THE SWEDISH CLUB CASEBOOK

11

# Machinery failure

# 11.1 Machinery failure caused by contamination

A vessel was in ballast and at anchor, awaiting further instructions. After seven days the weather deteriorated and the vessel´s anchor dragged. The anchor was heaved up and the vessel started to slow steam in the area. After about 24 hours the differential pressure alarm of the main engine duplex lubrication oil filter sounded in the engine control room. The crew found aluminium and other metal inside the lubrication filter, and in the crankcase of the main engine, metal particles were found.

## Serious damage to the main engine

The subsequent investigation alongside revealed that the metal particles found in the lubrication oil filters emanated from piston rings and piston skirts. Three pistons had almost seized. The main engine, a six-cylinder medium speed type, had severe damage and the following parts had to be renewed: all cylinder liners, three complete pistons, piston rings on all cylinders, all main and connecting rod bearings.

In addition, the turbo charger had to be overhauled as the nozzle ring was broken. The complete lubrication system had to be carefully cleaned and flushed. The vessel was off hire for almost two weeks.

The pistons in cylinder units no.1 and 3 were melted down in certain areas and the skirt in no.4 was torn. Liners were scuffed as a result of the above. The cylinder lubrication channels were found clogged and so cylinder lubrication had been inactive. The lubrication oil pump was found deteriorated due to the hard impurities in the lube oil system.

## Lubrication oil contaminated for some time

It was obvious that the engine had been operated on a high thermal load for a long time and that the turbocharger efficiency had been affected by fouling. The lubrication oil had actually been contaminated for some time.

There had been indications that something had gone wrong, for example it was written in the log book that the auto filter had been shooting up to 609 times a day.

- Fuel oil samples before and after purifiers were taken and analysed. The result indicated that the purifiers were working satisfactorily. All fuel oil analyses from bunkering were within specification.

- Several samples of the damaged piston rings were sent to a laboratory. The conclusion was that the excessive wear of liners and pistons was not caused by catalytic fines.

- The cylinder liner lubrication system was tested and was found to work properly.

- At the time of the casualty the main engine, including turbo charger, had been running 7,300 hours since its previous major overhaul. This overhaul had been carried out 18 months previously.

- Investigation of the maintenance records showed that maintenance had been carried out in accordance with manufacturer's instructions.

- When reviewing the monthly main engine reports it became obvious that the main engine exhaust temperatures of all cylinder units had increased 30°C – 40°C for the previous six months.

- The turbo charger revolutions had dropped from about 14,500 rpm to 12,000 rpm at 85% load as had the charge air pressure from 1.7 bar to 1.2 bar. These changes also began to appear in the past six months.

- Due to high exhaust gas temperatures, the engine was under a high thermal load, which finally caused it to break down.

## What can we learn?

- A first step to avoiding damage is to have a well implemented and proper management system. This implementation can only be assured with proper training and education for the crew and providing them with the essential knowledge and experience required for ordinary daily work and maintenance according to company procedures.

- 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.

- Implement robust on board fuel and lubrication oil management systems.

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

The company states that:

- The follow up of all engine logs has now been improved, especially the understanding of the exhaust gas temperatures and their alarm levels.

- The scope of performance reporting between vessel and office will also be intensified in the future.

- The trend logging of reported performance parameters in shore manager's engine performance monitoring system has been implemented.

- Engineers will be sent on four stroke engine training courses.



# 11.2 Maintenance job lead to flooding of engine room

The engineers on a bulk carrier were carrying out scheduled maintenance on one of the ballast pumps. They had closed all the isolating valves to the ballast pump and put up notices about the job in the engine room and engine control room, but not on the bridge. They didn't finish the job on the first day, so continued the next day.

## Preparing for port state inspection

The following day the Master asked an officer to print out the alarm list for the ballast water management system before arriving at the next port, as a port state inspection was expected. To get the list the officer had to start the ballast water management system, which he did.

The bilge high level alarm was suddenly activated in the engine room. An oiler checked the bilges and could see water pouring in, covering the tank top. An engineer turned off the power to the ballast water management system. He also found out that two ballast system valves were open from the main seawater crossover suction line. He closed these valves immediately to stop the ingress of the water. These valves had been opened automatically when the ballast water management system was started. The engineers pumped the water from the tank top into the bilge holding tank.

