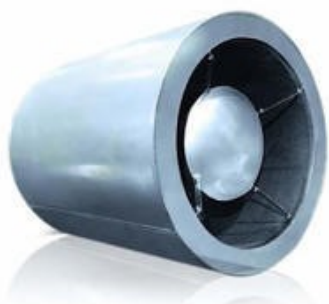




شركة مصنع عالم الناصريه المحدودة
AL NASSERIAH WORLD FACTORY COMPANY LTD

SOUND ATTENUATORS





Introduction :

HVAC equipment is one of the major sources of noise in a building, and its effect on the interior acoustical environment is important. Further, noise from outside equipment often propagates to the community. Therefore, mechanical equipment must be selected, and equipment spaces designed, with an emphasis on both the intended uses of the equipment and the goal of providing acceptable sound levels in the occupied spaces of the building in which the equipment is located and in the community. Furthermore, operation of HVAC equipment causes vibrations that can propagate into occupied spaces. Vibration can create uncomfortable conditions for occupants, and often creates secondary noise sources (e.g., vibrating walls, floors, piping and ducts).

Noise propagates from the sources through the air distribution duct systems, through the structure, and through a combinations of paths, reaching the occupants. Components of the mechanical system (e.g., fans, dampers, diffusers, junctions) may all produce sound by the nature of the airflow through and around them. As a result, almost all components must be considered. Because sound travels effectively in the same or the opposite direction of the airflow, downstream and upstream paths.

Engineers installing HVAC systems therefore have to find a way of keeping the residential and commercial HVAC systems silent so they do not make distracting noise when running. Sound attenuators, also called noise attenuators or mufflers, are used to keep the systems silent.

Noise attenuators have sound absorbing insulation inside to keep the sound down. Acoustic insulation inside the noise attenuator contains millions of air pockets that absorb the acoustic energy as it passes, reducing the noise.

The insulation inside the attenuators vary in thickness and density depending on the frequency of the sound produced. Increasing the baffle thickness enhances sound attenuation, but increases the pressure drop in the HVAC system. Moreover increasing length of the sound attenuator will enhance the sound attenuation without effecting the pressure in the HVAC system.

Definitions :

- **Attenuation** : is the gradual loss in intensity of any kind of flux through a medium.
- **Noise** : is unwanted sound considered unpleasant, loud or disruptive to hearing. From a physics standpoint, noise is indistinguishable from sound, as both are vibrations through a medium, such as air or water.
- **Noise Criteria (NC)** : are a common way to measure and specify background noise in unoccupied buildings and spaces. Their purpose is to produce a single-value representation of a complete sound spectrum.
- **Acoustic absorption** : refers to the process by which a material, structure, or object takes in sound energy when sound waves are encountered, as opposed to reflecting the energy.
- **Insertion loss** : describes the acoustic (noise reduction) performances of a muffler-like system.
- **Pressure Drop** : is defined as the difference in total pressure between two points of a fluid carrying network. A pressure drop occurs when frictional forces, caused by the resistance to flow, act on a fluid as it flows through the tube.
- **Decibel (dB)** : is a relative unit of measurement corresponding to one tenth of a **bel (B)**. It is used to express the ratio of one value of a power or field quantity to another.
- **Frequency** : the number of occurrences of a repeating event per unit of time.
- **Hertz (Hz)** : the standard unit of frequency in the International System of Units (SI), equal to one cycle per second.
- **Duct borne noise** : generated by the flow of air and is directly dependent on the velocity of air. This component of the noise (sometimes called regenerated noise) propagates along the ductwork, follows all transitions and takeoffs, and ultimately exits at the diffuser or grille.
- **Octave bands** : a type of frequency band, are a convenient way to measure and describe the various frequencies that are part of a sound. A frequency band is said to be an octave in width when its upper band-edge frequency, f_2 , is twice the lower band-edge frequency, f_1 : $f_2 = 2 f_1$.
- **A-weighting** : the most commonly used of a family of curves defined in the International standard IEC 61672:2003 and various national standards relating to the measurement of sound pressure level.
- **Sound Power Level** : or acoustic power is the rate at which sound energy is emitted, reflected, transmitted or received, per unit time.
- **Sound Power Level (SWL)** : characterizes the intrinsic acoustic power of an acoustic noise source.
- **Sound Power Level (SPL)** : characterizes the acoustic noise level observed at a certain distance from the source in a certain acoustic environment.
- **Sound Pressure** : acoustic pressure is the local pressure deviation from the ambient (average or equilibrium) atmospheric pressure, caused by a sound wave.
- **Acoustic insulation** : sound insulation, is a form of insulation that provides sound-proofing, preventing or reducing the transference of noise between rooms and from inside a building to outside and vice versa.
- **Sound Baffle** : is a construction or device which reduces the strength (level) of airborne sound. Sound baffles are a fundamental tool of noise mitigation, the practice of minimizing noise pollution or reverberation.

