

# 2021 IFGC Design, Installation and Inspection Principles

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

**Mark Fasel**

**International Code Council**

**Director of PMG Technical Resources**



- Former Building Commissioner City of Fishers, Indiana
- Former Senior Manager Government Affairs & Codes and Standards for Viega LLC.
- ICC Certified Plans Examiner, Building, Mechanical, Fuel Gas, Plumbing, and Electrical Inspector.
- Past President Indiana Assn. Building Officials.
- NFPA 2 Hydrogen Technologies Code TCM
- CSA Z21/83 Binational TCM
- ASTM D03 Gaseous Fuels TCM
- (317) 601-4279
- [mfasel@iccsafe.org](mailto:mfasel@iccsafe.org)
- [www.linkedin.com/in/markfaselPMG](http://www.linkedin.com/in/markfaselPMG)



## Contents

- **Welcome, Breaks, Lunch**
- **Introduction to the 2021 IFGC**
- **IFGC Definitions (Chapter 2)**
- **IFGC General Regulations (Chapter 3)**
- **IFGC Gas Piping Installations (Chapter 4)**
- **Venting (Chapter 5)**
- **Specific Appliances (Chapter 6)**



## 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 2021 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 2021 IFGC.
  - Locate applicable tables in the 2021 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.



## 2021 IFGC (Table of Contents)



# Chapter 1

## Scope and Administration

- Module 1

## 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.

## Chapter 2

### Definitions

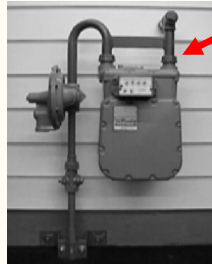
- Module 2



## Definitions

- **POINT OF DELIVERY.** For natural gas systems, the *point of delivery* is the outlet of the service meter assembly or the outlet of the service regulator or service shutoff valve where a meter is not provided. Where a valve is provided at the outlet of the service regulator or service shutoff valve where a meter is not provided. Where a valve is provided at the outlet of the service meter assembly, such valve shall be considered to be downstream of the point of delivery.

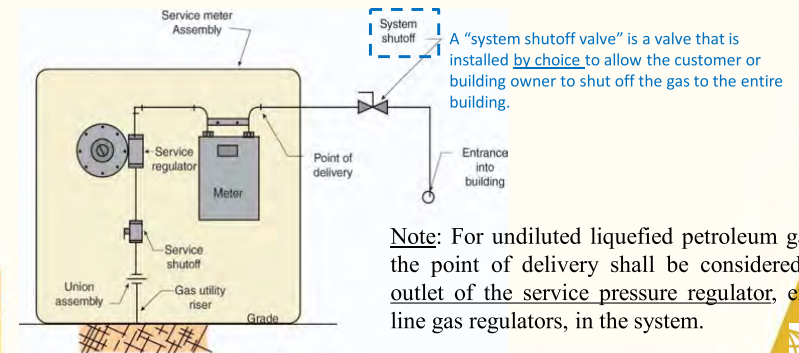
For undiluted liquefied petroleum gas systems, the point of delivery shall be considered to be the outlet of the service pressure regulator, exclusive of line gas regulators, in the system.



## Definitions

### POINT OF DELIVERY

**Point of Delivery** For natural gas systems, the point of delivery is the outlet of the service meter assembly or the outlet of the service regulator or service shutoff valve where a meter is not provided. Where a [system shutoff](#) valve is provided [after](#) the outlet of the service meter assembly, such valve shall be considered to be downstream of the point of delivery. For undiluted liquefied petroleum gas systems, the point of delivery shall be considered to be the outlet of the service pressure regulator, exclusive of line gas regulators, in the system.



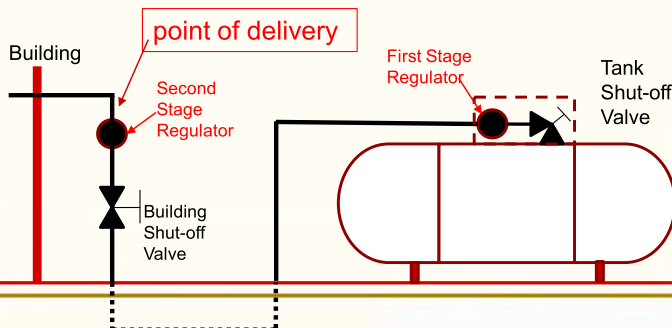
**Note:** For undiluted liquefied petroleum gas systems, the point of delivery shall be considered to be the outlet of the service pressure regulator, exclusive of line gas regulators, in the system.



## (LP) Applications

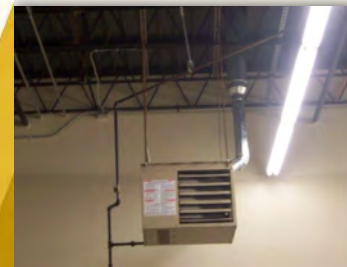
For liquefied petroleum (LP) applications, the point of delivery is the outlet of the service pressure regulator.

- ❑ NFPA 58 regulates the piping and components upstream of the outlet of the service pressure regulator, including the regulator itself.
- ❑ In typical two-stage LP systems, the service pressure regulator is the second-stage regulator. Two-stage systems use a first-stage regulator located at the tank to reduce tank pressure down to 10 psig and a second-stage regulator to reduce the 10 psig pressure down to 11 inches water column (w.c.).
- ❑ Some two-stage systems use separate first- and second-stage regulators and some use integral two-stage regulators, located at the tank, in which both the first- and second-stage regulators are contained within a single unit.



## Definitions

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



**EQUIPMENT.** Apparatus and devices other than appliances.



## Definitions

- **ANODELESS RISER.** A transition assembly in which plastic *pipng* is installed and terminated above ground outside of a building.



## Definitions

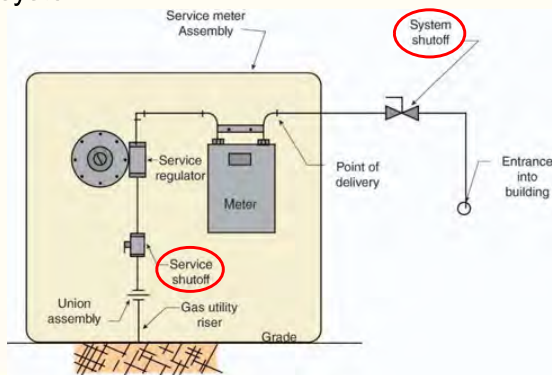
- **GAS PIPING.** An installation of pipe, valves or fittings installed on a premises or in a building and utilized to convey fuel gas.
- **VALVE.** A device used in piping to control the gas supply to any section of a system of piping or to an appliance.



## Definitions

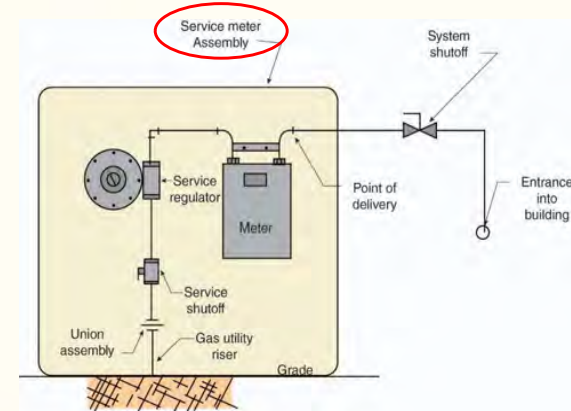
**SYSTEM SHUTOFF.** A valve installed after the point of delivery to shut off the entire piping system.

**SERVICE SHUTOFF.** A valve, installed by the serving gas supplier between the source of supply and the point of delivery, to shut off the entire piping system.



## Definitions

**SERVICE METER ASSEMBLY.** The meter, valve, regulator, piping, fittings and equipment installed by the service gas supplier before the point of delivery.



## Definitions

**PRESS-CONNECT JOINT.** A permanent mechanical joint incorporating an elastomeric seal or an elastomeric seal and corrosion-resistant grip or bite ring. The joint is made with a pressing tool and jaw or ring approved by the fitting manufacturer.



The fittings for steel pipe have a “bite ring” with teeth that indent in the steel pipe wall such that the fitting is impossible to remove or displace.

Press-connect fittings form a seal by means of a compressed O-ring that is specially formulated to tolerate high temperatures and extreme conditions dictated by the product standard ANSI LC-4/CSA 6.32.

The code now recognizes press-connect joints as suitable for high pressure (over 5 psig) applications indoors.



## 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.

**METER.** The instrument installed to measure the volume of gas delivered through it.

The meter is the actual point of commerce and is usually associated with the point of delivery. The code does not require or regulate meters.



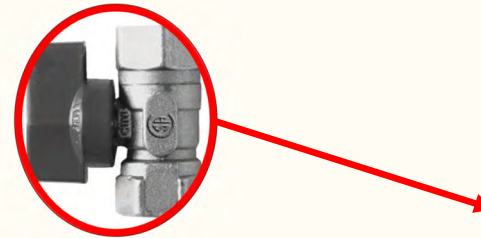
## Definitions

**REGULATOR.** A device for controlling and maintaining a uniform supply pressure, either pounds-to-inches water column (MP regulator) or inches-to-inches water column (*appliance* regulator).



## Definitions

**Valve: Appliance shutoff.** A valve located in the *piping* system, used to isolate individual appliances for purposes such as service or replacement.



# Chapter 3 General Regulations

- Module 3

## General Regulations Chapter 3

**301.1 Scope.** This chapter shall govern the approval and installation of all *equipment* and appliances that comprise parts of the building mechanical systems regulated by this code in accordance with Section 101.2.

- Governs the approval and installation of equipment and appliances.



## 2021 IFGC 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/h, clearances and approval agency.
- Most gas appliances are shipped for use on natural gas can be 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 FORCÉE POUR INSTALLATION À L'INTÉRIEUR SEULEMENT, DANS UN BÂTIMENT CONSTRUIT SUR LE SITE. ÉLECTRIQUE 115 V. 60 HZ 1 PH, MAXIMUM TOTAL INPUT 8.5 AMP. A. FACTORY EQUIPPED FOR NATURAL GAS/AGENCE À L'USAGE POUR NATUREL. GAZ. EQUIPPED WITH NO. 45 DRILL SIZE ORIFICE./ORIFICE EST IDENTIQUE AU TROU D'UN FORET N 45.

| HOURLY INPUT RATING<br>BTU/H (KW) | MANIFOLD PRESSURE<br>INCHES W.C. PO. C.E. (KPA) | NATURAL GAS/<br>INCH W.C. (KPA)/<br>PO. C.E. (KPA) | PROPANE/<br>INCH W.C. (KPA)/<br>PO. C.E. (KPA) |
|-----------------------------------|---|--|--|
| 80,000 (23.44)                    | 2.5 (.87)                                       | 10.5 (2.81)  | 13.0 (3.23)                                    |

MAXIMUM PERMISSIBLE GAS SUPPLY PRESSURE TO FURNACE 10.5 (2.81) 13.0 (3.23)  
PRESSION MAXIMUM D'ALIMENTATION EN GAZ À CHAUDIÈRE 10.5 (2.81) 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 REGLAGE DE PUISSANCE D'ENTRÉE 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/TEMPÉRATURE MAXIMA D'AIR SORTANT, 160 °F (71 °C)  
AIR TEMPERATURE RISE MAXIMUM EXTERNAL STATIC PRESSURE  
AUGMENTATION DE LA TEMPÉRATURE DE L'AIR PRESSION STATIQUE EXTERIEURE MAXIMAL  
°F (°C) INCH W.C. (KPA)-PO. C.E. (KPA)

| 30 (17) TO 80 (30)       | 0.50 (1.25)    |
|--------------------------|----------------|
| 0-2000 FT (0-610M)       | 80,000 (23.44) |
| 2000-4500 FT (610-1370M) | 72,000 (21.10) |

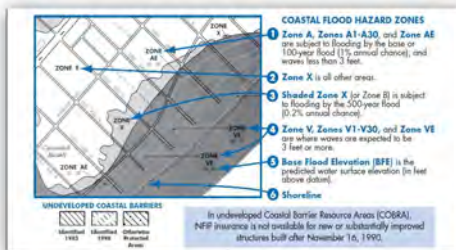
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## Flood Hazard

### IFGC 301.11 & IMC 301.16

**Flood hazard.** For structures located in flood hazard areas, mechanical systems, equipment and appliances shall be located at or above the elevation required by Section 1612 of the International Building Code for utilities and attendant equipment.

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



## Section 302 – Protection of Structure

- 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.





# Engineered wood products

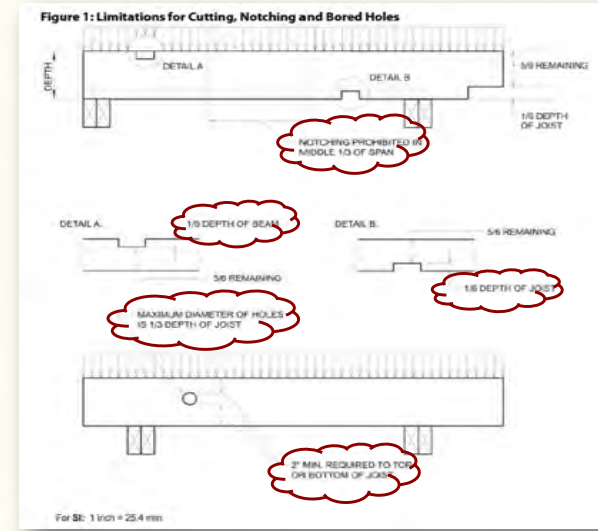
## IFGC 302.3.1

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.



# Section 302 – Protection of Structure

## IFGC 302.3 – Cutting, notching and boring in wood framing



# Section 302 – Protection of Structure

## IFGC 302.3.2 – Bored holes

- Holes bored for pipes or cable must not be within 2 inches (51 mm) of the top or bottom of the wood joist as illustrated in Figure 1. The diameter of the hole must not exceed one-third of the depth of the wood joist.

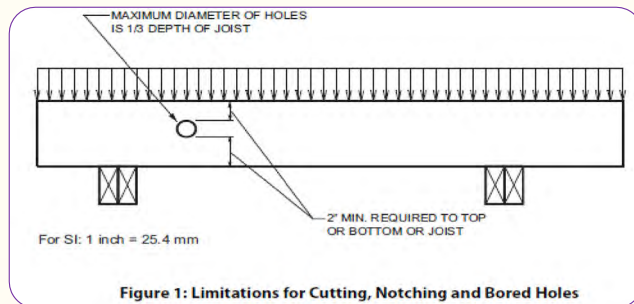


Figure 1: Limitations for Cutting, Notching and Bored Holes

Figure 1: Limitations for Cutting, Notching and Bored Holes

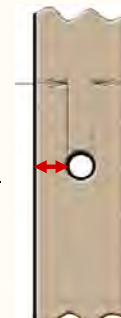


# Section 302 – Protection of Structure

## IFGC 302.3.4

- ❑ Bored holes in studs located in load-bearing and exterior walls must not exceed 40 percent of the stud depth.
- ❑ Studs in non-load-bearing walls must not have bored holes that exceed 60 percent of the depth of the stud. A bored-hole's edge must not be less than 5/8 inch away from a stud edge.

Not be less than 5/8 inch away from a stud edge

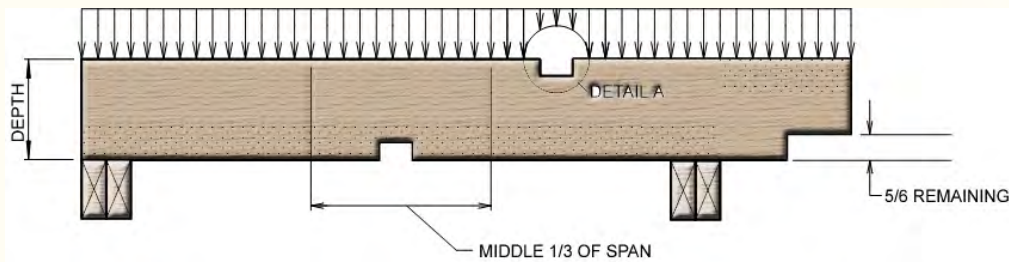


- 40% OF STUD DEPTH; LOAD-BEARING WALLS
- 60% OF STUD DEPTH; NONLOAD-BEARING WALLS



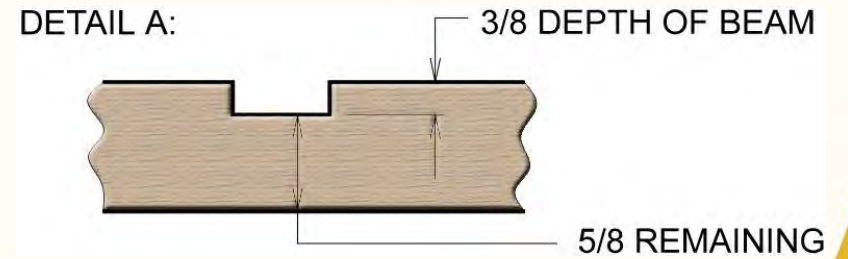
## Structural Integrity

Identify what is wrong



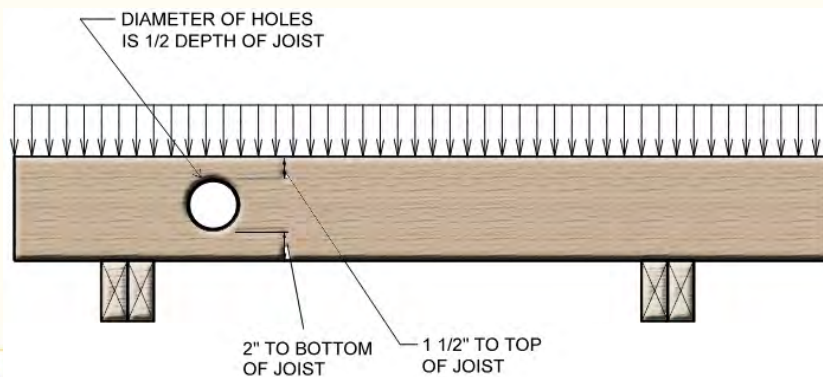
## Structural Integrity

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

- Six 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.

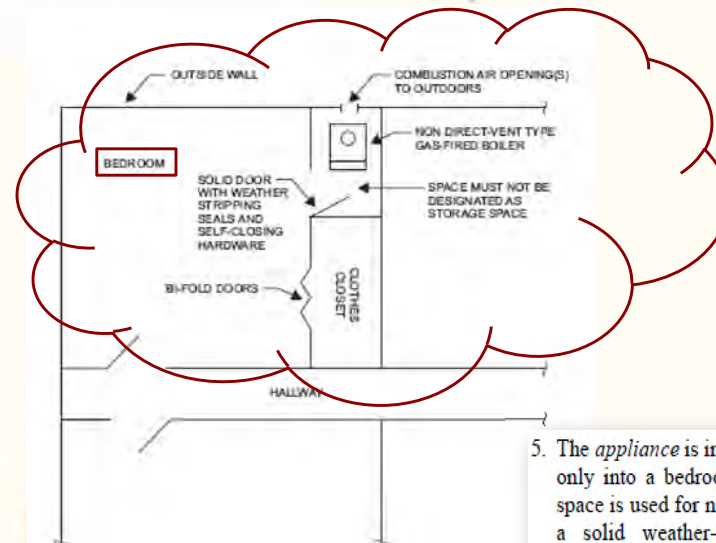


## Prohibited Locations

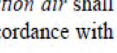
- Six exceptions (cont.)
  4. A single-listed, wall-mounted, unvented room heater with an input rating 10,000 Btu/hr.
  5. Appliances in a dedicated enclosure in which all combustion air is taken directly from the outdoors.
  6. Clothes dryer is installed in a residential bathroom or toilet room having a permanent opening with an area of not less than 100 square inches.



## Section– 303.3 Exception 5

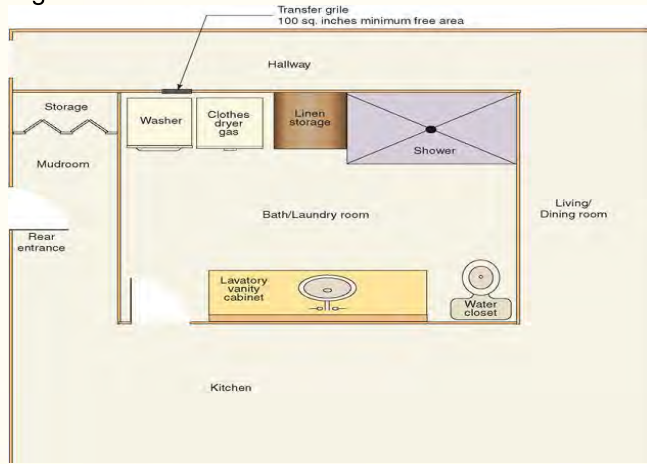


5. The appliance is installed in a room or space that opens only into a bedroom or bathroom, and such room or space is used for no other purpose and is provided with a solid weather-stripped door equipped with an approved self-closing device. All combustion air shall be taken directly from the outdoors in accordance with Section 304.6.



## 303.3 Exception #6

A clothes dryer is installed in a residential bathroom or toilet room having a permanent opening with an area of not less than 100 square inches (0.06 m<sup>2</sup>) that communicates with a space outside of a sleeping room, bathroom, toilet room or storage closet.



## 303.3.1 Prohibited Locations

**303.3.1 Fireplaces and decorative appliances in Group I-2 occupancies.** In **Group I-2, Condition 2 occupancies**, gas fireplace appliances and decorative gas appliances shall be prohibited except where such appliances are direct-vent appliances installed in public lobby and waiting areas that are not within smoke compartments containing patient sleeping areas. In **Group I-2, Condition 1 occupancies**, gas fireplace appliances and decorative gas appliances shall be prohibited in patient sleeping rooms. **In Group I-2 occupancies, the appliance controls shall be located where they can be accessed only by facility staff.** Such fireplaces shall comply with Sections 501.2 and 604.1 of this code and Section 915 of the International Fire Code.



## IBC 308.3 Institutional Group I-2

**308.3 Institutional Group I-2.** Institutional Group I-2 occupancy shall include buildings and structures used for medical care on a 24-hour basis for more than five persons who are incapable of self-preservation. This group shall include, but not be limited to, the following:

- Foster care facilities
- Detoxification facilities
- Hospitals
- Nursing homes
- Psychiatric hospitals

**308.3.1 Occupancy conditions.** Buildings of Group I-2 shall be classified as one of the occupancy conditions specified in Section 308.3.1.1 or 308.3.1.2 and shall comply with Section 407.

**308.3.1.1 Condition 1.** This occupancy condition shall include facilities that provide nursing and medical care but **do not provide** emergency care, surgery, obstetrics or inpatient stabilization units for psychiatric or detoxification, including but not limited to nursing homes and foster care facilities.

**308.3.1.2 Condition 2.** This occupancy condition shall include **facilities that provide nursing and medical care and could provide emergency care, surgery, obstetrics or inpatient stabilization units for psychiatric or detoxification, including but not limited to hospitals.**

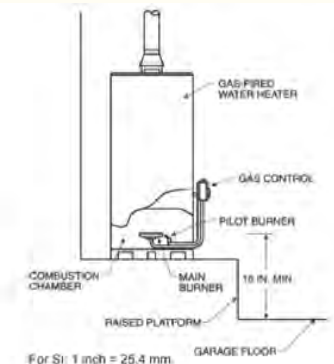


## Elevation of Ignition Source – 305.3

**305.3 Elevation of ignition source.** Equipment and appliances having an ignition source shall be elevated such that the source of ignition is not less than 18 inches (457 mm) above the floor in hazardous locations and public garages, private garages, repair garages, motor fuel-dispensing facilities and parking garages. For the purpose of this section, rooms or spaces that are not part of the living space of a dwelling unit and that communicate directly with a private garage through openings shall be considered to be part of the private garage.

**Exception:** Elevation of the ignition source is not required for appliances that are listed as flammable vapor ignition resistant.

- 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.



# Definitions

**APPLIANCE, FAN-ASSISTED COMBUSTION.** An *appliance* equipped with an integral mechanical means to either draw or force products of combustion through the combustion chamber or heat exchanger.



## APPLIANCE TYPE.

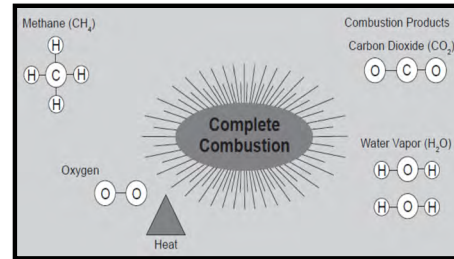
**Low-heat appliance (residential appliance).** Any *appliance* in which the products of combustion at the point of entrance to the flue under normal operating conditions have a temperature of 1,000°F (538°C) or less.

**Medium-heat appliance.** Any *appliance* in which the products of combustion at the point of entrance to the flue under normal operating conditions have a temperature of more than 1,000°F (538°C), but not greater than 2,000°F (1093°C).

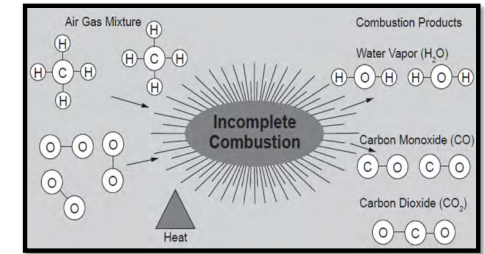
# Definitions

**COMBUSTION AIR.** Air necessary for complete combustion of a fuel, including theoretical air and excess air.

- Combustion air includes the amount of atmospheric air required for complete combustion of a fuel and is related to the molecular composition of the fuel being burned, the design of the fuel-burning equipment and the percentage of oxygen in the combustion air.



Complete combustion of fuel gas is essential for the proper operation of gas-fired appliances.



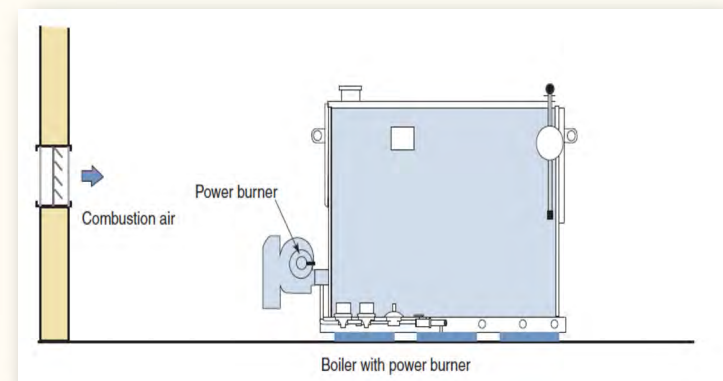
An inadequate combustion air supply to gas-fired appliances can compromise safety by causing incomplete combustion, resulting in appliance malfunction and production of excess carbon monoxide.

## 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

## Recall.....Definition

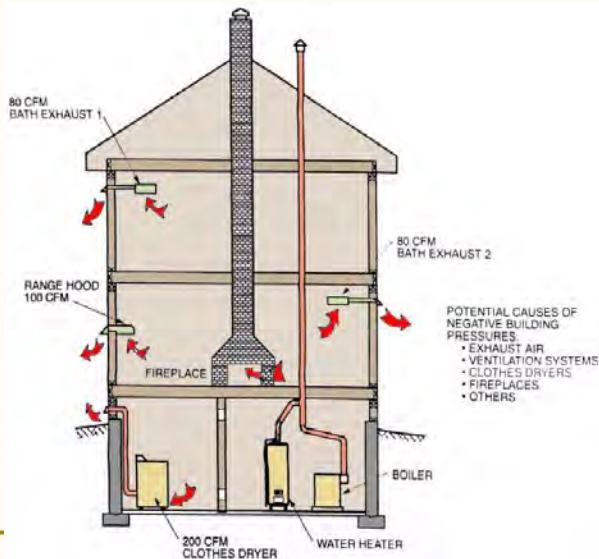
**COMBUSTION AIR.** Air necessary for complete combustion of a fuel, including theoretical air and excess air.



# Reliability of Air Supply

**304.4 Makeup air provisions.** Where exhaust fans, clothes dryers and kitchen ventilation systems interfere with the operation of appliances, makeup air shall be provided.

- The pressure relationships and conditions created by mechanical exhaust systems affect the reliability of the air supply available for combustion, ventilation and dilution air.
- Mechanical exhaust systems may have an adverse effect on appliances if the correct amount of make up air is not provided.
- Starving appliances of combustion air, vent not drafting and products of incomplete combustion could be emitted into the building.

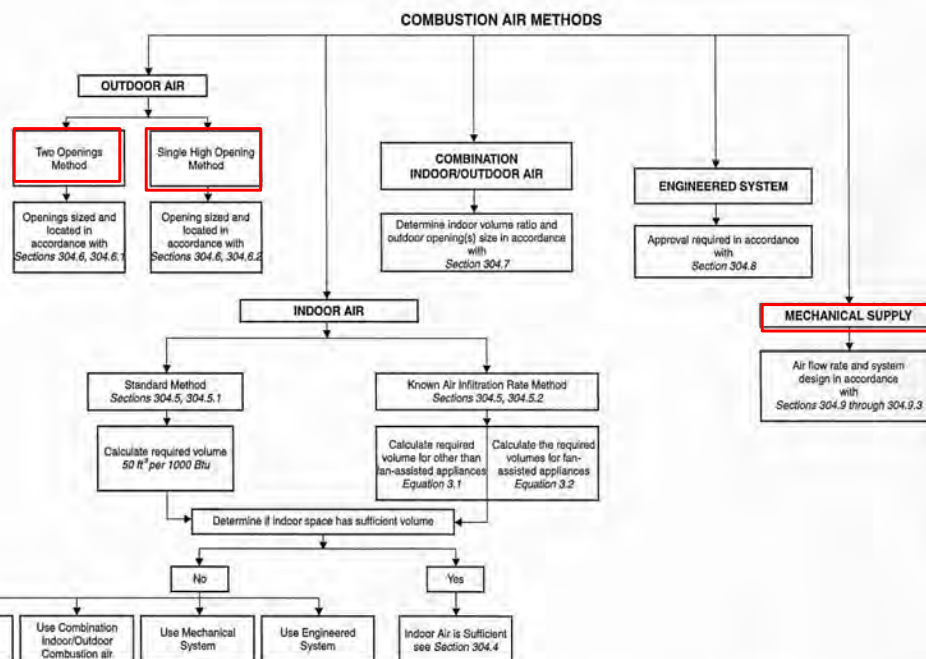


# Depletion of Combustion Air

- The force (hot air rising) involved moving exhaust gases up a B-vent system is very small, even a very slight negative pressure in the same room as a water heater draft hood could spill potentially deadly gases into the room.
- In the illustration (previous slide) the clothes dryer room is directly connected by openings to the utility room with the boiler and water heater, definitely, a cause for concern if infiltration is being used for combustion air.
- Advantages of direct-vent appliances.

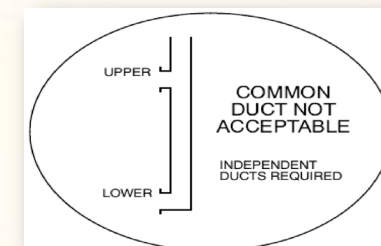


# Decision Tree for Combustion Air



# 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.
  - Horizontal combustion air ducts shall not slope downward toward the source of combustion air.
  - Duct openings to outdoors are at least 12 inches above grade.



## Outdoor Combustion Air – 304.6

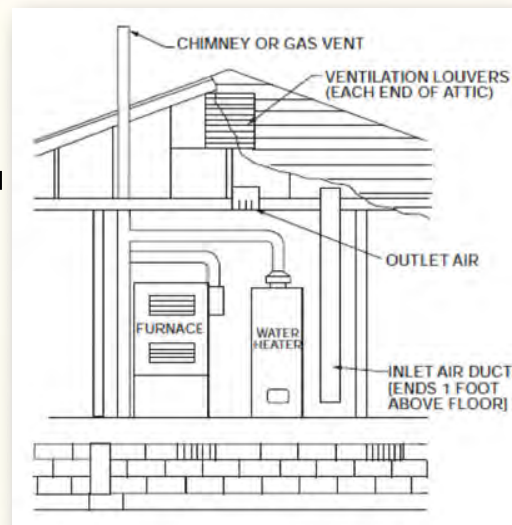
- Outdoor combustion air shall be provided through opening(s) to the outdoors in accordance with Section 304.6.1 or 304.6.2. The minimum dimension of air openings shall be not less than 3 inches.
  1. Section 304.6.1 Two-permanent-openings method.
  2. Section 304.6.2 One-permanent-opening method.



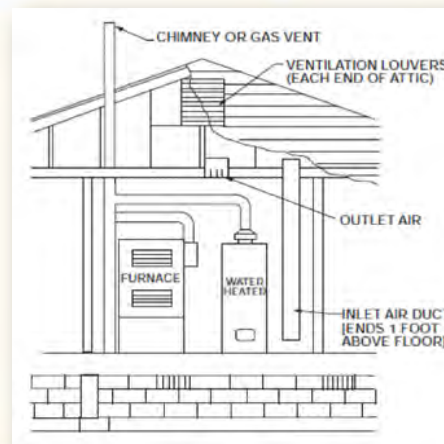
### Two-Opening Method Air From Ventilated Attic

**Section 304.6.1:** Where directly communicating with the outdoors, or where communicating with the outdoors through vertical ducts, each opening shall have a minimum free area of 1 square inch per 4,000 Btu/h of total input rating of all appliances in the enclosure.

- Two permanent openings, one commencing within 12 inches of the top and one commencing within 12 inches of the bottom of the enclosure, shall be provided.



### Two Opening Method



**Given:** Appliance input ratings regarding a **150,000 Btu/h gas furnace** and **50,000 Btu/h gas water heater** will be installed in a mechanical room with two vertical combustion air ducts to a ventilated attic .

Calculated the minimum net free area (square inches) required for each vertical combustion air utilizing the “Two Opening Method”



## Two Opening Method

**Step 1: Summation of all gas appliances located within enclosure.**

$$150,000\text{Btu/h} + 50,000\text{ Btu/h} = 200,000\text{ Btu/h}$$

**Step 2: Determine minimum net free area for each duct.**

$$200,000\text{Btu/h} / (4,000\text{ Btu/h} / 1\text{ sq. in.}) = \underline{50\text{ square inches}}$$

**Note:** Some minimum square ducts that could be use are:

- 14x4 (56 sq. in.)
- 10x6 (60 sq. in.)
- 8x8 (64 sq. in.)

