

NOISE REPORT ONBOARD OF CARGO VESSEL

Elena Gabriela Hulea

"Dunărea de Jos" University of Galati,
Faculty of Naval Architecture,
47 Domnească Street, 800008, Romania,
E-mail: elenagabriela_anton@yahoo.com

Costel Iulian Mocanu

"Dunărea de Jos" University of Galati,
Faculty of Naval Architecture,
47 Domnească Street, 800008, Romania,
E-mail: costel.mocanu@ugal.ro

ABSTRACT

Regarding the increasing demands for a low noise environment onboard ships, the classification societies introduced the measurement of noise levels onboard every ship not only for the first ship, no matter the type and size above 1600 gross tonnage. That why is necessary a good collaboration of all the parties involved in the construction of ships from designers, shipbuilders, till owners. This article describes the measurements technique used for obtaining the noise levels onboard a cargo vessel, to obtain the approval of Classification society.

Keywords: Code on noise level onboard ship, permissible levels, sound sources, measurement equipment

1. INTRODUCTION

The regulation and limits for maritime vessels, regarding the noise limits, have become more restrictive since the New International Maritime Organization Code (IMO): CODE ON NOISE LEVELS ONBOARD SHIP, MSC 337(91), which is a revision of the old code with the same name, under the name of IMO Resolution A468 (XII) "Code On Noise Levels Onboard Ships". The new version of this regulation, which entered into force for ships under construction from June 1, 2014, aims to prevent crew of hearing loss or damage, to raise necessities crew awareness, for a good communication onboard ship and alarms perception. And also to assure the necessary comfort of crew for rest, relaxation and other spaces and to assure favorable conditions to restore hearing after exposure to noise. All ship-owners must comply with the international regulations for new vessels. Even though noise issues can be controlled it is important for ship-owners to know how to do this in the most efficient and economical way.

The prediction of noise level has become very important, due to the negative effects which the acoustic discomfort has on the crew and passengers. The main sources of noise onboard ships are the Main Engine (M/E) and the propeller. As secondary sources we have diesel generators, air conditioning, ventilation, pumps, compressors, hydraulic systems. Thus, designers, owners, shipyards and ship-owners must have an account of these when adopting measures to limit noise on board the ship.

2. THE CASE STUDY

The vessel MV Paula, used for this study, presented in Fig.1...3, is a general cargo ship. This type of ship was designed by S.C. Willemsen Marine Support S.R.L. Galati and built at ATG Giurgiu (for a foreign ship-owner, intended to carry heavy goods in shallow waters) to meet the stringent noise standards.



Fig.1. MV Paula Cargo Vessel

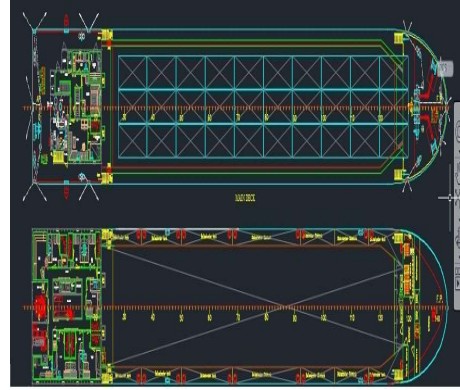


Fig.3. MV Paula top view

MAIN PARTICULARS

Hull:

Length between pp	87.59 m
Breadth moulded	11.40 m
Depth to main deck	5.50 m
Design draught	3.8 m
Capacities hold	3200 cbm

Main engine:

Type	LH 31
Speed.....	370 rpm
Number of cylinders	6 in line
Power at MCR.....	1323 kW

Auxiliary engine:

Type	6 CTA8.3-DCM
Speed.....	1500 rpm
Number of cylinders	6 in line
Delivery power	163 kW

Propeller

Number / type	1 / CPP
No. of blades	4
Diameter	1.90 m
Speed.....	370 rpm



Fig.2. MV Paula side view

3. MEASUREMENTS CONDITIONS

The measurements have been performed respecting the regulations of the noise levels register for new ships. Msc 337(91) requirements, which provide the basic recommendation to accomplish de project design taking into consideration the results of sea trial from the ship noise report.

