Analysis Damage Cylinder Head Engine on QSK 50 MCRS

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Abstract: Damage that often occurs to the cylinder head is usually a lack of radiator air so that the engine may overheat, then the cylinder head packing/gasket is damaged due to prolonged use or errors during installation. This study aims to determine the problems that occur to the cylinder head, especially on the QSK 50 MCRS engine, so that the treatment of the cylinder head is better, in order to optimize engine operation in industrial processes. This research was conducted to obtain data in order to determine the cause of the cylinder head damage on the QSK 50 MCRS engine. There are several steps will be done including cleaning, visual inspection, and measurement and analysis of damage to the cylinder head. The results of this study indicate that there is erosion during the component cleaning process. There is damage on each surface of the combustion chamber at the cylinder head. The characteristics of the damage indicated that there has been cavitation erosion on the surface of the combustion chamber. Cavitation erosion occurs on the surface of the combustion chamber due to air bubbles that burst or explode during the power stroke of the engine's four stroke cycle. Cavitation erosion is characterized by a surface with small holes. Analysis of the 16 cylinder head QSK 50 MCRS shows that all cylinder heads can still be used, because the cylinder heads are still within the standard coverage set out in the manual.

1 INTRODUCTION

Diesel engine is an internal combustion engine (Internal Combustion Engine), whose fuel is sprayed into the cylinder chamber when the piston is at top dead center (TDC). This occurs because of the air in the cylinder has a high heat, and could making it easier for the fuel that has been injected to burn by itself. Diesel engines generally have main components such as pistons, valves, crankshafts, high-pressure fuel pumps and other driving mechanisms. The energy generated by the diesel engine through the combustion of fuel that occurs in the cylinder. This causes the displacement of the piston movement in the cylinder which is carried out by the crankshaft on the bearings through the connecting rod.

Cylinder head is part of the cylinder block that serves to close the cylinder cavity, and the space is the combustion chamber. The cylinder head, combustion in the cylinder chamber can occur. The cylinder block is referred to as the base engine part or a major component of the engine. The cylinder head is called the second base because this component forms the basis for several components on the upper engine. The cylinder head will receive a heavy load because it withstands compression pressure, so that in it leads occur some damage to this section.

Damage that can occur to the cylinder head includes damaged cylinder head packing which causes compression to leak and the engine does not function properly. The damaging can occur to the connection between 2 cylinders or to the oil and air connection, which results in the engine not working properly. Cylinder heads that experience cracks usually occur in diesel engines, cracks that occur due to overheating, where the engine overheats caused by excessive load or the cooling system is damaged or damaged, one of them. Cracks are also often caused by malfunctioning of the thermosat where when the temperature increases and the thermostat does not open.

2 RESEARCH METHODOLOGY

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volume look as uniform as possible (Moore and Lopes, 1999). Please remember that all the papers must be in English and without orthographic errors.

Do not add any text to the headers (do not set running heads) and footers, not even page numbers, because text will be added electronically.

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2.1 QSK 50 MCRS Engine Specification Data

The QSK is a Cummins engine model. The QSK50 is an engine with V-16 cylinder configuration with a total volume (displacement) of 50 liters. The Modular Common Rail Fuel System (MCRS) has a simplified design that provides a constant high injection pressure regardless of engine speed or load conditions. The advantages of this engine model among others and low vibration for quiet operation.

The data obtained from the QSK 50 MCRS Engine reviewed are as follows:

1. Engine model : QSK 50 MCRS
2. Machine Serial Number : 33187437
3. Cylinder head type : Sectional
4. Number of cylinders : 16 Cylinders
5. Machine weight : 5700 kg
6. Combustion chamber type : Direct Injection Modular Common Rail

2.2 General Procedures for Performing Cleaning, Visual Inspection and Measurement

Here's how to do the cleaning:

- Clean the cylinder head from the remaining gasket attached.
- Measure the thickness of the cylinder head in each combustion chamber.
- Measure the surface area of the combustion chamber.
- Check the combustion area for cracks or leaks.
- Inspect the burning area for damage and erosion.
- Re-condition of components requiring repair and replacement of parts that do not meet specifications

2.3 Research Diagram

This study aims to determine whether the QSK 50 MCRS cylinder head analysis still meets the standards with the manual and to find out how to minimize damage to the cylinder head. The stages in analyzing the damage can be seen in the image below.

