



# ADDENDA

**ANSI/ASHRAE Addendum b to  
ANSI/ASHRAE Standard 41.10-2020**

# Standard Methods for Refrigerant Mass Flow Rate Measurements Using Flowmeters

Approved by ASHRAE and the American National Standards Institute on May 31, 2022.

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## FOREWORD

*Addendum b clearly defines the steady-state criteria; adds pretest uncertainty requirements; updates the test plan, values to be determined, steady-state requirements, and test results; and revises other requirements to make it easier for higher-tier standards to adopt Standard 41.10 by reference.*

**Note:** In this addendum, changes to the current standard are indicated in the text by underlining (for additions) and ~~strike through~~ (for deletions) unless the instructions specifically mention some other means of indicating the changes.

### Addendum b to Standard 41.10-2020

#### **Modify Section 3 as shown.**

~~error: the difference between the test result and its corresponding true value. the difference between the observed value of the measurand and its corresponding true value.~~

**post-test uncertainty:** an analysis to establish the uncertainty of a test result after conducting the test.

**pretest uncertainty:** an analysis to establish the expected uncertainty of a test result before conducting the test.

**steady-state criteria:** the criteria that establish negligible change of refrigerant mass flow rate with time.

**uncertainty:** a measure of the potential error in a measurement that reflects the lack of confidence in the result to a specified level. the limits of error within which the true value lies.

#### **Revise Section 5.1 as shown.**

**5.1 Test Plan.** ~~A test plan shall specify the refrigerant flow rate measurement system accuracy and the test points to be performed.~~ The test plan shall be one of the following documents:

- 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
- e. Any combination of items (a) through (d)

The test plan shall specify the following:

- a. The refrigerant mass flow rate measurement system accuracy
- b. The values to be determined and recorded selected from this list: refrigerant mass flow rate measurement and refrigerant mass flow rate measurement uncertainty
- c. Any combination of test points and targeted set points to be performed together with operating tolerances

#### **Revise Section 5.2 as shown.**

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

#### **Modify Section 5.3 as shown.**

**5.3 Accuracy or Measurement Uncertainty.** A selected refrigerant flowmeter shall meet or exceed the required refrigerant flow measurement system accuracy or measurement uncertainty specified in the test plan in Section 5.1 over the full range of operating conditions.

**Delete Section 5.4 and add new Sections 5.4 and 5.5 as shown. Renumber the remaining sections in Section 5.**

~~**5.4 Measurement Uncertainty.** The uncertainty in each refrigerant flow measurement shall be estimated using the method in Section 8 for each test point. Alternatively, the worst-case uncertainty for all test points shall be estimated and the same value reported for each test point.~~

**5.4 Pretest Uncertainty Analysis.** If required by the test plan in Section 5.1, perform an analysis to establish the expected uncertainty for each refrigerant mass flow test point prior to the conduct of that test in accordance with the pretest uncertainty analysis procedures in ASME PTC 19.1<sup>1</sup>.

**5.5 Post-Test Uncertainty Analysis.** If required by the test plan in Section 5.1, perform an analysis to establish the refrigerant mass flow measurement uncertainty for each refrigerant mass flow test point in accordance with the pretest uncertainty analysis procedures in ASME PTC 19.1<sup>1</sup>. Alternatively, if specified in the test plan, the worst-case uncertainty for all test points shall be estimated and reported for each test point. If specified in the test plan, the uncertainty of the refrigerant mass flow rate measurement shall not exceed the test plan requirement.

**Modify Section 5.7.2 as shown.**

**5.7.2 Liquid Flowmeters.** Liquid refrigerant flowmeters are restricted to applications where the entire refrigerant flow stream that enters and exits the flowmeter shall be in a liquid-only state during data recording. The subcooling at the flowmeter inlet shall be not less than 2 K (3°R). Trace amounts of liquids ~~gases~~ shall be less than 1% by mass unless otherwise specified by the flowmeter manufacturer or by the test plan in Section 5.1.

**Modify Section 5.8 as shown.**

**5.8 Steady-State Test Criteria for Refrigerant Mass Flow Rate Measurements for Compressors that do not Incorporate Pulse-Width Modulation.** Refrigerant mass flow rate test data shall be recorded at steady-state conditions unless otherwise specified in the test plan in Section 5.1. ~~If the test plan requires refrigerant mass flow rate test data points to be recorded at steady-state test conditions and provides the operating condition tolerance but does not specify the steady-state criteria, then determine that steady-state test conditions have been achieved using one of the following methods:~~

- ~~a. Apply the steady-state criteria in Section 5.8.1 if the test plan provides test points for refrigerant mass flow rate measurement.~~
- ~~b. Apply the steady-state criteria in Section 5.8.2 if the test plan provides targeted set points for refrigerant mass flow rate measurement.~~

**5.8.1 Steady-State Test Criteria Under Laboratory Test Conditions.** ~~If the test plan requires refrigerant mass flow rate test data points to be recorded at steady-state test conditions and provides the operating condition tolerance but does not specify the steady-state criteria, then determine that steady-state test conditions have been achieved using one of the following methods:~~

- ~~a. Apply the steady-state criteria in Section 5.8.3 if the test plan provides test points for refrigerant mass flow rate measurement.~~
- ~~b. Apply the steady-state criteria in Section 5.8.4 if the test plan provides targeted set points for refrigerant mass flow rate measurement.~~

**5.8.2 Steady-State Test Criteria Under Field Test Conditions.** If the test plan requires refrigerant mass flow rate test data points to be recorded at steady-state test conditions and provides the operating condition tolerance but does not specify the steady-state criteria, the methods in Section 5.8.1 are optional.

**[Informative Note:** The steady-state methods in Section 5.8.1 are likely to be impractical under field test conditions. Under these circumstances, the user may want to select another method to determine the conditions for field test data to be recorded.]

**Revise subsection title numbers and Equations 5-16 as shown.**

~~5.8.1~~ **5.8.3 Steady-State Refrigerant Mass Flow Rate Criteria for Test Points**

~~5.8.2~~ **5.8.4 Steady-State Refrigerant Mass Flow Rate Criteria for Targeted Set Points**

$$b\Delta t \leq 0.50\dot{m}_L \quad \text{kg/s (lb}_m\text{/h)} \quad (5-16)$$

$$|b\Delta t| \leq 0.50\dot{m}_L \quad \text{kg/s (lb}_m\text{/h)} \quad (5-16)$$

**Revise Section 9.1 as shown.**

**9.1 Post-Test Uncertainty Estimate Analysis.** ~~An estimate~~ A post-test analysis of the measurement system uncertainty, performed in accordance with ASME PTC ~~49.1<sup>11</sup>~~ 19.1<sup>1</sup>, shall accompany each refrigerant mass flow measurement if specified in the test plan in Section 5.1.

[*Informative Note:* Informative Annexes B and C contain examples of uncertainty calculations.]

**Revise Section 10.6 as shown.**

**10.6 Test Results.** If specified in the test plan in Section 5.1:

- a. Refrigerant mass flow rate, kg/s (lb<sub>m</sub>/h).
- b. ~~Uncertainty in refrigerant mass flow rate unless otherwise required by the test plan in Section 5.1, kg/s (lb<sub>m</sub>/h)~~
- b. Refrigerant mass flow rate pretest uncertainty, kg/s (lb<sub>m</sub>/s)
- c. Refrigerant mass flow rate post-test uncertainty, kg/s (lb<sub>m</sub>/s)
- d. Lubricant circulation rate through the flowmeter if required in Section 5.5, percent

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