ASME PTC 19.3-2024

[Revision of ASME PTC 19.3-1974 (R2004)]

Temperature Measurement

Performance Test Codes

AN AMERICAN NATIONAL STANDARD

The American Society of Mechanical Engineers

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Two Park Avenue • New York, NY • 10016 USA

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Two Park Avenue, New York, NY 10016-5990

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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 system. 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

In 1974, thermowell calculations were first added to ASME PTC 19.3 to establish a consistent and reliable methodology to evaluate whether a given design of such product would be likely to withstand flow-induced forces, especially in steam lines.

In 2004, this Committee identified gaps in the thermowell calculation set out in ASME PTC 19.3 and determined that the subject matter was sufficiently involved to justify the creation of a separate standard dealing specifically with that issue.

In 2010, that independent thermowell calculation standard was first published as ASME PTC 19.3 TW. ASME PTC 19.3 TW was amended and reapproved in 2016.

Since 1974, no significant changes had been made to this Code. However, following publication of ASME PTC 19.3 TW in 2010, it was plain that this Code could not be approved without removing the now obsolete calculation language.

Moreover, in the years following 1974, technology in temperature measurement has experienced significant change. Although foundational principles for the described technology remain much the same, the former ASME PTC 19.3 code was last revised when the IPTS-68 Temperature scale was new. We now live in a world where ITS-90 is very mature. Many sensors that were once commonplace in the world of temperature measurement, such as mercury-in-glass thermometers, are common no more. Other sensors that were less common, such as swaged mineral insulated thermocouples and noncontact temperature-measuring devices, are now quite common. With these technological shifts in mind, the ASME PTC 19.3 Committee set out to update the 1974 edition.

ASME PTC 19.3-2024 includes many changes while preserving the excellent work of the previous edition. The thermocouple, resistance temperature detectors, and calibration sections were updated significantly to reflect modern construction techniques and technological advancements. Thermowell calculations contained in ASME PTC 19.3-1974 (R2004) have been removed as they were made obsolete by the publication of ASME PTC 19.3 TW.

ASME PTC 19.3-2024 was approved by the ASME PTC Standards Committee on May 9, 2023, and was approved as an American National Standard by the American National Standard Institute Board of Standards Review on March 29, 2024.

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, 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

(4) the editions 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 Inquiry 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.

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Section 1
General

1-1 OBJECT

The purpose of this ASME Performance Test Code (PTC) is to give instructions and guidance for the accurate determination of temperature values in support of the ASME Performance Test Codes. The choice of method, instruments, required calculations, and corrections to be applied depends on the purpose of the measurement, allowable uncertainty, and characteristics of the equipment being tested.

Measurement of temperature is generally considered to be one of the simplest and most accurate measurements performed in engineering. While true when compared to other measured parameters, there are many challenges. Accurate measurement of temperature can be obtained only by observance of suitable precautions in the selection, installation, and use of temperature-measuring instruments and in the proper interpretation of the results obtained with them. In some cases, an arbitrarily standardized method is prescribed in the Performance Test Codes that is to be followed in making temperature measurements under such conditions.

Some of the instruments available for temperature measurement can indicate temperature to a closer degree of accuracy than is required in some of the tests considered in the Performance Test Codes. The difficulty in obtaining accurate temperature measurements with such instruments is encountered in installation or use of the temperature-measuring instruments. Specific directions and precautions in usage of the instruments are given in subsequent sections for each of the various types of temperature-measuring instruments.

1-2 SCOPE

The methods for temperature measurement and the protocols used for data transmission are provided in this Code. Guidance is given for setting up the instrumentation and determining measurement uncertainties. Information regarding the instrument type, design, applicable temperature range, accuracy, output, and relative cost is provided.

Information on temperature-measuring devices that are not normally used in field environments is given in Mandatory Appendices I, II, and III.

1-3 DEFINITIONS

Where special terms are used, they are specifically defined in the body of this Code at the point at which they are introduced. Otherwise, this Code is meant to be a straightforward text capable of interpretation without the need to resort to unusual definitions. To the extent that clarification of the intended meaning of a word is desired and the dictionary does not provide an acceptable explanation, users of this Code are directed to the definitions sections contained in the most recent edition of ASTM E344.

1-4 TEMPERATURE SCALES

Temperature is a measure of thermal potential. Two bodies are at the same temperature when there is no thermal (heat) flow from one to the other. If one body loses heat to another, the first is at a higher temperature.

To measure temperature, it is necessary to have a scale with appropriate units, just as it is necessary in measuring length to have the meter with its subdivisions of centimeter and millimeter or the yard with its subdivisions, the foot and the inch.

1-4.1 Thermodynamic Temperature Scale

The ideal temperature scale is known as the Thermodynamic Temperature Scale. Temperature measured on such a scale will obey all the laws of thermodynamics, which relate such physically measurable quantities as energy, specific heat, latent heat, pressure, and other quantities to temperature. The temperature scale defined in this manner is independent of the physical properties of any specific substance.