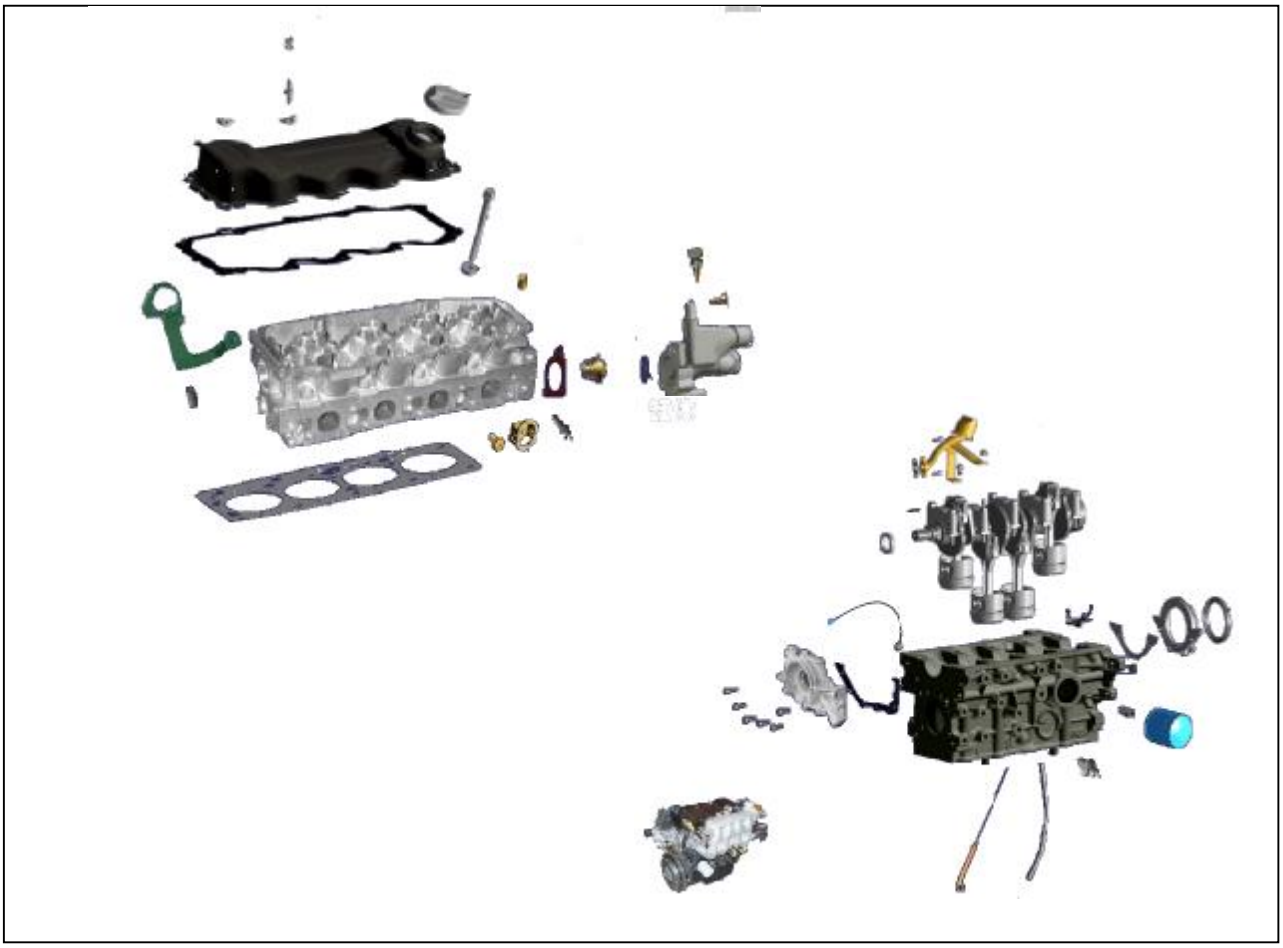
ENGINE

LOCATION INDEX

MECHANICAL LOCATION INDEX



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TOP AND BOTTOM TIMING GEAR COVER ASSEMBLY

Removal

Loosen and unscrew two bolts of the top timing gear cover assembly.

Remove the top timing gear cover and gasket assembly.

Remove the gasket from the top timing gear cover.

Remove the crank pulley.

Loosen and unscrew the two bolts on the timing gear cover.

Remove the timing gear cover and gasket assembly.

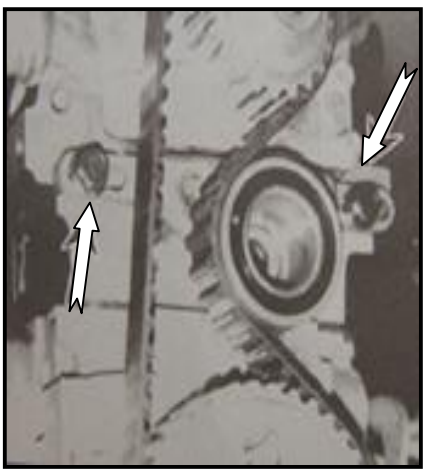
Remove the gasket from the bottom timing gear cover.

Installation

Clean the bottom timing gear cover and fix the new gasket on the bottom timing gear cover with glue. Install the bottom timing gear cover and gasket assembly on the crank shaft, screw in two bolts by hands and tighten them for a moment of 9.0~11N.m.

Clean the top timing gear cover and fix the new gasket on the top timing gear cover with glue. Fix the top timing gear cover and gasket assembly on the cylinder head with two bolts for a tightening moment of 9~11N.m.

TIMING BELT REMOVAL

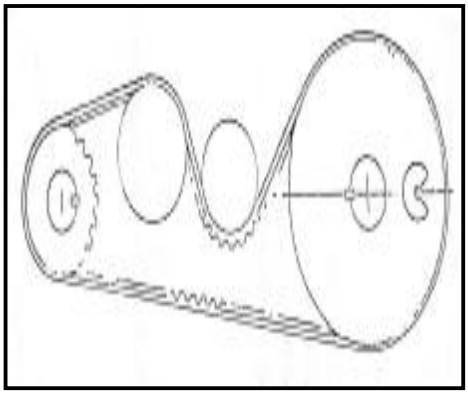


Rotate the crank shaft to the compression TDC on the first cylinder. Loosen the two bolts on the tension pulley (as indicated by the arrows in the figure) and push the tension pulley towards one side by a large-size screwdriver to release the belt tension.

Note: After the belt is taken out, do not rotate the gear to a large extent, otherwise the piston head and the valve will be damaged due to collision. To continue using the removed belt, carefully check whether there is abnormal abrasion, stratified cracks (especially those around the root) or fouling on the belt. Replace it immediately even if the slightest suspicion exists.

TIMING BELT INSTALLATION AND ALIGNMENT

Check whether the crank shaft is in the TDC position for the first cylinder. If necessary, slightly rotate the crank shaft for alignment and lock it around the flywheel ring gear. Make the tooth of the timing belt and the gullet of the flywheel in gear and drag the belt to the right in an upward vertical direction to enable it to engage with the cam gear and slot.



When installing the old belt, be sure to keep the original direction of movement and engage it with the original engaging teeth. After the belt is in place, check it and be sure that the positions of two gears haven't been changed.

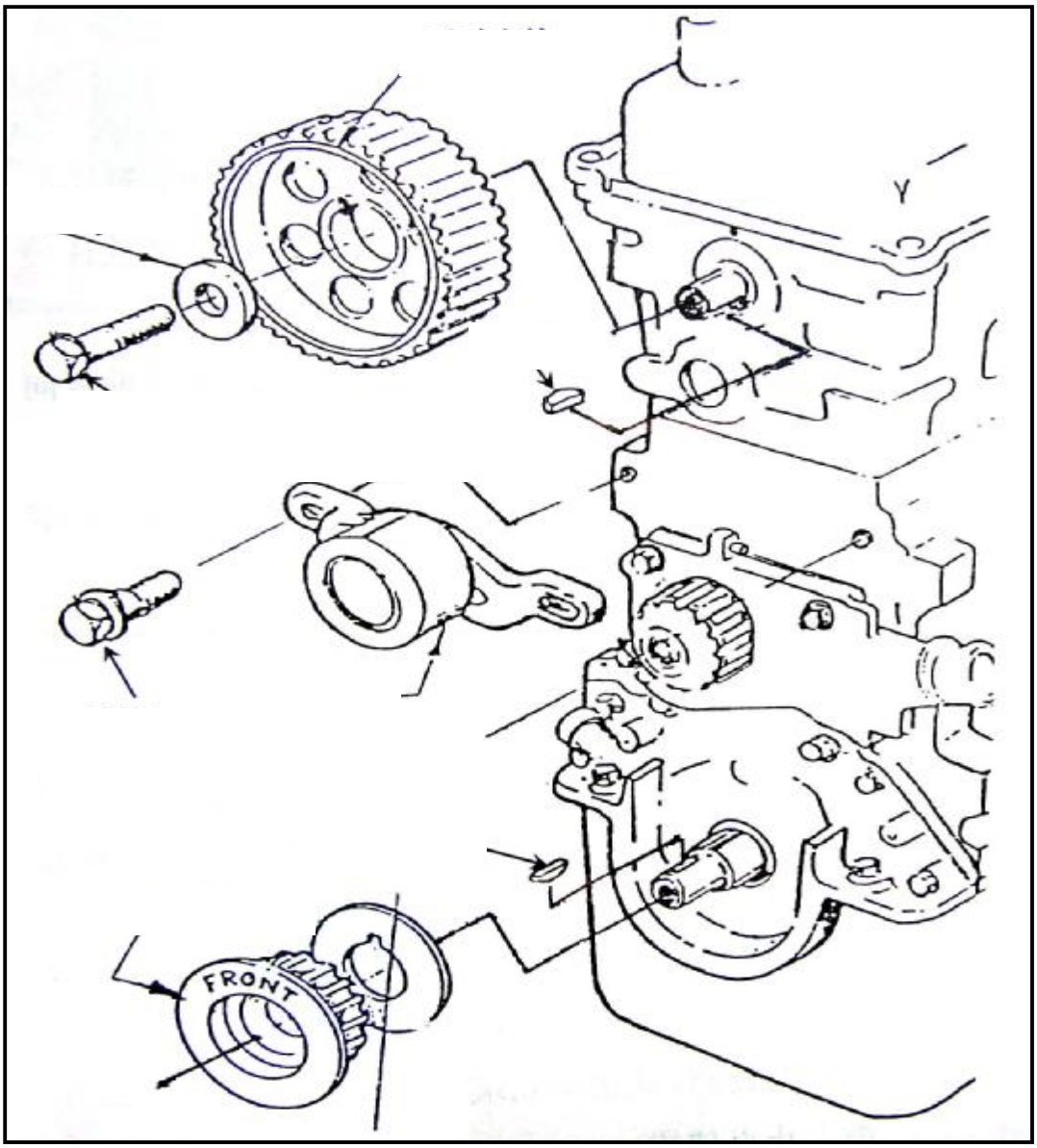
Carefully coil the belt around the tension pulley to enable it to engage with water pump gear. Check it again to ensure that the positions of the two teeth haven't been changed.

