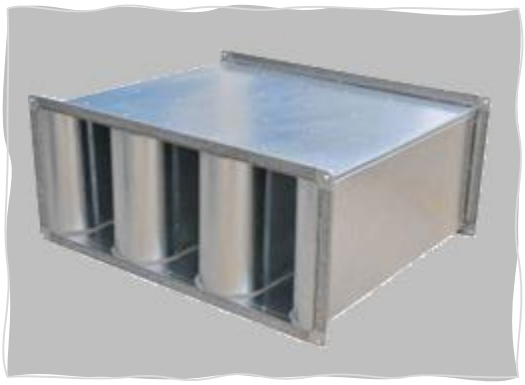
SOUND ATTENUATORS

## INTRODUCTION:

All Fans / Impeller used in Air-Conditioning system produce noise to the amount of work they do to move the air, much of the noise is generated by the fluctuations of radiated pressure and these pressure waves are distributed approximately equally in all directions, causing "Duct born noise" and "Breakout" or "Flanking noise". Sasco Sound Attenuators is the reliable answer for these noise problems.

After approximately determining the sound reduction requirements of the concerned area select suitable silencer to match, or reduce noise to the target level, while selecting silencers following parameters are to be considered.

1. **Insertion Loss**
2. **Air Flow Regenerated Noise**
3. **Static Pressure Drop**
4. **Forward or Reverse Flow**



Our sound attenuator (Silencer) are carefully designed to combat noise problems. Galvanized steel outer casing of the silencer is designed "HVAC" Standard, perforated baffles is filled with an odorless, incombustible vermin proof and moisture proof inorganic sound absorbing material. Primary function of this unit is to reduce noise, operate smoothly, efficiently and trouble free services.

### TYPICAL SOUND ATTENUATOR APPLICATIONS

- Plant room Ventilations.
- Silencers for fans & blowers.
- Air-conditioning Installations.
- Cooling towers & Chiller Yards.
- Power generation equipment.
- Acoustic enclosure ventilation.

### ADVANTAGES

- Guaranteed performance.
- Large range of standard models.
- Range of flanging options.
- Better Aerodynamics.
- Sturdy construction to suit application.
- Consistent quality and performance.
- Built to all sizes.
- Custom designed where required.
- Lower Self Noise.



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**Absorption:** The properties of material composition to convert sound energy into heat thereby reducing the amount of energy that can be reflected.

**Attenuation:** The reduction of sound energy as a function of distance travelled.

**Attenuator:** A device or equipment that prevents, reduces or absorbs sound often colloquially know as silencer.

**A-weighting:** An electronic altering system in a sound meter that allows meter to largely ignore lower frequency sounds in a similar fashion to the way our ears do.

**Background Noise:** The existing noise associated with a given environment, could be sound from many sources, near and far.

**Breakout Noise:** The transmission or radiation of noise through some part of the duct system to an occupied space in the building.

**Decibel (dB):** One tenth of a BEL; a BEL being a unit of amplication corresponding to a tenfold increase. In terms of sound level measurements it is related to datum levels as follows:
For sound pressure levels (SPL) datum=2x10-5 Pa
For Sound Power Level (SWL) datum = 1x10-12 Watts
SPL (dB)= 20 log [p/(1x10-5], where P is the amplitude of
the sound pressure waves concerned, measured in Pascal.

**Decibel, A- weighted (dBA):** Unit representing the sound level measured with the A-weighting network on a sound level meter.

**Decibel, C-Weighted (dBC):** Unit representing the sound level measured with the C-weighting network on a sound level meter.

**Directivity Factor:** When sound level radiates from any source levels can be higher in certain direction than others.
This is called 'Directivity'. Directivity factor is the ratio of the increased level to the average value.

**Directivity Index:** It is the directivity factor expressed in decibels (dB).

**Dynamic Insertion Loss (DIL) :** It is a measure of the acoustic performance of an attenuator when handling the rated air flow. Not necessarily the same as static insertion loss
because it may include regeneration and or other velocity effects and will account for the effects of the actual conditions for which the silencer is designed.

**End Reflection:** End reflection occurs when sound energy radiated from a hole. The sudden expansion to atmosphere causes some low frequency noise to be rejected back
towards the source, expressed in decibels (dB). The effect dependent on hole size and frequency. Maximum at lowest frequency from smallest hole.

**Hertz (Hz):** Frequency of sound expressed by cycles per second.

**Insulation (Sound):** It is the property of a material or partition to oppose sound transfer through its thickness.

**Loudness:** A listener's auditory impression of the strength of a sound. The average deviation above and below the static value due to sound wave is called sound pressure. The energy expended during the sound wave vibration is called intensity and is measured in intensity units. Loudness is the physical resonance to sound pressure and intensity.

**Noise Criteria Curves(NC):** Curve that dene the limits which the octave band spectrum of a noise source must not exceed if a certain level acceptance is to be achieved.

**Noise Criterion (NC) Curves:** Established 1/1 octave band noise spectra for rating the amount of noise of an occupied space with a single number.

**Noise Rating Curves:** A set of Curves based on the sensitivity of the human ear. They are used to give a single rating for a broadband of frequencies. They have greater decibel range than NC curves.

**Octave Band:** A range of frequencies where the highest frequency of the band is double the lowest frequency of the band. The band is usually specified by the center frequency.

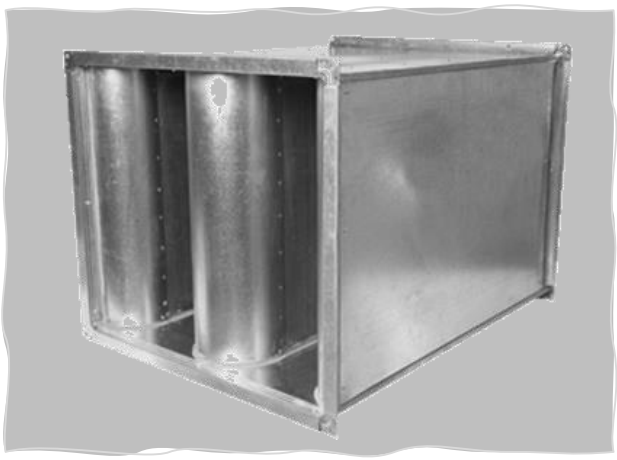
**Reverberation Time:** The reverberation time of an enclosed space is the time required, or that would be required where the decay rate to remain constant, for the sound pressure
level to decrease by 60 decibels.

**Sound Power Level of a Source(Lw):** The ratio expressed in decibels, of its sound power to the reference sound power, which is 10-12 Watts.

**Sound Power of Source(W):** The rate at which sound energy
is radiated by the source.

**Sound Pressure Level (Lp):** A measure of the air pressure
change caused by a sound wave expressed on a decibel scale
reference to a reference sound pressure of 2x10-5 Pa or 0.0002
microbar.

SASCO



**Test**

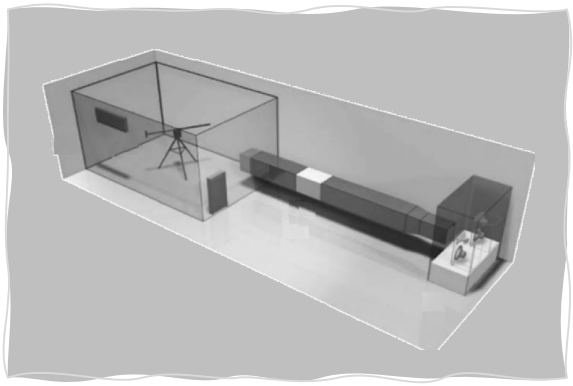
Sasco sound attenuators are tested in accordance with BS 4718 : 1971. "Methods of Test for silencers for Air Distribution Systems". These tests were carried out by the Sound Research Laboratories Limited(SRL) in Sudbury, Suffolk, U.K.

**Material**

All SASCO attenuator are constructed of lock forming quality galvanized steel sheets with Z275g/sqm as per ASTM A924 and ASTM A653

Attenuators are also available in the following materials:

- Stainless steel as per ASTM 240 type 304 or 316.

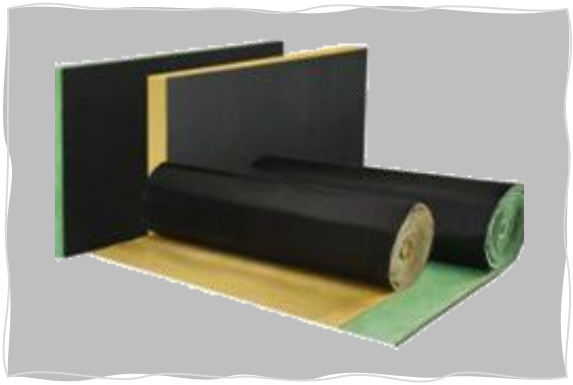


**Acoustic Infill**

SASCO use fiber glass insulation with woven glass cloth facing as the standard acoustic infill. The material is inert, non-flammable, non-hygroscopic, will not sustain vermin or fungus, rot proof and odorless. The "Acoustic Infill" shall be faced with glass tissue or equivalent. The infill material is guaranteed against erosion up to air velocities of 30 m/s and temperatures up to 121oC.