**Calculate minimum round duct size?**

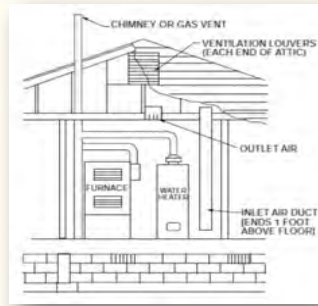
$$A = (\pi \times D^2) / 4$$

Re-write equation to solve for diameter

$$D = (A \times 4/\pi)^{1/2}$$

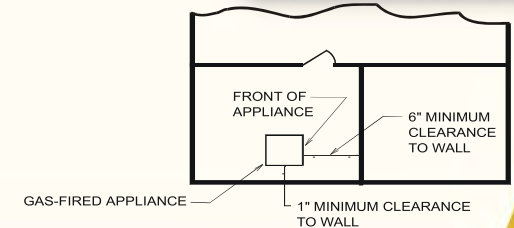
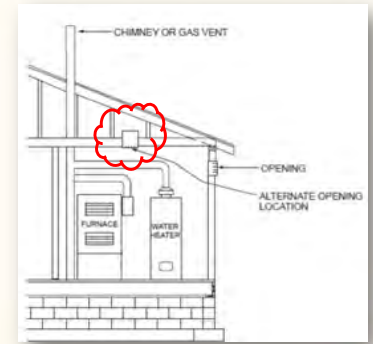
$$D = (50 \times 4/\pi)^{1/2}$$

$$D = \underline{8\text{ inches}}$$



## One-Permanent Opening Method

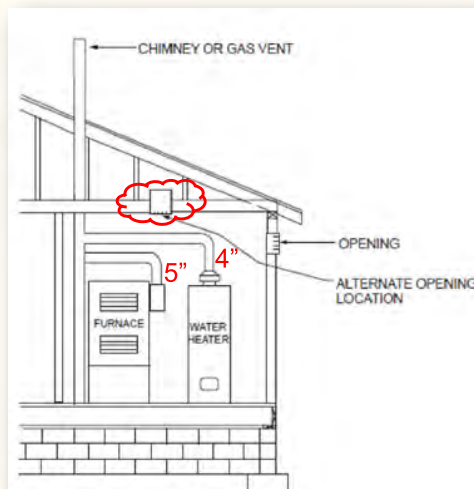
**Section 304.6.2:** One permanent opening, commencing within 12 inches of the top of the enclosure, shall be provided. The *appliance* shall have clearances of not less than 1 inch (25 mm) from the sides and back and 6 inches (152 mm) from the front of the *appliance*.



## One Opening Method

**Given:** Appliance input ratings regarding a **150,000 Btu/h gas furnace** and **50,000 Btu/h gas water heater** will be installed in a mechanical room with one opening in the exterior wall.

Calculated the minimum net free area (square inches) required for the exterior wall combustion air opening utilizing the “One-Permanent Opening Method”



## One Opening Method

**Step 1: Summation of all gas appliances located within enclosure.**

$$150,000\text{Btu/h} + 50,000\text{ Btu/h} = 200,000\text{ Btu/h}$$

**Step 2: Determine minimum net free area for opening.**

$$200,000\text{Btu/h} / (3,000\text{ Btu/h} / 1\text{ sq. in.}) = \underline{67\text{ square inches}}$$

**Step 3: Check total area for 5” diameter and 4” diameter connectors**

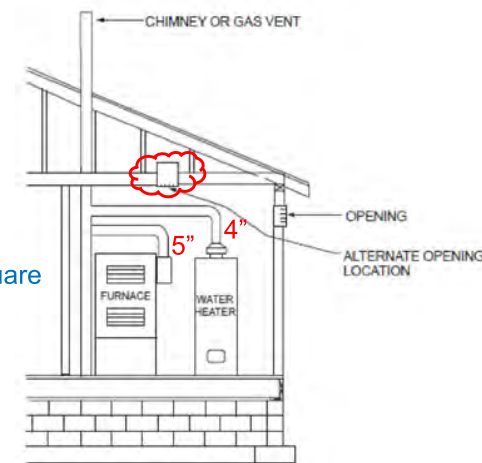
$$A = \pi \times D^2/4$$

$$= [\pi \times 5^2/4] + [\pi \times 4^2/4]$$

$$= 19.64\text{ in}^2 + 12.56\text{ in}^2$$

$$= 32.20\text{ in}^2 \text{ (Less than } 67\text{ in}^2)$$

Therefore, a minimum net free area of 67 square inches must be provide for the one opening.





# One Opening Method

Step 1: Summation of all gas appliances located within enclosure.  
 $150,000\text{Btu/h} + 50,000\text{ Btu/h} = 200,000\text{ Btu/h}$

Step 2: Determine minimum net free area for opening.  
 $200,000\text{Btu/h} / (3,000\text{ Btu/h} / 1\text{ sq. in.}) = \mathbf{67\text{ square inches}}$

**Note:** Some minimum square ducts that could be used to the attic are:

- 14x6 (84 sq. in.)
- 12x6 (72 sq. in.)
- 10x8 (80 sq. in.)

Calculate minimum round duct size?

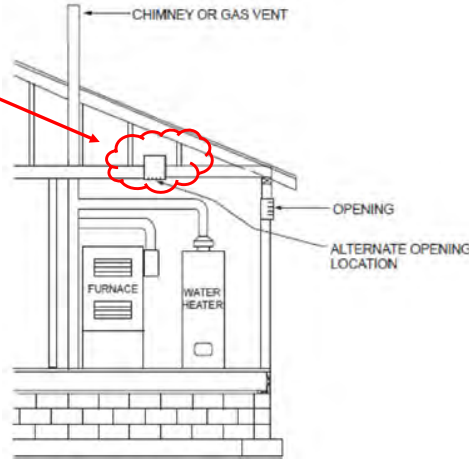
$$A = (\pi \times D^2) / 4$$

Re-write equation to solve for diameter

$$D = (A \times 4/\pi)^{1/2}$$

$$D = (67 \times 4/\pi)^{1/2}$$

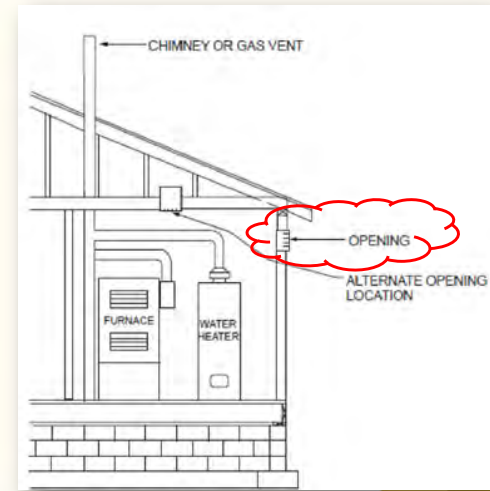
$$D = \mathbf{10\text{ inches}}$$



# One Opening Method

**Given:** Provide the one opening on the exterior wall with a wood or metal louver.

Would the "net free area" have to be modified?



# One Opening Method

Step 1: Summation of all gas appliances located within enclosure.  
 $150,000\text{Btu/h} + 50,000\text{ Btu/h} = 200,000\text{ Btu/h}$

Step 2: Determine minimum net free area for opening.  
 $200,000\text{Btu/h} / (3,000\text{ Btu/h} / 1\text{ sq. in.}) = \mathbf{67\text{ square inches}}$

**Note:** Some minimum square ducts that could be use are:

- 14x6 (84 sq. in.)
- 12x6 (72 sq. in.)
- 10x8 (80 sq. in.)

Calculate minimum round duct size?

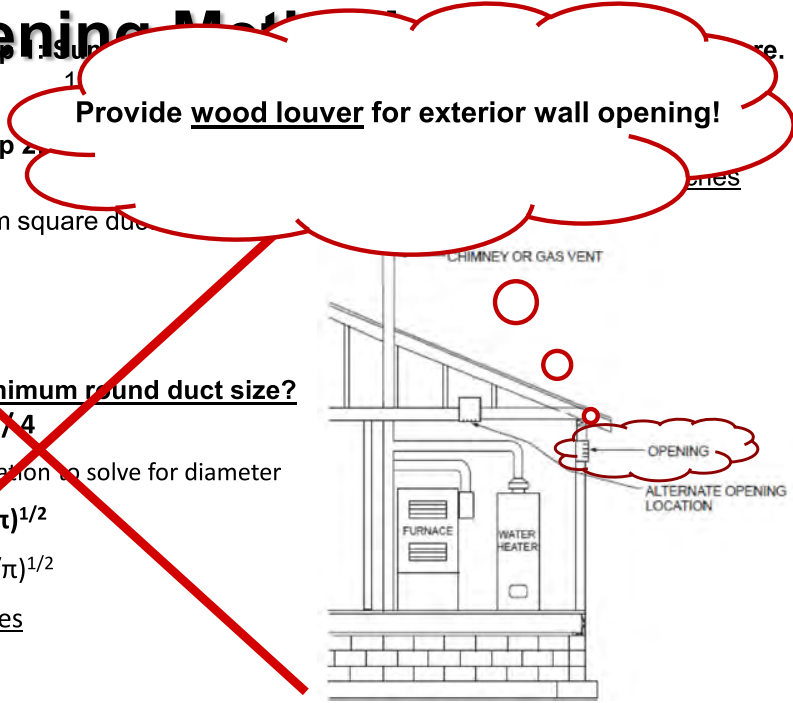
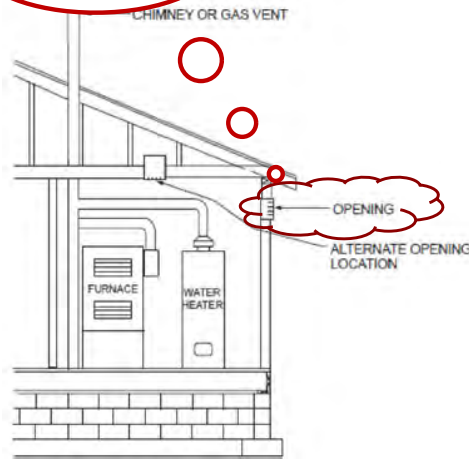
$$A = (\pi \times D^2) / 4$$

Re-write equation to solve for diameter

$$D = (A \times 4/\pi)^{1/2}$$

$$D = (67 \times 4/\pi)^{1/2}$$

$$D = \mathbf{10\text{ inches}}$$



# Free Area of an Opening – 304.10

**304.10 Louvers and grilles.** The required size of openings for combustion, ventilation and dilution air shall be based on the net free area of each opening. Where the free area through a design of louver, grille or screen is known, it shall be used in calculating the size opening required to provide the free area specified. Where the design and free area of louvers and grilles are not known, it shall be assumed that wood louvers will have 25-percent free area and metal louvers and grilles will have 75-percent free area. Screens shall have a mesh size not smaller than 1/4 inch (6.4 mm). Nonmotorized louvers and grilles shall be fixed in the open position. Motorized louvers shall be interlocked with the appliance so that they are proven to be in the full open position prior to main burner ignition and during main burner operation. Means shall be provided to prevent the main burner from igniting if the louvers fail to open during burner start-up and to shut down the main burner if the louvers close during operation.

**Note:** The method provided in 304.10 regarding 25% and 75% free area for louvers may be unrealistic and every effort should be made to obtain the free area from the manufacturer.



# One Opening Method

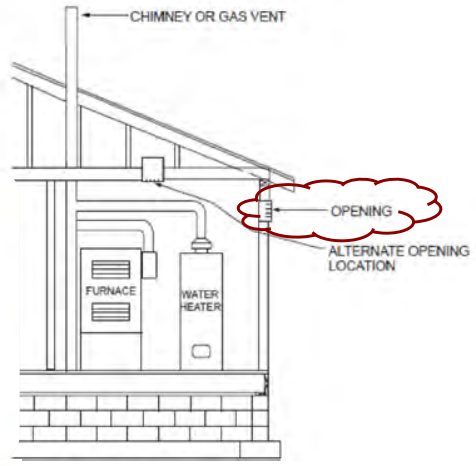
**Step 1: Summation of all gas appliances located within enclosure.**  
 150,000Btu/h + 50,000 Btu/h = 200,000 Btu/h

**Step 2: Determine minimum net free area for the opening.**  
 200,000Btu/h / (3,000 Btu/h / 1 sq. in.) = 67 square inches

**Note:** Calculate minimum opening area for a wood louver when free area is unknown (25%).

$A = 67 \text{ sq. in.} / 0.25$   
 $A = \underline{268 \text{ sq. in.}}$

(12x24 = 288 sq. in.)



# One Opening Method

Step 2

Provide metal louver for exterior wall opening!

**Note:** Some minimum square ducts could be use are:

- 14x6 (84 sq. in.)
- 12x6 (72 sq. in.)
- 10x8 (80 sq. in.)

**Calculate minimum round duct size?**

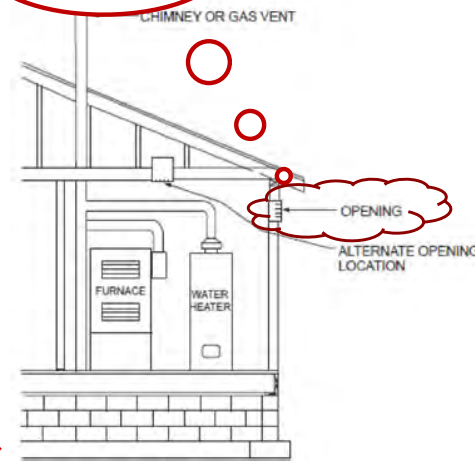
$A = (\pi \times D^2) / 4$

Re-write equation to solve for diameter

$D = (A \times 4 / \pi)^{1/2}$

$D = (67 \times 4 / \pi)^{1/2}$

$D = \underline{10 \text{ inches}}$



# One Opening Method

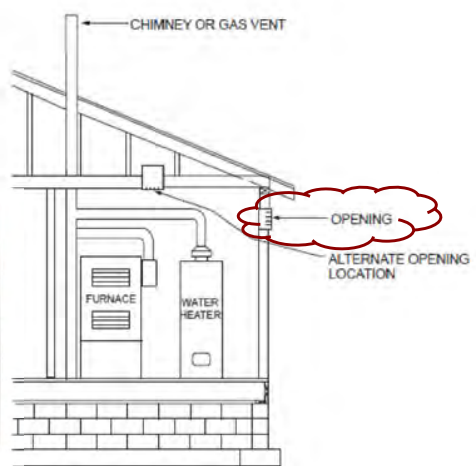
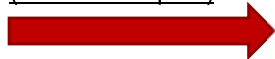
**Step 1: Summation of all gas appliances located within enclosure.**  
 150,000Btu/h + 50,000 Btu/h = 200,000 Btu/h

**Step 2: Determine minimum net free area for the opening.**  
 200,000Btu/h / (3,000 Btu/h / 1 sq. in.) = 67 square inches

**Note:** Calculate minimum opening area for a metal louver when free area is unknown (75%).

$A = 67 \text{ sq. in.} / 0.75$   
 $A = \underline{90 \text{ sq. in.}}$

(12x8 = 96 sq. in.)

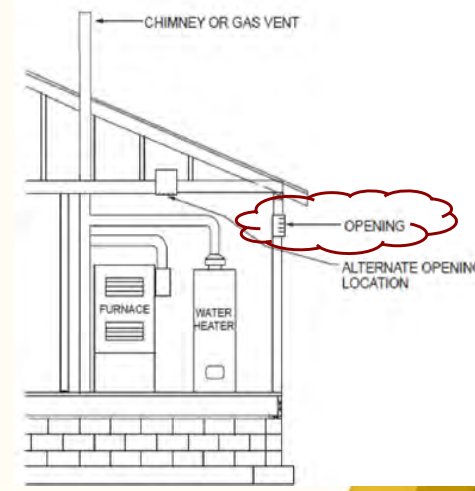


## 2021 IECC C402.5.5

**C402.5.5 Rooms containing fuel-burning appliances.**  
 In Climate Zones 3 through 8, where combustion air is supplied through openings in an exterior wall to a room or space containing a space-conditioning fuel-burning appliance, one of the following shall apply:

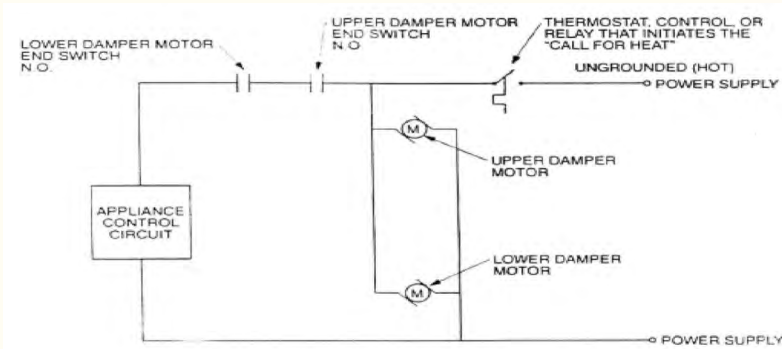
1. The room or space containing the appliance shall be located outside of the building thermal envelope.
2. The room or space containing the appliance shall be enclosed and isolated from conditioned spaces inside the building thermal envelope. Such rooms shall comply with all of the following:
  - 2.1. The walls, floors and ceilings that separate the enclosed room or space from conditioned spaces shall be insulated to be not less than equivalent to the insulation requirement of below-grade walls as specified in Table C402.1.3 or Table C402.1.4.
  - 2.2. The walls, floors and ceilings that separate the enclosed room or space from conditioned spaces shall be sealed in accordance with Section C402.5.1.1.
  - 2.3. The doors into the enclosed room or space shall be fully gasketed.
  - 2.4. Water lines and ducts in the enclosed room or space shall be insulated in accordance with Section C403.
  - 2.5. Where an air duct supplying combustion air to the enclosed room or space passes through conditioned space, the duct shall be insulated to an R-value of not less than R-8.

**Exception:** Fireplaces and stoves complying with Sections 901 through 905 of the International Mechanical Code, and Section 2111.14 of the International Building Code.



## Free Area of an Opening – 304.10

Louvers and grilles must be fixed in an open position or must be interlocked with the equipment so that the equipment cannot fire until the openings are proven to be open (see Figure below).

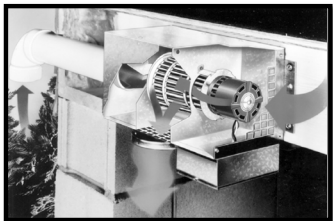


## Mechanical Combustion Air Supply – 304.9

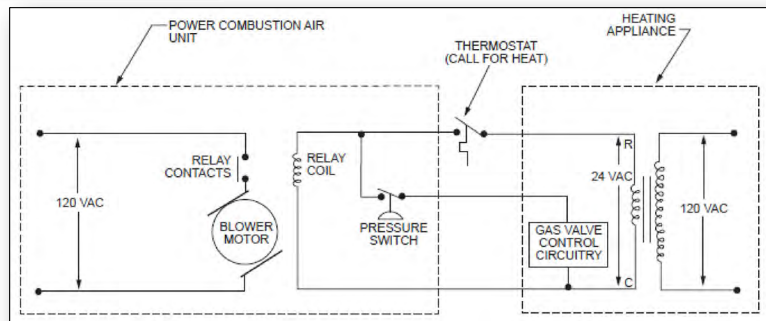
- Where all combustion air is provided by a mechanical air supply system, the combustion air shall be supplied from the outdoors at a rate not less than 0.35 cubic feet per minute per 1,000 Btu/h of total input rating of all appliances located within the space.
- Each of the appliances served shall be interlocked with the mechanical air supply system to prevent main burner operation when the mechanical air supply system is not in operation.



## Appliance Interlock – 304.9.2

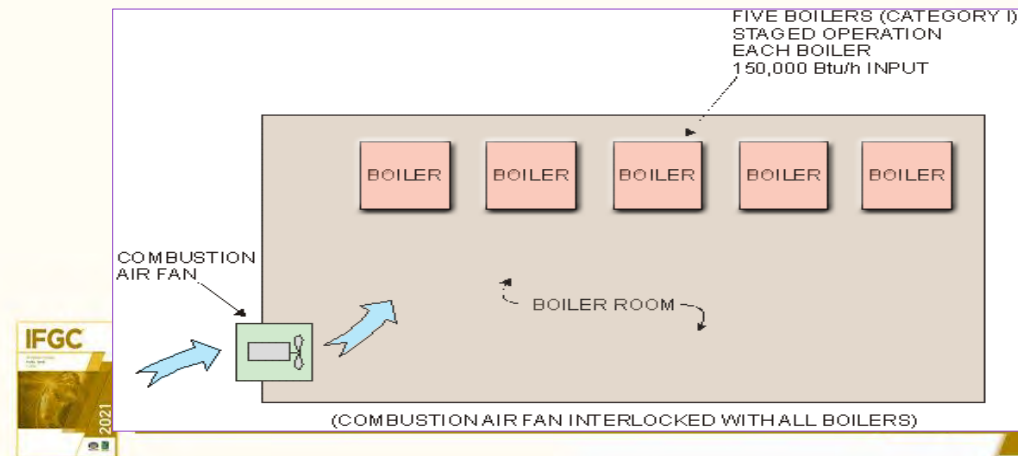


Each of the appliances served shall be interlocked with the mechanical air supply system to prevent main burner operation when the mechanical air supply system is not in operation.



## Mechanical Combustion Air Calculation

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



# Mechanical Combustion Air Calculation

**Given:** Five gas boilers with input ratings of 150,000 Btu/h each will be installed in a boiler room.

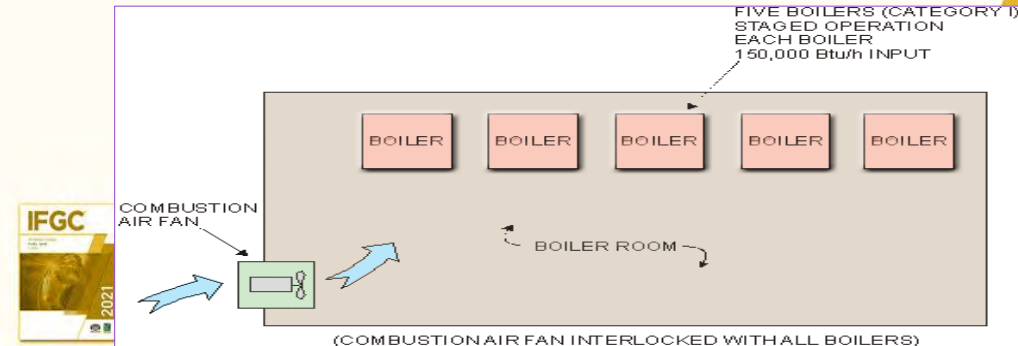
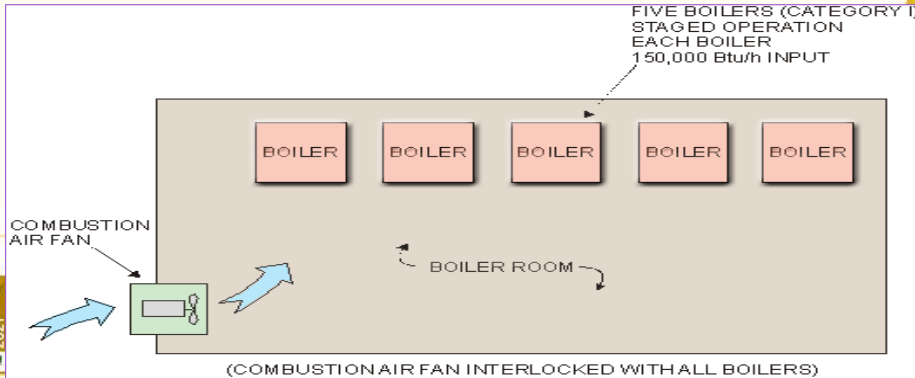
Calculated the minimum mechanical combustion air supply in cubic feet per minute (cfm) required for the appliances assuming full load condition.

# Mechanical Combustion Air Calculation

**Step 1: Total gas input rating of all gas boilers located within enclosure.**  
 $150,000 \text{ Btu/h} \times 5 = 750,000 \text{ Btu/h}$

**Step 2: Determine minimum supply air flow rate (cfm) required.**  
 $750,000 \text{ Btu/h} / (1,000 \text{ Btu/h} / 0.35 \text{ cfm}) = \underline{263 \text{ cfm}}$

Therefore, a minimum of **263 cfm** is required for full load condition.

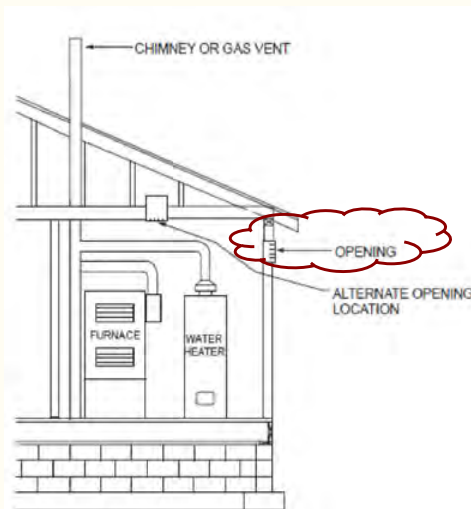


## 2021 IECC C402.5.5

**C402.5.5 Rooms containing fuel-burning appliances.**  
 In Climate Zones 3 through 8, where combustion air is supplied through openings in an exterior wall to a room or space containing a space-conditioning fuel-burning appliance, one of the following shall apply:

1. The room or space containing the appliance shall be located outside of the building thermal envelope.
2. The room or space containing the appliance shall be enclosed and isolated from conditioned spaces inside the building thermal envelope. Such rooms shall comply with all of the following:
  - 2.1. The walls, floors and ceilings that separate the enclosed room or space from conditioned spaces shall be insulated to be not less than equivalent to the insulation requirement of below-grade walls as specified in Table C402.1.3 or Table C402.1.4.
  - 2.2. The walls, floors and ceilings that separate the enclosed room or space from conditioned spaces shall be sealed in accordance with Section C402.5.1.1.
  - 2.3. The doors into the enclosed room or space shall be fully gasketed.
  - 2.4. Water lines and ducts in the enclosed room or space shall be insulated in accordance with Section C403.
  - 2.5. Where an air duct supplying combustion air to the enclosed room or space passes through conditioned space, the duct shall be insulated to an R-value of not less than R-8.

**Exception:** Fireplaces and stoves complying with Sections 901 through 905 of the International Mechanical Code, and Section 2111.14 of the International Building Code.



## Contaminated Atmospheres – 304.12

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

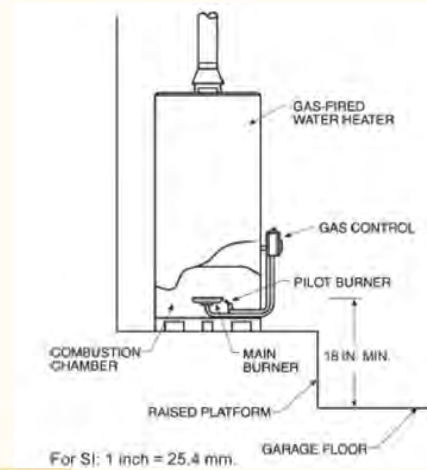


## Installation – 305.1

- 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



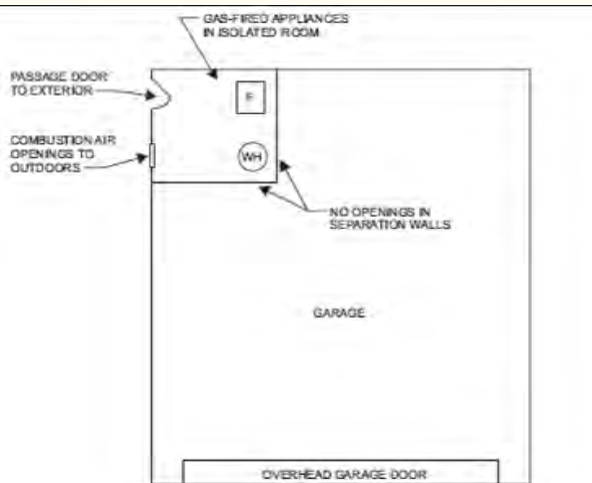
## Elevation of Ignition Source – 305.3



- 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

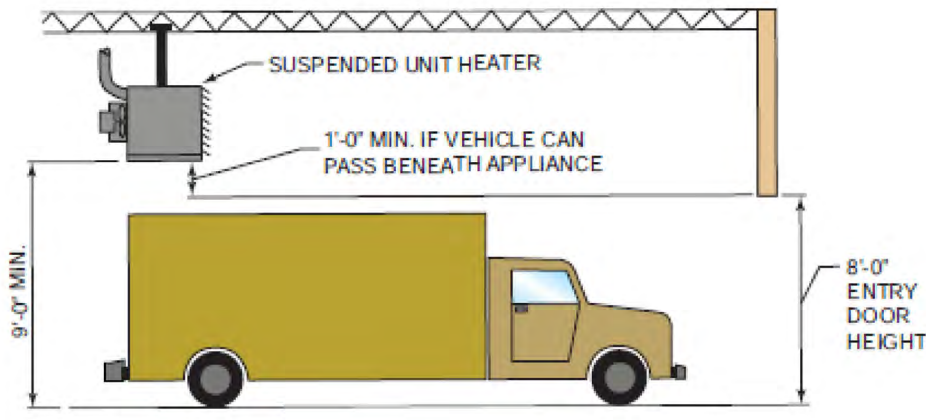


## Garage Installation

| Public Garages<br>(Section 305.4)   | Private Garages<br>(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. |



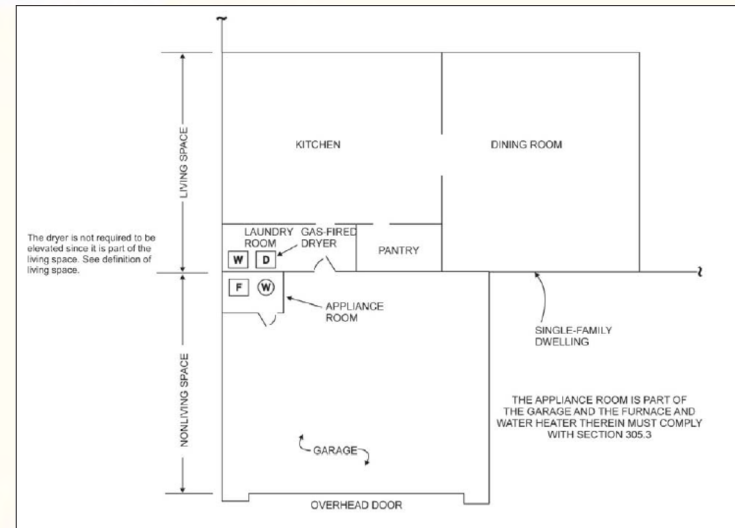
# Garage Installations



Public Garages



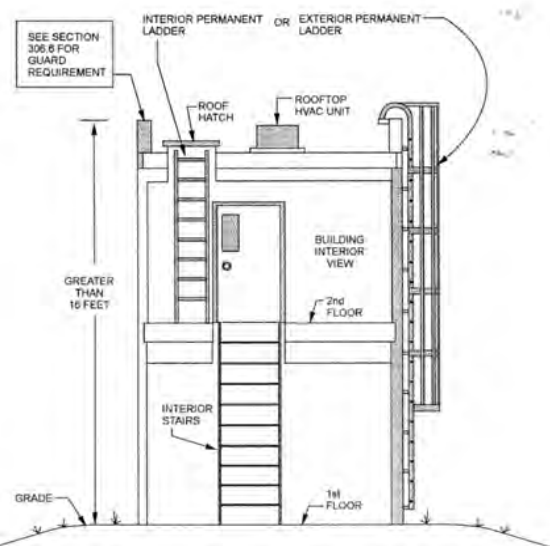
# Garage Installations



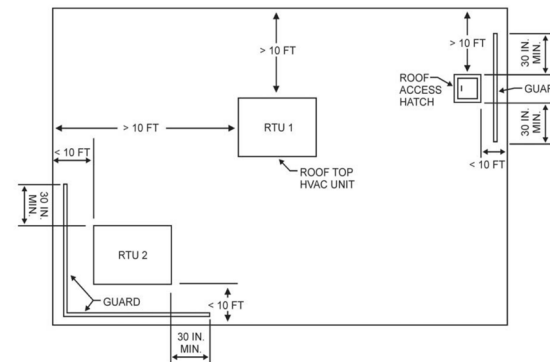
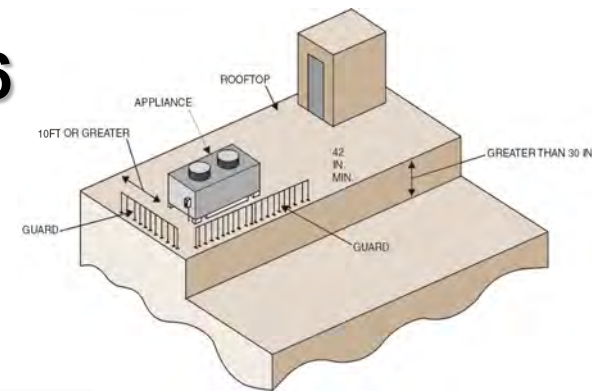
Garage Space vs. Living Space



# Equipment and appliances on roof or elevated structures – 306.5



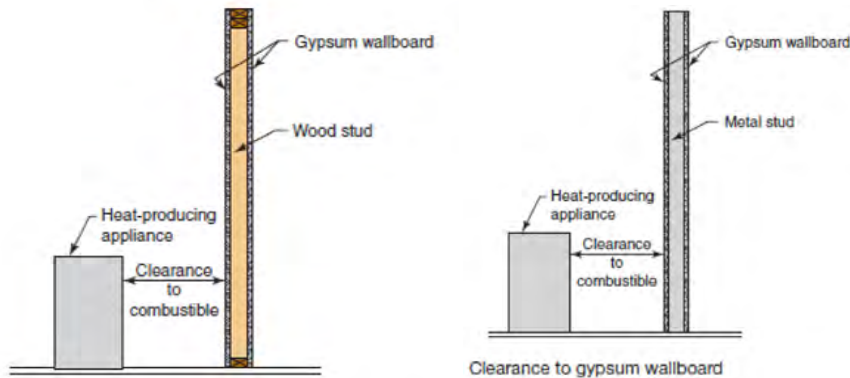
# Guards – 306.6



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

# Scope - 308.1

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



# 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.



# Clearance

- 2021 IFGC,
- Table 308.2

**TABLE 308.2** <sup>a</sup> **REDUCTION OF CLEARANCES WITH SPECIFIED FORMS OF PROTECTION**

WHERE THE REQUIRED CLEARANCE WITH NO PROTECTION FROM APPLIANCE, VENT CONNECTOR, OR SINGLE-WALL METAL PIPE IS: (inches)

| 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)] | 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. |                       |                       |                       | 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 and rear Col. 1   | Above and rear Col. 2 | Sides and rear Col. 1 | Sides and rear Col. 2 | Above and rear Col. 1   | Above and rear Col. 2 | Sides and rear 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<sup>3</sup>, 1 Btu per inch per square foot per hour per °F = 0.144 W/m<sup>2</sup> · 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 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.

