Vacuum Tubing & Piping Sizing Guide

In a gas chlorination system it is desirable to keep as much of the piping as possible under vacuum. This will maximize safety by preventing leaks to atmosphere.

It is recommended that when possible the vacuum regulator be mounted directly onto the gas source (i.e. cylinder mounting or ton container mounting) or as close to it as possible and the ejector be installed as close to the application point as possible.

Depending on the system layout, there may be a relatively long distance between them. This technical bulletin offers information to select the proper pipe size for the vacuum system so the pressure drop, due to friction, does not cause an undesired decrease in the feed capacity.

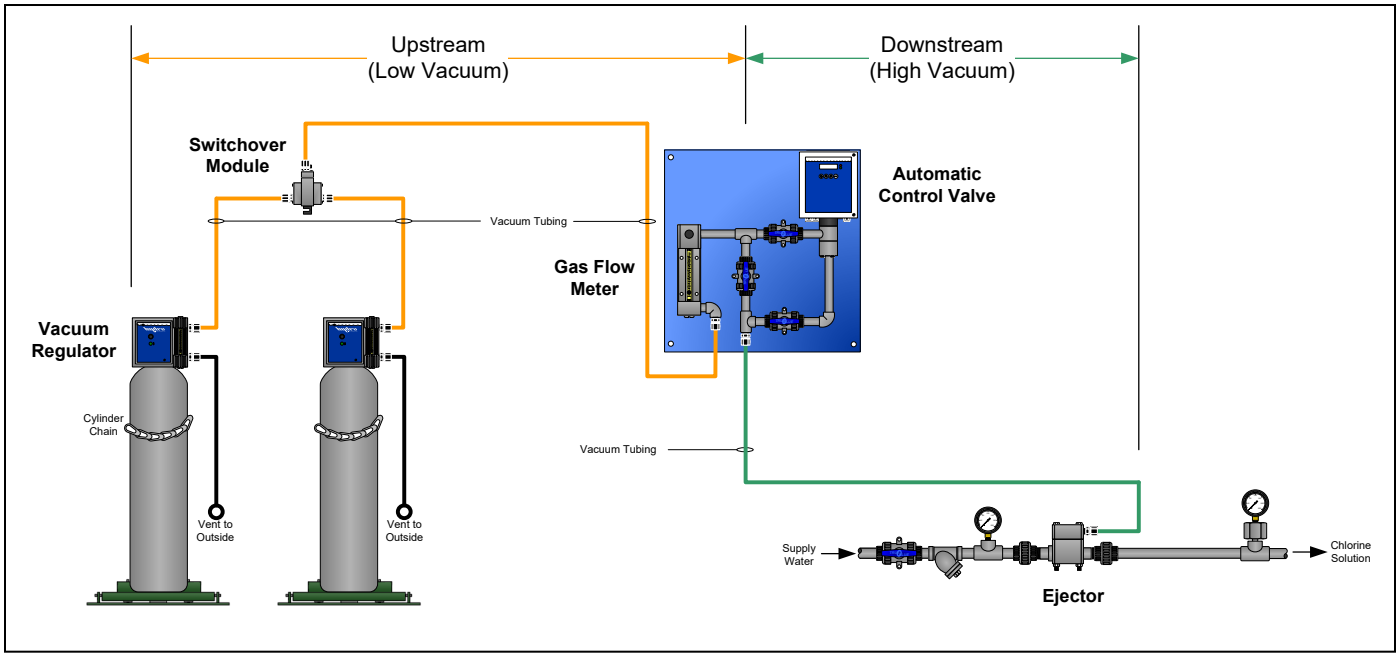
A vacuum feed system has two sections. One section operates at a regulated vacuum of approximately 1" to 4" Hg (depending on feed rate). This section is called the 'Low Vacuum' side of the system; it is between the vacuum regulator and the control valve. The other section operates at ≥14" Hg for sonic flow systems or 7.5" to 9.5" Hg for differential pressure systems. This section is called the 'High Vacuum' side of the system; it is between the control valve and the ejector.

Both the low vacuum side and the high vacuum side of the system can be sources of friction loss and their sum must never exceed the allowable margin lest the overall feed capacity of the system be diminished. It should be considered that elbows, valves and other fittings will increase the effective pipe length. Allowances must be included when determining the effective piping length by taking into consideration the quantity and type of fitting in the vacuum line. Please consult Hydro Instruments if you need assistance with such calculations.

NOTE: The two sections of vacuum piping do not need to be the same pipe size.

