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American National Standard

NATIONAL FUEL GAS CODE

Secretariats

American Gas Association
(Administrative)
1515 Wilson Boulevard, Arlington, VA 22209

American Society of Mechanical Engineers
345 East 47th Street, New York, NY 10017

National Fire Protection Association
470 Atlantic Avenue, Boston, MA 02210

HISTORY OF DEVELOPMENT OF NATIONAL FUEL GAS CODE

(This History is informative and is not part of the Code.)

As a result of the expressed need within the gas industry, among public safety authorities, insurance groups, architects, designers and builders, for one Code that would cover all facets of fuel gas piping and appliance installations downstream from meter set assemblies or other facilities comprising the gas service entrance to consumers' premises, a meeting of a Conference Group on Piping and Installation Standards, consisting of representatives from the American Gas Association, the American Society of Mechanical Engineers and the National Fire Protection Association, was held on October 25, 1967, to consider the development of a National Fuel Gas Code.

At a January 1968 meeting, a working group of this conference group developed the objectives and scope of a proposed National Standards Committee which envisioned the combining of American National Standards Z21.30 (NFPA No. 54), *Installation of Gas Appliances and Gas Piping;* Z83.1 (NFPA No. 54A), *Installation of Gas Piping and Gas Equipment on Industrial Premises and Certain Other Premises;* and B31.2, *Fuel Gas Piping*, into a National Fuel Gas Code. The proposed scope ultimately agreed on limited coverage of piping systems to a maximum operating pressure of 60 psig. National Standards Committees Z21, Z83 and B31 agreed to relinquish, respectively, Z21.30, Z83.1 and that portion of B31.2 covering piping systems at pressures up to and including 60 psig.

On August 13, 1971, the American National Standards Institute approved the scope of activities and the formation of a National Standards Committee on National Fuel Gas Code, Z223, co-sponsored by the American Gas Association, the American Society of Mechanical Engineers and the National Fire Protection Association.

In order to establish a National Fuel Gas Code to satisfy the immediate needs of the gas industry for a single installation code, the Z223 Committee, at its organizational meeting on December 6, 1972, agreed to combine NFPA No. 54–1969 and Z83.1–1972 with only those editorial revisions necessary to accomplish the combination and to reflect the new scope of the standard. Although Z83.1–1972 references pertinent provisions in B31.2–1968 regarding coverage for higher gas pressures, further revisions incorporating fuel gas piping coverage from B31.2–1968 will be necessary.

This, the first edition, includes the combination of NFPA No. 54–1969 and Z83.1–1972 together with amendments to Pars. 1.4.5.5, 1.4.5.6 and 1.4.5.7. It was approved as American National Standard by the American National Standards Institute, Inc., on June 4, 1974, and by the National Fire Protection Association on May 23, 1974.

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NATIONAL FUEL GAS CODE

PART 1

INSTALLATION OF GAS PIPING AND GAS EQUIPMENT ON NONINDUSTRIAL PREMISES

1.1 GENERAL

1.1.1 Scope.

1.1.1.1 Applicability: Part 1 of this Code is a safety code for nonindustrial gas piping systems on consumers' premises and the installation of nonindustrial type gas utilization equipment and accessories for use with fuel gases such as natural gas, manufactured gas, liquefied petroleum gas in the vapor phase, liquefied petroleum gas-air mixtures, or mixtures of these gases, including:

(a) The design, fabrication, installation, testing, operation and maintenance of gas piping systems from the point of delivery to the connections with each gas utilization device. Piping systems covered by Part 1 of this Code are limited to a maximum operating pressure of ½ psig (14 inches water column). For purposes of this Code, the point of delivery is defined as the outlet of the meter set assembly, or the outlet of the service regulator or service shutoff valve where no meter is provided.

(b) The installation of gas utilization equipment and related accessories supplied at gas pressures of ½ psig or less, and their ventilation and venting systems.

1.1.1.2 Nonapplicability: Part 1 of this Code does not apply to:

(a) Gas piping systems for industrial installations as covered in Part 2 of this Code.

(b) Gas equipment supplied through piping systems covered in 1.1.1.2 (a).

(c) Gas equipment designed and installed for specific manufacturing, production, processing and power generating applications.

1.1.1.3 Other Standards: In applying Part 1 of this Code, reference should also be made to the manufacturer's instructions and the serving gas supplier regulations. Also see:

(a) *American National Standard for the Storage and Handling of Liquefied Petroleum Gases*, Z106.1 (NFPA No. 58–1974).[1, 3]

(b) *Standard for the Installation and Use of Stationary Combustion Engines and Gas Turbines*, NFPA No. 37–1970.[3]

(c) *Standard on Incinerators and Rubbish Handling*, NFPA No. 82–1972.[3]

(d) *Standard for Prevention of Furnace Explosions in Fuel Oil — and Natural Gas-Fired Watertube Boiler-Furnaces with One Burner*, NFPA No. 85–1973.[3]

(e) *Standard for Ovens and Furnaces — Design, Location, and Equipment*, NFPA No. 86A–1974.[3]

(f) *American National Standard Installation of Gas Utilization Equipment in Large Boilers*, Z83.3–1971, and Addenda, Z83.3a–1972.[1, 2]

(g) *American National Standard for Mobile Homes*, A119.1–1972 (NFPA No. 501B–1974).[1, 3]

(h) *American National Standard for Recreational Vehicles*, A119.2–1971. (NFPA No. 501C–1974).[1, 3]

(i) Other standards as referenced in Part 1 of this Code.

1.1.1.4 "Approved": The word "approved," as used in Part 1 of this Code, means acceptable to the authority having jurisdiction.

1.1.2 Qualified Installing Agency. Installation and replacement of gas piping or gas appliances and repair of gas appliances shall be performed only by a qualified installing agency. By the term "qualified installing agency" is meant any individual, firm, corporation, or company which either in person or through a representative is engaged in and is responsible for the installation or replacement of gas piping on the outlet side of the meter, or of the service regulator when a meter is not provided, or the connection, installation or repair of gas appliances, who is experienced in such work, familiar with all precautions required, and has complied with all the requirements of the authority having jurisdiction.

1.1.3 General Precautions.

1.1.3.1 Turn Gas Off: All gas piping or gas appliance installation shall be performed with the gas turned off to eliminate hazards from leakage of gas.

1.1.3.2 Notification of Interrupted Service: It shall be the duty of the installing agency, when the gas supply is to be turned off, to notify all affected consumers.

1.1.3.3 Before Turning Gas Off: Before turning off the gas to premises for the purpose of installation, repair, replacement or maintenance of gas piping or appliances, all burners shall be turned off. When two or more consumers are served from the same supply system, precautions shall be exercised to assure that only service to the proper consumer is turned off.

1.1.3.4 Checking for Gas Leaks: Soap and water solution, or other material acceptable for the purpose, shall be used in locating gas leakage. *Matches, candles, flame or other sources of ignition shall not be used for this purpose.*

1.1.3.5 Use of Lights: Artificial illumination used in connection with a search for gas leakage shall be restricted to battery operated flashlights (preferably of the safety type) or approved safety lamps. In searching for leaks, electric switches should not be operated. If electric lights are already turned on, they should not be turned off.

1.1.3.6 Working alone: An individual shall not work alone in any situation where accepted working practice dictates that two or more men are necessary to perform the work safely.

[1]Available from the American National Standards Institute, Inc., 1430 Broadway, New York, New York 10018.
[2]Available from American Gas Association, Laboratories, 8501 East Pleasant Valley Road, Cleveland, Ohio 44131.
[3]Available from the National Fire Protection Association, 470 Atlantic Avenue, Boston, Mass. 02210.

1.1.3.7 Handling of Liquid from Drips: Liquid which is removed from a drip in existing gas piping shall be handled with proper precautions, and shall not be left on the consumer's premises.

1.1.3.8 No Smoking: When working on piping which contains or has contained gas, smoking shall not be permitted.

1.1.3.9 Handling Flammable Liquids: Flammable liquids used by the installer shall be handled with proper precautions and shall not be left within the premises from the end of one working day to the beginning of the next.

1.1.3.10 Work Interruptions: When interruptions in work occur, the system shall be left in a safe and satisfactory condition.

1.2 GAS PIPING INSTALLATION

1.2.1 Piping Plan: It is recommended that before proceeding with the installation of a gas piping system, a piping sketch or plan be prepared showing the proposed location of the piping as well as the size of different branches. Adequate consideration should be given to future demands, and provisions made for added gas service.

Before any final plans or specifications are completed, the serving gas supplier or the authority having jurisdiction should be consulted.

When an additional appliance is to be served through any present gas piping, capacity of the existing piping shall be checked for adequacy, and replaced with larger piping if necessary.

1.2.2 Provision for Meter Location: The meter location shall be such that the meter can be easily read and the connections are readily accessible for servicing. Location, space requirements, dimensions, and type of installation shall be acceptable to the serving gas supplier.

Gas piping at multiple meter installations shall be plainly marked by a metal tag or other permanent means attached by the installing agency, designating the building or the part of the building being supplied.

1.2.3 Interconnections.

1.2.3.1 Interconnections Supplying Separate Consumers: When two or more meters, or two or more service regulators when meters are not provided, are installed on the same premises and supply separate consumers, the gas piping systems shall not be interconnected on the outlet side of the meters or service regulators.

1.2.3.2 Interconnections for Stand-By Fuels: When a supplementary gas for stand-by use is connected downstream from a meter or a service regulator when a meter is not provided, a suitable device to prevent backflow shall be installed. A three-way valve installed to admit the stand-by supply and at the same time shut off the regular supply may be used for this purpose.

1.2.4 Size of Piping to Gas Appliances.

1.2.4.1 Size of Supply Piping for Gas Appliances: Gas piping shall be of such size and so installed as to provide a supply of gas sufficient to meet the maximum demand without undue loss of pressure between the meter,

or service regulator when a meter is not provided, and the appliance or appliances. The size of gas piping depends upon the following factors:

(a) Allowable loss in pressure from meter, or service regulator when a meter is not provided, to appliance.
(b) Maximum gas consumption to be provided.
(c) Length of piping and number of fittings.
(d) Specify gravity of the gas.
(e) Diversity factor.

1.2.4.2 Gas Consumption: The quantity of gas to be provided at each outlet shall be determined, whenever possible, directly from the manufacturer's Btu rating of the appliance which will be installed. In case the ratings of the appliances to be installed are not known, Table 1-B1 of Appendix 1-B shows the approximate consumption of average appliances of certain types.

1.2.4.3 Gas Piping Size: The gas-carrying capacities for different sizes and lengths of iron pipe, or equivalent rigid pipe, and semirigid tubing are shown in the capacity tables given in Appendix 1-B. The serving gas supplier shall designate which table(s) shall be used.

For any gas piping system, for special gas appliances or for conditions other than those covered by the capacity tables in Appendix 1-B, such as longer runs, greater gas demands, or greater pressure drops, the size of each gas piping system shall be determined by standard engineering methods acceptable to the authority having jurisdiction and the serving gas supplier.

1.2.4.4 Diversity Factor: The diversity factor (*see Part 1.7, Definitions*) is an important factor in determining the correct gas piping size to be used in multiple family dwellings. It is dependent upon the number and kinds of gas appliances being installed. Consult the serving gas supplier or the authority having jurisdiction for the diversity factor to be used.

1.2.4.5 Additions to Existing Gas Piping: Additions to existing utility gas piping shall conform to the capacity table(s) in Appendix 1-B that are designated by the serving gas supplier. Additions to existing undiluted liquefied petroleum gas piping shall conform to Table 1-B7 or 1-B8 of Appendix 1-B. Existing gas piping that does not conform to these provisions shall be replaced by the proper size of pipe or tubing. Additions shall not be made to existing pipe or tubing which is smaller than that permitted by the applicable capacity table in Appendix 1-B.

1.2.5 Gas Piping in Mobile Home and Recreational Vehicle Parks: Gas piping systems in mobile home and recreational vehicle parks extending from the outlet of a meter set assembly or the outlet of a service regulator when a meter is not provided to the terminal of the gas riser at each site shall comply with the following specific provisions and with all other applicable provisions in 1.1 and 1.2 of Part 1 of this Code.

1.2.5.1 Protection of Piping: Piping shall be buried to a sufficient depth or covered in a manner so as to protect the piping system from physical damage.

1.2.5.2 Prohibited Locations: Piping shall not be installed underground beneath mobile homes or recreational vehicles with an enclosing foundation.

1.2.5.3 Location, Protection and Sizing of Riser: A gas riser to each site shall be placed in the rear one-third section of the site and not less than 18 inches from the roadside wall of the mobile home or recreational vehicle. An additional riser may be placed on the site to service the hitch gas supply connection. The gas riser(s) shall be located and protected or supported so as to minimize the likelihood of damage by moving vehicles. The minimum size of the gas piping outlet at a site shall be ¾ inch for other than undiluted, liquefied petroleum gases.

1.2.5.4 Location of Shutoff Valves:

(a) Outlets for the individual sites and gas piping to any building supplied by the system shall be provided with a readily accessible approved valve which cannot be locked in the open position.

(b) A readily accessible valve shall be provided near the point of gas delivery for shutting off the entire park system. The valve provided by the serving gas supplier may be considered acceptable for this purpose provided it is readily accessible.

1.2.5.5 Connection: Connections to the gas piping system shall be made with pipe, listed connectors or semirigid tubing. Provisions for flexibility shall be provided when necessary. Connectors having aluminum exterior surfaces shall not be used.

1.2.5.6 Demand Factors:

(a) The hourly volume of gas required for any site gas outlet or any section of a park gas piping system may be computed from Table 1-B9 of Appendix 1-B.

(b) Other gas equipment or appliances, other than site outlets, shall be computed at the manufacturer's maximum cubic foot per hour input rating or from Table 1-B1 of Appendix 1-B and shall be added to the figures given in Table 1-B9 of Appendix 1-B.

1.2.6 Acceptable Piping Materials.

1.2.6.1 Piping Materials:

(a) **Metallic Pipe; Piping Joints and Fittings.** Metallic gas pipe shall be steel or wrought-iron pipe complying with *American National Standard for Wrought-Steel and Wrought-Iron Pipe*, B36.10–1970.[1] Threaded copper, brass, or aluminum alloy pipe in iron pipe sizes may be used with gases not corrosive to such material. Aluminum alloy pipe shall be factory coated to protect against external corrosion where it is in contact with masonry, plaster, or insulation or is subject to repeated wettings by such liquids as water (except rain water), detergents or sewage. Aluminum alloy pipe shall not be used in exterior locations or underground. Aluminum alloy pipe shall comply with *American National Standard Specification for Aluminum-Alloy Seamless Pipe and Seamless Extruded Tube,*

[1]Available from the American National Standards Institute, Inc., 1430 Broadway, New York, New York 10018.

H38.7–1972 (ASTM B241–71b)[1] (except that the use of alloy 5456 is prohibited), and shall be suitably marked at each end of each length indicating compliance with the Code.

Metallic pipe joints may be screwed, flanged or welded, and nonferrous metallic pipe may also be soldered or brazed with material having a melting point in excess of 1,000 F.

Metallic fittings (except stopcocks or valves) shall be steel, brass, or malleable or ductile iron when used with steel or wrought-iron pipe; shall be copper or brass when used with copper or brass pipe; and, shall be aluminum alloy when used with aluminum alloy pipe. When approved by the authority having jurisdiction, special fittings, such as saddle tees and gland-type compression couplings, may be used to connect steel or wrought-iron pipe. Cast-iron fittings in sizes 6 inches and larger may be used to connect steel and wrought-iron pipe when approved by the authority having jurisdiction.

(b) Metallic Tubing; Tubing Joints and Fittings. When acceptable to the serving gas supplier, seamless copper, aluminum alloy or steel tubing may be used with gases not corrosive to such material. Copper tubing shall comply with standard Type K or L, of *American National Standard Specification for Seamless Copper Water Tube*[1] H23.1–1970 (ASTM B88–69)[2] or *American National Standard Specification for Seamless Copper Tube for Air Conditioning and Refrigeration Field Service*, H23.5–1967 (ASTM B280–66a).[1] Steel tubing shall comply with the *Specification for Electric-Resistance-Welded Coiled Steel Tubing for Gas and Fuel Oil Lines*, ASTM A539–73,[2] or *American National Standard Specification for Copper Brazed Steel Tubing*, B36.35–1966 (ASTM A254–64).[1] Aluminum alloy tubing shall be of standard Type A or B, or equivalent, complying with *American National Standard Specification for Aluminum-Alloy Drawn Seamless Tubes*, H38.3–1972 (ASTM B210–71),[1] or Type A or equivalent complying with *American National Standard Specification for Aluminum-Alloy Seamless Pipe and Seamless Extruded Tube*, H38.7–1972 (ASTM B241–7 lb).[1] Aluminum-alloy tubing shall be factory coated to protect against external corrosion where it is in contact with masonry, plaster, or insulation or is subject to repeated wettings by such liquids as water (except rain water), detergents or sewage. Aluminum-alloy tubing shall not be used in exterior locations or underground.

Metallic tubing joints shall either be made with approved gas tubing fittings or be soldered or brazed with a material having a melting point in excess of 1,000 F. Metallic ball sleeve compression type tubing fittings shall not be used for this purpose.

(c) Plastic Pipe, Tubing and Fittings. When acceptable to the serving gas supplier, plastic pipe or tubing conforming with specification ASTM D2513–73, *Specification for Thermoplastic Gas Pressure Pipe, Tubing, and Fittings*,[2] or specification ASTM D2517–73, *Specification for Reinforced Thermosetting Plastic Gas Pressure Pipe and Fittings*,[2] and compatible fittings may be used for outside piping underground only.

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[1]Available from the American National Standards Institute, Inc., 1430 Broadway, New York, New York 10018, or the American Society for Testing and Materials, 1916 Race Street, Philadelphia, Pennsylvania 19103.

[2]Available from the American Society for Testing and Materials, 1916 Race Street, Philadelphia, Pennsylvania 19103.

The installation shall be such as to avoid excessive stresses due to thermal contraction.

Plastic pipe, tubing and fittings shall be joined by either the solvent cement method, adhesive method, heat-fusion method, or by means of compression couplings or flanges. The joining method used shall be compatible with the materials being joined. The recommendations of the manufacturer shall also be taken into consideration when determining which method is to be used. The following shall be observed when making such joints:

1. Plastic pipe or tubing shall not be threaded.
2. Solvent cement joints, adhesive joints, and heat-fusion joints shall be made in accordance with qualified procedures which have been established and proven by test to produce gastight joints at least as strong as the pipe or tubing being joined.
3. Solvent cement or heat-fusion joints shall not be made between different kinds of plastics.
4. Heat-fusion or mechanical joints shall be used when joining polyethylene pipe, tubing or fittings.
5. Flanges, flared joints, or special joints may be used providing they are properly qualified and utilized.
6. When compression type mechanical joints are used, the gasket material in the fitting shall be compatible with the plastic piping and with the gas distributed by the system. An internal tubular rigid stiffener shall be used in conjunction with the fitting, and the stiffener shall be flush with end of the pipe or tubing and extend at least to the outside end of the compression fitting when installed. The stiffener shall be free of rough or sharp edges and shall not be a force fit in the plastic. A split tubular stiffener shall not be used.
7. The joint shall be designed and installed to effectively sustain the longitudinal pull-out forces caused by contraction of the piping or by external loading.

1.2.6.2 Workmanship and Defects: Gas pipe or tubing and fittings shall be clear and free from cutting burrs and defects in structure or threading and shall be thoroughly brushed, and chip and scale blown.

Defects in pipe or tubing or fittings shall not be repaired. When defective pipe, tubing or fittings are located in a system, the defective material shall be replaced.

1.2.6.3 Pipe Coating: When in contact with material exerting a corrosive action, metallic piping and fittings coated with a corrosion-resistant material shall be used.

1.2.6.4 Use of Old Piping Material: Pipe, tubing, fittings, and valves removed from any existing installation shall not be again used until they have been thoroughly cleaned, inspected and ascertained to be equivalent to new material.

1.2.6.5 Joint Compounds: Joint compounds shall be resistant to the action of liquefied petroleum gases.

1.2.7 Metallic Pipe Threads.

1.2.7.1 Specifications for Metallic Pipe Threads: Metallic pipe and fitting threads shall comply with *American National Standard for Pipe*

Threads (Except Dryseal), B2.1–1968.[1]

1.2.7.2 Damaged Threads: Metallic pipe with threads which are stripped, chipped, corroded, or otherwise damaged shall not be used.

1.2.7.3 Number of Threads: Metallic pipe shall be threaded in accordance with Table 1-1.

Table 1-1

Specifications for Threading Metallic Pipe

Iron Pipe Size (Inches)	Approximate Length of Threaded Portion (Inches)	Approximate No. of Threads to be Cut
1/2	3/4	10
3/4	3/4	10
1	7/8	10
1 1/4	1	11
1 1/2	1	11
2	1	11
2 1/2	1 1/2	12
3	1 1/2	12
4	1 5/8	13

1.2.8 Concealed Piping in Buildings.

1.2.8.1 General: Gas piping may be installed in concealed locations in accordance with this section.

1.2.8.2 Piping in Partitions: Concealed gas piping should be located in hollow rather than solid partitions. Tubing shall not be run inside walls or partitions unless protected against physical damage. This rule does not apply to tubing which passes through walls or partitions.

1.2.8.3 Piping in Floors:

(a) Except as provided in 1.2.8.3(b), gas piping in solid floors such as concrete shall be laid in channels in the floor suitably covered to permit access to the piping with a minimum of damage to the building. When piping in floor channels may be exposed to excessive moisture or corrosive substances, it shall be suitably protected.

(b) When approved by the authority having jurisdiction and acceptable to the serving gas supplier, gas piping may be embedded in concrete floor slabs constructed with portland cement. Piping shall be surrounded with a minimum of 1-½ inches of concrete and shall not be in physical contact with other metallic structures such as reinforcing rods or electrically neutral conductors. When piping may be subject to corrosion at point of entry into concrete slab, it shall be suitably protected from corrosion. Piping shall not be embedded in concrete slabs containing quickset additives or cinder aggregate.

[1]Available from the American National Standards Institute, Inc., 1430 Broadway, New York, New York 10018.

1.2.8.4 Connections in Original Installations: When installing gas piping which is to be concealed, unions, tubing fittings, running threads, right and left couplings, bushings, and swing joints made by combinations of fittings shall not be used.

1.2.8.5 Reconnections: When necessary to insert fittings in gas pipe which has been installed in a concealed location, the pipe may be reconnected by use of a ground joint union with the nut center-punched to prevent loosening by vibration. Reconnection of tubing in a concealed location is prohibited.

1.2.9 Piping Underground.

1.2.9.1 Protection of Piping: Piping shall be buried a sufficient depth or covered in a manner so as to protect the piping from physical damage. Consideration should be given to protecting the piping from physical damage when it passes through flower beds, shrub beds, and other such cultivated areas.

1.2.9.2 Connection of Plastic Piping: Connections between metallic and plastic piping shall be made outside underground.

1.2.9.3 Protection Against Corrosion: Gas piping in contact with material which will corrode the piping shall be protected against corrosion in an approved manner. When dissimilar metals are joined underground, an insulated coupling shall be used. Metallic piping shall not be laid in contact with cinders.

1.2.9.4 Piping Through Foundation Wall: Underground gas piping, when installed below grade through the outer foundation or basement wall of a building, shall be either encased in a sleeve or otherwise protected against corrosion. The piping or sleeve shall be sealed at the foundation or basement wall to prevent entry of gas or water.

1.2.9.5 Piping Underground Beneath Buildings: When the installation of gas piping underground beneath buildings is unavoidable, the piping shall be encased in a conduit. The conduit shall extend into a normally usable and accessible portion of the building and, at the point where the conduit terminates in the building, the space between the conduit and the gas piping shall be sealed to prevent the possible entrance of any gas leakage. The conduit shall extend at least 4 inches outside the building, be vented above grade to the outside and be installed in a way as to prevent the entrance of water.

1.2.10 Installation of Piping: Drips, grading, protection from freezing, and branch pipe connections, as provided for in 1.2.10.2, 1.2.10.4, 1.2.10.7, and 1.2.10.14(a), shall apply only when other than dry gas is distributed and climatic conditions make such provisions necessary.

1.2.10.1 Building Structure: The building structure shall not be weakened by the installation of any gas piping. Before any beams or joists are cut or notched, special permission should be obtained from the authority having jurisdiction.

1.2.10.2 Gas Piping to be Graded: All gas piping shall be graded not less than ¼ inch in 15 feet to prevent traps. All horizontal lines shall

grade to risers and from the risers to the meter, or to service regulator when a meter is not provided, or to the appliance.

1.2.10.3 Piping Supports:

(a) Gas piping in buildings shall be supported with pipe hooks, metal pipe straps, bands or hangers suitable for the size of piping, of adequate strength and quality, and located at proper intervals, so that the piping cannot be moved accidentally from the installed position. Gas piping shall not be supported by other piping.

(b) Spacing of supports in gas piping installations shall not be greater than shown in Table 1-2.

Table 1-2

Support of Piping

Size of Pipe (Inches)	Spacing of Supports (Feet)	Size of Tubing (Inch O.D.)	Spacing of Supports (Feet)
½	6	½	4
¾ or 1	8	⅝ or ¾	6
1¼ or larger (horizontal)	10	⅞ or 1	8
1¼ or larger (vertical)	every floor level		

1.2.10.4 Protect Against Freezing: Gas piping shall be protected against freezing temperatures. When piping must be exposed to wide ranges or sudden changes in temperatures, special care shall be taken to prevent stoppages.

1.2.10.5 Overhanging Rooms: When there are overhanging kitchens or other rooms built beyond foundation walls, in which gas appliances are installed, care shall be taken to avoid placing the gas piping where it will be exposed to low temperatures (40°F or below for manufactured gas) or to extreme changes of temperatures. In such cases the gas piping shall be brought up inside the building proper and run around the sides of the room in the most practical manner.

1.2.10.6 Gas Pipe Turns: Changes in direction of gas pipe may be made by the use of fittings, factory bends or field bends. Field bends shall be made under the following limitations:

(a) Metallic Pipe.

1. Bends shall be made only with bending equipment and procedures especially intended for that purpose.
2. All bends shall be smooth and free from buckling, cracks or other evidence of mechanical damage.
3. The longitudinal weld of the pipe shall be near the neutral axis of the bend.
4. Pipe shall not be bent through an arc of more than 90 degrees.
5. The inside radius of a bend shall be not less than 6 times the out-

side diameter of the pipe.

(b) Plastic Pipe.

1. Plastic pipe may be bent provided that the pipe is not damaged and the internal diameter of the pipe is not effectively reduced.

2. The radius of the inner curve of such bends shall not be less than 25 times the inside diameter of the pipe.

3. If the piping manufacturer specifies the use of special bending equipment or procedures, such equipment or procedures shall be used.

1.2.10.7 Provide Drips Where Necessary: A drip shall be provided at any point in the line of pipe where condensate may collect. When condensation is excessive, a drip should be provided at the outlet of the meter. This drip should be so installed as to constitute a trap wherein an accumulation of condensate will shut off the flow of gas before it will run back into the meter.

1.2.10.8 Location and Size of Drips: All drips shall be installed only in such locations that they will be readily accessible to permit cleaning or emptying. A drip shall not be located where the condensate is likely to freeze. The size of any drip used shall be determined by the capacity and the exposure of the gas piping which drains to it and in accordance with recommendations of the serving gas supplier.

1.2.10.9 Use Tee: If dirt or other foreign material is a problem, a tee fitting with the bottom outlet plugged or capped shall be used at the bottom of any pipe riser (*see Figure 1-1*).

1.2.10.10 Avoid Clothes Chutes, etc.: Gas piping inside any building shall not be run in or through an air duct, clothes chute, chimney or gas vent, ventilating duct, dumb waiter, or elevator shaft.

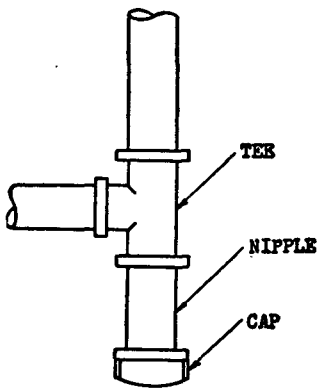

Fig. 1-1. Suggested Method of Installing Tee.

1.2.10.11 Cap All Outlets:

(a) Each outlet, including a valve or cock outlet, shall be securely closed gastight with a threaded plug or cap immediately after installation and shall be left closed until an appliance is connected thereto. Likewise, when an appliance is disconnected from an outlet and the outlet is not to be used again immediately, it shall be securely closed gastight. The outlet shall not be closed with tin caps, wooden plugs, corks, or by other improvised methods.

(b) The above provision does not prohibit the normal use of a listed quick-disconnect device.

1.2.10.12 Outlets:

(a) The outlet fittings or piping shall be securely fastened in place.

(b) Outlets shall not be located behind doors.

(c) Outlets shall be located far enough from floors, walls, patios, slabs, and ceilings to permit the use of proper wrenches without straining, bending or damaging the piping.

(d) The unthreaded portion of gas piping outlets shall extend not less than one inch through finished ceilings, or indoor or outdoor walls.

(e) The unthreaded portion of gas piping outlets shall extend not less than 2 inches above the surface of floors or outdoor patios or slabs.

(f) The provisions of 1.2.10.12(d) and 1.2.10.12(e) do not apply to listed quick-disconnect devices of the flush-mounted type. Such devices shall be installed in accordance with the manufacturer's installation instructions.

1.2.10.13 Prohibited Devices: No device shall be placed inside the gas piping or fittings that will reduce the cross-sectional area or otherwise obstruct the free flow of gas.

1.2.10.14 Branch Pipe Connection:

(a) All branch outlet pipes shall be taken from the top or sides of horizontal lines and not from the bottom.

(b) When a branch outlet is placed on a main supply line before it is known what size of pipe will be connected to it, the outlet shall be of the same size as the line which supplies it.

1.2.10.15 Electrical Bonding and Grounding:

(a) A gas piping system within a building shall be electrically continuous and bonded to any grounding electrode, as defined by the *National Electrical Code*, ANSI C1–1975 (NFPA No. 70–1975).[1]

(b) Underground gas service piping shall not be used as a grounding electrode except when it is electrically continuous uncoated metallic piping, and its use as a grounding electrode is acceptable both to the serving gas supplier and to the authority having jurisdiction, since gas piping systems are often constructed with insulating bushings or joints, or are of coated or nonmetallic piping.

1.2.11 Gas Shutoff Valves.

1.2.11.1 Accessibility of Gas Valves: Main gas shutoff valves controlling

[1]Available from the American National Standards Institute, Inc., 1430 Broadway, New York, New York 10018, or the National Fire Protection Association, 470 Atlantic Avenue, Boston, Mass. 02210.

several gas piping systems shall be placed an adequate distance from each other so they will be easily accessible for operation and shall be installed so as to be protected from physical damage. It is recommended that they be plainly marked with a metal tag attached by the installing agency so that the gas piping systems supplied through them can be readily identified. It is advisable to place a shutoff valve at every point where safety, convenience of operation, and maintenance demands.

1.2.11.2 Shutoff Valves for Multiple House Lines:

(a) In multiple tenant buildings supplied through a master meter, or one service regulator when a meter is not provided, or where meters or service regulators are not readily accessible from the appliance location, an individual shutoff valve for each apartment or for each separate house line shall be provided at a convenient point of general accessibility.

(b) In a common system serving a number of individual buildings, shutoff valves shall be installed at each building.

1.2.12 Test of Piping for Tightness: Before any system of gas piping is finally put in service, it shall be carefully tested to assure that it is gastight. Where any part of the system is to be enclosed or concealed, this test should precede the work of closing in. To test for tightness, the piping may be filled with the fuel gas, air or inert gas, but not with any other gas or liquid. OXYGEN SHALL NEVER BE USED.

(a) Before appliances are connected, piping systems shall withstand a pressure of at least 6.0 inches mercury or 3.0 pounds gage for a period of not less than 10 minutes without showing any drop in pressure. Pressure shall be measured with a mercury manometer or slope gage, or an equivalent device so calibrated as to be read in increments of not greater than one-tenth pound. The source of pressure shall be isolated before the pressure tests are made.

(b) Systems for undiluted liquefied petroleum gases shall withstand the pressure test in accordance with 1.2.12(a), or, when appliances are connected to the piping system, shall withstand a pressure of not less than 10.0 inches nor more than 14.0 inches water column (8.0 ounces per square inch) for a period of not less than 10 minutes without showing any drop in pressure. Pressure shall be measured with a water manometer or an equivalent device calibrated so as to be read in increments of not greater than 0.1 inch water column. The source of pressure shall be isolated before the pressure tests are made.

1.2.13 Leakage Check After Gas Turn On.

1.2.13.1 Close All Gas Outlets: Before turning gas under pressure into any piping, all openings from which gas can escape shall be closed.

1.2.13.2 Check for Leakage: Immediately after turning on the gas, the piping system shall be checked by one of the following methods to ascertain that no gas is escaping:

(a) **Checking for Leakage Using the Gas Meter.** Immediately prior to the test it should be determined that the meter is in operating condition and has not been bypassed.

Checking for leakage can be done by carefully watching the test dial of the meter to determine whether gas is passing through the meter. To assist in observing any movement of the test hand, wet a small piece of

paper and paste its edge directly over the center line of the hand as soon as the gas is turned on. Allow 5 minutes for a ½-foot dial and proportionately longer for a larger dial in checking for gas flow. This observation should be made with the test hand on the upstroke.

In case careful observation of the test hand for a sufficient length of time reveals no movement, the piping shall be purged and a small gas burner turned on and lighted and the hand of the test dial again observed. If the dial hand moves (as it should), it will show that the meter is operating properly. If the test hand does not move or register flow of gas through the meter to the small burner, the meter is defective and the gas should be shut off and the serving gas supplier notified.

(b) Checking For Leakage Not Using a Meter. This can be done by attaching to an appliance orifice, a manometer or equivalent device calibrated so that it can be read in increments of 0.1 inch water column, and momentarily turning on the gas supply and observing the gaging device for pressure drop with the gas supply shutoff. No discernible drop in pressure shall occur during a period of 3 minutes.

(c) When Leakage Is Indicated. If the meter test hand moves, or a pressure drop on the gage is noted, all appliances or outlets supplied through the system shall be examined to see if they are shut off and do not leak. If they are found tight there is a leak in the piping system. The gas supply shall be shut off until the necessary repairs have been made, after which the test specified in 1.2.13.2(a) or (b) shall be repeated.

1.2.14 Purging.

1.2.14.1 Purging All Gas Piping:

(a) After piping has been checked, all gas piping shall be fully purged. A suggested method for purging the gas piping to an appliance is to disconnect the pilot piping at the outlet of the pilot valve. Piping shall not be purged into the combustion chamber of an appliance.

(b) The open end of piping systems being purged shall not discharge into confined spaces or areas where there are sources of ignition unless precautions are taken to perform this operation in a safe manner by ventilation of the space, control of purging rate, and elimination of all hazardous conditions.

1.2.14.2 Lighting Pilots: After the gas piping has been sufficiently purged, all appliances shall be purged and the pilots lighted. The installing agency shall assure itself that all piping and appliances are fully purged before leaving the premises.

1.3 APPLIANCE INSTALLATION

1.3.1 General.

1.3.1.1 Appliances, Accessories and Equipment To Be "Approved": Gas appliances, accessories, and equipment shall be "Approved." "Approved" shall mean "acceptable to the authority having jurisdiction."

NOTE: In determining acceptability, the authority having jurisdiction may base acceptance on compliance with NFPA, American National 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 (*see Part 1.7, Definitions*) of nationally recognized testing laboratories,[1] i.e., laboratories qualified and equipped to conduct the necessary tests, in a position to determine compliance with appropriate standards for the current production of listed items, and the satisfactory performance of such equipment or materials in actual usage.

1.3.1.2 Type of Gas: It shall be determined whether the appliance has been designed for use with the gas to which it will be connected. No attempt shall be made to convert the appliance from the gas specified on the rating plate for use with a different gas without consulting the serving gas supplier or the appliance manufacturer for complete instructions.

