ASME PTC 19.5-2022
[Revision of ASME PTC 19.5-2004 (R2013)]

Flow Measurement

Performance Test Codes

AN AMERICAN NATIONAL STANDARD

The American Society of
Mechanical Engineers

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NOTICE

All ASME Performance Test Codes (PTCs) shall adhere to the requirements of ASME PTC 1, General Instructions. It is expected that the Code user is fully cognizant of the requirements of ASME PTC 1 and has read them before applying ASME PTCs.

ASME PTCs provide unbiased test methods for both the equipment supplier and the users of the equipment or systems. The Codes are developed by balanced committees representing all concerned interests and specify procedures, instrumentation, equipment-operating requirements, calculation methods, and uncertainty analysis. Parties to the test can reference an ASME PTC confident that it represents the highest level of accuracy consistent with the best engineering knowledge and standard practice available, taking into account test costs and the value of information obtained from testing. Precision and reliability of test results shall also underlie all considerations in the development of an ASME PTC, consistent with economic considerations as judged appropriate by each technical committee under the jurisdiction of the ASME Board on Standardization and Testing.

When tests are run in accordance with a Code, the test results, without adjustment for uncertainty, yield the best available indication of the actual performance of the tested equipment. Parties to the test shall ensure that the test is objective and transparent. All parties to the test shall be aware of the goals of the test, technical limitations, challenges, and compromises that shall be considered when designing, executing, and reporting a test under the ASME PTC guidelines.

ASME PTCs do not specify means to compare test results to contractual guarantees. Therefore, the parties to a commercial test should agree before starting the test, and preferably before signing the contract, on the method to be used for comparing the test results to the contractual guarantees. It is beyond the scope of any ASME PTC to determine or interpret how such comparisons shall be made.

FOREWORD

The history of this Instruments and Apparatus Supplement began when the American Society of Mechanical Engineers (ASME) organized the Research Committee on Fluid Meters in 1916. This Committee's stated objective was to prepare "a textbook on the theory and use of fluid meters sufficient as a standard reference." The first edition of Part 1 of their report, published in 1924, met that objective. It received immediate approval and was widely referenced by users of fluid meters and educators. The Committee originally planned to issue the report on Fluid Meters in three parts: Part 1, Their Theory and Application, followed by Parts 2, A Description of Meters, and 3, Selection and Installation. However, Part 1 was so well received that second and third editions were needed before the other two parts could be prepared. The second edition of Part 1 was considerably different from the first, although it followed roughly the same format and arrangement; the third edition was very similar to the second. These were published in 1927 and 1930, respectively.

Part 2 of the report was published in 1931 and contained a complete description of the physical characteristics of the meters then being manufactured. Unfortunately, the material in Part 2 rapidly became obsolete and the Committee decided to advise those interested in the descriptions to secure them from the manufacturers, whose literature would necessarily be up to date.

Part 3, published in 1933, gave instructions for correct installation of meters and discussed the effect of incorrect installation. However, Part 3 was also abandoned, in this case because the Committee decided the material in it should be an integral part of the complete report.

The fourth edition of Part 1 was issued in 1937 as a completely new draft. Earlier editions had been criticized because the material as presented was difficult to put to practical use. A change in format and the addition of new material apparently corrected this problem, since this edition went through many printings.

The fifth edition, issued in 1959, followed this successful general format and included material gained in the long interval since the previous edition. The Committee also issued a manual, Flowmeter Computation Handbook, in 1961. The procedures in this publication could be adapted to computer programming.

The format of the sixth edition, published in 1971, differed slightly from that of the fourth and fifth editions. Each section was complete by itself, so altering one section would not affect the preceding or following sections.

The sixth edition, somewhat like the third edition and its Part 3, was divided into two parts. The material on installation and application became both a part of the complete report and a separate publication, ASME Performance Test Code (PTC) 19.5, Flow Measurement. This was in accordance with an agreement made between the Research Committee on Fluid Meters and the Performance Test Code Committee in 1964. Practically all of the material in ASME PTC 19.5 was taken from Fluid Meters, and most of the writers were also members of the Research Committee on Fluid Meters. The two committees decided to combine the material into one publication in such a way that the sections dealing with specifications and instructions could be published separately, which would reduce the work of the committees and the number of separate publications. However, this publication also prompted considerable criticism that the material as presented was difficult to put to practical use.