The total allowable friction loss for sonic flow systems of 500 PPD or less is 1.0" Hg. For larger sonic flow systems with capacities greater than 500 and up to 2,000 PPD, the allowable drop is 1.5" Hg.

Basic System Layout Showing Upstream (Low Vacuum) and Downstream (High Vacuum) Sections

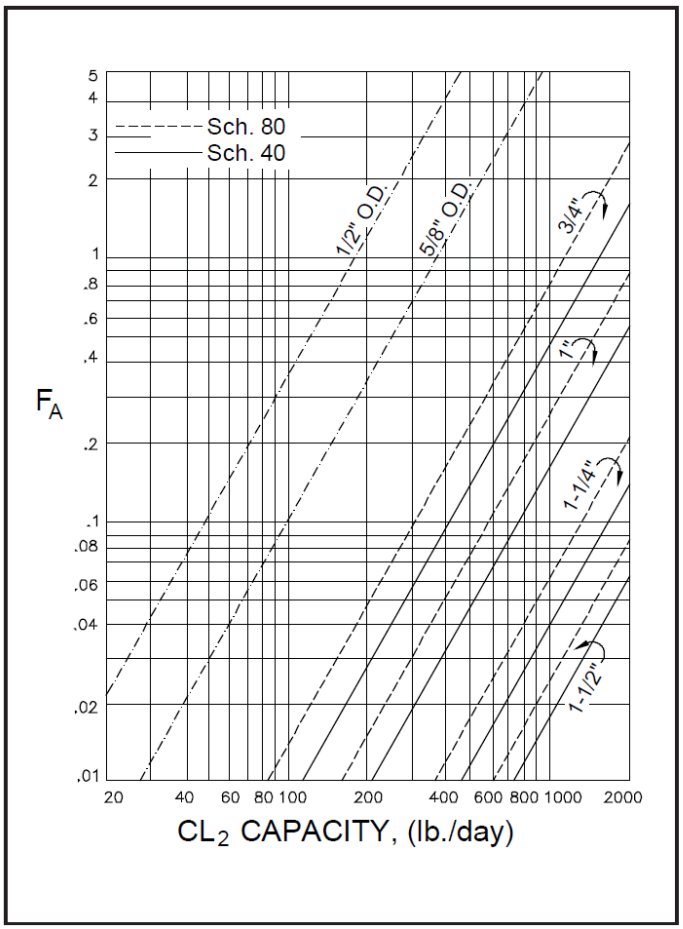


To find the suitable pipe size depending on the length, use the sizing information provided in the graphs or use the table on page 4. By trying various pipe sizes and making the total friction less than the limiting value, the proper pipe sizes can be determined.

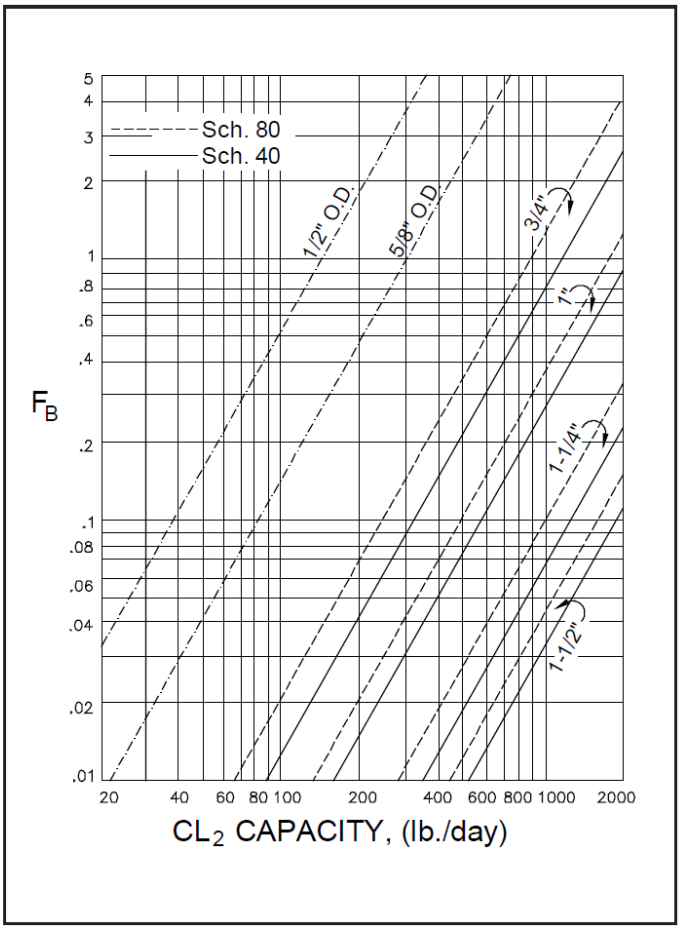
The graphs below show the friction loss per 100 ft. of pipe vs. gas flow capacity for different pipe sizes. F_A refers to the upstream (i.e. low vacuum side) pipe section and F_B to the downstream (i.e. high vacuum side) pipe section.

