Client:	
Installation:	Fire pump Engine
Date:	29/05/2019
BME Job No.	
Report No.	
Bartech Engineer	
Engine Type	Deutz DFP6 1013 C20
Equipment Serial Numbers	
Engine Hours	Not available
Reason & Description of Planned Work scope:	Dismantle and report

Tel: +44 (0) 1206 791552
Fax: +44 (0) 1206 225241
Email: info@bartechmarine.com
Web: www.bartechmarine.com
Vat No: GB 4635797 08
Company No: 02154196
Registered Office:
Unit D E & F, Chandlers Row,
Colchester, Essex, CO1 2HG
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Introduction

Initial information from site was the engine had excessive movement in the crankshaft, so was removed for dismantle and inspection in Bartech's workshop.

The unit was delivered to Bartech using the customer's courier with the engine sitting on a pallet, plus a separate pallet of removed and supplied parts.

The pallet of parts and engine were unloaded and moved into workshop for visual inspection and photographs.

On the separate pallet was an engine flywheel with substantial damage to the ring gear and back of the wheel. There was also a starter motor with its bendix pinion badly damaged, a coupling of universal design, an adaptor for the flywheel, an exhaust pipe and new starter motor.

The engine was empty of oil, but full of coolant. This needed to be removed and disposed of, to carryout the inspection.

Work Carried Out

The engine was placed onto legs for easier working height and after a visual inspection carried out. Early inspection showed he crankshaft had suffered a major issue.

The bell housing was cracked through in the lower section (Fig. 1) and the rear timing case had sustained extensive damage with heavy scoring and partial removal of material (Fig. 2 & 3)

Fig 1. Cracked bell housing

Fig 2. Worn case

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Fig 3. Damaged aperture on timing case

The crankshaft had dropped and was resting on the lower section of the rear timing case. With the aid of a pry bar the crankshaft could be manually lifted 30mm.

A rotation check was attempted but found crankshaft would only move 120° in either direction.

There was no oil in the oil pan to obtain an oil sample so one has been taken from the oil filter.

The engine was drained of its coolant and all water pipe work removed followed by the exhaust and air manifolds.

It was noted the engine has had a new cylinder head gasket in the past as there was no paint on the gasket and calibration marks were etched on the bolt heads. During the dismantle, it was found that a considerable number of bolts and retaining screws were looser than they should be.

With the valve cover removed, it was observed that all the exhaust valve push rods were bent, and two inlet valve push rods were also bent (Fig. 4)

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Fig 4. Bent push rod

The valve gear retaining bolts were found to be finger tight on the exhaust side of the operating mechanism, indicating these are stretched beyond their reusable value.

The cylinder heads were removed, and it was observed that number 1 piston assembly had come into contact with the base of cylinder head, and that all exhaust valves had contacted pistons. (Fig. 5 & 6)

Fig 5. Valve mark on top of piston

Fig 6. Marks on valve

This will be as a result of the excessive movement on the end of the crankshaft where the timing gears are located, which would have misaligned the valve timing.

A visual look into the cylinder bores indicated piston damage to both number 1 and 2 pistons.

The fuel injection pump was then removed and marked for the relevant positions with associated adjusting shims.

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The engine's oil pan was removed and found to contain various amounts of metal from internal components (Fig. 7 & Fig. 8). The oil pump suction pipe was removed to gain access to the connecting rods.

Fig 7. Metal debris in oil pan

Fig 8. Metal debris in oil pan

The crankshaft was found to have snapped in two pieces (Fig 9) and subsequently broken bearing caps from number 1 and 2 cylinders (Fig 10).

Fig. 9 Snapped crankshaft

Fig 10. Broken bearing cap

The connecting rod bolts on number 1 piston assembly were bent and with the bolts removed, it was found the bearing shell had welded itself to the connecting rod due to excessive heat.

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Fig 11. Bearing in connecting rod No 1

Fig 12. Bearing in connecting rod No 1

The connecting rod from number 2 cylinder was then removed and found the lower section of the piston skirt was damaged with a piece missing with score marks up and down the piston (Fig. 13)

Fig 13. Scored piston

To enable the remaining pistons to be inspected the broken section of crankshaft was extracted by removing the bell housing and timing cover.

Looking up from underneath the engine it was noted that one of the camshaft bearing bushes had become dislodged and was jamming open a cam follower. This bush had been damaged to the extent it had wrapped around a camshaft lobe (Fig. 14), due to a lack of oil following the break to the crankcase disrupting the oil flow.

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Fig. 14 Camshaft bush damage

The remaining pistons were removed, and the cylinder liners extracted. The liners and remaining pistons are in good condition with the big end bearings found to be in good condition, showing the damage has been localised to the cracked crankshaft.

