Damage Analysis of The Electric Generator Diesel Engine Connecting Rod

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Abstract. Diesel engine power plant suffered damage to a number of engine components after being operated a long time before. Damage begins with the sound of harsh sounds and then followed by very large vibrations. With this incident, the operator in charge then performs an emergency stop. Visually it is known that engine components that are damaged include the engine block and cylinder liner broken, broken piston rods, and broken crankcase covers. A number of engine components look out of position. From the visual observations obtained that the damage that occurs in the diesel engine most likely starts from damage that occurs in the piston rod. Therefore, the damage analysis carried out is only aimed at efforts to determine the types and factors that cause damage to the piston rod. A number of laboratory tests have been carried out including analysis of macroscopic examination of fracture surfaces, metallographic tests. From the results of damage analysis obtained shows that damage to the diesel engine piston rod is likely caused by wear that occurs at the small end of the piston rod so that it causes looseness in the bushing and causes enlargement in the gap between the rod eye and bushings. This condition causes a very large increase in stress on the bushing and rod eye so that the bushing is overloaded and in the end can cause damage (crack / break) on the bushing.

1. Introduction

Operators who are monitoring around the operating unit and the unit next to them hear a rough sound (knocking) and then check the sound source. Shortly thereafter the unit experiences over vibrations accompanied by rough sound (knocking), then the operator performs an emergency stop on the unit. After the engine stopped the operator did a visual check found damage to the engine block, liner, broken piston rod, broken crankcase cover and some components were out of position.

Figure 1. The engine block and crankcase cover on the right front are broken

2. Literatur Review.

The connecting rod is divided into several regions namely the top is the pin-end, the middle area is called the shank, and the bottom is the crank-end / big-end (figure 2). The pin-end and crank-end holes are each equipped with a very high accuracy bearing bearing. When connected to the piston the pin-end hole must be equipped with a solid bearing (bushings), while the crank-end part that besides getting the compressive force and thrust from the piston movement also gets a high temperature due to the rotational motion of the crankshaft so the presence of the bushing is also very important [1]. The parts of the connecting rod [2], 1. Fillet, 2. Seat for the nut, 3. Seat for the bolt, 4. Piston pin bushings, 5. Shank, 6. Bolt, 7. Parting line, 8. Connecting rod cap, 9. Bolt (nut), 10. Thrust bearing surface, 11. Piston pin bore, 12. Crankshaft hole

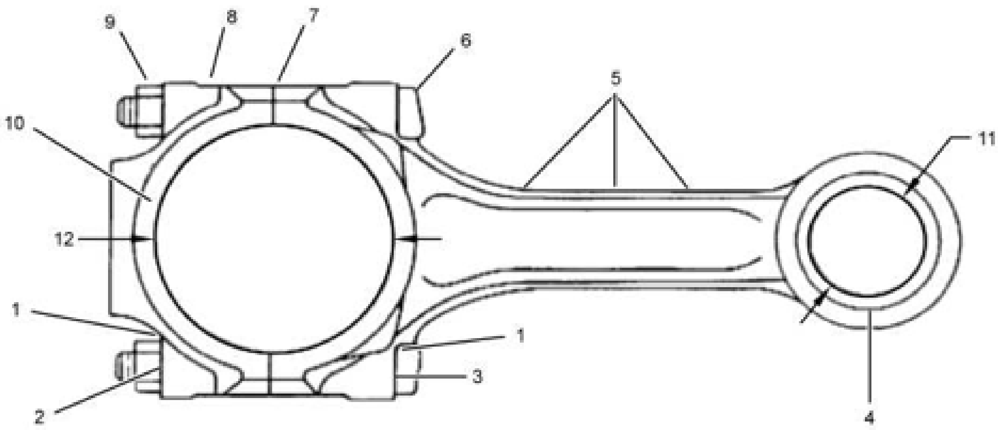

Figure 2. Parts of the connecting rod [2]

The connecting rod damage based on findings often results in major failure in the diesel engine, it was found that any casting defects might be developed depending on the cyclic loading behavior of the connecting rod [3].

3. Statement of Problem

Analysis of connecting rods using the method of visual inspection and some laboratory testing metallography and micro structure.

4. Objective of This Work.

The propose of this analysis connecting rod piston:

- To clearing procedure failure analysis connecting rod.
- Visual observation of connecting rod damage.

- Associate visual observation after laboratory testing.

5. Problem Description

In the failure analysis of connecting rod piston to determine the root cause of the damage.

6. Observation at Field

Observation were before damage of connecting rod[1] recording was carried out as follows: 1. Normal of exhaust temperatur, 2. Supply fuel to system combustion normal, 3. Pressure oil normal, 4.

6.1 Inspection of Broken at cylinder block.

Figure 3. Cylinder engine block broken

6.2 Inspection of Material Engine.

The broken engine component is in the oil pan (oil pan), after checking the components found according to the picture attached:

- Broken piston rod.
- Oil cooling jet
- Close the crankcase.
- Bushing flakes.

