Engine

Service Manual

Case G 4.0 and G 4.0T

4 Cylinder Diesel Engines

Reprinted

Contents

General information 10

Introduction

This Service manual has been designed to provide assistance in the service and overhaul of these engines. For Service and overhaul procedures the assumption is made that the engine is removed from the machine, refer to Engine Removal in your Machine Service Manual.

Some of the illustrations used throughout this manual, may not exactly reflect your engine, they are to be used as a guide only.

Warning! *Read and remember the "Safety precautions". They are given for your protection and must be used at all times.*

When reference is made to the "left" or "right" side of the engine, this is as seen from the flywheel end of the engine.

Special and Shop Equipment tools have been made available and a list of these tools are given in section 23. Reference to the relevant Special and Shop Equipment tools are also made at the beginning of each operation.

Original setscrews or studs used in holes, which are open to the inside of the engine, have a sealant which is applied by the manufacturer. If the setscrew or stud is to be used again, the threads must be cleaned and a suitable sealant should be used on the threads.

Danger is indicated in the text by two methods:

Warning! *This indicates that there is a possible danger to the person.*

Caution: *This indicates that there is a possible danger to the engine.*

Note: *Is used where the information is important, but there is not a danger.*

Engine identification

The engine number is stamped on a label (A2) which is fastened to the left side of the cylinder block.

Code letters	Engine type
AK	Four cylinder, turbocharged
AP	Four cylinder, naturally aspirated
AQ	Four cylinder, turbocharged
AS	Four cylinder, naturally aspirated (103 mm cylinder bore)

An example of an engine number is:

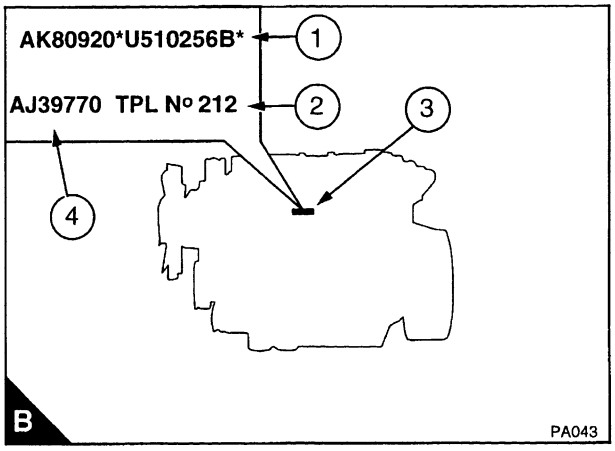
AQ12345U123456A

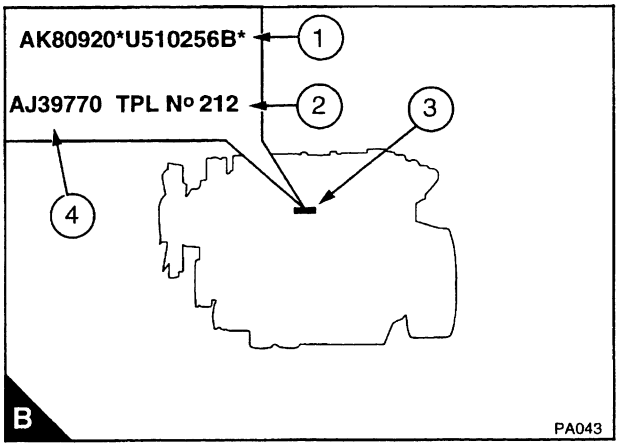
Note: *If you need parts, service or information for your engine, you must give the complete engine number to your Case Dealer. If there is a number in the area of the label marked TPL No, then this number must also be given to your Case Dealer.*

Other Identification labels installed to the Engine include:

An emissions legislation label (A3) on the side of the cylinder block.

A label (A1) with the fuel injection pump part number is located on the fuel injection pump.





If a short engine is installed two engine serial numbers and a TPL number on the engine serial number plate (B3), examples are shown above.

If parts are required for the short engine in service use serial number (B4). If parts which were moved from the original engine to the short engine are needed use the serial number (B1) and TPL number (B2).

Safety

General safety precautions

These safety precautions are important. You must refer also to the local regulations in the country of use. Some items only refer to specific applications.

