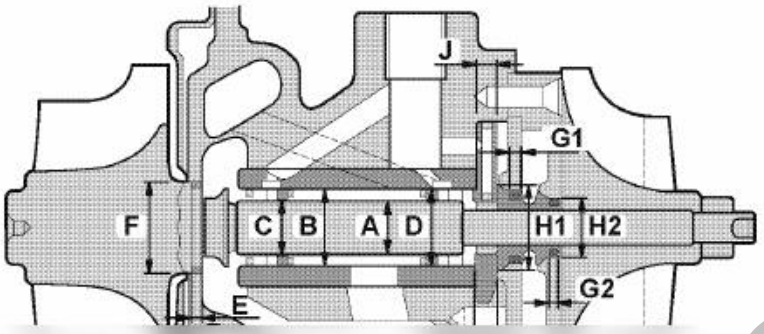
Service Standards



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INSPECTION

Cylinder Block

The cylinder block is a light alloy casting machined with functionally designed ribs and support structures. The sidewalls are shaped to maximize rigidity, strength and quiet operation.

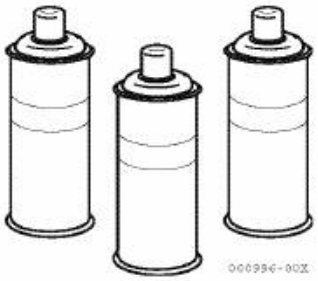


Figure 5-58



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Every 1000 Hours of Operation

Perform the following maintenance every 1000 hours of operation or 4 years, whichever comes first.

- **Checking the Fuel Injection Timing**
  See Flywheel and Housing on page 5-70.
- **Checking the Fuel Injector Spray Pattern**
  See Fuel Injectors on page 6-52.
- **Checking or Replacing the Seawater Pump Impeller**
  See Seawater Pump on page 7-17.
- **Replacing Coolant (LLC)**
  See Removing and Installing Coolant Pump on page 7-15.
- **Cleaning the Seawater Passages**
  See Draining and Filling Closed Cooling System on page 7-10.
- **Replacing the Anodes (4JH4-TE and 4JH4-HTE Only)**
  See Draining and Filling Closed Cooling System on page 7-10.
- **Checking the Diaphragm Assembly (4JH4-TE and 4JH4-HTE only)**
  See 4JH4-TE and 4JH4-HTE Engines on page 5-30.
- **Replacing the Alternator V-belt**
  See Replace V-Belt on page 11-8.
- **Adjusting Intake / Exhaust Valve Clearance**
  See Inspecting Intake / Exhaust Valves and Valve Guides on page 5-47.
- **Checking Remote Control Cable Operation**
  See Checking and Adjusting Remote Control Operation on page 5-100.
- **Adjusting Propeller Shaft Alignment (If Equipped with Marine Gear)**
  See Principal Engine Specifications on page 3-67.
- **Replacing Rubberized Hoses (Fuel and Water)**
  See Servicing the Fuel System on page 6-12 and Inspecting the Cylinder Block on page 5-40.

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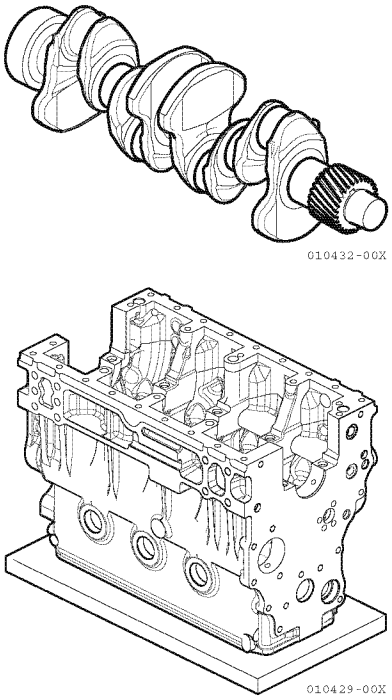


