AN AMERICAN NATIONAL STANDARD

ASME PTC 10-1997

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Performance Test Code on Compressors and Exhausters

PERFORMANCE TEST CODES

The American Society of Mechanical Engineers

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This document will be revised when the Society approves the issuance of a new edition. There will be no addenda issued to ASME PTC 10-1997.

Please Note: ASME issues written replies to inquiries concerning interpretation of technical aspects of this document. The interpretations are not part of the document. PTC 10-1997 is being issued with an automatic subscription service to the interpretations that will be issued to it up to the publication of the next edition.

The American Society of Mechanical Engineers
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FOREWORD

(This Foreword is not a part of ASME PTC 10-1997.)

PTC 10 was last revised in 1965 and it has been reaffirmed many times in the intervening period. The PTC 10 Committee has been in various states of activity for approximately the past 20 years. During that time the Code has been completely rewritten to be far more explanatory in nature.

The performance testing of compressors is complicated by the need in virtually every case to consider and make correction for the differences between the test and specified conditions. The techniques used to do so are based upon the rules of fluid-dynamic similarity. Some familiarity with this fundamental technique will be a significant aid to the users of PTC 10.

Compressors and exhausters come in all sorts of configurations. A very simple case is a single section compressor with one impeller, and single inlet and outlet flanges. Many more complex arrangements exist with multiple inlets, outlets, impellers, sections, intercoolers and side seams. Typical gases handled are air, its constituents, and various hydrocarbons. Tests are commonly run in the shop or in the field, at speeds equal to or different from the specified speed, and with the specified or a substitute gas. In order to handle this vast array of possibilities PTC 10 reduces the problem to the simplest element, the section, and provides the instructions for combining multiple sections to compute the overall results.

Uncertainty analysis can play a very important role in compressor testing, from the design of the test to interpretation of the test results. In all but the very simplest of cases the development of an analytic formulation, i.e., in simple equation form, for overall uncertainty computation is formidable. The test uncertainty will always be increasingly more complex to evaluate with the complexity of the compressor configuration, and by the very nature of the test will be a function of the performance curves.

The modern personal computer is readily capable of completing the calculations required. The Committee developed software and used it to perform both the basic code calculations and uncertainty analysis computations for a wide range of possible compressor configurations.

This Code was approved by the PTC 10 Committee on January 18, 1991. It was approved and adopted by the Council as a standard practice of the Society by action of the Board on Performance Test Codes on October 14, 1996. It was also approved as an American National Standard by the ANSI Board of Standards Review on April 22, 1997.

NOTICE

All Performance Test Codes MUST adhere to the requirements of 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 this Code. It is expected that the Code user is fully cognizant of Parts I and III of PTC 1 and has read them prior to applying this Code.

ASME Performance Test Codes provide test procedures which 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. They specify procedures, instrumentation, equipment operating requirements, calculation methods, and uncertainty analysis.

When tests are run in accordance with this 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.

Approved by Letter Ballot #95-1 and BPTC Administrative Meeting of March 13–14, 1995

PERSONNEL OF PERFORMANCE TEST CODE COMMITTEE NO. 10 ON COMPRESSORS AND EXHAUSTERS

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

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Nonmandatory Appendices

SECTION 1 — OBJECT AND SCOPE

1.1 OBJECT

The object of this Code is to provide a test procedure to determine the thermodynamic performance of an axial or centrifugal compressor or exhauster doing work on a gas of known or measurable properties under specified conditions.

This Code is written to provide explicit test procedures which will yield the highest level of accuracy consistent with the best engineering knowledge and practice currently available. Nonetheless, no single universal value of the uncertainty is, or should be, expected to apply to every test. The uncertainty associated with any individual PTC 10 test will depend upon practical choices made in terms of instrumentation and methodology. Rules are provided to estimate the uncertainty for individual tests.

1.2 SCOPE

1.2.1 General. The scope of this Code includes instructions on test arrangement and instrumentation, test procedure, and methods for evaluation and reporting of final results.

Rules are provided for establishing the following quantities, corrected as necessary to represent expected performance under specified operating conditions with the specified gas:

(a) quantity of gas delivered
(b) pressure rise produced
(c) head
(d) shaft power required
(e) efficiency
(f) surge point
(g) choke point

Other than providing methods for calculating mechanical power losses, this Code does not cover rotor dynamics or other mechanical performance parameters.

1.2.2 Compressor Arrangements. This Code is designed to allow the testing of single or multiple casing axial or centrifugal compressors or combinations thereof, with one or more stages of compression per casing. Procedures are also included for externally piped intercoolers and for compressors with interstage side load inlets or outlets.

Internally cooled compressors are included provided that test conditions are held nearly identical to specified conditions.

Compressors, as the name implies, are usually intended to produce considerable density change as a result of the compression process. Fans are normally considered to be air or gas moving devices and are characterized by minimal density change. A distinction between the two at times may be unclear. As a very rough guide, either PTC 10 or PTC 11 may be used for machines falling into the approximate pressure ratio range of 1.05 to 1.2.

The methods of PTC 10, which provide for the pronounced effects of density change during compression, have no theoretical lower limit. However, practical considerations regarding achievable accuracy become important in attempting to apply PTC 10 to devices commonly classified as fans. For example, the low temperature rise associated with fans may lead to large uncertainty in power requirement if the heat balance method is chosen. Fans also may require traversing techniques for flow and gas state measurements due to the inlet and discharge ducting systems employed. Refer to PTC 11 on Fans for further information.

1.3 EQUIPMENT NOT COVERED BY THIS CODE

The calculation procedures provided in this Code are based on the compression of a single phase gas. They should not be used for a gas containing suspended solids or any liquid, when liquid could be formed in the compression process, or when a chemical reaction takes place in the compression process.

This does not preclude the use of this Code on a gas where condensation occurs in a cooler providing the droplets are removed prior to the gas entering the next stage of compression.