Terminology and calculation formulas

The index of sound reduction R'_w (dB) which contains sound insulation performance in sea trial of ship cabins and compartments.

The continuous equivalent sound level

$$L_{Aeq,T} = 10 \log \frac{1}{T} \int_0^T \frac{p_a(t)^2}{p_0^2} \cdot dt \quad (1)$$

$L_{Aeq(T)}$ (dB(A)); $p_a(t)$ = A- sound level pressure equivalent, T- time interval and p_0 (20 μ Pa):

$$L_{Ceq,T} = 10 \log \frac{1}{T} \int_0^T \frac{p_c(t)^2}{p_0^2} \cdot dt \quad (2)$$

$L_{Ceq(T)}$ (dB(C): $p_c(t)$ = C - the instantaneous sound pressure; T - time interval, and p_0 (20 μ Pa)

$$L_{Cpeak} = 10 \log \frac{p_{peak}^2}{p_0^2} \quad (3)$$

The sound pressure level L_p

$$L_p = 10 \log \frac{p^2}{p_0^2} \quad (4)$$

L_p (dB): p = sound pressure (Pa) and p_0 (20 μ Pa).

The measurements have been performed on the Black Sea, in sea trials, in ballast condition in nominal regime, when all the noise sources were operating at nominal parameters.

The characteristics conditions of the sea trials include: operation of the main engine, speed over 12 knots, operation of the propeller. Draught forward~ 2.7m, draught aft ~ 3.35 m, wind speed / direction [m/s / ° Bf] ~ 25/ 3 m/s and depth of water ~ 45.0 m.

The powerful noise is from the Engine Room, because the main engine is running as well as diesel generators for the power generation. The noise of the ventilation system of the rooms operating at maximum capacity will also be taken into account, for measuring the noise of the ventilation on the decks and cabins.

Type and characteristics of measuring instruments. For noise level measurements it has been used the calibrated equipment presented in the below Fig.4:

Item no.	Instruments	Type
1	Microphone	4155
2	Sound Level Meter	2250
3	Calibrator	4230
4	Wind mask	-
5	Utility Software for Hand-held Analyzers	BZ 5503
6	Noise Explorer	7815
7	Notebook	LIFEBOOK E

Fig.4. Measurements equipment

We have used the renowned model 2250 of Brüel & Kjær because can carry out the measurements transmission loss of a ship cabin construction and can offer important absorption index .

4. MEASUREMENTS ANALISYS

The measurements have been performed during the ship sailing in straight line (without the rudder heeling) on the Black Sea, with constant speed.

For analysing analyzing noise onboard ship a noise point system is used, which is useful as any other mathematic formula. The points have been established in the representative part of the rooms, according to the different task, that the seafarers must be carried out during a working day. The microphone was placed approx. 10 cm from the most exposed ear.

Every measurement point is marked with NLn., from wing bridge till floor.

In the calculation have been included bangs (metal against metal), hydraulic noise when using gear and resonance areas.

Measuring point						
Position	Room	Deck	Room no.	Reading * dB(A)	Limit dB(A)	Remarks
1.	PS Wingbridge	Nav.		71.7	70	(+) * NL 1- Fig.6
2.	Wheelhouse	Nav.		67.8	65	(+) NL 2 - Fig. 7
3.	STB Wingbridge	Nav.		71.1	70	(+) * NL 3 - Fig.8
4.	Messroom	Poop		64.8	65	NL 4 - Fig. 9
5.	Captain bedroom	Poop		60.7	60	(+) NL 5 - Fig.10
6.	Captain dayroom	Poop		63.8	60	(++) NL 6 - Fig.11
7.	AC room	Poop		78.7	90	NL 7 - Fig.12
8.	Galley	Main		71.3	75	NL 8 - Fig.13
9.	Pilot / Owner	Main		67.4	60	(++) NL 9 - Fig.14
10.	1 Crew (PS Middle)	Main		65.9	60	(++) NL 10 - Fig.15
11.	1 Crew (PS Fore)	Main		62.2	60	(+) NL 11- Fig.16
12.	Chief mate	Main		61.5	60	(+) NL 12 - Fig.17
13.	1 Crew (STB Fore)	Main		60.2	60	(+) NL 13 - Fig.18
14.	1 Crew (STB Middle)	Main		62.5	60	(+) NL 14 - Fig.19
15.	1 Crew (STB Aft)	Main		65.5	60	(++) NL 15 - Fig.20
16.	Laundry / Changing	Main		76.2	85	NL 16 - Fig.21
17.	Steering Gear room	Main		92.5	90	(+) NL 17 - Fig.22
18.	Floor in fore side	Floor		102.9	90	(++) NL 18 - Fig. 23
19.	Floor in aft side	Floor		102.0	90	(++) NL 19 - Fig. 24