1.3.1.3 Safety Shutoff Devices for Unlisted LP-Gas Appliances Used Indoors: Safety shutoff devices of the complete shutoff type shall be installed on manually controlled water heaters and automatically controlled appliances, except domestic ranges and commercial cooking equipment having pilot input ratings of 500 Btu per hour or less, for use with undiluted liquefied petroleum gases.

1.3.1.4 Use of Air or Oxygen under Pressure: When air or oxygen under pressure is used in connection with the gas supply, effective means such as a back pressure regulator and relief valve shall be provided to prevent air or oxygen from passing back into the gas piping. The serving gas supplier shall be consulted for details. When oxygen is used, see the *Standard for Installation and Operation of Oxygen-Fuel Gas Systems for Welding and Cutting*, NFPA No. 51–1974.[2]

1.3.1.5 Flammable Vapors: Gas appliances shall not be installed in any location where flammable vapors are likely to be present, unless the design, operation and installation are such as to eliminate the possible ignition of the flammable vapors.

1.3.1.6 Installation in Residential Garages:

(a) Gas appliances may be installed on the floor of a residential garage provided a door of the garage opens to an adjacent ground or driveway level that is at or below the level of the garage floor. When this condition does not exist, appliances shall be installed so that the burners and pilots are at least 18 inches above the floor.

(b) Gas appliances shall be located, or reasonably protected, so that they are not subject to physical damage by a moving vehicle.

1.3.1.7 Installation in Commercial Garages:

(a) Floor-mounted appliances in commercial garages for more than 3 motor vehicles shall be installed as follows:

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[1]Among the laboratories nationally recognized by the authorities having jurisdiction in the United States and Canada from whom listings are available are the Underwriters' Laboratories, Inc., the Factory Mutual Research Corporation, the American Gas Association Laboratories, the Underwriters' Laboratories of Canada, the Canadian Standards Association Testing Laboratories, and the Canadian Gas Association Approvals Division.

The National Fire Protection Association and the American National Standards Institute do not approve, inspect or certify any installations, procedures, equipment or materials, nor do they approve or evaluate testing laboratories.

[2]Available from National Fire Protection Association, 470 Atlantic Avenue, Boston, Mass. 02210.

1. Appliances may be located in a room separated from other parts of the garage by construction having at least a one hour fire-resistance rating. This room shall not be used for combustible storage and shall have no direct access from the garage storage or repair areas. All air for combustion purposes entering such a room shall be from outside of the building, or

2. Floor mounted appliances may be located in the garage if they are installed so that the bottom of the combustion chamber is at least 18 inches above the floor and outside grade level. Such appliances shall be protected from physical damage by vehicles.

(b) Overhead heaters shall be installed at least 8 feet above the floor.

(c) Direct-vent appliances may be located within a garage. When necessary, they shall be protected against physical damage.

1.3.1.8 Installation in Aircraft Hangars: Heaters in aircraft hangars shall be installed in accordance with *American National Standard for Aircraft Hangars*, Z214.1–1972 (NFPA No. 409–1973).[1]

1.3.1.9 Venting of Flue Gases: Appliances shall be vented in accordance with the provisions of Part 1.5, Venting of Appliances.

1.3.1.10 Extra Device or Attachment: No device or attachment shall be installed on any appliance which may in any way impair the combustion of gas.

1.3.1.11 Adequate Capacity of Piping: When connecting additional appliances to a gas piping system, the existing piping shall be checked to determine if it has adequate capacity (*see 1.2.4*). If inadequate, the existing system shall be enlarged as necessary or separate gas piping of adequate capacity shall be run from the meter, or from the service regulator when a meter is not provided, to the appliance.

1.3.1.12 Avoid Strain on Gas Piping: Gas appliances shall be adequately supported and so connected to the piping as not to exert undue strain on the connections.

1.3.1.13 Venting of Gas Appliance Pressure Regulators:

(a) Gas appliance pressure regulators requiring access to the atmosphere for successful operation shall be equipped with vent piping leading outdoors or into the combustion chamber adjacent to a constantly burning pilot, unless constructed or equipped with a vent limiting means to limit the escape of gas from the vent opening in the event of diaphragm failure.

(b) Vent limiting means on gas appliance pressure regulators, when tested at the inlet pressure indicated, shall limit the escape of gas to not more than that specified in Table 1-3.

(c) In the case of vents leading outdoors, means shall be employed to prevent water from entering this piping and also to prevent stoppage of it by insects and foreign matter.

[1]Available from the American National Standards Institute, Inc., 1430 Broadway, New York, New York 10018, or the National Fire Protection Association, 470 Atlantic Avenue, Boston, Mass. 02210.

Table 1-3

Gas Pressure Regulator	Test Inlet Pressure, inches w.c.	Max. Gas Flow Rate, CFH	
		Nat., Mfd., Mixed, LP Gas-Air	Undiluted LP Gases
Listed Class I	10.5	2.5	1.0
Listed Class II	21.0	2.5	1.0
Unlisted	21.0	2.5	1.0

(d) In the case of vents entering the combustion chamber, the vent shall be located so that the escaping gas will be readily ignited by the pilot flame and the heat liberated thereby will not adversely affect the normal operation of the safety shutoff system. The terminus of the vent shall be securely held in a fixed position relative to the pilot flame. For manufactured gas, a flame arrester in the vent piping may also be necessary.

1.3.1.14 Combination of Appliances: Any combination of appliances, attachments, or devices used together in any manner shall comply with the standards which apply to the individual appliances.

1.3.1.15 Installation Instructions: The installing agency shall conform with the appliance manufacturer's specific recommendations in completing an installation that will provide satisfactory performance and serviceability. The installing agency shall also leave the manufacturer's installation, operating and maintenance instructions in a location on the premises where they will be readily available for reference and guidance of the authority having jurisdiction, servicemen and the owner or operator.

1.3.1.16 Protection of Outdoor Appliances: Appliances not listed for outdoor installation but installed outdoors shall be provided with protection to the degree that the environment requires and be accessible for service. (*See 1.3.3.1.*)

1.3.2 Draft Hoods.

1.3.2.1 When Required:

(a) Every vented appliance, except incinerators, dual oven type combination ranges, direct-vent appliances and units designed for power burners or for forced venting, shall be installed with a draft hood. The draft hood supplied with or forming a part of listed vented appliances shall be installed without alteration, exactly as furnished and specified by the appliance manufacturer. If a draft hood is not supplied by the appliance manufacturer when one is required, it shall be supplied by the installing agency, be of a listed or approved type and, in the absence of other instructions, be the same size as the appliance flue collar. When a draft hood is required with a conversion burner, it shall be of a listed or ap-

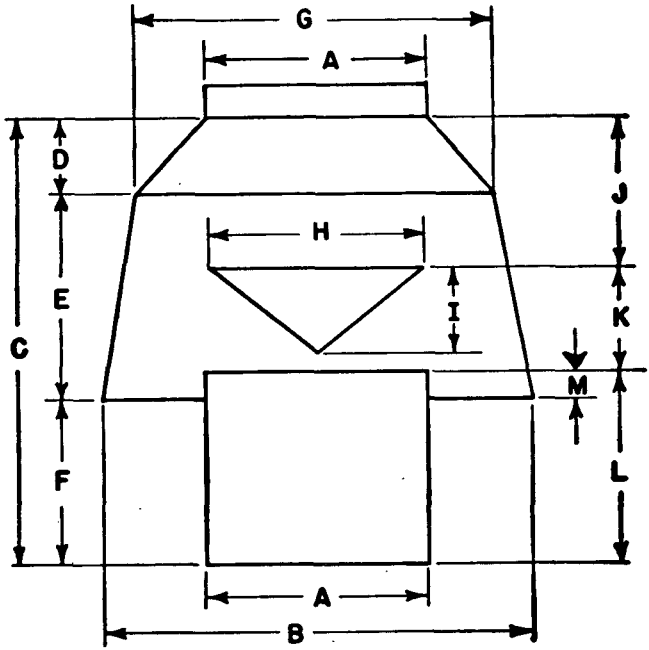


Table of Dimensions
(inches)

A	B	C	D	E	F	G	H	I	J	K	L	M
3	5.5	7.0	0.7	3.8	2.5	4.4	3.0	1.5	2.3	1.5	3.2	0.7
4	7.2	9.5	1.0	5.0	3.5	6.0	4.0	2.0	3.0	2.0	4.5	1.0
5	9.4	10.8	1.5	5.3	4.0	8.0	5.0	2.3	3.5	2.4	4.9	0.9
6	11.5	12.0	1.9	5.6	4.5	9.8	6.0	2.5	4.0	2.7	5.3	0.8
7	13.5	13.9	2.3	6.4	5.3	11.6	7.0	2.9	4.6	3.1	6.2	0.9
8	15.5	15.8	2.7	7.1	6.0	13.4	8.0	3.2	5.3	3.5	7.0	1.0
9	17.5	17.5	3.1	7.7	6.7	15.2	9.0	3.5	5.8	4.0	7.7	1.0
10	19.7	18.8	3.6	7.9	7.3	17.2	10.0	3.8	6.2	4.3	8.3	1.0
11	22.2	20.7	4.3	8.4	8.0	19.6	11.0	4.1	6.6	4.6	9.5	1.5
12	24.7	22.2	5.0	8.7	8.5	22.0	12.0	4.4	7.0	5.0	10.2	1.7

NOTE: This is only one design of a vertical hood and should not be construed as the only design that may be used. A hood of any other design which will comply with *American National Standard for Draft Hoods*, Z21.12–1971, should be satisfactory within the limits of performance specified.

Fig. 1-2. Suggested General Dimensions for a Vertical Draft Hood

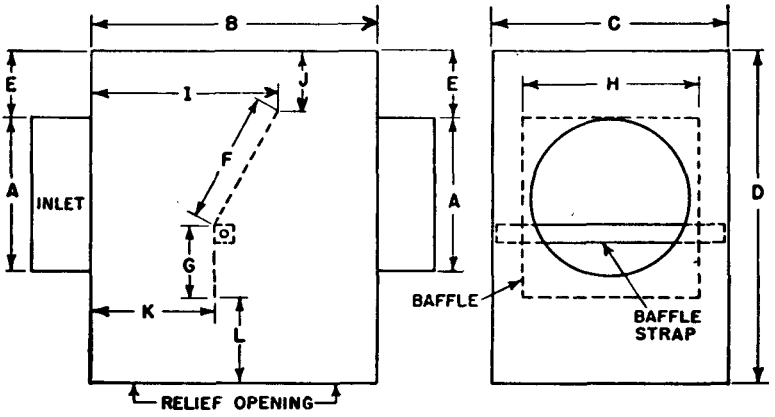


Table of Dimensions
(inches)

A	B	C	D	E	F	G	H	I	J	K	L
3	6	5	9 7/8	1 1/2	2 1/2	1 9/16	3 1/2	3 3/4	1 3/8	2 1/2	4 3/4
4	8	6 3/4	11 5/8	2	3 3/8	2 1/8	4 5/8	5	1 7/8	3 3/8	4 3/4
5	10	8 3/8	13 1/4	2 1/2	4 3/16	2 5/16	5 7/8	6 1/4	2 3/8	4 3/16	4 3/4
6	12	10	15	3	5	3 1/8	7	7 1/2	2 7/8	5	4 3/4
7	14	11 3/4	16 3/4	3 1/2	5 7/8	3 11/16	8 1/8	8 3/4	3 3/8	5 7/8	4 3/4
8	16	13 3/8	18 3/8	4	6 11/16	4 1/8	9 3/8	10	3 7/8	6 11/16	4 3/4
9	18	15	20 1/8	4 1/2	7 1/2	4 11/16	10 1/2	11 1/4	4 3/8	7 1/2	4 3/4
10	20	16 3/4	21 3/4	5	8 3/8	5 1/8	11 5/8	12 1/2	4 7/8	8 3/8	4 3/4
11	22	18 3/8	23 1/2	5 1/2	9 3/16	5 11/16	12 3/4	13 3/4	5 3/8	9 3/16	4 3/4
12	24	20	25 1/4	6	10	6 1/4	14	15	5 7/8	10	4 3/4

NOTE: This is only one design for a horizontal hood and should not be construed as the only design that may be used. A hood of any other design which will comply with the *American National Standard for Draft Hoods*, Z21.12–1971, should be satisfactory within the limits of performance specified.

Fig. 1-3. Suggested General Dimensions for a Horizontal Draft Hood

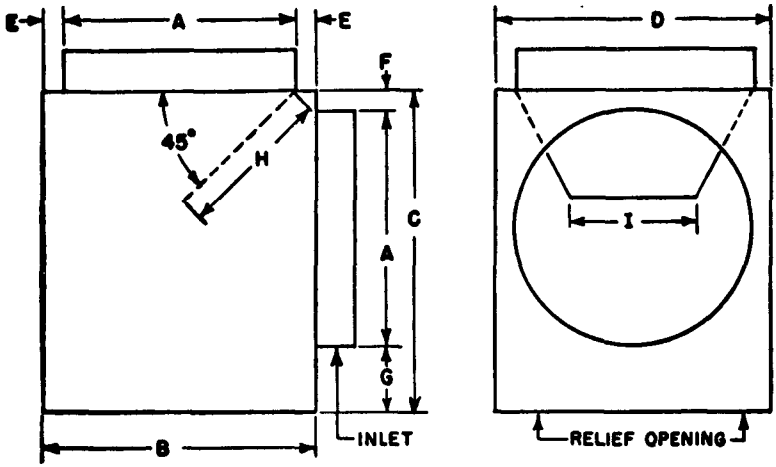


Table of Dimensions
(Inches)

A	B	C	D	E	F	G	H	I
3	4	4 1/4	4	1/2	1/2	3/4	2	1 1/4
4	5	5 1/2	5	1/2	1/2	1	2 11/16	1 5/8
5	6	6 3/4	6	1/2	1/2	1 1/4	3 5/16	2
6	7	8	7	1/2	1/2	1 3/4	4	2 3/8
7	8	9 1/4	8	1/2	1/2	1 3/4	4 11/16	2 3/4
8	9	10 1/2	9	1/2	1/2	2	5 5/16	3 1/8
9	10	11 3/4	10	1/2	1/2	2 1/4	6	3 1/2
10	11	13	11	1/2	1/2	2 1/2	6 11/16	3 7/8
11	12	14 1/4	12	1/2	1/2	2 3/4	7 5/16	4 1/4
12	13	15 1/2	13	1/2	1/2	3	8	4 5/8

NOTE: This is only one design of a horizontal to vertical hood and should not be construed as the only design that may be used. A hood of any other design which will comply with *American National Standard for Draft Hoods*, Z21.12–1971, should be satisfactory within the limits of performance specified.

Fig. 1-4. Suggested General Dimensions for a Horizontal to Vertical Draft Hood

proved type supplied by the installing agency or as recommended by the manufacturer.

(b) When the installer determines that a draft hood of special design is needed or preferable for a particular installation, advice of the manufacturer, the serving gas supplier or authority having jurisdiction shall be secured. (*For suggested general dimensions of draft hood, see Figures 1-2, 1-3, and 1-4.*)

1.3.2.2 Installation: The draft hood shall be in the same room as the combustion air opening of the appliance. In no case shall a draft hood be installed in a false ceiling, in a different room, or in any manner that will permit a difference in pressure between the draft hood relief opening and the combustion air supply. The draft hood supplied for gas conversion burners shall be so located that the burner is capable of safe and efficient operation.

1.3.2.3 Positioning: A draft hood shall be installed in the position for which it was designed with reference to the horizontal and vertical planes and shall be located so that the relief opening is not obstructed by any part of the appliance or adjacent construction. The appliance and its draft hood shall be located so that the relief opening is accessible for checking vent operation.

1.3.2.4 Clearance: A draft hood shall be located so that the draft hood relief opening is not less than 6 inches from any surface except that of the appliance it serves and the venting system to which the draft hood is connected. When a greater or lesser clearance is indicated on the appliance label, the clearance shall not be less than that specified on the label. These clearances shall not be reduced.

1.3.3 Accessibility and Clearance.

1.3.3.1 Accessibility for Service:

(a) Every gas appliance shall be located with respect to building construction and other equipment so as to permit access to the appliance. Sufficient clearance shall be maintained to permit cleaning of heating surfaces; the replacement of filters, blowers, motors, burners, controls and vent connections; the lubrication of moving parts where necessary; and the adjustment and cleaning of burners and pilots. For attic installation the passageway and servicing area adjacent to the appliance shall be floored.

(b) Appliances listed for outdoor installation may be installed without protection in accordance with the provisions of their listing and shall be accessible for servicing.

1.3.3.2 Clearance to Combustible Materials: Gas appliances and their vent connectors shall be installed with clearances from combustible material so that their operation will not create a hazard to persons or property.

Minimum clearances between combustible walls and the back and sides of various conventional types of appliances and their vent connectors are specified in 1.4 and 1.5.

1.3.4 Air for Combustion and Ventilation.

1.3.4.1 General:

(a) The provisions of 1.3.4 apply to appliances installed in buildings and which require air for combustion, ventilation and dilution of flue gases from within the building. They do not apply to (1) direct vent appliances which are constructed and installed so that all air for combustion is obtained from the outside atmosphere and all flue gases are discharged to the outside atmosphere, or (2) enclosed furnaces which incorporate an integral total enclosure and use only outside air for combustion and dilution of flue gases.

(b) Appliances shall be installed in a location in which the facilities for ventilation permit satisfactory combustion of gas, proper venting and the maintenance of ambient temperature at safe limits under normal conditions of use. Appliances shall be located so as not to interfere with proper circulation of air within the confined space. When buildings are so tight that normal infiltration does not provide the necessary air, outside air shall be introduced.

(c) While all forms of building construction cannot be covered in detail, air for combustion, ventilation and dilution of flue gases for gas appliances vented by natural draft normally may be obtained by application of one of the methods covered in 1.3.4.2, 1.3.4.3 and 1.3.4.6.

1.3.4.2 Appliances Located in Unconfined Spaces:

(a) In unconfined spaces in buildings of conventional frame, masonry, or metal construction, infiltration normally is adequate to provide air for combustion, ventilation, and dilution of flue gases.

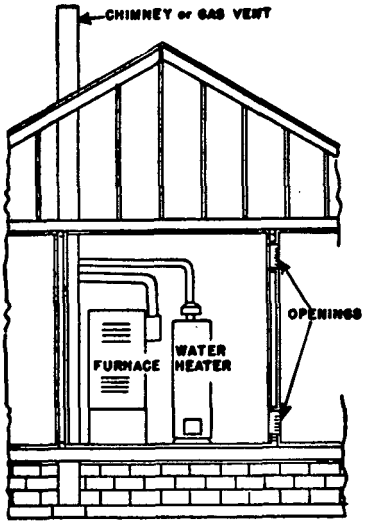
(b) If the unconfined space is within a building of unusually tight construction, air for combustion, ventilation, and dilution of flue gases shall be obtained from outdoors or from spaces freely communicating with the outdoors. A permanent opening or openings having a total free area of not less than one square inch per 5,000 Btu per hour of total input rating of all appliances shall be provided. Ducts may be used to convey make-up air from the outdoors and shall be of the same cross-sectional area as the free area of the openings to which they connect. The ducts may be connected to the cold air return of the heating system only if they connect directly to outside air. The minimum dimension of rectangular air ducts shall be not less than 3 inches.

1.3.4.3 Appliances Located In Confined Spaces:

(a) All Air From Inside Buildings: The confined space shall be provided with two permanent openings, one commencing within 12 inches of the top and one commencing within 12 inches of the bottom of the enclosure. Each opening shall have a minimum free area of one square inch per 1,000 Btu per hour of the total input rating of all appliances in the enclosure. These openings must freely communicate with interior areas having adequate infiltration from the outside. (*See Figure 1-5.*)

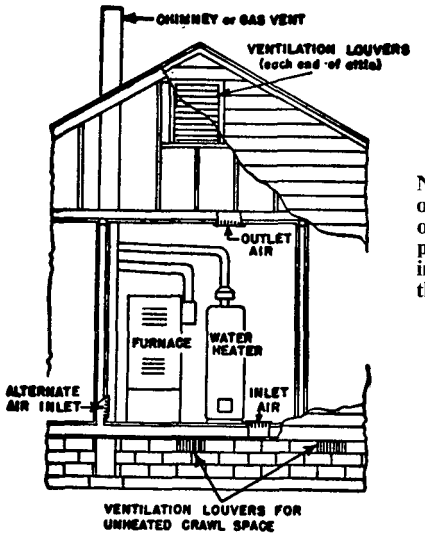
(b) All Air From Outdoors: The confined space shall be provided with two permanent openings, one commencing within 12 inches of the top and one commencing within 12 inches of the bottom of the enclosure. The openings shall communicate directly, or by ducts, with outdoors or spaces (crawl or attic) that freely communicate with outdoors.

1. When directly communicating with the outdoors, each opening shall have a minimum free area of one square inch per 4,000 Btu per hour of total input rating of all appliances in the enclosure. (*See Figure 1-6.*)



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

Fig. 1-5. Appliances Located in Confined Spaces; All Air from Inside the Building. See 1.3.4.3 (a).



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 of the total input rating of all appliances in the enclosure.

Fig. 1-6. Appliances Located in Confined Spaces; All Air from Outdoors — Inlet Air from Ventilated Crawl Space and Outlet Air to Ventilated Attic. See 1.3.4.3 (b).

2. When communicating with the outdoors through vertical ducts, each opening shall have a minimum free area of one square inch per 4,000 Btu per hour of total input rating of all appliances in the enclosure. (*See Figure 1-7.*)

3. When communicating with the outdoors through horizontal ducts, each opening shall have a minimum free area of one square inch per 2,000 Btu per hour of total input rating of all appliances in the enclosure. (*See Figure 1-8.*)

4. When ducts are used, they 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 inches.

(c) Ventilation Air From Inside Building — Combustion and Draft Hood Dilution Air From Outdoors: The confined space shall be provided with two openings located and sized as in 1.3.4.3(a). In addition there shall be one opening directly communicating with outdoors or spaces (crawl or attic) that freely communicate with outdoors. This opening shall have a minimum free area of one square inch per 5,000 Btu per hour of total input of all appliances in the enclosure. Ducts may be used to convey make-up air and shall be of the same cross-sectional area as the free area of the openings to which they connect. The ducts may be connected to the cold air return of the heating system only if they connect directly to outside air. The minimum dimension of rectangular air ducts shall not be less than 3 inches. (*See Figure 1-9.*)

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 of the total input rating of all appliances in the enclosure.

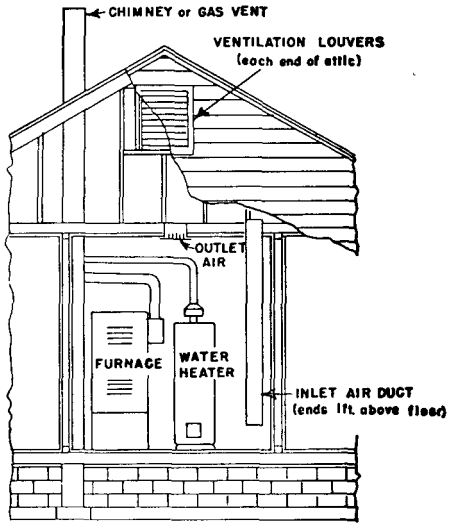
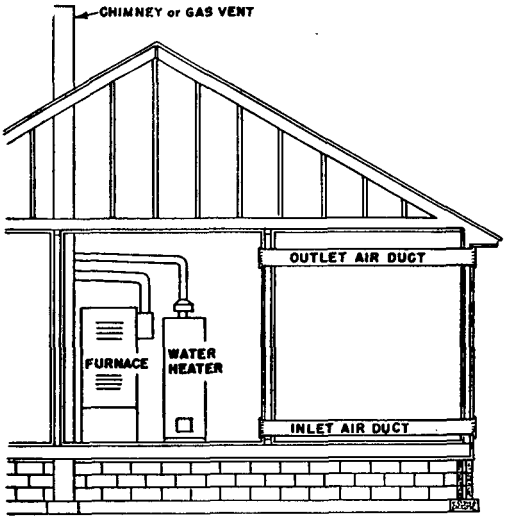


Fig. 1-7. Appliances Located in Confined Spaces; All Air from Outdoors Through Ventilated Attic. See 1.3.4.3(b)



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

*If the appliance room is located against an outside wall and the air openings communicate directly with the outdoors, each opening shall have a free area of not less than one square inch per 4,000 Btu per hour of the total input rating of all appliances in the enclosure.

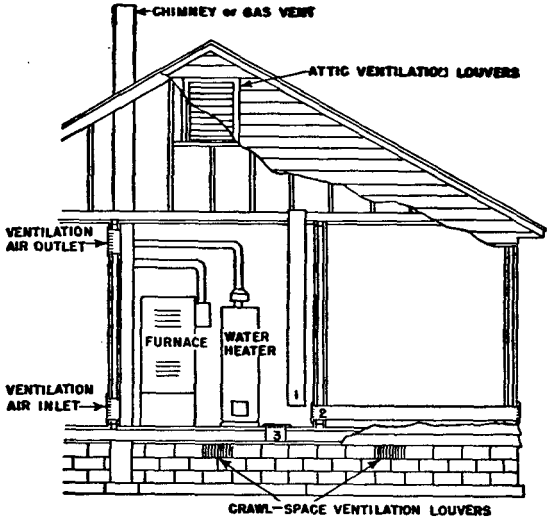
Fig. 1-8. Appliances Located in Confined Spaces; All Air from Outdoors. See 1.3.4.3(b)

1.3.4.4 Louvers and Grilles: In calculating free area in 1.3.4.2 and 1.3.4.3, consideration shall be given to the blocking effect of louvers, grilles or screens protecting openings. Screens used shall not be smaller than ¼-inch mesh. If the free area through a design of louver or grille is known, it should 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.

1.3.4.5 Special Conditions Created by Mechanical Exhausting or Fireplaces: Operation of exhaust fans, kitchen ventilation systems, clothes dryers, or fireplaces may create conditions requiring special attention to avoid unsatisfactory operation of installed gas appliances.

1.3.4.6 Specially Engineered Installations: The size of combustion air openings specified in 1.3.4.2 and 1.3.4.3 shall not necessarily govern when special engineering provides an adequate supply of air for combustion, ventilation, and dilution of flue gases.

1.3.5 Appliances on Roofs.



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 shall be installed at each end of attic with alternate air inlet No. 1.

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 of the total input rating of all appliances in the enclosure.

Crawl-Space Ventilation Louvers for unheated crawl space shall be installed 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 of the total input rating of all appliances in the enclosure.

Fig. 1-9. Appliances Located in Confined Spaces; Ventilation Air from Inside Building — Combustion and Draft Hood Dilution Air from Outside, Ventilated Attic or Ventilated Crawl Space. See 1.3.4.3(c)

1.3.5.1 General:

(a) Appliances shall be designed or enclosed so as to withstand climatic conditions in the area in which they are installed. If enclosures are provided, each enclosure shall permit easy entry and movement, shall be of reasonable height, and shall have at least 2 feet clearance to either side of the service access panel(s) of the appliance(s) in the enclosure.

(b) Roofs on which appliances are to be installed shall be capable of supporting the additional load or shall be reinforced to support the additional load.

(c) All access locks, screws and bolts shall be of corrosion-resistant material.

1.3.5.2 Installation:

(a) Appliances shall be installed in accordance with their listing and the manufacturer's installation instructions.

(b) Appliances shall be installed on a well-drained surface. At least 6 feet clearance shall be available between the appliance and the edge of a roof or similar hazard, or rigidly fixed rails or guards at least 3 feet in height shall be provided on the exposed side except that parapets or other building structure at least 3 feet in height may be utilized in lieu of rails or guards.

(c) Each appliance requiring an external source of electrical power for its operation shall be provided with an accessible electrical diconnect means near the appliance.

(d) When water stands on the roof at the appliance or in the passageways to the appliance, or when the roof is of a design having a water seal, a suitable platform or walkway or both shall be provided above the water line. Such platform(s) or walkway(s) shall be located adjacent to the appliance and control panels so that the appliance can be safely serviced when water stands on the roof.

1.3.5.3 Access to Appliances:

(a) Appliances located on roofs or other elevated locations shall be accessible.

(b) Buildings of more than one story in height shall have an inside means of access to the roof.

(c) The inside means of access shall be a permanent, or fold-away, inside stairway or ladder, terminating in an enclosure, scuttle or trap door. Such scuttles or trap doors shall be at least 24 inches by 24 inches in size, and shall open easily and safely under all conditions, especially snow, and shall be constructed so as to permit access from the roof side unless deliberately locked on the inside.

At least 6 feet clearance shall be available between the access opening and the edge of the roof or similar hazard, or rigidly fixed rails or guards at least 3 feet in height shall be provided on the exposed side except that parapets or other building structure at least 3 feet in height may be utilized in lieu of guards or rails.

(d) Proper permanent lighting shall be provided at the roof access. The switch for such lighting shall be located inside the building near the access means leading to the roof.

1.3.5.4 Additional Provisions: Also see provisions of 1.3.1.16, 1.3.3.1 and 1.5.9.3.

1.3.6 Appliance Connections to Building Piping.

1.3.6.1 Connecting Gas Appliances: Gas appliances shall be connected by one of the following:

(a) Rigid pipe.

(b) Semirigid tubing extensions of a tubing piping system.

(c) Listed appliance connectors that are in the same room as the appliance.

(d) Semirigid tubing in lengths up to 6 feet that are in the same room as the appliance. When acceptable to the serving gas supplier, greater lengths may be used and need not be connected to an outlet in the same room as the appliance.

The connector or tubing shall be installed so as to be protected against physical damage.

Aluminum-alloy tubing and connectors shall be factory coated to pro-

tect against external corrosion where they are in contact with masonry, plaster, or insulation or are subject to repeated wettings by such liquids as water (except rain water), detergents or sewage. Aluminum-alloy tubing shall not be used in exterior locations.

(e) Listed gas hose connectors in accordance with 1.3.6.2.

1.3.6.2 Use of Gas Hose Connectors: Listed gas hose connectors shall be used as follows:

(a) Indoor. Indoor gas hose connectors may be used with laboratory, shop or ironing equipment that requires mobility during operation. A shutoff valve shall be installed where the connector is attached to the building piping. The connector shall be of minimum length but shall not exceed 6 feet. The connector shall not be concealed and shall not extend from one room to another nor pass through wall partitions, ceilings or floors.

(b) Outdoor. Outdoor gas hose connectors may be used to connect portable outdoor gas-fired appliances. A shutoff valve or a listed quick-disconnect device shall be installed where the connector is attached to the supply piping and in such a manner to prevent the accumulation of water or foreign matter. This connection shall only be made in the outdoor area where the appliance is to be used.

1.3.6.3 Appliance Shutoff Valves: Any appliance connected to a piping system shall have an accessible manual shutoff valve installed upstream of the union or connector and within 6 feet of the appliance it serves.

1.3.6.4 Quick-Disconnect Devices: Appliance connectors may be connected to the building piping by means of a listed quick-disconnect device, and when installed indoors, a manual shutoff valve shall be installed upstream of the quick-disconnect device.

1.3.7 Electrical Connections.

1.3.7.1 Electrical Connections: Electrical connections between gas appliances and the building wiring shall conform to the *National Electrical Code*, ANSI C1–1975 (NFPA No. 70–1975).[1]

1.3.7.2 Electric Ignition and Control Devices: No devices employing or depending upon an electrical current shall be used to control or ignite a gas supply if of such character that failure of the electrical current could result in the escape of unburned gas or in failure to reduce the supply of gas under conditions which would normally result in its reduction, unless other means are provided to prevent the development of dangerous temperatures, pressures or the escape of gas.

1.3.7.3 Electrical Circuit: The electrical circuit employed for operating the automatic main gas-control valve, automatic pilot, room temperature thermostat, limit control or other electrical devices used with the gas appliance shall be in accordance with the wiring diagrams supplied with the appliance.

[1]Available from the American National Standards Institute, Inc., 1430 Broadway, New York, New York 10018, or the National Fire Protection Association, 470 Atlantic Avenue, Boston, Mass. 02210.

1.3.7.4 Continuous Power: All gas appliances using electrical controls shall have the controls connected into a permanently live electric circuit, i.e., one that is not controlled by a light switch. Central heating gas appliances should be provided with a separate electrical circuit.

1.3.7.5 Transformers: It is recommended that any separately mounted transformer necessary for the operation of the gas appliance be mounted on a junction box, and a switch with "On" and "Off" markings installed in the hot wire side of the transformer primary.

1.3.7.6 Wire Size: It is recommended that multiple conductor cable, not lighter than No. 18 American Wire Gage, having type "T" insulation or equivalent be used on control circuits. Multiple conductor cables should be color coded to assist in correct wiring and to aid in tracing low-voltage circuits.

1.3.8 Room Temperature Thermostats.

1.3.8.1 Locations: Room temperature thermostats should be located in the natural circulating path of room air. The device should not be placed so that it is exposed to cold air infiltration, drafts from outside openings such as windows and doors, air current from warm or cold air registers, or so that the natural circulation of the air is cut off such as behind doors, in shelves, or in corners.

Thermostats controlling floor furnaces shall not be located in a room or space which can be separated from the room or space in which the register of the floor furnace is located.

1.3.8.2 Exposure: A room temperature thermostat should not be exposed to heat from nearby radiators, fireplaces, radios, television sets, lamps, rays of the sun, or mounted on a wall containing pipes or warm air ducts, or a chimney or gas vent, which would affect its operation and prevent it from properly controlling the room temperature.

1.3.8.3 Drafts: Any hole in the plaster or panel through which the wires pass from the thermostat to the appliance being controlled shall be adequately sealed with suitable material to prevent drafts from affecting the thermostat.

1.4 INSTALLATION OF SPECIFIC APPLIANCES

1.4.1 General. A listed appliance or accessory may be installed in accordance with its listing, or as elsewhere specified in 1.4.

1.4.2 Domestic Ranges.

1.4.2.1 Clearance from Combustible Material:

(a) Listed domestic ranges, except as noted in 1.4.2.1(b) and 1.4.2.1(c), when installed on combustible floors shall be set on their own bases or legs and shall be installed in accordance with their listing and the manufacturer's instructions. In the absence of clearance information, the range shall be installed with clearances of not less than that shown in Table 1-4. The clearance shall not interfere with combustion air, accessibility for operation and servicing.

Table 1-4

Minimum Clearances for Listed Domestic Ranges, Unless Otherwise Marked

Type of Range	Spacing of Center Line of Top Burners From Side of Range	Distance from Combustible Material-Inches			
		Sides		Rear	
		Wall Not Extending Above Cooking Top	Wall Extending Above Cooking Top	Body of Range	Projecting Flue Box
Insulated	Less than 10 in.	1/2	4 1/2	1	1
Insulated	10 in. or more	1/2	1/2	1	1
Flush to Wall	Less than 10 in.	Flush	4 1/2	Flush	—
Flush to Wall	10 in. or more	Flush	Flush	Flush	—

(b) Listed domestic ranges with listed gas room heater sections shall be installed so that the warm air discharge side shall have a minimum clearance of 18 inches from adjacent combustible material. A minimum clearance of 36 inches shall be provided between the top of the heater section and the bottom of cabinets. The minimum clearance between the back of the heater section and combustible material shall be in accordance with Table 1-6, Minimum Clearances for Listed Room Heaters.

(c) Domestic ranges which include a solid or liquid fuel burning section shall be spaced from combustible material and otherwise installed in accordance with the standards applying to the supplementary fuel section of the range.

(d) Unlisted domestic ranges shall be installed with at least a 6-inch clearance at the back and sides to combustible material. Combustible floors under unlisted appliances shall be protected in an approved manner.[1]

1.4.2.2 Vertical Clearance Above Cooking Top: Domestic ranges shall have a vertical clearance above the cooking top of not less than 30 inches to combustible material or metal cabinets, except the clearance may be reduced to not less than 24 inches as follows:

(a) The underside of the combustible material or metal cabinet above the cooking top is protected with asbestos millboard at least 1/4-inch thick covered with sheet metal not lighter than No. 28 manufacturer's standard gage, or,

(b) A metal ventilating hood of not lighter than No. 28 manufacturer's standard gage sheet metal is installed above the cooking top with a clearance of not less than 1/4-inch between the hood and the underside of the combustible material or metal cabinet, and the hood is at least as wide as the range is and is centered over the range.

[1]For details of protection, refer to the *Code for the Installation of Heat-Producing Appliances*, available from the American Insurance Assoociatin, 85 John Street, New York, New York 10038.

