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NFPA 31 Installation of Oil Burning Equipment 1983

National Fire Protection Association Batterymarch Park, Quincy, MA 02269

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Policy Adopted by NFPA Board of Directors on December 3, 1982

The Board of Directors reaffirms that the National Fire Protection Association recognizes that the toxicity of the products of combustion is an important factor in the loss of life from fire. NFPA has dealt with that subject in its technical committee documents for many years.

There is a concern that the growing use of synthetic materials may produce more or additional toxic products of combustion in a fire environment. The Board has, therefore, asked all NFPA technical committees to review the documents for which they are responsible to be sure that the documents respond to this current concern. To assist the committees in meeting this request, the Board has appointed an advisory committee to provide specific guidance to the technical committees on questions relating to assessing the hazards of the products of combustion.

Statement on NFPA Procedures

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Standard for the Installation of
Oil Burning Equipment

NFPA 31-1983

1983 Edition of NFPA 31

This edition of NFPA 31, *Standard for the Installation of Oil Burning Equipment*, was prepared by the Technical Committee on Liquid Fuel Burning Equipment, released by the Correlating Committee on Flammable Liquids, and acted on by the National Fire Protection Association, Inc. on November 16, 1982, at its Fall Meeting in Philadelphia, Pennsylvania. It was issued by the Standards Council on December 7, 1982 with an effective date of December 27, 1982, and supersedes all previous editions.

The 1983 edition of this document has been approved by the American National Standards Institute.

Origin and Development of NFPA 31

Oil Burning Equipment standards date from 1902 when they were issued by the National Board of Fire Underwriters. Subsequently, the project was turned over to the NFPA and a completely revised edition was first presented to the Association in 1913. The responsibility for this standard is now that of the Technical Committee on Liquid Fuel Burning Equipment. During the last three decades, editions have been issued in the years 1948, 1951, 1953, 1955, 1956, 1957, 1959, 1961, 1963, 1964, 1965, 1968, 1972, 1974, and 1978.

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This list represents the membership at the time the Committee was balloted on the text of this edition. Since that time, changes in the membership may have occurred.

NOTE: Membership on a Committee shall not in and of itself constitute an endorsement of the Association or any document developed by the Committee on which the member serves.

Contents

Standard for the Installation of Oil Burning Equipment

NFPA 31-1983

Chapter 1 General Provisions

1-1 Application and Scope.

1-1.1 This standard applies to oil-fired stationary equipment, including but not limited to industrial-, commercial- , and residential-type steam, hot water, or warm air heating plants; domestic-type range burners and space heaters; portable oil burning equipment except internal combustion engines, oil lamps, and portable devices such as blow torches, melting pots, and weed burners; and, further, including all accessory equipment and control systems, whether electric, thermostatic, or mechanical, and electrical wiring in connection therewith.

1-1.2 This standard is intended to prescribe reasonable minimum requirements for safety to life and property from fire in the installation of oil burners and the equipment used in connection with them, including tanks, piping, pumps, control devices, and accessories. Careful attention to the maintenance, proper operation, and normal care of the equipment is necessary for the continued safe operation. (*See 1-4.2.*)

1-1.3 Where the circumstances or conditions of any particular installation are unusual and such as to render the strict application of this standard impractical, the authority having jurisdiction may permit such modifications as will provide a substantially equivalent degree of safety and be consistent with good engineering practice.

1-2 Definitions. For the purpose of this installation standard, the following terms shall be interpreted in accordance with the following definitions.

Air Heater. An indirect-fired appliance intended to supply heated air for space heating and other purposes, but not intended for permanent installation.

Antiflooding Device. A primary safety control which causes the flow of fuel to be shut off upon a rise in fuel level or upon receiving excess fuel, and which operates before the hazardous discharge of fuel can occur.

Appliances, Industrial.

(a) *Low-Heat Industrial Appliance.* An industrial appliance such as a commercial cooking range, pressing machine boiler at any pressure, bake oven, candy furnace, stereotype furnace, drying and curing appliance, and other process appliances in which materials are heated or melted at temperatures (excluding flue-gas temperatures) not exceeding 600°F (316 °C). Appliances otherwise classed as medium-heat appliances may be considered as low-heat appliances if not larger than 100 cu ft (2.8 m^3) in size excluding any burner equipment and blower compartment.

(b) *Medium-Heat Industrial Appliance.* An industrial appliance such as an annealing furnace (glass or metal), charcoal furnace, galvanizing furnace, gas producer, commercial or industrial incinerator, and steam boiler operating at over 50 psig (345 kPa) pressure when such appliance is larger than 100 cu ft (2.8 m^3) in size, and other furnaces classified as medium-heat appliances in accordance with recognized good practice. Appliances otherwise classed as medium-heat appliances may be considered as low-heat appliances if not larger than 100 cu ft (2.8 m^3) in size excluding any burner equipment and blower compartment.

(c) *High-Heat Industrial Appliance.* An industrial appliance such as billet and bloom furnace, blast furnace, brass melter, cupola, glass furnace, open-hearth furnace, and ceramic kiln and vitreous enamelizing oven (ferrous metals) when such appliances are larger than 100 cu ft (2.8 m^3) in size, and other furnaces classified as high-heat appliances in accordance with recognized good practice.

Approved. Acceptable to the "authority having jurisdiction."

NOTE: The National Fire Protection Association does not approve, inspect or certify any installations, procedures, equipment, or materials nor does it approve or evaluate testing laboratories. In determining the acceptability of installations or procedures, equipment or materials, the authority having jurisdiction may base acceptance on compliance with NFPA or other appropriate standards. In the absence of such standards, said authority may require evidence of proper installation, procedure or use. The authority having jurisdiction may also refer to the listings or labeling practices of an organization concerned with product evaluations which is in a position to determine compliance with appropriate standards for the current production of listed items.

Authority Having Jurisdiction. The "authority having jurisdiction" is the organization, office or individual responsible for "approving" equipment, an installation or a procedure.

NOTE: The phrase "authority having jurisdiction" is used in NFPA documents in a broad manner since jurisdictions and "approval" agencies vary as do their responsibilities. Where public safety is primary, the "authority having jurisdiction" may be a federal, state, local or other regional department or individual such as a fire chief, fire marshal, chief of a fire prevention bureau, labor department, health department, building official, electrical inspector, or others having statutory authority. For insurance purposes, an insurance inspection department, rating bureau, or other insurance company representative may be the "authority having jurisdiction." In many circumstances the property owner or his designated agent assumes the role of the "authority having jurisdiction"; at government installations, the commanding officer or departmental official may be the "authority having jurisdiction."

Boiler. A closed vessel in which water is heated, steam is generated, steam is superheated, or any combination thereof, by the application of heat from combustible fuels in a self-contained or attached furnace.

Boiler, High Pressure. A boiler for generating steam at pressures in excess of 15 psi (103 kPa), or for heating water to a temperature in excess of 250°F (121°C) or at a pressure in excess of 160 psi (1103 kPa).

Boiler, Hot Water Supply. A low-pressure hot water boiler having a volume exceeding 120 gal (454 L), or a heat input exceeding 200,000 Btu per hour (58.6 kw) or an operating temperature exceeding 200°F (93°C) that provides hot water to be used externally to itself.

Boiler, Low Pressure. A boiler for generating steam at pressures not in excess of 15 psig (103 kPa) or for furnishing water at a temperature not in excess of 250°F (121°C) at pressures not in excess of 160 psig (1103 kPa).

Burner, Automatically Ignited. A burner equipped so that main burner fuel may be turned on and ignited automatically.

Burner, Manually Ignited. A burner equipped so that main burner fuel is turned on only by hand and ignited under supervision.

Burner, Mechanical Draft Type. A burner which includes a power-driven fan, blower or other mechanism as the primary means for supplying the air for combustion.

Burner, Natural Draft Type. A burner which depends primarily upon the natural draft created in the chimney or venting system to induce the air required for combustion into the burner.

Central Heating Appliance. A stationary heating appliance comprising the following classifications: boilers, central furnaces, floor furnaces, and wall furnaces. A floor-mounted unit heater to be connected to a duct system is classified also as a central heating appliance .

Centralized Oil Distribution System. A system of piping through which oil is supplied from a separate central supply tank or tanks to more than one building, mobile home, recreational vehicle, or other structure.

Chimney. One or more passageways, vertical, or nearly so, for conveying flue gases to the outside atmosphere.

(a) *Factory-Built Chimney.* A chinmey composed of listed factory-built components assembled in accordance with the terms of listing to form the completed chimney.

(b) *Masonry Chimney.* A field-constructed chimney of solid masonry units, bricks, stones, listed masonry chimney units or reinforced portland cement concrete, lined with suitable chimney flue liners built in accordance with applicable building code requirements.

(c) *Metal Chimney.* A field-constructed chimney of metal made in accordance with applicable building code requirements.

Chimney Connector. The pipe which connects a fuel-burning appliance to a chimney.

Chimney Flue. The flue gas conveying passageway in a chimney.

Clearance. The distance between a heat-producing appliance, chimney, chimney connector, vent, vent connector, or plenum, and other surfaces.

Combustible Material. Material made of or surfaced with wood, compressed paper, plant fibers, plastics, or other material that will ignite and burn, whether flameproofed or not, or whether plastered or unplastered.

Constant-Level Valve. A device for maintaining within a reservoir a constant level of oil fuel for delivery to an oil burner.

Control, Limit. An automatic safety control responsive to changes in fluid flow or level, pressure, or temperature and which is normally set beyond the operating range for limiting the operation of the controlled equipment by shutting off the energy supply.

Control, Primary Safety (Combustion Safeguard). A safety control responsive directly to flame properties, sensing the presence or absence of flame and, in the event of ignition failure or unintentional flame extinguishment, causing safety shutdown.

Control, Safety. Automatic controls (including relays, switches, and other auxiliary equipment used in conjunction therewith to form a safety-control system) which are intended to prevent unsafe operation of the controlled equipment.

Conversion Range Oil Burner. An oil burner designed to burn kerosene, range oil or similar fuel. This burner is intended primarily for installation only in a stove or range, a portion or all of which originally was designed for the utilization of solid fuel and which is flue-connected.

Cooking Appliance, Floor-Mounted Restaurant-type. A range, oven, broiler, and other miscellaneous cooking appliance of a type designated for use in hotel and restaurant kitchens and for mounting on the floor.

Damper. A valve or plate for controlling draft or the flow of gases including air.

Direct-Fired Appliance. A fuel-burning appliance in which the products of combustion (flue gases) are mixed with the medium (e.g., air) being heated.

Direct Vent Appliance. A system consisting of an appliance, combustion air and flue gas connections between the appliance and the outside atmosphere, and a vent cap supplied by the manufacturer, and constructed so that all air for combustion is obtained from the outside atmosphere and all flue gases are discharged to the outside atmosphere.

Draft Booster. A power operated fan, blower, or other device installed in the chimney connector to increase the natural draft developed in the connected chimney.

Draft Regulator, Barometric. A device built into a fuel-burning appliance or made a part of a chimney connector or vent connector, which functions to reduce ex-

cessive draft through an appliance to a desired value by admitting ambient air into the appliance chimney, chimney connector, vent or vent connector.

Fire Wall. A wall constructed of solid masonry units, or of hollow masonry units faced on each side with brick, or reinforced concrete. They are used to subdivide a building or separate buildings to restrict the spread of fire. The wall starts at the foundation and extends continuously, through all stories to and above the roof, except where the roof is of fire-resistive or semi-fire-resistive construction and the wall is carried up tightly against the underside of the roof slab.

Flue Collar. That portion of an appliance designed for attachment of a chimney or vent connector or a draft hood.

Fuel Oil. Any hydrocarbon oil as specified by ASTM D396, or the Canadian Government Specification Board, 3-GP-28, and having a flash point not less than 100°F (38°C).

Furnace, Central Warm-Air. A self-contained indirect-fired or electrically heated appliance designed to supply heated air through ducts to spaces remote from or adjacent to the appliance location.

(a) *Gravity-type Central Furnace.* A central furnace depending primarily on circulation of air by gravity.

(b) *Gravity-type Central Furnace with Integral Fan.* A central furnace equipped with a fan as an integral part of its construction and operable on gravity systems only. The fan is used only to overcome the internal resistance to air flow.

(c) *Gravity-type Central Furnace with Booster Fan.* A central furnace equipped with a booster fan which does not materially restrict free circulation of air by gravity flow when such a fan is not in operation.

(d) *Forced-Air-type Central Furnace.* A central furnace equipped with a fan which provides the primary means for circulation of air.

(i) Horizontal-type Central Furnace. A furnace designed with air flow through the furnace essentially in a horizontal path.

(ii) Upflow-type Central Furnace. A furnace designed with air flow essentially in a vertical path, discharging air at or near the top of the furnace.

(iii) Downflow-type Central Furnace. A furnace designed with air flow essentially in a vertical path, discharging air at or near the bottom of the furnace.

Furnace, Duct. A central furnace designed for installation in a duct of an air distribution system to supply warm air for heating and which depends for air circulation on a blower not furnished as part of the furnace.

Furnace, Floor. A self-contained indirect-fired or electrically heated furnace designed to be suspended from the floor of the space to be heated. A fuel-burning floor furnace is designed to take air for combustion from outside the space being heated and is provided with means for observing flame and lighting the appliance from such space.

Furnace, Stationary-type Industrial. A low-, medium- or high-heat appliance classified in accordance with its character and size and the temperatures developed in the portions thereof where substances or materials are heated for baking, drying, roasting, melting, vaporizing or other purposes.

Gallon of Oil. The amount of oil that will occupy one standard US Gal (231 cu in.) at a temperature of 60°F (16°C).

Heat Reclaimer (Chimney Connector Type). A heat exchanger intended to be installed in a chimney connector, between a heating appliance and the chimney, to transfer heat from the flue gases through metal to air or water.

Heating and Cooking Appliance. An oil-fired appliance not intended for central heating. These appliances include kerosene stoves, oil stoves, portable kerosene heaters, and conversion range oil burners.

Indirect-Fired Appliance. A fuel-burning appliance in which products of combustion (flue gases) are not mixed in the appliance with the medium (e.g., air) being heated.

Installation. The complete setting-in-place, ready for operation of an oil burning equipment together with its accessories and equipment.

Kerosene Stove. An unvented, self-contained, self-supporting kerosene burning range or room heater equipped with an integral fuel tank not exceeding 2-gal (7.5-L) capacity.

Labeled. Equipment or materials to which has been attached a label, symbol or other identifying mark of an organization acceptable to the "authority having jurisdiction" and concerned with product evaluation, that maintains periodic inspection of production of labeled equipment or materials and by whose labeling the manufacturer indicates compliance with appropriate standards or performance in a specified manner.

