Work Card Page 1 (5)	Criteria for Replacement of Connecting Rod Big-end and Main Bearing Shells	506-01.16 Edition 04

L27/38, L23/30H, L21/31, L21/31S, L23/30S, L27/38S

Safety precautions

- ☐ Engine stopped
- ☐ Shut-off starting air
- ☐ Shut off cooling water
- ☐ Shut off fuel oil
- ☐ Shut-off cooling oil
- ☐ Stop lub. oil circulation
- ☐ Press Blocking - Reset

Short Description

Inspection of bearing shells.

Starting Position

Bearing shells removed from engine:

Big-end bearing	506-01.30
Main bearing and guide bearing	510-01.05

Related Procedure

Inspection of main and guide bearing shells	506-01.30
In-situ inspection of connecting rod big-end bearing	510-01.05

Qualified Manpower

Duration in h	:	1/4
Number	:	1

Data

Data for pressure and tolerance	(Page 500.35)
Data for tightening torque	(Page 500.40)
Declaration of weight	(Page 500.45)

Special tools

Plate No.	Item No.	Note

Hand Tools

Magnifier (x30)

Replacement and wearing parts

Plate No.	Item No.	Quantity

L27/38, L23/30H, L21/31, L21/31S, L23/30S, L27/38S

The area around the engine

WARNING

The area around the engine must be clean and tidy!

General

This Working Card gives information about the evaluation of the connecting rod big-end and main bearing shells when wear appears on the running surface under normal operating conditions.

Bearing damages caused by incorrect running conditions, like

- Corrosion

- Overloading, overheating a.s.o.

are not described in this Working Card.

In these cases, the bearing shells must be exchanged, of course, and in order to avoid further bearing failures, the cause of the failure must be found and eliminated.

Inspection and replacement criteria for aluminium tin bi-metal bearings

Compared with overlay plated, or tri-metal, bearing construction, aluminium tin bi-metal bearings have a homogeneous construction throughout the lining layer. Thus surface wear will never change the operating characteristics of the bearing unless the lining is completely removed. The lining thickness is typically of the order of 0.4 to 1.0 mm for medium speed diesel engine bearings. This level of thickness would not be lost by conventional wear and would only be removed by virtue of major operating problems causing high temperature generation at the bore surface, or by fatigue.

Although conventional wear will never change the properties of the surface of the lining, the resulting increase in clearance can have several effects. These will all limit the acceptable level of wear, regardless of the lining material. The oil flow requirement through the bearing will increase, and ultimately the capacity of the engine oil pump will be reached. Hydrodynamic oil film formation is also a function of clearance, very large values resulting in reduction of film thickness. Additionally, as clearance increases, all bearing materials become more prone to suction cavitation erosion.

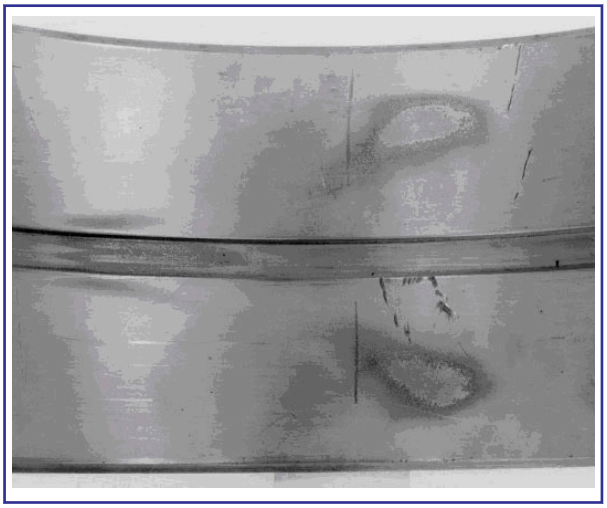

Figure 1: Suction cavitation erosion due to high clearance.

Under normal engine operating conditions, surface wear of un-plated tin-based aluminium alloy bearing alloys, such as A20 & A104, should be negligible. The surface hardness is significantly higher than overlay plated (tri-metal) bearings and affords as much reduced wear rate.