All the timing gears were found to be damaged (Fig. 15 & 16)

Fig 15. Damaged timing gears

Fig 16. Damaged timing gears

The entire crankcase assembly was rotated 180° to remove the remaining section of crankshaft. With the case rotated all the remaining main bearing caps were removed, as well as the crankshaft section.

With all the bearing shells removed, a crack running along the bearing mount on number 3 main bearing bore (Fig. 17) and large sections of the crankcase were missing from numbers 1 and 2 main bearing apertures (Fig 18).

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Fig. 17 Crack in bearing mount

Fig. 18 Damage to gearing aperture

Looking down into the crankcase the camshaft was jammed with the dislodged bush, which was preventing the camshaft from being removed. The bush had to be broken up so the camshaft could be removed.

All cam followers were removed, and the camshaft inspected. The camshaft looks in good condition, although the teeth are stripped from the gear on the drive end. The gear wheel is a shrunk on fit so will require a new assembly if considering rebuild with new case and crank.

The following sub-assemblies have not yet been dismantled, because of the significant damage already found with the major assemblies:

- Oil pump
- Oil cooler
- Oil filter housing
- Governor
- Water pump
- Fuel pump injectors
- Turbo

Measurement sheets for the camshaft, connecting rods, crankcase and liners accompany this report.

Outstanding Actions

If a new base engine is to be used, then the CSR parts fitted to the damaged unit could be transferred if not damaged. The engine water header tank requires repairing due the fretting on which the support brackets have been mounted. (Figure 19 & 20)

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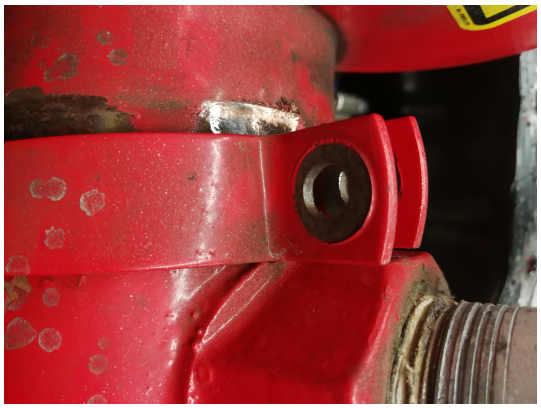
Fig 19. Fretting on header tank



Flg 20. Fretting on header tank

Recommendations

Because of the significant amount of damage, a replacement engine long block is required, we have sourced a good condition used engine. All good components from the existing engine can be overhauled and installed to provide an identical set.

It is our opinion that this damage has been caused by an extensive amount of continued vibration at high frequency. This must be investigated further and eliminated prior to any new or replacement unit being fitted. The unit to which this engine is the prime mover should also be investigated for possible damage.

When the engine is tested it would be beneficial to obtain a vibration analysis report, so a comparison figure can be compared to that obtained onsite.

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Registered Office:
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Colchester, Essex, CO1 2HG

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		TEST SHEET NO	BMTS
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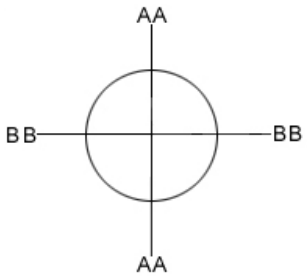
JOB NO		CAM SERIAL NO	
ENGINEER	I	ENGINE NO	



JOURNAL NOMINAL DIMENSION		LOBE HEIGHT NOMINAL DIMENSION	

NO.1	JOURNAL DIM	AA	64.94	BB	64.94	LOBE HEIGHT FM FREE END	NO.1	
							NO.2	
NO.2		AA	64.94	BB	64.94		NO.3	
							NO.4	
NO.3		AA	64.94	BB	64.94		NO.5	
							NO.6	
NO.4		AA	64.94	BB	64.94		NO.7	
							NO.8	
NO.5		AA	64.94	BB	64.94		NO.9	
							NO.10	
NO.6		AA	64.93	BB	64.93		NO.11	
							NO.12	
NO.7	REAR JOURNAL	AA	64.93	BB	64.93		NO.13	
							NO.14	
NO.8		AA		BB			NO.15	
							NO.16	

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COMMENTS:

Tel: +44 (0) 1206 791552
Fax: +44 (0) 1206 225241
Email: info@bartechmarine.com
Web: www.bartechmarine.com

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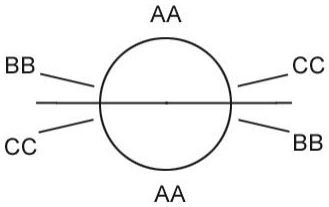
DATE	24/5/19	TEST SHEET NO	BMTS
JOB NO		ALTERNATOR NO	
ENGINEER		VESSEL NAME	
CONNECTING ROD TYPE		ENGINE NO	



