Client:	[redacted]
Installation:	[redacted]
Date:	[redacted]
BME Job No.	[redacted]
Report No.	[redacted]
Bartech Engineer	[redacted]
Engine Type	MTU 8V 396
Equipment Serial Numbers	[redacted]
Reason & Description of Planned Work scope:	• Platform Dismantle & Extraction • RCA • Overhaul In-house

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Contents

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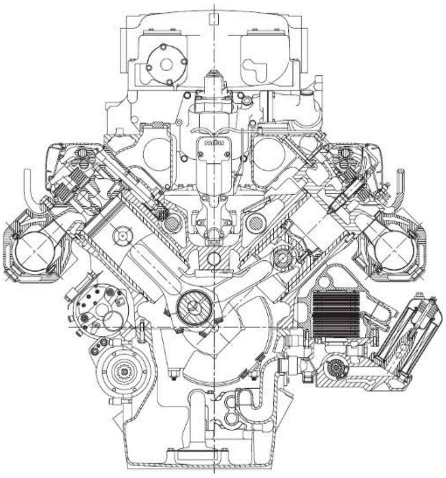
1.0 Project Overview

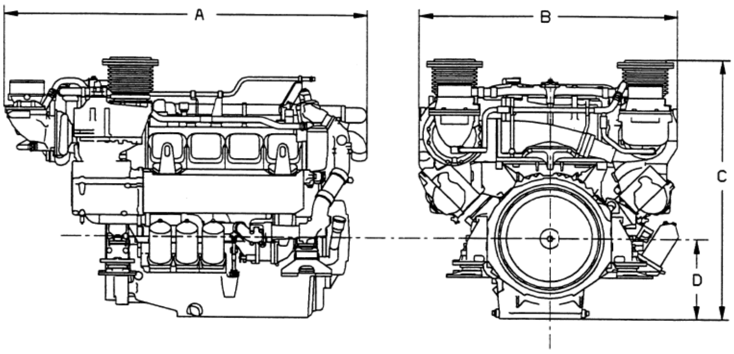
It has been recently reported that the [redacted] engine on [redacted] had been manually shut down due to failure of the hydraulic pump drive shaft bearings on the MTU 8V396 TE34 engine. The failed bearing subsequently damaged the gear train on the engine and potentially other engine components.
The engine has been shut down and isolated for further investigation.

This project aimed to bring the engine and subsequent pump back into operation by overhauling the engine at Bartech.

[redacted] engine details:

Installation: [redacted]
Equipment: MTU 8V396
Serial Number: [redacted]
Speed: 1800
Tag No: [redacted]





A	Overall Length	approx. 2133 mm
B	Overall Width	approx. 1522 mm
C	Overall Height	approx. 1526 mm
D	Crankshaft Height (from oil pan)	approx. 475 mm
E	Weight	approx. 3170kg

2.0 Stage 1: Mobilisation & dismantle.

The below actions were carried out on the platform by 2 Bartech engineers. At the same time as the dismantle the engineers started to carry out a visual root cause analysis of any obvious causes for the engine issues relating to the assemblies, they took off the engine and the initial overview of the complete engine.

Also for part of the RCA, the engineers reviewed the current maintenance reports, overhaul reports, running logs and oil analysis reports. This will be shown in the history log appendix.

Work carried out:

1) Remove any auxiliary equipment
2) Remove exhaust manifolds
3) Remove turbochargers
4) Remove expansion tank, which is located above plate cooler
5) Remove plate cooler inspecting oil holes
6) Dismantle plate cooler, inspecting each plate for debris
7) Remove all coolant pipework and thermostats and inspect all bores
8) Fuel filter assembly to be removed and dismantled
9) All Fuel pipes to be removed and dismantled
10) Remove air flaps and Air Inlet pipework bores to be checked for cleanliness

All assemblies and crankcase were wrapped, protected and sent back to Bartech Workshop.

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2.1 Engineers Report

Client:	
Installation:	
Date:	
BME Job No.	
Report No.	
Bartech Engineer	
Engine Type	MTU 8V396TE34 (Fire Pump [redacted])
Equipment Serial Numbers	
Engine Hours	1149hrs (from control panel)
Reason & Description of Planned Work scope:	Survey engine to advise on the best method or return to service following gear train bearing failure.

Introduction

Bartech was invited to attend [redacted] Platform following the failure of the hydraulic pump drive shaft bearings on the MTU 8V396 TE34 engine. The purpose of the visit was to discuss the options available for repairing the engine.

Work Carried Out

Upon arrival on the platform, the hydraulic pump, drive housing and shaft had already been removed by the platform staff. It was immediately apparent that a catastrophic failure had occurred. Fortunately, there was someone in the engine module at the time and the emergency stop was activated. Had the engine been allowed to continue running, the damage could have been much more serious. This illustrates the importance of having personnel present in the module during any engine test run.

When the engine was inspected, the inner bearing in the crankcase was found to be missing half its inner race (Figure 1) and the outer bearing had disappeared completely.

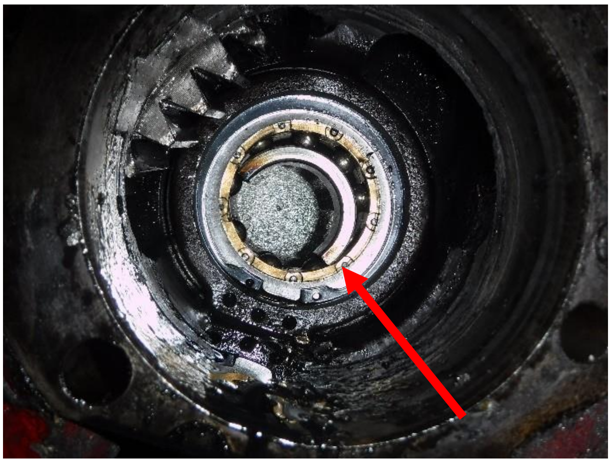

Figure 1 Inner bearing race damage

Figure 2 Ball bearing shaped hole in gear tooth

The bearing that failed is a brass caged high-speed bearing. It is spinning at 2790rpm when the engine is turning at 1800rpm (as a comparison, the average car would be travelling at approx 210mph if its wheels were turning at 2790rpm). At present we do not know the reason for bearing failure. The bearing may have failed by itself or due to ingestion of debris from elsewhere in the geartrain or engine. We would not know this until the engine is dismantled. Alternatively, the problem could be with the hydraulic pump as its input shaft did appear to be slightly bent. However, the pump shaft was free to turn.

For a comprehensive RCA on the engine, it would need to be dismantled and inspected methodically in a clean environment to prevent any contaminants from affecting the results.

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There was also damage to the teeth on the drive shaft which appeared as though a ball bearing had passed right through it (Figure 2). Damage was also found to the idler gear teeth and the crankcase (Figure 3). There was also evidence of metal filings and rubber residue (from the rubber drive coupling) around the outside of the crankcase (Figure 4). Platform staff had cut open the oil filters and found evidence of swarf inside. To get to the filters, engine oil must first pass through the oil pump and the oil cooler so both these components will be contaminated. Both these items will require completely dismantling, cleaning, measuring and refurbishment. The swarf could have passed into the oil galleries and could have affected the engine lubrication system and the integrity of the crankshaft, main bearings, big ends, etc.

Repair of this kind of damage is not straightforward. To change this idler gear, the crankshaft has to be removed which also requires removal of the sump, cylinder heads and pistons. Normally, to remove the crankshaft from an engine, it is turned upside down and the crankshaft is then lifted out of the crankcase.
Whilst onboard, discussions were held with various platform personnel and with [redacted], who is the onshore Senior Lifting Engineer for [redacted]. He was onboard to review methods for repair or extraction of the engine and what lifting equipment may be required.


Figure 3 Damage to idler teeth and crankcase

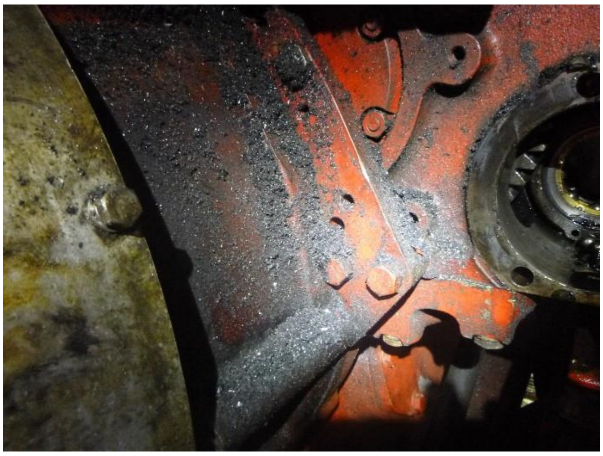
Figure 4 Swarf around hole in crankcase

Any repair decision must take into account the current location of the engine within the platform. The engine is located on the cellar deck level of the platform in the module next to C3 leg. Therefore, the engine module does not have an outside wall. Also, there is no access hatch in the roof of the module, but there is a hatch through to next door (Figure 5 & 6) in C3 leg. This hatch is a couple of inches too narrow to accommodate the complete engine so the exhaust manifolds would have to be removed for it to fit through. There is then a hatch in the roof of C3 leg. This hatch was utilised when the original engine was removed and replaced with the current MTU. This engine location is typical of many platforms where it is not a straightforward task to remove the engine.

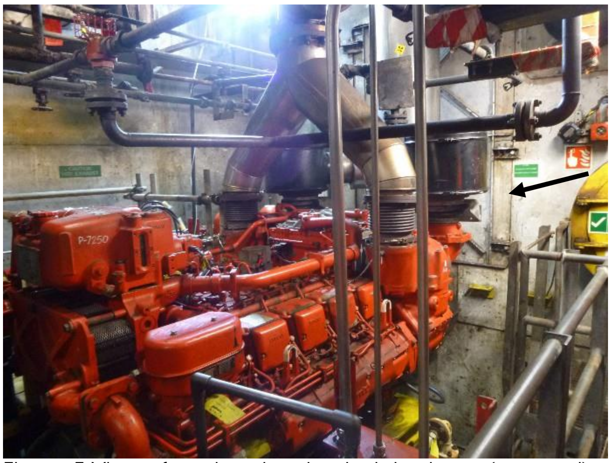
Figure 5 View of engine showing hatch at rear (arrowed)


Figure 6 Laydown area other side of hatch (drive shaft arrowed)

Following on from the survey, three options were formulated:

Option 1: Repair in situ. The engine would be raised on a set of fabricated legs. These legs would be bolted to the engine feet and the bed frame. This would then give sufficient room under the engine to remove the sump and lower the crankshaft from underneath the engine.

Option 2: Move the engine next door into C3 leg. Next to the leg is a small laydown area which would be just about large enough to work on the engine. The floor would have to be scaffolded as the driveshaft from the engine to the gearbox runs across this floor, approx 12" above the floor. There are also 3 sets of bolts still in the ceiling where pad eyes were fitted to aid the removal of the previous engine. These would be utilised to lift and turn the engine although they would need to be appropriately certified before use.

Option 3: Remove the engine completely and ship onshore for repair at Bartech's premises.

After internal discussions in Bartech, and discussions with [redacted], the three options were considered and the following conclusions were reached:

Option 1: This option was discounted as the least desirable due to the space constraints within the module and the added dangers of working under an engine and lowering the crankshaft. Lowering a crank (or any other heavy object) from a bolted position is inherently more dangerous than lifting as you do not have the opportunity to gauge the strain on the slings as the slack is taken up. Also, if something goes wrong, the object can only go down towards the floor potentially causing further damage.

All top end assemblies would require removal so that the pistons and connecting rods could be extracted leaving the bare crank. Special blocks would be required to mate with the main bearing journals on the crank (whilst also avoiding the crankpins).

Carrying out any repair onboard the platform carries a certain amount of risk. At present, we do not know the extent of any damage to the gear train or crankcase. We also do not know what caused the hydraulic pump shaft bearing to fail, whether the bearing failed by itself or whether some debris came from elsewhere in the engine and caused the bearing to fail is unclear.

Other damage may be present to the geartrain and/or crankcase which may require that option 1 turns into option 3.

In addition, facilities onboard the platform are very limited for cleaning of engine parts and manufacturing of parts or tooling that may become necessary during the repair. We know that the oil filters, oil pump and oil cooler will have been contaminated with swarf laden oil. Space for storage of the assemblies and parts removed from the engine is also restricted. There is also the danger that parts may be damaged or lost.

Option 2: This option was considered to be preferable to Option 1 as it would enable the crankcase to be turned over for crankshaft removal. However, all the caveats covered in Option 1 concerning parts cleaning, space etc apply equally to Option 2. Also, once the engine is in C3 leg module, it is halfway to being completely removed from the platform.

Option 3: This option is considered the best option from an engine integrity point of view. Bartech's workshop has a fully equipped machine shop with lathe, mill etc for the manufacture of items as required. We also have access to oxy-acetylene equipment, a full suite of measuring devices and a 40-ton hydraulic press. In addition, we have plenty of room, in a clean environment, to arrange all items removed from the engine in a structured fashion to avoid both loss and damage.

Repair at Bartech's fully equipped workshop would make any problems that become apparent much easier to deal with. Once repairs are completed, the engine can then be bench tested to ensure it is working as it should.

It is recognised that removal of the engine from the platform would involve extensive fabrication and construction work but it is felt that this negative is offset by the advantages of repairs being carried out in a quality-controlled workshop environment followed by a measured engine test.

Recommendations

Bartech would recommend that Option 3 is carried out.

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Root Cause Analysis (RCA) Report	
Client: [redacted]	Job No: [redacted]
Installation: [redacted] Platform	Date: [redacted]
Project title: MTU 8V396TE34 roller bearing failure	

Event description

An engine test was carried out on the platform and partway through the testing, sparks were observed coming from the area of the hydraulic pump motor. It was evident at this point part that part of the engine may have come loose or been dislodged and would require further investigation. The platform reported that the module cooling fan had stopped working, so the engine was shut down manually and isolated for a closer inspection. The following was identified and reported:

- There was teeth damage to the internal gear train.
- The platform had reported that there had been a complete failure of drive gear ball-type bearings and seals.
- The rubber coupling from the engine drive hydraulic fan pump had disintegrated.
- The hydraulic pump shaft was bent on the pump side of the engine.

Timeline leading up to the event

	Sequence of Events A copy of the [redacted] eLogbook has been issued dating back to [redacted]. This showed a comprehensive sequence of events leading up to the failure. The main points of focus had been highlighted in the eLogbook. A summary of these events are shown below:
13/05/18 -	The engine coolant started to overflow from being too hot from an issue on the seawater circuit.
18/05/18 -	It was noted the exhaust/ lube oil temperatures were over-temperature, causing the plate pack vapour vent to lift, suspecting cooling water circulation problems.
20/05/18 -	A test was carried out on the engine and partway through the engine testing, sparks were observed coming from the area of the hydraulic pump motor emanating from the engine side. It was evident at this point part that part of the engine may have come loose or been dislodged and would require further investigation. The module cooling fan had stopped working. At this point, the engine was shut down manually and isolated for inspection.

