ADDENDA

ANSI/ASHRAE Addendum d to
ANSI/ASHRAE Standard 55-2017

Thermal Environmental Conditions for Human Occupancy

Approved by ASHRAE and the American National Standards Institute on July 31, 2020.

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FOREWORD

Addendum d removes the Graphical Comfort Zone Method (Section 5.3.1) from the standard and replaces it with example graphics using the Analytical Comfort Zone Method (Section 5.3.2) and the Elevated Air Speed Comfort Zone Method (Section 5.3.3). All references to the graphical method have been removed, and section headings have been updated.

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 d to Standard 55-2017

Modify Section 5.3 as shown.

5.3 Method for Determining Acceptable Thermal Environment in Occupied Spaces. Section 5.3 is permitted to be used to determine the requirements for thermal comfort in all occupied spaces within the scope of this standard.

Acceptable thermal environments shall be determined using one of the ~~three~~ two methods shown in Table 5.3.1 and any applicable requirements of Sections ~~5.3.4~~5.3.3 and ~~5.3.5~~5.3.4.

Informative Note: *Average air speed* and *average air temperature* have precise definitions in this standard. See Section 3 for all defined terms.

~~**5.3.1 Graphic Comfort Zone Method**~~

~~**5.3.1.1 Applicability.** Use of this method shall be limited to representative occupants with metabolic rates between 1.0 and 1.3 met and clothing insulation I_{cl} between 0.5 and 1.0 clo who are not exposed to direct-beam solar radiation. Average air speed V_a greater than 0.2 m/s (40 fpm) requires the use of Section 5.3.3.~~

~~The Graphic Comfort Zone is limited to a humidity ratio at or below 0.012 kg·H_2O/kg dry air (0.012 lb·H_2O/lb dry air), which corresponds to a water vapor pressure of 1.910 kPa (0.277 psi) at standard pressure or a dew-point temperature t_{dp} of 16.8°C (62.2°F).~~

~~**5.3.1.2 Methodology.** Figure 5.3.1 specifies the comfort zone for environments that meet the above criteria. Two zones are shown—one for 0.5 clo of clothing insulation I_{cl} and one for 1.0 clo of insulation.~~

~~Comfort zones for intermediate values of clothing insulation I_{cl} shall be determined by linear interpolation between the limits for 0.5 and 1.0 clo using the following relationships:~~

$$\cancel{t_{min,\,Icl} = [(I_{cl} - 0.5\text{ clo})\, t_{min,\,1.0clo} + (1.0\text{ clo} - I_{cl})\, t_{min,\,0.5clo}]/0.5\text{ clo}}$$

$$\cancel{t_{max,\,Icl} = [(I_{cl} - 0.5\text{ clo})\, t_{max,\,1.0clo} + (1.0\text{ clo} - I_{cl})\, t_{max,\,0.5clo}]/0.5\text{ clo}}$$

~~where~~

~~$t_{min,\,Icl}$~~	=	~~lower operative temperature t_o limit for clothing insulation I_{cl}~~
~~$t_{max,\,Icl}$~~	=	~~upper operative temperature t_o limit for clothing insulation I_{cl}~~
~~I_{cl}~~	=	~~thermal insulation of the clothing in question, clo~~

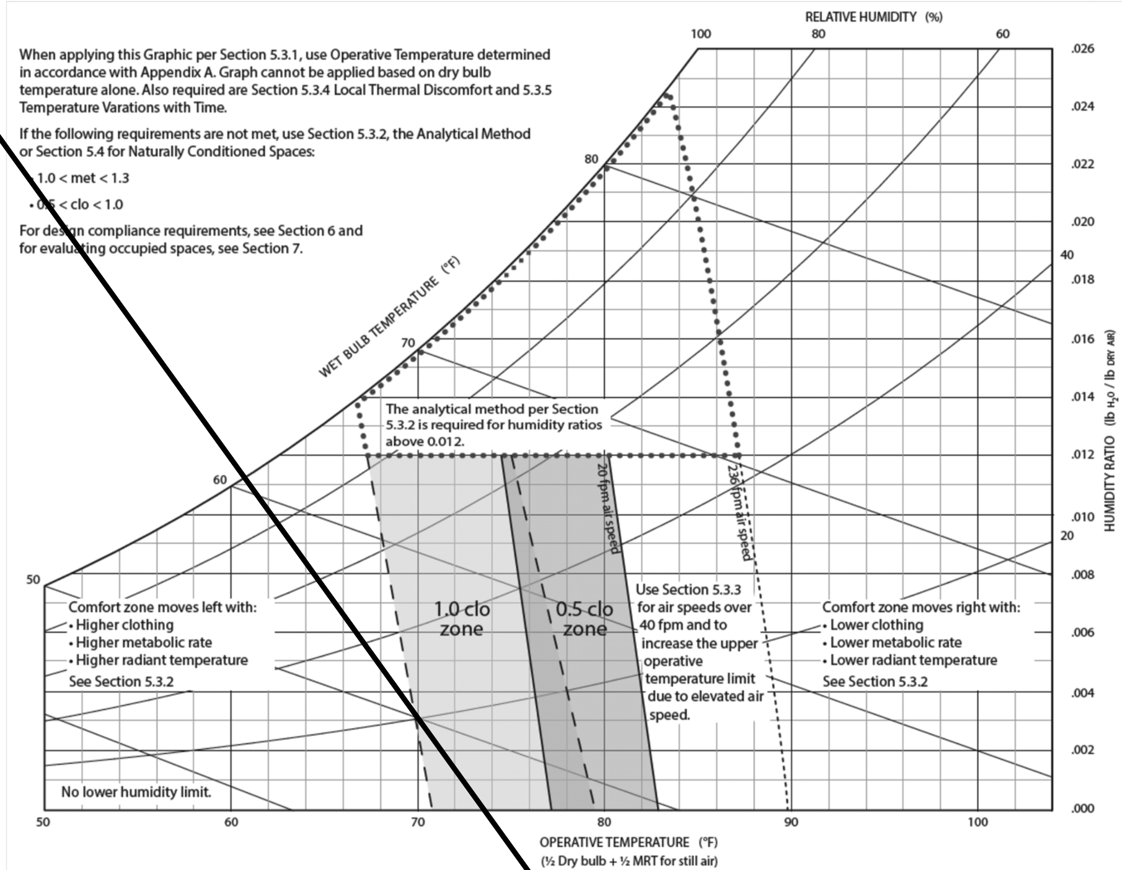
~~Average air speeds V_a greater than 0.2 m/s (40 fpm) increase the lower and upper operative temperature t_o limit for the comfort zone in accordance with Section 5.3.3.~~

~~5.3.2~~5.3.1 Analytical Comfort Zone Method

~~5.3.2.1~~5.3.1.1 Applicability. It is permissible to apply the method in this section to all spaces within the scope of this standard where the occupants have activity levels that result in average metabolic rates between 1.0 and 2.0 met. Average air speeds V_a greater than 0.20 m/s (40 fpm) require the use of Section ~~5.3.3~~5.3.2.

~~5.3.2.2~~5.3.1.2 Methodology. The computer code[3] in Normative Appendix B is to be used with this standard. Compliance is achieved if –0.5 < PMV < +0.5. Alternative methods are permitted. If any other method is used, it is the user's responsibility to verify and document that

(a)



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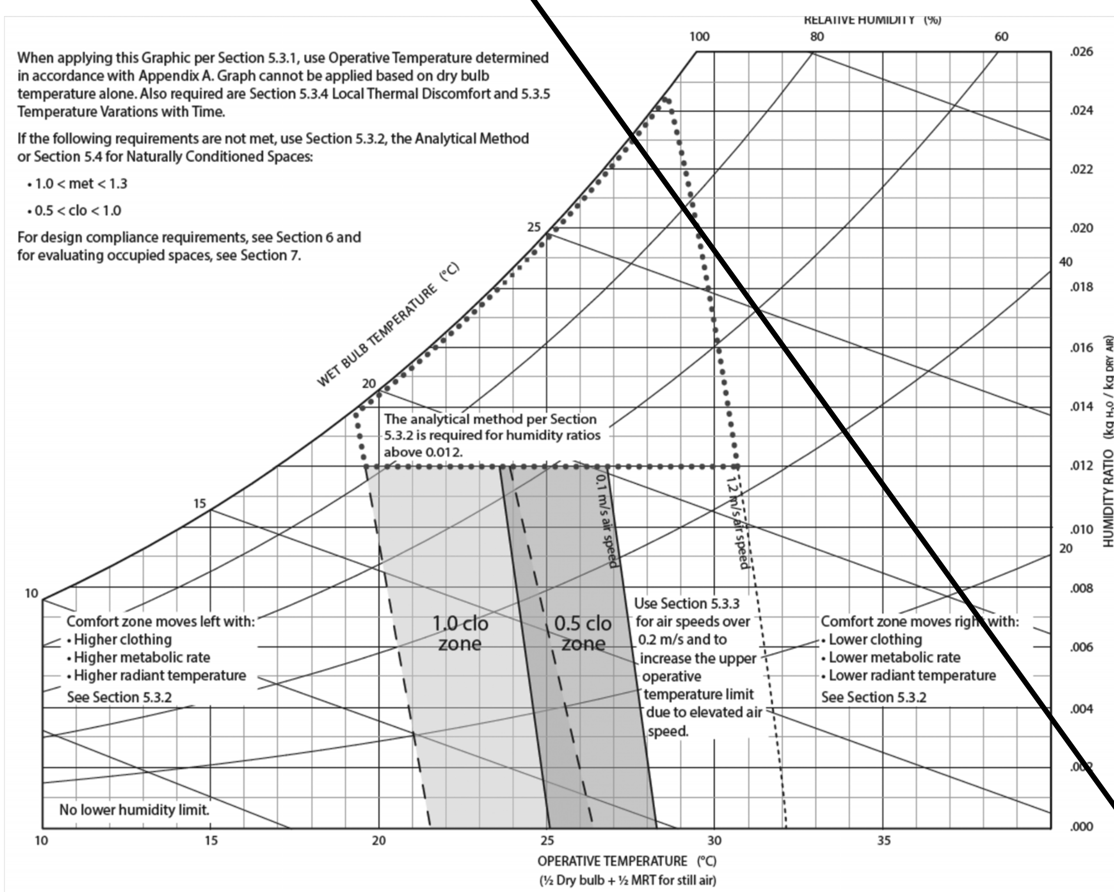


