The Swedish Club

engine damage

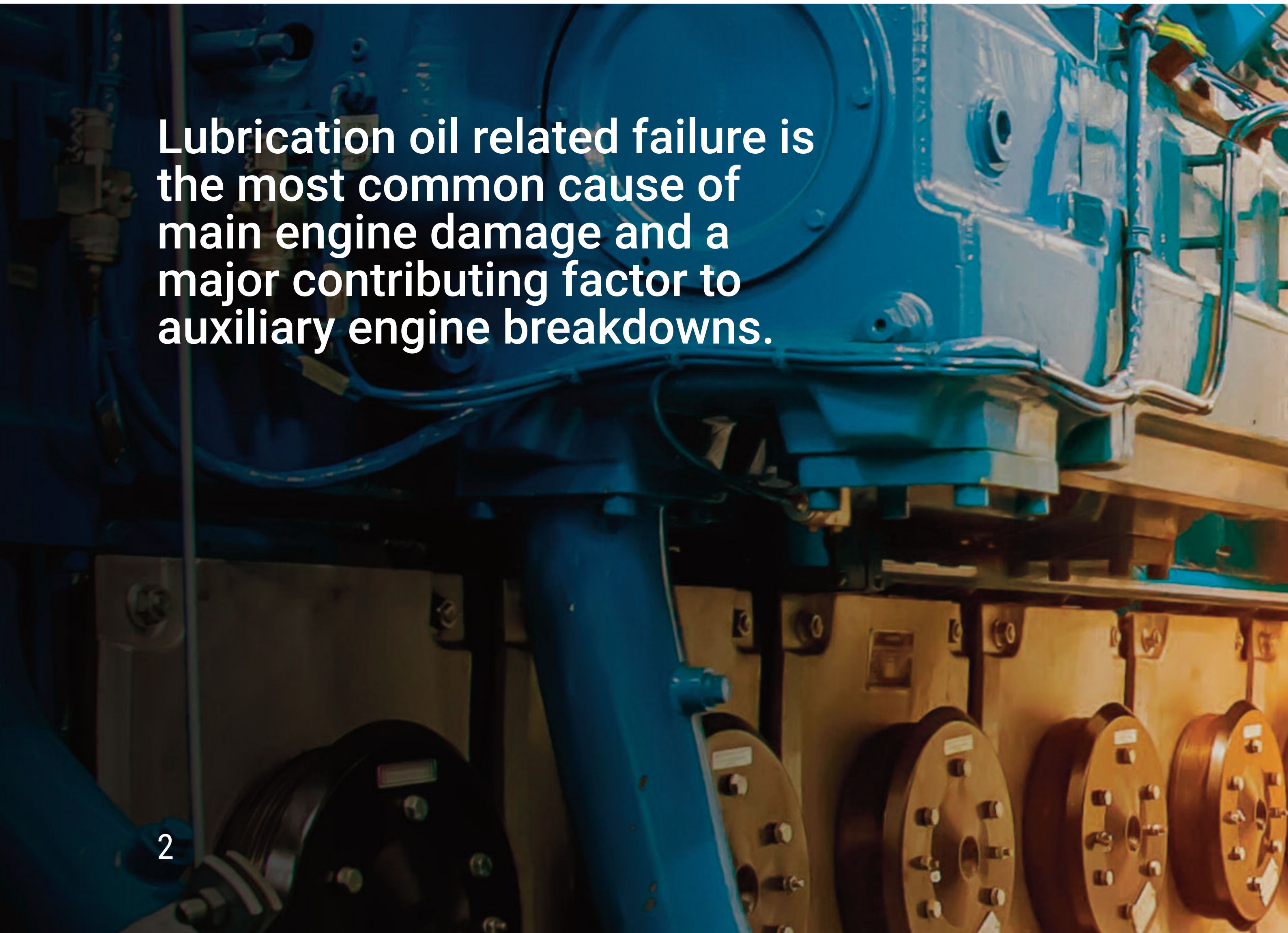
Introduction

By **Peter Stålberg**
Senior Technical Advisor

Main engine damage is an expensive category of claims that occurs far too frequently. Statistically a vessel will suffer between one and two incidences of main engine damage during its lifetime. With an average claims cost of around USD 650,000, it is important to identify the main causes of this damage and understand how they can be prevented.

The case studies we present have been chosen to showcase some of the most common causes of engine damage. We have taken them from real life situations where an insurance claim has been made. The circumstances we describe are by no means unusual. Sloppy maintenance, failing to follow manufacturers' instructions, poor fuel and lube oil management, lack of process – all are seen far too frequently.

