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THE IDENTIFICATION OF THE CAUSES FOR THE FAULTY RUNNING OF NAVAL DIESEL GENERATORS

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Abstract: *Onboard ships, diesel generators represent one of the main sources of noise and vibration. For a proper functioning and to transmit lesser vibrations to ship's hull, the generators are mounted on dampers. In this paper are analyzed the results of the measurements conducted onboard training-ship Mircea during a march on the Black Sea. The generators worked under various operating conditions, thus led to determine the critical vibrations. Finally, after the analysis a few recommendations and solutions were made.*
Key words: *Diesel generators, vibrations, dampers*

1. INTRODUCTION

Noise and vibrations onboard ships represent a constant concern for naval designers and ship builders. It is well-known that a noisy working environment conducts into a decrease of the efficiency of the personnel from that environment. On the other hand, excessive vibrations of the machinery conduct to the appearance of early defects and fatigue. Standards stipulate regular inspections of the machinery in order to prevent such faults.

In the machine compartment, beside the main engine there are other sources of vibrations, like diesel generators, pumps etc. Each of these sources contributes to the global vibration of the ship. In order to minimize the vibrations transmitted to ship's hull, these installations are mounted on dumpers and shock absorbers.

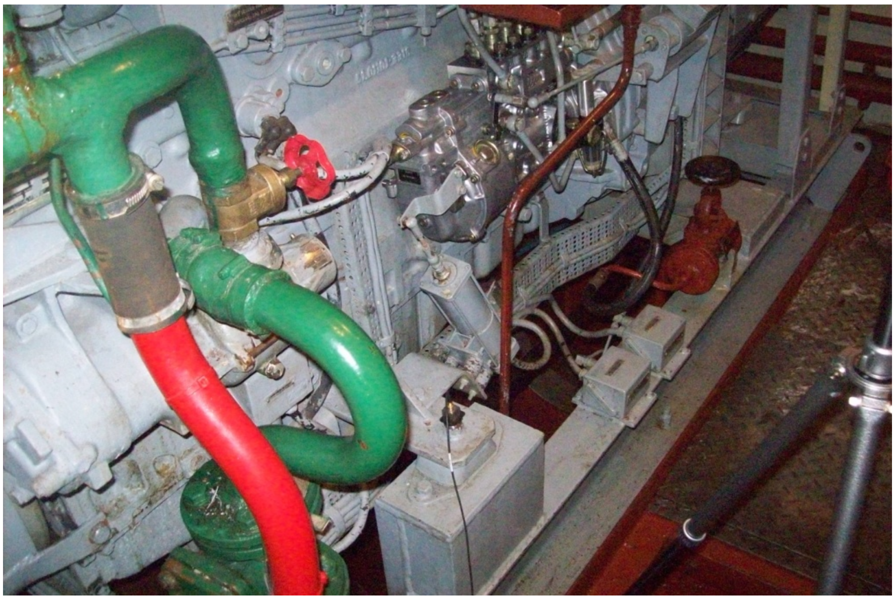
2. THE DIESEL GENERATORS ONBOARD TRAINING-SHIP MIRCEA

During marches, the personnel from the machine compartment noticed that at certain working regime, the diesel generators begun to vibrate more or less visible.

Onboard training-ship Mircea there are 3 diesel generators in the machine compartment which can be coupled two by two or all three simultaneously. The diesel generators are type D2866E – DEMP, running at 50Hz with 1500 RPM.

3. MEASUREMENTS AND RESULTS

The measurements were made using a triaxial accelerometer DeltaTron type 4506B from Bruel&Kjaer. The accelerometer was placed on coupling between generator block and the resilient mounting, right and left.



A FFT analysis of the recorded signals was performed using the software PULSE from Bruel&Kjaer. The frequency range was 1-5 Hz for the analysis of vibration displacement, and 4-200 Hz for the analysis of vibration velocity.

There are 8 diagrams showing the results for each combination of diesel generators and for each direction – vertical, longitudinal or transverse.