# CSST

ANSI LC-1 contains material, performance criteria and installation requirements for CSST gas distribution systems. CSST systems are used as an alternative to more traditional gas piping systems for the distribution of natural gas within buildings.

- Corrugated stainless steel tubing is a semirigid stainless steel tubing with a plastic jacket.
- CSST is available in the yellow jacketed original type and also in the black jacketed arc-resistant type.



Non-arc-resistant CSST

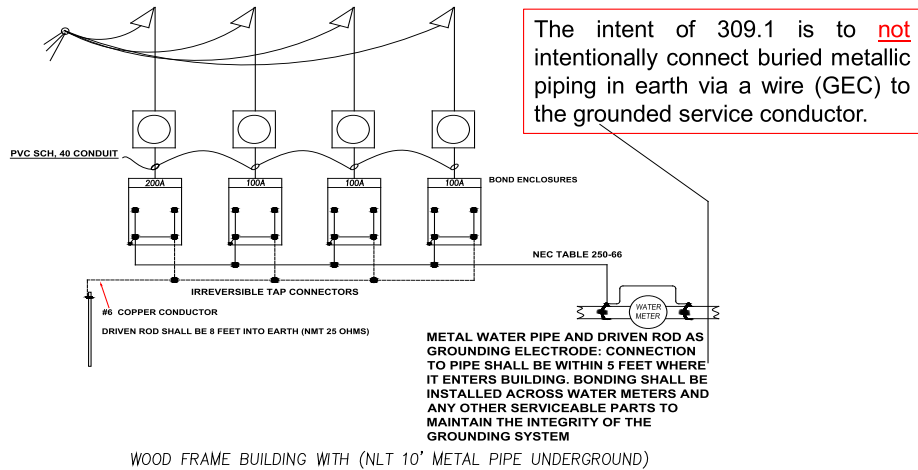
Photo courtesy of OmegaFlex



# Section 309 Electrical

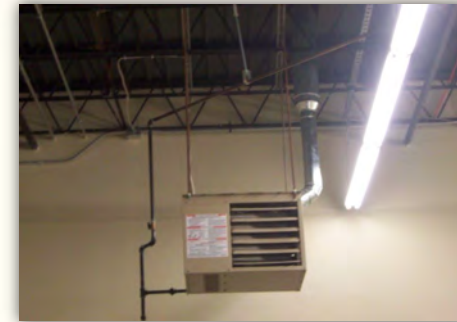
## 309.1 Grounding. Gas piping shall not be used as a grounding electrode.

- Underground gas piping cannot be used as an earth electrode because it is not recognized as such in the NEC and because of the perceived risk of potential current flow on piping that conveys flammable gas.



# Section 310 Electrical Bonding

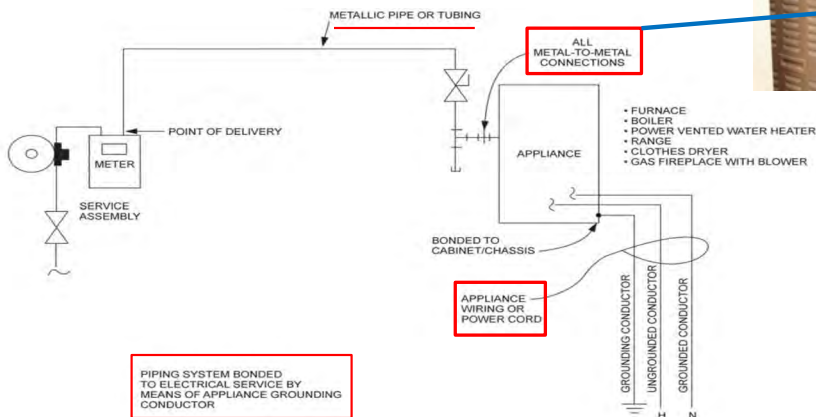
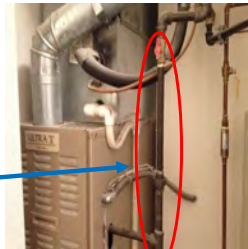
## Gas Pipe & Tubing other than CSST (310.1)



Schedule 40 Steel Gas Piping System



## Gas Pipe & Tubing other than CSST



Gas Pipe Bonding by Appliance Equipment Grounding Conductor Permitted: 2021 IFGC 310.1 & 2020 NEC 250.104(B) Informational Note #2

## CSST Bonding (310.2)

**310.2 CSST.** This section applies to corrugated stainless steel tubing (CSST) that is **not listed with an arc-resistant jacket or coating system in accordance with ANSI LC 1/CSA 6.26**. CSST gas piping systems and piping systems containing **one or more** segments of CSST shall be electrically continuous and bonded to the electrical service grounding electrode system or, where provided, the lightning protection grounding electrode system.



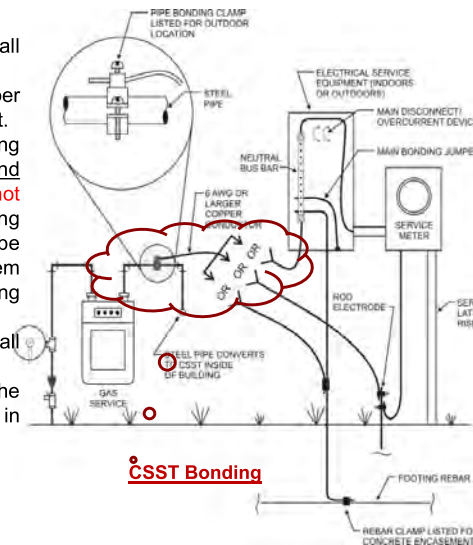
**310.2.1 Point of connection.** The bonding jumper shall connect to a **metallic pipe, pipe fitting or CSST fitting**.

**310.2.2 Size and material of jumper.** The bonding jumper shall be not smaller than **6 AWG copper wire** or equivalent.

**310.2.3 Bonding jumper length.** The length of the bonding jumper between the **connection to a gas piping system and the connection to a grounding electrode system shall not exceed 75 feet (22 860 mm)**. Any additional grounding electrodes installed to meet this requirement shall be bonded to the electrical service grounding electrode system or, where provided, the lightning protection grounding electrode system.

**310.2.4 Bonding connections.** Bonding connections shall be in accordance with **NFPA 70**.

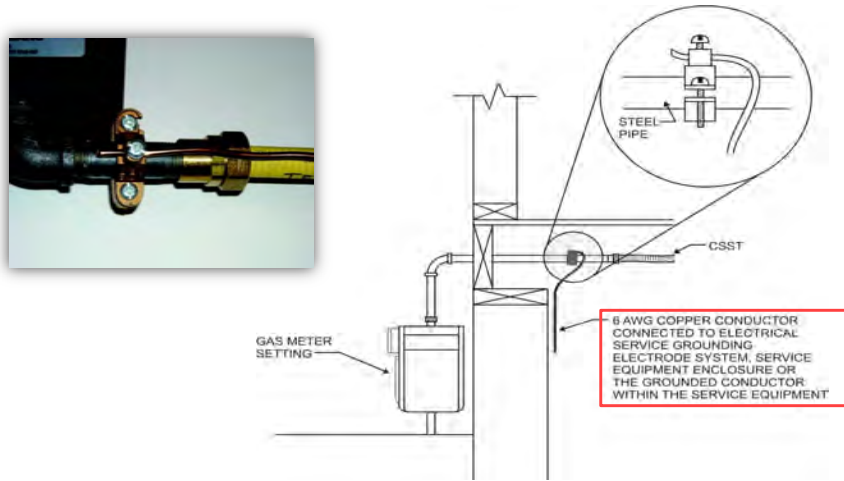
**310.2.5 Connection devices.** Devices used for making the bonding connections shall be listed for the application in accordance with **UL 467**.





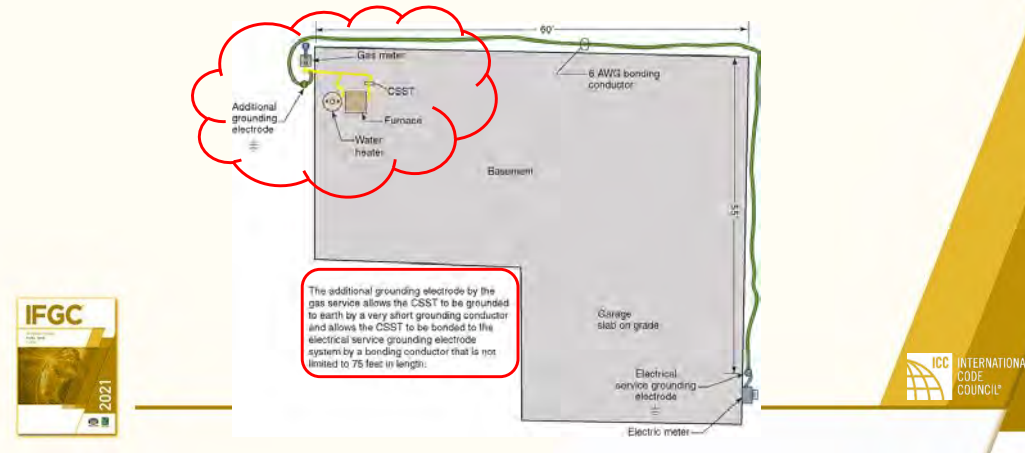
# Gas Piping CSST Bonding (310.2)

**310.2.1 Point of connection.** The bonding jumper shall connect to a metallic pipe, pipe fitting or CSST fitting.



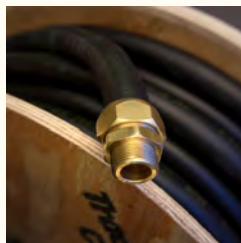
# 310.2.3 Bonding Jumper Length

**310.2.3 Bonding jumper length.** The length of the bonding jumper between the connection to a gas piping system and the connection to a grounding electrode system shall not exceed 75 feet (22 860 mm). **Any additional grounding electrodes installed to meet this requirement shall be bonded to the electrical service grounding electrode system or, where provided, the lightning protection grounding electrode system.**



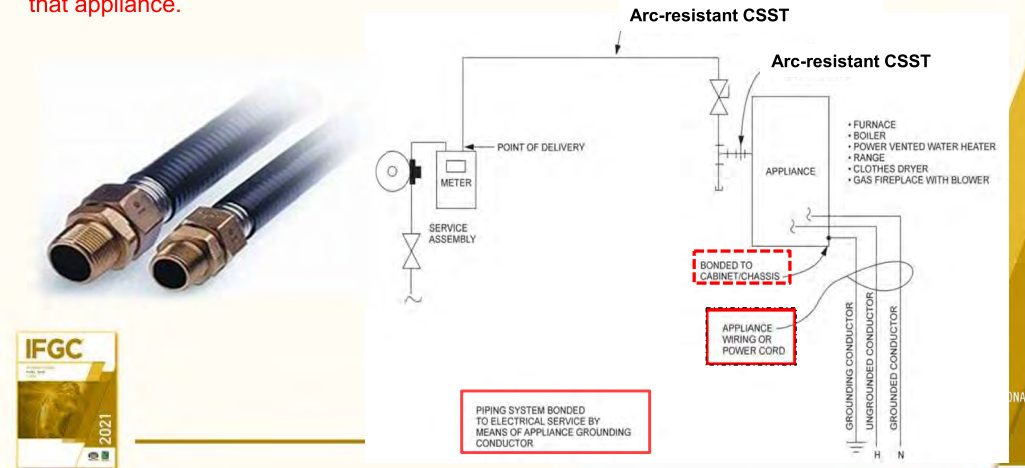
# 310.3 ARC-RESISTANT CSST

- ❑ The inherent protection is in the form of proprietary specialized jackets that cover the CSST and allow induced currents to be dissipated without causing perforation of the tubing. Such jacket/coverings are conductive and distribute the electrical charge to limit the possibility of an arc to a grounded object.
- ❑ Testing has shown that the arc-resistant products do not need the more robust method of bonding that is required for the traditional (yellow) CSST by Section 310.2.
- ❑ Arc-resistant CSST still has to be bonded, but it is generally automatically bonded by its connection to appliances that are grounded by their electrical supply circuits.



# 310.3 Arc-resistant CSST

**310.3 Arc-resistant CSST.** This section applies to corrugated stainless steel tubing (CSST) that is listed with an arc-resistant jacket or coating system in accordance with ANSI LC 1/CSA 6.26. The CSST shall be electrically continuous and bonded to an effective ground fault current path. Where any CSST component of a piping system does not have an arc-resistant jacket or coating system, the bonding requirements of Section 310.2 shall apply. **Arc-resistant-jacketed CSST shall be considered to be bonded where it is connected to an appliance that is connected to the appliance grounding conductor of the circuit that supplies that appliance.**





## Identification - 401.9

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

**401.9 Identification.** Each length of pipe and tubing and each pipe fitting, utilized in a fuel gas system, shall bear the identification of the manufacturer.

### Exceptions:

- Steel pipe sections that are 2 feet (610 mm) and less in length and are cut from longer sections of pipe.
- Steel pipe fittings 2 inches and less in size.
- Where identification is provided on the product packaging or crating.
- Where other *approved* documentation is provided.



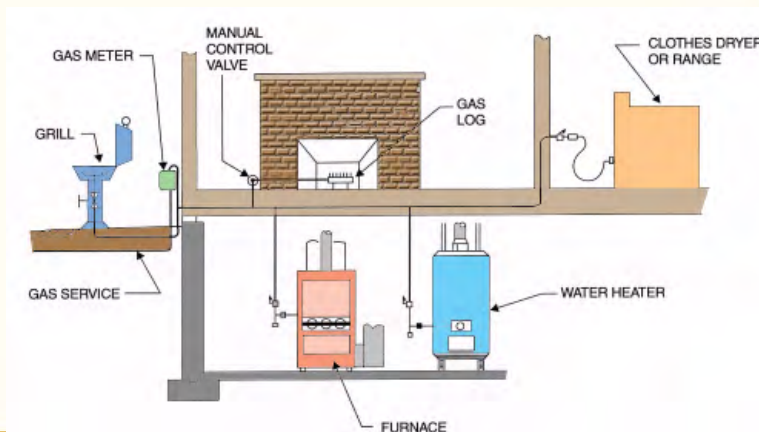
Each length of pipe and fittings shall bear the identification of the manufacturer

## 2021 IFGC Section 402 Gas Pipe Sizing

Piping systems shall be of such size and so installed as to provide a supply of gas sufficient to meet the maximum demand and supply gas to each appliance inlet at not less than the minimum supply pressure required by the appliance.

## Pipe Sizing-402

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



## 402.2 Maximum Gas Demand for Pipe Sizing

- [Table 402.2 for estimated gas input for typical appliances and the reference to the table was deleted](#) in 2015 as a result of the code requiring the actual maximum input rating of the appliances to be known and used for sizing purposes.

**402.2 Maximum gas demand.** The volumetric flow rate of gas to be provided shall be the sum of the maximum input of the *appliances* served.



## 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.

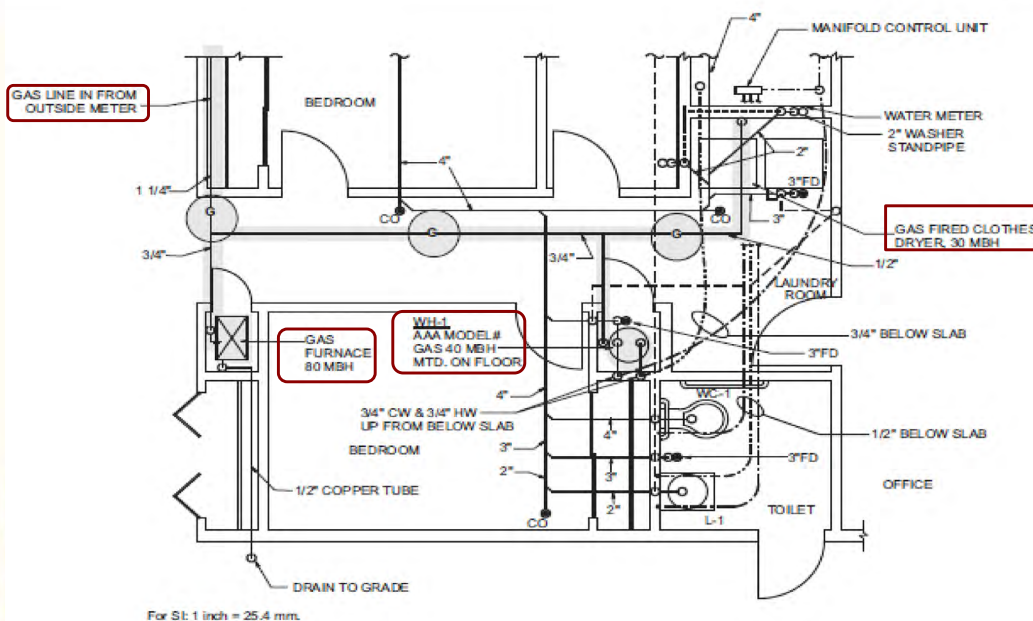


## Pipe Sizing

- Section 402.4.2 – Branch length method
  - 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.
  - 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.



## A Gas Piping System Plan



## Five Step Review Process

- Determine maximum gas demand
- Determine length to most remote outlet
- Select correct table
- Locate gas demand figures
- 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

What you need to know to determine compliance

|                               | Needed Information   | Definition   | Explanation  | Where Located  |
|-------------------------------|--|--|--|--|
| Pressure Drop (loss)          | Allowable loss in pressure from point of delivery to gas appliance. Point of delivery is normally the outlet of the first fitting downstream of the gas meter.   | The loss in pressure due to friction or obstruction in pipes, valves, fittings and regulators.   | This is the designer's choice.   | Indicated on plans   |
| Demand                        | Maximum gas demand   | The total volume of gas used per hour by all appliances as indicated on each appliance label.  | Piping must be sized to accommodate full length of gas runs and simultaneous utilization of the gas appliance in the plan. (See "Diversity factor" below.)                             | Indicated on plans, located on appliance labels  |
| Pipe Length & Fittings        | Length of piping and number of fittings  | This is the distance of each segment of pipe.<br>Fittings: When using the tables, an additional allowance is necessary where four or more fittings are used.                       | Scaled drawings of both plans and elevations are required to determine the full length of the gas runs from the most remote outlet to determine if the piping has been properly sized. | On plans   |
| Pipe Sizes                    | Labeled pipe sizes   | This is the diameter and type of pipe to convey the gas.   | Each pipe segment must have its size and type of material called out on the plan to be able to verify that it has the required capacity to satisfy the demand.                         | On plans   |
| Specific Gravity              | Specific gravity of the gas  | The ratio of the weight of a given volume of the gas to that of the same volume of air, both measured under the same conditions.   | Obtained from serving gas supplier.  |  |
| Diversity Factor (correction) | Diversity factor (The volumetric flow rate of gas to be provided shall be adjusted for altitude where the installation is above 2,000 feet (610 m) in elevation) | Design for predicted gas demand that is less than the total aggregate demand; or other specific circumstances of a job that might alter the normal application of code provisions. | When it is not probable that all appliances will be operated simultaneously, a reduction can be factored in.   | On plans in form of calculations and support documentation provided by design professional |

## 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

### Tables 402.4(1) through 402.4(37)

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 0.60 specific gravity.

Table 402.4(2)



## Tables 402.4(1) through 402.4(37)

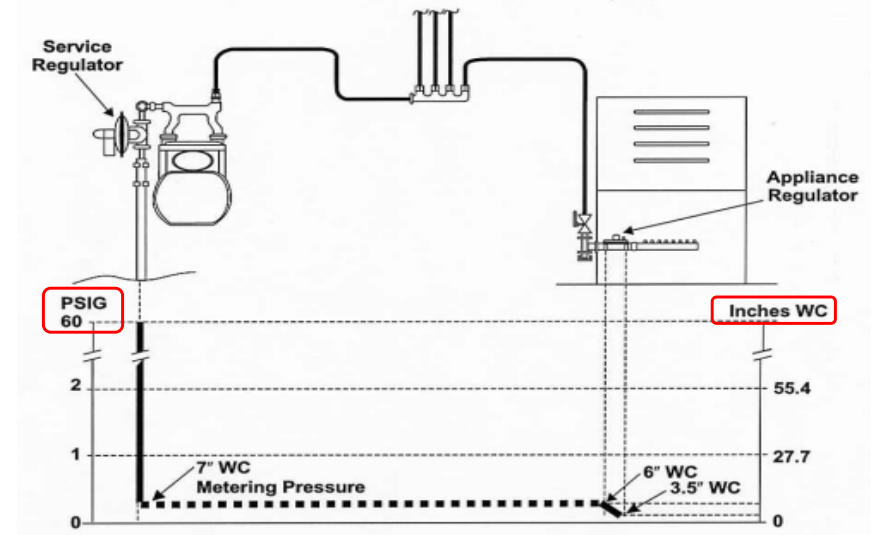
Which table would you use?

- 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 0.60 specific gravity.

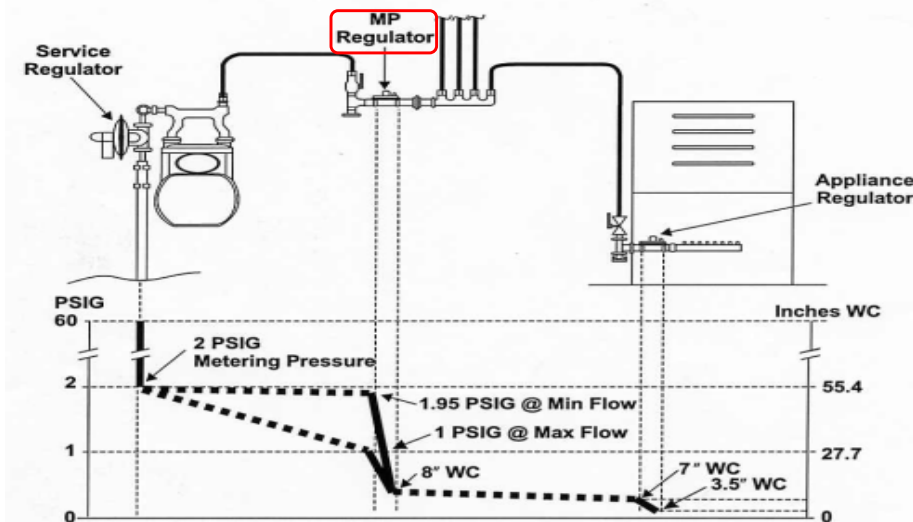
Table 402.4(5)



## Gas Flow Controls Example “Low Pressure”



## Gas Flow Controls Example “Medium Pressure”



## Variance of BTUs

- Natural gas is **not** a manufactured product and the heat value (BTU's) of the gas varies considerably from region to region.
- At a constant pressure a pipe can convey a set volume of gas per hour based on the diameter, we measure this as **cubic feet per hour or CFH**.
- BTU's of gas varies, but the amount of CFH a pipe can deliver is constant, the sizing tables use CFH to size the diameter of the pipe.



## CFH Calculation

DEMAND (D) - CFH  
 ENERGY (N) - BTU/3  
 FT  
 APPLIANCE  
 INPUT (A) - BTU/H

$$D = \frac{A}{N}$$

$$= \frac{129,000 \text{ BTU/H}}{1000 \text{ BTU/3 FT}}$$

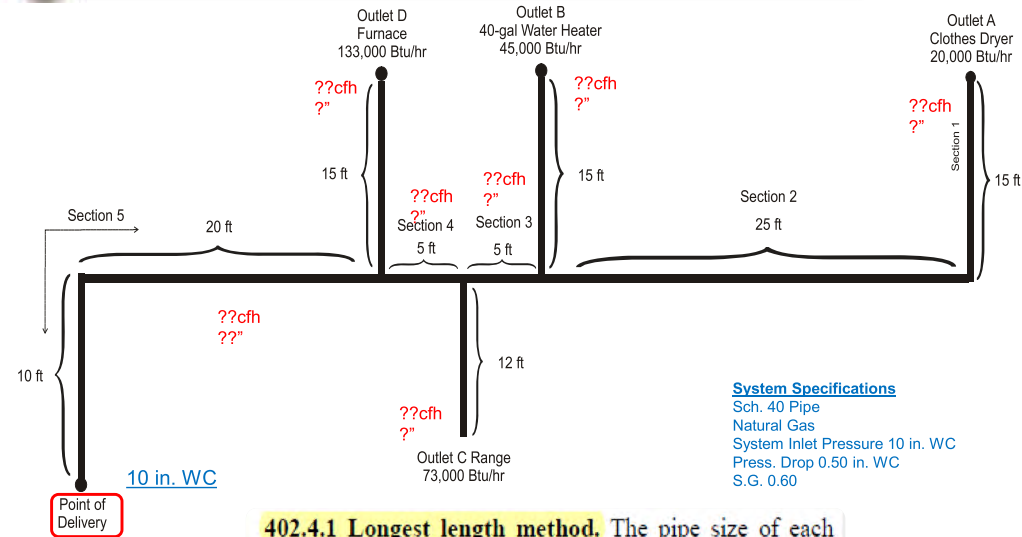
$$D = 120 \frac{\text{ft}^3}{\text{h}} \Rightarrow \underline{120 \text{ CFH}}$$

NOTE:  
 NATURAL GAS  
 PRODUCES 1000 BTU'S  
 OF ENERGY PER  
 CUBIC FOOT OF  
 VOLUME.

CALCULATE  
 THE DEMAND  
 IN CFH FOR  
 A 129,000 BTU/H  
 BOILER.



## Gas System Sizing Problem IFGC 402.4.1 Longest Length Method)



**402.4.1 Longest length method.** The pipe size of each section of gas piping shall be determined using the longest length of piping from the point of delivery to the most remote outlet and the load of the section.

## Gas System Sizing Problem

## Gas System Sizing Problem

- Determine maximum gas demand:

Outlet A: 20 cfh (ft<sup>3</sup>/h)  
 Outlet B: 45 cfh (ft<sup>3</sup>/h)  
 Outlet C: 73 cfh (ft<sup>3</sup>/h)  
 Outlet D: 133 cfh (ft<sup>3</sup>/h)

Total system gas demand: 271 cfh (ft<sup>3</sup>/h)

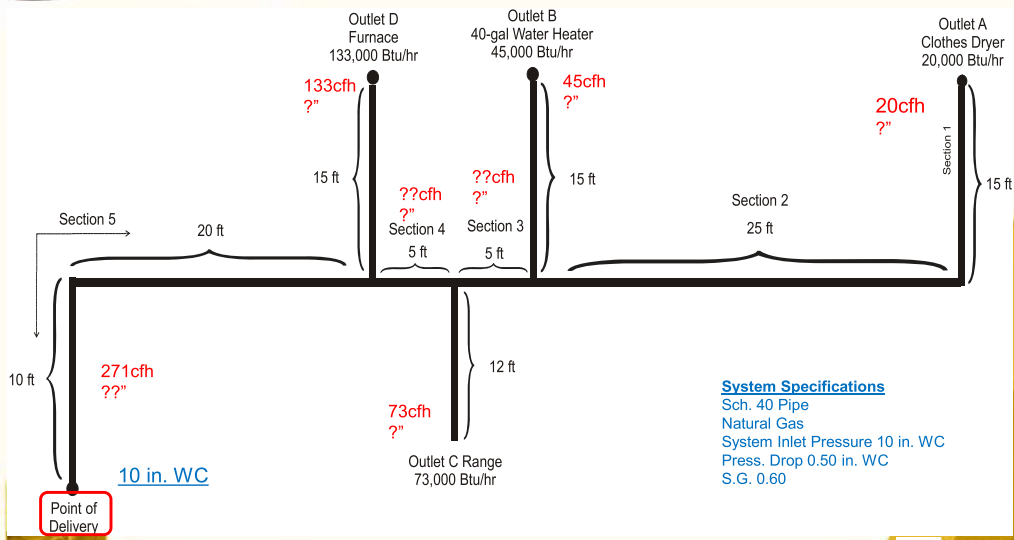
Given:

| 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<sup>3</sup>.



# Gas Demands in CFH



**System Specifications**  
 Sch. 40 Pipe  
 Natural Gas  
 System Inlet Pressure 10 in. WC  
 Press. Drop 0.50 in. WC  
 S.G. 0.60

# Gas System Sizing Problem

2. Determine length to the most remote outlet:

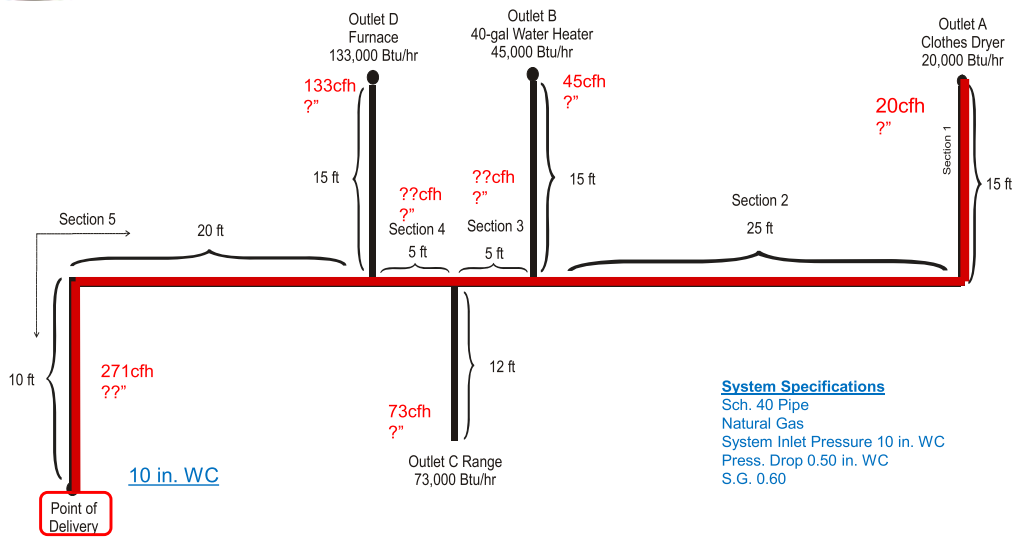
- Section 1: 15 ft.
- Section 2: 25 ft.
- Section 3: 5 ft.
- Section 4: 5 ft.
- Section 5: 30 ft.

Total pipe length to most remote outlet: 80 ft.



# Gas System Sizing Problem

(IFGC 402.4.1 Longest Length Method)



**System Specifications**  
 Sch. 40 Pipe  
 Natural Gas  
 System Inlet Pressure 10 in. WC  
 Press. Drop 0.50 in. WC  
 S.G. 0.60

# Gas System Sizing Problem

3. The most remote outlet from the “point of delivery” is the Clothes Dryer that has a demand of 20cfh.





# 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

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            |

| Nominal     | PIPE SIZE (inch)                       |       |       |       |       |       |       |        |        |        |        |         |         |         |
|-------------|--|-------|-------|-------|-------|-------|-------|--------|--------|--------|--------|---------|---------|---------|
|             | 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 | 3,600  | 7,400  | 13,400 | 21,400 | 44,000  | 81,000  | 125,000 |
| 90          | 52                                     | 110   | 207   | 424   | 635   | 1,220 | 1,950 | 3,400  | 7,000  | 12,800 | 20,400 | 42,000  | 79,000  | 120,000 |
| 100         | 50                                     | 104   | 195   | 400   | 600   | 1,160 | 1,840 | 3,200  | 6,600  | 12,300 | 19,800 | 40,600  | 77,000  | 117,000 |
| 125         | 44                                     | 92    | 173   | 355   | 532   | 1,020 | 1,630 | 2,800  | 5,800  | 10,900 | 17,400 | 35,400  | 68,000  | 105,000 |
| 150         | 40                                     | 83    | 157   | 322   | 482   | 928   | 1,480 | 2,600  | 5,400  | 10,100 | 16,300 | 33,400  | 64,000  | 100,000 |
| 175         | 37                                     | 77    | 144   | 296   | 443   | 854   | 1,360 | 2,400  | 5,000  | 9,500  | 15,500 | 31,600  | 61,000  | 95,000  |
| 200         | 34                                     | 71    | 134   | 275   | 412   | 794   | 1,270 | 2,200  | 4,600  | 8,800  | 14,600 | 29,800  | 58,000  | 89,000  |



# Gas System Sizing Problem

## Locate nominal size of pipe required:

- Pipe Sections 1 and 2 (Outlet A):** The demand for pipe sections 1 & 2 is clearly 20cfh. Therefore, locate pipe size from Table 402.4(2) that requires a 1/2-inch pipe.

