

## 8-1 – 12

### 802.1, 802.8.2, 802.10.4.1, 802.10.4.2

**Proponent:** Ed Roether, representing the ADA/A117 Harmonization Task Group

**Revise as follows:**

**802.1 General.** Wheelchair spaces and wheel chair space locations in assembly areas with spectator seating shall comply with Section 802. Team and player seating shall comply with Sections 802.2 through 802.6 802.7.

**802.8.2 Identification.** Each designated aisle seat shall be identified by ~~the International Symbol of Accessibility~~ a sign or marker.

**802.10.4.1 Spaces with Seating on Risers.** Where tiered seating is provided, wheelchair space locations shall be integrated into the tiered seating area on a riser or a cross-aisle.

**802.10.4.2 Distance from the Screen.** Wheelchair space locations shall be located in accordance with one of the following:

1. Within the rear 60 percent of the seats provided; or
2. Located within the area of an auditorium in which the vertical viewing angles, as measured to the top of the screen, are from the 40th to the 100th percentile of vertical viewing angles for all seats as ranked from the seats in the first row (1st percentile) to seats in the back row (100th percentile).

**Reason:** The ADA/A117 Harmonization Task Group (HTG) was created as a task group of the A117.1 Committee to compare the 2010 ADA with the 2009 A117.1 Standard. The HTG has recommend a series of changes through a set of change proposals. The HTG is recommending changes, for the most part, address where the ADA was viewed as more stringent than the A117. Where the A117 contained provisions not addressed in the ADA, these were not considered a conflict needing action to amend the A117. In addition there are a number of places where the ADA and A117.1 are different as a result of specific actions, by the A117.1 Committee during the development of the 2009 edition, to remain or create a difference where, in the judgment of the committee the ADA was deficient.

**Reason for 802.1:** Provides consistency with ADA regulation of team and player seating.

**Reason for 802.8.2:** ADA allows more flexibility for identification of designated aisle seats. In this case the task group felt that the flexibility should be included in the A117.

**Reason for 802.10.4.1:** ADA provisions provide clear allowance for located the wheelchair space locations on risers and cross aisles. A117.1 is not as specific.

**Reason for 802.10.4.2:** ADA provides two options for determining distance to the screen. A117.1 currently only has one of these two..

Committee Action:      AS                      AM                      D

802.1-ROETHER.doc

## 8-2 – 12

### 802.1, 802.7.2

**Proponent:** Kim Paarlberg, International Code Council

#### **Revise as follows:**

**802.1 General.** Wheelchair spaces and wheel chair space locations in assembly areas with spectator seating shall comply with Section 802. Where tiered seating includes dining surfaces or work surfaces, wheelchair spaces and wheelchair space locations shall comply with Section 802.6, 802.7, 802.9, 802.10 and 902. Team and player seating shall comply with Sections 802.2 through 802.6.

**802.7 Companion Seat.** A companion seat, complying with Section 802.7, shall be provided beside each wheelchair space.

**802.7.1 Companion Seat Type.** The companion seat shall be equivalent in size, quality, comfort and amenities to the seats in the immediate area to the wheelchair space location. Companion seats shall be permitted to be moveable.

**802.7.2 Companion Seat Alignment.** In row seating, the companion seat shall be located to provide shoulder alignment with the wheelchair space occupant. The shoulder of the wheelchair space occupant shall be measured either 36 inches (915 mm) from the front or 12 inches (305 mm) from the rear of the wheelchair space. The floor surface for the companion seat shall be at the same elevation as the wheelchair space floor surface.

**EXCEPTION:** Companion seat alignment is not required in tiered seating includes dining surfaces or work surfaces.

**802.10 Wheelchair Space Dispersion.** The minimum number of wheelchair space locations shall be in accordance with Table 802.10. Wheelchair space locations shall be dispersed in accordance with Sections 802.10.1, 802.10.2 and 802.10.3. In addition, wheelchair space locations shall be dispersed in accordance with Section 802.10.4 in spaces utilized primarily for viewing motion picture projection. Once the required number of wheelchair space locations has been met, further dispersion is not required.

**Reason:** The quantity of change proposals submitted by International Code Council is reflective of three elements of our work: 1. ICC is the Secretariat for the Standard and some changes reflect inconsistencies or improvements suggested by staff; 2. ICC develops and publishes a Commentary on the standard and writing the commentary illuminates issues of the text and figures; and 3. ICC provides an interpretation service for the standard which results in the observation of provisions the users find most confusing.

The intent of this proposal is to address dinner theaters or tiered classrooms with tables. Scoping criteria for dining or work surfaces is 5%. Most dining and works areas are level, so distribution throughout is appropriate. However, where combined with tiered levels to view an event, there should be allowances to use the same distribution and line of site as the seating in sports arenas of theaters. Should alignment with the companion seat is not required since the intent is really to address the dining or work surface for both the person using wheelchair and their companion. Since the scoping is higher than typical tiered assembly seating, it seems that the 5% would address both wheelchair and designated aisle seat requirements. Also, in dinner theaters, what constitutes the aisle would be difficult to interpret at best.



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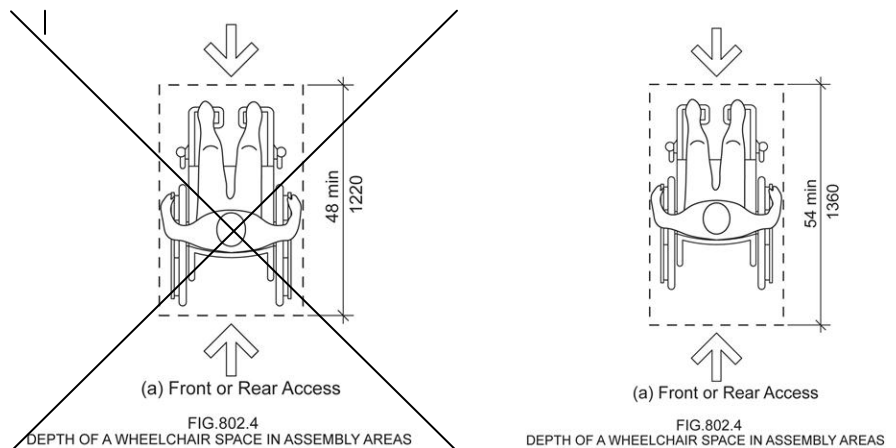
## 8-3 – 12

### 802.4, Figure 802.4

**Proponent:** Edward Steinfeld, IDEA Center, School of Architecture and Planning, University at Buffalo, State University of New York

**Revise as follows:**

**802.4 Depth.** Where a wheelchair space can be entered from the front or rear, the wheelchair space shall be ~~48~~ <sup>54</sup> inches (1220 <sup>1360</sup> mm) minimum in depth. Where a wheelchair space can only be entered from the side, the wheelchair space shall be 60 inches (1525 mm) minimum in depth.



**Reason:** Many of the technical requirements of the ICC/ANSI A117.1 (2009) Accessible and Usable Buildings and Facilities (ICC/ANSI) designed to accommodate wheeled mobility users are based on research completed from 1974 to 1978 using a research sample that included about 60 individuals who used manual wheelchairs (Steinfeld et al., 1979).

The Center for Inclusive Design and Environmental Access (IDeA) at the University at Buffalo, SUNY recently completed an anthropometric study of 500 wheeled manual and powered mobility device users (Steinfeld, et al., 2010). Measurements of body and device size were captured in three dimensions. The functional anthropometric measurements required measuring reaching ability, grip strength and the minimum space needed for turning. It is the most extensive anthropometric study of wheeled mobility device users in the United States. Additional information about the study can be found at <http://www.udeworld.com/ansi-standards-review>. The proposed revisions are based on new anthropometric information that was generated from the database of anthropometric measurements developed as part of the study.

#### **Analysis**

Unlike turning spaces that are based on dynamic requirements, clear floor space represents the space required for a stationary wheeled mobility device. This area is typically depicted as a rectangular space the dimensions of which are based on measurements of occupied length and occupied breadth of wheeled mobility devices, which are defined as follows:

- **Occupied length:** measured as the horizontal distance between the forward-most point and the rear-most point on the wheelchair or occupant.
- **Occupied width:** measured as the horizontal distance between the side-most points of the wheelchair or participant on the right and left sides.

The results of our analysis suggest that the existing standard on clear floor space (48" length, 30" width) does not accommodate the occupied lengths and widths of the wheeled mobility user population and excludes powered wheeled mobility device users disproportionately as compared to manual device users. A length of 48" accommodates the occupied length of 75% of manual wheelchair users and only about 50% of powered chair and scooter users. A width of 30" accommodates the occupied width of 90% of manual wheeled mobility device users and only 75% of powered chair users.

We have taken the position that the clear floor space standards should accommodate the occupied lengths and widths of at least 90% of manual and powered wheeled mobility device users. A length of 54" accommodates the occupied lengths of 95% of manual chair users, and 90% of the powered chair users. A width of 32" accommodates the occupied widths of over 95% of manual wheeled mobility device users and 90% of the powered wheelchair users. **Proposed changes to section 802 Assembly Areas reflect the 6-inch adjustment in occupied wheelchair length needed to accommodate over 90% of the manual and powered wheelchair user population.**

The analysis was summarized in the Final Project Report to the U.S. Access Board and in a memorandum entitled "Evaluation of Clear Floor Space Requirements," that was submitted to the ICC/ANSI A117 Task Force on Anthropometry of Wheeled Mobility Subcommittee on Clear Floor Space Clearances.

**References** (See <http://www.udeworld.com/ansi-standards-review>)

Paquet, V. (2012). *Evaluation of Clear Floor Space Requirements*. A memorandum submitted to the ICC/ANSI A117 Task Force on Anthropometry of Wheeled Mobility Subcommittee on Clear Floor Space Clearances.

Steinfeld, E., Paquet, V., D'Souza, C., Joseph, C., and Maisel, J. (2010). *Final Report: Anthropometry of Wheeled Mobility Project*. Washington, DC: U.S. Access Board.

Steinfeld, E., Schroeder, S. and Bishop, M. (1979). *Accessible buildings for people with walking and reaching limitations*. Washington, DC: U.S. Department of Housing and Urban Development.

Committee Action:           AS                   AM                   D

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802.4-STEINFELD.doc

## 8-4 – 12

### 802.10.1

**Proponent:** Ed Roether, ADA/A117.1 Harmonization Task Group

**Revise as follows:**

**802.10.1 Horizontal Dispersion.** Wheelchair space locations shall be dispersed horizontally to provide viewing options. Where seating encircles the stage or field, in whole or in part, horizontal dispersion shall include the entire seating area. Two wheelchair spaces shall be permitted to be located side-by-side.

**EXCEPTION:** Horizontal dispersion shall not be required in assembly areas with 300 or fewer seats if the wheelchair space locations are located within the 2<sup>nd</sup> and 3<sup>rd</sup> quartile of the row length. Intermediate aisles shall be included in determining the total row length. If the row length in the 2<sup>nd</sup> and 3<sup>rd</sup> quartile of the row is insufficient to accommodate the required number of companion seats and wheelchair spaces, the additional companion seats and wheelchair spaces shall be permitted to extend into the 1<sup>st</sup> and 4<sup>th</sup> quartile of the row.

**Reason:** The ADA/A117 Harmonization Task Group (HTG) was created as a task group of the A117.1 Committee to compare the 2010 ADA with the 2009 A117.1 Standard. The HTG has recommend a series of changes through a set of change proposals. The HTG is recommending changes, for the most part, address where the ADA was viewed as more stringent than the A117. Where the A117 contained provisions not addressed in the ADA, these were not considered a conflict needing action to amend the A117. In addition there are a number of places where the ADA and A117.1 are different as a result of specific actions, by the A117.1 Committee during the development of the 2009 edition, to remain or create a difference where, in the judgment of the committee the ADA was deficient.

DOJ regulations

35.151 (g) and 36.406 (f) Assembly areas. (2) Assembly areas that are required to horizontally disperse wheelchair spaces and companion seats by section 221.2.3.1 of the 2010 Standards and have seating encircling, in whole or in part, a field of play or performance area shall disperse wheelchair spaces and companion seats around that field of play or performance area;

The intent of this proposal is to coordinate how ICC A117.1 would be interpreted if the seating was U-shaped or circular rather than just straight.

Committee Action:            AS                    AM                    D

802.10.1-Roether.doc

## 8-5 – 12

### 802.10.3.1 (New), 906.1 (New), 906.2 (New), 906.3 (New)

**Proponent:** Dominic Marinelli, representing United Spinal Association

**Add new text as follows:**

**802.10.3.1 Charging Stations.** Where charging stations are provided at wheelchair space locations they shall comply with Section 906.

#### **906 Charging Stations.**

**906.1 General.** A charging station shall consist of a grounded duplex outlet.

**906.2 Clear Floor Space.** A clear floor space complying with Section 305 shall be provided.

**906.3 Height.** Accessible charging stations shall comply with at least one of the reach ranges specified in Section 308.

**Reason:** Today's Wheelchairs and assistive technology equipment require re-charging. At places of assembly people often gather for extended periods of time and their mobility device and/or assistive technology equipment may require recharging. Section 906.1 clarifies that a charging station consists of a grounded duplex outlet.

The Exception to 802.10.3.1 recognizes that in smaller assembly venues, the electrical wiring may not extend to each wheelchair space location.

Committee Action:           AS                   AM                   D

802.10.3.1(NEW)-MARINELLI.doc

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## 8-6 – 12

### 802.11 (NEW)

**Proponent:** Hansel Bauman, Architect, representing National Association of the Deaf

**Revise as follows:**

**802.11 Assembly Room Presentation Lighting.** Room lighting shall be provided which will illuminate a presentation area in the foreground of each assembly space. The illuminated presentation area shall be 10 square feet minimum and shall be illuminated between 3 feet minimum and 6 feet maximum above the finish floor. The illumination shall be 10 footcandles minimum.

**Reason:** This recommendation addresses the visual conflict that arises when sign language is used during visual slide/powerpoint presentations. One the one hand the room is darkened to better view the visual presentation yet the darkened conditions make it difficult to see sign language by either the presenter or by interpreters. Thus obstructing access to communication.

Committee Action:           AS                   AM                   D

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## 8-7 – 12

### 802.12 (NEW), 802.12.1 (NEW), 802.12.2 (NEW)

**Proponent:** Hansel Bauman, Architect, representing National Association of the Deaf

**Add new text as follows:**

**802.12 Visual communication in Meeting Rooms.** Meeting rooms with an occupant load of more than 6 shall be designed to comply with this section.

**802.12.1 Arrangement of Space.** Table and seating in meeting rooms shall be arranged in a radius configuration to enable direct lines of visual communication in sign language between all occupants. The arrangement shall include a clear aisle of 36 inches minimum behind each seated occupant.

**802.12.2 Lighting.** Lighting shall comply with Section 802.11. The lighting for the presentation are shall be on a separate circuit so that it can remain illuminated when other areas of the room are darkened.

**Reason:** These recommendations address the visual needs of deaf and hard of hearing individuals who communicate visually through sign language in group meeting situations.

Committee Action:            AS                    AM                    D

802.12 (NEW)-BAUMAN.doc

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## 8-8 – 12

### 804.2, 804.2.2

**Proponent:** Kim Paarlberg, International Code Council

**Revise as follows:**

**804.2 Clearance.** Where a pass-through kitchen is provided, clearances shall comply with Section 804.2.1.

Where a ~~U-shaped~~ kitchen is ~~provided~~ enclosed on three contiguous sides, clearances shall comply with Section 804.2.2.

