



PROPOSED CHAPTER 133,
FLAMMABLE AND COMBUSTIBLE LIQUIDS
OF TITLE 12 N.J.A.C.,

(Formerly known as Proposed Safety Regulation No. 51)

DO NOT CIRCULATE

STATE OF NEW JERSEY
DEPARTMENT OF LABOR AND INDUSTRY. *Div. of Labor.*
BUREAU OF ENGINEERING AND SAFETY,
TRENTON, NEW JERSEY

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FOREWORD

This regulation is promulgated to establish reasonable standards for the storage, handling or use of flammable and combustible liquids.

Flammable and combustible liquids continue to represent a substantial hazard in the protection of life and property. In a recent study, it was revealed that flammable and combustible liquid fires represented the 5th highest in frequency of all materials involved in fire. On a property loss basis of dollars and cents, flammable and combustible liquids ranked second highest.

The immense strides made in the chemical industry and petroleum industry places the flammable or combustible liquid in the forefront as a product or raw material. It follows that these products or raw materials find their way into places of employment. Therefore, this regulation is promulgated to safeguard the worker and the place in which he works.

This Regulation is promulgated by the Commissioner of Labor and Industry of the State of New Jersey under authority vested in him by Section 9 of the Worker Health and Safety Act, P.L. 1965, c.154, N.J.S.A. 34:6A as follows:

The Commissioner shall make and promulgate rules and regulations reasonably necessary to implement the purposes of this act. Such rules and regulations shall have the force and effect of law and shall be enforced in the manner provided in this act.....

The same statute provides authority for the Commissioner to grant exceptions from the requirements of rules and regulations in accordance with Section 23 as follows:

The Commissioner shall have the power and authority to grant exceptions from the literal requirements of rules and regulations promulgated under this act. Such exception shall be granted in any particular case only where it is clearly evident that it is necessary to prevent undue hardship or where existing conditions prevent compliance. In no case shall any exception be granted unless in the opinion of the Commissioner reasonable protection of the health and safety of workers and the public will be maintained hereby. An application for an exception shall be filed in writing with the Commissioner, setting forth specifically the requirements of the rules and regulations from which an exception is desired and the reason why enforcement of the applicable provisions of the rules and regulations is unreasonable. The Commissioner shall grant or deny the exception within 30 days from the date of receipt by him of the application. The Commissioner shall maintain a record of all exceptions granted and shall make such record reasonably available for public examination and shall mail a copy of all rulings granting exceptions to the members of the board.

It is important to note that in some cases approval of more than one State Agency could be a requirement.

Under Title 34 Chapter 7 of the Revised statutes, originally enacted in 1935, construction of containers (Pressure Vessels) is regulated by the New Jersey Board of Boiler, Refrigeration and Pressure Vessels rules. This board operates as part of the Mechanical Inspection Bureau in the Division of Labor, Department of Labor and Industry. Nothing contained in this regulation is intended to be in conflict with or less restrictive than the current rules promulgated by the board and approved by the Commissioner. Copies of current pressure vessel rules and regulations may be obtained upon request from the Mechanical Inspection Bureau.

Prior to promulgation this Regulation was submitted to the New Jersey State Industrial Safety Committee, Public Hearing, and the New Jersey Industrial Safety Board in accordance with requirements of the Worker Health and Safety Act.

SECTION 1
GENERAL PROVISIONS

1.1 PURPOSE

- 1.1.1 The purpose of this Regulation is to provide reasonable standards for the storage, handling and use of flammable and combustible liquids for the protection of the health and safety of all employees.

1.2 SCOPE OF REGULATION

- 1.2.1 This Regulation shall apply in places of employment included in the Worker Health and Safety Act, P.L. 1965, c. 154, N.J.S.A. 34:6A using:

- (a) Liquids with a flash point below 200°F
- (b) Liquids with flash points above 200°F which when heated assume the characteristics of liquids with flash points below 200°F.

- 1.2.2 This Regulation shall not apply to:

- (a) Class III B liquids
- (b) Transportation of flammable and combustible liquids.
- (c) Liquids without flash points that may be flammable under some conditions, such as certain halogenated hydrocarbons and mixtures containing halogenated hydrocarbons.
- (d) Mists, sprays or foams, except flammable aerosols.

- 1.2.3 Additional requirements may be necessary for the safe storage and use of liquids which have unusual burning characteristics, which are subject to self-ignition when exposed to the air, which are highly reactive with other substances, which are subject to explosive decomposition, or have other special properties which dictate safeguards over and above those specified in this Regulation.

1.3 VALIDITY

- 1.3.1 Nothing in this Regulation shall be construed to prevent the enforcement of other rules, regulations and codes of the Bureau which prescribe more restrictive requirements.
- 1.3.2 Should any section, paragraph, sentence or word of this Regulation be declared for any reason to be invalid, such decision shall not affect the remaining portions of this Regulation.

1.4 EXISTING INSTALLATIONS

1.4.1 Flammable or combustible liquid installations within the scope of these Regulations which were installed on or before the effective date of these Regulations may be continued in service unless the continued operation of such equipment, systems, and installations constitute a serious and substantial threat to the health and safety of employees.

1.4.2 Maintenance of existing equipment shall be in accordance with these Regulations.

1.5 STORAGE

1.5.1 Flammable or combustible liquids shall be stored in a tank that complies with Section 3 or a container that complies with Section 5.

1.6 ELECTRICAL WIRING AND EQUIPMENT

1.6.1 General

(a) All installations of electrical wiring and equipment shall be installed in accordance with the National Electrical Code, NFPA 70-1968 except as provided in 1.6.2 through 1.6.7.

1.6.2 Class I, Division 1 Areas

(a) Electrical wiring and equipment in locations where flammable vapor-air mixtures may exist under normal operation shall be classified Class I, Division 1 except as provided in 1.6.2(b).

(b) Electrical wiring and equipment installed in locations when the ventilation of the building, area or space is such that the flammable vapor-air mixture under normal operating conditions are limited to pits, the interior of equipment and not more than 10 feet from equipment which exposes Class I liquids to the air shall be classified as Class I Division 1 within 10 feet in all directions from the points of vapor liberation.

(c) All areas within pits shall be classified Division 1 if any part of the pit is within a Division 1 or 2 classified area.

1.6.3 Class I, Division 2 Areas

- (a) Electrical wiring and equipment in locations where flammable vapor-air mixtures may exist under abnormal conditions for a distance beyond the Division 1 locations shall be classified Division 2 in accordance with 1.6.3(b) or 1.6.3(c).
- (b) Class I Division 2 locations shall include an area within 20 feet horizontally, 3 feet vertically beyond a Division 1 area, and up to 3 feet above the floor or grade level within 20 feet horizontally beyond the Division 1 location.
- (c) If only Class II or III liquids are handled, then ordinary electrical equipment may be used. Such electrical equipment shall be located so that hot metal will not fall into open equipment.

1.6.4 Pressurized Area

- (a) Where the requirements of 1.6.1, 1.6.2, and 1.6.3 require the installation of explosion-proof equipment, ordinary electrical equipment including switchgear may be used if installed in a room or enclosure which is maintained under positive pressure with respect to the hazardous area. Ventilation make-up air shall be uncontaminated by flammable vapors.
- (b) A pressurized area shall be protected by an alarm system that will be actuated on loss of pressure or the atmosphere in the room rises above one fifth of the lower flammable limit of the flammable vapor.

1.6.5 Dry Cleaning Plants

- (a) Electrical equipment installed in hazardous locations in dry cleaning plants shall comply with 10.7.

1.6.6 Spray Finishing

- (a) Electrical equipment installed in hazardous locations in spray finishing areas shall comply with 16.5.

1.6.7 Dip Tanks

- (a) Electrical equipment installed in hazardous locations in dip tank areas shall comply with 17.5.

1.7 BUILDINGS OR STRUCTURES

- 1.7.1 The construction of buildings or structures not specifically provided for in this Regulation shall comply with the Safety Regulation on building construction.

1.8 OPERATING INSTRUCTIONS

- 1.8.1 Safe operating instructions shall be approved and posted at all operating locations such as but not limited to tank car or tank vehicle loading or unloading, or liquid handling and transfer.

1.9 PLAN FILING

- 1.9.1 Plan filings for flammable and combustible liquid projects shall be in accordance with Safety Regulation No. 30, Plan Filing.

SECTION 2 - DEFINITIONS

AEROSOL	Amaterial which is dispensed from its container as a mist, spray or foam by a propellant under pressure.
API	American Petroleum Institute 1271 Avenue of the Americas New York, N.Y. 10020
APPROVED	Acceptable to the Commissioner. Devices having been accepted for a specific purpose by a nationally recognized testing agency may be deemed to be acceptable.
ASME	American Society of Mechanical Engineers United Engineering Center 345 East 47th Street New York, N. Y. 10017
ASSEMBLY OCCUPANCY	The occupancy or use of a building or structure or any portion thereof by a gathering of persons for civic, political, travel, religious, social or recreational purposes.
ASTM	American Society of Testing Materials 1916 Race Street Philadelphia, Pa. 19103
ATMOSPHERIC TANK	A storage tank which has been designed to operate at pressures from atmospheric through 0.5 psig.
AUTOMOTIVE SERVICE STATION	The use of a building or structure or any portion thereof for the purpose of dispensing motor fuels from fixed equipment into the fuel tanks of motor vehicles and for other services incidental thereto.
BARREL	A volume of 42 U.S. gallons.
BOILING POINT	The boiling point of a liquid at a pressure of 14.7 psia (760 mm). Where an accurate boiling point is unavailable for the material in question, or for mixtures which do not have a constant boiling point, for purpose of this code the 10 per cent point of a distillation performed in accordance with the Standard Method of Test for Distillation of Petroleum Products, ASTM D-86-62, may be used as the boiling point of the liquid.

BOIL-OVER

The expulsion of crude oil (or certain other liquids) from a burning tank. The light fractions of the crude oil burn off producing a heat wave in the residue which on reaching a water strata may result in the expulsion of a portion of the contents of the tank in the form of froth.

BONDING

The connecting of two or more conductive objects together by means of a conductor deliberately applied or that an electrically conductive path inherently exists, either of which has a resistance of one million ohms or less.

BUILDING

A structure enclosed within exterior walls or fire walls built, erected and framed of component structural parts designed for the housing, shelter, enclosure and support of individuals, animals or property of any kind.

BULK PLANT

That portion of a property where flammable or combustible liquids are received by tank vessel, pipe line, tank car or tank vehicle, and are stored or blended in bulk for the purpose of distributing such liquids by tank vessels, pipe line, tank car, tank vehicle or container.

BUREAU

The Bureau of Engineering and Safety
Division of Labor
Department of Labor and Industry
State of New Jersey

BUSINESS OCCUPANCY

The occupancy or use of a building or structure or any portion thereof for the transaction of business, or the rendering or receiving of professional services.

CARGO TANK

Any container having a liquid capacity in excess of 100 gallons, used for the carrying of flammable or combustible liquids or asphalt and mounted permanently or otherwise upon a tank vehicle.

CELLER

That portion of a building partly underground, having half or more than half of its clear height below the average grade of the adjoining ground.

EMPLOYEE	Any person engaged in service to an employer for wages, salary or other compensation.
EMPLOYER	Any person or corporation, partnership, individual proprietorship, joint venture, firm, company or legal entity who engages the services of an employee and who pays his wages, salary or other compensation; and any person exercising supervision of employees on an employer's behalf.
FIRE AREA	An area of a building separated from the remainder of the building by construction having a fire resistance rating of at least one-hour and having all communicating openings properly protected by an assembly having a fire resistance rating of at least one hour.
FIRE RESISTANCE RATING	The time in hours that the material or construction will withstand the standard fire exposure as determined by a fire test made in conformity with the Standard Methods of Fire Tests of Building Construction and Materials, NFPA No. 251-1969.
FLAMMABLE AEROSOL	An aerosol which is required to be labeled "Flammable" under the U.S. Federal Hazardous Substances Labeling Act. For the purposes of this Regulation such aerosols shall be considered Class IA liquids.
FLAMMABLE LIQUID	See LIQUID
FLASH POINT OF A LIQUID	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. The flash point of liquids having a viscosity less than 45 SSU at 100°F and a flash point below 175°F, shall be determined in accordance with the Standard Method of Test for Flash Point by the Tag Closed Tester, ASTM D-56-1969.

CHEMICAL PLANT	An integrated plant or that portion of such a plant other than a refinery or distillery where flammable or combustible liquids are produced by chemical reactions or used in chemical reactions.
CLOSED CONTAINER	A container as herein defined, so sealed by means of a lid or other device that neither liquid nor vapor will escape from it at ordinary temperatures.
COMBUSTIBLE LIQUID	See LIQUIDS.
COMMISSIONER	Commissioner of the Department of Labor and Industry or his authorized representative.
CONTAINER	Any can, barrel, or drum.
CRUDE PETROLEUM	Hydrocarbon mixtures that have a flash point below 150°F. and which have not been processed in a refinery.
DEPARTMENT	Department of Labor and Industry
DIP TANK	A tank, vat or container of flammable or combustible liquid in which articles or materials are immersed for the purpose of coating, finishing, treating or similar processes.
DISTILLERY	A plant or that portion of a plant where flammable or combustible liquids produced by fermentation are concentrated and where the concentrated products may also be mixed, stored, and packaged.
DRY CLEANING SYSTEM CLASSIFICATION	Dry cleaning plants or systems classified as follows: Class I systems shall mean those utilizing Class I liquids. Class II systems shall mean those utilizing Class II liquids or systems utilizing Class III liquids which do not comply with Class III or Class IV systems. Class III systems shall mean those employing equipment listed by Underwriters' Laboratories, Inc., utilizing Class III liquids. Class IV systems shall mean those utilizing liquids which are nonflammable (will not support combustion) or nonflammable at ordinary temperatures and only moderately flammable at higher temperatures.

	The flash point of liquids having a viscosity of 45 SSU or more at 100°F or a flash point of 175°F or higher shall be determined in accordance with the Standard Method of Test for Flash Point by the Pensky Martens Closed Tester, ASTM D-93-1969.
FUEL OIL	Kerosene or any hydrocarbon oil that complies with Specifications for Fuel Oils, ASTM D-396 - 1963 T and has a flash point not less than 100°F.
GALLON	A U.S. Standard gallon
GROUNDING (EARTHING)	The connecting of one or more conductive objects to ground by means of a conductor deliberately applied or that an electrically conductive path inherently exists, either of which has a resistance of one million ohms or less.
HIGH HAZARD OCCUPANCY	The occupancy or use of a building or structure or any portion thereof that involves highly combustible, highly flammable, hazardous chemical or explosive material, or which has inherent characteristics that constitute a special fire hazard.
ICC	See definition of USDOT.
ICC CONTAINER	Any container approved by the USDOT for shipping any liquid, gaseous or solid material of a flammable, toxic or other hazardous nature.
IMPORTANT BUILDING	A building normally occupied by employees during normal working hours.
INDUSTRIAL PLANT	A plant where (1) the use of flammable or combustible liquids is incidental to the principal business or (2) 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.
LIQUID	Any material which has a fluidity greater than that of 300 penetration asphalt when

tested in accordance with the Test for Penetration for Bituminous Materials, ASTM D-5-1965. When not otherwise identified, the term liquid shall include both flammable and combustible liquids.

COMBUSTIBLE
LIQUID

Any liquid having a flash point at or above 140°F. and shall be known as Class III liquids. Class IIIA shall include those having flash points at or above 140°F. and below 200°F. Class IIIB shall include those having flash points at or above 200°F.

Where the term combustible liquids or Class III liquids is used in this Regulation, it shall mean only Class IIIA liquids.

FLAMMABLE
LIQUID

Any liquid having a flash point below 140°F. and having a vapor pressure not exceeding 40 pounds per square inch (absolute) at 100°F.

Flammable liquids shall be divided into two classes of liquids as follows:

CLASS I liquids shall include those having flash points below 100°F. and may be sub-divided as follows.

CLASS IA shall include those having flash points below 73°F. and having a boiling point below 100°F.

CLASS IB shall include those having flash points below 73°F. and having a boiling point at or above 100°F.

CLASS IC shall include those having flash points at or above 73°F. and below 100°F.

CLASS II liquids shall include those having flash points at or above 100°F. and below 140°F.

The volatility of liquids is increased

when artificially heated to temperatures equal to or higher than their flash points. When so heated Class II and III liquids shall be subject to the applicable requirements for Class I or II liquids. This definition may also be applied to high flash point liquids when so heated even though these same liquids when not heated are outside of its scope.

UNSTABLE (REACTIVE) LIQUID	A liquid which in the pure state or as commercially produced or transported will vigorously polymerize, decompose, condense, or will become self-reactive under conditions of shock, pressure, or temperature.
LOW PRESSURE TANK	A storage tank which has been designed to operate at pressures above 0.5 psig but not more than 15 psig.
MARINE SERVICE STATION	That portion of a property where flammable or combustible liquids used as fuels are stored and dispensed from fixed equipment on shore, piers, wharves, or docks into the fuel tanks of self-propelled craft, and shall include all facilities used in connection therewith.
MECHANICAL INSPECTION BUREAU	New Jersey Department of Labor and Industry Mechanical Inspection Bureau John Fitch Plaza, Box V Trenton, N. J. 08625
MERCANTILE OCCUPANCY	The occupancy or use of a building or structure or any portion thereof for the displaying, selling or buying of goods, wares, or merchandise.
NATIONALLY RECOGNIZED TESTING AGENCY	A laboratory such as the Underwriter's Laboratories, Inc., U.S. Bureau of Mines, Factory Mutual Laboratories or the American Gas Association Laboratories.
NFPA	National Fire Protection Association 60 Batterymarch Street Boston, Massachusetts 02110

OIL BURNING EQUIPMENT

An oil burner of any type together with its tank, piping, wiring, controls and related devices shall include all oil burners, oil-fired units, and heating and cooking appliances but exclude those exempted by 13.2.

ORGANIC COATING

A liquid mixture of binders such as alkyd, nitrocellulose, acrylic, or oil and flammable and combustible solvents such as hydrocarbon, ester, ketone, or alcohol which when spread in a thin film convert to a durable protective and decorative film.

PIPING SYSTEM

Pipe, tubing, flanges, bolting, gaskets, valves, fittings, the pressure containing parts of other components such as expansion joints and strainers and devices which serve such purposes as mixing, separating, scrubbing, distributing, metering, or controlling flow.

PLACE OF EMPLOYMENT

Any building or other premises occupied by an employer in or about which an employee customarily is suffered or permitted to work.

PLAN FILING

Delivery in person or by mail of application, project data form and fee; and when required, drawings, and other related data to the offices of the Bureau of Engineering and Safety for approval and deposit in its records.

PORTABLE TANK

A closed container having a liquid capacity over 60 gallons and not intended for fixed installation.

PRESSURE VESSEL

A storage tank or vessel which has been designed to operate at pressures above 15 psig.

PROPERTY LINE	The line of adjoining property or the nearest side of any public way.
PSI (PSIG)	Pounds per square inch gauge.
PSIA	Pounds per square inch absolute
PUBLIC WAY	A thoroughfare other than railroads, designated for public use by lawful procedure.
QUALIFIED PERSON	A person selected and directed by an employer to perform a specific task or duty involving flammable or combustible liquids, who has the degree of competence necessary to accomplish the work in a safe manner.
REFINERY	A plant in which flammable or combustible liquids are produced on a commercial scale from crude petroleum, natural gasoline, or other hydrocarbon sources.
SAFETY CAN	An approved container, of not more than five gallons capacity, having a spring-closing lid and spout cover and so designed that it will safely relieve internal pressure when subject to fire exposure.
SHALL	Indicates a mandatory requirement.
SPRAYING AREA	Any area in which dangerous quantities of flammable vapors or combustible residues, dusts or deposits are present due to the operation of spraying processes and shall include the interior of spray booths, the interior of ducts exhausting from spraying processes, any area in the direct path of the spray, and any area containing dangerous quantities of air suspended powder or air suspended combustible residue, dust, deposits, vapor or mists.
STORAGE OCCUPANCY	The occupancy or use of a building or structure or any portion thereof for the storage of goods, wares, merchandise, raw materials, agricultural or manufactured products, including parking garages, or the sheltering of live stock and other animals; except when classed as a high hazard occupancy.
TANK, ATMOSPHERIC	See ATMOSPHERIC TANK
TANK, LOW PRESSURE	See LOW PRESSURE TANK
TANK VEHICLE	Any vehicle other than railroad tank cars and boats, with a cargo tank mounted thereon or built as integral part thereof used for the transportation of flammable or combustible liquids.

Tank vehicle include self-propelled vehicles, and full trailers and semi-trailers without motive power and with wheels carrying either part of all of the load.

UNSTABLE (REACTIVE)
LIQUID

See LIQUID

USAS

A standard of the USASI

USASI

United States Of America Standards
Institute
10 East 40th Street
New York, New York 10016

USDOT

United States Department Of
Transportation (the Interstate Commerce
Commission) Washington, D.C. 20433

VAPOR PRESSURE

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 323-1958.

WHARF

Any pier, bulkhead or other
structure over or contiguous to
navigable water used in conjunction
with a bulk plant, the primary
function of which is the transfer of
flammable or combustible liquid cargo
in bulk between the bulk plant and
any tank, vessel, ship, barge, lighter,
boat or other mobile floating craft.

SECTION 3 - TANK STORAGE

3.1 DESIGN AND CONSTRUCTION OF TANKS

3.1.1 Materials

- (a) Tanks shall be built of steel except as provided in 3.1.1 (b) through 3.1.1 (e).
- (b) Tanks may be built of materials other than steel for installation underground or if required by the properties of the liquid stored. Tanks located aboveground or inside buildings shall be of noncombustible construction.
- (c) Tanks built of materials other than steel shall be designed to specifications embodying principles recognized as good engineering design for the material used.
- (d) Unlined concrete tanks may be used for storing flammable or combustible liquids having a gravity of 40 degrees API or heavier. Concrete tanks with special lining may be used for other services provided the design is in accordance with sound engineering practice.
- (e) Tanks may have combustible or noncombustible linings.
- (f) Special engineering consideration shall be required if the specific gravity of the liquid to be stored exceeds that of water or if the tanks are designed to contain flammable or combustible liquids at a liquid temperature below zero degrees F.

3.1.2 Fabrication

- (a) Tanks may be of any shape or type consistent with sound engineering design.
- (b) Metal tanks shall be welded, riveted and caulked, or brazed, or constructed by use of a combination of these methods. Filler metal used in brazing shall be nonferrous metal or an alloy having a melting point above 1000°F. and below that of the metal joined.

3.1.3 Atmospheric Tanks

- (a) Atmospheric tanks shall be built in accordance with approved standards of design. Atmospheric tanks may be built in accordance with;

- (1) Underwriters' Laboratories, Inc. Subjects No. 142, Standard for Aboveground Tanks for Flammable Liquids - 1968; No. 58, Standard for Underground Storage Tanks - 1968; or No. 80, Standard for Inside Tanks for Oil-Burner Fuel - 1968.
- (2) American Petroleum Institute Standards No. 12A, Specification for Oil Storage Tanks with Riveted Shells, Seventh Edition, September 1951 or No. 650, Welded Steel Tanks for Oil Storage, Third Edition, 1966.
- (b) Tanks designed for underground service not exceeding 2,500 gallons capacity may be used aboveground.
- (c) Low pressure tanks and pressure vessels may be used as atmospheric tanks.
- (d) Atmospheric tanks shall not be used for the storage of a flammable or combustible liquid at a temperature at or above its boiling point.

3.1.4 Low Pressure Tanks

- (a) The normal operating pressure of the tank shall not exceed the design pressure of the tank.
- (b) Low pressure tanks shall be built in accordance with approved standards of design. Low pressure tanks may be built in accordance with;
 - (1) American Petroleum Institutes Standard No. 620, Recommended Rules for the Design and Construction of Large, Welded, Low-Pressure Storage Tanks, Third Edition, 1966.
 - (2) The principles of the Code for Unfired Pressure Vessels, Section VIII of the ASME Boiler and Pressure Vessels Code, 1968 Edition.
 - (3) Atmospheric tanks built according to Underwriters' Laboratories, Inc. requirements in 3.1.3 (a) may be used for operating pressures not exceeding one psig and shall be limited to 2.5 psig under emergency venting conditions.
 - (4) Pressure vessels may be used as low pressure tanks.

