NFPA No.
54
ASA Z21.30

GAS APPLIANCES
GAS PIPING 1964

An American Standard

Seventy-five Cents

NATIONAL FIRE PROTECTION ASSOCIATION
International

60 Batterymarch Street, Boston, Mass. 02110

3M-11-68-(55M)
NP-SM
Printed in U.S.A.

National Fire Protection Association

International

Official NFPA Definitions

Adopted Jan. 23, 1964. Where variances to these definitions are found, efforts to eliminate such conflicts are in process.

SHALL is intended to indicate requirements.

SHOULD is intended to indicate recommendations or that which is advised but not required.

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Units of Measurements

Units of measurements used here are U. S. standard. 1 U. S. gallon = 0.83 Imperial gallons = 3.785 liters. One foot = 0.3048 meters. One inch = 25.40 millimeters. One pound per square inch = 0.06805 atmospheres = 2.307 feet of water. One pound = 453.6 grams.

Standard for the Installation of

Gas Appliances and Gas Piping

ASA Z21.30 – 1964

NFPA No. 54 – 1964

1964 Edition of ASA Z21.30 — NFPA No. 54

The 1964 edition incorporates changes to the 1959 edition. It was adopted by the National Fire Protection Association (NFPA) on May 20, 1964 and endorsed by the American Standards Association, Inc. (ASA) on September 18, 1964. The ASA designation is Z21.30 — 1964, UDC 696.2:697.245. The NFPA designation is No. 54 — 1964.

Changes, other than editorial, are denoted by a vertical line in the margin except as follows:

a. Part 5 has been completely revised.

b. Appendix D is entirely new.

Foreword

These standards are the cumulative result of years of experience of many men and many organizations acquainted with the installation of gas piping and appliances designed for utilization of gaseous fuels. They are intended to protect the public by assuring the safe and satisfactory utilization of gas.

In the preparation of these standards, due consideration was given the fact that they are national in scope, and that as such they must be sufficiently general to permit the continuance of local policies which are in accordance with good practice. They have been prepared to specify results rather than outline in detail how such results shall be obtained.

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Development of American Standard Installation of Gas Appliances and Gas Piping

ASA Z21.30 — NFPA No. 54

The National Fire Protection Association's Committee on Explosives and Combustibles, predecessor of the present NFPA Committee on Gases, appointed a subcommittee during the committee year 1913-1914 to prepare a fire protection code for city gas installations. After several years of cooperative work with the United States Bureau of Standards and other interested agencies, a code was adopted by the NFPA in 1920. Revisions to this code were adopted in 1930, 1932, 1940, 1941 and 1943. The 1932 text was approved by the American Standards Association on March 6, 1933, as American Recommended Practice for the Installation, Maintenance and Use of Piping and Fittings for City Gas, Z27-1933.

In 1915, the American Gas Institute and the National Commercial Gas Association, in cooperation with the United States Bureau of Standards, began the work of gathering information needed for the preparation of a uniform gas safety code. In 1919, the American Gas Institute and the National Commercial Gas Association were combined with the formation of the American Gas Association which continued the standardization activities. This work resulted in the American Standard Gas Safety Code for Installation and Work in Buildings, K2-1927, which was approved by the American Standards Association on March 10, 1927.

In 1925, when the American Gas Association Laboratories were established, the American Gas Association Approval Requirements Committee was appointed to serve as a supervising body in charge of standardization of appliance and installation specifications. One of its subcommittees was the Subcommittee on Requirements for House Piping and Appliance Installation which had for an assignment the preparation of installation standards supplementing the basic general requirements for gas piping and gas appliances of the Gas Safety Code which was then under preparation. The first edition was published in June, 1928.

The A.G.A. Approval Requirements Committee became the Sectional Committee on Approval and Installation Requirements for Gas-Burning Appliances, Z21, of the American Standards Association in September, 1930; consequently, the Subcommittee on Requirements for House Piping and Appliance Installation automatically became a subcommittee of the sectional committee.

A revised text of A.G.A. Requirements and Recommended Practice for House Piping and Appliance Installation was adopted by the A.G.A. Approval Requirements Committee in December, 1940. This text could not be accepted as an American Standard in view of the existence of K2-1927 and Z27-1933.

After World War II the need became evident for an up-to-date American Standard covering the installation of gas piping and appliances for the guidance of municipalities, state and federal bodies, architects and builders. ASA Sectional Committee, Z21, and its installation subcommittee were expanded to provide liason between these committees and the National Fire Protection Association Committee on Gases. Extensive work by the subcommittee during 1948-1950 resulted in the preparation of a proposed text that was distributed widely for comment to gas companies, gas equipment manufacturers, fire insurance underwriters, safety and accident prevention organizations, interested bodies of utility commissioners, building officials, manufacturing associations, labor unions, and others. In the meantime, by mutual agreement between the sponsors of K2-1927 and Z27-1933, the American Standards Association withdrew these texts in 1949.

The work of the expanded committee resulted in a text adopted by the NFPA in May 1950 and adopted as American Standard by the American Standards Association, Inc., on December 5, 1950, under the title, "American Standard Installation of Gas Piping and Gas Appliances in Buildings (not applicable to undiluted liquefied petroleum gas)."

This text was revised in 1954. Subsequently, the standard was expanded to cover undiluted liquefied petroleum gas so that there would be a single standard for the installation of gas appliances. Considerable work was done to incorporate the essential features of NFPA Standard on Liquefied Petroleum Gas Piping and Appliance Installation in Buildings (No. 52), editions of which were published in 1953 and 1956. Also, it was believed desirable to extend the coverage of the gas piping portion to cover all piping from the outlet of the meter set assembly. Following these principles, a new edition was adopted by the National Fire Protection Association in June 1959 and endorsed as American Standard by the American Standards Association, Inc., on July 21, 1959.

The current edition reflects the expanding use of gas and new types of domestic and commercial gas appliances. Experience also showed the need for standardized and specific data on gas appliance venting systems.

Standard for the Installation of Gas Appliances and Gas Piping

ASA Z21.30 — 1964

NFPA No. 54 — 1964

Contents

Part 1 – General

1.1 *SCOPE*

1.1.1 Applicability:

This standard applies to the design, fabrication, installation, tests and operation of appliance and piping systems for fuel gases such as natural gas, manufactured gas, undiluted liquefied petroleum gases, liquefied petroleum gas-air mixtures, or mixtures of any of these gases, as follows:

(a) Low pressure (not in excess of ½ pound per square inch or 14 inches water column) domestic and commercial piping systems extending from the outlet of the meter set assembly, or the outlet of the service regulator when a meter is not provided, to the inlet connections of appliances.

(b) The installation and operation of domestic and commercial appliances supplied at pressures of ½ pound per square inch or less.

1.1.2 Nonapplicability:

This standard does not apply to:

(a) Gas piping systems for industrial installations at any pressure or any other gas piping system operating at pressures greater than ½ pound per square inch. For piping in such installations refer to ASME Code for Pressure Piping, Section 2 of ASA B31.1-1955 and Addenda B31.1a-1961.*

(b) Gas equipment supplied through piping systems covered in 1.1.2(a), and

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

1.1.3 Other Standards:

In applying this standard, reference should also be made to the manufacturer's instructions, serving gas supplier regulations, and local building, heating, plumbing or other codes in effect in the area in which the installation is made.

1.1.4 "Approved:"

The word "approved," as used in this standard, means acceptable to the authority having jurisdiction.

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*Available from the American Standards Association, Inc., 10 East 40th Street, New York, New York, 10016, or the American Society of Mechanical Engineers, 345 East 47th St., New York, New York, 10017.

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.

1.3 *GENERAL PRECAUTIONS*

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.

1.3.2 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.

1.3.3 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.

1.3.4 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.*

1.3.5 Use of Lights:

Artificial illumination used in connection with a search for gas leakage shall be restricted to electric hand 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.

1.3.6 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.

1.3.7 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.

1.3.8 No Smoking:

When working on piping which contains or has contained gas, smoking shall not be permitted.

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.

1.3.10 Work Interruptions:

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

Part 2 – Gas Piping Installation

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.

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.

2.3 *INTERCONNECTIONS*

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.

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.

2.4 *SIZE OF PIPING TO GAS APPLIANCES*

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) Specific gravity of the gas.

(e) Diversity factor.

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 is given to show 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.

2.4.3 Gas Piping Size:

(a) Capacities in cubic feet per hour of 0.60 specific gravity gas for different sizes and lengths are shown in Tables 2A and 2B for iron pipe or equivalent rigid pipe and in Table 2C for semirigid tubing. Tables 2A and 2C are based upon a pressure drop of 0.3 inch water column, whereas Table 2B is 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.

(b) 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 4A for iron pipe or equivalent rigid pipe and in Table 4B for semirigid tubing. In using these tables no additional allowance is necessary for an ordinary number of fittings.

(c) 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 2A, 2B and 2C 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.

Table 1

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 2A

Maximum Capacity of Pipe in Cubic Feet of Gas per Hour

(Based upon a Pressure Drop of 0.3 Inch Water Column and 0.6 Specific Gravity Gas)

Length in Feet	Nominal Iron Pipe Size, Inches								
	½	¾	1	1¼	1½	2	2½	3	4
10	132	278	520	1,050	1,600	3,050	4,800	8,500	17,500
20	92	190	350	730	1,100	2,100	3,300	5,900	12,000
30	73	152	285	590	890	1,650	2,700	4,700	9,700
40	63	130	245	500	760	1,450	2,300	4,100	8,300
50	56	115	215	440	670	1,270	2,000	3,600	7,400
60	50	105	195	400	610	1,150	1,850	3,250	6,800
70	46	96	180	370	560	1,050	1,700	3,000	6,200
80	43	90	170	350	530	990	1,600	2,800	5,800
90	40	84	160	320	490	930	1,500	2,600	5,400
100	38	79	150	305	460	870	1,400	2,500	5,100
125	34	72	130	275	410	780	1,250	2,200	4,500
150	31	64	120	250	380	710	1,130	2,000	4,100
175	28	59	110	225	350	650	1,050	1,850	3,800
200	26	55	100	210	320	610	980	1,700	3,500

Application of the gravity factor converts the figures given in Tables 2A, 2B and 2C to capacities with another gas of different specific gravity. Such application is accomplished by multiplying the capacities given in Tables 2A, 2B and 2C by the mutlipliers shown in Table 3. In case the exact specific gravity does not appear in the Table, choose the next higher value specific gravity shown.

(d) To determine the size of each section of gas piping in a system within the range of Tables 2A, 2B, 2C, 4A or 4B proceed as follows: (A sample calculation is presented in Appendix B.)