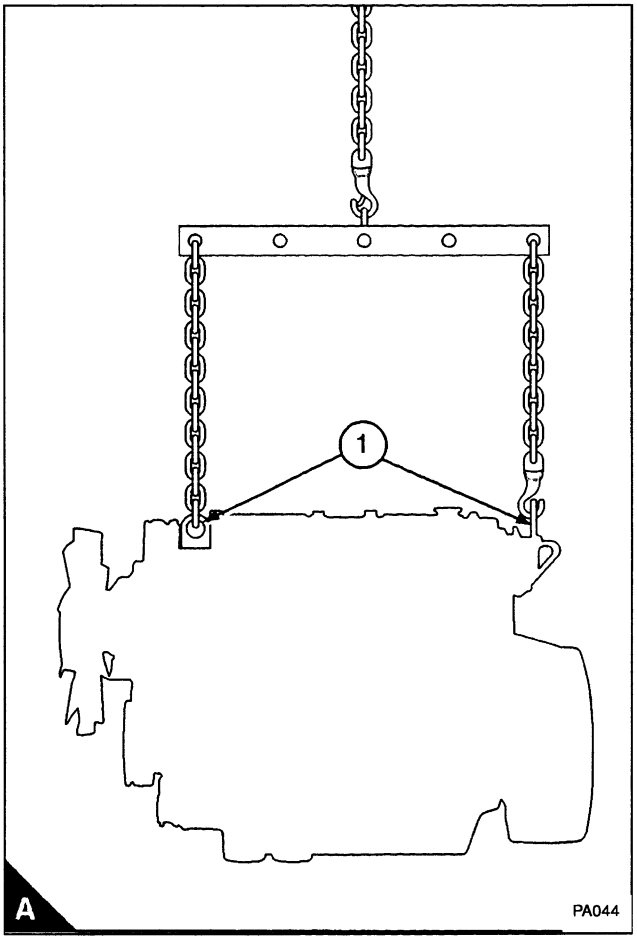
- Do not fill the engine with lubricating oil above the mark on the dipstick or damage could occur to the engine.
- If the lubrication system has been drained, the rocker gear and the camshaft reservoir must be lubricated before the engine is started or damage could occur to the engine.
- Only use these engines in the type of application for which they have been designed.
- Do not change the specification of the engine.
- Do not smoke when you put fuel in the tank.
- Clean away fuel which has been spilt. Material which has been contaminated by fuel must be moved to a safe place.
- Do not put fuel in the tank while the engine runs (unless it is absolutely necessary).
- Do not clean, add lubricating oil, or adjust the engine while it runs (unless you have had the correct training; even then extreme care must be used to prevent injury).
- Do not make adjustments that you do not understand.
- Make sure that the engine does not run in a location where it can cause a concentration of toxic emissions.
- Other persons must be kept at a safe distance while the engine is in operation.
- Do not permit loose clothing or long hair near moving parts.
- Keep away from moving parts during engine operation. Warning! Some moving parts cannot be seen clearly while the engine runs.
- Do not operate the engine if a safety guard has been removed.
- Do not remove the filler cap of the cooling system while the engine is hot and while the coolant is under pressure, because dangerous hot coolant can be discharged.
- Do not allow sparks or fire near the batteries (especially when the batteries are on charge) because the gases from the electrolyte are highly flammable. The battery fluid is dangerous to the skin and especially to the eyes.
- Disconnect the battery terminals before a repair is made to the electrical system.
- Only one person must control the engine.
- Make sure that the engine is operated only from the operators position.
- If your skin comes into contact with high-pressure fuel, obtain medical assistance immediately.
- Diesel fuel and lubricating oil (especially used lubricating oil) can damage the skin of certain persons. Protect your hands with gloves or a special solution to protect the skin.
- Do not wear clothing which is contaminated by lubricating oil. Do not put material which is contaminated with oil into the pockets of clothing.
- Discard used lubricating oil in a safe place to prevent contamination.
- Make sure that the control lever of the transmission drive is in the "neutral" position before the engine is started.
- Use extreme care if emergency repairs must be made in adverse conditions.
- The combustible material of some components of the engine (for example certain seals) can become extremely dangerous if it is burned. Never allow this burnt material to come into contact with the skin or with the eyes, see page 10.06.
- Read and use the instructions relevant to lift equipment which are given on page 10.05.
- Always use a safety cage to protect the operator when a component is to be pressure tested in a container of water. Install safety wires to secure the plugs which seal the hose connections of a component which is to be pressure tested.
- Do not allow compressed air to contact your skin. If compressed air enters your skin, obtain medical help immediately.
- Turbochargers operate at high speeds and at high temperatures. Keep fingers, tools and items away from the inlet and outlet ports of the turbocharger and prevent contact with hot surfaces.
- Do not clean an engine while it runs. If cold cleaning fluids are applied to a hot engine, certain components on the engine may be damaged.
- Install only genuine Case parts, supplied by Case Dealers.

Engine lifting equipment

The maximum dry weight of the engine is 500 kg (1100 lb).

Before the engine is lifted:

- Always use engine lifting equipment of the approved type and of the correct capacity to lift the engine. It is recommended that lifting equipment of the type shown in (A) is used to provide a vertical lift, directly above the engine lift brackets (A1). Never use a single lift bracket to raise an engine.
- Check the engine lift brackets for damage and that they are secure before the engine is lifted. The torque for the setscrews for the engine lift brackets is 44 Nm (33 lbf ft) 4,5 kgf m.
- To prevent damage to the rocker cover, make sure that there is clearance between the hooks and the rocker cover.
- Use lifting equipment or obtain assistance to lift heavy engine components such as the cylinder block, cylinder head, flywheel housing, crankshaft and flywheel.