## Water in the lubrication oil

One hour later the main engine bearing wear alarm – 'water level 50%', went off. The main engine system lubrication oil was found to have 0.09% water content. The second lubricating oil purifier was started. A couple of hours later the main engine bearing wear alarm went off once again. A second sample of the lubrication oil was taken, and it was found that the oil had 0.08% water in it.

The Chief Engineer decided to partially change 3,000 litres of lubrication oil in the system.

Afterwards a third sample was taken and the water content was 0.019%. The engine was stopped, and a full change of the lubrication oil was completed. A crosshead bearing was opened for inspection. No damage was found. However, one of the rubber diaphragm seals for draining the crankcase to the system lubricating oil tank was found to be defective. This had caused the water flooding into the engine room to contaminate the lube oil.

## Severe engine problems through voyage

The main engine was restarted, and the voyage resumed. The main engine was an electronic controlled model i.e. the exhaust valves and fuel injection system were powered by hydraulics. The system lubrication oil was used as a hydraulic medium. The following day there were problems with some hydraulic components and the main engine had to be stopped. A couple of cylinder units and pumps had to be dismantled, cleaned and reassembled. The main engine could not be restarted because of low hydraulic pressure. It was decided that one of the cylinders had to be blanked off. The main engine was started and stopped several times over a number of days as the hydraulic system was leaking. Because the engine was running on low rpms, the scavenge trunking became fouled with oil deposits, so the engine had to be stopped several times and the trunking had to be cleaned.

Because water contaminated the lubrication oil there was serious damage to several crosshead bearings, crosshead pins, main engine cylinders, hydraulic pumps and main engine turbo charger bearings.

## What can we learn?

- A proper risk analysis should always be carried out before any repairs/maintenance, especially if the affected system is complicated and can be controlled from different locations.

- It is also worth considering physically disconnecting power to components so they cannot be activated accidently during the repair/maintenance.

- It is essential that the bridge and engine crew discuss all jobs that can affect each other's department. If a job on the ballast system is planned, the bridge need to be informed and if the job is extended to the following day the OOW needs to be informed. The OOW has to ensure that this information is written clearly and discussed during the watch handover.

- If there are excessive quantities of water on the tank top there is a risk that this will enter the main engine sump tank via a defective diaphragm and subsequently contaminate the main engine lubricating oil system, resulting in severe damage to the main engine components.

- If heavy contamination of water is found in the system:

  (i) the lube oil in the sump tank must be transferred to a settling tank.

  (ii) the sump tank and crank case should be cleaned.

  (iii) a complete fresh oil change filled to the level recommended by the engine manufacturer.

- The design of both Wärtsilä and MAN Diesel lubricating oil outlet diaphragms are quite similar.

  (i) Wärtsilä recommends: Inspection/replace at 40,000 running hours or at dry dock.

  (ii) MAN Diesel recommends: Inspect the diaphragm sealing in the crankcase oil outlet every 32,000 hours of operation, and replace the diaphragm if indicated by the inspection.

- It is recommended that all diaphragms are replaced every five years in connection with the vessel's special survey.

- The exchange of rubber diaphragms should be included in the vessels PMS system.

- It is recommended to owners that spare diaphragms are kept on board at all times, in addition to enough system lubrication oil to completely replenish the system.




# 11.3 Machinery failure of the CPP caused heavy contact with lock gate

A vessel was berthed alongside the quay, waiting to proceed through a lock to another berth. The pilot called on the radio and asked the Master if it would be possible to depart in half an hour. Pre-departure checks were completed by the OOW, the radar was tuned and the ECDIS set up for departure. The OOW did not check the controllable pitch propeller (CPP) as the vessel had only been alongside for twelve hours and the OOW assumed everything should be OK. He also felt stressed about preparing everything for departure in such a short time. According to the company's SMS, the CPP should always be tested before departure.

## Rapid handover

The Master came on the bridge accompanied by the pilot. The OOW carried out a quick handover and then proceeded to the forward mooring station. The Master and pilot had a short pilot briefing and afterwards the Master gave the order to let go all lines.