Loosen the two fixing bolts of the tension pulley to try to push it to the right (seeing from the direction of pulley) as possible, tighten its two fixing bolts and loosen the locking device of the crankshaft.

Rotate the crankshaft clockwise (seeing from the direction of pulley) for two circles to the compression TDC position on the first cylinder.

Hold the middle of the right belt that is away from both the crankshaft gear and camshaft gear with the thumb and the first finger. If the tension of the belt is up to standard, the belt shall be able to twist at 90° at this point.

To adjust the tension of the belt, loosen the two fixing bolts of the tension pulley, push the tension pulley to the right with a screwdriver as a ram, then fasten the fixing bolts again, rotate the crank shaft and check the tension again. Right tension may be obtained after 2~3 adjustments. Fasten the tension pulley with fixing bolts for a moment of 16-20N. after such adjustments are completed.



DRIVER BELT, TENSION PULLEY AND GENERATOR

Removal

Pull the abutment on the tension pulley by tools to the direction of the generator (or align the gauge holes on the front and rear part of the tensioning device and drive a pin to fix the tensioning device).

Remove the driver belt and the two fixing bolts on the generator to take the generator out.

For installation, reverse the above removal steps.

Tension pulley and Generator Bracket

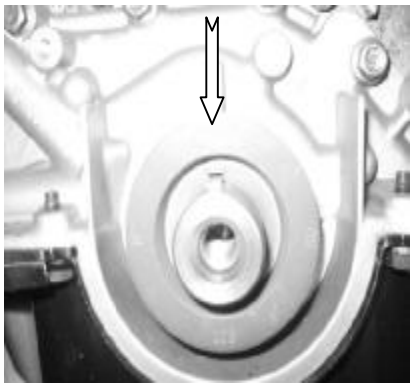
Removal

Remove the three fixing bolts on the belt tension pulley to take it out.

Loosen the connecting nuts on the cylinder head and binding bolts on the cylinder block on the generator bracket.

For installation, reverse the above removal steps.

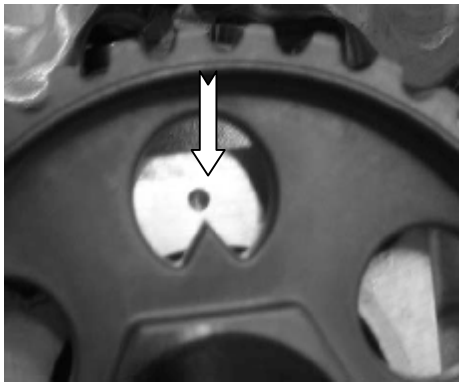
DETERMINATION OF ENGINE TIMING （TDC FOR CYLINDER 1）



Unscrew 2 M6 bolts to remove upper timing gear cover. Put one wrench on the bolts of crank pulley, rotate the crank shaft clockwise (seeing from the direction of pulley) until the top dead center (TDC) gap indicator on the pulley lines up with the TDC indicator (O) on the bottom timing gear cover.

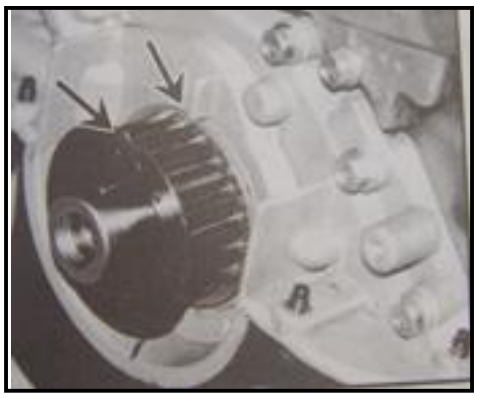
Note: The spark plug can be taken away before rotating the crank for labor saving.

Check whether the TDC indicator on the cam shaft gear lines up with that on the front end of cylinder head. If not, rotate the crank shaft clockwise in one full circle to make them line up with each other. At this time, the engine is in the position of TDC of the first cylinder.

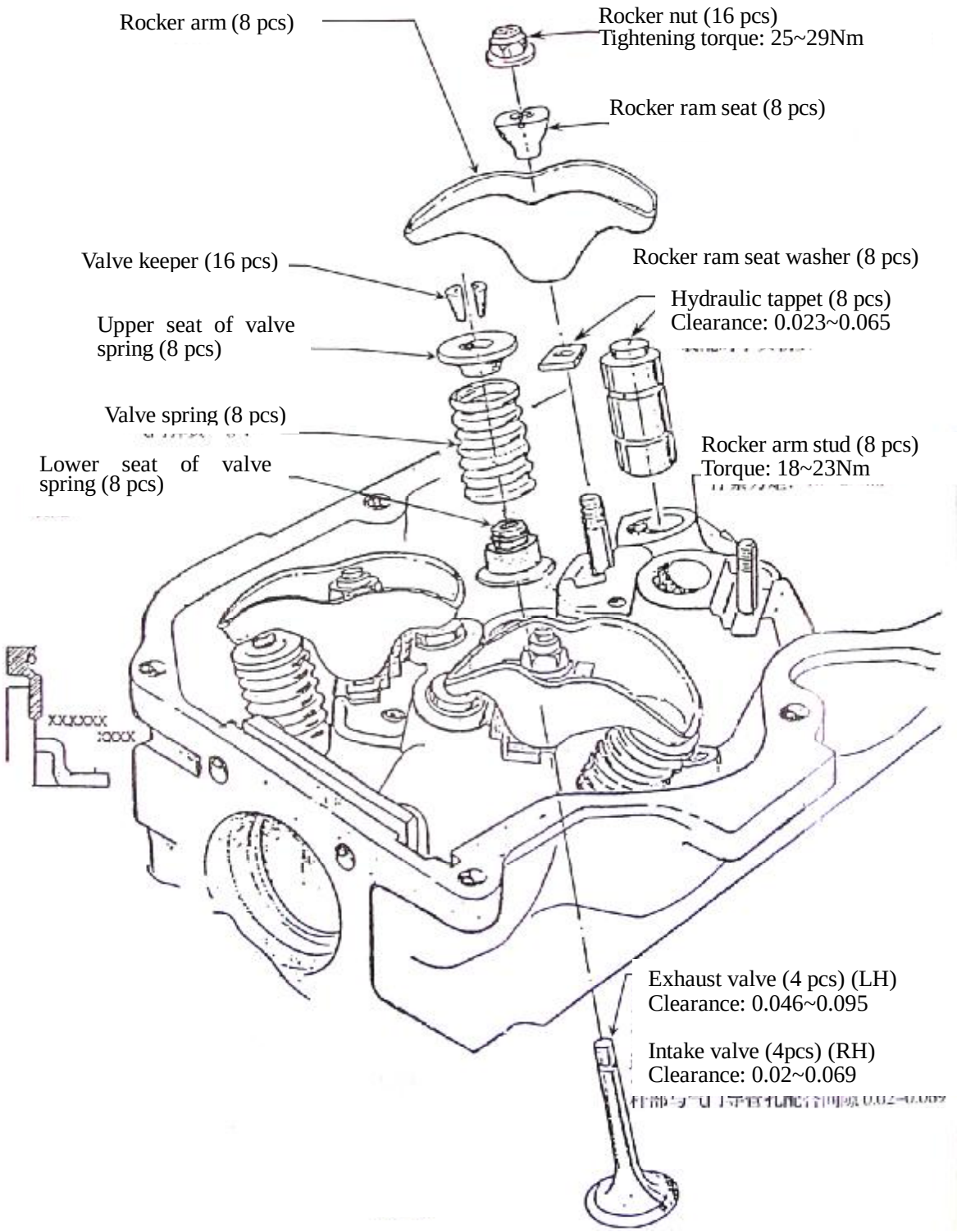


In case the crank pulley and timing gear have been removed, the TDC for the first cylinder can be determined as follows:

Rotate the crankshaft to make the TDC indicator on the crank pulley line up with that on the oil pump body. Check whether the TDC indicator on the cam shaft gear lines up with that on the front end of cylinder head. If not, rotate the crank shaft for one circle to make the cam gear indicator line up with that on the cylinder head.



