemical plants, and distilleries;
- Class I or Class II liquids in the fuel tanks of a motor vehicle, aircraft, boat, or portable or stationary engine;
- Flammable or combustible paints, oils, varnishes, and similar mixtures used for painting or maintenance when not kept for a period in excess of 30 days;
- Beverages when packed in individual containers not exceeding 1 gallon in size.

Design, Construction, and Capacity of Containers

Only approved containers and portable tanks may be used to store flammable and combustible liquids. Metal containers and portable tanks meeting the requirements of the Department of Transportation (DOT) (49 CFR 178) are deemed acceptable when containing products authorized by the DOT (49 CFR 173).





The latest version of NFPA 30, *Flammable and Combustible Liquids Code*, indicates that certain petroleum products may be safely stored within plastic containers if the terms and conditions of the following specifications are met:

- (a) ANSI/ASTM D 3435-80, *Plastic Containers (Jerry Cans) for Petroleum Products*.
- (b) ASTM F 852-86, *Standard for Portable Gasoline Containers for Consumer Use*.
- (c) ASTM F 976-86, *Standard for Portable Kerosine Containers for Consumer Use*.
- (d) ANSI/UL 1313-83, *Nonmetallic Safety Cans for Petroleum Products*.

This standard also requires portable tanks to have provision for emergency venting. Top-mounted emergency vents must be capable of limiting internal pressure under fire exposure conditions to 10 psig or 30 percent of the bursting pressure of the tank, whichever is greater. Portable tanks are also required to have at least one pressure-activated vent with a minimum capacity of 6,000 cubic feet of free air at 14.7 psia and 60°F. These vents must 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.

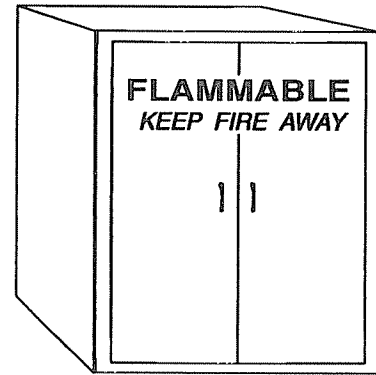
Maximum allowable sizes of various types of containers and portable tanks are specified based on the class of flammable and combustible liquid they contain.



Design, Construction and Capacity of Storage Cabinets

Not more than 60 gallons of Class I and/or Class II liquids, or not more than 120 gallons of Class III liquids may be stored in an individual cabinet.

This standard permits both metal and wooden storage cabinets. Storage cabinets shall be designed and constructed to limit the internal temperature to not more than 325°F when subjected to a standardized 10-minute fire test. All joints and seams shall remain tight and the door shall remain securely closed during the fire test. Storage cabinets shall be conspicuously labeled, "Flammable - Keep Fire Away."



The bottom, top, door, and sides of metal cabinets shall be at least No. 18 gage sheet metal and double walled with 1½-inch air space. 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.

Design and Construction of Inside Storage Rooms

Construction

Construction is to comply with the test specifications included in NFPA 251-1969, *Standard Methods of Fire Tests of Building Construction and Materials*.

Openings to other rooms or buildings shall be provided with non-combustible 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. This method may be preferred if there is an extensive need to transfer flammable liquids into and out of the room by means of hand trucks.



Rating and Capacity

Storage in inside storage rooms shall comply with the following:

STORAGE IN INSIDE ROOMS			
Fire Protection Provided ¹	Fire Resistance	Maximum Floor Area (ft ²)	Total Allowable Quantities (gal/ft ² floor area)
Yes	2 hr.	500	10
No	2 hr.	500	4
Yes	1 hr.	150	5
No	1 hr.	150	2

Wiring

Electrical wiring and equipment located in inside storage rooms used for Class I liquids shall be approved under Subpart S, Electrical, for Class I, Division 2 Hazardous Locations; for Class II and Class III liquids, shall be approved for general use.

Ventilation

Every inside storage room shall be provided with either a gravity or a mechanical exhaust ventilation system designed to provide for a complete change of air within the room at least six times per hour. Ventilation is vital to the prevention of flammable liquid fires and explosions. It is important to ensure that air flow through the system is constant and prevents the accumulation of any flammable vapors.

¹ Fire protection system shall be sprinkler, water spray, carbon dioxide, or other system.



Storage

In every inside storage room, there shall be maintained an aisle at least 3 feet wide. Easy movement within the room is necessary in order to reduce the potential for spilling or damaging the containers and to provide both access for fire fighting and a ready escape path for occupants of the room, should a fire occur.

Containers over 30 gallons capacity shall not be stacked one upon the other. Such containers are built to DOT specifications and are not required to withstand a drop test greater than 3 feet when full.

Dispensing shall be only by approved pump or self-closing faucet.

Storage Inside Building

Egress

Flammable or combustible liquids, including stock for sale, shall not be stored so as to limit use of exits, stairways, or areas normally used for the safe egress of people.

Office Occupancies

Storage shall be prohibited except that which is required for maintenance and operation of equipment. Such storage shall be kept in closed metal containers stored in a storage cabinet or in safety cans or in an inside storage room not having a door that opens into that portion of the building used by the public.

General Purpose Public Warehouses

There are tables in the standard summarizing the storage requirements applicable to "General Purpose Public Warehouses." These tables refer to indoor storage of flammable and combustible liquids which are confined in containers and portable tanks. Storage of incompatible materials that create a fire exposure (e.g., oxidizers, water-reactive chemicals, certain acids and other chemicals) is not permitted.



Warehouses or Storage Buildings

The last type of inside storage covered by this paragraph addresses storage in "warehouses or storage buildings." These structures are sometimes referred to as outside storage rooms. Practically any quantity of flammable and combustible liquid can be stored in these buildings provided that they are stored in a configuration consistent with the tables in this paragraph.

Containers in piles shall be separated by pallets or dunnage where necessary to provide stability and to prevent excessive stress on container walls.

Stored material shall not be piled within 3 feet of beams or girders and shall be at least 3 feet below sprinkler deflectors or discharge orifices of water spray, or other fire protection equipment.

Aisles of at least 3 feet in width shall be maintained to access doors, windows or standpipe connections.

Storage Outside Buildings

Requirements covering "storage outside buildings" are summarized in tables in this paragraph. Associated requirements are given for storage adjacent to buildings. Also included are requirements involving controls for diversion of spills away from buildings and security measures for protection against trespassing and tampering. Certain housekeeping requirements are given which relate to control of weeds, debris and accumulation of unnecessary combustibles.

Fire Control

Suitable fire control devices, such as small hose or portable fire extinguishers, shall be available at locations where flammable or combustible liquids are stored.

At least one portable fire extinguisher having a rating of not less than 12-B units shall be located:



- outside of, but not more than 10 feet from, the door opening into any room used for storage; and
- not less than 10 feet, nor more than 25 feet, from any Class I or Class II liquid storage area located outside of a storage room but inside a building.

