ASME PTC 1-2022

(Revision of ASME PTC 1-2015)

General Instructions

Performance Test Codes

AN AMERICAN NATIONAL STANDARD

The American Society of
Mechanical Engineers

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The American Society of Mechanical Engineers
Two Park Avenue • New York, NY • 10016 USA

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FOREWORD

This Code on General Instructions was first printed in preliminary form in *Mechanical Engineering* in 1920 and was presented at a public hearing at the spring meeting of The American Society of Mechanical Engineers (ASME) held in Chicago, Illinois, in 1921. It was approved and adopted as a standard practice of ASME in 1924.

During the years 1920 through 1970, the function of the Power Test Codes (as they were then known) continued to evolve and broaden. In recognition of these developments, the Code on General Instructions was revised twice. The revisions were approved by the Council on Standards and Certification on June 17, 1945, and May 7, 1970, respectively.

During the years 1970 through 1985, the scope of the Power Test Codes, now known as Performance Test Codes (PTCs), was further broadened as a result of

(a) their designation as American National Standards by the American National Standards Institute (ANSI)

(b) an increased awareness of the relationship between U.S. domestic standards and their international counterparts and a related need to reconcile substantially conflicting requirements between U.S. and international documents

(c) clarification on the use of uncertainty in test codes

These developments resulted in several additional revisions to the Code on General Instructions that were approved by the Board on Performance Test Codes (BPTC) on May 13, 1970 (with the October 1971 Addenda); October 29, 1979; June 18, 1986; and June 12, 1991.

The subsequent revision of the Code was initiated in mid-1998. A Project Team was appointed by the BPTC to develop this revision under the ASME Redesign Process. The revised document was approved by the BPTC on November 19, 1998.

The next revision was a major updating of the Code, now called ASME PTC 1. The existing information contained in ASME PTC 1 was divided into two separate documents. One is the Code writer's guide, the ASME PTC 1 Template, available on the ASME PTC Committee web page. The other, ASME PTC 1, contains mandatory information for all code users. This revision was approved by the BPTC on December 9, 2003. It was also approved as an American National Standard by the ANSI Board of Standards Review on March 10, 2004.

The 2011 revision contained modifications to the 2004 version whereby some new committees were added and others discontinued. The template was not updated at this time. The 2011 revision was approved by the PTC Standards Committee (formerly BPTC) on May 24, 2011, and approved and adopted as a standard practice of ASME by action of the Board on Standardization and Testing on August 8, 2011. It was also approved as an American National Standard by the ANSI Board of Standards Review on November 14, 2011.

In the 2015 revision of PTC 1, the template was no longer required but was retained as a recommended document. In recognition of the need for an acceptable method to prepare for and validate the acceptability of a test, another permissible use of test uncertainty was added to PTC 1. This addition allows flexibility in the individual contributions to the specified measurement's uncertainty contributors while ensuring that the overall total test uncertainty is achieved. This method strictly specifies each measurement's systematic uncertainty along with its permissible variation (data fluctuation) or a total measurement uncertainty, including both systematic and random effects for each measured parameter and/or variable or each type of measured parameter or variable. While a pretest and post-test uncertainty analysis is always required, it is limited to demonstrate the achievement of uncertainty limits placed upon each individual measurement without having to calculate a total test uncertainty for the result. However, if the user of the Code wishes to exceed any of the specified uncertainty limits in any parameter or variable, a complete test uncertainty analysis is required to establish that the Code's limit level of uncertainty for the test result has been met. This requires using the systematic, random, and total measurements' uncertainty limits of each parameter and variable in accordance with PTC 19.1. Once the Code Limit Uncertainty is determined for the result, exceeding the upper limit of any individual parameter's or variable's specified uncertainty is allowable only if it is demonstrated that the selection of all instrumentation used will result in an overall test uncertainty equal to or less than what it would have been had all parameters' uncertainty requirements been met.