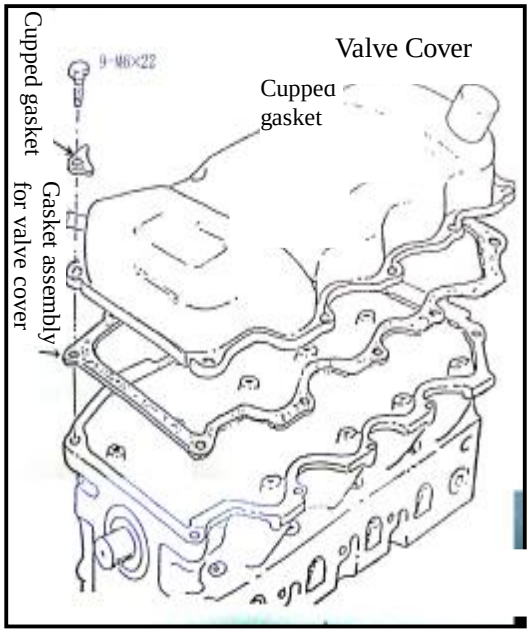
VALVE MECHANISM COMPONENTS



VALVE COVER AND GASKET

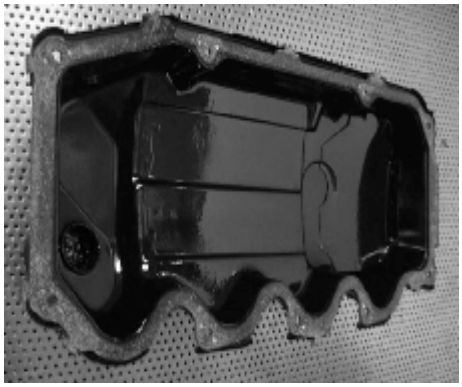
Removal

Remove 9 bolts to take out the cupped gasket and high tension wire support, clutch and throttle cable support.



Remove the valve cover and gasket assembly.

Take the sheet gasket out.



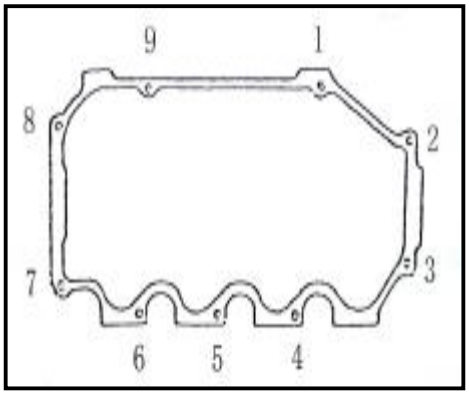
Installation

Clean the junction face of the cylinder head and the valve cover.

Push the wedge of the sheet gasket for the valve cover into corresponding valve cover to integrate them.

Install the combined valve cover and sheet gasket assembly on the cylinder head.

Put 9 hexagonal-head long cylindrical end bolts into the cupped gaskets and supports and screw them into the cylinder head.



Tighten the bolts in 2 steps according to the graphics and tightening order. First step: tighten them to the moment of 4.0-6.0Nm.Second step: tighten them to the moment of 8.0-10.0Nm.

ROCKER MECHANISM

Removal

Loosen the rocker nuts to take them out.

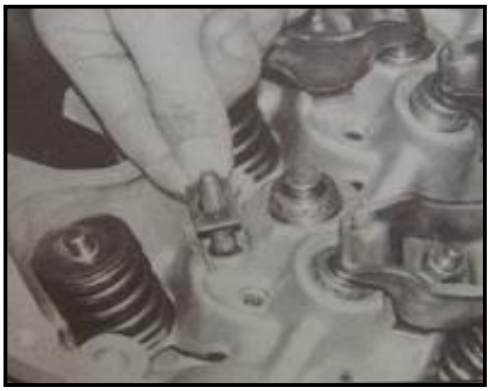
Take the level bracket out.

Take the rocker arm out.

Take the gasket of the level bracket out.

Place each set of rock arm and level bracket in one same plastic bag for distinction. The removed rocker nuts cannot be reused.

Installation:



Check whether theire is abnormal abrasion on the contact surface of the rocker. Replace it if necessary.

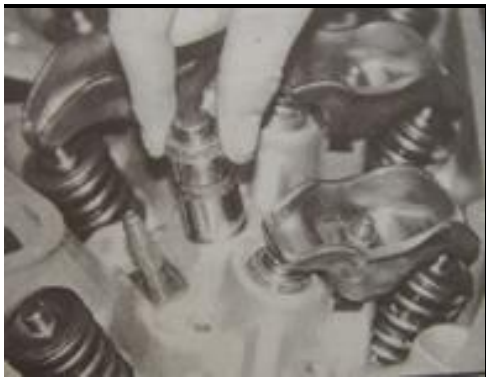
Put the rocker seat gasket into the stud.

Lubricate the rocker arm and rocker seat by motor oil.

Install the rocker arm and seat, screw in the new nuts by hands, then tighten them for the moment of 25—29N.m.

Note: The corresponding hydraulic tappet shall be in the Min. position before each rocker arm is installed and tightened with nuts.

HYDRAULIC TAPPET



Removal

Take the hydraulic tappets out and place them into an oil-filled vessel to prevent the hydraulic tappet oil from leaking out.

Check the top and bottom contact surfaces of the hydraulic tappet to observe whether there are abnormal abrasion or scrapes. If yes, replace it with new one if necessary.

Installation

Apply hyperbolic gear oil or motor oil on the tappet and external diameter as well as its two ends and place the tappet into the cylinder head hole in the original order.

Tappet

Size of Hydraulic Tappet

Class	Outside circle diameter (unit: mm)	Hole diameter of the cylinder head tappet (unit: mm)	Fit clearance (unit: mm)
Standard	¢22.200~¢22.212	¢22.25±0.015	0.023~0.065
T25	¢22.454~¢22.466	¢22.50±0.015	0.023~0.065

VALVE, VALVE SPRING AND OIL SEAL ASSEMBLY OF THE VALVE

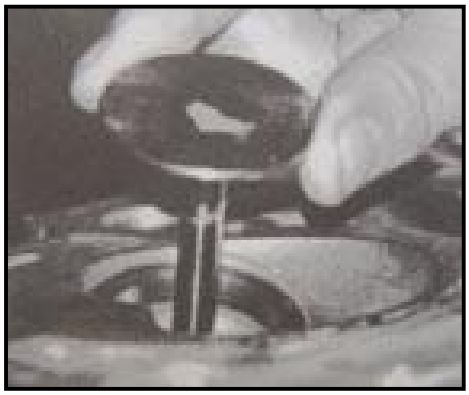
Removal

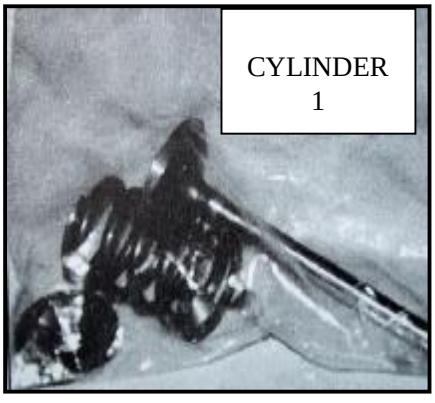
Compress the valve spring with a special compression device and take the valve cotter out. Do not over compress the spring, which shall be compressed to the travel stroke that the valve cotter can slide from the groove, otherwise the valve stem may bend.

If the valve cotter cannot slide out when the spring is compressed, remove the compression device and place a proper pipe on the spring seat. In this way, the valve cotter will not be collided. Place a piece of wood on the valve head (with the side of the combustion chamber of the cylinder head towards the table) and then hammer at the top of the pipe.

Reinstall the special compression device and compress the valve spring to take the cotter out. After the valve cotter is taken out, slowly loosen the bolts to remove the compression device.

Remove the valve spring seat and valve spring and take the valve oil seal and spring seat assembly out with a screwdriver. The seal oil seal spring seat must be replaced.

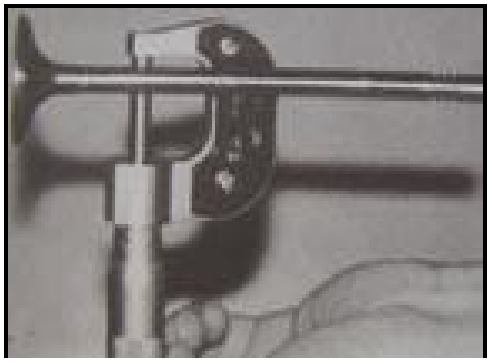




Put one set of valve, valve cotter, spring and spring seat into one plastic bag, each of which shall be tagged with numbers for installing them back to the original position.

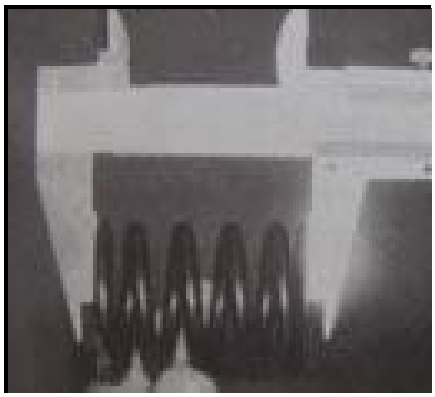
Valve stem size and fit clearance

Class	Intake（mm）			Exhaust（mm）		
	Diameter of valve stem	Inner Diameter of valve guide	Clearance	Diameter of valve stem	Inner Diameter of valve guide	Clearance
Standard	$8.043^{+0}_{-0.018}$	8.063—8.094	0.02—0.069	$8.017^{+0}_{-0.018}$	8.063—8.094	0.046—0.095
Oversized 0.4	$8.443^{+0}_{-0.018}$	8.463—8.494		$8.417^{+0}_{-0.018}$	8.463—8.494	



Measure the free length and elasticity of the valve spring

Compression length (mm)	Spring load (N)	Free Length of Spring (mm)
L_1=37.084	422	L_0=47.2
L_2=27.7	892.7	
L_3=27.0	945	



Grinding valve and valve seat ring

	UAES's new two-valve
Face angle of intake valve	44º30′ ---45º30′
Width of the sealing band for the intake valve seat ring	1.75---2.32mm
Face angle of exhaust valve	91º (0º-0º30 ′)
Width of the sealing band for the exhaust valve seat ring	1.44±0.1

Installation

Before installation, the cylinder head shall be completely cleaned and there shall be no any trace of abrasive dust on the cylinder head, valve or valve guide.

