The Swedish Club

Auxiliary Engine Damage

LOSS PREVENTION
ESSENTIALS

How to avoid auxiliary engine damage

Ensure you have the necessary knowledge and experience before commencing any overhaul work.

If you have not received training on the specific engine model, consider engaging an expert from the manufacturer.

Always strictly follow manufacturer's instructions.

During overhaul, check and double check that stud bolts for connection rods and bearing keeps are tightened 100% in accordance with manufacturer's instructions.

Ensure that required tools are available and calibrated as necessary.

Regularly monitor the quality of your lubrication oil and take prompt action when irregularities are detected.

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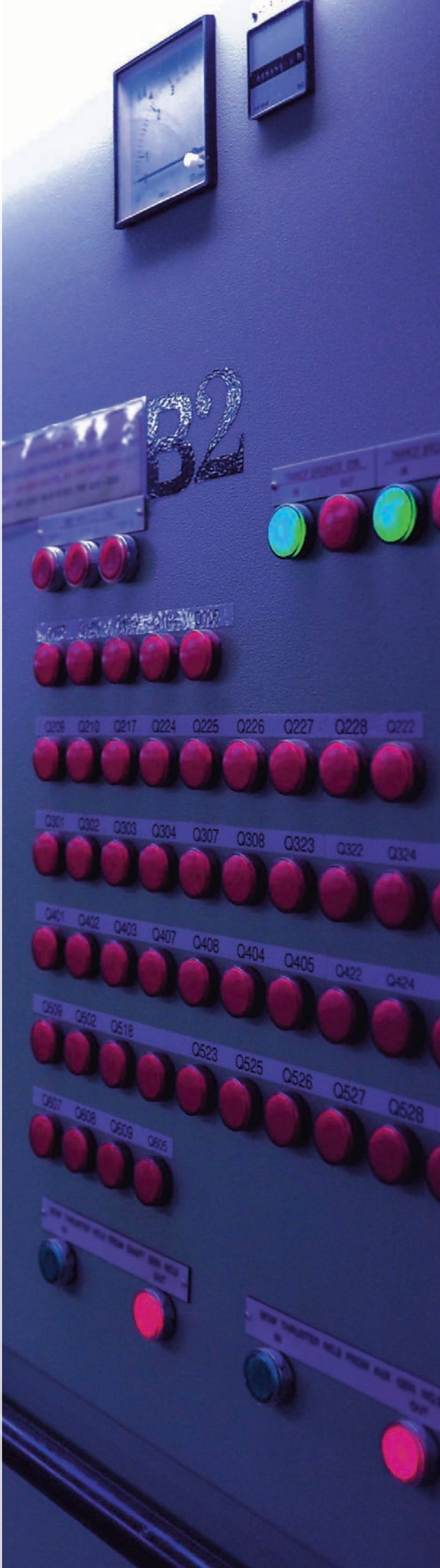
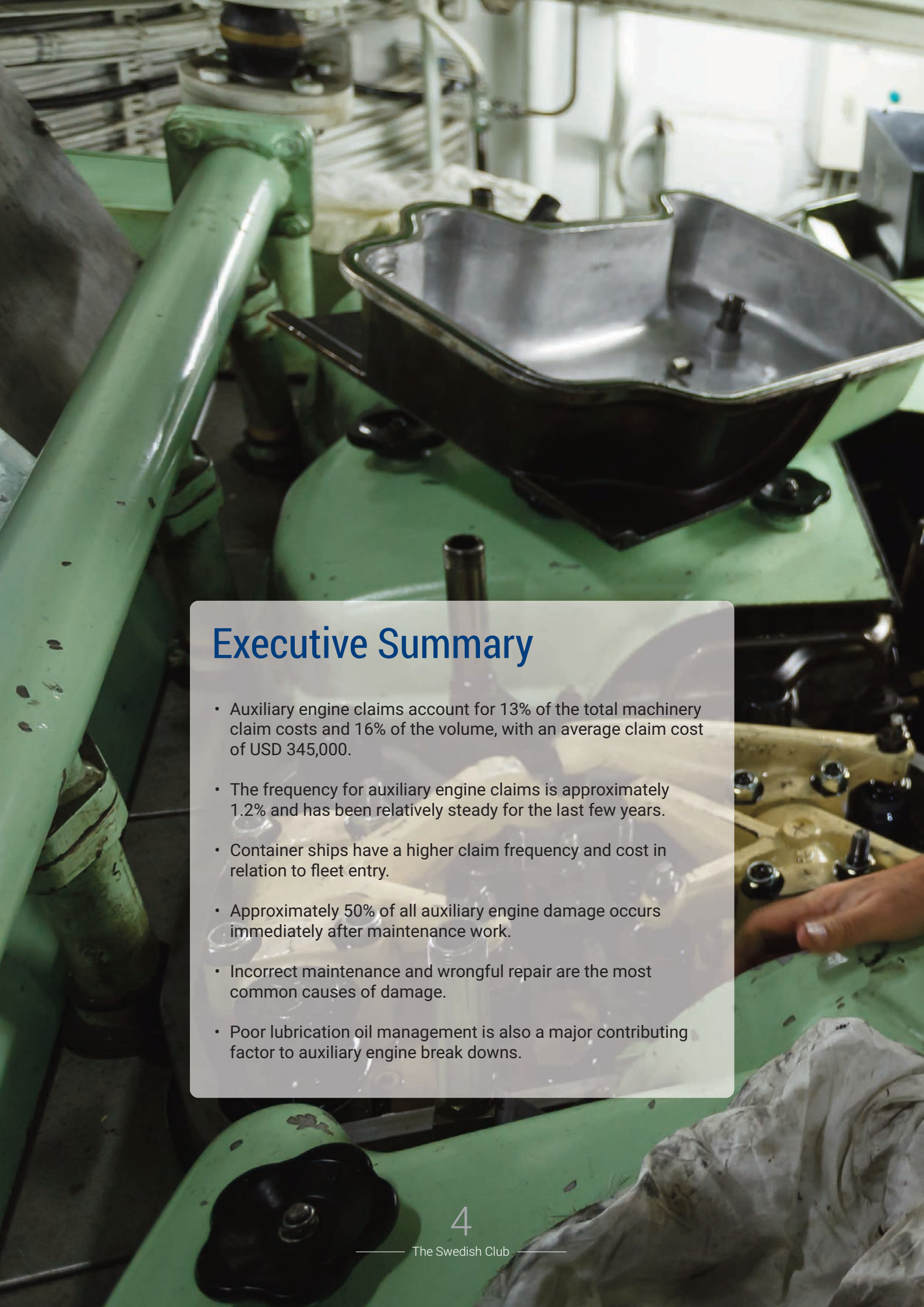




