ACCUSONIC MEANS PERFORMANCE INTEGRITY

Introduction

As a supplier of different types of flowmeter technologies, it is imperative for Accusonic Technologies to objectively define the performance capabilities and application suitability for each type of flowmeter under consideration. After a proper and thorough evaluation of all possible issues, Accusonic will then offer an informed flowmeter recommendation to the customer. This principle of thoroughly considering all the customer's needs and the application/installation requirements before making an objective flowmeter recommendation is defined in this paper as "Performance Integrity". This paper will focus on the manufacturer's motivations and customer's responsibilities in what should be a partnership with performance integrity as a key component of this union. Additionally this paper will look at the circumstances faced by suppliers, like Accusonic, of both diametrical (single and multiple-path) and multiple-path chordal transit-time flowmeters when making flowmeter recommendations.

Manufacturer's Motivation

A flowmeter manufacturer is in the business to sell products that result in a profitable business venture. To be successful for the long term, the manufacturer must consider the nature of their customer service to ensure repeat business. As such, logic dictates that a manufacturer's flowmeter recommendation is based on what is truly in the customer's best interest. It is illogical for a manufacturer to make a recommendation that is in the manufacturer's best interest and not the customer's as, in the long run, if the customer is not being served, they are unlikely to do business again with this manufacturer. The question is whether long-term thinking is actually applied by flowmeter manufacturers or is it possible that recommendations are sometimes made with only short-term objectives in mind? It is left for the reader to ponder this question and to consider this issue when next evaluating the recommendations of their flowmeter manufacturer.

Another issue worth considering is the motivation of the individual making the recommendation on behalf of the flowmeter manufacturer. Is it possible that if the individual making the recommendation is a salesperson, that the individual is more concerned with their next commission check rather than how a particular flowmeter may operate over the next five years? This is not to say that a sales person may consciously disregard the customer's needs but it is possible that their recommendation may be less than objective. Clearly this leads to the issue of credibility and trust. Credibility and trust can and should be developed based on relationships among individuals as well as companies and can only be accomplished over the long term.

Consider the situation of a salesperson working for an independent representative firm that represents a number of different manufacturers offering complementary yet overlapping flowmeter products. This salesperson is under various pressures from different sources to sell an array of flow measurement products. These pressures can include the individual's income requirements, quotas established by the rep firm's management for the salesperson, and quotas established on the rep firm by the various principles. Is it possible that these pressures may influence the flowmeter recommendation from this salesperson? For example, will high quotas influence a salesperson to recommend one technology over another simply to help the individual reach such a quota, especially if a bonus commission may result? Do such situations actually occur? Once again, it is left to the reader to decide.

It should be understood that neither manufacturers nor representative firms will condone the above approach as it does not properly serve the customer and will therefore not serve the manufacturer in the long run either. These scenarios are presented for the benefit of flowmeter users so they can consider the objectivity of the individual and company making their flowmeter recommendations. This again brings us to the actual relationship between the manufacturer and the customer and the level of trust that exists between the two.

Customer's Responsibility

As addressed above, when considering a manufacturer's flowmeter recommendation, the onus is on the customer to consider the objectivity and credibility of the individual and company making the recommendation. However, there are other responsibilities placed on the customer in this evaluation process. First and foremost is to adequately educate themselves as to the various flow measurement technologies that are applicable to their particular industry. This does not mean that an expert knowledge level needs to be attained, but a working knowledge of the various measurement methods and their applications should be achieved. Most manufacturers and representative firms are quite willing to assist flowmeter users in acquiring this knowledge, but again, the manufacturer's motivation must be considered.

Before requesting a flowmeter recommendation from potential manufacturers, the customer (or their engineer) needs to define performance criteria, normally defined by measurement accuracy, based on the particular application and installation conditions. Additionally, the customer needs to establish the equipment and installation budgets. Ideally, a total cost of ownership budget is also developed to be used in the evaluation of the recommendations from different flowmeter suppliers, but this extra step is much more the exception than the rule. Budget development should allow for consideration of the true performance required of the flowmeter. Customers should expect a flowmeter suitable for custody transfer or billing applications will cost more than flowmeters that cannot provide this level of accuracy or uncertainty. The actual application and installation requirements will define the required flowmeter performance and will therefore dictate the necessary budget. Complete application and installation details should be defined and incorporated into an ISA S5.1 instrument data sheet or some equivalent data sheet document.