**EXCEPTION:** Spaces that do not provide a cooktop or conventional range shall not be required to comply with Section 804.2 provided there is a 40-inch (1015 mm) minimum clearance between all opposing base cabinets, counter tops, appliances, or walls within work areas.

**804.2.1 Pass-through Kitchens.** In pass-through kitchens where counters, appliances or cabinets are on two opposing sides, or where counters, appliances or cabinets are opposite a parallel wall, clearance between all opposing base cabinets, counter tops, appliances, or walls within kitchen work areas shall be 40 inches (1015 mm) minimum. Pass-through kitchens shall have two entries.

**804.2.2 U-Shaped Enclosed Kitchens.** In kitchens enclosed on three contiguous sides, clearance between all opposing base cabinets, countertops, appliances, or walls within kitchen work areas shall be 60 inches (1525 mm) minimum.

**Exception:** In kitchens with counters, appliances or cabinets on only one wall or two opposing walls, the clearance between all opposing base cabinets, counter tops, and appliances, or walls within the kitchen work area is permitted to be 40 inches (1015 mm) minimum where the kitchen includes a turning space complying with Section 304.3.2 and 305.7.2 is provided under either the accessible sink or the accessible work surface.

**Reason:** The quantity of change proposals submitted by International Code Council is reflective of three elements of our work: 1. ICC is the Secretariat for the Standard and some changes reflect inconsistencies or improvements suggested by staff; 2. ICC develops and publishes a Commentary on the standard and writing the commentary illuminates issues of the text and figures; and 3. ICC provides an interpretation service for the standard which results in the observation of provisions the users find most confusing.

The change for terminology from U-shaped kitchen to enclosed kitchen is for two reasons. 1) The term is confusing and not commonly used to represent the kitchens intended. Most people do not consider a kitchen with a wall at the end (see Figure 804.2.2) or a kitchen with walls on two sides a U-shaped kitchen. 2) The language should be revised for consistency with Type A and Type B. The U-shaped kitchens in the dwelling units means cabinets on three sided.

If a kitchen is not within a dwelling unit, literally a turning space is not required. Be adding the turning space requirement to kitchens, the space under the sink or work surface would have to be 36" wide in order to accommodate a T-turn, rather than both at 30". There would be no impact on typical U-shaped kitchens since they have 60" between counters already. While this is intended for access to appliances and work surfaces consistent with alcove provisions, this still gets you a turning space.

The galley kitchen would have knee and to clearance under the sink or work surface for a turning space. A 60" width between counters is not justified. This also shoots the efficiency of the kitchen for other family members that do not use wheelchairs.

**Type A kitchens read as follows:**

**1003.12.1 Clearance.** Clearance complying with Section 1003.12.1 shall be provided.

**1003.12.1.1 Minimum Clearance.** Clearance between all opposing base cabinets, counter tops, appliances, or walls within kitchen work areas shall be 40 inches (1015 mm) minimum.

**1003.12.1.2 U-Shaped Kitchens.** In kitchens with counters, appliances, or cabinets on three contiguous sides, clearance between all opposing base cabinets, countertops, appliances, or walls within kitchen work areas shall be 60 inches (1525 mm) minimum

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## 8-9 – 12

### 804.2, 804.2.2, 1003.12.1.2, 1004.12.1.1

**Proponent:** Kim Paarlberg, International Code Council

**Revise as follows:**

**804.2 Clearance.** Where a pass-through kitchen is provided, clearances shall comply with Section 804.2.1.

Where a ~~U-shaped~~ kitchen is ~~provided~~ enclosed on three contiguous sides, clearances shall comply with Section 804.2.2.

**EXCEPTION:** Spaces that do not provide a cooktop or conventional range shall not be required to comply with Section 804.2 provided there is a 40-inch (1015 mm) minimum clearance between all opposing base cabinets, counter tops, appliances, or walls within work areas.

**804.2.1 Pass-through Kitchens.** In pass-through kitchens where counters, appliances or cabinets are on two opposing sides, or where counters, appliances or cabinets are opposite a parallel wall, clearance between all opposing base cabinets, counter tops, appliances, or walls within kitchen work areas shall be 40 inches (1015 mm) minimum. Pass-through kitchens shall have two entries.

**804.2.2 U-Shaped Enclosed Kitchens.** In kitchens enclosed on three contiguous sides, clearance between all opposing base cabinets, countertops, appliances, or walls within kitchen work areas shall be 60 inches (1525 mm) minimum.

**EXCEPTION:** In kitchens with islands, the clearance between all opposing base cabinets, counter tops, and appliances, or walls within the kitchen work area is permitted to be 40 inches (1015 mm) minimum where the kitchen includes a turning space complying with Section 304.3.2 and 305.7.2 is provided under either the accessible sink or the accessible work surface.

**1003.12.1.2 U-Shaped Kitchens.** In kitchens with counters, appliances, or cabinets on three contiguous sides, clearance between all opposing base cabinets, countertops, appliances, or walls within kitchen work areas shall be 60 inches (1525 mm) minimum.

**EXCEPTION:** In kitchens with islands, the clearance between all opposing base cabinets, counter tops, and appliances, or walls within the kitchen work area is permitted to be 40 inches (1015 mm) minimum.

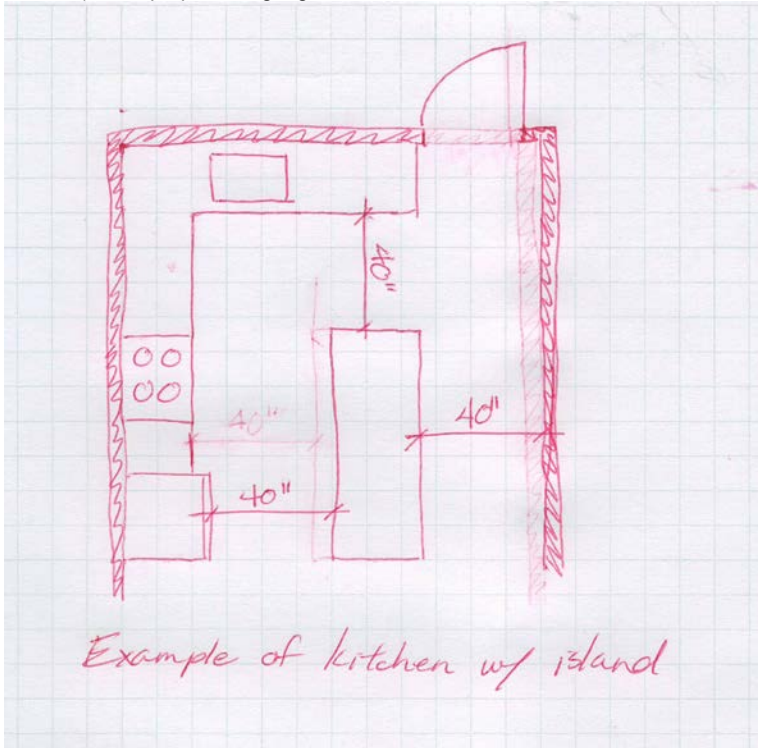
**1004.12.1.2 U-Shaped Kitchens.** In kitchens with counters, appliances, or cabinets on three contiguous sides, clearance between all opposing base cabinets, countertops, appliances, or walls within kitchen work areas shall be 60 inches (1525 mm) minimum.

**EXCEPTION:** In kitchens with islands, the clearance between all opposing base cabinets, counter tops, and appliances, or walls within the kitchen work area is permitted to be 40 inches (1015 mm) minimum.

**Reason:** The quantity of change proposals submitted by International Code Council is reflective of three elements of our work: 1. ICC is the Secretariat for the Standard and some changes reflect inconsistencies or improvements suggested by staff; 2. ICC develops and publishes a Commentary on the standard and writing the commentary illuminates issues of the text and figures; and 3. ICC provides an interpretation service for the standard which results in the observation of provisions the users find most confusing.

The change for terminology from U-shaped kitchen to enclosed kitchen is for two reasons. 1) The term is confusing and not commonly used to represent the kitchens intended. Most people do not consider a kitchen with a wall at the end (see Figure 804.2.2) or a kitchen with walls on two sides a U-shaped kitchen. 2) The language should be revised for consistency with Type A and Type B. The U-shaped kitchens in the dwelling units means cabinets on three sided.

The current terminology does not deal with kitchens with islands, which is the prevalent design at this time (at least in the Midwest). The propose language would deal with this issue for all three levels of accessibility.



Committee Action: AS AM D

804.2 #2-PAARLBERG.doc

## 8-10 – 12

### 804.3, 1002.12, 1003.12.3

**Proponent:** Kim Paarlberg, International Code Council

**Revise as follows:**

**804.3 Work Surface.** At least one work surface shall be provided in accordance with Section 902. At least one accessible work surface shall be located in accordance with Section 804.5.5.2 or 804.5.5.3.

**EXCEPTION:** Spaces that do not provide a cooktop or conventional range shall not be required to provide an accessible work surface.

**1002.12 Kitchens** and kitchenettes. Kitchens and kitchenettes shall comply with Section 804. ~~At least one work surface, 30 inches (760 mm) minimum in length, shall comply with Section 902.~~

~~**EXCEPTION:** Spaces that do not provide a cooktop or conventional range shall not be required to provide an accessible work surface.~~

**1003.12.3 Work Surface.** At least one section of counter shall provide a work surface 30 inches (760 mm) minimum in length complying with Section 1003.12.3.

**EXCEPTION:** Spaces that do not provide a cooktop or conventional range shall not be required to provide an accessible work surface.

**Reason:** The quantity of change proposals submitted by International Code Council is reflective of three elements of our work: 1. ICC is the Secretariat for the Standard and some changes reflect inconsistencies or improvements suggested by staff; 2. ICC develops and publishes a Commentary on the standard and writing the commentary illuminates issues of the text and figures; and 3. ICC provides an interpretation service for the standard which results in the observation of provisions the users find most confusing.

The current language for the work surface being next to the oven is hidden. Other revisions are for consistency between the levels of accessibility and kitchenettes.

Committee Action:           AS                   AM                   D

804.3 (revised)-PAARLBERG.doc

## 8-11 – 12

### 804.3

**Proponent:** Kim Paarlberg, International Code Council

**Revise as follows:**

**804.3 Work Surface.** At least one work surface, 30 inches minimum in length shall be provided in accordance with Section 902.

**EXCEPTION:** Spaces that do not provide a cooktop or conventional range shall not be required to provide an accessible work surface.

**Reason:** The quantity of change proposals submitted by International Code Council is reflective of three elements of our work: 1. ICC is the Secretariat for the Standard and some changes reflect inconsistencies or improvements suggested by staff; 2. ICC develops and publishes a Commentary on the standard and writing the commentary illuminates issues of the text and figures; and 3. ICC provides an interpretation service for the standard which results in the observation of provisions the users find most confusing.

This proposal is being submitted in response to a question which is received on a frequent basis. The question is how much work surface is required in an employee break room or other space where the general kitchen requirements are applicable. This question is important to answer the typical follow-up question regarding how much of the counter top must be at the 34 inch height and how much can be at the standard height. The 30 inch minimum length was selected from the dwelling unit provisions of Sections 1002.12 and 1003.12.3. While the exception does help for spaces that do not provide a cooktop or conventional range, if the break room does include a cooktop (regardless of how small) the exception is not applicable.

It seems strange that in dwelling units only a small amount of work space is required and when you go to dining or food service lines or service counters we are typically given a specific length or percentage of the elements which must comply. However, when we get to this issue in the general kitchen requirements and look at spaces such as an employee break room, we don't have a maximum limit or specify a minimum length or percentage. Where the exception in Section 804.3 is not applicable the kitchen seems to be stuck with a requirement for 100 percent of the counter/work surface to be kept at the 34 inch maximum height. In a small break room with 20 feet of counter is it really necessary that all 20 feet of counter be at the lower height and that standard height cabinets cannot be used? And if it is set up as a galley kitchen with 10 feet of cabinets on both sides, do both counters have to comply with the work surface requirements?

This revision is also needed to ensure that the work surface is of an adequate size to be useful. If the standard does not specify a minimum length, then a designer could argue a 6 inch work surface is adequate. Therefore while the revision may be viewed as reducing an existing requirement (from possibly 100% of the counter down to 30 inches minimum) it will also ensure that the work surface is adequate and usable.

While this may ultimately be a scoping issue that should be addressed in the scoping document, it seems as if adding a minimum length is consistent with other locations of the standard and will assist users in determining how to properly apply the standard.

Because the standard cabinet/counter is 24 inches in depth, if the committee decided to make the work space requirement 36 inches minimum in length to match the alcove requirements of Section 305.7.2 that would seem reasonable.

Committee Action:           AS                   AM                   D

804.3-PAARLBERG.doc

## 8-12 – 12

**804.5.1, 804.5.3, 804.5.1, 804.5.5.1, 804.5.6.1 (New), 1003.12.5.1 (New), 1003.12.5.2, 1003.12.5.3, 1003.12.5.4.1, 1003.12.5.5.1, 1003.12.5.6.1**

**Proponent:** Kim Paarlberg, International Code Council

**Revise as follows:**

**804.5.1 Clear Floor Space.** A clear floor space complying with Sections 804.5 and 305 shall be provided at each kitchen appliance.

**804.5.3 Dishwasher.** ~~A clear floor space positioned adjacent to the dishwasher door, shall be provided.~~ The dishwasher door in the open position shall not obstruct the clear floor space for the dishwasher or an adjacent sink.

**804.5.4.1 Approach.** ~~A clear floor space, positioned for a parallel or forward approach to the cooktop, shall be provided.~~

**804.5.5.1 Clear floor space.** ~~A clear floor space shall be provided.~~ The oven door in the open position shall not obstruct the clear floor space for the oven.

**804.5.6.1 Clear floor space.** A clear floor space, ~~positioned for a parallel approach to~~ for the refrigerator/ freezer, shall be provided positioned for a parallel approach. The centerline of the clear floor space shall be offset 24 inches (610 mm) maximum from the centerline of the appliance.

**1003.12.5.1 ~~1003.12.5.2~~ Clear Floor Space.** A clear floor space, ~~positioned for a parallel or forward approach~~ complying with Sections 1003.12.5 and 305, shall be provided at each kitchen appliance.

**1003.12.5.2 ~~1003.12.5.4~~ Operable Parts.** All appliance controls shall comply with Section 1003.9.

### **EXCEPTIONS:**

1. Appliance doors and door latching devices shall not be required to comply with Section 309.4.
2. Bottom-hinged appliance doors, when in the open position, shall not be required to comply with Section 309.3.

**1003.12.5.3 Dishwasher.** ~~A clear floor space, positioned adjacent to the dishwasher door, shall be provided.~~ The dishwasher door in the open position shall not obstruct the clear floor space for the dishwasher or an adjacent sink.

**1003.12.5.4.1 Approach.** ~~A clear floor space, positioned for a parallel or forward approach to the cooktop, shall be provided.~~

**1003.12.5.5.1 Clear floor space.** ~~A clear floor space shall be provided.~~ The oven door in the open position shall not obstruct the clear floor space for the oven.

**1003.12.5.6.1 Clear floor space.** A clear floor space, ~~positioned for a parallel approach to~~ for the refrigerator/ freezer, shall be provided positioned for a parallel approach. The centerline of the clear floor space shall be offset 24 inches (610 mm) maximum from the centerline of the appliance.

**Reason:** The quantity of change proposals submitted by International Code Council is reflective of three elements of our work: 1. ICC is the Secretariat for the Standard and some changes reflect inconsistencies or improvements suggested by staff; 2. ICC develops and publishes a Commentary on the standard and writing the commentary illuminates issues of the text and figures; and 3. ICC provides an interpretation service for the standard which results in the observation of provisions the users find most confusing.

