Acoustic study on African Fastcat 435

Measurements carried out by Illbruck Insulation company
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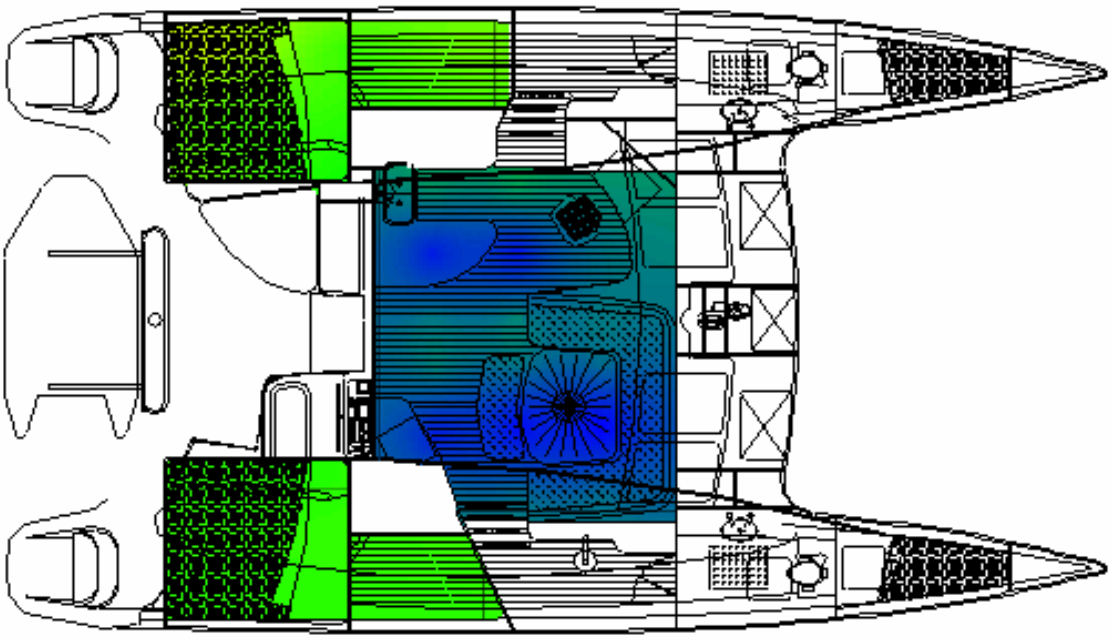
1/ Introduction / Measurement description

In order to get a reliable idea of the acoustic level on an African Fastcat 435, we measured acoustic pressure under two different engine speed (2000 rpm and 3000 rpm), for several microphone positions and for rear and main cabins. Goal was to get reliable data to represent sound level in the entire cabins and to understand the main acoustic phenomenon.

