ADDENDA

ANSI/ASHRAE Addendum a to
ANSI/ASHRAE Standard 41.6-2021

Standard Methods for Humidity Measurement

Approved by ASHRAE and the American National Standards Institute on November 30, 2022.

This addendum was approved by a Standing Standard Project Committee (SSPC) for which the Standards Committee has established a documented program for regular publication of addenda or revisions, including procedures for timely, documented, consensus action on requests for change to any part of the standard. Instructions for how to submit a change can be found on the ASHRAE® website (www.ashrae.org/continuous-maintenance).

The latest edition of an ASHRAE Standard may be purchased on the ASHRAE website (www.ashrae.org) or from ASHRAE Customer Service, 180 Technology Parkway, Peachtree Corners, GA 30092. E-mail: orders@ashrae.org. Fax: 678-539-2129. Telephone: 404-636-8400 (worldwide), or toll free 1-800-527-4723 (for orders in US and Canada). For reprint permission, go to www.ashrae.org/permissions.

 ISSN 1041-2336

Approved American National Standard
ANSI
www.ansi.org

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 Senior 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.

(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

Addendum a to Standard 41.6-2021

a. makes it easier for the higher-tier ASHRAE standards to adopt this standard by reference,
b. updates the uncertainty requirements, and
c. updates the steady-state criteria sections.

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

Addendum a to Standard 41.6-2021

Modify Section 3 as shown.

3. DEFINITIONS

accuracy: ~~the degree of conformity of an indicated value to the 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 before conducting the test.

steady-state criteria: the criteria that establish negligible change of humidity difference 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.

Modify Section 5 as shown.

5.1 Test Plan. The test plan shall be one of the following options:

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. A combination of items (a) through (d)

The test plan shall specify:

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

Modify Section 5.3.3.1 and replace Figure 1 as shown.

5.3.3.1 Steady-State Wet-bulb Temperature Criteria for Test Points

[...]

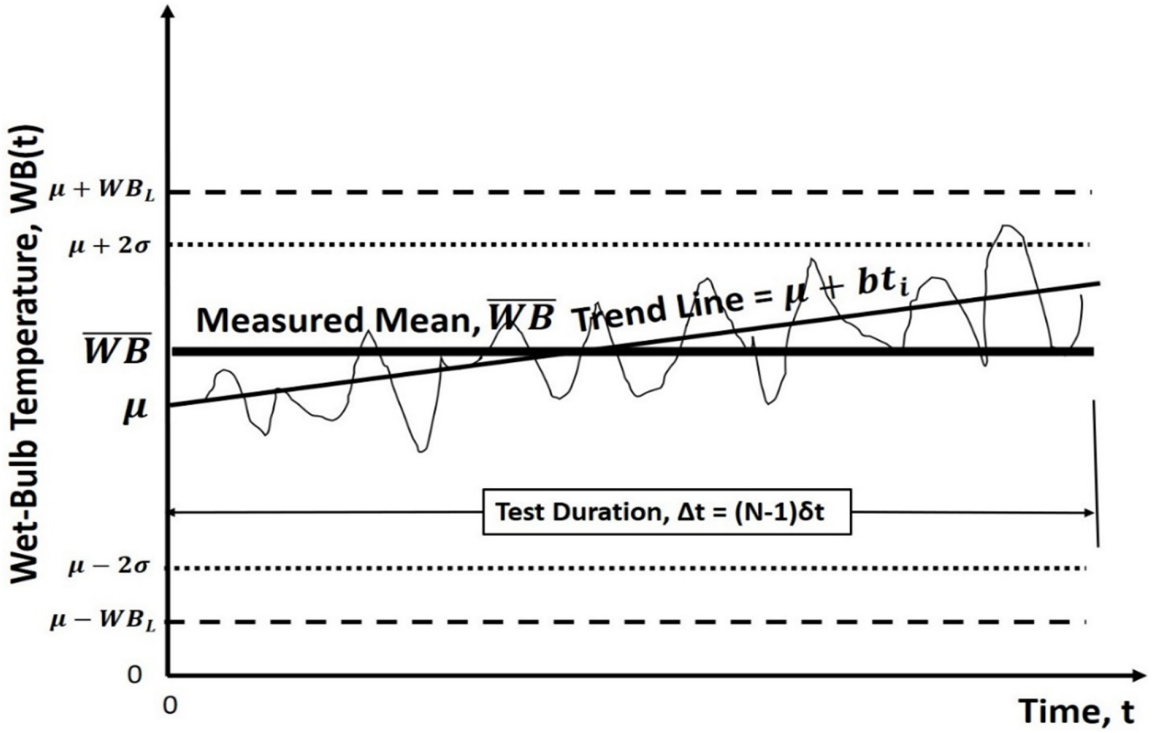

Figure 1 Graphical illustration of the method for determining wet-bulb temperature criteria for test points.