1. Determine the gas demand of each appliance to be attached to the piping system. When Tables 2A, 2B, or 2C 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 4A or 4B 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. 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.
3. In Tables 2A, 2B, 2C, 4A or 4B, whichever is appropriate, select the column showing that distance or the next longer distance if the Table does not give the exact length. This is the only distance 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 Tables 2A, 2B or 2C are multiplied by the appropriate multiplier from Table 3.
4. Use this vertical column to locate ALL gas demand figures for this particular system of piping.
5. 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.
6. Opposite this demand figure, in the first column at the left in Tables 2A, 2B, 2C, 4A, or 4B, will be found the correct size of gas piping.
7. 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.

(e) For any gas piping system, for special gas appliances or for conditions other than those covered by Tables 2A, 2B, 2C, 4A or 4B, such as longer runs, or greater gas demands, 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.

Table 2B

Maximum Capacity of Pipe in Cubic Feet of Gas per Hour.

(Based upon a Pressure Drop of 0.5 Inch Water Column and 0.6 Specific Gravity Gas)

Length in Feet	Nominal Iron Pipe Size, Inches								
	1/2	3/4	1	1 1/4	1 1/2	2	2 1/2	3	4
10	175	360	680	1,400	2,100	3,950	6,300	11,000	23,000
20	120	250	465	950	1,460	2,750	4,350	7,700	15,800
30	97	200	375	770	1,180	2,200	3,520	6,250	12,800
40	82	170	320	660	990	1,900	3,000	5,300	10,900
50	73	151	285	580	900	1,680	2,650	4,750	9,700
60	66	138	260	530	810	1,520	2,400	4,300	8,800
70	61	125	240	490	750	1,400	2,250	3,900	8,100
80	57	118	220	460	690	1,300	2,050	3,700	7,500
90	53	110	205	430	650	1,220	1,950	3,450	7,200
100	50	103	195	400	620	1,150	1,850	3,250	6,700
125	44	93	175	360	550	1,020	1,650	2,950	6,000
150	40	84	160	325	500	950	1,500	2,650	5,500
175	37	77	145	300	460	850	1,370	2,450	5,000
200	35	72	135	280	430	800	1,280	2,280	4,600

Table 2C

Maximum Capacity of Semirigid Tubing in Cubic Feet of Gas per Hour

(Based on a Pressure Drop of 0.3 Inch Water Column and 0.6 Specific Gravity Gas)

Outside Diameter (Inches)	Length of Tubing (Feet)									
	10	20	30	40	50	60	70	80	90	100
3/8	19	12	10	9	—	—	—	—	—	—
1/2	45	30	24	20	18	17	15	14	13	12
5/8	97	64	52	44	38	35	32	30	28	26
3/4	161	105	88	71	64	59	54	50	46	44
7/8	245	169	135	114	97	91	80	75	71	67

Table 3

Multipliers to be used only with Tables 2A, 2B and 2C 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 4A

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
1/2	275	189	152	129	114	103	96	89	83	78	69	63
3/4	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
1 1/4	2205	1496	1212	1039	913	834	771	724	677	630	567	511
1 1/2	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 4B

Maximum Capacity of Semirigid 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 (Inches)	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

2.4.4 Diversity Factor:

The diversity factor (see Part 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.

2.4.5 Additions to Existing Gas Piping:

Additions to existing utility gas piping shall conform to Tables 2A, 2B or 2C, whichever is designated by the serving gas supplier. Additions to existing undiluted liquefied petroleum gas piping shall conform to Table 4A or 4B. 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 which is smaller than that permitted in Tables 2A, 2B or 4A, or to existing tubing which is smaller than that permitted in Table 2C or 4B.

2.5 *GAS PIPING IN MOBILE HOME AND TRAVEL TRAILER PARKS*

Gas piping systems in mobile home and travel trailer 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 trailer site shall comply with the following specific provisions and with all other applicable provisions in Part 1 and Part 2 of this standard.

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.

2.5.2 Prohibited Locations:

Piping shall not be installed under trailer sites and patio slabs adjacent to trailers when an enclosing foundation is used under the trailer.

2.5.3 Location, Protection and Sizing of Riser:

The gas riser to each trailer site should be placed in the rear one-third section of the site and not less than 18 inches from the roadside wall of the trailer. It 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 trailer site shall be ¾ inch for other than undiluted liquefied petroleum gases.

2.5.4 Location of Shutoff Valves:

(a) Outlets for the individual trailers 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 trailer park system. The valve provided by the serving gas supplier may be considered acceptable for this purpose provided it is readily accessible.

2.5.5 Connection of Trailer:

Trailers shall be connected to the gas piping system with rigid pipe, listed connectors or semirigid tubing. Connectors having aluminum exterior surfaces shall not be used.

2.5.6 Demand Factors:

(a) The hourly volume of gas required for any trailer site gas outlet or any section of a trailer park gas piping system may be computed from Table 5.

(b) Other gas equipment or appliances, other than trailer site outlets, shall be computed at the manufacturer's maximum cubic foot per hour input rating or from Table 1 and shall be added to the figures given in Table 5.

Table 5

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

2.6 *ACCEPTABLE PIPING MATERIALS*

2.6.1 Piping Material:

(a) PIPE. Gas pipe shall be steel or wrought-iron pipe complying with the American Standard for Wrought-Steel and Wrought-

Iron Pipe, ASA B36.10-1959.* Threaded copper, brass, or aluminum alloy pipe in iron pipe sizes may be used with gases not corrosive to such material except that aluminum alloy pipe shall not be used in exterior locations, or underground, or where it is in contact with masonry, plaster, or insulation, or is subject to repeated corrosive wettings. Aluminum alloy pipe shall comply with specification ASTM B-241 (except that the use of alloy 5456 is prohibited) and shall be suitably marked at each end of each length indicating compliance with ASTM specifications.**

(b) TUBING. 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 be of standard type K or L, or equivalent, complying with specification ASTM B88-62 and having a minimum wall thickness for each tubing size in compliance with ASTM specifications.** Aluminum alloy tubing shall be of standard Type A or B, or equivalent, complying with specification ASTM B-318-62, having a minimum wall thickness for each tubing size, and being suitably marked every 18 inches in compliance with ASTM specifications.** Aluminum alloy tubing shall not be used in exterior locations, or underground, or where it is in contact with masonry, plaster, or insulation, or is subject to repeated corrosive wettings.

(c) PIPING JOINTS AND FITTINGS. Pipe joints may be screwed, flanged or welded, and nonferrous pipe may also be soldered or brazed with material having a melting point in excess of 1,000° F. Tubing joints shall either be made with approved flared gas tubing fittings, or be soldered or brazed with a material having a melting point in excess of 1,000° F. Compression type tubing fittings shall not be used for this purpose.

Fittings (except stopcocks or valves) shall be malleable iron or steel when used with steel or wrought-iron pipe, and shall be copper or brass when used with copper or brass pipe or tubing, and shall be aluminum alloy when used with aluminum alloy pipe or tubing. When approved by the authority having jurisdiction, special fittings 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.

2.6.2 Workmanship and Defects:

Gas pipe or tubing and fittings shall be clear and free from cut-

*Available from the American Standards Association, Inc., 10 East 40th Street, New York, New York, 10016.

**Available from American Society for Testing and Materials, 1916 Race St., Philadelphia, Pa. 19103.

ting 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.

2.6.3 Pipe Coating:

When in contact with material exerting a corrosive action, piping and fittings coated with a corrosion resisting material shall be used.

2.6.4 Use of Old Piping Material:

Gas 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.

2.6.5 Joint Compounds:

Joint compounds (pipe dope) shall be applied sparingly and only to the male threads of pipe joints. Such compounds shall be resistant to the action of liquefied petroleum gases.

2.7 *PIPE THREADS*

2.7.1 Specifications for Pipe Threads:

Pipe and fitting threads shall comply with the American Standard for Pipe Threads (Except Dryseal), B2.1-1960.*

2.7.2 Damaged Threads:

Pipe with threads which are stripped, chipped, corroded, or otherwise damaged shall not be used.

2.7.3 Number of Threads:

Pipe shall be threaded in accordance with Table 6.

Table 6
Specifications for Threading 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

*Available from the American Standards Association, Inc., 10 East 40th Street, New York, New York, 10016.

2.8 *CONCEALED PIPING IN BUILDINGS*

2.8.1 Minimum Size:

No gas pipe smaller than standard ½ inch iron pipe size shall be used in any concealed location.

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.

2.8.3 Piping in Floors:

(a) Except as provided in 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 1½ inches of concrete and shall not be in physical contact with other metallic structures such as reinforcing rods or electrical 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.

2.8.4 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.

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.

2.9 *PIPING UNDERGROUND*

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.

2.9.2 Protection Against Corrosion:

(a) 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 insulated coupling shall be used. Piping shall not be laid in contact with cinders.

(b) Underground piping for manufactured gas shall be one size larger than that specified by Table 2A or Table 2B, as designated by the serving gas supplier, but in no case less than 1¼ inch.

2.9.3 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.

2.9.4 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.

2.10 *INSTALLATION OF PIPING*

Drips, grading, protection from freezing, and branch pipe connections, as provided for in 2.10.2, 2.10.4, 2.10.7, and 2.10.14(a), shall apply only when other than dry gas is distributed and climatic conditions make such provisions necessary.

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.

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.

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, and 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 7.

Table 7
Support of Piping

Size of Pipe (Inches)	(Feet)	Size of Tubing (Inch O.D.)	(Feet)
1/2	6	1/2	4
3/4 or 1	8	5/8 or 3/4	6
1 1/4 or larger (horizontal)	10	7/8 or 1	8
1 1/4 or larger (vertical)	every floor level		

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.

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.

2.10.6 Do Not Bend Pipe:

Gas pipe shall not be bent. Fittings shall be used when making turns in gas pipe.

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.

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.

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).

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.

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.

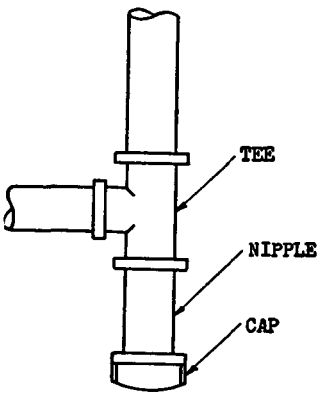


Fig. 1. Suggested Method of Installing Tee.

2.10.12 Location of Outlets:

The unthreaded portion of gas piping outlets shall extend at least one inch through finished ceilings and walls, and when extending through floors shall be not less than 2 inches above them. The outlet fitting or the piping shall be securely fastened. Outlets shall not be placed behind doors. Outlets shall be far enough from floors, walls and ceilings to permit the use of proper wrenches without straining, bending or damaging the piping.

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.

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.

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, ASA C1-1962 (NFPA No. 70)*

(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.