2/ Acoustic Measurements

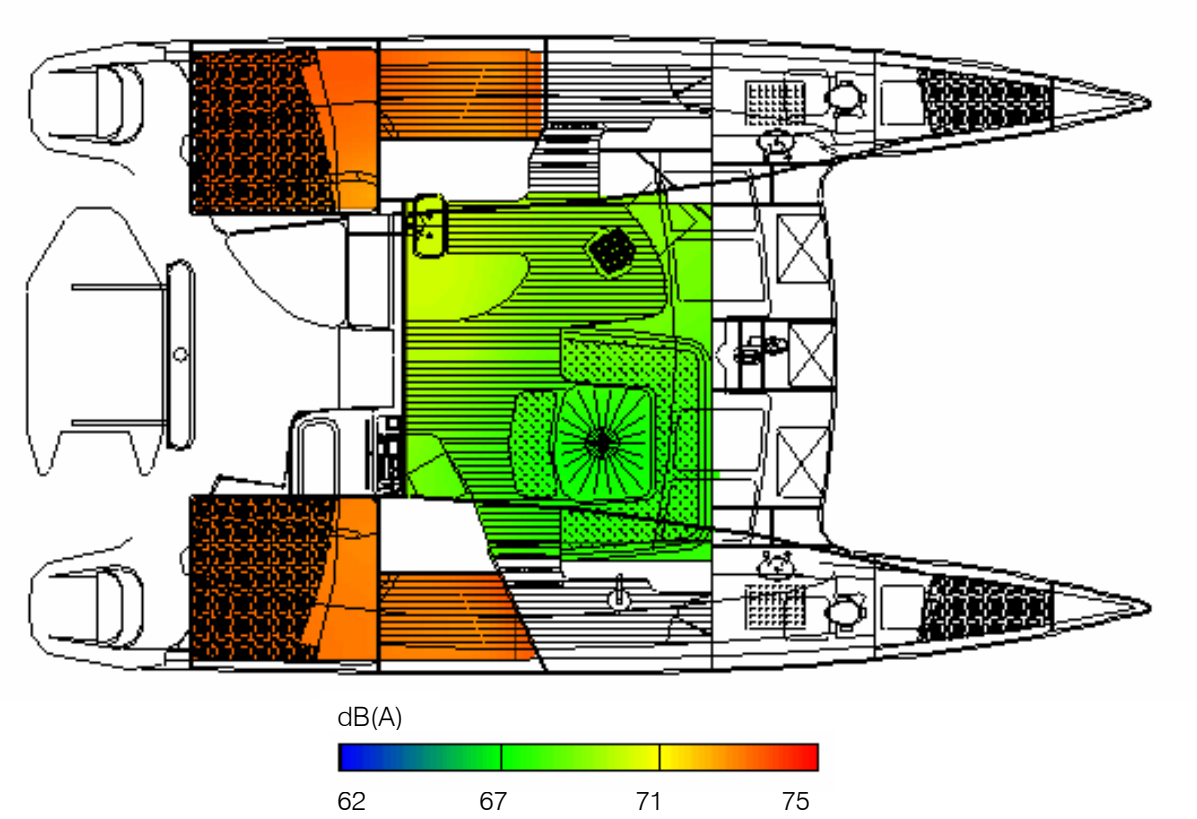
The following pictures represents the sound level as a function of the engine speed:

2000 rpm



At 2000 rpm maximum sound levels are measured in both rear cabins with 68.3dB(A) for the right cabin and 70dB(A) for the left cabin. As the boat has a symmetric conception and as both engines are running, we should normally measure the same levels. Point is it was only possible to control the rpm of the right engine and it could be possible the left engine was running higher. Concerning the main room, sound level is comprised in between 62.6 and 65dB(A) with a modal behaviour due to rigid surfaces (walls / glass…)