~~**Figure 5.3.1 Graphic Comfort Zone Method: Acceptable range of operative temperature t_o and humidity for spaces that meet the criteria specified in Section 5.3.1 (1.0 ≤ met < 1.3; 0.5 < clo < 1.0)—(a) I-P and (b) SI.**~~

Table 5.3.1 Applicability of Methods for Determining Acceptable Thermal Environments in Occupied Spaces

Average Air Speed, m/s (fpm)	Humidity Ratio	met	clo	Comfort Zone Method
~~<0.20 (40)~~	~~<0.012 kg·H_2O/kg dry air~~	~~1.0 to 1.3~~	~~0.5 to 1.0~~	~~Section 5.3.1, "Graphic Comfort Zone Method"~~
<0.20 (40)	All	1.0 to 2.0	0 to 1.5	Section ~~5.3.2~~5.3.1, "Analytical Comfort Zone Method"
>0.20 (40)	All	1.0 to 2.0	0 to 1.5	Section ~~5.3.3~~5.3.2, "Elevated Air Speed Comfort Zone Method"

the method used yields the same results. The *ASHRAE Thermal Comfort Tool*[3] is permitted to be used to comply with this section.

Figure 5.3.1.1 provides graphical examples of comfort zones using the Analytical Comfort Zone Method. Direct use of these charts to comply with the Analytical Comfort Zone Method is allowable for the specific input conditions described on each chart. In each figure, the darker shade comfort zone is the same, and the lighter shade comfort zone represents a single altered input (a) clothing insulation and (b) metabolic rate.

Informative Note: See Informative Appendix L for more explanation of predicted mean vote (PMV) and its relationship to predicted percentage dissatisfied (PPD).

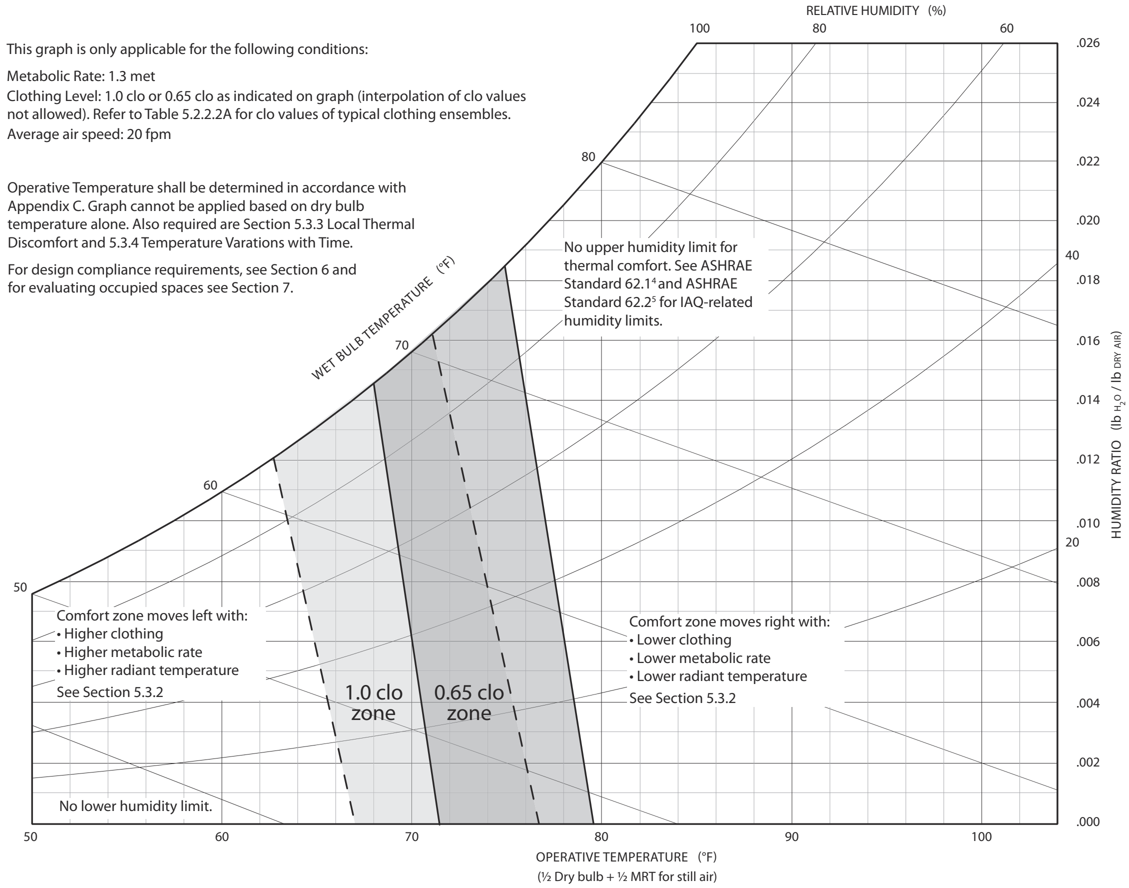
~~5.3.2.2.1~~5.3.1.2.1 When direct-beam solar radiation falls on a representative occupant, the mean radiant temperature t_r shall account for long-wave mean radiant temperature t_{rlw} and short-wave mean radiant temperature t_{rsw} using one of the following options.

a. Full calculation of mean radiant temperature t_r as follows:
   1. Step 1: Determine long-wave mean radiant temperature t_{rlw}.
   2. Step 2: Determine short-wave mean radiant temperature t_{rsw} using Normative Appendix C.
   3. Step 3: Mean radiant temperature t_r is equal to t_{rlw} + t_{rsw} determined in Step 1 and Step 2
b. Use a mean radiant temperature t_r that is 2.8°C (5°F) higher than average air temperature t_a if all of the following conditions are met:
   1. A space with air temperature stratification less than Section ~~5.3.4.3~~5.3.3.3.
   2. A space without active radiant surfaces.
   3. Building envelope opaque surfaces of the space (walls, floor, roof) meet U-value prescriptive requirement of ASHRAE/IES 90.1[2].
   4. Outside air temperature is less than 43°C (110°F).
   5. Vertical fenestration has less than 9 ft. (3 m) total height.
   6. No skylights are present.
   7. The space complies with all requirements in a single row of Tables ~~5.3.2.2.1~~5.3.1.2.1A, B, C or D. Interpolation between values within a single table (~~5.3.2.2.1~~5.3.1.2.1A, B, C or D), but not between tables, is permissible. Solar absorptance properties for shade fabrics used in Tables ~~5.3.2.2.1~~5.3.1.2.1A, B, C or D shall use the most similar color from Table ~~5.3.2.2.1~~5.3.1.2.1E unless more specific data are available from the manufacturer.

Tables ~~5.3.2.2.1~~5.3.1.2.1A through D show criteria that allow use of mean radiant temperature *tr* that is 2.8°C (5°F) higher than average air temperature t_a for high-performance glazing units (Table ~~5.3.2.2.1~~5.3.1.2.1A); clear, low-performance glazing units (Table ~~5.3.2.2.1~~5.3.1.2.1B); tinted glazing units (Table ~~5.3.2.2.1~~5.3.1.2.1C); and electrochromic glazing units (Table ~~5.3.2.2.1~~5.3.1.2.1D). See Normative Appendix C Section C2(e) for a description of f_{bes}.

~~5.3.3~~5.3.2 Elevated Air Speed Comfort Zone Method

~~5.3.3.1~~5.3.2.1 Applicability. It is permissible to apply the method in this section to all spaces within the scope of this standard where the occupants have activity levels that result in average metabolic rates between 1.0 and 2.0 met, clothing insulation I_{cl} between 0.0 and 1.5 clo, and average air speeds V_a greater than 0.20 m/s (40 fpm).