Executive Summary

- Auxiliary engine claims account for 13% of the total machinery claim costs and 16% of the volume, with an average claim cost of USD 345,000.
- The frequency for auxiliary engine claims is approximately 1.2% and has been relatively steady for the last few years.
- Container ships have a higher claim frequency and cost in relation to fleet entry.
- Approximately 50% of all auxiliary engine damage occurs immediately after maintenance work.
- Incorrect maintenance and wrongful repair are the most common causes of damage.
- Poor lubrication oil management is also a major contributing factor to auxiliary engine break downs.

1. Introduction

This report has been created in response to members' concerns over damage to auxiliary engines. Its objective is to investigate auxiliary engine claims, highlight predominating factors and provide advice with a view of reducing the frequency/severity of auxiliary engine damage.

The Swedish Club has always had a proactive policy directed at raising awareness of claims trends and hands on advice on how to mitigate casualties. This report aims to shine a light on the important issue of damage to auxiliary engines, a significant segment of machinery claims – both in number and cost.

2. Overview

Auxiliary engines run at high revolutions and have a common lubrication system for both cylinder and crank case lubrication. Auxiliary engines are not under the same strict regime from the classification society and maintenance is often carried out by the vessel crew.

The Club has seen all too frequently the following causes of damage:

- Incorrect maintenance and repairs
- Failure to adhere to repair procedures and use of incorrect tools
- Crew lacking formal engine specific training
- Inexperienced crew and no expert in attendance
- Failure to detect contamination due to poor lubrication oil management
- Not following up on results from lubrication oil sampling

3. Scope of the report

Vessels insured for Hull & Machinery (H&M) 2010-2016:

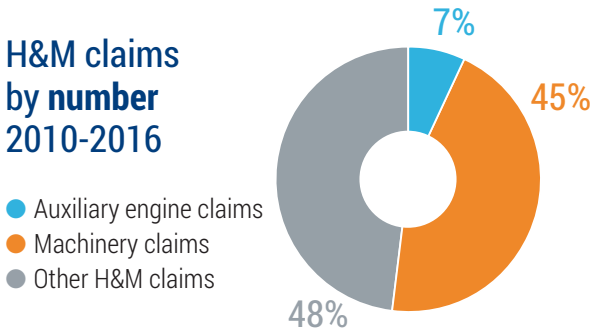
Total number of vessels: 2,295
All vessel types and sizes
Only damage in excess of the deductible (average USD 105,000) are included in this report

Total number of H&M claims: 2,294
Number of machinery claims: 1,197
Number of auxiliary engine claims: 192

