STANDARD

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

Methods of Testing for Rating Liquid-Cooled Refrigerant Condensers

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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

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:

a. condensing heat rejection (q_c), kW (Btu/h)
b. subcooling heat rejection (q_s), kW (Btu/h)
c. total heat rejection (q_t), kW (Btu/h)
d. dew-point temperature (T_c) of entering refrigerant vapor, °C (°F)
e. temperature of entering refrigerant vapor, °C (°F)
f. temperature of leaving refrigerant liquid, °C (°F)
g. temperature of entering cooling liquid, °C (°F)
h. temperature of leaving cooling liquid, °C (°F)
i. cooling liquid mass flow rate (w_w), kg/s (lb/h)
j. 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:

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

l. maximum allowable uncertainty for the reported dew-point temperature

m. maximum allowable uncertainty for the reported cooling liquid pressure drop

n. arrangement of refrigerant and liquid connections

o. method used to determine the amount of noncondensable gases in the system, and the maximum allowable amount of noncondensable gases in the system

5.1.2.2 For refrigerants covered by ANSI/ASHRAE Standard 34,[1] the designation of the refrigerant given in ANSI/ASHRAE Standard 34 shall be specified in 5.1.2.1(h).

5.1.3 The confirming measurement of total heat rejection, q_{tc}, shall be within 3% of the primary test, but the primary test shall govern for rating purposes.

5.1.4 Refrigerant flow through the condenser shall be produced by one of the following means (see Figures 5.1.4):

a. refrigerating compressor and low-side evaporator or calorimeter, or

b. refrigerant boiler.

5.2 Primary Test Method

5.2.1 The primary test for closed condensers (see Figure 5.2.1) shall consist of determination of the heat rejected from the refrigerant by the following:

a. measurement of heat rejected to the cooling liquid

b. calculation of heat rejected through the external surfaces of the condenser to the ambient air

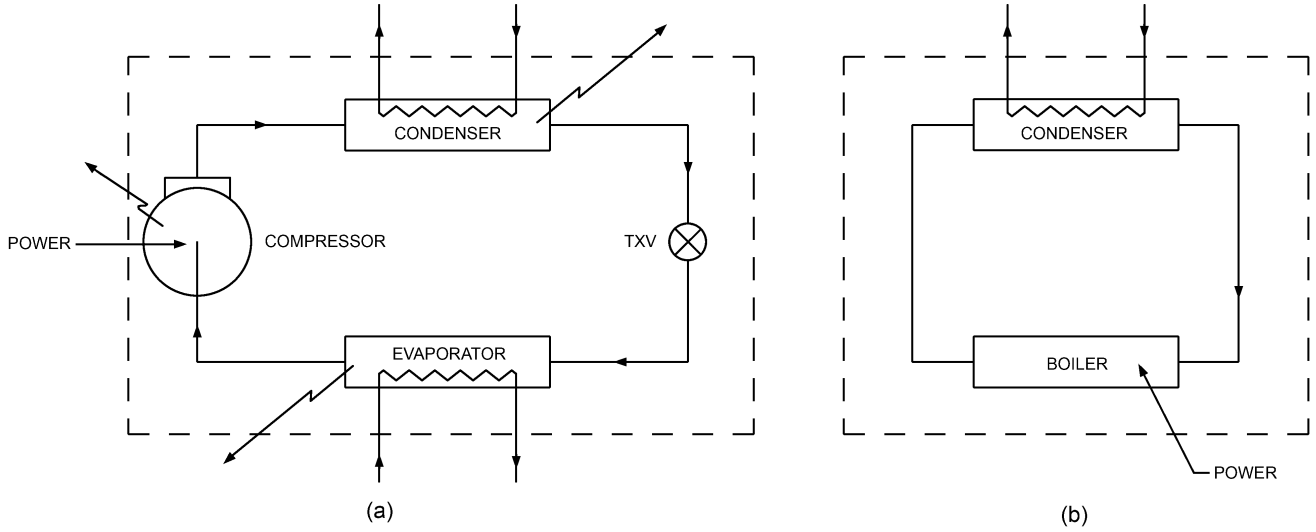
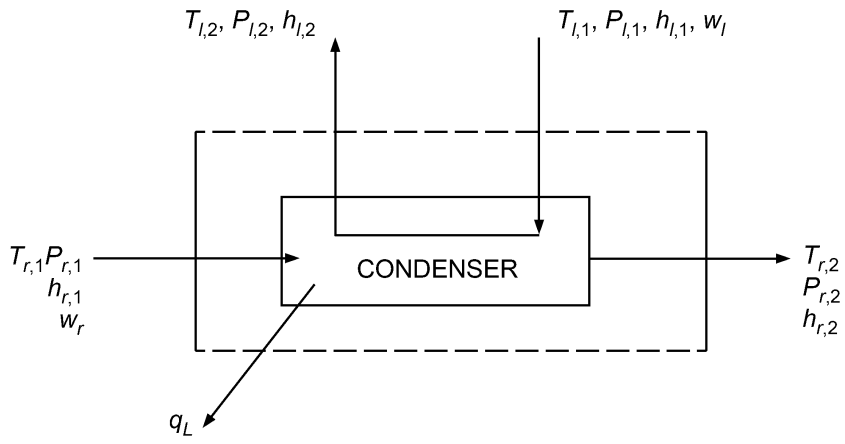


FIGURE 5.1.4 Methods of producing refrigerant flow through condenser: (a) compressor and (b) boiler.



SYMBOLS
h = enthalpy
P = pressure
T = temperature
q = heat rejected
w = mass flow rate

SUBSCRIPTS
r = refrigerant
L = external surfaces
l = liquid
1 = inlet
2 = outlet

FIGURE 5.2.1 Primary test method.