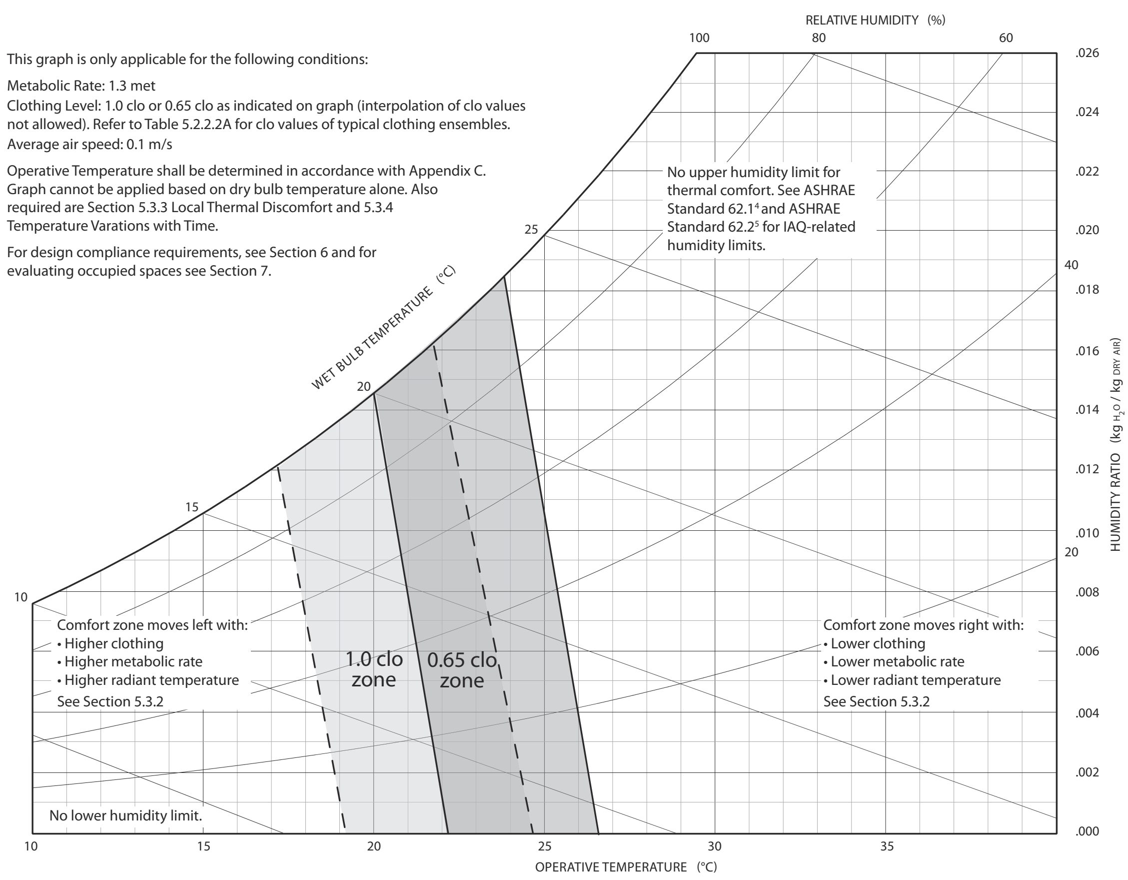
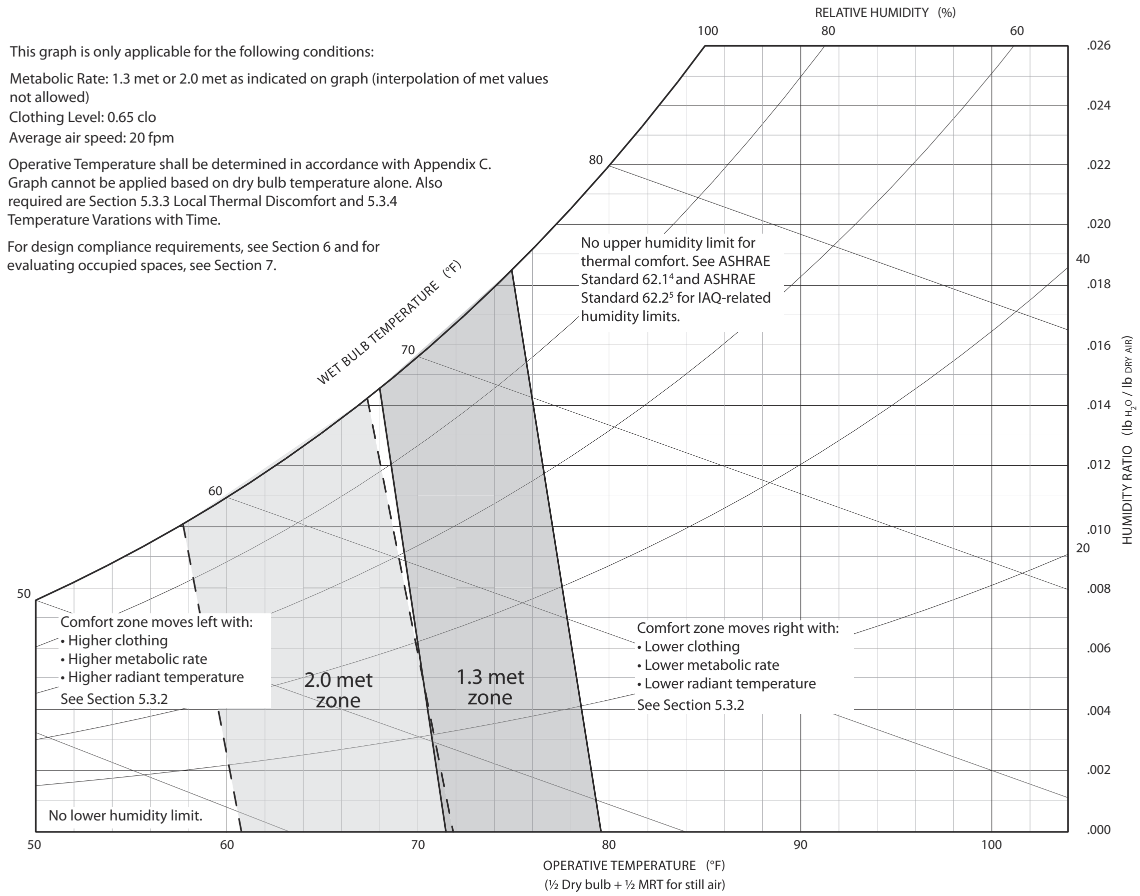


Figure 5.3.1.1A Analytical Comfort Zone Method example—effect of increased clo value.



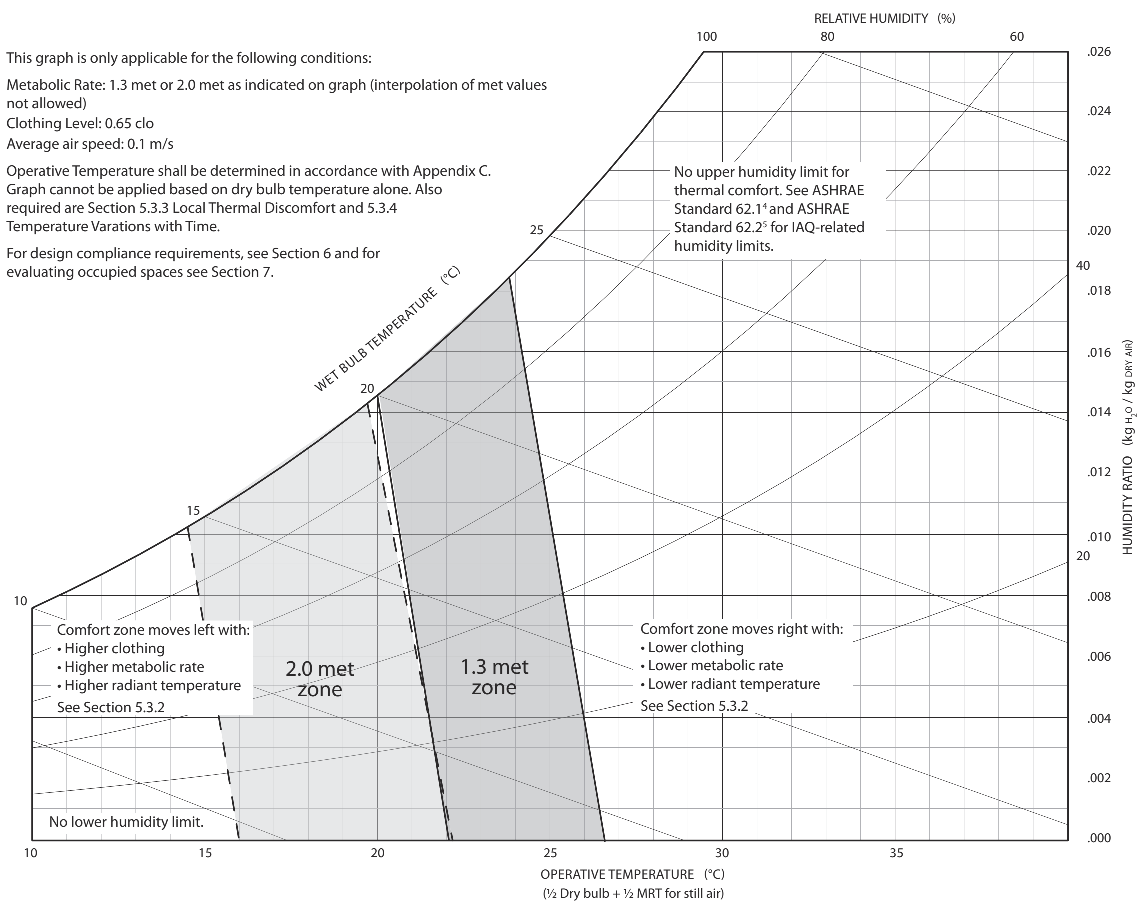


Figure 5.3.1.1B Analytical Comfort Zone Method example—effect of increased met value.

Table ~~5.3.2.2.1~~5.3.1.2.1A High-Performance (Low-e) Glazing Units

Representative Occupant Distance from Interior Window or Shade Surface, ft (m)	Fraction of Body Exposed to Sun (f_{bes}), %	Glazing Unit Total Solar Transmission (T_{sol}), %	Glazing Unit Indirect SHGC (SHGC – T_{sol}), %	Interior Shade Openness Factor, %	Interior Shade Solar Absorptance of Window-Facing Side, %
≥3.3 (1)	≤50	≤35	≤4.5	≤9	≤65
≥3.3 (1)	≤100	≤35	≤4.5	≤5	≤65

Table ~~5.3.2.2.1~~5.3.1.2.1B Clear Low-Performance Glazing Units

Representative Occupant Distance from Interior Window or Shade Surface, ft (m)	Fraction of Body Exposed to Sun (f_{bes}), %	Glazing Unit Total Solar Transmission (T_{sol}), %	Glazing Unit Indirect SHGC (SHGC – T_{sol}), %	Interior Shade Openness Factor, %	Interior Shade Solar Absorptance of Window-Facing Side, %
≥9.9 (3)	≤50	≤83	≤10	≤1	≤25
≥13.2 (4)	≤50	≤83	≤10	≤1	≤65
≥11.2 (3.4)	≤100	≤83	≤10	≤1	≤25
≥14.5 (4.4)	≤100	≤83	≤10	≤1	≤65

