Perkins
THE HEART OF EVERY GREAT MACHINE

UENR0623-02 (en-us)
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# Systems Operation
# Testing and Adjusting

## 854E-E34TA, 854F-E34T and 854F-E34TA Industrial Engines

JR (Engine)
JS (Engine)
JT (Engine)
JV (Engine)

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- Fuel injection pump and fuel transfer pump

Lip type seals are used on both the front of the crankshaft and the rear of the crankshaft.

A timing ring is installed to the crankshaft. The timing ring is used by the ECM in order to measure the engine speed and the engine position.

A timing ring for the balancer can be installed to the crankshaft. The timing ring for the balancer drives the balancer.

## Gears and Timing Gear Case

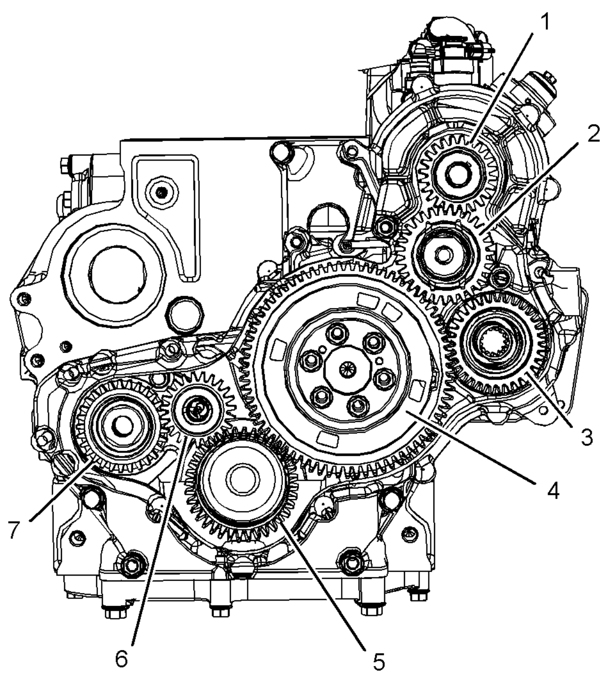


Illustration 8 g02859276

Typical example

The crankshaft oil seal is mounted in the cover of the timing case. The timing case is made of cast iron. The timing case cover is made from aluminum.

The timing gears are made of steel.

The crankshaft gear (5) drives the camshaft gear (4) and an idler gear (6) for the engine oil pump. The idler gear (6) for the engine oil pump drives the oil pump gear (7). The camshaft gear (4) drives the idler gear (2) and the accessory drive gear (3). The idler gear (2) drives the fuel injection pump gear (1).

The camshaft gear rotates at half the engine speed. The fuel injection pump gear rotates at one and a half times engine speed.

## Camshaft

The engine has a single camshaft. The camshaft is made of cast iron. The camshaft lobes are chill hardened.

The camshaft is driven at the front end. As the camshaft turns, the camshaft lobes move the valve system components. The valve system components move the cylinder valves.

The camshaft gear must be timed to the crankshaft gear. The relationship between the lobes and the camshaft gear causes the valves in each cylinder to open at the correct time. The relationship between the lobes and the camshaft gear also causes the valves in each cylinder to close at the correct time.

The coolant then flows into the housing of the water temperature regulator (2). If the water temperature regulator is closed, the coolant goes directly through a bypass to the inlet side of the water pump. If the water temperature regulator is open, and the bypass is closed then the coolant flows to the top of the radiator (1).

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# Lubrication System

Lubricating oil from the oil pan flows through a strainer and a pipe to the suction side of the engine oil pump. Pressure for the lubrication system is supplied by the oil pump. The crankshaft gear drives a lower idler gear. The lower idler gear drives the oil pump gear. The pump has an inner rotor and an outer rotor. The axis of rotation of the rotors are off-center relative to each other. There is an interference fit between the inner rotor and the drive shaft.

The inner rotor has four lobes which mesh with the five lobes of the outer rotor. When the pump rotates, the distance increases between the lobes of the outer rotor and the lobes of the inner rotor in order to create suction. When the distance decreases between the lobes, pressure is created.

The lubricating oil flows from the outlet side of the oil pump through a passage to a plate type oil cooler. The oil cooler is located on the right side of the cylinder block.