Consequently, the Board on Performance Test Codes, which is now the PTC Standards Committee under the Board on Standardization and Testing, formed a committee to address these concerns. This committee produced ASME PTC 19.5-2004, Flow Measurement, which included a much broader range of methods of flow measurement than any of its predecessors. Even so, it did not include every method, only those that were judged at the time to meet the requirements and needs of test codes by providing results of the highest level of accuracy consistent with the best engineering knowledge and practice currently available.

ASME PTC 19.5-2022 provides guidance on the proper use of flowmeters including guidance on estimating their measurements' systematic uncertainties. The choice of flow-measurement devices and calibration requirements in any given case depends on the requirements of the PTC referencing this Supplement.

ASME PTC 19.5-2022 includes recommendations from the ASME Board on Standardization Testing Task Groups on ASME equations for fluid flow through a classic ASME venturi, wall tap nozzle, and orifice meter, which reconcile some differences between ASME PTC 19.5 and ASME MFC-3. These recommendations resulted in updates to the discharge coefficients for venturi meters, wall tap nozzles, and orifice meters; updates to the straight-length requirements; and some updates to the systematic uncertainties.

ASME PTC 19.5-2022 has added further guidance and a method for determining the uncertainty of extrapolating the calibration data of some flowmeters. The PTC referencing this Supplement should define the acceptable added uncertainty for extrapolation of the meter's data used in specific applications.

Sections have been added to cover the frequently used Coriolis and ultrasonic flowmeters. A new section on vortex meters, which are used in some performance testing, has also been added. PTC documents typically do not reference the use of electromagnetic flowmeters; the ASME PTC 19.5 Committee recommends the use of ASME MFC-16-2014 for guidance.

This Code is available for public review on a continuing basis. This provides an opportunity for additional input from industry, academia, regulatory agencies, and the public-at-large.

ASME PTC 19.5-2022 was approved by the PTC Standards Committee on April 21, 2021, and was approved as an American National Standard by the American National Standard Institute Board of Standards Review on January 5, 2022.

ASME PTC COMMITTEE
Performance Test Codes

(The following is the roster of the committee at the time of approval of this Code.)

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General. ASME codes and standards are developed and maintained by committees with the intent to represent the consensus of concerned interests. Users of ASME codes and standards may correspond with the committees to propose revisions or cases, report errata, or request interpretations. Correspondence for this Code should be sent to the staff secretary noted on the committee's web page, accessible at https://go.asme.org/PTCcommittee.

Revisions and Errata. The committee processes revisions to this Code on a periodic basis to incorporate changes that appear necessary or desirable as demonstrated by the experience gained from the application of the Code. Approved revisions will be published in the next edition of the Code.

In addition, the committee may post errata on the committee web page. Errata become effective on the date posted. Users can register on the committee web page to receive e-mail notifications of posted errata.

This Code is always open for comment, and the committee welcomes proposals for revisions. Such proposals should be as specific as possible, citing the paragraph number(s), the proposed wording, and a detailed description of the reasons for the proposal, including any pertinent background information and supporting documentation.

Cases

(a) The most common applications for cases are

(1) to permit early implementation of a revision based on an urgent need

(2) to provide alternative requirements

(3) to allow users to gain experience with alternative or potential additional requirements prior to incorporation directly into the Code

(4) to permit the use of a new material or process

(b) Users are cautioned that not all jurisdictions or owners automatically accept cases. Cases are not to be considered as approving, recommending, certifying, or endorsing any proprietary or specific design, or as limiting in any way the freedom of manufacturers, constructors, or owners to choose any method of design or any form of construction that conforms to the Code.

(c) A proposed case shall be written as a question and reply in the same format as existing cases. The proposal shall also include the following information:

(1) a statement of need and background information

(2) the urgency of the case (e.g., the case concerns a project that is underway or imminent)

(3) the Code and the paragraph, figure, or table number(s)

(4) the edition(s) of the Code to which the proposed case applies

(d) A case is effective for use when the public review process has been completed and it is approved by the cognizant supervisory board. Approved cases are posted on the committee web page.

