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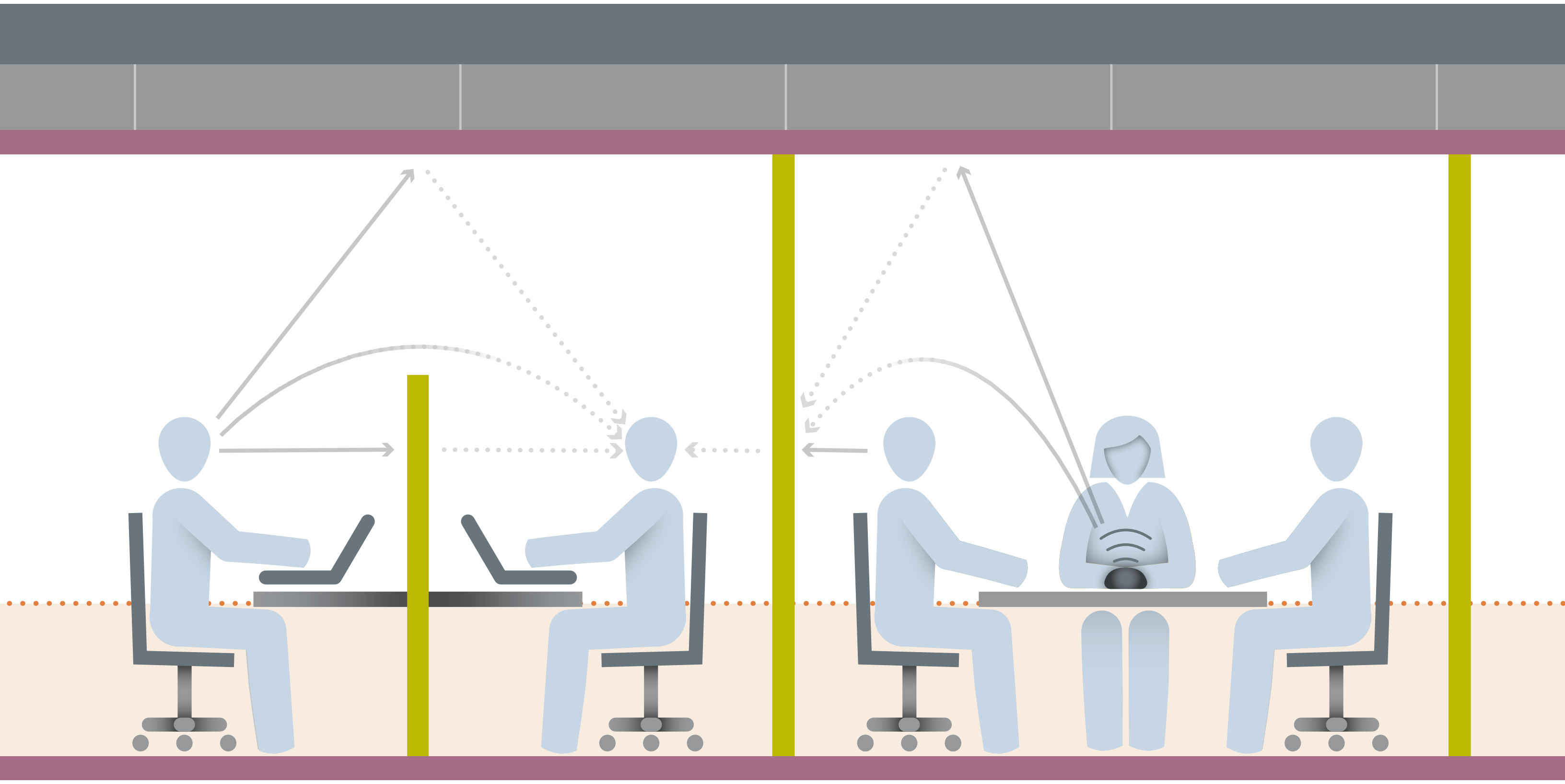


Workplace Acoustical Performance: Designing for Privacy

Privacy, and the ability to concentrate, are essential for individual focus work as well as private collaboration. People need to be able to hear what they want to hear, when they want to hear it. They also need to know that confidential conversations are protected. Yet, knowledge workers continue to identify noise and the lack of speech privacy as leading sources of dissatisfaction in the workplace. Tackling noise and poor privacy requires an understanding of 1) speech intelligibility, 2) ways to address unwanted speech and noise, and 3) how construction elements work together for optimal acoustical performance in the workplace.