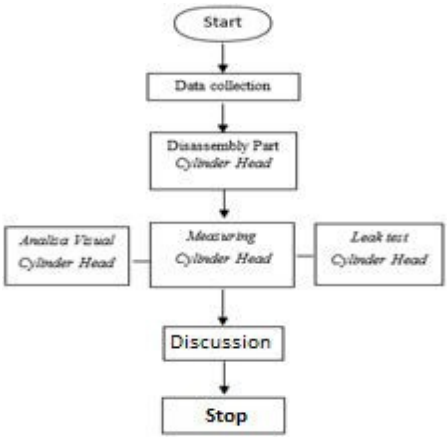


Figure 1: Research diagram.

3 RESULTS AND DISCUSSION

3.1 Cylinder Head Disassembly

From initial observations made on the QSK 50 MCRS cylinder head engine, it shows that the hour meter unit is 14,000 HM. The cylinder head is damaged on the surface of the combustion chamber, due to erosion.

Figure 2: Corrosion on cylinder head.

During the process of dismantling from the cylinder head on the QSK 50 MCRS engine. Actually, evidence was found that the right side of the combustion chamber surface was eroded. Therefore the cylinder head must be disassembled and then re- inspected to ensure the actual specifications on the cylinder head.

3.2 Disassembly Valve

One of the aims is to remove the components in the

cylinder head such as valve, spring valve, cotter, and retainer. The tools and materials used are as follows:

- Tools used: hydraulic press, magnetic tool, valve spring tool
- Materials used: majun

Safety used: safety helmet, safety shoes, safety goggles, hand gloves.

Figure 3: Disassembly valve.

Information:

a) Place the cylinder head under the hydraulic press,
b) valve spring device above the retaining valve,
c) Then press the valve spring tool with a hydraulic press. When Cotter is seen, take it using the magnetic tool,
d) After the cotter is removed, the retainer, valve spring, and valve can be removed.

3.3 Cleaning Process

In this step the cylinder head will be cleaned of dirt/dirt adhering to the components and cleaned of rust and oil adhering to the cylinder head. Because the slightest will affect the results of the measurements later. Figure 3 shows the process of inserting the cylinder head into the hot tank to remove the remnants of dirt/soil, paint, rust. Shows the spraying process on the cylinder head and grinding process uses an air angle grinder with a steel wire brush.

This process requires tools such as diesel fuel, gasoline, brushes, Scooth Brite, cloth cloth, air angle grinder, soap and hot tanks to facilitate cylinder head repair. After cleaning the cylinder head and smeared with a little diesel as an outer coating to prevent rust on the cylinder head. These steps are carried out to simplify the measurement process in order to get actual results from the measurement process.

Figure 4: Inserting the cylinder head into the hot tank.

3.4 Visual Cylinder Head Analysis

During the cleaning process, components were found to be damaged in part of each surface of the combustion chamber on the cylinder head. The characteristics of the damage can be indicated that there has been "erosion" on the surface of the combustion chamber, and erosion on the surface of the combustion chamber due to air bubbles or exploding during the power stroke of the four stroke engine cycle. Erosion is characterized by a surface with small holes. The phenomenon of the shrinkage porosity defect is caused by the inclusion of aluminum oxide carried into the Cylinder Head Type- A product which is the initiation of the formation of shrinkage porosity. The presence of aluminum oxide in Cylinder Head Type-A products is caused by the relatively long transfer of melting time from the smelting furnace and the relatively high auto carrier distance, which also affects the furnace pouring time. (Wahyudi and Wiryolukito 2020).

When these bubbles enter an area of high pressure, they burst (explode inward) sending a "beam" of liquid hitting the metal surface at supersonic speeds. Minor cracks sometimes occur and coalesce until a small portion of the metal particles is released and results in holes in the component.

Deep pitting/pitting on the liner surface is the result of cavity erosion. The damage could accumulate in one area of the liner wall only. Actually, at the time of revelation stated that the damaged area was located between the cylinder head and the liner surface.

The aluminum housing of the cooling system can be damaged by cavitary erosion, especially if there is obstruction in the intake/inlet line which results in a

low pressure and subsequently cavitation of the fluid in the pump impeller. Bubbles (bubbles) are formed on the low pressure side (suction/suction). It will burst on the high pressure side (exhaust/exhaust). Using of filler metal in the powder thermal spray technique. This technique is still different, and the joining category is included in the dissimilar metal. Therefore, an important problem that must be solved is how to repair casting defects by eliminating repair weaknesses with the methods that have been developed (Permana, Suratman et al.).