The reason for requiring that portable fire extinguishers be located a distance away from the storage room is that fires involving Class I and Class II flammable liquids are likely to escalate rapidly. If the fire is too close to the storage area, it may be impossible to get to it once the fire has started.

Open flames and smoking shall not be permitted in flammable or combustible liquid storage areas.

Materials which react with water shall not be stored in the same room with flammable or combustible liquids. Many flammable and combustible liquid storage areas are protected by automatic sprinkler or water spray systems and hose lines. Consequently, any storage of water-reactive material in the storage area creates an unreasonable risk.

Industrial Plants

Scope

This paragraph applies to those industrial plants where:

- the use of flammable or combustible liquids is incidental to the principal business; or
- where flammable or combustible liquids are handled or used only in unit physical operations such as mixing, drying, evaporating, filtering,



distillation, and similar operations which do not involve chemical reaction.

This paragraph shall not apply to chemical plants, refineries or distilleries.

Incidental Storage or Use of Flammable or Combustible Liquids

Application

This subparagraph is applicable to those portions of an industrial plant where the use and handling of flammable or combustible liquids is only incidental to the principal business, such as paint thinner storage in an automobile assembly plant, solvents used in the construction of electronic equipment, and flammable finishing materials used in furniture manufacturing.

Containers

Flammable or combustible liquids shall be stored in tanks or closed containers.

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:

- 25 gallons of Class IA liquids in containers
- 120 gallons of Class IB, IC, II, or III liquids in containers
- 660 gallons of Class 1B, 1C, II, or III liquids in a single portable tank.

Handling Liquids at Point of Final Use

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

Where flammable or combustible liquids are used or handled, except in closed containers, means shall be provided to dispose promptly and safely of leakage



or spills.

Flammable or combustible liquids shall be drawn from or transferred into vessels, containers, or portable tanks within a building only in the following manner:

- (1) Through a closed piping system,
- (2) From safety cans,
- (3) By means of a device drawing through the top, or
- (4) From containers or portable tanks by gravity through an approved self-closing valve.

Transfer operations must be provided with adequate ventilation. Sources of ignition are not permitted in areas where flammable vapors may travel.

Transferring liquids by means of air pressure on the container or portable tanks is prohibited. This may result in an overpressure which could exceed what the container or tank could withstand. In addition, a flammable atmosphere could be created within the container or tank. This atmosphere would be particularly sensitive to ignition because of the increased pressure.

Unit Physical Operations

Application

This subparagraph applies to those portions of industrial plants where flammable or combustible liquids are handled or used in unit physical operations such as mixing, drying, evaporating, filtering, distillation, and similar operations which do not involve chemical change. Examples are plants compounding cosmetics, pharmaceuticals, solvents, cleaning fluids, insecticides, and similar types of activities.



Location

Industrial plants shall be located so that each building or unit of equipment is accessible from at least one side for fire fighting and fire control purposes.

Drainage

Emergency drainage systems shall be provided to direct flammable or combustible liquid leakage and fire protection water to a safe location.

Ventilation

The standard requires that adequate ventilation be provided in operating areas. Appropriate measures must be taken to trap and remove hazardous vapors.

Tank Vehicle and Tank Car Loading and Unloading

Tank vehicle and tank car loading or unloading facilities shall be separated from above-ground tanks, warehouses, and similar facilities by a distance of 25 feet for Class I liquids and 15 feet for Class II and Class III liquids measured from the nearest position of any fill stem.

Fire Control

These requirements basically state that hazards shall be evaluated and appropriate fire protection provided. Such an evaluation must consider the hazards of the operation, the various materials used, the design of the plant and equipment, materials handling and transfer requirements, any unusual conditions and the available fire protection sprinkler systems and other types of protective systems that may be necessary to protect employees.

Sources of Ignition

General

Adequate precautions shall be taken to prevent the ignition of flammable vapors. Sources of ignition include but are not limited to open flames; lightning; smoking; cutting and welding; hot surfaces; frictional heat; static, electrical, and mechanical sparks; spontaneous ignition, including heat-producing chemical



reactions; and radiant heat.

These are some examples of common ignition sources, although the list is neither all-inclusive nor applicable in all cases. Again, it is emphasized that control of ignition sources is the second line of defense; minimizing the possibility of a spill or leak is the primary objective of this regulation.

Bonding

Class I liquids shall not be dispensed into containers unless the nozzle and container are electrically interconnected.

Electrical

All electrical wiring and equipment shall be installed according to the requirements of Subpart S, Electrical.

Locations where flammable vapor-air mixtures may exist under normal operations shall be classified Class I, Division 1 according to the requirements of Subpart S. For those pieces of equipment installed in accordance with the above paragraphs on unit physical operations, the Division 1 area shall extend 5 feet in all directions from all points of vapor liberation. Unventilated pits within any Class I area are classified as Division 1 locations.

Locations where flammable vapor-air mixtures may exist under abnormal conditions and for a distance beyond Division 1 locations shall be classified Division 2 according to the requirements of Subpart S, Electrical. These locations include an area within 20 feet horizontally, 3 feet vertically beyond a Division 1 area, and up to 3 feet above floor or grade level within 25 feet, if indoors, or 10 feet if outdoors, from any pump, bleeder, withdrawal fitting, meter, or similar device handling Class I liquids. Adequately ventilated pits are Class I, Division 2 locations.



Repairs to Equipment

Hot work, such as welding or cutting operations, use of spark-producing power tools, and chipping operations shall be permitted only under supervision of an individual in responsible charge.

Housekeeping

Maintenance and operating practices shall follow established procedures that control leakage and prevent accidental escape of flammable or combustible liquids. Spills shall be cleaned up promptly.

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.

Bulk Plants

Storage

Class I liquids shall be stored in closed containers, or in storage tanks above ground outside of buildings, or underground in accordance with the requirements of this section.

Class II and III liquids shall be stored in containers, or in tanks within buildings or above ground outside of buildings, or underground in accordance with the requirements of this section.

Buildings

Rooms in which flammable or combustible liquids are stored or handled by pumps shall have exit facilities arranged to prevent occupants from being trapped in the event of fire.

Rooms in which Class I liquids are stored or handled shall be heated only by



means not constituting a source of ignition, such as steam or hot water.

Adequate ventilation shall be provided for all rooms, buildings, or enclosures in which Class I liquids are pumped or dispensed.

Loading and Unloading Facilities

Tank vehicle and tank car loading or unloading facilities shall be separated from above-ground tanks, warehouses, and similar facilities a distance of 25 feet for Class I liquids and 15 feet for Class II and Class III liquids measured from the nearest position of any fill spout. (Buildings for pumps or shelters for personnel may be considered as a part of the loading and unloading facilities).

Equipment such as piping, pumps, and meters used for the transfer of Class I liquids between storage tanks and the fill stem of the loading rack shall not be used for the transfer of Class II or Class III liquids.

