ANSI/ASHRAE Standard 41.10-2008
(Supersedes ANSI/ASHRAE Standard 41.10-2003)

ASHRAE STANDARD

# Standard Methods for Volatile-Refrigerant Mass Flow Measurements Using Flowmeters

Approved by the ASHRAE Standards Committee on January 19, 2008; by the ASHRAE Board of Directors on January 23, 2008; and by the American National Standards Institute on January 24, 2008.

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ISSN 1041-2336

Approved American National Standard
ANSI
www.ansi.org

American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc.
1791 Tullie Circle NE, Atlanta, GA 30329
www.ashrae.org

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**NOTE**

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## FOREWORD

*First published in 2003, Standard 41.10 is designed to help users select a suitable flowmeter for measuring volatile refrigerant mass flow rates and perform the test measurement.*

*Selecting an appropriate refrigerant mass flowmeter can be a daunting task given the wide variety of operating principles, measurement precision, and costs of commercial products. Some meters can be used for either liquids or gases, while others can be used only for liquids or only for gases. Considerable pressure losses are inherent in some approaches, but the pressure losses in some other types of meters are very small and often negligible. Useful basic information can be found in the* 2005 ASHRAE Handbook—Fundamentals*, Chapter 14, "Measurements and Instruments," and in various textbooks that focus on measurement technology. Once a meter has been selected, the user may need to consult with the meter manufacturer regarding installation specifics, operations, range limits, calibration limits, and other similar performance specifics in order to obtain the expected measurement accuracy.*

*This revision of the standard incorporates updated references, makes some minor text edits to improve readability, and revises Appendix B so that the flow rates are in appropriate SI units.*

*The project committee wishes to acknowledge Daniel Giguère for his assistance in the revision of this standard.*

## 1. PURPOSE

This standard provides recommended practices for the measurement of mass flow rate of volatile refrigerants using flowmeters.

## 2. SCOPE

(a) This standard applies where the entire flow stream of the volatile refrigerant enters and exits either as a "vapor only" or "liquid only" state.

(b) This standard covers all refrigerants listed in *ANSI/ASHRAE Standard 34-2004, Designation and Safety Classification of Refrigerants.*[1]

## 3. DEFINITIONS

The following definitions apply to the terms used in this standard. Additional definitions are given in *ASHRAE Terminology of Heating, Ventilation, Air Conditioning, & Refrigeration*.[2]

***bubble-point temperature:*** a liquid-vapor equilibrium point for a volatile pure liquid or for a multicomponent 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.

***dew-point temperature:*** a vapor-liquid equilibrium point for a volatile pure liquid or for a multicomponent 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.

***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.*

***flowmeter:*** a device employing a detecting element that determines the flow rate of a volatile refrigerant in the gaseous or liquid phase within a closed conduit by measuring a suitable response of the detecting element.

***oil circulation rate:*** the ratio of the mass of lubricant circulating through a refrigerant system to the total mass of refrigerant and lubricant 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 random 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.

***subcooling:*** at a defined pressure, the difference between a given liquid temperature and the *bubble-point temperature*.

***superheat:*** at a defined pressure, the difference between a given vapor temperature and the *dew-point temperature*.

***systematic error:*** an error that persists and cannot be considered as due entirely to chance. Systematic errors can be corrected through calibration.

***test article:*** a compressor, condensing unit, or other apparatus for which volatile refrigerant mass flow rates are measured using this standard.

***uncertainty:*** an estimated value for the error in a measurement, which may be the result of both *systematic* and *random error.* Because only random errors can be treated by statistical methods, and only systematic errors can be corrected through calibration, uncertainty computed using this standard will result from random errors.