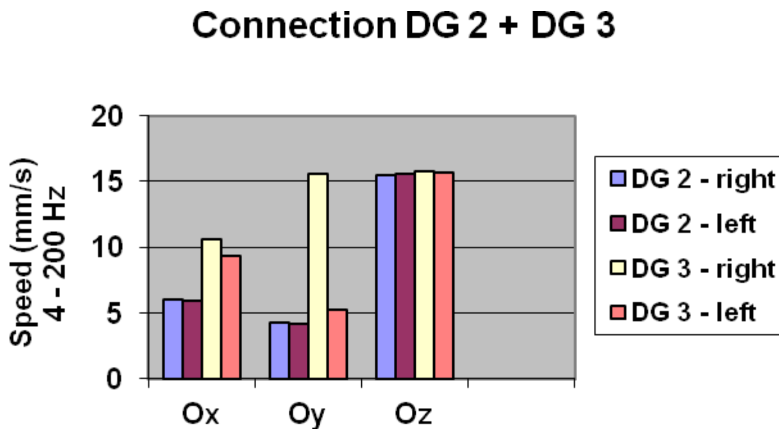


Fig.1 Velocity of the vibrations (DG2 connected with DG3)

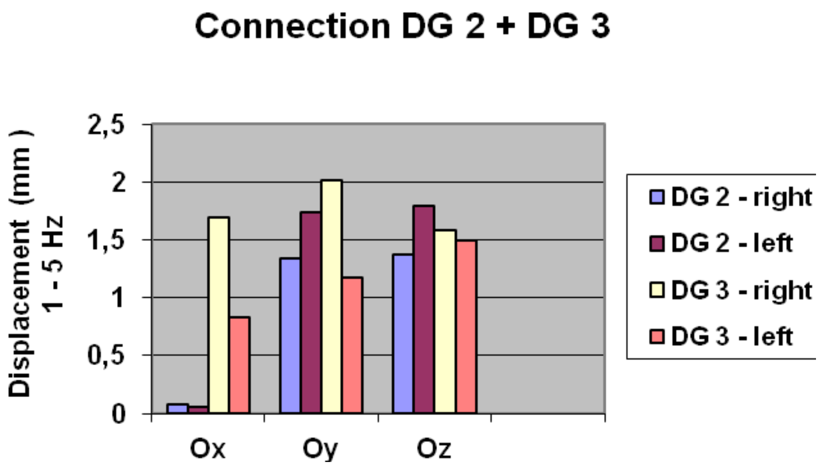


Fig. 2 Displacement of the vibrations (DG2 connected with DG3)

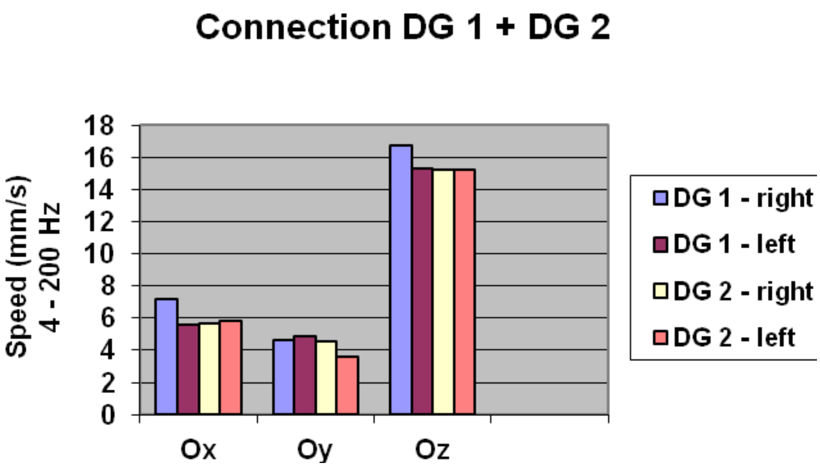


Fig. 3 Velocity of the vibrations (DG1 connected with DG2)

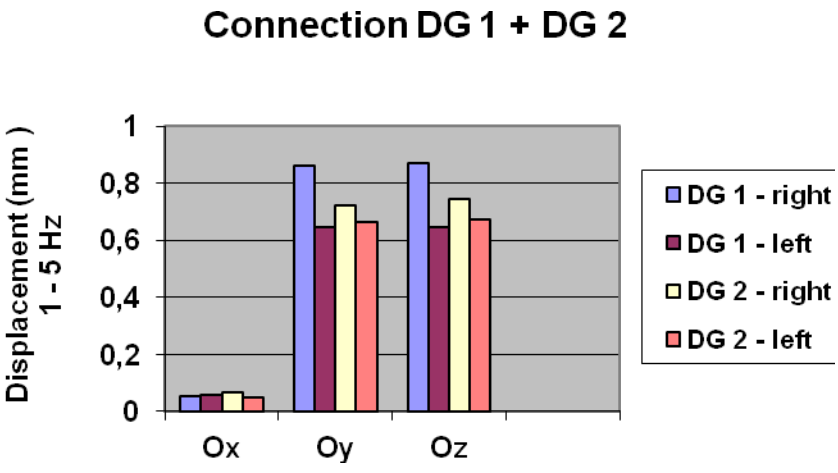


Fig. 4 Displacement of the vibrations (DG1 connected with DG2)

