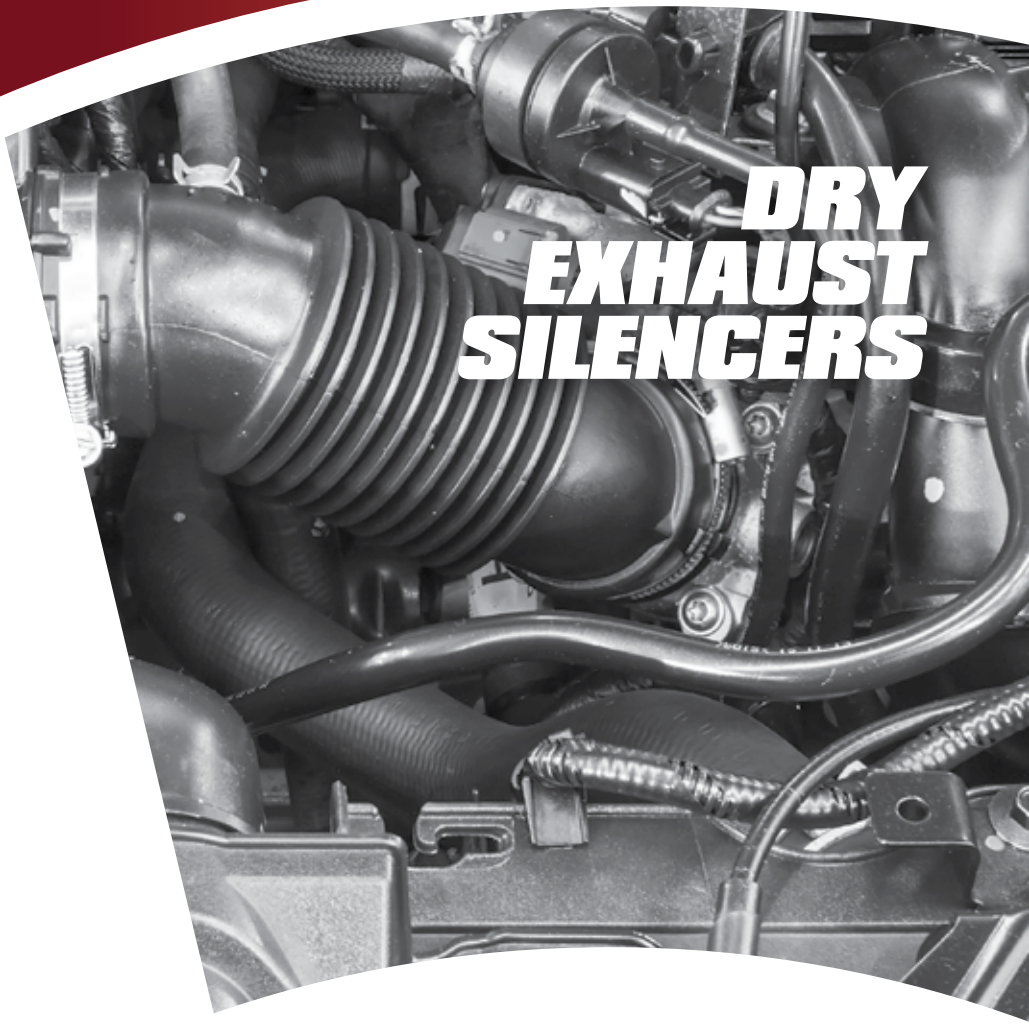


DRY EXHAUST SILENCERS

AXCES

INTRODUCTION TO AN INDUSTRIAL SILENCER

The purpose of an exhaust silencer is to reduce engine noise emission. An engine without a silencer will create an unbearable amount of exhaust noise in our environment. Noise is defined as unwanted sound.

Sound is a pressure wave formed from pulses of alternating high and low pressure air. In a combustion engine, pressure waves are generated when the exhaust valve repeatedly opens and lets high-pressure gas into the exhaust system. These pressure pulses are the sound we hear. As the RPM of the engine increases so do the pressure fluctuations and therefore the sound emitted is of a higher frequency.

All noise emitted by an engine does not specifically come from the exhaust system. Other contributors to engine noise emission include intake noise, mechanical noise and vibration induced noise from the engine's body and transmission.

The industrial silencer has to be able to allow the passage of exhaust gasses whilst restricting the transmission of sound.

EXHAUST SILENCER DESIGN

There are numerous variations of the two main types of silencers designs commonly used, namely Absorptive and Reactive. Generally industrial silencer will have both reactive and absorptive properties.

The Reactive Silencer

The Reactive Silencers use the phenomenon of destructive interference to reduce noise. This means that they are designed so that the sound waves produced by an engine partially cancel themselves out in the muffler. For complete destructive interference to occur, a reflected pressure wave of equal amplitude which is 180 degrees out of phase needs to collide with the transmitted pressure wave. Reflections occur, where there is a change in geometry or an area discontinuity.

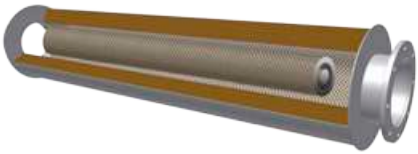
A Reactive silencer generally consists of a series of resonating and expansion chambers that are designed to reduce the sound pressure level at certain frequencies. The inlet and outlet tubes are generally offset and have perforations that allow sound pulses to scatter out in numerous directions inside a chamber resulting in destructive interference.

Reactive silencers are used widely in an exhaust systems where the exhaust gas flow and hence noise emission varies within time.

Reactive silencers have the ability to reduce noise at various frequencies due to the numerous chambers and changes in geometry that the exhaust gasses are forced to pass through.

The downside to Reactive mufflers is that larger back pressure is created.

The Aborptive silencer



An Absorptive muffler uses absorption to reduce sound energy. Sound waves are reduced as their energy is converted into heat in the absorptive material. A typical Absorptive muffler consists of a straight, circular and perforated pipe that is encased in a larger steel housing. Between the perforated pipe and the casing is a layer of sound absorptive material that absorbs some of the pressure pulses.

Absorptive mufflers create less back pressure then reactive mufflers. However, they do not reduce noise as well as Reactive mufflers.

Generally Reactive silencer use resonating chambers that target specific frequencies to control noise whereas an Absorptive silencer reduces noise considerably over the entire spectrum and more so at higher frequencies.

It is good practice to design a silencer to work best in the frequency range where the engine has the highest sound energy. In practice the sound spectrum of an engine exhaust is continually changing, as it is dependent on the engine speed that is continually varying. It is impossible to design a muffler that achieves complete destructive interference, some interference will always occur.

Noise spectrum variation makes silencer design quite difficult and testing is the only sure way to determine whether the silencer performs well at all engine speeds. However, as a general rule of thumb, exhaust noise is generally limited to the fundamental frequency and the first few harmonics, which can be calculated. These frequencies should therefore be used as a starting point for preliminary muffler design.

A practical way of determining the frequency range to be controlled is to measure the unsilenced engine noise. This measured spectrum can then be used to identify the frequencies, at which the higher noise levels occur. The high noise level frequencies should be treated with appropriate noise control to achieve an overall noise reduction.

FUNCTIONAL REQUIREMENTS OF AN INDUSTRIAL EXHAUST SILENCER

There are numerous functional requirements that should be considered when designing a silencer for a specific application. Such functional requirements may include adequate insertion loss, back pressure, size, durability, desired sound, cost, shape and style. These functional requirements are detailed below focusing on an muffler's functional requirements.

Insertion Loss and Transmission Loss

The main function of a silencer is to "silence" or attenuate sound. An effective silencer will reduce the sound pressure of the noise source to the required level. In the case of an industrial muffler the noise in the exhaust system, generated by the engine, is to be reduced.

A mufflers performance or attenuating capability is generally defined in terms of insertion loss or transmission loss. Insertion loss is defined as the difference between the acoustic power radiated without and with a muffler fitted. The transmission loss is defined as the difference in decibels between the sound power incident at the entry to the silencer to that transmitted by the silencer.

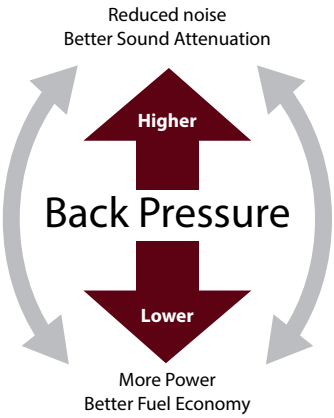
The silencer designer must determine the required insertion loss so that a suitable style of muffler can be designed for the specific purpose.

As a general principle when designing a muffler, a Reactive muffler with many area discontinuities will achieve a greater attenuation than one with fewer area discontinuities. The addition of sound absorptive material will always increase the attenuation capacity of a muffler, but should be located in an appropriate place.

Back Pressure

Back pressure represents the extra static pressure exerted by the muffler on the engine through the restriction in flow of exhaust gasses.

Generally the better a muffler is at attenuating sound the more back pressure is generated. In a Reactive muffler where good attenuation is achieved, the exhaust gasses are forced to pass through numerous geometry changes and a fair amount of back pressure may be generated, which reduces the power output of the engine. Back pressure should be kept to a minimum to avoid power losses.



Every time the exhaust gasses are forced to change direction, additional back pressure is created. Therefore, to limit backpressure, geometric changes are to be kept to a minimum. A typical example of this is a "straight through" absorption silencer. Exhaust gasses are allowed to pass virtually unimpeded through the straight perforated pipe.

Durability

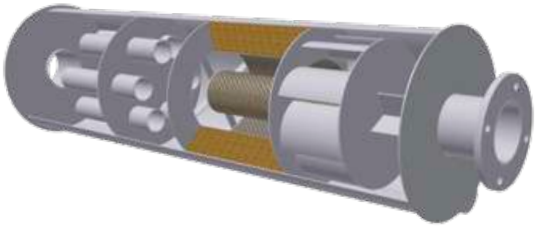
The life expectancy of a silencer is another important functional requirement, especially when dealing with hot exhaust gasses and absorptive silencers that are found in performance vehicles.

Overtime, hot exhaust gasses tend to clog the absorptive material with unburnt carbon particles or burn the absorptive material in the muffler. This causes the insertion loss to deteriorate. There are however, good products such as mineral wool, fibreglass, sintered metal composites and white wool that resist such unwanted effects.

Reactive type silencers with no absorptive material are very durable and their performance does not diminish with time.