The bedding-in process will produce a moderate initial wear rate, while geometric inaccuracies in crank journals, housings and the bearings themselves are being accomodated. Once bedding-in is completed, wear rate usually becomes immeasurable.

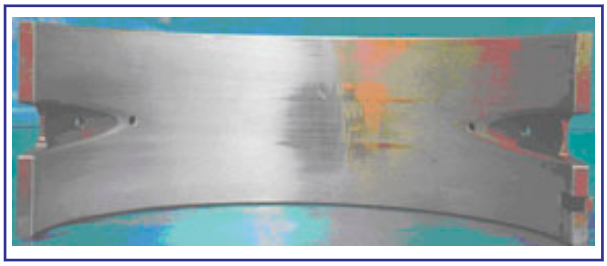

Figure 2: A104 bearing after 22.000 hours. ***Can refit.***

Direct measurement of bearing wall thickness is the simplest way of assessing the level of wear. The most common procedure would be to use a ball ended micrometer. However, at the low levels of wear that will usually occur, measurement inaccuracy can mask the true wear rate, but since it is only gross wear that will become the limitation, this method is acceptable. It should be noted that some bearings are deliberately bored eccentric to counter housing distortion, and this must be taken into account when assessing wall thickness measurements. Alternatively, Plastigauge, or other soft material, may be used for direct measurement of diametral clearance. The engine manufacturers' advice on maximum diametral clearance should be sought. If no such advice is available, a general rule is that the maximum clearance should not increase by more than 50% of the minimum design clearance.

A significant rate of wear would only be anticipated under severe adverse conditions, most commonly where oil entrained hard debris is present. Fine debris would be evidenced by an abraded appearance of the bore surface, while coarse debris would produce deep scoring with raised edges, often polished an eventually bedded-in. Large debris may not become completely embedded in the lining material, and would also score the shaft. Severe scoring of the bearing could cause overheating, tin melt and eventually seizure. However, aluminium tin bearing materials, such as A20 and A104, are tolerant of a significant level of contaminant, and can absorb it without detriment, and such bearings can be refitted.

