



— With you at all times —

## Main Engine Damage



**2018**



## How to avoid main engine damage

Implement robust onboard fuel and lubrication oil management systems.

Carry out drip sampling when bunkering. Avoid consuming the fuel until analysis results are available.

In addition to onboard testing of lubrication oil, submit samples for laboratory analysis at regular intervals, at least every third month.

At regular intervals, carry out system checks of purifiers and filters for both fuel and lubrication oil systems.

Ensure that maintenance manuals are at hand and that proper tools are available and calibrated. Crew members must have the necessary training and experience to carry out maintenance.

It is highly recommended that engine maintenance is carried out as part of a computer based PMS (Planned Maintenance System), linked with the onshore organisation.

During major overhauls it is recommended that an expert from the manufacturer is in attendance – consider a formal service agreement.

Always take engine alarms seriously, for example oil mist detection, and investigate thoroughly. A fully functional alarm system is essential for the safe operation of the main engine.

The Swedish Club is with you at all times, providing a full range of insurance solutions for every area of your business, from essentials including Protection & Indemnity (P&I), Freight Demurrage and Defence (FD&D), Marine, Energy & Offshore, to specialist insurance products such as Kidnap & Ransom, and War Risks.

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## Executive summary

- Main engine claims account for 28% of all machinery claims and 34% of the costs, with an average claims cost close to USD 650,000.
- The claims frequency has for the last ten years been steady at between 0.020 and 0.025 claims per vessel and year.
- Passenger vessels/ferries have the highest frequency with 0.066 claims per vessel and year.
- Vessels propelled by medium/high speed engines have a claims frequency 2.5 times higher compared with slow speed engines.
- Lubrication oil related failure is the most common cause of damage.
- The most expensive type of damage is on crank shaft/bearings with an average cost of MUSD 1.2 per claim.

# 1. Introduction

This, the third Main Engine Damage report from The Swedish Club, sheds light on an expensive category of damage that is all too frequent. Statistically a vessel will suffer between one and two incidences of main engine damage during its life time. Considering the costly consequences for ship owners and their hull insurers, it is important to identify the main causes of this damage and examine how these can be prevented.

## 2. Overview

Initially the study aims to put main engine damage claims into context by examining claims statistics for the Hull and Machinery (H&M) segment. It then examines in detail main engine damage claims - specifically frequency, vessel type, engine manufacturer, engine speed, damaged parts and cause of damage.

The Swedish Club has invited two of the world's major engine manufacturers, MAN Engines and Wärtsilä, to provide their own insight into this issue, and to share loss prevention advice obtained from their archives.

The statistics from the years 2015-2017 are compared with the period of the previous studies, 2010-2014.

## 3. Scope of the report

Vessels insured for Hull & Machinery (H&M) 2015-2017

- Total number of vessel years: 8,758
- All vessel types and sizes
- Only damages in excess of the deductible (average USD 105,000) are included in this report

Total number of H&M claims: 1,219

Number of machinery claims: 734

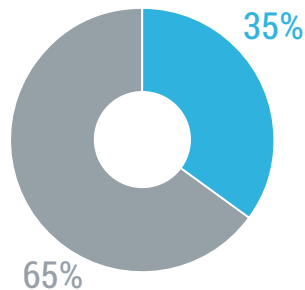
Number of main engine claims: 202

## 4. Claims statistics

### 4.1 Hull & machinery claims

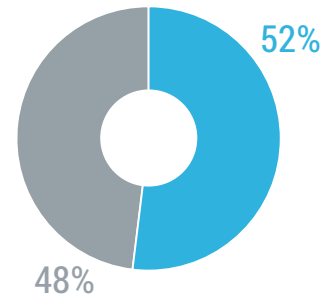
#### H&M claims by cost 2010-2014

- Machinery claims
- Other H&M claims



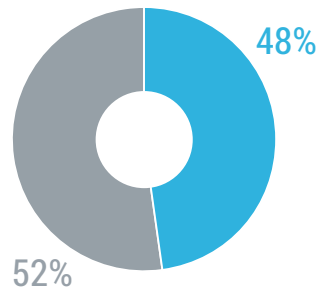
#### H&M claims by number 2010-2014

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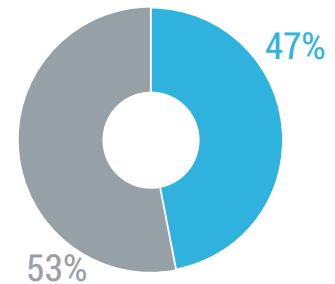
#### H&M claims by cost 2015-2017