Knowledge workers no longer need to come to work just to "get work done." Technology has enabled work to be done anywhere, anytime. And yet, we still "go to work."

Why?

One reason: we want to connect. We need to interact with peers, supervisors, and others. Certain things are best done in person, and we need to see and hear each other.

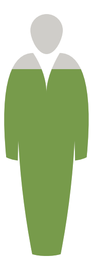
The challenge we often have is that while we are "at work," we also need to do work that requires focus or concentration. We need to work with minimal distractions.

In either instance, we need to be able to manage what we want to hear, and what we don't want to hear. To comprehend what is important, we must first hear it clearly, while also being able to minimize the distracting effect of unwanted, irrelevant sounds, or noise.

Because different activities require different ways of managing acoustical information, we seek out a variety of workspaces, each with specific characteristics that support the work we're doing at the time.[1]

Employers who understand and address this need for varying workspaces are more successful.[2]

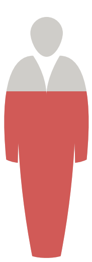
Numerous studies have measured employee satisfaction with their workplace environments, and have pointed to noise as a major cause of reduced effectiveness, higher stress, and decreased job satisfaction. In one landmark study, evaluations from more than 50,000 workers in 351 buildings confirm that the lack of speech privacy is the single greatest source of dissatisfaction.[3,4] Additionally, almost 30% of those in private offices say that acoustics interfere with their ability to do their jobs.[5] This hurts innovation.



To foster innovation...

77%

of employees have a preference for quiet when focus is needed.



However...

69%

are dissatisfied with the noise level at their primary workspace.[6]

Strategies to improve collaboration were ineffective if the ability to focus was not also considered. Simply stated, providing employees with both the opportunity and the space to do focus work is a primary driver of organizational effectiveness. Why is this?

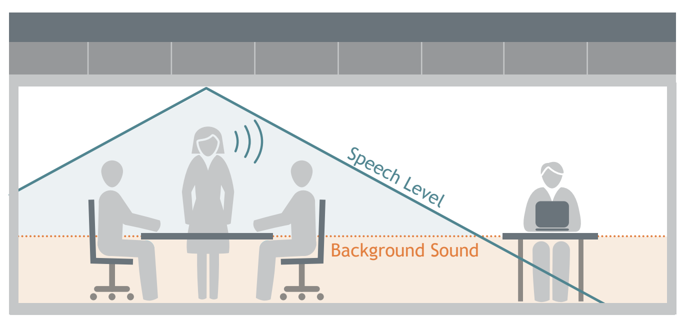
Connecting and conversing requires we hear and understand each other, through intelligible language. High-focus work takes effort, and irrelevant, unwanted sounds draw resources away from our ability to do high-focus work—whether we're doing it individually or collaborating.[7]

Think about two people that must collaborate on a high-focus task. They will have the same requirements for blocking irrelevant acoustical information while still needing to understand each other. To make matters more complex, sometimes what we have to say to each other needs to be private, and must not be overheard by people outside of our conversation.

It is critical that architects, designers, facility managers, and building owners be aware of the varying and sometimes complex acoustical needs of the organizations they serve. This is true for environments such as legal offices, where confidentiality is critical; owner-occupied or leased office buildings, where privacy is expected in meeting rooms and closed offices; as well as open-plan administrative offices and call centers. In all types of buildings, and for all types of businesses, freedom from distraction, adequate intelligibility, and privacy are important—and often at the same time!