Viton seals

Some seals used in engines and in components installed to engines are made of Viton.

Viton is used by many manufacturers and is a safe material under normal conditions of operation.

If Viton is burned, a product of this burnt material is an acid which is extremely dangerous. Never allow this burnt material to come into contact with the skin or with the eyes.

If it is necessary to come into contact with components which have been burnt, make sure that the precautions which follow are used:

- Make sure that the components have cooled.
- Use Neoprene gloves and discard the gloves safely after use.
- Wash the area with calcium hydroxide solution and then with clean water.
- Disposal of components and gloves which are contaminated must be in accordance with local regulations.

If there is contamination of the skin or eyes, wash the affected area with a continuous supply of clean water or with calcium hydroxide solution for 15-60 minutes. Obtain immediate medical attention.

Specifications 11

Basic engine data 11A

Basic engine data

Cycle ..... Four stroke

Number of cylinders 4

Cylinder arrangement ..... In line

Firing order 1,3,4,2

Direction of rotation ..... Clockwise from the front

Induction system

AP and AS ..... Naturally aspirated

AK and AQ ..... Turbocharged

Cubic capacity

AK, AP, and AQ ..... 4 litres (243 in^3)

AS ..... 4,23 litres (258 in^3)

Compression ratio 17.25:1

Combustion system ..... Direct injection

Nominal bore

AK, AP, and AQ ..... 100 mm (3.94 in)

AS ..... 103 mm (4.05 in)

Stroke ..... 127 mm (5.00 in)

Valve tip clearances (cold):

- Inlet ..... 0,20 mm (0.008 in)

- Exhaust ..... 0,45 mm (0.018 in)

Lubricating oil pressure
(minimum at maximum engine speed and normal engine temperature)

AK, AP, and AQ ..... 280 kPa (40 lbf/ in^2) 2,5 kgf/cm^2

AS ..... 207 kPa (30 lbf/ in^2) 2,1 kgf/cm^2

Typical dry installed engine weight ..... 500 kg (1100 lb)

Rocker cover

To remove and to install **12A-01**

To remove

1 Disconnect the breather hose.

2 Remove the cap nuts, washers, sealing washers and washers from the top of the rocker cover.

3 Remove the rocker cover and gasket.

Caution: *When the rocker cover is installed, the cap nuts are tightened onto the nuts of the rocker brackets. During removal of the cap nuts, it is possible to loosen the nuts of the rocker brackets. The nuts of the rocker brackets should be tightened to the correct torque every time the cover is removed.*

To install

1 Check the sealing washers for the cap nuts.

Warning! *The rocker cover gasket may be made from viton, read the safety precautions in section 10 for viton seals.*

2 Check the condition of the rocker cover gasket. If necessary, the gasket can be removed and replaced.

3 Clean the gasket face of the cylinder head and install the rocker cover.

4 Install in the following order the washers, sealing washers, washers and cap nuts.

Caution: *Damage to the sealing washer can occur if the cap nut is not tightened centrally through the sealing washer and the rocker cover. If the sealing washer is damaged, it must be replaced.*

5 Tighten the rocker cover cap nuts to 20 Nm (15 lbf ft) 2,1 kgf m.

6 Install the breather hose.

Rocker assembly

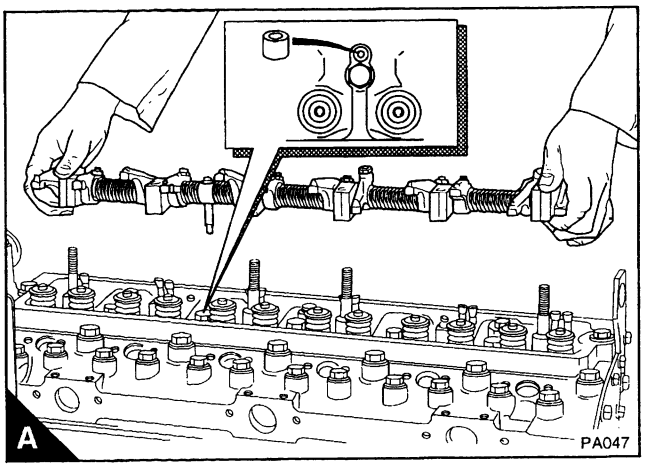
To remove and to install **12A-02**

To remove

1 Remove the rocker cover, operation 12A-01.

2 Release evenly and gradually the fasteners of the rocker shaft brackets; begin with the end brackets and move toward the centre. Remove the fasteners and lift off the rocker assembly.

3 Remove the rubber oil seal (A) from the oil supply connection or from the oil supply hole in the cylinder head.



To install

1 Install a new rubber oil seal (A) in the oil supply hole in the cylinder head.

2 Check that the push rods are installed correctly in the sockets of the tappets. Install the rocker assembly; make sure that the oil supply connection is installed correctly into the oil seal. Check that the ends of the adjustment screws are install correctly in the sockets of the push rods.