[. . .]

$\overline{\text{WB}}$, as determined by Equation 5-5, represents the steady-state mean wet-bulb temperature provided that one of the following criteria is satisfied:

a. Apply Equation 5-6 if $2\sigma \geq \text{WB}_L$, where WB_L is the specified operating tolerance limit for wet-bulb temperature, and if Equation 5-6 is satisfied by not less than 95% of the sampled wet-bulb temperatures.

$$\left|\text{WB}_i - \mu\right| \leq 2\sigma \qquad \text{°C (°F)} \tag{5-6}$$

The horizontal dotted lines that are located 2σ above and below μ are the boundaries of the 95% sampled wet-bulb temperature scatter envelope.

b. Apply Equation 5-7 if $\text{WB}_L \geq 2\sigma$, where WB_L is the specified operating tolerance limit for wet-bulb temperature, and if Equation 5-7 is satisfied by not less than 95% of the sampled wet-bulb temperatures.

$$\left|\text{WB}_i - \mu\right| \leq \text{WB}_L \qquad \text{°C (°F)} \tag{5-7}$$

The horizontal dashed lines that are located WB_L above and below μ are the boundaries of the 95% sampled wet-bulb temperature scatter envelope.

Replace Figure 2 as shown.

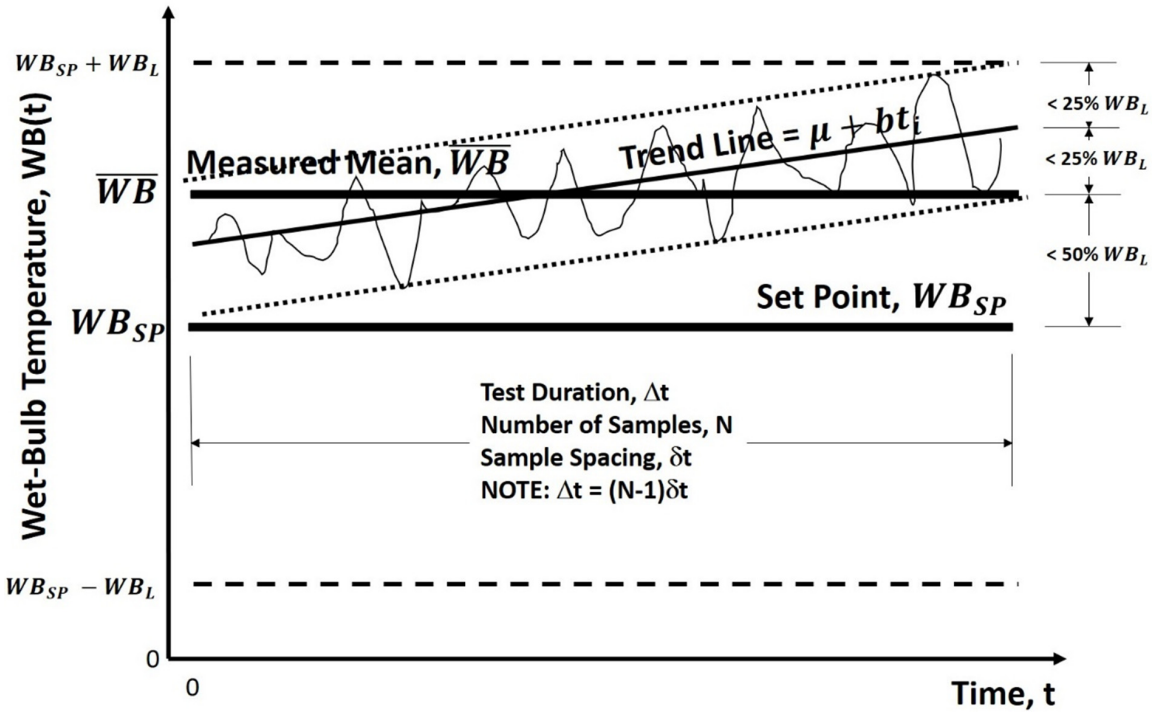

Figure 2 Graphical illustration of the method for determining wet-bulb temperature criteria for targeted set points.