Measuring Privacy

Speech privacy can be easily understood as the absence of speech intelligibility. Speech intelligibility is based on the audibility of speech sounds as they arrive at a listener's ear, in relation to the background sound levels at the listener's location.



If the speech sounds at the listener's location are well above the background sound level, the speech sounds will be clearly heard and understood, or intelligible. But, if the speech sounds at the listener's ear are well below the background sound level, the speech will not be understood, and communication will not take place. Even when a listener is able to hear the muffled speech sounds of someone talking, privacy still exists because the listener cannot understand what is being said.[8]

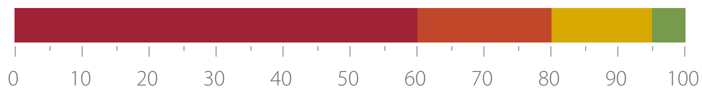
1 Gensler, 2016.
2 Gensler, 2013.
3 Kim & de Dear, 2013.
4 Frontczak, et al., 2012.
5 Jensen & Arens, 2005.
6 Gensler, 2013.
7 Escera and Corral 2007; Sussman, Winkler, and Schröger 2003; Parmentier et al., 2011.
8 Cavanaugh, Farrell, Hirtle, & Watters, 1962.

This relationship of speech sounds (signal) to background sounds (noise) at the listener's location is called the signal-to-noise ratio, and is central to the concept of speech privacy. Only where speech is not intelligible (where the intruding speech signal is below the background sound level) does speech privacy exist.[9] Therefore, creating a condition of speech privacy requires one of two actions:

- Reducing the speech sound arriving at the listener's location OR
- Increasing the background sound level at the listener's location

Using this concept, standards have been developed which define levels of speech intelligibility and privacy in terms of a measure called the Privacy Index,[10] with levels validated through extensive prior research.

Privacy Index (PI)



No Privacy

Poor
Speech is readily understood

Non-Intrusive
Overheard speech is not distracting

Confidential
Overheard speech is not intelligible

Ensuring the Right Levels of Speech Privacy

Achieving the desired level of speech privacy requires careful assessment and alignment of three key factors:

FUNCTIONAL NEEDS

Consider the Privacy Index (above), and align these to the expectations of the primary users and the voice levels used in each instance.

Private Offices and Conference Rooms
Confidential privacy is the common design goal. Users of these spaces generally assume their conversations will not be easily understood by people outside the room.

Spaces for Focus Work
Non-intrusive privacy is a common design goal.

Collaboration Spaces
Disruption from outside the space should be minimized to support the collaborative focus work of the team. Likewise, voice levels of the collaborative team need to be contained, so as not to distract people in adjacent spaces.

AMBIENT ENVIRONMENT AND BACKGROUND SOUND

The background sound which exists in the space must be controlled to ensure a non-intrusive background sound, at the right level.[11] Most important of these factors are:

HVAC Noise
New buildings, with highly-efficient air-conditioning systems, tend to have extremely low inherent background noise levels. Conversely, older buildings may have loud HVAC systems, but which may be emitting lots of sound at frequencies ineffective for masking speech.

Urban Environments
Urban environments may have high levels of traffic noise.

WALLS, CEILINGS, AND FLOOR

Introduce the structures and materials necessary to block and absorb sound between spaces. The manner in which these are deployed will have a direct effect on both speech privacy and speech intelligibility.

EFFECTIVE ACOUSTIC DESIGN

Addressing these three factors to create an effective acoustic design in the workplace doesn't have to be complex—it can be as simple as A, B, C.