3000 rpm

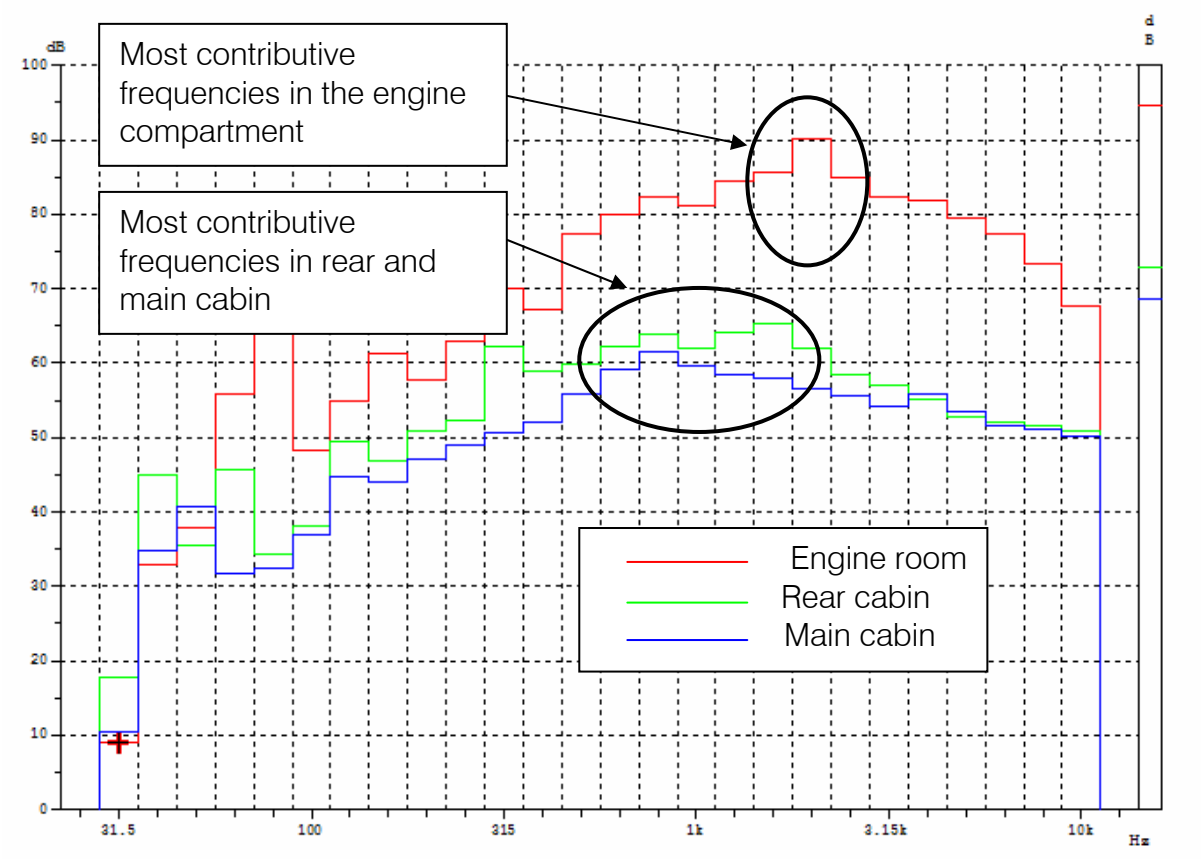


Once again, highest levels are measured for the rear cabins with 74.3dB(A) for the right cabin and 75.2dB(A) for the left. In the main cabin, levels rise from 66.7 to 69.2dB(A)

As engines are the main sources, it is now interesting to go deep into details concerning acoustic spectrums in order to understand the main acoustic phenomenon.

3/ Spectrum analysis

The following graph represents acoustic levels as a function of frequencies in the engine compartment, rear and main cabin.



In order to reduce the global sound level (average over all frequency bands), one has to reduce the main contributive frequencies.

In the engine compartment, it clearly appears we have to damp energy for frequency bands comprised in between 1600Hz and 2500Hz.

In rear cabins, the global level is mainly due to frequencies comprised in between 1250Hz and 1600Hz but also due to lower frequencies (325Hz and 800Hz). As a consequence and for these cabins, the sound level is driven by to main sources:

- Noise radiated by the engine itself (1600Hz)
- Vibrations transmitted from the engine to the hull via the cylinder-blocs

In the main room, sound level is mainly driven by one frequency band: 800Hz that corresponds to engine vibrations. In this case, acoustic radiation from the engine is not the main source.