Unfortunately, it is common that insufficient data is provided by the customer to a manufacturer for the proper analysis to be performed. It is also not unusual that requests for additional information are met with resistance from the customer with questions such as “Why do you need this information? XYZ Company doesn’t.” The question the customer should be asking is why XYZ Company is not asking for the information. Customers should recognize that this additional information is required to perform the thorough review that the customer should want the manufacturer to perform. This best serves the interest of the customer as well as the manufacturer. It is the manufacturers that do not obtain all the required application information to perform the thorough analysis that should be called into question, not the firms that are going the extra step to assure a thorough analysis. Remember, contrary to popular thought, flowmeters that provide high levels of performance are not commodity items and there is no such thing as a universal flowmeter. Nearly all flowmeters will perform well when used in the right application and all flowmeters will perform poorly in the wrong applications. The relationship that should exist between the customer and the manufacturer is one of a partnership to work towards a common goal, not an adversarial one that is much more likely to result in failure. Utilizing the “Performance Integrity” principle is a key step in establishing this relationship.

Another issue to consider is the impact on this whole process if an independent contractor is left to make the choice for the end user’s flowmeter requirement. Unless the contractor also has operational responsibility for the plant or facility, numerous issues affecting the long-term performance of the flowmeter may be disregarded in the selection process. This may decrease the cost to the contractor while increasing the total cost of ownership to the end user.

Application Suitability of Diametrical (Single or Multiple-Path) and Multiple-Path Chordal Transit-Time Flowmeters

The points previously raised in this discussion are applicable to all types of flowmeter products as well as other instrumentation. In this section and the next, the discussion will be limited to two different types of transit-time flowmeters; diametrical (single and multiple-path) and multiple-parallel-path chordal. As a supplier of both types of transit-time flowmeters mentioned here, Accusonic Technologies routinely considers all necessary issues for a given installation prior to making the recommendation of one technology over the other. If neither technology is suitable, we will inform the customer of this and recommend the appropriate technology.

When considering the suitability of diametrical and chordal transit-time flowmeters, once again, an objective analysis must be performed that includes evaluation of the application/installation conditions as well as the performance (accuracy/uncertainty) required by the customer and the established budget. After a thorough analysis of these variables, the flowmeter manufacturer can make an informed and intelligent recommendation for the user's consideration.

Transit-time flowmeters measure the effect of the fluid velocity on an ultrasonic signal sent with the direction of flow and then against the direction of flow. The fluid velocity speeds up the signal with the direction of flow and slows the signal against the direction of flow. The measured time difference between the two signals is used to calculate the fluid velocity. Diametrical and chordal types of transit-time flowmeters use different integration methods to calculate the flowrate.

Diametrical flowmeters are available in single-path (figure 1) and multiple-path (figure 2) configurations. They can be refractive systems, such as clamp-on transducer designs, or orthogonal, such as wetted/insert transducer designs. Chordal flowmeters are generally multiple-path designs utilizing wetted or insert transducers (figure 3). Each of these various designs has their own application suitability range, performance capability, and cost range. In many cases, the different transit-time flow measurement methods can all work on a given application. The differentiation is the performance capability and the costs. This is where the understanding of the customer's needs come into consideration. The final recommendation will be based on the customer's required accuracy and what the budget will allow. The manufacturer may make a list of recommendations that highlight the particular recommended flowmeter's performance and cost allowing the customer to make an informed decision.

The primary application constraint that would prevent the recommendation of a transit-time flowmeter is the presence of a high level of entrained air or gas bubbles or high levels of inorganic solids. Even with the presence of bubbles or inorganic solids, it is possible that a transit-time flowmeter may still be a recommended choice. The specific site conditions must be considered should this situation be present. With the "Performance Integrity" principle, the manufacturer will recommend that a customer not use a flowmeter offered by that manufacturer should none of their products be suitable. To state once again, there is no such thing as a universal flowmeter and very few flowmeter suppliers offer such a broad range of flowmeter products that they have the right solution for every application.

Figure 1 - SINGLE PATH - DIAMETRAL TRANSIT-TIME FLOWMETER

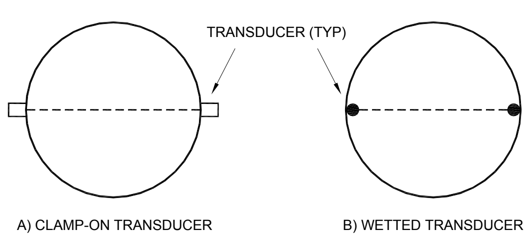


Figure 2
MULTIPLE-PATH DIAMETRAL TRANSIT-TIME FLOWMETER

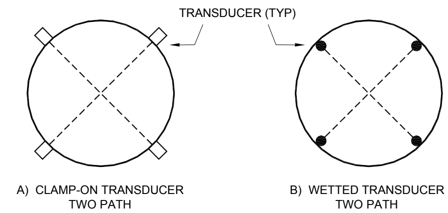
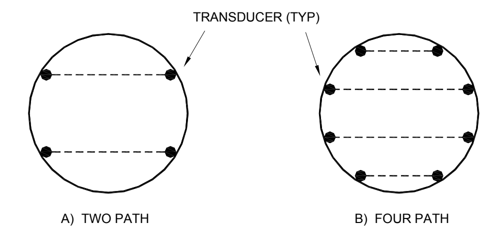


