MODULE DEFINITIONS:

PSIG. The pound per square inch or, more accurately, pound-force per square inch (symbol: psi or lbf/in2 or lbf/in2 or lbf/sq in or lbf/sq in) is a unit of pressure or of stress based on avoirdupois units. It is the pressure resulting from a force of one pound-force applied to an area of one square inch.

WATER COLUMN. Hydrostatic pressure in water is directly related to the depth in which the pressure is measured. Very frequently the vertical distance from the surface to the pressure point we wish to measure is referred to as "WATER COLUMN".

PRESSURE, FIELD TEST. A test performed in the field to prove system tightness.

PRESSURE-LIMITING DEVICE. A pressure-responsive mechanism designed to stop automatically the operation of the pressure-imposing element at a predetermined pressure.

PRESSURE RELIEF DEVICE. A pressure-actuated valve or rupture member designed to relieve excessive pressure automatically.

PRESSURE RELIEF VALVE. A pressure-actuated valve held closed by a spring or other means and designed to relieve pressure automatically in excess of the device's setting.

PRESSURE VESSELS. Closed containers, tanks or vessels that are designed to contain liquids or gases, or both, under pressure.

IGNITION SOURCE. A flame, spark or hot surface capable of igniting flammable vapors or fumes. Such sources include *appliance* burners, burner ignitors and electrical switching devices.

FUEL GAS. A natural gas, manufactured gas, liquefied petroleum gas or a mixture of these.

FLAMMABLE VAPOR OR FUMES. Mixtures of gases in air at concentrations equal to or greater than the LFL and less than or equal to the upper flammability limit (UFL).

PURGE. To clear of air, water or other foreign substances.

IFGC Chapter 4 - GAS PIPING INSTALLATIONS [2012] Code Excerpts

SECTION 401 (IFGC) GENERAL

401.1 Scope.

This chapter shall govern the design, installation, modification and maintenance of piping systems. The applicability of this code to piping systems extends from the point of delivery to the connections with the appliances and includes the design, materials, components, fabrication, assembly, installation, testing, inspection, operation and maintenance of such piping systems.

401.8 Minimum sizes.

All pipe utilized for the installation, extension and alteration of any piping system shall be sized to supply the full number of outlets for the intended purpose and shall be sized in accordance with Section 402.

SECTION 402 (IFGS) PIPE SIZING

402.1 General considerations.

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.

402.2 Maximum gas demand.

The volumetric flow rate of gas to be provided, in cubic feet per hour, shall be calculated using the manufacturer's input ratings of the appliances served adjusted for altitude. Where an input rating is not indicated, the gas supplier, appliance manufacturer or a qualified agency shall be contacted, or the rating from Table 402.2 shall be used for estimating the volumetric flow rate of gas to be supplied.

The total connected hourly load shall be used as the basis for pipe sizing, assuming that all appliances could be operating at full capacity simultaneously. Where a diversity of load can be established, pipe sizing shall be permitted to be based on such loads.

402.3 Sizing.

Gas piping shall be sized in accordance with one of the following:

1. Pipe sizing tables or sizing equations in accordance with Section 402.4.
2. The sizing tables included in a listed piping system's manufacturer's installation instructions.
3. Other approved engineering methods.

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.

402.4.2 Branch length method.

Pipe shall be sized as follows:

1. Pipe size of each section of the longest pipe run from the point of delivery to the most remote outlet shall be determined using the longest run of piping and the load of the section.
2. 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.

402.4.3 Hybrid pressure.

The pipe size for each section of higher pressure gas piping shall be determined using the longest length of piping from the point of delivery to the most remote line pressure regulator. The pipe size from the line pressure regulator to each outlet shall be determined using the length of piping from the regulator to the most remote outlet served by the regulator.

402.5 Allowable pressure drop.

The design pressure loss in any piping system under maximum probable flow conditions, from the point of delivery to the inlet connection of the appliance, shall be such that the supply pressure at the appliance is greater than or equal to the minimum pressure required by the appliance.

402.6 Maximum design operating pressure.

The maximum design 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 system is welded.

