



Design Standard Acoustical Performance

Purpose:

Acoustic quality is often cited as a major factor influencing productivity and level of satisfaction in institutional and commercial facilities, and is central to the effectiveness of educational facilities. Appropriate acoustical characteristics enhance the utility of audio/visual systems, and are central to the proper functioning of certain kinds of spaces, such as classrooms, recording studios and post-production spaces, and music facilities. The performance standards cited herein are intended to establish and maintain a minimum level of acoustical quality in the educational and work facilities of South San Francisco Unified School District buildings.

Design Standard:

A. Related Acoustical Standards

1. ANSI S12.60-2010 - American National Standard Acoustical Performance Criteria, Design Requirements, and Guidelines for Schools
2. ASTM E90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements
3. ASTM E336 - Standard Test Method for Measurement of Airborne Sound Insulation in Buildings
4. ASTM E413 - Classification for Rating Sound Insulation
5. ASTM E 477 - American Society for Testing & Materials: Test for Duct Lining & Silencer Performance
6. ASTM E492 - Standard Test Method for Laboratory Measurement of Impact Sound Transmission Through Floor-Ceiling Assemblies Using the Tapping Machine
7. ASTM E557 - Standard Guide for The Installation of Operable Partitions
8. ASTM E989 - Standard Classification for Determination of Impact Insulation Class (IIC)
9. ASTM E1007 - Standard Test Method for Field Measurement of Tapping Machine Impact Sound Transmission through Floor-Ceiling Assemblies and Associated Support Structures.
10. ASTM E1130 – Standard Test Method for Objective Measurement of Speech Privacy in Open Offices Using Articulation Index.
11. ANSI S1.13 - American National Standards Institute: Measurement of Sound Pressure Levels



12. ISO 3382, Acoustics - Measurement of the reverberation time of rooms with reference to other acoustical parameters

B. Quality Assurance

Acoustical requirements and testing criteria to be as stated below:

Renovations: Where required by program, measurements are to be taken in spaces to be renovated to establish baseline data and to establish project goals. Review with SSFUSD the costs/benefits for achieving the criteria published herein. Where appropriate, review the acoustical program in conjunction with the classroom instructional technology program so that all acoustic criteria are considered. Since renovation projects are generally limited in scope, provide alternate recommendations for acoustical treatment to achieve best cost/benefit performance using surface applied materials.

New Programs/Spaces: Where required by program, measurements are to be taken to verify that the project meets the acoustical requirements and criteria at substantial completion.

Measurements are to include the following:

- Noise criteria (NC) in all instructional, office, and meeting spaces with the HVAC system operating at full load (ANSI S1.13)
- Ten-minute L_{eq}^1 in all instructional, office, and meeting spaces (ANSI S1.13). These measurements may be conducted with the HVAC system off, if desired, since they are intended to measure intrusion of noise from outdoor sources.
- Noise Isolation Class (NIC) for a random sample of typical wall conditions (ASTM E336)
- Noise Isolation Class and Field Impact Insulation Class (FIIC) for a random sample of floor/ceilings (ASTM E336 and E1007)
- NIC of all operable walls (ASTM E336)
- Reverberation Time in a random sample of classrooms and other instructional spaces (ISO 3382)
- Articulation Index (AI) in open office areas, at the discretion of the owner (ASTM E1130)

C. Environmental Noise

Interior noise levels due to outdoor noise sources shall comply with the following limits:

Space Type	Average "A"-weighted Sound Level (measured in any 10-minute period)
Classrooms, Labs, Conference Rooms, Presentation or Multi-purpose Spaces	35 dBA

¹ L_{eq} — The equivalent steady-state A-weighted sound level that, in a stated period of time, would contain the same acoustic energy as the time-varying sound level during the same time period.