The purpose of this change is to reduce redundant language. If the clear floor space is required at each appliance at the beginning, it need not be repeated unless additional specifics are required.

Committee Action:           AS                   AM                   D

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## 8-13 – 12

### 606.2, 804.2, 804.2.3 (New), 1002.12, 1003.12.1.1, 1004.12.1.1

**Proponent:** Kim Paarlberg, International Code Council

#### Revise as follows:

**606.2 Clear Floor Space.** A clear floor space complying with Section 305.3, positioned for forward approach, shall be provided. Knee and toe clearance complying with Section 306 shall be provided. The dip of the overflow shall not be considered in determining knee and toe clearances.

#### EXCEPTIONS:

1. Where a turning space is provided in the room, a parallel approach complying with Section 305 and centered on the sink, shall be permitted to a kitchen sink in a kitchenette, a space where a cook top or conventional range is not provided.

*(portions of section not shown remain unchanged)*

**804.2 Clearance.** Where a pass-through kitchen is provided, clearances shall comply with Section 804.2.1. Where a U-shaped kitchen is provided, clearances shall comply with Section 804.2.2. Kitchenettes shall comply with Section 804.2.3.

~~**EXCEPTION:** Spaces that do not provide a cooktop or conventional range shall not be required to comply with Section 804.2 provided there is a 40-inch (1015 mm) minimum clearance between all opposing base cabinets, counter tops, appliances, or walls within work areas.~~

**804.2.3 Kitchenettes.** Kitchenettes, spaces that do not provide a cooktop or conventional range shall provided a 40-inch (1015 mm) minimum clearance between all opposing base cabinets, counter tops, appliances, or walls within work areas. A turning space shall be provided within the room and shall be permitted to use the knee and toe clearance under the sink.

**1002.12 Kitchens** and kitchenettes. Kitchens and kitchenettes shall comply with Section 804. At least one work surface, 30 inches (760 mm) minimum in length, shall comply with Section 902.

**EXCEPTION:** Kitchenettes, spaces that do not provide a cooktop or conventional range shall not be required to provide an accessible work surface.

**1003.12.1.1 Minimum Clearance.** In kitchens and kitchenettes, clearance between all opposing base cabinets, counter tops, appliances, or walls within kitchen work areas shall be 40 inches (1015mm) minimum. A turning space provided within the room and shall be permitted to use the knee and toe clearance under the sink.

**1004.12.1.1 Minimum Clearance.** In kitchens and kitchenettes, clearance between all opposing base cabinets, counter tops, appliances, or walls within kitchen work areas shall be 40 inches (1015mm) minimum.

**Reason:** The quantity of change proposals submitted by International Code Council is reflective of three elements of our work: 1. ICC is the Secretariat for the Standard and some changes reflect inconsistencies or improvements suggested by staff; 2. ICC develops and publishes a Commentary on the standard and writing the commentary illuminates issues of the text and figures; and 3. ICC provides an interpretation service for the standard which results in the observation of provisions the users find most confusing.

Clarify when clearances are required in kitchenettes. Otherwise, there is an argument that a kitchenette only has to have a 36" route between the counter and a wall. Also, include exception for work surface and parallel approach to sink, otherwise, Type A and Type B units could have a higher requirement than an Accessible unit.

In Accessible units and Type A units have to have a turning circle within the room. If there is a kitchenette, which currently does not require a work area and allows a side approach sink, is the intent to allow there to be a pull-in back-out scenario, or would the turning space over ride? If you have to have a turning space in the room, how about letting them use space under the sink?

Possible define kitchenette, and then get rid of the redundant language in the exceptions.

**106 Definitions**

Kitchenette: A kitchen or break room area where at least a counter and sink are provided, but a cooktop or conventional range is not provided.

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## 8-14 – 12

### 805.4, 805.6, 805.6.3

**Proponent:** Kim Paarlberg, International Code Council

#### **Revise as follows:**

**805.4 Bus Signs.** Bus route identification signs shall have visual characters complying with Sections 703.2.2, 703.2.3, and 703.2.5 through 703.2.8. In addition, bus route identification numbers shall be visual characters complying with Section 703.2.4.

#### **EXCEPTIONS:**

1. Bus schedules, timetables and maps that are posted at the bus stop or bus bay shall not be required to comply with Section 805.4.
2. Bus route identification signage shall be permitted to comply with Section 703.7.

**805.6 Rail Station Signs.** Rail station signs shall comply with Section 805.6.

#### **EXCEPTIONS:**

1. Signs shall not be required to comply with Sections 805.6.1 and 805.6.2 where audible signs are remotely transmitted to hand-held receivers, or are user- or proximity-actuated.
2. Bus route identification signage shall be permitted to comply with Section 703.7.

**805.6.3 Station Names.** Stations covered by this section shall have identification signs with visual characters complying with Section 703.2. The signs shall be clearly visible and within the sight lines of a standing or sitting passenger from within the vehicle on both sides when not obstructed by another vehicle.

**EXCEPTION:** Station identification signage shall be permitted to comply with Section 703.7.

**Reason:** The quantity of change proposals submitted by International Code Council is reflective of three elements of our work: 1. ICC is the Secretariat for the Standard and some changes reflect inconsistencies or improvements suggested by staff; 2. ICC develops and publishes a Commentary on the standard and writing the commentary illuminates issues of the text and figures; and 3. ICC provides an interpretation service for the standard which results in the observation of provisions the users find most confusing.

Bus signs and rail station signs should be able to use variable message signage. This is not an option in ADA because they do not have requirements for these types of signs. However, it is logical to allow this option since variable message signage effectively meets visual signage requirement.



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## 8-15 – 12

### 808 (New), 809 (New)

**Proponent:** Neil A. Snyder, American Speech-Language-Hearing Association

#### **Add new text as follows:**

**808.** Add the text of ANSI/ASA S12.60-2010/Parts 1 & 2, American National Standard Acoustical Performance Criteria, Design Requirements, and Guidelines for Schools, Part 1: Permanent Schools; Part 2: Relocatable Classroom Factors at the end of A117.1, Chapter 8, Special Rooms and Spaces, as a new section 808 and 809 respectively.

**809.** Add the text of ANSI/ASA S12.60-2010/Parts 1 & 2, American National Standard Acoustical Performance Criteria, Design Requirements, and Guidelines for Schools, Part 1: Permanent Schools; Part 2: Relocatable Classroom Factors at the end of A117.1, Chapter 8, Special Rooms and Spaces, as a new section 808 and 809 respectively.

**Reason:** The American Speech-Language-Hearing Association (ASHA) recommends an appropriate acoustical environment for all students in educational settings. Therefore, ASHA endorses ANSI S12.60-2010 Acoustical Performance Criteria, Design Requirements, and Guidelines for Schools (ANSI S12.60-2010) as the national building and design standards for classroom acoustics. It is well recognized that the acoustical environment in a classroom or other educational environment is a critical variable in the academic, psychoeducational, and psychosocial development of children with normal hearing as well as children with hearing loss and/or other disabilities (e.g., auditory processing disorders, learning disabilities, attention deficit disorders). Inappropriate levels of reverberation and/or noise can deleteriously affect speech perception, reading/spelling ability, classroom behavior, attention, concentration, and educational achievement. In addition to compromising student function, poor classroom acoustics may also negatively affect teacher performance and increase vocal pathologies and absenteeism. Thus, all educational settings have an incentive to develop acoustical conditions that meet national standards. For children with hearing loss and/or other disabilities, the acoustics of the proposed educational setting(s) should be considered and addressed during the determination of a child's educational needs and placement.

Acoustical factors in a classroom include: (1) the level of the background (ambient) noise in the room; (2) the relative intensity of the information carrying components of the speech signal to the non-information carrying signal or noise (i.e., signal-to-noise ratio [SNR]); and (3) the reverberant characteristics of the environment.

It is important to note that these acoustical criteria are essentially identical to the recently approved ANSI Standard on classroom acoustics. Additionally, ANSI S12.60-2010 provides acoustic guidelines for learning spaces greater than 20,000 ft<sup>3</sup>.

It is imperative that all new construction adhere to the acoustical criteria indicated above and stipulated in ANSI S12.60-2010. The fundamental strategy for improving acoustics within existing classrooms is acoustical modification of that environment. Acoustical measurement and/or modifications of educational settings should be multidisciplinary in nature and conducted by trained qualified professionals, such as audiologists, architects, and acoustical engineers. It is important to realize that these acoustical criteria are considered minimal. Some students, for example those with hearing loss, may require further signal enhancement technology. For additional information on acoustical criteria and hearing assistive technology, see ASHA's Acoustics in Educational Settings: Technical Report and Guidelines for Addressing Acoustics in Educational Settings. <http://www.asha.org/docs/html/TR2005-00042.html>

#### **Acoustical Performance Criteria, Design Requirements, and Guidelines for Schools,**

##### **Part 1: Permanent Schools**

##### **1 Scope and purpose**

##### **1.1 Scope**

1.1.1 Part 1 of ANSI/ASA S12.60 is applicable to core learning spaces and classrooms with interior volumes not exceeding 566 m<sup>3</sup> (20 000 ft<sup>3</sup>) and to ancillary learning spaces of any volume. Learning spaces with volumes larger than 566 m<sup>3</sup> (20 000 ft<sup>3</sup>) are considered ancillary learning spaces for purposes of this standard. Annex A provides testing procedures when optional tests are performed to determine conformance with the source background noise requirements and the noise isolation requirements of this standard. Annex B provides commentary information on various paragraphs of this standard. Annex C provides guidelines for controlling reverberation in classrooms and other learning spaces.

This Part does not apply for natatoria, auditoria, music performance spaces, teleconferencing rooms, or special education rooms such as those for severely acoustically challenged students, which all require special acoustical design and treatment that is not within the scope of this standard. This Part does not apply to relocatable classrooms or relocatable modular learning spaces, which are covered by Part 2 of ANSI/ASA S12.60.

1.1.2 Acoustical performance criteria are specified in this standard by limits on the greatest one-hour average A-weighted and C-weighted background noise levels and by limits on reverberation times when students are expected to be present.

1.1.3 The control of background noise levels in this standard is achieved, in part, by specifying the minimum outdoor-to-indoor transmission class (OITC) ratings and sound transmission class (STC) ratings, depending upon the sound source, to reduce noise that intrudes into the classroom or learning space from sources outside of the building envelope, and specifying minimum STC ratings for walls and floor-ceiling assemblies where noise that originates within the school building intrudes into the classroom

through classroom walls and floor/ceiling assemblies. The control of noise from footsteps or other impacts on a floor above is achieved by specifying an impact insulation class (IIC) rating for the floor/ceiling assembly.

1.1.4 This standard applies to siting and building-design-dependent sources of intrusive noise in learning spaces in schools, including noise produced by heating, ventilating, and air-conditioning (HVAC) systems; building services; and exterior sound sources such as vehicular traffic and aircraft overflights. This standard applies to the design and performance of unoccupied spaces and does not apply to sound generated within a classroom by its occupants including voices and the sounds of classroom activities such as the moving of chairs, nor does it apply to the sound from portable or permanent built-in equipment used during the course of instruction, such as computers, as long as the equipment can be turned off in the room.

## **1.2 Purpose**

This standard is intended to provide a minimum set of requirements, based on the best scientific evidence available at the time of publication, that can be adopted by reference to this standard and enforced by an authority having jurisdiction. This standard, in conjunction with the information provided in the annexes, is intended to help school planners and designers provide good acoustical characteristics for classrooms and other learning spaces in which speech communication is an important part of the learning process.

## **2 Normative references**

The following referenced documents are indispensable for the application of this standard. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ANSI S1.1, American National Standard Acoustical Terminology

ANSI/ASA S1.13, American National Standard Measurement of Sound Pressure Levels in Air

ANSI/ASA S12.9-1992/Part 2 (R2008), American National Standard Quantities and Procedures for Description and Measurement of Environmental Sound, Part 2: Measurement of Long-Term Wide-Area Sound

ANSI/ASA S12.9-1993/Part 3 (R2008), American National Standard Quantities and Procedures for Description and Measurement of Environmental Sound, Part 3: Short-Term Measurements with an Observer Present

ASTM E90-09, Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements

ASTM E336-09, Standard Test Method for Measurement of Airborne Sound Attenuation between Rooms in Buildings

ASTM E41 3-04 (2009), Classification for Rating Sound Insulation

ASTM E966-04, Standard Guide for Field Measurements of Airborne Sound Insulation of Building Façades and Façade Elements

ASTM E1 007-04e1, Standard Test Method for Field Measurement of Tapping Machine Impact Sound Transmission through Floor-Ceiling Assemblies and Associated Support Structures

ASTM E1 332-90(2003), Standard Classification for Determination of Outdoor-Indoor Transmission Class

IEC 61672-1, Electroacoustics — Sound level meters — Part 1: Specifications ANSI/Infocomm 1 M-2009, Audio Coverage Uniformity in Enclosed Listener Areas

## **3 Definitions**

For the purposes of this standard, the terms and definitions given in ANSI S1.1 and the following apply. The definitions of acoustical terms given here are consistent with those given in ANSI S1.1 but may be simplified for the purposes of this document.

### **3.1 General terms**

3.1.1 classrooms and other learning spaces. Locations within school buildings where students assemble for educational purposes.

3.1.1.1 core learning spaces. Spaces for educational activities where the primary functions are teaching and learning and where good speech communication is critical to a student's academic achievement. These spaces include, but are not limited to, classrooms (enclosed or open plan), instructional pods or activity areas, group instruction rooms, libraries, offices used for educational purposes, therapy rooms, and music rooms for instruction or practice.

3.1.1.2 ancillary learning spaces. Spaces where good communication is important to a student's educational progress but for which the primary educational functions are informal learning, social interaction, or similar activity other than formal instruction. For purposes of this part, ancillary learning spaces include corridors, cafeterias, and gymnasias but do not include natatoria, auditoria, music performance spaces, teleconferencing rooms, or special education rooms such as those for severely acoustically challenged students.

3.1.1.3 relocatable classroom. Educational classroom structure that utilizes factory-built modular construction methods that can be efficiently, repeatedly transported over public roads without the removal of the floor, roof, or other significant structural modification, and that typically consists of one or two modules (units, boxes, floors), but can consist of multiple units. Relocatable classrooms are frequently called portable classrooms, temporary classrooms, mobile classrooms, or learning cottages.

3.1.2 acoustical privacy. The acoustical attenuation between spaces that is needed to prevent conversation in one space from being understood in an adjacent space.

### **3.2 Terms relating to acoustical performance and design**

3.2.1 noise level or sound level. Terms employed interchangeably throughout this standard to represent the overall frequency-weighted sound pressure level of an airborne sound. This descriptor is used to express the strength of a sound in a manner related to how the ear perceives it. Noise level or sound level is expressed in decibels, unit symbol dB.

3.2.1.1 A-weighted sound level. Sound pressure level measured with a conventional frequency weighting that roughly approximates how the human ear hears different frequency components of sounds at typical listening levels for speech. The A-weighting (see IEC 61672-1) attenuates the low-frequency (or low-pitch) content of a sound. A-weighted sound level is expressed in decibels, unit symbol dB.

3.2.1.2 C-weighted sound level. Sound pressure level measured with a conventional frequency weighting (see IEC 61672-1) that does not significantly attenuate the low-frequency (or low-pitch) content of a sound. C-weighted sound level is expressed in decibels, unit symbol dB.