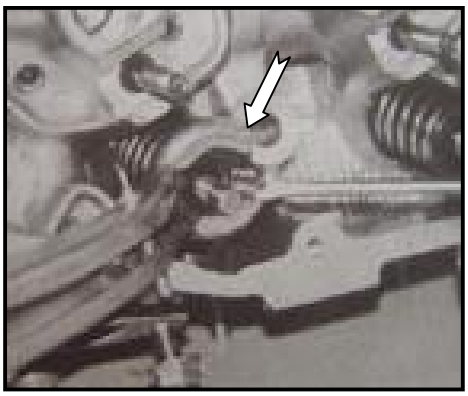
Lubricate the valve stem and valve guide bore with clean motor oil.

Install the valve. The assembly shall be completed according to the original valve indicators.

Note: The intake valves are interchangeable, but the exhaust valves are not.

Press the valve oil seal and spring seat assembly into the upper end of the valve guide, apply some motor oil on the guide opening or the edge of the valve oil seal and wrap the glove of the valve cotter by adhesive tape. After the valve is installed, take away the adhesive tape.

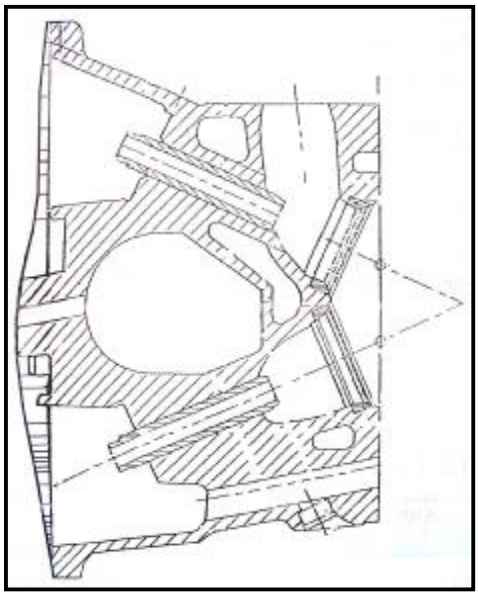
Install the valve spring and valve spring seat, compress the valve spring seat to the stroke that enables the valve cotter groove to appear by special compression device and install the cotter. Then slowly release the compression device and remove it.



After the whole valve cotter is installed, put the cylinder head on a piece of wood and knock at the small end of the valve stem by a plastic or copper hammer to help the valve mechanism to be in place better.

Size of intake valve seat ring and cylinder head seat ring bore

Class	Diameter of intake valve seat ring (unit: mm)	Diameter of the seat ring bore of cylinder head (mm)	Interference (mm)
Standard	$43.877^{+0.01}_{-0.01}$	$43.763^{+0.025}_{0}$	0.079 — 0.124
Oversized 0.5	$44.377^{+0.01}_{-0.01}$	$44.263^{+0.025}_{0}$	
Oversized 1.0	$44.877^{+0.01}_{-0.01}$	$44.763^{+0.025}_{0}$	



Size of exhaust valve seat ring and cylinder head seat ring bore

Class	Diameter of exhaust valve seat ring (mm)	Diameter of cylinder head seat ring bore (mm)	Interference (mm)
Standard	$38.877^{+0.01}_{-0.01}$	$38.263^{+0.025}_{0}$	0.079—0.124
Oversized 0.5	$39.377^{+0.01}_{-0.01}$	$38.763^{+0.025}_{0}$	
Oversized 1.0	$39.877^{+0.01}_{-0.01}$	$39.263^{+0.025}_{0}$	
UAES's new two-valve	$38.377^{+0.01}_{-0.01}$	$38.263^{+0.025}_{0}$	0.079—0.124
Oversized 0.5	$38.877^{+0.01}_{-0.01}$	$38.763^{+0.025}_{0}$	
Oversized 1.0	$39.377^{+0.01}_{-0.01}$	$39.263^{+0.025}_{0}$	

Size of valve guide and valve guide bore

Class	Valve guide bore (unit: mm)	Diameter of cylinder head guide hole (unit: mm)	Interference (unit: mm)
Standard	$13.555^{0}_{-0.01}$	13.481—13.519	0.026—0.07
Oversized	$14.305^{0}_{-0.01}$	14.231—14.269	
Oversized	$14.505^{0}_{-0.01}$	14.481—14.519	

COMPRESSION PRESSURE

COMPRESSION INSPECTION

Warning

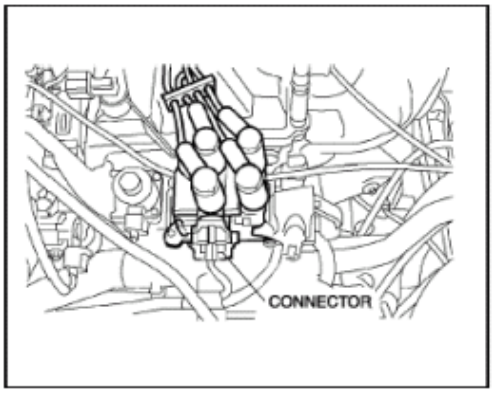
- **Hot engines and oil can cause severe burns. Be careful not to burn yourself during removal/installation of each component.**

1. Verify that the battery is fully charged.
   - Recharge it if necessary.
2. Warm up the engine to the normal operating temperature.
3. Stop the engine and allow it to cool off for **about 10 min**.
4. Perform "Fuel Line Safety Procedures". Leave the fuel pump relay removed.

Warning

- **Fuel vapor is hazardous. It can very easily ignite, causing serious injury and damage. Always keep sparks and flames away from fuel.**
- **Fuel line spills and leakage are dangerous. Fuel can ignite and cause serious injuries or death and damage. Fuel can also irritate skin and eyes. To prevent this, always complete the "Fuel Line Safety Procedure".**

5. Remove the ignition coil connector.
6. Remove the spark plugs.
7. Connect a compression gauge into the spark plug hole.
8. Fully depress the accelerator pedal and crank the engine.
9. Note the maximum gauge reading.
10. Inspect each cylinder as above.



- If the measured value is less than the limited value, or there is a cylinder whose compression value varies from that of other cylinders, add a small amount of engine oil through the spark plug hole. Then measure the compression pressure and perform the respective operations for the following cases.

— If the compression increases, the piston, the piston rings, or cylinder wall may be worn and overhaul is required.

— If the compression stays low, a valve may be stuck or improperly seated and overhaul is required.

— If the compression in adjacent cylinders stays low, the cylinder head gasket may be damaged or the cylinder head distorted and overhaul is required.

Cylinder Pressure Standard Value：1.00-1.35 Mpa (10-13.5 kgf/cm2)

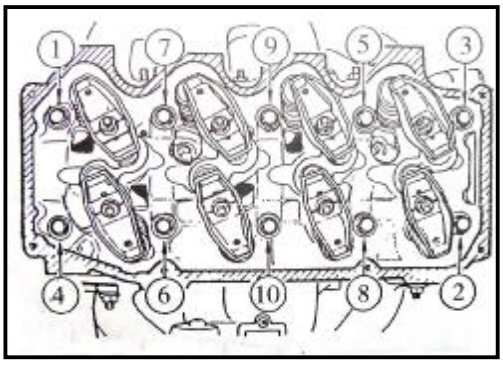
11. Disconnect the compression gauge.
12. Install the spark plugs.
13. Connect the ignition coil connector.
14. Install the fuel pump relay.

CYLINDER HEAD GASKET REPLACEMENT

Removal

Rotate the cam shaft clockwise until the key slot goes downwards vertically.

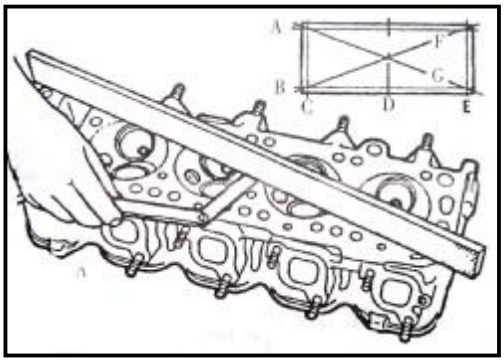
Loosen the bolts on the cylinder head in the order illustrated in the figure.



Note: The bolts removed from the cylinder head must be changed and cannot be reused.

Inspection and Installation

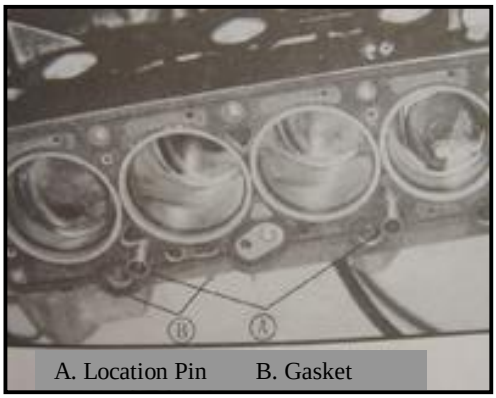
Check the out-of-flat of the base plane of the cylinder head, which shall not be above 0.15mm.



Clean the threaded holes of the cylinder block. No lubricant shall be settled in the threaded holes, otherwise the liquid pressure may lead to the cracking of the cylinder block after the bolts are screwed in.

Rotate the crank shaft clockwise to the position that enables the piston of the first cylinder to be about 20mm lower than the top plane of the cylinder block, thus to avoid the valve to collide with the top of the piston when installing the cylinder head assembly.

Put the cylinder gasket into the dowel.

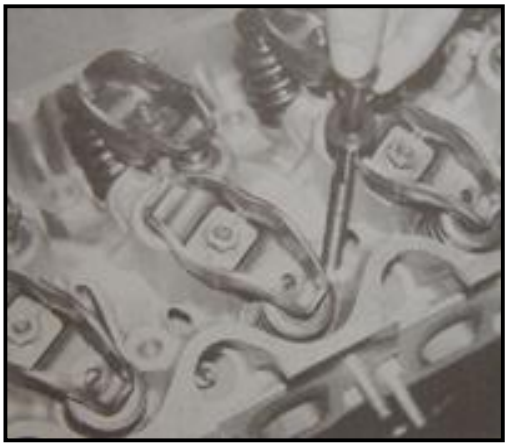


Note: The side with indicator of the cylinder gasket shall be upward.

