

Restrictive Flow Orifices

The Restrictive Flow Orifice (RFO) is for use in conjunction with high purity compressed gas applications in both the semiconductor and allied chemical industries. Matheson Tri-Gas pioneered the development of RFO technology.

Restrictive Flow Orifices are used to limit the potential danger of an uncontrolled flow from a compressed gas cylinder. Unchecked, the instantaneous flow from a 44 liter compressed gas cylinder filled to 2,000 psig can be as much as 20,000 liters per minute. By inserting an RFO into the outlet of the CGA connection the flow rate could be reduced by a factor of 100 to approximately 200 liters per minute.

The Restrictive Flow Orifice is designed to thread onto the outlet of most CGA connections that have external male threads. This would include the family of DSS face seal connections (CGA 630 and 710) that are used in high purity semiconductor applications.

The RFO has no moving parts. It is about 3/8" long and is generally constructed of 3344LS. The orifice opening usually varies from 0.006" to 0.060". It is possible to have orifices that are as small as 0.004" and as large as 0.150" depending upon the application.

The orifice is generally unfiltered. A KEL-F gasket is provided as part of the assembly to help create a seal between the restrictor and the valve body. Refer to Figure 1.

The flow rate through an orifice is a function of the following variables:

- Pressure
- Temperature
- Specific Gravity
- Orifice Opening

Correlations assist in predicting the flow of a particular gas or mixture through an RFO. This is done by first determining the flow through the same RFO at the required pressure with a reference gas and then adjusting the specific gravity accordingly.

The pertinent equation is presented below.

$$\text{Flow} = \text{The Flow Rate of } \text{N}_2 \text{ at the Same Pressure}$$

$$\sqrt{\frac{1}{\text{Specific Gravity}}}$$

TABLE I Cases Offered with Restrictive Flow Orifices Specific Gravity @ 70° F (1 atm), CGA and DSS Connections

Gas	Specific Gravity	CGA	OSA	Gas	Specific Gravity	CGA	OSA	Gas	Specific Gravity	CGA	
		STD	DSS			STD	DSS			STD	DSS
Ammonia	0.593	660	720	Halocarbon 116	4.826	660	716	Nitrogen Trifluoride	2.460	670	640
Argon	1.375	-	716	Halocarbon 12	4.262	660	716	Nitrous Oxide	1.528	326	-
Arsenic Pentaffluoride	6.090	-	642	Halocarbon 13	3.610	660	716	Oxygen	1.105	540	716
Arsine	2.718	-	632	Halocarbon 14	3.075	-	716	Perfluoropropane	6.652	660	716
Boron Trifluoride	4.045	660	634	Halocarbon 23	2.436	660	716	Phosphene	1.190	350	632
Boron Trifluoride	2.375	330	642	Helium	0.138	-	716	Phosphorus Pentaffluoride	4.310	330	642
Carbon Dioxide	1.527	326	716	Hydrogen	0.089	330	724	Silane	1.126	350	632
Carbon Monoxide	0.957	350	724	Hydrogen Bromide	2.780	330	634	Silicon Tetrafluoride	5.833	-	636
Chlorine	2.479	660	728	Hydrogen Chloride	1.264	330	634	Silicon Tetrafluoride	3.675	330	642
Diborane	0.950	350	632	Hydrogen Fluoride	0.689	670	638	Sulfur Hexafluoride	5.105	-	716
Dichlorosilane	3.473	670	638	Hydrogen Selenide	2.711	330	632	Trichlorosilane	4.094	-	636
Dicarbonyne	2.149	-	632	Hydrogen Sulfide	1.152	330	722	Tungsten Hexafluoride	10.674	670	638
Dimethane	2.634	350	632	Hydrogen	2.900	-	716	Xenon	4.558	-	716
Halocarbon 11	4.770	660	-	Neon	0.696	-	716				
Halocarbon 113	5.368	660	716	Nitrogen	0.967	-	716				

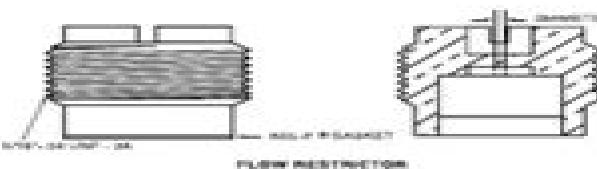


Figure 1: Restrictive Flow Orifice

Typical nitrogen flows for different orifice sizes at different pressures can be found in Table I.

By using this table, a reference flow rate for nitrogen can be determined and then the reference equation can be used with this value.

For a mixture a "weighted" or "averaged" specific gravity can be used by multiplying the volume or mole fraction of each component by its specific gravity and then summing.

Table II summarizes some of the gases that can be offered with restrictive flow orifices.

In addition to providing safety features that have been mandated by various local and state codes, the restrictive flow orifice also results in a lower flow rate, which is desirable in many semiconductor applications. While the RFO was not designed to be a modulator or control valve, it will, as its name implies, substantially reduce the flow rate under a specific set of pressure and temperature conditions for a given gas.

More detailed information on restrictive flow orifices is available from your local Matheson Tri-Gas Sales Engineer.

TABLE I Orifice Flow Rate at Varying Pressures

Orifice Size	Pressure-PSIG		
	0	500	1000
0.006 in.	0 slpm	7 slpm	15 slpm
0.010 in.	0 slpm	18 slpm	36 slpm
0.011 in.	0 slpm	150 slpm	310 slpm
0.040 in.	0 slpm	245 slpm	485 slpm
0.052 in.	0 slpm	525 slpm	—

A Practical Guide To Restrictive Flow Orifices

A. R. Lansdown

A Practical Guide To Restrictive Flow Orifices:

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Ray,1990-01-15 Chemical Engineering Bibliography **Handbook on Prisons** Yvonne Jewkes,Jamie Bennett,2016-02-23

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