CONTROL
For the Process Industries

Flowmeter Shootout Part III: How Users Choose

The Final Considerations Between Selecting a Type of Flowmeter and Selecting a Specific Flowmeter

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The previous two articles in this series have presented the Paradigm Case Method of Flowmeter Selection. According to this method, the first step in selecting a flowmeter for a specific application is to select the type of flowmeter whose paradigm case application is closest to the application in question. The previous articles defined paradigm case applications for 10 types of flowmeters.

Once a flowmeter type is selected, however, more work remains to be done. There are many steps between selecting a type of flowmeter, such as a magnetic or Coriolis meter, and selecting a specific flowmeter. Application, performance, and supplier criteria need to be considered. These criteria serve to narrow down the selection to a particular model from a particular supplier.

This article discusses how flowmeter users select their flowmeters. The data is based on a worldwide survey of flowmeter users conducted by Flow Research and Ducker Research earlier this year. The data is taken from the North American segment of the survey.

Users were asked to rate the importance of factors when specifying or purchasing flowmeters. A scale of 1 to 5 was used, with 5 meaning "most important." Table I gives the results.

Table I. Rate the importance of factors you use when specifying or purchasing flowmeters (scale is 1 to 5)

Criteria	Ranking	Minimum	Maximum
Reliability	4.81	4	5
Compatibility	4.80	4	5
Repeatability	4.78	4	5
Application	4.69	2	5
Technical support	4.67	3	5
User friendly/simplicity	4.60	4	5
Accuracy	4.45	1	5
Maintainability/Repair	4.30	3	5
Price	3.77	1	5

One interesting aspect of Table I is that while price is important, it ranks lower in importance than a number of other factors. This result coincides with the results of a previous survey of flowmeter users done in 1994. In that survey, reliability and accuracy were the top two criteria, followed by price. Purchase price is obviously an important consideration for flowmeter users, but it is apparently not the most important consideration.

The application is clearly the first step in deciding what type of flowmeter to use, and this criterion was ranked very high in the survey. How does the application determine the type of flowmeter used? Certain features of the application can rule in certain flowmeters and can rule out others. These features include the type of fluid, type of measurement, pipe size, flow profile considerations, and many other factors.

Table II. Flowmeter Application Chart

Flowmeter Type	Liquid	Gas	Steam	Pipe size	Clean Fluid	Dirty Fluid
Coriolis	x	x		1/6 to 6 in,	x	Ltd.
DP	x	x	x	½in. and up	x	Ltd.
Magnetic	x			1/10 to 100 in.	x	x
Pos. Disp.	x	x		2 – 30 in.	x	
Thermal	Ltd.	x		Insertion	x	
Turbine	x	x		2 – 30 in.	x	
Ultrasonic-Transit Time	x	x	Ltd.	½inch and up	x	Ltd.
Ultrasonic-Doppler	x			½inch and up		x
Vortex	x	x	x	½inch to12 in.	x	

Ltd. = Limited

Flowmeter Advantages and Disadvantages

While the application can dictate the use of certain flowmeters, so can the advantages and disadvantages of various meters. For example, one advantage of Coriolis meters is their high accuracy, so it is unlikely that anyone would use a Coriolis meter on an application requiring only 5% accuracy.

Once someone has taken a look at the application requirements, taking a look at the advantages and disadvantages of different types of meters is the next logical step. This is where questions like sensitivity to flow profile, amount of pressure drop, degree of accuracy, and rangeability can come into consideration. Table III gives the advantages and disadvantages of the types of flowmeters most commonly used in industrial environments.

Table III. Flowmeter Advantages and Disadvantages Chart

Flowmeter Type	Advantages	Disadvantages
Coriolis	High accuracy; Low maintenance; Insensitive to flow profile	High initial cost, depending on size and model; Bent tubes subject to fouling; Not available for pipe sizes over six inches
DP	Low initial cost; Ease of installation; Well understood; Many industry approvals	Limited rangeability; Permanent pressure drop; Uses square root method to calculate flowrate; Requires periodic maintenance
Magnetic	Obstructionless; High accuracy; No pressure drop	Cannot meter nonconductive fluids (e.g., hydrocarbons); Relatively high initial cost; Electrodes subject to coating
Positive Displacement	High accuracy; Insensitive to flow profile; High rangeability	Cannot handle dirty fluids; Subject to wear; Pressure drop
Thermal	Relatively low initial cost: Good	Limited accuracy: Sensitive to

	for low velocity flows	problems of dirty fluids
Turbine	High accuracy; Well-known technology; Medium purchase price	Cannot handle dirty fluids; Bearings subject to wear; Pressure drop
Ultrasonic-Transit Time	High accuracy, depending on model; Obstructionless; Clamp-on convenience; No pressure drop	Limited ability to handle dirty fluids; Can be affected by flow profile; Some models have high initial cost
Ultrasonic-Doppler	Can meter dirty flows; No pressure drop; Clamp-on convenience	Low to medium accuracy; Reynolds number limitations
Vortex	Highly versatile: can measure liquid, gas, and steam; Good accuracy	Limited ability to handle low flows; Vibration can affect accuracy; Few industry approvals

The Importance of Accuracy

Given that accuracy is an important consideration when users are selecting flowmeters, how accurate do flowmeters have to be? This is another question posed by Flow Research and Ducker Research in our end-user survey. The results are shown in Table IV.