Charts for Systems up to 2,000 PPD Cl_2 or SO_2

Upstream (Low Vacuum Side)



Downstream (High Vacuum Side)



Formulas:

L_A = Length in ft. of pipe in the upstream (i.e. low vacuum side) pipe section

L_B = Length in ft. of pipe in the downstream (i.e. high vacuum side) pipe section

NOTE: Elbows, valves and other fittings will increase the effective pipe length. Allowances must be included when determining the effective piping length by taking into consideration the quantity and type of fitting in the vacuum line.

For system capacities 500 PPD and less

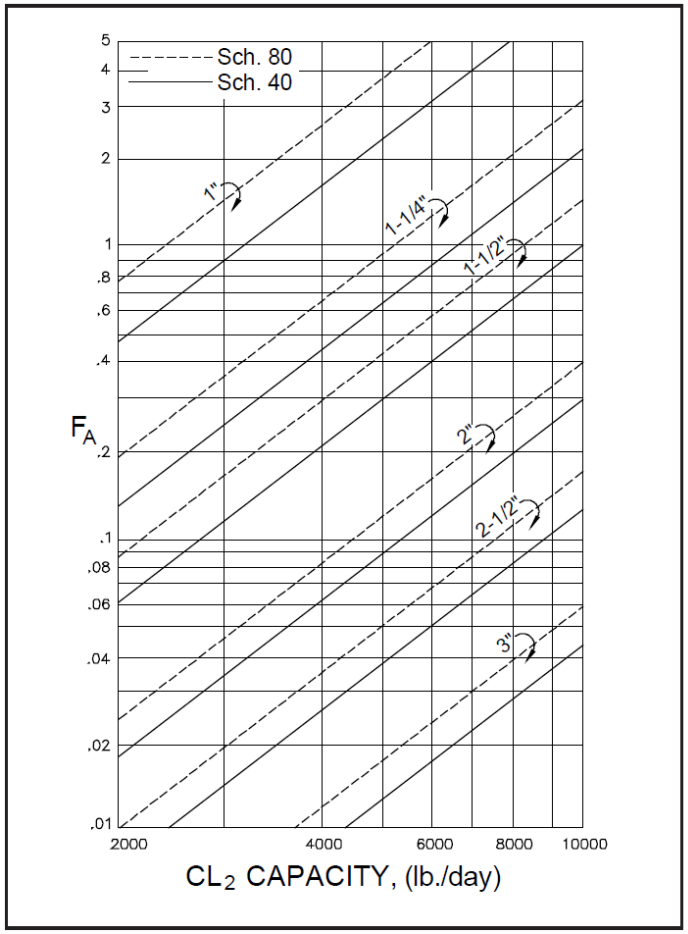
$(F_A)(L_A) + (F_B)(L_B)$ must be less than 100

For system capacities greater than 500 PPD and up to 2,000 PPD

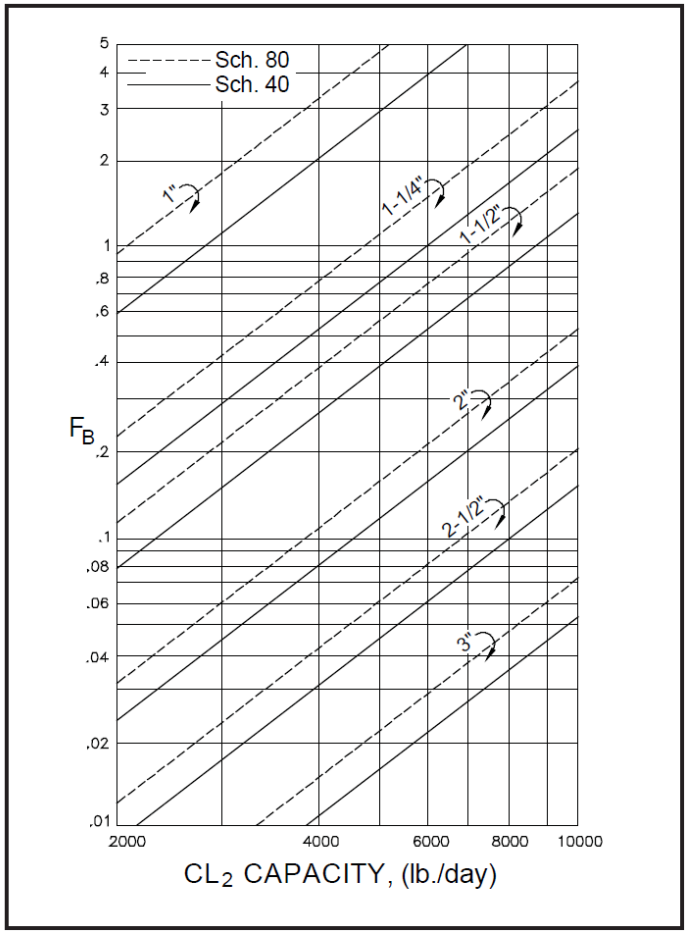
$(F_A)(L_A) + (F_B)(L_B)$ must be less than 150