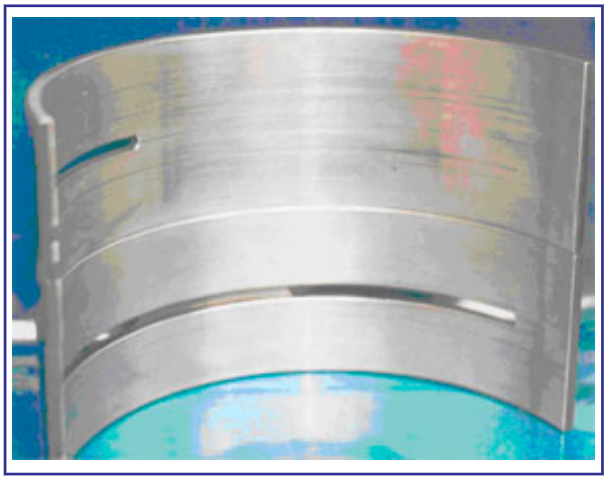

Figure 3: Acceptable level of contaminant. ***Can refit.***

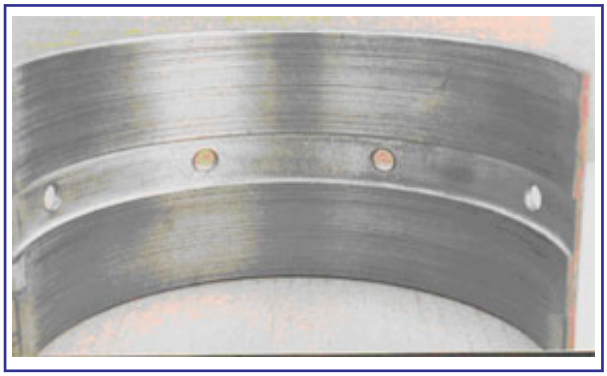

Figure 4: Multiple scoring due to excessive fine debris. ***Do not refit.***

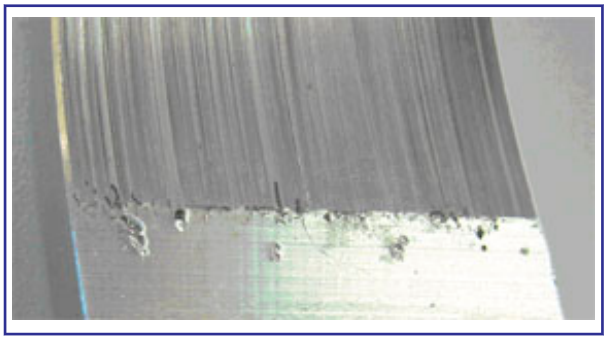

Figure 5: Large embedded debris. ***Do not refit.***

Replacement frequency for un-plated bi-metal bearings depends upon visual appearance and/or operating time. If, on removal and examination, the bore surface appears overheated, significantly scored, debris contaminated or showing other signs of distress, then the bearings should be renewed. It is

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often the case that bearings operate satisfactorily even though damaged, particularly if the damage progresses slowly. However, if such parts are refitted after inspection or overhaul they may be less tolerant to slight geometric variations introduced during the rebuild.

If significant debris has been present in the oil, over a long time interval, differential wear of the crank surface may have occurred. This is termed cam wear and is characterised by wear or wiping of the bearing surface between the ends of partial grooves. If this is evident, the bearings should be replaced, and the differential wear of the crank surface eliminated.

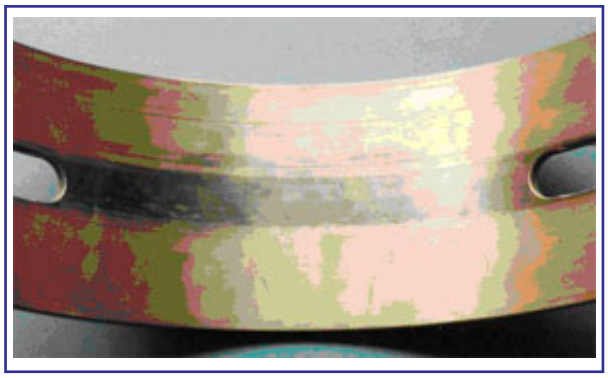

Figure 6: Cam wear. ***Do not refit.***

Any indication of loss of lining is an obvious reason not to refit the bearings. However, the cause for such damage should be investigated, and corrected where possible. The two most likely causes are fatigue and cavitation erosion. Provided the engine has been running at its design rating, fatigue should not occur unless some introduced defect is present. Possibilities include oil or debris trapped between the bearing and its housing, mechanical damage to the housing bore, the bearing back or bearing bore, or lack of support behind the bearing.

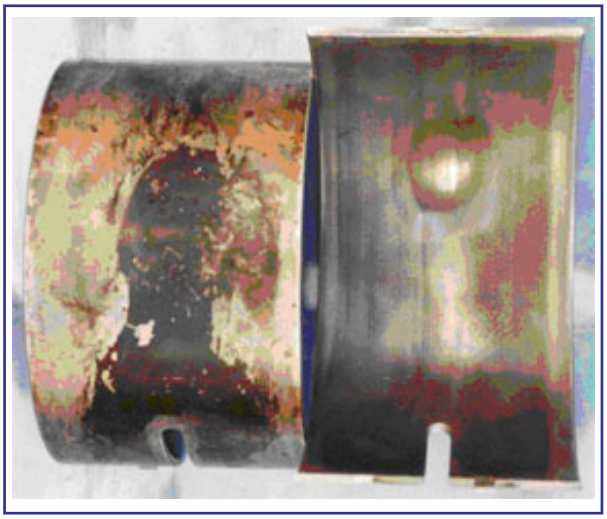

Figure 7: Carbonised oil behind bearing, causing overloading. ***Do not refit.***