3 Install the fasteners of the rocker shaft brackets and tighten the fasteners evenly and gradually; begin with the inner fasteners and work towards the end fasteners. Tighten the fasteners evenly to 75 Nm (55 lbf ft) 7,6 kgf m.

4 Check and adjust the valve tip clearances, see operation 12A-05.

Rocker assembly

To disassemble and to assemble **12A-03**

To disassemble

1 Remove the circlips from both ends of the rocker shaft. Make sure that the ends of the rocker shaft are not damaged. Release the location screw (A1) for the oil supply connection.

2 Disassemble the assembly and make a note of the position of each component to make sure that they can be assembled more easily.

To assemble

1 Make sure that the oil holes in the rocker shaft and in the rocker levers are not restricted.

2 Lubricate the components with clean engine lubricating oil before assembly. Assemble the components in the correct order (A) with the arrows (A2) on the pedestals in the position shown. Make sure that the location screw (A1) for the oil supply connection is installed correctly in the rocker shaft. Install the circlips to the ends of the rocker shaft.

To inspect and to correct **12A-04**

To inspect

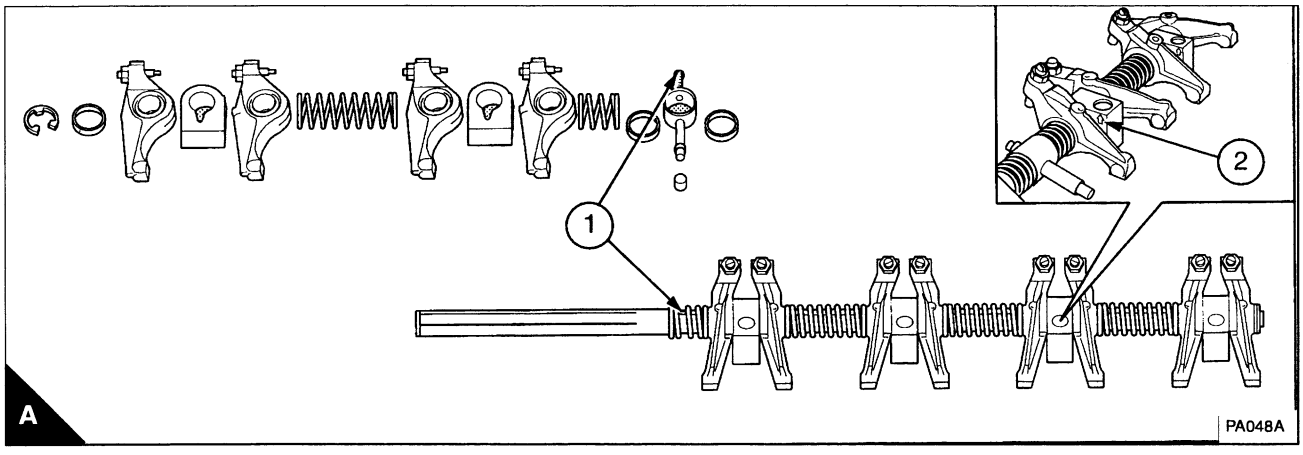
1 Clean and inspect all the components for wear and any other damage. Check the clearance of the rocker levers on the rocker shaft. If the clearance is larger than 0,13 mm (0.005 in), replace the rocker lever bushing and/or the rocker shaft.

To correct

1 To replace the rocker lever bushing, press out the old bushing with a suitable mandrel.

2 Align the lubrication hole of the new bushing on the same side as the rocker lever lubrication hole and press the bushing into position.

3 Ream the bushing in the rocker lever to give a clearance on the rocker shaft of 0,03/0,09 mm (0.001/0.004 in). Clean thoroughly the bushing and check that the oil hole is free from debris.