2.11 *GAS SHUTOFF VALVES*

2.11.1 Accessibility of Gas Valves:

Main gas shutoff valves controlling 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

*Available from the National Fire Protection Association, 60 Batterymarch St., Boston, Mass. 02110 in pamphlet form and in the National Fire Codes, Volume 5. Also available from the American Standards Association, Inc., 10 East 40th St., New York, N.Y. 10016.

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.

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.

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 gas tight. 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 stand a pressure of at least six inches mercury or three pounds gage for a period of not less than ten 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 stand the pressure test in accordance with 2.12.(a), or, when appliances are connected to the piping system, shall stand a pressure of not less than ten inches water column for a period of not less than ten minutes without showing any drop in pressure. Pressure shall be measured with a water manometer or an equivalent device so calibrated as to be read in increments of not greater than one-tenth inch water column. The source of pressure shall be isolated before the pressure tests are made.

2.13 *LEAKAGE CHECK AFTER GAS TURN ON*

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.

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 five minutes for a one-half 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 shut off. 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 2.13.2(a) or (b) shall be repeated.

2.14 *PURGING*

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 ap-

pliance 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.

2.14.2 Light 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.

Part 3 — Appliance Installation

3.1 *GENERAL*

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 would normally base acceptance on compliance with NFPA, ASA or other appropriate standards. In the absence of such standards, said authority would normally require evidence of proper installation, procedure or use. The authority having jurisdiction would normally refer to the listings or labeling (see Part 7., Definitions) practices of nationally recognized testing laboratories,* *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.

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.

3.1.3 Automatic Pilots for LP-Gas Appliances:

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, shall be equipped with automatic pilots of the complete shutoff type.

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

*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 Engineering Division, 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 Standards Association, Inc., do not approve, inspect or certify any installations, procedures, equipment or materials, nor do they approve or evaluate testing laboratories.

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. 51-1964.*

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.

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.

3.1.7 Installation in Commercial Garages:

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

1. Heaters 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 heaters may be located in the garage if they are installed so that the bottom of the combusion chamber is at least 18 inches above the floor and outside grade level. Such heaters shall be protected from physical damage by vehicles.

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

(c) Sealed combustion system heaters may be located within a garage. When necessary, they shall be protected against physical damage.

3.1.8 Installation in Aircraft Hangars:

Heaters in aircraft hangars shall be installed in accordance with NFPA No. 409-1962, Standard on Aircraft Hangars.*

*Available from the National Fire Protection Association, 60 Batterymarch Street, Boston, Mass. 02110.

3.1.9 Venting of Flue Gases:

Appliances shall be vented in accordance with the provisions of Part 5, Venting of Appliances.

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.

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 2.4). 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 appliance.

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.

3.1.13 Venting of Pressure Regulators:

(a) Gas appliance pressure regulators requiring access to the atmosphere for successful operation shall be equipped with vent piping leading to the outer air 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 appliance pressure regulators for use with natural, manufactured or mixed gases or LP-Gas-air mixtures shall limit the escape of gas in the event of diaphragm rupture to not more than 1.0 cubic foot per hour of 0.6 specific gravity gas at 7.0 inches water column pressure.

(c) Vent limiting means on appliance pressure regulators for use with undiluted liquefied petroleum gases shall limit the escape of gas in the event of diaphragm rupture to not more than 0.5 cubic foot per hour of 1.53 specific gravity gas at 11.0 inches water column pressure. (Appliance pressure regulators complying with the Addenda to the American Standard Listing Requirements for Domestic Gas Appliance Pressure Regulators, Z21.18a-1960, are required to be equipped with a device that will comply with this limitation.)

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

(e) In the case of vents entering the combustion chamber, the vent shall be located so that the escaping gas will be readily ignited from the pilot flame and the heat liberated will not adversely affect the operation of the thermal element of the automatic pilot. 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.

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.

3.1.15 Installation Instructions:

The installing agency shall conform with the appliance manufacturer's specific recommendations in completing an installation to assure 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.

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 3.3.1.)

3.2 *DRAFT HOODS*

3.2.1 Requirements:

(a) Every vented appliance, except incinerators, dual oven type combination ranges, sealed combustion system 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 and be of a listed or approved type, and in the absence of other instructions shall 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 approved 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 2, 3 and 4.)

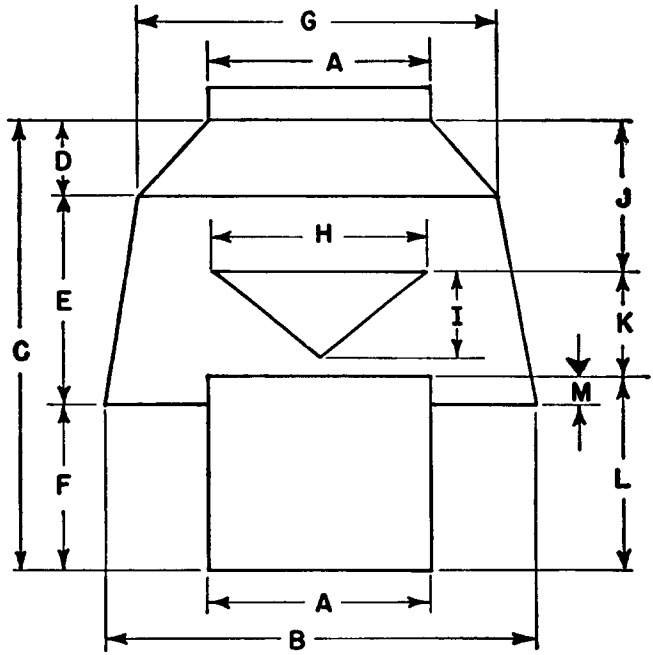


Table of Dimensions
(inches)

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 meet the American Standard Listing Requirements for Draft Hoods, Z21.12-1937 should be satisfactory within the limits of performance specified.

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

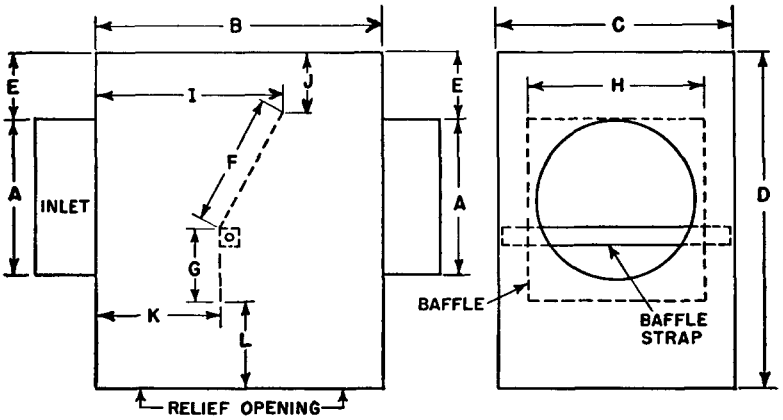


Table of Dimensions
(inches)

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 9/16	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 meet the American Standard Listing Requirements for Draft Hoods, Z21.12-1937 should be satisfactory within the limits of performance specified.

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

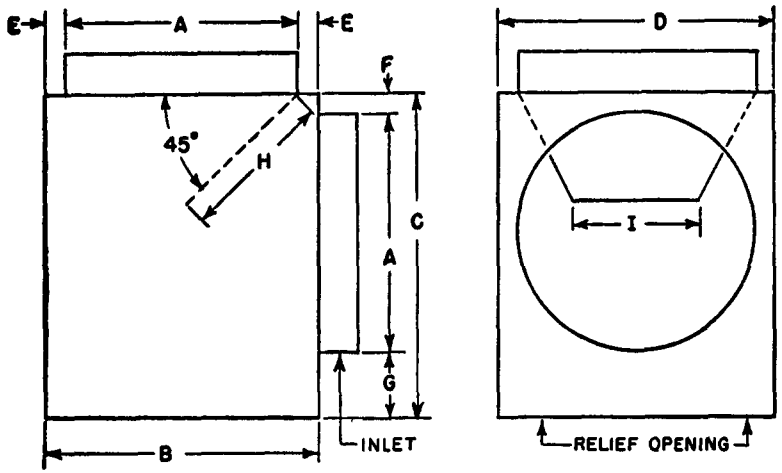


Table of Dimensions
(inches)

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 meet the American Standard Listing Requirements for Draft Hoods, Z21.12-1937, should be satisfactory within the limits of performance specified.

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

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.

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.

3.3 *ACCESSIBILITY AND CLEARANCE*

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 required; 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.

3.3.2 Permissible Temperatures on Combustible Materials:

(a) All gas appliances and their vent connectors shall be installed so that continued or intermittent operation will not create a hazard to persons or property. They shall not, during operation, raise the temperature of unprotected combustible walls, partitions, floors, or ceilings more than 90°F above normal room temperature when measured with mercury thermometers or conventional bead type thermocouples. (When wall and partition temperatures are measured with disc type thermocouples as specified in American Standard Approval Requirements for the types of appliances involved, an indicated temperature rise of 120° F will correspond to the 90° F rise measured with thermometers or conventional bead type thermocouples.)

(b) Minimum clearances between combustible walls and the back and sides of various conventional types of appliances and their vent connectors are specified in Parts 4 and 5.

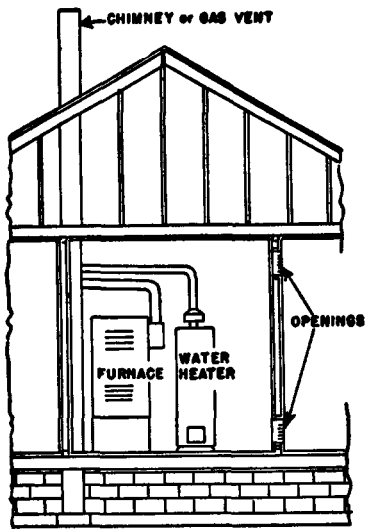
3.4 *AIR FOR COMBUSTION AND VENTILATION*

3.4.1 General

(a) The provisions of 3.4 are intended to apply to appliances that are installed in buildings and which require air for combustion, ventilation and draft hood dilution from within the building. They are not intended to apply to (1) sealed combustion system 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, or (2) enclosed furnaces which incorporate an integral total enclosure and use only outside air for combustion and draft hood dilution.

