



Designation: E2320 – 19

Standard Classification for Serviceability of an Office Facility for Thermal Environment and Indoor Air Conditions^{1,2}

This standard is issued under the fixed designation E2320; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reappraisal. A superscript epsilon (ϵ) indicates an editorial change since the last revision or reappraisal.

1. Scope

1.1 This classification contains pairs of scales for classifying an aspect of the serviceability of an office facility, that is, the capability of an office facility to meet certain possible requirements for suitable thermal environment and indoor air conditions.

1.2 Within this aspect of serviceability, each pair of scales shown in Figs. 1-5³ is for classifying one topic of serviceability. Each topic typically is broken down into two more demand functions and supply features. Each paragraph in an Occupant Requirement Scale (DEMAND Scale, see Figs. 1-5) summarizes one level of requirement for serviceability on that function, which occupants might require. The matching paragraph in the Facility Rating Scale (SUPPLY Scale, see Figs. 1-5) is a translation of the requirement into a description of certain features of a facility which, taken in combination, indicate that the facility is likely to meet that level of required serviceability.

1.3 The paragraphs in the Facility Rating Scale (see Figs. 1-5) are indicative and not comprehensive. They are for quick scanning to estimate approximately, quickly, and economically how well a facility is likely to meet the needs of one or another type of occupant group over time. The paragraphs are not for measuring, knowing, or evaluating how an office facility is performing.

¹ This classification is under the jurisdiction of ASTM Committee E06 on Performance of Buildings and is the direct responsibility of Subcommittee E06.25 on Whole Buildings and Facilities.

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² Portions of this document are based on material originally prepared by the International Centre For Facilities (ICF) and © 1993 by ICF and Minister of PUBLIC Works and Government Services Canada. Their cooperation in the development of this standard is acknowledged.

³ Text in Figs. 1-5 is derived from Davis, et al., *Serviceability Tools, Vol 2, Scales for Setting Occupant Requirement and Rating Buildings*, International Centre for Facilities, Ottawa, Ontario, Canada, 1993, 2003, and Davis, et al., *Serviceability Tools, Vol 4, Requirement Scales for Office Buildings*, and Vol 5, *Rating Scales for Office Buildings*, International Centre for Facilities, Ottawa, Ontario, Canada, 1993, 2003.

1.4 This classification can be used to estimate the level of serviceability of an existing facility. It can also be used to estimate the serviceability of a facility that has been planned but not yet built, such as one for which schematic or preliminary drawings and outline specifications have been prepared.

1.5 This standard indicates what would cause a facility to be rated (classified) at a certain level of serviceability but does not state how to conduct a serviceability rating or how to assign a serviceability score. That information is found in Practice E1334. The scales in this classification are complimentary to and compatible with Practice E1334. Each requires the other.

1.6 This standard indicates what would cause a requirement to be classified as being at a specific level, but does not state how to ascertain a requirement, or how to assign a specific level. This information is found in Practice E1679. The scales in this classification are complimentary to and compatible with Practice E1679. Each requires the other.

1.7 The scales are intended to identify the levels of various requirements unique to a particular user, and the serviceability (capability) of a building to meet those requirements. The scales thus supplement rather than include code requirements. It remains the responsibility of designers, builders, and building managers to meet applicable code requirements relative to their respective roles in facility design, construction, and ongoing management.

1.8 The values stated in inch-pound units are to be regarded as standard. The values given in parentheses are mathematical conversions to SI units that are provided for information only and are not considered standard.

1.9 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety, health, and environmental practices and determine the applicability of regulatory requirements prior to use.*

1.10 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

DEMAND A.4.1	For Temperature and Humidity
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Demand Scales in this Topic: A.4.1 information on requirements for interior temperature and humidity.

Subject Matter: Occupant requirements for thermal comfort for occupants, humidity for occupants, air movement, and humidification for machines.

Notes:

From the options below, please select the level that best describes the REQUIREMENT.