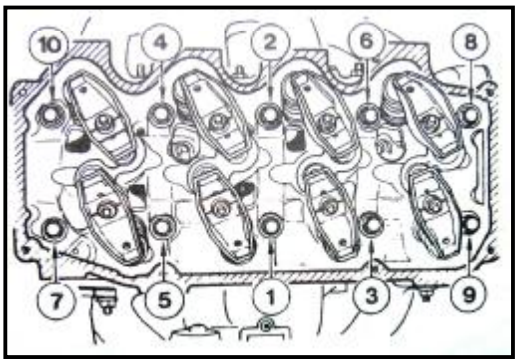
Install the cylinder head in place with the key slot of the cam shaft downward vertically.

Note: The cylinder gasket can only be used for one time, so the removed one shall be replaced with a new one when removing the cylinder head.

Put the bolts and the flat gasket of the cylinder head into the threaded hole to screw them in by hands.



Tighten the bolts of the cylinder head in four steps according to the order illustrated in the figure:



a. First step: tighten it at the moment of 20-40N.
b. Second step: tighten it at the moment of 20-40N.
c. Third step: rotate 90 degrees.
d. Fourth step: rotate 90 degrees.
e. Moment-angular tension indicating wrench can be used for degree rotation.

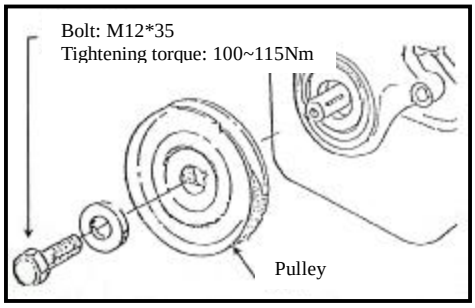
CRANKSHAFT PULLEY

Removal

Removal 3 fixing bolts on the starter to take it out. Fasten the flywheel ring gear with a proper screwdriver or rod to disenable the crank shaft to rotate.

Loosen the fixing bolts of the crank pulley and take out the bolts and washer to pull out the pulley (use a gear puller, if necessary).

Installation

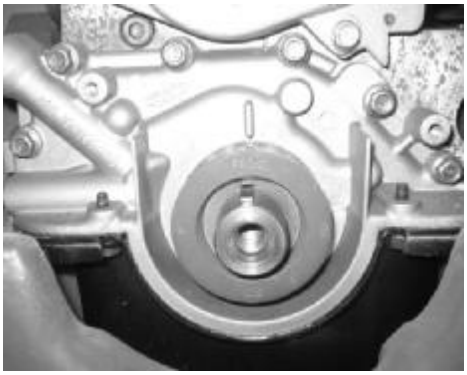


Clean the pulley and crankshaft journals and wipe clean the lube in the pulley groove. Install the pulley on the crank shaft journal, with the key slot to line up with the whiney key.

Put the washer over the bolts and screw it in by hands. Fasten the flywheel ring gear to disenable the crank shaft to rotate. Tighten the bolts for a moment of 100-115N.m

CRANKSHAFT GEAR

Removal



Fix the crankshaft to disenable it to rotate and remove the pulley.

Pull the crankshaft gear out by a wheel puller or two large-size screw drivers and remove the whiney key.

Installation

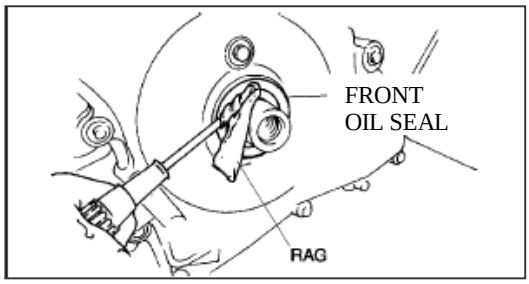
Check whether there are abrasion, pit corrosion or scrapes on the gear.

Install the whiney key, with a protrusion height of 1.392-1.739mm.

Install the gasket and pay attention to its direction (with the warped surface forward).

Install the crank shaft gear (with the convex surface forward), place it on the locating abutment with a auxiliary pulley and bolts.

FRONT OIL SEAL REPLACEMENT



Front Oil Seal Removal

Cut the oil seal lip using a razor knife.

Remove the oil seal using a screwdriver protected with a rag.

Front Oil Seal Installation Note

Apply clean engine oil to the oil seal lip.

Push the oil seal slightly in by hand.

Tap the oil seal in evenly using the **SST** and a hammer.

FLY WHEEL REMOVAL AND INSTALLATION

Removal

Remove 9 fixing bolts. New bolts shall be used for installation.

Remove the fly wheel to check whether there are cracks on the friction surface of the clutch plate and there is abrasion and pit corrosion on the teeth of the ring gear, etc.

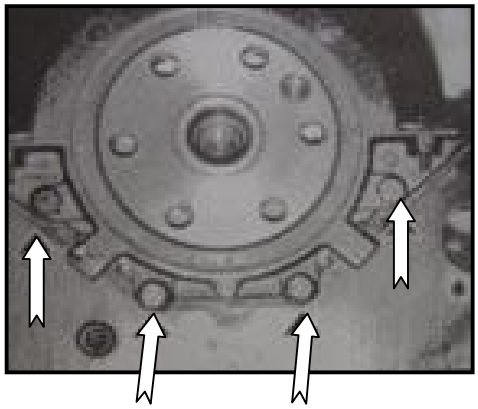
Installation

The clearance of the ring gear and the fly wheel is 0.48-0.86mm. The ring gear shall be pressed into the fly wheel after heating.

The gauge holes of the fly wheel and the locating journal are easy fit at a clearance of 0.012-0.074mm. It shall be gently pushed into the journal after alignment. Do not hammer at the crank shaft.

During the assembly process, align the installation mark bore and the manufacturing bore on the crank shaft. Tighten 9 new bolts applied with a coat of glue in advance at a moment of 82-92Nm.

REAR OIL SEAL REPLACEMENT



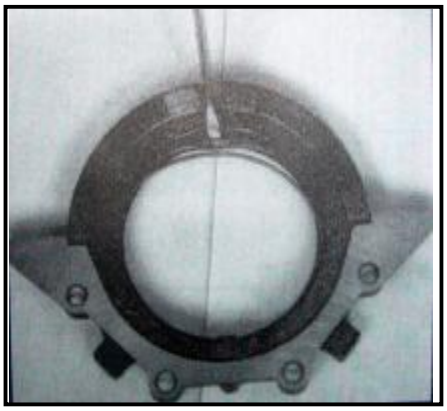
Removal

Remove 4 bolts (as indicated by arrows).

Take the rear oil seal support assembly out.

Take the rear oil seal support gasket.

Pries the rear oil seal out of the rear oil seal support with a chisel or a screwdriver. Note: do not damage the rear oil seal support.



Installation

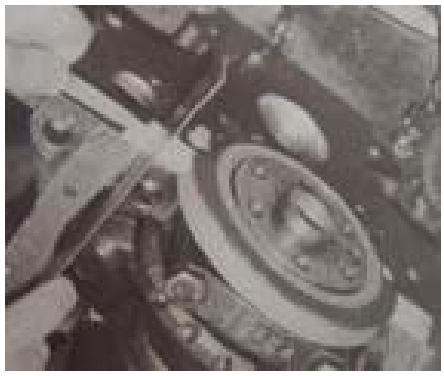
Put the support on the vice clamp whose jaw has a piece of wood.

Make the side with the part numbers of the rear oil seal outward and align the rear oil seal with the rear oil seal support bore. Press the rear oil seal into its support with a vice clamp, with the clearance between the rear oil seal and oil seal support bore to be 0.26—0.50mm.

Install the new rear oil seal support gasket.

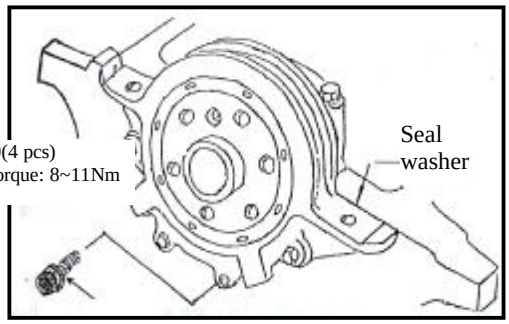
Install the rear oil seal assembly. Before assembling, wrap a piece of plastic plate on the crank shaft to avoid colliding the oil seal. And apply some motor oil on the oil seal edge and oil seal journal.

Measure the out-of-flat of the bottom plane of the rear oil seal bracket and the sump flange surface of the cylinder block, which shall be within the range of ±0.26mm.



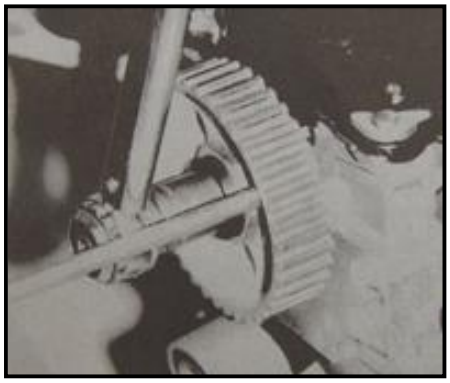
Tighten the 4 M6 bolts to a moment of 8.0-11.0Nm.

Take away the plastic tape.



CAMSHAFT GEAR

Removal



Rotate the crankshaft to the compression TDC position of the first cylinder.

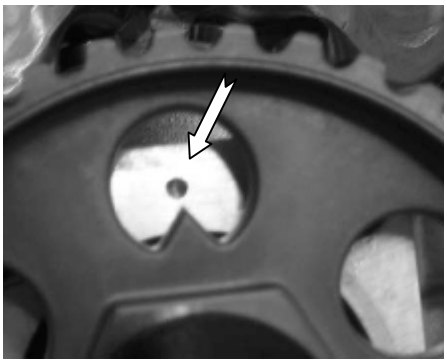
Remove the belt.

