



ADDENDA

**ANSI/ASHRAE Addendum d to
ANSI/ASHRAE Standard 55-2013**

Thermal Environmental Conditions for Human Occupancy

Approved by ASHRAE on May 29, 2015, and by the American National Standards Institute on June 1, 2015.

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FOREWORD

Addendum b to Standard 55-2013 changed the still-air threshold from 0.15 to 0.2 m/s (30 to 40 fpm) to align the compliance paths that previously had differing definitions of “still air.” This addendum updates additional references and figures in the standard that were impacted by Addendum b. The air-speed limit to prevent draft sensation in cool environments is moved to Section 5.3.3.4, “Average Air Speed (V_a) without Occupant Control,” to clarify how the limit fits into the other air-speed limits and Figure 5.3.3A, “Acceptable ranges of operative temperature (t_o) and average air speed (V_a) for the 1.0 and 0.5 clo comfort zones presented in figure 5.3.1, at humidity ratio 0.010.” Normative Appendix C, “Procedure for Evaluating Cooling Effect of Elevated Air Speed Using SET” is also modified to state that the SET model cooling effect applies to both air and radiant temperature. Addendum b to Standard 55-2013 is published and available for free download from the ASHRAE website at <https://www.ashrae.org/standards-research--technology/standards-addenda>.

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

Addendum d to Standard 55-2013

Replace Figure 5.3.3A with the figure shown, and revise the figure caption as shown.

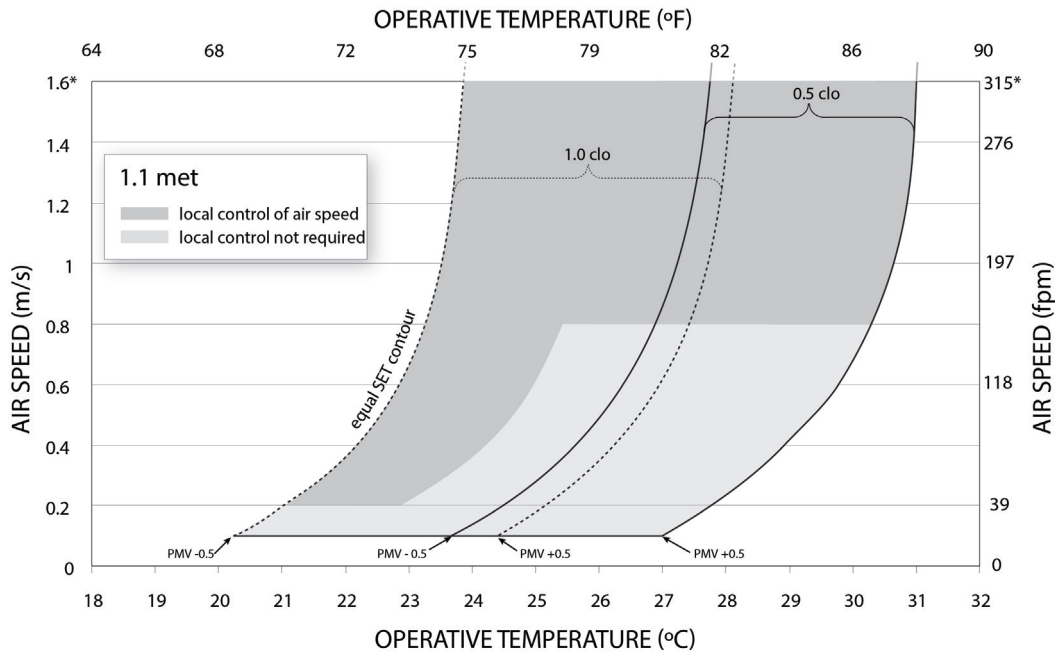


FIGURE 5.3.3A Acceptable ranges of operative temperature (t_o) and average air speed (V_a) for the 1.0 and 0.5 clo comfort zones presented in Figure 5.3.1, at humidity ratio 0.010.

Modify Figure 5.3.3B as shown.

