ADDENDA

ANSI/ASHRAE Addenda o, p, and q to
ANSI/ASHRAE Standard 55-2010

Thermal Environment Conditions for Human Occupancy

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FOREWORD

This addendum clarifies the normative language that appears in Section 7 (Evaluation of the Thermal Environment) of the body of the standard.

This revised Section 7 provides standardized measurement methods for the evaluation of comfort conditions in existing buildings. The intention is to assist users of the standard in understanding what is actually happening in buildings. Use of standardized methods allows better comparison among different buildings and in the same building under a variety of conditions.

The methods have also been simplified when compared to previous versions of Standard 55. For example, air speed measurement has been simplified in several ways and is likely to be less costly. A similar provision is made for MRT, which in many spaces can be foreseen to be effectively the same as air temperature. The evaluator decides how to sample the spaces to be measured; in some cases, there might be very few measurements. The evaluator also has measurement choices, especially allowing the use of surveys that are not too complicated and can, for instance, be automated over the web. The following approach is preferred by many: to identify (by survey or complaint logs) the level of comfort experience by occupants and, only when a problem is identified, to follow with physical measurements in the building.

The requirements for precision and trend-logging capability in automation systems (BAS) are intended to encourage more continuous monitoring in buildings by exploiting monitoring capability that already exists in many buildings.

Note that the revised Section 7 does not include criteria for overall building pass/fail. Others have proposed such criteria: the 7th edition of CIBSE Guide A, (CIBSE 2006) specifies a duration of comfort zone exceedance for one or more percent of occupied hours per annum as their criterion for overheating, while EN15251 (2007) gives a comfort-zone exceedance range of 3%–5%. Standard 55 has a significant purpose and scope without taking this extra step, which evidence suggests requires more substantiation (Borgeson/Brager, "Comfort standards and variations in exceedance for mixed-mode buildings," BRI, 2011). Overall criteria may be supportable in time after accumulation of a large set of standardized measurements as specified in Section 7.

The specified measurement methods accommodate design-day analysis. However, comfort issues, when they exist in a building, may not be a design or capacity problem. For instance, many comfort problems exist during low-load situations, with people being overcooled or ineffectively heated. Evaluation of the existing building could assist the evaluator to recognize what is happening and implement a solution by an alternative control strategy. An example of this is the insight about VAV box minimums being too high coming out of ASHRAE's Research Project RP-1515, "Thermal and air quality acceptability in buildings that reduce energy by reducing minimum airflow from overhead diffusers."

In evaluating existing buildings, additional factors come into play, such as extremes of weather beyond design criteria; equipment performance tolerances (for instance, many AHRI Standards allow performance 10% above or below equipment ratings); thermostat settings by occupants and other occupant behavior; metabolism; clothing characteristics and space uses that were not evident during design; non-steady-state conditions during start-up; and other factors. Such factors, if present, must be taken into account in the evaluation.

There is a trend to require commissioning in more and more buildings, for instance, by ASHRAE Standard 189.1 and IECC 2012. As with all commissioning, the process for comfort commissioning should be outlined by the commissioning agent and usually is done for a sampling of conditions, spaces, and components. The commissioning requirement can be met by the occupant surveys, BAS trend logging, and, in some cases, by supplemental equipment to measure parameters.

In general, Section 7 of Standard 55 does not require measurement of every thermal comfort parameter in every space under every load condition. The scope of the evaluation can be very broad or very narrow as selected by the evaluator, but in all cases should be done in a standardized manner consistent with Section 7 for the reasons described above.

***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 o to Standard 55-2010

Revise Section 3 as follows. Modify one definition and add a new definition in Section 3 as shown below. The remainder of Section 3 is unchanged. The definition of comfort zone was added by Addendum b currently published and posted for free on the ASHRAE website at https://www.ashrae.org/standards-research--technology/standards-addenda.

3. DEFINITIONS

zone, comfort: ~~a two dimensional range, often represented on a modified psychrometric chart,~~ those combinations of ~~operative~~ temperature, mean radiant temperature and humidity that ~~is~~ are predicted to be an *acceptable thermal environment* at particular values of air speed, metabolic rate, and clothing insulation.

exceedance hours: Number of occupied hours within a defined time period in which the environmental conditions in an occupied space are outside the *comfort zone*. Units: hours.

Revise Section 7 as follows.

7. EVALUATION OF THE THERMAL ENVIRONMENT

At the design stage, it is permissible to evaluate the thermal environment by calculations. Simple hand calculations and computer models of buildings and systems are available for this purpose. Use this section to evaluate existing thermal environments with respect to this standard. ***Note:*** Full-scale laboratory testing may provide a more controlled validation, however.

7.1 Measuring Device Criteria. The measuring instrumentation used shall meet the requirements for measuring range and accuracy given in ASHRAE Standard 70[5] or Standard 113[6] or in ISO 7726,[1] and the referenced source shall be so identified.

7.2 Measurement Positions

7.2.1 Location of Measurements. Measurements shall be made in occupied zones of the building at locations where the occupants are known to or are expected to spend their time.

Such locations might be workstation or seating areas, depending on the function of the space. In occupied rooms, measurements shall be taken at a representative sample of occupant locations spread throughout the occupied zone. In unoccupied rooms, the evaluator shall make a good-faith estimate of the most significant future occupant locations within the room and make appropriate measurements.

If occupancy distribution cannot be estimated, then the measurement locations shall be as follows:

a. In the center of the room or zone.
b. 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.