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Investigative Team	Methods Used
	Engine Dismantle – visual inspection highlighting any potential issues Detailed inspection 5 WHY Methodology

Findings

The engine arrived at the Bartech workshop on [redacted] and was offloaded from the delivery vehicle around 08.00. The engine was transported into the workshop (Figure 1) to allow the dismantling process to begin. The Bartech team of engineers visually inspected the engine to highlight any potential causes of engine failure. The 5 WHY Methodology would be used as issues were highlighted and throughout the inspection process.

Figure 1: Engine in Bartech workshop before work commenced

Engine Dismantle

1. The engine was barred over one complete revolution successfully, which eliminated any mechanical faults internally relating to the movement of the crankshaft.
2. Fuel pipes removed – ok
3. Fuel lift pump was removed and this rotated as expected. It was highlighted that some of the bolts holding the lift pump to the engine were loose.
4. It was highlighted the intercooler had excessive amounts of carbon (Figure 2)

Figure 2: Showing excessing carbon build up on Intercooler

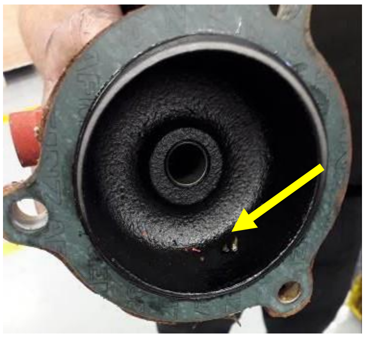
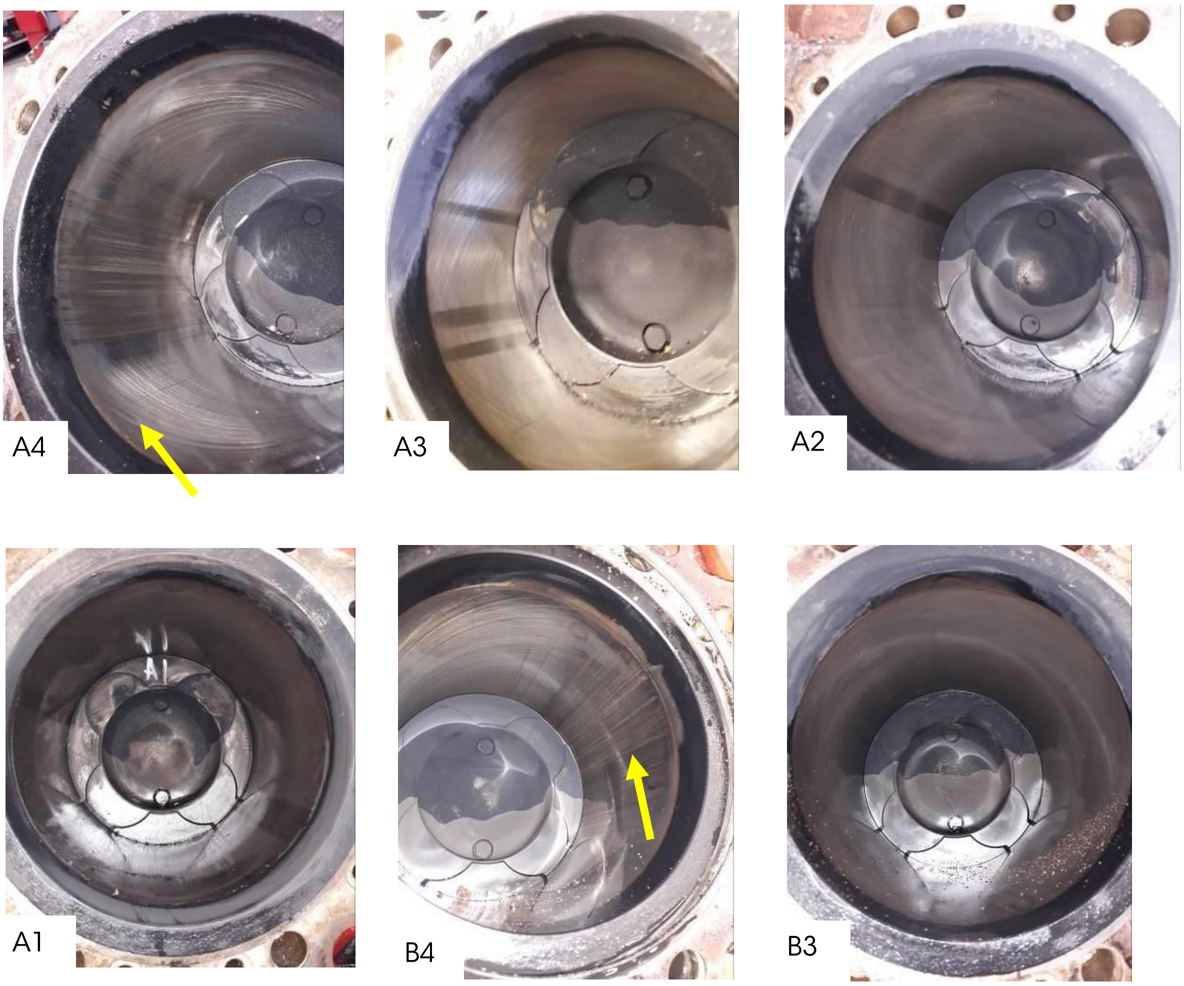


Figure 3: Small sections of bearing were found on fuel lift pump adaptor

5. Top rocker cover removed – ok
6. Injectors removed – ok
7. Plate cooler removed
8. Intercooler removed, air flaps appear to be working – ok
9. Removed coolant pipework – ok
10. Fuel lift pump adaptor cover was removed – small sections from a bearing were found on the back of adaptor housing from the bearing failure. (Figure 3)
11. Fuel pump was removed – ok
12. Intermediate covers where removed – some of the cap screws appeared to be corroded, making it difficult for the capscrews to be removed – it was evident that these have been affected by water being present on the engine at some stage.
13. Rocker gear removed – ok
14. Pushrods removed – ok
15. Removed gear train top cover – ok
16. Removed air inlet manifolds – O rings were still soft
17. Remaining fluids were drained from internal galleries
18. Removed fuel filter housing assembly – ok
19. Cylinder heads removed – ok
20. Starter motor removed – gear teeth ok
21.

22. Upon the first visual inspection of the liners, scoring was identified. Figure 4 represents the condition of each liner. A4 and B4 have significant scoring marks which can be felt with a finger. The other liners are showing signs of wear on the same positions relative to that bank but are not as significant as A4 and B4. A comprehensive inspection will be carried out after Engine dismantle. At this stage it is not believed this is related to the bearing failure, however, it is recommended that this is investigated to determine the cause.

Figure 4: Representing the condition of each liner after the cylinder heads were removed



B2

B1

23. Sump removed – debris was found in the sump; the debris contained pieces of roller bearing and gear teeth (figures 5 & 6).

Figure 5. Sump

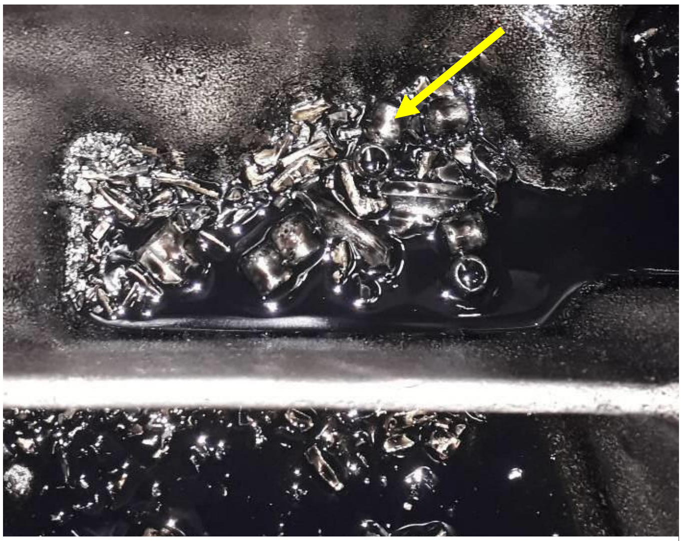


Figure 6. Showing debris in sump

24. Removed water pump drive gear - ok
25. Removed bearing housing – ok
26. Removed flywheel – ok
27. Removed oil filter housing – ok
28. Removed oil cooler – ok
29. Removed drive end cover – ok

30. The piston and connecting rods were removed and labelled appropriately. A thorough inspection would take place once the items are cleaned.
31. Liners removed

At this stage, there still wasn't clear evidence of why the drive for the hydraulic fan had failed. A decision was made to take a closer visual inspection of the hydraulic fan drive assembly. The drive assembly was laid out on to the bench (Figure 7). At this stage, we carried out the 5 WHY Methodology inspecting the types of scenarios that would cause the bearing to fail.

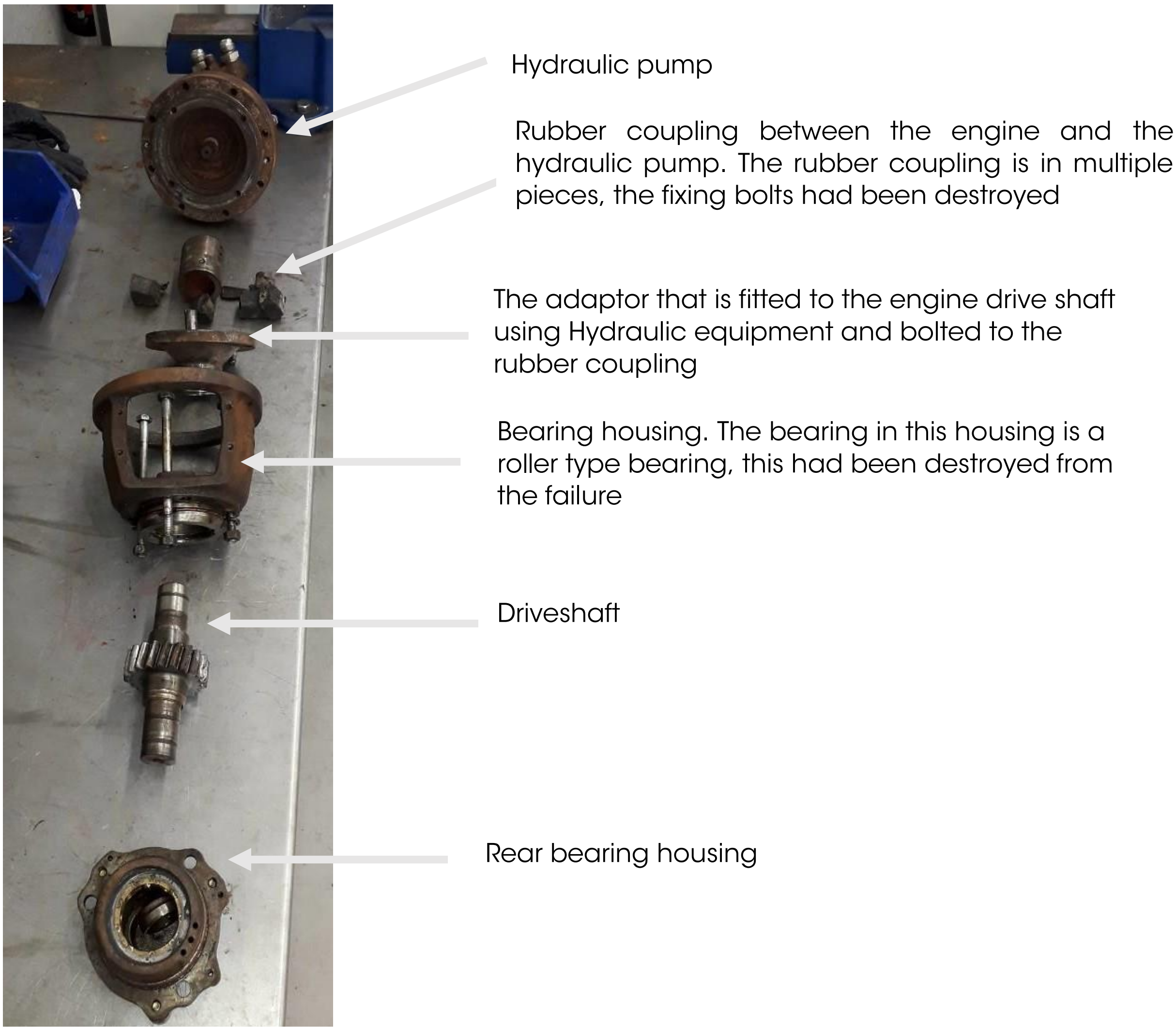


Figure 7. Drive assembly

5 WHY Methodology 18/07/18

The 5 Why Methodology was carried out whilst inspecting the hydraulic pump driving arrangement (See Appendix 2). Detailed Pictures of some of the items are shown below.

Figure 8: Damaged rear bearing

Figure 9: Driveshaft for hydraulic pump showing damage to the teeth

Figure 10: Damaged front bearing housing

Figure 11: Damaged rubber coupling, drive coupling (Left) shows a broken bolt still in situ

Figure 12: Hydraulic pump, the spline staff has been bent in the failure.

Identification of Root Cause
After carrying out the RCA procedure using 5 Why methodology and inspection of the failed components, Bartech concluded that the root cause of failure pointed towards the Centa-flex rubber coupling. The rubber coupling had failed with the rubber section collapsing. This had caused the rubber segments to become jammed in the bearing housing. The bearing housing acts as the guard for the driving shafts which has minimal clearance around the driving shaft. The rubber becoming jammed had caused the bolts to shear. This had put an uneven load onto the bearing which had then caused the bearing to fail. The front bearing (which is a roller type bearing), had disintegrated forcing the roller bearings and broken pieces into the gear train. This has subsequently applied pressure to the drive shaft forcing it out of alignment caused the rear bearing to fail. The ball type and roller type bearings from the failed bearings had entered the gear train, damaging the teeth on multiple gears. Bartech will provide a full inspection document indicating the damaged gears.
Corrective Action
Once the engine has been dismantled. Bartech will provide a comprehensive inspection of all items from the engine. An inspection report will be provided detailing the measurements and condition on engine components highlighting which items should be replaced. During the engine reassembly process, further inspections will be carried out where measurements and test for conformity will be undertaken. Alignments will also be checked and final assembly of the engine will be carried out to OEM specification processes and measurements. <u>Recommendation</u> Bartech recommends that the maintenance schedule for this engine is reviewed. Annual inspections are recommended to ensure this type of failure is prevented in the future. Bartech is happy to recommend and provide assistance with providing details and recommendations for future PPM on this engine.