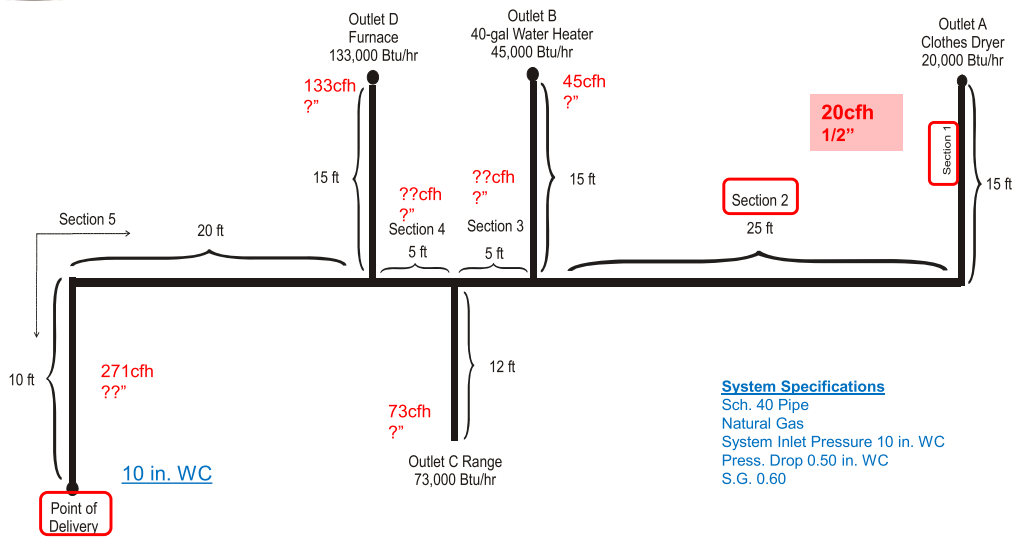
TABLE 402.4(2)  
SCHEDULE 40 METALLIC PIPE

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

| Nominal     | PIPE SIZE (inch)                       |       |       |       |       |       |       |        |        |        |        |         |         |         |
|-------------|--|-------|-------|-------|-------|-------|-------|--------|--------|--------|--------|---------|---------|---------|
|             | 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 | 3,600  | 7,400  | 13,400 | 21,400 | 44,000  | 81,000  | 125,000 |
| 90          | 52                                     | 110   | 207   | 424   | 635   | 1,220 | 1,950 | 3,400  | 7,000  | 12,800 | 20,400 | 42,000  | 79,000  | 120,000 |
| 100         | 50                                     | 104   | 195   | 400   | 600   | 1,160 | 1,840 | 3,200  | 6,600  | 12,300 | 19,800 | 40,600  | 77,000  | 117,000 |
| 125         | 44                                     | 92    | 173   | 355   | 532   | 1,020 | 1,630 | 2,800  | 5,800  | 10,900 | 17,400 | 35,400  | 68,000  | 105,000 |
| 150         | 40                                     | 83    | 157   | 322   | 482   | 928   | 1,480 | 2,600  | 5,400  | 10,100 | 16,300 | 33,400  | 64,000  | 100,000 |
| 175         | 37                                     | 77    | 144   | 296   | 443   | 854   | 1,360 | 2,400  | 5,000  | 9,500  | 15,500 | 31,600  | 61,000  | 95,000  |
| 200         | 34                                     | 71    | 134   | 275   | 412   | 794   | 1,270 | 2,200  | 4,600  | 8,800  | 14,600 | 29,800  | 58,000  | 89,000  |



# Gas System Sizing Problem (IFGC 402.4.1 Longest Length Method)



**System Specifications**  
 Sch. 40 Pipe  
 Natural Gas  
 System Inlet Pressure 10 in. WC  
 Press. Drop 0.50 in. WC  
 S.G. 0.60

## Gas System Sizing Problem

- Next, we will size the main gas pipe line from **Section 3** through **Section 5**:
- Locate nominal size of pipe required for pipe **Section 3**.
  - Pipe Section 3:**
    - Calculated demand of 20cfh + 45cfh = 65cfh.
    - Then locate pipe size from Table 402.4(2) that requires a 3/4-inch pipe.



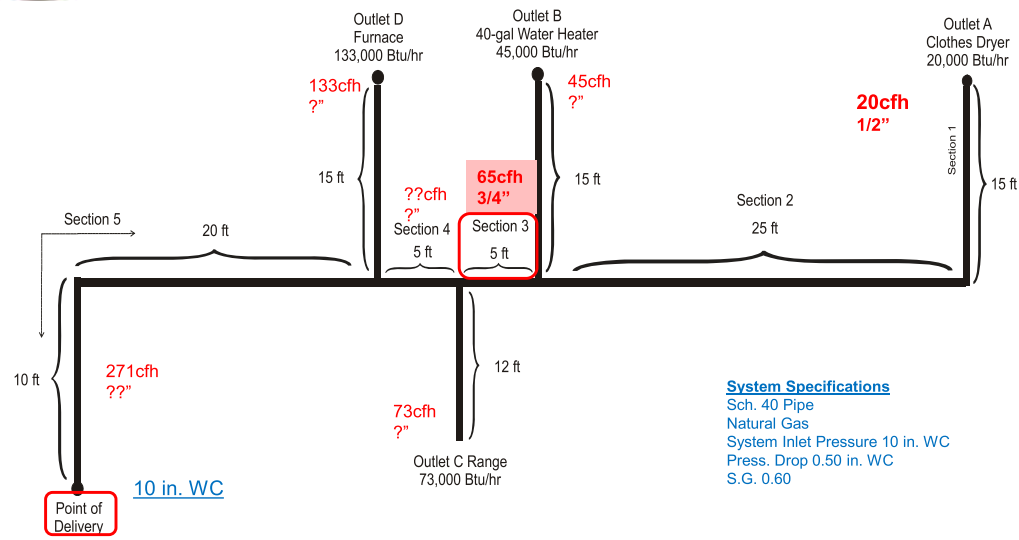
**TABLE 402.4(2)  
 SCHEDULE 40 METALLIC PIPE**

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

| Nominal     | PIPE SIZE (inch)                       |       |       |       |       |       |       |        |        |        |        |         |         |         |
|-------------|--|-------|-------|-------|-------|-------|-------|--------|--------|--------|--------|---------|---------|---------|
|             | 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 | 3,700  | 7,500  | 13,500 | 21,500 | 44,000  | 81,000  | 125,000 |
| 90          | 52                                     | 110   | 207   | 424   | 635   | 1,220 | 1,950 | 3,400  | 7,000  | 12,800 | 20,000 | 41,000  | 77,000  | 116,000 |
| 100         | 50                                     | 104   | 195   | 400   | 600   | 1,160 | 1,840 | 3,200  | 6,600  | 12,200 | 19,000 | 39,000  | 73,000  | 110,000 |
| 125         | 44                                     | 92    | 173   | 355   | 532   | 1,020 | 1,630 | 2,800  | 5,800  | 10,600 | 16,300 | 33,000  | 63,000  | 96,000  |
| 150         | 40                                     | 83    | 157   | 322   | 482   | 928   | 1,480 | 2,600  | 5,300  | 9,800  | 15,000 | 30,000  | 57,000  | 87,000  |
| 175         | 37                                     | 77    | 144   | 296   | 443   | 854   | 1,360 | 2,400  | 5,000  | 9,200  | 14,000 | 28,000  | 53,000  | 80,000  |
| 200         | 34                                     | 71    | 134   | 275   | 412   | 794   | 1,270 | 2,200  | 4,600  | 8,500  | 12,800 | 25,600  | 49,000  | 73,000  |



# Gas System Sizing Problem (IFGC 402.4.1 Longest Length Method)



**System Specifications**  
 Sch. 40 Pipe  
 Natural Gas  
 System Inlet Pressure 10 in. WC  
 Press. Drop 0.50 in. WC  
 S.G. 0.60

# Gas System Sizing Problem

- Next, we will size the main gas pipe line from **Section 2** through **Section 5**:
- Locate nominal size of pipe required for pipe **Section 4**.

### Pipe Section 4:

- Calculated demand of 20cfh + 45cfh + 73cfh = **138cfh**. Then locate pipe size from Table 402.4(2) that requires a 1-inch pipe.



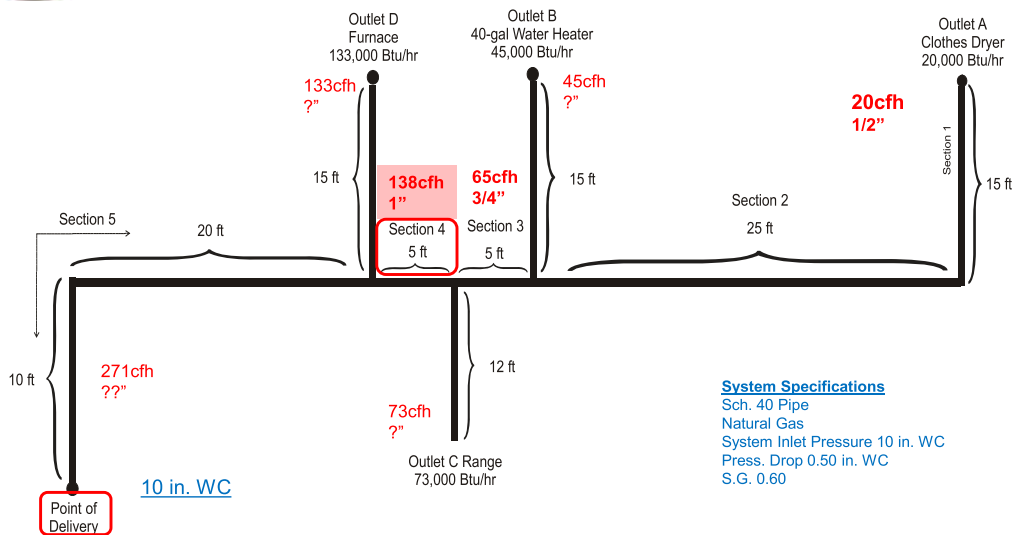
**TABLE 402.4(2)  
SCHEDULE 40 METALLIC PIPE**

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

| Nominal     | PIPE SIZE (inch)                       |       |       |       |       |       |       |        |        |        |        |         |         |         |
|-------------|--|-------|-------|-------|-------|-------|-------|--------|--------|--------|--------|---------|---------|---------|
|             | 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 | 3,680  | 7,500  | 13,700 | 22,000 | 45,000  | 83,000  | 127,000 |
| 90          | 52                                     | 110   | 207   | 424   | 635   | 1,220 | 1,950 | 3,480  | 7,100  | 13,200 | 21,200 | 43,000  | 80,000  | 122,000 |
| 100         | 50                                     | 104   | 195   | 400   | 600   | 1,160 | 1,840 | 3,320  | 6,800  | 12,800 | 20,600 | 42,000  | 78,000  | 118,000 |
| 125         | 44                                     | 92    | 173   | 355   | 532   | 1,020 | 1,630 | 2,960  | 6,100  | 11,500 | 18,600 | 38,000  | 72,000  | 111,000 |
| 150         | 40                                     | 83    | 157   | 322   | 482   | 928   | 1,480 | 2,700  | 5,600  | 10,500 | 17,000 | 35,000  | 68,000  | 104,000 |
| 175         | 37                                     | 77    | 144   | 296   | 443   | 854   | 1,360 | 2,480  | 5,200  | 9,700  | 15,800 | 33,000  | 64,000  | 99,000  |
| 200         | 34                                     | 71    | 134   | 275   | 412   | 794   | 1,270 | 2,300  | 4,900  | 9,200  | 14,800 | 31,000  | 61,000  | 94,000  |



# Gas System Sizing Problem (IFGC 402.4.1 Longest Length Method)



# Gas System Sizing Problem

- Next, we will size the main gas pipe line from **Section 2** through **Section 5**:
- Locate nominal size of pipe required for pipe **Section 5**.

### Pipe Section 5:

- Calculated demand of 20cfh + 45cfh + 73cfh + 133cfh = **271cfh**. Then locate pipe size from Table 402.4(2) that requires a 1-1/4 inch pipe.

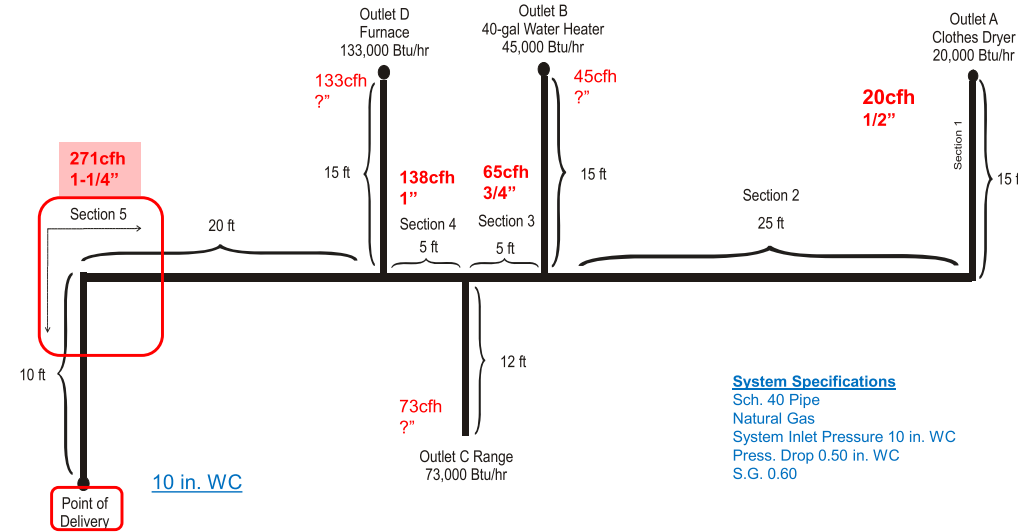




# Gas System Sizing Problem (IFGC 402.4.1 Longest Length Method)

**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            |



**System Specifications**  
Sch. 40 Pipe  
Natural Gas  
System Inlet Pressure 10 in. WC  
Press. Drop 0.50 in. WC  
S.G. 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   | 917   | 1,430 | 2,760 | 4,400 | 7,780  | 15,900 | 28,700 | 46,500 | 95,500  | 173,000 | 275,000 |
| 30               | 95                                     | 199   | 374   | 748   | 1,150 | 2,220 | 3,530 | 6,250  | 12,700 | 23,000 | 37,300 | 76,700  | 139,000 | 220,000 |
| 40               | 81                                     | 170   | 320   | 617   | 985   | 1,900 | 3,020 | 5,350  | 10,900 | 19,700 | 31,900 | 65,600  | 119,000 | 189,000 |
| 50               | 72                                     | 151   | 284   | 533   | 873   | 1,680 | 2,680 | 4,740  | 9,660  | 17,500 | 28,300 | 58,200  | 106,000 | 167,000 |
| 60               | 65                                     | 137   | 257   | 518   | 791   | 1,520 | 2,430 | 4,290  | 8,760  | 15,800 | 25,600 | 52,700  | 95,700  | 152,000 |
| 70               | 60                                     | 126   | 237   | 466   | 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 | 3,600  | 7,300  | 13,000 | 20,800 | 42,000  | 79,000  | 127,000 |
| 90               | 52                                     | 110   | 207   | 424   | 635   | 1,220 | 1,950 | 3,400  | 6,800  | 12,200 | 1,950  | 3,900   | 7,300   | 110,000 |
| 100              | 50                                     | 104   | 195   | 400   | 600   | 1,160 | 1,840 | 3,200  | 6,400  | 11,600 | 1,840  | 3,200   | 6,400   | 104,000 |
| 125              | 44                                     | 92    | 173   | 355   | 532   | 1,020 | 1,630 | 2,800  | 5,600  | 1,020  | 1,630  | 2,800   | 5,600   | 92,000  |
| 150              | 40                                     | 83    | 157   | 322   | 482   | 928   | 1,480 | 2,600  | 5,200  | 928    | 1,480  | 2,600   | 5,200   | 83,000  |
| 175              | 37                                     | 77    | 144   | 296   | 443   | 854   | 1,360 | 2,400  | 4,800  | 854    | 1,360  | 2,400   | 4,800   | 77,000  |
| 200              | 34                                     | 71    | 134   | 275   | 412   | 794   | 1,270 | 2,200  | 4,400  | 794    | 1,270  | 2,200   | 4,400   | 71,000  |



## Gas System Sizing Problem

- Lastly, we will size branch gas Outlet B, Outlet C, and Outlet D.
- Locate nominal size of pipe required for pipe Outlet B.
  - Outlet B:
    - Demand of branch gas Outlet B is 45cfh.
    - Then locate pipe size from Table 402.4(2) that requires a 1/2 inch pipe.

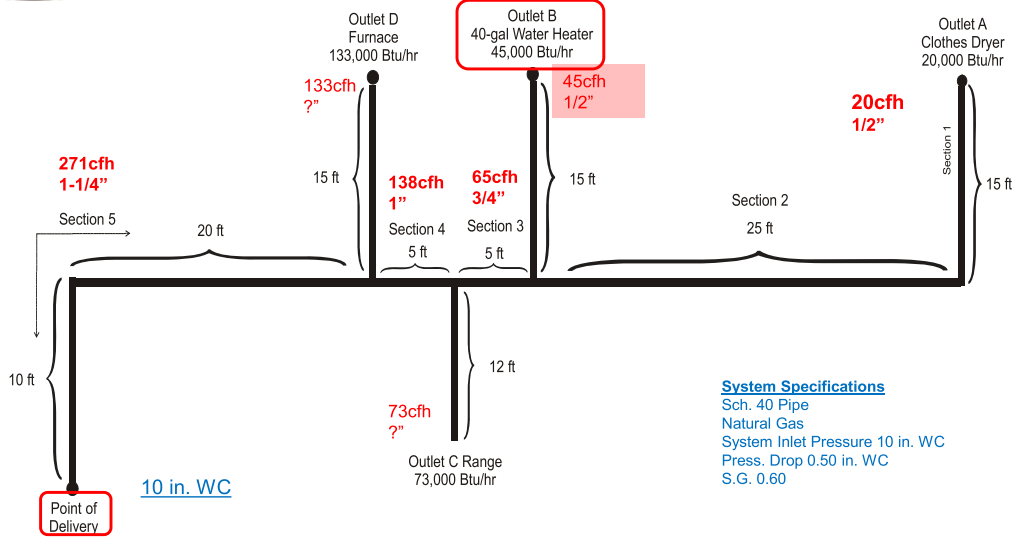
**TABLE 402.4(2)  
SCHEDULE 40 METALLIC PIPE**

|                  |                 |
|------------------|-----------------|
| 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 | 3,600  | 7,300  | 13,000 | 20,800 | 42,000  | 79,000  | 127,000 |
| 90               | 52                                     | 110   | 207   | 424   | 635   | 1,220 | 1,950 | 3,400  | 6,800  | 12,200 | 1,950  | 3,900   | 7,300   | 110,000 |
| 100              | 50                                     | 104   | 195   | 400   | 600   | 1,160 | 1,840 | 3,200  | 6,400  | 11,600 | 1,840  | 3,200   | 6,400   | 104,000 |
| 125              | 44                                     | 92    | 173   | 355   | 532   | 1,020 | 1,630 | 2,800  | 5,600  | 1,020  | 1,630  | 2,800   | 5,600   | 92,000  |
| 150              | 40                                     | 83    | 157   | 322   | 482   | 928   | 1,480 | 2,600  | 5,200  | 928    | 1,480  | 2,600   | 5,200   | 83,000  |
| 175              | 37                                     | 77    | 144   | 296   | 443   | 854   | 1,360 | 2,400  | 4,800  | 854    | 1,360  | 2,400   | 4,800   | 77,000  |
| 200              | 34                                     | 71    | 134   | 275   | 412   | 794   | 1,270 | 2,200  | 4,400  | 794    | 1,270  | 2,200   | 4,400   | 71,000  |



# Gas System Sizing Problem (IFGC 402.4.1 Longest Length Method)



# Gas System Sizing Problem

- Lastly, we will size branch gas Outlet B, Outlet C, and Outlet D.
- Locate nominal size of pipe required for pipe Outlet C.
  - **Outlet C:**
    - Demand of branch gas Outlet C is 73cfh.
    - Then locate pipe size from Table 402.4(2) that requires a 3/4 inch pipe.



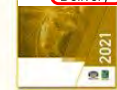
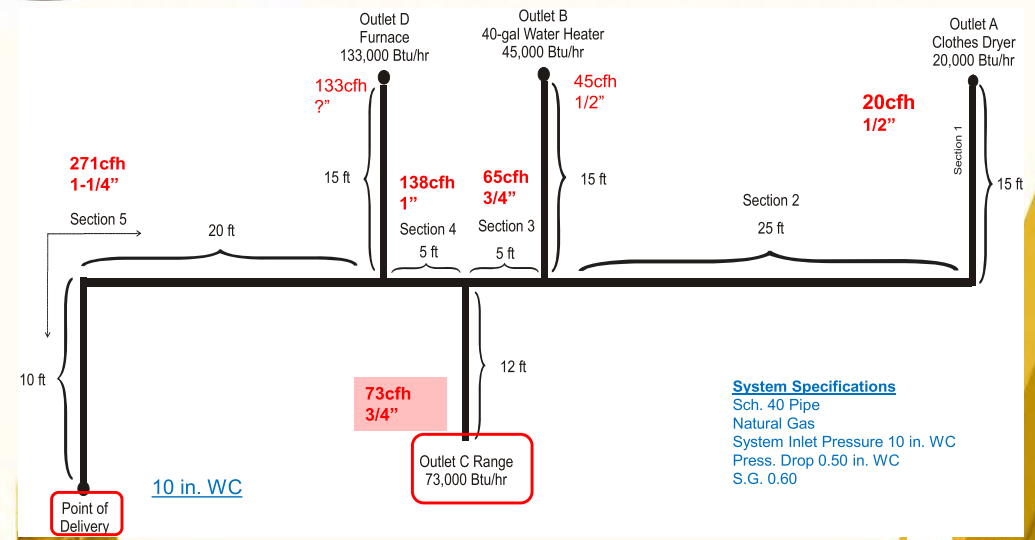
TABLE 402.4(2) SCHEDULE 40 METALLIC PIPE

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

| Nominal     | PIPE SIZE (inch)                       |       |       |       |       |       |       |        |        |        |        |         |         |         |
|-------------|--|-------|-------|-------|-------|-------|-------|--------|--------|--------|--------|---------|---------|---------|
|             | 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 | 3,700  | 7,600  | 13,900 | 22,000 | 45,000  | 84,000  | 128,000 |
| 90          | 52                                     | 110   | 207   | 424   | 635   | 1,220 | 1,950 | 3,400  | 7,100  | 13,200 | 21,000 | 43,000  | 81,000  | 124,000 |
| 100         | 50                                     | 104   | 195   | 400   | 600   | 1,160 | 1,840 | 3,200  | 6,700  | 12,600 | 20,000 | 41,000  | 79,000  | 121,000 |
| 125         | 44                                     | 92    | 173   | 355   | 532   | 1,020 | 1,630 | 2,800  | 5,800  | 10,900 | 17,300 | 35,000  | 69,000  | 107,000 |
| 150         | 40                                     | 83    | 157   | 322   | 482   | 928   | 1,480 | 2,600  | 5,300  | 9,900  | 16,000 | 33,000  | 65,000  | 101,000 |
| 175         | 37                                     | 77    | 144   | 296   | 443   | 854   | 1,360 | 2,400  | 5,000  | 9,300  | 15,200 | 31,000  | 61,000  | 95,000  |
| 200         | 34                                     | 71    | 134   | 275   | 412   | 794   | 1,270 | 2,200  | 4,600  | 8,600  | 14,300 | 29,000  | 57,000  | 88,000  |



# Gas System Sizing Problem (IFGC 402.4.1 Longest Length Method)



# Gas System Sizing Problem

- Lastly, we will size branch gas Outlet B, Outlet C, and Outlet D.
- Locate nominal size of pipe required for pipe Outlet D.

## Outlet D:

- Demand of branch gas Outlet D is 133cfh.
- Then locate pipe size from Table 402.4(2) that requires a 1 inch pipe.



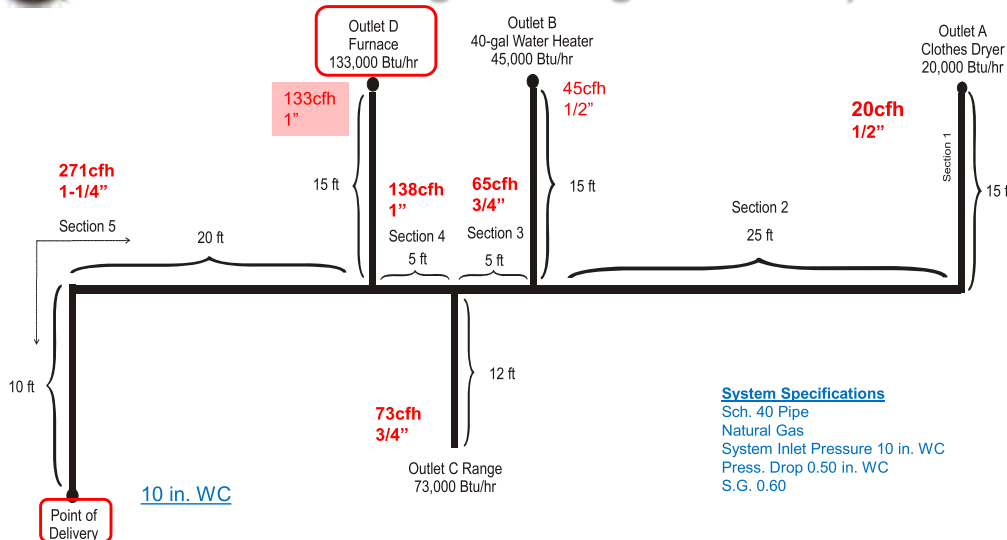
**TABLE 402.4(2)  
SCHEDULE 40 METALLIC PIPE**

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

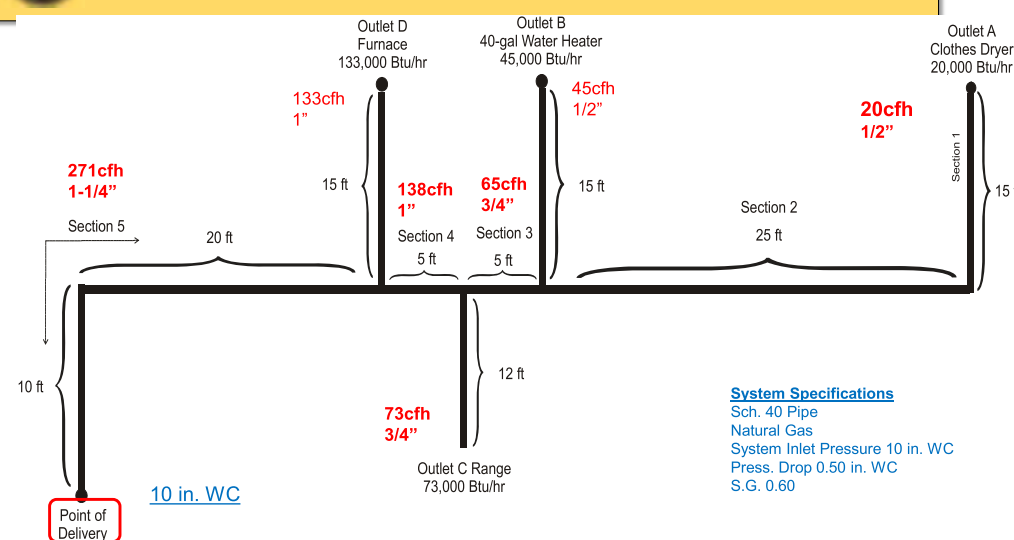
| Nominal     | PIPE SIZE (inch)                       |       |       |       |       |       |       |        |        |        |        |         |         |         |
|-------------|--|-------|-------|-------|-------|-------|-------|--------|--------|--------|--------|---------|---------|---------|
|             | 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 | 3,600  | 7,400  | 13,400 | 21,600 | 44,500  | 81,500  | 125,000 |
| 90          | 52                                     | 110   | 207   | 424   | 635   | 1,220 | 1,950 | 3,400  | 7,000  | 12,800 | 20,400 | 42,500  | 79,500  | 119,000 |
| 100         | 50                                     | 104   | 195   | 400   | 600   | 1,160 | 1,840 | 3,200  | 6,600  | 12,300 | 19,600 | 40,500  | 76,500  | 114,000 |
| 125         | 44                                     | 92    | 173   | 355   | 532   | 1,020 | 1,630 | 2,800  | 5,800  | 10,800 | 17,200 | 35,500  | 67,500  | 102,000 |
| 150         | 40                                     | 83    | 157   | 322   | 482   | 928   | 1,480 | 2,600  | 5,300  | 9,900  | 15,800 | 32,500  | 61,500  | 93,000  |
| 175         | 37                                     | 77    | 144   | 296   | 443   | 854   | 1,360 | 2,400  | 5,000  | 9,300  | 14,600 | 30,000  | 57,000  | 86,000  |
| 200         | 34                                     | 71    | 134   | 275   | 412   | 794   | 1,270 | 2,200  | 4,600  | 8,600  | 13,600 | 28,000  | 53,000  | 80,000  |



## Gas System Sizing Problem (IFGC 402.4.1 Longest Length Method)



## Design Complete! (Using Longest Length Method)

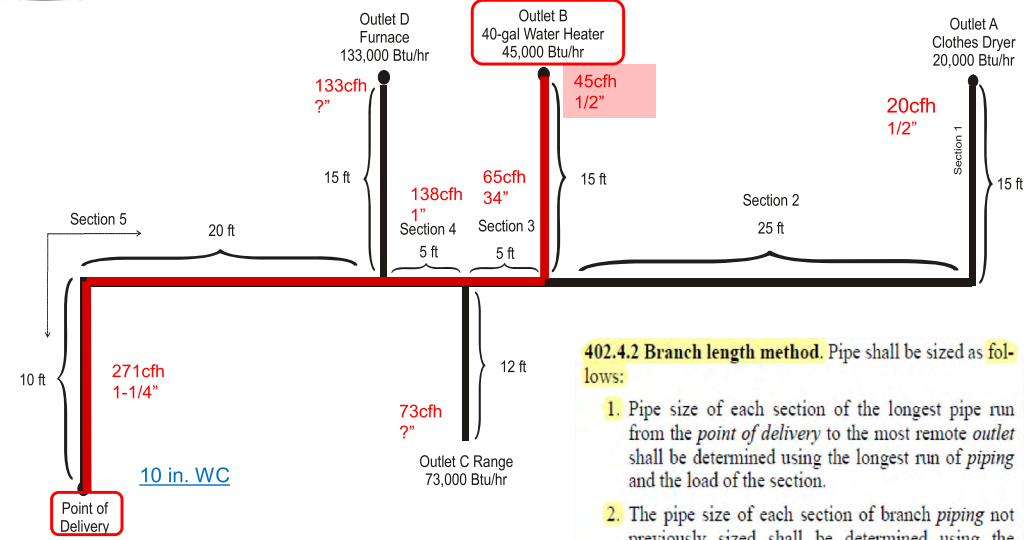


# Gas System Sizing Problem (IFGC 402.4.2 Branch Length Method)



# Gas System Sizing Problem (IFGC 402.4.2 Branch Length Method)

- We will size branch gas Outlet B, Outlet C, and Outlet D using the Branch Length Method.
- Locate nominal size of pipe required for pipe Outlet B.
  - Outlet B:
    - Demand of branch gas Outlet B is 45cfh.
    - Find the length of piping from Outlet B to the "point of delivery" (55 feet).
    - Then locate pipe size from Table 402.4(2) that requires a 1/2 inch pipe.



**402.4.2 Branch length method.** Pipe shall be sized as follows:

- 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.
- 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 (Branch Length Method)

- We will size branch gas Outlet B, Outlet C, and Outlet D using the Branch Length Method.
- Locate nominal size of pipe required for pipe Outlet C.
  - Outlet C:
    - Demand of branch gas Outlet C is 73cfh.
    - Find the length of piping from Outlet C to the "point of delivery" (47 feet).
    - Then locate pipe size from Table 402.4(2) that requires a 3/4 inch pipe.