South San Francisco Unified School District



Section 01 00 02

Version 1, 2011.9.30

Offices, Staff Lounges	40 dBA
Indoor Pool, Non-Noise Sensitive Athletic Facilities	45 dBA

Interior noise transmission at room adjacencies:

Spaces	Sound Transmission Class
Between Classroom and Corridors, stairs, office or conference Room	STC 45
Between Classroom and Classroom	STC 50
Between Classroom and Toilet Room	STC 53
Between Classroom and Music Room, Mechanical Room, Cafeteria, Gymnasium, Indoor pool	STC 60

D. Sound Insulation

1. Airborne Sound Insulation Ratings for Walls
 - a. Sound rated walls should have the following characteristics.
 - i. Where double layers of gypsum board are used on sound rated walls, offset the long edge joints by 24 inches and the short edge joints by 48 inches.
 - ii. Insulation should be the depth of stud cavities, but should not be compressed.
 - iii. Hold back the face layer of gypsum board ¼" from intersecting surfaces and caulk with acoustical sealant.
 - iv. Seal all penetrations, including pipes, ducts, electrical conduit, and outlet boxes with acoustical sealant. Oversize penetrations to avoid direct contact between the penetrating element and gypsum board, framing, etc.
 - v. Where fire ratings are also required select sealants that have both fire resistive and acoustical characteristics.
 - vi. Seal gaps where full height walls meet structural decks above. Details should be developed to address specific conditions.
 - b. Certain acoustically critical spaces require consideration beyond adherence to this standard. Examples include Recording Studios. Although the standard may prove adequate in addressing these spaces, an acoustical



South San Francisco Unified School District



Section 01 00 02

Version 1, 2011.9.30

consultant should review the specific conditions in which they occur and provide additional recommendations, as needed.

2. Floor/Ceiling Airborne and Impact Sound Insulation Ratings:
 - a. Airborne sound insulation ratings (STC) for floor/ceilings shall be equal to or greater than those for walls at similar adjacencies.
 - b. Impact insulation ratings for floor/ceiling assemblies separating occupied spaces shall be as follows:
 - i. IIC 45 – Any space located over classrooms, offices, labs, event spaces, or other instructional spaces of normal sensitivity
 - ii. IIC 70 or greater – Recording Studios, Meeting Rooms, or other spaces of “high acoustical sensitivity,” as identified in room data sheets for each project.
 - c. The following vertical adjacencies present significant difficulties in obtaining adequate impact sound insulation and should be avoided:
 - i. Fitness/Weight over classrooms, offices, meeting rooms, or other noise sensitive spaces
3. Acceptable Sources for determining laboratory airborne and impact sound insulation ratings include the following:
 - a. *Catalog of STC and IIC Ratings for Wall and Floor/Ceiling Assemblies*; California Office of Noise Control, Department of Health Services
 - b. *Architectural Acoustics Design Data for Acousticians*, United States Gypsum
4. Operable partitions shall be used where specifically approved by SSFUSD. This is because operable partitions, while acceptable for certain uses, generally do not provide the same degree of sound insulation as fixed partitions, and should not be relied upon to provide sound insulation on a daily basis. Operable partitions shall have a minimum field measured sound insulation performance rating of NIC 44. The installing contractor shall have the completed installation tested and report the acoustical performance (ASTM E 336).
5. Speech Privacy at Open Office Areas – The acoustical treatment of open office spaces shall be designed with the intent of achieving a maximum articulation index (AI) of 0.40. This may be verified by means of pre-occupancy testing at the discretion of the owner. Acoustical design strategies may include some combination of high NRC ceiling tiles (NRC 0.80 or greater), cubicle partitions that are a minimum of 60 inches tall with sound absorbing surfaces (NRC 0.80 minimum) and internal septa (minimum STC 25), and electronic sound masking systems.



South San Francisco Unified School District



Section 01 00 02

Version 1, 2011.9.30

E. Room Acoustics

1. Teaching and Presentation Spaces shall have reverberation times in the 500 Hz octave band that are no longer than the following limits:

Space Type	Reverberation Time (RT60 ²)
Classrooms, labs and other learning spaces with volumes less than 10,000 cubic feet	0.60 seconds
Classrooms, labs and other learning spaces with volumes greater than 10,000 cubic feet but less than 20,000 cubic feet	0.70 seconds
Classrooms, labs and other learning spaces with volumes greater 20,000 cubic feet (does not include performance, rehearsal, or music instruction spaces)	1.0 second
Gymnasias and Indoor Swimming Pools	1.5 seconds
Performance, Rehearsal, Music instruction spaces	Determined by Architect's acoustical consultant

F. HVAC Noise and Vibration

1. Indoor Background Noise Levels
Noise criteria in general are discussed in the ASHRAE Applications Handbook chapter titled, "Sound and Vibration Control." The air velocity should decrease at each duct branch from the fan discharge until the air velocity is reduced to that defined at the neck of supply and return air terminal devices. Final duct branch air velocities should not exceed the diffuser neck velocity criteria by more than 100 fpm. All ducts must be sized accounting for the internal lining to meet these criteria.
2. Vibration Isolation
Mechanical equipment should be isolated from the building structure per the guidelines in the ASHRAE Applications Handbook chapter titled, "Sound and Vibration Control."

