# Acoustics in Restaurants

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THE INSIDE STORY

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# Acoustics in Restaurants

Noise in restaurants is a hot topic: customers either complain about the high decibel level or seek it out; restaurateurs bill their establishments as quiet or a hot spot to attract just the right clientele and critics often rate acoustics as important parts of their reviews.

A 2011 Zagat survey showed that only poor service bested noise as restaurant customers' most common complaint[I]. In a "Consumer Reports" survey of 47,565 readers, reflecting 110,517 restaurant experiences at 102 different table-service chain restaurants, one out of four complained about the noise level at least once[II].

On the opposite side there are restaurants that are too quiet, places in which customers are uncomfortable talking with fellow diners, because they fear every word can be clearly understood at the next table. That drives them away as much as extremely loud noise does.

Conversation does best, i.e. the ear is most sensitive to speech, at a level between 48 dBA and 72dBA. Yet studies have measured ambient noise in restaurants at levels that can damage hearing[III]. OSHA warns that as little as two hours exposure to 100 dBA and eight at 90 dBA on the A scale will do permanent damage to hearing. It is, explains Doug Greenlee of SoundKinetics, the voice range of frequencies that matter; the rest is filtered out[IV].

Excessive noise levels in restaurants have multiple causes, among them modernist décor, featuring hard surfaces off of which sound reverberates, as well as sound generators such as open kitchens, live music and crowded spaces with diners packed in and tables close to each other. Often restaurant owners seek out a noisy environment believing that it signals the place is popular and making money.

Noise is exacerbated by the sound of people trying to talk loud enough to be heard and understood. In fact, people talking is considered the loudest source of restaurant noise[V]. People talk louder as other people raise their voices in order to make themselves heard (the Lombard Effect).

Too late restaurant owners realize they may be losing customers. Thus, acousticians often complain they are called in after the fact when renovations to solve the problems are more difficult and more expensive than if they were done at the outset. Specialists now are pleading for "design with ears in mind."

Acoustic products manufacturers are responding to restaurant demands for style and sound control with stylized products that use advanced technologies and materials, to integrate smoothly with minimalist design trends that call for lots of bare, hard surfaces[VI].

# Noise Challenges in Restaurants

Restaurants hear from patrons, employees and even OSHA when the noise levels are ear splittingly high. At the same time many who design restaurants, especially clubs or bars, want to be seen as edgy, trendy and the "in" place to be. All too often restaurateurs equate high volumes or "buzz" with popularity; it means that the place is full, it's popular and they are making money.

While customers may not complain about the high volume, they are only in the place for a few hours at most; employees spend up to eight or more hours at work day after day. OSHA has guidelines for how long anyone can be subjected to varying noise levels before risking permanent hearing damage (see OSHA section)VII.

As Baby Boomers age restaurant owners will be increasingly faced with another noise related problem: diners who are hearing impaired. A few restaurants are offering quiet areas, little nooks where even when the rest of the joint is jumping, customers can actually carry on a conversation. They are few and far between, but they exist[VIII].

There is, however, a thin line between buzz and alienating customers. In an effort to appeal to customer's sense of modern décor, new restaurants, even and especially upscale ones, often are housed in large, open rooms with wood floors, bare tables, high ceilings and lots of windows, all of which serves to increase reverberation[IX]. Combined with more sources of sound, it's no wonder that ambient noise in some restaurants has been measured at levels that equal a construction site[X].

"There is a nice balance that leads to enough liveliness and control on reverberation. I've found that it typically resides in the 1.0 to .8 second area…really small restaurants need to be less than .8 seconds and closer to .6 seconds. Really big restaurants could be closer to 1.1 seconds." – Doug Greenlee, SoundKinetics[XI].

**NOISE AS A CRITERIA IN RESTAURANT REVIEWS**

"More than a decade ago, we started to offer decibel level ratings of every restaurant we reviewed," wrote Michael Bauer in a July 2014 posting on the website, "Inside Scoop SF." He is the executive food and wine editor and restaurant critic for the San Francisco Chronicle. "The reason wasn't because I was on a crusade, but because it was what the public wanted.[XII]"

Increasingly restaurant reviewers are adding noise to their evaluations. In fact, many carry sound meters along on visits, rating the noise level along with the food quality, service and other factors.

Restaurant reviewers aren't the only ones. Patrons are taking matters into their own hands with easily available apps for smartphones. They then post their reviews on websites. Diners who post on Yelp can deduct a star for loud noise and on OpenTable customers can classify the sound as quiet, moderate or energetic.[XIII] In fact, a 2011 column on healthyhearing.com rating noise meter apps was so popular that the author, Amanda Tonkin, Healthy Hearing's associate editor, updated it in November 2014[XIV].

The San Francisco Chronicle's Bauer uses "bells" to rank the level of noise in the restaurants he reviews, i.e. 3-bells means that talking normally gets difficult (70-75 decibels); 4-bells, diners can talk only in raised voices (75-80) and the "Bomb," when it's too noisy for normal conversation (80+). The majority of restaurants he has reviewed in the last two years have fallen into either the 4-bell or Bomb categories.