The acoustic infill tested to the following tests:

- Surface Burning Characteristics: UL 723, ASTM E84, ASTM E136
- Mold Growth: ASTM D2020, UL 181
- Moisture Absorption: ASTM D-07 B, ASTM C550
- Fire Resistance: NFPA 90A
- Acoustic Performance: ASTM C1071, ASTM C423-77

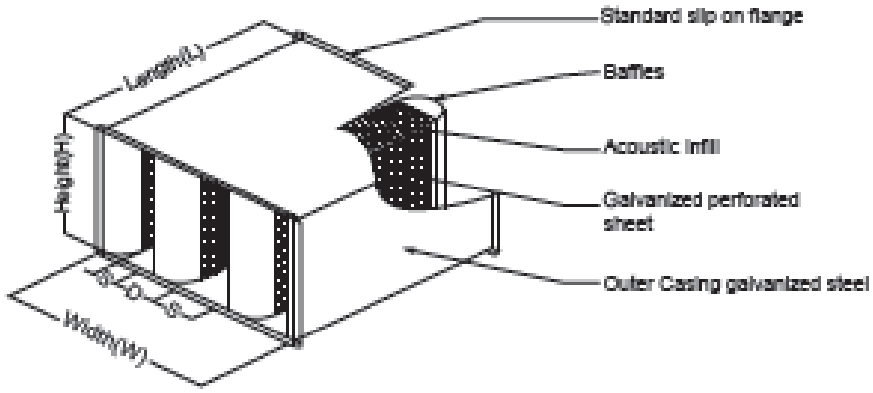


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## RECTANGULAR SOUND ATTENUATOR




**Outer Casing:** Lock formed 20 gauge minimum galvanized sheet steel constructed to the relevant HVAC Ductwork specification where applicable. All fixings are by rivets for strength and rigidity. Silencer with MS angle frame for joining is available upon request.

**Baffles:** Splitters are made of minimum 24 gauge perforated galvanized Steel filled with inorganic sound absorbing material that is resistant to vermin and moisture. Also known as splitter having a standard width of 200 mm. Splitters made of 22 gauge lock forming quality Galvanized steel complying with ASTM A 653 and having Z275 coating. The splitters contain acoustic infill which complies with Class O Building Regulations. The infill has a glass tissue facing and is contained behind galvanized perforated metal. This dual protection prevents damage and fiber erosion up to 30 m/s airway velocity.

**Flanges:** Slip on flange on either side are securely sealed to the attenuator casing to ensure and air tight seal and reduce the possibility of air noise.

**Acoustic Insulation:** Is of superior quality noncombustible and have fungi resistant characteristics. It has excellent noise reduction coefficient.

**Air Gap:** is a gap between two splitters, standard available gaps are 75,100,150, & 200mm.

**Bull Nose:** is constructed as round convex shape on one side of the splitter to provide smooth airflow.

| MODEL | BAFFLE ( D) WIDTH MM | AIR GAP(S) SPACING MM | FREE AREA |
|---|---|---|---|
| SASPD-75 | 200 | 75 | 25% |
| SAMPD-100 | 200 | 100 | 33% |
| SAMPD-150 | 200 | 150 | 42% |
| SALPD-200 | 200 | 200 | 50% |

SOUND ATTENUATORS

## CIRCULAR SOUND ATTENUATOR (SA-RPD)

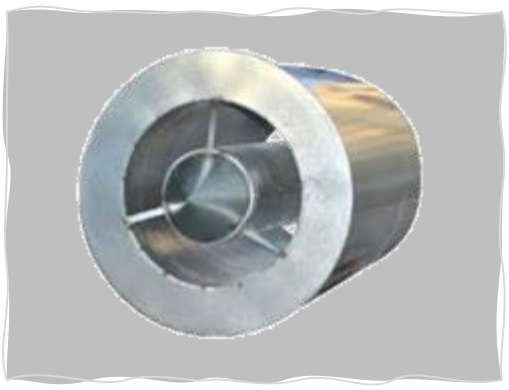
constructed from Galvanized sheet steel, with a peripheral out of airstreams acoustic lining. Casing provided with end ring flanges suitable for direct connection to circular fans or flanged ducts.

### Casing

Casing is Shall be made of lock forming quality galvanized steel complying with ASTM A653 and having Z275 coating made of 1.0mm Thick (20 Gauge) galvanized steel.
Casing provided with circular flanges as standard which will be sealed with Mastic Sealant to prevent leakage of Air.
Circular Sound Attenuators are constructed with the following dimensions : Inner Dia — 300 to 1000 mm Outer Dia — 435 to 1200 mm High-pressure duct sealant is applied inside the casing along the length of each seam,

Acoustic infill : Black strong durable dimensionally stable woven glass fabric (32 Kg/cum density) complying with the following standard.

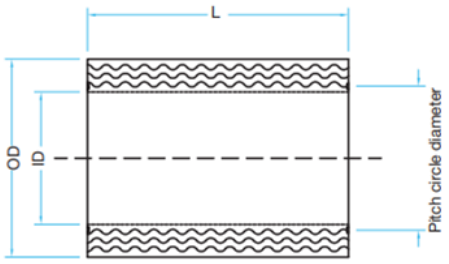
Surface burning characteristics : UL 723, ASTM E84, BS 476
Fire resistance : NFPA 90A & B , NFPA 255
Flame spread classification not more than 25
Smoke development rating not more than 50

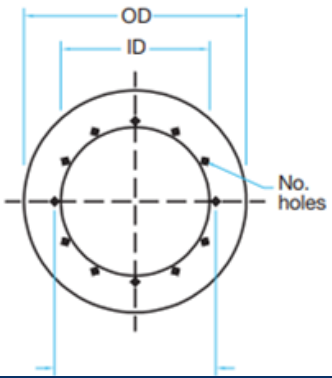


## CONSTRUCTION

Type SA attenuator casings and splitters

| Internal diameter | Outer Diameter | POD diameter | Standard Length |
|---|---|---|---|
| 315 | 435 | 170 | 1220 |
| 355 | 475 | 170 | 1220 |
| 400 | 520 | 210 | 1220 |
| 450 | 600 | 210 | 1220 |
| 500 | 650 | 265 | 1220 |
| 550 | 700 | 265 | 1220 |
| 630 | 780 | 335 | 1220 |
| 700 | 850 | 335 | 1220 |
| 800 | 950 | 420 | 1220 |
| 900 | 1100 | 420 | 1220 |
| 1000 | 1200 | 500 | 1220 |






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**SFRD FIRE RATED SILENCER**

Fire rated silencers are used in fire rated ducts system in the car park exhaust system, smoke ventilation system and stairwell pressurization duct, etc

Fire rated silencers are made as per the same construction method of fire rated ducts and the internal acoustic insulation are high temperature resistant rockwool or mineral wool insulation.

**Outer Casing:** Lock formed similar gauge galvanized sheet steel constructed to the fire rated duct system. All fixings are by rivets for strength and rigidity.

**Baffles:** Splitters are made of minimum 24 gauge perforated galvanized Steel filled with inorganic sound absorbing material that is resistant to vermin and moisture.

**Media:** acoustic infill is fire resistant rock wool insulation . The splitters contain acoustic infill which complies with Class O Building Regulations. The infill has a glass tissue facing and is contained behind galvanized perforated metal. This dual protection prevents damage and fiber erosion up to 30 m/s airway velocity.

**Flanges:** Slip on flange on either side are securely sealed to the attenuator casing to ensure and air tight seal and reduce the possibility of air noise.

**Air Gap:** is a gap between two splitters, standard available gaps are 75,100,150, & 200mm.

**Bull Nose:** is constructed as round convex shape on one side of the splitter to provide smooth airflow.



| MODEL | BAFFLE ( D) WIDTH MM | AIR GAP(S) SPACING MM | FREE AREA |
|---|---|---|---|
| FRSPD-75 | 200 | 75 | 25% |
| FRMPD-100 | 200 | 100 | 33% |
| FRMPD-150 | 200 | 150 | 42% |
| FRLPD-200 | 200 | 200 | 50% |

SASCO FIRE RATED DUCT

SOUND ATTENUATORS

## CROSS TALK SILENCER

Crosstalk and Vent Shaft Duct Silencers permit circulation of air through walls and vent shafts without degrading the acoustic performance of common walls. Cross Talk Silencers are designed to maintain sound transmission ratings in low velocity (below 4 m/s) applications where air is transferred between adjoining spaces. The acoustic media provides excellent attenuation of speech and unwanted noise while permitting fresh air to circulate continuously. Available for a variety of applications including walls, ceilings, and doors

## MODELS

Cross Talk Silencers are available in three different shapes, each ideal for a different application: -

L-Shaped silencers are designed to reduce unwanted noise entering a space from a common plenum, shaft, or corridor. –

Z-Shaped silencers are designed to minimize sound transmission through a wall or ceiling. –

U-Shaped silencers are designed to prevent noise transfer between rooms or maintain STC performance.11

## CONSTRUCTION

Cross Talk Silencers consist of a 22 gauge solid metal casing lined with acoustic media.