Table ~~5.3.2.2.1~~5.3.1.2.1C Tinted Glazing Units

Representative Occupant Distance from Interior Window or Shade Surface, ft (m)	Fraction of Body Exposed to Sun (f_{bes}), %	Glazing Unit Total Solar Transmission (T_{sol}), %	Glazing Unit Indirect SHGC (SHGC – T_{sol}), %	Interior Shade Openness Factor, %	Interior Shade Solar Absorptance of Window-Facing Side, %
≥3.3 (1)	≤50	≤10	≤20	≤8	≤25
≥3.3 (1)	≤50	≤10	≤20	≤1	≤65
≥4 (1.2)	≤100	≤10	≤20	≤1	≤25
≥4.9 (1.5)	≤100	≤10	≤20	≤1	≤65
>9.2 (2.8)	≤50	<15	≤8	No shade	No shade

Table ~~5.3.2.2.1~~5.3.1.2.1D Dynamic Glazing Units (Increasing T_{sol} Represents Decreasing Tint)

Representative Occupant Distance from Interior Window or Shade Surface, ft (m)	Fraction of Body Exposed to Sun (f_{bes}), %	Glazing Unit Total Solar Transmission (T_{sol}), %	Glazing Unit Indirect SHGC (SHGC – T_{sol}), %	Interior Shade Openness Factor, %	Interior Shade Solar Absorptance of Window-Facing Side, %
≥3.3 (1)	≤50	≤0.5	≤10	N/A	No shade
≥3.3 (1)	≤100	≤0.5	≤10	N/A	No shade
≥4.9 (1.5)	≤50	≤3	≤10	N/A	No shade
≥6.6 (2)	≤100	≤3	≤10	N/A	No shade
≥7.6 (2.3)	≤50	≤6	≤10	N/A	No shade
≥9.9 (3)	≤50	≤9	≤10	N/A	No shade

Table ~~5.3.2.2.1~~5.3.1.2.1E Interior Shade Solar Absorptance Based on Color Description of Window-Facing Side of Shade

Solar Absorptance, %	<15	15 to 25	25 to 65	>65
Color Description	White	Silver, cornsilk, wheat, oyster, beige, pearl	Beige, pewter, smoke, pebble, stone, pearl grey, light grey	Charcoal, graphite, chestnut

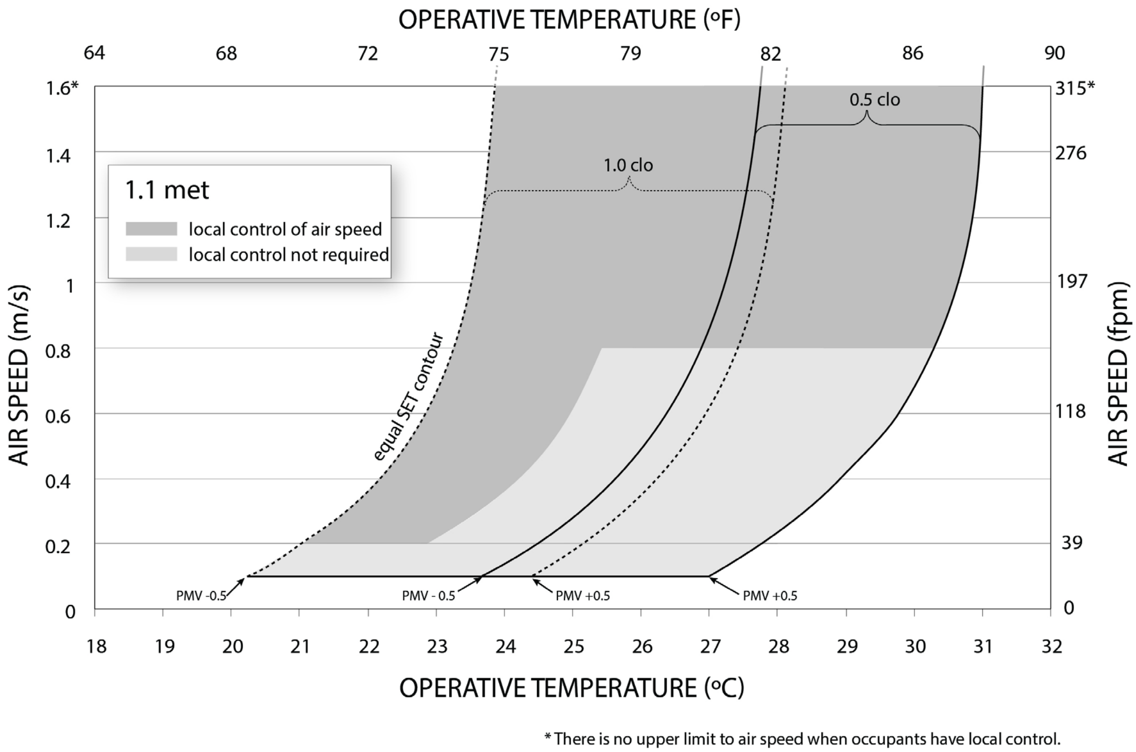


Figure ~~5.3.3~~5.3.2A Acceptable ranges of operative temperature t_o and average air speed V_a for the 1.0 and 0.5 clo comfort zones presented in Figure 5.3.1 at humidity ratio 0.010.

~~5.3.3.2~~5.3.2.2 Methodology. The calculation method in Normative Appendix D is to be used with this method. This method uses the Analytical Comfort Zone Method in Section ~~5.3.2~~5.3.1 combined with the Standard Effective Temperature (SET) method described in Appendix D.

Figure ~~5.3.3~~5.3.2A represents two particular cases (0.5 and 1.0 clo) of the Elevated Air Speed Comfort Zone Method and shall be permitted as a method of compliance for the conditions specified on the figure. The figure also defines comfort zones for air movement with occupant control (darkly shaded; Section 5.3.2.3) versus without occupant control (lightly shaded; Section 5.3.2.4). It is permissible to determine the operative temperature range by linear interpolation between the limits found for each zone in Figure ~~5.3.3~~5.3.2A.

Figure 5.3.2B provides a graphical example of a comfort zone using the Elevated Air Speed Comfort Zone Method with occupant control (lighter shade zone; Section 5.3.2.3) compared to one using the Analytical Comfort Zone Method (darker shade zone; Section 5.3.1). Direct use of this chart to comply with the Elevated Air Speed Comfort Zone Method with occupant control using the lighter shade zone is allowable for the specific input conditions described on the chart.

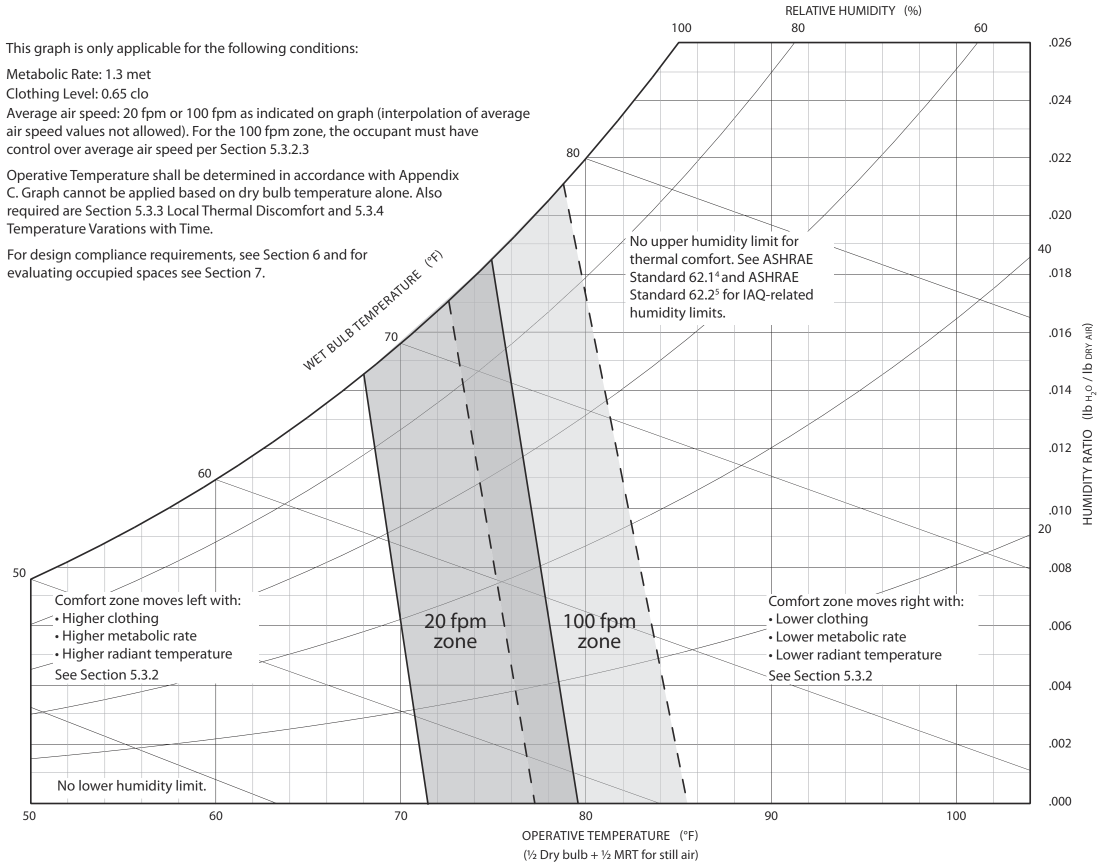
Alternative methods are permitted. If any other method is used, the user shall verify and document that the method used yields the same results. The *ASHRAE Thermal Comfort Tool*[3] is permitted to be used to comply with this section.

When direct beam solar radiation falls on a representative occupant, the mean radiant temperature (t_r) shall account for long-wave mean radiant temperature (t_{rlw}) and short-wave mean radiant temperature (t_{rsw}) in accordance with Section ~~5.3.2.2.1~~5.3.1.2.1.

Figure ~~5.3.3~~5.3.2C~~B~~ describes the steps for determining the limits to airspeed inputs in SET model.

~~5.3.3.3~~5.3.2.3 Average Air Speed V_a with Occupant Control. Section ~~5.3.3.4~~5.3.2.4 does not apply when the occupants have control over average air speed V_a and one of the following criteria is met:

a. One means of control for every six occupants or less.
b. One means of control for every 84 m^2 (900 ft^2) or less.
c. In multioccupant spaces where groups gather for shared activities, such as classrooms and conference rooms, at least one control shall be provided for each space, regardless of size.