Modify Section 5.3.4.1 and replace Figure 3 as shown.

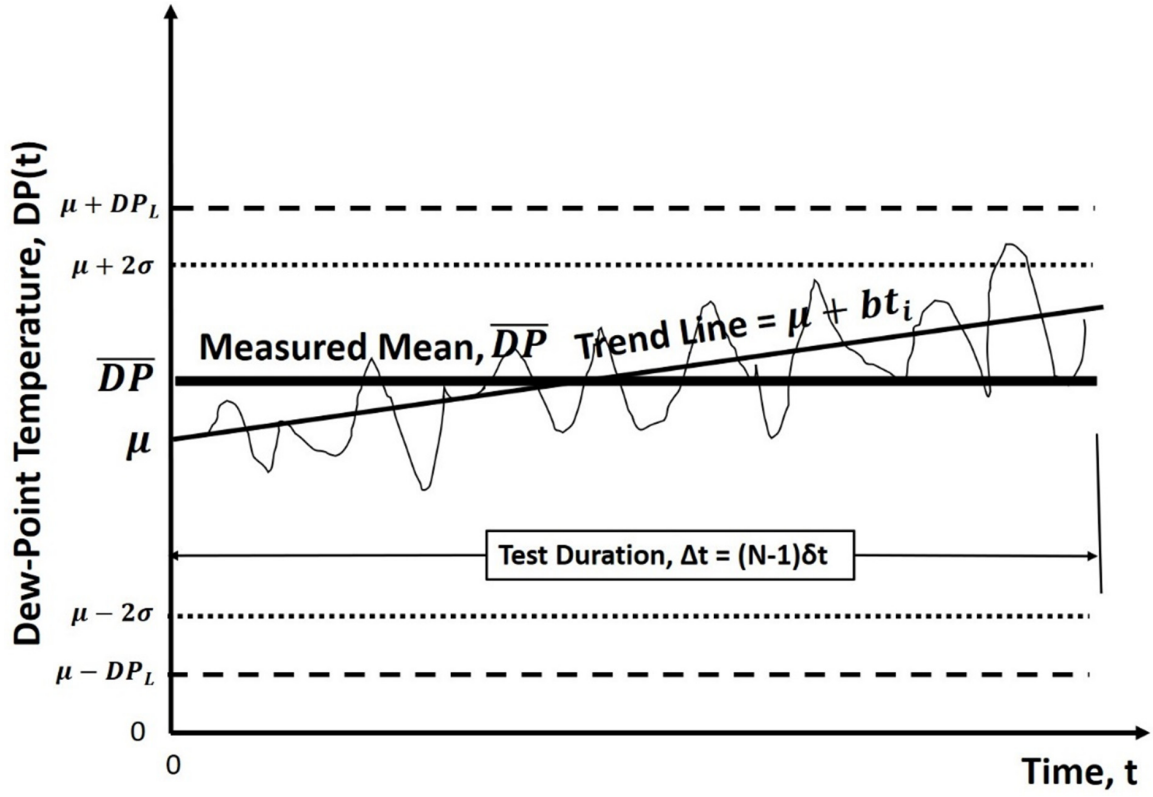

Figure 3 Graphical illustration of the method for determining dew-point temperature criteria for test points.

5.3.4.1 Steady-State Dew-point Temperature Criteria for Test Points

[. . .]