In either case, measurements shall be taken in locations where the most extreme values of the thermal parameters are estimated or observed to occur. Typical examples might be near windows, diffuser outlets, corners, and entries. Measurements are to be made sufficiently away from the boundaries of the occupied zone and from any surfaces to allow for proper circulation around measurement sensors with positions as described below.

A measure of absolute humidity (such as humidity ratio) is required to be determined at only one location within the occupied zone in each occupied room or HVAC-controlled zone, provided it can be demonstrated that there is no reason to expect large humidity variations within that space. Otherwise, absolute humidity shall be measured at all locations defined above.

7.2.2 Height Above Floor of Measurements. Air temperature and air speed shall be measured at the 0.1, 0.6, and 1.1 m (4, 24, and 43 in.) levels for sedentary occupants at the locations specified in Section 7.2.1. Standing activity measurements shall be made at the 0.1, 1.1, and 1.7 m (4, 43, and 67 in.) levels. Operative temperature or PMV-PPD 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.

Radiant asymmetry shall be measured at the 0.6 m (24 in.) level for seated occupants and the 1.1 m (43 in.) level for standing occupants. If desk-level furniture (that is in place) blocks the view of strong radiant sources and sinks, the measurements are to be taken above desktop level. Floor surface temperatures are to be measured with the anticipated floor coverings installed. Humidity shall be measured at any level within the occupied zone if only one measurement location is required. Otherwise it shall be measured at the 0.6 m (24 in.) level for seated occupants and the 1.1 m (43 in.) level for standing occupants.

7.3 Measurement Periods

7.3.1 Air Speed. The measuring period for determining the average air speed at any location shall be three minutes.

7.3.2 Temperature Cycles and Drifts. For determining compliance with the non-steady-state requirements of Section 5, the rate of change of operative temperature is used. It is the difference between maximum and minimum operative temperatures measured during the same cycle, divided by the elapsed time in minutes.

$$\text{Rate of change (degrees/h)} = 60\,(t_{o,\,max} - t_{o,\,min}) \,/\, \text{time (minutes)}$$

The measurements shall be made every five minutes or less for at least two hours to establish the nature of the temperature cycle. The use of an automatic recorder is the preferred method of measurement; however, it is possible to make the measurements required in this section without the use of recording equipment.

7.3.3 Clothing and Activity. In buildings, it may be appropriate to measure the clothing and activity levels of the occupants. These shall be estimated in the form of mean values over a period of 0.5 to 1.0 hour immediately prior to measuring the thermal parameters.

7.4 Measuring Conditions. In order to determine the effectiveness of the building system at providing the environmental conditions specified in this standard, measurements shall be made under the following conditions.

To test during the heating period (winter conditions), the measurements required shall be made when the indoor-outdoor temperature difference is not less than 50% of the difference used for design and with cloudy to partly cloudy sky conditions. If these sky conditions are rare and not representative of the sky conditions used for design, then sky conditions representative of design conditions are acceptable.

To test during the cooling period (summer conditions), the measurements required shall be made when the outdoor-indoor temperature difference and humidity difference are not less than 50% of the differences used for design and with clear to partly cloudy sky conditions. If these sky conditions are rare and not representative of the sky conditions used for design, then sky conditions representative of design conditions are acceptable.

To test interior zones of large buildings, the measurements required shall be made with the zone loaded to at least 50% of the design load for at least one complete cycle of the HVAC system if the system is not proportionally controlled. Simulation of heat generated by occupants is recommended.

7.5 Validating the Thermal Environment for New Buildings and Installations

7.5.1 Define Criteria. Before validating a thermal environment that meets the requirements of this standard, the original design conditions specified shall be defined. From this definition, the validation team will evaluate the system's ability to meet and maintain the desired comfort level(s). The comfort criteria definition shall include but not be limited to the following:

- Temperature (air, radiant, surface)
- Humidity
- Air speed

The environmental conditions that were originally specified shall be defined as well to ensure that measurements taken correspond correctly to the design parameters. Environmental conditions shall include but are not limited to the following:

- Outdoor temperature design conditions
- Outdoor humidity design conditions
- Clothing (seasonal)
- Activity expected

7.5.2 Select Validation Method. In order to determine the thermal environment's ability to meet the defined criteria as outlined in Section 7.5.1 above, there are two methods (one described in Section 7.5.2.1 and the other in Section 7.5.2.2) that can be implemented. The first method of validating the thermal environment is to statistically determine occupant satisfaction through the evaluation of survey results. The second is to technically establish comfort conditions through the analysis of environment variables.

7.5.2.1 Survey Occupants. Since the purpose of this standard is to ensure that thermal environmental conditions in a room, building, etc., are acceptable to a majority of the occupants within the space, an effective way to evaluate the environmental conditions is to survey the occupants.

It is important, however, that the results of the survey be properly interpreted and used. Because space design conditions might differ from actual operating conditions, survey results are not a definitive means of determining whether the design engineer has succeeded in incorporating the requirements of this standard. In addition, occupant psychosocial conditions can impose a strong influence on subjective assessments of the environment, assumed design variables might be no longer valid, and operating control modules might be different from those the design engineer had anticipated.

But when properly used, occupant surveys are a direct method of assessing thermal comfort under operating conditions and, thus, the acceptability of the thermal environment. Survey results can also help designers enhance design protocols and help building operators identify and address reasons for discomfort.

Note: Related information and sample survey forms are provided in Informative Appendix E.

7.5.2.2 Analyze Environment Variables. The second method for evaluating the comfort conditions is to analyze specific environmental data for compliance with the requirements of this standard. Each application of validating the thermal environment is unique. A specific test plan will be required to accommodate the project scope.

