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TO MEMBERS OF THE ASSOCIATION

Dear Member:

LOSS PREVENTION: MACHINERY DAMAGE

Your Managers are pleased to announce a new initiative aimed at preventing claims resulting from machinery damage. Such damage has a wide range of potential consequences which may impact hull & machinery, cargo and P&I interests alike.

A greater awareness of the types of machinery damage that can occur, and the implementation of effective measures to prevent them, are key to reducing both their frequency and the severity of their consequences.

The first two case studies are as attached. Members are recommended to refer to the Club's new website section on machinery damage at:

http://www.american-club.com/page/machinery-damages

This section of the Club's website will be periodically updated with new case studies and other relevant information taking into account best practices in the prevention of shipboard machinery failures. Members will henceforward be advised of such updates by way of Member Alert.

Yours faithfully,

Joseph E.M. Hughes, Chairman & CEO
Shipowners Claims Bureau, Inc., Managers for
THE AMERICAN CLUB

Machinery failures: Tales of the Unexpected?

As marine casualty investigators the work of our surveyors frequently involves investigation into machinery breakdowns; quite often main and auxiliary engines.

Occasionally the alleged cause of damage can be so far-fetched that it must be true! Mostly however the failure will occur through a few common causes.

In spite of major improvements in design and quality control over the years, significant failures still occur. Why? Statistically around 40% of claims on H&M Underwriters are for machinery damages with corresponding monetary values much higher as a proportion. Consequential claims on P&I insurance can also be even more costly and then ensuing long debates on "seaworthiness" can create huge legal expenses.

Through quality control measures, latent defects[1] in components whilst not totally eradicated have become very much less prevalent. Similarly, as investigation into cases has shown, whilst marine engines are still largely hand built, quality assurance procedures have virtually eradicated errors in construction.

But against such progress, man's inhumanity towards machine continues virtually unabated and when taking a fresh look at this and past research into failures and causation, some of which is now decades old, the one common denominator that still prevails today is the human element.

In spite of the major advances in design and materials made, investigation into failures of the nature of that highlighted in our alerts will show that in particular the level of competency and the knowledge base of engineers at sea has fallen and fallen significantly.

Where Do We Go From Here

The industry collectively faces a conundrum; no amount of design excellence and material selection in the construction of sophisticated marine machinery will amount to actual progress with reliability when faced with the downward trend of the level of engineering ability at sea.

[1] A 'latent defect' is a material defect that is not discoverable by "normal" i.e. manual / visual means. Such material defects, because of the early days and standards of machinery manufacture and construction have been a constant named insured peril in marine insurance policies.

Design and construction excellence and operator skills have been on steeply divergent paths. The latest engines, whilst intentionally simple in general construction terms are now becoming much more sophisticated in terms of the peripheral necessities of electronic monitoring and electronic control of fuel injection, exhaust valve and cylinder lubrication timing etc., brought on by the recent advent of the "camshaft-less" engine concept.

New trends in fuels for ships for example, driven largely by environmental considerations will require yet more sophistication in engine rooms as far as the main machinery and the supporting auxiliary plant is concerned.

But whatever advances are made, unless marine machinery can be made totally operator free - at best presently doubtful, the human element will continue to play a major role in failures.

The American Club would like to thank John Poulson CEng., of Atlantic Marine Associates, Inc. for his contribution to this series - and who will be producing more case studies soon.

Disclaimer

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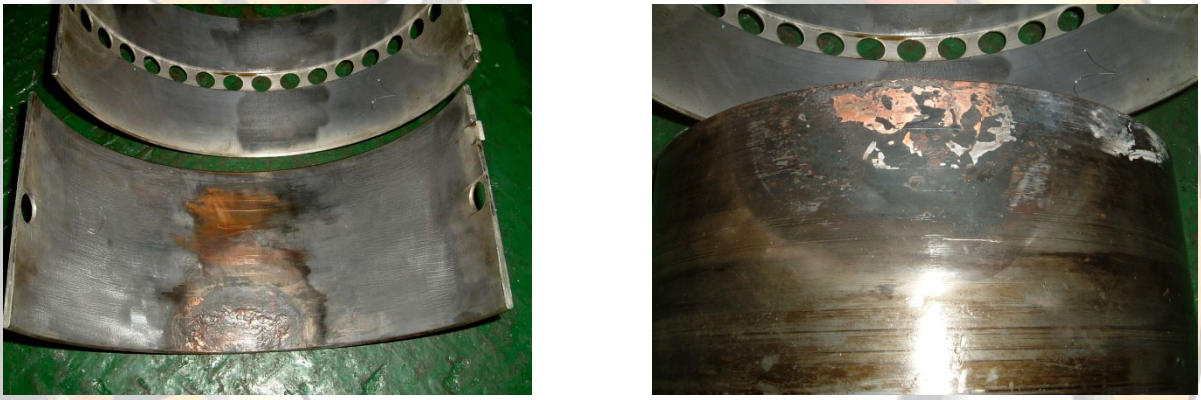
Lubricating Oil Maintenance is Critical

If there is one standout cause for failures of main and auxiliary engines, it is through inadequate monitoring and maintenance of the condition of lubricating oil – literally the life-blood of any engine. Indeed it has been largely the progress made with the development of lubricating oil over the past 60 years or so that has allowed engines themselves to be developed and for example be able to operate on heavy fuel oils.