TABLE 402.4(2)  
SCHEDULE 40 METALLIC PIPE

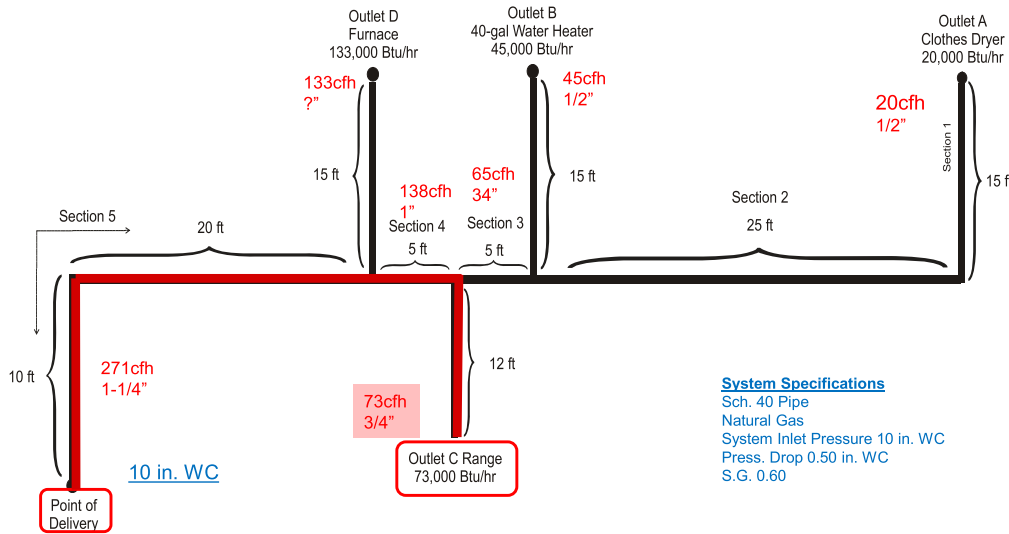
|                  |                 |
|------------------|-----------------|
| Gas              | Natural         |
| Inlet Pressure   | Less than 2 psi |
| Pressure Drop    | 0.5 in. w.c.    |
| Specific Gravity | 0.60            |

| Nominal     | PIPE SIZE (inch)                       |       |       |       |       |       |       |        |        |        |        |         |         |         |
|-------------|--|-------|-------|-------|-------|-------|-------|--------|--------|--------|--------|---------|---------|---------|
|             | 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 | 3,600  | 7,300  | 13,300 | 21,100 | 43,300  | 79,500  | 124,000 |
| 90          | 52                                     | 110   | 207   | 424   | 635   | 1,220 | 1,950 | 3,400  | 6,800  | 12,500 | 19,800 | 40,500  | 75,000  | 115,000 |
| 100         | 50                                     | 104   | 195   | 400   | 600   | 1,160 | 1,840 | 3,200  | 6,400  | 11,800 | 18,600 | 38,200  | 71,000  | 109,000 |
| 125         | 44                                     | 92    | 173   | 355   | 532   | 1,020 | 1,630 | 2,800  | 5,600  | 10,200 | 15,800 | 32,200  | 60,000  | 92,000  |
| 150         | 40                                     | 83    | 157   | 322   | 482   | 928   | 1,480 | 2,600  | 5,200  | 9,500  | 14,400 | 29,200  | 54,000  | 82,000  |
| 175         | 37                                     | 77    | 144   | 296   | 443   | 854   | 1,360 | 2,400  | 4,800  | 8,800  | 13,200 | 26,800  | 50,000  | 75,000  |
| 200         | 34                                     | 71    | 134   | 275   | 412   | 794   | 1,270 | 2,200  | 4,400  | 8,100  | 12,000 | 24,400  | 45,000  | 68,000  |





# Gas System Sizing Problem (Branch Length Method)



**System Specifications**  
Sch. 40 Pipe  
Natural Gas  
System Inlet Pressure 10 in. WC  
Press. Drop 0.50 in. WC  
S.G. 0.60

**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            |

| Nominal     | PIPE SIZE (inch)                       |       |       |       |       |       |       |        |        |        |        |         |         |         |
|-------------|--|-------|-------|-------|-------|-------|-------|--------|--------|--------|--------|---------|---------|---------|
|             | 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                                    | 350   | 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 | 3,680  | 7,500  | 13,700 | 22,000 | 45,200  | 83,500  | 127,000 |
| 90          | 52                                     | 110   | 207   | 424   | 635   | 1,220 | 1,950 | 3,480  | 7,100  | 21,000 | 43,100 | 80,000  | 121,000 |         |
| 100         | 50                                     | 104   | 195   | 400   | 600   | 1,160 | 1,840 | 3,320  | 6,800  | 12,600 | 20,300 | 41,600  | 78,000  | 117,000 |
| 125         | 44                                     | 92    | 173   | 355   | 532   | 1,020 | 1,630 | 2,960  | 6,000  | 11,100 | 18,000 | 36,600  | 69,000  | 106,000 |
| 150         | 40                                     | 83    | 157   | 322   | 482   | 928   | 1,480 | 2,680  | 5,500  | 10,100 | 16,600 | 33,800  | 64,000  | 98,000  |
| 175         | 37                                     | 77    | 144   | 296   | 443   | 854   | 1,360 | 2,460  | 5,000  | 9,300  | 15,400 | 31,300  | 59,000  | 89,000  |
| 200         | 34                                     | 71    | 134   | 275   | 412   | 794   | 1,270 | 2,280  | 4,700  | 8,600  | 14,200 | 28,900  | 55,000  | 83,000  |



# Gas System Sizing Problem (Branch Length Method)

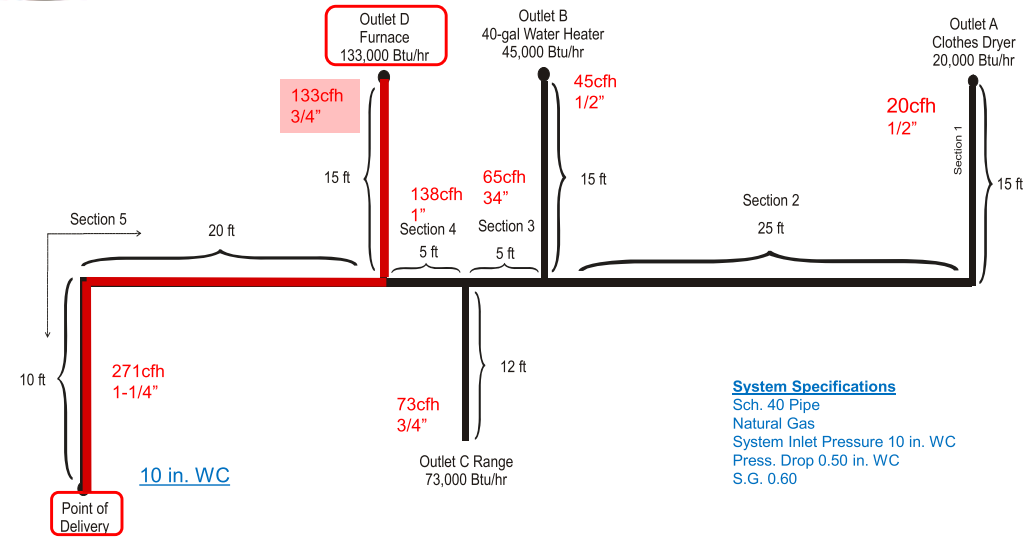
- We will size branch gas Outlet B, Outlet C, and Outlet D using the Branch Length Method.
- Locate nominal size of pipe required for pipe Outlet D.

**Outlet D:**

- Demand of branch gas Outlet D is 133cfh.
- Find the length of piping from Outlet D to the "point of delivery" (45 feet).
- Then locate pipe size from Table 402.4(2) that requires a 3/4 inch pipe.



# Gas System Sizing Problem (Branch Length Method)



**System Specifications**  
Sch. 40 Pipe  
Natural Gas  
System Inlet Pressure 10 in. WC  
Press. Drop 0.50 in. WC  
S.G. 0.60





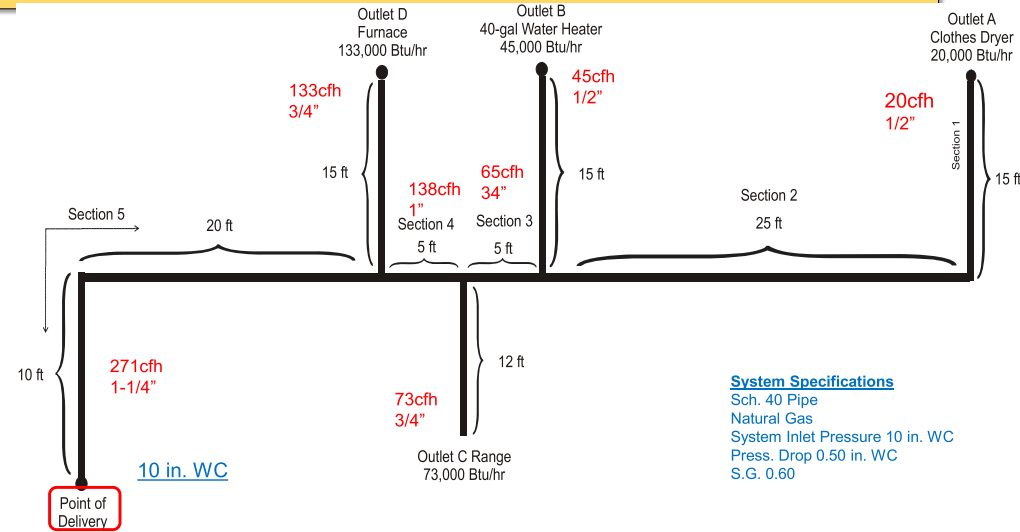
**TABLE 402.4(2)  
SCHEDULE 40 METALLIC PIPE**

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

| Nominal     | PIPE SIZE (inch)                       |       |       |       |       |       |       |       |        |        |        |        |         |         |
|-------------|--|-------|-------|-------|-------|-------|-------|-------|--------|--------|--------|--------|---------|---------|
|             | 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   | 350   | 678   | 1,390 | 2,090 | 4,020 | 6,400 | 11,300 | 23,100 | 41,800 | 67,600 | 139,000 | 252,000 |
| 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 | 3,600 | 7,400  | 13,400 | 21,400 | 44,000 | 81,000  | 126,000 |
| 90          | 52                                     | 110   | 207   | 424   | 635   | 1,220 | 1,950 | 3,300 | 6,800  | 12,500 | 20,000 | 41,000 | 77,000  | 118,000 |
| 100         | 50                                     | 104   | 195   | 400   | 600   | 1,160 | 1,840 | 3,100 | 6,400  | 11,800 | 19,000 | 39,000 | 74,000  | 113,000 |
| 125         | 44                                     | 92    | 173   | 355   | 532   | 1,020 | 1,630 | 2,800 | 5,800  | 10,600 | 17,400 | 35,000 | 67,000  | 103,000 |
| 150         | 40                                     | 83    | 157   | 322   | 482   | 928   | 1,480 | 2,500 | 5,200  | 9,600  | 15,800 | 32,000 | 61,000  | 93,000  |
| 175         | 37                                     | 77    | 144   | 296   | 443   | 854   | 1,360 | 2,300 | 4,800  | 8,900  | 14,600 | 29,000 | 55,000  | 84,000  |
| 200         | 34                                     | 71    | 134   | 275   | 412   | 794   | 1,270 | 2,100 | 4,400  | 8,200  | 13,400 | 27,000 | 51,000  | 78,000  |



## Design Complete! (Using Branch Length Method)

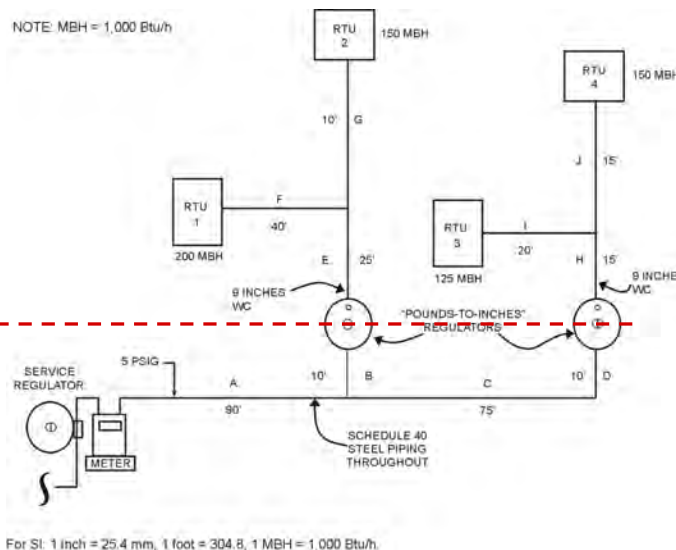


## Hybrid Pressure System Sizing – 402.4.3

**System Specifications**  
Sch. 40 Pipe  
Natural Gas  
System Inlet Pressure Varies  
Press. Drop 0.50 in. WC  
S.G. 0.60  
Use T-402.4(7) & T-402.4(2)

9 inches WC

5 psig



## 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).



Table 402.4(7)



| TABLE 402.4(7)<br>SCHEDULE 40 METALLIC PIPE |  |       |        |        |        |        |         |         |             |
|---|--|-------|--------|--------|--------|--------|---------|---------|-------------|
| PIPE SIZE (inch)                            |  |       |        |        |        |        |         |         |             |
| Nominal                                     | 1/2                                    | 3/4   | 1      | 1 1/2  | 2      | 2 1/2  | 3       | 4       | Gas Natural |
| Actual ID                                   | 0.822                                  | 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 | 5,890  | 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  | 44,800  | 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  | 17,900  | 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<sup>3</sup>/h, 1 degree = 0.01745 rad. Note: All table entries have been rounded to three significant digits.

# Hybrid Pressure System Sizing – 402.4.3 (Calculate Demand)

**System Specifications**  
 Sch. 40 Pipe  
 Natural Gas  
 System Inlet Pressure Varies  
 Press. Drop 3.5 psi & 0.50 in. WC  
 S.G. 0.60  
 Use T-402.4(7) & T-402.4(2)

9 inches WC  
 5 psig

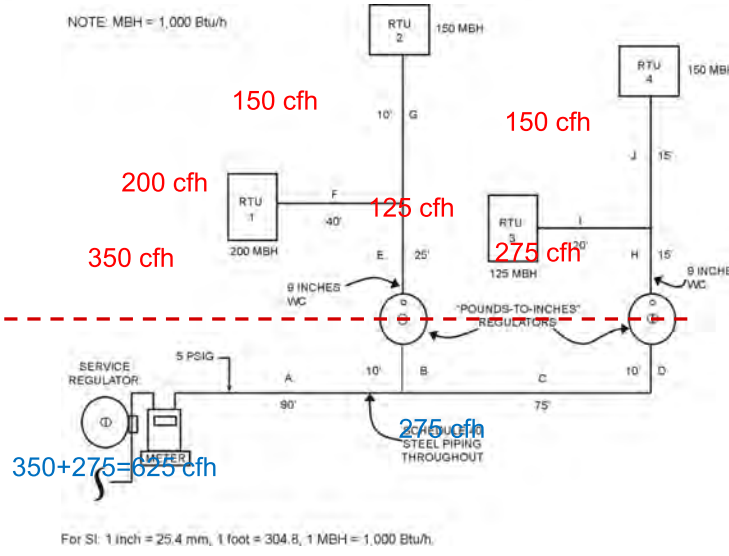


Table 402.4(7)



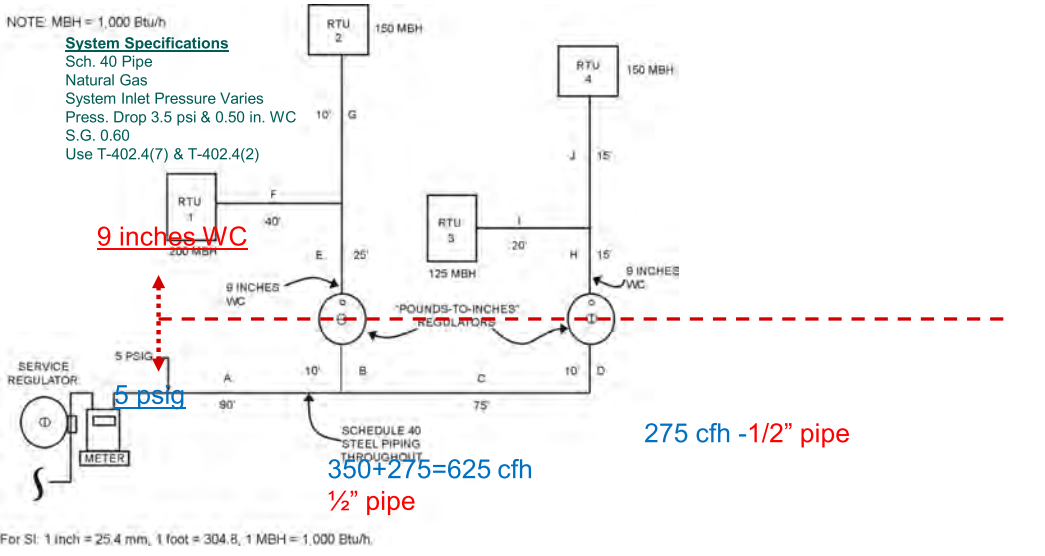
| TABLE 402.4(7)<br>SCHEDULE 40 METALLIC PIPE |  |       |        |        |        |        |         |         |             |
|---|--|-------|--------|--------|--------|--------|---------|---------|-------------|
| PIPE SIZE (inch)                            |  |       |        |        |        |        |         |         |             |
| Nominal                                     | 1/2                                    | 3/4   | 1      | 1 1/2  | 2      | 2 1/2  | 3       | 4       | Gas Natural |
| Actual ID                                   | 0.822                                  | 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 | 5,890  | 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  | 44,800  | 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  | 17,900  | 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<sup>3</sup>/h, 1 degree = 0.01745 rad. Note: All table entries have been rounded to three significant digits.

# Hybrid Pressure System Sizing – 402.4.3 (Size 5 psig side)

**System Specifications**  
 Sch. 40 Pipe  
 Natural Gas  
 System Inlet Pressure Varies  
 Press. Drop 3.5 psi & 0.50 in. WC  
 S.G. 0.60  
 Use T-402.4(7) & T-402.4(2)

9 inches WC  
 5 psig



# Table 402.4(7)



| TABLE 402.4(7)<br>SCHEDULE 40 METALLIC PIPE |           | PIPE SIZE (inch) |       |        |        |        |        |         |         |         |  |
|---|-----------|------------------|-------|--------|--------|--------|--------|---------|---------|---------|--|
|   |           | 1/2              | 3/4   | 1      | 1 1/4  | 1 1/2  | 2      | 2 1/2   | 3       | 4       |  |
| Nominal                                     | Actual ID | 0.622            | 0.824 | 1.049  | 1.380  | 1.610  | 2.067  | 2.469   | 3.068   | 4.026   |  |
| Capacity in Cubic Feet of Gas Per Hour      |           |                  |       |        |        |        |        |         |         |         |  |
| Length (ft)                                 | 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   | 776       | 1,590            | 2,820 | 5,870  | 8,770  | 17,200 | 27,200 | 48,700  | 97,000  |         |  |
| 175   | 678       | 1,430            | 2,490 | 5,100  | 7,650  | 15,000 | 23,500 | 41,500  | 84,700  |         |  |
| 200   | 673       | 1,360            | 2,490 | 4,510  | 6,760  | 13,000 | 20,800 | 36,700  | 74,900  |         |  |
| 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 | 33,900  | 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 | 22,800  | 46,600  |         |  |
| 650   | 333       | 696              | 1,310 | 2,690  | 4,030  | 7,770  | 12,400 | 21,800  | 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   | 289       | 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              | 1,049 | 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  | 6,950  | 12,300  | 25,000  |         |  |
| 2,000                                       | 181       | 379              | 714   | 1,470  | 2,200  | 4,230  | 6,780  | 11,900  | 24,300  |         |  |

For SE: 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<sup>3</sup>/h, 1 degree = 0.01745 rad.

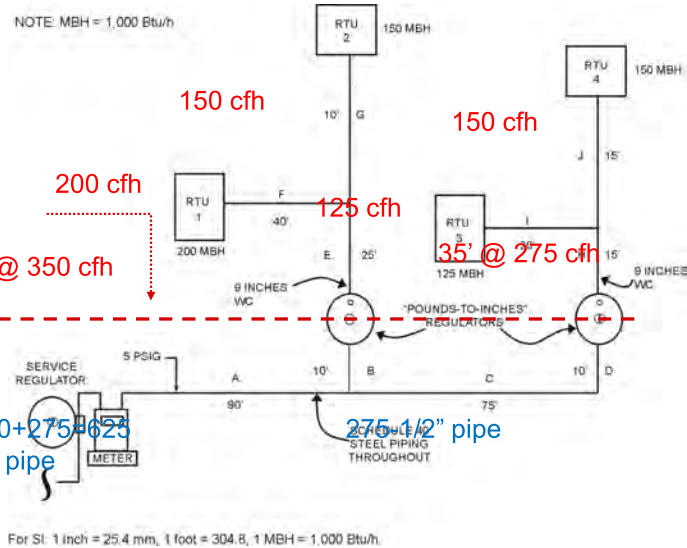
# Hybrid Pressure System Sizing – 402.4.3

- Using IFGC Table 402.4(2), determine the minimum required size of piping Sections E through J.



# Hybrid Pressure System Sizing – 402.4.3 (Size 9 inch WC side)

**System Specifications**  
 Sch. 40 Pipe  
 Natural Gas  
 System Inlet Pressure Varies  
 Press. Drop 3.5 psi & 0.50 in. WC  
 S.G. 0.60  
 Use T-402.4(7) & T-402.4(2)



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

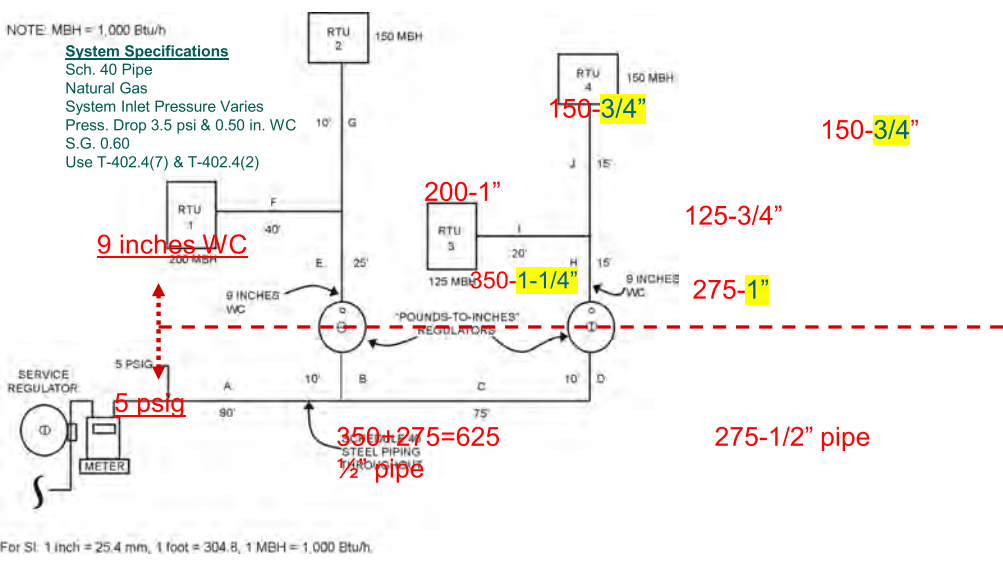
TABLE 402.4(2)  
SCHEDULE 40 METALLIC PIPE

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

|  |           | PIPE SIZE (inch) |       |       |       |       |       |       |        |        |        |        |         |         |         |  |
|--|-----------|------------------|-------|-------|-------|-------|-------|-------|--------|--------|--------|--------|---------|---------|---------|--|
|  |           | 1/2              | 3/4   | 1     | 1 1/4 | 1 1/2 | 2     | 2 1/2 | 3      | 4      | 5      | 6      | 8       | 10      | 12      |  |
| Nominal                                | 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  |  |
| Capacity in Cubic Feet of Gas Per Hour |           |                  |       |       |       |       |       |       |        |        |        |        |         |         |         |  |
| Length (ft)                            | 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 | 3,600 | 7,430  | 13,400 | 21,400 | 44,500 | 81,100  | 123,000 |         |  |
| 90                                     | 52        | 110              | 207   | 424   | 635   | 1,220 | 1,950 | 3,400 | 7,000  | 12,800 | 20,300 | 42,100 | 78,100  | 114,000 |         |  |
| 100                                    | 50        | 104              | 195   | 400   | 600   | 1,160 | 1,840 | 3,200 | 6,700  | 12,300 | 19,600 | 40,300 | 75,100  | 109,000 |         |  |
| 125                                    | 44        | 92               | 173   | 355   | 532   | 1,020 | 1,630 | 2,800 | 5,900  | 10,900 | 17,300 | 35,500 | 67,000  | 97,000  |         |  |
| 150                                    | 40        | 83               | 157   | 322   | 482   | 928   | 1,480 | 2,600 | 5,400  | 10,000 | 16,000 | 33,000 | 62,400  | 91,000  |         |  |
| 175                                    | 37        | 77               | 144   | 296   | 443   | 854   | 1,360 | 2,400 | 5,000  | 9,300  | 15,000 | 30,600 | 58,100  | 84,700  |         |  |
| 200                                    | 34        | 71               | 134   | 275   | 412   | 794   | 1,270 | 2,200 | 4,600  | 8,600  | 14,000 | 28,500 | 54,500  | 79,900  |         |  |



# Hybrid Pressure System Sizing – 402.4.3



## 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<sup>3</sup>/h or 728,000 Btu/h (20.6 m<sup>3</sup>/hr or 213,356 W) for gas with a heating value of 1,000 Btu/ft<sup>3</sup> (37.5 MJ/m<sup>3</sup>).
- 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 .



## 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: 1-1/4"
  - F. Load: 200,000 Btu Size: 1"
  - G. Load: 150,000 Btu Size: 1"



## Hybrid Pressure System Sizing – 402.4.3

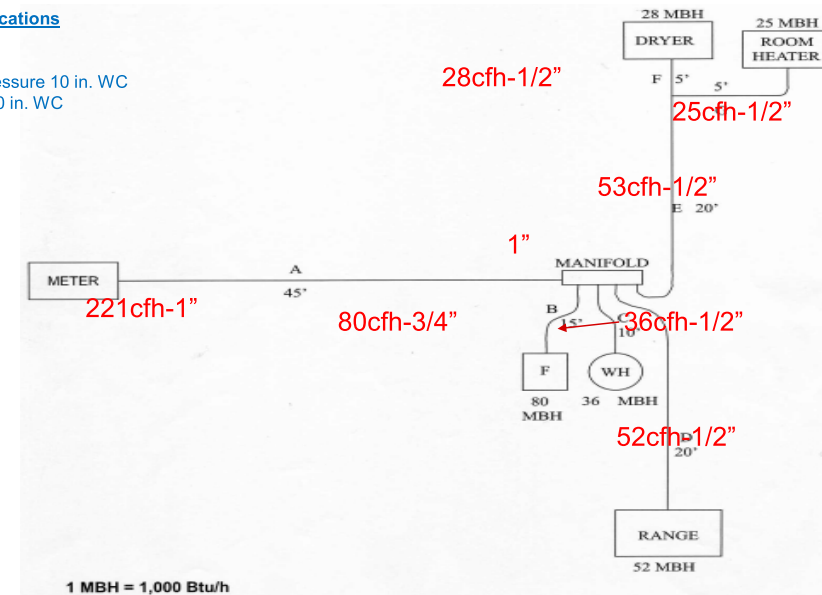
- Determine the size of piping for Sections H, I and J in the same manner previously described in Item 2.
- The most remote point is 35 feet (20 feet + 15 feet).
- H.Load: 275,000 Btu Size: 1"
- I. Load: 125,000 Btu Size: 3/4"
- J. Load: 150,000 Btu Size: 3/4"



## Parallel System – 10” WC

### System Specifications

Sch. 40 Pipe  
Natural Gas  
System Inlet Pressure 10 in. WC  
Press. Drop 0.50 in. WC  
S.G. 0.60



## Parallel System – 10” WC

- Piping arranged in parallel.
- Main section and individual appliance runs constructed of Sch. 40 Pipe (IFGC Table 402.4(2)).
- Supply pressure is 10 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<sup>3</sup>.
- Use “Branch Method” to determine pipe sizes



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            |

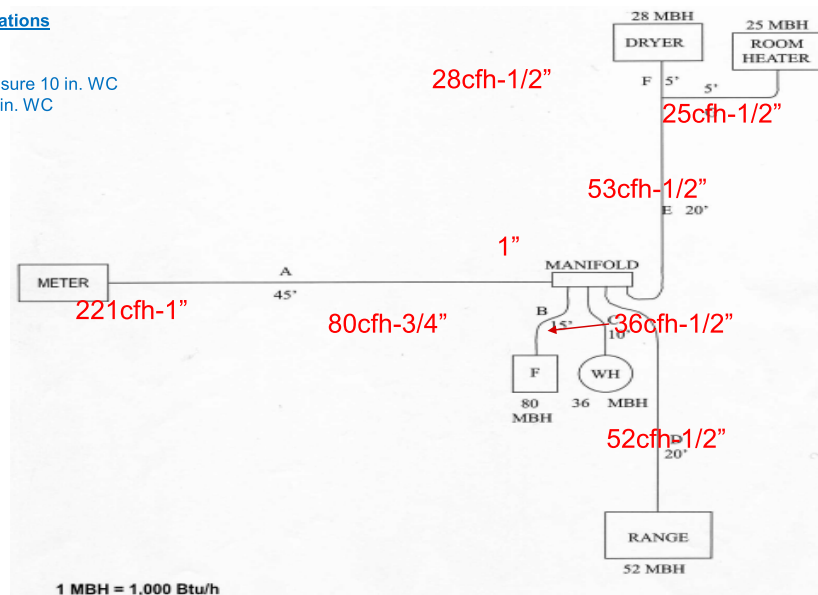
| Nominal     | PIPE SIZE (inch)                       |       |       |       |       |       |       |        |        |        |        |         |         |         |
|-------------|--|-------|-------|-------|-------|-------|-------|--------|--------|--------|--------|---------|---------|---------|
|             | 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 | 3,680  | 7,500  | 13,700 | 22,000 | 45,200  | 83,000  | 127,000 |
| 90          | 52                                     | 110   | 207   | 424   | 635   | 1,220 | 1,950 | 3,480  | 7,100  | 13,100 | 21,000 | 43,000  | 79,000  | 120,000 |
| 100         | 50                                     | 104   | 195   | 400   | 600   | 1,160 | 1,840 | 3,320  | 6,800  | 12,600 | 20,300 | 41,500  | 77,000  | 116,000 |
| 125         | 44                                     | 92    | 173   | 355   | 532   | 1,020 | 1,630 | 2,980  | 6,100  | 11,300 | 18,300 | 37,200  | 70,000  | 108,000 |
| 150         | 40                                     | 83    | 157   | 322   | 482   | 928   | 1,480 | 2,680  | 5,600  | 10,300 | 16,700 | 34,000  | 65,000  | 101,000 |
| 175         | 37                                     | 77    | 144   | 296   | 443   | 854   | 1,360 | 2,480  | 5,200  | 9,700  | 15,700 | 32,000  | 61,000  | 94,000  |
| 200         | 34                                     | 71    | 134   | 275   | 412   | 794   | 1,270 | 2,280  | 4,800  | 9,000  | 14,500 | 29,500  | 56,000  | 86,000  |



# Parallel System – 10” WC

## System Specifications

Sch. 40 Pipe  
Natural Gas  
System Inlet Pressure 10 in. WC  
Press. Drop 0.50 in. WC  
S.G. 0.60



## 402.7 Maximum Operating Pressure (Press-Connect Joint)

**2021 CODE:** 402.7 Maximum operating pressure. The maximum operating pressure for piping systems located inside buildings shall not exceed 5 pounds per square inch gauge (psig) (34 kPa gauge) except where one or more of the following conditions are met:

1. The piping joints are welded or brazed.
2. The piping is joined by fittings listed to ANSI LC-4/CSA 6.32 and installed in accordance with the manufacturer's instructions.

(Items 3 through 8 are unchanged)

The code now recognizes press-connect joints as suitable for high pressure (over 5 psig) applications indoors.



## Materials - 403

### Some common piping materials.

**403.4.5 Corrugated stainless steel tubing.** Corrugated stainless steel tubing shall be listed in accordance with ANSI LC 1/CSA 6.26.



**403.4 Metallic pipe.** Metallic pipe shall comply with Sections 403.4.1 through 403.4.4.

**403.4.1 Cast iron.** Cast-iron pipe shall not be used.

**403.4.2 Steel.** Steel, stainless steel and wrought-iron pipe shall be not lighter than Schedule 10 and shall comply with the dimensional standards of ASME B36.10M and one of the following standards:

1. ASTM A53/A53M.
2. ASTM A106.
3. ASTM A312.

**403.4.3 Copper and copper alloy.** Copper and copper alloy pipe 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). Threaded copper, copper alloy and aluminum-alloy pipe shall not be used with gases corrosive to such materials.



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## 403.4.3 – 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.



## 403.4.5 – 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.



## 403.9.3 Threaded Joint Sealing

**403.9.3 Threaded joint sealing.** Threaded joints shall be made using a thread joint sealing material. Thread joint sealing materials shall be nonhardening and shall be resistant to the chemical constituents of the gases to be conducted through the piping. Thread joint sealing materials shall be compatible with the pipe and fitting materials on which the sealing materials are used.



**Change Significance:** The code addressed pipe thread sealants but never required them to be used.

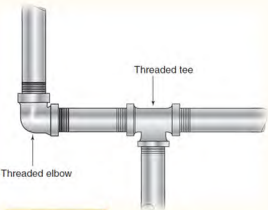
- Thread sealants act primarily as a lubricant to allow the threads to make up tight to form a metal-to-metal seal and any imperfections or voids in the threads are filled in by the thread sealant material.
- The most common thread sealants used today are pastes made with PTFE (Teflon) and Teflon tapes.
- Sealing compounds must not be hardening so that pipe joints can be disassembled when necessary, so that shrinkage of the sealant is minimized and so that the material can be resilient to vibration and movement.



## 404.5 Fittings in Concealed Locations

**404.5 Fittings in concealed locations.** Fittings installed in concealed locations shall be limited to the following types:

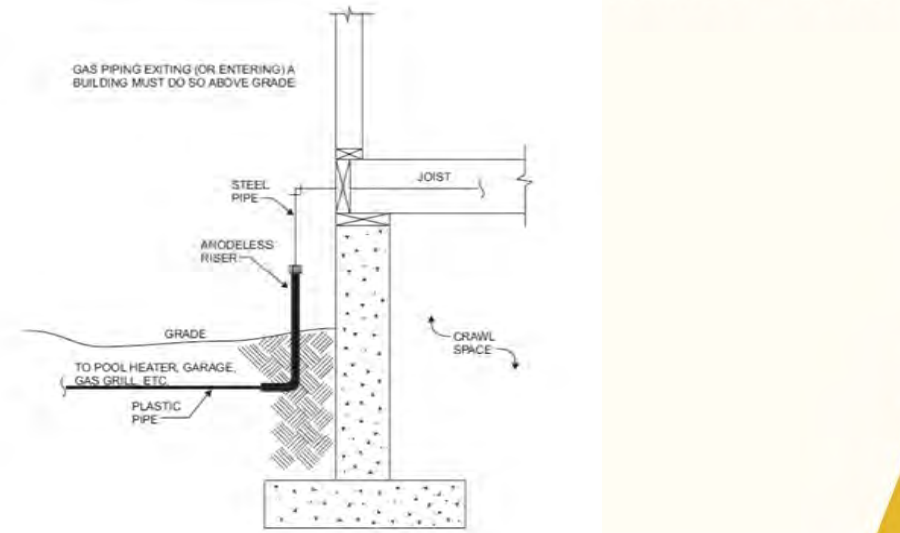
- Threaded elbows, tees, couplings, [plugs and caps](#).
- Brazed fittings.
- Welded fittings.
- Fittings listed to ANSI LC-1/CSA 6.26 or ANSI LC-4/CSA 6.32.