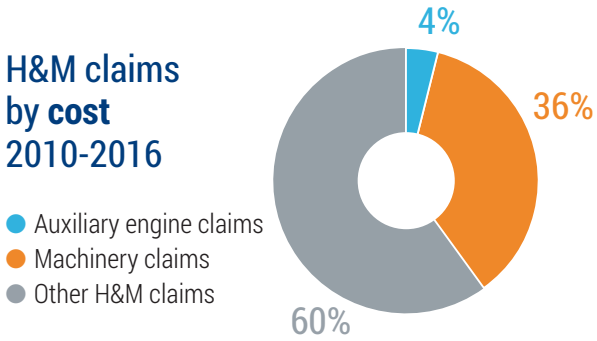
4. Claims statistics

4.1 Hull & machinery claims

H&M claims by number 2010-2016

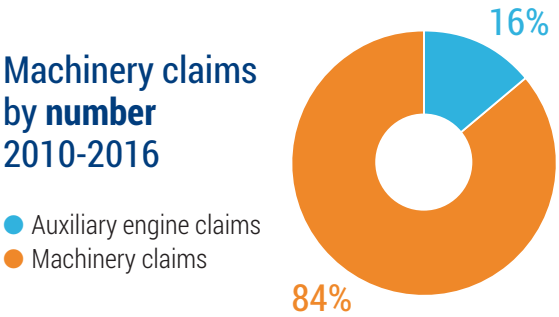


H&M claims by cost 2010-2016

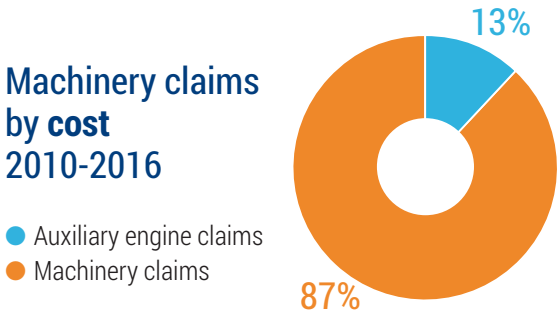


4.2 Machinery claims

Machinery claims by number 2010-2016



Machinery claims by cost 2010-2016



4.3 Machinery claims per claims type, 2010-2016

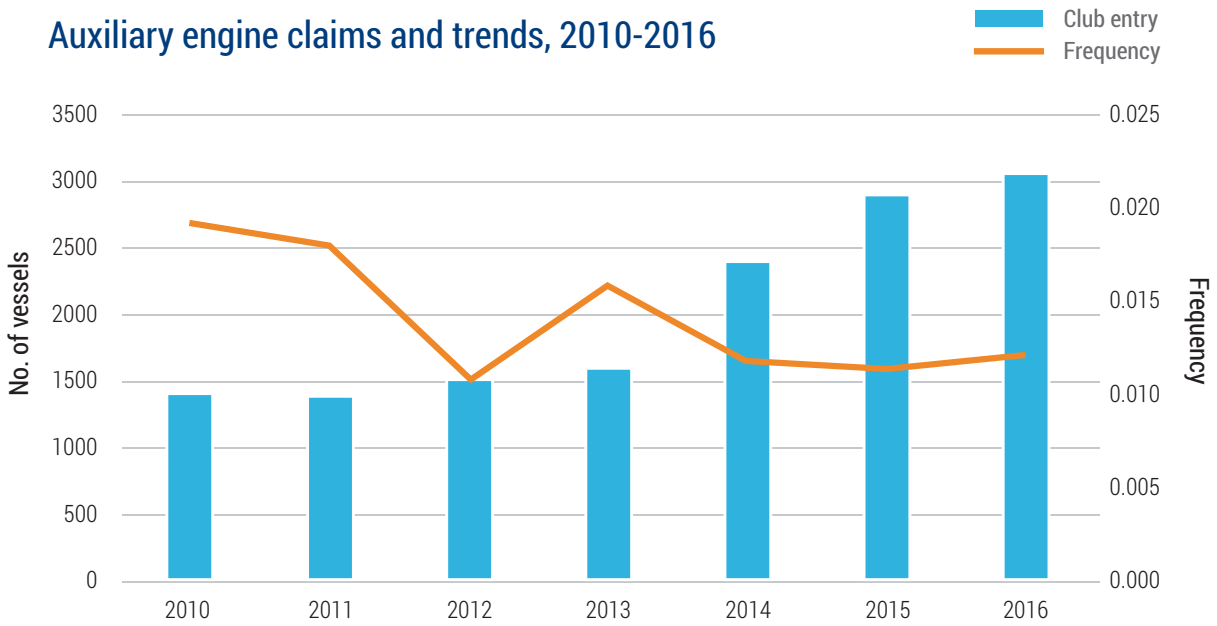
Claims Type	Number of claims	Cost (USD)	Average cost (USD)
Main engine	313	180, 364, 796	576,245
Propulsion*	244	109,613,532	449,236
Auxiliary engine	**192**	**66,166,087**	**344,615**
