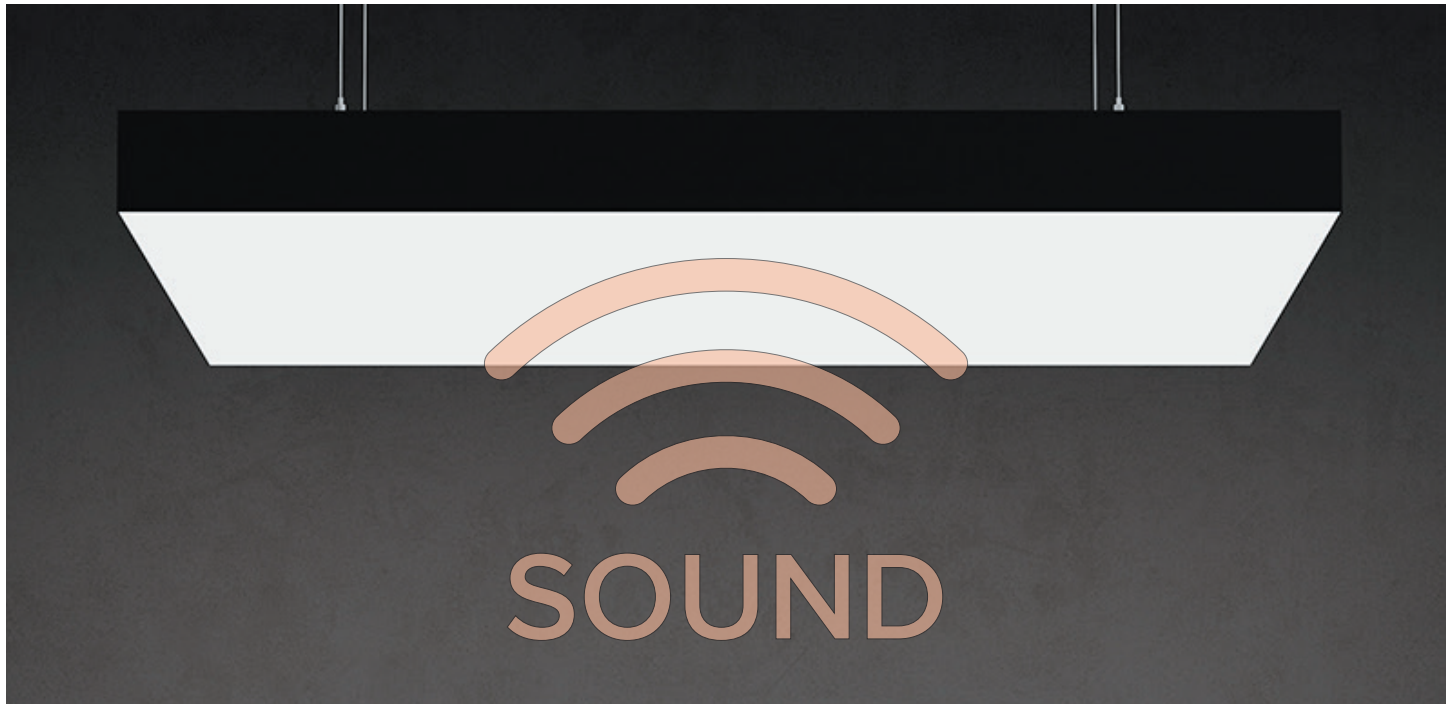




A NIGHTMARE OF NOISE: LIGHTING CAN HELP



Just as smartphones combined a multitude of established technologies, and today your home speaker includes an array of functions that extend well beyond music, integrated ceilings are combining elements that have traditionally been considered separately but are now part of a more advanced system. A perfect example is the fusion of acoustics and lighting.

In the past, the world of lumens, footcandles, and color temperature was the domain of the lighting world, while sound absorption, reverberation, and noise reduction coefficients were for strictly for acoustics experts to ponder.

That is changing...