### Configuration

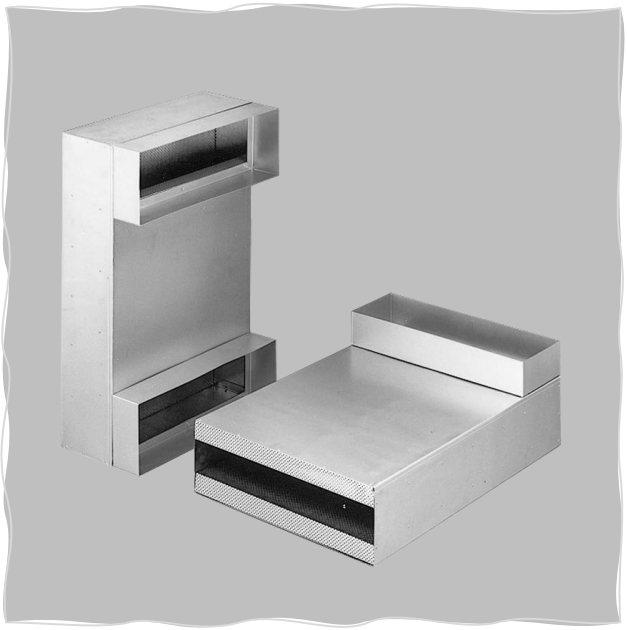
- L Shape
- U Shape
- Z Shape

### Acoustic Media

- Fiber glass
- Fiberglas with Melinex or Mylar
- Fiber free foam

### Material

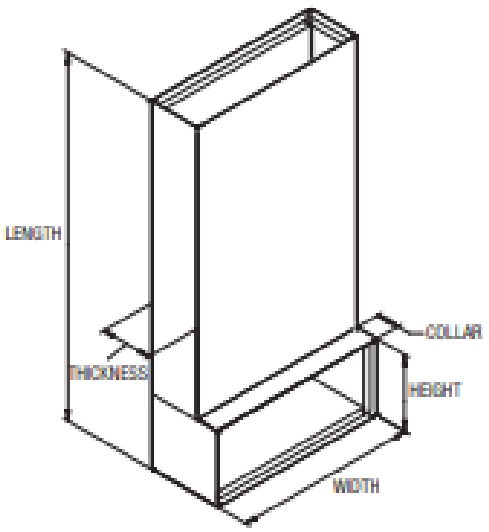
- Galvanized steel
- Stainless Steel
- Aluminum



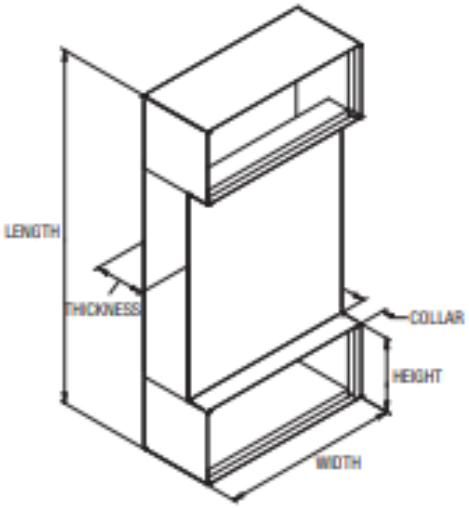


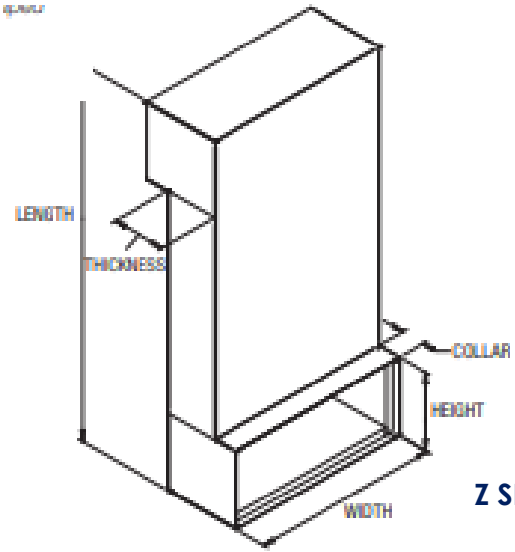
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## L SHAPE




## U SHAPE



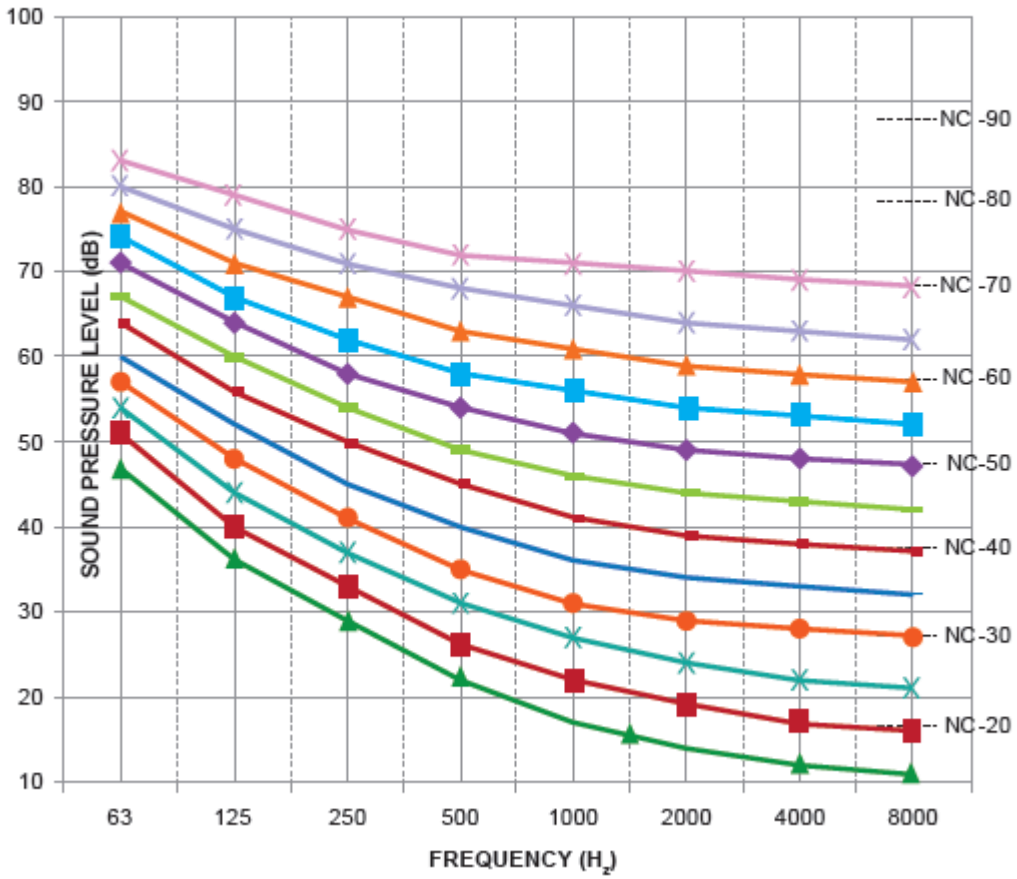

## Z SHAPE

### Size guide

| Width (mm) | | Height(mm) | Collar(mm) | Length(mm) |
|---|---|---|---|---|
| Min | Max | | | |
| 150 | 1200 | 150 | 100 | 1200 |
| 150 | 1200 | 200 | 100 | 1200 |
| 150 | 1200 | 250 | 100 | 1200 |

**Noise Criteria (NC)** is a single number rating derived from sound pressure levels in all eight octave bands, and is intended to predict an occupant's response to the overall sound level. The critical octave band for evaluating sound performance ranges from 63 to 8000 Hz. To determine NC rating value, sound pressure levels are plotted with a family of criterion curves shown in Figure. The level which intersects the highest curves determines the overall NC rating.