## CPP not responding

The vessel proceeded towards the lock and was in the final approach when the Master realised that the CPP was not responding correctly and the vessel was rapidly approaching the lock. The Master attempted to recover control of the CPP system, but the pitch was stuck at approximately 40% ahead, causing the vessel to accelerate. The Master panicked and was unsure what to do, so he shouted on the radio to the mooring parties to get the lines ashore and stop the vessel. The forward mooring party managed to get the forward spring secured to a bollard but no other lines were attached. The pilot ordered the tug that was standing by beside the vessel, to push the vessel towards the quay. This caused the vessel to make heavy contact with the quay, but unfortunately did not slow it down enough. The vessel continued towards the lock at a speed of about three knots, the forward spring broke with a loud bang, and finally the vessel made heavy contact with the outer lock gate.

Forty seconds after the impact the Master pushed the emergency stop button for propulsion, after which the engine control room took control of propulsion.

## Important evidence destroyed

Shortly after the incident the Chief Engineer and First Engineer inspected the CPP system to determine if something was wrong. Before any third party was able to investigate the CPP, the Chief Engineer cleared the system. This destroyed any evidence of what might have caused the failure. The vessel was boarded by port state and class inspectors. The vessel sustained damage to its bulbous bow, the tug sustained minor damage and the lock gates sank. Fortunately there were no injuries or pollution - however there were costly repairs to both the lock and vessel.

It was also discovered that the company had had four similar CPP near misses reported on sister vessels. The company had not made any changes to the PMS or sent any special instructions to the vessels in the fleet.

## What can we learn?

- Ensure that the OOW understands why it is important to test all equipment as per the checklist, both for departure and arrival. This highlights the importance of carrying out the checks required by the SMS.

- The Master did not save the vessel's VDR – this was done by a port state inspector two hours after the incident. Always save the VDR, as soon as possible after an accident. It is important to have procedures that ensure that any evidence of what may have caused an accident is not removed or cleared in order to understand and learn why the accident happened.

- Always try to establish why an accident happened so it can be shared with the fleet. The near misses that had been reported to the company were never acted upon – there is no point in having a near miss reporting system if nothing is then done about the reports. Near misses and best practices should be shared within the fleet.



# 11.4 Routine job in the engine room caused grounding

A vessel was in ballast and sailing about seven miles from land on its way to the loading port in the NW Atlantic. It was early spring with heavy winds blowing and large waves. There was also some ice in the water, so the crew had to clear the lower starboard sea-chest which was blocked with ice. The crew changed to the upper intake and then removed the large cover from the lower sea suction filter, finding it choked with ice slush. While removing the ice the main sea water valve, located on the side shell plate, began to leak.

## Excessive force applied

Whilst the crew were replacing the filter cover, one of the engineers applied a large valve wheel key to the actuator valve, in an attempt to stop the leakage. Too much force was applied damaging the gear mechanism that operates the valve spindle and water began leaking into the engine room at high pressure.

The crew made attempts to stop the leakage, but the pressure and volume of water were too great. Attempts to pump out the water entering the engine room were also unsuccessful as electric motors and control gear were splashed with sea water causing short circuits which disabled the bilge pumps.

## Vessel began drifting

The vessel blacked out and began drifting in the severe weather conditions approximately 6-7 NM off the coast. The coast guard arrived at the scene and tried to attach a tow line, however the attempts failed. The vessel then dropped both anchors, but this did not stop the vessel from drifting. The vessel eventually grounded, and the crew was evacuated.

The following day a salvage team boarded the vessel by helicopter. They were assisted by two tugs. Wires were connected from the grounded vessel to the tugs. Fortunately the weather improved and the vessel was refloated and towed to the nearest port.

## Cleaning operations

An underwater inspection revealed extensive damage to the vessel shell plating. Operations continued over the following days, cleaning the engine room spaces with high pressure hoses and removing the pollutant from the vessel.

## What can we learn?

- When carrying out a critical job like cleaning the sea suction, it is important that there are clear procedures on how the job should be done and, as in any critical operation, it is best to have two people check to ensure that mistakes are detected.

- A job like this should require a work permit and risk assessment to be completed.