Fig.5. Measurements results

In the above Fig.5 are shown the results in sea trial at reading column and permissive values at limits column to SOLAS Ch. II-1, Reg. 3-12 Noise Code MSC. 337(91): CODE ON NOISE LEVELS ONBOARD SHIPS.

The values measured in the crew, wing bridge, wheelhouse, AC room, messroom, captain dayroom, steering gear compartment are presented in the next Figure 6...24 (noise levels values in the 1/1 octave band, are exported directly from the sound level meter at the date of the measurements):

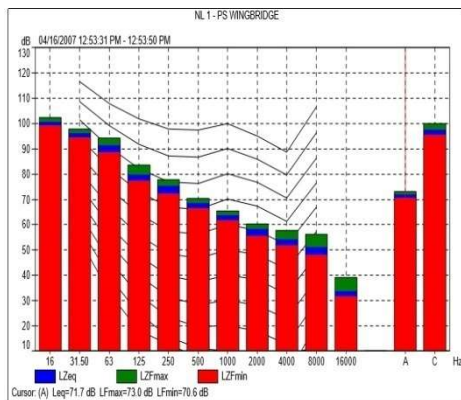


Fig.6. NL 1- PS wingbridge

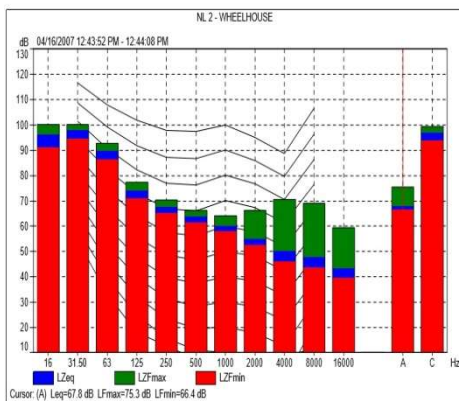


Fig.7. NL 2- Wheelhouse

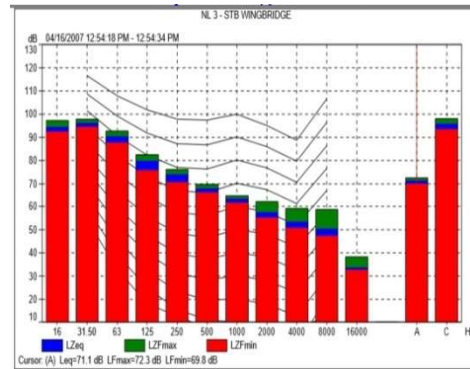


Fig.8. NL 3- STB wingbridge

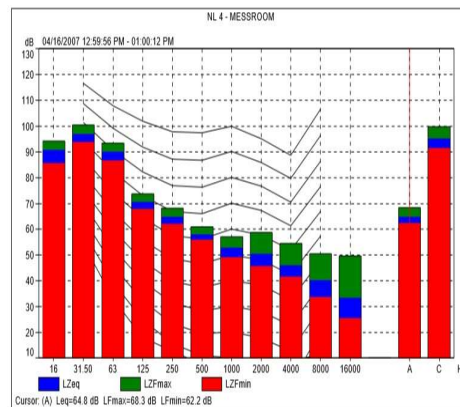


Fig.9. NL 4 - Messroom

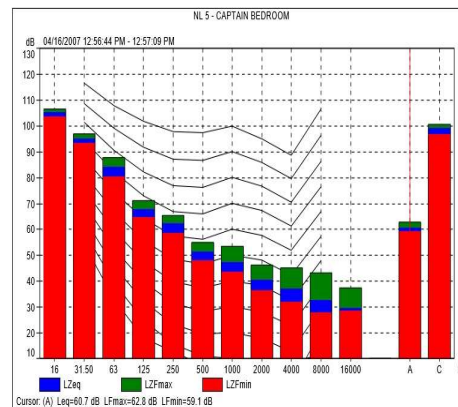


Fig.10. NL 5 - Captain bedroom

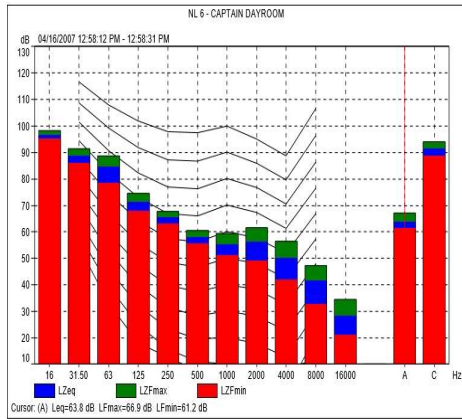


Fig.11. NL 6 - Captain dayroom

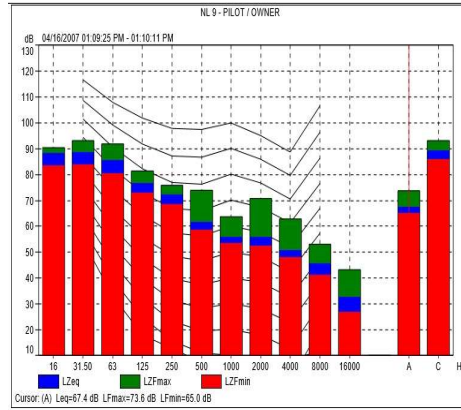


Fig.14. NL9 - Pilot / Owner

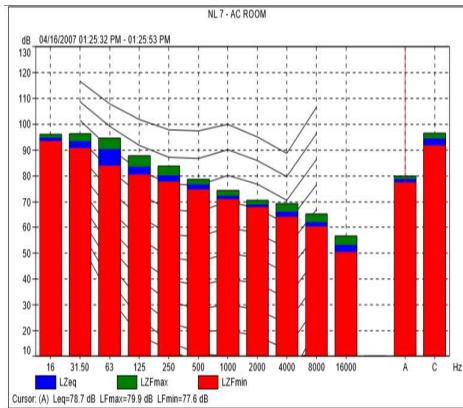


Fig.12. NL7 - AC room

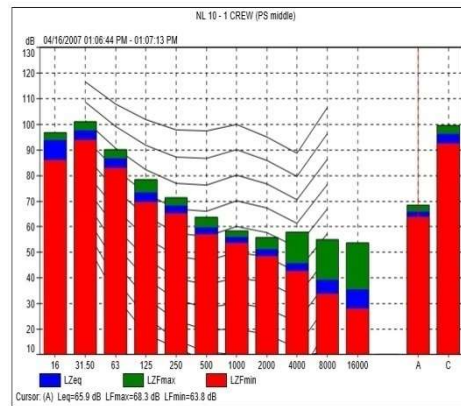


Fig.15. NL 10 - 1 Crew (PS Middle)

