2015 International Fuel Gas Code Update

Based on the International Fuel Gas Code® (IFGC®)

Description

- This seminar is designed to familiarize and assist code officials in locating, describing and applying the applicable code requirements of the IFGC to determine compliance or noncompliance.

Overview

- Administration
- Definitions
- General regulations
- Gas piping installations
- Chimneys and vents
- Specific appliances

Seminar Goal

- The goal of this is for you to apply the 2015 International Fuel Gas Code to the design, plan review, installation and inspection of all fuel-gas-related construction.

Objectives

- Upon completion, participants will be better able to:
  - Locate general topics in the 2015 IFGC.
  - Locate applicable tables in the 2015 IFGC for specific situations.
  - Apply code requirements to clear-cut real world situations.
  - Explain the intent behind a given code requirement.
  - Use judgment to identify borderline scenarios as compliant or noncompliant.

Module 1

Chapter 1
Scope and Administration

Administration

“Due Process of Law”

- The responsibilities of the various professionals are also established:
- The code official reviews the proposed work for code compliance.
- As a public servant, the code official enforces the code in an unbiased, proper manner.
- The design professional designs a safe, operational fuel gas system.
- The contractor installs the system in strict accordance with the plans and/or manufacturer’s installation requirements.

Applicability - 102

- Codes and standards referenced in Chapter 8 shall be considered part of the requirements of this code.
- Provisions of this code shall apply, where conflicts occur between the provisions of this code and the referenced standards.

Module 2

Chapter 2 Definitions

Definitions

- **APPLIANCE.** Any apparatus or device that utilizes a fuel or raw material to produce light, heat, power, refrigeration or air conditioning.

Definitions

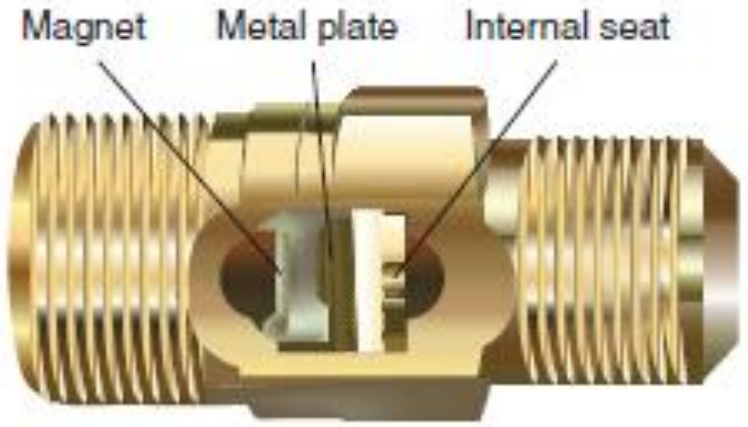
- **COMBUSTIBLE ASSEMBLY.** Wall, floor, ceiling or other assembly constructed of one or more component materials that are not defined as noncombustible.
- **COMBUSTIBLE MATERIAL.** Any material not defined as noncombustible.

Definitions

- EQUIPMENT. Apparatus and devices other than appliances.

Definitions

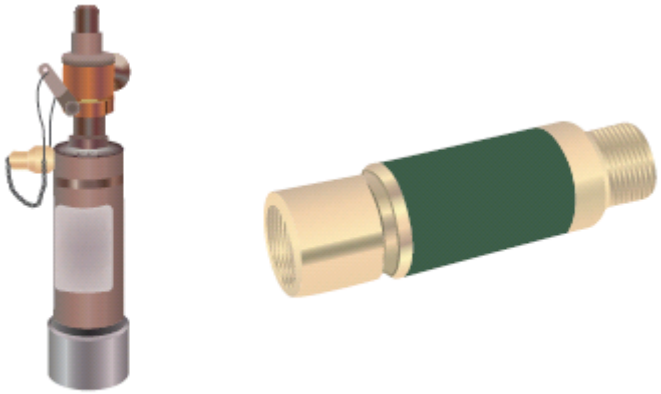
- **EXCESS FLOW VALVE (EFV).** A valve designed to activate when the fuel gas passing through it exceeds a prescribed flow rate.



Listed excessive flow valve

Definitions

- **FLASHBACK ARRESTOR CHECK VALVE.** A device that will prevent the backflow of one gas into the supply system of another gas and prevent the passage of flame into the gas supply system.



Check valve and flash arrestor

Definitions

1. The recorded temperature of the surface and interior thermocouples shall not at any time during the test rise more than 54ºF (30ºC) above the furnace temperature at the beginning of the test.
2. Shall not be flaming from the specimen after the first 30 seconds.
3. If the weight loss of the specimen during testing exceeds 50 percent, the recorded temperature of the surface and interior thermocouples shall not at any time during the test rise above the furnace air temperature at the beginning of the test, and there shall not be flaming of the specimen.

Definitions

- **REGULATOR, PRESSURE.** A device placed in a gas line for reducing, controlling and maintaining the pressure in that portion of the *piping system downstream of the device.*

Definitions

- **REGULATOR, SERVICE PRESSURE.** For natural gas systems, a device installed by the serving gas supplier to reduce and limit the service line pressure to delivery pressure.

Definitions

- **THIRD-PARTY CERTIFICATION AGENCY.** An approved agency operating a product or material certification system that incorporates initial product testing, assessment and surveillance of a manufacturer's quality control system.

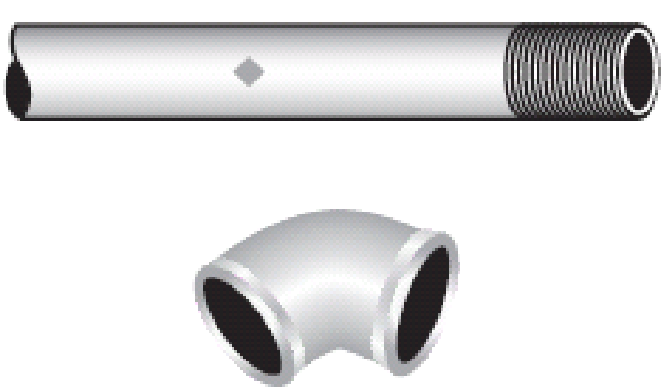
Each length of pipe and fittings shall bear the identification of the manufacturer

Definitions

- **THIRD-PARTY CERTIFIED.** Certification obtained by the manufacturer indicating that the function and performance characteristics of a product or material have been determined by testing and ongoing surveillance by an approved third-party certification agency.

Definitions

- **THIRD-PARTY TESTED.** Procedure by which an approved testing laboratory provides documentation that a product, material or system conforms to specified requirements.



Each length of pipe and fittings shall bear the identification of the manufacturer

Definitions

1. ___E.___ Third-Party Certified

2. ___F.___ Regulator Service Pressure

3. ___A.___ Excess Flow Valve (EFV)

4. ___B.___ Third-Party Tested

5. ___D.___ Flashback Arrestor Check Valve

6. ___C.___ Third-Party Certification Agency

Module 3

Chapter 3
General Regulations

General Regulations Chapter 3

- Governs the approval and installation of equipment and appliances.

General Regulations/Requirements

- In accordance with other codes
  - Labeling
  - Structural safety
  - Combustion, ventilation, dilution air
  - Clearance reduction for required clearances

Consistency

- International Building Code (IBC)
- International Mechanical Code (IMC)
- International Energy Conservation Code (IECC)
- International Plumbing Code (IPC)
- Listed Appliances
- Manufacturer’s Instructions

Listed and labeled – 301.3

- Code intends that appliances be installed and used in a manner consistent with the nature of their listing. This will prevent an appliance from being used in an application other than for what it was listed.

Label Information-301.5

- Allows a code official to determine which fuel can be used, the design pressure, BTU, clearances and approval agency.
- Most gas appliances are shipped for use on natural gas and are field converted to propane utilizing this information as well as the Manufacturer Installation Instructions.

Label Information-301.5

- Required information
  - Manufacturer's name or trademark
  - Model number
  - Serial number
  - Hourly rating in Btu/h (W)
  - Type of fuel
  - Seal or mark of testing agency
  - Minimum clearance requirements

AMERICAN STANDARD INC.
THE TRANE COMPANY
TRENTON, N.J. 08619
Made in U.S.A.

MODEL NO./NUMERO DE MODELE : TUE080A936K2
SERIAL NO./NUMERO DE SERIE : N315TK12G

CATEGORY I FORCED AIR FURNACE FOR INDOOR INSTALLATION ONLY IN A BUILDING CONSTRUCTED ON-SITE. CATEGORIE I GÉNÉRATEUR D'AIR CHAUD A AIR FORCEE POUR INSTALLATION A L'INTERIEUR SEULEMENT, DANS UN BATIMENT CONSTRUIT SUR LE SITE.
ELECTRIC 115 V. 60 HZ 1 PH. MAXIMUM TOTAL INPUT 8.5 I AMPS.
ELECTRIQUE 115 V. 60HZ 1 PH. PUISSANCE D ENTREE TOTALE MAXIMUM 8.5 I A.
FACTORY EQUIPPED FOR NATURAL GAS/AGENCE A L'USINE POUR NATUREL GAZ.
EQUIPPED WITH NO. 45 DRILL SIZE ORIFICE./L'ORIFICE EST IDENTIQUE AU TROU D'UN FORET N 45.

HOURLY INPUT RATING DEBIT CALORIFQUE BTU/H	(KW)	MANIFOLD PRESSURE PRESSION A LA TUBULURE INCHES W.C. PO/ C.E. (KPA)		NATURAL GAS/ GAZ NATUREL INCH W.C. (KPA)/ PO. C.E. (KPA)		PROPANE/ GAZ PROPANE INCH W.C. (KPA)/ PO. C.E. (KPA)	
80,000	(23.44)	3.5	(.87)				
MAXIMUM PERMISSIBLE GAS SUPPLY PRESSURE TO FURNACE				10.5	(2.61)	13.0	(3.23)
PRESSION MAXIMUM D'ALIMENTATION EN GAZ À CHAUDIERE				10.5	(2.61)	13.0	(3.23)
MINIMUM GAS SUPPLY PRESSURE FOR PURPOSES OF INPUT ADJUSTMENT				5.0	(1.24)	10.0	(2.49)
PRESSION MINIMUM D'ALIMENTATION EN GAZ POUR LE REGLACE DE PUISSANCE D'ENTREE				5.0	(1.24)	10.0	(2.49)

LOW INPUT/ENTRÉE FAIBLE BTU/H _____ (KW)- .00
LIMIT SETTING/ LIMITE COUPE-CIRCUIT, 190 °F (88 °C)-
DESIGN MAXIMUM OUTLET AIR TEMPERATURE/TEMPERATURE MAXIMA D'AIR SORTANT, 160°F (71 °C)

AIR TEMPERATURE RISE AUGMENTATIONDE LA TEMPÉATUREDE L'AIR °F (°C)				MAXIMUM EXTERNAL STATIC PRESSURE PRESSION STATIQUE EXTERIEURE MAXIMAL INCH W.C. (KPA)-PO. C.E.(KPA)	
30	(17)	TO 60	(33)	0.50	(.125)

CANADA ONLY: THIS APPLIANCE EQUIPPED ONLY FOR ALTITUDES 0-4,500FT (0-1370M) CET APPAREIL EST EQUIPE POUR DES ALTITUDES COMPRISES ENTRE 0 ET 4,500 PIEDS (0-1370M) SEULEMENT.
NO CHANGE IN ORIFICE SIZE OR ADJUSTMENT TO MANIFOLD PRESSURE REQUIRED, THE INPUT RATING BELOW:
AUCUN CHANGEMENT DANS LA DIMENSION DE L'ORIFICE OU AJUSTMENT DE LA PRESSION DU COLLECTEUR N'EST REQUIS, VALEUR NIMINALE D'ENTRÉE CI-APRÈS:

ALTITUDES/ALTITUDES	INPUT BTU/H/ DEBIT (KW)	
0-2000 FT (0-610M)	80,000	(23.44)
2000- 4500 FT (610-1370M)	72,000	(21.10)

ANS Z21.47-1993 CAN/CGA-2.3-M93 CENTRAL FURN. 21C340885 P01

Label and Listing

- Manufacturer: Trane Co.
- Model number: TUE 080 A936KZ
- Serial number: N315TK1ZG
- Hourly rating in Btu/hr (W): 80,000
- Type of fuel: Natural Gas
- Testing agency: AGA
- Test Standard: ANSI Z21.47-2003

Flood Hazard – 301.11

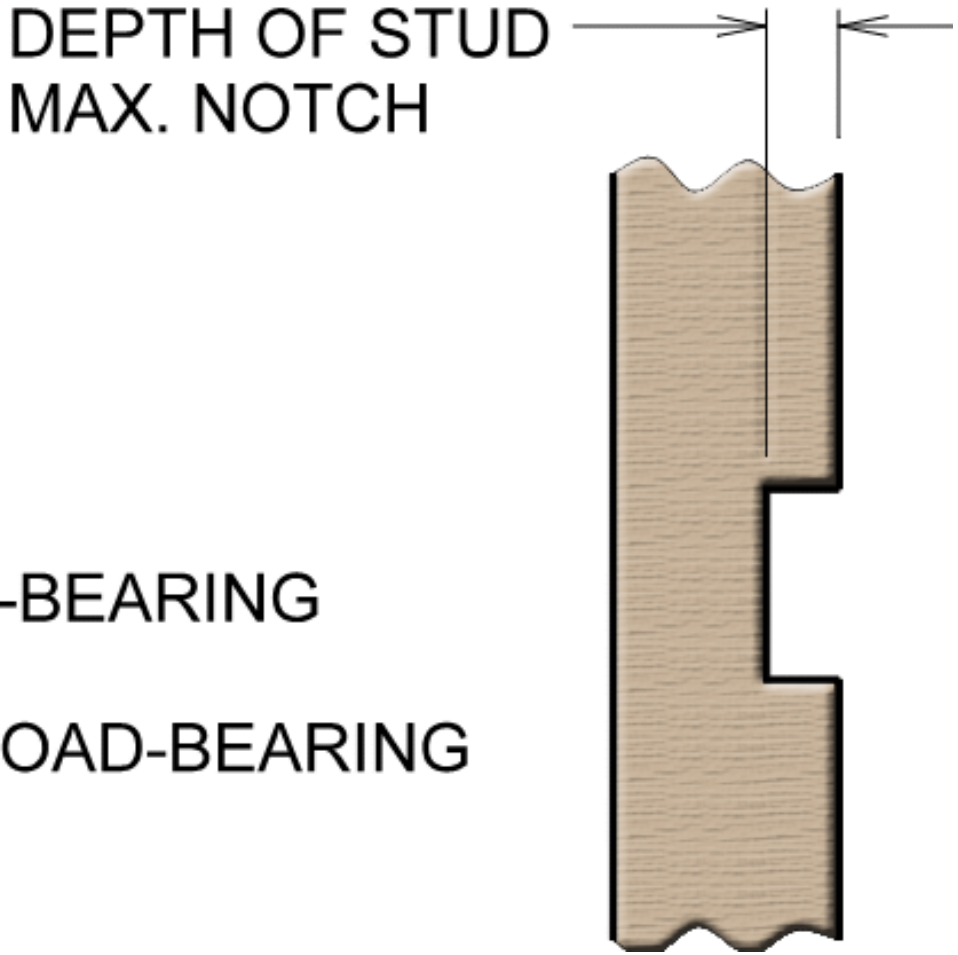
- Section 1612 of the IBC for utilities and attendant equipment.
  - For structures located in flood hazard areas, the appliance, equipment and system installations shall be located at or above the elevation required.

Structural Integrity – 302

- Installation of fuel gas piping systems and appliances must not affect:
  - Structural integrity of building components
  - Fire-resistive integrity of building components

- Cutting, notching and drilling of structural members and penetration of assemblies must be regulated.

Cutting and Notches in Wood Studs



- 25%; LOAD-BEARING WALLS
- 40%; NONLOAD-BEARING WALLS

Bored Hole Requirements

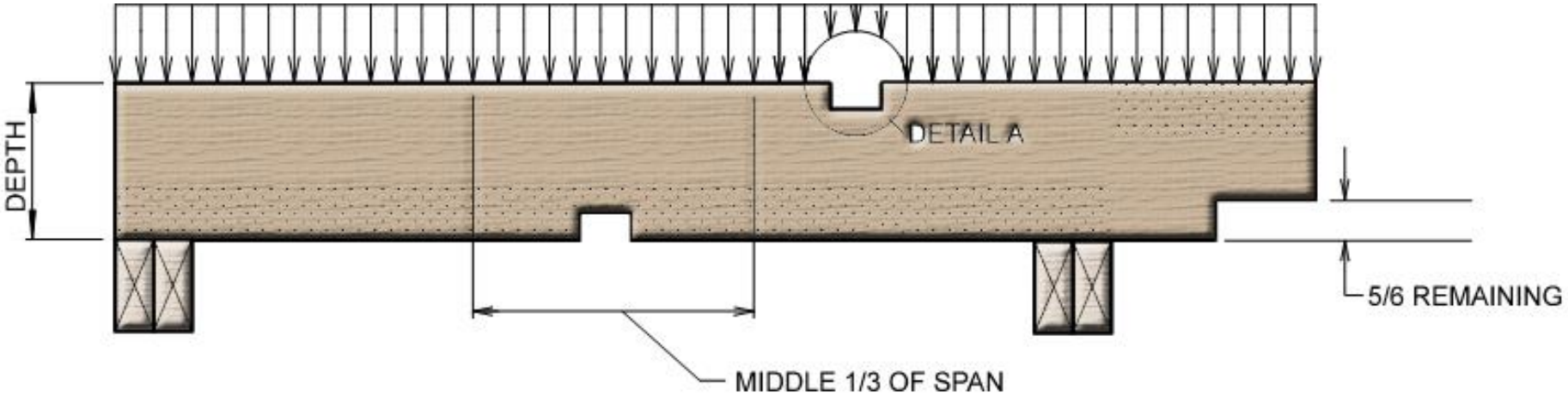
- 40% OF STUD DEPTH; LOAD-BEARING WALLS
- 60% OF STUD DEPTH; NONLOAD-BEARING WALLS

Engineered wood products – 302.3.1

- Cuts, notches and holes bored in trusses, structural composite lumber, structural glued-laminated members and I-joists are prohibited except where permitted by the manufacturer's recommendations or where the effects of such alterations are considered in the design by a registered design professional.

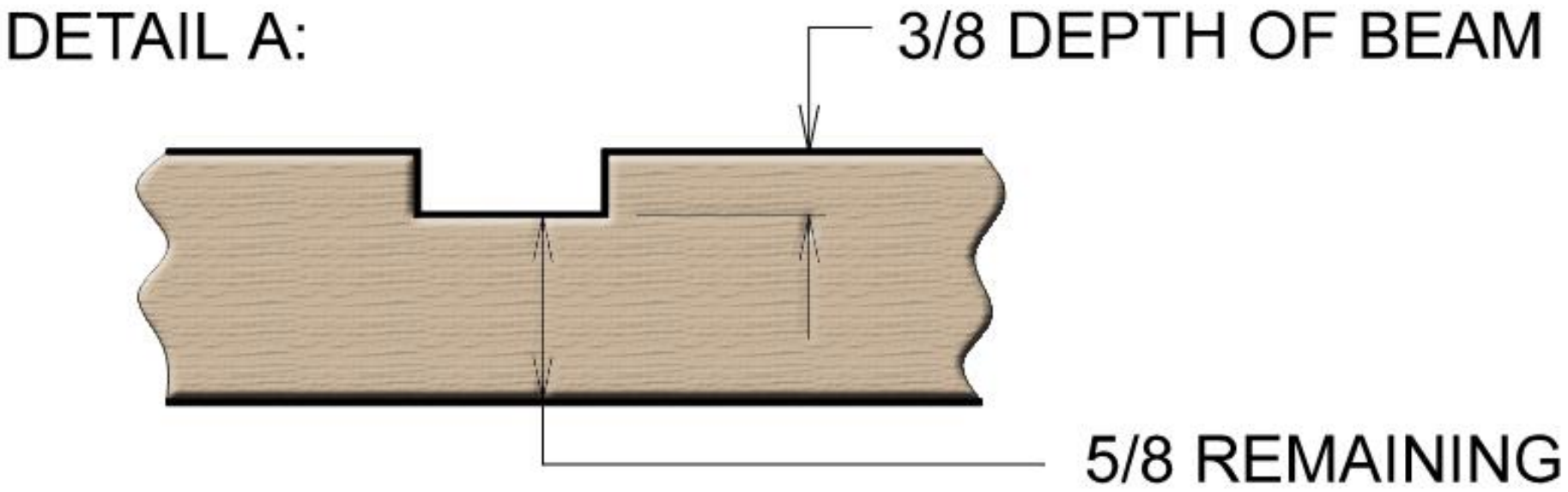
Structural Integrity

Identify what is wrong



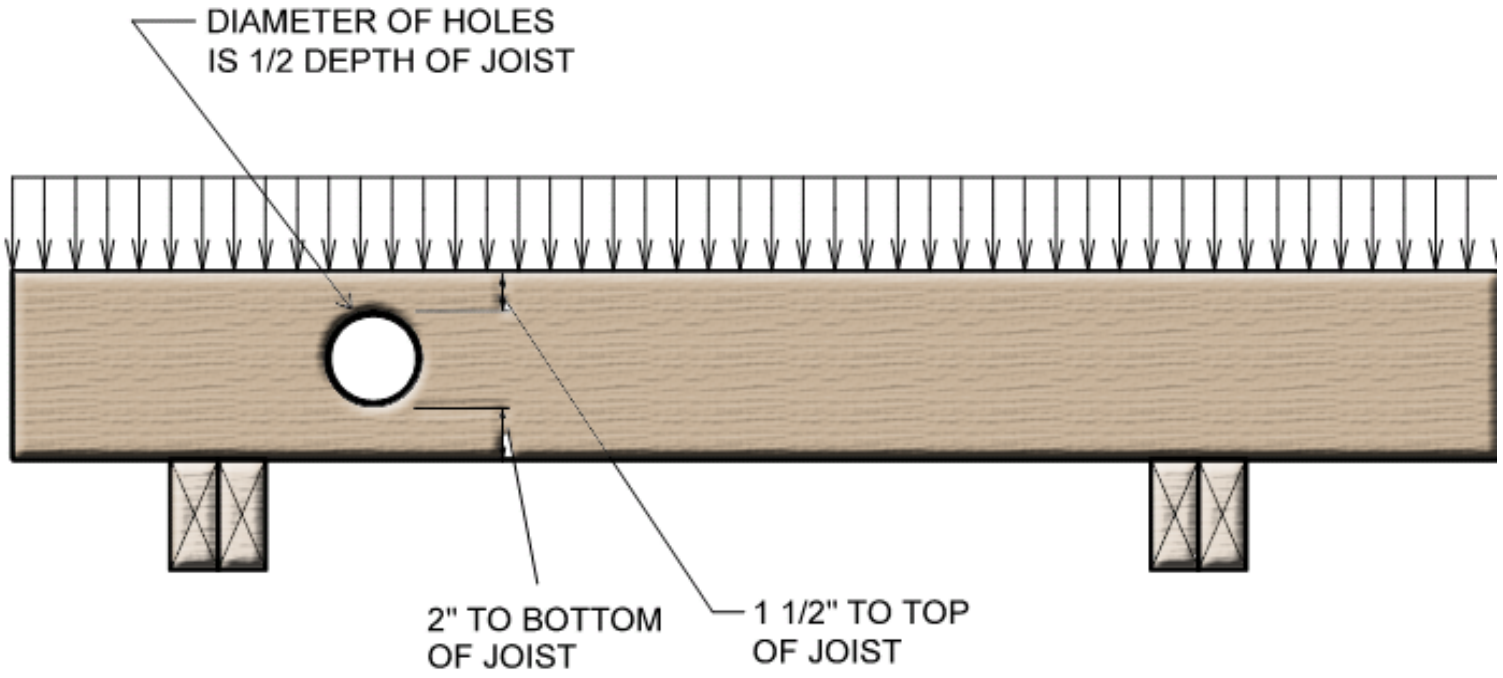
Structural Integrity

Identify what is wrong.



Structural Integrity

Identify what is wrong.



Appliance Location - 303

Hazardous locations (Section 303.2)	**Appliances shall not be located in hazardous locations unless listed and approved for such use.**
Closets and alcoves (Sections 303.5)	Furnaces and boilers installed in closets and alcoves must be listed for such installation
Outdoor installations (Section 303.6)	.Appliances installed outdoors must be listed for such installation

Prohibited Locations – 303.3

- Fuel-fired appliance shall not be located in:
  - Sleeping rooms
  - Bathrooms
  - Toilet rooms
  - Storage closets
  - Surgical rooms

Prohibited Locations

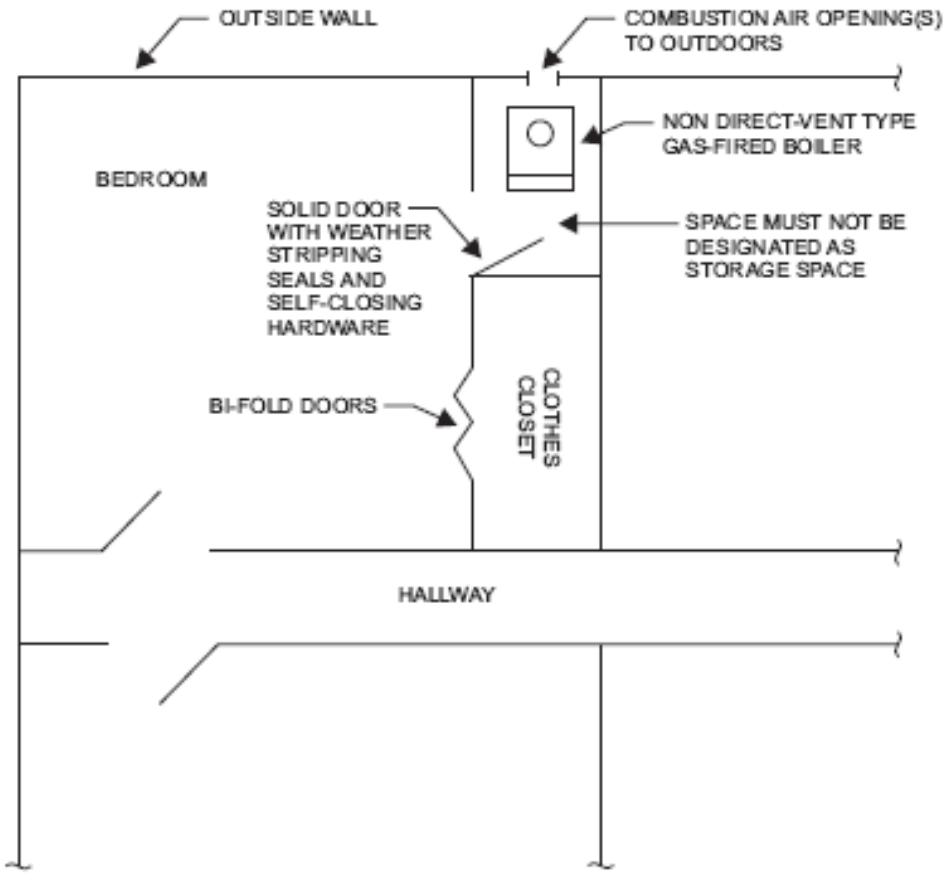
- Five exceptions
  1. Direct-vent appliances.
  2. Vented room heaters, wall furnaces, vented decorative appliances or decorative appliances.
  3. A single wall-mounted, unvented room heater with an input rating 6000 Btu/hr installed in a bathroom.

Prohibited Locations

- Five exceptions (cont.)
  4. A single-listed, wall-mounted, unvented room heater with an input rating 10,000 Btu/hr.
  5. Appliances in a dedicated enclosure in which all combustion air is taken directly from the outdoors.

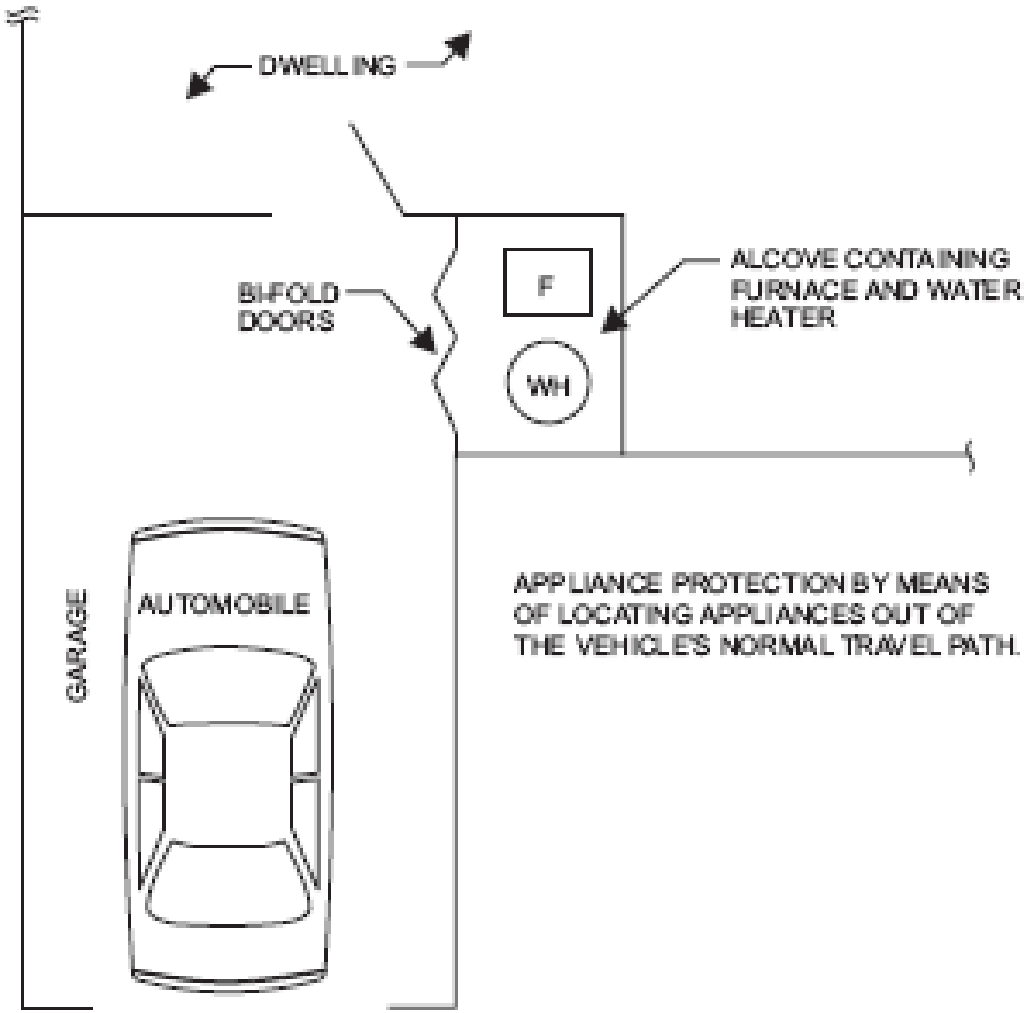
Prohibited Locations – 303.3

Appliance locations



Protection from Vehicle Impact – 303.4

Appliance Protected from Vehicle Impact



Appliance Location

1. A water heater is located in a closet that is accessed through a bathroom. All combustion air is taken from the building interior in full compliance with Section 304.5.

YES or NO

Appliance Location

2. A wall-mounted, unvented room heater is installed in a bedroom with exterior walls. The heater has a oxygen depletion safety shutoff device and the bedroom has the volume required by Section 304.5. The input rating of the heater is 11,000 Btu/hr.

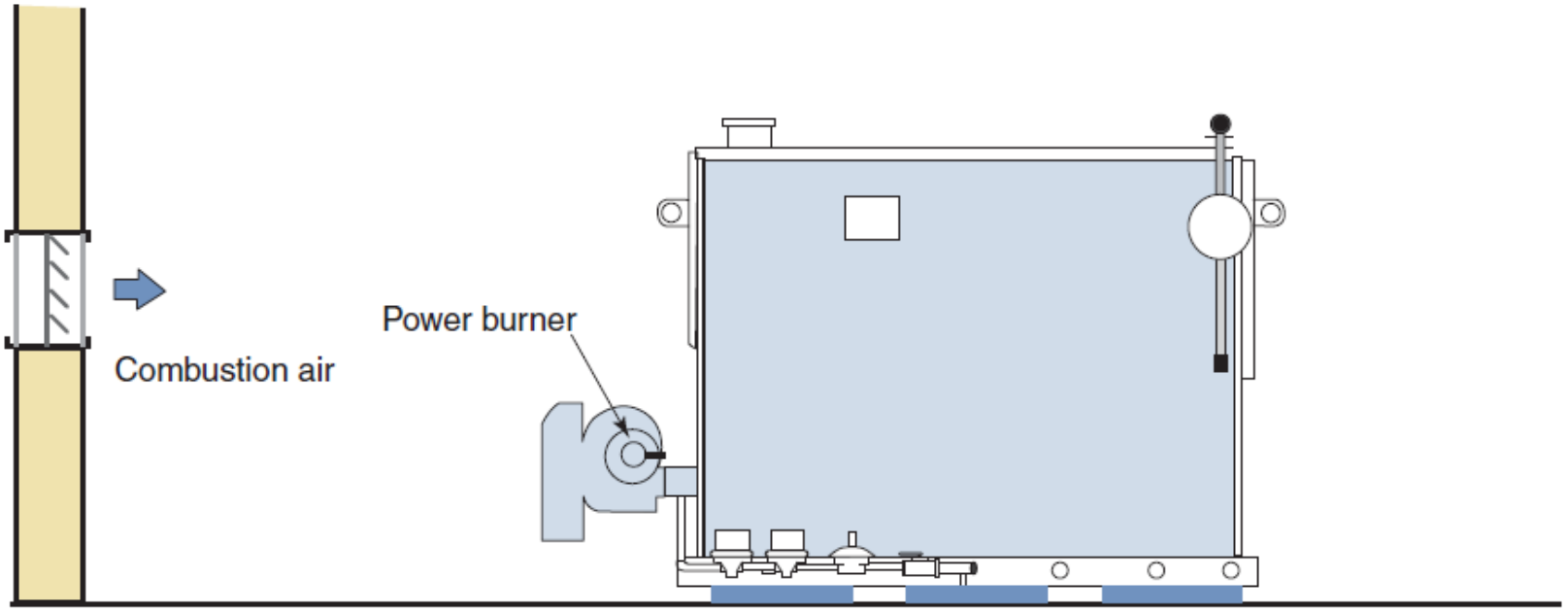
YES or NO

Combustion, Ventilation, and Dilution Air – 304

- Gas utilization equipment requires air for combustion, ventilation and dilution of flue gases

- Requirements assure:
  - Proper air supply for the combustion and venting process
  - Ventilation cooling for appliances

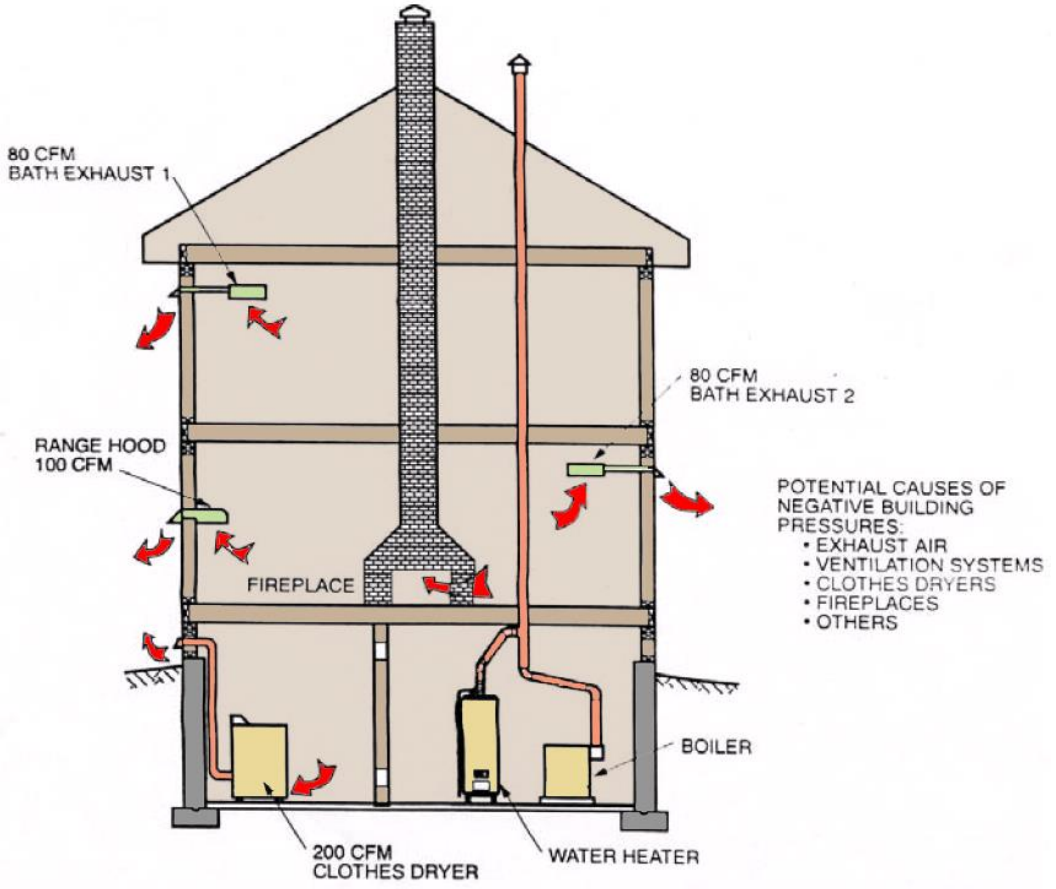
Combustion, Ventilation, and Dilution Air – 304



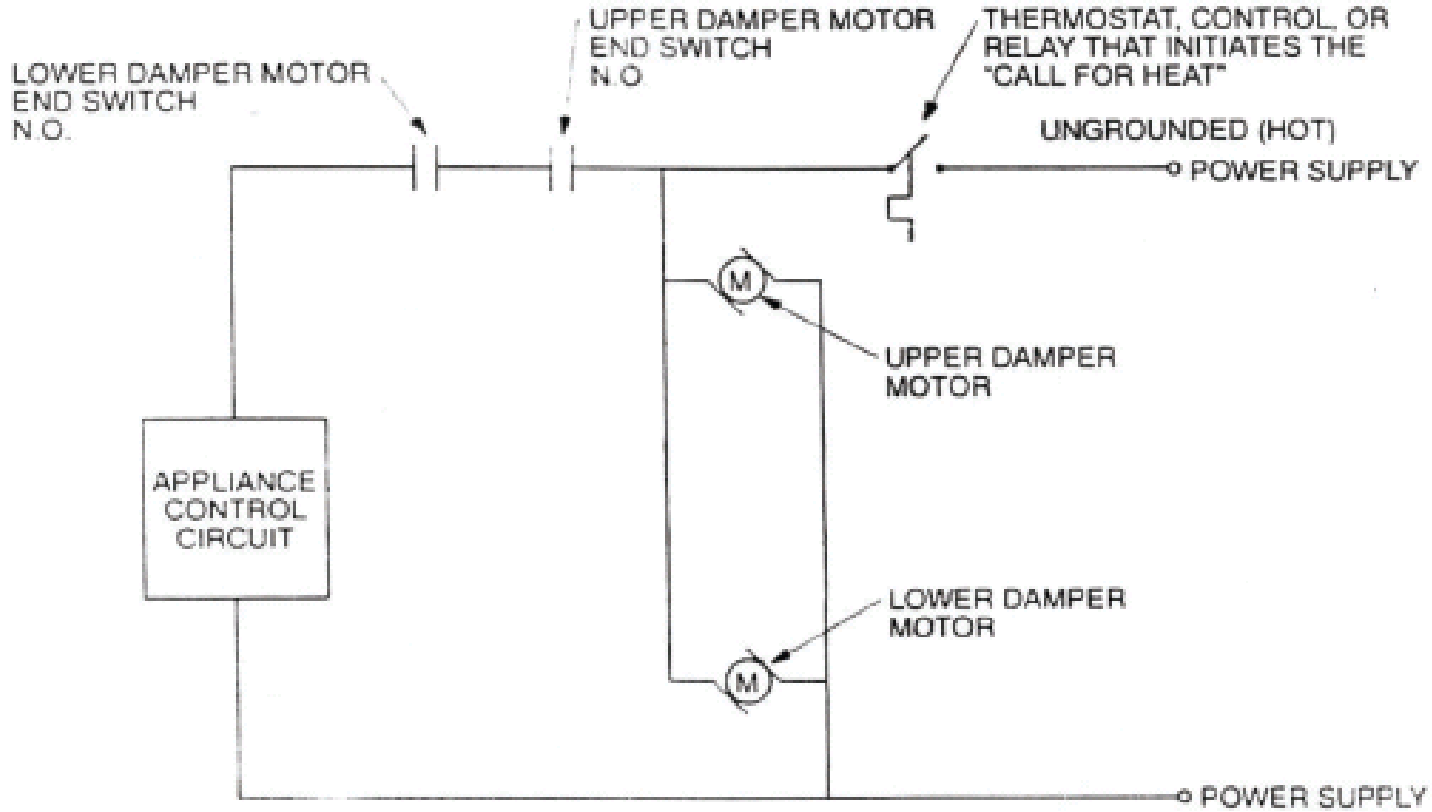
Boiler with power burner

Reliability of Air Supply – 304.4

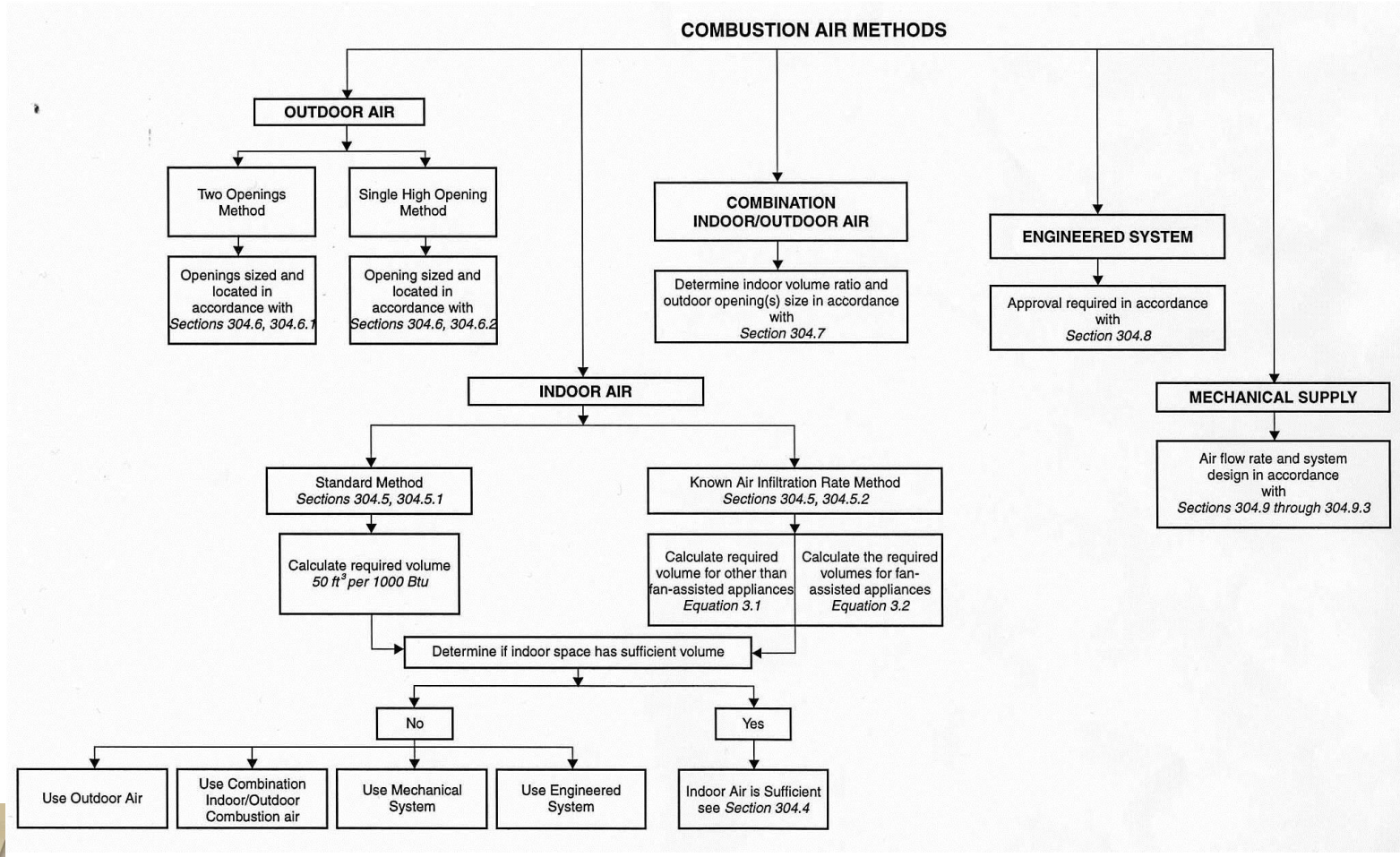
- Maintenance of appropriate relationships
  - Choice of appliance location / contaminated atmospheres
  - Advantages of direct-vent appliances



Free Area of an Opening – 304.10



Decision Tree for Combustion Air



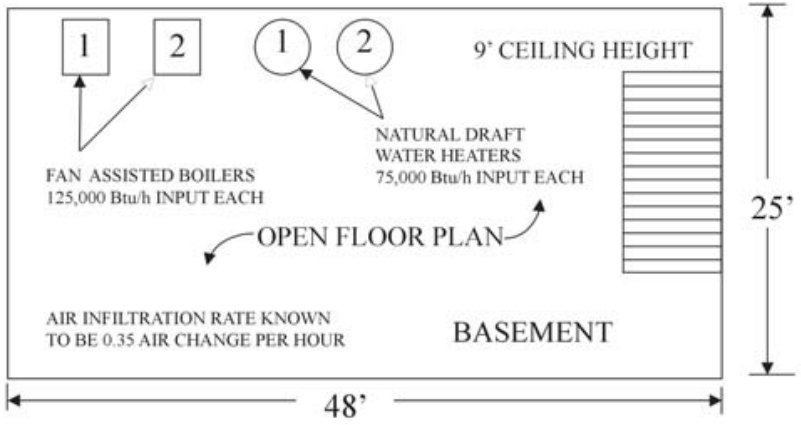
Indoor Combustion Air – 304.5

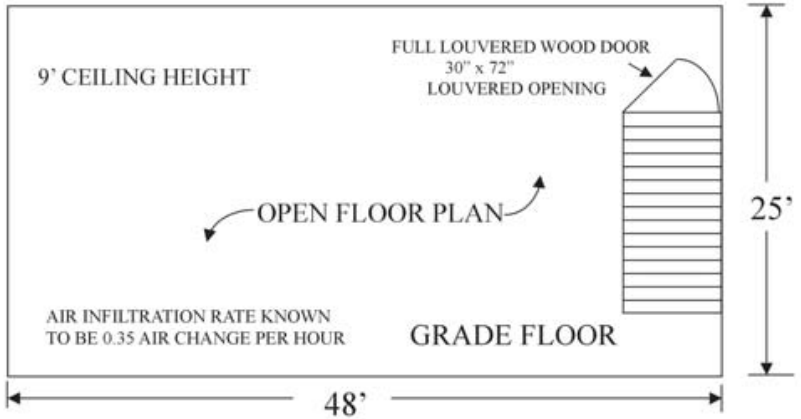
- To determine if volume of spaces meets combustion air demand of appliances:
  1. Determine type (s) of appliance (s)
  2. Determine input rating for appliances
  3. Determine if air change rate (ACR) is known
  4. Determine volume calculation method to use
  5. Calculate the required volume for each appliance.

Indoor Combustion Air – 304.5

- To determine if volume of spaces meets combustion air demand:
  6. Find available volume of room or rooms.
  7. Determine if makeup air required for exhaust systems, clothes dryers, etc..
  8. Add the calculated volumes and compare the total required volume to the available volume.
  9. Determine if available volume is sufficient. Determine if spaces need to be combined to increase available volume.

