Main Engine Damage
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Main Engine Damage

Findings
- Main engine claims account for 46% of total machinery claims cost with an average claim per vessel of USD 545,000.
- The frequency trend for main engine claims is stable at 2% of the vessels entered with The Swedish Club experiencing main engine damage.
- Since 2011, the average cost of main engine damage has decreased from USD 634,000 to USD 545,000 (-14%).
- Container and dry cargo ships have a disproportionately large claims cost in relation to fleet entry.
- Korean built vessels make up 31% of the club fleet but amount to only 12% of main engine claims cost. China on the other hand is over-represented with 30% of the club entries and 36% of the total main engine claim costs.
- Four-stroke main engines experience 2.5 times more claims than two-strokes.
- Four-strokes in V configuration have an average of 42% higher claims costs than inline configuration.
- Bearing failures are the most expensive main engine claim categories with an average cost of nearly USD 1.6 million per claim. The cost for bearing failures is high due to consequential damage to crankshafts, etc.
- Lubrication failure is still the most expensive cause of damage.

Executive summary
Cause of damage
- Contaminated lubrication oil
- Experts not in attendance at major overhauls
- Using contaminated bunkers
- Purifiers not operated as per manufacturers’ instructions
- Engine components not overhauled as per manufacturers’ instructions
- Crew with insufficient experience/training

Recurring issues
- Insufficient planning
- Insufficient experience/training
- Non-compliance with company procedures
- Procedures which are unclear, not comprehensive enough or have not been implemented
- Experts not in attendance at major overhauls
- Not having adequate follow-up methods after maintenance work

Core statistics: Vessels insured for Hull & Machinery (H&M) 2012–2014:
- Total number of vessel/years: 5,467
- All vessel types and sizes
- Claims equal to, or more than, USD 10,000 on 100% basis considered
- Deductibles included

Number of machinery claims: 487
Number of main engine claims: 118
Total number of H&M claims: 1051
Introduction

In 2012, The Swedish Club presented the findings from a seven-year study of main engine damage (2005-2011). This report sets out the results of a follow-up study, spanning the three year period 2012-2014.

The objectives of this report are to update the analysis published in 2012; identify new claims trends; and to review and reinforce the Club’s Main Engine Damage Loss Prevention Program. The fundamental aim is to reduce the frequency/severity of main engine damage.

Overview

The Swedish Club provides members with a range of cover, including Protection and Indemnity (P&I); Freight Demurrage and Defence (FD&D) and Marine & Energy and Ancillary (Marine) covers.

The Swedish Club has always had a proactive policy, directed at raising awareness of main engine damage and encouraging manufacturers to respond with new and more effective measures for reducing the frequency of engine damage.

Hull & Machinery claims

The Club’s H&M claims in the 2005-2011 and 2012-2014 periods are shown in Graphs 3 and 4, respectively.

Seven claims categories are represented. It can be seen that as a proportion, the machinery claims have fallen since 2011. Machinery claims accounted for 50% of H&M claims in the earlier study, decreasing to 46% in the later period.

In cost terms the proportion of machinery claims remains almost the same. For the period 2005-2011, the cost of machinery claims accounted for 36% of the total H&M claims costs. In the most recent analysis this proportion remained similar at 37%.

In the comparison between total H&M claims cost and vessels entered for H&M by vessel type, container vessels are found to be overrepresented and account for 46% of the total cost while accounting for 37% of the fleet. Frequency of claims per vessel type is also presented in graph 1.

Graph 1. H&M claims by vessel type, 2012-2014
Graph 2. H&M claims by number, 2005-2011

Graph 3. H&M claims by number, 2012-2014

Graph 4. H&M claims by cost, 2005-2011, adjusted to 2014's level

Graph 5. H&M claims by cost, 2012-2014
The Swedish Club experienced 487 machinery claims in the 2012–2014 period, costing a total of USD 187.6 million. Main engine damage remains the most expensive category, contributing 34.3% of total machinery claims cost (30.4% in the earlier period) and 12.7% (10.9%) of the total H&M claims cost. Despite the rise in claims cost share, the average cost of a main engine claim has reduced by 14.0% compared to the previous survey period.

The average cost of main engine damage between 2005–2011 was almost USD 634,000. The latest survey records 118 main engine claims averaging USD 545,000 which is a 14% decrease (Table 1).