² Reverberation Time (RT60) - The time it takes for sound to decay 60 dB in a room. Large rooms with hard surfaces, such as concert halls, have reverberation times around 2 seconds. Smaller rooms with sound absorbing surfaces have shorter reverberation times. Music sounds richer in rooms with long reverberation times, but speech may be difficult to understand. Speech is more intelligible in rooms with shorter reverberation times, but music may sound dry.



South San Francisco Unified School District



Section 01 00 02

Version 1, 2011.9.30

3. Outdoor Noise Levels

Building systems shall not exceed an A-weighted sound level of 50 decibels when measured at a distance of 30 feet from the building. Where equipment producing tones, or narrow band tonal noise is utilized, this requirement shall be reduced to 45 dBA.

4. Plumbing noise shall not exceed the following maximum "A" -weighted sound levels:

Space Type – Room(s)	L _{MAX} (slow response)
Classrooms, Offices	40
Teaching Labs, Computer Center, Resource Center	45
Open Offices, Lobby, Corridor, Labs with fume hoods	50

5. Elevator

Limit overall elevator noise emissions to the following maximum A-weighted sound pressure levels in any mode of operation:

- 80 decibels measured 3 feet from any piece of equipment in the machine room.
- 50 decibels measured 5 feet above the cab floor near the center during all sequences of operation, including door operation, and exhaust air blower.
- 45 decibels measured in the elevator lobby 10 feet from the elevator doors.

G. Preferred Product Criteria

1. Maintainable Surfaces

SSFUSD prefers acoustic treatments that are cleanable and replaceable over the duration of time the products will be in place – thirty or more years. If the design professional wishes to propose a product other than those listed in the approved products list below, submit product literature to the District for approval prior to designing the product into the project.

2. Approved Surface-Applied Acoustic Treatments

SSFUSD Approved Surface-Applied Acoustic Treatments	
Item #	Surface condition/material type
SLOPED AND FLAT CEILING ACOUSTIC TREATMENT	
1	Armstrong Cirrus 12”X12” mineral fiber tile, glued-on using an approved adhesive.



South San Francisco Unified School District



Section 01 00 02

Version 1, 2011.9.30

2	Armstrong Optima 4'X8' glass fiberboard. The one-inch thick glass fiber panels shall be applied to ceiling using molding and stick clips.
3	Armstrong Painted Nubby 4'X8' glass fiberboard. The one-inch thick glass fiber panels shall be applied to ceiling using molding and stick clips.
	WALL ACOUSTIC TREATMENT
4	Armstrong Optima 4'X8' glass fiberboard. The one-inch thick panels shall be furred out on 1' by 3' furring strips to create a one-inch airspace behind the panel.
5	Armstrong Optima 4'X8' glass fiberboard. The one-inch thick panels shall be furred out on 1' by 3' furring strips to create a one-inch airspace behind the panel.
6	Armstrong Painted Nubby 4'X8' glass fiberboard. The one-inch thick panels shall be furred out on 1' by 3' furring strips to create a one-inch airspace behind the panel.
7	Armstrong Painted Nubby 4'X8' glass fiberboard. The one-inch thick panels shall be furred out on 1' by 3' furring strips to create a one-inch airspace behind the panel.

- a. Sprayed-on acoustic treatments are prohibited for SSFUSD applications. Sprayed-on acoustic treatments have resulted in ceilings and walls that are dirty in appearance, un-cleanable, and not locally repairable.
- b. Approved Acoustic Surface-Mounted Products
 - i. Acoustical Foam Panels: Pinta Contour or equal.
 1. Density: 0.5 to 0.7 lbs per cubic foot (ASTM D2574-77)
 2. Long-Term Service Temperature: 302 degrees F
 3. Color: White
 4. Size: 24 inches x 24 inches x 1.75 inch
 5. Microbial Growth: passes UL 181, Section 11
 6. Noise Reduction Coefficient (NRC): 0.65 (Type A mounting)
 7. Finish: Hypalon Coated Color Arctic White
 8. Composite Flame Spread: 25
 9. Smoke Density: 65
 10. Accessories:
 - i. Adhesive: Non-toxic, water-based adhesive.
 - ii. Unfaced Fiberglass Panels (used with smooth-faced panel): Owens Corning 703 or equal.
 1. Density: 3 per cubic foot
 2. Thickness: 2 inches
 3. Accessories:
 - ii. Stick-clips with white protective caps and using 3-M 77N contact adhesive.
 - iii. Acoustical Wall Panels: Armstrong Optima Acoustical Wall Panel, Item #3154 or equal.
 1. Surface Texture: Smooth
 2. Composition: Fiberglass
 3. Color: White
 4. Size: 48 inches x 96 inches x 1 inch



