

APPENDIX B

SIZING OF VENTING SYSTEMS SERVING APPLIANCES EQUIPPED WITH DRAFT HOODS, CATEGORY I APPLIANCES AND APPLIANCES LISTED FOR USE WITH TYPE B VENTS

This appendix is informative and is not part of the code.

User note:

About this appendix: Appendix B provides commentary, guidance and examples for the design of venting systems for the types of appliances that vent by natural draft and have draft hoods or are listed as Category I or are listed for use with Type B vents.

EXAMPLES USING SINGLE APPLIANCE VENTING TABLES

Example 1: Single draft-hood-equipped appliance.

An installer has a 120,000 British thermal unit (Btu) per hour input *appliance* with a 5-inch-diameter draft hood outlet that needs to be vented into a 10-foot-high Type B vent system. What size vent should be used assuming (a) a 5-foot lateral single-wall metal vent connector is used with two 90-degree elbows, or (b) a 5-foot lateral single-wall metal vent connector is used with three 90-degree elbows in the vent system?

Solution:

Table 504.2(2) should be used to solve this problem, because single-wall metal vent connectors are being used with a Type B vent.

- (a) Read down the first column in Table 504.2(2) until the row associated with a 10-foot height and 5-foot lateral is found. Read across this row until a vent capacity greater than 120,000 Btu per hour is located in the

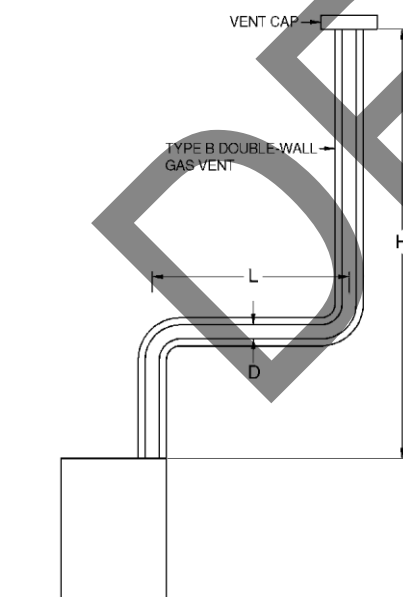
shaded columns labeled “NAT Max” for draft-hood-equipped appliances. In this case, a 5-inch-diameter vent has a capacity of 122,000 Btu per hour and can be used for this application.

- (b) If three 90-degree elbows are used in the vent system, then the maximum vent capacity listed in the tables must be reduced by 10 percent (see Section 504.2.3 for single *appliance* vents). This implies that the 5-inch-diameter vent has an adjusted capacity of only 110,000 Btu per hour. In this case, the vent system must be increased to 6 inches in diameter (see calculations below).

$$122,000 (.90) = 110,000 \text{ for 5-inch vent}$$

From Table 504.2(2), Select 6-inch vent

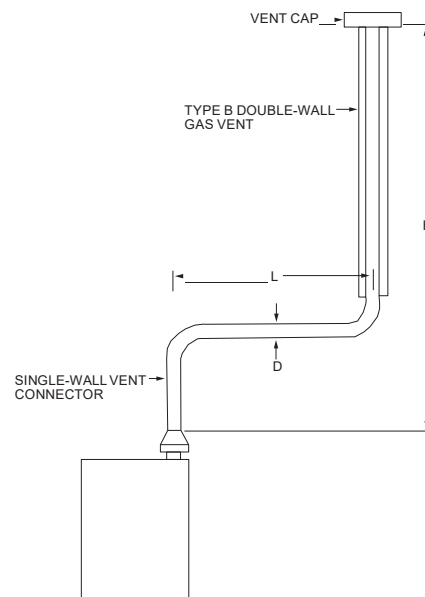
$186,000 (.90) = 167,000$; This is greater than the required 120,000. Therefore, use a 6-inch vent and connector where three elbows are used.



For SI: 1 foot = 304.8 mm, 1 British thermal unit per hour = 0.2931 W. Table 504.2(1) is used where sizing Type B double-wall gas vent connected directly to the appliance.

Note: The appliance can be either Category I draft hood equipped or fan-assisted type.

FIGURE B-1
TYPE B DOUBLE-WALL VENT SYSTEM SERVING A SINGLE APPLIANCE WITH A TYPE B DOUBLE-WALL VENT



For SI: 1 foot = 304.8 mm, 1 British thermal unit per hour = 0.2931 W. Table 504.2(2) is used where sizing a single-wall metal vent connector attached to a Type B double-wall gas vent.

Note: The appliance can be either Category I draft hood equipped or fan-assisted type.

FIGURE B-2
TYPE B DOUBLE-WALL VENT SYSTEM SERVING A SINGLE APPLIANCE WITH A SINGLE-WALL METAL VENT CONNECTOR

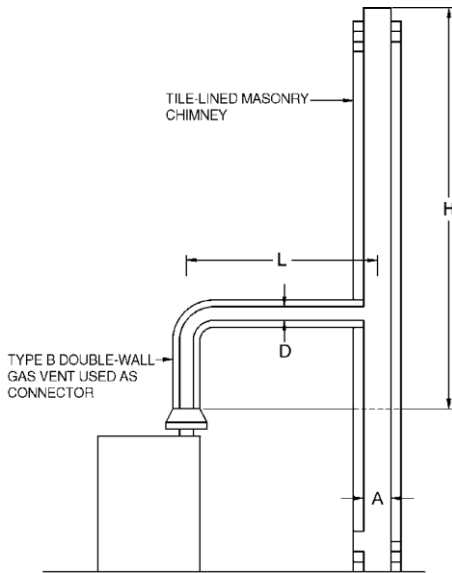


Table 504.2(3) is used where sizing a Type B double-wall gas vent connector attached to a tile-lined masonry chimney.

Note: "A" is the equivalent cross-sectional area of the tile liner.

Note: The appliance can be either Category I draft hood equipped or fan-assisted type.

FIGURE B-3
VENT SYSTEM SERVING A SINGLE APPLIANCE
WITH A MASONRY CHIMNEY OF TYPE B
DOUBLE-WALL VENT CONNECTOR

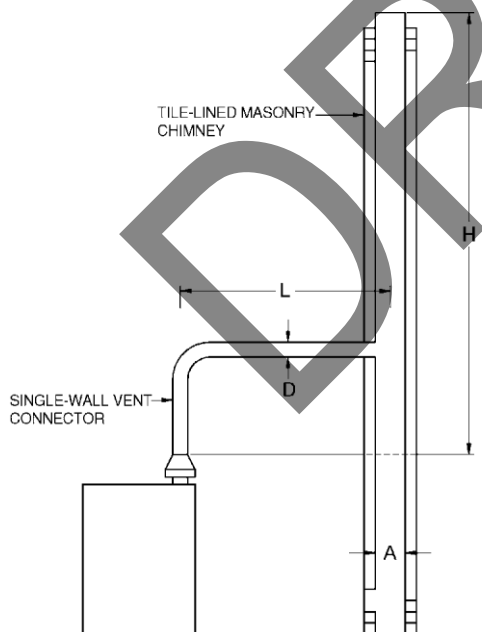
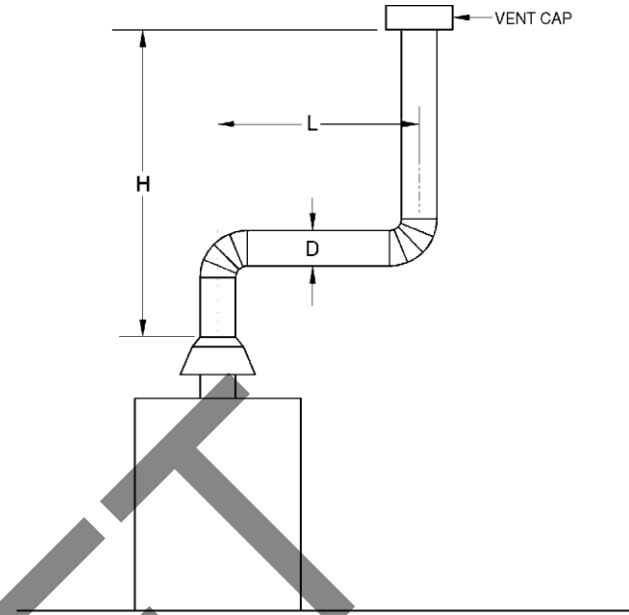


Table 504.2(4) is used where sizing a single-wall vent connector attached to a tile-lined masonry chimney.

Note: "A" is the equivalent cross-sectional area of the tile liner.

Note: The appliance can be either Category I draft hood equipped or fan-assisted type.

FIGURE B-4
VENT SYSTEM SERVING A SINGLE APPLIANCE
USING A MASONRY CHIMNEY AND A
SINGLE-WALL METAL VENT CONNECTOR



Asbestos cement Type B or single-wall metal vent serving a single draft-hood-equipped appliance [see Table 504.2(5)].