And as the case studies show, often a number of seemingly minor omissions will combine to escalate an easily handled routine problem into an onboard crisis.



Lubrication oil related failure is the most common cause of main engine damage and a major contributing factor to auxiliary engine breakdowns.

Prevention

Prevention of damage is, of course, preferable to cure. Time and time again we see problems that would have been prevented by having a well implemented and proper management system. This can be easily achieved through proper training and education of the crew, providing them with the essential knowledge and experience required for ordinary daily work and maintenance according to company procedures.

It is highly recommended that members have a computer based planned maintenance system (PMS) on board linked with the shore organisation. The PMS should be approved and audited by a classification society to ensure a good standard.

More detailed advice on how to prevent engine damage can be found in The Swedish Club's loss prevention publications *Main Engine Damage* and *Auxiliary Engine Damage*.

Time and time again we see problems that would have been prevented by having a well implemented and proper management system.

Quick facts

- Lubrication oil related failure is the most common cause of main engine damage and a major contributing factor to auxiliary engine breakdowns.
- Vessels propelled by medium/high speed engines have a claims frequency 2.5 times higher than slow speed engines.
- In comparison with other vessels insured by the Club, bulkers and tankers are the best performers with regard to main engine claims cost. The majority of these vessels have slow speed engines.
- Passenger vessels/ferries have the highest frequency of main engine claims – often these vessels have multiple medium speed engine installations.
- Approximately 50% of all auxiliary engine damage occurs immediately after maintenance work.
- Incorrect maintenance and wrongful repair are the most common causes of damage to auxiliary engines. In most cases, this is due to the incorrect assembly of vital engine parts in connection with regular overhaul, in particular, the assembly of connecting rods, bearings and pistons.
- The most expensive type of main engine damage is on crank shaft and associated bearings with an average cost of MUSD 1.2 per claim, as spare parts are expensive and the repairs labour intensive.

Case study 1

Poor fuel management and sloppy maintenance routines leads to salvage operation

Commentary:	Third Engineer
Vessel:	22,400 GT bulk carrier
Engine type:	MAN B&W 5S42MC
Repair cost:	USD 1,450,000

“We were sailing to Europe with 30,000 tonnes of wood products. A few days after bunkering and leaving Singapore, we noticed that vibration was coming from the no. 1 purifier. This was shut down straight away as we were worried that there was an imbalance in the bowl, and we changed to the no. 2 purifier.

To be honest, I was a bit worried that something like this might happen as eight weeks ago we had opened the purifier and noticed sludge and deposits inside, as well as a damaged seal ring. The Chief Engineer had told us it didn’t need replacing – he had a lot of experience, so we didn’t disagree with him and left it as it was. I wasn’t sure the spare seal rings on board were in good condition so I suggested that we should try to get some spare rings before leaving Singapore. Unfortunately, the schedule was hectic and somehow we forgot this.

Vibration and knocking

A few days later we then noticed vibration on the no. 2 purifier, which we knew must also have been due to excess sludge, and so we shut it down and opened for inspection. We noticed that the seal ring was damaged and we also found out that the spare we had on board was faulty and could not be used.

Then, a day later I saw that there were high exhaust temperatures on all the cylinders of the no. 2 diesel generator. I called the Chief Engineer, and he ordered the main engine load to be reduced and the diesel generator shut down. We then started the no. 1 diesel generator and put it on the switchboard.

A few hours later I heard a knocking noise and saw a leak coming from the no. 2 cylinder cover on the no. 1 diesel generator. We were worried that the valves were misaligned and so we shut down the diesel generator and stopped the main engine.

“A few hours later I heard a knocking noise and saw a leak coming from the no. 2 cylinder cover on the no. 1 diesel generator.”

Drifting

The ship then started drifting and it took us three days to get one of the two diesel generators working again. We managed to get the no. 2 diesel generator started on marine gas oil by manually pushing in the fuel rack, however we simply couldn’t get it to run on the main switchboard. Every time we tried, it shut down.

We finally managed to get the main engine running on HFO by again forcing in the fuel rack manually, and we continued the voyage as advised by the shore office. Unfortunately, this luck didn’t last, and the main engine stopped after a while. The diesel generator that we were using was showing high exhaust gas temperatures, and so we had to shut it down, leaving us in total blackout. After some time salvors arrived and towed us to the nearest port.

Technician support

When technicians arrived on board they asked us to restart the purifiers. As expected, they kept going into shut down and we told them that the purifiers had not been working for a while.