Assess the environment for which comfort conditions are going to be verified. Determine the need to verify floor surface temperature, vertical temperature difference, and radiant temperature asymmetry. When this need exists, it is important to ensure the maximum potential for variance is exploited (e.g., take radiant asymmetry temperature reading on a sunny day with the blinds open).

Under all expected operating conditions, air speed (nondirectional), air temperature, and humidity shall be verified.

- Verify satisfactory air speed with a group of readings taken at a strategic location within the space. For VAV systems, readings shall be taken at maximum flow with minimum supply-air temperature.
- Determine the best location for providing accurate air temperature and humidity readings. Proof of performance for both air temperature and humidity shall require trended data.

Where variables are going to be trended, successful comfort control shall be a function of steady-state performance. Steady state shall require that the trended variable remain within a specified range without cycling. Cycling is defined as fluctuation over 50% of the permitted range every 15 minutes or more frequently. This verification shall include trending variables for at least one occupied cycle during each seasonal condition. When thermal conditions in the occupied zone have a high sensitivity to time of day and weather conditions, the measurement shall be made such that the high and low extremes of the thermal parameters are determined. ASHRAE Standard 113[6] offers a procedure for determining air speed and temperature variations in building spaces and provides additional guidance for the measurement of mechanical equipment parameters.

7.5.3 Provide Documentation. The effort of validation also involves ensuring a thoroughly documented process. Whichever method of validating the thermal environment is chosen, the process shall be well documented.

7.5.3.1 Documenting Surveys. When the occupants of a building are surveyed as outlined in Section 7.5.2.1, the survey method shall be developed, written, and turned over with the sample survey sheets to the appropriate parties for review and approval.

7.5.3.2 Documenting Variable Analysis. For analysis of the environmental variables outlined in Section 7.5.2, the trend logs and data analysis shall be prepared. Again, the method of trending must be included with this submission for approval if it has not been provided prior to validation.

7. EVALUATION OF COMFORT IN EXISTING BUILDINGS

7.1 Introduction. Evaluation of comfort in existing buildings is not a requirement of this standard. When such evaluation is otherwise required (e.g., by code or another standard) use one of the following methods:

7.1.1 Occupant surveys using 7.2.1, 7.3.1, 7.4.1.

7.1.2 Environmental measurement using 7.2.2, 7.3.2, 7.3.3, 7.3.4, 7.4.2.

7.1.3 When using the building automation system as an adjunct to 7.1.1 or 7.1.2, it shall have the characteristics described in 7.3.5.

7.2 Criteria for Comfort in Existing Buildings

7.2.1 Comfort Determination from Occupant Surveys. Acceptability and satisfaction are directly determined from the responses of occupants using the scales and comfort limits described in Section 7.3.1 below.

7.2.2 Prediction of Comfort from Environmental Measurements

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. The modeled 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 to adjust the comfort zone boundaries for elevated air movement. Occupied zone conditions must also conform to requirements for avoiding local thermal discomfort (as specified in Section 5.3.4) and to limits to rate of temperature change over time, as specified in Section 5.3.5.

- Parameters to be measured and/or recorded:
  - Occupant metabolic rate (*met*) and clothing (*clo*) observations
  - Air temperature (t_a) and humidity
  - 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.
  - Air speed, unless it can be otherwise demonstrated that, within the space, average air speed meets the requirements of Section 5.3.3.2.

7.2.2.2 Naturally conditioned spaces: Section 5.4 prescribes the use of the adaptive model for determining the comfort zone boundaries. The air movement extensions to comfort zone boundaries (Table 5.3) shall be used when elevated air movement is present.

- Parameters to be measured:
  - Indoor air temperature and mean radiant temperature
  - Outdoor air temperature

7.3 Measurement Methods

7.3.1 Surveys of Occupant Responses to Environment. Surveys shall be solicited from the entire occupancy or a representative sample thereof. If more than 45 occupants are solicited, the response rate must exceed 35 percent. If solicited occupants number between 20 and 45, at least 15 must respond. For under 20 solicited occupants, 80 percent must respond.

7.3.1.1 Satisfaction Surveys:

- Thermal satisfaction shall be measured with a scale ending with the questions: "very satisfied" and "very dissatisfied."
- Thermal satisfaction surveys shall include diagnostic questions allowing causes of dissatisfaction to be identified.

7.3.1.2 Point-in-Time Surveys:

- Thermal acceptability questions shall include a continuous or seven-point scale ending with the questions: "very unacceptable—very acceptable"
- Thermal sensation questions shall include the ASHRAE seven-point thermal sensation scale subdivided as follows: cold, cool, slightly cool, neutral, slightly warm, warm, hot.

Point-in-time surveys shall be solicited during times representative of the building's occupancy.

7.3.2 Physical Measurement Positions within the Building

- 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:

a. the center of the room or space

b. 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).

- Height above floor: Air temperature and average air speed 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 5.2.4.4).

Radiant temperature asymmetry that may cause local thermal discomfort (Sections 5.2.4.1) shall be measured in the affected occupants' locations, with the sensor oriented to capture the greatest surface temperature difference.

7.3.3 Timing of Physical Measurements. Measurement periods shall span two hours or more and, in addition, shall represent a sample of the total occupied hours in the period selected for evaluation (year, season, or typical day) or shall take place during periods directly determined to be the critical hours of anticipated occupancy.

Measurement intervals for air temperature, mean radiant temperature, and humidity shall be five minutes or less, and for air speed shall be three minutes or less.

7.3.4 Physical Measurement Device Criteria. The measuring instrumentation used shall meet the requirements for measurement range and accuracy given in Table 7.3. Air temperature sensors shall be shielded from radiation exchange with the surroundings.