FIGURE B-5
ASBESTOS CEMENT TYPE B OR SINGLE-WALL
METAL VENT SYSTEM SERVING A SINGLE
DRAFT-HOOD-EQUIPPED APPLIANCE

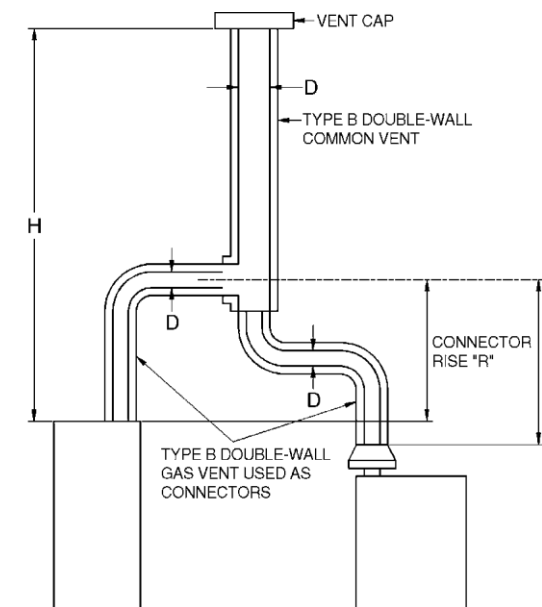


Table 504.3(1) is used where sizing Type B double-wall vent connectors attached to a Type B double-wall common vent.

Note: Each appliance can be either Category I draft hood equipped or fan-assisted type.

FIGURE B-6
VENT SYSTEM SERVING TWO OR MORE APPLIANCES
WITH TYPE B DOUBLE-WALL VENT AND TYPE B
DOUBLE-WALL VENT CONNECTOR

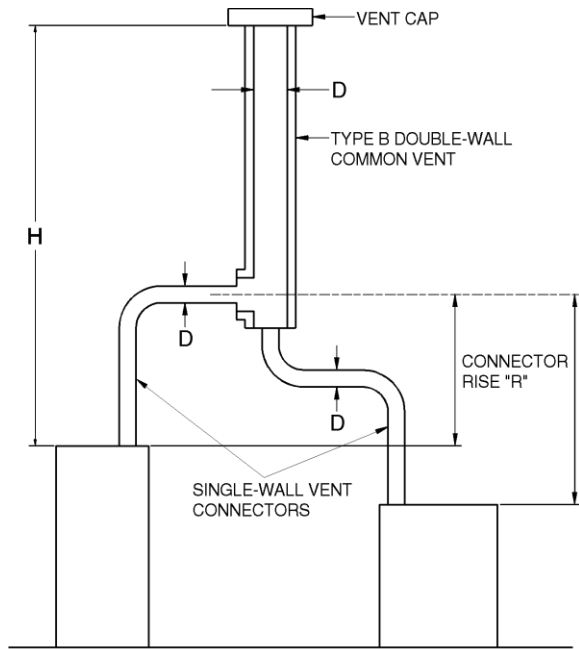


Table 504.3(2) is used where sizing single-wall vent connectors attached to a Type B double-wall common vent.

Note: Each appliance can be either Category I draft hood equipped or fan-assisted type.

FIGURE B-7
VENT SYSTEM SERVING TWO OR MORE APPLIANCES
WITH TYPE B DOUBLE-WALL VENT AND
SINGLE-WALL METAL VENT CONNECTORS

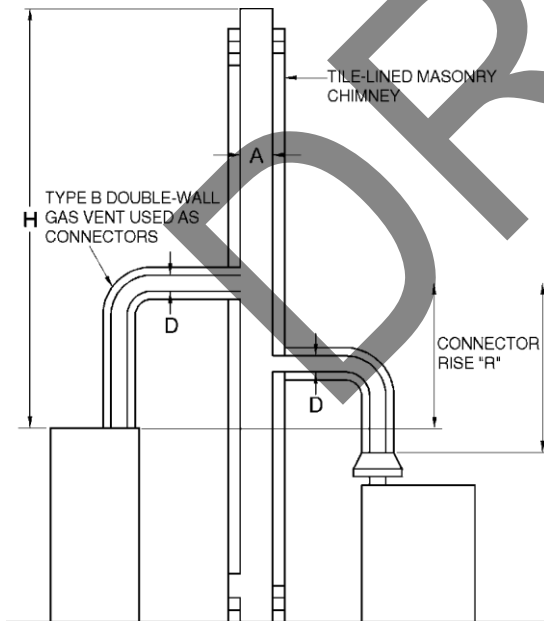


Table 504.3(3) is used where sizing Type B double-wall vent connectors attached to a tile-lined masonry chimney.

Note: "A" is the equivalent cross-sectional area of the tile liner.

Note: Each appliance can be either Category I draft hood equipped or fan-assisted type.

FIGURE B-8
MASONRY CHIMNEY SERVING TWO OR MORE APPLIANCES
WITH TYPE B DOUBLE-WALL VENT CONNECTOR

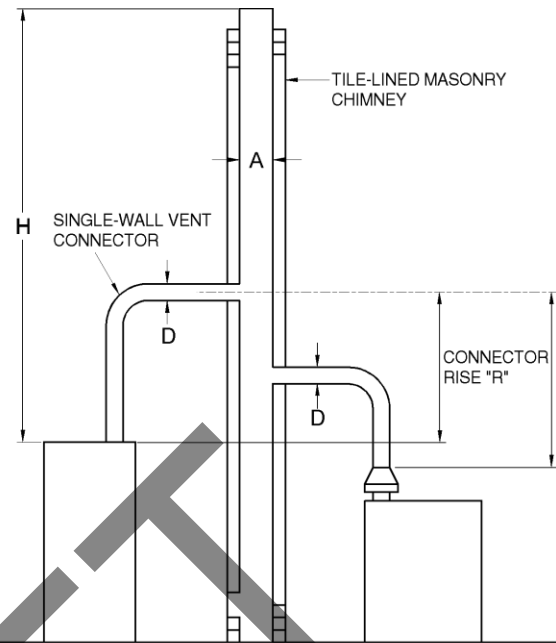
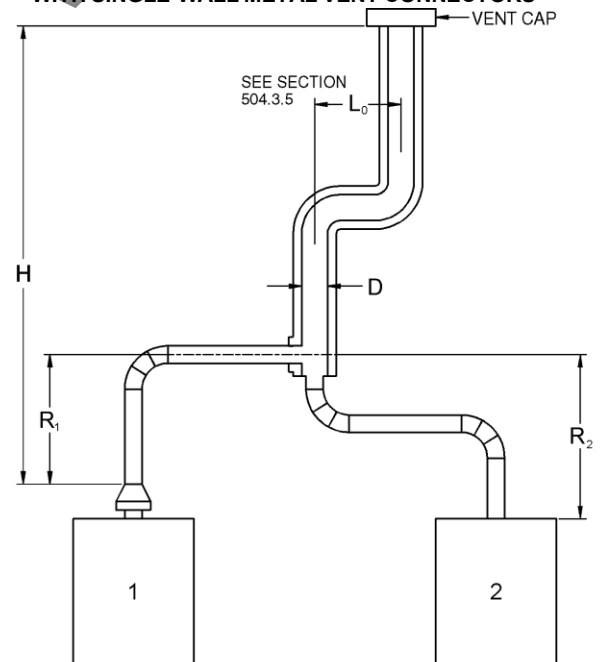


Table 504.3(4) is used where sizing single-wall metal vent connectors attached to a tile-lined masonry chimney.

Note: "A" is the equivalent cross-sectional area of the tile liner.

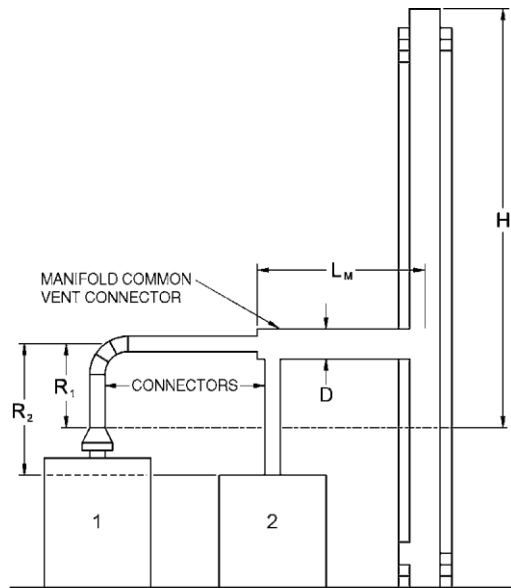
Note: Each appliance can be either Category I draft hood equipped or fan-assisted type.

FIGURE B-9
MASONRY CHIMNEY SERVING TWO OR MORE APPLIANCES
WITH SINGLE-WALL METAL VENT CONNECTORS



Asbestos cement Type B or single-wall metal pipe vent serving two or more draft-hood-equipped appliances [see Table 504.3(5)].

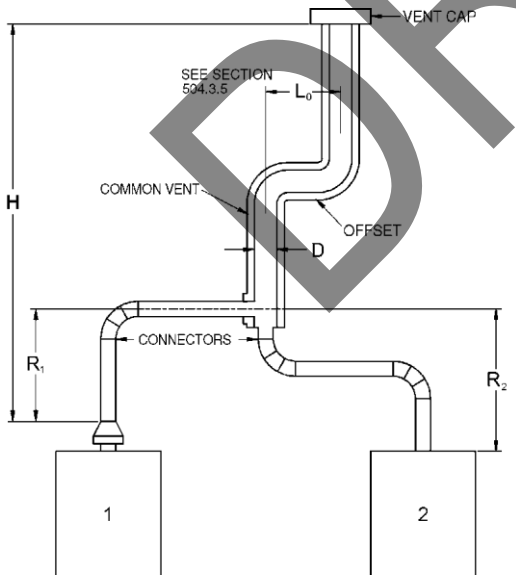
FIGURE B-10
ASBESTOS CEMENT TYPE B OR SINGLE-WALL
METAL VENT SYSTEM SERVING TWO OR MORE
DRAFT-HOOD-EQUIPPED APPLIANCES



Example: Manifolded Common Vent Connector LM shall be not greater than 18 times the common vent connector manifold inside diameter; i.e., a 4-inch (102 mm) inside diameter common vent connector manifold shall not exceed 72 inches (1829 mm) in length (see Section 504.3.4).