The technicians showed us that the seal rings were damaged, and when they opened the drain both water and oil came out. They told us that when they inspected components from the main engine and the diesel generators, they could see wear, pitting and deposits on the valves and linings, proving that there were water and impurities in the fuel. ”

Viewpoint: Peter Stålberg

This damage is about poor fuel management in combination with sloppy maintenance routines.

The vessel bunkered in Singapore and started burning the bunker as soon as the bunker test results were received. Although the fuel was within the ISO specification it was challenging and needed careful onboard treatment before delivery to the engines.

The primary cause of the breakdown was failure of the purifiers. With both purifiers having damaged seals, it is highly probable that the impurities and water contained within the fuel oil were not removed before being burnt by the main engine and diesel generators. Finally, the purifiers were stopped and the vessel continued to consume the fuel without any purification. As a result, the engines were not able fully to burn the fuel being fed and suffered overheating and internal damage

Lessons learned

To consume untreated heavy fuel is never a good idea. In hindsight, with the fuel treatment system out of order the engine crew should have immediately switched over to marine gas oil whilst the problem with the purifiers were rectified.

Another important aspect of this series of events is the lack of spare parts on board. It seems that the engine crew did not have full control of their inventory of consumables which hindered them in carrying out relatively simple repairs to the purifiers.

It is also recommended that the effectiveness of the fuel oil treatment system is periodically verified by analysing fuel oil samples taken before and after treatment.

Case study 2

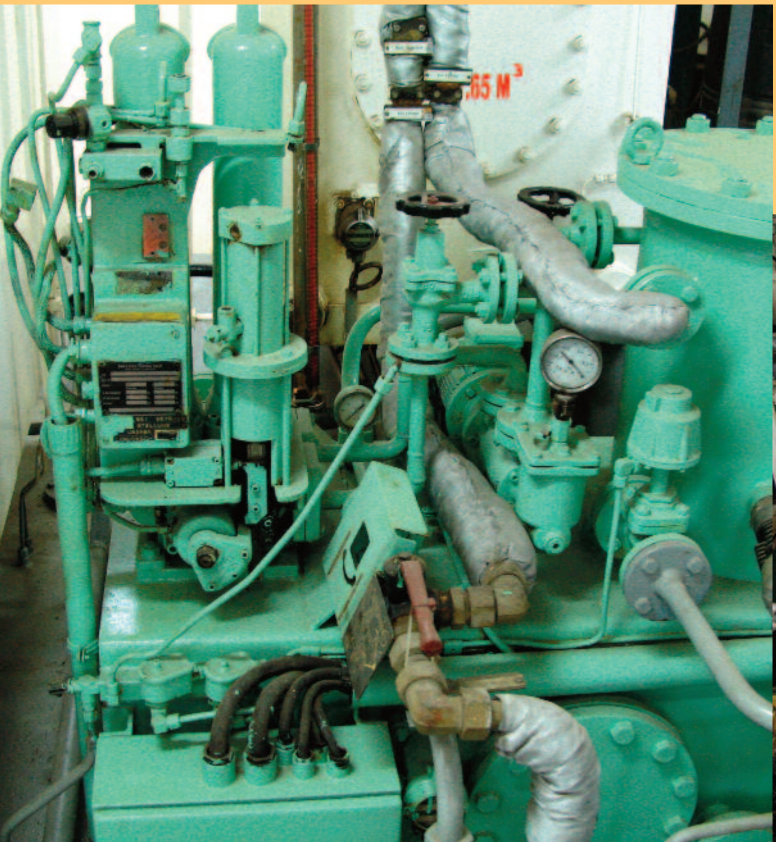
Breakdown of diesel generators due to carelessness

Commentary: Chief Engineer
Vessel: 4,000 TEU container
Engine type: NSD 7RT-flex96C, Aux engines 3x MAN B&W 8L27/38
Repair cost: USD 160,000

"We were en route from Mersin to Gioia Tauro in Italy, loaded with 3,098 TEU of general cargo in containers. 15 of these units were reefer containers, and the ship had an average power load ranging from 600 to 1080 kW.

Low lubricating oil pressure

A few days into the voyage, the no. 2 diesel generator stopped working and the crankcase safety valves automatically released. When we inspected it, we suspected this was due to low lubricating oil pressure caused by a faulty lubricating oil pump, but we weren't entirely sure. It turns out that there was major damage to the engine, but we didn't investigate it further nor did we consider the cause for the damage at this time. The engine remained out of service, and so the no. 1 & no. 3 diesel generator took over the power load of the vessel.