The material below is not a cause but an effect.

Figure 4. Broken engine components

6.3 Inspection of Oil Filter

To identify the particles that are in the oil filter of the engine components, checking the oil filter is carried out. Because the oil filter functions to filter particles under 2 microns, if the particles are smaller than 2 microns, the particles will be carried to the lubrication system.

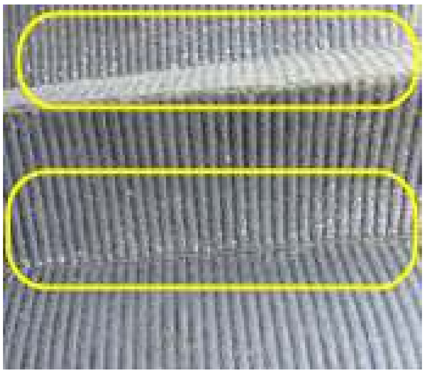

Figure 5. Large particles at oil filter

6.4 Inspection Valve, Cylinder Head and Top Crown Piston

Suction valves and exhaust valves collide with the piston top crown due to piston movement, when the bushing and rod eye distances are enlarged causing the piston to collide with the valve during the TDC step (top dead spot). If you look at the picture below traces of collision between the valve and piston top crown [4].

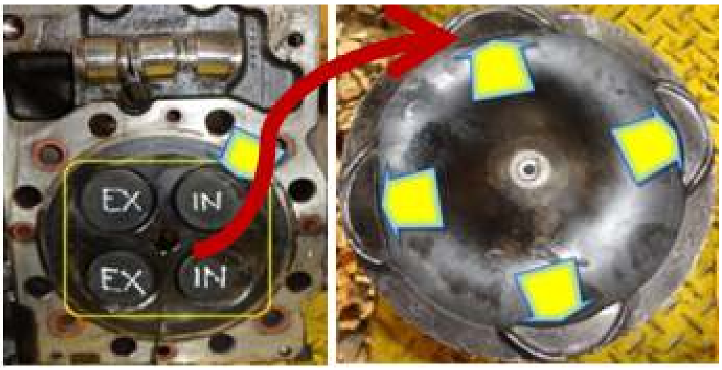

Figure 6. Top crown piston damage

Figure 7. Normal piston [4]

6.5 Inspection of Liner dan Under Top Crown

The piston position is still in the cylinder liner, which is caused when the rod eye is detached from the piston pin, the piston rod movement becomes abnormal and the piston bottom is damaged due to the movement of the piston rod. After the piston is released from its position the piston pin is still in position, this indicates that damage does not occur to the piston itself and the piston pin. And it should be noted from damage to the damaged part, that the right and left sides of the piston body are damage.

Figure 8. Pistons and Liners broken

6.6 Checking Connecting Rod

Broken connecting rod into 3 parts and in the position of the broken eye rod into 4 parts of them (A, B, C, D) according to the label listed.

Figure 9. Connecting rod faults

The fracture in Fig. 10 position A is about the shape of the rough surface, where during the rise and fall of the large load piston it is in position A.

Figure 10. Fault in position A & D.

Figure 11. Small end (rod eye) fracture shape in position B

Figure 12. Fault position of C small end (rod eye).

6.7 Micro Structure Testing
The microlocation structure of 3 fracture samples 2 in the fault area is bainite-ferrite and cracks occur due to impact loads.

Figure 13. Micro Structure of the rod eye fracture

7. Discussion
When the unit operates the bushing spins and starts to exit the bore, a little part of the bushing is released into debris and this splinter is found in the oil pan. The remaining bushings that are still inside the bore are overloaded so that damage occurs to the rod eye. From the results of a visual examination showed that the damage began in the rod in the rod eye area. The occurrence of fatigue is caused by an enlarged bushing chamber due to wear or friction that is significant enough to form the distance between the bushing and the surface of the loose rod eye diameter. After cracking propagate large enough the cross section of the rest can not withstand the load so that it occurs broken. When the piston rod is not in the piston pin and the piston rod is released and collides with the engine block. The failure was followed by a broken piston rod colliding with the engine block.

8. References
[1] C. Juarez, F. Rumiche, A. Rozas, J. Cuisano, and P. Lean, “Failure analysis of a diesel generator connecting rod,” *Case Stud. Eng. Fail. Anal.*, vol. 7, pp. 24–31, 2016.
[2] S. Guidelines, “Specifications for Connecting Rods { 1218 },” pp. 1–19, 2010.
[3] Z. Sajuri, “FAILURE ANALYSIS OF A FRACTURED CONNECTING ROD Finite Element Analysis,” vol. 2, no. 11, pp. 737–741.
[4] S. Guidelines, “Inspection Procedures and Specifications for Pistons { 1214 },” pp. 1–48, 2010.