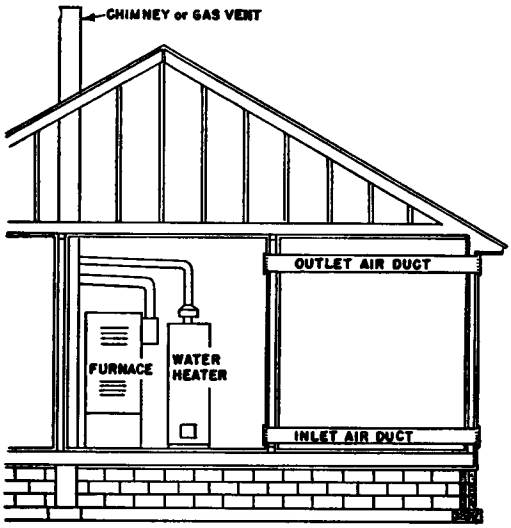
(b) Appliances shall be installed in a location in which the facilities for ventilation permit satisfactory combustion of gas, proper venting and the maintenance of ambient temperature at safe limits under normal conditions of use. Appliances shall be located so as not to interfere with proper circulation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

(c) While all forms of building construction cannot be covered in detail, air for combustion, ventilation and draft hood dilution for gas appliances vented by natural draft normally may



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. 5. Appliances Located in Confined Spaces All Air from Inside the Building. See 3.4.3 (a).



***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. 6. Appliances Located in Confined Spaces All Air from Outdoors. See 3.4.3 (b).

be obtained by application of one of the methods covered in 3.4.2, 3.4.3 and 3.4.6.

3.4.2 Appliances Located in Unconfined Spaces:

(a) In unconfined spaces in buildings of conventional frame, brick or stone construction, infiltration normally is adequate to provide air for combustion, ventilation, and draft hood dilution.

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

3.4.3 Appliances Located in Confined Spaces:

(a) *All Air From Inside Building:*

The confined space shall be provided with two permanent openings, one near the top of the enclosure and one near the bottom. Each opening shall have a free area of not less than one square inch per 1,000 Btu per hour of the total input rating of all appliances in the enclosure, freely communicating with interior areas having in turn adequate infiltration from the outside. (See Figure 5.)

(b) *All Air From Outdoors:*

The confined space shall be provided with two permanent openings, one in or near the top of the enclosure and one in or near the bottom. The openings shall communicate directly, or by means of ducts, with outdoors or to such spaces (crawl or attic), that freely communicate with outdoors. (See Figures 6, 7, and 8.)

When directly communicating with outdoors or by means of vertical ducts, each opening shall have a free area of not less than one square inch per 4,000 Btu per hour of total input rating of all appliances in the enclosure. If horizontal ducts are used, each opening shall have a free area of not less than one square inch per 2,000 Btu per hour of total input of all appliances in the enclosure.

Ducts 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 enclosure shall be provided with two openings for ventilation, located and sized as described in 3.4.3 (a). In addition, there shall be one opening directly communicating with outdoors or to such spaces (crawl or attic) that freely communicate with outdoors. This opening shall have a free area of not less than one square inch per 5,000 Btu per hour of total input of all appliances in the enclosure. A duct used to convey make-up air shall be of the same cross-sectional area as the free area of the opening required. Such ducts connected directly to outdoor air only may be connected to the cold air return of the heating system. The minimum dimension of rectangular air ducts shall be not less than 3 inches. (See Figure 9.)

3.4.4 Louvers and Grilles:

In calculating free area in 3.4.2 and 3.4.3, consideration shall be given to the blocking effect of louvers, grilles or screens protect-

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.

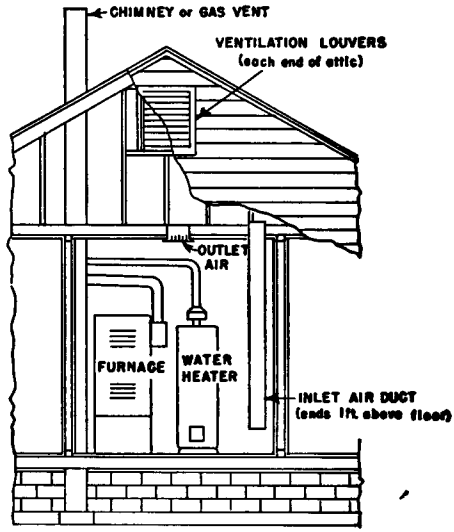
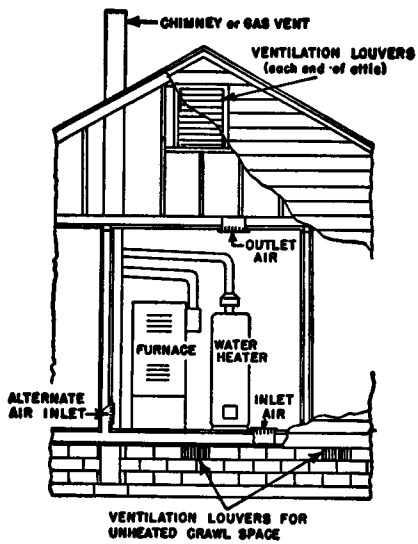


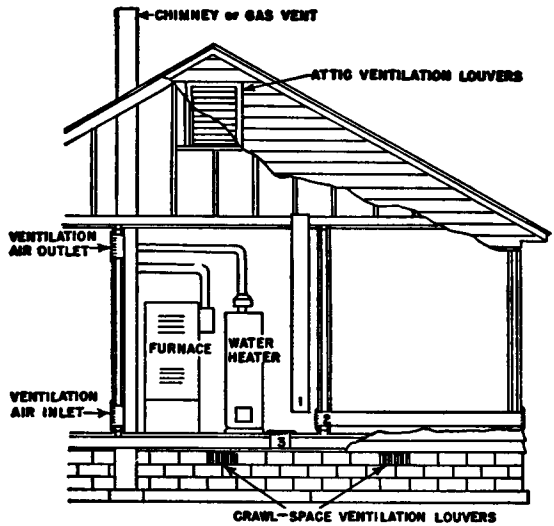
Fig. 7. Appliances Located in Confined Spaces All Air from Outdoors Through Ventilated Attic. See 3.4.3 (b).



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. 8. Appliances Located in Confined Spaces All Air from Outdoors — Inlet Air from Ventilated Crawl Space and Outlet Air to Ventilated Attic. See 3.4.3 (b).



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

Attic Ventilation Louvers are required at each end of attic with alternate air inlet No. 1.

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 are required with alternate air inlet No. 3.

Each Ventilation Air Opening from inside the building shall have a free area of not less than 1 square inch per 1,000 Btu per hour of the total input rating of all appliances in the enclosure.

Fig. 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 3.4.3 (c).

ing 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 per cent free area and metal louvers and grilles will have 60-75 per cent free area.

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.

3.4.6 Specially Engineered Installations:

The size of combustion air openings specified in 3.4.2 and 3.4.3 shall not necessarily govern when special engineering assures an adequate supply of air for combustion, ventilation, and draft hood dilution.

3.5 *APPLIANCE CONNECTIONS TO BUILDING PIPING*

3.5.1 Connecting Gas Appliances:

Gas appliances shall be connected by:

(a) Rigid pipe, or,

(b) Semi-rigid tubing extensions of a tubing piping system, or,

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

(d) Semi-rigid 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 not be used in exterior locations nor in interior locations where they are in contact with masonry, plaster, or insulation or are subject to repeated corrosive wettings.

3.5.2 Appliance Shutoff Valves:

Any appliance connected to a piping system supplying two or more appliances should have an accessible manual shutoff valve installed upstream of the union or connector and within 6 feet of the appliance it serves.

3.5.3 Use of Gas Hose:

The connection of an appliance with any type of gas hose is prohibited, except when used with laboratory, shop or ironing equipment that requires mobility during operation. Such connections shall have the shutoff or stopcock installed at the connection to the building piping. When gas hose is used, it shall be of the minimum practical length, but not to exceed 6 feet, and shall not extend from one room to another nor pass through any walls, partitions, ceilings or floors. Under no circumstances shall gas hose be concealed from view or used in a concealed location. Only listed gas hose shall be used. Listed gas hose shall be used only in accordance with its listing. Gas hose shall not be used where it is likely to be subject to excessive temperatures (above 125° F).

3.6 *ELECTRICAL CONNECTIONS*

3.6.1 Electrical Connections:

Electrical connections between gas appliances and the building

wiring shall conform to the National Electrical Code, ASA C1-1962 (NFPA No. 70)*

3.6.2 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 a 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.

3.6.3 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.

3.6.4 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. It is recommended that central heating gas appliances for domestic use be provided with a separate electrical circuit.

3.6.5 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.

3.6.6 Wire Size:

It is recommended that multiple conductor cable, not lighter than No. 18 American Wire Gage, having type "T" (formerly type SN) 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.

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*Available from the National Fire Protection Association, 60 Batterymarch St., Boston, Mass. 02110 in pamphlet form and in the National Fire Codes, Volume 5. Also available from the American Standards Association, Inc., 10 East 40th St., New York, N. Y. 10016.

3.7 *ROOM TEMPERATURE THERMOSTATS*

3.7.1 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.

3.7.2 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.

3.7.3 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.

Part 4 — Installation Requirements for Specific Appliances

4.1 *GENERAL*

A listed appliance or accessory may be installed in accordance with its listing, or as elsewhere required in Part 4.

4.2 *DOMESTIC RANGES*

4.2.1 Clearance from Combustible Material:

(a) Listed domestic ranges (except as noted in 4.2.1(b) and 4.2.1(c)) when installed on combustible floors shall be set on their own bases or legs and shall be installed with clearances of not less than that shown on the marking plate and the manufacturer's instructions. In the absence of clearance information on the marking plate, the range shall be installed with clearances of not less than that shown in Table 8. The clearance shall not interfere with requirements for combustion air, accessibility for operation, or servicing.

(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 between it and 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

Table 8

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	—

section and combustible material shall be in accordance with Table 10, 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.*

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 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 range is and is centered over the range.

4.2.3 Install Level:

Ranges shall be installed so that the cooking top or oven racks are level.

4.3 *BUILT-IN DOMESTIC COOKING UNITS*

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 the requirements for combustion air and accessibility for operation and servicing.

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

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*For details of protection, refer to NBFU Code for the Installation of Heat Producing Appliances, available from the National Board of Fire Underwriters, 85 John St., New York, N. Y. 10038.

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.

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 than that distance specified by the permanent marking on the unit.

4.3.4 Install Level:

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

4.4 *OPEN TOP BROILER UNITS*

4.4.1 Listed Units:

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

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.

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 minimum clearance of 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.

4.4.4 Commercial Units:

Commercial open top broiler units shall be provided with ventilation in accordance with "Ventilation of Restaurant Cooking Equipment," NFPA No. 96-1964.*

4.5 *WATER HEATERS*

4.5.1 Prohibited Installations:

Water heaters, with the exception of those having sealed combustion systems, shall not be installed in bathrooms, bedrooms, or any occupied rooms normally kept closed.

Single-faucet automatic instantaneous water heaters, as permitted under 5.1.2, in addition to the above, shall not be installed in kitchen sections of light housekeeping rooms or rooms used by transients.

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.