Put one pole into one hole of the cam shaft gear to lock it. Loosen the gear bolts and remove them and the gasket.

Note:

New bolts shall be used for reinstallation. The camshafts of different engines are not interchangeable. In case the cam shaft shall be replaced, replace it with a new one according to the indicators on the original gear.

Installation



Check whether there are abrasion, pit corrosion or scrapes on the gear.

Install the whitney key of the cam shaft, with a protrusion height of 1.64-2.11mm.

Install the camshaft gear onto the camshaft and put new bolts into the gasket. The new bolts that haven't been applied with a coat of glue in advance shall be applied with a coat of glue first and be tightened for a moment of 52-60N.m.

Check whether the crank shaft is in the compression TDC position.

CAMSHAFT AND CAMSHAFT THRUST SPACER

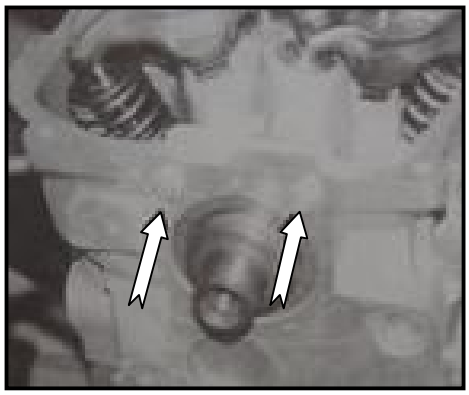
Removal

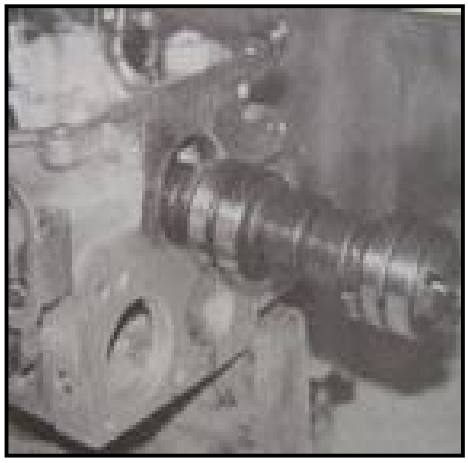
Measure the axial clearance of the cam shaft, which shall be between 0.049~0.129mm.

Loosen the bolts of the thrust spacer to take them out.

Take the thrust spacer out (as illustrated in the figure).

Draw the cam shaft assembly out from the rear end of the cylinder head and be careful not to damage the cam shaft hole of the cylinder head during this process.



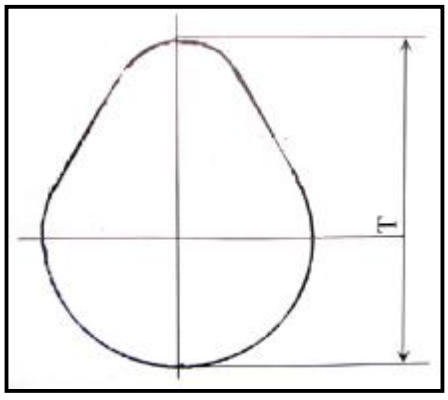


Inspection

Check whether there is any abrasion on the cam and the journal of the cam shaft. Change the one with serious abrasion.

Change the thrust space if the axial clearance of the cam shaft is above the specification.

Measure the bore diameter of the cam shaft of the cylinder head or check the relative displacement of the journal and bore with the cam shaft. Change the cam shaft if the bore is excessively wore.



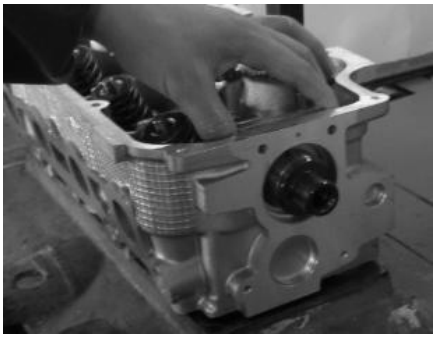
Cam Height

Engine model	Admission cam T (unit: mm)	Exhaust cam T (unit: mm)
480	38.602	37.586
480E	37.559	37.559

SIZE OF CAMSHAFT JOURNAL AND HOLE OF THE CYLINDER HEAD

Installation

To replace the cam shaft, observe the shape of the rear end of the cam shaft for right selection.



Before installation, apply the cam of the cam shaft with hyperbolic gear oil or motor oil. The cam shaft shall be assembled from the cylinder head in a back-to-front order.

Apply some motor oil to the thrust spacer of the cam shaft and put the thrust spacer into the groove of the cylinder head.

Screw two bolts into the threaded holes of the thrust spacer and tighten them for a moment of 9—13Nm.

Check the axial clearance of the cam shaft, which shall be within the specified range.

If adopting oversized hydraulic tappet (0.25), a carefully selected cam shaft shall be used, otherwise it will block the hydraulic tappet.

1. Standard size

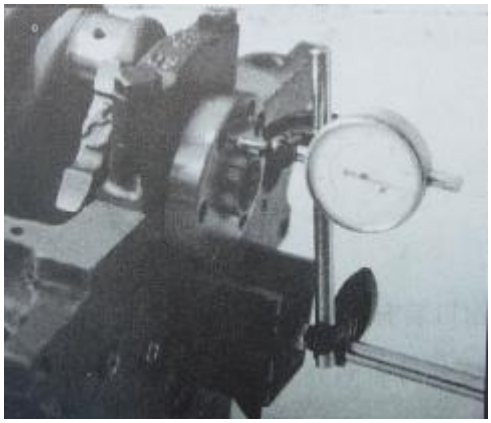
Number of cam shaft journal	Diameter of cam shaft journal (unit: mm)	Diameter of the cam shaft hold of the cylinder head (unit: mm)
1	44.74—44.76	44.783—44.808
2	44.99—45.01	45.033—45.058
3	45.24—45.26	45.283—45.308
4	45.49—45.51	45.533—45.558
5	45.74—45.76	45.783—45.808

2. Oversized (0.38)

Number of cam shaft journal	Diameter of cam shaft journal (unit: mm)	Diameter of the cam shaft hold of the cylinder head (unit: mm)
1	45.12—45.14	45.163—45.188
2	45.37—45.39	45.413—45.438
3	45.62—45.64	45.663—45.688
4	45.87—45.89	45.913—45.938
5	46.12—46.14	45.163—45.188

CRANKSHAFT, CRANKSHAFT THRUST SPACER, BEARING SHELL AND MAIN BEARING CAP

Removal



Check the axial clearance of the crank shaft before removal.

Kiss the end side of the crank shaft with the contacts of a dial gauge (less degree of shrinkage). Push the crank shaft away from the contacts and adjust the dial gauge to 0, then push the crank shaft to the direction of contacts as possible with a0 stout carrying pole. Check the reading of the dial gauge, which shall be the axial clearance. The axial clearance of a crank shaft is 0.092-0.303mm.

The leaf of a clearance gauge can be used to check the axial clearance of a crank shaft if there is no dial gauge, which shall be placed between the third main bearing cap and crank shaft (push and pull the crank shaft).

Loosen the bolts and studs of the main bearing shell, (beginning from the middle bearing cap), take out the bolts and the threaded rods to remove the main bearing cap and the lower shell of the main bearing shell. This lower shell shall still remain in the main bearing cap.

Take the crank shaft out.

Remove the crank shaft thrust spaces (2 pieces) from the cylinder block.

Inspection

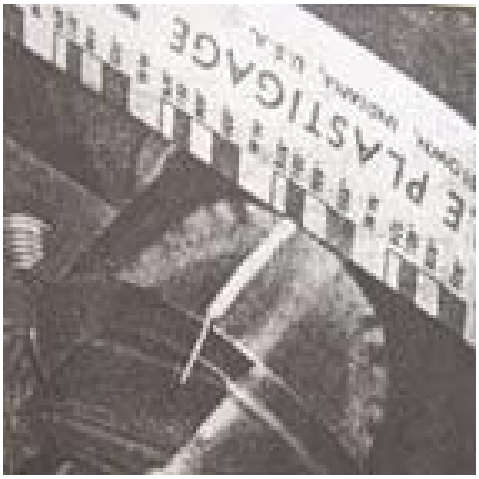
Check the main journal and main bearing shell clearance.

Clean the main journal of the crank shaft, the internal bore of the main bearing cap and main bearing shell with a non-woven fabrics. Place the plastic clearance gauge (its length slightly shorter than the length of the main journal) on the main journal, which shall be in parallel with the generator of the main journal.

Note: Do not rotate the crank shaft!

Install the main bearing cap. Tighten the bolts of the main bearing cap at the moment of 90-100N.m by hands. Do not rotate the crank shaft.

Remove the main bearing bolts. Carefully take out the main bearing cap and arrange them in order. Read the bearing clearance according to the ratio on the envelope of the plastic clearance gauge. Check the bearing clearance from the third main bearing and extend to both sides. The main bearing clearance shall be 0.011—0.058mm.

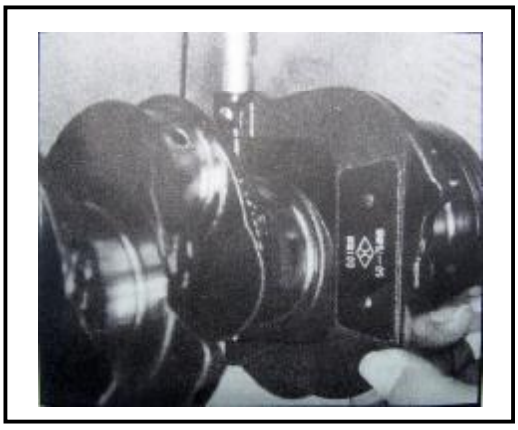


Check the bearing clearance of the connecting rod.