Generally silencers are made from corrosion resistive materials such as stainless steel. Mild steel is generally used for temperatures up to 500°C, type 409 stainless steel up to 700 °C and type 321 stainless steel for even higher temperatures. Diesel exhaust gas temperatures are usually around 550°C.

Shape and Style



Industrial silencers can be manufactured in all different shapes, styles and sizes depending on the desired application. Generally industrial silencers consist of an inlet and outlet tube separated by a larger chamber that is oval or round in geometry. The inside detail of this larger chamber may be one of numerous constructions. The end user of silencers usually does not care what is inside this chamber as long as the muffler produces the desired sound and is aesthetically pleasing. It is therefore the task of the muffler designer to ensure that the muffler is functional as well as marketable.

HOW SOUND IS MEASURED

Noise is measured in units called decibels, shown as dB. Some sounds, which can be measured, cannot be detected by the human ear. For example, people cannot usually hear bats communicating at very high frequencies or when whales use very low frequencies. To account for the way that the human ear responds to sound of various frequencies a frequency weighting, known as the A-weighting, is commonly applied when measuring noise. The exception is when measuring peak noises, where a C-weighting is applied to ensure that proper account is taken of the sound energy in the peak sound.

Noise can contain many different frequencies. However, when considering ways to control noise, low-frequency noise needs to be treated differently to high-frequency noise. So the division of the A-weighted measurement into its constituent frequencies (frequency analysis) becomes necessary.

NOISE ACTION AND LIMIT VALUES

The Noise Regulations require employers to take specific action at certain action values. These relate to:

- The levels of exposure to noise of employees averaged over a working day or week
- The maximum noise (peak sound pressure) to which employees are exposed in a working day

Lower Exposure Action Values (LEAV)

- Daily or weekly exposure of 80 dB
- Peak sound pressure of 135 dB

There are also levels of noise exposure which must not be exceeded (but take account of any reduction in exposure provided by hearing protection)

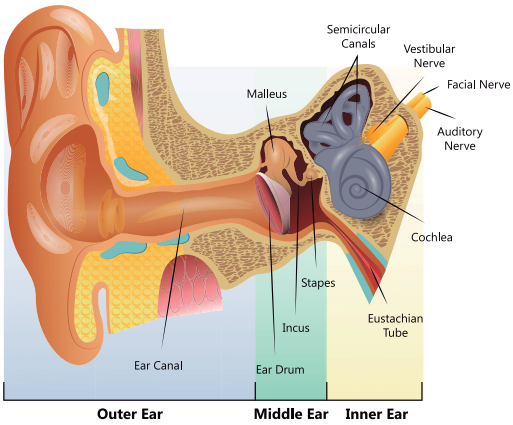
- Exposure Limit Values (ELV)
- Daily or weekly exposure of 87 dB
- Peak sound pressure of 140 dB

NOISE EXPOSURE

The noise exposure level takes account of both the sound pressure level and exposure time. Generally the potential for hearing to be damaged by noise is related to the noise 'dose' a person receives. Being exposed to a noise level of 105 dB (a band) for 5 minutes would be the same dose as being exposed to 94 dB (a factory) for 1 hour, or 88 dB (chamber music) for 4 hours.

Each 3 dB added doubles the sound energy. When 10dB is added, the energy is increased ten-fold, while adding 20 dB is a hundred-fold increase. Therefore:

- If the sound intensity is doubled, the noise level increases by 3 dB
- Two instruments with the same noise level of 85 dB together produce 88 dB
- A noise level reduction of 3 dB halves the sound pressure level



Halving the noise dose can be achieved either by halving the exposure time, or by halving the noise level, which corresponds to a reduction of 3 dB. These noise exposures are identical:

- 80 dB for 8 hours
- 83 dB for 4 hours
- 86 dB for 2 hours
- 89 dB for 1 hour
- 92 dB for 30 minutes

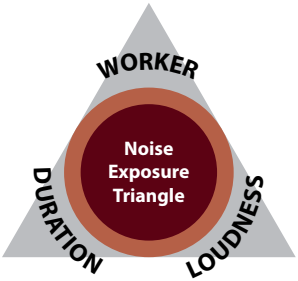
Upper Exposure Action Values (UEAV):

- Daily or weekly exposure of 85 dB
- Peak sound pressure of 137 dB

Average Noise level (dB)	Time taken to receive a dose equivalent to the upper exposure action value (85 dB)
85	8 hours
95	45 minutes
100	15 minutes
105	5 minutes
110	Under 2 minutes
115	Under 30 seconds

EXPOSURE WHEN NOT AT WORK

It is important that people consider noise exposure when not at work because cumulative exposure leads to hearing damage, whether or not it is work-related. Sound exposure includes all the sounds heard during each day. Common off-hours exposure to high noise levels may include audio and video equipment (personal car stereos, computer speakers, televisions), concerts, clubs and cinemas, sporting events, power tools and noisy hobbies. In general, an employer needs only to consider the work-related noise exposure when deciding what action to take to control risks. However the employer needs to consider whether risk-control measures need to be adapted in certain situations, for example if it is known that an employee is exposed to noise during other employment.



Reove any element and overexposure to noise is prevented

Reduce **loudness** or **duration** and exposure is reduced

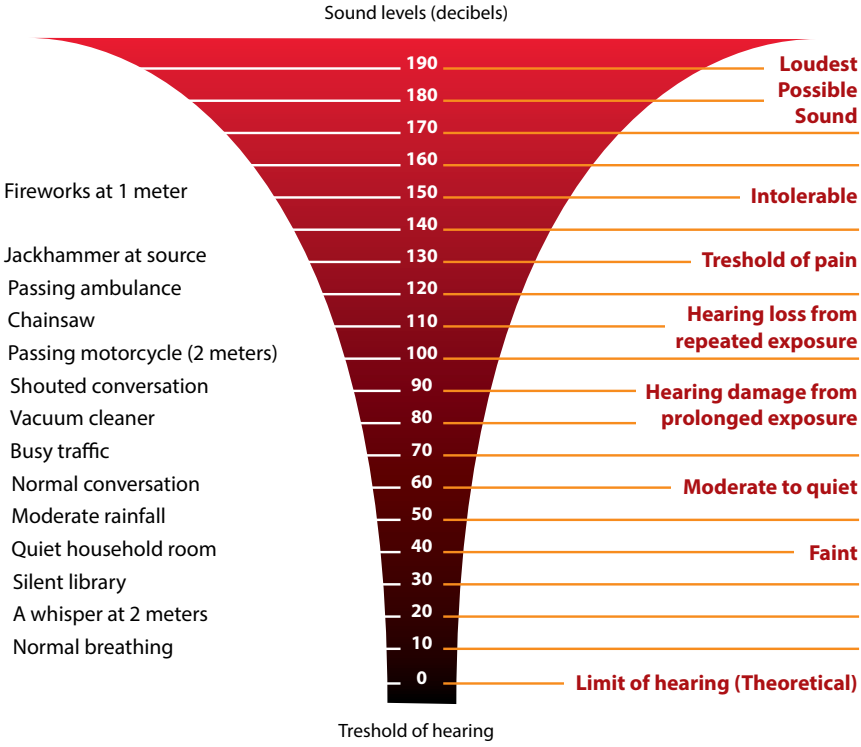
SYMPTOMS OF HEARING DAMAGE

Hearing loss can be temporary or permanent. People often experience temporary deafness after leaving a noisy place such as a machine room or a factory. Although hearing recovers within a few hours, this should not be ignored. It is a sign that if you continue to be exposed to high levels of noise, your hearing could be permanently damaged. Permanent hearing damage can be caused immediately by sudden, extremely loud, explosive noises such as caused by pyrotechnics. Remember that the hearing of young people can be damaged as easily as the old.

Hearing loss is usually gradual because of prolonged exposure to noise. It may only be when damage caused by noise over years combines with hearing loss due to ageing that people realise how deaf they have become. This may mean their family complains about the television being too loud, they cannot keep up with conversations in a group, or they have trouble using a telephone. Eventually everything becomes muffled and people find it difficult to catch sounds like 't', 'd', and 's', so they confuse similar words.

Hearing loss is not the only problem. People may develop tinnitus, a distressing condition that can lead to disturbed sleep. Other rarer conditions include hyperacusis (a general intolerance or oversensitivity to everyday sounds) and diplacusis (a difference in the perception of sound by the ears, either in frequency or time). Research among symphony orchestras suggests more than 27% of musicians suffer hearing loss, with 24% suffering from tinnitus, 25% from hyperacusis, 12% from distortion and 5% from diplacusis. However, there are other studies which give a range of figures from 10-60% for hearing damage among musicians.

DECIBEL SCALE



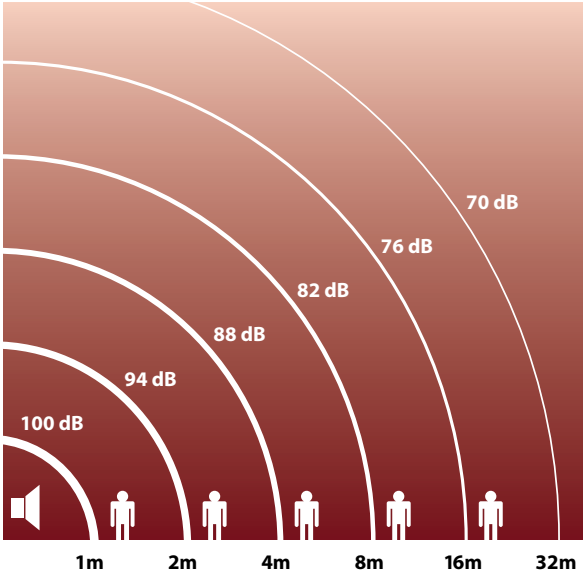
NOISE LEVEL EXPOSURE TIME

This graph shows sound intensity and how long humans can endure this without harm.

HARMFUL SOUND LEVEL		
180 dB	Rocket launch	**IMMEDIATE EARDRUM RUPTURE**
134 dB	Jet Engine (30m distance)	**0.3 SECONDS**
125 dB	Pain Treshold	
RISKY SOUND LEVEL		
110 dB	Disco, Headphones, Music Studio	**2 MINUTES**
90 dB	Lawnmower, Heavy Truck Passing	**2.5 HOURS**
85 dB	Max. Workspace Noise Level	**8 HOURS**
SAFE SOUND LEVEL		
80 dB	Trafficked Street	
60 dB	Normal Conversation	

DISTANCE ATTENUATION

This graph shows the inner relation between sound intensity over distance. For a lineair reduction of the sound intensity a doubling of the distance has to occur.



