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PERFORMANCE
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FOREWORD

Performance tests of industrial heat exchangers are often conducted to compare test results with manufacturer's rating data, to evaluate the cause(s) of degradation, to verify regulatory compliance, or to assess process improvements. All tests have associated costs. Those costs can be great if the test results are inconclusive. Historically, testing heat exchanger performance in operating processes was not conducted according to standard, acceptable methods; therefore, the results were inconsistent. Many of the unacceptable results have been attributed to small deviations in test conditions and measurement practices. In other cases, analysis of the data did not consider all factors which affect performance.

As industry implements improvements to reduce costs and increase output, performance margins of process streams tend to be reduced. The need for accurate performance test methods is increasing to meet the commercial demand. A single consistent test philosophy and methodology including measurement and analysis techniques for delivery of accurate and repeatable heat exchanger test data would provide a foundation to assess performance. Such a test standard has wide applicability in the power, food-processing, chemical and petroleum industries, among others. It was with the intent of satisfying these industry needs that the Board on Performance Test Codes (BPTC) authorized the formation of the PTC 12.5 Committee to explore the development of the present Code.

The PTC 12.5 Committee began its deliberations late in 1994. An early version of the draft code was subjected to a thorough review by industry, including members of the BPTC. Comments were incorporated in the version which was approved by the Committee on 11 August 1999. PTC 12.5-2000 on Single Phase Heat Exchangers was then approved as a Standard practice of the Society by action of the Board on Performance Test Codes on 8 May 2000. It was approved as an American National Standard by the ANSI Board of Standards Review on September 26, 2000.

(Revised 26 September 2000)

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.

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SECTION 0 — INTRODUCTION

Performance testing of industrial heat exchangers is conducted to compare installed capability with design specifications, assess degradation, and evaluate the benefit of performance improvements such as cleanings, heat transfer surface enhancements and unit replacement. Industrial and experimental experience indicates that results can vary significantly with small changes in the test and analysis methods. Application of detailed and consistent test practices is needed for reliable and accurate results. A commercial standard for heat exchanger testing provides a basis for comparison of results from different test organizations and designs.

This Test Code provides comprehensive guidance to plan, conduct, and analyze results for accurate performance tests of single phase heat exchangers. The key test requirements are applicable to most heat exchanger designs with two single phase fluid streams in a wide variety of industrial applications. Guidance is sufficiently detailed for a test engineer to estimate the cost and benefit of performing an accurate test. Step-by-step examples are provided for shell-and-tube, plate-frame, and room air cooler designs. Even though the guidance is comprehensive, flexibility is provided to permit a variety of analysis methods. The user may perform Code calculations using the data provided, proprietary computer software, or other analytic tools.

During the development of this Code, data from the open literature has been compiled and evaluated in order to establish a basis for the accuracy of test results. The appendices provide a description of these evaluations for technical topics including steady state criteria, uncertainty analysis, shell-side performance methods, mean temperature difference, tube-side performance methods, fouling resistance, plate-frame performance methods, room cooler analysis, and thermal physical properties. These appendices provide valuable background material for the user.

SECTION 1 — OBJECT AND SCOPE

1.1 OBJECT

This Code provides methods and procedures for testing single phase heat exchangers. The Code presents and describes the methods for determining heat exchanger performance, for measuring fluid conditions and related phenomena, and for projecting performance parameters to reference conditions. Performance parameters included are overall heat transfer coefficient, heat transfer rate, and pressure drop. Guidelines are provided for recommended instrumentation and accuracy.

1.2 SCOPE

The scope of this Code includes instruments, calculation techniques, and methods to determine the steady state performance of single phase heat exchangers at both test conditions and reference conditions. This Code applies to, but is not limited to, the following types of heat exchangers:

(a) Shell-and-tube;
(b) Plate-frame;
(c) Plate-fin;
(d) Tube-in-plate fin.

Single-phase fluid streams, including liquid-to-liquid, gas-to-liquid, and gas-to-gas are included. Excluded from this Code are heat exchangers used in condensation, vaporization, fired, direct contact, non-newtonian fluid, and more than two-fluid applications.

1.3 EXPECTED UNCERTAINTY

The values of the overall uncertainty of performance parameters determined in accordance with this Code are expected to lie within the band described by the overall uncertainty interval stated below.

Performance Parameter [Note (1)]	Expected Uncertainty [Note (2)]
Overall Heat Transfer Coefficient, U*	±3–10%
Heat Transfer Rate, Q*	±3–10%
Nozzle-to-Nozzle Pressure Loss, $\Delta P_{n\text{-}n}$*	±3–12%

NOTES:
(1) At reference conditions.
(2) Based on 95% confidence.