**NC DIAGRAM**




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**Recommended Noise Criterion - NC**

Noise in different types of rooms should not exceed the Noise Criterion limits as listed below:

| Type of Room - Space Type | Recommended NC Level NC Curve | Equivalent Sound Level (Dba) |
|---|---|---|
| **Residences** | | |
| Apartment Houses | 25-35 | 35-45 |
| Assembly Halls | 25-30 | 35-40 |
| Churches, Synagogues, Mosques | 30-35 | 40-40 |
| 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** | | |
| Individula rooms or suites | 25-35 | 35-45 |
| Meeting or banquets' 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 |
| Business machines/computers | 40-45 | 50-55 |
| **Hospitals and clinics** | | |
| Private rooms | 25-30 | 35-40 |
| Wards | 25-30 | 35-40 |
| Laboratories | 30-30 | 40-45 |
| Public areas | 35-40 | 45-50 |
| **Schools** | | |
| Lecture and classrooms | 25-30 | 35-40 |
| Open plan classrooms | 35-40 | 45-50 |
| Movies motion picture theaters | 30-35 | 40-45 |
| Legitimate Theaters | 20-25 | 30-65 |
| Private Resicences | 25-35 | 35-45 |
| TV Broadcast studies | 15-25 | 25-35 |
| Recording studios | 15-20 | 25-30 |
| Concert and recital halls | 15-20 | 25-30 |

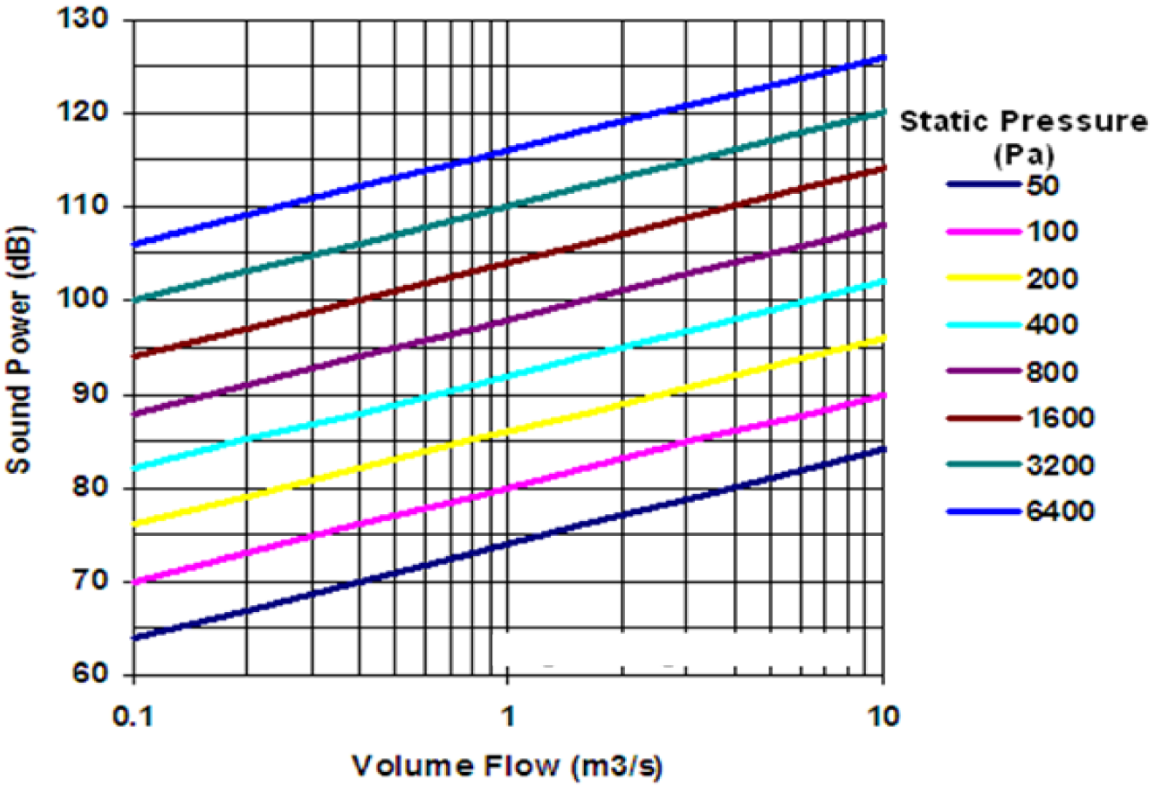



**TABLE 1: Spectrum Correction**

| Fan type | Octave band central frequency(Hz) | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 63 | 125 | 250 | 500 | 1000 | 2000 | 4000 | 8000 |
| Centrifugal fan, backward-curved blades | -4 | -6 | -9 | -11 | -13 | -16 | -19 | -22 |
| Centrifugal fan, forward curved blades | -2 | -6 | -13 | -18 | -19 | -22 | -25 | -30 |
| Centrifugal fan, straight radial blades | -3 | -5 | -7 | -7 | -8 | -11 | -16 | -18 |
| Axial fan | -7 | -9 | -7 | -7 | -8 | -11 | -16 | -18 |

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**TABLE 2**

Attenuation of straight unlined rectangular sheet metal ducts-dB/m



| Minimum Duct Dimension S in mm | Mid-Frequency Octave bands, Hz | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 63 | 125 | 250 | 500 | 1000 | 2000 | 4000 | 8000 |
| 000-200 | 0.6 | 0.6 | 0.45 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 |
| 201-400 | 0.6 | 0.6 | 0.45 | 3 | 0.2 | 0.2 | 0.2 | 0.2 |
| 401-800 | 0.6 | 0.6 | 0.3 | 0.15 | 0.15 | 0.15 | 0.15 | 0.15 |
| 801-1600 | 0.3 | 0.15 | 0.15 | 0.1 | 0.06 | 0.06 | 0.06 | 0.06 |

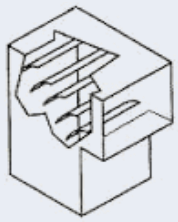
Attenuation of straight unlined circular or round sheet metal ducts-dB



| Minimum Duct Dimension S in mm | Mid-Frequency Octave bands, Hz | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 63 | 125 | 250 | 500 | 1000 | 2000 | 4000 | 8000 |
| 000-180 | 0.03 | 0.03 | 0.05 | 0.05 | 0.1 | 0.1 | 0.1 | 0.1 |
| 180-380 | 0.03 | 0.03 | 0.03 | 0.05 | 0.007 | 0.007 | 0.007 | 0.007 |
| 381-760 | 0.02 | 0.02 | 0.02 | 0.03 | 0.05 | 0.05 | 0.05 | 0.05 |
| 761-1520 | 0.01 | 0.01 | 0.01 | 0.02 | 0.02 | 0.02 | 0.02 | 0.02 |

**TABLE 3**

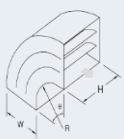
Attenuation of mitered bends without turning vanes or with short chord turning vanes (rectangular ducts)-dB



| Minimum Duct Dimension S in mm | Mid-Frequency Octave bands, Hz | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 63 | 125 | 250 | 500 | 1000 | 2000 | 4000 | 8000 |
| 000-200 | 0 | 0 | 0 | 0 | 6 | 8 | 4 | 3 |
| 201-400 | 0 | 0 | 0 | 6 | 8 | 4 | 3 | 3 |
| 401-800 | 0 | 0 | 6 | 8 | 4 | 3 | 3 | 3 |
| 801-2000 | 0 | 6 | 8 | 4 | 3 | 3 | 3 | 3 |

Attenuation of radiused bends or mitered bends with long chord turning vanes (Circular or rectangular ducts)-dB





| Minimum Duct Dimension S in mm | Mid-Frequency Octave bands, Hz | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 63 | 125 | 250 | 500 | 1000 | 2000 | 4000 | 8000 |
| 000-250 | 0 | 0 | 0 | 0 | 6 | 8 | 4 | 3 |
| 251-500 | 0 | 0 | 0 | 6 | 8 | 4 | 3 | 3 |
| 501-1000 | 0 | 0 | 6 | 8 | 4 | 3 | 3 | 3 |
| 1001-2000 | 0 | 6 | 8 | 4 | 3 | 3 | 3 | 3 |

