

# Compact Silencer System – for reduced noise

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**Noise is an increasing, yet underestimated form of environmental pollution. The Compact Silencer System (CSS) provides more efficient noise abatement onboard ships than is possible with conventional silencers.**

People are affected in different ways by the same sounds. Often, we take for granted the sounds we hear everyday. On different occasions and in varying situations, however, common everyday sounds can interfere with our routine tasks. When this happens, sounds become noise.

Noise is an unwanted sound and its 'loudness' is measured in decibels (dB). The decibel scale is logarithmic, so a six-decibel increase in the sound level already represents a doubling of the sound pressure. Sound pressure is usually measured in A-weighted curves, and follows more or less the threshold

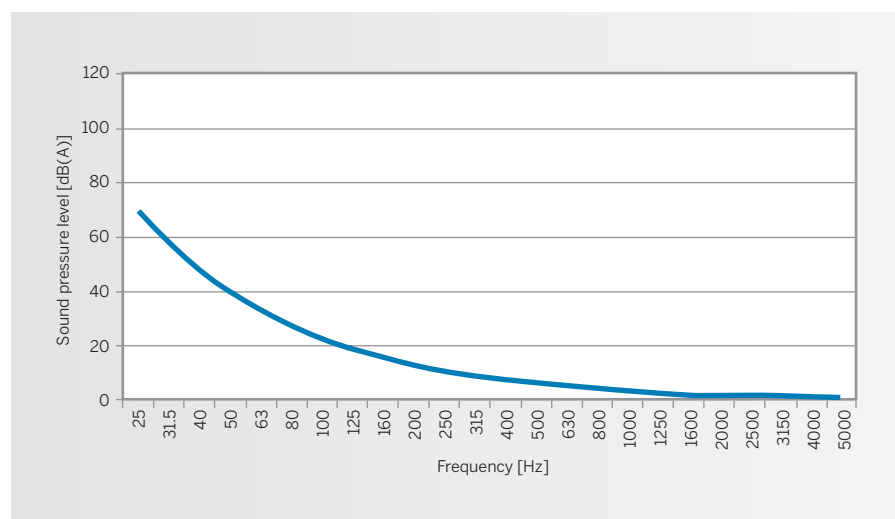
of hearing. A high noise level will have a negative impact on the environment.

An adult with good hearing can hear frequencies between 20 and 20,000 hertz (Hz), while frequencies between 2000 Hz and 8000 Hz are considered the most annoying. Those below 500 Hz or above 10,000 Hz are considered less annoying, see Figure 1.

Low frequency noise, in the frequency range below 100–200 Hz, has received increasing attention during the last decade. This frequency range may be perceived as annoying for some people, while others will not notice it at all. Some individuals become annoyed by low frequency noise as soon as the noise level exceeds the hearing threshold. In addition low frequency noise may excite buildings and other structures resulting in secondary noise sources like rattling windows. The firing frequency of medium speed diesel engines is within the low frequency range and also typically dominates the noise spectra.

During recent decades, conventional silencers have been used as a primary method of reducing exhaust gas noise from a 4-stroke diesel or gas engine (Figure 2). A conventional silencer consists of an absorption and a reactive chamber.

Increasing power output demand results in higher exhaust gas noise, especially in the low frequency range. Adding more conventional silencers will result in a higher pressure drop and will typically not have a sufficient influence →



■ Fig. 1 – Threshold of hearing



■ Fig. 2 – Conventional silencer system.

on low frequencies. This higher pressure drop, however, increases the thermal load on the engine and this could even damage it. A higher back pressure will also lead to higher fuel consumption, since the engine will have to consume more fuel to “push” the exhaust gases through the exhaust gas pipe.

Every reciprocating engine generates sound occurring at different frequencies. A conventional silencer is able to reduce the level by, say, 35 dBA in a certain area of the frequency spectra (Figure 3). To cover the remaining frequencies, additional silencers have to be added, resulting in an even higher pressure drop when using conventional silencers. Other factors that affect the output sound level are the exhaust gas pipe design, the number of bends, the surrounding environment, and so on.

After-treatment of the exhaust gas is an added challenge to reducing the noise. Some equipment, such as SCR’s and boilers, reduce the noise, but only in a certain spectrum of the frequency. When this kind of equipment is added, the back pressure increases. This means that a conventional silencer with a lower back pressure is needed, which usually results in lower noise reduction.