Turbo charger	134	40,850,539	304,855
Steering gear	48	20,165,111	420,106
Boiler, auxiliary boiler	50	16,901,509	338,030
Crane	66	16,417,241	248,746
Electrical, engine room automation	47	10,899,178	231,897
Cargo gear and equipment, cargo heating	16	7,463,057	466,441
Deck equipment, other	23	4,180,816	181,775
Stern tube	6	1,844,055	307,343
Other**	58	16,444,440	283,525
TOTAL	1197	491,310,361	319,447

* Propeller, shaft, gearbox

** Machinery and equipment for lifesaving, navigation, thruster etc.

4.4 Claims by frequency

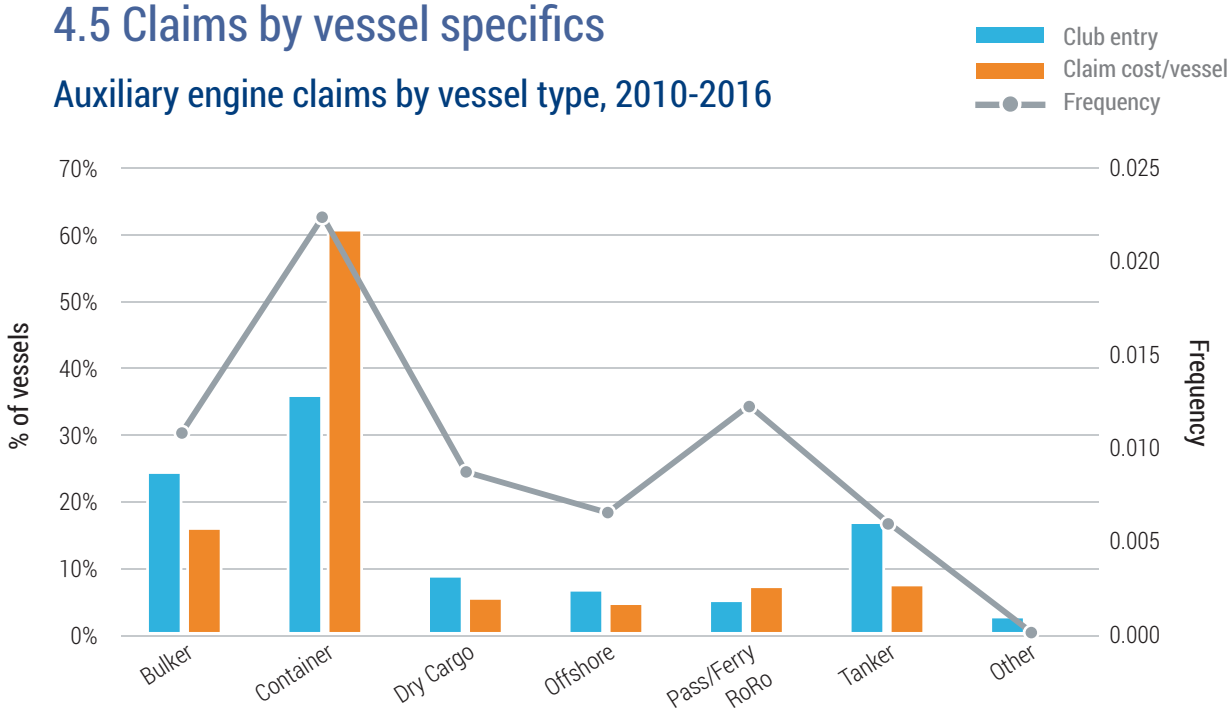
Auxiliary engine claims and trends, 2010-2016