The lubricating oil flows from the oil cooler through a passage to the oil filter head. The oil then flows through a bypass valve that permits the lubrication system to function if the oil filter becomes blocked. Under normal conditions, the oil then flows to the oil filter.

The oil flows from the oil filter through a passage that is drilled across the cylinder block to the oil gallery. The oil gallery is drilled through the total length of the left side of the cylinder block.

Lubricating oil from the oil gallery flows through high-pressure passages to the main bearings of the crankshaft. Then, the oil flows through the passages in the crankshaft to the connecting rod bearing journals. The pistons and the cylinder bores are lubricated by the splash of oil and the oil mist.

Lubricating oil from the main bearings flows through passages in the cylinder block to the journals of the camshaft. Then, the oil flows from the front journal of the camshaft at a reduced pressure to the cylinder head. The oil then flows through the center of the rocker shaft to the rocker arm levers. Oil flows to the hydraulic lash adjusters in the rocker arm levers. The valve stems, the valve springs and the valve lifters are lubricated by the splash and the oil mist.

The hub of the idler gear is lubricated by oil from the oil gallery. The timing gears are lubricated by the splash from the oil.

Engines have piston cooling jets that are supplied with oil from the oil gallery. The piston cooling jets spray lubricating oil on the underside of the pistons in order to cool the pistons.

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# Electrical System

The electrical system is a negative ground system.

The charging circuit operates when the engine is running. The alternator in the charging circuit produces direct current for the electrical system.

## Starting Motor

The starting motor turns the engine via a gear on the engine flywheel. The starting motor speed must be high enough in order to initiate a sustained operation of the fuel ignition in the cylinders.

The ignition switch is deactivated once the desired engine speed has been achieved. The circuit is disconnected. The armature will stop rotating. Return springs that are located on the shafts and the solenoid will disengage the pinion from flywheel ring gear back to the rest position.

The armature of the starting motor and the mechanical transmissions may be damaged if the increases in the speed of the engine are greater than the pinion of the starting motor. Damage may occur when the engine is started or after the engine is started. An overrunning clutch prevents damage to the armature of the starting motor and mechanical transmissions.

## Alternator

The electrical outputs of the alternator have the following characteristics:

- Three-phase
- Full-wave
- Rectified

The alternator is an electro-mechanical component. The alternator is driven by a belt from the crankshaft pulley. The alternator charges the storage battery during the engine operation.

The alternator is cooled by an external fan which is mounted behind the pulley. The fan may be mounted internally. The fan forces air through the holes in the front of the alternator. The air exits through the holes in the back of the alternator.

The fuel manifold (2) stores high-pressure fuel from the fuel injection pump. The high-pressure fuel will flow to the injectors.

The fuel pressure sensor (3) measures the fuel pressure in the fuel manifold (2).

The pressure relief valve (1) will prevent the fuel pressure from getting too high.

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# Electronic Control System

## Introduction

The engine is designed for electronic control. The engine has an Electronic Control Module (ECM), a fuel injection pump, and electronic unit injectors. All these items are electronically controlled. There are also various engine sensors. The engine is equipped with an electronically controlled wastegate for the turbocharger. The ECM controls the engine operating parameters through the software within the ECM and the inputs from the various sensors. The software contains parameters that control the engine operation. The parameters include all the operating maps and customer-selected parameters.

