A21 ENGINE

PDF created with pdfFactory Pro trial version www.pdffactory.com

CHAPTER I ENGINE PARAMETER AND SPECIAL TOOL

I. TECHNICAL DATA DESCRIPTION

ENGINE FEATURE

Engine model	SQR481H
Engine type	Four cylinders, water-cooled, in-line double overhead camshaft, 16 valves, controllable burning rate (CBR) and variable valve timing (VVT)
Cylinder diameter (mm)	81
Piston stroke	77.5
Displacement	1.597
Compression ratio	10.5
Rated Power (net power)	87
Revolution at rated power(RPM)	6200
Maximum torque (Nm)	275
Revolution at max. torque (RPM)	4300
Minimum fuel consumption rate	275

PDF created with pdfFactory Pro trial version www.pdffactory.com

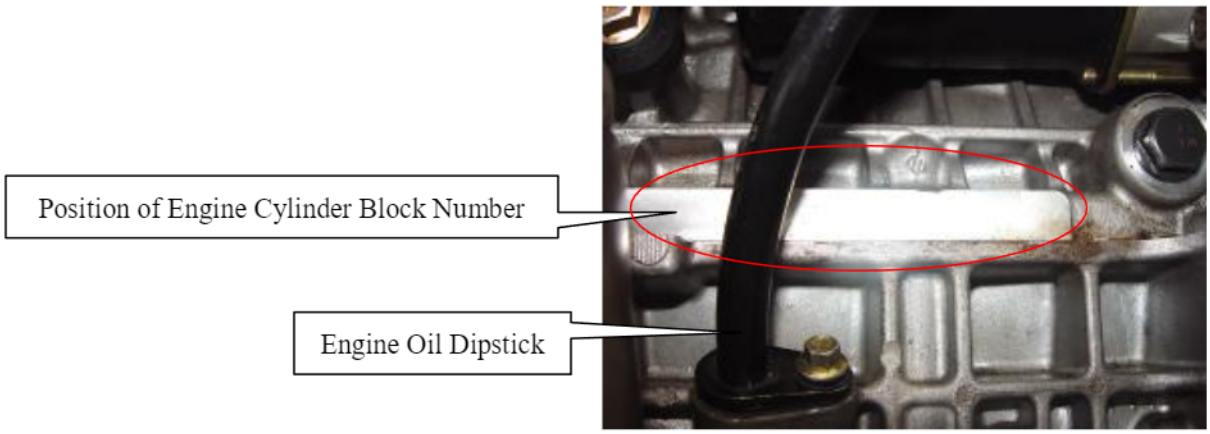
II. SPECIAL TOOL:

	Camshaft Timing Tool
	Crankshaft Timing Tool
	Flywheel Tool
	Guide Sleeve Of Crankshaft Oil Seal
	Guide Sleeve Of Camshaft Oil Seal
	Hydraulic Hoist

PDF created with pdfFactory Pro trial version www.pdffactory.com

III. ENGINE NUMBER POSITION



CHAPTER II ENGINE ACCESSORIES

SECTION I ENGINE TIMING CALIBRATION

1. Dismantle dynamo belt

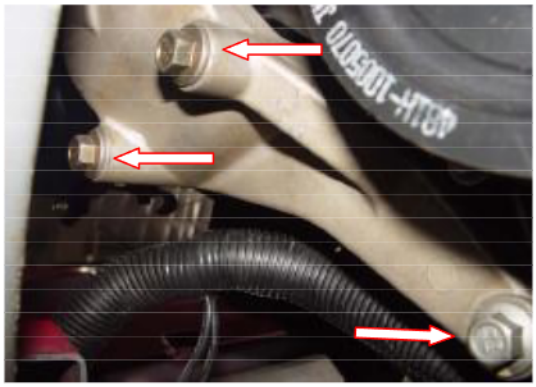
Use wrench to clamp the tension pulley bolt, screw it counterclockwise and dismantle the generator bolt.

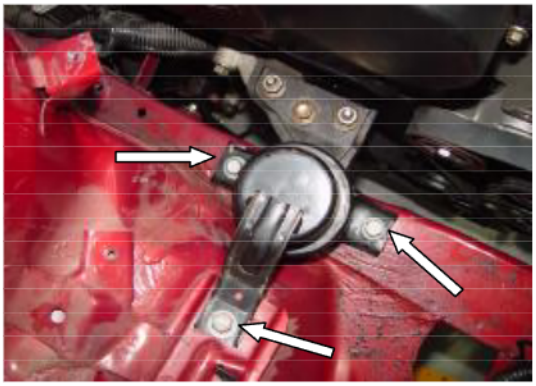


PDF created with pdfFactory Pro trial version www.pdffactory.com

2. Dismantle the right engine mounting bracket

Use small crane to hoist the engine, dismantle the bolts of right suspension and lift down the right mounting bracket.





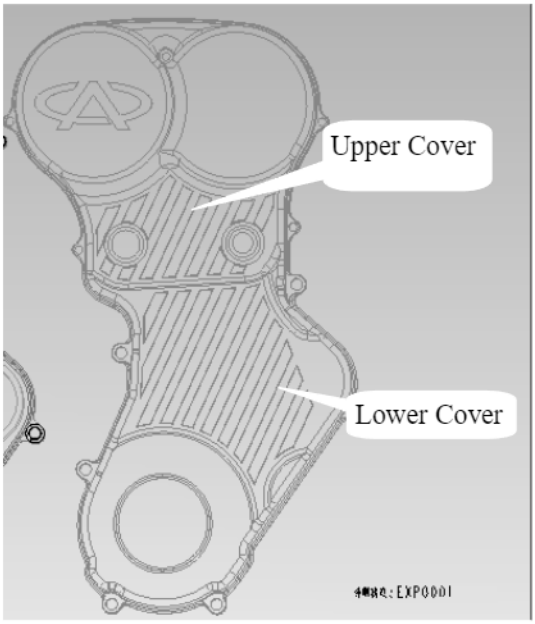
3. Dismantle crankshaft pulley

Shift the car into the 5th gear, step on the brake, and dismantle the fixed bolt of crankshaft pulley.



