Meriam Instrument
LFE Data Sheet

1. **AIR FLOW IN SCFM**
   AT STANDARD CONDITIONS
   OF 29.92 AND 70°F.

SCFM = Standard cubic feet per minute.
ACFM = Actual cubic feet per minute
CFM = Cubic feet per minute.

When the flowing gas is air and the operating pressure
And temperature are at 29.92" Hg. Abs. And 70°F (standard
Conditions). The Laminar Flow Element can be selected directly
from the capacity chart.

NOTE:	SCFM =	ACFM =	CFM
	at	at	at
	29.92"	29.92"	29.92"
	Hg. Abs.	Hg. Abs.	Hg. Abs.
	70°F.	70°F.	70°F.

EXAMPLE 1:

Select a Laminar Flow element for the following conditions:

The gas flowing is AIR at a flow rate of 15 SCFM.
The pressure of the flowing AIR is 29.92" Hg. Abs.
The temperature of the AIR is 70°F.

Since this flow is at standard condition, the Laminar Flow Element can be selected
Diretly from the capacity chart.

The Laminar flow Element selected in this example would be a Model 50MW20-1-1/2.

If we wish to compute the approximate differential pressure that this selection would
Develop, we can use the equation:

Diff. Pressure =

$$\text{SCFM (calculated)} \times \frac{\text{Diff. Pressure}^*}{\text{SCFM}^*}$$

* Catalog ratings for Laminar Flow Elements selected.

For the above example
Diff. Pressure = $15 \times \frac{8}{22}$ = 5.454 H20 Differential.

A check should be made for Laminar Flow by calculating the Reynold's Number. See Section IV.

II. AIR OR GAS FLOW IN SCFM AT OTHER THAN 29.92 AND 70°F.

When the flow is given in another standard of SCFM Of air or some other gas, and the operating pressure and temperature are not at 29.92 and 70°F, then the **equivalent** SCFM air flow at 29.92 and 70°F must be computed as though The laminar flow element were flowing air under (Meriam) Standard conditions. To do this, use the equation below:

$$SCFM^* = SCFM \times \frac{29.92}{Pg} \times \frac{Tg}{530} \times \frac{hg}{181.87}$$

SCFM* = The **equivalent** amount of air in SCFM, if the flowing conditions were air, Flowing through the Laminar Flow Element under a pressure of 29.92" Hg. Abs. And at 70°F.

SCFM = Standard Cubic Feet per Minute of gas referenced to base conditions of 70°F and 29.92" Hg. Absolute.
Pg = Pressure of the following gas in Inches Hg. Abs.
Tg = Temperature of the flowing gas in degrees Rankin (°R). (°R = 460 + Temperature in °F)
Hg = Viscosity of the gas at the flowing Temperature, in micropoise

EXAMPLE 2.

Select a Laminar Flow Element for the following conditions:

The gas flowing is HELIUM at a flow rate of 1.25 SCFM.

The pressure of the HELIUM gas is 1.4 PSIG (= 32.781" Hg. Abs.)
The temperature of the HELIUM is 90°F (=550°R)
The viscosity of HELIUM @ 90°F is 201.13 micropoise.
From the above equation we can calculate the **equivalent** SCFM air Flow as:

$$SCFM^* = 1.25 \times \frac{29.92}{32.78} \times \frac{550}{530} \times \frac{201.13}{181.88} = 1.309$$

Upon examing the ratings for the various Laminar Flow Elements we can see that the Model 50MJ10-10 will handle this flow since it is rated at 1.6 SCFM * @ 8" H20 differential pressure.
A check should be made for Laminar Flow By calculating the Reynold's Number. See Section IV.

III. AIR OR GAS FLOW IN ACFM OR CFM UNITS.

When the air or gas flow is given in other than SCFM*, then the SCFM value must be computed from the equations below. The sizing of a laminar flow element can then proceed as in Example 2.