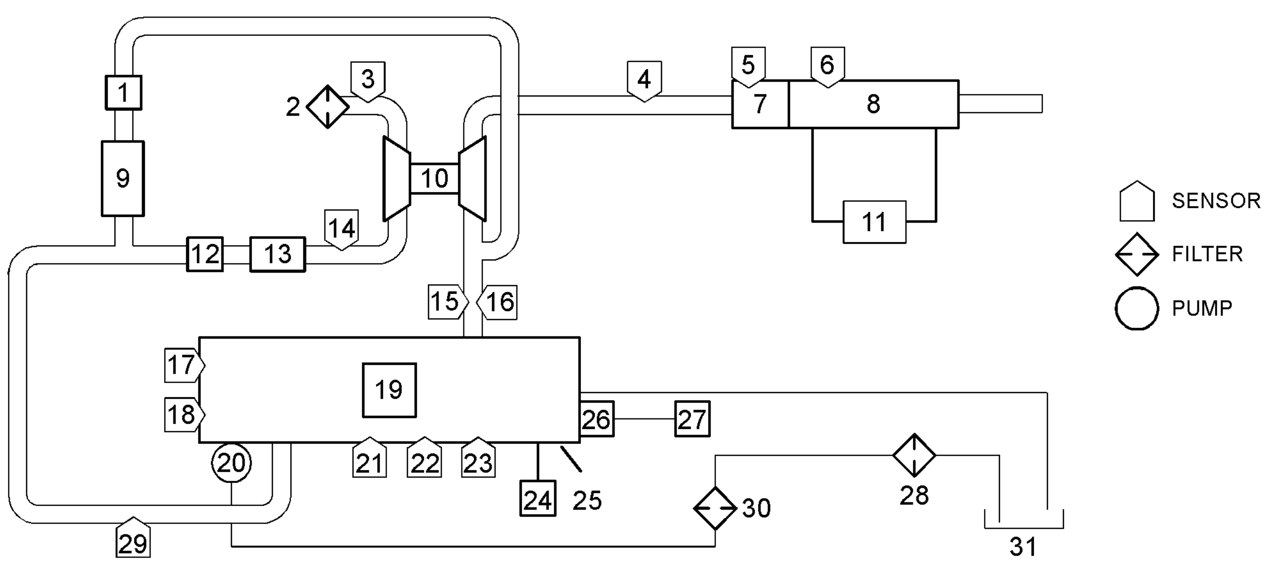


Illustration 26 g02889596

Typical example

(1) Valve for the NOx Reduction System (NRS)
(2) Air cleaner
(3) Air inlet temperature sensor
(4) Oxygen sensor
(5) Diesel Oxidation Catalyst (DOC) inlet temperature sensor
(6) Diesel Particulate Filter (DPF) inlet temperature sensor
(7) Diesel Oxidation Catalyst (DOC)
(8) Diesel Particulate Filter (DPF)
(9) Exhaust Cooler for the NOx Reduction System (NRS)
(10) Turbocharger
(11) DPF differential pressure sensor (wall flow DPF only)
(12) Engine intake throttle valve
(13) Air-to-air aftercooler
(14) Wastegate regulator
(15) Engine exhaust gas pressure sensor

When the engine is cranking, the ECM uses the signal from the speed/timing sensor on the camshaft. When the engine is running the ECM uses the signal from the speed/timing sensor on the crankshaft. This speed/timing sensor is the primary source of the engine position.

**Event Code** – An event code may be activated in order to indicate an abnormal engine operating condition. These codes usually indicate a mechanical problem instead of an electrical system problem.

**Failure Mode Identifier (FMI)** – This identifier indicates the type of failure that is associated with the component. The FMI has been adopted from the SAE practice of J1587 diagnostics. The FMI follows the parameter identifier (PID) in the descriptions of the fault code. The descriptions of the FMIs are in the following list.

**0** – The data is valid but the data is above the normal operational range.

**1** – The data is valid but the data is below the normal operational range.

**2** – The data is erratic, intermittent, or incorrect.

**3** – The voltage is above normal or the voltage is shorted high.

**4** – The voltage is below normal or the voltage is shorted low.

**5** – The current is below normal or the circuit is open.

**6** – The current is above normal or the circuit is grounded.

**7** – The mechanical system is not responding properly.

**8** – There is an abnormal frequency, an abnormal pulse width, or an abnormal time period.

**9** – There has been an abnormal update.

**10** – There is an abnormal rate of change.

**11** – The failure mode is not identifiable.

**12** – The device or the component is damaged.

**13** – The device requires calibration.

**14** – There is a special instruction for the device.

**15** – The signal from the device is high (least severe).

**16** – The signal from the device is high (moderate severity).

**17** – The signal from the device is low (least severe).

**18** – The signal from the device is low (moderate severity).

**19** – There is an error in the data from the device.

**20** – There is an error in the data from the device (high).

**21** – There is an error in the data from the device (low).

**31** – The device has failed and the engine has shut down.

**Flash File** – This file is software that is inside the ECM. The file contains all the instructions (software) for the ECM and the file contains the performance maps for a specific engine. The file may be reprogrammed through flash programming.

