

Session E64

Noise and Acoustics: What's New in the 2018 FGI Guidelines

Ed Logsdon, PE Acoustics

Elizabeth Valmont, PhD

Continuing Education Information

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- Complete the AIA verification form (be sure to check off the sessions you attend) and retain it for your records. CE credits will be uploaded to the AIA transcript system within 6-8 weeks of the close of the conference.

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- Have your IDCEC verification form STAMPED by the room monitor at the start of each session you attend. This is the ONLY proof of attendance that will be accepted.
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Ed Logsdon, P.E.

FGI Acoustic Working Group (since 2010) & APRC

- Electrical Engineer, PE – Acoustics (Oregon)
- Member of CAHED, ASHE, ASA and IEEE
- President, National Council of Acoustical Consultants (NCAC) 2004 – 2006
- ***Hospital Acoustics LinkedIn*** – Group Manager
- 30 years of experience
 - ***Executone***, Nurse call installer
 - ***St. Joseph Hospital, Sisters of Mercy***, Ann Arbor, MI, Biomed
 - ***Aspen Labs*** – R&D Engineer electrosurgical generators, arthroscopic camera, fiber optic light source and automatic cuff/tourniquet
 - ***D. L. Adams Associates***, VP / Acoustical Consultant



D. L. ADAMS
ASSOCIATES

acoustics | performing arts | technology

Acoustic Working Group (AWG) Activities

Recognized by Acoustical Society of America (ASA) as [S12 WG44 – “Speech Privacy in Healthcare”](#) with joint [Noise and Speech Privacy Technical Sub-Committee](#). Engaged in five activities.

1 Research - 12 proposals, 2 funded to date

- Harvard Sleep Study, 2007 – 2011
- Mayer Rothschild Task Force – residential healthcare

2 Development

- FGI Guidelines – 2010, 2014 & 2018 editions
- ANSI (new standard published)
- USGBC – LEED for Healthcare, 2011
- IgCC Healthcare criteria
- CISCA Healthcare criteria

AWG Activities (continued)

3 Education

- 40 seminars & webinars on healthcare acoustics presented in US, UK, EU and Japan

4 Publishing

- “Sound & Vibration 2.0” (2011) – by Springer-Verlag

5 Outreach

- Members work with WHO, CDC, GSA, HUD and other regulatory groups

AWG-Acoustics Proposal Review Committee Mission

- Review the acoustics-related proposals for changes to the 2014 Hospital and Outpatient (H/OP) and, Residential (R) documents.
- Review comments to the draft of the 2018 Guidelines.
- Provide acoustical recommendations to the larger group.
- Offer technical expertise on what should be considered minimum requirements.
- Review the acoustical requirements of all three volumes for **consistency**.

Acoustics Proposal Review Committee

2018-cycle Acoustics Proposal Review Committee (APRC)

- Evaluated ~100 proposals from all sources
- Consists of:
 - Kurt Rockstroh, FAIA
 - Jane Rohde, AIA
 - Paul Barach, MD, MPH
 - Chair David Sykes, MA
 - Six FGI-nominated acoustics consultants

APRC Technical Subcommittee



David Sykes, chair



Noral Stewart



Ed Logsdon



Bill Cavanaugh



Jean-François Latour



Mandy Kachur

Newest APRC Members

Elizabeth Valmont, Ph.D (Architecture), Associate AIA, LEED AP

- Acoustics Faculty, University of Southern California 10 years
- Associate, Arup (Los Angeles)
- “40 under 40 Award” winner (2016 BD&C, CSE Magazines)



Dr. Daniel Fink MD, MBA

- General Internist (retired), Cedars Mt. Sinai
- Chairman, The Quiet Coalition
- Board Member , ATA
- Member, Mayer-Rothschild Task Force



Mayer-Rothschild and FGI-Funded Residential Care Facility Assessment

- Comprehensive assessment of 2014 acoustics requirements to inform 2018 Residential Guidelines proposals/changes
- Retirement Community
 - 1800 residents
 - 10 independent living buildings
 - 1 assisted living
 - 1 skilled nursing
 - 3 community buildings
- Spaces assessed and correlated to resident feedback
 - Residential units: Independent living, assisted living, skilled nursing
 - Assembly spaces: Chapel, Catering hall with stage
 - Dining
 - Recreation: Music, Arts and Crafts, Swimming Pool
 - Outdoor measurements: building equipment, ambient community noise

