A NEW STANDARD FOR TURBINE METERS

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The International Standards Organization Technical Committee 30 - Measurement of Fluid Flow in Closed Conduits set up Working Group 15 to prepare a draft standard on Turbine Meters for gaseous fluids. ISO TC 30/WG 15, as the group is more commonly referred to, has been working on a draft proposal for several years and is approaching the point where a draft standard can be submitted to the Technical Committee for review and hopefully acceptance as a standard.

There are technical experts from scientific institutions, government bodies, manufacturers, and users. Nine countries have participating representatives on Working Group 15. In general, the draft is at about the 90% completion level but the remaining 10% will be the difficult part.

As stated by ISO " The object of ISO is to promote the development of standards in the world with the view to facilitating international exchange of goods and services, and to developing cooperation in the sphere of intellectual, scientific, technological and economic activity ".

There are a number of different turbine meter designs. The most common meter design is the axial flow turbine meter type where the entire flow passes thru the meter rotor. The tangential turbine meter design has been employed in some small sizes. Additionally there are insertion type turbine meters which measure the fluid velocity in a sector of the pipe area and some by-pass meter designs where a part of the fluid passes thru the meter rotor and the remaining flow by passes the rotor. The draft proposal does not identify the type of meter although initially it restricted itself to the axial flow type with no fluid by-pass. The application of the standard to turbine meters in general on specific design types will be reconsidered by the working group when the document is in its final form.

Turbine Meters are used in all types of measurement applications such as custody transfer, flow control, and in plant metering. Several draft proposals were submitted to the working group to be considered and the result to date is a combination of the original proposals plus some additions. As presently formed, the draft defines many meter characteristics and also the method of use.

Turbine Meters for the measurement of gaseous fluids have been around a long time. There are letters of patent issued at the beginning of this century on turbine meter designs. These early meters were vertical axis meters and it is easy to speculate that the reason they failed to achieve widespread use was simply due to bearing design. The precision ball bearing of today was unknown. The usage of the meter practically disappeared for a number of years and reappeared in the 50's. In some way, the liquid turbine meters revived interest in the possibilities of using the same principles on gaseous flow. The first new generation of designs started in Western Europe and were followed by interest in North America. Some liquid turbine meters were tested on air, as an example, to determine what might be expected of the turbine meter on very low density fluids. The results were not very encouraging - with some exceptions. In the following years, gas turbine meter technology advanced rapidly and so did the use of turbine meters. The centers of manufacture were Western Europe and North America, but there were differences in the approach to the meter design. Today, the meter designs are very similiar with one or two specific exceptions and these differences are a result of different practices and requirements.

There are a number of documents that relate to gas turbine meters. There is Recommendation #32 of the Organization International Metrologie Légale. This document specifies certain performance characteristics as well as construction and design requirements. This document is incorporated in the EEC Directives. American Gas Association Report No. 7 concerns itself with turbine meters used in the measurement of natural gas.

Since any draft document is subject to change, the comments made concerning the gas turbine meter standard must be considered with that in mind. In the scope of the draft it is stated that the standard will specify dimensions, ranges, and output characteristics. In addition performance specifications are provided to promote uniformity in reporting performance characteristics and provide for acceptable performance levels. Addition construction and test requirements are set forth to provide minimum specifications on such items and provide information for the proper use of the flowmeter. Guidelines for installation, operation, accessories, and techniques for calculating flow and volumes to reference conditions are given. At this moment there are 28 pages to the draft and there are additional items to add that will expand the document.

The section headings reveal the contents of the draft. There is a section on the definition of terms. Although this section is not written at this time, it is necessary to insure the understanding of special terms used in reference to gas turbine meters. There are definitions for some items under the subsection where the term is used or limits are placed on the term as a performance specification. The section "Principle of Measurement" is a very brief description of a gas turbine meter. The section "Flow Rating" sets forth the fact that the turbine meter maximum and minimum flow ratings will be specified for a range of gas densities that the meter will perform within the performance specifications defined in a later section. This is an interesting departure from present practice in that the minimum flow rating is recognized not as a fixed ratio to the maximum flow rating but can be any ratio that stays within the tolerances of performance. Further, it recognizes that density changes can affect the minimum rating.

Construction is one section with many sub paragraphs. There are many generalized statements as one would expect with a proprietary device. There is one sub section on Connections and Capacities which defines the preferred nominal pipe size for a given maximum flow for the meter. The numbers are based on the maximum flow ratings in the "G Series" (which are a subset of ISO preferred numbers) and also on the pipe sizes such that the velocities in the pipe are relatively low and typical of good design practice. These are preferred and not mandatory relationships. The meter length is defined but is a point still under discussion. There are differences in meter lengths (flange face to face dimensions) between European designs and North American designs. Likewise on some short form meters there are variations on meter length also. Meter length standardization would permit interchangeability of various meters without a change in pipe work, however, it is possible to interchange any meter providing one is willing to change piping.

Other items of construction which are covered are the pressure tapping for the measurement of the reference pressure. The size of the actual internal diameter has limits and other provisions identify the method of marking the reference pressure point. It is mandatory that the flow direction be marked. For meters with removable internal mechanisms, there is a subsection which defines some construction requirements plus marking requirements. The construction requirement is simply that the mechanism must be capable of maintaining a proper position on repeated mounting and dismounting so that the performance limits are not violated. Overloading of the turbine meter is defined as well as the length of time for such loading that will not cause damage to the meter. The conditions of this rating is at maximum working pressure.