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 the requirements for combustion air, draft hood clearance and relief, and accessibility for servicing. (See Table 9.)

Table 9

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, uninsulated, underfired).

Type B—Underfired, insulated automatic storage heaters.

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

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

*Available from the National Fire Protection Association, 60 Batterymarch Street, Boston, Mass., 02110.

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

4.5.4 Connections:

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

4.5.5 Closed Systems:

No water heater shall be installed in a closed system of water piping unless an approved water pressure relief valve is provided.

4.5.6 Temperature Limiting Devices:

An automatic storage type water heater or a hot water storage vessel shall be installed with an automatic gas shutoff system, or a temperature relief valve, or a combination temperature and pressure relief valve.

4.5.7 Temperature, Pressure and Vacuum Relief Valves:

The installation and adjustment of temperature, pressure, and vacuum relief valves or combinations thereof, and automatic gas shutoff valves or devices shall be in accordance with the requirements of the authority having jurisdiction, or, with the manufacturer's instructions accompanying such devices.

4.5.8 Automatic (Instantaneous or Storage) Types:

(a) *Independent Gas Piping*: Gas piping shall be separate and direct from the meter, or service regulator when a meter is not provided, to the appliance unless gas piping of ample capacity exists or is installed (see 2.4).

4.5.9 Automatic Instantaneous Type:

(a) *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.

4.5.10 Circulating or Tank Types:

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

(b) *Size of Water Circulating Piping*: The size of the water

*For details of protection refer to the NBFU Code for the Installation of Heat Producing Appliances, available from the National Board of Fire Underwriters, 85 John Street, New York, N. Y., 10038.

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 10).

4.6 *ROOM HEATERS*

4.6.1 Installations in Sleeping Quarters:

Room heaters installed in sleeping quarters for use of transients, as in hotels, motels and auto courts, shall be of the vented type and shall be connected to an effective chimney or gas vent and equipped with an automatic pilot. It is recommended that room heaters in-

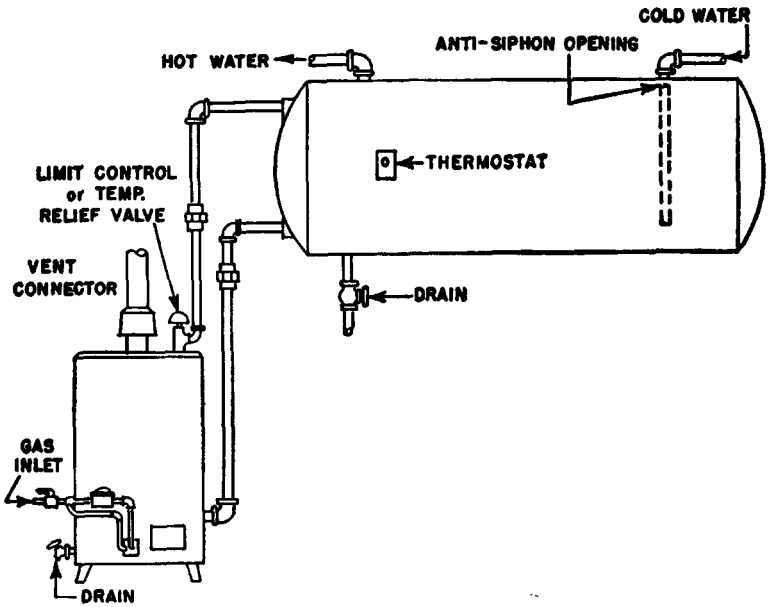


Fig 10. Suggested Location for Anti-Siphon Opening in Cold Water Inlet

stalled in all sleeping quarters or rooms generally kept closed be of the vented type and be connected to an effective chimney or gas vent and equipped with an automatic pilot.

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 an automatic pilot.

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 10, 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 the requirements of combustion air and accessibility. (See 3.3.1 and 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 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

Table 10

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	....

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.*

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.

4.6.5 Connection:

The provisions of 3.6, Appliance Connections to Building Piping, shall be observed.

4.7 *CENTRAL HEATING BOILERS AND FURNACES*

4.7.1 Independent Gas Piping:

Gas piping shall be separate and direct from the meter, or service regulator when a meter is not provided, to the boiler or furnace, unless gas piping of ample capacity exists or is installed (see 2.4).

4.7.2 Manual Main Shutoff Valves:

When a complete shutoff type automatic pilot system 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 automatic pilot system 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.

4.7.3 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 11 except as provided in 4.7.3(a) 1, 2 and 3.

1. Central heating furnaces and boilers listed for installation at lesser clearances than specified in Table 11 may be installed in accordance with their listing and the manufacturer's instructions.
2. Central heating furnaces and boilers listed for installation at greater clearances than specified in Table 11, shall be installed in accordance with their listing and the manufacturer's instructions unless protected as specified in 4.7.3(a)3.

*For details of protection, refer to the NBFU Code for the Installation of Heat Producing Appliances, available from the National Board of Fire Underwriters, 85 John St., New York, N. Y. 10038.

Table 11

Clearances To Combustible Material For Furnaces And Boilers Installed In Rooms Which Are Large In Comparison With Size Of Appliance, Except As Provided In 4.7.3 (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 11

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 required beyond this distance.

5. Clearance from supply ducts within 6 feet of the plenum shall not be less than 6 inches. No clearance is required 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.

Table 12

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. 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.

3. Central heating furnaces and boilers may be installed in rooms, but not in confined spaces such as alcoves and closets, with reduced clearances to combustible material provided the combustible material or the appliance is protected as described in Table 12.

(b) Central heating furnaces and boilers shall not be installed in confined spaces such as alcoves and closets unless they have been specifically listed for such installation and are installed in accordance with their listing. The installation clearances for furnaces and boilers in confined spaces shall not be reduced by the protection methods described in Table 12.

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.

The clearance to these appliances shall not interfere with the requirements for combustion air, draft hood clearance and relief, and accessibility for servicing. (See 3.3.1 and 3.4.)

4.7.4 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.*

4.7.5 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.**

*For details of protection refer to the NBFU Code for the Installation of Heat Producing Appliances, available from the National Board of Fire Underwriters, 85 John St., New York, N. Y. 10038.

**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, 62 Worth Street, New York, N. Y., 10013, and the Institute of Boiler and Radiator Manufacturers Installation Guides, available from the Institute of Boiler and Radiator Manufacturers, 608 Fifth Avenue, New York, N. Y. 10020.

4.7.6 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.

4.7.7 Temperature or Pressure Limiting Devices:

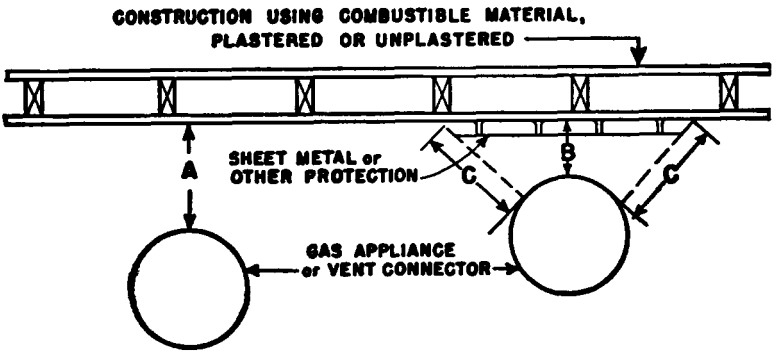
Steam and hot water boilers respectively shall be provided with approved automatic limiting devices for shutting down the burner(s) to prevent boiler steam pressure or boiler water temperature from exceeding the maximum allowable working pressure or temperature.

4.7.8 Low Water Cutoff:

Steam boilers shall be provided with an automatic low water fuel cutoff for shutting down the burner in the event that the boiler water level drops to the lowest safe water line.

4.7.9 Steam Safety and Pressure Relief Valves:

Steam and hot water boilers shall be equipped respectively



A equals the required clearance with no protection specified in Tables 11 and 13 and in the sections applying to various types of appliances.

B equals the reduced clearance permitted in accordance with Table 12. The protection applied to the construction using combustible material shall extend far enough in each direction to make C equal to A.

Fig. 11. Extent of Protection Required to Reduce Clearances From Gas Appliances or Vent Connectors.

with listed steam safety or pressure relief valves of appropriate discharge capacity and conforming with ASME requirements.* 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.

4.7.10 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.**

(c) When the furnace is installed within a confined space, the air circulated by the furnace shall be handled by ducts which are sealed to the furnace casing and are entirely separate from the means provided for supplying combustion and ventilation air.

4.7.11 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 throughput required 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

*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, N. Y. 10017.

**Reference may be made to the Standard for the Installation of Air Conditioning and Ventilating Systems of Other than Residence Type, NFPA No. 90A, Standard for the Installation of Residence Type Warm Air Heating and Air Conditioning Systems, NFPA No. 90B, available from the National Fire Protection Association, 60 Batterymarch St., Boston, Mass. 02110, and to the Design and Installation Manuals of the National Warm Air Heating and Air Conditioning Association, available from the National Warm Air Heating and Air Conditioning Association, 640 Engineers Bldg., Cleveland, Ohio 44114.

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.

4.7.12 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.

4.8 *WALL FURNACES*

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 BW 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 BW gas vent system listed for installation in multistory buildings may be installed in single story or multistory buildings. Type BW gas vents shall be attached directly to a solid header plate which may be an integral part of the vented wall furnace, and which serves as a fire stop at that point. 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 12 for Type BW gas vent installation requirements.)

(d) Sealed combustion system 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.

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.

4.8.3 Manual Main Shutoff Valve:

A manual main shutoff valve shall be installed ahead of all controls including the pilot gas valve.

4.8.4 Combustion and Circulating Air:

Adequate combustion and circulating air shall be provided (see 3.4).

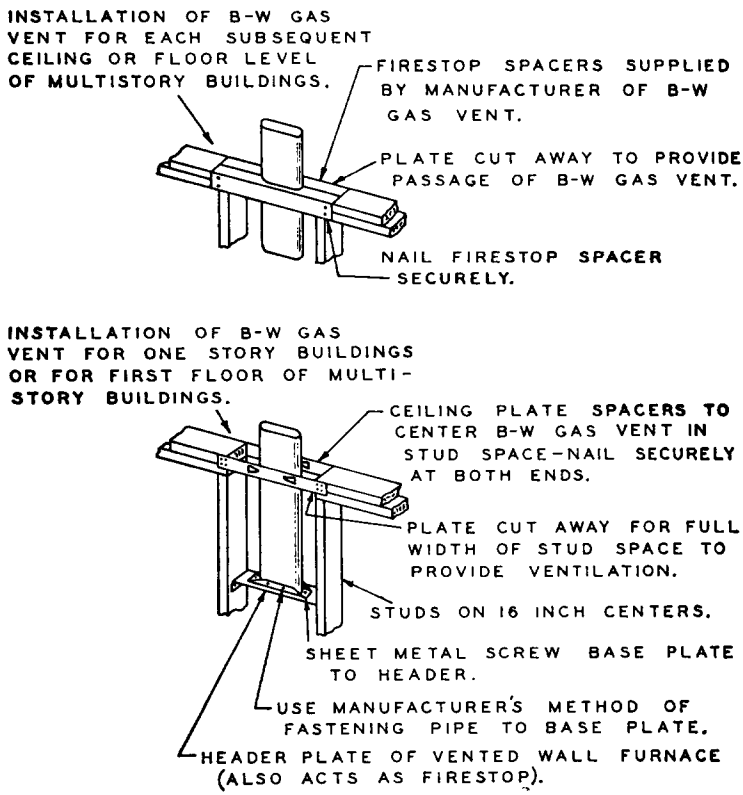


Figure 12. Installation of Type B-W Gas Vents for Vented Wall Furnaces.