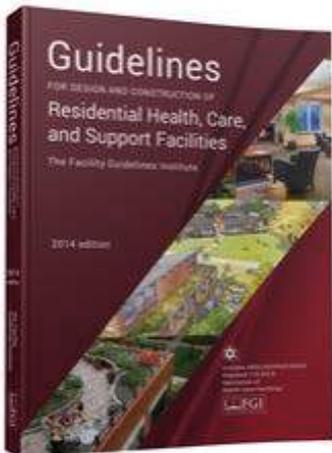
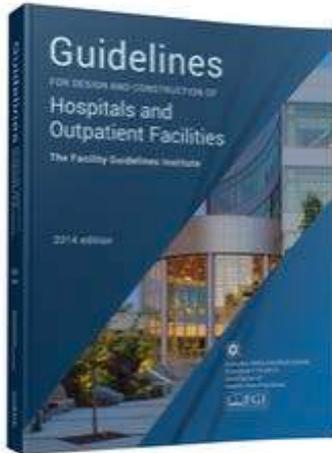


FGI Critical Support

- Pamela Blumgart, FGI Managing Editor
- Heather Livingston, FGI Associate Editor
- Yvonne Chiarelli, FGI Editorial/Scribe Consultant



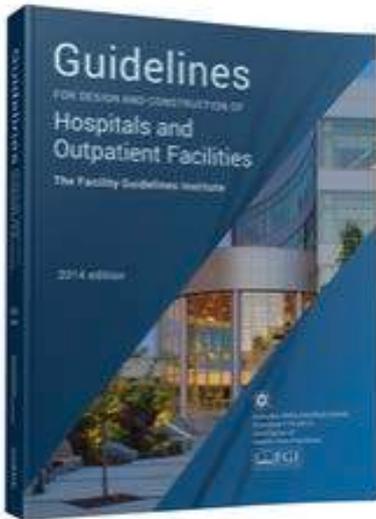
FGI Includes Five Sections on Acoustics



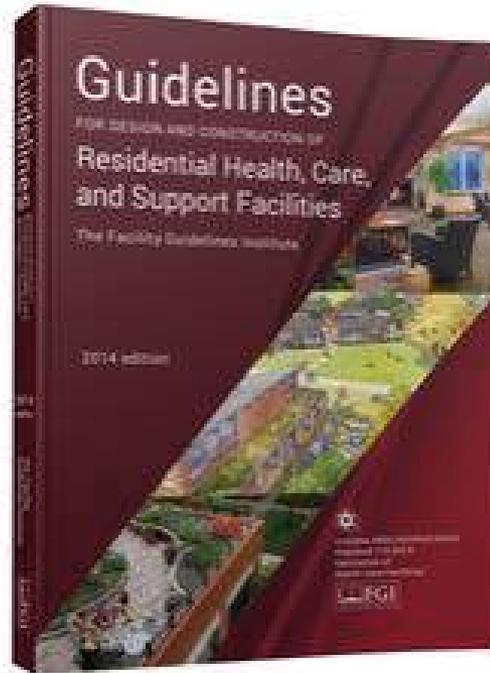
2018 proposals were submitted for all sections

- Site exterior noise
 - Block sound through façade
- Speech privacy / Sound Isolation
 - Wall & Floor-ceiling constructions
 - Control of background noise levels
- Speech Intelligibility / Room Finishes
 - Sound absorbing surfaces to control reverberation
- HVAC and building systems
 - Equipment selection and system design to control background sound level
- Building vibration
 - Isolation and structural design

Standalone Outpatient Edition



2010



2014



2018

Standalone Outpatient Edition



Importance of Acoustics

- Drive to build more facilities to address growing need - 50,000 Baby Boomers retiring each month
 - “Micro Hospitals”, Outpatient Clinics, Urgent Care Centers, Emergency Care, etc.
- English as a second language
 - Many patients are also challenged with translation
- Facility Owners looking to brand their services
 - Patients react better to quiet environments



Policy Changes

- Nationwide poor HCAHPS scores for noise
 - “During this hospital stay, how often was the area around your room quiet at night?”
 - Typically the lowest score of all questions surveyed
- National issue of “alarm fatigue” in healthcare
- National drive to build “healing environments”
 - Improve sleep quality
 - Lower heart rate, respiratory rates and blood pressure
 - Reduce staff stress



“Hearing loss - “the new norm”

- Noise-Induced Hearing Loss – affects 48 million Americans
- Increased number of hearing disorders in elderly and young people due to environmental, workplace and recreational exposure
 - Personal headphones, loud concerts, raves, sporting events, etc.



