



STANDARD

ANSI/ASHRAE Standard 22-2018
(Supersedes ANSI/ASHRAE Standard 22-2014)

Methods of Testing for Rating Liquid-Cooled Refrigerant Condensers

Approved by the ASHRAE on April 30, 2018, and by the American National Standards Institute on May 1, 2018.

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.

© 2018 ASHRAE

ISSN 1041-2336



Includes Uncertainty Analysis Methodology workbook (See Appendix A).
(Requires Microsoft Excel®)



ASHRAE Standard Project Committee 22
Cognizant TC: 8.5, Liquid-To-Refrigerant Heat Exchangers
SPLS Liaison: Krishnan Gowri

Joseph B. Huber*, *Chair*
Lorenzo Cremaschi*
Steven J. Eckels*
Satheesh Kulankara*

James T. Schaefer, Jr.*
Kenneth J. Shultz*
Thomas P. Carter

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

ASHRAE STANDARDS COMMITTEE 2017–2018

Steven J. Emmerich, *Chair*
Donald M. Brundage, *Vice-Chair*
Niels Bidstrup
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
Srinivas Katipamula
Kwang Woo Kim
Larry Kouma
Arsen K. Melikov
R. Lee Millies, Jr.
Karl L. Peterman
Erick A. Phelps

David Robin
Peter Simmonds
Dennis A. Stanke
Wayne H. Stoppelmoor, Jr.
Richard T. Swierczyna
Jack H. Zarour
Lawrence C. Markel, *BOD ExO*
M. Ginger Scoggins, *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 22-2018 Methods of Testing for Rating Liquid-Cooled Refrigerant Condensers

SECTION	PAGE
Foreword	2
1 Purpose.....	2
2 Scope.....	2
3 Definitions	2
4 Required Test Results.....	2
5 Test Methods	2
6 Instruments and Test Apparatus.....	5
7 Test Procedure.....	6
8 References.....	7
Informative Appendix A—Uncertainty Analysis	8
Informative Appendix B—Method to Compute the Enthalpy Difference of a Liquid Stream when an EoS-Based Function Is not Available	11
Informative Appendix C—Method for Determining the Presence of Noncondensable Gases in Liquid-Cooled Refrigerant Condensers	15

NOTE

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

© 2018 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

ASHRAE Standard 22 prescribes methods for testing liquid-cooled refrigerant condensers. To attain this objective, the standard lists and defines the terms for rating liquid-cooled refrigerant condensers and establishes testing methods that are to be used as a basis for obtaining ratings of liquid-cooled refrigerant condensers.

This standard was prepared under the auspices of ASHRAE. It may be used, in whole or in part, by an association or government agency with due credit to ASHRAE. Adherence is strictly on a voluntary basis and merely in the interests of obtaining uniform guidelines throughout the industry. This 2018 revision of the standard updates references.

The uncertainty analysis methodology discussed in Informative Appendix A has been incorporated into a Microsoft Excel[®] workbook that can be located online at <http://www.ashrae.org/22-2018>.

1. PURPOSE

This standard prescribes methods of testing the thermal performance and liquid-side pressure drop of liquid-cooled refrigerant condensers.

2. SCOPE

This standard applies to the methods of testing for thermodynamic performance rating of liquid-cooled refrigerant condensers that operate at subcritical pressures of the refrigerant.

3. DEFINITIONS

condensing heat rejection (q_c): the portion of the total heat rejection of a condenser that is used for desuperheating and condensing the entering refrigerant vapor to a saturated liquid. This is the product of the mass rate of refrigerant flow (w_r) and the difference between the enthalpy of the entering refrigerant vapor and that of the saturated refrigerant liquid at the leaving pressure.

liquid-cooled refrigerant condenser: a factory-made assembly of elements by which the flows of refrigerant vapor and cooling liquid are maintained in such a heat transfer relationship that the refrigerant vapor is condensed into a liquid.

subcooling: the difference between the bubble point temperature of the refrigerant corresponding to the pressure of the refrigerant leaving the condenser and the measured refrigerant temperature leaving the condenser.

subcooling heat rejection (q_s): the total heat rejection minus the condensing heat rejection. This is the product of the mass rate of refrigerant flow (w_r) and the difference between the enthalpy of a saturated refrigerant liquid at the pressure of the

leaving refrigerant and that of the refrigerant liquid at the actual leaving temperature.

superheat: the difference between the measured refrigerant temperature entering the condenser and the dew-point temperature of the refrigerant corresponding to the pressure of the refrigerant entering the condenser.

total heat rejection (q_t): the total useful capacity of a liquid-cooled refrigerant condenser for removing heat from the refrigerant circulated through it. This is the product of the mass rate of refrigerant flow (w_r) and the difference of enthalpy of the entering and leaving refrigerant fluid.

uncertainty: an estimated value for the error in a measurement, which may be the result of both systematic and random error.

4. REQUIRED TEST RESULTS

4.1 In expressing test results, the following parameters shall be stated:

- condensing heat rejection (q_c), kW (Btu/h)
- subcooling heat rejection (q_s), kW (Btu/h)
- total heat rejection (q_t), kW (Btu/h)
- dew-point temperature (T_c) of entering refrigerant vapor, °C (°F)
- temperature of entering refrigerant vapor, °C (°F)
- temperature of leaving refrigerant liquid, °C (°F)
- temperature of entering cooling liquid, °C (°F)
- temperature of leaving cooling liquid, °C (°F)
- cooling liquid mass flow rate (w_w), kg/s (lb/h)
- cooling liquid pressure drop through condenser, kPa (psi)

4.2 For all parameters listed in Section 4.1, uncertainty shall be calculated as described in Section 7.4.

5. TEST METHODS

5.1 Standard Test Methods

5.1.1 Tests shall consist of a primary measurement and a simultaneous confirming measurement at the conditions specified. The primary and confirming measurements shall be completely independent.

5.1.2 Specified Conditions

5.1.2.1 Specified conditions shall include the following:

- either the total heat rejection, kW (Btu/h) or the dew-point temperature of entering refrigerant vapor, °C (°F)
- temperature of the entering cooling liquid, °C (°F)
- cooling liquid mass flow rate, kg/s (lb/h)
- minimum superheat of entering vapor, °C (°F)
- minimum and maximum ambient temperature, °C (°F)
- subcooling, °C (°F), or leaving refrigerant temperature, °C (°F)
- cooling liquid used
- refrigerant used
- maximum allowable uncertainty for the reported condensing heat rejection
- maximum allowable uncertainty for the reported subcooling heat rejection
- maximum allowable uncertainty for the reported total heat rejection