1.4.2.3 Install Level: Ranges shall be installed so that the cooking top or oven racks are level.

1.4.3 Built-in Domestic Cooking Units.

1.4.3.1 Installation: Listed built-in domestic cooking units shall be installed in accordance with their listing and the manufacturer's instructions. Listed built-in domestic cooking units may be installed in combustible material unless otherwise marked.

The installation shall not interfere with combustion air, accessibility for operation and servicing.

Unlisted built-in domestic cooking units shall not be installed in, or adjacent to, combustible material.

1.4.3.2 Vertical Clearance Above Top Cooking Unit: Built-in domestic top (or surface) cooking units shall have a vertical clearance above the cooking top of not less than 30 inches to combustible material or metal cabinets, except the clearance may be reduced to not less than 24 inches as follows:

(a) The underside of the combustible material or metal cabinet above the cooking top is protected with asbestos millboard at least ¼-inch thick covered with sheet metal not lighter than No. 28 manufacturer's standard gage, or,

(b) A metal ventilating hood of not lighter than No. 28 manufacturer's standard gage sheet metal is installed above the cooking top with a clearance of not less than ¼-inch between the hood and the underside of the combustible material or metal cabinet, and the hood is at least as wide as the unit is and is centered over the unit.

1.4.3.3 Horizontal Clearance of Listed Top Cooking Units from Walls Extending Above Top Panel: The minimum horizontal distance from the center of the burner head(s) of a top (or surface) cooking unit to vertical combustible walls extending above the top panel shall be not less then that distance specified by the permanent marking on the unit.

1.4.3.4 Install Level: Built-in cooking units shall be installed so that the cooking top, broiler pan, or oven racks are level.

1.4.4 Open Top Broiler Units.

1.4.4.1 Listed Units: Listed open top broiler units shall be installed in accordance with their listing and the manufacturer's instructions.

1.4.4.2 Unlisted Units: Unlisted open top broiler units shall be installed in accordance with the manufacturer's instructions, but shall not be installed in combustible material.

1.4.4.3 Protection Above Domestic Units: Domestic open top broiler units shall be provided with a metal ventilating hood of not lighter than No. 28 manufacturer's standard gage with a clearance of not less than ¼-inch between the hood and the underside of combustible material or metal cabinets. A clearance of at least 24 inches shall be maintained between the cooking top and the combustible material or metal cabinet, and the hood shall be at least as wide as the open top broiler unit is and be centered over the unit.

14.4.4 Commercial Units: Commercial open top broiler units shall be provided with ventilation in accordance with the *Standard for the Installation of Equipment for the Removal of Smoke and Grease-Laden Vapors from Commercial Cooking Equipment*, NFPA No. 96–1973.[1]

1.4.5 Water Heaters.

1.4.5.1 Prohibited Installations: Water heaters, with the exception of those having direct-vent systems, shall not be installed in bathrooms, bedrooms, or any occupied rooms normally kept closed.

Single-faucet automatic instantaneous water heaters, as permitted under 1.5.1.2, in addition to the above, shall not be installed in kitchen sections of light housekeeping rooms or rooms used by transients.

1.4.5.2 Location: Water heaters shall be located as close as practicable to the chimney or gas vent. They should be located so as to provide short runs of piping to fixtures.

1.4.5.3 Clearance:

(a) Listed water heaters shall be installed in accordance with their listing and the manufacturer's instructions. In no case shall the clearances be such as to interfere with combustion air, draft hood clearance and relief, and accessibility for servicing. (*See Table 1-5.*)

Table 1-5

Minimum Clearances for Listed Water Heaters

Type of Heater	Distance from Combustible Material Inches	
	Nearest Part of Jacket	Flat Side
Type A	6	....
Type B	2	....
Type C	....	Flush
Counter Type Unit	In accordance with manufacturer's instructions.	

Type A — Miscellaneous (including circulating tank, instantaneous).

Type B — Underfired, insulated automatic storage heaters.

Type C — Type B units with one or more flat sides and listed for installation flush to wall.

Counter Type — Type B units specifically designed for installation in or beneath a counter.

(b) Unlisted water heaters shall be installed with a clearance of 12 inches on all sides and rear. Combustible floors under unlisted water

[1]Available from the National Fire Protection Association, 470 Atlantic Avenue, Boston, Mass. 02210.

heaters shall be protected in an approved manner.[1]

1.4.5.4 Connections: Water heaters shall be connected in a manner to permit observation, maintenance, and servicing.

1.4.5.5 Pressure Limiting Devices: A water heater installation shall be provided with overpressure protection by means of an approved device constructed, listed and installed in accordance with nationally recognized standards for such devices.

1.4.5.6 Temperature Limiting Devices: An automatic storage-type water heater installation or a hot water storage vessel installation shall be provided with overtemperature protection by means of an approved device constructed, listed and installed in accordance with nationally recognized standards for such devices.

1.4.5.7 Temperature, Pressure and Vacuum Relief Devices: The installation of temperature, pressure, and vacuum relief devices or combinations thereof, and automatic gas shutoff devices shall be in accordance with nationally recognized standards for such devices.

1.4.5.8 Automatic Instantaneous Type:

Cold Water Supply: The water supply to any automatic instantaneous water heater shall be such as to provide sufficient pressure to properly operate the water actuated control valve, when drawing hot water from a faucet on the top floor.

1.4.5.9 Circulating or Tank Types:

(a) **Connection to Boiler or Tank:** The method of connecting the circulating water heater to the tank shall provide proper circulation of water through the heater and permit a safe and useful temperature of water to be drawn from the tank. (*See Figure 1–10*).

(b) **Size of Water Circulating Piping:** The size of the water circulating piping, in general, shall conform with the size of the water connections of the heater.

(c) **Sediment Drain:** A suitable water valve or cock, through which sediment may be drawn off or the tank emptied, shall be installed at the bottom of the tank.

(d) **Anti-Siphoning Devices:** Means acceptable to the authority having jurisdiction shall be provided to prevent siphoning in any boiler or tank to which any circulating water heater is attached. A cold water tube with a hole near the top is commonly accepted for this purpose (*See Figure 1–10*).

1.4.6 Room Heaters.

1.4.6.1 Installations in Sleeping Quarters: Room heaters installed in sleeping quarters for use of transients, as in hotels and motels, shall be vented by one of the methods described in 1.5, Venting of Appliances (*see 1.5.2.2*), and equipped with a safety shutoff device. It is recommended that room heaters installed in all sleeping quarters or rooms generally kept closed be similarly vented and equipped with a safety shutoff device.

[1]For details of protection refer to the *Code for the Installation of Heat Producing Appliances*, available from the American Insurance Association, 85 John Street, New York, New York 10038.

1.4.6.2 Installations in Institutions: Room heaters installed at any location in institutions such as homes for the aged, sanitariums, convalescent homes, orphanages, etc., shall be of the vented type and shall be connected to an effective chimney or gas vent and equipped with a safety shutoff device.

1.4.6.3 Clearance: A room heater shall be placed so as not to cause a hazard to walls, floors, curtains, furniture, doors when open, etc., and to the free movements of persons within the room. Appliances designed and marked "For use in noncombustible fire-resistive fireplace only," shall not be installed elsewhere. Listed room heaters shall be installed with clearances not less than specified in Table 1-6, except that appliances listed for installation at lesser clearances may be installed in accordance with their listings. In no case shall the clearances be such as to interfere with combustion air and accessibility. (*See 1.3.3.1 and 1.3.4*).

Unlisted room heaters shall be installed with clearances from combustible material not less than the following:

(a) **Circulating Type:** Room heaters having an outer jacket surrounding the combustion chamber, arranged with openings at top and bottom so

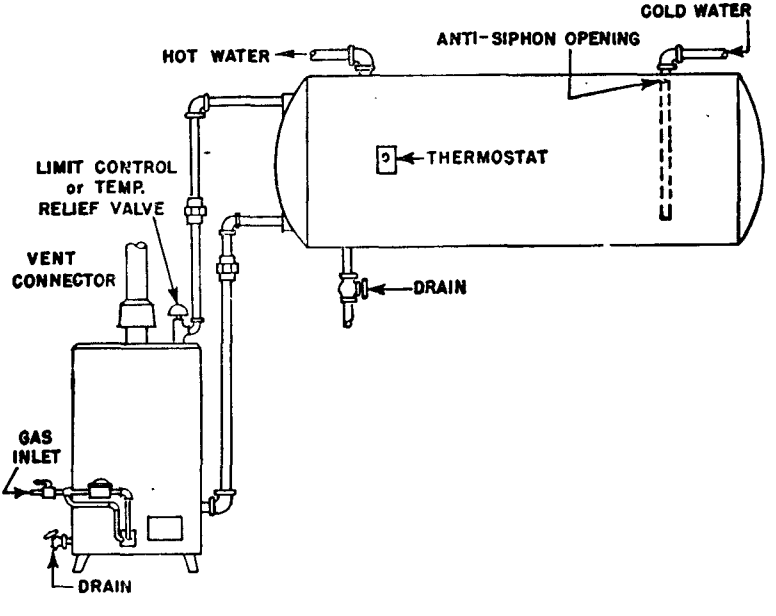


Fig. 1-10. Suggested Location for Anti-Siphon Opening in Cold Water Inlet.

that air circulates between the inner and outer jacket, and without openings in the outer jacket to permit direct radiation, shall have clearance at sides and rear of not less than 12 inches.

(b) Radiating Type: Room heaters other than those described above as of circulating type shall have clearance at sides and rear of not less than 18 inches; except that heaters which make use of metal, asbestos or ceramic material to direct radiation to the front of the appliance shall have a clearance of 36 inches in front, and if constructed with a double back of metal or ceramic may be installed with a clearance of 18 inches at sides and 12 inches at rear. Combustible floors under unlisted room heaters shall be protected in an approved manner.[1]

Table 1-6

Minimum Clearances for Listed Room Heaters

Types of Appliance	Distance from Combustible Material, Inches	
	Jacket, Sides and Rear	Projecting Flue Box or Draft Hood
Warm Air Circulators	6	2
Radiant Heaters	6	2
Wall Heaters	Flush	....

1.4.6.4 Wall-Type Room Heaters: Wall-type room heaters shall not be installed in or attached to walls of combustible material unless listed for such installation.

1.4.6.5 Connection: The provisions of 1.3.6, Appliance Connections to Building Piping, shall be observed.

1.4.7 Central Heating Boilers and Furnaces.

1,4.7.1 Manual Main Shutoff Valves: When a complete shutoff type safety shutoff device is not utilized, a manual main shutoff valve shall be provided ahead of all controls except the manual pilot gas valve.

When a complete shutoff type safety shutoff device is utilized, a manual main shutoff valve shall be provided ahead of all controls.

1.4.7.2 Clearance:

(a) Central heating boilers and furnaces installed in rooms which are large in comparison with the size of the appliance, shall be installed with clearances not less than specified in Table 1-7 except as provided in 1.4.7.2(a) 1 and 2.

1. Central heating furnaces and boilers listed for installation at lesser clearances than specified in Table 1-7 may be installed in accordance with their listing and the manufacturer's instructions.

2. Central heating furnaces and boilers installed in unconfined spaces may be installed with reduced clearances to combustible material

[1]For details of protection, refer to the *Code for the Installation of Heat Producing Appliances*, available from the American Insurance Association, 85 John Street, New York, New York 10038.

Table 1-7

Clearances to Combustible Material for Furnaces and Boilers Installed in Rooms which Are Large in Comparison with Size of Appliance, Except as Provided in 1.4.7.2(a) (See Note 9)

	Minimum Clearance, Inches				
	Above and Sides of Bonnet or Plenum	Jacket Sides and Rear	Front (See Note 1)	Projecting Flue Box or Draft Hood	Vent Connector (See Note 2)
I. Listed automatically fired, forced air or gravity system, with 250 F temperature limit control.	2 (See Notes 3 and 4)	6	18	6	6
II. Unlisted automatically fired, forced air or gravity system, equipped with temperature limit control which cannot be set higher than 250 F.	6 (See Note 5)	6	18	18 (See Note 6)	18 (See Note 6)
III. Listed Automatically Fired Heating Boilers — Steam boilers operating at not over 15 psi gage pressure and hot water boilers operating at not in excess of 250 F.	6 (See Note 7)	6	18	6	6
IV. Unlisted Automatically Fired Heating Boilers — Steam boilers operating at not over 15 psi gage pressure and hot water boilers operating at not in excess of 250 F.	6 (See Note 7)	6	18	18 (See Note 6)	18 (See Note 6)
V. Central heating boilers and furnaces, other than above.	18 (See Note 8)	18	18	18 (See Note 6)	18 (See Note 6)

NOTES APPLICABLE TO TABLE 1-7

1. Front clearance shall be sufficient for servicing the burner and furnace or boiler.
2. The vent connector clearance does not apply to listed Type B gas vents.
3. This clearance may be reduced to 1 inch for a listed forced air or gravity furnace equipped with:
   a. A limit control that cannot be set higher than 200 F, or
   b. A marking to indicate that the outlet air temperature cannot exceed 200 F.
4. Clearance from supply ducts within 3 feet of the plenum shall not be less than that specified from the bonnet or plenum. No clearance is necessary beyond this distance.
5. Clearance from supply ducts within 6 feet of the plenum shall not be less than 6 inches. No clearance is necessary beyond this distance.
6. For unlisted gas appliances equipped with an approved draft hood, this clearance may be reduced to 9 inches.
7. This clearance is above top of boiler.
8. Clearance from supply ducts shall not be less than 18 inches out to 3 feet from the bonnet or plenum, not less than 6 inches from 3 feet to 6 feet, and not less than 1 inch beyond 6 feet.
9. Rooms which are large in comparison with the size of the appliance are rooms having a volume equal to at least 12 times the total volume of a furnace and at least 16 times the total volume of a boiler. Total volume of furnace or boiler is determined from exterior dimensions and is to include fan compartments and burner vestibules, when used. When the actual ceiling height of a room is greater than 8 feet, the volume of a room shall be figured on the basis of a ceiling height of 8 feet.

provided the combustible material or the appliance is protected as described in Table 1-8.

(b) Central heating furnaces and boilers installed in confined spaces shall be installed in accordance with their listing and, when such units are installed in spaces such as alcoves and closets, they shall be specifically listed for such installation. The installation clearances for furnaces and boilers in confined spaces shall not be reduced by the protection methods described in Table 1-8.

(c) When the plenum is adjacent to plaster on metal lath or noncombustible material attached to combustible material, the clearance shall be measured to the surface of the plaster or other noncombustible finish when the clearance specified is 2 inches or less.

(d) The clearance to these appliances shall not interfere with combustion air, draft hood clearance and relief, and accessibility for servicing. (*See 1.3.2.4, 1.3.3.1 and 1.3.4.*)

1.4.7.3 Erection and Mounting: A central heating boiler or furnace shall be erected in accordance with the manufacturer's instructions and shall be installed on a floor of fire-resistive construction with noncombustible flooring and 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, unless listed for installation on a combustible floor or the floor is protected in an approved manner.[1]

[1]For details of protection refer to the *Code for the Installation of Heat Producing Appliances*, available from the American Insurance Association, 85 John Street, New York, New York 10038.

Table 1-8

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 Fig. 1-11). Thicknesses are minimum.	Where the required Clearance with no protection is:											
	36 inches			18 inches			12 inches		9 inches	6 inches		
	Above	Sides & Rear	Vent Connector	Above	Sides & Rear	Vent Connector	Above	Sides & Rear	Vent Connector	Above	Sides & Rear	Vent Connector
(a) 1/4 in. asbestos millboard spaced out 1"†	30	18	30	15	9	12	9	6	6	3	2	3
(b) 28 gage sheet metal on 1/4" asbestos millboard	24	18	24	12	9	12	9	6	4	3	2	2
(c) 28 gage sheet metal spaced out 1"†	18	12	18	9	6	9	6	4	4	2	2	2
(d) 28 gage sheet metal on 1/8" asbestos millboard spaced out 1"†	18	12	18	9	6	9	6	4	4	2	2	2
(e) 1 1/2" asbestos cement covering on heating appliance	18	12	36	9	6	18	6	4	9	2	1	6
(f) 1/4" asbestos millboard on 1" mineral wool bats reinforced with wire mesh or equivalent	18	12	18	6	6	6	4	4	4	2	2	2
(g) 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	2
(h) 1/4" asbestos cement board or 1/4" asbestos millboard	36	36	36	18	18	18	12	12	9	4	4	4
(i) 1/4" cellular asbestos	36	36	36	18	18	18	12	12	9	3	3	3

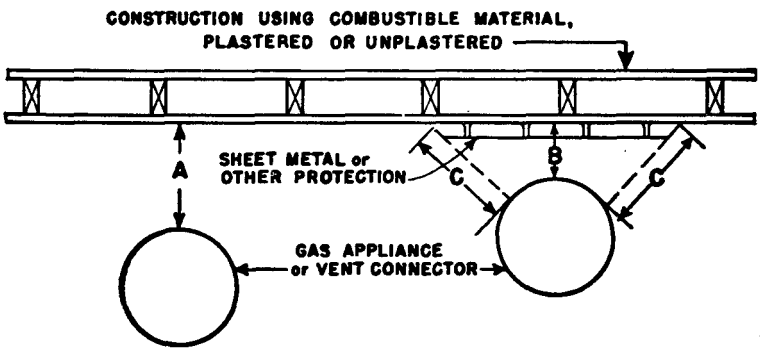
*Except for the protection described in (e), all clearances shall be measured from the outer surface of the appliance to the combustible material disregarding any intervening protection applied to the combustible material.

†Spacers shall be of noncombustible material.

1.4.7.4 Connection of Flow and Return Piping: The method of connecting the flow and return piping on steam and hot water boilers shall be in accordance with the manufacturer's recommendations to facilitate a positive, balanced and unobstructed flow of water or steam through the boiler. The direction of flow through the boiler shall be established by use of normal return and flow connections.[1]

1.4.7.5 Feed Water and Drain Connections: Steam and hot water boilers shall be provided with means of introducing feed or make-up water from a water supply through an individual control valve and connection to the boiler piping system. A drain valve shall also be provided and connected with the lowest water space practicable for the purpose of draining or flushing the boiler.

1.4.7.6 Temperature or Pressure Limiting Devices: Steam and hot water boilers respectively shall be provided with approved automatic limiting devices for shutting down the burner(s) to prevent boiler steam pressure or boiler water temperature from exceeding the maximum allowable working pressure or temperature.



A equals the clearance with no protection specified in Tables 1-7 and 1-10 and in the sections applying to various types of appliances.
B equals the reduced clearance permitted in accordance with Table 1-8. The protection applied to the construction using combustible material shall extend far enough in each direction to make C equal to A.

Fig. 1-11. Extent of Protection Necessary to Reduce Clearances from Gas Appliances or Vent Connectors.

1.4.7.7 Low Water Cutoff: Steam boilers shall be provided with an automatic means to shut off the fuel supply to the burner(s) if the boiler water level drops to the lowest safe water line.

[1]For common piping systems reference may be made to the *American Society of Heating, Refrigerating and Air Conditioning Engineers Guide*, available from the American Society of Heating Refrigerating and Air Conditioning Engineers, Inc., 345 East 47th Street, New York, New York 10017, and the *I-B-R Guides*, available from the Hydronics Institute, 35 Russo Place, P.O. Box 262, Berkeley Heights, New Jersey 07922.

1.4.7.8 Steam Safety and Pressure Relief Valves: Steam and hot water boilers shall be equipped respectively with listed steam safety or pressure relief valves of appropriate discharge capacity and conforming with ASME requirements.[1] Steam safety valves and pressure relief valves shall be set to discharge at a pressure not to exceed the maximum allowable working pressure of the boiler.

1.4.7.9 Plenum Chambers and Air Ducts:

(a) A plenum chamber supplied as a part of a furnace shall be installed in accordance with the manufacturer's instructions.

(b) When a plenum chamber is not supplied with the furnace, any fabrication and installation instructions provided by the manufacturer shall be followed. The method of connecting supply and return ducts shall facilitate proper circulation of air.[2]

(c) When a furnace is installed so that supply ducts carry air circulated by the furnace to areas outside the space containing the furnace, the return air shall also be handled by a duct(s) sealed to the furnace casing and terminating outside the space containing the furnace.

1.4.7.10 Refrigeration Coils:

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

(b) Furnaces shall not be located upstream from cooling units, unless the cooling unit is designed or equipped so as not to develop excessive temperature or pressure.

(c) Refrigeration coils shall be installed in parallel with or on the downstream side of central furnaces to avoid condensation in the heating element, unless the furnace has been specifically listed for downstream installation. With a parallel flow arrangement, the dampers or other means used to control flow of air shall be sufficiently tight to prevent any circulation of cooled air through the furnace.

(d) Adequate means shall be provided for disposal of condensate and to prevent dripping of condensate on the heating element.

1.4.7.11 Cooling Units Used with Heating Boilers:

(a) Boilers, when used in conjunction with refrigeration systems, shall be installed so that the chilled medium is piped in parallel with the heating boiler with appropriate valves to prevent the chilled medium from entering the heating boiler.

(b) When hot water heating boilers are connected to heating coils located in air handling units where they may be exposed to refrigerated air circulation, such boiler piping systems shall be equipped with flow control valves or other automatic means to prevent gravity circulation of the boiler water during the cooling cycle.

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[1]For details of requirements on low pressure heating boiler safety devices refer to *ASME Boiler and Pressure Vessel Code*, Low Pressure Heating Boilers, Section IV, available from The American Society of Mechanical Engineers, United Engineering Center, 345 East 47th Street, New York, New York 10017.

[2]Reference may be made to the *Standard for the Installation of Air Conditioning and Ventilating Systems*, NFPA No. 90A — 1974 and to the *Standard for the Installation of Residence Type Warm Air Heating and Air Conditioning Systems*, NFPA No. 90B — 1973, available from the National Fire Protection Association, 470 Atlantic Avenue, Boston, Mass. 02210.

1.4.8 Wall Furnaces.

1.4.8.1 Installation:

(a) Listed wall furnaces shall be installed in accordance with their listing and the manufacturer's instructions. They may be installed in or attached to combustible material.

(b) Unlisted wall furnaces shall not be installed in or attached to combustible material.

(c) Vented wall furnaces connected to a Type B-W gas vent system listed only for single story shall be installed only in single story buildings or the top story of multistory buildings. Vented wall furnaces connected to a Type B-W gas vent system listed for installation in multistory buildings may be installed in single story or multistory buildings. Type B-W gas vents shall be attached directly to a solid header plate which serves as a fire stop at that point and which may be an integral part of the vented wall furnace. The stud space in which the vented wall furnace is installed shall be ventilated at the first ceiling level by installation of the ceiling plate spacers furnished with the gas vent. Fire stop spacers shall be installed at each subsequent ceiling or floor level penetrated by the vent. (*See Figure 1-12 for Type B-W gas vent installation.*)

(d) Direct vent wall furnaces shall be installed with the vent-air intake terminal in the outside atmosphere. The thickness of the walls on which the appliance is mounted shall be within the range of wall thickness marked on the appliance and covered in the manufacturer's installation instructions.

(e) Panels, grilles and access doors which must be removed for normal servicing operations shall not be attached to the building.

1.4.8.2 Location: Wall furnaces shall be located so as not to cause a hazard to walls, floors, curtains, furniture or doors. Wall furnaces installed between bathrooms and adjoining rooms shall not circulate air from bathrooms to other parts of the building.

1.4.8.3 Manual Main Shutoff Valve: A manual main shutoff valve shall be installed ahead of all controls including the pilot gas valve.

1.4.8.4 Combustion and Circulating Air: Adequate combustion and circulating air shall be provided (*see 1.3.4*).

1.4.9 Floor Furnaces.

1.4.9.1 Installation:

(a) Listed floor furnaces shall be installed in accordance with their listing and the manufacturer's instructions. They may be installed in combustible floors.

(b) Unlisted floor furnaces shall not be installed in combustible floors.

1.4.9.2 Manual Main Shutoff Valve:

A separate manual main shutoff valve shall be provided ahead of all controls and a union connection shall be provided downstream from this valve to permit removal of the controls or the floor furnace.

1.4.9.3 Temperature Limit Controls:

(a) Listed automatically operated floor furnaces shall be equipped

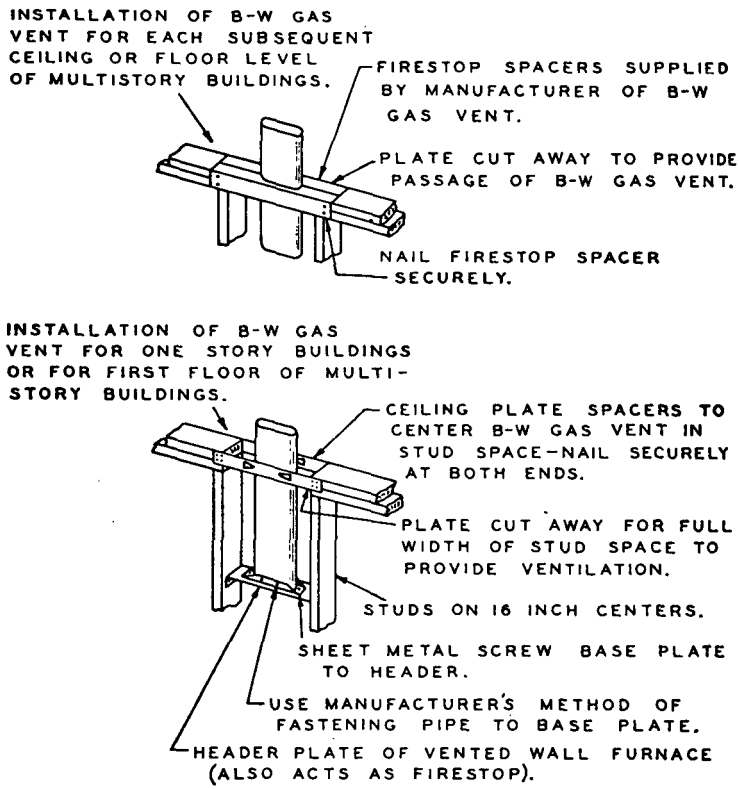

Fig. 1-12. Installation of Type B-W Gas Vents for Vented Wall Furnaces.

with a temperature limit control in accordance with the terms of their listing.

(b) Unlisted automatically operated floor furnaces shall be equipped with a temperature limit control arranged to shut off the flow of gas to the burner in the event the temperature at the warm air outlet register exceeds 350 F above room temperature.

1.4.9.4 Combustion and Circulating Air: Adequate combustion and circulating air shall be provided (*see 1.3.4*).

1.4.9.5 Placement: The following provisions apply to furnaces to serve one story.

(a) Floor furnaces shall not be installed in the floor of any aisle or passageway of any auditorium, public hall, or place of assembly, or in an exitway from any such room or space.

(b) **Walls and Corners:** The register of a floor furnace with a horizontal warm air outlet shall not be placed closer than 6 inches to the nearest wall. A distance of at least 15 inches from two adjoining sides of the floor register to walls shall be provided to eliminate the necessity of occupants walking over the warm air discharge from registers. Wall-register models shall not be placed closer than 6 inches to a corner.

(c) **Draperies:** The furnace shall be placed so that a door, drapery, or similar object cannot be nearer than 12 inches to any portion of the register of the furnace.

(d) **Central Location:** The furnace should be installed in a central location favoring slightly the sides exposed to the prevailing winter winds.

1.4.9.6 Bracing: The space provided for the furnace shall be framed with doubled joists and with headers not lighter than the joists.

1.4.9.7 Support: Means shall be provided to support the furnace when the floor register is removed.

1.4.9.8 Clearance: The lowest portion of the floor furnace shall have at least a 6-inch clearance from the general ground level, except that when the lower 6-inch portion of the floor furnace is sealed by the manufacturer to prevent entrance of water, the clearance may be reduced to not less than 2 inches. When these clearances are not present, the ground below and to the sides shall be excavated to form a "basin-like" pit under the furnace so that the required clearance is provided beneath the lowest portion of the furnace. A 12-inch clearance shall be provided on all sides except the control side, which shall have an 18-inch clearance.

1.4.9.9 Access: The space in which any floor furnace is installed shall be accessible by an opening in the foundation not less than 24 by 18 inches, or a trap door not less than 24 by 24 inches in any cross section thereof, and a passageway not less than 24 by 18 inches in any cross section thereof. The serving gas supplier should be consulted with reference to the access facilities for servicing when it provides service.

1.4.9.10 Seepage Pan: When the excavation exceeds 12 inches in depth or water seepage is likely to collect, a watertight copper pan, concrete pit or other suitable material shall be used, unless adequate drainage is provided or the equipment is sealed by the manufacturer to meet this condition. A copper pan shall be made of not less than 16-ounce-per-square-foot sheet copper. The pan shall be anchored in place so as to prevent floating, and the walls shall extend at least 4 inches above the ground level with at least 6 inches clearance on all sides, except the control side which shall have at least 18 inches clearance.

1.4.9.11 Wind Protection: Floor furnaces shall be protected, where necessary, against severe wind conditions.

1.4.9.12 Upper Floor Installations: 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 sep-

arated from the nonhabitable space) with means for air intake to meet the provisions of 1.3.4, with access for servicing, with minimum furnace clearances of 6 inches to all sides and bottom, and with the enclosure constructed of portland cement plaster on metal lath or material of equal fire resistance.

1.4.9.13 First Floor Installation: Listed floor furnaces installed in the first or ground floors of buildings need not be enclosed unless the basements of these buildings have been converted to apartments or sleeping quarters, in which case the floor furnace shall be enclosed as specified for upper floor installations and shall project into a nonhabitable space.

1.4.10 Duct Furnaces.

1.4.10.1 Clearance:

(a) Listed duct furnaces shall be installed with clearances of at least 6 inches between adjacent walls, ceilings and floors of combustible material and the appliance projecting flue box or draft hood, except that duct furnaces listed for installation at lesser clearances may be installed in accordance with their listings. In no case shall the clearance be such as to interfere with combustion air and accessibility. (*See 1.3.3.1 and 1.3.4.*)

(b) Unlisted duct furnaces shall be installed with clearances to combustible material in accordance with the clearances specified for unlisted furnaces and boilers in Table 1-7. Combustible floors under unlisted duct furnaces shall be protected in an approved manner.[1]

1.4.10.2 Erection of Appliances: Duct furnaces shall be erected and firmly supported in accordance with the manufacturer's instructions.

1.4.10.3 Access Panels: The ducts connected to duct furnaces shall have removable access panels on both the upstream and downstream sides of the furnace.

1.4.10.4 Location of Draft Hood and Controls: The controls, combustion air inlet, and draft hoods for duct furnaces shall be located outside the ducts. The draft hood shall be located in the same enclosure from which combustion air is taken.

1.4.10.5 Circulating Air: When a duct furnace is installed in a confined space, the air circulated by the furnace shall be handled by ducts which are sealed to the furnace casing and which separate the circulating air from the combustion and ventilation air.

1.4.10.6 Duct Furnaces Used with Refrigeration Systems:

(a) A duct 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 throughput necessary for heating or cooling, whichever is greater.

(b) To avoid condensation within heating elements, duct furnaces used in conjunction with cooling equipment shall be installed in parallel with

[1]For details of protection refer to the *Code for the Installation of Heat Producing Appliances*, available from the American Insurance Association, 85 John Street, New York, New York 10038.

or on the upstream side of cooling coils, unless the duct 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.

(c) When duct 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.

(d) Duct 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.

1.4.10.7 Installation in Commercial Garages and Aircraft Hangars: Duct furnaces installed in garages for more than 3 motor vehicles or in aircraft hangars shall be of a listed type and shall be installed in accordance with 1.3.1.7 and 1.3.1.8.

1.4.11 Conversion Burners:

1.4.11.1 Installation of conversion burners shall conform to *American National Standard Installation of Domestic Gas Conversion Burners*, Z21.8–1971,[1] except that an automatic means to shut off the fuel supply to the burner(s) shall be provided in accordance with 1.4.7.7.

1.4.12 Unit Heaters.

1.4.12.1 Support: Suspended type unit heaters shall be safely and adequately supported with due consideration given to their weight and vibration characteristics. Hangars and brackets shall be of noncombustible material.

1.4.12.2 Manual Main Shutoff Valves: When a complete shutoff type safety shutoff device is not utilized, a manual main shutoff valve shall be provided ahead of all controls except the manual pilot gas valve.

When a complete shutoff type safety shutoff device is utilized, a manual main shutoff valve shall be provided ahead of all controls.

A union connection shall be provided downstream from the manual main shutoff valve to permit removal of the controls.

1.4.12.3 Clearance:

(a) Suspended Type Unit Heaters.

1. Listed unit heaters shall be installed with clearances from combustible material of not less than 18 inches at the sides, 12 inches at the bottom and 6 inches above the top when the unit heater has an internal draft hood, or 1 inch above the top of the sloping side of a vertical draft hood.

[1]Available from the American National Standards Institute, Inc., 1430 Broadway, New York, New York 10018, or the American Gas Association, Laboratories, 8501 East Pleasant Valley Road, Cleveland, Ohio 44131.

2. Unit heaters listed for reduced clearances shall be installed in accordance with their listing and the manufacturer's instructions.

3. Unlisted unit heaters shall be installed with clearances to combustible material of not less than 18 inches.

4. Additional clearances for servicing shall be in accordance with the manufacturer's recommendations contained in the installation instructions.

(b) Floor-Mounted Type Unit Heaters.

1. Listed unit heaters shall be installed with clearances from combustible material at the back and one side only of not less than 6 inches. When the flue gases are vented horizontally, the 6 inch clearance shall be measured from the draft hood or vent instead of the rear wall of the unit heater.

2. Unit heaters listed for reduced clearances shall be installed in accordance with their listing and the manufacturer's instructions.

3. Floor-mounted type unit heaters may be installed on combustible floors if listed for such installation.

4. Combustible floors under unlisted floor-mounted unit heaters shall be protected in an approved manner.[1]

5. Additional clearances for servicing shall be in accordance with the manufacturer's recommendations contained in the installation instructions.

1.4.12.4 Combustion and Circulating Air: Adequate combustion and circulating air shall be provided (*see 1.3.4*).

1.4.12.5 Ductwork: A unit heater shall not be attached to a warm air duct system unless listed and marked for such installation.

1.4.12.6 Installation in Commercial Garages and Aircraft Hangars: Unit heaters installed in garages for more than 3 motor vehicles or in aircraft hangars shall be of a listed type and shall be installed in accordance with 1.3.1.7 and 1.3.1.8.

1.4.13 Infrared Radiant Heaters.

1.4.13.1 Support: Suspended type infrared radiant heaters shall be safely and adequately fixed in position independent of gas and electric supply lines. Hangers and brackets shall be of noncombustible material.

1.4.13.2 Clearance:

(a) Listed heaters shall be installed with clearances from combustible material in accordance with their listing and the manufacturer's instructions.

(b) Unlisted heaters shall be installed in accordance with clearances from combustible material acceptable to the authority having jurisdiction.

[1]For details of protection refer to the *Code for the Installation of Heat Producing Appliances*, available from the American Insurance Association, 85 John Street, New York, New York 10038.

1.4.13.3 Combustion and Ventilating Air:

(a) Where unvented infrared heaters are used, natural or mechanical means shall be provided to exhaust at least 4 cfm per 1,000 Btu per hour input of installed heaters.

(b) Exhaust openings for removing flue products shall be above the level of the heaters.

1.4.13.4 Installation in Commercial Garages and Aircraft Hangars: Overhead heaters installed in garages for more than 3 motor vehicles or in aircraft hangars shall be of a listed type and shall be installed in accordance with 1.3.1.7 and 1.3.1.8.

1.4.14 Clothes Dryers.

1.4.14.1 Clearance:

(a) Listed Type 1 clothes dryers shall be installed with a minimum clearance of 6 inches from adjacent combustible material, except that clothes dryers listed for installation at lesser clearances may be installed in accordance with their listing.

(b) Listed Type 2 clothes dryers shall be installed with clearances of not less than shown on the marking plate and in the manufacturer's instructions. Type 2 clothes dryers designed and marked "For use only in fire-resistive locations" shall not be installed elsewhere.