Hot Topic - *TELEMEDICINE*

- Is used to
 - Support care providers
 - Address more need with less money
 - Reach rural locations
- Challenges
 - Quality of calls, i.e., connectivity in remote locations
 - Patient understanding and trust
 - Privacy – need sound isolation and room acoustics
 - **HIPAA**
- Solutions
 - Appropriate acoustics
 - Proper system selection (microphone, display, camera, lighting, etc.)
 - Early design consideration



NOISE IS A PUBLIC HEALTH PROBLEM

International Noise Awareness Day

Center for Hearing and Communication

- Wednesday, April 25, 2018
- 23rd anniversary
- NOISE - You have to make some noise to end it.



International Noise Awareness Day



National Institute on Deafness and
Other Communication Disorders (NIDCD)

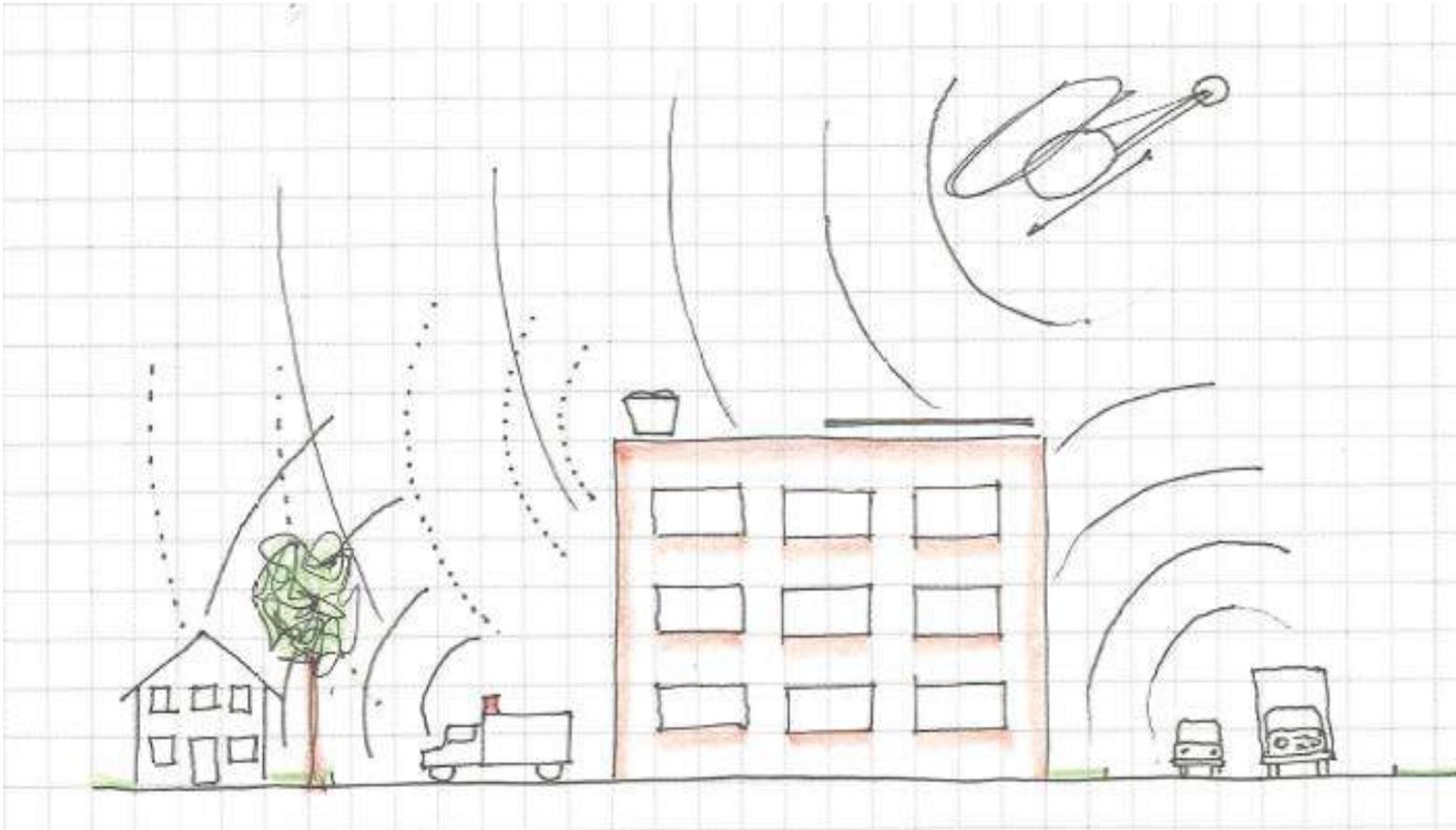
“May is Better Hearing Month”

Overview of the APRC's Recommendations for 2018 FGI Guidelines

- 1 Site Exterior Noise
- 2 Speech Privacy / Sound Isolation
- 3 Speech Intelligibility / Room Finishes
- 4 HVAC & Building Systems
- 5 Building Vibration



Site Exterior Noise



Sirens, helicopters, traffic, etc.