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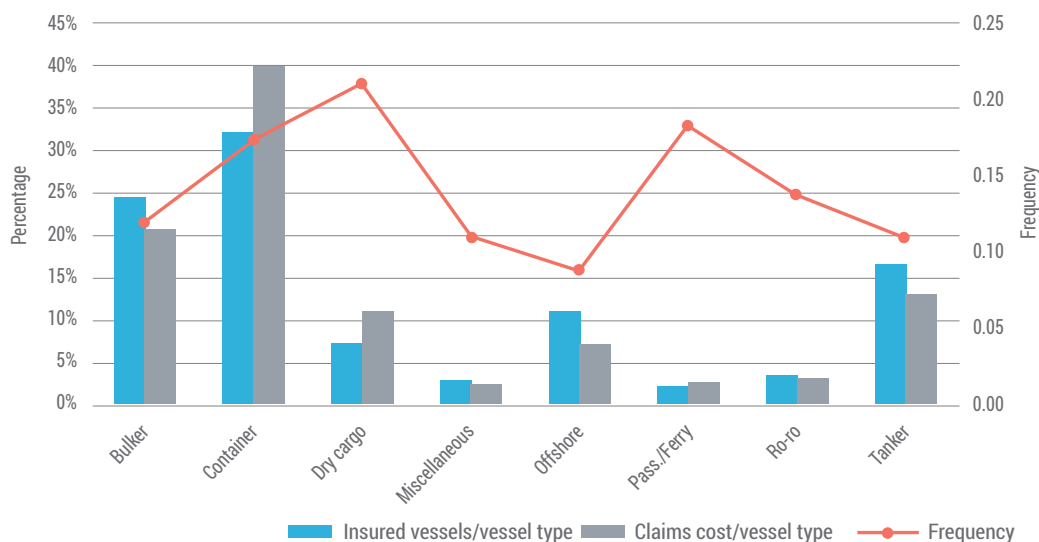
#### H&M claims by number 2015-2017

- Machinery claims
- Other H&M claims



Machinery claims costs have increased from 35% to 48%, an increase of 35%. Partly this is due to increased cost for labour and spare parts. The number of machinery claims has decreased from 52% to 47%.

#### H&M claims by vessel type, 2015-2017

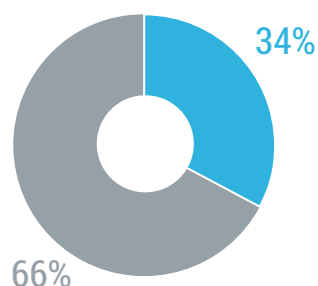


This chart shows that both container and dry cargo vessels are overrepresented in hull and machinery claims cost compared with fleet entry. Dry cargo vessels have the highest frequency, followed by passenger vessels/ferries and container vessels.

## 4.2 Machinery claims

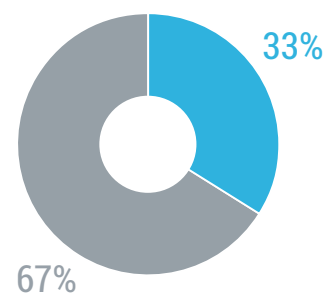
### Machinery claims by cost 2010-2014

- Main engine claims
- Other machinery claims



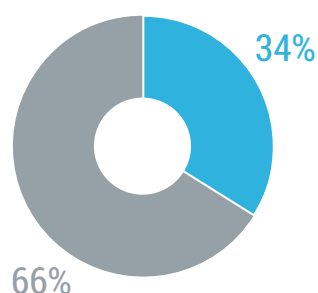
### Machinery claims by number 2010-2014

- Main engine claims
- Other machinery claims



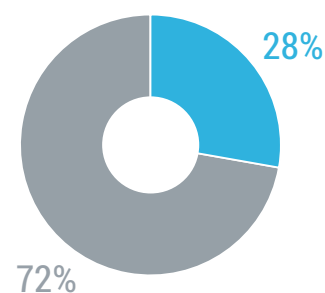
### Machinery claims by cost 2015-2017

- Main engine claims
- Other machinery claims



### Machinery claims by number 2015-2017

- Main engine claims
- Other machinery claims



The trend in main damage claims in 2015 – 2017 is virtually unchanged, compared with 2010-2014, with main engine damage contributing to approximately a third of all machinery claims both in terms of cost and number of claims. The number of claims has reduced slightly during the period 2015 – 2017, but overall claims costs have remained the same.