High temperature alarm

Following this we then began having problems with the no. 3 diesel generator – the over speed trip kept cutting in, so we replaced the engine's governor with the spare one we had available. We then put the engine back into operation only to find, after ten minutes and only 300kw of load, that the high temperature alarm was sounding for the no. 4 main bearing. The engine crew stopped the engine almost immediately, but at that point the crankcase safety valves released.

Shore support

We immediately notified the shore office, and they arranged for urgent delivery of a power pack generator at the next port to help the remaining diesel generator to cope with the vessel's power load, plus all the spare parts needed to repair the seized generators. In addition, they said they would send us two experienced Service Engineers, along with a Superintendent Engineer, to help us dismantle, inspect and recover both damaged diesel generators."

Viewpoint: Peter Stålberg

The investigation revealed that the casualty originated from careless handling of the mesh filter elements in the lube oil filter for the no. 2 generator. Filter cartridges in steel mesh, which are quite fragile, are cleaned by means of ultrasound washing in a dedicated basket. Instead of using the specified basket the engine crew had tossed the filter elements directly into the cleaner where they had sustained damage when rubbing against each other during the cleaning process. As the filter disintegrated, broken parts of the filter element spread throughout the lubrication oil system of the no. 2 diesel generator engine and caused severe damage to bearings and journals.

Furthermore, an investigation of the lubrication arrangement revealed that the lubricating oil of no. 2 and no. 3 engines was being purified by lubrication oil purifier no. 2 simultaneously through the common diesel generator lubrication oil drain tank. This arrangement allowed the diesel generators' sump tanks to be inter-connected via the lubrication oil drain tank, with the intervention of the lubrication oil purifier.

The initial contamination of the oil in the no. 2 diesel generator caused metal particles to contaminate the lubricating oil system. Subsequently, the contaminated lubricating oil entered the no. 3 diesel generator through the lubrication oil drain tank, causing damage to its major moving components.

Ironically, the oil filter, which is there to protect the engine from impurities in the oil was damaged and caused widespread damage in the auxiliary engines.

Lessons learned

The root cause for the casualty was the inability of the engine crew to follow the manufacturer's instructions on procedures for maintenance.

In addition, one can always argue that having an interconnected lube oil system for different engines is not good practice and should be avoided to safeguard from contamination of both engines lube oil systems should there be problems with the other.

The initial contamination of the oil in the no. 2 diesel generator caused metal particles to contaminate the lubricating oil system.

Case study 3

Forgotten rubber membrane seals caused lube oil contamination

Commentary: Chief Engineer
Vessel: 30,000 GT chemical/oil tanker
Engine type: MAN B&W 6S50MC-C
Repair cost: USD 250,000

“We were at anchor off Tenerife. During overhaul work a large amount of sea water entered the engine room bilge from the inert gas system overboard drain line. We later estimated this to be around 25 cubic metres.

Water in the engine room

Unfortunately, we had no knowledge of the problem until one of the crew rushed into the engine control room and told us that he had seen water in the engine room bilges. After the incident I was surprised to find out that the inert gas system abnormality alarm had been disabled by a member of my engine room team ten days earlier, which is why we didn’t know what was going on.

Whilst all this was happening, we had a Class Surveyor on board carrying out an Annual Survey. We were told afterwards that three bilge high level alarms had gone off, but because of all the confusion, with all of the alarms being tested, the duty engineer simply didn’t notice them which further delayed our action to mitigate the consequence of the flooding

Defective seal in the crankcase oil outlet

There was so much water that it spilled over from the aft bilge well in the engine room compartment and filled the tank top area which was under the main engine crankcase oil pan. Following this we discovered that the water had got into the main engine crankcase lubricating oil sump tank, as one of the seals in the crankcase oil outlet must have been defective. This should never have happened – the crankcase oil outlet should be tight and only allow crankcase lubricating oil to drain from the main engine oil pan into the sump tank.

Oil change

We then pumped out the contaminated lubricating oil into a storage tank so we could dispose of it later. We also cleaned the main engine crankcase and the lubricating oil sump tank to remove the contaminated lubricating oil and any sea water and added a fresh charge of crankcase lubricating oil - approximately 25,000 litres.

All I can say is that actually we believed we were very lucky. When all this was happening, the main engine was not running and so we avoided contaminating the whole engine with sea water. Unfortunately, later we realised that the oil lubrication pump had been in operation, and sea water had contaminated the engine lube oil system.