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

BORE FREE END NO 2	A-A	72.510	B-B	72.527	C-C	72.520	ROD SERIAL NO
BORE DRIVE END:	A-A	72.511	B-B	72.524	C-C	72.522	

BORE FREE END NO 3	A-A	72.520	B-B	72.521	C-C	72.525	ROD SERIAL NO
BORE DRIVE END:	A-A	72.521	B-B	72.518	C-C	72.530	

BORE FREE END NO 4	A-A	72.512	B-B	72.535	C-C	72.500	ROD SERIAL NO
BORE DRIVE END:	A-A	72.512	B-B	72.536	C-C	72.498	

BORE FREE END NO 5	A-A	72.517	B-B	72.535	C-C	72.510	ROD SERIAL NO
BORE DRIVE END:	A-A	72.520	B-B	72.527	C-C	72.517	

BORE FREE END NO 6	A-A	72.516	B-B	72.508	C-C	72.537	ROD SERIAL NO
BORE DRIVE END:	A-A	72.518	B-B	72.506	C-C	72.539	

DIMENSIONS TO BE TAKEN WITH & WITHOUT BEARING SHELLS			NOMINAL SIZE
INDICATE IF MEASURED	~~* WITH~~	* WITHOUT	72.48/72.52

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Tel: +44 (0) 1206 791552
Fax: +44 (0) 1206 225241
Email: info@bartechmarine.com
Web: www.bartechmarine.com

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

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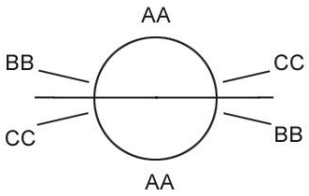
DATE	24/5/19	TEST SHEET	BMTS
JOB NO		UNIT NO	
ENGINEER		CRANKCASE NO	
		ENGINE NO	



MEASURMENT TO BE TAKEN WITH BEARING SHELLS	
STATE WITH OR WITHOUT BEARING SHELLS	NOMINAL SIZE

POSITION	AA F.E	AA D.E	BB F.E	BB D.E	CC F.E	CC D.E	RUNNING CLEARANCE
NO.1							
NO.2							
NO.3							
NO.4	90.565	90.562	90.496	90.499	90.608	90.592	
NO.5	90.548	90.557	90.508	90.520	90.528	90.538	
NO.6	90.562	90.560	90.545	90.545	90.522	90.510	
NO.7	90.560	90.567	90.528	90.531	90.528	90.529	
NO.8							
NO.9							
NO.10							
NO.11							
NO.12							

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COMMENTS:

No 1,2 and 3 badly damaged

No spec in manual

Tel: +44 (0) 1206 791552
Fax: +44 (0) 1206 225241
Email: info@bartechmarine.com
Web: www.bartechmarine.com

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

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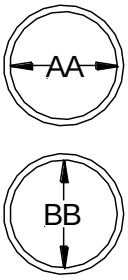
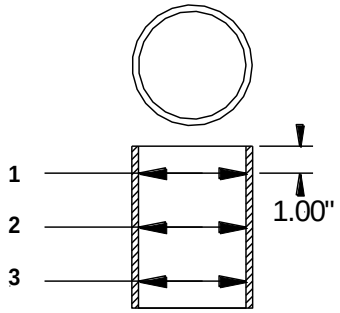
Test Sheet
Cylinder Liners
(Bme018F6 / Issue 1)

DATE	24/5/19	TEST SHEET NO	BMTS
JOB NO	J	ALTERNATOR NO	
ENGINEER		VESSEL NAME	
PORT / STARBOARD SIDE		ENGINES NO	





OUR SERIAL NO		NOMINAL SIZE	107.98/108.02 108.1 Max

CYL NO 1	AA	1: 108.010	2: 108.012	3: 107.998	BB	1: 108.025	2: 108.032	3: 108.036
CYL NO 2	AA	1: 108.016	2: 108.012	3: 108.005	BB	1: 108.026	2: 108.030	3: 108.021
CYL NO 3	AA	1: 108.030	2: 108.033	3: 108.027	BB	1: 108.029	2: 108.030	3: 108.022
CYL NO 4	AA	1: 108.023	2: 108.027	3: 108.022	BB	1: 108.027	2: 108.028	3: 108.025
CYL NO 5	AA	1: 108.031	2: 108.027	3: 108.017	BB	1: 108.028	2: 108.032	3: 108.035
CYL NO 6	AA	1: 108.021	2: 108.022	3: 108.013	BB	1: 108.020	2: 108.015	3: 108.008
CYL NO 7	AA	1:	2:	3:	BB	1:	2:	3:
CYL NO 8	AA	1:	2:	3:	BB	1:	2:	3:

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Fax: +44 (0) 1206 225241
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