INSTALLATION RECOMMENDATIONS

BEFORE INSTALLATION

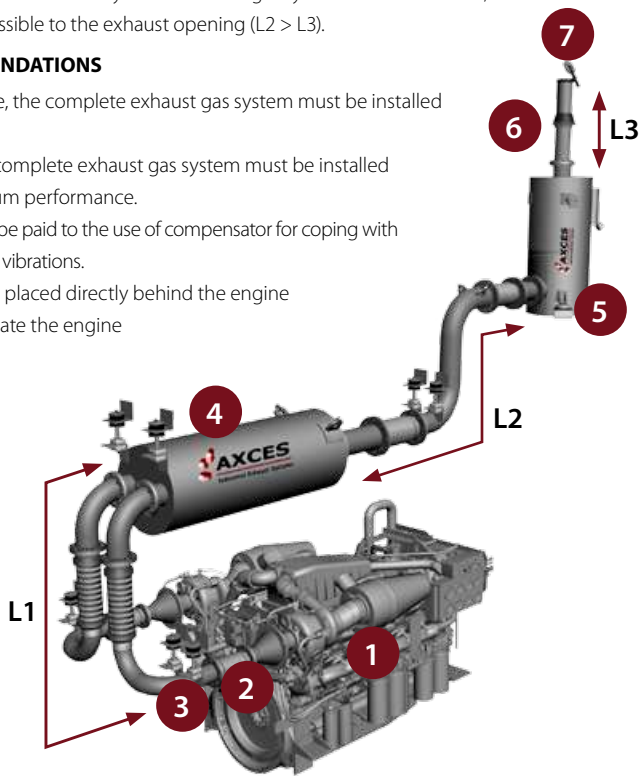
- Remove all packing material.
- Check the product for damage. If there are any abnormalities, these must be reported as quickly as possible to the Customer Service Department on +31 (0)166 603 285.

SILENCER LOCATION/POSITION

- The silencers can be installed either vertically or horizontally, depending on the given flow direction.
- Single silencer (4) may be installed anywhere between the engine (1) and halfway to the exhaust gas system, preferably as close as possible to the engine. (L1 < L2).
- The primary silencer (4) as described above with double silencers, the secondary silencer (5) anywhere between halfway to the exhaust gas system and the exhaust; preferably as close as possible to the exhaust opening (L2 > L3).

INSTALLATION RECOMMENDATIONS

- For optimal performance, the complete exhaust gas system must be installed vibration-free.
- The silencer (4) and the complete exhaust gas system must be installed vibration-free for optimum performance.
- Sufficient attention must be paid to the use of compensator for coping with expansions and excessive vibrations.
- A fixed point (3) must be placed directly behind the engine compensator (2) to alleviate the engine compensator when starting and stopping the engine (1) and to limit line resonance as much as possible.
- Take notice of the flow indicator.



- Any condensate tapping device (the drain) must be at the lowest point.
- Provide correct acoustic dismantling if the condensate tapping point is connected to a drain line.
- Always provide a smooth flow through the lines and avoid right angled bends and/or other abrupt flow changes to prevent unnecessary pressure loss.
- If the silencer is provided with a spark arrestor, install the silencer so that the spark collector can be regularly cleaned.
- If the silencer is installed on and/or via flexible (rubber) supports and/or suspension, provide sufficient ventilation to prevent overheating of the rubber. The suspension points must therefore not be shortened too far. Also look carefully at the installation of the "thermoplaque" insulators below and above the supports.
- If an exhaust gas pipe has to be fed through a deck, it is preferable for a deck duct (6) to be used.
- If the extraction section is installed vertically, it is preferable for a hood (7) to be used.

AFTER-CARE

- It is recommended to check the bolt connections after the installation has been at operating temperature several times.
- If the silencer is provided with a spark arrestor, this must be cleaned at least once every 2 months.

WARNING/DANGER

- Take notice of the maximum power of the engine supply.
- Exhaust gases are always toxic, even after the installation of a catalyst and/or soot trap.
- Exhaust gas systems (including the silencer) contain very hot parts when operational and for a long time after use.
- Never remove drain plugs, other cleaning plugs or inspection hatches during operation.

INFORMATION "CE-MARKING"

- The machine guideline came into force on 1 January 1995. Machines sold on the European market must be provided with a statement in accordance with this guideline.
- On the basis of this guideline, the exhaust silencer(s) we supply can be classed as a "machine without a CE-stamp, working nonindependently and intended for incorporation". As in: 89/392/EEC,91/368/EEC,93/44/EEC page L183/2F paragraph B.

FINALLY

- If you have any questions or would like advice, we are always at your service.

AXCES SILENCER

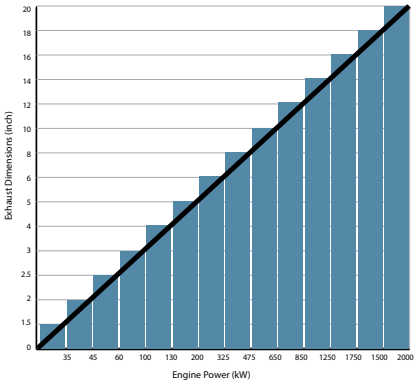
Axces Silencer	Pipe Diameter	Attennuation dB(A)	Type	Frequency	Application	Spark Arrestor
ABS	1.5" - 20"	-25	Absorptive	Mid-Higher	Dry Silencer	No
ABS-IS	1.5" - 20"	-25	Absorptive	Mid-higher	Dry Silencer	Yes
REAB35	1.5" - 20"	-35	Reactive/Absorptive	All ranges	Dry Silencer	No
REAB35-IS	1.5" - 20"	-35	Reactive/Absorptive	All ranges	Dry Silencer	Yes
REAB40	2" - 20"	-40	Reactive/Absorptive	All ranges	Dry Silencer	No
REAB40-IS	2" - 20"	-40	Reactive/Absorptive	All ranges	Dry Silencer	Yes
REAB45	4" - 20"	-45	Reactive/Absorptive	All ranges	Dry Silencer	No
REAB45-IS	3" - 20"	-45	Reactive/Absorptive	All ranges	Dry Silencer	Yes
REF25	1.5" - 20"	-20	Reactive	Lower	Dry Silencer	No
REF45	1.5" - 20"	-30	Reactive	Lower	Dry Silencer	No
AOR35	2" - 20"	-35	Reactive/Absorptive	All ranges	Oval Silencer	No
AOR35-IS	2" - 20"	-35	Reactive/Absorptive	All ranges	Oval Silencer	Yes
AOR45	2" - 20"	-45	Reactive/Absorptive	All ranges	Oval Silencer	No
AOR45-IS	2" - 20"	-45	Reactive/Absorptive	All ranges	Oval Silencer	Yes
ACR	2" - 20"	-35	Reactive/Absorptive	All ranges	Compact Silencer	No
ACR-IS	2" - 20"	-35	Reactive/Absorptive	All ranges	Compact Silencer	Yes
AIS25	12" - 40"	-25	Absorptive	Mid-Higher	Intake Silencer	No
AIS35	12" - 40"	-25	Absorptive	Mid-Higher	Intake Silencer	No
AVS	4" - 16"	-40	Absorptive	Mid-Higher	Vent Silencer	No

Axces Spark Arrestor	Pipe Diameter	Attennuation dB(A)	Type	Frequency	Application	Spark Arrestor
SA	1.5" - 20"	-	None	None	Spark arrestor (SA)	Yes
CP18	1.5" - 20"	-18	Reactive	Lower	SA which attenuates noise	Yes
CP24	2" - 20"	-24	Reactive	Lower	SA which attenuates noise	Yes
CP32	3" - 20"	-32	Reactive	Lower	SA which attenuates noise	Yes

PIPE DIAMETERS

The silencer size is important as well as the pipe diameter of the exhaust system. To calculate the optimal diameter and silencer for your engine, a rough indication is given in the next graph:

100 pk = 73.5 kW
(1 pk = 1 / 1.36 kW)



100 kW = 136 pk
(1 kW = 1.36 * pk)

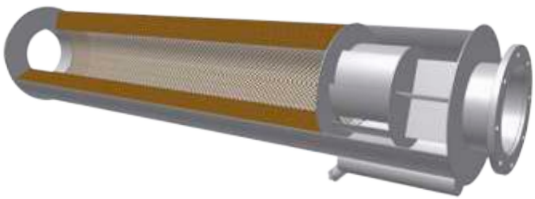
Axces Silencer	Size (inch)	NB (mm)	Pipe (mm)
0 kW - 35 kW	1.5	40	48.3
35 kW - 45 kW	2	50	60.3
45 kW - 60 kW	2.5	65	76.1
60 kW - 100 kW	3	80	88.9
100 kW - 130 kW	4	100	114.3
130 kW - 200 kW	5	125	139.7
200 kW - 325 kW	6	150	168.3
325 kW - 475 kW	8	200	219.1
475 kW - 650 kW	10	250	273.0
650 kW - 850 kW	12	300	323.9
850 kW - 1250 kW	14	350	355.6
1250 kW - 1500 kW	16	400	406.4
1500 kW - 1750 kW	18	450	457.2
1750 kW - 2000 kW	20	500	508.0

EXHAUST SILENCER TYPES

Axces has a wide range that covers all applications and engine sizes. These silencers are divided in series depending on the application, damping technique and the desired damping levels. All of our silencers can be found in the Silencer section in our webshop.

ABSORPTIVE TYPE

The noise is absorbed by specific acoustical fibre inside the silencer. The Absorptive Type silencer is most effective in the middle and high frequency range.



Axces Silencer	Pipe Diameter	Attennuation dB(A)	Spark Arrestor	Type	Frequency	Application
ABS	1.5" - 20"	-25	No	Absorptive	Mid-higher	Main Silencer

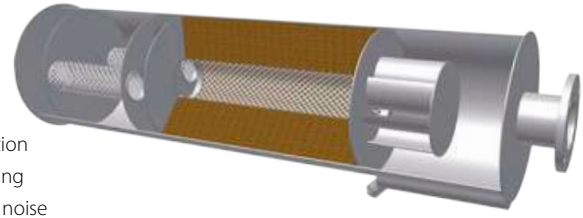
REACTIVE TYPE

The noise is reduced by creating a gas flow through separate chambers in the silencer. The Reactive Type silencer is most effective in lower and middle frequency range.