1

Highlights of APRC Activities in Support of 2018 Editions

SITE EXTERIOR NOISE - OITC/STC of façade (H,OP,R)

- *Issue:* Outdoor Indoor Transmission Class criteria are more appropriate than STC for façade evaluation, but test data are sparse
- *Resolution:* 2010 *Guidelines* listed STC, 2014 *Guidelines* listed OITC, 2018 will list both providing guidance on how to select.
- *Implications:* More flexibility for the designer.
- Consistent across all three volumes

Exterior Site Noise Exposure Category	A	B	C	D
General description	Minimal	Moderate	Significant	Extreme
Day-night average sound level (L _{dn}) (dB) ¹	< 65	65–69	70–74	≥ 75
Average hourly nominal maximum	< 75	75–79	80–84	> 85

table excerpt

Sound Isolation (STC) Demo

20 STC 25 STC 30 STC 35 STC 40 STC 45 STC 50 STC 55 STC 60 STC

Animated Auditory demonstrations
NASA
NASA's research in Speech Communication and Music Listening
Animation

PARTITION INSERTION LOSS

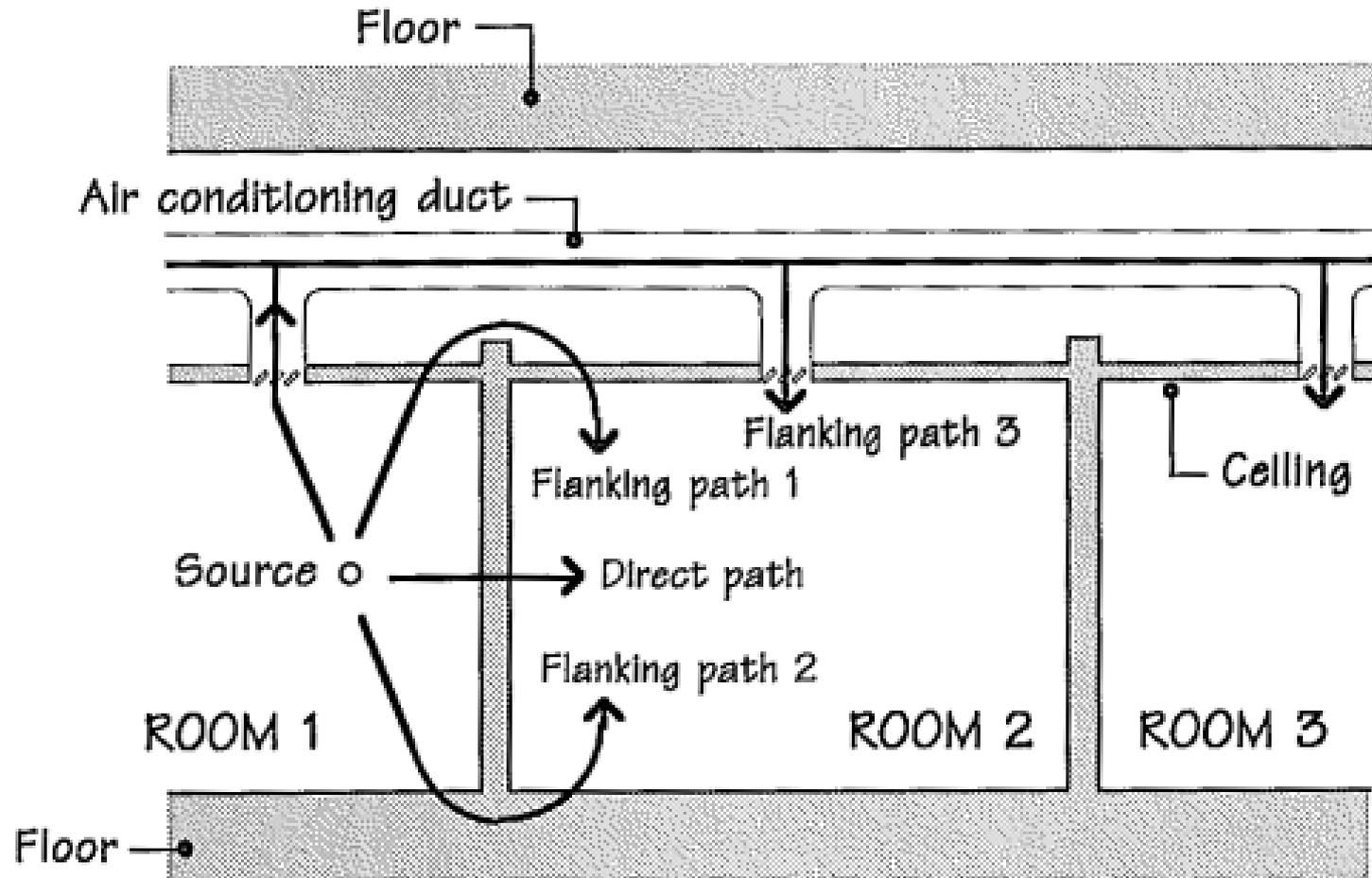
IL [dB]