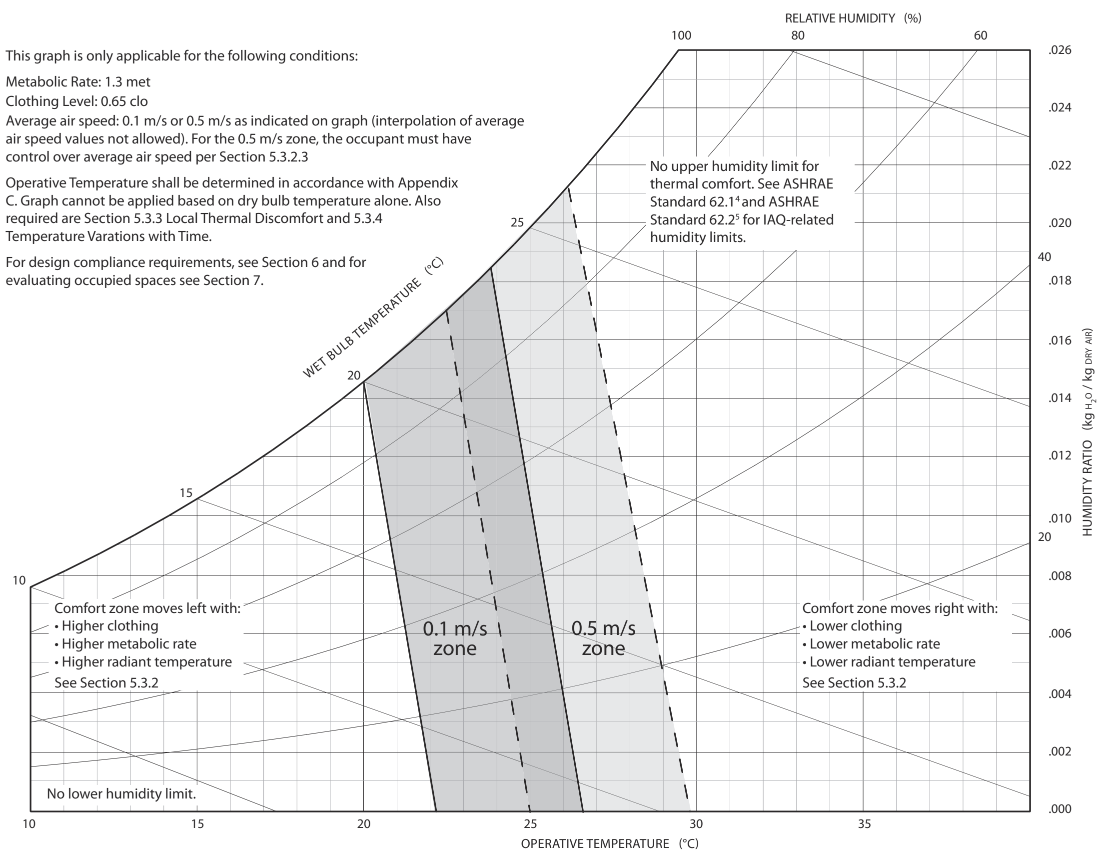


Figure 5.3.2B Analytical Comfort Zone Method example (lightly shaded zone) compared to the Analytical Comfort Zone Method example (darkly shaded zone) from Figure 5.3.1.1.

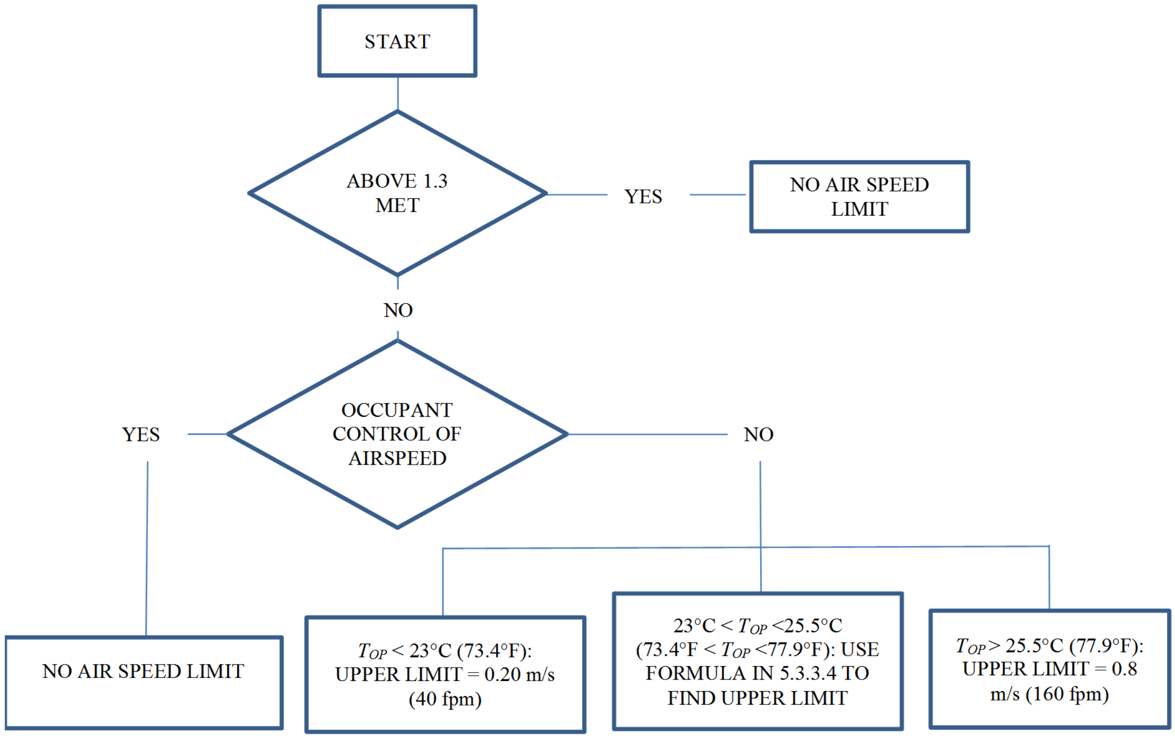


Figure ~~5.3.3B~~5.3.2C Flowchart for determining limits to airspeed inputs in the Elevated Air Speed Comfort Zone Method.

Multioccupant spaces that are subdivided by movable walls shall have one control for each space subdivision.

~~5.3.3.4~~5.3.2.4 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~~5.3.2.3, the following limits apply to the SET model and Figure ~~5.3.3~~5.3.2A.

a. 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).

b. For operative temperatures t_o between 23.0°C and 25.5°C (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 D. In Figure ~~5.3.3~~5.3.2A this curve is shown between the dark and light shaded areas. It is permitted to determine the curve using the following equation:

$$V_a = 50.49 - 4.4047(t_o) + 0.096425(t_o)^2 \text{ (m/s, °C)}$$

$$V_a = 31375.7 - 857.295(t_o) + 5.86288(t_o)^2 \text{ (fpm, °F)}$$

c. 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).

Exception to ~~5.3.3.4~~5.3.2.4(c):

1. Representative occupants with clothing insulation I_{cl} greater than 0.7 clo.
2. Representative occupants with metabolic rates above 1.3 met.

Informative Note: These limits are shown by the light gray area in Figure ~~5.3.3~~5.3.2A.

~~5.3.4~~5.3.3 Local Thermal Discomfort

~~5.3.4.1~~5.3.3.1 Applicability. The requirements specified in this section are required to be met only when representative occupants meet both of the following criteria:

a. Have clothing insulation I_{cl} less than 0.7 clo.

b. Are engaged in physical activity with metabolic rates below 1.3 met.

Table ~~5.3.4.2~~5.3.3.2 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)

Table ~~5.3.5.3~~5.3.4.3 Limits on Temperature Drifts and Ramps

Time Period, h	0.25	0.5	1	2	4
Maximum Operative Temperature t_o Change Allowed, °C (°F)	1.1 (2.0)	1.7 (3.0)	2.2 (4.0)	2.8 (5.0)	3.3 (6.0)

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 if so, then by criterion b. above, the requirements of ~~5.3.4~~5.3.3 do not apply to them.

~~5.3.4.2~~5.3.3.2 Radiant Temperature Asymmetry. Radiant temperature asymmetry shall not exceed the values in Table ~~5.3.4.2~~5.3.3.2. 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 t_{rsw} 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~~5.3.3.3 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~~5.3.3.1).

~~5.3.4.4~~5.3.3.4 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).

~~5.3.5~~5.3.4 Temperature Variations with Time

~~5.3.5.1~~5.3.4.1 Applicability. The fluctuation requirements of this section shall be met when they are not under the direct control of the individual occupant.

~~5.3.5.2~~5.3.4.2 Cyclic Variations. Cyclic variations in operative temperature t_o that have a period not greater than 15 minutes shall have a peak-to-peak amplitude no greater than 1.1°C (2.0°F).

~~5.3.5.3~~5.3.4.3 Drifts or Ramps. Monotonic, noncyclic changes in operative temperature t_o and cyclic variations with a period greater than 15 minutes shall not exceed the most restrictive requirements from Table ~~5.3.5.3~~5.3.4.3.

Informative Note: For example, the operative temperature shall not change more than 2.2°C (4.0°F) during a 1.0 h period, and more than 1.1°C (2.0°F) during any 0.25 h period within that 1.0 h period.

Modify Section 6.2 as shown.

6.2 Documentation. The method and design conditions appropriate for the intended use of the building shall be selected and documented as follows.

