3-7   CYLINDER FLOWS

After finding how many nozzles of each type are required for a system, the sum of all the nozzle flow numbers is used to determine the number and size of the cylinders required, in accordance with the cylinder flow number limits given below.

Table 3-30. Cylinder Flow Number Limits

Maximum Flow Numbers of Cylinders	
Cylinder	**Flow Number**
RG-1.25G	4 — Single Cylinder Only (cannot manifold)
RG-2.5G	8 — Single Cylinder Systems Only (cannot manifold)
RG-4GS/RG4GM 1 Cylinder 2 Cylinders 3 Cylinders 4 Cylinders	Can manifold up to 4 cylinders[1] 12 24 36 48
RG-6GS 1 Cylinder 2 Cylinders	Can manifold up to 2 cylinders[1] 18 36

[1] Only like cylinders can be manifolded (i.e., four RG-4GS or 4GM; two RG6G)

3-8   PIPING REQUIREMENTS

Range Guard systems do not require balanced piping to achieve proper distribution of wet chemical to all nozzles. Balanced piping is not necessary because a liquid has no difficulty in turning corners or changing directions. Range Guard nozzles come equipped with permanent predetermined orifices. This means that the liquid will be delivered in the exact quantities necessary to the duct, plenum and appliance hazards as required.

All pipe shall be schedule 40 (standard weight) black steel. Pipe may be chrome plated. Galvanized pipe shall not be used. All pipe and fittings must be made tight without pipe dope or thread sealant.

Pipe fittings shall be standard weight steel, cast iron, malleable iron or ductile iron. Galvanized fittings shall not be used. Branch line connection and individual nozzle connections may be made by using either the outlet or the run of a tee.

3-8.1   Stainless Steel Tubing and Fittings

Stainless steel tubing may be used on all Range Guard systems. Fittings may be stainless steel compression or stainless steel flare types. Bending of tubing using mandrels is permissible.

3-8.2   Pipe Sizing

Pipe sizes are determined by the total number of flow numbers running through a particular piece of pipe. This is the flow demand for that portion of the system.

Note: It is not permissible to drop pipe diameters below the required value. For example, using 1/2-inch pipe to flow 18 flow numbers is not permissible. However, increasing pipe diameter is acceptable (i.e., using 1-inch pipe to flow 18 flow numbers) providing the system complies with internal pipe volume limitations.

Table 3-31. Flow Number Range and Pipe Type

Flow Number Range	Minimum Pipe Size	.035 Wall Stainless Steel Tubing Size
1 — 2	1/4-inch	3/8-inch
1 — 8	3/8-inch	N/A
1 — 12	1/2-inch	5/8-inch
13 — 24	3/4-inch	7/8-inch
25 — 48	1-inch	1-inch

3-8.3   General Rules

- A maximum of 100 equivalent ft. (30.5 m) but not more than 40 linear ft. (12.2 m) of 1/4-in. pipe may be used from each branch line.
- The highest point of the system shall not exceed 12 ft. (3.7 m) above the cylinder outlet.
- The vertical rise of a branch line above the supply line shall not exceed a maximum of 4 ft. (1.2 m).
- Maximum discharge pipe volume limitations shall not be exceeded.
- Maximum equivalent length limitations shall not be exceeded.
- Maximum flow points for a given pipe shall not be exceeded.
- There are to be no low points or "traps" present in discharge piping.

3-8.4   Discharge Line Volume Limitations

There is a discharge line volume limitation in Range Guard systems. Discharge line volume is the **total** volume of **all** pipe, tubing, and fittings used in single or multiple cylinder systems.

To measure discharge line volume, it is necessary to measure all pipe length from the center of one fitting to the center of the next fitting and multiply by the volume-per-foot factor given in Table 3-32 and Table 3-33.

Table 3-32. Piping Discharge Line Volume

Size	Piping Discharge Line Volume
1/4 in.	1.25 in.^{3} per linear foot — (67.2 cm^3 per linear meter)
3/8 in.	2.29 in.^{3} per linear foot — (123.1 cm^3 per linear meter)
1/2 in.	3.65 in.^{3} per linear foot— (196.2 cm^3 per linear meter)
3/4 in.	6.40 in.^{3} per linear foot — (344.1 cm^3 per linear meter)
1 in.	10.37 in.^{3} per linear foot — (557.5 cm^3 per linear meter)

Table 3-33. Tubing Discharge Line Volume

Size	Piping Discharge Line Volume
3/8 in.	0.88 in.^{3} per linear foot — (47.3 cm^3 per linear meter)
5/8 in.	2.90 in.^{3} per linear foot — (155.9 cm^3 per linear meter)
7/8 in.	6.11 in.^{3} per linear foot — (328.5 cm^3 per linear meter)
1 in.	8.15 in.^{3} per linear foot — (438.2 cm^3 per linear meter)