Axces Silencer	Pipe Diameter	Attennuation dB(A)	Spark Arrestor	Type	Frequency	Application
REF25	1.5" - 20"	-20	No	Reactive/Absorptive	Lower	Pre-silencer for extra low freq.
REF45	1.5" - 20"	-30	No	Reactive	Lower	Pre-silencer for extra low freq.

EXHAUST SILENCER TYPES

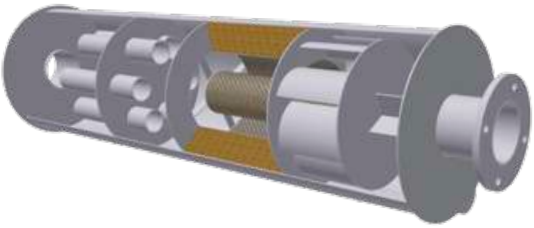
REACTIVE-ABSORPTIVE TYPE



The Reflection | Absorption Type silencers are based on a combination of Absorptive and Reactive damping techniques in order to reduce the noise in the complete frequency range.

Axces Silencer	Pipe Diameter	Attennuation dB(A)	Spark Arrestor	Type	Frequency	Application
REAB35	1.5" - 20"	-35	No	Reactive/Absorptive	All ranges	Main Silencer
REAB40	1.5" - 20"	-40	No	Reactive/Absorptive	All ranges	Main Silencer
REAB45	1.5" - 20"	-45	No	Reactive/Absorptive	All ranges	Main Silencer

SILENCER TYPES WITH INTEGRATED SPARK ARRESTOR



Axces silencers can be equipped with an internal spark arrestor. Axces spark arrestors are DNV and RMRS type approved.

Axces Silencer	Pipe Diameter	Attennuation dB(A)	Spark Arrestor	Type	Frequency	Application
ABS-IS	1.5" - 20"	-25	Yes	Absorptive	Mid-higher	Main Silencer
REAB 35-IS	1.5" - 20"	-35	Yes	Reactive/Absorptive	All ranges	Main Silencer
REAB 40-IS	1.5" - 20"	-40	Yes	Reactive/Absorptive	All ranges	Main Silencer
REAB 45-IS	1.5" - 20"	-45	Yes	Reactive/Absorptive	All ranges	Main Silencer

EXHAUST SILENCER TYPES

SPARK ARRESTOR WITH ATTENUATION

Axces has a wide range of Spark Arrestors with Attenuation which can be mounted in the exhaust gas system. Axces spark arrestors are DNV, BV and RMRS type approved.

Axces Silencer	Pipe Diameter	Attennuation dB(A)	Spark Arrestor	Type	Frequency	Application
CP18	1.5" - 20"	-18	Yes	Reactive	Lower	SA with damping level
CP24	2" - 20"	-24	Yes	Reactive	Lower	SA with damping level
CP32	3" - 20"	-32	Yes	Reactive	Lower	SA with damping level

SPARK ARRESTOR

Axces has a wide range of separate Spark Arrestors which can be mounted in the exhaust gas system. Axces spark arrestors are DNV, BV and RMRS type approved.

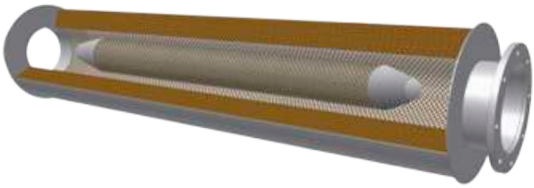
Axces Silencer	Pipe Diameter	Attennuation dB(A)	Spark Arrestor	Type	Frequency	Application
SA Spark Arr.	1.5" - 20"	-	Yes	None	None	Spark arrestor (SA)

AIR INTAKE SILENCER TYPES

Axces has a wide range that covers all applications and engine sizes. These silencers are divided in series depending on the application, damping technique and the desired damping levels. You can find all of our silencers in the Silencer section in our webshop.

AIS25

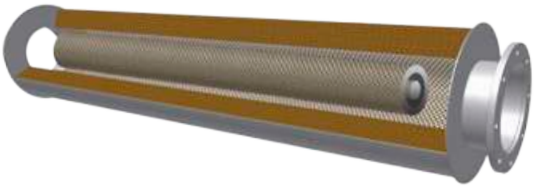
The noise is absorbed by specific acoustical fibre inside the silencer. The Absorptive Type silencer is most effective in the middle and high frequency range.



Axces Silencer	Pipe Diameter	Attennuation dB(A)	Spark Arrestor	Type	Frequency	Application
AIS25	12" - 40"	-25	No	Absorptive	Mid-higher	Main Silencer

AIS35

The noise is absorbed by specific acoustical fibre inside the silencer. The Absorptive Type silencer is most effective in the middle and high frequency range.

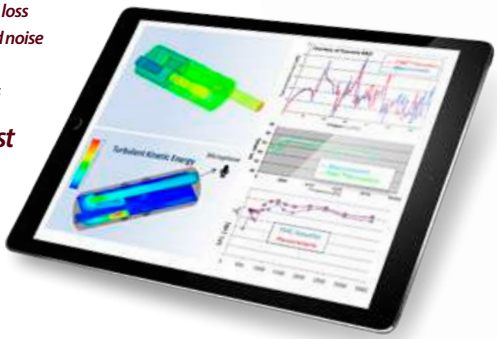


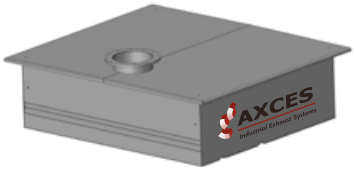
Axces Silencer	Pipe Diameter	Attennuation dB(A)	Spark Arrestor	Type	Frequency	Application
AIS35	12" - 40"	-35	No	Absorptive	Mid - Higher	Main Silencerv

CUSTOM MADE EXHAUST SILENCERS

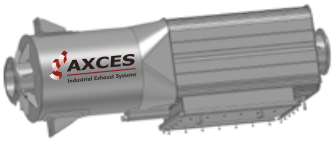
Axces designs its silencers and exhaust systems using the best Aero-Vibro-Acoustic Simulations software. This software can thoroughly calculate every aspect related to noise in an early stage of the design of the system. These calculations guarantee:

- ✓ *Customized compact design*
- ✓ *Accurate efficient and simulation of:*
  - *Pipe noise*
  - *Transmission loss*
  - *Shell radiated noise*
  - *Flow noise*
  - *CFD Analyses*
- ✓ *Lower cost*



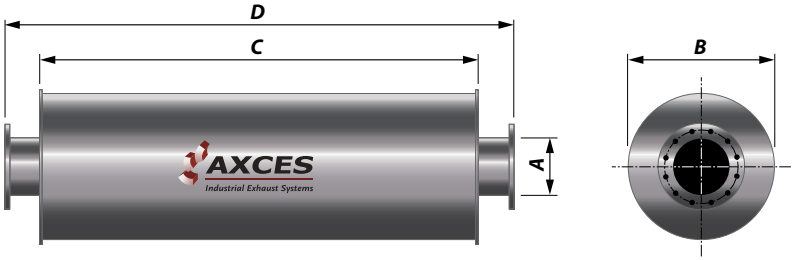


CUSTOM MADE EXHAUST SILENCERS

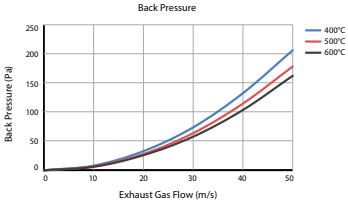


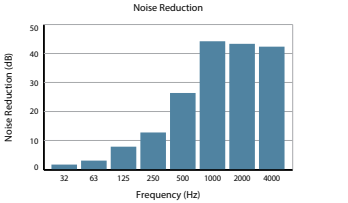
TYPE ABS

Damping level 20-25 dB(A)
without integrated Spark Arrestor



Article No.	A (inch)	NB (mm)	Pipe (mm)	B (mm)	C (mm)	D (mm)	Weight (kg)
130100000015	1.5	40	48.3	114	620	750	6
130100000020	2	50	60.3	143	670	800	8
130100000025	2.5	60	76.1	172	750	880	10
130100000030	3	80	88.9	187	820	950	15
130100000040	4	100	114.3	243	1000	1140	25
130100000050	5	125	139.7	313	1220	1250	30
130100000060	6	150	168.3	376	1250	1450	50
130100000080	8	200	219.1	388	1500	1700	95
130100000100	10	250	273.0	584	2000	2250	175
130100000120	12	300	323.9	611	2000	2250	225
130100000140	14	350	355.6	671	2250	2500	270
130100000160	16	400	406.4	751	2750	3000	350
130100000180	18	450	457.2	851	3250	3500	420
130100000200	20	500	508.0	951	3750	4000	500





Damping Of The Noise Level ± 20-25 dB(A).

Damping Basics of the silencers type ABS are according the absorbtion principal.

Spark Arrestor The silencers type ABS are excluding an integrated Spark Arrestor.

Mounting The silencers type ABS can be installed both horizontal and vertical.

Exhaust Gas Speed Advised Exhaust Gas Speed between 20-50 m/s.

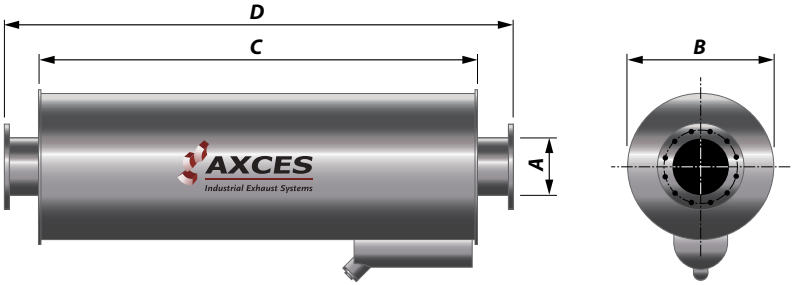
Material Silencers type ABS are produced out of Steel 37-2 (S235JRG2).

Temperature Maximum allowable temperature is 600°C.

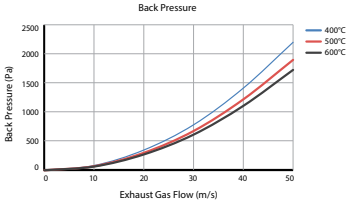
Custom Made Axces silencers are also manufactured based on specific dimensions or client's requirements.