Requirement Level	DEMAND	A.4.1 For Temperature and Humidity
9 ☐	THERMAL COMFORT FOR OCCUPANTS: The temperature should feel comfortable at all times. No hot or cold areas in internal spaces, or near windows or external walls. HUMIDITY FOR OCCUPANTS: Levels of humidity should be comfortable at all times. No stuffy areas. AIR MOVEMENT: Air movement should normally be barely perceptible. No drafty or stuffy areas. HUMIDITY FOR MACHINES: Require conditions at all times in the range specified for computers (personal or laptop), printers and copiers. Effective control of relative humidity in range of 40 % to 60 % in all areas where this type of equipment is operated.	
8 ☐		
7 ☐	THERMAL COMFORT FOR OCCUPANTS: An acceptable range of thermal comfort must be met almost all the time, in most spaces. These conditions exist except for about 5 working days each year when outdoor conditions are extreme. For example: conditions met in most spaces except for a few work areas which experience only minor discomfort for a few hours. HUMIDITY FOR OCCUPANTS: Can tolerate minor discomfort for about 5 working days each year when outdoor conditions are extremely dry or humid. For example: when insufficient dehumidification creates a stuffy feeling or insufficient humidification resulting in dry skin or static electricity. AIR MOVEMENT: Air movement should normally be barely perceptible. Minimal drafty areas or stuffy areas for brief periods of time. HUMIDITY FOR MACHINES: Effective control of relative humidity in range of 30 % to 70 % in all areas where computers (personal and laptops), printers and copiers are operated. These conditions exist except for about 5 working days per year during extreme weather conditions.	
6 ☐		

FIG. 1 Demand Scale A.4.1 for Information on Temperature and Humidity

5 ○	THERMAL COMFORT FOR OCCUPANTS: An acceptable range of comfort must be met most of the time. Can tolerate minor discomfort for about 10 working days per year in very cold or hot weather. A minor difference in temperature between parts of the building is acceptable. For example: warm or chilly in areas of the building near external walls or windows. HUMIDITY FOR OCCUPANTS: Can tolerate varying humidity levels throughout the building for about 10 working days each year. May require occasional appliance use (humidifier or dehumidifier) for specific situations during extreme weather conditions. AIR MOVEMENT: Some slightly drafty or stuffy areas are acceptable, but not where individuals must typically work. Drafty areas or stuffy areas are noticeable. HUMIDITY FOR MACHINES: Effective control of relative humidity in range of 20 % to 80 % in some areas where computers (personal and laptops), printers and copiers. Except for all but about 10 working days each year during extreme weather conditions. May require occasional appliance use (humidifier or dehumidifier) for specific situations.
4 ○	
3 ○	THERMAL COMFORT FOR OCCUPANTS: Can tolerate building temperature that is moderately uncomfortable in some areas. Can tolerate moderate discomfort for about 15 working days per year in cold or hot weather. For example: regular differences in air temperature in various parts of the facility; overheating on sunny sides of a building or feeling chilled near windows and external walls in cold weather. HUMIDITY FOR OCCUPANTS: Can tolerate poor humidity levels for about 15 working days per year in cold or hot weather. AIR MOVEMENT: Can tolerate lack of or excessive air movement from building systems. HUMIDITY FOR MACHINES: Limited control of relative humidity in range of 15 % to 85 % in designated areas for computers (personal and laptops), printers or copiers. Except for all but about 15 working days each year during extreme weather conditions. Performance problems can be tolerated. Requires appliance use (humidifier or dehumidifier) for specific situations.
2 ○	

FIG. 1 Demand Scale A.4.1 for Information on Temperature and Humidity (continued)

2. Referenced Documents

2.1 ASTM Standards:⁴

- E631 Terminology of Building Constructions
- E1334 Practice for Rating the Serviceability of a Building or Building-Related Facility (Withdrawn 2013)⁵
- E1480 Terminology of Facility Management (Building-Related)
- E1679 Practice for Setting the Requirements for the Serviceability of a Building or Building-Related Facility, and for Determining What Serviceability is Provided or Proposed

2.2 ASHRAE Standards:⁶

- ANSI/ASHRAE 52.2-2017 Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size
- ANSI/ASHRAE 55-2017 Thermal Environmental Conditions for Human Occupancy
- ANSI/ASHRAE 62.1-2019 Ventilation for Acceptable Indoor Air Quality
- ASHRAE Position Document on Indoor Air Quality

⁴For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

⁵The last approved version of this historical standard is referenced on www.astm.org.