$\overline{DP}$, as determined by Equation 5-21, represents the steady-state mean dew-point temperature provided that one of the following criteria is satisfied:

a. Apply Equation 5-22 if $2\sigma \geq DP_L$, where DP_L is the specified operating tolerance limit for dew-point temperature, and if Equation 5-22 is satisfied by not less than 95% of the sampled dew-point temperatures.

$$\left|DP_i - \mu\right| \leq 2\sigma \qquad °C\ (°F) \tag{5-22}$$

The horizontal dotted lines that are located 2σ above and below μ are the boundaries of the 95% sampled dew-point temperature scatter envelope.

b. Apply Equation 5-23 if $DP_L \geq 2\sigma$, where DP_L is the specified operating tolerance limit for dew-point temperature, and if Equation 5-23 is satisfied by not less than 95% of the sampled dew-point temperatures.

~~$\left|DP_i - \mu\right| \leq T_L$ °C (°F)~~ ~~(5-23)~~

$$\left|DP_i - \mu\right| \leq DP_L \qquad °C\ (°F) \tag{5-23}$$

The horizontal dashed lines that are located DP_L above and below μ are the boundaries of the 95% sampled dew-point temperature rate scatter envelope.

[. . .]

Replace Figure 4 as shown.

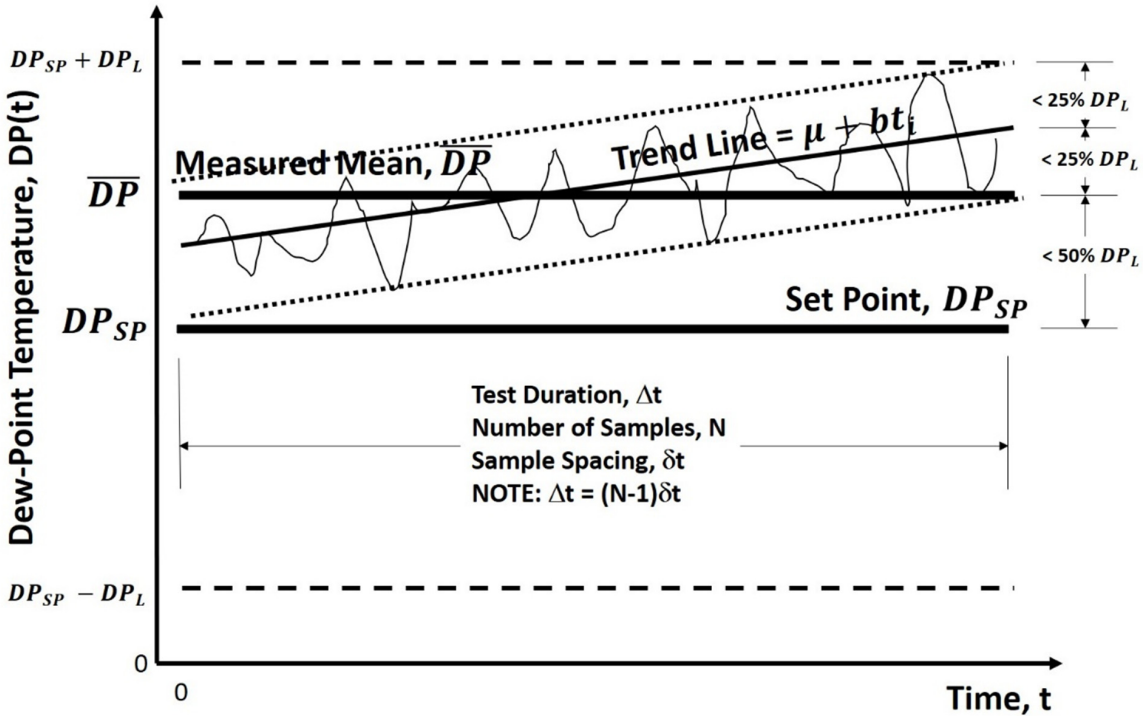

Figure 4 Graphical illustration of the method for determining dew-point temperature criteria for targeted set points.

Modify Section 5.3.5.1 and replace Figure 5 as shown.

5.3.5.1 Steady-State Relative Humidity Criteria for Test Points

[. . .]