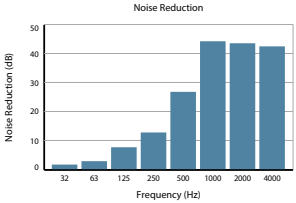
TYPE ABS-IS

Damping level 20-25 B(A)
with integrated Spark Arrestor



Article No.	A (inch)	NB (mm)	Pipe (mm)	B (mm)	C (mm)	D (mm)	Weight (kg)
131100000015	1.5	40	48.3	114	710	840	10
131100000020	2	50	60.3	143	870	1000	15
131100000025	2.5	60	76.1	172	1020	1150	20
131100000030	3	80	88.9	187	1120	1250	25
131100000040	4	100	114.3	243	1250	1420	45
131100000050	5	125	139.7	313	1300	1440	60
131100000060	6	150	168.3	376	1560	1710	90
131100000080	8	200	219.1	388	1850	2030	110
131100000100	10	250	273.0	584	2000	2250	250
131100000120	12	300	323.9	611	2250	2500	295
131100000140	14	350	355.6	671	2500	2750	350
131100000160	16	400	406.4	751	2750	3000	450
131100000180	18	450	457.2	851	3250	3500	500
131100000200	20	500	508.0	951	3750	4000	625





Damping Of The Noise Level 20-25 dB(A).

Damping Basics of the silencers type ABS-IS are according the reflectionabsorption principal.

Spark Arrestor The silencers type ABS-IS are excluding an integrated Spark Arrestor.

Mounting The silencers type ABS-IS can be installed both horizontal and vertical.

Exhaust Gas Speed Advised Exhaust Gas Speed between 20-50 m/s.

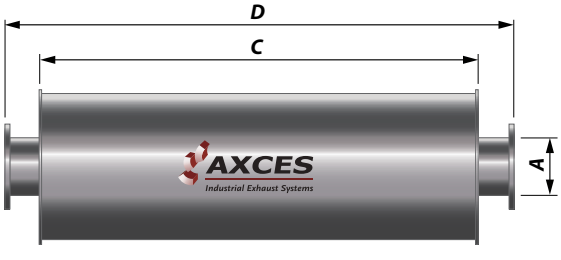
Material Silencers type ABS-IS are produced out of Steel 37-2 (S235JRG2).

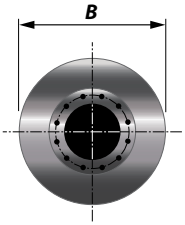
Temperature Maximum allowable temperature is 600°C.

Custom Made Axces silencers are also manufactured based on specific dimensions or client's requirements.

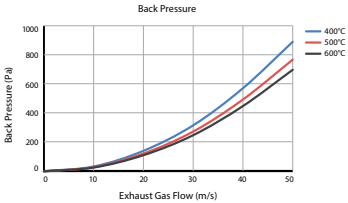
TYPE REAB35

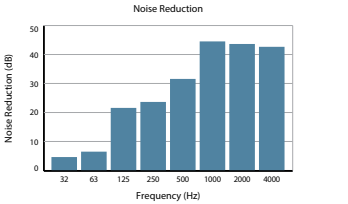
Damping level 35 dB(A)
without integrated Spark Arrestor





Article No.	A (inch)	NB (mm)	Pipe (mm)	B (mm)	C (mm)	D (mm)	Weight (kg)
140100000015	1.5	40	48.3	200	750	900	10
140100000020	2	50	60.3	200	750	900	15
140100000025	2.5	60	76.1	260	850	1000	22
140100000030	3	80	88.9	310	850	1000	30
140100000040	4	100	114.3	360	1270	1500	50
140100000050	5	125	139.7	400	1270	1500	65
140100000060	6	150	168.3	475	1500	1750	125
140100000080	8	200	219.1	560	1750	2000	170
140100000100	10	250	273.0	635	2250	2500	250
140100000120	12	300	323.9	760	2500	2750	320
140100000140	14	350	355.6	800	2750	3000	410
140100000160	16	400	406.4	860	3000	3250	500
140100000180	18	450	457.2	910	3250	3500	565
140100000180	20	500	508.0	960	3500	3750	640





Damping Of The Noise Level ±35 dB(A).

Damping Basics of the silencers type REAB35 are according the reflectionabsorption principal.

Spark Arrestor The silencers type REAB35 are excluding an integrated Spark Arrestor.

Mounting The silencers type REAB35 can be installed both horizontal and vertical.

Exhaust Gas Speed Advised Exhaust Gas Speed between 20-50 m/s.

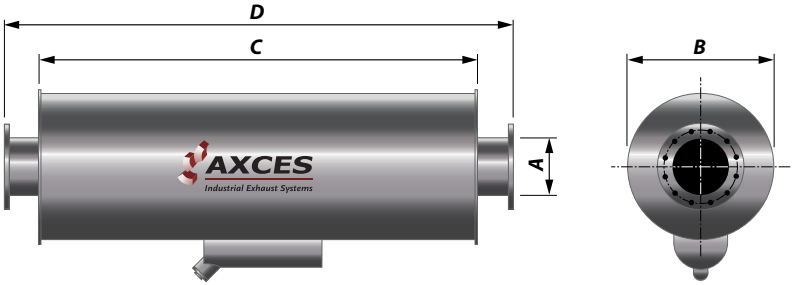
Material Silencers type REAB35 are produced out of Steel 37-2 (S235JRG2).

Temperature Maximum allowable temperature is 600°C.

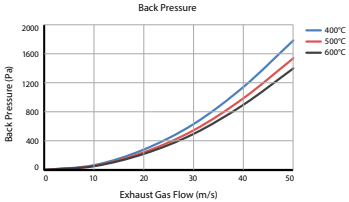
Custom Made Axces silencers are also manufactured based on specific dimensions or client's requirements.

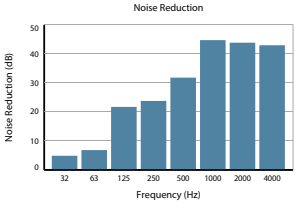
TYPE REAB35-IS

Damping level 35 dB(A)
with integrated Spark Arrestor



Article No.	A (inch)	NB (mm)	Pipe (mm)	B (mm)	C (mm)	D (mm)	Weight (kg)
141200000015	1.5	40	48.3	200	750	900	10
141200000020	2	50	60.3	200	750	900	15
141200000025	2.5	60	76.1	260	850	1000	22
141200000030	3	80	88.9	310	850	1000	30
141200000040	4	100	114.3	360	1270	1500	50
141200000050	5	125	139.7	400	1270	1500	65
141200000060	6	150	168.3	475	1500	1750	125
141200000080	8	200	219.1	560	1750	2000	170
141200000100	10	250	273.0	635	2250	2500	250
141200000120	12	300	323.9	760	2500	2750	320
141200000140	14	350	355.6	800	2750	3000	410
141200000160	16	400	406.4	860	3000	3250	500
141200000180	18	450	457.2	910	3250	3500	565
141200000200	20	500	508.0	960	3500	3750	640





Damping Of The Noise Level ± 35 dB(A).

Damping Basics of the silencers type REAB35-IS are according the reflection-absorption principal.

Spark Arrestor The silencers type REAB35-IS are including an integrated Spark Arrestor.

Mounting The silencers type REAB35-IS can be installed both horizontal and vertical.

Exhaust Gas Speed Advised Exhaust Gas.

Speed between 20-50 m/s.

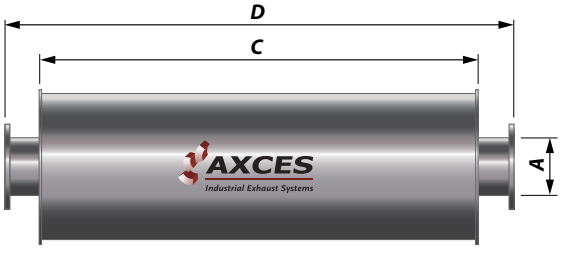
Material Silencers type REAB35-IS are produced out of Steel 37-2 (S235JRG2).

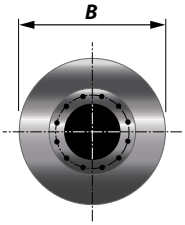
Temperature Maximum allowable temperature is 600°C.

Custom Made Axces silencers are also manufactured based on specific dimensions or client's requirements.

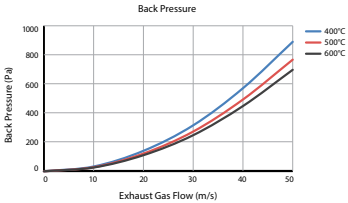
TYPE REAB40

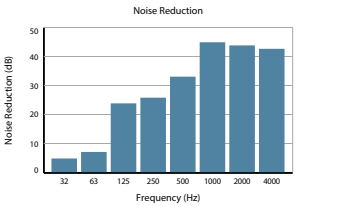
Damping level 40 dB(A)
without integrated Spark Arrestor





Article No.	A (inch)	NB (mm)	Pipe (mm)	B (mm)	C (mm)	D (mm)	Weight (kg)
140300000015	1.5	40	48.3	250	750	900	20
140300000020	2	50	60.3	250	750	900	25
140300000025	2.5	60	76.1	300	750	900	35
140300000030	3	80	88.9	300	1000	1250	40
140300000040	4	100	114.3	400	1250	1500	80
140300000050	5	125	139.7	400	1500	1750	90
140300000060	6	150	168.3	480	1500	1750	130
140300000080	8	200	219.1	600	1750	2000	200
140300000100	10	250	273.0	700	2250	2500	300
140300000120	12	300	323.9	800	2500	2750	400
140300000140	14	350	355.6	950	3000	3250	625
140300000160	16	400	406.4	950	3500	3750	800
140300000180	18	450	457.2	1100	4000	4250	1250
140300000200	20	500	508.0	1200	4500	4750	1500





Damping Of The Noise Level ±40 dB(A).

Damping Basics of the silencers type REAB40 are according the reflectionabsorption principal.

Spark Arrestor The silencers type REAB40 are excluding an integrated Spark Arrestor.

Mounting The silencers type REAB40 can be installed both horizontal and vertical.

Exhaust Gas Speed Advised Exhaust Gas Speed between 20-50 m/s.

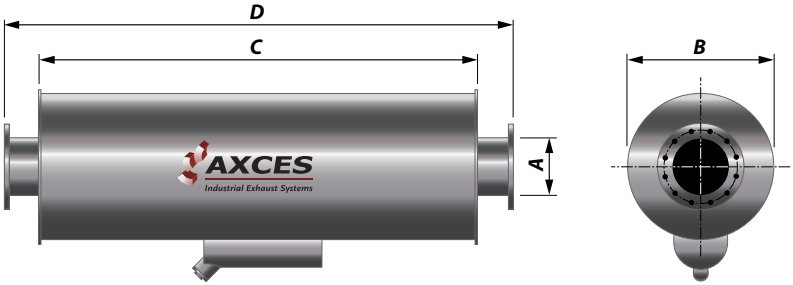
Material Silencers type REAB40 are produced out of Steel 37-2 (S235JRG2).