Check the bearing clearance of the connecting rod according to the above methods. The bearing clearance of the connecting rod shall be 0.006—0.06mm.

Size of connecting rod journal and connecting-rod bearing shell

Class	Diameter of connecting rod journal (unit: mm)	Thickness of connecting-rod bearing shell (unit: mm)
Standard	47.89—47.91	1.480—1.487
Downsized by 0.025	47.89—47.91	1.492—1.499
Downsized by 0.25	47.64—47.66	1.605—1.612
Downsized by 0.5	47.39—47.41	1.730—1.737
Downsized by 0.75	47.14—47.16	1.855—1.862
Downsized by1.0	47.89—46.91	1.980—1.987

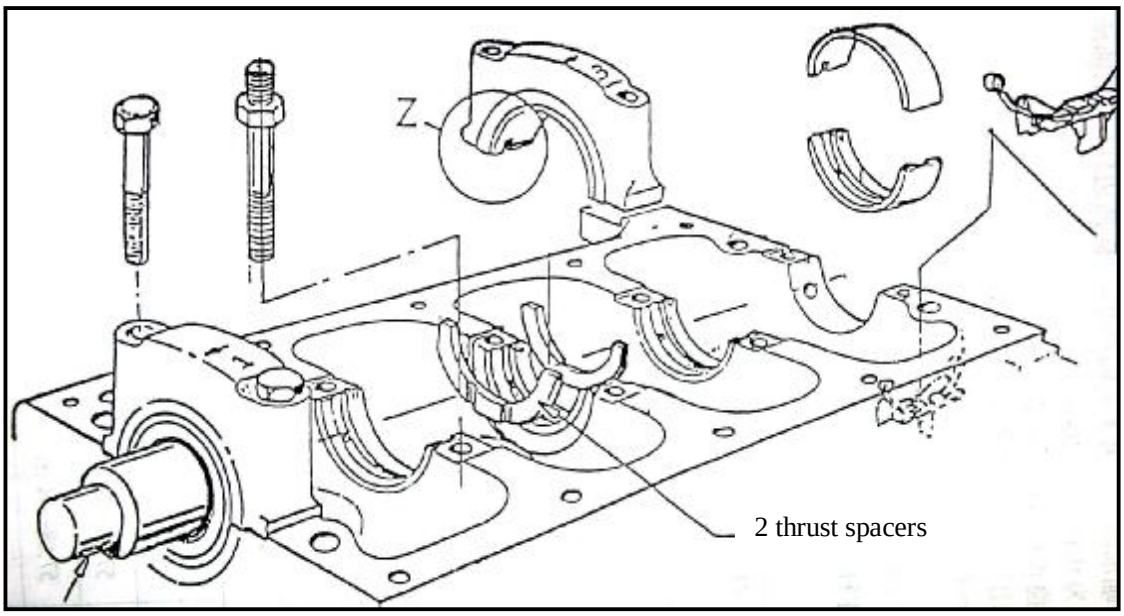


Diameter of main journal and size of main bearing shell

Class	Diameter of main journal (unit: mm)	Diameter of the main bearing bore of the cylinder block (unit: mm)	Thickness of the main bearing shell (unit: mm)
Standard	57.98—58.00	62.2935±0.0065	2.131—2.138
Oversized by 0.4	57.98—58.00	62.6935±0.0065	2.331—2.338
Downsized by 0.02	57.98—58.00	62.2935±0.0065	2.141—2.148
Downsized by 0.25	57.73—57.75	62.2935±0.0065	2.256—2.263
Downsized by 0.50	57.48—57.50	62.2935±0.0065	2.381—2.388
Downsized by 0.75	57.23—57.25	62.2935±0.0065	2.506—2.513
Downsized by 0.25 and oversized by 0.4	57.73—57.75	62.6935±0.0065	2.456—2.463
Downsized by 0.50 and oversized by 0.4	57.48—57.50	62.6935±0.0065	2.518—2.558
Downsized by 0.75 and oversized by 0.4	57.23—57.25	62.6935±0.0065	2.706—2.713

Size of crank shaft thrust, thrust spacer and cylinder block thrust

Class	Size of cylinder block thrust (unit: mm)	Size of crank shaft thrust (unit: mm)	Thickness of thrust spacer (unit: mm)
Standard	24±0.03	28.825-28.875	2.326±0.025
Oversized by 0.38	24±0.03	29.205-29.255	2.516±0.025



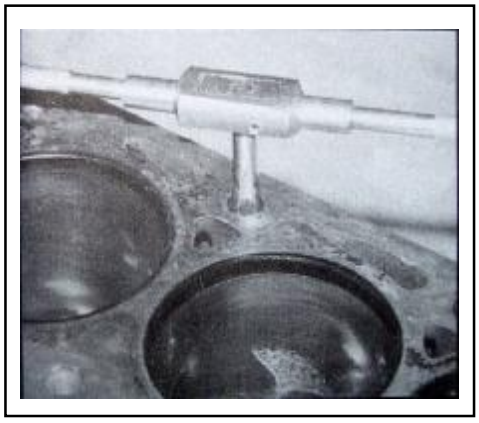
Installation

Before installation, tap the threaded hole on the cylinder block with tapping drill, especially those of the cylinder head bolts and main bearing bolts.

Cylinder head bolt: M10X1.5~6H

Main bearing bolt: M12X1.75~6H

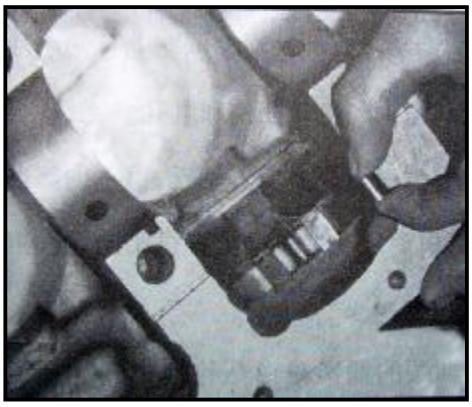
Installation of the whiney key of the crank shaft: gently drive the whiney key into the key slot. The clearance between the whiney key and key slot is 0.00~0.051mm. Check the protrusion after the whiney key is installed, which shall be 1.392~1.739mm.



There are two pieces of crank shaft thrust spacers, which are installed on the front and rear thrust surfaces. Before installation, apply some motor oil on the side of the thrust spacer with oil groove and make this side towards the cylinder block and the other side towards the crank shaft.

Apply some motor oil on the main journal, connecting rod journal, thrust surface and bearing shell before the crank shaft is installed.

The top of the main bearing cap is cast with numbers- 1, 2, 3, 4, 5 and one arrow. During the assembly, start the installation in a front-to-back order and enable the guide finger towards the front end surface of the cylinder block. The width of 1, 2, 4, 5 main bearing cap is same, but that of the third main bearing cap is larger than others. The location of the main bearing cap depends on the rabbet and the rabbet and the cylinder block is interference fit, with the interference to be 0.025~0.145mm. After the assembly, the sides of the first and fifth main bearing cap shall be even with or lower than the back and front end surface of the cylinder block.



Among the main bearing bolts, 9 are hexagonal-head flanged bolts and 1 is stud. For transverse engine, the stud shall be installed on the left threaded hole of the second main bearing cap (seeing from the front) for installing the support of the suction strainer. For a north-south engine, the stud

shall be installed on the left threaded hole of the fourth main bearing cap (seeing from the front).

Apply some motor oil on the head joint before installing the main bearing cap bolts.

Tighten the main bearing cap bolts and stud by hands, then tighten them to the moment of 90~100Nm.

The twist moment of the crank shaft (assembly with piston connecting rod) is 16Nm max.

Oil baffle assembly

Removal

Take the oil baffle assembly out from the right side of the back of the cylinder block (seeing from the front)

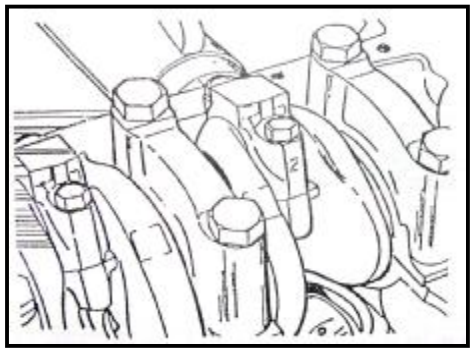
Installation

Install the oil baffle assembly from the right side of the back of the cylinder block (see from the front). The tension spring of the oil baffle assembly shall be lower than the crankcase flange of the cylinder block.

PISTON REMOVAL, MEASURE AND INSTALLATION

Removal

Rotate the crank shaft to the bottom dead center (BDC) of the removed cylinder, check whether there is a cylinder number on the connecting rod body and cap, which shall be on the left of the rod (seeing from the front). If there is no such a number, number each cylinder before removal.



Remove the connecting rod bolts to dismantle the connecting rod cap, take the connecting-rod bearing shell out and label the cylinder number and bottom and top shell on the back of the shell.

Push the connecting rod and piston out from the cylinder block with a wooden club and take the cylinder rod out.

Remove the piston ring with a special tool or the leaf of a clearance gauge and label each cylinder and bottom and top leaf.

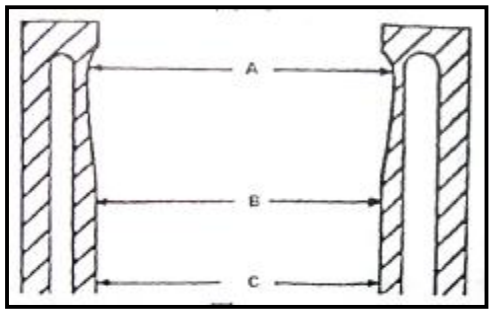
Press the piston pin out of the piston and the small end of the connecting rod with a press machine and put the piston, piston ring and pin of each cylinder together.

Rinsing and inspection

Rinse and clean the carbon deposit on the piston, piston ring and pin.