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SOUND ATTENUATORS

| TABLE 4 | | | | | | |
|---|---|---|---|---|---|---|
| END REFLECTION ATTENUATION (dB) | | | | | | |
| Duct Dimensions(mm) | Mid-Frequency Octave bands, Hz | | | | | |
| | 63.5 | 125 | 250 | 500 | 1000 | 2000 and higher |
| 125 | 17 | 12 | 8 | 4 | 1 | 0 |
| 250 | 12 | 8 | 4 | 1 | 0 | 0 |
| 500 | 8 | 4 | 1 | 0 | 0 | 0 |
| 1000 | 4 | 1 | 0 | 0 | 0 | 0 |
| 2000 | 1 | 0 | 0 | 0 | 0 | 0 |

| TABLE 5 | |
|---|---|
| Percentage of total sound factors, dB | |
| Volume of air(%) | Attenuation in dB |
| 1 | -20 |
| 2 | -17 |
| 3 | -15 |
| 4 | -14 |
| 5 | -13 |
| 10 | -10 |
| 20 | -7 |
| 50 | -3 |
| 100 | 0 |

| TABLE 7 | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| DIRECTIVITY FACTOR, dBa | | | | | | | | |
| JUNCTION OF TWO ROOM SURFACE | | | | | | | | |
| Outlet Area ($cm^2$) | Mid-Frequency Octave bands, Hz | | | | | | | |
| | 63.5 | 125 | 250 | 500 | 1000 | 2000 | 4000 | 8000 |
| 10-50 | 6 | 6 | 6 | 6 | 7 | 7 | 7 | 8 |
| 50-100 | 6 | 6 | 6 | 6 | 7 | 8 | 8 | 8 |
| 100-500 | 6 | 7 | 7 | 7 | 8 | 8 | 8 | 8 |
| 500-1000 | 7 | 7 | 7 | 7 | 8 | 8 | 8 | 8 |
| 1000-5000 | 7 | 8 | 8 | 8 | 9 | 9 | 9 | 9 |
| 5000-10000 | 8 | 8 | 9 | 9 | 9 | 9 | 9 | 9 |

| CENTER OF ONE ROOM SURFACE | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Outlet Area ($cm^2$) | Mid-Frequency Octave bands, Hz | | | | | | | |
| | 63.5 | 125 | 250 | 500 | 1000 | 2000 | 4000 | 8000 |
| 10-50 | 3 | 3 | 3 | 4 | 5 | 7 | 8 | 8 |
| 50-100 | 3 | 3 | 4 | 5 | 7 | 8 | 8 | 8 |
| 100-500 | 3 | 3 | 5 | 6 | 7 | 8 | 8 | 8 |
| 500-1000 | 4 | 5 | 6 | 7 | 8 | 9 | 9 | 9 |
| 1000-5000 | 4 | 5 | 6 | 7 | 8 | 9 | 9 | 9 |
| 5000-10000 | 6 | 7 | 8 | 9 | 9 | 9 | 9 | 9 |

| TABLE 6 | |
|---|---|
| Distance Factor, dB | |
| Distance in Meter | Attenuation in dB |
| 1 | -11 |
| 1.5 | -14 |
| 2 | -17 |
| 3 | -20 |
| 4 | -23 |
| 5 | -25 |
| 6 | -26 |
| 7 | -28 |
| 8 | -29 |
| 9 | -30 |



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## SELECTION PROCESS

The first step is to analyze your system and determine the amount of noise reduction required. This is expressed as insertion loss in decibels when referring to silencer acoustical performance data.

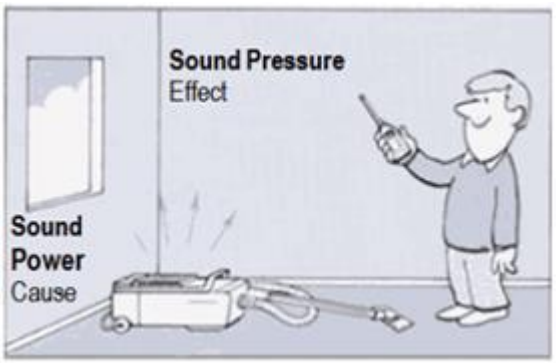
The maximum amount of resistance that can add in a system. This is expressed as static pressure drop.

Additional resistance for the fan or air moving equipment in the system will have to be able to overcome to maintain the same air flow and efficiency.

### Data required

a) Design air flow
b) Duct dimension
c) Maximum permissible static pressure
d) Sound power level

## SOURCE SOUND POWER LEVEL



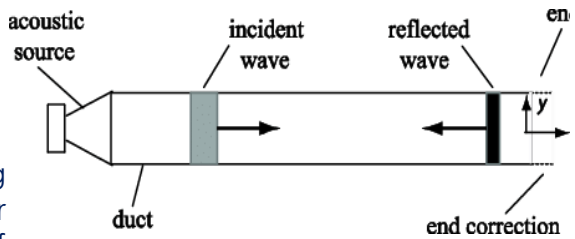

Using the fan manufacturers catalog information, obtain the in-duct sound power level at the mid frequency octave bands of interest, or calculate the approximate in-duct sound power level from Table 1.

## SOUND ATTENUATION IN DUCTS & ELBOWS

Calculate the duct system between the fan and the critical noise outlet. The critical noise outlet in the duct system is usually the noise outlets closest to the fan using information assess. The total duct attenuation:
Straight unlined ducts provided a degree of attenuation. This is frequency dependent and varies with the minimum duct dimension and duct length.

## END REFLECTION ATTENUATION

Outlet Reflection:-At low frequencies some of the sound power on reaching the critical noise outlet is reflected along the duct. The degree of attenuation due to this phenomenon is dependent and the total area of the outlet. The sound power level leaving the critical outlet is obtained

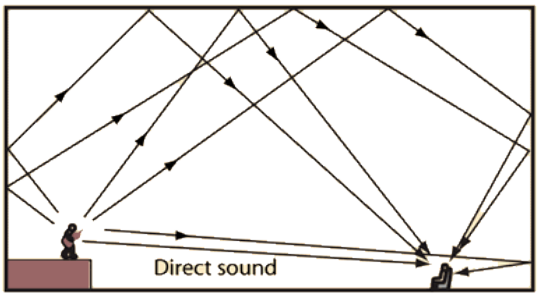


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SOUND ATTENUATORS

## ROOM SIDE ANALYSIS

In a room the sound pressure waves will reach the listener along two paths. Direct & Reverberant.

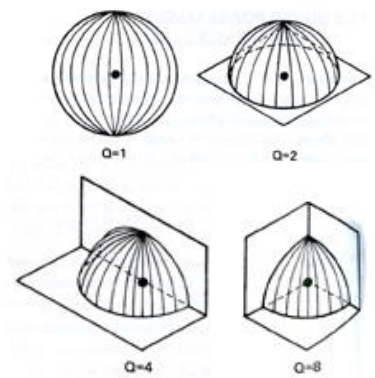



**DIRECT SPL:-**Directly, reducing as the ( distance ) from the noise source knows as the direct sound pressure level . This is influenced by the percentage of air leaving the outlet, distance from outlet to listener and directivity.

To estimate the direct sound pressure level Calculate the percentage of the total sound leaving the critical noise outlet, this is approximately equal to the percentage of fan air volume which passes through the critical outlet

Estimate the distance between the nearest listening position and the critical outlet, the commonly applied distance is 1.5 meters

Directivity effect is due to the location of the outlet




## REVERBERANT SPL

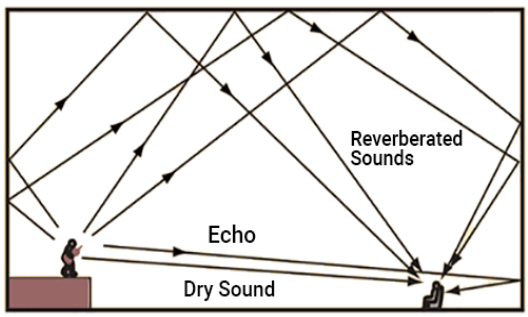
By multiple reflections off the room surfaces and room contents which will depend upon the size of the room and the reverberation time known as the reverberant sound pressure level

To estimate the Reverberant sound pressure level For the fan system in question, calculated the percentage of the sound emerging from all the noise outlets in the room served by the fan

This approximates to the percentage of the fan air volume serving the room under investigation

The amount of reflection or absorption of the sound emerging from the noise outlets, depends upon the volume and the reverberation time ( which is a function of the amount of absorption ) of the room

The reverberant sound pressure level in the room is equal to the sum of the sound pressure level leaving the critical outlet and the total reverberate factors




To arrived at the combined sound pressure level , it is necessary to logarithmically sum the reverberant sound pressure level

After calculating the Direct SPL & Reverberant SPL, both values are logarithmically added to get the resultant sound pressure level in the room

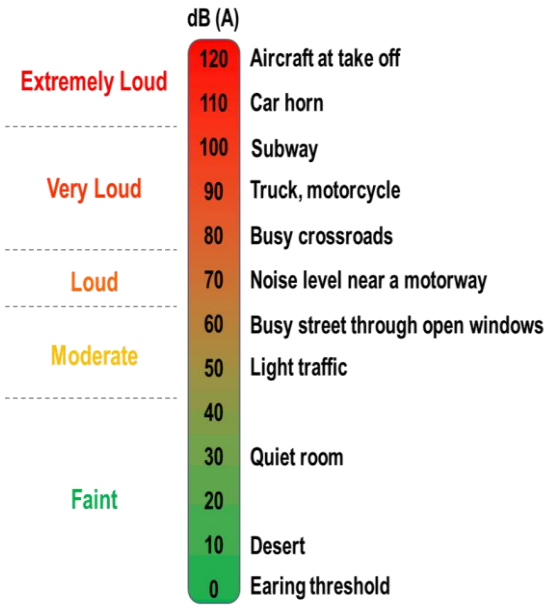


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## ROOM SIDE ANALYSIS

### dB ADDITION

| Decibel Addition( Logarithmic) | | | |
|---|---|---|---|
| Difference between two sources | Example | Add to the higher level | Resultant sound level |
| 0 dB | 60 & 60 dB | 3 dB | 63 dB |
| 1 dB | 60 & 61 dB | | 64 dB |
| 2 dB | 60 & 62 dB | 2 dB | 64 dB |
| 3 dB | 60 & 63 dB | | 65 dB |
| 4-9 dB | 60 & 65 dB | 1 dB | 66 dB |
| 10 dB or more | 60 & 70 dB | 0 dB | 70 dB |




### INSERTION LOSS

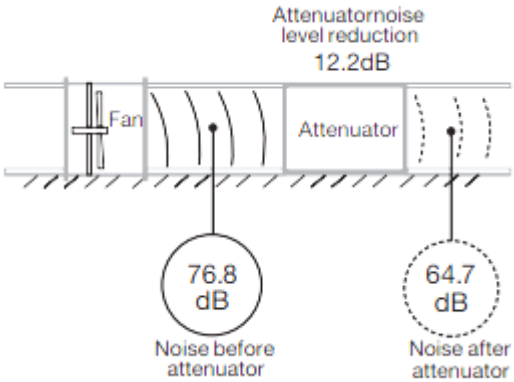
The specification will usually give a criterion (NC) or the accepted criterion depend on the application as per the table.