Listed. Equipment or materials included in a list published by an organization acceptable to the "authority having jurisdiction" and concerned with product evaluation, that maintains periodic inspection of production of listed equipment or materials and whose listing states either that the equipment or material meets appropriate standards or has been tested and found suitable for use in a specified manner.

NOTE: The means for identifying listed equipment may vary for each organization concerned with product evaluation, some of which do not recognize equipment as listed unless it is also labeled. The "authority having jurisdiction" should utilize the system employed by the listing organization to identify a listed product.

Oil Burner. A device for burning oil in heating appliances such as boilers, furnaces, water heaters, ranges and the like. A burner of this type may be furnished with or without a primary safety control; and it may be a pressure atomizing gun type, a horizontal or vertical rotary type, or a mechanical or natural draft vaporizing type.

Oil Burning Equipment. An oil burner of any type together with its tank, piping, wiring, controls and related devices and including all oil burners, oil-fired units, and heating and cooking appliances but excluding those exempted by 1-1.1.

Oil Burning Stove. A self-contained, free standing, above-the-floor indirect-fired appliance equipped with one or more oil burners. It may be equipped with an integral oil tank or may be designed for connection to a separate oil supply tank.

Oil-Fired Unit. An appliance equipped with one or more oil burners and all the necessary safety controls, electrical equipment and related equipment manufactured for assembly as a complete unit. This definition does not include kerosene stoves or oil stoves.

Portable Kerosene Heater. An unvented, self-contained, self-supporting heater, with integral reservoir, designed to be carried from one location to another.

Pump, Automatic Oil. A pump, not an integral part of an oil burner, which automatically pumps oil from the supply tank and delivers the oil by gravity under a constant head to an oil-burning appliance. The pump is designed to stop pumping automatically in case of total breakage of the oil supply line between the pump and the appliance.

Pump, Oil Transfer. An oil pump, automatically or manually operated, which transfers oil through continuous piping from a supply tank to an oil-burning appliance or to an auxiliary tank, and which is not designed to stop pumping automatically in case of total breakage of the oil supply line between the pump and the appliance.

Range. An appliance intended primarily for cooking, including roasting, baking or broiling or any combination of these functions.

Readily Accessible. Capable of being reached easily and quickly for operation, maintenance, and inspection.

Room Heater. A self-contained, free-standing air-heating appliance intended for installation in the space being heated and not intended for duct connection.

Room Heater, Circulating. A room heater with an outer jacket surrounding the heat exchanger arranged with openings at top and bottom so that air circulates between the heat exchanger and the outer jacket. Room heaters which have openings in an outer jacket to permit some direct radiation from the heat exchanger are classified as radiant type.

Room Heater, Radiant. A room heater designed to transfer heat primarily by direct radiation.

Shall. Indicates a mandatory requirement.

Should. Indicates a recommendation or that which is advised but not required.

Sump. The receptacle employed with a vacuum tank.

Tank, Auxiliary. A tank having a capacity of not over 60 gal (227 L) listed for installation in the supply piping between a burner and its main fuel supply tank. It may be included as an integral part of an automatic pump, or a transfer pump, or may be a separate tank.

Tank, Gravity. A supply tank from which the oil is delivered directly to the burner by gravity.

Tank, Integral. A tank which is furnished by the manufacturer as an integral part of an oil-burning appliance.

Tank, Storage. A separate tank which is not connected to the oil-burning appliance.

Tank, Supply. A separate tank connected directly or by a pump to the oil-burning appliance.

Tank, Vacuum or Barometric. A tank not exceeding 5-gal (11-L) capacity, which maintains a definite level of oil in a sump or similar receptacle by barometric feed. Fuel is delivered from the sump to the burner by gravity.

Unit Heater. A self-contained heating appliance, which may or may not include an integral fan for circulating air, which may be of the floor-mounted or suspended type, intended for the heating of the space in which it is installed. A unit heater may be an indirect-fired fuel burning appliance or may utilize steam, hot water or electricity.

Valve, Manual Oil Shutoff. A manually operated valve in an oil line for the purpose of turning on or completely shutting off the oil supply to the burner.

Valve, Oil Control. An automatically or manually operated device consisting essentially of an oil valve for controlling the fuel supply to a burner.

(a) *Metering (Regulating) Valve.* An oil control valve for regulating burner input.

(b) *Safety Valve.* An automatic oil control valve of the "on" and "off" type (without any by-pass to the burner) that is actuated by a safety control or by an emergency device.

Vent, Type L. A passageway, vertical or nearly so, composed of listed factory-built components assembled in accordance with the terms of listing for conveying flue gases from oil and gas appliances or their vent connectors to the outside atmosphere.

Wall Furnace. A self-contained, vented appliance complete with grills or equivalent, designed for incorporation in or permanent attachment to the structure of a building, mobile home or recreational vehicle, and furnishing heated air directly into the space to be heated through openings in the casing. Such appliances shall not be provided with duct extensions beyond the vertical and horizontal limits of the casing proper, except that boots, not to exceed 10 in. (254 mm) beyond the horizontal of

the casing, for extension through walls of nominal thickness may be permitted. When provided, such boots shall be supplied by the manufacturer as an integral part of the appliance. This definition excludes floor furnaces, unit heaters and central furnaces.

Water Heater. An indirect-fired fuel burning or electrically heated appliance for heating water to a temperature not more than 200°F (93°C) having an input not greater than 200,000 Btu or 58.6 kw per hr and a water containing capacity not exceeding 120 US gal (454 L).

1-2.1 For additional definitions of terms relating to chimneys and heat-producing appliances, refer to NFPA 97M, *Standard Glossary of Terms Relating to Chimneys, Vents and Heat Producing Appliances.*

1-3 Use of Approved Equipment. Oil-burning equipment shall be approved. Approved shall mean acceptable to the authority having jurisdiction as to design, equipment, installation, or intended use as required by this standard. Devices listed for a specific purpose by an approved testing agency may be considered as meeting the requirements of this standard.

1-4 General.

1-4.1 Before installing or remodeling any oil-burning equipment for commercial or industrial applications, plans or sketches showing the relative location of burners, tanks, pumps, piping, and elevations of buildings and their lowest floors or pits, relating to the proposed installation or alteration, shall be submitted to the authority having jurisdiction.

1-4.2 The installation shall be made in accordance with the instructions of the manufacturer.

1-4.2.1 Such instructions shall include directions and information as deemed by the manufacturer to be adequate for attaining proper and safe installation, maintenance, and use of the appliance. These instructions shall be left with the owner.

1-4.2.2 The installation shall be made by qualified, competent technicians, experienced in making such installations.

1-4.3 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.

1-4.4 Oil-burning appliances shall be installed only in locations where combustible dusts and flammable gases or vapors are not normally present.

1-4.5 After installation of the oil-burning equipment, operation and combustion performance tests shall be conducted to make certain that the burner is operating in a safe and acceptable manner and that all controls and safety devices function properly.

1-4.6 Contractors installing industrial oil-burning systems shall furnish diagrams showing the main oil lines and controlling valves, one of which shall be posted at the oil-burning equipment and another at some point which will be accessible in case of emergency.

1-5 Air for Combustion and Ventilation.

1-5.1 **General.** Appliances shall be installed in a location in which the facilities for ventilation permit satisfactory combustion of oil, proper venting, and the maintenance of ambient temperature at safe limits under normal conditions of use. Appliances shall be located in such a manner as not to interfere with proper circulation of air within the confined space. When buildings are so tight that normal infiltration does not meet air requirements, outside air shall be introduced. Ducts used to convey air from the outdoors shall be of the same cross-sectional area as the free area of the openings to which they connect. The minimum dimension of rectangular air ducts shall be not less than 3 in. (76 mm).

1-5.2 For residence-type installations and similar usages, the requirements of 1-5.1 normally may be obtained by application of one of the methods covered in 1-5.3 and 1-5.4.

1-5.2.1 For installation of commercial and industrial equipment see 1-5.7.

1-5.3 Appliances Located in Unconfined Spaces.

1-5.3.1 In unconfined spaces in buildings of conventional frame, brick or stone construction, infiltration normally is adequate to provide air for combustion and ventilation.

1-5.3.2 If the unconfined space is within a building having insufficient air because of tight construction, the air for combustion and ventilation shall be obtained from outdoors or from spaces freely communicating with the outdoors. Under these conditions a permanent opening or openings having a total free area of not less than one sq in. per 5,000 Btu per hr (28 sq in. per gal per hr) of total input rating of all appliances shall be provided.

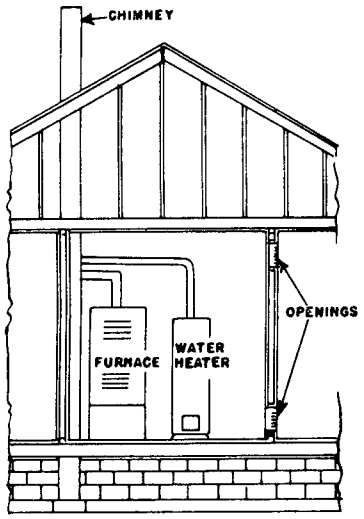
1-5.4 Appliances Located in Confined Spaces.

1-5.4.1 All Air from Inside Building. The confined space shall be provided with two permanent openings, one near the top of the enclosure and one near the bottom. Each opening shall have a free area of not less than one sq in. per 1,000 Btu per hr (140 sq in. per gal per hr) of the total input rating of all appliances in the enclosure freely communicating with interior areas having in turn adequate infiltration from the outside. (*See Figure 1-A.*)

1-5.4.2 All Air from Outdoors.

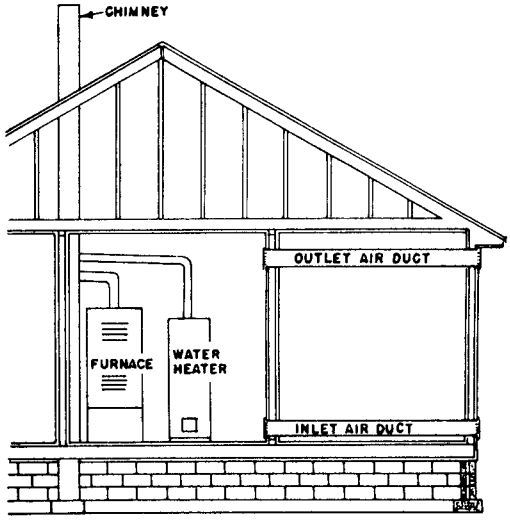
(a) The confined space shall be provided with two permanent openings, one in or near the top of the enclosure and one in or near the bottom. The openings shall communicate directly, or by means of ducts, with outdoors or to such spaces (crawl or attic) that freely communicate with outdoors. (*See Figures 1-B, 1-C and 1-D.*)

(b) When directly communicating with outdoors or by means of vertical ducts, each opening shall have a free



Note: Each opening shall have a free area of not less than one square inch per 1,000 Btu per hour (140 square inches per gallon per hour) of the total input rating of all appliances in the enclosure.

Figure 1-A Appliances Located in Confined Spaces — All Air from Inside the Building. (*See 1-5.4.1*)



Note: Each air duct opening shall have a free area of not less than one square inch per 2,000 Btu per hour (70 square inches per gallon per hour) of the total input rating of all appliances in the enclosure.*

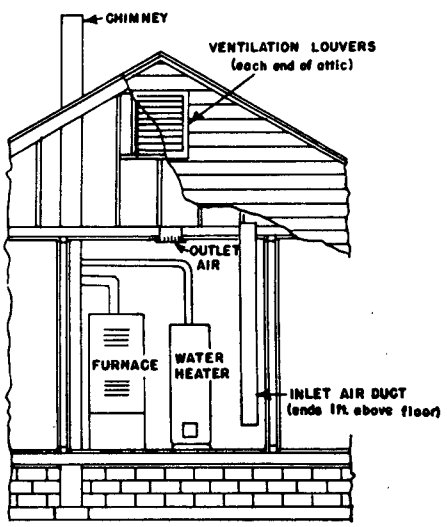
Figure 1-B Appliances Located in Confined Spaces — All Air from Outdoors (*See 1-5.4.2*)

area of not less than one sq in. per 4,000 Btu per hr (35 sq in. per gal per hr) of total input rating of all appliances in the enclosure. If horizontal ducts are used, each opening shall have a free area of not less than one sq in. per 2,000 Btu per hr (70 sq in. per gal per hour) of total input of all appliances in the enclosure.

1-5.4.3 Ventilation Air from Inside Building – Combustion Air from Outdoors. The enclosure shall be provided with two openings for ventilation, located and sized as described in 1-5.4.1. In addition, there shall be one opening directly communicating with outdoors or to such spaces (crawl or attic) that freely communicate with outdoors. This opening shall have a free area of not less than one sq in. per 5,000 Btu per hr (28 sq in. per gal per hr) of total input of all appliances in the enclosure.

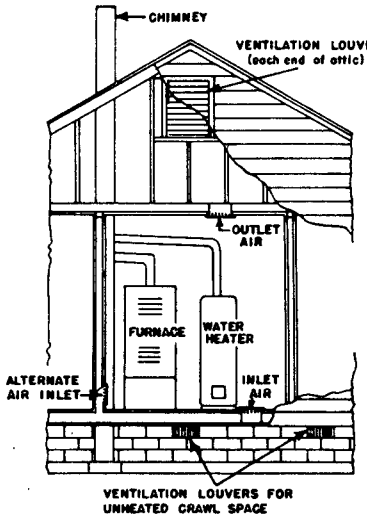
1-5.5 Louvers and Grilles. In calculating free area in 1-5.3, 1-5.4 and 1-5.7, consideration shall be given to the blocking effect of louvers, grilles or screens protecting openings. Screens used shall not be smaller than ¼ in. (6.3 mm) mesh and shall be readily accessible for cleaning. If the free area through a design of louver or grille is known, it shall be used in calculating the size opening required to provide the free area specified. If the design and free area is not known, it may be assumed that wood louvers will have 20-25 percent free area and metal louvers and grilles will have 60-75 percent free area.

1-5.6 Special Conditions. Where an appliance is installed in a location in which the operation of exhaust fans, kitchen ventilation systems, clothes dryers, or fireplaces may create conditions of unsatisfactory combustion or venting, special provisions shall be made subject to the approval of the authority having jurisdiction.



Note: The inlet and outlet air openings shall each have a free area of not less than one square inch per 4,000 Btu per hour (35 square inches per gallon per hour) of the total input rating of all appliances in the enclosure.