### Table 1. Machinery claims, 2012–2014

<table>
<thead>
<tr>
<th>Claims Type</th>
<th>Number</th>
<th>Average cost (USD)</th>
<th>Change (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Main engine</td>
<td>118</td>
<td>545,000</td>
<td>-14%</td>
</tr>
<tr>
<td>Aux engine</td>
<td>79</td>
<td>326,000</td>
<td>-7%</td>
</tr>
<tr>
<td>Turbocharger</td>
<td>79</td>
<td>335,000</td>
<td>-8%</td>
</tr>
<tr>
<td>Propulsion*</td>
<td>109</td>
<td>442,000</td>
<td>-37%</td>
</tr>
<tr>
<td>Rudder/Steering gear</td>
<td>22</td>
<td>321,000</td>
<td>-48%</td>
</tr>
<tr>
<td>Boiler</td>
<td>22</td>
<td>247,000</td>
<td>-22%</td>
</tr>
<tr>
<td>Other**</td>
<td>91</td>
<td>235,000</td>
<td>-21%</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td>487</td>
<td>385,000</td>
<td>-19%</td>
</tr>
</tbody>
</table>

*Propeller, shaft, gearbox etc
**Machinery such as electrical equipment, cranes, cargo gear, deck equipment
Main engine claims

An overview of the main engine claims frequency trend over a 10-year period shows minor fluctuations over the period and has stabilized to around 0.02 claims per vessel/year (graph 6 below).

Graph 6. Main engine claims and trends, 2005-2014

![Graph 6. Main engine claims and trends, 2005-2014]

Overview of main engine claims by vessel specifics

Container vessels account for more than 47% of the total cost of main engine damage claims but only 37% of the fleet, presented in Graph 7. This trend has broad similarities with Graph 1 where container vessels are also overrepresented. It can be concluded that container vessels are therefore particularly exposed to main engine claims. Conversely, Graph 7 shows that bulker and tanker vessels are underrepresented in the hierarchy of total main engine damage claims costs. Dry cargo vessels have the highest claims per insured vessel value.

When comparing the relation between number of club entries and claims cost as well as claim frequency by vessel builder country, it is shown that Korea, which accounts for almost 31% of club entries, only shares 12% of the total main engine claims cost (Graph 8).

Conversely China is overrepresented by a large margin, with almost 30% of club entries and 36% of the total claim costs for all engine types.
Overview of main engine claims by engine specifics

Main engine claims and entry by make of engine is show in Graph 9, represented by the codes A-F. Codes A-C are low speed engine makes and D-F and ‘Other’ are medium/high. The identity of the manufacturers is available to Club members only, upon request.

The survey shows that despite accounting for over 57% of club entries, engine makers with code A represent only 40% of main engine claims cost. Codes D and E on the other hand are overrepresented with about 15% club entries in total and over a third of the total main engine claims costs together. ‘Other’ engine makes have extremely few vessels insured hence the disproportionate result.

Graph 9. Main engine claims by engine make, 2012-2014

Graph 10 shows that vessels entered with The Swedish Club for H&M consist mainly of low speed engine vessels. However in terms of claim frequency it is shown that vessels with medium and high speed engines have a higher claim/entry ratio.

The configuration of medium/high speed engines relates to the claim cost. V configured engines have a 42% higher average claim cost than inline as show in Graph 11. The frequency of claims is approximately the same.

Graph 10. Main engine claims by engine make, 2012-2014

Graph 11. Four-stroke-Inline versus V configuration, 2012-2014
Damaged parts

Table 2 focus on the seven most common damaged parts in the main engine claims category. The tables show numbers and costs per damaged parts for claims for the 2012-2014 period. The latest survey shows that bearing damage now constitutes the part with the most expensive damage, with an average cost of USD 1.6 million.