The required or selected criterion
If the combined sound pressure level exceeds the criterion in any octave band then the difference is the insertion loss required from the attenuator

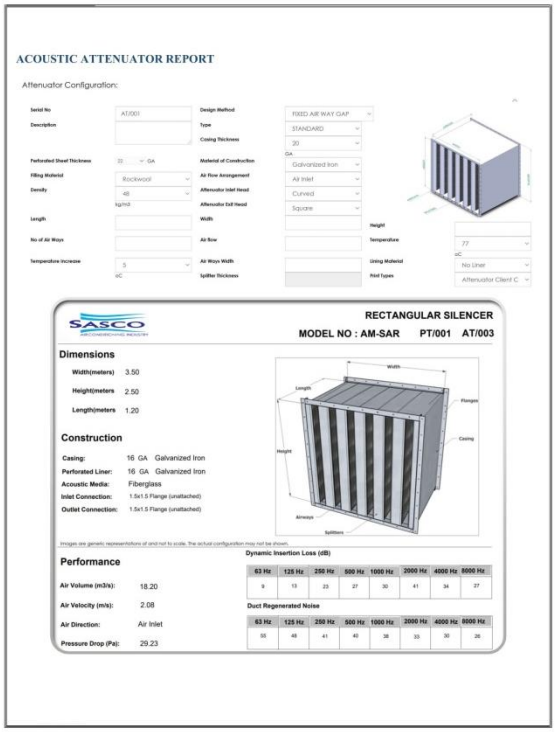
To allow for the possible addition of noise from other sources a safety margin of typically 23 db may be added

The attenuator can now be selected to meet the parameters of insertion loss, physical size and the pressure loss. Insertion loss figures are place in line s as a final check

The above analysis method takes no account of regenerated noise from the attenuators or ductwork elements



## SOUND ATTENUATOR SELECTION SHEET



ACOUSTIC ATTENUATOR REPORT

Attenuator Configuration:

RECTANGULAR SILENCER

MODEL NO : AM-SAR PT/001 AT/003

Dimensions

| | |
|---|---|
| Width(meters) | 3.50 |
| Height(meters | 2.50 |
| Length(meters | 1.20 |

Construction

| | |
|---|---|
| Casing: | 16 GA Galvanized Iron |
| Perforated Liner: | 16 GA Galvanized Iron |
| Acoustic Media: | Fiberglass |
| Inlet Connection: | 1.5x1.5 Flange (unattached) |
| Outlet Connection: | 1.5x1.5 Flange (unattached) |

Performance

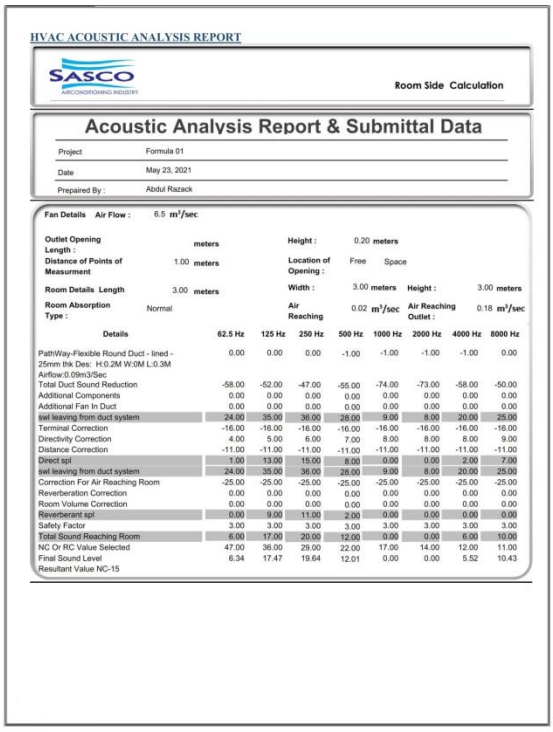
| | |
|---|---|
| Air Volume (m3/s): | 18.20 |
| Air Velocity (m/s): | 2.08 |
| Air Direction: | Air Inlet |
| Pressure Drop (Pa): | 29.23 |

Dynamic Insertion Loss (dB)

| 63 Hz | 125 Hz | 250 Hz | 500 Hz | 1000 Hz | 2000 Hz | 4000 Hz | 8000 Hz |
|---|---|---|---|---|---|---|---|
| 9 | 13 | 23 | 27 | 30 | 41 | 34 | 27 |

Duct Regenerated Noise

| 63 Hz | 125 Hz | 250 Hz | 500 Hz | 1000 Hz | 2000 Hz | 4000 Hz | 8000 Hz |
|---|---|---|---|---|---|---|---|
| 55 | 48 | 41 | 40 | 38 | 33 | 30 | 28 |



HVAC ACOUSTIC ANALYSIS REPORT

SASCO AIRCONDITIONING INDUSTRY

Room Side Calculation

Acoustic Analysis Report & Submittal Data

| | |
|---|---|
| Project | Formula 01 |
| Date | May 23, 2021 |
| Prepared By : | Abdul Razack |

Fan Details Air Flow : 6.5 $m^3/sec$

| | | | | | | |
|---|---|---|---|---|---|---|
| Outlet Opening Length : | meters | Height : | 0.20 meters | | | |
| Distance of Points of Measurment | 1.00 meters | Location of Opening : | Free Space | | | |
| Room Details Length | 3.00 meters | Width : | 3.00 meters | Height : | 3.00 meters | |
| Room Absorption Type : | Normal | Air Reaching | 0.02 $m^3/sec$ | Air Reaching Outlet : | 0.18 $m^3/sec$ | |

| Details | 62.5 Hz | 125 Hz | 250 Hz | 500 Hz | 1000 Hz | 2000 Hz | 4000 Hz | 8000 Hz |
|---|---|---|---|---|---|---|---|---|
| PathWay-Flexible Round Duct - lined - 25mm thk Des: H:0.2M W:0M L:0.3M Airflow:0.09m3/Sec | 0.00 | 0.00 | 0.00 | -1.00 | -1.00 | -1.00 | -1.00 | 0.00 |
| Total Duct Sound Reduction | -58.00 | -52.00 | -47.00 | -55.00 | -74.00 | -73.00 | -58.00 | -50.00 |
| Additional Components | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Additional Fan In Duct | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| swl leaving from duct system | 24.00 | 35.00 | 36.00 | 28.00 | 9.00 | 8.00 | 20.00 | 25.00 |
| Terminal Correction | -16.00 | -16.00 | -16.00 | -16.00 | -16.00 | -16.00 | -16.00 | -16.00 |
| Directivity Correction | 4.00 | 5.00 | 6.00 | 7.00 | 8.00 | 8.00 | 8.00 | 9.00 |
| Distance Correction | -11.00 | -11.00 | -11.00 | -11.00 | -11.00 | -11.00 | -11.00 | -11.00 |
| Direct spl | 1.00 | 13.00 | 15.00 | 8.00 | 0.00 | 0.00 | 2.00 | 7.00 |
| swl leaving from duct system | 24.00 | 35.00 | 36.00 | 28.00 | 9.00 | 8.00 | 20.00 | 25.00 |
| Correction For Air Reaching Room | -25.00 | -25.00 | -25.00 | -25.00 | -25.00 | -25.00 | -25.00 | -25.00 |
| Reverberation Correction | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Room Volume Correction | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Reverberant spl | 0.00 | 9.00 | 11.00 | 2.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Safety Factor | 3.00 | 3.00 | 3.00 | 3.00 | 3.00 | 3.00 | 3.00 | 3.00 |
| Total Sound Reaching Room | 6.00 | 17.00 | 20.00 | 12.00 | 0.00 | 0.00 | 6.00 | 10.00 |
| NC Or RC Value Selected | 47.00 | 36.00 | 29.00 | 22.00 | 17.00 | 14.00 | 12.00 | 11.00 |
| Final Sound Level | 6.34 | 17.47 | 19.64 | 12.01 | 0.00 | 0.00 | 5.52 | 10.43 |
| Resultant Value NC-15 | | | | | | | | |

SRL

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Birmingham, London, Manchester, Sudbury

**C/23529/T02a**

**13 March 2017**

Sasco Airconditioning Industry
Abu Dhabi, UAE
P.O.Box 94687

To whom it may concern,

**Laboratory Tests – Attenuators for Static/Dynamic Insertion Loss, Airflow Generated Noise and Pressure Drop**

I would like to confirm that we have tested the following silencers.

