Optimized Acoustics™

A Guide to Acoustic Design

Rockfon®

Part of the ROCKWOOL Group

When auditory distractions are reduced or eliminated:

75%
of employees are more productive

57%
have increased motivation

49%
are happier at work overall

Statistics from the *Udemy 2018 Workplace Distraction Report*

A Sound Design

Everywhere you look, new, modern spaces are coming to life. Wider, more open spaces. Rooms and floors created to promote collaboration and unity. A sense of togetherness, and of oneness. All of which makes thoughtful acoustic design more important than ever.

Rockfon products are used in offices, restaurants, concert halls, libraries, hospitals, schools and universities—places where human comfort truly matters, and helps elevate the human experience. Our products not only deliver optimized acoustic experiences, but we are dedicated to sustainability, energy efficiency, and the health of people and our planet.

Acoustic design is especially important for schools, medical centers and office environments.

Learning
The acoustics inside classrooms determine whether students can understand their teachers.

Healing
Acoustics can improve patient and resident comfort and safety, while helping maintain caregiver and employee accuracy and productivity.

Productivity
The acoustics inside office buildings impact employee performance, attendance and retention.

Overall Wellbeing
Without appropriate room acoustic design inside buildings, noise can seriously harm human health by causing short- and long-term health problems[1].

The Optimized Acoustics™ Approach

50% of employees say noise keeps them from being productive[2]. In schools, more noise means lower student scoring on national standardized tests[3]. And in hospitals, studies have shown that noise decreases patient and staff satisfaction, impacting health and recovery time[4] and also increasing costs and decreasing revenue[5].

Optimized Acoustics can help ensure your building design is on a path towards higher performance. With the Optimized Acoustics design approach you can create spaces where absorption, isolation and background sound performance work together without sacrificing superior aesthetic design.

Before you begin, ask yourself these questions.

- **Requirements:** What are you wanting to achieve? Which acoustic standards or guidelines need to be met?
- **Consultation:** Will a manufacturer or consultant assist with acoustic product selection and application?
- **Noise Sensitivity:** What will the building occupants be doing, and how important are speech intelligibility, privacy and freedom from disruptive noise? Is the sensitivity level high, moderate or low?
- **Noise Potential:** How much noise is expected to be generated from inside the room—such as from a lively meeting or noisy equipment? And what about from adjacent rooms? Is the noise level high, moderate or low?

The Acoustic Roles of Ceilings, Walls and Slabs

To ensure optimized acoustics you need to use the right combination of highly absorptive ceiling panels, robust walls and floor slabs, all working together. Acoustic ceilings are used to absorb the sounds in the room. Walls that are built full-height to the structural slab or roof above, and without holes or gaps, block outside noise from coming into the space. When rooms are above or below one another, the floor slab also plays the main role in sound insulation.

Rockfon acoustic ceiling tiles can achieve Noise Reduction Coefficients (NRC) of 0.95 or higher, optimizing speech intelligibility and achieving the ultimate privacy in schools, medical facilities and office spaces. Rockfon ceiling tiles comply with all acoustic requirements in building standards and guidelines including those from the Facilities Guidelines Institute (FGI), Green Building Institute (GBI), Collaborative for High Performance Schools (CHPS) and others. They also meet or exceed all environmental and sustainability standards, such as the LEED® Green Rating System and the WELL™ Building Standard.

What is NRC?

Noise Reduction Coefficient measures the amount of sound absorbed by ceiling panels or other materials.

What is STC?

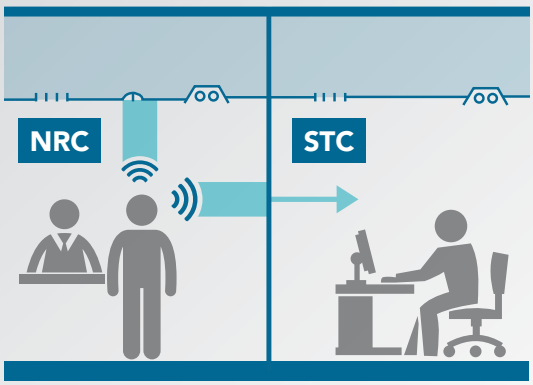
Sound Transmission Class measures a wall's or floor/ ceiling assembly's ability to block noise transfer between adjacent rooms.

What is dBA?

A-Weighted Decibels represent how loud sound is to the human ear.

What is SPP?