3.2.1.3 one-hour average A-weighted or C-weighted sound level. Level of the time-mean-square A-weighted or C-weighted sound pressure averaged over a one-hour period. One-hour average sound level is expressed in decibels, unit symbol dB.

3.2.2 background noise. Sound in a furnished, unoccupied learning space, including sounds from outdoor sources, building services and utilities. For the purposes of this standard, background noise excludes sound generated by people within the building or sound generated by temporary or permanent instructional equipment.

3.2.2.1 interior-source background noise. Noise from building services and utilities.

3.2.2.2 exterior-source background noise. Noise from transportation sources, such as aircraft, vehicle traffic, or from other outdoor noise sources (e.g., lawn maintenance, playground activities, or industrial sources).

3.2.3 reverberation. An acoustical phenomenon that occurs in an enclosed space, such as a classroom, when sound persists in that space as a result of repeated reflection or scattering from surfaces enclosing the space or objects in the space such as chairs, desks, or cabinets.

3.2.3.1 reverberation time. A measure of the degree of reverberation in a space and equal to the time required for the level of a steady sound to decay by 60 dB after it has been turned off. Reverberation time is expressed in seconds, unit symbol s.

3.2.4 sound absorption and reflection. Acoustical phenomena that occur whenever sound strikes a surface. For the calculation or measurement of reverberation time, absorbed sound is the portion of the sound energy striking a surface that is not returned as sound energy. Reflected sound is the remaining portion that bounces off the surface.

3.2.5 attenuation of airborne sound. A measure of the decrease in sound level when sound passes through construction assemblies between spaces within a building, or from outside to inside. Attenuation is expressed in decibels, unit symbol dB.

3.2.5.1 sound transmission class. A one-number rating of the sound-blocking ability of a partition, door, window, etc., calculated in accordance with ASTM E413 from measurements of one-third-octave band sound pressure levels and sound absorption made in a laboratory and in accordance with ASTM E90, abbreviation STC.

3.2.5.2 outdoor-indoor transmission class. A one-number rating of the sound-blocking ability of a partition, door, window, etc., calculated in accordance with ASTM E1332 from measurements of one-third-octave band sound pressure levels and sound absorption made in a laboratory and in accordance with ASTM E90, abbreviation OITC.

3.2.5.3 composite sound transmission class. When a wall or other structure is made from multiple elements (for example concrete block, door, and window), the reduction in sound level is a function of the transmission loss and the area of each of the elements.

3.2.6 structure-borne impact sound. The acoustical phenomenon of sound generation and transmission due to impacts or other interaction of objects with a structure, the most common being footsteps on a floor.

3.2.6.1 impact insulation class. Single-number rating of structure-borne noise radiated below by a floor or floor-ceiling assembly when tested in a laboratory in accordance with ASTM E492 and calculated in accordance with ASTM E989; abbreviation IIC.

NOTE 1 The IIC rating is derived from the sound pressure levels measured in the receiving room when a standard tapping machine is operating on the floor assembly above, adjusted to what they would be for a specific amount of absorption in the receiving space below.

NOTE 2 The higher the IIC rating, the lower the impact sound pressure levels.

3.3 classroom audio distribution system. A system for which the primary design goal is to electro-acoustically distribute the audio portion of curricular content throughout a learning space. This content may include, but is not limited to, live voices from teachers and peers, as well as prerecorded or streaming media content from various sources, or both. The systems are not typically designed for public address purposes (such as building-wide announcements) or for the delivery of alert or warning signals, though they may include these capabilities. Classroom audio distribution systems may also include provisions to assist persons with low-amplitude voice levels or those with certain hearing conditions.

#### **4 Applications**

4.1 The acoustical performance criteria and design requirements of this standard apply to the design and construction of all new classrooms and learning spaces as specified in 1.1.

4.2 The acoustical performance criteria and design requirements of this standard apply to major renovations as defined by the adopting authority (e.g., State or local building authority, school board, or owner).

4.3 Alterations, renovations, repairs, and maintenance that diminish the acoustical performance of existing classrooms shall not be permitted.

#### **5 Acoustical performance criteria and noise isolation design requirements and guidelines**

##### **5.1 Introduction**

Acoustical performance criteria and design requirements are contained in the following sub-clauses and were selected to provide an appropriate acoustical learning environment. The performance criteria shall apply to classrooms and other core learning spaces and to ancillary learning spaces. For purposes of design calculations and field measurements used to determine conformance to the requirements of this standard, it shall be assumed that the learning spaces are furnished consistent with their use and the building is unoccupied with doors and windows closed.

5.2 Performance criteria for background noise levels

5.2.1 Exterior-source background noise levels

5.2.1.1 The one-hour average A- and C-weighted exterior-source background noise level within the enclosed space for the noisiest continuous one-hour period during times when learning activities take place shall not exceed the limits specified in Table 1.

5.2.1.2 When transportation or military sources are the dominant noise source(s), the yearly average, one-hour, or day-night (as available) A-weighted sound level shall, where practical, be predicted using the methods and computer programs developed by the U.S. Department of Transportation or U.S. Department of Defense. These include Integrated Noise Model (INM) and Noisemap for aircraft noise, Traffic Noise Model (TNM) for road noise, and the Federal Railroad Administration procedures for rail noise. These calculated levels shall be used in lieu of measured sound levels to determine the exterior-source background noise level.

5.2.1.3 The one-hour average A- and C-weighted sound level for exterior-source background noise, if measured, shall be measured in accordance with the procedures of Annex A based on guidance in ANSI/ASA S12.9 Part 2 or ANSI/ASA S12.9 Part 3 as applicable.

**Table 1 — Limits on A- and C-weighted sound levels of background noise and reverberation times in unoccupied furnished learning spaces**

| <u>Learning space a)</u>   | <u>Greatest one-hour average A- and C-weighted sound level of exterior-source background noise b), f) (dB)</u> | <u>Greatest one-hour average A- and C-weighted sound level of interior-source background noise c), f) (dB)</u> | <u>Maximum permitted reverberation times for sound pressure levels in octave bands with midband frequencies of 500, 1000, and 2000 Hz (s)</u> |
|--|--|--|---|
| Core learning space with enclosed volume ~ 283 m3 (~ 10 000 ft3)   | 35 / 55  | 35 / 55  | 0.6 s e)  |
| Core learning space with enclosed volume > 283 m3 and ~ 566 m3 (> 10 000 ft3 and ~ 20 000 ft3)   | 35 / 55  | 35 / 55  | 0.7 s   |
| Core learning spaces with enclosed volumes > 566 m3 (> 20 000 ft3) and all ancillary learning spaces   | 40 / 60 d)   | 40 /60 d)  | <u>No requirement</u>   |
| a) See 3.1.1.1 and 3.1.1.2 for definitions of core and ancillary learning spaces.<br>b) The greatest one-hour average A- and C-weighted interior-source and the greatest one-hour average A- and C-weighted exterior-source background noise levels are evaluated independently and will normally occur at different locations in the room and at different times of day.<br>c) See 5.2.2 for other limits on interior-source background noise level.<br>d) See 5.2.3 for limits in corridors adjacent to classrooms.<br>e) See 5.3.2 for requirement that core learning spaces ~ 283 m3 (~ 10 000 ft3) shall be readily adaptable to allow reduction in reverberation time to 0.3 s.<br>f) The design location shall be at a height of 1 m above the floor and no closer than 1 m from a wall, window, or fixed object such as HVAC equipment or supply or return opening. See A.1 .3 for measurement location. |  |  |   |

5.2.2 Interior-source background noise levels

5.2.2.1 Limits on interior-source A- or C-weighted background noise levels from building services and utilities and calculation of HVAC noise levels

The levels of interior-source background noise shall be calculated using, as a minimum, the octave-band sound pressure levels with nominal midband frequencies from 63 Hz through 8 kHz unless the equipment rating standard specifies a different range. The calculation shall include the sound from all relevant HVAC sources and paths.

The one-hour average A- or C-weighted level of interior-source background noise shall not exceed the limits specified in Table 1. Multi-stage types of HVAC equipment may operate at multiple conditions resulting in different sound levels that contribute to the one-hour average A- or C-weighted sound level. The sound levels for the different conditions shall not exceed the limits in Table 2. The noise level of the different operational conditions, if measured, shall be measured in accordance with the procedures of Annex A. The one-hour average A- or C-weighted sound levels of any other building system sounds (e.g., lighting) for which sound power data are available, shall be combined on time-mean-square basis with the calculated one-hour average A- or C-weighted sound level of the HVAC noise before determining conformance. Where sound power data are not available, estimated one-hour average A- or C-weighted sound levels shall be used.

**Table 2 — Limits on one-hour average A- and C-weighted sound levels (designated by X / Y below) from sources associated with building services and utilities**

| <u>Room type</u>    | <u>HVAC operating condition</u>                              | <u>Building services a) sound level limits (dB) c) d)</u> |                                  |
|---------------------|--|---|----------------------------------|
|                     |  | <u>Single mode HVAC Type 1</u>                            | <u>Multiple mode HVAC Type 2</u> |
| Core learning space | Design or maximum capacity heating or cooling                | 35 / 55   | 37 / 57                          |
|                     | Reduced or low capacity heating or cooling or ventilation b) | Not applicable  | 34 / 54                          |
| Ancillary space     | Design or maximum capacity heating or cooling                | 40 / 60   | 42 / 62                          |
|                     | Reduced or low capacity heating or cooling or ventilation b) | Not applicable  | 39 / 59                          |

Type 1 - represents systems that have a single operational mode of performance.

Type 2 - represents systems that have multiple stages of cooling or heating, multiple or variable fan speeds, or ventilation-only modes.

a> The level for HVAC sound shall be combined with the level of the sound from other building systems such as lights, plumbing, etc., if applicable. If present, the contribution of an outdoor condenser or chiller to the classroom sound level shall be combined with the sound from other building services.

b> The operating condition is one that occurs frequently and represents airflow less than design or reduced refrigeration capacity or both.

c> The HVAC design location shall be at the loudest position that is at a height of 1 m above the floor and no closer than 1 m from a wall or fixed object such as HVAC supply or return opening.

d) An HVAC unit designed to provide climate control and ventilation for individual classrooms that conforms to the 35 dB hourly equivalent level requirements of ANSI/ASA S12.60 Part 2 shall be considered to conform to the requirements of ANSI/ASA S12.60 Part 1.

5.2.2.2 Limits on disturbing sounds from building services and utilities

Disturbing tonal sounds, such as hums, buzzes, whines, or whistles generated by HVAC systems and other building services and utilities shall be controlled so as to not interfere with speech communication or be distracting or annoying to the occupants of the learning spaces. Such sounds, if any, that were not able to be controlled during the design process shall be mitigated after construction. The prominence of any tonal sounds shall be quantified using the methods in ANSI/ASA S1.13, and there shall be no "prominent discrete tones" as defined in ANSI/ASA S1.13.

5.2.3 Background noise in corridors

When corridors adjacent to classrooms are used solely for conveyance of occupants within the school building and structured learning activities do not occur there, the one-hour average A-weighted background noise level in such corridors shall not exceed 45 dB.

5.2.4 Equipment, machinery, and components associated with instruction

The limits on background noise level established in 5.2.1 through 5.2.3 do not apply to portable or permanent (built-in) equipment, machinery, and components associated with instruction, such as computers, audiovisual equipment, shop machinery, fume hoods, kitchen exhaust, and similar devices provided such equipment can be turned off from within the learning space. Calculations of background noise level shall not include such equipment and all measurements shall be made with such equipment and emergency equipment turned off. Calculations of background noise level shall include all equipment that cannot be turned off from within the learning space except for emergency equipment.

5.3 Performance criteria for reverberation times

5.3.1 The reverberation times shall conform to the limits specified in Table 1.

5.3.2 Core learning spaces ≤ 283 m3 (≤ 10 000 ft3) shall be readily adaptable to allow reduction in reverberation time to 0.3 s. A classroom is readily adaptable if it can be readily improved through adding the required sound absorption as calculated with the Sabine equation (Equation 1). According to this formula, the minimum total sound absorption A needed to achieve a reverberation time of T60 seconds or less in a room of enclosed volume V is given by:

$$A \geq kV / T60 \quad (1)$$

The constant k = 0.161 s/m when volume V is in cubic meters and the sound absorption A is in square meters. Constant k = 0.049 s/ft when volume V is in cubic feet and sound absorption A is in square feet.

It shall be shown, or be readily apparent, that available surface area to add new sound absorptive materials (carpet, wall panels, etc.) on existing sound reflective finishes and/or additional sound absorption from improving readily upgradable existing acoustical finishes, such as replacing ceiling panels, are together adequate to provide the required sound absorption. For purposes of this standard, no further calculations are required if it can be shown that the area of reflective wall or ceiling area readily available for adding sound absorptive finishes is at least the lesser of 80 m2 or 0.28 V m2 where V is the room volume in m3 (860 ft2 or 0.086 V ft2 where V is the room volume in ft3).

5.4 Noise isolation design requirements

5.4.1 Outdoor-to-indoor attenuation of airborne sound

5.4.1.1 The background noise level inside classrooms from exterior sources is a function of two independent factors: (1) the exterior noise environment, and (2) the reduction of the exterior noise from outdoors to indoors by the building shell. It shall be the responsibility of the user, e.g., the school board, to determine and specify the site exterior noise environment which is the one-hour average A-weighted sound level for the noisiest hour on the average (school) day during school hours. To this end, the user shall conduct a site assessment to determine the greatest outdoor one-hour average A-weighted sound level at the proposed location of the classroom or other core learning space.

5.4.1.2 In addition to the requirement of 5.2.1.1 to reduce the one-hour average interior A-weighted sound levels below 35 dB and the corresponding one-hour average C-weighted sound levels to less than 55 dB, all newly constructed core learning spaces shall be designed to conform to a minimum Outdoor-Indoor Transmission Class (OITC) shown in Table 3. Where a wall contains windows, doors, or penetrations for ventilation, the composite structure, including the window, doors, or penetrations, shall conform to the OITC requirement.

5.4.1.3 When there is an exterior walkway within 3 m (10 ft) or a playground within 9 to 15 m (30 to 50 ft) of the exterior wall of a core learning space, the basic wall shall have an STC rating of at least 45 and exterior doors shall have an STC rating of at least 30. If there are windows in such a wall within 3 m (10 ft) of an exterior walkway or within 9 to 15 m (30 to 50 ft) of a playground, the composite STC rating of the wall including the windows and doors shall be at least STC 40. If a playground is closer than 9 m (30 ft) to the wall of a core learning space, the composite STC rating of the exterior wall shall have a rating of at least STC 50, except that this requirement shall not apply where the playground is dedicated for use only by the adjacent learning space and will therefore not be active while learning activities are occurring in the core learning space.

