BSR/ASHRAE Standard 164.2-2012 (RA 202X)

Public Review Draft

Method of Test for Residential Self-Contained Humidifiers

First Public Review (September 2025)

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BSR ~~ANSI~~/ASHRAE Standard 164.2-2012,
Method of Test for Residential Self-Contained Humidifiers

NOTE

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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

This standard provides rules for the testing of self-contained system humidifiers for residential applications. It was prepared by ASHRAE Standard Project Committee (SPC) 164. The cognizant technical committee is ASHRAE TC 5.11, Humidifying Equipment.

The purpose of this standard is to provide a uniform method for testing in a laboratory environment. Although the method of test originated in ANSI/AHRI Standard 620-2004, Performance Rating Of Self-Contained Humidifiers For Residential Applications*, the committee has developed this separate method of test to be used independently of the AHRI rating standard so manufacturers, specifiers, installers, and users of central system residential humidifiers can test a humidifier's capacity under a variety of conditions with uniform results.*

This method of test was prepared in cooperation with the Air-Conditioning, Heating, and Refrigeration Institute to utilize with ANSI/AHRI Standard 620-2004.

Insert Foreword as shown on next page.

1. PURPOSE

This standard establishes a method of test for the humidification rate and power input of self-contained humidifiers for whole house applications.

2. SCOPE

2.1 The scope of this standard covers a method of test for the humidification rate of residential self-contained humidifiers that do not require other mechanical devices and are not connected to the central heating/ventilation system.

2.2 This method of test describes the test apparatus, conduct of the test, and information to be recorded.

2.3 Tests covered include methods for measuring energy input, water flow rate, water temperature, and water pressure to the test humidifier.

3. DEFINITIONS

humidification rate: a measure of the ability of a humidifier to add moisture to its surrounding atmosphere, expressed as a unit of weight of water evaporated per unit of time.

humidifier: a device designed to add moisture to the air.

portable humidifier: a type of humidifier that has the characteristics described in AHAM-HU-1, *Household Humidifiers*.[1]

self-contained humidifier: a humidifier that adds moisture to the air without the need of other mechanical devices and is not connected to the central heating/ventilation system.

shall: the word *shall* is to be understood as indicating requirements of this standard.

4. UNITS OF MEASUREMENT

4.1 Systems of Units. The International System of Units (le Système International d'Unités)[2] is employed in this standard. Values shall be based on the National Institute of Standards and Technology values, which in turn are based on the fundamental values of the International Bureau of Weights and Measures. Inch-pound units appear in parentheses (I-P) after SI units. Where necessary, equivalent I-P formulas are provided.

4.2 Basic Units. The unit of length is either the metre (foot), designated m (ft), or the millimetre (inch), designated mm (in.). The unit of mass is the kilogram (pound mass), designated kg (lb_m). The unit of time is the minute, designated min, or the second, designated s. The unit of temperature is degree Celsius (Fahrenheit), designated °C (°F).

4.3 Flow Rate and Velocity. The unit for the flow rate for air is litres per second (cubic feet per minute), designated L/s (cfm). The unit for the flow rate for water is kilograms per hour (pounds mass per hour), designated kg/h (lb_m/h). The unit for velocity is meters per second (feet per minute), designated m/s (fpm).

4.4 Pressure. The unit of pressure is the pascal or kilopascal (pounds per square inch, inch water gage, or the inch mercury column), designated Pa (psi, in. wg, or in. Hg). The inch mercury column shall be based on a one-inch column of mercury at 0°C (32°F), under standard gravity (*in vacuo*).

4.5 Power and Energy. In this standard, the unit of power is the kilowatt, designated kW.

5. INSTRUMENTS AND METHODS OF MEASUREMENT

5.1 Pressure. Pressure at a point shall be measured on an indicator, such as a manometer, a transducer, or an oil-filled gage. The instrument that is selected for a particular measurement shall meet the requirements of this standard.