Indoor Combustion Air Calculation





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

Indoor Combustion Air Calculation

1. Calculate required volume for each boiler (Equation 3-2).
2. Calculate required volume for each water heater (Equation 3-1).
3. Total volumes required for all appliances

	Boiler 1	5,350
	Boiler 2	5,350
	Water heater 1	4,500
+	Water heater 2	4,500
Total:		19,700 ft.^{3}

Indoor Combustion Air Calculation

4. Determine available (actual) volume in building
   - Basement volume 48ft. X 25ft. X 9ft. = 10,800 ft^3
   - Grade-floor volume 48ft. X 25ft. X 9ft. = 10,800 ft^3

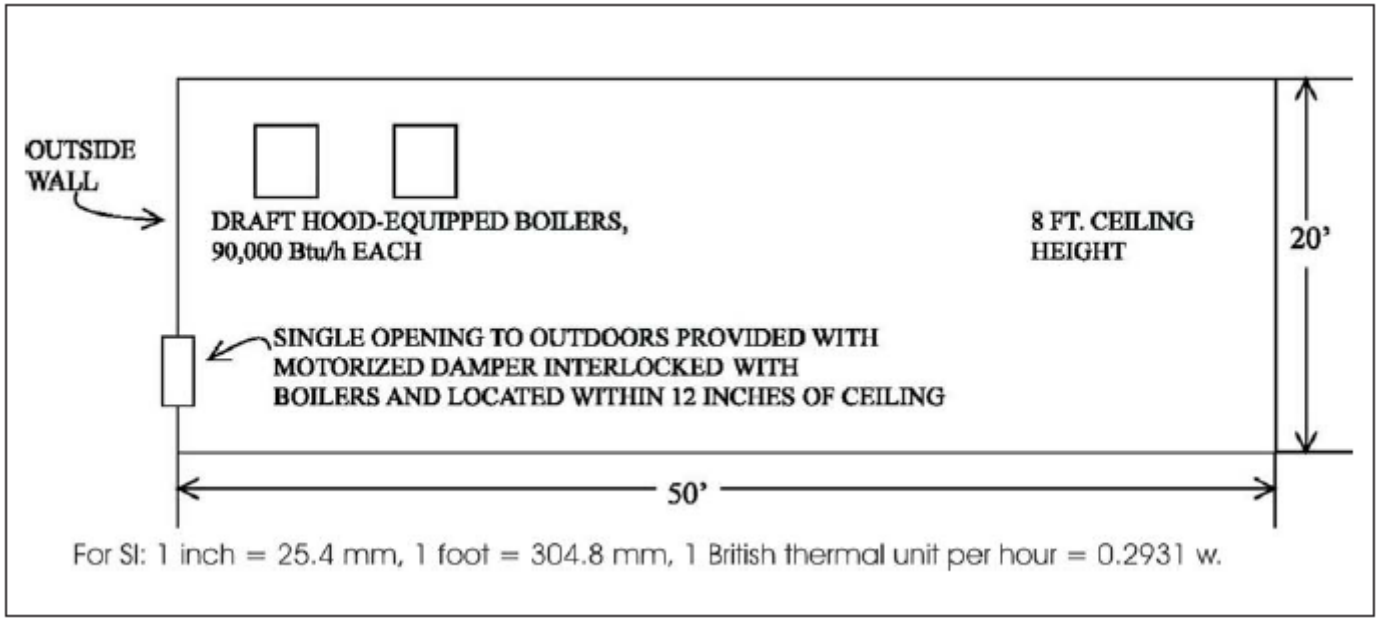
5. Louvered door opening area adequate?
   - Determine actual louvered opening. Section 304.10
     - 30 in. x 72 in. = 2,160 in^2 x .25 = 540 in^2
   - Determine required area. Section 304.5.2
     - (400,000 Btu/h / 1,000) x 2 = 800 in.

Indoor Combustion Air Calculation

- Combined volume (both stories) > Required
- Louvered door opening area: Inadequate
- Possible Solutions?

Adding outdoor openings in accordance with Section 304.7 or providing metal louvers in the door instead of wood.

Combined Indoor/Outdoor Air – 304.7

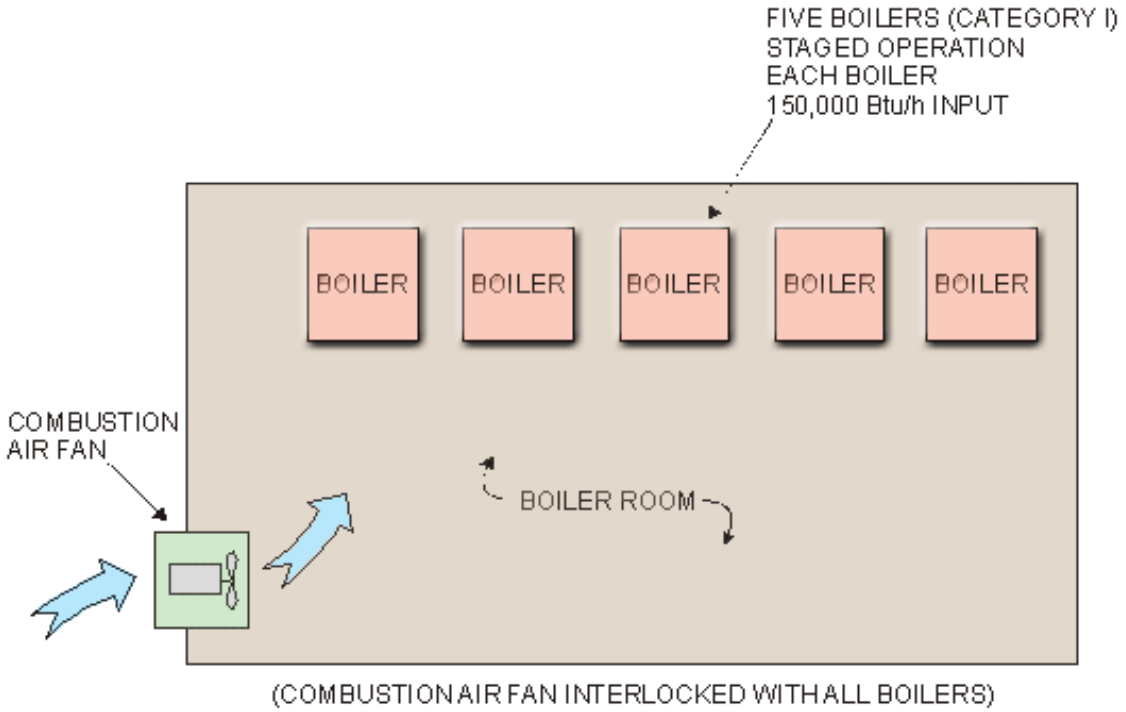


Combined Indoor/Outdoor Air – 304.7

- Required volume of room = 9,000 $ft.^3$
- Actual room volume = 8,000 $ft.^3$
- Ratio of available to required = 0.89
- Outdoor size reduction factor = 0.11
- Area of boiler vent connector = 56.5 in^2
- Actual required size = 6.6 in^2
- Minimum area must be = 9 in^2

Mechanical Combustion Air Calculation

- Calculate required airflow rate for combustion air fan (304.9)



Mechanical Combustion Air Calculation

1. Total appliance input rating:

= 750,000 Btu/h

2. Total input Btu/h / 1000 Btu/h x 0.35 CFM

= 262.5 CFM

Combustion Air Ducts – 304.11

- In general, combustion air ducts must:
  - Be composed of corrosion-resistant material.
  - Terminate in an unobstructed space.
  - Serve a single appliance enclosure.
  - Not serve both upper / lower combustion openings.

Combustion Air Ducts – 304.11

- In general, combustion air ducts must: (cont.)
  - Maintain separation between openings at air source.
  - Not be screened where terminating in attic.
  - Not be sloped.
  - Duct openings to outdoors are at least 12 inches above grade.

Contaminated Atmospheres – 304.12

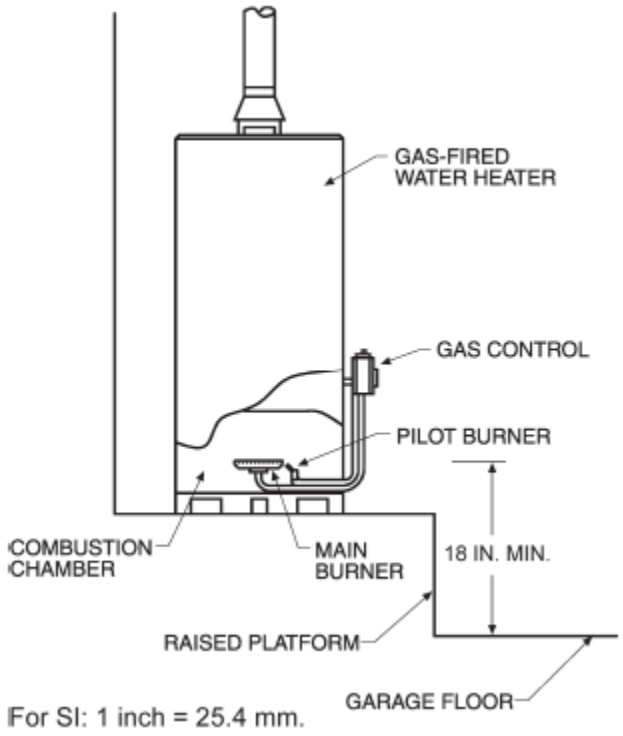
- If
  - Indoor combustion air is contaminated or,
  - Contamination of occupancy is anticipated
- Then
  - Outdoor combustion air must be provided

Installation – 305.1

- Installation instructions must be available:
  - On site
  - At time of inspection

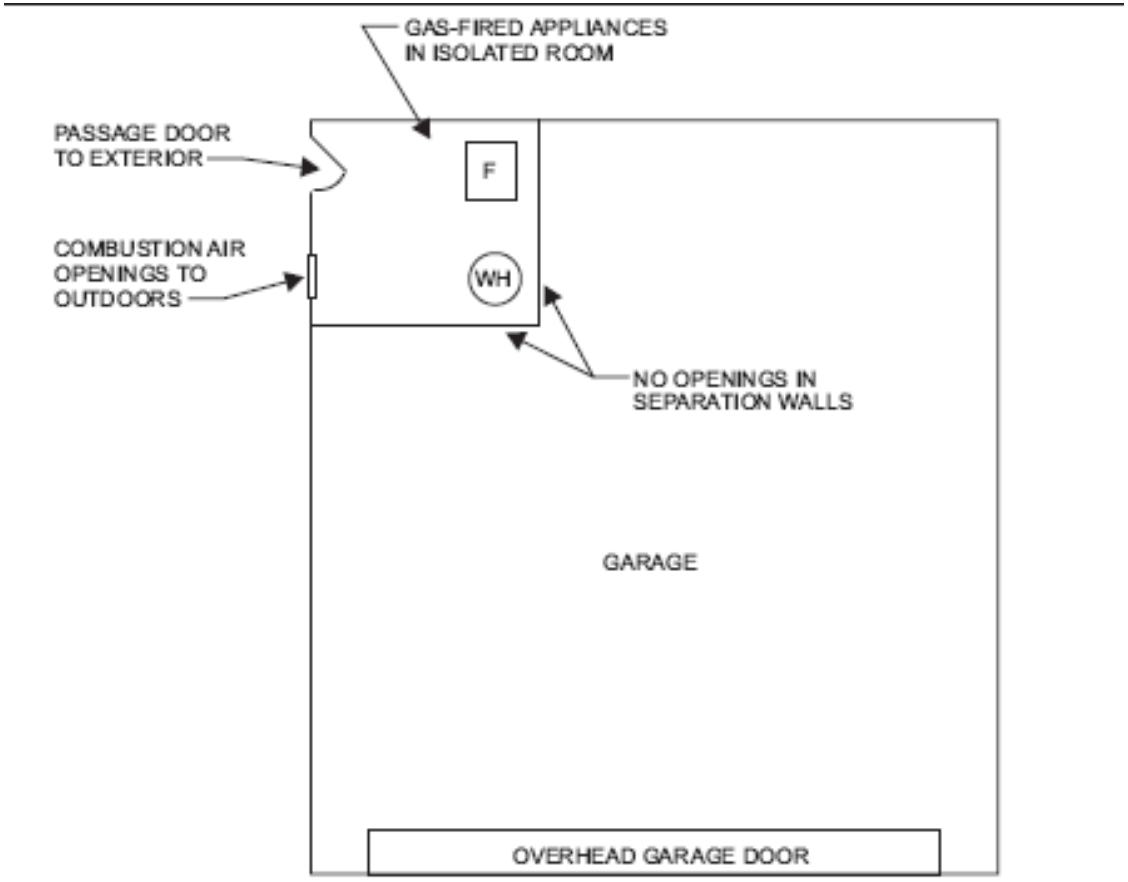
- If the code and manufacturer's instructions disagree:
  - the most restrictive provision must prevail

Elevation of Ignition Source – 305.3



- Elevate appliances so that the ignition source is no less than 18 inches above floor in:
  - Hazardous locations.
  - Public garages.
  - Private garages.
  - Repair garages.
  - Motor fuel-dispensing facilities.
  - Parking garages.

Installation in Residential Garages – 305.3.1

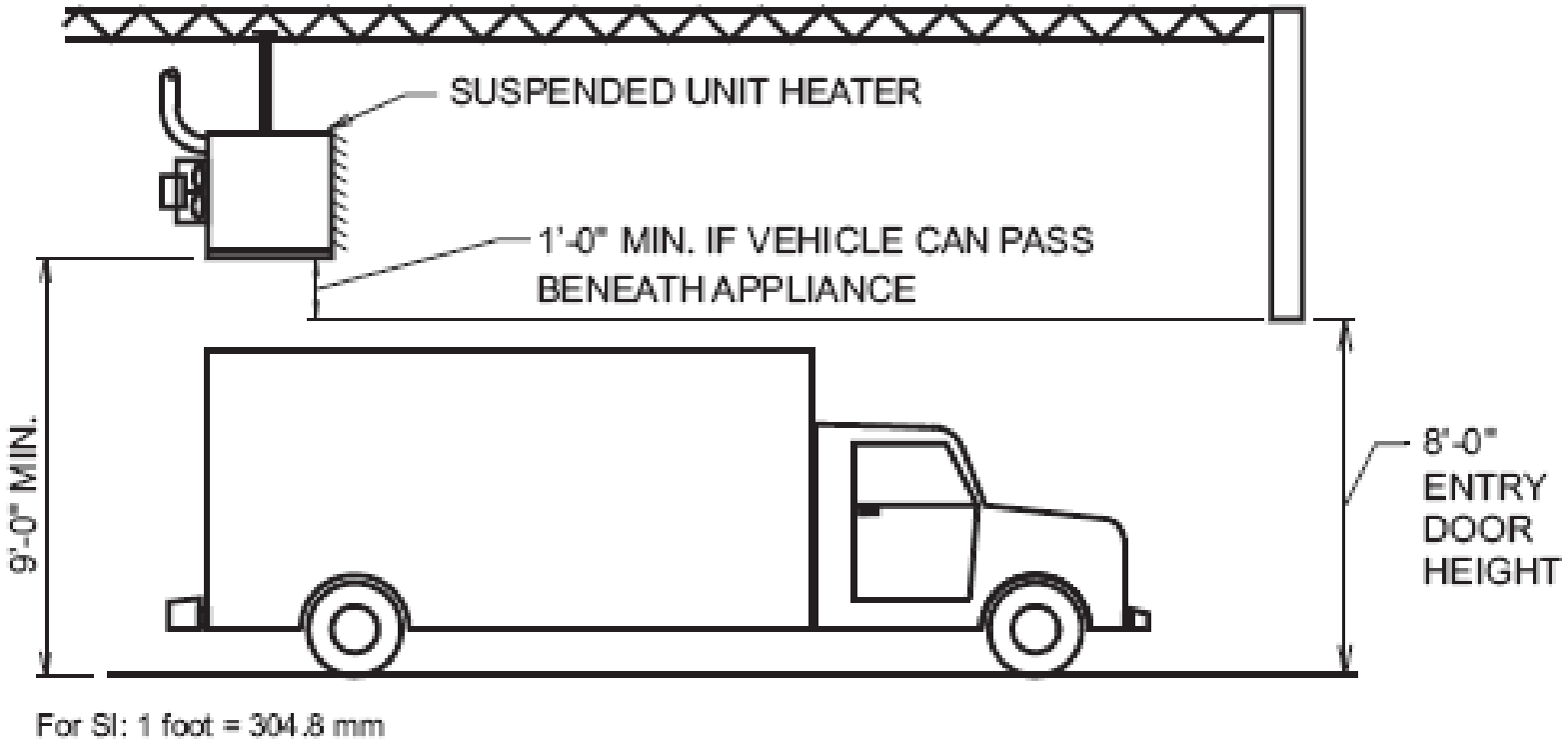


Elevation of Appliances Not Required

Garage Installation

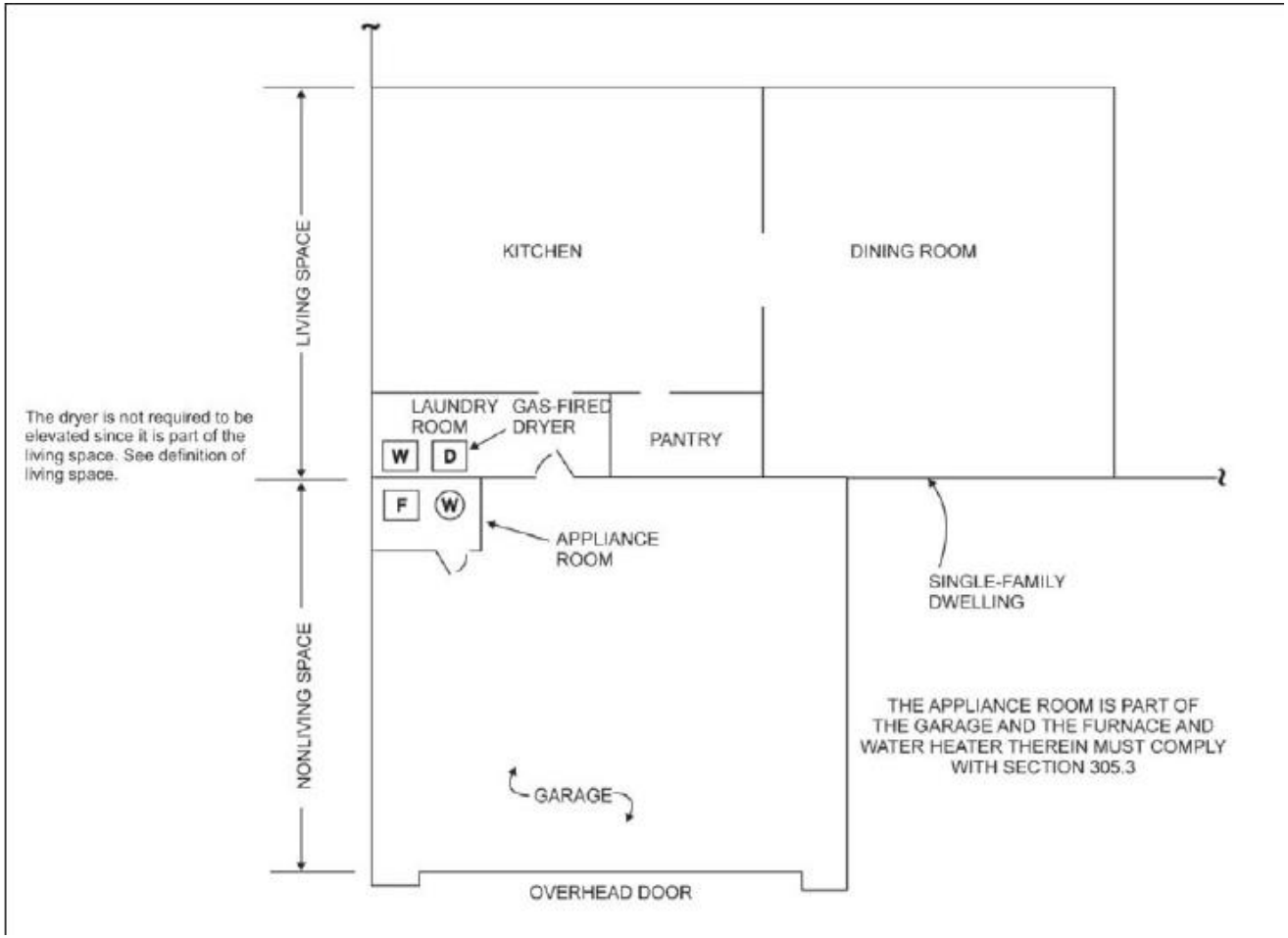
Public Garages (Section 305.4)	Private Garages (Section 305.5)
8 feet (2438 mm) above floor	6 feet (1829 mm) above floor
Where the motor vehicles are capable of passing under an appliance, the appliance must be installed at the clearance required by the manufacture and not less than 1 foot (305 mm) higher than the tallest vehicle garage door opening.	
If appliances are protected from motor vehicle impact, are installed in accordance with NFPA 30A, and the ignition source elevation requirements of this code are met, the 8-foot (2438 mm) height requirement does not apply.	If appliances are protected from motor vehicle impact and the ignition source elevation requirements of this code are met, the 6-foot (1829 mm) height requirement does not apply.

Garage Installations



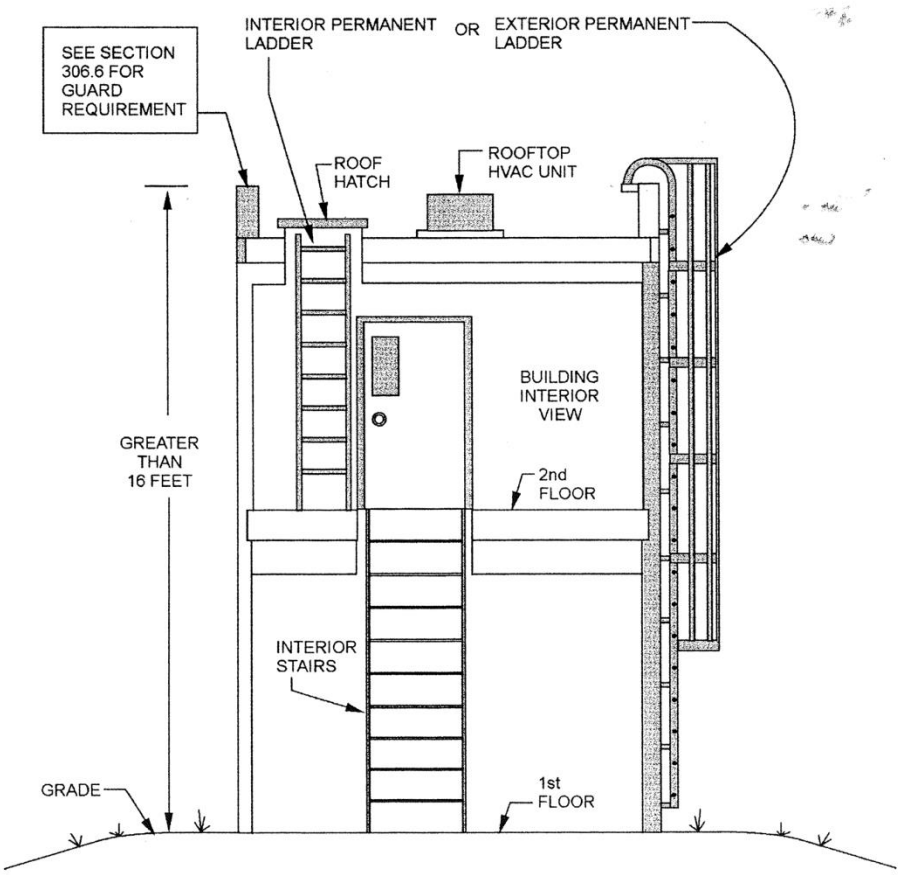
Public Garages

Garage Installations

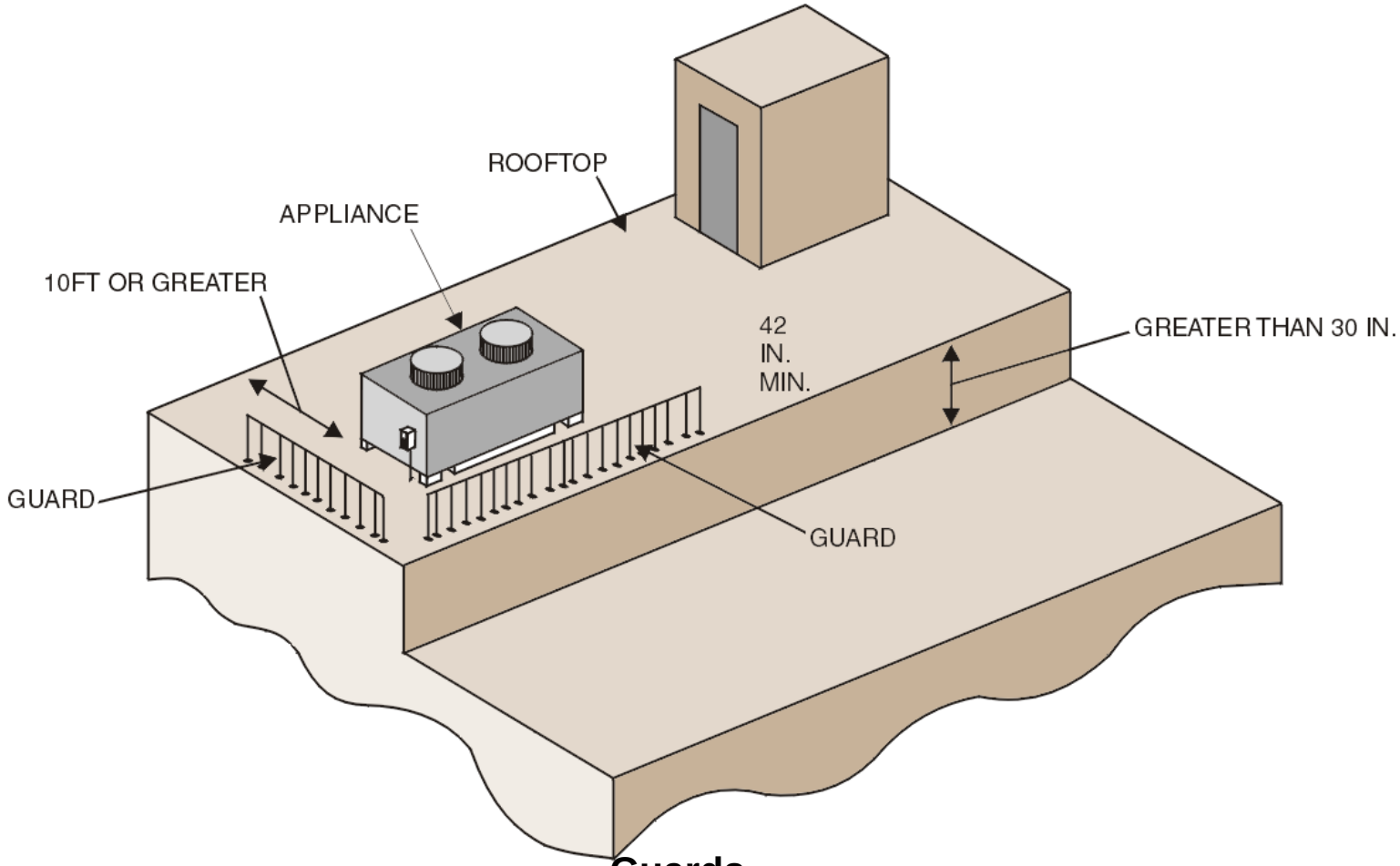


Garage Space vs. Living Space

Equipment and appliances on roof or elevated structures – 306.5

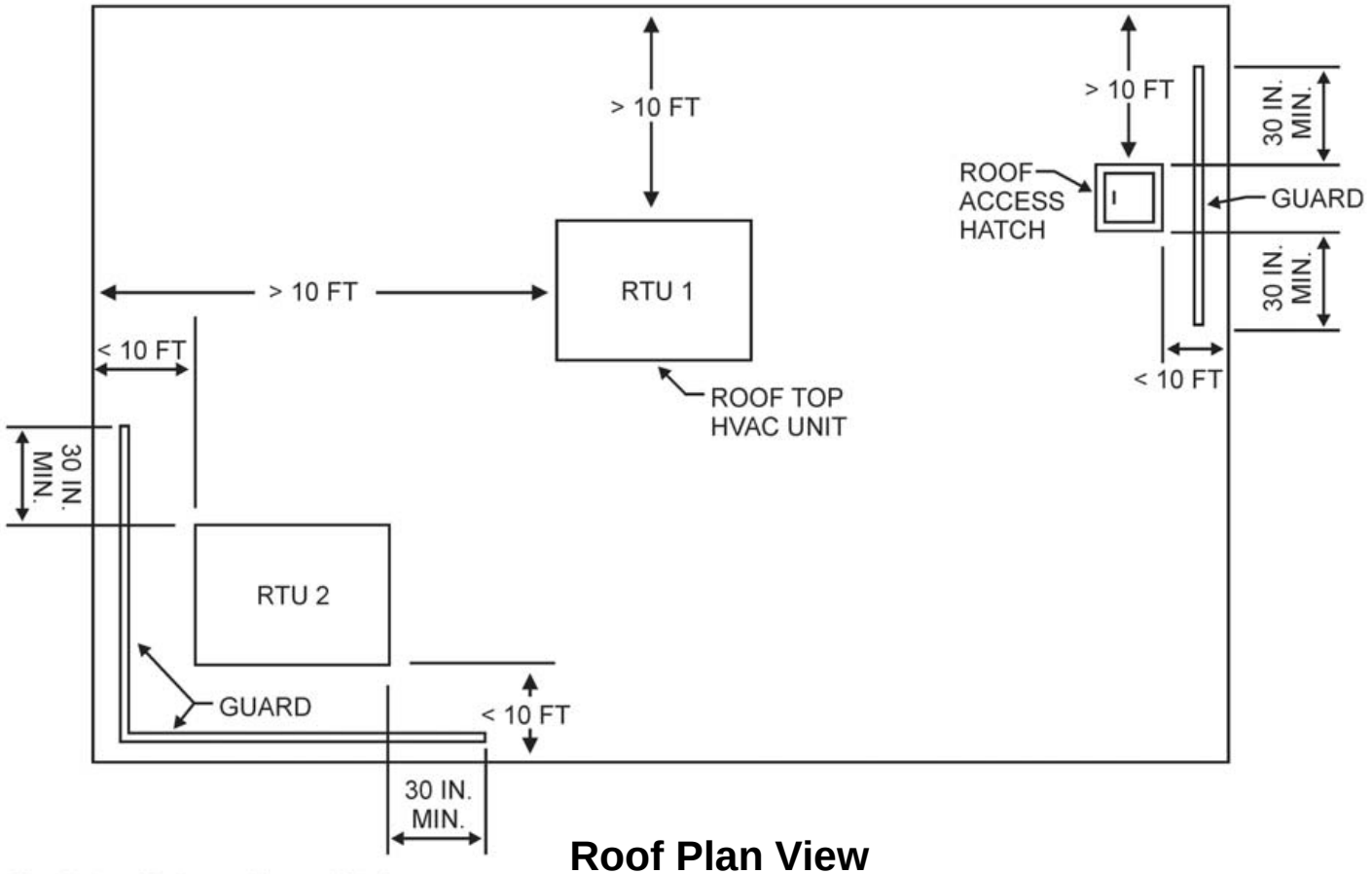


Guards – 306.6



Guards

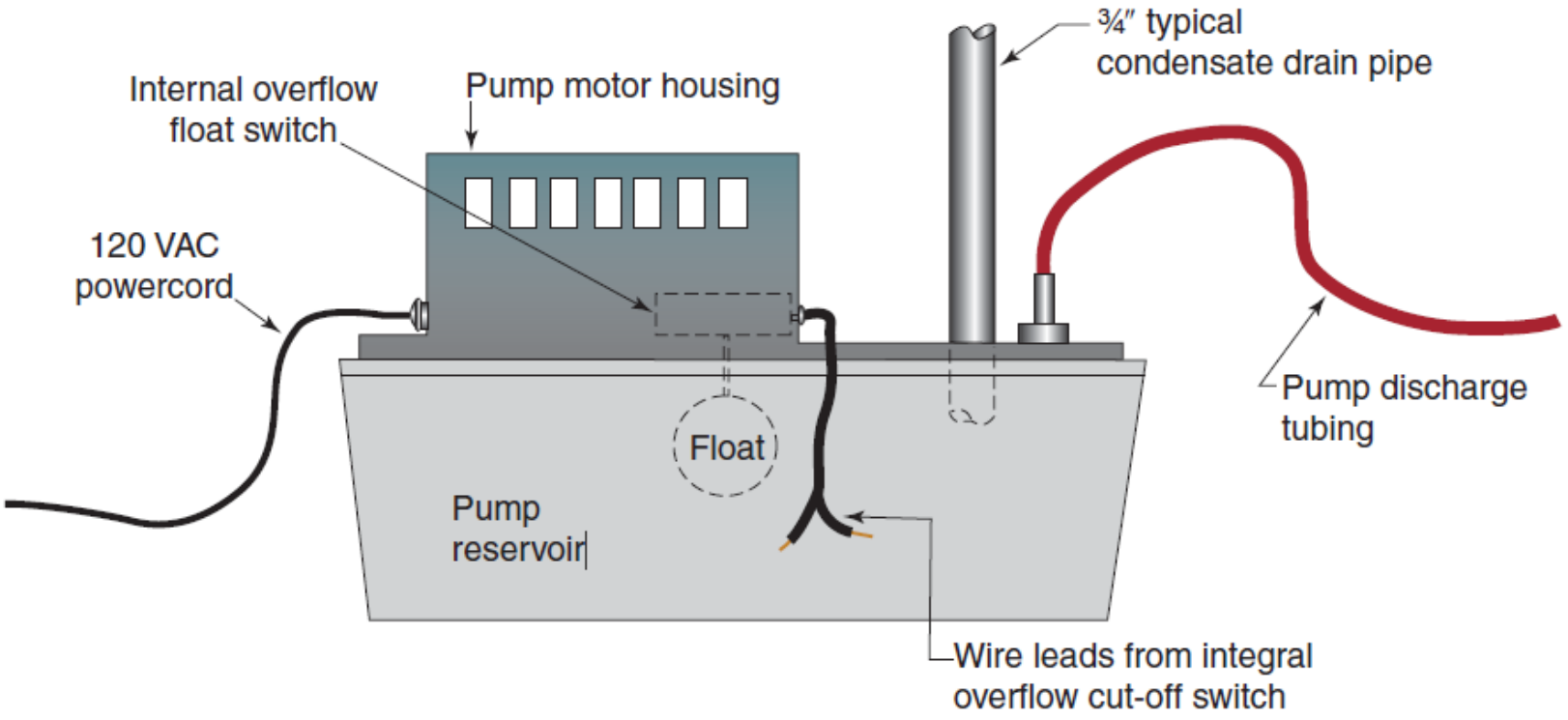
Guards – 306.6



Roof Plan View

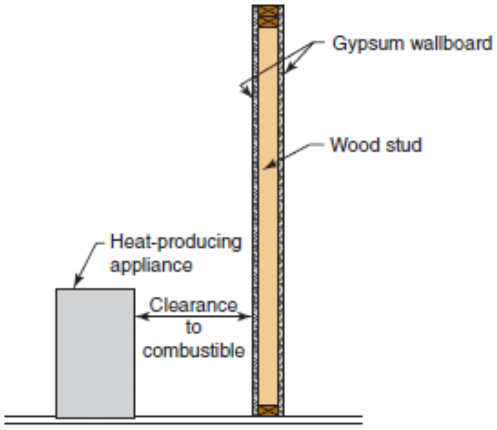
For SI: 1 inch = 25.4 mm, 1 foot = 304.8 mm.

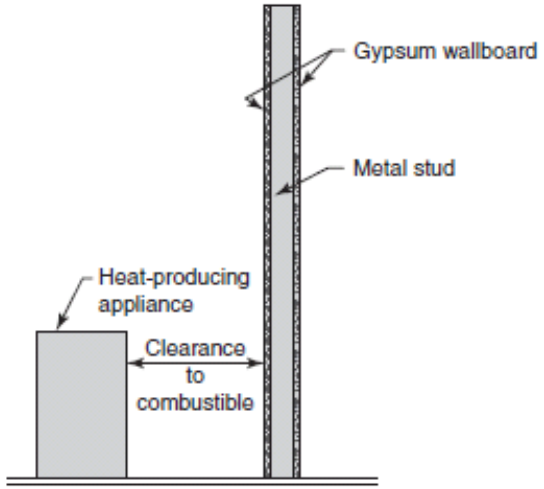
Condensate pumps – 307.6



Scope - 308.1

- For the purposes of this code, gypsum board is identified as a combustible material, as it is in the IMC.





Clearance to gypsum wallboard

Clearance Reduction - Table 308.2

2015 IFGC, Table 308.2, page 30

TABLE 308.2 [a through k]
REDUCTION OF CLEARANCES WITH SPECIFIED FORMS OF PROTECTION

TYPE OF PROTECTION APPLIED TO AND COVERING ALL SURFACES OF COMBUSTIBLE MATERIAL WITHIN THE DISTANCE SPECIFIED AS THE REQUIRED CLEARANCE WITH NO PROTECTION [see Figures 308.2(1), 308.2(2), and 308.2(3)]	WHERE THE REQUIRED CLEARANCE WITH NO PROTECTION FROM APPLIANCE, VENT CONNECTOR, OR SINGLE-WALL METAL PIPE IS: (inches)									
	36		18		12		9		6	
	Allowable clearances with specified protection (inches)									
	Use Column 1 for clearances above appliance or horizontal connector. Use Column 2 for clearances from appliance, vertical connector and single-wall metal pipe.									
	Above Col. 1	Sides and rear Col. 2	Above Col. 1	Sides and rear Col. 2	Above Col. 1	Sides and rear Col. 2	Above Col. 1	Sides and rear Col. 2	Above Col. 1	Sides and rear Col. 2
1. 3 1/2-inch-thick masonry wall without ventilated airspace	—	24	—	12	—	9	—	6	—	5
2. 1/2-inch insulation board over 1-inch glass fiber or mineral wool batts	24	18	12	9	9	6	6	5	4	3
3. 0.024-inch (nominal 24 gage) sheet metal over 1-inch glass fiber or mineral wool batts reinforced with wire on rear face with ventilated airspace	18	12	9	6	6	4	5	3	3	3
4. 3 1/2-inch-thick masonry wall with ventilated airspace	—	12	—	6	—	6	—	6	—	6
5. 0.024-inch (nominal 24 gage) sheet metal with ventilated airspace	18	12	9	6	6	4	5	3	3	2
6. 1/2-inch-thick insulation board with ventilated airspace	18	12	9	6	6	4	5	3	3	3
7. 0.024-inch (nominal 24 gage) sheet metal with ventilated airspace over 0.024-inch (nominal 24 gage) sheet metal with ventilated airspace	18	12	9	6	6	4	5	3	3	3
8. 1-inch glass fiber or mineral wool batts sandwiched between two sheets 0.024-inch (nominal 24 gage) sheet metal with ventilated airspace	18	12	9	6	6	4	5	3	3	3

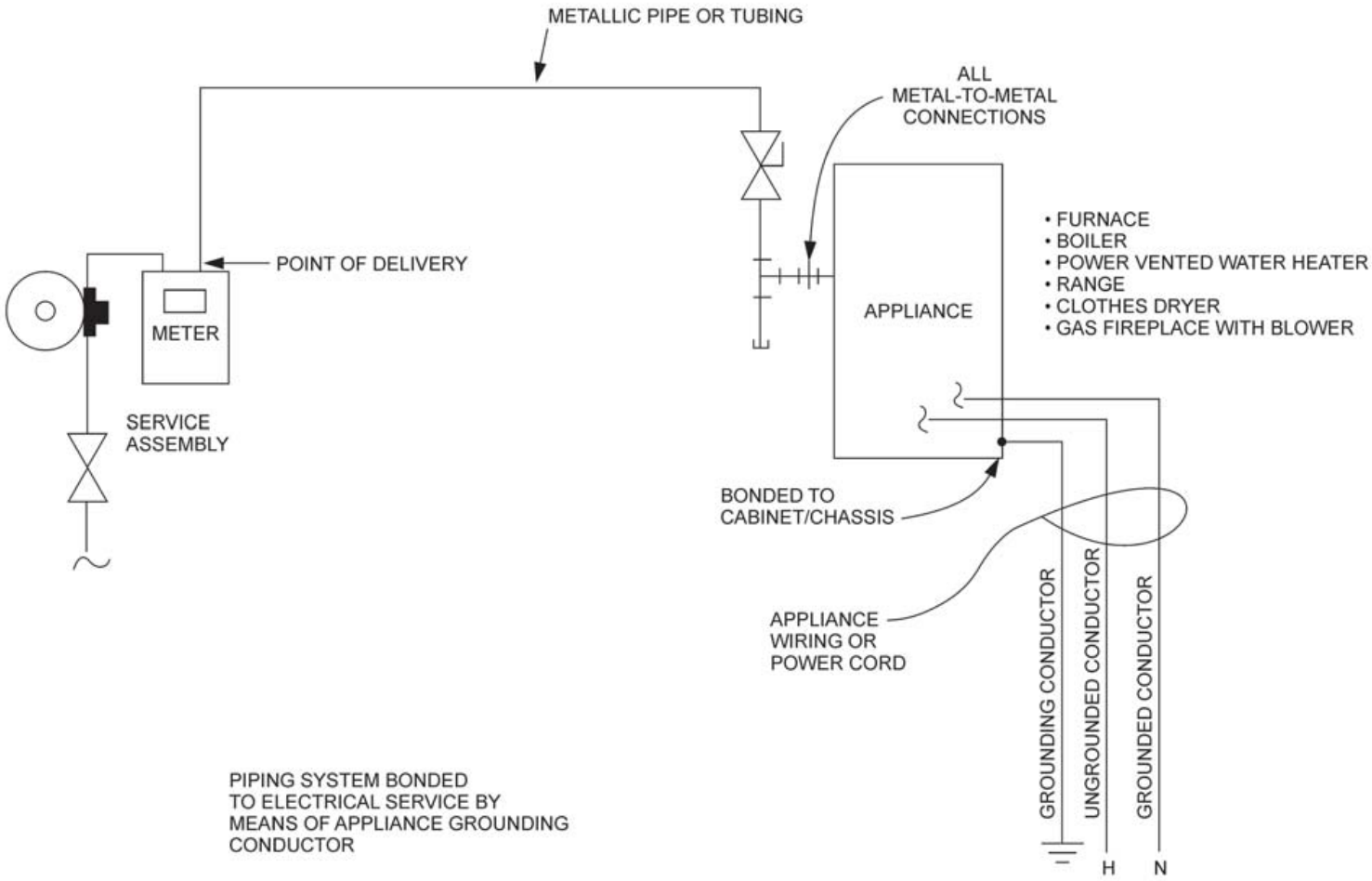
For SI: 1 inch = 25.4 mm, °C = [(°F - 32)/1.8], 1 pound per cubic foot = 16.02 kg/m^3, 1 Btu per inch per square foot per hour per °F = 0.144 W/m^2 · K.

a. Reduction of clearances from *combustible materials* shall not interfere with combustion air, draft hood clearance and relief, and accessibility of servicing.
b. All clearances shall be measured from the outer surface of the *combustible material* to the nearest point on the surface of the appliance, disregarding any intervening protection applied to the *combustible material*.
c. Spacers and ties shall be of *noncombustible material*. No spacer or tie shall be used directly opposite an appliance or connector.
d. For all clearance reduction systems using a ventilated airspace, adequate provision for air circulation shall be provided as described [see Figures 308.2(2) and 308.2(3)].
e. There shall be not less than 1 inch between clearance reduction systems and combustible walls and ceilings for reduction systems using ventilated airspace.
f. Where a wall protector is mounted on a single flat wall away from corners, it shall have a minimum 1-inch air gap. To provide air circulation, the bottom and top edges, or only the side and top edges, or all edges shall be left open.
g. Mineral wool batts (blanket or board) shall have a minimum density of 8 pounds per cubic foot and a minimum melting point of 1500°F.
h. Insulation material used as part of a clearance reduction system shall have a thermal conductivity of 1.0 Btu per inch per square foot per hour per °F or less.
i. There shall be not less than 1 inch between the appliance and the protector. In no case shall the clearance between the appliance and the combustible surface be reduced below that allowed in this table.
j. All clearances and thicknesses are minimum; larger clearances and thicknesses are acceptable.
k. Listed single-wall connectors shall be installed in accordance with the manufacturer's instructions.

Clearance Reduction

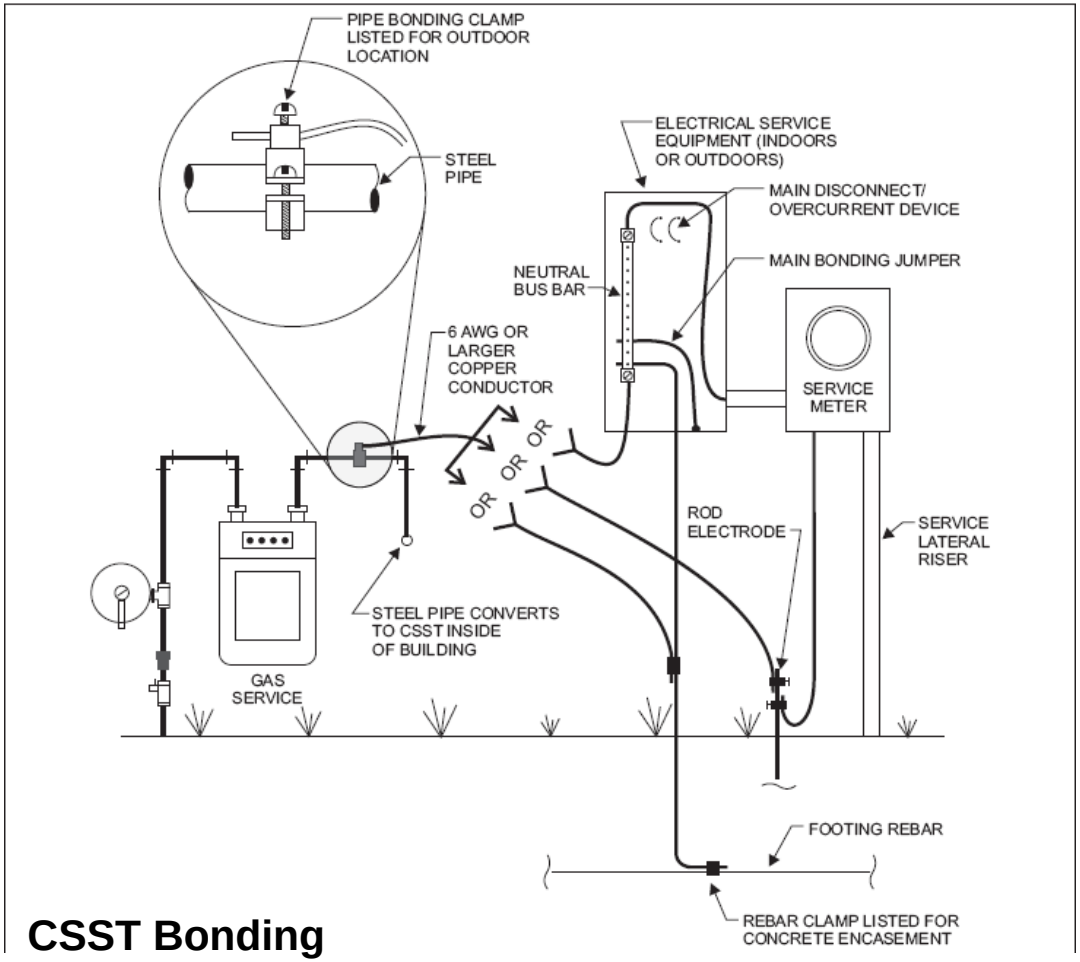
- Rooms considered large in comparison with size of equipment
  - Assemblies listed for such appliances are also permitted.
  - Linear interpolation is permitted between distances in Table 308.2.
  - Reduced clearances below range of the table are not permitted.
  - Clearances shall not be reduced where reduction is specifically prohibited by the terms of the appliance or equipment listing.