4. Dismantle the timing belt cover

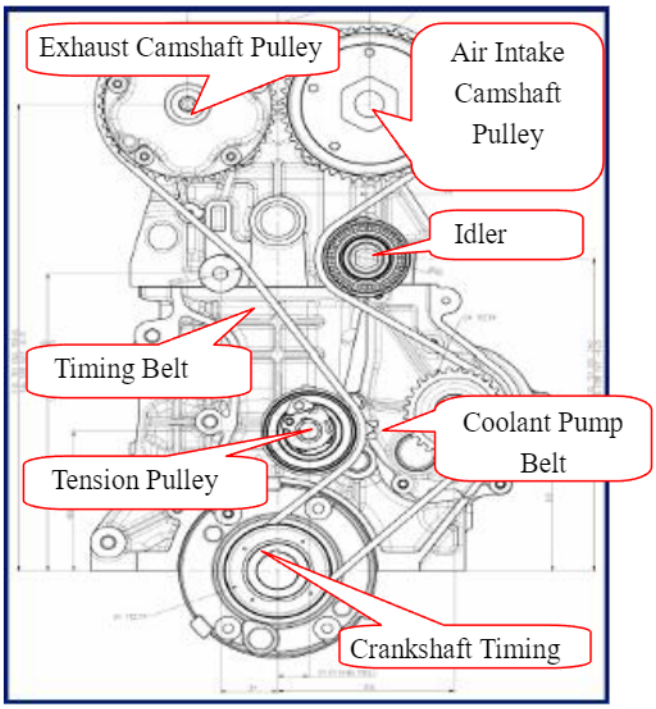
Dismantle the upper cover and lower cover of timing belt respectively.



PDF created with pdfFactory Pro trial version www.pdffactory.com

4. Dismantle timing belt

Loosen the central fixed bolt of tension pulley of timing belt, dismantle the timing belt. Meanwhile, loosen the hollow stay bolts connecting the air intake and exhaust camshaft pulleys and the camshafts.

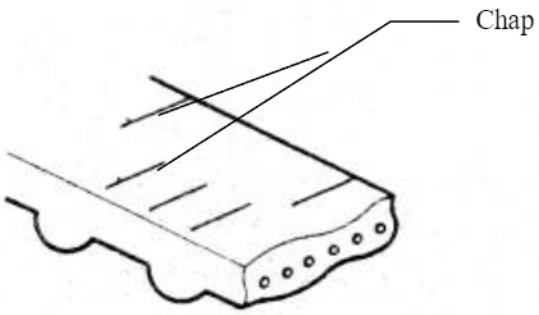


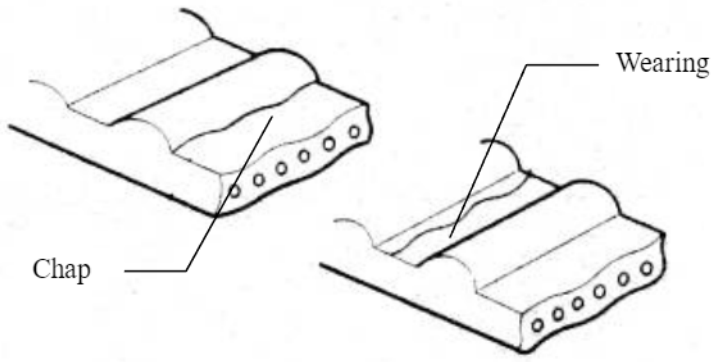
Carry out detailed inspection on various portions of timing belt. If any one shown in the figure occurs, you should replace with new spare parts.

(1) Chap of back-side rubber

(2) Chap of dedendum, chap of separated cord fabric.

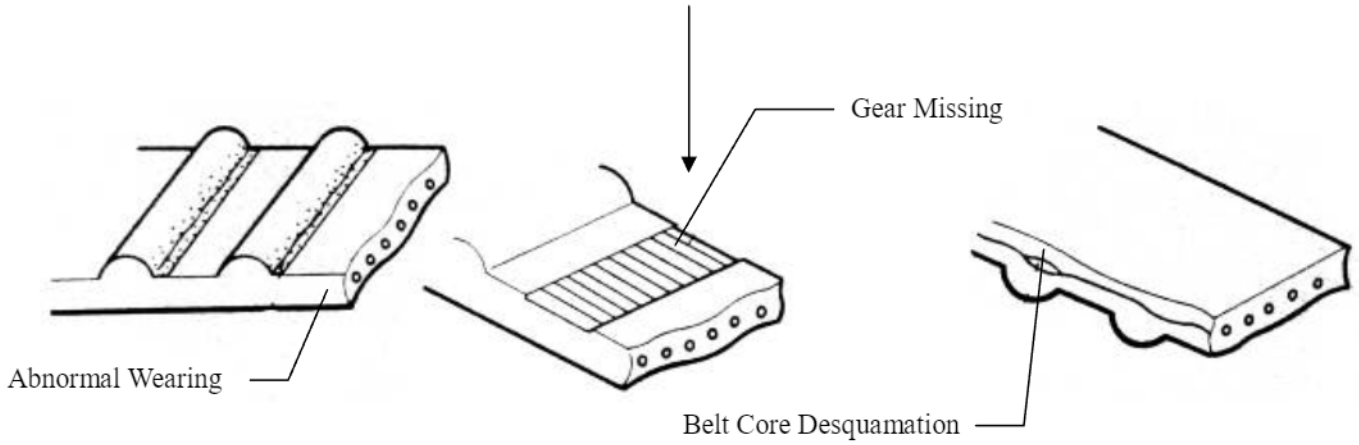
(3) Wearing, gear missing and incomplete gear of cord fabric.





(4) Abnormal wearing of belt flank.

PDF created with pdfFactory Pro trial version www.pdffactory.com



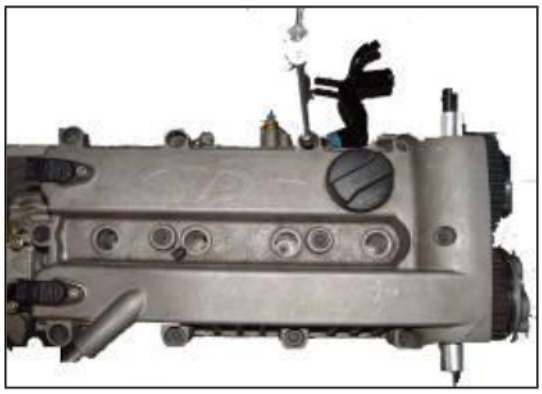
Even if no outer damage is confirmed, you should also replace the belt when any of the following conditions occurs.

(1) If the water in the coolant pump is leaked and more water should be filled continuously.

(2) If the belt is spotted with much oil stains, and the rubber may be damaged due to expansion, you should replace the belt.