5.4.1.4 Verification measurements, if required, shall be performed in accordance with the procedures in Annex A.

**Table 3 — Minimum OITC rating for core learning spaces**

| <b>A-weighted outdoor noise level(dB) a, b)</b> | <b>OITC rating walls with windows</b> | <b>OITC rating roofs and walls without</b> |
|---|---------------------------------------|--|
|---|---------------------------------------|--|



|                 |               | <b>windows</b> |
|-----------------|---------------|----------------|
| <55             | 30            | 36             |
| 56              | 31            | 37             |
| 57              | 32            | 38             |
| 58              | 33            | 39             |
| 59              | 34            | 40             |
| 60              | 35            | 41             |
| 61              | 35            | 41             |
| 62              | 36            | 42             |
| 63              | 37            | 43             |
| 64              | 38            | 44             |
| 65              | 39            | 45             |
| 66              | 39            | 45             |
| 67              | 40            | 46             |
| 68              | 41            | 47             |
| 69              | 42            | 48             |
| 70              | 43            | 49             |
| 71              | 43            | 49             |
| 72              | 44            | 50             |
| 73              | 45            | 51             |
| 74              | 46            | 52             |
| 75              | 47            | 53             |
| 76              | 47            | 53             |
| 77              | 48            | 54             |
| 78              | 49            | 55             |
| 79              | 50            | 56             |
| 80              | 50            | 56             |
| >80             | Not permitted | Not permitted  |
| a) See 5.4.1.1. |               |                |
| b) See 5.2.1.   |               |                |

5.4.2 Indoor-to-indoor attenuation of airborne sound

5.4.2.1 Wall and floor-ceiling assemblies that separate enclosed or open-plan core learning spaces from adjacent spaces shall be designed to achieve the minimum STC ratings specified in Table 4. The STC rating requirements of Table 4 also shall apply to the design of temporary partitions that subdivide a learning space.

**Table 4 — Minimum STC ratings required for single or composite wall and floor-ceiling assemblies that separate a core learning space from an adjacent space**

| <b>Adjacent space</b>   |   |  |   |
|---|---|--|---|
| <b><u>Other enclosed or open-plan core learning space, therapy room, health care room and space requiring a high degree of acoustical privacy a), b)</u></b>  | <b><u>Common-use and public-use toilet room and bathing room a)</u></b> | <b><u>Corridor, staircase, office, or conference room c), d)</u></b> | <b><u>Music room, music performance space, auditorium, mechanical equipment room, e) cafeteria, gymnasium, or indoor swimming pool.</u></b> |
| 50  | 53  | 45   | 60  |
| <p>a&gt; These requirements do not apply to toilets opening only into the core learning space and used only by occupants of the core learning space.</p> <p>b&gt; A 20 cm (8") concrete masonry unit wall having a surface weight density of at least 180 kg/m<sup>2</sup> painted and sealed on both sides, acoustically sealed at the entire perimeter and extending from the floor slab to the structural deck above, is an acceptable alternate assembly that conforms to the intent of 5.4.2.1.</p> <p>c&gt; For corridor, office, or conference room walls containing doors, the basic wall, exclusive of the door, shall have an STC rating as shown in the appropriate column in this table. The entrance door shall conform to the requirements of 5.4.2.4.</p> <p>d&gt; When acoustical privacy is required, the minimum composite STC rating, including the effects of doors, of the partitions around an office or conference room, shall be increased to 50.</p> <p>e&gt; The isolation between core learning spaces and mechanical equipment rooms shall have a STC rating of 60 or greater unless it is shown that the sound level in the mechanical equipment room combined with a lower STC rating can achieve the required sound level in the core learning space. In no case shall the design STC between such spaces be less than 45.</p> |   |  |   |

5.4.2.2 All penetrations in sound-rated partitions shall be sealed and treated as necessary to achieve the required STC ratings. Attention shall be given to flanking paths that would reduce the isolation between spaces.

5.4.2.3 For walls containing doors between a core learning space and corridors or stairwells, the minimum STC ratings of Table 4 apply to the wall exclusive of the door. For walls containing doors between a core learning space and offices, conference rooms, or

toilets that open only to the one core learning space, the minimum STC ratings of Table 4 apply to the wall exclusive of the door. In all other cases, the STC rating applies to the composite construction including the effects of doors, windows, penetrations, etc.

5.4.2.4 Interior door assemblies and up to 1 m<sup>2</sup> (10 ft<sup>2</sup>) of window glazing area immediately adjacent to the door opening into core learning spaces from corridors, stairways, offices, or conference rooms shall achieve a STC rating of 30 or greater in their operable condition. The STC rating for interior entry doors into music rooms from corridors or staircase areas shall be at least 40 if such doors are within 9 m (30 ft) of a door to a core learning space. A vestibule entry composed of two sets of doors with STC ratings of 30 or greater shall be considered to conform to the STC 40 requirement.

5.4.2.5 It shall be the responsibility of the user, e.g., the school board, to determine if and when an office or conference room needs to have a high degree of acoustical privacy. If so, then the STC rating between these specifically designated spaces and adjacent spaces shall be at least 50.

5.4.2.6 Verification measurements, if required, shall be made in accordance with the procedures in Annex A.

#### **5.4.3 Structure-borne impact sound isolation**

The floor-ceiling assemblies of normally occupied rooms located above learning spaces shall be designed for a laboratory test rating of at least IIC 45 if they are located above core learning spaces and IIC 40 if they are located above ancillary learning spaces. These IIC ratings shall apply without carpeting on the floor in the room above the learning space. In new construction, gymnasias, dance studios, or other rooms with high floor-impact activity shall not be located above classrooms or other core learning spaces. In renovations, existing gymnasias, dance studios, and similar rooms with high floor-impact activity when it is located above core learning spaces shall either be relocated or the IIC rating of the separating floor-ceiling assembly shall be at least 70 when located above a core learning space with an enclosed volume not greater than 566 m<sup>3</sup> (20 000 ft<sup>3</sup>); at least 65 when located above a core learning space with an enclosed volume greater than 566 m<sup>3</sup> (20 000 ft<sup>3</sup>); and at least 65 when located above an ancillary learning space.

#### **5.5 Classroom audio distribution systems 5.5.1 Uniformity of coverage**

Classroom audio distribution systems, if installed, shall not be used as a substitute for achieving the acoustical design requirements of this standard. Such systems, if installed, shall have uniform coverage within  $\pm 2.5$  dB for octave-band sound pressure levels with midband frequencies of 500 Hz, 1000 Hz, 2000 Hz, and 4000 Hz. Measurements of the coverage uniformity, if performed, shall be conducted in accordance with the measurement procedures contained in ANSI/INFOCOMM 1 M-2009.

#### **5.5.2 Limitations on sound intrusion into adjacent learning spaces**

Classroom audio distribution systems shall be adjustable so that their sound output can be reduced to levels such that the sound from the system does not intrude on adjacent learning spaces.

#### **5.6 Conformance testing**

This standard does not require testing to demonstrate conformance. When optional tests are performed to verify conformance to the requirements of this standard, the procedures in Annex A shall be followed.

NOTE If the school is a prototype design that will be repeated at multiple sites, it is recommended that conformance testing be undertaken on the first structure.

### **Annex A (normative)**

#### **Verification of conformance by measurement**

##### **A.1 Verification of conformance with interior-source background noise requirements**

A.1.1 Interior-source background noise level measurements shall be taken during time periods when the outdoor sound contribution to the indoor sound is minimal. Both background measurements and HVAC measurements shall be taken under nominally the same outdoor environment.

A.1.2 Identify the listening area within the classroom where direct teacher and student speech communication generally takes place. With the HVAC and other noise sources operating in their respective design operational modes, perform an acoustical survey of the classroom within that listening area. This survey shall be done at what are potentially the noisiest locations within the room, including at the HVAC inlet or outlet air ducts, in the vicinity of the HVAC equipment, or at any other location that the observer identifies as a significant source of interior-generated noise. Identify the noisiest location within the listening area using a sound level meter that conforms to the requirements for either Class 1 or Class 2 performance as specified in IEC 61672-1. The meter shall have a minimum frequency range encompassing the octave bands from 63 Hz to 8 kHz. The location with the highest A-weighted sound level shall be termed the "key" location.

A.1.3 Measurements, including the above screening for the "key" location, shall be taken at any time such that outdoor noise levels (except for HVAC equipment such as condensing sections or chillers) are at least 6 dB below the interior-source noise levels; that is, they contribute less than 0.5 dB to the measurement of the interior source background noise. The microphone shall be located at a height of 1.0 to 1.2 m (40 to 48 in.) above the floor and no closer than 1 m (40 in.) from a wall, fixed object such as HVAC plenum, or bookshelves, and no closer than 0.5 m (20 in.) from a readily movable object such as a desk, chair, or table.

A.1.4 At the key location, first measure the sound with the HVAC equipment turned off. Then take five consecutive A- and C-weighted 60-second time-averaged sound level measurements with the HVAC operating. If each of the measured A- and C-weighted levels with HVAC equipment operating is at least 6 dB higher than the background A- and C-weighted levels, respectively, then the HVAC noise shall be considered to be the primary source of interior noise. If the HVAC sound is the primary source of interior-generated noise, then the steadiness of the noise shall be determined following the procedure in A.1.6.

A.1.5 For heat pump systems, the sound testing shall be performed in the cooling mode if the outdoor ambient temperature is 10° C (50° F) or above and in the heating mode if the outdoor ambient temperature is below 10° C (50° F). For fuel furnaces and compressor cooling systems, the sound testing shall be performed in the cooling mode.

A.1.6 The average of five consecutive 60-second measurements in each mode of operation shall be recorded. For each mode, it shall be determined if the background sound levels are steady. The criterion for steady background sound levels shall be that the difference between the highest and lowest data sound levels of the five 60-second samples is not more than 3 dB.

A.1.7 If the background noise level is steady, then measurements shall be repeated in each operational mode of the HVAC equipment and the sound levels shall be compared to the limits in Table 2.

A.1.8 If the background noise level is unsteady, then the source of the unsteadiness shall be determined—exterior or interior.

A.1.8.1 If the source is exterior, then the interior-source background noise measurements shall be repeated at a time when the exterior noise is less. If no such time can be found, then it is likely that the outdoor sound is too great and it shall be measured and conformance verified for exterior-source background noise by the procedure in A.2.

A.1.8.2 If the source is interior, then one-hour average A-weighted sound level measurements including operation at both design conditions and other typical conditions shall be taken and reported. These measurements shall be used in lieu of the five 60-second averages to determine the interior-source background noise level for the room at the key location. The one-hour measurements shall be compared to the limits in Table 2.

A.1.9 Measured sound levels within 2 dB of the background noise criterion shall be reported as conforming to the background noise criterion.

## **A.2 Verification of conformance to the exterior-source background noise requirement**

### **A.2.1 Verification of conformance with the outdoor-to-indoor noise level reduction requirement**

A.2.1.1 The outdoor-indoor noise isolation class (OINIC) shall be measured in accordance with the procedures of ASTM E966.

A.2.1.2 If present with sufficiently high sound level, the actual major outdoor noise source (e.g., aircraft, road or rail traffic, industrial noise) may be used for the OINIC measurements at a specific application site; otherwise, an artificial noise source(s) shall be used.

A.2.1.3 The OINIC shall always be measured for a wall with windows. If the only wall with windows is shielded from direct exposure to the dominant exterior source sound, and a roof or another wall without windows is exposed to the dominant exterior source sound, then the OINIC shall also be measured for the roof or wall without windows.

A.2.1.4 Where a requirement exists for a wall or room to conform to a specified OITC, a measured OINIC for that wall or room within 3 points of the specified OITC shall be considered as verifying the specified performance.

### **A.2.2 Determining or verifying the user-stipulated exterior-source, outdoor, free-field, loudest-hour environmental noise levels**

A.2.2.1 The one-hour average A-weighted sound levels shall be measured in accordance with ANSI/ASA S12.9 Part 2 and ANSI/ASA S12.9 Part 3, as applicable, and in accordance with ANSI/ASA S1.13. Extraordinary sounds such as a vehicle crash, a loud airplane where normally there are none, or siren where normally there are none, shall be excluded from the reported hourly environmental noise level.

A.2.2.2 Sound levels within 2 dB of a previously estimated and stipulated one-hour average A-weighted sound level shall be considered as verifying conformance to the estimated and stipulated result.

### **A.2.3 Overall outdoor-to-indoor tolerance**

The sum of the deviations reported for A.2.1.2 and A.2.2.2 shall be  $\leq 2$  dB.

## **A.3 Verification of conformance to the inside-to-inside sound isolation requirements**

### **A.3.1 Verification of inside-to-inside airborne sound isolation**

A.3.1.1 The noise isolation class (NIC) between rooms shall be measured in accordance with the procedures in ASTM E336.

A.3.1.2 Where a requirement exists for isolation to conform to a specified STC, a measured NIC within 3 points of the specified STC shall be considered as verifying conformance to the specified performance.

A.3.1.3 In some cases walls containing doors and windows, such as corridor walls, are exempt from the overall STC requirement as affected by the doors and windows. For these cases calculate the composite STC based on the expected STC of the various elements such as wall, doors, and windows and their respective areas. To determine conformance, compare the composite STC with a measured NIC.

### **A.3.2 Verification of inside-to-inside impact sound isolation**

A.3.2.1 The apparent impact insulation class (AIIIC) shall be measured in accordance with the procedures in ASTM E1007.

A.3.2.2 A resulting AIIIC within 5 points of the specified IIC shall be considered as verifying conformance to specified performance.

## **A.4 Verification of conformance to reverberation time requirements**

Conformance with the reverberation time requirements of this standard may be verified by either of the two options below.

1) Calculation option: Absorption coefficients shall be provided in octave bands with mid-band frequencies of 500, 1000, and 2000 Hz for surface material and acoustic treatments used within the space. Using these absorption coefficients and the room dimensions, the Sabine equation [Equation (1)], shall be used to calculate conformance to the standard. These calculations are required during the design phase and may be used to demonstrate conformance.

2) Measurement options: If field measurements are made to demonstrate conformance, the methods described in ASTM E2235-04 and ISO 3382-2 can be referred to for general guidance on the test method. In either case, the following requirements shall be met. When using the interrupted noise method to obtain decays, a minimum of five decays shall be measured at each measurement position. These measurements shall be repeated for at least six combinations of three microphone positions and two source positions. If the integrated impulse response method (described in ISO 3382-2) is used to obtain the decays, there is no need for repeated decays at each measurement position. However, measurements shall be made for a minimum of the six combinations of three microphone positions and two source positions.

The use of an approximately omni-directional loudspeaker source is preferred, but other types of loudspeakers may be used including corner loudspeakers and loudspeakers with directionality similar to a human talker. In all cases the source-to-receiver distance shall not be less than 1/3 of the largest dimension of the room.

If omni-directional or human-simulating sound sources are used, they shall be placed at positions that are typical for teachers and/or students when they are speaking to the class. Microphone locations shall be selected from locations where student listeners typically would be located.

Measurements shall be at a minimum for the octave bands including 250 Hz through 4000 Hz.

In determining the decay rate, the calculation shall begin with the first point of the decay that is more than 5 dB below the level when the sound was on.

A measured reverberation time  $\pm 0.1$  s shall be considered to conform to this standard.

## **A.5 Terms and definitions used in Annex A**

A.5.1 apparent impact insulation class (AIIIC). Single-number rating of the structure-borne noise radiated below by a floor or floor-ceiling assembly when tested in the field in accordance with ASTM E1007 and calculated in accordance with ASTM E989.

NOTE 1 The rating is derived from the sound pressure levels measured in the receiving room when a standard tapping machine is operating on the floor assembly above, adjusted to what they would be for a specific amount of absorption in the receiving space below.

NOTE 2 The higher the AIIIC rating, the lower the impact sound pressure levels.

NOTE 3 AIIIC is sometimes also referred to as "field impact insulation class" or FIIC.

A.5.2 noise isolation class (NIC). A one-number rating of the attenuation of airborne sound between enclosed spaces calculated in accordance with ASTM E413 from one-third octave band sound levels measured in accordance with ASTM E336 or from the attenuation of airborne sound calculated between the spaces during design.