SASPD-75,

SAMPD-100,

SAMPD-150,

SALPD-200

The results of the testing can be seen in report 23529/T01.

Yours sincerely,

R Calvert

**Richard Calvert**
For and on behalf of
SRL Technical Services Limited
Tel: 01787 247595
Email: rcalvert@srltsl.com

SRL Technical Services Limited Registered office: Holbrook House, Little Waldingfield, Sudbury, Suffolk, CO10 0TF Registered in England No 707694

## DYNAMIC INSERTION LOSS TABLE

| DYNAMIC INSERTION | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| SASDP-75 | | Mid - frequency Octave Bands, Hz | | | | | | | |
| MODEL | LENGTH(MM) | 63 | 125 | 250 | 500 | 1000 | 2000 | 4000 | 8000 |
| SASPD-75 | 600 | 9 | 13 | 22 | 36 | 45 | 39 | 33 | 29 |
| SASPD-75 | 900 | 10 | 16 | 27 | 41 | 49 | 47 | 38 | 31 |
| SASPD-75 | 1200 | 11 | 18 | 31 | 46 | 50 | 50 | 43 | 33 |
| SASPD-75 | 1500 | 12 | 21 | 36 | 50 | 50 | 50 | 48 | 35 |
| SASPD-75 | 1800 | 13 | 24 | 41 | 50 | 50 | 50 | 50 | 37 |
| SASPD-75 | 2100 | 13 | 26 | 45 | 50 | 50 | 50 | 50 | 39 |
| SASPD-75 | 2400 | 13 | 29 | 50 | 50 | 50 | 50 | 50 | 41 |
| **SAMPD-100** | | **Mid - frequency Octave Bands, Hz** | | | | | | | |
| MODEL | LENGTH(MM) | 63 | 125 | 250 | 500 | 1000 | 2000 | 4000 | 8000 |
| SAMPD-100 | 600 | 7 | 10 | 18 | 34 | 46 | 40 | 33 | 29 |
| SAMPD-100 | 900 | 8 | 12 | 22 | 37 | 50 | 46 | 36 | 31 |
| SAMPD-100 | 1200 | 9 | 14 | 26 | 40 | 50 | 50 | 39 | 33 |
| SAMPD-100 | 1500 | 9 | 17 | 30 | 44 | 50 | 50 | 41 | 35 |
| SAMPD-100 | 1800 | 10 | 19 | 34 | 47 | 50 | 50 | 44 | 37 |
| SAMPD-100 | 2100 | 11 | 21 | 38 | 50 | 50 | 50 | 47 | 39 |
| SAMPD-100 | 2400 | 11 | 24 | 42 | 50 | 50 | 50 | 49 | 41 |
| **SAMPD-150** | | **Mid - frequency Octave Bands, Hz** | | | | | | | |
| MODEL | LENGTH(MM) | 63 | 125 | 250 | 500 | 1000 | 2000 | 4000 | 8000 |
| SAMPD-150 | 600 | 8 | 12 | 17 | 34 | 44 | 28 | 23 | 22 |
| SAMPD-150 | 900 | 8 | 14 | 20 | 37 | 47 | 32 | 26 | 24 |
| SAMPD-150 | 1200 | 9 | 15 | 23 | 40 | 50 | 36 | 29 | 26 |
| SAMPD-150 | 1500 | 10 | 17 | 26 | 43 | 53 | 40 | 32 | 28 |
| SAMPD-150 | 1800 | 11 | 18 | 29 | 46 | 57 | 44 | 35 | 31 |
| SAMPD-150 | 2100 | 11 | 20 | 32 | 49 | 50 | 48 | 38 | 33 |
| SAMPD-150 | 2400 | 12 | 21 | 35 | 50 | 50 | 50 | 41 | 35 |
| **SALPD-200** | | **Mid -frequency Octave Bands,Hz** | | | | | | | |
| MODEL | LENGTH(MM) | 63 | 125 | 250 | 500 | 1000 | 2000 | 4000 | 8000 |
| SALPD-200 | 600 | 7 | 11 | 16 | 25 | 27 | 23 | 21 | 20 |
| SALPD-200 | 900 | 8 | 12 | 18 | 30 | 33 | 26 | 23 | 21 |
| SALPD-200 | 1200 | 8 | 14 | 21 | 35 | 39 | 33 | 25 | 23 |
| SALPD-200 | 1500 | 9 | 15 | 23 | 40 | 44 | 33 | 28 | 24 |
| SALPD-200 | 1800 | 9 | 17 | 26 | 45 | 50 | 37 | 30 | 26 |
| SALPD-200 | 2100 | 10 | 18 | 28 | 50 | 50 | 40 | 32 | 27 |
| SALPD-200 | 2400 | 11 | 19 | 30 | 50 | 50 | 43 | 34 | 28 |

SOUND ATTENUATORS

## JOINING & FINISH

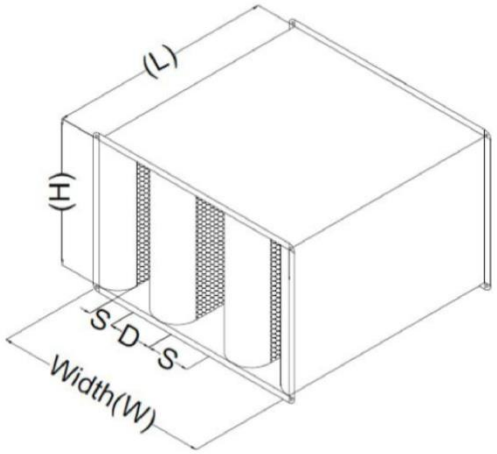
## SECTION SIZING & JOINING FLANGE

- All Sound attenuators are provided with 30 mm slip on flanges as standard
- Flange frame of sound attenuator can be connected to duct using Nut , Bolts & GI clamp
- Matching flanges for attaching to accompanying ductwork can also be supplied.
- For Sound attenuator with MS or GI angle frame, there will be predrilled holes at 150 mm distance to enable easy installation to the duct using nut & bolts
- Sound attenuators are normally supplied as a single unit.
- Sound attenuators of more than 2100 mm size will be made in multi section.



**Customized Attenuator Options**
**The following are available**

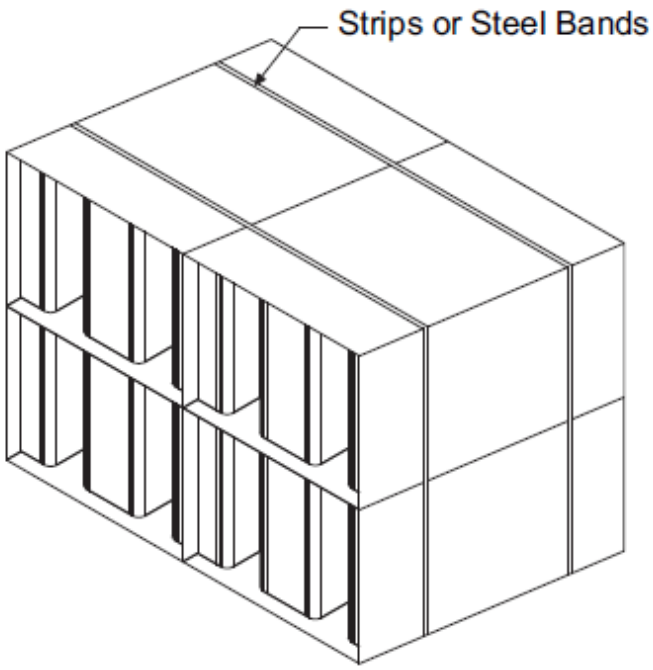
• Different materials of construction such as Stainless Steel Grades 304 and 316.
• Paints / protective coatings such as epoxy paint.
• Flange material/dimensions profile can be specified e.g. Ductmate, Plain Steel Angle, Slip Connection
• Access doors for easy cleaning





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## SOUND ATTENUATOR
## MODULAR/MULTI SECTION SILENCER






Commercial acoustics rectangular sound attenuators are supplied in multiple modules of many different sizes for convenience and economy in shipping, handling and installation
When sound attenuators banks are large, multiple modules are shipped loose for erection at the job site. To avoid possible leaks and damage, two factors need to be considered.