Sponsor Acceptance		
Sponsor name and title	Signature	Date
	REMOVED	

Bartech Job number reference: [redacted]	Engine type: MTU 8V 396 TE.34	Produced by: Luke Miller *(Project support engineer)*
Client: [redacted]	Platform: [redacted]	Date: [redacted]

Appendix 2
3.0 5 Whys

The Problem	WHY 1	WHY 2	WHY 3	WHY 4	WHY 5	Result	Action
Damaged gear train	Bearing failure	Potentially overloaded	Rubber coupling failure between the engine and hydraulic pump	Perished coupling or misalignment	Extended periods between maintenance	Extended periods between maintenance periods have left any issues unidentified	Review maintenance schedules
Damaged gear train	Bearing failure	Water ingress	oil seal failed	Beyond service life	The seal hasn't been changed during a periodic maintenance schedule	A corroded bearing would cause a bearing failure. There is no evidence that the oil seal failed	Review Maintenance schedule
Damaged gear train	Bearing failure	Debris in oil	–	–	–	The Bearings are not oil-fed, they rely on lubrication from oil on the gear train (splash fed). There is no evidence of any major debris in the oil system	No action
Damaged gear train	Bearing failure	Beyond service life	–	–	–	The engine has not performed many hours during service life, therefore it is unlikely the bearing is beyond the service life	No action

Client:	[redacted]
Installation:	[redacted]
Date:	[redacted]
BME Job No.	[redacted]
Report No.	[redacted]
Bartech Engineer	[redacted]
Engine Type	MTU 396 8V
Equipment Serial Numbers	[redacted]
Reason & Description of Planned Work scope:	Dismantle and inspect engine prior to overhaul and rebuild.

Introduction

Engine Type: MTU 8V 396
Platform: [redacted]
Engine Serial No.: [redacted]

The above engine had been removed from the platform and arrived at Bartech attached to the bed frame. The turbochargers and manifolds had been removed along with the auxiliary pipework and exhaust. On initial inspection (figure 1), the engine appeared to be in good condition. There were no major defects or damage sustained apart from the visual parts of the gear train which had sustained damage. Details of the gear train damage are contained in a separate report.

Work Carried Out

The engine was barred over for one rotation to check for any tight spots or rotation restrictions, (Figure 2) and none was evident. All auxiliary components were removed to allow access to the main engine block. This included the starter motor, oil cooler, thermostatic housing and water pump.


Figure 1. Engine on arrival to the workshop


Figure 2. Bared over for one rotation

The valve covers were removed, and the valve operating gear was visually checked, all appeared to be ok. The charge air cooler had evidence of contamination which could have been caused by dirty filters or leaking exhaust gases being drawn into the cooler. The valve operating equipment was removed and placed to one side. The air manifolds were removed along with the seawater cooler. We noted the cooler plate measurements and spacers were loose between the clamping plates.

The rocker covers and rocker gear were removed, allowing access to the injectors which were then extracted (Figure 3). The cylinder heads were removed on both A and B bank (Figure 4). No major faults were found on the cylinder heads upon initial inspection. These will be dismantled and inspected later in the overhaul process.

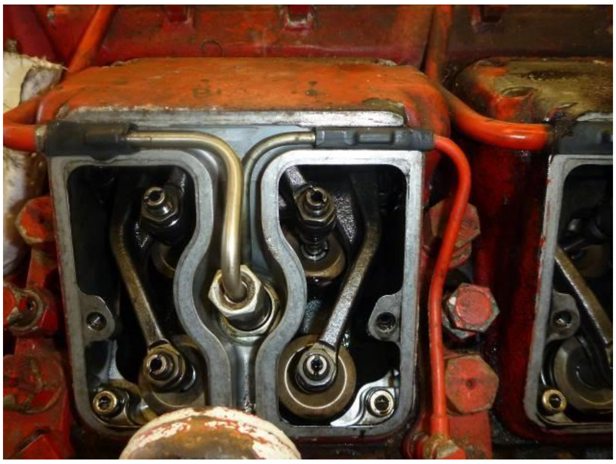


Figure 3. Removal of injector

Figure 4. Cylinder heads being removed

The covers at the free end of the engine were removed to gain as much access to the gear train as possible. It was noted that several gears have sustained chipped and damaged teeth as a result of the failure. (See gear train report).

Once the intercooler was removed and lifted from the main engine block, the pistons and the big end bearing caps were removed. The pistons were then extracted from the top of the engine block. Upon inspection of the cylinder liners, it was found that No.'s 1 & 4 on 'A bank' were out of ovality tolerance and would require replacing. (Figures 5 & 6). Light horizontal scoring was found on the majority of the liners. We expect to be able to hone the liners. (Figures 7 & 8).

Figure 5. Liners out of ovality

Figure 6. Measuring of the ovality

The piston liners were removed from the main crankcase to reveal the cooling jacket passage.


Figure 7. Honing of liners

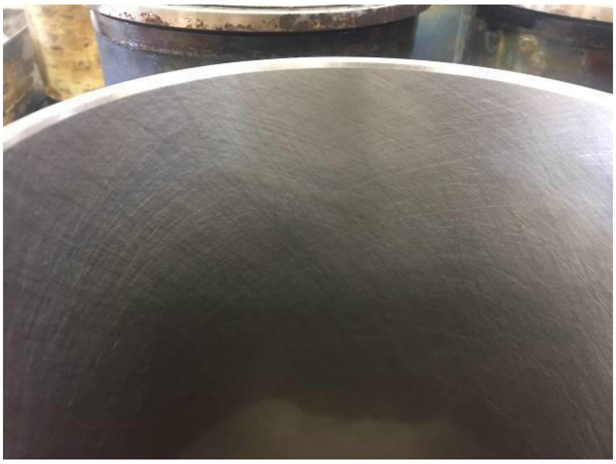


Figure 8. Honed liners

The crankshaft was rotated so A bank, No. 1 piston was at Top Dead Centre before the fuel injection pump was split from its timing gears. This allowed the fuel injection pump to be lifted clear of the crankcase. A full report on the strip and testing of this pump will be conducted later as part of the engine repair process. The flywheel was then marked for identification purposes before being removed from the crankshaft (Figure 8).

The cylinder block was rotated 180° to facilitate the removal of the flywheel housing, shaft seal, seal carrier, grooved ball bearing and bearing retaining plate (Figure 9).


Figure 8. Flywheel marked and removed


Figure 9. Cylinder block rotated 180°

The crankshaft bearing caps were marked with identification numbers relating to their position and orientation before removal (Figure 10).

The shell bearings were inspected, and slight wear marks were identified. However, there was no excessive wear to these items.

The crankshaft was elevated and gently lifted clear from the casing. The camshaft and intermediate gear trains were split from their drive components and removed from the gear housing. This allowed the camshafts to be removed.

The crankshaft bearing cap retaining studs were also removed to allow for accurate measurements against the manufacturer's tolerances. The bare crankcase was chemically cleaned before the necessary measurements could be conducted (Figure 11).


Figure 10. Bearing caps marked


Figure 11. Crankcase chemically cleaned

Recommendations

A full root cause analysis will be carried out alongside the engine overhaul.
All of the engine components will be fully dismantled, cleaned, inspected and tested prior to the rebuild of the reconditioned engine.

4.1 Cylinder Heads

Client:	[redacted]
Installation:	[redacted]
Date:	[redacted]
BME Job No.	[redacted]
Report No.	[redacted]
Bartech Engineer	[redacted]
Engine Type	MTU 396 8V
Equipment Serial Numbers	[redacted]
Reason & Description of Planned Work scope:	Dismantle, clean, inspect, rebuild and test cylinder heads.

Introduction

Engine Type: MTU 8V 396
Platform: [redacted]
Engine Serial No.: [redacted]

The cylinder heads were dismantled, pressure tested, cleaned and inspected before standard replacement items were fitted. Crack detection was carried out by Magnetic Particle Inspection (MPI) before final pressure and vacuum testing is conducted.

Work Carried Out

The cylinder heads were removed from the main engine block and an initial visual inspection was carried out. There was no obvious damage or defects found to the castings.

After removal from the engine, each cylinder head was etched with a unique individual serial number to aid in future identification.

The valve springs were compressed using a hydraulic press, and the collets and valve spring retainer was dismantled. This allowed for the outer and inner springs and the valve rotator to be removed (Figure 1). The valve stem seals were displaced from the valve guides and the valves were etched with an identification number. These were then removed from the cylinder head (Figure 2).


Figure 1. Removal of valve springs


Figure 2. Valves ready for removal

Upon removal of the valves, it was evident that carbon deposits had built up inside the exhaust ports and on the exhaust valve stems. An initial pressure test was conducted on the cylinder head coolant jackets to confirm the integrity of the casting.

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The castings were pressurised to 60 PSI and held for 20 minutes. No leaks or pressure drops were recorded.

The cylinder heads were chemically cleaned to remove any paint and carbon deposits. Upon completion, the injector sleeves, valve guides and plugs were removed for re-tapping of all threads (Figure 3).

Further visual inspection was conducted to confirm that each unit was now in good condition and undamaged. No faults were found.

To ensure that no cracks had developed within the head castings, a Magnetic Particle Inspection (MPI) was carried out (Figure 4). The combustion faces were also measured with the use of a straight edge and feeler gauges to ensure that no warping had occurred and that these were within the manufacturer's specification. No issues were recorded during this process (see attached test sheet). It was noted that the valve seats were sitting below the recommended depth by MTU (Figure 5) and for this reason, they will be replaced.

It was found that the valve guides on three of the cylinder heads had cracks on the tops which run down the sides (Figure 6). These will be replaced during the rebuild.

Figure 3. Removal of valve seats

Figure 4. MPI crack testing of all heads

Figure 5. Valve seat depths

Figure 6. Cracks in valve guides

Rebuild

As per standard procedure, the injector sleeves, valve guides and plugs were all replaced and torqued to the OEM specifications. To ensure an airtight seal, the valve seats were replaced and reground (Figure 7).

A final pressure test was carried out at a pressure of 60 PSI for 1 hour. No leaks or pressure drops were detected, confirming the integrity of the coolant seals and casting (see attached test sheet).

Figure 7. Sleeves, guides & plugs replaced

Figure 8. Valve guide bore measured

The valve springs were cleaned and each spring length was measured. The valves were also cleaned and their sealing face, stem diameter and stem shaft straightness were also measured.

The valve depth was measured and the valve guide bores (Figure 8) to confirm the required clearance was achieved in relation to the combustion face when the valves are in the closed position. All were found to be within the manufacturer's recommended tolerances. The valves and seats were then lapped to create a good seal (Figures 9 & 10.) A vacuum test conducted on both the inlet and outlet ports confirmed a satisfactory seal.

The inlet valve guides were fitted with valve seals before the valve rotators and springs were located and compressed under a hydraulic press. This allowed the valve retainers and collets to be attached before a final vacuum test confirmed a satisfactory valve seal.


Figure 9. Valves and seats


Figure 10. Valves and seats

The cylinder head external faces were painted and all internal faces were sprayed with a rust inhibitor spray to prevent future corrosion.


Figure11. Fitted heads


Figure 12. Cylinder Heads refitted

The rocker gear was dismantled separately from the cylinder heads and laid out on a workbench (Figures 13 & 14.) All the rocker gear was then visually inspected before being crack detected and measured (Figure 15.)


Figure 13. Rocker Gear on bench


Figure 14. Rocker Gear on bench


Figure 15. Crack detected and measured


Figure 16. Rocker Gear fitted to heads

The rocker gear was then fitted back to the completed cylinder heads (Figure 16.)

General

Date	[redacted]	Cylinder Head P/N	5550105141
Job No.	[redacted]	Engine	[redacted]
		No. Of Cylinders	8

Fill in below as appropriate i.e. if the engine is not a V configuration where there is no A or B bank (e.g. Inline engine) fill out first table and complete table for the relevant amount of cylinders only.

For clarity please appropriate tick box

Inlet 0.35 to 0.6 mm
Ext -0.15 to + 0.1mm

V Engine ☐ In – line Engine ☐

Additional Note: If you are only overhauling for example a couple of heads, although a full set would be 12 please use the note box at the bottom of this form to state this i.e. " only 2 heads overhauled as per customer request" or something of this nature.

Measurements - A Bank……Before dismantling

Cylinder No.			1	2	3	4	5	6	7	8
	Nominal Sizes	BME Test S/N	2852	2853	2854	2855				
Valve Stem Diameter	Min: Max:	Inlet A								
		Inlet B								
	Min: Max:	Exhaust A								
		Exhaust B								
Valve Guide Bore	Min: Max:	Inlet A								
		Inlet B								
		Exhaust A								
		Exhaust B								
Depth Of Valve Head Below Cyl Head Face		Inlet A	.69	.73	.64	.66				
		Inlet B	.7	.71	.65	.715				
		Exhaust A	.145	.168	.165	.140				
		Exhaust B	.18	.149	.155	.120				
Valve Springs (Free Length)		Inlet Inner A								
		Inlet Inner B								
		Inlet Outer A								
		Inlet Outer B								
		Exh Inner A								
		Exh Inner B								
		Exh Outer A								
		Exh Outer B								

Measurements - B Bank

Cylinder No.			1	2	3	4	5	6	7	8
	Nominal Sizes	BME Test S/N					2856	2857	2858	2859
Valve Stem Diameter	Min: Max:	Inlet A								
		Inlet B								
	Min: Max:	Exhaust A								
		Exhaust B								
Valve Guide Bore	Min: Max:	Inlet A								
		Inlet B								
		Exhaust A								
		Exhaust B								
Depth Of Valve Head Below Cyl Head Face		Inlet A					.685	.665	.635	.70
		Inlet B					.66	.67	.63	.605
		Exhaust A					.10	.098	.068	.158
		Exhaust B					.12	.18	.0030	.120
Valve Springs (Free Length)		Inlet Inner A								
		Inlet Inner B								
		Inlet Outer A								
		Inlet Outer B								
		Exh Inner A								
		Exh Inner B								
		Exh Outer A								
		Exh Outer B								

Engineer	

Comments from Measuring Procedure

In-House Crack Detection Using Dye Penetrant Method

General

Date	[redacted]	Cylinder Head P/N	5550105141
Job No.	[redacted]	Engine	MTU 8V396
		No. Of Cylinders	8

Fill in below as appropriate i.e. if the engine is not a V configuration where there is no A or B bank (e.g. Inline engine) fill out first table and complete table for the relevant amount of cylinders only.

For clarity please appropriate tick box

Inlet 0.35 to 0.6 mm
Ext -0.15 to + 0.1mm

V Engine ☐ Inline Engine ☐

Additional Note: If you are only overhauling, for example, a couple of heads, although a full set would be 12 please use the note box at the bottom of this form to state this i.e. " only 2 heads overhauled as per customer request" or something of this nature.