New lighting products that offer acoustic properties are beginning to make their way into the world of lighting design, blurring the traditional separation of design roles and requiring lighting people to not necessarily become experts, but to have an understanding of some of the basics of acoustic design.

As a company with extensive experience and expertise in lighting that is leading the inclusion of acoustic performance to solve two design problems with single “true” acoustic lighting solutions, Cooledge has put together this brief guide to acoustic fundamentals and how they can be combined with lighting products to deliver an exceptional experience for your eyes... and ears.

Multiple studies have concluded that ambient noise and sound privacy are the two biggest sources of frustration and reduced productivity for office workers. It is not a stretch to assume that this feeling applies many other public environments.

“...the better acoustical condition nevertheless had a more positive effect on employees’ perception of disturbances and cognitive stress...The study shows the importance of focusing on the acoustical conditions in open-plan offices in order to improve employees’ well-being and through means of that also organizational efficiency.”

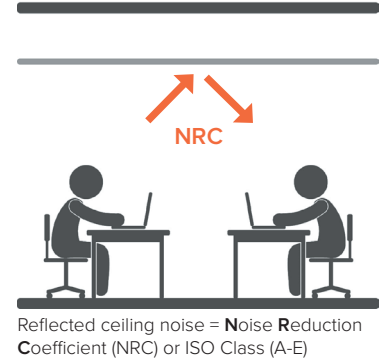
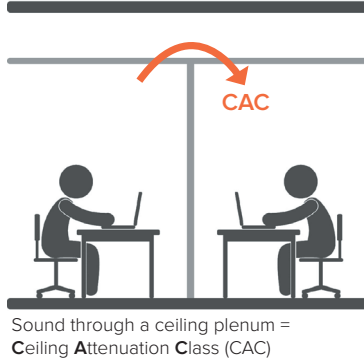
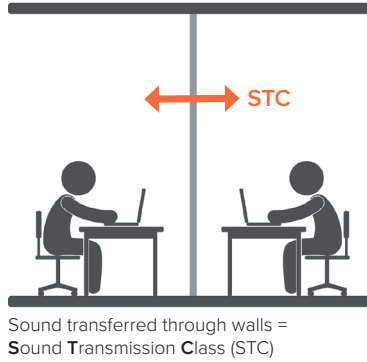
The Effect Of Noise Absorption Variation In Open-plan Offices: A Field-study With A Cross-over Design (Seddigh, Berntson, Jonsson, Danielson, Westerlund – Stockholm University)

“Studies indicate that approximately 80 percent of office workers believe that their productivity would increase if their working environment was more acoustically private.”

American Society of Interior Designers; Armstrong World Industries, Inc.; DynaSound, Inc.; Milliken and Co.; Steelcase, Inc, 2005.

THE BASICS: ACOUSTICS AND LIGHTING

There are 3 types of acoustic problems that impact people’s impression and enjoyment of a space. Solutions have different classifications that depend on which of the three problems they are intended to address: STC, CAC, or NRC (as shown below).



The problem for which lighting can offer solutions is that of reflected ceiling noise: a problem that is most prevalent in the type of “open concept” spaces that are becoming the mainstay of modern workplaces and increasingly popular in almost every other type of architectural environment.