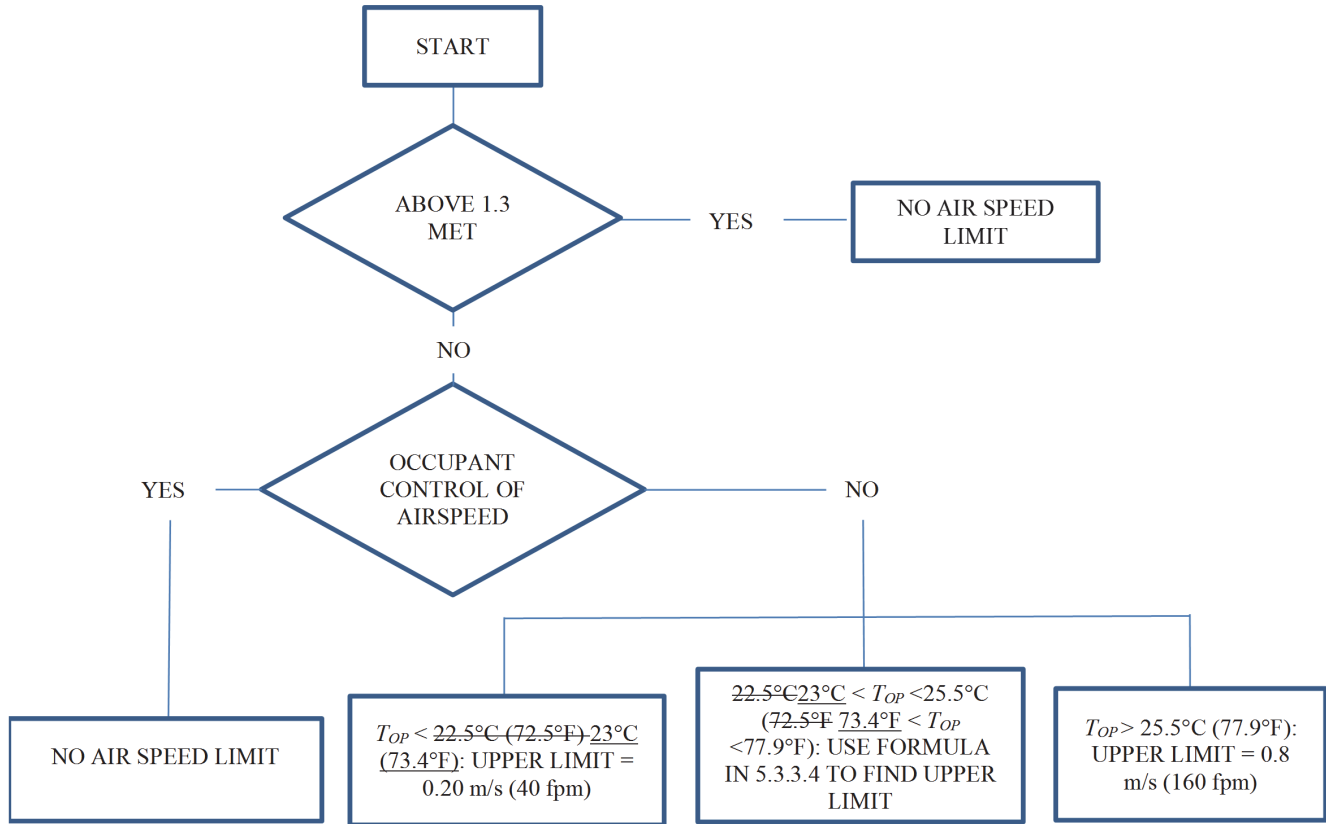


FIGURE 5.3.3B Flowchart for determining limits to airspeed inputs in the Elevated Air Speed Comfort Zone Method.

Revise Section 5.3.3.4 as shown.

5.3.3.4 Average Air Speed (V_a) without Occupant Control. If occupants do not have control over the local air speed meeting the requirements of Section 5.3.3.3, the following limits apply to the SET model and Figure 5.3.3A.