ANA Rectangular Sound Attenuator

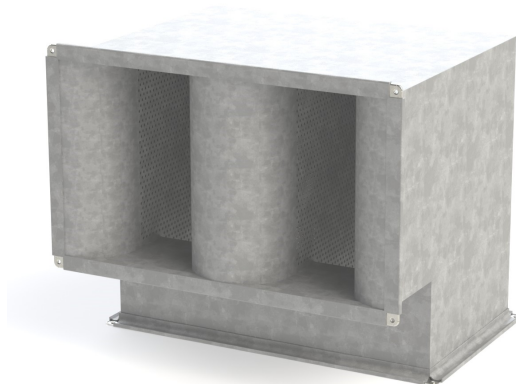
Model : NSA-R



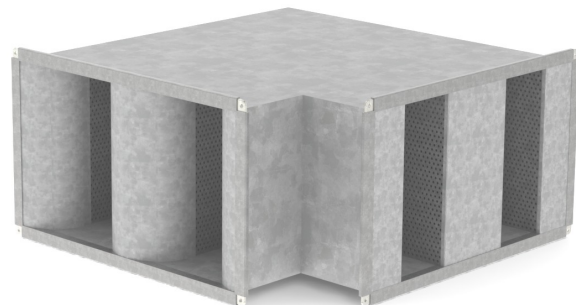
- Case is constructed from galvanized steel sheet **G90**, with a thickness of (**gauge 20**).
- Triangular baffle Inlet to minimize the pressure drop, rectangular outlet and can be made cylindrical, covers around 50% of the free area with a thickness of (**15-20-25 cm**) or in between for each baffle.
- Fiber glass with a density of (24 kg/m^3), and covered with a perforated sheet to reduce the noise and turbulence of the flow.
- Duct Mate Flange connection is our standard, for heavy weight fixation.

ANA Bend Vertical & Horizontal Sound Attenuator

Model : NSA-B



NSA-B-V



NSA-B-H

- Case is constructed from galvanized steel sheet **G90**, with a thickness of (**gauge 20**).
- Cylindrical baffle Inlet to minimize the pressure drop, rectangular outlet and can be made triangular or cylindrical, covers around 50% of the free area with a thickness of (**15-20-25 cm**) or in between for each baffle.
- Fiber glass with a density of (24 kg/m^3), and covered with a perforated sheet to reduce the noise and turbulence of the flow.
- Duct Mate Flange connection is our standard.

ANA Circular Sound Attenuator

Model : NSA-C



NSA-C-P

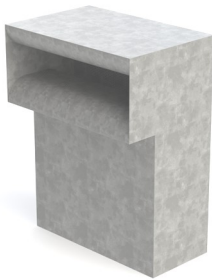


NSA-C-O

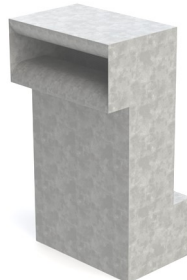
- Case is constructed from galvanized steel sheet **G90**, with a thickness of (**gauge 20**).
- For higher performance we can add an aero dynamically designed pod or else it will be without pod.
- Fiber glass with a density of (24 kg/m^3), and covered with a perforated sheet to reduce the noise and turbulence of the flow.
- Holes will be provided on both sides of sound attenuator in order to connect with fan or in duct applications.

ANA Cross-Talk Sound Attenuator

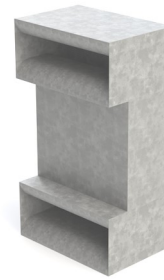
Model : NSA-CT



NSA-CT-L



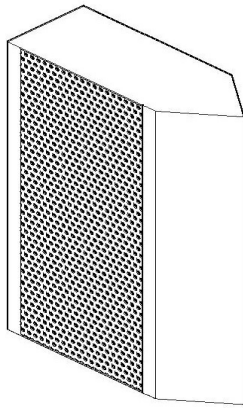
NSA-CT-Z



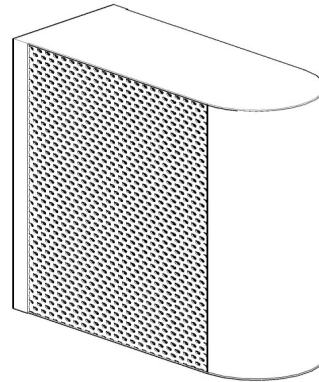
NSA-CT-C

- Case is constructed from galvanized steel sheet **G90**, with a thickness of (**gauge 20**).
- Triangular baffle Inlet to minimize the pressure drop, rectangular outlet and can be made cylindrical.
- Fiber glass with a density of (24 kg/m^3), and covered with a perforated sheet to reduce the noise and turbulence of the flow.
- Cross-talk attenuators are used in low velocity air streams for limited or narrow spaces.
- 60% free area set as minimum to avoid pressure drops.
- Types :
 1. Z-model : Minimize sound transmission through a wall or door.
 2. L-model : Reducing unwanted noise entering a space a common plenum, shaft or corridor.
 3. U-model : Prevent noise transfer between rooms through the false ceiling.