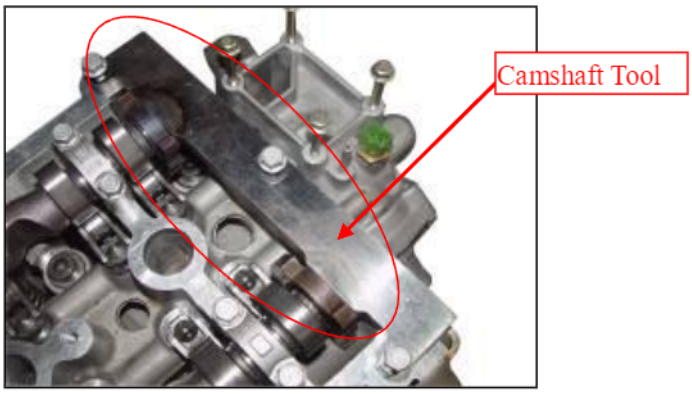
5. Dismantle the valve chamber cover

Loosen the fixed bolt of valve chamber cover, and lift down the valve chamber cover.



6. Camshaft phase alignment

Rotate the camshaft and clamp the camshaft tool into the eccentric groove of camshaft sensor signal pulley.

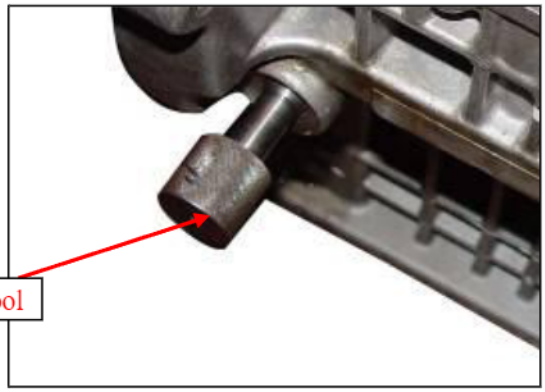


PDF created with pdfFactory Pro trial version www.pdffactory.com

PDF created with pdfFactory Pro trial version www.pdffactory.com

7. Crankshaft phase alignment

Screw off the bulkhead of cylinder block, screw the crankshaft tool into it, rotate the crankshaft until the crankshaft tool completely clamps the crankshaft. At this time, the crankshaft cannot rotate clockwise and counterclockwise.



8. Mount and strain the timing belt

Mount the timing belt in the position shown in the figure, use allen wrench to rotate the tension pulley in order to strain the belt, fasten the tension pulley bolt. And fasten the fixed bolt of air intake and exhaust camshaft pulleys and the camshafts.

Torque:120±5Nm.

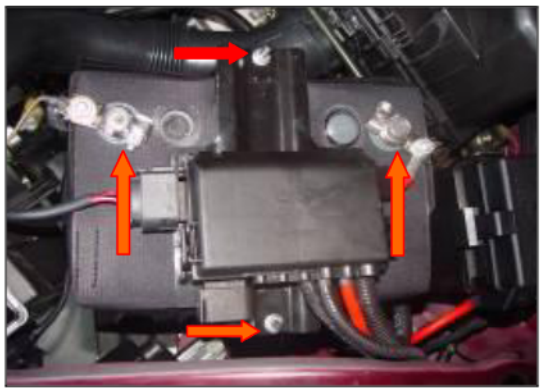


9. Lift down the special timing calibration tools, and then fasten the valve chamber cover, timing belt cover, the right engine mounting bracket of engine, and dynamo belt.

PDF created with pdfFactory Pro trial version www.pdffactory.com

SECTION II LIFTING AND INSTALLATION OF ENGINE

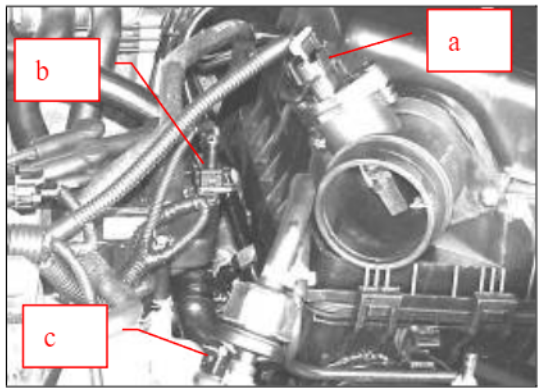
1. When the ignition switch is shut off, you can pull out the battery earth cable, loosen the fastening screw,and dismantle the battery.



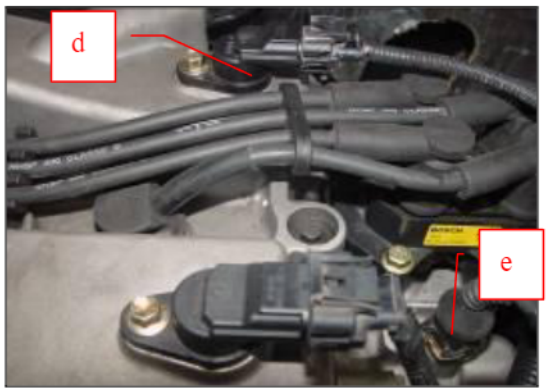
2. Loosen the condenser drainpipe, screw off the expanded pot lid, and discharge all the anti-freezing solution.



3. Dismantle the airflow lines between the throttle valve case and the air flow meter, dismantle the (a) lead connector of air flow meter, (b) lead connector of ignition coil,(c) lead connector of canister solenoid valve.



4. Remove the (d) the wire harness plug of water temperature sensor, and (e) wire harness plug of air intake and exhaust camshaft position sensor.

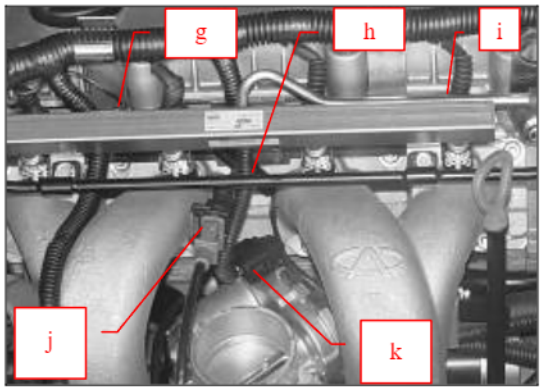


PDF created with pdfFactory Pro trial version www.pdffactory.com

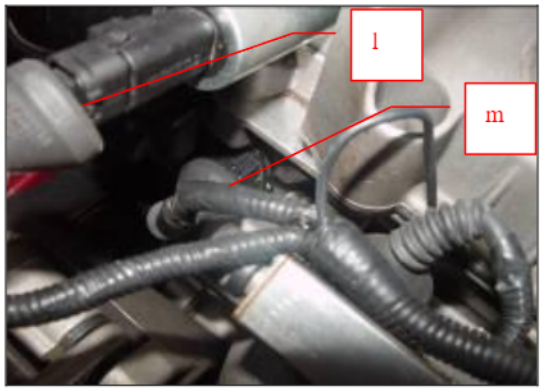
5. Remove the (f) the harness plug of CBR solenoid valve.