7.3.5 Measurements from Building Automation System (BAS)

7.3.5.1 Location. BAS space sensor locations shall be evaluated against the location criteria in 7.3.2.

7.3.5.2 Precision. BAS space temperature sensor accuracy shall be 0.5°C (1°F) or less, and space humidity sensor accuracy shall be ±5% relative humidity.

7.3.5.3 Trending Capabilities. The BAS shall have the ability to trend space temperature data at intervals not exceeding 15 minutes over 30 days or longer.

7.3.5.4 Additional Concurrent Data, Data such as equipment status, supply and return air, and water temperatures shall be observed for time periods concurrent with the space temperature data.

7.4 Evaluation Methods

7.4.1 Evaluation Based on Survey Results

- The probability of occupants satisfied from satisfaction survey scores shall be predicted by dividing the number of votes falling between "just satisfied" and "very satisfied," inclusive, by the total number of votes.
  - Responses to diagnostic dissatisfaction questions shall be tallied by category.
- For point-in-time surveys, comfort shall be evaluated using votes on the acceptability and/or thermal sensation scales. On each scale, votes between –1 and +3, inclusive, shall be divided by total votes to obtain the probability of comfort acceptability observed during the survey period.

7.4.2 Evaluation Based on Physical Measurements of the Thermal Environment

Perform one of the following approaches, 7.4.2.1 or 7.4.2.2.

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

- **Mechanically Conditioned Buildings**
  - Occupied spaces shall be evaluated using the PMV and SET comfort zone as defined in Sections 5.3.1 and 5.3.3.
  - Local thermal discomfort shall be evaluated using the limits to environmental asymmetry prescribed in Section 5.3.4.
- **Buildings with Occupant-Controlled Operable Windows.** Occupied spaces shall be evaluated using the indoor operative temperature contours of the adaptive model comfort zone in Section 5.4, including the contour extensions for air speeds above 0.3 m/s.

7.4.2.2 Approaches to Predicting whether a Thermal Environment is Acceptable over Time.

Section 7.4.2.2.1 shall be used to quantify the number of hours in which environmental conditions are outside the comfort zone requirements during occupied hours in the time period of interest. Exceedance is measured by exceedance hours (EH) (see definition in Section 3). 7.4.2.2.2 is permitted but not required to be used with 7.4.2.2.1.

7.4.2.2.1 Exceedance hours are calculated for the PMV comfort zone and adaptive model comfort zone as follows:

Letting each sum be over occupied hours within the specified period, and comfort indices respective to that hour,

For *PMV comfort zone*: EH = ΣH_{disc} where H_{disc} *is a discomfort hour.* $H_{disc} = 1$ if $|PMV| - 0.5 > 0$ and 0 otherwise.

TABLE 7.3 Instrumentation Measurement Range and Accuracy

Quantity	Measurement Range	Accuracy
Air temperature	10°C to 40°C (50°F to 104°F)	± 0.2°C (+/–0.4°F)
Mean radiant temperature	10°C to 40°C (50°F to 104 °F)	±1°C (+/–2°F)
Plane radiant temperature	0°C to 50°C (32°F to 122°F)	±0.5°C (+/–1°F)
Surface temperature	0°C to 50°C (32°F to 122°F)	±1°C (+/–2°F)
Humidity, relative	25%–95% rh	±5% rh
Air speed	0.05 to 2 m/s (10 to 400 fpm)	±0.05 m/s (±10 fpm)
Directional radiation	–35 W/m^2 to + 35 W/m^2 (–11 Btu/h·ft^2 to +11 Btu/h·ft^2)	±5 W/m^2 (±1.6 Btu/h·ft^2)

For adaptive model comfort zone, where $H_{>upper}$ and $H_{<lower}$ are discomfort hours outside of comfort zone boundaries T_{upper} and T_{lower}, EH = Σ $(H_{>\ upper} + H_{<\ lower})$ where $H_{>\ upper}$ = 1 if $T_{op} > T_{upper}$ and 0 otherwise, and $H_{<\ lower}$ = 1 if $T_{op} < T_{lower}$ and 0 otherwise.

Units are in hours. Exceedance hours can also be expressed as a probability by dividing EH by total occupied hours.

7.4.2.2.2 It is permissible to quantify the expected number of episodes of discomfort, rate-of-change exceedances, and local discomfort exceedances, within a time period of interest.

Add the following two new informative appendices (X1 and X2)

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INFORMATIVE APPENDIX X— MEASUREMENT OF THE THERMAL ENVIRONMENT

X1. PHYSICAL MEASUREMENTS

X1.1 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.

- In the PMV-based method (Section 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 PPD curve. This is an empirical profit fit 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%.

- 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 3, Definitions, defines prevailing mean outdoor air temperature. Local discomfort limits are not used in the adaptive method.

X1.2 Environmental and Occupant Measurements

Environmental parameters are described in Section 5.4, and their measurement requirements described in Section 7.3. For nonsteady conditions, the Section 7.3.3 prescribes measurement timing.

The two personal parameters, activity level and clothing, must also be estimated for the occupants of the space. Estimation methods are presented in Normative Appendices A and B. For evaluating a space, each of these parameters shall be estimated in the form of mean values over a period of 0.25 to 1.0 hours immediately prior to measuring the indoor environmental parameters.

If the occupants are not yet present, such as during design and commissioning, one may use clothing and activity values agreed upon by owners and designers as appropriate for the building's function.