Caps and plugs are permitted to be concealed



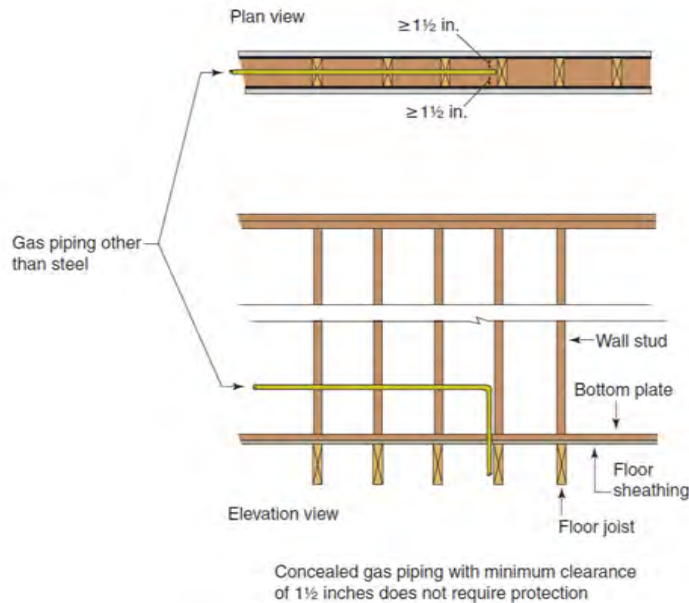
## Underground penetration prohibited – 404.6



Above Grade Entrance/Exit



## 404.7 – Protection against physical damage



## 404.7.1 – Piping through holes or notches

- Is located less than 1-1/2 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 1-1/2 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 1-1/2 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).



# Installation Above Ground

**404.9 Above-ground outdoor piping.** Piping installed outdoors shall be elevated not less than 3 1/2 inches (89 mm) above ground and where installed across roof surfaces, shall be elevated not less than 3 1/2 inches (89 mm) above the roof surface. Piping installed above ground, outdoors, and installed across the surface of roofs shall be securely supported and located where it will be protected from physical damage. Where passing through an outside wall, the piping shall be protected against corrosion by coating or wrapping with an inert material. Where piping is encased in a protective pipe sleeve, the annular space between the piping and the sleeve shall be sealed.



# 404.18 Pipe Cleaning

**404.18 Pipe debris removal.** The interior of piping shall be clear of debris. The use of a flammable or combustible gas to clean or remove debris from a piping system shall be prohibited.

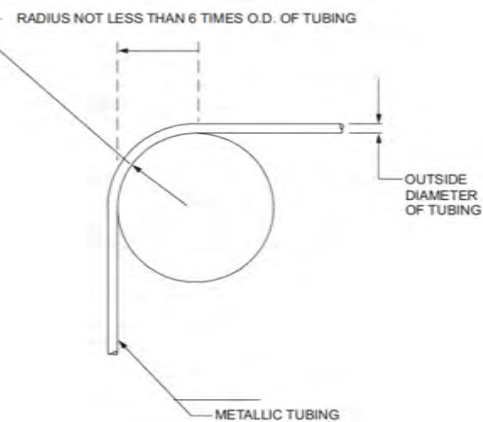
- The code prohibits the practice of using fuel gas as a medium for flushing foreign matter and debris from fuel-supply piping.



# Bends in Gas Piping-405.2

**405.2 Metallic pipe.** Metallic pipe bends shall comply with the following:

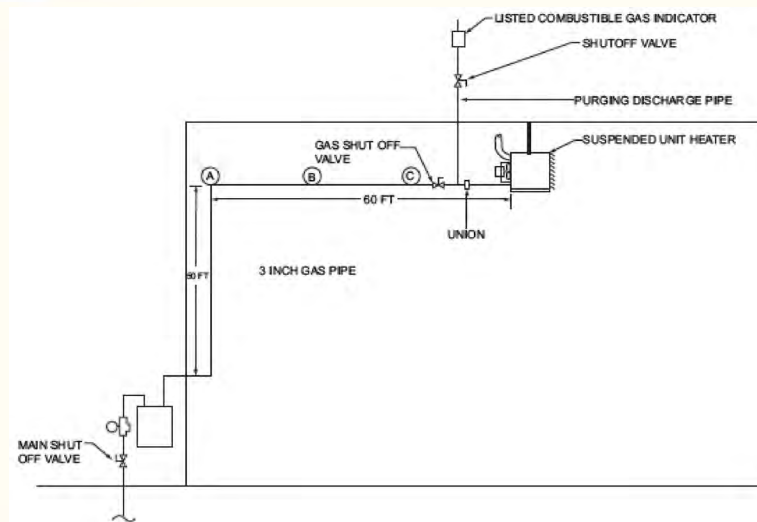
1. Bends shall be made only with bending tools and procedures intended for that purpose.
2. All bends shall be smooth and free from buckling, cracks or other evidence of mechanical damage.
3. The longitudinal weld of the pipe shall be near the neutral axis of the bend.
4. Pipe shall not be bent through an arc of more than 90 degrees (1.6 rad).
5. The inside radius of a bend shall be not less than six times the outside diameter of the pipe.



Bends in Metal Piping



# Purging – 406.7



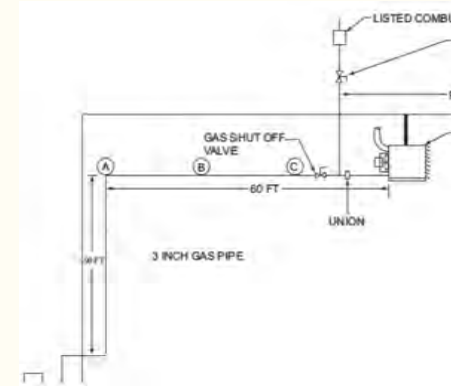
## Combustible Gas Indicator Section 406.7.1.4

- 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

- Design operating pressure greater than 2 psig.
- 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

- 2021 IFGC,
- Table 406.7.1.1

TABLE 406.7.1.1  
SIZE AND LENGTH OF PIPING

| NOMINAL PIPE SIZE (inches) <sup>a</sup> | 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.

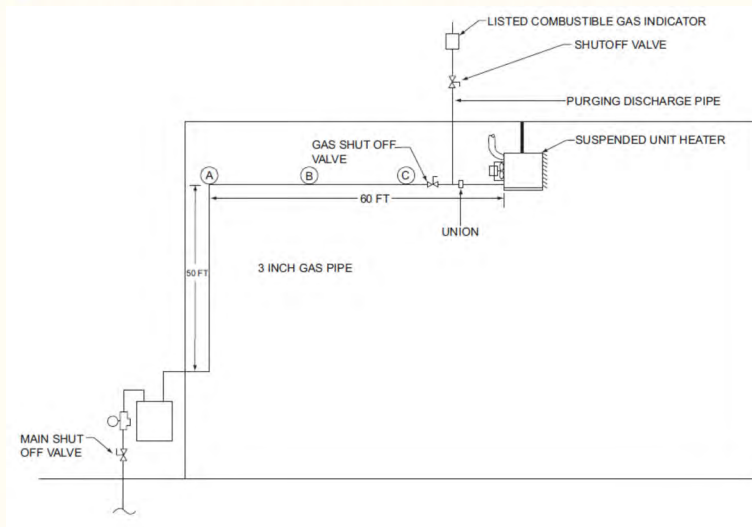
a. CSST EHD size of 62 is equivalent to nominal 2-inch pipe or tubing size.

## 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) <sup>a</sup> | LENGTH OF PIPING (feet) |
|---|-------------------------|
| $\geq 2\frac{1}{2} < 3$                 | > 50                    |
| $\geq 3 < 4$                            | > 30                    |
| $\geq 4 < 6$                            | > 15                    |
| $\geq 6 < 8$                            | > 10                    |
| $\geq 8$                                | 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.

## Sediment Trap - 408.4

Where a sediment trap is not incorporated as part of the appliance, a sediment trap shall be installed downstream of the appliance shutoff valve as close to the inlet of the appliance as practical. The sediment trap shall be either a tee fitting having a capped nipple of any length installed vertically in the bottommost opening of the tee or other device approved as an effective sediment trap.

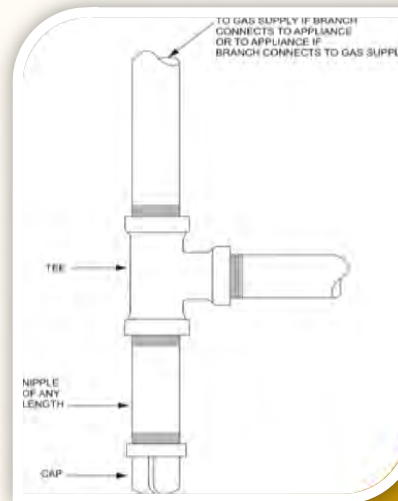
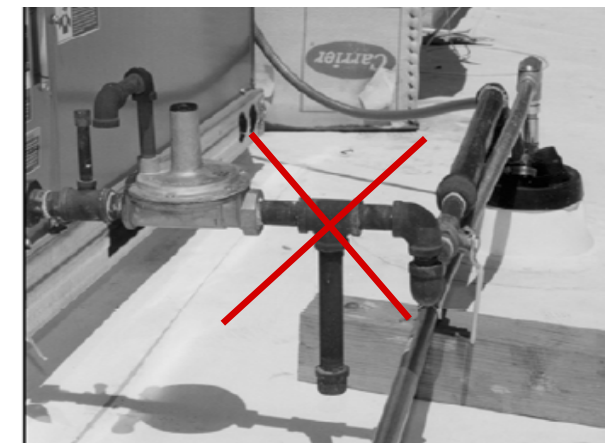


FIGURE 408.4  
METHOD OF INSTALLING A TEE FITTING SEDIMENT TRAP

## Sediment Trap – 408.4

- A sediment trap shall be installed downstream of the appliance shutoff valve as close to the inlet of the appliance as practical.



Ineffective installation arrangement of a sediment trap.

# Shut-off Valves – 409.3 & 409.4

**409.3 Shutoff valves for multiple-house line systems.** Where a single meter is used to supply gas to more than one building or tenant, a separate shutoff valve shall be provided for each building or tenant.

**409.3.1 Multiple-tenant buildings.** In multiple-tenant buildings, where a common piping system is installed to supply other than one- and two-family dwellings, shutoff valves shall be provided for each tenant. Each tenant shall have access to the shutoff valve serving that tenant's space.

**409.3.2 Individual buildings.** In a common system serving more than one building, shutoff valves shall be installed outdoors at each building.

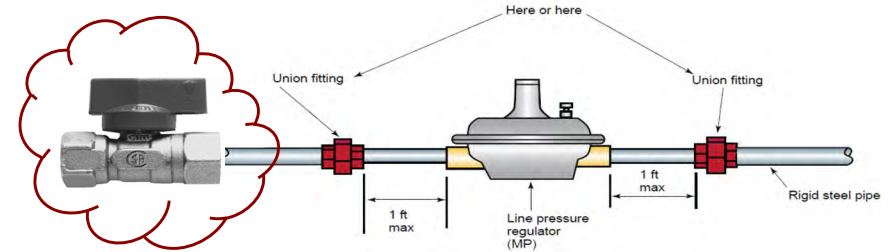
**409.3.3 Identification of shutoff valves.** Each house line shutoff valve shall be plainly marked with an identification tag attached by the installer so that the piping systems supplied by such valves are readily identified.

**409.4 MP regulator valves.** A *listed* shutoff valve shall be installed immediately ahead of each MP regulator.



# 409.4 MP regulator valves

**409.4 MP regulator valves.** A *listed* shutoff valve shall be installed immediately ahead of each MP regulator.



Note: Where regulators are connected to rigid piping, a union shall be installed within 1 foot of either side of the MP regulator (**IFGC 410.2 Item #7**).

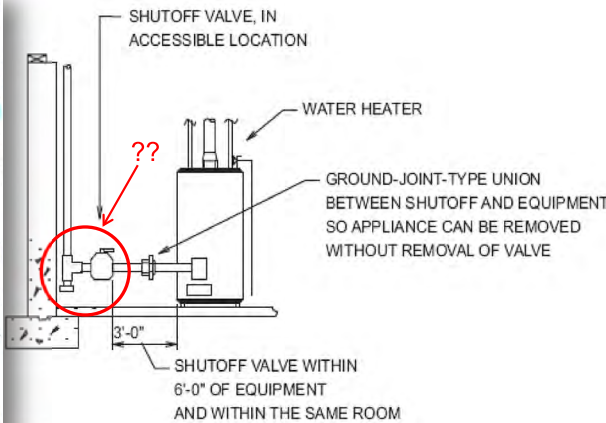
# Appliance shut-off Valves – 409.5

**409.5 Appliance shutoff valve.** Each *appliance* shall be provided with a shutoff valve in accordance with Section 409.5.1, 409.5.2 or 409.5.3.

**409.5.1 Located within same room.** The shutoff valve shall be located in the same room as the *appliance*. The shutoff valve shall be within 6 feet (1829 mm) of the *appliance*, and shall be installed upstream of the union, connector or quick disconnect device it serves. Such shutoff valves shall be provided with *access*. *Appliance* shutoff valves located in the firebox of a *fireplace* shall be installed in accordance with the *appliance* manufacturer's instructions.

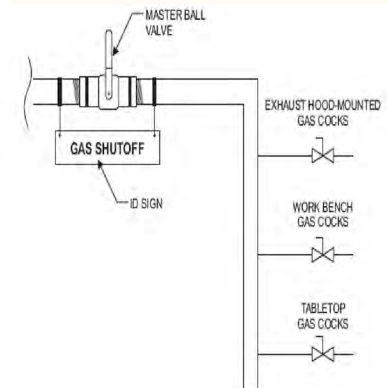
**409.5.2 Vented decorative appliances and room heaters.** Shutoff valves for vented decorative appliances, room heaters and decorative appliances for installation in vented *fireplaces* shall be permitted to be installed in an area remote from the appliances where such valves are provided with ready *access*. Such valves shall be permanently identified and shall not serve another *appliance*. The piping from the shutoff valve to within 6 feet (1829 mm) of the *appliance* shall be designed, sized and installed in accordance with Sections 401 through 408.

**409.5.3 Located at manifold.** Where the *appliance* shutoff valve is installed at a manifold, such shutoff valve shall be located within 50 feet (15 240 mm) of the *appliance* served and shall be readily accessible and permanently identified. The piping from the manifold to within 6 feet (1829 mm) of the *appliance* shall be designed, sized and installed in accordance with Sections 401 through 408.



# Shutoff valve for laboratories – 409.6

**409.6 Shutoff valve for laboratories.** Where provided with two or more fuel gas outlets, including table-, bench- and hood-mounted outlets, each laboratory space in educational, research, commercial and industrial occupancies shall be provided with a single dedicated shutoff valve through which all such gas outlets shall be supplied. The dedicated shutoff valve shall be readily accessible, located within the laboratory space served, located adjacent to the egress door from the space and shall be identified by approved signage stating "Gas Shutoff."

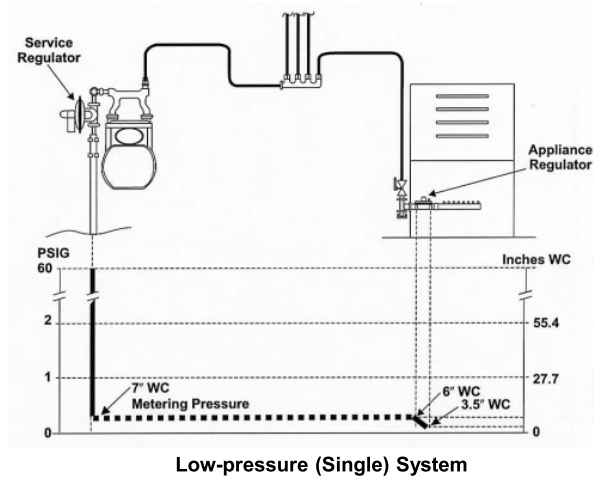


Main Shutoff Valve for Laboratories



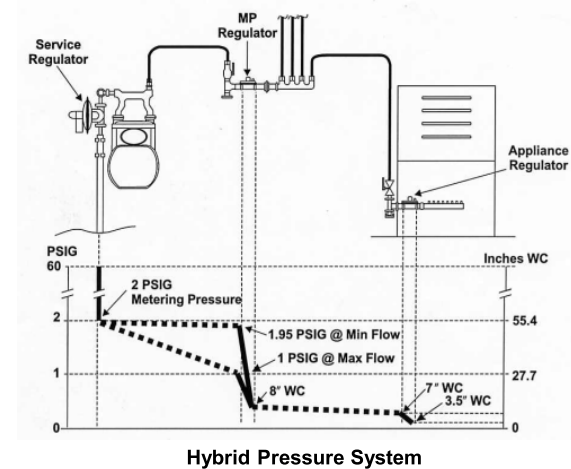
# Gas Flow Controls

- Medium Pressure (MP) gas regulators

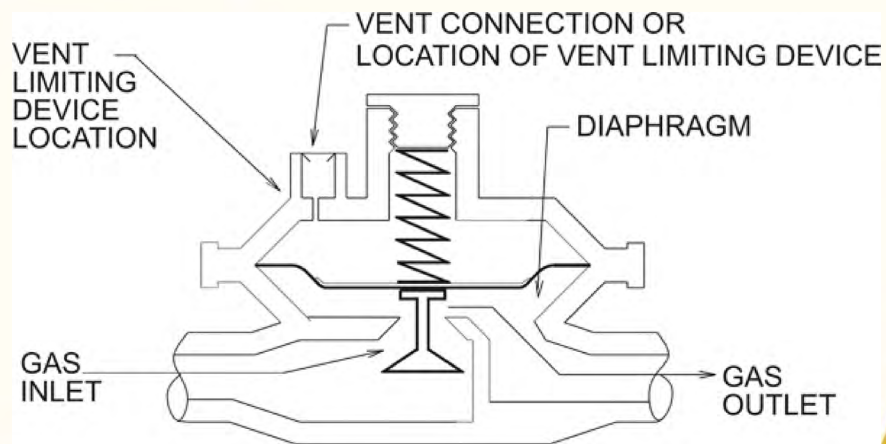


# Gas Flow Controls

- Medium Pressure (MP) gas regulators



## Venting of Regulators – 410.3



Gas Pressure Regulator

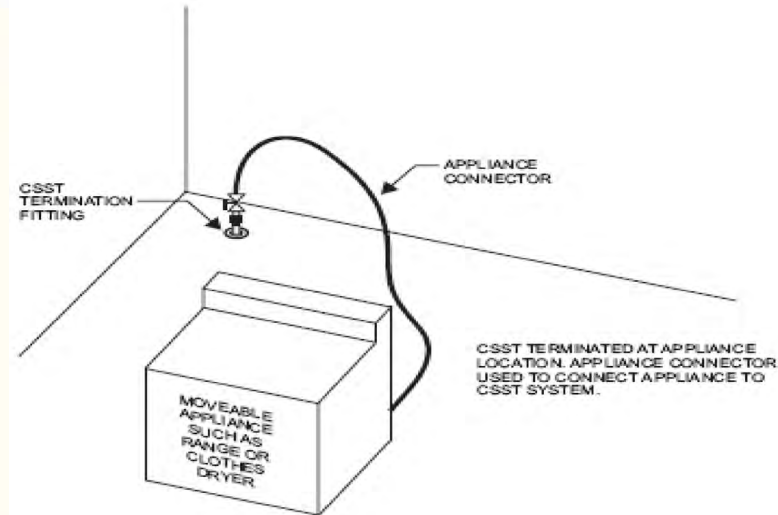
## Vent piping – 410.3.1

- 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.

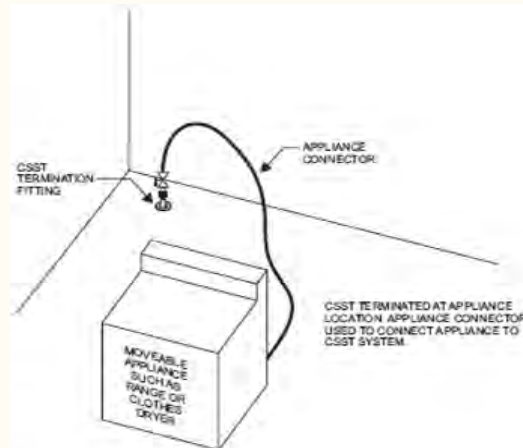
## Appliance Connections - 411

- Choice of the 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



## Connecting appliances- 411.1

- 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.



**411.1 Connecting appliances.** Except as required by Section 411.1.1, *appliances* shall be connected to the *piping* system by one of the following:

- Rigid metallic pipe and fittings.
- Corrugated stainless steel tubing (CSST) where installed in accordance with the manufacturer's instructions.
- Semirigid metallic tubing and metallic fittings. Lengths shall not exceed 6 feet (1829 mm) and shall be located entirely in the same room as the *appliance*. Semirigid metallic tubing shall not enter a motor-operated *appliance* through an unprotected knockout opening.
- Listed* and *labeled appliance* connectors in compliance with ANSI Z21.24/CGA 6.10 and installed in accordance with the manufacturer's instructions and located entirely in the same room as the *appliance*.
- Listed* and *labeled* quick-disconnect devices in compliance with ANSI Z21.41/CGA 6.9 used in conjunction with *listed* and *labeled appliance* connectors.
- Listed* and *labeled* convenience outlets in compliance with ANSI Z21.90/CGA 6.24 used in conjunction with *listed* and *labeled appliance* connectors.
- Listed* and *labeled* outdoor *appliance* connectors in compliance with ANSI Z21.75/CSA 6.27 and installed in accordance with the manufacturer's instructions.
- 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.
- Gas hose connectors for use in laboratories and educational facilities in accordance with Section 411.4.



# 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.



# 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.

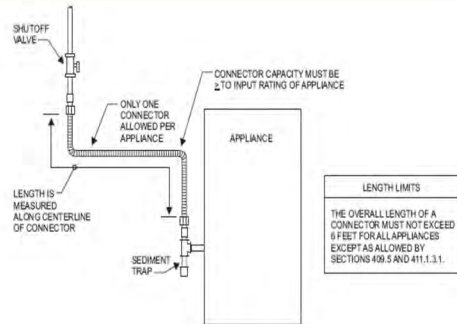


## Connector Installation

**411.1.3.1 Maximum length.** Connectors shall have an overall length not to exceed 6 feet (1829 mm). Measurement shall be made along the centerline of the connector. Only one connector shall be used for each appliance.

**Exception:** Rigid metallic piping used to connect an appliance to the piping system shall be permitted to have a total length greater than 6 feet (1829 mm), provided that the connecting pipe is sized as part of the piping system in accordance with Section 402 and the location of the appliance shutoff valve complies with Section 409.5.

**411.1.3.2 Minimum size.** Connectors shall have the capacity for the total demand of the connected appliance.

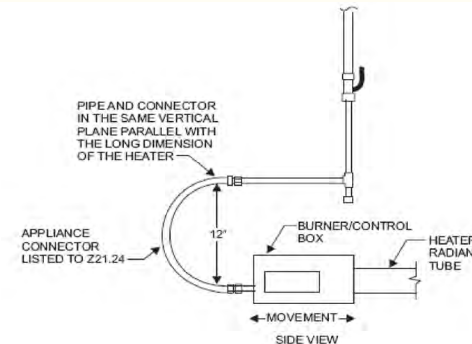


Connector Installation



## Suspended low-intensity infrared tube heaters – 411.3

**411.3 Suspended low-intensity infrared tube heaters.** Suspended low-intensity infrared tube heaters shall be connected to the building piping system with a connector listed for the application complying with ANSI Z21.24/CGA 6.10. The connector shall be installed as specified by the tube heater manufacturer's instructions.



Suspended low-intensity infrared tube heaters



## Verify Hangers and Supports - 415.1

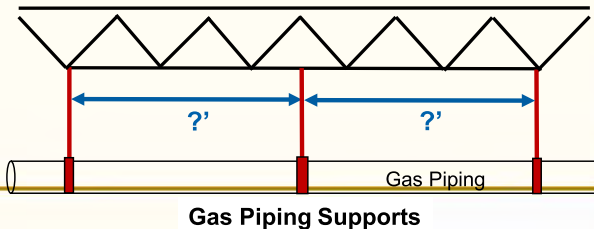
**415.1 Interval of support.** Piping shall be supported at intervals not exceeding the spacing specified in Table 415.1. Spacing of supports for CSST shall be in accordance with the CSST manufacturer's instructions.

**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          |

**415.1 Interval of support.** Piping shall be supported at intervals not exceeding the spacing specified in Table 415.1. Spacing of supports for CSST shall be in accordance with the CSST manufacturer's instructions.

- Verify that hangers and supports are of sufficient strength to support piping, compatible materials and spaced correctly.



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

## Chapter 5 Chimneys and Vents

- Module 5

## Definitions

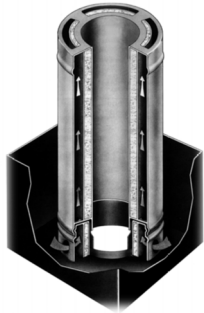
**APPLIANCE, VENTED.** An *appliance* designed and installed in such a manner that all of the products of combustion are conveyed directly from the *appliance* to the outdoor atmosphere through an *approved* chimney or vent system.





# Definitions

**CHIMNEY.** A primarily vertical structure containing one or more flues, for the purpose of carrying gaseous products of combustion and air from an *appliance* to the outside atmosphere.



**Factory built chimneys**

Chimneys differ from vents in their materials of construction and the type of appliance they are designed to serve. Chimneys are capable of venting much higher temperature flue gases than vents.

# Definitions

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



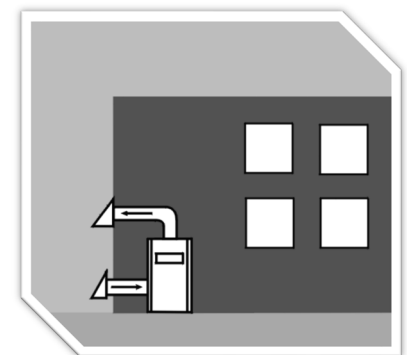
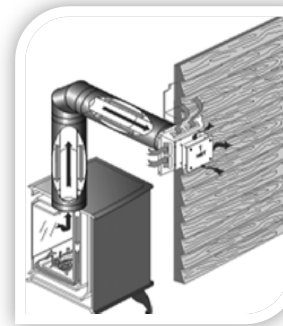
# Definitions

**DILUTION AIR.** Air that is introduced into a draft hood and is mixed with the flue gases.



# Definitions

**DIRECT-VENT APPLIANCES.** Appliances that are constructed and installed so that all air for combustion is derived directly from the outdoor atmosphere and all flue gases are discharged directly to the outdoor atmosphere.



# Definitions

**VENT.** A pipe or other conduit composed of factory-made components, containing a passageway for conveying combustion products and air to the atmosphere, *listed* and *labeled* for use with a specific type or class of *appliance*.

**Special gas vent.** A vent *listed* and *labeled* for use with *listed* Category II, III and IV appliances.

**Type B vent.** A vent *listed* and *labeled* for use with appliances with draft hoods and other Category I appliances that are *listed* for use with Type B vents.

**Type BW vent.** A vent *listed* and *labeled* for use with wall furnaces.

**Type L vent.** A vent *listed* and *labeled* for use with appliances that are *listed* for use with Type L or Type B vents.



**Type B Vent**

**VENTED APPLIANCE CATEGORIES.** Appliances that are categorized for the purpose of vent selection are classified into the following four categories:

- Gas appliances are categorized for the purpose of matching the appliance to the required type of venting. Not all gas appliances are assigned a category.

**Category I.** An appliance that operates with a nonpositive vent static pressure and with a vent gas temperature that avoids excessive condensate production in the vent.

- These appliances include draft-hood-equipped and fan-assisted types.

**Category II.** An appliance that operates with a nonpositive vent static pressure and with a vent gas temperature that is capable of causing excessive condensate production in the vent.

- The condition of nonpositive pressure (draft dependent) combined with low flue-gas temperatures makes it difficult to design such an appliance. At the time of this publication, no such appliances are known to exist in the marketplace. If they did exist, they would require an engineered design for venting and would likely use a venting system with a mechanical fan at the vent terminus to maintain negative pressure in the vent.



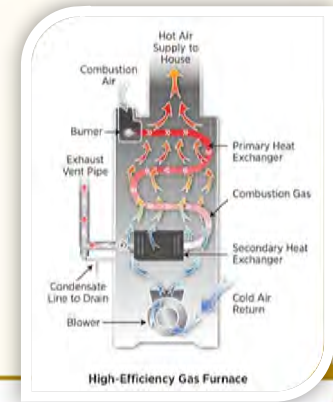
**2021 IFGC**

**Category III.** An appliance that operates with a positive vent static pressure and with a vent gas temperature that avoids excessive condensate production in the vent.

- These appliances include mid-efficiency (approximately 78 to 83 percent) appliances that are typically side-wall-vented with stainless steel special vents.

**Category IV.** An appliance that operates with a positive vent static pressure and with a vent gas temperature that is capable of causing excessive condensate production in the vent.

- These appliances include high-efficiency (84 percent and higher) condensing-type furnaces, boilers and water heaters.



## Category I – IV Chart

|              | 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. |

## Flue-Gas Temperature

- Flue-gas temperature affects vent operation because the hotter the gases are, the lighter they are.
- The design BTUH (British Thermal Units per Hour) capacity of the vent plus the furnace input and efficiency are factors affecting the temperature of the flue-gases.
- Higher BTUH furnaces produce higher flue-gas temperatures. On the other hand, the higher the efficiency of a furnace, the lower the flue-gas temperature.
- Two cases which can cause poor venting are the oversizing of the vent or reducing the BTUH input to an existing vent system. Either case will result in excessive cooling of the flue gases and a reduction of the vent forces.

# Definitions

**OFFSET (VENT).** A combination of *approved* bends that makes two changes in direction bringing one section of the vent out of line but into a line parallel with the other section.



# General Requirements

- Venting Systems
  - Convey products of combustion to the outdoors

**501.2 General.** Every *appliance* shall discharge the products of combustion to the outdoors, except for appliances exempted by Section 501.8.



# 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.

**501.8 Appliances not required to be vented.** The following appliances shall not be required to be vented:

1. Ranges.
2. Built-in domestic cooking units *listed* and marked for optional venting.
3. Hot plates and laundry stoves.
4. Type 1 clothes dryers (Type 1 clothes dryers shall be exhausted in accordance with the requirements of Section 614).
5. A single booster-type automatic instantaneous water heater, where designed and used solely for the sanitizing rinse requirements of a dishwashing machine, provided that the heater is installed in a commercial kitchen having a mechanical exhaust system. Where installed in this manner, the draft hood, if required, shall be in place and unaltered and the draft hood *outlet* shall be not less than 36 inches (914 mm) vertically and 6 inches (152 mm) horizontally from any surface other than the heater.
6. Refrigerators.
7. Counter appliances.
8. Room heaters *listed* for unvented use.
9. Direct-fired makeup air heaters.
10. Other appliances *listed* for unvented use and not provided with flue collars.
11. Specialized appliances of limited input such as laboratory burners and gas lights.

# 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 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.



## Types of Venting Systems

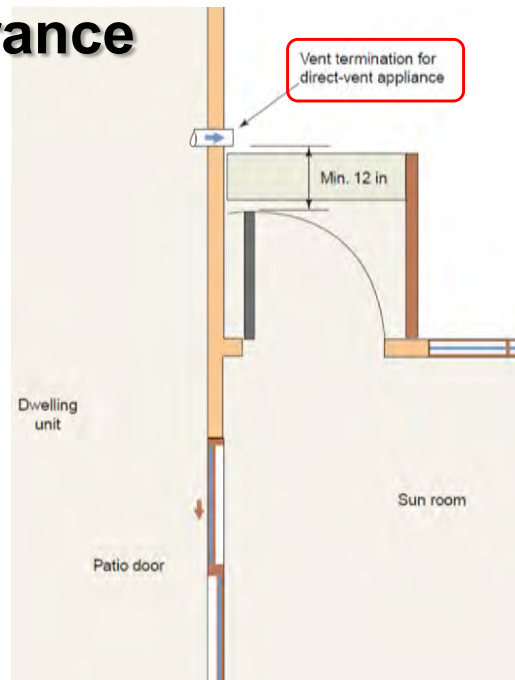
**502.1 General.** Vents, **except as provided in Section 503.7**, shall be listed and labeled. **Type B and BW vents shall be tested in accordance with UL 441.** Type L vents shall be tested in accordance with UL 641. **Vents for Category II and III appliances shall be tested in accordance with UL 1738.** **Plastic vents for Category IV appliances shall not be required to be listed and labeled where such vents are as specified by the appliance manufacturer and are installed in accordance with the appliance manufacturer's instructions.**

- 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 Clearance to Vent Terminals

**502.7.1 Door swing.** Appliance and equipment vent terminals shall be located such that doors cannot swing within 12 inches horizontally of the vent terminal. Door stops or closers shall not be installed to obtain this clearance.



## Nice Table....IFGC Table 503.4

**TABLE 503.4**  
**TYPE OF VENTING SYSTEM TO BE USED**

| APPLIANCES  | TYPE OF VENTING SYSTEM  |
|---|---|
| Listed <b>Category I</b> appliances                         | Type B gas vent (Section 503.6)   |
| Listed appliances equipped with draft hood                  | Chimney (Section 503.5)   |
| Appliances listed for use with Type B gas vent              | Single-wall metal pipe (Section 503.7)  |
| Listed vented wall furnaces                                 | 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)   |
| <b>Category II, Category III and Category IV</b> 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   |

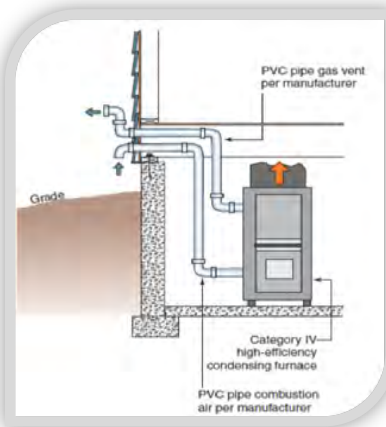
# 503.4.1 Plastic Pipe Vents

Plastic plumbing pipes such as PVC, ABS and CPVC are not listed and labeled as appliance vents, (see the definition of "Special gas vent"), the code now requires plastic pipe venting materials to be labeled in accordance with the product standards specified by the appliance manufacturer or shall be listed and labeled in accordance with UL 1738.

**Special gas vent.** A vent listed and labeled for use with listed Category II, III and IV appliances.

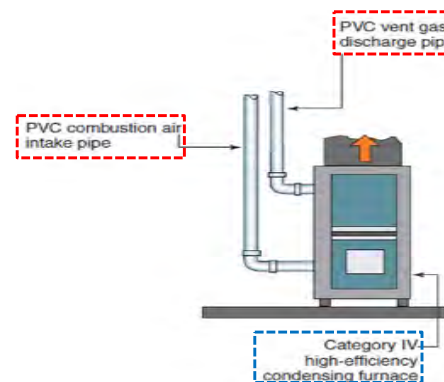
**503.4.1 Plastic piping.** Where plastic piping is used to vent an appliance, the appliance shall be listed for use with such venting materials and the appliance manufacturer's installation instructions shall identify the specific plastic piping material. The plastic pipe venting materials shall be labeled in accordance with the product standards specified by the appliance manufacturer or shall be listed in accordance with UL 1738.