- The frequency of auxiliary engine claims shows minor fluctuations with some reduction towards the end of the period under investigation.
- The current frequency is slightly above 0.01 claims per vessel per year (i.e. 1 claim per year for every 100 vessels entered).

4.5 Claims by vessel specifics

Auxiliary engine claims by vessel type, 2010-2016



- Container vessels have a significantly higher claims frequency due to the larger number of installed engines on these vessels. In addition, these engines have considerable output, hence the repair cost is greater compared with other vessels.

5. Cause of damage

Of the cases analysed, the Club has identified four major causes of damage:

1. Connecting rod bolts

(58 cases, mainly wrong assembly of bolts & nuts for main bearings, conecting rod studs etc.)

a. Improper tightening of bolts
b. Hydraulic tool/pump not calibrated
c. Lack of crew training and adherence to procedures

2. Contamination of lubrication oil

(27 cases, contaminated with H_2O or soot.)

a. Improper lube oil management
b. Lube oil filters degraded over time
c. Introduction of dirt (rags) during maintenance
d. Damage/leaking lube oil cooling water heat exchanger

3. Incorrect maintenance & procedures

(25 cases)

a. Incorrect adjustment of valve clearance
b. Installed pistons in wrong directions
c. Installed wrong type of plungers in fuel pumps
d. Mixed up inlet and outlet valves during overhaul
e. Not following manufacturer's service letter regarding required modifications
f. Not installing correct bearings following crankshaft grinding

4. Overspeed

(16 cases)

a. Overspeed trips NOT in working condition
b. Wrong assembly after exchange of governor
c. Wrong assembly of fuel linkage
d. Worn out drive system for governor

On a small number of casualties (4 cases) latent defects were the cause of damage. These were:

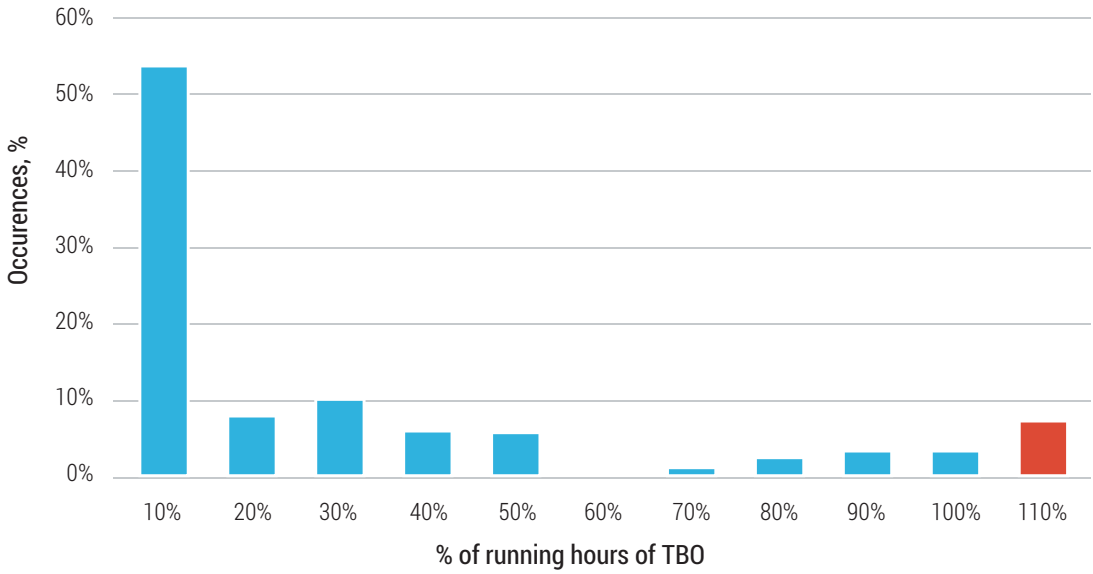
a. Wrong material in fly wheel
b. Connecting rod machined incorrectly by manufacturer
c. Piston cracked
d. Fuel injectors cracked at new building yard

