Sound Advice

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RATING BACKGROUND NOISE IN ROOMS

By Noral D. Stewart

The steady background sound in rooms, usually from HVAC systems, has most commonly been evaluated using NC ratings developed by Beranek in 1957. The sound is measured in octave bands from 63 to 8000 Hz and plotted against a set of curves. The lowest curve the sound spectrum touches is the NC rating. The curves for a given rating allow less sound with increasing frequency. The rating numbers correspond to the curve level in the 1000-2000 Hz octaves. Actual sound spectra frequently do not match the curves, but intercept the lowest curve at a low frequency. Thus, the actual sound at 1000-2000 Hz is often less than the NC rating. The overall sound is less than expected based on the rating, but the sound may be unpleasant.

In 1971, Beranek, Blazier, and Figwer introduced PNC curves to resolve some problems with the NC curves. These extended the range to 32 Hz and required less sound at the lowest and highest frequencies for a more pleasing spectrum. These curves were never widely accepted.

Blazier introduced a very different RC system in 1981, primarily to rate noise in offices. It responded to problems below 63 Hz, provided a numerical rating based on speech interference, and provided descriptors to indicate a rumbly or hissy nature. The numerical rating of the sound is the arithmetic average of the octave-band levels at 500, 1000, and 2000 Hz. The curves, which are straight lines, are used only to evaluate the quality of the sound. A major appeal of the system is its simplicity. This system extended criteria to 16 Hz though many believe it is too restrictive for sound below 63 Hz. It was intentionally made restrictive in this range because of common experience with fluctuating rumble in offices. Blazier has recognized the lowest curves could be too restrictive and did not even extend it below RC 25. The original system also did not identify some problems due to excessive noise in the 125-250 Hz region.

Beranek sought to overcome some of the problems of the RC system with the NCB curves introduced in 1987. This system adopts several principals of the RC system, but uses curves that are not straight lines. The numerical rating is determined by the arithmetic average of levels in the 500, 1000, 2000, and 4000 Hz octaves. Thus, for the same sound, the NCB rating is lower than the RC rating. This system can be used for very quiet spaces. It is much less restrictive than the RC system below 63 Hz. This is appropriate for quieter spaces since low levels of rumble are below the threshold of hearing quieter spaces tend to have well-designed systems that do not fluctuate. However, many believe the rumble criteria are not restrictive enough for louder areas such as offices.

Blazier introduced RC Mark II in 1997 to overcome some of the problems of the RC system. The primary problem addressed was the failure of RC to identify roar problems in the 125-250 Hz. region. It introduces a Quality Assessment Index to rate sound quality that requires a program to easily evaluate. The RC Mark II procedure also further restricts sound at 16 Hz, except at lower rating levels where some restrictions at the lowest frequencies are relaxed. ASHRAE recommends use of RC Mark II for critical evaluations but allows NC methods for normal design goals.

In 2007 Schomer introduced the RNC rating method in an effort to resolve the differences between NCB and RC. The curves are similar to the NCB curves but there is a penalty for low-frequency fluctuating noise. This requires that the fluctuation be measured in a specific way. The RNC method is difficult to use. ANSI S12.2-2008 Criteria for Room Noise recognizes the NC and RNC methods as well as A-weighted sound level.