SPACE SOUND LEVELS IN THE APPLICATION OF AIR TERMINALS AND AIR OUTLETS @ PROJECT MADRASETNA studios

Approved by:
Prof./ Ibrahim El-Noshokaty.

CEO Enoshmink Technology.
CTO Technical committee ASA.

Checked by:
Dr : shaimaa Ragaey.

R&D Department :
Eng: Ahmed taha.

Section 1. Purpose

1.1 Purpose.

The purpose of this Study is to provide a consistent industry-accepted method for estimating Sound Pressure Levels in a conditioned occupied space for the application of Air Terminals and air outlets.

1.1.1 Intent.

This standard is intended for the guidance of the industry, including manufacturers, engineers, installers, contractors, and users.

1.1.2 Review and Amendment.

This standard is subject to review and amendment as technology advances.

Section 2. Scope

2.1 Scope.

This standard includes sound levels from most but not all components in the air distribution system. Air Terminals, air outlets, and the low-pressure ductwork which connects them are considered as sound sources and are the subject of this Standard.

This Standard does not make provisions to estimate space sound level contributions from the central system fan, ductwork upstream of the Air Terminal, equipment room machinery, or exterior ambient sound.

This Standard is not currently applicable for underfloor radiated or discharge sound calculations. this study does not provide for the determination of sound power in The methods described in this Standard can be used to identify acoustically critical paths in the system design. The design effects of inserting alternative components and changes in the system can be evaluated. The accuracy of evaluating the difference in sound pressure between two alternatives is greater than individual estimations.

Section 3. Definitions

All terms in this document follow the standard industry definitions in the current edition of ASHRAE Terminology of Heating, Ventilation, Air Conditioning and Refrigeration unless otherwise defined in this section.

3.1 Air Terminal (Terminal).

A device that modulates the volume of air delivered to a conditioned space in response to a given load. The various types of Air Terminals are defined as follows:

3.1.1 Bypass Terminal.

Air Terminal that diverts excess primary air to the return.

3.1.2 Integral Diffuser Terminal.

Diffuser with the features of an Air Terminal.

3.1.3 Dual Duct Terminal.

Air Terminal with two supply inlets that is used primarily for mixing cold and warm air streams at varying proportions.

3.1.4 Induction Terminal.

Air Terminal that supplies varying proportions of primary and induced air. 3.1.5 Parallel Flow Fan-Powered Terminal. Air Terminal in which primary airflow is modulated in response to the cooling demand and in which the integral fan is operated to deliver induced air.

3.1.6 Reheat Terminal.

Air Terminal that heats a single source of supply air.

3.1.7 Series Flow Fan-Powered Terminal.

Air Terminal in which the primary air flow is modulated and mixed with induced air by a continuously operated integral fan to provide a relatively constant volume discharge. 3.1.8 Single Duct Terminal. Air Terminal supplied with one source of primary air.

3.2 Ceiling/Space Effect.

Attenuation of Sound Power transmitted to an occupied space from above the ceiling as a result of the ceiling itself and the size of the space above the ceiling.

3.3 Duct Breakout.

The sound is associated with fan or airflow noise that radiates through the duct walls into the surrounding area.

3.4 Environmental Adjustment Factor.

Difference between Sound Power Levels measured using a free field calibrated reference sound source and a reverberant field calibrated reference sound source. Sound Power measured in accordance with ASHRAE Standard 130 is based upon a free field calibrated reference sound source and the Environmental Adjustment Factors are used to correct these values to those using a reverberant field calibrated reference sound source because building spaces more closely represent a reverberant sound field.

3.5 Equivalent Diameter.

Diameter of a circular equivalent of any duct for equal cross-sectional areas. 3.6 Insertion Loss. Reduction in observed Sound Pressure Level caused by installation of an Air Terminal, ductwork, or silencer.

3.7 Noise.

Any unwanted sound.

3.7.1 Background Noise.

Total noise that interferes with the measurement of the particular sound of interest which may include airborne sound, structure borne vibrations, and electrical noise in instruments.