Baffle construction and details



Triangular Inlet - Standard



Cylindrical Inlet - Optional



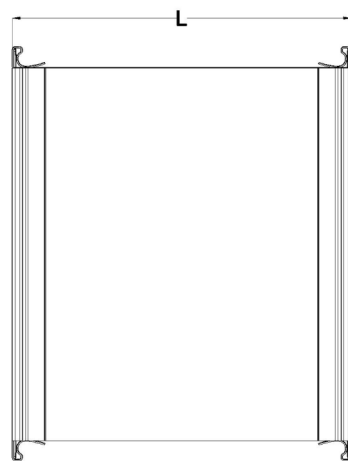
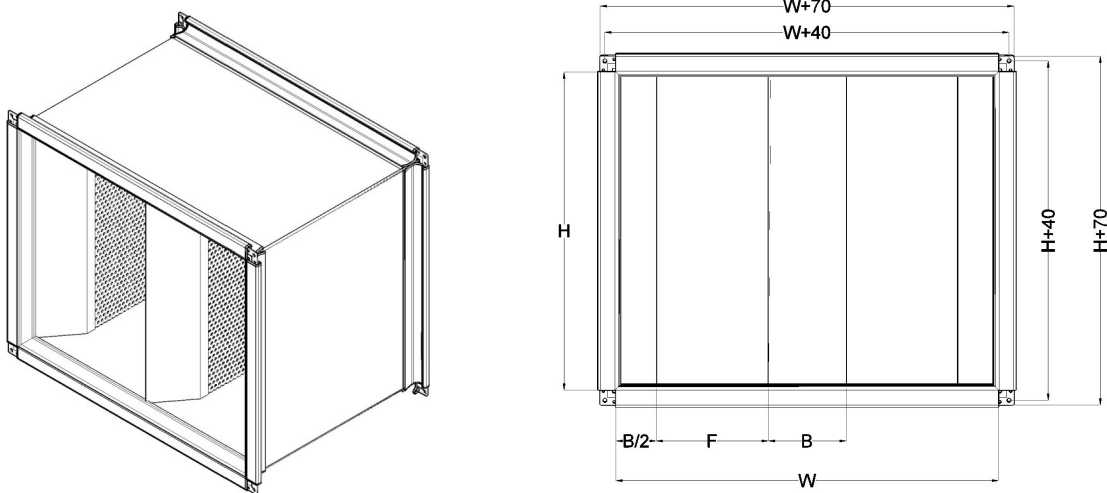
- Baffle is constructed from galvanized steel sheet **G90**, with a thickness of **(gauge 20)** and standard shape is Aerodynamic cylindrical shape and Triangular Baffle option is available upon request.
- Two sides of baffles are covered with perforated sheet to protect insulation from erosion
- Baffle is filled with fiber glass with 25mm thickness and density of 24kg/m³ as standard and other options are available (32kg/m³, 48kg/m³) with different thickness in order to absorb more noise and the baffle meets the below international standards.

1. Acoustic performance : ASTM C 1071 - ASTM C432-77
2. Fire resistant : NFPA 90A
3. Surface Burning Characteristics : UL723-ASTM C550
4. Moisture absorption : ASTM D2020-UL 181