4.9 *FLOOR FURNACES*

4.9.1 Installation:

Listed floor furnaces may be installed in combustible floors. Unlisted floor furnaces shall not be installed in combustible floors.

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.

4.9.3 Combustion and Circulating Air:

Adequate combustion and circulating air shall be provided (see 3.4).

4.9.4 Placement:

The following requirements 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 grille 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 grille to walls shall be provided to eliminate the necessity of occupants walking over the warm air discharge from grilles. 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.

4.9.5 Bracing:

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

4.9.6 Support:

Means shall be provided to support the furnace when the floor grille is removed.

4.9.7 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.

4.9.8 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.

4.9.9 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.

4.9.10 Wind Protection:

Floor furnaces shall be protected, where necessary, against severe wind conditions.

4.9.11 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 separated from the nonhabitable space) with means for air intake to meet the provisions of 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.

4.9.12 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.

4.10 *DUCT FURNACES*

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 the requirements for combustion air and accessibility. (See 3.3.1 and 3.4.)

(b) Unlisted duct furnaces shall be installed with clearances to combustible material in accordance with the requirements for unlisted furnaces and boilers, Table 11. Combustible floors under unlisted duct furnaces shall be protected in an approved manner.*

4.10.2 Erection of Appliance:

Duct furnaces shall be erected and firmly supported in accordance with the manufacturer's instructions.

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.

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.

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.

*For details of protection refer to the NBFU Code for the Installation of Heat Producing Appliances, available from the National Board of Fire Underwriters, 85 John St., New York, N. Y. 10038.

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 required 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 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.

4.10.7 Installation in Commercial Garages and Aircraft Hangars:

Duct furnaces installed in garages for more than three motor vehicles or in aircraft hangars shall be of a listed type and shall be installed in accordance with 3.1.7 and 3.1.8.

4.11 *CONVERSION BURNERS*

Installation of conversion burners shall conform to American Standard Installation of Domestic Gas Conversion Burners, Z21.8-1958.*

4.12 *CONVERSION BURNERS FOR DOMESTIC RANGES*

Installation of conversion burners in ranges originally designed to utilize solid or liquid fuels shall conform to American Standard Requirements for Installation of Gas Conversion Burners in Domestic Ranges, Z21.38-1957.*

*Available from American Gas Association, Inc., 605 Third Ave., New York, N. Y. 10016.

4.13 *UNIT HEATERS*

4.13.1 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.

4.13.2 Clearance:

(a) *Suspended Type Unit Heaters.*

1. Listed unit heaters shall be installed with clearance 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.

2. Unit heaters listed for reduced clearances may be installed in accordance with the clearance marked on the unit which will require not less than 6 inches from the draft hood relief opening and 6 inches above an elbow attached directly to the draft hood outlet.

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

4. Additional clearances required 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 clearance 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 may be installed at the clearances marked on the unit from the back, two side walls and ceiling. Walls and ceiling will be required to have at least 6 inches clearance from the draft hood relief openings and the nearest point of the draft hood exterior to the unit.

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.*

*For details of protection refer to the NBFU Code for the Installation of Heat Producing Appliances, available from the National Board of Fire Underwriters, 85 John Street, New York, N. Y., 10038.

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

4.13.3 Combustion and Circulating Air:

Adequate combustion and circulating air shall be provided (see 3.4).

4.13.4 Ductwork:

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

4.13.5 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 3.1.7 and 3.1.8.

4.14 *INFRARED RADIANT HEATERS*

4.14.1 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.

4.14.2 Clearance:

(a) Listed heaters shall be installed with clearances from combustible material of not less than shown on the marking plate and in the manufacturer's instructions.

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

4.14.3 Combustion and Ventilating Air:

Adequate combustion and ventilating air shall be provided.

4.14.4 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 3.1.7 and 3.1.8.

4.15 *CLOTHES DRYERS*

4.15.1 Clearance:

(a) Listed Type 1 clothes dryers shall be installed with 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.*

4.15.2 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.

4.15.3 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 3.4.5.)

(b) Provision for make-up air shall be provided for Type 2 clothes dryers, with a minimum free area (see 3.4.4) of one square inch for each 1,000 Btu per hour total input rating of the dryer(s) installed.

4.15.4 Exhaust Ducts for Type 1 Clothes Dryers:

(a) A clothes dryer exhaust duct shall not be connected into any vent connector, gas vent or chimney.

(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.

4.15.5 Exhaust Ducts for Type 2 Clothes Dryers:

(a) Exhaust ducts for Type 2 clothes dryers shall comply with 4.15.4.

(b) Exhaust ducts for Type 2 clothes dryers shall be constructed of sheet metal or other noncombustible material. Such ducts shall be of adequate strength to meet the conditions of service with minimum thicknesses equivalent to No. 22 galvanized sheet gage.

(c) Exhaust ducts for Type 2 clothes dryers shall have a clearance of at least 6 inches to combustible material except as provided in 4.15.5 (d).

*For details of protection refer to the NBFU Code for the Installation of Heat Producing Appliances, available from the National Board of Fire Underwriters, 85 John Street, New York, N. Y., 10038.

(d) 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 12.

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

(f) 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.

4.15.6 Multiple Family or Public Use:

Clothes dryers installed for multiple family or public use shall be equipped with approved automatic pilots.

4.16 *INCINERATORS*

4.16.1 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 above a charging door to combustible material 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 wtih 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 12. 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.

4.16.2 Mounting:

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

(b) Unlisted incinerators, except as provided in 4.16.2 (c) and 4.16.2 (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 4.16.2(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 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 4.16.2 (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.

4.16.3 Draft Hood Prohibited:

Draft hoods shall not be installed in the vent connector of an incinerator.

4.16.4 Vent Connector Clearance:

Vent connectors shall have at least 18 inches clearance from combustible material and shall not pass through combustible walls unless guarded at the point of passage as specified in 5.8.14.

4.16.5 Vent Connector Material:

The vent connector from an incinerator to a chimney shall be galvanized steel of a thickness at least No. 24 manufacturer's standard gage or of material having equivalent or superior heat and corrosion resistant properties, and the joints shall be secured by sheet metal screws.

4.17 *REFRIGERATORS*

4.17.1 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 a 12-inch clearance above the top.

4.17.2 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.

4.18 *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.*

(c) The vertical distance between tops of all domestic hot

*For details of protection refer to the NBFU Code for the Installation of Heat Producing Appliances, available from the National Board of Fire Underwriters, 85 John Street, New York, N. Y., 10038.

plates and laundry stoves and combustible material shall be at least 30 inches.

4.19 *HOTEL AND RESTAURANT RANGES, DEEP FAT FRYERS AND UNIT BROILERS*

4.19.1 Clearance for Listed Appliances:

Listed hotel and restaurant ranges, deep fat fryers and unit broilers 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. Hotel and restaurant ranges, deep fat fryers and unit broilers 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.

4.19.2 Clearance for Unlisted Appliances:

(a) Unlisted hotel and restaurant ranges, deep fat fryers and unit broilers, except as provided in 4.19.2 (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 the cooking top and at the front of the appliance.

(b) Unlisted hotel and restaurant ranges, deep fat fryers and unit broilers 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 12.

(c) Unlisted hotel and restaurant ranges, deep fat fryers and unit broilers 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 inches 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.

4.19.3 Mounting on Combustible Floor:

(a) Listed hotel and restaurant ranges, deep fat fryers and unit broilers listed specifically for installation on floors constructed of combustible material may be mounted on combustible floors.

(b) Listed floor mounted hotel and restaurant ranges, deep fat fryers and unit broilers 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) Hotels and restaurant ranges, deep fat fryers, and unit broilers, which are not listed for mounting on a combustible floor shall be mounted in accordance with 4.19.3 (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 3/8 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 3/16 inch in thickness.

4.19.4 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 certified 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 4.19.2 for a distance of at least 2 feet above the surface of the cooking top.

4.19.5 Install Level:

All hotel and restaurant ranges, deep fat fryers, and unit broilers shall be installed level on a firm foundation.

4.19.6 Ventilation:

Adequate means shall be provided to properly ventilate the space in which hotel and restaurant equipment is installed to permit proper combustion of the gas. When exhaust fans are used for ventilation, special precautions may be required to avoid interference with the operation of the equipment.

4.20 *COUNTER APPLIANCES*

4.20.1 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.

4.20.2 Clearance for Listed Appliances:

Listed counter appliances such as commercial hot plates and griddles, food and dish warmers, and coffee brewers and urns, when installed on combustible surfaces shall be 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. Counter appliances listed for installation at lesser clearances may be installed in accordance with their listing and the manufacturer's instructions.

4.20.3 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 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 counter appliances may be installed with reduced clearances to combustible material pro-

vided the combustible material is protected as described in Table 12. Unlisted food and dish warmers shall be installed with a horizontal clearance from combustible material of not less than 6 inches.

4.20.4 Mounting of Unlisted Appliances:

Unlisted 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.

4.21 *PORTABLE BAKING AND ROASTING OVENS*

4.21.1 Clearance for Listed Appliances:

Listed portable baking and roasting ovens shall be installed at least 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. Portable baking and roasting ovens 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.

4.21.2 Mountings for Listed Appliances:

Portable baking and roasting ovens that are listed specifically for installation on a floor constructed of combustible material may be mounted in accordance with their listing.

4.21.3 Clearance for Unlisted Appliances:

(a) Unlisted portable baking and roasting ovens except as provided in 4.21.3 (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 at the front of the appliance.

(b) Unlisted portable baking and roasting ovens may be installed in rooms, but not in confined spaces such as alcoves or closets, with reduced clearance to combustible material, provided the combustible material or the appliance is protected as described in Table 12.

(c) Unlisted portable baking and roasting ovens 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 inches from such wall or material. Such protection shall extend at least 12 inches beyond the back, side, top or 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.