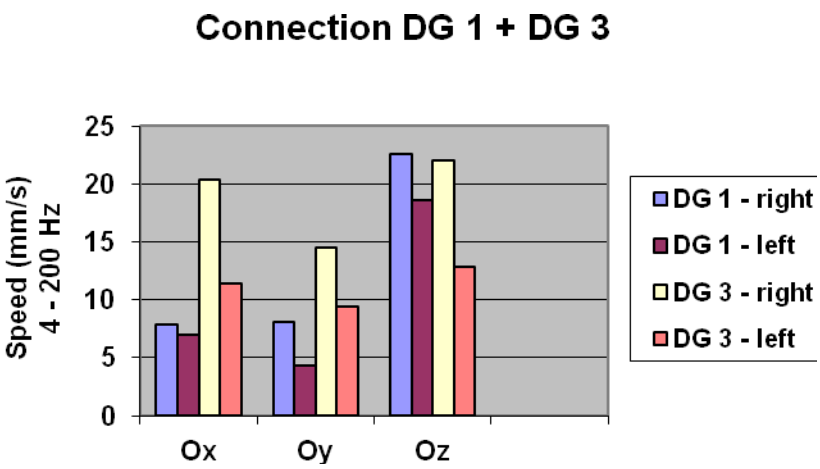


Fig. 5 Velocity of the vibrations (DG1 connected with DG3)

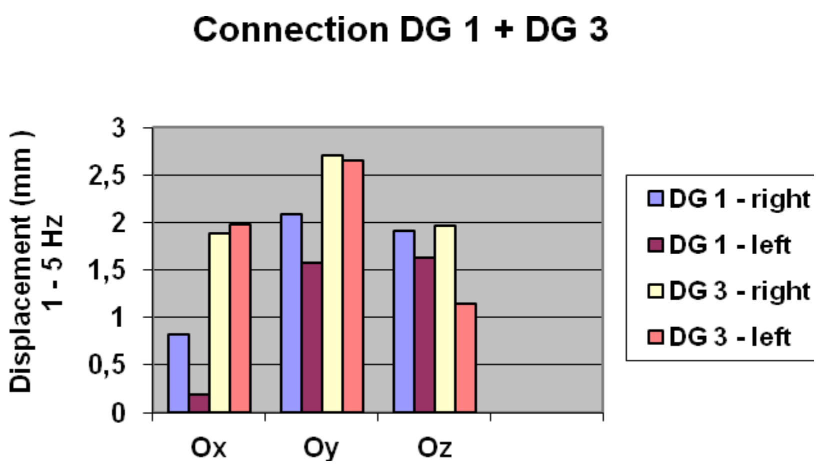


Fig. 6 Displacement of the vibrations (DG1 connected with DG3)

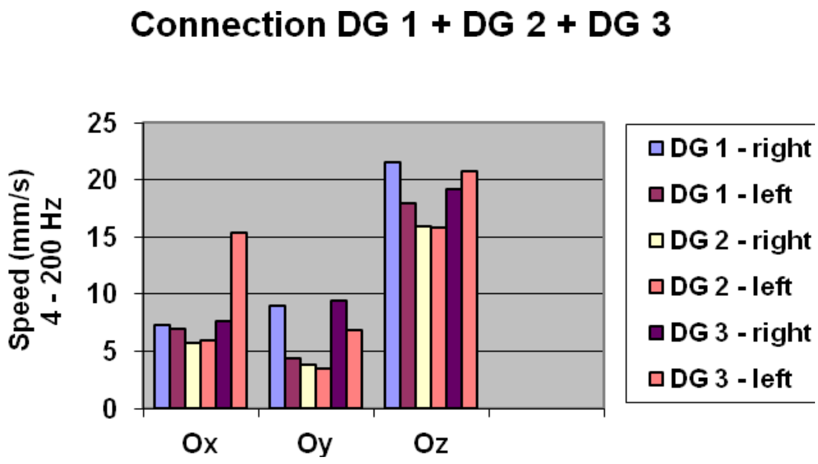


Fig. 7 Velocity of the vibrations (DG1 connected with DG 2 and DG3)