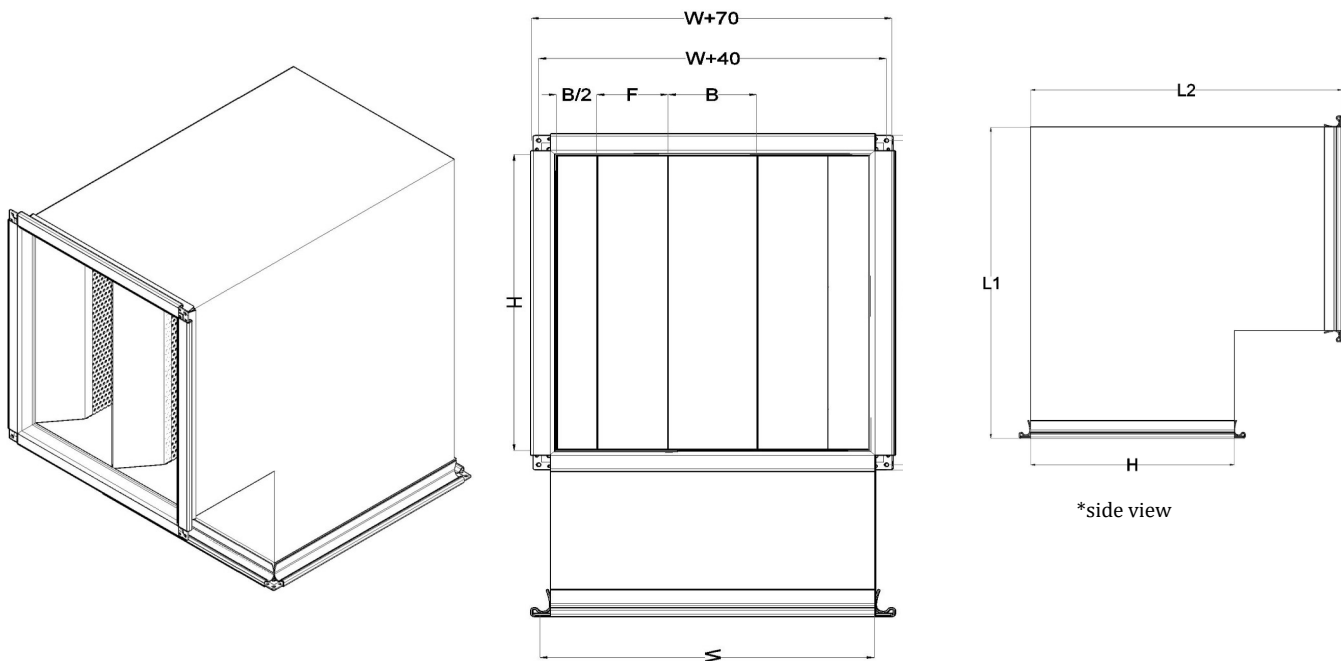
SOUND ATTENUATORS

ANA Sound Attenuator Dimensions

Rectangular Sound Attenuator

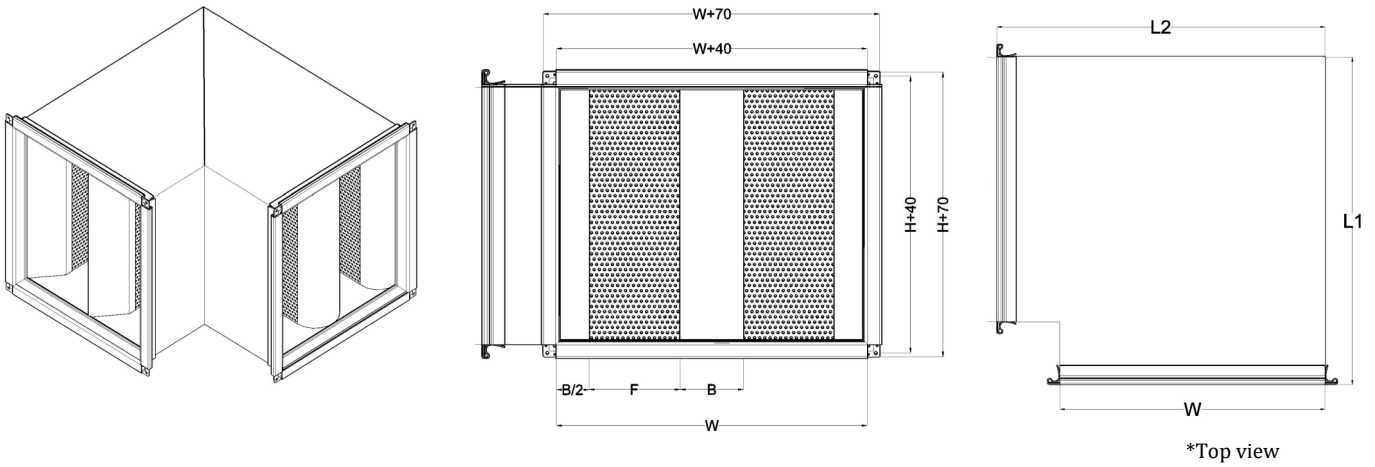


Bend Vertical Sound Attenuator

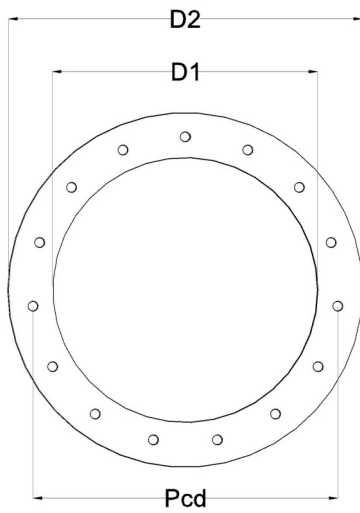


SOUND ATTENUATORS

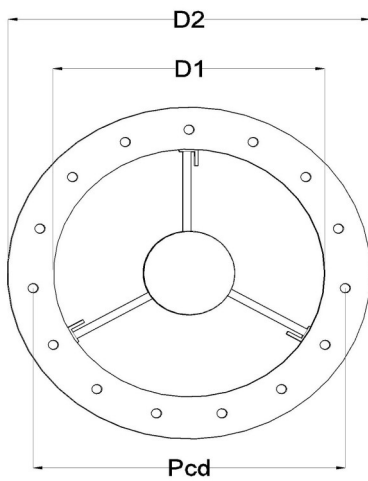
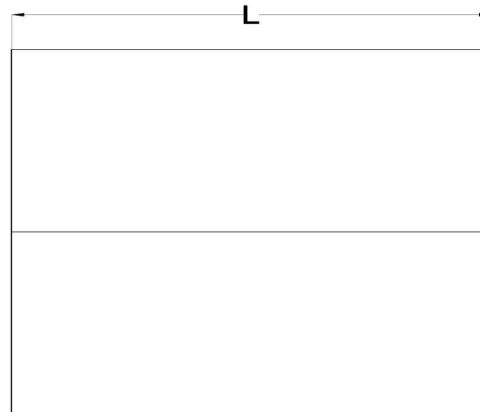
Bend Horizontal Sound Attenuator



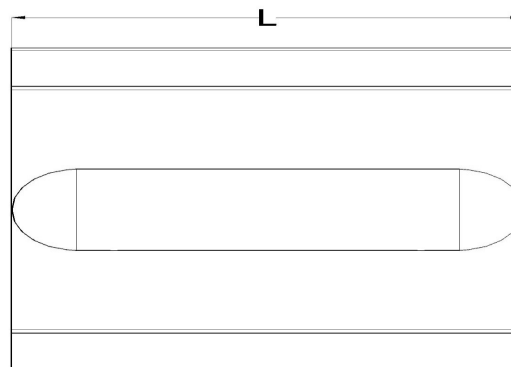
Circular Sound Attenuator



NSA-C-0



NSA-C-P



*D1 - Inner Diameter
*D2 - Outer Diameter
*Pcd - Pitch Circle Diameter

SOUND ATTENUATORS

Recommended Noise Criteria - NC

| Type of Room - Space Type | Recommended NC Level NC Curve | Equivalent Sound Level dB _A |
|-----------------------------------|----------------------------------|---|
| Residences | | |
| Apartment Houses | 25-35 | 35-45 |
| Assembly Halls | 25-30 | 35-40 |
| Churches | 30-35 | 40-45 |
| Courtrooms | 30-40 | 40-50 |
| Factories | 40-65 | 50-75 |
| Private Homes, rural and suburban | 20-30 | 30-38 |
| Private Homes, urban | 25-30 | 34-42 |
| Hotels/Motels | | |
| - Individual rooms or suites | 25-35 | 35-45 |
| - Meeting or banquet rooms | 25-35 | 35-45 |
| - Service and Support Areas | 40-45 | 45-50 |