⁶Available from American Society of Heating, Refrigerating, and Air-Conditioning Engineers, Inc. (ASHRAE), 1791 Tullie Circle, NE, Atlanta, GA 30329, <http://www.ashrae.org>.

1 ☐	THERMAL COMFORT FOR OCCUPANTS: Can tolerate building temperature that is uncomfortable in most areas. Can tolerate extreme discomfort for about 20 working days per year in very cold or hot weather. Except routine differences in air temperature in various parts of the facility such as: overheating on sunny sides of a building or feeling chilled or warm near windows and external walls during any extreme hot or cold periods of weather. HUMIDITY FOR OCCUPANTS: Humidity control is not required. Extreme humidity or dryness would not affect majority of activities. AIR MOVEMENT: Operations do not require building system air movement. Natural air movement or use of portable appliances is acceptable. Drafty areas or stuffy areas are normally acceptable. HUMIDITY FOR MACHINES: No control of relative humidity for computers (personal and laptops), printers or copiers. Performance problems can be tolerated.
0 ☐	No requirement.
Select Relative Importance of scale = ☐ Extremely Important ☐ Important ☐ Minor Importance	
Select Threshold Level of Scale: First, indicate whether Threshold Level of scale is a ☐ Minimum OR ☐ Maximum OR, if there is NO Maximum or Minimum Threshold level, then select ☐ None.	
Then, (unless there is none) select the Threshold Level of this scale ☐ 9 ☐ 8 ☐ 7 ☐ 6 ☐ 5 ☐ 4 ☐ 3 ☐ 2 ☐ 1	
If unable to choose scale level, select ☐ OTHER and indicate reason below: ☐ Lack Information ☐ Postpone decision ☐ In-depth evaluation required ☐ Not applicable ☐ Refer question to someone else: Whom? e-mail or phone?	

FIG. 1 Demand Scale A.4.1 for Information on Temperature and Humidity (continued)

3. Terminology

3.1 Definitions:

3.1.1 *facility*—a physical setting used to serve a specific purpose.

3.1.1.1 *Discussion*—A facility may be within a building, a whole building, or a building with its site and surrounding environment; or it may be a construction that is not a building. The term encompasses both the physical object and its use. **E631**

3.1.2 *facility serviceability*—the capability of a facility to perform the function(s) for which it is designed, used, or required to be used.

3.1.2.1 *Discussion*—The scope of this performance is of the facility as a system, including its subsystems, components and materials and their interactions, such as acoustical, hydrothermal, air purity, and economic; and of the relative importance of each performance requirement. **E631**

3.1.3 *office*—a place, such as a room, suite, or building, in which business, clerical, or professional activities are conducted. **E631**

3.1.4 For standard definitions of additional terms applicable to this classification, see Terminologies **E631** and **E1480**.

3.2 Definitions of Terms Specific to This Standard:

3.2.1 *air, ventilation*—that portion of supply air that is outdoor air plus any recirculated air that has been treated for the purpose of maintaining acceptable indoor air quality.

ANSI/ASHRAE 62.1-2019

3.2.1.1 *Discussion*—This definition contains the term, “acceptable indoor air quality,” which is defined by ANSI/ASHRAE 62.1-2019 as, “air in which there are no known contaminants at harmful concentrations as determined by cognizant authorities and with which a substantial majority of the people exposed (80 % or more) do not express dissatisfaction.”

3.2.2 *breathing zone*—the region within an occupied space between planes 3 in. and 72 in. (75 mm and 1800 mm) above the floor and more than 2 ft (600 mm) from the walls or fixed air-conditioning equipment. **ANSI/ASHRAE 62.1-2019**

3.2.3 *contaminant*—an unwanted airborne constituent that may reduce acceptability of the air.