3.1.5 Pressure Vessels

- (a) Pressure vessels shall be built in accordance with the Code for Unfired Pressure Vessels, Section VIII of the ASME Boiler and Pressure Vessels Code, 1968 Edition, shall be stamped "National Board" or "New Jersey Standard" and shall comply with the requirements of the Mechanical Inspection Bureau.

3.1.6 Provisions for Internal Corrosion

- (a) When tanks are not designed in accordance with the American Petroleum Institute, American Society of Mechanical Engineers or the Underwriters' Laboratories, Inc. Standards, or if corrosion is anticipated beyond that provided for in the design formulas used, additional metal thickness or suitable protective coatings or linings shall be provided to compensate for the corrosion loss expected during the design life of the tank.

3.2 INSTALLATION OF OUTSIDE ABOVEGROUND TANKS

3.2.1 Location With Respect to Property Lines and Public Ways

- (a) Every aboveground tank for the storage of flammable or combustible liquids, except those liquids with boil-over characteristics and unstable liquids, operating at pressure not in excess of 2.5 psig and equipped with emergency venting which will not permit pressures to exceed 2.5 psig shall be located in accordance with Table 3.2.1 (a).

TABLE 3.2.1(a)

TYPE OF TANK	PROTECTION	MINIMUM DISTANCE IN FEET FROM PROPERTY LINE OR NEAREST IMPORTANT BUILDING.
Floating Roof	Diked or Drained	$\frac{1}{2}$ time diameter of tank but need not exceed 90 feet
	None	Diameter of tank but need not exceed 175 feet
Vertical with Weak Roof to Shell Seam	Approved foam or inerting system on the tank	$\frac{1}{2}$ times diameter of tank but need not exceed 90 feet and shall not be less than 5 feet
	Diked or Drained	Diameter of tank but need not exceed 175 feet
	None	2 times diameter of tank but need not exceed 350 feet
Horizontal and Vertical, with Emergency Relief Venting to Limit Pressures to 2.5 psig	Approved inerting system on the tank or approved foam system on vertical tanks	$\frac{1}{2}$ times Table 3.2.1(e) but shall not be less than 5 feet
	Diked or Drained	Table 3.2.1(e)
	None	2 times Table 3.2.1(e)

- (b) Every aboveground tank for the storage of flammable or combustible liquids, except those liquids with boil-over characteristics and unstable flammable or combustible liquids, operating at pressures exceeding 2.5 psig or equipped with emergency venting which will permit pressures to exceed 2.5 psig shall be located in accordance with Table 3.2.1(b)

TABLE 3.2.1(b)

TYPE OF TANK	PROTECTION	MINIMUM DISTANCE IN FEET FROM PROPERTY LINE OR NEAREST IMPORTANT BUILDING
ANY TYPE	Diked or Drained	1-1/2 times Table 3.2.1(b) but shall not be less than 25 feet
	None	3 times Table 3.2.1(b) but shall not be less than 50 feet

- (c) Every aboveground tank for the storage of flammable or combustible liquids with boil-over characteristics shall be located in accordance with Table 3.2.1(c)

TABLE 3.2.1(c)

TYPE OF TANK	PROTECTION	MINIMUM DISTANCE IN FEET FROM PROPERTY LINE OR NEAREST IMPORTANT BUILDING
Floating Roof	Diked or Drained	Diameter of tank but need not exceed 175 feet
	None	2 times diameter of tank but need not exceed 350 feet
Fixed Roof	Approved foam or inerting system	Diameter of tank but need not exceed 175 feet
	Diked or Drained	2 times diameter of tank but need not exceed 350 feet
	None	4 times diameter of tank but need not exceed 350 feet

- (d) Every aboveground tank for the storage of unstable liquids shall be located in accordance with Table 3.2.1(d)

TABLE 3.2.1(d)

TYPE OF TANK	PROTECTION	MINIMUM DISTANCE IN FEET FROM PROPERTY LINE OR NEAREST IMPORTANT BUILDING
Horizontal and Vertical Tanks with Emergency Relief Venting to permit Pressure Not in Excess of 2.5 psig	Tank protected with any one of the following: Approved water spray, Approved inerting, Approved insulation and refrigeration, Approved barricade	Table 3.2.1(e) but not less than 25 feet
	Diked or Drained	2-1/2 times Table 3.2.1(e) but not less than 50 feet
	None	5 times Table 3.2.1(e) but not less than 100 feet
Horizontal and Vertical Tanks with Emergency Relief Venting to Permit Pressure Over 2.5 psig	Tank protected with any one of the following: Approved water spray, Approved inerting, Approved insulation and refrigeration, Approved barricade	2 times Table 3.2.1(e) but not less than 50 feet
	Diked or Drained	4 times Table 3.2.1(e) but not less than 100 feet
	None	8 times Table 3.2.1(e) but not less than 150 feet

- (e) Reference minimum distances for use in Tables 3.2.1(a) through 3.2.1(d).

TABLE 3.2.1(e)

CAPACITY TANK GALLONS	MINIMUM DISTANCE IN FEET FROM PROPERTY LINE OR NEAREST IMPORTANT BUILDING
275 or less	5
276 to 750	10
751 to 12,000	15
12,001 to 30,000	20
30,001 to 50,000	30
50,001 to 100,000	50
100,001 to 500,000	80
500,001 to 1,000,000	100
1,000,001 to 2,000,000	135
2,000,001 to 3,000,000	165
3,000,001 or more	175

- (f) Where end failure of horizontal pressure tanks and vessels may expose property, the tank shall be placed with the longitudinal axis parallel to the nearest important exposure.

3.2.2 Spacing (Shell-to-Shell) Between Aboveground Tanks

- (a) The distance between any two flammable or combustible liquid storage tanks shall not be less than three feet.
- (b) Except as provided in 3.2.3(c), the distance between any two adjacent tanks shall not be less than one-sixth the sum of their diameters except when the diameter of one tank is less than one-half the diameter of adjacent tank, the distance between the two tanks shall not be less than one-half the diameter of the smaller tank.
- (c) Unstable flammable or combustible liquids, the distance between such tanks shall not be less than one-half the sum of their diameters.

- (d) When tanks are compacted in three or more rows or in an irregular pattern, greater spacing or other means shall be provided at the discretion of the Bureau so that inside tanks are accessible.
- (e) The minimum separation between a liquefied petroleum gas container and a flammable or combustible liquid storage tank shall be 20 feet, except in the case of flammable or combustible liquid tanks operating at pressures exceeding 2.5 psig or equipped with emergency venting which will permit pressures to exceed 2.5 psig in which case the provisions of 3.2.2(a) and 3.2.2(b) shall apply. Suitable means shall be taken to prevent the accumulation of flammable or combustible liquids under adjacent liquefied petroleum gas containers such as by diversion curbs or grading. When flammable or combustible liquid storage tanks are within a diked area, the liquefied petroleum gas containers shall be outside the diked area and at least 10 feet away from the center line of the wall of the diked area. The foregoing provisions shall not apply when liquefied petroleum gas containers of 125 gallons or less capacity are installed adjacent to fuel oil supply tanks of 550 gallons or less capacity.

3.2.3 Location of Outside Aboveground Tanks with Respect to Important Buildings on Same Property.

- (a) Every outside aboveground tank shall be separated from important buildings on the small property by distance not less than those specified in 3.2.1(a), (b), (c) and (d) whichever is applicable.

3.2.4 Normal Venting for Aboveground Tanks

- (a) Atmospheric storage tanks shall be adequately vented to prevent the development of vacuum or pressure sufficient to distort the roof of a cone roof tank or exceeding the design pressure in the case of other atmospheric tanks, as a result of filling or emptying, and atmospheric temperature changes.
- (b) Normal vents shall be sized either in accordance with:
 - (1) the American Petroleum Institute Guide for Venting Atmospheric and Low Pressure Storage Tanks, RP-2000 2nd Edition May 1965 or
 - (2) other accepted standard;
 - or
 - (3) shall be at least as large as the filling or withdrawal connection, whichever is larger but in no case less than 1½ inch nominal inside diameter.

- (c) Low-pressure tanks and pressure vessels shall be adequately vented to prevent development of pressure or vacuum, as a result of filling or emptying and atmospheric temperature changes, from exceeding the design pressure of the tank or vessel. Protection shall also be provided to prevent overpressure from any pump discharging into the tank or vessel when the pump discharge pressure can exceed the design pressure of the tank or vessel.
- (d) If any tank or pressure vessel has more than one fill or withdrawal connection and simultaneous filling or withdrawal can be made, the vent size shall be based on the maximum anticipated simultaneous flow.
- (e) Unless the vent is designed to limit the internal pressure to 2.5 psi or less, the outlet of vents and vent drains shall be arranged to discharge in such a manner as to prevent localized overheating of any part of the tank in the event vapors from such vents are ignited.
- (f) Tanks and pressure vessels storing Class IA liquids shall be equipped with venting devices which shall be normally closed except when venting to pressure or vacuum conditions. Tanks and pressure vessels storing Class IB and IC liquids shall be equipped with venting devices which shall be normally closed except when venting under pressure or vacuum conditions or with approved flame arresters; and, out-side aboveground atmospheric tanks under 1,000 gallons capacity containing other than Class IA flammable liquids may have open vents. (See 3.2.6(a)).
- (g) Flame arresters or venting devices required in 3.2.4(f) may be omitted for IB and IC liquids where conditions are such that their use may, in case of obstruction, result in tank damage.

3.2.5 Emergency Relief Venting for Fire Exposure for Aboveground Tanks.

- (a) Every aboveground storage tank shall have some form of construction or device that will relieve excessive internal pressure caused by exposure fires.
- (b) In a vertical tank the construction referred to in 3.2.5(a) may take the form of a floating roof, lifter roof, a weak roof-to-shell seam, or other approved pressure relieving construction. The weak roof-to shell seam shall be constructed to fail preferential to any other seam.

- (c) Where entire dependence for emergency relief is placed upon pressure relieving devices, the total venting capacity of both normal and emergency vents shall be enough to prevent rupture of the shell or bottom of the tank if vertical, or of the shell or heads if horizontal. If unstable liquids are stored, the effects of heat or gas resulting from polymerization, decomposition, condensation, or reactivity shall be taken into account. The total capacity of both normal and emergency venting devices shall be not less than that derived from Table 3.2.5 except as provided in 3.2.5(d) or 3.2.5(e). Such device may be a self-closing manhole cover, or one using long bolts that permit the cover to lift under internal pressure, or an additional or large relief valve. The wetted area of the tank shall be calculated on the basis of 55 per cent of the total exposed area of a sphere or spheroid, 75 per cent of the total exposed area of a horizontal tank and the first 30 feet abovegrade of the exposed shell area of a vertical tank.

TABLE 3.2.5

WETTED AREA VERSUS CUBIC FEET FREE AIR HOUR
(14.7 psia and 60°F.)

Sq. Ft.	CFH	Sq. Ft.	CFH	Sq. Ft.	CFH
20	21,100	200	211,000	1,000	524,000
30	31,600	250	239,000	1,200	557,000
40	42,100	300	265,000	1,400	587,000
50	52,700	350	288,000	1,600	614,000
60	63,200	400	312,000	1,800	639,000
70	73,700	500	354,000	2,000	662,000
80	84,200	600	392,000	2,400	704,000
90	94,800	700	428,000	2,800	742,000
100	105,000	800	462,000	and over	
120	126,000	900	493,000		
140	147,000	1,000	524,000		
160	168,000				
180	190,000				
200	211,000				

- (d) For tanks and storage vessels designed for pressures over 1 psig, the total rate of venting shall be determined in accordance with Table 3.2.5, except that when the exposed wetted area of the surface is greater than 2,800 sq ft, the total rate of venting shall be calculated by the following formula:

$$CFH = 1,107 A^{0.82}$$

Where:

CFH= venting requirement, in cubic feet of free air per hour.

A= exposed wetted surface, in square feet.

- (e) The total emergency relief venting capacity for any specific stable liquid may be determined by the following formula:

$$\text{Cubic feet of free air per hour} = V \times \frac{1337}{L \sqrt{M}}$$

Where:

V= cubic feet of free air per hour from Table 3.2.5

L= latent heat of vaporization of specific liquid in Btu per lb.

M= molecular weight of specific liquid.

- (f) The required air flow rate of 3.2.5(c) or (e) may be multiplied by the appropriate factor listed in the following schedule when protection is provided as indicated. Only one factor may be used for any one tank.

.5 for drainage in accordance with 3.2.7(b) for tanks over 200 square feet of wetted area.

.3 for approved insulation

- (g) The outlet of all vents and vent drains on tanks equipped with emergency venting to permit pressures exceeding 2.5 psig shall be arranged to discharge in such a way as to prevent localized overheating of any part of the tank, in the event vapors from such vents are ignited.

- (h) Each commercial tank venting device shall have stamped on it the opening pressure, the pressure at which the valve reaches the full open position, and the flow capacity at the latter pressure, expressed in cubic feet per hour of air at 60°F and at a pressure of 14.7 psia.
- (i) The flow capacity of tank venting devices 12 inches and smaller in nominal pipe size shall be determined by actual test of each type and size of vent. These flow tests may be conducted by the manufacturer if certified by a qualified impartial observer, or may be conducted by an outside agency. The flow capacity of tank venting devices larger than 12 in. nominal pipe size, including manhole covers with long bolts or equivalent, may be calculated provided that the opening pressure is actually measured, the rating pressure and corresponding free orifice area are stated, the word "calculated" appears on the nameplate, and the computation is based on a flow coefficient of 0.5 applied to the rated orifice area.

3.2.6 Vent Piping for Aboveground Tanks

- (a) Where vent pipe outlets for tanks storing Class I liquids are adjacent to buildings or public ways, they shall be located so that the vapors are released at a safe point outside of buildings and not less than 12 feet above the adjacent ground level. In order to aid their dispersion, vapors shall be discharged upward or horizontally away from closely adjacent walls. Vent outlets shall be located so that flammable vapors will not be trapped by eaves or other obstructions and shall be at least five feet from building openings.
- (b) When tank vent piping is manifolded, pipe sizes shall be such as to discharge, within the pressure limitations of the system, the vapors they may be required to handle when manifolded tanks are subject to the same fire exposure.

3.2.7 Drainage, Dikes and Walls for Aboveground Tanks

- (a) The area surrounding a tank or a group of tanks shall be provided with drainage as in 3.2.8, or shall be diked as provided in 3.2.9.

3.2.8 Drainage

- (a) Where protection of adjoining property or waterways is by means of a natural or man-made drainage system, such systems shall comply with 3.2.8(b) through (d).
- (b) A slope of not less than 1 per cent away from the tank toward the drainage system shall be provided.
- (c) The drainage system shall terminate in vacant land or other area or in an impounding basin having a capacity not smaller than that of the largest tank served. This termination area and the route of the drainage system shall be so located that, if the flammable or combustible liquids in the drainage system are ignited, the fire will not seriously expose tanks or property.
- (d) The drainage system, including automatic drainage pumps, shall not discharge to adjoining property, natural water courses, public sewers, or public drains.

3.2.9 Diked Areas.

- (a) Where protection of adjoining property or waterways is accomplished by retaining the liquid around the tank by means of a dike, the diking shall comply with 3.2.9(b) through (h).
- (b) Except as provided in 3.2.9(c), the volumetric capacity of the diked area shall not be less than the greatest amount of liquid that can be released from the largest tank within the diked area, assuming a full tank. The capacity of the diked area enclosing more than one tank shall be calculated by deducting the volume of the tanks other than the largest tank below the height of the dike.
- (c) For a tank or group of tanks with fixed roofs containing crude petroleum with boil-over characteristics, the volumetric capacity of the diked area shall not be less than the capacity of the largest tank served by the enclosure, assuming a full tank. The capacity of the diked enclosing shall be calculated by deducting the volume below the height of the dike of all the tanks within the enclosure.

- (d) Walls of the diked area shall be of earth, steel, concrete or solid masonry designed to be liquidtight and to withstand a full hydrostatic head. Earthen walls 3 feet or more in height shall have a flat section at the top not less than 2 feet wide. The slope of an earthen wall shall be consistent with the angle of repose of the material of which the wall is constructed.
- (e) The walls of the diked area shall be restricted to an average height of 6 feet above interior grade.
- (f) Where provision is made for draining water from diked areas, drainage shall be provided at a uniform slope of not less than one per cent away from tanks toward a sump, drainbox or other safe means of disposal located at the greatest practical distance from the tank. Such drains shall not discharge flammable or combustible liquids to natural water courses, public sewers, or public drains. Control of drainage shall be accessible under fire conditions.
- (g) No loose combustible material, empty or full drum or barrel, shall be permitted within the diked area.
- (h) Each diked area containing two or more tanks shall be sub-divided preferably by drainage channels or at least by intermediate curbs in order to prevent spills from endangering adjacent tanks within the diked area as follows:
 - (1) When storing normally stable liquids in vertical cone roof tanks constructed with weak roof-to-shell seam or approved floating roof tanks or when storing crude petroleum in producing areas in any type of tank, one sub-division for each tank in excess of 10,000 bbls. and one sub-division for each group of tanks (no tank exceeding 10,000 bbls. capacity) having an aggregate capacity not exceeding 15,000 bbls.
 - (2) When storing normally stable flammable or combustible liquids in tanks not covered in 3.2.9(h) (1), one sub-division for each tank in excess of 100,000 gallons (2,500 bbls.) and one sub-division for each group of tanks (no tank exceeding 100,000 gallons capacity) having an aggregate capacity not exceeding 150,000 gallons (3,570 bbls.)

- (3) When storing unstable liquids in any type of tank, one sub-division for each tank except that tanks installed in accordance with the drainage requirements of NFPA No. 15 Standard for Water Spray Systems for Fire Protection, 1962, shall require no additional sub-division.
- (4) The drainage channels or intermediate curbs shall be located between tanks so as to take full advantage of the available space with due regard for the individual tank capacities. Intermediate curbs, where used, shall be not less than 18 inches in height.

3.2.10 Stairs, Platforms and Walkways for Aboveground Tanks

- (a) Stairs, platforms and walkways shall be of metal, concrete or wood.

3.2.11 Tank Openings Other Than Vents for Aboveground Tanks

- (a) Connections for all tank openings shall be vapor and liquidtight. Vents are covered in 3.2.4 through 3.2.6.
- (b) Each connection to an aboveground tank through which liquid can normally flow shall be provided with an internal or an external valve located as close as practical to the shell of the tank. Such valves, when external, and their connections to the tank shall be of steel except when the chemical characteristics of the liquid stored are incompatible with steel. When materials other than steel are necessary, they shall be suitable for the pressures, structural stresses and temperatures involved, including fire exposures.
- (c) Each connection below the liquid level through which liquid does not normally flow shall be provided with a liquid-tight closure. This may be a valve, plug or blind, or a combination of these.
- (d) Openings for gaging shall be provided with a vapor-tight cap or cover.

- (e) For Class IB and Class IC liquids other than crude oils, gasolines and asphalts, the fill pipe shall be so designed and installed as to minimize the possibility of generating static electricity. A fill pipe entering the top of a tank terminate within six inches of the bottom of the tank and shall be installed to avoid excessive vibration.
- (f) Filling and emptying connections which are made and broken shall be located outside of buildings at a location free from any source of ignition and not less than five feet away from any building opening. Such connections shall be closed and liquidtight when not in use. The connection shall be properly identified.

3.3 INSTALLATION OF UNDERGROUND TANKS

3.2.1 Location

- (a) Excavation for underground storage tanks shall be made with due care to avoid undermining of foundations of existing structures.
- (b) Underground tanks or tanks under buildings shall be so located with respect to existing building foundations and supports that the loads carried by the latter cannot be transmitted to the tank.
- (c) The distance from any part of a tank storing Class I liquids to the nearest wall of any basement or pit or to any property line shall be not less than 10 feet. The distance from any part of a tank storing Class II or Class III liquids to the nearest wall of any basement or pit or to any property line shall be not less than 5 feet.

3.3.2 Depth and Cover

- (a) Underground tanks shall be set on firm foundations and surrounded with at least six inches of noncorrosive, inert materials such as clean sand, earth or gravel well tamped in place.
- (b) The tank shall be placed in the hole with care since dropping or rolling the tank into the hole can break a weld, puncture or damage the tank or scrape off the protective coating of coated tanks.

- (c) Tanks shall be covered with a minimum of two feet of earth, or shall be covered with not less than one foot of earth, on top of which shall be placed a slab of reinforced concrete not less than four inches thick.
- (d) When underground tanks are, or are likely to be, subjected to traffic, they shall be protected against damage from vehicles passing over them by at least three feet of earth cover, or 18 inches of well-tamped earth, plus six inches of reinforced concrete.
When asphaltic or reinforced concrete paving is used as part of the protection, it shall extend at least one foot horizontally beyond the outline of the tank in all directions.

3.3.3 Corrosion Protection

- (a) Corrosion protection for the tank and its piping shall be provided by one or more of the following methods:
 - (1) Use of protective coatings or wrappings
 - (2) Cathodic protection
 - (3) Corrosion resistant materials of construction.

3.3.4 Vents

- (a) Location and Arrangement of Vents for Class I liquids:
Vent pipes from tanks storing Class I liquids shall be so located that the discharge point is outside of buildings, higher than the fill pipe opening, and not less than 12 feet above the adjacent ground level. Vent pipes shall discharge only upward in order to disperse vapors. Vent pipes two inches or less nominal inside diameter shall not be obstructed by devices that will cause excessive back pressure. Vent pipe outlets shall be so located that flammable vapors will not enter building openings, or be trapped under eaves or other obstructions. If the vent pipe is less than ten feet in length or greater than two inches nominal inside diameter, the outlet shall be provided with a vacuum and pressure relief device or there shall be an approved flame arrester located in the vent line at the outlet or within the approved distance from the outlet.
- (b) Size of Vents: Each tank shall be vented through piping adequate in size to prevent blow-back of vapor or liquid at the fill opening while tank is being filled. Vent pipes shall be not less than $1\frac{1}{4}$ inch nominal inside diameter. Vent piping sized with Table 3.3.4(b) will prevent the pressure in the tank from exceeding 2.5 psig.

TABLE 3.3.4(b)
VENT LINE DIAMETERS (2)

MAXIMUM FLOW GPM	PIPE LENGTH (1)		
	50 ft.	100 ft.	200 ft.
100	1 1/4-inch	1 1/4-inch	1 1/4-inch
200	1 1/4-inch	1 1/4-inch	1 1/4-inch
300	1 1/4-inch	1 1/4-inch	1 1/2-inch
400	1 1/4-inch	1 1/2-inch	2-inch
500	1 1/2-inch	1 1/2-inch	2-inch
600	1 1/2-inch	2-inch	2-inch
700	2-inch	2-inch	2-inch
800	2-inch	2-inch	3-inch
900	2-inch	2-inch	3-inch
1000	2-inch	2-inch	3-inch

Notes to Table

1. Vent lines of 50 ft., 100 ft. and 200 ft. of pipe plus 7 ells.
2. The vent size depends upon the filling or withdrawal rate whichever is larger, the vent line length and the tank design pressure. Vent piping sized in accordance with this table will prevent the pressure in the tank from exceeding 2.5 psig.

(c) Location and Arrangement of Vents for Class II or Class III Liquids: Vent pipes from tanks storing Class II or Class III flammable liquids shall terminate outside of building and higher than the fill pipe opening. Vent outlets shall be above normal snow level. They may be fitted with return bends, coarse screens or other devices to minimize ingress of foreign material.

- (d) Vent piping shall be constructed in accordance with Section 3. Vent pipes shall be so laid as to drain toward the tank without sags or traps in which liquid can collect. They shall be located so that they will not be subjected to physical damage. The tank end of the vent pipe shall enter the tank through the top.
- (e) When tank vent piping is manifolded, pipe sizes shall be such as to discharge, within the pressure limitations of the system, the vapors they may be required to handle when manifolded tanks are filled simultaneously.