5.1.1 Manometers and Other Air-Pressure-Indicating Instruments. Air pressure and atmospheric pressure shall be measured with electronic instruments, such as transducers or with manometers of the liquid column type using inclined or vertical legs, or with other instruments that provide a maximum error of 1% of the maximum observed reading or 1 Pa (0.005 in. wg), whichever is larger.

5.1.1.1 Averaging. Since the flows and the pressures measured in this standard are not expected to be steady, the pressure readings indicated on the instrument that is used can fluctuate with time. In order to obtain a true reading, either the instrument shall be damped or the readings shall be averaged in a suitable manner. Mental averaging is permitted if the fluctuations are small and regular. Multipoint or continuous record averaging shall be accomplished with instruments and analyzers designed for this purpose.

(This foreword is not a part of this standard. It is merely informative and does not contain requirements necessary for conformance to the standard.)

This is a reaffirmation of Standard 164.2-2012. This standard was prepared under the auspices of the American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE). It may be used, in whole or in part, by an association or government agency with due credit to ASHRAE. Adherence is strictly on a voluntary basis and merely in the interests of obtaining uniform guidelines throughout the industry. This version of the reaffirmation has no changes.

5.1.1.2 Corrections. Manometer readings shall be corrected for any difference in density of gage fluid from standard, for any difference in gas column balancing effect from standard, or for any change in length of the graduated scale due to temperature. However, corrections are not required for temperatures between 14°C (58°F) and 26°C (78°F), for latitudes between 30° and 60°, and for elevations up to 1500 m (5000 ft).

5.1.2 Water-Pressure-Indicating Instruments. Water pressure shall be measured with oil-filled gages, electronic transducers, or other instruments that provide a maximum error of no more than ±2% of the maximum observed reading or ±3.5 kPa (0.5 psi), whichever is larger.

5.1.2.1 Averaging. Since the flows and the pressures measured in this standard are not expected to be steady, the pressure reading indicated on any instrument can fluctuate with time. In order to obtain a true reading, either the instrument shall be damped or the readings shall be averaged in a suitable manner. It is acceptable to accomplish averaging mentally if the fluctuations are small and regular.

Note: Multipoint or continuous record averaging can be accomplished with instruments and analyzers designed for this purpose.

5.2 Airflow Rate. Airflow rate shall be determined using ANSI/ASHRAE Standard 51 or ANSI/AMCA Standard 210, *Laboratory Methods of Testing Fans for Certified Aerodynamic Performance Ratings.*[3]

5.3 Power

5.3.1 Watt-Hour Meters. Power shall be measured using a watt-hour meter connected to the humidifier over the duration of the test. Watt-hour meters shall have an accuracy of ±1.0% of the observed reading.

5.3.1.1 Calibration. Watt-hour meters shall be calibrated and certified traceable to the National Institute of Standards and Technology (NIST) or other national physical measures recognized as equivalent to NIST.

5.4 Water Flow

5.4.1 Scale and Weigh Tanks. Water flow for evaporation shall be measured using a scale, a pressurized water supply tank to the humidifier, and a waste water tank, as shown in Figure 1. A chronometer shall be used to determine the rate of water flow. The scale shall have an accuracy of ±0.0045 kg (0.01 lb).

5.4.1.1 Calibration. The scale shall be calibrated and certified traceable to the National Institute of Standards and Technology or other national physical measures recognized as equivalent to NIST.

5.4.2 Chronometer. A timepiece that displays time in seconds and keeps time accurate to ±2 min per day or better shall be used for all time measurements.

5.5 Air Density. Air density shall be calculated from measurements of wet-bulb temperature, dry-bulb temperature, and atmospheric pressure, or any other parameters if the maximum error in the calculated density does not exceed ±0.5%.

5.5.1 Temperature. Both wet- and dry-bulb air temperatures shall be measured in accordance with ANSI/ASHRAE Standard 41.1, *Standard Method for Temperature Measurement*.[4] A measurement accuracy of ±0.5°C (1.0°F) or better shall be obtained. The smallest scale division of the instrument shall be no greater than 0.25°C (0.5°F).