Static Protection

Bonding facilities for protection against static sparks during the loading of tank vehicles through open domes shall be provided:

- (1) Where Class I liquids are loaded, or
- (2) Where Class II or Class III liquids are loaded into vehicles which may contain vapors from previous cargoes of Class I liquids.

The standard requires appropriate bonding equipment and procedures. Facilities for materials that do not have a static electricity hazard are not required to be bonded.

Container Filling Facilities

Class I liquids shall not be dispensed into containers unless the nozzle and container are electrically interconnected.



Electrical Equipment

This subparagraph applies to areas where Class I liquids are stored or handled. For areas where Class II or Class III liquids only are stored or handled, the electrical equipment may be installed in accordance with requirements for ordinary (non-hazardous) locations.

Classification of electrical equipment hazardous areas is given in a table referenced in this subparagraph.

Sources of Ignition

Class I liquids shall not be handled, drawn, or dispensed where flammable vapors may reach a source of ignition.

Smoking shall be prohibited except in designated locations. "No Smoking" signs shall be conspicuously posted where hazard from flammable liquid vapors is normally present.

Drainage and Waste Disposal

Provision shall be made to prevent flammable or combustible liquids which may be spilled at loading or unloading points from entering public sewers and drainage systems, or natural waterways. Connection to such sewers, drains, or waterways by which flammable or combustible liquids might enter shall be provided with separator boxes or other approved means whereby such entry is precluded. Crankcase drainings and flammable or combustible liquids shall not be dumped into sewers, but shall be stored in tanks or tight drums outside of any building until removed from the premises.

Fire Control

Suitable fire-control devices, such as small hose or portable fire extinguishers, shall be available to locations where fires are likely to occur.



Service Stations

Liquids shall be stored in approved closed containers not exceeding 60 gallons capacity, in underground tanks, or in tanks in special enclosures or aboveground as provided for in this section (Service Stations).

No Class I liquids may be dispensed into portable containers unless the metal container has a tight closure with screwed or spring cover, and is fitted with a spout or so designed that the contents can be poured without spilling.

A clearly identified and easily accessible switch(es) or a circuit breaker(s) shall be provided at a location remote from dispensing devices, including remote pumping systems, to shut off the power to all dispensing devices in the event of an emergency.

Processing Plants

Scope

This paragraph applies to those plants or buildings which contain chemical operations such as oxidation, reduction, halogenation, hydrogenation, alkylation, polymerization, and other chemical processes but does not apply to chemical plants, refineries or distilleries.

Processing Building

This section requires that appropriate facilities be provided for flammable and combustible liquid processing within buildings. Buildings must be safely constructed with appropriate drainage, ventilation and explosion relief.

Emergency drainage systems shall be provided to direct flammable or combustible liquid leakage and fire protection water to a safe location. If connected to public sewers or discharged into public waterways, these systems



shall be equipped with traps or separators.

Liquid Handling

The storage of flammable or combustible liquids in tanks shall be in accordance with the provisions of this section (Processing Plants). Piping must be identified and meet safety requirements.

The transfer of large quantities of flammable or combustible liquids shall be through piping by means of pumps or water displacement. Except as required in process equipment, gravity flow shall not be used. The use of compressed air as a transferring medium is prohibited. Equipment must be designed to assure containment. Where the vapor space is usually within the flammable range or other operational hazards indicate a need, equipment must be protected against explosion by construction or other appropriate measures.

Fire Control

Fire control provisions, including portable extinguishers, water supply, fixed extinguishing systems, and alarm systems shall be provided. An analysis similar to that required for plants having unit physical operations must be performed. Appropriate fire control facilities must be provided as indicated by the special hazards of the plant.

Sources of Ignition

As in other paragraphs of this section, sources of ignition shall be prevented from igniting flammable vapors.

Waste and Residues

Combustible waste material and residues in a building or operating area shall be kept to a minimum, stored in closed metal waste cans, and disposed of daily.



Refineries, Chemical Plants, and Distilleries

General

Plants must be protected from catastrophic fire, explosion and/or release of toxic materials. Refer to 29 CFR 1910.119, *Process Safety Management of Highly Hazardous Chemicals*, which requires programmatic control regarding these hazards. Recognized safe-practice documents from the affected industries identify necessary controls.

Storage Tanks

Flammable and combustible liquids shall be stored in tanks, in containers, or in portable tanks in accordance with requirements of this section (Refineries, Chemical Plants, and Distilleries).

Wharves

Wharves handling flammable or combustible liquids shall be in accordance with requirements of this section.

Location of Process Units

Process units shall be located so that they are accessible from at least one side for the purpose of fire control.

Fire Control

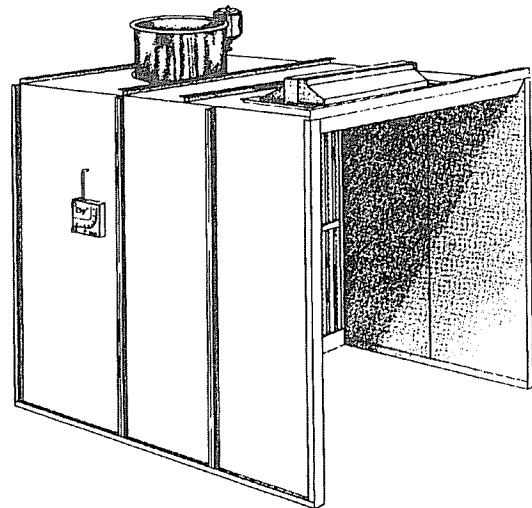
Fire control provisions, including portable fire extinguishers, water supply, and fixed extinguishing systems shall be provided.



SPRAY FINISHING USING FLAMMABLE AND COMBUSTIBLE MATERIALS - 1910.107

Background

This regulation is based on the National Fire Protection Association's standard NFPA 33, *Spray Finishing Using Flammable and Combustible Materials*, 1969 edition. Many technological changes have occurred in the field of spray finishing since this edition was published. The current edition of NFPA 33 is entitled *Spray Application Using Flammable and Combustible Materials* to recognize the hazards inherent to operations such as spray-up molding (e.g., fiberglass).



Scope

This section applies to flammable and combustible finishing materials when applied as a spray by compressed air, "airless" or "hydraulic atomization," steam, electrostatic methods, or by any other means in continuous or intermittent processes. This section also covers the application of combustible powders by powder spray guns, electrostatic powder spray guns, fluidized beds, or electrostatic fluidized beds. This section does not apply to outdoor spray application of buildings, tanks, or other similar structures, nor to small portable spraying apparatus not used repeatedly in the same location. In these situations, there would be lesser chance of combustible residue buildup and greater chance of atmospheric dilution of flammable vapors.