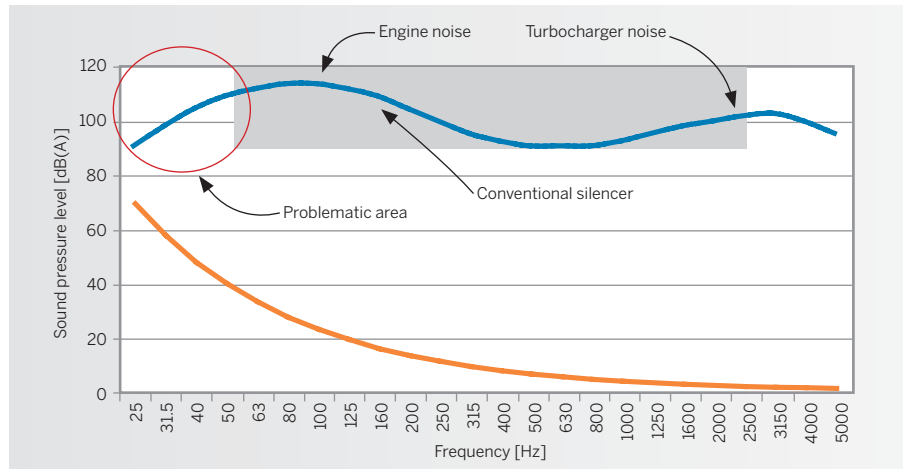
The Compact Silencer System (CSS) has been designed to be optimized according to the installation. The number of elements is defined by taking into account all equipment in the exhaust gas pipe.

With a conventional silencer system, the design of the noise reduction system usually starts from the engine. With the CSS, the design is reversed, meaning that the noise level acceptability at a certain distance from the ship’s exhaust gas pipe outlet, is used to dimension the types and number of elements to be used.

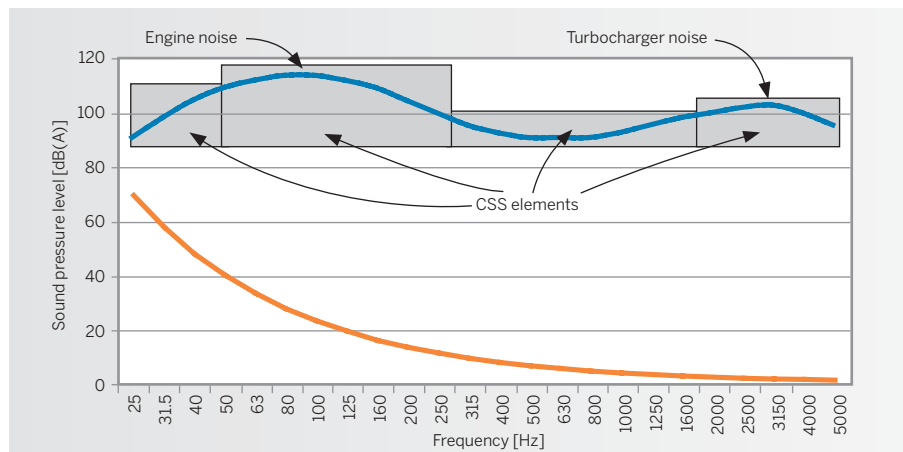
**The Compact Silencer System**

The Compact Silencer System is a patented technology and method of designing complete exhaust systems using multiple silencer elements distributed along the exhaust pipe. This technology enables the design of a complete exhaust gas system. CSS replaces conventional single unit silencers onboard ships and offshore structures where the need for low weight, a low centre of gravity, and minimum silencer space are required.

The CSS elements are utilized in the best way so that space and material for



■ Fig. 3 – Noise reduction principle with a conventional silencer.



■ Fig. 4 – Noise reduction principle with the Compact Silencer System.

the exhaust system can be minimized. The pre-insulated silencer elements have been designed to have almost the same diameter as the insulated exhaust gas pipe. The design of the CSS also takes into account any additional equipment in the exhaust gas pipe. Having SCR’s in the exhaust gas pipe makes the adding of CSS elements an ideal solution for reducing the unwanted noise in any frequency spectrum not covered by the SCR.

The CSS offers more flexibility in ship design, without sacrificing performance. CSS is smart, lean and slender. The acoustical properties of the silencer can be optimized according to specific sound level requirements at certain areas. For example, on the bridge deck, in harbour, and so on.

While the elements of the CSS are longer than conventional silencers, it is, however, merely a case of replacing the exhaust gas pipe with an alternative type.