Figure 5-55

53. Remove the tappets from the tappet holes in the cylinder block **(Figure 5-56)**.

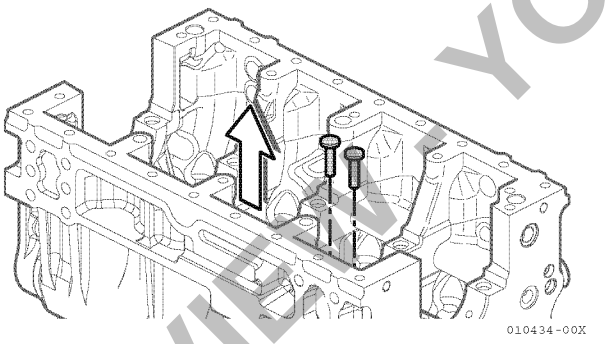


Figure 5-56

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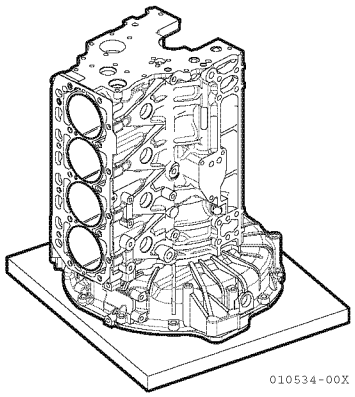


Figure 5-134

12. Apply the liquid gasket to the gear case flange. Mount the gear case and lubricating oil line O-ring to the cylinder block **(Figure 5-135)**.

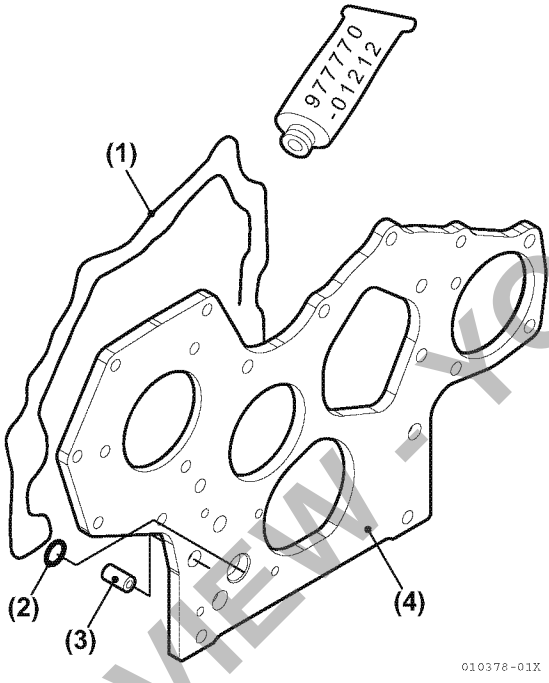


Figure 5-135

1 – Liquid Gasket
2 – O-Ring
3 – Knock Pin
4 – Gear Case

- When mounting the gear case, match the two cylinder block knock pins.
- Coat the O-ring for the cylinder block with lubricating oil and line with grease before installing **(Figure 5-135)**.

13. Assemble the piston and connecting rod:
    - When assembling the piston and connecting rod, ensure correct orientation.
    - Install each piston ring on the piston, with the punched manufacturer's mark facing upward **(Figure 5-136)**.

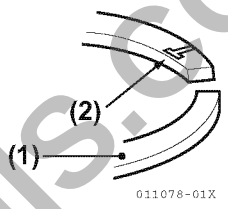


Figure 5-136

1 – Piston Ring
2 – Punched Manufacturer's Mark

- The piston ring joints must be staggered at 120° to each other. Do not position the top ring joint in line with the piston pin **(Figure 5-137)** and **(Figure 5-138)**. The coil expander joint must be opposite the oil ring joint **(Figure 5-139)**.