Interpretations. Upon request, the committee will issue an interpretation of any requirement of this Code. An interpretation can be issued only in response to a request submitted through the online Interpretation Submittal Form at https://go.asme.org/InterpretationRequest. Upon submitting the form, the inquirer will receive an automatic e-mail confirming receipt.

ASME does not act as a consultant for specific engineering problems or for the general application or understanding of the Code requirements. If, based on the information submitted, it is the opinion of the committee that the inquirer should seek assistance, the request will be returned with the recommendation that such assistance be obtained. Inquirers can track the status of their requests at https://go.asme.org/Interpretations.

ASME procedures provide for reconsideration of any interpretation when or if additional information that might affect an interpretation is available. Further, persons aggrieved by an interpretation may appeal to the cognizant ASME committee or subcommittee. ASME does not "approve," "certify," "rate," or "endorse" any item, construction, proprietary device, or activity.

Interpretations are published in the ASME Interpretations Database at https://go.asme.org/Interpretations as they are issued.

Committee Meetings. The PTC Standards Committee regularly holds meetings that are open to the public. Persons wishing to attend any meeting should contact the secretary of the committee. Information on future committee meetings can be found on the committee web page at https://go.asme.org/PTCcommittee.

Section 1
Object, Scope, and Uncertainty

1-1 OBJECT

The purpose of this ASME Performance Test Code (PTC) Supplement is to give instructions and guidance for the accurate determination of flows commonly needed in support of individual PTCs. The choice of flow measurement device and calibration requirement depends on the requirements of the PTC referencing this Supplement. The purpose of the measurement, uncertainty required, and specific application must all be taken into consideration. It is not the intent of this Supplement to supersede the guidance or requirements of any PTC. The intent is to provide a common document that can be referenced by all PTCs.

1-2 SCOPE

This Supplement describes the techniques and methods of flow measurements required or recommended by ASME PTCs. A variety of commonly used flow measurement devices are included to provide details for the different applications referenced by various PTCs. This is a supplementary document that does not supersede the mandatory requirements of any PTC, unless such an agreement has been expressed in writing prior to testing or a PTC requires that specified sections or paragraphs within this Supplement be used.

1-3 UNCERTAINTY

This Supplement provides guidance on potential magnitudes and sources of uncertainty to assist in the derivation of the expected overall systematic uncertainty of a specific flow measurement. This overall systematic uncertainty includes estimated component uncertainties for

(a) flow coefficients for an uncalibrated meter
(b) calibration
(c) extrapolation of a calibrated meter beyond its calibrated range
(d) installation requirements and potential risks for deviations
(e) additional requirements to improve the flow measurement

The uncertainty of any flow measurement depends on the type and design of the instrument; the characteristics of the flow along with flow conditioning upstream and downstream; the pressure, temperature, density, frequency output, and stability of the flow; and the installation of sensing lines for differential-pressure measurements.

The specific uncertainty for each flow measurement can be determined by information in this Supplement; the specific ASME PTC; ASME PTC 19.1; and, in some cases, manufacturer's guidance. The uncertainty values shown in this Supplement are typically systematic values for a component or examples of systematic uncertainties. The reported uncertainty values are at 95% confidence level. The uncertainty values represent plus/minus (±) values unless asymmetrical uncertainty exists, in which case the plus (+) and minus (−) values along with sign will be shown.

1-4 REFERENCES TO ASME STANDARDS

Below is a list of ASME publications referenced in this Code. In all cases, the latest edition shall apply. Specific references to ASME and other publications are included within each section.

ASME B31.1. Power Piping.
ASME B31.3. Process Piping.
ASME MFC-3M. Measurement of Fluid Flow in Pipes Using Orifice, Nozzle, and Venturi.
ASME MFC-7. Measurement of Gas Flow by Means of Critical Flow Venturi Nozzles.
ASME MFC-8M. Fluid Flow in Closed Conduits: Connections for Pressure Signal Transmissions Between Primary and Secondary Devices.
ASME MFC-16. Measurement of Liquid Flow in Closed Conduits with Electromagnetic Flowmeters.