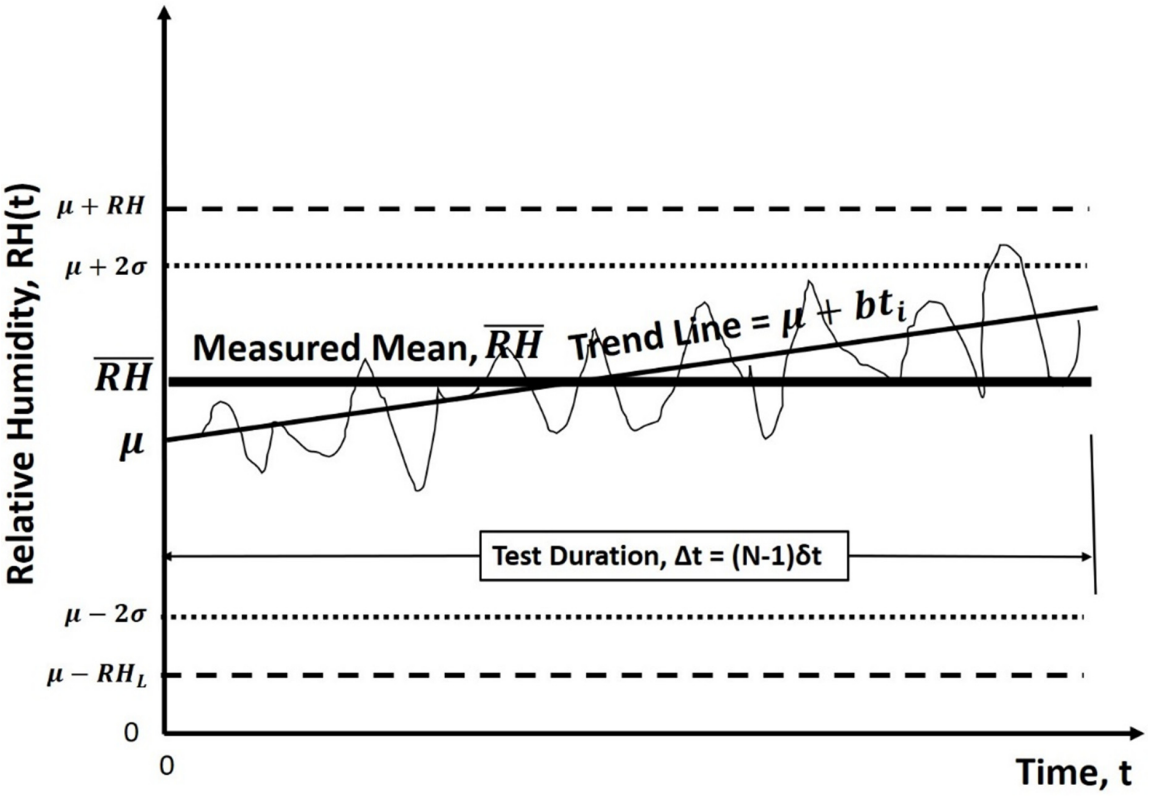

Figure 5 Graphical illustration of the method for determining relative humidity criteria for test points.

[. . .]

$\overline{\text{RH}}$, as determined by Equation 5-42, represents the steady-state mean relative humidity provided that one of the following criteria is satisfied:

a. Apply Equation 5-43 if $2\sigma \geq \text{RH}_L$, where RH_L is the specified operating tolerance limit for relative humidity, and if Equation 5-38 is satisfied by not less than 95% of the sampled relative humidities.

$$\left|\text{RH}_i - \mu\right| \leq 2\sigma \qquad \% \tag{5-38}$$

The horizontal dotted lines that are located 2σ above and below μ are the boundaries of the 95% sampled relative humidity scatter envelope.

b. Apply Equation 5-39 if $\text{RH}_L \geq 2\sigma$, where RH_L is the specified operating tolerance limit for relative humidity, and if Equation 5-39 is satisfied by not less than 95% of the sampled relative humidities.

$$\left|\text{RH}_i - \mu\right| \leq \text{RH}_L \qquad \% \tag{5-39}$$

The horizontal dashed lines that are located RH_L above and below μ are the boundaries of the 95% sampled relative humidity scatter envelope.

[. . .]

Replace Figure 6 as shown.