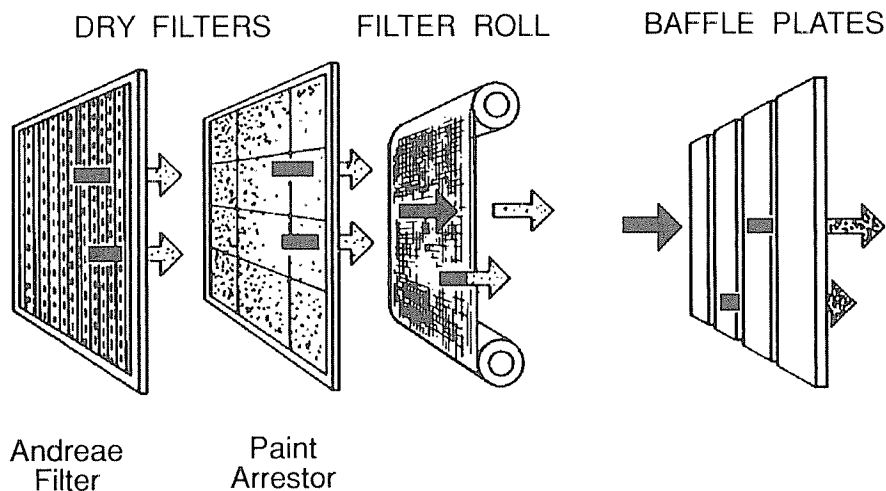


Definitions

Authority Having Jurisdiction. As defined in NFPA 33, the organization, office, or individual responsible for "approving" equipment, an installation or a procedure. Where public safety is primary, the "authority having jurisdiction" may be a federal, state, local or other regional department or individual such as a fire chief, fire marshall, chief of a fire prevention bureau, labor department, health department, building official, electrical inspector, or others having statutory authority.

Dry Spray Booth. A spray booth not equipped with a water washing system.

A dry spray booth may be equipped with (1) distribution or baffle plates to promote an even flow of air through the booth or cause deposit of overspray before it enters exhaust ducts; or (2) overspray dry filters to minimize dusts or residues entering exhaust ducts; or (3) overspray dry filter rolls designed to minimize dusts or residues entering exhaust ducts; or (4) where dry powders are being sprayed, with powder collection systems so arranged in the exhaust to capture oversprayed material. Some examples of filter types are shown below.





Spray Area. Any area in which dangerous quantities of flammable vapors or mists, or combustible residues, dusts, or deposits are present due to the operation of spraying processes.

The current edition of NFPA 33 offers greater insight into the meaning of the spray area. According to this document, a spray area shall include:

- (a) The interior of spray booths or rooms.
- (b) The interior of ducts exhausting from spraying processes.
- (c) Any area in the direct path of spraying operations.

The authority having jurisdiction may, for the purpose of this standard, define the limits of the spray area in any specific case. When spraying operations are strictly confined to predetermined spaces which are provided with adequate and reliable ventilation, such as a properly constructed spray booth, the "spray area" will ordinarily not extend beyond the booth enclosure. When, however, the spray operations are not confined to adequately ventilated spaces, the "spray area" may extend throughout the entire room containing spraying operations.

The implications of the above definition are as follows. A spray area is, by definition, a Class I, Division 1 hazardous location. As discussed later in this section, electrical devices and wiring within the spray area must comply with Subpart S, Electrical. The authority having jurisdiction may define the entire room to be a spray area if operations are not confined. Installation of expensive electrical devices and wiring would then be required throughout the entire room.



It is therefore in the employer's interest to conduct spray operations in a spray booth or room in order to confine the vapors, mist and residue and limit the area requiring use of Class I, Division 1 electrical equipment. Confining spray operations to a spray booth or room also increases the safety of the operation, facilitates maintenance and clean up, and provides a healthier working environment. The employer may also enjoy consideration for preferred insurance rates.

Spray Room. A power-ventilated fully enclosed room used exclusively for open spraying of flammable or combustible materials. The entire spray room is a spray area. A spray booth is not a spray room.

Spray Booths

Construction

Spray booths shall be substantially constructed of steel, securely and rigidly supported, or of concrete or masonry except that aluminum or other substantial non-combustible material may be used for intermittent or low volume spraying. Spray booths shall be designed to sweep air currents toward the exhaust outlet.

Interiors

The interior surfaces of spray booths shall be smooth and continuous without edges and otherwise designed to prevent pocketing of residues and facilitate cleaning and washing without injury.

Floors

The floor surface of a spray booth and operator's working area, if combustible, shall be covered with non-combustible material of such character as to facilitate the safe cleaning and removal of residues.



Distribution or Baffle Plates

Distribution or baffle plates, if installed to promote an even flow of air through the booth or cause the deposit of overspray before it enters the exhaust duct, shall be of non-combustible material and readily removable or accessible on both sides for cleaning. Such plates shall not be located in exhaust ducts.

Dry-Type Overspray Collectors

In conventional dry type spray booths, overspray dry filters or filter rolls, if installed, shall conform to the following:

- (1) The spraying operations except electrostatic spraying operations shall be so designed, installed and maintained that the average air velocity over the open face of the booth (or booth cross section during spraying operations) shall be not less than 100 linear feet per minute (fpm). Electrostatic spraying operations may be conducted with an air velocity over the open face of the booth of not less than 60 fpm.

The above requirements were taken from NFPA 33-1969 and pertain to those hazards associated with fire protection or the removal of flammable vapor accumulation from the interior of the booth during spraying operations. These requirements apply to maintaining the concentration of flammable vapors below the lower explosive limit (LEL) in a spray booth but do not apply to maintaining operator exposure to within the permissible exposure limits (PELs). Where a health hazard has been established, controls and modifications may be required and could include increasing the air velocity beyond that stated above.



- (2) Visible gauges or audible alarms or pressure-activated devices shall be installed to indicate or insure that the required air velocity is maintained. Filter rolls shall be inspected to insure proper replacement of filter media.
- (3) All discarded filter pads and filter rolls shall be immediately removed to a safe, well-detached location or placed in a water-filled metal container and disposed of at the close of the day's operation unless maintained completely in water.
- (4) Space within the spray booth on the downstream and upstream sides of filters shall be protected with an automatic sprinkler, dry chemical, or carbon dioxide extinguishing system.
- (5) Filters or filter rolls shall not be used when applying a spray material known to be highly susceptible to spontaneous heating and ignition.
- (6) Clean filters or filter rolls shall be non-combustible or a type having a combustibility not in excess of class 2 filters as listed by Underwriter's Laboratories, Inc.
- (7) Filters and filter rolls shall not be alternately used for different types of coating materials, where the combination of materials may be conducive to spontaneous ignition.

Frontal Area

Each spray booth having a frontal area larger than 9 square feet shall have a metal deflector or curtain not less than 2½ inches deep installed at the upper outer edge of the booth over the opening.