Measurements - A Bank……Before dismantling

Cylinder No.			1	2	3	4	5	6	7	8
	Nominal Sizes	BME Test S/N	2852	2853	2854	2855				
Valve Stem Diameter	Min: Max:	Inlet A	.55	.50						
		Inlet B								
	Min: Max:	Exhaust A								
		Exhaust B								
Valve Guide Bore	Min: Max:	Inlet A								
		Inlet B								
		Exhaust A								
		Exhaust B								
Depth Of Valve Head Below Cyl Head Face		Inlet A	.55	.40	.42	.48				
		Inlet B	.50	.45	.55	.38				
		Exhaust A	.00	.00	.14	.02				
		Exhaust B	.10	.10	.10	.10				
Valve Springs (Free Length)		Inlet Inner A								
		Inlet Inner B								
		Inlet Outer A								
		Inlet Outer B								
		Exh Inner A								
		Exh Inner B								
		Exh Outer A								
		Exh Outer B								

Measurements - B Bank

Cylinder No.			1	2	3	4	5	6	7	8
	Nominal Sizes	BME Test S/N					2856	2857	2858	2859
Valve Stem Diameter	Min: Max:	Inlet A								
		Inlet B								
	Min: Max:	Exhaust A								
		Exhaust B								
Valve Guide Bore	Min: Max:	Inlet A								
		Inlet B								
		Exhaust A								
		Exhaust B								
Depth Of Valve Head Below Cyl Head Face		Inlet A					.42	.60	.42	.41
		Inlet B					.55	.51	.4	.44
		Exhaust A					.13	.08	.04	.06
		Exhaust B					.12	.12	.10	.15
Valve Springs (Free Length)		Inlet Inner A								
		Inlet Inner B								
		Inlet Outer A								
		Inlet Outer B								
		Exh Inner A								
		Exh Inner B								
		Exh Outer A								
		Exh Outer B								

Engineer	

Comments from Measuring Procedure

All inlet and exhausts vacuum tested before dismantling all passed

In-House Crack Detection Using Dye Penetrant Method

Date	[redacted]	Cylinder Head P/N	
Job No.	[redacted]	Engine	MTU 396 8V
Engineer	[redacted]	No. Of Cylinders	8

Measurements - 'A' Bank Valve Gear

Cylinder No / Location				A1	A2	A3	A4	A5	A6
BME Test S/N (If applicable)									
Inlet Lever Bush	New Upper Limit	Max Limit: 1.1032 1.1024	A-A	1.1028 1.1032	1.1027 1.1031	1.1028 1.1034	1.1027 1.1030		
	New Lower Limit		B-B	1.1030 1.1042	1.1028 1.1038	1.1032 1.1042	1.1028 1.1037		
Exhaust Lever Bush	New Upper Limit	Max Limit: 1.1032 1.1024	A-A	1.1028 1.1037	1.1028 1.1039	1.1028 1.1034	1.1027 1.1038		
	New Lower Limit		B-B	1.1028 1.1033	1.1028 1.1033	1.1028 1.1032	1.1027 1.1032		

Cylinder No / Location			1	2	3	4	5	6
Fulcrum Shaft	Inlet	New Upper Limit 1.1016	1.1009 1.1008	1.1009 1.1009	1.1010 1.1009	1.1008 1.1009		
	Exhaust	New Lower Limit 1.1007	1.1010 1.1008	1.1009 1.1008	1.1010 1.1009	1.1009 1.1010		

Measurements - 'B' Bank Valve Gear

Cylinder No / Location				R1	R2	R3	R4	R5	R6
BME Test S/N (If applicable)									
Inlet Lever Bush	New Upper Limit	Max Limit:	A-A	1.1028 1.1033	1.1027 1.1031	1.1028 1.1033	1.1027 1.1030		
	New Lower Limit		B-B	1.1036 1.1042	1.1028 1.1036	1.1032 1.1042	1.1032 1.1040		
Exhaust Lever Bush	New Upper Limit	Max Limit:	A-A	1.1028 1.1036	1.1029 1.1037	1.1028 1.1037	1.1027 1.1036		
	New Lower Limit		B-B	1.1027 1.1034	1.1028 1.1034	1.1028 1.1033	1.1028 1.1034		

Cylinder No / Location			1	2	3	4	5	6
Fulcrum Shaft	Inlet	New Upper Limit	1.1010 1.1009	1.1009 1.1008	1.1010 1.1010	1.1008 1.1009		
	Exhaust	New Lower Limit	1.1008 1.1010	1.1010 1.1008	1.1008 1.1010	1.1008 1.1008		

Client:	[redacted]
Installation:	[redacted]
Date:	[redacted]
BME Job No.	[redacted]
Report No.	[redacted]
Bartech Engineer	[redacted]
Engine Type	MTU 8V 396
Equipment Serial Numbers	[redacted]
Reason & Description of Planned Work scope:	Fully dismantle, inspect and report on the condition of the engine crankcase & sump.

Introduction

Engine Type: MTU 8V 396
Platform: [redacted]
Engine Serial No.: [redacted]

As part of the complete engine overhaul, the crankcase required full dismantling, cleaning and inspecting.

Upon initial inspection, the crankcase appeared to be in good condition, with no major signs of external damage sustained.

Work Carried Out

The crankcase was chemically cleaned and the crankshaft bearing caps were crack tested via Magnetic Particle Inspection (MPI). This was to confirm that no cracks had developed within the casting faces, bearing recesses or stress points (Figure 1).

The crankshaft bearing cap studs were individually marked and removed from the crankcase. These were cleaned, inspected for thread damage and measured to confirm correct length and straightness. They were then inserted into the casing body to the manufacturer’s specified height and set in position using high strength retaining compound (Figure 2).

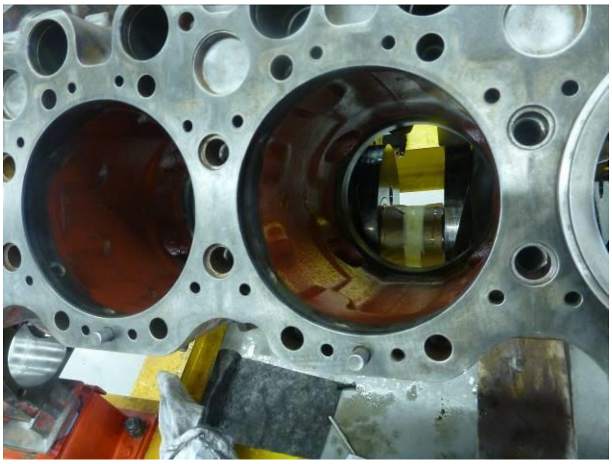

Figure 1. MPI Crack testing on all faces

Figure 2. Studs reset to specified length

The bearing surfaces of the casing and bearing caps were thoroughly cleaned before being mated together and torqued down in the specified order and tightness. This was conducted with the bearing shells fitted. Internal measurements were also taken at specific locations within the bearing housing. This procedure was repeated with the bearing shells in place (Figures 3 & 4).

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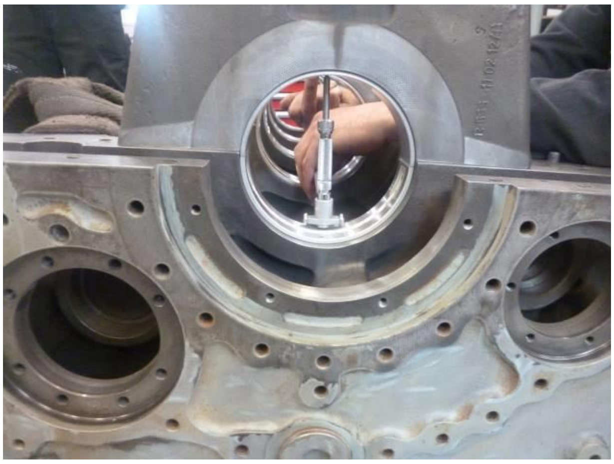

Figure 3. Measurements taken with bearing shells

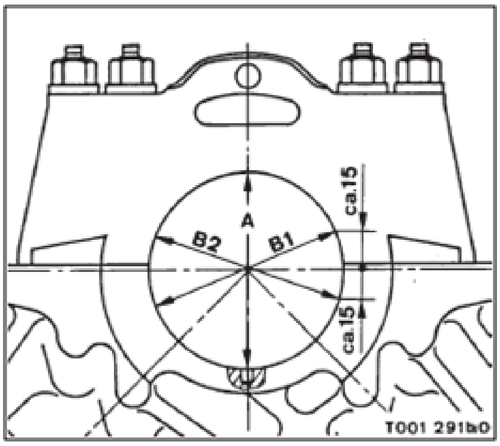

Figure 4. Axis where measurements were taken on each bearing journal

The measurements were recorded. All ovality to the main bearing bores were recorded and were within the maximum/ minimum manufacturers recommended tolerances.

The length of the main bearing cap protrusion was measured and recorded.

The crankcase was subjected to thorough cleaning in order to remove any rust and debris from all orifices, galleries, cooling jackets and mating surfaces. Threaded holes were also cleaned and re-tapped to ensure all threads were suitable for reuse (Figure 5).

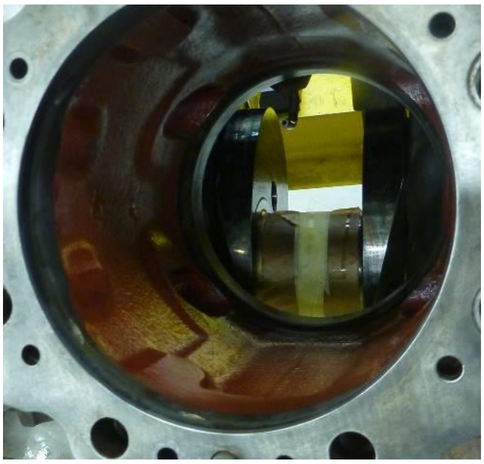

Figure 5. Cylinder cooling jacket after cleaning

Upon removal from the above engine (Figure 6) it was apparent that there was a large amount of metal swarf in the bottom of the oil sump. The first step was to drain the excess oil and remove the metal contaminants. (Figures 7- 10.)


Figure 6. Sump separated from engine case


Figure 7. Broken gears in sump


Figure 8. Broken gears & swarf in sump


Figure 9. Broken gears in sump


Figure 10. Broken gears in sump

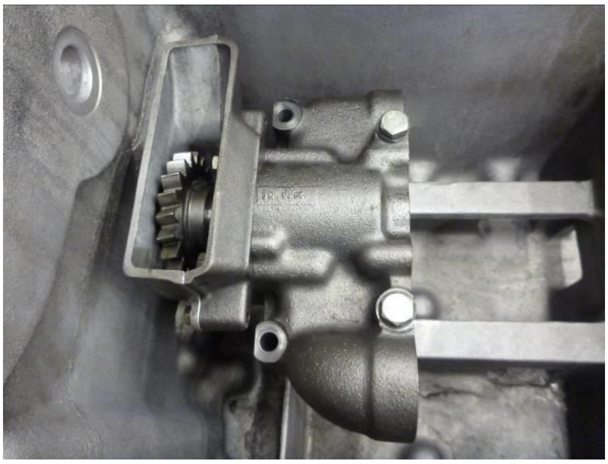
Figure 11. Gear refitted

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The pick-up and feed pipes remained attached to the oil pump in order for these to be included in the cleaning and visual inspection process. During the initial inspection, it was found that the pump was in good condition, with no major signs of damage evident. Due to the fact that the pump is located in the sump, only oil residue was found on the unit. The sump was cleaned, inspected and repainted ready to install.

The pipework was removed from the oil pump and no issues were recorded. However, the sealing O-rings have become hard over time and required replacement.

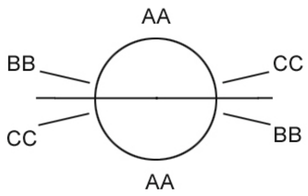
The gear was then also removed from the pump utilising a 3-legged puller. The woodruff key was removed and replaced back in the gear to prevent loss. The gear was then cleaned, crack detected and refitted. (Figure 11.)

The oil pump was then split into its respective halves. Again, no faults were found throughout this process. There were no signs of excessive wear or damage evident.

The pump housing was subjected to a Magnetic Particle Inspection (MPI) to confirm that there was no damage to the castings. The bearing bushes, O rings and copper sealing washers were replaced during the rebuilding process (Figure 12.)

Figure12. Rebuilt sump

DATE	[redacted]	TEST SHEET	
JOB NO	[redacted]	UNIT NO	
ENGINEER	G Bushnell	CRANKCASE NO	[redacted]
		ENGINE NO	[redacted]



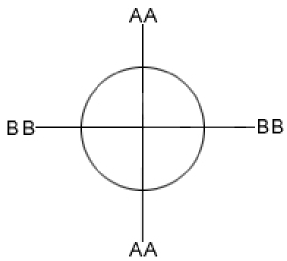
MEASUREMENT TO BE TAKEN WITH BEARING SHELLS	
STATE WITH ~~OR WITHOUT~~ BEARING SHELLS	NOMINAL SIZE 5.5554/ 5.5561

						limits	.0048/ .0079
POSITION	AA F.E	AA D.E	BB F.E	BB D.E	CC F.E	CC D.E	RUNNING CLEARANCE
NO.1	5.5570	5.5572	5.5577	5.5567	5.5574	5.5576	.0067/ .0077
NO.2	5.5572	5.5573	5.5566	5.5570	5.5580	5.5582	.0067/ .0084
NO.3	5.5572	5.5572	5.5574	5.5577	5.5573	5.5577	.0073/ .0078
NO.4	5.5570	5.5570	5.5573	5.5573	5.5575	5.5577	.0071/ .0079
NO.5	5.5569	5.5571	5.5570	5.5577	5.5573	5.5573	.0070/ .0079
NO.6							
NO.7							
NO.8							
NO.9							
NO.10							
NO.11							
NO.12							

INDICATE IF ABOVE ITEM	*USED	*REJECTED	* DELETE AS APPROPRIATE
IF ITEM REJECTED PLEASE COMPLETE NEW DIMENSION SHEET			

4.2.2 Test Sheet

DATE	[redacted]	TEST SHEET NO	
JOB NO	[redacted]	ALTERNATOR NO	
ENGINEER	[redacted]	VESSEL NAME	
PORT / STARBOARD SIDE		ENGINE NO	MTU 396 8V



MEASURMENT MUST BE TAKEN WITH AND WITHOUT BEARING SHELLS.

STATE WITH OR WITHOUT BEARING SHELLS					NOMINAL SIZE	2.2441/ 2.2453 2.6378/ 2.6396		
NO.1	AA F.E.	2.4449	AA D.E.	2.2450	BB F.E.	2.2446	BB D.E.	2.2447
NO.2	AA F.E.	2.6395	AA D.E.	2.6398	BB F.E.	2.6395	BB D.E.	2.6398
NO.3	AA F.E.	2.63	AA D.E.	2.63	BB F.E.	2.63	BB D.E.	2.63
NO.4	AA F.E.	2.6401	AA D.E.	2.6398	BB F.E.	2.6399	BB D.E.	2.6390
NO.5	AA F.E.	2.6402	AA D.E.	2.6395	BB F.E.	2.6396	BB D.E.	2.6392
NO.6	AA F.E.		AA D.E.		BB F.E.		BB D.E.	
NO.7	AA F.E.		AA D.E.		BB F.E.		BB D.E.	
NO.8	AA F.E.		AA D.E.		BB F.E.		BB D.E.	
NO.9	AA F.E.		AA D.E.		BB F.E.		BB D.E.	
NO.10	AA F.E.		AA D.E.		BB F.E.		BB D.E.	
A Bank					B Bank			

INDICATE IF ABOVE ITEM	*USED	*REJECTED	* DELETE AS APPROPRIATE

IF ITEM REJECTED PLEASE COMPLETE NEW DIMENSION SHEET

COMMENTS

Client:	[redacted]
Installation:	[redacted]
Date:	[redacted]
BME Job No.	[redacted]
Report No.	[redacted]
Bartech Engineer	[redacted]
Engine Type	MTU 8V 396
Equipment Serial Numbers	[redacted]
Reason & Description of Planned Work scope:	Visually and dimensionally inspect camshafts following the removal from the MTU 396 engine.