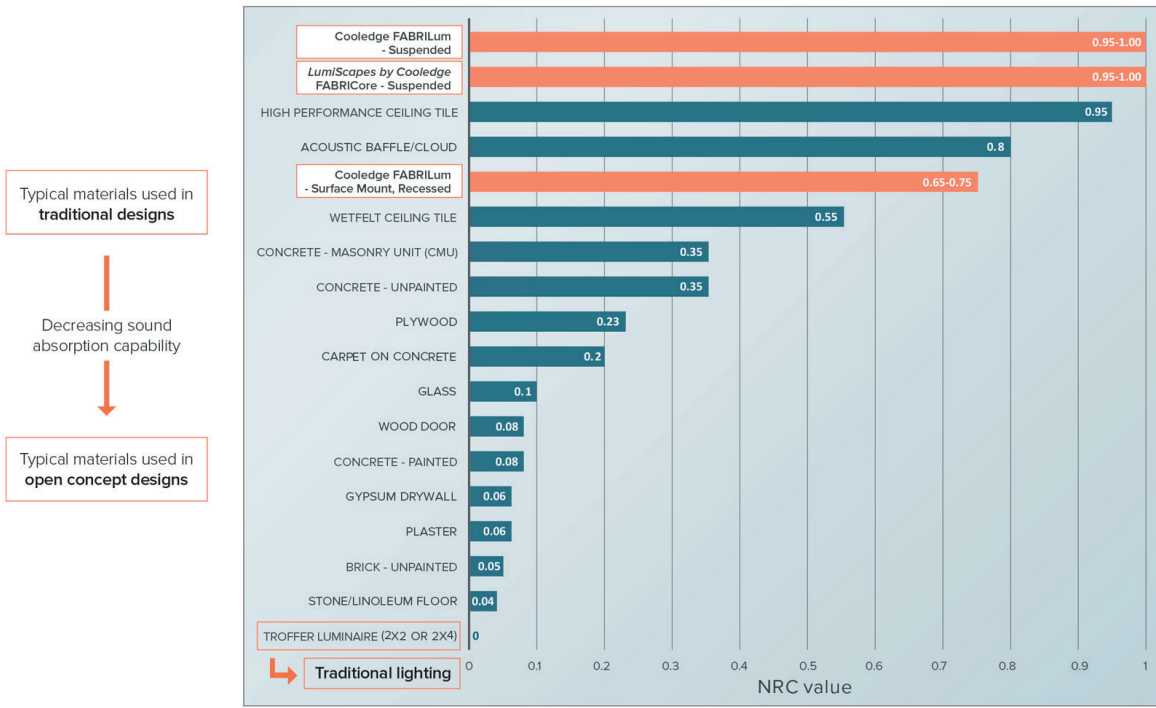
The Noise Reduction Coefficient is a value used to characterize the average capability of a material or object to absorb sound. Acoustic design requires a more detailed look at the specific properties of a given object or in our case the light fixture. However, as an indicator the NRC value provides a simple way to compare the relative acoustic performance with other materials.

It represents the average absorption for 4 sound frequencies typically encountered in the range of normal speech. A value of 0 means that

all sound will be reflected, 0.5 means 50% of the sound is absorbed and 50% is reflected, while 1.0 means 100% of the sound is absorbed.

To see how this might useful, have a look at this chart. One of the things you will notice is that materials typically used in traditional designs tend to have higher NRC values than those incorporated into modern open designs.

For example stone and tile that is used for floors because of its durability, maintenance, and aesthetics typically has an NRC value near zero, meaning that it reflects almost all of the sound waves back into the space, hence increasing the potential for noise problems. Similarly other materials used in open designs generally exhibit poor acoustic properties Note that traditional light fixtures are generally assigned an NRC value of zero.



Compiled by Cooledge Lighting from multiple sources



BIGGER IS BETTER WHEN IT COMES TO SOUND ABSORPTION

New lighting products that have been introduced to the market as “acoustic” incorporate sound absorbing materials that give them a high NRC or sound absorption rating but most lack another key characteristic that is fundamental to their value: size.

Cooledge Luminous Ceiling products incorporate sound absorbing properties AND just as importantly, they are large enough to make a difference. Imagine a single sheet of paper towel compared to one that is the size of a large beach blanket – both have the same absorbing properties, but which one will soak up the most water? Similarly, a linear pendant mounted luminaire may have a high NRC rating but how useful will it be in comparison to a large-scale Cooledge luminaire or an even larger Specialty Illumination Solution luminous ceiling from Cooledge that has a similar NRC value?

This concept can be quantified on a more technical level...