Informative Note: Some of the requirements in items (a) through (h) below are not applicable to naturally conditioned buildings.

a. The method of design compliance shall be stated for each space and/or system: ~~Graphic Comfort Zone Method (Section 5.3.1),~~ Analytical Comfort Zone Method (Section ~~5.3.2~~5.3.1), Elevated Air Speed Comfort Zone Method (Section ~~5.3.3~~5.3.2), or the use of Section 5.4 for Occupant-Controlled Naturally Conditioned Spaces.

b. The design operative temperature (t_o) and humidity (including any tolerance or range), the design outdoor conditions (see 2009 *ASHRAE Handbook—Fundamentals*[1], Chapter 14), and total indoor loads shall be stated. The design exceedance hours (see Section 3, "Definitions") shall be documented based on the design conditions used.
c. Values assumed for comfort parameters used in the calculation of thermal conditions, including operative temperature t_o, humidity, average air speed V_a, clothing insulation I_{cl}, and metabolic rate, shall be stated for heating and cooling design conditions. If an acceptable level of comfort is not being provided to any representative occupants, this shall be stated. Where Table 5.2.1.2 gives a range, the basis for selecting a single value within that range shall be stated. If the clothing insulation or metabolic rate parameters for a given space are outside the applicable bounds defined by the standard, or if the space is not regularly occupied as defined in Section 2.3, the space shall be clearly identified as not under the scope of the standard.
d. Local thermal discomfort shall be addressed, at a minimum, by a narrative explanation of why an effect is not likely to exceed Section 5 limits. Where calculations are utilized to determine the effect of local thermal discomfort in accordance with Section 5, the calculation inputs, methods, and results shall be stated.
e. System equipment capacity shall be provided for each space and/or system documenting performance meeting the design criteria stated. For each unique space, the design system or equipment heating and/or cooling capacity shall meet the thermal loads calculated under the heating and cooling design conditions stated for compliance with this standard.
f. Where elevated air speed with occupant control is employed to provide acceptable thermal conditions, documentation shall be provided to identify the method and equipment for occupant control.
g. Air speed, radiant temperature asymmetry, vertical air-temperature difference, surface temperatures, and temperature variations with time shall be determined in accordance with generally accepted engineering standards (e.g., *ASHRAE Handbook—HVAC Applications*, Chapter 57). The method used and quantified selection criteria, characteristics, sizes, and indices that are applicable to the method shall be stated.
h. When direct beam solar radiation falls on a representative occupant, documentation shall include solar design condition (solar altitude, direct beam intensity), the method in Section ~~5.3.2.2.1~~5.3.1.2.1 used for compliance, and the resultant mean radiant temperature t_r.

Modify Section 7.2.2.1 as shown.

7.2.2.1 Mechanically Conditioned Spaces. ~~Use Section 5.3.1.2 to determine the PMV-based comfort zone for the occupants' expected clothing and metabolic rate.~~ Use Section 5.3.1, "Analytical Method," to determine the comfort of occupants under the measured environmental conditions. ~~The modeled c~~Clothing and activity levels of the occupants must be as observed or as expected for the use of the indoor space in question. Use Section ~~5.3.3~~5.3.2 to adjust the comfort zone's lower and upper operative temperature limits for elevated air movement. Occupied zone conditions must also conform to requirements for avoiding local thermal discomfort (as specified in Section ~~5.3.4~~5.3.3) and to limits to rate of temperature change over time, as specified in Section ~~5.3.5~~5.3.4.

Parameters to be measured and/or recorded include the following:

a. Occupant metabolic rate (met) and clothing (clo) observations
b. Air temperature and humidity
c. Mean radiant temperature t_r, unless it can be otherwise demonstrated that, within the space, t_r is within 1°C (2°F) of t_a
d. Air speed, unless it can be otherwise demonstrated that, within the space, average air speed V_a meets the requirements of Section ~~5.3.3~~5.3.2

Modify Section 7.3.2 as shown.

7.3.2 Physical Measurement Positions within the Building

a. **Floor plan.** Thermal environment measurements shall be made in the building at a representative sample of locations where the occupants are known to, or are expected to, spend their time. When performing evaluation of similar spaces in a building, it shall be permitted to select a representative sample of such spaces.

If occupancy distribution cannot be observed or estimated, then the measurement locations shall include both of the following:

1. The center of the room or space
2. 1.0 m (3.3 ft) inward from the center of each of the room's walls. In the case of exterior walls with windows, the measurement location shall be 1.0 m (3.3 ft) inward from the center of the largest window.

Measurements shall also be taken in locations where the most extreme values of the thermal parameters are observed or estimated to occur (e.g., potentially occupied areas near windows, diffuser outlets, corners, and entries).

b. **Height above floor.** Air temperature and average air speed V_a shall be measured at the 0.1, 0.6, and 1.1 m (4, 24, and 43 in.) levels for seated occupants at the plan locations specified above. Measurements for standing occupants shall be made at the 0.1, 1.1, and 1.7 m (4, 43, and 67 in.) levels. Operative temperature or PMV shall be measured or calculated at the 0.6 m (24 in.) level for seated occupants and the 1.1 m (43 in.) level for standing occupants. Floor temperature that may cause local discomfort shall be measured at the surface by contact thermometer or infrared thermometer (Section ~~5.3.4.5~~5.3.3.5).

Radiant temperature asymmetry that may cause local thermal discomfort (Sections ~~5.3.4.4~~5.3.3.4) shall be measured in the affected occupants' locations, with the sensor oriented to capture the greatest surface temperature difference.

Modify Section 7.4.2.1 as shown.

7.4.2.1 Approaches to Predicting whether a Thermal Environment is Acceptable at a Specific Instance in Time

a. Mechanically conditioned buildings:
   1. Occupied spaces shall be evaluated using the PMV and SET comfort zone as defined in Sections~~ 5.3.1 and 5.3.3~~5.3.2.
   2. Local thermal discomfort shall be evaluated using the limits to environmental asymmetry prescribed in Section ~~5.3.4~~5.3.3.

b. Buildings with occupant-controlled operable windows:
   1. Occupied spaces shall be evaluated using the indoor operative temperature t_o contours of the adaptive model comfort zone in Section 5.4, including the contour extensions for average air speeds V_a above 0.3 m/s (59 fpm).

Add new normative references in Section 8 as shown. The remainder of Section 8 is unchanged.

8. REFERENCES

[. . .]

4. ASHRAE. 2016. ANSI/ASHRAE Standard 62.1-2016, *Ventilation for Acceptable Indoor Air Quality*. Atlanta: ASHRAE

5. ASHRAE. 2016. ANSI/ASHRAE Standard 62.2-2016, *Ventilation and Acceptable Indoor Air Quality in Residential Buildings*. Atlanta: ASHRAE

~~4~~6. ISO. 2005. ISO 7730, *Ergonomics of the Thermal Environment—Analytical Determination and Interpretation of Thermal Comfort using Calculation of the PMV and PPD Indices and Local Thermal Comfort Criteria*. Geneva, Switzerland: International Organization for Standardization.

~~5~~7. ASHRAE. 2013. 2013 *ASHRAE Handbook—Fundamentals.* Atlanta: ASHRAE.

Modify Normative Appendix B normative reference number and example table as shown. The reminder of Normative Appendix B is unchanged.

This is a normative appendix and is part of this standard.)

NORMATIVE APPENDIX B
COMPUTER PROGRAM FOR CALCULATION OF PMV-PPD

(Reference Annex D of ISO 7730[~~4~~6]. Used with permission from ISO. For additional technical information and an I-P version of the equations in this appendix, refer to the ASHRAE Thermal Comfort Tool[3] referenced in Section 8 of this standard. The Thermal Comfort Tool allows for I-P inputs and outputs, but the algorithm is implemented in SI units.)

[. . .]

EXAMPLE~~—Values used to generate the comfort envelope in Figure 5.3.1.~~

Run	Air Temp.		RH	Radiant Temp.		Air Speed					
#	°F	C	%	°F	C	fpm	m/s	met	clo	PMV	PPD %
1	67.3	19.6	86	67.3	19.6	20	0.10	1.1	1	–0.5	10
2	75.0	23.9	66	75.0	23.9	20	0.10	1.1	1	0.5	10
3	78.2	25.7	15	78.2	25.7	20	0.10	1.1	1	0.5	10
4	70.2	21.2	20	70.2	21.2	20	0.10	1.1	1	–0.5	10
5	74.5	23.6	67	74.5	23.6	20	0.10	1.1	0.5	–0.5	10
6	80.2	26.8	56	80.2	26.8	20	0.10	1.1	0.5	0.5	10
7	82.2	27.9	13	82.2	27.9	20	0.10	1.1	0.5	0.5	10
8	76.5	24.7	16	76.5	24.7	20	0.10	1.1	0.5	–0.5	10

Modify Section C1 introduction reference numbers as shown. The remainder of Section C1 is unchanged.

C1. CALCULATION PROCEDURE

Solar gain to the human body is calculated using the effective radiant field (ERF), a measure of the net radiant energy flux to or from the human body (2013 *ASHRAE Handbook—Fundamentals* [~~5~~7], Chapter 9.24). ERF is expressed in W/m^2 (Btuh/ft^2), where "area" refers to body surface area. The surrounding surface temperatures of a space are expressed as mean radiant temperature $\bar{t}_r$, which equals long-wave mean radiant temperature $\overline{t_{rlw}}$ when no solar radiation is present. The ERF on the human body from long-wave exchange with surfaces is related to $\overline{t_{rlw}}$ by

$$\mathrm{ERF} = f_{eff} h_r (\overline{t_{rlw}} - t_a) \tag{C-1}$$

where f_{eff} is the fraction of the body surface exposed to radiation from the environment (= 0.696 for a seated person and 0.725 for a standing person), h_r is the radiation heat transfer coefficient (W/m^2·K [Btuh/ft^2·°F]), and t_a is the air temperature (°C [°F]).

[. . .]

Modify Section D1 introduction as shown. The remainder of Section D1 is unchanged.

D1. 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 method~~s~~. This appendix describes the calculation procedures for the Elevated Air Speed Comfort Zone Method.

[. . .]

Modify Section E1 introduction as shown.