X2. SURVEYING OCCUPANTS

The use of occupant thermal environment surveys is an acceptable way of assessing comfort conditions for the acceptability ranges discussed in this standard. With surveys, one may measure the percent who are "satisfied," "acceptable," or "comfortable" by putting those direct questions to a representative sample of the occupants. One may also obtain the percent satisfied using the ASHRAE Thermal Sensation scale, making the traditional assumption that satisfaction occurs when the seven-point scale is within TSENS = –1.5 ≤ satisfied ≤ +1.5 (when using a scale unit resolution of 0.5 or less), or –2 < satisfied < +2 (when the scale resolution is limited to integers).

Surveys obtain occupants' comfort perceptions directly, whereas measurements of the environment predict those perceptions indirectly through models. However, surveys cannot be done in all cases. Because they require engaging the occupants and taking some of their time, it is necessary to have a well-planned communications approach and to use a survey that has been optimized for length and content. The timing and frequency of repetition must also be weighed.

All surveys should strive for a representative sample size and a high response rate across the occupied space in the building. If the objective of the survey is to assess an entire building or installation, an adequate sample size and response rate help lower the risks of generalizing a limited observation to the entire occupant population. Section 7.3.1 prescribes minimum response rates for surveys. It is possible that in operating buildings, the perceptions of nonrespondents may be less important than those of respondents who take the time to answer the questions.

Thermal environment surveys are invaluable tools for diagnostic purposes in existing buildings and facilities. As a diagnostic tool, the goal is not a broad-brush assessment of environmental quality, but rather a detailed insight into the building's day-to-day operation through occupant feedback. For such purposes, each response is valuable regardless of the size or response rate of the survey.

There are two types of thermal environment surveys. In either type of survey, the essential questions relate to thermal comfort, but additional questions can help identify problems and formulate possible responses.

X2.1 Right-now or point-in-time surveys are used to evaluate thermal sensations of occupants at a single point in time. Thermal comfort researchers have used these point-in-time surveys to correlate thermal comfort with environmental factors, such as those included in the PMV model: metabolic rate, clothing insulation, air temperature, radiant temperature, air speed, and humidity.

A sample point-in-time survey is included in Figure X1. This is a thermal sensation survey that asks occupants to rate their sensation (from "hot" to "cold") on the ASHRAE seven-point thermal sensation scale. The scale units are sometimes designated *TSENS*.

One may, however, ask the direct question "Is the environment thermally acceptable?" with the scale "very unacceptable-------very acceptable." The scale is best divided into seven scale units or more.

Sometimes preference scales for temperature and air movement are also used (e.g., these scales are common in the comfort field study database found in *ASHRAE RP 884, Towards an Adaptive Model of Thermal Comfort and Preference* [1998 Atlanta, GA]):

"Prefer to be:" "cooler/no change/warmer"

"Prefer": "less air movement/no change/more air movement"

In order to use the results of a point-in-time survey to assess comfort acceptability ranges over time, the survey would have to be implemented under multiple thermal conditions and in multiple building operating modes. The difficulty of arranging multiple surveys in workplace environments usually limits the feasibility of using the point-in-time survey approach for assessing comfort over time. This limitation may diminish with the advent of web-based apps oriented toward building operation.

X2.2 A second form of thermal environment survey—a satisfaction survey—is used to evaluate thermal comfort response of the building occupants in a certain span of time. Instead of evaluating thermal sensations and environmental variables indirectly to assess percentage dissatisfied, this type of survey directly asks occupants to provide satisfaction responses.

An example thermal satisfaction survey is included in Figure X2. below. It asks occupants to rate their satisfaction with their thermal environment (from "very satisfied" to "very dissatisfied") on a seven-point satisfaction scale. Acceptability is determined in two ways: by the percentage of occupants who have responded "neutral" through "very satisfied" (0, +1, +2, or +3) with their environment or by taking a slightly broader view of acceptability, including the percentage who have responded (–1, 0, +1, +2, +3).

The basic premise of the satisfaction survey is that occupants by nature can recall instances or periods of thermal discomfort, identify patterns in building operation, and provide "overall" or "average" comfort votes on their environment. The surveyor may identify a span of time for the respondents to consider. The occupants provide the time integration.

Questions to identify the nature (causes) of dissatisfaction may be included in satisfaction surveys (questions 7a through 7e in Figure X2).

Since the survey results encompass a larger time frame, the survey can be made every six months or repeated in heating and/or cooling seasons. In a new building, the first thermal satisfaction survey may be done approximately six months after occupancy, late enough to avoid assessing the effects of putting the building into commission, but early enough to help identify and solve long-term building problems that have escaped detection in the commissioning process.

The thermal satisfaction survey can be used by researchers, building operators, and facility managers to provide acceptability assessments of building systems' performance and operations in new buildings, in addition to periodic post-occupancy evaluation in existing facilities.

E1. THERMAL ENVIRONMENT POINT-IN-TIME SURVEY

1. Record the approximate outside air temperature _____ and seasonal conditions:

☐ Winter ☐ Spring ☐ Summer ☐ Fall

2. What is your general thermal sensation? (Check the one that is most appropriate)

*(**Note to survey designer:** This scale must be used as-is to keep the survey consistent with ASHRAE Standard 55.)*

☐ Hot
☐ Warm
☐ Slightly Warm
☐ Neutral
☐ Slightly Cool
☐ Cool
☐ Cold

3. Either (a) place an "X" in the appropriate place where you are located now:

*(**Note to survey designer:** Provide appropriate sketch for your space or building.)*

or (b) place an "X" in the check box that best describes the area of the building where you are located now.