2. The piping is located in a ventilated chase or otherwise enclosed for protection against accidental gas accumulation.

3. The piping is located inside buildings or separate areas of buildings used exclusively for:

    3.1. Industrial processing or heating;
    3.2. Research;
    3.3. Warehousing; or
    3.4. Boiler or mechanical rooms.

4. The piping is a temporary installation for buildings under construction.

5. The piping serves appliances or equipment used for agricultural purposes.

6. The piping system is an LP-gas piping system with a design operating pressure greater than 20 psi (137.9 kPa) and complies with NFPA 58.

402.6.1 Liquefied petroleum gas systems.

LP-gas systems designed to operate below -5°F (-21°C) or with butane or a propane-butane mix shall be designed to either accommodate liquid LP-gas or prevent LP-gas vapor from condensing into a liquid.

General piping considerations.

The first goal of determining the pipe sizing for a fuel gas piping system is to make sure that there is sufficient gas pressure at the inlet to each appliance. The majority of systems are residential and the appliances will all have the same, or nearly the same, requirement for minimum gas pressure at the appliance inlet. This pressure will be about 5-inch water column (w.c.) (1.25 kPa), which is enough for proper operation of the appliance regulator to deliver about 3.5-inches water column (w.c.) (875 kPa) to the burner itself. The pressure drop in the piping is subtracted from the source delivery pressure to verify that the minimum is available at the appliance.

There are other systems, however, where the required inlet pressure to the different appliances may be quite varied. In such cases, the greatest inlet pressure required must be satisfied, as well as the farthest appliance, which is almost always the critical appliance in small systems.

There is an additional requirement to be observed besides the capacity of the system at 100-percent flow. That requirement is that at minimum flow, the pressure at the inlet to any appliance does not exceed the pressure rating of the appliance regulator. This would seldom be of concern in small systems if the source pressure is 1/2 psi (14-inch w.c.) (3.5 kPa) or less but it should be verified for systems with greater gas pressure at the point of supply.

To determine the size of piping used in a gas piping system, the following factors must be considered:

(1) Allowable loss in pressure from point of delivery to appliance.

(2) Maximum gas demand.

(3) Length of piping and number of fittings.

(4) Specific gravity of the gas.

(5) Diversity factor.

For any gas piping system, or special appliance, or for conditions other than those covered by the tables provided in this code, such as longer runs, greater gas demands or greater pressure drops, the size of each gas piping system should be determined by standard engineering practices acceptable to the code official.

Longest length method.

This sizing method is conservative in its approach by applying the maximum operating conditions in the system as the norm for the system and by setting the length of pipe used to size any given part of the piping system to the maximum value.

To determine the size of each section of gas piping in a system within the range of the capacity tables, proceed as follows:

(1) Divide the piping system into appropriate segments consistent with the presence of tees, branch lines and main runs. For each segment, determine the gas load (assuming all appliances operate simultaneously) and its overall length. An allowance (in equivalent length of pipe) as determined from Table A.2.2 shall be considered for piping segments that include four or more fittings.

(2) Determine the gas demand of each appliance to be attached to the piping system. Where Tables 402.4(1) through 402.4(24) are to be used to select the piping size, calculate the gas demand in terms of cubic feet per hour for each piping system outlet. Where Tables 402.4(25) through 402.4(37) are to be used to select the piping size, calculate the gas demand in terms of thousands of Btu per hour for each piping system outlet.

(3) Where the piping system is for use with other than undiluted liquefied petroleum gases, determine the design system pressure, the allowable loss in pressure (pressure drop), and specific gravity of the gas to be used in the piping system.
(4) Determine the length of piping from the point of delivery to the most remote outlet in the building/piping system.

(5) In the appropriate capacity table, select the row showing the measured length or the next longer length if the table does not give the exact length. This is the only length used in determining the size of any section of gas piping. If the gravity factor is to be applied, the values in the selected row of the table are multiplied by the appropriate multiplier from Table A.2.4.

(6) Use this horizontal row to locate ALL gas demand figures for this particular system of piping.

(7) Starting at the most remote outlet, find the gas demand for that outlet in the horizontal row just selected. If the exact figure of demand is not shown, choose the next larger figure left in the row.

(8) Opposite this demand figure, in the first row at the top, the correct size of gas piping will be found.

(9) Proceed in a similar manner for each outlet and each section of gas piping. For each section of piping, determine the total gas demand supplied by that section.

Examples of piping system design and sizing.

