ASME PTC 47.2-2019

Gasification 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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Two 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.

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

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The PTC Committee Page can be found at http://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
Two Park Avenue, New York, NY 10016-5990

CONTENTS

Figures

Tables

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 for determining 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 typical fuels for gas turbines have been natural gas and liquid fuels. But today, due to environmental concerns and economic considerations, power generation suppliers are developing gasification systems that can use solid and liquid fuels (coal, biomass, waste, heavy oils, etc.). Preparation of an alternative fuel suitable for a gas turbine includes removal of ash, contaminants, erodents, and corrodents. 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 the determining overall power plant performance for gasification power generation plants. The organizational meeting of the PTC 47 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 need 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 April 16, 2019. It was then approved as an American National Standard by the ANSI Board of Standards Review on July 17, 2019.

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 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, 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 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 PTC 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 PTC 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 PTC 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 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.

INTRODUCTION

ASME PTC 47 comprises five Performance Test Codes (PTCs) that describe testing procedures for an integrated gasification combined cycle (IGCC) power plant. ASME PTC 47, Integrated Gasification Combined Cycle Power Generation Plants, is used for testing the overall performance of an IGCC plant. If a plant passes the ASME PTC 47 test, no further testing is required. If a plant does not pass the ASME PTC 47 test, one or more secondary subsystems may be tested to isolate the problem(s), using the following PTCs:

(a) ASME PTC 47.1, Cryogenic Air Separation Unit of an Integrated Gasification Combined Cycle Power Plant, for testing the performance of the air separation unit (ASU)

(b) ASME PTC 47.2, Gasification Block of an Integrated Gasification Combined Cycle Power Plant, for testing the thermal performance of the gasification equipment

(c) ASME PTC 47.3, Syngas Conditioning Block of an Integrated Gasification Combined Cycle Power Plant, for testing the thermal performance of the syngas cleaning equipment (in development)

(d) 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

It is recommended that overall plant and subsystems be tested separately rather than 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 only subsystem performance parameters are being measured.

Plant owners can use test results to determine the fulfillment of contract guarantees. Plant owners can also use the test results to compare plant performance to a design number or to track plant performance changes over time. However, test results conducted in accordance with this Code will not provide a basis for comparing the thermoeconomic effectiveness of different plant designs.

APPLICATIONS AND LIMITATIONS. Gasification units that convert hydrocarbon feed into a combustible fuel gas (syngas), usually composed primarily of hydrogen, carbon monoxide, and methane, are included within the scope of this Code. This Code applies to the following types of gasifiers, some of which are depicted in Nonmandatory Appendix C.

(a) Moving-Bed (or Fixed-Bed) Gasifiers. These are gasifiers in which hydrocarbon and ash particles move slowly down through a bed while reacting with gases moving up through the bed.

(b) Fluidized-Bed Gasifiers. These are gasifiers in which the oxidizing gas is forced upward through the solid hydrocarbon feed at a superficial gas velocity either slightly less or greater than the terminal velocity of most of the individual particles.

(c) Entrained-Flow Gasifiers. These gasifiers are characterized by cocurrent flow of the hydrocarbon feed and oxidizing medium.

(d) Oxygen-Blown Gasifiers. These gasifiers use relatively pure oxygen as the oxidizing agent for partial combustion.

(e) Air-Blown Gasifiers. These gasifiers use air rather than oxygen as the oxidizing agent.

(f) Slagging Gasifiers. These are gasifiers from which the ash leaves as molten slag rather than as a nonagglomerated solid.

(g) Agglomerating-Ash Gasifiers. These gasifiers contain hot zones where ash particles are agglomerated into small pellets for removal.

(h) Dry-Ash Gasifiers. These are gasifiers from which ash leaves as either agglomerated or nonagglomerated solids rather than as molten slag.

Section 1
Object and Scope

1-1 OBJECT

The object of this Code is to provide uniform test methods for determining the performance and effective syngas production of an integrated gasification combined cycle (IGCC) gasification block. These test procedures yield highly accurate results consistent with current engineering knowledge and practice.

1-1.1 Accuracy

The accuracy of a test may be affected by factors within the discretion of the operator. A test is considered an ASME Code test if the following conditions are met:

(a) Test procedures comply with the procedures and variations defined in this Code.

(b) The uncertainty values of the test results determined in accordance with Section 7 do not exceed the uncertainty limits defined in subsection 1-3.

1-1.2 Performance Characteristics

(a) This Code provides explicit procedures for determining the following performance characteristics:
- *(1)* corrected product syngas energy
- *(2)* corrected gasification effectiveness

(b) Tests may be designed to satisfy different performance goals, including
- *(1)* specified fuel consumption
- *(2)* specified oxygen consumption
- *(3)* specified syngas sensible and chemical energy rate
- *(4)* specified steam production

(c) These performance characteristics are typically required for
- *(1)* comparing actual performance with guaranteed performance
- *(2)* comparing actual performance with a reference
- *(3)* determining the performance of the equipment after modifications

1-2 SCOPE

This Code applies to gasifiers that convert liquid or solid feedstock into syngas by means of an oxygen- or air-blown gasification process. It can be used to measure the performance of a gasifier in its normal operating condition, with all equipment in new condition.

The Code addresses the boundaries of the gasification block and the principal streams moving through the gasification block that significantly affect its thermal performance (see Figure 3-2.2-1). This Code provides methods to measure the quality and quantity of product (e.g., syngas) and by-product (e.g., slag and ash), feedstock consumption rates, oxidant consumption, steam consumption and production, water consumption, inert gas consumption, and power use. The Code includes methods for calculating cold gas efficiency and carbon conversion as examples, but these calculations are not within the scope of this Code.

Gasifier performance tests conducted in accordance with this Code shall meet the following conditions:

(a) A means shall be available for determining, through direct or indirect measurement, all electric power feeds entering or exiting the test boundary.

(b) A means shall be available for determining, through direct or indirect measurement, the composition and condition of all pressurized flows entering or leaving the test boundary.

(c) A means shall be available for determining, through direct or indirect measurement, all parameters required to correct test results to a base reference condition.

(d) The test uncertainties shall be less than or equal to the specified uncertainty limits.