Temperature Maximum allowable temperature is 600°C.

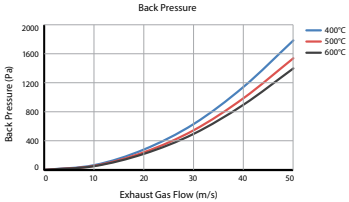
Custom Made Axces silencers are also manufactured based on specific dimensions or client's requirements.

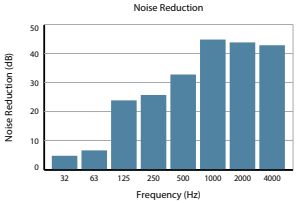
TYPE REAB40-IS

Damping level 40 dB(A)
with integrated Spark Arrestor



Article No.	A (inch)	NB (mm)	Pipe (mm)	B (mm)	C (mm)	D (mm)	Weight (kg)
141300000015	1.5	40	48.3	250	750	900	20
141300000020	2	50	60.3	250	750	900	25
141300000025	2.5	60	76.1	300	750	900	35
141300000030	3	80	88.9	300	1000	1250	40
141300000040	4	100	114.3	400	1250	1500	80
141300000050	5	125	139.7	400	1500	1750	90
141300000060	6	150	168.3	480	1500	1750	130
141300000080	8	200	219.1	600	1750	2000	200
141300000100	10	250	273.0	700	2250	2500	300
141300000120	12	300	323.9	800	2500	2750	400
141300000140	14	350	355.6	950	3000	3250	625
141300000160	16	400	406.4	950	3500	3750	800
141300000180	18	450	457.2	1100	4000	4250	1250
141300000200	20	500	508.0	1200	4500	4750	1500





Damping Of The Noise Level ± 40 dB(A).

Damping Basics of the silencers type REAB40-IS are according the reflectionabsorption principal.

Spark Arrestor The silencers type REAB40-IS are including an integrated Spark Arrestor.

Mounting The silencers type REAB40-IS can be installed both horizontal and vertical.

Exhaust Gas Speed Advised Exhaust Gas Speed between 20-50 m/s.

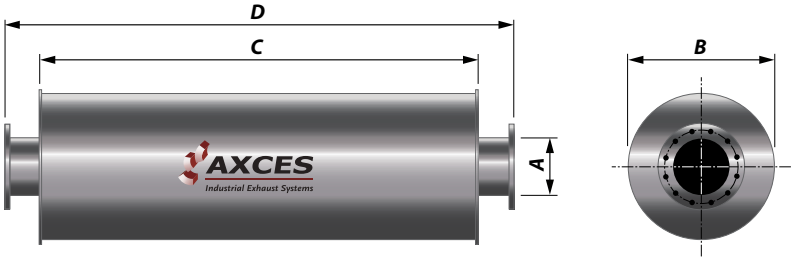
Material Silencers type REAB40-IS are produced out of Steel 37-2 (S235JRG2).

Temperature Maximum allowable temperature is 600°C.

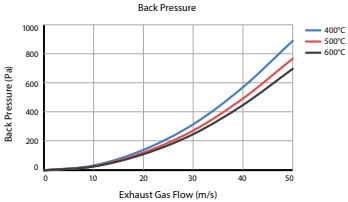
Custom Made Axces silencers are also manufactured based on specific dimensions or client's requirements.

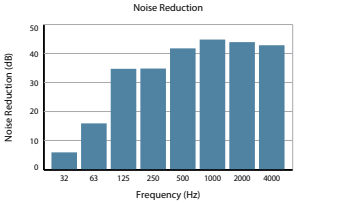
TYPE REAB45

Damping level 45 dB(A)
without integrated Spark Arrestor



Article No.	A (inch)	NB (mm)	Pipe (mm)	B (mm)	C (mm)	D (mm)	Weight (kg)
140400000015	1.5	40	48.3	260	850	1000	30
140400000020	2	50	60.3	310	850	1000	40
140400000025	2.5	60	76.1	360	1250	1500	60
140400000030	3	80	88.9	380	1250	1500	70
140400000040	4	100	114.3	475	1500	1750	120
140400000050	5	125	139.7	475	1500	1750	130
140400000060	6	150	168.3	560	2250	2500	200
140400000080	8	200	219.1	660	2250	2500	260
140400000100	10	250	273.0	860	2750	3000	480
140400000120	12	300	323.9	910	3000	3250	550
140400000140	14	350	355.6	960	3500	3750	690
140400000160	16	400	406.4	1060	4000	4250	1050
140400000180	18	450	457.2	1210	4500	4750	1400
140400000200	20	500	508.0	1300	5000	5250	1735





Damping Of The Noise Level ±45 dB(A).

Damping Basics of the silencers type REAB45 are according the reflectionabsorption principal.

Spark Arrestor The silencers type REAB45 are excluding an integrated Spark Arrestor.

Mounting The silencers type REAB45 can be installed both horizontal and vertical.

Exhaust Gas Speed Advised Exhaust Gas Speed between 20-50 m/s.

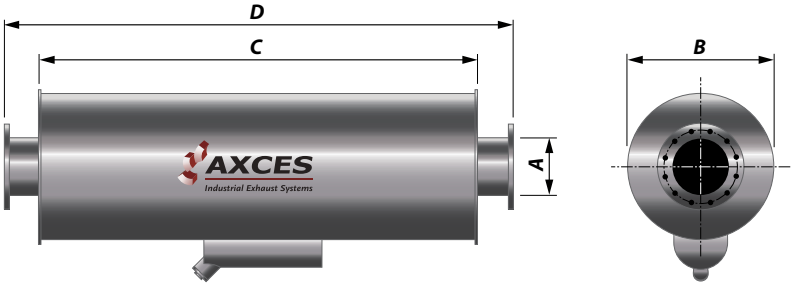
Material Silencers type REAB45 are produced out of Steel 37-2 (S235JRG2).

Temperature Maximum allowable temperature is 600°C.

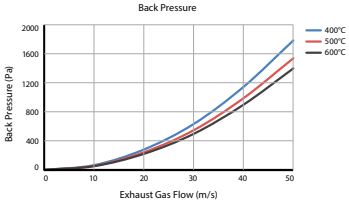
Custom Made Axces silencers are also manufactured based on specific dimensions or client's requirements.

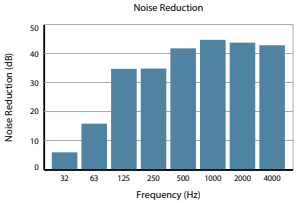
TYPE REAB45-IS

Damping level 45 dB(A)
with integrated Spark Arrestor



Article No.	A (inch)	NB (mm)	Pipe (mm)	B (mm)	C (mm)	D (mm)	Weight (kg)
141400000015	1.5	40	48.3	260	850	1000	30
141400000020	2	50	60.3	310	850	1000	40
141400000025	2.5	60	76.1	360	1250	1500	60
141400000030	3	80	88.9	380	1250	1500	70
141400000040	4	100	114.3	475	1500	1750	120
141400000050	5	125	139.7	475	1500	1750	130
141400000060	6	150	168.3	560	2250	2500	200
141400000080	8	200	219.1	660	2250	2500	260
141400000100	10	250	273.0	860	2750	3000	480
141400000120	12	300	323.9	910	3000	3250	550
141400000140	14	350	355.6	960	3500	3750	690
141400000160	16	400	406.4	1060	4000	4250	1050
141400000180	18	450	457.2	1210	4500	4750	1400
141400000200	20	500	508.0	1300	5000	5250	1735





Damping Of The Noise Level ± 45 dB(A).

Damping Basics of the silencers type REAB45-IS are according the reflectionabsorption principal.

Spark Arrestor The silencers type REAB45-IS are including an integrated Spark Arrestor.

Mounting The silencers type REAB45-IS can be installed both horizontal and vertical.

Exhaust Gas Speed Advised Exhaust Gas Speed between 20-50 m/s.

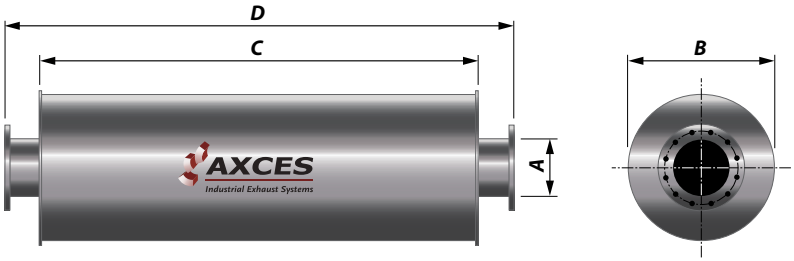
Material Silencers type REAB45-IS are produced out of Steel 37-2 (S235JRG2).

Temperature Maximum allowable temperature is 600°C.

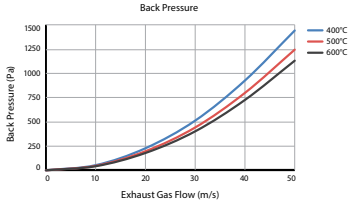
Custom Made Axces silencers are also manufactured based on specific dimensions or client's requirements.

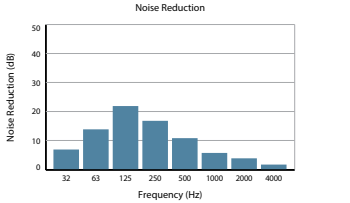
TYPE REF25

Damping level 20 dB(A)
without integrated Spark Arrestor



Article No.	A (inch)	NB (mm)	Pipe (mm)	B (mm)	C (mm)	D (mm)	Weight (kg)
150100000015	1.5	40	48.3	200	750	900	15
150100000020	2	50	60.3	200	750	900	16
150100000025	2.5	60	76.1	260	850	1000	22
150100000030	3	80	88.9	310	850	1000	30
150100000040	4	100	114.3	360	1270	1500	50
150100000050	5	125	139.7	400	1270	1500	65
150100000060	6	150	168.3	475	1500	1750	120
150100000080	8	200	219.1	560	1750	2000	165
150100000100	10	250	273.0	635	2250	2500	230
150100000120	12	300	323.9	760	2500	2750	330
150100000140	14	350	355.6	860	2750	3000	380
150100000160	16	400	406.4	910	3000	3250	410
150100000180	18	450	457.2	960	3250	3500	480
150100000200	20	500	508.0	1060	3500	3750	705





Damping Of The Noise Level ±20 dB(A).