The Washington Post uses a four tier rating system for its restaurant reviews: quiet (under 60 decibels); conversation is easy (60-70 decibels); must speak with raised voice (71-80 decibels) and extremely loud (over 80 decibels). And the high end Chicago Magazine merely mentions "high noise levels" at the end of its restaurant reviews.

The problem is so often cited by diners that news organizations and websites increasingly are running stories focusing solely on the noise[XV]. In January 2013, "Inside Scoop SF," a San Francisco based website, posted an explanation of how to find quiet restaurants in its reviews after a reader commented on the problem[XVI].

# Acoustics in Restaurants

## OSHA

Wait staff, bartenders and others who work in some restaurant, nightclubs and bars sometimes are at risk for hearing damage. Numerous studies have shown that noise levels do, at times, violate OSHA standards for permissible noise exposure for prolonged periods of time.

OSHA representatives can conduct noise readings at any time and employers violating OSHA regulations can be fined between $5,000 and $70,000, depending on the circumstances. For failing to rectify a known violation employers can be required to pay fines up to $7,000 a day[XVII].

It is, however, not known how often this is enforced in a restaurant, nightclub or bar environment. OSHA's permissible noise exposures range from eight hours a day at 90 dBA to 15 minutes or less at 115 dBA[XVIII].

## OPTIONS FOR NOISE CONTROL

In June 2012, Julian Treasure, a British sound expert, gave a TED talk in which he laid out the case for architects designing with their ears, as well as their eyes. He got a big rise out of his audience early on when he showed a photograph of a trendy restaurant, all high ceilings, hard, bare surfaces and close tables, noting, "That is why we end up sitting in restaurants…shouting from a foot away in an effort to be heard by our dinner companion.[XIX]"

It may be fashionable to incorporate high ceilings, metal, bare tables and floors, glass, wood and other exposed solid materials into restaurant décor, but these are just the kinds of things off of which sound bounces, reverberating and ricocheting until diners cry, "uncle," often fleeing to other venues.

When *Architecture & Design*, the online presence of Infolink Building Products News magazine, focused on acoustics, it quoted interior design consultant Kori Todd, saying that Acoustics for restaurants "are often an afterthought, but are increasingly being integrated into the design.[XX]"

It's no surprise that acoustics are gradually becoming a major feature in building design in general. In fact, acoustics now are contributing to LEED® points in various types of construction.[XXI] Manufacturers have addressed this by offering more sustainable acoustic materials, produced in more sustainable ways.

Acoustics are dependent on a variety of factors, including the shape and size of the room, materials used in it, as well as where and how they are placed. Sound absorption materials alone do little to affect noise or reduce sound transmission.[XXII] Different materials reflect and absorb sound to different degrees.[XXIII]

Acousticians typically begin their assessments with reverberation time testing, devising scenarios with varying numbers of diners. This and the calculations regarding the size and shape of the space, allow them to determine the types of products that will help them reach the desired dBA.

The goal is to improve speech clarity and intelligibility, which is done using better absorptive materials and decreasing reverberation.

When evaluating and designing acoustics for a restaurant, consultants have to take into account the fact that the noise level waxes and wanes during the day and even during a dining period.

They typically partner with all concerned parties, including, if possible, the original architect, to analyze the ceilings and walls, as well as everything in the room, paying particular attention to what and where sound absorbing treatments would be appropriate and cost effective. The quickest and easiest fix often is to reduce the number of tables and spread them further apart[XXIV], but that often is not a possibility for financial reasons.

The shape of the room explains the way sound moves around the room. Therefore, ideally, placement of acoustic materials is customized for each room and is determined by the way sound moves in that, specific space. In other words, there is no one size fits all solution[XXV].

Implementing sound absorption strategies can be tricky. Properly done, it will improve speech intelligibility and clarity; too much and space seems dead; too little and patrons complain. Different people perceive differ-

ent noise levels in their own ways. Young people tend to gravitate towards environments that are louder and noisier than they do as they age.

Many companies offer panels made of efficient, sound absorbing materials. Properly placed, i.e. on at least two surfaces, such as the ceiling and a wall, they will prevent sound waves from bouncing back and forth horizontally and vertically.[XXVI]

In addition to sound absorbing materials, sophisticated technology is able to create a “dry environment” with a significant amount of absorption. The sound system is then configured to provide a customizable range of liveliness, i.e. noise, such as music.[XXVII] An expensive, but effective solution.

**Summary**

If noise is an issue, restaurant owners have attractive, effective and affordable acoustical treatment options for their ceilings and walls. Manufacturers and acoustical consultants are well prepared to provide technical and installation guidance.

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## Acoustics Glossary

***ABCs of noise control*** – Absorb, block, cover.

***Acoustic baffles*** - Used in as part of a ceiling, acoustic baffles absorb reflected or reverberated sound. They absorb sound energy, resulting in less reverberation.

***Acoustic blades*** – Similar to acoustic baffles, they are hung vertically from a ceiling to absorb sound

***Acoustical capacity*** – The number of people needed to create a 3dB signal to noise ratio, i.e. the lower limit for sufficient quality of verbal communications under specified preconditions.