Table IV. What degree of accuracy do you require in your flowmeters?

Degree of Accuracy	Percent
Less than .5 percent	22.7%
.5 percent	30.9%
1 percent	30.9%
2 percent	6.2%
3 percent	3.1%
5 percent	1.0%
Over 5%	1.0%
Other	4.2%
Total	100.0%

The above chart shows that close to one-fourth of users require accuracy values of greater than 0.5%. This is a high value of accuracy, and often applies to custody transfer situations. It also shows that the large majority of flowmeter applications – some 85% – require accuracy values of 1% or better. It is also noteworthy that over half the users surveyed require accuracies of 0.5% or better.

Given the importance of accuracy, it is no wonder that the flowmeters that have shown the strongest growth over the past several years are known for their accuracy. This includes Coriolis and ultrasonic meters, which have shown the fastest growth. Magnetic flowmeters, which have also shown significant growth, are also capable of measuring with high accuracy. All these meters have a high reliability value, which also helps explain their growth.

What is Reliability?

Most people have a pretty good idea of what reliability is – something is reliable if it doesn't break down. But how does reliability apply to flowmeters? This is another question that was asked in the survey of flowmeter users. Table V shows the results:

Table V. Why do you consider reliability to be important when specifying or purchasing flowmeters?

Reason	Percent

Minimal breakdown	24.0%
Zero failure	16.0%
Product performance	12.0%
Less repairs/maintenance	12.0%
Other	36.0%
Total	100.0%

Table V shows how flowmeter users interpret the idea of reliability. The most important idea is that a reliable flowmeter is one that does not break down. This means that it continues to work without stopping, and performs as expected. Another aspect to reliability is the absence of failure and the ability to perform as expected.

A reliable flowmeter is like a reliable car – one that always starts, and doesn't leave you stranded in the middle of nowhere. It does not include the idea of no maintenance, however. A reliable car still needs periodic oil changes and tune-ups, and reliable flowmeters may still need periodic checkups and calibration. Apparently, though, a flowmeter is considered more reliable if it needs a minimum amount of care and attention.

The amplification of the idea of reliability helps explain why some flowmeters such as DP flowmeters, turbine meters, and positive displacement meters have been losing market share to new technology meters. These traditional meters need regular maintenance and checkups. The primary elements such as orifice plates on DP flowmeters need to be checked regularly for wear and for particle buildup. Turbine and positive displacement flowmeters both contain moving parts that are subject to wear.

New technology flowmeters, especially Coriolis and ultrasonic meters, have less need for regular maintenance and hence are perceived as more reliable than the traditional technology meters mentioned. Magnetic meters also do not have moving parts, and so have a reduced need for maintenance. Vortex meters do not have moving parts, but their primary element (the bluff body) is inserted into the flowstream. This needs to be checked periodically to make sure it is positioned correctly.

Other Criteria

Accuracy and reliability are not the only criteria mentioned by users when asked what criteria are important for flowmeter selection. Others include repeatability, compatibility, technical support, user friendliness, maintainability, and price. Repeatability is an important concept, and it is distinguished from accuracy. A flowmeter that provides repeatability gives the same reading time after time, even if this reading my not be completely accurate. This is like a bathroom scale that consistently weighs two pounds too heavy. If you know how to correct for the error, you can arrive at the correct reading even if the reading by itself is not correct.

User friendliness and technical support could be included under supplier criteria. These are considerations that come into play more in deciding between flowmeter suppliers than in deciding upon a type of flowmeter. Some suppliers emphasize user-friendliness more than others, and some provide better support than others. The choice among suppliers is normally made after a type of flowmeter is decided on.

The idea of compatibility has to do with how well the flowmeters work with each other, and with other types of equipment. A great deal of advance has been made in the past few years with Foundation Fieldbus and Profibus products, and these are now available for many types of flowmeters. Suppliers who are trying to position themselves at the forefront of the flowmeter market are the ones making their flowmeters available with Foundation Fieldbus or Profibus capabilities.

Maintainability is very closely related to reliability, and relates to the idea that flowmeters can be maintained in proper working order without a great deal of maintenance. This once again favors the new technology meters, which have fewer maintainability requirements than traditional technology meters. The lack of moving parts in the new technology meters has a lot to do with their minimal maintainability requirements.

Price is always a consideration. However, there are some important distinctions to be made in terms of price. One is purchase price vs. cost of ownership. A flowmeter can have a low purchase price, but can be very expensive to maintain. Alternatively, a flowmeter can have a high purchase price but require very little maintenance. In these cases, the lower purchase price may not be the best bargain.

Other components of price include the cost of installation, the cost of associated software, the cost of training people to use and maintain the meter, the cost of maintaining the meter, and the cost of maintaining an inventory

of any needed replacement parts. All these costs should be taken into account when deciding what flowmeter to buy, and this is one reason that many users are looking beyond purchase price when considering flowmeter cost.

Why the Switch to New Technology Flowmeters?

While there is still a good market for traditional technology flowmeters, the overall trend is toward new technology flowmeters. Why is this? The answer is that users perceive new technology flowmeters to be more accurate and more reliable than traditional technology flowmeters. Accuracy and reliability are the two strongest motivating forces in the flowmeter market, and the flowmeters that win the battle for the hearts and minds of users are the ones that are perceived to be most accurate and most reliable.

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