ASME TES-1–2020

Safety Standard for Thermal Energy Storage Systems: Molten Salt

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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The next edition of this Standard is scheduled for publication in 2023. This Standard will become effective 6 months after the Date of Issuance.

ASME issues written replies to inquiries concerning interpretations of technical aspects of this Standard. Periodically certain actions of the ASME TES Committee may be published as Cases. Cases and interpretations are published on the ASME website under the Committee Pages at http://cstools.asme.org/ as they are issued.

Errata to codes and standards may be posted on the ASME website under the Committee Pages to provide corrections to incorrectly published items, or to correct typographical or grammatical errors in codes and standards. Such errata shall be used on the date posted.

The Committee Pages can be found at http://cstools.asme.org/. There is an option available to automatically receive an e-mail notification when errata are posted to a particular code or standard. This option can be found on the appropriate Committee Page after selecting “Errata” in the “Publication Information” section.

The American Society of Mechanical Engineers
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FOREWORD

In July 2013, the American Society of Mechanical Engineers (ASME) conducted a survey of industry professionals on thermal energy storage (TES). The results indicated interest in the development of standards or guidance documents for the TES sector. ASME again surveyed industry professionals in May 2014 and determined that the proposed standard or guide should focus on safety related to electrical utility applications, specifically TES systems. The results also suggested that the standard should be suitable for use by manufacturers, owners, designers, and others concerned with or responsible for the application of prescribed safety requirements.

A group was formed from the list of survey respondents to discuss the development of an initial TES standard or guideline. This group met on a monthly basis throughout the latter part of 2014 until June 2015. Based on their efforts, ASME formed a Safety Standards Committee for Thermal Energy Storage Systems (TES Safety Standards Committee) in June 2015. At that time the TES committee charter and membership were approved by ASME.

The purpose of the committee is to develop and maintain safety standards covering the design, construction, installation, inspection, testing, commissioning, maintenance, operation, and decommissioning of TES systems. Recognizing the range of TES technologies, the TES Safety Standards Committee decided to initially focus on one technology, molten salt TES systems. Following the completion of this task, the Committee will address standards or guides for other TES systems.

Since late 2015, the TES Safety Standards Committee has worked to develop a safety standard for molten salt TES systems. ASME TES-1–2020 is the result of these efforts. The American National Standards Institute approved ASME TES-1-2020 as an American National Standard on March 11, 2020.

ASME TES COMMITTEE
Thermal Energy Storage Systems

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

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CORRESPONDENCE WITH THE TES COMMITTEE

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, TES 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 TES 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 TES 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 TES 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.

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 TES 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 TES Standards Committee.

INTRODUCTION

Solar energy may be the leading renewable energy source, but storage challenges have limited its adoption by, among others, utilities. Thanks to innovations in thermal energy storage in megawatt-hour quantities, solar thermal energy has become more feasible for large-scale applications.

Thermal energy can be stored in sensible, latent, or chemical form. The storage of industrial quantities of thermal energy is in a nascent stage and primarily consists of sensible heat storage in nitrate salt eutectics and mixtures. The requirements and guidance described in this Standard are for the safe implementation of thermal energy storage in the generation of electrical power using a sensible heat method.

This Standard describes practices for designing and implementing thermal energy storage (TES) for large applications. These usually involve two-tank sensible heat systems using molten salts. The practices described in this Standard are to be used during factory manufacture and on the jobsite. The team implementing the Standard is expected to have a working knowledge of hydraulics, materials, electrical systems and controls, thermal energy fundamentals, applicable referenced standards, field test measurement methods, and how to use test and measurement equipment needed to meet these requirements.

This Standard was prepared with attention to other standards for energy storage systems. The tests described are useful in establishing compliance with other related standards.

SAFETY STANDARD FOR THERMAL ENERGY STORAGE SYSTEMS: MOLTEN SALT

1 SCOPE

This Standard establishes requirements for the design, construction, installation, inspection, testing, commissioning, maintenance, operation, and decommissioning of molten salt thermal energy storage (TES) systems. Molten salt thermal energy systems include the storage medium and associated storage vessels, controls for the system, and associated system components such as circulation pumps, valves, piping, and heat exchangers that are in contact with molten salt.

The following components are not included within the scope of this Standard:

(a) the solar receiver and parabolic trough system and associated heat transfer fluid piping

(b) solar field

(c) steam and water piping and associated pumps

(d) power block

(e) auxiliary heater

Figures 1-1 and 1-2 provide examples of molten salt TES systems.

2 DEFINITIONS

cladding: the weather-proof jacketing on the outside of any thermal insulation.

design basis document: the set of instructions establishing the owner-defined criteria (objectives, conditions, needs, requirements, etc.) the design engineering organization takes into account when designing the project.

designer: the person or organization in charge of the engineering design. The designer is responsible for complying with standards and regulations and demonstrating this compliance with equations when such equations are mandatory.

manufacturer: the person or organization responsible for the construction of the structural, mechanical, piping, and/or electrical equipment and components in accordance with the rules of this Standard and the requirements of the design.

molten salt: the liquid state of a salt mixture such as sodium nitrate and potassium nitrate. Molten salts are useful as a thermal storage medium and heat transfer fluid in TES systems.

owner: for the purposes of this Standard, the party ultimately responsible for the operation of a facility. The owner is the party licensed by the regulatory authority having jurisdiction; that is, the party with administrative and operational responsibility for the facility, including the planning activities described in para. 4.1. The owner may hire a third-party service provider to operate and maintain the TES system on its behalf.

purchaser: the owner of the TES system or the owner's designated agent.

NOTE: A single entity may fill one or more of the roles defined in the Definitions list.

3 REFERENCES

The codes, standards, and specifications listed in this section contain provisions that, to the extent referenced in this Standard, constitute requirements of this Standard.

API 510-2014, Pressure Vessel Inspection Code: In-Service Inspection, Rating, Repair, and Alteration

API 570-2016, Piping Inspection Code: In-Service Inspection, Rating, Repair, and Alteration of Piping Systems

API RP 580-2009, Risk-Based Inspection

API RP 2003-2015, Protection Against Ignitions Arising Out of Static, Lightning, and Stray Currents

API STD 610-2010, Centrifugal Pumps for Petroleum, Petrochemical and Natural Gas Industries

API STD 620-2013, Design and Construction of Large, Welded, Low-Pressure Storage Tanks

API STD 650-2013, Welded Tanks for Oil Storage

API STD 653-2014, Tank Inspection, Repair, Alteration, and Reconstruction

API STD 2000-2014, Venting Atmospheric and Low-Pressure Storage Tanks

API STD 2015-2018, Requirements for Safe Entry and Cleaning of Petroleum Storage Tanks

Publisher: American Petroleum Institute (API), 200 Massachusetts Avenue NW, Suite 1100, Washington, DC 20001-5571 (www.api.org)

ASME A13.1-2015, Scheme for the Identification of Piping Systems

ASME B31.1-2018, Power Piping

ASME B31.3-2016, Process Piping