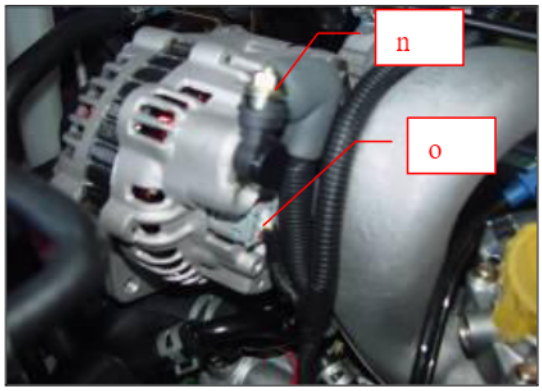
6. Dismantle (g) the earth cable bolt of cylinder head, remove (h) the wire harness plug of starter coil, (i) wire harness plugs of four oil injectors, (j) knock sensor plug, (k) wire harness plug of throttle valve controller.



7. Remove (l.) CBR solenoid valve plugs, and (m) oil temperature sensor plugs

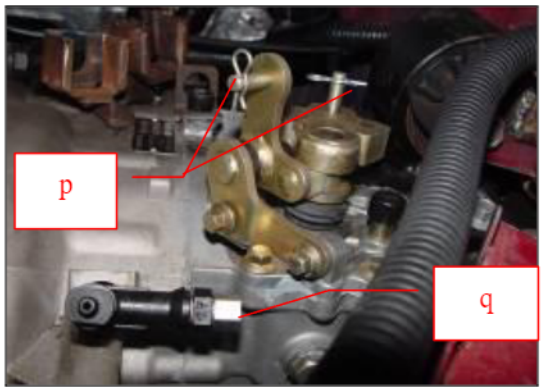


8. Loosen (n) generator positive pole output, pull out (o) exciting current harness plugs as well as the plugs of relevant parts of the A/C compressor, steering booster pump, oxygen sensor, and A/C high-low voltage switch.. Loosen the fixed bolt of starter harness to confirm the plugs of all parts are completely separated.

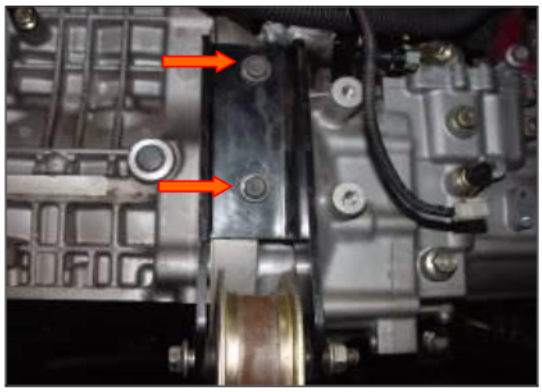


PDF created with pdfFactory Pro trial version www.pdffactory.com

9. Dismantle (p) transmission gearshift cable and (q) hydraulic pipe of clutch.



10. Use crane to hoist the engine hanger from the top, and dismantle the two hexagonal flange bolts of front suspension bracket.



11. Dismantle the hexagonal flange bolts of girder under the car body.



12. Remove the hexagonal flange bolts of rear suspension-cushion assembly of engine.

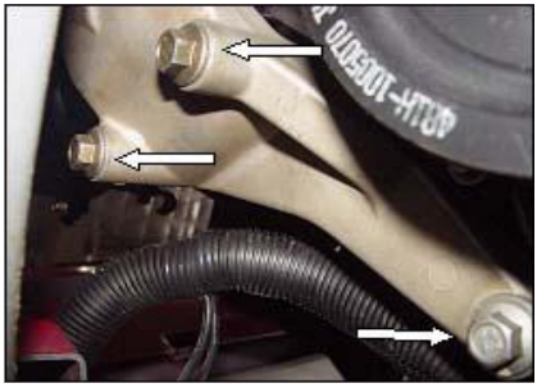


PDF created with pdfFactory Pro trial version www.pdffactory.com

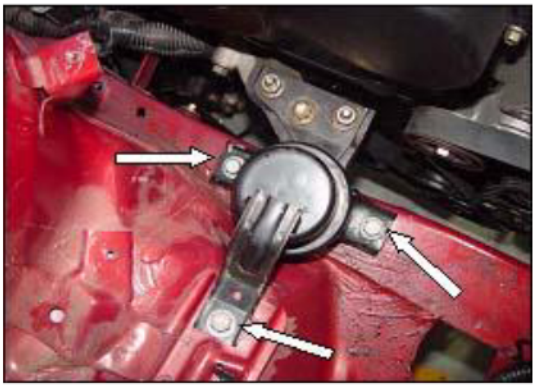
13. Dismantle the coolant reservoir and cleaning the reservoir.



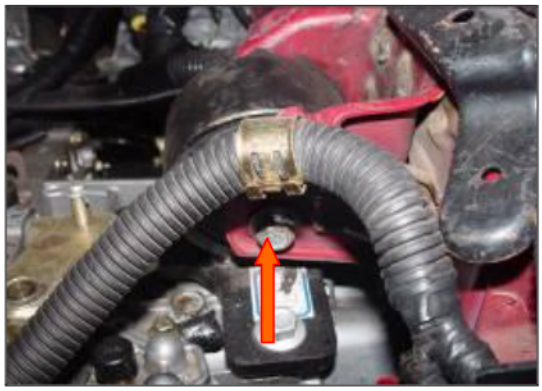
14. Loosen the three hexagonal flange bolts of engine's right bracket.



15. Loosen the three bolts of right suspension cushion, and dismantle the right suspension cushion assembly and bracket.



16. Dismantle the hexagonal flange bolts of left suspension cushion in order to ensure no connection between the engine and car body. Lift down the crane carefully and shift out the power assembly.



PDF created with pdfFactory Pro trial version www.pdffactory.com

SECTION III ENGINE ACCESSORIES

1 Replacement of Dynamo belt

1.1 Needed tools and auxiliary materials 13 #open end wrench and new dynamo belt

1.2 Process of removal

As the figure illustrated, rotate the13#open end wrench counterclockwise and recede the tension pulley. At the same time, the belt tension shall disappear, so you can dismantle the belt.



