ASME PTC 12.2-2010

[Revision of PTC 12.2-1998 (R2007)]

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Steam Surface Condensers

Performance Test Codes

AN AMERICAN NATIONAL STANDARD

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

The American Society of Mechanical Engineers
Three Park Avenue, New York, NY 10016-5990

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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 the parties to a commercial test 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 Code to determine or interpret how such comparisons shall be made.

FOREWORD

When the work of revising the ASME Power Test Codes of 1915 was undertaken, it was decided to include a committee to develop three separate test codes on condensing apparatus, feedwater heaters, and water-cooling equipment. The resulting Test Code for Steam-Condensing Apparatus, after passing through the preliminary stages in the procedure prescribed by the Main Committee, was printed in tentative form in the May 1924 issue of *Mechanical Engineering* and was presented to the Society for discussion at a public hearing held during the spring meeting in Cleveland in May 1924. At the December 1924 meeting of the PTC Supervisory Committee (now known as the Board on Performance Codes), it was approved in its final revised form, and on October 5, 1925, it was approved and adopted by the Council as a standard practice of the Society.

Early in 1933, Committee No. 12 decided to completely revise the Test Code for Steam-Condensing Apparatus. At the April 4, 1938, meeting of the PTC Supervisory Committee, this second version of the Code was approved, and on July 15, 1938, it superseded the previous one and was adopted by the Council as a standard practice of the Society.

With the reorganization of PTC Committee No. 12 on Condensers, Feedwater Heaters, and Deaerators in 1948, the main Power Test Codes Committee requested that the Test Code for Steam-Condensing Apparatus be updated. This third edition of the Code was approved at the December 4, 1953, meeting of the Power Test Codes Committee and adopted by the Council as a standard practice of the Society on March 9, 1954.

In January 1970, the PTC Supervisory Committee requested the Test Code for Steam-Condensing Apparatus be reviewed and updated. That fourth version of the Code was approved by the Board on Performance Test Codes on May 7, 1981, and it became an American National Standard in January 1983.

The Board on Performance Test Codes in 1988 directed the Code again be reviewed to ensure it reflected current engineering practices. A new Code Committee was organized in early 1989 containing members from a wide geographical area. It comprised about equal numbers of manufacturing, user, and general interest members to ensure balanced Committee actions. The 1989 Committee was organized into four subcommittees — Guiding Principles, Test Procedures, Instruments and Methods, and Computation of Results — to ensure each section of the Code revision would be properly addressed and the work would be accomplished effectively.

Based on experience with the two previous versions of the Condenser Code, the reorganized Committee determined to make this Code modern, accurate, practical, useful, and cost-effective. It also identified the objective of extending the Code to include performance monitoring, because of the relatively large effect of operating condensers on plant generation and efficiency.

These ambitious goals translated into extensive revisions that triggered an almost complete rewrite. The major areas were revised, and the rationale for the 1998 revision of this Code was as follows:

(a) *Instruments*. To take advantage of the then-significant advances in the field, instrumentation recommendations were modernized.

(b) *Heat Transfer*. To enlarge the schedule "window" for the condenser test while maintaining accurate test results, the separate heat-transfer resistance method with the latest correlations was adopted.

(c) *Implementation*. To clarify the Code rules and produce a virtually self-contained document, techniques and instrumentation descriptions were written in an explicit and detailed manner.

(d) *Uncertainty Determinations*. To ensure proper applications of uncertainty analysis, all the particulars of this somewhat daunting estimate (a very important and now necessary aspect of every test) were presented.

(e) *Data Acquisition*. To improve the condenser test effectiveness, computerized data acquisition for the testing and data reduction was recommended; however, the Code was written so that this approach was not necessary.

(f) *Cleanliness Testing*. To be certain the condenser performance results were not predestined, a mandatory cleanliness test was required by the 1998 edition of the Code. It is important to note, though, that the previous cleanliness test section was replaced in its entirety with a new, pragmatic fouling test procedure.

Last, the expanded fifth edition of the Code was retitled *Steam Surface Condensers*. This Code was approved by the PTC 12.2 Committee on January 20, 1996. It was then approved and adopted by the Council as a standard practice of the Society by action of the Board on Performance Test Codes (BPTC) on December 20, 1996. This Performance Test Code was also approved as an American National Standard by the ANSI Board of Standards Review on February 20, 1998.

The 1998 Condenser Test Code was mainly focused on conducting a rigorous, full-scale acceptance test. After several years of experience with that Code, it was reported that its use was infrequent because of the complicated and expensive requirements of a full-scale condenser performance test. The PTC 12.2 Committee was reconstituted on June 14, 2007, to undertake a revision of the Code. The Committee decided that the revision would include a less rigorous test that would also be considered as an acceptance test. The rationale was to better establish equipment-performance metrics with the philosophy of promoting testing. This less-accurate test provides a slight relaxation of the allowable test conditions and requirements. The revision includes an update of the condenser test technology.

This, the sixth edition of the Code, was approved by the PTC Standards Committee on November 2, 2009, and approved and adopted as a standard practice of the Society by action of the Board on Standardization and Testing on December 8, 2009. The Performance Test Code was also approved as an American National Standard by the ANSI Board of Standards Review on January 14, 2010.

ASME PTC COMMITTEE
Performance Test Codes

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

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CORRESPONDENCE WITH THE PTC COMMITTEE

General. ASME Codes are developed and maintained with the intent to represent the consensus of concerned interests. As such, users of this Code may interact with the Committee by requesting interpretations, proposing revisions, and attending Committee meetings. Correspondence should be addressed to

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

Proposing Revisions. Revisions are made periodically to the Code 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 periodically.