3.2.3.1 *Discussion*—Examples of air contaminants are: dust fumes; respirable particles; other particulate matter, gases, or vapors, or combinations thereof, in air. **ANSI/ASHRAE 62.1-2019**

SUPPLY A.4.1	For Temperature and Humidity
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Demand Scales in this Topic: A.4.1 information on requirements for interior temperature and humidity.		
Subject Matter: Building provision of: air temperature, solar gain near windows, heat loss near windows and external walls, humidity, and air movement.		
Notes:		
<i>From the options below, please select the level that best describes the RATING.</i>		
Rating Level	SUPPLY	A.4.1 Temperature and Humidity
9 ☐	Air temperature: Temperatures throughout the entire facility (all mechanical zones) are very similar and comfortable at all times. Target temperatures are met. For example: target temperatures: 68 °F to 75 °F (20 °C to 23.5 °C) in winter and 73 °F to 79 °F (23 °C to 26 °C) in summer. Solar gain near window: Windows and external wall areas are well insulated or screened from solar gains by suitable materials or devices. For example: very limited to no feeling of added solar warmth even during hot sunny weather. Heat loss near windows and external walls: Windows and external wall areas are well insulated resulting in a very limited effect on contiguous spaces during extreme hot and cold weather. Humidity: Effective humidity control is provided. The building is not stuffy or drafty in any area. In all spaces and for large computers and servers, humidity is within a range of 40 % to 60 %. Air movement: Air movement is just perceptible in all zones without the use of additional portable fans. Air movement is increased in hot humid weather. The building is not stuffy or drafty in any area.	
8 ☐		
7 ☐	Air temperature: Temperatures are almost always within an acceptable range for comfort throughout the building and in different mechanical zones temperatures are similar. Except for all but a few hours at a time on about 5 days or less per year. For example: target temperatures: 68 °F to 75 °F (20 °C to 23.5 °C) in winter and 73 °F to 79 °F (23 °C to 26 °C) in summer. Solar gain near windows: Windows and external wall areas are well insulated or screened from solar gains by reasonably suitable materials or devices. For example: limited to minimal feeling of added solar warmth even during hot sunny weather. Heat loss near windows and external walls: Windows and external wall areas are adequately insulated for typical weather conditions resulting in a limited effect on contiguous spaces during extreme hot and cold weather. Humidity: Humidification is normally adequately effective in the range of 30 % to 70 %. Humidification or dehumidification is only partially effective during very dry or very humid weather conditions on about 5 days per year. Air movement: Air movement is just perceptible in most areas without the use of additional portable fans. The building is not stuffy and there are no perceptible drafts.	

FIG. 1 Supply Scale A.4.1 for Information on Temperature and Humidity (continued)

6 ○

5 ○

Air temperature: Temperature is mainly within an acceptable range for comfort. Minor discrepancies in air temperature exist throughout various areas of the building except for all but a few hours at a time on about 10 days per year.

For example: target temperatures 68 °F to 75 °F (20 °C to 23.5 °C) in winter and 73 °F to 79 °F (23 °C to 26 °C) in summer.

Solar gain near windows: Windows and external wall areas are acceptably insulated and screened from solar gains by reasonable materials or devices. For example: noticeable feeling of added solar warmth during hot sunny weather.

Heat loss near windows and external walls: There is noticeable interior heat loss in some parts of the facility. For example: feel cold near external spaces when windows are in shade or during very cold weather.

Humidity: Humidification, 20 % to 80 %, on average days is adequately effective. In very dry weather insufficient humidification or insufficient dehumidification in very humid weather on about 10 working days per year.

Air movement: There is no local control of the mechanical air supply by occupants. Conference rooms and boardrooms have additional supply, or exhaust, controlled from within the space by occupants. There are some minor drafts or lack of air movement at a few individual work areas.

4 ○

3 ○

Air temperature: Temperature about the building varies on about 15 working days per year. Adjustments in one zone can worsen conditions in others. For example: overheating and being cold in different parts of the facility at the same time.

Solar gain near window: Windows and external wall areas have limited insulation and screening materials, or devices, protecting from solar gains. For example: noticeable feeling of added solar warmth during hot sunny weather.

Heat loss near windows and external walls: There is noticeable interior heat gain in some parts of the facility. For example: if working near external walls sometimes feel cold during cold weather, or frequently feel cold at some locations in the building during very cold weather, or both.