Electrical Bonding – 310



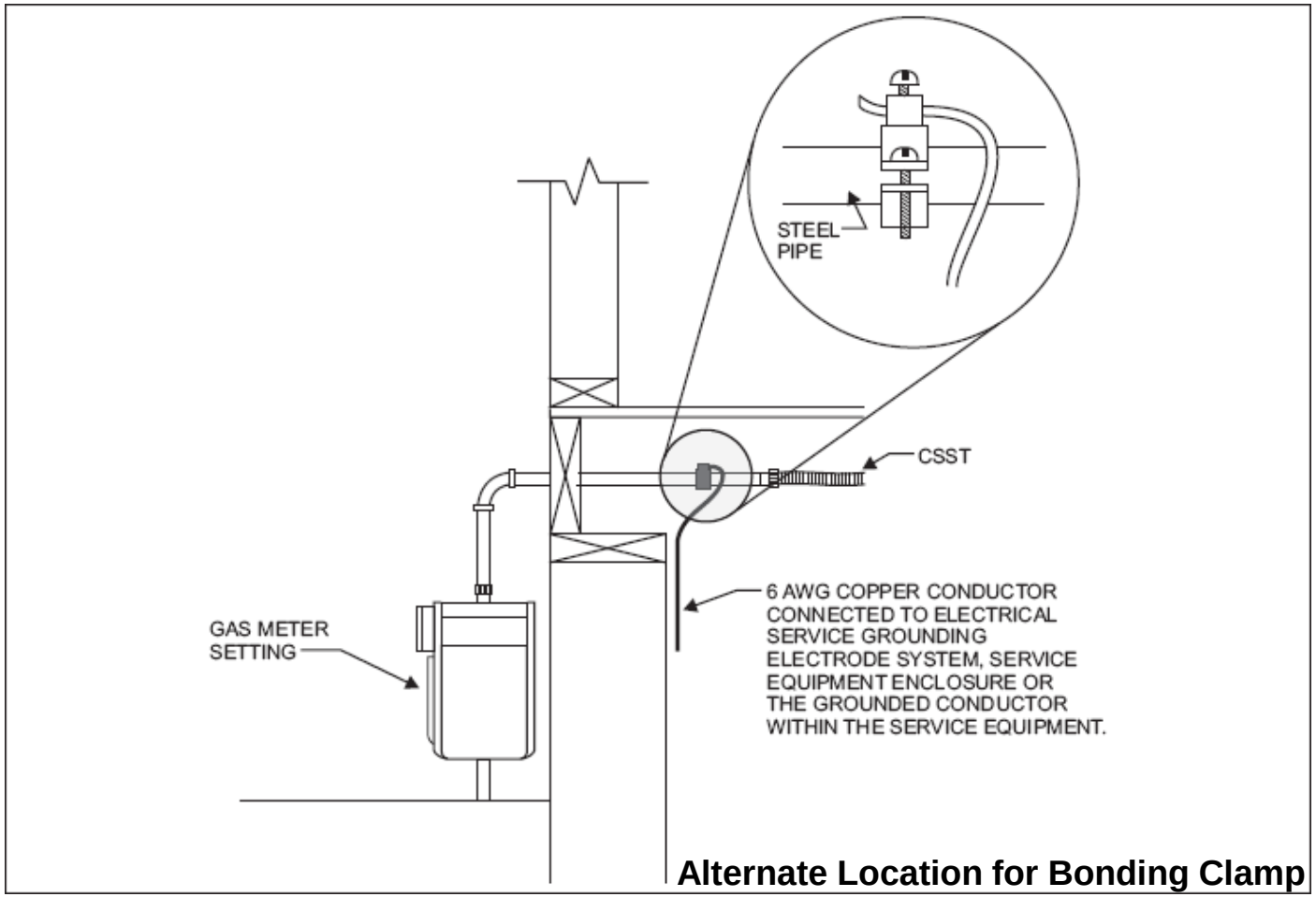
Gas Pipe Bonding by Appliance Branch Circuit

Corrugated Stainless Steel Tubing (CSST) – 310.1.1



CSST Bonding

Corrugated Stainless Steel Tubing (CSST) – 310.1.1



Alternate Location for Bonding Clamp

Bonding jumper length – 310.1.1.3

Electrical Bonding—Section 310

- 310.1.1.4 – Bonding connections
  - Bonding connections shall be in accordance with NFPA 70.
- 310.1.1.5 – Connection devices
  - Devices used for making the bonding connections shall be listed in accordance with UL 467.
  - **Note:** Never connect a bonding clamp to the Gas Company service inlet pipe, Natural or LP. These are not approved grounding electrodes or bonding means.

Module 4

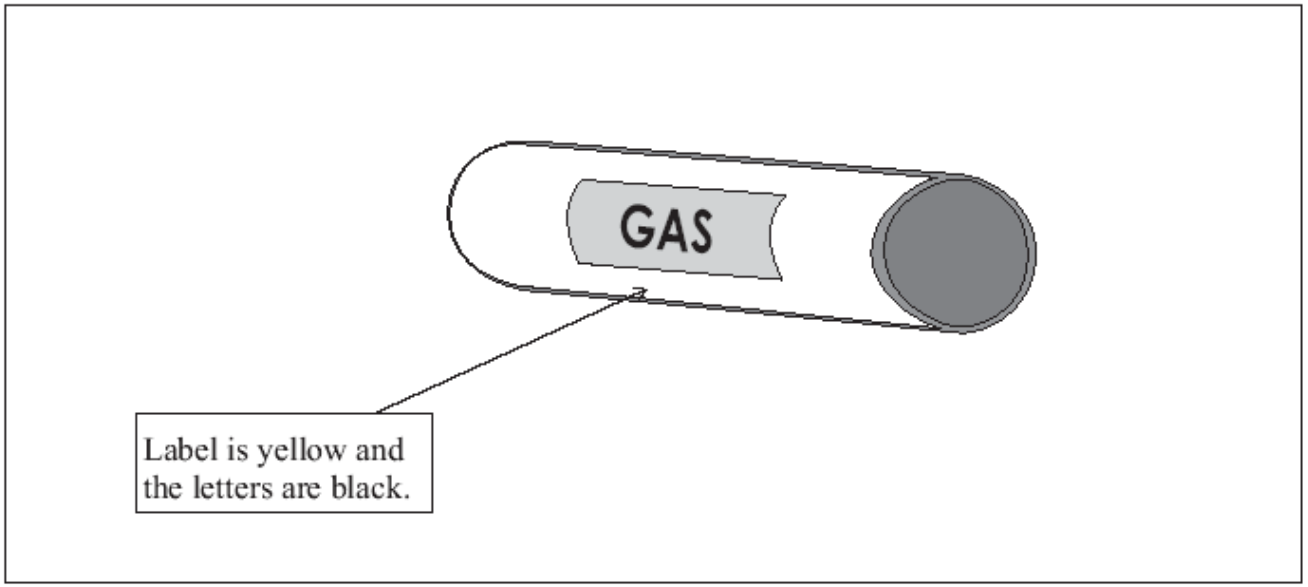
Chapter 4
Gas Piping Installations

Scope Includes

- Design
- Materials
- Components
- Installation
- Fabrication
- Assembly
- Testing
- Inspection
- Operation

Gas Piping Installation

- Addresses the intent to minimize hazards associated with the use and distribution of highly flammable fuel gas.

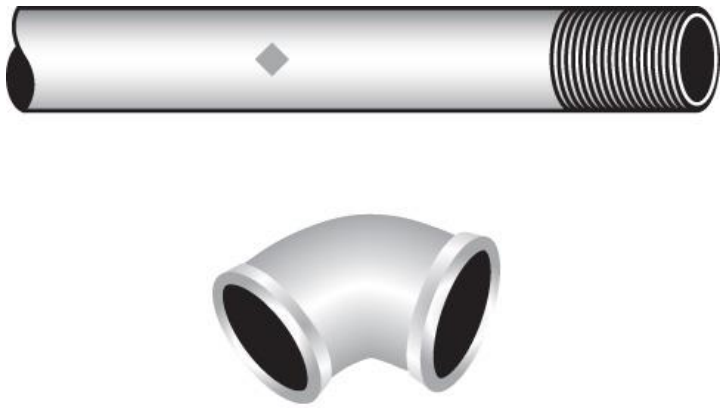


Piping meter identification – 401.7

- Multiple meter installations, one wants to be able to properly identify and locate the valve controlling the gas piping system to a given tenant space.
- Code requires that the piping system supplied by each meter be clearly and permanently identifiable.

Identification - 401.9

- Each length of pipe or tubing and each pipe fitting must have the manufacturer's identification.



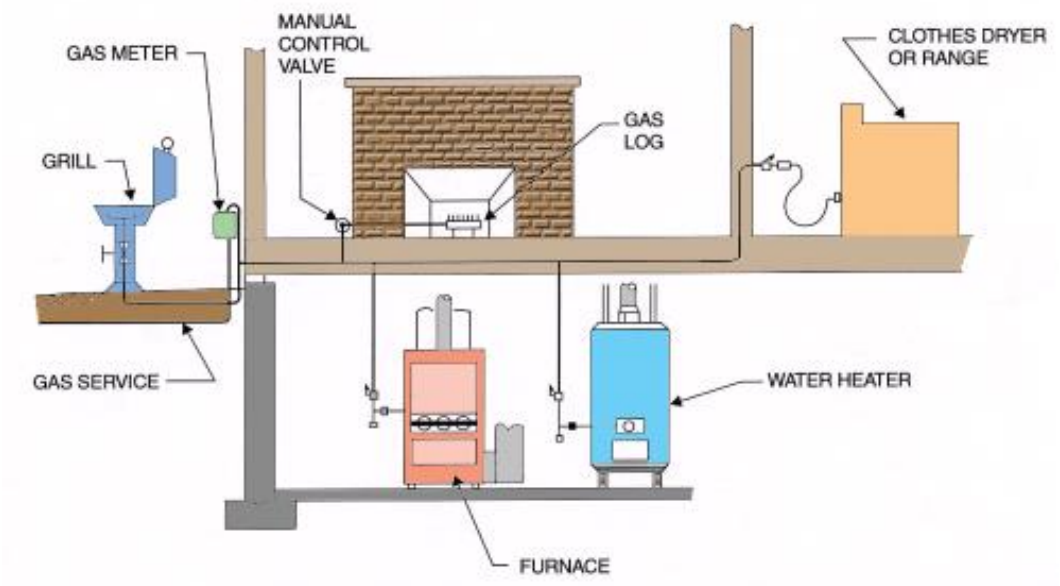
Each length of pipe and fittings shall bear the identification of the manufacturer

Third-party testing and certification - 401.10

- All piping, tubing and fittings shall comply with the applicable referenced standards, specifications and performance criteria of this code and shall be identified in accordance with Section 401.9.
- Piping, tubing and fittings shall either be tested by an approved third-party testing agency or certified by an approved third-party certification agency.

Pipe Sizing—402

- Sized to accommodate full utilization of all the gas utilization equipment in the plan simultaneously.



Five Step Review Process

1. Determine maximum gas demand
2. Determine length to most remote outlet
3. Select correct table
4. Locate gas demand figures
5. Locate nominal size of pipe required

What You Need to Know

- To determine compliance:
  - Allowable loss in pressure from point of delivery to gas utilization equipment
  - Maximum gas demand
  - Length of piping and number of fittings
  - Labeled pipe sizes
  - Specific gravity of the gas
  - Diversity factor

Page 35-70

Gas Piping System

- Tables in Chapter 4 determine sizing of gas piping.
- Variables to take into account
  1. Type of fuel gas
  2. Specific gravity of gas
  3. Gas supply pressure
  4. Pressure drop indicated
  5. Piping material used

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Gas Piping System

- Table A.2.4 lists multipliers
  - Used with Tables 402.4(1) through 402.4(22) where specific gravity of gas is other than 0.60.
- Several tables are used to determine sizing between
  - First- and second-stage regulators
  - Single- or second-stage regulators and appliances

Tables 402.4(1) through 402.4(35)

Which table would you use?

- A gas piping system using Schedule 40 steel piping with an identified pressure drop of 0.5 in wc; with a gas pressure of < 0.5 psi (< 3.4 kPa) and conveying a gas of 0.6 specific gravity.

Table 402.4(2)

Tables 402.4(1) through 402.4(35)

Which table would you use?

- A gas piping system using Schedule 40 steel piping with an identified pressure drop of 1.0 psi (6.9 kPa), gas pressure of 2 psi(14 kPa) and conveying a gas of 0.7 specific gravity.

Table 402.4(3) and Appendix Table A.2.4

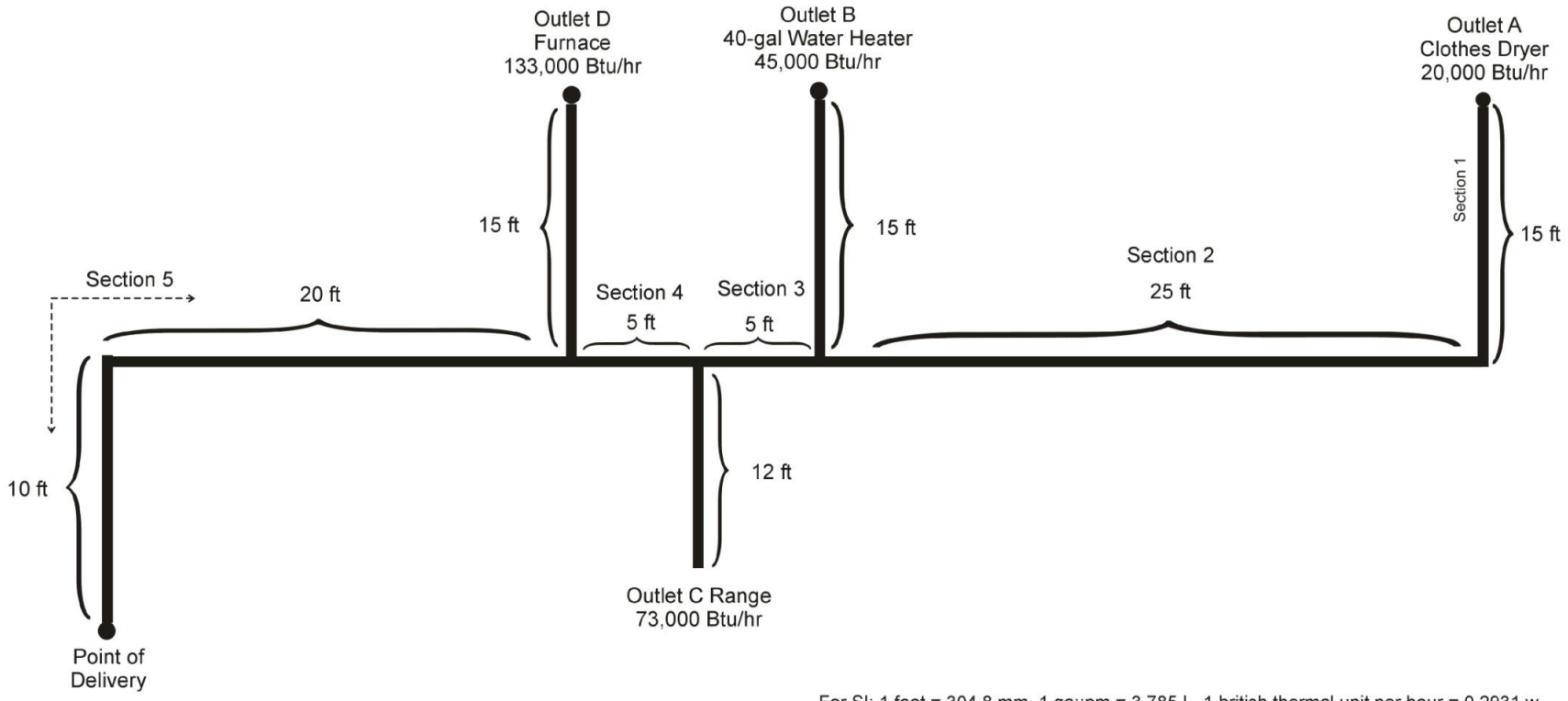
Pipe Sizing

- Section 402.4 – Sizing tables and equations
  - Includes two sizing methods and two equations to size piping or tubing length of low-pressure gas and for high-pressure gas.
- Section 402.4.1 – Longest length method
  - Pipe size of each section of gas piping is determined using the longest length of gas piping from the point of delivery to the most remote outlet, and the load of the section.

Pipe Sizing

- Section 402.4.2 – Branch length method
  1. Pipe size of each section of the longest pipe run from the point of delivery to the most remote outlet shall be determined using the longest run of piping and the load of the section.
  2. The pipe size of each section of branch piping not previously sized shall be determined using the length of piping from the point of delivery to the most remote outlet in each branch, and the load of the section.

Gas System Sizing Problem



For SI: 1 foot = 304.8 mm, 1 ga;;pm = 3.785 L, 1 british thermal unit per hour = 0.2931 w.

Gas System Sizing Problem

Given:

FUEL GAS	SPECIFIC GRAVITY	HEATING VALUE	MAXIMUM ALLOWABLE PRESSURE DROP	DELIVERY PRESSURE	PIPING MATERIAL
Natural	0.60	1,000 Btu per cubic foot	0.5 in wc	10 inches wc	Schedule 40 steel pipe

For SI: 1 inch water column = 0.2488 kPa, 1 British Thermal unit per cubic foot = 10.35 W/m^3.

Gas System Sizing Problem

1. Determine maximum gas demand:

Outlet A:	20 cfh (ft^3/h)
Outlet B:	45 cfh (ft^3/h)
Outlet C:	73 cfh (ft^3/h)
Outlet D:	133 cfh (ft^3/h)
Maximum gas demand:	271 cfh (ft^3/h)

Gas System Sizing Problem

2. Determine length to the most remote outlet:

Section 1:	15 ft.
Section 2:	25 ft.
Section 3:	5 ft.
Section 4:	5 ft.
Section 5:	30 ft.

Total pipe length to most remote outlet: 80 ft.

Gas System Sizing Problem

3. Select applicable table:

Specific gravity:	0.60
Gas pressure:	10 IN WC
Pressure drop:	0.5 IN WC
Type of material:	Steel Pipe
Special conditions:	NA
Table Used:	402.4(2)

Gas System Sizing Problem

4. Locate gas demand figures:
   - Horizontal row showing length of piping
   - Indicates length from point of delivery to most remote outlet
   - If not exact, use next longer distance
   - Use this row for all gas demand figures

Gas System Sizing Problem

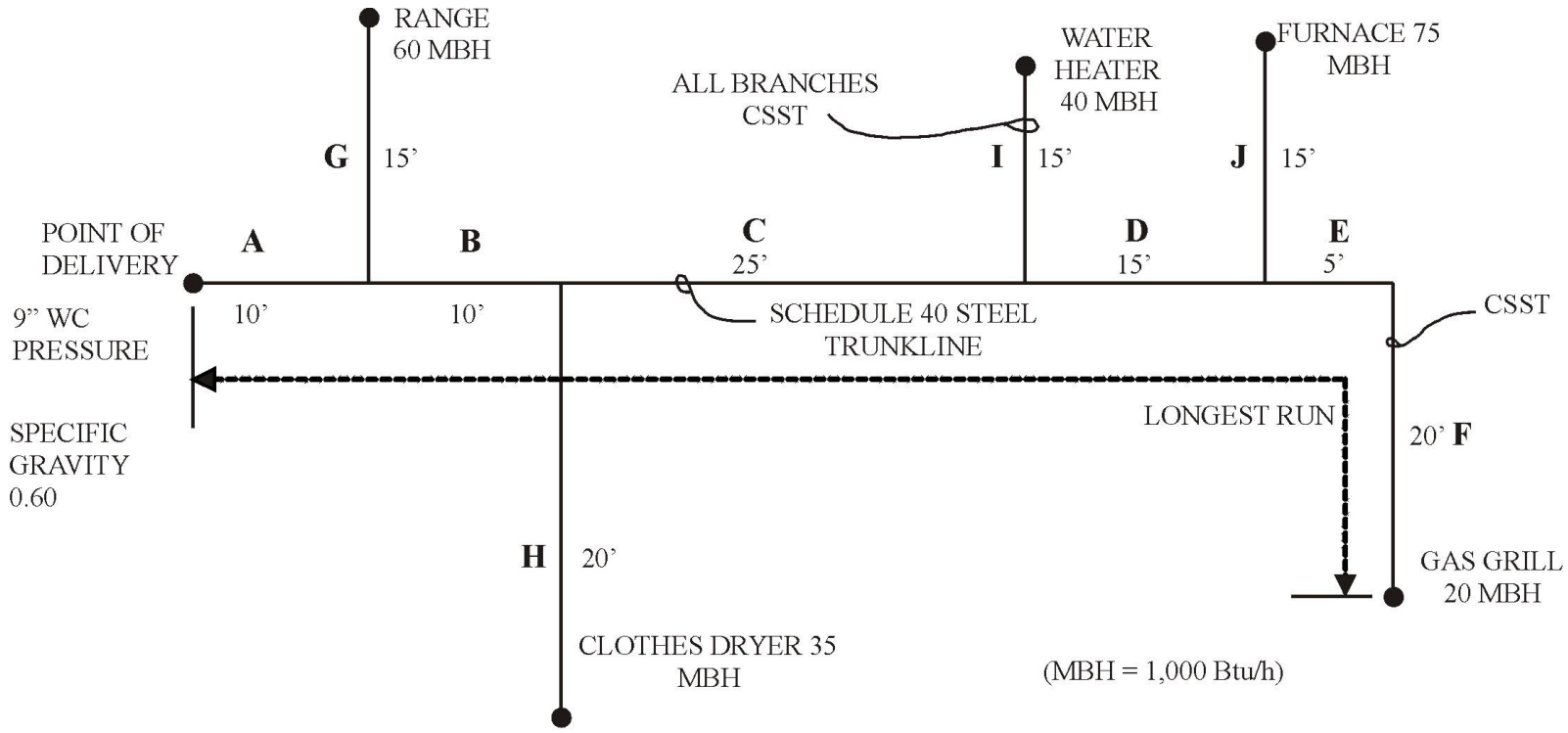
- Locate nominal size of pipe required:
  - Outlet A: 20 ft^3/h (from Step 1) requires 1/2-inch pipe
  - Outlet B: 45 ft^3/h requires 1/2-inch pipe
  - Pipe section 2: supplying A 20 $^{ft3/h}$ requires 1/2-inch pipe
  - Pipe section 3: supplying A, B 65 ft^3/h requires 3/4-inch pipe

Gas System Sizing Problem

5. Locate nominal size of pipe required:
   - Outlet C:
     - 73 ft^3/h requires 3/4 inch pipe
   - Outlet D:
     - 133 ft^3/h requires 1 inch pipe
   - Pipe Section 4 (A,B,C):
     - 138 ft^3/h requires 1 inch pipe
   - Pipe Section 5 (A,B,C,D):
     - 271 ft^3/h requires 1 ¼ inch pipe

Branch Length Method

- Determine the size of gas piping sections



For SI:1 inch = 25.4 mm, 1 foot = 304.8 mm, 1 MBH = 1,000 Btu/h.

Branch Length Method

The following information in Table I will be used to determine the size of the gas piping for the trunkline.

Table I

Specific gravity of gas	0.60
Inlet pressure	0.5 psi (3.4 kPa) or less
Pressure drop	0.5 inch wc (125 Pa)
Trunkline pipe material	Schedule 40 steel
Designed operating pressure of system	The system is designed to operate at 9 inches wc (2250 Pa) [less than 0.5 psig (3.4 kPa)]
Piping run—longest run	A to F = 85 feet (25 908 mm)
Appliance Load	
• Range	• 60 MBH
• Clothes dryer	• 35 MBH
• Water heater	• 40 MBH
• Furnace	• 75 MBH
• Gas grill	• 20 MBH
• Total load	• 230 MBH

For SI: (MBH = 1,000 Btu/h).

Branch Length Method

- Determine the size of trunkline sections
  - Determine load for each section of pipe
    - A = 230 MBH
    - B = 170 MBH
    - C = 135 MBH
    - D = 95 MBH
    - E = 20 MBH
  - Determine the table to use
    - Because longest run length of pipe is between rows, use next higher row. = 402.4(2)

Branch Length Method

- Determine the size of trunk line sections
  - Determine size for each section of pipe
    - A = 1 ¼ inch
    - B = 1 inch
    - C = 1 inch
    - D = ¾ inch
    - E = 3/8 inch

Branch Length Method

- We now have the following information about the proposed piping system:
  - The specific gravity of the gas is 0.6.
  - The gas pressure is 0.5 psi (3.4 kPa) or less.
  - The pressure drop is 0.5 inch (125 Pa) wc.
  - The material is Schedule 40 steel.
  - The longest run length is 85 feet (25 908 mm).

Branch Length Method

- We determine that the table to use to determine the size of each pipe section is Table 402.4(2). This table lists the maximum capacity of pipe:
  - In cubic feet of gas per hour (m^3/h).
  - For gas pressures of 0.5 psi (3.4 kPa) or less.
  - With a pressure drop of 0.5 inch (125 Pa) wc.
  - Based on a 0.6 specific gravity.
- Because the longest run length of pipe is between rows in the table, the 90-foot (27 432 mm) rows must be chosen.

TABLE 402.4(2)
SCHEDULE 40 METALLIC PIPE

Gas	Natural
Inlet Pressure	Less than 2 psi
Pressure Drop	0.5 in. w.c.
Specific Gravity	0.60

PIPE SIZE (Inch)														
Nominal	1/2	3/4	1	1 1/4	1 1/2	2	2 1/2	3	4	5	6	8	10	12
Actual ID	**0.622**	**0.824**	**1.049**	**1.380**	**1.610**	**2.067**	**2.469**	**3.068**	**4.026**	**5.047**	**6.065**	**7.981**	**10.020**	**11.938**
Length (ft)	**Capacity in Cubic Feet of Gas Per Hour**													
10	172	360	678	1,390	2,090	4,020	6,400	11,300	23,100	41,800	67,600	139,000	252,000	399,000
20	118	247	466	957	1,430	2,760	4,400	7,780	15,900	28,700	46,500	95,500	173,000	275,000
30	95	199	374	768	1,150	2,220	3,530	6,250	12,700	23,000	37,300	76,700	139,000	220,000
40	81	170	320	657	985	1,900	3,020	5,350	10,900	19,700	31,900	65,600	119,000	189,000
50	72	151	284	583	873	1,680	2,680	4,740	9,660	17,500	28,300	58,200	106,000	167,000
60	65	137	257	528	791	1,520	2,430	4,290	8,760	15,800	25,600	52,700	95,700	152,000
70	60	126	237	486	728	1,400	2,230	3,950	8,050	14,600	23,600	48,500	88,100	139,000
80	56	117	220	452	677	1,300	2,080	3,670	7,490	13,600	22,000	45,100	81,900	130,000
90	52	110	207	424	635	1,220	1,950	3,450	7,030	12,700	20,600	42,300	76,900	122,000
100	50	104	195	400	600	1,160	1,840	3,260	6,640	12,000	19,500	40,000	72,600	115,000
125	44	92	173	355	532	1,020	1,630	2,890	5,890	10,600	17,200	35,400	64,300	102,000
150	40	83	157	322	482	928	1,480	2,610	5,330	9,650	15,600	32,100	58,300	92,300
175	37	77	144	296	443	854	1,360	2,410	4,910	8,880	14,400	29,500	53,600	84,900
200	34	71	134	275	412	794	1,270	2,240	4,560	8,260	13,400	27,500	49,900	79,000
250	30	63	119	244	366	704	1,120	1,980	4,050	7,320	11,900	24,300	44,200	70,000
300	27	57	108	221	331	638	1,020	1,800	3,670	6,630	10,700	22,100	40,100	63,400
350	25	53	99	203	305	587	935	1,650	3,370	6,100	9,880	20,300	36,900	58,400
400	23	49	92	189	283	546	870	1,540	3,140	5,680	9,190	18,900	34,300	54,300
450	22	46	86	177	266	512	816	1,440	2,940	5,330	8,620	17,700	32,200	50,900
500	21	43	82	168	251	484	771	1,360	2,780	5,030	8,150	16,700	30,400	48,100
550	20	41	78	159	239	459	732	1,290	2,640	4,780	7,740	15,900	28,900	45,700
600	19	39	74	152	228	438	699	1,240	2,520	4,560	7,380	15,200	27,500	43,600
650	18	38	71	145	218	420	669	1,180	2,410	4,360	7,070	14,500	26,400	41,800
700	17	36	68	140	209	403	643	1,140	2,320	4,190	6,790	14,000	25,300	40,100
750	17	35	66	135	202	389	619	1,090	2,230	4,040	6,540	13,400	24,400	38,600
800	16	34	63	130	195	375	598	1,060	2,160	3,900	6,320	13,000	23,600	37,300
850	16	33	61	126	189	363	579	1,020	2,090	3,780	6,110	12,600	22,800	36,100
900	15	32	59	122	183	352	561	992	2,020	3,660	5,930	12,200	22,100	35,000
950	15	31	58	118	178	342	545	963	1,960	3,550	5,760	11,800	21,500	34,000
1,000	14	30	56	115	173	333	530	937	1,910	3,460	5,600	11,500	20,900	33,100
1,100	14	28	53	109	164	316	503	890	1,810	3,280	5,320	10,900	19,800	31,400
1,200	13	27	51	104	156	301	480	849	1,730	3,130	5,070	10,400	18,900	30,000
1,300	12	26	49	100	150	289	460	813	1,660	3,000	4,860	9,980	18,100	28,700
1,400	12	25	47	96	144	277	442	781	1,590	2,880	4,670	9,590	17,400	27,600
1,500	11	24	45	93	139	267	426	752	1,530	2,780	4,500	9,240	16,800	26,600
1,600	11	23	44	89	134	258	411	727	1,480	2,680	4,340	8,920	16,200	25,600
1,700	11	22	42	86	130	250	398	703	1,430	2,590	4,200	8,630	15,700	24,800
1,800	10	22	41	84	126	242	386	682	1,390	2,520	4,070	8,370	15,200	24,100
1,900	10	21	40	81	122	235	375	662	1,350	2,440	3,960	8,130	14,800	23,400
2,000	NA	20	39	79	119	229	364	644	1,310	2,380	3,850	7,910	14,400	22,700

For SI: 1 inch = 25.4 mm, 1 foot = 304.8 mm, 1 pound per square inch = 6.895 kPa, 1-inch water column = 0.2488 kPa, 1 British thermal unit per hour = 0.2931 W, 1 cubic foot per hour = 0.0283 m^3/h, 1 degree = 0.01745 rad.

Notes:

1. NA means a flow of less than 10 cfh.
2. All table entries have been rounded to three significant digits.

Branch Length Method

PIPE SECTION	LOAD (MBH)	SIZE (inches)
A	230 = (60 + 35 + 40 + 75 + 20)	$1^{1}/_{4}$
B	170 = (35 + 40 + 75 + 20)	1
C	135 = (40 + 75 + 20)	1
D	95 = (75 + 20)	$^{3}/_{4}$
E	20	$^{3}/_{8}$

For SI: 1 inch = 25.4 mm, MBH = 1,000 Btu/h.

Branch Length Method

Table II

Specific gravity of gas	0.60
Inlet pressure	0.5 psi (3.4 kPa) or less
Pressure drop	0.5 inch (125 Pa) wc
Branch piping material	CSST
Designed operating pressure of system	The system is designed to operate at 9 inches (229 mm) wc [less than 0.5 psig (3.4 kPa)]
Piping run—longest run	A to F = 85 feet (25 908 mm)
Appliance load	
• Range	• 60 MBH
• Clothes dryer	• 35 MBH
• Water heater	• 40 MBH
• Furnace	• 75 MBH
• Gas grill	• 20 MBH
• Total load	• 230 MBH

For SI: 1 MBH = 1000 Btu/h).

Branch Length Method

- Determine the load for the following branch sections

  - Section F: 20 ft^3/h
  - Section G: 60 ft^3/h
  - Section H: 35 ft^3/h
  - Section I: 40 ft^3/h
  - Section J: 75 ft^3/h

Branch Length Method

- Determine the length for each branch
  - Section F: 85 ft.
  - Section G: 25 ft.
  - Section H: 40 ft.
  - Section I: 60 ft.
  - Section J: 75 ft.
- Determine the table to use
  - Table 402.4(13)

Branch Length Method

PIPE SECTION	LOAD (MBH)	SIZE (inches)	PIPE SECTION	LENGTH OF PIPING AND TUBING (feet)	LOAD (MBH)	SIZE (inches)
A	230	$1^1/_4$	F			
B	170	1	G			
C	135	1	H			
D	95	$^3/_4$	I			
E	20	$^1/_2$	J			

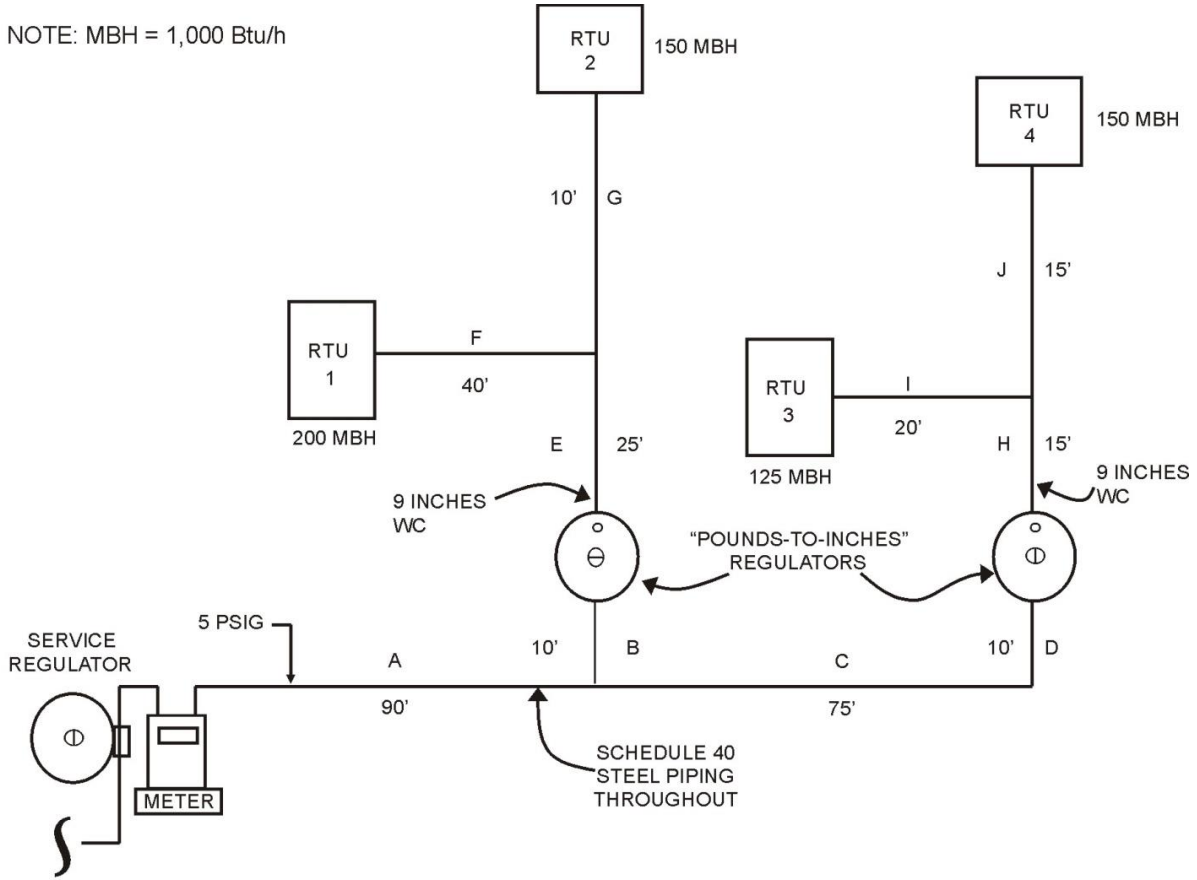
For SI: 1 inch = 25.4 mm, 1 MBH = 1,000 BTU/h, 1 foot = 304.8 mm.

Branch Length Method

- Determine the size for each section of gas pipe.

Pipe Section	Length (ft.)	Load (MBH)	Size
A	85	20	18
B	25	60	19
C	40	35	18
D	60	40	23
E	75	75	30

Hybrid Pressure System Sizing – 402.4.3



For SI: 1 inch = 25.4 mm, 1 foot = 304.8, 1 MBH = 1,000 Btu/h.

Hybrid Pressure System Sizing – 402.4.3

- Using IFGC Table 402.4(7), determine the minimum required size of piping Sections A through D. The longest run of piping from the point of delivery to the most remote regulator is 175 feet (53 340 mm).

Hybrid Pressure System Sizing – 402.4.3

- Section A serves a load of 625 MBH, and in the 175-foot row of the table, 1/2-inch pipe is shown to have a capacity of 728 ft^3/h or 728,000 Btu/h (20.6 m^3/hr or 213,356 W) for gas with a heating value of 1,000 Btu/ft^3 (37.5 MJ/m^3).
- Since Sections B, C and D all serve lesser loads than Section A, they too can be 1/2 inch in size.
- Because Table 402.4(7) is based upon a pressure drop of 3.5 psi, the available pressure at the inlets of the “pounds-to-inches” regulators under full load condition will be a minimum of 1.5 psig .

TABLE 402.4(7)
SCHEDULE 40 METALLIC PIPE

Gas	Natural
Inlet Pressure	5.0 psi
Pressure Drop	3.5 psi
Specific Gravity	0.60

PIPE SIZE (inch)									
Nominal	1/2	3/4	1	1 1/4	1 1/2	2	2 1/2	3	4
Actual ID	**0.622**	**0.824**	**1.049**	**1.380**	**1.610**	**2.067**	**2.469**	**3.068**	**4.026**
Length (ft)	**Capacity in Cubic Feet of Gas Per Hour**								
10	3,190	6,430	11,800	24,200	36,200	69,700	111,000	196,000	401,000
20	2,250	4,550	8,320	17,100	25,600	49,300	78,600	139,000	283,000
30	1,840	3,720	6,790	14,000	20,900	40,300	64,200	113,000	231,000
40	1,590	3,220	5,880	12,100	18,100	34,900	55,600	98,200	200,000
50	1,430	2,880	5,260	10,800	16,200	31,200	49,700	87,900	179,000
60	1,300	2,630	4,800	9,860	14,800	28,500	45,400	80,200	164,000
70	1,200	2,430	4,450	9,130	13,700	26,400	42,000	74,300	151,000
80	1,150	2,330	4,260	8,540	12,800	24,700	39,300	69,500	142,000
90	1,060	2,150	3,920	8,050	12,100	23,200	37,000	65,500	134,000
100	979	1,980	3,620	7,430	11,100	21,400	34,200	60,400	123,000
125	876	1,770	3,240	6,640	9,950	19,200	30,600	54,000	110,000
150	786	1,590	2,910	5,960	8,940	17,200	27,400	48,500	98,900
175	728	1,470	2,690	5,520	8,270	15,900	25,400	44,900	91,600
200	673	1,360	2,490	5,100	7,650	14,700	23,500	41,500	84,700
250	558	1,170	2,200	4,510	6,760	13,000	20,800	36,700	74,900
300	506	1,060	1,990	4,090	6,130	11,800	18,800	33,300	67,800
350	465	973	1,830	3,760	5,640	10,900	17,300	30,600	62,400
400	433	905	1,710	3,500	5,250	10,100	16,100	28,500	58,100
450	406	849	1,600	3,290	4,920	9,480	15,100	26,700	54,500
500	384	802	1,510	3,100	4,650	8,950	14,300	25,200	51,500
550	364	762	1,440	2,950	4,420	8,500	13,600	24,000	48,900
600	348	727	1,370	2,810	4,210	8,110	12,900	22,900	46,600
650	333	696	1,310	2,690	4,030	7,770	12,400	21,900	44,600
700	320	669	1,260	2,590	3,880	7,460	11,900	21,000	42,900
750	308	644	1,210	2,490	3,730	7,190	11,500	20,300	41,300
800	298	622	1,170	2,410	3,610	6,940	11,100	19,600	39,900
850	288	602	1,130	2,330	3,490	6,720	10,700	18,900	38,600
900	279	584	1,100	2,260	3,380	6,520	10,400	18,400	37,400
950	271	567	1,070	2,190	3,290	6,330	10,100	17,800	36,400
1,000	264	551	1,040	2,130	3,200	6,150	9,810	17,300	35,400
1,100	250	524	987	2,030	3,030	5,840	9,320	16,500	33,600
1,200	239	500	941	1,930	2,900	5,580	8,890	15,700	32,000
1,300	229	478	901	1,850	2,770	5,340	8,510	15,000	30,700
1,400	220	460	866	1,780	2,660	5,130	8,180	14,500	29,500
1,500	212	443	834	1,710	2,570	4,940	7,880	13,900	28,400
1,600	205	428	806	1,650	2,480	4,770	7,610	13,400	27,400
1,700	198	414	780	1,600	2,400	4,620	7,360	13,000	26,500
1,800	192	401	756	1,550	2,330	4,480	7,140	12,600	25,700
1,900	186	390	734	1,510	2,260	4,350	6,930	12,300	25,000
2,000	181	379	714	1,470	2,200	4,230	6,740	11,900	24,300

For SI: 1 inch = 25.4 mm, 1 foot = 304.8 mm, 1 pound per square inch = 6.895 kPa, 1-inch water column = 0.2488 kPa,
1 British thermal unit per hour = 0.2931 W, 1 cubic foot per hour = 0.0283 m^3/h, 1 degree = 0.01745 rad.

Note: All table entries have been rounded to three significant digits.

Hybrid Pressure System Sizing – 402.4.3

- A. Load: 625,000 Btu Size: 1/2"
- B. Load: 350,000 Btu Size: 1/2"
- C. Load: 275,000 Btu Size: 1/2"
- D. Load: 275,000 Btu Size: 1/2"

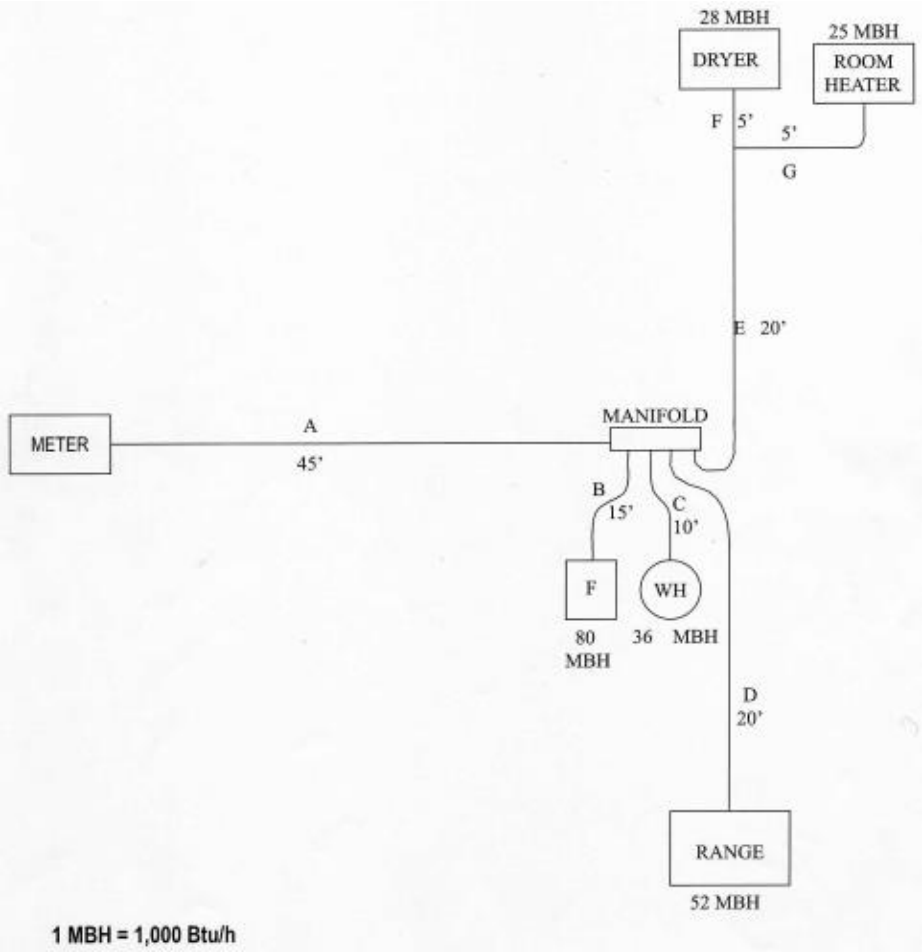
Hybrid Pressure System Sizing – 402.4.3

- Determine size of piping for Sections E, F and G.
- Table 402.4(2) and the longest length of piping from the regulator to the most remote outlet is used to determine the size of piping for Sections E, F and G. In this case, Rooftop Unit 1 is the most remote at 65 feet (40 feet + 2.5 feet) from the regulator. The minimum required size for each section is:
- E. Load: 350,000 Btu Size: 11/4"
- F. Load: 200,000 Btu Size: 1"
- G.Load: 150,000 Btu Size: 1"

Hybrid Pressure System Sizing – 402.4.3

- Determine the size of piping for Sections H, I and J in the same manner previously described in Item 2.
- The most remote point is 35 feet (20 feet + 15 feet).
- H.Load: 275,000 Btu Size: 1"
- I. Load: 125,000 Btu Size: 3/4"
- J. Load: 150,000 Btu Size: 3/4"

Parallel System – 6” WC



Parallel System – 6” WC

- Piping arranged in parallel.
- Main section and individual appliance runs constructed of CSST (2015 IFGC Table 402.4(15).
- Supply pressure is 6 inches (152 kPa) wc downstream of the meter.
- Natural gas with specific gravity of 0.60.
- Chosen pressure drop 0.5 inch (125 Pa) wc.
- Minimum appliance supply pressure requirements is 5 inches (1.25 kPa) wc.
- Heating value of gas is 1,000 Btu/ft^3.

Parallel System – 6” WC

SECTION	LOAD (CFH) (ft^3/h)	SECTION LENGTH	SECTION LENGTH USED WITH TABLE (feet)	REQUIRED SIZE
A	221	45	70	
B	80	15	60	
C	36	10	55	
D	52	20	65	
E	53	20	70	
F	28	5	70	
G	25	5	70	

For SI: 1 foot = 304.8 mm, 1 cubic foot per hour = 0.0283 m^3/h.

Parallel System – 6” WC

- Sizing Section A:
- Size Section A based on the appliance total load and length from the meter to the furthest appliance.
- Total load = 80 + 36 + 52 + 28 + 25 = 221 ft3/h (6.25 m^3/hr).
- Section length = 45 + 20 + 5 = 70 feet (21 336 mm).
- Use Table 402.4(15).

Parallel System – 6” WC

- Sizing Section B:
- Size Section B based on the appliance total load and length from the meter to the appliance.
- Total load = 80 ft^3/h (2.26 m^3/hr).
- Section length (furnace) = 45 + 15 = 60 feet (18 288 mm).
- Use Table 402.4(15).

Parallel System – 6” WC

- Sizing Section C:
- Size Section C based on the appliance total load and length from the meter to the appliance.
- Total load = 36 ft^3/h (1.02 m^3/hr).
- Section length (water heater) = 45 + 10 = 55 feet (16 764 mm).
- Use Table 402.4(15).

Parallel System – 6” WC

- Sizing Section D:
- Size Section D based on the appliance total load and length from the meter to the appliance.
- Total load = 52 ft3/h (1.47 $^{m3/hr}$).
- Section length (range) = 45 + 20 = 65 feet (19 812 mm).
- Use Table 402.4(15).

Parallel System – 6” WC

- Sizing Section E:
- Size Section E based on the appliance total load and length from the meter to the furthest appliance.
- Total load = 25 + 28 = 53 ft^3/h (1.50 m3/hr).
- Section length (dryer/room heater) = 45 + 20 + 5 = 70 feet (21 336 mm).
- Use Table 402.4(15).

Parallel System – 6” WC

- Sizing Section F:
- Size Section F based on the appliance total load and length from the meter to the furthest appliance.
- Total load = 28 ft^3/h (0.71 m3/hr)..
- Section length (dryer) = 45 + 20 + 5 = 70 feet (21 336 mm).
- Use Table 402.4(15).

Parallel System – 6” WC

- Sizing Section G:
- Size Section G based on the appliance total load and length from the meter to the furthest appliance.
- Total load (room heater) = 25 ft3/h (0.71 m3/hr).
- Section length = 45 + 20 + 5 = 70 feet (21 336 mm).
- Use Table 402.4(15).

Parallel System – 6” WC

TABLE 402.4(15)
CORRUGATED STAINLESS STEEL TUBING (CSST)

Gas	Natural
Inlet Pressure	Less than 2 psi
Pressure Drop	0.5 in. w.c.
Specific Gravity	0.60

	TUBE SIZE (EHD)													
Flow Designation	**13**	**15**	**18**	**19**	**23**	**25**	**30**	**31**	**37**	**39**	**46**	**48**	**60**	**62**
Length (ft)	**Capacity in Cubic Feet of Gas Per Hour**													
5	46	63	115	134	225	270	471	546	895	1,037	1,790	2,070	3,660	4,140
10	32	44	82	95	161	192	330	383	639	746	1,260	1,470	2,600	2,930
15	25	35	66	77	132	157	267	310	524	615	1,030	1,200	2,140	2,400
20	22	31	58	67	116	137	231	269	456	536	888	1,050	1,850	2,080
25	19	27	52	60	104	122	206	240	409	482	793	936	1,660	1,860
30	18	25	47	55	96	112	188	218	374	442	723	856	1,520	1,700
40	15	21	41	47	83	97	162	188	325	386	625	742	1,320	1,470
50	13	19	37	42	75	87	144	168	292	347	559	665	1,180	1,320
60	12	17	34	38	68	80	131	153	267	318	509	608	1,080	1,200
70	11	16	31	36	63	74	121	141	248	295	471	563	1,000	1,110
80	10	15	29	33	60	69	113	132	232	277	440	527	940	1,040
90	10	14	28	32	57	65	107	125	219	262	415	498	887	983
100	9	13	26	30	54	62	101	118	208	249	393	472	843	933
150	7	10	20	23	42	48	78	91	171	205	320	387	691	762
200	6	9	18	21	38	44	71	82	148	179	277	336	600	661
250	5	8	16	19	34	39	63	74	133	161	247	301	538	591
300	5	7	15	17	32	36	57	67	95	148	226	275	492	540

For SI: 1 inch = 25.4 mm, 1 foot = 304.8 mm, 1 pound per square inch = 6.895 kPa, 1-inch water column = 0.2488 kPa, 1 British thermal unit per hour = 0.2931 W, 1 cubic foot per hour = 0.0283 m^3/h, 1 degree = 0.01745 rad.

