

ASME PTC 4.4-2023
[Revision of ASME PTC 4.4-2008 (R2013)]

Gas Turbine Heat Recovery Steam Generators

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

ASME PTC 4.4 began as an appendix. In September 1973, the ASME PTC 4 Committee planned a new appendix for ASME PTC 4.1, Steam Generating Units, that would cover heat recovery steam generators (HRSGs) for combined cycles. During meetings in May 1976 and May 1977, the committee decided that the scope of their work was beyond the capacity of an appendix. Consequently, the ASME Performance Test Code (PTC) Supervisory Committee approved a charter for a separate PTC titled ASME PTC 4.4, Gas Turbine Heat Recovery Steam Generators. The ASME PTC 4 Committee presented the draft of ASME PTC 4.4 to the supervisory committee in February 1980, gaining final approval of the new PTC on January 26, 1981. ASME PTC 4.4-1981 was approved as an American National Standard by the American National Standards Institute (ANSI) Board of Standards Review on February 3, 1981.

In 2008, the ASME PTC 4.4 Committee revised the 1981 edition, providing a more specific HRSG testing procedure consistent with current industry practice. ASME PTC 4.4-2008 used two independent approaches to quantify unit capacity and added new sections related to measurement uncertainty.

ASME PTC 4.4-2023 updates the 2008 edition, adding practices on instrumentation and uncertainty calculation.

ASME PTC 4.4-2023 was approved by the ASME Board on Standardization and Testing on March 7, 2023. It was approved by the ANSI Board of Standards Review as an American National Standard on April 19, 2023.

ASME PTC COMMITTEE

Performance Test Codes

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

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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 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 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 References

1-1 OBJECT

The object of this Code is to establish procedures for conducting performance tests of heat recovery steam generators (HRSGs) used to recover gas turbine exhaust (GTE) energy. The steam generator may include supplemental firing. This Code provides standard test procedures yielding the highest level of accuracy consistent with current engineering knowledge and practice.

(a) The purpose of this Code is to determine the following:

- (1) capacity of the unit at specified conditions
- (2) energy input from GTE and supplementary firing
- (3) gas-side pressure drop
- (4) steam- and water-side pressure drops

(b) This Code provides methods for converting the performance at test conditions to specified operating conditions. A determination of any or all of the performance items listed above may be used for the following purposes:

- (1) checking the actual performance against guarantee
- (2) comparing these items at reference conditions
- (3) comparing different conditions or methods of operation
- (4) determining the specific performance of individual parts or sections of the HRSG unit
- (5) comparing the performance when firing different fuels
- (6) determining the effects of changes to equipment

1-2 SCOPE

(a) This Code addresses steam generators whose primary function is to recover heat from GTE. Methods noted in this document may also be used for testing other heat recovery units, which may include the following:

- (1) units heating water only
 - (2) units using working fluids other than water
 - (3) units obtaining hot gas heat input from sources other than gas turbines (GTs)
 - (4) HRSGs with fresh air firing capability
- (b) This Code does not cover the following testing:

(1) fired steam generators whose primary function does not include the recovery of heat from GTE. Fired steam generators are addressed in ASME PTC 4 and ASME PTC 34.

(2) auxiliary equipment such as pumps and fans, which are addressed in ASME PTC 8.2 and ASME PTC 11, respectively.

(3) deaerator performance, which is addressed in ASME PTC 12.3.

(4) equipment noise emissions, which are addressed in ASME PTC 36.

(5) gaseous emissions to atmosphere.

(6) steam purity.

1-3 TEST UNCERTAINTY

This Code requires an uncertainty analysis in accordance with ASME PTC 19.1 as detailed in [Section 7](#). The pretest uncertainty analysis is used to develop unit-specific test procedures that result in meeting an agreed-upon target uncertainty. Typical values of test uncertainties, various unit configurations, and performance parameters are presented in [Sections 3](#) and [4](#).

1-4 REFERENCES

The following publications are referenced in this Code. Unless otherwise specified, the latest edition shall apply.

- AGA Report 8 (2017). Thermodynamic Properties of Natural Gas and Related Gases — Part 1, DETAIL and GROSS Equations of State. American Gas Association.
- ASHRAE Handbook of Fundamentals. American Society of Heating, Refrigerating, and Air Conditioning Engineers.
- ASME MFC-2M. Measurement Uncertainty for Fluid Flow in Closed Conduit. The American Society of Mechanical Engineers.
- ASME PTC 4. Fired Steam Generators. The American Society of Mechanical Engineers.
- ASME PTC 6.2. Steam Turbines in Combined Cycles. The American Society of Mechanical Engineers.
- ASME PTC 8.2. Centrifugal Pumps. The American Society of Mechanical Engineers.
- ASME PTC 11. Fans. The American Society of Mechanical Engineers.