3.8 Noise Criteria (NC).

Standard curves used to describe a spectrum of measured Sound Pressure Levels with a single number.

3.9 Octave Band.

Frequency band with an upper band limit that is twice the frequency of the lower band limit. The mid frequency (center frequency) of an octave band is the geometric mean of its upper and lower band limits. The octave band mid frequencies of interest are listed in Table 1

3.10 Published Ratings.

A statement of the assigned values of those performance characteristics, under stated rating conditions, by which a unit may be chosen to fit an application. These values apply to all units of like nominal size and type produced by the same manufacturer. As used herein, the term Published Rating includes the rating of all performance characteristics shown on the unit or published in specifications, advertising or other literature controlled by the manufacturer, at stated rating conditions.

Table 1. Octave Band Mid Frequencies

Octave Band	Mid Frequency, Hz
1	63
2	125
3	250
4	500
5	1000
6	2000
7	4000
8	8000

3.10.1 Standard Rating.

A rating based on tests performed at standard rating conditions.

3.10.2 Application Rating.

A rating based on tests performed at application rating conditions (other than standard rating conditions).

3.11 Reverberation Room.

A test room with highly reflective surfaces that is designed to create a nearly homogeneous field of sound for the measurement of Sound Power Levels of a sound source.

3.12 Room Criteria (RC).

Standard curves used to describe a well balanced spectrum of measured Sound Pressure Levels with a single number.

3.17 Sound Power Level (Lw).

In a specified frequency band, ten times the common logarithm of the ratio of the Sound Power radiated by the sound source under test to the standard reference sound power of 10-12 Watt, dB.

3.18 Sound Pressure.

In a specified frequency band, a fluctuating pressure superimposed on the static pressure by the presence of sound.

3.19 Sound Pressure Level (Lp).

In a specified frequency band, 20 times the common logarithm (base 10) of the ratio of the Sound Pressure radiated by the noise source under test to the standard reference pressure of 20 μ pascals, dB.

3.20 Source-Path-Receiver Process.

The sound estimating method used in this Standard. In this process, a given Source of sound travels over a given Path to an occupied space where a Receiver hears the sound produced by the Source as in Table 3. Air Terminals and outlets are examples of sound Sources. The sound travels over one or more Paths where attenuation takes place. A person in the occupied space hears the noise at the Receiver's location.

3.21 Space Effect.

Attenuation of Sound Power entering a space as a result of the absorption properties of the space and the distance from the sound source to the receiver

Section 5. Description of Sound Estimating Method

5.1 Introduction.
The sound estimating method used in this standard is based on a simple process called Source-Path-Receiver. A given Source of sound travels over a given Path to an occupied space where a Receiver hears the sound produced by the Source.

5.2 Outline of the Sound Pressure Estimating Procedure.
This standard estimate space Sound Pressure Levels when the acoustic performance of Air Terminals and/or outlets is known. A second use of the standard is to estimate the maximum permissible Sound Power Level from a terminal device so that a selected acoustical design criterion (NC or RC) will not be exceeded.

5.3 Four steps are required to estimate Sound Pressure Levels by Octave Band:

5.4 Obtain Air Terminal or outlet Sound Power Levels at the specific unit operating point(s).
Source: Manufacturer's Data.