A.5.3 outdoor-indoor noise isolation class (OINIC). A one-number rating of the attenuation of airborne sound between the outdoors and inside a building calculated in accordance with the procedures of ASTM E1332 from one-third octave band sound levels measured in accordance with ASTM E966 or from the attenuation of airborne sound from outdoors to indoors calculated during design.

NOTE The measured or calculated attenuation of airborne sound between the outdoors and indoor spaces is substituted for the ASTM E90 data in the calculation method of E1332 to calculate the OINIC.

## **Annex B** **(informative)**

### **Commentary on specific paragraphs of this standard**

Commentary-1.1.1. Special-purpose classrooms such as teleconferencing rooms, special-education rooms such as those for students with hearing and listening impairments, or other spaces such as large auditoria may have unique acoustical requirements that are different than the minimum requirements set forth in this standard. Requiring conformance to the minimum requirements of this standard therefore may not be suitable or appropriate for such rooms. While these spaces are exempt from the minimum requirements of this standard, designers are expected to consider and design for the unique acoustical requirements of these spaces.

Commentary-1.1.2. An objective of these performance criteria is to achieve a level of speech that is sufficiently high relative to the background noise level for listeners throughout the classroom or learning space. However, a requirement for the relative difference between speech levels and levels of background noise, usually referred to as the signal-to-noise ratio, is not within the scope of this standard.

Commentary-1.1.4. The background noise generated by occupants and instructional equipment can seriously degrade communication or speech intelligibility in learning spaces. This evaluation should be made to aid in the application of practical noise control measures for school designers or staff. The measures may take the form of using neoprene chair-leg tips to minimize the sound of scuffling chairs and avoiding locating noisy projectors close to students.

Commentary-3.2.3.1 reverberation time. The decay rate depends on the amount of sound absorption in a room, the room geometry, and the frequency of the sound. In practice, the reverberation time is often measured by measuring the time required for a 20 or 30 dB decay and extrapolating that decay rate to the time required for a 60 dB decay.

Commentary-3.2.4 sound absorption and reflection. The level of a reflected sound in a room is determined by the amount of sound absorption at the surfaces, the room geometry, and the frequency of the sound. As the distance between a sound source and a receiver in a classroom increases, the sound at the position of a receiver is increasingly dominated by reflected sound.

Commentary-3.2.5 attenuation of airborne sound. The attenuation of airborne sound depends on the sound reduction through these elements, on their size, on sound leakage around their periphery, on the sound absorption in the receiving space, and on the frequency of the sound.

Commentary-3.2.5.3 composite sound transmission class. Elements with very little transmission loss, such as openings or holes, reduce the effective transmission loss of the composite wall. The reduced effectiveness can be observed even when the opening is a small percent of the total wall, and may not be significantly increased by the greater sound transmission loss of the remaining elements of the wall.

Commentary-4.1. Conformance to the requirements and guidelines of this standard should be considered to be a minimum goal for the acoustical qualities of such spaces, excluding auditoria. The standard does not provide recommendations for electronic aids for persons with hearing impairment, though conformance to this standard will help ensure effective application of such aids.

Commentary-4.2. During renovation of some facilities, it may not be practical to achieve the targets for sound levels or transmission loss. In those cases, the intent of this standard should be followed to the extent practical.

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## **Acoustical Performance Criteria, Design Requirements, and Guidelines for Schools,** **Part 2: Relocatable Classroom Factors**

### **1 Scope and purpose**

#### **1.1 Scope**

1.1.1 This part of ANSI/ASA S12.60 is applicable to relocatable classrooms and other relocatable modular core learning spaces of small to moderate size. This standard includes siting requirements, acoustical performance criteria, and design requirements for relocatable classrooms. Annex A (informative) provides commentary information on this standard, and Annex B (normative) provides procedures for determining compliance with the background sound requirements. This standard seeks to provide design flexibility without compromising the goal of obtaining adequate speech intelligibility for all students and teachers in classrooms and learning spaces within the scope of this standard.

1.1.2 Acoustical performance criteria are specified in this standard by limits on maximum one-hour A-weighted and C-weighted background noise levels and limits on maximum reverberation times.

1.1.3 The control of background noise levels in this standard is achieved, in part, by specifying the minimum outdoor-to-indoor level reduction for noise that intrudes into the classroom or learning space from sources outside of the school building envelope, and

noise isolation for school building elements for noise that originates within the school building and intrudes into the classroom through classroom walls and partitions, floor-ceiling assemblies, and ventilation systems.

1.1.4 This standard does not apply to noise generated within a classroom by its occupants. Occupant-generated noise sources include voices and the sounds of classroom activities such as the moving of chairs. Furthermore, this standard does not apply to the noise from portable or permanent built-in equipment used during the course of instruction, such as audiovisual equipment and computers.

1.1.5 The following annexes are provided to support this standard.

- Annex A: Commentary: Additional information, discussion, and explanation of various provisions of the standard (informative).

- Annex B: Determining compliance with the background sound requirements (normative).

1.2 Purpose  
This standard, in conjunction with the information provided in the commentary and annexes, is intended to help school planners and designers provide the acoustical qualities necessary for good speech communication between students and teachers in classrooms and other learning spaces without the use of electronic amplification systems. This standard is also intended to provide a minimum set of requirements that can be adopted by reference to this standard and enforced by an authority having jurisdiction.

## **2 Normative references**

The following referenced documents are indispensable for the application of this standard. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ANSI S1.1-1 994 (R2004), American National Standard Acoustical Terminology

ANSI S1.4-1 983 (R2006), American National Standard Specification for Sound Level Meters ANSI S1.13-2005, American National Standard Measurement of Sound Pressure Levels in Air

ANSI/ASA S12.9-1992/Part 2 (R2008), American National Standard Quantities and Procedures for Description and Measurement of Environmental Sound, Part 2: Measurement of Long-term, Wide-area Sound

ANSI/ASA S12.9-1993/Part 3 (R2008), American National Standard Quantities and Procedures for Description and Measurement of Environmental Sound, Part 3: Short-term Measurements with an Observer Present

ASTM E90-09, Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements

ASTM E336-08, Standard Test Method for Measurement of Airborne Sound Attenuation between Rooms in Buildings

ASTM E966-04, Standard Guide for Field Measurements of Airborne Sound Insulation of Building Façades and Façade Elements

ASTM E1 007-04e1, Standard Test Method for Field Measurement of Tapping Machine Impact Sound Transmission Through Floor-Ceiling Assemblies and Associated Support Structures

ASTM E1 332-90(2003), Standard Classification for Determination of Outdoor-Indoor Transmission Class

IEC 61672-1 :2002, Electroacoustics — Sound level meters — Part 1: Specifications

## **3 Definitions**

For the purposes of this standard, the terms and definitions given in ANSI S1.1 and the following apply. The definitions of acoustical terms given here are consistent with those given in ANSI S1.1 but may be simplified for the purposes of this document.

### **3.1 General terms**

3.1.1 Classrooms and other learning spaces. Locations within buildings where students assemble for educational purposes.

3.1.1.1 Core learning spaces. Spaces for educational activities where the primary functions are teaching and learning and where good speech communication is critical to a student's academic achievement. These spaces include, but are not limited to, classrooms (enclosed or open plan), instructional pods or activity areas, group instruction rooms, libraries, and offices used for educational purposes.

3.1.1.2 Ancillary learning spaces. Spaces where good communication is important to a student's educational progress but for which the primary educational functions are informal learning, social interaction, or similar activity other than formal instruction. These areas include, but are not limited to, corridors, cafeterias, gymnasias, and indoor swimming pools.

3.1.1.3 Relocatable classroom. Educational classroom structure that utilizes factory-built modular construction methods that can be efficiently, repeatedly transported over public roads without the removal of the floor, roof, or other significant structural modification, and that typically consists of one or two modules (units, boxes, floors), but can consist of multiple units. Frequently called portable classrooms, temporary classrooms, mobile classrooms, or learning cottages.

3.1.1.4 special-purpose classrooms. Teaching areas designed for specific activities where the finishes and building systems including lighting and HVAC systems are specifically designed to support the unique activities occurring in the spaces they serve. Examples could include art studios, kitchens, chemistry labs, metal shops, wood shops, and classrooms used primarily for instruction of children with special hearing problems or other learning disabilities.

3.1.2 Acoustical privacy. Pertains to the acoustical attenuation between spaces that is needed to prevent conversation in one space from being understood in an adjacent space.

### **3.2 Terms relating to acoustical performance and design**

3.2.1 Noise level or sound level. Generic terms employed interchangeably throughout this standard to represent the frequency-weighted sound pressure level of an airborne sound. This descriptor is used to express the magnitude of a sound in a manner related to how the ear perceives this magnitude. Noise level or sound level is expressed in decibels, unit symbol dB.

3.2.1.1 A-weighted sound level. Sound pressure level measured with a conventional frequency weighting that roughly approximates how the human ear hears different frequency components of sounds at typical listening levels for speech. The A-weighting (see ANSI S1.4 or IEC 61672-1) attenuates the low-frequency (or low-pitch) content of a sound. A-weighted sound level is expressed in decibels, unit symbol dB.

3.2.1.2 C-weighted sound level. Sound pressure level measured with a conventional frequency weighting (see ANSI S1.4 or IEC 61672-1) that does not significantly attenuate the low-frequency (or low-pitch) content of a sound. C-weighted sound level is expressed in decibels, unit symbol dB.

3.2.1.3 one-hour average A-weighted or C-weighted sound level. Level of the time-mean-square A-weighted or C-weighted sound pressure energy averaged over a one-hour period. One-hour average sound level is expressed in decibels, unit symbol dB.

3.2.2 Background noise level. Sound in a furnished, unoccupied learning space, including sounds from outdoors, building services, and utilities. For the purposes of this standard, this excludes sound generated by people within the building or sound generated by temporary or permanent instructional equipment.

3.2.2.1 interior-source background noise. Noise from building services and utilities.

3.2.2.2 exterior-source background noise. Noise from transportation sources, such as aircraft, vehicle traffic, or from other outdoor noise sources (e.g., industrial sources).

3.2.3 Reverberation. An acoustical phenomenon that occurs in an enclosed space, such as a classroom, when sound persists in that space as a result of repeated reflection or scattering from surfaces enclosing the space or objects in the space, such as chairs or cabinets.

3.2.3.1 Reverberation time. A measure of the amount of reverberation in a space and equal to the time required for the level of a steady sound to decay by 60 dB after it has been turned off. Reverberation time is expressed in seconds, unit symbol s.

NOTE For measurement of reverberation time see ASTM E2235.

3.2.4 Sound absorption and reflection. Acoustical phenomena that occur whenever sound strikes a surface. For purposes of the calculation or measurement of reverberation time, absorbed sound is the portion of the sound energy striking the surface that is not returned as sound energy. Reflected sound is the remaining portion that bounces off the surface.

3.2.4.1 Sound absorption coefficient. A measure of the ability of a material to absorb sound and equal to the ratio of the intensity of the absorbed sound to the intensity of the incident sound.

3.2.5 Attenuation of airborne sound. A measure of the decrease in sound level when sound passes through structures between spaces within a building, or from outside to inside.

3.2.5.1 Sound transmission class (STC). A one-number rating of the sound blocking ability of a partition, door, window, etc., calculated in accordance with ASTM E413 from one-third-octave band measurements made in a laboratory in accordance with ASTM E90.

3.2.5.2 Noise isolation class (NIC). A one-number rating of the attenuation of airborne sound between enclosed spaces calculated in accordance with ASTM E413 from one-third octave band measurements made in accordance with ASTM E336.

3.2.5.3 outdoor-indoor level reduction (OILR). A measure of the decrease in sound level (attenuation) in one-third octave bands when airborne sound passes from outdoors to indoors.

3.2.5.4 outdoor-indoor noise isolation class (OINIC). A one-number rating of the decrease in sound level (attenuation) when airborne sound passes from outdoors to indoors calculated in accordance with ASTM E1332 using values of outdoor-indoor level reduction instead of transmission loss.

3.2.6 structure-borne impact sound. The acoustical phenomenon of sound transmission due to impacts or other interaction of objects with a structure, the most common being footsteps on a floor.

3.2.6.1 Impact insulation class (IIC). Single number rating of structureborne noise radiated below by a floor or floor-ceiling assembly when tested in a laboratory in accordance with ASTM E492 and calculated in accordance with ASTM E989; abbreviation IIC.

NOTE 1 the rating is derived from the sound levels measured in the receiving room when a standard tapping machine is operating on the floor assembly above, adjusted to what they would be for a specific amount of absorption in the receiving space below  
NOTE 2 The higher the FIIC rating, the lower the impact sound levels.

3.2.6.2 Field impact insulation class (FIIC). Single number rating of the structureborne noise radiated below by a floor or floor-ceiling assembly when tested in the field in accordance with ASTM E1007 and calculated in accordance with ASTM E989; abbreviation FIIC.

NOTE 1 The rating is derived from the sound levels measured in the receiving room when a standard tapping machine is operating on the floor assembly above, adjusted to what they would be for a specific amount of absorption in the receiving space below.

NOTE 2 The higher the FIIC rating, the lower the impact sound levels.

NOTE 3 FIIC is also known as apparent impact insulation class, AIIC.

3.3 major renovation. Any reconstruction, rehabilitation, addition, or capital improvement of a structure, the cost of which equals or exceeds fifty percent of the market value of the structure itself before the start of construction of the improvement.

#### **4 Applications**

4.1 This standard applies to relocatable classrooms and other relocatable modular core learning spaces of small to moderate size with volumes not exceeding 566 m<sup>3</sup> (20 000 ft<sup>3</sup>) and to relocatable ancillary learning spaces of any volume. Learning spaces larger than the above volume limit shall be considered ancillary spaces for purposes of this standard. The standard does not apply to special-purpose classrooms such as music rooms, teleconferencing rooms, special-education rooms such as those for severely acoustically challenged students, or other spaces such as large auditoria that have unique or more stringent acoustical requirements.

4.2 The acoustical performance criteria and design requirements of this standard apply during the design and construction of all new relocatable classrooms or learning spaces of small to moderate size as specified in 4.1.

4.3 The acoustical performance criteria and design requirements of this standard apply during major renovation as defined in 3.3 of all relocatable classrooms or learning spaces of small to moderate size as specified in 4.1.

4.4 Relocation of a classroom shall not constitute new construction or major renovation. However, a relocated classroom shall continue to meet all the requirements of Clause 5 that were applicable to it before the relocation.

4.5 No renovations shall be allowed that diminish the acoustical performance of existing relocatable classrooms.

4.6 Sound reinforcement systems shall not be used as a substitute for meeting acoustical design requirements.

**5 Acoustical performance criteria and noise isolation design requirements and guidelines**

**5.1 Introduction**

Acoustical performance criteria and design requirements are contained in the following sub-clauses and are designed to ensure an appropriate acoustical learning environment. The performance criteria shall apply to relocatable classrooms and other relocatable modular core learning spaces and to ancillary learning spaces. For purposes of this standard it shall be assumed that the learning spaces are furnished consistent with their use and the building is unoccupied with doors and windows closed.

Acoustical design requirements for minimum noise isolation apply only to fully enclosed classrooms and learning spaces.

**5.2 Performance criteria for background noise**

**5.2.1 Exterior-source background noise**

**5.2.1.1** The one-hour average A-weighted exterior-source background noise level within the enclosed space for the noisiest continuous one-hour period during times when learning activities take place shall not exceed the limits specified in Table 1. The limits for the exterior-source background noise shall apply for the following conditions:

- 1) for the noisiest continuous one-hour period during times when learning activities take place;
- 2) portable and permanent (built-in) instructional equipment, such as computers and audiovisual equipment, are turned off.