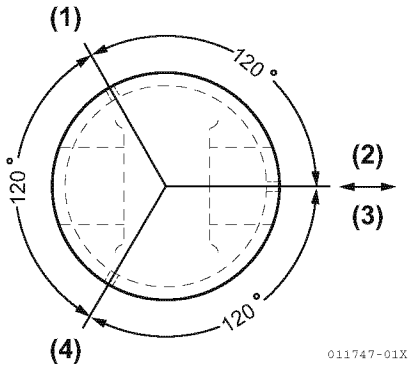


Figure 5-137

1 – Top Piston Ring Gap
2 – Direction of Piston Pin
3 – Oil Control Ring Gap
4 – Middle Piston Ring Gap

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1 – Coolant Temperature Switch
2 – Coolant Temperature Sensor (optional)
3 – Magnetic Relay (safety relay)
4 – Speed Sensor (alternator)
5 – Oil Pressure Sensor
6 – Oil Temperature Sensor (optional)
7 – Air Heater
8 – Sail Drive Seal Water Leakage Sensor
9 – Fuel Stop Solenoid
10 – B Type Instrument Panel (optional)
11 – Air Heater Intake Manifold
12 – Flywheel Housing

WIRING DIAGRAM

Allowable length by cross sectional area of battery cable	
Section of cable mm^2 ($in.^2$)	Allowable length L = 1 + 2 + 3 m (ft)
15 (0.023)	< 0.86 (0.26)
20 (0.031)	< 1.3 (0.40)
30 (0.046)	< 2.3 (0.70)
40 (0.062)	< 2.8 (0.85)
50 (0.077)	< 3.5 (1.07)
60 (0.093)	< 4.1 (1.25)



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SAFETY PRECAUTIONS

Before you perform maintenance, review the *Safety Section on page 2-1.*

INTRODUCTION

This section of the *Service Manual* describes the procedures for proper care and maintenance of the engine.

The Importance of Periodic

EPA REQUIREMENTS

The EPA emission regulation is applicable only in USA.

Conditions to Ensure Compliance with EPA Emission Standards

This product is an EPA-approved engine.

The following are the conditions that must be met in order to ensure that the emissions during operation

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Stop Solenoid

The MP fuel injection pumps are equipped with a stop solenoid that controls the fuel flow inside the fuel injection pump.

Usually, no current flows to the stop solenoid and the solenoid plunger is extended, releasing the fuel injection pump fuel rack in the “opened” position and allowing fuel to flow through the injection pump and to the engine.

To stop the engine, push the stop button while the key switch is turned to the ON position. Current flows to the stop solenoid “hold coil,” and the solenoid plunger extends and moves the injection pump fuel rack to the “closed” position, shutting off the fuel flow and stopping the engine.

Trochoid Fuel Pump

Note: The trochoid fuel pump located on the side of the MP fuel injection pump is not a “fuel supply” pump. The function of this pump is to raise the pressure of the fuel supplied by the electric fuel supply pump to the internal fuel pressure required by the MP fuel injection pump.

The use of an electric fuel supply pump is required on 3JH5E and 4JH5E model engines with the MP fuel injection pump.

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43. Remove the camshaft **(Figure 5-49)**:

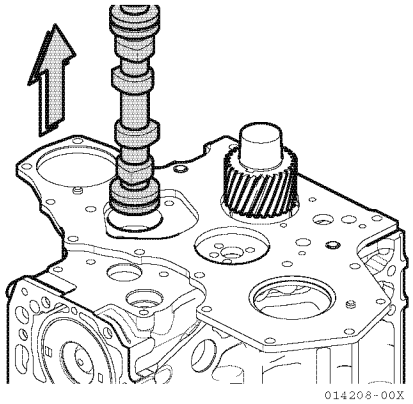


Figure 5-49

(a) Push up tappet by turning a camshaft to remove it from the cylinder block easily.

(b) Loosen the thrust metal bolts through the holes of the camshaft gear, and remove.