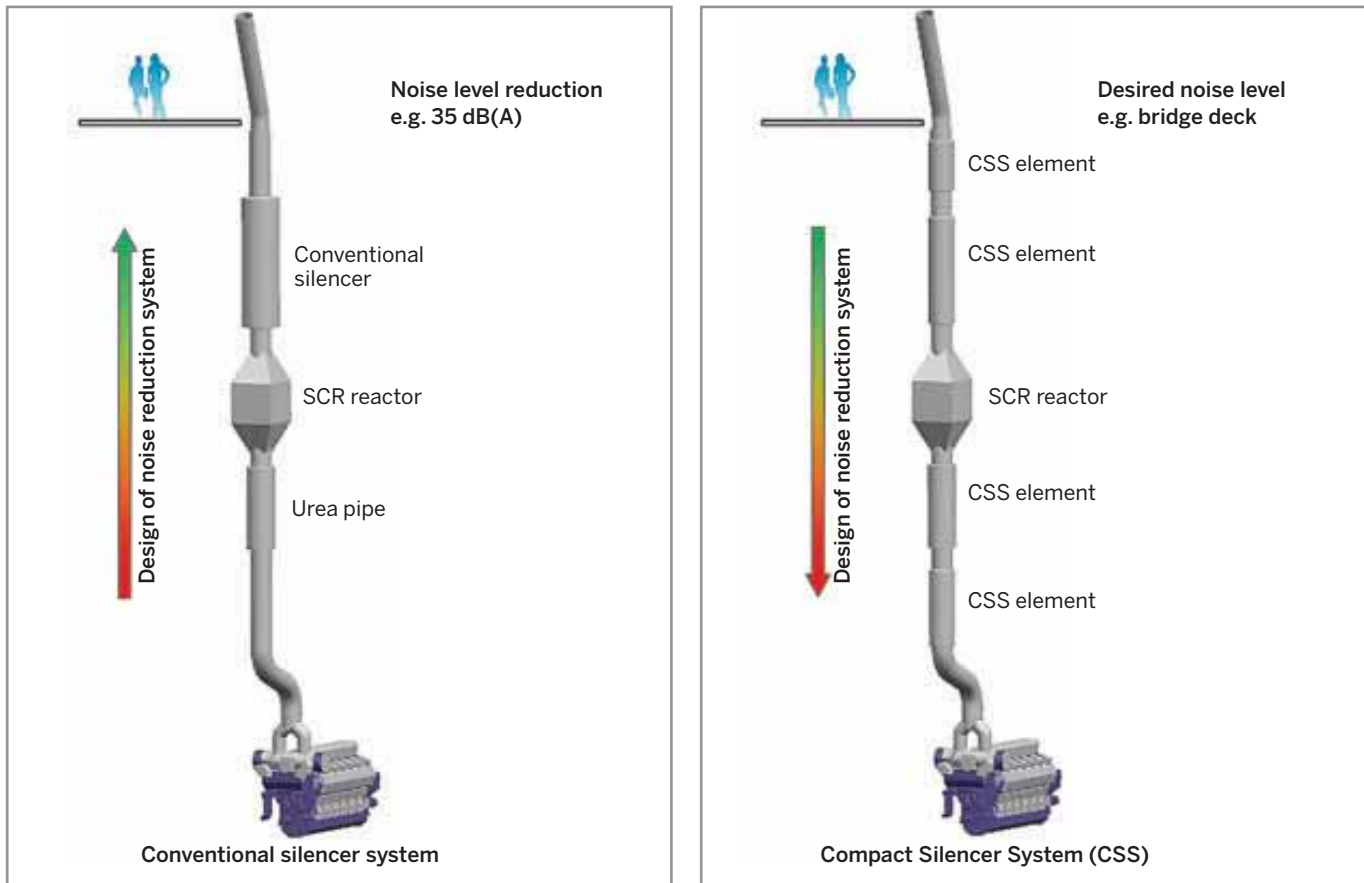
**CONCLUSION**

The benefits of the CSS are:

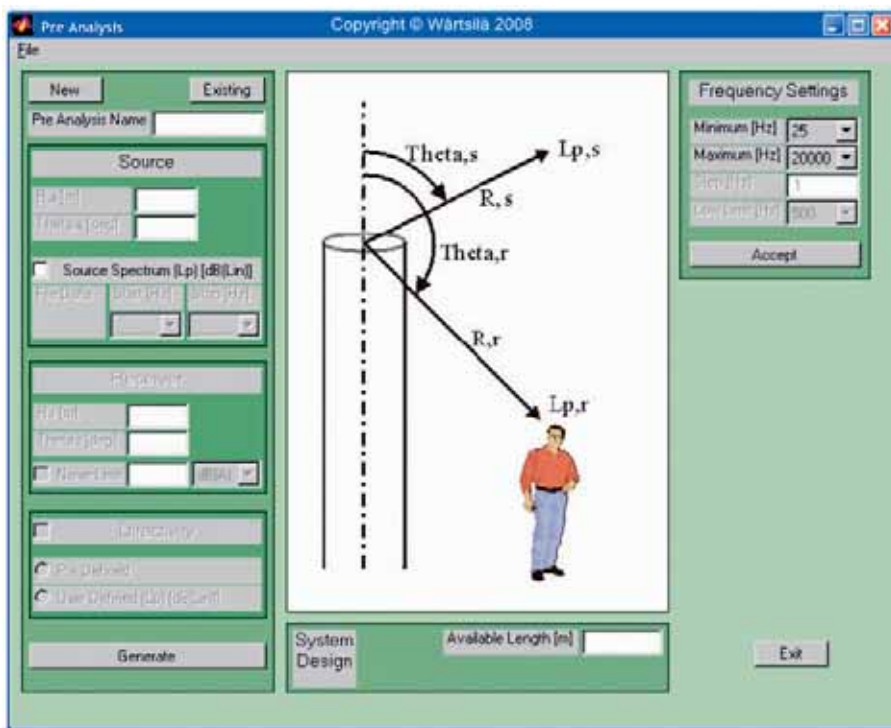
- More slender than conventional solutions
- Reduced overall weight
- Reduced pressure drop
- Reduced noise
- Easy installation (insulated)
- Acoustically more robust. ●



■ Fig. 5 – Pre-insulated CSS element.



■ Fig. 6 – Calculation methods using a conventional silencer system versus the Compact Silencer System.



■ Fig. 7 – Compact Silencer System software.



■ Fig. 8 – Compact Silencer System.