Speech Privacy Potential refers to the total acoustical privacy between two rooms and is based on the isolation of the architecture (STC) combined with the background sound level (dBA).



Comply with sound blocking requirements between rooms (STC) with full-height walls. Comply with sound absorption requirements within rooms (NRC) with high performance Rockfon stone wool ceiling panels.

Three Steps to Optimized Acoustics™

Optimized Acoustics is a 3-step architectural and acoustical design process. **Rockfon has created a set of interactive online design tools** to help you determine the right performance ratings for your space, and provide you with the best product options and construction details.

Here is a brief overview of the simple process that will help you determine the correct amount of sound absorption, noise blocking and background sound your project needs.

Step 1:

Select the appropriate NRC rating for your ceiling panels

How loud are the sounds *inside* the room? For example, a restaurant or a classroom might have a lot of noise, while a private office space might not.

As the amount of sound absorption is increased inside a room, the reverberation time and noise level decrease. It also can reduce echoing. This improves speech intelligibility, allowing students to better understand their teachers and patients to get more restorative sleep. Rockfon's NRC selection tool will help you determine the proper rating for your ceiling.

The Importance of Speech Privacy Potential (SPP)

Speech Privacy Potential is a better performance indicator of acoustic privacy between two adjacent rooms than either STC or background sound (dBA) alone. SPP factors both steps #2 and #3 of Rockfon's Optimized Acoustics design process, together. The STC rating plus the background sound level should total between 75 and 80—any less and privacy may not be achieved.

Step 2:

Select the appropriate STC rating for wall and floor/ceiling assemblies

How loud are the sounds *outside* the room? For example, is there a noisy lobby next door or gymnasium above?

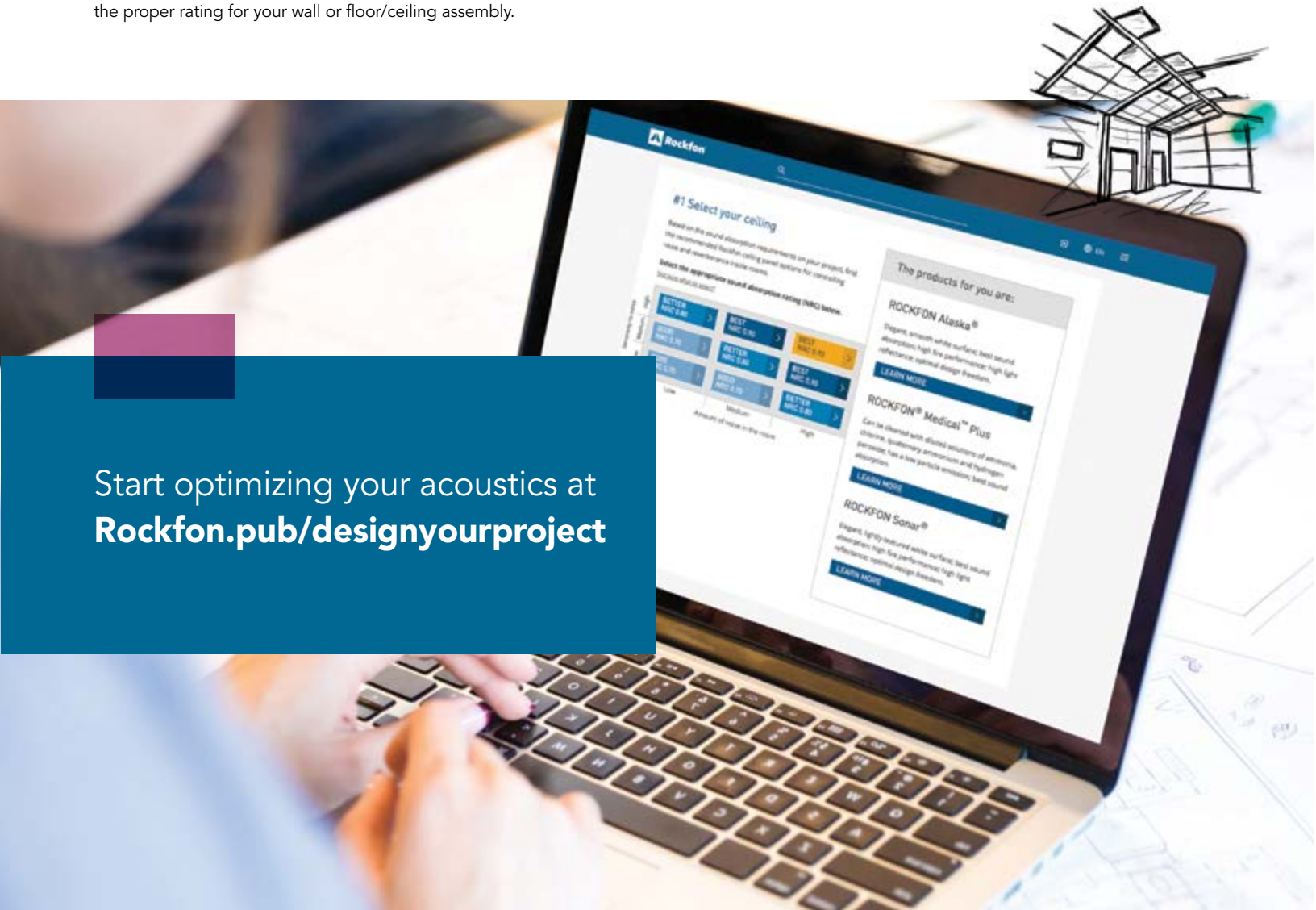
Sound blocking starts with your walls and floor slabs. If the adjacent room has a lot of people or equipment, and transmitted noise would interfere with sensitive activities being performed in the room being designed, you'll need a high STC rating. As the walls and slabs become more massive, the STC rating increases and the amount of noise getting through greatly decreases, making things much quieter. Rockfon's STC selection tool will help you determine the proper rating for your wall or floor/ceiling assembly.