**Table 1 — A-weighted sound levels of background noise and reverberation times in unoccupied, furnished learning spaces**

| <u>Learning space a)</u>  | <u>One-hour average A-weighted sound level of interior-source background noise b) (dB)</u> | <u>One-hour average A-weighted sound level of exterior-source background noise (dB)</u> | <u>Maximum reverberation time for sound pressure levels in octave bands with midband frequencies of 500, 1000, and 2000 Hz (s)</u> |
|---|--|---|--|
| Core learning space with enclosed volume ≤ 283 m <sup>3</sup> (≤ 10 000 ft <sup>3</sup> )   | 41 dBA upon adoption;<br>38 dBA in 2013;<br>35 dBA in 2017                                 | 35  | 0.5  |
| Core learning space with enclosed volume > 283 m <sup>3</sup> and ≤ 566 m <sup>3</sup> (> 10 000 ft <sup>3</sup> and ≤ 20 000 ft <sup>3</sup> ) | 41 dBA upon adoption;<br>38 dBA in 2013;<br>35 dBA in 2017                                 | 35  | 0.6  |
| All ancillary learning spaces   | 40 c)  | 40 c)   | No requirement   |

a) See 3.1.1.1 and 3.1.1.2 for definitions of core and ancillary learning spaces.  
 b) See 5.2.2.2 -5.2.2.4 for other limits on interior-source background noise.  
 c) See 5.2.3 for limits in corridors adjacent to classrooms.

5.2.1.2 When transportation or military sources are the dominant noise source(s), the one-hour average A-weighted sound level shall, where practical, be predicted using the methods and computer programs developed by the U.S. Department of Transportation or U.S. Department of Defense. These include Integrated Noise Model (INM) and Noisemap for aircraft noise, Traffic Noise Model (TNM) for road noise, and the Federal Transit Administration procedures for rail noise. These calculated levels shall be used in lieu of measured values to determine the exterior noise level.

5.2.1.3 The one-hour average A-weighted sound level for exterior source background noise, if measured, shall be measured in accordance with the procedures of Annex B based on guidance in ANSI/ASA S12.9 Part 2 or ANSI/ASA S12.9 Part 3 as applicable.

**5.2.2 Interior-source background noise**

**5.2.2.1 Limits on interior-source A-weighted background noise levels from building services and utilities and calculation of HVAC noise**

The one-hour average A-weighted level of interior-source background noise shall not exceed the limits specified in Table 1 when calculated as follows. The one-hour average A-weighted sound level for the HVAC shall be calculated using the duty cycles in Table 2 for 1-, 2-, and 3-stage HVAC systems. The noise level of the different stages, if measured, shall be measured in accordance with the procedures of Annex B. The one-hour average A-weighted sound level of any other building system noises (e.g., lighting) shall be added on an energy basis to the calculated one-hour average A-weighted sound level of the HVAC noise. Specifically, these "Integration Factors" shall be applied as indicated by the following example.

For a Type 3 unit, if the sound levels for the Maximum Capacity Heating, Low Capacity Heating, and Ventilation modes are 40, 35, and 32 dB, respectively, the energy average sound level for one-hour operation at the respective relative times of 17%, 25%, and 58%, will be:

$$10 \times \text{Log}_{10}[0.17 \times 10(40/10) + 0.25 \times 10(35/10) + 0.58 \times 10(32/10)] = 35.3 \text{ dB.}$$

**Table 2 — HVAC system duty cycles**

|   | <u>HVAC system operational modes integration factors a), b)</u> |                         |                           |
|---|---|-------------------------|---------------------------|
|   | <u>Single mode Type 1</u>                                       | <u>Dual mode Type 2</u> | <u>Triple mode Type 3</u> |
| <u>Max. capacity heating or cooling</u>   | 100%  | 34%                     | 17%                       |
| <u>Low capacity c) heating or cooling</u> | Not applicable  | Not applicable          | 25%                       |
| <u>Ventilation d)</u>                     | Not applicable  | 66%                     | 58%                       |

Type 1 - represents systems that have a single stage and operational mode of performance.  
 Type 2 - represents systems that have a single stage of cooling or heating and a ventilation-only mode.  
 Type 3 - represents systems that have two stages of cooling or heating with an additional ventilation-only mode.  
 a) See clause 5.2.2.1 for a worked example.  
 b) These duty cycles are based on testing done over a one-year period with classrooms sited in Modesto and Fontana, California. The buildings sited in Modesto were selected because of their cold winters and hot summers, and the Fontana units were selected because of their high cooling demand and long cooling season. Both of these are inland locations and, thus, they represent a more challenging HVAC environment than do temperate coastal areas. This study was conducted by Lawrence Berkeley National Laboratory with support from the DOE and the California Energy Commission.  
 c) Low capacity shall be no lower than 60% of maximum capacity for the given time weight values to apply. If other values are used for low capacity they shall be accompanied by appropriate time weighting and sufficient information to substantiate the values chosen.  
 d) Ventilation shall be at least at the rate required by applicable code.

**5.2.2.2 Limits on interior-source C-weighted background noise levels from building services and utilities**

The maximum one-hour average C-weighted steady background noise levels from the combination of HVAC systems, lighting, and other building services and utilities operating simultaneously shall not exceed the limits on A-weighted interior-source background noise levels in Table 1 by more than 20 dB.

**5.2.2.3 Limits on disturbing sounds from building services and utilities**

Disturbing sounds, such as rumble, or the tones from hums, buzzes, whines, or whistles generated by HVAC systems and other building services and utilities shall be controlled so as to not interfere with speech communication or be distracting or annoying to the occupants of the learning spaces. Rumble can be quantified using the methods in ANSI/ASA S12.2 and there shall be no "clearly perceptible vibration and rattles" as required in Clause 6 of ANSI/ASA S1 2.2. Also, the prominence of any tones shall be quantified using the methods in ANSI S1.13 and there shall be no "prominent discrete tones" as defined in ANSI S1.13.

**5.2.2.4 Limits on time-varying noise levels from building services and utilities**

The A-frequency-weighted and SLOW time-weighted noise level at any usable location in a room from HVAC systems and other building services shall not vary by more than 3 dB during any 5 s period, except during transition between operating modes of the HVAC system.

**5.2.3 Background noise in corridors**

When corridors adjacent to classrooms are used solely for conveyance of occupants within the school building and structured learning activities do not occur there, the one-hour A-weighted steady background noise level for such corridors shall not exceed 45 dB.

**5.2.4 Computers and audio-visual equipment**

The limits on background noise do not apply to portable or permanent (built-in) instructional equipment such as computers and audiovisual equipment. Calculations of background noise shall not include such equipment and all measurements shall be made with such equipment turned off.

**5.3 Performance criteria for reverberation times**

The reverberation times shall not exceed the limits specified in Table 1.

**5.4 Noise isolation design requirements**

**5.4.1 Outdoor to indoor attenuation of airborne sound**

5.4.1.1 The exterior-source background noise is a function of two independent factors: (1) the exterior noise environment, and (2) the reduction of the exterior noise from outdoors to indoors by the building shell. It shall be the responsibility of the user, e.g., the school board, to determine and specify the site exterior noise environment,  $L_{site}$ , which is the one-hour average A-weighted sound level for the noisiest hour on the average (school) day during school hours. To this end, the user shall conduct a site assessment to determine the maximum outdoor one-hour average A-weighted sound level at the proposed location of the relocatable classroom. It shall be the responsibility of the user to specify, and the supplier to provide, a modular classroom with an Outdoor-Indoor Noise Isolation Class (OINIC) greater than:

$$OINIC_{min} = L_{site} - 35.$$

5.4.1.2 All newly constructed relocatable classrooms shall be designed to meet a minimum OINIC of 20 dB. For an OINIC of 20 dB, selected sites shall not exceed a one-hour average A-weighted sound level of 55 dB for the noisiest hour during the time of day that school is normally in session. For sites with a one-hour average A-weighted sound level exceeding 55 dB, schools shall follow the requirements in Table 3.

**Table 3 — OINIC rating for relocatable classroom**

| <b>A-weighted outdoor noise level</b> | <b>OINIC rating for relocatable classroom</b> |
|---------------------------------------|---|
| ≤ 55                                  | 20 dB   |
| >55 dB and ≤ 60 dB                    | 25 dB   |
| >60 dB and ≤ 65 dB                    | 30 dB   |

5.4.1.3 Sites with an outdoor one-hour average A-weighted sound level that exceeds 65 dB shall be acceptable only if the requisite sound reduction can be achieved.

5.4.1.4 Verification measurements, if required, shall be performed in accordance with Annex B.

**5.4.2 Indoor to indoor attenuation of airborne sound**

5.4.2.1 Wall and floor-ceiling assemblies that separate enclosed or open-plan core learning spaces from adjacent spaces shall be designed to achieve the minimum STC ratings specified in Table 4 when tested in accordance with ASTM E90 in a laboratory. The STC rating requirements of Table 4 also shall apply to the design of temporary partitions that subdivide a learning space.

5.4.2.2 All penetrations in sound-rated partitions shall be sealed and treated to maintain the required ratings. Attention shall be given to flanking paths that would reduce the isolation between spaces so as to achieve an overall isolation between two core learning spaces of at least NIC 45 if tested.



**Table 4 — Minimum STC ratings required for single or composite interior wall and floor-ceiling assemblies that separate an enclosed core learning space from an adjacent space**

| <b>Adjacent space</b>   |   |   |            |
|---|---|---|------------|
| Other core learning space, speech clinic, health care room  | Common use and public use toilet room and bathing room a) | Corridor, staircase, office or conference room b) | Music room |
| 50  | 53  | 45c)  | 60         |
| a) This requirement does not apply to a toilet that opens only to a single core learning space.<br>b) For corridor, staircase, office or conference room walls containing doors, the basic wall exclusive of the door shall meet the STC rating shown. The door shall meet the requirements of 5.4.2.4.<br>c) STC 50 for critical privacy conditions. |   |   |            |

5.4.2.3 Except for walls containing doors between the core learning spaces and corridors, staircases, offices, or conference rooms, when a partition contains a door or window or is not of consistent construction throughout, the required minimum STC ratings in Table 4 apply to the overall composite partition. Basic wall assemblies which contain doors or interior windows with STC ratings less than those given in Table 4 shall have higher STC ratings sufficient to conform to the required minimum STC ratings of the composite construction. For walls containing doors to corridors or staircases, or to offices, conference rooms or toilets that open only to the one core learning space, the minimum STC ratings of Table 4 apply to the wall exclusive of the door. See B.3.1 .3 for the method to calculate the composite STC.

5.4.2.4 Interior doors into core learning spaces from corridors, stairways, offices, or conference rooms shall be capable of achieving STC 30 or higher in their operable condition. The STC rating for interior entry doors into music rooms from corridors or staircase areas shall be 40 or higher.

5.4.2. It shall be the responsibility of the user, e.g., the school board, to determine if and when the need for acoustical privacy around an office or conference room is critical. If so, then the minimum STC rating of the partitions around these specifically designated spaces shall be 50 or higher.

**5.4.3 Structureborne impact sound isolation**

The floor-ceiling assemblies of normally occupied rooms located above learning spaces shall be designed for an expected laboratory test rating of at least IIC 50 if above core learning spaces and IIC 45 if above ancillary learning spaces.

**5.5 Compliance testing**

This standard does not require compliance testing to demonstrate conformance. When optional tests are performed to verify conformance with the requirements of this standard, the procedures in Annex B shall be followed.

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**Annex A  
(Informative)  
Commentary**

Commentary-1.1.2 An objective of these performance criteria is to achieve a level of speech that is sufficiently high relative to the background noise level for listeners throughout the classroom or learning space. However, a requirement for the relative difference between speech levels and levels of background noise, usually referred to as the signal-to-noise ratio, is not within the scope of this standard.

Commentary-1.1.4 The background noise generated by occupants and instructional equipment can seriously degrade communication or speech intelligibility in learning spaces. This background noise should be evaluated in terms of the one-hour average A-weighted sound level.

Commentary-3.2.3.1 reverberation time. The decay rate depends on the amount of sound absorption in a room, the room geometry, and the frequency of the sound. In practice, the reverberation time is often measured by measuring a 20 or 30 dB decay and extrapolating that to the time required for a 60 dB decay.

Commentary-3.2.4 sound absorption and reflection. The magnitude of the reflected sound in a room is determined by the amount of sound absorption at the surfaces, the room geometry, and the frequency of the sound. As distance from a sound source in a classroom increases, the sound is increasingly dominated by reflected sound.

Commentary-3.2.4.1 sound absorption coefficient. The sound absorption coefficient of a material normally varies with frequency. It ranges from about 0.2 to about 1.0 for sound-absorbing materials, to less than 0.05 for a smooth, painted concrete floor. Sound absorption coefficients measured in a laboratory (that is, in a reverberation room) can be larger than 1.0 because of test method and sample size effects.

Commentary-3.2.5 attenuation of airborne sound. The attenuation of airborne sound depends on the sound reduction through these elements, on their size, on sound leakage around their periphery, on the sound absorption in the receiving space, and on the frequency of the sound.

Commentary-4.1 Conformance to the requirements of this standard should be considered to be a minimum goal for the acoustical qualities of such spaces, excluding auditoria. The standard does not provide recommendations for electronic aids for persons with hearing impairment.

Commentary-Table 1 — Maximum A-weighted steady background noise levels and maximum reverberation times in unoccupied, furnished learning spaces. Regarding note c), the use of corridors for formal learning purposes should be avoided. Regarding reverberation in core learning spaces with enclosed volumes >566 m<sup>3</sup> (>20 000 ft<sup>3</sup>) and all ancillary learning spaces, this standard does not specify a mandatory reverberation time for these spaces; however, spaces larger than 566 m<sup>3</sup> are not likely when using relocatable/modular construction.

Commentary-5.2.4 Background noise from instructional equipment. Control of such noise, especially from permanent built-in instructional equipment, should be carefully addressed in the planning stages for new and renovated schools.

Commentary-Table 2 Other situations may be substantially different in terms of percentages, but the decibel change is usually modest if the HVAC is one that was designed for that climate zone. For

example, in the clause 5.2.2.1 example, if the percent time of Max Fan and Low Fan were each to increase by about 50% (with a corresponding decrease in ventilation) to the percentages for Max Fan, Low Fan, and Ventilate of 25%, 40%, 35%, respectively, then the computed level goes up by just over 1 dB.

Commentary-5.4 Noise isolation design requirements. The first and most cost-effective step in achieving good noise isolation between learning spaces and other spaces in a school is accomplished in the facility planning stage. This includes optimizing the location of noisy spaces and activities to protect sensitive learning spaces. Where this is not possible, adequate noise isolation is needed.

Need for noise isolation. The acoustical performance criteria for background noise levels in 5.2 apply to unoccupied facilities. However, in occupied facilities, activity noises generated in one space can be transmitted through walls, floors, ceilings, and doors to adjacent learning spaces, thus contributing to the overall background noise level in those spaces. Adequate sound isolation is required to limit noise transmission between core learning spaces and adjacent spaces in occupied facilities. The minimum STC ratings of Table 4 are intended to provide this noise isolation for normal activities in adjoining spaces. Certain educational styles (such as open plan and group learning) intentionally avoid the use of full enclosures between learning groups. Sometimes, partial height sound barriers or no barriers at all separate adjacent learning groups. Adequate noise isolation between adjacent learning groups cannot be assured unless each learning group is fully enclosed by ceiling-height sound barriers. Because of the inherent low noise isolation, partially enclosed or unenclosed learning spaces are not recommended when good speech communication is desired. In occupied multistory educational facilities, the transmission of impact noise through the floor of the room above to the learning space below also contributes to the overall background noise level. To limit impact noise disturbances in learning spaces, this standard also provides minimum impact insulation class (IIC) design requirements for the floor-ceiling assemblies above learning spaces for multi-story educational facilities.