Figure 1-C Appliances Located in Confined Spaces — All Air from Outdoors Through Ventilated Attic. (*See 1-5.4.2.*)



Note: The inlet and outlet air openings shall each have a free area of not less than one square inch per 4,000 Btu per hour (35 square inches per gallon per hour) of the total input rating of all appliances in the enclosure.

Figure 1-D Appliances Located in Confined Spaces — All Air from Out-doors — Inlet Air from Ventilated Crawl Space and Outlet Air to Ventilated Attic. (*See 1-5.4.2.*)

1-5.7 For commercial and industrial equipment, permanent facilities for supplying an ample amount of outside air shall be provided in accordance with the following:

1-5.7.1 For furnace or boiler rooms adjacent to outside walls, and where combustion air is provided by natural ventilation from the outside, there shall be a permanent air supply inlet having a total free area of not less than one sq in. per 4,000 Btu per hr (35 sq in. per gal per hr) of total input rating of the burner or burners and in no case less than 35 sq in. (0.425 m^2).

1-5.7.2 For furnace or boiler rooms not adjacent to outside walls, the combustion air shall be supplied in a manner acceptable to the authority having jurisdiction.

1-5.8 Specially Engineered Installations. The size of combustion air openings specified in 1-5.3, 1-5.4, and 1-5.7 shall not necessarily govern when special engineering methods approved by the authority having jurisdiction assure an adequate supply of air for combustion and ventilation.

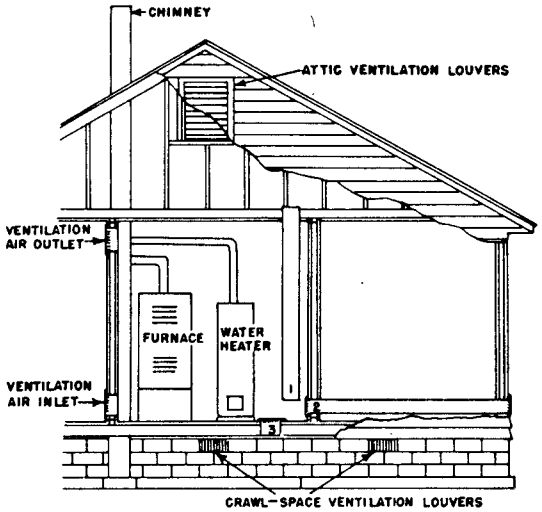
1-6 Disposal of Flue Gases.

1-6.1 All oil-fired appliances other than:

(a) Direct-fired heaters,

(b) Listed kerosene stoves,

(c) Listed portable kerosene heaters shall be chimney-connected except as provided in Section 1-8.



Note: Ducts used for make-up air may be connected to the cold air return of the heating system only if they connect directly to outdoor air.

Attic ventilation louvers are required at each end of attic with alternate air inlet No. 1.

Nos. 1, 2, and 3 mark alternate locations for air from outdoors. Free area shall be not less than 1 square inch per 5,000 Btu per hour (28 square inches per gallon per hour) of the total input rating of all appliances in the enclosure.

Crawl-space ventilation louvers for unheated crawl space are required with alternate air inlet No. 3.

Each ventilation air opening from inside the building shall have a free area of not less than 1 square inch per 1,000 Btu per hour (140 square inches per gallon per hour) of the total input rating of all appliances in the enclosure.

Figure 1-E Appliances Located in Confined Spaces. Ventilation Air from Inside Building — Combustion Air from Outside, Ventilated Attic or Ventilated Crawl Space. (*See 1-5.4.3.*)

1-7 Chimneys and Chimney Connectors.

1-7.1 Chimneys.

1-7.1.1 Masonry chimneys and metal chimneys (smokestacks) shall be built in accordance with accepted building code practice.

1-7.1.2 Factory-built chimneys shall be listed and shall be installed and used in accordance with their listings and the manufacturer's instructions.

1-7.1.3 The flue-gas exit of a chimney shall be at least 3 ft (1 m) above the highest point where it passes through the roof of a building and at least 2 ft (0.6 m) higher than any portion of a building within 10 ft (3 m) of such chimney. (*See Appendix C.*)

1-7.2 Chimney Connectors.

1-7.2.1 An appliance shall be placed so that the chimney connector will be as short as practicable. The horizontal length of a chimney connector for natural-draft burners shall not exceed 10 ft (3 m) unless a draft booster is used. For appliances requiring a negative chimney draft, the chimney connector shall be not longer than 75 percent of the portion of the chimney above the chimney-connector inlet.

1-7.2.2 No chimney connector shall pass through any floor or ceiling.

1-7.2.3 No chimney connector of any medium- or high-heat appliance shall pass through any combustible wall or partition. Chimney connectors of other appliances shall not pass through combustible walls or partitions unless they are guarded at the point of passage by (1) metal ventilated thimbles not less than 12 in. (0.3 m) larger in diameter than the connector or (2) metal or burned fireclay thimbles built in brickwork or other approved fireproofing materials extending not less than 8 in. (200 mm) beyond all sides of the thimble; or, in lieu of such protection, all combustible material in the wall or partition shall be cut away from the chimney connector a sufficient distance to provide the clearance required from such connector — any material used to close up such opening shall be noncombustible insulating material.

1-7.2.4 The chimney connector shall extend through a chimney wall to the inner face or liner but not beyond, and shall be firmly cemented to masonry. A thimble may be used to facilitate removal of the chimney connector for cleaning, in which case the thimble shall be permanently cemented in place with high-temperature cement.

1-7.2.5 The chimney connector for its entire length shall be not smaller than the flue collar of the appliance unless otherwise recommended by the appliance or chimney manufacturer. The chimney connector throughout its entire length shall be readily accessible for inspection, cleaning and replacement.

1-7.2.6 The chimney connector shall be of steel or refractory masonry and shall be maintained in good condition.

1-7.2.7 The chimney connector shall maintain a pitch or rise of at least ¼ in. to the ft (6.3 mm to the 0.3 m) (horizontal length of pipe) from the appliance to the chimney.

1-7.2.8 The chimney connector shall be installed so as to avoid sharp turns or other construction features which would create excessive resistance to the flow of flue gases. No device which will obstruct the free flow of flue gases shall be installed in a chimney connector or chimney. This shall not be construed to prohibit the use of devices specifically listed for installation in a chimney connector such as heat reclaimers, automatic dampers and safety controls.

1-7.2.9 The chimney connector shall be securely supported and joints fastened.

1-7.2.10 Clearances from combustible materials shall be in accordance with Table 4-1.

1-7.2.11 A connector shall not be connected to a chimney flue serving a fireplace unless the fireplace opening is sealed or the chimney flue which vents the fireplace is permanently sealed below the connection.

1-7.2.12 Connectors serving appliances operating under natural draft shall not be connected into any portion of a mechanical draft system operating under a positive pressure.

1-7.2.13 Connectors for appliances installed in attics shall be of a Type L vent material or the chimney shall be attached directly to the appliance.

1-7.3 Draft.

1-7.3.1 A chimney shall be capable of producing a draft not less than that for which the appliance connected thereto is listed and as recommended by the manufacturer of the appliance. To conform to this requirement, a draft booster may be used to increase low draft. When a draft booster is used, provision shall be made to shut off the fuel supply to the main burner in the event of failure of the draft booster. (*See Appendix E.*)

1-7.3.2 Two or more oil-burning appliances may be connected to a single chimney provided sufficient draft is available for safe combustion in each appliance and all products of combustion are safely removed to the outdoors.

1-7.3.3 Chimney-downdraft conditions cause faulty operation, thereby creating a hazard and, where this condition exists, corrective steps shall be taken.

1-7.4 Draft Regulators.

1-7.4.1 A draft regulator shall be provided for each oil-fired appliance required to be connected to a chimney unless the appliance design, conditions of installation, or combinations thereof, preclude excessive chimney draft, or the appliance is listed for use without one.

1-7.4.2 A draft regulator, when used, shall be installed in the same room or enclosure as the appliance and in such a manner that no difference in pressure between the air in the vicinity external to the regulator and the combustion air supply will be permitted.

1-7.4.3 A manually operated damper shall not be placed in the chimney connector from an oil-fired appliance.

Exception: When two or more oil-fired appliances are connected to a common chimney, manual isolating dampers are allowed. When such dampers are used, they shall be interlocked to prevent burner operation unless the damper is in a safe position.

1-7.4.4 Automatically operated dampers shall be of approved type designed to maintain a safe damper opening at all times and arranged to prevent starting of the burner unless the damper is opened to a safe position.

1-7.4.5 Where the chimney connectors of two or more appliances requiring draft regulators are manifolded together, a draft regulator shall be installed in the connector of each appliance.

1-7.4.6 Fixed baffles may be installed in the appliance flue collar where they are specified by the appliance manufacturer and are securely fastened into position. Such baffles when in a closed position shall not block off more than 80 percent of the chimney connector area.

1-8 Special Venting Arrangements.

1-8.1 Type L Venting Systems.

1-8.1.1 Listed Type L venting systems may be employed with appliances listed as suitable for use with Type L venting systems.

1-8.1.2 Type L venting systems shall be installed and used in accordance with their listings and the manufacturer's instructions.

1-8.1.3 A Type L venting system shall be capable of producing a draft not less than that for which the appliance(s) connected thereto is listed and as recommended by the manufacturer of the appliance.

1-8.1.4 The flue-gas exit of a Type L venting system shall be at least 2 ft (0.6 m) above the highest point where it passes through the roof of a building and at least 2 ft (0.6 m) higher than any portion of a building within 10 ft (3 m) of such Type L venting system.

1-8.2 Sealed Combustion System Appliances. Sealed combustion system appliances shall be listed and installed in accordance with their listing and the manufacturer's instructions.

1-9 Electrical Wiring and Equipment.

1-9.1 Electrical wiring and equipment used in connection with oil-burning equipment shall be installed in accordance with NFPA 70, *National Electrical Code®*.

1-9.2 Safety control circuits shall be two-wire, one side grounded, having a nominal voltage not exceeding 150. A safety control or protective device shall be connected so as to interrupt the ungrounded conductor.

1-9.3 The control circuit shall be connected to a power supply branch circuit fused at not more than the value appropriate for the rating of any control or device included in the circuit.

1-10 Fuel Oil.

1-10.1 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. For use of oil fuels other than those defined herein, see 1-1.3.

Exception: When acceptable to the authority having jurisdiction, oil burning equipment designed to burn crankcase oil may be used in commercial or industrial occupancies. Such oil burning equipment shall be listed for use with crankcase oils and shall be installed in accordance with the manufacturer's instructions and the terms of their listing. (See Section 1-11.)

1-10.2 Where heavy oils are used, provision shall be made for maintaining the oil at the proper atomizing temperature. Automatically operated burners requiring the preheating of oil shall be arranged so that no oil can be delivered for combustion until the oil is at a suitable atomizing temperature.

1-10.3 Except as permitted in 1-1.3, no steam coil operating at a pressure greater than 15 psig (103 kPa) shall be installed in an oil tank. When a pressure reducing valve is used to limit the steam pressure 15 psi (103 kPa) or less: (a) a relief valve set at not more than 5 psi (34 kPa) above the normal pressure in the coil shall be provided, and (b) provision shall be made to limit the steam temperature to 250°F (121°C).[1]

1-10.4 Hot water coils may be installed in oil tanks provided they are connected to indirect heaters and provisions are made to limit the water temperature to 250°F (121°C).

1-10.5 Electric heaters may be installed in oil tanks provided they are equipped with approved thermostats designed to prevent the oil from exceeding its minimum flash point.

1-10.6 When heaters are installed in an oil tank, provisions shall be made to prevent the oil level in the tank from dropping to a point which exposes the surface of the heater.

1-11 Crankcase Oil.

1-11.1 When storing, handling, or burning crankcase oils which may have flash points below 100°F (38°C) (Class I liquids as defined in NFPA 321, *Basic Classification of Flammable and Combustible Liquids*) or which may be heated above their flash points, attention must be given to electrical installations in areas where flammable vapors or gases may be present in the atmosphere. Typical locations are burner areas, fuel-handling equipment areas, fuel storage areas, pits, sumps, and low spots where fuel leakage or vapors may accumulate. Article 500 of NFPA 70, *National Electrical Code*, provides for classifying such areas and defines requirements for electrical installations in the areas so classified.

1-11.2 Crankcase oil properties may vary considerably, and light volatile materials may be released during storage, handling, or upon heating. Because of this characteristic, appropriate and adequate provisions shall be made to safely handle, store and burn crankcase oil. It is desirable that flexibility be built into the facility to accommodate the expected range of properties. Failure to observe the necessary design, installation and operating and maintenance procedures can result in fire, explosion, or personal injury.

1-11.3 When a supply tank is used, provisions shall be made to prevent stratification of fuel in the tank.

1-11.4 Adequate ventilation is essential in areas where oil leakage may occur, as at pumps, heaters, strainers and burners, or where maintenance may be performed. Confined fuel handling areas and burner sites shall be adequately ventilated, and forced air ventilation used where necessary. Provisions to safely dispose of spills in these areas are necessary.

1-11.5 Extensive treatment of this subject is beyond the

[1]Tank heaters which are connected so that the condensate or water is not returned to the boiler are preferred.

scope of this standard. The authority having jurisdiction shall be responsible for classifying areas where fuel is stored, handled or burned, and for revising the classification if conditions are changed. Installation shall conform to NFPA 70, *National Electrical Code*. Additional guidance can be obtained from API 2215, *Crude Oil as a Burner Fuel*, and from NFPA 30, *Flammable and Combustible Liquids Code*.

Chapter 2 Tank Storage

2-1 Design and Construction of Tanks.

2-1.1 Materials.

2-1.1.1 Tanks shall be built of steel except as provided in 2-1.1.2 through 2-1.1.5.

2-1.1.2 Tanks for underground service may be built of material other than steel.

2-1.1.3 Tanks built of materials other than steel shall be designed to specifications embodying principles recognized as good engineering design for the material used and shall be approved by the authority having jurisdiction.

2-1.1.4 Unlined concrete tanks may be used for aboveground or underground service for fuel oils having a gravity of 40 degrees API or heavier. Concrete tanks shall be built in accordance with sound engineering practice.

2-1.1.5 Tanks may have combustible or noncombustible linings.

2-1.2 Fabrication.

2-1.2.1 Tanks may be of any shape or type consistent with sound engineering design.

2-1.2.2 Metal tanks shall be welded, riveted and caulked, brazed, or bolted, 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 1,000°F (538°C) and below that of the metal joined.

2-1.2.3 Tanks shall be used under substantially atmospheric pressure and shall be built in accordance with approved standards of design. Atmospheric tanks may be built in accordance with:

(a) Underwriters Laboratories Inc., *Standard for Steel Aboveground Tanks for Flammable and Combustible Liquids*, UL 142; *Standard for Steel Underground Tanks for Flammable and Combustible Liquids*, UL 58; or *Standard for Steel Inside Tanks for Oil-burner Fuel*, UL 80.