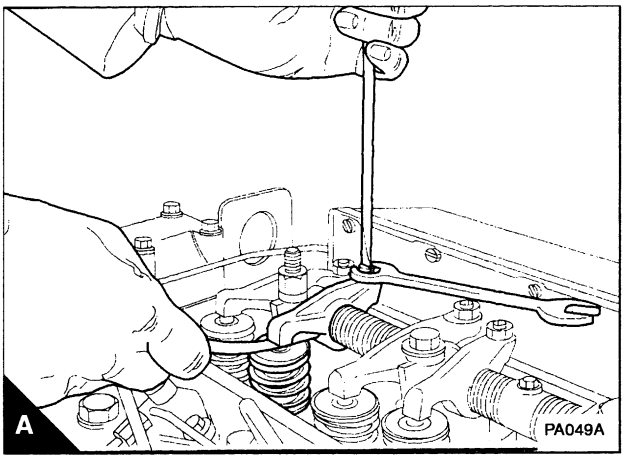


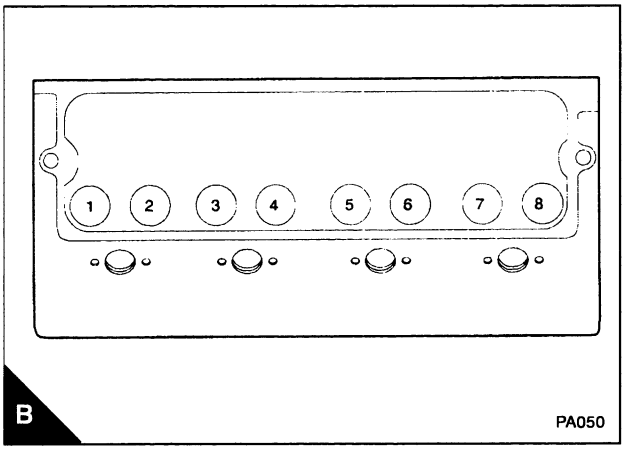
Valve tip clearances

To check and to adjust **12A-05**

Notes:

- The valve tip clearance is measured between the top of the valve stem and the rocker lever (A). With the engine hot or cold, the correct clearances are 0,20 mm (0.008 in) for the inlet valves and 0,45 mm (0.018 in) for the exhaust valves. The valve positions are shown at (B).
- The sequence of valves from number 1 cylinder is shown in the table below. Number 1 cylinder is at the front of the engine.





1 Rotate the crankshaft in the normal direction of rotation until the inlet valve (B7) of number 4 cylinder has just opened and the exhaust valve (B8) of the same cylinder has not closed completely. Check the clearances of the valves (B1 and B2) of number 1 cylinder and adjust them, if necessary.

2 Set the valves (B3 and B4) of number 2 cylinder as indicated above for number 4 cylinder. Then check / adjust the clearances of the valves (B5 and B6) of number 3 cylinder.

3 Set the valves (B1 and B2) of number 1 cylinder. Then check / adjust the clearances of the valves (B7 and B8) of number 4 cylinder.

4 Set the valves (B5 and B6) of number 3 cylinder. Then check / adjust the clearances of the valves (B3 and B4) of number 2 cylinder.

Cylinder and Valve number	1		2		3		4	
	1	2	3	4	5	6	7	8
Valve I = Inlet E = Exhaust	I	E	I	E	I	E	I	E

Valve springs

To change the valve springs (with cylinder head installed) **12A-06**

Shop Equipment Tools:

Valve spring compressor, PD.6118B

Stud adaptor used with PD.6118B, PD.6118-7

Setscrew adaptor used with PD.6118B, PD.6118-8

Note: *Steps 1 to 12 refer to a change of valve springs for a single cylinder.*

Warning! *Wear eye protection during this operation.*

1 Remove the rocker cover, operation 12A-01.

2 Rotate the crankshaft in the normal direction of rotation until the inlet valve of the relevant cylinder has just opened and the exhaust valve has not fully closed. In this position the piston will be at approximately top dead centre (TDC).

3 Remove the rocker assembly, operation 12A-02.

4 Install the valve spring compressor (A1) and the relevant adaptor (A2 or A3).

5 Compress the valve spring and remove the valve keepers. Make sure that the valve spring is compressed squarely or damage to the valve stem can occur.

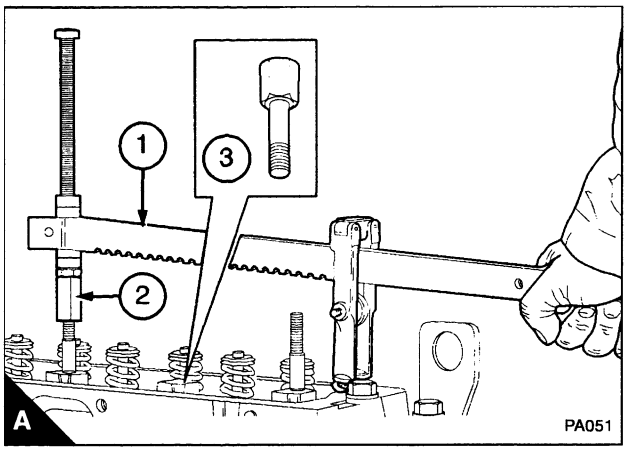
Caution: *Do not rotate the crankshaft while the valve springs are removed.*

6 Release the valve spring compressor and remove the valve spring caps and valve spring.

Caution: *The outer diameter of the exhaust valve guide is 1 mm larger than the inlet valve guide. To prevent leakage past the inlet valve stem it is important that the larger exhaust valve seal is not installed onto the inlet guide. The seals have a colour code for identification.*

7 Install new valve stem seals on the valve guides. Make sure that the red seal is installed to the exhaust valve and green seal is installed to the inlet valves.

8 Put the new valve springs in position.



Continued

9 Install the valve spring caps.

Caution: *Make sure that the valve spring is compressed squarely or damage may occur to the valve stem.*

10 Install the valve spring compressor, compress the valve spring and install the valve keepers. Remove the valve spring compressor.