Conveyors

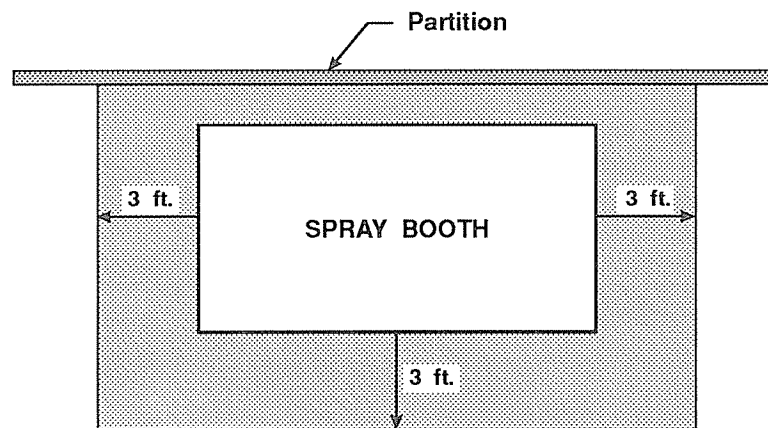
Where conveyors are arranged to carry work into and out of spray booths, the



conveyor openings shall be as small as practical.

Separation of Operations

Each spray booth shall be separated from other operations by not less than 3 feet, or by a greater distance, or by such partition or wall as to reduce the danger from juxtaposition of hazardous operations. This is illustrated in the figure below.



Cleaning

Spray booths shall be so installed that all portions are readily accessible for cleaning. A clear space of not less than 3 feet on all sides shall be kept free from storage or combustible construction.

Illumination

When spraying areas are illuminated through glass panels or other transparent materials, only fixed lighting units shall be used as a source of illumination. Panels shall effectively isolate the spraying area from the area in which the lighting unit is located, and shall be of a noncombustible material of such a nature or so protected that breakage will be unlikely. Panels shall be so arranged that normal accumulations of residue on the exposed surface of the



panel will not be raised to a dangerous temperature by radiation or conduction from the source of illumination.

Electrical and Other Sources of Ignition

Minimum Separation

There shall be no open flame or spark producing equipment in any spraying area nor within 20 feet thereof, unless separated by a partition.

Hot Surfaces

Space-heating appliances, steam pipes, or hot surfaces shall not be located in a spraying area where deposits of combustible residues may readily accumulate.

Wiring Conformance

Electrical wiring and equipment shall conform to the provisions of this section and shall otherwise be in accordance with Subpart S, Electrical.

Combustible Residues, Areas

Unless specifically approved for locations containing *both* deposits of readily ignitable residue and explosive vapors, there shall be no electrical equipment in any spraying area, whereon deposits of combustible residue may readily accumulate, except wiring in rigid conduit or in boxes or fittings containing no taps, splices, or terminal connections.

Wiring Type Approved

Electrical wiring and equipment not subject to deposits of combustible residues but located in a spraying area as herein defined shall be of explosion-proof type approved for Class I, Group D locations and shall otherwise conform to the provisions of Subpart S, Electrical, for Class I, Division 1, Hazardous Locations. Electrical wiring, motors, and other equipment outside of but within twenty (20) feet of any spraying area, and not separated therefrom by partitions, shall not



produce sparks under normal operating conditions and shall otherwise conform to the provisions of Subpart S, Electrical, for Class I, Division 2 Hazardous Locations.

The above definition of Division 2, Hazardous Locations, i.e., "outside of but within 20 feet of any spraying area, and not separated therefrom by partitions," was taken from the 1968 edition of NFPA 70, *National Electric Code* (NEC).

The current edition of the NEC is more specific in defining the extent of Class I or Class II, Division 1 and Division 2 locations for spraying operations using flammable and combustible materials. The current definitions are briefly summarized below.

Class I or Class II, Division 1 Locations

- (1) The interiors of spray booths or rooms.
- (2) The interior of exhaust ducts.
- (3) Any area in the direct path of spray operations.

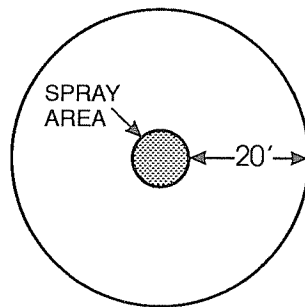
Class I or Class II, Division 2 Locations

The following spaces shall be considered Class I or Class II, Division 2 as applicable.

- (1) For open spraying, all space outside of but within 20 feet horizontally and 10 feet vertically of the Class I, Division 1 location and not separated from it by partitions. This is illustrated in the figure below.

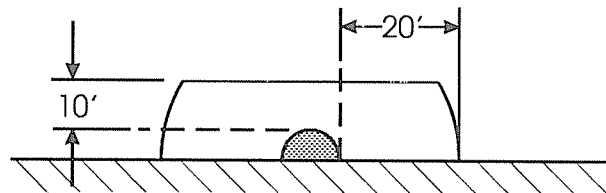


CLASS I OR CLASS II, DIVISION 2 LOCATIONS ADJACENT TO AN UNENCLOSED SPRAY OPERATION



TOP
(PLAN)

- Class I or Class II, Division 1
- Class I or Class II, Division 2



FRONT
(ELEVATION)



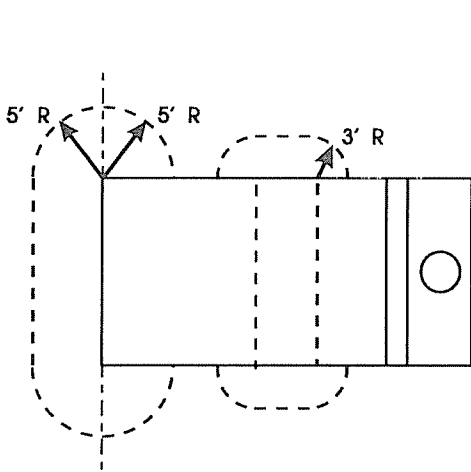
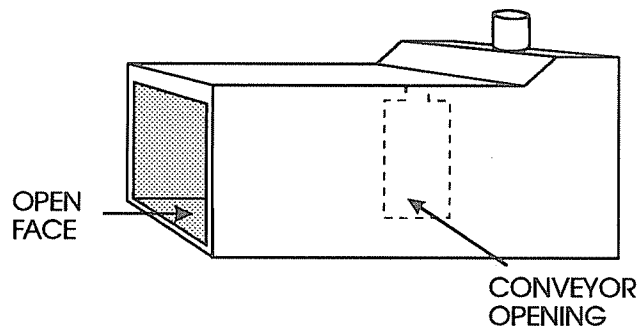
- (2) For spraying operations conducted within a closed top, open face or front spray booth, the space within 3 feet in all directions from openings other than the open face or front.