OCTAVE BAND CENTER FREQUENCY [Hz]

63 500 8000

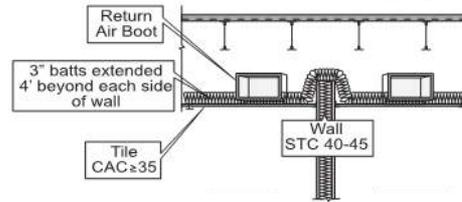
Animation courtesy of NASA Glenn Research Center

Flanking Sound



And adding Sound Masking is NOT always the answer!

Need Full Height Walls

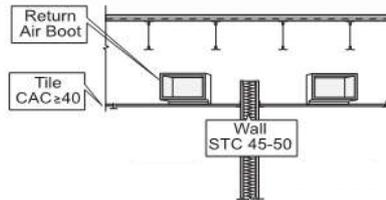
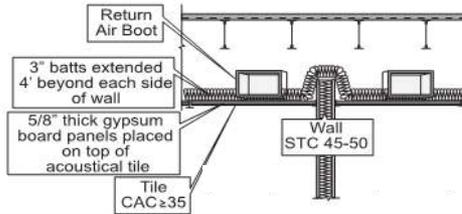


Estimated
Composite Sound-
Rating of Assembly

STC-35

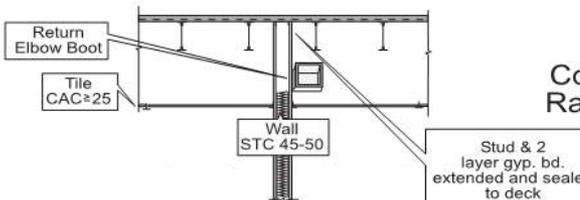
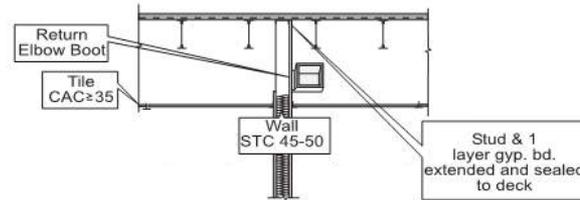
GOAL: STC 45

- Patient room to Patient Room
- Increase CAC of Tile
- Add fiberglass
- Add return-air boots



Estimated
Composite Sound-
Rating of Assembly

STC-40



Estimated
Composite Sound-
Rating of Assembly

STC-45

2

Highlights of APRC Activities in Support of 2018 Editions

Speech Privacy / Sound Isolation STC of partitions (H,OP,R)

- **Issue:** Existing text is not clear about wall/ceiling interface and plenum conditions to achieve rated STC of partition
- **Resolution:** Changed wording for clarification. Updated room designations and adjacency combinations so they are relevant to the specific edition.
- **Goal is Consistency across all three volumes**

Adjacency Combination		STC _c ²
Patient room	Patient room (wall–same floor)	45 ³
Patient room	Patient room (floor–to–floor)	50
Patient room	Corridor (with entrance)	35 ⁴
Patient room	Public space	50
Patient room	Service area	60 ⁵
Exam room	Corridor (with entrance)	35 ⁴
Exam room	Public space	50
Treatment room	Room	50
Treatment room	Corridor	35