11 Install the rocker assembly, operation 12A-02.

12 Check the valve tip clearances, operation 12A-05.

13 Install the rocker cover, operation 12A-01.

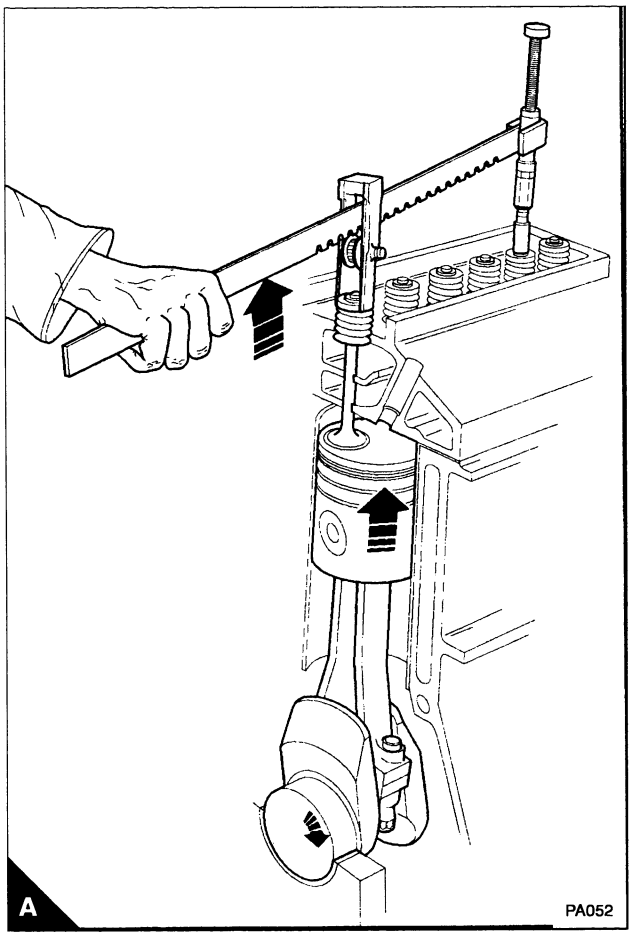
Note: *If other or all of the valve springs are to be changed, they can be changed two cylinders at a time. The sets of cylinders are 1 and 4, 2 and 3.*

If the rocker assembly has been removed, piston TDC can be found as follows:

1 Install the valve spring compressor and compress the valve springs to open the valve.

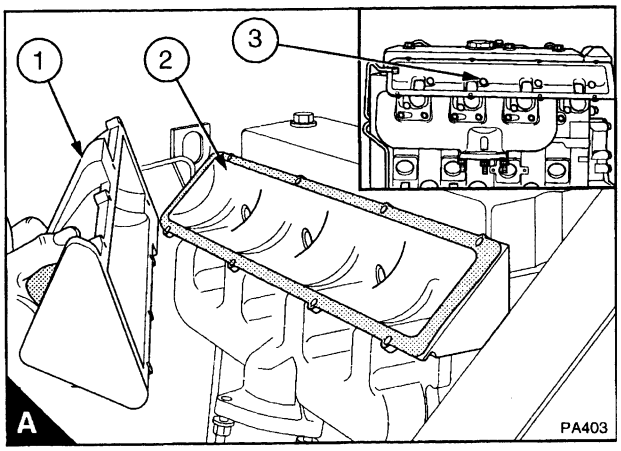
2 Rotate the crankshaft, by hand, in the normal direction of rotation until the piston touches the valve.

3 Continue to rotate the crankshaft, and at the same time, release pressure on the valve spring compressor until the piston is at TDC (A).



Cylinder head assembly

To remove and to install **12A-07**



To remove

1 For engines installed with turbochargers: Remove the air filter/cleaner hose at the compressor inlet of the turbocharger.

2 Remove the tube which is installed between the fuelled starting aid in the induction manifold and the fuel filter.

3 For engines installed with a boost control device: Remove the boost control tube which is installed between the induction manifold and the top of the fuel injection pump.

4 Remove the induction manifold.

Note: *For AS engines, the upper half of the induction manifold (A1) is sealed to the lower half (A2) with liquid sealant and secured with six cap screws. The upper half must be removed to gain access to the four screws (A3), located in the manifold, securing the manifold to the cylinder head.*

5 For engines installed with turbochargers: Disconnect all connections to the turbocharger and remove the turbocharger, operation 18A-01.

6 Release the exhaust manifold fasteners, starting at the No. 2 cylinder port, followed by No. 3 port, No. 4 port and finally No. 1 port.

7 Remove the low-pressure fuel tubes which are installed between the fuel injection pump and the fuel filter.

Remove the fuel tube installed between the fuel lift pump and the fuel filter. Remove the fuel filter bracket together with the fuel filter.

Caution: *Where access to the fuel injection pump outlet fittings is possible, make sure that a separate spanner is used to prevent movement of the fuel injection pump outlets when the connections of the high-pressure tubes are released. Install suitable covers to all open connections on the fuel injection pump.*

8 Remove the high-pressure fuel tubes.

9 Remove the fuel injector leak-off tube.

10 Remove the fuel injectors, operation 20A-02. Install suitable covers to the nozzles and the open connections.

11 Release the clip of the coolant by-pass hose at the cylinder head. Release the setscrews and remove the coolant by-pass connection and the hose.