| - Halls, corridors, lobbies | 35-40 | 50-55 |
| Offices | | |
| - Conference rooms | 25-30 | 35-40 |
| - Private | 30-35 | 40-45 |
| - Open-plan areas | 35-40 | 45-50 |
| - Business machines/computers | 40-45 | 50-55 |
| Hospitals and Clinics | | |
| - Private rooms | 25-30 | 35-40 |
| - Operating rooms | 25-30 | 35-40 |
| - Wards | 30-35 | 40-45 |
| - Laboratories | 35-40 | 45-50 |
| - Corridors | 30-35 | 40-45 |
| - Public areas | 35-40 | 45-50 |
| Schools | | |
| - Lecture and classrooms | 25-30 | 35-40 |
| - Open-plan classrooms | 35-40 | 45-50 |
| Others | | |
| Movie motion picture theaters | 30-35 | 40-45 |
| Libraries | 35-40 | 40-50 |
| Legitimate theaters | 20-25 | 30-65 |
| Private Residences | 25-35 | 35-45 |
| Restaurants | 40-45 | 50-55 |
| TV Broadcast studios | 15-25 | 25-35 |
| Recording Studios | 15-20 | 25-30 |
| Concert and recital halls | 15-20 | 25-30 |
| Sport Coliseums | 45-55 | 55-65 |
| Sound broadcasting | 15-20 | 25-30 |

SOUND ATTENUATORS

ANA Indoor Acoustic Analysis for Sound Attenuator Selection

ANA has a highly qualified technical team to do the Indoor Acoustic Analysis study which meets the standard recommended noise levels and provides the required sound attenuator dimensions.

