



CCG – 'Hero' Class Patrol Vessels **Sea Chest Grate Vibration Analysis**

For
Canadian Coast Guard/Dept. of Fisheries & Oceans
Ottawa, ON



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1 GENERAL

The Canadian Coast Guard/Department of Fisheries (CCG/DFO) has engaged Lengkeek Vessel Engineering (LVE) to perform an analysis and recommend a permanent solution to address the sea chest design and vibration issues being experienced on the 'Hero' Class Patrol vessels.

2 PRINCIPAL PARTICULARS, "HERO" CLASS PATROL VESSELS

Length	43.00 m
Beam Moulded	7.00 m
Displacement	257 MT
Design Draft	2.85 m

3 BACKGROUND

There are two main engine cooling water sea chests on the vessels. A lower sea chest located on center line between frames 16 and 17 and extending transversally approximately 600mm (P&S) and a higher sea chest located approximately 1900mm (S) to outboard between frames 16.5 and 17. Excessive vibration and noise has been noted coming from the lower sea chest. Upon investigation it was found that some of the grate mounting tabs were being broken off leading to eminent escalation of vibration and eventual loss of the grate plates. An attempt to fix the vibration by splitting and stiffening the grate was implemented on many of the boats but proved to be ineffective as the problem eventually returned.

4 INVESTIGATION

4.1 REVIEW OF EXISTING DRAWINGS

The original construction drawings were acquired and reviewed. These included:

- Profile and Decks Plans
- Shell Expansion
- Midship and Other Sections Plans
- Engine Room Including Engine Seats Construction Plans
- Sea Chests Arrangement

LVE found that design-wise for the sea chest all seemed to follow standard shipbuilding practice except the floor located in the middle of the sea chest at Frame 16.5 between center line and 600mm (P&S). The bottom edge of this span of floor is not connected to the hull plate or to the grate plate causing either the grate plate and/or floor to flutter. This, in turn causing the failure of the welded connection tabs.

There were no details of the tabs connecting the grate plates to the hull on any of the drawings. Only the general locations of the mounting holes were shown on the Sea Chest Arrangement.

4.2 REVIEW OF EXISTING REPORTS

"Noise Investigation" reports from CCGS 'A. LeBlanc' and a "Sea Grate Inspection/Repair" report from the CCGS "Private Robertson V.C." as well as an analysis authored by Vladan were reviewed. Numerous photographs of the various surveys, refits and repairs were also available.

The reports document attempts to correct the noise and vibration by splitting and stiffening the grate plates. All concur that both the original and temporary designs are flawed.

4.3 SURVEY OF CHIEF ENGINEERS

Interviews of available MSPV chief engineers (CE) were conducted by LVE through email and telephone to solicit information and opinions. The information collected concurred with the report findings and the temporary fixes that were attempted. It also revealed that the temporary fixes are indeed temporary as the noise and vibrations are returning causing even more tab failure.

4.4 REVIEW OF APPLICABLE STANDARDS, STATUTORY AND REGULATORY REQUIREMENTS

LVE reviewed applicable regulations for any related to sea chests and grate plates. The only applicable item located was the archived Transport Canada Marine Safety Bulletin No. 08/1989 mentioned in the reports and stated on the Sea Chest Arrangement drawing.

5 CONCLUSIONS

5.1 RESULTS OF TEMPORARY REPAIRS AND TRIALS

After reviewing the cases documented in reports, photographs and feedback from the chief engineers LVE believes the cause of the failures stems from the vibration of the grate plate as well as the unconnected floor at Fr 16.5.

Evidence for this conclusion is as follows:

- It is stated in the "Noise Investigation" reports from CCGS 'A. LeBlanc' that there was wear on the grate plate where it was making contact with the floor causing noise that was absent when operating without the grate plate installed. With and without the grate plate installed there was still vibration which seemed to be from the floor.
- On the CCGS 'Private Robertson' after the temporary repair by splitting and reinforcing the grate plates the vibrations abated for a while but eventually returned.
- Correspondence between the chiefs of the CCGS 'Corporal Kaebler' and the CCGS 'Private Robertson' indicate failure even after welding the grate plates to the hull on three sides using short pieces of flat bar.

In all cases one edge of the grate plate and the bottom edge of the floor were left unsupported indicating the need for anchoring to prevent vibration.

6 RECOMMENDATIONS

LVE recommends modifying the lower sea chest openings by introducing a hull insert between the forward and after sections thus creating four smaller openings as opposed to two larger ones. The insert is to be welded to the unsupported floor at frame 16.5 to anchor it and give it some rigidity. In addition to this LVE believes the connection tabs should be eliminated and replaced with a continuous landing around the edge of each opening thus leaving no edge free to start vibrating or fluttering. Finally, the grate plate thickness should be increased to deter flexing as well.

As a result of these recommendations the ratio of the open area to the sea to the suction pipe area serviced by the sea chest will be reduced to 4.86 to 1 slightly less than 5 to 1 suggested in

TCMS Bulletin No. 08/1989. As there have been no concerns in regard to the supply of cooling water LVE believe the resulting ratio will be sufficient.

7 REFERENCE DOCUMENTS

1. 6094-10000-02_K_Profile and Decks Plans
2. 6094-10000-03_I_Shell Expansion
3. 6094-10000-01_J_Midship and Other Sections Plans
4. 6094-10000-07_G_Engine Room Including Engine Seats Construction Plans
5. 6094-25600-02_0 Sea Chests Arrangement
6. Leblanc Vibration Report
7. Ship 7 A LeBlanc Report on Noise Related Work
8. Sea Grate Inspection Repair
9. Email – Sea Bay Grates Vessel 1
10. TC Bulletin No 08-1989
11. MSPV Lower Sea Bay Area Calcs