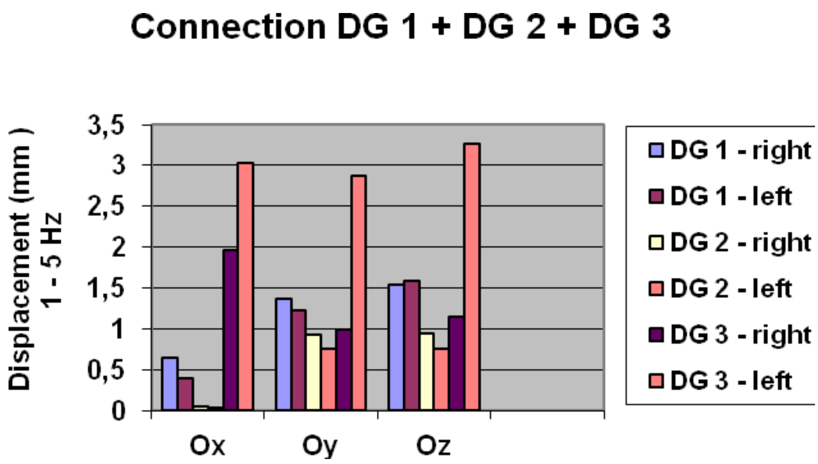


Fig. 8 Displacement of the vibrations (DG1 connected with DG 2 and DG3)

The analysis showed that the vibrations velocity is below limit in all directions. However, there are noticeable differences between the couplings of the diesel generators. When DG 1 is connected with DG 2, and DG 2 with DG 3, the vibrations reach maximum 15-16 mm/s (transverse direction). In the connections DG 1 + DG 3 and all three generators, the vibrations approach significant the 25 mm/s limit (also, in the transverse direction).

The analysis of the vibrations in terms of displacement reveals a similar behavior. But, this time the vibrations are excessive also in the longitudinal direction. In the connection DG 1 and DG 2 the vibrations are below 1mm. In the other connections, the amplitude of the vibrations increase, being in the range 1-2mm for the connection DG 2 + DG 3, but exceeding 2mm for the connections DG 1 + DG 3 and DG 1 + DG 2 + DG 3.

4. CONCLUSIONS

The results were compared with the values from the international standards: Det Norske Veritas [1], American Bureau of Shipping [2], ISO 4867:1984 [3]. DNV has a vibration limit of 25 mm/s for diesel generators resilient mounted (in the range 4-200 Hz), when measuring at block bottom. ABS limits the vibrations for diesel generators at 13 mm/s when measuring at bearings, and at 18 mm/s when measuring on block top. Also, ABS states that the displacement (in the range 1-5 Hz) is recommended below 1.0 mm (in either vertical, longitudinal or transverse direction) and damage probable occur above 2.0 mm.

When the vibrations produced by the diesel generators are analyzed in terms of velocity, one can observe that for all working combinations (DG 1 + DG 2, DG 1 + DG 3, DG 2 + DG 3, DG 1 + DG 2 + DG 3) the values are below the 25 mm/s limit. So, the conclusion may be that the diesel generators do not generate excessive vibrations.

But when we analyze the vibrations in terms of displacement, we find that the limit stated in standards is exceeded. Since all three diesel generators are identical and the mountings are also the same, one can expect that the behavior of the DG to be similar. But from all generators, only DG 2 vibrates in the limits. The vibrations of DG 3 and DG 1 exceed the limits, especially DG 3, which vibrations are above 2 mm. The response of the dumpers is similar for the right and left dumper of each diesel generator. But in the connection of all three generators, the left dumper of DG 3 suffers the most excessive vibrations.

The first explanation for this behavior is the coupling system of the diesel generators. Since the generators were designed to run independently, a parallel drive system was installed onboard the ship. This parallel functioning of the diesel generators over the years caused a permanent stress on the generators which led to malfunctions.

A second explanation is the fatigue of the dumpers of the diesel generators. And since the generators can be coupled differently, the physical properties of the dumpers were modified different over the years.

The possible solutions for the problems determined onboard training-ship Mircea are: modifying or replacement of the coupling system of the diesel generators which is the proper solution since the generators will not be replaced; the mounting of new dumpers as a temporary solution.

5. REFERENCES

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