The Class I or Class II, Division 2 location shown in the figure below shall extend from the open face or front of the spray booth in accordance with the following:

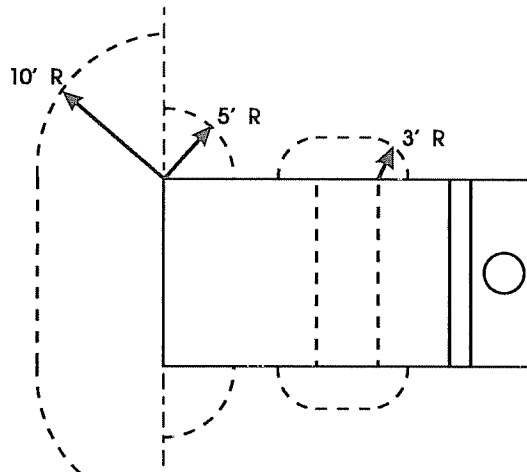
- If the ventilation system is interlocked with the spraying equipment so as to make the spraying equipment inoperable when the ventilation system is not in operation, the space shall extend 5 feet from the open face or front of the spray booth, and as otherwise shown in Figure "A" below.
- If the ventilation system is not interlocked with the spraying equipment so as to make the spraying equipment inoperable when the ventilation system is not in operation, the space shall extend 10 feet from the open face or front of the spray booth, and as otherwise shown in Figure "B" below.



CLASS I OR CLASS II, DIVISION 2 LOCATIONS ADJACENT TO A CLOSED TOP, OPEN FACED OR OPEN FRONT SPRAY BOOTH



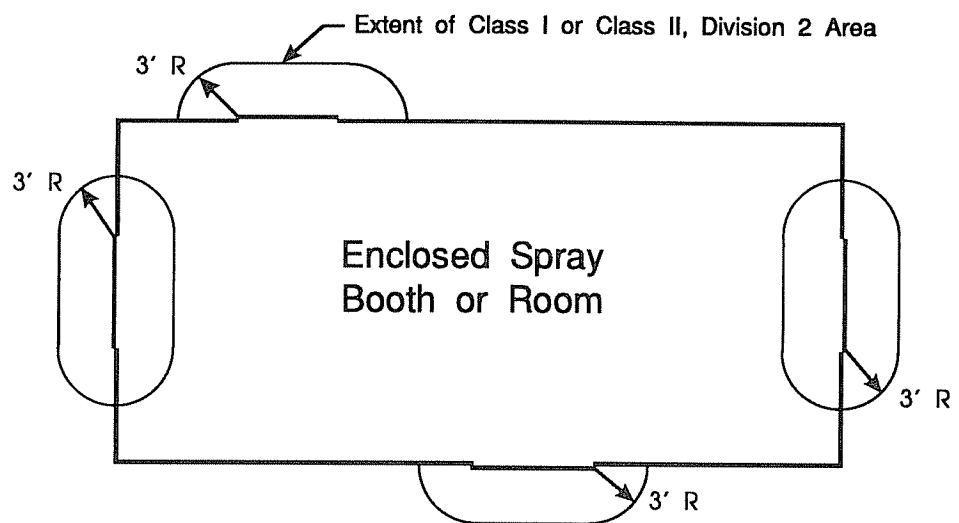
"A"
Ventilation Interlocked



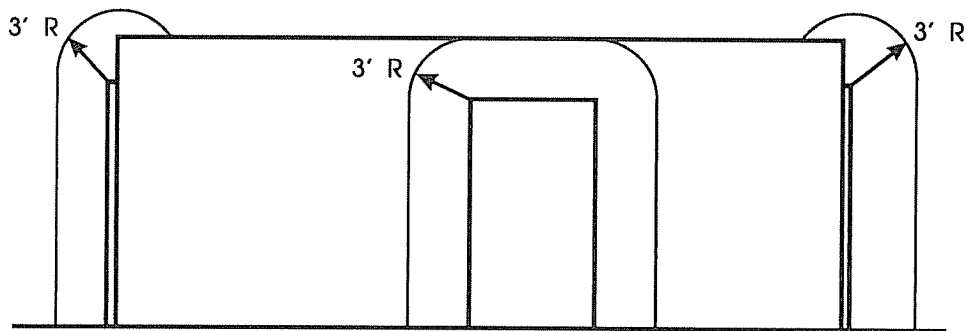
"B"
Ventilation Not Interlocked



- (3) For spraying operations confined to an enclosed spray booth or room, the space within 3 feet in all directions from any openings shall be considered Class I or Class II, Division 2 as shown in the figure below.



Top
(Plan)



Front
(Elevation)



Lamps

Electric lamps outside of, but within twenty (20) feet of any spraying area, and not separated therefrom by a partition, shall be totally enclosed to prevent the falling of hot particles and shall be protected from mechanical injury by suitable guards or by location.

Portable Lamps

Portable electric lamps shall not be used in any spraying area during spraying operations. Portable electric lamps, if used during cleaning or repairing operations, shall be of the type approved for hazardous Class I locations.

Grounding

All metal parts of spray booths, exhaust ducts, and piping systems conveying flammable or combustible liquids or aerated solids shall be properly electrically grounded in an effective and permanent manner.

Ventilation

General

All spraying areas shall be provided with mechanical ventilation adequate to remove flammable vapors, mists, or powders to a safe location and to confine and control combustible residues so that life is not endangered. Mechanical ventilation shall be kept in operation at all times while spraying operations are being conducted and for a sufficient time thereafter to allow vapors from drying coated articles and drying finishing material residue to be exhausted.

Independent Exhaust

Each spray booth shall have an independent exhaust duct system discharging to the exterior of the building, except that multiple cabinet spray booths in which identical spray finishing material is used with a combined frontal area of not more than 18 square feet may have a common exhaust. If more than one



fan serves one booth, all fans shall be so interconnected that one fan cannot operate without all fans being operated.

Fan-rotating Element

The fan-rotating element shall be non-ferrous or non-sparking or the casing shall consist of or be lined with such material.

Electric Motors

Electric motors driving exhaust fans shall not be placed inside booths or ducts.

Belts

Belts shall not enter the duct or booth unless the belt and pulley within the duct or booth are thoroughly enclosed.

Exhaust Ducts

Exhaust ducts shall be constructed of steel and shall be substantially supported. Exhaust ducts without dampers are preferred; however, if dampers are installed, they shall be maintained so that they will be in a full-open position at all times the ventilating system is in operation.

Discharge Clearance

Unless the spray booth exhaust duct terminal is from a water-wash spray booth, the terminal discharge point shall be not less than 6 feet from any combustible exterior wall or roof nor discharge in the direction of any combustible construction or unprotected opening in any non-combustible exterior wall within 25 feet.

Air Exhaust

Air exhaust from spray operations shall not be directed so that it will contaminate makeup air being introduced into the spraying area or other ventilating intakes. Air exhausted from spray operations shall not be recirculated.



Access Doors

When necessary to facilitate cleaning, exhaust ducts shall be provided with an ample number of access doors.

Drying Spaces

Freshly sprayed articles shall be dried only in spaces provided with adequate ventilation to prevent the formation of explosive vapors. In the event adequate and reliable ventilation is not provided, such drying spaces shall be considered a spraying area.

Flammable and Combustible Liquids - Storage and Handling

Conformance

The storage of flammable or combustible liquids in connection with spraying operations shall conform to the requirements of § 1910.106, where applicable.

Quantity

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.