3.3.5 Tank Openings Other Than Vents

- (a) Connections for all tank openings shall be vapor or liquid tight.
- (b) Openings for manual gaging, if independent of the fill pipe, shall be provided with a liquid-tight cap or cover. If inside a building, each such opening shall be protected against liquid overflow and possible vapor release by means of a spring loaded check valve or other approved device.
- (c) Fill and discharge lines shall enter tanks only through the top. Fill lines shall be sloped toward the tank.
- (d) For Class IB and Class IC liquids other than crude oils, gasoline, and asphalts, the fill pipe shall be so designed and installed as to minimize the possibility of generating static electricity by terminating within six inches of the bottom of the tank.
- (e) Filling and emptying connections which are made and broken shall be located outside of buildings at a location free from any source of ignition and not less than five feet away from any building opening. Such connections shall be closed and liquidtight when not in use. The connection shall be properly identified.

3.4 INSTALLATION OF TANKS INSIDE OF BUILDINGS

- 3.4.1 Location: Tanks shall not be permitted inside of buildings except as otherwise permitted by Section 6,8,9,10, 11 and 13.
- 3.4.2 Vents: Vents for tanks inside of buildings shall be as provided in 3.2.4, 3.2.5, 3.2.6(a) and 3.3.4, except that

emergency venting by the use of weak roof seams on tanks shall not be permitted. Vents shall discharge vapors outside the buildings.

- 3.4.3 The required airflow rates of 3.3.5(c) and (d) may be reduced by appropriate factors for: (a) emergency drainage of adequate capacity, (b) approved insulation, (c) approved water-spray or sprinkler installations, (d) the calorific value of the flammable liquid (when significantly lower than 20,000 btus per pound and when the heat contributed by the building construction and any combustible contents exposing tanks inside buildings is not significant), and (e) the miscibility of the flammable liquid with water.

3.4.5 Tank Openings Other Than Vents

- (a) Connections for all tank openings shall be vapor or liquidtight. Vents are covered in 3.4.2.
- (b) Each connection to a tank inside of buildings through which liquid can normally flow shall be provided with an internal or an external valve located as close as practical to the shell of the tank. Such valves, when external, and their connections to the tank shall be of steel except when the chemical characteristics of the liquid stored are incompatible with steel. When materials other than steel are necessary, they shall be suitable for the pressures, structural stresses and temperatures involved, including fire exposures.
- (c) Flammable or combustible liquid tanks located inside of buildings, except in one-story buildings designed and protected for flammable or combustible liquid storage, shall be provided with an automatic-closing heat-actuated valve on each withdrawal connection below the liquid level, except for connections used for emergency disposal, to prevent continued flow in the event of fire in the vicinity of the tank. This function may be incorporated in the valve required in 3.4.3(b), and if a separate valve, shall be located adjacent to the valve required in 3.4.3(b).
- (d) Openings for manual gaging, if independent of the fill pipe (see 3.4.4(f)), shall be provided with a vaportight cap or cover. Each such opening shall be protected against liquid over-flow and possible vapor release by means of a spring loaded check valve or other device.

- (e) For Class IB and Class IC liquids other than crude oils, gasolines and asphalts, the fill pipe shall be so designed and installed as to minimize the possibility of generating static electricity by terminating within six inches of the bottom of the tank.
- (f) The fill pipe inside of the tank shall be installed to avoid excessive vibration of the pipe.
- (g) The inlet of the fill pipe shall be located outside of buildings at a location free from any source of ignition and not less than five feet away from any building opening. The inlet of the fill pipe shall be closed and liquidtight when not in use. The fill connection shall be properly identified.
- (h) Tanks inside buildings shall be equipped with a device, or other means shall be provided, to prevent overflow into the building.

3.5 SUPPORTS, FOUNDATIONS AND ANCHORAGE FOR ALL TANK LOCATIONS

- 3.5.1 Tank supports shall be installed on firm foundations. Tank supports shall be of concrete, masonry or protected steel. Single wood timber supports (not cribbing) laid horizontally may be used for outside aboveground tanks if not more than 12 inches high at their lowest point.
- 3.5.2 Steel supports or exposed piling shall be protected by materials having a fire resistance rating of not less than two hours, except that steel saddles need not be protected if less than 12 inches high at their lowest point. When permitted by the Bureau, approved water spray protection or its equivalent may be used in lieu of fire-resistant materials to protect supports.
- 3.5.3 The design of the supporting structure for tanks such as spheres shall require special engineering consideration.
- 3.5.4 Every tank shall be so supported as to prevent the excessive concentration of loads on the supporting portion of the shell.
- 3.5.5 Tanks shall rest on the ground or on foundations made of concrete, masonry, piling or steel. Tank foundations shall be designed to minimize the possibility of uneven settling of the tank and to minimize corrosion in any part of the tank resting on the foundation.

- 3.5.6 Where a tank is located in an area that may be subjected to flooding, the applicable precautions outlined in Section 14 shall be observed.
- 3.5.7 In areas subject to earthquakes, the tank supports and connections shall be designed to resist damage as a result of such shocks.

3.6 SOURCES OF IGNITION

- 3.6.1 In locations where flammable vapors may be present, precautions shall be taken to prevent ignition by eliminating or controlling sources of ignition. Sources of ignition may include open flames, lightning, smoking, cutting and welding, hot surfaces, frictional heat, sparks (static, electrical and mechanical), spontaneous ignition, chemical and physical-chemical reactions and radiant heat.
- 3.6.2 Outside aboveground tanks shall be provided with lightning protection in accordance with the Lightning Protection Code, NFPA No 78-1968.
- 3.6.3 All tanks, containers, portable tanks and other equipment containing flammable liquids where vapors may be present shall be provided with static protection in accordance with Static Electricity, NFPA No 77-1966.
- 3.6.4 A fire lane shall be kept open at all times to and around a flammable or combustible liquid installation exceeding 1,000 gallons aggregate

3.7 TESTING

- 3.7.1 All tanks, whether shop-built or field-erected, shall be strength tested before they are placed in accordance with the applicable paragraphs of the Code under which they were built. The ASME Code stamp, API monogram, or the label of the Underwriters' Laboratories, Inc. on a tank shall be evidence of compliance with this strength test. Tanks not marked in accordance with the above Codes shall be strength tested before they are placed in service in accordance with good engineering principles and reference shall be made to the sections on testing in the Codes listed in 3.1.3(a), 3.1.4(b) and 3.1.5(b)
- 3.7.2 When the vertical length of the fill and vent pipes is such that when filled with liquid the static head imposed upon the bottom of the tank exceeds 10 pounds per square inch, the tank and related piping shall be tested hydrostatically to a pressure equal to the static head thus imposed. In special cases where the height of the vent above the top of the tank is excessive, the hydrostatic test pressure shall be specified by the Bureau.
- 3.7.3 In addition to the strength test called for 3.7.1 and 3.7.2 all tanks and connections shall be tested for tightness. Except for underground tanks, this tightness test shall be made at operating pressure with air, inert gas or water prior to placing the tank in service. In the case of field-erected tanks the strength test may be considered to be the test for tank tightness. Underground tanks and piping, before being covered, enclosed, or placed in use, shall be tested hydrostatically, or with air pressure at not less than three pounds per square inch and not more than five pounds per square inch.
- 3.7.4 All leaks or deformations shall be corrected in an acceptable manner before the tank is placed in service. Mechanical caulking is not permitted for correcting leaks in welded tanks except pin hole leaks in the roof.
- 3.7.5 Tanks to be operated at pressures below their design pressure may be tested by the applicable provisions of 3.7.1 or 3.7.2 based upon the pressure developed under full emergency venting of the tank.

SECTION 4 - PIPING, VALVES AND FITTINGS

4.1 SCOPE OF SECTION 4

- 4.1.1 This Section 4 shall apply to the design (including selection of materials), fabrication, assembly, test and inspection of piping systems containing flammable or combustible liquids.
- 4.1.2 This Section 4 shall not apply to any of the following:
 - (a) Tubing or casing on any oil or gas wells and any piping connected directly thereto.
 - (b) Motor vehicle, aircraft, boat or portable or stationary engine.
 - (c) Piping within the scope of any applicable boiler and pressure vessel Code.

4.2 DESIGN

- 4.2.1 The design of piping systems for flammable or combustible liquids shall be suitable for the expected working pressures and structural stresses.
- 4.2.2 Piping systems shall comply with the applicable provisions of Petroleum Refinery Piping, USAS B31.3-1966 and Liquid Petroleum Transportation Piping, USAS B31.4-1966.

4.3 MATERIALS FOR PIPING, VALVES AND FITTINGS

- 4.3.1 Materials for piping, valves, and fittings shall be steel or nodular iron except as provided in 4.3.2, 4.3.3, 4.3.4 and 4.3.5. Nodular iron may be used when within the scope of Ferritic Ductile Iron Castings for Valves, Flanges, Pipe Fittings and Other Piping Components, ASTM A 445-1966.
- 4.3.2 Materials other than steel may be used underground or if required by the properties of the flammable or combustible liquid handled.
- 4.3.3 Materials other than steel shall be designed to approval specifications.
- 4.3.4 Piping, valves, and fittings may have combustible or noncombustible linings.

4.3.5 When low melting point materials such as aluminum and brass or materials that soften on fire exposure such as plastics, or nonductile materials such as cast iron, are necessary, special consideration shall be given to their behavior on fire exposure. If such materials are used in aboveground piping systems or inside buildings, they shall be suitably protected against fire exposure or so located that any spill resulting from the failure of these materials could not unduly expose persons, important buildings or structures or can be readily controlled by remote valves.

4.4 PIPE JOINTS

4.4.1 Joints shall be made liquid-tight. Welded or screwed joints or approved connectors shall be used. Threaded joints and connections shall be made up tight with a suitable lubricant or piping compound.

4.4.2 Pipe joints dependent upon the friction characteristics of combustible materials for mechanical continuity of piping shall not be used inside buildings. They may be used outside of buildings above or below ground. If used aboveground, the piping shall either be secured to prevent disengagement at the fitting or the piping system shall be so designed that any spill resulting from such disengagement could not unduly expose persons, important buildings or structures, and could be readily controlled by remote valve.

4.5 SUPPORTS

4.5.1 Piping systems shall be substantially supported and protected against physical damage and excessive stresses arising from settlement, vibration, expansion or contraction.

4.6 PROTECTION AGAINST CORROSION

4.6.1 All piping for flammable or combustible liquids, both aboveground and underground, where subject to external corrosion, shall be painted or otherwise protected.

4.7 VALVES

4.7.1 Piping systems shall contain a sufficient number of valves to operate the system properly and to protect the plant. Piping systems in connection with pumps shall contain a sufficient number of valves to control properly the flow of liquid in normal operation and in the event of physical damage. Each connection to pipelines, by which equipment such as tank cars or tank vehicles discharge liquids by means of pumps into storage tanks, shall be provided with a check valve for automatic protection against backflow if the piping arrangement is such that back-flow from the system is possible.

4.8 TESTING

- 4.8.1 All piping before being covered, enclosed or placed in use shall be hydrostatically tested to 150 percent of the maximum anticipated pressure of the system, or pneumatically tested to 110 percent of the maximum anticipated pressure of the system, but not less than 5 pounds per square inch gage at the highest point of the system. This test shall be maintained for a sufficient time to complete visual inspection of all joints and connections, but for at least 10 minutes.

SECTION 5 - CONTAINER AND PORTABLE TANK STORAGE

5.1 SCOPE OF SECTION 5

5.1.1 This Section 5 shall apply only to the storage of flammable or combustible liquids in drums or other containers (including flammable aerosols) not exceeding 60 gallons individual capacity and those portable tanks not exceeding 660 gallons individual capacity.

5.1.2 Section 5 shall not apply to:

- (a) Flammable liquids in the fuel tanks of a motor vehicle, aircraft, boat or portable or stationary engine.
- (b) 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.
- (c) Beverages when packaged in individual containers not exceeding one gallon in size.

5.2 DESIGN, CONSTRUCTION, AND CAPACITY OF CONTAINERS

5.2.1 Only approved containers and portable tanks shall be used. Metal containers and portable tanks meeting the requirements of and containing products authorized by the USDOT Regulations shall be deemed to be acceptable.

5.2.2. Each portable tank shall be provided with one or more devices installed in the top with sufficient emergency venting capacity to limit internal pressure under fire exposure conditions to 10 psig, or 30 percent of the bursting pressure of the tank, whichever is greater. The total venting capacity shall be not less than that specified in 3.2.5(c) and (e). At least one pressure-actuated vent having a minimum capacity of 6,000 cu ft. of free air (14.7 psia and 60°F) shall be used. It shall be set to open at not less than 5 psig. If fusible vents are used, they shall be actuated by elements that operate at a temperature not exceeding 300°F.

5.2.3 Flammable and combustible liquids packaged for sale or use shall conform to Table 5.2.3 except as provided in 5.2.4 and 5.2.5.

TABLE 5.2.3
MAXIMUM ALLOWABLE SIZE OF CONTAINERS AND PORTABLE TANKS

CONTAINER TYPE	FLAMMABLE LIQUIDS				COMBUSTIBLE LIQUIDS
	Class IA	Class IB	Class IC	Class II	Class III
Plastic	1 pt.	1 qt.	1 gal.	1 gal.	1 gal.
Metal (Other Than USDOT Drums)	1 gal.	5 gal.	5 gal.	5 gal.	5 gal.
Safety Cans	2 gal.	5 gal.	5 gal.	5 gal.	5 gal.
Metal Drums (USDOT Spec.)	60 gal.	60 gal.	60 gal.	60 gal.	60 gal.
Approved Portable Tanks	660 gal.	660 gal.	660 gal.	660 gal.	660 gal.

5.2.4 Medicines, beverages, foodstuffs, cosmetics, and other common consumer items, when packaged according to commonly accepted practices, shall be exempt from the requirements of 5.2.

5.2.5 Upon presentation of satisfactory proof that storage of flammable or combustible liquids in metal containers would affect their chemical purity or result in excessive corrosion of the container, the Bureau may approve other containers.

5.3 DESIGN, CONSTRUCTION, AND CAPACITY OF STORAGE CABINETS

5.3.1 Not more than 60 gallons of flammable or 120 gallons of combustible liquids may be stored in a storage cabinet. When approved by the Bureau, three such cabinets may be located in a single fire area.

5.3.2 Storage cabinets shall be designed and constructed to limit the internal temperature to not more than 325°F when subjected to a ten-minute fire test using the standard time temperature curve as set forth in Standard Methods of Fire Tests of Building Construction and Materials, NFPA No. 251-1969. All joints and seams shall remain tight and the door shall remain securely closed during the first test. Cabinets shall be labeled in conspicuous lettering, "FLAMMABLE--KEEP FIRE AWAY".

5.3.3 Metal cabinets constructed in the following manner shall be deemed to be in compliance with 5.3.2. The bottom, top, door and sides of cabinet shall be at least No. 18 gage sheet iron and double walled with 1½ inch air space. Joints shall be riveted, welded or made tight by some equally effective means. The door shall be provided with a three-point lock, and the door sill shall be raised at least two inches above the bottom of the cabinet.

5.3.4 Wooden cabinets constructed in the following manner shall be deemed in compliance with 5.3.2. The bottom, sides and top shall be constructed of an approved grade of plywood at least 1 inch in thickness, which shall not break down or delaminate under fire conditions. All joints shall be rabbetted and shall be fastened in two directions with flathead wood screws. When more than one door is used, there shall be rabbetted overlap of not less than 1 inch. 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 the fire test.

5.4 DESIGN AND CONSTRUCTION OF INSIDE STORAGE ROOMS

5.4.1 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 Tests of Building Construction and Materials, NFPA No. 251-1969. Where an automatic sprinkler 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 liquidtight raised sills or ramps at least four inches in height, or the floor in the storage area shall be at least four inches below the surrounding floor. Openings shall be provided with approved self-closing fire doors. The room shall be liquidtight 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 properties are exposed, windows shall be protected as set forth in the Standard for the Installation of Fire Doors and Windows, NFPA No. 80-1968, for Class E or F openings. Wood at least one inch nominal thickness may be used for shelving, racks, dunnage, scuffboards, floor overlay and similar installations.

5.4.2 Storage in Inside Storage Rooms shall comply with Table 5.4.2

TABLE 5.4.2

FIRE PROTECTION (1) PROVIDED	FIRE RESISTANCE RATING	MAXIMUM SIZE	TOTAL ALLOWABLE QUANTITIES Gals./sq.ft.
YES	2 hour	500 sq. ft.	10
NO	2 hour	500 sq. ft.	4
YES	1 hour	150 sq. ft.	5
NO	1 hour	150 sq. ft.	2

Note to Table

1. Fire protection system shall be sprinkler, water spray or carbon dioxide system approved by the Bureau.

5.4.3 Electrical wiring and equipment located in Inside Storage Rooms used for Class I liquids shall be approved for Class I, Division 2 Hazardous Locations; for Class II and Class III liquids, shall be approved for general use.

5.4.4 Every Inside Storage Room shall be provided with either a gravity or a mechanical exhaust ventilation system. Such system shall be designed to provide for a complete change of air within the room at least six times per hour. If mechanical exhaust system is used, it shall be controlled by a switch located outside of the door. The ventilating equipment and any lightning fixtures shall be operated by the same switch. A pilot light shall be installed adjacent to the switch if Class I flammable liquids are dispensed within the room. Where gravity ventilation is provided, the fresh air intake, as well as the exhaust outlet from the room, shall be on the exterior of the building in which the room is located. The fresh air intake shall be remotely located from the exhaust outlet.

5.4.5 In every Inside Storage Room there shall be maintained one clear aisle at least three feet wide. Containers over 30 gallons capacity shall not be stacked one upon the other. Dispensing shall be by approved pump or self-closing faucet only.

5.4.6 Inside rooms shall be equipped with adequate vents to provide fire and explosion relief.

5.5 STORAGE INSIDE BUILDINGS

- 5.5.1 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.
- 5.5.2 The storage of flammable or combustible liquids in containers or portable tanks shall comply with 5.5.3 through 5.5.8 except that the Bureau may impose a quantity limitation or require greater protection where unusual hazard to life or property is involved. Increase of these amounts may be authorized where the type of construction, fire protection provided, or other factors substantially reduce the hazard.
- 5.5.3 Assembly Occupancies:
- (a) Storage in excess of 10 gallons shall be in containers stored in a storage cabinet or in safety cans or in an Inside Storage Room not having an opening communicating with that portion of the building used by the employee.
- 5.5.4 Mercantile Occupancies and Other Retail Stores:
- (a) In rooms or areas accessible to the public, storage shall be limited to quantities needed for display and normal merchandising purposes but shall not exceed two gallons per square foot of gross floor area. Materials needed for display and normal merchandising purposes normally shall be restricted to one case of each brand name and each size displayed. The gross floor area used for computing the maximum quantity permitted shall be considered as that portion of the store actually being used for merchandising flammable and combustible liquids.
 - (b) Where the aggregate quantity of additional stock exceeds 60 gallons of Class IA, 120 gallons of Class IB, 180 gallons of Class IC, 240 gallons of Class II, or 500 gallons of combustible liquids or any combination of flammable liquids exceeding 240 gallons shall be stored in a room or portion of the building that complies with the construction provisions for an Inside Storage Room as provided in 5.4.
 - (c) Containers in display area shall not be stacked more than three feet or two containers high, whichever is the greater, unless on fixed shelving or otherwise satisfactorily secured.

- (d) Shelving shall be of stable construction, of sufficient depth and arrangement such that containers displayed thereon shall not be easily displaced.
- (e) Leaking containers shall be removed to a storage room or taken to a safe location outside the building and the contents transferred to an undamaged container.

5.5.5 General Purpose Public Warehouses:

- (a) Storage shall be in accordance with Tables 5.5.5 or Table 5.5.6 and in buildings or in portions of such buildings cut off by walls having a fire resistance rating of not less than 2 hours. Material creating no fire exposure hazard to the flammable or combustible liquids may be stored in the same area.

5.5.6 Flammable and Combustible Liquid Warehouses or Storage Buildings:

- (a) If storage building is located 50 feet or less from a building or property line, the exposing wall shall be a blank wall having a fire-resistance rating of at least two hours.
- (b) The total quantity of liquids within a building shall not be limited but the arrangement of storage shall comply with Tables 5.5.5 and 5.5.6.
- (c) Containers in piles shall be separated by pallets or dunnage where necessary to provide stability and to prevent excessive stress on container walls.
- (d) Portable tanks stored over one tier high shall be designed to nest securely, without dunnage, and adequate materials handling equipment shall be available to handle tanks safely at the upper tier level.
- (e) No pile shall be closer than three feet to the nearest beam, chord, girder or other obstructions, and shall be three feet below sprinkler deflectors or discharge orifices of water spray, or other overhead fire protection systems.
- (f) Aisles at least three feet wide shall be provided where necessary for reasons of access to doors, windows or standpipe connections.

TABLE 5.5.5
INDOOR CONTAINER STORAGE (3)

CLASS LIQUID	STORAGE LEVEL	PROTECTED STORAGE (1) MAXIMUM PER PILE (2)		UNPROTECTED STORAGE MAXIMUM PER PILE (2)	
		Gals.	Height(4)	Gals.	Height(4)
IA	Ground & Upper Floors	2,750 <u>50</u>	3 ft. <u>1</u>	660 <u>12</u>	3 ft. <u>1</u>
	Basement	NOT PERMITTED		NOT PERMITTED	
IB	Ground & Upper Floors	5,500 <u>100</u>	6 ft. <u>2</u>	1,375 <u>25</u>	3 ft. <u>1</u>
	Basement	NOT PERMITTED		NOT PERMITTED	
IC	Ground & Upper Floors	16,500 <u>300</u>	6 ft. <u>2</u>	4,125 <u>75</u>	3 ft. <u>1</u>
	Basement	NOT PERMITTED		NOT PERMITTED	
II	Ground & Upper Floors	16,500 <u>300</u>	9 ft. <u>3</u>	4,125 <u>75</u>	9 ft. <u>3</u>
	Basement	5,500 <u>100</u>	9 ft. <u>3</u>	NOT PERMITTED	
Combustible	Ground & Upper Floors	55,000 <u>1,000</u>	15 ft. <u>5</u>	13,750 <u>250</u>	12 ft. <u>4</u>
	Basement	8,250 <u>450</u>	9 ft. <u>3</u>	NOT PERMITTED	

Notes to Table

1. A Sprinkler or equivalent fire protection system acceptable to the Bureau (Numbers underlined indicate corresponding number of 55-gallon drums.)
2. When two or more classes of materials are stored in a single pile, the maximum gallonage permitted in that pile shall be the smallest of the two or more separate maximum gallonages.
3. Aisles shall be provided so that no container is more than 12 feet from an aisle. Main aisles shall be at least eight feet wide and side aisles at least four feet wide.
4. Each pile shall be separated from each other pile by at least four feet. When stored on suitably protected racks or when the storage is suitably protected, containers may be piled up to the height limits in 5.5.6(e) where approved by the Bureau.

TABLE 5.5.6
INDOOR PORTABLE TANK STORAGE(3)

CLASS LIQUID	STORAGE LEVEL	PROTECTED STORAGE (1) MAXIMUM PER GROUP (2)		UNPROTECTED STORAGE MAXIMUM PER GROUP (2)	
		Gals.	Height (4)	Gals.	Height (4)
IA	Ground & Upper Floors	NOT PERMITTED		NOT PERMITTED	
	Basement	NOT PERMITTED		NOT PERMITTED	
IB	Ground & Upper Floors	20,000	7 ft.	2,000	7 ft.
	Basement	NOT PERMITTED		NOT PERMITTED	
IC	Ground & Upper Floors	40,000	14 ft.	5,500	7 ft.
	Basement	NOT PERMITTED		NOT PERMITTED	
II	Ground & Upper Floors	40,000	14 ft.	5,500	7 ft.
	Basement	20,000	7 ft.	NOT PERMITTED	
Combustible	Ground & Upper Floors	60,000	14 ft.	22,000	7 ft.
	Basement	20,000	7 ft.	NOT PERMITTED	

Notes to Table

1. A sprinkler or equivalent fire protection system installed in accordance with the applicable NFPA Standard and approved by the Bureau.
2. When two or more classes of materials are stored in a single pile, the maximum gallongge permitted in that pile shall be the smallest of the two or more separate maximum gallonages.
3. Aisles shall be provided so that no portable tank is more than 12 feet from an aisle. Main aisles shall be at least eight feet wide and side aisles at least four feet wide.
4. Each pile shall be separated from each other pile by at least four feet. When stored on suitably protected racks or when the storage is suitably protected, containers may be piled up to the height limits in 5.5.6(e) where approved by the Bureau.