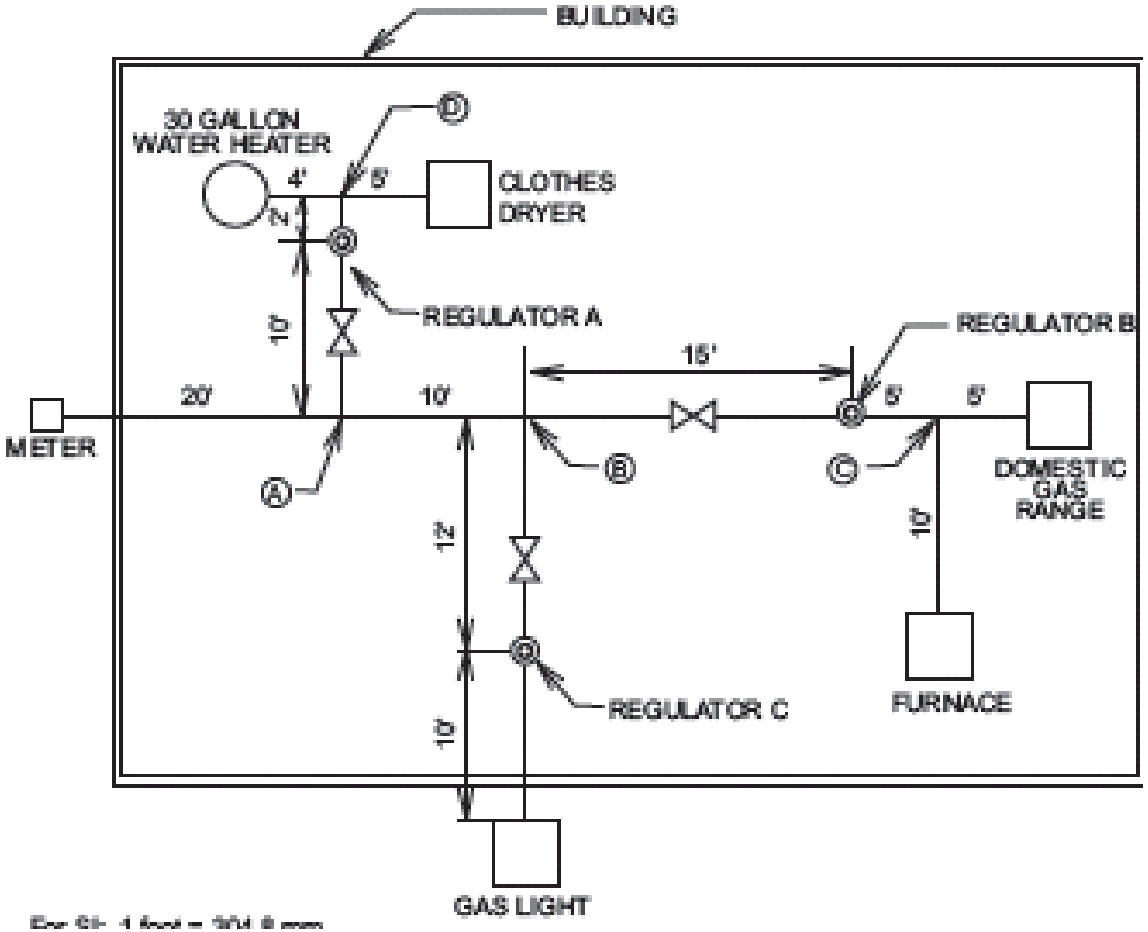
Notes:

1. Table includes losses for four 90-degree bends and two end fittings. Tubing runs with larger numbers of bends or fittings shall be increased by an equivalent length of tubing to the following equation: $L = 1.3n$, where L is additional length (feet) of tubing and n is the number of additional fittings or bends.
2. EHD—Equivalent Hydraulic Diameter, which is a measure of the relative hydraulic efficiency between different tubing sizes. The greater the value of EHD, the greater the gas capacity of the tubing.
3. All table entries have been rounded to three significant digits.

Parallel System – 6” WC

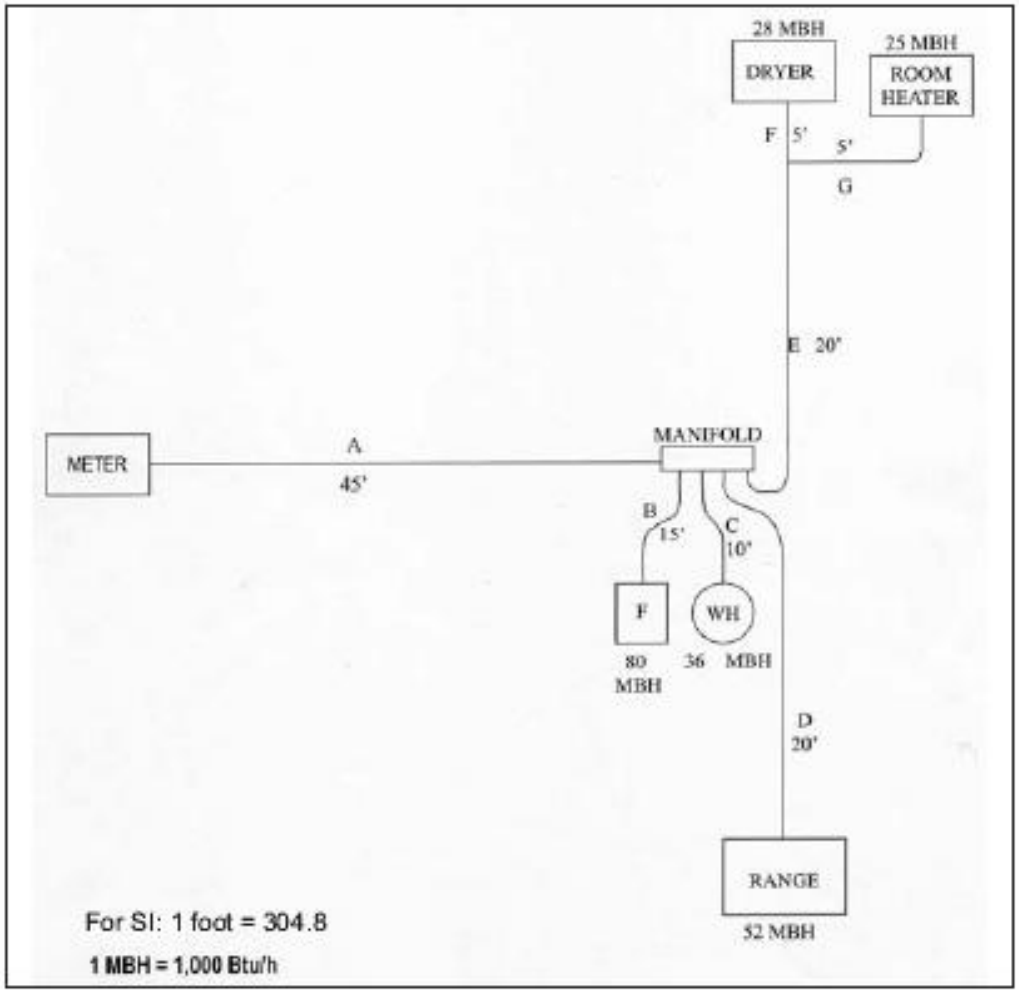
- Required Size (CSST)
  - A 37
  - B 25
  - C 19
  - D 23
  - E 23
  - F 18
  - G 18

MP Regulator



For SI: 1 foot = 304.8 mm, 1 gallon = 3.785 L.

Medium Pressure System



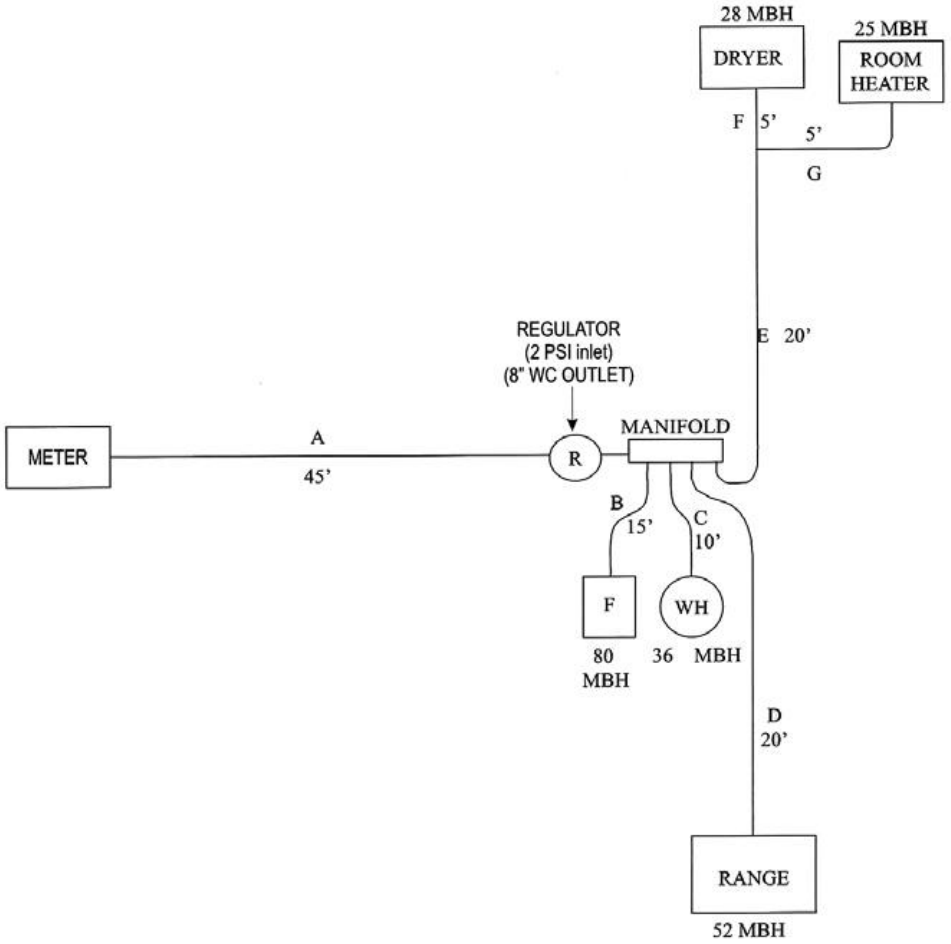
2 psi (14 kPa) Appliance Branch Runs

- All piping is CSST. Each brand or manufacturer has it's equivalent hydraulic diameter (EHD) rating to determine pipe size. We must know the manufacturer to determine EHD.
- Piping branches run parallel.
- Individual CSST appliance branch runs supplied by manifold.
- Supply pressure is 2 psi (14 kPa) downstream of the meter.
- Chosen pressure drop is 1 psi (6.8 kPa) for Section A [Table 402.4(18)].

2 psi (14 kPa) Appliance Branch Runs

- Natural gas with specific gravity of 0.60.
- Heating value of gas is 1,000 Btu/ft3.
- Supply pressure at manifold is 8 inches wc (2.0 kPa).
- Chosen pressure drop is 3 inches wc (0.75 kPa) for Sections B through G [Table 402.4(16)].
- Appliances need 5 inches wc (1.25 kPa) minimum supply pressure.
- Pressure drop across regulator is less than 1/2 psi (3.4 kPa) at full load of this system.

2 psi (14 kPa) Appliance Branch Runs



1 MBH = 1,000 Btu/h

2 psi (14 kPa) Appliance Branch Runs

SECTION	LOAD (ft^3/h)	ACTUAL SECTION LENGTH (INCLUDING EQUIVALENT LENGTH OF FITTINGS AND BENDS) (feet)	SECTION LENGTH USED WITH TABLE (feet)	REQUIRED SIZE (CSST)
A	221	45	45*	
B	80	15	15**	
C	36	10	10**	
D	52	20	20**	
E	53	20	25**	
F	28	5	25**	
G	25	5	25**	

For SI: 1 foot = 304.8 mm, 1 cubic foot per hour = 0.0283 m^3/h..

* Distance from meter to regulator is the run length for the main section.

** Distance from regulator to each appliance is the run length for appliance branch run sections.

Medium Pressure System

- Required Size (CSST)
  - A 18
  - B 15
  - C 13
  - D 13
  - E 15
  - F 13
  - G 13

2 psi (14 kPa) Appliance Branch Runs

- Sizing Section A:
- Size Section A based on the total load and length from the meter to the regulator.
- Total load = 80 + 36 + 52 + 28 + 25 = 221 ft3/h (6.25 m3/hr).
- Section length = 45 feet (13 716 mm).
- Use Table 402.4(18).

2 psi (14 kPa) Appliance Branch Runs

- Sizing Section B:
- Size Section B based on the appliance load and length from the regulator to the appliance.
- Appliance load = 80 ft3/h (2.26 m3/hr).
- Section length (furnace) = 15 feet (4568 mm).
- Use Table 402.4(16).

2 psi (14 kPa) Appliance Branch Runs

- Sizing Section C:
- Size Section C based on the appliance load and length from the regulator to the appliance.
- Total load = 36 ft3/h (1.02 m3/hr).
- Section length (water heater) = 10 feet (3048 mm).
- Use Table 402.4(16).

2 psi (14 kPa) Appliance Branch Runs

- Sizing Section D:
- Size Section D based on the appliance load and length from the regulator to the appliance.
- Total load = 52 ft3/h (1.47 m3/hr).
- Section length (range) = 20 feet (6096 mm).
- Use Table 402.4(16).

2 psi (14 kPa) Appliance Branch Runs

- Sizing Section E:
- Size Section E based on the appliance total load and length from the regulator to the furthest appliance.
- Total load = 25 + 28 = 53 ft3/h (1.50 m3/hr).
- Section length (dryer/room heater) = 20 + 5 = 25 feet (7620 mm).
- Use Table 402.4(16).

2 psi (14 kPa) Appliance Branch Runs

- Sizing Section F:
- Size Section F based on the appliance total load and length from the regulator to the furthest appliance.
- Total load (dryer) = 28 ft3/h (0.79 m3/hr).
- Section length = 20 + 5 = 25 feet (7620 mm).
- Use Table 402.4(16).

2 psi (14 kPa) Appliance Branch Runs

- Sizing Section G:
- Size Section G based on appliance total load and length from regulator to furthest appliance.
- Total load (room heater) = 25 ft3/h (0.71 m3/hr).
- Section length = 20 + 5 = 25 feet (7620 mm).
- Use Table 402.4(16).

2 psi (14 kPa) Appliance Branch Runs

Gas	Natural
Inlet Pressure	2 psi
Pressure Drop	1.0 psi
Specific Gravity	0.60

TABLE 402.4(18)
CORRUGATED STAINLESS STEEL TUBING (CSST)

	TUBE SIZE (EHD)													
Flow Designation	13	15	18	19	23	25	30	31	37	39	46	48	60	62
Length (ft)	Capacity in Cubic Feet of Gas Per Hour													
10	270	353	587	700	1,100	1,370	2,590	2,990	4,510	5,037	9,600	10,700	18,600	21,600
25	166	220	374	444	709	876	1,620	1,870	2,890	3,258	6,040	6,780	11,900	13,700
30	151	200	342	405	650	801	1,480	1,700	2,640	2,987	5,510	6,200	10,900	12,500
40	129	172	297	351	567	696	1,270	1,470	2,300	2,605	4,760	5,380	9,440	10,900
50	115	154	266	314	510	624	1,140	1,310	2,060	2,343	4,260	4,820	8,470	9,720
75	93	124	218	257	420	512	922	1,070	1,690	1,932	3,470	3,950	6,940	7,940
80	89	120	211	249	407	496	892	1,030	1,640	1,874	3,360	3,820	6,730	7,690
100	79	107	189	222	366	445	795	920	1,470	1,685	3,000	3,420	6,030	6,880
150	64	87	155	182	302	364	646	748	1,210	1,389	2,440	2,800	4,940	5,620
200	55	75	135	157	263	317	557	645	1,050	1,212	2,110	2,430	4,290	4,870
250	49	67	121	141	236	284	497	576	941	1,090	1,890	2,180	3,850	4,360
300	44	61	110	129	217	260	453	525	862	999	1,720	1,990	3,520	3,980
400	38	52	96	111	189	225	390	453	749	871	1,490	1,730	3,060	3,450
500	34	46	86	100	170	202	348	404	552	783	1,330	1,550	2,740	3,090

For SI: 1 inch = 25.4 mm, 1 foot = 304.8 mm, 1 pound per square inch = 6.895 kPa, 1-inch water column = 0.2488 kPa, 1 British thermal unit per hour = 0.2931 W, 1 cubic foot per hour = 0.0283 m^3/h, 1 degree = 0.01745 rad.

Notes:

1. Table does not include effect of pressure drop across the line regulator. Where regulator loss exceeds $^3/_4$ psi, DO NOT USE THIS TABLE. Consult with the regulator manufacturer for pressure drops and capacity factors. Pressure drops across a regulator may vary with flow rate.
2. CAUTION: Capacities shown in the table might exceed maximum capacity for a selected regulator. Consult with the regulator or tubing manufacturer for guidance.
3. Table includes losses for four 90-degree bends and two end fittings. Tubing runs with larger numbers of bends or fittings shall be increased by an equivalent length of tubing to the following equation: $L = 1.3n$ where L is additional length (feet) of tubing and n is the number of additional fittings or bends.
4. EHD—Equivalent Hydraulic Diameter, which is a measure of the relative hydraulic efficiency between different tubing sizes. The greater the value of EHD, the greater the gas capacity of the tubing.
5. All table entries have been rounded to three significant digits.

2 psi (14 kPa) Appliance Branch Runs

Gas	Natural
Inlet Pressure	Less than 2 psi
Pressure Drop	3.0 in. w.c.
Specific Gravity	0.60

TABLE 402.4(16)
CORRUGATED STAINLESS STEEL TUBING (CSST)

INTENDED USE: Initial supply pressure of 8.0 inches w.c. or greater													
	TUBE SIZE (EHD)												
Flow Designation	13	15	18	19	23	25	30	31	37	46	48	60	62
Length (ft)	Capacity in Cubic Feet of Gas Per Hour												
5	120	160	277	327	529	649	1,180	1,370	2,140	4,430	5,010	8,800	10,100
10	83	112	197	231	380	462	828	958	1,530	3,200	3,560	6,270	7,160
15	67	90	161	189	313	379	673	778	1,250	2,540	2,910	5,140	5,850
20	57	78	140	164	273	329	580	672	1,090	2,200	2,530	4,460	5,070
25	51	69	125	147	245	295	518	599	978	1,960	2,270	4,000	4,540
30	46	63	115	134	225	270	471	546	895	1,790	2,070	3,660	4,140
40	39	54	100	116	196	234	407	471	778	1,550	1,800	3,180	3,590
50	35	48	89	104	176	210	363	421	698	1,380	1,610	2,850	3,210
60	32	44	82	95	161	192	330	383	639	1,260	1,470	2,600	2,930
70	29	41	76	88	150	178	306	355	593	1,170	1,360	2,420	2,720
80	27	38	71	82	141	167	285	331	555	1,090	1,280	2,260	2,540
90	26	36	67	77	133	157	268	311	524	1,030	1,200	2,140	2,400
100	24	34	63	73	126	149	254	295	498	974	1,140	2,030	2,280
150	19	27	52	60	104	122	206	240	409	793	936	1,660	1,860
200	17	23	45	52	91	106	178	207	355	686	812	1,440	1,610
250	15	21	40	46	82	95	159	184	319	613	728	1,290	1,440
300	13	19	37	42	75	87	144	168	234	559	665	1,180	1,320

For SI: 1 inch = 25.4 mm, 1 foot = 304.8 mm, 1 pound per square inch = 6.895 kPa, 1-inch water column = 0.2488 kPa, 1 British thermal unit per hour = 0.2931 W, 1 cubic foot per hour = 0.0283 m^3/h, 1 degree = 0.01745 rad.

Notes:

1. Table includes losses for four 90-degree bends and two end fittings. Tubing runs with larger numbers of bends or fittings shall be increased by an equivalent length of tubing to the following equation: $L = 1.3n$ where L is additional length (feet) of tubing and n is the number of additional fittings or bends.
2. EHD—Equivalent Hydraulic Diameter, which is a measure of the relative hydraulic efficiency between different tubing sizes. The greater the value of EHD, the greater the gas capacity of the tubing.
3. All table entries have been rounded to three significant digits.

Branch Length Method

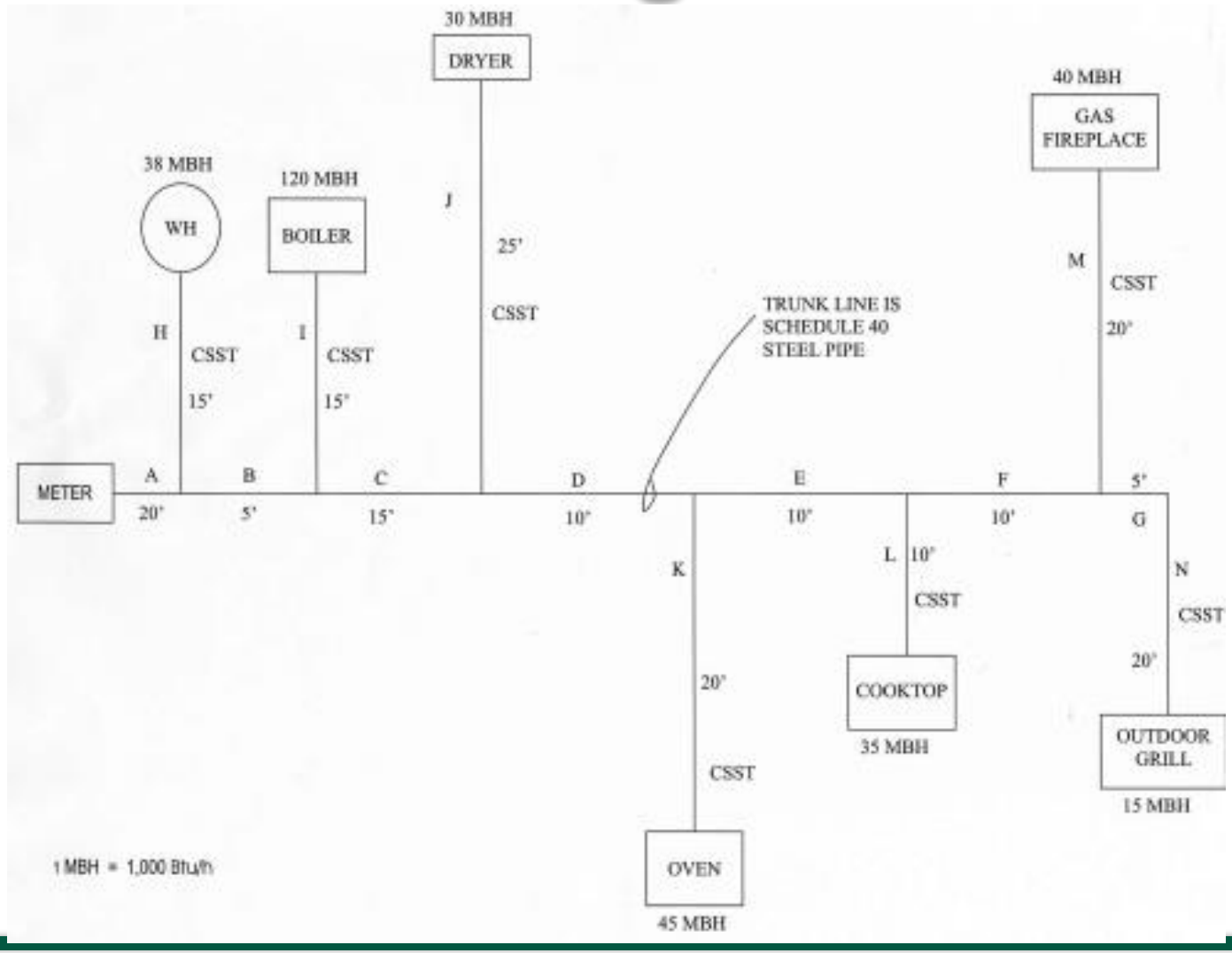
- Pipe shall be sized as follows:
  1. Pipe size of each section of the longest pipe run from the point of delivery to the most remote outlet shall be determined using the longest run of piping and the load of the section.
  2. Pipe size of each section of branch piping not previously sized shall be determined using the length of piping from the point of delivery to the most remote outlet in each branch and the load of the section. 2.25 kPa) wc.

Branch Length Method

- Given:
- Natural gas.
- Specific gravity 0.60.
- Pressure drop 0.5 inches (0.75 kPa) wc for steel pipe and 3 inches (76 mm) wc for CSST.
- Supply pressure 9 inches (2.25 kPa) wc.

ACTIVITY

Branch Length Method



Branch Length Method

All gas pipe and tube sizing tables have been replaced with new, recalculated tables most of which include lengths up to 2,000 feet (609 600 mm). New pressure and material application tables have been added.

1. Using Table 402.4(2) on page 36 of the IFGC, size Sections A through G.

SECTION	LOAD (MBH)	MATERIAL	LONGEST RUN LENGTH (feet)	REQUIRED SIZE
A	323	Schedule 40 steel pipe	95	
B	285			
C	165			
D	135			
E	90			
F	55			
G	15			

For SI: 1 foot = 304.8 mm, 1 MBH = 1,000 Btu/h.

Branch Length Method

2. Using Table 402.4(16) on page 50 of the IFGC, size Sections H through N.

SECTION	LOAD (MBH)	MATERIAL	BRANCH LENGTH (feet)	REQUIRED SIZE
H	38	CSST	35	
I	120		40	
J	30		65	
K	45		70	
L	35		70	
M	40		90	
N	15		95	

Branch Length Method

- Required Size 40” Steel Pipe
  - A 1 ¼”
  - B 1 ¼”
  - C 1”
  - D 1”
  - E ¾”
  - F ¾”
  - G 3/8”
- Required Size (CSST)
  - H 13
  - I 23
  - J 15
  - K 18
  - L 15
  - M 18
  - N 13

Piping Materials - 403

Fuel Gas Pipe

MATERIAL	STANDARD (see chapter 8)
Aluminum-alloy pipe and tubing	ASTM B 210; ASTM B 241
Copper or copper-alloy tube seamless (Type K or L)	ASTM B 88
Copper tube seamless (type ACR)	ASTM B 280
Corrugated stainless steel tubing (CSST)	ANSI LC 1/CSA 6.26
Plastic pipe and tubing	ASTM D 2513
Steel and wrought-iron pipe	ASME B36.10; ASME B36.10M; ASTM A 53; ASTM A 106
Steel tubing	ASTM A 254

403.5.2 – Copper and copper alloy tubing

- Copper tubing shall comply with Standard Type K or L of ASTM B 88 or ASTM B 280.
- Copper and copper alloy tubing shall not be used if the gas contains more than an average of 0.3 grains of hydrogen sulfide per 100 standard cubic feet of gas (0.7 milligrams per 100 liters).
- Contact the local natural gas company for number of grains per 100 liters.

403.5.4 – Corrugated stainless steel tubing

- ANSI/LC 1/CSA 6.26 provides material and performance criteria; and installation requirements for CSST gas distribution piping systems.
- Choice of material and design is up to the designer of the system.
- Material can be used as manifold, traditional or parallel.

Piping Material

- Identify any code violations apparent in the installation

403.6 – Plastic pipe and tubing fittings and Section 404.17.1 – Plastic pipe

- The installation of plastic pipe and tubing is limited to areas that are both outside the building and underground because of the potential hazard associated with the use of a material that has lower resistance to physical damage and heat as compared to metallic pipe.

403.9.2 – Number of threads

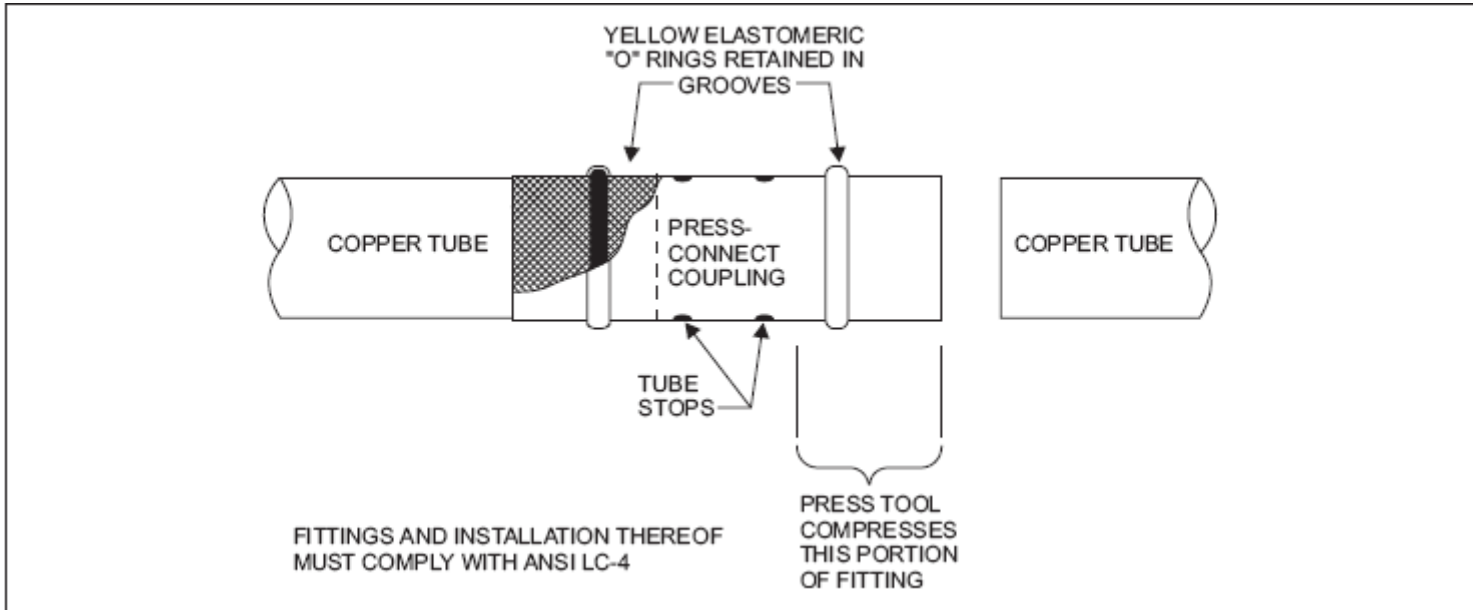
2015 IFGC, Table 403.9.2, page72

TABLE 403.9.2
SPECIFICATIONS FOR THREADING METALLIC PIPE

IRON PIPE SIZE (inches)	APPROXIMATE LENGTH OF THREADED PORTION (inches)	APPROXIMATE NUMBER 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

For SI: 1 inch = 25.4 mm.

Tubing joints – 403.10.2



Press Copper Fitting

Piping System Installation - 404

- Prohibited locations
- Piping in concealed locations
- Underground penetration prohibited
- Protection against physical damage
- Piping in solid floors
- Conduit with both ends terminating indoors
- Minimum burial depth
- Individual outdoor appliances

403.10.4 – Metallic Fittings

- Metallic fittings shall comply with the following:
  1. Threaded fittings in sizes larger than 4 inches (102 mm) shall not be used except where approved.
  2. Fittings used with steel or wrought-iron pipe shall be steel, copper alloy, malleable iron or cast iron.
  3. Fittings used with copper or copper alloy pipe shall be copper, or copper alloy.
  4. Fittings used with aluminum-alloy pipe shall be of aluminum alloy.

403.10.4 – Metallic Fittings

5. Cast-iron fittings:

   5.1. Flanges shall be permitted.

   5.2. Bushings shall not be used.

   5.3. Fittings shall not be used in systems containing flammable gas-air mixtures.

   5.4. Fittings in sizes 4 inches (102 mm) and larger shall not be used indoors except where approved.

   5.5. Fittings in sizes 6 inches (152 mm) and larger shall not be used except where approved.

403.10.4 – Metallic Fittings

6. Aluminum-alloy fittings. Threads shall not form the joint seal.
7. Zinc aluminum-alloy fittings. Fittings shall not be used in systems containing flammable gas-air mixtures.

403.10.4 – Metallic Fittings

6. Special fittings. Fittings such as couplings, proprietary-type joints, saddle tees, gland-type compression fittings, and flared, flareless or compression-type tubing fittings shall be used within the fitting manufacturer's pressure temperature recommendations; used within the service conditions anticipated with respect to vibration, fatigue, thermal expansion or contraction; installed or braced to prevent separation of the joint by gas pressure or external physical damage; and shall be approved.

403.10.4 – Metallic Fittings

9. Where pipe fittings are drilled and tapped in the field, the operation shall be in accordance with all of the following:

   9.1. The operation shall be performed on systems having operating pressures of 5 psi (34.5 kPa) or less.

   9.2. The operation shall be performed by the gas supplier or the gas supplier's designated representative.

   9.3. The drilling and tapping operation shall be performed in accordance with written procedures prepared by the gas supplier.

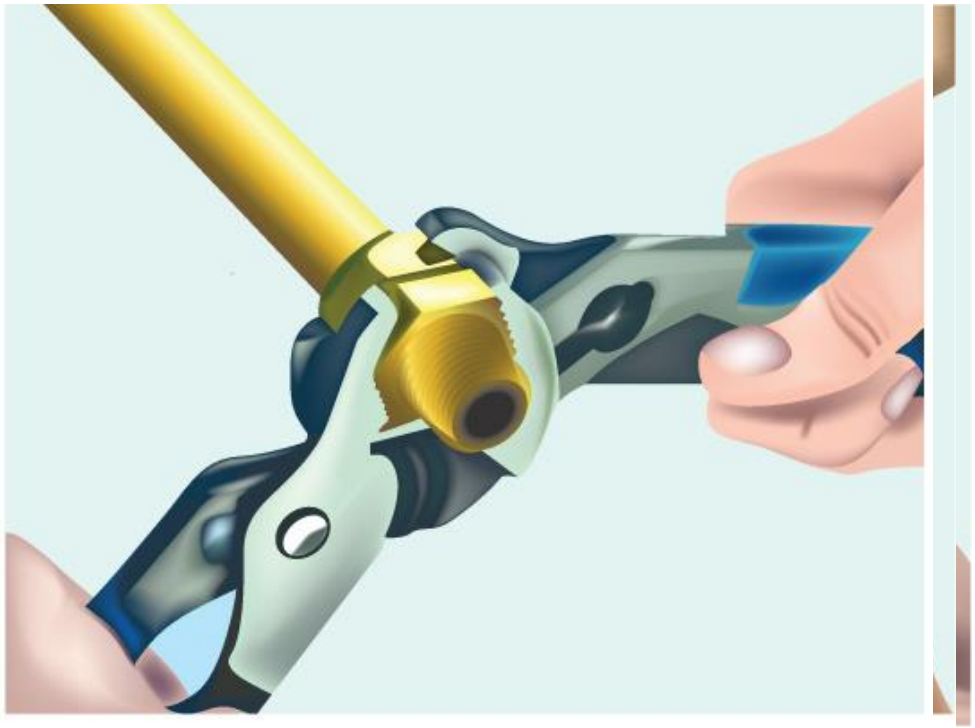
   9.4. The fittings shall be located outdoors.

   9.5. The tapped fitting assembly shall be inspected and proven to be free of leakage.

404.2 CSST Piping Systems

- CSST piping systems shall be installed in accordance with their listing and the manufacturer's installation instructions.

Sample installation instructions for CSST gas piping

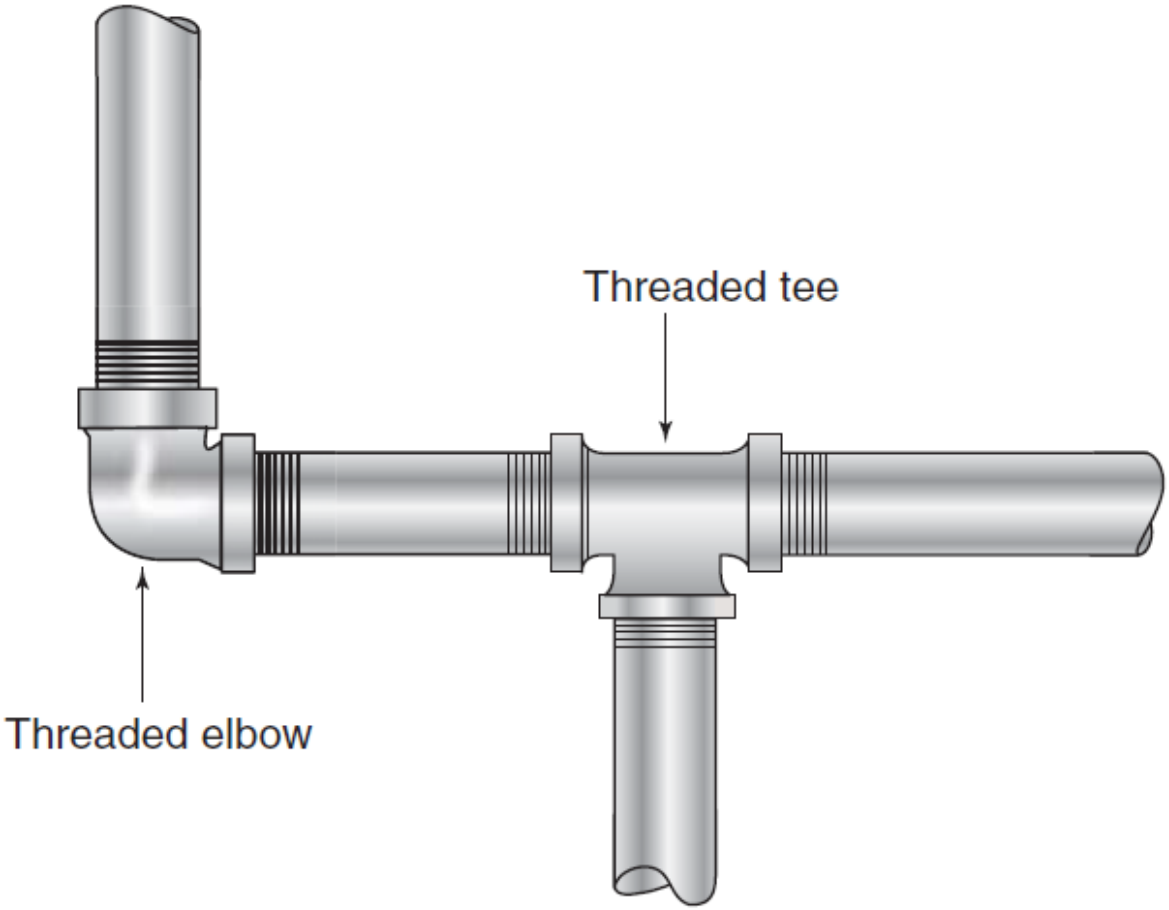


Step 4 – Tighten with wrenches until nut contacts body.

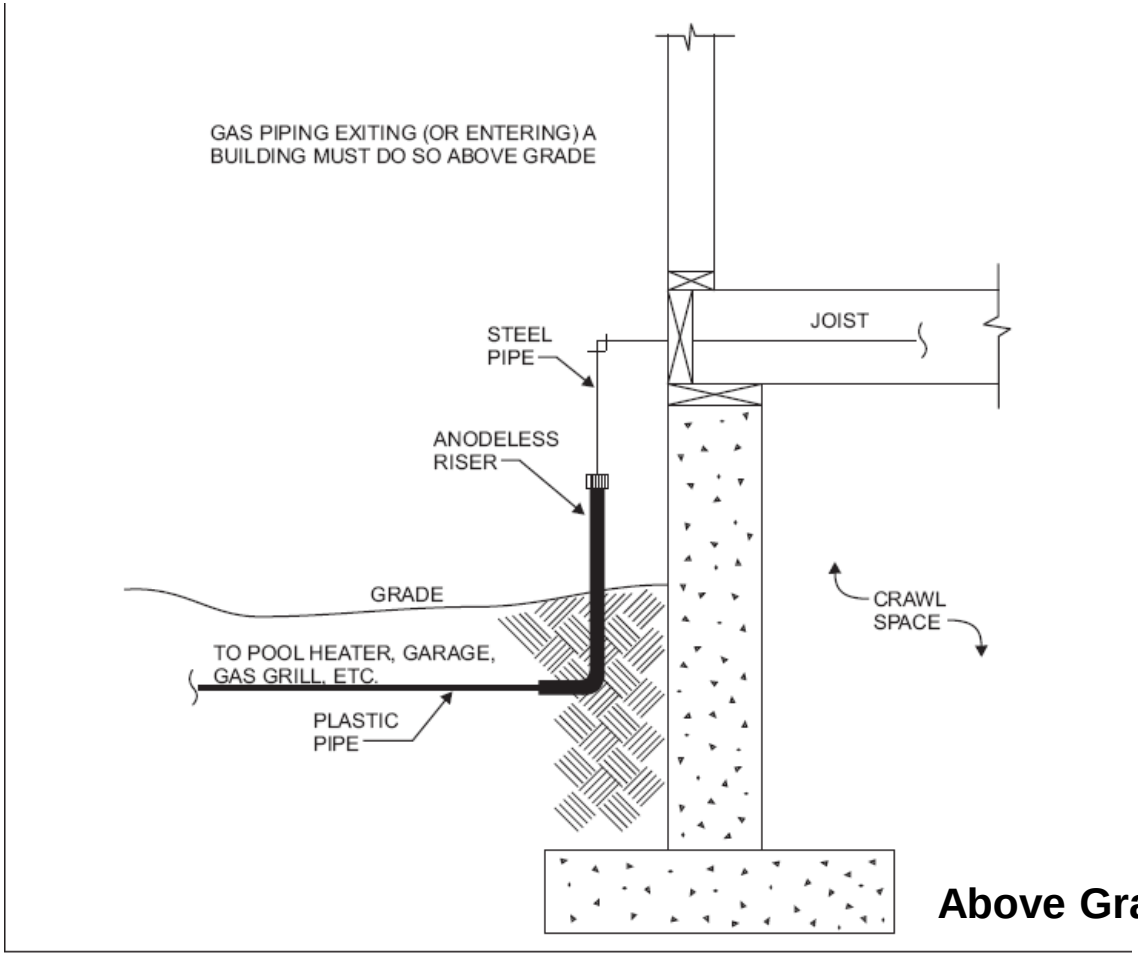
404.5 – Fittings in concealed locations

- Fittings installed in concealed locations shall be limited to the following types:
  1. Threaded elbows, tees and couplings.
  2. Brazed fittings.
  3. Welded fittings.
  4. Fittings listed to ANSI LC-1/CSA 6.26 or ANSI LC-4.

404.5 – Fittings in concealed locations



Underground penetration prohibited – 404.6

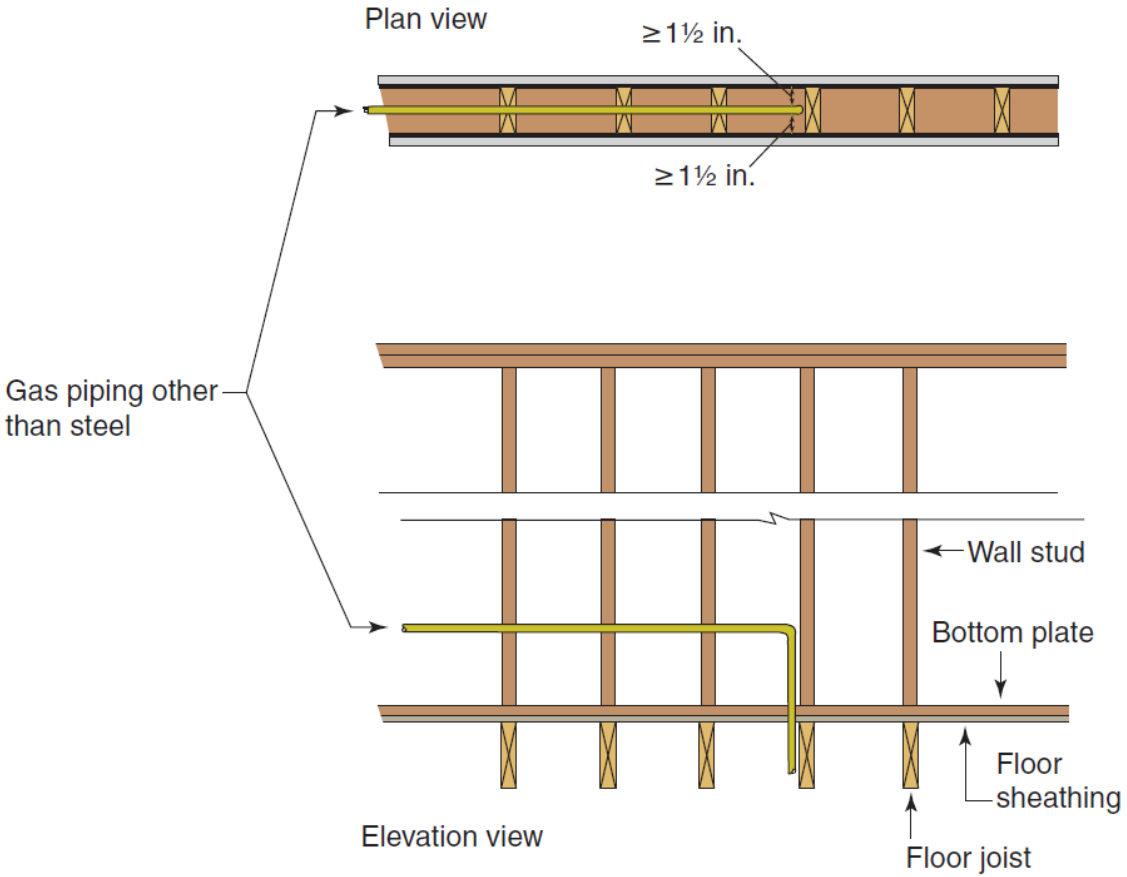


Above Grade Entrance/Exit

404.7 – Protection against physical damage

- Intended to minimize the possibility that nails or screws will be driven into the gas pipe.
- Where piping will be concealed within light-frame construction assemblies, the piping shall be protected against penetration by fasteners in accordance with Sections 404.7.1 through 404.7.3

404.7 – Protection against physical damage



Concealed gas piping with minimum clearance of 1½ inches does not require protection

404.7.1 – Piping through bored holes or notches

- Is located less than 11/2 inches (38 mm) from the framing member face to which wall, ceiling or floor membranes will be attached,
- Pipe shall be protected by shield plates that cover the width of the pipe and the framing member and that extend not less than 4 inches (51 mm) to each side of the framing member.
- Shield plates shall cover the framing member and extend not less than 4 inches (51 mm) above the bottom framing member and not less than 4 inches (51 mm) below the top framing member.