E1. INTRODUCTION

Thermal comfort is that condition of mind that expresses satisfaction with the thermal environment. Because there are large variations, physiologically and psychologically, from person to person, it is difficult to satisfy everyone in a space. The environmental conditions required for comfort are not the same for everyone. Extensive laboratory and field data have been collected that provide the necessary statistical data to define conditions that a specified percentage of occupants will find thermally comfortable.

~~The operative temperature t_o and humidity shown on the psychrometric chart in Figure 5.3.1 (graphical method) are for 80% occupant acceptability. This is based on a 10% dissatisfaction criterion for general (whole body) thermal comfort based on the PMV-PPD index, plus an additional 10% dissatisfaction that may occur on average from local (partial body) thermal discomfort (see below). Normative Appendix B provides a list of inputs and outputs used in the PMV/PPD computer program to generate these graphs.~~

Modify Sections E4 and E5 section references as shown.

E4. TEMPORAL VARIATION

It is possible for all six of these factors to vary with time. This standard only addresses thermal comfort in a steady state (with some limited specifications for temperature variations with time in Section ~~5.3.5~~5.3.4).

As a result, people entering a space that meets the requirements of this standard may not immediately find the conditions comfortable if they have experienced different environmental conditions just prior to entering the space. The effect of prior exposure or activity may affect comfort perceptions for approximately one hour.

E5. LOCAL THERMAL DISCOMFORT

Nonuniformity is addressed in Section ~~5.3.4~~5.3.3. Factors 1 through 6 may be nonuniform over an occupant's body, and this nonuniformity may be an important consideration in determining thermal comfort.

Modify Informative Appendix H as shown.

(This appendix 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.)

INFORMATIVE APPENDIX H
COMFORT ZONE METHODS

H1. DETERMINING ACCEPTABLE THERMAL CONDITIONS IN OCCUPIED SPACES

This standard recommends a specific percentage of occupants that constitutes acceptability and values of the thermal environment associated with this percentage.

For given values of humidity, air speed, metabolic rate, and clothing insulation, a comfort zone may be determined. The comfort zone is defined in terms of a range of operative temperatures (t_o) that provide acceptable thermal environmental conditions or in terms of the combinations of air temperature and mean radiant temperature t_r that people find thermally acceptable.

~~This standard contains a simplified Graphical Comfort Zone Method for determining the comfort zone that is acceptable for use for many typical applications. A computer program based on a heat balance model will determine the comfort zone for a wider range of applications. For a given set of conditions, the results from the two methods are consistent, and either method is acceptable for use as long as the criteria outlined in the respective section are met.~~

See Normative Appendix A and 2009 *ASHRAE Handbook—Fundamentals*, Chapter 9, for procedures to calculate operative temperature t_o. Dry-bulb temperature is a proxy for operative temperature under certain conditions described in Normative Appendix A.

~~H2. GRAPHICAL COMFORT ZONE METHOD~~

~~Use of this method is limited to representative occupants with metabolic rates between 1.0 and 1.3 met and clothing insulation between 0.5 and 1.0 clo in spaces with air speeds less than 0.2 m/s (40 fpm). Spaces with air distribution systems that are engineered such that HVAC-system-supplied air streams do not enter the occupied zone will seldom have averaged air speeds that~~

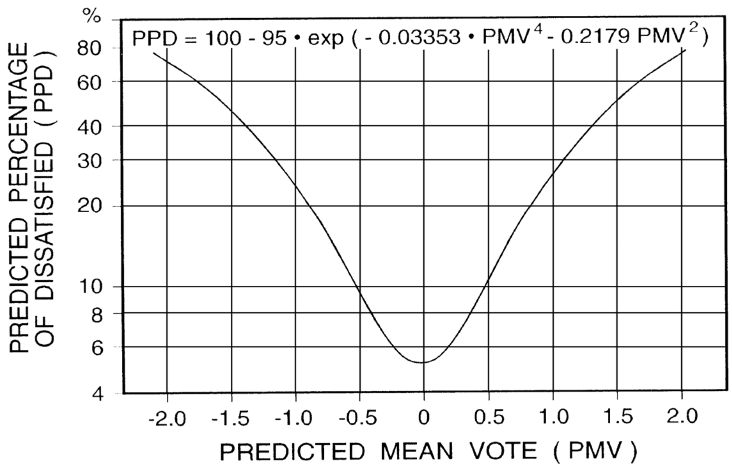


Figure H~~3~~2 Predicted percentage dissatisfied (PPD) as a function of predicted mean vote (PMV).

Table H~~3~~2 Acceptable Thermal Environment for General Comfort

PPD	PMV Range
<10	–0.5 < PMV < +0.5

~~exceed 0.2 m/s (40 fpm). See 2009 *ASHRAE Handbook—Fundamentals*, Chapter 21, for guidance on selecting air distribution systems.~~

~~Figure 5.3.1 in the Graphical Comfort Zone Method section shows the comfort zone for environments that meet the above criteria. Two zones are shown—one for 0.5 clo of clothing insulation and one for 1.0 clo of insulation. These insulation levels are typical of clothing worn when the outdoor environment is warm and cool, respectively.~~

~~Comfort zones for intermediate values of clothing insulation are determined by linear interpolation between the limits for 0.5 and 1.0 clo, using the relationships shown in this standard.~~

~~Elevated air speeds increase the lower and upper operative temperature (t_o) limit for the comfort zone if the criteria in Section 5.3.3 are met.~~

~~H3~~H2. ANALYTICAL COMFORT ZONE METHOD

This method applies to spaces where the occupants have activity levels that result in average metabolic rates between 1.0 and 2.0 met and where clothing is worn that provides 1.5 clo or less of thermal insulation.

The ASHRAE thermal sensation scale, which was developed for use in quantifying people's thermal sensation, is defined as follows:

+3	Hot
+2	Warm
+1	Slightly warm
0	Neutral
–1	Slightly cool
–2	Cool
–3	Cold

The predicted mean vote (PMV) model uses heat balance principles to relate the six key factors for thermal comfort to the average response of people on the above scale. The predicted percentage dissatisfied (PPD) index is related to the PMV as defined in Figure H3. It is based on the assumption that people voting +2, +3, –2, or –3 on the thermal sensation scale are dissatisfied and on the simplification that PPD is symmetric around a neutral PMV.

Table H3 defines the recommended PPD and PMV range for typical applications. ~~This is the basis for the Graphical Comfort Zone Method in the standard.~~

The comfort zone is defined by the combinations of the six key factors for thermal comfort for which the PMV is within the recommended limits specified in Table H3. The PMV model is calculated with the air temperature and mean radiant temperature t_r in question, along with the applicable metabolic rate, clothing insulation, air speed, and humidity. If the resulting PMV value generated by the model is within the recommended range, the conditions are within the comfort zone.

Use of the PMV model in this standard is limited to air speeds below 0.20 m/s (40 fpm). When air speeds exceed 0.20 m/s (40 fpm) the comfort zone boundaries are adjusted based on the SET model described in the elevated air speed section and in Normative Appendix D.

There are several computer codes available that predict PMV-PPD. The computer code in Normative Appendix B was developed for use with this standard and is incorporated into ASHRAE Thermal Comfort Tool. If any other software is used, it is the user's responsibility to verify and document that the version used yields the same results as the code in Normative Appendix B or the ASHRAE Thermal Comfort Tool for the conditions for which it is applied.

[. . .]

~~H4~~H3. ELEVATED AIR SPEED COMFORT ZONE METHOD

The outer boundary curves in Figure ~~5.3.3~~5.3.2A shift toward the left or right depending on clo and met level. An increase of 0.1 clo or 0.1 met corresponds approximately to a 0.8°C (1.4°F) or 0.5°C (0.9°F) reduction in operative temperature (t_0); a decrease of 0.1 clo or 0.1 met corresponds approximately to a 0.8°C (1.4°F) or 0.5°C (0.9°F) increase in operative temperature.

~~H5~~H4. HUMIDITY LIMITS

~~When the Graphical Comfort Zone Method is used, systems must be able to maintain a humidity ratio at or below 0.012, which corresponds to a water vapor pressure of 1.910 kPa (0.277 psi) at standard pressure or a dew-point temperature of 16.8°C (62.2°F).~~

There are no established lower humidity limits for thermal comfort; consequently, this standard does not specify a minimum humidity level. Nonthermal comfort factors, such as skin drying, irritation of mucus membranes, dryness of the eyes, and static electricity generation, may place limits on the acceptability of very low humidity environments.

Modify Informative Appendix I section references as shown. (Note: Tables and figures are unchanged and have been omitted here.)

(This appendix 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.)

INFORMATIVE APPENDIX I
LOCAL DISCOMFORT AND VARIATIONS WITH TIME

I1. LOCAL THERMAL DISOMFORT

Avoiding local thermal discomfort, whether caused by a vertical air temperature difference between the feet and the head, by an asymmetric radiant field, by local convective cooling (draft), or by contact with a hot or cold floor, is essential to providing acceptable thermal comfort.

The requirements specified in Section ~~5.3.4~~5.3.3 of this standard apply directly to a lightly clothed person (with clothing insulation between 0.5 and 0.7 clo) engaged in near sedentary physical activity (with metabolic rates between 1.0 and 1.3 met). With higher metabolic rates and/or with more clothing insulation, people are less thermally sensitive and, consequently, the risk of local discomfort is lower. Thus, it is acceptable to use the requirements of Section ~~5.3.4~~5.3.3 for metabolic rates greater than 1.3 met and with clothing insulation greater than 0.7 clo, since they will be conservative. People are more sensitive to local discomfort when the whole body is cooler than neutral and less sensitive to local discomfort when the whole body is warmer than neutral. The requirements of Section ~~5.3.4~~5.3.3 of this standard are based on environmental temperatures near the center of the comfort zone. These requirements apply to the entire comfort zone, but they may be conservative for conditions near the upper temperature limits of the comfort zone and may underestimate discomfort at the lower temperature limits of the comfort zone.

