



# ADDENDA

**ANSI/ASHRAE Addendum a to  
ANSI/ASHRAE Standard 55-2017**

# Thermal Environmental Conditions for Human Occupancy

Approved by ASHRAE on October 31, 2017, and by the American National Standards Institute on November 1, 2017.

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. The change submittal form, instructions, and deadlines may be obtained in electronic form from the ASHRAE website ([www.ashrae.org](http://www.ashrae.org)) or in paper form from the Senior Manager of Standards.

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- b. participation in the next review of the Standard,
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- d. permission to reprint portions of the Standard.

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## FOREWORD

Addendum a adds a new method for the avoidance of the draft risk at the ankle region. Currently, the standard does not provide guidance for assessing ankle draft. The new method applies to occupants with clothing insulation less than 0.7 clo and metabolic rate less than 1.3 met, complying with the entire Section 5.3.4, “Local Thermal Discomfort.”

This addendum uses mandatory language. Informative Appendix I is updated to take into account the new method, which is based on work described in the following sources:

Liu, S., S. Schiavon, A. Kabanshi, and W. Nazaroff. 2016. Predicted percentage of dissatisfied with ankle draft. *Indoor Air* 27(4):852–62.

<https://doi.org/10.1111/ina.12364>

<http://www.escholarship.org/uc/item/9076254n>

Schiavon, S., D. Rim, W. Pasut, and W. Nazaroff. 2016. Sensation of draft at uncovered ankles for women exposed to displacement ventilation and underfloor air distribution systems. *Building and Environment* 96:228–36.

<http://dx.doi.org/10.1016/j.buildenv.2015.11.009>

<http://escholarship.org/uc/item/4p692575>

**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 a to Standard 55-2017

### Modify Section 5.3.4 as shown.

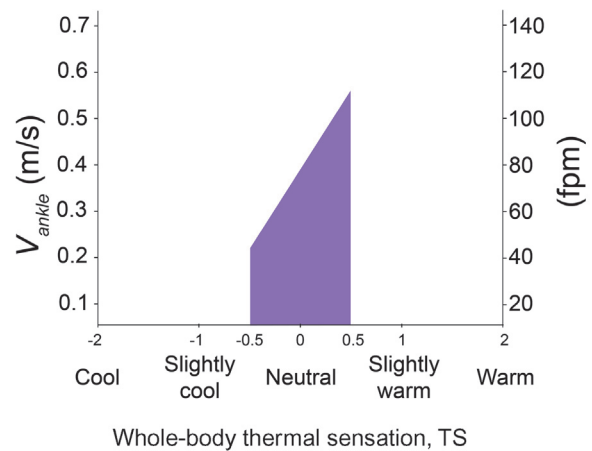
#### 5.3.4 Local Thermal Discomfort

**5.3.4.1 Applicability.** The requirements specified in this section are required to be met only when representative occupants meet both of the following criteria:

- Have clothing insulation  $I_{cl}$  less than 0.7 clo
- Are engaged in physical activity with metabolic rates below 1.3 met

For the purpose of compliance with this section, representative occupants’ ankle level is 0.1 m (4 in.) above the floor, and head level is 1.1 m (43 in.) for seated occupants and 1.7 m (67 in.) for standing occupants.

**Informative Note:** The standard does not contain requirements for standing occupants when all the representative occupants are seated. Many standing occupants have met rates greater than 1.3 (see Section 5.2.1), and by criterion (b) above, the requirements of Section 5.3.4 do not apply to them.



**Figure 5.3.4 Air speed limits at 0.1 m (4 in.) above the floor as a function of whole body thermal sensation.**

**Table 5.3.4.2 Allowable Radiant Temperature Asymmetry**

Radiant Temperature Asymmetry °C (°F)			
Ceiling Warmer than Floor	Ceiling Cooler than Floor	Wall Warmer than Air	Wall Cooler than Air
<5 (9.0)	<14 (25.2)	<23 (41.4)	<10 (18.0)

**5.3.4.2 Radiant Temperature Asymmetry.** Radiant temperature asymmetry shall not exceed the values in Table 5.3.4.2. The radiant temperature asymmetry is quantified in its definition in Section 3.

When direct-beam solar radiation falls on a representative occupant, the radiant temperature asymmetry shall include the solar contribution as follows: The short-wave mean radiant temperature  $\bar{t}_{rs,w}$ , as determined in Normative Appendix C, shall be multiplied by two and added to the plane radiant temperature  $t_{pr}$  for each horizontal or vertical direction in which the plane receives direct sunlight.