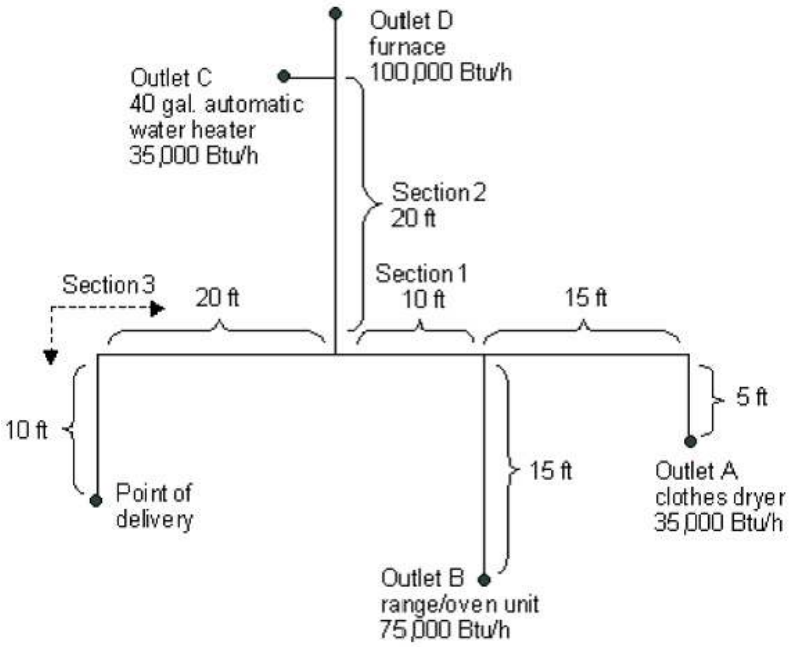
Example 1: Longest length method.

Determine the required pipe size of each section and outlet of the piping system shown in Figure A, with a designated pressure drop of 0.5-inch w.c. (125 Pa) using the Longest Length Method. The gas to be used has 0.60 specific gravity and a heating value of 1,000 Btu/ft3 (37.5 MJ/m3).

(1) Maximum gas demand for Outlet A: 35 cubic feet per hour (35 cfh)
(1) Maximum gas demand for Outlet B: 75 cubic feet per hour (75 cfh)

(1) Maximum gas demand for Outlet C: 35 cubic feet per hour (35 cfh)
(1) Maximum gas demand for Outlet D: 100 cubic feet per hour (100 cfh)

FIGURE A. PIPING PLAN SHOWING A STEEL PIPING SYSTEM



Solution:

(2) The length of pipe from the point of delivery to the most remote outlet (A) is 60 feet (18 288 mm). This is the only distance used.
(3) **Using the row marked 60 feet** (18 288 mm) in Table 402.4(2):

(a) Outlet A, supplying 35 cfh (0.99 m3/hr), **requires 1/2-inch pipe**.
(b) Outlet B, supplying 75 cfh (2.12 m3/hr), **requires 3/4-inch pipe.**

(c) Section 1, supplying Outlets A and B, or 110 cfh (3.11 m3/hr), **requires 3/4-inch pipe.**
(d) Section 2, supplying Outlets C and D, or 135 cfh (3.82 m3/hr), **requires 3/4-inch pipe.**
(e) Section 3, supplying Outlets A, B, C and D, or 245 cfh (6.94 m3/hr), **requires 1-inch pipe.**

The following methods can be used for gas pipe sizing:

- ○ Longest length method.
- ○ Branch length method.
- ○ Both the above.
- ○ none of the above.

The standard maximum design operating pressure for piping systems located inside buildings shall not exceed:

- 5 pounds per square inch gauge (psig).
- 7 pounds per square inch gauge (psig).
- 8 pounds per square inch gauge (psig).
- none of the above.

The majority of residential appliances require a minimum gas pressure at the appliance inlet of about:

- 1-inch water column (w.c.).
- 2-inch water column (w.c.).
- 5-inch water column (w.c.).
- none of the above.

To determine the size of piping used in a gas piping system, the following factors must be considered:

- Allowable loss in pressure from point of delivery to appliance.
- Maximum gas demand.
- Length of piping and number of fittings.
- All of the above.

Using Table 402.4(2) from the previous example, what size pipe would be required for for Outlet A,
supplying 75 cfh, and a 60 ft max length:

- 1/2 inch.
- 3/4 inch.
- 1 inch.
- none of the above.

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