(c) Unlisted clothes dryers shall be installed with clearances to combustible material of not less than 18 inches. Combustible floors under unlisted clothes dryers shall be protected in an approved manner.[1]

1.4.14.2 Exhausting to the Outside Air:

(a) Type 1 clothes dryers should not be installed in bathrooms or bedrooms unless exhausted to the outside air.

(b) Type 2 clothes dryers shall be exhausted to the outside air.

1.4.14.3 Provisions for Make-Up Air:

(a) When a Type 1 clothes dryer is exhausted to the outside, consideration shall be given to provision for make-up air. (*See 1.3.4.5.*)

(b) Provision for make-up air shall be provided for Type 2 clothes dryers, with a minimum free area (*see 1.3.4.4*) of one square inch for each 1,000 Btu per hour total input rating of the dryer(s) installed.

1.4.14.4 Exhaust Ducts for Type 1 Clothes Dryers:

(a) A clothes dryer exhaust duct shall not be connected into any vent connector, gas vent, chimney, crawl space, attic or other similar concealed space.

(b) Ducts for exhausting clothes dryers shall not be put together with sheet-metal screws or other fastening means which extend into the duct and which would catch lint and reduce the efficiency of the exhaust system.

1.4.14.5 Exhaust Ducts for Type 2 Clothes Dryers:

(a) Exhaust ducts for Type 2 clothes dryers shall comply with 1.4.14.4.

(b) Exhaust ducts for Type 2 clothes dryers shall be constructed of sheet metal or other noncombustible material. Such ducts shall be equiva-

[1]For details of protection refer to the *Code for the Installation of Heat Producing Appliances*, available from the American Insurance Association, 85 John Street, New York, New York 10038.

lent in strength and corrosion resistance to ducts made of No. 24 galvanized sheet gage steel.

(c) Type 2 clothes dryers shall be equipped or installed with lint controlling means.

(d) Exhaust ducts for Type 2 clothes dryers shall have a clearance of at least 6 inches to combustible material except as provided in 1.4.14.5(e).

(e) Exhaust ducts for Type 2 clothes dryers may be installed with reduced clearances to combustible material provided the combustible material is protected as described in Table 1-8.

(f) When ducts pass through walls, floors or partitions, the space around the duct shall be sealed with noncombustible material.

(g) Multiple installations of Type 2 clothes dryers shall be made in a manner to prevent adverse operation due to back pressures that might be created in the exhaust systems.

1.4.14.6 Multiple Family or Public Use: Clothes dryers installed for multiple family or public use shall be equipped with approved safety shut-off devices.

1.4.15 Incinerators.

1.4.15.1 Clearance:

(a) Listed incinerators shall be installed in accordance with their listing and the manufacturer's instructions, provided that in any case the clearance shall be sufficient to afford ready accessibility for firing, clean-out and necessary servicing.

(b) The clearances to combustible material above a charging door shall be not less than 48 inches. The clearance may be reduced to 24 inches provided the combustible material is protected with sheet metal not less than No. 28 manufacturer's standard gage spaced out 1 inch on noncombustible spacers, or equivalent protection. Such protection shall extend 18 inches beyond all sides of the charging door opening. Listed incinerators designed to retain the flame during loading need not comply with this paragraph.

(c) Unlisted incinerators shall be installed with clearances to combustible material of not less than 36 inches at the sides and top and not less than 48 inches at the front, but in no case shall the clearance above a charging door be less than 48 inches. Unlisted wall mounted incinerators shall be installed on a noncombustible wall communicating directly with a chimney.

(d) Domestic type incinerators may be installed with reduced clearances to combustible material in rooms, provided the combustible material is protected as described in Table 1-8. In confined spaces, such as alcoves, clearances shall not be so reduced.

(e) When a domestic type incinerator that is refractory lined or insulated with heat insulating material is encased in common brick not less than 4 inches in thickness, the clearances may be reduced to 6 inches at the sides and rear, and the clearance at the top may be reduced to 24 inches provided that the construction using combustible material above the charging door and within 48 inches is protected with No. 28 manufacturer's standard gage sheet metal spaced out 1 inch, or equivalent protection.

1.4.15.2 Mounting:

(a) Listed incinerators specifically listed for installation on combustible floors may be so installed.

(b) Unlisted incinerators, except as provided in 1.4.15.2(c) and (d), shall be mounted 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 inches beyond the incinerator base on all sides, except at the front or side where ashes are removed where it shall extend not less than 18 inches beyond the incinerator.

(c) Unlisted incinerators may be mounted on floors other than as specified in 1.4.15.2(b), provided the incinerator is so arranged that flame or hot gases do not come in contact with its base and, further, provided the floor under the incinerator is protected with hollow masonry not less than 4 inches thickness, covered with sheet metal of not less than No. 24 manufacturer's standard gage. Such masonry course shall be laid with ends unsealed and joints matched in such a way as to provide a free circulation of air from side to side through the masonry. The floor for 18 inches beyond the front of the incinerator or side where ashes are removed and 12 inches beyond all other sides of the incinerator shall be protected with not less than ¼-inch asbestos millboard covered with sheet metal of not less than No. 24 manufacturer's standard gage or with protection equivalent thereto.

(d) Unlisted incinerators which are set on legs that provide not less than 4 inches open space under the base of the appliance may be mounted on floors other than as specified in paragraph 1.4.15.2(b), provided the appliance is such that flame or hot gases do not come in contact with its base and, further, provided the floor under the appliance is protected with asbestos millboard not less than ¼ inch thick covered with sheet metal of not less than No. 24 manufacturer's standard gage. The above specified floor protection shall extend not less than 18 inches beyond the front of the incinerator or side where ashes are removed and 12 inches beyond all other sides of the incinerator.

1.4.15.3 Draft Hood Prohibited: Draft hoods shall not be installed in the vent connector of an incinerator.

1.4.15.4 Venting: Incinerators shall be vented in accordance with 1.5.3, 1.5.6, 1.5.7 and 1.5.8.

1.4.16 Refrigerators.

1.4.16.1 Clearance: Refrigerators shall be provided with adequate clearances for ventilation at the top and back. They shall be installed in accordance with the manufacturer's instructions. If such instructions are not available, at least 2 inches shall be provided between the back of the refrigerator and the wall and at least 12 inches above the top.

1.4.16.2 Venting or Ventilating Kits Approved for Use with a Refrigerator: If an accessory kit is used for conveying air for burner combustion or unit cooling to the refrigerator from areas outside the room in which it is located, or for conveying combustion products diluted with air containing waste heat from the refrigerator to areas outside the room in which it is located,

the kit shall be installed in accordance with the refrigerator manufacturer's instructions.

1.4.17 Hot Plates and Laundry Stoves.

(a) Listed domestic hot plates and laundry stoves installed on combustible surfaces shall be set on their own legs or bases. They shall be installed with minimum horizontal clearances of 6 inches from combustible material.

(b) Unlisted domestic hot plates and laundry stoves shall be installed with horizontal clearances to combustible material of not less than 12 inches. Combustible surfaces under unlisted domestic hot plates and laundry stoves shall be protected in an approved manner.[1]

(c) The vertical distance between tops of all domestic hot plates and laundry stoves and combustible material shall be at least 30 inches.

1.4.18 Floor-Mounted Commercial Cooking Equipment.

1.4.18.1 Clearance for Listed Appliances: Listed floor-mounted commercial cooking appliances, such as hotel and restaurant ranges, deep fat fryers, unit broilers, gas-fired kettles, steam cookers, steam generators and commercial baking and roasting ovens, shall be installed at least 6 inches from combustible material except that at least 2 inches clearance shall be maintained between the flue box or draft hood and combustible material. Floor-mounted commercial cooking appliances listed for installation at lesser clearances may be installed in accordance with their listing and the manufacturer's instructions. Appliances designed and marked "For use only in fire-resistive locations" shall not be installed elsewhere.

1.4.18.2 Clearance for Unlisted Appliances:

(a) Unlisted floor-mounted commercial cooking appliances, except as provided in 1.4.18.2(b) and (c), shall be installed to provide a clearance to combustible material of not less than 18 inches at the sides and rear of the appliance and from the vent connector and not less than 48 inches above cooking tops and at the front of the appliance.

(b) Unlisted floor-mounted commercial cooking appliances may be installed in rooms, but not in confined spaces such as alcoves, with reduced clearances to combustible material, provided the combustible material or the appliance is protected as described in Table 1-8.

(c) Unlisted floor-mounted commercial cooking appliances may be installed in rooms, but not in confined spaces such as alcoves, with reduced clearance of 6 inches to combustible material, provided the wall or combustible material is protected by sheet metal of not less than No. 26 manufacturer's standard gage, fastened with noncombustible spacers that are spaced at not less than 2-foot vertical and horizontal intervals to provide a clearance of 1½-inchs from such wall or material. Such protection shall extend at least 12 inches beyond the back, side, top or any other part of the appliance and the space between the sheet metal and wall or combustible material shall be open on both sides and top and bottom to permit circulation of air.

1.4.18.3 Mounting On Combustible Floor:

(a) Listed floor-mounted commercial cooking appliances that are

[1]For details of protection refer to the Code for the Installation of Heat Producing Appliances, available from the American Insurance Association, 85 John Street, New York, New York 10038.

listed specifically for installation on floors constructed of combustible material may be mounted on combustible floors in accordance with their listing.

(b) Listed floor-mounted commercial cooking appliances that are designed and marked "For use only in fire-resistive locations" shall be mounted on floors of fire-resistive construction with noncombustible flooring and 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 inches beyond the appliance on all sides.

(c) Floor-mounted commercial cooking appliances which are not listed for mounting on a combustible floor shall be mounted in accordance with 1.4.18.3(b) or be mounted in accordance with one of the following:

1. When the appliance is set on legs which provide not less than 18 inches open space under the base of the appliance, or where it has no burners and no portion of any oven or broiler within 18 inches of the floor, it may be mounted on a combustible floor without special floor protection, provided there is at least one sheet metal baffle between the burner and the floor.

2. When the appliance is set on legs which provide not less than 8 inches open space under the base of the appliance, it may be mounted on combustible floors provided the floor under the appliance is protected with not less than $\frac{1}{4}$-inch asbestos millboard covered with sheet metal of not less than No. 24 manufacturer's standard gage. The above specified floor protection shall extend not less than 6 inches beyond the appliance on all sides.

3. When the appliance is set on legs which provide not less than 4 inches under the base of the appliance, it may be mounted on combustible floors, provided the floor under the appliance is protected with hollow masonry not less than 4 inches in thickness covered with sheet metal of not less than No. 24 manufacturer's standard gage. Such masonry courses shall be laid with ends unsealed and joints matched in such a way as to provide for free circulation of air through the masonry.

4. When the appliance does not have legs at least 4 inches high, it may be mounted on combustible floors, provided the floor under the appliance is protected by two courses of 4-inch hollow clay tile, or equivalent, with courses laid at right angles and with ends unsealed and joints matched in such a way as to provide for free circulation of air through such masonry courses and covered with steel plate not less than $\frac{3}{16}$ inch in thickness.

1.4.18.4 Combustible Material Adjacent to Cooking Top: Any portion of combustible material adjacent to a cooking top section of a hotel or restaurant range, even though listed for close-to-wall installation, which is not shielded from the wall by a high shelf, warming closet, etc., shall be protected as specified in 1.4.18.2 for a distance of at least 2 feet above the surface of the cooking top.

1.4.18.5 Install Level: Floor-mounted commercial cooking appliances shall be installed level on a firm foundation.

1.4.18.6 Ventilation: Adequate means shall be provided to properly ventilate the space in which commercial cooking equipment is installed to permit proper combustion of the gas. When exhaust fans are used for

ventilation, special precautions may be necessary to avoid interference with the operation of the equipment.

1.4.19 Commercial Counter Appliances.

1.4.19.1 Vertical Clearance: A vertical distance of not less than 48 inches shall be provided between the top of all commercial hot plates and griddles and combustible material.

1.4.19.2 Clearance for Listed Appliances: Listed commercial counter appliances such as hot plates and griddles, food and dish warmers, and coffee brewers and urns, when installed on combustible surfaces, shall be set on their own bases or legs and shall be installed with a minimum horizontal clearance of 6 inches from combustible material, except that at least a 2-inch clearance shall be maintained between the flue box or draft hood and combustible material. Commercial counter appliances listed for installation at lesser clearances may be installed in accordance with their listing and the manufacturer's instructions.

1.4.19.3 Clearance for Unlisted Appliances: Unlisted commercial hot plates and griddles shall be installed with a horizontal clearance from combustible material of not less than 18 inches. Unlisted gas commercial counter appliances such as coffee brewers and urns, waffle bakers and hot water immersion sterilizers shall be installed with a horizontal clearance from combustible material of not less than 12 inches. Gas commercial counter appliances may be installed with reduced clearances to combustible material provided the combustible material is protected as described in Table 1-8. Unlisted food and dish warmers shall be installed with a horizontal clearance from combustible material of not less than 6 inches.

1.4.19.4 Mounting of Unlisted Appliances: Unlisted commercial counter appliances shall not be set on combustible material unless they have legs which provide not less than 4 inches of open space below the burners, and the combustible surface is protected with asbestos millboard at least ¼ inch thick covered with sheet metal of not less than No. 28 manufacturer's standard gage, or with equivalent protection.

1.4.20 Air Conditioning Appliances.

1.4.20.1 Independent Gas Piping: Gas piping serving a heating appliance may also serve a cooling appliance when heating and cooling appliances cannot be operated simultaneously. (*See 1.2.4.*)

1.4.20.2 Connection of Gas Engine-Powered Air Conditioners: To protect against the effects of normal vibration in service, gas engines shall not be rigidly connected to the gas supply piping.

1.4.20.3 Manual Main Shutoff Valves: When a complete shutoff type safety shutoff device is not utilized, a manual main shutoff valve shall be provided ahead of all controls except the manual pilot gas valve.

When a complete shutoff type safety shutoff device is utilized, a manual main shutoff valve shall be provided ahead of all controls.

A union connection shall be provided downstream from the manual main shutoff valve to permit removal of the controls.

1.4.20.4 Clearances for Indoor Installation:

(a) Listed air conditioning appliances installed in rooms which are large in comparison with the size of the appliance, shall be installed with clearances not less than specified in Line I of Table 1-7 except as provided in 1.4.20.4(a)1, 2 and 3.

1. Air conditioning appliances listed for installation at lesser clearances than specified in Table 1-7 may be installed in accordance with their listing and the manufacturer's instructions.

2. Air conditioning appliances listed for installation at greater clearances than specified in Table 1-7 shall be installed in accordance with their listing and the manufacturer's instructions unless protected as specified in 1.4.20.4(a)3.

3. Air conditioning appliances installed in unconfined spaces may be installed with reduced clearances to combustible material provided the combustible material or the appliance is protected as described in Table 1-8.

(b) Air conditioning appliances installed in confined spaces shall be installed in accordance with their listing and, when such units are installed in spaces such as alcoves and closets, they shall be specifically listed for such installation. The installation clearances for air conditioning appliances in confined spaces shall not be reduced by the protection methods described in Table 1-8.

(c) Unlisted air conditioning appliances shall be installed with clearances from combustible material of not less than 18 inches above the appliance and at sides, front and rear, and 9 inches from projecting flue box or draft hood.

(d) When the plenum for an air conditioner which includes provisions for heating air is adjacent to combustible material, the clearance shall be measured to the surface of the plaster or other noncombustible finish when the clearance specified is 2 inches or less.

(e) The clearance to these appliances shall not interfere with combustion air, draft hood clearance and relief, and accessibility for servicing. (*See 1.3.2.4, 1.3.3.1 and 1.3.4.*)

1.4.20.5 Erection and Mounting: An air conditioning appliance shall be erected in accordance with the manufacturer's instructions. Unless the appliance is listed for installation on a combustible surface such as a floor or roof, or unless the surface is protected in an approved manner,[1] it shall be installed on a surface of fire-resistive construction with noncombustible material and surface finish and with no combustible material against the underside thereof.

1.4.20.6 Connection of Flow and Return Piping: The method of connecting the flow and return piping on air conditioning appliances which provide heated or chilled fluid shall be in accordance with the manufacturer's recommendations to facilitate a positive, balanced and unobstructed flow through the system.

1.4.20.7 Cooling Towers: A cooling tower used in conjunction with an air conditioning appliance shall be installed in accordance with the manufacturer's installation instructions. The cooling tower shall be provided

[1]For details of protection see the *Code for the Installation of Heat Producing Appliances*, available from the American Insurance Association, 85 John Street, New York, New York 10038.

with a direct connection to a water supply through an individual control valve. A means by which the tower may be flushed or drained shall be provided.

1.4.20.8 Plenum Chambers and Air Ducts: A plenum chamber supplied as a part of an air conditioning appliance shall be installed in accordance with the manufacturer's instructions. When a plenum chamber is not supplied with the appliance, any fabrication and installation instructions provided by the manufacturer shall be followed. The method of connecting supply and return ducts shall facilitate proper circulation of air.[1]

When the air conditioner is installed within a confined space, the air circulated by the appliance shall be handled by ducts which are sealed to the casing of the appliance and which separate the circulating air from the combustion and ventilation air.

1.4.20.9 Refrigeration Coils: (*See 1.4.7.10 and 1.4.7.11.*)

1.4.20.10 Switches in Electrical Supply Line: Means for interrupting the electrical supply to the air conditioning appliance and to its associated cooling tower (if supplied and installed in a location remote from the air conditioner) shall be provided within sight of and not over 50 feet from the air conditioner and cooling tower.

1.4.21 Illuminating Appliances.

1.4.21.1 Clearances for Listed Appliances: Listed illuminating appliances shall be installed in accordance with their listing and the manufacturer's instructions.

1.4.21.2 Clearances for Unlisted Appliances:

(a) Enclosed type.

1. Unlisted enclosed illuminating appliances installed outdoors shall be installed with clearances in any direction from combustible material of not less than 12 inches.

2. Unlisted enclosed illuminating appliances installed indoors shall be installed with clearances in any direction from combustible material of not less than 18 inches.

(b) Open-flame type.

1. Unlisted open-flame illuminating appliances installed outdoors shall have clearances from combustible material not less than that specified in Table 1-9. The distance from ground level to the base of the burner shall be at least 7 feet when installed within two feet of walkways.

Lesser clearances may be used when acceptable to the authority having jurisdiction.

2. Unlisted open-flame illuminating appliances installed outdoors shall be equipped with a limiting orifice or other limiting devices which will maintain a flame height consistent with the clearance from combustible material, as given in Table 1-9.

3. Appliances designed for flame heights in excess of 30 inches may be installed if acceptable to the authority having jurisdiction. Such ap-

[1]Reference may be made to the *Standard for the Installation of Air Conditioning and Ventilating Systems*, NFPA No. 90A — 1974, *Standard for the Installation of Residence Type Warm Air Heating and Air Conditioning Systems*, NFPA No. 90B — 1973 available from the National Fire Protection Association, 470 Atlantic Avenue, Boston, Mass. 02210.

pliances shall be equipped with a safety shutoff device or automatic ignition.

4. Unlisted open-flame illuminating appliances installed indoors shall have clearances from combustible material acceptable to the authority having jurisdiction.

Table 1-9

Flame Height Above Burner Head, Inches	Minimum Clearance from Combustible Material, Feet*	
	Horizontal	Vertical
12	2	6
18	3	8
24	3	10
30	4	12

*Measured from the nearest portion of the burner head.

1.4.21.3 Mounting on Buildings: Illuminating appliances designed for wall or ceiling mounting shall be securely attached to substantial structures in such a manner that they are not dependent on the gas piping for support.

1.4.21.4 Mounting on Posts: Illuminating appliances designed for post mounting shall be securely and rigidly attached to a post.

Posts shall be rigidly mounted. The strength and rigidity of posts greater than 3 feet in height shall be at least equivalent to that of a 2½-inch diameter post constructed of 0.064 inch thick (No. 14 gage) steel or a one-inch schedule 40 steel pipe. Posts 3 feet or less in height shall not be smaller than a ¾-inch schedule 40 steel pipe.

Drain openings should be provided near the base of posts when there is a possibility of water collecting inside them.

1.4.21.5 Manual Shutoff Valves: An approved manual shutoff valve shall be installed at or near the base of, or readily accessible to, unlisted open-flame illuminating appliances.

1.4.21.6 Gas Pressure Regulators: When a gas appliance pressure regulator is not supplied with an illuminating appliance and the service line is not equipped with a service pressure regulator, it is recommended that an appliance pressure regulator be installed in the line to the illuminating appliance. For multiple installations, one regulator of adequate capacity may be used to serve a number of illuminating appliances.

1.4.22 Vented Decorative Appliances.

1.4.22.1 Installation:

(a) Listed vented decorative appliances shall be installed in accordance with their listing and the manufacturer's instructions. They may be installed in or attached to combustible material when so listed.

(b) Unlisted vented decorative appliances shall not be installed in or attached to combustible material. They shall have clearance at sides and

rear of not less than 18 inches; except that appliances which make use of metal, asbestos or ceramic material to direct radiation to the front of the appliance shall have a clearance of 36 inches in front, and if constructed with a double back of metal or ceramic may be installed with a clearance of 18 inches at sides and 12 inches at rear. Combustible floors under unlisted vented decorative appliances shall be protected in an approved manner.[1]

(c) Panels, grilles and access doors which must be removed for normal servicing operations shall not be attached to the building.

1.4.22.2 Manual Main Shutoff Valve: A manual main shutoff valve shall be installed ahead of all controls including the pilot gas valve.

1.4.22.3 Combustion and Circulating Air: Adequate combustion and circulating air shall be provided (*see 1.3.4*).

1.4.23 Stationary Gas Engines. The installation of gas engines shall conform with the *Standard for the Installation and Use of Stationary, Combustion Engines and Gas Turbines*,[2] NFPA No. 37-1970.[2]

1.5 VENTING OF APPLIANCES

1.5.1 Specifications for Venting.

1.5.1.1 Appliances Required to be Vented: Appliances of the following types shall be provided with venting systems or other means for removing the flue gases to the outside atmosphere.

(a) Steam and hot water boilers, warm air furnaces, floor furnaces, and wall furnaces.

(b) Unit heaters and duct furnaces.

(c) Incinerators.

(d) Water heaters with inputs over 5,000 Btu per hour, except as provided under 1.5.1.2(f) and (g).

(e) Built-in domestic cooking units listed and marked only as vented units.

(f) Room heaters listed only for vented use. Room heaters listed as "vented and unvented" units may be installed unvented, subject to approval of the authority having jurisdiction. (*Also see 1.4.6.1 and 1.4.6.2.*)

(g) Type 2 clothes dryers (*see 1.4.14.2 and 1.4.14.5*).

(h) Appliances equipped with gas conversion burners.

(i) Other listed appliances which have draft hoods supplied by the appliance manufacturer.

(j) Unlisted appliances, except as provided under 1.5.1.2(1).

1.5.1.2 Appliances Not Required to be Vented:

(a) Listed ranges.

(b) Built-in domestic cooking units listed and marked as unvented units.

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[1]For details of protection, refer to mounting provisions for unlisted room heaters in the *Code for the Installation of Heat Producing Appliances*, available from the American Insurance Association, 85 John Street, New York, New York 10038.

[2]Available from the National Fire Protection Association, 470 Atlantic Avenue, Boston, Mass. 02210.

(c) Listed hot plates and listed laundry stoves.

(d) Listed Type 1 clothes dryers (*see 1.4.14.2*).

(e)* Listed water heaters with inputs not over 5,000 Btu per hour.

(f)* Automatically controlled instantaneous water heaters which supply water to a single faucet which is attached to and made a part of the appliance (*see 1.4.5.1*).

(g)* A single listed booster type (automatic instantaneous)water heater when designed and used solely for the sanitizing rinse requirements of a National Sanitation Foundation Class 1, 2 or 3 dishwashing machine, provided that the input is limited to 50,000 Btu per hour, the storage capacity is limited to 12.5 gallons, and the heater is installed, with the draft hood in place and unaltered, in a commercial kitchen having a mechanical exhaust system. When installed in this manner, the draft hood outlet shall be not less than 36 inches vertically and 6 inches horizontally from any surface other than the heater.

(h)* Listed refrigerators.

(i)* Counter appliances.

(j)* Room heaters listed for unvented use (*see 1.4.6.1 and 1.4.6.2*).

(k)* Other appliances listed for unvented use and not provided with flue collars.

(l)* Specialized equipment of limited input such as laboratory burners or gas lights.

When any or all of the appliances starred above (*) are installed so that the aggregate input rating exceeds 30 Btu per hour per cubic foot of room or space in which they are installed, one or more of them shall be provided with a venting system or other approved means for removing the vent gases to the outside atmosphere so that the aggregate input rating of the remaining unvented appliance does not exceed the 30 Btu per hour per cubic foot figure. When the room or space in which they are installed is directly connected to another room or space by a doorway, archway, or other opening of comparable size, which cannot be closed, the volume of such adjacent room or space may be included in the calculations.

1.5.2 Minimum Safe Performance.

1.5.2.1 (a) Venting systems shall be engineered and constructed so as to develop a positive flow adequate to remove flue gases to the outside atmosphere.

(b) When venting systems serve appliances requiring draft for proper operation, they shall be designed and installed to develop adequate draft so as to satisfy the draft requirements of the appliance in accordance with the manufacturer's instructions.

1.5.2.2 Design and Construction: Gas appliances required to be vented shall be connected to a venting system, except as provided in 1.5.9. The venting system shall be designed and constructed in accordance with one of the following methods:

(a) Natural draft provisions of 1.5.3 through 1.5.8.

(b) Natural draft systems designed in accordance with approved engineering methods and installed in accordance with the plans and specifications of that design.

(c) Special venting arrangements of 1.5.9.

1.5.2.3 No portion of a venting system shall extend into or pass through any circulating air duct or plenum.

1.5.3 Type of Venting System to be Used.

1.5.3.1 Chimneys shall be used for venting the following types of appliances:
(a) Incinerators, except as provided in 1.5.3.4(b) and 1.5.9.2(a).
(b) Appliances which may be converted to the use of solid or liquid fuels.

1.5.3.2 Listed gas appliances equipped with draft hoods and other gas appliances listed for use with Type B gas vents may be connected to Type B gas vents except as provided in 1.5.3.1, 1.5.3.3 and 1.5.9.1.

1.5.3.3 Type B-W gas vents shall be used with listed vented wall furnaces when the appliance is so listed.

1.5.3.4 Single-wall metal pipe may be used in accordance with 1.5.7 for venting the following:
(a) Gas appliances except as provided in 1.5.3.1 and 1.5.3.3.
(b) Incinerators used outdoors such as in open sheds, breezeways, or carports as provided in 1.5.7.3(c).
1.5.3.5 Type L venting systems may be used for venting appliances listed for use with Type L venting systems.

1.5.4 Outside Gas Vents and Chimneys.

1.5.4.1 Materials: Outside uninsulated single-wall pipe is not recommended for use in cold climates for venting appliances equipped with draft hoods, since temperature differentials may cause condensation corrosion in such pipe.

1.5.4.2 Condensate Drain: When local experience indicates that condensate may be a problem, provisions shall be made to drain off the condensate.

1.5.5 Installation of Gas Vents and Venting Systems.

1.5.5.1 Application:
(a) Type B and Type B-W gas vents shall be installed in accordance with their listings and the manufacturer's instructions.
(b) Type B and Type B-W gas vents may be used for single or multiple story installation if so listed.
(c) A Type B-W gas vent shall have a listed capacity not less than that of the listed vented wall furnace to which it is connected.
(d) A Type L venting system shall be installed in accordance with its listing and the manufacturer's instructions.
(e) Vents and venting systems passing through roofs shall extend through the roof flashing, roof jack or roof thimble.

1.5.5.2 Gas Vent Termination: Type B and Type B-W gas vents and Type L venting systems shall terminate in accordance with the following as appropriate:
(a) Type B and Type B-W gas vents and Type L venting systems employing a listed cap or a listed roof assembly shall terminate in accordance

with the terms of their respective listings and the manufacturer's instructions.

(b) Type B and Type B-W gas vents and Type L venting systems terminating other than in accordance with 1.5.5.2(a) shall extend at least 2 feet above the highest point where they pass through a roof of the building and at least 2 feet higher than any portion of a building within a horizontal distance of 10 feet. (*See Figure 1-13.*)

(c) A gas vent and a venting system may be connected to a chimney terminating in accordance with 1.5.6.2.

(d) A Type B gas vent shall terminate not less than 5 feet in vertical height above the highest connected appliance draft hood or flue collar.

(e) A Type B-W gas vent serving a vented wall furnace shall terminate not less than 12 feet above the bottom of the furnace.

(f) Vents, except those of listed direct vent appliances (1.5.9.1) and mechanical draft systems (1.5.9.3) extending through an outside wall, shall not terminate adjacent to the wall or below eaves or parapets.

1.5.5.3 Size of Gas Vents:

(a) Vents shall be sized and constructed in accordance with approved engineering methods. Reference may be made to Tables 1-D1 through 1-D6 in Appendix 1-D, depending on the construction of the vent. As an alternate method for sizing an individual vent for a single appliance only, the effective area of the vent connector and vent shall be not less than the area of the appliance draft hood outlet. As an alternate method for sizing a vent connected to more than one appliance, the effective area of the vent shall be not less than the area of the largest vent connector plus 50 percent of the areas of additional draft hood outlets.

(b) A cap or roof assembly shall have a venting capacity not less than that of the gas vent to which it is attached.

(c) The sizing required in 1.5.5.3(a) shall not apply to 1.5.9. However, all installations made with direct vent appliances and mechanical draft systems shall comply with 1.5.2.1 and 1.5.9.

1.5.5.4 Gas Vents Serving Appliances on More than One Floor: A single or common Type B gas vent is permissible in multistory installations to vent gas appliances located on more than one floor level provided the venting system is engineered and installed in accordance with an approved engineering method.

1.5.5.5 Support of Gas Vents: All portions of gas vents shall be adequately supported for the design and weight of the materials employed. Listed gas vents shall be supported and spaced in accordance with their listings and the manufacturer's instructions.

1.5.5.6 Marking: In those localities where solid and liquid fuels are used extensively, gas vents shall be plainly and permanently identified by a label reading:

"This gas vent is for appliances which burn gas only. Do not connect to incinerators or solid or liquid fuel burning appliances."

This label shall be attached to the wall or ceiling at a point near where the gas vent connector enters the wall, ceiling or chimney.

The authority having jurisdiction shall determine whether their area constitutes such a locality.

Figure 1-13.

Typical Termination Locations for Gas Vents and Chimneys.

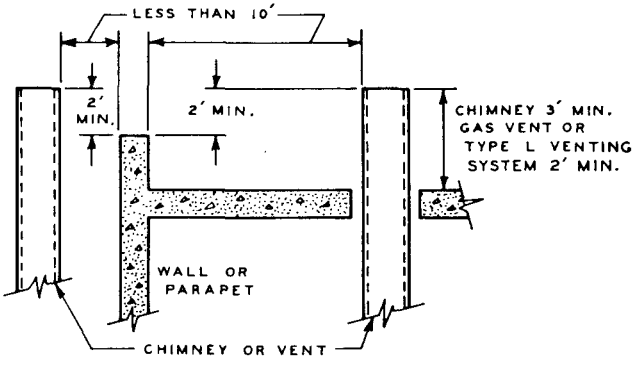

Fig. 1-13(a)

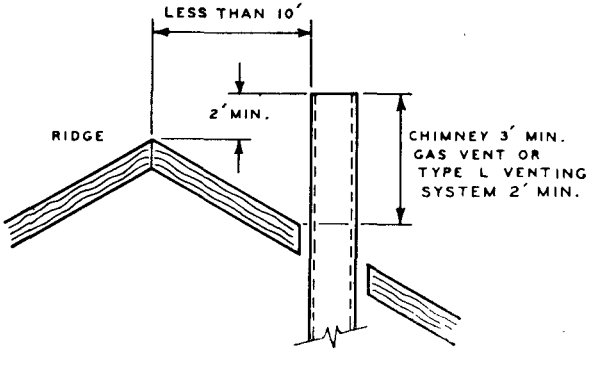

Fig. 1-13 (b)

A. Termination Less Than 10 Feet From Ridge, Wall or Parapet

Fig. 1-13. (continued)

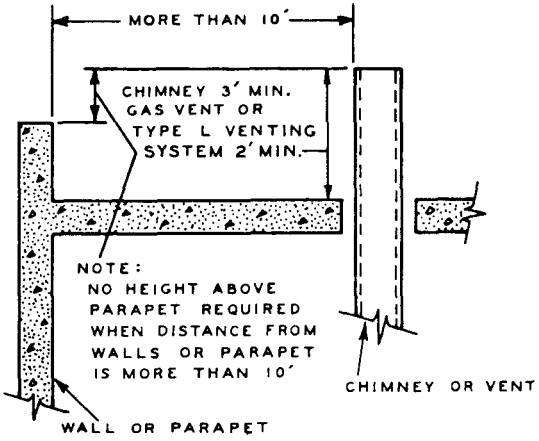

Fig. 1-13(c)

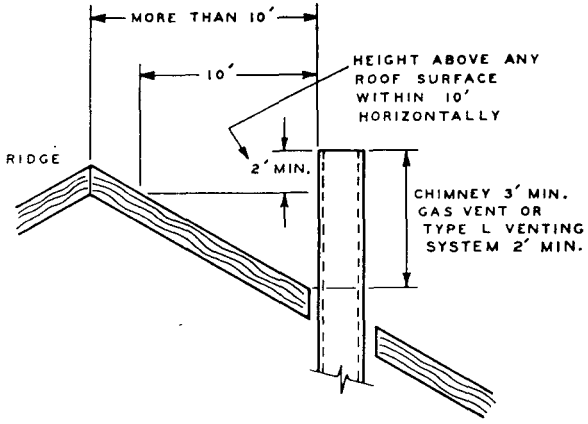

Fig. 1-13(d)

B. Termination More Than 10 Feet From Ridge, Wall or Parapet

1.5.6 Masonry, Metal and Factory-Built Chimneys.

1.5.6.1 Listing or Construction:

(a) Factory-built chimneys shall be installed in accordance with their listing and the manufacturer's instructions.

(b) Masonry or metal chimneys shall be built and installed in accordance with nationally recognized building codes or standards.[1]

1.5.6.2 Termination:

(a) Chimneys shall extend at least 3 feet above the highest point where they pass through a roof of a building and at least 2 feet higher than any portion of a building within a horizontal distance of 10 feet. (*See Figure 1-13.*)

(b) Chimneys shall extend at least 5 feet above the highest connected appliance draft hood outlet or flue collar.

1.5.6.3 Size of Chimneys:

(a) The effective area of chimney venting systems shall be in accordance with approved engineering methods. Reference may be made to Tables 1-D3 and 1-D6 in Appendix 1-D. As an alternate method of sizing individual chimney venting systems for a single appliance only, the effective area of the chimney connector and the chimney flue shall be not less than the area of the appliance draft hood outlet. As an alternate method for sizing a chimney connected to more than one appliance, the effective area of the chimney flue shall be not less than the area of the largest vent connector plus 50 percent of the area of additional draft hood outlets.

(b) When an incinerator is vented by a chimney serving other gas appliances, the gas input to the incinerator need not be included in calculating chimney size provided the chimney flue diameter is not less than one inch larger in equivalent diameter than the diameter of the incinerator flue outlet.

(c) The sizing provisions of 1.5.6.3(a) shall not apply to 1.5.9. However, all mechanical draft systems shall comply with 1.5.2.1 and 1.5.9.3.

1.5.6.4 Inspection of Chimneys:

(a) Before connecting a vent connector to a chimney, the chimney passageway shall be examined to ascertain that it is clear and free of obstructions.

(b) Cleanouts shall be constructed so that they will remain tightly closed when not in use. Tee fittings used as cleanouts or condensate drains shall have tight-fitting caps to prevent entrance of air into the chimney at those points.

(c) When an existing masonry chimney is unlined and local experience indicates that vent gas condensate may be a problem, an approved liner or another vent shall be installed. When inspection reveals that an existing chimney is not safe for the intended application, it shall be rebuilt to conform to nationally recognized standards, relined with a suitable liner, or

[1]Among such nationally recognized codes and standards are Article X of the *National Building Code* of The American Insurance Association, 85 John Street, New York, New York 10038, or American National *Standard for Chimneys, Fireplaces and Venting Systems,* A52.1 — 1971 (NFPA No. 211 — 1972), available from the American National Standards Institute, Inc., 1430 Broadway, New York, New York 10018, or the National Fire Protection Association, 470 Atlantic Avenue, Boston, Mass. 02210.

replaced with a gas vent or chimney suitable for the appliances to be attached.