Required data :

- Technical data sheet of the Units (AHU, PACU, FCU, HRU) which shows the air flow and Sound Power Level (SWL) at different octave band center frequency (63Hz to 8K Hz).
- HVAC AutoCAD drawing which includes Unit Location, Duct and Duct Branches, Air Outlets with dimensions and air flow.
- Provide us If there is any special requirements according to the project in order to provide the suitable selection.



INDOOR ACOUSTIC ANALYSIS FOR SOUND ATTENUATORS

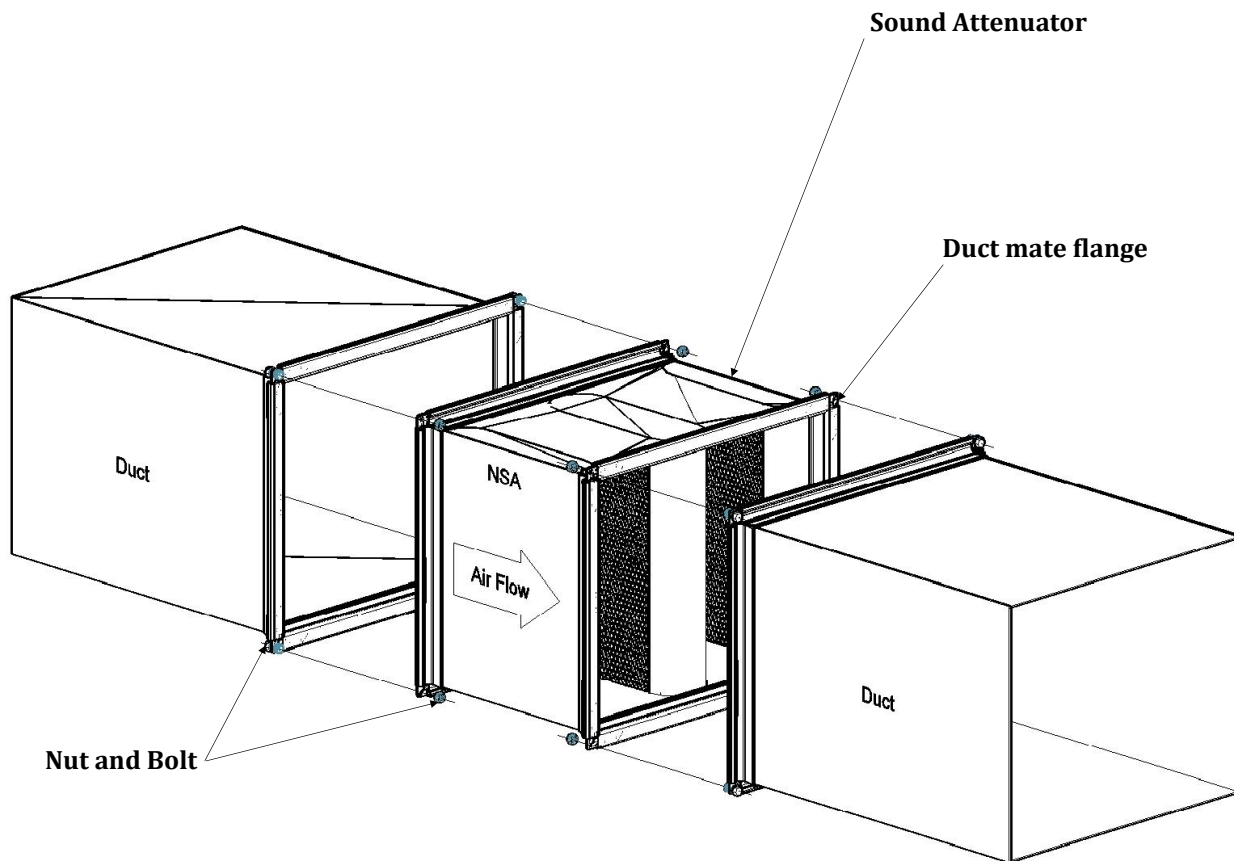
Project:
Client:

Date: 14/11/2020
Location: Roof
System: RTU-01 Mezzanine Floor
Tag: RTU-01S

| (Supply) | | | 2400 | LPS | OCTAVE BAND CENTER FREQUENCY, HZ | | | | | | | | |
|---|----------------------------|---------------------|---------------|-------|----------------------------------|-------|-------|---------------|-------|-------|-------|-------|-------|
| Qty. | | | 1 | | 63 | 125 | 250 | 500 | 1K | 2K | 4K | 8K | |
| Source Sound Power Level (SWL) | | | | dBA | 78.6 | 49.6 | 61.1 | 69.1 | 74.1 | 74.6 | 72.1 | 68.1 | 61.1 |
| Small Duct Dimensions (B) | B (mm) | Length (M) | | | | | | | | | | | |
| | 650 | 6.36 | | 4.2 | 4.2 | 2.1 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 |
| | 400 | 4.621 | | 3.0 | 3.0 | 2.3 | 1.5 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 |
| | 350 | 1.021 | | 0.7 | 0.7 | 0.5 | 0.3 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 |
| | 300 | 0.31 | | 0.2 | 0.2 | 0.2 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 |
| | | | | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Radiussed Elbow Width size (B) | B (mm) | Qty | | | | | | | | | | | |
| | 650 | 0 | | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | 400 | 3 | | 0.0 | 0.0 | 0.0 | 3.0 | 6.0 | 9.0 | 9.0 | 9.0 | 9.0 | 9.0 |
| | 350 | 1 | | 0.0 | 0.0 | 0.0 | 1.0 | 2.0 | 3.0 | 3.0 | 3.0 | 3.0 | 3.0 |
| | 300 | 2 | | 0.0 | 0.0 | 0.0 | 2.0 | 4.0 | 6.0 | 6.0 | 6.0 | 6.0 | 6.0 |
| Additional Attenuation | Plenum Box with duct liner | | | 2.0 | 3.0 | 4.0 | 5.0 | 7.0 | 7.0 | 8.0 | 8.0 | 8.0 | 8.0 |
| | | | | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Flexible Duct Size (in.) | 12 | End reflection loss | | 13.0 | 8.0 | 4.0 | 1.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Sound Power Level Leaving System (SWL) | | | | | 26.5 | 42.0 | 56.1 | 59.1 | 53.2 | 44.7 | 39.7 | 32.7 | 32.7 |
| Percentage Leaving Outlet | | LPS | 207 | 9% | -10.6 | -10.6 | -10.6 | -10.6 | -10.6 | -10.6 | -10.6 | -10.6 | -10.6 |
| Room height (m) | | | 3.5 | | -15.6 | -15.6 | -15.6 | -15.6 | -15.6 | -15.6 | -15.6 | -15.6 | -15.6 |
| Directivity + | Middle of Ceiling | Size | 600x600 | | 3.0 | 5.0 | 6.0 | 7.0 | 8.0 | 9.0 | 9.0 | 9.0 | 9.0 |
| Direct SPL | | | | | 3.2 | 20.7 | 35.8 | 39.9 | 35.0 | 27.5 | 22.5 | 15.5 | 15.5 |
| Percentage Reaching the room - | | LPS | 1656 | 69% | -1.6 | -1.6 | -1.6 | -1.6 | -1.6 | -1.6 | -1.6 | -1.6 | -1.6 |
| Volume (m) ³ - | | 632.83 | Perimeter (m) | 54.80 | -14.0 | -14.0 | -14.0 | -14.0 | -14.0 | -14.0 | -14.0 | -14.0 | -14.0 |
| Reverberation time (sec.) + | | | | | 0.7 | 0.7 | -1.4 | -2.3 | -3.3 | -3.5 | -3.0 | -3.0 | -3.0 |
| Reverberant SPL | | | | | 11.5 | 27.0 | 39.1 | 41.2 | 34.3 | 25.6 | 21.1 | 14.1 | 14.1 |
| Resultant Sound Pressure Level (Without SA) | | | dBA | 43.1 | 12.1 | 28.0 | 40.8 | 43.6 | 37.7 | 29.6 | 24.8 | 17.8 | 17.8 |
| Required Noise Criteria | | | | NC 30 | 57.0 | 48.0 | 41.0 | 35.0 | 31.0 | 29.0 | 28.0 | 27.0 | 27.0 |
| Safety Factor + | | | | | 3.0 | 3.0 | 3.0 | 3.0 | 3.0 | 3.0 | 3.0 | 3.0 | 3.0 |
| Insertion Loss Requirement | | | | | -41.9 | -17.0 | 2.8 | 11.6 | 9.7 | 3.6 | -0.2 | -6.2 | -6.2 |
| Sound Attenuator Selection: | | | | | OCTAVE BAND CENTER FREQUENCY | | | | | | | | |
| Selected Insertion Loss of Sound Attenuator | | | | | RS-165 | 63 | 125 | 250 | 500 | 1K | 2K | 4K | 8K |
| Number of Modules | | 3 | Module width | | 170 | 5.0 | 8.0 | 12.0 | 21.0 | 24.0 | 22.0 | 16.0 | 14.0 |
| | | | | | Airflow (m3/s) | | | | 2.40 | | | | |
| | | | | | W | H | L | Free Area (%) | | | | 49% | |
| Sound Attenuator Size (mm) | | 1000 | 650 | 700 | Pressure Drop (Pa) | | | | 9 | | | | |
| Duct Size (mm) | | 1000 | 650 | | Overall dBA (With SA) | | | | 23.6 | | | | |

ANA Sound Attenuator Installation and Maintenance Guidelines

- Recommended to install the sound attenuator after the volume control damper in order to avoid the regenerated noise
- Minimum 2-5 uniform duct diameters in upstream and downstream of the Sound Attenuator.
- Do not expose the Sound Attenuator to dirt or excess humidity while installing or during the storage.
- The HVAC system must be designed to achieve the dehumidification and air filtration in order to avoid the microbial growth within the sound attenuator and system.