1.3 Installation steps

The installing steps are reverse to those for removal.

2 Replacement of Generator Assembly

2.1 Needed tools and auxiliary materials Allen wrench, ratchet wheel, 13# sleeve, 10# open end wrench.

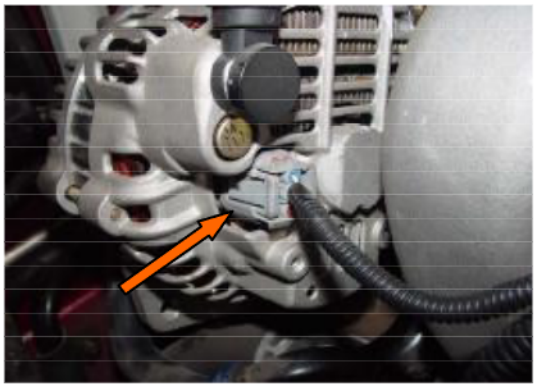
2.2 Process of removal:

1) Dismantle the negative pole harness of battery.

2) Dismantle the bolts connecting the generator and harness, and take out the harness.



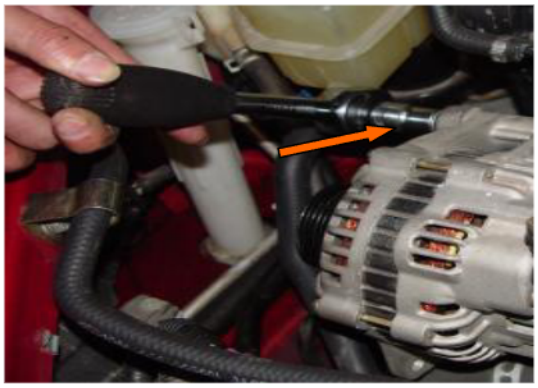
3) Pull out the harness plugs of generator regulator.



PDF created with pdfFactory Pro trial version www.pdffactory.com

4) Dismantle dynamo belt (Process of removal is shown in the "replacement of dynamo belt").

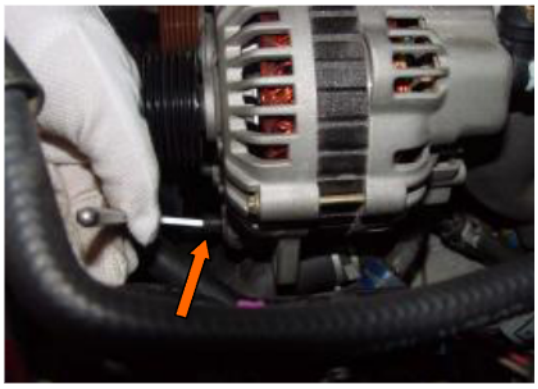
5) Use 13# sleeve to dismantle the bolt (I) connecting the generator and bracket.



2.3 Installation steps:

The Installation steps is opposite to Process of removal.

6) Use allen wrench to dismantle the bolt (II) connecting the generator and bracket, and then take out the generator.



3 Replacement of Air Conditioner Compressor

3.1 Needed tools and auxiliary materials

Small ratchet wheel, ratchet rod, 10# sleeve, big ratchet wheel, 13# sleeve, crosshead screwdriver, allen wrench coolant R134a, gauze, A/C pressure gauge

3.2 Process of removal:

1) Release Refrigerant for A/C compressor. Screw off the nuts in the test pressure port of high-pressure pipe, and use screwdriver to press down the central metal core in order to have the air conditioner pressure released completely.

PDF created with pdfFactory Pro trial version www.pdffactory.com

2) Lift down the wire harness plug.

3) Dismantle the dynamo belt. (The removal methods are detailed in the "replacement of dynamo belt".

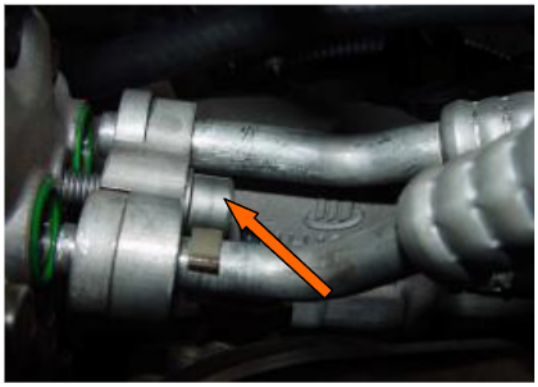
4) Dismantle the intake manifold. Detailed sequences are shown in "the removal of intake manifold ".

5) Loosen the bolt (I) connecting the A/C compressor and fixed bracket.



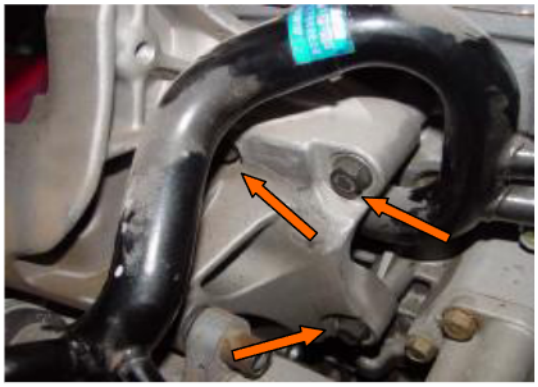
6) Loosen the bolt (II) connecting the A/C compressor and fixed bracket.

7) Use allen wrench to dismantle the bolts connecting the A/C compressor and pipes.



Note: After removing the A/C pipes, you should use clean gauze to block up the mouth of A/C pipes in order to prevent outer substances from falling into the A/C pipes.

8) Dismantle the three fixed bolts of A/C fixed bracket.



PDF created with pdfFactory Pro trial version www.pdffactory.com

9) Carefully handle the bracket and A/C compressor, and dismantle them.

3.3 Installation steps

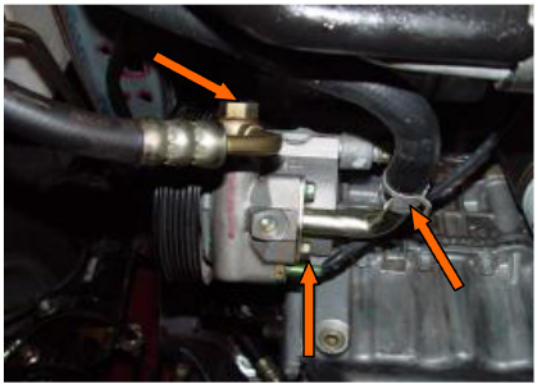
Installation steps is opposite to Process of removal.

