



**BSR/ASHRAE Addendum a to  
ANSI/ASHRAE Standard 41.1-2020**

**Public Review Draft**

# **Proposed Addendum a to Standard 41.1-2020, Standard Methods for Temperature Measurement**

**First Public Review (October 2021)  
(Draft shows Proposed Changes to Current Standard)**

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**(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

**Background.** *The first Addendum a to Standard 41.1-2020 public review period that ended on 6/27/21 had one substantive public review comment. The SSPC 41 voting members voted to accept the proposed response to public review comment in a letter ballot that closed on 7/30/21. The proposed response to the substantive public review comment was subsequently uploaded into ASHRAE's Online Comment Database, and then the commenter marked the proposed response to "resolved."*

*This second Addendum a to Standard 41.1-2020 Interdependent Substantive Change (ISC) public review draft consists of (a) the response to the first public review comment, (b) other changes that stem from the first public review comment, and (c) changes in the steady-state criteria sections stemming from a public review comment on a different 41-series standard.*

**This addendum makes proposed changes to the current standard. These changes are indicated in the text by underlining (for additions) and strikethrough (for deletions).**

*Section 3, Definitions: Revise or add the definitions as shown below.*

**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 interval for a test result prior to the conduct of a test.

**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.

*Section 5, Requirements: Revise Section 5.1 as shown below.*

**5.1 Test Plan.** 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:

- a. ~~The temperature or temperature difference measurement system accuracy. The maximum allowable value for either the accuracy or the measurement uncertainty of the temperature or temperature difference measurement system.~~
- b. The values to be determined and recorded ~~that~~ are selected from this list: temperature, temperature difference, pretest temperature measurement uncertainty, post-test temperature measurement uncertainty, pretest temperature difference measurement uncertainty, and post-test temperature difference measurement uncertainty.
- c. Any combination of test points and targeted set points to be performed together with operating tolerances.

*Section 5, Requirements: Add a new Section 5.4 and revise Section 5.5.*

**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 temperature or temperature difference 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>.

**5.45 Post-test Uncertainty Analysis.** If required by the test plan in Section 5.1, perform an analysis to establish the temperature or temperature difference measurement uncertainty for ~~The uncertainty in each temperature and temperature difference test point in accordance with the post-test uncertainty analysis procedures in ASME PTC 19.1<sup>1</sup>.~~ measurement shall be estimated as described in Section 8 for each test point if specified in the test plan. Alternatively, if specified in the test plan, the worst-case uncertainty for all test points shall be estimated and reported for each test point.

*Section 5.56, Steady-State Test Criteria: Revise as shown below to define the steady-state criteria requirements under laboratory and field test conditions.*

**5.56 Steady-State Test Criteria.** Temperature and temperature difference 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 temperature or temperature difference 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 5.5.1 if the test plan provides test points for temperature measurement.~~
- b. ~~Apply the steady state criteria in Section 5.5.2 if the test plan provides test points for temperature difference measurement.~~
- c. ~~Apply the steady state criteria in Section 5.5.3 if the test plan provides targeted set points for temperature measurement.~~
- d. ~~Apply the steady state criteria in Section 5.5.4 if the test plan provides targeted set points for temperature difference measurement.~~

**5.5.1 5.6.1 Steady-State Test Criteria Under Laboratory Test Conditions.** If the test plan requires temperature or temperature difference 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 5.6.3 if the test plan provides test points for temperature measurement.

- b. Apply the steady-state criteria in Section 5.6.4 if the test plan provides test points for temperature difference measurement.
- c. Apply the steady-state criteria in Section 5.6.5 if the test plan provides targeted set points for temperature measurement.
- d. Apply the steady-state criteria in Section 5.6.6 if the test plan provides targeted set points for temperature difference measurement.

**5.5.2 5.6.2 Steady-State Test Criteria Under Field Test Conditions.** If the test plan requires temperature or temperature difference 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 5.6.1 are optional.

**Informative Note:** The steady-state methods in Section 5.6.1 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.

*Section 5.5, Revise subsection header numbers and Equations 5-23 and 5-32 as shown below.*

~~5.5.1~~ **5.6.3 Steady-State Temperature Criteria for Test Points**

~~5.5.1~~ **5.6.4 Steady-State Temperature Difference Criteria for Test Points**

~~5.5.1~~ **5.6.5 Steady-State Temperature Criteria for Targeted Set Points**

~~5.5.1~~ **5.6.6 Steady-State Temperature Difference Criteria for Targeted Set Points**

$$b\Delta t \leq 0.50T_b \text{ } ^\circ\text{C (}^\circ\text{F)} \quad (5-23)$$

$$|b\Delta t| \leq 0.50T_L \text{ } ^\circ\text{C (}^\circ\text{F)} \quad (5-23)$$

$$b\Delta t \leq 0.50\theta_b \text{ } \text{K (}^\circ\text{R)} \quad (5-32)$$

$$|b\Delta t| \leq 0.50\theta_L \text{ } \text{K (}^\circ\text{R)} \quad (5-32)$$

*Section 8.1, Uncertainty Estimate: Revise as shown below.*

**8.1 ~~Post-Test Uncertainty Estimate~~ Analysis.** ~~An estimate~~ A post-test analysis of the measurement system uncertainty, performed in accordance with ASME PTC 19.1<sup>4</sup>, shall accompany each temperature measurement and temperature difference measurement if specified in the test plan in Section 5.1. Where two temperature measuring instruments are used to measure a temperature difference, the individual instrument accuracies shall be included in the temperature difference measurement uncertainty estimate.

**Informative Note:** An example of temperature measurement uncertainty calculations is provided in Informative Appendix B.

*Section 9.5, Test Results: Revise Section 9.5 as shown below.*

**9.5 Test Results.** If specified in the test plan in Section 5.1, report the following test results:

- a. Temperature, °C (°F)
- b. Pretest uncertainty estimate for the ~~Uncertainty~~ of temperature measurement, °C (°F)
- c. Post-test uncertainty estimate for the ~~Uncertainty of the~~ temperature measurement, °C (°F)
- a. Temperature difference, K (°R)
- b. Pretest uncertainty estimate for the temperature difference measurement, K (°R)
- c. Post-test uncertainty estimate for the temperature difference measurement, K (°R).

Section 10, References: Renumber references as shown below.

## 10. REFERENCES

1. ASME PTC 19.1-2018, *Test Uncertainty*, ASME, New York, NY.
2. ASME PTC 19.3 TW-2017, *Thermowells*, ASME, New York, NY.
3. ASTM STP MANL 12-4TH, *The Use of Thermocouples in Temperature Measurement*, 4<sup>th</sup> edition, ASTM, West Conshohocken, PA, 1993.
4. E.O. Doebelin, *Measurement Systems: Application and Design*, Fifth Edition, McGraw-Hill, Boston, MA.
5. ~~ASME PTC 19.1-2018, *Test Uncertainty*, ASME, New York, NY.~~

### Notes:

- a. Reference ~~4~~2 is only required if thermowells are included in the thermocouple temperature measurement.
- b. Reference ~~2~~3 is only required if thermocouples are used for the temperature measurement.
- c. Reference ~~3~~4 is only required if solid state devices are used for the temperature measurement.