This 2022 edition has been produced to clearly define the meaning of a "Code Test." Specifically, text has been added to expand upon the philosophy of the ASME PTCs and how users shall apply the ASME PTCs. In addition, clarification of parties to a test has been better defined and specific language has been added to advise how parties to a commercial test should be defined within the contract, along with responsibility delineation for when the Code calls for the parties to a test to take action. This edition of ASME PTC 1-2022 was approved as an American National Standard by the ANSI Board of Standards Review on February 18, 2022.

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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 Standards are developed and maintained with the intent to represent the consensus of concerned interests. As such, users of this Standard may interact with the Committee by requesting interpretations, proposing revisions or a case, and attending Committee meetings. Correspondence should be addressed to:

Secretary, PTC Standards Committee
The American Society of Mechanical Engineers
Two Park Avenue
New York, NY 10016-5990
http://go.asme.org/Inquiry

Proposing Revisions. Revisions are made periodically to the Standard to incorporate changes that appear necessary or desirable, as demonstrated by the experience gained from the application of the Standard. Approved revisions will be published periodically.

The Committee welcomes proposals for revisions to this Standard. 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 documentation.

Proposing a Case. Cases may be issued to provide alternative rules when justified, to permit early implementation of an approved revision when the need is urgent, or to provide rules not covered by existing provisions. Cases are effective immediately upon ASME approval and shall be posted on the ASME Committee web page.

Requests for Cases shall provide a Statement of Need and Background Information. The request should identify the Standard and the paragraph, figure, or table number(s), and be written as a Question and Reply in the same format as existing Cases. Requests for Cases should also indicate the applicable edition(s) of the Standard to which the proposed Case applies.

Interpretations. Upon request, the PTC Standards Committee will render an interpretation of any requirement of the Standard. Interpretations can only be rendered in response to a written request sent to the Secretary of the PTC Standards Committee.

Requests for interpretation should preferably be submitted through the online Interpretation Submittal Form. The form is accessible at http://go.asme.org/InterpretationRequest. Upon submittal of the form, the Inquirer will receive an automatic e-mail confirming receipt.

If the Inquirer is unable to use the online form, he/she may mail the request to the Secretary of the PTC Standards Committee at the above address. The request for an interpretation should be clear and unambiguous. It is further recommended that the Inquirer submit his/her request in the following format:

Subject:	Cite the applicable paragraph number(s) and the topic of the inquiry in one or two words.
Edition:	Cite the applicable edition of the Standard for which the interpretation is being requested.
Question:	Phrase the question as a request for an interpretation of a specific requirement suitable for general understanding and use, not as a request for an approval of a proprietary design or situation. Please provide a condensed and precise question, composed in such a way that a "yes" or "no" reply is acceptable.
Proposed Reply(ies):	Provide a proposed reply(ies) in the form of "Yes" or "No," with explanation as needed. If entering replies to more than one question, please number the questions and replies.
Background Information:	Provide the Committee with any background information that will assist the Committee in understanding the inquiry. The Inquirer may also include any plans or drawings that are necessary to explain the question; however, they should not contain proprietary names or information.

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Requests that are not in the format described above may be rewritten in the appropriate format by the Committee prior to being answered, which may inadvertently change the intent of the original request.

Moreover, ASME does not act as a consultant for specific engineering problems or for the general application or understanding of the Standard requirements. If, based on the inquiry information submitted, it is the opinion of the Committee that the Inquirer should seek assistance, the inquiry will be returned with the recommendation that such assistance be obtained.

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.

Attending Committee Meetings. The PTC Standards Committee regularly holds meetings and/or telephone conferences that are open to the public. Persons wishing to attend any meeting and/or telephone conference should contact the Secretary of the PTC Standards Committee. Future Committee meeting dates and locations can be found on the Committee Page at http://go.asme.org/PTCcommittee.