Table I1 shows the expected percent dissatisfied for each source of local thermal discomfort described in Sections ~~5.3.4.1~~5.3.3.1 through ~~5.3.4.4~~5.3.3.4. The criteria for all sources of local thermal discomfort should be met simultaneously at the levels specified for an environment to meet the requirements of Section 5.3 of this standard. The expected percent dissatisfied for each source of local thermal discomfort described in Sections ~~5.3.4.1~~5.3.3.1 through ~~5.3.4.4~~5.3.3.4 should be specified.

[. . .]

I3. 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~~5.3.2. When occupants are neutral to slightly cool, such as under certain combinations of met rate and clo value with operative temperatures (t_o) below 23.0°C (73.4°F), average air speeds within the comfort envelope of ±0.5 PMV should not exceed 0.20 m/s (40 fpm). This 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~~5.3.2.

I4. VERTICAL AIR TEMPERATURE DIFFERENCE

Thermal stratification that results in the air temperature at the head level being warmer than that at the ankle level may cause thermal discomfort. Section ~~5.3.4.3~~5.3.3.3 of this standard specifies allowable differences between the air temperature at head level and the air temperature at ankle level. Figure I4 shows the expected percentage of occupants who are dissatisfied due to the air temperature difference where the head level is warmer than the ankle level. Thermal stratification in the opposite direction is rare, is perceived more favorably by occupants, and is not addressed in this standard.

The allowable difference in air temperature from ankle level to head level is based on Figure I4 and assumes that a maximum of 5% of occupants are dissatisfied by the vertical air stratification.

[. . .]

I7. CYCLIC VARIATIONS

Cyclic variations refer to those situations where the operative temperature t_o repeatedly rises and falls, and the period of these variations is not greater than 15 minutes. If the period of the fluctuation cycle exceeds 15 minutes, the variation is treated as a drift or ramp in operative temperature and the requirements of Section ~~5.3.5.2~~5.3.4.2 apply. In some situations, variations with a period not greater than 15 minutes are superimposed on variations with a longer period. In these situations, the requirements of Section ~~5.3.5.1~~5.3.4.1 apply to the component of the variation with a period not greater than 15 minutes, and the requirements of Section ~~5.3.5.2~~5.3.4.2 apply to the component of the variation with a period greater than 15 minutes.

I8. DRIFTS OR RAMPS

Temperature drifts and ramps are monotonic, noncyclic changes in operative temperature t_o. The requirements of Section ~~5.3.5.2~~5.3.4.2 also apply to cyclic variations with a period greater than 15 minutes. Generally, drifts refer to passive temperature changes of the enclosed space, and ramps refer to actively controlled temperature changes.

Section ~~5.3.5.2~~5.3.4.2 specifies the maximum change in operative temperature t_o allowed during a period of time. For any given time period, the most restrictive requirements from Table ~~5.3.5.2~~5.3.4.2 apply. For example, the operative temperature may not change more than

2.2°C (4.0°F) during a 1.0 h period, and it also may not change more than 1.1°C (2.0°F) during any 0.25 h period within that 1.0 h period. If the user creates variations as a result of control or adjustments, higher values may be acceptable.

These local thermal comfort criteria were developed in order to keep the expected percent of occupants who are dissatisfied due to all of these local discomfort factors at or below 10%. The operative temperature (t_o) ranges required in the standard were developed in order to keep the predicted percent dissatisfied of occupants due to operative temperature only, without factoring in local thermal factors. When both local discomfort factors and operative temperature considerations are combined, the goal of this standard to standardize thermal conditions acceptable to a substantial majority of occupants (80%) is achieved. This is especially true if there is some overlap between those who are dissatisfied due to local factors and those who are dissatisfied due to operative temperature.

Modify Informative Appendix J section references as shown. (Note: Figure and table are unchanged and have been omitted here.)

(This appendix 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.)

INFORMATIVE APPENDIX J
OCCUPANT-CONTROLLED NATURALLY CONDITIONED SPACES

[. . .]

The allowable operative temperature (t_o) limits in Figure 5.4.2 may not be extrapolated to outdoor temperatures above and below the end points of the curves in this figure. If the prevailing mean outdoor temperature is less than 10°C (50°F) or greater than 33.5°C (92.3°F), this option may not be used, and no specific guidance for such conditions is included in this standard.

Figure 5.4.2 accounts for local thermal discomfort effects in typical buildings, so it is not necessary to address these factors when using this option. If there is reason to believe that local thermal comfort is a problem, it is acceptable to apply the criteria in Section ~~5.3.4~~5.3.3.

Figure 5.4.2 also accounts for people's clothing adaptation in naturally conditioned spaces by relating the acceptable range of indoor temperatures to the outdoor climate, so it is not necessary to estimate the clothing values for the space. No humidity or air speed limits are required when this option is used.

Figure 5.4.2 includes the effects of people's indoor air speed adaptation in warm climates, up to 0.3 m/s (59 fpm) in operative temperatures (t_o) warmer than 25°C (77°F). In naturally conditioned spaces where air speeds within the occupied zone exceed 0.3 m/s (59 fpm), the upper acceptability temperature limits in Figure 5.4.2 are increased by the corresponding ?t_0 in Table 5.4.2.4, which is based on equal SET values as illustrated in Section ~~5.3.3~~5.3.2. For example, increasing air speed within the occupied zone from 0.3 m/s (59 fpm) to 0.6 m/s (118 fpm) increases the upper acceptable temperature limits in Figure 5.4.2 by a ?t_0 of 1.2°C (2.2°F). These adjustments to the upper acceptability temperature limits apply only at t_0 > 25°C (77°F) in which the occupants are engaged in near sedentary physical activity (with metabolic rates between 1.0 met and 1.3 met).

Modify Section L1.1 section references as shown.

L1.1 Overview of Comfort Prediction Using Physical Measurements. Measurements of indoor environmental parameters are converted to predictions of occupants' thermal satisfaction through calculations and tests against comfort limits.

a. In the predicted-mean-vote-based (PMV) method (Section ~~5.3.2~~5.3.1), environmental measurements are combined with assumptions about clothing and activity level to calculate PMV, a measure of an average occupant's thermal sensation. In Standard 55, *comfort zone* is defined as conditions falling within and including PMV levels from –0.5 PMV to +0.5 PMV.

   At any given PMV level, a population's proportion of dissatisfied members may be predicted via the predicted percentage dissatisfied (PPD) curve. This is an empirical profit fit

Table L3 Comfort Evaluation Approaches for Various Applications

		Nature of Application	
		Short-Term	**Long-Term**
Measurement Method	**Occupant Surveys**	**Right-Now/Point-in-Time Survey (must survey relevant times and population):** • Binning (TSENS scores) leads to % comfort exceedance during period of survey. • Needs coincident temperature to extrapolate to full range of conditions. *(Used for research, problem diagnostics)*	**Occupant Satisfaction Survey:** • Survey scores give % dissatisfied directly. ("dissatisfaction" may be interpreted to start either below –1, or below 0). • Time period of interest can be specified to survey takers. *(Used for building management, commissioning, rating operators and real estate value, compliance with green building rating systems)*
	Environmental Measurements	**Spot Measurements, Temporary (Mobile) Sensors (must select a relevant time to measure):** • Use measurements to determine PMV (Section~~s 5.3.1, 5.3.3~~5.3.2). • Use measurements to determine compliance with adaptive model (Section 5.4). *(Used for real-time operation, testing and validating system performance)*	**Logging Sensors over Period of Interest, or Trend Data from Permanently Installed (BAS) Sensors:** • Exceedance hours: sum of hours over PMV or adaptive model limits. • Binned exceedances may be weighted by their severity. • Instances of excessive rate-of-temperature change or of local thermal discomfort can be counted. *(Used for evaluating system and operator performance over time)*

of thermal sensation (TSENS) survey scores obtained in a range of test environments in which dissatisfaction was assumed to occur at TSENS absolute values of 2 or greater. With this method, a PMV of ±0.5 predicts 90% of a population satisfied, or a 10% PPD.

However, in most buildings this 90% satisfied rating is rarely obtained, with maximum satisfaction around 80%. The difference has been ascribed to discomfort perceived in local parts of the body. The probability of local discomfort is predicted by testing environmental parameters measured in sensitive locations against empirically-determined limits. Rates of temperature change are also limited to avoid discomfort. Local discomfort effects are assumed to contribute an additional 10% PPD to the discomfort predicted by PMV, so that the total PPD expected in a building with PMV ±0.5 will be 20%.

b. In the adaptive method, used for naturally ventilated spaces, environmental measurements are linked to satisfaction through an empirical model in which the prevailing mean air outdoor temperature determines the position of percent satisfied contours bordering the comfort zone. Section 5.4 defines prevailing mean outdoor air temperature. Local discomfort limits are not used in the adaptive method.Modify Table L3 as shown.

Modify Section L3.2.1 section references as shown. The remainder of Section L3.2.1 is unchanged.

L3.2.1 Point-in-Time (Short-Term) Analyses

a. **PMV Model**
   1. **Measures.** PMV heat balance model prediction of thermal sensation and satisfaction from environmental measurements are described in Section 5.3 (including air movement extension in Section ~~5.3.3~~5.3.2). Limits to local thermal discomfort are described in Section ~~5.3.4~~5.3.3 and rates of temperature change are described in Section ~~5.3.5~~5.3.4.
   2. **Criteria for Passing.** –0.5 to +0.5 on the PMV scale, inclusive. This represents an estimated 90% s<atisfied with the thermal environment. Expressed as a comfort zone on a psychrometric chart, this represents a temperature range of 3K to 5K (5°F to 8°F), depending on clothing level and humidity (Figure 5.2.1.1).

b. **Local Thermal Discomfort Limits.** Local thermal should, by itself, not exceed the limits prescribed in Section ~~5.3.4~~5.3.3. At a minimum, an assumed 10% dissatisfaction caused by local discomfort is added to PMV-predicted discomfort to obtain the overall thermal dissatisfaction of an environment.

   Solar radiation on occupants in neutral or warm conditions should not exceed 10% of outdoor solar radiation incident on the window. The best-practice upper limit is 5% (ASHRAE 2013).

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.

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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.

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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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