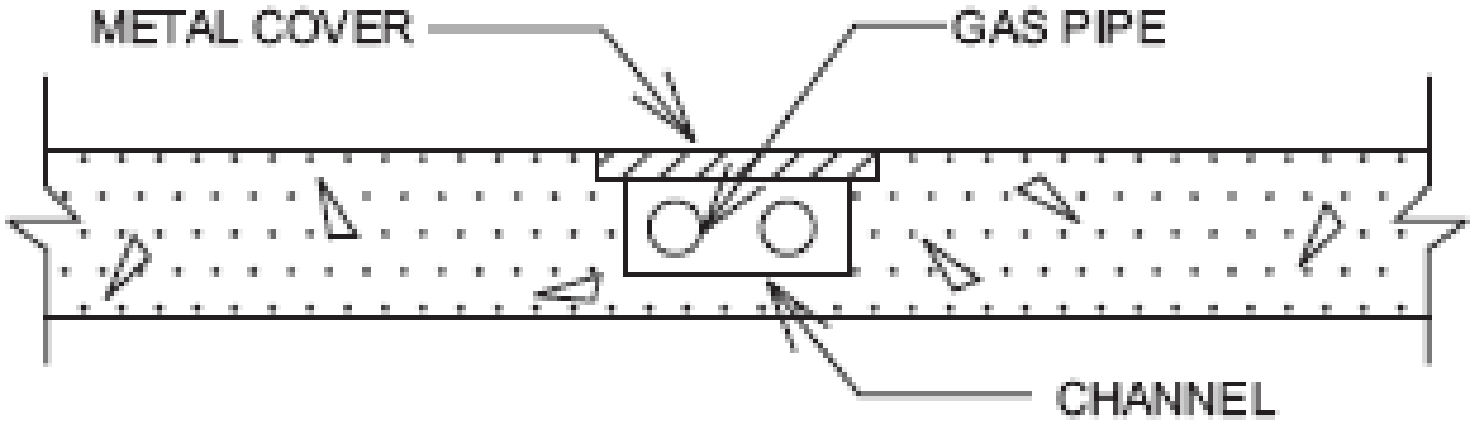
404.7.2 – Piping installed in other locations

- Is less than 11/2 inches (38 mm) from the framing member face to which wall, ceiling or floor membranes will be attached, the *piping* shall be protected by shield plates that cover the width and length of the *piping*.
- Located less than 11/2 inches (38 mm) from the nearest edge of the face of the framing member to which the membrane will be attached, the *piping* shall be protected by shield plates that cover the width and length of the *piping*.

404.7.3 – Shield plates

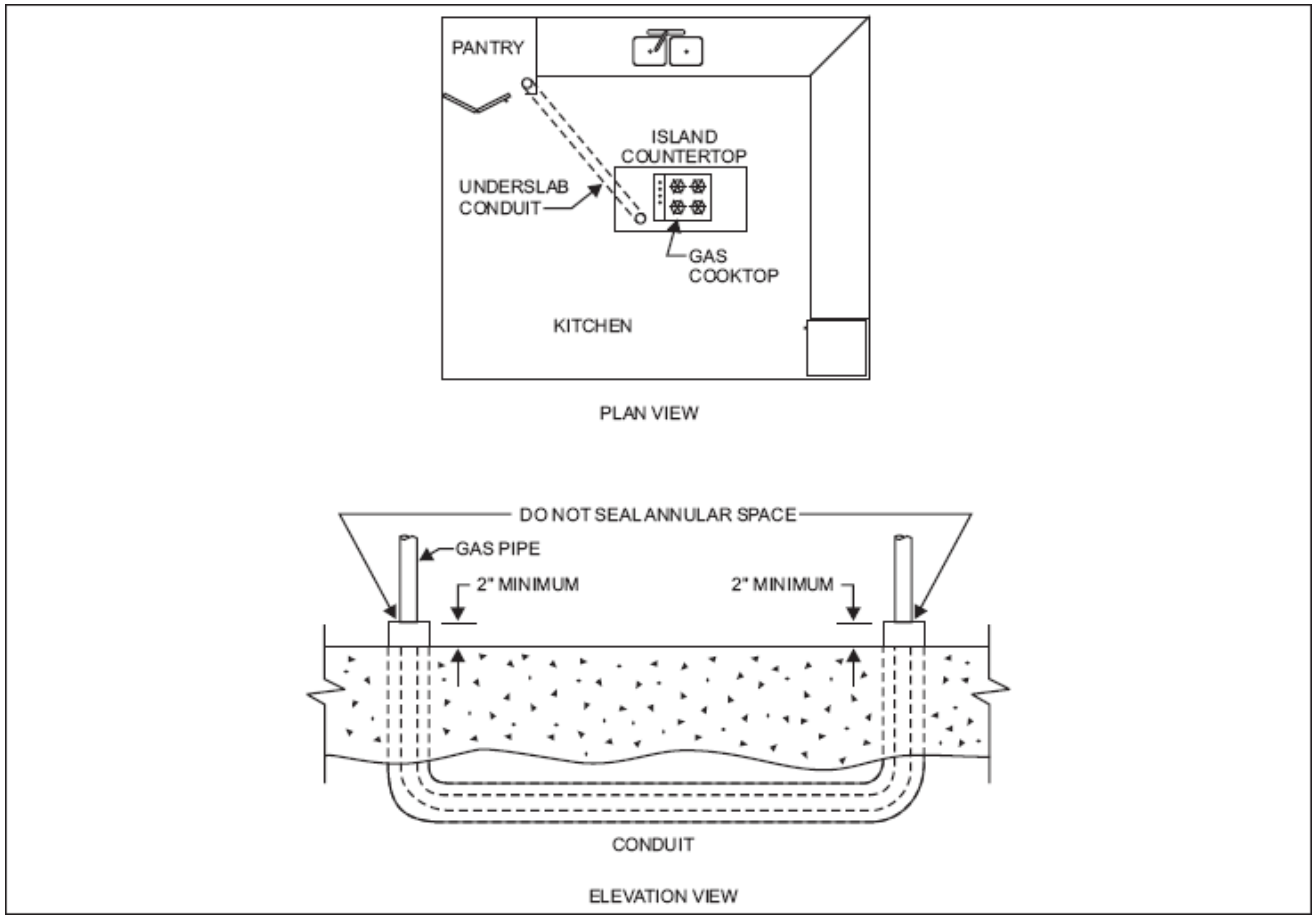
- Shield plates shall be of steel material having a thickness of not less than 0.0575 inch (1.463 mm) (No. 16 gage).

Piping in Solid Floors – 404.8



For SI: 1 inch = 25.4 mm.

Conduit with both ends terminating indoors – 404.8.2 & 404.14.2



Piping Under Slab Between Interior Points

Protective coatings and wrapping - 404.11.2

- Pipe protective coatings and wrappings approved for the application and shall be factory applied.
  - Exception: Where installed in accordance with the manufacturer's instructions, field application of coatings and wrappings shall be permitted for pipe nipples, fittings and locations where the factory coating or wrapping has been damaged or necessarily removed at joints.

Minimum burial depth – 404.11.2

- A depth of 12 inches (305 mm) below grade is considered sufficient to avoid possible harm to the underground piping system from the use of hand tools.

Prohibited devices -404.18

- Excess flow valves and other devices are allowed to be installed in gas piping provided that the piping system has been designed for such restrictions.

Listed excess flow valve

Piping System Installation—Section 404

- Section 404.12.1 – Individual outside appliances
  - Individual lines to outdoor lights, grills and other *appliances* shall be installed not less than 8 inches (203 mm) below finished grade, provided that such installation is approved and is installed in locations not susceptible to physical damage.
- Section 404.18 – Pipe cleaning
  - The use of a flammable or combustible gas to clean or remove debris from a piping system shall be prohibited.

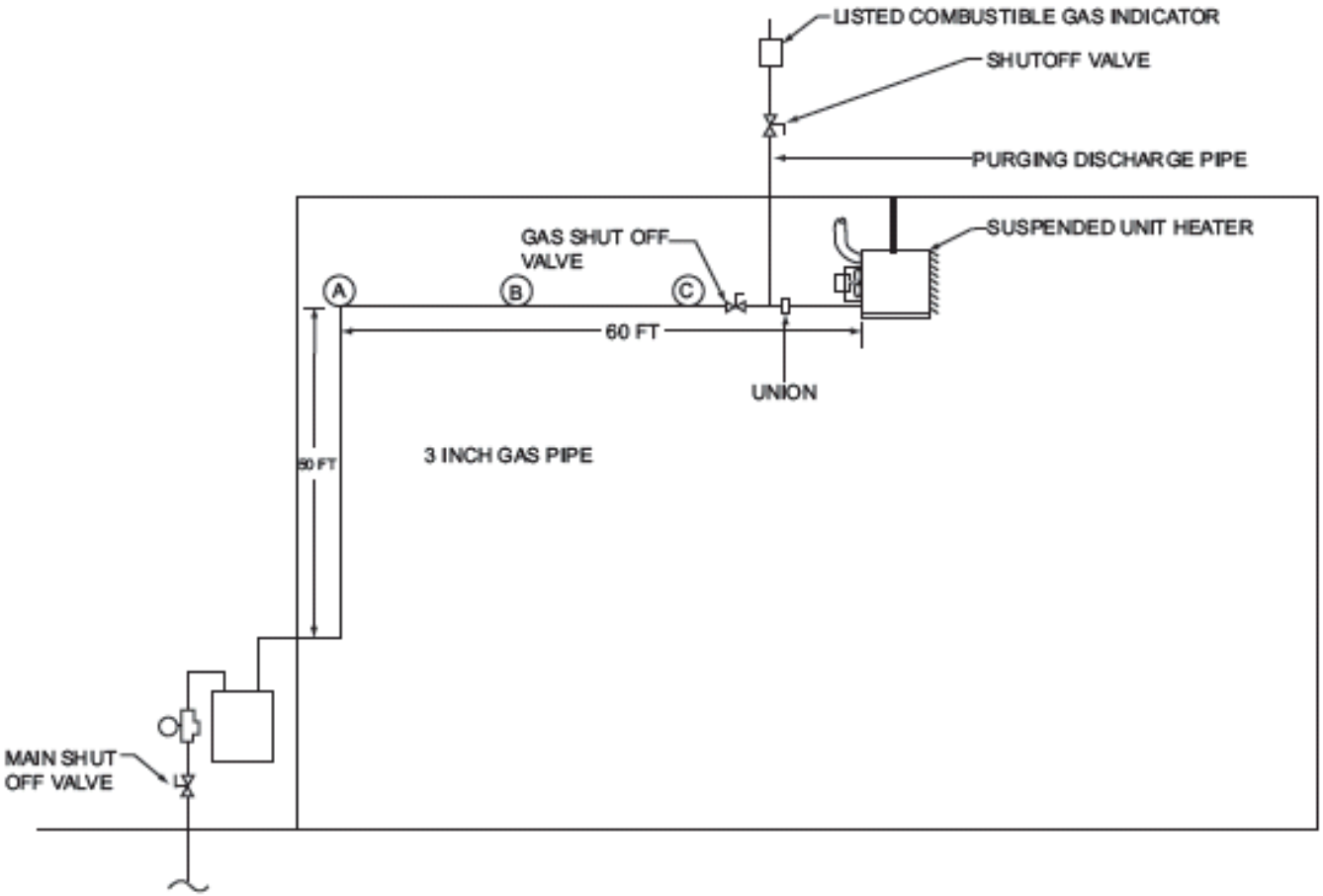
Inspection, Testing and Purging - 406

- All piping installation must be inspected and pressure tested.
- Includes:
  - Visual inspection
  - Pressure test
- Leakage test verifies connection to appliances are gas-tight.

Appliance isolation – 406.3.4

- Since the minimum required test pressure exceeds the maximum inlet pressure for most appliances, the appliance must not be connected to the piping system during pressure testing.

Purging – 406.7

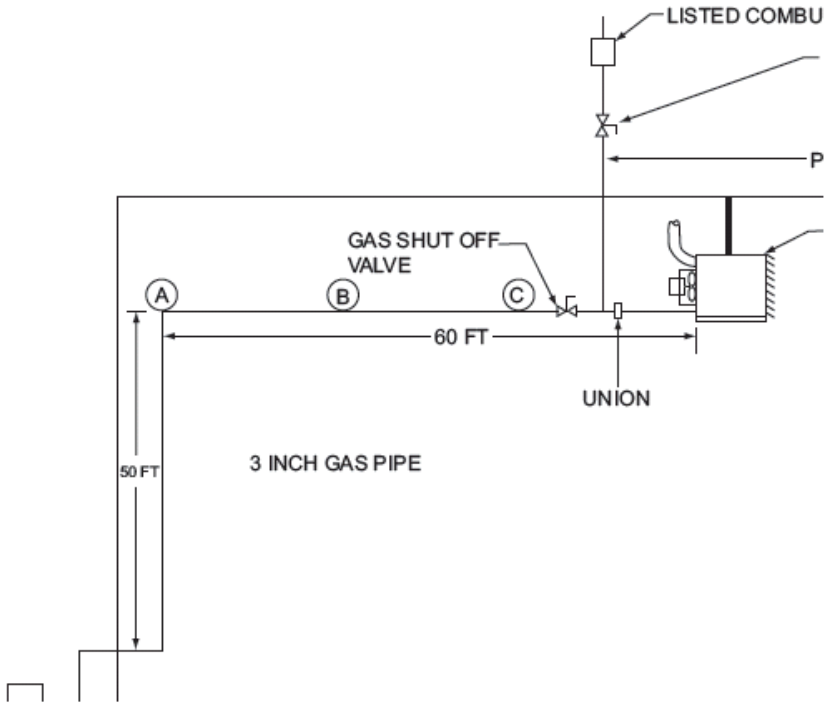


Combustible Gas Indicator Section 406.7.1.4

- Combustible gas indicator shall be listed and calibrated in accordance with the manufacturer's instruction and display a volume scale from zero to 100 percent in 1 percent or smaller increments.

GAS LINE PURGING CHECKLIST FOR THE FOLLOWING TWO CONDITIONS BASED ON IFGC SECTION 406.7.1

1. Design operating pressure greater than 2 psig.
2. Pipe being purged contains one or more sections of pipe or tubing meeting the size and length criteria of Table 406.7.1.1.



GAS LINE PURGING CHECKLIST BASED ON IFGC SECTION 406.7.1

2015 IFGC, Table 406.7.1.1 page 77

TABLE 406.7.1.1
SIZE AND LENGTH OF PIPING

NOMINAL PIPE SIZE (inches)[a]	LENGTH OF PIPING (feet)
≥ 2½ < 3	> 50
≥ 3 < 4	> 30
≥ 4 < 6	> 15
≥ 6 < 8	> 10
≥ 8	Any length

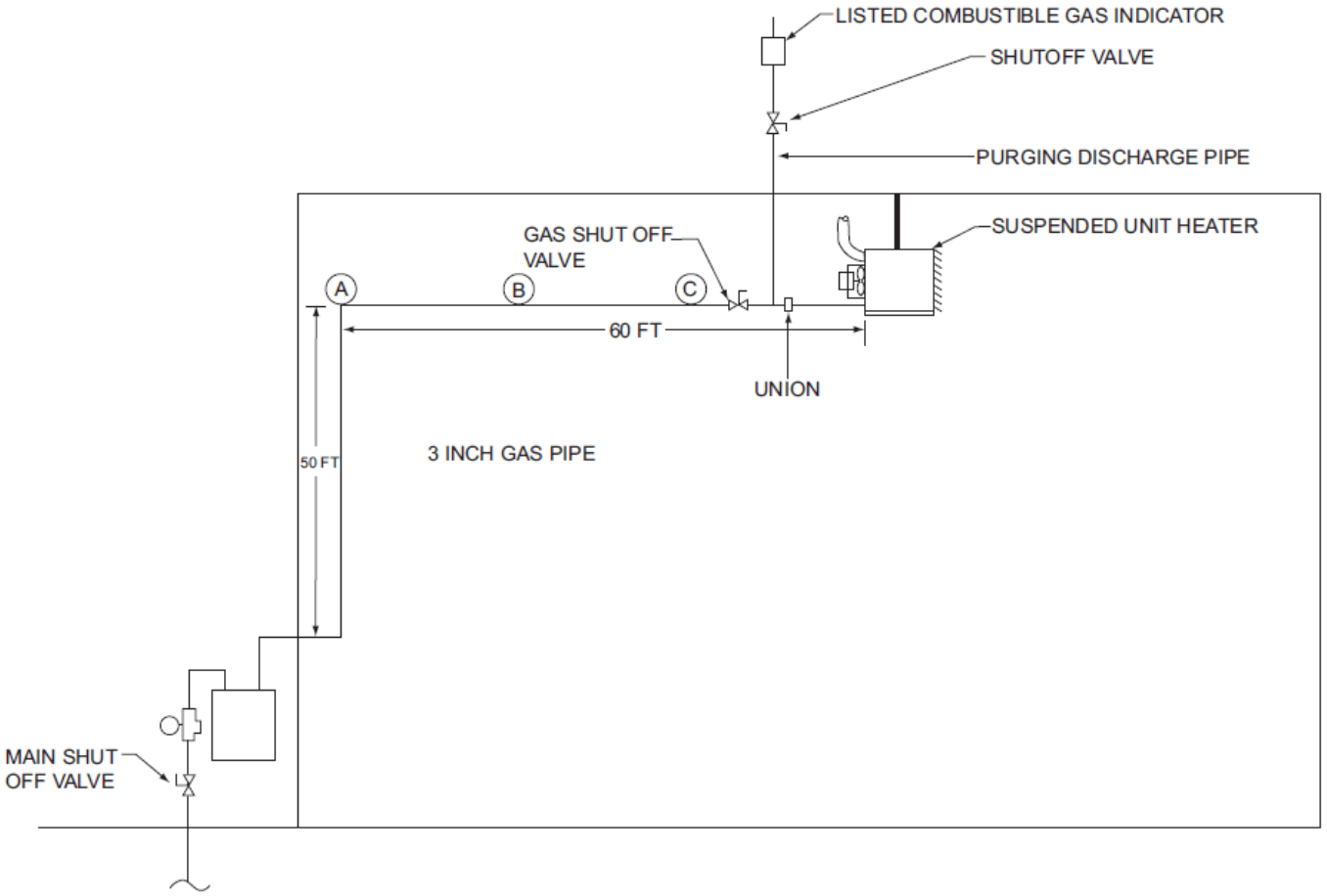
For SI: 1 inch = 25.4 mm, 1 foot = 304.8 mm.

a. CSST EHD size of 62 is equivalent to nominal 2-inch pipe or tubing size.

GAS LINE PURGING CHECKLIST BASED ON IFGC SECTION 406.7.1

- PROCEDURE
- Removal from Service
- Placing in Service
- Appliance/Equipment Purge

GAS LINE PURGING CHECKLIST BASED ON IFGC SECTION 406.7.1



GAS LINE PURGING CHECKLIST BASED ON IFGC SECTION 406.7.1

- PROCEDURE
- Appliance/Equipment Purge

TABLE 406.7.1.1
SIZE AND LENGTH OF PIPING

NOMINAL PIPE SIZE (inches)[a]	LENGTH OF PIPING (feet)
≥ 2 1/2 < 3	> 50
≥ 3 < 4	> 30
≥ 4 < 6	> 15
≥ 6 < 8	> 10
≥ 8	Any length

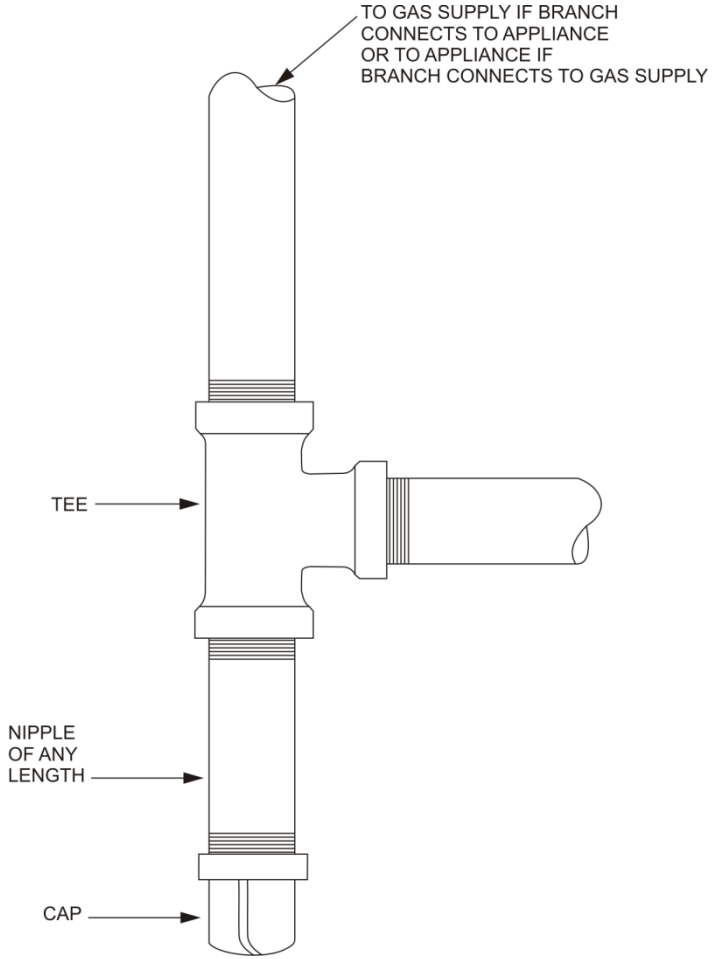
For SI: 1 inch = 25.4 mm, 1 foot = 304.8 mm.

a. CSST EHD size of 62 is equivalent to nominal 2-inch pipe or tubing size.

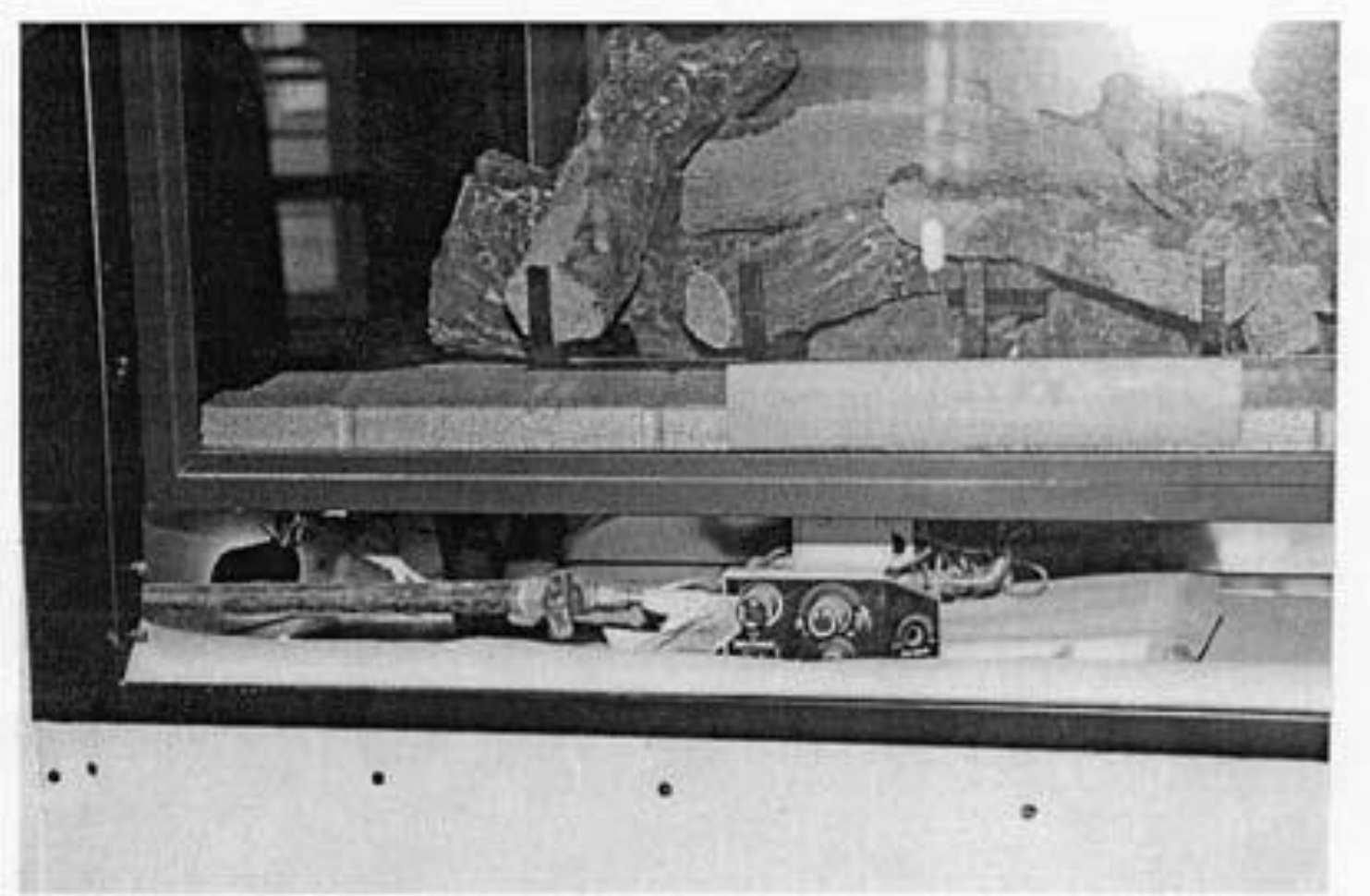
Piping support design and installation – 407.2

- All materials and devices used to hang or support gas piping must be constructed of metal.
- Piping is allowed to rest upon and be supported by building structural components.

Sediment Trap - 408.4



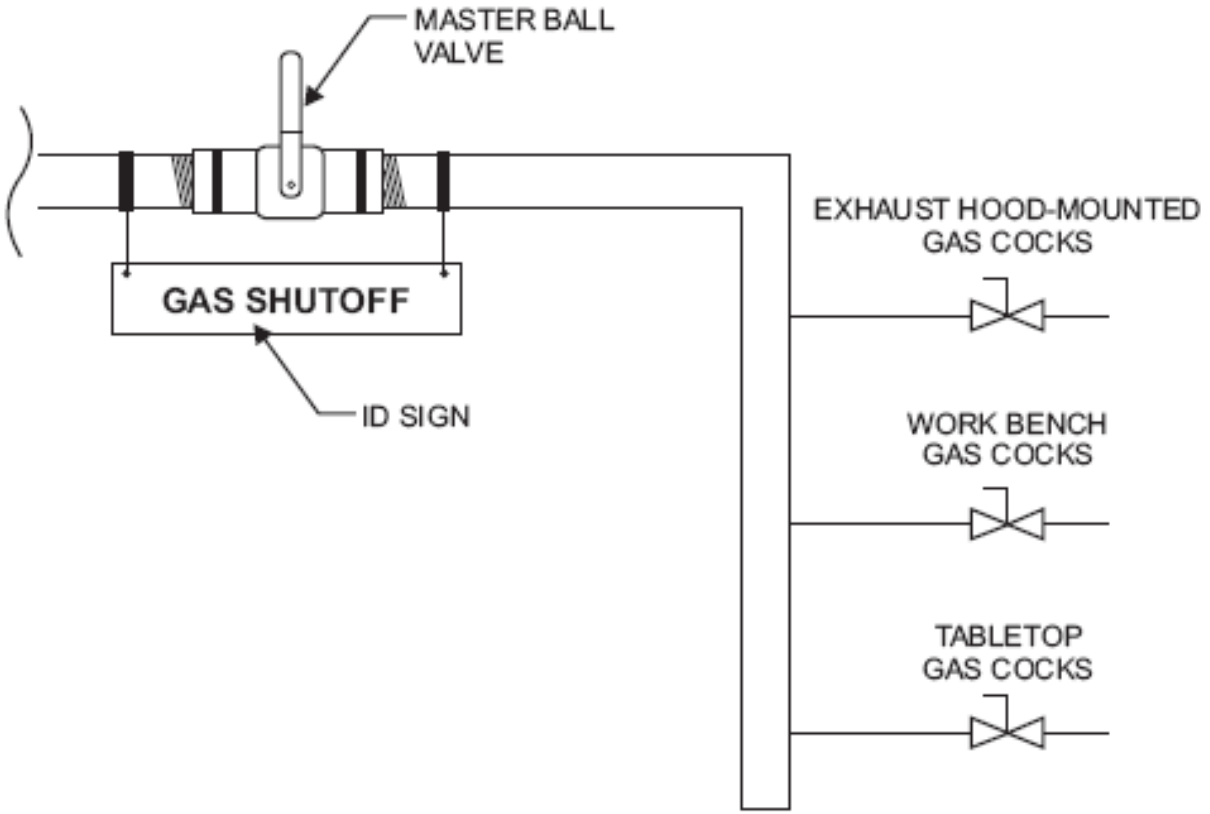
Shutoff Valves - 409



Appliance shutoff valves located at manifold – 409.5 and 409.5.3

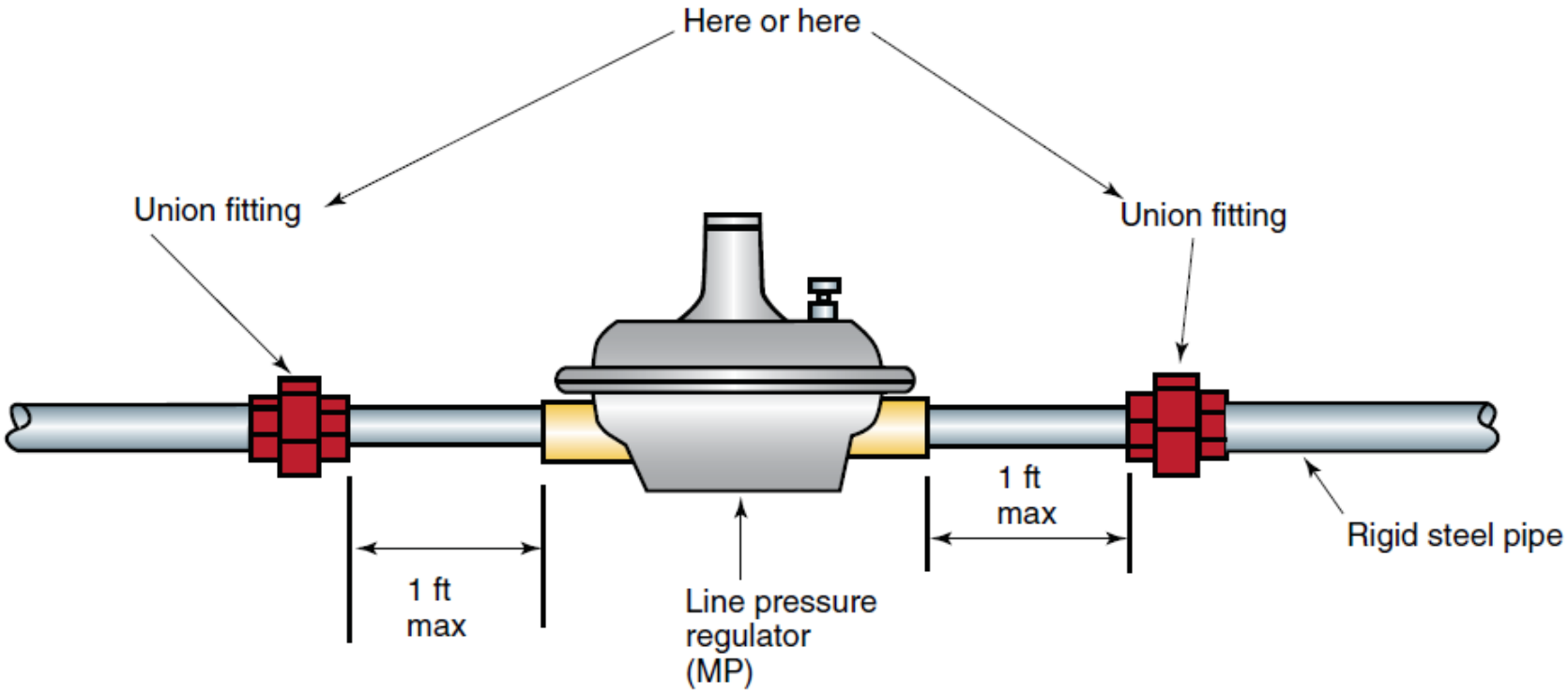
- Appliance shutoff valves are now permitted to be located within 50 feet (15 240 mm) of the appliance on a remote manifold.

Shutoff valve for laboratories – 409.6



Master Shutoff Valve for Laboratories

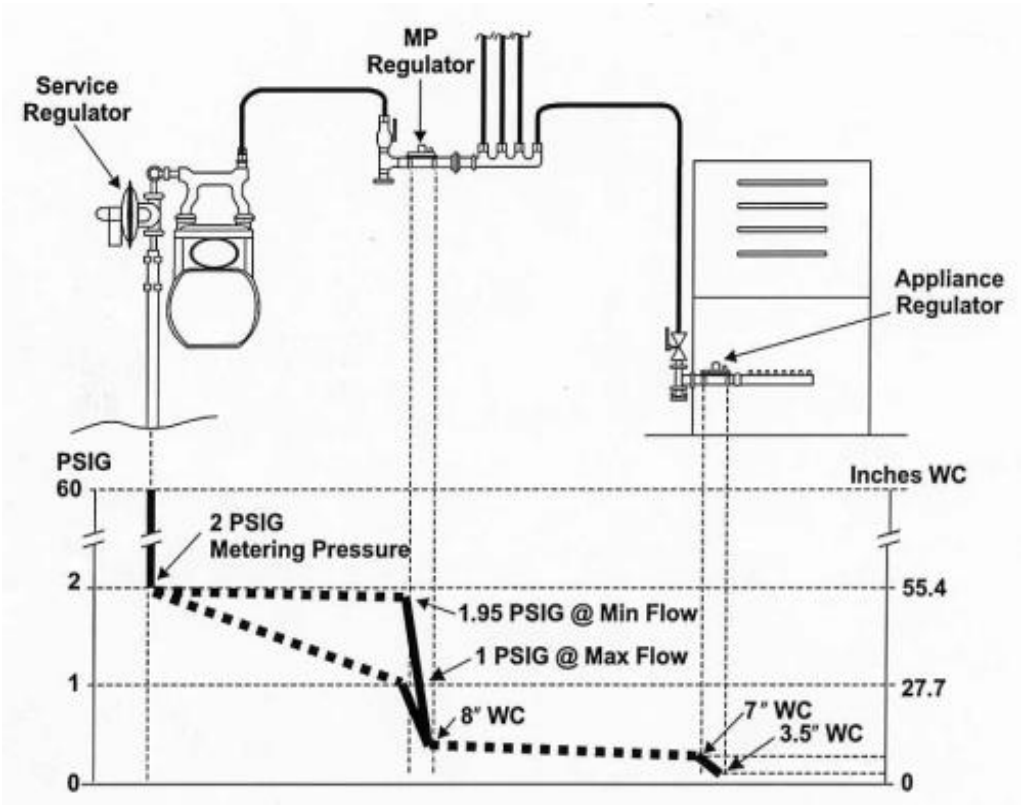
410.2 – MP regulators



Only one union is required. It can be upstream or downstream.

Gas Flow Controls

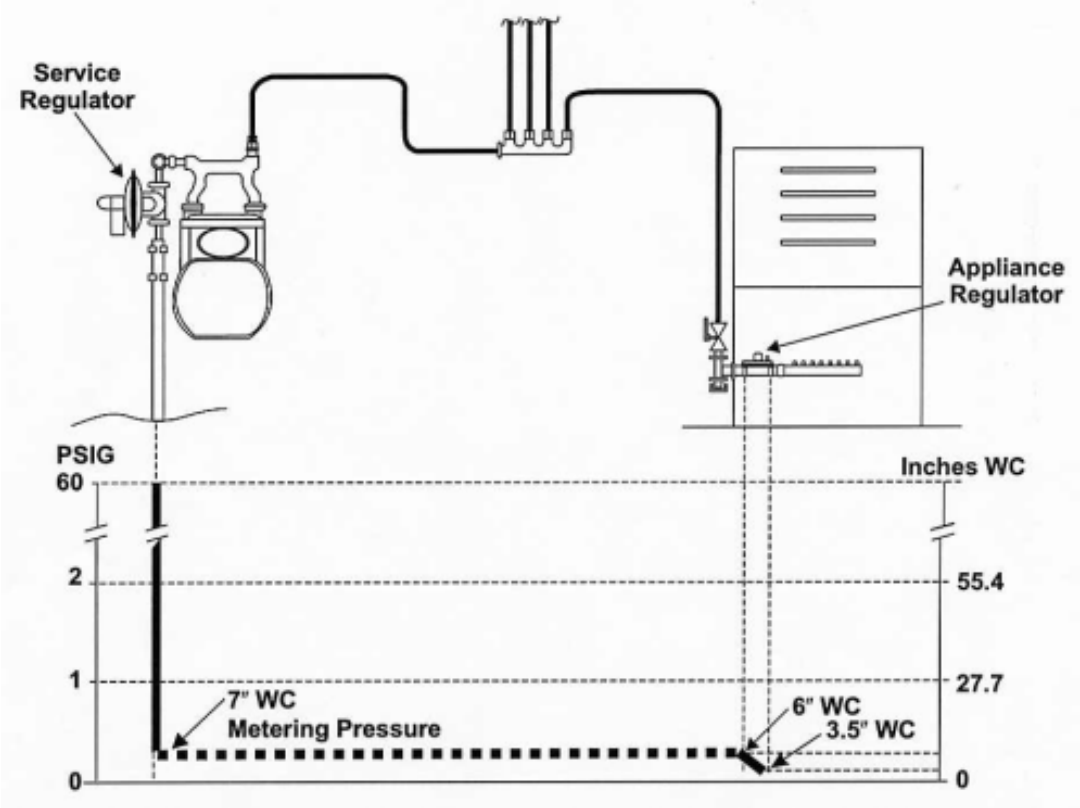
- Medium Pressure (MP) gas regulators



Hybrid Pressure System

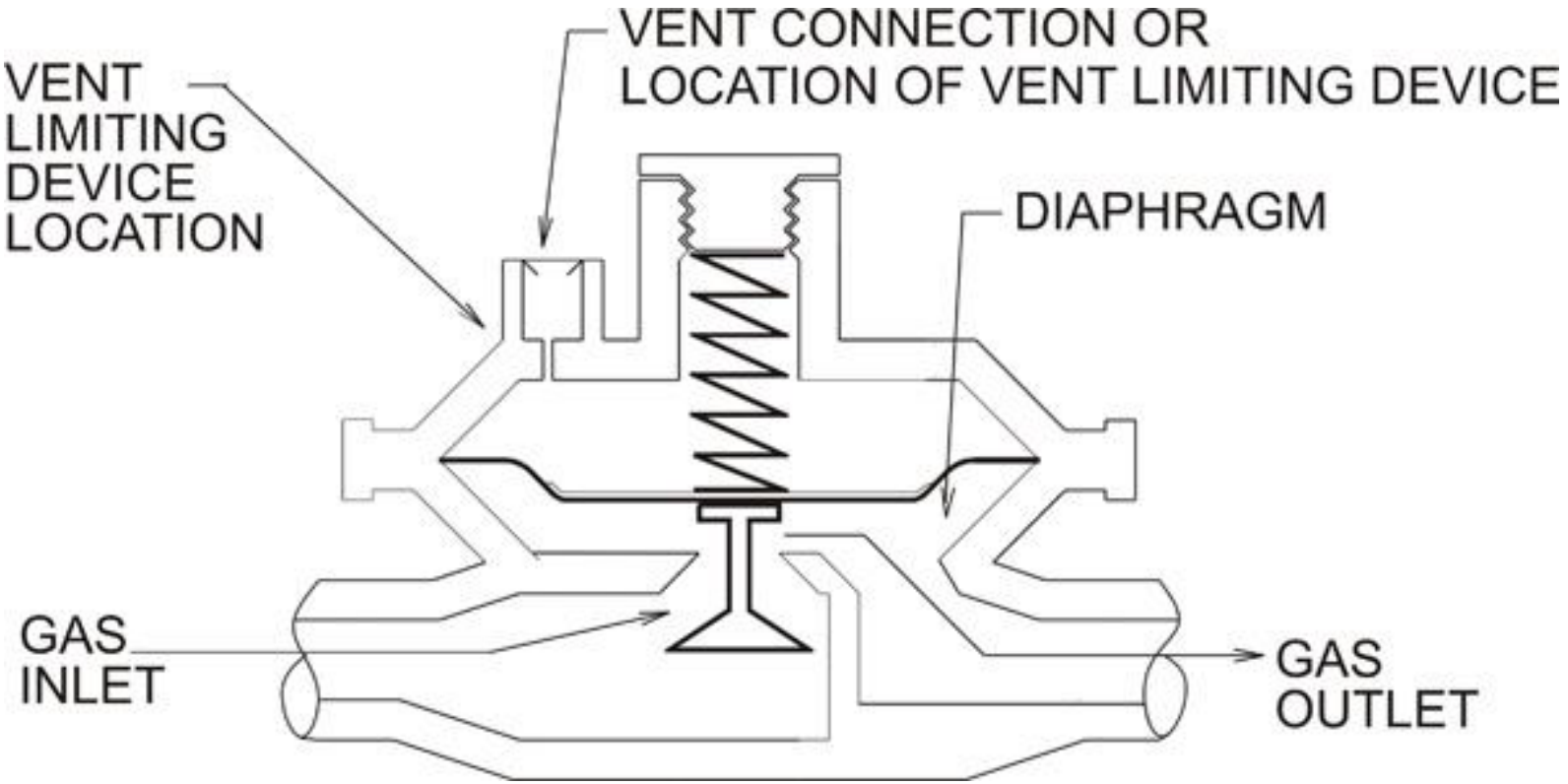
Gas Flow Controls

- Medium Pressure (MP) gas regulators



Low-pressure (Single) System

Venting of regulators – 410.3

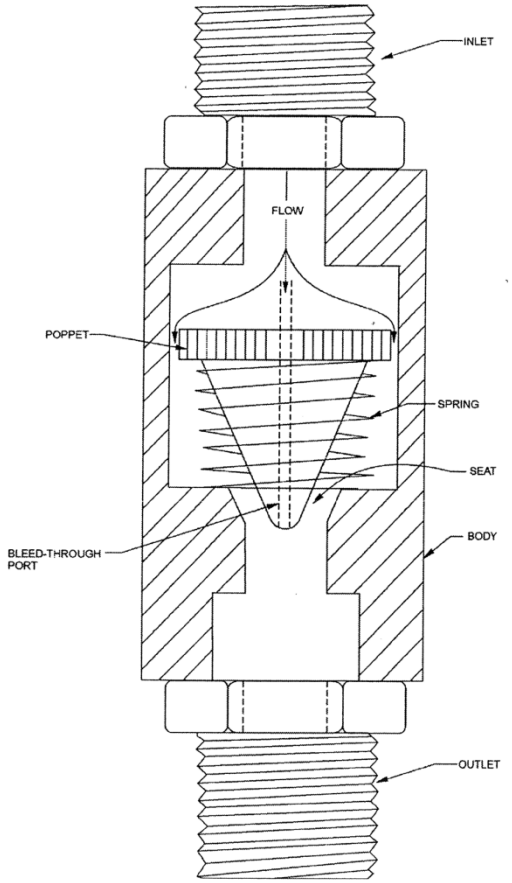


Gas Pressure Regulator

Vent piping – 410.3.1

- Regulator relief vents and breather vents must be connected to vent piping constructed of the same materials as allowed for gas distribution.
- The text addresses the practice of joining multiple vents to a manifold piping arrangement.

Excess Flow Valves - 410.4



Flashback arrestor check valve - 410.5

Check valve

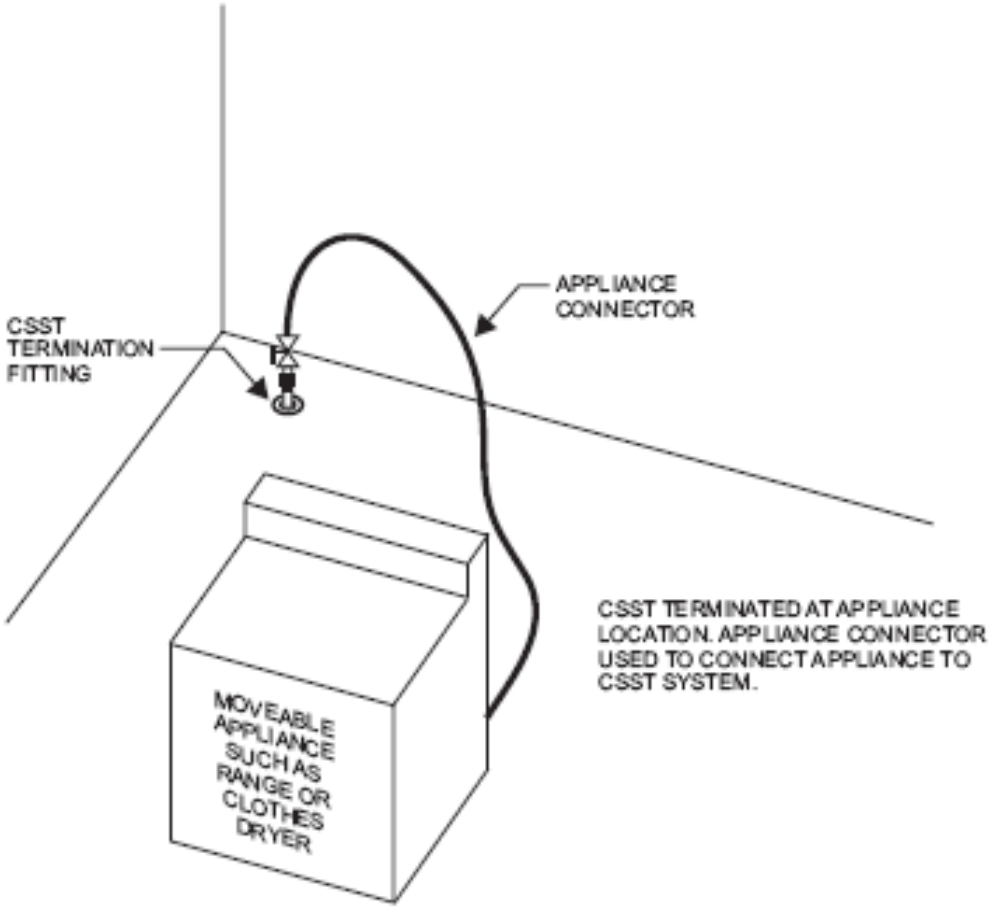
Flash arrestor

Check valve and flash arrestor

Appliance Connections - 411

- Choice of connection type to use must take into consideration:
  - Appliance movement
  - Vibration
  - Ambient conditions
  - Susceptibility to physical damage

Connecting appliances- 411.1



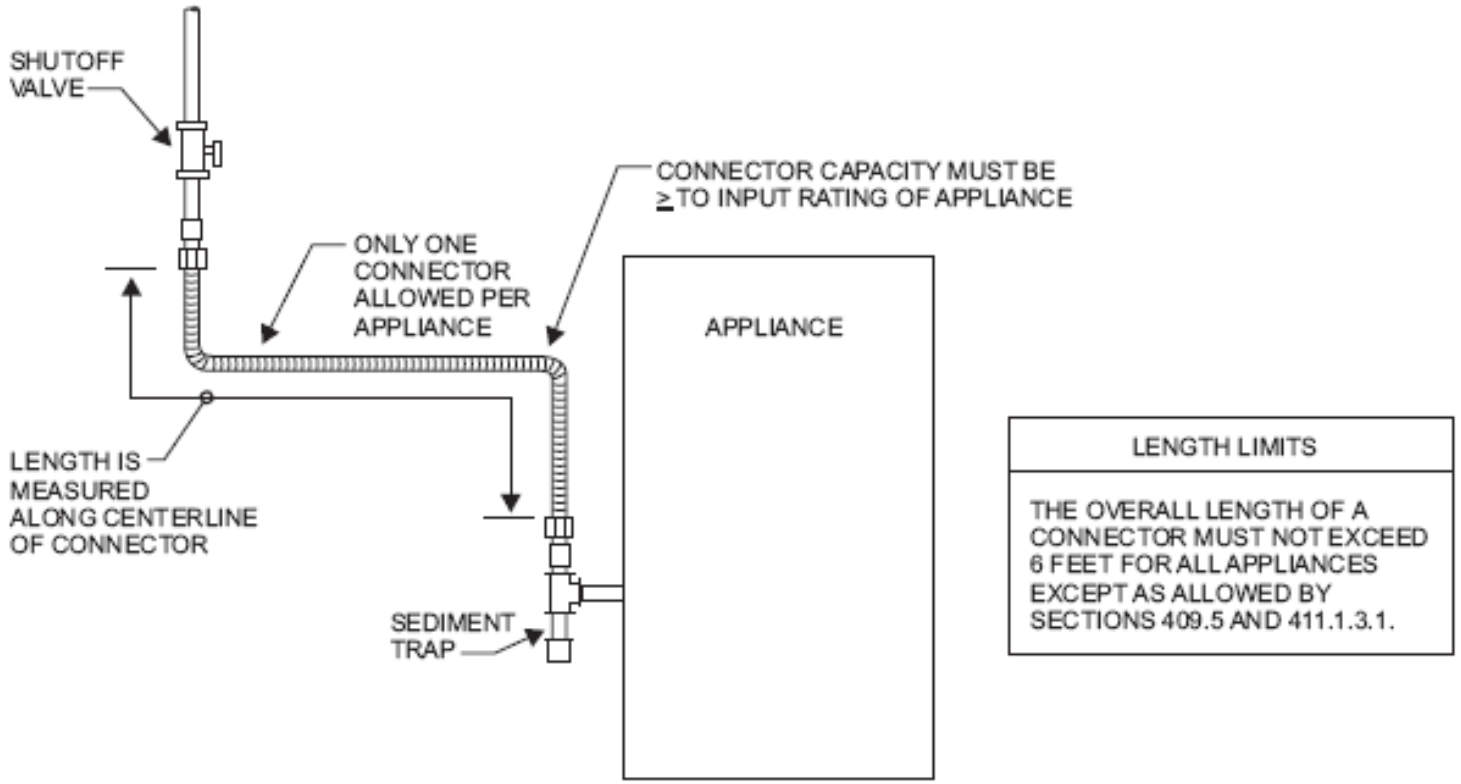
Connecting appliances- 411.1

- New requirement for appliances to be connected to a piping system and listed outdoor gas hose connectors in compliance with ANSI Z21.54 used to connect portable outdoor appliances. The gas hose connection shall be made only in the outdoor area where the appliance is used, and shall be to the gas piping supply at an appliance shutoff valve, a listed quick-disconnect device or listed gas convenience outlet.