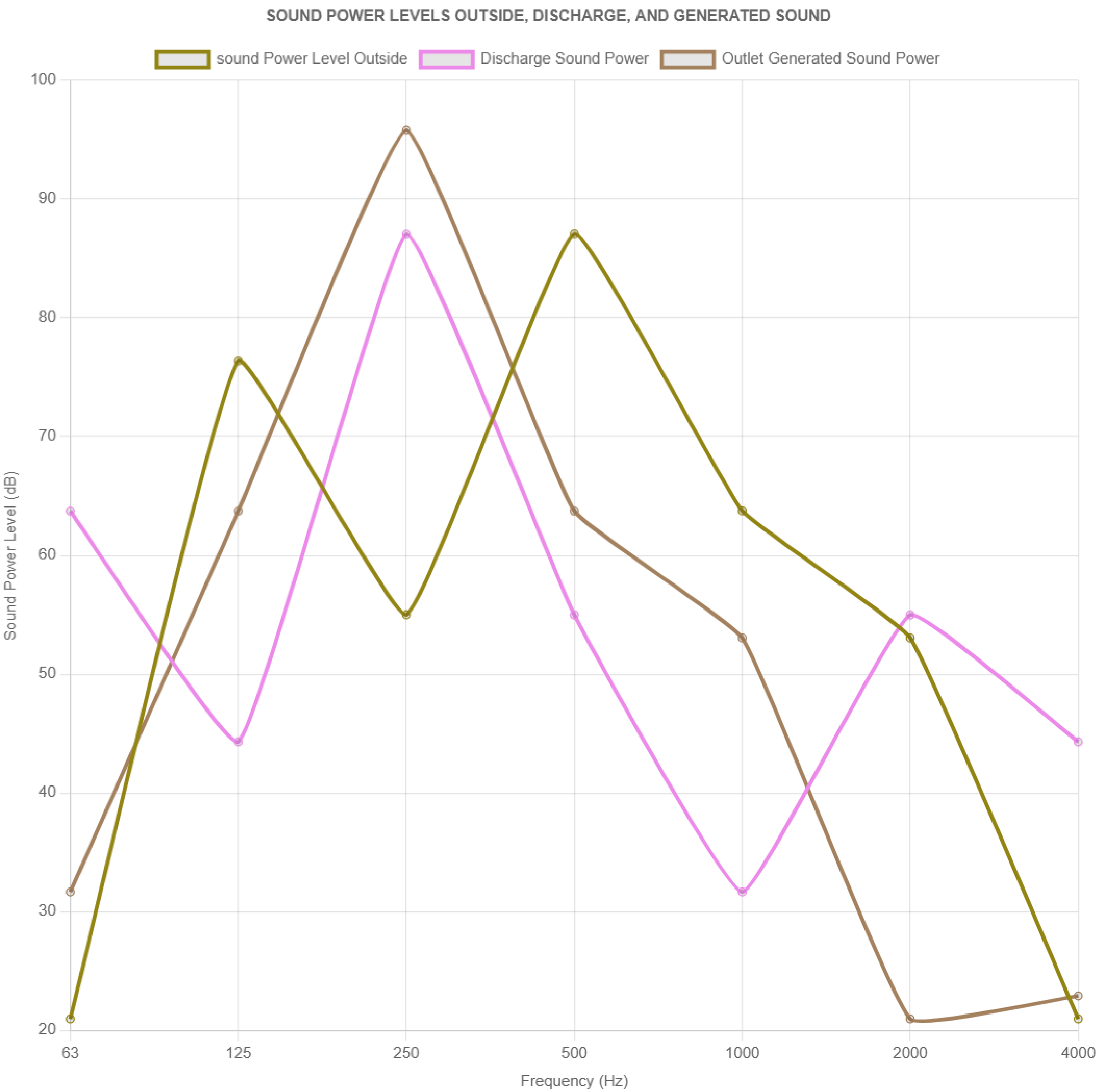
5.5 Identify the sound paths to be evaluated. Source:
Acoustic Model.