(b) American Petroleum Institute Standard No. 650, *Welded Steel Tanks for Oil Storage*, Seventh Edition.

2-1.2.4 Tanks built according to Underwriters Laboratories Inc. requirements in 2-1.23(a) may be used for operating pressures not exceeding 1 psig (7 kPa) and shall be limited to 2.5 psig (17kPa) under emergency venting conditions.

2-1.2.5 The tank shall be designed for the maximum static head which will be imposed when the vent or fill pipe is filled with oil. The maximum static head so imposed on tanks built in accordnace with 2-1.2.3(a) shall not exceed 10 psig (70 kPa) at the bottom of the tank.

2-1.2.6 Pressure tanks if required to conform to 2-1.2.5 shall be built in accordance with the principles of the ASME *Boiler and Pressure Vessels Code*, Section VIII Pressure Vessels, Division 1 or 2.

2-2 Installation of Underground Tanks (Including Tanks Under Buildings).

2-2.1 Only a tank complying with the construction provisions of Standard UL 58 [*see 2-1.2.3(a)*] or as provided in 2-1.2.6 shall be buried underground.

2-2.2 Excavation for underground tanks shall be made with due care to avoid undermining of foundations of existing structures. 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. The distance from any part of a tank storing fuel oil to the nearest wall of any basement, pit or property line shall be not less than 1 ft (0.3 m).

2-2.3 An underground tank shall be set on a firm foundation and surrounded with at least 6 in. (150 mm) of noncorrosive inert materials such as clean sand, earth or gravel well tamped in place. 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 metal or scrape off the protective coating of coated tanks. A tank shall be covered with a minimum of 2 ft (0.6 m) of earth, or shall be covered with not less than 1 ft (0.3 m) of earth on top of which shall be placed a slab of reinforced concrete not less than 4 in. (100 mm) thick. 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 3 ft (1 m) of earth cover, or 18 in. (0.5 m) of well-tamped earth, plus 6 in. (150 mm) of reinforced concrete or 8 in. (200 mm) of asphaltic concrete. When asphaltic or reinforced concrete paving is used as part of the protection, it shall extend at least 1 ft (0.3 m) horizontally beyond the outline of the tank in all directions.

2-2.4 Unless tests show that soil resistivity is 10,000 ohm-centimeters or more, and there are no other corrosive conditions, tanks and their piping shall be protected by either: (a) a properly installed and maintained cathodic protection system with or without coatings, or (b) corrosion resistant materials of construction such as special alloys, fiberglass reinforced plastic, or fiberglass reinforced plastic coatings, or equivalent approved system. Selection of the type of protection to be employed shall be based upon the corrosion history of the area and the judgment of a qualified engineer. (*See API Publica-*

tion 1615, Installation of Underground Petroleum Storage Systems, for further information.)

2-2.5 Underground tanks shall be equipped with an open vent or an automatically operated vent, arranged to discharge to the open air. Vent openings and vent pipes shall be of ample size to prevent abnormal pressure in the tank during filling but not smaller than the pipe size specified in Table 2-1.

Table 2-1

Capacity of Tank, US Gallons	Approx. Imperial Gallons	Diameter of Vent, Iron Pipe Size
500 or less	500 or less	1¼ inches
501 to 3,000	501 to 2,500	1½ inches
3,001 to 10,000	2,501 to 8,300	2 inches
10,001 to 20,000	8,301 to 16,600	2½ inches
20,001 to 35,000	16,601 to 29,000	3 inches

For SI Units: 1 gal = 3.785 L; 1 in. = 25.40 mm.

NOTE: Where tanks are filled by the use of a pump through tight connections, a vent pipe not less in size than the discharge of the pump should be used.

2-2.6 Except as provided in 3-8.8, all connections to an underground tank shall be made through the top of the tank.

2-2.7 An underground tank shall be provided with means for gaging. (*See Section 3-6.*)

2-2.8 Fuel oil tanks taken out of service shall be safeguarded or disposed of in a safe manner. For underground tanks, see NFPA 30, *Flammable and Combustible Liquids Code*, paragraph 2-3.4.1.

2-3 Installation of Unenclosed Tank Inside Building.

2-3.1 An unenclosed supply tank inside of a building shall conform to the following provisions:

2-3.1.1 A supply tank not larger than 10 gal (38 L) shall be specifically approved for the purpose.

2-3.1.2 An approved safety can may be used as a storage tank.

2-3.1.3 A supply tank larger than 10 gal (38 L) but not larger than 660 gal (2500 L) shall meet the construction provisions of Standard UL 80 [*see 2-1.2.3(a)*], or as provided in 2-1.2.5.

2-3.1.4 A supply tank shall be of such size and shape that it can be installed in and removed from the building as a unit.

2-3.2 The size and location of unenclosed tanks inside of any building or any one portion of a building separated from other portions by a fire wall shall be in accordance with the following:

2-3.2.1 Not more than six safety cans may be located in any one or more stories of a building. No such safety can shall have an individual capacity exceeding 5 gal (19 L).

2-3.2.2 A supply or storage tank located above the lowest story, cellar or basement shall not exceed 60-gal (227-L) capacity and the total capacity of tanks so located shall not exceed 60 gal (227 L).

2-3.2.3 A supply tank shall be not larger than 660 gal (2500 L). Not more than one 660-gal (2500-L) tank or two tanks of aggregate capacity of 660 gal (2500 L) or less shall be connected to oil-burning appliances and the aggregate capacity of such tanks installed in the lowest story, cellar, or basement of a building and unenclosed shall not exceed 1,320 gal (5000 L), unless separation is provided for each 660 gal (2500 L) 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. See Appendix A, Figure A-1 for further details.

2-3.3 An unenclosed supply tank not larger than 10 gal (38 L) shall be placed not less than 2 ft (0.6 m) horizontally from any source of heat either in or external to the appliance being served but in any case shall be located so that the temperature of the oil in the tank will not exceed 25°F (14°C) above room temperature.

2-3.4 An unenclosed supply tank larger than 10 gal (38 L) shall be placed not less than 5 ft (1.5 m) from any fire or flame either in or external to any fuel-burning appliance, nor shall such a tank obstruct quick and safe access to any utility service meters, switch panels and shutoff valves.

2-3.5 An unenclosed supply tank shall be securely supported by rigid noncombustible supports to prevent settling, sliding or lifting.

2-3.6 When a supply tank larger than 10-gal (38-L) capacity is provided with an opening in the bottom for use as a burner supply connection or as a drain, the tank shall be pitched toward the opening with a slope of not less than ¼ in. per ft (6.35 mm per 0.3 m) of length.

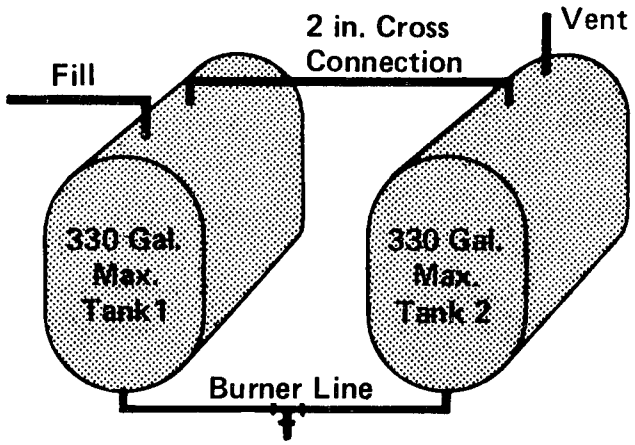
2-3.7 A shutoff valve shall be provided immediately adjacent to the burner supply connection at the bottom of a supply tank.

2-3.8 A supply tank larger than 10-gal (38-L) capacity shall be provided with an open vent pipe not smaller than the pipe size specified in Table 2-1 and a fill pipe, both terminating outside the building.

2-3.9 A supply tank provided with fill and vent pipes shall be equipped with a gaging device. (*See Section 3-6.*)

2-3.10 Any unused opening in a tank equipped with fill and vent pipes shall be closed vaportight by a pipe plug or cap screwed up tightly.

2-3.10.1 Cross connection of two supply tanks to the same burner shall be acceptable. (*See 2-3.2.3 and Figure A-1.*) Two cross connected supply tanks may be provided with a single fill and a single vent pipe, as shown in Figures 2-1 and 2-2.



For SI Units: 1 gal = 3.785 L; 1 in. = 25.4 mm.

Figure 2-1 Recommended Arrangement of Two Fuel Oil Tanks of Not More than 660 Gallons Aggregate Capacity.

In this arrangement of two tanks only one fill pipe and one vent pipe are used. During filling oil enters Tank No. 1. The displaced vapors pass through the cross connection at top into Tank No. 2. The expansion zone for both tanks is obviously in Tank No. 2 until the tanks equalize after filling is completed.

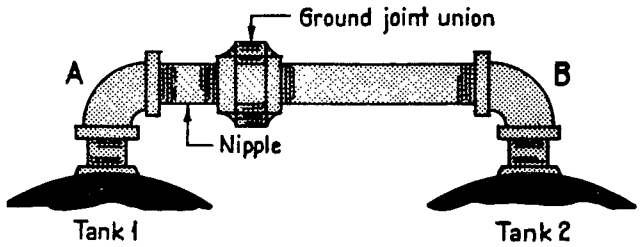


Figure 2-2 This shows the detail of the cross connection which can be used in Figure 2-2.

Swing joints (not shown) are normally used between A and B to permit tanks to settle without impairing the tightness of the pipe connections.

2-4 Installation of Enclosed Supply Tanks Inside Buildings.

2-4.1 A supply tank larger than 660-gal (2500-L) capacity shall be enclosed when installed inside of a building.

2-4.2 Tankage inside of a building in excess of that permitted in unenclosed tanks by 2-3.2.3 shall be enclosed.

2-4.3 Regardless of enclosure, a supply or storage tank located above the lowest story, cellar, or basement shall not exceed 60-gal (227-L) capacity and the total capacity of tanks so located shall not exceed 60 gal (227 L).

2-4.4 Only a tank meeting the construction provisions of Standards UL 58 and UL 80 [*see 2-1.2.3(a)*], or as provided in 2-1.2.6, shall be installed enclosed inside of a building.

2-4.5 Enclosed tanks in buildings shall be in accordance with the following:

2-4.5.1 In buildings of other than fire-resistive construction the gross capacity of the tank(s) shall be not more than 10,000 gal (37 850 L).

2-4.5.2 In buildings of fire-resistive construction the gross capacity of the tank(s) shall be not more than 15,000 gal (56 775 L).

2-4.5.3 The enclosure for tanks in 2-4.5.1 and 2-4.5.2 shall include walls, a floor and a top and be formed from walls, partitions, floors or floor-ceiling assemblies having a fire resistance rating of not less than 3 hours with the walls bonded to the floor. If the walls of such enclosure extend to and are bonded to the underside of a concrete floor or roof which has a fire resistance rating of not less than 3 hours, a separate top is not required for the tank enclosure.

Exception: The gross capacity of tanks may not be more than 50,000 gal (189 250 L) in any building provided:

(a) The individual capacity of any tank is not more than 25,000 gal (94 625 L).

(b) The tank(s) are in an enclosure having walls, a floor and a top, and constructed of assemblies having a fire resistance rating of not less than 3 hours with walls bonded to the floor.

(c) The tank enclosure is located in a room or area of the building cut off vertically and horizontally from other areas and floors of the building by assemblies having a fire resistance rating of not less than 2 hours. Access into the room shall be by an opening protected with a self-closing listed 3-hour (Class A) fire door. Fire doors shall be installed in accordance with NFPA 80, Standard for Fire Doors and Windows. The top and walls of the tank enclosure shall be independent of the building construction except that an exterior building wall having a fire resistance rating of not less than 3 hours may serve also as a wall of the tank enclosure.

2-4.6 The tank shall be supported at least 4 in. (100 mm) above the floor by masonry saddles at least 12 in. (0.3 m) thick, spaced not more than 8 ft (2.5 m) on centers and extending the full width of the tank. At least 15-in. (0.4-m) clearance shall be provided between the tank and the top and walls of the tank enclosure for the purpose of inspection and repair.

2-4.7 All connections to an enclosed supply tank having a capacity of more than 660 gal (2500 L) 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.

2-4.8 Each tank enclosure shall be provided with an opening protected by a self-closing listed 3-hour (Class A) fire door and a noncombustible liquidtight sill or ramp at least 6 in. (150 mm) high. Fire doors shall be installed in accordance with NFPA 80, *Standard for Fire Doors and Windows*. If the sill or ramp is more than 6 in. (150 mm) 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.

2-4.9 Provision shall be made for adequate ventilation of such enclosures prior to entering for inspection or repair of tanks.

2-4.10 An enclosed supply tank shall be equipped with an open vent or an automatically operated vent, terminating outside the building. Vent openings and vent pipes shall be of ample size to prevent abnormal pressure in the tank during filling but not smaller than the pipe size specified in Table 2-1.

2-4.11 An enclosed supply tank shall be provided with a gaging device. (*See Section 3-6.*)

2-5 Installation of Outside Aboveground Tanks Not Larger than 660 Gal (2500 L).

2-5.1 The provisions of Section 2-5 do not apply to centralized oil distribution systems. (*See Section 3-8.*)

2-5.2 Tankage not in excess of that permitted by 2-3.2.3 may be installed outside aboveground in a built-up area. The tanks may be adjacent to buildings but the distance to the line of adjoining property shall be in accordance with Table 2-4. Such tanks shall be suitably protected from the weather and from physical damage incident to outside use. The tanks shall not block normal means of egress.

2-5.3 A tank not larger than 60-gal (227-L) capacity may be a DOT-5 Shipping Container (drum), and so marked, a listed safety can, or a tank meeting the provisions of Standard UL 80 [*see 2-1.2.3(a)*], or as provided in 2-1.2.6.

2-5.4 A tank other than a DOT-5 Shipping Container having a capacity of not more than 660 gal (2500 L) shall meet the provisions of Standard UL 80 [*see 2-1.2.3(a)*], or as provided in 2-1.2.6.

2-5.5 Not more than one 660-gal (2500-L) tank or two tanks of aggregate capacity of 660 gal (2500 L) or less shall be connected to oil-burning appliances.

2-5.6 Two supply tanks connected to the same burner as permitted by 2-5.5 above may be cross-connected and provided with a single fill and a single vent as shown in Figures 2-1 and 2-2 but when so connected they shall be on a common slab and rigidly secured, one to the other.