4.21.4 Mounting of Unlisted Appliances:

Unlisted portable baking and roasting ovens shall be mounted in an approved manner.*

4.22 *AIR CONDITIONING APPLIANCES*

4.22.1 Independent Gas Piping:

Gas piping shall be separate and direct from the meter, or service regulator when a meter is not provided, to the air conditioning appliance, unless gas piping of ample capacity exists or is installed. An existing line serving the heating appliance may be satisfactory when heating and cooling appliances are not operated simultaneously. (See 2.4.)

4.22.2 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.

4.22.3 Manual Main Shutoff Valves:

When a complete shutoff type automatic pilot system 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 automatic pilot system 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.

4.22.4 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 11 except as provided in 4.22.4(a) 1, 2 and 3.

1. Air conditioning appliances listed for installation at lesser clearances than specified in Table 11 may be installed in

*For details of protection refer to the NBFU Code for the Installation of Heat Producing Appliances, available from the National Board of Fire Underwriters, 85 John Street, New York, N. Y., 10038.

accordance with their listing and the manufacturer's instructions.

2. Air conditioning appliances listed for installation at greater clearances than specified in Table 11 shall be installed in accordance with their listing and the manufacturer's instructions unless protected as specified in 4.22.4(a) 3. However, when clearances are specified to provide access for service, they shall not be reduced.

3. Air conditioning appliances may be installed in rooms, but not in confined spaces such as alcoves and closets, with reduced clearances to combustible material provided the combustible material or the appliance is protected as described in Table 12. However, when clearances are necessary or specified to provide access for service, they shall not be reduced.

(b) Air conditioning appliances shall not be installed in confined spaces such as alcoves and closets unless they have been specifically listed for such installation and are installed in accordance with their listing. The installation clearances for air conditioning appliances in confined spaces shall not be reduced by the protection methods described in Table 12.

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.

The clearance to these appliances shall not interfere with the requirements for combustion air, draft hood clearance and relief, and accessibility for servicing. (See 3.3.1 and 3.4.)

(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.

4.22.5 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 the surface is protected in an approved manner,* 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.

*For details of protection see the NBFU Code for the Installation of Heat Producing Appliances, available from the National Board of Fire Underwriters, 85 John Street, New York, N. Y. 10038.

4.22.6 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.

4.22.7 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 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.

4.22.8 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.*

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.

4.22.9 Refrigeration Coils:

(See 4.7.11 and 4.7.12.)

4.22.10 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.

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*Reference may be made to the Standard for the Installation of Air Conditioning and Ventilating Systems of Other Than Residence Type, NFPA No. 90A, Standard for the Installation of Residence Type Warm Air Heating and Air Conditioning Systems, NFPA No. 90B, available from the National Fire Protection Association, 60 Batterymarch Street, Boston, Mass. 02110, and to the Design and Installation Manuals of the National Warm Air Heating and Air Conditioning Association, 640 Engineers Building, Cleveland, Ohio 44114.

4.23 *ILLUMINATING APPLIANCES*

4.23.1 Clearances:

Listed illuminating appliances shall be installed in accordance with their listings and the manufacturer's instructions.

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

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

Unlisted open-flame illuminating appliances shall be installed only at locations and with clearances from combustible material acceptable to the authority having jurisdiction.

4.23.2 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.

4.23.3 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 shall be at least equivalent to that of a 2½ inch diameter post constructed of 0.064 inch thick (No. 14 gage) steel.

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

4.23.4 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.

Part 5 — Venting of Appliances

5.1 *REQUIREMENTS FOR VENTING*

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 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 either vented or unvented (see 4.6.1 and 4.6.2).

(g) Type 2 clothes dryers (see 4.15.2 and 4.15.5).

(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 5.1.2 (l).

5.1.2 Appliances Not Required to be Vented:

(a) Listed ranges.

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

(c) Listed hot plates and listed laundry stoves.

(d) Listed Type 1 clothes dryers (see 4.15.2).

★(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 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 in a commercial kitchen having a mechanical exhaust system.

★(h) Listed refrigerators.

★(i) Counter appliances.

★(j) Room heaters listed for unvented use (see 4.6.1 and 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 appliances 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.

5.2 *MINIMUM SAFE PERFORMANCE*

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

5.2.2 All gas appliances required to be vented shall be connected to a gas vent, chimney, or single-wall metal pipe in accordance with natural draft venting provisions of 5.3 through 5.8 or by one of the special venting arrangements of 5.9.

5.2.3 Gas vents, chimneys, single-wall metal pipes and vent connectors shall be sized in accordance with 5.4.3, 5.5.3, 5.6.3 and 5.8.3 or in accordance with approved engineering methods.

5.3 *TYPE OF VENTING SYSTEMS TO BE USED*

5.3.1 All gas appliances required to be vented shall be connected to a venting system except sealed combustion system appliances and as otherwise provided in 5.9.

5.3.2 Chimneys shall be used for venting the following types of appliances:

(a) Incinerators, except as provided in 5.3.5 (b).

(b) Appliances which may be converted to the use of solid or liquid fuels.

(c) Combination gas-oil burning appliances.
(d) Appliances listed for use with chimneys only.
(e) Unlisted appliances designed to be vented.

5.3.3 Type B gas vents may be used to vent listed gas appliances except as provided in 5.3.2, 5.3.4 and 5.9.1.

5.3.4 Type BW gas vents shall be used with listed vented wall furnaces when the appliance is so listed.

5.3.5 Single-wall metal pipe may be used to vent the following gas appliances:
(a) Gas appliances except as provided in 5.3.2 and 5.3.4.
(b) Incinerators for outdoor use, such as in open sheds, breezeways or carports.

5.4 *TYPE B AND TYPE BW GAS VENTS*

5.4.1 Listing:

Type B and Type BW gas vents shall be installed in accordance with their listings and the manufacturer's instructions. Type B and Type BW gas vents may be used for single story or multistory installations when so listed. Type BW gas vents shall have a listed capacity not less than that of the listed vented wall furnaces to which they are connected.

5.4.2 Gas Vent Termination:

(a) Gas vents installed with mechanical exhausters may be terminated not less than 12 inches above the highest point where they pass through a roof surface. (See 5.9.2.)

Gas vents installed with listed caps shall terminate in accordance with the terms of the vent cap's listing.

Gas vents installed with approved terminal devices shall be installed in accordance with the terms of their approval.

Gas vents installed without listed caps, approved terminal devices or mechanical exhausters shall extend at least 2 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 10 feet.

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

(c) Type BW gas vents serving a vented wall furnace shall not terminate less than 12 feet in vertical height above the bottom of the heater.

(d) Type B and Type BW gas vents shall terminate in an approved cap or roof assembly with a venting capacity not less

than that of the gas vent. The cap or roof assembly shall be of a design to prevent rain and debris from entering the gas vent.

5.4.3 Size of Gas Vents:

(a) The effective area of the gas vent when connected to a single appliance shall be not less than the area of the appliance draft hood outlet or in accordance with approved engineering methods. Reference may be made to Tables 1 and 2 in Appendix D, depending on the construction of the vent.

(b) The effective area of the gas vent when connected to more than one appliance shall be not less than the area of the largest vent connector plus 50 percent of the areas of additional vent connectors or in accordance with approved engineering methods. Reference may be made to Tables 4 and 5 in Appendix D, depending on the construction of the vent.

(c) Any shaped gas vent may be used, provided its equivalent effective area is equal to the effective area of the round pipe for which it is substituted and the minimum internal dimension of the gas vent is not less than 2 inches.

5.4.4 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.

5.4.5 Gas Vents Serving Two or More Gas Appliances Having Draft Hoods:

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

(b) Two or more gas appliances may be vented through a common vent connector or manifold located at the highest level consistent with available (normal) headroom or clearance to combustible material (see 5.8.3).

(c) The manifold, all junction fittings, and the common vent connector shall be of a size adequate for the combined volume of the vent gases (see 5.8.3).

5.4.6 Marking:

In those sections of the country where solid and liquid fuels

are used extensively, gas vent systems 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 system enters the wall, ceiling or chimney.

The authority having jurisdiction shall determine whether the locality constitutes such an area.

5.5 *MASONRY, METAL AND FACTORY-BUILT CHIMNEYS*

5.5.1 Listing or Construction:

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

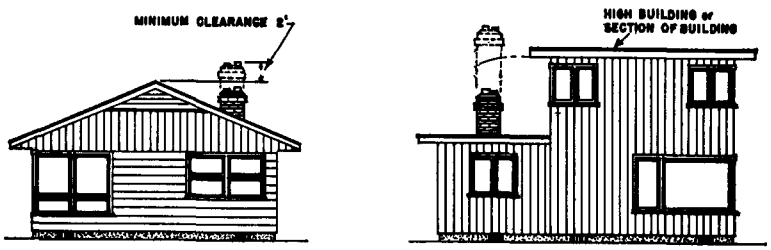
(b) Masonry or metal chimneys shall be built and installed in accordance with nationally recognized building codes.*

5.5.2 Termination:

(a) Chimneys shall extend at least 3 feet above the highest point where they pass through the roof of a building and at least 2 feet higher than any portion of any building within 10 feet.

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

*Article X of the National Building Code of The National Board of Fire Underwriters, 85 John St., New York, N. Y. 10038, or the Standard for Chimneys, Fireplaces and Vent Systems, NFPA No. 211 of the National Fire Protection Association, 60 Batterymarch St., Boston, Mass. 02110, are among such nationally recognized codes and standards.



Correct Chimney Designs Shown by Dotted Lines Carry Chimney Well Above Roof of High Building

Fig. 13. Typical Chimney Conditions Apt to Result in Back Drafts.

5.5.3 Size of Chimneys:

(a) The effective area of the chimney when connected to a single appliance shall be not less than the area of the appliance draft hood outlet or in accordance with approved engineering methods. Reference may be made to Table 3 in Appendix D.

(b) The effective area of the chimney when connected to more than one gas appliance shall be not less than the area of the largest vent connector plus 50 percent of the areas of additional vent connectors or in accordance with approved engineering methods. Reference may be made to Table 6 in Appendix D.

(c) 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 diameter is not less than 1 inch larger in equivalent diameter than the diameter of the incinerator flue outlet.

5.5.4 Inspection of Chimneys:

(a) Before connecting a vent connector to a chimney, the chimney passageway shall be examined to ascertain that it is properly constructed and 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 replaced with a gas vent or chimney suitable for the appliances to be attached.

5.5.5 Chimneys 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 an automatic pilot. A gas appliance vent connector and a flue connector from an appliance burning another fuel may be connected into the same chimney through separate openings, or both 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.

5.5.6 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.

5.5.7 Chimney Serving Two or More Gas Appliances:

Chimneys serving two or more gas appliances shall comply with the provisions outlined under 5.4.5.