Table 2. The seven most common types of claims, 2012-2014

<table>
<thead>
<tr>
<th>Damaged parts</th>
<th>Number</th>
<th>Average cost (USD)</th>
<th>Change (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bearing*</td>
<td>4</td>
<td>$1,601,000</td>
<td>110%</td>
</tr>
<tr>
<td>Camshaft</td>
<td>13</td>
<td>$1,050,000</td>
<td>-23%</td>
</tr>
<tr>
<td>Cylinder/liner</td>
<td>12</td>
<td>$486,627</td>
<td>-18%</td>
</tr>
<tr>
<td>Cylinder cover</td>
<td>5</td>
<td>$193,000</td>
<td>na</td>
</tr>
<tr>
<td>Fuel Pumps</td>
<td>5</td>
<td>$410,000</td>
<td>na</td>
</tr>
<tr>
<td>Piston</td>
<td>6</td>
<td>$528,000</td>
<td>33%</td>
</tr>
<tr>
<td>Multiple parts**</td>
<td>15</td>
<td>$509,000</td>
<td>-20%</td>
</tr>
</tbody>
</table>

*Includes crankshaft damage
**Damage where multiple engine parts are involved and the proximate cause could not be established.
Cause of damage

- Contaminated lubrication oil
- Experts not in attendance at major overhauls
- Using contaminated bunkers
- Purifiers not operated as per manufacturers’ instructions
- Engine components not overhauled as per manufacturers’ instructions
- Crew with insufficient experience/training

Tables 3 & 4 shows the top three most common causes of damage for the 2005-2011 and 2012-2014 periods respectively. Incorrect maintenance and/or repairs are the most frequent cause of damage in both periods. With an average cost per claim of USD 926,000, lubrication failure is still the most expensive cause of damage to the main engine.

### Table 3. Top 3 causes of damage by number, 2005-2011

<table>
<thead>
<tr>
<th>Cause</th>
<th>Number</th>
<th>Average cost (USD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Incorrect maintenance and/or repairs</td>
<td>33</td>
<td>741,354</td>
</tr>
<tr>
<td>Fuel management</td>
<td>27</td>
<td>318,000</td>
</tr>
<tr>
<td>Lubrication failure</td>
<td>23</td>
<td>1,194,000</td>
</tr>
</tbody>
</table>

### Table 4. Top 3 causes of damage by number, 2012-2014

<table>
<thead>
<tr>
<th>Cause</th>
<th>Number</th>
<th>Average cost (USD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Incorrect maintenance and/or repairs</td>
<td>17</td>
<td>849,000</td>
</tr>
<tr>
<td>Lubrication failure</td>
<td>13</td>
<td>926,000</td>
</tr>
<tr>
<td>Fuel management</td>
<td>8</td>
<td>342,000</td>
</tr>
</tbody>
</table>

### Maintenance

The latest survey has shown that most main engine claims are as a direct and indirect result of incorrect maintenance. Numerous cases have been noted where damage occurs shortly after the engines have been overhauled by ship or shore staff. This emphasizes the importance of correct maintenance.

### Recurring issues

- Insufficient planning.
- Insufficient experience/training.
- Non-compliance with company procedures.
- Procedures which are unclear, not comprehensive enough or have not been implemented.
- Experts not in attendance at major overhauls.
- Not having adequate follow-up methods after maintenance work.

### Limited experience

Shortage of seafarers with experience has been highlighted before in Club publications, but it is worth repeating. This fact emphasizes the importance of monitoring by shore staff. There is a significant risk that officers are being promoted before they have acquired the necessary experience for senior command.

It is also important that the maintenance of all engine components is included in the PMS (Planned Maintenance System).
Prevention

- Implement onboard fuel management and fuel system audits.
- Verify that the various parts, including purifiers are tested for proper function and are operated in accordance with manufacturers’ recommendations.
- It is imperative to monitor the quality of the lubrication oil. Samples of lubrication oils should be sent ashore for analysis at least every three months.
- During major overhauls it is highly recommended to have experts in attendance.
- It is important to only use spare parts approved by the engine manufacturer.
- Invest in employee training.
- Carry out comprehensive audits and inspections.
- Replace diaphragm sealings at crank case luboil outlets at recommended intervals.

Management

An in-depth investigation of machinery claims shows that a great deal of engine damage is related to insufficient management systems. In order to reduce machinery claims a well-implemented and proper management system is important.

It is essential that crewmembers have the necessary experience to ensure that ordinary daily work and maintenance is performed in accordance with company procedures. However it is of utmost importance to carry out comprehensive audits and inspections to prevent management plans from being compromised.

Insufficient reporting and follow up work is a major problem at the management stage. It is highly recommended that members have a PMS which is approved by a classification society and well-implemented both onboard and ashore, with annual controls put in place by the classification society to achieve best possible results.
Loss Prevention

The Loss Prevention unit is placed within the Strategic Business Development & Client Relationship department and provides active loss prevention support, analysis and reports, as well as advice to members.

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