5.6 STORAGE OUTSIDE BUILDINGS

5.6.1 Storage outside buildings shall be in accordance with Table 5.6.1 or Table 5.6.2 and 5.6.3 and 5.6.5.

TABLE 5.6.1
OUTDOOR CONTAINER STORAGE

I CLASS	II MAXIMUM PER PILE (1) GALLONS	III DISTANCE BETWEEN PILES (2)	IV DISTANCE TO PROPERTY LINE (3)
IA	1,100	5 ft.	40 ft.
IB	2,200	5 ft.	40 ft.
IC	4,400	5 ft.	40 ft.
II	8,800	5 ft.	20 ft.
Combustible	22,000	5 ft.	20 ft.

Notes to Table

1. When two or more classes of materials are stored in a single pile, the maximum gallonage in that pile shall be the smallest of the two or more separate gallonages.
2. Within 200 feet of each container, there shall be a 12-foot wide access way to permit approach of fire control apparatus.
3. When total quantity stored does not exceed 50 percent of maximum per pile, the distance in Column IV may be reduced 50 per cent.

TABLE 5.6.2
OUTDOOR PORTABLE TANK STORAGE

I CLASS	II MAXIMUM PER PILE (1) GALLONS	III DISTANCE BETWEEN (2) PILES	IV DISTANCE TO PROPERTY LINE (3)
IA	2,200	5 ft.	40 ft.
IB	4,400	5 ft.	40 ft.
IC	8,800	5 ft.	40 ft.
II	17,600	5 ft.	20 ft.
Combustible	44,000	5 ft.	20 ft.

Notes to Table

1. When two or more classes of materials are stored in a single pile, the maximum gallonage in that pile shall be the smallest of the two or more separate gallonages.
2. Within 200 feet of each portable tank, there shall be a 12-foot wide access way to permit approach of fire control apparatus.
3. When total quantity stored does not exceed 50 percent of maximum per pile, the distance in Column IV may be reduced 50 percent.

5.6.2 A maximum of 1,100 gallons of flammable or combustible liquids may be located adjacent to buildings located on the same premises and under the same management provided the provisions of 5.6.2(a) and (b) are complied with.

- (a) The building shall be a one-story building devoted principally to the handling and storing of flammable or combustible liquids or the building shall have two hour fire-resistive exterior walls having no opening within 10 feet of such storage.
- (b) Where quantity stored exceeds 1,100 gallons, or provisions of 5.6.2(a) cannot be met, a minimum distance of 10 feet between buildings and nearest container of flammable or combustible liquid shall be maintained.

5.6.3 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 at least six inches high. When curbs are used, provisions shall be made for draining of 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.

5.6.4 Storage area shall be protected against tampering or trespassers where necessary and shall be kept free of weeds, debris and other combustible material not necessary to the storage.

5.7 FIRE CONTROL.

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

(a) 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.

(b) At least one portable fire extinguisher having a rating of not less than 12-B units shall be located not less than 10 feet, nor more than 25 feet, from any flammable liquid storage area located outside of a storage room but inside a building.

5.7.2 When sprinklers are provided, they shall be installed in an approved manner.

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

5.7.4 Materials which will react with water shall not be stored in the same room with flammable or combustible liquids

5.7.5 Signs indicating "No Smoking or Ignition Sources Permitted" shall be posted in flammable or combustible liquid storage areas.

5.7.6 A fire lane shall be kept open at all times to and around a flammable or combustible liquid installation exceeding 1,000 gallons aggregate capacity.

5.7 FIRE CONTROL.

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

(a) 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.

(b) At least one portable fire extinguisher having a rating of not less than 12-B units shall be located not less than 10 feet, nor more than 25 feet, from any flammable liquid storage area located outside of a storage room but inside a building.

5.7.2 When sprinklers are provided, they shall be installed in an approved manner.

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

5.7.4 Materials which will react with water shall not be stored in the same room with flammable or combustible liquids

5.7.5 Signs indicating "No Smoking or Ignition Sources Permitted" shall be posted in flammable or combustible liquid storage areas.

5.7.6 A fire lane shall be kept open at all times to and around a flammable or combustible liquid installation exceeding 1,000 gallons aggregate capacity.

SECTION 6 - INDUSTRIAL PLANTS

6.1 SCOPE OF SECTION 6

- 6.1.1 This Section 6 shall apply to industrial plants utilizing flammable and combustible liquids.
- 6.1.2 This Section 6 shall not apply to chemical plants, refineries or distilleries, which are covered in Section 9.
- 6.1.3 Where portions of such plants involve chemical reactions such as oxidation, reduction, halogenation, hydrogenation, alkylation, polymerization, and other chemical processes, those portions of the plant shall be in accordance with Section 9.

6.2 INCIDENTAL STORAGE OR USE OF FLAMMABLE AND COMBUSTIBLE LIQUIDS

- 6.2.1 Section 6.2 shall be 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 automobile assembly, construction of electronic equipment, furniture manufacturing or other similar activities.
- 6.2.2 Flammable or combustible liquids shall be stored in tanks or closed containers.
 - (a) Except as provided in 6.2.2 (b) and 6.2.2 (c), all storage shall comply with 5.3 or 5.4.
 - (b) The quantity of liquid that may be located outside of an inside storage room or storage cabinet in a building or any fire area of a building shall not exceed that listed below:
 - (1) 25 gallons of Class 1A liquid in containers
 - (2) 120 gallons of Class 1B, 1C, II or III liquids in containers
 - (3) 660 gallons of Class 1B, 1C, II or III liquids in a single portable tank.
 - (c) Where large quantities of flammable or combustible liquids are necessary, storage may be in tanks which shall comply with the applicable requirements of Section 3.
- 6.2.3 Areas in which flammable or combustible liquids are transferred from one tank or container to another container shall be separated from other operations in the building by adequate distance or by construction having adequate fire resistance. Drainage or other means shall be provided to control spills. Adequate natural or mechanical ventilation shall be provided.

6.2.4 Handling Liquids at Point of Final Use.

- (a) Flammable liquids shall be kept in covered containers when not actually in use.
- (b) 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.
- (c) Class I liquids may be used only where there are no open flames or other sources of ignition within the possible path of vapor travel.
- (d) Flammable or combustible liquids shall be drawn from or transferred into vessels or containers or portable tanks within a building only through a closed piping system, from safety cans, by means of a device drawing through the top of a container, or from a container by gravity through an approved self-closing valve. Transferring by means of air pressure on the container or portable tank shall be prohibited.

6.3 UNIT PHYSICAL OPERATIONS

- 6.3.1 Section 6.3 shall be applicable in 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. Such plants shall include but are not limited to those compounding cosmetics, pharmaceuticals, solvents, cleaning fluids, insecticides and similar types of activities.
- 6.3.2 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. Buildings shall be located with respect to property lines as set forth in 9.2.1 and 9.2.2, except that the blank wall referred to in 9.2.2 shall have a fire resistance rating of at least two hours.
- 6.3.3 Areas where unstable liquids are handled or small scale unit chemical processes are carried on shall be separated from the remainder of the plant by a wall having at least two-hour fire resistance rating.
- 6.3.4 Drainage
 - (a) Emergency drainage systems shall be provided to direct flammable or combustible liquid leakage and fire protection water to a safe location. This may require curbs, scuppers, or special drainage systems to control the spread of fire, see 3.2.8.
 - (b) Emergency drainage systems shall not discharge to public sewers or public waterways.

- (c) The industrial plant shall be designed and operated to prevent the normal discharge of flammable or combustible liquids into public waterways, public sewers, or adjoining property.

6.3.5 Ventilation

- (a) Areas as defined in 6.3.1 using Class I liquids shall be ventilated at a rate of not less than one cubic foot per minute per square foot of solid floor area. This shall be accomplished by natural or mechanical ventilation which discharge or exhaust to a safe location outside of the building. Provision shall be made for introduction of make-up air in such a manner as not to short circuit the ventilation. Ventilation shall be arranged to include all floor areas or pits where flammable vapors may collect.

6.3.6 Storage, Transfer and Handling of Liquids

- (a) The storage, transfer and handling of liquids shall comply with 9.4.

6.4 TANK VEHICLE AND TANK CAR LOADING AND UNLOADING

- 6.4.1 Tank vehicle and tank car loading or unloading facilities shall be separated from aboveground tanks, warehouses, other plant buildings or nearest property line 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. Building for pumps or shelters for personnel may be a part of the facility. Operations of the facility shall comply with the appropriate portions of 7.3.

6.5 FIRE CONTROL

- 6.5.1 Portable fire extinguishment and control equipment shall be provided in such quantities and types as are needed for the special hazards of operation and storage.
- 6.5.2 Water shall be available in volume and at adequate pressure to supply water hose streams, foam-producing equipment, automatic sprinklers or water spray systems as the need is indicated by the special hazards of operation, storage, and dispensing.
- 6.5.3 Special extinguishing equipment such as that utilizing foam, inert gas, or dry chemical shall be provided as the need is indicated by the special hazard of operation and storage.

- 6.5.4 Where the need is indicated by special hazards of operation, flammable or combustible liquid processing equipment, major piping, and supporting steel shall be protected by approved water spray systems, deluge systems, approved fire resistant coatings, insulation or any combination of these.
- 6.5.5 An approved fire alarm system shall be provided for prompt notification of fire. Where service is available, a public fire alarm box shall be located nearby.
- 6.5.6 All plant fire protection facilities shall be adequately maintained and periodically inspected and tested to make sure they are always in satisfactory operating condition, and they will serve their purpose in time of emergency.

6.6 SOURCES OF IGNITION

- 6.6.1 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.
- 6.6.2 Class I liquids shall not be dispensed into containers unless the nozzle and container are electrically interconnected. Where the metallic floorplate on which the container stands while fillings is electrically connected to the fill stem or where the fill stem is bonded to the container during filling operations by means of a bond wire, the provisions of this section shall be deemed to have been complied with.

6.7 ELECTRICAL EQUIPMENT

- 6.7.1 Electrical wiring and equipment shall comply with 1.6.

6.8 REPAIRS TO EQUIPMENT

- 6.8.1 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. A qualified person shall make an inspection of the area to be sure that it is safe for the work to be done and that safe procedures will be followed for the work specified.

6.9 HOUSEKEEPING

- 6.9.1 Maintenance and operating practices shall be in accordance with established procedures which will tend to control leakage and prevent the accidental escape of flammable or combustible liquids. Spills shall be cleaned up promptly.
- 6.9.2 Adequate aisles shall be maintained for unobstructed movement of personnel and so that fire protection equipment can be brought to bear on any part of flammable or combustible liquid storage, use, or any unit physical operation.
- 6.9.3 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.
- 6.9.4 Ground area around buildings and unit operating areas shall be kept free of weeds, trash or other unnecessary combustible materials.

SECTION 7 - BULK PLANTS

7.1 STORAGE

- 7.1.1 Class I liquids shall be stored in closed containers, or in storage tanks aboveground outside of buildings, or underground in accordance with Section 3.
- 7.1.2 Class II and Class III liquids shall be stored in containers, or in tanks within buildings or aboveground outside of buildings, or underground in accordance with Section 3.
- 7.1.3 Containers of flammable or combustible liquids when piled one upon the other shall be separated by dunnage sufficient to provide stability and to prevent excessive stress on container walls. The height of pile shall be consistent with stability and strength of containers.

7.2 BUILDINGS

7.2.1 Exits

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

7.2.2 Heating

- (a) 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. Rooms containing heating appliances involving sources of ignition shall be located and arranged to prevent entry of flammable vapors.

7.2.3 Ventilation

- (a) Ventilation shall be provided for all rooms, buildings, or enclosures in which Class I liquids are pumped or dispensed to provide at least six air changes per hour. Design of ventilation systems shall take into account the relatively high specific gravity of the vapors. Ventilation may be provided by adequate openings in outside walls at floor level unobstructed except by louvers or coarse screens. Where natural ventilation is inadequate, mechanical ventilation shall be provided.
- (b) Class I liquids shall not be stored or handled within a building having a basement or pit into which flammable vapors may travel, unless such area is provided with ventilation designed to prevent the accumulation of flammable vapors therein.

- (c) Containers of Class I liquids shall not be drawn from or filled within buildings unless provision is made to prevent the accumulation of flammable vapors in hazardous concentrations. Where mechanical ventilation is required, it shall be kept in operation while flammable liquids are being handled.

7.3 LOADING AND UNLOADING FACILITIES

- 7.3.1 Tank vehicle and tank car loading or unloading facilities shall be separated from aboveground tanks, warehouses, other plant buildings or nearest property line by a distance of at least 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 a part of the facility.
- 7.3.2 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.
- 7.3.3 Valves used for the final control for filling tank vehicles shall be of the self-closing type and manually held open except where automatic means are provided for shutting off the flow when the vehicle is full or after filling a preset amount.
- 7.3.4 Static Protection: Bonding and grounding facilities for protection against static sparks during the loading of tank vehicles through open domes shall be provided where Class I liquids are loaded, or where Class II or Class III liquids are loaded into vehicles which may contain vapors from previous cargoes of Class I liquids.
 - (a) Protection as required in 7.3.4 shall consist of a metallic bond wire permanently electrically connected to the fill stem or to some part of the rack structure in electrical contact with the fill stem. The free end of such wire shall be provided with a clamp or equivalent device for convenient attachment to some metallic part in electrical contact with the cargo tank of the tank vehicle.
 - (b) Such bonding connection shall be made fast to the vehicle or tank before dome covers are raised and shall remain in place until filling is completed and all dome covers have been closed and secured.

(c) Bonding as specified in 7.3.4, 7.3.4(a) and 7.3.4(b) is not required:

- (1) Where vehicles are loaded exclusively with products not having a static accumulating tendency, such as asphalt, most crude oils, residual oils and water soluble liquids;
- (2) Where no Class I liquids are handled at the loading facility and the tank vehicles loaded are used exclusively for Class II and Class III liquids;
- (3) Where vehicles are loaded or unloaded through closed bottom or top connections.

(d) Filling through open domes into the tanks of tank vehicles or tank cars, that contain vapor-air mixtures within the flammable range or where the liquid being filled can form such a mixture, shall be by means of a downspout which extends near the bottom of the tank. This precaution is not required when loading liquids which are nonaccumulators of static charges.

(e) Bonded equipment shall be connected to a ground.

7.3.5 Stray Currents:

- (a) Tank car loading facilities where Class I liquids are loaded through open domes shall be protected against stray currents by bonding the pipe to at least one rail and to the rack structure if of metal. Multiple lines entering the rack area shall be electrically bonded together.
- (b) In addition, in areas where excessive stray currents are known to exist, all pipe entering the rack area shall be provided with insulating sections to electrically isolate the rack piping from the pipelines.
- (c) No bonding between the tank car and the rack or piping is required during either loading or unloading of Class II or Class III liquids.

7.3.6 Container Filling Facilities:

- (a) Class I liquids shall not be dispensed into containers unless the nozzle and container are electrically interconnected.
- (b) Where the metallic floorplate on which the container stands while filling is electrically connected to fill stem or where the fill stem is bonded to the container during fillings operations by means of a bond wire, the provisions of 7.3.6(a) shall be deemed to have been complied with.

7.4 ELECTRICAL EQUIPMENT

7.4.1 Electrical wiring and equipment shall comply with 1.6.

7.5 SOURCES OF IGNITION

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

7.5.2 Smoking shall be prohibited except in designated localities. "NO SMOKING" signs shall be conspicuously posted where hazard from flammable liquids vapors is normally present. Installations shall comply with Bureau Safety Regulation No 1, Smoking.

7.6 DRAINAGE AND WASTE DISPOSAL

7.6.1 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.

7.7 FIRE CONTROL

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

7.7.2 Additional fire-control equipment may be required where a tank of more than 50,000 gallons individual capacity contains Class I liquids and where an unusual exposure hazard exists from surrounding property. Such additional fire-control equipment shall be sufficient to extinguish a fire in the largest tank.

SECTION 8 - SERVICE STATIONS

8.1 STORAGE AND HANDLING

8.1.1 General Provisions

- (a) Liquids shall be stored in approved closed containers not exceeding 60 gallons capacity, in tanks located underground, in tanks in special enclosures as described in 8.1.2, or in aboveground tanks as provided for in 8.4.2(a) (b) and (c).
- (b) Aboveground tanks, located in an adjoining bulk plant, may be connected by piping to service station underground tanks if, in addition to valves at aboveground tanks, a valve is also installed within control of service station personnel.
- (c) Apparatus dispensing Class I liquids into the fuel tanks of motor vehicles of the public shall not be located at a bulk plant unless separated by a fence or similar barrier from the area in which bulk operations are conducted.
- (d) The provisions of 8.1.1(a) shall not prohibit the temporary use of moveable tanks in conjunction with the dispensing of flammable or combustible liquids into the fuel tanks of motor vehicles or other motorized equipment on premises not normally accessible to the public. Such installations shall be made only when approved by the Bureau.
- (e) The provisions of 8.1.1(a) shall not prohibit the dispensing of flammable liquids in the open from a tank vehicle to a motor vehicle. Such dispensing shall be permitted provided:
 - (1) The tank vehicle complies with the Standard on Tank Vehicles for Flammable Liquids, NFPA NO. 385 - 1966 and the Regulations of the Department of Public Safety.
 - (2) The dispensing is done on premises not open to the public.
 - (3) The dispensing hose does not exceed 50 feet in length.
 - (4) The dispensing nozzle is a listed automatic-closing type without a latch-open device.
 - (5) Approved by the Bureau.

- (f) Class I liquids shall not be stored or handled within a building having a basement or pit into which flammable vapors may travel.
- (g) Accurate inventory records shall be maintained and reconciled on all Class I liquid storage tanks for possible indication of leakage from tanks or piping.

8.1.2 Special Enclosures

- (a) When installation of tanks in accordance with 3.3 is impractical because of property or building limitations, tanks for flammable or combustible liquids may be installed in buildings if enclosed and approved by the Bureau.
- (b) Enclosure shall be substantially liquid and vaportight without backfill. Sides, top and bottom of the enclosure shall be of reinforced concrete at least six inches thick, with openings for inspection through the top only. Tank connections shall be so piped or closed that neither vapors nor liquid can escape into the enclosed space. Means shall be provided whereby portable equipment may be employed to discharge to the outside any liquid or vapors which might accumulate should leakage occur.
- (c) At automotive service stations provided in connection with tenant or customer parking facilities at or below grade level in large buildings of commercial, mercantile or residential occupancy, tanks containing Class I liquids, installed of necessity in accordance with 8.1.2(b), shall not exceed 6,000 gallons individual or 18,000 gallons aggregate capacity.

8.1.3 Inside Buildings

- (a) Except where stored in tanks as provided in 8.1.2, no Class I liquids shall be stored within any service station building except in closed containers of aggregate capacity not exceeding 120 gallons. One container not exceeding 60 gallons capacity equipped with an approved pump is permitted.
- (b) Class I liquids may be transferred from one container to another in lubrication or service rooms of a service station building provided the electrical installation complies with 8.5 and provided that any heating equipment complies with 8.6. See also 8.3.1 for other possible sources of ignition.

- (c) Class II and Class III liquids may be stored and dispensed inside service station buildings from tanks of not more than 120 gallons capacity each.

8.1.4 Labeling

- (a) No sale or purchase of any Class I, II or III liquids shall be made in containers unless such containers are clearly marked with the name of the product contained therein.

8.1.5 Dispensing into Portable Containers

- (a) No delivery of any Class I liquids shall be made into portable containers unless the container is constructed of metal or is approved by the Bureau, 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.

8.2 ATTENDANCE OR SUPERVISION OF DISPENSING

- 8.2.1 Each service station open to the public shall have an attendant whenever the station is open for business.

- 8.2.2 Service stations owned or operated by commercial, industrial or manufacturing establishments for servicing their own vehicles or those of their employees do not require an attendant.

8.3 DISPENSING SYSTEMS

8.3.1 Location

- (a) Dispensing devices at automotive service stations shall be so located that all parts of the vehicle being served will be on the premises of the service station.
- (b) Approved dispensing units may be located inside of buildings when approved by the Bureau. The dispensing area shall be separated from other areas in a manner approved by the Bureau. The dispensing unit and its piping shall be mounted either on a concrete island or protected against collision by suitable means and shall be located in a position where it cannot be struck by a vehicle out of control descending a ramp or other slope. The dispensing area shall be provided with an approved mechanical or gravity ventilation system. When dispensing units are located below grade, only approved mechanical ventilation shall be used, the entire dispensing area shall be protected by an approved automatic sprinkler system, and electrical equipment shall comply with 1.6. Ventilating systems shall be electrically interlocked with gasoline dispensing units so that the dispensing units cannot be operated unless the ventilating fan motors are energized.

8.3.2 Emergency Power Cutoff

- (a) 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.

8.3.3 Dispensing Units

- (a) Class I liquids shall be transferred from tanks by means of fixed pumps so designed and equipped as to allow control of the flow and to prevent leakage or accidental discharge.
- (b) Dispensing devices for Class I liquids shall be of approved type.
- (c) Class I liquids shall not be dispensed by pressure from drums, barrels, and similar containers. Approved pumps taking suction through the top of the container or approved self-closing faucets shall be used.
- (d) The dispensing units, except those attached to containers, shall be mounted either on a concrete island or protected against collision by suitable means.

8.3.4 Remote Pumping Systems

- (a) This section shall apply to systems for dispensing Class I liquids where such liquids are transferred from storage to individual or multiple dispensing units by pumps located elsewhere than at the dispensing units.
- (b) Pumps shall be designed or equipped so that no part of the system will be subjected to pressures above its allowable working pressure. Pumps installed above grade, outside of buildings, shall be located not less than ten feet from the adjoining property lines, and not less than five feet from any building opening. When an outside pump location is impractical, pumps may be installed inside of buildings as provided for dispensers in 8.3.1(b), or in pits as provided in 8.3.4(c). Pumps shall be substantially anchored and protected against physical damage by vehicles.

- (c) Pits for subsurface pumps or piping manifolds of submersible pumps shall withstand the external forces to which they may be subjected without damage to the pump, tank, or piping. The pit shall be no larger than necessary for inspection and maintenance and shall be provided with a fitted cover.
- (d) A control shall be provided that will permit the pump to operate only when a dispensing nozzle is removed from its bracket on the dispensing unit and the switch on this dispensing unit is manually actuated. This control shall also stop the pump when all nozzles have been returned to their brackets.
- (e) An approved impact valve, incorporating a fustible link, designed to close automatically in event of severe impact or fire exposure shall be properly installed in the dispensing supply line at the base of each individual dispensing device.
- (f) Testing: After the completion of the installation, including any paving, that section of the pressure piping system between the pump discharge and the connection for the dispensing facility shall be tested for at least 30 minutes at the maximum operating pressure of the system. Such tests shall be repeated at two-year intervals thereafter.

8.3.5 Delivery Nozzles

- (a) Hose nozzle valves of either the manual or automatic-closing type for dispensing Class I liquids into a fuel tank or into a container shall be manually held open during the dispensing operation except as provided in 8.3.5(b).
- (b) On any service station dispenser accessible to the public a listed automatic type nozzle with hold-open latch is permitted only when all dispensing of Class I liquids is to be done by the service station attendant.

8.3.6 Special Type Dispensers

- (a) Approved special dispensing devices such as, but not limited to, coin-operated, card-operated, and remote preset types are permitted at service stations open to the public, provided that dispensing of Class I liquids is performed by a qualified attendant when the station is open to the public.

- (b) It shall be the responsibility of the attendant to prevent the dispensing of Class I liquids into portable containers not in compliance with 8.1.5, control sources of ignition, and to immediately handle accidental spills and fire extinguishers if needed.
- (c) Emergency controls shall be installed at a location to not more than 100 feet from dispensers.
- (d) Instructions for the operation of dispensers shall be conspicuously posted.