(c) Pull out the camshaft gear and camshaft assembly from the cylinder block.

Note: The camshaft gear and camshaft are shrink-fitted. They must be heated to 180° to 200°C (356° to 392°F) to disassemble.

44. Remove the pistons and connecting rods **(Figure 5-50)**.

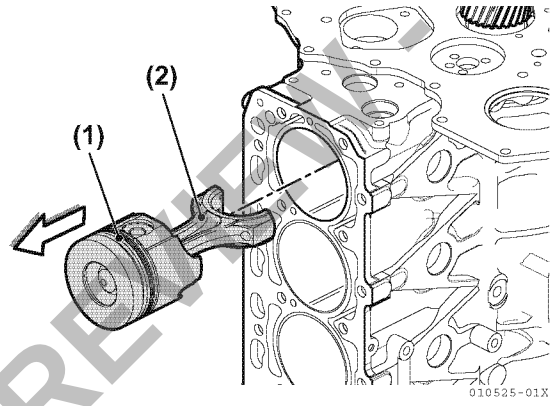


Figure 5-50

1 – Piston Connecting Rod
2 – Connecting Rod

(a) Loosen the rod bolts and remove the large end cap.

(b) Push the connecting rod and pull out the piston and connecting rod assembly.

45. Remove the gear case from the cylinder block **(Figure 5-51)**.

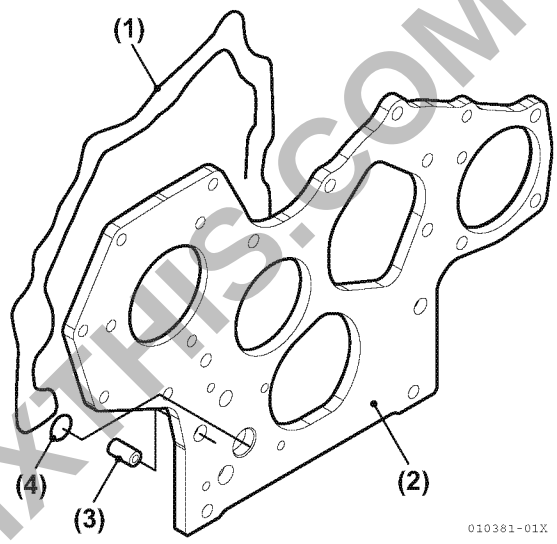


Figure 5-51

1 – Liquid Gasket
2 – Gear Case
3 – Knock Pin
4 – O-Ring

46. Remove the O-rings from the lubricating oil passage **(Figure 5-51)**.

Note:

- When mounting the gear case, match up the two knock pins for cylinder block.
- Coat the O-rings for the cylinder block lubricating oil passage with grease to maintain alignment when assembling.

47. Loosen but do not remove the main bearing bolts.

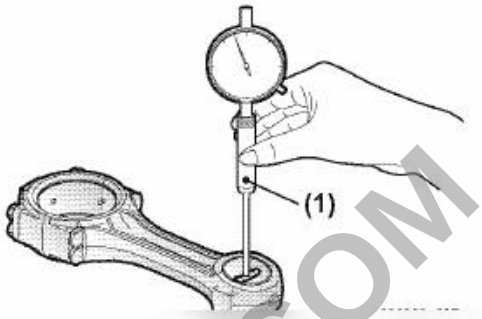
48. Turn the engine over, with the cylinder head mounting surface facing down **(Figure 5-52)**.