**5.3.4.3 Ankle Air Speed.** Air speed at 0.1 m (4 in.) above the floor shall be less than the value resulting from the following formula or in the shaded region of Figure 5.3.4:

$$\underline{V_{ankle}} < 0.35TS + 0.39 \quad (\underline{V_{ankle}} \text{ in m/s})$$

$$\underline{V_{ankle}} < 70.7TS + 79.6 \quad (\underline{V_{ankle}} \text{ in fpm})$$

where

$\underline{V_{ankle}}$  ≡ air speed at 0.1 m (4 in.) above the floor

TS ≡ whole-body thermal sensation; equal to PMV calculated using the input air temperature and speed averaged over two heights: 0.6 m (24 in.) and 1.1 m (43 in.) for seated occupants and 1.1 m (43 in.) and 1.7 m (67 in.) for standing occupants

**Exception to 5.3.4.3:** The requirement in this section does not apply when using elevated air speed in Section 5.3.3.

**5.3.4.3-5.3.4.4 Vertical Air Temperature Difference.** Air temperature difference between head level and ankle level shall not exceed 3°C (5.4°F) for seated occupants or 4°C (7.2°F) for standing occupants (see note in Section 5.3.4.1).

**5.3.4.4-5.3.4.5 Floor Surface Temperature.** When representative occupants are seated with feet in contact with the floor, floor surface temperatures within the occupied zone shall be 19°C to 29°C (66.2°F to 84.2°F).

*Revise Informative Appendix I as shown. The remainder of the appendix is unchanged. NOTE: The formulas shown, though not underlined, are new text added by this addendum.*

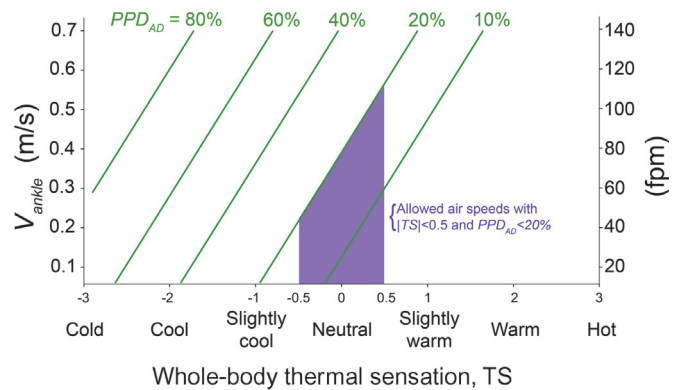
### 13. DRAFT

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 whole-body thermal sensation, air speed, air temperature, activity, turbulence intensity, and 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, otherwise, occupants are slightly warm, as set forth in Section 5.3.3. When occupants are neutral or cooler to slightly cool, such as under certain combinations of met rate and clo value with operative temperatures  $t_o$  below 23°C (73.4°F), average air speeds within the comfort envelope of  $\pm 0.5$  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 is within the elevated air speed comfort envelope described in Section 5.3.3.

Draft at the lower-leg region may occur in buildings conditioned by thermally stratified systems, such as displacement ventilation and underfloor air distribution, or with cold-dropping airflow along external walls and/or windows. This problem could also occur in vehicles when the air is supplied at the floor level. Manufacturers of air diffusers intended for the stratified systems often provide diffuser performance data that can assist designers in predicting  $V_{ankle}$ . Various approaches are used by different manufacturers to derive the performance data. A standard method of test does not yet exist.

The maximum air speed at the ankle is deduced from the predicted percentage of dissatisfied with ankle draft  $PPD_{AD}$ .  $PPD_{AD}$  is an index that establishes a quantitative prediction of the percentage of thermally dissatisfied people with the draft



**Figure 13 Air speed limits at 0.1 m (4 in.) above the floor as a function of whole-body thermal sensation and the predicted percentage of dissatisfied with ankle draft ( $PPD_{AD}$ ).**

at ankles.  $PPD_{AD}$  is calculated according to the following formula or is deduced from Figure 13.

$$PPD_{AD} = \frac{\exp(-2.58 + 3.05 V_{ankle} - 1.06 TS)}{1 + \exp(-2.58 + 3.05 V_{ankle} - 1.06 TS)} \quad \wedge$$

( $V_{ankle}$  in m/s)

$$PPD_{AD} = \frac{\exp(-2.58 + 0.015 V_{ankle} - 1.06 TS)}{1 + \exp(-2.58 + 0.105 V_{ankle} - 1.06 TS)} \quad \wedge$$

( $V_{ankle}$  in fpm)

where

$PPD_{AD}$   $\equiv$  predicted percentage of dissatisfied with ankle draft, %

$TS$   $\equiv$  whole-body thermal sensation; equal to PMV calculated using the input air temperature and speed averaged over two heights: 0.6 m (24 in.) and 1.1 m (43 in.) for seated occupants and 1.1 m (43 in.) and 1.7 m (67 in.) for standing occupants

$V_{ankle}$   $\equiv$  air speed at the 0.1 m (4 in.) above the floor

The air speed limits at 0.1 m (4 in.) in Section 5.3.4.3 are derived by setting  $PPD_{AD}$  equal to 20%.

The  $PPD_{AD}$  provides a simple tool to estimate the draft at ankles and lower legs. In this model, the whole-body thermal sensation can be approximated using the PMV with the input air temperature and speed averaged over two heights, and not three as in the rest of the standard. The two heights are 0.6 m (24 in.) and 1.1 m (43 in.) for seated occupants and 1.1 m (43 in.) and 1.7 m (67 in.) for standing occupants.

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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.

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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.

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