Step 3:

Ensure you have the proper background sound level

Quieter is not necessarily better. Some background sound is necessary to mask annoying or distracting noise and help achieve speech privacy. This background sound can be from music, nature, mechanical systems or electronic sound masking (or "white noise").

To ensure adequate sound privacy (SPP) you'll need to ensure the proper background sound, measured in dBAs, is achieved. Rockfon's background sound level selection tool will help you determine the proper background sound level based on your STC ratings.



Start optimizing your acoustics at
Rockfon.pub/designyourproject

Hear What the Standards, Guidelines and Rating Systems Say …

Acoustic Standards for Education

Many school buildings must now comply with the stringent acoustic requirements and performance levels in one or multiple standards, guidelines or building rating systems. The table below compiles the absorption, isolation and background sound level requirements from organizations such as the Collaborative for High Performance Schools (CHPS) and the Acoustical Society of America (ASA).

With Rockfon's Optimized Acoustics™, you can trust that your design will provide students and educators with an efficient, effective and enjoyable learning experience while complying with industry regulations.

DID YOU KNOW?

Ceiling Attenuation Class (CAC) is not included as an acoustic requirement in current building standards, guidelines and rating systems.

Accepted Standards for Educational Facilities*

	Background Sound Requires mechanical system noise to be below a maximum permissible level	**Absorption – NRC[6]** Requires sound absorbing finishes, such as acoustic ceilings, to control reverberation and noise	**Wall Insulation – STC[7]** Requires full-height, STC-rated walls between rooms to prevent noise transfer
American National Standard – Acoustical Performance Criteria, Design Requirements, and Guidelines for Schools[11]	✓ 35 dBA	✓ Reverb 0.60 - 0.70	✓ STC 50 for Classrooms
Collaborative for High Performing Schools (CHPS)[12]	✓ 35 - 45 dBA	✓ Reverb 0.60 - 0.70	✓ Classrooms STC 43 (minimum) Classroom STC 50 (enhanced)
Leadership in Energy and Environmental Design (LEED)	✓ 35 dBA (preferred) 40 dBA (maximum)	✓ Ceiling NRC 0.70 (min) Reverb 0.60 - 0.70	✓ STC 50 for Classrooms
Acoustical Society of America (ASA) Technical Committee on Architectural Acoustics (TCAA)[13]	✓ 35 dBA / NC[8] 25 - 30	✓ Ceiling NRC 0.75 (min) Reverb 0.40 - 0.60	✓ STC 50 for Classrooms[17]
Green Globes Assessment Protocol for Commercial Buildings[14, 17]	✓ RC[9] 30 Classrooms	✓ Ceiling NRC 0.80 Reverb 0.60	✓ STC 50 for Classrooms
American Academy of Audiology (AAA)[15]	✓ Endorsed	✓ Endorsed	✓ Endorsed
American Speech Language Hearing Association (ASHA)[16, 17]	✓ Endorsed	✓ Endorsed	✓ STC 50 for Classrooms[17]

*Every facility is different, and any single room may need to exceed the guidelines in this chart, depending on its purpose and its adjacent rooms. Values are current at the time of this publication but may change afterwards.

