

#### GENERAL SELECTION CRITERIA

There are well over 20 different types of flowmeters, even if we lump the various positive-displacement flowmeters together as one type. Unless the process engineer knows the pros and cons of each type, it can be a daunting task to properly select one. Here are just some of the factors to consider before selecting a flowmeter:

- Its size and measuring range of the flowmeter
- Chemical compatibility
- Process accuracy requirements
- Pressure requirements
- Acceptable pressure drop
- Cleaning requirements (i.e., do you need, and does the unit offer, clean-in-place capabilities?)
- Desired measurement units (such as volume, velocity or mass)
- Uni-directional or bi-directional measurement
- Fluid viscosity limitations
- Necessary approvals for use in hazardous areas, sanitary applications and so on (examples include Factory Mutual, Canadian Standards Assn., 3-A Standards and Accepted Practices, and Underwriters' Laboratory approvals)
- Custody-transfer approvals
- Data-output requirements (i.e., 4–20 mA, relay, digital or simple display)
- Calibration and re-calibration requirements
- Maintenance issues
- Operating costs
- Connection styles (flanged, wafer, threaded, weld-on and so on)

#### ACCURACY AND TURNDOWN

Accuracy can be a very nebulous term. Take for instance a typical accuracy statement of "±0.5%". The manufacturer certainly means to indicate that the flowmeter is ±99.5% accurate; not merely 0.5% accurate. Thus, the specification should really read ±0.5% "uncertainty".

In addition, with such a designation, there is no mention of what the ±0.5% refers to (i.e., percentage of "rate" or of "full scale.") This often disregarded term should be a major consideration in flowmeter selection (or that of any other measuring device, for that matter). Consider, for instance, that a flowmeter based on "full scale" has a very large error as the flowrate is reduced. By contrast, a flowmeter based on "rate" has the same accuracy all the way down to the low flow specification.

When evaluating flowmeters, one should also be mindful of claims of exaggerated turndown ratios. Some flowmeters will provide the stated accuracy over a very limited range, while others will do so over a very wide range.

Turndown ratio is an easy, but often erroneous or incomplete, way to express the rangeability of a flowmeter. Turndown ratio is simply the high end of the measurement range compared to the low end of the measurement range.

For example, a flow range of 1–33 ft/s equals a 33:1 turndown ratio. A flow range of 0.01 to 33 ft/s equals a 3,300:1 turndown ratio.

What isn't shown in either example is the accuracy or uncertainty over the range. While it is possibly true that the second flowmeter is capable of 3,300:1 turndown-ratio measurement, the uncertainty of the device may be as high as 37.5%. In addition to the turndown ratio specification, look for the uncertainty specification.

#### References

1. FCI Guide to Better Gas Flow Measurement, Fluid Components International, LLC., 2003.
2. Kohlmann, Michael, Selecting the Right Flowmeter for the Job, *Chem. Eng.*, pp. 60–64, September 2004.
3. Swearingen, Corte, Choosing the Right Flowmeter for the Job, *Chem. Eng.*, July 1999.

GAS FLOWMETER SELECTION CHART [ 1 ]

	Clean gas	Dry, dirty gas	Wet, dirty gas	Low flow	Wide turndown	High temp	Low pressure loss	Installation cost	Maintenance	Mass flow	Volumetric flow
Thermal dispersion	1	1	3	1	1	1	1	1	1	•	
Vortex shedding	1	2	4	3	2	1	1	2	2	•	•
Positive displacement	1	4	4	2	2	1	3	2	3		•
Target	1	2	3	4	3	1	2	1	2		•
Ultrasonic (transit time)	1	4	4	2	2	4	1	3	2		•
Orifice (DP)	1	3	3	3	3	1	3	2	2		•
Venturi (DP)	1	2	2	3	3	1	2	3	2		•
Pitot tube (DP)	1	4	4	3	3	1	2	1	2		•
Turbine	1	4	4	2	2	2	2	3	3		•

1 = Good match; 2 = Poor match; 3 = Acceptable under certain conditions; 4 = Not acceptable

A COMPARISON OF FLOWMETER OPTIONS [ 3 ]

Attribute	Variable-area	Coriolis	Gas mass-flow	Differential-pressure (DP)	Turbine	Oval-gear
Clean gases	yes	yes	yes	yes	yes	—
Clean liquids	yes	yes	—	yes	yes	yes
Viscous liquids	yes (special calibration)	yes	—	no	yes (special calibration)	yes, >10 centistokes (cSt)
Corrosive liquids	yes	yes	—	no	yes	yes
Accuracy, ±	2–4% fullscale	0.05–0.15 of reading	1.5% fullscale	2–3% fullscale	0.25–1% of reading	0.1–0.5% of reading
Repeatability, ±	0.25% of fullscale	0.05–0.10 of reading	0.5% of fullscale	1% of fullscale	0.1% of reading	0.1% of reading
Max pressure, psi	200 and up	900 and up	500 and up	100	5,000 and up	4,000 and up
Max temp., °F	250 and up	250 and up	150 and up	122	300 and up	175 and up
Pressure drop	medium	low	low	medium	medium	medium
Turndown ratio	10:1	100:1	50:1	20:1	10:1	25:1
Typical cost*	low end	high end	moderate	moderate	moderate	moderate

\*Costs vary depending on process temperature and pressure, accuracy required and approvals needed.