In one case, the medium speed main engine of a bulk carrier suffered a turbocharger failure whilst on transatlantic passage to New York. The engine had then labored for several days with a non-functional turbocharger creating very poor combustion and black exhaust smoke. Whilst in port and undergoing turbocharger repairs the attending surveyor recommended that lubricating oil samples be taken from the main engine for analysis.

It wasn't done, and several days later during another loaded passage, the main bearings and then the crankshaft failed leading to towage, large general average costs and extensive disputes over seaworthiness.



Failed main engine bearings due to poor condition of lubricating oil

Procedures to Follow

The whole process of taking samples, landing the samples for analysis, obtaining the laboratory results and associated recommendations can be accomplished quickly. The process necessarily involves the vessel's technical managers/owners as the feedback from the laboratory is initially to them – thence to the ship with associated instructions.

Therefore there is a due diligence aspect to the correct handling of the analysis process and this again can cause major legal disputes when not followed by the managers. Medium and high speed engines are particularly susceptible to depleted lubricating oil properties.

Bearing design takes into account at least the three components crucial to the system; the bearing shell itself, the other surface that it interacts with (co-operating surface), and the lubricant between the two.

Each of these components must work together to prevent the system from failing. During the design phase, engines generally have specific desired power output specifications and operating conditions and it is from these and other considerations that the systems' preliminary designs are drawn.

Viscosity is Key

The lubricant introduced between the co-operating surface and the bearing must be chosen primarily to reduce friction and wear. The viscosity of the lubricant in operation is proportional to its coefficient of friction and thus the oil film thickness between bearing and journal is proportional as well. Lubricants' viscosities are measured by using the viscosity index (V.I.), a measure of the rate that viscosity decreases as temperature of the lubricant increases. A lubricant must therefore be chosen to exceed the minimum oil film thickness at all desired operating temperatures based on experimentally determined values of this index.

In addition to lubricating oils' viscosity and viscosity index, each one has other intrinsic properties associated with it that affects its ability to accomplish other, less crucial tasks: facilitating heat transfer away from the bearing, protecting against corrosion, and removing wear debris from the system while preventing other contaminants from entering. A lubricant may perform well at some or most of these tasks, but not all of them. To improve its performance, chemical compounds (oil-additives) are added for the purpose of increasing certain desirable properties in the lubricant.

Severe crankshaft damage from breakdown of lubricating oil in a medium speed engine

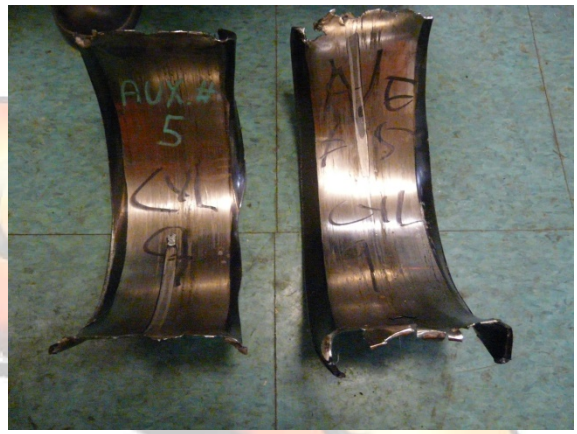
Man's Inhumanity to Machines

So against this background of extensive research and development of bearings and their lubricants you can imagine the exasperation of our surveyors when investigating the cause of engine bearing failures when on occasion they find:

- lubricating oil filter elements missing;
- system "O" rings missing;
- no record of analyses;
- oil condition so bad, holes punched through filter elements with a screwdriver to allow oil flow; and/or
- waste oil being recirculated back into the crankcase.

A particularly serious case developed with a reefer vessel having five main generators sharing a lubricating oil system. Water in the oil went undetected through a lack of analyses and the ship literally ground to a halts with all five engines sustaining severe bearing and crankshaft damage.

All crankshafts renewed



Typical bearing condition – all white metal removed

A properly designed and constructed diesel engine, when correctly matched to its intended service and afforded the periodical maintenance recommended by the manufacturer, can normally be expected to function reliably for many years and many thousands of running hours. Engines with over 150,000 accumulated running hours and giga-cycle (108 and higher fatigue cycles) are not uncommon.

The simplest way to prevent such reliability is to neglect its oil!

The American Club would like to thank John Poulson CEng., of Atlantic Marine Associates, Inc. for his contribution to this series - and who will be producing more case studies soon.

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