Note: This is an illustration of a typical manifolded vent connector. Different appliance, vent connector, or common vent types are possible. Consult Section 502.3.

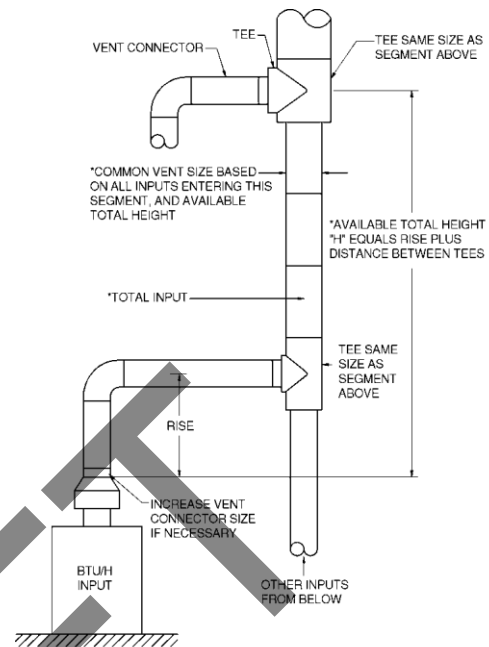
FIGURE B-11
USE OF MANIFOLD COMMON VENT CONNECTOR



Example: Offset Common Vent

Note: This is an illustration of a typical offset vent. Different appliance, vent connector, or vent types are possible. Consult Sections 504.2 and 504.3.

FIGURE B-12
USE OF OFFSET COMMON VENT



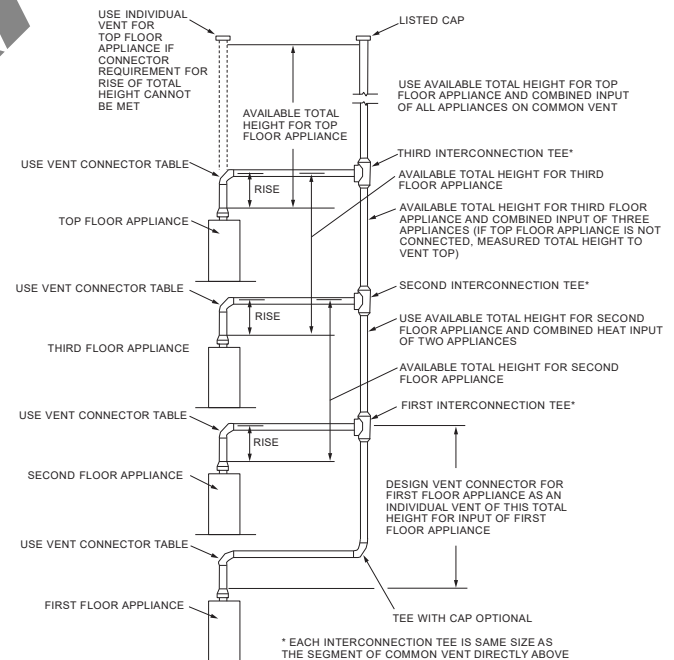
Vent connector size depends on:

- Input
- Rise
- Available total height "H"
- Table 504.3(1) connectors

Common vent size depends on:

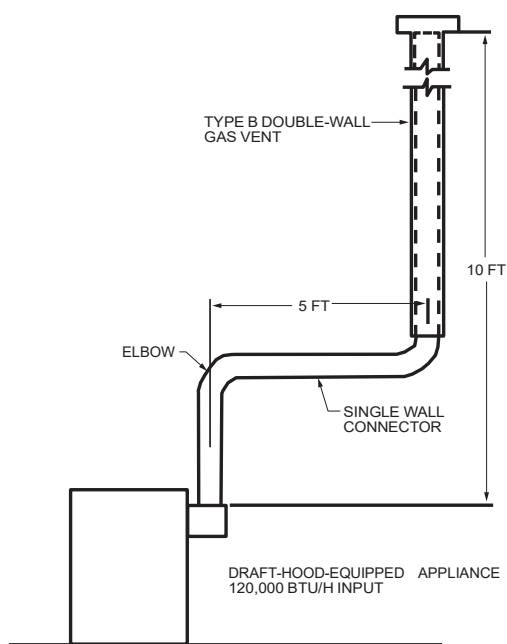
- Combined inputs
- Available total height "H"
- Table 504.3(1) common vent

FIGURE B-13
MULTISTORY GAS VENT DESIGN PROCEDURE FOR EACH SEGMENT OF SYSTEM



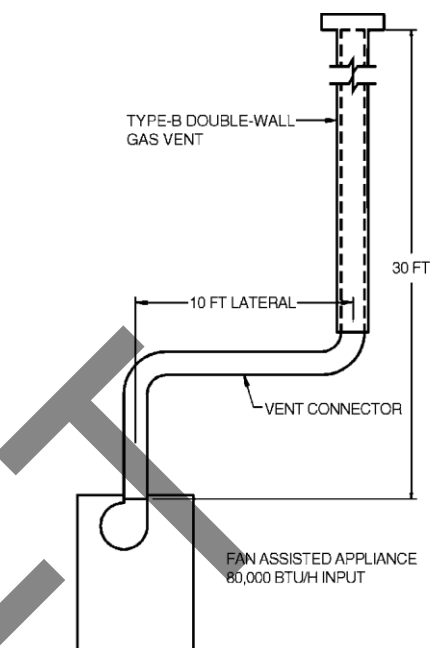
Principles of design of multistory vents using vent connector and common vent design tables (see Sections 504.3.11 through 504.3.17).

FIGURE B-14
MULTISTORY VENT SYSTEMS



For SI: 1 foot = 304.8 mm, 1 British thermal unit per hour = 0.2931 W.

FIGURE B-15 (EXAMPLE 1)
SINGLE DRAFT-HOOD-EQUIPPED APPLIANCE



For SI: 1 foot = 304.8 mm, 1 British thermal unit per hour = 0.2931 W.

FIGURE B-16 (EXAMPLE 2)
SINGLE FAN-ASSISTED APPLIANCE

Example 2: Single fan-assisted appliance.

An installer has an 80,000 Btu per hour input fan-assisted *appliance* that must be installed using 10 feet of lateral connector attached to a 30-foot-high Type B vent. Two 90-degree elbows are needed for the installation. Can a single-wall metal vent connector be used for this application?

Solution:

Table 504.2(2) refers to the use of single-wall metal vent connectors with Type B vent. In the first column find the row associated with a 30-foot height and a 10-foot lateral. Read across this row, looking at the FAN Min and FAN Max columns, to find that a 3-inch-diameter single-wall metal vent connector is not recommended. Moving to the next larger size single wall connector (4 inches), note that a 4-inch-diameter single-wall metal connector has a recommended minimum vent capacity of 91,000 Btu per hour and a recommended maximum vent capacity of 144,000 Btu per hour. The 80,000 Btu per hour fan-assisted *appliance* is outside this range, so the conclusion is that a single-wall metal vent connector cannot be used to vent this *appliance* using 10 feet of lateral for the connector.

However, if the 80,000 Btu per hour input *appliance* could be moved to within 5 feet of the vertical vent, then a 4-inch single-wall metal connector could be used to vent the *appliance*. Table 504.2(2) shows the acceptable range of vent capacities for a 4-inch vent with 5 feet of lateral to be between 72,000 Btu per hour and 157,000 Btu per hour.

If the *appliance* cannot be moved closer to the vertical vent, then Type B vent could be used as the connector material. In this case, Table 504.2(1) shows that for a 30-foot-high vent with 10 feet of lateral, the acceptable range of vent capacities for a 4-inch-diameter vent attached to a fan-assisted *appliance* is between 37,000 Btu per hour and 150,000 Btu per hour.

Example 3: Interpolating between table values.

An installer has an 80,000 Btu per hour input *appliance* with a 4-inch-diameter draft hood outlet that needs to be vented into a 12-foot-high Type B vent. The vent connector has a 5-foot lateral length and is also Type B. Can this *appliance* be vented using a 4-inch-diameter vent?

Solution:

Table 504.2(1) is used in the case of an all Type B vent system. However, since there is no entry in Table 504.2(1) for a height of 12 feet, interpolation must be used. Read down the 4-inch diameter NAT Max column to the row associated with 10-foot height and 5-foot lateral to find the capacity value of 77,000 Btu per hour. Read further down to the 15-foot height, 5-foot lateral row to find the capacity value of 87,000 Btu per hour. The difference between the 15-foot height capacity value and the 10-foot height capacity value is 10,000 Btu per hour. The capacity for a vent system with a 12-foot height is

equal to the capacity for a 10-foot height plus $\frac{2}{5}$ of the difference between the 10-foot and 15-foot height values, or $77,000 + \frac{2}{5}(10,000) = 81,000$ Btu per hour. Therefore, a 4-inch-diameter vent can be used in the installation.

EXAMPLES USING COMMON VENTING TABLES

Example 4: Common venting two draft-hood-equipped appliances.

A 35,000 Btu per hour water heater is to be common vented with a 150,000 Btu per hour furnace using a common vent with a total height of 30 feet. The connector rise is 2 feet for the water heater with a horizontal length of 4 feet. The connector rise for the furnace is 3 feet with a horizontal length of 8 feet. Assume single-wall metal connectors will be used with Type B vent. What size connectors and combined vent should be used in this installation?