All other air temperature measurements shall have an accuracy of ±0.25°C (0.5°F) or better. The smallest scale division of the instrument shall be no greater than 0.12°C (0.25°F).

5.5.1.1 Calibration. Temperature sensors shall be calibrated over the range of temperatures to be encountered during the test against a thermometer with a calibration that is traceable to the National Institute of Standards and Technology or other national physical measures recognized as equivalent to NIST.

5.5.1.2 Wet-Bulb Temperature. The wet-bulb temperature sensors shall have an air velocity over the water-moistened, wick-covered bulb of 3.5 to 10 m/s (700 to 2000 fpm). The dry-bulb sensor shall be mounted upstream of the wet-bulb sensor so that its reading will not be depressed.

5.5.1.3 Water Temperature. Water temperature shall be measured using a submerged well, an insulated wrap of the supply line, or any other method with a demonstrated accuracy of ±0.5°C (1.0°F) or better.

5.5.2 Atmospheric Pressure. The atmospheric pressure shall be measured with a mercury column barometer or other instrument with a demonstrated accuracy of ±200 Pa (0.06 in. Hg) and with scale divisions no larger than 50 Pa (0.01 in. Hg).

5.5.2.1 Calibration. Barometers shall be calibrated against a mercury column barometer with a calibration that is traceable to the National Institute of Standards and Technology or other national physical measures recognized as equivalent by NIST. Transducer-type barometers shall be calibrated for each test.

5.5.2.2 Corrections. Barometer readings shall be corrected for any difference in mercury density from standard or for any change in the length of the graduated scale due to temperature. Refer to the manufacturer's instructions for details.

5.6 Heat Measurements

5.6.1 Heat Steam Quantity Measurements. Steam quantity shall be measured with a mass flowmeter having an accuracy of ±2.0% of the quantity measured.

5.6.2 Heat Flow Rate Measurements. Flow rate measurements shall be made with a liquid-type flowmeter having an accuracy of ±2.0% of the quantity measured.

6. EQUIPMENT AND SETUP

6.1 Setup. The suggested setup of the testing apparatus is illustrated in Figure 1.

6.2 Air Treatment Facilities. The test facility shall be provided with air treating equipment to maintain the prescribed conditions of temperature, humidity, and pressure of the air entering the humidifier test section.

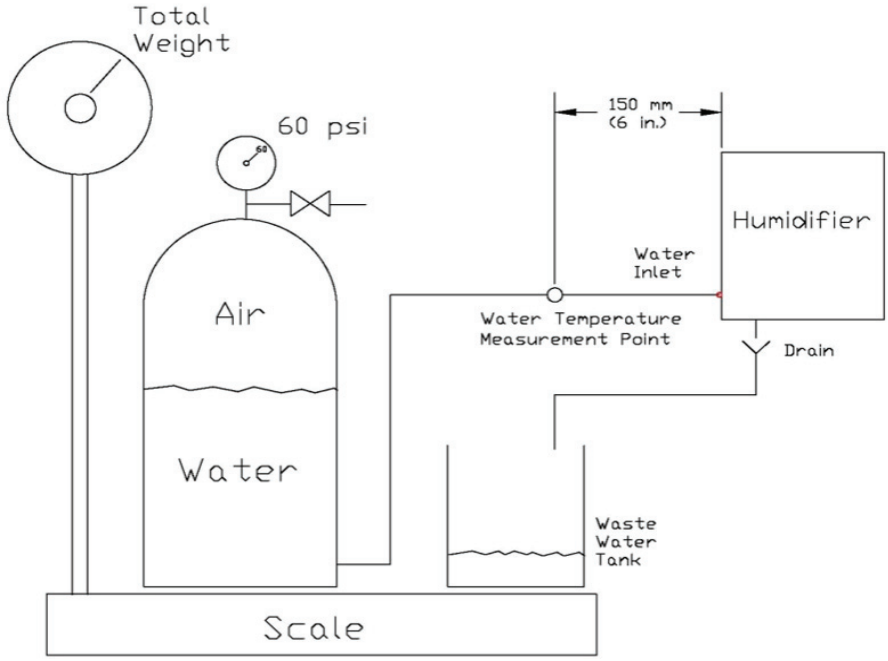

Figure 1 Test apparatus. The scale indicates the weight of supply water for the humidifier plus the weight of water drained from the humidifier at any time. The difference between the scale reading at one time and another time is the weight of water that the humidifier supplies to the surrounding air during this interval.