**Flash Programming** – Flash programming is the method of programming or updating an ECM with an electronic service tool over the data link instead of replacing components.

**FRC** – See “Fuel Ratio Control” .

**Fuel Injection Pump** – This item is sometimes referred to as the High Pressure Fuel Rail Pump. This is a device that supplies fuel under pressure to the fuel rail (high-pressure fuel rail).

**Fuel Manifold (Rail)** – This item is sometimes referred to as the High Pressure Fuel Rail. The fuel rail supplies fuel to the electronic unit injectors. The fuel injection pump and the fuel pressure sensor work with the ECM in order to maintain the desired fuel pressure in the fuel rail. This pressure is determined by calibration of the engine in order to enable the engine to meet emissions and performance requirements.

**Fuel Manifold (Rail) Pressure Sensor** – The fuel rail pressure sensor sends a signal to the ECM that is dependent on the pressure of the fuel in the fuel rail.

**Fuel Ratio Control (FRC)** – The FRC is a limit that is based on the control of the ratio of the fuel to air. The FRC is used for purposes of emission control. When the ECM senses a higher intake manifold air pressure (more air into the cylinder), the FRC increases the FRC Limit (more fuel into the cylinder).

**The Solenoid Valve for the Fuel Injection Pump** – This is sometimes referred to as the High Pressure Fuel Rail Pump Solenoid Valve or the Suction Control Valve. This is a control device in the fuel injection pump. The ECM controls the pressure in the fuel rail by using this valve to divert excess fuel from the pump to the fuel tank.

**Glow Plug** – The glow plug is an optional starting aid for cold conditions. One glow plug is installed in each combustion chamber in order to improve the ability of the engine to start. The ECM uses information from the engine sensors such as the engine temperature to determine when the glow plug relay must provide power to each glow plug. Each of the glow plugs then provides a very hot surface in the combustion chamber in order to vaporize the mixture of air and fuel. This improves ignition during the compression stroke of the cylinder.

**Glow Plug Control Unit** – The glow plug control unit is controlled by the ECM in order to provide high current to the glow plugs.