## 4.3 Top 10 claims by cost for machinery claims, 2015-2017

Claims type	Number of claims	Average cost (USD)	Change in average cost % since 2010-2014
<b>Main engine, excluding turbo charger</b>	<b>202</b>	<b>647,920</b>	<b>21%</b>
Steering	25	572,920	53%
Propulsion	168	476,898	4%
Deck equipment, windlasses	16	456,468	150%
Crane and cargo gear	59	359,901	40%
Auxiliary engine, excluding turbo charger	112	345,823	2%
Boiler	18	334,939	0%
Turbo charger	76	291,191	-7%
Electrical equipment	43	267,924	22%
Lifesaving equipment	1	182,410	-10%

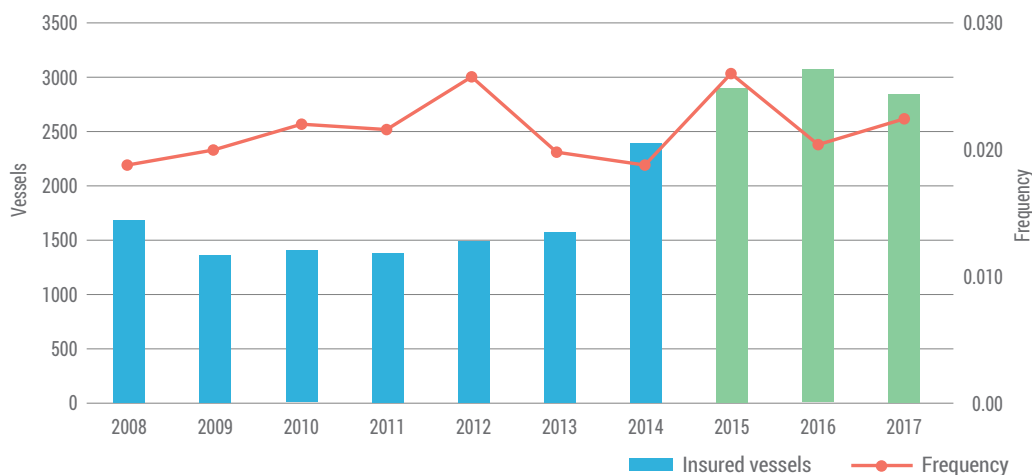
- The Club experienced 734 machinery claims in the 2015-2017 period, totalling 384 MUSD. Main engine damage is the most expensive category with a total cost of 131 MUSD, contributing to 16% of the cost of all H&M claims and 34% of all machinery claims.



- The average cost of main engine claims has increased by 21% compared with the period 2010-2014, amounting to almost USD 650,000 per claim. It should be noted that an increase in costs has, however, been seen across the board in all machinery claims, due to the increase in cost for labour and spare parts.
- Costly rudder and rudder bearing damage has affected the result for steering gear claims, which saw an average increase in cost of 53%.
- The increase in the average deck equipment claims cost is because the number of offshore vessels with sophisticated deck equipment that the Club insures has increased during the period 2015-2017.
- On a positive note, the average claims cost for damaged turbochargers is reducing, a trend that has been apparent since the last publication. The industry move from ball bearings to plain bearings for the turbine rotor shafts might have contributed to this positive trend.

## 4.4 Claims by frequency

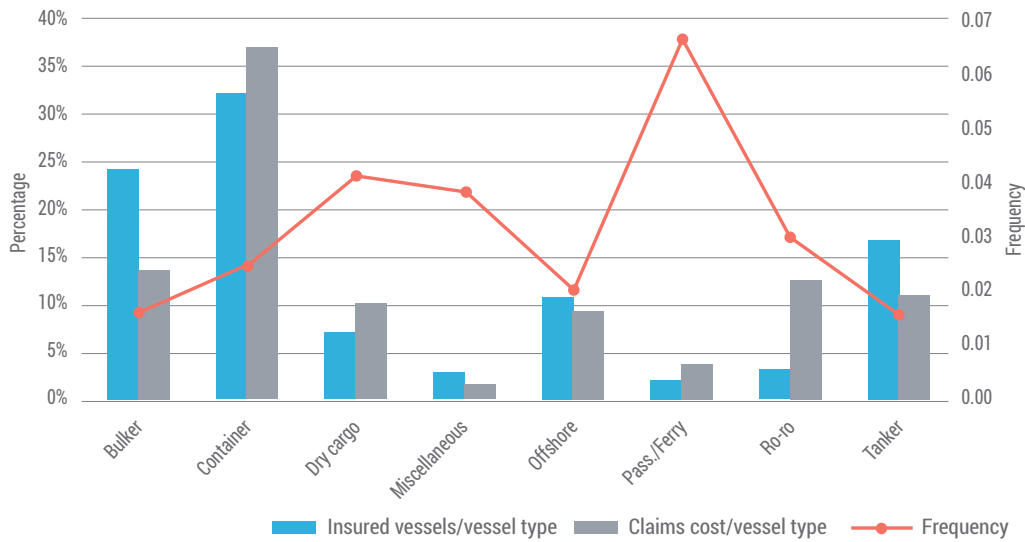
### Main engine claims and trends, 2008-2017