Solution:

Table 504.3(2) should be used to size single-wall metal vent connectors attached to Type B vertical vents. In the vent connector capacity portion of Table 504.3(2), find the row associated with a 30-foot vent height. For a 2-foot rise on the vent connector for the water heater, read the shaded columns for draft-hood-equipped appliances to find that a 3-inch-diameter vent connector has a capacity of 37,000 Btu per hour. Therefore, a 3-inch single-wall metal vent connector can be used with the water heater. For a draft-hood-equipped furnace with a 3-foot rise, read across the appropriate row to find that a 5-inch-diameter vent connector has a maximum capacity of 120,000 Btu per hour (which is too small for the furnace) and a 6-inch-diameter vent connector has a maximum vent capacity of 172,000 Btu per hour. Therefore, a 6-inch-diameter vent connector should be used with the 150,000 Btu per hour furnace. Since both vent connector horizontal lengths are less than the maximum lengths listed in Section 504.3.2, the table values can be used without adjustments.

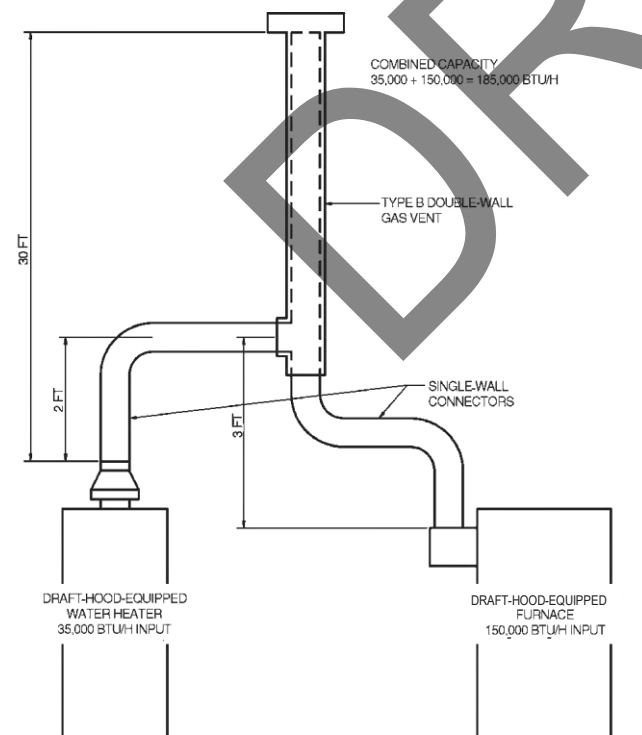


FIGURE B-17 (EXAMPLE 4)
COMMON VENTING TWO DRAFT-
HOOD-EQUIPPED APPLIANCES

In the common vent capacity portion of Table 504.3(2), find the row associated with a 30-foot vent height and read over to the NAT + NAT portion of the 6-inch-diameter column to find a maximum combined capacity of 257,000 Btu per hour. Since the two appliances total only 185,000 Btu per hour, a 6-inch common vent can be used.

Example 5a: Common venting a draft-hood-equipped water heater with a fan-assisted furnace into a Type B vent.

In this case, a 35,000 Btu per hour input draft-hood-equipped water heater with a 4-inch-diameter draft hood outlet, 2 feet of connector rise, and 4 feet of horizontal length is to be common vented with a 100,000 Btu per hour fan-assisted furnace with a 4-inch-diameter flue collar, 3 feet of connector rise, and 6 feet of horizontal length. The common vent consists of a 30-foot height of Type B vent. What are the recommended vent diameters for each connector and the common vent? The installer would like to use a single-wall metal vent connector.

Solution: [Table 504.3(2)].

Water Heater Vent Connector Diameter. Since the water heater vent connector horizontal length of 4 feet is less than the maximum value listed in Section 504.3.2, the venting table values can be used without adjustments. Using the Vent Connector Capacity portion of Table 504.3(2), read down the Total Vent Height (H) column to 30 feet and read across the 2-foot Connector Rise (R) row to the first Btu per hour rating in the NAT Max column that is equal to or greater than the water heater input rating. The table shows that a 3-inch vent connector has a maximum input rating of 37,000 Btu per

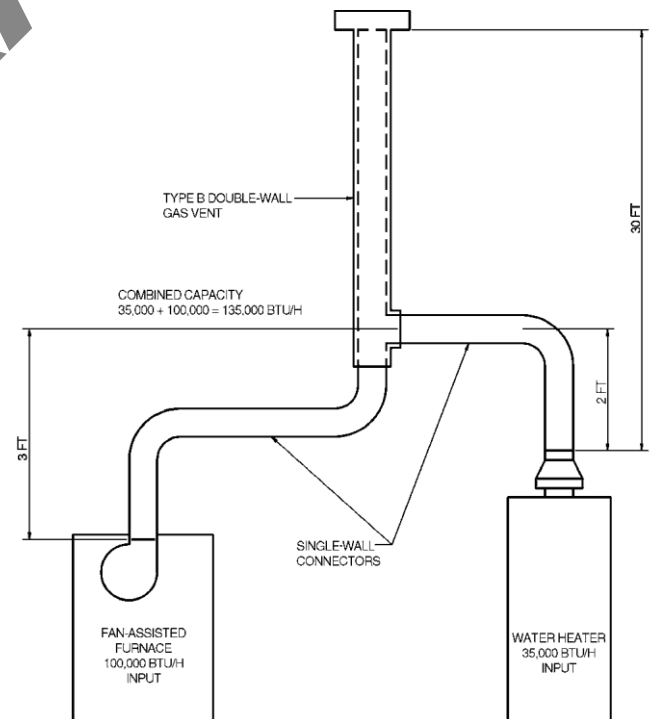


FIGURE B-18 (EXAMPLE 5A)
COMMON VENTING A DRAFT HOOD WITH A FAN-ASSISTED
FURNACE INTO A TYPE B DOUBLE-WALL COMMON VENT

hour. Although this is greater than the water heater input rating, a 3-inch vent connector is prohibited by Section 504.3.21. A 4-inch vent connector has a maximum input rating of 67,000 Btu per hour and is equal to the draft hood *outlet* diameter. A 4-inch vent connector is selected. Since the water heater is equipped with a draft hood, there are no minimum input rating restrictions.

Furnace Vent Connector Diameter. Using the Vent Connector Capacity portion of Table 504.3(2), read down the Total Vent Height (*H*) column to 30 feet and across the 3-foot Connector Rise (*R*) row. Since the furnace has a fan-assisted combustion system, find the first FAN Max column with a Btu per hour rating greater than the furnace input rating. The 4-inch vent connector has a maximum input rating of 119,000 Btu per hour and a minimum input rating of 85,000 Btu per hour. The 100,000 Btu per hour furnace in this example falls within this range, so a 4-inch connector is adequate. Since the furnace vent connector horizontal length of 6 feet does not exceed the maximum value listed in Section 504.3.2, the venting table values can be used without adjustment. If the furnace had an input rating of 80,000 Btu per hour, then a Type B vent connector [see Table 504.3(1)] would be needed in order to meet the minimum capacity limit.

Common Vent Diameter. The total input to the common vent is 135,000 Btu per hour. Using the Common Vent Capacity portion of Table 504.3(2), read down the Total Vent Height (*H*) column to 30 feet and across this row to find the smallest vent diameter in the FAN + NAT column that has a Btu per hour rating equal to or greater than 135,000 Btu per hour. The 4-inch common vent has a capacity of 132,000 Btu per hour and the 5-inch common vent has a capacity of 202,000 Btu per hour. Therefore, the 5-inch common vent should be used in this example.

Summary. In this example, the installer can use a 4-inch-diameter, single-wall metal vent connector for the water heater and a 4-inch-diameter, single-wall metal vent connector for the furnace. The common vent should be a 5-inch-diameter Type B vent.

Example 5b: Common venting into a masonry chimney.

In this case, the water heater and fan-assisted furnace of Example 5a are to be common vented into a clay tile-lined masonry chimney with a 30-foot height. The chimney is not exposed to the outdoors below the roof line. The internal dimensions of the clay tile liner are nominally 8 inches by 12 inches. Assuming the same vent connector heights, laterals, and materials found in Example 5a, what are the recommended vent connector diameters, and is this an acceptable installation?

Solution:

Table 504.3(4) is used to size common venting installations involving single-wall connectors into masonry chimneys.

Water Heater Vent Connector Diameter. Using Table 504.3(4), Vent Connector Capacity, read down the Total Vent Height (*H*) column to 30 feet, and read across the 2-foot Connector Rise (*R*) row to the first Btu per hour rating in the NAT Max column that is equal to or greater than the water heater input rating. The table shows that a 3-inch vent

connector has a maximum input of only 31,000 Btu per hour while a 4-inch vent connector has a maximum input of 57,000 Btu per hour. A 4-inch vent connector must therefore be used.

Furnace Vent Connector Diameter. Using the Vent Connector Capacity portion of Table 504.3(4), read down the Total Vent Height (*H*) column to 30 feet and across the 3-foot Connector Rise (*R*) row. Since the furnace has a fan-assisted combustion system, find the first FAN Max column with a Btu per hour rating greater than the furnace input rating. The 4-inch vent connector has a maximum input rating of 127,000 Btu per hour and a minimum input rating of 95,000 Btu per hour. The 100,000 Btu per hour furnace in this example falls within this range, so a 4-inch connector is adequate.