**503.4.2 Special gas vent.** Special gas vent shall be listed and labeled in accordance with UL 1738 and installed in accordance with the special gas vent manufacturer's instructions.



# 503.6.10.3 Category II, III and IV appliances

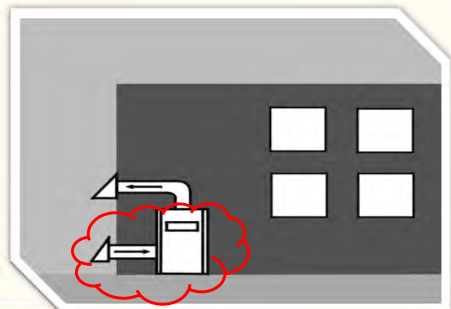
- ❑ The sizing of gas vents for Category II, III and IV appliances shall be in accordance with the appliance manufacturer's instructions.
- ❑ The sizing of plastic pipe that is specified by the appliance manufacturer as a venting material for Category II, III and IV appliances shall be in accordance with the manufacturer's instructions.



# 503.8 Venting System Terminal Clearances

**503.8 Venting system terminal clearances.** The clearances for through-the-wall direct-vent and nondirect-vent terminals shall be in accordance with Table 503.8 and Figure 503.8.

**Exception:** The clearances in Table 503.8 shall not apply to the combustion air intake of a direct-vent appliance.



# 503.8 Venting System Terminal Clearances (see code)

**Change Type:** Modification  
Though the wall vent terminal clearance distances have been placed in a new table for ease of use.



**503.8 Exception:** The clearances in Table 503.8 shall not apply to the combustion air intake of a direct-vent appliance



TABLE 503.8

THROUGH-THE-WALL VENT TERMINAL CLEARANCE

| FIGURE CLEARANCE | CLEARANCE LOCATION   | MINIMUM CLEARANCE FOR DIRECT-VENT TERMINALS  | MINIMUM CLEARANCE FOR NONDIRECT-VENT TERMINALS             |
|------------------|--|--|--|
| A                | Clearance above finished grade level, veranda, porch, deck, or balcony   | 12 inches  |  |
| B                | Clearance to window or door that is operable   | 6 inches: Appliances ≤ 10,000 Btu/hr   | 4 feet below or to side of opening or 1 foot above opening |
|                  |  | 9 inches: Appliances > 10,000 Btu/hr ≤ 50,000 Btu/hr   |  |
| B                | Clearance to window or door that is operable   | 12 inches: Appliances > 50,000 Btu/hr ≤ 150,000 Btu/hr   | 4 feet below or to side of opening or 1 foot above opening |
|                  |  | Appliances > 150,000 Btu/hr, in accordance with the appliance manufacturer's instructions and not less than the clearances specified for nondirect-vent terminals in Row B             |  |
| C                | Clearance to nonoperable window  | None unless otherwise specified by the appliance manufacturer  |  |
| D                | Vertical clearance to ventilated soffit located above the terminal within a horizontal distance of 2 feet from the center line of the terminal | None unless otherwise specified by the appliance manufacturer  |  |
| E                | Clearance to unventilated soffit   | None unless otherwise specified by the appliance manufacturer  |  |
| F                | Clearance to outside corner of building  | None unless otherwise specified by the appliance manufacturer  |  |
| G                | Clearance to inside corner of building   | None unless otherwise specified by the appliance manufacturer  |  |
| H                | Clearance to each side of center line extended above regulator vent outlet   | 3 feet up to a height of 15 feet above the regulator vent outlet   |  |
| I                | Clearance to service regulator vent outlet in all directions   | 3 feet for gas pressures up to 2 psi; 10 feet for gas pressures above 2 psi  |  |
| J                | Clearance to nonmechanical air supply inlet to building and the combustion air inlet to any other appliance                                    | Same clearance as specified for Row B  |  |
| K                | Clearance to a mechanical air supply inlet   | 10 feet horizontally from inlet or 3 feet above inlet  |  |
| L                | Clearance above paved sidewalk or paved driveway located on public property  | 7 feet and shall not be located above public walkways or other areas where condensate or vapor can cause a nuisance or hazard  |  |
| M                | Clearance to underside of veranda, porch, deck, or balcony   | 12 inches where the area beneath the veranda, porch, deck or balcony is open on not less than two sides. The vent terminal is prohibited in this location where only one side is open. |  |



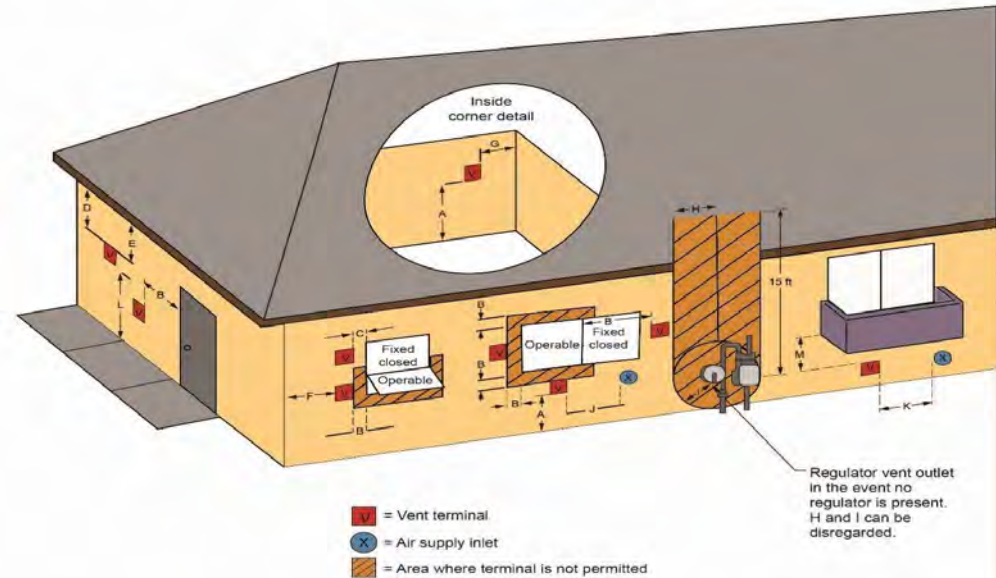
# 503.8 Venting System Terminal Clearances

| Figure Clearance | Clearance Location   | Minimum Clearance for Direct-Vent Terminals  | Minimum Clearances for Non-Direct Vent Terminals          |
|------------------|--|--|---|
| A                | Clearance above finished grade level, veranda, porch, deck, or balcony | 12 in.   |   |
| B                | Clearance to window or door that is openable                           | 6 in.: Appliances ≤ 10,000 Btu/hr<br>9 in.: Appliances > 10,000 Btu/hr ≤ 50,000 Btu/hr<br>12 in.: Appliances > 50,000 Btu/hr ≤ 150,000 Btu/hr<br>Appliances > 150,000 Btu/hr, in accordance with the appliance manufacturer's instructions and not less than the clearances specified for Non-Direct Vent Terminals in row B | 4 ft. below or to side of opening or 1 foot above opening |

Though the wall vent terminal clearance distances have been placed in a new table for ease of use.



## FIGURE 503.8 THROUGH-THE-WALL VENT TERMINAL CLEARANCE

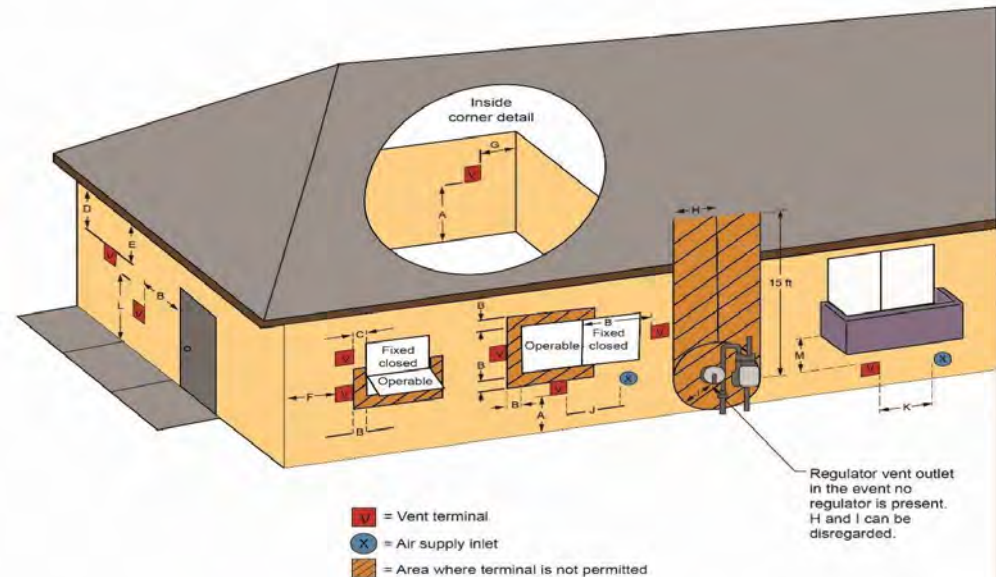


# 503.8 Venting System Terminal Clearances

| Figure Clearance | Clearance Location   | Minimum Clearance for Direct-Vent Terminals                   | Minimum Clearances for Non-Direct Vent Terminals |
|------------------|--|---|--|
| C                | Clearance to non-openable window   | None unless otherwise specified by the appliance manufacturer |  |
| D                | Vertical clearance to ventilated soffit located above the terminal within a horizontal distance of 2 feet (61 cm) from the center line of the terminal | None unless otherwise specified by the appliance manufacturer |  |
| E                | Clearance to unventilated soffit   | None unless otherwise specified by the appliance manufacturer |  |
| F                | Clearance to outside corner of building  | None unless otherwise specified by the appliance manufacturer |  |
| G                | Clearance to inside corner of building   | None unless otherwise specified by the appliance manufacturer |  |

Though the wall vent terminal clearance distances have been placed in a new table for ease of use.

## FIGURE 503.8 THROUGH-THE-WALL VENT TERMINAL CLEARANCE

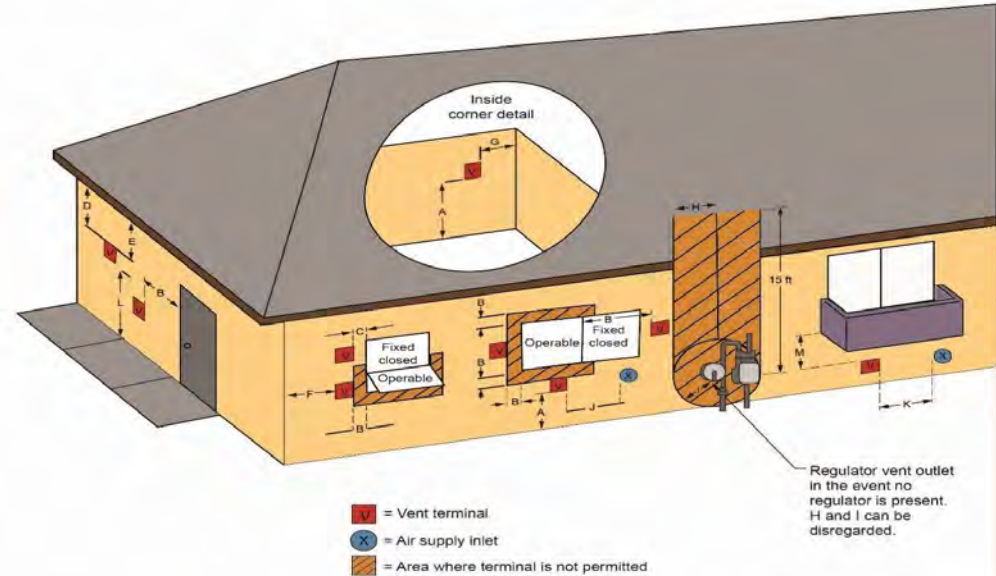


# 503.8 Venting System Terminal Clearances

| Figure Clearance | Clearance Location  | Minimum Clearance for Direct-Vent Terminals  | Minimum Clearances for Non-Direct Vent Terminals |
|------------------|---|--|--|
| H                | Clearance to each side of center line extended above regulator vent outlet  | 3 ft. up to a height of 15 ft. above the regulator vent outlet   |  |
| I                | Clearance to service regulator vent outlet in all directions  | 3 ft. for gas pressures up to 2 psi 10 ft. for gas pressures above 2 psi   |  |
| J                | Clearance to non-mechanical air supply inlet to building and the combustion air inlet to any other appliance  | Same clearance as specified for row B  |  |
| K                | Clearance to a mechanical air supply inlet  | 10 ft. horizontally from inlet or 3 ft. above inlet  |  |
| L                | Clearance above paved sidewalk or paved driveway located on public property   | 7 ft. and shall not be located above public walkways or other areas where condensate or vapor can cause a nuisance or hazard |  |
| M                | Clearance to underside of veranda, porch deck, 12 in. where the area beneath the veranda, porch deck or balcony is open on not less than two sides. The vent terminal is prohibited in this location where only one side is open. |  |  |

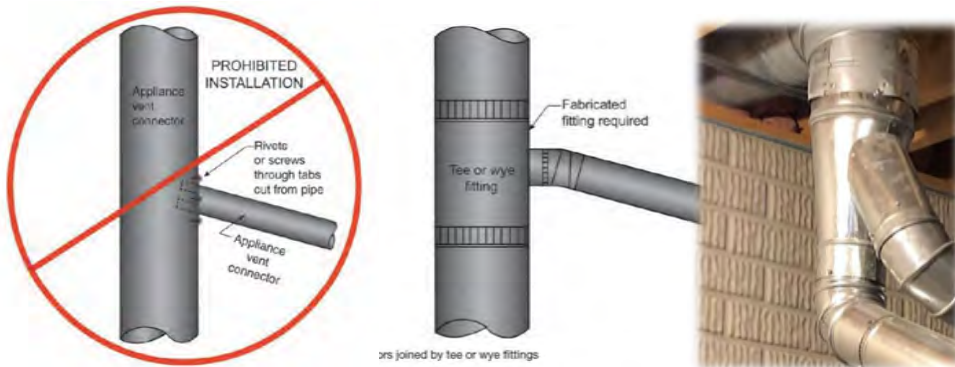
Though the wall vent terminal clearance distances have been placed in a new table for ease of use.

## FIGURE 503.8 THROUGH-THE-WALL VENT TERMINAL CLEARANCE



# 503.10.7 Vent Connector Junctions

**503.10.7 Connector junctions.** Where vent connectors are joined together, the connection shall be made with a tee or wye fitting.

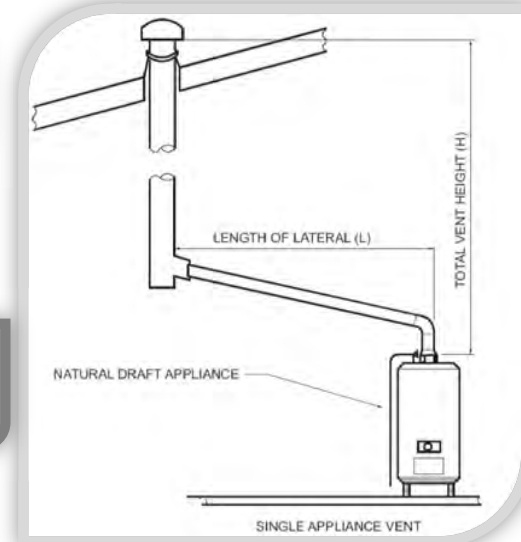


**Change Type:** Modification  
New text addresses the juncture of appliance vent connectors and the required method.

# Venting System: Category I Single Appliance

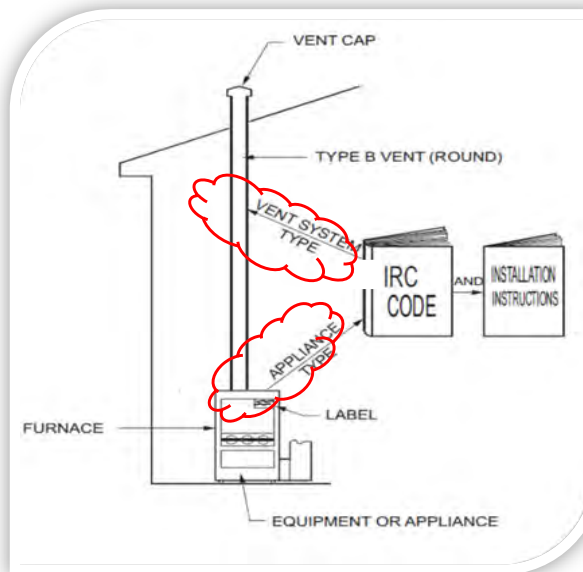
**503.6.10 Size of gas vents.** Venting systems shall be sized and constructed in accordance with Sections 503.6.10.1 through 503.6.10.4 and the *appliance* manufacturer's installation instructions.

**502.2 Connectors required.** Connectors shall be used to connect appliances to the vertical chimney or vent, except where the chimney or vent is attached directly to the *appliance*. Vent connector size, material, construction and installation shall be in accordance with Section 503.



# Compatibility

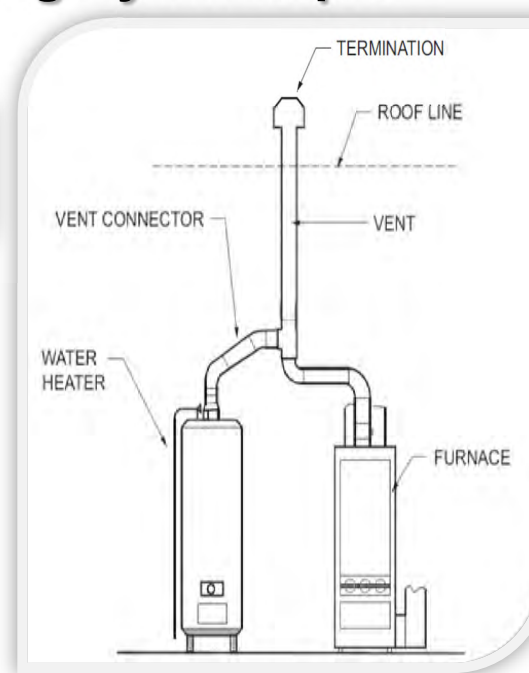
- Verify that types of vents and types of appliance are compatible



# Venting System: Category I Multiple Appliances

**503.10.8 Slope.** A vent connector shall be installed without dips or sags and shall slope upward toward the vent or chimney not less than  $\frac{1}{4}$  inch per foot (21 mm/m).

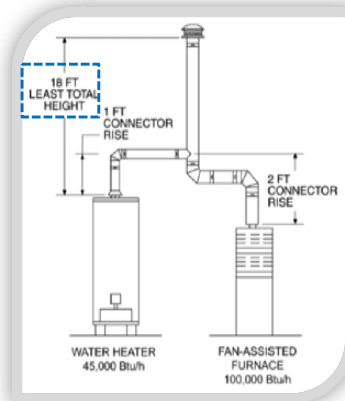
**Exception:** Vent connectors attached to a mechanical draft system installed in accordance with the *appliance* and draft system manufacturers' instructions.



# Height Measurement 504.3.12

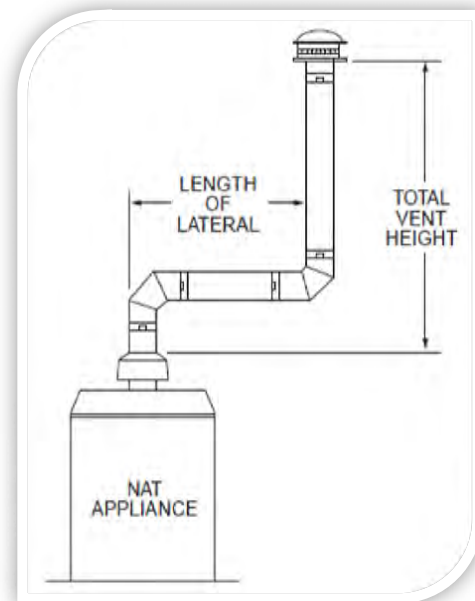
- Least total height (H)
  - Vertical distance from highest appliance outlet to lowest discharge opening of vent cap
- Least total height is used for vent sizing for all connected appliances on one floor level.

**504.3.12 Vent height measurement.** The available total height (H) for multiple appliances on the same floor shall be measured from the highest draft hood outlet or flue collar up to the level of the outlet of the common vent.



# Venting Activity: Single Appliance

Sizing a water heater lateral and vent utilizing a **step by step approach.**





# Venting Activity: Single Appliance

Determine proper lateral/vent size for a water heater installation in "new construction"

Determine proper lateral/vent size for a water heater installation in "new construction."

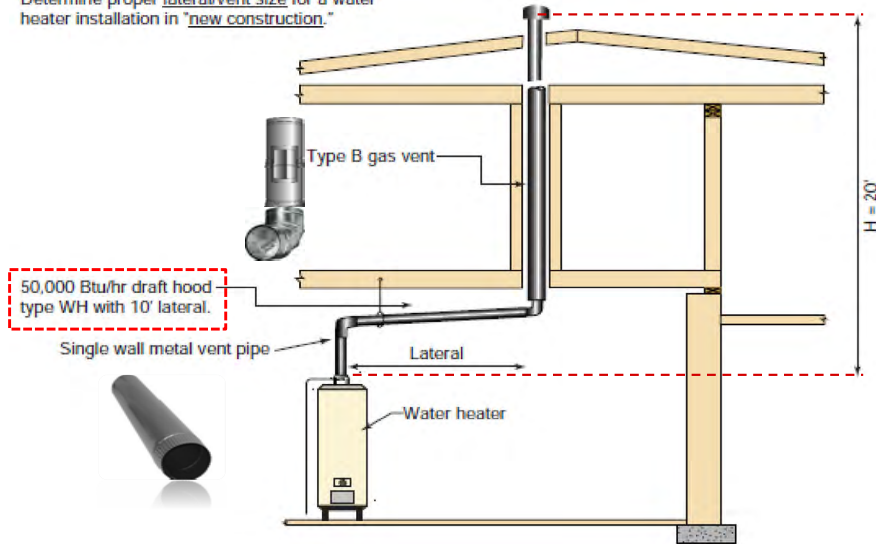


TABLE 504.2(2)  
TYPE B DOUBLE-WALL GAS VENT

| Number of Appliances      |                    | Single                                       |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |       |     |     |       |     |       |       |     |       |       |       |
|---------------------------|--------------------|--|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-------|-----|-----|-------|-----|-------|-------|-----|-------|-------|-------|
| Appliance Type            |                    | Category I                                   |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |       |     |     |       |     |       |       |     |       |       |       |
| Appliance Vent Connection |                    | Single-wall metal connector                  |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |       |     |     |       |     |       |       |     |       |       |       |
| HEIGHT (H) (feet)         | LATERAL (L) (feet) | VENT DIAMETER—(D) inches                     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |       |     |     |       |     |       |       |     |       |       |       |
|                           |                    | APPLIANCE INPUT RATING IN THOUSANDS OF BTU/H |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |       |     |     |       |     |       |       |     |       |       |       |
|                           |                    | 3  |     | 4   |     | 5   |     | 6   |     | 7   |     | 8   |     | 9   |     | 10  |     | 12    |     |     |       |     |       |       |     |       |       |       |
|                           |                    | FAN  | NAT | FAN | NAT | FAN | NAT | FAN | NAT | FAN | NAT | FAN | NAT | FAN | NAT | FAN | NAT | FAN   | NAT |     |       |     |       |       |     |       |       |       |
|                           |                    | Min  | Max | Min | Max | Min | Max | Min | Max | Min | Max | Min | Max | Min | Max | Min | Max | Min   | Max |     |       |     |       |       |     |       |       |       |
| 6                         | 0                  | 38   | 77  | 45  | 59  | 151 | 85  | 85  | 249 | 140 | 126 | 373 | 204 | 165 | 522 | 284 | 211 | 695   | 369 | 267 | 894   | 469 | 371   | 1,118 | 569 | 537   | 1,639 | 849   |
|                           | 2                  | 39   | 51  | 36  | 60  | 96  | 66  | 85  | 156 | 104 | 123 | 231 | 156 | 159 | 320 | 213 | 201 | 423   | 284 | 251 | 541   | 368 | 347   | 673   | 453 | 498   | 979   | 648   |
|                           | 4                  | NA   | NA  | 33  | 74  | 92  | 63  | 102 | 152 | 102 | 146 | 225 | 152 | 187 | 313 | 208 | 237 | 416   | 277 | 295 | 533   | 360 | 409   | 664   | 443 | 584   | 971   | 638   |
|                           | 6                  | NA   | NA  | 31  | 83  | 89  | 60  | 114 | 147 | 99  | 163 | 220 | 148 | 207 | 307 | 203 | 263 | 409   | 271 | 327 | 526   | 352 | 449   | 656   | 433 | 638   | 962   | 627   |
| 8                         | 0                  | 37   | 83  | 50  | 58  | 164 | 93  | 83  | 273 | 154 | 123 | 412 | 234 | 161 | 580 | 319 | 206 | 777   | 414 | 258 | 1,002 | 536 | 360   | 1,257 | 658 | 521   | 1,852 | 967   |
|                           | 2                  | 39   | 56  | 39  | 59  | 108 | 75  | 83  | 176 | 119 | 121 | 261 | 179 | 155 | 363 | 246 | 197 | 482   | 321 | 246 | 617   | 417 | 339   | 768   | 513 | 486   | 1,120 | 743   |
|                           | 5                  | NA   | NA  | 37  | 77  | 102 | 69  | 107 | 168 | 114 | 151 | 252 | 171 | 193 | 352 | 235 | 245 | 470   | 311 | 305 | 604   | 404 | 418   | 754   | 500 | 598   | 1,104 | 730   |
|                           | 8                  | NA   | NA  | 33  | 90  | 95  | 64  | 122 | 161 | 107 | 175 | 243 | 163 | 223 | 342 | 225 | 280 | 458   | 300 | 344 | 591   | 392 | 470   | 740   | 486 | 665   | 1,089 | 715   |
| 10                        | 0                  | 37   | 87  | 53  | 57  | 174 | 99  | 82  | 293 | 165 | 120 | 444 | 254 | 158 | 628 | 344 | 202 | 844   | 449 | 253 | 1,093 | 584 | 351   | 1,373 | 718 | 507   | 2,031 | 1,057 |
|                           | 2                  | 39   | 61  | 41  | 59  | 117 | 80  | 82  | 193 | 128 | 119 | 287 | 194 | 153 | 400 | 272 | 193 | 531   | 354 | 242 | 681   | 456 | 332   | 849   | 559 | 475   | 1,242 | 848   |
|                           | 5                  | 52   | 56  | 39  | 76  | 111 | 76  | 105 | 185 | 122 | 148 | 277 | 186 | 190 | 388 | 261 | 241 | 518   | 344 | 299 | 667   | 443 | 409   | 834   | 544 | 584   | 1,224 | 825   |
|                           | 10                 | NA   | NA  | 34  | 97  | 100 | 68  | 132 | 171 | 112 | 188 | 261 | 171 | 237 | 369 | 241 | 296 | 497   | 325 | 363 | 643   | 423 | 492   | 808   | 520 | 688   | 1,194 | 788   |
| 15                        | 0                  | 36   | 93  | 57  | 56  | 190 | 111 | 80  | 325 | 186 | 116 | 499 | 283 | 153 | 713 | 388 | 195 | 966   | 523 | 244 | 1,259 | 681 | 336   | 1,591 | 838 | 488   | 2,374 | 1,237 |
|                           | 2                  | 38   | 69  | 47  | 57  | 136 | 93  | 80  | 225 | 149 | 115 | 337 | 224 | 148 | 473 | 314 | 187 | 631   | 413 | 232 | 812   | 543 | 319   | 1,015 | 673 | 457   | 1,491 | 983   |
|                           | 5                  | 51   | 63  | 44  | 75  | 128 | 86  | 102 | 216 | 140 | 144 | 326 | 217 | 182 | 459 | 298 | 231 | 616   | 400 | 287 | 795   | 526 | 392   | 997   | 657 | 562   | 1,469 | 963   |
|                           | 10                 | NA   | NA  | 39  | 95  | 116 | 79  | 128 | 201 | 131 | 182 | 308 | 203 | 228 | 438 | 284 | 284 | 592   | 381 | 349 | 768   | 501 | 470   | 966   | 628 | 664   | 1,433 | 928   |
| 20                        | 0                  | 35   | 96  | 60  | 54  | 200 | 118 | 78  | 346 | 201 | 114 | 537 | 306 | 149 | 772 | 428 | 190 | 1,053 | 573 | 238 | 1,379 | 750 | 326   | 1,751 | 927 | 473   | 2,631 | 1,346 |
|                           | 2                  | 37   | 74  | 50  | 56  | 148 | 99  | 78  | 248 | 165 | 113 | 375 | 248 | 144 | 528 | 344 | 182 | 708   | 468 | 227 | 914   | 611 | 309   | 1,146 | 754 | 443   | 1,689 | 1,098 |
|                           | 5                  | 50   | 68  | 47  | 73  | 140 | 94  | 100 | 239 | 158 | 141 | 363 | 239 | 178 | 514 | 334 | 224 | 692   | 457 | 279 | 896   | 596 | 381   | 1,126 | 734 | 547   | 1,665 | 1,074 |
|                           | 10                 | NA   | NA  | 41  | 93  | 129 | 86  | 125 | 223 | 146 | 177 | 344 | 224 | 222 | 491 | 316 | 277 | 666   | 437 | 339 | 866   | 570 | 457   | 1,092 | 702 | 646   | 1,626 | 1,037 |
| 20                        | 15                 | NA   | NA  | NA  | NA  | NA  | 80  | 155 | 208 | 136 | 216 | 325 | 210 | 264 | 469 | 301 | 325 | 640   | 419 | 393 | 838   | 549 | 526   | 1,060 | 677 | 730   | 1,587 | 1,005 |
|                           | 20                 | NA   | NA  | NA  | NA  | NA  | 186 | 192 | 126 | 254 | 306 | 196 | 309 | 448 | 285 | 374 | 616 | 400   | 448 | 810 | 526   | 592 | 1,028 | 651   | 808 | 1,550 | 973   |       |

# Venting Activity: Single Appliance

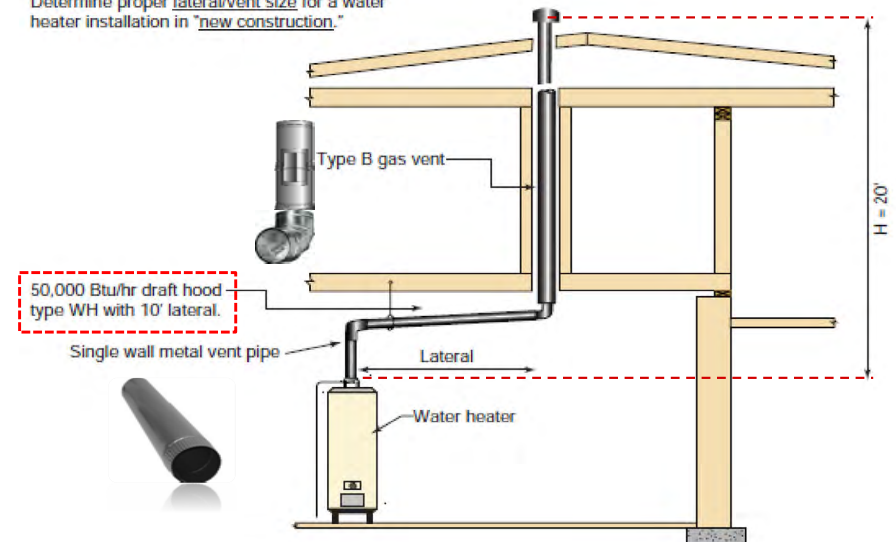
Step 1: Locate correct Table for the given application.



# Venting Activity: Single Appliance

Determine proper lateral/vent size for a water heater installation in "new construction"

Determine proper lateral/vent size for a water heater installation in "new construction."