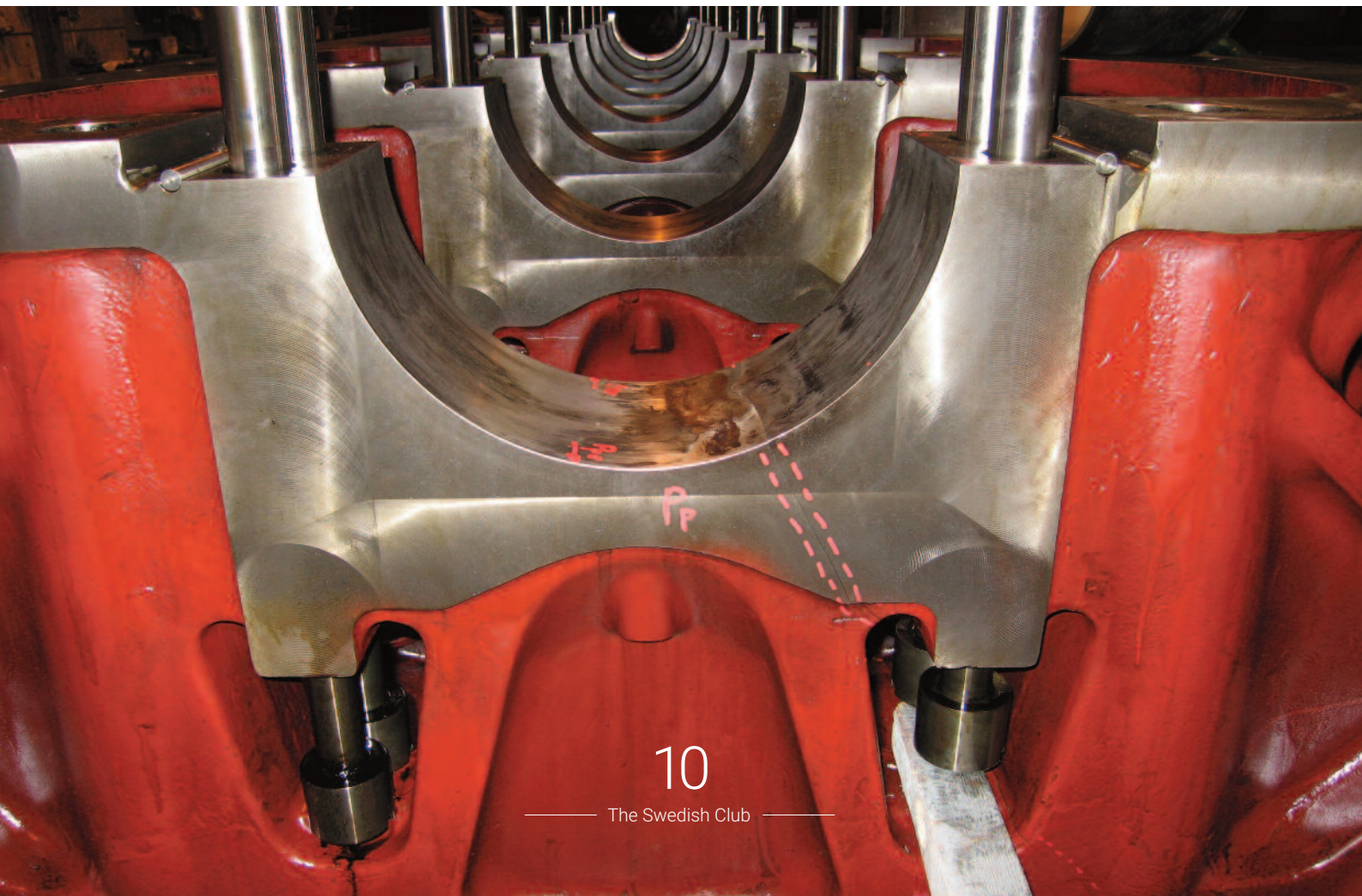
The frequency of main engine claims for the last ten years has been stable at slightly above 0.02 claims per vessel. We can see that during the last ten years The Swedish Club has almost doubled its fleet without any negative impact on the frequency.