The Committee welcomes proposals for revisions to this Code. 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 for the purpose of providing 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.

Request for cases shall provide a Statement of Need and background information. The request should identify the Code, 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 of the Code to which the proposed Case applies.

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

The request for interpretation should be clear and unambiguous. It is further recommended that the inquirer submit his request in the following format:

Subject: Cite the applicable paragraph number(s) and a concise description.

Edition: Cite the applicable edition of the Code 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. 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 this format will be rewritten in this format by the Committee prior to being answered, which may inadvertently change the intent of the original request.

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. ASME does not “approve,” “certify,” “rate,” or “endorse” any item, construction, proprietary device, or activity.

Attending Committee Meetings. The PTC Standards Committee holds meetings or telephone conferences, which are open to the public. Persons wishing to attend any meeting or telephone conference should contact the Secretary of the PTC Standards Committee.

STEAM SURFACE CONDENSERS

Introduction

This Code describes instruments, test procedures, and methods of test-data analysis to be used to determine and monitor the performance of steam surface condensers. It provides explicit test procedures that will yield results of the highest level of accuracy consistent with the best current engineering practices and knowledge in this field. The Code is not intended to be used for tests of condensers or heat exchangers operating above atmospheric pressure or air-cooled condensers.

To aid in an overall study of the Code, the following review sequences are recommended:

(a) A quick survey of the Code can be obtained by reading the introductions to each Section followed by the test procedures flowcharts in subsection 4-9 and Nonmandatory Appendices B, G, and H, and the Test Plan Checklist in Nonmandatory Appendix B.

(b) At the plant design, contractual agreement, or specification stage, it is advisable to review in order the following:

(1) achievable test uncertainty as stated in subsection 1-3

(2) test procedures, or alternatively the particular special test from Nonmandatory Appendix A

(3) test plan and flowcharts

(4) guiding principles (see Section 3)

(5) instrumentation and methods of measurement to determine the hardware that must exist or be installed in the condenser to determine the recommended measurements (see Section 4)

(c) Those interested in performance monitoring should review Nonmandatory Appendix C, then the test plan and flowcharts before reviewing Code Section details.

When this Code is to be used to determine fulfillment of contractual obligations, the contracting parties shall agree in advance on the test procedures, uncertainty estimates and implications, and methods of presentation of data and presentation of results.

Considerable efforts were made to write this condenser Code so that all the related technology would be contained within the document itself; however, this was not possible in all instances. In these cases and unless otherwise specified, all references to other codes refer to ASME Performance Test Codes. Any terms not defined herein are listed in ASME PTC 2, *Definitions and Values* [1]. Descriptions of instruments, apparatus, and the general basis of the uncertainty analysis beyond that specified in this Code may be found in the Supplements on Instruments and Apparatus, ASME PTC 19.1 [1]. A careful study should be made of all the referenced codes, but in the event of discrepancies between the specific directions contained herein and those Codes incorporated by reference, ASME PTC 12.2 shall govern.

Section 1
Object and Scope

1-1 OBJECT

This Code provides standard directions and rules for conducting and reporting performance tests of water-cooled, steam surface condensers, hereafter referred to as condensers. This Code provides explicit test procedures for performing a reasonably accurate, pragmatic level of performance testing.

If higher levels of accuracy are desired, the alternative test, described in Nonmandatory Appendix A, can be performed in lieu of the test.

Acceptance testing is used to determine compliance with contractual obligations and can be incorporated into commercial agreements. The test shall be considered an ASME Code test only if the test procedures comply with this Code.

1-1.1 Performance Parameters

This Code provides rules for determining the following condenser performance parameters:

(a) the absolute pressure maintained by the condenser
(b) the test pressure of the condenser corrected to the design-reference conditions
(c) the extent of condensate subcooling
(d) the amount of dissolved oxygen in the condensate
(e) the tubeside pressure drop

1-1.2 Test Methods

Test methods for determining the condenser performance and degree of tube fouling, expressed as a cleanliness factor and fouling resistance, are described for both tests.

1-2 SCOPE

The rules and instructions included in this Code are for the condenser. The test does not assess the performance of any of the auxiliary apparatus associated with the condenser. For any related equipment components, refer to other ASME Performance Test Codes.

1-3 UNCERTAINTY

The test results shall be considered the direct evidence of the condenser's performance. These test results shall not be adjusted by the test uncertainty.

(a) The uncertainty for this performance test has been predetermined for typical instrumentation as recommended in Section 4. Using the recommended instrumentation, the test uncertainties of the following parameters are expected to be no greater than those listed below:

(1) absolute pressure maintained by the condenser, ±0.17 kPa (±0.05 in. HgA)
(2) the test pressure adjusted to the design or reference point, ±0.51 kPa (±0.15 in. Hg)
(3) condensate subcooling, ±0.11°C (±0.2°F)
(4) dissolved oxygen in the condensate, ±4.0 μg/L (±4.0 ppb)
(5) tubeside pressure drop, ±9%

(b) The typical expected uncertainties of performing the alternative test, as described in Nonmandatory Appendix A, are as follows:

(1) absolute pressure maintained by the condenser, ±0.14 kPa (±0.04 in. HgA)
(2) the test pressure adjusted to the design or reference point, ±0.41 kPa (±0.12 in. Hg)
(3) condensate subcooling, ±0.11°C (±0.2°F)
(4) dissolved oxygen in the condensate, ±4.0 μg/L (±4.0 ppb)
(5) tubeside pressure drop, ±9%