2-5.7 Tanks having a capacity of 660 gal (2500 L) or less shall be securely supported by rigid noncombustible supports to prevent settling, sliding or lifting.

2-5.8 The filling of a portable container from a storage tank larger than 60 gal (227 L) shall be by means of a hand pump only.

2-5.9 A shutoff valve shall be provided in the burner supply line immediately adjacent to the gravity feed connection of a supply tank.

2-5.10 A tank not larger than 660-gal (2500-L) capacity shall be equipped with an open vent not smaller than the pipe size specified in Table 2-1.

2-5.11 A tank shall be provided with a means to determine the liquid level. (*See Section 3-6.*)

2-5.12 The fill opening shall be of such size and so located as to permit ready filling in a manner which will avoid spillage.

2-6 Installation of Outside Aboveground Tanks Larger than 660 Gal (2500 L).

2-6.1 A tank having a capacity of more than 660 gal (2500 L) shall meet the construction provisions of Standard UL 142 [*see 2-1.2.3(a)*], or as provided in 2-1.2.6, or shall comply with API Standard 650 [*see 2-1.2.3(b)*].

2-6.2 A tank shall be provided with a means to determine the liquid level. (*See Section 3-6.*)

2-6.3 Location with Respect to Property Lines, Public Ways and Important Buildings on the Same Property.

2-6.3.1 Every aboveground tank for the storage of fuel oils, equipped with emergency venting which will not permit pressures to exceed 2.5 psig (17 kPa), shall be located in accordance with Table 2-2.

2-6.3.2 Every aboveground tank for the storage of fuel oil, equipped with emergency venting which will permit pressures to exceed 2.5 psig (17 kPa), shall be located in accordance with Table 2-3.

2-6.3.3 Vertical tanks having a weak roof-to-shell seam and storing No. 6 fuel oil may be located at one-half the distances specified in Table 2-2, provided the tanks are not within a diked area or drainage path for a tank storing grade Nos. 1 through 5 fuel oil.

2-6.3.4 Reference table for minimum distances used in Table 2-2 shall be as shown in Table 2-4.

2-6.4 Spacing (Shell-to-Shell) Between Any Two Adjacent Aboveground Tanks.

2-6.4.1 The location of a tank with respect to any such other tank except tanks of 660-gal (2500-L) capacity or less shall be in accordance with Table 2-5.

2-6.4.2 The minimum horizontal separation between an LP-Gas container and a fuel oil tank shall be 20 ft (6 m). Suitable means shall be taken to prevent the accumulation of fuel oil under adjacent LP-Gas containers such as by dikes, diversion curbs or grading. When fuel oil storage tanks are within a diked area, the LP-Gas containers shall be outside the diked area and at least 10 ft (3 m) away from the center line of the wall of the diked area. The foregoing provisions shall not apply when LP-Gas containers of 125 gal (475 L) or less capacity are installed adjacent to fuel oil supply tanks of 660-gal (2500-L) or less capacity. No horizontal separation is required between aboveground LP-Gas containers and underground fuel oil tanks installed in accordance with Section 2-2.

2-6.5 Control of Spillage from Aboveground Tanks.

2-6.5.1 Facilities shall be provided so that any accidental discharge of any fuel oil will be prevented from endangering important facilities adjoining property or reaching waterways, as provided for in 2-6.5.2 or 2-6.5.3.

Table 2-2 Fuel Oil (Pressure 2.5 psig or Less)

Type of Tank	Protection	Minimum Distance in Feet from Property Line Which Is or Can Be Built Upon, Including the Opposite Side of a Public Way and Shall Be Not Less than 5 Ft	Minimum Distance in Feet from Nearest Side of Any Public Way or from Nearest Important Building on the Same Property and Shall Be Not Less than 5 Ft
Floating Roof	Protection for Exposures*	½ times diameter of tank	⅙ times diameter of tank
	None	Diameter of tank but need not exceed 175 ft	⅙ times diameter of tank
Vertical with Weak Roof to Shell Seam	Approved foam or inerting system on tanks not exceeding 150 ft in diameter**	½ times diameter of tank	⅙ times diameter of tank
	Protection for Exposures*	Diameter of tank	⅓ times diameter of tank
	None	2 times diameter of tank but need not exceed 350 ft	⅓ times diameter of tank
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	½ times Table 2-4	½ times Table 2-4
	Protection for Exposures*	Table 2-4	Table 2-4
	None	2 times Table 2-4	Table 2-4

For SI Units: 1 ft = 0.3048 m.

*Protection for Exposures shall mean fire protection for structures on property adjacent to liquid storage. Fire protection for such structures shall be acceptable when located (1) within the jurisdiction of any public fire department, or (2) adjacent to plants having private fire brigades capable of providing cooling water streams on structures on property adjacent to liquid storage.

**For tanks over 150 ft in diameter use "Protection for Exposures" or "None" as applicable.

Table 2-3 Fuel Oil (Pressure Greater than 2.5 psig)

Type of Tank	Protection	Minimum Distance in Feet from Property Line Which Is or Can Be Built Upon, Including the Opposite Side of a Public Way	Minimum Distance in Feet from Nearest Side of Any Public Way or from Nearest Important Building on the Same Property
Any Type	Protection for Exposures*	1½ times Table 2-4 but shall not be less than 25 ft	1½ times Table 2-4 but shall not be less than 25 ft
	None	3 times Table 2-4 but shall not be less than 50 ft	1½ times Table 2-4 but shall not be less than 25 ft

For SI Units: 1 ft = 0.3048 m.

*Protection for Exposures shall mean fire protection for structures on property adjacent to liquid storage. Fire protection for such structures shall be acceptable when located (1) within the jurisdiction of any public fire department, or (2) adjacent to plants having private fire brigades capable of providing cooling water streams on structures on property adjacent to liquid storage.

Table 2-4 Reference Table for Use in Tables 2-2 and 2-3

Capacity Tank Gallons	Minimum Distance in Feet from Property Line Which Is or Can Be Built Upon, Including the Opposite Side of a Public Way	Minimum Distance in Feet from Nearest Side of Any Public Way or from Nearest Important Building on the Same Property
275 or less	5	5
276 to 750	10	5
751 to 12,000	15	5
12,001 to 30,000	20	5
30,001 to 50,000	30	10
50,001 to 100,000	50	15
100,001 to 500,000	80	25
500,001 to 1,000,000	100	35
1,000,001 to 2,000,000	135	45
2,000,001 to 3,000,000	165	55
3,000,001 or more	175	60

For SI Units: 1 gal = 3.785 L; 1 ft = 0.3048 m.

Table 2-5 Minimum Tank Spacing (Shell-to-Shell)

	Floating Roof Tanks	Fixed Roof Tanks	
		Class I or II Liquids	Class IIIA Liquids
All tanks not over 150 ft diameter	⅙ sum of adjacent tank diameters but not less than 3 ft	⅙ sum of adjacent tank diameters but not less than 3 ft	⅙ sum of adjacent tank diameters but not less than 3 ft
Tanks larger than 150 ft diameter			
If remote impounding is in accordance with 2-6.5.2	⅙ sum of adjacent tank diameters	¼ sum of adjacent tank diameters	⅙ sum of adjacent tank diameters
If impounding is around tanks in accordance with 2-6.5.3	¼ sum of adjacent tank diameters	⅓ sum of adjacent tank diameters	¼ sum of adjacent tank diameters

For SI Units: 1 ft = 0.3048 m.

2-6.5.2 Remote Impounding. Where protection of adjoining property or waterways is by means of drainage to a remote impounding area, so that impounded liquid will not be held against tanks, such systems shall comply with the following:

(a) A slope of not less than 1 percent away from the tank shall be provided for at least 50 ft (15 m) toward the impounding area.

(b) The impounding area shall have a capacity not less than that of the largest tank that can drain into it.

(c) The route of the drainage system shall be so located that, if the liquids in the drainage system are ignited, the fire will not seriously expose tanks or adjoining property.

(d) The confines of the impounding area shall be located so that when filled to capacity the liquid level will not be closer than 50 ft (15 m) from any property line that is or can be built upon, or from any tank.

2-6.5.3 Impounding Around Tanks by Diking. When protection of adjoining property or waterways is by means of impounding by diking around the tanks, such system shall comply with the following:

(a) A slope of not less than 1 percent away from the tank shall be provided for at least 50 ft (15 m) or to the dike base, whichever is less.

(b) 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. To allow for volume occupied by tanks, the capacity of the diked area enclosing more than one tank shall be calculated after deducting the volume of the tanks, other than the largest tank, below the height of the dike.

(c) To permit access, the outside base of the dike at ground level shall be no closer than 10 ft (3 m) to any property line that is or can be built upon.

(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 ft (1 m) or more in height shall have a flat section at the top not less than 2 ft (0.6 m) 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) Except as provided in (f) below, the walls of the diked area shall be restricted to an average interior height of 6 ft (2 m) above interior grade.

(f) Dikes may be higher than an average of 6 ft (2 m) above interior grade where provisions are made for normal access and necessary emergency access to tanks, valves and other equipment, and safe egress from the diked enclosure.

(i) Piping passing through dike walls shall be designed to prevent excessive stresses as a result of settlement or fire exposure.

(ii) The minimum distance between tanks and toe of the interior dike walls shall be 5 ft (1.5 m).

(g) Each diked area containing two or more tanks shall be subdivided 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:

(i) When storing fuel oil in vertical cone roof tanks constructed with weak roof-to-shell seam or approved floating roof tanks, one subdivision for each tank in excess of 420,000 gal (10,000 bbl) and one subdivision for each group of tanks, no tank exceeding 420,000-gal (10,000-bbl) capacity, having an aggregate capacity not exceeding 630,000 gal (15,000 bbl).

(ii) When storing fuel oil in tanks not covered in (i), one subdivision for each tank in excess of 100,000 gal (2,500 bbl) and one subdivision for each group of tanks, no tank exceeding 100,000-gal capacity, having an aggregate capacity not exceeding 150,000 gal (3,570 bbl).

(h) Where provision is made for draining water from diked areas, such drains shall be controlled in a manner so as to prevent fuel oil from entering natural water courses, public sewers, or public drains, if their presence would constitute a hazard. Control of drainage shall be accessible under fire conditions from outside the dike.

(i) Storage of combustible materials, empty or full drums or barrels, shall not be permitted within the diked area.

2-6.6 Normal Venting for Aboveground Tanks.

2-6.6.1 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.

2-6.6.2 Normal vents shall be sized either in accordance with: (1) the American Petroleum Institute Standard 2000, *Venting Atmospheric and Low-Pressure Storage Tanks;* 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 1¼-in. (32-mm) nominal inside diameter.

2-6.6.3 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.

2-6.6.4 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.

2-6.6.5 The outlet of all vents and vent drains on tanks equipped with venting to permit pressures exceeding 2.5 psig (17 kPa) shall be arranged to discharge in such a way as to prevent localized overheating of, or flame impingement on, any part of the tank, in the event vapors from such vents are ignited.

2-6.7 Emergency Relief Venting for Fire Exposure for Aboveground Tanks.

2-6.7.1 Every aboveground tank shall have some form of construction or device that will relieve excessive internal pressure caused by exposure fires.

2-6.7.2 In a vertical tank the construction referred to in 2-6.6.1 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.

2-6.7.3 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. The total capacity of both normal and emergency venting devices shall be not less than that derived from Table 2-6 except as provided in 2-6.7.4 or 2-6.7.5. 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 larger relief valve or valves. The wetted area of the tank shall be calculated on the basis of 55 percent of the total exposed area of a sphere or spheroid, 75 percent of the total exposed area of a horizontal tank and the first 30 ft (9 m) abovegrade of the exposed shell area of a vertical tank. See Appendix A of NFPA 30, *Flammable and Combustible Liquids Code*, for calculation to determine exposed areas of typical sizes of horizontal tanks.

Table 2-6 Wetted Area Versus Cubic Feet Free Air per 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				

For SI Units: 1 sq ft = 0.0929 sq m; 1 cu ft = 0.02832 cu m.

NOTE: Interpolate for intermediate values.

2-6.7.4 The total emergency relief venting capacity for any specific liquid may be determined by the following formula:

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

where

V = cubic feet of free air per hour from Table 2-6
L = latent heat of vaporization of specific liquid in Btu per lb
M = molecular weight of specific liquids.

2-6.7.5 The required air flow rate of 2-6.7.3 or 2-6.7.4 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 2-6.5.2 for tanks over 200 sq ft (18.6 m²) of wetted area.

.3 for approved water spray in accordance with NFPA 15, *Standard for Water Spray Fixed Systems for Fire Protection*, and drainage in accordance with 2-6.5.2.

.3 for insulation in accordance with 2-6.7.5(a).

.15 for water spray with approved insulation in accordance with 2-6.7.5(a) and drainage in accordance with 2-6.5.2.

(a) Insulation systems for which credit is taken shall meet the following performance criteria and shall be subject to approval of the authority having jurisdiction:

(i) Remain in place under fire exposure conditions.

(ii) Withstand dislodgement when subjected to hose stream impingement during fire exposure. This requirement may be waived where use of solid hose streams is not contemplated or would not be practical.

(iii) Maintain a maximum conductance value of 4.0 Btu per hr per sq ft per degree F when the outer insulation jacket or cover is at a temperature of 1,660°F (904°C) and when the mean temperature of the insulation is 1,000°F (538°C).

2-6.7.6 The outlet of all vents and vent drains on tanks equipped with emergency venting to permit pressures exceeding 2.5 psig (17 kPa) shall be arranged to discharge in such a way as to prevent localized overheating of or flame impingement on any part of the tank, in the event vapors from such vents are ignited.

2-6.7.7 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. If the start to open pressure is less than 2.5 psig (17 kPa) and the pressure at full open position is greater than 2.5 psig (17 kPa), the flow capacity at 2.5 psig (17 kPa) shall also be stamped on the venting device. The flow capacity shall be expressed in cu ft per hr of air at 60°F (16°C) and 14.7 psia (101 kPa).

(a) The flow capacity of tank venting devices under 8 in. (200 mm) 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 a qualified, impartial outside agency. The flow capacity of

tank venting devices 8 in. (200 mm) nominal pipe size and larger, 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.

(b) A suitable formula for this calculation is:

$$CFH = 1{,}667\ C_f A \sqrt{P_t - P_a}$$

where

CHF = venting requirement in cu ft of free air per hr
C_f = 0.5 (the flow coefficient)
A = the orifice area in sq in.
P_t = the absolute pressure inside the tank in inches of water
P_a = the absolute atmospheric pressure outside the tank in inches of water.

2-7 Supports, Foundations and Anchorage for All Tank Locations.