1.5.6.5 Chimney Serving Appliances Burning Other Fuels: An automatically controlled gas appliance connected to a chimney, which also serves equipment for the combustion of solid or liquid fuel, shall be equipped with a safety shutoff device. (*Also see 1.5.8.4.*)

1.5.6.6 Support of Chimneys: All portions of chimneys shall be adequately supported for the design and weight of the materials employed. Listed factory-built chimneys shall be supported and spaced in accordance with their listings and the manufacturer's instructions.

1.5.7 Single-Wall Metal Pipe.

1.5.7.1 Construction: Single-wall metal pipe shall be constructed of sheet copper not less than No. 24 B&S gage, galvanized sheet steel not less than No. 20 galvanized sheet gage, or other approved noncombustible corrosion-resistant material.

1.5.7.2 Termination:

(a) Single-wall metal pipe shall not terminate less than 5 feet in vertical height above the highest connected appliance draft hood outlet or flue collar.

(b) Single-wall metal pipe shall extend at least 2 feet above the highest point where it passes through a roof of a building and at least 2 feet higher than any portion of a building within a horizontal distance of 10 feet. (*See Figure 1-13.*)

1.5.7.3 Installation With Appliances Permitted by 1.5.3.4:

(a) Single-wall metal pipe shall be used only for runs directly from the space in which the appliance is located through the roof or exterior wall to the outer air. A pipe passing through a roof shall extend without interruption through roof flashing, roof jack or roof thimble.

(b) Single-wall metal pipe shall not originate in any unoccupied attic or concealed space and shall not pass through any attic, inside wall, concealed space, or through any floor.

(c) Single-wall metal pipe used for venting incinerators shall be exposed and readily examinable for its full length and suitable clearances maintained. (*See Table 1-10.*)

(d) Minimum clearances from single-wall metal pipe to combustible material shall be in accordance with Table 1-10. The clearance from single-wall metal pipe to combustible material may be reduced when the combustible material is protected as specified for vent connectors in Table 1-8.

(e) When a single-wall metal pipe passes through an exterior wall constructed of combustible material, it shall be guarded at the point of passage by a method described in 1.5.8.15.

(f) When a single-wall metal pipe passes through a roof constructed of combustible material, it shall be guarded at the point of passage by a method described in 1.5.8.15 or by a noncombustible, nonventilating thimble not less than 4 inches larger in diameter than the vent pipe and extending not less than 18 inches above and 6 inches below the roof with the annular space open at the bottom and closed only at the top.

1.5.7.4 Size of Single-Wall Metal Pipe:

(a) Single-wall metal pipe shall be sized and constructed in accordance with approved engineering methods. Reference may be made to Tables 1-D2 and 1-D5 in Appendix 1-D. As an alternate method for sizing an individual pipe for a single appliance only, the effective area of the connector and the pipe shall be not less than the area of the appliance draft hood outlet. As an alternate method for sizing a pipe connected to more than one appliance, the effective area of the pipe shall be not less than the area of the largest connector plus 50 percent of the area of additional draft hood outlets.

(b) Any shaped single-wall metal pipe may be used, providing its equivalent effective area is equal to the effective area of the round pipe for which it is substituted and providing the minimum internal dimension of the pipe is not less than 2 inches.

(c) If used, a cap or a roof assembly shall have a venting capacity not less than that of the pipe to which it is attached.

Table 1-10

Clearances for Connectors

Appliance	Minimum Distance from Combustible Material		
	Listed Type B Gas Vent Material	Listed Type L Venting System Material	Connectors of Other than Type B or Type L Material
Listed appliances with draft hoods and appliances listed for use with Type B Gas Vents	as listed	as listed	6 inches
Boilers and furnaces with listed gas conversion burner and with draft hood	6 inches	6 inches	9 inches
Appliances listed for use with Type L venting systems	not permitted	as listed	9 inches
Residential incinerators	not permitted	9 inches	18 inches
Unlisted appliances with draft hood	not permitted	6 inches	9 inches
Appliances other than those above	not permitted	9 inches	18 inches

1.5.7.5 Support of Single-Wall Metal Pipe: All portions of single-wall metal pipe shall be adequately supported for the design and weight of the material employed.

1.5.7.6 Marking: Single-wall metal pipe shall comply with the marking provisions of 1.5.5.6.

1.5.8 Vent Connectors.

1.5.8.1 When Required: Vent connectors shall be used to connect gas appliances to the gas vent, chimney or single-wall metal pipe, except when the gas vent, chimney or single-wall metal pipe is directly connected to the appliance.

1.5.8.2 Materials:

(a) Vent connectors used for gas appliances having draft hoods and for appliances having draft hoods and equipped with listed conversion burners shall be constructed of materials having a resistance to corrosion and heat not less than that of No. 28 galvanized sheet gage steel, No. 26 B&S gage copper or No. 24 B&S gage aluminum, except as provided in 1.5.8.2(b).

(b) Vent connectors serving listed gas appliances with draft hoods and other appliances listed for use with Type B vents may be constructed of Type B gas vent material.

(c) Vent connectors made of Type L venting system material may be used with gas or combination gas-oil fuel-burning residential appliances including residential type incinerators.

(d) Vent connectors used for appliances other than those described in paragraphs 1.5.8.2(a), (b) and (c) shall be constructed of materials having a resistance to corrosion and heat not less than that of No. 24 galvanized sheet gage steel or No. 22 B&S gage copper.

1.5.8.3 Size of Vent Connector:

(a) Vent connectors for appliances with a single draft hood shall be sized and constructed in accordance with approved engineering methods. Reference may be made to Tables 1-D1 through 1-D3 in Appendix 1-D, depending on the construction of the connector. As an alternate method the effective area of the connector shall be not less than the area of the draft hood outlet.

(b) For single appliances having more than one draft hood outlet, the manifold shall be constructed according to the instructions of the appliance manufacturer. If there are no instructions, the manifold shall be constructed in accordance with approved engineering methods. As a second alternate, the effective area of the manifold shall equal the combined areas of the draft hood outlets.

(c) When two or more gas appliances are connected to a common vent or chimney, the effective area of each vent connector shall be in accordance with approved engineering methods. Reference may be made to Tables 1-D4 through 1-D6 in Appendix 1-D. As an alternate method, each vent connector shall have an effective area not less than the area of the draft hood outlet of the appliance to which it is connected.

(d) The vertical rise of each vent connector of a multiple venting system shall be in accordance with approved engineering methods. Reference may be made to Tables 1-D4 through 1-D6 in Appendix 1-D.

(e) When the size of a connector is increased to overcome installation limitations and obtain connector capacity equal to the appliance input, the size increase shall be made at the appliance draft hood outlet.

(f) The effective area of the vent connector, when connected to one or more appliances requiring draft for operation, shall be obtained by the application of approved engineering methods to perform as specified in 1.5.2.1.

1.5.8.4 Two or More Appliances Connected to a Single Vent:

(a) When two or more vent connectors enter a common gas vent, chimney, or single-wall metal pipe, the smaller connector should enter at the highest level consistent with the available headroom or clearance to combustible material.

(b) Two or more gas appliances may be vented through a common vent connector or manifold. The common vent connector or manifold shall be located at the highest level consistent with available headroom or clearance to combustible material, and shall be sized in accordance with approved engineering methods. Reference may be made to Tables 1-D4 through 1-D6 in Appendix 1-D. As an alternate method, the area of the common vent connector or manifold and all junction fittings shall be not less than the combined areas of the draft hood outlets or of the individual vent connectors.

(c) A gas appliance and an appliance burning another fuel may be connected to one chimney through separate openings or may be connected through a single opening if joined by a suitable fitting located as close as practical to the chimney. If two or more openings are provided into one chimney, they should be at different levels. If the gas appliance is automatically controlled, it shall be equipped with a safety shutoff device.

1.5.8.5 Clearance: Minimum clearances from vent connectors to combustible material shall be in accordance with Table 1-10. The clearances from vent connectors to combustible materials may be reduced when the combustible material is protected as specified for vent connectors in Table 1-8.

When vent connectors must pass through walls or partitions of combustible material, a thimble shall be used and installed in accordance with one of the methods outlined in 1.5.8.15.

1.5.8.6 Avoid Unnecessary Bends: The vent connector shall be installed so as to avoid excessive turns or other construction features which create unnecessary resistance to flow or vent gases.

1.5.8.7 Joints: Vent connectors shall be firmly attached to draft hood outlets or flue collars by sheet-metal screws or other approved means.

Vent connectors using listed Type B or Type L gas vent material shall be securely assembled using the method shown in the manufacturer's instructions.

Joints of other than listed gas vent material shall be securely fastened by sheet-metal screws or other approved methods.

1.5.8.8 Pitch: Vent connectors shall be installed without any downward pitch from the appliance and without any dips or sags.

Vent connectors attached directly to side outlet draft hoods, such as on floor furnaces, shall be pitched upward from the appliance at least ¼ inch per foot.

1.5.8.9 Length: The horizontal run of the vent connector shall be as short and direct as possible. The maximum length of a single-wall vent connector venting one appliance shall not exceed 75 percent of the height of the gas vent. The maximum length of a Type B double-wall vent connector, venting one appliance, shall not exceed 100 percent of the height of the gas vent. When greater lengths of connectors are necessary, they shall be constructed in accordance with approved engineering methods.

Combined venting systems shall be in accordance with Tables 1-D4, 1-D5, or 1-D6 of Appendix 1-D.

1.5.8.10 Support: Vent connectors shall be adequately supported for the design and weight of the materials employed to maintain proper clearances, to prevent physical damage, and to prevent separation of the joints.

1.5.8.11 Location: When the vent connector used for an appliance having a draft hood must be located in or pass through a crawl space or other area difficult of access which may be cold, that portion of the vent connector shall be of listed double-wall Type B gas vent material or material having equivalent insulation qualities. Single-wall metal pipe used as a vent connector shall not pass through any floor or ceiling.

1.5.8.12 Chimney Connection: In entering a passageway in a masonry or metal chimney, the vent connector shall be installed above the extreme bottom to avoid stoppage. Means shall be employed which will prevent the vent connector from entering so far as to restrict the space between its end and the opposite wall of the chimney. A thimble or slip joint may be used to facilitate removal of the vent connector. The vent connector shall be firmly attached to or inserted into the thimble or slip joint to prevent the vent connector from falling out.

1.5.8.13 Fireplace: A vent connector shall not be connected to a chimney flue serving a fireplace unless the fireplace opening is permanently sealed.

1.5.8.14 Dampers: Manually operated dampers shall not be placed in the vent connectors from gas appliances except that manually operated dampers may be installed in the vent connector of listed gas incinerators when recommended by the manufacturer. Such a damper or draft regulator shall be installed in accordance with the instructions accompanying the incinerator. Fixed baffles, such as baffles ahead of draft hoods, are not classified as dampers.

1.5.8.15 Use of Thimbles:

(a) Vent connectors made of single-wall metal pipe shall not pass through any combustible walls unless they are guarded at the point of passage by ventilated metal thimbles not smaller than the following:

1. For listed gas appliances equipped with draft hoods and gas appliances listed for use with Type B gas vents, except incinerators — 4 inches larger in diameter than the vent connector, unless there is a run of not less than 6 feet of vent connector in the open, between the draft hood outlet and the thimble, in which case the thimble may be 2 inches larger in diameter than the vent connector.
2. For unlisted gas appliances having draft hoods — 6 inches larger in diameter than the vent connector.
3. For incinerators and all other appliances — 12 inches larger in diameter than the vent connector.

(b) In lieu of thimble protection, all combustible material in the wall shall be cut away from the vent connector a sufficient distance to provide the specified clearance from such vent connector to combustible material. Any material used to close up such opening shall be noncombustible.

1.5.9 Special Venting Arrangements.

1.5.9.1 Appliances With Direct Vent Systems:

(a) The provisions of draft hoods as shown in 1.3 and 1.5.3 through 1.5.8, inclusive, do not apply to listed appliances having direct vent systems constructed and installed so that all air for combustion is derived from the outside atmosphere and all flue gases are discharged to the outside atmosphere. Such appliances, having integral venting, shall be considered as being properly vented when they are installed in accordance with their listing, the manufacturer's instructions and 1.5.9.1(b).

(b) Vent terminals of direct vent appliances shall be located not less than 9 inches from any opening through which combustion products could enter the building. A direct vent appliance may be installed in a building opening, such as a window. The bottom of the vent terminal and the air intake shall be located at least 12 inches above grade.

1.5.9.2 Appliances With Integral Vents:

(a) Appliances incorporating integral venting means shall be considered properly vented when installed in accordance with their listings and the manufacturer's instructions.

(b) Vent terminals of appliances using natural draft venting shall be located not less than 9 inches from any opening through which combustion products could enter the building. Vent terminals of appliances using forced draft venting shall be located not less than 12 inches from any opening through which combustion products could enter the building.

1.5.9.3 Mechanical Draft Systems:

(a) Appliances, except incinerators, requiring venting may also be vented by means of mechanical draft systems of either forced or induced draft design.

(b) Forced draft systems and all portions of induced draft systems under positive pressure during operation shall be designed and installed so as to be gastight or as to prevent leakage of combustion products into a building.

(c) Vent connectors serving gas appliances vented by natural draft shall not be connected into any portion of a mechanical draft system operating under positive pressure.

(d) When a mechanical draft system is employed, provision shall be made to prevent the flow of gas to the main burners when the draft system is not performing so as to satisfy the operating requirements of the appliance for safe performance.

(e) The exit terminals of mechanical draft systems shall be located not less than 12 inches from any opening through which combustion products could enter the building nor less than 2 feet from an adjacent building, and not less than 7 feet above grade when located adjacent to public walkways.

1.5.9.4 Ventilating Hoods and Exhaust Systems:[1]

[1]Information on the construction and installation of ventilating hoods may be obtained from the *Standard for the Installation of Equipment for the Removal of Smoke and Grease-Laden Vapors from Commercial Cooking Equipment*, NFPA No. 96-1973, available from the National Fire Protection Association, 470 Atlantic Avenue, Boston, Mass. 02210.

(a) Ventilating hoods and exhaust systems may be used to vent gas-burning appliances installed in commercial applications.

(b) When automatically operated appliances, such as water heaters, are vented through natural draft ventilating hoods, dampers shall not be installed in the ventilating system. When the ventilating hood or exhaust system is equipped with power means of exhaust, the appliance control system shall be interlocked so as to permit appliance operation only when the power means of exhaust is in operation, except as provided in 1.5.1.2(g).

1.6 PROCEDURES TO BE FOLLOWED TO PLACE AN APPLIANCE IN OPERATION

1.6.1 Adjusting The Burner Input.

1.6.1.1 Burner Input: Each burner shall be adjusted to its proper input in accordance with the manufacturer's instructions. Overrating of burners is prohibited.

1.6.1.2 High Altitude: Ratings of gas appliances are based on sea level operation and need not be changed for operation at elevations up to 2,000 feet. For operation at elevations above 2,000 feet, appliance ratings should be reduced at the rate of 4 percent for each 1,000 feet above sea level before selecting an appropriately sized gas appliance.

1.6.1.3 Checking Burner Input:

(a) Checking Burner Input Using a Meter: To check the Btu input rate, the test hand on the meter should be timed for at least one revolution and the input determined from this timing. Test dials are generally marked ½, 1, 2 or 5 cubic feet per revolution depending upon the size of the meter. Instructions for converting the test hand readings to cubic feet per hour are given in Table 1-11.

(b) Checking Burner Input Not Using a Meter: The fixed orifice size for each burner may be determined in accordance with Table 1-C1 for utility gases and Table 1-C2 for undiluted liquefied petroleum gases in Appendix 1-C.

1.6.1.4 Adjusting Input: The input rate shall be adjusted to the proper rate by changing a fixed orifice size, changing the adjustment of an adjustable orifice, or by readjustment of the gas pressure regulator outlet pressure (when a regulator is provided) within limitations authorized by the serving gas supplier.

1.6.2 Primary Air Adjustment. The primary air for injection (Bunsen) type burners shall be adjusted for proper flame characteristics in accordance with the manufacturer's instructions. Normally, the primary air adjustment should first be set to give a soft blue flame having luminous tips and then increased to a point where the yellow tips just disappear. If the burner cannot be adjusted as above, consult the manufacturer or serving gas supplier. After setting the primary air, the adjustment means shall be secured in position.

Table 1-11

Gas Input to Burner in Cubic Feet Per Hour

Seconds For One Revolution	Size of Test Meter Dial: One-Half Cu. Ft.	One Cu. Ft.	Two Cu. Ft.	Five Cu. Ft.
	Cubic Feet Per Hour			
10	180	360	720	1,800
11	164	327	655	1,636
12	150	300	600	1,500
13	138	277	555	1,385
14	129	257	514	1,286
15	120	240	480	1,200
16	112	225	450	1,125
17	106	212	424	1,059
18	100	200	400	1,000
19	95	189	379	947
20	90	180	360	900
21	86	171	343	857
22	82	164	327	818
23	78	157	313	783
24	75	150	300	750
25	72	144	288	720
26	69	138	277	692
27	67	133	267	667
28	64	129	257	643
29	62	124	248	621
30	60	120	240	600
31	58	116	232	581
32	56	113	225	563
33	55	109	218	545
34	53	106	212	529
35	51	103	206	514
36	50	100	200	500
37	49	97	195	486
38	47	95	189	474
39	46	92	185	462
40	45	90	180	450
41	44	88	176	440
42	43	86	172	430
43	42	84	167	420
44	41	82	164	410
45	40	80	160	400
46	39	78	157	391
47	38	77	153	383
48	37	75	150	375
49	37	73	147	367

NOTE: To convert to Btu per hour multiply by the Btu heating value of the gas used.

Table 1-11 (Continued)

Gas Input to Burner in Cubic Feet Per Hour

Seconds For One Revolution	Size of Test Meter Dial: One-Half Cu. Ft.	One Cu. Ft.	Two Cu. Ft.	Five Cu. Ft.
		Cubic Feet Per Hour		
50	36	72	144	360
51	35	71	141	353
52	35	69	138	346
53	34	68	136	340
54	33	67	133	333
55	33	65	131	327
56	32	64	129	321
57	32	63	126	316
58	31	62	124	310
59	30	61	122	305
60	30	60	120	300
62	29	58	116	290
64	29	56	112	281
66	29	54	109	273
68	28	53	106	265
70	26	51	103	257
72	25	50	100	250
74	24	48	97	243
76	24	47	95	237
78	23	46	92	231
80	22	45	90	225
82	22	44	88	220
84	21	43	86	214
86	21	42	84	209
88	20	41	82	205
90	20	40	80	200
94	19	38	76	192
98	18	37	74	184
100	18	36	72	180
104	17	35	69	173
108	17	33	67	167
112	16	32	64	161
116	15	31	62	155
120	15	30	60	150
130	14	28	55	138
140	13	26	51	129
150	12	24	48	120
160	11	22	45	112
170	11	21	42	106
180	10	20	40	100

NOTE: To convert to Btu per hour multiply by the Btu heating value of the gas used.

1.6.3 Safety Shutoff Devices. When a safety shutoff device is provided, it shall be checked for proper operation and adjustment in accordance with the manufacturer's instructions. If the device does not function properly to turn off the gas supply in the event of pilot outage, it shall be properly serviced or replaced with new equipment.

1.6.4. Automatic Ignition. Appliances equipped with means for automatic ignition, such as used with domestic gas range top burners, shall be checked for proper operation. If necessary, proper adjustments shall be made.

1.6.5 Protective Devices. All protective devices furnished with the appliance, such as a limit control, fan control to blower, temperature and pressure relief valve, low water cutoff device, manual operating features, etc., shall be checked for proper operation.

1.6.6 Checking the Draft. Vent connected appliances shall be operated for several minutes and checked to see that the products of combustion are going up the chimney, or gas vent, properly by passing a lighted match or taper around the edge of the relief opening of the draft hood. If the chimney or gas vent is drawing properly, the match flame will be drawn into the draft hood. If not, the products of combustion will tend to extinguish this flame. If the products of combustion are escaping from the relief opening of the draft hood, the appliance shall not be operated until proper adjustments or repairs are made to provide adequate draft through the chimney or gas vent.

1.6.7 Operating Instructions.

1.6.7.1 The consumer should know how to operate the appliance safely.

1.6.7.2 When operating instructions are furnished by the manufacturer, they shall be left in a prominent position near the appliance.

1.6.8 Notification of Completion. When regulations so require, the serving gas supplier or the authority having jurisdiction shall be notified that the installation has been completed.

1.7 DEFINITIONS

Air Conditioning. The treatment of air so as to control simultaneously its temperature, humidity, cleanness and distribution to meet the requirements of a conditioned space.

Air Mixer. That portion of an injection (Bunsen) type burner into which the primary air is introduced.

Air Shutter. An adjustable device for varying the size of the primary air inlet(s).

Appliance. Any device which utilizes gas to produce light, heat, power, refrigeration, or air conditioning.

Appliance — Automatically Controlled. Appliances equipped with an automatic burner ignition and safety shutoff device and other automatic devices which:

(a) Accomplish complete turn-on and shutoff of the gas to the main burner or burners.

(b) Graduate the gas supply to the burner or burners, but do not effect complete shutoff of the gas.

Appliance Flue. The flue passages within the appliance.

Approved. Acceptable to the authority having jurisdiction.

Automatic Gas Shutoff Device. A device constructed so that the attainment of a water temperature in a hot water supply system in excess of some predetermined limit acts in such a way as to cause the gas to the system to be shut off.

Automatic Ignition. Ignition of gas at the burner(s) when the gas controlling device is turned on, including reignition if the flames on the burner(s) have been extinguished by means other than by the closing of the gas controlling device.

Baffle. An object placed in an appliance to change the direction of, or retard, the flow of air, air-gas mixtures, or flue gases.

Boiler, High Pressure. A self-contained gas-burning appliance for supplying steam or hot water. A high-pressure boiler operates in excess of the following pressures or temperatures:

Steam boiler — 15 psig steam pressure
Hot water boiler — 160 psig water pressure
250 F water temperature

Boiler, Low-Pressure. A self-contained, gas-burning appliance for supplying hot water or low-pressure steam, primarily intended for domestic and commercial space heating application.

Branch Line. Gas piping which conveys gas from a supply line to the appliance.

Broiler. A general term including broilers, salamanders, barbecues, and other devices cooking primarily by radiated heat, excepting toasters.

Btu. Abbreviation for British Thermal Unit which is the quantity of heat required to raise the temperature of one pound of water one degree Fahrenheit.

Built-In Domestic Cooking Unit. (*See Range, Built-In Domestic Cooking Unit.*)

Bungalow (Utility) Type Domestic Gas Range. (*See Range, Domestic Bungalow.*)

Burner. A device for the final conveyance of the gas, or a mixture of gas and air, to the combustion zone.

(a) **Injection (Bunsen) Type Burner.** A burner employing the energy of a jet of gas to inject air for combustion into the burner and mix it with the gas.

1. Atmospheric Injection Type Burner. A burner in which the air at atmospheric pressure is injected into the burner by a jet of gas.

(b) **Luminous or Yellow-Flame Burner.** A burner in which secondary air only is depended on for combustion of the gas.

(c) **Power Burner.** A burner in which either gas or air or both are supplied at pressure exceeding, for gas, the line pressure, and for air, atmospheric pressure; this added pressure being applied at the burner. A burner for which air for combustion is supplied by a fan ahead of the appliance is commonly designated as a forced-draft burner.

1. Premixing Burner. A power burner in which all or nearly all of the air for combustion is mixed with the gas as primary air.

(d) **Forced-Draft Burner.** (*See Power Burner.*)

(e) **Induced-Draft Burner.** A burner which depends on the draft induced by a fan beyond the appliance for its proper operation.

(f) Pressure Burner. A burner which is supplied with an air-gas mixture under pressure (usually from 0.5 to 14.0 inches of water and occasionally higher.)

Chimney. (*Also see Gas Vents.*) A vertical shaft enclosing one or more flues for conveying flue gases to the outside atmosphere.

(a) Factory-Built Chimney. A listed chimney.

(b) Masonry Chimney. A chimney of solid masonry units, bricks, stones, listed masonry units or reinforced concrete, lined with suitable flue liners.

(c) Metal Chimney. A field-constructed chimney of metal.

Closed Water Piping System. A system of water piping where a check valve or other device prevents the free return of water or steam to the water main.

Clothes Dryer. A device used to dry wet laundry by means of heat derived from the combustion of fuel gases. Dryer classifications are as follows:

(a) Type 1. Factory-built package, multiple produced. Primarily used in family living environment. May or may not be coin-operated for public use. Usually the smallest unit physically and in function output.

(b) Type 2. Factory-built package, multiple produced. Used in business with direct intercourse of the function with the public. May or may not be operated by public or hired attendant. May or may not be coin-operated. Not designed for use in individual family living environment. May be small, medium or large in relative size.

Combustible Material. As pertaining to materials adjacent to or in contact with heat producing appliances, vent connectors, gas vents, chimneys, steam and hot water pipes, and warm air ducts, shall mean materials made of or surfaced with wood, compressed paper, plant fibers, or other materials that will ignite and burn. Such material shall be considered combustible even though flame-proofed, fire-retardant treated, or plastered.

Combustion. Combustion, as used herein, refers to the rapid oxidation of fuel gases accompanied by the production of heat, or heat and light. Complete combustion of a fuel is possible only in the presence of an adequate supply of oxygen.

Combustion Chamber. The portion of an appliance within which combustion occurs.

Combustion Products. Constituents resulting from the combustion of a fuel with the oxygen of the air, including the inerts but excluding excess air.

Commercial Baking and Roasting Oven. An oven that can be moved from place to place as a unit. It may be composed of one or more sections or units and may be of the following types:

(a) Cabinet Oven. A stationary deck oven having more than one deck heated by a single burner or group of burners.

(b) Sectional Oven. A single stationary deck oven or one composed of one or more independently heated stationary decks.

(c) Reel-Type Oven. A single oven employing trays that are moved by mechanical means.

Concealed Gas Piping. Gas piping, which, when in place in a finished building, would require removal of permanent construction to gain access to the piping.

Condensate (Condensation). The liquid which separates from a gas (in-

cluding flue gas) due to a reduction in temperature.

Controls. Devices designed to regulate the gas, air, water or electrical supply to a gas appliance. These may be manual or automatic.

Conversion Burner, Gas. A unit consisting of a burner and its controls utilizing gaseous fuel for installation in an appliance originally utilizing another fuel.

(a) **Firing Door Type.** A conversion burner specifically for boiler or furnace firing door installation.

(b) **Inshot Type.** A conversion burner normally for boiler or furnace ash pit installation and fired in a horizontal position.

(c) **Upshot Type.** A conversion burner normally for boiler or furance ash pit installation and fired in a vertical position at approximately grate level.

Counter Appliances, Gas. Appliances such as gas-operated coffee brewers and coffee urns and any appurtenant water heating equipment, food and dish warmers, hot plates and griddles.

Cubic Foot (Cu. Ft.) of Gas. The amount of gas which would occupy 1 cubic foot when at a temperature of 60 F, saturated with water vapor and under a pressure equivalent to that of 30.0 inches of mercury.

Deep Fat Fryer, Hotel and Restaurant. An appliance including a cooking vessel in which oils or fats are placed to such a depth that the cooking food is essentially supported by displacement of the cooking fluid or a perforated container immersed in the cooking fluid rather than by the bottom of the vessel, designed primarily for use in hotels, restaurants, clubs, and similar institutions.

Demand. The maximum amount of gas per unit of time, usually expressed in cubic feet per hour, or Btu per hour, required for the operation of the appliance or appliances supplied.

Dilution Air. Air which enters a draft hood or draft regulator and mixes with the flue gases.

Direct-Fired Oven. An oven in which the flue gases flow through the oven compartment.

Direct Vent Appliances. Appliances which are constructed and installed so that all air for combustion is derived from the outside atmosphere and all flue gases are discharged to the outside atmosphere.

Diversity Factor. Ratio of the maximum probable demand to the maximum possible demand.

Draft Hood. A device built into an appliance, or made a part of the vent connector from an appliance, which is designed to (1) provide for the ready escape of the flue gases from the appliance in the event of no draft, back draft, or stoppage beyond the draft hood, (2) prevent a back draft from entering the appliance, and (3) neutralize the effect of stack action of the chimney or gas vent upon the operation of the appliance.

Draft Regulator. A device which functions to maintain a desired draft in the appliance by automatically reducing the draft to the desired value.

Drip. The container placed at a low point in a system of piping to collect condensate and from which it may be removed.

Dry Gas. A gas having a moisture and hydrocarbon dew point below any normal temperature to which the gas piping is exposed.

Duct Furnace. A furnace normally installed in distribution ducts of air conditioning systems to supply warm air for heating. This definition shall apply only to an appliance which depends for air circulation on a blower

not furnished as part of the furnace.

Excess Air. Air which passes through the combustion chamber and the appliance flues in excess of that which is theoretically required for complete combustion.

Exposed Piping. Gas piping which will be in view in the finished structure.

Flames.

(a) Yellow, Luminous or Non-Bunsen. The flame produced by burning gas without any premixing of air with the gas.

(b) Bunsen. The flame produced by premixing some of the air required for combustion with the gas before it reaches the burner ports or point of ignition.

Floor Furnace. A completely self-contained unit furnace suspended from the floor of the space being heated, taking air for combustion from outside this space.

(a) Gravity Type Floor Furnace. A floor furnace depending primarily upon circulation of air by gravity. This classification shall also include floor furnaces equipped with booster-type fans which do not materially restrict free circulation of air by gravity flow when such fans are not in operation.

(b) Fan Type Floor Furnace. A floor furnace equipped with a fan which provides the primary means for circulation of air.

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

Flue Exhauster. A device installed in and made a part of the vent which will provide a positive induced draft.

Flue Gases. Products of combustion plus excess air in appliance flues or heat exchangers (before the draft hood or draft regulator).

Furnace — Central Furnace. A self-contained, gas-burning appliance for heating air by transfer of heat of combustion through metal to the air, and 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 or blower as an integral part of its construction and operable on gravity systems only. The fan or blower is to be used only to overcome the internal resistance to airflow.

(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 fans are not in operation.

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

1. Horizontal Type Central Furnace. A furnace designed for low headroom installation with airflow through the appliance essentially in a horizontal path.

2. Upflow Type Central Furnace. A furnace designed with airflow essentially in a vertical path, discharging air at or near the top of the furnace.

3. Downflow Type Central Furnace. A furnace designed with airflow essentially in a vertical path, discharging air at or near the bottom of the furnace.

Garage, Residential. A building or room in which not more than three

self-propelled passenger vehicles are or may be stored, and which will not normally be used for other than minor service or repair operations on such stored vehicles.

Gas Piping System. Piping from the meter or service regulator when a meter is not provided to an appliance or appliances.

Gas Vents. Factory-built vent piping and vent fittings listed by a nationally recognized testing agency, that are assembled and used in accordance with the terms of their listings, for conveying flue gases to the outside atmosphere.

(a) Type B Gas Vent. A gas vent for venting gas appliances with draft hoods and other gas appliances listed for use with Type B Gas Vents.

(b) Type B-W Gas Vent. A gas vent for venting listed gas-fired vented wall furnaces.

Gravity. (*See Specific Gravity.*)

Heating Value (Total). The number of British Thermal Units produced by the combustion, at constant pressure, of one cubic foot of gas when the products of combustion are cooled to the initial temperature of the gas and air, when the water vapor formed during combustion is condensed, and when all the necessary corrections have been applied.

Hot Plate, Commercial. (*See Counter Appliances, Gas.*)

Hot Plate, Domestic. A gas-burning appliance consisting of one or more open-top type burners mounted on short legs or a base.

Hotel and Restaurant Range. A self-contained gas range providing for cooking, roasting, baking or broiling, or any combination of these functions, and not designed specifically for domestic use.

Incinerator, Domestic Gas-Fired. A domestic appliance used to reduce combustible refuse material to ashes which is manufactured, sold and installed as a complete unit.

Indirect Oven. An indirect oven is one in which the flue gases do not flow through the oven compartment.

Infrared Radiant Heater. A heater which directs a substantial amount of its energy output in the form of infrared radiant energy into the area to be heated. Such heaters may be of either the vented or unvented type.

Joint, Adhesive. A joint made in plastic piping by the use of an adhesive substance which forms a continuous bond between the mating surfaces without dissolving either one of them.

Joint, Heat Fusion. A joint made in thermoplastic piping by heating the parts sufficiently to permit fusion of the materials when the parts are pressed together.

Joint, Solvent Cement. A joint made in thermoplastic piping by the use of a solvent or solvent cement which forms a continuous bond between the mating surfaces.

Kettle, Gas-Fired. An appliance with a cooking chamber which is heated either by a steam jacket in which steam is generated by gas heat or by direct gas heat applied to the cooking chamber.

Labeled. Equipment or materials to which has been attached a label of a nationally recognized testing laboratory that maintains periodic inspection of production of labeled equipment or materials and by whose labeling is indicated compliance with nationally recognized standards or the conduct of tests to determine suitable usage in a specified manner.

Laundry Stove, Domestic. A gas-burning appliance consisting of one or more open-top type burners mounted on high legs or having a cabinet base.

Limit Control. A device responsive to changes in pressure, temperature or liquid level for turning on, shutting off, or throttling the gas supply to an appliance.

Listed. Equipment or materials included in a list published by a nationally recognized testing laboratory that maintains periodic inspection of production of listed equipment or materials and whose listing states either that the equipment or material meets nationally recognized standards or has been tested and found suitable for use in a specified manner.

Main Burner. A device or group of devices essentially forming an integral unit for the final conveyance of gas or a mixture of gas and air to the combustion zone, and on which combustion takes place to accomplish the function for which the appliance is designed.

Manifold, Gas. The conduit of an appliance which supplies gas to the individual burners.

Measured Gas. Gas which has passed through and the volume of which has been measured by a meter, or gas which has been otherwise measured such as by liquid volume or weight.

Meter. An instrument installed to measure the volume of gas delivered through it.

Meter Set Assembly. The piping and fittings installed by the serving gas supplier to connect the inlet side of the meter to the gas service and to connect the outlet side of the meter to the customer's house or yard piping.

Mixer. The combination of mixer head, mixer throat and mixer tube.

(a) Mixer Head. The portion of an injection (Bunsen) type burner, usually enlarged, into which primary air flows to mix with the gas stream.

(b) Mixer Throat. The portion of the mixer which has the smallest cross-sectional area and which lies between the mixer head and the mixer tube.

(c) Mixer Tube. The portion of the mixer which lies between the throat and the burner head.

Mixer Face. The air inlet end of the mixer head.

Orifice. The opening in a cap, spud or other device whereby the flow of gas is limited and through which the gas is discharged to the burner.

Orifice Cap (Hood). A movable fitting having an orifice which permits adjustment of the flow of gas by the changing of its position with respect to a fixed needle or other device.

Orifice Spud. A removable plug or cap containing an orifice which permits adjustment of the flow of gas either by substitution of a spud with a different sized orifice or by the motion of a needle with respect to it.

Pilot. A small flame which is utilized to ignite the gas at the main burner or burners.

Piping. Where the word piping is used in these standards, it refers to either pipe or tubing, or both.

(a) Pipe. Refers to a rigid conduit of iron, steel, copper, brass, aluminum, or plastic.

(b) Tubing. Refers to a semi-rigid conduit of copper, steel, aluminum, or plastic.

Plastic.

(a) Thermoplastic. A plastic which is capable of being repeatedly softened by increase of temperature and hardened by decrease of temperature.

(b) Thermosetting. A plastic which is capable of being changed into a substantially infusible or insoluble product when cured under application

of heat or chemical means.

Pressure Regulator, Service. A device designed to reduce and limit the gas pressure to domestic and commercial customers when the pressure of the supply system is in excess of ½ pound per square inch or 14 inches water column.

Primary Air. The air introduced into a burner which mixes with the gas before it reaches the port or ports.

Purge. To free a gas conduit of air, or gas, or a mixture of gas and air.

Quick-Disconnect Device. A hand-operated device which provides a means for connecting and disconnecting an appliance or an appliance connector to a gas supply and which is equipped with an automatic means to shut off the gas supply when the device is disconnected.