3.5 Actual Data Measurement

Before starting the measurement, a manual is needed to know the measurement procedure and the specifications of the component itself. In this process, several measuring instruments are needed to obtain maximum measuring results. The measuring instruments used in measuring cylinder head are as follows:

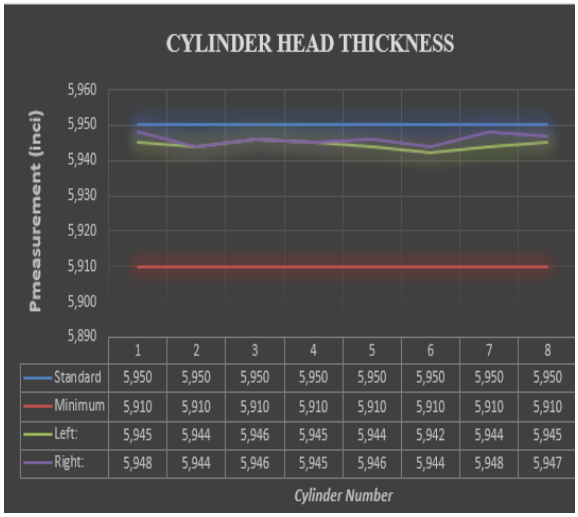
1. Vernier digital caliper
2. Call Indicator

The general procedure in the manual for inspecting and repairing cylinder heads is as follows:

1. Clean the cylinder head from adhering dirt such as (soil, paint, and rust marks) attached,
2. Measure the length, thickness, and indentation (pitting) of the cylinder head,
3. Check the combustion chamber area for cracks and leaks,
4. Inspect the burning area for damage or erosion,
5. Repair of components that require repair and replacement of parts that do not meet specifications.

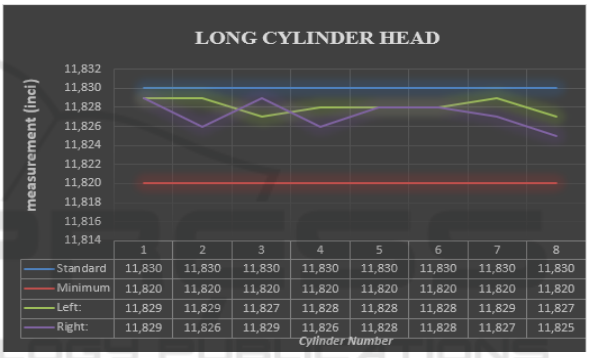
3.5.1 Cylinder Head Thickness and Length

This measurement is done so that the results obtained can be compared with the manual and to detect damage visually. Because damage to this area can have a major impact on engine performance. The impact of damage to this area includes compression compression, the entry of oil into the combustion chamber, which results in incomplete combustion. In the measurement step, a digital caliper is used. The measurement results can be seen in the image below. Based on the data in Figure 5, the cylinder head thickness still meets the standard measurement results are still above the standard because the cylinder head thickness is minimum.



	1	2	3	4	5	6	7	8
Standard	5,950	5,950	5,950	5,950	5,950	5,950	5,950	5,950
Minimum	5,910	5,910	5,910	5,910	5,910	5,910	5,910	5,910
Left:	5,945	5,944	5,946	5,945	5,944	5,942	5,944	5,945
Right:	5,948	5,944	5,946	5,945	5,946	5,944	5,948	5,947

Figure 5: Cylinder head thickness measurement results.



	1	2	3	4	5	6	7	8
Standard	11,830	11,830	11,830	11,830	11,830	11,830	11,830	11,830
Minimum	11,820	11,820	11,820	11,820	11,820	11,820	11,820	11,820
Left:	11,829	11,829	11,827	11,828	11,828	11,828	11,829	11,827
Right:	11,829	11,826	11,829	11,826	11,828	11,828	11,827	11,825

Figure 6: Cylinder head length measurement results.

3.5.2 Cylinder Head Thickness and Length

High pressure and temperature in engine operation can cause changes in the shape of the cylinder head surface, usually in the form of indentations or depressions on the cylinder head surface. Therefore, it is necessary to measure the pitting cylinder head. This is to check the flatness of the cylinder head surface. Because the density of each combustion chamber in the cylinder head greatly affects the life and performance of the engine itself. If there is pitting on the surface of the cylinder head that occurs too far from the specifications, it will result in fatal damage, namely:

1. Coolant will enter the lubrication system so that the lubricant will not working properly as it should.
2. There is a compression leak so that the compressed air will enter the cooling system or vice versa which can result in a hydraulic block in the combustion chamber and cause

more severe damage.
3. Damage the components in the cylinder head due to changes position.