Figure 3
MULTIPLE PATH CHORDAL TRANSIT-TIME FLOWMETER



Performance Capabilities of Diametrical (Single or Multiple-Path) and Multiple-Parallel-Path Chordal Transit-Time Flowmeters

As to performance capabilities, the defining factor lies in the uncertainties of the different flow measurement methods for the specific application under consideration. Accuracy, or better stated as uncertainty, is arrived at by considering all the potential error sources related to the measurement technique and the application. Only after objectively defining all the potential error sources can a flowmeter's accuracy/uncertainty statement be established. It must be emphasized that this uncertainty analysis should be performed for the given application and installation conditions. This approach to uncertainty analysis development is rarely performed by a flowmeter manufacturer as most flowmeter accuracy statements are based solely on the flowmeter's performance under ideal conditions. Actual field conditions rarely approach the pristine, benign conditions found in factories or laboratories. It is interesting to review the accuracy statements included on many flowmeter manufacturers' data sheets. It is not unusual to see the word "Typical" in these accuracy statements. In this situation, typical *really* means "under ideal conditions" such as a fully developed flow profile above a certain velocity. It is doubtful that any English dictionary would define typical in this manner.

To perform a thorough uncertainty analysis for a given flowmeter application/installation, all potential error sources need to be identified. This is true for all types of flowmeters. Potential error sources will vary based on the flow measurement method to be evaluated for a given application and installation. If a flowmeter calibration is required, additional error sources need to be considered depending on the type of calibration used for a given flowmeter. For example, if a flowmeter is calibrated in a traceable laboratory with a lab uncertainty of +/-0.25%, what is the actual flowmeter uncertainty when the flowmeter is then installed under the actual conditions that exist in the field? The conditions present in the field, including hydraulic considerations, are likely to be significantly different than the conditions under which the flowmeter was calibrated. This difference will create an additional uncertainty that needs to be quantified for these particular site specific conditions in order to ultimately determine the total flowmeter uncertainty. Quantification of these and other potential error sources is not addressed in this discussion but is addressed in a separate paper.

Of particular note relative to the various types of transit-time flowmeters is the major impact of two potential sources of error and how they impact the types of transit-time flowmeters differently. One significant potential error source is the uncertainty of the physical elements involved in the measurement and, most specifically, the pipe dimensional information. Wetted/insert transducer systems *can* minimize this uncertainty to a much greater extent than a flowmeter utilizing clamp-on transducers. Uncertainty in the pipe wall dimensions, the non-uniformity of the pipe dimensions, and the actual roundness of the pipe can all lead to a greater uncertainty for clamp-on transducer type transit-time flowmeters than a transit-time flowmeter that utilizes wetted/insert transducers.

The second major potential error source is the uncertainty due to hydraulic conditions, specifically the flow velocity profile. Diametrical designs, whether clamp-on or wetted transducer style, are much more susceptible than chordal type flowmeters to increased uncertainty due to a disturbed flow profile present in the metering section. Should a disturbed flow profile exist, additional paths are required to minimize the uncertainty. However, since diametrical transit-time flowmeters, clamp-on or wetted transducer designs, *are Reynolds Number dependent*, they are limited to how well they can resolve very disturbed asymmetrical flow profiles. This limitation will cause an increased uncertainty. Depending upon the severity and variability of the distortion, uncertainty may increase even with the addition of extra diametrical measurement paths. Since chordal multiple-path transit-time flowmeters *are* ***not*** *Reynolds Number dependent*, distorted flow profiles can be resolved to a much greater degree leading to a lower overall flowmeter uncertainty.

The two major potential error sources identified above, along with all other error sources and other factors, including the customer's budget, must be considered before the flowmeter supplier can provide an objective recommendation on transit-time flow measurement technology. This effort will lead to a successful flowmeter installation that best serves both the customer and the supplier.

Conclusion

Both manufacturers and customers are motivated to supply and install products that meet the customer's technical and financial needs. This can best be accomplished through a partnership approach. This relationship naturally takes time to develop and evolve. It is the manufacturer's responsibility to recommend products to the customer that meet the customer's needs and then to stand behind the product and its application. It is the customer's responsibility to adequately inform the manufacturer of all of the customer's needs, requirements and site specific conditions. The customer should also carefully evaluate the manufacturer's objectivity relative to the recommendations. The Performance Integrity Principle described in this discussion is a key element in allowing the customer to gain the needed confidence and trust in the manufacturer.

The Performance Integrity Principle is the cornerstone of all flowmeter recommendations made by Accusonic Technologies.

For more information on transit-time flowmeters and Accusonic Technologies, visit www.accusonic.com. Accusonic Technologies is a Division of ADS LLC.