table excerpt

Room Acoustics (NRC) Demo

APPROX.
AVG NRC



0.8

0.2

0.15

0.1

0.01

APPROX.
AVG RT



0.00
SEC

0.125
SEC

0.250
SEC

0.500
SEC

0.875
SEC

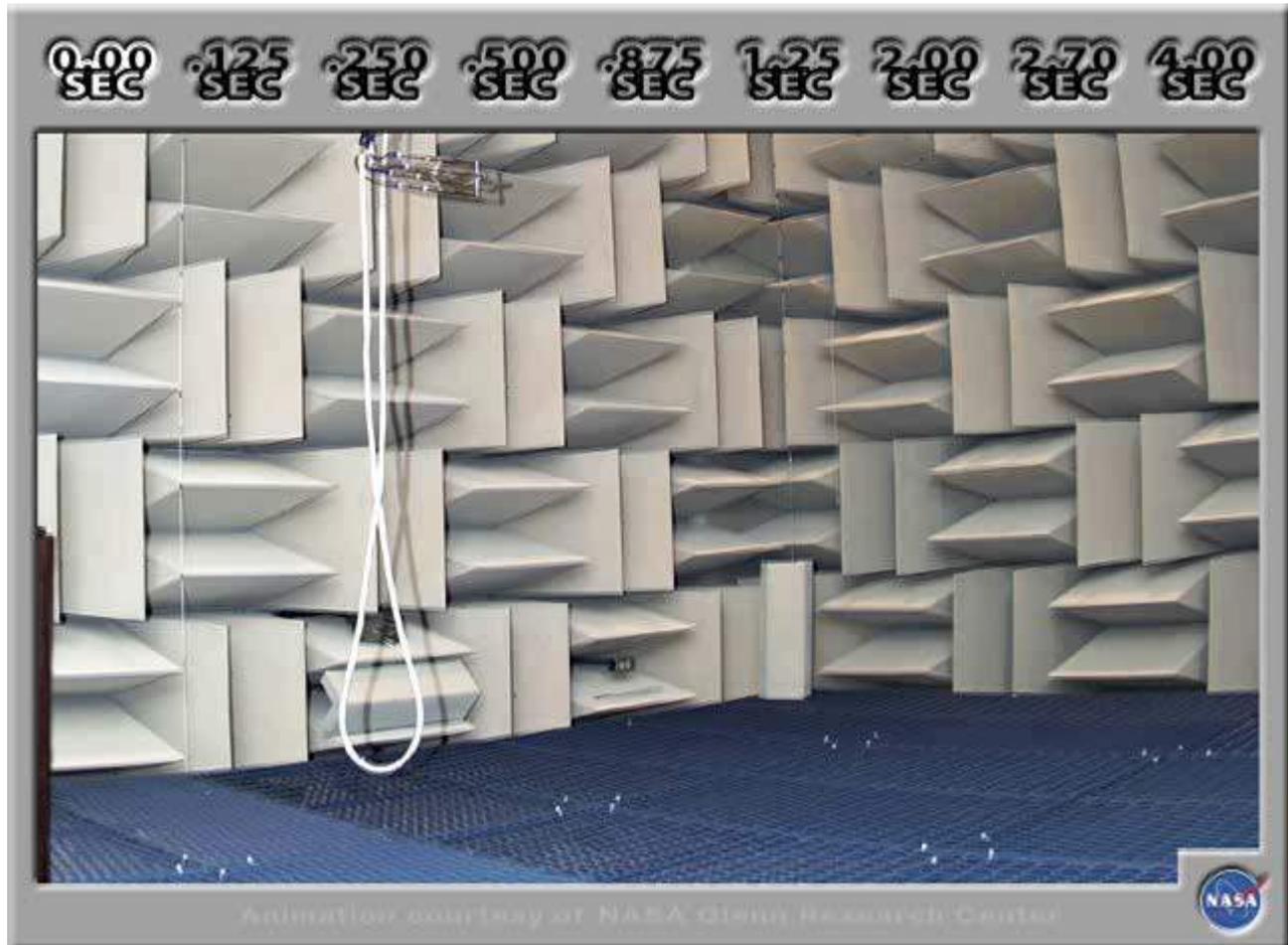
1.25
SEC

2.00
SEC

2.70
SEC

4.00
SEC

Note:
Higher Noise Reduction
Coefficient (NRC) lowers
Reverberation Time (RT)



3

Highlights of APRC Activities in Support of 2018 Editions

Added HIPAA speech privacy for Pharmacy (R)

- **Issue:** HIPAA speech privacy requirements were not addressed for pharmacy in the Residential Guidelines
- **Resolution:** Added criteria and a note about sound masking as an alternative to increase **Speech Privacy**
- **Implications:** Reasonable attempts to provide speech privacy, such as placing the waiting area away from the consultation counter and providing background sound level in the waiting area, need to be incorporated into the design.