1. Cubic feet per minute (CFM)

$$SCFM = 17.714 * CFM \frac{(Pg)}{(Tg)}$$

or actual cubic feet per minute (ACFM)

$$SCFM = 17.714 * ACFM \frac{(Pg)}{(Tg)}$$

2. Standard cubic centimeters per minute (SCCM)

$$SCFM = \frac{SCCM}{28316}$$

3. Standard liters per minute (SLM)

$$SCFM = \frac{SLM}{28.316}$$

4. Pounds Per Minute (PPM)

$$SCFM = \frac{PPM}{\text{Density **}}$$

5. Pounds per hour (PPH)

$$SCFM = \frac{PPH}{60 \times \text{Density **}}$$

$$* \ 17.714 = \frac{530}{29.92} = \frac{T\ Std.}{P\ Std.}$$

** At standard conditions (29.92" Hg & 70°F)

Example 3:

Select a Laminar Flow Element for the following conditions:

The gas flowing is HELIUM at a flow rate of 1.184 ACFM.
The pressure of the HELIUM gas is 1.4 PSIG (=32.781 Hg. Abs.)
The temperature of the HELIUM is 90°F. (=550°R)
The viscosity of HELIUM @ 90°F is 201.13 micropoise.

From the above equation for actual cubic feet per minute, we can calcualte SCFM:

$$SCFM = \frac{17.714 \times 1.184 \times 32.781}{550} = 1.25$$

From this value we can proceed to calculate the Laminar Flow Element rating as in Section II.

IV. OBSERVANCE OF REYNOLD'S NUMBER FOR THE LAMINAR FLOW ELEMENT SELECTED

To maintain **laminar** flow with **linearity** through the LFE, Consideration must be given to the Reynolds number for the Maximum flow condition. Meriam LFE elements will produce linear flow Characteristics when the Reynolds number is 150 at 4" differential and 300 at 8" differential.
It should be pointed out that true linearity will not be retained at elevated Reynolds number. However, a calibration made at the operating condition will Be fully usable and repeatable.

To calculate the approximate Reynolds number for the LFE selected, use the equation:

$$Rd = \frac{228 Sg\ Pg\ Diff.}{Hg}$$

Where:
Rd= Reynold's Number
Sg= Specific gravity of the flowing gas.
Pg=Pressure of the flowing gas in inches Hg. Abs.
Diff = Differential pressure calculated for the Laminar Flow Element selected
Hg = Viscosity of the gas at the flowing temperature, in micropoise

Calculation of Rd for conditions as presented in Example 2:

$$Rd = \frac{228 \times 0.138 \times 32.78 \times 6.545}{201.13} = 35.8$$

EXAMPLE 4:

Select a Laminar Flow Element for the following conditions:
The gas flowing is ARGON at a flow rate of 0.9 SCFM.
The pressure of the flowing ARGON is 20 psig (=70.64" HgAbs.).
The temperature of the ARGON is 60°F (= 520°R).
The viscosity of ARGON at 60°F is 222.51 micropoise.
The specific gravity of ARGON at standard conditions is 1.380.

From our **equivalen**t air flow equation (See Section II):

$$SCFM^* = 0.9 \times \frac{29.92}{70.64} \times \frac{520}{530} \times \frac{222.51}{181.87} = 458$$

This flow rate could be determined by our Model 50MJ10-11 which has a rating of 0.7 SCFM* @ 8" H20.
The differential pressure expected would be equal to:

$$\text{Diff. Pressure} = .458 \times \frac{8}{0.7} = 5.23\text{" H20}$$

If we now compute the Reynold's number for these conditions we find that:

$$RD = \frac{228 \times 1.380 \times 70.64 \times 5.23}{222.51} = 522$$

This Reynold's number is too high even though the flow rate calculation gave us an acceptable Differential pressure. Therefore, we will have to size the LFE with a larger size or the Model 50MJ10 Type 10. The same calculations will give us a differential of approximately 2.29 and a Reynold's number of 228. This model would be acceptable for the application.

GAS STANDARD CONDITIONS OF 29.92" Hg. Abs. And 70°F

Gas	Density (lb/ft)	Viscosity Micropises	Specific Gravity
Air	0.0749	181.87	1.000
Argon	0.1034	225.95	1.380
Helium	0.0103	193.9	0.138
Hydrogen	0.0052	88.41	0.0695
Nitrogen	0.0725	175.85	0.968
Oxygen	0.0828	203.47	1.105
Carbon Dioxide	0.1143	146.87	1.526

NOTE: Ref. NBS Technical Note 564 for Gas Viscosity Data