Introduction

Engine Type: MTU 8V 396
Platform: [redacted]
Engine Serial No.: [redacted]

The camshafts were removed and inspected to determine if there were any signs of damage (Figure 1). The journals and lobes on both shafts were also inspected for scoring and pitting.

Figure 1. Camshaft removed from the engine

Initial Inspection

Upon initial inspection of the camshafts, it was evident that there had been no damage sustained from the drive train. The journals and lobes were also found to be in good condition with no signs of corrosion, rust or damage (Figure 2 & 3).

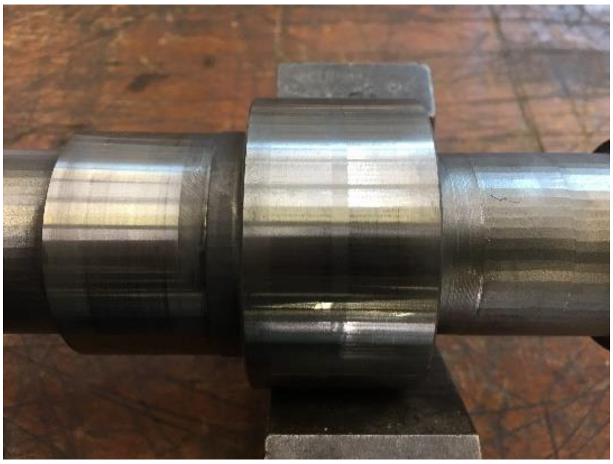


Figure 2. Camshaft journal

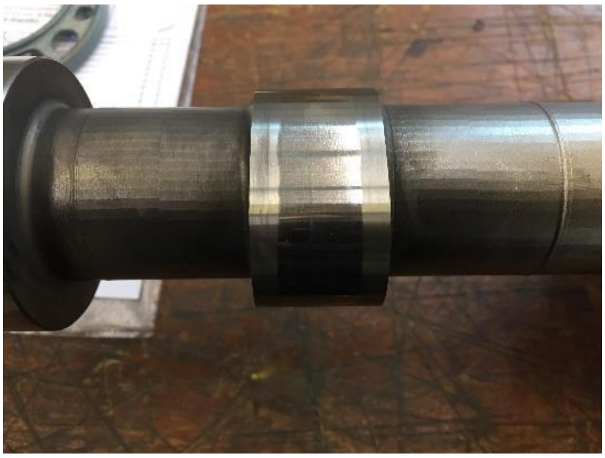


Figure 3. Camshaft lobes

The journals were then dimensionally inspected using a micrometer. (Figure 4)
All were found to be within the new specification (see attached test sheet).

The cam lobes were also in good condition, with only slight marking found from the followers.


Figure 4. Inspected using a micrometer

Work Carried Out

All journals and lobes were lightly polished using 240 grit emery cloth.

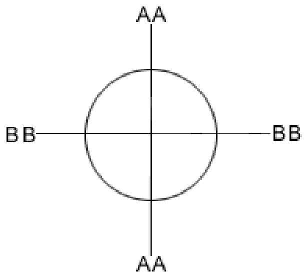
The gearwheel teeth were subsequently cleaned and checked for any damage which might have been sustained from the gear train. The gearwheel was MPI crack detected and no damage was found.

The camshaft assemblies were then thoroughly cleaned. An MPI crack detection test was also carried out, with no issues recorded (see attached test sheet).

Both camshaft assemblies were therefore acceptable and in a serviceable condition.

4.3.1 Test Sheet

		TEST SHEET NO	
DATE	[redacted]	PART NO	5510501101 (A bank)
JOB NO	[redacted]	CAM SERIAL NO	
ENGINEER	[redacted]	ENGINE NO	[redacted]



JOURNAL NOMINAL DIMENSION	2.2410/ 2.2417 2.6347/ 2.6354	LOBE HEIGHT NOMINAL DIMENSION	

NO.1	JOURNAL DIM	AA	2.2415	BB	2.2415	LOBE HEIGHT FM FREE END	NO.1	
							NO.2	
NO.2		AA	2.6352	BB	2.6352		NO.3	
							NO.4	
NO.3		AA	2.6354	BB	2.6354		NO.5	
							NO.6	
NO.4		AA	2.6353	BB	2.6353		NO.7	
							NO.8	
NO.5		AA	2.6354	BB	2.6354		NO.9	
							NO.10	
NO.6		AA		BB			NO.11	
							NO.12	
NO.7	REAR JOURNAL	AA		BB			NO.13	
							NO.14	
NO.8		AA		BB			NO.15	
							NO.16	

INDICATE IF ABOVE ITEM	*USED	*REJECTED	* DELETE AS APPROPRIATE

IF ITEM REJECTED PLEASE COMPLETE NEW DIMENSION SHEET

COMMENTS:

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Registered Office:
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Client:	[redacted]
Installation:	[redacted]
Date:	[redacted]
BME Job No.	[redacted]
Report No.	[redacted]
Bartech Engineer	[redacted]
Engine Type	MTU 396 8V
Equipment Serial Numbers	[redacted]
Reason & Description of Planned Work scope:	To visually and dimensionally inspect a set of connecting rods.

Introduction

Engine Type: MTU 8V 396
Platform: [redacted]
Engine Serial No.: [redacted]

The large and small ends were dimensionally inspected for size and ovality. These tolerances were obtained from the wear limit section of the manual.

Initial Inspection

The connecting rods were inspected for any damage. All were found to be in very good condition (Figures 1 & 2). The bolts were also inspected for length and all were found to be within new specification limits and can therefore be re-used. (Figure 3).


Figure 1. Visual inspection


Figure 2. Visual inspection of shank

Work Carried Out

All of the connecting rods were initially torqued up without the bearing shells fitted and dimensionally inspected to check conformity to OEM specification. All were found to be within new tolerances. The small end bushes were also inspected and were found to be within specification. (Figures 4 & 5)

Figure 3. Inspection of bolts

Figure 4. Inspection of large end without shells


Figure 5. Inspection of small end

Figure 6. Inspection of large end with shells fitted

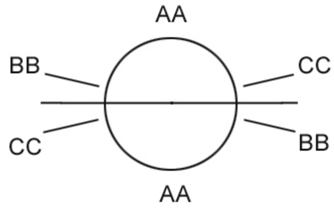
The connecting rods were cleaned using scotch brite. The connecting rods were then washed and re-measured (Figure 6) with the bearing shells fitted (see attached measurement sheets).

The connecting rods were all crack detected using MPI (Magnetic Particle Inspection) method. (Figure 7). No issues were recorded during this process (see attached test sheet).

Figure 7. Magnetic particle inspection

4.4.1 Con Rod Test Sheet

DATE	[redacted]	TEST SHEET NO	
JOB NO	[redacted]	ALTERNATOR NO	
ENGINEER	[redacted]	VESSEL NAME	[redacted]
CONNECTING ROD TYPE	A Bank	ENGINE NO	[redacted]



BORE FREE END NO 1	A-A	4.4107	B-B	4.4106	C-C	4.4106	ROD SERIAL NO
BORE DRIVE END:	A-A	4.4108	B-B	4.4105	C-C	4.4105	

BORE FREE END NO 2	A-A	4.4105	B-B	4.4103	C-C	4.4102	ROD SERIAL NO
BORE DRIVE END:	A-A	4.4106	B-B	4.4100	C-C	4.4102	

BORE FREE END NO 3	A-A	4.4104	B-B	4.4103	C-C	4.4102	ROD SERIAL NO
BORE DRIVE END:	A-A	4.4105	B-B	4.4104	C-C	4.4103	

BORE FREE END NO 4	A-A	4.4105	B-B	4.4102	C-C	4.4104	ROD SERIAL NO
BORE DRIVE END:	A-A	4.4105	B-B	4.4102	C-C	4.4105	

BORE FREE END NO 5	A-A		B-B		C-C		ROD SERIAL NO
BORE DRIVE END:	A-A		B-B		C-C		

BORE FREE END NO 6	A-A		B-B		C-C		ROD SERIAL NO
BORE DRIVE END:	A-A		B-B		C-C		

DIMENSIONS TO BE TAKEN WITH & WITHOUT BEARING SHELLS			NOMINAL SIZE
INDICATE IF MEASURED	*	* WITHOUT	4.4094/4.4103

INDICATE IF ABOVE ITEM	* USED	* REJECTED	

IF ITEM REJECTED PLEASE COMPLETE NEW DIMENSION SHEET

COMMENTS

* DELETE AS APPROPRIATE

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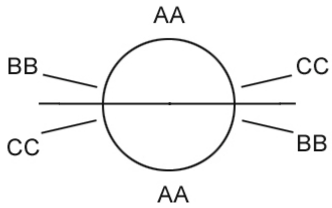
DATE	[redacted]	TEST SHEET NO	
JOB NO	[redacted]	ALTERNATOR NO	
ENGINEER	[redacted]	VESSEL NAME	[redacted]
CONNECTING ROD TYPE	B Bank	ENGINE NO	[redacted]



BORE FREE END NO 1	A-A	4.4105	B-B	4.4107	C-C	4.4105	ROD SERIAL NO
BORE DRIVE END:	A-A	4.4106	B-B	4.4106	C-C	4.4105	

BORE FREE END NO 2	A-A	4.4105	B-B	4.4106	C-C	4.4106	ROD SERIAL NO
BORE DRIVE END:	A-A	4.4107	B-B	4.4106	C-C	4.4104	

BORE FREE END NO 3	A-A	4.4103	B-B	4.4105	C-C	4.4103	ROD SERIAL NO
BORE DRIVE END:	A-A	4.4103	B-B	4.4102	C-C	4.4101	

BORE FREE END NO 4	A-A	4.4105	B-B	4.4105	C-C	4.4105	ROD SERIAL NO
BORE DRIVE END:	A-A	4.4107	B-B	4.4104	C-C	4.4105	

BORE FREE END NO 5	A-A		B-B		C-C		ROD SERIAL NO
BORE DRIVE END:	A-A		B-B		C-C		

BORE FREE END NO 6	A-A		B-B		C-C		ROD SERIAL NO
BORE DRIVE END:	A-A		B-B		C-C		

DIMENSIONS TO BE TAKEN WITH & WITHOUT BEARING SHELLS			NOMINAL SIZE
INDICATE IF MEASURED	*	* WITHOUT	4.4094/4.4103

INDICATE IF ABOVE ITEM	* USED	* REJECTED	

IF ITEM REJECTED PLEASE COMPLETE NEW DIMENSION SHEET

COMMENTS

* DELETE AS APPROPRIATE

Client:	[redacted]
Installation:	[redacted]
Date:	[redacted]
BME Job No.	[redacted]
Report No.	[redacted]
Bartech Engineer	[redacted]
Engine Type	MTU 8V396
Equipment Serial Numbers	[redacted]
Reason & Description of Planned Work scope:	Visual and dimensional inspection of crankshaft

Introduction

Engine Type: MTU 8V 396
Platform: [redacted]
Engine Serial No.: [redacted]

The crankshaft was removed from the engine, chemically cleaned and placed on crank stand ready for visual and dimensional inspection. (Figures 1 & 2)


Figure 1. Crankshaft prior to removal


Figure 2. Crankshaft cleaned ready for inspection

Initial inspection

The connecting rod journals and main bearing journals were visually inspected. The main bearing journals were in very good condition. The connecting rod journals were also in good condition but had some light scoring evident. (Figures 3 & 4)


Figure 3. Main bearing journal

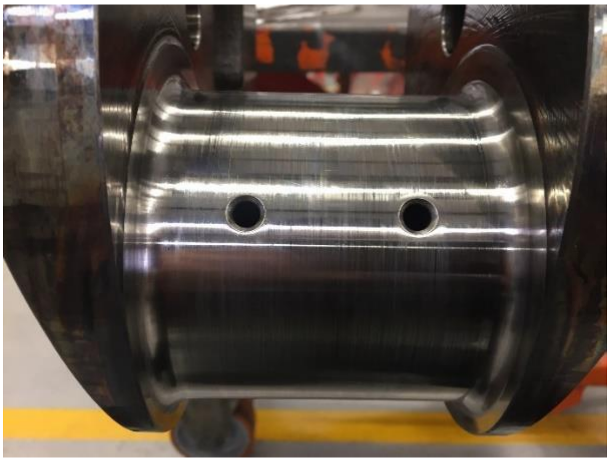


Figure 4. Connecting rod journal

The gear was visually inspected and all teeth were found to be in good condition with no damage or wear present. (Figure 5)


Figure 5. Crankshaft gear

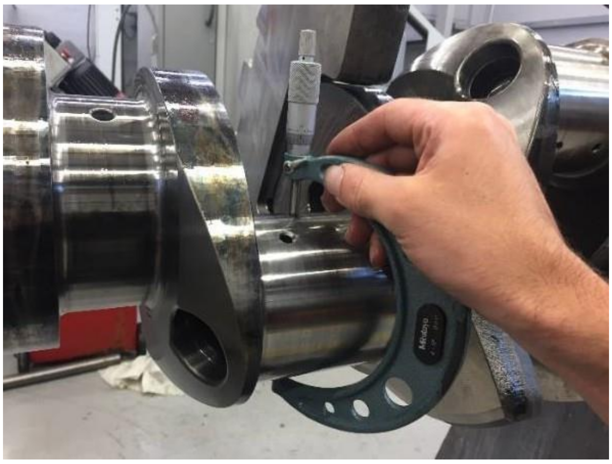


Figure 6. Dimensional inspection

The connecting rod journals were lightly polished using 240 grit emery cloth to remove the light scoring. The crankshaft was then dimensionally inspected using a micrometer and all journals were found to be within the OEM specification. (Figure 6).

See dimension sheet for full measurements.

The crankshaft was then crack tested using the MPI method, no issues were found (Figure 7.) The crankshaft was then installed back into the crankcase (Figure 8.)