Containers

Original closed containers, approved portable tanks, approved safety cans or a properly arranged system of piping shall be used for bringing flammable or combustible liquids into spray finishing rooms. Open or glass containers shall not be used.

Transferring Liquids

Except as discussed in the next paragraph, "Spraying Containers," the withdrawal of flammable and combustible liquids from containers having a capacity of greater than 60 gallons shall be by approved pumps. The



withdrawal of flammable or combustible liquids from containers and the filling of containers, including portable mixing tanks, shall be done only in a suitable mixing room or in a spraying area when the ventilating system is in operation. Adequate precautions shall be taken to protect against liquid spillage and sources of ignition.

Spraying Containers

Containers supplying spray nozzles shall be of closed type or provided with metal covers kept closed.

Containers supplying spray nozzles by gravity flow shall not exceed 10 gallons capacity.

Original shipping containers shall not be subject to air pressure for supplying air nozzles. Containers under air pressure supplying spray nozzles shall be of limited capacity, not exceeding that necessary for 1 day's operation; shall be designed and approved for such use; shall be provided with a visible pressure gage; and shall be provided with a relief valve; all in conformance with the *ASME Code for Unfired Pressure Vessels*. Containers under pressure supplying spray nozzles, air storage tanks and coolers shall conform to the standards of the *ASME Code for Unfired Pressure Vessels* for construction, tests and maintenance.

Pipes and Hoses

All containers or piping to which is attached a hose or flexible connection shall be provided with a shutoff valve at the connection. Such valves shall be kept shut when spraying operations are not being conducted.

When a pump is used to deliver products, automatic means shall be provided to prevent pressure in excess of the design working pressure of accessories, piping, and hose.

All pressure hose and couplings shall be inspected at regular intervals



appropriate to this service. The hose and couplings shall be tested with the hose extended, and using the "in-service maximum operating pressures." Any hose showing material deteriorations, signs of leakage, or weakness in its carcass or at the couplings, shall be withdrawn from service and repaired or discarded.

Piping systems conveying flammable or combustible liquids shall be of steel or other material having comparable properties of resistance to heat and physical damage. Piping systems shall be properly bonded and grounded.

Spray Liquid Heaters

Electrical powered spray liquid heaters shall be approved and listed for the specific location in which used. Heaters shall not be located in spray booths nor other locations subject to the accumulation of deposits or combustible residue.

Pump Relief

If flammable or combustible liquids are supplied to spray nozzles by positive displacement pumps, means shall be provided to prevent the discharge pressure exceeding the safe operating pressure of the system. Any discharge shall be to a safe location.

Grounding

Whenever flammable or combustible liquids are transferred from one container to another, both containers shall be effectively bonded and grounded to prevent discharge sparks of static electricity.

Protection

Conformance

In sprinklered buildings, the automatic sprinkler system in rooms containing spray finishing operations shall conform to the requirements of § 1910.159. In unsprinklered buildings where sprinklers are installed only to protect spraying



areas, the installation shall conform to such standards insofar as they are applicable. Sprinkler heads shall be located so as to provide water distribution throughout the entire booth.

Valve Access

Automatic sprinklers protecting each spray booth (together with its connecting exhaust) shall be under an accessibly located separate outside stem and yoke (OS&Y) subcontrol valve.

Cleaning of Heads

Sprinklers protecting spraying areas shall be kept as free from deposits as practical by cleaning daily if necessary.

Portable Extinguishers

An adequate supply of suitable portable fire extinguishers shall be installed near all spraying areas.

Operations and Maintenance

Spraying

Spraying shall not be conducted outside of predetermined spraying areas.

Cleaning

All spraying areas shall be kept as free from the accumulation of deposits of combustible residues as practical, with cleaning conducted daily if necessary. Scrapers, spuds, or other such tools used for cleaning purposes shall be of non-sparking material.

Residue Disposal

Residue scrapings and debris contaminated with residue shall be immediately removed from the premises and properly disposed of. Approved metal waste



cans shall be provided wherever rags or waste are impregnated with finishing material and all such rags or waste deposited therein immediately after use. The contents of waste cans shall be properly disposed of at least once daily or at the end of each shift.

Clothing Storage

Spray finishing employees' clothing shall not be left on the premises overnight unless kept in metal lockers.

Cleaning Solvents

The use of solvents for cleaning operations shall be restricted to those having flash points not less than 100°F; however, for cleaning spray nozzles and auxiliary equipment, solvents having flash points not less than those normally used in spray operations may be used. Such cleaning shall be conducted inside spray booths and ventilating equipment operated during cleaning.

Hazardous Materials Combinations

Spray booths shall not be alternately used for different types of coating materials, where the combination of the materials may be conducive to spontaneous ignition, unless all deposits of the first used material are removed from the booth and exhaust ducts prior to spraying with the second used material. Examples of dangerous combinations are:

- Deposits of lacquers containing nitrocellulose combined with finishes containing drying oils, such as varnishes, oil-based stains, air-drying enamels, and primers.
- Bleaching compounds based on hydrogen peroxide, hypochlorites, perchlorates, or other oxidizing compounds combined with any organic finishing materials.



"No Smoking" Signs

"No Smoking" signs in large letters on contrasting color background shall be conspicuously posted at all spraying areas and paint storage rooms.

Fixed Electrostatic Apparatus

Location

Transformers, power packs, control apparatus, and all other electrical portions of the equipment, with the exception of high-voltage grids, electrodes, and electrostatic atomizing heads and their connections, shall be located outside of the spraying area, or shall otherwise conform to the requirements for electrical contained earlier in this section.

Insulators, Grounding

High-voltage leads to electrodes shall be properly insulated and protected from mechanical injury or exposure to destructive chemicals. Electrostatic atomizing heads shall be effectively and permanently supported on suitable insulators and shall be effectively guarded against accidental contact or grounding. An automatic means shall be provided for grounding the electrode system when it is electrically de-energized for any reason. All insulators shall be kept clean and dry.

Safe Distance

A safe distance shall be maintained between goods being painted and electrodes or electrostatic atomizing heads or conductors of at least twice the sparking distance. A suitable sign indicating this safe distance shall be conspicuously posted near the assembly.

Conveyors Required

Goods being painted using this process are to be supported on conveyors. The conveyors shall be so arranged as to maintain safe distances between the goods



and the electrodes or electrostatic atomizing heads at all times.

Fail-safe Controls

Electrostatic apparatus shall be equipped with automatic controls which will operate without time delay to disconnect the power supply to the high voltage transformer and to signal the operator under any of the following conditions:

- Stoppage of ventilating fans or failure of ventilating equipment from any cause.
- Stoppage of the conveyor carrying goods through the high voltage field.
- Occurrence of a ground or of an imminent ground at any point on the high voltage system.
- Reduction of clearance below that specified in "Safe Distance" above.

Guarding

Adequate booths, fencing, railings, or guards shall be so placed about the equipment that they, either by their location or character or both, assure that a safe isolation of the process is maintained from plant storage or personnel. Such railings, fencing, and guards shall be of conducting material, adequately grounded.

