Mechanical and Thermal Energy Storage Systems

Performance Test Codes

AN AMERICAN NATIONAL STANDARD

The American Society of Mechanical Engineers

ASME PTC 53-2022

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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 53, Mechanical and Thermal Energy Storage Systems, defines uniform test procedures and quantifiable test methods for assessing and reporting the performance of mechanical or thermal energy storage systems (ESSs) across various technology platforms. ASME PTC 53 is intended to have broad applicability; however, this Code is not intended to overlap the scope of similar codes published by other organizations such as the American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) and the Institute of Electrical and Electronics Engineers (IEEE). ASME PTC 53 covers mechanical and thermal technologies including compressed air, flywheels, thermal storage ranging from molten salts to cryogenic liquids, and pumped hydromechanical energy.

The ASME PTC 53 Committee issued ASME PTC 53 as a Draft Standard for Trial Use in 2018 to allow technology developers, engineers, and consumers to consider consistent strategies, methods, and systems for performance testing. ASME PTC 53-2022 builds on the Draft Standard, adding Sections on instrumentation and measurement, computation and reporting of results, and uncertainty. ASME PTC 53-2022 is a complete PTC for industry use.

ASME PTC 53-2022 was approved by the American National Standards Institute as an American National Standard on September 15, 2022.

ASME PTC COMMITTEE
Performance Test Codes

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

CORRESPONDENCE WITH THE PTC COMMITTEE

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 and Scope

1-1 OBJECT

The object of this Code is to establish uniform test methods and procedures for conducting performance tests of mechanical or thermal energy storage systems (ESSs). An ESS is a system that consumes energy to increase the internal energy of the storage media and releases that stored energy to produce useful power or heat. The standard test procedures for ESSs established by this Code provide the highest level of accuracy consistent with current engineering practice.

This Code provides procedures for measuring the following parameters:

(a) the quantity of energy input
(b) the rate of energy input (power)
(c) the quantity of non-useful energy flows in and out of the system during input, steady-state storage, and discharge
(d) the quantity of useful energy output
(e) the rate of useful energy output (power)

This Code provides quantifiable methods to assess the performance of mechanical or thermal ESSs in various technology platforms and applications.

When tests are conducted in accordance with a code, the test results themselves, without adjustment for uncertainty, yield the best available indication of actual performance of the equipment tested within the operational parameters defined in a Performance Test Code (PTC). This Code does not specify means to compare results to contractual guarantees. Therefore, parties to a commercial test should agree on the method for comparing results to commercial guarantees before starting the test.[1] It is beyond the scope of this Code to determine or interpret how such comparisons are made.

This Code shall not be used to troubleshoot equipment. However, this Code can be used to quantify the magnitude of performance anomalies of equipment suspected of performing poorly or to confirm the need for maintenance if simpler means are not adequate. This Code can be used as a source or reference for simple routine or special equipment test procedures.

1-2 SCOPE

1-2.1 Types of Systems to Which This Code May Apply

This Code applies to ESSs in which mechanical or thermal means are used to affect the storage and release of energy from suitable mechanical, thermal, or fluid media.

This Code applies to the measurement of the performance of an ESS at the specified conditions, with all equipment associated with the system functioning in accordance with those conditions.

An ESS may use any of various media, including, but not limited to, the following:

(a) thermal energy storage media, such as phase-change media (e.g., liquefied air or water-ice) or sensible heating media (e.g., molten salt or thermal fluids and oils)
(b) compression media, such as compressed air or springs
(c) gravitational media, such as pumped hydromechanical energy or railcars on inclines
(d) chemical media, such as hydrogen or ammonia reactions
(e) kinetic media, such as flywheels

This Code provides methods to measure energy and material flows to and from an ESS that are relevant to assessment of ESS performance. For example, some ESSs may use energy inputs from multiple external sources. Some ESSs may also produce by-products such as water, carbon dioxide, or industrial gases that may have economic value or disposal costs of interest to users of this Code.

[1] Manufacturers typically provide correction curves or multiplication factors to adjust the performance guarantees for off-design conditions typically encountered during a test.