Masonry Chimney. From Table B-1, the equivalent area for a nominal liner size of 8 inches by 12 inches is 63.6 square inches. Using Table 504.3(4), Common Vent Capacity, read down the FAN + NAT column under the Minimum Internal Area of Chimney value of 63 to the row for 30-foot height to find a capacity value of 739,000 Btu per hour. The combined input rating of the furnace and water heater, 135,000 Btu per hour, is less than the table value, so this is an acceptable installation.

Section 504.3.17 requires the common vent area to be not greater than seven times the smallest *listed appliance* categorized vent area, flue collar area, or draft hood outlet area. Both appliances in this installation have 4-inch-diameter outlets. From Table B-1, the equivalent area for an inside diameter of 4 inches is 12.2 square inches. Seven times 12.2 equals 85.4, which is greater than 63.6, so this configuration is acceptable.

Example 5c: Common venting into an exterior masonry chimney.

In this case, the water heater and fan-assisted furnace of Examples 5a and 5b are to be common vented into an exterior masonry chimney. The chimney height, clay tile liner dimensions, and vent connector heights and laterals are the same as in Example 5b. This system is being installed in Charlotte, North Carolina. Does this exterior masonry chimney need to be relined? If so, what corrugated metallic liner size is recommended? What vent connector diameters are recommended?

Solution:

In accordance with Section 504.3.20, Type B vent connectors are required to be used with exterior masonry chimneys. Use Tables 504.3(7a), (7b) to size FAN+NAT common venting installations involving Type-B double wall connectors into exterior masonry chimneys.

The local 99-percent winter design temperature needed to use Table 504.3(7b) can be found in the ASHRAE *Handbook of Fundamentals*. For Charlotte, North Carolina, this design temperature is 19°F.

Chimney Liner Requirement. As in Example 5b, use the 63 square inch Internal Area columns for this size clay tile liner. Read down the 63 square inch column of Table 504.3(7a) to the 30-foot height row to find that the combined *appliance* maximum input is 747,000 Btu per hour. The combined input rating of the appliances in this installation, 135,000 Btu per hour, is less than the maximum value, so this

criterion is satisfied. Table 504.3(7b), at a 19°F design temperature, and at the same vent height and internal area used above, shows that the minimum allowable input rating of a space-heating appliance is 470,000 Btu per hour. The furnace input rating of 100,000 Btu per hour is less than this minimum value. So this criterion is not satisfied, and an alternative venting design needs to be used, such as a Type B vent shown in Example 5a or a *listed* chimney liner system shown in the remainder of the example.

In accordance with Section 504.3.19, Table 504.3(1) or 504.3(2) is used for sizing corrugated metallic liners in masonry chimneys, with the maximum common vent capacities reduced by 20 percent. This example will be continued assuming Type B vent connectors.

Water Heater Vent Connector Diameter. Using Table 504.3(1), Vent Connector Capacity, read down the Total Vent Height (*H*) column to 30 feet, and read across the 2-foot Connector Rise (*R*) row to the first Btu/h rating in the NAT Max column that is equal to or greater than the water heater input rating. The table shows that a 3-inch vent connector has a maximum capacity of 39,000 Btu/h. Although this rating is greater than the water heater input rating, a 3-inch vent connector is prohibited by Section 504.3.21. A 4-inch vent connector has a maximum input rating of 70,000 Btu/h and is equal to the draft hood outlet diameter. A 4-inch vent connector is selected.

Furnace Vent Connector Diameter. Using Table 504.3(1), Vent Connector Capacity, read down the Vent Height (*H*) column to 30 feet, and read across the 3-foot Connector Rise (*R*) row to the first Btu per hour rating in the FAN Max column that is equal to or greater than the furnace input rating. The 100,000 Btu per hour furnace in this example falls within this range, so a 4-inch connector is adequate.

Chimney Liner Diameter. The total input to the common vent is 135,000 Btu per hour. Using the Common Vent Capacity Portion of Table 504.3(1), read down the Vent Height (*H*) column to 30 feet and across this row to find the smallest vent diameter in the FAN+NAT column that has a Btu per hour rating greater than 135,000 Btu per hour. The 4-inch common vent has a capacity of 138,000 Btu per hour. Reducing the maximum capacity by 20 percent (Section 504.3.19) results in a maximum capacity for a 4-inch corrugated liner of 110,000 Btu per hour, less than the total input of 135,000 Btu per hour. So a larger liner is needed. The 5-inch common vent capacity *listed* in Table 504.3(1) is 210,000 Btu per hour, and after reducing by 20 percent is 168,000 Btu per hour. Therefore, a 5-inch corrugated metal liner should be used in this example.

Single-Wall Connectors. Once it has been established that relining the chimney is necessary, Type B double-wall vent connectors are not specifically required. This example could be redone using Table 504.3(2) for single-wall vent connectors. For this case, the vent connector and liner diameters would be the same as found above with Type B double-wall connectors.

**TABLE B-1
MASONRY CHIMNEY LINER DIMENSIONS
WITH CIRCULAR EQUIVALENTS**

NOMINAL LINER SIZE (inches)	INSIDE DIMENSIONS OF LINER (inches)	INSIDE DIAMETER OR EQUIVALENT DIAMETER (inches)	EQUIVALENT AREA (square inches)
4 × 8	$2\frac{1}{2} \times 6\frac{1}{2}$	4	12.2
		5	19.6
		6	28.3
		7	38.3
8 × 8	$6\frac{3}{4} \times 6\frac{3}{4}$	7.4	42.7
		8	50.3
8 × 12	$6\frac{1}{2} \times 10\frac{1}{2}$	9	63.6
		10	78.5
12 × 12	$9\frac{3}{4} \times 9\frac{3}{4}$	10.4	83.3
		11	95
12 × 16	$9\frac{1}{2} \times 13\frac{1}{2}$	11.8	107.5
		12	113.0
		14	153.9
16 × 16	$13\frac{1}{4} \times 13\frac{1}{4}$	14.5	162.9
		15	176.7
16 × 20	13 × 17	16.2	206.1
		18	254.4
20 × 20	$16\frac{3}{4} \times 16\frac{3}{4}$	18.2	260.2
		20	314.1
20 × 24	$16\frac{1}{2} \times 20\frac{1}{2}$	20.1	314.2
		22	380.1
24 × 24	$20\frac{1}{4} \times 20\frac{1}{4}$	22.1	380.1
		24	452.3
24 × 28	$20\frac{1}{4} \times 20\frac{1}{4}$	24.1	456.2
		26.4	543.3
28 × 28	$24\frac{1}{4} \times 24\frac{1}{4}$	27	572.5
		27.9	607
30 × 30	$25\frac{1}{2} \times 25\frac{1}{2}$	30	706.8
		30.9	749.9
30 × 36	$25\frac{1}{2} \times 31\frac{1}{2}$	33	855.3
		34.4	929.4
36 × 36	$31\frac{1}{2} \times 31\frac{1}{2}$	36	1017.9

For SI: 1 inch = 25.4 mm, 1 square inch = 645.16 mm².

- a. Where liner sizes differ dimensionally from those shown in Table B-1, equivalent diameters can be determined from published tables for square and rectangular ducts of equivalent carrying capacity or by other engineering methods.