# Venting Activity Single Appliance

**Step 2: Locate actual vent height indicated in Table 504.2(2).**

**Step 3: Locate lateral length indicated for the 50,000 Btu/h draft hood type Water Heater for the given application.**



TABLE 504.2(2)  
TYPE B DOUBLE-WALL GAS VENT

| Number of Appliances      |                          | Single                                       |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |       |     |     |       |     |     |       |       |     |       |       |     |
|---------------------------|--------------------------|--|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-------|-----|-----|-------|-----|-----|-------|-------|-----|-------|-------|-----|
| Appliance Type            |                          | Category I                                   |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |       |     |     |       |     |     |       |       |     |       |       |     |
| Appliance Vent Connection |                          | Single-wall metal connector                  |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |       |     |     |       |     |     |       |       |     |       |       |     |
| HEIGHT<br>(H)<br>(feet)   | LATERAL<br>(L)<br>(feet) | VENT DIAMETER—(D) inches                     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |       |     |     |       |     |     |       |       |     |       |       |     |
|                           |                          | APPLIANCE INPUT RATING IN THOUSANDS OF BTU/H |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |       |     |     |       |     |     |       |       |     |       |       |     |
|                           |                          | 3  |     | 4   |     | 5   |     | 6   |     | 7   |     | 8   |     | 9   |     | 10  |     | 12    |     |     |       |     |     |       |       |     |       |       |     |
|                           |                          | 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                        | 38   | 77  | 45  | 59  | 151 | 85  | 85  | 249 | 140 | 126 | 373 | 204 | 165 | 522 | 284 | 211 | 695   | 369 | 267 | 894   | 469 | 371 | 1,118 | 569   | 537 | 1,639 | 849   |     |
|                           | 2                        | 39   | 51  | 36  | 60  | 96  | 66  | 85  | 156 | 104 | 123 | 231 | 156 | 159 | 320 | 213 | 201 | 423   | 284 | 251 | 541   | 368 | 347 | 673   | 453   | 498 | 979   | 648   |     |
|                           | 4                        | NA   | NA  | 33  | 74  | 92  | 63  | 102 | 152 | 102 | 146 | 225 | 152 | 187 | 313 | 208 | 237 | 416   | 277 | 295 | 533   | 360 | 409 | 664   | 443   | 584 | 971   | 638   |     |
|                           | 6                        | NA   | NA  | 31  | 83  | 89  | 60  | 114 | 147 | 99  | 163 | 220 | 148 | 207 | 307 | 203 | 263 | 409   | 271 | 327 | 526   | 352 | 449 | 656   | 433   | 638 | 962   | 627   |     |
| 8                         | 0                        | 37   | 83  | 50  | 58  | 164 | 93  | 83  | 273 | 154 | 123 | 412 | 234 | 161 | 580 | 319 | 206 | 777   | 414 | 258 | 1,002 | 536 | 360 | 1,257 | 658   | 521 | 1,852 | 967   |     |
|                           | 2                        | 39   | 56  | 39  | 59  | 108 | 75  | 83  | 176 | 119 | 121 | 261 | 179 | 155 | 363 | 246 | 197 | 482   | 321 | 246 | 617   | 417 | 339 | 768   | 513   | 486 | 1,120 | 743   |     |
|                           | 5                        | NA   | NA  | 37  | 77  | 102 | 69  | 107 | 168 | 114 | 151 | 252 | 171 | 193 | 352 | 235 | 245 | 470   | 311 | 305 | 604   | 404 | 418 | 754   | 500   | 598 | 1,104 | 730   |     |
|                           | 8                        | NA   | NA  | 33  | 90  | 95  | 64  | 122 | 161 | 107 | 175 | 243 | 163 | 223 | 342 | 225 | 280 | 458   | 300 | 344 | 591   | 392 | 470 | 740   | 486   | 665 | 1,089 | 715   |     |
| 10                        | 0                        | 37   | 87  | 53  | 57  | 174 | 99  | 82  | 293 | 165 | 120 | 444 | 254 | 158 | 628 | 344 | 202 | 844   | 449 | 253 | 1,093 | 584 | 351 | 1,373 | 718   | 507 | 2,031 | 1,057 |     |
|                           | 2                        | 39   | 61  | 41  | 59  | 117 | 80  | 82  | 193 | 128 | 119 | 287 | 194 | 153 | 400 | 272 | 193 | 531   | 354 | 242 | 681   | 456 | 332 | 849   | 559   | 475 | 1,242 | 848   |     |
|                           | 5                        | 52   | 56  | 39  | 76  | 111 | 76  | 105 | 185 | 122 | 148 | 277 | 186 | 190 | 388 | 261 | 241 | 518   | 344 | 299 | 667   | 443 | 409 | 834   | 544   | 584 | 1,224 | 825   |     |
|                           | 10                       | NA   | NA  | 34  | 97  | 100 | 68  | 132 | 171 | 112 | 188 | 261 | 171 | 237 | 369 | 241 | 296 | 497   | 325 | 363 | 643   | 423 | 492 | 808   | 520   | 688 | 1,194 | 788   |     |
| 15                        | 0                        | 36   | 93  | 57  | 56  | 190 | 111 | 80  | 325 | 186 | 116 | 499 | 283 | 153 | 713 | 388 | 195 | 966   | 523 | 244 | 1,259 | 681 | 336 | 1,591 | 838   | 488 | 2,374 | 1,237 |     |
|                           | 2                        | 38   | 69  | 47  | 57  | 136 | 93  | 80  | 225 | 149 | 115 | 337 | 224 | 148 | 473 | 314 | 187 | 631   | 413 | 232 | 812   | 543 | 319 | 1,015 | 673   | 457 | 1,491 | 983   |     |
|                           | 5                        | 51   | 63  | 44  | 75  | 128 | 86  | 102 | 216 | 140 | 144 | 326 | 217 | 182 | 459 | 298 | 231 | 616   | 400 | 287 | 795   | 526 | 392 | 997   | 657   | 562 | 1,469 | 963   |     |
|                           | 10                       | NA   | NA  | 39  | 95  | 116 | 79  | 128 | 201 | 131 | 182 | 308 | 203 | 228 | 438 | 284 | 284 | 592   | 381 | 349 | 768   | 501 | 470 | 966   | 628   | 664 | 1,433 | 928   |     |
| 20                        | 0                        | 35   | 96  | 60  | 54  | 200 | 118 | 78  | 346 | 201 | 114 | 537 | 306 | 149 | 772 | 428 | 190 | 1,053 | 573 | 238 | 1,379 | 750 | 326 | 1,751 | 927   | 473 | 2,631 | 1,346 |     |
|                           | 2                        | 37   | 74  | 50  | 56  | 148 | 99  | 78  | 248 | 165 | 113 | 375 | 248 | 144 | 528 | 344 | 182 | 708   | 468 | 227 | 914   | 611 | 309 | 1,146 | 754   | 443 | 1,689 | 1,098 |     |
|                           | 5                        | 50   | 68  | 47  | 73  | 140 | 94  | 100 | 239 | 158 | 141 | 363 | 239 | 178 | 514 | 334 | 224 | 692   | 457 | 279 | 896   | 596 | 381 | 1,126 | 734   | 547 | 1,665 | 1,074 |     |
|                           | 10                       | NA   | NA  | 41  | 93  | 129 | 86  | 125 | 223 | 146 | 177 | 344 | 224 | 222 | 491 | 316 | 277 | 666   | 437 | 339 | 866   | 570 | 457 | 1,092 | 702   | 646 | 1,626 | 1,037 |     |
| 20                        | 15                       | NA   | NA  | NA  | NA  | NA  | NA  | NA  | 186 | 192 | 126 | 254 | 306 | 196 | 309 | 448 | 285 | 374   | 616 | 400 | 448   | 810 | 526 | 592   | 1,028 | 651 | 808   | 1,550 | 973 |
|                           | 20                       | NA   | NA  | NA  | NA  | NA  | NA  | NA  | 186 | 192 | 126 | 254 | 306 | 196 | 309 | 448 | 285 | 374   | 616 | 400 | 448   | 810 | 526 | 592   | 1,028 | 651 | 808   | 1,550 | 973 |

TABLE 504.2(2)  
TYPE B DOUBLE-WALL GAS VENT

| Number of Appliances      |                          | Single                                       |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |       |     |     |       |     |     |       |     |     |       |       |
|---------------------------|--------------------------|--|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-------|-----|-----|-------|-----|-----|-------|-----|-----|-------|-------|
| Appliance Type            |                          | Category I                                   |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |       |     |     |       |     |     |       |     |     |       |       |
| Appliance Vent Connection |                          | Single-wall metal connector                  |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |       |     |     |       |     |     |       |     |     |       |       |
| HEIGHT<br>(H)<br>(feet)   | LATERAL<br>(L)<br>(feet) | VENT DIAMETER—(D) inches                     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |       |     |     |       |     |     |       |     |     |       |       |
|                           |                          | APPLIANCE INPUT RATING IN THOUSANDS OF BTU/H |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |       |     |     |       |     |     |       |     |     |       |       |
|                           |                          | 3  |     | 4   |     | 5   |     | 6   |     | 7   |     | 8   |     | 9   |     | 10  |     | 12    |     |     |       |     |     |       |     |     |       |       |
|                           |                          | 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                        | 38   | 77  | 45  | 59  | 151 | 85  | 85  | 249 | 140 | 126 | 373 | 204 | 165 | 522 | 284 | 211 | 695   | 369 | 267 | 894   | 469 | 371 | 1,118 | 569 | 537 | 1,639 | 849   |
|                           | 2                        | 39   | 51  | 36  | 60  | 96  | 66  | 85  | 156 | 104 | 123 | 231 | 156 | 159 | 320 | 213 | 201 | 423   | 284 | 251 | 541   | 368 | 347 | 673   | 453 | 498 | 979   | 648   |
|                           | 4                        | NA   | NA  | 33  | 74  | 92  | 63  | 102 | 152 | 102 | 146 | 225 | 152 | 187 | 313 | 208 | 237 | 416   | 277 | 295 | 533   | 360 | 409 | 664   | 443 | 584 | 971   | 638   |
|                           | 6                        | NA   | NA  | 31  | 83  | 89  | 60  | 114 | 147 | 99  | 163 | 220 | 148 | 207 | 307 | 203 | 263 | 409   | 271 | 327 | 526   | 352 | 449 | 656   | 433 | 638 | 962   | 627   |
| 8                         | 0                        | 37   | 83  | 50  | 58  | 164 | 93  | 83  | 273 | 154 | 123 | 412 | 234 | 161 | 580 | 319 | 206 | 777   | 414 | 258 | 1,002 | 536 | 360 | 1,257 | 658 | 521 | 1,852 | 967   |
|                           | 2                        | 39   | 56  | 39  | 59  | 108 | 75  | 83  | 176 | 119 | 121 | 261 | 179 | 155 | 363 | 246 | 197 | 482   | 321 | 246 | 617   | 417 | 339 | 768   | 513 | 486 | 1,120 | 743   |
|                           | 5                        | NA   | NA  | 37  | 77  | 102 | 69  | 107 | 168 | 114 | 151 | 252 | 171 | 193 | 352 | 235 | 245 | 470   | 311 | 305 | 604   | 404 | 418 | 754   | 500 | 598 | 1,104 | 730   |
|                           | 8                        | NA   | NA  | 33  | 90  | 95  | 64  | 122 | 161 | 107 | 175 | 243 | 163 | 223 | 342 | 225 | 280 | 458   | 300 | 344 | 591   | 392 | 470 | 740   | 486 | 665 | 1,089 | 715   |
| 10                        | 0                        | 37   | 87  | 53  | 57  | 174 | 99  | 82  | 293 | 165 | 120 | 444 | 254 | 158 | 628 | 344 | 202 | 844   | 449 | 253 | 1,093 | 584 | 351 | 1,373 | 718 | 507 | 2,031 | 1,057 |
|                           | 2                        | 39   | 61  | 41  | 59  | 117 | 80  | 82  | 193 | 128 | 119 | 287 | 194 | 153 | 400 | 272 | 193 | 531   | 354 | 242 | 681   | 456 | 332 | 849   | 559 | 475 | 1,242 | 848   |
|                           | 5                        | 52   | 56  | 39  | 76  | 111 | 76  | 105 | 185 | 122 | 148 | 277 | 186 | 190 | 388 | 261 | 241 | 518   | 344 | 299 | 667   | 443 | 409 | 834   | 544 | 584 | 1,224 | 825   |
|                           | 10                       | NA   | NA  | 34  | 97  | 100 | 68  | 132 | 171 | 112 | 188 | 261 | 171 | 237 | 369 | 241 | 296 | 497   | 325 | 363 | 643   | 423 | 492 | 808   | 520 | 688 | 1,194 | 788   |
| 15                        | 0                        | 36   | 93  | 57  | 56  | 190 | 111 | 80  | 325 | 186 | 116 | 499 | 283 | 153 | 713 | 388 | 195 | 966   | 523 | 244 | 1,259 | 681 | 336 | 1,591 | 838 | 488 | 2,374 | 1,237 |
|                           | 2                        | 38   | 69  | 47  | 57  | 136 | 93  | 80  | 225 | 149 | 115 | 337 | 224 | 148 | 473 | 314 | 187 | 631   | 413 | 232 | 812   | 543 | 319 | 1,015 | 673 | 457 | 1,491 | 983   |
|                           | 5                        | 51   | 63  | 44  | 75  | 128 | 86  | 102 | 216 | 140 | 144 | 326 | 217 | 182 | 459 | 298 | 231 | 616   | 400 | 287 | 795   | 526 | 392 | 997   | 657 | 562 | 1,469 | 963   |
|                           | 10                       | NA   | NA  | 39  | 95  | 116 | 79  | 128 | 201 | 131 | 182 | 308 | 203 | 228 | 438 | 284 | 284 | 592   | 381 | 349 | 768   | 501 | 470 | 966   | 628 | 664 | 1,433 | 928   |
| 20                        | 0                        | 35   | 96  | 60  | 54  | 200 | 118 | 78  | 346 | 201 | 114 | 537 | 306 | 149 | 772 | 428 | 190 | 1,053 | 573 | 238 | 1,379 | 750 | 326 | 1,751 | 927 | 473 | 2,631 | 1,346 |
|                           | 2                        | 37   | 74  | 50  | 56  | 148 | 99  | 78  | 248 | 165 | 113 | 375 | 248 | 144 | 528 | 344 | 182 | 708   | 468 | 227 | 914   | 611 | 309 | 1,146 | 754 | 443 | 1,689 | 1,098 |
|                           | 5                        | 50   | 68  | 47  | 73  | 140 | 94  | 100 | 239 | 158 | 141 | 363 | 239 | 178 | 514 | 334 | 224 | 692   | 457 | 279 | 896   | 596 | 381 | 1,126 | 734 | 547 | 1,665 | 1,074 |
|                           | 10                       | NA   | NA  | 41  | 93  | 129 | 86  | 125 | 223 | 146 | 177 | 344 | 224 | 222 | 491 | 316 | 277 | 666   | 437 | 339 | 866   | 570 | 457 |       |     |     |       |       |

TABLE 504.2(2)  
TYPE B DOUBLE-WALL GAS VENT

| Number of Appliances      |                 | Single                                       |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |       |     |     |       |     |     |       |     |     |       |       |
|---------------------------|-----------------|--|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-------|-----|-----|-------|-----|-----|-------|-----|-----|-------|-------|
| Appliance Type            |                 | Category I                                   |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |       |     |     |       |     |     |       |     |     |       |       |
| Appliance Vent Connection |                 | Single-wall metal connector                  |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |       |     |     |       |     |     |       |     |     |       |       |
| HEIGHT<br>(ft)            | LATERAL<br>(ft) | VENT DIAMETER—(D) inches                     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |       |     |     |       |     |     |       |     |     |       |       |
|                           |                 | APPLIANCE INPUT RATING IN THOUSANDS OF BTU/H |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |       |     |     |       |     |     |       |     |     |       |       |
|                           |                 | 3  |     | 4   |     | 5   |     | 6   |     | 7   |     | 8   |     | 9   |     | 10  |     | 12    |     |     |       |     |     |       |     |     |       |       |
|                           |                 | FAN  | NAT | FAN | NAT | FAN | NAT | FAN | NAT | FAN | NAT | FAN | NAT | FAN | NAT | FAN | NAT | FAN   | NAT | FAN | NAT   |     |     |       |     |     |       |       |
|                           |                 | Min  | Max | Min | Max | Min | Max | Min | Max | Min | Max | Min | Max | Min | Max | Min | Max | Min   | Max | Min | Max   |     |     |       |     |     |       |       |
| 6                         | 0               | 38   | 77  | 45  | 59  | 151 | 85  | 85  | 249 | 140 | 126 | 373 | 204 | 165 | 522 | 284 | 211 | 695   | 369 | 267 | 894   | 469 | 371 | 1,118 | 569 | 537 | 1,639 | 849   |
|                           | 2               | 39   | 51  | 36  | 60  | 96  | 66  | 85  | 156 | 104 | 123 | 231 | 156 | 159 | 320 | 213 | 201 | 423   | 284 | 251 | 541   | 368 | 347 | 673   | 453 | 498 | 979   | 648   |
|                           | 4               | NA   | NA  | 33  | 74  | 92  | 63  | 102 | 152 | 102 | 146 | 225 | 152 | 187 | 313 | 208 | 237 | 416   | 277 | 295 | 533   | 360 | 409 | 664   | 443 | 584 | 971   | 638   |
|                           | 6               | NA   | NA  | 31  | 83  | 89  | 60  | 114 | 147 | 99  | 163 | 220 | 148 | 207 | 307 | 203 | 263 | 409   | 271 | 327 | 526   | 352 | 449 | 656   | 433 | 638 | 962   | 627   |
| 8                         | 0               | 37   | 83  | 50  | 58  | 164 | 93  | 83  | 273 | 154 | 123 | 412 | 234 | 161 | 580 | 319 | 206 | 777   | 414 | 258 | 1,002 | 536 | 360 | 1,257 | 658 | 521 | 1,852 | 967   |
|                           | 2               | 39   | 56  | 39  | 59  | 108 | 75  | 83  | 176 | 119 | 121 | 261 | 179 | 155 | 363 | 246 | 197 | 482   | 321 | 246 | 617   | 417 | 339 | 768   | 513 | 486 | 1,120 | 743   |
|                           | 5               | NA   | NA  | 37  | 77  | 102 | 69  | 107 | 168 | 114 | 151 | 252 | 171 | 193 | 352 | 235 | 245 | 470   | 311 | 305 | 604   | 404 | 418 | 754   | 500 | 598 | 1,104 | 730   |
|                           | 8               | NA   | NA  | 33  | 90  | 95  | 64  | 122 | 161 | 107 | 175 | 243 | 163 | 223 | 342 | 225 | 280 | 458   | 300 | 344 | 591   | 392 | 470 | 740   | 486 | 665 | 1,089 | 715   |
| 10                        | 0               | 37   | 87  | 53  | 57  | 174 | 99  | 82  | 293 | 165 | 120 | 444 | 254 | 158 | 628 | 344 | 202 | 844   | 449 | 253 | 1,093 | 584 | 351 | 1,373 | 718 | 507 | 2,031 | 1,057 |
|                           | 2               | 39   | 61  | 41  | 59  | 117 | 80  | 82  | 193 | 128 | 119 | 287 | 194 | 153 | 400 | 272 | 193 | 531   | 354 | 242 | 681   | 456 | 332 | 849   | 559 | 475 | 1,242 | 848   |
|                           | 5               | 52   | 56  | 39  | 76  | 111 | 76  | 105 | 185 | 122 | 148 | 277 | 186 | 190 | 388 | 261 | 241 | 518   | 344 | 299 | 667   | 443 | 409 | 834   | 544 | 584 | 1,224 | 825   |
|                           | 10              | NA   | NA  | 34  | 97  | 100 | 68  | 132 | 171 | 112 | 188 | 261 | 171 | 237 | 369 | 241 | 296 | 497   | 325 | 363 | 643   | 423 | 492 | 808   | 520 | 688 | 1,194 | 788   |
| 15                        | 0               | 36   | 93  | 57  | 56  | 190 | 111 | 80  | 325 | 186 | 116 | 499 | 283 | 153 | 713 | 388 | 195 | 966   | 523 | 244 | 1,259 | 681 | 336 | 1,591 | 838 | 488 | 2,374 | 1,237 |
|                           | 2               | 38   | 69  | 47  | 57  | 136 | 93  | 80  | 225 | 149 | 115 | 337 | 224 | 148 | 473 | 314 | 187 | 631   | 413 | 232 | 812   | 543 | 319 | 1,015 | 673 | 457 | 1,491 | 983   |
|                           | 5               | 51   | 63  | 44  | 75  | 128 | 86  | 102 | 216 | 140 | 144 | 326 | 217 | 182 | 459 | 298 | 231 | 616   | 400 | 287 | 795   | 526 | 392 | 997   | 657 | 562 | 1,469 | 963   |
|                           | 10              | NA   | NA  | 39  | 95  | 116 | 79  | 128 | 201 | 131 | 182 | 308 | 203 | 228 | 438 | 284 | 284 | 592   | 381 | 349 | 768   | 501 | 470 | 966   | 628 | 664 | 1,433 | 928   |
| 20                        | 15              | NA   | NA  | NA  | NA  | NA  | 72  | 158 | 186 | 124 | 220 | 290 | 192 | 272 | 418 | 269 | 334 | 568   | 367 | 404 | 742   | 484 | 540 | 937   | 601 | 750 | 1,399 | 894   |
|                           | 0               | 35   | 96  | 60  | 54  | 200 | 118 | 78  | 346 | 201 | 114 | 537 | 306 | 149 | 772 | 428 | 190 | 1,053 | 573 | 238 | 1,379 | 750 | 326 | 1,751 | 927 | 473 | 2,631 | 1,346 |
|                           | 2               | 37   | 74  | 50  | 56  | 148 | 99  | 78  | 248 | 165 | 113 | 375 | 248 | 144 | 528 | 344 | 182 | 708   | 468 | 227 | 914   | 611 | 309 | 1,146 | 754 | 443 | 1,689 | 1,098 |
|                           | 5               | 50   | 68  | 47  | 73  | 140 | 94  | 100 | 239 | 158 | 141 | 363 | 239 | 178 | 514 | 334 | 224 | 692   | 457 | 279 | 896   | 596 | 381 | 1,126 | 734 | 547 | 1,665 | 1,074 |
| 20                        | 10              | NA   | NA  | 41  | 93  | 129 | 86  | 125 | 223 | 146 | 177 | 344 | 224 | 222 | 491 | 316 | 277 | 666   | 437 | 339 | 866   | 570 | 457 | 1,092 | 702 | 646 | 1,626 | 1,037 |
|                           | 15              | NA   | NA  | NA  | NA  | NA  | 80  | 155 | 208 | 136 | 216 | 325 | 210 | 264 | 469 | 301 | 325 | 640   | 419 | 393 | 838   | 549 | 526 | 1,060 | 677 | 730 | 1,587 | 1,005 |
|                           | 20              | NA   | NA  | NA  | NA  | NA  | NA  | 186 | 192 | 126 | 254 | 306 | 196 | 309 | 448 | 285 | 374 | 616   | 400 | 448 | 810   | 526 | 592 | 1,028 | 651 | 808 | 1,550 | 973   |

# Venting Activity: Single Appliance

**Step 5:** Select “86” in the “NAT” column. Then move vertically upward to find the correct size vent diameter indicated in Table 504.2(2).



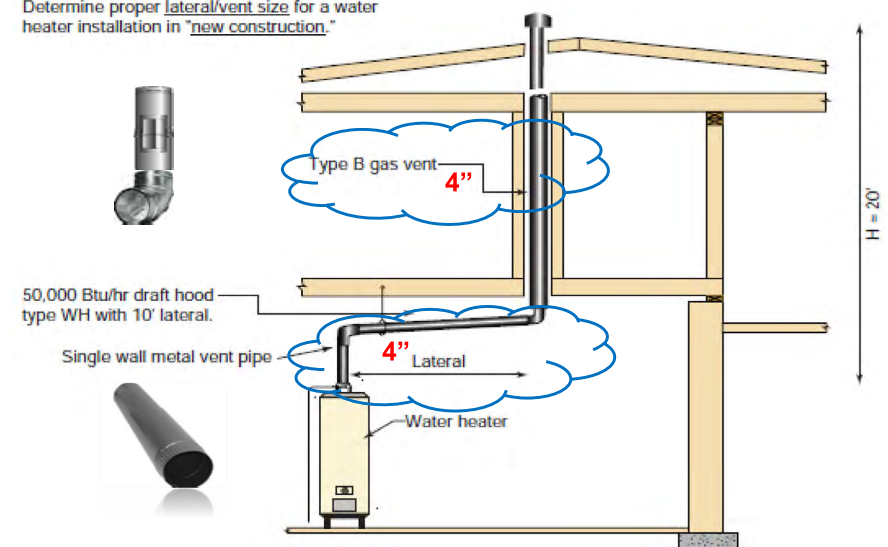
TABLE 504.2(2)  
TYPE B DOUBLE-WALL GAS VENT

| Number of Appliances      |                 | Single                                       |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |       |     |     |       |     |     |       |     |     |       |       |
|---------------------------|-----------------|--|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-------|-----|-----|-------|-----|-----|-------|-----|-----|-------|-------|
| Appliance Type            |                 | Category I                                   |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |       |     |     |       |     |     |       |     |     |       |       |
| Appliance Vent Connection |                 | Single-wall metal connector                  |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |       |     |     |       |     |     |       |     |     |       |       |
| HEIGHT<br>(ft)            | LATERAL<br>(ft) | VENT DIAMETER—(D) inches                     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |       |     |     |       |     |     |       |     |     |       |       |
|                           |                 | APPLIANCE INPUT RATING IN THOUSANDS OF BTU/H |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |       |     |     |       |     |     |       |     |     |       |       |
|                           |                 | 3  |     | 4   |     | 5   |     | 6   |     | 7   |     | 8   |     | 9   |     | 10  |     | 12    |     |     |       |     |     |       |     |     |       |       |
|                           |                 | FAN  | NAT | FAN | NAT | FAN | NAT | FAN | NAT | FAN | NAT | FAN | NAT | FAN | NAT | FAN | NAT | FAN   | NAT | FAN | NAT   |     |     |       |     |     |       |       |
|                           |                 | Min  | Max | Min | Max | Min | Max | Min | Max | Min | Max | Min | Max | Min | Max | Min | Max | Min   | Max | Min | Max   |     |     |       |     |     |       |       |
| 6                         | 0               | 38   | 77  | 45  | 59  | 151 | 85  | 85  | 249 | 140 | 126 | 373 | 204 | 165 | 522 | 284 | 211 | 695   | 369 | 267 | 894   | 469 | 371 | 1,118 | 569 | 537 | 1,639 | 849   |
|                           | 2               | 39   | 51  | 36  | 60  | 96  | 66  | 85  | 156 | 104 | 123 | 231 | 156 | 159 | 320 | 213 | 201 | 423   | 284 | 251 | 541   | 368 | 347 | 673   | 453 | 498 | 979   | 648   |
|                           | 4               | NA   | NA  | 33  | 74  | 92  | 63  | 102 | 152 | 102 | 146 | 225 | 152 | 187 | 313 | 208 | 237 | 416   | 277 | 295 | 533   | 360 | 409 | 664   | 443 | 584 | 971   | 638   |
|                           | 6               | NA   | NA  | 31  | 83  | 89  | 60  | 114 | 147 | 99  | 163 | 220 | 148 | 207 | 307 | 203 | 263 | 409   | 271 | 327 | 526   | 352 | 449 | 656   | 433 | 638 | 962   | 627   |
| 8                         | 0               | 37   | 83  | 50  | 58  | 164 | 93  | 83  | 273 | 154 | 123 | 412 | 234 | 161 | 580 | 319 | 206 | 777   | 414 | 258 | 1,002 | 536 | 360 | 1,257 | 658 | 521 | 1,852 | 967   |
|                           | 2               | 39   | 56  | 39  | 59  | 108 | 75  | 83  | 176 | 119 | 121 | 261 | 179 | 155 | 363 | 246 | 197 | 482   | 321 | 246 | 617   | 417 | 339 | 768   | 513 | 486 | 1,120 | 743   |
|                           | 5               | NA   | NA  | 37  | 77  | 102 | 69  | 107 | 168 | 114 | 151 | 252 | 171 | 193 | 352 | 235 | 245 | 470   | 311 | 305 | 604   | 404 | 418 | 754   | 500 | 598 | 1,104 | 730   |
|                           | 8               | NA   | NA  | 33  | 90  | 95  | 64  | 122 | 161 | 107 | 175 | 243 | 163 | 223 | 342 | 225 | 280 | 458   | 300 | 344 | 591   | 392 | 470 | 740   | 486 | 665 | 1,089 | 715   |
| 10                        | 0               | 37   | 87  | 53  | 57  | 174 | 99  | 82  | 293 | 165 | 120 | 444 | 254 | 158 | 628 | 344 | 202 | 844   | 449 | 253 | 1,093 | 584 | 351 | 1,373 | 718 | 507 | 2,031 | 1,057 |
|                           | 2               | 39   | 61  | 41  | 59  | 117 | 80  | 82  | 193 | 128 | 119 | 287 | 194 | 153 | 400 | 272 | 193 | 531   | 354 | 242 | 681   | 456 | 332 | 849   | 559 | 475 | 1,242 | 848   |
|                           | 5               | 52   | 56  | 39  | 76  | 111 | 76  | 105 | 185 | 122 | 148 | 277 | 186 | 190 | 388 | 261 | 241 | 518   | 344 | 299 | 667   | 443 | 409 | 834   | 544 | 584 | 1,224 | 825   |
|                           | 10              | NA   | NA  | 34  | 97  | 100 | 68  | 132 | 171 | 112 | 188 | 261 | 171 | 237 | 369 | 241 | 296 | 497   | 325 | 363 | 643   | 423 | 492 | 808   | 520 | 688 | 1,194 | 788   |
| 15                        | 0               | 36   | 93  | 57  | 56  | 190 | 111 | 80  | 325 | 186 | 116 | 499 | 283 | 153 | 713 | 388 | 195 | 966   | 523 | 244 | 1,259 | 681 | 336 | 1,591 | 838 | 488 | 2,374 | 1,237 |
|                           | 2               | 38   | 69  | 47  | 57  | 136 | 93  | 80  | 225 | 149 | 115 | 337 | 224 | 148 | 473 | 314 | 187 | 631   | 413 | 232 | 812   | 543 | 319 | 1,015 | 673 | 457 | 1,491 | 983   |
|                           | 5               | 51   | 63  | 44  | 75  | 128 | 86  | 102 | 216 | 140 | 144 | 326 | 217 | 182 | 459 | 298 | 231 | 616   | 400 | 287 | 795   | 526 | 392 | 997   | 657 | 562 | 1,469 | 963   |
|                           | 10              | NA   | NA  | 39  | 95  | 116 | 79  | 128 | 201 | 131 | 182 | 308 | 203 | 228 | 438 | 284 | 284 | 592   | 381 | 349 | 768   | 501 | 470 | 966   | 628 | 664 | 1,433 | 928   |
| 20                        | 15              | NA   | NA  | NA  | NA  | NA  | 72  | 158 | 186 | 124 | 220 | 290 | 192 | 272 | 418 | 269 | 334 | 568   | 367 | 404 | 742   | 484 | 540 | 937   | 601 | 750 | 1,399 | 894   |
|                           | 0               | 35   | 96  | 60  | 54  | 200 | 118 | 78  | 346 | 201 | 114 | 537 | 306 | 149 | 772 | 428 | 190 | 1,053 | 573 | 238 | 1,379 | 750 | 326 | 1,751 | 927 | 473 | 2,631 | 1,346 |
|                           | 2               | 37   | 74  | 50  | 56  | 148 | 99  | 78  | 248 | 165 | 113 | 375 | 248 | 144 | 528 | 344 | 182 | 708   | 468 | 227 | 914   | 611 | 309 | 1,146 | 754 | 443 | 1,689 | 1,098 |
|                           | 5               | 50   | 68  | 47  | 73  | 140 | 94  | 100 | 239 | 158 | 141 | 363 | 239 | 178 | 514 | 334 | 224 | 692   | 457 | 279 | 896   | 596 | 381 | 1,126 | 734 | 547 | 1,665 | 1,074 |
| 20                        | 10              | NA   | NA  | 41  | 93  | 129 | 86  | 125 | 223 | 146 | 177 | 344 | 224 | 222 | 491 | 316 | 277 | 666   | 437 | 339 | 866   | 570 | 457 | 1,092 | 702 | 646 | 1,626 | 1,037 |
|                           | 15              | NA   | NA  | NA  | NA  | NA  | 80  | 155 | 208 | 136 | 216 | 325 | 210 | 264 | 469 | 301 | 325 | 640   | 419 | 393 | 838   | 549 | 526 | 1,060 | 677 | 730 | 1,587 | 1,005 |
|                           | 20              | NA   | NA  | NA  | NA  | NA  | NA  | 186 | 192 | 126 | 254 | 306 | 196 | 309 | 448 | 285 | 374 | 616   | 400 | 448 | 810   | 526 | 592 | 1,028 | 651 | 808 | 1,550 | 973   |

# Venting Activity: Single Appliance

Determine proper lateral/vent size for a water heater installation in “new construction”

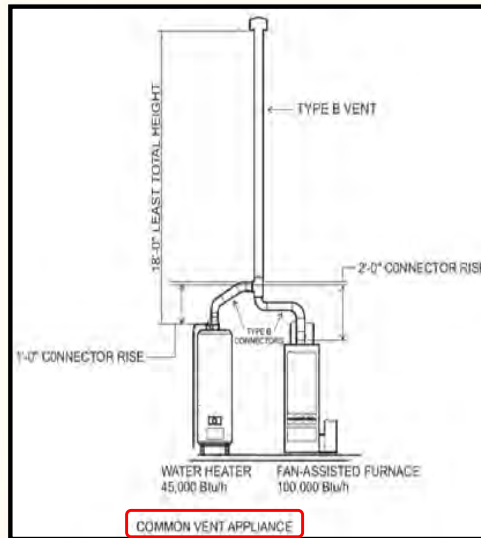
Determine proper lateral/vent size for a water heater installation in “new construction.”



## Venting Activity Multiple Appliances

### Discuss 5 Important Details:

1. By inspection, observe piping arrangement.
2. Observe all dimensions.
3. Identify vent and connector materials.
4. Identify appliance input ratings.
5. Identify natural draft and fan-assisted appliances.

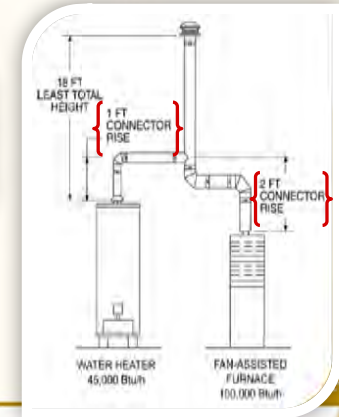


## Connector Rise Measurement (504.3.11)

### Rise Measurement - Rise (R)

- Vertical distance from the draft hood outlet or flue collar to the level where the vent gas streams merge.

**504.3.11 Connector rise measurement.** Connector rise ( $R$ ) for each appliance connector shall be measured from the draft hood outlet or flue collar to the centerline where the vent gas streams come together.

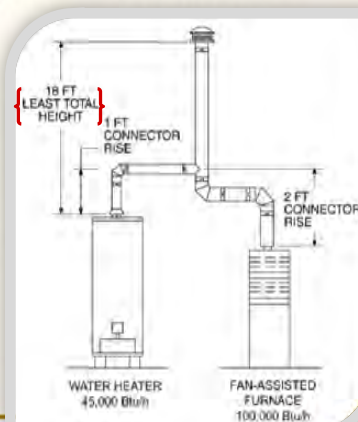


## Review-Height Measurement

### (504.3.12)

- Least total height ( $H$ )
  - 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.

**504.3.12 Vent height measurement.** For multiple appliances all located on one floor, available total height ( $H$ ) shall be measured from the highest draft hood outlet or flue collar up to the level of the outlet of the common vent.



## Venting Activity: Multiple Appliances

Sizing connectors and a common vent for multiple appliances utilizing a step by step approach.

All connectors and common vent are B-vent.