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Piston Pin Bushing

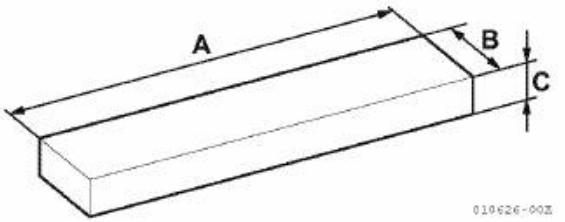
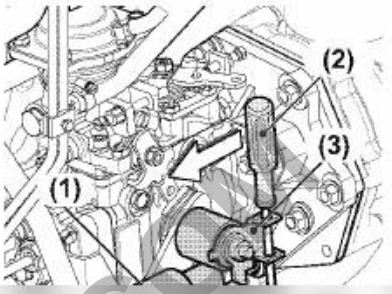
- Measure piston pin clearance. Excessive piston pin bearing wear may result in damage to the piston pin or the piston itself.
- Measure the piston pin bearing inside diameter and the piston pin outside diameter. Calculate the oil clearance from the difference of the measured values **(Figure 5-102)**. *See Crankshaft on page 5-62.*



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No.	Tool Name Applicable Model	Applicable Model and Tool Size	Illustration
8	C.S.D. cancel spacer for the adjustment of fuel injection timing	Spacer: 129671-51990 	

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Section 2

SAFETY

SAFETY STATEMENTS

Yanmar is concerned for your safety and the condition of your marine engine. Safety statements are one of the primary ways to call your attention to the potential hazards associated with Yanmar Marine engines. Follow the precautions listed throughout the manual before operation, during operation and during periodic maintenance procedures for your safety, the safety of others and to protect the performance of your marine engine. Keep the decals from becoming dirty or torn and replace them if they are lost or damaged. Also, if you need to replace a part that has a decal attached to it, make sure you order the new part and decal at the same time.



This safety alert symbol appears with most safety statements. It means attention, become alert, your safety is involved! Please read and abide by the message that follows the safety alert symbol.

⚠ DANGER

Indicates a hazardous situation which, if not avoided, *will* result in death or serious injury.

⚠ WARNING

Indicates a hazardous situation which, if not avoided, *could* result in death or serious injury.

⚠ CAUTION

Indicates a hazardous situation which, if not avoided, *could* result in minor or moderate injury.

NOTICE

Indicates a situation which can cause damage to the engine, personal property and / or the environment, or cause the equipment to operate improperly.

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DIESEL FUEL

Diesel Fuel Specifications

Diesel fuel should comply with the following specifications. The table lists several specifications for diesel fuels.

DIESEL FUEL SPECIFICATION	LOCATION
No. 2-D, No. 1-D, ASTM D975	USA
EN590:96	European Union
ISO 8217 DMX	International
BS 2869-A1 or A2	United Kingdom
JIS K2204 Grade No. 2	Japan

Bio-Diesel Fuels

Yanmar approves the use of bio-diesel fuels that do not exceed a blend of 5% non-mineral oil based fuel with 95% standard diesel fuel. Such bio-diesel fuels are known in the marketplace as B5 bio-diesel fuels. B5 bio-diesel fuel can reduce particulate matter and the emission of “greenhouse” gases compared to standard diesel fuel. *NOTICE: If the B5 bio-diesel fuel used does not meet the approved specifications, it will cause abnormal wear of injectors, reduce the life of the engine and it may affect the warranty coverage of your engine.*

B5 diesel fuels must meet certain specifications

The bio-diesel fuels must meet the minimum specifications for the country in which they are used:

- In Europe, bio-diesel fuels must comply with the European Standard EN14214.
- In the United States, bio-diesel fuels must comply with the American Standard ASTM D-6751.

Bio-diesel should be purchased only from recognized and authorized diesel fuel suppliers.