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INTRODUCTION

APPLICATIONS AND LIMITATIONS. This Code provides direction to users, parties to a test, and the ASME committees responsible for writing Performance Test Codes (PTCs). Code users and parties to a test shall consider this Code as part of each test, and all the requirements herein shall be applicable in addition to those within the individual PTCs covering a particular test.

The objectives of ASME PTC 1, General Instructions, are as follows:

(a) to define the purpose and scope of ASME PTCs

(b) to list major industry applications where PTCs can be used

(c) to provide direction on the use of PTCs concerning the planning, preparation, execution, and reporting of test results.

Test results determined by a PTC or a group of PTCs can be used as defined by a contract as the basis for determining fulfillment of contract performance guarantees. Test results can also be used for comparison to a design number, to trend performance changes over time, to help evaluate possible modifications or to validate them, or for any application in which the performance is needed.

The results of a test conducted in accordance with PTCs will not provide the sole basis for comparing the thermo-economic effectiveness of different plant and equipment designs or different generation technologies.

GUIDANCE IN USING ASME PERFORMANCE TEST CODES. ASME PTCs are developed primarily to address the needs of contract acceptance and/or compliance testing. This is not intended, however, to limit or prevent the use of PTCs for other types of testing where the accurate determination of performance is required.

PTCs are not tutorials: they are intended for use by persons experienced in testing power plants and equipment performance by following the rules of any Code. Prerequisites include detailed knowledge of power-plant operations, thermodynamic analyses, calculations of heat balance, testing and measurement uncertainties and their analyses, testing methods, and the use, control, and calibration of test-equipment and measuring instrumentation.

ASME PTCs are developed to support the achievement of specific test goals. Test goals are the overall objective and achievement of the test execution (corrected or uncorrected performance parameter or guarantee performance parameter desired to be determined: power output, heat rate, capacity, steam rate, efficiency, performance ratio, etc.) at a specific set of reference conditions and operating criterion.

ASME PTCs provide rules and procedures for designing and executing a test setup that is used to support the test goal. A test setup is a detailed approach that encompasses the test strategy, required measurements, corrections, assumptions, estimations, operating limitations, deliverables, and resources required to perform testing for determination of a test goal.

The test setup rules and practices within the ASME PTCs are the same as in any field of practice where the scientific method is applied to ensure a controlled experiment or test. The test setup is implemented to ensure accuracy of the results from the test. When a controlled experiment or test is conducted, the test must be designed to limit or minimize the effects of variables other than those of the independent variables over which the parties to the test have no control. Uncontrolled variables that influence the dependent variables will be determined from the test.

Ideally, a test setup of a controlled experiment or test on a power plant or equipment would be designed, planned, executed, and reported whereby all of the influential parameters are specifically set to a desired value and under the control of the parties to the test.

For example, if a control set consisting of all exogenous factors (such as the influential parameters of ambient temperature, relative humidity, barometric pressure, wind speed, wind direction, fuel composition, fuel temperature, load disposition, valve isolation, valve lineup, and auxiliary alignments) at the test boundary and within the control system were matched perfectly to the conditions that support determination of the test goals or the guaranteed performance parameters (e.g., heat rate, power output, steam rate, capacity, and performance ratio), then analytical corrections would be unnecessary.

Therefore, the test would directly measure the performance parameters that could then be compared to the guarantee at reference and operating conditions. Such a design would put the measured results on the same basis as the guarantees for comparisons without any analytical manipulations. However, the ability to achieve this ideal state, where the Test Goal and Test Setup are perfectly matched, is very impractical in practice, and thus requires a Test Setup that is as close as

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possible to the Test Goal's specified conditions, balancing uncertainty, cost, and the value of information obtained from the test.

