

# Low frequency noise can be attenuated efficiently

MAN Teglholmen, Copenhagen, Denmark - case study

In many major cities in recent years an extensive renovation of certain neighborhoods is carried out. Especially in old port areas, modern apartment buildings and fashionable office buildings are built in large scale. Many of these new buildings are located immediately adjacent to existing industrial enterprises. At the same time special requirements for limits on low frequency noise has been tightened.

This has brought great challenges for a number of companies - including MAN Diesel's Danish section, which is located at Teglholmen in Copenhagen - Denmark. MAN Diesel at Teglholmen carry out extensive development work on large diesel engines, featured on-site is a comprehensive test engine installation comprising a large slow-speed 2-stroke diesel engine of type 4T50MX tested under different conditions. Exhaust noise from the diesel engine is due to a firing frequency in the range from 5 to 8 Hz, strongly dominated by low frequencies. The exhaust noise is exited to the surroundings through an approx. 55 m high chimney, which is situated less than 200 meters from the newly built residential apartments which feature large glass facades.



The requirement for the indoor noise level in an apartment must not exceed a sound pressure level of 20 dB(A) at night. The residential apartment facades are very poorly soundproofed regarding noise at very low frequencies. This fact, combined with the above requirements and sound measurements made with the test engine in operation, lead to the following attenuation requirements with regards to exhaust noise emitted from the chimney top.

Frequency (Hz)	16	31,5	63	125
Attenuation (dB)	5	20	10	10

Table 1 Requirements for the silencing of exhaust noise emitted from the stack outlet.

Not only does the silencer solution have to function extremely well at very low frequencies, the task has been further complicated as the only available space for the construction of the silencers is in the chimney itself.

Silentor was chosen to solve the problem and planned a silencer solution consisting of two main parts. One main device mounted in the upper half of the chimney, consisting of a combined absorption and reflection silencer solution in order to achieve broad-spectrum noise reduction based on Silentors unique exhaust silencer principles. The second main device mounted in the bottom of the chimney below the entrance called a Helmholtz resonator consists of a chamber in the bottom of the stack and a downwards moving piston. The connection to the rest of the exhaust system consists of an adjustable opening, allowing the resonator's damping characteristics to be tuned with the aim of gaining an additional attenuation in a relatively narrow band frequency range, around the double engine firing frequency. This is where sound measurements indicate the sound attenuation in 16 Hz octave band is provoked by the noise of this double firing frequency.



Once the Silentor solution was installed, further measurements proved that it worked beyond resulting in effective attenuation around the engine's double firing frequency, but the combined absorption and reflection silencer solution alone provides enough noise attenuation to meet the requirements as shown below.

Frequency (Hz)	16	31,5	63	125
Attenuation (dB)	19,1	25,2	14,7	17,8

Table 2 Achieved attenuation of exhaust noise from stack using only Silentors combined absorption and reflection silencer solution.

This means that MAN Diesel may choose not to use the Helmholtz resonator which has the disadvantage, in contrast to the combined absorption and reflection silencer solution, that it requires maintenance once it is operational.

The achieved noise reduction is not only so good that MAN can freely experiment with different engine speeds in the test facility. The Silentor solution ensures that any future tightening of requirements for low frequency noise would not become an obstacle to the use of the engine test facility.

Because of the obtained attenuation perhaps MAN can even reduce the requirements for the damping of the structure-borne noise from the engine test facility.