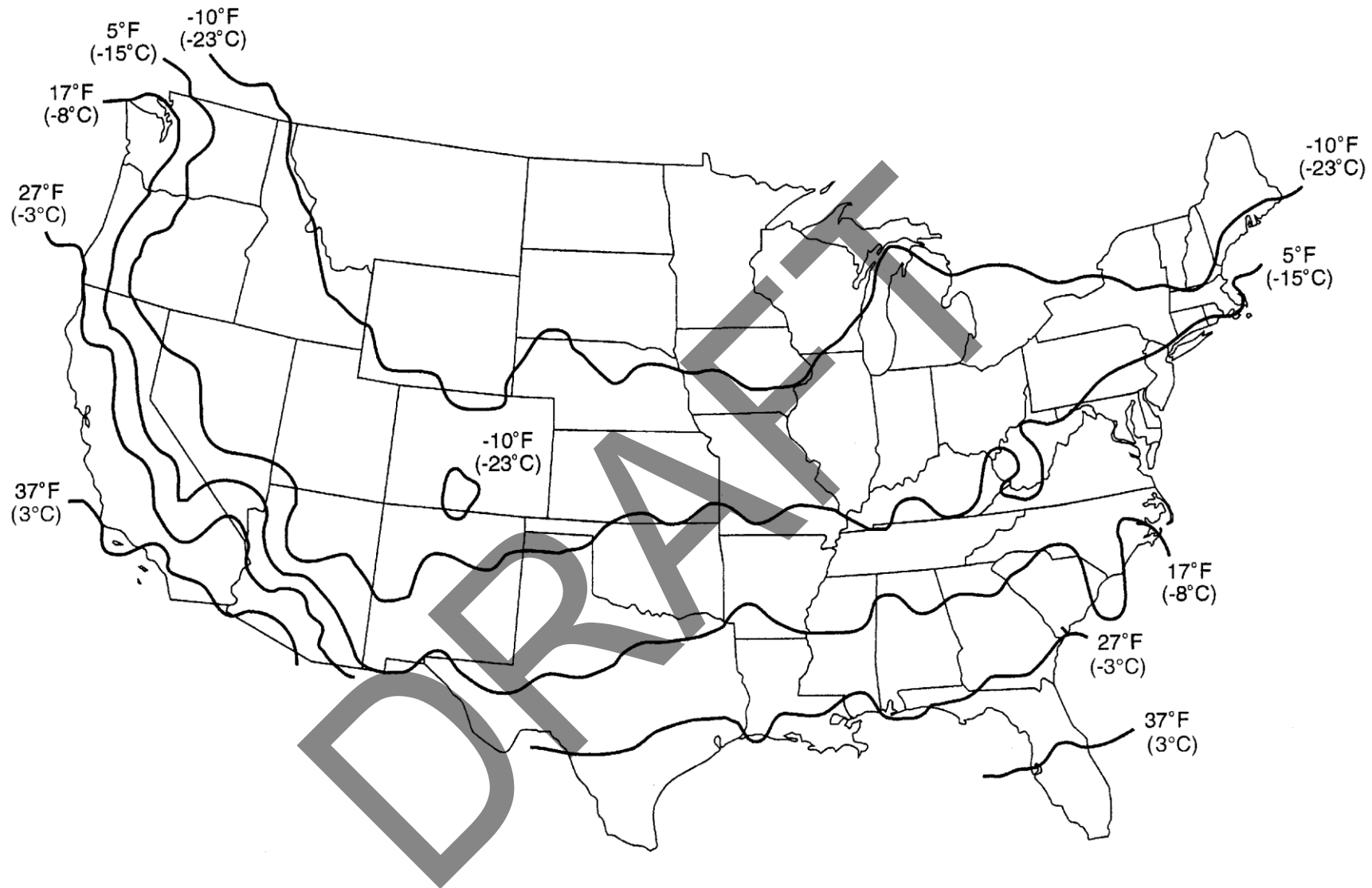


FIGURE B-19

NFGC:

99% Winter Design Temperatures for the Contiguous United States

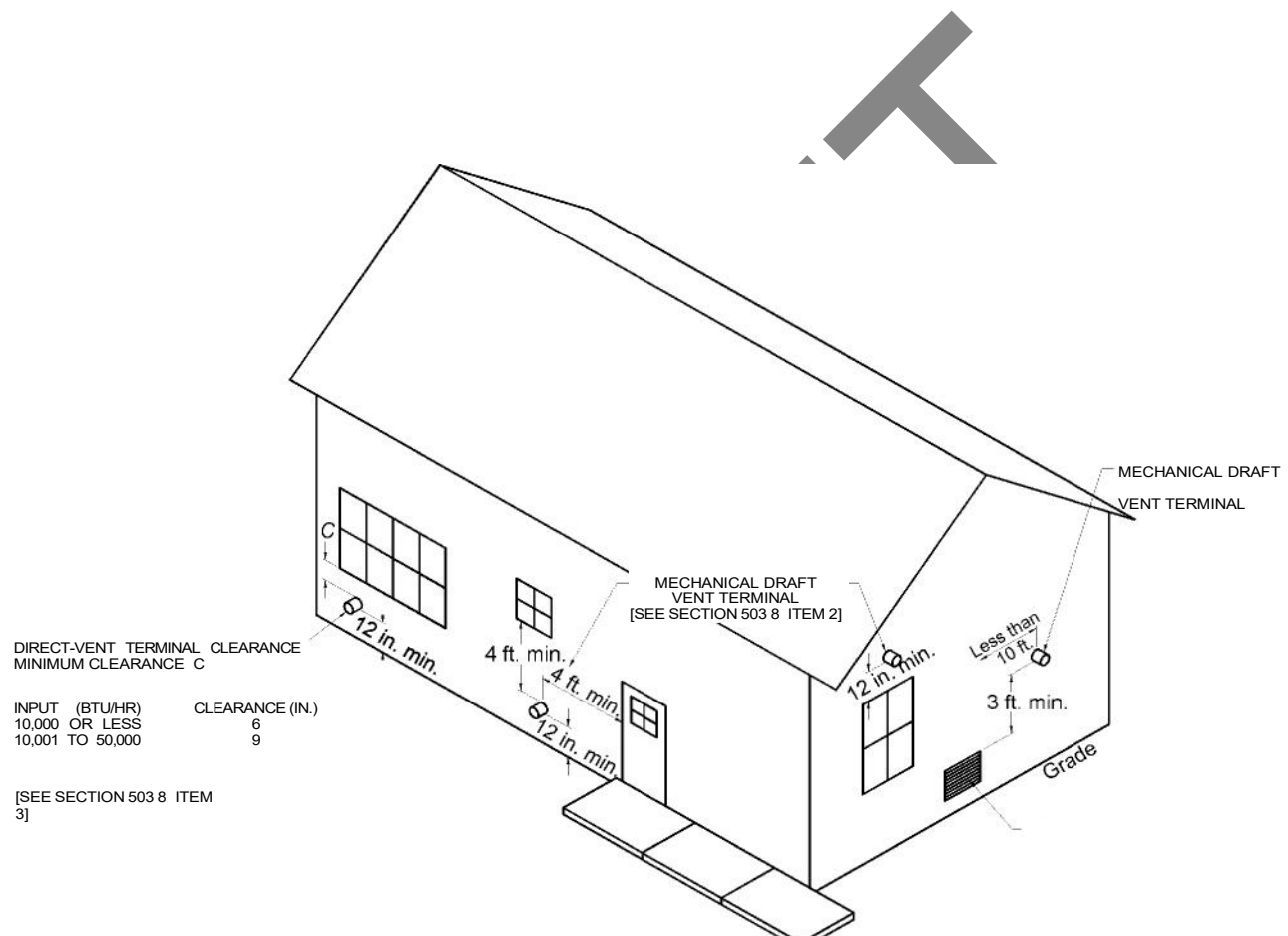
This map is a necessarily generalized guide to temperatures in the contiguous United States. Temperatures shown for areas such as mountainous regions and large urban centers are not necessarily accurate. The climate data used to develop this map are from the *ASHRAE Handbook—Fundamentals* (Climate Conditions for the United States).

For 99% winter design temperature in Alaska, consult the *ASHRAE Handbook—Fundamentals*.

99% winter design temperatures for Hawaii are greater than 37°F.

APPENDIX C

DIRECT-VENT VENTING SYSTEMS



For SI: 1 inch = 25.4 mm, 1 foot = 304.8 mm, 1 British thermal unit per hour = 0.2931 W.

APPENDIX C

EXIT TERMINALS OF MECHANICAL DRAFT AND DIRECT-VENT VENTING SYSTEMS

APPENDIX D

RECOMMENDED PROCEDURE FOR SAFETY INSPECTION OF AN EXISTING APPLIANCE INSTALLATION

(This appendix is informative and is not part of the code.)

The following procedure is intended as a guide to aid in determining that an appliance is properly installed and is in a safe condition for continuing use.

This procedure is predicated on central furnace and it should be recognized that generalized procedures cannot anticipate all situations. Accordingly, in some cases, deviation from this procedure is necessary to determine safe operation of the equipment.

- (a) This procedure should be performed prior to any attempt at modification of the appliance or of the installation.
- (b) If it is determined there is a condition that could result in unsafe operation, the appliance should be shut off and the owner advised of the unsafe condition. The following steps should be followed in making the safety inspection:

1. Conduct a check for gas leakage. (See Section 406.6)
2. Visually inspect the venting system for proper size and horizontal pitch and determine there is no blockage or restriction, leakage, corrosion, and other deficiencies that could cause an unsafe condition.
3. Shut off all gas to the appliance and shut off any other fuel-gas-burning appliance within the same room. **Use the shutoff valve in the supply line to each appliance.**
4. Inspect burners and crossovers for blockage and corrosion.
5. **Applicable only to furnaces.** Inspect the heat exchanger for cracks, openings, or excessive corrosion.
6. **Applicable only to boilers.** Deleted.
7. Insofar as is practical, close all building doors and windows and all doors between the space in which the appliance is located and other spaces of the building. Turn on clothes dryers. Turn on any exhaust fans, such as range hoods and bathroom exhausts, so they will operate at maximum speed. Do not operate a summer exhaust fan. Close fireplace dampers. If, after completing Steps 8 through 13, it is believed sufficient combustion air is not available, refer to Section 304 of this code for guidance.

8. Place the appliance being inspected in operation. **Follow the lighting instructions.** Adjust the thermostat so appliance will operate continuously.

9. Determine that the pilot(s), where provided, is burning properly and that the main burner ignition is satisfactory by interrupting and reestablishing the electrical supply to the appliance in any convenient manner. If the appliance is equipped with a continuous pilot(s), test the pilot safety device(s) to determine if it is operating properly by extinguishing the pilot(s) when the main burner(s) is off and determining, after 3 minutes, that the main burner gas does not flow upon a call for heat. If the appliance is not provided with a pilot(s), test for proper operation of the ignition system in accordance with the appliance manufacturer's lighting and operating instructions.

10. Visually determine that the main burner gas is burning properly (i.e., no floating, lifting, or flashback). Adjust the primary air shutter(s) as required.

11. If the appliance is equipped with high and low flame controlling or flame modulation, check for proper main burner operation at low flame.

12. Test for spillage at the draft hood relief opening after 5 minutes of main burner operation. Use a flame of a match or candle or smoke.

13. Turn on all other fuel-gas-burning appliances within the same room so they will operate at their full inputs. **Follow lighting instructions for each appliance.**

14. Repeat Steps 10 and 11 on the appliance being inspected.

15. Return doors, windows, exhaust fans, fireplace dampers, and any other fuel-gas-burning appliance to their previous conditions of use.