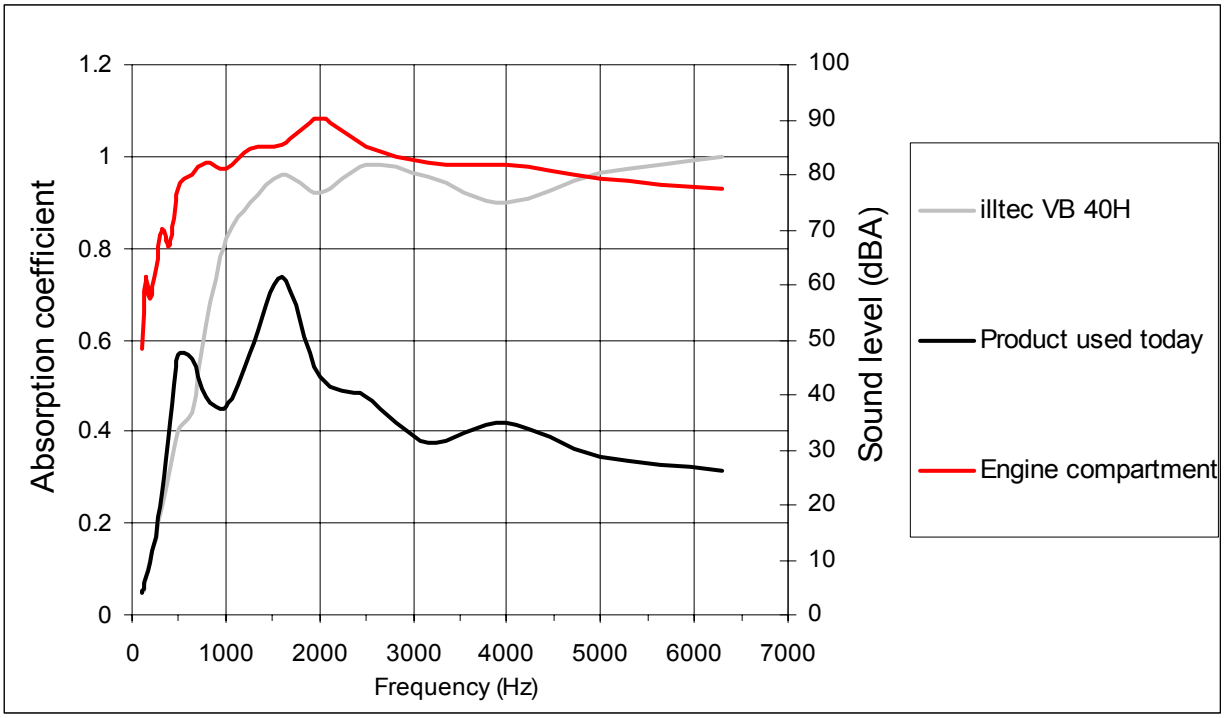
4/ Recommendations

Thanks to the following analysis, it appears there are two main sources to damp:

- Acoustic radiations from the engine
- Vibrations transmitted from the engine to the hull.

Concerning acoustic radiations, the best way it to damp energy in the engine compartment thanks to absorbent material and to reduce acoustic leaks as much as possible.

The following graph represents acoustic absorption of illtec VB40H (Illbruck solution) in comparison to the product used today. Sound level in the engine compartment has been added to this graph.



It clearly appears illtec VB40H suits to the problematic. Indeed we have a high absorption where frequencies are the most contributive to the noise level in the engine room.

In order to be fully efficient, the product should cover an area as important as possible and so, hull sides should be treated as much as possible. By the way and in order to reduce leaks created by pass-through, one should cut cross into illtec VB40H instead of holes to pass the different tubes:

In order to reduce noise emitted by the structure itself (due to engine vibrations), one has to damp the hull and especially in the engine compartment. Damping could be achieved using patch of illdamp covering 30% of the engine compartment. Illdamp is an efficient damping material applied thanks to its adhesive foil. Point is this material has a mass per unit area of 5Kg/m2.

5/ Conclusions

One of the main important goal for African Cats is to reduce mass of boats conserving high performances.

In order to propose the best solution in terms of acoustic treatments, Illbruck Insulation carried out a specific study on African Fastcat 435.

Analysis of measurements point out two main sources one has to damp in order to reduce noise:

- Air borne sound radiations from engines
- Structure borne sound radiation (vibration transmitted from the engine to the hull).

In order to damp the first source, illbruck proposed illtec VB40H that combines a high absorption efficiency for frequencies of interest (1600Hz to 2000Hz) combined with a light weight concept (0.44Kg/m2 instead of 0.8Kg/m2 for the product used today).

To reduce structure borne sound, one has to damp the hull and especially in the engine compartment. The only way to do it is to use patch of illdamp that are unfortunately 5Kg/m2.

A combination of both solutions should give a decrease of 4 to 5dB(A) on the global level. If, for weight reasons, African Cats decide to only apply illtec VB 40H, we should obtain an improvement of 2 to 3dB(A) in rear cabins.