STANDARD

ANSI/ASHRAE Standard 41.10-2013
(Supersedes ANSI/ASHRAE Standard 41.10-2008)

Standard Methods for Refrigerant Mass Flow Measurement Using Flowmeters

Approved by the ASHRAE Standards Committee on June 22, 2013; by the ASHRAE Board of Directors on June 26, 2013; and by the American National Standards Institute on June 27, 2013.

 ISSN 1041-2336

SPECIAL NOTE

This American National Standard (ANS) is a national voluntary consensus standard developed under the auspices of ASHRAE. *Consensus* is defined by the American National Standards Institute (ANSI), of which ASHRAE is a member and which has approved this standard as an ANS, as "substantial agreement reached by directly and materially affected interest categories. This signifies the concurrence of more than a simple majority, but not necessarily unanimity. Consensus requires that all views and objections be considered, and that an effort be made toward their resolution." Compliance with this standard is voluntary until and unless a legal jurisdiction makes compliance mandatory through legislation.

ASHRAE obtains consensus through participation of its national and international members, associated societies, and public review.

ASHRAE Standards are prepared by a Project Committee appointed specifically for the purpose of writing the Standard. The Project Committee Chair and Vice-Chair must be members of ASHRAE; while other committee members may or may not be ASHRAE members, all must be technically qualified in the subject area of the Standard. Every effort is made to balance the concerned interests on all Project Committees.

The Manager of Standards of ASHRAE should be contacted for:

a. interpretation of the contents of this Standard,
b. participation in the next review of the Standard,
c. offering constructive criticism for improving the Standard, or
d. permission to reprint portions of the Standard.

DISCLAIMER

ASHRAE uses its best efforts to promulgate Standards and Guidelines for the benefit of the public in light of available information and accepted industry practices. However, ASHRAE does not guarantee, certify, or assure the safety or performance of any products, components, or systems tested, installed, or operated in accordance with ASHRAE's Standards or Guidelines or that any tests conducted under its Standards or Guidelines will be nonhazardous or free from risk.

ASHRAE INDUSTRIAL ADVERTISING POLICY ON STANDARDS

ASHRAE Standards and Guidelines are established to assist industry and the public by offering a uniform method of testing for rating purposes, by suggesting safe practices in designing and installing equipment, by providing proper definitions of this equipment, and by providing other information that may serve to guide the industry. The creation of ASHRAE Standards and Guidelines is determined by the need for them, and conformance to them is completely voluntary.

In referring to this Standard or Guideline and in marking of equipment and in advertising, no claim shall be made, either stated or implied, that the product has been approved by ASHRAE.

CONTENTS

ANSI/ASHRAE Standard 41.10-2013, Standard Methods for Refrigerant Mass Flow Measurement Using Flowmeters

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.

(This foreword is not 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. Unresolved objectors on informative material are not offered the right to appeal at ASHRAE or ANSI.)

FOREWORD

First published in 2003, Standard 41.10 prescribes methods for refrigerant mass flow-rate measurement using flowmeters. A companion standard, ASHRAE Standard 41.9-2010,[A1] prescribes methods for refrigerant mass flow-rate measurement using calorimeters.

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 textbooks that focus on measurement technology. Once a flowmeter has been selected, the user may need to consult with the meter manufacturer regarding installation specifics, operating, range limits, calibration limits, and other similar performance specifics in order to obtain the expected measurement accuracy.

This revision updates the 2008 edition of the standard. Revisions have been implemented to bring this standard into compliance with ASHRAE's mandatory language requirements. References have been updated, and an Informative Bibliography (Annex A) has been added. Other changes were made to improve readability.

1. PURPOSE

This standard prescribes methods for refrigerant mass flow-rate measurement using flowmeters.

2. SCOPE

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

3. DEFINITIONS

The following definitions apply to the terms used in this standard.

bubble-point temperature: a liquid-vapor equilibrium point for a pure liquid or for a multicomponent mixture of miscible, 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.

error: the difference between the true value of the quantity measured and the observed value. All errors in experimental data are 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 refrigerant in the gaseous or liquid phase within a closed conduit by measuring a response of the detecting element.

lubricant 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 reproduces subsequent readings for an unchanging input. Calibration does not correct random errors.

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

steady-state test conditions: operation where at least three successive data points obtained at each set of specified conditions are neither successively increasing nor successively decreasing. To ensure conditions are stable, data readings shall be taken not less than 3 minutes apart and the test shall be continued until 3 successive readings are within the limits of tolerances specified in Section 5.1.

systematic error: an error that persists but is not due to chance. Calibration corrects systematic errors.

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 are treatable by statistical methods, and calibration only corrects systematic errors, uncertainty computed using this standard results from random errors.

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

4. CLASSIFICATIONS

4.1 Operating State—Gaseous or Liquid

4.1.1 Gaseous refrigerant flowmeters are restricted to applications where the entire flow stream of the refrigerant enters and exits as a vapor only state.

4.1.2 Liquid refrigerant flowmeters are restricted to applications where the entire flow stream of the refrigerant enters and exits as a liquid only state.