12 Remove the rocker cover, operation 12A-01.

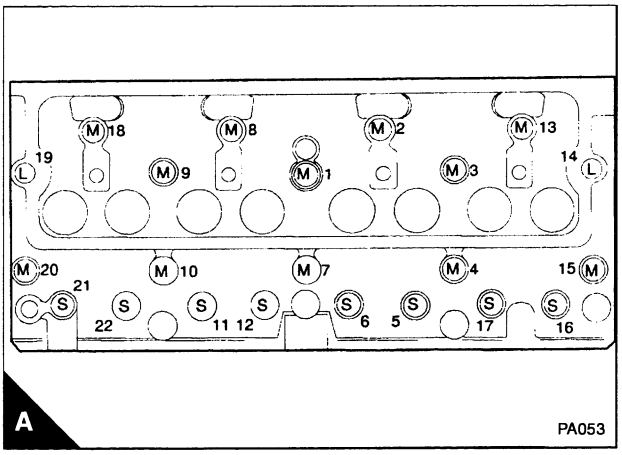
13 Remove the rocker assembly, operation 12A-02.

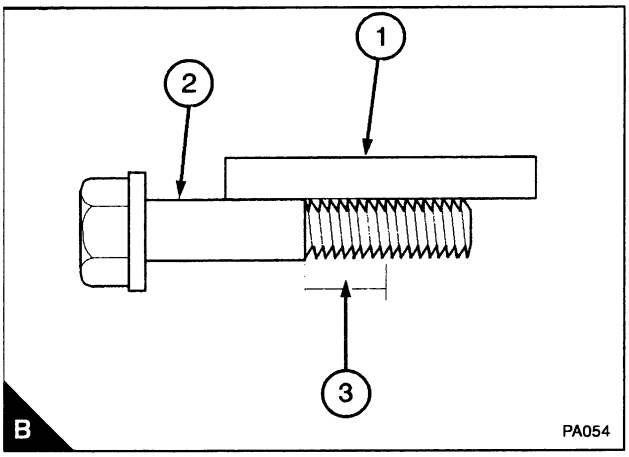
14 Remove the push rods.

15 Release the cylinder head setscrews evenly and gradually in the reverse sequence to that shown in (A). Check the setscrews for distortion with a straight edge (B1) held along the setscrew (B2). If there is a visual reduction in the diameter of the thread (B3) that has not been in engagement with the cylinder block, the setscrew must be replaced.

Caution: *Do not use a lever to separate the cylinder head from the cylinder block.*

16 Remove the cylinder head and put it on a surface that will not damage the face of the cylinder head.





To install
Engine types - AK, AP, and AQ

Shop Equipment Tools:

Angle gauge, to tighten cylinder head setscrews, MS.1531

1 Clean the bottom face of the cylinder head and top face of the cylinder block. Make sure that there is no debris in the cylinder bores.

Note: *The engines have two location pins (A2), one at each end of the cylinder head, pressed into the cylinder block to hold the cylinder head and cylinder head gasket in the correct position when the cylinder head is installed.*

Caution:

- *To prevent damage to the cylinder head gasket, make sure that the location pins are pressed in the cylinder block before the cylinder head is installed.*
- *The cylinder head gasket must be installed without sealing compound.*

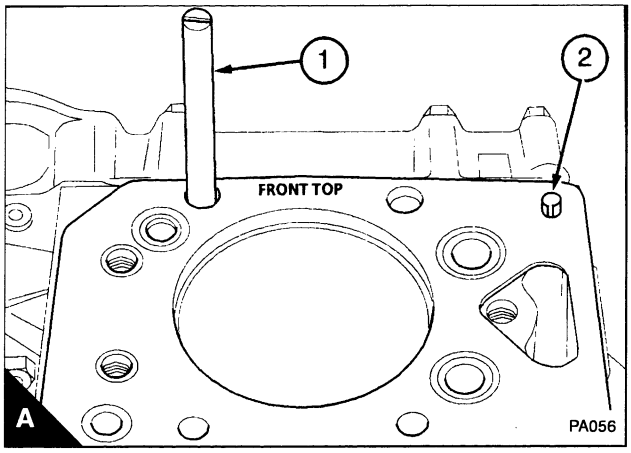
2 Put the cylinder head gasket in position; It is stamped "FRONT TOP" for correct assembly (A).