8.4 MARINE SERVICE STATIONS

- 8.4.1 The dispensing area shall be located from other structures so as to provide room for safe ingrees and egresses of craft to be fueled. Dispensing units shall in all cases be at least 20 feet from any activity not associated with the handling of fuel.
 - (a) Dispensing shall be by approved dispensing units with or without integral pumps and may be located on open piers, wharves or floating docks or on shore or on piers of the solid fill type.
 - (b) Dispensing nozzles shall be automatic-closing without a latch-open device.
- 8.4.2 Tanks, and pumps not integral with the dispensing unit, shall be on shore or on a pier of the solid fill type, except as provided in 8.4.2(a) and (b).
 - (a) Where shore location would require excessively long supply lines to dispensers, the Bureau may authorize the installation of tanks on a pier provided that applicable portions of Section 3 relative to spacing, diking and piping are complied with and the quantity so stored does not exceed 1,100 gallons aggregate capacity.
 - (b) Shore tanks supplying marine stations may be located aboveground, where rock ledges or high water table make underground tanks impractical.
 - (c) Where tanks are at an elevation which would produce gravity head on the dispensing unit, the tank outlet shall be equipped with a pressure control valve positioned adjacent to and outside the tank block valve specified in 3.2.11(b), so adjusted that liquid cannot flow by gravity from the tank in case of piping or hose failure.

8.4.3 Piping between shore tanks and dispensing units shall be as specified in Section 4, except that, where dispensing is from a floating structure, suitable lengths of oil-resistant flexible hose may be employed between the shore piping and the piping on the floating structure as made necessary by change in water level or shore line.

- (a) A readily accessible valve to shut off the supply from shore shall be provided in each pipeline at or near the approach to the pier and at the shore end of each pipeline adjacent to the point where flexible hose is attached.
- (b) Piping shall be located so as to be protected from physical damage.
- (c) Piping handling Class I liquids shall be grounded to control stray currents.

8.5 ELECTRICAL EQUIPMENT

8.5.1 Electrical wiring and equipment shall comply with 1.6.

8.6 HEATING EQUIPMENT

8.6.1 Heating equipment may be installed in the conventional manner in an area except as provided in 8.6.2 through 8.6.5.

8.6.2 Heating equipment may be installed in a special room separated from an area classified by 1.6 by walls having a fire resistance rating of at least one hour and without any openings in the walls within eight feet of the floor into an area classified in 1.6. This room shall not be used for combustible storage and all air for combustion purposes shall come from outside the building.

8.6.3 Heating equipment using gas or oil fuel may be installed in the lubrication, sales or service room where there is no dispensing or transferring of Class I liquids provided the bottom of the combustion chamber is at least 18 inches above the floor and the heating equipment is protected from physical damage by vehicles.

8.6.4 Heating equipment using gas or oil fuel listed for use in garages may be installed in the lubrication or service room where Class I liquids are dispensed provided the equipment is installed at least eight feet above the floor.

8.6.5 Electrical heating equipment shall conform to 8.5.

8.7 CONSTRUCTION

- 8.7.1 Building and spaces used as service stations shall be classified as low hazard storage.
- 8.7.2 Service stations may be permitted in separate buildings, open parking structures, public garages or in shops used for repair, body work, or painting. When dispensing is provided in repair, body work or painting shops, the dispensing shall be cut off by construction having at least a 3/4 hour fire resistance rating.
- 8.7.3 Service stations when in separate buildings shall have no basement or cellars.
- 8.7.4 Service stations shall be of Type 1,2, or 3 construction, comply with Table 301.0 and Table 705.1 of Safety Regulation on the building code.

8.8 DRAINAGE AND WASTE DISPOSAL

- 8.8.1 Provision shall be made in the area where Class I liquids are dispensed to prevent spilled liquids from flowing into the interior of service station buildings. Such provision may be by grading driveways, raising door sills, or other equally effective means. Crankcase drainings and flammable or combustible liquids shall not be dumped into sewers but shall be stored in tanks or drums outside of any building until remove from the premises.

8.9 SOURCES OF IGNITION

- 8.9.1 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.
- 8.9.2 Conspicuous and legible signs prohibiting smoking shall be posted within sight of the customer being served. The motors of all equipment being fueled shall be shut off during the fueling operation.

8.10 FIRE CONTROL

- 8.10.1 Each service station shall be provided with at least one fire extinguisher having a minimum classification of 6 B, C located so that an extinguisher will be within 75 feet of each pump, dispenser, underground fill pipe opening, and lubrication or service room.

SECTION 9 - PROCESSING PLANTS

9.1 SCOPE OF SECTION 9

- 9.1.1 This Section 9 shall apply to processing plants utilizing flammable and combustible liquids.
- 9.1.2 This Section 9 shall also apply to chemical plants, refineries and distilleries.

9.2 LOCATION

- 9.2.1 The location of each processing vessel shall be based upon its flammable or combustible liquid capacity. Processing vessels shall be located with respect to distances to lines of adjoining property in accordance with Table 9.2.1, except when the processing plant is designed with 9.2.2.

TABLE 9.2.1

PROCESSING VESSELS WITH EMERGENCY RELIEF VENTING TO PERMIT PRESSURE	STABLE LIQUIDS	UNSTABLE LIQUIDS
Not in excess of 2.5 psig	2 times Table 3.2.1(e)	5 times Table 3.2.1(e)
Over 2.5 psig	3 times Table 3.2.1(e)	8 times Table 3.2.1(e)

- 9.2.2 The distances required in 9.2.1 may be waived when the vessels are housed within a building and the exterior wall facing the line of adjoining property is a blank wall having a fire resistance rating of not less than four hours. When Class IA or unstable liquids are handled, the blank wall shall have explosion resistance.

9.3 PROCESSING BUILDING

9.3.1 Construction

- (a) Processing buildings shall be of fire resistive or non-combustible construction, except heavy timber construction with load-bearing walls may be permitted for plants utilizing only stable Class II or Class III liquids. Except as provided in 9.3.2 or in the case of explosion resistant walls used in conjunction with explosion relieving facilities, see 9.3.4, load-bearing walls shall be prohibited. Buildings shall be without basements or covered pits.

- (b) Areas shall have adequate exit facilities arranged to prevent occupants from being trapped in the event of fire. Exits shall not be exposed by the drainage facilities described in 9.3.2.

9.3.2 Drainage

- (a) Emergency drainage systems shall be provided to direct flammable or combustible liquid leakage and fire protection water to a safe location. This may require curbs, scuppers, or special drainage systems to control the spread of fire. See 3.2.7(b).
- (b) Emergency drainage systems, if connected to public sewers or discharged into public waterways, shall be equipped with traps or separators.
- (c) The processing plant shall be designed and operated to prevent the normal discharge of flammable or combustible liquids to public waterways, public sewers, or adjoining property.

9.3.3 Ventilation

- (a) Enclosed processing buildings shall be ventilated at a rate of not less than one cubic foot per minute per square foot of solid floor area. This shall be accomplished by natural or mechanical ventilation with discharge or exhaust to a safe location outside of the building. Provision shall be made for introduction of make-up air in such a manner as not to short circuit the ventilation. Ventilation shall be arranged to include all floor areas or pits where flammable vapors may collect.

9.3.4 Explosion Relief

- (a) Areas where Class IA or unstable liquids are processed shall have explosion venting through one or more of the following methods:
 - (1) Open air construction
 - (2) Lightweight walls and roof
 - (3) Lightweight wall panels and roof hatches
 - (4) Windows of explosion venting type
- (b) The explosion venting ratio shall be not less 1 square foot for each 30 cubic feet of volume.

9.4 LIQUID HANDLING

9.4.1 Storage

- (a) The storage of flammable or combustible liquids in tanks shall be in accordance with the applicable provisions of Section 3.
- (b) If the storage of flammable or combustible liquids in outside aboveground or underground tanks is not practical because of temperature considerations or production considerations, tanks may be permitted inside of buildings or structures in accordance with the applicable provisions of Section 3.
- (c) Storage tanks inside of buildings shall be permitted only in areas at or above grade which have adequate drainage and are separated from the processing area by construction having a fire resistance rating of at least two hours.
- (d) The storage of flammable or combustible liquids in containers or portable tanks shall be in accordance with the applicable provisions of Section 5.

9.4.2 Piping, Valves and Fittings

- (a) Piping, valves and fittings shall be in accordance with Section 4.
- (b) Approved flexible connectors may be used where vibration exists or where frequent movement is necessary. Approved hose may be used at transfer stations.
- (c) Piping containing flammable or combustible liquids shall be identified.

9.4.3 Transfer

- (a) 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 shall be prohibited.
- (b) Positive displacement pumps shall be provided with pressure relief discharging back to the tank or to pump suction.

9.4.4 Equipment

- (a) Equipment shall be designed and arranged to prevent the unintentional escape of liquids and vapors and to minimize the quantity escaping in the event of accidental release.
- (b) Where the vapor space of equipment is usually within the flammable range, the probability of explosion damage to the equipment can be limited by inerting, by providing an explosion suppression system, or by designing the equipment to contain the peak explosion pressure which may be modified by explosion relief. Where the special hazards of operation, sources of ignition, or exposures indicate a need, consideration shall be given to providing protection by one or more of the above means.

9.5 TANK VEHICLE AND TANK CAR LOADING AND UNLOADING

- 9.5.1 Tank vehicle and tank car loading or unloading facilities shall be separated from aboveground tanks, warehouses, other plant buildings or nearest line of adjoining property 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. Buildings for pumps or shelters for personnel may be a part of the facility. Operations of the facility shall comply with the appropriate portions of 7.3.

9.6 FIRE CONTROL

- 9.6.1 Approved portable fire extinguishers of appropriate size, type and number shall be provided.
- 9.6.2 A reliable water supply shall be available in pressure and quantity adequate to meet the probable fire demands.
- 9.6.3 Hydrants shall be provided in accordance with accepted good practice.
- 9.6.4 Hose connected to a source of water shall be installed so that all vessels, pumps, and other equipment containing flammable or combustible liquids can be reached with at least one hose stream. Nozzles that are capable of discharging a water spray shall be provided.
- 9.6.5 Processing plants shall be protected by an approved automatic sprinkler system or equivalent extinguishing system. If special extinguishing systems including but not limited to those employing foam, carbon dioxide or dry chemical are provided, approved equipment shall be used and installed in an approved manner.

9.6.6 An approved means for prompt notification of fire to those within the plant and any public fire department available shall be provided. Where service is available, a public fire alarm box shall be located nearby.

9.6.7 All plant fire protection facilities shall be adequately maintained and periodically inspected and tested to make sure they are always in satisfactory operating condition and they will serve their purpose in time of emergency.

9.7 SOURCES OF IGNITION

9.7.1 General

(a) 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.

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

9.7.2 Maintenance and Repair

(a) When necessary to do maintenance work in a flammable or combustible liquid processing area, the work shall be authorized by a responsible member of supervision

(b) 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. The individual in responsible charge shall make an inspection of the area to be sure that it is safe for the work to be done and that safe procedures will be followed for the work specified.

9.8 ELECTRICAL EQUIPMENT

9.8.1 Electrical wiring and equipment shall comply with 1.6.

9.9 HOUSEKEEPING

9.9.1 Maintenance and operating practices shall be in accordance with established procedures which will tend to control leakage and prevent the accidental escape of flammable or combustible liquids. Spills shall be cleaned up promptly.

- 9.9.2 Adequate aisles shall be maintained for unobstructed movement of personnel and so that fire protection equipment can be brought to bear on any part of the processing equipment.
- 9.9.3 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.
- 9.9.4 Ground area around buildings and operating areas shall be kept free of tall grass, weeds, trash or other combustible materials.

SECTION 10

DRY CLEANING PLANTS

10.1 SCOPE OF SECTION 10

10.1.1 This Section 14 shall apply to the process of removing dirt, grease, paints and other stains from wearing apparel, textiles, fabrics, rugs, or other material, by the use of nonaqueous liquids (solvents), and it shall include the process of dyeing clothes or other fabrics or textiles in a solution of dye colors and nonaqueous liquid solvents.

10.2 CLASS I SYSTEMS

10.2.1 New dry cleaning plants or systems utilizing Class I solvents shall be prohibited.

10.3 CLASS II SYSTEMS

10.3.1 Class II systems shall be located in buildings having walls of masonry or noncombustible construction and wall finish shall be plain or plastered without furring or concealed spaces. Floors of dry cleaning sections shall be of fire-resistive construction and without pits, wells or pockets; and where located over a basement, floor shall be vapor-and liquid-tight. Roof and floors above grade floor, if of combustible construction, shall have the ceilings over the dry cleaning areas protected by cement or gypsum plaster on metal lath or equivalent construction having a fire resistance rating of not less than one hour. Dry cleaning buildings shall not be closer than 10 feet to the line of adjoining property, except that if exposing walls are blank walls having a fire resistance rating of at least four hours the building may be located on the property line.

10.3.2 Dry cleaning operations shall be restricted to the lowest floor of a building but shall not be located on any floor below grade, nor in the same building with other occupancies. Operation incidental to the dry cleaning business such as laundering, pressing, and ironing may be in a communicating building or located on the same floor with the dry cleaning plant, provided the dry cleaning operations are separated therefrom by noncombustible partitions having a fire resistance rating of not less than two hours and the communicating openings are protected by approved fire doors.

- 10.3.3 Door openings on stairs or elevators leading from a dry cleaning area to a basement, or opening into a room having openings or stairs to basements, shall be provided with noncombustible sills or ramps raised at least 6 inches. Approved self-closing fire doors shall be provided at such openings. Enclosures shall be of construction equivalent to the floor construction but having a fire resistance rating of not less than one hour.
- 10.3.4 Rooms in which articles are hung up to dry shall be constructed with noncombustible walls, partitions and ceilings having a fire resistance rating of not less than 2 hours. Entrances to drying rooms shall be provided with approved self-closing fire doors. If the drying room is in a separate building it shall conform in all respects to provisions for a dry cleaning building.
- 10.3.5 A mechanical system of ventilation shall be installed in dry cleaning areas and drying rooms. The mechanical system of ventilation shall be installed in dry cleaning areas and drying rooms in accordance with Bureau Safety Regulation on exhaust systems.
- 10.3.6 The mechanical system of ventilation shall have sufficient capacity to insure complete and continuous change of air once every 6 minutes and shall be provided with means for remote control. The system shall operate automatically when any dry cleaning equipment is in use.

10.4 CLASS III SYSTEMS

- 10.4.1 Class III systems, if located in the same building with other occupancies, shall be separated from the remainder of the building vertically and horizontally by construction having a fire resistance rating of not less than one hour with openings protected by approved fire doors, except that such separation shall not be required for operations incidental to or in connection with the dry cleaning business, such as laundering, scouring, scrubbing, drying, pressing or ironing, and the requirement for such separation may be waived at the discretion of the Bureau based upon a consideration of such factors as type of building construction, nature of occupancy, storage and operating capacity of the system and extent of private fire protection provided.

10.5 CLASS IV SYSTEMS

- 10.5.1 Class IV systems shall be exempt from all other provisions of this Section 10.
- 10.5.2 Self-service dry cleaning plants utilizing only solvents approved for Class IV dry cleaning installations may be installed.

- 10.5.3 Spotting operations using flammable or combustible liquids shall not be permitted where self-service dry cleaning equipment is installed.

10.6 HEATING EQUIPMENT

- 10.6.1 Where Class II systems are used, heating shall be by steam or hot water only. Where Class III systems are used, heating shall be by any approved means which does not involve any open flame or ignition source in the dry cleaning area. Steam and hot water pipes and radiators for heating and drying purposes shall be at least one inch from all woodwork and shall be protected by substantial metal screens arranged so as to prevent combustible goods or materials from coming in contact with pipes and radiators.
- 10.6.2 For Class II or III systems boilers shall be located in a detached building or in a boiler room cut off from the dry cleaning room by partitions of noncombustible material having a fire resistance rating of not less than two hours and without openings. For Class II systems, openings into such boiler rooms shall be at least 10 feet from any exterior openings into the cleaning room.

10.7 ELECTRICAL EQUIPMENT AND LIGHTING

- 10.7.1 Where Class II systems are used, electrical wiring and equipment shall be of a type approved for Class 1, Division 1 hazardous locations.
- 10.7.2 Where Class II systems are used, electrical equipment located eight feet or more above the floor shall be of a type approved for Class 1, Division 2 hazardous locations.
- 10.7.3 Where Class III systems are used, electrical wiring and equipment may be a type approved for ordinary locations.
- 10.7.4 Lighting shall be by electricity.

10.8 STORAGE AND HANDLING OF CLEANING SOLVENTS

- 10.8.1 Aboveground containers comprising purifiers, clarifiers, and filters, in Class II systems shall not exceed 350 gallons individual capacity and shall not exceed in capacity any industrial tank to which they may be connected. Solvent storage tanks for Class II and Class III systems may be inside of buildings if individual capacity of tanks does not exceed 275 gallons and the aggregate capacity of storage tanks does not exceed 550 gallons. Quantities of solvents for Class II and Class III systems in excess of the above shall be stored in accordance with Section 5.

- 10.8.2 Pressure type filters shall be equipped with a reliable pressure gauge and shall not be operated at pressures exceeding those for which they are designed. The filters shall be provided with an air bleeding valve and line connected to discharge into the washer or into the storage tank vent line. Such air bleeding lines shall not discharge into the room.
- 10.8.3 The handling of solvents from storage tanks through the various machines and back to the settling and clear solvent tanks shall be through closed circuits of piping. Pumps of positive displacement type shall have a by-pass and relief valve.
- 10.8.4 Sight glasses, the breakage of which would permit the escape of liquids, shall be of a type not readily damaged by heat and shall be reliably protected against physical damage.
- 10.8.5 Liquid level gauge glasses in Class II systems shall be equipped with an automatic device which will immediately shut off the flow of solvent if the glass is broken. These liquid level gauge glasses shall be guarded against physical damage.
- 10.8.6 When underground treating and settling tanks are used, a separate suction and discharge connection shall be provided to the pump for removal of sludge. The suction pipe shall be carried to the tank bottom, and the discharge connection to a suitable container.
- 10.8.7 All piping shall be tested to a pressure of at least fifty per cent in excess of normal operating pressure and proved tight and protected against physical damage.
- 10.8.8 Piping, valves, fittings and ground joint unions for solvents shall be designed for the working pressures and structural stresses to which they may be subjected. They shall be of steel or other material suitable for use with the solvent. Pipe systems shall be substantially supported and protected against physical damage and excessive stresses arising from settlement, vibration, expansion or contraction. Pipe systems shall contain a sufficient number of valves to operate the system properly and to protect the plant. Cast iron fittings for pressure piping shall be prohibited.

10.9 WASHING MACHINES

- 10.9.1 Washing machines shall be substantially constructed. The loading door opening shall be equipped with a close-fitting door so designed as to prevent solvent leaks due to splash. The machine shall be provided with interlocks to prevent cylinder rotation under power except for inching when doors are open.
- 10.9.2 Each washing machine shall be provided with an overflow

pipe one size larger than the size of the solvent supply line to the machine. Such overflow pipe shall be connected to the shell of the washer so that the top of the overflow is below the bottom of the trunnion shaft; it shall be without shut-off valves and shall be arranged to discharge to a suitable tank. The supply pipe shall enter the washing machine above the charged liquid level.

10.9.3 Individual button and lint traps shall be provided for each washer.

10.9.4 In Class II systems, each washing machine shall be provided with approved extinguishing equipment, arranged to operate automatically in case of fire, consisting of a carbon dioxide system or a steam jet not less than 3/4 inch with a continuously available steam supply at a pressure of not less than 15 pounds per square inch.

10.10 STILLS AND CONDENSERS

10.10.1 Steam or hot water only shall be used as the source of heat. If steam is used, a pressure regulating valve shall be installed in the steam supply line to the still.

10.10.2 Stills and condensers shall be liquid- and gas-tight.

10.10.3 Stills shall be designed for operation on the vacuum principle.

10.10.4 If a relief valve is provided it shall be equipped with a vent line extending to the outside.

10.10.5 A check valve shall be installed in the steam line between the boiler and the still.

10.10.6 Each still shall be provided with a combination vacuum and pressure gauge.

10.10.7 Each still shall be equipped with a constant level valve to automatically maintain the solvent liquid level in the still at the proper height.

10.11 DRYING TUMBLERS AND CABINETS

10.11.1 Drying tumblers in Class II systems shall be of substantial construction, well secured to substantial foundations, and shall be provided with self-closing explosion hatches having an area equal to at least one square foot for each 30 cubic feet of cylinder volume. Hatches shall be arranged to open away from the operator.

- 10.11.2 Drying tumblers in Class II systems shall be provided with a steam jet, of not less than 3/8 inch size, for humidifying during the drying process.
- 10.11.3 Drying tumblers and drying cabinets shall be ventilated to the outside air by means of properly constructed pipes or ducts connected to an exhaust fan of sufficient capacity to remove all dust, vapors, or lint generated by the process. Such discharge pipes or ducts shall be carried to a height of not less than six feet above the roof, and shall be provided with cleanout facilities, if used for Class II systems.
- 10.11.4 Discharge pipes shall not terminate within ten feet measured horizontally from any door, window or frame walls of any adjoining or adjacent building.
- 10.11.5 The fan shall be properly housed and so interlocked as to insure operation while the drying tumbler is in use. The fan spiders, blades or running rings shall be constructed to non-ferrous metal. In no case shall the fan motor be mounted within the ventilating duct.
- 10.11.6 Each drying tumbler in Class II systems shall be provided with approved extinguishing equipment, arranged to operate automatically in case of fire, consisting of a carbon dioxide or steam jet system as specified in 10.9.4.

10.12 EXTRACTORS

- 10.12.1 The baskets shall have a rim of non-ferrous metal and shall be well balanced.
- 10.12.2 Extractors shall be provided with liquid-tight covers, or they shall be designed so that none of the liquid solvent is thrown out of the extractor while it is in operation. Cover shall be equipped with automatic mechanical or electrical interlocks which will prohibit operating the extractors while the cover is open and which will prohibit opening the cover until the basket comes to rest.
- 10.12.3 Extractors shall be provided with a drain pipe not less than 1½ inches in diameter connected direct to underground storage tanks or to a suitable aboveground container, or to the washer through an approved extractor pump with connections fitted with proper valves.
- 10.12.4 Brakes, if used, shall be so designed as to prevent the creation of sparks or excessive heat.
- 10.12.5 Extractors shall not be operated at a speed in excess of that prescribed by the manufacturer as shown on name plate which shall be provided on each machine.

10.12.6 Extractors equipped with a solvent spray nozzle for spray rinsing of garments after the primary extraction shall comply as follows:

- (a) Installation of spray rinse equipment on existing extractors shall be approved by the Bureau.
- (b) Extractor covers shall be made splash proof to prevent leakage of the solvent, and shall be equipped with a latch to hold the cover closed during operation.
- (c) Supply pumps of positive displacement type shall be provided with a bypass and relief valve set so as to prevent excessive pressure.
- (d) Valves in supply line between pumps and outlet shall be installed in such a manner that the cutoff is effected ahead of any flexible portion of the supply line.
- (e) Extractor drain lines shall not be less than 2 inches for extractors up to and including 40 inches in diameter and 3 inches for extractors in excess of 40 inches in diameter.
- (f) Extractors shall be provided with at least one drain line open at all times. If more than one extractor drain line is provided for the purpose of alternating use, quick opening valves or equivalent shall be installed in each line and inter-locked so that when either valve is shut the other valve is open.
- (g) If a separate extractor drain tank is provided, it shall have a capacity equal to the combined total gallonage of the charged solvent extraction, the rinse and the rinse extraction.
- (h) Drainage from extractors to all tanks shall be by gravity flow.

10.13 COMBINATION DRY CLEANING UNIT

10.13.1 The provisions of this section shall apply to combination dry cleaning units wherein the washing and extracting cycles are completed within the same enclosure.

10.13.2 The machines shall be of substantial construction and shall be provided with splash proff doors, or covers, with interlocking means to prevent cylinder rotation, under power, except for inching at slow speed when doors or covers are open.

Such interlocks shall provide that during the extracting cycle, opening of the door or cover will disconnect the drive motor and apply braking means to bring the cylinder to rest before access to cylinder is possible. Machines shall be provided with braking means to insure stoppage within reasonable time without the creation of sparks or excessive heat.