South San Francisco Unified School District



5. Edge Profile: Square cut edge
 6. Noise Reduction Coefficient (NRC): D mounting (On Furring Strips) – Optima (0.90)
 7. Composite Flame Spread: Class A
 8. Trim Accessories:
 - iii. "H" Channel, 1-5/8 inches x 8 feet x 1", Item #3108
 - iv. "C" Channel, 1 inch x 8 feet x 1 inch, Item #3107
- iv. Acoustical Ceiling Tiles (glue on): Armstrong Cirrus Square Tile or equal.
1. Surface Finish: Factory applied latex paint
 2. Composition: Wet-formed mineral fiber
 3. Color: White
 4. Size: 12 inches x 12 inches x 3/4-inch
 5. Edge Profile: Square cut edge
 6. Nominal Noise Reduction Coefficient (NRC): 0.60
 7. Composite Flame Spread: Class A
 8. Accessories:
 - i. Adhesive: Provide adhesive that is formulated to maintain a tensile adhesion (bond strength of not less than 1/2 lb./inch for a long period of time under temperature and moisture conditions likely to be encountered and to maintain sufficient plasticity to allow for movement of parts of the building as it ages.
 - ii. Acceptable Material: Henry Acoustical Tile Adhesive
- c. Approved Acoustic Surface-Mounted Products Application Preparation
- i. Wall Panels: Any relatively smooth interior surface such as drywall or plaster is suitable. For block, brick or concrete, first apply a polyethylene film to the wall as an airflow and vapor barrier, and then apply horizontal furring strips.
 - ii. Glue-on Tiles: Direct the installer to measure each ceiling area and establish layout of acoustical units to balance border widths at opposite edges of each ceiling. Avoid use of less than half width units at borders, and comply with reflected ceiling plans. Coordinate panel layout with mechanical and electrical fixtures
 1. Adhesive: direct Contractor to install ceiling tile by glue-up method to drywall using acoustical tile cement.
 2. Wall Moldings shall be slip-on molding with 15/16" flange as follows: 3/4" thick, Item #7843.
 3. Accessories: to assist in leveling tiles use 1/16" thick fiber spline approximately 3" long at each corner.
 - iii. Trim and Furring Strips
 1. Specify the attachment of the "C" Channels that will carry the weight of the panels using mechanical fasteners appropriate for the wall structure or furring strips. Adhesive may be used in conjunction with the mechanical

**South San Francisco Unified School District**

fasteners, but should not be used as the sole means of support at the base of the installation.

2. Furring strips, if used, should be horizontally spaced 12 inches on center when panels are installed below 5 feet from the finished floor; and 24 inches on center when installed above 5 feet from finished floor.
3. Exposed edges of furring strips may be field painted.
4. Fasteners used to attach "C" and "H" channels should be installed no more than 2 feet on center.
5. "H" Channels are used at locations where two panels butt against one another.
6. "C" Channels are used at the perimeters of the installation and to frame any openings that may have to be cut through a panel.

3. Approved Lay-in Acoustic Ceiling Tile Treatments

	SSFUSD Approved Lay-In Acoustic Ceiling Treatments
Item #	
8	Armstrong, white 2'x4' "Fine Fissured" Mineral Fiber.
9	Armstrong, white 2'x4' "Optima" Fiberglass.
10	Armstrong vinyl, white 2'x4' "Optima Health Zone" Fiberglass.
11	USG, white, 2'x4' "Radar 2310" Mineral Fiber.

Approved Manufacturers:

- o Armstrong
- o USG
- o Pinta/ Illbruck

Substitutes Allowed:

Yes, if performance and quality equivalency can be evidenced.

Associated Design Standards:

- o Section 09 51 23 Design Standard Acoustical Panel Ceilings
- o Section 14 20 00 Design Standard Elevators
- o Division 22 Mechanical Design Standards

End of Document