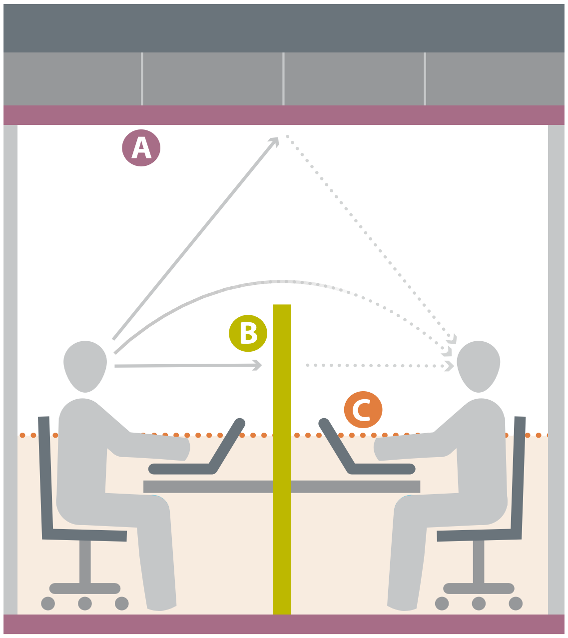
9 Egan, 1988.

10 ASTM International, 2016.

11 Cavanaugh, Farrell, Hirtle, & Watters, 1962.

Effective Acoustic Design: The A, B, Cs

The basic approach to managing speech privacy may be simply described as "Following the A, B, Cs":



A ABSORB: absorb sounds within the space

Highly absorptive ceilings and carpeted floors

- Reduce sound levels within rooms
- Minimize undesirable reflections
- Performance indicated by NRC or SAA rating

B BLOCK: block sounds between the spaces

Physical construction using demountable or unitized wall systems and suspended ceiling tiles

- Block sound transmission between rooms
- Wall sound blocking indicated by STC ratings
- Ceiling sound blocking indicated by CAC ratings

C COVER: cover intruding sounds with background sound

Electronic sound masking system

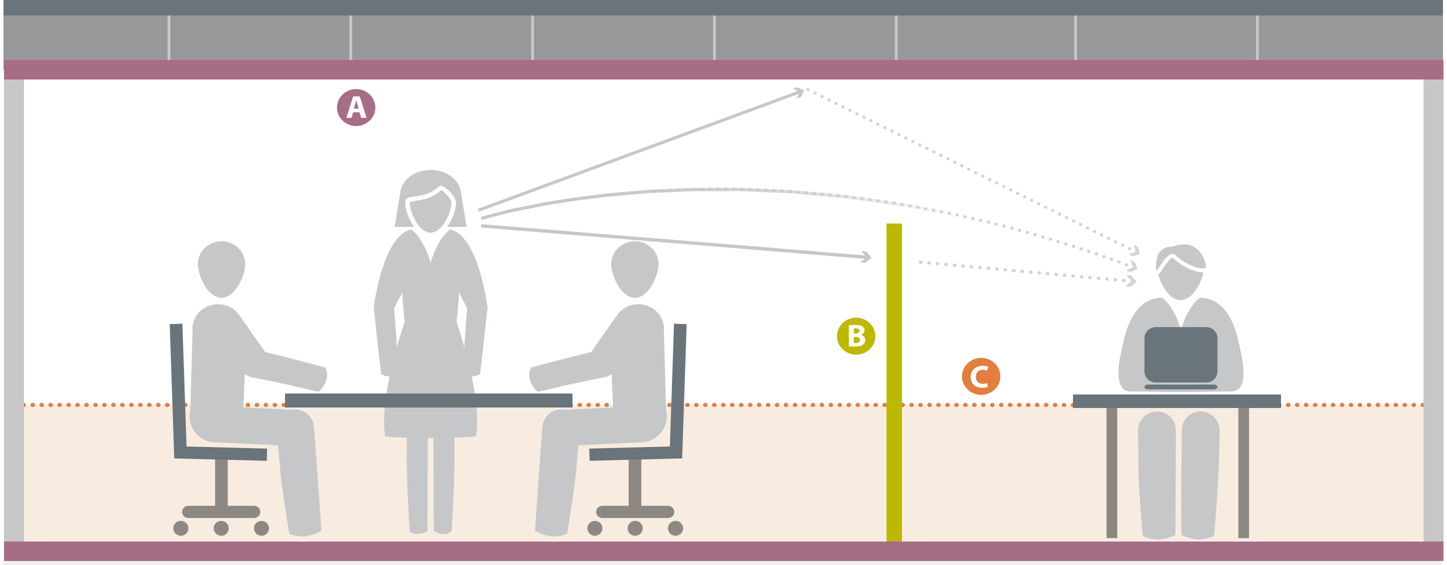
- Carefully tuned in frequency and level to meet desired functional and privacy needs of different areas throughout the space
- Indicated by the sound level, measured in dBA