Table 3-34. Maximum Allowable Piping Volume

Cylinder Size	Total Discharge Pipe Volume Max. per Cylinder	Total Discharge Tubing Max. per Cylinder	Max. Allowable 3/8-inch Pipe Volume per System
RG-125 (4.7 L)	72 in.^{3} (1180 cm^3) [1]	51 in.^{3} (836 cm^3) [1]	72 in.^{3} (1180 cm^3)
RG-250 (9.5 L)	139 in.^{3} (2278 cm^3) [1]	99 in.^{3} (1622 cm^3) [1]	95 in.^{3} (1557 cm^3)
RG-400 (15 L)	400 in.^{3} (6555 cm^3)	282 in.^{3} (4621 cm^3) [1]	95 in.^{3} (1557 cm^3)
RG-600 (22.7 L)	400 in.^{3} (6555 cm^3)	282 in.^{3} (4621 cm^3) [1]	95 in.^{3} (1557 cm^3)

[1] Cannot Manifold

Note: The maximum allowable 3/8-inch pipe volume is not in addition to the total discharge line volume, but represents a portion of the total volume which may be dedicated to 3/8-inch pipe alone.

3-8.4.1   EQUIVALENT LENGTH LIMITATIONS

Equivalent feet is defined as the actual measured length of discharge line plus the equivalent length for each fitting in the line as obtained from the data given in Table 3-35 and Table 3-36.

Table 3-35. Pipe Fitting Equivalent Length

Pipe Fittings	Equivalent Length				
	1/4 in. (6.3 mm)	3/8 in. (9.5 mm)	1/2 in. (13 mm)	3/4 in. (19 mm)	1 in. (25.4 mm)
90° Elbow	0.9 ft. (.27 m)	1.3 ft. (.40 m)	1.5 ft. (.46 m)	2.1 ft. (.64 m)	2.7 ft. (.82 m)
45° Elbow	0.4 ft. (.12 m)	0.6 ft. (.18 m)	0.8 ft. (.24 m)	1.0 ft. (.30 m)	1.3 ft. (.40 m)
Tee (Outlet)	2.0 ft. (.61 m)	2.7 ft. (.82 m)	3.5 ft. (1.07 m)	4.5 ft. (1.37 m)	5.8 ft. (1.77 m)
Tee (Run)	0.5 ft. (.15 m)	0.8 ft. (.24 m)	1.1 ft. (.34 m)	1.4 ft. (.43 m)	1.7 ft. (.52 m)
Red. (1/2 in. to 1/4 in.) (13 mm to 6.3 mm)	0.3 ft. (.09 m)	—	—	—	—
Red. (1/2 in. to 3/8 in.) (13 mm to 9.5 mm)	—	0.3 ft. (.09 m)	—	—	—
Red. (3/4 in. to 1/2 in.) (19 mm to 13 mm)	—	—	0.4 ft. (.12 m)	—	—
Red. (1 in. to 3/4 in.) (25.4 mm to 19 mm)	—	—	—	0.5 ft. (.15 m)	—

Equivalent feet is measured from the cylinder (the farthest cylinder in a manifold) to the most remote nozzle. Equivalent feet is also measured between the two most remote nozzles. Equivalent feet is measured only along that branch with the most equivalent feet. Table 3-36 lists the maximum equivalent lengths for each cylinder size.

Table 3-36. Tube Fitting Equivalent Length

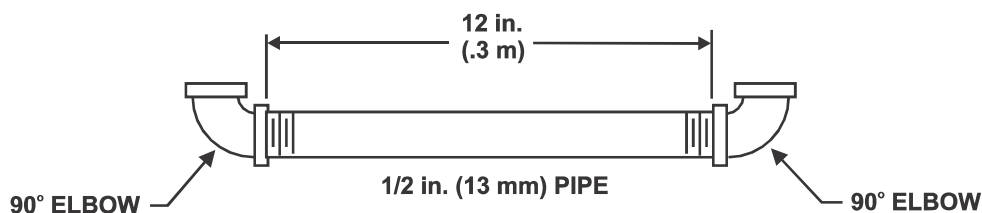| Tube Fittings	Equivalent Length			
	3/8 in. (9.5 mm)	5/8 in. (16 mm)	7/8 in. (22 mm)	1 in. (25.4 mm)
90° Elbow	1.5 ft. (.46 m)	2.5 ft. (.76 m)	4.0 ft. (1.22 m)	4.5 ft. (1.37 m)
90° Bend	0.5 ft. (.15 m)	1.0 ft. (.30 m)	1.0 ft. (.30 m)	1.0 ft. (.30 m)
45° Elbow	0.8 ft. (.24 m)	1.3 ft. (.40 m)	2.0 ft. (.61 m)	2.3 ft. (.70 m)
45° Bend	0.5 ft. (.15 m)	0.5 ft. (.15 m)	0.5 ft. (.15 m)	0.5 ft. (.15 m)
Tee (Outlet)	1.5 ft. (.46 m)	2.5 ft. (.76 m)	4.0 ft. (1.2 m)	4.5 ft. (1.37 m)
Tee (Run)	0.5 ft. (.15 m)	0.5 ft. (.15 m)	1.0 ft. (.30 m)	1.0 ft. (.30 m)