2-7.1 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. Appendix E of API Standard 650, *Specification for Welded Steel Tanks for Oil Storage*, and Appendix B of API Standard 620, *Recommended Rules for the Design and Construction of Large, Welded, Low-Pressure Storage Tanks*, provide information on tank foundations.

2-7.2 When tanks are supported above the foundations, tank supports shall be installed on firm foundations. Supports for tanks storing fuel oil 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 in. (0.3 m) high at their lowest point.

2-7.3 Steel supports or exposed piling for tanks storing fuel oil shall be protected by materials having a fire resistance rating of not less than 2 hour, except that steel saddles need not be protected if less than 12 in. (0.3 m) high at their lowest point. At the discretion of the authority having jurisdiction, water spray protection in accordance with NFPA 15, *Standard for Water Spray Fixed Systems for Fire Protection*, or NFPA 13, *Standard for the Installation of Sprinkler Systems*, or equivalent may be used.

2-7.4 Every tank shall be so supported as to prevent the excessive concentration of loads on the supporting portion of the shell.

2-7.5 Where a tank is located in an area that may be subjected to flooding, the applicable precautions outlined in Paragraph 2-5.6 of NFPA 30, *Flammable and Combustible Liquids Code*, shall be observed.

2-7.6 In areas subject to earthquakes, the tank supports and connections shall be designed to resist damage as a result of such shocks.

2-8 Testing.

2-8.1 All tanks, whether shop-built or field-erected, shall be tested before they are placed in service in accordance with the applicable paragraphs of the code under which they were built. The ASME Code stamp, API monogram, or the listing mark of Underwriters Laboratories Inc. on a tank shall be evidence of compliance with this test. Tanks not marked in accordance with the above codes shall be 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 2-1.2.3(a), 2-1.2.3 (b), or 2-1.2.6.

2-8.2 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 psi (70 kPa), 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 determined by using recognized engineering practice.

2-8.3 In addition to the test called for in 2-8.1 and 2-8.2, all tanks and connections shall be tested for tightness. Except for underground tanks, this tightness 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 test called for in 2-8.1 or 2-8.2 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 for tightness hydrostatically, or with air pressure at not less than 3 psi (21 kPa) and not more than 5 psi (34 kPa). (*See Section 3-10 for testing pressure piping.*)

2-8.4 Before the tank is initially placed in service, all leaks or deformations shall be corrected in an acceptable manner. Mechanical caulking is not permitted for correcting leaks in welded tanks except pin hole leaks in the roof.

2-8.5 Tanks to be operated at pressures below their design pressure may be tested by the applicable provisions of 2-8.1 or 2-8.2 based upon the pressure developed under full emergency venting of the tank.

2-9 Special Situations.

2-9.1 In particular installations, the provisions of this chapter may be altered at the discretion of the authority having jurisdiction after consideration of the special features such as topographical conditions, barricades, walls, nature of occupancies and proximity to buildings or adjoining property and height and character of construction of such buildings, capacity and construction of proposed tanks and character of liquids to be stored, degree of private fire protection to be provided and the adequacy of facilities of the fire department to cope with fuel oil fires.

Chapter 3 Piping, Pumps and Valves

3-1 Piping Materials and Design.

3-1.1 All piping shall be wrought-iron, steel or brass pipe, or brass or copper tubing except as provided in 3-1.2. Wall thicknesses of wrought iron and steel pipe shall be in accordance with design methods outlined in the *Standard on Wrought-Steel and Wrought-Iron Pipe*, ANSI B36.10. 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.

3-1.2 Piping may be of materials other than those specified in 3-1.1 if used underground. Such piping shall be designed to specifications embodying principles recognized as good engineering design for the material used and shall be approved by the authority having jurisdiction.

3-1.3 Piping used in the installation of oil burners and appliances other than conversion range oil burners shall be not smaller than $\frac{3}{8}$-in. iron pipe size or $\frac{3}{8}$-OD tubing except that $\frac{1}{4}$-in. pipe or $\frac{5}{16}$-OD tubing may be used in the suction line of systems where the top of the tank is below the level of the oil pump. Copper tubing shall have 0.035-in. nominal and 0.032-in. minimum wall thicknesses.

3-1.4 Pipe shall be connected with standard fittings and tubing with fittings of listed type. Pipe connectors made of combustible materials or depending upon the frictional characteristics of combustible materials shall not be used inside of buildings or aboveground outside of buildings. If used belowground outside of buildings, connectors shall be of listed type and installed in accordance with their listing. All threaded joints and connections shall be made tight with suitable lubricant or pipe compound. Unions requiring gaskets or packings, right or left couplings, and sweat fittings employing solder having a melting point of less than 1,000°F (538°C) shall not be used in oil lines. Cast-iron fittings shall not be used.

3-1.5 Piping shall be substantially supported and protected against physical damage and, where necessary, protected agaist corrosion. All buried piping shall be protected against corrosion.

3-1.6 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, flexible connectors or otherwise arranged to permit the tanks to settle without impairing the tightness of the pipe connections.

3-2 Fill and Return Piping.

3-2.1 A fill pipe shall terminate outside of a building at a point at least 2 ft (0.6 m) from any building opening at the same or lower level. A fill pipe shall terminate in a manner designed to minimize spilling when the filling hose is disconnected. Fill opening shall be equipped with a tight metal cover designed to discourage tampering.

3-2.1.1 A fill pipe shall be of such size and be so located as to permit ready filling in a manner that will avoid spillage, and it shall be identified at its terminus as a fuel oil fill.

3-2.2 A return line from a burner or pump to a supply tank shall enter the top of the tank.

3-2.3 Cross connections, except between two supply tanks not exceeding 660-gal (2500-L) aggregate capacity, permitting gravity flow from one tank to another shall be prohibited.

3-2.4 An auxiliary tank shall be filled by a pump transferring the oil through continuous piping from the supply tank.

3-2.5 An auxiliary tank shall be located at a level above the top of the supply tank from which it is filled.

3-2.6 An auxiliary tank shall be provided with an overflow pipe draining to the supply tank and extending into the top of the supply tank not more than 1 in. (25 mm). This requirement does not apply to an auxiliary tank specifically listed for use without an overflow pipe.

3-2.7 An overflow pipe from an auxiliary tank and a return line from a burner or pump shall have no valves or obstructions.

3-3 Supply Connections.

3-3.1 All piping, except the burner supply line from a tank having a capacity not over 660 gal (2500 L) and the cross connection between two tanks having an aggregate capacity of 660 gal (2500 L) or less, shall be connected into the top of a supply tank. When two tanks are cross connected, the tops of the tanks shall be on the same horizontal plane. (*See Figures 2-1 and 2-2.*)

3-3.2 The burner supply connection to a tank having a capacity of more than 660 gal (2500 L) or to two or more tanks having an aggregate capacity of more than 660 gal (2500 L) shall be connected into the top of each tank, except as permitted by 3-3.6 or 3-9.8.

3-3.3 A transfer pump or an automatic pump may be used to deliver oil from a supply tank to a burner or to an auxiliary tank. Except as permitted by 3-3.6 and Section 3-8, a transfer pump shall not be connected to a tank having a capacity over 660 gal (2500 L) or to two tanks having an aggregate capacity of over 660 gal (2500 L).

3-3.4 The pressure at the oil supply inlet to an appliance shall be not greater than 3 psi (21 kPa) unless the appliance is approved for a higher inlet pressure.

3-3.5 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.

3-3.6 For commercial and industrial installations the oil supply from tanks of any capacity permitted by this standard may be in accordance with the following:

3-3.6.1 The burner supply line may be connected to an outside aboveground supply tank at a point 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.

3-3.6.2 A transfer pump may be used.

3-4 Vent Piping.

3-4.1 Vent pipes shall be so laid as to drain toward one tank without sags or traps in which liquid can collect. They shall be located so that they will not be subjected to physical damage aboveground. Vent pipes from tanks may be connected into one outlet pipe. The outlet pipe shall at least be one pipe size larger than the largest individual vent pipe connected thereto. In no case shall the point of connection between two or more vent pipes be lower than the top of any fill pipe opening. The lower end of a vent pipe shall enter the tank through the top and shall extend into the tank not more than 1 in. (25 mm).

3-4.2 Vent pipes shall terminate outside of buildings at a point not less than 2 ft (0.6 m) measured vertically or horizontally from any building opening. Outer ends of vent pipes shall terminate in a weatherproof vent cap or fitting or be provided with a weatherproof hood. All vent caps shall have a minimum free open area equal to the cross-sectional area of the vent pipe and shall not employ screens finer than four mesh. Vent pipes shall terminate sufficiently above the ground to avoid being obstructed with snow and ice. Vent pipes from tanks containing heaters shall be extended to a location where oil vapors discharging from the vent will be readily diffused. If the static head with a vent pipe filled with oil exceeds 10 psi (70 kPa), the tank shall be designed for the maximum static head which will be imposed.

3-4.3 Vent pipes shall not be cross connected with pipes other than vent pipes.

3-5 Pressurized Tank Feed. Air or other gases shall not be used to pressurize tanks.

3-6 Oil Gaging.

3-6.1 All tanks in which a constant oil level is not maintained by an automatic pump shall be equipped with a method of determining the oil level.

3-6.2 Test wells shall not be installed inside buildings. For outside service they shall be equipped with a tight metal cover designed to discourage tampering.

3-6.3 Gaging devices such as liquid level indicators or signals shall be designed and installed so that oil or vapor will not be discharged into a building from the fuel supply system. Inside tanks provided with fill and vent pipes used for No. 1 or No. 2 fuel oil shall be provided with a device to indicate either visually or audibly at the fill point when the oil in the tank has reached a predetermined safe level.

3-6.4 No tank used in connection with any oil burner shall be equipped with a glass gage or any gage which, when broken, will permit the escape of oil from the tank.

3-7 Oil Pumps and Valves.

3-7.1 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.

3-7.2 An automatic pump not an integral part of a burner shall be a listed type installed in full compliance with its listing.

3-7.3 A readily accessible manual shutoff valve 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.

3-7.4 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 shutoff 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.

3-7.5 Any fuel oil line incorporating a heater shall be provided with a relief valve arranged to discharge to the return line when any valve, pump, or other device may prevent the release of excessive pressure because of the expansion of the oil when heated.

3-7.6 Where oil is supplied to a burner requiring uniform flow by gravity feed and a 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 ensure 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 valves shall not be connected to tanks or tank vents.

3-7.7 Provision shall be made for adequate ventilation of enclosures, such as vaults or pits, where pumps and accessories are installed prior to entering for inspection or repair.

3-8 Centralized Oil Distribution Systems.

3-8.1 A centralized oil distribution system shall conform to Section 3-8 and all other applicable provisions of this standard.

3-8.2 The installation and maintenance of the distribution system shall be supervised by a qualified company acceptable to the authority having jurisdiction. Accurate inventory records shall be maintained and reconciled on all storage tanks for possible indication of leakage from tanks or piping.

3-8.3 Plans showing the relative location of tanks, pumps, valves, piping and structure to be supplied by the system shall be approved by and filed with the authority having jurisdiction.

3-8.4 Oil may be fed from the supply tank or tanks by gravity or by transfer pump. All distribution piping outside of diked areas shall be underground.

3-8.5 The capacity of a single tank or the aggregate capacity of two or more tanks supplying a centralized oil distribution system shall be not more than 20,000 gal (75 700 L) except that underground tanks installed in accordance with Section 2-2 may be of any capacity permitted by this standard.

3-8.6 Atmospheric tanks located entirely aboveground shall be built in accordance with the requirement for aboveground tanks included in 2-1.2.3. Atmospheric tanks located underground or partially underground shall be built in accordance with the requirements for underground tanks included in 2-1.2.3.

3-8.7 Aboveground and partially buried tanks shall be diked in accordance with 2-6.5.3 except that the volumetric capacity of the diked area shall be not less than the total volume above the adjacent grade level of all tanks within the diked area.

3-8.8 A distribution main may be connected to a tank or tanks having aggregate capacity of not more than 20,000 gal (75 700 L) at a point below the liquid level. When the distribution main is so connected, a readily accessible internal or external shutoff valve shall be installed in the main as close as practical to the tank. If external and aboveground, the shutoff valve and its tank connections shall be made of steel. Connections between the tank(s) and the distribution main shall be made with double swing joints, flexible connectors or otherwise arranged to permit the tank(s) to settle without damaging the system. Such connections when aboveground shall be located within the diked area.

3-8.9 Only appliances equipped with primary safety controls specifically listed for the appliance shall be connected to a centralized oil distribution system.

3-8.10 A readily accessible manual shutoff valve shall be installed in each branch line which enters a building, mobile home, travel trailer, or other structure. This valve may be either inside or outside of such structure. If outside, the valve shall be protected from weather and damage. If inside, the valve shall be located directly adjacent to the point at which the supply line enters the structure.

3-8.11 A device shall be provided which will automatically shut off the oil supply at or ahead of the point where it enters the interior of the structure, if the supply line between this device and the appliance is broken. This device shall be located on the appliance side of the manual shutoff valve required in 3-8.10. This device shall be solidly supported and protected from damage.

3-8.12 Means shall be provided to limit the oil pressure at the appliance inlet to a maximum of 3 psig (21 kPa). If a pressure reducing valve is to be used, it shall be a type approved for the service.

3-8.13 A manual-reset device shall be provided to shut off automatically the oil supply to the appliance if the oil pressure at the appliance inlet exceeds 8 psig (55 kPa), except that such a shutoff device is not required when (1) the distribution system is supplied from a gravity tank in which the maximum level of oil (hydrostatic head) is such that the pressure in the system at the appliance inlet cannot exceed 3 psig (21 kPa), or (2) the pressure-limiting device provided in accordance with 3-8.12 is such that if the device fails to regulate the pressure to not more than 3 psig (21 kPa), the oil supply automatically will be shut off.

3-9 Oil Distribution Systems for Roof-Mounted or Ceiling-Suspended Oil-Fired Units.

3-9.1 An oil distribution system for roof-mounted or ceiling-suspended oil-fired units shall conform to Section 3-9 and all other applicable provisions of this standard.

3-9.2 The installation and maintenance of the oil distribution systems shall be supervised by a qualified company acceptable to the authority having jurisdiction.

3-9.3 Plans showing the relative location of tanks, pumps, valves, piping and their relationship to structure supplied by the systems shall be approved by and filed with the authority having jurisdiction.

3-9.4 Oil may be fed directly to the burner(s), directly from a tank or by means of a fuel distribution system which includes a transfer pump.

3-9.4.1 When fed directly from a storage tank, the fuel supply system shall be designed so that under normal operating conditions the burner fuel unit operates with less than 10 in. Hg (34 kPa) vacuum at the inlet.

