



STANDARD

ANSI/ASHRAE Standard 23.1-2019
(Supersedes ANSI/ASHRAE Standard 23.1-2010)

Methods for Performance Testing Positive Displacement Refrigerant Compressors and Condensing Units that Operate at Subcritical Pressures of the Refrigerant

Approved by ASHRAE on and the American National Standards Institute on June 21, 2019.

ASHRAE® Standards are scheduled to be updated on a five-year cycle; the date following the Standard number is the year of ASHRAE approval. The latest edition of an ASHRAE Standard may be purchased on the ASHRAE website (www.ashrae.org) or from ASHRAE Customer Service, 1791 Tullie Circle, NE, Atlanta, GA 30329-2305. E-mail: orders@ashrae.org. Fax: 678-539-2129. Telephone: 404-636-8400 (worldwide) or toll free 1-800-527-4723 (for orders in US and Canada). For reprint permission, go to www.ashrae.org/permissions.

© 2019 ASHRAE

ISSN 1041-2336



ASHRAE Standard Project Committee 23.1
Cognizant TC: 8.1, Positive Displacement Compressors
SPLS Liaison: Erick A. Phelps

Margaret M. Mathison*, *Chair*
Richard L. Hall*, *Secretary*
Erik S. Anderson*
Craig R. Bradshaw*
Doug Collings*

James L. Douglas*
Paul Flanigan
Orkan Kurtulus*
Michael Perevozchikov
Justin M. Prosser*

Michael Saunders*
John P. Scott*
Michael A. Wegenka*
Andrew M. Welch*

* Denotes members of voting status when the document was approved for publication

ASHRAE STANDARDS COMMITTEE 2018–2019

Donald M. Brundage, *Chair*
Wayne H. Stoppelmoor, Jr., *Vice-Chair*
Els Baert
Charles S. Barnaby
Niels Bidstrup
Robert B. Burkhead
Michael D. Corbat
Drury B. Crawley
Julie M. Ferguson
Michael W. Gallagher

Walter T. Grondzik
Vinod P. Gupta
Susanna S. Hanson
Roger L. Hedrick
Rick M. Heiden
Jonathan Humble
Kwang Woo Kim
Larry Kouma
R. Lee Millies, Jr.
Karl L. Peterman

Erick A. Phelps
David Robin
Lawrence J. Schoen
Dennis A. Stanke
Richard T. Swierczyna
Rusty Tharp
Adrienne G. Thomle
Craig P. Wray
Lawrence C. Markel, *BOD ExO*
Michael CA Schwedler, *CO*

Steven C. Ferguson, *Senior Manager of Standards*

SPECIAL NOTE

This American National Standard (ANS) is a national voluntary consensus Standard developed under the auspices of ASHRAE. *Consensus* is defined by the American National Standards Institute (ANSI), of which ASHRAE is a member and which has approved this Standard as an ANS, as "substantial agreement reached by directly and materially affected interest categories. This signifies the concurrence of more than a simple majority, but not necessarily unanimity. Consensus requires that all views and objections be considered, and that an effort be made toward their resolution." Compliance with this Standard is voluntary until and unless a legal jurisdiction makes compliance mandatory through legislation.

ASHRAE obtains consensus through participation of its national and international members, associated societies, and public review.

ASHRAE Standards are prepared by a Project Committee appointed specifically for the purpose of writing the Standard. The Project Committee Chair and Vice-Chair must be members of ASHRAE; while other committee members may or may not be ASHRAE members, all must be technically qualified in the subject area of the Standard. Every effort is made to balance the concerned interests on all Project Committees.

The Senior Manager of Standards of ASHRAE should be contacted for

- a. interpretation of the contents of this Standard,
- b. participation in the next review of the Standard,
- c. offering constructive criticism for improving the Standard, or
- d. permission to reprint portions of the Standard.

DISCLAIMER

ASHRAE uses its best efforts to promulgate Standards and Guidelines for the benefit of the public in light of available information and accepted industry practices. However, ASHRAE does not guarantee, certify, or assure the safety or performance of any products, components, or systems tested, installed, or operated in accordance with ASHRAE's Standards or Guidelines or that any tests conducted under its Standards or Guidelines will be nonhazardous or free from risk.

ASHRAE INDUSTRIAL ADVERTISING POLICY ON STANDARDS

ASHRAE Standards and Guidelines are established to assist industry and the public by offering a uniform method of testing for rating purposes, by suggesting safe practices in designing and installing equipment, by providing proper definitions of this equipment, and by providing other information that may serve to guide the industry. The creation of ASHRAE Standards and Guidelines is determined by the need for them, and conformance to them is completely voluntary.

In referring to this Standard or Guideline and in marking of equipment and in advertising, no claim shall be made, either stated or implied, that the product has been approved by ASHRAE.