Acoustic Standards for Healthcare

Patient satisfaction and recovery are directly related to hospital and medical center acoustics, and organizations including the World Health Organization recommend maximum noise levels for optimal patient care and staff comfort[18]. The table below compiles the absorption, isolation and background sound level requirements from organizations such as Leadership in Energy and Environmental Design (LEED) and the Facilities Guidelines Institute (FGI).

With Rockfon's Optimized Acoustics™, you can be assured that your design will provide both staff and patients with a better working and healing environment, while complying with all industry regulations, guidelines and suggestions.

DID YOU KNOW?

Ceiling Attenuation Class (CAC) is not included as an acoustic requirement in current building standards, guidelines and rating systems.

HIPAA—The Healthcare Insurance Portability and Accountability Act requires that institutions handling private medical and financial information make reasonable effort to keep the information, even when spoken, private for the protection and dignity of the patient, but does not have any specific acoustic requirements.

Evidence Based Design—The Center for Health Design categorizes the use of high-performing, sound-absorptive, acoustic ceilings (NRC 0.90 or higher) as a priority design recommendation based on the strength of the evidence available and the impact on safety, quality and cost. [20. 21.]

Accepted Standards for Healthcare Facilities*

	Background Sound Requires mechanical system noise to be below a maximum permissible level	**Absorption – NRC[6]** Requires sound absorbing finishes, such as acoustic ceilings, to control reverberation and noise	**Wall Insulation – STC[7]** Requires full-height, STC-rated walls between rooms to prevent noise transfer
Facilities Guidelines Institute (FGI) – Guidelines for the Design and Construction of Hospitals (2018)	✓ **45 dBA for Patient Rooms**	✓	✓ **STC 45 for Patient Rooms**
Leadership in Energy and Environmental Design (LEED)[19]	✓ **35 - 45 dBA**	✓	✓ **STC 45 for Patient Rooms**
Green Globes Assessment Protocol for Commercial Buildings[14]	✓ **45 dBA Patient Rooms**	✓ **Ceiling NRC 0.90 Reverb 0.50**	✓ **STC 50 for Healthcare**
National Institutes of Health (NIH) – Design Requirements Manual	✓ **NC[8] 40 - 45 for Laboratories**	✓ **Ceiling NRC 0.80 (min) in Laboratories**	✓ **STC 50 Between Areas NIC[10] 45 Within Areas**

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Acoustic Standards for Office Spaces

Studies show that performance, employee retention and health can all suffer from poor office and workspace acoustics. With more than 90 percent of an organization's operating costs linked to employee efficiency, ceiling design can play a critical role in an organization's bottom line. The table below compiles the absorption, isolation and background sound level requirements and standards from organizations such as the WELL Building Standard and the Green Globes Assessment Protocol for Commercial Buildings.

Rockfon's Optimized Acoustics™ will help ensure your design will provide office staff with comfortable and more productive working spaces, while adhering to industry standards.

DID YOU KNOW?

Ceiling Attenuation Class (CAC) is not included as an acoustic requirement in current building standards, guidelines and rating systems.

Accepted Standards for Office Spaces*

	Background Sound Requires mechanical system noise to be below a maximum permissible level	**Absorption – NRC[6]** Requires sound absorbing finishes, such as acoustic ceilings, to control reverberation and noise	**Wall Insulation – STC[7]** Requires full-height, STC-rated walls between rooms to prevent noise transfer
WELL Building Standard[22]	✓ **NC[8] 35 Offices** **NC[8] 40 Open Offices**	✓ **Ceiling NRC 0.90 Open Offices;** **Ceiling NRC 0.80** **Offices & Conference**	✓ **NIC[10] 40 Offices** **NIC[10] 53 Conference**
Leadership in Energy and Environmental Design (LEED)[23]	✓ **35 dBA Office** **45 dBA Open Plan**	✓ **Reverb < 0.60 Seconds**	✓ **STC 50 Executive Office** **STC 45 Standard Office**
Green Globes Assessment Protocol for Commercial Buildings[14]	✓ **RC[9] 40 Open Office** **RC[9] 35 Private Office**	✓ **Ceiling NRC 0.90** **Reverb 0.40 Open Offices**	✓ **STC 45 for Offices** **STC 45 for Conference Rooms**
Government of Canada Workplace 2.0 Fit-up Standards	✓[24]	✓[24]	✓ **STC 45 Up to Ceiling** **Plenum Barrier Above Ceiling**
ASHREA/USGBC Performance Measurement Protocols for Commercial Buildings	✓ **NC[8] 25 - 35 Offices** **NC[8] 40 Open Offices**	✓ **Reverb < 0.60 Seconds**	✓[25]

*Every facility is different, and any single room may need to exceed the guidelines in this chart, depending on its purpose and its adjacent rooms. Values are current at the time of this publication but may change afterwards.