☐ North
☐ East
☐ South
☐ West
☐ Core
☐ Don't know

4. On which floor of the building are you located now?

☐ 1st
☐ 2nd
☐ 3rd
☐ Other (provide the floor number):_____

5. Are you near an exterior wall (within 15 ft)?

☐ Yes
☐ No

6. Are you near a window (within 15 ft)?

☐ Yes
☐ No

7. Using the list below, please check each item of clothing that you are wearing right now. (Check all that apply):

*(**Note to survey designer:** This list can be modified at your discretion.)*

☐ Short-Sleeve Shirt	☐ Dress	☐ Nylons
☐ Long-Sleeve Shirt	☐ Shorts	☐ Socks
☐ T-shirt	☐ Athletic Sweatpants	☐ Boots
☐ Long-Sleeve Sweatshirt	☐ Trousers	☐ Shoes
☐ Sweater	☐ Undershirt	☐ Sandals
☐ Vest	☐ Long Underwear Bottoms	
☐ Jacket	☐ Long Sleeve Coveralls	
☐ Knee-Length Skirt	☐ Overalls	
☐ Ankle-Length Skirt	☐ Slip	

☐ Other: (Please note if you are wearing something not described above, or if you think something you are wearing is especially heavy.) _____

8. What is your activity level right now? (Check the one that is most appropriate)

☐ Reclining
☐ Seated
☐ Standing relaxed
☐ Light activity standing
☐ Medium activity standing
☐ High activity

Figure X1 Thermal Environment Point-in-Time Survey

E2. THERMAL ENVIRONMENT SATISFACTION SURVEY[1]

1. Either (a) place an "X" in the appropriate place where you spend most of your time:

*(**Note to survey designer:** Provide appropriate sketch for your space or building.)*

or (b) place an "X" in the check box that best describes the area of the building where your space is located.

- ☐ North
- ☐ East
- ☐ South
- ☐ West
- ☐ Core
- ☐ Don't know

2. On which floor of the building is your space located?

- ☐ 1st
- ☐ 2nd
- ☐ 3rd
- ☐ Other (provide the floor number)_____

3. Are you near an exterior wall (within 15 ft)?

- ☐ Yes
- ☐ No

4. Are you near a window (within 15 ft)?

- ☐ Yes
- ☐ No

5. Which of the following do you personally adjust or control in your space? (Check all that apply.)

*(**Note to survey designer:** This list can be modified at your discretion.)*

- ☐ Window blinds or shades
- ☐ Room air-conditioning unit
- ☐ Portable heater
- ☐ Permanent heater
- ☐ Door to interior space
- ☐ Door to exterior space
- ☐ Adjustable air vent in wall or ceiling
- ☐ Ceiling fan
- ☐ Adjustable floor air vent (diffuser)
- ☐ Portable fan
- ☐ Thermostat
- ☐ Operable window
- ☐ None of these
- ☐ Other: _____

Please respond to the following questions based on your overall or average experience in the past [six] months.

(***Note to survey designer:*** The above statement can be modified for a different span of time.)

6. How satisfied are you with the temperature in your space? (Check the one that is most appropriate)

Very Satisfied ☐☐☐☐☐☐☐ **Very Dissatisfied**

7. If you are dissatisfied with the temperature in your space, which of the following contribute to your dissatisfaction:

a. In warm/hot weather, the temperature in my space is (check the most appropriate box):

*(**Note to survey designer:** Include a scale or, as shown below, check boxes.)*

- ☐ Always too hot
- ☐ Often too hot
- ☐ Occasionally too hot
- ☐ Occasionally too cold
- ☐ Often too cold
- ☐ Always too cold

b. In cool/cold weather, the temperature in my space is (check the most appropriate box):

*(**Note to survey designer:** Include a scale or, as shown below, check boxes.)*

- ☐ Always too hot
- ☐ Often too hot
- ☐ Occasionally too hot
- ☐ Occasionally too cold
- ☐ Often too cold
- ☐ Always too cold

c. When is this most often a problem? (check all that apply):

- ☐ Morning (before 11am)
- ☐ Mid-day (11am–2pm)
- ☐ Afternoon (2pm–5pm)
- ☐ Evening (after 5pm)
- ☐ Weekends/holidays

[1] This survey has been adapted from the CBE occupant IEQ survey developed by the Center for the Built Environment at the University of California at Berkeley.

Figure X2 Thermal Environment Satisfaction Survey

- ☐ Monday mornings
- ☐ No particular time
- ☐ Always
- ☐ Other:

d. How would you best describe the source of this discomfort? (Check all that apply):

*(**Note to survey designer:** This list can be modified at your discretion.)*

- ☐ Humidity too high (damp)
- ☐ Humidity too low (dry)
- ☐ Air movement too high
- ☐ Air movement too low
- ☐ Incoming sun
- ☐ Heat from office equipment
- ☐ Drafts from windows
- ☐ Drafts from vents
- ☐ My area is hotter/colder than other areas
- ☐ Thermostat is inaccessible
- ☐ Thermostat is adjusted by other people
- ☐ Clothing policy is not flexible
- ☐ Heating/cooling system does not respond quickly enough to the thermostat
- ☐ Hot/cold surrounding surfaces (floor, ceiling, walls or windows)
- ☐ Deficient window (not operable)
- ☐ Other: _____

e. Please describe any other issues related to being too hot or too cold in your space:

_____
_____
_____
_____
_____
_____
_____
_____
_____
_____
_____
_____
_____
_____
_____

Figure X2 (continued) Thermal Environment Satisfaction Survey

(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 a right to appeal at ASHRAE or ANSI.)

INFORMATIVE APPENDIX Y— THERMAL COMFORT ANALYSIS

Y1. EVALUATION OF COMFORT IN OPERATING BUILDINGS.