Precautions and concerns regarding the use of bio-fuels:

- Bio-diesel fuels have a higher content of methyl-esters, which may deteriorate certain metal, rubber and plastic components of the fuel system. The customer and / or boat builder are responsible to verify the usage of bio-diesel compatible components on the vessel fuel supply and return systems.
- Free water in bio-diesel may result in plugging of fuel filters and increased bacterial growth.
- High viscosity at low temperatures may result in fuel delivery problems, injection pump seizures, and poor injection nozzle spray atomization.
- Bio-diesel may have adverse effects on some elastomers (seal materials) and may result in fuel leakage and dilution of the engine lubricating oil.
- Even bio-diesel fuels that comply with a suitable standard as delivered, will require additional care and attention to maintain the quality of the fuel in the equipment or other fuel tanks. It is important to maintain a supply of clean, fresh fuel. Regular flushing of the fuel system, and / or fuel storage containers, may be necessary.
- The use of bio-diesel fuels that do not comply with the standards as agreed to by the diesel engine manufacturers and the diesel fuel injection equipment manufacturers, or bio-diesel fuels that have degraded as per the precautions and concerns above, may affect the warranty coverage of your engine.

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Piston and Piston Rings

Pistons are made of a special light alloy with superior thermal expansion characteristics. The back of the piston combustion chamber is oil-jet cooled.

The ID marks (model mark and size mark) are infused on the top surface of the piston **(Figure 5-85)**.

Size Mark

Size Mark
ML
MS

NOTICE: Piston shape differs among engine models. If any incorrect piston is installed, combustion performance will drop. Be sure to check the applicable engine model identification



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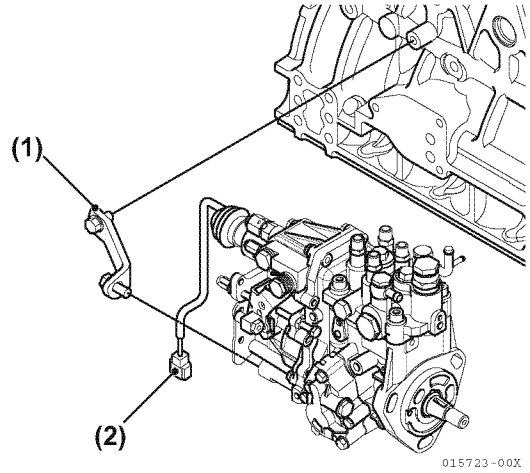


Figure 6-29

12. Remove the rear fuel injection pump bracket **(Figure 6-29, (1))** from the fuel injection pump.
13. Disconnect the lubricating oil line **(Figure 6-30, (1))** and the clamp **(Figure 6-30, (2))** from the pump. *NOTICE: Take care not to damage or bend the oil line. For 4JH5E and 3JH5E models, it may be preferable to remove the complete oil line assembly from the engine before proceeding.*

Note: On 4JH5E and 3JH5E models, the fuel injection pump drive gear cover is attached to the gear case cover by four bolts.

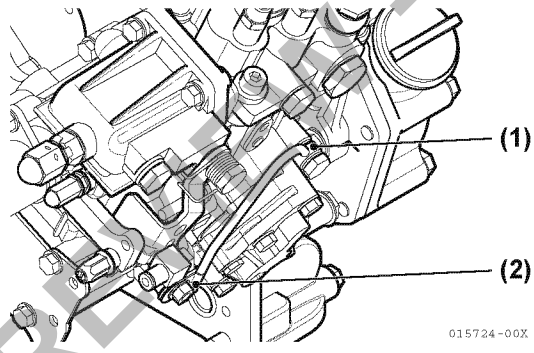


Figure 6-30

14. Remove the fuel injection pump drive gear cover **(Figure 6-31, (1))** from the gear case cover **(Figure 6-31, (2))**.