Commercial cooking appliances – 411.1.1

- Connectors listed to ANSI Z21.69 are required for all commercial cooking appliances that are moved from cleaning/sanitation purposes.
- Connectors are designed to tolerate repeated movement to allow for cleaning operations or relocation.

Connector Installation

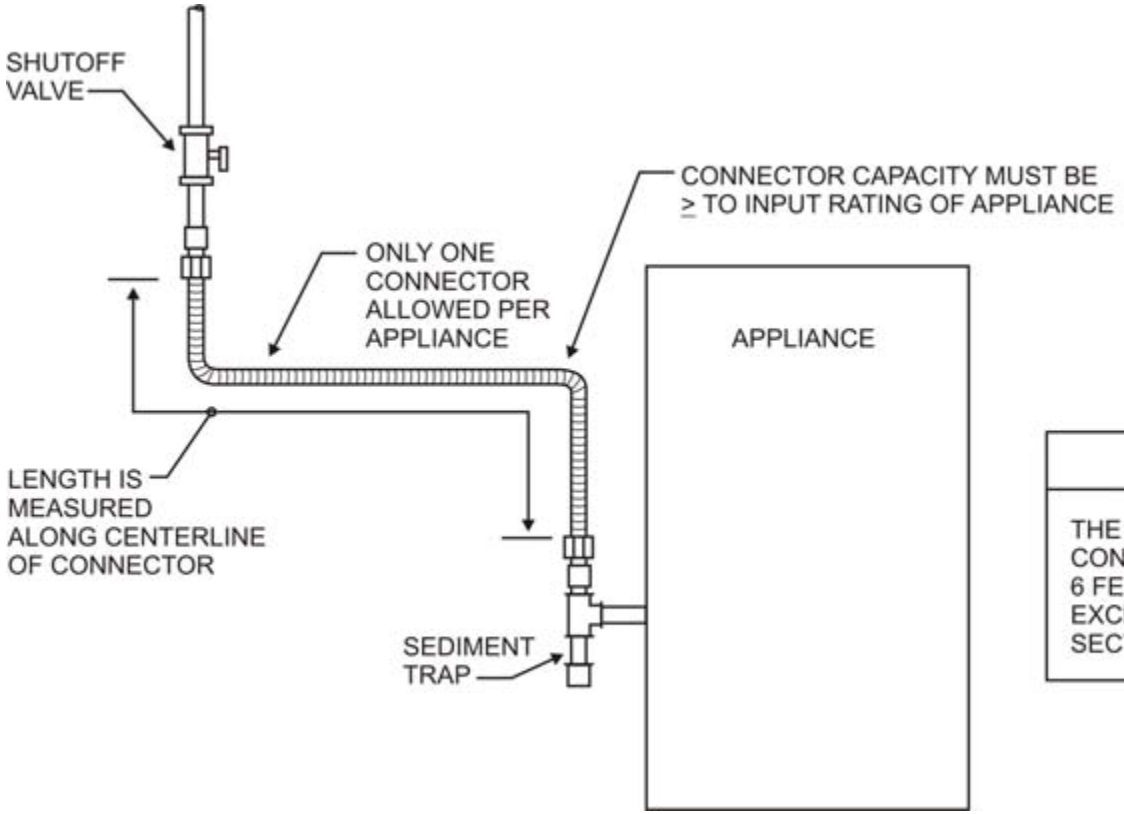


Connector Installation

411.1.2 – Protection against damage

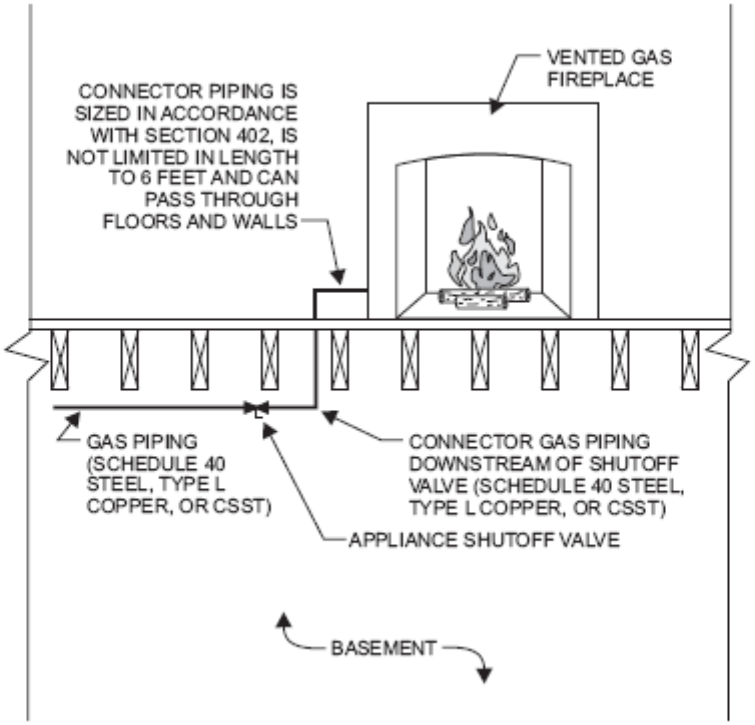
- Between the shutoff valve and appliance, a means of disconnecting the piping must be provided by a union fitting or similar arrangement.
- Most manufacturers require that a sediment trap be installed at the point of connection to the gas supply (see Section 408.4).
- In accordance with the CSST manufacturer's instructions, CSST can connect directly to fixed-in-place, nonmovable appliances.

411.1.3 – Connector installation



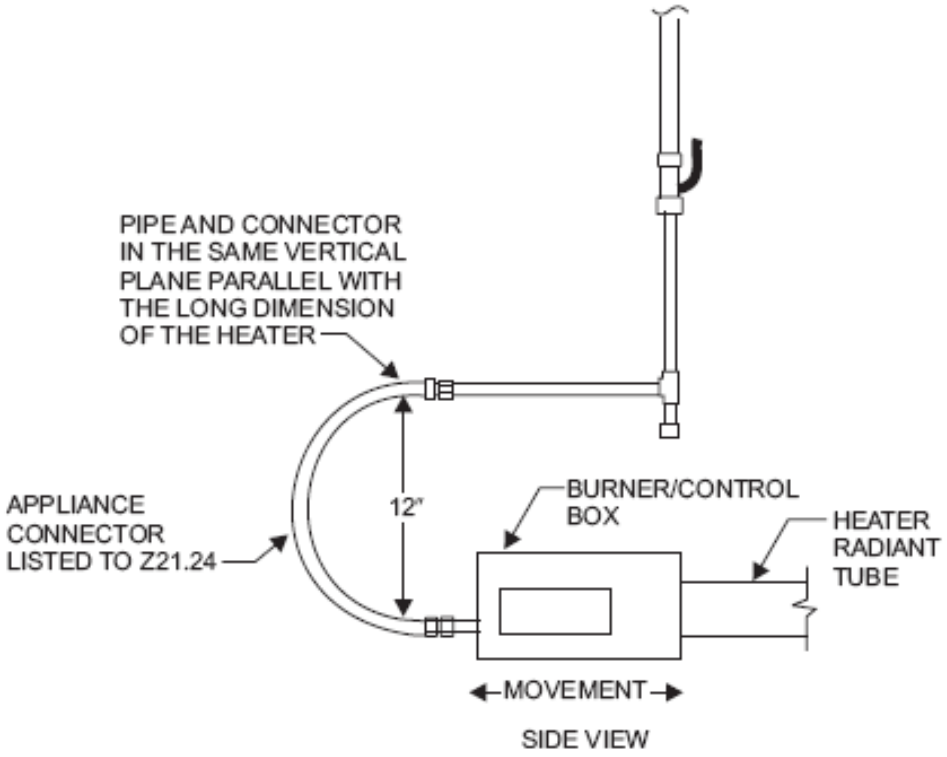
LENGTH LIMITS
THE OVERALL LENGTH OF A CONNECTOR MUST NOT EXCEED 6 FEET FOR ALL APPLIANCES EXCEPT AS ALLOWED BY SECTIONS 409.5 AND 411.1.3.1.

Prohibited locations and penetrations – 411.1.3.3



Connector Piping Downstream of Shutoff Valve

Suspended low-intensity infrared tube heaters – 411.3



Connector Piping Downstream of Shutoff Valve

415.1 – Interval of support

2015 IFGC, Table 415.1, page 84

TABLE 415.1
SUPPORT OF PIPING

STEEL PIPE, NOMINAL SIZE OF PIPE (inches)	SPACING OF SUPPORTS (feet)	NOMINAL SIZE OF TUBING (SMOOTH-WALL) (inch O.D.)	SPACING OF SUPPORTS (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 (horizontal)	8
1 1/4 or larger (vertical)	Every floor level	1 or larger (vertical)	Every floor level

For SI:1 inch = 25.4 mm, 1 foot = 304.8 mm.

Overpressure Protection Devices—Section 416

- 416.2.1 – Pressure under 14 inches w.c.
- 416.2.2 – Pressure over 14 inches w.c.
- 416.2.3 – Device capability
- 416.2.4 – Failure detection

416.2.5 – Relief valve

1. The line pressure regulator for which the relief valve is providing overpressure protection has failed wide open.
2. The gas pressure at the inlet of the line pressure regulator for which the relief valve is providing overpressure protection is not less than the regulator's normal operating inlet pressure

416.3 – Devices

1. Pressure relief valve.
2. Monitoring regulator.
3. Series regulator installed upstream from the line regulator and set to continuously limit the pressure on the inlet of the line regulator to the maximum values specified by Section 416.2.1.
4. Automatic shutoff device installed in series with the line pressure regulator and set to shut off when the pressure on the downstream piping system reaches the maximum values specified by Section 416.2.1. This device shall be designed so that it will remain closed until manually reset.

Overpressure Protection Devices—Section 416

- 416.3.1 – Construction and installation
- 416.3.2 – External control piping
- 416.3.3 – Setting

Module 5

Chapter 5
Chimneys and Vents

Chimneys and Vents

- Code provides requirements for:
  - Installation
  - Maintenance
  - Repair
  - Approval
  - Of residential and commercial
  - chimney and venting systems.

Purpose of Venting

- Venting Systems
  - Convey products of combustion to the outdoors

General Requirements

- Every fuel-burning appliance is required to be vented except as allowed by Section 501.8
- Venting method must be designed for particular type of appliance
- Venting material and method of installation depend on characteristics of gas utilization equipment

Operating Characteristics

- Positive or non-positive pressure in the venting system
- Temperature of vent gases and possibility of condensation

Sizing of venting systems/General

- Minimize condensation. (It is essential to operate closer to maximum than minimum capacity, and also to use the smallest allowable vent size).
- Maintain the required draft in Category I and II appliance venting systems.
- Assure that products of combustion are conveyed to the outdoors.
- Prevent damage due to possible condensation from flue gases.
- Avoid overheating the equipment and surrounding building materials.

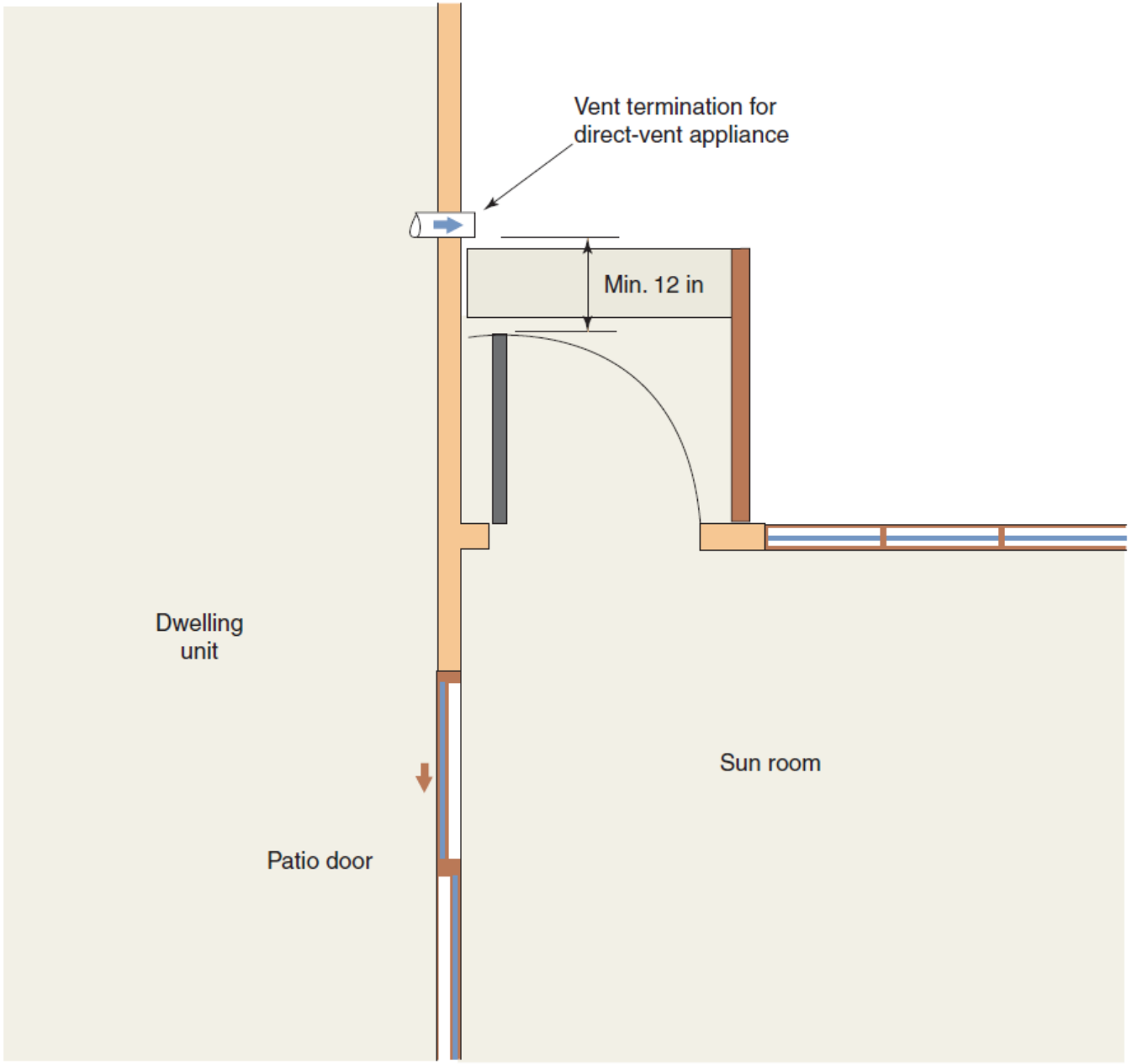
Sizing of venting systems/General

	Pressure		Excessive Condensation		Explanation
	Positive	Non-positive	Avoids	Creates	
Category I		✓	✓		Natural draft (draft hood or fan assisted) - typically B-vent.
Category II		✓		✓	Rare or nonexistent.
Category III	✓		✓		Appliances currently vented with special alloy stainless steel vents.
Category IV	✓			✓	Typically high efficiency condensing gas appliances vented with low temperature plastic vent materials.

Types of Venting Systems

- Type B Gas Vent
- Type BW Gas Vent
- Type L Vent
- Chimney
- Single-Wall Metal Pipe
- Plastic Pipe and Stainless Steel special vents

502.7.1 – Door swing



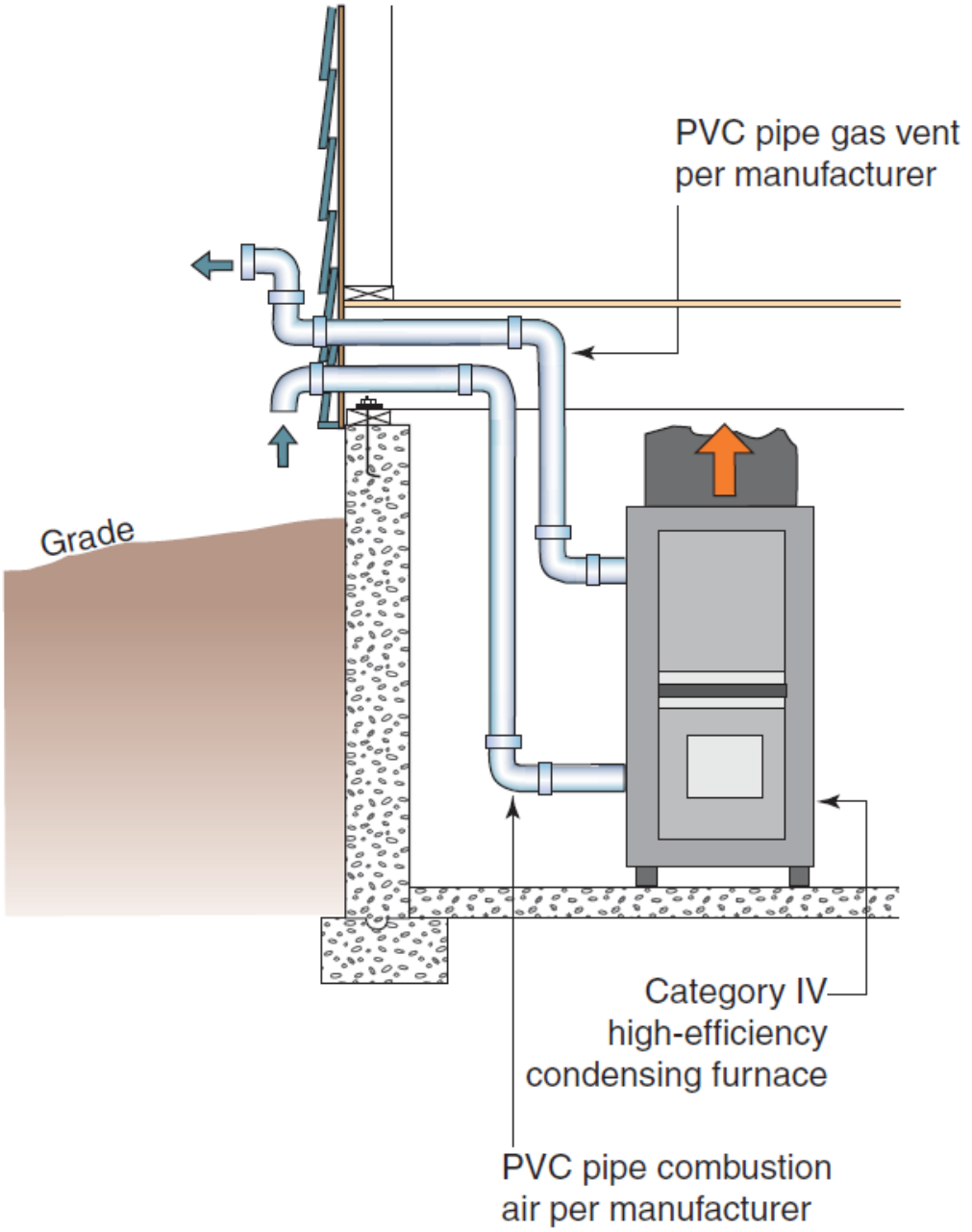
Type of venting system to be used

2015 IFGC, Table 503.4, page 90

TABLE 503.4
TYPE OF VENTING SYSTEM TO BE USED

APPLIANCES	TYPE OF VENTING SYSTEM
Listed Category I appliances Listed appliances equipped with draft hood Appliances listed for use with Type B gas vent	Type B gas vent (Section 503.6) Chimney (Section 503.5) Single-wall metal pipe (Section 503.7) Listed chimney lining system for gas venting (Section 503.5.3) Special gas vent listed for these appliances (Section 503.4.2)
Listed vented wall furnaces	Type B-W gas vent (Sections 503.6, 608)
Category II appliances	As specified or furnished by manufacturers of listed appliances (Sections 503.4.1, 503.4.2)
Category III appliances	As specified or furnished by manufacturers of listed appliances (Sections 503.4.1, 503.4.2)
Category IV appliances	As specified or furnished by manufacturers of listed appliances (Sections 503.4.1, 503.4.2)
Incinerators	In accordance with NFPA 82
Appliances that can be converted for use with solid fuel	Chimney (Section 503.5)
Unlisted combination gas and oil-burning appliances	Chimney (Section 503.5)
Listed combination gas and oil-burning appliances	Type L vent (Section 503.6) or chimney (Section 503.5)
Combination gas and solid fuel-burning appliances	Chimney (Section 503.5)
Appliances listed for use with chimneys only	Chimney (Section 503.5)
Unlisted appliances	Chimney (Section 503.5)
Decorative appliances in vented fireplaces	Chimney
Gas-fired toilets	Single-wall metal pipe (Section 626)
Direct-vent appliances	See Section 503.2.3
Appliances with integral vent	See Section 503.2.4

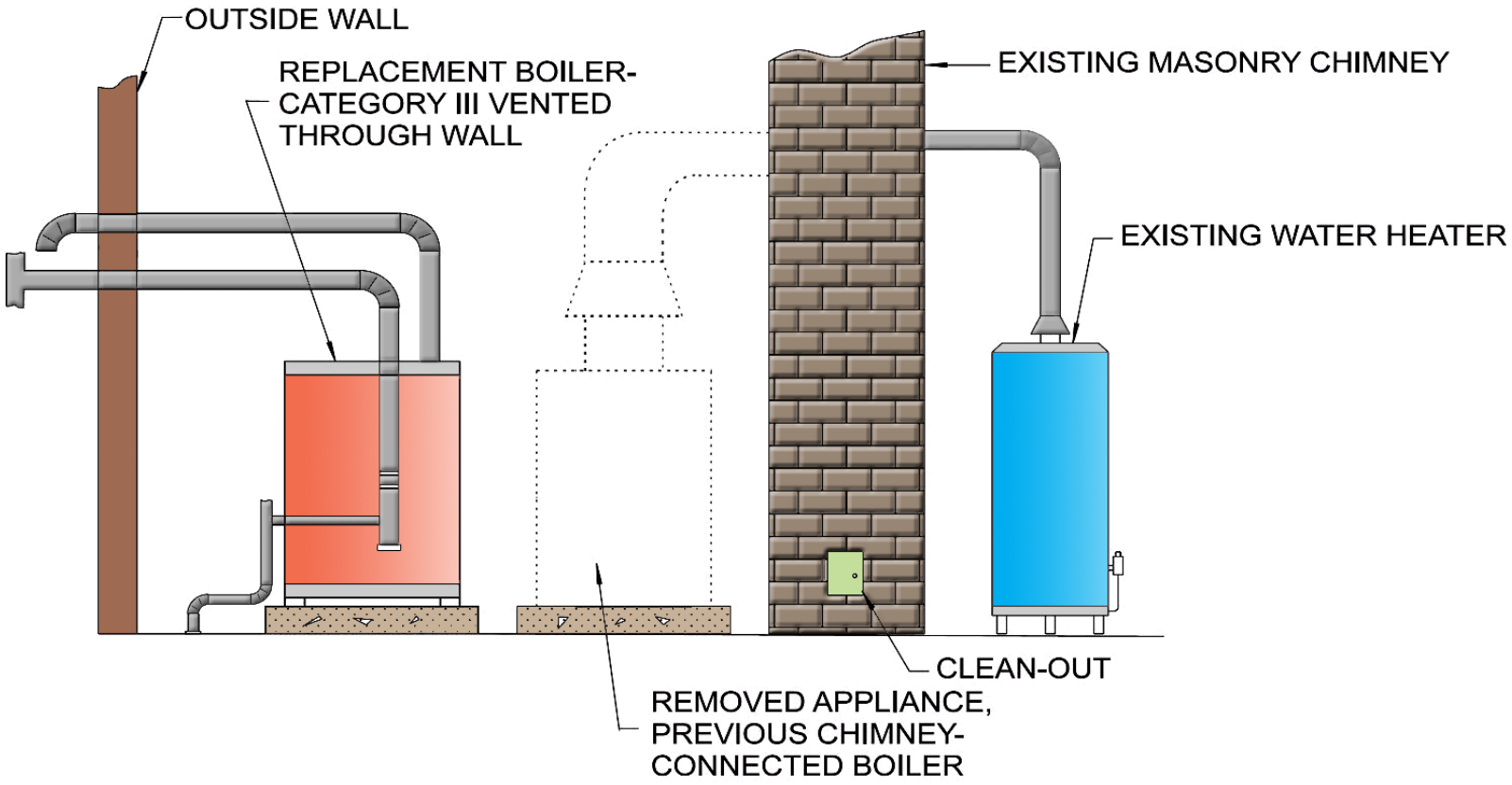
503.4.1 – Plastic piping



501.11 – Masonry chimneys

- Manufacturer's instructions for gas-fired appliances specify very limited conditions under which the appliance is allowed to vent to a masonry chimney.
- The conditions include: size; state or condition; location and construction of a chimney.

Existing Chimneys and Vents – 501.15



REMOVING BOILER AND LEAVING A WATER HEATER AS THE ONLY APPLIANCE VENTED TO THE CHIMNEY

Typical Manufacturer's Installation Instructions for Gas-fired Appliance

Installer's Guide

Note: When an existing furnace is removed from a venting system serving other appliances, the venting system is likely to be too large to properly vent the remaining attached appliances.

Examine the remaining vent system and size the vent or chimney for code compliance based on type, location and BTU

The following steps shall be followed with each appliance remaining connected to the common venting system placed in operation, while the other appliances remaining connected to the common system are in operation:

1. Seal any unused openings in the common venting system.

2. Visually inspect the venting system for proper size and horizontal pitch. Determine there is no blockage or restriction, leakage, corrosion or other deficiencies that could cause an unsafe condition.

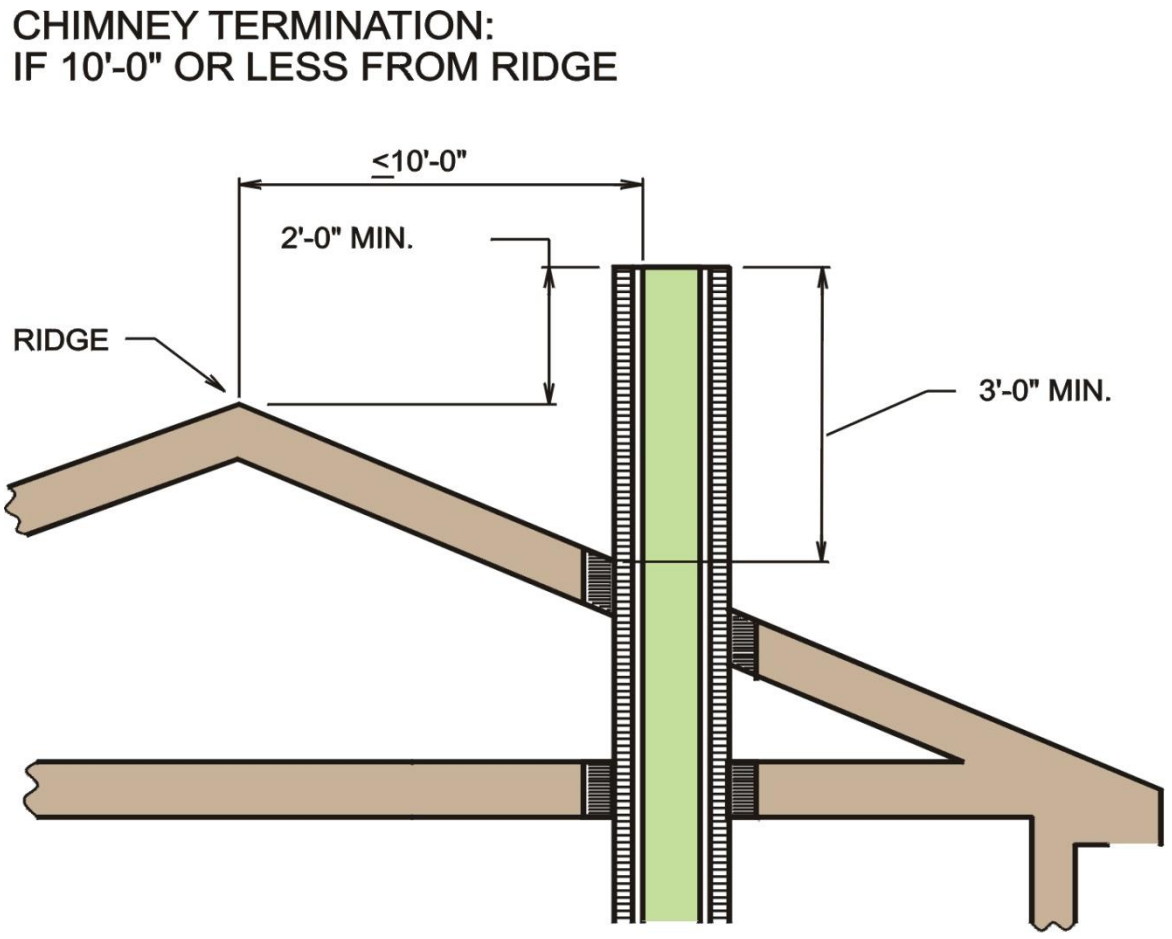
3. Insofar as practical, close all building doors and windows, and all doors between the space in which the appliances remaining connected to the common venting system are located and other spaces of the building. Turn on clothes dryers and any appliances not connected to the common venting system. Turn 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.

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

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

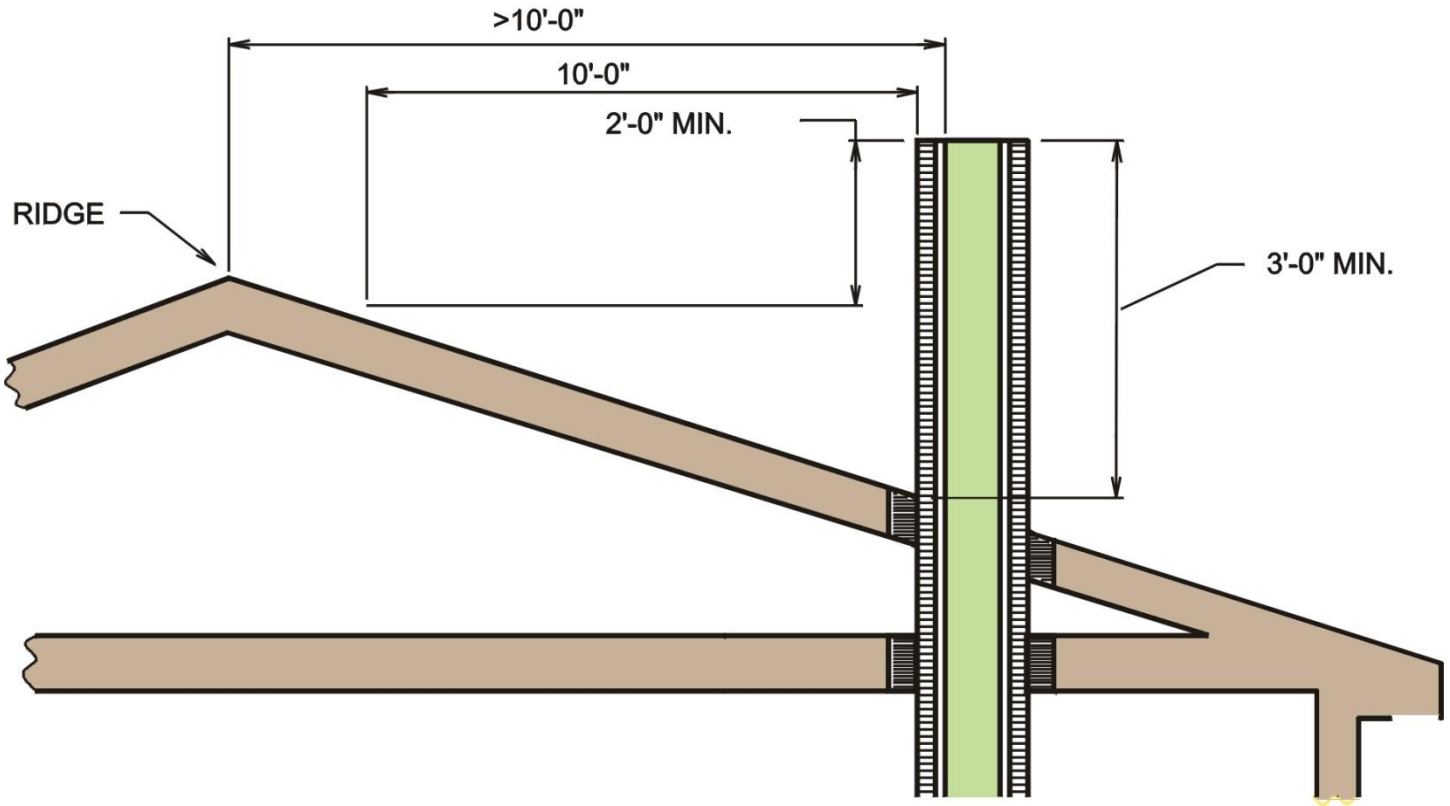
6. After it has been determined that each appliance remaining connected to the common venting system properly vents when tested as outlined above, return doors, windows, exhaust fans, fireplace dampers and any other gas-burning appliances to their previous condition of use.

501.3 and 503.5.3 – Masonry chimneys



501.3 and 503.5.3 – Masonry chimneys

CHIMNEY TERMINATION:
IF MORE THAN 10'-0" FROM RIDGE



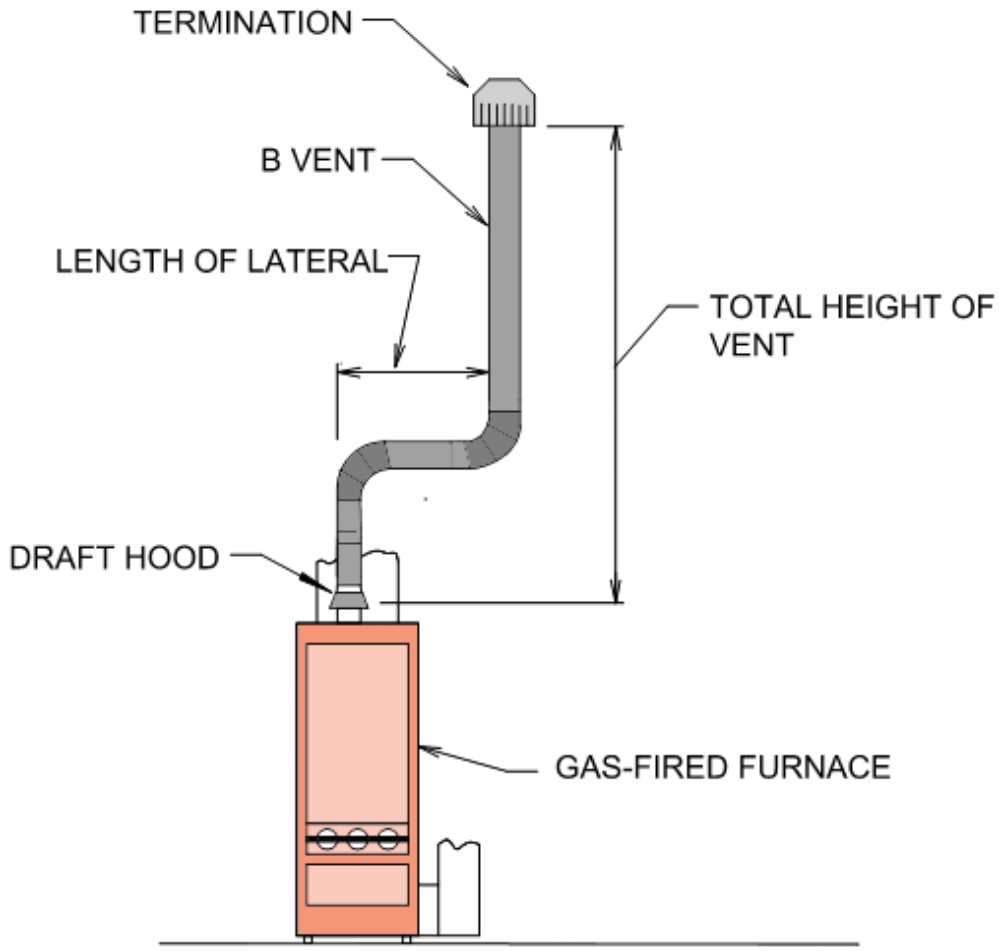
503.5.7.1 – Solid fuel-burning appliances

- Each appliance or fireplace must be provided with a dedicated independent chimney, or a dedicated independent flue in multiple-flue chimney constructions.
- Appliances and fireplaces cannot share a common chimney or flue-way with any other appliance or fireplace.
- If multiple appliances are vented together, a greater potential exists for a chimney fire or the discharge of combustion byproducts back into the building.

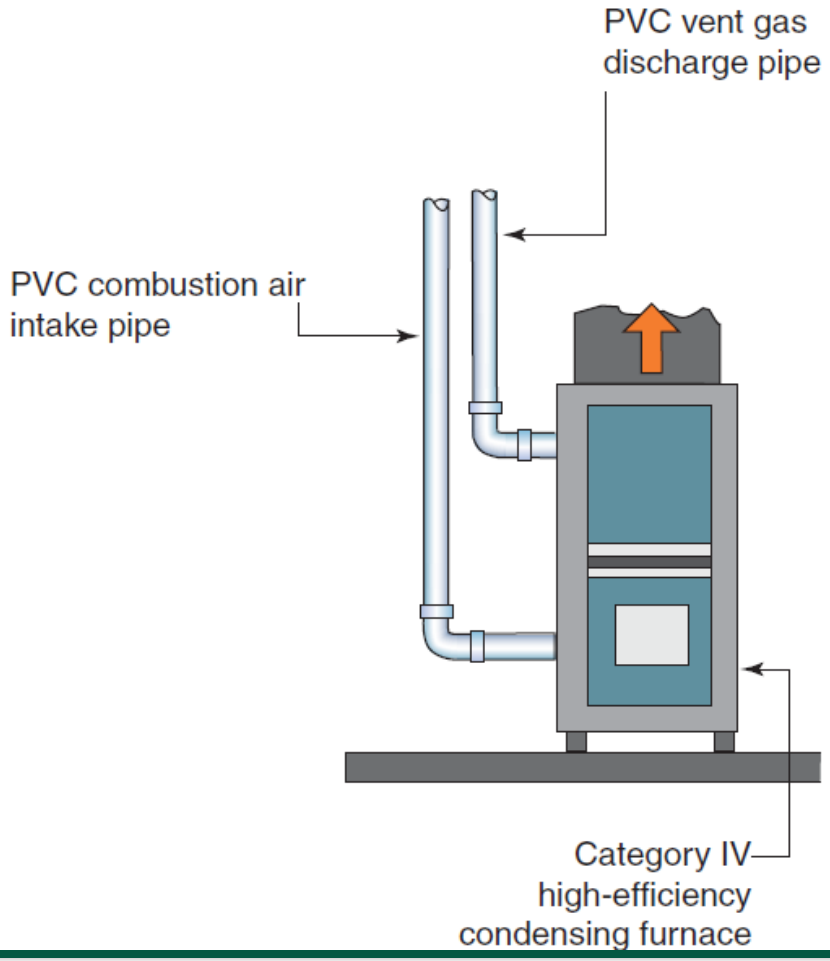
Decorative shrouds

- Decorative shrouds are intended to conceal chimney and vent terminations to improve the appearance of a building.
- Only specific listed/tested assemblies are allowed

Vent System Performance Factors



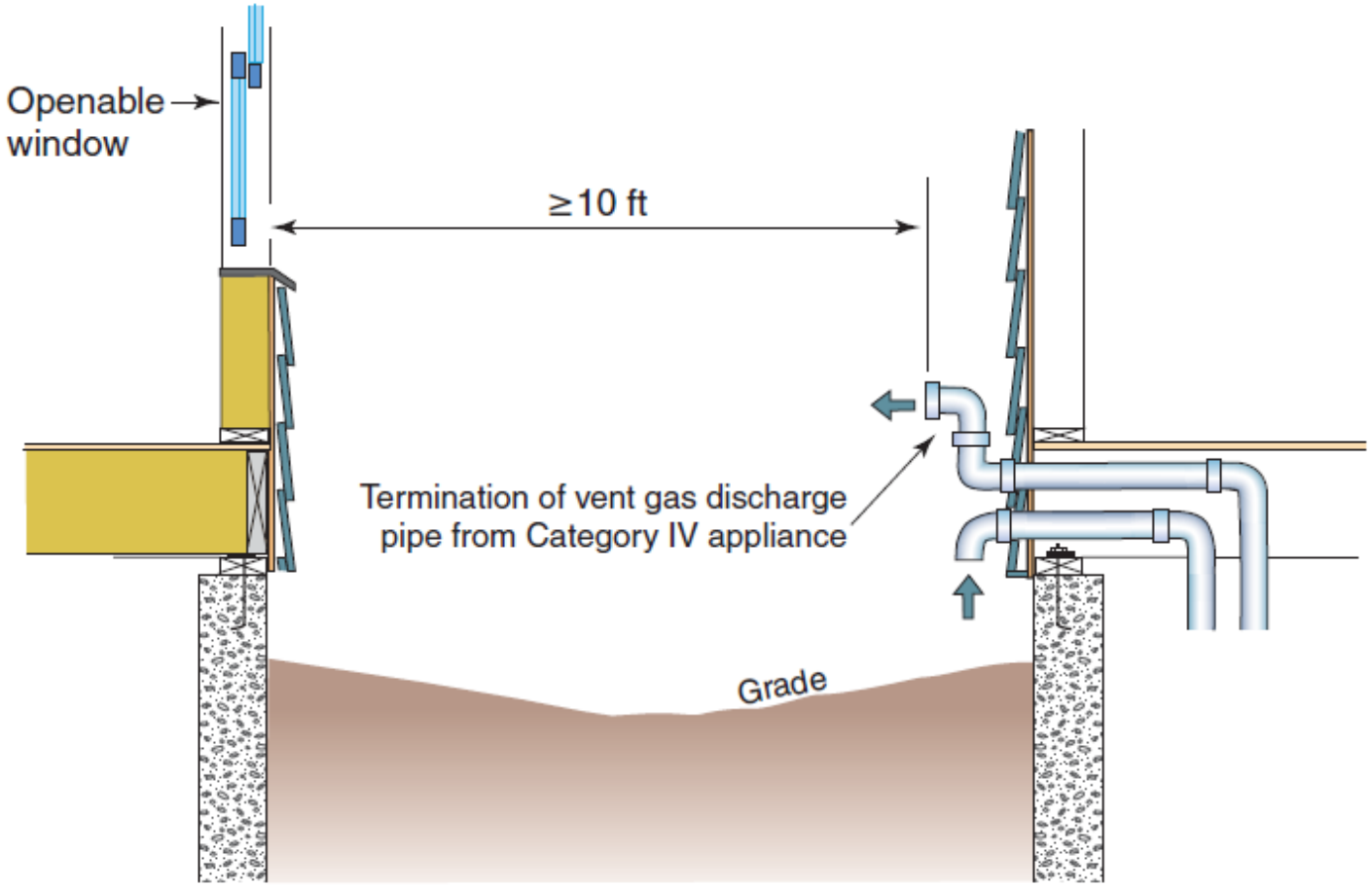
503.6.9.3 – Category II, III and IV appliance



503.6.10 – Gas vents serving appliances on more than one floor

- A common gas vent shall be permitted in multiple-story installations to vent Category I gas utilization equipment located on more than one floor level.
- Section 503.6.10.1 requires the appliances and venting system to be located in a space that does not communicate with living space.

503.8 – Venting system termination location



503.10 – Vent connectors for Category I appliances

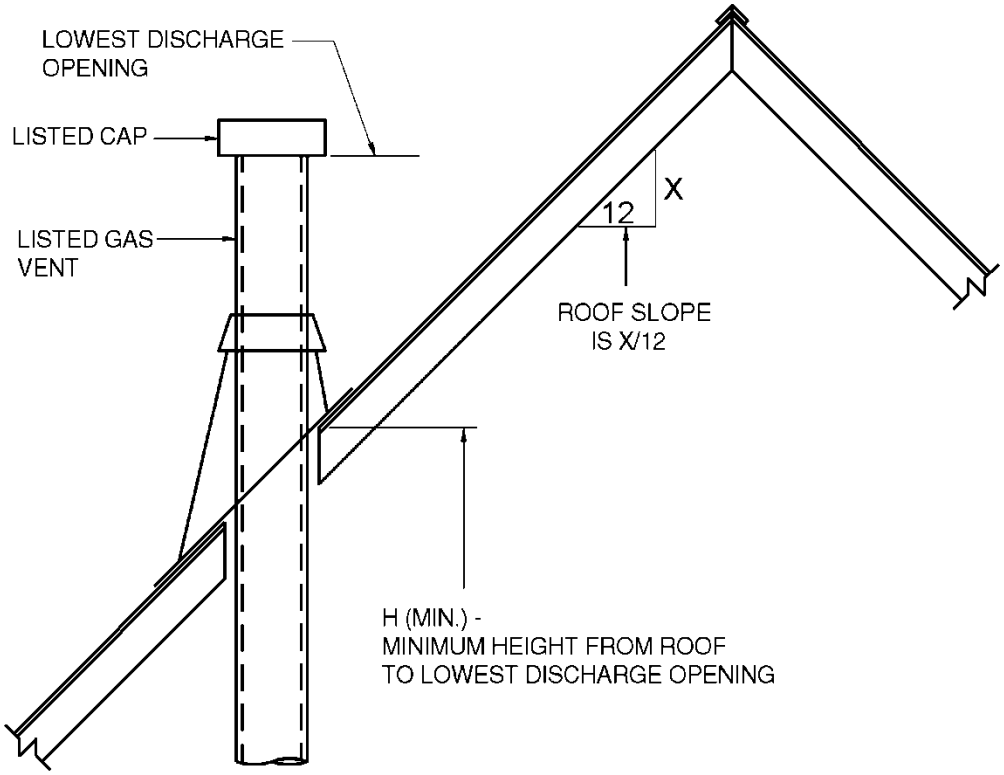
- Provide clean, outdoor air to the appliance (see Section 304.12); and
- Limit the length of wet time in the vent. The duration of wet time and attendant corrosion in a vent may be minimized in three ways:
  - Use a double-wall, Type B gas vent for the entire system, including connectors.
  - Use the smallest vent size allowed by the tables.

503.7.4 – Limitations of use

- 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 outdoor atmosphere.

Passage through ceilings, floors or walls – 503.10.8

ROOF SLOPE	H (min) ft
Flat to 6/12	1.0
Over 6/12 to 7/12	1.25
Over 7/12 to 8/12	1.5
Over 8/12 to 9/12	2.0
Over 9/12 to 10/12	2.5
Over 10/12 to 11/12	3.25
Over 11/12 to 12/12	4.0
Over 12/12 to 14/12	5.0
Over 14/12 to 16/12	6.0
Over 16/12 to 18/12	7.0
Over 18/12 to 20/12	7.5
Over 20/12 to 21/12	8.0



504.3.4 – Combined connectors

Offset

Common Vent System

All single wall fittings and pipe

504.3.5, 504.3.6 and 504.3.7 – Offsets

- Evaluation of a common vent system
  - Connectors are manifolded before the Type B vent. Ten-percent common vent capacity reduction (
  - Offset in the common vent at ceiling, using two, 45-degree (0.79 rad) elbows. Ten-percent common vent capacity reduction
  - Because the connector manifold is actually part of the common vent, it must be constructed of the same materials as the common vent (i.e., Type B vent)

504.3.5, 504.3.6 and 504.3.7 – Offsets

- Connector length limit
  - Connectors are necessary for chimney and vent systems that serve multiple appliances. To reduce friction loss and flue gas heat loss, and to conserve available draft, connectors must be kept to a minimum length

Connector Length Limit

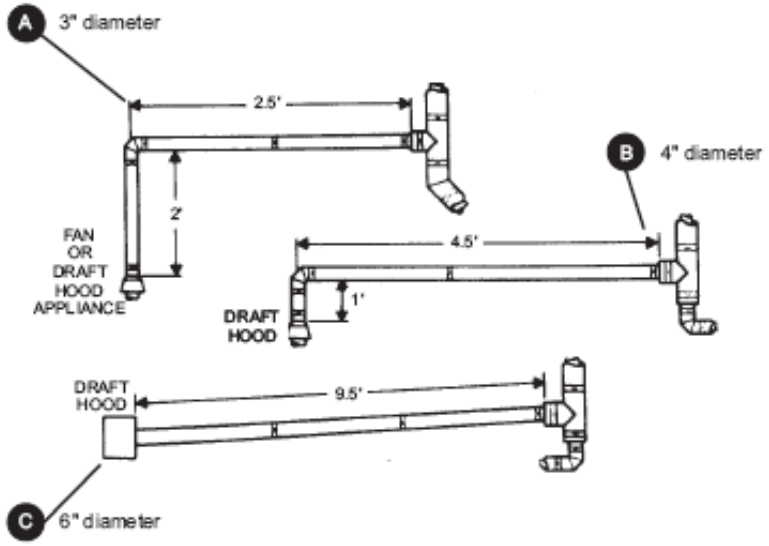


TABLE 504.3.2
MAXIMUM VENT CONNECTOR LENGTH

CONNECTOR DIAMETER (inches)	CONNECTOR MAXIMUM HORIZONTAL LENGTH (feet)
3	$4^1/_2$
4	6
5	$7^1/_2$
6	9
7	$10^1/_2$
8	12
9	$13^1/_2$
10	15
12	18
14	21
16	24
18	27
20	30
22	33
24	36

For SI: 1 inch = 25.4 mm, 1 foot = 304.8 mm.