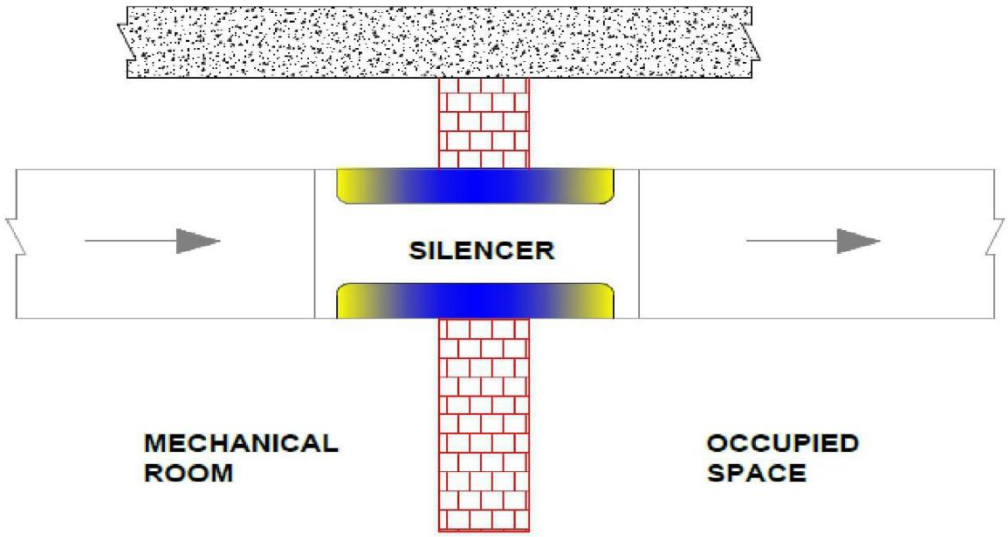
1st : Fastening the individual sound attenuators modules together.
2nd : Sealing the joints between assembles modules to prevent leakage.

There are many methods of assembling and sealing multiple modules. The best of which should be determined by the installing contractor.

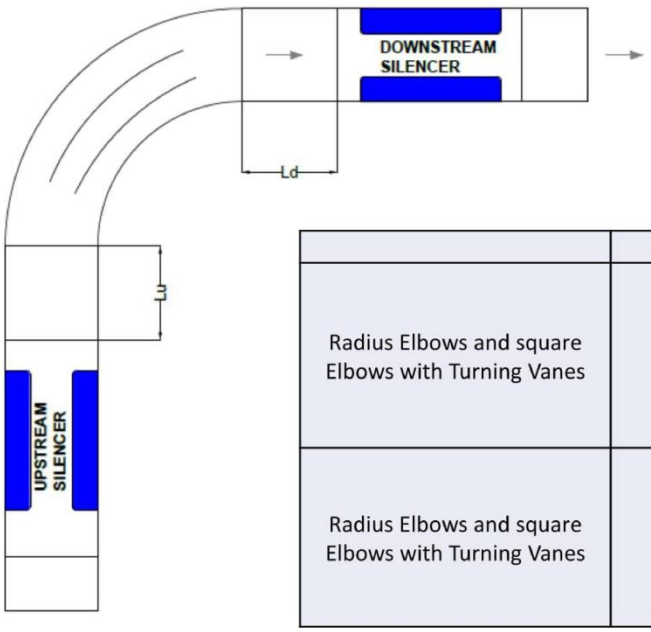
ASSEMBLY : The multiple modules should be drawn together using at least two steel bands or straps. Lightweight structural angles can be used as a frame and facilitate attachment to the duct. Tack welds, made along each adjoining surface , will provide added structural integrity

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## LOCATION FOR ATTENUATOR INSTALLATION




## ELBOW EFFECT ON THE PERFORMANCE OF ATTENUATORS



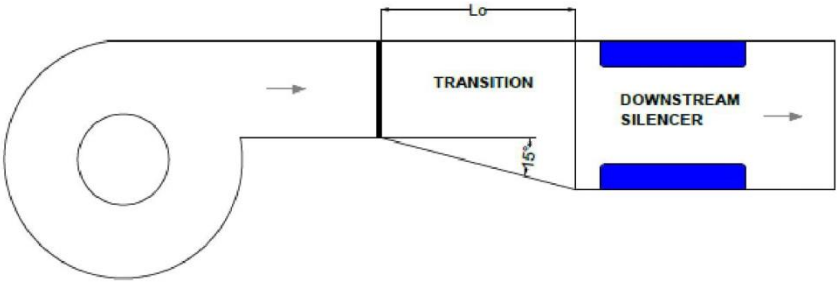

| | Lu x Ld | Δ P FACTOR |
|---|---|---|
| Radius Elbows and square Elbows with Turning Vanes | Deq x 3<br>Deq x 2<br>Deq x 1<br>Deq x 0.5<br>Directly Connected | 1.0<br>1.25<br>1.75<br>3.0<br>Not Advised |
| Radius Elbows and square Elbows with Turning Vanes | Deq x 3<br>Deq x 2<br>Deq x 1 | 1.0<br>1.5<br>2.0 |

SOUND ATTENUATORS



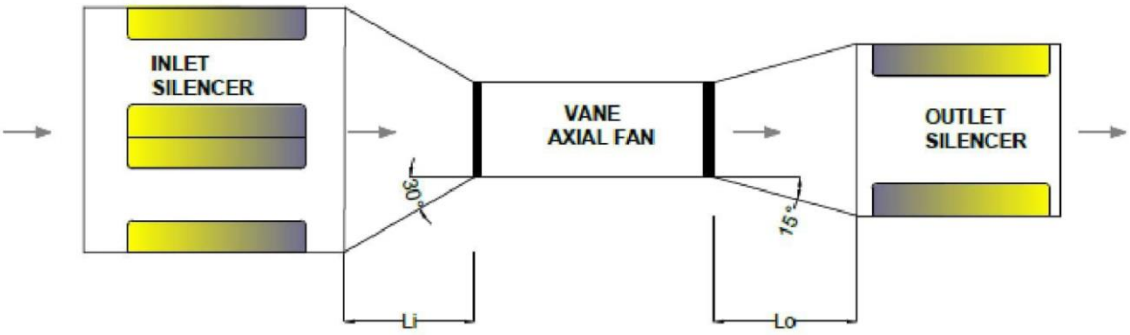
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## CENTRIFUGAL FANS




**Lo- one fan wheel diameter for every 1000 fpm of exit velocity**

## INSTALLATION OF ATTENUATOR WITH AXIAL FAN




| | Li | Lo | Δ P FACTOR |
|---|---|---|---|
| RECTANGULAR SILENCER | Not Less Than 0.75 x Deq | Not Less Than 1 xDeq For every 1000 fpm Duct Velocity | 1 |

## DUCT SILENCERS INSTALLED INDOORS

Duct silencers installed inside buildings are designed to be essentially maintenance-free for the life of the product. The same method and routine used for periodic cleaning of the ductwork will also apply to the duct silencers. The acoustic media used in duct silencers is protected by the perforated metal liner so it will not erode during normal duct cleaning with vacuum equipment.

## DUCT SILENCERS INSTALLED OUTDOORS

Silencers exposed to the outdoors should have all external joints and seams caulked with suitable sealant. Wherever possible, silencers should be shielded from exposure to moisture from rain by providing suitable hoods, louvers or dampers. Occasional exposure of the silencers to moisture will not affect the longevity or the acoustical performance, provided that the water evaporates after exposure.

Duct silencers installed outdoors should be inspected at 6-month intervals. Silencers specified for outdoor locations require all seams to be caulked with mastic sealant for waterproofi

ng, and all exposed welds to be coated with zinc-rich paint for rust proofing. Inspect the condition of the joints and replace loose or damaged sealant. Inspect the welds and casings for signs of rusting. Remove visible rust using a wire brush and recoat with zinc-rich spray paint.

## SILENCERS EXPOSED TO HIGH HUMIDITY

Silencers exposed to high humidity levels, such as those installed on cooling tower discharge fans, should be inspected frequently for signs of rusting. Remove visible rust using a wire brush and recoat with zinc-rich spray paint. As a general rule, the lifetime of a silencer exposed to high humidity will be less than one installed in a dry indoor location. Replacement of the silencer may be required at 10-year intervals or even sooner under more extreme conditions.

## SILENCERS EXPOSED TO CORROSIVE ELEMENTS

Silencers specified for installation in locations where the outer casings will be exposed to high temperature or corrosive elements are typically constructed with corrosive-resistant materials or finished with corrosion-resistive coatings. Similarly, silencers that must convey high-temperature or corrosive gases will be constructed internally with non-corrosive materials. The required maintenance and expected lifetime of these products will vary. Consult the factory for specific maintenance information for silencers used in such applications.



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