5.6 *SINGLE-WALL METAL PIPE*

5.6.1 Installation With Gas Appliances Permitted by 5.3.5(a):

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

(b) Single-wall metal pipe used to vent gas appliances shall comply with the installation provisions of 5.4.2 (a), (b) and (d).

(c) 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.

(d) 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.

(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 5.8.14.

(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 5.8.14 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.

5.6.2 Installation With Incinerators Permitted by 5.3.5(b):

Single-wall metal pipe not less than No. 20 galvanized sheet gage or other equivalent noncombustible, corrosion-resistant material may be used for venting incinerators installed in locations such as open sheds, breezeways, or carports, provided the metal pipe is exposed and readily examinable for its full length and suitable clearances are maintained. See Table 13.

5.6.3 Size of Single-Wall Metal Pipe:

(a) The effective area of single-wall metal pipe when connected to a single appliance shall be not less than the area of the

Table 13

Vent Connector Clearances for Gas Appliances

Appliance	Minimum Distance from Combustible Material	
	Listed Type B Gas Vent Material	Vent Connectors of Other than Type B Material
Listed Boiler	As Listed	6 inches
" Warm Air Furnace	" "	6 "
" Water Heater	" "	6 "
" Room Heater	" "	6 "
" Floor Furnace	" "	6 "
" Incinerator	Not Permitted	18 "
" Conversion Burner (with draft hood)	6 inches	9 "
Unlisted Appliances having draft hoods	6 "	9 "
Unlisted Appliances without draft hoods	Not Permitted	18 "

appliance draft hood outlet or in accordance with approved engineering methods. Reference may be made to Table 2 in Appendix D.

(b) The effective area of single-wall metal pipe when connected to more than one appliance shall be not less than the area of the largest vent connector plus 50 percent of the areas of additional vent connectors or in accordance with approved engineering methods. Reference may be made to Table 5 in Appendix D.

(c) 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 the minimum internal dimension of the pipe is not less than 2 inches.

5.6.4 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.

5.6.5 Single-Wall Metal Pipe Serving Two or More Gas Appliances Having Draft Hoods:

Single-wall metal pipe serving two or more gas appliances having draft hoods shall comply with the provisions outlined under 5.4.5.

5.6.6 Marking:

Single-wall metal pipe shall comply with the marking provisions of 5.4.6.

5.7 *OUTSIDE GAS VENTS AND CHIMNEYS*

5.7.1 Materials:

Outside gas vents and chimneys are not recommended for use in cold climates. When they must be used in these climates, the material shall possess high insulation qualities or be adequately insulated.

5.7.2 Condensate Drain:

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

5.7.3 Prohibited Termination:

Natural draft vents extending through outside walls shall not terminate adjacent to outside walls or below eaves or parapets.

5.8 *VENT CONNECTORS*

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.

5.8.2 Materials:

(a) Vent connectors used for conversion burners without draft hoods, incinerators and unlisted appliances without draft hoods shall be constructed of materials having a resistance to corrosion and heat not less than that of No. 24 galvanized sheet gage.

(b) Vent connectors used for gas appliances having draft hoods and for listed conversion burners having draft hoods shall be constructed of materials having a resistance to corrosion and heat not less than that of No. 28 galvanized sheet gage, except that Type B vent material may be used as the connector between the draft hood and the chimney.

5.8.3 Size of Vent Connector:

(a) The effective area of the vent connector, when connected to an appliance having a single draft hood, shall be not less than the area of the draft hood outlet or shall be in accordance with approved engineering methods. Reference may be made to Tables 1, 2 and 3 in Appendix D.

(b) For single appliances having more than one draft hood outlet, the instructions of the appliance manufacturer shall be followed. If there are none, the effective area of the vent connector shall equal the combined areas of the draft hood outlets for which it acts as a common connector to the venting system.

(c) When two or more appliances are connected to a common vent or chimney, the effective area of each vent connector shall be not less than the area of the appliance draft hood outlet or shall be in accordance with approved engineering methods. Reference may be made to Tables 4, 5 and 6 in Appendix D.

(d) Each vent connector of a multiple venting system shall have the greatest possible vertical rise consistent with the headroom available between the draft hood outlet and the point of interconnection to a manifold, to a common vent, or to a chimney, or the vertical rise shall be in accordance with approved engineering methods. Reference may be made to Tables 4, 5 and 6 in Appendix 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.

5.8.4 Clearance:

Minimum clearances from vent connectors to combustible material shall be in accordance with Table 13. The clearances from vent connectors to combustible materials may be reduced when the combustible material is protected as specified in Table 12.

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 5.8.14.

5.8.5 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 of vent gases.

5.8.6 Joints:

Vent connectors shall be firmly attached to draft hood outlets by sheetmetal screws or other approved means.

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

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

5.8.7 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.

Vent connectors attached to top outlet draft hoods by means of a 90-degree elbow may be horizontal or pitched upward from the appliance.

5.8.8 Length:

The horizontal run of the vent connector shall be as short and direct as possible and the appliance shall be located as near the gas vent, chimney or single-wall metal pipe as practicable. The maximum length of an uninsulated horizontal run of vent connector shall not exceed 75 percent of the height of the gas vent, chimney or single-wall metal pipe or shall be in accordance with approved engineering methods. Reference may be made to Appendix D.

5.8.9 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.

5.8.10 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 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.

5.8.11 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 it from falling out.

5.8.12 Fireplace:

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

5.8.13 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.

5.8.14 Use of Thimbles:

(a) When passing through combustible walls or partitions, vent connectors built of listed Type B gas vent material shall be installed so that the clearances required by the listing are maintained.

(b) 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:

For listed appliances, 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.

For unlisted appliances having draft hoods—6 inches larger in diameter than the vent connector.

For incinerators and unlisted appliances without draft hoods—12 inches larger in diameter than the vent connector.

(c) 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 clearance required from such vent connector to combustible material. Any material used to close up such opening shall be noncombustible.

5.9 SPECIAL VENTING ARRANGEMENTS

5.9.1 Appliances with Sealed Combustion Systems:

(a) The provisions of draft hoods as shown in Part 3 and Sections 5.2.2 through 5.8, inclusive, do not apply to listed appliances having sealed combustion 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 and the manufacturer's instructions.

(b) Vent terminals of sealed combustion system appliances shall be located not less than 9 inches from any building opening. A sealed combustion system appliance may be installed in a building opening, such as a window.

5.9.2 Venting System Exhausters:

(a) Venting system exhausters may be used in lieu of natural

draft vents for any gas appliance except incinerators. When exhausters are used with gas appliances requiring venting, provisions shall be made to prevent the flow of gas to the main burner in the event of failure of the exhaust system.

(b) Vent connectors serving gas appliances vented by natural draft shall not be connected into the discharge side of power exhausters.

(c) The exit terminals of exhauster equipped gas venting systems shall be located not less than 9 inches from any building opening nor less than 2 feet from an adjacent building, and not less than 7 feet above grade when located adjacent to public walkways.

5.9.3 Ventilating Hoods and Exhaust Systems:*

(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 5.1.2(g).

5.9.4 Outdoor Appliances with Integral Vents:

Appliances listed for outdoor installation incorporating integral venting means shall be considered as being properly vented when they are installed in accordance with their listings and the manufacturer's instructions.

*Information on the construction and installation of ventilating hoods may be obtained from NFPA No. 96, Standard on Ventilation of Restaurant Cooking Equipment, available from the National Fire Protection Association, 60 Batterymarch Street, Boston, Mass., 02110.

Part 6 – Procedures to be Followed to Place an Appliance in Operation

6.1 *ADJUSTING THE BURNER INPUT*

6.1.1 Burner Input:

Each burner shall be adjusted to its proper input in accordance with the manufacturer's instructions. Over-rating of burners is prohibited.

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.

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 14.

(b) *Checking Burner Input Not Using a Meter.*

The fixed orifice size for each burner may be determined in accordance with Table 1 for utility gases and Table 2 for undiluted liquefied petroleum gases in Appendix C.

6.1.4 Adjusting Input:

The input rate shall be adjusted to the required 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.

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

Continued on page 54 - 96

Table 14

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 14 (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.

or serving gas supplier. After setting the primary air, the adjustment means shall be secured in position.

6.3 *AUTOMATIC PILOTS*

When an automatic pilot is provided, it shall be checked for proper operation and adjustment in accordance with the manufacturer's instructions. If the pilot 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.

6.4 *AUTOMATIC IGNITION*

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

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 cut-off device and manual operating features, etc., shall be checked to assure proper operation.

6.6 *CHECKING THE DRAFT*

Vent connected appliances shall be operated for a few 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 assure adequate draft through the chimney or gas vent.

6.7 *OPERATING INSTRUCTIONS*

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

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

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.

Part 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. A gas appliance is any device which utilizes gas to produce light, heat, power, refrigeration, or air conditioning.

APPLIANCE—AUTOMATICALLY CONTROLLED. Appliances equipped with an automatic pilot 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 GAS SHUTOFF VALVE. 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.

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.

AUTOMATIC PILOT. Consists of an automatic pilot device and pilot burner securely assembled in fixed functional relationship.

AUTOMATIC PILOT DEVICE. A device employed with gas-burning equipment which will either automatically shut off the gas supply to the burner(s) being served or automatically actuate electrically or otherwise a gas shut-off device when the pilot flame is extinguished. The pilot burner may or may not be constructed integrally with the device.

AUTOMATIC PILOT DEVICE, COMPLETE SHUTOFF TYPE. An automatic pilot device for shutting off automatically the gas supply to the main burner and pilot in event of pilot or gas failure.

AUTOMATIC VALVE FOR GAS APPLIANCES. An automatic or semiautomatic 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.

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. 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 the combustion of the gas.

(c) *Power Burner.* A burner in which either gas or air or both are supplied at pressures exceeding, for gas, the line pressure, and for air, atmospheric pressure; this added pressure being applied at the 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) *Pressure Burner.* A burner which is supplied with an air-gas mixture under pressure (usually from 0.5 to 14 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.

CONCEALED GAS PIPING. Gas piping, which, when in place in the finished building, would require removal of permanent construction to gain access to the piping.

CONDENSATE—(CONDENSATION). The liquid which separates from a gas (including 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.

CONTROL COCK. A cock used in piping to control the gas supply to any section of a system of piping or to an appliance.

CONVERSION BURNER. A burner designed to supply gaseous fuel to an appliance originally designed to utilize another fuel.

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

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

(c) *Up-Shot Type.* A conversion burner normally designed for boiler or furnace 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 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 required 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. A direct-fired oven is one in which the flue gases flow through the oven compartment.

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) assure the ready escape of the flue gases 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, and with means for observing flames and lighting the appliance from such 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 air flow.