ANSI/ASHRAE Standard 41.9-2000 (RA 2006)
Reaffirmation of ANSI/ASHRAE Standard 41.9-2000

ASHRAE STANDARD

Calorimeter Test Methods for Mass Flow Measurements of Volatile Refrigerants

This standard was approved by the ASHRAE Standards Committee on June 25, 2000, and reaffirmed October 2, 2005; by the ASHRAE Board of Directors on June 29, 2000, and reaffirmed January 22, 2006; and by the American National Standards Institute on October 6, 2000, and reaffirmed January 23, 2006.

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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.

(This foreword is not a 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.)

FOREWORD

This is a reaffirmation of ASHRAE Standard 41.9-2000. This standard falls under the Standards Committee classification of Standard Method of Measurement. This standard was prepared under the auspices of the American Society of Heating, Refrigerating and Air-Conditioning Engineers (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 changes made for the 2006 reaffirmation were that dates throughout the standard were updated, including those in the references section.

1. PURPOSE

This standard provides recommended practices for measuring the mass flow rate of volatile refrigerants using calorimeters.

2. SCOPE

2.1 This standard applies to the measurement of the flow of a volatile refrigerant in the following cases and no others:

a. where the entire flow stream of the volatile refrigerant enters the calorimeter as a subcooled liquid and leaves as a superheated vapor (evaporator-type) and

b. where the entire flow stream of the volatile refrigerant enters the calorimeter as a superheated vapor and leaves as a subcooled liquid (condenser-type).

2.2 This standard applies to all of the refrigerants listed in the *ASHRAE Handbook—Fundamentals*[1] and in *ANSI/ASHRAE Standard 34*.[2]

3. DEFINITIONS

The following definitions apply to the terms used in this standard. Additional definitions are given in the *ASHRAE Terminology of Heating, Ventilation, Air Conditioning, & Refrigeration*.[3]

azeotropic refrigerant: an azeotropic blend contains two or more refrigerants whose equilibrium-vapor 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 that determines the mass flow rate of a volatile refrigerant by measuring the heat input/output that will result in a known enthalpy change for the volatile refrigerant.

dew-point temperature: a vapor-liquid 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 maximum temperature required for a liquid drop to form in the vapor.

enthalpy (heat content): thermodynamic quantity equal to the sum of the internal energy of a system plus the product of the pressure-volume work done on the system.

error: the difference between the true value of the quantity measured and the observed value. All errors in experimental data can be classified as one of two types: systematic (fixed) errors or random (precision) errors. The terms *accuracy* and *precision* are often used to distinguish between systematic and random errors. A measurement with small systematic errors is said to be unbiased. A measurement with small random errors is said to have high precision. A measurement that is unbiased and precise is said to be accurate.

fixed error: same as systematic error.

fractionation: a change in composition of a refrigerant blend by preferential evaporation of the more volatile component(s) or condensation of the less volatile component(s).

glide: the absolute value of the difference between the starting and ending temperatures of a phase-change process (condensation or evaporation) for a zeotropic refrigerant exclusive of any liquid subcooling or vapor superheating.

near-azeotropic: a zeotropic refrigerant blend with a temperature glide sufficiently small that it may be disregarded without consequential error in analysis for a given application.

nonazeotropic: a synonym for zeotropic (zeotropic is the preferred term).

oil circulation: the ratio of the mass of oil circulating through a refrigerant system to the total mass of refrigerant and oil flowing through the system at a specified set of operating conditions.

precision error: same as random error.

random error: an error that causes readings to take ran-dom values on either side of a mean value. The random error is quantified based on how well an instrument can reproduce subsequent readings for an unchanging input. Random errors cannot be corrected through calibration.

refrigerant blend (or mixture): a refrigerant composed of two or more different chemical compounds, often used individually as refrigerants for other applications.

refrigerant mass flow rate: the mass flow rate of volatile refrigerant potentially mixed with lubricant up to the oil circulation limits defined in 5.2.2.

saturation temperature: the equilibrium temperature of an azeotropic refrigerant resulting from a two-phase mixture of a vapor and liquid at a given absolute pressure.