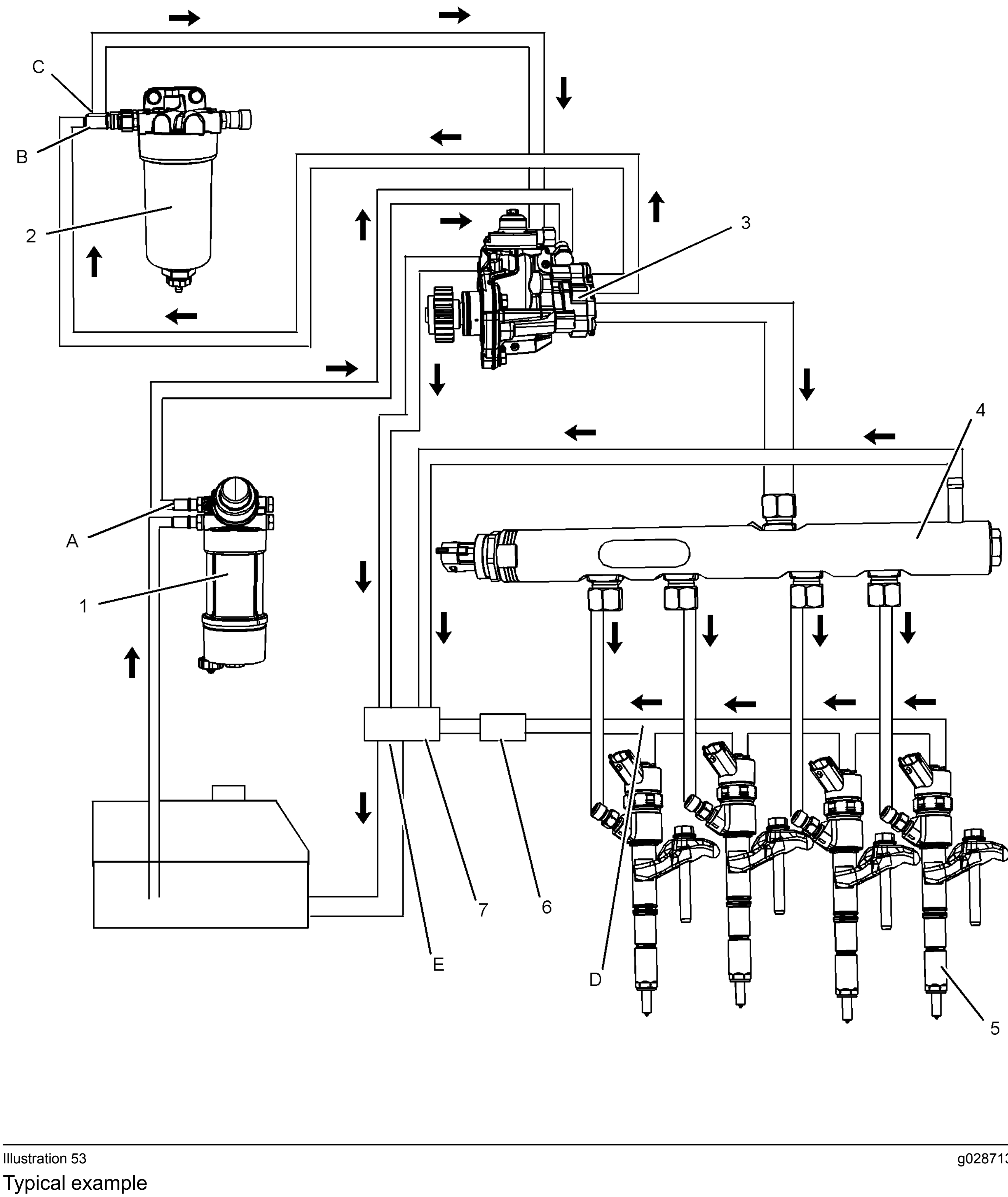


Illustration 53 g02871337

Typical example

(1) Primary fuel filter
(2) Secondary fuel filter
(3) Fuel injection pump
(4) Fuel manifold (rail)
(5) Electronic unit injector
(6) Check valve
(7) Manifold connector

7. If an engine valve lash is found in any position, examine the valve mechanism components for excessive wear or damage. Examine the hydraulic lash adjusters for damage.

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# Valve Depth - Inspect

Table 8

| Required Tools | | | |
|---|---|---|---|
| Tool | Part Number | Part Description | Qty |
| A | 21825617 | Dial gauge | 1 |
| B | 21825496 | Dial gauge holder | 1 |

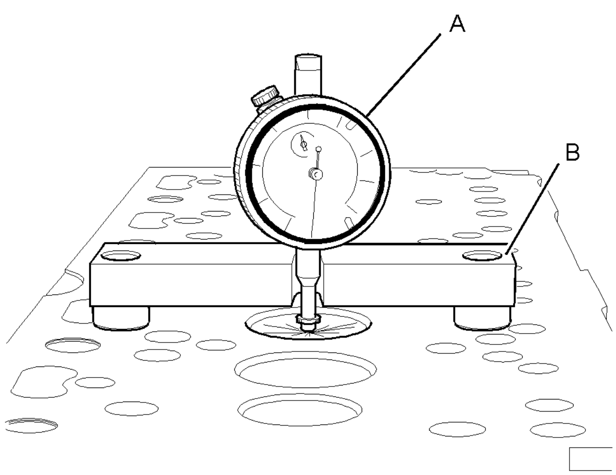


Illustration 61 g01201916

Typical example

1. Ensure that the face of the valves are clean. Ensure that the bottom face of the cylinder head is clean. Ensure that the cylinder head is not distorted. Refer to Systems Operation, Testing and Adjusting, “Cylinder Head - Inspect” for the procedure to measure flatness of the cylinder head.
2. Use the Tooling (A) to check the depths of the inlet valves and the exhaust valves below the face of the cylinder head. Use Tooling (B) to zero Tooling (A).
3. For the minimum and maximum limits for a new engine for the inlet valves and the exhaust valves, refer to Specifications, “Cylinder Head”.
4. Service wear occurs on an engine which has been in operation. If the valve depth below the cylinder head face on a used engine exceeds the specification for service wear, the following components must be replaced.
   - Valves
   - Valve inserts

   For the wear limits for the inlet valves and exhaust valves, refer to Specifications, “Cylinder Head”.
5. Check each valve for cracks. Check the stems of the valves for wear. Ensure that the valves are the correct fit in the valve guides. Refer to Systems Operation, Testing and Adjusting, “Valve Guide - Inspect” for the procedure to inspect the valve guides.
6. Check the load on the valve springs. Refer to Specifications, “Cylinder Head Valves” for the correct lengths and specifications for the valve springs.

