ADDENDA

ANSI/ASHRAE Addendum a to
ANSI/ASHRAE Standard 184-2016

Method of Test for Field Performance of Liquid-Chilling Systems

Approved by ASHRAE and the American National Standards Institute on December 7, 2018.

This addendum was approved by a Standing Standard Project Committee (SSPC) for which the Standards Committee has established a documented program for regular publication of addenda or revisions, including procedures for timely, documented, consensus action on requests for change to any part of the standard. Instructions for how to submit a change can be found on the ASHRAE® website (https://www.ashrae.org/continuous-maintenance).

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FOREWORD

ASHRAE Standard 184 was published in 2016 and prescribes methods of testing to measure performance, such as capacity and efficiency, of liquid-chilling systems as installed in the field within a building system. A key concept of the testing process is to conduct an analysis to estimate the uncertainty of both measurements and the results calculated from those measurements. This analysis process starts during the planning phase while preparing for the test (pretest estimate of uncertainty) and finishes after the test is conducted (posttest estimate of uncertainty). The standard refers users to ASME PTC 19.1, Test Uncertainty*, for the uncertainty analysis methods.*

This addendum to the standard provides additional guidance on conducting this analysis by adding two informative appendices to the standard. One includes a spreadsheet-based calculator that guides the user through the calculations but continues to rely on some level of expertise in providing the input data and making engineering judgments about the test setup to quantify the uncertainty with reasonable estimates. On that point, the second new appendix provides examples of typical measurement instruments, their specifications and technical information, and how to extract and interpret the information to create the inputs to the uncertainty calculations.

Note: In this addendum, changes to the current standard are indicated in the text by underlining (for additions) and ~~strikethrough~~ (for deletions) unless the instructions specifically mention some other means of indicating the changes.

Addendum a to Standard 184-2016

Modify Normative Appendix C as shown.

NORMATIVE APPENDIX C CALCULATION OF PERFORMANCE AND UNCERTAINTY OF RESULTS

Chiller performance and uncertainty of results shall be calculated according to one of the following methods:

a. Following the procedures in ASME PTC 19.1, *Test Uncertainty* [15].
b. Any other equivalent means, in accordance with requirements of this standard.

Informative Note: See Informative Appendix I for an example spreadsheet calculator as a companion document to this standard.

Add a new Informative Appendix I as shown.

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INFORMATIVE APPENDIX I EXAMPLE SPREADSHEET WORKBOOK FOR UNCERTAINTY ANALYSIS

This appendix provides guidance on the calculations required for reducing test data in accordance with the equations found in Sections 6 and 7, as well as guidance on the test uncertainty analysis required by Section 7.6.4 and Normative Appendix C.

An example spreadsheet workbook shows one possible approach to implement the calculations for test results, along with uncertainty of both measurements and calculated results. The nomenclature of the spreadsheet follows the terminology of ASME PTC 19.1, *Test Uncertainty* [15]. The spreadsheet supports both pretest and posttest uncertainty and allows for side-by-side comparison as a means to quickly identify where the test went as planned or where it may have deviated from the pretest expectations.

The workbook files can be downloaded at https://www.ashrae.org/184-2016.

The general flow of using the spreadsheet is shown in Table I-1.

The workbook does not currently support all types of chillers within the scope of the standard but is structured in a manner that demonstrates how it could be extended to other types using the same types of measurement worksheet tabs and result worksheet tabs.

Note: See Informative Appendix J for examples of how to work with manufacturer specifications and use such information as inputs to the uncertainty analysis workbook.

Table I-1 General Flow Using Spreadsheet

	[Worksheet Tab Names]
a. Enter information about the test setup, such as chiller type, units of measure, and other settings that globally control calculations throughout the workbook.	[Input Configuration]
a. There is a separate worksheet tab for each type of measurement (flow rate, temperature, electrical power, etc.). For each measurement worksheet tab, fill in the shaded cells to provide the following information: 1. Uncertainty estimates i. One or more sources of systematic uncertainty ii. (For pretest estimate only) random uncertainty 2. Test data (trend log values) 3. Identify which instruments, if any, have correlated systematic uncertainty (only applicable when multiple redundant measurements are taken and averaged).	[EvapFlow, EvapTempIn, EvapTempOut, PowerInput1, etc.]
a. Review the calculated result worksheet tabs. In general, most of these are calculated automatically without further input from the user. However, a few will have shaded cells that require additional user input based on the specific test setup. The result worksheet tabs progress from intermediate results, such as temperature difference from two temperature measurements, to final results such as capacity, efficiency, and energy balance. 1. Identify which instruments, if any, have correlated systematic uncertainty (typically only applicable to results calculated from the same type of measurement, such as temperature difference between two temperature sensors, or total input power measured by two or more power meters).	[EvapΔT, EvapNetCapacity, CoolingEnergyEfficiency, EnergyBalance, etc.]
a. Review the test results summary in a report format.	[SummaryResults]

Add a new Informative Appendix J as shown.

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INFORMATIVE APPENDIX J EXAMPLES OF EVALUATING INSTRUMENT UNCERTAINTY

Appendix J provides examples, in a spreadsheet workbook format, of real world determination of instrument uncertainty, focusing on the expanded systematic uncertainty of the residual errors remaining after calibration. The sets of examples cover temperature, pressure, fluid flow, and power. The workbook uses typical accuracy specifications or technical data as might be obtained from a manufacturer's published product literature. The workbook then provides several examples of how such values would be converted to the corresponding values that can be entered directly into the relevant measurement worksheet tab of the example uncertainty analysis spreadsheet workbook found in Informative Appendix I. In many instances, these data may be the only published accuracy information available for a device, and, as such, the examples are provided to assist with this important interpretation. Manufacturers published accuracies would be used, typically, where no specific calibration data for an instrument is available.

The spreadsheet workbook file may be downloaded from https://www.ashrae.org/184-2016.

Note: In the interests of facilitating understanding of and familiarity with the example spreadsheet workbook found in Appendix I, it is recommended to start by entering just a single source of systematic uncertainty, such as the calibration data, to identify how this contributes to the final uncertainty result and summary. Other systematic errors (such as environmental influences, spatial influences such as installation location effects, instrument or data acquisition system resolution, stability and drift over time, etc.), may be added later, as familiarity grows with the workbook and the test environment.

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ASHRAE's short-range goal is to ensure that the systems and components within its scope do not impact the indoor and outdoor environment to a greater extent than specified by the Standards and Guidelines as established by itself and other responsible bodies.

As an ongoing goal, ASHRAE will, through its Standards Committee and extensive Technical Committee structure, continue to generate up-to-date Standards and Guidelines where appropriate and adopt, recommend, and promote those new and revised Standards developed by other responsible organizations.

Through its *Handbook*, appropriate chapters will contain up-to-date Standards and design considerations as the material is systematically revised.

ASHRAE will take the lead with respect to dissemination of environmental information of its primary interest and will seek out and disseminate information from other responsible organizations that is pertinent, as guides to updating Standards and Guidelines.

The effects of the design and selection of equipment and systems will be considered within the scope of the system's intended use and expected misuse. The disposal of hazardous materials, if any, will also be considered.

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