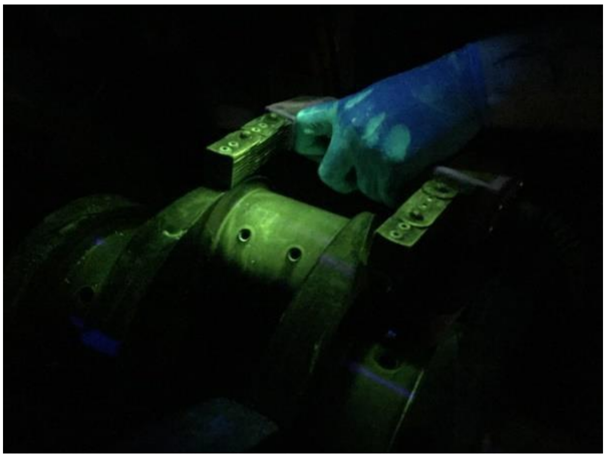
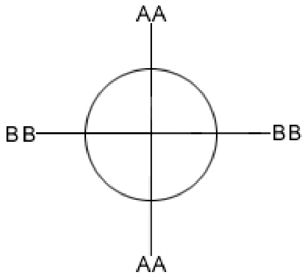


Figure 7. Magnetic particle inspection


Figure 8. Crankshaft installed

4.5.1 Test Sheet

DATE	[redacted]	TEST SHEET NO	
JOB NO	[redacted]	VESSEL NAME	[redacted]
ENGINEER	[redacted]	ENGINE NO	[redacted]



MAIN BEARING JOURNALS FROM FREE END			CRANKPIN BEARING JOURNALS FROM FREE END		
NOMINAL DESIGN DIMENSIONS	UPPER LIMIT	5.5506	NOMINAL DESIGN DIMENSIONS	UPPER LIMIT	4.1334
	LOWER LIMIT	5.5496		LOWER LIMIT	4.1325
NO.1	AA 5.5500	BB 5.5499	NO.1	AA 4.1334	BB 4.1332
NO.2	AA 5.5499	BB 5.5498	NO.2	AA 4.1332	BB 4.1331
NO.3	AA 5.5499	BB 5.5499	NO.3	AA 4.1330	BB 4.1330
NO.4	AA 5.5498	BB 5.5499	NO.4	AA 4.1330	BB 4.1329
NO.5	AA 5.5499	BB 5.5498	NO.5	AA 4.1329	BB 4.1328
NO.6	AA	BB	N0.6	AA 4.1330	BB 4.1329
NO.7	AA	BB	NO.7	AA 4.1329	BB 4.1329
N0.8	AA	BB	NO.8	AA 4.1329	BB 4.1329
NO.9	AA	BB			
NO.10	AA	BB			

INDICATE IF ABOVE ITEM	*USED	*REJECTED	* DELETE AS APPROPRIATE

LLOYDS REF/DETAILS:

COMMENTS/NOTES:

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Company No: 02154196
Registered Office:
Unit D E & F, Chandlers Row, Colchester, Essex, CO1 2HG

Client:	[redacted]
Installation:	[redacted]
Date:	[redacted]
BME Job No.	[redacted]
Report No.	[redacted]
Bartech Engineer	[redacted]
Engine Type	MTU 8V 396
Equipment Serial Numbers	[redacted]
Reason & Description of Planned Work scope:	Fully dismantle, inspect and rebuild fuel filters using new seals and filters.

Introduction

Engine Type: MTU 8V 396
Platform: [redacted]
Engine Serial No.: [redacted]

All assembly components were physically checked against the OEM manual (Figure 1).

Work Carried Out

The fuel filter lids were removed from the engine and the filter elements, seals and spring tensioning mechanism were extracted for inspection (figure 2). The fuel filters showed little signs of external wear or damage. The seals and filter cartridges were discarded and replaced.

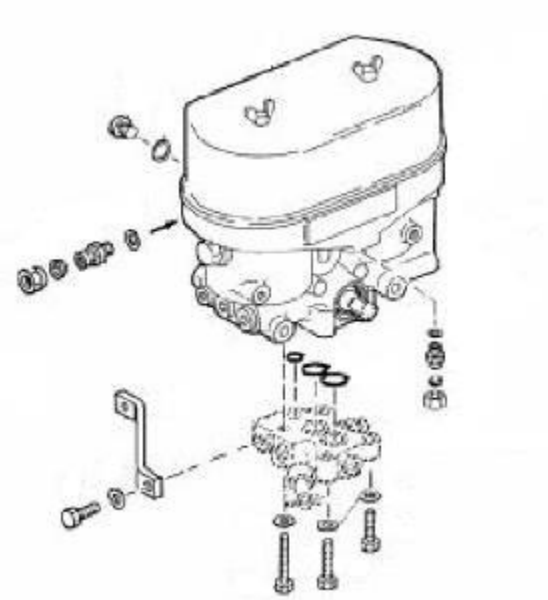

Figure 1. Fuel filter from manual

Figure 2. Filter on engine

The main body was chemically cleaned to remove grease and contaminants (Figure 3). The assembly was then repainted and refitted to the engine.

Figure 3. Cleaning complete & filter refitted

Client:	[redacted]
Installation:	[redacted]
Date:	[redacted]
BME Job No.	[redacted]
Report No.	[redacted]
Bartech Engineer	[redacted]
Engine Type	MTU 8V 396
Equipment Serial Numbers	[redacted]
Reason & Description of Planned Work scope:	Fully dismantle, clean, inspect and rebuild the fuel feed pump.

Introduction

Engine Type: MTU 8V 396
Platform: [redacted]
Engine Serial No.: [redacted]

The fuel feed pump was inspected to determine if there were any signs of damage. The unit was found to be in a used condition, with slight rust damage evident (Figure 1).

The pump was then marked prior to dismantling for identification during the rebuild process (Figure 2).

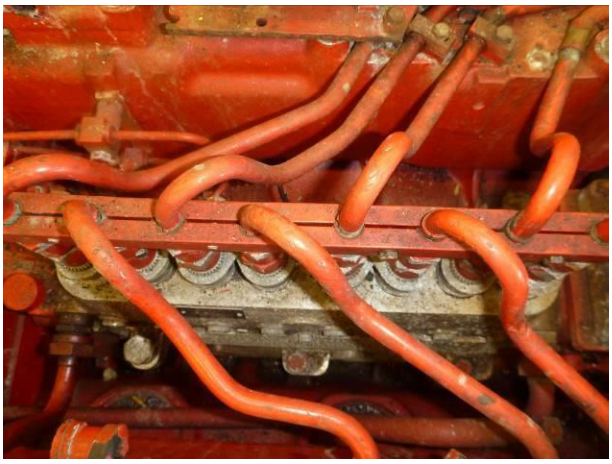

Figure 1. Fuel feed pump upon removal from the engine

Figure 2. Pump ready to be removed

Initial Inspection

The priming pump and valve block were fully dismantled from the main pump housing. The remaining items were then removed from the main housing and inspected. There were no issues of note.

Internal components were then chemically cleaned to remove the paint and rust damage. All the bushes and shafts were found to be in good working order.

The pump was reassembled using all new seals (Figure 3).

A small amount of flange sealant was used on the pump body.

The pump was then tested and the results are in the attached test sheet.

The item was then refitted to the engine.


Figure 3. Pump installed before painting

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Registered Office:
Unit D E & F, Chandlers Row,
Colchester, Essex, CO1 2HG

[redacted]

Make of Pump	Pump Number	Direction of Rotation	Test Machine	Last Job Ref. No.	Teste By	Job Ref. No•
Bosch	[redacted]	CIW	CFP1		[redacted]	[redacted]
M,lleage	Serial Number	Remarks	Period	Date	Date .	
	[redacted]				[redacted]	

Rack Opening	Speed (R.P.M)	1	2	3	4	5	6	7	8	9	10	11	12
18	750	99	99	99	99	99	99	99	99				
16	750	81	80	80	80	SO	80	80	80				
7	750	29	29	29	29	30	29	29	29				
6	300	15	16	15	15'	15	14	15	14				

Phase Angle									
Before Adjustment				orreet					Plu,:iger Stroke (mm)
After AdjlJstment				Corre.ct					

GOVERNOR TEST

MECHANICAL			NUMBER			HYDRAULIC			NUMBER		
Before Adjustment			After Adjustment			Before Adjustment			After Adjustment		
Idling Maximum		R.P.M.	ldnng Maxlm1.1m		R.P.M.	Relief Valves P.S.I.	High	LOW	Relief Valves P.S.I.	High	·tow
Idling Minimum		R.P.M.	Idling .Minimum		R.P.M.	Idling Speed Setting		R.P.M.	Idllng ·S d Setting		R.P.M.
Cutting In Speed		R.P.M.	Cutting In Speed		R.P.M.	Idllng pressure P.S.I.	Opening	Closing	Idling Pressure P.S.I.	Opening	. Closing .
No Load C.R.O. 7 mm		R.P.M.	No Load C.R.O. 7 mm		R.P.M.	Idling Fuel		mm^3/cycle	Idllng Fuel		rrim' lcycle
Complete Cut-out		R.P.M.	Complete Cut-out		R.P.M.	Maximum Fuel		mni^3/cycle	Maximum Fuel		mm^3/cycle
Rack Movement		R.P.M.	Rack Movement		R.P.M.	Excess Fuel Travel		M.M.	Excess FuelTravel		M.M.

Client:	[redacted]
Installation:	[redacted]
Date:	[redacted]
BME Job No.	[redacted]
Report No.	[redacted]
Bartech Engineer	[redacted]
Engine Type	MTU 8V 396
Equipment Serial Numbers	[redacted]
Reason & Description of Planned Work scope:	Visually inspected gear train once removed from the MTU 396 engine.

Introduction

Engine Type: MTU 8V 396
Platform: [redacted]
Engine Serial No.: [redacted]

The engine was bared over and the damage to the top section of the gear train was evident.

The gears were removed and inspected to determine if there were any further signs of damage (Figure 1).

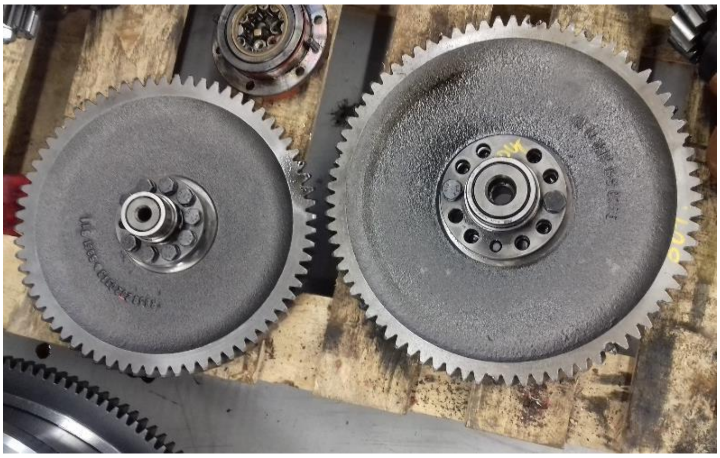


Figure 1. Gears removed from the engine

Initial Inspection

Upon initial inspection of the gears, it was evident that there was damage to the gear teeth of the left-hand large idler gear caused by the roller bearings breaking up on the hydraulic pump drive. (Figure 3, 4 & 5).

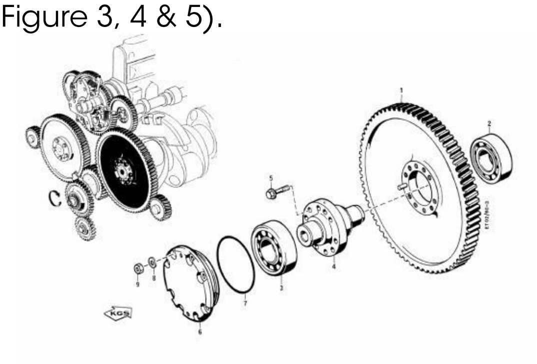


Fig.2. Large idler gear


Figure 3. Damaged teeth on gear


Figure 4. Ball bearing shape hole in teeth

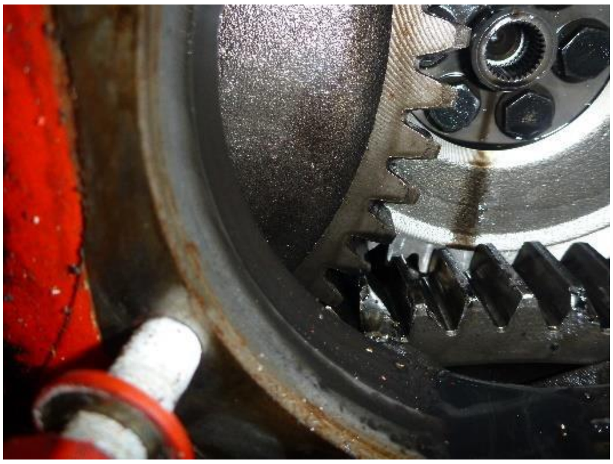


Figure 5. Ball bearing shape hole in teeth

It was noted that the hydraulic pump drive shaft had also sustained damage (figures 6 & 7).


Figure 6. Hydraulic pump drive shaft


Figure 7. Damage to teeth

All of the remaining gears were checked for damage (Figure 8) and nothing further was found.


Figure 8. Remaining gears removed and checked

Work Carried Out

The teeth of the remaining gear train assembly were cleaned and checked for any damage which might have been sustained from the bearing failure. The remaining gear was crack detected, and there was no damage.

The damaged gears, as well as the engine coolant pump drive idler gear on the right side, will be replaced during the engine rebuild.

Client:	[redacted]
Installation:	[redacted]
Date:	[redacted]
BME Job No.	[redacted]
Report No.	[redacted]
Bartech Engineer	[redacted]
Engine Type	MTU 8V 396
Equipment Serial Numbers	[redacted]
Reason & Description of Planned Work scope:	Inspect cylinder liners following removal from the engine. Clean liners hone and inspect.

Introduction

Engine Type: MTU 8V 396
Platform: [redacted]
Engine Serial No.: [redacted]

All liners were inspected and measured to make sure they conform and were fit for re-use.

Work Carried Out

Prior to starting the measuring of the liners, they were all cleaned. (Figure 1)

Having removed the cylinder liners from the cylinder block these were then cleaned and during this process, it was noted that two of the liners had some light scoring which could just be felt with a fingernail. It was proven later that these markings were caused by carbon build-up and would hone out and leave no trace.

It was also noted that two of the liners (A4 and B4) had a ridge at the top of the ring travel. These were measured first to determine how deep the ridge was. It was found that these were out of max wear tolerance and were therefore rejected and replaced with new (Figure 2).

Figure 1. Liners ready for dimensional inspection

Figure 2. Ridge at top of ring travel

The remaining liners were then honed (Figures 3, 4, & 5) and placed on a pallet ready to be dimensionally inspected for size and ovality. All remaining liners were found to be within OEM spec. (Figures 6).