The evaluation approach depends on the intended application. The list of possible evaluation applications is extensive. They require evaluation over varying time periods, from short-term (ST) to long-term (LT).

- Real-time operation of a building using comfort metrics (ST)
- Evaluating HVAC system performance (ST, LT)
- Building management decisions regarding upgrades, continuous commissioning, and rating the performance of operators and service providers (LT)
- Real-estate portfolio management: rating building quality and value (LT, ST)
- Validating compliance with LEED existing buildings requirements (ST, LT)
- Validating compliance with requirements of codes—energy, hospital, etc. (ST)

TABLE Y1. 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, LEED compliance).
	Environmental Measurements	**Spot Measurements, Temporary (Mobile) Sensors:** Must select a relevant time to measure. Use measurements to determine PMV (Sections 5.3.1, 5.3.3). 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).

There are two main approaches to evaluating thermal comfort in buildings in operating buildings. One is to directly determine occupant thermal sensations and satisfaction through the statistical evaluation of occupant surveys. The other is to use comfort models to estimate sensations and satisfaction of the occupancy from measured environmental variables. The measurements needed for each of these approaches are described in Appendix X.

Surveys and physical measurements may be used in combination with each other for the purpose of problem diagnosis and research. In the short-term, right-now or point-in-time surveys are used to obtain comfort perceptions coincident with short-interval logged environmental measurements or BAS system trend data. For evaluating building performance over time, occupant satisfaction surveys results are correlated with averages of long-term measurements of environmental conditions.

Y1.1 Analysis Based on Occupant Surveys. Surveys can assess comfort directly, in contrast to the indirect approach of calculating comfort through comfort models using measured environmental variables.

- **Short-Tterm Analyses (Using Instantaneous Comfort Determinations)**
  - **Measures from Right-Now or Point-in-Time Surveys**
    - Thermal acceptability votes.
    - Thermal sensation (TSENS) votes. When averaged for a population, TSENS votes correspond directly to PMV votes.
    - Temperature/and Air movement preference votes ("less"/"no change"/"more")

- **Criteria for Passing**:
  - –0.5 to +0.5 on the PMV scale, inclusive, is the criterion for passing in Standard 55.
  - Field surveys usually consider TSENS values of –1 and +1 as representing "satisfied;" the break along the categorical seven-point thermal sensation scale is at –1.5 and +1.5, inclusive.
- **Local Discomfort Determination**
  - Rarely asked; questions about any local discomfort (e.g., ankle, neck discomfort).
  - Rarely asked; questions addressing solar radiation effects on comfort.

- **Long-Term Analyses, (Representing Time Periods Such as Season or Year):**

Occupant satisfaction survey. Thermal environment questions apply over time (three to six months or more). The survey includes diagnostic questions to identify sources of dissatisfaction.

Point-in-time surveys may be repeated over time to obtain a long-term record of comfort. Because occupants have other responsibilities and limited time, repeated surveys must be very short and quickly completed.

- **Measures from Occupant Satisfaction Surveys**
  - Thermal satisfaction scale ("very satisfied—very dissatisfied").
- **Criteria for Passing**:
  - From neutral (0 scale unit) to +3. (votes below this range generally comprise 40% of a building's total votes in the CBE survey benchmark database. [ASHRAE 2013, *Performance Measurement Protocols for Commercial Buildings: Best Practices Guide.* Atlanta, GA]).
  - Scale units –1 to +3. (votes below this range generally comprise 20% of a building's total votes in the CBE survey benchmark database).
- **Branching Dissatisfaction Questions (Count Responses and Tally by Category)**
  - Fix and resurvey only the problem areas. Document improvement.
- **Accumulated Scores from Repeated Point-in-Time Surveys**
  - If point-in-time surveys can be repeated sufficiently, the distribution of accumulated votes can be used to evaluate long-term comfort in the building.

Y1.2 Analysis Based on Measurements of Environmental Variables. Environmental measurements are linked to occupant comfort through comfort models. There are two comfort models (PMV and adaptive) specific to different types of buildings (mechanically conditioned versus naturally ventilated, respectively). Since there are also buildings that contain a mix of the two types over time and space within the building (termed *mixed mode* buildings), there is active investigation underway on how the two models apply to these types of buildings.

The following measures and criteria underlie the documentation of comfort performance based on physical environmental measurements.

Y1.2.1 Point-in-Time (Short-Term) Analyses:

a. PMV Model:

- **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). Limits to local discomfort are described in Section 5.3.4 and rates of temperature change in Section 5.3.5.
- **Criteria for passing:**

–0.5 to +0.5 on the PMV scale, inclusive.

Expressed as a comfort zone on a psychrometric chart, this represents a temperature range of 3 to 5 K (5°F to 8°F) depending on clothing level and humidity (Figure 5.2.1.1)

b. Local discomfort limits

Based on the limits in Chapter 5, presence of local discomfort is estimated. Local discomfort is added to PMV-predicted discomfort. In addition, it should by itself not exceed the limits prescribed in Section 5.3.4.

Solar radiation on occupants in neutral or warm conditions should not exceed 5% of outdoor solar radiation incident on the window. (ASHRAE 2013, *Performance Measurement Protocols for Commercial Buildings: Best Practices Guide*. Atlanta, GA)

c. Adaptive Model (Section 5.3)

The Adaptive Model is an empirical model of adaptive human responses to environments offering operable window control. The comfort zone on a given day is dependent on a running mean of previous outdoor air temperatures, to which people continuously adapt over time.