4 Replacement of Power Steering Pump

4.1 Needed tools and auxiliary materials 17#open end wrench,ratchet wheel,ratchet rod, power steering oil.

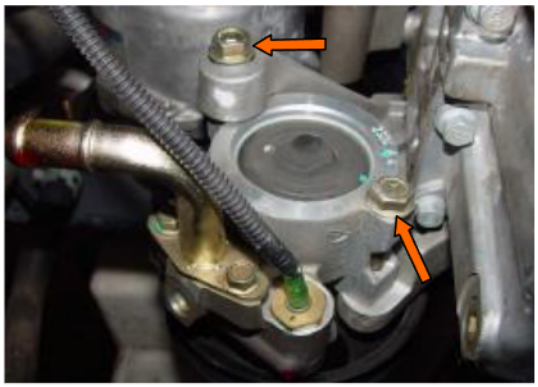
4.2 Process of removal

1) Pull out the harness plugs of power steering switch: use17#open end wrench and vice clamp to loosen the connecting bolts of oil pipe and clips, and discharge the power steering oil.



2) Dismantle the dynamo belt. Detailed removal methods are shown in the "displacement of dynamo belt".

3) Dismantle the bolt connecting power steering oil pump and bracket.



4) otate the steering pump pulley to make the fixed bolt exposed, and then screw it off. At this time, you can dismantle the power steering pump.



PDF created with pdfFactory Pro trial version www.pdffactory.com

4.3 Installation steps

The installing steps are reverse to those for removal.

5 Replacement of Idler

5.1 Needed tools and auxiliary materials

Ratchet wheel wrench, 13# ,15# sleeves

5.2 Process of removal

1) Dismantle the dynamo belt. Detailed sequences are shown in the "removal of dynamo belt".

2) Dismantle the bolts connecting the idler and engine/, and undo the idler wheel.



5.3 Installation steps

Installation steps is opposite to the Process of removal.

6 Replacement of Air Intake Flow Sensor

6.1 Needed tools

Ratchet wheel, ratchet rod, 10# sleeve, and slot head screwdriver.

6.2 Process of removal

1) Pull out the plugs connecting the sensor and wire harness, and use slot head screwdriver to loosen the clamp at the connection point of air intake hose and air cleaner.



2) Screw off the bolts connecting the sensor and air cleaner, and then dismantle the sensor.



PDF created with pdfFactory Pro trial version www.pdffactory.com

6.3 Installation steps

The installing steps are reverse to those for removal.

7 Replacement of Air cleaner Core

7.1 Needed tools

Right-angled screwdriver.

7.2 Process of removal

1) Undo the clips around the air cleaner case.

2) Uplift the filter case and take out the filter paper.

7.3 Installation steps

Installation steps are opposite to the process of removal.

8 Replacement of Ignition Coil

8.1 Needed tools

Ratchet wheel, ratchet rod, 10# sleeve.

8.2 Process of removal

1) Put the ignition switch key at the OFF position, and pull out the ignition coil plug.

2) Remove the high voltage cable from the ignition coil.



PDF created with pdfFactory Pro trial version www.pdffactory.com

3) Use 10# sleeve to dismantle the fixed bolts of ignition coil.



8.3 Installation steps

Installation steps is opposite to Process of removal.

9 Replacement of High Voltage Cable

9.1 Process of removal

1) Remove one end of the high voltage cable from the ignition coil.



2) Pull out the connection end of high voltage cable and sparking plug, and dismantle the high voltage cable.



Note: If the spare parts of high voltage cable corresponding to various cylinders are ordered, you can replace the high voltage cable of single cylinder; otherwise, you must replace the assembly.

9.2 Installation steps

The installing steps are reverse to those for removal.

PDF created with pdfFactory Pro trial version www.pdffactory.com

10 Replacement of Sparking Plug

10.1 Needed tools

Carry-on wrenches

10.2 Process of removal

1) Pull out the connection end of high voltage cable and sparking plug.

2) Use carry-on wrenches to screw off the sparking plug.



Torque:

10.3 Installation steps

The installing steps are reverse to those for removal.

11 Replacement of Camshaft Position Sensor

11.1 Needed tools

Allen wrench

11.2 Process of removal

1) Put the ignition key at the position of OFF, and shut off the sensor plug.

2) Use allen wrench to loosen the sensor fixed bolt



11.3 Installation steps

The installing steps are reverse to those for removal.

Installation precautions: In the case of installation, you should apply a layer of oil onto the O-type ring of sensor.

PDF created with pdfFactory Pro trial version www.pdffactory.com

12 Replacement of Starter

12.1 Needed tools and auxiliary materials

A set of open end wrenches and a set of sleeve wrenches.

12.2 Removal

1) Dismantle the conductor of engine oil dipstick. Loosen the bolts connecting the engine oil dipstick with cylinder block and intake manifold.

Note: After pulling out the conductor of engine oil dipstick, you should immediately use clean gauze to block up the hole in the cylinder block in order to prevent outer substances entering into the cylinder block.

2) Loosen the two bolts connecting the starter and transmission.

3) Take out the starter and remove the electric plugs of it.

12.3 Installation

The installing steps are reverse to those for removal.

13 Replacement of Oil Filter

13.1 Needed tools and auxiliary materials

Special tools for oil replacement, engine oil.

13.2 Removal

Use special tool to clamp the oil filter, and rotate it counterclockwise to dismantle it.