Connector Length Limit

A:Actual connector length = 2.5

Max. allowed = 4.5

B:Actual connector length = 4.5

Max. allowed = 6.0

C: Actual connector length = 9.5

Max. allowed = 9.0

504.3.3 – Length alternative

- Maximum capacity of the vent connector shall be reduced by 10 percent for each additional multiple of maximum connector length permitted by Section 504.3.2.
- Minimum capacity for the fan-assisted appliance shall be determined by using Table 504.2(1) for Type B, double-wall connectors and Table 504.2(2) for single-wall connectors.

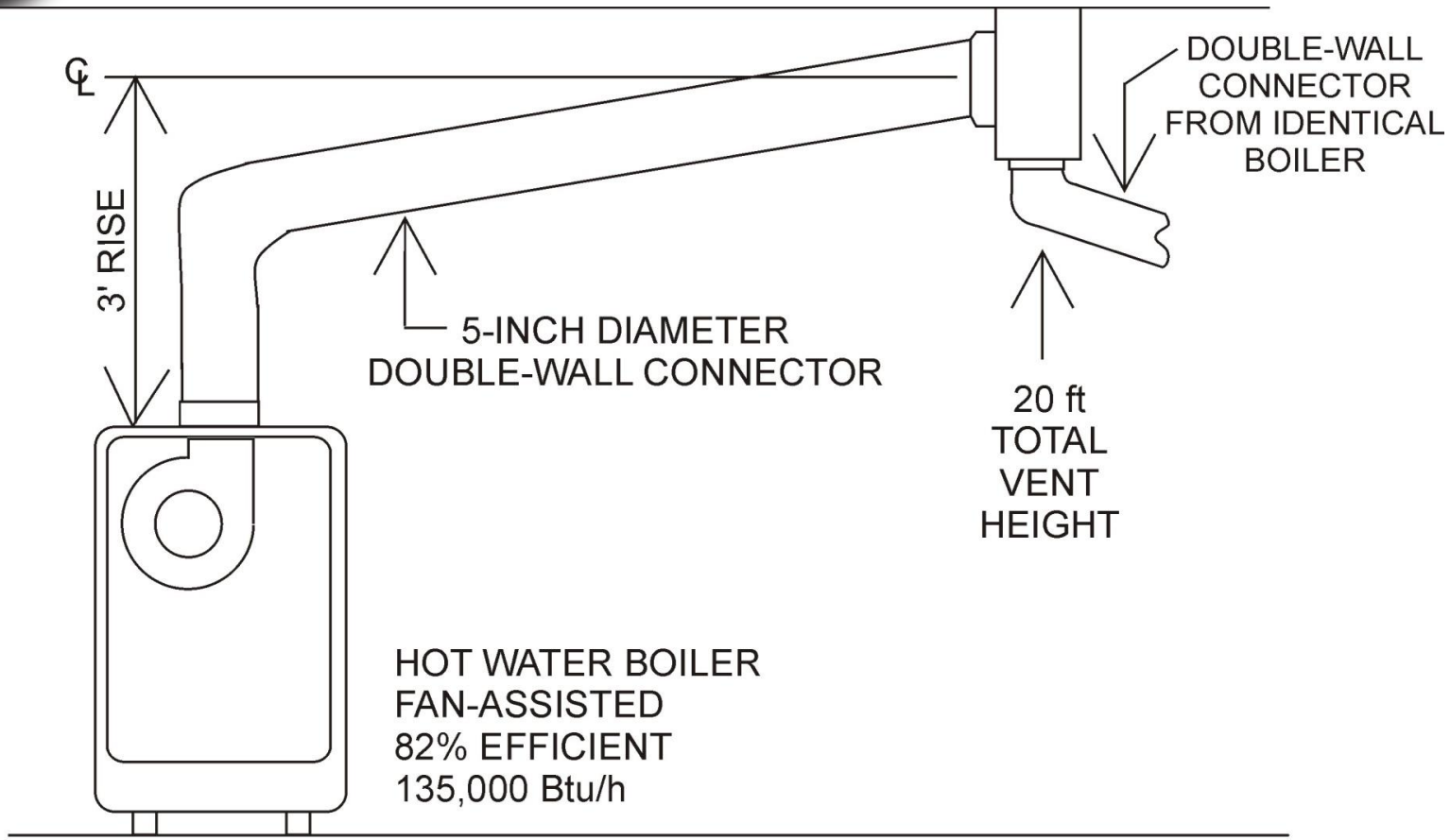
Length Alternative

TABLE 504.3.2
MAXIMUM VENT CONNECTOR LENGTH

CONNECTOR DIAMETER (inches)	CONNECTOR MAXIMUM HORIZONTAL LENGTH (feet)
3	$4^1/_2$
4	6
5	$7^1/_2$
6	9
7	$10^1/_2$
8	12
9	$13^1/_2$
10	15
12	18
14	21
16	24
18	27
20	30
22	33
24	36

For SI: 1 inch = 25.4 mm, 1 foot = 304.8 mm.

Length Alternative



For SI: 1 inch = 25.4 mm, 1 foot = 304.8 mm.

Length Alternative

1. Determine maximum allowable vent connector length
   - Use Table 504.3.2
   - 5 inch connector diameter
   - 7 ½ feet.

225

Length Alternative

2. Determine absolute maximum allowable vent connector length
   - Use Section 503.10.9
   - 5 inch connector diameter
   - 20 feet.

195

Number of Appliances	Two or more
Appliance Type	Category I
Appliance Vent Connection	Type B double-wall connector

TABLE 504.3(1)
TYPE B DOUBLE-WALL VENT

VENT CONNECTOR CAPACITY

VENT HEIGHT *(H)* (feet)	CONNECTOR RISE *(R)* (feet)	TYPE B DOUBLE-WALL VENT AND CONNECTOR DIAMETER—*(D)* inches																							
		3			4			5			6			7			8			9			10		
		APPLIANCE INPUT RATING LIMITS IN THOUSANDS OF BTU/H																							
		FAN		NAT	FAN		NAT	FAN		NAT	FAN		NAT	FAN		NAT	FAN		NAT	FAN		NAT	FAN		NAT
		Min	Max	Max	Min	Max	Max	Min	Max	Max	Min	Max	Max	Min	Max	Max	Min	Max	Max	Min	Max	Max	Min	Max	Max
6	1	22	37	26	35	66	46	46	106	72	58	164	104	77	225	142	92	296	185	109	376	237	128	466	289
	2	23	41	31	37	75	55	48	121	86	60	183	124	79	253	168	95	333	220	112	424	282	131	526	345
	3	24	44	35	38	81	62	49	132	96	62	199	139	82	275	189	97	363	248	114	463	317	134	575	386
8	1	22	40	27	35	72	48	49	114	76	64	176	109	84	243	148	100	320	194	118	408	248	138	507	303
	2	23	44	32	36	80	57	51	128	90	66	195	129	86	269	175	103	356	230	121	454	294	141	564	358
	3	24	47	36	37	87	64	53	139	101	67	210	145	88	290	198	105	384	258	123	492	330	143	612	402
10	1	22	43	28	34	78	50	49	123	78	65	189	113	89	257	154	106	341	200	125	436	257	146	542	314
	2	23	47	33	36	86	59	51	136	93	67	206	134	91	282	182	109	374	238	128	479	305	149	596	372
	3	24	50	37	37	92	67	52	146	104	69	220	150	94	303	205	111	402	268	131	515	342	152	642	417
15	1	21	50	30	33	89	53	47	142	83	64	220	120	88	298	163	110	389	214	134	493	273	162	609	333
	2	22	53	35	35	96	63	49	153	99	66	235	142	91	320	193	112	419	253	137	532	323	165	658	394
	3	24	55	40	36	102	71	51	163	111	68	248	160	93	339	218	115	445	286	140	565	365	167	700	444
20	1	21	54	31	33	99	56	46	157	87	62	246	125	86	334	171	107	436	224	131	552	285	158	681	347
	2	22	57	37	34	105	66	48	167	104	64	259	149	89	354	202	110	463	265	134	587	339	161	725	414
	3	23	60	42	35	110	74	50	176	116	66	271	168	91	371	228	113	486	300	137	618	383	164	764	466
30	1	20	62	33	31	113	59	45	181	93	60	288	134	83	391	182	103	512	238	125	649	305	151	802	372
	2	21	64	39	33	118	70	47	190	110	62	299	158	85	408	215	105	535	282	129	679	360	155	840	439
	3	22	66	44	34	123	79	48	198	124	64	309	178	88	423	242	108	555	317	132	706	405	158	874	494
50	1	19	71	36	30	133	64	43	216	101	57	349	145	78	477	197	97	627	257	120	797	330	144	984	403
	2	21	73	43	32	137	76	45	223	119	59	358	172	81	490	234	100	645	306	123	820	392	148	1,014	478
	3	22	75	48	33	141	86	46	229	134	61	366	194	83	502	263	103	661	343	126	842	441	151	1,043	538
100	1	18	82	37	28	158	66	40	262	104	53	442	150	73	611	204	91	810	266	112	1,038	341	135	1,285	417
	2	19	83	44	30	161	79	42	267	123	55	447	178	75	619	242	94	822	316	115	1,054	405	139	1,306	494
	3	20	84	50	31	163	89	44	272	138	57	452	109	78	627	272	97	834	355	118	1,069	455	142	1,327	555

TABLE 504.2(1)—continued
TYPE B DOUBLE-WALL GAS VENT

Number of Appliances	Single
Appliance Type	Category I
Appliance Vent Connection	Connected directly to vent

HEIGHT (H) (feet)	LATERAL (L) (feet)	VENT DIAMETER—(D) inches																							
		10			12			14			16			18			20			22			24		
		APPLIANCE INPUT RATING IN THOUSANDS OF BTU/H																							
		FAN		NAT	FAN		NAT	FAN		NAT	FAN		NAT	FAN		NAT	FAN		NAT	FAN		NAT	FAN		NAT
		Min	Max	Max	Min	Max	Max	Min	Max	Max	Min	Max	Max	Min	Max	Max	Min	Max	Max	Min	Max	Max	Min	Max	Max
15	0	0	1,596	840	0	2,380	1,240	0	3,323	1,720	0	4,423	2,270	0	5,678	2,900	0	7,099	3,620	0	8,665	4,410	0	10,393	5,300
	2	63	1,019	675	86	1,495	985	114	2,062	1,350	147	2,719	1,770	186	3,467	2,260	239	4,304	2,800	290	5,232	3,410	346	6,251	4,080
	5	105	1,003	660	140	1,476	967	182	2,041	1,327	229	2,696	1,748	283	3,442	2,235	355	4,278	2,777	426	5,204	3,385	501	6,222	4,057
	10	135	977	635	177	1,446	936	227	2,009	1,289	283	2,659	1,712	346	3,402	2,193	432	4,234	2,739	510	5,159	3,343	599	6,175	4,019
	15	155	953	610	202	1,418	905	257	1,976	1,250	318	2,623	1,675	385	3,363	2,150	479	4,192	2,700	564	5,115	3,300	665	6,129	3,980
20	0	0	1,756	930	0	2,637	1,350	0	3,701	1,900	0	4,948	2,520	0	6,376	3,250	0	7,988	4,060	0	9,785	4,980	0	11,753	6,000
	2	59	1,150	755	81	1,694	1,100	107	2,343	1,520	139	3,097	2,000	175	3,955	2,570	220	4,916	3,200	269	5,983	3,910	321	7,154	4,700
	5	101	1,133	738	135	1,674	1,079	174	2,320	1,498	219	3,071	1,978	270	3,926	2,544	337	4,885	3,174	403	5,950	3,880	475	7,119	4,662
	10	130	1,105	710	172	1,641	1,045	220	2,282	1,460	273	3,029	1,940	334	3,880	2,500	413	4,835	3,130	489	5,896	3,830	573	7,063	4,600
	15	150	1,078	688	195	1,609	1,018	248	2,245	1,425	306	2,988	1,910	372	3,835	2,465	459	4,786	3,090	541	5,844	3,795	631	7,007	4,575
	20	167	1,052	665	217	1,578	990	273	2,210	1,390	335	2,948	1,880	404	3,791	2,430	495	4,737	3,050	585	5,792	3,760	689	6,953	4,550

(continued)

Length Alternative

3. Evaluate steps 1 and 2
   - Apply the more restrictive criteria, or
   - Apply connector length alternative provisions of Section 504.3.3

30

Length Alternative

4. Extend the vent connector maximum length to 15 feet, a 10-percent capacity reduction is applied to ity of 176,000 B

[176,000 x

$$(A/B \times C) + D$$

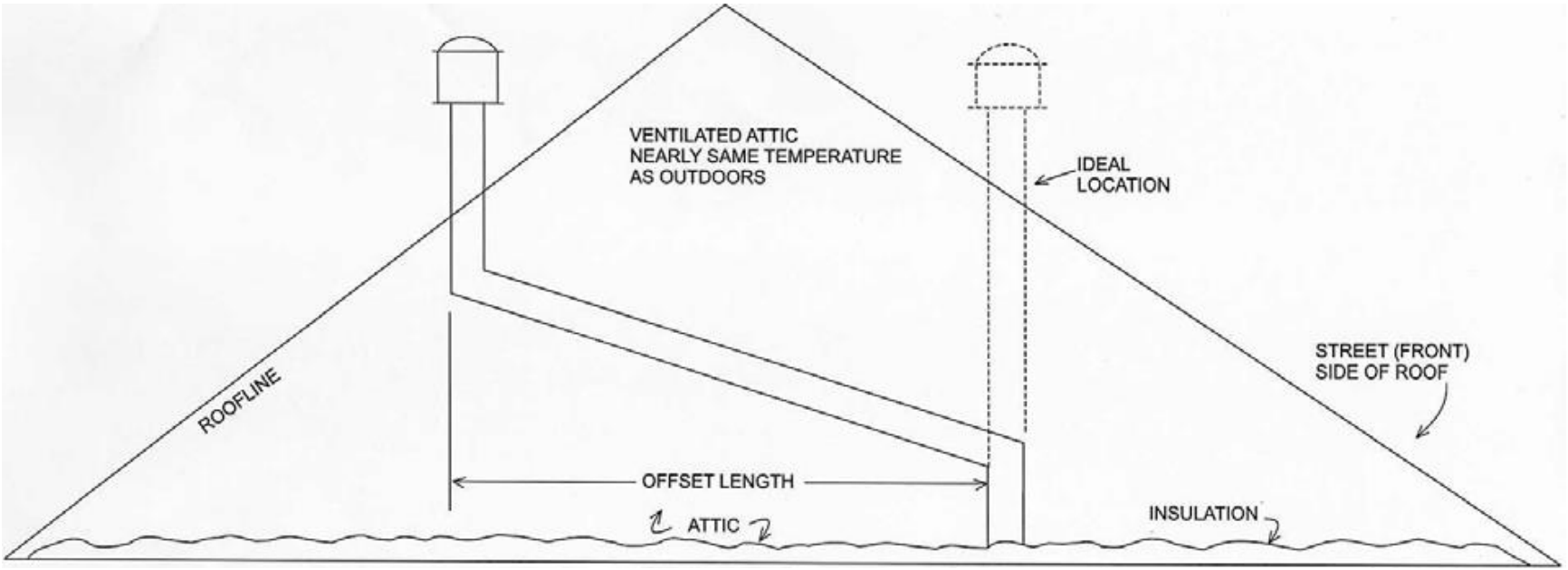
$$(2.5/5 \times 30) + 195 =$$

$$(1/2 \times 30) + 195 =$$

$$15 + 195 = 210$$

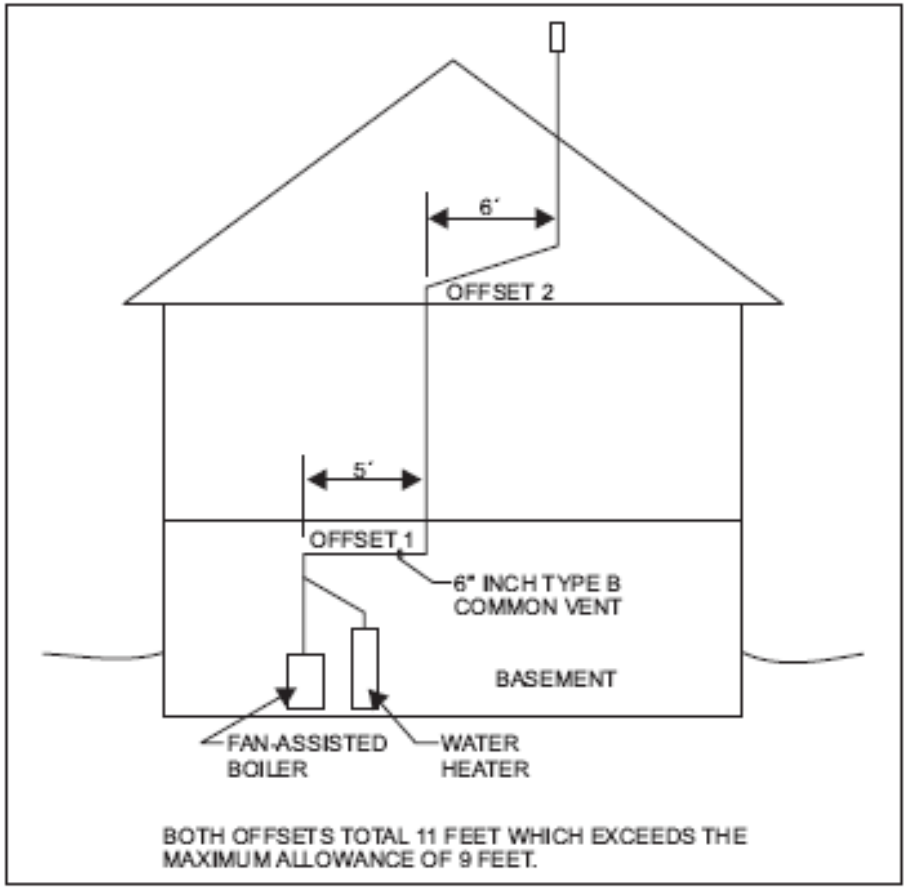
- The 158,000 than the boiler inp
- The boiler input exceeds the minimum required input of 59,000 Btu/h in Tables 504.2(1) (see 504.3.3, Condition 2).

Common Vent offsets – 504.3.5



Offset in Attic to Avoid Streetside Roof Penetration

Common vertical vent offset – 504.3.5



504.3.6 – Elbows in vents

- Each and every fitting that creates a change in direction (elbow) causes a capacity reduction penalty to be applied to the common vent.
  - Not greater than 45 degrees (0.79 rad) is a 5-percent penalty.
  - Greater than 45 degrees (0.79 rad) is a 10-percent penalty.

504.3.7 – Elbows in connectors

- Each fitting above and beyond the two “free” elbows causes a capacity reduction penalty to be applied to the connector.
  - Not greater than 45 degrees (0.79 rad) is a 5-percent penalty.
  - Greater than 45 degrees (0.79 rad) is a 10-percent penalty.

504.2.8 – Vent area and diameter 504.3.17 – Vertical vent maximum size

The area of a 4-inch (102 mm) appliance draft outlet is:

$\pi R^2 =$

$\pi 2^2 =$

$3.141 \times 4 = 12.56 \text{ in}^2$

$12.56 \text{ in}^2 \times 7 = 87.9 \text{ in}^2$

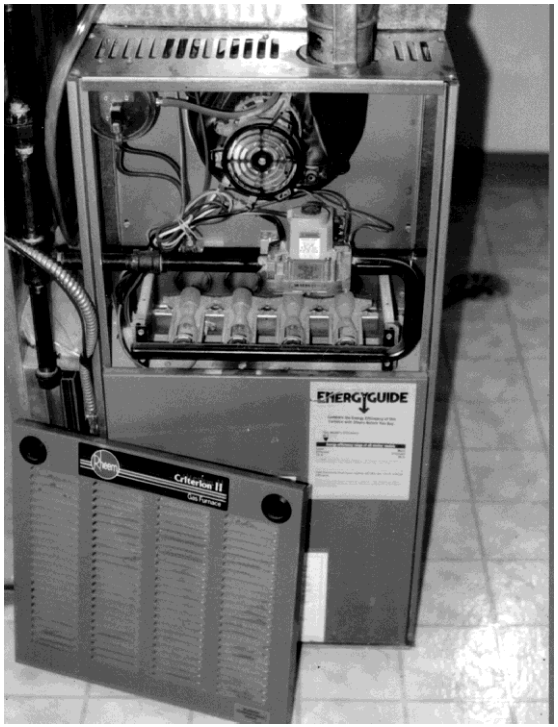
- 87.9 square inches (0.06 m2) is larger than the area of a 10-inch (254 mm) vent and smaller than the area of a 12-inch (305 mm) vent, therefore a 10-inch (254 mm) vent is the largest size vent to which the 4-inch (102 mm) draft hood could connect.

504.2.9 and 504.3.20 – Chimney and vent location

- Indicate that the sizing tables in Section 504 are not to be used for chimneys and vents exposed to the outdoors below the roof line. Provisions are included for enclosing Type B vents to prevent them from being exposed to wind and outdoor temperatures.

Tables 504.2(1) and 504.2(4)

- Central furnaces (forced air types)
- Low pressure boilers
- Water heaters
- Duct furnaces
- Unit heaters
- Vented room heaters
- Floor furnaces
- Conversion burners



504.2.2 – Minimum size

- Total vent height is a minimum of 10 feet (3048 mm);
- Vents for appliance draft hood outlets or flue collars 12 inches (305 mm) in diameter or less are not reduced more than one size;
- Vents for appliance draft hood outlets or flue collars greater than 12 inches (305 mm) in diameter are not reduced more than two sizes;

504.2.2 – Minimum size

- Maximum capacity listed in the tables for a fan-assisted appliance is reduced by 10 percent; and
- For other than fan-assisted appliances, the draft hood outlet is greater than 4 inches (102 mm) in diameter. A 3-inch-diameter (76 mm) vent cannot connect to a 4-inch-diameter (102 mm) draft hood outlet.

Vent offsets – 504.2.3

- To create a lateral (horizontal) run of vent or a vent connector, one or two elbows are necessary.
- Tables account for two 90-degree changes in direction.

504.2.6 – Multiple input rate appliances

AMERICAN STANDARD INC.
THE TRANE COMPANY
TRENTON, N.J. 08619
MADE IN U.S.A.

FORCED AIR FURNACE CATEGORY I

ANS Z21.47 - 1990 CENTRAL FURN

FOR INDOOR INSTALLATION IN A BUILDING CONSTRUCTED ON SITE.

NRTL

MODEL NO.	SERIAL NO.	EQUIPPED FOR
TUD080R936A1	G36515785	NAT. GAS
INPUT 80,000 BTU/HR.	LIMIT SETTING 190 °F	MFRD. 05/92
TEMP. RISE °F FROM 30 TO 60	MAX. EXT. STATIC PRESS .50 INCHES WATER	MAX. DESIGN AIR TEMP. 100 °F
VOLTS/PHASE/HERTZ 115/1/60	TOTAL AMPS 8.5	SERVICE CODE 1

FLAME ROLLOUT SWITCH - REPLAC IF BLOWN WITH CATALOG No. WG05X033 (323 F CUTOFF TEMP.) ONE TIME THERMAL FUSE.

MANIFOLD PRESSURE (IN INCHES OF WATER) NAT. 3.5 LP 10.5
SUPPLY PRESSURE (IN INCHES OF WATER) MAX. NAT. 10.5, L P 13.0
MIN. NAT. 4.5L P 11.0 FOR PURPOSE OF INPUT ADJUSTMENT.

LOW INPUT 52,000 BTU/HR

MINIMUM CLEARANCE COMBUSTIBLE MATERIALS:

FOR CLOSET INSTALLATION AS FOLLOWS:

SIDES	0	IN. W/SINGLE WALL VENT			
FLUE	6	IN. W/SINGLE WALL VENT	1	IN. W/TYPE B-1	VENT
FRONT	6	IN.	BACK 0	IN.	TOP 1 IN.

Multiple Input Rated Appliance
Category I, Gas Forced-Air Furnace

504.2.7 – Liner system sizing and connections

- Corrugated metal vent systems installed with bends or offsets shall have their maximum capacity
- Corrugated metal liners are constructed of semirigid piping having a higher flow resistance
- Chimney lining systems for chimneys serving gas-fired appliances include stainless steel and aluminum piping

504.2.8 – Vent area and diameter

- Maximum capacity of a venting system must be based on the component of the system having the least capacity; likewise, the minimum Btu/h (W) input required for proper vent system operation must be based on the largest component of the system, because the largest component will naturally have the highest minimum input requirement

504.2.9 – Chimney and vent locations

- Chimneys that have one or more walls exposed to the outdoors and unenclosed exterior vents can develop condensation and weak draft problems in cold weather.
- Chimney lined with a listed liner is to be sized as if it was a Type B vent

504.2.14 – Table interpolation

- Interpolated maximum vent capacity = (A/B x C) + D
- Interpolated minimum vent capacity = E - (A/B x F)

A. = Difference between the design height entry and the next lower height entry in the applicable table.

B. = Difference between the closest consecutive height entries in the applicable table.

C. = Difference between the maximum capacity column consecutive entries in the applicable table.

D. = Lower capacity entry in the applicable table.

E. = Higher capacity entry in the applicable table.

F. = Difference between the minimum capacity column entries in the applicable table.

Height entries - 504.2.17 and 504.3.28

- Tables 504.2(1) through 504.2(6)
  - Actual height of a vent falls between entries in the height column
  - Either interpolation shall be used or the lower appliance input rating
- FAN MAX and NAT MAX column values and the higher appliance input rating shall be used for the FAN MIN column values.

Height entries - 504.2.17 and 504.3.28

- Consider a single, Category I appliance with an 8 inch B-vent height of 18 feet.
- The lateral offset is 5 feet and the B-vent is directly connected to the appliance.

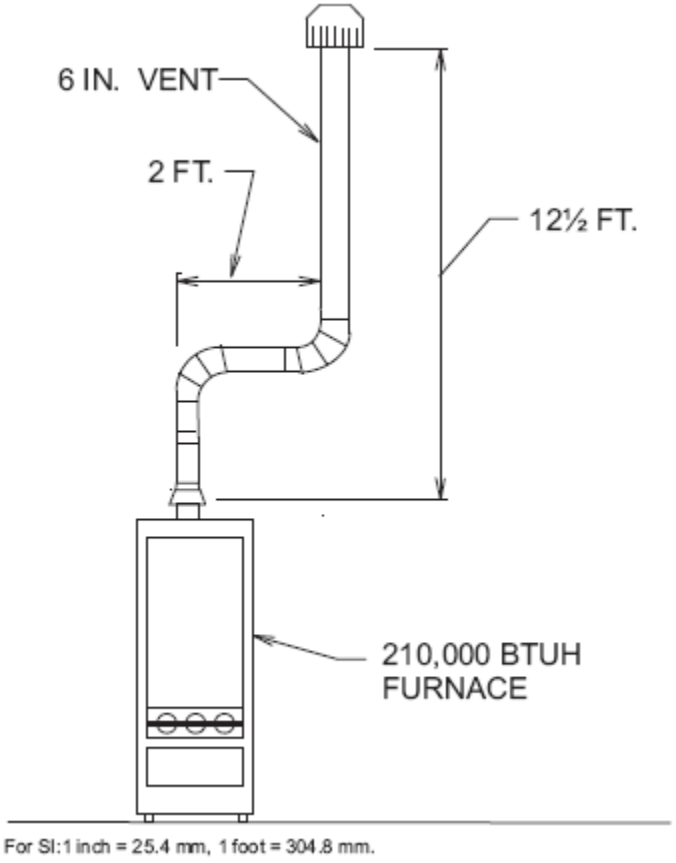
Refer to Table 504.2(1).
For FAN MAX and NAT MAX, use the values for the 15-foot (5486 mm) vent height with the 5-foot (1524 mm) lateral offset. Therefore, FAN MAX = 620 Btu/h
(182 W/hr) and NAT MAX = 403 Btu/h (118 W/hr).

For FAN MIN, use the value for the 15-foot (5486 mm) vent height with the 5- foot (1524 mm) lateral offset. Therefore, FAN MIN = 76 Btu/h (25 W/hr).

Refer to Table 504.2(1).

- For FAN MAX, the value for 15 feet (5486 mm) vent height with 5 foot (1524 mm) lateral offset is 620 Btu/h (182 W/hr) and the value for 20-foot (6096 mm) vent height with 5-foot (1524 mm) lateral offset is 697 Btu/h (204 W/hr).
- FAN MAX = [((18 feet - 15 feet)/ (20 feet - 15 feet)) x (697 Btu/h - 620 Btu/h)] + 620 Btu/h = 666 Btu/h
- For NAT MAX, the value for 15 feet (5486 mm) vent height with 5 foot (1524 mm) lateral offset is 403 Btu/h (118 W/hr) and the value for 20 feet (6096 mm) with 5 foot (1524 mm) lateral offset is 460 Btu/h (135 W/hr). NAT MAX = [((18 feet - 15 feet)/ (20 feet - 15 feet)) x (460 Btu/h - 403 Btu/h)] + 403 Btu/h = 437 Btu/h
- For FAN MIN, the value for 15 feet (5486 mm) vent height with 5 foot (1524 mm) lateral offset is 76 Btu/h (22 W/hr) and the value for 20 feet (6096 mm) with 5 foot (1524 mm) lateral offset is 73 Btu/h (21 W/hr). FAN MIN = 76 Btu/h - [((18 feet - 15 feet)/ (20 feet - 15 feet)) x (76 Btu/h – 73 Btu/h)] = 74 Btu/h

Table Interpolation



For SI: 1 inch = 25.4 mm, 1 foot = 304.8 mm.

Table Interpolation

Consider the system to have the following characteristics:

- Vent type is Type B from furnace connection to terminal
- Input rating of draft hood furnace = 210,000 Btu/h (61,545 W/hr)
- Vertical design height of vent = $12^{1}/_{2}$ feet (3810 mm)
- Diameter of vent = 6 inches (152 mm)
- Length of lateral = 2 feet (610 mm)

Table Interpolation

TABLE 504.2(1)
TYPE B DOUBLE-WALL GAS VENT

Number of Appliances	Single
Appliance Type	Category I
Appliance Vent Connection	Connected directly to vent

HEIGHT (H) (feet)	LATERAL (L) (feet)	VENT DIAMETER—(D) inches																					
		3			4			5			6			7			8			9			
		APPLIANCE INPUT RATING IN THOUSANDS OF BTU/H																					
		FAN		NAT	FAN		NAT	FAN		NAT	FAN		NAT	FAN		NAT	FAN		NAT	FAN		NAT
		Min	Max	Max	Min	Max	Max	Min	Max	Max	Min	Max	Max	Min	Max	Max	Min	Max	Max	Min	Max	Max
6	0	0	78	46	0	152	86	0	251	141	0	375	205	0	524	285	0	698	370	0	897	470
	2	13	51	36	18	97	67	27	157	105	32	232	157	44	321	217	53	425	285	63	543	370
	4	21	49	34	30	94	64	39	153	103	50	227	153	66	316	211	79	419	279	93	536	362
	6	25	46	32	36	91	61	47	149	100	59	223	149	78	310	205	93	413	273	110	530	354
8	0	0	84	50	0	165	94	0	276	155	0	415	235	0	583	320	0	780	415	0	1,006	537
	2	12	57	40	16	109	75	25	178	120	28	263	180	42	365	247	50	483	322	60	619	418
	5	23	53	38	32	103	71	42	171	115	53	255	173	70	356	237	83	473	313	99	607	407
	8	28	49	35	39	98	66	51	164	109	64	247	165	84	347	227	99	463	303	117	596	396
10	0	0	88	53	0	175	100	0	295	166	0	447	255	0	631	345	0	847	450	0	1,096	585
	2	12	61	42	17	118	81	23	194	129	26	289	195	40	402	273	48	533	355	57	684	457
	5	23	57	40	32	113	77	41	187	124	52	280	188	68	392	263	81	522	346	95	671	446
	10	30	51	36	41	104	70	54	176	115	67	267	175	88	376	245	104	504	330	122	651	427
15	0	0	94	58	0	191	112	0	327	187	0	502	285	0	716	390	0	970	525	0	1,263	682
	2	11	69	48	15	136	93	20	226	150	22	339	225	38	475	316	45	633	414	53	815	544
	5	22	65	45	30	130	87	39	219	142	49	330	217	64	463	300	76	620	403	90	800	529
	10	29	59	41	40	121	82	51	206	135	64	315	208	84	445	288	99	600	386	116	777	507
	15	35	53	37	48	112	76	61	195	128	76	301	198	98	429	275	115	580	373	134	755	491
20	0	0	97	61	0	202	119	0	349	202	0	540	307	0	776	430	0	1,057	575	0	1,384	752
	2	10	75	51	14	149	100	18	250	166	20	377	249	33	531	346	41	711	470	50	917	612
	5	21	71	48	29	143	96	38	242	160	47	367	241	62	519	337	73	697	460	86	902	599
	10	28	64	44	38	133	89	50	229	150	62	351	228	81	499	321	95	675	443	112	877	576
	15	34	58	40	46	124	84	59	217	142	73	337	217	94	481	308	111	654	427	129	853	557
	20	48	52	35	55	116	78	69	206	134	84	322	206	107	464	295	125	634	410	145	830	537

(continued)

Table Interpolation

- **Step 1:** Find the maximum vent capacity (MAX) at the first height entry greater than
  - 121/2 feet, [i.e., 15 feet].
- **Step 2:** Find the maximum vent capacity (MAX) at the next height entry lower than
  - 121/2 feet, [i.e., 10 feet].

Table Interpolation

- **Step 3:** Determine the difference between the two maximum vent capacities.
- **Step 4**: Determine the maximum vent capacity for a 121/2-foot-high (3810 mm) vent.

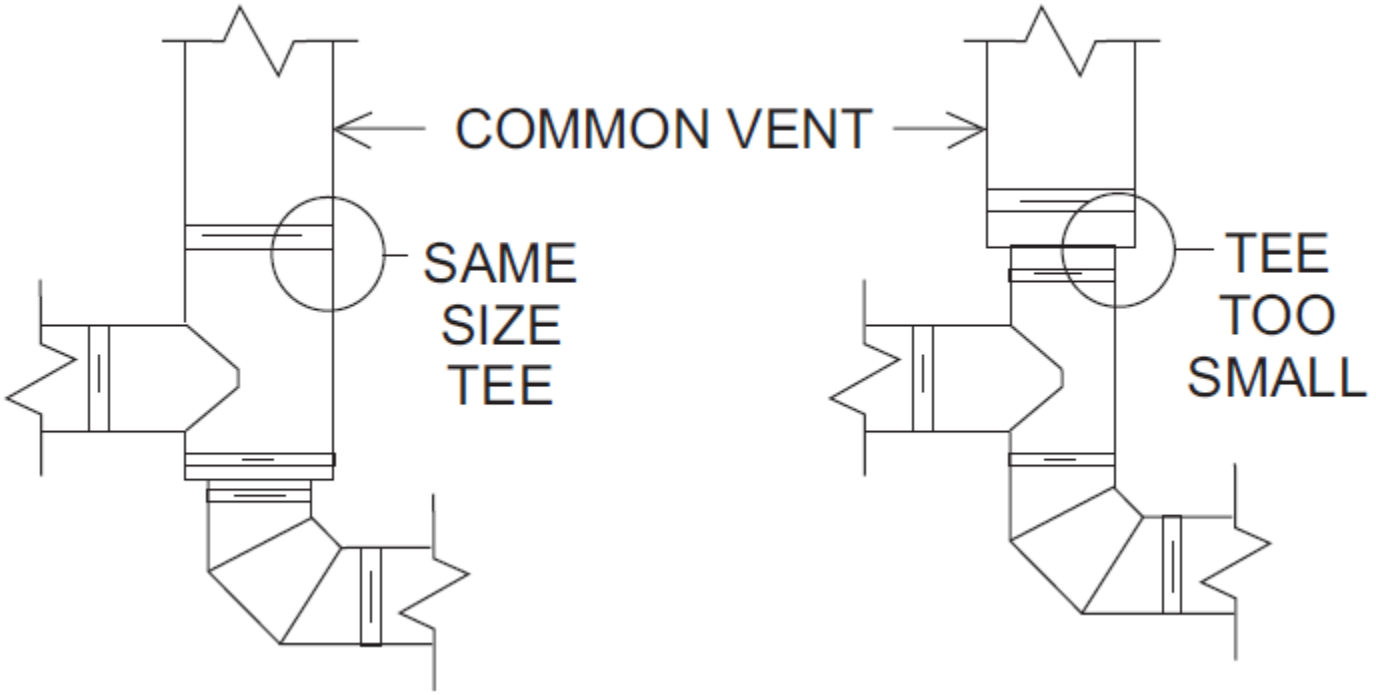
Sizing Venting System: Two or More Appliances – 504.3

- A common vent is a vent for two or more appliances on the same floor level
- Must be designed to vent products of combustion when:
  - Any one
  - Any combination, and
  - All of the connected appliances operate

Sizing Venting System: Two or More Appliances

- Connector, for purposes of designing a common vent
  - Is that part of the vent piping between the appliance outlet and its junction with the rest of the system
  - For each connector the correct size must be found

Vent fitting – 504.3.9



Common Vent Fittings

Tee and wye fittings – 504.3.9.1

- This code section requires tees and wyes used in common vent systems to be constructed of the same materials as the common vent.

Height and Rise Measurements – 504.3.11 & 504.3.12

- Least total height
  - Vertical distance from highest appliance outlet to lowest discharge opening of vent cap
- Least total height is used for vent sizing for all connected appliances on one floor level.

Size B vent system

- Rise Measurement - Rise (R)
  - Vertical distance from the draft hood outlet or flue collar to the level where the vent gas streams merge

Size B vent system

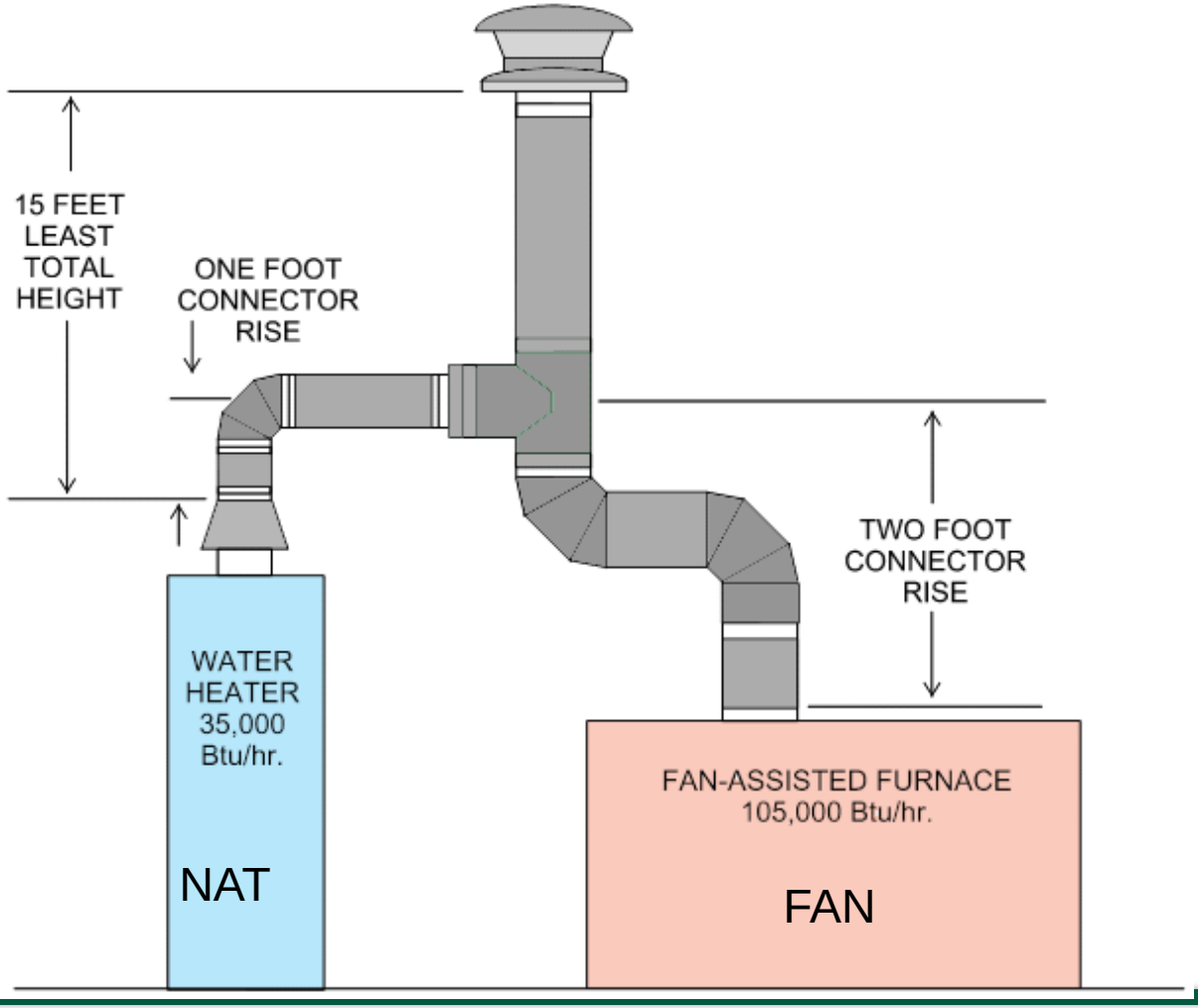


TABLE 504.3(1)
TYPE B DOUBLE-WALL VENT

Number of Appliances	Two or more
Appliance Type	Category I
Appliance Vent Connection	Type B double-wall connector

VENT CONNECTOR CAPACITY

VENT HEIGHT *(H)* (feet)	CONNECTOR RISE *(R)* (feet)	TYPE B DOUBLE-WALL VENT AND CONNECTOR DIAMETER—*(D)* inches																							
		3			4			5			6			7			8			9			10		
		APPLIANCE INPUT RATING LIMITS IN THOUSANDS OF BTU/H																							
		FAN		NAT	FAN		NAT	FAN		NAT	FAN		NAT	FAN		NAT	FAN		NAT	FAN		NAT	FAN		NAT
		Min	Max	Max	Min	Max	Max	Min	Max	Max	Min	Max	Max	Min	Max	Max	Min	Max	Max	Min	Max	Max	Min	Max	Max
6	1	22	37	26	35	66	46	46	106	72	58	164	104	77	225	142	92	296	185	109	376	237	128	466	289
	2	23	41	31	37	75	55	48	121	86	60	183	124	79	253	168	95	333	220	112	424	282	131	526	345
	3	24	44	35	38	81	62	49	132	96	62	199	139	82	275	189	97	363	248	114	463	317	134	575	386
8	1	22	40	27	35	72	48	49	114	76	64	176	109	84	243	148	100	320	194	118	408	248	138	507	303
	2	23	44	32	36	80	57	51	128	90	66	195	129	86	269	175	103	356	230	121	454	294	141	564	358
	3	24	47	36	37	87	64	53	139	101	67	210	145	88	290	198	105	384	258	123	492	330	143	612	402
10	1	22	43	28	34	78	50	49	123	78	65	189	113	89	257	154	106	341	200	125	436	257	146	542	314
	2	23	47	33	36	86	59	51	136	93	67	206	134	91	282	182	109	374	238	128	479	305	149	596	372
	3	24	50	37	37	92	67	52	146	104	69	220	150	94	303	205	111	402	268	131	515	342	152	642	417
15	1	21	50	30	33	89	53	47	142	83	64	220	120	88	298	163	110	389	214	134	493	273	162	609	333
	2	22	53	35	35	96	63	49	153	99	66	235	142	91	320	193	112	419	253	137	532	323	165	658	394
	3	24	55	40	36	102	71	51	163	111	68	248	160	93	339	218	115	445	286	140	565	365	167	700	444
20	1	21	54	31	33	99	56	46	157	87	62	246	125	86	334	171	107	436	224	131	552	285	158	681	347
	2	22	57	37	34	105	66	48	167	104	64	259	149	89	354	202	110	463	265	134	587	339	161	725	414
	3	23	60	42	35	110	74	50	176	116	66	271	168	91	371	228	113	486	300	137	618	383	164	764	466
30	1	20	62	33	31	113	59	45	181	93	60	288	134	83	391	182	103	512	238	125	649	305	151	802	372
	2	21	64	39	33	118	70	47	190	110	62	299	158	85	408	215	105	535	282	129	679	360	155	840	439
	3	22	66	44	34	123	79	48	198	124	64	309	178	88	423	242	108	555	317	132	706	405	158	874	494
50	1	19	71	36	30	133	64	43	216	101	57	349	145	78	477	197	97	627	257	120	797	330	144	984	403
	2	21	73	43	32	137	76	45	223	119	59	358	172	81	490	234	100	645	306	123	820	392	148	1,014	478
	3	22	75	48	33	141	86	46	229	134	61	366	194	83	502	263	103	661	343	126	842	441	151	1,043	538
100	1	18	82	37	28	158	66	40	262	104	53	442	150	73	611	204	91	810	266	112	1,038	341	135	1,285	417
	2	19	83	44	30	161	79	42	267	123	55	447	178	75	619	242	94	822	316	115	1,054	405	139	1,306	494
	3	20	84	50	31	163	89	44	272	138	57	452	109	78	627	272	97	834	355	118	1,069	455	142	1,327	555

COMMON VENT CAPACITY

VENT HEIGHT (H) (feet)	4			5			6			7			8			9			10		
	COMBINED APPLIANCE INPUT RATING IN THOUSANDS OF BTU/H																				
	FAN +FAN	FAN +NAT	NAT +NAT	FAN +FAN	FAN +NAT	NAT +NAT	FAN +FAN	FAN +NAT	NAT +NAT	FAN +FAN	FAN +NAT	NAT +NAT	FAN +FAN	FAN +NAT	NAT +NAT	FAN +FAN	FAN +NAT	NAT +NAT	FAN +FAN	FAN +NAT	NAT +NAT
6	92	81	65	140	116	103	204	161	147	309	248	200	404	314	260	547	434	335	672	520	410
8	101	90	73	155	129	114	224	178	163	339	275	223	444	348	290	602	480	378	740	577	465
10	110	97	79	169	141	124	243	194	178	367	299	242	477	377	315	649	522	405	800	627	495
15	125	112	91	195	164	144	283	228	206	427	352	280	556	444	365	753	612	465	924	733	565
20	136	123	102	215	183	160	314	255	229	475	394	310	621	499	405	842	688	523	1,035	826	640
30	152	138	118	244	210	185	361	297	266	547	459	360	720	585	470	979	808	605	1,209	975	740
50	167	153	134	279	244	214	421	353	310	641	547	423	854	706	550	1,164	977	705	1,451	1,188	860
100	175	163	NA	311	277	NA	489	421	NA	751	658	479	1,025	873	625	1,408	1,215	800	1,784	1,502	975

Size B vent system

- Find each connector size
- Correct Table: Table 504.3(1)
- Least total height and vent rise
  - Vent height: 15 feet
  - Water heater rise: 1 foot
  - Furnace rise: 3 feet
- Vent connector size
  - Water heater: 4 inch
  - Furnace: 5 inch

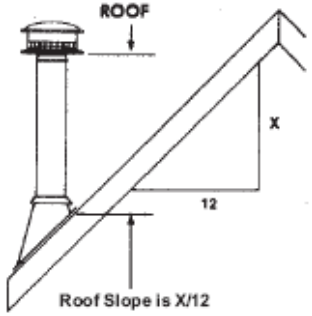
Size B vent system

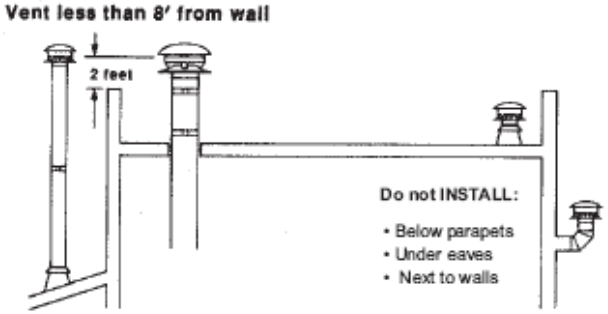
- Find common vent size
- Total Btu/h input:
  - Combined input rating: 164,000 Btu/h
  - Size of common vent: 5 inch

Flue gases must leave the structure – 503.6.4

This chart is applicable only to vents that are both 12 inches (305 mm) or less in size and located at least 8 feet (2438 mm) from a vertical wall or similar obstruction.