## 4.5 Claims by vessel specifics

### Main engine claims by vessel type, 2015-2017



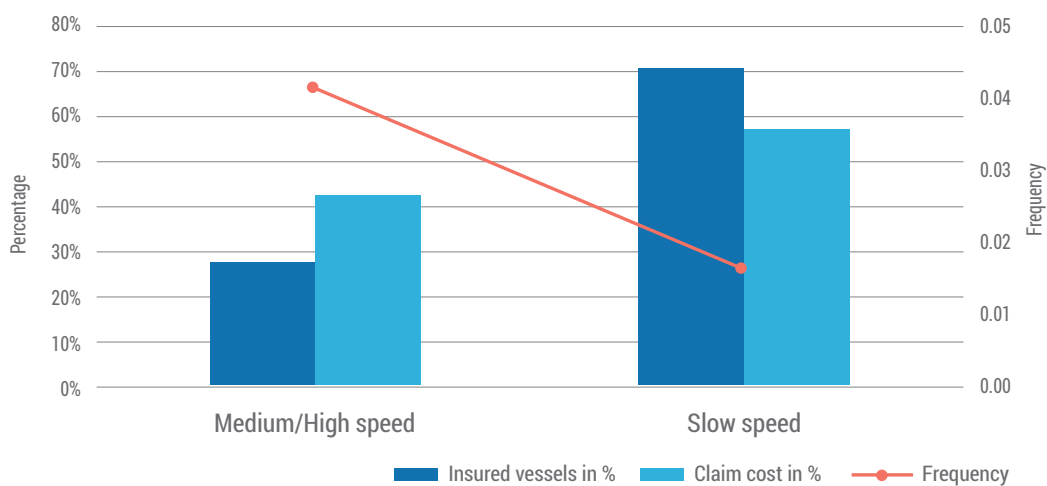
- The graph shows that bulkers and tankers are the best performers with regard to claims cost in comparison with Club entry. A majority of these vessels have slow speed engines.
- Passenger vessels/ferries have the highest frequency of main engine claims – 0.066 claims per vessel and year. Often these vessels have multiple medium speed engine installations. The same is also true for Ro-ro vessels.





## 4.6 Claims by engine speed

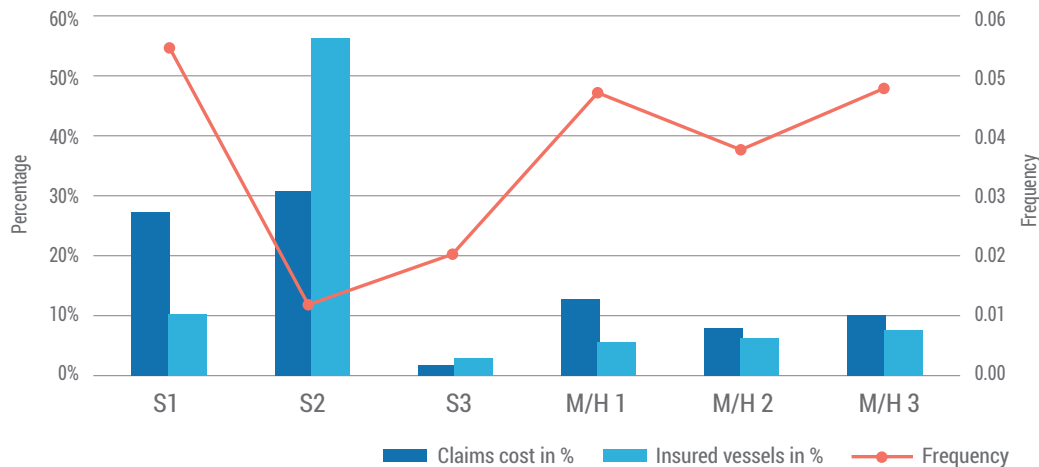
### Main engine claims by engine speed, 2015-2017



Medium/high speed engines are 2.5 times more frequently damaged compared with slow speed engines. They also have a disproportionate claims cost (43%) in relation to the number of insured vessels (28%).