This measurement uses a dial indicator and a straight edge. The surface of the cylinder head that experiences high pressure and temperature is measured for flatness, then the measurement results will be compared with the standards in the manual to determine whether the cylinder head can still be used, requires repair or needs to be replaced with a new one.

Figure 7: Pitting measurement on cylinder head.

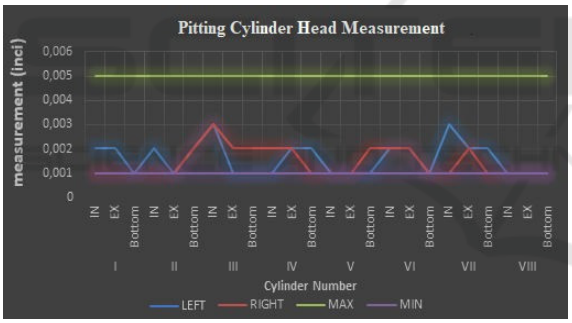


Figure 8: Pitting measurement results on the cylinder head.

Figure 8 shows the results of pitting measurements on the cylinder head. The measurement results indicate that the cylinder head still meets the standard and can be reused, the hole measurement value is still below the maximum value.

3.5.3 Leak Test (Pressure Test Cylinder Head

The purpose of the cylinder head leak test is to check whether the cylinder head is leaking or not, so that it can determine the pressure (pressure) of the cylinder head. Figure 4.15 shows the tank pressure test used for the cylinder head leak test.

Figure 9: Tank pressure test.

In testing the cylinder head leak, several stages are carried out, namely:

1. The bottom surface hole is tightly closed using a good platform for testing to prevent air from escaping.
2. Using compressed air of about 100 psi (pounds per square inch).
3. Using a cylinder head pressure tester.

This method is done by inserting the cylinder head into the air and then applying air pressure.

After testing, the results showed that there was no leakage at the orifice valve. In addition to the pressure test, a visual inspection of the cylinder head is also carried out to check:

1. Broken bolts / studs.
2. Corrosion of hose connections.
3. Oil leaks.
4. The vacuum hose hose is damaged / missing.
5. Coolant leaks.

3.6 Burn Area Analysis of Damage

In this step a visual inspection of the combustion area should be carried out to check for damage and erosion. Erosion of these areas will have a negative effect on engine performance. Checkpoints for erosion are shown in Figure 10. Check areas that are suspected of being damaged and eroded, namely:(16) firering (combustion chamber area); (17) seating area; (18) the area between the injector nozzle orifice and the valve seat. Erosion in other areas of the surface may occur but will not affect the operation of the machine.

During the cleaning process, components were found to be damaged each surface of the combustion chamber on the cylinder head. The characteristics of the damage indicates that there has been "erosion" on the surface of the combustion chamber, erosion on the surface of the combustion chamber due to air bubbles that burst or explode during the power stroke of the engine's four stroke cycle. Erosion is characterized by a surface with small holes.

When these bubbles enter an area of high pressure, they burst (explode inward) sending a "beam" of liquid hitting the metal surface at supersonic speeds. Minor cracks sometimes occur and coalesce until a small part of the metal particles is released and results in holes in the component.

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The aluminum housing of the cooling system can be damaged by cavitary erosion, especially if there is obstruction in the intake/inlet line which results in a low pressure and subsequently cavitation of the fluid in the pump impeller. Bubbles (bubbles) formed on the low pressure side (suction/suction) will burst on the high pressure side (exhaust/exhaust). Figure 10 shows erosion on the cylinder head.

Figure 10: Erosion on cylinder head.

4 CONCLUSIONS

Based on and discussion in research regarding Cylinder Head Damage Analysis on the QSK 50 MCRS Engine, it is obtained as follows.

1. Analysis of the 16 cylinder heads of QSK 50 MCRS shows that all cylinder heads can still be reused, because the cylinder heads are still within the standard range that has been set in the manual.
2. For longer cylinder head use, it is better to prevent more fatal damage by performing regular servicing. Therefore, in the assembly process and maintenance of the cylinder head is important and in the assembly process must be in accordance with the procedures set out in the manual.

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