13.3 Installation

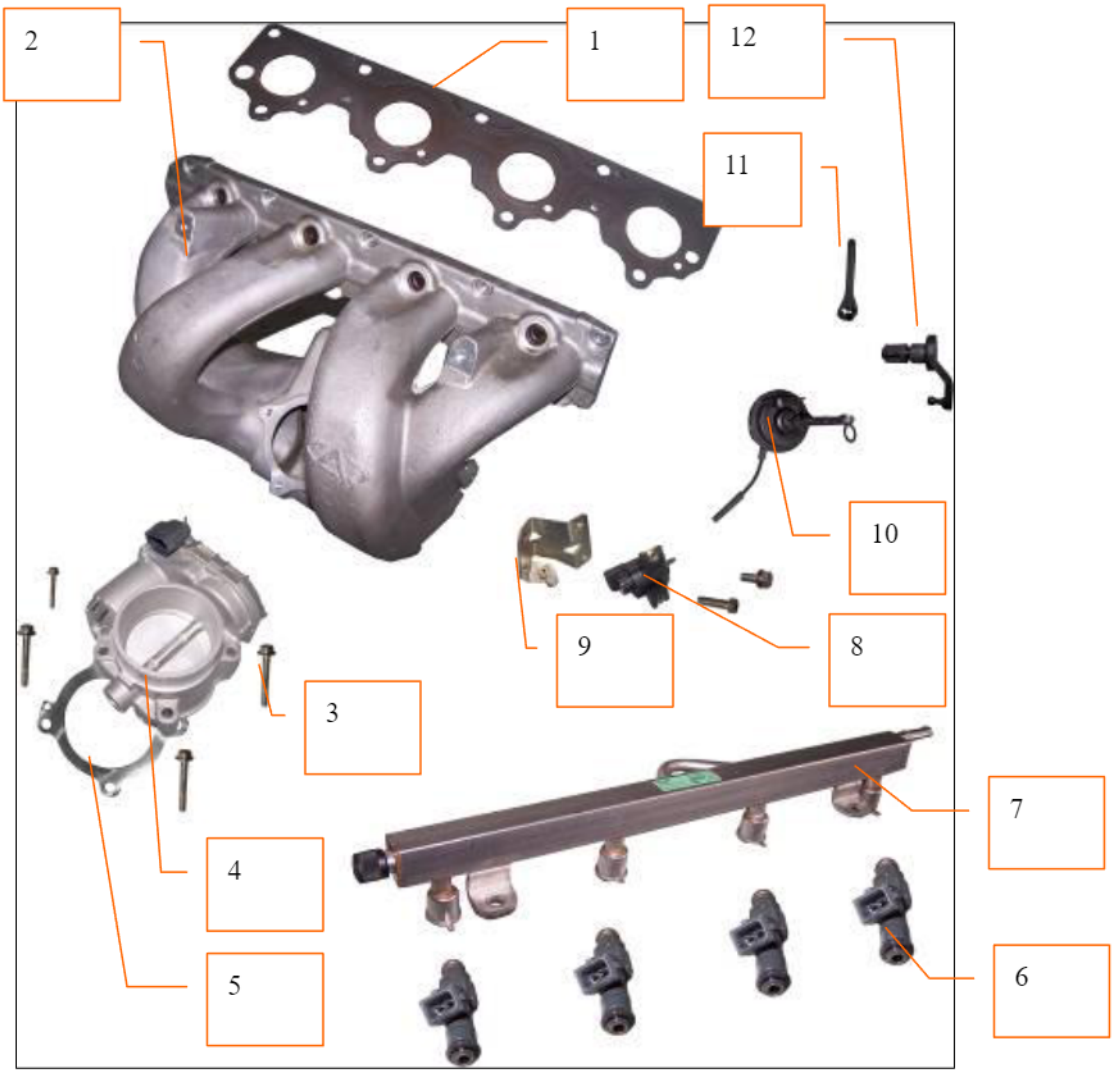
The installing steps are reverse to those for removal. Please fill adequate engine oil after assembling the oil filter.