Measures:

- Air temperature indoors
- Running mean of outside air temperature, defined in Section 3 as the *prevailing mean outdoor air temperature*

Criteria for passing:

- Exceedance hours as for PMV calculations above

d. Limits to Rate of Environmental Change

Measures:

- Exceedance hours as for PMV calculations above.
- Number of episodes of exceedance in a defined time period.

Y1.2.2 Time-Integrated Analyses, (Long-Term; over Typical Day, Season, or Year):

- **Measures:**
  - Trend logging of physical measurements over time.
  - *T*: *H* in occupied zone. Globe temperature includes MRT and approximates operative temperature T_o in most indoor situations.

- Measuring indoor air movement over time is very difficult and rarely done. In many indoor situations the indoor airspeed conforms to the still air conditions of the PMV comfort zone (0.2 m/s [40 fpm]), in which case, air speed measurement is not necessary.
- Based on the limits in Section 5, local discomfort hours are estimated. Local discomfort hours are added to overall discomfort hours predicted by the PMV model.

- **Criteria Metrics:**
  - The prescribed metric is the exceedance hour (equivalent to discomfort hour), predicted during occupied hours within any time interval. See definition in Section 3 and formulas in Section 7.4.2.2.1. Units are in hours. No limits are prescribed.
  - In addition, it is possible to account for the severity of exceedance at any time, using a metric analogous to the familiar degree-day. Weighted exceedance hours (equivalent to degree-of-discomfort hours) are the number of occupied hours within a defined time period in which the environmental conditions in an occupied zone are outside the comfort zone boundary, weighted by the extent of exceedance beyond the boundary. Units: thermal sensation scale units x hours. The formula for the PMVcomfort zone uses terms defined in Section 7.4.2.2.1:

    WEH = $\Sigma\,(H_{disc}\,(|PMV| - 0.5))$. Units: thermal sensation scale units x hours.

    This is a useful metric but not required in Standard 55. No limits are recommended.
  - Temperature-weighted exceedance hours. It may be useful to convert PMV comfort zone WEHs to a temperature x hours scale, using the conversion 0.3 (thermal sensation scale units)/°C (0.15 [thermal sensation scale units]/°F). The unit for temperature-weighted exceedance hours is temperature x hours.).

    This is a useful metric but not required in Standard 55. No limits are recommended.
  - The WEH for the adaptive model also uses a temperature x hours scale:

    WEH = $\Sigma\,(H_{> upper}\,(T_{op} - T_{upper}) + H_{< lower}\,(T_{lower} - T_{op}))$

    This is a useful metric but not required in Standard 55. No limits are recommended.
  - Expected number of episodes of discomfort, rate-of-change exceedences, local discomfort exceedences within a time period of interest.

    This is a useful metric but not required in Standard 55. No limits are recommended.

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FOREWORD

This addenda aligns Section 5.3.4.2 (Draft) with the definition of average air speed that was clarified in Addendum i.

Note: *In this addendum, changes to the current addendum are indicated in the text by underlining (for additions) and ~~strikethrough~~ (for deletions) unless the instructions specifi-*

Addendum p to Standard 55-2010

Modify Section 5.3.4.2 as shown below. Note that this section in numbered 5.2.4.2 in the current published version of the Standard. Section 5.2.4.2 was modified by Addendum f currently published and posted for free on the ASHRAE website at www.ashrae.org/standards-research--technology/standards-addenda.

5.3.4.2 Draft. At operative temperatures below 22.5°C (72.5°F), ~~air speed~~ *average air speed* caused by the building, its fenestration, and its HVAC system shall not exceed 0.15 m/s (30 fpm) ~~at any height from the ankle to the head~~. This limit does not require consideration of air movement produced by office equipment or occupants.

(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 addendum deletes Section 5.3.3.4 (Air Speed Measurement) for consistency with Addendum i. The deleted section is mostly informative text. New definitions are added for "average air speed" and "average air temperature" to clarify how these commonly used terms apply to averages across the human body. Note that these definitions are also included in Addendum n.

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 q to Standard 55-2010

Add the following definitions to Section 3.0.

air speed, average: the average air speed surrounding a *representative occupant.* The average is with respect to location and time. The spatial average is for three heights as defined for *average air temperature*. The air speed is averaged over an interval not less than 1 and not more than 3 minutes. Variations that occur over a period greater than 3 minutes shall be treated as multiple different air speeds.

temperature, air average (t_a): the average temperature of the air surrounding a *representative occupant*. The average is with respect to location and time. The spatial average is the numerical average of the air temperature at the ankle level, the waist level, and the head level. These levels are 0.1, 0.6, and 1.1 m (4, 24, and 43 in.) for seated occupants and 0.1, 1.1, and 1.7 m (4, 43, and 67 in.) for standing occupants. Time averaging is over a period not less than 3 and not more than 15 minutes.

Delete Section 5.3.3.4. Note that this is Section 5.2.3.4 in the current published standard.

5.3.3.4 ~~Air Speed Measurement.~~ ~~At operative temperatures above 22.5°C (72.5°F), the overall heat balance of the body determines comfort. For this, the average air speed specified in Section 5.5 is used.~~

~~At operative temperatures below 22.5°C (72.5°F), however, the problem is avoiding local thermal discomfort, usually occurring on an unclothed portion of the body. The SET and PMV models do not distinguish between clothed and unclothed portions of the body, so the following conservative approach is adopted. The *maximum* mean air speed of the three measurement heights is used for the SET calculations, thereby overpredicting the whole-body cooling to a level that more closely approximates the cooling of the most affected local part. ***Note:*** To eliminate sources of air movement beyond the designer's control, the measurements should be taken without occupants present and with any nearby heat-generating equipment turned OFF.~~

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.