- 10.13.3 Each machine shall be provided with an overflow pipe one size larger than the size of the solvent supply line to the machine. Such overflow shall be connected so that the top of the overflow is below the bottom of the trunnion shaft and arranged to discharge into a suitable tank.
- 10.13.4 Individual button and lint traps, with suitable lids shall be provided for each machine.
- 10.13.5 The supply pipes to machines, whether from pumps, filters or storage tanks, shall be arranged to deflect solvent steam away from tub openings.
- 10.13.6 Cylinder shall be supported so as to provide sufficient clearance to prevent striking or rubbing adjacent parts during rotation.
- 10.13.7 Machine shall be furnished with name plate indicating maximum cylinder speed and warning that machine shall not be operated in excess of such speed.
- 10.13.8 Each machine in a Class II system shall be provided with approved extinguishing equipment, arranged to operate automatically in case of fire, consisting of a carbon dioxide or steam jet system as specified in 10.9.4.

10.14 BONDING AND GROUNDING FOR CLASS II AND III SYSTEMS.

- 10.14.1 Storage tanks, treatment tanks, purifiers, pumps, piping, washers, extractors, drying tumblers, drying cabinets, combination units, and other such equipment, if not inherently electrically conductive, shall be bonded together. This system of equipment, if it is not grounded due to the electrical power services installed thereon, shall be grounded. Isolated units of equipment, such as drying cabinets, shall be grounded.
- 10.14.2 Pulleys and belting in dry cleaning rooms, shall be provided with properly grounded combs, collectors, or neutralizers.
- 10.14.3 When fabrics are transferred from one piece of equipment to another, the two pieces of equipment shall be electrically bonded together.

- 10.14.4 Metal tops of spotting tables shall be permanently and effectively grounded.

10.15 SCOURING, BRUSHING AND SPOTTING

- 10.15.1 The brushing (prespotting) table shall have a liquid-tight top with a curb on all sides not less than 1 inch high. The top of the table shall be pitched so as to insure thorough draining to a $1\frac{1}{2}$ inch drain connected to a suitable container especially provided and marked for that purpose.
- 10.15.2 All scouring or brushing and spotting (prespotting) operations utilizing solvents with lower flash points than the solvents used in the plant dry cleaning machines shall be limited to one gallon and dispensed from approved safety cans. Additional storage shall be in approved safety cans of not over one gallon capacity.
- 10.15.3 Scouring or brushing operations utilizing in excess of one gallon of solvent with lower flash points than the solvent used in the plant dry cleaning machines shall be conducted only in a room or building conforming to all the requirements for a dry cleaning system utilizing the same type of solvent.
- 10.15.4 The total amount of Class I or II solvent used on scouring or brushing tables or in scrubbing tubs, in accordance with 10.15.3, shall not exceed 3 gallons. The scouring or brushing table or scrubbing tub shall be so located as to ensure thorough and effective disposal of vapors through the ventilating system. Scrubbing tubs shall be used only for articles, the character of which prevents their washing in the usual washing machines. Scrubbing tubs shall be secured to the floor and shall be provided with permanent $1\frac{1}{2}$ inch trapped drains to a suitable container specially provided and marked for that purpose.

10.16 FIRE CONTROL

- 10.16.1 Adequate portable fire extinguishers of a type suitable for fighting fires involving flammable or combustible liquids, shall be provided in all dry cleaning plants; at least one extinguisher shall be provided at each entrance to every room or area where flammable or combustible liquids are stored or used.

10.17 SMOKING PROHIBITED

- 10.17.1 Smoking in plants employing Class II or Class III systems, except in smoking rooms so designated, shall be strictly prohibited and "No Smoking" signs shall be posted.

SECTION 11

PLANTS MANUFACTURING ORGANIC COATINGS

11.1 SCOPE OF SECTION 11

11.1.1 This Section 11 shall apply to:

- (a) Processes manufacturing protective and decorative finishes or coatings (paints) for industrial, automotive, marine, transportation, institutional, household or other purposes.
- (b) The handling of flammable and combustible liquids, certain combustible solids and potential dust explosive conditions.

11.2 LOCATION

11.2.1 Each organic coating manufacturing operation within 50 feet of the property line shall have the exposing wall constructed in accordance with Table 11.2.1.

TABLE 11.2.1 (1)

DISTANCES IN FEET FROM PROPERTY LINE	CONSTRUCTION OF EXPOSING WALL EXPRESSED IN TERMS OF FIRE RESISTANCE RATING
Less than 10	at least 4 hours
10 to 30	at least 3 hours
Over 30 but less than 50	at least 2 hours

Note to Table

1. When approved automatic sprinkler systems are installed, a 50 per cent reduction in the distances to property lines may be made.

11.2.2 An organic coating manufacturing operation shall not be located in the same building with other occupancies. Operations incidental to or in connection with organic coating manufacturing shall not be classed as "other occupancies" for the purpose of this provision.

11.2.3 An organic coating manufacturing operation shall be accessible from at least one side for the purpose of fire control.

- 11.2.4 Where topographical conditions are such that flammable and combustible liquids may flow from the organic coating manufacturing operation so as to constitute a fire hazard to properties of others, drainage facilities shall be provided in accordance with 11.4.7 and 11.4.8.

11.3 STORAGE OF RAW MATERIALS AND FINISHED PRODUCTS.

- 11.3.1 The storage, handling and use of flammable and combustible liquids shall be in accordance with Sections 3 and 5.
- 11.3.2 Tank storage for flammable and combustible liquids inside of buildings shall be permitted only in storage areas at or abovegrade which are detached from the processing area or cut off from the processing area by noncombustible construction having at least a two hour fire resistance rating and openings shall be equipped with approved fire doors. This is not intended to prevent processing equipment from containing flammable and combustible liquids or storage in such quantities as are essential to the continuity of operations.
- 11.3.3 Tank car and tank vehicle loading and unloading stations for Class I liquids shall be separated from the processing area, other plant buildings, or nearest property line by a clear distance of not less than 25 feet.
- 11.3.4 Loading and unloading structures and platforms for flammable and combustible liquids shall be designed and installed in accordance with 7.3.
- 11.3.5 Tank cars for flammable liquids shall be unloaded in accordance with MCA Sheet TC-4, Unloading Flammable Liquids from Tank Cars - 1952.
- 11.3.6 Tank vehicles for flammable and combustible liquids shall be loaded and unloaded in accordance with Section 12.
- 11.3.7 Finished products that are flammable or combustible liquids shall be stored outside of buildings, in a separate building, or in a separate room cut off from the processing area by a noncombustible wall or partition having at least a two-hour fire resistance rating and openings shall be equipped with approved fire doors. The storage of finished products shall be in tanks or in closed containers in accordance with Sections 5 and 7.

- 11.3.8 Wet nitrocellulose shall be stored, handled and used in accordance with Bureau Safety Regulation No 57, Wet Nitrocellulose.
- 11.3.9 The size of the package containing the organic peroxide shall be selected so that, as nearly as practical, full packages are utilized at one time. Any peroxide spilled shall be promptly cleaned up and disposed of as recommended by the supplier.
- 11.3.12 Nitrocellulose storage areas shall be provided with two means of egress remotely located from each other.

11.4 PROCESS BUILDINGS

- 11.4.1 Buildings shall be of fire resistive or noncombustible construction without load bearing walls and without basements or pits. The first floor shall be at or above grade.
- 11.4.2 Raw material and finished stock storage buildings shall be limited to one story in height and either detached or cut off from manufacturing buildings by noncombustible construction having a fire-resistance rating of at least two hours and openings shall be equipped with approved fire doors.
- 11.4.3 Stairway enclosures and structures housing elevators shall be enclosed by noncombustible walls having a fire-resistance rating of at least two hours, and be equipped with approved fire doors.
- 11.4.4 Each manufacturing room shall have at least two exits, well separated, one of which shall be directly to the outside. Access to all exits shall be kept clear and doors shall open in the direction of travel. Door fastenings shall be of the safety release type. Supervisory management offices, change and locker rooms located in manufacturing buildings shall be provided with adequate exits.
- 11.4.5 Structures in which Class I liquids or finely divided flammable solids are processed shall be provided with explosion venting. Explosion venting by one or more of the following methods shall be provided:
 - (1) Open air construction
 - (2) Lightweight walls and roof
 - (3) Lightweight wall panels and roof hatches
 - (4) Windows of explosion venting type

The explosion venting ratio shall be not less than one square foot for each 30 cubic foot of volume.

- 11.4.6 Enclosed buildings in which Class I liquids are processed or handled shall be ventilated at a rate of not less than 1/2 cubic foot per minute per square foot of solid floor area. This shall be accomplished by exhaust fans preferably taking suction at floor levels, and discharging to a safe location outside the building. Provision shall be made for introduction of noncontaminated intake air in such a manner that all portions of solid floor areas will be subject to continuous uniformly distributed movement of air.
- 11.4.7 Heating in hazardous areas, if required, shall be provided by indirect means. Ignition sources such as open flames, or electrical heating elements, except as provided in 11.9 shall not be used within the building.
- 11.4.8 Drainage facilities shall be provided to direct flammable and combustible liquid leakage and fire protection water to a safe location away from buildings or adjoining property.
- 11.4.9 Emergency drainage systems containing flammable and combustible liquids shall not discharge to public sewers or public waterways.

11.5 PROCESS MILLS, MIXERS, AND KETTLES

- 11.5.1 Mills operating with close clearances and used for the processing of flammable and heat sensitive materials, such as nitrocellulose, shall be located in a detached building or in a noncombustible structure without other occupancy. The amount of nitrocellulose or other flammable material brought into the area shall be no more than required for a batch.
- 11.5.2 Mixers shall be of the enclosed type or, if of the open type shall be provided with properly fitted covers. Where gravity flow is used, a shutoff valve shall be installed as close as practical to the mixer and a control valve shall be provided near the end of the fill pipe.
- 11.5.3 Open kettles shall be located in an outside area, provided with a protective roof or in a separate building or noncombustible construction or separated from other areas by means of a noncombustible wall or partition having a fire-resistance rating of two hours.
- 11.5.4 The vaporizer section of heat transfer systems heating closed kettles containing solvents shall be remotely located. Contact heated kettles containing solvents shall be equipped with safety devices that in case of fire can turn the process heat off, turn the cooling medium on, and inject inert gas into the kettle.

- 11.5.5 The kettle and thin-down tank shall be instrumented, controlled and interlocked so that any failure of the controls will result in a safe condition. The kettle shall be provided with a pressure rupture disc in case the normal vent become inoperative. The vent piping from the rupture disc shall be of minimum length and shall discharge to a safe location. The thindown tank shall be adequately vented. Thinning operations shall be provided with an adequate vapor removal system.

11.6 PROCESS PIPING

- 11.6.1 All piping, valves and fittings shall be designed for the working pressures and structural stresses to which they may be subjected. They shall be of steel or other material approved for the service intended.
- 11.6.2 Valves shall be of an indicating type. Terminal valves on remote pumping systems shall be of the "dead-man" type which will shut off both the pump and the flow of solvent.
- 11.6.3 Piping systems shall be substantially supported and protected against physical damage. Piping shall be pitched to avoid unintentional trapping of liquids or suitable drains shall be provided.
- 11.6.4 Approved flexible connectors may be used where vibration exists or where frequent movement is necessary. Approved hose shall be used at dispensing stations.
- 11.6.5 Before being placed in service, all piping shall be free of leaks when tested to not less than $1\frac{1}{2}$ times the working pressure or a minimum of not less than 5 psig at the highest point in the system. Tests shall continue for a minimum of 30 minutes.

11.7 TRANSFER OF FLAMMABLE AND COMBUSTIBLE LIQUIDS IN PROCESS AREAS

- 11.7.1 The transfer of large quantities of flammable and combustible liquids shall be through piping by means of pumps. The use of compressed air as a transfer medium shall be prohibited.
- 11.7.2 Pumps shall be selected for the flammable and combustible liquid used, the working pressures and the structural stresses to which they may be subjected.
- 11.7.3 Where solvents are pumped from storage to points of use, approved switches shall be provided in the processing areas and at the pumps to shut down the pumps in case of fire.
- 11.7.4 Empty and filled containers shall be stored outside the filling area.

11.8 RAW MATERIALS IN PROCESS AREAS

- 11.8.1 The amount of nitrocellulose brought into the operating area shall not exceed that required for a shift. Any nitrocellulose which may be spilled on the floor or elsewhere shall be promptly swept up, put into a pail of water, and removed at the end of the day or shift and disposed of by use or by burning in the open at a suitable detached location.
- 11.8.2 Organic peroxides brought into the operating area shall be in the original shipping container and shall not exceed the quantity required for a shift. When in the operating area the peroxide shall not be placed in locations exposed to ignition sources, heat or mechanical shocks.

11.9 ELECTRICAL EQUIPMENT

- 11.9.1 Electrical wiring and equipment shall comply with 1.6.

11.10 PROTECTION AGAINST STATIC ELECTRICITY AND LIGHTNING

- 11.10.1 All equipment such as tanks, machinery and piping, where an ignitable mixture may be present shall be bonded and connected to a ground. The bond or ground or both shall be physically applied or shall be inherently present by the nature of the installation. For static purposes this electrically conductive path shall have a resistance of not more than one million ohms.
- 11.10.2 Electrically isolated sections of metallic piping or equipment shall be bonded to the other portions of the system or grounded.
- 11.10.3 Tank vehicles loaded or unloaded through open connections shall be grounded and bonded to the receiving system.
- 11.10.4 When a flammable mixture is transferred from one portable container to another, a bond shall be provided between the two containers.
- 11.10.5 Steel framing of buildings shall be grounded with resistance of not more than five ohms for lightning protection.

11.11 FIRE CONTROL AND DETECTION

- 11.11.1 Important manufacturing and storage buildings shall be protected by a sprinkler system or a water spray system. Sprinkler systems or water spray systems shall be installed in accordance with the Installation of Sprinkler Systems, NFPA No. 13 - 1969 or Water Spray Systems, NFPA No. 15 - 1969.

- 11.11.2 An adequate supply of portable fire extinguishers suitable for flammable liquid fires shall be provided.
- 11.11.3 Standpipe and hose shall be provided in important operating buildings.
- 11.11.4 Where good public fire protection facilities are not readily available, private fire protection facilities shall be provided.
- 11.11.5 A suitable fire alarm system shall be provided.
- 11.11.6 All plant fire protection facilities shall be adequately maintained, periodically inspected and tested.

11.12 MAINTENANCE

- 11.12.1 The cleaning of tanks or vessels which have contained flammable or combustible liquids shall only be done under the supervision of persons who understand the fire and explosion potential.
- 11.12.2 When necessary to make repairs involving "hot work" the work shall be authorized by the responsible individual in charge before the work is started.
- 11.12.3 When necessary to enter a tank, pit, manhole or other confined spaces, such entry shall be made in accordance with Bureau Safety Regulation No 10, Work in Confined Spaces.
- 11.12.4 Industrial trucks shall be of a type approved for the location and comply with Bureau Safety Regulation No. 73, Industrial Trucks.
- 11.12.5 Open flames and direct-fired heating devices shall be prohibited in areas where flammable vapor-air mixtures may exist.
- 11.12.6 Smoking shall be prohibited except in designated safe areas.
- 11.12.7 Empty containers previously used for flammable or combustible liquids shall be removed to a well detached, outside location.
- 11.12.8 Full containers of flammable liquids stored outside shall be kept a safe distance from buildings or other exposures.
- 11.12.9 Adequate aisles shall be maintained for unobstructed movement of personnel and so that fire protection equipment can be utilized in all parts of processing and storage areas of buildings.

SECTION 12
LOADING AND UNLOADING TANK VEHICLES

12.1 SCOPE OF SECTION 12

12.1.1 This Section 12 shall apply to the filling and discharging of tank vehicles at the loading or unloading site.

12.2 TANK VEHICLES

12.2.1 Drivers shall be thoroughly instructed in the proper method of operating tank vehicles when loading or unloading its contents.

12.2.2 Tank vehicles shall not be loaded or unloaded unless they are in proper repair, devoid of accumulation of grease, oil or other flammables, and free of leaks.

12.2.3 No tank vehicle shall be filled at a cargo temperature above the maximum allowable cargo temperature.

12.2.4 No material shall be loaded into a tank vehicle at a temperature above its ignition temperature, unless properly safeguarded in an approved manner.

12.2.5 Flammable liquids with a vapor pressure of 18 psia or over at 100°F. shall be loaded only into cargo tanks constructed in accordance with USDOT Specifications MC 304, MC 330 or MC 331.

12.2.6 Flammable and combustible liquids shall be loaded only into cargo tanks whose material used in construction shall be chemically compatible with the chemical characteristics of the liquid. The flammable and combustible liquid being loaded shall also be compatible with the liquid hauled on the previous load unless the cargo tank has been cleaned.

12.2.7 No tank vehicle, or any compartment thereof, which has been utilized for Class I liquid, shall be loaded with Class II or III liquid until such tank or compartment and all piping, pumps, meters and hose connected thereto have been completely drained. A tank, compartment, piping, pump, meter or hose which does not drain completely shall be flushed at the loading point with a quantity of Class II or Class III liquid equal to twice the capacity of piping, pump, meter and hose, to clear any residue of Class I liquid from the system.

12.3 FILLING AND DISCHARGING TANK VEHICLES

12.3.1 The driver, operator or attendant of any tank vehicle shall not remain in the vehicle but shall not leave the vehicle while it is being filled or discharged. Delivery hose, when attached to a tank vehicle shall be considered to be a part of the tank vehicle.

- 12.3.2 Motors of tank trucks or tractors shall be shut down during making and breaking hose connections. If loading or unloading is done without the use of a power pump, the tank truck or tractor motor shall be shut down throughout such operations.
- 12.3.3 The cargo tank shall be bonded to the fill-stem or some part of the rack structure electrically interconnected with the fill stem piping, except tank vehicles handling asphalt, tank vehicles loading any flammable liquid through bottom connections, and tank vehicles used exclusively for transporting Class II or III liquids when loaded at locations where no Class I liquids are handled.
- 12.3.4 The bond-wire connection shall be made prior to opening the dome covers. It shall be maintained in place during the entire filling operation and the dome covers shall be securely closed before the bond-wire is disconnected from the cargo tank.
- 12.3.5 No external bond-wire connection nor bond-wire integral with a hose are needed for the unloading of flammable or combustible liquids into underground tanks.
- 112.3.6 No cargo tank or compartment thereof used for the transportation of any flammable or combustible liquid or asphalt shall be loaded liquid full. Sufficient space (outage) shall be left vacant in every case to prevent leakage from or distortion of such tank or compartment by expansion of the contents due to rise in temperature in transit and in no case less than one percent.
- 12.3.7 Simultaneous delivery to underground tanks from two or more hoses shall be made by means of tight connections between the hose and the fill pipe.
- 12.3.8 Cargo tanks shall be free of all water before they are loaded with hot asphalt.

12.4 IGNITION SOURCES

- 12.4.1 Smoking by tank vehicle drivers, helpers, repairmen, or other personnel is prohibited while they are loading and unloading.
- 12.4.2 Open flames shall not be used near manholes or vents.

12.5 PARKING AND GARAGING

- 12.5.1 Tank vehicles containing flammable or combustible liquids shall not be parked out of doors at any one point for longer than one hour, except off the streets, and at least 25 feet from any building used for assembly, institutional or residential occupancy.

12.5.2 Tank vehicles shall not be parked or garaged in any building other than those specifically approved for such use by the Bureau.

SECTION 13

OIL BURNING EQUIPMENT

13.1 SCOPE OF SECTION 13

- 13.1.1 This Section 13 shall apply to the installation of oil burning equipment together with its tanks, piping, wiring, controls and related devices.
- 13.1.2 This Section 13 shall not apply to combustion engines, oil lamps, and portable devices such as blow torches, melting pots and weed burners.

13.2 USE OF APPROVED EQUIPMENT

- 13.2.1 Oil burning equipment shall be approved.

13.3 GENERAL INSTALLATION REQUIREMENTS

- 13.3.1 The installation shall be made in accordance with the instructions of the manufacturer.
- 13.3.2 The installation shall be such as to provide reasonable accessibility for cleaning heating surfaces, removing burners, replacing motors, controls, air filters, draft regulators and other working parts and for adjusting, cleaning and lubricating parts requiring such attention.
- 13.3.3 After installation of the oil burning equipment, operation tests shall be conducted to make certain that the burner is operating in a safe acceptable manner and that all safety devices function properly.

13.4 FUEL OIL

- 13.4.1 The grade of fuel oil used in a burner shall be that for which the burner is approved and as stipulated by the manufacturer. Crankcase oil or any oil containing gasoline shall not be used.

13.5 DESIGN, CONSTRUCTION AND INSTALLATION OF FUEL OIL TANKS

- 13.5.1 The design and construction of fuel oil tanks shall comply with 3.1, except as provided in 13.5.2 through 13.5.5.
- 13.5.2 An outside aboveground tank not larger than 60 gallons capacity may be an ICC-5 Shipping Container (drum) and so marked or may be an approved safety can.
- 13.5.3 Section 3.1.4 shall not apply to the construction of fuel oil tanks.

- 13.5.4 Atmospheric aboveground tanks built according to Underwriters' Laboratories, Inc. standards in section 3.1.3.1 shall be limited to 2.5 psig under emergency venting conditions.
- 13.5.5 If pressure tanks built according to 3.1.5 are larger than 550 gallons or are to be buried underground, all openings in such tanks shall be located above the highest normal liquid level.
- 13.5.6 The installation of fuel oil tanks shall comply, where applicable, with 3.2 through 3.7 except as provided in 13.2.7 and 13.2.13.
- 13.5.7 An unenclosed inside fuel oil supply tank shall have a capacity of not more than 550 gallons. Not more than one 550 gallon tank or two tanks of aggregate capacity of 550 gallons or less shall be connected to one oil burning appliance and the aggregate capacity of such tanks installed in the lowest story, cellar or basement of a building shall not exceed 1100 gallons unless separation is provided for each 550 gallons of tank capacity. Such separation shall consist of an unpierced masonry wall or partition extending from the lowest floor to the ceiling above the tank or tanks and shall have a fire resistance rating of not less than 2 hours.
- 13.5.8 A supply tank larger than 550 gallons capacity shall be enclosed when installed inside of a building as follows:
- (a) The nominal gross capacity of enclosed tanks inside a building shall not exceed:
 - (1) 10,000 gallons in buildings of other than fire-resistive construction.
 - (2) 15,000 gallons in buildings of fire-resistive construction.
 - (3) 50,000 gallons with an individual tank capacity not exceeding 25,000 gallons in any building; provided that the tank or tanks, enclosed as specified in 13.3.8 (d), and in addition are located in a room cut off vertically and horizontally from other portions of the main building by noncombustible construction having a fire-resistance rating of two hours.
 - (b) The tank shall be supported at least four inches above the floor by masonry saddles at least 12 inches thick, spaced not more than eight feet on centers and extending the full width of the tank.
 - (c) All connections to an enclosed supply tank having a capacity of more than 550 gallons shall be made through the top of the tank, and the transfer of oil shall be by pump only and through continuous piping to and from the consuming appliances.

(d) The walls of tank enclosures shall be constructed of solid masonry units or poured concrete construction having a fire-resistance rating of not less than three hours and bonded to the floor. The floor shall be of concrete or other fire-resistive construction. The top shall be of reinforced concrete at least five inches thick or equivalent fire-resistive construction, except that where the floor or roof construction above the enclosure is concrete or other fire-resistive construction, the walls may be extended to and bonded to the underside of the construction above in lieu of a separate top. At least 15 inches clearance shall be left around the tank for the purpose of inspection and repair.

(e) Each tank enclosure shall be provided with an approved self-closing fire door and a noncombustible liquid tight sill or ramp at least six inches high. If the sill or ramp is more than six inches high, the walls to a height corresponding to the level of oil that will be retained shall be built to withstand the lateral pressure due to the liquid head.

13.5.9 Stoves which are designed for barometric feed shall not be connected to separate oil supply tanks.

13.5.10 Non flue connected stoves shall be equipped with integral tanks of capacity not more than 2 gallons.

13.5.11 Supply or storage tanks located above the lowest story, cellar or basement shall not exceed 60 gallons capacity and the total capacity of tanks so located shall not exceed 60 gallons.