Roof Slope	MINIMUM HEIGHT ABOVE ROOF
Flat to 6/12	1-0
Over 6/12 to 7/12	1-3
Over 7/12 to 8/12	1-6
Over 8/12 to 9/12	2-0
Over 9/12 to 10/12	2-6
Over 10/12 to 11/12	3-3
Over 11/12 to 12/12	4-0
Over 12/12 to 14/12	5-0
Over 14/12 to 16/12	6-0
Over 16/12 to 18/12	7-0
Over 18/12 to 20/12	7-6
Over 20/12 to 21/12	8-0





INSTALL

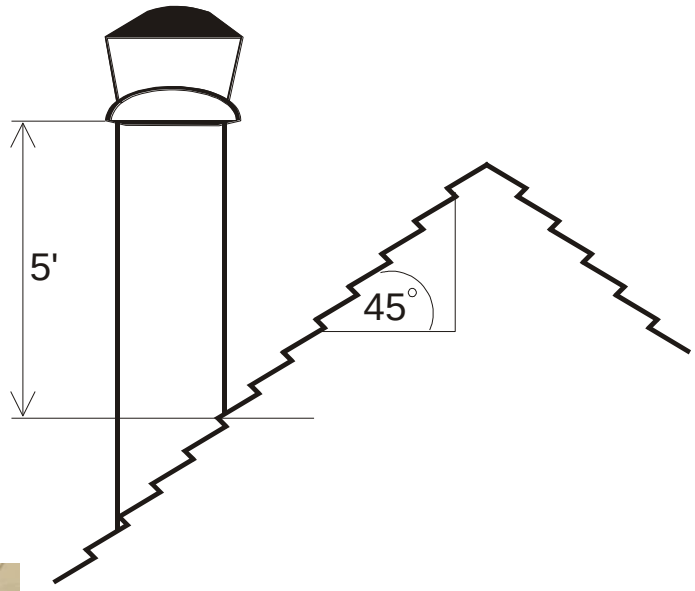
• At least 2 feet higher than wall located within 8 feet horizontally of vent.

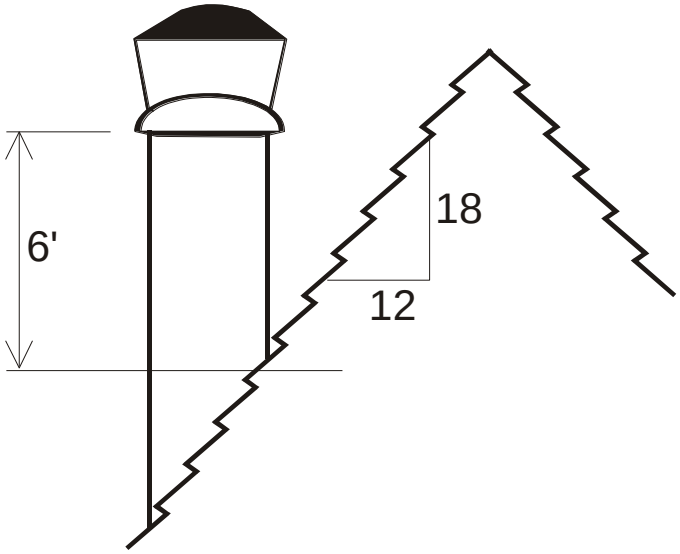
For SI: 1 foot = 304.8 mm.

Top Location Rules

Gas Vent Termination

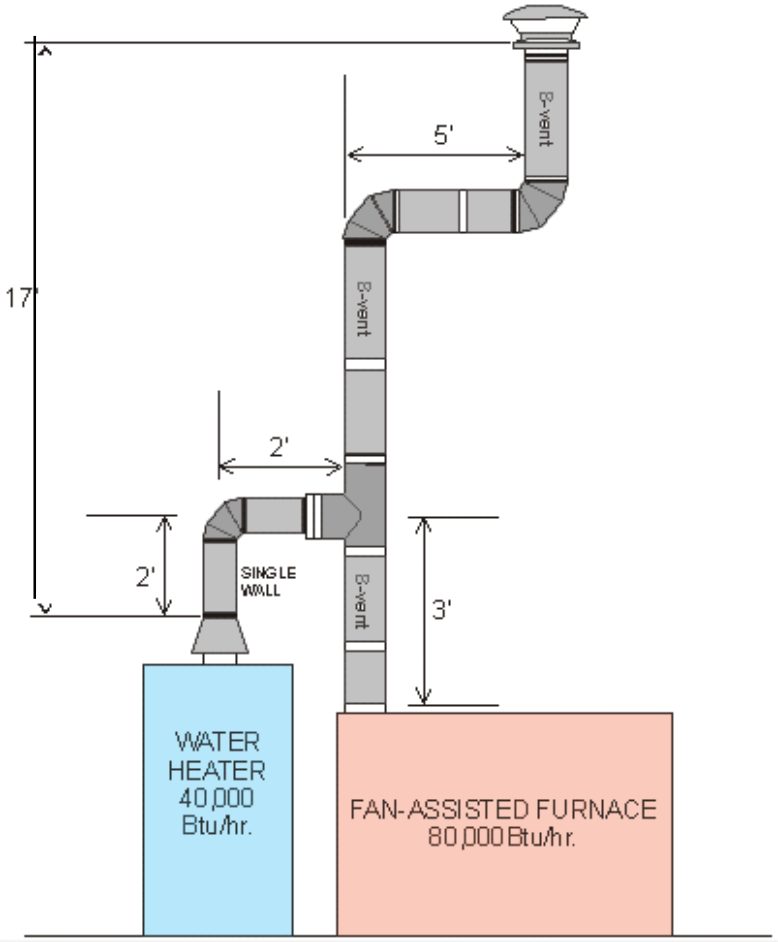
- Determine which diagram shows correct vent termination requirement





Venting System

- Given the following information, size the entire venting system.
  - Water heater 40,000 Btu/h
  - Natural draft
  - 3-inch draft hood
  - Furnace 80,000 Btu/h
  - Fan assisted
  - 4 inch flue collar



2015 IFGC, Table 504.3.(1), page 115

TABLE 504.3(1)
TYPE B DOUBLE-WALL VENT

Number of Appliances	Two or more
Appliance Type	Category I
Appliance Vent Connection	Type B double-wall connector

VENT CONNECTOR CAPACITY

VENT HEIGHT (H) (feet)	CONNECTOR RISE (R) (feet)	TYPE B DOUBLE-WALL VENT AND CONNECTOR DIAMETER—(D) inches																							
		3			4			5			6			7			8			9			10		
		APPLIANCE INPUT RATING LIMITS IN THOUSANDS OF BTU/H																							
		FAN		NAT	FAN		NAT	FAN		NAT	FAN		NAT	FAN		NAT	FAN		NAT	FAN		NAT	FAN		NAT
		Min	Max	Max	Min	Max	Max	Min	Max	Max	Min	Max	Max	Min	Max	Max	Min	Max	Max	Min	Max	Max	Min	Max	Max
6	1	22	37	26	35	66	46	46	106	72	58	164	104	77	225	142	92	296	185	109	376	237	128	466	289
	2	23	41	31	37	75	55	48	121	86	60	183	124	79	253	168	95	333	220	112	424	282	131	526	345
	3	24	44	35	38	81	62	49	132	96	62	199	139	82	275	189	97	363	248	114	463	317	134	575	386
8	1	22	40	27	35	72	48	49	114	76	64	176	109	84	243	148	100	320	194	118	408	248	138	507	303
	2	23	44	32	36	80	57	51	128	90	66	195	129	86	269	175	103	356	230	121	454	294	141	564	358
	3	24	47	36	37	87	64	53	139	101	67	210	145	88	290	198	105	384	258	123	492	330	143	612	402
10	1	22	43	28	34	78	50	49	123	78	65	189	113	89	257	154	106	341	200	125	436	257	146	542	314
	2	23	47	33	36	86	59	51	136	93	67	206	134	91	282	182	109	374	238	128	479	305	149	596	372
	3	24	50	37	37	92	67	52	146	104	69	220	150	94	303	205	111	402	268	131	515	342	152	642	417
15	1	21	50	30	33	89	53	47	142	83	64	220	120	88	298	163	110	389	214	134	493	273	162	609	333
	2	22	53	35	35	96	63	49	153	99	66	235	142	91	320	193	112	419	253	137	532	323	165	658	394
	3	24	55	40	36	102	71	51	163	111	68	248	160	93	339	218	115	445	286	140	565	365	167	700	444
20	1	21	54	31	33	99	56	46	157	87	62	246	125	86	334	171	107	436	224	131	552	285	158	681	347
	2	22	57	37	34	105	66	48	167	104	64	259	149	89	354	202	110	463	265	134	587	339	161	725	414
	3	23	60	42	35	110	74	50	176	116	66	271	168	91	371	228	113	486	300	137	618	383	164	764	466
30	1	20	62	33	31	113	59	45	181	93	60	288	134	83	391	182	103	512	238	125	649	305	151	802	372
	2	21	64	39	33	118	70	47	190	110	62	299	158	85	408	215	105	535	282	129	679	360	155	840	439
	3	22	66	44	34	123	79	48	198	124	64	309	178	88	423	242	108	555	317	132	706	405	158	874	494
50	1	19	71	36	30	133	64	43	216	101	57	349	145	78	477	197	97	627	257	120	797	330	144	984	403
	2	21	73	43	32	137	76	45	223	119	59	358	172	81	490	234	100	645	306	123	820	392	148	1,014	478
	3	22	75	48	33	141	86	46	229	134	61	366	194	83	502	263	103	661	343	126	842	441	151	1,043	538
100	1	18	82	37	28	158	66	40	262	104	53	442	150	73	611	204	91	810	266	112	1,038	341	135	1,285	417
	2	19	83	44	30	161	79	42	267	123	55	447	178	75	619	242	94	822	316	115	1,054	405	139	1,306	494
	3	20	84	50	31	163	89	44	272	138	57	452	109	78	627	272	97	834	355	118	1,069	455	142	1,327	555

COMMON VENT CAPACITY

VENT HEIGHT (H) (feet)	4			5			6			7			8			9			10		
	COMBINED APPLIANCE INPUT RATING IN THOUSANDS OF BTU/H																				
	FAN +FAN	FAN +NAT	NAT +NAT	FAN +FAN	FAN +NAT	NAT +NAT	FAN +FAN	FAN +NAT	NAT +NAT	FAN +FAN	FAN +NAT	NAT +NAT	FAN +FAN	FAN +NAT	NAT +NAT	FAN +FAN	FAN +NAT	NAT +NAT	FAN +FAN	FAN +NAT	NAT +NAT
6	92	81	65	140	116	103	204	161	147	309	248	200	404	314	260	547	434	335	672	520	410
8	101	90	73	155	129	114	224	178	163	339	275	223	444	348	290	602	480	378	740	577	465
10	110	97	79	169	141	124	243	194	178	367	299	242	477	377	315	649	522	405	800	627	495
15	125	112	91	195	164	144	283	228	206	427	352	280	556	444	365	753	612	465	924	733	565
20	136	123	102	215	183	160	314	255	229	475	394	310	621	499	405	842	688	523	1,035	826	640
30	152	138	118	244	210	185	361	297	266	547	459	360	720	585	470	979	808	605	1,209	975	740
50	167	153	134	279	244	214	421	353	310	641	547	423	854	706	550	1,164	977	705	1,451	1,188	860
100	175	163	NA	311	277	NA	489	421	NA	751	658	479	1,025	873	625	1,408	1,215	800	1,784	1,502	975

2015 IFGC,
Table 504.3(2),
page 117

TABLE 504.3(2)
TYPE B DOUBLE-WALL VENT

Number of Appliances	Two or more
Appliance Type	Category I
Appliance Vent Connection	Single-wall metal connector

VENT CONNECTOR CAPACITY

VENT HEIGHT (H) (feet)	CONNECTOR RISE (R) (feet)	SINGLE-WALL METAL VENT CONNECTOR DIAMETER—(D) inches																								
		3			4			5			6			7			8			9			10				
		APPLIANCE INPUT RATING LIMITS IN THOUSANDS OF BTU/H																								
		FAN		NAT	FAN		NAT	FAN		NAT	FAN		NAT	FAN		NAT	FAN		NAT	FAN		NAT	FAN		NAT		
		Min	Max	Max	Min	Max	Max	Min	Max	Max	Min	Max	Max	Min	Max	Max	Min	Max	Max	Min	Max	Max	Min	Max	Max		
6	1	NA	NA	26	NA	NA	46	NA	NA	71	NA	NA	102	207	223	140	262	293	183	325	373	234	447	463	286		
	2	NA	NA	31	NA	NA	55	NA	NA	85	168	182	123	215	251	167	271	331	219	334	422	281	458	524	344		
	3	NA	NA	34	NA	NA	62	121	131	95	175	198	138	222	273	188	279	361	247	344	462	316	468	574	385		
8	1	NA	NA	27	NA	NA	48	NA	NA	75	NA	NA	106	226	240	145	285	316	191	352	403	244	481	502	299		
	2	NA	NA	32	NA	NA	57	125	126	89	184	193	127	234	266	173	293	353	228	360	450	292	492	560	355		
	3	NA	NA	35	NA	NA	64	130	138	100	191	208	144	241	287	197	302	381	256	370	489	328	501	609	400		
10	1	NA	NA	28	NA	NA	50	119	121	77	182	186	110	240	253	150	302	335	196	372	429	252	506	534	308		
	2	NA	NA	33	84	85	59	124	134	91	189	203	132	248	278	183	311	369	235	381	473	302	517	589	368		
	3	NA	NA	36	89	91	67	129	144	102	197	217	148	257	299	203	320	398	265	391	511	339	528	637	413		
15	1	NA	NA	29	79	87	52	116	138	81	177	214	116	238	291	158	312	380	208	397	482	266	556	596	324		
	2	NA	NA	34	83	94	62	121	150	97	185	230	138	246	314	189	321	411	248	407	522	317	568	646	387		
	3	NA	NA	39	87	100	70	127	160	109	193	243	157	255	333	215	331	438	281	418	557	360	579	690	437		
20	1	49	56	30	78	97	54	115	152	84	175	238	120	233	325	165	306	425	217	390	538	276	546	664	336		
	2	52	59	36	82	103	64	120	163	101	182	252	144	243	346	197	317	453	259	400	574	331	558	709	403		
	3	55	62	40	87	107	72	125	172	113	190	264	164	252	363	223	326	476	294	412	607	375	570	750	457		
30	1	47	60	31	77	110	57	112	175	89	169	278	129	226	380	175	296	497	230	378	630	294	528	779	358		
	2	51	62	37	81	115	67	117	185	106	177	290	152	236	397	208	307	521	274	389	662	349	541	819	425		
	3	54	64	42	85	119	76	122	193	120	185	300	172	244	412	235	316	542	309	400	690	394	555	855	482		
50	1	46	69	34	75	128	60	109	207	96	162	336	137	217	460	188	284	604	245	364	768	314	507	951	384		
	2	49	71	40	79	132	72	114	215	113	170	345	164	226	473	223	294	623	293	376	793	375	520	983	458		
	3	52	72	45	83	136	82	119	221	123	178	353	186	235	486	252	304	640	331	387	816	423	535	1,013	518		
100	1	45	79	34	71	150	61	104	249	98	153	424	140	205	585	192	269	774	249	345	993	321	476	1,236	393		
	2	48	80	41	75	153	73	110	255	115	160	428	167	212	593	228	279	788	299	358	1,011	383	490	1,259	469		
	3	51	81	46	79	157	85	114	260	129	168	433	190	222	603	256	289	801	339	368	1,027	431	506	1,280	527		

COMMON VENT CAPACITY

VENT HEIGHT (H) (feet)	TYPE B DOUBLE-WALL COMMON VENT DIAMETER—(D) inches																				
	4			5			6			7			8			9			10		
	COMBINED APPLIANCE INPUT RATING IN THOUSANDS OF BTU/H																				
	FAN +FAN	FAN +NAT	NAT +NAT	FAN +FAN	FAN +NAT	NAT +NAT	FAN +FAN	FAN +NAT	NAT +NAT	FAN +FAN	FAN +NAT	NAT +NAT	FAN +FAN	FAN +NAT	NAT +NAT	FAN +FAN	FAN +NAT	NAT +NAT	FAN +FAN	FAN +NAT	NAT +NAT
6	NA	78	64	NA	113	99	200	158	144	304	244	196	398	310	257	541	429	332	665	515	407
8	NA	87	71	NA	126	111	218	173	159	331	269	218	436	342	285	592	473	373	730	569	460
10	NA	94	76	163	137	120	237	189	174	357	292	236	467	369	309	638	512	398	787	617	487
15	121	108	88	189	159	140	275	221	200	416	343	274	544	434	357	738	599	456	905	718	553
20	131	118	98	208	177	156	305	247	223	463	383	302	606	487	395	824	673	512	1,013	808	626
30	145	132	113	236	202	180	350	286	257	533	446	349	703	570	459	958	790	593	1,183	952	723
50	159	145	128	268	233	208	406	337	296	622	529	410	833	686	535	1,139	954	689	1,418	1,157	838
100	166	153	NA	297	263	NA	469	398	NA	726	633	464	999	846	606	1,378	1,185	780	1,741	1,459	948

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

Sizing of Venting Systems for Two or More Appliances

A. Diameter for the water heater connector.

4 inches

B. Diameter for the furnace connector.

4 inches

C. Percent capacity reduction for common vent.

20 percent, Sections 504.3.5 and 505.3.6

Sizing of Venting Systems for Two or More Appliances

D. Diameter of common vent.

5 inches, (159,000 Btu/h ´ 0.80 = 127,200 Btu/h)

E. Maximum allowable horizontal connector length.

6 feet or in accordance with Sections 504.3.2 and 503.10.9 the MAX Length allowed is 12.75' (75% ´ 17' = 12.75)

Sizing of Venting Systems for Two or More Appliances

F. Maximum allowable length of common vent offset.

7.5

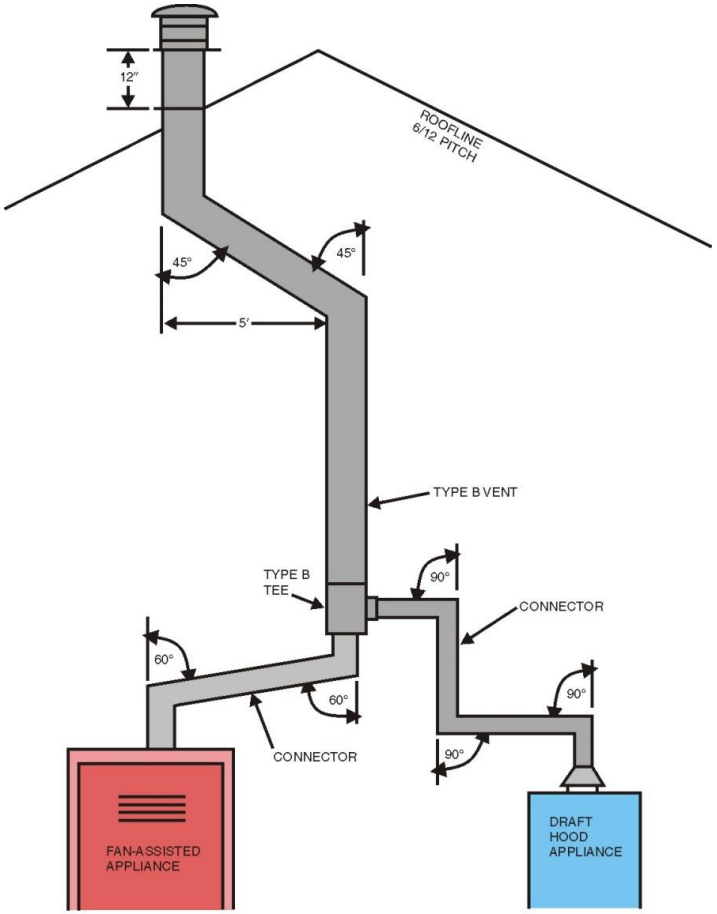
G. Is interpolation necessary?

No

Sizing of Venting Systems for Two or More Appliances

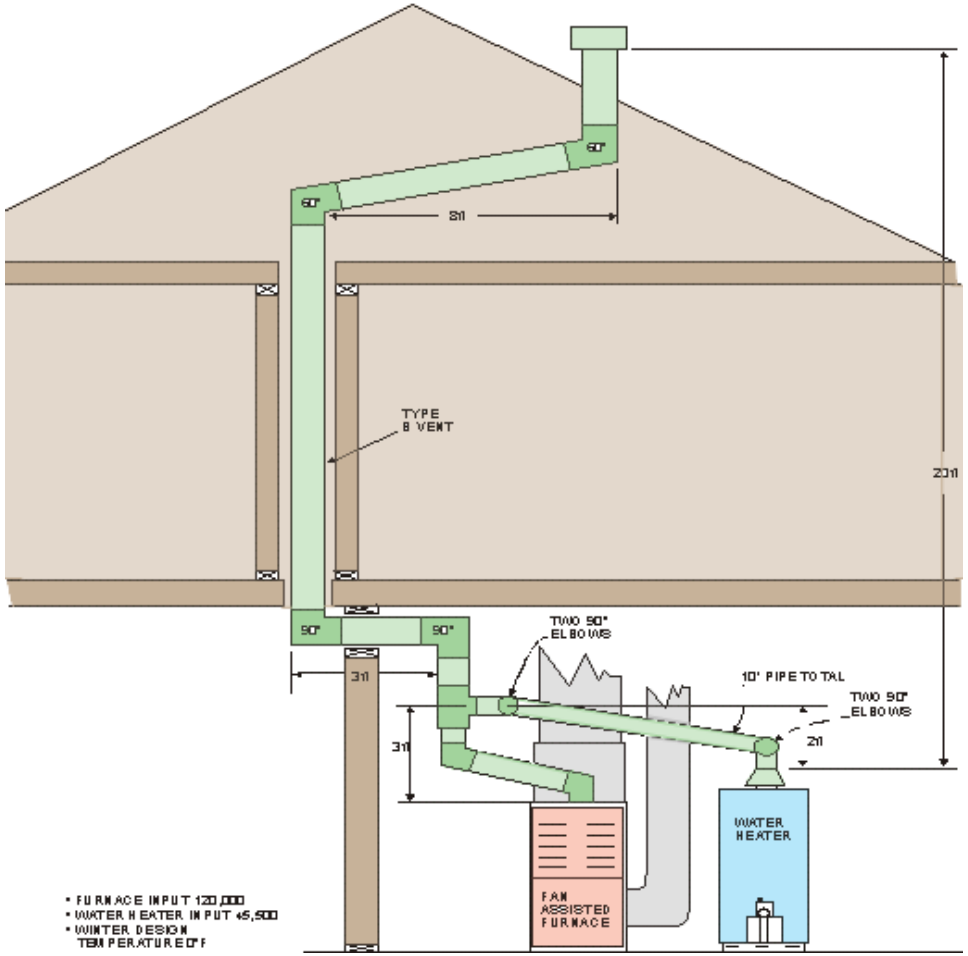
- A two-appliance, FAN + NAT system, combining a water heater (NAT) equipped with a draft hood with a fan-assisted, Category I furnace (FAN).
- Single-wall vent connectors are used for the water heater. Add a double-wall vent connector for the furnace.
- Vent height is 35 feet (10 668 mm).
- Furnace connector rise is 4 feet (1219 mm).
- Water heater connector rise is 2 feet (610 mm).
- Furnace input is 75,000 Btu/h (21 983 W).
- Water heater input is 42,000 Btu/h (12 310 W).

Sizing of Venting Systems for Two or More Appliances



For SI:1 inch = 25.4 mm, 1 degree = 0.01745 rad.

Sizing of Venting Systems for Two or More Appliances



Sizing of Venting Systems for Two or More Appliances

- Determine the venting system sizing for the two appliances.
- Find the size of the common vent based on least total height and the combination of connected appliances

Sizing of Venting Systems for Two or More Appliances

A. Furnace Connector
Material:
Size:

- Type B
- 4 inches, [Table 504.3(1)]

B. Water Heater Connector
Material:
Size:

- Single-wall
- 4 inches, [Table 504.3(2)]

C. Common Vent Size:

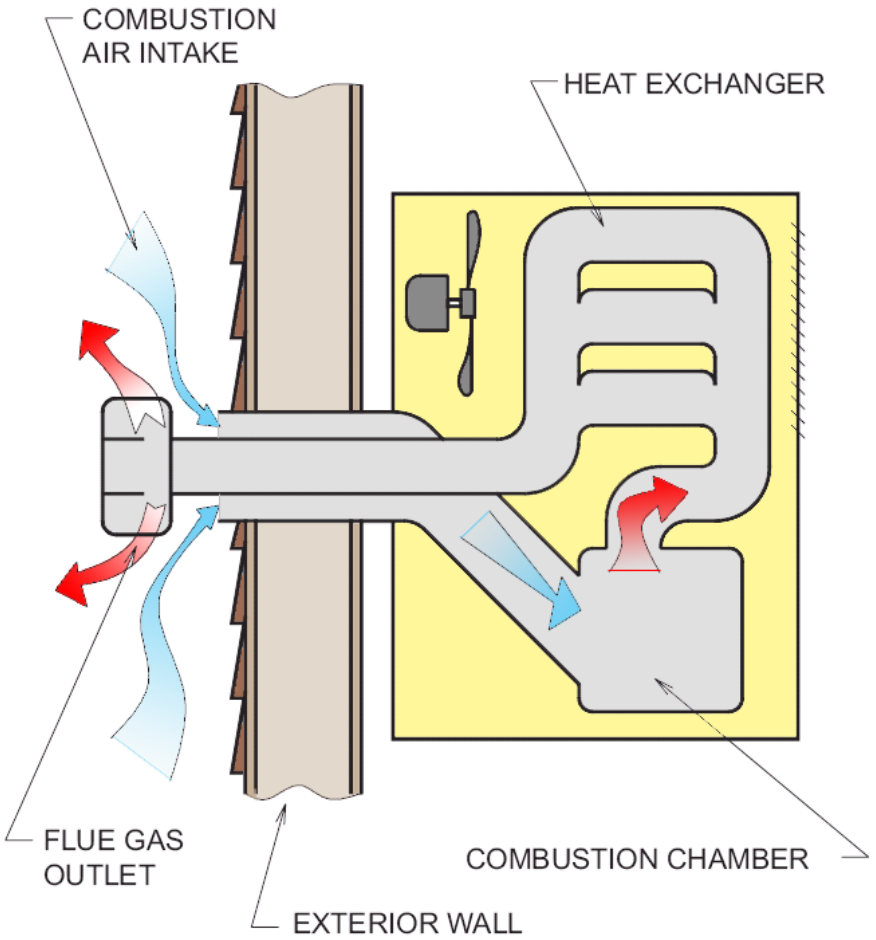
- 4 inches (10% reduction for offset, 132,000 Btu/h ´ 0.9 = 118,800 Btu/h)

Sizing of Venting Systems for Two or More Appliances

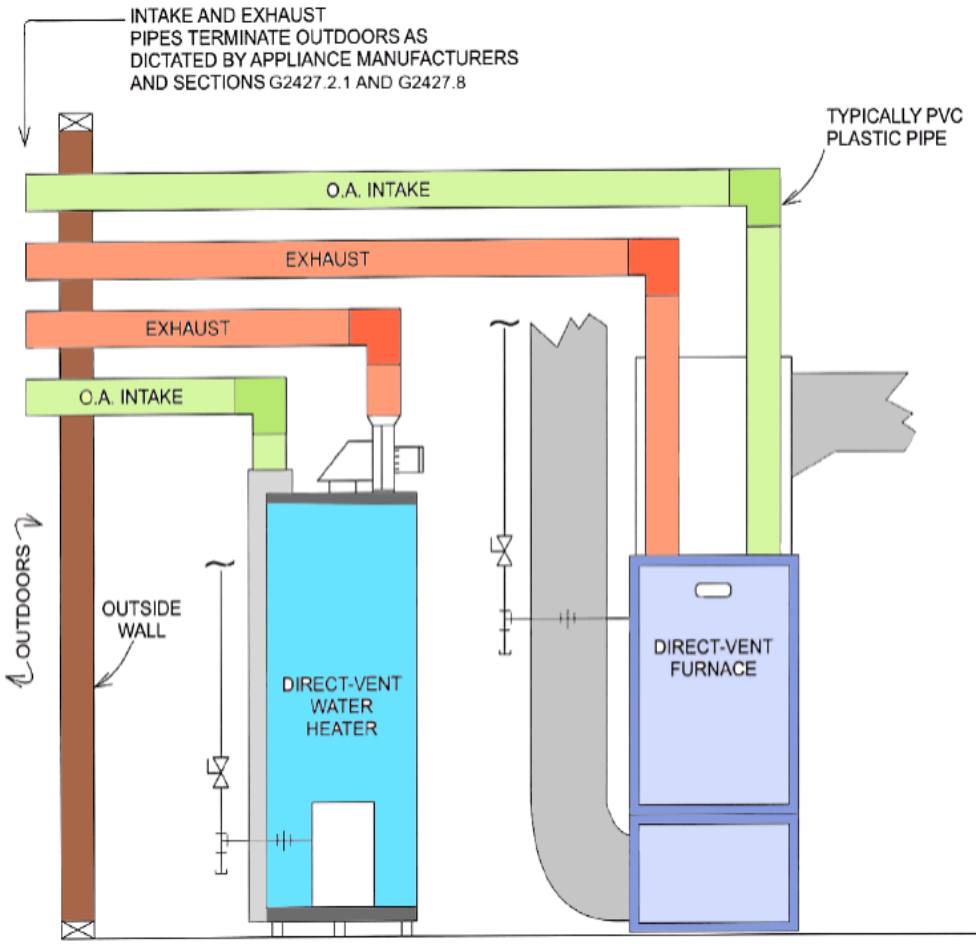
D. Interpolation Necessary? No

E. Any Noted Violations?

Direct-vent terminations



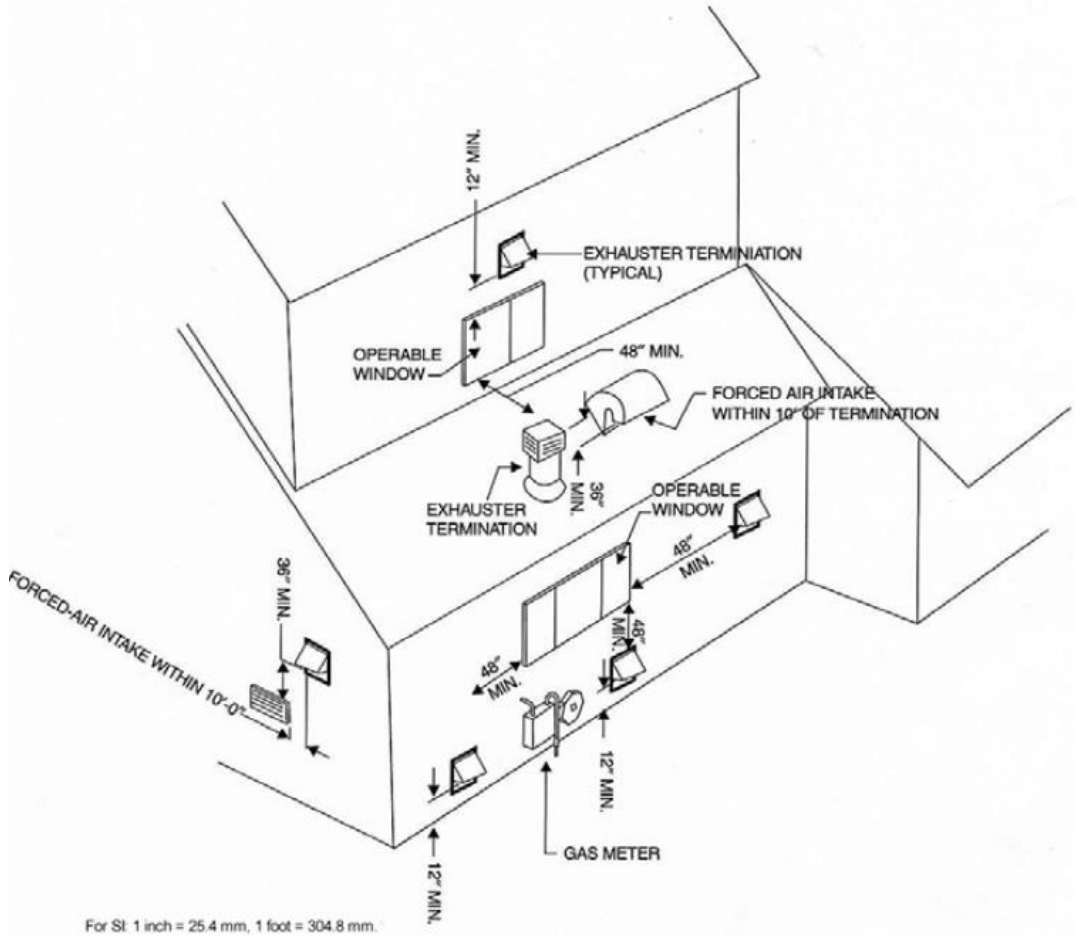
Direct Vent Appliances



503.3.3 – Mechanical draft systems
503.8 – Venting system termination location

- Must be listed and installed in accordance with its appliance manufacturer's instructions;
  - Must be located a minimum of 7 feet (2134 mm) above the level of adjacent walkways;
  - Must be a minimum of 3 feet (914 mm) higher than any air intake area within 10 feet (3048 mm); and
  - The vent system must terminate:
  - 4 feet (1219 mm) below;
  - 4 feet (1219 mm) horizontally from; or
  - 1 foot (304.8 mm) above any door, operable window or gravity air intake into any building.

503.3.3 – Mechanical draft systems
503.8 – Venting system termination location

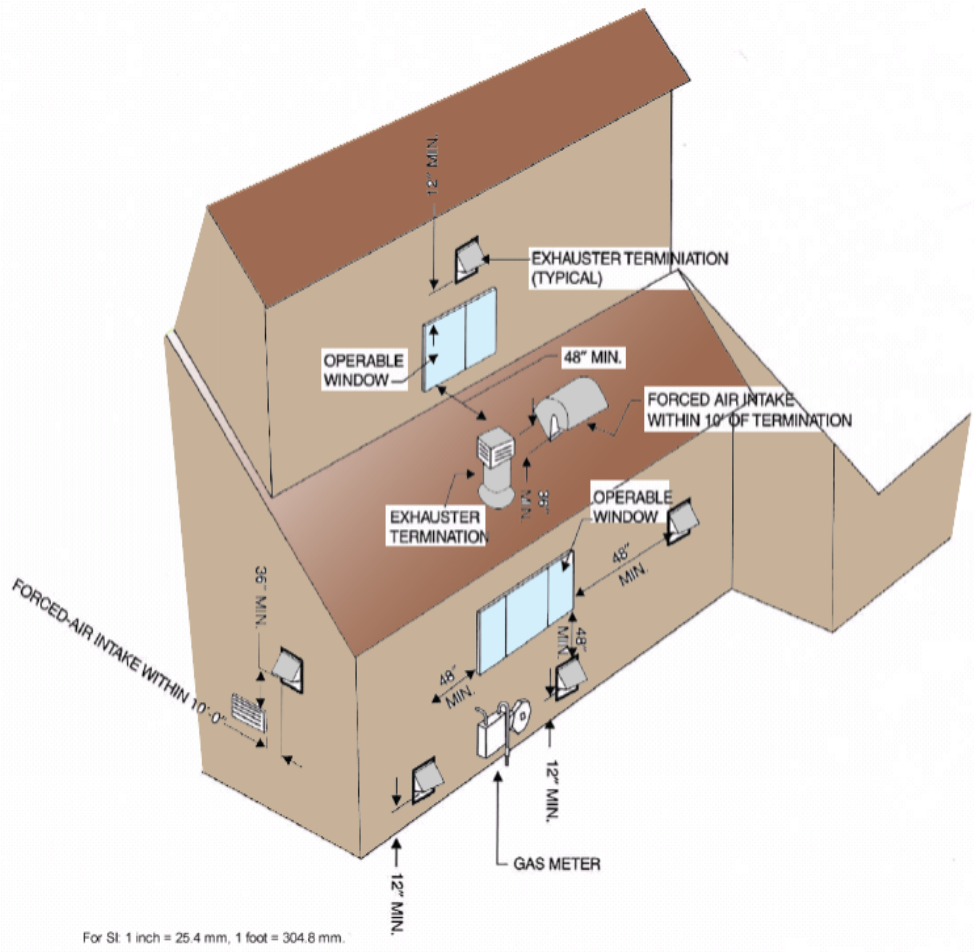


Mechanical Draft Venting System Terminations

Commercial cooking appliance vented by exhaust hoods

Solenoid Valve Interlock Method

Mechanical Draft Venting System Terminations



Module 6

Chapter 6
Specific Appliances

Specific Appliances

- Provides requirements for all aspects of specific appliances
- Special requirements for installation and location
- Assures for installation in accordance with manufacturer's installation instructions

Scope

- Approval
- Design
- Installation
- Construction
- Maintenance
- Alteration
- Repair

Appliances

- Standards
- Typical Application
- Prohibited Installations
- Major code enforcement issues

Appliances

- Decorative Gas-Fired Appliances for Installation in Vented Fireplaces (Section 602)
- Vented Gas Fireplaces (Section 604)
- Vented Gas Fireplace Heaters (Section 605)
- Vented Wall Furnaces (Section 608)

Appliances

- Floor Furnaces (Section 609)
- Non-recirculating Direct-Fired Industrial Air Heaters (Section 611)
- Recirculating Direct-Fired Industrial Air Heaters (Section 612)
- Cloths Dryers (Section 613)
- Clothes Dryer exhaust (Section 614)

TABLE 614.8.4.1 Dryer Exhaust Duct Fitting Equivalent Length

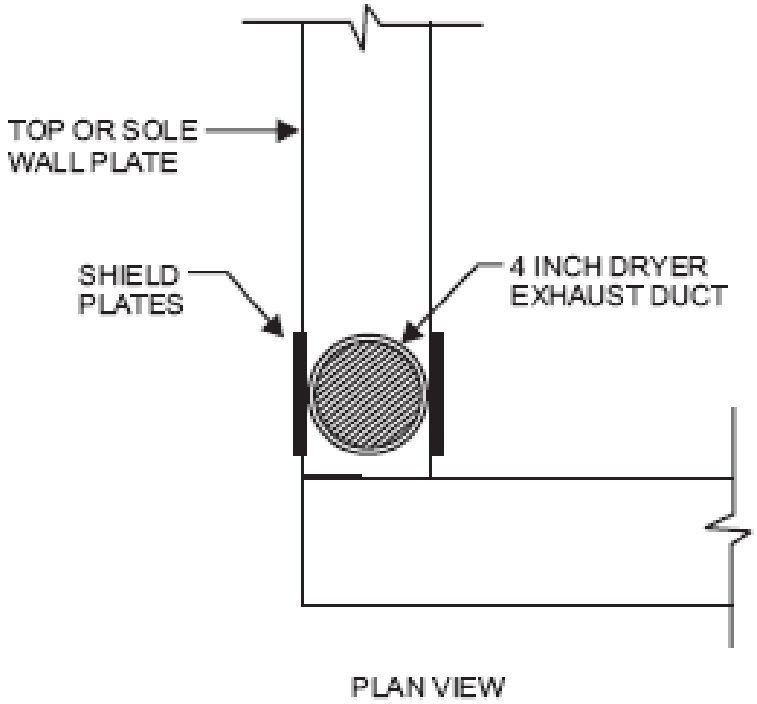
2015 IFGC, Table 614.8.4.1, page 126

[M] TABLE 614.8.4.1
DRYER EXHAUST DUCT FITTING EQUIVALENT LENGTH

DRYER EXHAUST DUCT FITTING TYPE	EQUIVALENT LENGTH
4 inch radius mitered 45-degree elbow	2 feet, 6 inches
4 inch radius mitered 90-degree elbow	5 feet
6 inch radius smooth 45-degree elbow	1 foot
6 inch radius smooth 90-degree elbow	1 foot, 9 inches
8 inch radius smooth 45-degree elbow	1 foot
8 inch radius smooth 90-degree elbow	1 foot, 7 inches
10 inch radius smooth 45-degree elbow	9 inches
10 inch radius smooth 90-degree elbow	1 foot, 6 inches

For SI: 1 inch = 25.4 mm, 1 foot = 304.8 mm, 1 degree = 0.01745 rad.

Projection required – 614.6.3



- Section 614.6.3 requires clothes dryer exhaust ducts to be protected from penetration by fasteners such as drywall screws and trim nails

614.8.4.3 – Dryer exhaust duct power ventilator length

- The maximum length of the exhaust duct shall be determined by the dryer exhaust duct power ventilator manufacturer's installation instructions.

Length identification – 614.6.6

Sample of typical placard to be placed behind all future dryer installation locations
Approx. size: 8" x 6" (heavy plastic-like laminate material)
Type: .014" poly carbonate label with area for length display to be punched out with typical hole punch and exhibit a paint-resistant laminate coating
Permanent pressure-sensitive 3M adhesive and 4 holes 3/32"
Provided and installed by HVAC or sheet metal tradesman at trim-out

- Requires a label or tag to be placed by the point of connection to a concealed clothes dryer exhaust duct system.

Common exhaust systems for clothes dryers located in multistory structures

- Provides 11 provisions for the construction of a multistory common exhaust shaft to serve clothes dryers on multiple floors.
  - The shaft in which the duct is installed shall be constructed and fire-resistant rated as required by the IBC.
  - Dampers shall be prohibited in the exhaust duct.
  - Rigid metal ductwork shall be installed within the shaft to convey the exhaust.

Common exhaust systems for clothes dryers located in multistory structures

- Provides 11 provisions for the construction of a multistory common exhaust shaft to serve clothes dryers on multiple floors.
  - The ductwork within the shaft shall be designed and installed without offsets.
  - The exhaust fan motor design shall be in accordance with Section 503.2 of the IMC.
  - The exhaust fan motor shall be located outside of the airstream.

Common exhaust systems for clothes dryers located in multistory structures

- Provides 11 provisions for the construction of a multistory common exhaust shaft to serve clothes dryers on multiple floors.
  - The exhaust fan shall run continuously, and shall be connected to a standby power source.
  - The exhaust fan operation shall be monitored in an approved location and shall initiate an audible or visual signal when the fan is not in operation.
  - Makeup air shall be provided for the exhaust system.

Common exhaust systems for clothes dryers located in multistory structures

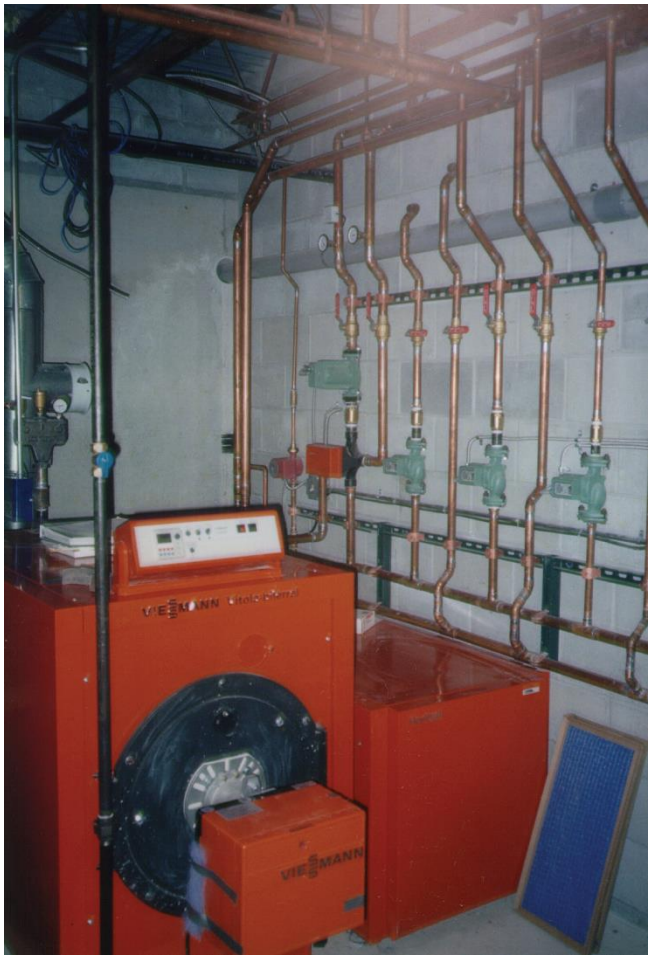
- Provides 11 provisions for the construction of a multistory common exhaust shaft to serve clothes dryers on multiple floors.
  - A cleanout opening shall be located at the base of the shaft to provide access to the duct to allow for cleaning and inspection.
  - Screens shall not be installed at the termination.

Appliances

- Forced-Air Warm-Air Furnaces (Section 618)
- Unit Heaters (Section 620)
- Unvented Room Heaters (Section 621)
- Cooking Appliances (Section 623)

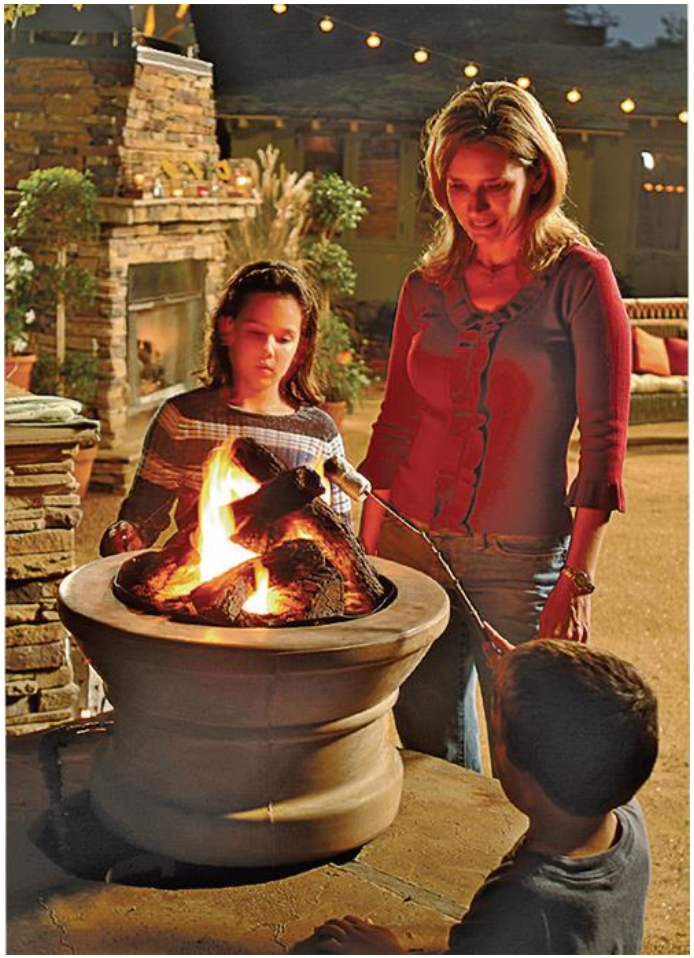
Appliances

- Water Heaters (Section 624)
- Air Conditioning Equipment (Section 627)
- Illuminating Appliances (Section 628)
- Boilers (Section 631)



Outdoor Decorative Appliances–636.1

- Permanently, fixed-in-place outdoor decorative appliances must be tested in accordance with ANSI Z21.97 and installed in accordance with the manufacturer's instructions.



Review and Final Questions

Final Reflection

This slide will help the learner to reflect on the day and what they will take back to the job and apply.

- **What?** What happened and what was observed in the training?
- **So what?** What did you learn? What difference did this training make?
- **Now what?** How will you do things differently back on the job as a result of this training?

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