6.3 Temperature Measuring Facilities. Air temperature measurements and fluid temperature measurements shall be made in accordance with the applicable provisions of ANSI/ASHRAE Standard 41.1, *Standard Method for Temperature Measurement*[4], except in those cases where the specific requirements of Section 6.5.1 apply.

6.3.1 Mixers. When necessary, mixers shall be used to provide a uniform air temperature. Mixing or other types of devices shall be used to ensure uniform temperature profiles to the humidifier and measurement devices in accordance with ANSI/ASHRAE Standard 41.1, *Standard Method for Temperature Measurement.*[4]

6.4 Heat Measuring Apparatus. Means shall be provided to measure the amount of water, steam, or electricity used to supply heat to a self-contained humidifier with a recirculating coil in accordance with Sections 5.3 and 5.6.

6.5 Humidifier Installation. Self-contained humidifiers shall be set up according to the manufacturer's installation instructions.

7. OBSERVATIONS AND CONDUCT OF TEST

7.1 Test Apparatus. The test apparatus is composed of the following components:

a. Humidifier installation (Figure 1)
b. Air temperature measurement (Section 7.2.1)
c. Air velocity measurement (Section 7.2.2)
d. Supplementary heat measurement (Section 7.2.3)

7.2 Conditions of Test. The following conditions shall be maintained throughout the test (Section 7.2.2):

7.2.1 Air Temperatures. The air temperature entering the self-contained humidifier shall be maintained at the dry-bulb and wet-bulb temperatures selected. During any test, the variation of dry-bulb temperatures shall not be more than 0.6°C (1.0°F) and the variation of wet-bulb temperatures shall not be more than 0.3°C (0.6°F). The average of the dry-bulb and the average of the wet-bulb temperatures shall be the air temperature entering the self-contained humidifier. These temperatures shall be ±1.1°C (±2.0°F) of the selected dry-bulb temperature and ±0.6°C (±1°F) of the selected wet-bulb temperature.

7.2.2 Air Velocity. The air velocity in the humidifier test area shall be no greater than 0.23 m/s (45 fpm) or as recommended by the manufacturer based on 23.9°C (75.0°F) dry-bulb temperature and 13.6°C (56.5°F) wet-bulb temperature as measured at the air treatment apparatus throughout the test. This air velocity shall be substantially uniform and not influence the airflow through the test unit. No diverters, plates, or air-directing devices other than those supplied with the self-contained humidifier by the manufacturer shall be used to direct air at a higher-than-average velocity either toward or away from the self-contained humidifier under test.

7.2.3 Supplemental Heat

7.2.3.1 Electrical Supply. Self-contained humidifiers that require electrical energy for proper operation shall be connected to a power supply having the proper voltage and frequency, as measured at the electrical terminals of the self-contained humidifier. A wattmeter shall be installed in the electrical circuit when a self-contained humidifier is connected to an electrical supply circuit. The voltage supplied to the electrical terminals of the self-contained humidifier shall

be maintained. (A test tolerance of ±1% of the value being observed shall be allowed.)

7.2.3.2 Units Using Steam. The pressure of the feed steam entering the recirculating coil shall be maintained. (A test tolerance of ±0.7 kPa [±0.1 psi] shall be allowed.)

7.2.3.3 Units Using Hot Water. The pressure of the feed water entering the recirculating coil shall be maintained. (A test tolerance of ±7.0 kPa [±1.0 psi] shall be allowed.) The temperature of the water entering the recirculating coil shall be maintained. (A test tolerance of ±2.2°C [±4.0°F] shall be allowed.)

