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Application of Sone Loudness Ratings for Non-Ducted Air Moving Devices

AIR MOVEMENT AND CONTROL ASSOCIATION INTERNATIONAL, INC.

The International Authority on Air System Components

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Application of Sone Loudness Ratings for Non-Ducted Air Moving Devices

1. Purpose

The loudness of a sound as heard by the human ear depends not only upon the overall intensity of the sound, but on its frequency distribution as well. The ear acts as an analyzer, determining the loudness in a rather complicated way from the sound intensities at the various frequencies. This loudness can be measured by making a proper summation of the sound intensity in each of eight octave bands, and the resulting units are called “sones.” By definition, one “sone” is the loudness of a sound with a frequency of 1000 cycles per second and a sound pressure of 0.02 microbar. Practically, one sone is approximately equal to the loudness of a quiet refrigerator in a quiet kitchen.

The sone scale is linear to the human ear. A sound of 20 sones is twice as loud as one of 10 sones. Because of its linearity, and because it is related to loudness as perceived by the ear, the sone is used as a single number method of rating the sound output of non-ducted fans and power ventilators. Within the present state of the art, when comparing sone loudness ratings, differences of ±6% or less are not considered significant.

The AMCA method of rating in sones gives the loudness at a distance of 5 feet from the unit in free space with no nearby reflecting surfaces. Most practical applications, however, will involve the determination of total loudness within a room.

The charts and formulae given in this bulletin are for the purpose of estimating the loudness of fans as installed, and take into consideration room size and acoustical qualities as well as the number and loudness ratings of the fans. It will be necessary to know the acoustical characteristics of other noise sources within the room to be able to estimate the total loudness of all sources. For the addition of sounds, it is assumed that the noise spectrums are similar. The room effect chart is for the reverberant field in the room, and applies everywhere except in the space near the fan. Within this space, the direct sound field can be estimated and added to the reverberant field to obtain total loudness.

The sound pressure level in a room as measure by a Sound Level Meter on the “A” network, (dBA) can be estimated by use of the Loudness -dBA correlation chart. This chart gives the relationship between loudness in sones and dBA levels for normal fan spectrums within ±2 dBA, which is about the same order as experimental errors in sound measurements. It must be emphasized that this correlation applies only after the calculation for room effect and direct sound field have been completed and does not apply to the fan alone.

2. Suggested Limits for Room Loudness

2.1 Auditoriums and music halls

1	to	3	Concert and opera halls
1.5		5	Legitimate theaters
2		6	Movie theaters
2		6	Semi-outdoor amphitheaters
2		6	Lecture halls
1.5		5	Multi-purpose
3		9	Courtrooms
4		12	Auditorium lobbies
2		6	T.V. audience studios

2.2 Churches and schools

1.7	to	5	Sanctuaries
2.5		8	Schools and classrooms
4		12	Recreation halls
6		18	Kitchens
2		6	Libraries
4		12	Laboratories
5		15	Corridors and halls

2.3 Hospitals and clinics

1.7	to	5	Private rooms
2.5		8	Wards
4		12	Laboratories
2.5		8	Operating Rooms
4		12	Lobbies and waiting rooms
4		12	Halls and corridors

2.4 Hotels

4	to	12	Lobbies
8		24	Banquet rooms
3		9	Ball rooms
2		6	Individual rooms or suites
7		21	Kitchen and laundries
4		12	Halls and corridors
6		18	Garages