3-9.4.2 If the limitations of 3-9.4.1 are exceeded, a fuel supply system incorporating a transfer pump(s) is needed and shall be provided.

3-9.5 The fuel supply systems shall conform to the following general requirements:

3-9.5.1 All components (pumps, reservoirs, valves, regulators, relief valves, controls, etc.) shall be listed for use with fuel oil.

3-9.5.2 Control and/or relief provisions shall be provided to preclude pressurizing the main distribution lines 50 percent above the working pressure.

3-9.5.3 No dead-ended main distribution oil lines shall be permitted unless provisions are made for air purging. These purge points shall be closed by plugs or caps when not actually in use.

3-9.5.4 Means shall be provided to limit the oil pressure at the burner inlet to a maximum of 3 psig (21 kPa). If a pressure reducing valve is to be used, it shall be a type approved for the service.

3-9.6 The capacity of a single tank or the aggregate capacity of two or more tanks supplying a distribution system for roof-mounted or ceiling-suspended oil-fired units shall not be more than 20,000 gal (75 700 L) except

that underground tanks installed in accordance with Section 2-2 may be of any capacity permitted by this standard.

3-9.7 Tanks, piping, pumps and valves shall comply with the provisions of Chapters 2 and 3.

3-9.8 If required by design, individual supply tanks (auxiliary or day tanks) connected to burners shall comply with provisions of 2-3.2.2, 3-2.5, 3-2.6 and 3-2.7.

3-9.9 Valves and drip trays (roof-mounted units only) shall be provided to prevent oil spillage during service.

3-9.10 A readily accessible and identified manual shutoff valve shall be installed in each branch line which serves an individual burner and in the oil distribution line. This valve may be either inside or outside of a protective enclosure. If outside, the valve shall be protected from weather and damage. If inside, the valve shall be located directly adjacent to the point at which the supply line enters the protective enclosure.

3-9.11 Only appliances equipped with primary safety controls specifically listed for the appliance shall be connected to a distribution system for roof-mounted or ceiling-suspended oil-fired units.

3-9.12 A switch in the electrical supply to the transfer pump shall be provided. Such switch, which is capable of being locked in the open position, shall be at a convenient location so the fuel supply system can be shut down for maintenance. Provisions shall be made so that shutdown of the fuel supply system shall interrupt the electrical supply to the units described in 3-9.1 (*see also 4-3.8*).

3-10 Tests of Piping.

3-10.1 After installation and before being covered, piping shall be tested for leaks. Piping shall be tested hydrostatically, or with equivalent air pressure, at not less than 1½ times the maximum working pressure but not less than 5 psi (34 kPa) at the highest point of the system. The test shall be made so as not to impose a pressure of more than 10 psi (70 kPa) on the tank. This test shall be maintained for at least 30 minutes or for sufficient time to complete visual inspection of all joints and connections. Instead of a pressure test, suction lines may be tested under a vacuum of not less than 20 in. (68 kPa) maintained for at least 30 minutes.

3-10.2 When the vertical length of the fill and vent pipes is such that when filled with liquid the static head imposed exceeds 10 psi (70 kPa), the piping shall be tested hydrostatically to a pressure equal to the static head thus imposed. (*See 2-1.2.5.*)

Chapter 4 Installation of Oil Burners and Oil-Fired Units

4-1 General Requirements.

4-1.1 Oil burners may be installed in boilers and furnaces. They may also be permitted by authorities having jurisdiction for use in firing ovens, water heaters, ranges, special furnaces and the like.

4-1.2 Where oil burners are installed in appliances originally designed for solid fuel, the ash door of the appliance shall be removed or bottom ventilation otherwise provided to prevent the accumulation of vapors in the ash pit, unless the ash pit is used as part of the combustion chamber.

4-1.3 Oil-fired appliances shall be installed in rooms that are large compared with the size of the appliance, except that an appliance specifically listed for installation in a confined space such as an alcove or closet may be so installed when the installation is in compliance with the listing. In alcove and closet installations, the clearances from the appliance to the walls and ceilings shall be not less than as specified in the listing, regardless of the type of construction.

4-1.4 A suitable combustion chamber of firebrick, stainless steel, or other material, as furnished by the manufacturer or specified in his installation instructions, shall be employed.

4-1.5 Prior to installation of an oil burner, the furnace, boiler, or appliance shall be examined and shown to be in good condition and repair and that the combustion chamber and flue gas passages are tight against leaks.

4-1.6 Installations of oil-burning boilers with inputs of 12,500,000 Btu per hour and above shall comply with the applicable provisions of NFPA 85, *Standard for Prevention of Furnace Explosions in Fuel Oil- and Natural Gas-Fired Single Burner Boiler-Furnaces*, or NFPA 85D, *Standard for Prevention of Furnace Explosions in Fuel Oil-Fired Multiple Burner Boiler-Furnaces*. Installation of oil burning ovens and furnaces coming under the scopes of NFPA 86A, *Ovens and Furnaces*, NFPA 86B, *Industrial Furnaces*, and NFPA 86C, *Industrial Furnaces Using a Special Processing Atmosphere*, shall comply with the applicable provisions of those standards.

4-2 Posting of Instructions. Complete instruction for the care and operation of the central heating appliances as furnished by the manufacturer shall be conspicuously posted near the equipment.

4-3 Controls.

4-3.1 Oil burners, other than oil stoves with integral tanks, shall be provided with some means for manually stopping the flow of oil to the burner. Such device or devices shall be placed in a readily accessible location at a safe distance from the burner. With electrically driven equipment this shall be accomplished by an identified switch in the burner supply circuit, placed near the entrance to the room where the appliance is located. An

identifiable valve in the oil supply line operable from a location reached without passing near the burner shall be used for other than electrically driven or controlled equipment. (*See also Appendix E.*)

4-3.1.1 A control to stop and start the burner shall be installed at a location where service personnel can view the flame or at the burner control panel located adjacent to the burner. This requirement may be met by the control device in 4-3.1, provided the requirements of both 4-3.1 and 4-3.1.1 are met.

4-3.2 Oil burners shall be equipped with a primary safety control of a type specifically listed for the burner with which it is used.

4-3.3 Primary safety controls for burners may consist of the combustion type electrical control or an anti-flooding device. The proper control to be furnished with each burner is indicated in the listing by the testing agency.

4-3.4 Each appliance fired by oil burners and each oil-fired unit shall be provided with automatic limit controls which will prevent unsafe pressure or low water in a steam boiler, low water or overtemperature within a water boiler, and overtemperature within a furnace or heater.

4-3.5 Limiting controls and low-water shutoffs intended to prevent unsafe operation of heating equipment by opening an electrical circuit to the burner or oil shutoff device shall be so arranged as to effect the direct opening of that circuit, whether the switching mechanism is integral with the sensing element or remote from same.[1]

Exception: A limit control which interrupts the pilot circuit of a magnetic-type motor controller, which, in turn, directly opens the safety circuit when it is necessary to interrupt a single-phase circuit carrying a load greater than the capacity of available limit controls or to interrupt a multiphase circuit is acceptable.

4-3.6 A water heater shall be provided with water pressure, temperature and vacuum relief devices. Means shall be provided to prevent siphoning in any boiler or tank to which any circulating water heater is attached.

4-3.7 Electric motor-driven oil burners, with integral oil pumps and electric motor-driven pump sets for use with such burners not equipped with integral pumps, shall be provided with a motor controller incorporating no-voltage protection, to be wired into the power supply to the motor.

4-3.8 In systems where either steam or air is used for atomizing the oil, or where air for combustion is supplied by a source which may be interrupted without shutting off the oil supply, the oil and atomizing or air supply shall be interlocked in a manner to immediately shut off the oil supply upon failure of the atomizing or air supply.

4-3.9 When automatically operated burners are used in installations equipped with forced- or induced-draft fans, or both, means shall be provided to immediately shut off the oil supply upon fan failure.

4-3.10 Oil burners not equipped to provide safe automatic restarting after shutdown shall require manual restarting after any control functions to extinguish the burner flame.

4-3.11 An acceptance test shall be conducted where more than one burner is fired in a single combustion chamber or one burner is adapted to firing two or more combustion chambers, to make sure that the primary safety control will function properly in the event of ignition failure or unsafe flame extinguishment at one or more burners.

4-4 Requirements for Specific Appliances (Clearances, Mounting, etc.).

4-4.1 Boilers, Furnaces, Floor-Mounted Unit Heaters and Water Heaters.

4-4.1.1 Appliances in rooms shall be installed with the clearances from combustible material not less than as indicated in Figure 4-1 and Table 4-1, except that appliances specifically listed for installation at lesser clearance may be installed in accordance with their listing. In no case shall the clearance be such as to interfere with the requirements for combustion air and accessibility. (*See Sections 1-4 and 1-5.*) For installation of chimney connector see 1-7.2.

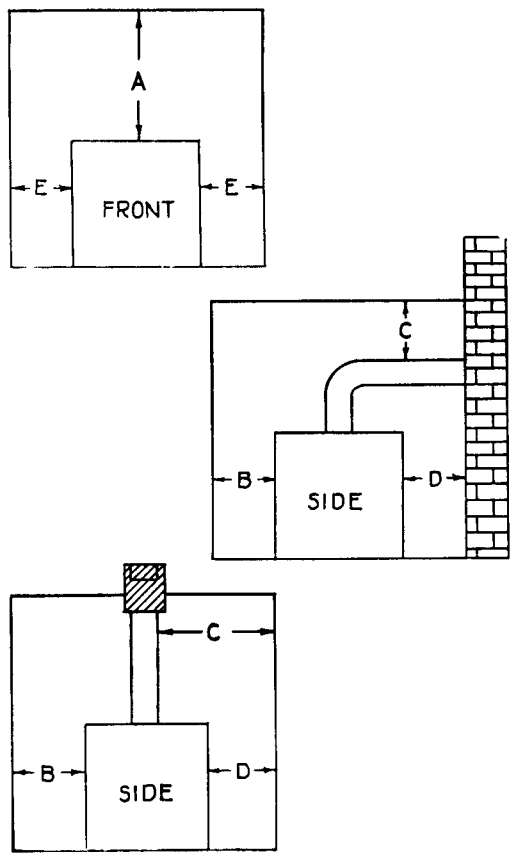


Figure 4-1 Clearances to Combustible Materials.

[1]The purpose of this requirement is to avoid interposing in the limit control circuit other controls, the failure of which may be the cause of an unsafe condition which the limit control is intended to prevent.

Table 4-1

Classification as to Type of Appliance	A Above (1)	B Front	C Chimney Connector (4)	D Rear	E Sides
Form I	2(2)	24	18	6	6
Form II(3)	6	24	18	6	6
Form III	18	48	18	18	18
Form IV	48	96	36	36	36
Form V(3)	6	24	18	18	18

For SI Units: 1 in. = 25 mm; 1 ft = 0.3048 m.

NOTE 1: This column indicates clearances above the top of the appliance or above the top and from the sides of furnace bonnet or plenum.

NOTE 2: This clearance may be reduced to 1 in. (25 mm) for a listed, forced air or gravity system equipped with a limit control that cannot be set higher than 200°F.

NOTE 3: The clearance from the bottom of a suspended furnace or unit heater to combustible material shall be not less than 18 in. (0.5 mm).

NOTE 4: See 1-7.2 for installation of chimney connectors.

Description of Classifications — Refer to Table 4-1

Form I. Automatically fired warm-air furnaces, except horizontal types, and floor-mounted unit heaters equipped with approved limit controls that cannot be set higher than 250°F (121°C), not larger than 100 cu ft in size (excluding blower compartments and burner equipment).

Form II. Horizontal-type warm-air furnaces, and water-wall-type heating boilers operating at not in excess of 250°F (121°C) for water boilers and at not over 15 psig pressure for steam boilers, and water heaters, not larger than 100 cu ft in size (excluding burner equipment and blower compartments of furnaces).

Form III. Low-heat appliances, which include steam boilers operating at not more than 50 psig pressure, or not larger than ten boiler horsepower regardless of operating pressure, and boilers, furnaces except floor furnaces, and heaters not classified under Forms I, II, IV, and IV.

Form IV. Medium-heat appliances, which include steam boilers other than as classified above.

Form V. Suspended-type unit heaters not more than 100 cu ft in size (excluding fan and burner equipment).

4-4.1.2 Appliances may be installed in rooms, but not in alcoves or closets, with lesser clearances to combustible material, provided the combustible material or appliance is protected as described in Table 4-2 and Appendix B.

4-4.1.3 Floor-mounted appliances, except as provided in 4-4.1.4 and 4-4.1.5, shall be placed on the ground, or on floors of fire-resistive construction with noncombustible flooring or surface finish and with no combustible material against the underside thereof, or on fire-resistive slabs or arches having no combustible material against the underside thereof. Such construction shall extend not less than 12 in. (0.3 m) beyond the appliance on all sides.

4-4.1.4 Appliances listed specifically for installation on a floor constructed of combustible material may be placed in accordance with the conditions of such listing.

4-4.1.5 Appliances may be placed on combustible floors although not listed for such installation, provided the floor under the appliance is protected in accordance with the requirements of accepted building code practice. An appliance listed for installation under Form I or II in Table 4-1 may be placed on a combustible floor protected with hollow masonry not less than 4 in. (100 mm) thick covered with sheet metal not less than 24 gage. Such masonry shall be laid with ends unsealed and joints matched in such a way as to permit free circulation of air from side to side through the masonry. Figure 4-2 shows a permissible variation for placing the hollow masonry to accommodate a downflow furnace. For such installations the furnace shall be securely anchored to maintain the clearances required in Table 4-1.

4-4.1.6 The supply and return duct system of a central heating appliance shall be installed in accordance with NFPA 90A, *Air Conditioning and Ventilating Systems*, and NFPA 90B, *Warm Air Heating and Air Conditioning Systems*.

4-4.1.7 A return system shall be arranged so that negative pressure from the circulating fan cannot affect the air supply for combustion or act to draw products of combustion from joints or openings in the appliance, chimney connectors or chimney.

4-4.1.8 A downflow furnace shall be installed so that there are no open passages in the floor through which flame or hot gases from a fire originating in the room below the floor can travel to the room above.

4-4.1.9 A downflow furnace shall be automatically operated and equipped with an approved temperature limit control that will limit outlet air temperature to 200°F (93°C). The furnace shall be designed to prevent unsafe temperatures in the event of reverse flow.

4-4.2 Attic Furnaces. A furnace may be installed in an attic provided it is listed for such installation and installed in accordance with its conditions of listing.

4-4.3 Duct Furnaces.

4-4.3.1 A duct furnace, except as provided in 4-4.3.3 shall be installed with clearances of at least 6 in. (150 mm) to adjacent walls, ceilings and floors of combustible material, except a duct furnace listed for installation at lesser clearance may be installed in accordance with its listing.