Figure 3-37. 1/2 in. (13 mm) Piping with 90° Elbow

Equivalent Feet (from Table 3-35)

90° 1/2 in. (13 mm) Elbow: 1.5 eq. ft.

90° 1/2 in. (13 mm) Elbow: 1.5 eq. ft.

1.0 ft. of 1/2 in. (13 mm) Pipe

4.0 eq. ft. TOTAL

A tee can be considered one of two ways, depending on orientation. Figure 3-47 shows the different orientations that can occur. The equivalent feet for a reducing tee is determined by the larger size of the tee. Refer to Table 3-9 or 3-10 for equivalent feet.
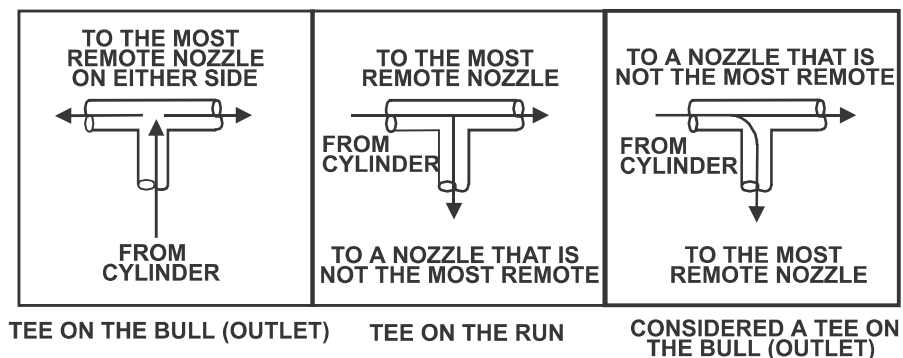
EXAMPLE

Figure 3-38. Tees

Table 3-37. Remote Nozzles

Cylinder Size	Equivalent Feet from Cylinder to Most Remote Nozzle	Equivalent Feet Between Most Remote Nozzles
RG-125	39 ft. (11.9 m)	33 ft. (10.1 m)
RG-260	63.4 ft. (14.3 m)	43.7 ft. (13.3 m)
RG-400	132 ft. (40.2 m)[2]	95 ft. (29 m)[2]
RG-600	75 ft. (22.9 m)[2]	80 ft. (24.4 m)[2]

[2] The maximums listed in Table 3-37 apply to manifold systems as well as single cylinder systems.

3-8.4.2   **MINIMUM PIPE LENGTH**

The minimum pipe length, to prevent splash, required between cylinder and closest cooking appliance nozzle used to protect a liquid hazard, such as a deep fat fryer, is given in Table 3-38. For pipe sizes larger than 1/2-inch (1.3 cm) use formulas 1 and 2, to find the equivalent length in 1/2-inch (1.3 cm) pipe.

Table 3-38. Minimum Allowable Pipe

Pipe Size	Minimum Allowable Pipe
1/4-inch and 3/8-inch	8-1/2 (2.6 m) linear feet plus (1) 90° elbow (2.6 m)
1/2-inch	Two (2) 90° Elbows and 7 linear feet (2.1m)
3/4-inch and 1-inch	10 equivalent feet of 1/2-inch (13 mm) pipe (see formulas 1 & 2 and Figure 3-39)

Formula 1:

equivalent feet (meters) of 1-inch (25 mm) pipe x (0.079) = # of equivalent feet (meters) of 1/2-inch (13 mm) pipe