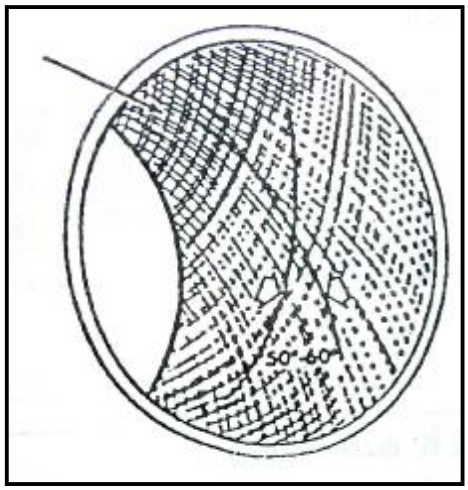
Rinse and clean the carbon deposit on the bottom of the cylinder bore.

Measure the diameter of the cylinder bore.



	480 M cylinder bore (unit: mm)		480 E cylinder bore (unit: mm)	
Ex-factory grouping	1	79.94-79.95	1	79.94-79.95
	2	79.95-79.96	2	79.95-79.96
	3	79.96-79.97	3	79.96-79.97
	4	79.97-79.98	4	79.97-79.98
Ex-factory repair	A	80.23-80.24	A	80.23-80.24
	B	80.24-80.25	B	80.24-80.25
	C	80.25-80.26	C	80.25-80.26
For Maintenance	Standard	79.965-77.975	Standard	79.965-77.975
	Oversized by 0.29	80.245-80.255	Oversized by 0.29	80.245-80.255
	Oversized by 0.5	80.466-80.475	Oversized by 0.5	80.466-80.475

Grind the cylinder bore according to the size for maintenance with the grinding angle to be 50° ~60° .



Measure the piston from the point that is 19mm away from the bottom of the skirt.

	Diameter of 480M piston skirt (unit: mm)		Diameter of 480E piston skirt (unit: mm)	Diameter of UAES's new two-valve piston skirt (unit: mm)
Ex-factory grouping	1	79.91-79.92	79.915-79.925	79.915-79.925
	2	79.92-79.93	79.925-79.935	79.925-79.935
	3	79.93-79.94	79.935-79.94	79.935-79.94
	4	79.94-79.95	79.945-79.955	79.945-79.955
Ex-factory repair	A	80.20-80.21	80.205-80.215	80.205-80.215
	B	80.21-80.22	80.215-80.225	80.215-80.225
	C	80.22-80.23	80.225-80.235	80.225-80.235
Spare parts	Standard	79.93-79.955	79.965-79.975	
	Oversized by 0.29	80.21-80.235	80.245-80.255	
	Oversized by 0.5	80.43-80.455	80.465-80.475	80.435-80.455

Measure the diameter of piston pin bore

Diameter of 480M piston pin bore (unit: mm)		Diameter of 480E piston pin bore (unit: mm)	
White	20.630-20.633	White	20.630-20.633
Red	20.633-20.636	Red	20.633-20.636
Blue	20.636-20.639	Blue	20.636-20.639

Measure the diameter of the piston pin

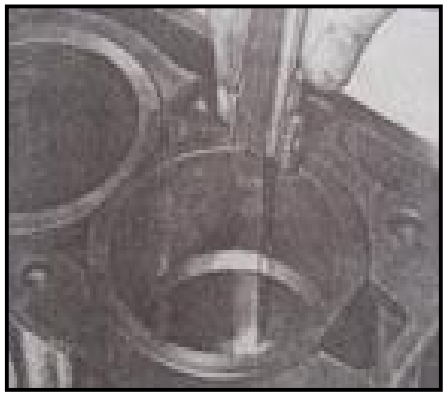
Diameter of 480M piston pin bore (unit: mm)		Diameter of 480E piston pin bore (unit: mm)	
White	20.622-20.625	White	20.622-20.625
Red	20.625-20.628	Red	20.625-20.628
Blue	20.628-20.631	Blue	20.628-20.631

Measure the end clearance of the piston ring

First compression ring: 0.30-0.50mm

Second compression ring: 0.30-0.50mm

Oil ring: 0.40-1.40mm



Measure the axial clearance of piston ring in the piston groove

	Height of the piston ring (unit: mm)	Size of piston ring groove (unit: mm)	Fit clearance (unit: mm)
First compression ring	$1.60^{0}_{-0.012}$	$1.6^{+0.06}_{+0.04}$	0.050-0.082
Second compression ring	$2.0^{0}_{-0.012}$	$2.0^{+0.06}_{+0.04}$	0.050-0.082
Sealing strip of oil ring	0.61±0.025	$4.0^{+0.03}_{+0.01}$	0.01-0.23
Spring of oil ring	2.68±0.05		
Cast iron oil ring	$4.0^{-0.015}_{-0.025}$	$4.0^{+0.03}_{+0.01}$	0.025-0.055

480 UAES's new two-valve

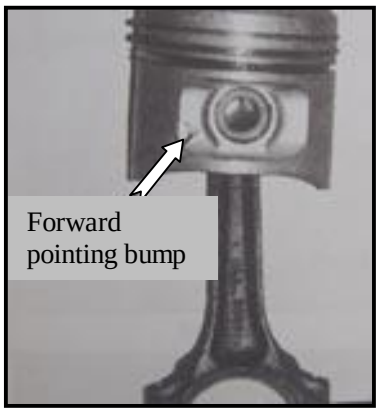
	Height of the piston ring (unit: mm)	Size of piston ring groove (unit: mm)
First compression ring	1.2（-0.03～-0.01）	1.2（0.03～0.05）
Second compression ring	1.5（-0.03～-0.01）	1.5（0.02～0.04）
Sealing strip of oil ring	0.46±0.02	3（0.01～0.03）
Spring of oil ring	2.75±0.05 2.0±0.02	

Measure the small-end bore diameter of the connecting rod Φ20.589

Check whether the big-end injection hole of the connecting rod is blocked, with the outlet diameter to be Φ1mm.

Installation

Piston weights and spare piston skirts are not grouped, but the piston pin holes shall be grouped. Before assembly, check the piston crown marks. The marks of the four cylinders must be same.

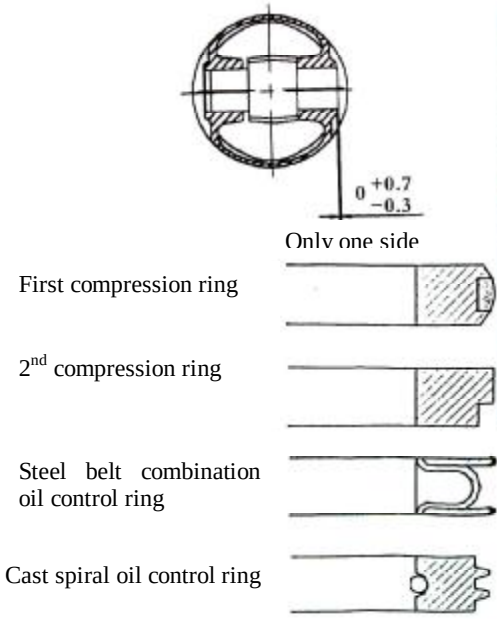


Heat the small end of the connecting rod to 230~400℃, apply SAE50 lube or glue type of graphite oil, then press the piston pin into the small end bore of the connecting rod and the piston pin bore. One end of the piston pin can be 0.7mm（max）higher than the pin boss or lower than the pin seat, and the other end shall be in the pin boss.

The forward pointing arrow on the piston crown and the forward pointing bump on the external surface of the piston pin seat shall be in the same direction with the "F" near the big end on the connecting rod body (For some blanks forged with the number "480", the side with the number shall be upward.

After connecting the piston, piston pin and the connecting rod together, print or chisel the cylinder number (size: 3mm) on the top of the piston, connecting rod body and left of the connecting rod cap. The printing shall not lead to the distortion of the junction plane.

When installing the piston ring, the side with characters shall be upward and the external slit of the second compression ring shall be downward. Detailed order is as follows: (1) install the oil control piston ring; (2) install the second compression ring and (3) install the first compression ring. When installing the ring, the max. expanding must be less than (size of cylinder bore + 1.65mm) , otherwise the ring is subject to distortion or broken off. The opening of the two sealing strips of Steel belt combination oil control ring shall be staggered from each other by 120° while the one of cast iron oil ring shall be stagger from that of spiral bushing ring by 180° . The piston shall be able to rotate freely in the ring groove and no jamming shall exist.

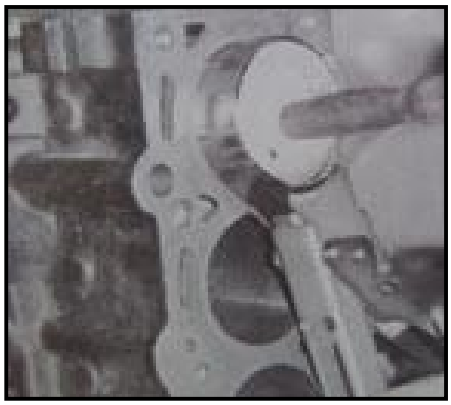


Size of piston ring

480# piston ring	
Paint mark (type)	Paint mark (type)
No paint (Standard)	No paint (Standard)
Purple paint (oversized by 0.29)	Purple paint (oversized by 0.29)
Blue paint (oversized by 0.5)	Blue paint (oversized by 0.5)

INSTALLATION OF THE PISTON AND CONNECTING ROD ASSEMBLY

Apply some motor oil in the piston, piston ring and cylinder, with the first and second compression ring staggered from the opening of the oil control piston ring by 120° , then install the piston and connecting rod assembly into the cylinder. The piston and connecting rod assembly may be pushed into the cylinder by a hammer.



Apply some motor oil on the connecting-rod bearing shell and install the connecting rod cap and body. The connecting rod cap is fixed by two elastic dowels.

Tighten the connecting rod bolts to the moment of 30-36N.m. Before installation, apply some motor oil on the bolt heads and threads.

The side clearance of the big end of the connecting rod is 0.0092-0.268mm.