## 4.7 Claims by engine manufacturer

### Main engine claims by manufacturer, 2015-2017



- The graph illustrates the proportions in terms of cost and insured vessels per engine make and speed segment (slow and medium/high speed) for the top three engine makers in both speed segments.
- Almost 60% of all insured vessels during the period of 2015-2017 were running on a slow speed S2 engine. They account for 30% of the claims and have a frequency of 0.012 claims per vessel. It is the best performing type of engine in the insured fleet.
- Generally speaking slow speed engines are more robust and have a lower damage frequency compared with medium/high speed engines. Manufacturer S1 slow speed engines break the trend though, with an overrepresentation on the claims side carrying almost 30% of all claims costs and representing only 10% of the insured fleet.
- The medium/high speed engines are in a minority in The Swedish Club's insured fleet. The top three engine makers account for 31% of all the costs in the fleet and 19% of all the insured vessels.
- In particular M/H 1 high speed engines show a disproportionate result, accounting for 13% of costs but only 5% of insured vessels.

## 5. Cause of damage

Previous studies: 2010 - 2014

Current study: 2015 - 2017

Immediate cause	No. of casualties	Average cost	Immediate cause	No. of casualties	Average cost
Lubrication failure	23	663,351	Lubrication failure	40	763,320
Incorrect maintenance and/or repairs	18	768,662	Incorrect maintenance and/or repairs	19	544,167
Fatigue/cracking	14	432,524	Poor fuel management	11	344,069

The table above shows the three most common causes of damage for the periods of 2010-2014 and 2015-2017 respectively. Lubrication failure is still the most expensive and frequent cause of damage, followed by incorrect maintenance and/or repairs.

## 6. Damaged parts

Damaged parts	No. of claims	Average cost (USD)
Crank shaft/bearing	28	1,194,092
Camshaft	4	880,114
Cylinder/liner	32	543,623
Bearing	17	588,168
Piston	7	391,419
Fuel pumps	19	227,940
Cylinder cover	4	195,699

This table focuses on the seven most damaged parts arranged by highest average cost. As can be seen, damage to crank shaft and associated bearings is the most expensive claim as spare parts are expensive and the repairs labour intensive.

## 7. Best practice

Prevention of damage is naturally preferable to cure. A first step to avoiding damage is to have a well-implemented and proper management system. This is ensured by facilitating 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. Further, it is highly recommended that members have a computer based PMS, on board linked with the shore organisation. The PMS should be approved and audited by a classification society to ensure the quality is of a good standard.

## Manufacturers' comments



### MAN | PrimeServ Three tips to reduce down time

**1. The right people** - having the right people, with the right knowledge on board is essential. They need training on a regular basis and should have clear working processes, guidance and audits to ensure continuous improvements.

**2. Maintenance** – it is important that the operator follows all required maintenance intervals according to the manufacturer's requirements and uses only OEM spare parts for maintenance. Engine pre-alarms and alarms must be handled with priority and root causes analysis should be applied when resolving issues.

**3. Monitoring** - fluids such as fuel, lube oil and cooling water have a significant impact on engine operation and should be constantly monitored using laboratories with stringent quality controls. This will enable the operator to react to any changes of fluid quality immediately. When available, take advantage of manufacturers' remote monitoring technology to reduce down times.



**WÄRTSILÄ**

TECHNICAL SERVICES

### A guide to problem free operation of ship machinery

While modern maintenance planning systems, digital services and trained personnel are undoubtedly important, the foundation for problem free machinery operations is set when the focus is put on basics. A well designed, thoroughly specified engine room combined with efforts made for superior supervision during the construction/commissioning period pays off later in the lifecycle of the machinery. For example, it may be hard to believe, but poor cleaning of piping during construction still remains one of the main reasons behind fuel equipment/bearing issues today.

Also, consistency in engine room manning has an impact. The 'Same Crew Same Vessel' concept creates a 'my ship' attitude where the crew takes ownership over installation. Problems are fixed immediately as they occur, even the smallest ones, which enables condition monitoring and leaves no opportunity for gradual deterioration of the installation.

Prudent engineering practices should not be underestimated. Following manuals, bulletins and other instructions published by the manufacturer is key to avoiding errors in machinery operations and maintenance activities. Assembly mistakes can remain hidden and cause disturbances at a later date, greatly affecting the engine's reliability.

Maintaining a detailed engine room logbook constructs a historical data timeline which can be used to identify focus areas, and aid learning from past experiences.

Proper trending of Cooling Water, Lubrication Oil and Fuel Oil analyses creates an understanding of the overall condition of the machinery and assists in calibrating maintenance needs as well as component lifetimes.



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