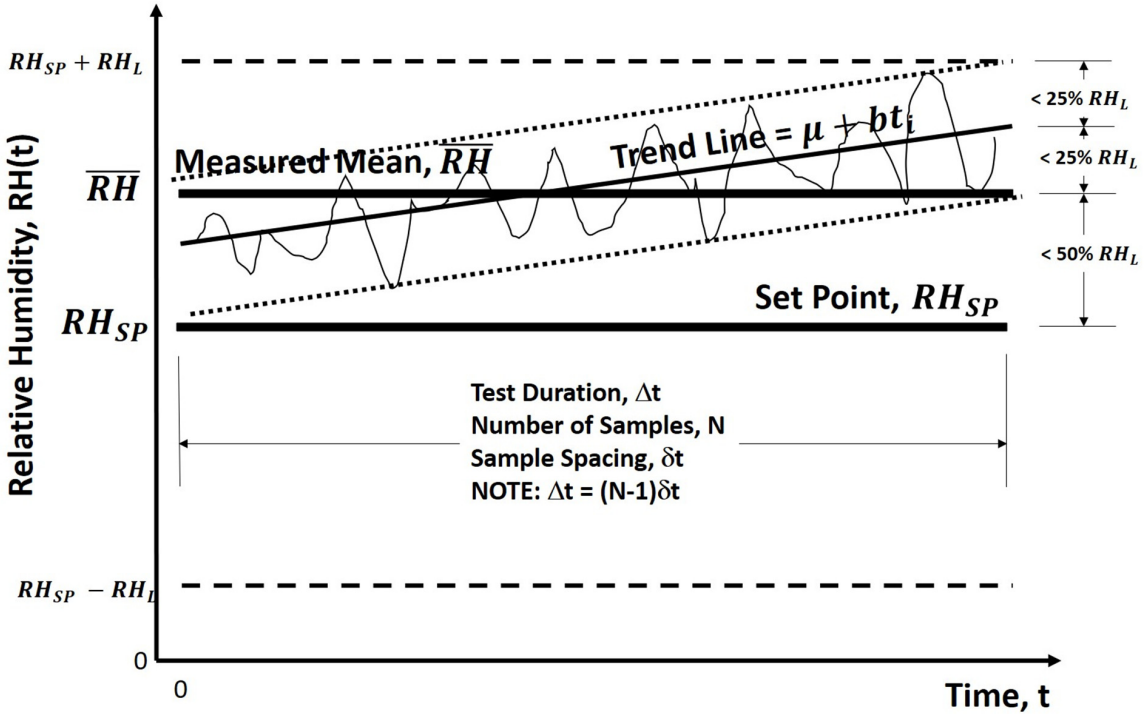

Figure 6 Graphical illustration of the method for determining relative humidity criteria for targeted set points.

Modify Section 8.1 as shown.

8. UNCERTAINTY ANALYSIS

8.1 Post-test Uncertainty ~~Estimate~~ Analysis. ~~An estimate of the measurement uncertainty, performed in accordance with ASME PTC 19.1[4] shall accompany each humidity measurement if specified in the test plan in Section 5.1.~~ A post-test analysis of the measurement system uncertainty, performed in accordance with ASME PTC 19.1[1], shall accompany each humidity measurement if specified in the test plan in Section 5.1.

[. . .]

Modify Section 9.6 as shown.

9.6 Test Results if Specified in the Test Plan in Section 5.1

~~a. Humidity using one of the options in Section 5.2.1 at a defined absolute pressure and dry-bulb temperature.~~

~~b. Uncertainty in humidity using one of the options in Section 5.2.1 at a defined absolute pressure and dry-bulb temperature if required by the test plan in Section 5.1.~~

a. Wet-bulb temperature, °C (°F)
b. Pretest wet-bulb temperature uncertainty, °C (°F)
c. Post-test wet-bulb temperature uncertainty, °C (°F)
d. Dew-point temperature, °C (°F)
e. Pretest dew-point temperature uncertainty, °C (°F)
f. Post-test dew-point temperature uncertainty, °C (°F)
g. Relative humidity, %
h. Pretest relative humidity uncertainty, %
i. Post-test relative humidity uncertainty, %

Update Section 10 as shown.

10. REFERENCES

1.ASME. 2018. ASME PTC 19.1, *Test Uncertainty*. New York: American Society of Mechanical Engineers.

~~1.~~2. ASHRAE. 2020. ANSI/ASHRAE Standard 41.1, *Standard Methods for Temperature Measurement*. Peachtree Corners, GA: ASHRAE. (See Note 1.)