- For operative temperatures (t_o) above 25.5°C (77.9°F), the upper limit to average air speed (V_a) shall be 0.8 m/s (160 fpm).
- For operative temperatures (t_o) between 22.5-23.0°C and 25.5°C (72.5-73.4°F and 77.9°F), the upper limit to average air speed (V_a) shall follow an equal SET contour as described in Normative Appendix C. In Figure 5.3.3A this curve is shown between the dark and light shaded areas. It is acceptable to approximate the curve in Figure 5.3.3A in I-P and SI units by using the following equation:

$$V = 50.49 - 4.4047 t_a + 0.096425(t_a)^2 \text{ (m/s, } ^\circ\text{C)}$$

$$V = 31375.7 - 857.295 t_a + 5.86288(t_a)^2 \text{ (fpm, } ^\circ\text{F)}$$

- For operative temperatures (t_o) below 23.0°C (73.4°F), the limit to average air speed (V_a) shall be 0.2 m/s (40 fpm).

Exceptions to Section 5.3.3.4(c):

- Representative occupants with clothing insulation (I_{cl}) greater than 0.7 clo
- Representative occupants with metabolic rates above 1.3 met

Notes: a- These limits are shown by the light gray area in Figure 5.3.3A.

- Section 5.3.4.3 has further requirements for operative temperatures (t_o) below 22.5°C (72.5°F) at particular levels of clo and met.

Delete Section 5.3.4.3 as shown.

5.3.4.3 Draft. At operative temperatures (t_o) below 22.5°C (72.5°F), average air speed (V_a) caused by the building, its fenestration, and its HVAC system shall not exceed 0.20 m/s (40 fpm). This limit does not require consideration of air movement produced by office equipment or occupants.

Exception: Higher average air speeds (V_a) that are permitted by Section 5.3.3

Revise Normative Appendix C, Sections C1 and C2, as shown. The remainder of Appendix C is unchanged.

C1. CALCULATION OVERVIEW

Section 5.3 requires that the Elevated Air Speed Comfort Zone Method be used when average air speed (V_a) is greater than 0.20 m/s (40 fpm). The SET model shall be used to account for the cooling effect of air speeds greater than the maximum allowed in the Graphic Comfort Zone or Analytical Comfort Zone methods. This Appendix describes the calculation procedures for the Elevated Air Speed Comfort Zone Method.

For a given set of environmental and personal variables, including an elevated average air speed and an average air temperature (t_a), and a mean radiant temperature (t_r), the

SET is first calculated. Then the average air speed (V_a) is replaced by still air (0.150.1 m/s [3020 fpm]), and a second average air temperature is found that yields the same SET as in the first calculation. The second average air temperature is used to calculate PMV. The average air temperature and radiant temperature are adjusted according to the cooling effect. The cooling effect (CE) of the elevated airspeed is the value that, when subtracted equally from both the average air temperature and the mean radiant temperature, yields the same SET under still air as in the first SET calculation under elevated airspeed. The PMV adjusted for an environment with elevated average air speed is calculated using the adjusted average air temperature, the adjusted radiant temperature, and still air (0.1 m/s [20 fpm]).

- Enter the average air temperature (t_a), radiant temperature, relative humidity, clo value, and met rate.
- Set the average air speed (V_a).
- Note the calculated value for SET in the output data.
- Reduce the average air speed (V_a) to 0.150.1 m/s (3020 fpm).
- Reduce the average air temperature (t_a) and radiant temperature (t_r) equally in small increments until the SET is equal to the value noted in Step (c).
- This air temperature value is the adjusted average air temperature. The cooling effect (CE) is the quantity by which the average air temperature and radiant temperature have been reduced. The resulting air temperature value is the adjusted average air temperature, and the resulting radiant temperature is the adjusted mean radiant temperature.
- The PMV adjusted for elevated average air speed is calculated using the following inputs:
 - Adjusted average air temperature from Step (f)
 - Adjusted mean radiant temperature from Step (f)
 - Average air speed (V_a) of 0.150.1 m/s (3020 fpm)
 - Original relative humidity
 - Original mean radiant temperature (t_r)
 - Original clo value
 - Original met rate.