***Acoustical cloud*** – Acoustical panels installed near the ceiling of a room, such as a concert hall, to reflect sound.

***Acoustical stimulation*** - Noise

***Ambient Noise*** – All of the noise in a particular environment

***Architectural acoustics*** – A branch of acoustical engineering. Using science and engineering to attain good sound within a building. Most often designed by acoustic consultants.

***Attenuation*** – Reduction of noise or vibration; usually stated in decibels

***Audible frequency range*** – Sound frequency range normally heard by the human ear. Normally between 20 HZ and 20 kHZ, although humans are most sensitive to frequencies between 2,000 and 5,000 HZ.

***Average room absorption coefficient*** – Usually stated in Sabins (see Sabin) or metric Sabins. Total room absorption divided by total room surface area in square feet or square meters.

***A-weighting*** – Response of the human ear. It refers to a group of curves typically used to define how sound pressure levels are measured. It is applied to instrument measured sound levels as a way of accounting for the relative loudness perceived by the human ear, which is less sensitive to low audio frequencies. Units are typically written as dB(A) or dBA.

***Background noise level*** – Noise level in a room/ area, measured when the specific noise being studied is absent.

***Café effect*** – Cumulative increase in noise in a room as people raise their voices in order to be heard above background sounds.

***Cocktail party effect*** – Ability of a listener to focus on a particular conversation partner or source, despite interfering background noise.

***dB*** – Decibel (see decibel).

***dB (A)*** – A-weighted sound pressure level (see A-weighting).

***Decibel (dB)*** – Degree of loudness. Also a unit used to express the relative intensity of sounds. The scale for this ranges from zero for the least perceptible sound to approximately 130 (pain level).

***Direct sound*** – Sound reaching a given location directly, i.e. straight line from the source.

***FSTC (field sound transmission class)*** – Same as STC, but measured in the field and used to quantify actual as built partition transmission loss, incorporating corrections for the sound absorption of the room.

***Hertz (Hz)*** – Measure of sound frequency in cycles per second. The human voice, like many sounds, is com-posed of a combination of many frequencies.

***Kilohertz (kHz)*** – One kHz equals $10^3$ Hz

***Lombard effect*** – Tendency of speakers to speaker louder and at a higher pitch when there is loud noise around them in order to make themselves heard and understood.

***Lombard Reflex*** **–** Actual change in articulation in order to be heard and understood over background noise, i.e. talking louder, higher pitch and better articulation.
***Noise*** – Undesirable sound.

***Noise isolation class (NIC)*** **–** Method for rating a partition's ability to block airborne noise transfer. Also known as STC (sound transmission class) or FSTC (field sound transmission class).

***Noise reduction coefficient (NRC)*** **–** Representation of the amount of sound energy absorbed when sound strikes a particular surface. Zero (0) means all is reflected and 1 indicates all is absorbed.

***Psychoacoustics*** **–** The scientific study of sound perception; i.e. the study of the psychological and physiological responses associated with sound. Also, psychophysics.

***Privacy Index*** **–** Calculation and measurement of conversation privacy.

***Reverberation time (RT)*** **–** The time required for an average sound in a room to decrease by 60 decibels, once the source has stopped emitting a sound. It usually is expressed in seconds. Often used as the chief way to describe an acoustic environment, i.e. space with a long RT is considered a "live" environment, but one in which the sound dies down quickly is considered "dead."

***Reverberation time testing*** **–** Testing done to determine the reverberation time in varying scenarios, i.e. raised voice and normal voice with varying numbers of people present in the space. Usually done as part of determining a space's acoustic model and the products required to achieve the target dBA reduction in reverberation time.

***Sabin*** **–** Unit of acoustic sound absorption used to calculate reverberation time in a space. Named for Wallace Clement Sabine, it means that one square foot of 100 percent absorbing material equals one imperial Sabin and one square meter of 100 percent absorbing material equals one metric Sabin.

***SII*** **–** Speech intelligibility index. Replaced the AI (Articulation Index). Measurement of speech that is audible and usable for the listener. Zero (0) means none of it can be heard and/or understood. An SII of 1.0 means that all of the speech is audible and usable.

***Signal to noise ratio (SNR)*** **–** Measures the comparison of the level of a desired signal to the level of the background noise. Often expressed in decibels.

***STC (sound transmission class)*** **–** Rating of how a building partition lessens sound. Used to rate interior partitions, ceilings, floors, doors, windows and exterior wall configurations. Reflects reduction in noise a partition can provide.

***Sound*** **–** Pressure variations the ear can detect.

***Speech transmission index (STI)*** **–** Way to measure speech transmission quality.

***Threshold of hearing*** **–** Lowest sound that can be heard by the human ear.

***TL (transmission loss)*** **–** Decrease in intelligible sound as an acoustic pressure wave radiates outward from its source. The signal spreads and weakens the farther it goes.

***White noise*** **–** Random noise, containing equal power per unit of bandwidth.