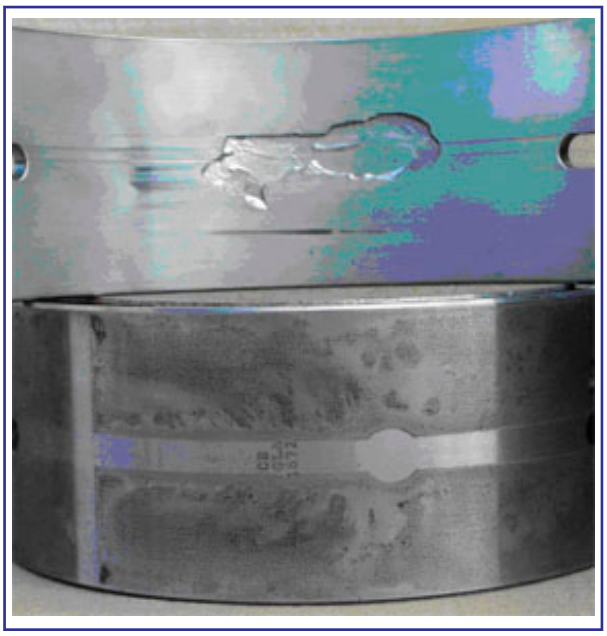

Figure 8: Lack of support behind bearing back results in fatigue in the bore. ***Do not refit.***

Aluminium tin bearings are resistant to corrosion in a normal engine environment, but can suffer damage due to water if the engine has been shut down for a long time. If all the oil has drained away, the bore surface and bond lines can oxidise. Such bearings should not be refitted.

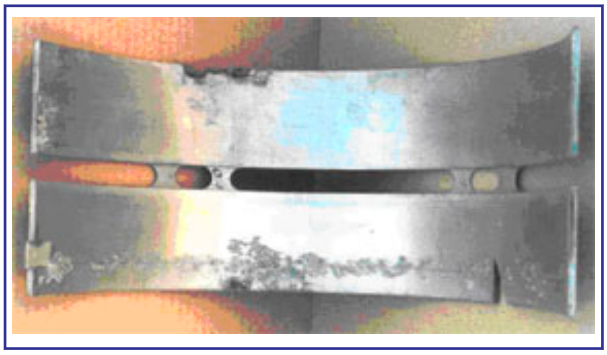

Figure 9: Corrosion due to water (in this case, outside the engine). ***Do not refit.***

As with any bearing material, if the interface between the bearing back and the housing bore shows signs of fretting, the bearing should be renewed, and any damage to the housing rectified. Even if the bearing bore surface has not been damaged, refitting in such a condition may still result in later damage.

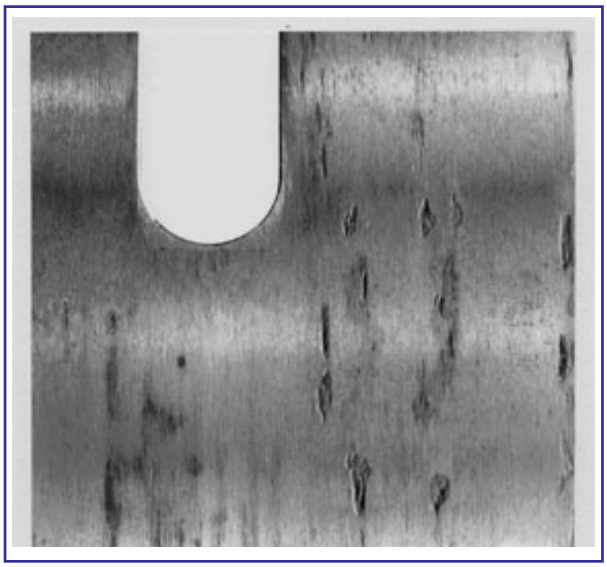

Figure 10: Fretting pits on bearing back. ***Do not refit.***

If bearings are in otherwise good condition, they should be checked for the presence of positive freespread before re-fitting. Some loss of freespread is normal, but bearings without positive freespread, possibly caused by high temperature operation, cannot be refitted correctly and must be discarded. Such bearings would have continued to operate successfully had the assembly not been dismantled, as freespread loss only occurs when the clamping bolts are released.