6. Observations

6.1 Time between overhaul (TBO)

The chart below demonstrates the time that a casualty occurs in relation to the recommended maintenance interval (TBO) of the engine. The TBO of an auxiliary engine is normally between 12,000-16,000 hours.

Casualties % in relation to TBO recommended by manufacturers



Note: *In addition to TBO related occurrences there are several cases where a crew member has carried out regular maintenance shortly before the breakdown. Common mistakes include replacing the oil filter but leaving rags behind, or cleaning the oil cooler and damaging a packing. These types of cases have been incorporated as TBO=0 in the analysis.*

As can be seen, a majority of the casualties, 55%, occur within only 10% of the TBO, corresponding to the first 1,000 hours or so of operation after overhaul. In most cases, the damage occurs only a few hours after start up.

6.2 Do it right - or don't do it at all

Reviewing our records we note that the common factor for these occurrences in most cases is the incorrect assembly of vital engine parts in connection with regular overhaul. In particular, the assembly of connecting rods, bearings and pistons causes severe and costly accidents.

- Non adherence to procedures, lack of training and experience are major factors. A connecting rod assembly is a critical and highly stressed joint and must be re-assembled exactly in accordance with manufacturer's instructions with proper tools. All too often the Club sees insufficient understanding of the importance of the procedures.

- Special hydraulic tools are often used for the engine assembly. These tools must be treated with care and need to be calibrated and regularly carefully checked before use.

- The manager has the responsibility to ensure that crew are competent to undertake such repairs/overhaul. The crew should either be trained on the specific engine types or alternatively, an expert from the manufacturer should be engaged to attend the overhaul.

6.3 Lube oil – the root of all evil

Poor lubrication oil management is in many cases the predominating factor for an auxiliary engine breakdown.

Auxiliary engines are 4-stroke engines and as such the engine oil is used for cooling of pistons crowns and lubrication of cylinder liners, bearings, etc. There is an apparent risk that the lube oil will be contaminated with soot and combustion particles, especially if the engine has accumulated some running hours.

Proper lubrication oil management is critical for minimising the risk of engine failures. This is essential when operating the engine on heavy fuel oil (HFO). The lubrication oil must be analysed at regular intervals. Detection of water, soot particles, metal particles, etc. will serve as an early warning for engine problems. Negative results from oil analysis must be investigated and addressed promptly.

"Imagine you bring your car to the local workshop for regular maintenance. After you have picked up your newly mended and overhauled vehicle, and you are on your way home, there is suddenly a loud noise from the engine and the car comes to a shrieking and abrupt halt.

You open the hood only to realise that the engine has failed catastrophically with bits and pieces from liners and pistons scattered all around.

This is effectively what has happened in around 55% of all cases of auxiliary engine failures reported to the Club."

7. Best practice

Whilst prevention is always better than cure, steps can be taken to mitigate the damage caused by the failure of the auxiliary engine. Most modern auxiliary engine installations can be started and stopped remotely from the engine control room. It is good practice to always be present at the engine when starting same, especially after longer periods of still-stand and after overhaul. During start-up, if anything goes wrong, it usually happens very quickly. If someone is present at the engine there is at least a possibility to intervene and shut down the engine manually.

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