



STANDARD

ANSI/ASHRAE Standard 24-2019
(Supersedes ANSI/ASHRAE Standard 24-2013)

Methods of Testing for Rating Evaporators Used for Cooling Liquids

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Includes uncertainty calculation methodology workbook.
(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 website at www.ashrae.org/technology.

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FOREWORD

This is a revision of ANSI/ASHRAE Standard 24-2013. 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 standards throughout the industry.

The following changes were made for the 2019 revision:

- *References were updated.*
- *Minor editorial changes were made.*
- *The requirement for uncertainty analysis was added.*
- *The requirement to use liquid enthalpy for the calculation of total refrigerant capacity was added.*
- *This standard was developed with laboratory testing in mind. There are no special provisions made for testing field-installed equipment.*

This standard includes an Excel workbook to assist with uncertainty calculations (Appendix A). Download the workbook at ASHRAE website at https://www.ashrae.org/24_2019.

1. PURPOSE

This standard prescribes methods of testing the thermal performance and liquid-side pressure drop of evaporators that operate at subcritical pressures of the evaporating refrigerant.

2. SCOPE

This standard

- a. lists and defines the terms for rating the thermal performance and liquid-side pressure drop of evaporators used for cooling liquids;
- b. establishes the methods of test that shall be used as a basis for obtaining the thermal performance and pressure drop of evaporators that operate at subcritical pressures of the evaporating refrigerant; and
- c. applies to laboratory testing for purposes of rating evaporators within its scope. This standard is not intended for field testing of evaporators of any type.

3. DEFINITIONS

evaporator: a factory-made assembly of elements in which the heat is transferred from the liquid to the refrigerant, causing the refrigerant to evaporate and the liquid to be cooled.

net refrigeration capacity: that portion of the total refrigeration capacity of an evaporator that produces useful cooling. This is the product of the mass flow rate of liquid and the differences in enthalpy between entering and leaving liquid expressed in

energy units per unit of time. It is represented also by the total refrigeration capacity less the heat leakage rate.

pressure drop of flowing fluids: the difference in total pressure between two points along a flow stream.

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

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

total refrigeration capacity (of the evaporator): the product of the mass flow rate of refrigerant and the difference in enthalpy between the leaving and entering refrigerant, expressed in energy units per unit of time.

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 Test results shall be expressed in the following terms:

- a. Net refrigeration capacity, kW (Btu/h)
- b. Temperature of the entering liquid, °C (°F)
- c. Temperature of leaving liquid, °C (°F)
- d. Liquid mass flow rate, kg/s (lbm/h)
- e. Description of both fluid streams sufficient to obtain necessary physical properties
- f. Pressure of the liquid stream as it enters the heat exchanger, kPa (psi)
- g. Pressure drop of the liquid stream, kPa (psi)
- h. Saturation temperature of refrigerant leaving the evaporator, °C (°F)
- i. Superheat of refrigerant leaving the evaporator, °C (°F)
- j. Temperature of refrigerant entering expansion device, °C (°F)
- k. Refrigerant designation

4.2 For all measured or calculated parameters listed in Section 5.1, 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 test and a simultaneous confirming test at the conditions specified. The primary and confirming measurements shall be completely independent.

5.1.2 The specified conditions shall include the following:

- a. Either the net refrigeration capacity, W (Btu/h), or the saturation temperature, °C (°F), of the refrigerant leaving the evaporator
- b. Temperature of leaving liquid, °C (°F)
- c. Liquid flow rate, kg/s (lbm/h)
- d. Superheat of leaving refrigerant, °C (°F)
- e. Temperature of refrigerant entering expansion device, °C (°F)
- f. Liquid being cooled by the evaporator
- g. Refrigerant used