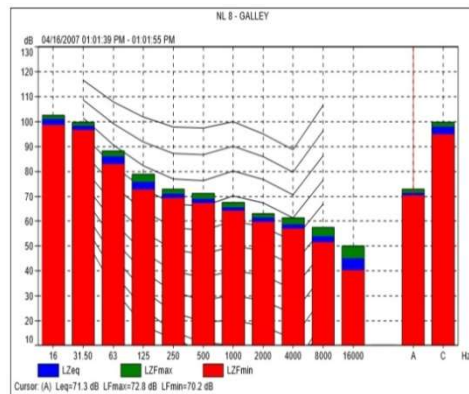


Fig.13. NL8 - Galley

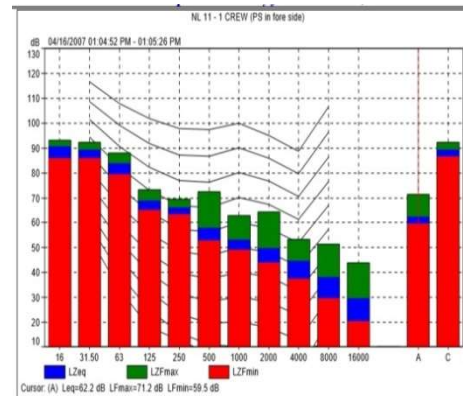


Fig.16. NL 11 - 1 Crew (PS in fore side)

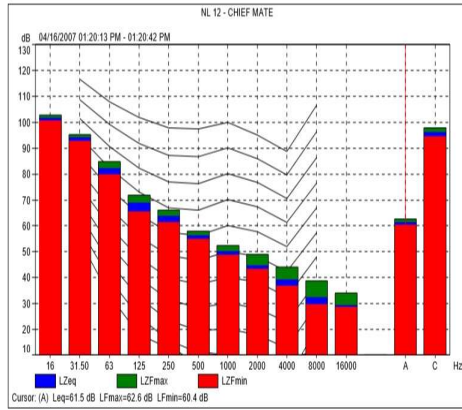


Fig.17. NL 12 - Chief Mate

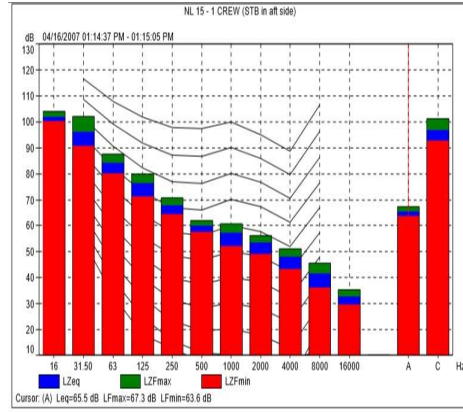


Fig.20. NL15 – 1 Crew (STB in aft side)

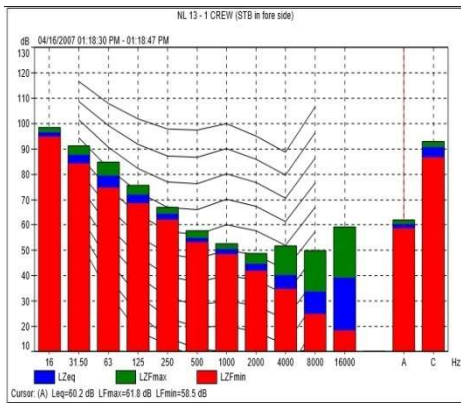


Fig.18. NL13 – 1 Crew (STB in fore side)

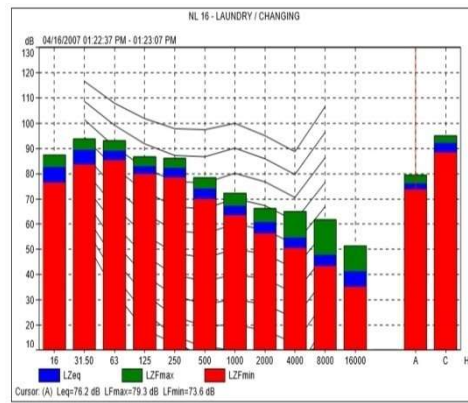


Fig.21. NL 16 - Laundry / Changing

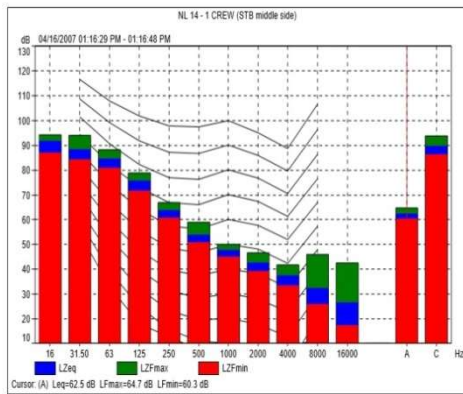


Fig.19. NL14 – 1 Crew (STB Middle)