13.5.12 Oil supply tanks other than those furnished as an integral part of the stove or range shall not be located within 5 feet, horizontally, of any fire or flame; except that tanks not over 6 gallons capacity may be within this distance but not within 2 feet of the stove in which the burner is installed, provided the temperature rise of the oil supply at this distance is not excessive when the burner is operated at full capacity.

13.6 PIPING MATERIALS AND DESIGN

13.6.1 All piping shall be wrought iron, steel, or brass pipe, or brass or copper tubing. Aluminum tubing shall not be used between the fuel oil tank and the burner unit. Wall thickness of pipe shall be in accordance with the design methods of Petroleum Refinery Piping, USAS B31.3-1966. Listed flexible metal hose may be used to reduce the effect of jarring and vibration or where rigid connections are impracticable and shall be installed in full compliance with its listing.

- 13.6.2 Piping used in the installation of oil burners and appliances shall be not smaller than 3/8 inch iron pipe size or 3/8 inch OD tubing. Cooper or brass tubing shall have 0.035 inch nominal and 0.032 inch minimum wall thickness.
- 13.6.3 Pipe shall be connected with standard fittings and tubing with fittings of approved type. Connectors shall not be used inside of buildings or aboveground outside of buildings. If used below-ground outside of buildings, connectors shall be of approved type and installed in accordance with their approval. All threaded joints and connections shall be made tight with suitable lubricant or pipe compound. Unions requiring gaskets or packing, right and left couplings, and sweat fittings employing solder having a melting point of less than 100°F. shall not be used in oil lines. Cast iron fittings shall not be used.
- 13.6.4 Piping shall be substantially supported and protected against physical damage and where necessary protected against corrosion. All buried piping except copper piping shall be protected against corrosion.
- 13.6.5 Proper allowance shall be made for expansion, contraction, jarring and vibration. Pipe lines, other than tubing, connected to underground tanks, except straight fill lines and test wells, shall be provided with double swing joints arranged to permit the tanks to settle without impairing the tightness of the pipe connections.

13.7 FILL AND RETURN PIPING

- 13.7.1 A fill pipe on a tank larger than 60 gallons shall terminate outside of a building at least two feet from any building opening. Every fill terminal shall be equipped with a tight metal cover.
- 13.7.2 A return line from a burner or pump to a supply tank shall enter the top of the tank.
- 13.7.3 An auxiliary tank installed in the supply piping between a burner and its main fuel supply tank shall be filled by pumping from storage tanks.

13.8 SUPPLY CONNECTIONS

- 13.8.1 All piping, except the burner supply line from a tank having a capacity not over 550 gallons and the cross connection between two such tanks having an aggregate capacity of 550 gallons or less, shall be connected into the top of the supply tank.

- 13.8.2 The burner supply connection to tank or tanks having a capacity of more than 550 gallons shall be connected to the top of the tank except in commercial and industrial installations the burner supply connection may be below the liquid level but each such connection shall be provided with an internal or external shutoff valve located as close as practicable to the shell of the tank. External valves and their connections to the tank shall be of steel.
- 13.8.3 A transfer pump may be used to deliver oil from a supply tank to a burner or to an auxiliary tank, Except in commercial, industrial or centralized oil distribution installations, such a pump shall be connected to tankage having a capacity of not more than 550 gallons or to two tanks having an aggregate capacity of not over 550 gallons.
- 13.8.4 The pressure at the oil supply inlet to an appliance shall not be greater than 3 psi.
- 13.8.5 Where supply tanks are set below the level of the burner the oil piping shall be so laid as to pitch toward the supply tank without traps.
- 13.8.6 Pressurized tank feed shall not be used.
- 13.8.7 All tanks in which a constant oil level is not maintained by an automatic pump shall be equipped with an approved method of determining the oil level.

13.9 VENT PIPING

- 13.9.1 Vent pipes shall terminate outside of buildings not less than two feet measured vertically or horizontally from any window or other building opening. Vent terminals shall terminate in a weather-proff vent cap which shall have a minimum free open area equal to the cross-sectional area of the vent pipe. If the static head of the vent pipe filled with oil exceeds 10 psi, the tank shall be designed for the maximum static head which will be imposed.

13.10 OIL PUMPS

- 13.10.1 An oil pump not a part of a listed burner shall be a positive displacement type which automatically shuts off the oil supply when stopped.
- 13.10.2 An automatic pump not an integral part of a burner shall be a listed type installed in full compliance with its listing.

13.11 VALVES

- 13.11.1 Readily accessible manuel shut-off valves shall be installed at each point where required to properly control

the flow of fuel in normal operation and where required to avoid oil spillage during servicing. The valve shall be installed to close against the supply.

13.11.2 Where a shutoff is installed in the discharge line of an oil pump not an integral part of a burner, a pressure relief valve shall be connected into the discharge line between the pump and the shut-off valve and arranged to return surplus oil to the supply tank or to bypass it around the pump, unless the pump includes an internal bypass.

13.11.3 Where oil is supplied to a burner requiring uniform flow by gravity feed and constant level valve is not incorporated in the burner assembly or the oil is not supplied by an automatic pump, a constant level valve shall be installed in the supply line at the gravity tank or as close thereto as practicable, to insure uniform delivery of oil to the burner. The vent opening of such constant level valve shall be connected by piping or tubing to the outside of the building, unless the constant level valve is provided with an anti-flooding device. Vent piping or tubing of constant level valve shall not be connected to tanks or tank vents.

13.12 INSTALLATION OF OIL BURNERS AND OIL-FIRED UNITS

13.12.1 The installation of oil burning equipment shall be in accordance with Bureau Safety Regulation No 41, Heat Producing Appliances and Air Conditioning Systems.

SECTION 14

PROTECTION OF TANKS CONTAINING FLAMMABLE OR COMBUSTIBLE LIQUIDS IN LOCATIONS THAT MAY BE FLOODED

14.1 SCOPE OF SECTION 14

14.1.1 Section 14 shall apply to the protection of tanks containing flammable or combustible liquids that may become buoyant due to a rise in the level of the water table or due to their location in an area that may be subjected to flooding.

14.2 ABOVEGROUND TANKS

14.2.1 Vertical Tanks.

- (a) No aboveground vertical storage tank containing a flammable or combustible liquid shall be located so that the allowable liquid level within the tank is below the established maximum flood stage, unless the tank is provided with a guiding structure such as described in 14.6.
- (b) Independent water supply facilities shall be provided at locations where there is no ample and dependable public water supply available for loading partially empty tanks with water.
- (c) In addition to the preceding requirements, each tank so located that more than 70 per cent, but less than 100 per cent, of its allowable liquid storage capacity will be submerged at the established maximum flood stage, shall be safeguarded by one of the following methods:
 - (1) Tank shall be raised, or its height shall be increased, until its top extends above the maximum flood stage a distance equivalent to 30 per cent or more of its allowable liquid storage capacity, provided, however, that the submerged part of the tank shall not exceed $2\frac{1}{2}$ times the diameter; or,
 - (2) As an alternative to the foregoing, adequate non-combustible structural guides, designed to permit the tank to float vertically without loss of product, shall be provided.

14.2.2 Horizontal Tanks

- (a) Independent water supply facilities shall be provided at locations where there is no ample and dependable public water supply available for loading partially empty tanks with water.

- (b) Each horizontal tank so located that more than 70 per cent of its storage capacity will be submerged at the established flood stage, shall be anchored, attached to a foundation of concrete or of steel and concrete, of sufficient weight to provide adequate load for the tank when filled with flammable or combustible liquid and submerged by flood waters to established flood stage, or adequately secure by other means.

14.2.3 Other Types of Tanks

- (a) Spherical and spheroidal tanks shall be protected by applicable methods as specified for either vertical or horizontal tanks.

14.3 UNDERGROUND TANKS

- 14.3.1 At locations where there is no ample and dependable water supply, or where filling of underground tanks with liquids is impracticable because of the character of their contents, their use, or for other reasons, each tank shall be safeguarded against movement when empty and submerged by high ground water or flood waters by anchoring, weighting with concrete or other approved solid loading material, or securing by other means. Each such tank shall be so constructed and installed that it will safely resist external pressure due to high ground water or flood waters.

- 14.3.2 At locations where there is an ample and dependable water supply available, underground tanks containing flammable or combustible liquids, so installed that more than 70 per cent of their storage capacity will be submerged at the maximum flood stage, shall be so anchored, weighted, or secured by other means, as to prevent movement of such tanks when filled with flammable or combustible liquids, and submerged by flood waters to the established flood stage.

14.4 PIPE CONNECTIONS

- 14.4.1 Pipe connections below the allowable liquid level in a tank shall be provided with valves or cocks located as closely as practicable to the tank shell. Such valves and their connections to tanks shall be of steel or other material suitable for use with the liquid being stored. Cast iron shall not be permitted.

14.5 INDEPENDENT WATER SUPPLY FACILITIES

- 14.5.1 At locations where an independent water supply is required, it shall be entirely independent of public power and water supply. Independent source of water shall be available when flood waters reach a level not less than 10 feet below the bottom of the lowest tank on a property.
- 14.5.2 The self-contained power and pumping unit shall be so located or so designed that pumping into tanks may be carried on continuously throughout the rise in flood waters from a level 10 feet below the lowest tank to the level of the potential flood stage.
- 14.5.3 Capacity of the pumping unit shall be such that the rate of rise of water in all tanks shall be equivalent to the established potential average rate of rise of flood waters at any stage.
- 14.5.4 Each independent pumping unit shall be tested periodically to insure that it is in satisfactory operating condition.

14.6 STRUCTURAL GUIDES

- 14.6.1 Structural guides for holding floating tanks above their foundations shall be so designed that there will be no resistance to the free rise of a tank, and shall be constructed of noncombustible material.
- 14.6.2 The strength of the structure shall be adequate to resist lateral movement of a tank subject to a horizontal force in any direction equivalent to not less than 25 pounds per square foot acting on the projected vertical cross-sectional area of the tank.
- 14.6.3 Where tanks are situated on exposed points or bends in a shore line where swift currents in flood waters will be present, the structures shall be designed to withstand a unit force of not less than 50 pounds per square foot.

14.7 SAFE PRACTICES

14.7.1 Water Loading

- (a) The filling of a tank to be protected by water loading shall be started as soon as flood waters reach a dangerous flood stage. The rate of filling shall be at least equal to the rate of rise of the flood waters (or the established average potential rate of rise).
- (b) Sufficient fuel to operate the water pumps shall be available at all times to insure adequate power to fill all tankage with water.
- (c) All valves on connecting pipe lines shall be closed and locked in closed position when water loading has been completed.

14.7.2 Floating Tanks

- (a) Where structural guides are provided for the protection of floating tanks, all rigid connections between tanks and pipe lines shall be disconnected and blanked off or blinded before the flood waters reach the bottom of the tank, unless control valves and their connections to the tank are of a type designed to prevent breakage between the valve and the tank shell.
- (b) All valves attached to tanks other than those used in connection with water loading operations shall be closed and locked.
- (c) If a tank is equipped with a swing line, the swing pipe shall be raised to and secured at its highest position.

14.8 INSTRUCTIONS

- 14.8.1 Detailed printed instructions of what to do in flood emergencies shall be posted in a prominent location.

SECTION 15

ABANDONMENT OR REMOVAL OF UNDERGROUND TANKS

15.1 SCOPE OF SECTION 15

15.1.1 This Section 15 shall apply to the abandonment or removal of underground tanks that had been used for the storage of flammable or combustible liquids.

15.2 METHODS

15.2.1 Underground tanks taken out of service shall be placed in a "temporarily out of service" condition and shall be safe-guarded or disposed of by any of the three following means:

(a) Tanks shall be rendered "temporarily out of service" only when it is planned that they will be returned to active service within a reasonable period.

(b) Abandoned within 90 days.

(c) Removed.

15.3 RECORDS

15.3.1 In cases where tanks are either rendered "temporarily out of service" or permanently abandoned, records shall be kept of tank size, location, date of abandonment, and method used for placing the abandoned tank in a safe condition.

15.3.2 With any of the methods described in 15.2, no cutting torch or other flame or spark producing equipment shall be used until the tank has been completely purged or otherwise rendered safe. In each case, the steps given shall be carried out successively.

15.4 TANKS RENDERED TEMPORARILY OUT OF SERVICE

15.4.1 With tanks rendered "temporarily out of service",

(a) The fill line, gage opening, and pump suction shall be capped and secured against tampering.

(b) The vent line shall be left open.

15.5 TANKS ABANDONED IN PLACE

15.5.1 With underground tanks abandoned in place,

(a) All flammable or combustible liquid shall be removed from the tank and from all connecting lines.

(b) The suction, inlet, gage, and vent lines shall be disconnected.

(c) The tank and any remaining stubs shall be filled completely with an inert solid material.

(d) All tank inlets and outlets shall be capped.

15.6 TANKS REMOVED

15.6.1 When underground tanks are removed,

(a) All flammable or combustible liquids in the tank and connecting lines shall be removed.

(b) The suction, inlet, gage and vent lines shall be disconnected. Sections of connecting lines which are not to be used shall be removed. Inlets, outlets, and leaks, if any, shall be capped or plugged.

(c) After removal, the tank shall be gas freed; on the premises if it can be done safely at that location, or transported to an area not accessible to the public and the tank gas freed at that location.

15.7 TANKS THAT ARE JUNKED

15.7.1 If a tank is to be disposed of as junk, it shall be re-tested for flammable vapors, and, if necessary, rendered gas free. After junking and before releasing to junk dealer, a sufficient number of holes or openings shall be made in it to render it unfit for further use.

15.8 TANKS THAT ARE REUSED

15.8.1 Used tanks which are to be reused for flammable or combustible liquid service shall meet all the provisions of Section 3 for the installation of underground tanks.

SECTION 16

WHARVES

16.1 SCOPE OF SECTION 16

16.1.1 This Section 16 shall apply to wharves.

16.1.2 This Section shall not apply to marine service stations.

16.2 BASIC COMPLIANCE

16.2.1 Wharves shall comply with Section 7 except as specifically provided in this Section 16.

16.2.2 Piping, valves and fittings shall comply with Section 4 and 16.5.

16.3 LOCATION

16.3.1 Wharves at which flammable or combustible liquid cargoes are to be transferred in bulk quantities to or from tank vessels, shall be at least 100 feet from any bridge over a navigable waterway, or from an entrance to or superstructure of any vehicular or railroad tunnel under a waterway.

16.3.2 The termination of the wharf loading or unloading fixed piping shall be of least 200 feet from a bridge or from an entrance to or superstructure of a tunnel.

16.4 CONSTRUCTION

16.4.1 Substructure and deck shall be substantially designed for the use intended. Deck may employ any material which will afford the desired combination of flexibility, resistance to shock, durability, strength and fire resistance. Heavy timber construction is acceptable.

16.4.2 Wharves on which the primary function is other than the transfer of flammable or combustible liquid cargo in bulk, shall be constructed in accordance with the Standard for the Construction and Protection of Piers and Wharves, No 87-1968.

16.5 PIPING, VALVES AND FITTINGS

16.5.1 Flexibility of piping shall be assured by appropriate layout and arrangement of piping supports so that motion of the wharf structure resulting from wave action, currents, tides or the mooring of vessels will not subject the pipe to repeated strain beyond the elastic limit.

16.5.2 Pipe joints depending upon the friction characteristics of combustible materials or grooving of pipe ends for mechanical continuity of piping shall not be used.

- 16.5.3 Swivel joints may be used in piping to which hoses are connected, and for articulated swivel-joint transfer systems, provided that the design is such that the mechanical strength of the joint will not be impaired if the packing material should fail, as by exposure to fire.
- 16.5.4 Piping systems shall contain a sufficient number of valves to operate the system properly and to control the flow of liquid in normal operation and in the event of physical damage.
- 16.5.5 In addition to 16.6.4, each line conveying flammable liquids leading to a wharf shall be provided with a readily accessible block valve located on shore near the approach to the wharf and outside of any diked area. Where more than one line is involved, the valves shall be grouped in one location.
- 16.5.6 Means of easy access shall be provided for cargo line valves located below the wharf deck.
- 16.5.7 Pipe lines on flammable or combustible liquids wharves shall be adequately bonded and grounded. If excessive stray currents are encountered, insulating joints shall be installed. Bonding and grounding connections on all pipe lines shall be located on wharf side of hose riser insulating flanges, if used, and shall be accessible for inspection.

16.6 HOSE

- 16.6.1 All pressure hoses and couplings shall be inspected at intervals appropriate to the service. With the hose extended, test the hose and couplings 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.
- 16.6.2 Hose or articulated swivel-joint pipe connections used for cargo transfer shall be capable of accomodating the combined effects of change in draft and maximum tidal range, and mooring lines shall be kept adjusted to prevent surge of the vessel from placing stress on the cargo transfer system.
- 16.6.3 Hose shall be supported so as to avoid kinking and damage from chafing.

16.7 PUMPS

- 16.7.1 Loading pumps capable of building up pressures in excess of the safe working pressure of cargo hose or loading arms shall be provided with by-passes, relief valves,

or other arrangement to protect the loading facilities against excessive pressure. Relief devices shall be tested at least once each year to determine that they function satisfactorily at the pressure at which they are set.

16.8 STORAGE AND HANDLING OF LIQUIDS

- 16.8.1 Package cargo of flammable and combustible liquids, including full and empty drums, bulk fuel and stores may be handled over a wharf and at such times and places as may be agreed upon by the wharf superintendent and the senior deck officer on duty.
- 16.8.2 Tanks used exclusively for ballast water or Class II or III liquids may be installed on suitably designed wharves.
- 16.8.3 Loading or discharging shall not commence until wharf superintendent and officer in charge of tank vessel agree that tank vessel is properly moored and all connections are properly made.
- 16.8.4 Mechanical work shall not be performed on the wharf during cargo transfer, except under special authorization based on a review of the area involved, methods to be employed, and precautions necessary.

16.9 FIRE CONTROL

- 16.9.1 Portable fire extinguishers with a rating of not less than 12-BC shall be located within 75 feet of those portions of the facility where fires are likely to occur, such as hose connections, pumps and separator tanks.
- 16.9.2 Where piped water is available, ready-connected fire hose in size appropriate for the water supply shall be provided so that manifolds where connections are made and broken can be reached by at least one hose stream.
- 16.9.3 Material shall not be placed on wharves in such a manner as to obstruct access to fire fighting equipment or important pipe line control valves.
- 16.9.4 Where the wharf is accessible to vehicle traffic, an unobstructed roadway to the shore end of the wharf shall be maintained for access of fire fighting apparatus.

SECTION 17

SPRAY FINISHING

17.1 SCOPE OF SECTION 17

- 17.1.1 This Section 17 shall apply to locations or areas where the application of flammable or combustible paint, varnish, lacquer, stain or other flammable or combustible liquid is applied as a spray by whatever means, in continuous or intermittent processes.

17.2 LOCATION OF SPRAY FINISHING OPERATIONS

- 17.2.1 Spray finishing operations shall not be conducted in buildings, except in a room designed for the purpose, protected with an approved system of automatic sprinklers and separated vertically and horizontally from other areas by construction having not less than 1 hour fire resistance rating.

17.3 SPRAY BOOTHS

- 17.3.1 Spray booths shall be substantially constructed of non-combustible material.
- 17.3.2 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.
- 17.3.3 The floor of the spray booth and operators' working area, if combustible, shall be covered with noncombustible material of such character as to facilitate the safe cleaning and removal of residues.
- 17.3.4 If installed, baffle plates shall be noncombustible material, readily removable or accessible on both sides for cleaning, and designed to promote an even flow of air through the booth and to prevent the deposit of overspray before it enters the exhaust duct. Such baffle plates shall not be located in exhaust ducts.
- 17.3.5 Each spray booth having a frontal area larger than nine 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.
- 17.3.6 Each spray booth shall be separated from other operations by not less than three feet, or by a partition or wall to reduce the danger from juxtaposition of hazardous operations.
- 17.3.7 Spray booths shall be so installed that all portions are readily accessible for cleaning. A clear space of not less than three feet on all sides shall be kept free from storage or combustible construction.

17.3.8 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 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.

17.4 DRY TYPE OVERSPRAY COLLECTORS - (EXHAUST AIR FILTERS)

17.4.1 Overspray dry filters or filter rolls, if installed in conventional dry type spray booths, shall conform to 17.4.3 through 17.4.8.

17.4.2 The 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 as provided in Safety Regulation No 42, Exhaust Systems. Visible gauges or audible alarm or pressure activated devices shall be installed to indicate or insure that the required air velocity is maintained.

17.4.3 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.

17.4.4 The location of filters in a spray booth shall be so as to not reduce the effective booth enclosure of the articles being sprayed.

17.4.5 Space within spray booth on the downstream and upstream sides of filter shall be protected with approved automatic sprinklers.

17.4.6 Filters or filter rolls shall not be used when applying a spray material known to be highly susceptible to spontaneous heating and ignition.

17.4.7 Clean filters or filter rolls shall be noncombustible or of approved type.

17.4.8 Filters and filter rolls shall not alternately be used for different types of coating materials, where the combination of materials may be conducive to spontaneous ignition.

17.5 ELECTRICAL AND OTHER SOURCES OF IGNITION

- 17.5.1 There shall be no open flame or spark producing equipment in any spraying area as defined in Section 2, nor within 20 feet thereof, unless separated by a partition, except as permitted in 17.10.
- 17.5.2 Room heating appliances, steam pipes or hot surfaces shall not be located in a spraying area where deposits of combustible residues may readily accumulate.
- 17.5.3 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 residues may readily accumulate, except wiring in rigid conduit or in boxes or fittings containing no taps, splices or terminal connections and except as hereinafter provided in 17.10.2.
- 17.5.4 Where electrical wiring and equipment not subject to deposits of combustible residues is located in a spraying area, such wiring and equipment shall be of an explosion-proof type approved for use in Class 1, Division 1 hazardous locations.
- 17.5.5 Where electrical wiring, motors, or other equipment is located outside of but within 20 feet of any spraying area and is not separated from the spraying area by partitions, such wiring, motors, or other equipment that does not produce sparks under normal operating conditions shall be of a type approved for use in Class I, Division 2 hazardous locations.
- 17.5.6 Electric lamps outside of but within 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 physical damage by suitable guards or by location.
- 17.5.7 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 locations.
- 17.5.8 All metal parts of spray booths, exhaust ducts and piping systems conveying flammable or combustible liquids or aerated solids shall be bonded and connected to a ground.

17.6 VENTILATION OF SPRAY BOOTHS AND SPRAY FINISHING AREAS

- 17.6.1 All spraying areas shall be provided with mechanical ventilation adequate to prevent the dangerous accumulation of flammable vapors, mists, or powders and to safely remove such vapors to a safe location. Mechanical exhaust ventilation shall be in accordance with Safety Regulation No.42, Exhaust Systems.
- 17.6.2 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.
- 17.6.3 Each spray booth shall have an independent exhaust duct system discharging to building exterior, except multiple cabinet spray booths in which identical spray finishing material is used with a combined frontal area of not more than eighteen 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 operating all.
- 17.6.4 Electric motors driving exhaust fans shall not be placed inside booths or ducts. Fan rotating element shall be non-ferrous or non-sparking or the casing shall consist of or be lined with such material.
- 17.6.5 Belts shall not enter duct or booth unless belt and pulley within the duct or booth are tightly enclosed.
- 17.6.6 Exhaust ducts shall be constructed of steel and shall be substantially supported.
- 17.6.7 Exhaust ducts shall have a clearance from unprotected combustible construction or material of not less than 18 inches. If combustible construction is provided with the following protection applied to all surfaces within 18 inches, clearances may be reduced to the distances indicated:
- (a) 0.0149 inch thickness uncoated sheet steel (no. 28 manufacturers' standard gauge) on $\frac{1}{4}$ -inch asbestos mill board-----12 inches
 - (b) 0.0149 inch thickness uncoated sheet steel (no. 28 manufacturers' standard gauge) on 1/8-inch asbestos mill board spaced out one inch on non-combustible spacers ----- 9 inches
 - (c) 0.0299 inch thickness uncoated sheet steel (no. 22 manufacturers' standard gauge) on 1-inch mineral wool batts reinforced with wire mesh or the equivalent ----- 3 inches

- (d) Where ducts are protected with an approved automatic sprinkler system, properly maintained; the clearance from unprotected combustible construction or material may be reduced to-----
6 inches

17.6.8 Air exhausted from spraying operations shall not be recirculated.

17.7 STORAGE AND HANDLING OF FLAMMABLE OR COMBUSTIBLE LIQUIDS.

- 17.7.1 Where the quantity of liquid in 5-gallon and smaller containers, other than original sealed containers, exceeds a total of 10 gallons it shall be stored in a storage cabinet conforming to 5.3 or in storage rooms or mixing rooms conforming to 5.4.
- 17.7.2 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 areas. Open containers shall not be used.
- 17.7.3 Containers supplying spray nozzles shall be of closed type or provided with metal covers kept closed. Containers not resting on floors shall be noncombustible supports or suspended by wire cables. Containers supplying spray nozzles by gravity flow shall not exceed 10 gallons capacity.
- 17.7.4 All containers or piping to which is attached a hose or flexible connection shall be provided with a shut-off valve at the connection. Such valves shall be kept shut when not in use.
- 17.7.5 Heaters shall not be located in spray booths or other locations subject to the accumulation of deposits or combustible residue.
- 17.7.6 If flammable or combustible liquids are supplied to spray nozzles by positive displacement pumps, pump discharge line shall be provided with an approved relief valve discharging to pump suction or to a safe detached location, or a device provided to stop the prime mover if the discharge pressure exceeds the safe operating pressure of the system.
- 17.7.7 Whenever flammable or combustible liquids are transferred from one container to another, both containers shall be bonded and grounded. Piping systems for flammable or combustible liquids shall be permanently bonded and grounded.

