ASME PTC 51-2011

Gas Turbine Inlet Air-Conditioning Equipment

Performance Test Codes

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AN AMERICAN NATIONAL STANDARD

The American Society of Mechanical Engineers
Three Park Avenue • New York, NY • 10016 USA

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This Code will be revised when the Society approves the issuance of a new edition.

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The American Society of Mechanical Engineers
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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

ASME Performance Test Codes (PTCs) have long existed for determining the performance of gas turbines units and for gas-turbine-based overall plant performance in electric power production facilities. These codes have advised the user to conduct testing of gas turbines and gas-turbine-based plants with inlet conditioning out of service and to correct the results of the test with results of a subsequent test of the inlet conditioning system. Yet users of the test codes were without a test code to provide guidance of the performance of such a test since a Performance Test Code has heretofore not existed to determine the performance of gas turbine inlet air-conditioning equipment. With the growing use of gas turbine inlet air-conditioning equipment in the electric power generation industry, the need for a code addressing gas turbine inlet air-conditioning equipment became very apparent. In response to these needs, the ASME Board on Performance Test Codes approved the formation of a committee (PTC 51) in September 2002 with the charter of developing a code for the determination of inlet air-conditioning equipment performance. The organizational meeting of this Committee was held in March 2003. The resulting Committee included experienced and qualified users, manufacturers, and general interest category personnel from both the regulated and nonregulated electric power generating industry.

In developing the first issue of this Code, the Committee reviewed common industry practices with regard to inlet air-conditioning equipment testing. The Committee was not able to identify any general consensus testing methods, and discovered many conflicting philosophies, approaches, and performance definitions. For some inlet air-conditioning equipment, correction approaches to standard conditions did not exist. The Committee has strived to develop an objective code that addresses the multiple needs for explicit testing methods and procedures, while attempting to provide maximum flexibility in recognition of the wide range of inlet air-conditioning designs and the multiple needs for this Code.

This Code was approved by the PTC 51 Committee on November 17, 2010. It was then approved and adopted by the Performance Test Code Standards Committee on December 9, 2010. It was also approved as an American National Standard by the ANSI Board of Standards Review on March 30, 2011.

ACKNOWLEDGMENTS

The PTC 51 Committee wishes to acknowledge the contribution of the following individuals to the development of Nonmandatory Appendix A: Keith Khasiak, Joseph Shakal, Paul Sojka, and especially Robert Burgess, who served as Chair of the developmental group.

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Performance Test Codes

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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
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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.

Requests for Cases shall provide a Statement of Need and Background Information. The request should identify the Code, 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 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 only be rendered 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/her request in the following format:

Subject:	Cite the applicable paragraph number(s) and the topic of the inquiry.
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 or Subcommittee. ASME does not approve, certify, rate, or endorse any item, construction, proprietary device, or activity.

Attending Committee Meetings. The PTC Standards Committee and PTC Committees hold meetings regularly, which are open to the public. Persons wishing to attend any meeting should contact the Secretary of the PTC Committee.

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GAS TURBINE INLET AIR-CONDITIONING EQUIPMENT

Section 1
Object and Scope

1-1 OBJECT

This Code provides procedures for in situ testing of inlet air-conditioning systems (cooling/heating) as they apply to gas turbines in simple, cogeneration, and combined-cycle applications.

The intent of this Code is to provide results with the lowest reasonably achievable uncertainty consistent with the best engineering knowledge and practice in the industry, such that appropriate instrumentation and measurement techniques and procedures be used to determine the following performance variables, as applicable:

– performance factor
– carryover
– auxiliary consumption (power/thermal)
– temperature change
– water discharge
– water consumption
– distribution/stratification
– pressure drop

This Code also provides procedures for the calculation of the results, and for the correction of the results to reference conditions, as a measure of gas turbine inlet air-conditioning systems performance.

1-2 SCOPE

This Code may be used for in situ testing of inlet air-conditioning systems (cooling/heating) as they apply to gas turbines in simple, cogeneration, and combined-cycle applications. Cooling systems covered by this Code include evaporative systems (foggers and media-based evaporative coolers) and mechanical/thermal refrigeration systems. Heating systems covered by this Code include compressor-bleed type systems and heating-coil systems.

This Code is limited to gas turbine inlet air-conditioning systems and does not apply to the following:

– building heating, cooling, or refrigeration systems
– gas turbine compressor intercoolers
– wet compression, overspray, deluge, overfogging, and similar technologies
– other power plant applications such as air-cooled electrical generators
– gas turbine performance

In addition, this Code does not apply to the testing of individual atomizing nozzles. However, the Committee recognizes that carryover is a critical characteristic of fogging systems. As such, there may be situations that require the quantification of water droplet size. To address this need, the Code further provides the procedures for determining water droplet size associated with laboratory bench testing of atomizing nozzles; please see Nonmandatory Appendix A.

This Code contains rules and procedures for conducting and reporting tests of gas turbine inlet air-conditioning systems, including requirements for pretest arrangements, testing techniques, instrumentation, methods of measurement, and methods for calculating test results and uncertainty.

1-3 UNCERTAINTY

A pretest uncertainty analysis is required to demonstrate that the proposed instrumentation and measurement techniques meet the requirements of this Code; this analysis shall include an estimate of the random uncertainty based on experience. A posttest uncertainty analysis is required to evaluate overall test uncertainty, including the actual random uncertainty and spatial uncertainties associated with the test result. To accomplish testing with reasonable accuracy, limits for both the test instrument uncertainty and the variation for each required measurement are established in this Code.

Limits on uncertainty and variations for each measurement were set in recognition of the fact that there is a diverse range of inlet air-conditioning system designs covered by this Code. Each unique system has corresponding uncertainty levels that are dependent on the system type, specific design complexity, and consistency of operation during a test and cannot be generally categorized for purposes of establishing uncertainty limits on the test results achievable from testing in accordance with this Code.