



# ASHRAE STANDARD

## Methods of Testing for Rating Positive Displacement Refrigerant Compressors and Condensing Units

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#### NOTE

When addenda, interpretations, or errata to this standard have been approved, they can be downloaded free of charge from the ASHRAE Web site at <http://www.ashrae.org>.

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## FOREWORD

This revision updates the 1993 version of the standard in several important ways. First, it covers zeotropic alternative refrigerant, whereas the previous version focused on azeotropic refrigerants. Second, the test methods described in the 1993 standard are inappropriate for emerging supercritical refrigerants such as CO<sub>2</sub>, so the scope of this revision has been narrowed accordingly and the development of a separate method-of-test standard has been proposed to cover supercritical refrigerants. Third, the six test methods for determining refrigerant mass flow rates now include the four calorimeter methods defined in ANSI/ASHRAE 41.9-2000 and the two flowmeter test methods defined in ANSI/ASHRAE 41.10-2003. Fourth, this revision gives the user the flexibility to select the same test method for both the primary and confirming tests, but the primary and confirming tests must be simultaneous and completely independent. Fifth, it includes test methods that properly account for the effects of liquid refrigerant injection within the scope of this standard. Finally, the test requirements have been updated to include computations of compressor efficiencies and to harmonize this standard with relevant standards promulgated by ARI, ISO, and other standards developers.

## 1. PURPOSE

The purpose of this standard is to provide methods of testing for rating positive displacement refrigerant compressors and condensing units.

## 2. SCOPE

**2.1** This standard applies to the methods of testing for rating single-stage positive-displacement refrigerant compressors and condensing units that (a) do not have liquid injection and (b) are operated at subcritical (saturated) temperatures of the refrigerant.

**2.2** This standard applies to the methods of testing for rating single-stage positive-displacement refrigerant compressors and condensing units that (a) incorporate liquid injection that is controlled by a steady flow rate method and (b) are operated at subcritical (saturated) temperatures of the refrigerant.

**2.3** This standard applies to all of the refrigerants listed in the *ASHRAE Handbook—Fundamentals*<sup>1</sup> and in ANSI/ASHRAE Standard 34<sup>2</sup> that fall within the scope defined in Sections 2.1 and 2.2 above.

## 3. DEFINITIONS

The following definitions apply to the terms used in this standard. Additional definitions that might be helpful are given in *ASHRAE Terminology of Heating, Ventilation, Air Conditioning, & Refrigeration*.<sup>3</sup>

**azeotropic refrigerant:** a blend that contains two or more refrigerants whose equilibrium vapor-phase and liquid-phase compositions are the same at a given pressure. The temperature of an azeotropic refrigerant remains constant as it evaporates or condenses at constant pressure (compare to *zeotropic refrigerant*).

**bubble-point temperature:** a liquid-vapor equilibrium point for a volatile pure liquid or for a multi-component mixture of miscible, volatile pure component liquids, in the absence of noncondensables, where the temperature of the mixture at a defined pressure is the minimum temperature required for a vapor bubble to form in the liquid.

**calorimeter:** a thermally insulated apparatus containing a heat exchanger in which the mass flow rate of a volatile refrigerant is determined by measuring the heat input/output that will result in a corresponding enthalpy change for the volatile refrigerant.

**capacity:** the rate of heat removal by the refrigerant used in the compressor or condensing unit in a refrigerating system. This rate equals the product of the refrigerant mass flow rate and the difference in the specific enthalpies of the refrigerant vapor at its thermodynamic state entering the compressor or condensing unit and refrigerant liquid at the thermodynamic state entering the mass flow control device.

**compressor or condensing unit efficiency (isentropic efficiency):** the ratio of the work absorbed for compressing a unit mass of refrigerant in a compressor or condensing unit to the work absorbed for compressing the same unit mass of refrigerant in an isentropic compressor or condensing unit.

**condensing unit:** a machine designed to condense refrigerant vapor to a liquid by compressing the vapor in a positive displacement compressor and rejecting heat to a cooling medium. A condensing unit usually consists of one or more positive displacement compressors and motors, condensing coils, liquid receivers, and other devices mounted on a common base.

**condenser liquid flow rate:** the mass flow rate of liquid through the condensing unit under the conditions specified.

**confirming test:** a completely independent and simultaneous test conducted to verify the accuracy of the primary test (compare to *primary test*). Compressor or condensing unit ratings are determined from the primary test results.

**cooling liquid flow rate:** the total amount of liquid required for all cooling purposes in a compressor or condensing unit.