4-4.3.2 A duct furnace flue pipe shall be installed to provide a clearance to combustible material of not less than 18 in. (0.5 m).

4-4.3.3 A duct furnace and its chimney connector may be installed in a room but not in a confined space, such as an alcove or closet, with reduced clearances to combustible material, provided the combustible material is protected as described in Table 4-2 and the requirements for

Table 4-2 Clearances (Inches) With Specified Forms of Protection*

Type of Protection Applied to the combustible material unless otherwise specified and covering all surfaces within the distance specified as the required clearance with no protection. (*See App B.*) Thicknesses are minimum.	Where the required Clearance with no protection is:										
	36 inches			18 inches			12 inches		9 inches	6 inches	
	Above	Sides & Rear	Chimney Connector	Above	Sides & Rear	Chimney Connector	Above	Sides & Rear	Chimney Connector	Above	Sides & Rear
(a) 1/4 in. insulating millboard** spaced out 1"†	30	18	30	15	9	12	9	6	6	3	2
(b) 28 gage sheet metal on 1/4" insulating millboard**	24	18	24	12	9	12	9	6	4	3	2
(c) 28 gage sheet metal spaced out 1"†	18	12	18	9	6	9	6	4	4	2	2
(d) 28 gage sheet metal on 1/8" insulating millboard** spaced out 1"†	18	12	18	9	6	9	6	4	4	2	2
(e) 1/4" insulating millboard** on 1" mineral wool bats reinforced with wire mesh or equivalent	18	12	18	6	6	6	4	4	4	2	2
(f) 22 gage sheet metal on 1" mineral wool bats reinforced with wire or equivalent	18	12	12	4	3	3	2	2	2	2	2
(g) 1/4" insulating millboard**	36	36	36	18	18	18	12	12	9	4	4

*All clearances shall be measured from the outer surface of the equipment to the combustible material disregarding any intervening protection applied to the combustible material.
**A factory fabricated board formed with noncombustible materials, normally fibers, and having a thermal conductivity in the range of 1 Btu inch per square foot per °F, or less.
†Spacers shall be of noncombustible material.

For SI Units: 1 in. = 25 mm.

combustion air and accessibility comply with Sections 1-4 and 1-5.

4-4.3.4 A duct furnace shall be firmly supported.

4-4.3.5 Access panels shall be provided in the ducts on both the upstream and downstream sides of the furnace.

4-4.3.6 Controls shall be located outside the duct except for the sensing element of a control.

4-4.4 Floor Furnaces.

4-4.4.1 Floor furnaces shall not be installed in floors of combustible construction unless specifically listed for such installation and installed in accordance with their listing.

4-4.4.2 The floor around the furnace shall be braced and headed with a framework of material not lighter than the joists. Floor furnaces shall be supported independently of the floor grilles.

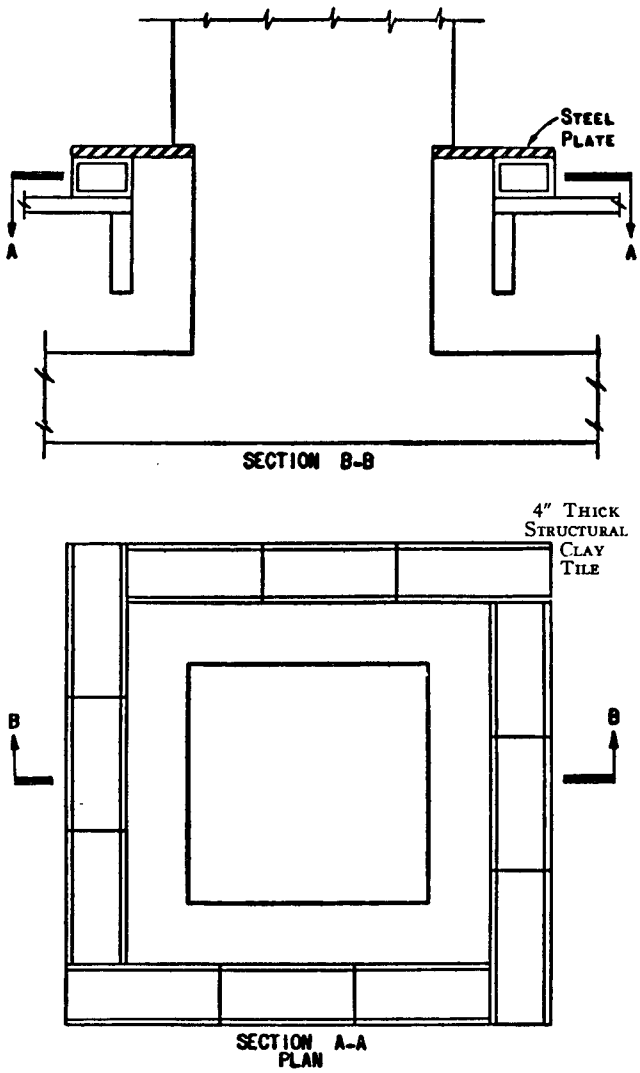
4-4.4.3 With the exception of wall-register models, a floor furnace shall be placed not closer than 6 in. (150 mm) to the nearest wall, and wall-register models shall be placed not closer than 6 in. (150 mm) to a corner. The furnace shall be so placed that a door, drapery, or similar object cannot be nearer than 12 in. (0.3 m) to any portion of the register of the furnace.

4-4.4.4 The bottoms of the floor furnaces shall have at least 6 in. (150 mm) clearance from the ground. Where the ground must be excavated to provide this clearance, the excavation shall extend at least 12 in. (0.3 m) beyond the furnace on all sides, and not less than 18 in. (0.5 m) on the control side. Where such excavation exceeds 12 in. (0.3 m), or the ground contour and ground moisture conditions are such that water seepage is likely, a watertight pan constructed of copper, galvanized iron, or other suitable corrosion-resistant material and properly anchored in place, or a waterproof concrete pit shall be provided under the furnace. The sides of a pan or pit shall extend 4 in. (100 mm) above ground level.

4-4.4.5 Floor furnaces shall be made readily accessible. Openings in foundation walls and trap doors in floors shall be not smaller than 18 in. by 24 in. (0.5 m by 0.6 m). Under-floor passageways to the furnace shall be not less than 24 in. high by 24 in. wide (0.6 m by 0.6 m).

4-4.4.6 Provision shall be made for proper air supply for combustion.

4-4.4.7 Listed floor furnaces may be installed in an upper floor provided the furnace assembly projects below into a utility room, closet, garage, or similar nonhabitable space. In such installations, the floor furnace shall be enclosed completely (entirely separated from the nonhabitable space) with means for air intake and with access facilities for servicing on the control side. The minimum furnace clearances shall be 6 in. (150 mm) to all sides and bottom. The enclosure shall be constructed of portland cement plaster on metal lath or material of equal fire resistance.



For SI Units: 1 in. = 25 mm.

Figure 4-2 Installation of Downflow Furnace on Combustible Floor.

4-4.4.8 No floor furnace shall be installed in the floor of any aisle or passageway of any auditorium, public hall or public assembly room or in an exit way from any such room or space.

4-4.4.9 Except as indicated in 4-4.4.10, a floor furnace chimney connector shall be installed with clearances to combustible material of not less than 9 in. (225 mm).

4-4.4.10 A floor furnace chimney connector may be installed with lesser clearances to combustible material provided the combustible material is protected as described in Table 4-2 and Appendix B.

4-4.5 Furnaces Used with Refrigeration Systems.

4-4.5.1 A furnace shall not be installed in conjunction with a refrigeration coil when circulation of cooled air is provided by the blower unless the blower has sufficient capacity to overcome the external static resistance imposed by the duct system, furnace and the cooling coil at the air throughout required for heating or cooling, whichever is greater.

4-4.5.2 To avoid condensation within heating elements, furnaces used in conjunction with cooling equipment shall be installed in parallel with or on the upstream side of cooling coils unless the furnace has been specifically listed for downstream installation. With a parallel flow arrangement, the dampers or other means used to control the flow of air shall be sufficiently tight to prevent any circulation of cooled air through the unit.

4-4.5.3 When furnaces are to be located upstream from cooling units, the cooling unit shall be so designed or equipped as to not develop excessive temperatures or pressures.

4-4.5.4 Furnaces may be installed downstream from evaporative coolers or air washers if the heating element is made of corrosion-resistant material. Stainless steel, ceramic-coated steel, or an aluminum-coated steel in which the bond between the steel and the aluminum is an iron-aluminum alloy are considered to be corrosion resistant. Air washers operating with chilled water which delivers air below the dew point of the ambient air at the appliance are considered as refrigeration systems.

4-4.6 Industrial Furnaces and Boilers, Stationary Type.

4-4.6.1 Industrial furnaces and power boilers, stationary type, shall include low-heat, medium-heat and high-heat appliances. See Section 1-2, Definitions, for examples of each.

4-4.6.2 Low-heat Appliances:

(a) Low-heat appliances shall be installed with clearances not less than those indicated by Form III, in Table 4-1.

(b) Low-heat appliances which are approved for installation with lesser clearances than specified in paragraph (a) above may be installed in accordance with their listing.

(c) Low-heat appliances may be installed with lesser clearances to combustible material provided the combustible material is protected as described in Table 4-2 and Appendix B.

(d) Floor-mounted low-heat appliances, except as provided in 4-4.6.2(e) and 4-4.6.2(f), shall be placed on the ground, or on floors of fire-resistive construction with noncombustible flooring or surface finish and with no combustible material against the underside thereof, or on fire-resistive slabs or arches having no combustible material against the underside thereof. Such construction shall extend not less than 12 in. (0.3 m) beyond the appliance on all sides.

(e) Appliances which are listed specifically for installation on a floor constructed of combustible material may be placed in accordance with the conditions of such listing.

(f) Low-heat appliances may be placed on combustible floors although not listed for such installation, provided the floor under the appliance is protected in accordance with the requirements of accepted building code practice.

4-4.6.3 Medium-heat Appliances:

(a) Medium-heat appliances shall be installed with clearances not less than those indicated by Form IV, Table 4-1.

(b) Medium-heat appliances, except as provided in 4-4.6.3(c), shall be placed on the ground or on floors of fire-resistive construction with noncombustible flooring or surface finish and with no combustible material against the underside thereof, or on fire-resistive slabs or arches having no combustible material against the underside thereof. Such construction shall extend not less than 3 ft (1 m) beyond the appliance on all sides.

(c) Medium-heat appliances may be placed on combustible floors although not listed for such installation, provided the floor under the appliance is protected in accordance with accepted building code practice.

(d) Rooms containing medium-heat appliances shall be provided with means of ventilation adequate to prevent accumulation of hot air over or near the appliance.

4-4.6.4 High-heat Appliances:

(a) High-heat appliances shall be installed with clearances to combustible material of not less than 10 ft (3 m) at the sides and rear, and not less than 15 ft (4.5 m) above, and not less than 30 ft (9 m) at the front or side where hot products are removed.

(b) Rooms containing high-heat appliances shall be provided with means of ventilation adequate to prevent accumulation of hot air over or near the appliance.

(c) High-heat appliances shall be mounted on the ground, or on floors of fire-resistive construction with noncombustible flooring or surface finish and with no combustible material or construction against the underside thereof, which floors shall in all cases extend not less than 10 ft (3 m) on all sides and not less than 30 ft (9 m) at the front or side where hot products are removed.

4-4.7 Miscellaneous Heaters (Air Heater, Salamander, etc.).

4-4.7.1 A direct-fired heater, salamander, shall not be used within an enclosed space or in proximity to combustible material. It may be used where salamanders fired by coal or coke are allowed.

4-4.7.2 An air heater shall be of a type designed to discharge air at a temperature of not more than 250°F (121°C).

4-4.7.3 A flexible duct, if used, shall be made of material resistant to heat and flame and that will withstand prolonged exposure to temperatures as high as 250°F (121°C).

4-4.7.4 An air heater installed inside a building shall be provided with a chimney connector to conduct the flue gases to the outside.

4-4.8 Recessed Wall Furnaces.

4-4.8.1 Listed recessed wall furnaces may be installed in combustible construction. Because of the necessity for closely correlating the installation of recessed wall furnaces with the building construction, the authority having jurisdiction shall be consulted for the proper installation methods to be followed. Recessed wall furnaces shall be installed in accordance with the manufacturer's instructions.

4-4.8.2 Recessed wall furnaces shall be located so as not to cause a hazard to walls, floors, curtains, furniture, doors, etc. The face of a warm air register shall be not less than 36 in. (1 m) from any wall or combustible surface directly opposite the register.

4-4.8.3 Panels, grilles, and access doors which must be removed for normal servicing operations shall not be attached to the building construction.

4-4.8.4 Adequate combustion and circulating air shall be provided.

4-4.9 Restaurant-Type Cooking Appliances, Floor Mounted.

4-4.9.1 Floor-mounted restaurant-type cooking appliances shall be installed with clearances to combustible material of not less than 18 in. (0.5 m) at the sides and rear of the appliance and from the chimney connector thereof, and not less than 48 in. (1.2 m) above the cooking top and at the front of the appliance.

4-4.9.2 Floor-mounted restaurant-type cooking appliances which are listed for installation with lesser clearances than specified in 4-4.9.1 may be installed in accordance with the conditions of their listing.

4-4.9.3 Floor-mounted restaurant-type cooking appliances may be installed in rooms, but not in confined spaces such as alcoves, with lesser clearance to woodwork or other combustible material, provided the combustible material is protected as described in Table 4-2, Protection Types (b), (c) and (d). Where a wall or cabinet of combustible material adjacent to the cooking top section of the appliance is not shielded from the cooking top section by a high shelf, warming closet, or other such part of the appliance, the protection shall extend for a distance of at least 2 ft (0.6 m) above the surface of the cooking top. Such wall or cabinet shall be protected even though the appliance is listed for "close-to-the-wall" installation.

4-4.9.4 Floor-mounted appliances, except as provided in 4-4.9.5 and 4-4.9.6, shall be placed on floors of fire-resistive construction with noncombustible flooring or surface finish and with no combustible material against the underside thereof, or on fire-resistive slabs or arches having no combustible material against the underside thereof. Such construction shall in all cases extend not less than 12 in. (0.3 m) beyond the appliance on all sides.

4-4-9.5 Floor-mounted appliances that are specifically listed for installation on a floor constructed of combustible material may be placed in accordance with the conditions of such listing.

4-4.9.6 Floor-mounted appliances may be placed on combustible floors although not listed for such installation, provided the floor under the appliance is protected in accordance with the requirements of accepted building code practice.