Damping Basics of the silencers type REF25 are according the reflection principal.

Spark Arrestor The silencers type REF25 are excluding an integrated Spark Arrestor.

Mounting The silencers type REF25 can be installed both horizontal and vertical.

Exhaust Gas Speed Advised Exhaust Gas Speed between 20-50 m/s.

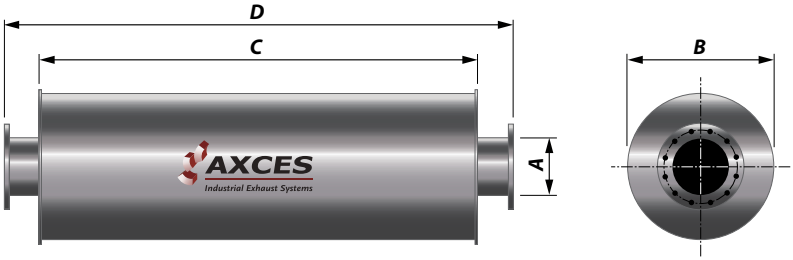
Material Silencers type REF25 are produced out of Steel 37-2 (S235JRG2).

Temperature Maximum allowable temperature is 600°C.

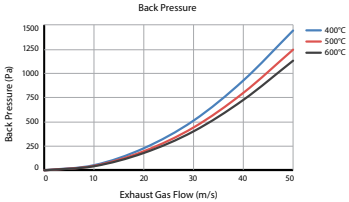
Custom Made Axces silencers are also manufactured based on specific dimensions or client's requirements.

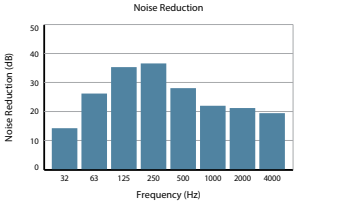
TYPE REF45

Damping level 30 dB(A)
without integrated Spark Arrestor



Article No.	A (inch)	NB (mm)	Pipe (mm)	B (mm)	C (mm)	D (mm)	Weight (kg)
150400000015	1.5	40	48.3	260	750	900	17
150400000020	2	50	60.3	310	850	1000	25
150400000025	2.5	60	76.1	360	850	1000	30
150400000030	3	80	88.9	400	1250	1500	48
150400000040	4	100	114.3	475	1500	1750	100
150400000050	5	125	139.7	475	1750	2000	135
150400000060	6	150	168.3	560	2250	2500	180
150400000080	8	200	219.1	660	2250	2500	210
150400000100	10	250	273.0	860	2750	3000	380
150400000120	12	300	323.9	910	3000	3250	410
150400000140	14	350	355.6	960	3500	3750	560
150400000160	16	400	406.4	1060	4000	4250	750
150400000180	18	450	457.2	1210	4500	4750	1100
150400000200	20	500	508.0	1300	5000	5250	1400





Damping Of The Noise Level ±30 dB(A).

Damping Basics of the silencers type REF45 are according the reflection principal.

Spark Arrestor The silencers type REF45 are excluding an integrated Spark Arrestor.

Mounting The silencers type REF45 can be installed both horizontal and vertical.

Exhaust Gas Speed Advised Exhaust Gas Speed between 20-50 m/s.

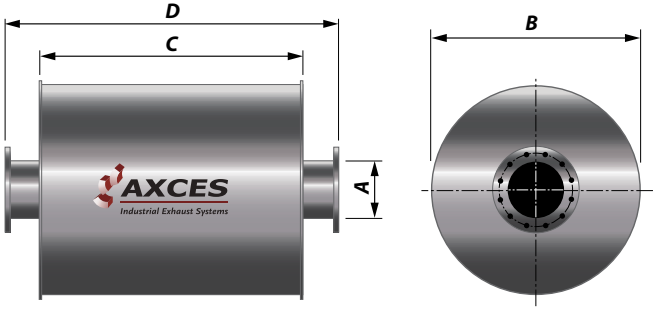
Material Silencers type REF45 are produced out of Steel 37-2 (S235JRG2).

Temperature Maximum allowable temperature is 600°C.

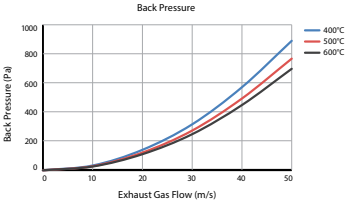
Custom Made Axces silencers are also manufactured based on specific dimensions or client's requirements.

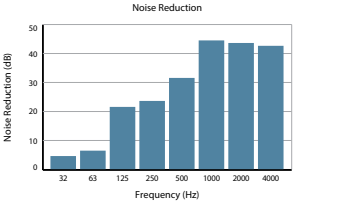
TYPE ACR

Damping level 25 dB(A)
without integrated Spark Arrestor



Article No.	A (inch)	NB (mm)	Pipe (mm)	B (mm)	C (mm)	D (mm)	Weight (kg)
170100000020	2	50	60.3	206	215	300	10
170100000025	2.5	60	76.1	306	320	420	14
170100000030	3	80	88.9	306	320	420	20
170100000040	4	100	114.3	356	390	540	25
170100000050	5	125	139.7	401	535	650	30
170100000060	6	150	168.3	482	606	750	40
170100000080	8	200	219.1	556	756	900	50
170100000100	10	250	273.0	708	856	1000	60
170100000120	12	300	323.9	800	1006	1200	70
170100000140	14	350	355.6	908	1256	1500	100
170100000160	16	400	406.4	1060	1408	1600	160
170100000180	18	450	457.2	1212	1510	1700	200
170100000200	20	500	508.0	1312	1810	2000	250





Damping Of The Noise Level ±25 dB(A).

Damping Basics of the silencers type ACR are according the reflection absorption principal.

Spark Arrestor The silencers type ACR are excluding an integrated Spark Arrestor.

Mounting The silencers type ACR can be installed both horizontal and vertical.

Exhaust Gas Speed Advised Exhaust Gas Speed between 20-50 m/s.

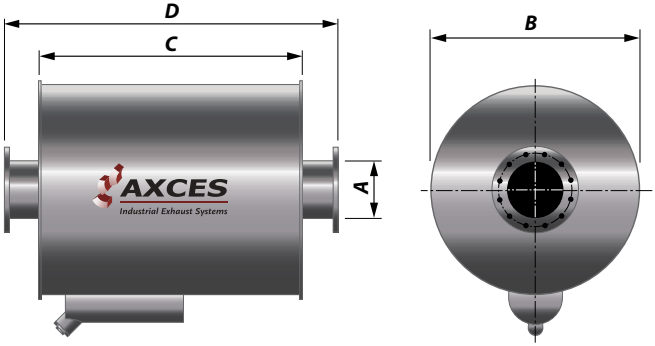
Material Silencers type ACR are produced out of Steel 37-2 (S235JRG2).

Temperature Maximum allowable temperature is 600°C.

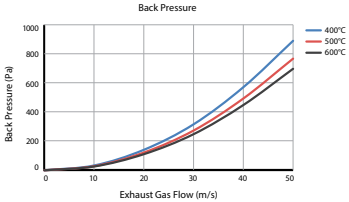
Custom Made Axces silencers are also manufactured based on specific dimensions or client's requirements.

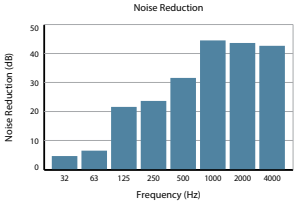
TYPE ACR-IS

Damping level 25 dB(A)
with integrated Spark Arrestor



Article No.	A (inch)	NB (mm)	Pipe (mm)	B (mm)	C (mm)	D (mm)	Weight (kg)
170200000020	2	50	60.3	206	215	300	10
170200000025	2.5	60	76.1	306	320	420	14
170200000030	3	80	88.9	306	320	420	20
170200000040	4	100	114.3	356	390	540	25
170200000050	5	125	139.7	401	535	650	30
170200000060	6	150	168.3	482	606	750	40
170200000080	8	200	219.1	556	756	900	50
170200000100	10	250	273.0	708	856	1000	60
170200000120	12	300	323.9	800	1006	1200	70
170200000140	14	350	355.6	908	1256	1500	100
170200000160	16	400	406.4	1060	1408	1600	160
170200000180	18	450	457.2	1212	1510	1700	200
170200000200	20	500	508.0	1312	1810	2000	250





Damping Of The Noise Level ±25 dB(A).

Damping Basics of the silencers type ACR-IS are according the reflection absorption principal.

Spark Arrestor The silencers type ACR-IS are excluding an integrated Spark Arrestor.

Mounting The silencers type ACR-IS can be installed both horizontal and vertical.

Exhaust Gas Speed Advised Exhaust Gas Speed between 20-50 m/s.

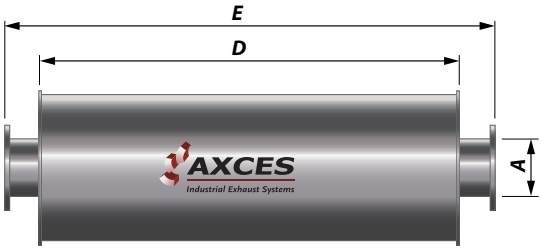
Material Silencers type ACR-IS are produced out of Steel 37-2 (S235JRG2).

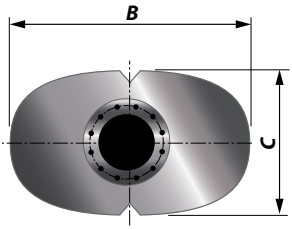
Temperature Maximum allowable temperature is 600°C.

Custom Made Axces silencers are also manufactured based on specific dimensions or client's requirements.