Figure 3. Liner being honing

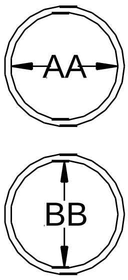
Figure 4. Liner being honing

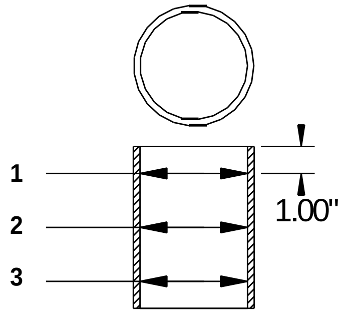
Figure 5. Liner after honing

Figure 6. Dimensional inspection

4.9.1 Cylinder Liner Test Sheet

DATE	[redacted]
JOB NO	[redacted]
ENGINEER	[redacted]
CUSTOMER	[redacted]





LINER NO								
A1	AA	1:165.084	2:165.068	3:165.070	BB	1:165.064	1:165.066	1:165.062
A2	AA	1:165.070	2:165.070	3:165.070	BB	1:165.078	1:165.086	1:165.080
A3	AA	1:165.082	2:165.080	3:165.068	BB	1:165.058	1:165.060	1:165.060
A4	AA	1:165.136	2:165.128	3:165.078	BB	1:165.086	1:165.108	1:165.080
B1	AA	1:165.058	2:165.038	3:165.048	BB	1:165.058	1:165.060	1:165.058
B2	AA	1:165.084	2:165.082	3:165.076	BB	1:165.064	1:165.068	1:165.078
B3	AA	1:165.078	2:165.078	3:165.074	BB	1:165.066	1:165.072	1:165.074
B4	AA	1:155.110	2:165.106	3:165.068	BB	1:165.082	1:165.096	1:165.080
	AA	1:	2:	3:	BB	1:	2:	3:
A4 new	AA	1: 165.064	2:165.084	3:165.060	BB	1:165.084	1:165.064	1:165.062
B4 new	AA	1:165.058	2:165.052	3:165.042	BB	1:165.052	1:165.058	1:165.054
	AA	1:	2:	3:	BB	1:	2:	3:
	AA	1:	2:	3:	BB	1:	2:	3:
	AA	1:	2:	3:	BB	1:	2:	3:
	AA	1:	2:	3:	BB	1:	2:	3:
	AA	1:	2:	3:	BB	1:	2:	3:

Out of tolerance

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Company No: 02154196
Registered Office:
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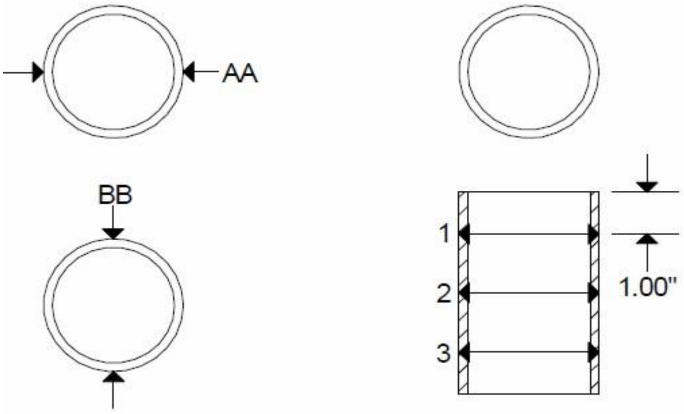
DATE	[redacted]
JOB NO	[redacted]
ENGINEER	[redacted]
CUSTOMER	[redacted]



		6.4871 / 6.4879		6.4891 / 6.4900				
LINER NO								
A1	AA	1: 6.4870	2:	3: 6.4885	BB	1:	2:	3:
A2	AA	1: 6.4873	2:	3: 6.4890	BB	1:	2:	3:
A3	AA	1: 6.4875	2:	3: 6.4884	BB	1:	2:	3:
A4	AA	1: 6.4867	2:	3: 6.4885	BB	1:	2:	3:
B1	AA	1: 6.4875	2:	3: 6.4891	BB	1:	2:	3:
B2	AA	1: 6.4870	2:	3: 6.4887	BB	1:	2:	3:
B3	AA	1: 6.4870	2:	3: 6.4888	BB	1:	2:	3:
B4	AA	1: 6.4871	2:	3: 6.4889	BB	1:	2:	3:
	AA	1:	2:	3:	BB	1:	2:	3:
	AA	1:	2:	3:	BB	1:	2:	3:
	AA	1:	2:	3:	BB	1:	2:	3:
	AA	1:	2:	3:	BB	1:	2:	3:
	AA	1:	2:	3:	BB	1:	2:	3:
	AA	1:	2:	3:	BB	1:	2:	3:
	AA	1:	2:	3:	BB	1:	2:	3:
	AA	1:	2:	3:	BB	1:	2:	3:

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Vat No: GB 4635797 08
Company No: 02154196
Registered Office:
Unit D E & F, Chandlers Row, Colchester, Essex, CO1 2HG

Client:	[redacted]
Installation:	[redacted]
Date:	[redacted]
BME Job No.	[redacted]
Report No.	[redacted]
Bartech Engineer	[redacted]
Engine Type	MTU 8V 396
Equipment Serial Numbers	[redacted]
Reason & Description of Planned Work scope:	Fully dismantle, inspect and clean exhaust manifolds.

Introduction

Engine Type: MTU 8V 396
Platform: [redacted]
Engine Serial No.: [redacted]

The exhaust manifolds were removed from the engine during the dismantling of the MTU 396 engine returned for overhaul.

Both manifolds needed to be dismantled, cleaned and inspected prior to the rebuild of the engine in order to determine if any damage had been sustained.

Initial Inspection

The exhaust manifolds were completely dismantled, and all internal components were inspected. Heavy carbon deposits were found in the outer casings.

Work Carried Out

The manifolds were chemically cleaned in order to remove the paint and carbon deposits. Once this was completed, the gasket faces were cleaned and the last remaining carbon was removed.

All of the plugs and bungs were removed and new copper washers were fitted. The O-ring recesses were thoroughly cleaned due to evidence of corrosion caused by not using anti-freeze in the cooling system.

The manifolds were then refitted to the engine for testing and painting.

Figure 1. Manifold refitted to B bank

Figure 2. Manifold on A bank once overhauled

Client:	[redacted]
Installation:	[redacted]
Date:	[redacted]
BME Job No.	[redacted]
Report No.	[redacted]
Bartech Engineer	[redacted]
Engine Type	MTU 8V396
Equipment Serial Numbers	[redacted]
Reason & Description of Planned Work scope:	Visually and dimensionally inspect engine set of pistons and gudgeon pins

Introduction

Engine Type: MTU 8V 396
Platform: [redacted]
Engine Serial No.: [redacted]

After the connecting rod/piston assemblies were removed from the engine the pistons were then removed from the connecting rods. The crowns were separated from the skirts, carbon stripped, chemically cleaned and laid out on a pallet ready for visual and dimensional inspection. (Figure 1)

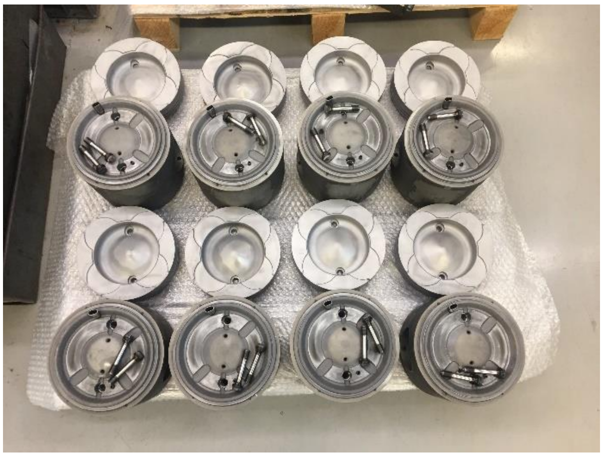

Figure 1. Pistons dismantled and cleaned

Figure 2. Inspection of crown bolts

Work Carried Out

Before the pistons were inspected the crown/skirt bolts were measured for length to make sure they were suitable for further service, all were found to be within OEM spec. (Figure 2)

The pistons were then visually inspected. The skirts had some light scoring which had taken off some of the phosphate coating. The skirts were then dimensionally inspected at the two points stated in the OEM manual and all were found to be within OEM specification so were deemed fit for continued service (Figures 3 & 4).

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Registered Office:
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Colchester, Essex, CO1 2HG

Figure. 3. Light scoring to skirt

Figure 4. Dimensional inspection of skirt

Figure 5. Inspection of ring grooves

Figure 6. Inspection of gudgeon pins

The crowns were then visually inspected and all were in very good condition. The piston ring grooves were then dimensionally inspected using slip gauges, all were found to be within OEM specification (Figure 5).

The gudgeon pins were lightly polished and dimensionally inspected and were also found to be within OEM specification. (Figure 6)

Piston crowns and bolts were then crack tested by MPI method and no issues were identified.

4.11.1 Groove Gap Dimensions

DATE	[redacted]	TEST SHEET NO	
JOB NO	[redacted]	ALTERNATOR NO	
ENGINEER	[redacted]	VESSEL NAME	[redacted]
PORT / STARBOARD SIDE		ENGINE NO	[redacted]

INDICATE IF MEASUREMENTS ARE	*RING GROOVES	~~*RING GAPS~~	* DELETE AS APPROPRIATE

	.1415/ .1423	.1402/ .1409	.2378/ .2386		
PISTON	TOP	SECOND	THIRD	FOURTH	FIFTH
A1	.1415	.1405	.2385		
A2	.1415	.1405	.2385		
A3	.1415	.1405	.2385		
A4	.1415	.1405	.2385		
B1	.1415	.1405	.2385		
B2	.1415	.1405	.2385		
B3	.1415	.1405	.2385		
B4	.1415	.1405	.2385		

INDICATE IF ABOVE ITEM	*USED	*REJECTED	* DELETE AS APPROPRIATE

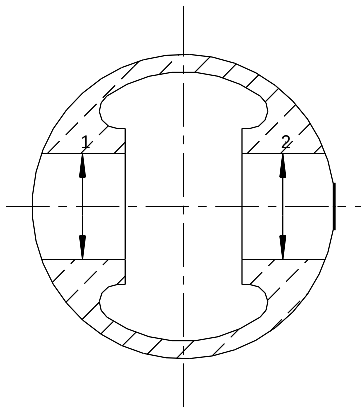
IF ITEM REJECTED PLEASE COMPLETE NEW DIMENSION SHEET

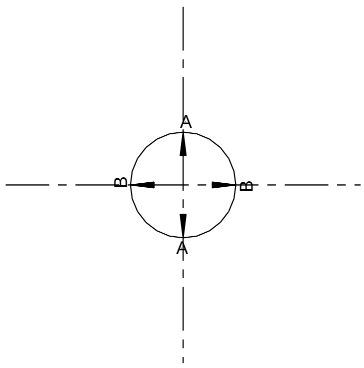
COMMENTS

4.11.2 Piston Bore Dimensions

DATE	[redacted]	TEST SHEET NO	
JOB NO	[redacted]	ALTERNATOR NO	
ENGINEER	[redacted]	VESSEL NAME	
PORT / STARBOARD SIDE		ENGINE NO	

	1		2	
PISTON	AA	BB	AA	BB
A1	2.3633	2.3633	2.3633	2.3635
A2	2.3633	2.3633	2.3633	2.3634
A3	2.3634	2.3634	2.3634	2.3635
A4	2.3633	2.3634	2.3633	2.3634
B1	2.3634	2.3634	2.3634	2.3634
B2	2.3631	2.3633	2.3631	2.3633
B3	2.3633	2.3635	2.3633	2.3634
B4	2.3633	2.3634	2.3634	2.3634





INDICATE IF ABOVE ITEM	*USED	*REJECTED	* DELETE AS APPROPRIATE

IF ITEM REJECTED PLEASE COMPLETE NEW DIMENSION SHEET

Client:	[redacted]
Installation:	[redacted]
Date:	[redacted]
BME Job No.	[redacted]
Report No.	[redacted]
Bartech Engineer	[redacted]
Engine Type	MTU 8V 396
Equipment Serial Numbers	[redacted]
Reason & Description of Planned Work scope:	Fully dismantle, clean, inspect and rebuild turbochargers.

Introduction

Engine Type: MTU 8V 396
Platform: [redacted]
Engine Serial No.: [redacted]

The turbochargers were removed and inspected prior to dismantling. It was evident that these were both in extremely poor condition. There were no signs of damage to the turbine blades. (Figure 1).

The units were marked prior to dismantling for identification purposes during the rebuild process.

Initial Inspection

The exhaust outlet was removed followed by the air side turbine housing was removed (Figure 2). No damage or unusual makings were discovered.


Figure 1. Turbocharger dismantled


Figure 2. Turbine dismantled

The rotor assemblies were dismantled in accordance with the instructions shown in the MTU workshop manual. All parts were found to be within manufacturers tolerances.

The rotor was then sent for balancing. (Figure 3.).

All the main castings were air lined and oil passages blown through. All the main castings were painted externally with Matt black high-temperature paint.

New bearing sleeves were fitted to both the main bodies. The turbocharger was reassembled in accordance with the workshop manual using all new gaskets and seals (Figure 4.).

Full rotation at each section of the build was confirmed.

The casting orientation was replaced to the original markings made upon dismantle and the compressor wheels were fitted using the appropriate bespoke hydraulic tools.

Following rebuild, the thrust was found to be within manufacturer's instructions.

The turbochargers were then rebuilt (Figure 5).


Figure 3. Rotor Balancing


Figure 4. Ready to be rebuilt


Figure 5. Complete turbochargers


Figure 5. Complete turbochargers

Client:	[redacted]
Installation:	[redacted]
Date:	[redacted]
BME Job No.	[redacted]
Report No.	[redacted]
Bartech Engineer	[redacted]
Engine Type	MTU 8V 396
Equipment Serial Numbers	
Reason & Description of Planned Work scope:	Dismantle, inspect and report on condition of the water pump.

Introduction

Engine Type: MTU 8V 396
Platform: [redacted]
Engine Serial No.: [redacted]

After the water pump was removal from the engine it was evident that it was in good condition with little corrosion damage, or rust deposits (Figures 1 & 2). There was also no visible damage to the impeller (Figure 3).


Figure 1. Coolant pump before dismantling


Figure 2. Coolant pump


Figure 3. No damage to impeller

Initial Inspection

The connector ring was removed from the main pump casing with the aid of a heat being applied.

This allowed for a full inspection of the impellers (Figure 5). No damage was found including the three connecting ring retaining lugs (figure 4).

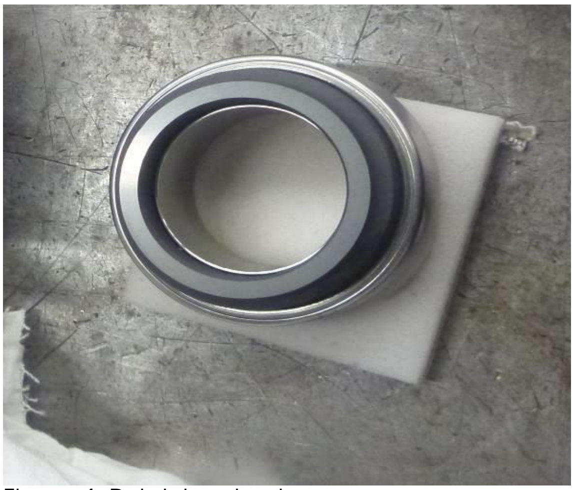


Figure 4. Retaining ring lug


Figure 5. Impellor blades

Rebuild

Following cleaning the pump was rebuilt using new gaskets and seals.