Humidity: Humidification (or dehumidification) with a target range of 15 % to 85 %, is installed but it is only partially effective. These systems are ineffective on about 15 working days per year during low or high humidity conditions.

Air movement: In some areas there is no perceptible air movement, or drafts exist from too much air movement. Portable fans are common. The building is stuffy or drafty in many places, including at individual workstations.

2 ○

FIG. 1 Supply Scale A.4.1 for Information on Temperature and Humidity (continued)

1 ○	Air temperature: Local temperature adjustments have limited affect or worsen conditions in other areas. For example: areas in one area of the building feel cold while areas in another part feel hot. Solar gain near window: Windows and external wall areas have minimal insulation and screening materials or devices for protection from solar gains. For example: there can be overheating if working near windows on the east, west, or south, due to uncontrolled solar gains. Heat loss near windows and external walls: There can be substantial interior heat gain contiguous to windows and external walls in sun facing areas of the facility. Cooler temperatures are very noticeable when working near windows or external walls during cold weather. Humidity: No humidity or dehumidification control equipment is installed. The need for or use of portable humidification or dehumidification in specific areas is often required. Air movement: There is no perceptible air movement from building mechanical systems. Portable fans are used throughout the building to create air movement. The building is generally stuffy or excessively drafty.
0 ○	No information is available.
If unable to choose scale level, select ☐ OTHER and indicate reason below:	
☐ Lack Information ☐ Postpone decision ☐ In-depth evaluation required ☐ Not applicable ☐ Refer question to someone else: Whom? e-mail or phone?	

FIG. 1 Supply Scale A.4.1 for Information on Temperature and Humidity (continued)

3.2.4 *filter efficiency*—percentage efficiency measured by ANSI/ASHRAE Standard 52.2-2017 Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size.

3.2.5 *flushing*—running a building air conditioning system with 100 % outdoor air, and no recirculated air, in order to dilute the indoor air contaminants in the occupied zone (assuming well-mixed conditions in the occupied zone, so ventilation effectiveness approaches 100 %).

3.2.5.1 *Discussion*—In cold or hot weather, some buildings do not have sufficient heating or cooling capacity to maintain indoor temperatures within target range concurrently with flushing, or to bring it back within a recovery time acceptable to the building owner or occupants.

3.2.6 *HVAC*—heating, ventilating, and air conditioning equipment or system.

3.2.7 *net occupiable space*—the floor area of an occupiable space defined by the inside surfaces of its walls but excluding shafts, column enclosures, and other permanently enclosed, inaccessible areas. **ANSI/ASHRAE 62.1-2019**

3.2.8 *odor*—a quality of gasses, liquids, or particles that stimulates the olfactory organ. **ANSI/ASHRAE 62.1-2019**

4. Significance and Use

4.1 Each Occupant Requirement Scale (see Figs. 1-5) in this classification provides a means to set the required level of serviceability of a building or facility for one topic of service-

ability and to compare that level against any level of any other occupant, or of any building or facility.

4.2 Each Facility Rating Scale (see Figs. 1-5) in this classification provides a means to estimate the level of serviceability of a building or facility for one topic of serviceability and to compare that level against any level of requirement of any occupant, or of any other building or facility.

4.3 This classification can be used for comparing how well different buildings or facilities meet a particular requirement for serviceability. It is applicable despite differences such as location, structure, mechanical systems, age, and building shape.

4.4 This classification can be used to estimate the amount of variance of serviceability from target or from requirement, for a single office facility, or within a group of office facilities.

4.5 This classification can be used to estimate the following:

4.5.1 Serviceability of an existing facility for uses other than its present use.

4.5.2 Serviceability (potential) of a facility that has been planned but not yet built.

4.5.3 Serviceability (potential) of a facility for which re-modeling has been planned.

4.6 Use of this classification does not result in building evaluation or diagnosis. Building evaluation or diagnosis generally requires a special expertise in building engineering or technology, and the use of instruments, tools, or measurements.

DEMAND A.4.2	For Indoor Air Quality Conditions
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Demand Scales in this Topic: Information on indoor air quality.

Subject Matter: Occupant requirements for: occupant reaction air quality issues and air contaminants.

Notes: a) Smoking is not discussed in this scale as it is typically addressed by local ordinances, bylaws, or policies.