17.8 FIRE CONTROL

- 17.8.1 Suitable portable fire extinguishers, small hose or other fire extinguishing equipment shall be installed near all spraying areas as may be specified by the Bureau.

17.9 OPERATIONS AND MAINTENANCE.

- 17.9.1 All spraying areas shall be kept as free from the accumulation of deposits of combustible residues as practical, with cleaning conducted daily if necessary.
- 17.9.2 Scrapers, spuds or other such tools used for cleaning purposes shall be of non-sparking material.
- 17.9.3 Residue scrapings and debris contaminated with residue shall be immediately removed from premises and properly disposed of.
- 17.9.4 The use of solvents for cleaning operations shall be restricted to Class II and III liquids except solvents with flash points not less than those normally used in spraying operations may be used for cleaning spray nozzles and auxiliary equipment, provided such cleaning is conducted inside spray booths and ventilating equipment is operating during cleaning.
- 17.9.5 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.
- 17.9.6 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 and at the end of each shift.

17.10 DRYING, CURING, OR FUSION.

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

17.10.2 Except as specifically provided in 17.10.3, drying, curing or fusion units, utilizing a heating system having open flames or which may produce sparks, shall not be installed in a spraying area, but may be installed adjacent thereto when equipped with an interlocked ventilating system arranged to:

- (1) Thoroughly ventilate the drying space before heating system can be started;
- (2) Maintain a safe atmosphere at any source of ignition;
- (3) Automatically shut down heating system in the event of failure of the ventilating system.

17.10.3 Automobile refinishing booths or enclosures, otherwise installed and maintained in conformity with this Section 17, may alternately be used for drying with portable electrical infra-red drying apparatus when conforming with the following:

- (a) Interior of spray enclosures shall be kept free of overspray deposits.
- (b) During spray operations, the drying apparatus and electrical connections and wiring thereto shall not be located within spray enclosure nor in any other location where spray residue may be deposited thereon.
- (c) Spraying apparatus, drying apparatus, and ventilating system of spray enclosure shall be equipped with suitable inter-locks so arranged that:
 - (1) Spraying apparatus cannot be operated while drying apparatus is inside spray enclosure.
 - (2) Spray enclosure will be purged of spray vapors for a period of not less than 3 minutes before drying apparatus can be energized.
 - (3) Ventilating system will maintain a safe atmosphere within the enclosure during the drying process and drying apparatus will automatically shut off in the event of failure of the ventilating system.
- (d) Within 18 inches of the floor level, electrical wiring and equipment shall be of a type approved for Class I, Division 2 hazardous locations.
- (e) All metallic parts of drying apparatus shall be properly electrically bonded and grounded.

17.11 POWDER COATING

- 17.11.1 Electrical equipment and other sources of ignition shall comply with 17.5.1, 17.5.6, 17.5.8, and Article 502 of the National Electrical Code, NFPA No 70-1968.
- 17.11.2 Exhaust ventilation shall be sufficient to maintain the atmosphere below the lowest explosive limit for the material being applied. All non-deposited air suspended powders shall be safely removed via exhaust ducts to the powder recovery cyclone or receptacle. Powders shall not be released to the outside atmospheres.
- 17.11.3 All preheated parts that are to be coated shall not be heated to a point in excess of the ignition temperature of the powder.
- 17.11.4 All areas shall be kept free of the accumulation of powder coating dusts, particularly such horizontal surfaces as ledges, beams, pipes, hoods, booths and floors.
- 17.11.5 Electrostatic Fluidized Beds.
 - (a) Electrostatic fluidized beds and associated equipment shall be of approved types. The maximum surface temperature of this equipment in the coating area shall not exceed 150°F. The high voltage circuits shall be so designed as to not produce a spark of sufficient intensity to ignite any powder-air mixtures nor result in appreciable shock hazard upon coming in contact with a grounded object under normal operating conditions.
 - (b) Transformers, power packs, control apparatus and all other electrical portions of the equipment, with the exception of the charging electrodes and their connections to the power supply shall be located outside of the powder coating area or shall otherwise conform to 17.11.1.
 - (c) All electrically conductive objects within the charging influence of the electrodes shall be adequately grounded. The powder coating equipment shall carry a prominent, permanently installed warning regarding the necessity for grounding these objects.
 - (d) Objects being coated shall be maintained in contact with the conveyor or other support in order to insure proper grounding. Hangers shall be regularly cleaned to insure effective contact and areas of contact shall be sharp points or knife edges where possible.
 - (e) The electrical equipment shall be so interlocked with the ventilation system that the equipment cannot be operated unless the ventilation fans are in operation.

17.12 SMOKING PROHIBITED

17.12.1 Smoking shall be prohibited in any spray finishing area.

17.12.2 "No Smoking" signs with lettering in appropriate size and contrast shall be conspicuously posted in spray finishing areas.

17.13 WELDING WARNING SIGNS.

17.13.1 Conspicuous signs shall be posted in the vicinity of all spraying areas, dipping operations and paint storage rooms, conveying the following warning:

NO WELDING

The use of welding or cutting equipment in, or near this area is dangerous because of fire and explosion. Welding and cutting shall be done only under the supervision of the foreman in charge.

SECTION 18

DIP TANKS

18.1 SCOPE OF SECTION 18

- 18.1.1 This Section 18 shall apply to dip tank operations in which articles or materials are passed through contents of tanks, vats or containers of flammable or combustible liquids, including coatings, finishing, treating and similar processes.

18.2 LOCATION OF DIP TANK OPERATIONS

- 18.2.1 Dip tank operations shall not be conducted in buildings except in a room designed for the purpose, protected with an approved system of automatic sprinklers and separated vertically and horizontally from other areas by noncombustible construction having not less than 2 hours fire resistance rating.

- 18.2.2 Dip tanks shall not be located in basements.

- 18.2.3 Dip tanks shall not be located so as to block access to an exit.

18.3 VENTILATION OF VAPOR AREAS

- 18.3.1 All vapor areas shall be provided with mechanical ventilation adequate to prevent the dangerous accumulation of vapors and to remove such vapors to a safe location.

- 18.3.2 Required ventilation systems shall be so arranged that the failure of any ventilating fan shall automatically stop any dipping conveyor system.

- 18.3.3 Ventilation systems shall conform to Safety Regulation on exhaust systems.

18.4 CONSTRUCTION OF DIP TANKS.

- 18.4.1 Dip tanks, including drain boards if provided, shall be constructed of substantial noncombustible material, and their supports shall be of heavy metal, reinforced concrete or masonry.

- 18.4.2 Dip tanks of over 150 gallons in capacity or 10 square feet in liquid surface area shall be equipped with a properly trapped overflow pipe leading to a safe location outside buildings.

- 18.4.3 The bottom of the overflow connection shall be not less than 6 inches below the top of the tank.

- 18.4.4 Dip tanks over 500 gallons in liquid capacity shall be equipped with bottom drains automatically and manually arranged to quickly drain tank in event of fire, unless the viscosity of the liquid at normal atmospheric temperature makes this impractical. Manual operation shall be from a safely accessible location. Where gravity flow is not practicable, automatic pumps shall be provided.
- 18.4.5 Such drains shall be trapped and discharged to a closed properly vented salvage tank or to a safe outside location.
- 18.4.6 Dip tanks utilizing a conveyor system shall be so arranged that in the event of fire, the conveyor system shall automatically cease motion and required bottom drains shall open.

18.5 ELECTRICAL AND OTHER SOURCES OF IGNITION

- 18.5.1 There shall be no open flame, spark producing devices, or heated surfaces having a temperature sufficient to ignite vapors in any vapor area.
- 18.5.2 In any vapor area, electrical wiring and equipment shall be of a type approved for Class I, Division 1 hazardous locations.
- 18.5.3 Unless specifically approved for locations containing both deposits of readily ignitable residues and explosive vapors, there shall be no electrical equipment in the vicinity of dip tanks or associated drain boards or drying operations which are subject to splashing or dripping of dip tank liquids, except wiring in rigid conduit or in threaded boxes or fittings containing no taps, splices or terminal connections, and except permitted for electrostatic equipment.
- 18.5.4 In any floor space outside a vapor area, but within 20 feet therefrom, and not separated by tight partitions, there shall be no open flames or spark producing devices, except drying and baking apparatus may be installed adjacent to vapor areas when conforming to 17.10.3.
- 18.5.5 Electrical wiring and equipment in areas covered by 18.5.4 shall be of a type approved for Class I, Division 2 hazardous locations.

18.6 OPERATION AND MAINTENANCE

- 18.6.1 Areas in vicinity of dip tanks shall be kept as clear of combustible stock as practical and shall be kept entirely free of combustible debris.

- 18.6.2 When waste or rags are used in connection with dipping operations, approved metal waste cans shall be provided and all impregnated rags or waste deposited therein immediately after use. The contents of waste cans shall be disposed of at the end of each shift.

18.7 FIRE CONTROL

- 18.7.1 Areas in the vicinity of dip tanks shall be provided with manual fire extinguishers suitable for flammable or combustible liquid fires.
- 18.7.2 Dip tanks of over 150 gallons capacity or 4 square feet liquid surface area shall be protected with at least one of the following automatic extinguishing facilities:
- (a) Approved automatic water spray extinguishing system;
 - (b) Approved automatic foam extinguishing system;
 - (c) Approved automatic carbon dioxide system;
 - (d) Approved automatic dry chemical extinguishing system;
 - (e) Dip tank covers conforming to 18.8.
- 18.7.3 When dip tank liquids are artificially heated, provision shall be made to prevent a temperature rise greater than 50 degrees F. below the flash point of the liquid.

18.8 DIP TANK COVERS

- 18.8.1 Covers arranged to close automatically in the event of fire shall be actuated by approved automatic devices and shall also be arranged for manual operation.
- 18.8.2 Covers shall be of substantial noncombustible material or of tin-clad type with enclosing metal applied with locked joints.
- 18.8.3 Chains or wire rope shall be used for cover support or operating mechanism where the burning of a cord would interfere with the action of a device.
- 18.8.4 Covers shall be kept closed when tanks are not in use.

18.9 HARDENING AND TEMPERING TANKS

- 18.9.1 Hardening and tempering tanks shall conform to 18.4, 18.6 and 18.7.1, but shall be exempt from other provisions of Section 18.

- 18.9.2 Tanks shall be located as far as practicable from furnaces and shall not be located on or near combustible floors.
- 18.9.3 Tanks shall be provided with a noncombustible hood and vent or other equally effective means, venting to outside of building to serve as a vent in case of fire. All such vent ducts shall be treated as flues and be kept well away from combustible roofs or materials.
- 18.9.4 Tanks shall be equipped with a high temperature limit switch arranged to sound an alarm when the temperature of the quenching medium reaches 50°F below the flash point.
- 18.9.5 Hardening and tempering tanks of over 500 gallons capacity or 25 square feet liquid surface area shall be protected as specified in 18.7.3.
- 18.9.6 Air under pressure shall not be used to fill or to agitate oil in tanks.

18.10 FLOW COAT OPERATIONS.

- 18.10.1 Flow coat operations shall conform to the provisions for dip tanks, considering the area of the sump and **any** areas on which paint flows as the area of a dip tank.
- 18.10.2 Paint shall be supplied by direct low pressure pumping arranged to automatically shut down by means of approved heat actuated devices, in case of fire, or by a gravity tank not exceeding 10 gallons in capacity.

18.11 ROLL COATING

- 18.11.1 The processes of roll coating, spreading and impregnating, in which fabrics, paper or other material is passed directly through a tank or through containing flammable liquids, or over the surface of a roller that revolves partially submerged in a flammable liquid, shall conform to 18.11.2 and to the applicable provisions of Sections 17 and 18.
- 18.11.2 Adequate arrangements shall be made to prevent sparks from static electricity by electrically bonding and grounding all metallic rotating and other parts of machinery and equipment **and** by the installation of static collectors or maintaining a conductive atmosphere by means such as high relative humidity.

APPENDIX A.

EMERGENCY RELIEF VENTING FOR FIRE EXPOSURE

FOR ABOVEGROUND TANKS

A1.1 The requirements for emergency venting given in Table 3.2.5 and the modification factors in 3.2.5(e) are derived from a consideration of:

1. Probable maximum rate of heat transfer per unit area;
2. Size of tank and the percentage of total area likely to be exposed;
3. Time required to bring tank contents to boil;
4. Time required to heat unwet portions of the tank shell or roof to a temperature where the metal will lose strength;
5. Effect of drainage, insulation and the application of water in reducing fire exposure and heat transfer.

A1.2 Table 3.2.5 is based on a composite curve which is considered to be composed of three straight lines when plotted on log-log paper. The curve may be defined in the following manner:

The first straight line is drawn on log-log paper between the point 400,000 Btu/hr., at 20 sq. ft. exposed surface area and the point 4,000,000 Btu/hr., at 200 sq. ft. exposed surface area. The equation for this portion of the curve is $Q=20,000A$.

The second straight line is drawn on log-log graph paper between the points 4,000,000 Btu/hr., at 200 sq. ft. exposed surface area and 9,950,000 Btu/hr., at 1,000 sq. ft. exposed surface area. The equation for this portion of the curve is $Q=199,300A^{.566}$.

The third straight line is plotted on log-log graph paper between the points 9,950,000 Btu/hr., at 1,000 sq. ft. exposed surface area and 14,090,000 Btu/hr., at 2,800 sq. ft. exposed surface area. The equation for this portion of the curve is $Q=963,400A^{.338}$.

Q = 20,000 A		Q = 199,300 A ^{.566}		Q = 963,400 A ^{.338}	
A	Q	A	Q	A	Q
20	400,000	200	4,000,000	1,000	10,000,000
30	600,000	250	4,539,000	1,200	10,593,000
40	800,000	300	5,032,000	1,400	11,122,000
50	1,000,000	350	5,491,000	1,600	11,601,000
60	1,200,000	400	5,922,000	1,800	12,040,000
70	1,400,000	500	6,719,000	2,000	12,449,000
80	1,600,000	600	7,450,000	2,400	13,188,000
90	1,800,000	700	8,129,000	2,800	14,000,000
100	2,000,000	800	8,768,000	and over	
120	2,400,000	900	9,372,000		
140	2,800,000	1,000	10,000,000		
160	3,200,000				
180	3,600,000				
200	4,000,000				

For areas exceeding 2,800 square feet it has been concluded that complete fire involvement is unlikely, and loss of metal strength from overheating will cause failure in the vapor space before development of maximum possible vapor evolution rate. Therefore, additional venting capacity beyond the vapor equivalent of 14,090,000 Btu/hr. will not be effective or required.

For tanks and storage vessels designed for pressures over 1 psig, additional venting for exposed surfaces beyond 2,800 sq ft is believed to be desirable because, under these storage conditions, liquids are stored close to their boiling points. Therefore, the time to bring the container contents to boiling conditions may not be significant. For these situations a heat input valve should be determined on the basis of

$$Q = 21,000 A^{0.82}$$

The flow capacities are based on the assumption that the stored liquid will have the characteristics of hexane, and the vapor liberated has been transposed to equivalent free air at 60°F. and 14.7 psia by using appropriate factors in:

$$CFH = \frac{70.5Q}{L \sqrt{M}} \text{ where } 70.5 \text{ is the factor for converting pounds of gas}$$

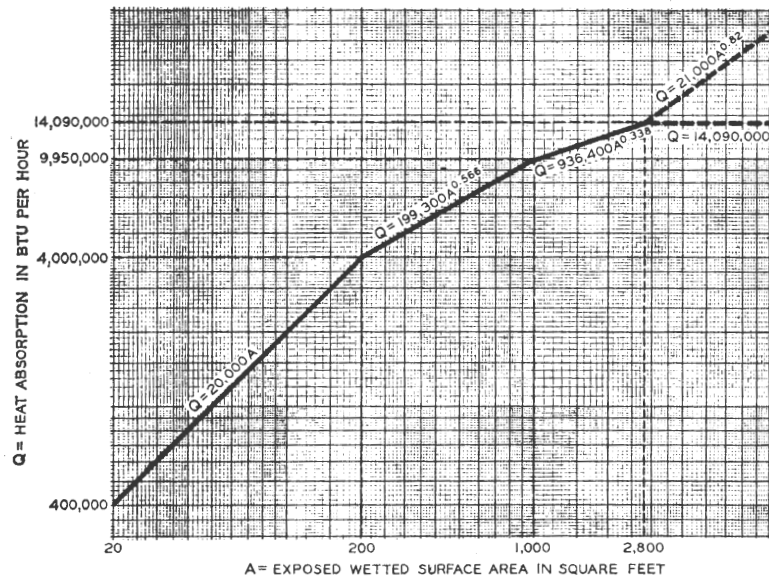
to cubic feet of air, Q = the total heat input per hour expressed in Btu; L = latent heat of vaporization; and M = molecular weight.

No consideration has been given to possible expansion from the heating of the vapor above the boiling point of the liquid, its specific heat, or the difference in density between the discharge temperature and 60°F., since some of these changes are compensating.

Since tank vent valves are ordinarily rated in CFH standard air, the figures derived from Table 3.2.5 may be used with the appropriate tank pressure as a basis for valve selection.

The attached table gives for a variety of chemical the constants which can be used to compute the vapor generated and equivalent free air for liquids other than hexane, where greater exactness is desired. Inspection of the Table will show that the use of hexane in deriving Table 3.2.5 provides results which are within an acceptable degree of accuracy for the listed liquids.

Chemical	$L \sqrt{M}$	Molecular Weight	Heat of Vaporization Btu per Lb. at Boiling Point
Acetaldehyde	1673	44.05	252
Acetic acid	1350	60.05	174
Acetic anhydride	1792	102.09	177
Acetone	1708	58.08	224
Acetonitrile	2000	41.05	312
Acrylonitrile	1930	53.05	265
n-Amyl alcohol	2025	88.15	216
iso-Amyl alcohol	1990	88.15	212
Aniline	1795	93.12	186
Benzene	1493	78.11	169
n-Butyl acetate	1432	116.16	133
n-Butyl alcohol	2185	74.12	254
iso-Butyl alcohol	2135	74.12	248
Carbon disulfide	1310	76.13	150
Chlorobenzene	1422	112.56	134
Cyclohexane	1414	84.16	154
Cyclohexanol	1953	100.16	195
Cyclohexanone	1625	98.14	164
o-Dichlorobenzene	1455	147.01	120
cis-Dichloroethylene	1350	96.95	137
Diethyl amine	1403	73.14	164
Dimethyl acetamide	1997	87.12	214
Dimethyl amine	1676	45.08	250
Dimethyl formamide	2120	73.09	248
Dioxane (diethylene ether)	1665	88.10	177
Ethyl acetate	1477	88.10	157
Ethyl alcohol	2500	46.07	368
Ethyl chloride	1340	64.52	167
Ethylene dichloride	1363	98.97	137
Ethyl ether	1310	74.12	152
Furan	1362	68.07	165
Furfural	1962	96.08	200
Gasoline	1370-1470	96.0	140-150
n-Heptane	1383	100.20	138
n-Hexane	1337	86.17	144
Hydrogen cyanide	2290	27.03	430
Methyl alcohol	2680	32.04	474
Methyl ethyl ketone	1625	72.10	191
Methyl methacrylate	1432	100.14	143
n-Octane	1412	114.22	132
n-Pentane	1300	72.15	153
n-Propyl acetate	1468	102.13	145
n-Propyl alcohol	2295	60.09	296
iso-Propyl alcohol	2225	60.09	287
Tetrahydro furan	1428	72.10	168
Toluene	1500	92.13	156
Vinyl acetate	1532	86.09	165
o-Xylene	1538	106.16	149



Curve for Determining Requirements for Emergency Venting During Fire Exposure.

**APPROXIMATE WETTED AREAS
FOR HORIZONTAL TANKS**
(Wetted Area Equals 75 Percent Total Area)

Tank Diameter, Feet	3	4	5	6	7	8	9	10	11	12
Tank Length, Feet	APPROXIMATE WETTED AREA OF TANKS WITH FLAT HEADS									
3	32									
4	30	55								
5	46	65	88							
6	53	74	109	128						
7	60	84	112	142	173					
8	67	93	124	156	190	226				
9	74	102	136	170	206	245	286			
10	81	112	147	184	223	264	308	353		
11	88	121	159	198	239	283	329	377	428	
12	95	131	171	213	256	301	350	400	454	509
13	102	140	183	227	272	320	371	424	480	537
14	109	150	194	241	289	339	393	447	506	565
15	116	159	206	255	305	358	414	471	532	594
16	123	169	218	269	322	377	435	495	558	622
17	130	178	230	283	338	395	456	518	584	650
18	137	188	242	298	355	414	477	542	610	678
19		197	253	312	371	433	499	565	636	707
20		206	265	326	388	452	520	589	662	735
21		216	277	340	404	471	541	612	683	763
22		225	289	354	421	490	562	636	714	792
23		235	300	368	437	508	584	659	740	820
24		244	312	383	454	527	605	683	765	848
25			324	397	470	546	626	706	791	876
26			336	411	487	565	647	730	817	905
27			347	425	503	584	668	754	843	933
28			359	440	520	603	690	777	869	961
29			371	454	536	621	711	801	895	989
30			383	468	553	640	732	824	921	1018
31			395	482	569	659	753	848	947	1046
32				496	586	678	775	871	973	1074
33				510	602	697	796	895	999	1103

**APPROXIMATE WETTED AREAS FOR HORIZONTAL
TANKS — Continued**

Tank Diameter, Feet	3	4	5	6	7	8	9	10	11	12
Tank Length, Feet	APPROXIMATE WETTED AREA OF TANKS WITH FLAT HEADS									
34			524	619	715	817	918	1025	1131	
35			539	635	734	838	942	1051	1159	
36			553	652	753	860	966	1077	1187	
37			567	668	772	881	989	1103	1216	
38				685	791	902	1013	1129	1244	
39				701	810	923	1036	1155	1272	
40				718	828	944	1060	1181	1301	
41				734	847	966	1083	1207	1329	
42				751	866	987	1107	1233	1357	
43				767	885	1008	1130	1259	1385	
44					904	1029	1154	1284	1414	
45					923	1051	1178	1310	1442	
46					941	1072	1201	1336	1470	
47					960	1093	1225	1362	1498	
48					979	1114	1248	1388	1527	
49					998	1135	1272	1414	1555	
50						1157	1295	1440	1583	
51						1178	1319	1466	1612	
52						1199	1342	1492	1640	
53							1220	1366	1518	1668
54							1246	1389	1544	1696
55							1263	1413	1570	1725
56								1437	1593	1753
57								1460	1622	1781
58								1484	1648	1809
59								1507	1674	1839
60								1531	1700	1866
61									1725	1894
62									1752	1923
63									1778	1951
64									1803	1979
65									1829	2007
66									1855	2036
67										2064
68										2092
69										2120
70										2149
71										2177
72										2205