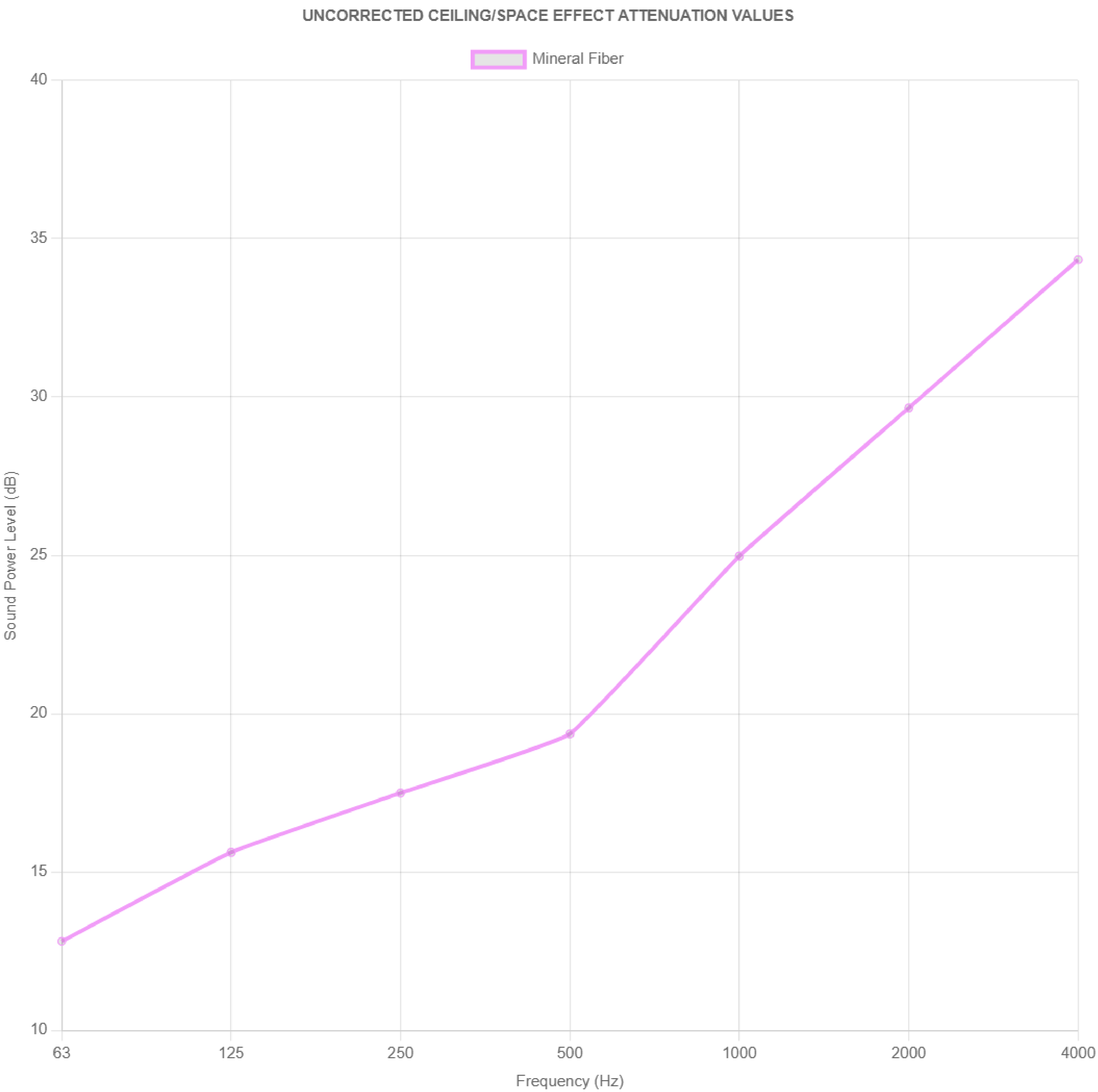
5.6 Determine the attenuation path factors for each path. Source:

5.7 Logarithmically add the acoustic contribution from each sound path to determine the overall Sound Pressure Level.

5.8 Acoustical Models.
The models identify receiver sound paths and graphically illustrate the process of sound level prediction.

5.9 Upstream Sound Sources.
This standard does not take into consideration sound breaking out of the inlet ducts to Air Terminal devices as shown (by the dashed-line arrow) in the upstream duct breakout radiated path in. Sound emitted from this element can come from these sources:


SOUND POWER LEVELS OUTSIDE, DISCHARGE, AND GENERATED SOUND
sound Power Level Outside
Discharge Sound Power
Outlet Generated Sound Power
Sound Power Level (dB)
100
90
80
70
60
50
40
30
20
63
125
250
500
1000
2000
4000
Frequency (Hz)



UNCORRECTED CEILING/SPACE EFFECT ATTENUATION VALUES
Mineral Fiber
40
35
30
25
20
15
10
Sound Power Level (dB)
63
125
250
500
1000
2000
4000
Frequency (Hz)