Ventilation

Where electrostatic atomization is used, the spraying area shall be so ventilated as to insure safe conditions from a fire and health standpoint.

Fire Protection

All areas used for spraying, including the interior of the booth, shall be protected by automatic sprinklers where this protection is available. Where this protection is not available, other approved automatic extinguishing equipment



shall be provided.

Electrostatic Hand Spraying Equipment

Application

This paragraph shall apply to any equipment using electrostatically charged elements for the atomization and/or, precipitation of materials for coatings on articles, or for other similar purposes in which the atomizing device is hand held and manipulated during the spraying operation.

Spray Gun Ground

The handle of the spraying gun shall be electrically connected to ground by a metallic connection and to be so constructed that the operator in normal operating position is in intimate electrical contact with the grounded handle.

Grounding - General

All electrically conductive objects in the spraying area shall be adequately grounded. This requirement shall apply to paint containers, wash cans, and any other objects or devices in the area. The equipment shall carry a prominent permanently installed warning regarding the necessity for this grounding feature.

Maintenance of Grounds

Objects being painted or coated shall be maintained in metallic contact with the conveyor or other grounded support. Hooks shall be regularly cleaned to insure this contact and areas of contact shall be sharp points or knife edges where possible. Points of support of the object shall be concealed from random spray where feasible and where the objects being sprayed are supported from a conveyor, the point of attachment to the conveyor shall be so located as to not collect spray material during normal operation.



Interlocks

The electrical equipment shall be so interlocked with the ventilation of the spraying area that the equipment cannot be operated unless the ventilation fans are in operation.

Ventilation

The spraying operation shall take place within a spray area which is adequately ventilated to remove solvent vapors released from the operation.

Drying, Curing, or Fusion Apparatus

Conformance

This standard adopts the provisions of NFPA 86A-1969, *Standard for Ovens and Furnaces*, by reference where process ovens and similar items are used in connection with spray finishing. To prevent oven explosions, the work space must be pre-ventilated before starting the oven. A safe atmosphere must be maintained at any source of ignition. In addition, the heating system must shut down in the event of a failure of the ventilation system.

Alternate Use Prohibited

Spray booths, rooms, or other enclosures used for spraying operations shall not alternately be used for the purpose of drying by any arrangement which will cause a material increase in the surface temperature of the spray booth, room, or enclosure.

Alternate Use Permitted

Automobile refinishing spray booths or enclosures, otherwise installed and maintained in full conformity with this section, may alternately be used for drying with portable electrical infrared drying apparatus when conforming with the following:



- (1) Interior (especially floors) of spray enclosures shall be kept free of overspray deposits.
- (2) During spray operations, the drying apparatus and electrical connections and wiring thereto shall not be located within spray enclosures nor in any other location where spray residues may be deposited thereon.
- (3) The spraying apparatus, the drying apparatus, and the ventilating system of the spray enclosure shall be equipped with suitable interlocks so arranged that:
 - The spraying apparatus cannot be operated while the drying apparatus is inside the spray enclosure.
 - The spray enclosure will be purged of spray vapors for a period of not less than 3 minutes before the drying apparatus can be energized.
 - The ventilating system will maintain a safe atmosphere within the enclosure during the drying process and the drying apparatus will automatically shut off in the event of failure of the ventilating system.
- (4) All electrical wiring and equipment of the drying apparatus shall conform with the applicable sections of Subpart S, Electrical.
- (5) The drying apparatus shall contain a prominently located, permanently attached warning sign indicating that ventilation should be maintained during the drying period and that spraying should not be conducted in the vicinity that spray will deposit on apparatus.



Powder Coating

This finishing process is increasing in industrial importance. It generally invokes application of plastic particles to pre-warmed parts. The coating is then fused in place by heating the part in an oven. Electrostatic forces are frequently used to apply the coating.

Electrical and Other Sources of Ignition

Powder coating operations must conform to the general spray finishing requirements which provide protection against open flames, spark producing equipment and hot surfaces. Wiring must conform to OSHA electrical requirements for Class II hazardous locations regarding combustible dusts. Powder coating equipment and booths must be grounded. Portable lamps may not be used during spraying operations. Only approved portable lamps may be used during cleaning and repair.

Ventilation

This standard requires appropriate exhaust ventilation. Powders must be safely removed to recovery equipment and must not be released to the outside atmosphere.

Drying, Curing, or Fusion Equipment

NFPA 86A-1969 is adopted by reference to safeguard fusion ovens. See description above regarding such ovens.

Operation and Maintenance

Accumulations of combustible dusts must be prevented on ledges and similar surfaces. Good housekeeping must be practiced and hazardous dust clouds must not be created during cleaning operations.



Electrostatics

The use of electrostatic energy to apply powder must not create an ignition hazard. The controls for electrostatic application of liquid droplets also apply to powders. In addition, the standard requires that equipment be maintained at less than 150°F. (Note that warmed parts are often coated). There are specific requirements to prevent spark ignition of powder and to provide appropriate bonding and grounding.

Organic Peroxides and Dual Component Coatings

General

The organic peroxides are a group of chemicals in the high hazard class which have become increasingly useful as chain reaction initiators or catalysts in the manufacture of plastics and other materials. These chemicals which were formerly consumed by chemical process industries in limited quantities are now being stored in greater volume and processed in more dangerous concentrations in a wider variety of industries. A number of fires and explosions have been attributed to these chemicals.

The rapidly expanding reinforced plastics manufacturing industry is one of the larger consumers of organic peroxides. The plastic is frequently applied to the reinforcing material by spraying automatically proportioned mixtures of a resin monomer and an organic peroxide catalyst.

The organic peroxides are marketed in a large number of commercial peroxide preparations and in the form of solids, liquids and pastes. Some of the materials are diluted in order to decrease their hazard potential. The most widely used peroxides are benzoyl peroxide and methyl ethyl ketone (MEK) peroxide. These per-oxygen materials contain a large amount of active oxygen and this is an important factor in determining hazard characteristics as it supports combustion even though air is excluded. Organic peroxides burn much more rapidly than



ordinary flammable liquids or combustible solids.

Conformance

All spraying operations involving the use of organic peroxides and other dual component coatings shall be conducted in approved sprinklered spray booths meeting the requirements of this section.

Smoking

Smoking shall be prohibited and "No Smoking" signs shall be prominently displayed and only non-sparking tools shall be used in any area where organic peroxides are stored, mixed, or applied.

NOTE:

The use of organic peroxides and monomers in spray finishing involves possible hazardous chemical reactions. Reference should be made to various industry recognized documents which address control methods relating to these processes and materials. The following are examples of relevant standards and guidance documents in this area:

NFPA 43A, *Liquid, Solid Oxidizing Materials*

NFPA 43B, *Organic Peroxide Formulations*

NFPA 49, *Hazardous Chemicals Data*