Technical Notes

1. Source: *World Health Organization, Regional Office for Europe, Summary of growing evidence of the impact of hazardous environments on human health.*

2. Source: *GSA Public Buildings Service, Sound Matters: How to achieve acoustic comfort in the contemporary office.*

3. Source: *Antioxidants & Redox Signaling, The Adverse Effects of Environmental Noise Exposure on Oxidative Stress and Cardiovascular Disease.*

4. Source: *The Construction Specifier, The New Era of Healthcare Acoustics.*

5. Source: *Healthcare Leadership, The Business Case for Building Better Hospitals Through Evidence-Based Design*

6. NRC is Noise Reduction Coefficient, the metric used to describe the sound absorbing capability of an architectural surface material or finish. It is measured in a laboratory per ASTM C423.

7. STC is Sound Transmission Class, the metric used to describe the sound blocking capacity of an architectural assembly. It is measured in a laboratory per ASTM E90 and ASTM E413.

8. NC is Noise Criterion, one of several methods of specifying maximum permissible noise levels for building mechanical, electrical, plumbing and conveying systems.

9. RC is Room Criterion, one of several methods of specifying maximum permissible noise levels for building mechanical, electrical, plumbing and conveying systems.

10. NIC is Noise Isolation Class, a metric used to describe the sound blocking capacity of all architectural components that make up constructed rooms combined. As such, NIC oftentimes better represents what building occupants will perceive. It is measured inside the building per ATSM E336 and ATSM E413.

11. The ANSI/ASA S12.60 Standard can be downloaded at webstore.ansi.org/.

12. The CHPS National Core Criteria can be downloaded at chps.net.

13. The ASA-TCAA booklet *Classroom Acoustics I – A resource for creating learning environments with desirable listening conditions* can be downloaded at acousticalsociety.org/classroom-acoustics.

14. *The Green Globes Assessment Protocol for Commercial Buildings* (ANSI-GBI 01-2019) can be downloaded at thegbi.org/ansi.

15. *The AAA Position Statement on Classroom Acoustics (August 2011)* can be downloaded at audiology.org.

16. *The ASHA Position Statement on Acoustics in Educational Settings (Jan 2005)* can be downloaded at asha.org.

17. The ASA-TCAA and the ASHA specifically require that partitions must continue all the way to structural deck above to be effective sound barriers. Otherwise, sound from one room can easily pass through a lay-in acoustical tile ceiling, over the partition wall, and down through the lay-in acoustical tile ceiling of the next room.

18. The Center for Health Design, *Sound Control for Improved Outcomes in Healthcare Settings.*

19. LEED v4.1 references the acoustic criteria in the 2018 version of the FGI Guidelines.

20. This priority design recommendation is published in *The Business Case for Building Better Hospitals Through Evidence-Based Design*, a document published by The Center for Health Design in September 2008.

21. The studies leading to this design recommendation used European class A (0.90 Alpha-W) ceiling panels. European Class A panels are equivalent to ceiling panels with a Noise Reduction Coefficient of NRC 0.90. Refer to *Sound Control for Improved Outcomes in Healthcare Settings*, a document published by The Center for Health Design in January 2007.

22. Values are from the *WELL Building Standard v1*. The version 2 pilot is currently under public review. Values shall be updated once version 2 has been finalized. Absorption is for ceilings and are minimums. Additional wall absorption is also required. Isolation values are for when sound masking is not used.

23. Values are from *LEED v4.1 for Interior Design and Construction.*

24. The standard refers to "acoustic ceilings" being typical, but does not require a specific performance level. It also refers to HVAC noise control, but does not require specific performance levels.

25. The protocol has "Advanced Performance Methods" that deal with speech privacy and sound isolation, but specific performance requirements are not provided. It refers users of the protocol to the "applicable regulations or guidelines for each country."

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