- It is also important to run drills on how to deal with a salvage operation, so the crew is prepared.

# 11.5 CPP caused vessel to strike the quay and crane

The container vessel had finished its cargo operation and the pilot had boarded. Two tugs would assist the vessel during departure. It was a clear summer day with no strong winds or currents.

## Engine stopped

The two tugs pulled the vessel clear of the berth and the propeller pitch was then set to Stop (Zero). Both tugs were cast off. The pilot ordered dead slow ahead. However, when the Master set the propeller pitch control to dead slow ahead, the main engine stopped. The Master called the engine control room to find out why the main engine had stopped and requested the main engine be restarted.

## Movement astern

Shortly afterwards the main engine started. However, the vessel immediately started to move astern. The Master called the engine room again and asked for the main engine to be stopped. It was discovered that the propeller pitch was now at full astern. The pilot called for the tugs to return, and the Chief Officer on the forecastle dropped the starboard anchor. The Chief Engineer was ordered to use the Emergency Stop to stop the main engine, which he did. However, the movement astern of the vessel could not be stopped. Moments later, the starboard quarter of the vessel struck the berth and front leg of a gantry crane.

The impact caused minor damage to the vessel and berth. The front leg of the gantry crane was knocked off the rail, but the crane was still standing. The crane was repaired and back in operation later the next day. However, the damage to the crane resulted in other liner vessels scheduled to call at the berth being delayed.

## Faulty CPP

The container vessel needed repairs to the controllable pitch propeller (CPP) hub and temporary repairs to the shell plating before sailing.

It is relevant to note that propulsion of the vessel was controlled by a CPP. The propeller turns in the same direction all the time when the vessel is sailing and only the angle/pitch of the propeller blades is changed to sail forward or go astern.

Inspections on board revealed that the CPP hub was leaking hydraulic oil and the propeller pitch control system had lost oil pressure. A feature of some CPPs is that if the oil pressure of the pitch control system is lost, the system will automatically place the blades at full astern pitch. The rationale for this is that the main engine can be operated in both directions (right- or left-hand turning). With the blades fixed at full astern, the vessel can still be manoeuvred by starting and stopping the main engine in different directions despite the inoperable propeller pitch control.

## What can we learn?

- Usually, an alarm should be triggered if there is a loss of oil. A low-level alarm should have been activated. It is important to act on and investigate all alarms that go off.

- It is important to follow the PMS for the CPP and ensure that all jobs are carried out correctly. This is one of the best preventive measures to ensure the equipment is working properly. Do not postpone planned maintenance.

- It is also essential that oil samples are taken to ensure there is no water or other contamination in the oil.

- Before arrival and departure, the engineer of the watch should check that the CPP is working properly.

- Ensure that all the appropriate crew is trained on how the CPP system works. This will include both deck and engine officers

# Glossary of common industry abbreviations

| Term | Meaning |
| --- | --- |
| AB | Able seaman |
| AIS | Automatic identification system |
| ARPA | Automatic radar plotting aid |
| COLREGS | International Regulations for Preventing Collisions at Sea |
| COSWP | Code of Safe Working Practices for Merchant Seafarers |
| CPA | Closest point of approach |
| CSM | Cargo securing manual |
| ECDIS | Electronic chart display information system |
| ETA | Estimated time of arrival |
| GM | Metacentric height |
| GPS | Global positioning system |
| IHO | International Hydrographic Organization |
| IMDG Code | International Maritime Dangerous Goods Code |
| IMO | International Maritime Organization |
| IMSBC Code | International Maritime Solid Bulk Cargoes Code |
| ISM | International Safety Management Code |
| JRCC | Joint rescue coordination centre |
| MOU | Memorandum of understanding |
| NM | Nautical miles |
| OOW | Officer on watch |
| PA | Public address system |
| PMS | Planned maintenance system |
| SMS | Safety management system |
| SSAS | Ship security alert system |
| SSP | Ship security plan |
| STS | Ship-to-ship (transfer) |
| TML | Transportable moisture limit |
| UHF | Ultra high frequency (radio) |
| VDR | Voyage data recorder |
| VHF | Very high frequency (radio) |
| VTS | Vessel traffic serice |

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