



STANDARD

ANSI/ASHRAE Standard 41.9-2018
(Supersedes ANSI/ASHRAE Standard 41.9-2011)

Standard Methods for Refrigerant Mass Flow Measurements Using Calorimeters

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NOTE

Approved addenda, errata, or interpretations for this standard can be downloaded free of charge from the ASHRAE website at www.ashrae.org/technology.

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FOREWORD

This 2018 revision of Standard 41.9 represents a comprehensive update. The most significant changes are with regard to (a) the criteria for steady-state operation, (b) the lubricant circulation rate measurement methods, and (c) the uncertainty calculation methods. This revision improves clarity and readability, and complies with ASHRAE's mandatory language requirements

This standard references the 2013 edition of ASHRAE Standard 15, Safety Standards for Refrigerant Systems. Users are encouraged to consult the latest edition of Standard 15 for the most up-to-date refrigerant safety information whenever this standard is applied.

1. PURPOSE

This standard prescribes methods for measuring mass flow rates for refrigerants and refrigerant/lubricant mixtures using calorimeters.

2. SCOPE

2.1 This standard applies to measuring mass flow rates for refrigerants and refrigerant/lubricant mixtures using calorimeters in laboratories.

2.2 This standard applies where the entire flow stream of the refrigerant or the refrigerant/lubricant mixture enters the calorimeter as a subcooled liquid and leaves as a superheated vapor (evaporator type).

2.3 This standard applies where the entire flow stream of the refrigerant or the refrigerant/lubricant mixture enters the calorimeter as a superheated vapor and leaves as a subcooled liquid (condenser type).

3. DEFINITIONS

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

accuracy: the degree of conformity of an indicated value to the corresponding *true value*.

calorimeter: a thermally insulated apparatus containing a heat exchanger that determines refrigerant mass flow rate by measuring the heat input/output that will result in a known enthalpy change for the refrigerant.

error: the difference between the test result and its corresponding *true value*.

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.

measurement system: the instruments, signal conditioning systems (if any), and data acquisition system (if any).

random error: the portion of the total error that varies randomly in repeated measurements of the *true value* throughout a test process.

refrigerant mass flow rate: the mass flow rate of refrigerant potentially mixed with lubricant.

secondary fluid: a fluid of known properties that is used as a heating medium.

secondary refrigerant: a refrigerant of known properties that is used as a heating medium.

systematic error: the portion of the total error that remains constant in repeated measurements of the *true value* throughout a test process.

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*.

test point: a specific set of test operating conditions and tolerances for recording data. A test plan normally contains multiple test points.

true value: the unknown, error-free value of a test result.

uncertainty: a measure of the potential error in a measurement that reflects the lack of confidence in the result to a specified level.

unit under test (UUT): a compressor or condensing unit that is the subject of refrigerant mass flow rate measurements.

4. CLASSIFICATIONS

4.1 Calorimeter Types. Calorimeters that are within the scope of this standard are classified as one of the two types listed in Sections 4.1.1 and 4.1.2.

4.1.1 Evaporator calorimeters:

- a. Secondary refrigerant calorimeter
- b. Secondary fluid calorimeter
- c. Primary refrigerant calorimeter

4.1.2 Condenser calorimeter.

5. REQUIREMENTS

5.1 Test Plan. A test plan shall specify the test points to be performed. The test plan shall be one of the following:

- a. A document provided by the person or the organization that authorized the tests and calculations to be performed
- b. A method of test standard
- c. A rating standard
- d. A regulation or code

5.2 Values to be Determined and Reported. The test values to be determined and reported shall be as shown in Table 5-1. Use the unit of measure in Table 5-1 unless otherwise specified in the test plan in Section 5.1.

5.3 Refrigerant Mass Flow Rate. Determine the refrigerant mass flow rate, kg/s (lb_m/h), through the unit under test using