Range, Built-In Domestic Cooking Unit. A gas appliance for domestic food preparation, providing at least one function of (1) top or surface cooking, (2) oven cooking, or (3) broiling, and designed to be recessed into, placed upon, or attached to counters, cabinets, walls or partitions.

Range, Domestic Bungalow (Utility Type). A domestic range having a gas oven and top section, and a gas, solid or liquid fuel section designed for space heating and heating a solid top section, but not for oven heating.

Range, Domestic Gas. A self-contained, free-standing, gas-burning appliance designed for domestic cooking purposes and having a top section and an oven section. It may have a broiling section.

Range, Domestic Gas Room Heater Type. A domestic gas range having a gas oven and top section, and a separate room heater section designed for gas fuel.

Regulator, Gas Pressure. A device, either adjustable, nonadjustable or convertible, for controlling and maintaining a uniform outlet gas pressure.

(a) Adjustable.

1. Spring Type, Standard Adjustment. A regulator in which the regulating force acting upon the diaphragm is derived principally from a spring, the loading of which is adjustable.

2. Spring Type, Limited Adjustment. A regulator in which the regulating force acting upon the diaphragm is derived principally from a spring, the loading of which is adjustable over a range of not more than 1.0 inch water outlet pressure.

(b) Nonadjustable.

1. Spring Type, Nonadjustable. A regulator in which the regulating force acting upon the diaphragm is derived principally from a spring, the loading of which is not adjustable.

2. Weight Type. A regulator in which the regulating force acting upon the diaphragm is derived from a weight or combination of weights.

(c) Convertible. A regulator whose adjustment means can be positioned from one predetermined outlet pressure setting to another predetermined outlet pressure setting with no intermediate pressure settings and without addition, deletion, or substitution of parts.

Refrigerator (Using Gas Fuel). A gas-burning appliance which is designed to extract heat from a suitable chamber.

Relief Opening. The opening provided in a draft hood to permit the ready escape to the atmosphere of the flue products from the draft hood in the event of no draft, back draft, or stoppage beyond the draft hood, and to permit inspiration of air into the draft hood in the event of a strong chimney updraft.

Room Heater, Unvented. An unvented, self-contained, free-standing,

nonrecessed (except as noted under "g" of the following classifications), gas-burning appliance for furnishing warm air by gravity or fan circulation to the space in which installed, directly from the heater without duct connection. Unvented room heaters shall not have a normal input rating in excess of 40,000 Btu per hour, except as noted under "g" of the following classifications.

(a) Unvented Circulator. A room heater designed to convert the energy in fuel gas to convected and radiant heat by direct mixing of air to be heated with the combustion products and excess air inside the jacket. Unvented circulators have an external jacket surrounding the burner and may be equipped with radiants with the jacket open in front of the radiants.

(b) Coal Basket. An unvented, open-flame type room heater consisting of a metal basket filled with simulated coals which gives the appearance of a coal fire when in operation. A coal basket is for installation in a fireplace.

(c) Fireplace Insert. Consists of an unvented open-flame radiant-type heater mounted in a decorative metal panel to cover the fireplace or mantel opening.

(d) Gas Log. An unvented, open-flame type room heater consisting of a metal frame or base supporting simulated logs. A gas log is for installation in a fireplace.

(e) Radiant Heater. An open-front unvented room heater designed primarily to convert the energy in fuel gas to radiant heat by means of refractory radiants or similar radiating materials. A radiant heater has no external jacket. A radiant heater is for installation in a fireplace.

(f) Unvented Overhead Heater. An unvented room heater for suspension from the ceiling in the room being heated.

(g) Wall Heater, Unvented Closed Front. An unvented circulator having a closed front, for insertion in or attachment to a wall or partition. These heaters shall be plainly marked, "UNVENTED HEATER," in letters ½-inch high and shall not have a normal input rating in excess of 25,000 Btu per hour.

Room Heater, Vented. A vented, self-contained, free-standing, nonrecessed, gas-burning appliance for furnishing warm air to the space in which installed, directly from the heater without duct connections.

(a) Vented Circulator. A room heater designed to convert the energy in fuel gas to convected and radiant heat, by transfer of heat from flue gases to a heat exchanger surface, without mixing of flue gases with circulating heated air. Vented circulators may be equipped with transparent panels and radiating surfaces to increase radiant heat transfer as long as separation of flue gases from circulating air is maintained. Vented circulators may also be equipped with an optional circulating air fan, but shall perform satisfactorily with or without the fan in operation.

(b) Fan Type Vented Circulator. A vented circulator equipped with an integral circulating air fan, the operation of which is necessary for satisfactory appliance performance.

(c) Vented Overhead Heater. A room heater designed for suspension from, or attachment to or adjacent to the ceiling of the room being heated and transferring the energy of the fuel gas to the space being heated primarily by radiation downward from a hot surface, and in which there is no mixing of flue gases with the air of the space being heated.

Safety Shutoff Device. A device that will shut off the gas supply to the controlled burner(s) in the event the source of ignition fails. This device

may interrupt the flow of gas to main burner(s) only, or to pilot(s) and main burner(s) under its supervision.

Secondary Air. The air externally supplied to the flame at the point of combustion.

Service Pipe. The pipe which brings the gas from the gas main to the meter.

Service Regulator. (*See Pressure Regulator, Service.*)

Shutoff. (*See Valve.*)

Specific Gravity. As applied to gas, the ratio of the weight of a given volume to that of the same volume of air, both measured under the same conditions.

Steam Cooker. A gas-fired appliance which cooks, defrosts or reconstitutes food by direct contact with steam.

Steam Generator. A separate appliance primarily intended to supply steam for use with commercial cooking equipment.

Thermostat, Electric Switch Type. A device which senses changes in temperature and controls electrically, by means of separate components, the flow of gas to the burners to maintain selected temperatures.

Thermostat, Integral Gas Valve Type. An automatic device, actuated by temperature changes, designed to control the gas supply to the burners in order to maintain temperatures between predetermined limits, and in which the thermal actuating element is an integral part of the device.

(a) Graduating Thermostat. A thermostat in which the motion of the valve is approximately in direct proportion to the effective motion of the thermal element induced by temperature change.

(b) Snap-Acting Thermostat. A thermostat in which the thermostatic valve travels instantly from the closed to the open position, and vice versa.

Type B Gas Vent. (*See Gas Vents.*)

Type B-W Gas Vent. (*See Gas Vents.*)

Type L Venting System. A venting system composed of listed factory-built components assembled in accordance with the terms of listing for venting appliances listed for use with Type L venting systems. They may be used also where Type B gas vents are permitted.

Unit Broiler. A broiler constructed as a separate appliance.

Unit Heater.

(a) Low-Static Pressure. A self-contained, automatically controlled, vented, gas-burning appliance. Such an appliance is intended for installation in the space to be heated without the use of ducts. It shall have integral means for circulation of air, normally by a propeller fan(s), and may be equipped with louvers or face extensions made in accordance with the manufacturer's specifications.

(b) High-Static Pressure. A self-contained, automatically controlled, vented, gas-burning appliance having integral means for circulation of air against 0.2 inch or greater static pressure. It is equipped with provisions for attaching an outlet air duct when the appliance is for installation in the space to be heated, or is equipped with provisions for attaching both inlet and outlet air ducts when the appliance is for installation remote from the space to be heated or for outdoor installation.

Unmeasured Gas. Gas which has not passed through and the volume of which has not been measured by a meter, or gas which has not otherwise been measured such as by liquid volume or weight.

Utility Gases. Natural gas, manufactured gas, liquefied petroleum gas-air mixtures, or mixtures of any of these gases.

Valve. A device used in piping to control the gas supply to any section of a system of piping or to an appliance.

Valve, Automatic. An automatic or semi-automatic device consisting essentially of a valve and operator that controls the gas supply to the burner(s) during operation of an appliance. The operator may be actuated by application of gas pressure on a flexible diaphragm, by electrical means, by mechanical means or by other means.

Valve, Automatic Gas Shutoff. A valve used in conjunction with an automatic gas shutoff device to shut off the gas supply to a gas-fired water heating system. It may be constructed integrally with the gas shutoff device, or be a separate assembly.

Valve, Individual Main Burner. A valve which controls the gas supply to an individual main burner.

Valve, Main Burner Control. A valve which controls the gas supply to the main burner manifold.

Valve, Manual Main Gas-Control. A manually operated valve in the gas line for the purpose of completely turning on or shutting off the gas supply to the appliance except to pilot or pilots which are provided with independent shutoff.

Valve, Relief. A safety valve designed to forestall the development of a dangerous condition by relieving either pressure, temperature, or vacuum in a hot water supply system.

(a) Pressure. A valve which automatically opens and closes a relief vent, depending on whether the pressure is above or below a predetermined value.

(b) Temperature. A valve which automatically opens and automatically closes a relief vent, depending on whether the temperature is above or below a predetermined value.

(c) Vacuum. A valve which automatically opens and closes a vent for relieving a vacuum within the hot water supply system depending on whether the vacuum is above or below a predetermined value.

Vent Connector. That portion of the venting system which connects the gas appliance to the gas vent, chimney or single-wall metal pipe.

Vent Gases. Products of combustion from gas appliances plus excess air, plus dilution air in the venting system above the draft hood or draft regulator.

Vented Decorative Gas Appliance. A vented appliance whose only function lies in the esthetic effect of the flames.

Vented Wall Furnace. A self-contained, vented appliance complete with grilles or equivalent, designed for incorporation in or permanent attachment to the structure of a building furnishing heated air, circulated by gravity or by a fan, 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 inches beyond the horizontal limits of the casing for extension through walls of nominal thickness may be permitted. When such boots are provided they shall be supplied by the manufacturer as an integral part of the appliance. This definition excludes floor furnaces, unit heaters, direct vent wall furnaces and central furnaces.

(a) Gravity Type Vented Wall Furnace. A wall furnace depending on circulation of air by gravity.

(b) Fan Type Vented Wall Furnace. A wall furnace equipped with a fan.

Venting System. The gas vent, chimney or single-wall metal pipe, and

vent connector if used, assembled to form a continuous open passageway from the gas appliance to the outside atmosphere for the purpose of removing vent gases.

Water Heater. An appliance for supplying hot water for domestic or commercial purposes other than for space heating.

(a) Circulating Heaters.

1. Automatic Circulating Tank Type Heater. A water heater which furnishes hot water to be stored in a separate vessel. Storage tank temperatures are controlled by means of a thermostat installed on the water heater. Circulation may be either gravity or forced.

2. Nonautomatic Circulating Tank Type Heater. A water heater which furnishes hot water to be stored in a separate vessel. Storage tank temperatures are controlled by means of a thermostat installed in the storage vessel.

(b) Automatic Instantaneous Water Heater. A water heater which has a rated input of at least 4,000 Btu per hour per gallon of self-stored water. Automatic control is obtained by water-actuated control, thermostatic control, or combination of water-actuated control and thermostatic control. This classification includes faucet type heaters designed to deliver water through a single faucet integral with or directly adjacent to the heater.

(c) Domestic Storage Heater. A water heater that heats and stores water at a thermostatically controlled temperature for delivery on demand. Input rating may not exceed 75,000 Btu per hour.

(d) Counter Top Domestic Storage Heater.

1. Flush Type. A vented automatic storage water heater with flat sides, top, front, and back which is designed primarily for flush installation in conjunction with or adjacent to a counter 36 inches high, wherein the front and top of the heater casing are exposed.

2. Recessed Type. A vented automatic storage water heater with flat sides, top, front and back, which is designed for flush installation beneath a counter 36 inches high, wherein the front of the heater casing is exposed.

3. Concealed Type. A vented automatic storage heater which is designed for flush installation beneath a counter top 36 inches high, wherein the entire heater is concealed.

(e) Commercial Storage Heater. A water heater that heats and stores water at a thermostatically controlled temperature for delivery on demand. Input rating: 75,000 Btu per hour or more.

(f) Side-Arm Type Water Heater. A water heater designed for use with auxiliary storage systems, usually containing water-carrying parts of the tubular or cast element design.

APPENDIX 1-A WORK ON GAS SUPPLY SYSTEM

(This Appendix is informative and is not a part of the Code.)

This appendix applies only to work on gas supply systems ahead of the outlet of the meter set assembly, or of the service regulator when a meter is not provided.

Serving Gas Supplier's Main

No person, unless in the employ of or having permission from the serving gas supplier, shall open or make connections with a gas main.

Service Gas Piping

No person, unless in the employ of or having permission from the serving gas supplier, shall repair, alter, open or make connections to the service gas piping, or do any other work on the parts of the gas supply system up to the meter set assembly or the service regulator when a meter is not provided.

Meter or Service Regulator When a Meter is Not Provided

No person, unless in the employ of or having permission from the serving gas supplier, shall disconnect the inlet of the gas meter or service regulator when a meter is not provided, nor move such meter or regulator. A gas fitter or plumber may disconnect the outlet of such a meter or regulator from the house piping only when necessary. He shall remake the joint at the meter or service regulator outlet when a meter is not provided, carefully replacing all insulating fittings or insulating parts of such fittings, and shall leave the gas turned off at the meter or regulator unless the serving gas supplier's rules require or allow deviation from this procedure.

Notify Serving Gas Supplier of Any Repairs Needed

In case any work done by a gas fitter or plumber discloses the need for repairs or alterations on any part of the gas supply system, the serving gas supplier shall be notified promptly of this fact.

Notify Serving Gas Supplier of Any Leaks

If gas is leaking from any part of the gas supply system, a gas fitter or plumber not in the employ of the serving gas supplier may make necessary repairs and shall promptly notify the serving gas supplier.

APPENDIX 1-B SIZING AND CAPACITIES OF GAS PIPING

(This Appendix is informative and is not a part of the Code.)

In order to determine the size of piping to be used in designing a gas piping system, the following factors must be considered:

(a) Allowable loss in pressure from meter, or service regulator when a meter is not provided, to appliance.
(b) Maximum gas consumption to be provided.
(c) Length of piping and number of fittings.
(d) Specific gravity of the gas.
(e) Diversity factor.

Description of Tables

(a) The quantity of gas to be provided at each outlet should be determined, whenever possible, directly from the manufacturer's Btu input rating of the appliance which will be installed. In case the ratings of the appliances to be installed are not known, Table 1-B1 shows the approximate consumption of average appliances of certain types in Btu per hour.

To obtain the cubic feet per hour of gas required, divide the total Btu input of all appliances by the average Btu heating value per cubic foot of the gas. The average Btu per cubic foot of the gas in the area of the installation may be obtained from the serving gas supplier.

(b) Capacities for gas at low pressures (0.5 psig or less) in cubic feet per hour of 0.60 specific gravity gas for different sizes and lengths are shown in Tables 1-B2 and 1-B3 for iron pipe or equivalent rigid pipe and in Tables 1-B4 and 1-B5 for semi-rigid tubing. Tables 1-B2 and 1-B4 are based upon a pressure drop of 0.3 inch water column, whereas Tables 1-B3 and 1-B5 are based upon a pressure drop of 0.5 inch water column. In using these Tables no additional allowance is necessary for an ordinary number of fittings. The serving gas supplier shall designate which table(s) shall be used.

(c) Capacities in thousands of Btu per hour of undiluted liquefied petroleum gases based on a pressure drop of 0.5 inch water column for different sizes and lengths are shown in Table 1-B7 for iron pipe or equivalent rigid pipe and in Table 1-B8 for semirigid tubing. In using these tables, no additional allowance is necessary for an ordinary number of fittings.

(d) Gas piping systems that are to be supplied with gas of a specific gravity of 0.70 or less can be sized directly from Tables 1-B2 through 1-B5, unless the authority having jurisdiction specifies that a gravity factor be applied. When the specific gravity of the gas is greater than 0.70, the gravity factor shall be applied.

Application of the gravity factor converts the figures given in Tables 1-B2 through 1-B5 to capacities with another gas of different specific gravity. Such application is accomplished by multiplying the capacities given in Tables 1-B2 through 1-B5 by the multipliers shown in Table 1-B6. In case the exact specific gravity does not appear in the Table, choose the next higher value specific gravity shown.

(e) For any gas piping system, for special gas appliances or for conditions other than those covered by Tables 1-B2 through 1-B5, 1-B7, or 1-B8, such as longer runs, greater gas demands, or greater pressure drops, the size of each gas piping system shall be determined by standard engineering methods acceptable to the authority having jurisdiction and the serving gas supplier.

Use of Capacity Tables

To determine the size of each section of gas piping in a system within the range of the capacity tables, proceed as follows: (*Also see sample calculation at end of Appendix 1-B.*)

1. Determine the gas demand of each appliance to be attached to the piping system. When Tables 1-B2 through 1-B5 are to be used to select the piping size, calculate the gas demand in terms of cubic feet per hour for each piping system outlet. When Tables 1-B7 or 1-B8 are to be used to select the piping size, calculate the gas demand in terms of thousands of Btu per hour for each piping system outlet.

2. When the piping system is for use with other than undiluted liquefied petroleum gases, determine the design system pressure, the allowable loss in pressure (pressure drop), and the specific gravity of the gas to be used in the piping system.

3. Measure the length of piping from the gas meter, or service regulator when a meter is not provided, to the most remote outlet in the building.

4. In the appropriate capacity table, select the column showing the measured length, or the next longer length if the table does not give the exact length. This is the only length used in determining the size of any section of gas piping. If the gravity factor is to be applied, the values in the selected column of the table are multiplied by the appropriate multiplier from Table 1-B6.

5. Use this vertical column to locate ALL gas demand figures for this particular system of piping.

6. Starting at the most remote outlet, find in the vertical column just selected the gas demand for that outlet. If the exact figure of demand is not

shown, choose the next larger figure below in the column.

7. Opposite this demand figure, in the first column at the left, will be found the correct size of gas piping.

8. Proceed in a similar manner for each outlet and each section of gas piping. For each section of piping determine the total gas demand supplied by that section.

Table 1-B1

Approximate Gas Input for Some Common Appliances

Appliance	Input Btu per hr. (Approx.)
Range, Free Standing, Domestic	65,000
Built-In Oven or Broiler Unit, Domestic	25,000
Built-In Top Unit, Domestic	40,000
Water Heater, Automatic Storage 30 to 40 Gal. Tank	45,000
Water Heater, Automatic Storage 50 Gal. Tank	55,000
Water Heater, Automatic Instantaneous (2 gal. per minute	142,800
Capacity (4 gal. per minute	285,000
(6 gal. per minute	428,400
Water Heater, Domestic, Circulating or Side-Arm	35,000
Refrigerator	3,000
Clothes Dryer, Type 1 (Domestic)	35,000
Gas Light	2,500
Incinerator, Domestic	35,000

For specific appliances or appliances not shown above, the input should be determined from the manufacturer's rating.

Table 1-B2

Maximum Capacity of Pipe in Cubic Feet of Gas per Hour for Gas Pressures of 0.5 Psig or Less and a Pressure Drop of 0.3 Inch Water Column

(Based on a 0.60 Specific Gravity Gas)

Nominal Iron Pipe Size, Inches	Internal Diameter, Inches	Length of Pipe, Feet													
		10	20	30	40	50	60	70	80	90	100	125	150	175	200
¼	.364	32	22	18	15	14	12	11	11	10	9	8	8	7	6
⅜	.493	72	49	40	34	30	27	25	23	22	21	18	17	15	14
½	.622	132	92	73	63	56	50	46	43	40	38	34	31	28	26
¾	.824	278	190	152	130	115	105	96	90	84	79	72	64	59	55
1	1.049	520	350	285	245	215	195	180	170	160	150	130	120	110	100
1¼	1.380	1,050	730	590	500	440	400	370	350	320	305	275	250	225	210
1½	1.610	1,600	1,100	890	760	670	610	560	530	490	460	410	380	350	320
2	2.067	3,050	2,100	1,650	1,450	1,270	1,150	1,050	990	930	870	780	710	650	610
2½	2.469	4,800	3,300	2,700	2,300	2,000	1,850	1,700	1,600	1,500	1,400	1,250	1,130	1,050	980
3	3.068	8,500	5,900	4,700	4,100	3,600	3,250	3,000	2,800	2,600	2,500	2,200	2,000	1,850	1,700
4	4.026	17,500	12,000	9,700	8,300	7,400	6,800	6,200	5,800	5,400	5,100	4,500	4,100	3,800	3,500

Table 1-B3

Maximum Capacity of Pipe in Cubic Feet of Gas per Hour for Gas Pressures of 0.5 Psig or Less and a Pressure Drop of 0.5 Inch Water Column

(Based on a 0.60 Specific Gravity Gas)

Nominal Iron Pipe Size, Inches	Internal Diameter, Inches	Length of Pipe, Feet													
		10	20	30	40	50	60	70	80	90	100	125	150	175	200
1/4	.364	43	29	24	20	18	16	15	14	13	12	11	10	9	8
3/8	.493	95	65	52	45	40	36	33	31	29	27	24	22	20	19
1/2	.622	175	120	97	82	73	66	61	57	53	50	44	40	37	35
3/4	.824	360	250	200	170	151	138	125	118	110	103	93	84	77	72
1	1.049	680	465	375	320	285	260	240	220	205	195	175	160	145	135
1 1/4	1.380	1,400	950	770	660	580	530	490	460	430	400	360	325	300	280
1 1/2	1.610	2,100	1,460	1,180	990	900	810	750	690	650	620	550	500	460	430
2	2.067	3,950	2,750	2,200	1,900	1,680	1,520	1,400	1,300	1,220	1,150	1,020	950	850	800
2 1/2	2.469	6,300	4,350	3,520	3,000	2,650	2,400	2,250	2,050	1,950	1,850	1,650	1,500	1,370	1,280
3	3.068	11,000	7,700	6,250	5,300	4,750	4,300	3,900	3,700	3,450	3,250	2,950	2,650	2,450	2,280
4	4.026	23,000	15,800	12,800	10,900	9,700	8,800	8,100	7,500	7,200	6,700	6,000	5,500	5,000	4,600

Table 1-B4

Maximum Capacity of Semi-Rigid Tubing in Cubic Feet of Gas per Hour for Gas Pressures of 0.5 Psig or Less and a Pressure Drop of 0.3 Inch Water Column (Based on a 0.60 Specific Gravity Gas)

Outside Diameter, Inch	Length of Tubing, Feet													
	10	20	30	40	50	60	70	80	90	100	125	150	175	200
3/8	20	14	11	10	9	8	7	7	6	6	5	5	4	4
1/2	42	29	23	20	18	16	15	14	13	12	11	10	9	8
5/8	86	59	47	40	36	33	30	28	26	25	22	20	18	17
3/4	150	103	83	71	63	57	52	49	46	43	38	35	32	30
7/8	212	146	117	100	89	81	74	69	65	61	54	49	45	42

Table 1-B5

Maximum Capacity of Semi-Rigid Tubing in Cubic Feet of Gas per Hour for Gas Pressures of 0.5 Psig or Less and a Pressure Drop of 0.5 Inch Water Column (Based on a 0.60 Specific Gravity Gas)

Outside Diameter, Inch	Length of Tubing, Feet													
	10	20	30	40	50	60	70	80	90	100	125	150	175	200
3/8	27	18	15	13	11	10	9	9	8	8	7	6	6	5
1/2	56	38	31	26	23	21	19	18	17	16	14	13	12	11
5/8	113	78	62	53	47	43	39	37	34	33	29	26	24	22
3/4	197	136	109	93	83	75	69	64	60	57	50	46	42	39
7/8	280	193	155	132	117	106	98	91	85	81	71	65	60	55

Table 1-B6

Multipliers to Be Used only with Tables 1-B2 through 1-B5 when Applying the Gravity Factor

Specific Gravity	Multiplier	Specific Gravity	Multiplier
.35	1.31	1.00	.78
.40	1.23	1.10	.74
.45	1.16	1.20	.71
.50	1.10	1.30	.68
.55	1.04	1.40	.66
.60	1.00	1.50	.63
.65	.96	1.60	.61
.70	.93	1.70	.59
.75	.90	1.80	.58
.80	.87	1.90	.56
.85	.84	2.00	.55
.90	.82	2.10	.54

Table 1-B7

Maximum Capacity of Pipe in Thousands of Btu per Hour of Undiluted Liquefied Petroleum Gases (Based on a Pressure Drop of 0.5 Inch Water Column)

Nominal Iron Pipe Size, Inches	Length of Pipe, Feet											
	10	20	30	40	50	60	70	80	90	100	125	150
½	275	189	152	129	114	103	96	89	83	78	69	63
¾	567	393	315	267	237	217	196	185	173	162	146	132
1	1071	732	590	504	448	409	378	346	322	307	275	252
1¼	2205	1496	1212	1039	913	834	771	724	677	630	567	511
1½	3307	2299	1858	1559	1417	1275	1181	1086	1023	976	866	787
2	6221	4331	3465	2992	2646	2394	2205	2047	1921	1811	1606	1496

Table 1-B8

Maximum Capacity of Semi-Rigid Tubing in Thousands of Btu per Hour of Undiluted Liquefied Petroleum Gases (Based on a Pressure Drop of 0.5 Inch Water Column)

Outside Diameter, Inch	Length of Tubing, Feet									
	10	20	30	40	50	60	70	80	90	100
3/8	39	26	21	19	—	—	—	—	—	—
1/2	92	62	50	41	37	35	31	29	27	26
5/8	199	131	107	90	79	72	67	62	59	55
3/4	329	216	181	145	131	121	112	104	95	90
7/8	501	346	277	233	198	187	164	155	146	138

Table 1-B9

Demand Factors for Use in Calculating Gas Piping Systems in Trailer Parks

Demand Factors for use in Calculating Gas Piping Systems in Trailer Parks	
No. of Trailer Sites	Btu Per Hour Per Trailer Site
1	125,000
2	117,000
3	104,000
4	96,000
5	92,000
6	87,000
7	83,000
8	81,000
9	79,000
10	77,000
11 - 20	66,000
21 - 30	62,000
31 - 40	58,000
41 - 60	55,000
Over 60	50,000

Example of Piping System Design:

Determine the required pipe size of each section and outlet of the piping system shown in Exhibit 1-1, with a designated pressure drop of 0.50 inch water column. Gas to be used has 0.65 specific gravity and a heating value of 1,000 Btu per cubic foot.

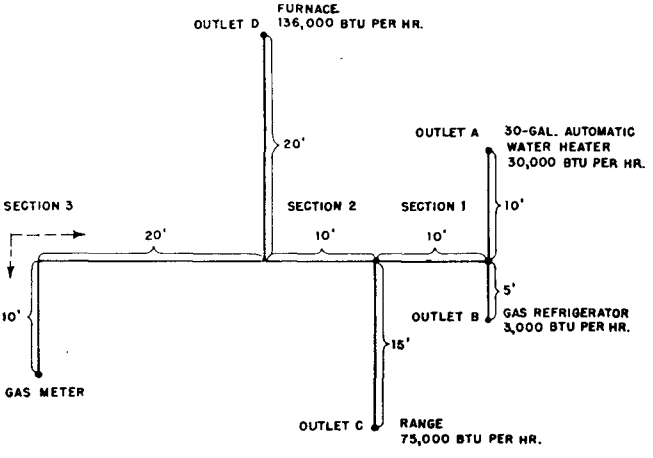

Exhibit 1-1.

Solution:

(1) Maximum gas demand for outlet A:

$$\frac{\text{Consumption (rating plate input, ot Table 1-B1 if necessary)}}{\text{Btu of gas}} =$$

$$\frac{\text{30,000 Btu per hour rating}}{\text{1,000 Btu per cubic foot}} = \frac{\text{30 cubic feet per hour}}{\text{(or 30 cfh)}}$$

Maximum gas demand for outlet B:

$$\frac{\text{Consumption}}{\text{Btu of gas}} = \frac{3{,}000}{1{,}000} = 3 \text{ cfh}$$

Maximum gas demand for outlet C:

$$\frac{\text{Consumption}}{\text{Btu of gas}} = \frac{75{,}000}{1{,}000} = 75 \text{ cfh}$$

Maximum gas demand for outlet D:

$$\frac{\text{Consumption}}{\text{Btu of gas}} = \frac{136{,}000}{1{,}000} = 136 \text{ cfh}$$

(Solution continued from p. 92)

(2) The length of pipe from the gas meter to the most remote outlet (A) is 60 feet. This is the only distance used.

(3) Using the column marked 60 feet in Table 1-B3 (provided this is the Table designated for use by the serving gas supplier):

Outlet A, supplying 30 cfh, requires $\frac{3}{8}$ inch pipe.

Outlet B, supplying 3 cfh, requires $\frac{1}{4}$ inch pipe.

Section 1, supplying outlets A and B, or 33 cfh, requires $\frac{3}{8}$ inch pipe.

Outlet C, supplying 75 cfh, requires $\frac{3}{4}$ inch pipe.

Section 2, supplying outlets A, B and C, or 108 cfh, requires $\frac{3}{4}$ inch pipe.

Outlet D, supplying 136 cfh, requires $\frac{3}{4}$ inch pipe.

Section 3, supplying outlets A, B, C and D, or 244 cfh, requires 1 inch pipe.

(4) If the gravity factor (see (d) under Description of Tables) is applied to this example, the values in the column marked 60 feet of Table 1-B3 would be multiplied by the multiplier (.96) from Table 1-B6, and the resulting cubic feet per hour values would be used to size the piping.

APPENDIX 1-C FLOW OF GAS THROUGH FIXED ORIFICES

(This Appendix is informative and is not a part of the Code).

Table 1-C1

Utility Gases

(Cubic feet per hour at sea level)

Specific Gravity = 0.60

Orifice Coefficient = 0.90

For utility gases of another specific gravity, select multiplier from Table 1-C3.

For altitudes above 2,000 feet, first select the equivalent orifice size at sea level from Table 1-C4.

Orifice or Drill Size	Pressure at Orifice — Inches Water Column								
	3	3.5	4	5	6	7	8	9	10
80	.48	.52	.55	.63	.69	.73	.79	.83	.88
79	.55	.59	.64	.72	.80	.84	.90	.97	1.01
78	.70	.76	.78	.88	.97	1.04	1.10	1.17	1.24
77	.88	.95	.99	1.11	1.23	1.31	1.38	1.47	1.55
76	1.05	1.13	1.21	1.37	1.52	1.61	1.72	1.83	1.92
75	1.16	1.25	1.34	1.52	1.64	1.79	1.91	2.04	2.14
74	1.33	1.44	1.55	1.74	1.91	2.05	2.18	2.32	2.44
73	1.51	1.63	1.76	1.99	2.17	2.32	2.48	2.64	2.78
72	1.64	1.77	1.90	2.15	2.40	2.52	2.69	2.86	3.00
71	1.82	1.97	2.06	2.33	2.54	2.73	2.91	3.11	3.26
70	2.06	2.22	2.39	2.70	2.97	3.16	3.38	3.59	3.78
69	2.25	2.43	2.61	2.96	3.23	3.47	3.68	3.94	4.14
68	2.52	2.72	2.93	3.26	3.58	3.88	4.14	4.41	4.64
67	2.69	2.91	3.12	3.52	3.87	4.13	4.41	4.69	4.94
66	2.86	3.09	3.32	3.75	4.11	4.39	4.68	4.98	5.24
65	3.14	3.39	3.72	4.28	4.62	4.84	5.16	5.50	5.78
64	3.41	3.68	4.14	4.48	4.91	5.23	5.59	5.95	6.26
63	3.63	3.92	4.19	4.75	5.19	5.55	5.92	6.30	6.63
62	3.78	4.08	4.39	4.96	5.42	5.81	6.20	6.59	6.94
61	4.02	4.34	4.66	5.27	5.77	6.15	6.57	7.00	7.37
60	4.21	4.55	4.89	5.52	5.95	6.47	6.91	7.35	7.74
59	4.41	4.76	5.11	5.78	6.35	6.78	7.25	7.71	8.11
58	4.66	5.03	5.39	6.10	6.68	7.13	7.62	8.11	8.53
57	4.84	5.23	5.63	6.36	6.96	7.44	7.94	8.46	8.90
56	5.68	6.13	6.58	7.35	8.03	8.73	9.32	9.92	10.44
55	7.11	7.68	8.22	9.30	10.18	10.85	11.59	12.34	12.98
54	7.95	8.59	9.23	10.45	11.39	12.25	13.08	13.93	14.65
53	9.30	10.04	10.80	12.20	13.32	14.29	15.27	16.25	17.09
52	10.61	11.46	12.31	13.86	15.26	16.34	17.44	18.57	19.53
51	11.82	12.77	13.69	15.47	16.97	18.16	19.40	20.64	21.71
50	12.89	13.92	14.94	16.86	18.48	19.77	21.12	22.48	23.65
49	14.07	15.20	16.28	18.37	20.20	21.60	23.06	24.56	25.83
48	15.15	16.36	17.62	19.88	21.81	23.31	24.90	26.51	27.89
47	16.22	17.52	18.80	21.27	23.21	24.93	26.62	28.34	29.81
46	17.19	18.57	19.98	22.57	24.72	26.43	28.23	30.05	31.61

Table 1-C1 (Continued)

Orifice or Drill	Pressure at Orifice — Inches Water Column								
Size	3	3.5	4	5	6	7	8	9	10
45	17.73	19.15	20.52	23.10	25.36	27.18	29.03	30.90	32.51
44	19.45	21.01	22.57	25.57	27.93	29.87	31.89	33.96	35.72
43	20.73	22.39	24.18	27.29	29.87	32.02	34.19	36.41	38.30
42	23.10	24.95	26.50	29.50	32.50	35.24	37.63	40.07	42.14
41	24.06	25.98	28.15	31.69	34.81	37.17	39.70	42.27	44.46
40	25.03	27.03	29.23	33.09	36.20	38.79	41.42	44.10	46.38
39	26.11	28.20	30.20	34.05	37.38	39.97	42.68	45.44	47.80
38	27.08	29.25	31.38	35.46	38.89	41.58	44.40	47.27	49.73
37	28.36	30.63	32.99	37.07	40.83	43.62	46.59	49.60	52.17
36	29.76	32.14	34.59	39.11	42.76	45.77	48.88	52.04	54.74
35	32.36	34.95	36.86	41.68	45.66	48.78	52.10	55.46	58.34
34	32.45	35.05	37.50	42.44	46.52	49.75	53.12	56.55	59.49
33	33.41	36.08	38.79	43.83	48.03	51.46	54.96	58.62	61.55
32	35.46	38.30	40.94	46.52	50.82	54.26	57.95	61.70	64.89
31	37.82	40.85	43.83	49.64	54.36	58.01	61.96	65.97	69.39
30	43.40	46.87	50.39	57.05	62.09	66.72	71.22	75.86	79.80
29	48.45	52.33	56.19	63.61	69.62	74.45	79.52	84.66	89.04
28	51.78	55.92	59.50	67.00	73.50	79.50	84.92	90.39	95.09
27	54.47	58.83	63.17	71.55	78.32	83.59	89.27	95.04	99.97
26	56.73	61.27	65.86	74.57	81.65	87.24	93.17	99.19	104.57
25	58.87	63.58	68.22	77.14	84.67	90.36	96.50	102.74	108.07
24	60.81	65.67	70.58	79.83	87.56	93.47	99.83	106.28	111.79
23	62.10	67.07	72.20	81.65	89.39	94.55	100.98	107.49	113.07
22	64.89	70.08	75.21	85.10	93.25	99.60	106.39	113.24	119.12
21	66.51	71.83	77.14	87.35	95.63	102.29	109.24	116.29	122.33
20	68.22	73.68	79.08	89.49	97.99	104.75	111.87	119.10	125.28
19	72.20	77.98	83.69	94.76	103.89	110.67	118.55	125.82	132.36
18	75.53	81.57	87.56	97.50	108.52	116.03	123.92	131.93	138.78
17	78.54	84.82	91.10	103.14	112.81	120.33	128.52	136.82	143.91
16	82.19	88.77	95.40	107.98	118.18	126.78	135.39	144.15	151.63
15	85.20	92.02	98.84	111.74	122.48	131.07	139.98	149.03	156.77
14	87.10	94.40	100.78	114.21	124.44	133.22	142.28	151.47	159.33
13	89.92	97.11	104.32	118.18	128.93	138.60	148.02	157.58	165.76
12	93.90	101.41	108.52	123.56	135.37	143.97	153.75	163.69	172.13
11	95.94	103.62	111.31	126.02	137.52	147.20	157.20	167.36	176.03
10	98.30	106.16	114.21	129.25	141.82	151.50	161.81	172.26	181.13
9	100.99	109.07	117.11	132.58	145.05	154.71	165.23	175.91	185.03
8	103.89	112.20	120.65	136.44	149.33	160.08	170.96	182.00	191.44
7	105.93	114.40	123.01	139.23	152.56	163.31	174.38	185.68	195.30
6	109.15	117.88	126.78	142.88	156.83	167.51	178.88	190.46	200.36
5	111.08	119.97	128.93	145.79	160.08	170.82	182.48	194.22	204.30
4	114.75	123.93	133.22	150.41	164.36	176.18	188.16	200.25	210.71
3	119.25	128.79	137.52	156.26	170.78	182.64	195.08	207.66	218.44
2	128.48	138.76	148.61	168.64	184.79	197.66	211.05	224.74	235.58
1	136.35	147.26	158.25	179.33	194.63	209.48	223.65	238.16	250.54

Table 1-C2

LP-Gases
(Btu per hour at sea level)

	Propane	Butane
Btu per Cubic Foot =	2,500	3,175
Specific Gravity =	1.53	2.00
Pressure at Orifice, Inches Water Column =	11	11
Orifice Coefficient =	0.9	0.9

For altitudes above 2,000 feet, first select the equivalent orifice size at sea level from Table 1-C4.