16. **Applicable only to furnaces.** Check both the limit control and the fan control for proper operation. Limit control operation can be checked by blocking the circulating air inlet or temporarily disconnecting the electrical supply to the blower motor and determining that the limit control acts to shut off the main burner gas.

17. **Applicable only to boilers.** Deleted.

DRAFT

INDEX

A

ACCESS, APPLIANCES

General.....	306
Shutoff valves	409.1.3, 409.3.1, 409.5
Wall furnaces, vented.....	608.6

AIR HEATERS, DIRECT-FIRED 611, 612

Industrial	611, 612
Venting	501.8

AIR, COMBUSTION

Defined	202
Requirements	304

AIR-CONDITIONING EQUIPMENT 627

Clearances	308.3
----------------------	-------

ALTERNATE MATERIALS AND METHODS 105.2

APPLIANCE

Broilers for indoor use	623.5
Connections to building piping	411
Cooking	623
Decorative	602
Decorative vented.	202, 303.3, Table 503.4, 604
Domestic cooking	623.3
Electrical	309
General	Chapter 6
Installation	Chapter 6
Listing	301.3
Prohibited locations	303.3, 623.2
Protection from vehicle impact	303.4

ARC-RESISTANT CSST..... 310.3

B

BENDS, PIPE..... 405

BOILERS

Existing installations	Appendix D
Listed	631
Prohibited locations	303.3
Unlisted	632

BONDING..... 310

BUSHINGS..... 403.10.5

C

CENTRAL FURNACE

Clearances	308.4
Defined	202
Drain pans	307.5

Existing installation	Appendix D
---------------------------------	------------

CERTIFICATES..... 104.7

CERTIFICATION 401.10

CHIMNEY..... Chapter 5

Alternate methods of sizing.....	503.5.5
Clearance reduction.....	308
Defined.....	202
Existing	501.15, 503.5.6.1
Masonry	501.3

CLEARANCE REDUCTION 308

CLEARANCES

Air-conditioning appliances	627.4
Boilers.....	308.4
Chimney.....	501.15.4
Clearance reduction.....	308
Vent connectors	503.10.5

CLOTHES DRYER

Defined	202
Exhaust	614
General	613

CODE OFFICIAL

Defined	202
Duties and powers	104

COMBUSTION AIR

Combination indoor and outdoor.....	304.7
Defined.....	202
Ducts.....	304.11
Free area of openings.	304.5.3.1, 304.5.3.2, 304.6.1, 304.6.2, 304.7, 304.10
Fumes and gases	304.12
Indoor.....	304.5
Makeup air	304.4
Mechanical supply	304.9
Openings connecting spaces.....	304.5.3
Outdoor	304.6

COMPRESSED NATURAL GAS 413

CONCEALED PIPING 404.5

CONDENSATE DISPOSAL..... 307

CONTROLS

Boilers	631.2
Gas pressure regulators	410, 628.4

CONVERSION BURNERS 619

COOKING APPLIANCES..... 623

CORROSION PROTECTION 404.11

CREMATORIES..... 606

CUTTING, NOTCHING AND

BORED HOLES.....	302.3
------------------	-------

INDEX

D

DAMPERS, VENT	503.14, 503.15, 504.2.1, 504.3.1
DECORATIVE APPLIANCES	303.3.1, 602, 604
DECORATIVE SHROUDS	503.5.4, 503.6.5.1
DEFINITIONS	Chapter 2
DIRECT-VENT APPLIANCES	
Defined	202
Installation	304.1, 503.2.3
DIVERSITY FACTOR	402.2, Appendix A
DRAFT HOOD	202, 503.12
DUCT FURNACE	202, 610

E

ELECTRICAL BONDING	310
ELECTRICAL CONNECTIONS	309.2
EXCESS FLOW VALVES	410.4
EXHAUST INTERLOCK	505.1.1
EXHAUST SYSTEMS	503.2.1, 503.3.4, 505.1.1

F

FEES	106.5, 106.6
FLASHBACK ARRESTOR	410.5
FLOOD HAZARD	301.11
FLOOR FURNACES	609
FURNACES	
Central heating, clearance	308.3, 308.4
Duct	610
Floor	609
Prohibited location	303.3
Vented wall	608
Warm-air	618

G

GARAGE, INSTALLATION	305.3, 305.4, 305.5, 305.9, 305.10
GASEOUS HYDROGEN SYSTEMS ..	635, Chapter 7
General requirements	703
Piping, use and handling	704
Testing	705
GROUNDING, ELECTRODE	309.1

H

HISTORIC BUILDINGS	102.6
HOT PLATES AND LAUNDRY STOVES	501.8, 623.1

I

ILLUMINATING APPLIANCES	628
INCINERATORS	503.2.5, 606, 607
INFRARED RADIANT HEATERS	411.3, 630
INSPECTIONS	104.4, 107
INSTALLATION, APPLIANCES	
Garage	305.3, 305.3.1, 305.3.2, 305.4, 305.5, 305.9, 305.10
General	305
Listed and unlisted appliances	301.3, 305.1
Specific appliances	Chapter 6

K

KILNS	629
--------------------	-----

L

LIQUEFIED PETROLEUM GAS	
Defined	202
Motor vehicle fuel-dispensing stations	412
Piping material	403.6.2, 403.11
Size of pipe or tubing	Appendix A
Storage	401.2
Systems	402.7.1
Thread compounds	403.9.3
LISTED AND LABELED APPLIANCES	301.3
LOG LIGHTERS	603

M

MANUFACTURED HOME CONNECTIONS	411
MATERIALS, DEFECTIVE	
Repair	301.9
Workmanship and defects	403.7
METERS	
Identification	401.7
Interconnections	401.6
Multiple installations	401.7
MINIMUM SAFE PERFORMANCE, VENT SYSTEMS	503.3, 503.3.1, 503.3.2

N

NONCORRUGATED STAINLESS STEEL TUBING	402.5
---	-------

O

OUTLET CLOSURES	404.15
Outlet location	404.16
OVERPRESSURE PROTECTION DEVICES	416

OXYGEN DEPLETION SAFETY SYSTEM

Defined	202
Unvented room heaters	303.3(3), 303.3(4), 621.6

P

PIPE SIZING 402

PIPING

Bends	405
Bonding	310
Changes in direction.....	405
Concealed locations	404.5
Identification	401.5
Inspection	406
Installation	404
Materials	403
Maximum pressure.....	402.7
Plastic	403.6, 403.6.3, 403.11, 404.17
Prohibited penetrations and locations	404.3, 404.6
Purging	406.7
Sediment traps	408.4
Sizing.....	402
Support.	407, 415
Testing.....	406
Tracer wire	404.17.3

POLYAMIDE PIPE, TUBE AND FITTINGS 403.6

POOL HEATERS 617

POWERS AND DUTIES OF THE CODE OFFICIAL 104

PRESSURE DROP 402.6

PROHIBITED INSTALLATIONS

Elevator shafts.....	301.15
Floor furnaces	609.2
Fuel-burning appliances	303.3
Piping in partitions	404.4
Plastic piping	404.17
Unvented room heater	621.2, 621.4

PURGING 406.7

R

RADIANT HEATERS 630

RANGES, DOMESTIC 623.3

REFRIGERATORS 501.8, 625

REGULATORS, PRESSURE 410, 628.4

RISERS, ANODELESS..... 403.6.1

ROOFTOP INSTALLATIONS 306.5

ROOM HEATER

Defined.....	202
Location	303.3
Unvented.....	621
Vented.....	622

S

SAFETY SHUTOFF DEVICES

Flame safeguard device.....	602.2
Unvented room heaters	621.6

SAUNA HEATERS 615

SCOPE..... 101.2

SCOPE AND ADMINISTRATION Chapter 1

Alternate materials and methods	105.2
Appeals	109
Certificates	104.7
Conflicts	102.1
Connection of utilities.....	107.6
Construction documents	106.3.1
Duties and powers of code official	104
Fees	106.5, 106.6
Inspections and testing	104.3, 106.4, 107
Liability	103.4
Modifications	105.1
Permits	106
Referenced codes and standards	102.8
Requirements not covered by code	102.9
Severability	101.5
Scope	101.2
Temporary equipment.....	110
Title	101.1
Violations and penalties	108

SEDIMENT TRAP 408.4

SEISMIC RESISTANCE 301.12

SERVICE SPACE 306

SHUTOFF VALVES..... 409

SPA HEATERS..... 617

STAINLESS STEEL TUBING 403.5.2, 403.10.3

STANDARDS. Chapter 8

STRUCTURAL SAFETY 302

SUPPORTS, PIPING 407, 415

T

TEMPORARY EQUIPMENT..... 110

TESTING..... 107

THIMBLE, VENT 503.7.7, 503.10.10

THREADS

Damaged	403.9.1
Specifications	403.9

TOILETS, GAS-FIRED 626

TUBING JOINTS 403.10.2

INDEX

U

<u>UNDERGROUND PENETRATIONS</u>	404.6
<u>UNIT HEATERS</u>	620
<u>UNLISTED BOILERS</u>	632
<u>UNSAFE CHIMNEYS</u>	503.5.6.3
<u>UNVENTED ROOM HEATERS</u>	621

V

<u>VALIDITY</u>	106.5.2
<u>VALVES, MULTIPLE-HOUSE LINES</u>	409.3
<u>VALVES, SHUTOFF</u>	
Appliances	409.5
<u>VENTED DECORATIVE APPLIANCES</u>	604
<u>VENTED ROOM HEATERS</u>	622
<u>VENTED WALL FURNACES</u>	608
<u>VENTILATING HOODS</u>	503.2.1, 503.3.4, 505.1.1