Although this sounds rather straight forward and reasonable, it is one of those statements that cause so many problems in the future. How do you test at full pressure ? A minimum set of requirements for the meter badge or label are given to provide the basic information required for use of the meter. Additional information can be provided but there is a mandatory list of what must be provided.

One section of the draft proposal for a gas turbine meter standard is that on Pressure Testing. This section closely follows a similiar section in a published ISO standard on valves. The inclusion of such requirements will do much in reducing the confusion faced by manufacturers for compliance with unknown requirements and the same for users since they will know what minimum requirements are for pressure testing and any other requirements must be identified. This is not a section trying to define a pressure vessel code but simply one stating that the integrity of the meter pressure containing shell will meet these minimum test requirements. As previously indicated, you may disagree with the specifications but at least you know what they are as a minimum requirement.

Section 7 concerns itself with Performance characteristics of gas turbine meters. Again, the minimum performance requirements are specified. Anyone requiring performance specifications better than those defined may specify those conditions. It is recognized the gas turbine meters are individual meters and as such require individual calibration. Additional items under the

performance section relate to the meter position, temperature range of the fluid, pressure loss, installation conditions and accessories driven by the meter. All the items which influence the performance characteristics of the meter are related back to the range of conditions required to remain within the performance specifications. In general, the performance specifications are ± 2% from minimum flow to 20% of maximum specified flow and ± 1% from 20% of maximum specified flow to maximum specified flow.

Section 8 is concerned with the characteristics of the read out of the gas turbine meter and recognizes that such output can be in mechanical or electrical form. Perhaps there is an excessive amount of specifications for this subject but it does provide for minimum requirements for the devices. Much of the material relates to present documents specifying the size of odormeter wheels and numerals.

Section 9 is Recommendations for Use and concerns itself with the installation of the meter and other such topics as start up procedure. A great deal of the material is of "teaching nature", the "Be Careful" type passages of standards. Although some people object to this type material as not being relevant to a standard, it should be pointed out that the finest equipment is only as good as the final user makes it - by the installation and operation. There are many poor installations because other considerations were more important than performance, yet both could have been accommodated with a little thought and understanding. This section will not make experts but it does set forth many simple precautions and considerations for use of the gas turbine meter.

Section 10 - Other Meter Performance Considerations is a brief section defining the methods for calculating certain gas turbine meter performance characteristics under varying operating conditions. The material is given in simple

mathematical terms and should allow any user to calculate the various changes that may be expected in such items as pressure loss across the meter at any operating conditions.

Section 11 - Data Computation and Presentation. This section relates to the methods of converting line condition volumes to reference condition volumes for pressure and temperature measurement based systems. The equations for mass flow are also presented to provide a complete and consistent form of calculation. A sub section on plotting of the test data is presented to provide uniformity in the presentation of plotted test results.

Section 12 - Field Checks. Regardless of any argument concerning the necessity to provide such a section in a standard, it seems to me that one of the great concerns of novice users is their ability to check the device they have installed. There are a number of methods and only the most simple are described but in many cases these are the most important for routine work. Additional systems including master meters for check calibration at periodic intervals could be included but there is sufficient information to indicate that if the measurement is critical, then treat the entire installation with special care.

Section 13 - Safety is a short paragraph relating to electrical equipment in hazardous atmospheres.

There is one Appendix at this draft which provides informational notes on some effects of the flow stream or fluid that can affect the meter performance. There is a second Appendix under preparation to describe standard test methods for installation disturbances. This would provide a standard test procedure and therefore the results could be compared directly between various meter designs.

That is a brief overview of the draft proposal on gas turbine meters. A few specifics have been mentioned but only a few since the draft is still a draft and is the subject of work by the working group. Working Group 15 will meet at Delft, The Netherlands, in mid September to discuss and edit the present draft. In addition, it must consider some comments by national working groups concerning the draft. There is considerable work to be accomplished before the final editing is completed. The most difficult task is to insure clarity. There is the basic problem of any group working with a document to understand the meaning and intent of any part while not realizing that the same part will be ambiguous to someone who has not been part of the discussions.

Any standard must be a living document, subject to change for clarity and also to incorporate new information. Turbine meters are not classical devices and therefore designers have considerable freedom to make mechanical improvements and performance characteristic improvements since each unit is calibrated. This does not mean there is no area where standardization can not take place but it does mean the standard can not be restrictive to improvements.

The working group on the draft proposal for a turbine meter standard for gases addressed a problem very early in its deliberations and that was the proposition of a single standard for gas turbine meters regardless of the meter's application. The standard being prepared is not directed toward custody transfer meters nor is it directed toward non-custody transfer meters.

The greatest application of gas turbine meters is in the fuel gas industry and there are legal requirements in many places concerning these meters. The draft recognizes that there may be other documents covering the application of gas turbine meters and as such the requirements of these documents may take precedence over the standard proposed. Efforts have been made to incorporate many of these requirements but there are some that are clearly changed to reflect the state of technology and hopefully these changes can be recognized in other documents.

When will the work be completed ? It is hoped that a draft maybe submitted by the middle of next year and a great deal of this timing is dependent on the accomplishments of the next working group meeting.

References

[1] Paper presented at the North Sea Flow Measurement Workshop, a workshop arranged by NFOGM & TUV-NEL

Note that this reference was not part of the original paper, but has been added subsequently to make the paper searchable in Google Scholar.