7.2.4 Water Supply Source(s) for Evaporation. The water supply source shall be directly connected to the self-contained humidifier, and a water control valve on the self-contained humidifier shall regulate the water flow rate. The pressure of the water entering the water control valve shall be maintained. (A tolerance of ±34 kPa [±5.0 psi] shall be allowed.) The temperature of the water entering the water control valve shall be maintained. (A test tolerance of ±1.1°C [±2.0°F] shall be allowed.)

7.3 Performance of Test. The self-contained humidifier to be tested shall be installed in the test apparatus as described in Sections 6 and 7. The air temperature, static pressure, water pressure, and temperature required for the test shall be maintained.

7.3.1 Internal Heating Source. The water or steam flow rate through the recirculating coil of the self-contained humidifier shall be adjusted to maintain the required inlet water temperature and pressure or inlet steam pressure during the test.

7.3.2 Data to Be Recorded. All data required to determine the humidification rate of the self-contained humidifier shall be recorded.

7.3.2.1 Air Temperatures. Dry-bulb and wet-bulb temperatures, °C (°F), entering the humidifier test section shall be observed and recorded.

7.3.2.2 Electrical Power Input. Power input when solenoids, heaters, and other devices are operating (including transformer), expressed in watts, shall be recorded in watt-hours. Electric energy input shall be calculated from this data.

7.3.2.3 Water and Steam Flow, Temperature, and Pressure. Water and steam temperature and pressure shall be observed and recorded as follows:

a. Water temperature entering and leaving the humidifier, °C (°F)
b. Water temperature entering and leaving the recirculating coil, °C (°F) (recirculating coil on self-contained humidifier using a coil for heat)
c. Water flow rate, kg/h (lbm/h)
d. Water pressure during test or during preliminary water adjustment, kPa gage (psig)
e. Steam pressure entering unit (when used), kPa gage (psig)
f. Temperature of condensate, °C (°F)

7.3.2.4 Evaporative Water Quantity. Weights or volumes of water consumed during a test run shall be observed and recorded as follows:

a. Weight of water in tanks at the beginning of the test, kg (lb_m)
b. Weight of water in tanks at the end of the test, kg (lb_m)

7.3.2.5 Time. The time of each reading and the elapsed time between successive readings of all data shall be recorded to the nearest 0.1 min.

7.3.2.6 Water Quantity. Weights or volumes of water consumed during a test run shall be observed and recorded as follows:

a. Weight of water in tanks at the beginning of the test, kg (lb_m)

7.3.3 Conducting the Test. After the required conditions of the test have been attained, a minimum of five data points shall be recorded over approximately equal time intervals. The duration of time between data points shall not be less than 15 min. The test shall be continued until the variation in humidification rate is ±5% or less for four successive readings.

7.3.4 Humidification Capacity. The humidification capacity of the test humidifier shall be determined using Equation 1 and shall be the average of successive test readings complying with Section 8.

8. CALCULATIONS

8.1 Calibration Correction. Calibration corrections, when required, shall be applied to individual readings before averaging or other calculations. Calibration corrections are not required if the correction is smaller than one half the maximum allowable error specified for each instrument.

8.2 Humidification Capacity. The humidification capacity in kg/h (lb_m/h) is the water supply rate minus the waste water flow rate, as shown in Equation 1.

Calculation of Humidification Capacity. The humidification capacity shall be calculated using the following equation:

$$H_m = (H_s - H_I) \quad (1)$$

where

H_m = humidification capacity, kg/h (lb_m/h)[†]
H_s = water supply rate, kg/h (lb_m/h)
H_I = waste water rate, kg/h (lb_m/h)

8.3 Supplemental Heat

8.3.1 Calculation of Recirculating Water or Steam Heat Input. The heat input to the recirculating water coil shall be calculated from the measured water flow rate and the

[†] Other consistent units, such as L/day (gal/day), are acceptable.