Design Criteria for Speech Privacy for Enclosed Rooms and Open-Plan Spaces¹
²

Level	Metrics			
Speech Privacy—Closed Plan	PI	AI	SII	SPC
Secure	N/A	N/A	N/A	≥70
Confidential	≥95%	≤0.05	≤0.10	60–69
Normal	80–94%	0.06–0.20	0.11–0.25	52–59
Defining Standard	ASTM E1130	ASTM E1130	ANSI S3.5	ASTM E2638
Speech Privacy—Open Plan	PI	AI	SII	SPC
Confidential ²	Special consideration required. ³			
Normal	80–94%	0.06–0.20	0.11–0.25	52–59
Marginal	60–79%	0.21–0.40	0.26–0.45	45–51
Defining Standard:	ASTM E1130	ASTM E1130	ANSI S3.5	ASTM E2638

table excerpt

3

Highlights of APRC Activities in Support of 2018 Editions

Speech Intelligibility / Acoustical criteria for unfurnished rooms (R)

- *Issue:* AHJs are having difficulty enforcing the average absorption criteria table, particularly for living units
- *Resolution:* Absorption criteria for living units were eliminated from the main body and moved to the appendix for guidance and explanation
- *Implications:* Speech and noise in Reverberant environments negatively affect the residents.

Space ¹	Design Coefficient ²	Subjective Description
Private patient room	0.15	“Average” room
Multi-bed patient room	0.15	“Average” room
Corridor	0.15	“Average” room

table excerpt

3

Highlights of APRC Activities in Support of 2018 Editions

Reverberant noise levels in dining rooms (R)

- *Issues: Life Safety:* Biggest source of complaints. Affects people's behavior (e.g., avoidance of busy times, eating in room instead of dining room).
- *Resolution:* Added criteria of seating density and sound absorption per person to reduce noise and reverberation. Also, called attention to controlling noise produced by kitchen equipment.
- *Implication:* A different approach to design, but one that is readily accessible to architects.



Background Noise (NC) Demo

30 NC **35 NC** **40 NC** **45 NC** **50 NC**

NOISE CRITERION [NC]

SPL [dB]

OCTAVE BAND CENTER FREQUENCY [Hz]

63 1000 8000

Animation courtesy of NASA Glenn Research Center

4

Highlights of APRC Activities in Support of 2018 Editions

HVAC noise in dining areas (R)

- *Issue:* Resident complaints recorded during Mayer-Rothschild residential study
- *Resolution:* Added criteria in the *Maximum Design Criteria for Noise in Interior Spaces Caused by Building Systems* table. Also added comments about **kitchen** equipment noise in Appendix.
- *Implications:* Additional noise control measures **may** be needed in HVAC design. THESE ARE NOT OVERLY STRICT (HUD MINIMUMS)

Table 2.5-5: Maximum Design Criteria for Noise in Interior Spaces Caused by Building Systems¹

Room Type	NC / RC(N) / RNC ^{2, 3, 4}	dB(A)
Resident rooms/dwelling units	40	45
Medication rooms	45	40
Multiple occupant resident care areas	45	50
Corridors and community spaces	45	50

table excerpt

3

4

Highlights of APRC Activities in Support of 2018 Editions

Loud Natatoria (R)

- *Issue:* Resident complaints about lack of speech intelligibility in natatoria. This space is often used for physical therapy and instruction. This is a **life-safety issue** (speech and noise).
- *Resolution:* Added HVAC background sound criteria and sound absorption criteria. TURNING UP THE VOLUME DOESN'T WORK.
- *Implications:* Noise control and sound absorption will have to be addressed for these spaces. It is often neglected.