Expert assistance

A few days into the voyage we checked an oil sample with our onboard test-kit. The sample indicated some water in the lube oil. On arrival at our destination a service engineer from M.A.N Primeserve came onboard. We assisted him with checking of bearings and journals. We found some light corrosion which we could polish but in the end we had to renew the no. 1 and no. 2 lower cross head bearing shells as they were damaged due to corrosion.”

Viewpoint: Peter Stålberg

The flooding of the engine room was unfortunate but caused no direct damage. Typically, there will be water on the tank top in the engine room when a major sea water pipe starts leaking, a valve is mistakenly operated or when a vessel is under repair at a shipyard and bilge cannot be disposed of.

What really caused the problem here was the defective rubber membrane seals between the engine crank case and the lubrication sump oil tank below the engine. I regret to say that this is a classic incident, and we see one or two cases of this type every year. In most occurrences the water ingress into the lube oil sump tank is not noticed and the engine is operated with contaminated lubrication oil. Usually cross head and main bearings are damaged by means of wear and corrosion and need replacement. The cost for these claims is often in the region of USD 350,000.

Despite repeated member alerts and service letters from the engine manufacturers, many owners have failed to implement maintenance routine in the vessels Planned Maintenance System (PMS). The rubber membrane seals should be checked and replaced every five years in connection with the vessel's special survey.

What really caused the problem here was the defective rubber membrane seals between the engine crank case and the lubrication sump oil tank below the engine.

Lessons learned

It is important to ensure that your engine room alarm system is working 100%. Manufacturer's instructions must be strictly adhered to and service instructions should be incorporated into the vessels's PMS.

Engine cleanliness – the low sulphur challenge

Interview with **Serge Dal Farra**, Global Marketing Manager at Total Lubmarine

These case studies show that despite increased regulation and training, a default in proper lubrication and monitoring strategies is the root of many major incidents. Preventing deposit build-up in ship engines has become the main challenge not only for marine engine manufacturers but also lubricant manufacturers since the majority of the global shipping fleet switched to low-sulphur fuels in January 2020.

Sulphur fuel oil blends can vary with viscosity, density, pour point and concentration of catalytic fines. Choosing a compatible lubricant that compensates for these varying specifications is now essential to avoid engine fouling and costly repairs.

Rising to this challenge requires an understanding of the multiple operating parameters of the engine, combined with smart engine monitoring, visual inspections and drain oil analysis and interpretation.

Engine cleanliness is of key importance, preventing costly engine damage, maximising time between overhaul and contributing to improved engine performance by sealing of combustion space. In addition a clean engine ensures proper ring movement, reducing the risk of ring breakage, and clean piston toplands and crowns minimise the risks of bore polishing.

> Engine cleanliness is of key importance, preventing costly engine damage, maximising time between overhaul and contributing to improved engine performance.

We recommend testing the lubricant every four weeks so that the iron level is analysed to check for engine wear and lubricant performance. By testing the level of remaining basicity of the lubricant after use, it is possible to determine if the feed rate of the lubricant is appropriate and sufficient to keep the engine clean and optimised.

Incorrect lubrication is the most frequent and expensive cause of main engine damage. This can all too often be avoided, and with it many of the costs associated in time, money and people, by choosing the right monitoring programme to better help protect a ship's engine.

Loss prevention

Loss prevention is at the heart of everything we do

It saves lives
It protects the environment
It delivers onboard efficiencies

One of the key aims of The Swedish Club is to assist our members and partners in managing current and future risks. Being a step ahead is paramount when it comes to preventing accidents and building an enhanced marine safety culture.

We put a great deal of effort into loss prevention analyses and knowledge-sharing with our members and the shipping community. Learning from incidents that have taken place, we endeavour to prevent them reoccurring by working with our members to offer them guidance and education initiatives.

Peter Stålberg
Senior Technical Advisor
peter.stalberg@swedishclub.com
lossprevention@swedishclub.com

Training

- Emergency Response Training
- Stress Test Drill
- Monthly Safety Scenario
- Maritime Resource Management (MRM)
- Online Training
- Training support material
  - The Swedish Club Casebook
  - The Swedish Club Monthly Safety Scenario Calendar

Initiatives

- The Swedish Club Philippine Pre Engagement Medical Examination (PEME)
- Swedish Club Operations Review (SCORE)
- Benchmarking
- Awareness campaigns

Intelligence

- Trade Enabling Loss Prevention (TELP)
  - Correspondents Advice
  - Bunker Advice
  - Claims Alert
  - Piracy Alert
- Member Circulars and Alerts
- Loss prevention publications and Advice series
- Loss prevention guidance

Our complete portfolio of loss prevention solutions can be found at:
www.swedishclub.com/loss-prevention


EXIT