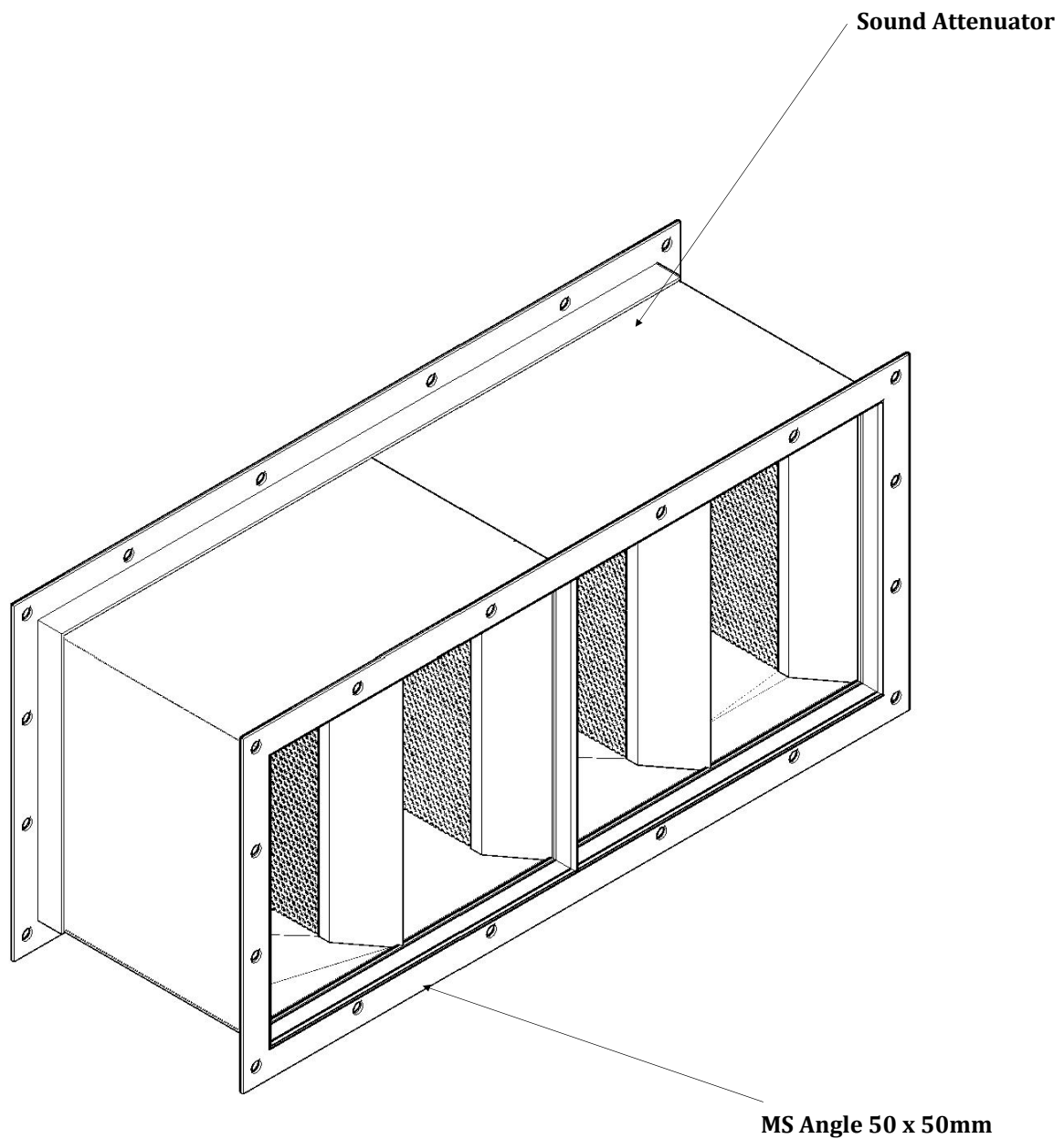


Rectangular Sound Attenuator Installation

* Need to provide duct hangers and support

SOUND ATTENUATORS

ANA Sound Attenuator Multi Section Assembly



[illegible]