

What's in a number?

Frequency is important in any dynamic system. However, we sometimes use single-number ratings – such as the NC curves or STC ratings – for convenience. In this article, Ahmad Bayat discusses some of the pitfalls of such single-number systems.



Sound and vibration can be difficult to describe. The complete and rigorous [characterization](#) of an environment is painstaking. Assumptions can often be made that allow the use a sort of shorthand in describing environments and specifying design criteria.

One common shortcut is the use of *single-number* ratings and criteria. We might say that the noise level is 45dB(A) at a particular site, or that noise levels in an office should meet NC-35. These expressions collapse the frequency spectrum into a single number. Overall noise levels, like “dB(A)” work by adding up the energy across the spectrum. NRC (noise reduction coefficient) ratings, commonly used for ceilings and acoustical panels, express the average absorption at different frequencies from 250~2000Hz. The NC (noise criterion) and STC (sound transmission class) rating systems work by comparing data to a reference spectrum and applying a simple rule.

When using these types of shorthand, it is possible to miss important details buried within those single-number ratings. In particular, we might fail to appreciate what is happening *at different frequencies* within the spectrum.

For sound and vibration, the frequency spectrum works as it does for light. Lower frequencies are like redder colors, and higher frequencies are like bluer colors. Using a single number for allowable noise is like specifying overall illumination for an office: it doesn't consider that the light shouldn't include too much of any one color or that infrared light doesn't count since we can't see it.

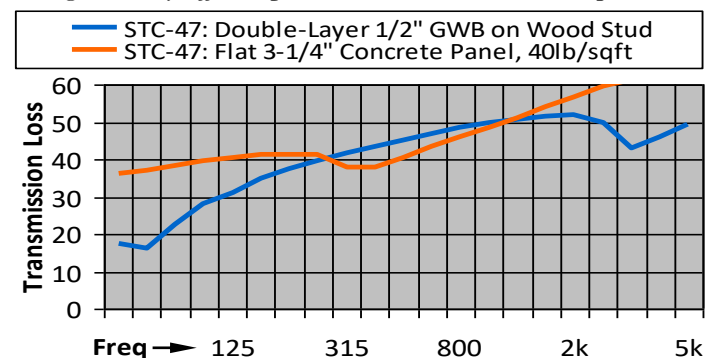
Single-number systems are handy; it's easier to talk about a *number* than a *spectrum*, but the details of the spectrum are still important. We can use the STC rating system as an example.

The STC system for building partitions makes assumptions. The source is assumed to have frequency content similar to that of the human voice, and the receiver is assumed to be sensitive in the frequency range of human hearing. The reference curve used by the system makes

assumptions about the performance of walls and windows, which provide more isolation at high than at low frequencies.

However, these assumptions aren't correct in every circumstance. For example, many animals' hearing is sensitive at much higher frequencies than humans. Scientific instruments are sometimes sensitive at frequencies far below human hearing. Even with respect to humans, modern TVs and stereos produce far more low-frequency bass than does the human voice. The STC system describing acoustical isolation was conceived in the days of transistor radio, and it was intended for use in residential settings. The system fails to address some design scenarios.

Frequency content is important when evaluating different partitions, since two different walls might have the *same* STC rating but very *different* performance at different frequencies.



The plot above shows the detailed performance of two walls: a typical gypsum board construction and a concrete panel. Both have the *same* STC rating, but their performance is *not identical*. The concrete panel might work much better in places where low-frequency sound below 300Hz is problematic; conversely, the gypsum board partition offers more acoustical isolation for human voices at 300~800Hz. Above 2kHz, the concrete panel again outperforms. Which wall is better depends on the setting.

When designing or describing a system, an understanding of the meaning and details behind single number ratings is important. *Cont. Ahmad Bayat by visiting www.va-consult.com*

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