Orifice or Drill Size	Propane	Butane or Butane-Propane Mixtures
.008	500	554
.009	641	709
.010	791	875
.011	951	1,053
.012	1,130	1,250
80	1,430	1,590
79	1,655	1,830
78	2,015	2,230
77	2,545	2,815
76	3,140	3,480
75	3,465	3,840
74	3,985	4,410
73	4,525	5,010
72	4,920	5,450
71	5,320	5,900
70	6,180	6,830
69	6,710	7,430
68	7,560	8,370
67	8,040	8,910
66	8,550	9,470
65	9,630	10,670
64	10,200	11,300
63	10,800	11,900
62	11,360	12,530
61	11,930	13,280
60	12,570	13,840
59	13,220	14,630
58	13,840	15,300
57	14,550	16,090
56	16,990	18,790
55	21,200	23,510
54	23,850	26,300
53	27,790	30,830
52	31,730	35,100
51	35,330	39,400
50	38,500	42,800

Table 1-C2 (Continued)

Orifice or Drill Size	Propane	Butane or Butane-Propane Mixtures
49	41,850	45,350
48	45,450	50,300
47	48,400	53,550
46	51,500	57,000
45	52,900	58,500
44	58,050	64,350
43	62,200	69,000
42	68,700	76,200
41	72,450	80,200
40	75,400	83,500
39	77,850	86,200
38	81,000	89,550
37	85,000	94,000
36	89,200	98,800
35	95,000	105,300
34	97,000	107,200
33	101,000	111,900
32	105,800	117,000
31	113,200	125,400
30	129,700	143,600
29	145,700	163,400
28	154,700	171,600
27	163,100	180,000
26	169,900	187,900
25	175,500	194,600
24	181,700	201,600
23	186,800	206,400
22	193,500	214,500
21	198,600	220,200
20	203,700	225,000
19	217,100	241,900
18	225,600	249,800

Table 1-C3

Multipliers for Utility Gases of Another Specific Gravity

Specific Gravity	Multiplier	Specific Gravity	Multiplier
0.45	1.155	0.95	0.795
0.50	1.095	1.00	0.775
0.55	1.045	1.05	0.756
0.60	1.000	1.10	0.739
0.65	0.961	1.15	0.722
0.70	0.926	1.20	0.707
0.75	0.894	1.25	0.693
0.80	0.866	1.30	0.679
0.85	0.840	1.35	0.667
0.90	0.817	1.40	0.655

Table 1-C4

Equivalent Orifice Sizes at High Altitudes
(Includes 4% input reduction for each 1,000 feet)

Orifice Size at Sea Level	Orifice Size Required at Other Elevations								
	2000	3000	4000	5000	6000	7000	8000	9000	10000
1	2	2	3	3	4	5	7	8	10
2	3	3	4	5	6	7	9	10	12
3	4	5	7	8	9	10	12	13	15
4	6	7	8	9	11	12	13	14	16
5	7	8	9	10	12	13	14	15	17
6	8	9	10	11	12	13	14	16	17
7	9	10	11	12	13	14	15	16	18
8	10	11	12	13	13	15	16	17	18
9	11	12	12	13	14	16	17	18	19
10	12	13	13	14	15	16	17	18	19
11	13	13	14	15	16	17	18	19	20
12	13	14	15	16	17	17	18	19	20
13	15	15	16	17	18	18	19	20	22
14	16	16	17	18	18	19	20	21	23
15	16	17	17	18	19	20	20	22	24
16	17	18	18	19	19	20	22	23	25
17	18	19	19	20	21	22	23	24	26
18	19	19	20	21	22	23	24	26	27
19	20	20	21	22	23	25	26	27	28
20	22	22	23	24	25	26	27	28	29
21	23	23	24	25	26	27	28	28	29
22	23	24	25	26	27	27	28	29	29
23	25	25	26	27	27	28	29	29	30
24	25	26	27	27	28	28	29	29	30
25	26	27	27	28	28	29	29	30	30
26	27	28	28	28	29	29	30	30	30
27	28	28	29	29	29	30	30	30	31
28	29	29	29	30	30	30	30	31	31
29	29	30	30	30	30	31	31	31	32
30	30	31	31	31	31	32	32	33	35
31	32	32	32	33	34	35	36	37	38
32	33	34	35	35	36	36	37	38	40
33	35	35	36	36	37	38	38	40	41
34	35	36	36	37	37	38	39	40	42
35	36	36	37	37	38	39	40	41	42
36	37	38	38	39	40	41	41	42	43
37	38	39	39	40	41	42	42	43	43
38	39	40	41	41	42	42	43	43	44
39	40	41	41	42	42	43	43	44	44
40	41	42	42	42	43	43	44	44	45
41	42	42	42	43	43	44	44	45	46
42	42	43	43	43	44	44	45	46	47
43	44	44	44	45	45	46	47	47	48
44	45	45	45	46	47	47	48	48	49
45	46	47	47	47	48	48	49	49	50
46	47	47	47	48	48	49	49	50	50

Table 1-C4 (Continued)

Orifice Size at Sea Level	Orifice Size Required at Other Elevations								
	2000	3000	4000	5000	6000	7000	8000	9000	10000
47	48	48	49	49	49	50	50	51	51
48	49	49	49	50	50	50	51	51	52
49	50	50	50	51	51	51	52	52	52
50	51	51	51	51	52	52	52	53	53
51	51	52	52	52	52	53	53	53	54
52	52	53	53	53	53	53	54	54	54
53	54	54	54	54	54	54	55	55	55
54	54	55	55	55	55	55	56	56	56
55	55	55	55	56	56	56	56	56	57
56	56	56	57	57	57	58	59	59	60
57	58	59	59	60	60	61	62	63	63
58	59	60	60	61	62	62	63	63	64
59	60	61	61	62	62	63	64	64	65
60	61	61	62	63	63	64	64	65	65
61	62	62	63	63	64	65	65	66	66
62	63	63	64	64	65	65	66	66	67
63	64	64	65	65	65	66	66	67	68
64	65	65	65	66	66	66	67	67	68
65	65	66	66	66	67	67	68	68	69
66	67	67	68	68	68	69	69	69	70
67	68	68	68	69	69	69	70	70	70
68	68	69	69	69	70	70	70	71	71
69	70	70	70	70	71	71	71	72	72
70	70	71	71	71	71	72	72	73	73
71	72	72	72	73	73	73	74	74	74
72	73	73	73	73	74	74	74	74	75
73	73	74	74	74	74	75	75	75	76
74	74	75	75	75	75	76	76	76	76
75	75	76	76	76	76	77	77	77	77
76	76	76	77	77	77	77	77	77	77
77	77	77	77	78	78	78	78	78	78
78	78	78	78	79	79	79	79	80	80
79	79	80	80	80	80	.013	.012	.012	.012
80	80	.013	.013	.013	.012	.012	.012	.012	.011

Use of Orifice Tables

A. To Check Burner Input in Accordance with 1.6.1.3(b):

Gage size of burner orifice and determine flow rate at sea level from Table 1-C1 — Utility Gases (cubic feet hour), or from Table 1-C2 — LP-Gases (Btu per hour). When the specific gravity of the utility gas is other than 0.6, select the multiplier from Table 1-C3 for the specific gravity of the utility gas served and apply to the flow rate as determined from Table 1-C1. When altitude is above 2,000 feet, first select equivalent orifice size at sea level using Table 1-C4 and then determine flow rate from Table 1-C1 or Table 1-C2 as directed above.

Having determined flow rate (as adjusted for specific gravity and/or altitude when necessary), check the burner input at sea level with the manufacturer's rated input.

B. To Select Correct Orifice Size for Rated Burner Input:

The selection of a fixed orifice size for any rated burner input is affected by many variables, including orifice coefficient, and it is recommended that the appliance manufacturer be consulted for that purpose. When correct orifice size cannot be readily determined, the orifice flow rates, as stated in the tables in this appendix, may be used to select a fixed orifice size with a flow rate to approximately equal the required rated burner input.

For gases of the specific gravity and pressure conditions stipulated at elevations under 2,000 feet, Table 1-C1 (in cubic feet per hour) or Table 1-C2 (in Btu per hour) may be used directly.

When the specific gravity of the gas is other than 0.6, select the multiplier from Table 1-C3 for the utility gas served and **divide** the rated burner input by the selected factor to determine equivalent input at a specific gravity of 0.60 and then select orifice size as directed above.

When the appliance is located at an altitude of 2,000 feet or above, first use the manufacturer's rated input at sea level to select orifice size as directed above, then use Table 1-C4 to select the equivalent orifice size for use at the higher altitude.

APPENDIX 1-D

SIZING OF VENTING SYSTEMS SERVING APPLIANCES EQUIPPED WITH DRAFT HOODS AND APPLIANCES LISTED FOR USE WITH TYPE B VENTS

(This Appendix is informative and is not a part of the Code.)

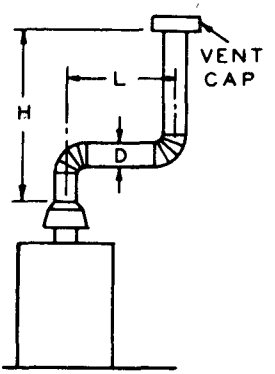

Figure 1-D1
Double Wall or Asbestos Cement Type B Vents or Single-Wall Metal Vents Serving a Single Appliance. (See Tables 1-D1 and 1-D2.)

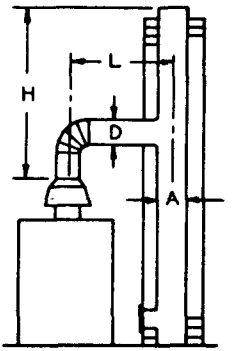

Figure 1-D2
Masonry Chimney Serving a Single Appliance. (See Table 1-D3.)

Notes for Single Appliance Vents. *(See Tables 1-D1, 1-D2 and 1-D3.)*

1. For single-wall metal pipe, use Table 1-D2.
2. If the vent size determined from the Tables is less than the size of the draft hood, the smaller sized vent may be used as long as the vent height "H" is at least 10 feet.
3. Vents for draft hoods 12 inches in diameter or less should not be reduced more than one size (12 inches to 10 inches is a one-size reduction). For larger gas-burning equipment, reductions of more than two sizes (24 inches to 20 inches is a two-size reduction) are not recommended.
4. Regardless of the vent size shown, do not connect any 4-inch draft hoods to 3-inch vents.
5. Zero (0) lateral "L" applies only to a straight vertical vent attached to a top outlet draft hood.
6. Use sea level input rating when calculating vent size for high altitude installation.
7. Designation "NR" in Tables 1-D1, 1-D2 and 1-D3 indicates not recommended.
8. Number followed by an asterisk (*) in Tables 1-D2 and 1-D3 indicate the possibility of continuous condensation, depending on locality. Consult local serving gas supplier and/or local codes.

Table 1-D1

Capacity of Type B Double-Wall Vents with Type B Double-Wall Connectors Serving a Single Appliance

Height H	Lateral L	Vent Diameter — D													
		3"	4"	5"	6"	7"	8"	10"	12"	14"	16"	18"	20"	22"	24"
		Maximum Appliance Input Rating in Thousands of Btu Per Hour													
6′	0	46	86	141	205	285	370	570	850	1170	1530	1960	2430	2950	3520
	2′	36	67	105	157	217	285	455	650	890	1170	1480	1850	2220	2670
	6′	32	61	100	149	205	273	435	630	870	1150	1470	1820	2210	2650
	12′	28	55	91	137	190	255	406	610	840	1110	1430	1795	2180	2600
8′	0	50	94	155	235	320	415	660	970	1320	1740	2220	2750	3360	4010
	2′	40	75	120	180	247	322	515	745	1020	1340	1700	2110	2560	3050
	8′	35	66	109	165	227	303	490	720	1000	1320	1670	2070	2530	3030
	16′	28	58	96	148	206	281	458	685	950	1260	1600	2035	2470	2960
10′	0	53	100	166	255	345	450	720	1060	1450	1925	2450	3050	3710	4450
	2′	42	81	129	195	273	355	560	850	1130	1480	1890	2340	2840	3390
	10′	36	70	115	175	245	330	525	795	1080	1430	1840	2280	2780	3340
	20′	NR	60	100	154	217	300	486	735	1030	1360	1780	2230	2720	3250
15′	0	58	112	187	285	390	525	840	1240	1720	2270	2900	3620	4410	5300
	2′	48	93	150	225	316	414	675	985	1350	1770	2260	2800	3410	4080
	15′	37	76	128	198	275	373	610	905	1250	1675	2150	2700	3300	3980
	30′	NR	60	107	169	243	328	553	845	1180	1550	2050	2620	3210	3840
20′	0	61	119	202	307	430	575	930	1350	1900	2520	3250	4060	4980	6000
	2′	51	100	166	249	346	470	755	1100	1520	2000	2570	3200	3910	4700
	10′	44	89	150	228	321	443	710	1045	1460	1940	2500	3130	3830	4600
	20′	35	78	134	206	295	410	665	990	1390	1880	2430	3050	3760	4550
	30′	NR	68	120	186	273	380	626	945	1270	1700	2330	2980	3650	4390

Table 1-D1 (Continued)

Height H	Lateral L	Vent Diameter — D													
		3"	4"	5"	6"	7"	8"	10"	12"	14"	16"	18"	20"	22"	24"
		Maximum Appliance Input Rating in Thousands of Btu Per Hour													
30'	0	64	128	220	336	475	650	1060	1550	2170	2920	3770	4750	5850	7060
	2'	56	112	185	280	394	535	865	1310	1800	2380	3050	3810	4650	5600
	20'	NR	90	154	237	343	473	784	1185	1650	2200	2870	3650	4480	5310
	40'	NR	NR	NR	200	298	415	705	1075	1520	2060	2700	3480	4270	5140
40'	0	66	132	228	353	500	685	1140	1730	2400	3230	4180	5270	6500	7860
	2'	59	118	198	298	420	579	960	1420	2000	2660	3420	4300	5260	6320
	20'	NR	96	167	261	377	516	860	1310	1830	2460	3200	4050	5000	6070
	40'	NR	NR	NR	223	333	460	785	1205	1710	2310	3020	3840	4780	5820
60'	0	NR	136	236	373	535	730	1250	1920	2700	3650	4740	6000	7380	9000
	2'	NR	125	213	330	470	650	1060	1605	2250	3020	3920	4960	6130	7400
	30'	NR	NR	170	275	397	555	930	1440	2050	2780	3640	4700	5730	7000
	60'	NR	NR	NR	NR	334	475	830	1285	1870	2560	3380	4330	5420	6600
80'	0	NR	NR	239	384	550	755	1290	2020	2880	3900	5100	6450	8000	9750
	2'	NR	NR	217	350	495	683	1145	1740	2460	3320	4310	5450	6740	8200
	40'	NR	NR	NR	275	404	570	980	1515	2180	2980	3920	5000	6270	7650
	80'	NR	NR	NR	NR	NR	NR	850	1420	2000	2750	3640	4680	5850	7200
100'	0	NR	NR	NR	400	560	770	1310	2050	2950	4050	5300	6700	8600	10300
	2'	NR	NR	NR	375	510	700	1170	1820	2550	3500	4600	5800	7200	8800
	50'	NR	NR	NR	NR	405	575	1000	1550	2250	3100	4050	5300	6600	8100
	100'	NR	NR	NR	NR	NR	NR	870	1430	2050	2850	3750	4900	6100	7500

See Figure 1-D1 and Notes for Single Appliance Vents.

Table 1-D2

Capacity of Single-Wall Metal Pipe or Type B Asbestos Cement Vents Serving a Single Appliance

Height H	Lateral L	Vent Diameter — D							
		3"	4"	5"	6"	7"	8"	10"	12"
		Maximum Appliance Input Rating in Thousands of Btu Per Hour							
6'	0	39	70	116	170	232	312	500	750
	2'	31	55	94	141	194	260	415	620
	5'	28	51	88	128	177	242	390	600
8'	0	42	76	126	185	252	340	542	815
	2'	32	61	102	154	210	284	451	680
	5'	29	56	95	141	194	264	430	648
	10'	24*	49	86	131	180	250	406	625
10'	0	45	84	138	202	279	372	606	912
	2'	35	67	111	168	233	311	505	760
	5'	32	61	104	153	215	289	480	724
	10'	27*	54	94	143	200	274	455	700
	15'	NR	46*	84	130	186	258	432	666
15'	0	49	91	151	223	312	420	684	1040
	2'	39	72	122	186	260	350	570	865
	5'	35*	67	110	170	240	325	540	825
	10'	30*	58*	103	158	223	308	514	795
	15'	NR	50*	93*	144	207	291	488	760
	20'	NR	NR	82*	132*	195	273	466	726
20'	0	53*	101	163	252	342	470	770	1190
	2'	42*	80	136	210	286	392	641	990
	5'	38*	74*	123	192	264	364	610	945
	10'	32*	65*	115*	178	246	345	571	910
	15'	NR	55*	104*	163	228	326	550	870
	20'	NR	NR	91*	149*	214*	306	525	832
30'	0	56*	108*	183	276	384	529	878	1370
	2'	44*	84*	148*	230	320	441	730	1140
	5'	NR	78*	137*	210	296	410	694	1080
	10'	NR	68*	125*	196*	274	388	656	1050
	15'	NR	NR	113*	177*	258*	366	625	1000
	20'	NR	NR	99*	163*	240*	344	596	960
	30'	NR	NR	NR	NR	192*	295*	540	890
50'	0	NR	120*	210*	310*	443*	590	980	1550
	2'	NR	95*	171*	260*	370*	492	820	1290
	5'	NR	NR	159*	234*	342*	474	780	1230
	10'	NR	NR	146*	221*	318*	456*	730	1190
	15'	NR	NR	NR	200*	292*	407*	705	1130
	20'	NR	NR	NR	185*	276*	384*	670*	1080
	30'	NR	NR	NR	NR	222*	330*	605*	1010

See Figure 1-D1 and Notes for Single Appliance Vents.

Table 1-D3

Capacity of Masonry Chimneys and Single-Wall Vent Connectors Serving a Single Appliance

Height H	Lateral L	Single-Wall Vent Connector Diameter — D							
		To be used with chimney areas not less than those at bottom							
		3"	4"	5"	6"	7"	8"	10"	12"
		Maximum Appliance Input Rating in Thousands of Btu Per Hour							
6'	2'	28	52	86	130	180	247	400	580
	5'	25*	48	81	118	164	230	375	560
8'	2'	29	55	93	145	197	265	445	650
	5'	26*	51	87	133	182	246	422	638
	10'	22*	44*	79	123	169	233	400	598
10'	2'	31	61	102	161	220	297	490	722
	5'	28*	56	95	147	203	276	465	710
	10'	24*	49*	86	137	189	261	441	665
	15'	NR	42*	79*	125	175	246	421	634
15'	2'	35*	67	113	178	249	335	560	840
	5'	32*	61	106	163	230	312	531	825
	10'	27*	54*	96	151	214	294	504	774
	15'	NR	46*	87*	138	198	278	481	738
	20'	NR	NR	73*	128*	184	261	459	706
20'	2'	38*	73	123	200	273	374	625	950
	5'	35*	67*	115	183	252	348	594	930
	10'	NR	59*	105*	170	235	330	562	875
	15'	NR	NR	95*	156	217	311	536	835
	20'	NR	NR	80*	144*	202	292	510	800
30'	2'	41*	81*	136	215	302	420	715	1110
	5'	NR	75*	127*	196	279	391	680	1090
	10'	NR	66*	113*	182*	260	370	644	1020
	15'	NR	NR	105*	168*	240*	349	615	975
	20'	NR	NR	88*	155*	223*	327	585	932
	30'	NR	NR	NR	NR	182*	281*	544	865
50'	2'	NR	91*	160*	250*	350*	475	810	1240
	5'	NR	NR	149*	228*	321*	442	770	1220
	10'	NR	NR	136*	212*	301*	420*	728	1140
	15'	NR	NR	124*	195*	278*	395*	695	1090
	20'	NR	NR	NR	180*	258*	370*	660*	1040
	30'	NR	NR	NR	NR	NR	318*	610*	970
Minimum Internal Area of Chimney-A Square Inches		19		28	38	50	63	95	132

See Table 1-D7 for Masonry Chimney Liner Sizes.
See Figure 1-D2 and Notes for Single Appliance Vents.

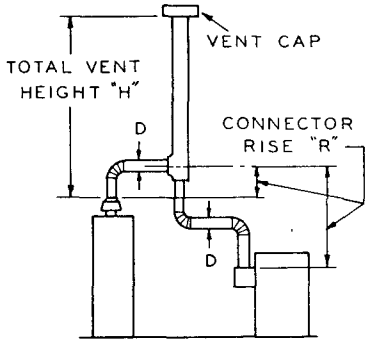

Figure 1-D3
Double-Wall or Asbestos Cement Type B Vents or Single-Wall Metal Vents Serving Two or More Appliances. (See Tables 1-D4 and 1-D5.)

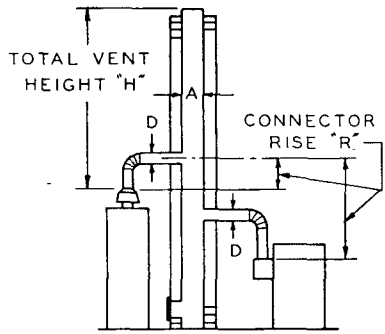

Figure 1-D4
Masonry Chimney Serving Two or More Appliances. (See Table 1-D6.)

Notes for Multiple Appliance Vents. (*See Tables 1-D4, 1-D5, and 1-D6.*)

1. For single-wall metal pipe connectors, use Table 1-D5.

2. Maximum Vent Connector Length: 1½ feet for every inch of connector diameter. Greater lengths require increase in size, rise or total vent height, to obtain full capacity.

3. Each 90-degree turn in excess of the first two reduces the connector capacity by 10 percent.

4. Each 90-degree turn in the common vent reduces capacity by 10 percent.

5. Where possible, locate vent closer to or directly over smaller appliance connector.

6. Connectors must be equal to or larger than draft hood outlets.

7. If both connectors are same size, common vent must be at least one size larger, regardless of tabulated capacity.

8. Common vent must be equal to or larger than largest connector.

9. Interconnection fittings must be same size as common vent.

10. Use sea level input rating when calculating vent size for high altitude installation.

11. Designation "NR" in Tables 1-D4, 1-D5 and 1-D6 indicates not recommended.

Table 1-D4

Capacity of Type B Double-Wall Vents with Type B Double-Wall Connectors Serving Two or More Appliances

Vent Connector Capacity

Total Vent Height "H"	Connector Rise "R"	Vent Connector Diameter — D													
		3"	4"	5"	6"	7"	8"	10"	12"	14"	16"	18"	20"	22"	24"
		Maximum Appliance Input Rating in Thousands of Btu Per Hour													
6'	1'	26	46	72	104	142	185	289	416	577	755	955	1180	1425	1700
	2'	31	55	86	124	168	220	345	496	653	853	1080	1335	1610	1920
	3'	35	62	96	139	189	248	386	556	740	967	1225	1510	1830	2180
8'	1'	27	48	76	109	148	194	303	439	601	805	1015	1255	1520	1810
	2'	32	57	90	129	175	230	358	516	696	910	1150	1420	1720	2050
	3'	36	64	101	145	198	258	402	580	790	1030	1305	1610	1950	2320
10'	1'	28	50	78	113	154	200	314	452	642	840	1060	1310	1585	1890
	2'	33	59	93	134	182	238	372	536	730	955	1205	1490	1800	2150
	3'	37	67	104	150	205	268	417	600	827	1080	1370	1690	2040	2430
15'	1'	30	53	83	120	163	214	333	480	697	910	1150	1420	1720	2050
	2'	35	63	99	142	193	253	394	568	790	1030	1305	1610	1950	2320
	3'	40	71	111	160	218	286	444	640	898	1175	1485	1835	2220	2640
20'	1'	31	56	87	125	171	224	347	500	740	965	1225	1510	1830	2190
	2'	37	66	104	149	202	265	414	596	840	1095	1385	1710	2070	2470
	3'	42	74	116	168	228	300	466	672	952	1245	1575	1945	2350	2800
30'	1'	33	59	93	134	182	238	372	536	805	1050	1330	1645	1990	2370
	2'	39	70	110	158	215	282	439	632	910	1190	1500	1855	2240	2670
	3'	44	79	124	178	242	317	494	712	1035	1350	1710	2110	2550	3040
40'	1'	35	62	97	140	190	248	389	560	850	1110	1405	1735	2100	2500
	2'	41	73	115	166	225	295	461	665	964	1260	1590	1965	2380	2830
	3'	46	83	129	187	253	331	520	748	1100	1435	1820	2240	2710	3230
60' to 100'	1'	37	66	104	150	204	266	417	600	926	1210	1530	1890	2280	2720
	2'	44	79	123	178	242	316	494	712	1050	1370	1740	2150	2590	3090
	3'	50	89	138	200	272	355	555	800	1198	1565	1980	2450	2960	3520

Table 1-D4 (Continued)

Common Vent Capacity

Total Vent Height "H"	Common Vent Diameter													
	3"	4"	5"	6"	7"	8"	10"	12"	14"	16"	18"	20"	22"	24"
	Combined Appliance Input Rating in Thousands of Btu Per Hour													
6′	—	65	103	147	200	260	410	588	815	1065	1345	1660	1970	2390
8′	—	73	114	163	223	290	465	652	912	1190	1510	1860	2200	2680
10′	—	79	124	178	242	315	495	712	995	1300	1645	2030	2400	2920
15′	—	91	144	206	280	365	565	825	1158	1510	1910	2360	2790	3400
20′	—	102	160	229	310	405	640	916	1290	1690	2140	2640	3120	3800
30′	—	118	185	266	360	470	740	1025	1525	1990	2520	3110	3680	4480
40′	—	131	203	295	405	525	820	1180	1715	2240	2830	3500	4150	5050
60′	—	NR	224	324	440	575	900	1380	2010	2620	3320	4100	4850	5900
80′	—	NR	NR	344	468	610	955	1540	2250	2930	3710	4590	5420	6600
100′	—	NR	NR	NR	479	625	975	1670	2450	3200	4050	5000	5920	7200

See Figure 1-D3 and Notes for Multiple Appliance Vents.

Table 1-D5

Capacity of A Single-Wall Metal Pipe or Type B Asbestos Cement Vent Serving Two or More Appliances

Vent Connector Capacity

Total Vent Height "H"	Connector Rise "R"	Vent Connector Diameter — D					
		3"	4"	5"	6"	7"	8"
		Maximum Appliance Input Rating in Thousands of Btu Per Hour					
6'-8'	1'	21	40	68	102	146	205
	2'	28	53	86	124	178	235
	3'	34	61	98	147	204	275
15'	1'	23	44	77	117	179	240
	2'	30	56	92	134	194	265
	3'	35	64	102	155	216	298
30' and up	1'	25	49	84	129	190	270
	2'	31	58	97	145	211	295
	3'	36	68	107	164	232	321

Common Vent Capacity

Total Vent Height "H"	Common Vent Diameter						
	4"	5"	6"	7"	8"	10"	12"
	Combined Appliance Input Rating in Thousands of Btu Per Hour						
6'	48	78	111	155	205	320	NR
8'	55	89	128	175	234	365	505
10'	59	95	136	190	250	395	560
15'	71	115	168	228	305	480	690
20'	80	129	186	260	340	550	790
30'	NR	147	215	300	400	650	940
50'	NR	NR	NR	360	490	810	1190

See Figure 1-D3 and Notes for Multiple Appliance Vents.

Table 1-D6

Capacity of A Masonry Chimney and Single-Wall Vent Connectors Serving Two or More Appliances

Single-Wall Vent Connector Capacity

Total Vent Height "H"	Rise Connector "R"	Vent Connector Diameter — D					
		3"	4"	5"	6"	7"	8"
		Maximum Appliance Input Rating in Thousands of Btu Per Hour					
6'-8'	1'	21	39	66	100	140	200
	2'	28	52	84	123	172	231
	3'	34	61	97	142	202	269
15'	1'	23	43	73	112	171	225
	2'	30	54	88	132	189	256
	3'	34	63	101	151	213	289
30' and up	1'	24	47	80	124	183	250
	2'	31	57	93	142	205	282
	3'	35	65	105	160	229	312

Common Chimney Capacity

Total Vent Height "H"	Minimum Internal Area of Chimney — "A" Square Inches					
	19	28	38	50	78	113
	Combined Appliance Input Rating in Thousands of Btu Per Hour					
6'	45	71	102	142	245	NR
8'	52	81	118	162	277	405
10'	56	89	129	175	300	450
15'	66	105	150	210	360	540
20'	74	120	170	240	415	640
30'	NR	135	195	275	490	740
50'	NR	NR	NR	325	600	910

See Table 1-D7 for Masonry Chimney Liner Sizes.

See Figure 1-D4 and Notes for Multiple Appliance Vents.

Example of Multiple Vent Design Using Table 1-D4
Double Wall Type B Vent

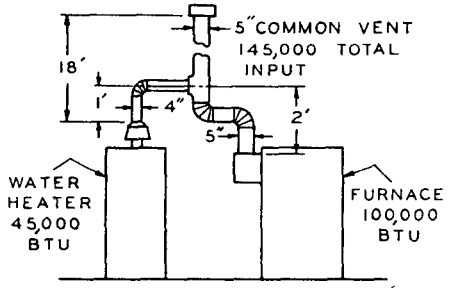

Figure 1-D5 Example: Connect a 45,000 Btu water heater with a 1 foot connector rise "R" and a 100,000 Btu furnace with a 2 foot connector rise "R" to a common vent with a minimum total vent height "H" of 18 feet.

1. WATER HEATER VENT CONNECTOR SIZE. Using Table 1-D4, read down Total Vent Height "H" column to 15 feet and read across 1 foot connector rise "R" line to Btu rating equal to or higher than water heater input rating. This figure shows 53,000 Btu and is in the column for 4-inch connector. Since this is in excess of the water heater input it is not necessary to find the maximum input for an 18 foot minimum total vent height. Use a 4-inch connector.

2. FURNACE VENT CONNECTOR SIZE. Under Vent Connector Tables read down Total Vent Height "H" column to 15 foot and read across 2 foot Connector Rise "R" line. Note 5-inch vent size shows 99,000 Btu per hour or less than furnace input. However, with 20 foot Total Height read across 2-foot connector rise line. Note 5-inch vent size shows 104,000 Btu per hour. Since 18-foot height is 3/5th of difference between 15- and 20-foot heights, take difference between 99,000 and 104,000 or 5,000 and add 3/5 of this to 15 foot figure of 99,000, 99,000 + 3,000 = 102,000 which is maximum input for 18-foot Total Vent Height. Therefore a 5-inch connector would be the correct size for the furnace, providing the furnace had a 5-inch or smaller draft hood outlet.

3. COMMON VENT SIZE. Total input to Common Vent is 145,000 Btu. Note that for 15-foot Total Vent Height "H" maximum Btu for 5-inch vent is 144,000. For 20-foot Total Vent Height "H" maximum Btu for 5-inch vent is 160,000.

Therefore for 18-foot Total Vent Height maximum allowable input would be 3/5 of difference between 144,000 and 160,000 = 3/5 x 16,000 or 9,600; 144,000 +9,600 = 153,600 which is greater than total input to common vent. Therefore common vent can be 5-inch-diameter pipe.

Table 1-D7

Masonry Chimney Liner Dimensions with Circular Equivalents

Nominal Liner Size Inches	Inside Dimensions of Liner in Inches	Inside Diameter or Equivalent Diameter Inches	Equivalent Area Square Inches
4 x 8	2½ x 6½	4	12.2
		5	19.6
		6	28.3
		7	38.3
8 x 8	6¾ x 6¾	7.4	42.7
		8	50.3
8 x 12	6½ x 10½	9	63.6
		10	78.5
12 x 12	9¾ x 9¾	10.4	83.3
		11	95
12 x 16	9½ x 13½	11.8	107.5
		12	113.0
		14	153.9
16 x 16	13¼ x 13¼	14.5	162.9
		15	176.7
16 x 20	13 x 17	16.2	206.1
		18	254.4
20 x 20	16¾ x 16¾	18.2	260.2
		20	314.1
20 x 24	16½ x 20½	20.1	314.2
		22	380.1
24 x 24	20¼ x 20¼	22.1	380.1
		24	452.3
24 x 28	20¼ x 24¼	24.1	456.2
28 x 28	24¼ x 24¼	26.4	543.3
		27	572.5
30 x 30	25½ x 25½	27.9	607
		30	706.8
30 x 36	25½ x 31½	30.9	749.9
		33	855.3
36 x 36	31½ x 31½	34.4	929.4
		36	1017.9

When liner sizes differ dimensionally from those shown in Table 1-D7, equivalent diameters may be determined from published tables for square and rectangular ducts of equivalent carrying capacity or by other engineering methods.

NATIONAL FUEL GAS CODE

PART 2

INSTALLATION OF GAS PIPING AND GAS EQUIPMENT ON INDUSTRIAL PREMISES AND CERTAIN OTHER PREMISES

2.1 GENERAL

2.1.1 Scope.

2.1.1.1 Applicability: Part 2 of this Code is a safety code for industrial gas piping systems on industrial premises and certain other premises and the installation of industrial gas utilization equipment and accessories for use with fuel gases such as natural gas, manufactured gas, liquefied petroleum gas in the vapor phase, liquefied petroleum gas-air mixtures, or mixtures of these gases, and gas-air mixtures within the flammable range, including:

(a) The design, fabrication, installation, testing, operation and maintenance of gas piping systems from the point of delivery to the connections with each gas utilization device. Piping systems covered by Part 2 of this Code are limited to a maximum operating pressure of 60 psig, except those piping systems for gas-air mixtures within the flammable range are limited to a maximum pressure of 10 psig. For purposes of this Code, the point of delivery is defined as the outlet of the meter set assembly, or the outlet of the service regulator or service shutoff valve when no meter is provided.

(b) The installation of gas utilization equipment, related accessories, and their ventilation and venting systems.

2.1.1.2 Nonapplicability: Part 2 of this Code does not apply to:

(a) Gas piping and appliance installations covered by Part I of this Code.

(b) Portable LP-Gas equipment of all types which are not connected to a fixed fuel piping system, such as plumbers' torches, portable heaters (salamanders), portable engines, self-propelled vehicles and asphalt kettles.

(c) Undiluted LP-Gas installations or portions of such installations covered by American National Standard *Storage and Handling of Liquefied Petroleum Gases*, Z106.1 (NFPA No. 58–1974),[1] except that Subparts 2.2, 2.3, 2.5 and 2.7 of this Code shall apply to such installations.

(d) Installation of farm equipment such as brooders, dehydrators, dryers and irrigation equipment. [*Reference may be made to Chapter 5 of American National Standard for Prevention of Fire and Dust Explosions in Grain Elevators and Bulk Grain Handling Facilities, Z12.4–1971* (NFPA No. 61B–1973).] [1]

(e) Raw material (feed stock) applications except for piping to special atmosphere generators.