Acoustic engineers use something called a “sabin” to quantify sound absorption. The sabin is sort of like the lumen of acoustics. In this

case, more sabin means more sound absorption. The quantity of sabins is dependent on two things:

1. The sound absorption characteristics of a material
2. The area of material

- An imperial sabin is the quantity of sound absorption provided by 1 sqft of material if it absorbed 100% of the sound reaching it
- A metric sabin is the quantity of sound absorption provided by 1 m² of material if it absorbed 100% of the sound reaching it

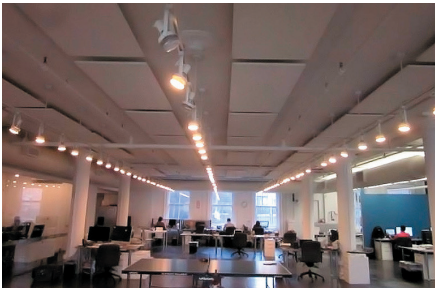
While acoustics experts consider sound absorption characteristics of materials at various sound frequencies, as we learned above, the NRC value can stand in as a good approximation of the total sound absorption capability of a material. New lighting products that claim to be acoustic typically have a high NRC value – some even reaching 1.0 (= 100%). However, to deliver sabins, size is an equally important factor as shown below:

	2x4 Acoustic Ceiling Tile	Acoustical Island suspended 10'x4'. (3mx1.2m)	Acoustic Linear Pendant luminaire	FABRILum & Single FABRiCore spaced	FABRILum cloud (2 by 2)
Acoustic Solution					
Average Sabin* (sqft)	6.40	34.0	11.0	15.3	58.1
Average Sabin* (m²)	0.58	3.1	1.0	1.4	5.4
Typical luminous flux (lm)	0	0	2,443 lm	10,000 lm	40,000 lm
Beam spread at 10' (3m) height (FWHM)	0	0	16'x13' (5mx4m)	26'x26' (8mx8m)	33'x33" (10m x 10m)
Light level straight under the luminaire at 10' (3m)	0	0	10.2 fc (110 lx)	38.9 fc (419 lx)	106.4 fc (1,145 lx)

* Using the NRC as an average.



COMBINING LIGHTING AND SOUND ABSORPTION USUALLY RESULTS IN COMPROMISING THE QUALITY OF THE LIGHTING



Dozens of bright point sources are used to provide general illumination to make room for acoustic panels



Credit: Acoustical Solutions
Lighting and acoustic clouds battle for space, making for a lot of clutter in the ceiling



Credit: Dox Acoustics
A creative approach to acoustics limits the options available to provide general illumination within a space

THERE IS NO NEED TO SACRIFICE THE QUALITY OF LIGHTING AND STILL PROVIDE A GOOD ACOUSTIC ENVIRONMENT

“ A 300 percent increase in perceived ‘worker satisfaction’ was reported as a result of the reduction in noise levels from conversational noise. In addition a measured 20% increase in sales productivity was recorded at the end of the six months following the refurbishment. ”

American Society of Interior Designers; Armstrong World Industries, Inc.; DynaSound, Inc.; Milliken and Co.; Steelcase, Inc, 2005.

COOLEEDGE LUMINOUS CEILING: NO COMPROMISES

The desire for “open concept” spaces combined with the trend toward using stone or tile for floors for durability and easy maintenance that results in low sound absorption and higher sound reflectance is a “nightmare of noise” in the making for offices, retail stores, and public areas.

In open spaces, an effective method of reducing sound pollution is to suspend acoustic clouds or baffles from the ceiling.

However, there is a better way that does not require sacrificing the quality of light.

Cooledge luminous ceiling products can replace acoustic clouds AND provide illumination in a single product - saving the cost of the acoustic materials and avoiding the visual clutter created when trying to combine luminaires for general lighting in the same space as the sound absorbing fixtures.

In other words: NO compromises.



Acoustic baffles compete with light fixtures for space and their own piece of the budget resulting in compromises and clutter.



FABRILum RSB luminaires combine meaningful acoustic performance and exceptional illumination for a single, budget-friendly price and a clean, efficient design aesthetic.