Putting It Together

As in all good design, multiple factors need to be kept in balance with each other, in a way that serves the functional needs. Likewise, achieving an effective acoustic environment requires using each of the building blocks appropriately, and in balance with the other elements. Haworth's extensive knowledge developed through our own research and experience with our customers, provides valuable insight to the ratings, and combinations which yield the desired results.

SPACES FOR FOCUS WORK

We seek these spaces to minimize noisy distractions.



PI > 80: Non-Intrusive

- **A** Materials with NRC/SAA of 0.70 or better on ceilings and suspended baffles
- **B** Walls or other separations may be needed
- **C** Background sound levels of 46–48 dBA

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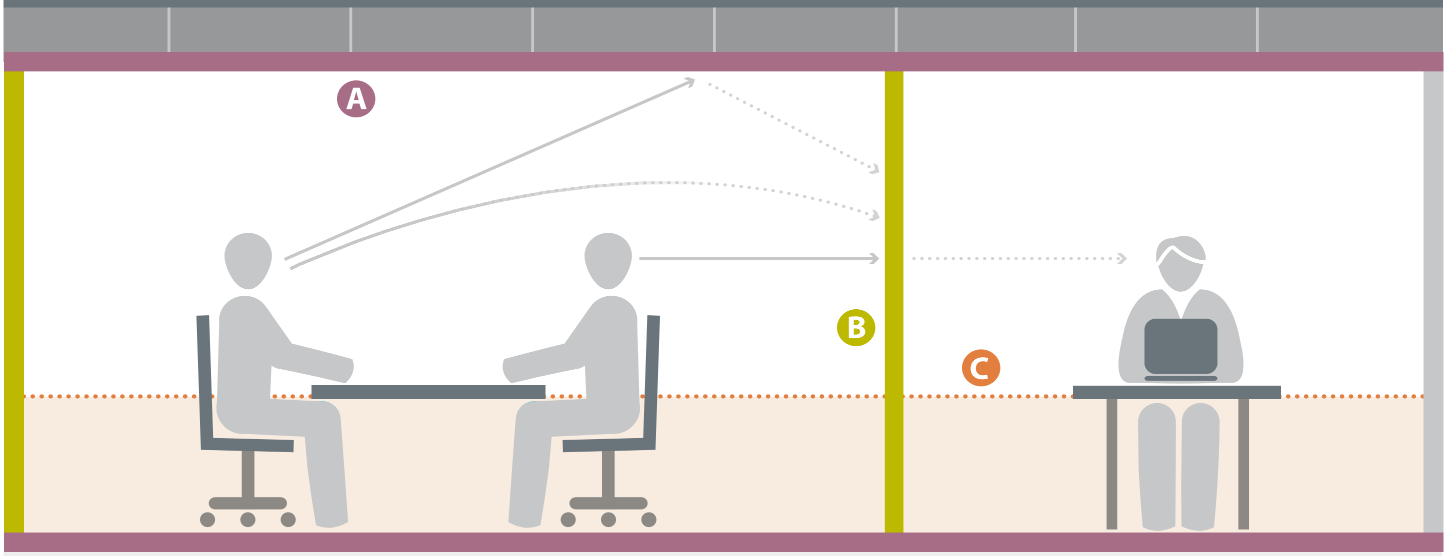
PRIVATE OFFICES AND SMALLER MEETING ROOMS

We look to these rooms to ensure confidentiality of sensitive conversations.