CONTENTS

ANSI/ASHRAE Standard 23.1-2019

Methods for Performance Testing Positive Displacement Refrigerant Compressors and Condensing Units that Operate at Subcritical Pressures of the Refrigerant

SECTION	PAGE
Foreword	2
1 Purpose	2
2 Scope	2
3 Definitions	2
4 Classifications	3
5 Requirements	3
6 Instruments	7
7 Compressor Test Report	8
8 Condensing Unit Operating Conditions	9
9 Condensing Unit Test Report	9
10 References	10
Informative Appendix A: Bibliography	15
Informative Appendix B: Thermodynamic State Points	16

NOTE

Approved addenda, errata, or interpretations for this standard can be downloaded free of charge from the ASHRAE website at www.ashrae.org/technology.

© 2019 ASHRAE

1791 Tullie Circle NE · Atlanta, GA 30329 · www.ashrae.org · All rights reserved.

ASHRAE is a registered trademark of the American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc.
ANSI is a registered trademark of the American National Standards Institute.

(This foreword is not part of this standard. It is merely informative and does not contain requirements necessary for conformance to the standard. It has not been processed according to the ANSI requirements for a standard and may contain material that has not been subject to public review or a consensus process. Unresolved objections on informative material are not offered the right to appeal at ASHRAE or ANSI.)

FOREWORD

This 2019 revision of ASHRAE Standard 23.1 meets ASHRAE's mandatory language requirements. The scope of this standard has been expanded to cover (a) multistage compressors in addition to single-stage compressors and (b) intermediate cooling or refrigerant injection in addition to liquid injection. Descriptions, equations, and figures have been revised to clarify steps required to apply this standard.

1. PURPOSE

This standard prescribes methods for performance testing positive displacement refrigerant compressors and condensing units that operate at subcritical pressures of the refrigerant.

2. SCOPE

2.1 This standard applies to methods for performance testing single-stage and multistage positive displacement refrigerant compressors and condensing units that operate at discharge pressures less than the critical pressure of the refrigerant.

2.2 This standard applies to compressors and condensing units that either (a) do not have intermediate cooling or refrigerant injection or (b) do have intermediate cooling or refrigerant injection, and the power required for intermediate cooling or refrigerant injection, if any, is included in the measured total input power to the compressor or condensing unit.

3. DEFINITIONS

The following definitions apply to the terms used in this standard.

accuracy: the degree of conformity of an indicated value to the corresponding true value.

bubble-point temperature: a liquid-vapor equilibrium point for a pure liquid or for a multicomponent mixture of miscible, pure component liquids, in the absence of noncondensables, where the temperature of the mixture at a defined pressure is the minimum temperature required for a vapor bubble to form in the liquid.

calorimeter: a thermally insulated apparatus containing a heat exchanger that is used to determine the mass flow rate of a refrigerant by measuring the heat input/output that will result in a corresponding enthalpy change for the refrigerant.

capacity: the rate of heat removal by the refrigerant used in the compressor or condensing unit in a refrigerating system. This rate equals the product of the refrigerant mass flow rate and the difference in the specific enthalpies of the refrigerant vapor at its thermodynamic state entering the compressor or

condensing unit and refrigerant liquid at the thermodynamic state entering the expansion device.

compressor: see *positive displacement refrigerant compressor*.

compressor or condensing unit efficiency (isentropic efficiency): the ratio of the work absorbed for compressing a unit mass of refrigerant entering the stage of the compressor or condensing unit to the work absorbed for compressing the same unit mass of refrigerant by isentropic compression within the stage.

condenser liquid flow rate: the mass flow rate of liquid through the condensing unit under the conditions specified.

condensing unit: a machine designed to condense refrigerant vapor to a liquid by compressing the vapor in a positive displacement compressor and rejecting heat to a cooling medium. A condensing unit consists of a condensing heat exchanger and one or more positive displacement compressors and motors with ancillaries.

confirming test: an independent and simultaneous test performed to validate the primary test results (compare to *primary test*). Compressor or condensing unit ratings are determined from the primary test results.

cooling liquid flow rate: the total mass flow rate of liquid required for all cooling purposes in a compressor or condensing unit.

dew-point temperature: a vapor-liquid equilibrium point for a pure liquid or for a multicomponent mixture of miscible, pure components, in the absence of noncondensables, where the temperature of the mixture at a defined pressure is the maximum temperature required for a liquid drop to form in the vapor.

economizer: a heat exchanger or flash tank that is used to subcool liquid refrigerant exiting the condenser for vapor injection.

energy efficiency ratio (EER): a dimensional ratio of the cooling capacity (Btu/h) to the power input (W).

error: the difference between the test result and its corresponding true value.

flowmeter: a device employing a detecting element that determines the mass flow rate of a refrigerant in the gaseous or liquid phase within a closed conduit by measuring the corresponding response of the detecting element.

hermetic compressor: a compressor assembly containing a motor within a gas-tight housing that is permanently sealed by welding or brazing with no access for servicing internal parts in the field.

intermediate cooling: a method of using a heat exchanger to (a) cool the compressor mechanism or lubricant or (b) cool the refrigerant to reduce discharge temperature. The heat-exchanger component of the intermediate cooling means is integral to the compressor. The intermediate cooling thermal load is not taken into account in the calculations of isentropic efficiency, compressor or condensing unit capacity, or volumetric efficiency.

liquid injection: a method of (a) internally cooling the compressor mechanism or lubricant or (b) reducing discharge