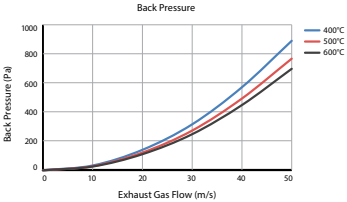
TYPE AOR 35

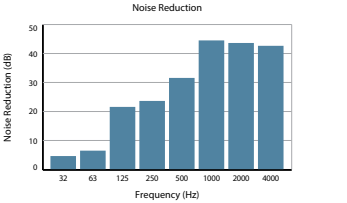
Damping level 35 dB(A)
without integrated Spark Arrestor





Article No.	A (inch)	NB (mm)	Pipe (mm)	B (mm)	C (mm)	D (mm)	E (mm)	Weight (kg)
180100000020	2	50	60.3	280	150	750	900	20
180100000025	2.5	60	76.1	350	180	850	1000	30
180100000030	3	80	88.9	420	220	850	1000	40
180100000040	4	100	114.3	480	240	1270	1500	60
180100000050	5	125	139.7	535	270	1270	1500	80
180100000060	6	150	168.3	635	320	1500	1750	150
180100000080	8	200	219.1	750	375	1750	2000	200
180100000100	10	250	273.0	850	425	2250	2500	180
180100000120	12	300	323.9	1000	510	2500	2750	360
180100000140	14	350	355.6	1065	535	2750	3000	450
180100000160	16	400	406.4	1150	570	3000	3250	550
180100000180	18	450	457.2	1210	610	3250	3500	625
180100000200	20	500	508.0	1275	640	3500	3750	700





Damping Of The Noise Level ±35 dB(A).

Damping Basics of the silencers type AOR35 are according the reflection absorption principal.

Spark Arrestor The silencers type AOR35 are excluding an integrated Spark Arrestor.

Mounting The silencers type AOR35 can be installed both horizontal and vertical.

Exhaust Gas Speed Advised Exhaust Gas Speed between 20-50 m/s.

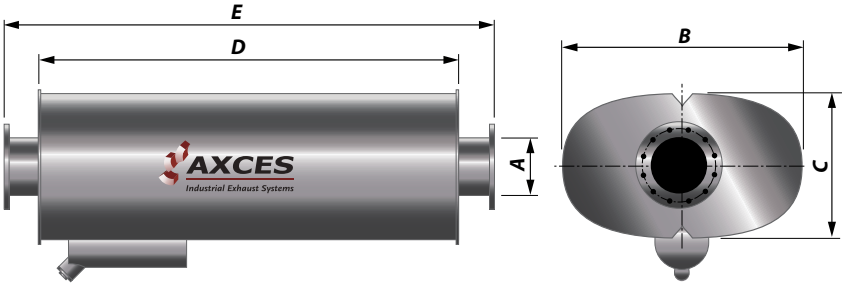
Material Silencers type AOR35 are produced out of Steel 37-2 (S235JRG2).

Temperature Maximum allowable temperature is 600°C.

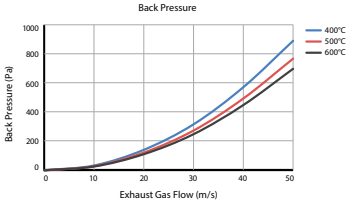
Custom Made Axces silencers are also manufactured based on specific dimensions or client's requirements.

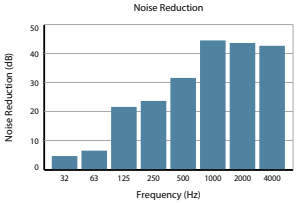
TYPE AOR 35-IS

Damping level 35 dB(A)
with integrated Spark Arrestor



Article No.	A (inch)	NB (mm)	Pipe (mm)	B (mm)	C (mm)	D (mm)	E (mm)	Weight (kg)
180110000020	2	50	60.3	280	150	750	900	20
180110000025	2.5	60	76.1	350	180	850	1000	30
180110000030	3	80	88.9	420	220	850	1000	40
180110000040	4	100	114.3	480	240	1270	1500	60
180110000050	5	125	139.7	535	270	1270	1500	80
180110000060	6	150	168.3	635	320	1500	1750	150
180110000080	8	200	219.1	750	375	1750	2000	200
180110000100	10	250	273.0	850	425	2250	2500	180
180110000120	12	300	323.9	1000	510	2500	2750	360
180110000140	14	350	355.6	1065	535	2750	3000	450
180110000160	16	400	406.4	1150	570	3000	3250	550
180110000180	18	450	457.2	1210	610	3250	3500	625
180110000200	20	500	508.0	1275	640	3500	3750	700





Damping Of The Noise Level ±35 dB(A).

Damping Basics of the silencers type AOR35-IS are according the reflection absorption principal.

Spark Arrestor The silencers type AOR35-IS are excluding an integrated Spark Arrestor.

Mounting The silencers type AOR35-IS can be installed both horizontal and vertical.

Exhaust Gas Speed Advised Exhaust Gas Speed between 20-50 m/s.

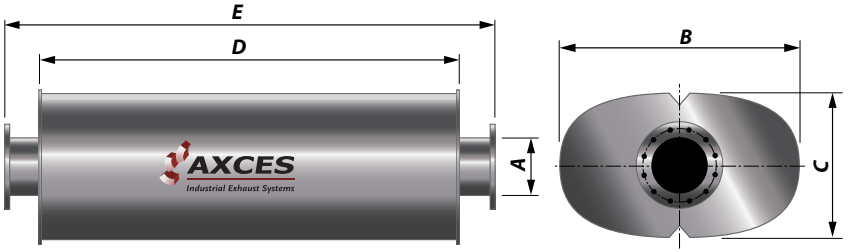
Material Silencers type AOR35-IS are produced out of Steel 37-2 (S235JRG2).

Temperature Maximum allowable temperature is 600°C.

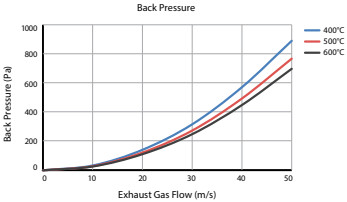
Custom Made Axces silencers are also manufactured based on specific dimensions or client's requirements.

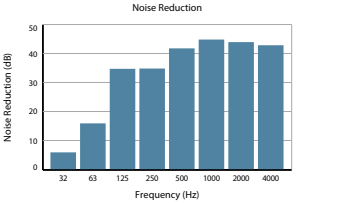
TYPE AOR 45

Damping level 45 dB(A)
without integrated Spark Arrestor



Article No.	A (inch)	NB (mm)	Pipe (mm)	B (mm)	C (mm)	D (mm)	E (mm)	Weight (kg)
180210000020	2"	50	60.3	420	220	850	1000	45
180210000025	2.5"	60	76.1	480	240	1250	1500	68
180210000030	3"	80	88.9	510	260	1250	1500	80
180210000040	4"	100	114.3	635	320	1500	1750	130
180210000050	5"	125	139.7	635	320	1500	1750	145
180210000060	6"	150	168.3	750	375	2250	2500	225
180210000080	8"	200	219.1	875	440	2250	2500	300
180210000100	10"	250	273.0	1150	570	2750	3000	510
180210000120	12"	300	323.9	1210	610	3000	3250	610
180210000140	14"	350	355.6	1275	640	3500	3750	750
180210000160	16"	400	406.4	1410	705	4000	4250	1100
180210000180	18"	450	457.2	1605	805	4500	4750	1460
180210000200	20"	500	508.0	1725	865	5000	5250	1800





Damping Of The Noise Level ±45 dB(A).

Damping Basics of the silencers type AOR45 are according the reflection absorption principal.

Spark Arrestor The silencers type AOR45 are excluding an integrated Spark Arrestor.

Mounting The silencers type AOR45 can be installed both horizontal and vertical.

Exhaust Gas Speed Advised Exhaust Gas Speed between 20-50 m/s.

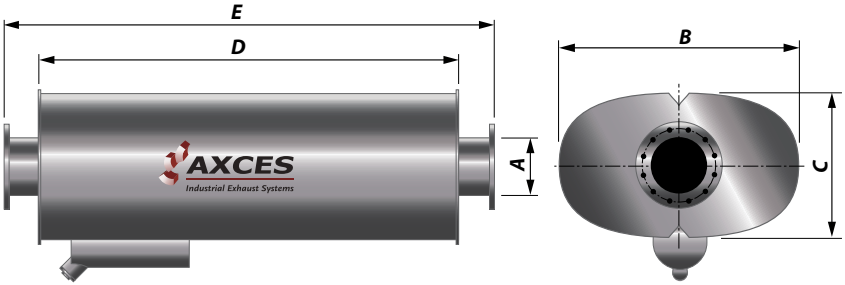
Material Silencers type AOR45 are produced out of Steel 37-2 (S235JRG2).

Temperature Maximum allowable temperature is 600°C.

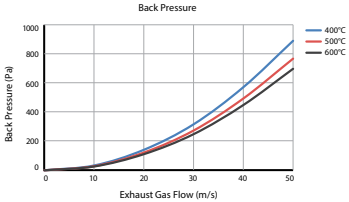
Custom Made Axces silencers are also manufactured based on specific dimensions or client's requirements.

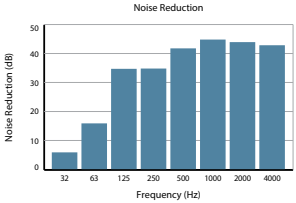
TYPE AOR 45-IS

Damping level 45 dB(A)
with integrated Spark Arrestor



Article No.	A (inch)	NB (mm)	Pipe (mm)	B (mm)	C (mm)	D (mm)	E (mm)	Weight (kg)
180200000020	2"	50	60.3	420	220	850	1000	45
180200000025	2.5"	60	76.1	480	240	1250	1500	68
180200000030	3"	80	88.9	510	260	1250	1500	80
180200000040	4"	100	114.3	635	320	1500	1750	130
180200000050	5"	125	139.7	635	320	1500	1750	145
180200000060	6"	150	168.3	750	375	2250	2500	225
180200000080	8"	200	219.1	875	440	2250	2500	300
180200000100	10"	250	273.0	1150	570	2750	3000	510
180200000120	12"	300	323.9	1210	610	3000	3250	610
180200000140	14"	350	355.6	1275	640	3500	3750	750
180200000160	16"	400	406.4	1410	705	4000	4250	1100
180200000180	18"	450	457.2	1605	805	4500	4750	1460
180200000200	20"	500	508.0	1725	865	5000	5250	1800





Damping Of The Noise Level ±45 dB(A).

Damping Basics of the silencers type AOR45-IS are according the reflection absorption principal.

Spark Arrestor The silencers type AOR45-IS are excluding an integrated Spark Arrestor.

Mounting The silencers type AOR45-IS can be installed both horizontal and vertical.

Exhaust Gas Speed Advised Exhaust Gas Speed between 20-50 m/s.

Material Silencers type AOR45-IS are produced out of Steel 37-2 (S235JRG2).

Temperature Maximum allowable temperature is 600°C.

Custom Made Axces silencers are also manufactured based on specific dimensions or client's requirements.