[redacted]	10:00 P-[redacted]	[redacted] ran up for 2 weekly ops check. Ran fine but fuel pressure was flagged up on the log sheet as it was 3.6Bar (3.5Bar max). e-mail sent to PTL for passing on to the TA as stated on the log sheet. Pump ran for the 1 hour, shut back down and now on s/by. Diesel day tank topped up.	Production: Gas	
[redacted]	12:15 [redacted] ops check run	[redacted] ran up for ops check and con mon. No issues. Pump left s/by with [redacted] as lead.	Production: Gas	
[redacted]	10:30 [redacted] gearbox oil	[redacted] gearbox oil has burnt out again. Checking gearbox temps through the morning and the thermostat/heater appear to be controlling fine.	Production: Gas	
	14:49 [redacted] gearbox	W/O [redacted] raised to change [redacted] gearbox oil and inspect the cooler and pipework again.	Production: Gas	
[redacted]	14:30 [redacted] Jkt htr	[redacted] jacket heater and circulating pump reset.	Production: Gas	
[redacted]	09:50 [redacted] Online	[redacted] started for maintenance.	Production: Gas	
[redacted]	01:00 [redacted]	[redacted] 2 weekly operational check carried out to test functionality of SCE CAPS-F017-02-01. Start mechanism used was pressure transmitter PEA-66165. Flow rate of 1229m3/hr recorded at 10barg. WO [redacted] signed off.	Production: Gas	Operational Action
	01:00 [redacted]	[redacted] 2 weekly operational check carried out to test functionality of SCE CAPS-F017-02-01. Start mechanism used was pressure transmitter PEA-66165. Flow rate of 1229m3/hr recorded at 10barg. WO [redacted] signed off.	Production: Gas	Operational Action
[redacted]	08:00 [redacted]	[redacted] Seawater Cooling strainers cleaned, very little debris present	Production: Gas	Operational Action
	11:29 [redacted]	Started and shutdown [redacted] for conmon. Noted gearbox oil has turned black again and smells rancid. Took temp readings of gearbox using gun. Highest temp on gearbox was 60 degrees Celsius. Inlet to gearbox cooler is 50 degrees Celsius and out outlet is 30 degrees Celsius. Cooler does seem to be working, likely the heater element which is causing issues again.	Production: Gas	Operational Action
[redacted]	14:00 [redacted]	[redacted] sea water strainers changed out under WCC and personal isolation. Awaiting [redacted] test run due to wind direction.	Production: Gas	
	17:43 [redacted]	Unable to test run [redacted] due to wind direction throughout the day. Fire pumps can be run up tonight to complete P1 routine as advised by Mech dept. Con Mon can be carried out later this week.	Production: Gas	
[redacted]	17:30 [redacted]	Wind in the wrong sector all day for a test run of [redacted]	Production: Gas	
	23:00 Fire Pump [redacted]	Routine test run of [redacted] carried out by local start battery bank 1. WO [redacted] signed off	Production: Gas	
[redacted]	13:00 [redacted]	[redacted] ran up for mechies con-mon	Production: Gas	
	16:00 [redacted]	[redacted] stopped and restarted to allow debris in [redacted] to settle after. [redacted] test run	Production: Water	
	20:00 [redacted] diesel top up	[redacted] diesel day tank topped back up.	Production: Gas	
[redacted]	20:00 [redacted] Jacket Htr	[redacted] jacket heater does not appear to be functioning correctly; while it is indicating that it is online and there are no trips present, the coolant and heater are cool and the low temp alarm will not reset. W/O [redacted] raised to have this checked.	Production: Gas	
[redacted]	05:02 [redacted] Isolated	[redacted] isolated for gearbox oil change on [redacted].	Production: Gas	
[redacted]	14:20 [redacted]	[redacted] de-isolated following gearbox oil maintenance. [redacted]	Production: Gas	Operational Action
	16:30 [redacted]	Carried out operational check of [redacted]. WO [redacted] signed off.	Production: Gas	Operational Action
[redacted]	23:00 Fire Pumps	After service water issues, [redacted] & [redacted] kicked in. Pumps shut down and [redacted] diesel day tank topped back up. [redacted] engine oil topped up from 20% to 40%. Seems to be burning around 20% of the oil over a 1hr test run.	Production: Gas	
[redacted]	14:30 [redacted]	Isolation applied to [redacted] hydraulic starter accumulators. LVR updated. [redacted]	Production: Gas	Operational Action
[redacted]				

	08:15 Fire pumps	[redacted] switched to manual whilst service water strainers were inspected and cleaned by Mechanical	Production: Gas	
	11:00 Fire pumps	[redacted] started using low pressure auto start method. Condition monitoring carried out by mechanical department. Work order [redacted] signed off.	Production: Gas	
	11:00 Fire pumps	Operational LVR completed for valves operated when test running [redacted]	Production: Gas	
[redacted]	05:28 Process shutdown	The process has been shut down due to a leak/crack on service water supply tank [redacted] in leg [redacted] which takes out [redacted] and [redacted] All chokes & flow wing valves have been closed in. All chemical injection pumps have been closed in. Produced water flash drum block valve in CD1 has been closed in. The hydrocyclone oil reject manual block valves have been closed in. Both test and production UMC XCVs have also been closed in.	Production: Oil	
[redacted]	04:54 [redacted]	Noted [redacted] gearbox oil has degraded again and smells foul after being changed out in January. Raised a Work Order [redacted] to change oil and fault find on heater	Production: Gas	Operational Action
[redacted]	16:30 [redacted]	Service water tank [redacted] repairs/inspection. Isolation made up for fire p/p [redacted]	Production: Utilities / Power	Operational Action
[redacted]	16:35 [redacted]	Fire pump [redacted] isolated [redacted]	Production: Utilities / Power	Operational Action
[redacted]	13:15 Fire Pump Cut In test	Fire Pump cut in test carried out for [redacted] isolated at time of test. Pump sequence [redacted] selected. Pressure vented down at [redacted] The available pumps started within the allowable time but unable to confirm any start signal for [redacted] due to the isolation. [redacted] shutdown and [redacted] selected as lead again.	Production: Gas	
[redacted]	13:00 [redacted] Spec Blind Swing	[redacted] created for [redacted] Spec Blind Swinging.	Production: Water	Operational Action
	16:30 [redacted] Spec Blind Swing	Currently at requested. [redacted] created for [redacted] Spec Blind Swinging	Production: Gas	Operational Action
[redacted]	10:00 [redacted]	Put [redacted] in place to allow swinging of spec blind on [redacted] discharge for [redacted] vessel entry	Production: Gas	Operational Action
	15:00 [redacted]	Raised Work Order [redacted] for stripping [redacted] fuel injection leakage pump discharge pipework and checking nrv as the sump is overflowing and weeping from seal. Isolation will require pumping out diesel day tank into barrels	Production: Gas	Operational Action
	17:32 [redacted]	Spec Blind swung into closed position on [redacted] discharge for vessel entry on [redacted]	Production: Gas	Operational Action
[redacted]	12:00 [redacted]	[redacted] de-isolation carried out.	Production: Utilities / Power	Operational Action
[redacted]	22:00 [redacted] fire pump	Diesel leak cleaned up. Weeping fitting looked at my Mechies but will require a permit to remove the lid and tighten up the t hrough tank connector. They will pass on to dayshift	Production: Gas	
[redacted]	07:15 Fire Pumps	Looked over [redacted] and [redacted] with Bartech vendor and took pictures for his report.	Production: Gas	Operational Action
[redacted]	02:00 [redacted]	Created and put in place [redacted] to allow mechanical maintenance to replace diesel filters on engine	Production: Gas	Operational Action
[redacted]	04:00 [redacted]	Isolation applied [redacted]	Production: Utilities / Power	Operational Action
[redacted]	17:00 Diesel Samples	[redacted] diesel sample (x2) collected and taken to lab. [redacted] diesel outlet isolated, no sample taken.	Production: Gas	
[redacted]	15:00 [redacted] diesel de-isolated	[redacted] diesel supply valve de-isolated.	Production: Gas	
[redacted]	12:00 [redacted]	De-isolated [redacted] on [redacted] and updated LVR to reflect valve positions	Production: Gas	Operational Action
	14:00 [redacted] Firepump	[redacted] Firepump De-Isolated Under [redacted]	Production: Utilities / Power	Operational Action
	15:00 [redacted]	Attended [redacted] go/no go meeting. Currently waiting on [redacted] engine oil heating up before going for a start, emergency fuel valve shut off test and performance test	Production: Gas	Operational Action
	17:29 [redacted]	Got confirmation from the DSV that hydraulic [redacted] are in the open position.	Production: Water	

		Went down [redacted] and opened [redacted] to test the caps which have been in place where [redacted] normally sit. No leaks were found and the JIMS tags have been updated.		
		Carries out seat leakage tests on [redacted] Both were 1.5 LITRES/MIN. A lot more than was expected, these readings have been recorded and handed into maintenance supervisor.		
		[redacted] is now in a position for fire pump [redacted] to run. [redacted] are all in the open position allowing a path from the sea to [redacted].		
	19:40 Fire Pump [redacted]	Control start initiated to run [redacted]. Pump isolated from the main and routed overboard. Pump started but then the discharge pressure and flow soon began to drop off. Inspection of the overboard flow confirmed there was reduced flow. It was also noted that the water was very dirty. Suspect the pump had picked up debris into the suction basket. Pump manually shutdown. The engine coolant then began to overflow as the coolant temperature was hot. Pump left in manual and valves routed back into the system. Awaiting discussions and future test run on dayshift.	Production: Gas	
[redacted]	04:10 Fire Pump [redacted]	Operation LVR event created with new tag numbers following test run	Production: Gas	
	17:04 [redacted]	Assisted gas tech with [redacted] firepump workscopes. Line walked and lined up for test. Jacket water heaters reset a couple of times. Test run commenced & currently ongoing.	Production: Utilities / Power	Operational Action
[redacted]	20:30 Fire Pum [redacted]	Operation LVR event created with new tag numbers following test run	Production: Gas	
	01:00 [redacted]	[redacted] fire pump heater checked all ok.	Production: Utilities / Power	Operational Action
	08:00 [redacted]	Carried out test run overboard of [redacted]. Pump pressure and flow looked fine whilst attaining around 1150m3/hr at 10bar. Engine parameters where okay although air charge coolant temp was slightly high. Noticed gearbox bearing smoking and shutdown pump immediately	Production: Gas	Operational Action
	11:00 [redacted]	[redacted] heater reset and powered back up ok, now back online showing around 40 deg C.	Production: Utilities / Power	Operational Action
	14:00 [redacted] Firepump	[redacted] Firepump Test Runs carried out throughout the day. Readings taken and logged.	Production: Utilities / Power	Operational Action
[redacted]	14:00 [redacted]	Greased [redacted] gearbox bearing and ran up engine for a performance test. Test data with prodsupv. Lined up [redacted] into firemain, in auto. Re-locked all valves into the correct locked positions and updated LVR	Production: Gas	Operational Action
	22:00 Fire Pump [redacted]	[redacted] started locally on battery 1. Pump set up to carry out performance test. Pump flows were down from where they should be. Flow transmitter blown through but only getting 1076 m3/hr at 100%. Also at higher flow rates the coolant temperature was rising. large amounts of smoke was noticed coming from the gearbox at the top of C3 leg. Pump shutdown. Lined up back into the fire main but selected to manual to prevent automatic start.	Production: Gas	
[redacted]	22:50 Fire Pump [redacted]	WO [redacted] signed off following local start from battery bank 1	Production: Gas	
	01:40 Fire Pump [redacted]	Operational LVR event submitted for valves operated during test run	Production: Gas	
	10:00 P[redacted] Firepump	[redacted] Firepump Isolated under [redacted] AC & DC Supplies Isolated.	Production: Utilities / Power	Operational Action
	11:00 [redacted]	Created ICC for [redacted] gearbox inspection and LVR	Production: Gas	
	13:00 [redacted]	[redacted] isolated for gearbox bearing inspection	Production: Gas	
[redacted]	15:00 [redacted]	Attended [redacted] TBT with Mech Dept	Production: Gas	
	04:00 Fire Pump [redacted]	JIMS tag updated following blind removal	Production: Gas	
	08:02 [redacted] Firepump	[redacted] Firepump DFT carried out under [redacted] Jacket water heater reset and now back online.	Production: Utilities / Power	Operational Action
	11:00 [redacted]	Started up [redacted] for test run and gearbox inspection. Stated up on Bat1 (CRO) no issues and ran for 20 mins overboard @10b 1260m3/hr . No signs of bearing or packing being damaged but had to button the engine to too Exhaust / Lube oil temps over temp. So much so plate pack cooler vapour vent lifted. Suspect cooling water circulation problems . 8Bar delivery of cooling water so maybe thermostat.	Production: Gas	
	17:03 [redacted]	[redacted] Re-Isolated for Thermostat inspection and plate cooler drain.	Production: Gas	
[redacted]	22:00 [redacted]	[redacted] fire pump Isolated for Mech work scopes [redacted]	Production: Utilities / Power	Operational Action
	19:30 [redacted]	Fire pump [redacted] DFT'd. Jacket water heater reset and back on line. To be monitored during the shift.	Production: Utilities / Power	Operational Action
[redacted]	19:40 [redacted] fire pump	[redacted] de-isolated [redacted] Jacket water heater on.	Production: Gas	

	08:00	[redacted]	Started up [redacted] (Bank 2 CRO) no issues at first . After a few minutes of mechys adjusting thermostat engine temps were steady (bit low) but engine rand fine for and hour @ 10bar . Completed Operations WO then began the Performance Test .3/4 way through test sparks were noticed on the Hydraulic pump motor on the side of the engine and a part dislodged so shut down an isolated for inspection . Performance test = Pump @ 12.4bar 1090m3/hr ([redacted] 10bar 1248m3/hr 9bar 1344m3/hr 8.5bar 1410m3/hr	Production: Gas	
	08:05	Fire pumps	[redacted] Diesel fire pump started	Production: Control Room	Operational Action
	10:00	Fire pumps	[redacted] Diesel fire pump shutdown due to issues with module hydraulic cooling fan.	Production: Control Room	Operational Action
	13:00	[redacted]	Reisolated [redacted] for inspection	Production: Gas	
	15:05	[redacted] Firepump Isolation	[redacted] Firepump isolated under [redacted].	Production: Utilities / Power	Operational Action
[redacted]	22:00	ISSOW	[redacted] Fire pump Isolated. Disconnected relays and cable [redacted]	Production: Utilities / Power	Operational Action
[redacted]	12:56	COA Weekly Report - Mechanical	[redacted] Damage to gear train due to potential bearing failure. Bartech mobilising 23/05 to assess potential to facilitate repair offshore. Significant scope required to bring pump back into service [redacted] Pump tripped on high vibrations and significant vibrations noted by PAM. Looking to mob PAM to undertake detailed sweep of machine as vibrations are not recognised in failure modes by Solar SD Prep [redacted] final scope exclusions confirmend N/C defect repair, additional options being reviewed to provide the best overall solution for the asset. Other Plumbers mobilised to assist with leaks in accommodation [redacted] mobilising to assist with cleaning of hydrocyclones	Onshore: Mechanical	Weekly Report
[redacted]	14:00	[redacted] fire pump	[redacted] sprinkler system isolated for [redacted]	Production: Gas	
[redacted]	10:00	Open Hazardous Drains	Open hazardous drain spool removed from above [redacted] and replaced with a temporary hose. This is to allow for the installation of a lifting beam.	Production: Gas	
[redacted]	14:00	[redacted]	Single point ICC created for the pump discharge spec blind. Isolation now in place to allow pipework removal from & around the gearbox.	Production: Gas	
[redacted]	08:00	HVAC	Stand alone isolation applied for the removal of ducting at the top of [redacted] to allow the removal of [redacted] gearbox. Isolation will be removed once a blank has been put in place to restore extract to [redacted]	Production: Utilities / Power	Operational Action