C2. CALCULATION PROCEDURE

The following is a formal description of this process that can be automated.

Suppose t_a is the average air temperature and v_{elev} is the elevated average air speed such that $v_{elev} > 0.150.1$ m/s (3020 fpm). Let $v_{still} = 0.150.1$ m/s (3020 fpm). Consider functions PMV and SET, which take six parameters, which we will denote with the shorthand PMV ($.,*$) and SET ($.,*$). The variables of importance will be listed explicitly, while the parameters that are invariant will be denoted with the “*” shorthand. The variables we will refer to explicitly are the average air temperature (t_a), mean radiant temperature (t_r), average air speed (V_a), and relative humidity (RH).

To define the adjusted average air temperature t_{adj} To define the cooling effect, CE, we assert that it satisfies the following:

$$SET(t_{adj}, v_{elev}, *) = SET(t_{adj}, v_{still}, *) \quad (C-1)$$

$$\text{SET}(t_a, t_r, v_{elev}, *) = \text{SET}(t_a - \text{CE}, t_r - \text{CE}, v_{still}, *) \quad (\text{C-1})$$

That is, the adjusted average air temperature yields the same SET given still air as the actual air temperature does at elevated average air speed. In order to determine t_{adj} , the cooling effect, an iterative root-finding method, such as the bisection or secant method, may be employed. The root of the parameterized function $f(t) - f(\text{ce})$ is the cooling effect (CE), satisfies the definition of t_{adj} :

$$f(t) = \text{SET}(t_{db}, v_{elev}, *) - \text{SET}(t, v_{still}, *) \quad (\text{C-2})$$

$$f(\text{ce}) = \text{SET}(t_a, t_r, v_{elev}, *) - \text{SET}(t_a - \text{ce}, t_r - \text{ce}, v_{still}, *) \quad (\text{C-2})$$

The adjusted PMV is given by

$$\text{PMV}_{adj} = \text{SET}(t_{adj}, v_{still}, *) \quad (\text{C-3})$$

$$\text{PMV}_{adj} = \text{PMV}(t_a - \text{CE}, t_r - \text{CE}, v_{still}, *) \quad (\text{C-3})$$

Note: For the use of SET in ASHRAE Standard 55, the function for self-generated air speed as a function of met rate has been removed.

Modify Informative Appendix H Section H3 as shown.

H3. DRAFT

Draft is unwanted local cooling of the body caused by air movement. It is most prevalent when the whole body thermal sensation is cool (below neutral). Draft sensation depends on

the air speed, the air temperature, the activity, and the clothing. Sensitivity to draft is greatest where the skin is not covered by clothing, especially the head region comprising the head, neck, and shoulders and the leg region comprising the ankles, feet, and legs.

Use of elevated air speed to extend the thermal comfort range is appropriate when occupants are slightly warm, as set forth in Section 5.3.3. When occupants are neutral to slightly cool, such as under certain combinations of met rate and clo value with operative temperatures (t_o) below ~~22.5~~23.0°C (72.5)73.4°F, average air speeds within the comfort envelope of ± 0.5 PMV should not exceed 0.20 m/s (40 fpm). This draft limit applies to air movement caused by the building, its fenestration, and its HVAC system and not to air movement produced by office equipment or occupants. This standard allows average air speed to exceed this draft limit if it is under the occupants' local control and it is within the elevated air speed comfort envelope described in Section 5.3.3.

Modify Informative Appendix H Table H1 as shown.

TABLE H1 Expected Percent Dissatisfied Due to Sources of Local Discomfort from Draft or Other Sources

Draft	Vertical Air Temperature Difference	Warm or Cool Floors	Radiant Asymmetry
<20%	<5%	<10%	<5%

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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.

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