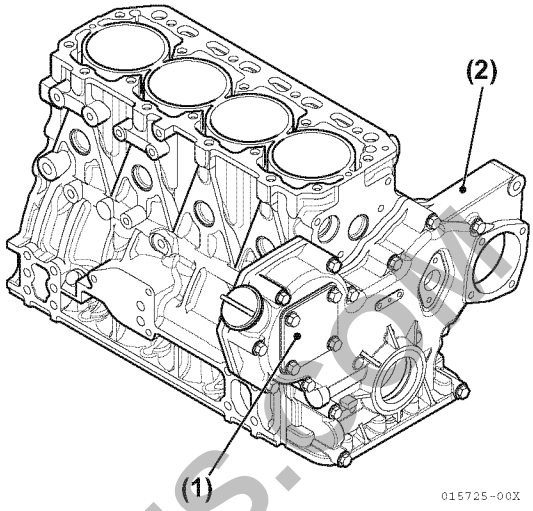


Figure 6-31

15. To position the fuel injection pump for easier removal and installation, install a dial gauge *(see Checking and Adjusting Fuel Injection Timing on page 6-32)* into the injection pump plunger opening. Using a wrench on the crankshaft pulley bolt, rotate the crankshaft until the dial gauge shows that the injection pump plunger is at the bottom of it's stroke.
16. To aid in reassembly, make reference marks on the fuel injection pump drive gear, and on the gear case cover or idler gear. *NOTICE: After marking the position of the pump drive gear, do not rotate the engine crankshaft. Rotating the crankshaft will cause the fuel injection pump to become misaligned.*
    - On 3JH5E and 4JH5E models, the idler gear is not visible. Make a reference mark on the fuel injection pump drive gear **(Figure 6-32, (1))** and a matching mark on the bore of the gear case opening **(Figure 6-32, (2))**. *NOTICE: Do not loosen or remove the four bolts retaining the fuel injection pump drive gear to the fuel injection pump hub. Do not disassemble the fuel injection pump drive gear from the hub. Correct fuel injection timing will be very difficult or impossible to achieve.*

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CLEANING THE AIR CLEANER

Disassemble the intake silencer (air cleaner) periodically for inspection. With use, the air filter will become clogged over a period of time. A clogged air filter decreases the volume of intake air and may cause decreased power output and affect emissions.

1. Disassemble the air cleaner and clean it with a neutral detergent.
2. Reassemble after it is completely dry.

Turbocharger Service

Removal

NOTICE: Ensure the work area is clean at all times when working on the turbocharger. Never leave connections for oil inlets or outlets unprotected. Dust and debris in the turbocharger bearing housing will damage the turbocharger.

1. Remove intake pipe for 4JH4-TE **(Figure 9-3, (1))** and intake pipes (turbine, intercooler, intake manifold) for 4JH4-HTE **(Figure 9-4, (1))**.

4JH4-TE Engine

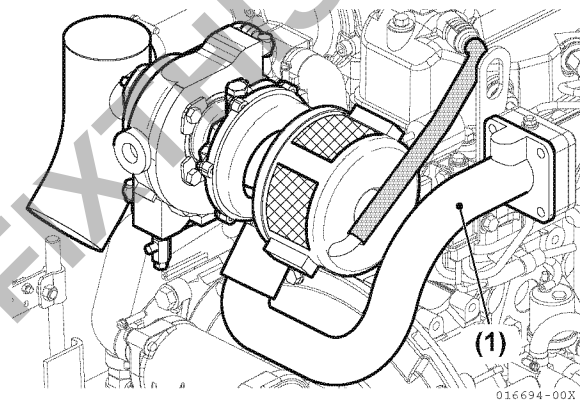


Figure 9-3

4JH4-HTE Engine

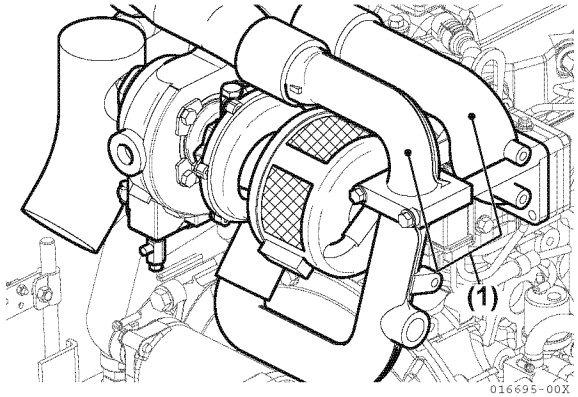


Figure 9-4

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