Charts for Systems 2,000 to 10,000 PPD Cl_2 or SO_2

Upstream (Low Vacuum Side)



Downstream (High Vacuum Side)



Formulas:

L_A = Length in ft. of pipe in the upstream (i.e. low vacuum side) pipe section

L_B = Length in ft. of pipe in the downstream (i.e. high vacuum side) pipe section

NOTE: Elbows, valves and other fittings will increase the effective pipe length. Allowances must be included when determining the effective piping length by taking into consideration the quantity and type of fitting in the vacuum line.

For system capacities 2,000 to 10,000 PPD

$(F_A)(L_A) + (F_B)(L_B)$ must be less than 100

Example:

Capacity = 8,000 PPD
L_A = 200 ft.
L_B = 800 ft.

$(F_A)(L_A) + (F_B)(L_B)$ must be less than 100

If a 2” Schedule 80 pipe is used for the upstream side and a 3” Schedule 80 pipe is used for the downstream side.

(0.28)(200) + (0.05)(800) = 96

Chlorine & Sulfur Dioxide

GAS FEED RATE	LENGTH OF VACUUM LINE							
	100 ft.	200 ft.	300 ft.	500 ft.	1000 ft.	1500 ft.	2300 ft.	2950 ft.
	30m	60m	90m	150m	300m	450m	700m	900m
50 PPD 1 Kg/h	3/8”	3/8”	1/2”	1/2”	1/2”	5/8”	5/8”	3/4”
100 PPD 2 Kg/h	3/8”	1/2”	5/8”	5/8”	3/4”	3/4”	3/4”	3/4”
250 PPD 5 Kg/h	1/2”	5/8”	3/4”	3/4”	1”	1”	1”	1”
500 PPD 10 Kg/h	5/8”	3/4”	1”	1”	1-1/2”	1-1/2”	1-1/2”	1-1/2”
750 PPD 15 Kg/h	1”	1”	1-1/2”	1-1/2”	1-1/2”	1-1/2”	2”	2”
1000 PPD 20 Kg/h	1”	1-1/4”	1-1/2”	1-1/2”	1-1/2”	2”	2”	2”
1500 PPD 30 Kg/h	1”	1-1/4”	1-1/2”	2”	2”	2”	2”	2-1/2”
2000 PPD 40 Kg/h	1”	1-1/4”	1-1/2”	2”	2”	2”	2”	2-1/2”
4000 PPD 80 Kg/h	1-1/2”	2”	2”	2-1/2”	2-1/2”	3”	3”	4”
6000 PPD 120 Kg/h	2”	2”	2-1/2”	2-1/2”	3”	4”	4”	4”
8000 PPD 160 Kg/h	2”	2-1/2”	3”	3”	3-1/2”	4”	4”	4-1/2”
10,000 PPD 200 Kg/h	2-1/2”	3”	3”	4”	4”	6”	6”	6”

NOTES:

1. In the above table:
   a. 3/8”, 1/2” and 5/8” refer to the OD (outer diameter) of flexible polyethylene plastic tubing.
   b. 3/4”, 1”, 1-1/4”, 1-1/2”, 2”, 2-1/2”, 3”, 4” and 6” refer to Schedule 80 PVC rigid piping.
2. The above recommendations are based on calculations limiting friction loss to 0.5” Hg or less.
3. Elbows, valves and other fittings will increase the effective pipe length. Allowances must be included when determining the effective piping length by taking into consideration the quantity and type of fitting in the vacuum line.

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