Caution on variability of sound isolation test results. The same wall or floor-ceiling assembly design when tested in a laboratory can achieve results over a significantly wide range. With enough tests a typical expected result can be established. A single test result can be unrepresentative. Likewise, there is a variation when tests are conducted in the field. The apparent performance of the partition in the field when rated by the apparent STC or FIIIC is virtually always less than the laboratory result due to flanking around the partition and possibly lesser quality construction. Flanking between adjacent classrooms in modular construction can be severe if details are not appropriately controlled. Specifically, the gypsum in side walls should not be continuous from one classroom to another. Floor flanking also can be a problem. On the other hand, the perceived overall isolation for airborne sound can be enhanced by strong absorption in the receiving room in comparison with the size of the partition. While this is factored into the NIC if measurements are done, the required STC values should not be reduced in anticipation of such absorption benefit still achieving the required NIC in a field test. Note that while a similar absorptive benefit can reduce the sound heard from impacts above, no credit for it is given in the required FIIIC result if measurements are made.

Ancillary learning spaces. Recommendations are given in Table A.1 for STC ratings for partitions (that is, walls and floor-ceiling assemblies) that enclose an ancillary learning space or that separate two ancillary spaces. When the partition includes two or more elements, such as doors, windows, or penetrations of the partition for HVAC ducts or other services, the STC of this composite construction also should conform to the recommendations of Table A.1.

Commentary-Table A.1 — Minimum STC ratings recommended for single or composite wall, floor-ceiling and roof-ceiling assemblies separating an ancillary space from an adjacent space.

| <u>Receiving ancillary learning space</u>  | <u>Adjacent space</u>  |                   |                                     |   |
|--|--|-------------------|-------------------------------------|---|
|  | <u>Corridor or staircase a), common use, and public use toilet and bathing room b)</u> | <u>Music room</u> | <u>Office or conference room a)</u> | <u>Mechanical equipment Room f), cafeteria, gymnasium or indoor swimming pool</u> |
| <u>Corridor</u>  | <u>45</u>  | <u>60c)</u>       | <u>45d)</u>                         | <u>55c)</u>   |
| <u>Music Room</u>  | <u>45</u>  | <u>60</u>         | <u>60e)</u>                         | <u>60</u>   |
| <u>Office or conference room</u>   | <u>45</u>  | <u>60</u>         | <u>45d)</u>                         | <u>60</u>   |
| <p>a) <u>For</u><br/>corridor, staircase, office or conference room walls containing entrance doors to the ancillary learning space, the STC rating of the basic wall, exclusive of the door, should be 45. The entrance door should conform to the requirements of 5.4.2.4.</p> <p>b) <u>The</u><br/>STC rating for an ancillary space/toilet partition does not apply when the toilet is private and connected to a private office. An STC rating higher than 45 may be required for separating a quiet office or conference room from a common use or public use toilet or bathing room.</p> <p>c) <u>When</u><br/>the corridor will not be used as an ancillary learning space, the minimum STC rating may be reduced to not less than 45. Use of corridors as ancillary learning spaces should be avoided when they are located next to the noisy spaces indicated in the table by the high STC ratings.</p> <p>d) <u>When</u><br/>the need for acoustical privacy is critical, the STC rating should be increased to 50.</p> <p>e) <u>This</u><br/>is justified to prevent the music space from interfering with the office or conference room.</p> <p>f) <u>When</u><br/>the adjacent space is a mechanical equipment room containing fans circulating 140 m<sup>3</sup>/min (5000 ft<sup>3</sup>/min) or more, the minimum STC rating should be 60. When the fan circulation is less than this rate, the STC rating may be as low as 40 providing the maximum A-weighted steady background noise level in the adjacent ancillary learning space does not exceed 40 dB. The minimum STC rating includes the effect of any entry door(s) into the mechanical equipment room.</p> |  |                   |                                     |   |

Commentary-5.4.2.3 Core learning spaces. Composite assemblies are walls, floor-ceiling and roof-ceiling constructions composed of more than one element (for example, a wall with a door, window, or penetrations by HVAC ducts or other services). This standard requires that walls between core learning spaces meet the composite STC requirement, which means that any door in such a wall will need to be acoustically rated. See 5.4.2.4 for special requirements for doors in corridor, office or conference room walls that are not required to meet the STC requirements for composite walls including the doors. Walls and floor-ceiling assemblies may not maintain their design STC rating if penetrations or openings for piping; electrical devices; recessed cabinets; soffits; or heating, ventilating or exhaust ducts are unsealed.

Commentary-5.4.2.4 Entry doors into classrooms and other core learning spaces. The intent of the STC 30 requirement is to require solid core wood doors or heavy-duty steel doors with good seals. The location of classroom entry doors across a corridor should be staggered to minimize noise transmission between these classrooms. Provisions should be made to ensure that the perimeter seals of sound rated doors are well maintained. Seals for entrance doors should be inspected and adjusted, as necessary, every six months. The gaskets of door seals should never be painted.

Commentary-5.4.3 Structureborne impact sound isolation. There is no way to mathematically predict what an IIC rating will be. Structures have to be tested. Very little if any test data is available for classroom-type structures. Almost all test data is for residential structures with gypsum ceilings. Achieving this rating with frame-type construction usually requires an isolated gypsum ceiling and a cushioning agent under a hard surface floor or the use of carpet. ANSI/ASA S12.60 currently requires the IIC requirements be met without carpet even if carpet is to be used.

## **Annex B (Normative)**

### **Verifying Compliance with the Background Sound Level Requirements by Measurement**

#### **B.1 Verifying compliance with the interior source background noise requirement**

**B.1 .1 Interior source background noise measurements shall be taken during time periods when the outdoor sound contribution to the indoor sound is minimal. Both background measurements and HVAC measurements shall be taken under nominally the same outdoor environment.**

**B.1 .2 Identify the listening area within the classroom where direct teacher and student speech communication generally takes place. With the HVAC and other noise sources operating in their respective noisiest operational mode, perform a quick acoustical survey of the classroom within that listening area. This shall be done at the potentially noisiest locations within the room, including at the HVAC inlet or outlet air ducts, in the vicinity of the HVAC equipment, or at any other location that the observer feels could be a significant source of interior-generated noise. Identify the noisiest location within the listening area using a sound level meter that conforms to the requirements for Type 1 in ANSI S1.4 or Class 1 in IEC 61672. The location with the highest A-weighted sound level shall be termed the "key" location.**

**B.1 .3 Measurements, including the above screening for the "key" location, shall be taken at any time such that outdoor noise contributes less than 0.5 dB to the measurement of the interior source background noise. The microphone shall be located at a height of 1.0 to 1.2 m (40 to 48 in.) above the floor; no closer than 1 m (40 in.) from a wall or fixed object such as HVAC plenum or bookshelves; and no closer than 0.5 m (20 in.) from a readily movable object such as a desk, chair, or table.**

**B.1 .4 At the key location, first measure the sound with the HVAC equipment turned off. Then take five consecutive A- and C-weighted 60-second time-average sound level measurements with the HVAC operating. If the measured A- and C-weighted levels with HVAC equipment operating are at least 6 dB higher than the background A- and C-weighted levels, respectively, then the HVAC noise shall be considered to be the primary source of interior noise. If the HVAC sound is the primary source of interior generated noise, then measurements shall be repeated in each operational mode of the HVAC equipment as described in Table 2; otherwise, the method of clause B.1 .8.2 shall be used.**

**B.1 .5 For heat pump systems, the sound testing shall be performed in the cooling mode if the outdoor ambient temperature is 10 °C (50 °F) or above and in the heating mode if the outdoor ambient temperature is below 10 °C (50 °F). For fuel furnaces and compressor cooling systems, the sound testing shall be performed in the cooling mode.**

**B.1 .6 The average of five consecutive 60-second measurements in each mode of operation shall be recorded. For each mode, it shall be determined if the background sound data are steady. The criterion for steady background sound data shall be that the difference between the highest and lowest data points of the five 60-second samples is not more than 3 dB.**

**B.1 .7 These data, if steady, then shall be used to calculate an integrated single value sound level using the percent factors from Table 2.**

**B.1 .8 If the background noise level is unsteady, then the source of the unsteadiness shall be determined—exterior or interior.**

**B.1 .8.1 If the source is exterior, then the interior-source background noise measurements shall be repeated at a time when the exterior noise is less. If no such time can be found, then it is likely that the outdoor sound is too great and it shall be measured.**

**B.1 .8.2 If the source is interior, then one-hour average A-weighted sound level measurements shall be taken and reported. These measurements shall be used in lieu of the five 60-second averages to determine the interior-source background noise level for the room at the key location.**

**B.1 .9 Measured results within 2 dB of the background noise criterion shall be reported as passing the test for meeting the background noise criterion.**

#### **B.2 Verifying compliance with the exterior source background noise requirement**

##### **B.2.1 Verifying compliance with the outdoor-to-indoor noise level reduction requirement**

**B.2.1.1 The OINIC shall be computed using the following 2-step process.**

**B.2.1.1.1 The OILR shall be measured in one-third octave bands from 80 to 4000 Hz following the guidance in ASTM E966.**

**B.2.1.1.2 The OINIC shall be calculated using the OILR data in accordance with the procedure described in ASTM E1332 using the values of OILR instead of transmission loss.**

**B.2.1 .2 In situ, the source and geometry are defined. In this case, if present with sufficient intensity, the actual major outdoor noise source (e.g., aircraft, road or rail traffic, industrial noise) shall be used for the OILR measurements at a specific application site; otherwise, an artificial noise source(s) shall be used. The space shall be evaluated with the surfaces exposed that would be exposed to the exterior sound in the application. Results within 2 dB of the stipulated OINIC rating shall be reported as verifying the stipulated OINIC rating.**

B.2.1 .3 At a factory when a classroom is being rated for general use, the source and exposure situation are not well defined. The classroom shall be rated based on the greatest exposure likely to occur. A modular classroom shall be assumed to have one, two, or three exposed surfaces (wall or roof section that can be the whole roof) as given in the following three cases:

B.2.1 .3.1 Case 1 – Three exposed surfaces. This case shall include two adjacent, (normally) perpendicular walls and the roof section adjacent to the two walls. This case occurs any time two or more adjacent walls of a classroom face the outdoors and the classroom is part of a single-story unit or on the top floor of a multi-story unit. Examples include a single, stand-alone classroom, a 2- classroom unit, or any corner unit that is either single story or occupies the top story.

B.2.1 .3.2 Case 2 – Two exposed surfaces. This case shall include either two adjacent walls or one wall with its adjacent roof section. The one wall with its adjacent roof section situation occurs for classrooms that adjoin three other interior spaces and that are part of a single-story facility or occupy part of the top floor of a multi-story facility. The two-wall situation occurs for any corner unit in a multistory facility that occupies any floor other than the top floor.

B.2.1 .3.3 Case 3 – One exposed surface. This case shall include one wall. It occurs for classrooms in a multi-story unit that horizontally adjoin three other interior spaces and that occupy any floor other than the top floor.

B.2.1.4 ASTM E966 describes methods to measure the OILR for single, individual partitions such as a wall alone or roof alone rather than a complete room with multiple surfaces exposed to the sound. When sound can enter the enclosed space through multiple surfaces, the sound through the various surfaces combines, and as a result the overall OILR and OINIC for the space will be less than (poorer than) that of the exposed surface that produces the lowest (poorest) OINIC.

B.2.1.4.1 If N multiple surfaces are sequentially exposed to sound and the OINIC determined for each without significant exposure of other surfaces, the overall OINIC for the room with all such surfaces exposed shall be computed from:

$$\text{OINIC}_{\text{Room}} = -10 \log (10 - (\text{OINIC}_1/10) \sim 10 - (\text{OINIC}_2/10) \sim \dots \sim 10 - (\text{OINIC}_N/10) ) \quad (\text{B.1})$$

where N is the number of surfaces exposed.

B.2.1.4.2 If the OINIC is evaluated for one surface of a space exposed and it is assumed that additional surfaces that would be exposed have the same ability to block sound, then the OINIC shall be estimated by:

$$\text{OINIC} = \text{OINIC}_{\text{meas}} - 10 \log (A / A_{\text{meas}}) \quad (\text{B.2})$$

where OINIC<sub>meas</sub> is the OINIC for the surface that is evaluated, A<sub>meas</sub> is the area of that surface, and A is the full area that would be exposed in the typical situation.

## **B.2.2 Determining or verifying the user-stipulated exterior-source, outdoor, free-field, loudest-hour environmental noise levels**

B.2.2.1 The one-hour average A-weighted sound levels shall be measured in accordance with ANSI/ASA S12.9 Part 2 and ANSI/ASA S12.9 Part 3, as applicable, and in accordance with ANSI S1 .13. Extraordinary sounds such as a vehicle crash, a loud plane where normally there are none, or siren where normally there are none, shall be excluded from the reported hourly environmental noise level.

B.2.2.2 Results within 2 dB of a previously estimated and stipulated one-hour average A-weighted sound level shall be considered as verifying the estimated and stipulated result.

## **B.3 Verifying inside-to-inside sound isolation**

### **B.3.1 Verifying inside-to-inside airborne sound isolation**

B.3.1 .1 The noise isolation class (NIC) between rooms shall be measured in accordance with ASTM E336.

B.3.1.2 Where a requirement exists for a composite partition including floor-ceilings to meet a specified STC, an NIC within 5 points of the specified STC shall be considered as verifying the specified performance.

B.3.1 .3 In some cases walls containing doors, such as corridor walls, are exempt from the composite STC requirement. However, a minimum expected STC of the composite wall can be calculated based on the areas of the door and wall and the minimum required STC of each. The approximate expected composite STC of the wall with the door can be estimated from:

$$\text{Composite STC} = 10 \log (A_w \sim A_d) - 10 \log \{ A_w \times 10^{(-\text{STC}_w/10)} \sim A_d \times 10^{(-\text{STC}_d/10)} \} \quad (\text{B.3})$$

where

A<sub>w</sub> is the area of the wall exclusive of the door;

A<sub>d</sub> is the area of the door;

STC<sub>w</sub> is the STC of the wall exclusive of the door;

STC<sub>d</sub> is the STC of the door and its seals.

This result can then be compared to a measured NIC for evaluation. For a more accurate result, the above equation should be applied to the result at each of the one-third-octave bands included in the STC to get a composite result in each band, and the composite STC determined from those results in accordance with ASTM E413.

### **B.3.2 Verifying inside-to-inside impact sound isolation**

B.3.2.1 The field impact insulation class (FIIC) shall be measured in accordance with ASTM E1007.

B.3.2.2 A resulting FIIC within 5 points of the specified IIC shall be considered as verifying specified performance.

## **Bibliography**

ANSI/ASA S1 2.2-2008, American National Standard Criteria for Evaluating Room Noise

ANSI/ASA S1 2.60-2002 (R 2009), American National Standard Acoustical Performance Criteria, Design Requirements, and Guidelines for Schools

ASTM E41 3-04 (2009), Standard Classification for Rating Sound Insulation

ASTM E492-09, Standard Test Method for Laboratory Measurement of Impact Sound Transmission through Floor-Ceiling Assemblies Using the Tapping Machine

ASTM E989-06, Standard Classification for Determination of Impact Insulation Class (IIC)

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