From the options below, please select the level that best describes the REQUIREMENT.

Requirement Level	DEMAND	A.4.2 Indoor Air Quality Conditions
9 ☐	OCCUPANT REACTION: Occupants need to remain very alert at all times. Indoor air conditions that might cause people to be temporarily drowsy or ill cannot be tolerated under any circumstance.	
	CONTAMINANTS: Air reaching occupants must be free of noxious odors from: building finishes and materials, occupant and business operations (that is: business equipment and cleaning operations), and occupants bioeffluent and fragrance (that is: perfumes or colognes).	
8 ☐		
7 ☐	OCCUPANT REACTION: Indoor air conditions must enable occupants to remain alert.	
	CONTAMINANTS: Occupants must seldom notice short lived minor odors in the air that last for brief periods of time, from building finishes and materials, occupant and business operations (that is, business equipment and cleaning operations) or occupant bioeffluents and fragrance (that is, perfumes or colognes).	
6 ☐		
5 ☐	OCCUPANT REACTION: Occupants need to remain alert but can tolerate occasional indoor air conditions in which some people feel a little drowsy.	
	CONTAMINANTS: Occupants can occasionally tolerate poor indoor air quality conditions in some areas of the building caused by: building finishes and materials that contribute only minor contaminants to the air; occupant and business operations in places where there are no individual workplaces. For example: archives file shelving, can tolerate some areas where airflow is less efficient because of this equipment and some small stuffy areas where cleaning agents or occupant bioeffluents and fragrance (that is, perfumes or colognes).	
4 ☐		
3 ☐	OCCUPANT REACTION: Occupants can tolerate poor indoor air conditions. For example: that might make some people feel drowsy, or irritate eyes, throat or nose, etc.	
	CONTAMINANTS: Odors may be noticeable within 15 to 20 s after entering the building, and some symptoms of drowsiness, sore or irritated eyes, throat, nose, skin, or respiratory system may be experienced from: building finishes and materials; occupant and business operations in individual workplaces including spaces where there is limited work activity such as archives file shelving, storage areas, or occupant bioeffluents and fragrance (that is, perfumes, colognes or cleaning agents).	

FIG. 2 Demand Scale A.4.2 for Information on Indoor Air Quality Conditions

2 ☐ 1 ☐ 0 ☐	OCCUPANT REACTION: Condition of indoor air is not a concern but must not be a health hazard. For example: situations in which occupants are seldom present or building is used mainly for storage or equipment. CONTAMINANTS: The quality of indoor air is not a concern but must not be a health hazard created from: building finishes and materials or occupant and business operations. No information is available.
Select Relative Importance of scale = ☐ Extremely Important ☐ Important ☐ Minor Importance	
Select Threshold Level of Scale: First, indicate whether Threshold Level of scale is a ☐ Minimum OR ☐ Maximum OR, if there is NO Maximum or Minimum Threshold level, then select ☐ None.	
Then, (unless there is none) select the Threshold Level of this scale ☐9 ☐8 ☐7 ☐6 ☐5 ☐4 ☐3 ☐2 ☐1	
If unable to choose scale level, select ☐ OTHER and indicate reason below: ☐ Lack Information ☐ Postpone decision ☐ In-depth evaluation required ☐ Not applicable ☐ Refer question to someone else: Whom? e-mail or phone?	

FIG. 2 Demand Scale A.4.2 for Information on Indoor Air Quality Conditions (continued)

4.7 This classification applies only to facilities that are building constructions, or part thereof. (While classification may be useful in rating the serviceability of facilities that are not building constructions, such facilities are outside the scope of this classification. See discussion under definition 3.1.1.)

4.8 This classification is not intended for, and is not suitable for, use for regulatory purposes nor for fire hazard assessment nor for fire risk assessment.

5. Basis of Classification

5.1 The scales in Figs. 1-5 contain the basis for classification.

5.2 Instructions for the use of this classification are contained in Practice E1679.

6. Keywords

6.1 air quality; building; facility; facility occupants; function; humidity; indoor air; office performance; rating; rating scale; requirements; serviceability; temperature; thermal environment; ventilation