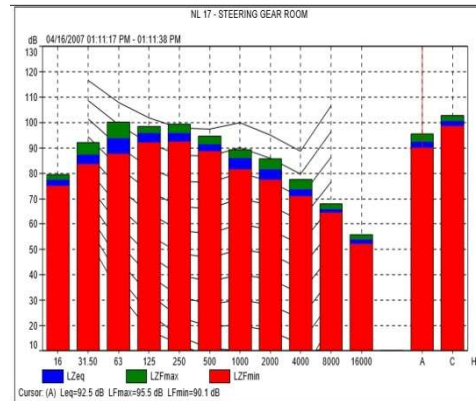


Fig.22. NL 17 - Steering Gear Room

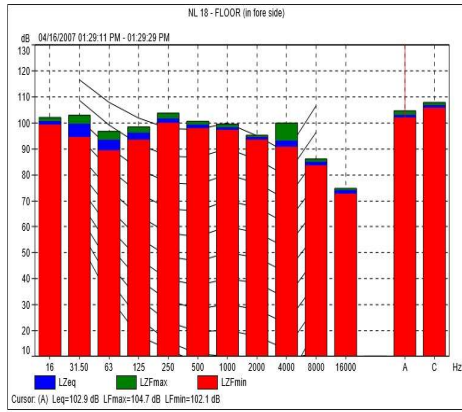


Fig.23. NL 18 - Floor (in fore side)

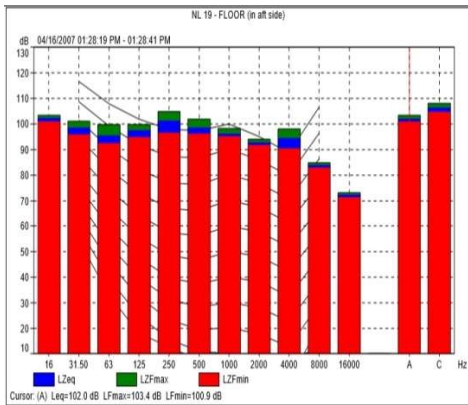


Fig.24 NL19 – Floor (in aft side)

The measurements with the approved and calibrated equipment described in Fig. 4, have been performed in the representative rooms of the ship, and the location of measurements points is presented below Fig. 25...28:

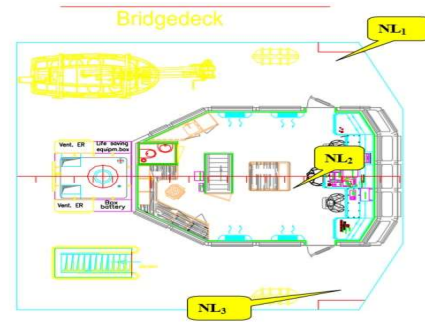


Fig.25. Bridge deck

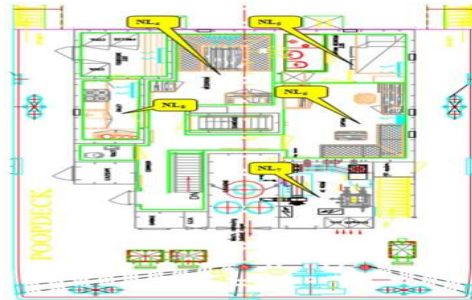


Fig.26. Poop deck

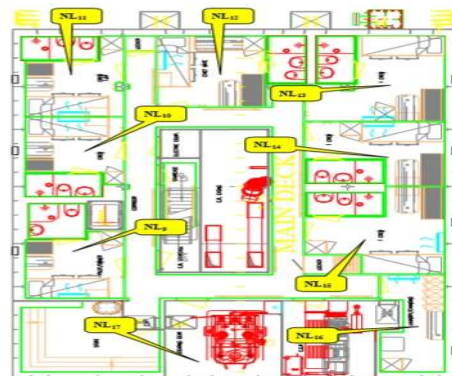


Fig.27. Main deck

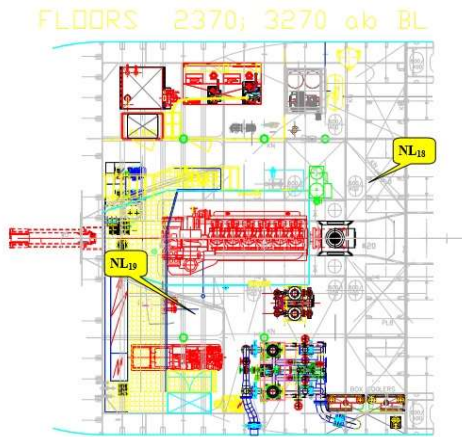


Fig.28. Floor

5. CONCLUDING REMARKS

The measurements were performed on the filter of weight "A", according to the above mentioned IMO Resolutions and frequency analysis in 1/1 octave band center. Measurements were performed during the operation at nominal parameters of general ventilation system and air conditioning system of social and living rooms. In addition, the other conditions recommended by mentioned IMO Resolution, were followed.

According Fig.5 the acoustic conditions onboard of this cargo are good for the entire crew, both for the resting cabins and working places.

The good results from the cabins are due to the solutions adopted as: solid rubber mat which has been put on the floor, absorption panels were mounted above the head of the berths and in ceiling of the passage way between the cabins. A heigh influence had the materials chosen for mess construction as solid rubber mats were mounted in lockers, the ceiling and steel bulkheads were insulated with rock wool, also the ceiling was mounted with a flexible joint in top and bottom and frames were insulated off steel.

Remark: because an exceeding up to 3 dB(A) is acceptable, there are the following

measuring points with values above 3 dB(A), marked in the table of page # with (++):

Item no.	Rooms	Remarks
1	NL 6 - room: Cap-tain dayroom	+ 3.8 dB(A)
2	NL 9 - room: 1 Crew	+ 7.4 dB(A)
3	NL 10 - room: 1 Crew	+ 5.9 dB(A)
4	NL 15 - room: 1 Crew STB aft	+ 5.5 dB(A)
5	NL 18 - Floor in fore side	+ 12.9 dB(A)
6	NL 19 - Floor in aft side	+ 12.0 B(A)

Engine Rooms: the admissible noise level is exceeded, being normally regarding the rated power of M/E; but for an unprotected human ear, according to IMO Resolution A 468 (XII) it is necessary (against the noise dangerous action), on every access doors to Engine Rooms, a warning signal (written on label): is acceptable, there are the following measuring points with values above 3 dB(A), marked in the table of page # with (++):

WARNING !EXCEEDED NOISE LEVEL! USE EAR PROTECTORS!
or warning labels, like these:



Fig.29. Warning labels

Same labels shall be posted on every access door in spaces having a noise level higher than 85 dB(A) like Steering Gear room.

Recommendation: Having in mind this ship has UMS classification, the exceedings recorded in the Engine Room are not important (there are not permanent work places in this compartment).

Acknowledgements

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REFERENCES

- [1]. **Resolution MSC 337(91) CODE ON NOISE LEVELS ONBOARD SHIPS** - November 2012;
- [2]. **IMO Resolution A 468 (XII) CODE ON NOISE LEVELS ONBOARD SHIPS**;
- [3]. **Willemssen Marine Support S.R.L., Noise Protocol M/V PAULA**;
- [4]. **Willemssen Marine Support S.R.L., Noise Measurements Report onboard M/V PAULA**;
- [5]. **Borelli D., Gaggero T., Badino A., "Noise emitted from ships", 2012**
- [6]. **Bosoanca, I., Noise Onboard FT MODULE CARRIER VESSEL** The Annals Of "Dunarea De Jos" University Of Galati Fascicle Xi – Shipbuilding. Issn 1221-4620, 2017
- [7]. **Det Norske Veritas RULES FOR CLASIFICATION OF SHIPS.**

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