So, when conducting a PTC test, the Test Setup should determine performance at specific operating conditions and with certain fixed parameters at the boundary and within the limits of the plant or the equipment being tested. Such setups, that limit analytic corrections to yield results of the highest level of accuracy based on current engineering knowledge, take into account test costs and the value of the information obtained from testing. To accomplish this, one must have thorough knowledge of which influential parameters are within their control and which influential parameters are outside their control. The main part of test setup is control of equipment and/or plant operating conditions and reference conditions, when possible, to be consistent with the specified performance. If a difference from the specified operating or reference condition cannot be eliminated, then parties to the test must agree upon and develop analytical methods to correct for their influence on the performance test results.

It important to recognize that part of the test setup is knowing how the choice of controlled or imposed upon operating modes affects the plant or equipment performance calculations and calculation methodology. For a properly designed test, the thermal performance model should develop the plant or equipment correction curves based on the established test setup and the planned or imposed mode of operation during the test. During the performance test, the plant or equipment shall then be operated in accordance with the operating philosophy upon which the correction curves or models are based. Care must be taken to ensure that when a correction is applied, it does not result in a performance at a condition at which the equipment could not actually operate, such as beyond a pressure, temperature, or flow capacity limit.

Section 1
Purpose, Scope, and Organization

1-1 DEFINITION AND PURPOSE

ASME PTCs provide uniform rules and procedures for the planning, preparation, execution, and reporting of performance test results. Test results provide numerical characteristics to the performance of equipment, systems, and plants being tested. A performance test is an engineering setup and evaluation where measurements of key parameters are taken under controlled circumstances to provide inputs to calculations. These results can be used to benchmark or ascertain performance at a particular time and can indicate how well the performance of the specified equipment compares to an established design, predicted criteria, or previous test results. Throughout ASME PTC 1, when the term "equipment" is used with reference to the object of a performance test, it can refer to specific equipment, systems, or entire plants.

1-2 STANDARDS COMMITTEES

ASME PTCs are developed by technical committees that are governed, organized, and appointed by the Performance Test Codes Supervisory Committee under the auspices of the Board on Standardization and Testing. Each code-writing committee is organized to include representatives of several interest groups. The qualifications of each member of a code-writing committee are subject to examination and approval by the Supervisory Committee. Members of the code-writing committees are highly qualified, technically competent professionals, generally members of ASME, who have expertise in the field or in an area of expertise needed by the committee, such as special instrumentation. Each member presents their views on matters under consideration as members of a learned profession, not as representatives of employers or special interest groups.

1-3 SCOPE AND ORGANIZATION OF PTCs

Most ASME PTCs are applicable to a specified type of equipment defined by the Code. There may be several subcategories of equipment covered by a single code. Types of equipment to which PTCs apply can be classified into the following five broad categories:

(a) power production, energy conversion, and storage
(b) combustion and heat transfer
(c) performance monitoring
(d) fluid handling
(e) emissions

The quantities that characterize performance are defined in each code for the equipment within its scope. Absolute performance characteristics determined by adherence to a PTC can be evaluated and compared to design or predicted characteristics or previous test results, or they can be used to benchmark or ascertain performance at a particular time.

Some PTCs are written as general reference documents in support of the equipment PTCs. These can be considered as technical reference material for the equipment codes. Three types of reference codes exist.

The first type covers guidance and reference information. It currently consists of ASME PTC 2, which contains standards for terms, units, values of constants, and technical nomenclature.

The second type covers instrumentation used in the measurement of thermodynamic or process fluid parameters, such as pressure, temperature, flow, and shaft power. Individual codes referring to process or thermodynamic quantities are known as Performance Test Code Instruments and Apparatus Supplements. They are supplementary to the information on mandatory instrumentation requirements contained in the equipment codes. Instrumentation information in equipment test codes supersedes the information given in these supplements, but otherwise these supplements can be incorporated by reference in equipment test codes where deemed appropriate by the committee.

The third type addresses how to analyze the uncertainties associated with measurement of all primary parameters to develop overall test uncertainty. It currently consists of PTC 19.1.