temperature difference between the water entering and leaving the coil by using the following equation:

$$q_w = K_1 \cdot w \cdot c(t_{w1} - t_{w2}) \quad (2)$$

where

c = specific heat of water at test conditions, kJ/kg °C (Btu/lb_m·°F)
K_1 = 1000/3600 (SI) or 1 (I-P)
q_w = water heat input, W (Btu/h)
t_{c1} = water temperature entering coil, °C (°F)
t_{c2} = water temperature leaving coil, °C (°F)
w = water flow rate, kg/h (lb_m/h)

The heat input to the recirculating steam coil shall be calculated from the measured condensate flow rate and the difference in enthalpy of the steam at the conditions specified:

$$q_{st} = K_2 \cdot w \cdot \Delta h \quad (3)$$

where

K_2 = 1000/3600 (SI) or 1 (I-P)
q_{st} = steam heat input, W (Btu/h)
w = condensate flow rate, kg/h (lb_m/h)
Δh = difference in enthalpy of steam between entering and leaving conditions, kJ/kg (Btu/lb)

8.3.2 Supplemental Electrical Heat. The supplemental heat input q_e (W) to the humidifier is included in the electrical energy measurement in Section 7.3.2.2.

9. REPORT AND RESULTS OF TEST

9.1 Report. The report of a laboratory test shall include the objective of the test, the results, the test data, and descriptions of the humidification unit, including the test setup and the setup of the test instruments as outlined in Section 7. The test barometric pressure shall be clearly identified. The laboratory shall be identified by name and location. Performance data shall be summarized in a suitable table.

9.2 Identification. Performance sheets shall list the test humidifier unit and test setup. Sufficient details shall be listed to identify clearly the unit and setup.

10. NORMATIVE REFERENCES

1. AHAM HU-1-2003, *Household Humidifiers*, 2003, Association of Home Appliance Manufacturers, 1111 19th St., NW, Suite 402, Washington, DC 20036, USA.
2. Page, C.H., and P. Vigoureux. *The International System of Units (SI)*, NIST SP 330, *The International System of Units (SI),* National Institute of Standards and Technology.
3. *ANSI/ASHRAE 51-2007, ANSI/AMCA Standard 210-2007, Laboratory Methods of Testing Fans for Certified Aerodynamic Performance Ratings*, ASHRAE, 1791 Tullie Circle N.E., Atlanta, GA 30329, USA.
4. ANSI/ASHRAE Standard 41.1-1986 (RA 2006), *Standard Method for Temperature Measurement*, 2001, ASHRAE, 1791 Tullie Circle N.E., Atlanta, GA 30329, USA.

(This annex 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.)

ANNEX A INFORMATIVE REFERENCES

2008 ASHRAE Handbook—HVAC Systems and Equipment, Chapter 21), ASHRAE, 1791 Tullie Circle N.E., Atlanta, GA 30329, USA.

ANSI/AHRI Standard 620-2004, *Performance Rating of Self-Contained Humidifiers for Residential Applications,* 2004 Air Conditioning Heating and Refrigeration Institute, 2111 Wilson Blvd, Suite 500, Arlington, VA 22203, USA.

ANSI/ASHRAE 41.2-1987 (RA 92), Standard Methods for Laboratory Airflow Measurement, ASHRAE, 1791 Tullie Circle N.E., Atlanta, GA 30329, USA.

ANSI/ASHRAE 41.3-1989, *Standard Method for Pressure Measurement*, ASHRAE, 1791 Tullie Circle N.E., Atlanta, GA 30329, USA.

ANSI/ASHRAE 41.6-2006, *Standard Method for Measurement of Moist Air Properties*, ASHRAE, 1791 Tullie Circle N.E., Atlanta, GA 30329, USA.

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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 · 1791 Tullie Circle NE · Atlanta, GA 30329 · www.ashrae.org

About ASHRAE

ASHRAE, founded in 1894, is an international organization of some 50,000 members. ASHRAE fulfills its mission of advancing heating, ventilation, air conditioning, and refrigeration to serve humanity and promote a sustainable world through research, standards writing, publishing, and continuing education.

For more information or to become a member of ASHRAE, visit www.ashrae.org.

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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.

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