This is a preview of "ANSI/ASHRAE Standard...". Click here to purchase the full version from the ANSI store.

STANDARD

ANSI/ASHRAE Standard 181-2014

Methods of Testing for Rating Liquid-to-Liquid Heat Exchangers

Approved by the ASHRAE Standards Committee on June 28, 2014; by the ASHRAE Board of Directors on July 2, 2014; and by the American National Standards Institute on July 3, 2014.

ASHRAE Standards are scheduled to be updated on a five-year cycle; the date following the standard number is the year of ASHRAE Board of Directors 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.

© 2014 ASHRAE ISSN 1041-2336

Approved American National Standard ANSI www.ansi.org

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

This is a preview of "ANSI/ASHRAE Standard...". Click here to purchase the full version from the ANSI store.

ASHRAE Standard Project Committee 181
Cognizant TC: TC 8.5, Liquid-to-Refrigerant Heat Exchangers
SPLS Liaison: Adam W. Hinge

Joseph B. Huber, *Chair**
Thomas P. Carter*
Lorenzo Cremaschi*
Steven J. Eckels*
Justin P. Kauffman
James T. Schaefer, Jr. *
Kenneth J. Shultz*
Umair Surani*

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

ASHRAE STANDARDS COMMITTEE 2013–2014

William F. Walter, *Chair*
Richard L. Hall, *Vice-Chair*
Karim Amrane
Joseph R. Anderson
James Dale Aswegan
Charles S. Barnaby
Steven F. Bruning
John A. Clark
Waller S. Clements
David R. Conover
John F. Dunlap
James W. Earley, Jr.
Steven J. Emmerich
Julie M. Ferguson
Krishnan Gowri
Cecily M. Grzywacz
Rita M. Harrold
Adam W. Hinge
Debra H. Kennoy
Malcolm D. Knight
Rick A. Larson
Mark P. Modera
Cyrus H. Nasseri
Janice C. Peterson
Heather L. Platt
Douglas T. Reindl
Julia A. Keen, *BOD ExO*
Thomas E. Werkema, Jr., *CO*

Stephanie C. Reiniche, *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 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.

This is a preview of "ANSI/ASHRAE Standard...". Click here to purchase the full version from the ANSI store.

CONTENTS

ANSI/ASHRAE Standard 181-2014,
Methods of Testing for Rating Liquid-to-Liquid Heat Exchangers

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	3
7 Test Procedure	3
8 References	4
Informative Appendix A: Uncertainty Analysis	5
Informative Appendix B: Method to Compute the Enthalpy Difference of a Liquid Stream when an EoS-Based Function Is not Available	8

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.

© 2014 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 is a preview of "ANSI/ASHRAE Standard...". Click here to purchase the full version from the ANSI store.

(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 objectors on informative material are not offered the right to appeal at ASHRAE or ANSI.)

FOREWORD

This standard prescribes methods for testing liquid-to-liquid heat exchangers. To meet this objective, the standard lists and defines the terms for rating liquid-to-liquid heat exchangers and establishes testing methods that are to be used as a basis for obtaining ratings of liquid-to-liquid heat exchangers.

The uncertainty analysis methodology discussed in Informative Appendix A has been incorporated into a Microsoft Excel® workbook which can be located online at www.ashrae.org/181_2014_UAM.

1. PURPOSE

This standard prescribes methods of testing the thermal performance and pressure drop of liquid-to-liquid heat exchangers.

2. SCOPE

This standard

a. lists and defines the terms for rating the thermal performance of liquid-to-liquid heat exchangers;
b. establishes the methods of test to be used as a basis for obtaining the thermal performance and pressure drop of liquid-to-liquid heat exchangers using water or other single-phase liquids; and
c. applies to laboratory testing for purposes of rating heat exchangers within its scope. This standard is not intended for field testing of heat exchangers of any type.

3. DEFINITION OF TERMS

clean: heat exchanger performance without a fouling layer or factor.

cold stream: of the two liquid streams entering the heat exchanger, the stream with the lower entering fluid temperature. Energy will be transferred to this stream.

hot stream: of the two liquid streams entering the heat exchanger, the stream with the higher entering fluid temperature. Energy will be transferred from this stream.

liquid-to-liquid heat exchanger: a factory-made assembly of elements in which energy is transferred from one liquid to another liquid, causing one liquid to be cooled and the other to be heated.

log-mean temperature difference (LMTD): logarithmic mean of the temperature difference between the hot and cold streams at each end of the heat exchanger.

temperature of flowing fluids: the mixed mean stream temperature at a station perpendicular to the flow direction.

thermal capacity (of the heat exchanger): the quantity of energy transferred between the two liquids. This quantity is the product of mass flow rate for the liquid stream and the difference in enthalpy of the liquid stream as it flows through the heat exchanger, expressed in energy units per unit of time.

4. REQUIRED TEST RESULTS

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

a. Net thermal capacity, kW (Btu/h)
b. Temperature of entering liquid for both streams, °C (°F)
c. Temperature of leaving liquid for both streams, °C (°F)
d. Liquid mass flow rate of both streams, kg/s (lb/h)
e. Description of liquids sufficient to obtain necessary physical properties
f. Pressure of both fluid streams as they enter the heat exchanger, kPa (psia)
g. Pressure drop of both fluid streams, kPa (psi)
h. Log mean temperature difference (LMTD), °C (°F)

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 The thermal capacity of both the hot stream and cold stream shall be determined at the conditions specified.

5.1.2 The specified conditions shall include the following:

a. Temperature of both entering liquid streams, °C (°F)
b. Liquid flow rate of both liquid streams, kg/s (lb/h)
c. Pressure of both liquid streams as they enter the heat exchanger, kPa (psi)
d. Hot and cold liquids used
e. Maximum allowable uncertainty for the reported net thermal capacity
f. Maximum allowable uncertainty for the reported log mean temperature difference
g. Maximum allowable uncertainty for the reported pressure drops
h. Arrangement of liquid connections to the heat exchanger

5.1.3 The calculated hot stream thermal capacity shall be within ±3.0% of the calculated cold stream thermal capacity as calculated by

$$|q_h - q_c|/[(q_h + q_c)/2] \le 3.0\% \qquad (5\text{-}1)$$

where

q_h = thermal capacity of the hot stream, kW (Btu/h)

q_c = thermal capacity of the cold stream, kW (Btu/h)

5.1.4 The stated thermal capacity of the heat exchanger shall be the arithmetic average of the hot-stream thermal capacity and the cold-stream thermal capacity.

5.2 Calculation of Thermal Capacity (see Figure 5-1)

5.2.1 Determine the thermal capacity for a particular stream by determining the product of the mass flow rate of the