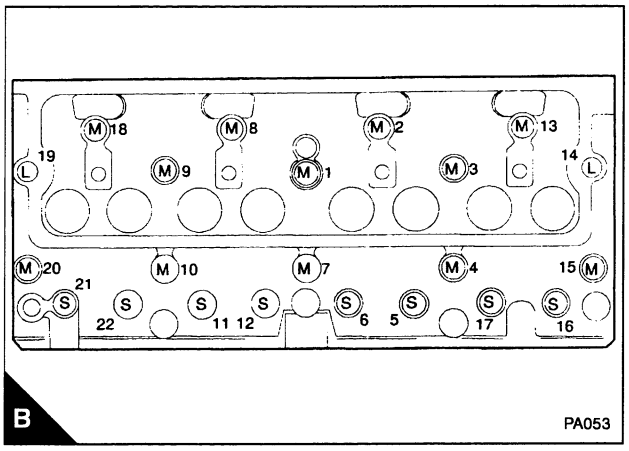
3 To make sure the cylinder head is installed into the correct position, install two suitable 1/2 UNF guide studs in positions 16 and 21 (B). Put the cylinder head in position. Make sure that the two location pins (A2) are fully engaged in the cylinder head.

4 Lightly lubricate the threads of the cylinder head setscrews and the thrust faces of the setscrew heads. Engage some of the setscrews in their correct positions and remove the guide studs. Engage the remainder of the setscrews in their correct positions.

5 Gradually and evenly tighten the setscrews to a torque of 110 Nm (80 lbf ft) 11,1 kgf m in the sequence shown in (B).

6 Repeat Step 5 to make sure that all the setscrews are tightened to the correct torque.

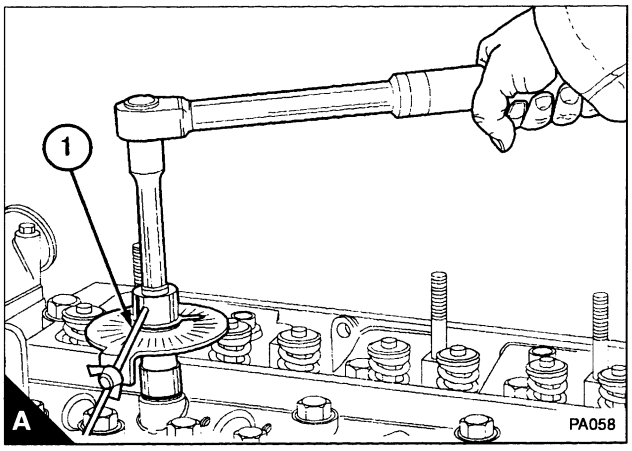


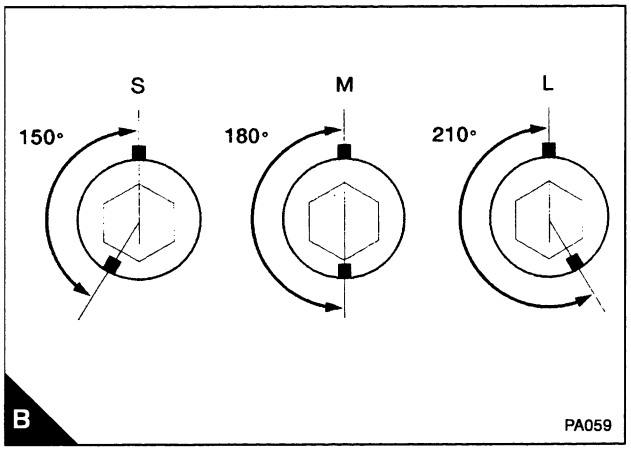


7 Tighten the setscrews, in the correct sequence, a further part of a turn according to the length of the setscrews, see (12A.10/A). Short setscrews (S) must be turned a further 150° (2.5 flats). Medium length setscrews (M) must be turned a further 180° (3 flats). Long setscrews (L) must be turned a further 210° (3.5 flats). A shop equipment tool (A) can be used for this operation.

Install the tool between the socket and the handle. Position the stop (A1) against a suitable protrusion on the cylinder head to prevent movement of the degree dial in a clockwise direction. Rotate the pointer to align with the relevant angle on the degree dial for the length of setscrew. Tighten the setscrew until the pointer on the tool is aligned with the zero position on the degree dial.

If no tool is available, make a suitable mark on the cylinder head in line with a corner of each setscrew (B). Make another mark, at the correct angle (counter-clockwise), on the edge of the flange of each fastener according to the length of the setscrew. Tighten each setscrew in the correct sequence until the marks on the flange are next to, and in line with, the marks on the cylinder head.





8 Put the push rods in position. Make sure that the end of each push rod is installed correctly in the tappet socket.

9 Install the rocker assembly, operation 12A-01.

10 Set the valve tip clearances, operation 12A-05.

11 Install the fuel injectors, operation 20A-02.

12 Install the high-pressure fuel tubes; tighten the connection nuts to 22 Nm (16 lbf ft) 2,2 kgf m.

Caution: *Where access to the fuel injection pump outlet fittings is possible, make sure that a separate wrench is used to prevent movement of the fuel injection pump outlets when the connections of the high pressure tubes are tightened.*

13 Install the fuel filter and the bracket. Install the low-pressure fuel tubes between the fuel injection pump and the fuel filter.

14 Install the coolant by-pass connection, tighten the setscrews and hose clip.

Continued

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