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# Valve Guide - Inspect

Perform this test in order to determine if a valve guide should be replaced.

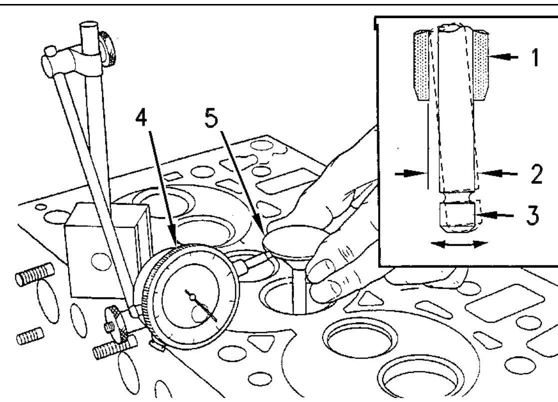


Illustration 62 g00314806

Measure the radial movement of the valve in the valve guide.

(1) Valve guide
(2) Radial movement of the valve in the valve guide
(3) Valve stem
(4) Dial indicator
(5) Valve head

1. Place a new valve in the valve guide.
2. Place a dial indicator with a magnetic base on the face of the cylinder head.

**3.** Check the front camshaft bearing for wear. Refer to Specifications, “Camshaft Bearings” for the correct specification of the camshaft bearing. If a new bearing is needed, use a suitable adapter to press the bearing out of the bore. Ensure that the oil hole in the new bearing faces the front of the block. The oil hole in the bearing must be aligned with the oil hole in the cylinder block. The bearing must be aligned with the face of the recess.

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# Cylinder Head - Inspect

**1.** Remove the cylinder head from the engine.

**2.** Remove the water temperature regulator housing.

**3.** Inspect the cylinder head for signs of gas or coolant leakage.

**4.** Remove the valve springs and valves.

**5.** Clean the bottom face of the cylinder head thoroughly. Clean the coolant passages and the lubricating oil passages. Make sure that the contact surfaces of the cylinder head and the cylinder block are clean, smooth, and flat.

**6.** Inspect the bottom face of the cylinder head for pitting, corrosion, and cracks. Inspect the area around the valve seat inserts and the holes for the fuel injection nozzles carefully.

**7.** Test the cylinder head for leaks at a pressure of 200 kPa (29 psi).

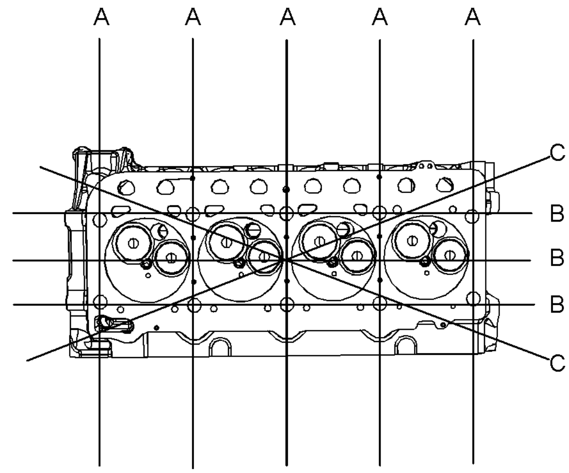


Illustration 69 g02490336

Flatness of the cylinder head (typical example)

(A) Side to side
(B) End to end
(C) Diagonal

**8.** Measure the cylinder head for flatness. Use a straight edge and a feeler gauge to check the cylinder head for flatness.

- Measure the cylinder head from one side to the opposite side (A).
- Measure the cylinder head from one end to the opposite end (B).
- Measure the cylinder head from one corner to the opposite corner (C).

Refer to Specifications, “Cylinder Head” for more information.

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# Piston Height - Inspect

Table 10

| Required Tools | | | |
|---|---|---|---|
| Tool | Part Number | Part Description | Qty |
| A | 21825617 | Dial Gauge | 1 |
| B | 21825496 | Dial gauge holder | 1 |

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