Formula 2:

equivalent feet (meters) of 3/4-inch (19 mm) pipe x (0.254) = # of equivalent feet (meters) of 1/2-inch (13 mm) pipe
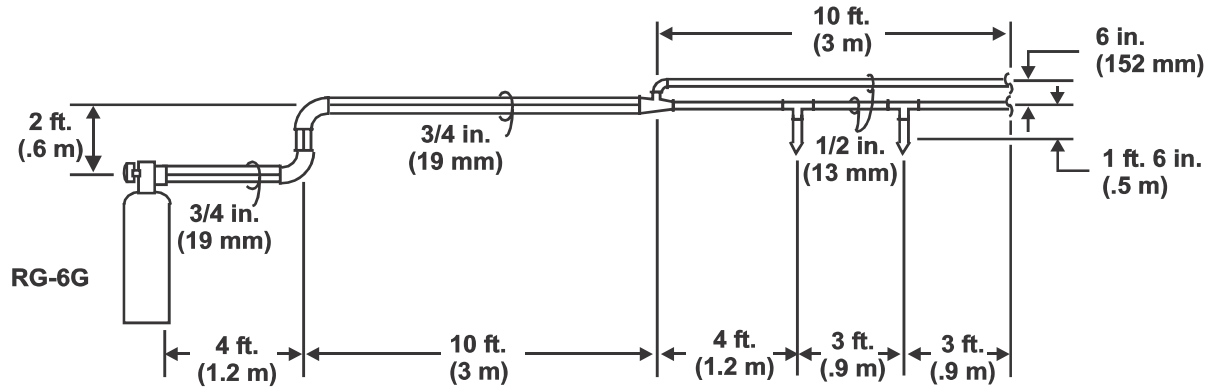
EQUIVALENT FEET CYLINDER TO CLOSEST NOZZLE

Figure 3-39. Pipe Size and Nozzle Distance

3/4-inch Pipe

(1) 1/2-inch to 3/4-inch reducer;	(1)(0.4) = 0.4 ft. of 3/4-inch Pipe
(2) 90° 3/4-inch elbow;	(2)(2.1) = 4.2 ft. of 3/4-inch Pipe
(1) 3/4-inch to 1/2-inch reducing Tee (run);	(1)(1.4) = 1.4 ft. of 3/4-inch Pipe
Linear Feet of 3/4-inch Pipe:	<u>16.0</u>
Equivalent Feet of 3/4-inch Pipe;	22 ft. of 3/4-inch Pipe

(a) (22.0) x (0.254) = 5.5 eq ft. of 1/2-inch Pipe. (from Formula 2)

3/4-inch Pipe

From (a)	5.5FT. of 1/2-inch Pipe
(1) 1/2-inch Tee (Outlet);	(1)(3.5) = 3.5 ft.. of 1/2-inch Pipe
(1) 1/2-inch to 3/8-inch reducer;	(1)(0.3) = 0.3 ft. of 1/2-inch Pipe
Linear Feet of 1/2-inch Pipe:	<u>5.5</u>
Equivalent Feet of 3/4-inch Pipe;	14.8 ft. of 1/2-inch Pipe

Therefore, this example does meet the minimum pipe requirement.

3-8.4.3   SPECIAL 3/8-INCH PIPING ONLY SYSTEM

On RG-125, RG-260, and RG-400 single cylinder systems only, 3/8-inch discharge piping may be used for the entire piping network following the guidelines in Table 3-39. If a pneumatic release or pressure switch is used, it must be on the upper end of a 12 in. (305 mm) vertical length of black pipe.

Table 3-39. 3/8 in. Piping Only System

Limitations	RG-1.25G	RG-2.50G	RG-4GS/RG-4GM[2]
Maximum Discharge Line Volume	72 in.^{3} (1180 cm^3)	99 in.^{3} (1622 cm^3)	161 in.^{3} (2638 cm^3)
Maximum Equivalent Length of Discharge Line Between Cylinder and Most Remote Nozzle	39 ft. (11.9 m)	40 ft. (12.2 m)	59 ft. (18.0m)
Maximum Equivalent Length of Discharge Line Between Most Remote Nozzles	33 ft. (10 m)	42 ft. (12.8 m)	50 ft. (15.2 m)
Maximum Equivalent Length of 1/2-inch (13 mm) Discharge Pipe Between Cylinder and Hood	12 ft. (3.7 m)	12 ft. (3.7 m)	24 ft. (7.3 m)
Minimum Equivalent Length of Discharge Line Between Cylinder and an Appliance Nozzle Protecting a Liquid Hazard, such as Deep Fat Fryer	8-1/2 ft. (2.6 m) linear feet plus 90° elbow	8-1/2 ft. (2.6 m) linear feet plus 90° elbow	8-1/2 ft. (2.6 m) linear feet plus 90° elbow

[2] The limitations on this section (Paragraph 3-8.4.3) supersedes all other limitations when designing a system using 3/8-inch pipe originating from the 4-gallon cylinder outlet.