Vibration

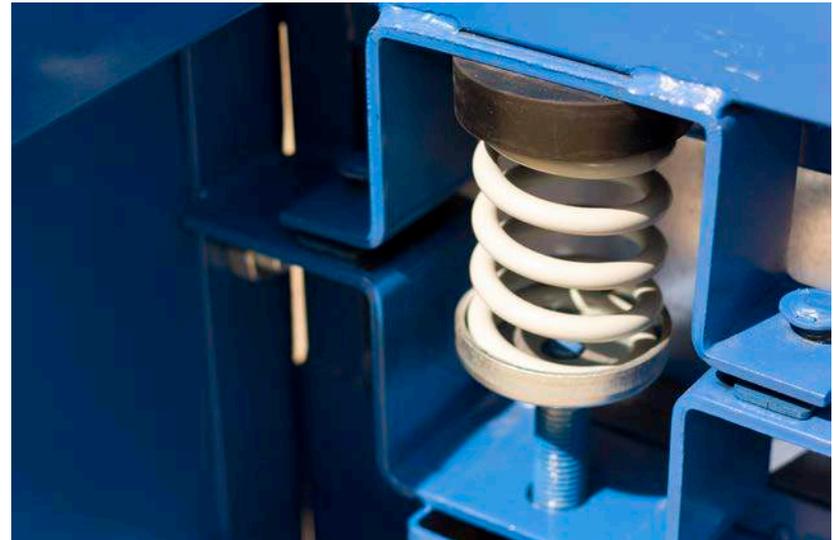


5

Highlights of APRC Activities in Support of 2018 Editions

Revised structural building vibration criteria (H,OP)

- *Issue:* 2014 Guidelines listed limits for different structural types, steel vs wood.
- *Resolution:* Single table to address **footfall**. Vibration limits are specific to the type of equipment and use of the space, not structural type.
- *Implications:* List vibration limits based on type of space. Limits should be consistent in all design volumes. Building equipment is assumed to properly isolated.



ASIC Design Criteria - References FGI

Designation	Tolerance Limit ¹ , mips	Applicability
—	32,000	Ordinary workshops ²
—	16,000	Offices ²
—	8,000	Computer equipment Residences ^{2,3}
—	6,000	Hospital patient rooms ⁴
—	4,000	Surgery facilities, laboratory robots Bench microscopes up to 100×, operating rooms ⁵
VC-A	2,000	Microbalances, optical comparators, mass spectrometers Industrial metrology laboratories, spectrophotometers Bench microscopes up to 400×
VC-B	1,000	Microsurgery, microtomes and cryotomes for 5 to 10 μm slices Tissue and cell cultures, optical equipment on isolation tables Bench microscopes at greater than 400×, atomic force microscopes
VC-C	500	High-precision balances, spectrophotometers, magnetic resonance imagers Microtomes and cryotomes for <5 μm slices, chemotaxis Electron microscopes at up to 30,000×
VC-D	250	Cell implant equipment, micromanipulation Confocal microscopes, high-resolution mass spectrometers Electron microscopes (SEMs, TEMs) at greater than 30,000×
VC-E	125	Unisolated optical research systems, extraordinarily sensitive systems

¹ As measured in one-third octave bands over the frequency range 8 to 80 Hz (VC-A and VC-B) or 1 to 80 Hz (VC-C through VC-E); see Figure 6-2.
² Provided for reference only. Evaluate using Chapter 4 or Chapter 7.
³ Corresponds to approximate average threshold of perception (ASA, 1983).
⁴ When required by FGI (2014). Evaluate using Section 6.2.
⁵ Corresponds to approximate threshold of perception of most sensitive humans (ASA, 1983). Evaluate using Section 6.2.





Highlights of APRC Activities in Support of 2018 Editions

Change Residential floor to Impact Isolation Class Rating (R)

- *Issue:* 2014 Guidelines list velocity based vibration criteria that are more suitable for hospital environments and construction type
- *Resolution:* Substituted the Impact Insulation Class (IIC) rating for the Residential facilities.
- *Implications:* Criteria now follow the IBC. Hard flooring may require underlayment for spaces without ceilings in the room underneath.

Table 2.5-8: Maximum Limits on Floor Vibration Caused by Footfalls in Residential Health, Care, and Support Facilities

Space Type	Footfall Vibration Peak Velocity (micro-in/s)
Resident rooms, dwelling units, and other resident areas	6000
Examination rooms	6000
Administrative areas	8000

REMOVED

table excerpt

Highlights of APRC Activities in Support of 2018 Editions

Rejected Proposals

- **Increase acoustical absorption requirements** in many spaces (H,OP,R)
 - *Costs for premium acoustical products (NRC 0.9 or higher) are prohibitive*
- **Require access to music** as part of the base building requirements (H,OP,R)
 - *Most patients have personal music devices*
- **Allow sound masking systems coupled with a decrease in partition STC** as an alternate to existing STC table (H,OP)
 - *Speech privacy is more than Visual Privacy*
 - *Sound masking is not a panacea to sound isolation*

Where to find Acoustical Consultants?



ncaac.com/resources/directory/



Directory of Acoustical Consultants

Thank you for your kind attention!

Ed Logsdon
303-455-1900

Logsdon.edward@gmail.com

Elizabeth Valmont
310-625-2342

elizabeth.valmont@arup.com