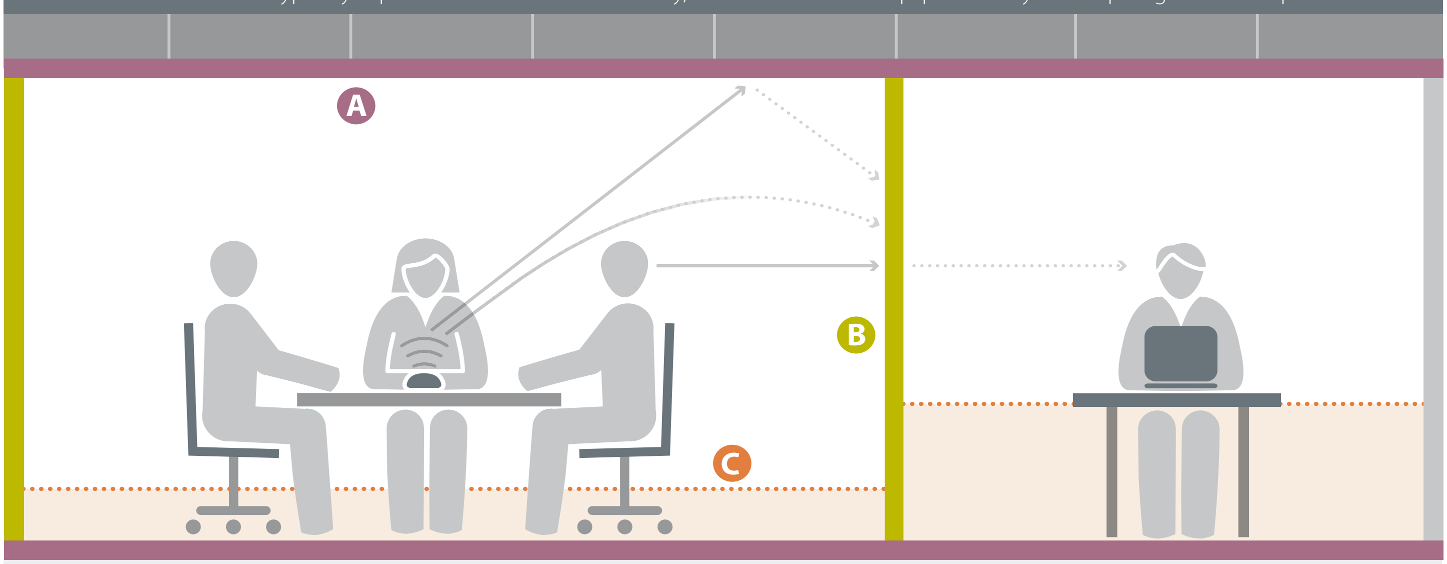


PI ≥ 95: Confidential

- A NRC/SAA of 0.60 is adequate
- B Walls with STC in high 30s, and CAC of ceiling in the high 30s with minimized penetrations
- C Background sound levels of 44 dBA (may be reduced with higher STC and CAC)

LARGE MEETING/TELECONFERENCING ROOMS

These rooms are typically expected to ensure confidentiality, but teleconference equipment may also require greater absorption.



PI ≥ 95: Confidential

- A NRC/SAA 0.70 or greater
- B Walls with STC of 42 and ceiling with CAC of 42
- C Background sound in meeting room is limited to aid intelligibility, but higher in adjacent rooms to ensure privacy

Conclusion

The investment in facilities is significant for any organization. Ultimately, facilities serve the organization and its people. With noise and speech privacy as leading causes for concern in the workplace, appropriately addressing acoustical performance benefits both the organization and its employees. When construction elements work together to accurately control levels of speech intelligibility and honor privacy, people hear what they need to hear, when they need to hear it. Investing in the right acoustical workplace designs for each area, based on function and use, creates the necessary environment for focus, productivity, and innovation.

Learn More

For more information on creating environments to support workflow and encourage productivity, read these white papers:

Designing for Focus Work

Movable Walls & Raised Floors: Optimizing Adaptable Workplaces to Meet Changing Business Needs

Optimizing the Workplace for Innovation: Using Brain Science for Smart Design

Acoustic Terminology

Understand the important terms commonly used in acoustic design.

