

# Flowmeter Sizing

## Gas Sizing

For non-standard gases or conditions, use the tables below to find the flowrate of Air @ 20°C and 1013 mbar and match to the equivalent flowmeter type and size.

To convert from Air at other temperatures or pressures, use table 1.

To convert from other gases to Air, use table 2.

Table 1: Multiplier to give equivalent flow @ 20°C and 1013 mbar

Fluid Conditions	0 bar g	1 bar g	2 bar g	3 bar g	4 bar g	5 bar g	6 bar g	7 bar g
0°C	0.965	0.685	0.560	0.485	0.434	0.396	0.367	0.343
10°C	0.983	0.697	0.570	0.494	0.442	0.403	0.374	0.349
20°C	1.000	0.709	0.580	0.502	0.450	0.410	0.380	0.355
30°C	1.017	0.721	0.590	0.511	0.457	0.417	0.387	0.362
40°C	1.034	0.733	0.599	0.519	0.465	0.424	0.393	0.368
50°C	1.050	0.745	0.609	0.528	0.472	0.431	0.399	0.373
60°C	1.066	0.756	0.618	0.536	0.479	0.438	0.405	0.379
70°C	1.082	0.768	0.627	0.544	0.486	0.444	0.411	0.385
80°C	1.098	0.779	0.636	0.552	0.493	0.451	0.417	0.390
90°C	1.113	0.790	0.645	0.559	0.500	0.457	0.423	0.396
100°C	1.128	0.800	0.654	0.567	0.507	0.463	0.429	0.401

Table 2: Multiplier to give equivalent flow of Air

Fluid	Symbol	Multiplier
Acetylene	C <sub>2</sub> H <sub>2</sub>	0.948
Ammonia	NH <sub>3</sub>	0.767
Argon	Ar	1.175
Butane	C <sub>4</sub> H <sub>10</sub>	1.417
Carbon Dioxide	CO <sub>2</sub>	1.233
Carbon Monoxide	CO	0.983
Chlorine	Cl <sub>2</sub>	1.565
Ethane	C <sub>2</sub> H <sub>6</sub>	1.019
Ethylene	C <sub>2</sub> H <sub>4</sub>	0.984
Hydrogen	H <sub>2</sub>	0.264
Hydrogen Chloride	HCl	1.122
Hydrogen Sulphide	H <sub>2</sub> S	1.085
Methane	CH <sub>4</sub>	0.744
Neon	Ne	0.835
Nitrogen	N <sub>2</sub>	0.984
Nitrous Oxide	N <sub>2</sub> O	1.233
Oxygen	O <sub>2</sub>	1.051
Propane	C <sub>3</sub> H <sub>8</sub>	1.234
Sulphur Dioxide	SO <sub>2</sub>	1.487

### Example 1

50 L/min of Air @ 2 barg & 40°C

Using table 1:

Equivalent flow of Air @ 1013 mbar and 20°C

$$= 50 \text{ L/min} \times 0.599$$

$$= 30 \text{ L/min}$$

### Example 2

50 L/min of Hydrogen @ 1013 mbar & 20°C

Using table 2:

Equivalent flow of Air @ 1013 mbar and 20°C

$$= 50 \text{ L/min} \times 0.264$$

$$= 13.2 \text{ L/min}$$

### Example 3

50 L/min of Hydrogen @ 2 barg & 40°C

Using tables 1 & 2:

Equivalent flow of Air @ 1013 mbar and 20°C

$$= 50 \text{ L/min} \times 0.599 \times 0.264$$

$$= 7.9 \text{ L/min}$$

# Flowmeter Sizing

## Liquid Sizing

For liquids other than water, use the Specific Gravity (SG) of the liquid and the table below to find the water flowrate and match to the equivalent flowmeter type and size.

### Multiplier to give equivalent water flow

Liquid SG (g/cm <sup>3</sup> )	Multiplier
0.7	0.819
0.8	0.882
0.9	0.942
1.0	1.000
1.1	1.056
1.2	1.111
1.3	1.166
1.4	1.218
1.5	1.271
1.6	1.323

### Example

25 L/min of Liquid with a Specific Gravity of 1.2

Using the table:

Equivalent flow of Water

$$\begin{aligned} &= 25 \text{ L/min} \times 1.111 \\ &= 27.8 \text{ L/min} \end{aligned}$$

# Calibration and Accuracy

Calibrations are normally carried out in series on air or water, and accuracies are stated as either % of full scale or VDI/VDE 3513 accuracy class.

Further levels of calibration accuracy, fully traceable or UKAS Certification, can also be applied in most requested cases.

### VDI/VDE 3513 class 2.5

Total tolerance = 1.875% of measured flow + 0.625% of full scale.

### Example

For an actual flow of 70 L/min using a flowmeter with a full scale of 100 L/min

Using the equation above:

$$\begin{aligned} \text{Total tolerance} &= 1.875\% \text{ of } 70 \text{ L/min} + 0.625\% \text{ of } 100 \text{ L/min} \\ &= 1.3125 + 0.625 \text{ L/min} \\ &= 1.9375 \text{ L/min} \end{aligned}$$

# Unit Conversion

Conversion factors for common engineering units.

## Flowrate

Multiply to Convert	To			
	From	cm <sup>3</sup> /min	L/min	L/h
cm <sup>3</sup> /sec	60	0.06	3.6	0.0036
cm <sup>3</sup> /min	1	0.001	0.06	0.00006
L/min	1000	1	60	0.06
L/h	16.67	0.0166	1	0.001
m <sup>3</sup> /h	16670	16.67	1000	1
CFM	28320	28.32	1699.2	1.6992
CFH	471.9	0.4719	28.32	0.02832
Imp GPM	454.6	4.546	272.76	0.27276
Imp GPH	75.77	0.07577	4.546	0.004546
US GPM	3785	3.785	227.1	0.2271
US GPH	63.08	0.06308	3.785	0.003785

## Pressure

Multiply to Convert	To	
	mbar	bar
psi	68.947	0.069
atms.	1013	1.013
inch H <sub>2</sub> O	2.486	0.0025
Kg/cm <sup>2</sup>	980.662	0.981
mm H <sub>2</sub> O	0.0977	0.000098
mm Hg	1.329	0.001
kPa	10	0.01

## Temperature

To Convert	To
	From
°C	°C
°F	$\frac{(^{\circ}\text{F} - 32)}{1.8}$
K	K - 273.15