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STANDARD

ANSI/ASHRAE Standard 181-2018
(Supersedes ANSI/ASHRAE Standard 181-2014)

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

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

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

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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.

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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.

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 which can be located online at ***http://www.ashrae.org/181-2018****.*

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.