VENTS

Appliances not requiring vents	501.8
Caps	503.6.7
Direct vent	503.2.3
Exhaust hoods	505.1.1, 503.3.4
Gas vent termination	503.6.5
General	Chapter 5
Integral	505
Listed and labeled	502.1
Mechanical vent	505
Plastic pipe	503.4.1
Wall penetrations	503.16

VENT, SIZING

Category I appliances	502, 503, 504
Multiple appliance	504.3
Multistory	504.3.13, 504.3.14, 504.3.15, 504.3.16
Single appliance	504.2

<u>VIOLATIONS AND PENALTIES</u>	108
--	-----

W

<u>WALL FURNACES, VENTED</u>	608
<u>WARM AIR FURNACES</u>	618
<u>WATER HEATERS</u>	624
<u>WIND RESISTANCE</u>	301.10

INDEX

A

ACCESS, APPLIANCES

Duct	furnaces	61
0-3		
General		3
06		
Shutoff valves	409.1.3, 409.3.1, 409.5	
Wall	furnaces, vented	608.6

ADJUSTMENTS	608.6, 621.6
-------------	--------------

ADMINISTRATION	Chapter 1
Alternate materials and methods	10
5.2	
Alternate methods of sizing chimneys	503.5.5
Appeals	1
09	
Certificates	10
4.8	
Duties and powers of code official	4
04	
Fees	106.4, 106.5
Inspections	104.4, 104.8, 107
Liability	10
3.4	
Permits	1
06	
Plan review	106.5.3(3)
Severability	10
1.5	
Scope	10
1.2	
Title	10
1.1	
Violations and penalties	10
8	

AIR, COMBUSTION

Defined	2
02	
Requirements	303.3, 304

AIR-CONDITIONING EQUIPMENT

27	
Clearances	30
8.3	

ALTERNATE MATERIALS AND METHODS

5.2	10
-----	----

APPLIANCES

Broilers	for indoor use	62
3-5		
Connections to building piping		4
	11	
Cooking		6
23		
Decorative		6
02		
Decorative vented		202, 303.3,
	Table 503.4, 604	
Domestic	ranges	62
3-4		
Electrical		3
09		
Installation	Chapter	6
Prohibited locations		30
3-3		
Protection from damage		30
3-4		

B

BENDS, PIPE

05	4
----	---

BOILERS

Existing installations	Appendix D
------------------------	------------

<p> Listed 63 4 Prohibited locations 30 3.3 Unlisted 63 2 BUSHINGS 403.10.4, 404.3 C CENTRAL FURNACES Defined 2 02 Existing installation Appendix D CERTIFICATES 10 4.8 CHIMNEYS Chapter 5 Alternate methods of sizing 503.5. 5 Clearance reduction 30 8 Damper opening area 63 4 Defined 20 2 CLEARANCE REDUCTION 3 08 CLEARANCES Air conditioning equipment 627. 4 Boilers 308. 4 Domestic ranges 623. 4 Floor furnaces 609.4, 609.6 Open-top broiler units 623.5. 1 Refrigerators 625. 4 Unit heater 620. 4 CLOTHES DRYERS </p>	<p> Defined 2 02 Exhaust 6 14 General 6 13 CODE OFFICIAL Defined 2 02 Duties and powers 1 04 COMBUSTION AIR Combination indoor and outdoor 304.7 Defined 202 Exhaust effect 304.4 Free area 304.5.3.1, 304.5.3.2, 304.6.1, 304.6.2, 304.10 Horizontal ducts 304.6.1 Indoor 304.5 Outdoor 304.6 Sauna heaters 615.5 Sources of (from) 3 04.11 Vertical ducts 304.6.1 COMPRESSED NATURAL GAS 413 CONCEALED PIPING 404.2 CONDENSATE DISPOSAL 307 CONTROLS Boilers 63 1.2 Gas pressure regulators 410.1, 628.4 CONVERSION BURNERS 503.12.1, 619 COOKING APPLIANCES 623 CORROSION PROTECTION 40 4.8 CREMATORIES 606 CUTTING, NOTCHING, AND BORED HOLES 30 2.3 </p>
--	---

D	
DAMPERS, VENT	503
.14	
DECORATIVE APPLIANCES	
602	
DEFINITIONS	
Chapter 2	
DIRECT VENT APPLIANCES	
Defined	
202	
Installation	30
4.1	
DITCH FOR PIPING	
107.1(1) DIVERSITY FACTOR	402.2,
Appendix A DRAFT HOODS	
.202, 503.12	
DUCT FURNACES	202,
610	
E	
ELECTRICAL CONNECTIONS	309
.2	
EXHAUST SYSTEMS	202, 503.2.1,
503.3.4	
F	
FEES	104.8, 106.4,
106.5	
FLOOD HAZARD	301
.14	
FLOOR FURNACES	
609	
FURNACES	
Central heating, clearance	308.3,
308.4 Duct	
610	
Floor	
609	
Prohibited location	30
3.3	
Vented wall	60
8	
G	
GARAGE, INSTALLATION	305.3, 305.4,
305.5	
GASEOUS HYDROGEN SYSTEMS	635,
Chapter 7	

General requirements	
703	
Piping, use and handling	
704	
Testing	
705	
GROUNDING, PIPE	30
9.1	
H	
HISTORIC BUILDINGS	102
.6	
HOT PLATES AND LAUNDRY	
STOVES	501.8,
623.1	
ILLUMINATING APPLIANCES	6
28	
INCINERATORS	606,
607	
INFRARED RADIANT HEATERS	6
30	
INSPECTIONS	104.4, 104.8,
107	
INSTALLATION, APPLIANCES	
Garage	
305	
General	
301	
Listed and unlisted appliances	301.3,
305.1 Specific appliances	
Chapter 6	
K	
KILNS	62
9	
L	
LIQUEFIED PETROLEUM GAS	
Defined	
202	
Motor vehicle fuel dispensing stations	
412	
Piping material	403.6.2,
403.11	

Size of pipe or tubing	4
Appendix A Storage	4
01.2	
Systems	402
6.1	
Thread compounds	403
9.3	
LOG LIGHTERS	6
03	
M	
MAKE-UP AIR HEATERS	611,
612 Industrial	612
Venting	501
8	
MATERIALS, DEFECTIVE	
Repair	30
1.9	
Workmanship and defects	40
3.7	
METERS	
Interconnections	40
1.6	
Identification	40
1.7	
Multiple installations	40
1.6	
MINIMUM SAFE PERFORMANCE, VENT SYSTEMS	503
3	
O	
OUTLET CLOSURES	404.1
2	
Location	404.13
OVERPRESSURE PROTECTION	4
16	
OXYGEN DEPLETION SYSTEM	
Defined	202

Unvented room heaters	303.3(3), 621.6
-----------------------------	-----------------

P

PIPE SIZING	402
PIPING	
Bends	405
Changes in direction	405
Drips and slopes	408
Installation	404
Inspection	406
Materials	403
Purging	406.7
Sizing	402
Support	407, 415
Testing	406
POOL HEATERS	617
POWERS AND DUTIES OF THE CODE OFFICIAL	104
PROHIBITED INSTALLATIONS	
Floor furnaces	609.2
Fuel burning appliances	303.3
Piping in partitions	404.2
Plastic piping	4
04.14.1	
Unvented room heater	621.4
Vent connectors	503.3.3
PURGING	406.7

R

RADIANT HEATERS	630
RANGES, DOMESTIC	623.4
REFRIGERATORS	501.8, 625
REGULATORS, PRESSURE	410.1, 628.4
ROOFTOP INSTALLATIONS	306.5
ROOM HEATERS	
Defined	202
Location	303.3
Unvented	621
Vented	622

S

SAFETY SHUTOFF DEVICES	
Flame safeguard device	602.2
Unvented room heaters	621.6
SAUNA HEATERS	615
SCOPE	101.2
SEISMIC RESISTANCE	301.12
SERVICE SPACE	306
SPA HEATERS	617

STANDARDS		APPLIANCES	
Chapter 8		604	
STRUCTURAL SAFETY		VENTED ROOM HEATERS	622
2.4	30	VENTED WALL FURNACES	608
SUPPORTS, PIPING	407,	VENTS	
415		Caps	
T			50
TESTING		3.6.6	
407		Direct vent	
THIMBLE, VENT			5
503.10.11,		03.2.3	
503.10.15		Equipment not requiring vents	
THREADS			
Damaged		501.8	
	40	Gas vent termination	
3.9.1			5
Specifications		03.6.4	
403.9		General	
TOILETS		Chapter 5	
626		Integral	505
U		Listed and labeled	
UNIT HEATERS			
620		502.1	
UNLISTED BOILERS		Mechanical vent.	
632			50
UNVENTED ROOM HEATERS		5	
624		VENT, SIZING	
V		Category I appliances	502,
VALIDITY		503, 504 Multi-appliance	504.3
4.2	106	Multistory	504.3.13, 504.3.14,
VALVES, MULTIPLE			504.3.15, 504.3.16
HOUSE LINES	409.3	Single appliance	
VALVES, SHUTOFF	Appliances-	504.2	
409.5		VIBRATION ISOLATION	
VENTILATING HOODS	503.2.1,		3
503.3.4		01.8	
VENTED DECORATIVE		VIOLATIONS AND PENALTIES	
			10
		8	
		WALL FURNACES, VENTED	608
		WARM AIR FURNACES	618
		WATER HEATERS	624
		WIND RESISTANCE	301.10