A-Weighted Decibel (dBA)
Measure of a sound level averaged across multiple frequencies, and weighted to approximate the relative sensitivity of human hearing to different frequencies. The A-weighted scale gives relatively less importance to high and low frequencies.[12]

Ceiling Attenuation Class (CAC)
Single-number rating of the transmission loss (TL) of a ceiling suspended over a partition separating two rooms with a common ceiling plenum.[13] A higher number indicates more sound will be blocked. Like STC, CAC is measured only in a laboratory, and describes the performance only where the ceilings cover both rooms.

Decibel (dB)
Standard measure of sound pressure level at specific frequencies. Though pressure is normally measured in Pascals or psi, the decibel is used for sound pressure measurement because the range of values of sound pressure vary greatly from the threshold of hearing (0 dB) to the threshold of pain (above 120 dB), and because the human ear responds to varying pressure levels logarithmically.[14]

Hertz (Hz)
Measure of the frequency of the sound wave, or the number of times the wave cycles, each second. In music, specific frequencies correspond to specific notes on a musical scale (e.g.: middle-C corresponds to 256 Hz). The frequency range of human speech extends from about 160 Hz to nearly 5,000 Hz.[15]

Noise Isolation Class (NIC)
Single-number rating indicating the sound isolation between two adjacent rooms or spaces in a building.[16] A higher number indicates more sound will be blocked. Unlike STC or CAC, NIC is a measure of the actual constructed space, not just a wall, and includes the effect of all construction elements and materials together.

Noise Reduction Coefficient (NRC)
Measure of the ability of a surface material to absorb sound in mid-frequency ranges. It is the average of the absorption at four frequencies from 250 to 2000 Hz, and is expressed as a number from 0.00 to 1.00, rounded to the nearest 0.05. A higher number indicates more sound is absorbed.[17] Testing for NRC will use one of several different mounting methods, denoted by a letter code, sometimes also followed by a number (e.g.: E400). NRC values for different materials should be compared only for like mounting methods.

Privacy Index (PI)
Degree of privacy between two spaces. It is expressed as a number from 0 to 100 (though it is not an indication of the percentage or fraction of speech will be overheard). It takes into account the acoustical performance of all construction elements, the background sound level, and the voice level and spectrum of the talker. PI values greater than 80 indicate some degree of privacy is to be expected.[18]

Sound Absorption Average (SAA)
A measure of the ability of a surface to absorb sound, intended to replace NRC. It is the average of the absorption at 12 frequencies from 200 to 2,500 Hz, and is expressed as a number from 0.00 to 1.00, rounded to the nearest 0.01. A higher number indicates more sound is absorbed. Testing for SAA follows the same method as for NRC.[19]

Sound Transmission Class (STC)
A single-number rating of the sound transmission loss of a partition. A higher number indicates more sound will be blocked.[20] Differences of less than 2 points are generally indistinguishable by the human ear (e.g.: walls rated STC 44 and 46 will likely sound about the same). STC is only measured in an acoustical laboratory; similar field measurements will be termed ASTC (Apparent Sound Transmission Class), and will be lower.

12 Cavanaugh, and Wilkes, 1999.
13 ASTM International, 2016.
14 Cavanaugh, and Wilkes, 1999.
15 Cavanaugh, and Wilkes, 1999.
16 ASTM International, 2013.
17 Egan, 1988.
18 ASTM International, 2016.
19 ASTM International, 2013.
20 Egan, 1988.

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Contributors

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Beck Johnson holds a B.S. in Scientific and Technical Communication and an M.A. in Communication. With 15+ years of experience in social science research methodologies and as a Senior Research Specialist at Haworth she conducts primary and secondary research addressing workplace issues—creating knowledge insights to support Haworth's vision as industry knowledge leader. Her goal is to build knowledge of leading workplace issues and related social science and provide credible communication to clients and their teams at various stages of the design process.

Haworth research investigates links between workspace design and human behavior, health and performance, and the quality of the user experience. We share and apply what we learn to inform product development and help our customers shape their work environments. To learn more about this topic or other research resources Haworth can provide, visit www.haworth.com.