ASME PTC 53-2018

Draft Standard for Trial Use

Mechanical and Thermal Energy Storage Systems

Performance Test Codes

This is a Draft Standard for Trial Use and Comment. This Draft Standard is not an approved consensus standard of ASME nor is it an American National Standard. ASME has approved its issuance and publication as a Draft Standard only. Distribution of this Draft Standard for comment shall not continue beyond 1 year from the date of issuance. The content of this Draft Standard for Trial Use and Comment was not approved through ASME's consensus process. Following the 1-year trial and comment period, this Draft Standard, along with comments received, will be submitted to a Consensus Committee or Project Team. The Consensus Committee or Project Team will review and revise this Draft Standard based, in part, upon experience during the trial term and resulting comments. A public review in accordance with established American National Standards Institute (ANSI) procedures is required at the end of the Trial-Use Period and before a Draft Standard for Trial Use is submitted to ANSI for approval as an American National Standard. Thereafter, it is expected that this Draft Standard (including any revisions thereto) will be submitted to ANSI for approval as an American National Standard. Suggestions for revision should be directed to the Secretary, PTC 53 Committee using the following form: http://go.asme.org/PTC53CommentForm.

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This Draft Standard for Trial Use will be revised following the conclusion of the Trial-Use Period. There will be no written interpretations of the requirements of this Draft Standard for Trial Use issued.

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NOTICE

All Performance Test Codes must adhere to the requirements of ASME PTC 1, General Instructions. The following information is based on that document and is included here for emphasis and for the convenience of the user of the Code. It is expected that the Code user is fully cognizant of Sections 1 and 3 of ASME PTC 1 and has read them prior to applying this Code.

ASME Performance Test Codes provide test procedures that yield results of the highest level of accuracy consistent with the best engineering knowledge and practice currently available. They were developed by balanced committees representing all concerned interests and specify procedures, instrumentation, equipment-operating requirements, calculation methods, and uncertainty analysis.

When tests are run in accordance with a Code, the test results themselves, without adjustment for uncertainty, yield the best available indication of the actual performance of the tested equipment. ASME Performance Test Codes do not specify means to compare those results to contractual guarantees. Therefore, it is recommended that before starting the test, and preferably before signing the contract, the parties to a commercial test agree on the method to be used for comparing the test results to the contractual guarantees. It is beyond the scope of any Code to determine or interpret how such comparisons shall be made.

FOREWORD

ASME PTC 53, Mechanical and Thermal Energy Storage Systems, is a Draft Standard for Trial Use applicable to mechanical and thermal energy storage system(s) (ESS). When the full Code is issued, it will define uniform test procedures and quantifiable test methods for assessing, determining, and reporting the performance of mechanical or thermal ESS across varying technology platforms. ASME PTC 53 is intended to have broad applicability; however, the Code is not intended to overlap the scope of similar codes published by other agencies 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 will cover mechanical and thermal technologies including compressed air, flywheels, thermal storage ranging from molten salts to cryogenic liquids, and pumped hydromechanical energy.

(a) The PTC 53 Committee is issuing as a Draft Standard for Trial Use the first three Sections of the Code to allow current technology developers, engineers, and consumers to consider consistent strategies, methods, and systems for performance testing.

(1) Section 1 describes the scope and object of the Code.

(2) Section 2 describes definitions and terms used in the Code.

(3) Section 3 describes guiding principles for application of the Code.

(b) Sections and Appendices on various unit configurations, data collection and handling requirements, performance parameters, uncertainty analysis, test reports, and more definitive test boundaries for representative ESS applications are currently in development and will be added to the final Code. The following Sections will be added, per the guidance found in ASME PTC 1-2015:

(1) Section 4, Instruments and Methods of Measurement

(2) Section 5, Computation of Results

(3) Section 6, Report of Results

(4) Section 7, Test Uncertainty

The PTC 53 Committee intends to accept comments on the first three Sections of the Code while preparing the remaining Sections.

Submitting Comments and Proposing Revisions. Comments and proposals for revision should be directed to the Secretary, PTC 53 Committee using the following form: http://go.asme.org/PTC53CommentForm. Any proposals for revision 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.

The comment form contains instructions on how to submit comments.

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.

ASME PTC COMMITTEE
Performance Test Codes

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

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Section 1
Object and Scope

1-1 OBJECT

The objective of this Draft Standard, hereafter referred to as the "Code," is to establish uniform test methods and procedures for conducting performance tests of mechanical or thermal energy storage system(s) (ESS). An ESS is a system that consumes energy to increase the internal energy of the storage media and releases the stored energy, producing useful power or heat. This Code provides standard test procedures for ESS with the goal to 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 nonuseful energy flows in/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)

The Code provides quantifiable methods to assess the performance of mechanical or thermal energy storage systems for 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 this Performance Test Code (PTC). This Code does not specify means to compare those results to contractual guarantees. Therefore, it is recommended that parties to a commercial test agree on the method to be used 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 is not to be used in troubleshooting equipment. However, this Code can be used to quantify the magnitude of performance anomalies of equipment that is suspected to be 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 simpler 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 mechanical or thermal ESS including, but not limited to, compressed air, flywheel, molten salt, and pumped hydromechanical ESS and sensible, latent, cryogenic, thermochemical, ice-based, or phase-change-material thermal ESS.

ASME PTC 53 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

(f) electrolytic media, such as flow batteries

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

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 ESS may use energy inputs from multiple external sources. Some ESS 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.

1-2.2 Types of Systems to Which This Code Does Not Apply

Electrical battery storage devices (lead-acid, lithium ion, etc.) have been specifically excluded from this Code since the test procedures for that technology have been defined in test codes promulgated by others.

1-3 UNCERTAINTY

This Code requires an uncertainty analysis in accordance with ASME PTC 19.1. 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 Section 3.

Test uncertainty is an estimate of the limit of error of a test result. It is the interval about a test result that contains the true value with a given probability, or level of confidence. Test uncertainty is based on calculations using statistics, instrumentation information, calculation procedure, and actual test data. Code tests are suitable for use whenever performance must be determined with minimum uncertainty. Code tests are meant specifically for equipment operating in an industrial setting.

1-4 REFERENCES

The following is a list of publications referenced in this Code:

ASME PTC 1, General Instructions
ASME PTC 2, Definitions and Values
ASME PTC 3.1, Diesel and Burner Fuels
ASME PTC 3.2, Solid Fuels
ASME PTC 3.3, Gaseous Fuels
ASME PTC 19.1, Test Uncertainty
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