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[1]Available from the American National Standards Institute, Inc., 1430 Broadway, New York, N. Y. 10018, or the National Fire Protection Association, 470 Atlantic Avenue, Boston, Mass. 02210.

(f) Oxygen-fuel gas cutting and welding systems. (*Reference may be made to NFPA No. 51–1974, Oxygen-Fuel Gas Systems for Welding and Cutting.*)[2]

(g) Industrial gas applications using such gases as acetylene and acetylenic compounds, hydrogen, ammonia, carbon monoxide, oxygen and nitrogen.

(h) Piping systems containing gas-air mixtures within the flammable range operating at pressures greater than 10 psig.

(i) Petroleum refineries, pipeline compressor or pumping stations, and natural gas processing plants.

(j) Large integrated chemical plants or portions of such plants where flammable or combustible liquids or gases are produced by chemical reactions or used in chemical reactions.

(k) LP-Gas installation at utility gas plants. (*Reference may be made to NFPA No. 59–1974, Liquefied Petroleum Gases at Utility Gas Plants.*)[2]

(l) LNG installations. [*Reference may be made to American National Standard Production, Storage and Handling of Liquefied Natural Gas, Z225.1–1972 (NFPA No. 59A–1972).*][1]

(m) Gas transmission and distribution piping systems covered by American National Standard *Gas Transmission and Distribution Piping Systems*, B31.8–1968, and Supplement, B31.8b–1969.[3]

2.1.1.3 In applying Part 2 of this Code, reference shall also be made to the manufacturer's instructions, gas supplier regulations, and local building, plumbing, heating or other codes in effect in the area in which the installation is made.

2.1.2 Acceptable Gas Equipment and Accessories.

2.1.2.1 Gas appliances, accessories and equipment shall be "Approved." "Approved" shall mean "acceptable to the authority having jurisdiction."

2.1.2.2 Acceptance of gas equipment and accessories shall be on the basis of a sound engineering evaluation. Consideration shall be given to the use of listed equipment and accessories. However, much of the equipment covered by this Code is not listed. In such cases, the equipment shall be safe and suitable for the proposed service and be recommended for the service by the manufacturer.

NOTE: The National Fire Protection Association and the American National Standards Institute do not approve, inspect or certify any installations, procedures, equipment or materials nor do they approve or evaluate testing laboratories.

In determining the acceptability of installations or procedures, equipment or materials, the authority having jurisdiction may also base acceptance on compliance with NFPA, ANSI or other appropriate standards. In the absence of such standards, said authority may require evidence

[1]Available from the American National Standards Institute, Inc., 1430 Broadway, New York, N.Y. 10018, or the National Fire Protection Association, 470 Atlantic Avenue, Boston, Mass. 02210.

[2]Available from the National Fire Protection Association, 470 Atlantic Avenue, Boston, Mass. 02210.

[3]Available from the American National Standards Institute, Inc., 1430 Broadway, New York, N. Y. 10018, or The American Society of Mechanical Engineers, 345 East 47th Street, New York, N. Y. 10017.

of proper installation, procedure or use. The authority having jurisdiction may also refer to the listings or labeling practices of nationally recognized testing laboratories,[1] i.e., laboratories qualified and equipped to conduct the necessary tests, in a position to determine compliance with appropriate standards for the current production of listed items, and the satisfactory performance of such equipment or materials in actual usage; or the recommendations of a nationally recognized engineering agency specializing in the field of safety to life and property.[2]

2.1.3 Assignment and Coordination of Gas Equipment Design, Construction and Maintenance.

2.1.3.1 Because industrial gas applications are so varied in nature, many agencies are jointly involved with their safe and satisfactory use. See Appendix 2-A for suggested guidelines and check list.

2.2 GENERAL SAFETY PRECAUTIONS

NOTE: For safety precautions on gas suppliers' facilities see Appendix 2-B.

2.2.1 Checking for Gas Leaks.

2.2.1.1 Matches, candles, and other open flames shall not be used to check for gas leakage. Checks for leaks shall be made with approved gas leak detectors or by brushing a soap and water solution or its equivalent on fittings and other suspected locations (*See 2.4.25*).

2.2.2 Emergency Procedure for Gas Leaks.

2.2.2.1 When an investigation discloses a concentration of gas inside of a building, the following immediate actions shall be taken, simultaneously if possible.

(a) Clear the room, building, or area of all occupants.

(b) Ventilate the affected portion of the building by opening windows and doors.

(c) Use every practical means to eliminate sources of ignition. Take precautions to prevent smoking, striking matches, operating electrical switches or devices, opening furnace doors, etc. If possible, cut off all electric circuits at a remote source to eliminate operation of automatic switches in the dangerous area. Safety flashlights designed for use in hazardous atmospheres are recommended for use in such emergencies.

(d) Shut off the supply of gas to the areas involved.

(e) Investigate other buildings in the immediate area to determine the presence of escaping gas therein.

(f) Notify the gas supplier.

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[1] Among the laboratories nationally recognized by the authorities having jurisdiction in the United States and Canada are the Underwriters' Laboratories, Inc., The Factory Mutual Research Corporation, The American Gas Association, Laboratories, the Underwriters' Laboratories of Canada, the Canadian Standards Association Testing Laboratories, and the Canadian Gas Association Approvals Division.

[2] Among the engineering agencies specializing in the field of safety to life and property nationally recognized by the authorities having jurisdiction are the Factory Insurance Association and the Factory Mutual Research Corporation.

2.2.3 Smoking or Open Flames.

2.2.3.1 Smoking, open flames, lanterns, welding or other sources of ignition shall not be permitted when working on piping which contains or has contained gas until proper safety precautions have been taken.

2.2.4 Work Interruptions.

2.2.4.1 When interruptions in work occur while repairs or alterations are being made to an existing piping system, the system shall be left in safe condition (*See 2.4.16*).

2.2.5 Interrupted Service.

2.2.5.1 Except in the case of an emergency, all affected points of consumption shall be notified before the supply of gas is shut off.

2.2.5.2 Except in the case of an emergency, the main valve at the point of delivery shall not be closed until all burner and pilot valves supplied with gas are turned off. A test shall be made to ascertain that there is no gas passing the point of delivery. This may be done by observing the test hand on a meter or by using a manometer or equivalent device. Where there is more than one meter, precautions shall be taken to assure that the proper meter is turned off. When turning the gas back on, the provisions of 2.4.27 shall apply.

2.2.6 Handling of Drip Liquids.

2.2.6.1 Liquid which is removed from a drip in existing gas piping shall be handled cautiously to avoid spillage or ignition and shall be disposed of promptly in a safe manner. For disposal recommendations call the gas supplier.

2.2.7 Modifications to Existing Gas Piping Systems.

2.2.7.1 Modifications to existing gas piping systems should normally be made with the gas shut off. Consideration should be given to conditions under which the work is to be performed, length of pipe being vented, pressure involved, etc. Hot taps, however, may be used if they are installed by trained and experienced crews. For further precautions see 841.28 of American National Standard *Gas Transmission and Distribution Piping Systems*, B31.8–1968, and Supplement, B31.8b–1969.[1]

2.2.8 Precautions Against Accidental Ignition During Alterations in the Piping System.

2.2.8.1 Provisions for electrical continuity shall be made before alterations are made in the piping system. Whenever the accidental ignition in the open air of a gas-air mixture might be likely to cause personal injury or property damage, precautions shall be taken as, for example:

(a) Prohibit smoking and open flames in the area.

(b) Install a metallic bond around the location of cuts in gas pipes to be made by other means than cutting torches.

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[1]Available from the American National Standards Institute, Inc., 1430 Broadway, New York, N. Y. 10018, or The American Society of Mechanical Engineers, 345 East 47th Street, New York, N. Y. 10017.

(c) Take precautions to prevent static electricity sparks.
(d) Provide a fire extinguisher of appropriate size and type in accordance with American National *Standard for the Installation of Portable Fire Extinguishers*, Z112.1–1971 (NFPA No. 10–1974).[1]

2.3 SIZING OF GAS PIPING SYSTEMS

2.3.1 General.

2.3.1.1 It is recommended, before proceeding with the installation of a gas piping system, that a piping sketch or plan be prepared showing the proposed location and size of the piping and the various load demands. Consideration should be given to future demands.

2.3.1.2 Well in advance of the completion of final plans or specifications, the gas supplier should be consulted.

2.3.1.3 When connecting additional equipment to a gas piping system, the existing piping shall be checked to determine if it has adequate capacity (*see 2.3.2*). If inadequate, the existing system shall be enlarged as required or separate gas piping of adequate capacity shall be run from the meter or from the service regulator when a meter is not provided to the equipment.

2.3.2 Capacity.

2.3.2.1 Proper Size: Piping shall be of such a size and so installed as to provide a supply of gas sufficient to meet the requirements of demand and pressure at the point of use.

2.3.2.2 Maximum Gas Consumption: The volume of gas to be provided (in cubic feet per hour) shall be determined directly from the manufacturer's input ratings of the equipment served. When input rating is not indicated, the gas supplier, equipment manufacturer, or a qualified agency shall be contacted for estimating the volume of gas to be supplied.

NOTE 1: To obtain the cubic feet per hour of gas required, divide the Btu per hour rating by the average Btu per cubic foot heating value of the gas supplied. The average heating value of the gas may be obtained from the local gas supplier.

NOTE 2: Preferable practice is to use the total connected hourly load as the basis for pipe sizing since all equipment may be operating at full capacity simultaneously. If, however, a diversity of load can be established, smaller sized piping may be used.

2.3.2.3 Allowable Pressure Loss:
(a) The design pressure loss in any piping system from the point of supply or last pressure regulator to the inlet connection of equipment under maximum probable flow conditions shall not exceed 0.5 inch water column for piping systems operating at ½ psig or less, or 10 percent of the initial gage pressure for piping systems operating at higher pressures, except as provided below.

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[1]Available from the American National Standards Institute, Inc., 1430 Broadway, New York, N. Y. 10018, or The National Fire Protection Association, 470 Atlantic Avenue, Boston, Mass. 02210.

(b) Where initial inlet pressure is available to allow a design pressure loss in excess of the above, all gas equipment shall be provided with gas pressure reducing regulators. Each gas pressure reducing regulator so specified shall, by manufacturer's specifications, supply the gas equipment manufacturer's rated volume and pressure at both the maximum and the minimum operating pressures of the piping system.

(c) The provisions of 2.3.2.3(a) and 2.3.2.3(b) do not apply to flammable gas-air mixture piping. For such systems see 2.3.2.1.

2.3.2.4 Equivalent Length of Piping: For equivalent length of pipe, bends, fittings and valves, see Table 2-D1 in Appendix 2-D.

2.3.2.5 Piping Tables:

(a) Tables 2-D2 to 2-D8 in Appendix 2-D indicate approximate capacities for single runs of piping. If the specific gravity of the gas is other than 0.60, correction factors shall be applied. Correction factors for use with Tables 2-D2 to 2-D8, inclusive, are given in Table 2-D9.

(b) Where more complex systems are involved, detailed engineering calculations shall be made considering all the factors listed in 2.3.2. A suggested procedure with two examples of using tables to size a gas piping system is presented in Appendix 2-D.

2.3.3 Extensions. The size of extensions to existing piping systems shall be calculated considering all the factors listed in 2.3.2.

2.3.4 Valves.

(a) Manual shutoff valves shall be provided at appropriate points in larger piping systems and at each unit of gas utilization equipment.

(b) An exterior shutoff valve to permit turning off the gas supply to each building in an emergency shall be provided. The emergency shutoff valves shall be plainly marked as such and their locations posted at appropriate points.

2.4 INSTALLATION OF GAS PIPING SYSTEMS

2.4.1 Piping System Operating Pressure Limitations.

2.4.1.1 The maximum design operating pressure in piping systems that are not welded or are not enclosed in a chase (or otherwise enclosed for protection against accidental gas accumulations) and are located inside buildings or separate areas of buildings not used exclusively for industrial processing or heating, research, warehousing, or boiler or mechanical equipment rooms, shall not exceed 5 psig except with the approval of the authority having jurisdiction. This does not apply for temporary uses in buildings under construction. (*See Note.*)

NOTE: The scope of Part 2 of this standard includes fuel gas piping systems operating at pressures greater than ½ psig on certain nonindustrial premises such as office and apartment buildings including those of the high-rise type with high-pressure gas utilization equipment on the roof or on an upper floor of the building. The intent is to limit the operating pressure of such a piping system to a pressure no higher than needed to maintain adequate delivery pressures at the utilization equipment being served and to specify additional precautions where pressures over 5 psig are used. When operating pressures greater than 5 psig are needed in buildings not used exclusively for industrial processing or heating, research, warehousing, or boiler or mechanical rooms, the piping system must be welded or be enclosed. Also see Note for 2.4.9.

2.4.2 Selection of Materials.

2.4.2.1 General: The following sets forth basic information regarding selection of materials for piping systems. For more detailed information or for unusual applications, see American National Standard *Code for Pressure Piping, Fuel Gas Piping*, B31.2–1968,[1] except that Sections 205.2.2–d and 205.3 thereof are not applicable.

2.4.2.2 Steel and Wrought-Iron Pipe: Standard weight (Schedule 40) steel and wrought-iron pipe shall be acceptable for gas pressures up to 125 psig. For pressures in excess of 125 psig, pipe shall be selected in accordance with American National Standard *Code for Pressure Piping, Fuel Gas Piping*, B31.2–1968.[1]

2.4.2.3 Cast-Iron Pipe: Cast-iron pipe shall not be used for any piping system within the scope of Part 2 of this code.

2.4.2.4 Copper or Brass Pipe and Tubing:

(a) Copper or brass pipe and tubing shall comply with 849.6 of American National Standard *Gas Transmission and Distributing Piping Systems*, B31.8–1968, and Supplement B31.8b–1969.[1]

(b) Since gases containing more than an average of 0.3 grain of hydrogen sulfide per 100 standard cubic feet cause copper and its alloys to be unsuitable for gas piping, the gas supplier shall be consulted before using these materials.

2.4.2.5 Piping Joints and Fittings:

(a) Piping joints may be threaded, flanged, or welded, and nonferrous pipe may also be soldered or brazed with materials having a melting point in excess of 1,000 F. Uncoated threaded joints shall not be used in piping in contact with soil or where crevice corrosion may occur.

Tubing joints shall either be made with approved gas tubing fittings, or be soldered or brazed with a material having a melting point in excess of 1,000 F.

(b) Fittings (except stopcocks or valves) shall be steel, brass, or malleable or ductile iron when used with steel or wrought-iron pipe, and shall be copper or brass when used with copper or brass pipe or tubing. Compression or gland type fittings may be used to connect steel or wrought-iron pipe if adequately braced so that neither the gas pressure nor external physical damage will force the joint apart. Cast-iron fittings in sizes 4 inches and larger may be used to connect steel and wrought-iron pipe outside of buildings only. Cast-iron fittings and zinc-aluminum valves and fittings shall not be used in systems containing flammable gas-air mixtures. Cast-iron flanges may be used.

(c) Reducing fittings are preferred to bushings. Cast-iron or plastic bushings shall not be used. Any bushing used shall reduce at least 2 pipe sizes.

2.4.2.6 Valves: Shutoff valves shall be selected giving consideration to pressure drop, service involved, emergency use and reliability of operation.

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[1]Available from the American National Standards Institute, Inc., 1430 Broadway, New York, N. Y. 10018, or The American Society of Mechanical Engineers, 345 East 47th Street, New York, N. Y. 10017.

2.4.2.7 Gaskets: Material for gaskets shall be capable of withstanding the design pressure of the piping system, the chemical constituents of the gas conducted through the piping systems, and of maintaining its physical and chemical properties at the design temperature and pressure. Gaskets shall be made of metal having a melting point of over 1,000 F or shall be confined within an assembly having a melting point of over 1,000 F. Aluminum "O" rings and spiral wound metal gaskets are also acceptable. When a flange is opened, the gasket shall be replaced.

2.4.2.8 Used Materials: Pipe, fittings, valves, or other materials removed from an existing installation shall not be used again unless they have been thoroughly cleaned, inspected, and ascertained to be adequate for the service intended.

2.4.2.9 Other Materials: Material not covered by the standards or specifications listed herein shall be investigated and tested to determine that it is safe and suitable for the proposed service, and, in addition, shall be recommended for that service by the manufacturer and shall be acceptable to the authority having jurisdiction.

2.4.2.10 Joint Compounds: Joint compounds (pipe dope) shall be resistant to the action of liquefied petroleum gas or to any other chemical constituents of the gases to be conducted through the piping. Consult the gas supplier regarding the use of auxiliary or substitute gases during peak loads.

2.4.3 Pipe Threads.

2.4.3.1 Specifications for Pipe Threads: Pipe and fitting threads shall comply with the American National *Standard for Pipe Threads* (Except Dryseal), B2.1–1968.[1]

2.4.3.2 Damaged Threads: Pipe with threads which are stripped, chipped, corroded, or otherwise damaged shall not be used. If a weld opens during the operation of cutting or threading, that portion of the pipe shall not be used.

2.4.4 Entry Piping.

2.4.4.1 Gas piping shall, where practical, enter the building aboveground and remain in an aboveground and ventilated location except as provided in 2.4.5.

2.4.5 Underground Piping.

2.4.5.1 Piping Underground Beneath Buildings: When the installation of gas piping underground beneath buildings is unavoidable, the piping shall be encased in a conduit. The conduit shall extend into a normally usable and accessible portion of the building and, at the point where the conduit terminates in the building, the space between the conduit and the gas piping shall be sealed to prevent the possible entrance of any gas leakage. The conduit shall extend at least 4 inches outside the building, be vented

[1]Available from the American National Standards Institute, Inc., 1430 Broadway, New York, N. Y. 10018, or The American Society of Mechanical Engneers, 345 East 47th Street, New, York, N. Y. 10017.

above grade to the outside and be installed in a way as to prevent the entrance of water.

2.4.5.2 Piping Through Foundation Wall: Underground piping, when installed below grade through the outer foundation wall of a building, shall be encased in a protective pipe. The annular space between the gas piping and the sleeve shall be sealed at the foundation or basement wall to prevent entry of gas or water.

2.4.5.3 Protection of Piping: Where soil conditions are unstable and settling of piping or foundation walls may occur, or heavy vehicular traffic may occur, adequate measures shall be provided to prevent excessive stressing of the piping. Piping shall be buried a sufficient depth or covered in a manner so as to protect the piping from physical damage.

2.4.5.4 Protection Against Corrosion: Gas piping in contact with earth, or other material which may corrode the piping, shall be protected against corrosion in an approved manner. When dissimilar metals are joined underground, an insulating fitting shall be used. Piping shall not be laid in contact with cinders.

2.4.6 Aboveground Piping.

2.4.6.1 Outdoor gas piping in industrial plant yards installed aboveground shall be securely supported and located where it will be protected from physical damage.

2.4.6.2 Gas piping shall not be installed in crawl spaces or unfrequented basement spaces unless adequate ventilation is provided. Such piping shall be protected against corrosion.

2.4.7 Piping Inside Buildings.

2.4.7.1 When gas piping is installed in buildings, the building structure shall not be weakened by such installation. Concealed piping shall be avoided where practical.

2.4.8 Concealed Piping.

2.4.8.1 General: Gas piping shall not be installed in concealed locations except in accordance with the provisions of this section and section 2.4.13.

2.4.8.2 Piping in Partitions: Concealed gas piping should be located in hollow rather than solid partitions. Tubing shall not be run inside walls or partitions unless protected against physical damage, but this rule does not apply to tubing which passes through walls or partitions (*See 2.4.8.4*).

2.4.8.3 Piping in Floors:

(a) Except as provided in 2.4.8.3(b), gas piping in solid floors such as concrete shall be laid in channels in the floor suitably covered to permit access to the piping with a minimum of damage to the building. When piping in floor channels may be exposed to excessive moisture or corrosive substances, it shall be suitably protected.

(b) In other than industrial occupancies and when approved by the authority having jurisdiction and acceptable to the serving gas supplier,

gas piping may be embedded in concrete floor slabs constructed with portland cement. Piping shall be surrounded with a minimum of 1½ inches of concrete and shall not be in physical contact with other metallic structures such as reinforcing rods or electrically neutral conductors. When piping may be subject to corrosion at point of entry into concrete slab, it shall be suitably protected from corrosion. Piping shall not be embedded in concrete slabs containing quickset additives or cinder aggregate.

2.4.8.4 Connections in Original Installations: When installing gas piping which is to be concealed, the following connections shall not be concealed: unions; tubing fittings; running threads; right and left couplings; bushings; and swing joints made by combinations of fittings (*See 2.4.8.2*).

2.4.8.5 Reconnections: When necessary to insert fittings in gas pipe which has been installed in a concealed location, the pipe may be reconnected by welding, flanges, or the use of a ground joint union with the nut center-punched to prevent loosening by vibration. Reconnection of tubing in a concealed location is prohibited.

2.4.9 Piping in Vertical Chases.

2.4.9.1 If pressure reduction is needed in branch connections for compliance with 2.4.1.1, such reduction shall take place either inside the chase or immediately adjacent to the outside wall of the chase. Regulator venting and downstream overpressure protection shall comply with 2.5.2.3 and 2.5.2.4. The regulator shall be accessible for service and repair.

(a) Regulators equipped with a vent limiting means may be vented into the chase.

(b) Regulators not equipped with a vent limiting means shall be vented directly to outdoors or to a point within the top 10 feet of the chase.

2.4.9.2 Chase construction shall comply with local building codes with respect to fire resistance and protection of horizontal and vertical openings.

(a) A chase shall be ventilated to the outdoors and only at the top. The opening(s) shall have a minimum free area (in square inches) equal to the product of one-half of the maximum pressure in the piping (in psig) times the largest nominal diameter of that piping (in inches), or the cross sectional area of the chase, whichever is smaller. When more than one fuel gas piping system is present, the free area for each system shall be calculated and the largest area used.

NOTE: Only vertical chases are recognized by the coverage. It is believed that welded joints for a horizontal gas line would be preferable to a horizontal chase.

2.4.10 Corrosion Control.

2.4.10.1 Corrosion protection shall be provided for all underground piping by any method or combination of methods where investigation indicates that such protection is needed.

NOTE: The gas supplier may be consulted for recommendations.

2.4.11 Piping Subjected to Below-Freezing Temperatures.

2.4.11.1 Piping, which carries gas containing moisture, shall be protected, if necessary, against freezing and the formation of hydrates. Such piping, if installed aboveground, shall be properly insulated.

NOTE: The gas supplier may be consulted for recommendations.

2.4.12 Drains and Drips.

2.4.12.1 The following provisions for drips, drains, and gradings shall apply only when other than dry gas is supplied and climatic conditions make such provisions necessary.

(a) The pitch of the piping shall be no less than ¼ inch in 15 feet, and there shall be no traps in the piping.

(b) Drips shall be installed only where they can be readily emptied or cleaned.

(c) Drips shall not be located where the condensate is likely to freeze.

(d) The size of any drip shall not be smaller than the diameter of the pipe to which it is attached.

(e) Where expedient for the removal of condensate and scale, a "T" with its bottom opening extended and capped should be located at each low point in the line.

2.4.13 Hangers, Supports, and Anchors.

2.4.13.1 Piping shall be supported in a substantial and workmanlike manner, so as to prevent or damp out excessive vibration, and shall be anchored sufficiently to prevent undue strains on connected equipment. Pipe hangers and supports shall conform to the requirements of MSS SP-58-1963, *Hangers and Supports*.[1]

2.4.13.2 Supports, hangers, and anchors should be installed so as not to interfere with the free expansion and contraction of the piping between anchors. Suitable spring hangers, sway bracing, etc., shall be provided where necessary. All parts of the supporting equipment shall be designed and installed so that they will not be disengaged by movement of the supported piping.

2.4.13.3 If the design of the piping system requires supports or anchors which are welded directly to the pipe, it is preferable that such supports or anchors consist of members which completely encircle the pipe.

2.4.14 Expansion and Flexibility.

2.4.14.1 Piping systems shall be designed to have sufficient flexibility to prevent thermal expansion or contraction from causing excessive stresses in the piping material, excessive bending or loads at joints, or undesirable forces or moments at points of connections to equipment and at anchorage or guide points. Formal calculations or model tests shall be required only where reasonable doubt exists as to the adequate flexibility of the system.

2.4.14.2 Flexibility shall be provided by the use of bends, loops, or offsets; or provision shall be made to absorb thermal changes by the use of

[1]Available from the Manufacturers Standardization Society of the Valve & Fittings Industry, 1815 North Fort Myer Drive, Arlington, Va. 22209.

expansion joints or couplings of the slip type, by the use of expansion joints of the bellows type, or by the use of "ball" or "swivel" joints. If expansion joints are used, anchors or ties of sufficient strength and rigidity shall be installed to provide for end forces due to fluid pressure and other causes.

2.4.14.3 Pipe alignment guides shall be used with expansion joints according to the recommended practice of the joint manufacturer.

2.4.15 Pipe Bends.

2.4.15.1 Pipe bends shall be made in such a way that they are free from buckling, cracks, or other evidence of physical damage. In addition, the gas-carrying capacity of the pipe shall not be reduced.

2.4.16 Outlets.

2.4.16.1 Each outlet, including a valve outlet, shall be securely closed gastight with a threaded plug or cap immediately after installation and shall be left closed until the gas equipment is connected thereto. Likewise, when the gas equipment is disconnected from an outlet and the outlet is not to be used again immediately, it shall be securely closed gastight.

2.4.17 Special Local Conditions.

2.4.17.1 Where local conditions include earthquake, tornado, unstable ground or flood hazards, special consideration shall be given to increased strength and flexibility of piping supports and connections.

NOTE: The gas supplier may be consulted for recommendations.

2.4.18 Back Pressure Protection.

2.4.18.1 When the design of utilization equipment connected is such that air, oxygen or stand-by gases may be forced into the gas supply system, suitable protective devices shall be installed as close to the utilization equipment as practical. Gas and air combustion mixers incorporating double diaphragm "zero" or "atmosphere" governors or regulators require no further protection unless connected directly to compressed air or oxygen at pressures of 5 psig or more.

2.4.18.2 Suitable protective devices include but are not limited to the following:

(a) Check valves.

(b) Three-way valves (of type that completely closes one side before starting to open the other side).

(c) Reverse flow indicators controlling positive shutoff valves.

(d) Normally closed air-actuated positive-shutoff pressure regulators.

2.4.19 Low Pressure Protection.

2.4.19.1 A suitable protective device shall be installed between the meter and the utilization equipment if the operation of the equipment is such (i.e., gas compressors) that it may produce a vacuum or a dangerous reduction in gas pressure at the meter. Such devices include, but are not limited to mechanical, diaphragm-operated, or electrically operated low-pressure shutoff valves.

2.4.20 Systems Containing Gas-Air Mixtures Outside the Flammable Range. When gas-air mixing machines are employed to produce mixtures above or below the flammable range, they shall be provided with suitable stops to prevent adjustment of the mixture to within or approaching the flammable range.

2.4.21 Systems Containing Flammable Gas-Air Mixtures.

2.4.21.1 A central premix system with flammable mixture in blower or compressor shall consist of the following components:

(a) Gas-mixing machine in the form of an automatic gas-air proportioning device combined with downstream blower or compressor.
(b) Flammable mixture piping, minimum Schedule 40.
(c) Automatic firecheck(s).
(d) Safety blowout(s) or backfire preventers for systems utilizing flammable mixture lines above 2½ inches IPS or equivalent.

2.4.21.2 The following components may also be utilized in any type central premix system:

(a) Flowmeter(s).
(b) Flame arrester(s).

2.4.21.3 Gas-mixing machines shall have nonsparking blowers and should be so constructed that a flashback will not rupture machine casings.

2.4.21.4 A mixing blower system shall be limited to applications with minimum practical lengths of mixture piping, limited to a maximum mixture pressure of 10 inches water column, and limited to gases containing no more than 10 percent hydrogen.

The blower shall be equipped with a gas-control valve at its air entrance so arranged that gas is admitted to the air stream, entering the blower in proper proportions for correct combustion by the type of burners employed; the said gas-control valve being of either the zero governor or mechanical ratio valve type which controls the gas and air adjustment simultaneously. No valves or other obstructions shall be installed between the blower discharge and the burner or burners.

NOTE: The mixing blower is acknowledged as a special case because of its inability to tolerate control valves or comparable restrictions between mixing blower and burner(s). With these limitations, mixing blower installations are not required to utilize safety blowouts, backfire preventers, explosion heads, flame arresters or automatic firechecks which introduce pressure losses.

2.4.21.5 Installation of Gas-Mixing Machines:

(a) The machine should be located in a large, well-ventilated area. If the machine is in a small detached building or cut-off room, room construction and explosion vents shall be provided according to requirements of NFPA No. 68–1974, *Explosion Venting Guide.*[1] Such rooms or below-grade installations shall have adequate positive ventilation.

(b) When gas-mixing machines are installed in well-ventilated areas, the type of electrical equipment shall be governed by the *National Electrical*

[1]Available from the National Fire Protection Association, 470 Atlantic Avenue, Boston, Mass. 02210.

Code, ANSI C1–1975 (NFPA No. 70–1975),[1] for general service conditions unless other hazards in the area prevail.

When gas-mixing machines are installed in small detached buildings or cut-off rooms, the electrical equipment and wiring shall be installed in accordance with the *National Electrical Code*, ANSI C1–1975 (NFPA No. 70–1975),[1] for hazardous locations (Article 500, Sections 501–1 through 501–16, Class I, Division 2).

(c) Air intakes for gas-mixing machines using compressors or blowers shall be taken from outdoors wherever practical.

(d) Controls for gas-mixing machines shall include interlocks and safety shutoff valve of the manual reset type in the gas supply connection to each machine arranged to automatically shut off the gas supply in event of high or low gas pressure. Except for open burner installations only, this shall be interlocked so that the blower or compressor will stop operating following a gas supply failure. When a system employs pressure air, suitable means shall be provided to shut off the gas supply in the event of air failure.

NOTE: Additional interlocks may be necessary for safe operation of equipment supplied by the gas-mixing machine.

(e) Centrifugal gas-mixing machines in parallel can cause troublesome downstream pulsation or equipment overload. Such systems shall be carefully reviewed by user and equipment manufacturer before installation and means or plans for minimizing these effects be prepared and utilized as required.

2.4.21.6 Use of Automatic Firechecks, Safety Blowouts or Backfire Preventers: Automatic firechecks and safety blowouts or backfire preventers shall be provided in piping systems distributing flammable air-gas mixtures from gas-mixing machines to protect the piping and the machines in event of flashback in accordance with the following recommendations:

(a) Approved automatic firechecks shall be installed upstream as close as practicable to the burner inlets following the firecheck manufacturer's instructions.

NOTE 1: Two basic methods are generally used. One calls for a separate firecheck at each burner; the other a firecheck at each group of burners. The second method is generally more practical if a system consists of many closely spaced burners.

NOTE 2: An approved automatic firecheck shall be installed as near as practicable upstream from a flame arrester used for local protection where test burners or lighting torches are employed.

(b) A separate manually operated gas valve shall be provided at each automatic firecheck for shutting off the flow of gas-air mixture through the firecheck after a flashback has occurred. The valve shall be located upstream as close as practicable to the inlet of the automatic firecheck.

CAUTION: These valves shall not be reopened after a flashback has occurred until the firecheck has cooled sufficiently to prevent reignition of the flammable mixture and has been properly reset.

[1]Available from the National Fire Protection Association, 470 Atlantic Avenue, Boston, Mass. 02210.

(c) A safety blowout or backfiring preventer shall be provided in the mixture line near the outlet of each gas-mixing machine where the size of the piping is larger than 2½ inches IPS or equivalent, to protect the mixing equipment in event of an explosion passing through an automatic fire-check. The manufacturer's instructions shall be followed when installing these devices, and particularly after a disc has burst.

The discharge from the safety blowout or backfire preventer shall be located or shielded so that particles from the ruptured disc cannot be directed toward personnel. Whenever there are interconnected installations of gas-mixing machines with safety blowouts or backfire preventers, provision shall be made to keep the mixture from other machines from reaching any ruptured disc opening. Check valves shall not be used for this purpose.

(d) Explosion heads (rupture disc) may be provided in large capacity premix systems to relieve excessive pressure in pipelines. They shall be located at and vented to a safe outdoor location. Provisions shall be provided for automatically shutting off the supply of gas-air mixture in the event of rupture.

2.4.22 Electrical Bonding and Grounding.

2.4.22.1 Each aboveground portion of a gas piping system upstream from the equipment shutoff valve shall be electrically continuous and bonded to any grounding electrode, as defined by the *National Electrical Code*, ANSI C1–1975 (NFPA No. 70–1975).[1]

2.4.22.2 Underground gas piping shall not be used as a grounding electrode except when it is electrically continuous uncoated metallic pipe, and its use as a grounding electrode is acceptable both to the serving gas supplier and to the authority having jurisdiction, since gas piping systems are often constructed with insulating bushings or joints, or are of coated or nonmetallic piping.

2.4.23 Electrical Circuits.

2.4.23.1 Electrical circuits shall not utilize gas piping or components except that low-voltage (50 volts or less) control circuits, ignition circuits, and electronic flame detection device circuits may make use of piping or components for a part of an electric circuit.

2.4.24 Electrical Connections.

2.4.24.1 All electrical connections between wiring and electrically operated control devices in a piping system shall conform to the requirements of the *National Electrical Code* (*see 2.4.22*).

2.4.24.2 Any essential safety control depending upon electric current as the operating medium shall be of a type which will shut off (fail safe) the flow of gas in the event of current failure.

2.4.25 Testing.

2.4.25.1 General:

[1]Available from the American National Standards Institute, Inc., 1430 Broadway, New York, N. Y. 10018, or the National Fire Protection Association, 470 Atlantic Avenue, Boston, Mass. 02210.

(a) Prior to initial operation, installed piping shall be pressure tested to assure tightness.

(b) In the event repairs or additions are made following the pressure test, the affected piping shall be retested, except that in the case of minor repairs or additions retest may be omitted, when precautionary measures are taken to assure sound construction.

(c) Because it is sometimes necessary to divide a piping system into test sections and install test heads, connecting piping, and other necessary appurtenances for testing, it is not required that the tie-in sections of pipe be pressure tested. Tie-in connections, however, shall be tested with soap-suds after gas has been introduced and the pressure has been increased sufficiently to give some indications should leaks exist.

(d) The test procedure used shall be capable of disclosing all leaks in the section being tested and shall be selected after giving due consideration to the volumetric content of the section and to its location.

(e) A piping system may be tested as a complete unit or in sections as the construction progresses. Under no circumstances shall a valve in a line be used as a bulkhead between gas in one section of the piping system and air or water in an adjacent section, unless two valves are installed in series with a valved "tell-tale" located between these valves. A valve shall not be subjected to the test pressure unless it can be determined that the valve, including the valve closing mechanism, is designed to safely withstand the proposed test pressure.

(f) Regulator and valve assemblies fabricated independently of the piping system in which they are to be installed, may be tested with inert gas at the time of fabrication.

2.4.25.2 Test Medium:

(a) Except as provided in 2.4.25.2(b), the test medium shall be air, water or inert gas (e.g., nitrogen, carbon dioxide).

(b) Fuel gas may be used in piping systems operating at pressures of ½ pound per square inch or less.

2.4.25.3 Test Preparation:

(a) Whenever possible, pipe joints, including welds, shall be left uninsulated and exposed for examination during the test. If the pipe end joints have been previously tested in accordance with this standard, they may be insulated, covered, or concealed.

(b) Piping shall be provided with additional temporary supports, if necessary, to support the weight of the test fluid.

(c) Expansion joints shall be provided with temporary restraints, if required, for the additional thrust load under test.

(d) Equipment which is not to be included in the test shall be either disconnected from the piping or isolated by blanks, blind flanges, or caps. Flanged joints at which blinds are inserted to blank off other equipment during the test need not be tested.

(e) If a pressure test is to be maintained for a period of time and the test fluid in the system is subject to thermal expansion, precautions shall be taken to avoid excessive pressure.

(f) All testing of piping systems shall be done with due regard for the safety of employees and the public during the test. Bulkheads, anchorage, and bracing suitably designed to resist test pressures shall be installed if