~~2.~~3. ASHRAE. 2014. ANSI/ASHRAE Standard 41.3*, Standard Methods for Pressure Measurement*. Peachtree Corners, GA: ASHRAE. (See Note 2.)

~~3.~~4. Brenner, J.P., F.N. Nellis, D.T. Reindl. 2011. *Design Specifications for Wet-Bulb Aspirator Apparatus*. ASHRAE Research Project 1460-RP, ASHRAE, Atlanta, GA.

~~4. ASME. 2018. ANSI/ASME PTC 19.1, *Test Uncertainty*. New York: American Society of Mechanical Engineers (ASME).~~

Modify Informative Appendix F as shown.

[. . .]

F2. METHOD

Follow the step-by-step procedures outlined in Section 5, Uncertainty of a Measurement, of ASME PTC 19.1-2018[4], to estimate the uncertainty in SI units in Section F3.1 and in I-P units in Section F3.2. Note that, in general, using a commercial equation solver software, such as MATLAB or EES, significantly reduces the time and effort required to complete an uncertainty analysis.

[. . .]

POLICY STATEMENT DEFINING ASHRAE'S CONCERN FOR THE ENVIRONMENTAL IMPACT OF ITS ACTIVITIES

ASHRAE is concerned with the impact of its members' activities on both the indoor and outdoor environment. ASHRAE's members will strive to minimize any possible deleterious effect on the indoor and outdoor environment of the systems and components in their responsibility while maximizing the beneficial effects these systems provide, consistent with accepted Standards and the practical state of the art.

ASHRAE's short-range goal is to ensure that the systems and components within its scope do not impact the indoor and outdoor environment to a greater extent than specified by the Standards and Guidelines as established by itself and other responsible bodies.

As an ongoing goal, ASHRAE will, through its Standards Committee and extensive Technical Committee structure, continue to generate up-to-date Standards and Guidelines where appropriate and adopt, recommend, and promote those new and revised Standards developed by other responsible organizations.

Through its *Handbook*, appropriate chapters will contain up-to-date Standards and design considerations as the material is systematically revised.

ASHRAE will take the lead with respect to dissemination of environmental information of its primary interest and will seek out and disseminate information from other responsible organizations that is pertinent, as guides to updating Standards and Guidelines.

The effects of the design and selection of equipment and systems will be considered within the scope of the system's intended use and expected misuse. The disposal of hazardous materials, if any, will also be considered.

ASHRAE's primary concern for environmental impact will be at the site where equipment within ASHRAE's scope operates. However, energy source selection and the possible environmental impact due to the energy source and energy transportation will be considered where possible. Recommendations concerning energy source selection should be made by its members.

ASHRAE · 180 Technology Parkway · Peachtree Corners, GA 30092 · www.ashrae.org

About ASHRAE

Founded in 1894, ASHRAE is a global professional society committed to serve humanity by advancing the arts and sciences of heating, ventilation, air conditioning, refrigeration, and their allied fields.

As an industry leader in research, standards writing, publishing, certification, and continuing education, ASHRAE and its members are dedicated to promoting a healthy and sustainable built environment for all, through strategic partnerships with organizations in the HVAC&R community and across related industries.

To stay current with this and other ASHRAE Standards and Guidelines, visit www.ashrae.org/standards, and connect on LinkedIn, Facebook, Twitter, and YouTube.

Visit the ASHRAE Bookstore

ASHRAE offers its Standards and Guidelines in print, as immediately downloadable PDFs, and via ASHRAE Digital Collections, which provides online access with automatic updates as well as historical versions of publications. Selected Standards and Guidelines are also offered in redline versions that indicate the changes made between the active Standard or Guideline and its previous version. For more information, visit the Standards and Guidelines section of the ASHRAE Bookstore at www.ashrae.org/bookstore.

IMPORTANT NOTICES ABOUT THIS STANDARD

To ensure that you have all of the approved addenda, errata, and interpretations for this Standard, visit www.ashrae.org/standards to download them free of charge.

Addenda, errata, and interpretations for ASHRAE Standards and Guidelines are no longer distributed with copies of the Standards and Guidelines. ASHRAE provides these addenda, errata, and interpretations only in electronic form to promote more sustainable use of resources.

11/22