ASME PTC 47.4-2015

REAFFIRMED 2020

Power Block of an Integrated Gasification Combined Cycle Power Plant

Performance Test Codes

AN AMERICAN NATIONAL STANDARD

The American Society of Mechanical Engineers

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The next edition of this Code is scheduled for publication in 2020.

ASME issues written replies to inquiries concerning interpretations of technical aspects of this Code. Interpretations are published on the Committee Web page and under go.asme.org/InterpsDatabase. Periodically certain actions of the ASME PTC Committee may be published as Cases. Cases are published on the ASME Web site under the PTC Committee Page at go.asme.org/PTCcommittee as they are issued.

Errata to codes and standards may be posted on the ASME Web site 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 PTC Committee Page can be found at go.asme.org/PTCcommittee. 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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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 been developed and have long existed for determining the performance of most major components used in electric power production facilities. A PTC has heretofore not existed to determine the overall performance of an integrated gasification combined cycle (IGCC) power generation plant. The ability to fire a wide range of fuels has been a key advantage of gas turbines over competing technologies. Until recently, the traditional fuels for gas turbines have been natural gas and liquid fuels. Today, environmental concerns and economic considerations are causing power generation suppliers to develop gasification systems that can use solid and liquid fuels (e.g., coal, biomass, waste, and heavy oils). Preparation of an alternative fuel suitable for a gas turbine includes removal of ash, contaminants, erodents, and corrodents. In response to these needs, the ASME Board on Performance Test Codes approved the formation of the PTC 47 Committee in 1993 with the charter of developing a code for determining overall power plant performance of gasification power generation plants. The organizational meeting of this Committee was held in November 1993. The resulting Committee included experienced and qualified users, manufacturers, and general interest personnel.

The Committee has striven 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 plant designs.

This Code was approved by the PTC 47 Committee and the PTC Standards Committee on February 3, 2015. It was then approved as an American National Standard by the America National Standards Institute (ANSI) Board of Standards Review on May 22, 2015.

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 or a Case, and attending Committee meetings. Correspondence should be addressed to:

Secretary, PTC 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 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 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 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 at go.asme.org/Inquiry.

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 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 go.asme.org/PTCcommittee.

INTRODUCTION

This Code describes testing procedures for the IGCC power block and is part of the following set of related Codes:

(a) ASME PTC 47, Integrated Gasification Combined Cycle Power Generation Plants, for testing the overall plant performance on an IGCC plant.

(b) ASME PTC 47.1, Cryogenic Air Separation Unit, for testing the performance of the air separation unit (ASU). If the physical IGCC plant includes an ASU, the inclusion of the ASU within the overall test envelope is recommended but not required.

(c) ASME PTC 47.2, Gasification System, for testing the thermal performance of the combined gasifier and fuel gas cleaning equipment.

(d) ASME PTC 47.3, Fuel Gas Cleaning, for testing the contaminant content of gas delivered to the power block.

(e) ASME PTC 47.4, Power Block of an Integrated Gasification Combined Cycle Power Plant, for testing the thermal performance of the gas turbine combined cycle power block.

NOTE: ASME PTC 47.1, ASME PTC 47.2, and ASME PTC 47.3 are in the course of preparation.

It is recommended that overall plant and subsystems be tested separately, not simultaneously, to accommodate any boundary constraints and valve isolations and lineups that may be needed for subsystem testing. In highly integrated IGCC plants, the entire plant may need to be operating during a subsystem test, even though the only performance parameters being measured are those of the subsystem.

Test results can be used as defined by a contract to determine the fulfillment of contract guarantees. Test results can also be used by a plant owner to compare plant performance to a design number, or to trend plant performance changes in time. However, the results of a test conducted in accordance with this Code will not provide a basis for comparing the thermoeconomic effectiveness of different plant designs.

POWER BLOCK OF AN INTEGRATED GASIFICATION COMBINED CYCLE POWER PLANT

Section 1
Object and Scope

1-1 OBJECT

The object of this Code is to provide uniform test methods and procedures for the determination of the thermal performance and electrical output of an integrated gasification combined cycle (IGCC) power block.

(a) This Code provides explicit procedures for the determination of the following performance results:

(1) corrected net power
(2) corrected net heat rate
(3) corrected heat input

(b) Tests may be designed to satisfy different goals, including

(1) specified disposition
(2) specified net corrected power
(3) specified net power

1-2 SCOPE

This Code applies to combined cycle power plants (power blocks) that operate in conjunction with a gasification plant, an IGCC power plant, or an IGCC cogeneration plant. This Code does not apply to power blocks other than those associated with IGCC plants.

This Code is applicable to the combined cycle power block of IGCC power plants, whereas ASME PTC 46 is applicable to conventional combined cycles. The thermal streams and corrections in ASME PTC 46 for conventional combined cycles are normally limited to gas or liquid hydrocarbon fuel input and steam or water input. In ASME PTC 47.4, test measurements and associated corrections are needed to address multiple thermal streams such as heated hydrocarbon syngas fuel input, water and steam inputs from gasification process units, nitrogen input from the air separation plant, and air extraction to the air separation plant.

Emissions tests, operational demonstration tests, and reliability tests are outside the scope of this Code.

1-3 UNCERTAINTY

The explicit measurement methods and procedures to be used for the power block of an IGCC have been developed to provide guidelines for test procedures that yield results of the highest level of accuracy based on current engineering knowledge, taking into account test costs and the value of information obtained from testing. The calculation of test uncertainty shall be performed in accordance with ASME PTC 19.1 and as outlined in this Code.

Because of the diverse range of integration of the power block with the gasification block and the air separation unit block, the test results will have different levels of uncertainty.

A pretest uncertainty analysis shall be performed to establish the expected level of uncertainties for the test. Most tests conducted in accordance with this Code will result in uncertainties that are lower than those shown in Table 1-3-1. A post-test uncertainty analysis is also required to validate the test.

The largest expected overall test uncertainties are given in Table 1-3-1. These values are not targets. A primary philosophy underlying this Code is that the lowest achievable uncertainty is in the best interest of all parties to the test. Deviations from the methods recommended in this Code are acceptable only if it can be demonstrated they provide equal or lower uncertainty.

Table 1-3-1 Largest Expected Test Uncertainty

Test Result	Test Uncertainty
Corrected net power	1.0%
Corrected heat rate	1.5%
Corrected heat input	1.5%