PDF created with pdfFactory Pro trial version www.pdffactory.com

CHAPTER III ENGINE BLOCK

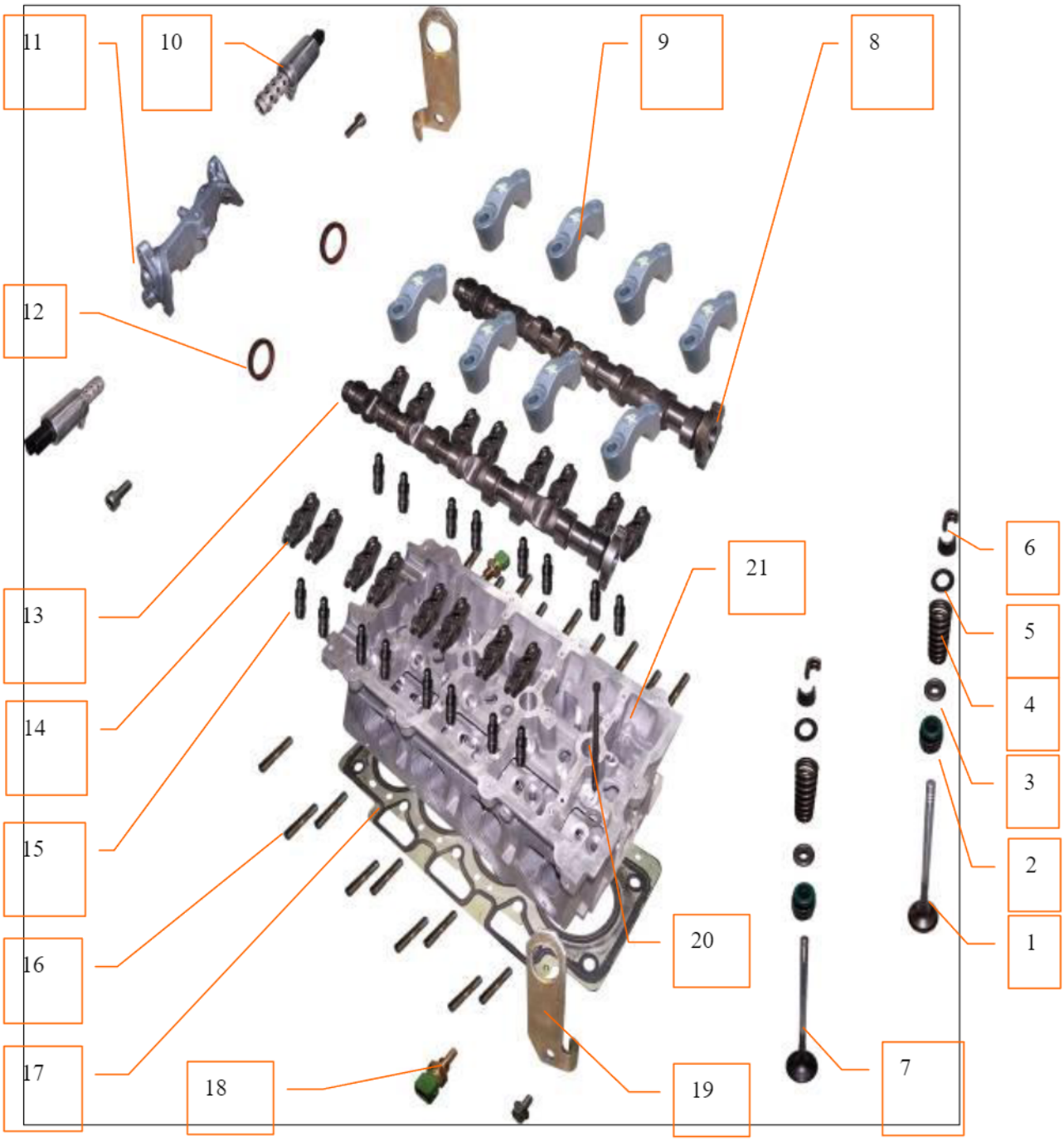
SECTION I ENGINE CYLINDER HEAD

1. Structure Diagram



1. Pad-Intake Manifold
2. Intake Manifold Assembly
3. Hexagonal Flange Bolt
4. Throttle Valve Assembly
5. Gasket-Throttle Body Assembly
6. Oil Injector Assembly
7. Fuel Delivery Pipe Assembly
8. CBR Position Sensor
9. Bracket-Actuator
10. Actuator
11. Rocker 2-CBR System
12. Rocker 1—CBR System

PDF created with pdfFactory Pro trial version www.pdffactory.com



1. Intake Valve
2. Valve Oil Seal
3. Spring Seat
4. Valve Spring
5. Spring Retainer
6. Keeper
7. Exhaust Valve
8. Intake Camshaft Assembly
9. Bearing Cap Assembly
10. Control Valve-Camshaft Phaser Assembly
11. First Bearing Cap Assembly
12. Front Camshaft Oil Seal
13. Exhaust Camshaft Assembly
14. Rocker Assembly
15. Hydraulic Tappet Assembly
16. Stud Bolt (9 Bars)
17. Cylinder Head Gasket
18. Temperature Sensor
19. Engine Hanger
20. Cylinder head Bolt
21. CBR Cylinder head Assembly

PDF created with pdfFactory Pro trial version www.pdffactory.com

2. Maintenance

2.1 Replace intake manifold, CBR control valve plate, delivery pipe, oil injector



2.1.1 Needed tools and auxiliary materials

Ratchet wheel, ratchet rod, 10# sleeve and crosshead screwdriver

2.1.2 Process of removal

1) Put the ignition key at the OFF position.

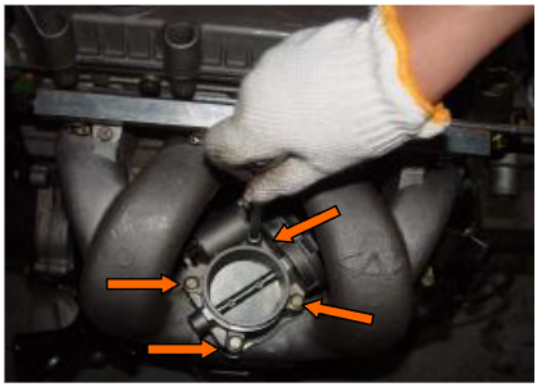
2) Loosen the oil injector plug.

3) Loosen the electric plug of CBR control valve, and dismantle the bolts connecting the engine oil dipstick and intake manifold.



4) Loosen the clamp at the connection end of air intake hose and valve body.

5) Dismantle the connecting bolts of valve body, and take out the valve body.



6) Loosen the joint of oil intake pipe.

7) Dismantle the fixed nut of intake manifold, and remove the intake manifold.



PDF created with pdfFactory Pro trial version www.pdffactory.com

2.1.3 Installation steps

The installing steps are reverse to those for removal.

Note: Pay more attention to the position of seal ring. There is a slot at the arrow pointing position.



2.2 Replace camshaft, bearing bushing, valve and valve oil seal

2.2.1 Needed tools and auxiliary materials

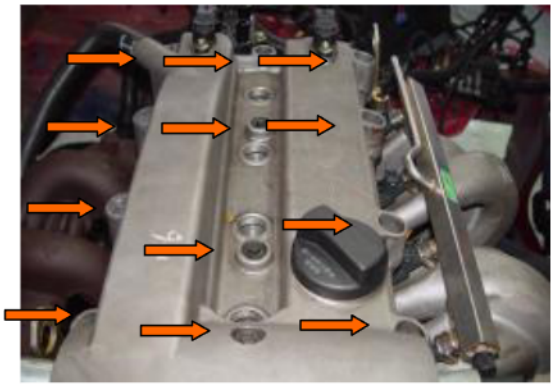
Special tool for valve oil seal, engine lubricant, a set of sleeve tools and one adjustable wrench, special timing tool, a set of allen wrenches.

2.2.2 Removal

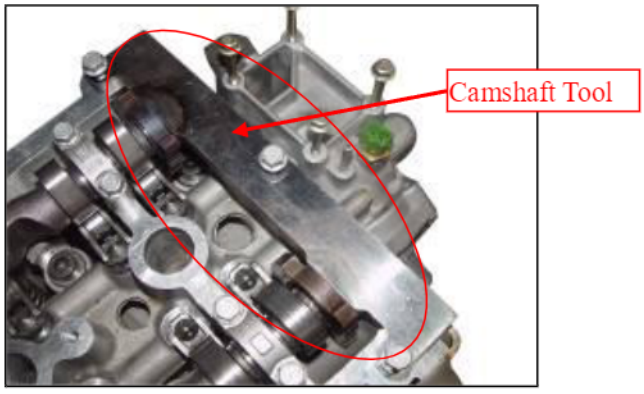
1) Dismantle the dynamo belt (detailed methods are shown in the "removal of dynamo belt ").

2) Dismantle the timing belt (detailed method are shown in the " replacement of engine timing belt and timing calibration".

3) Dismantle the engine valve chamber cover.

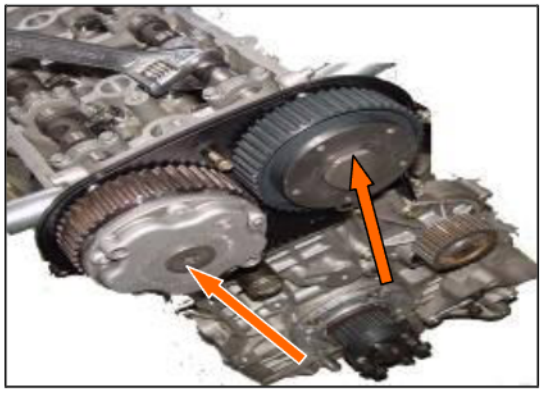


4) Clamp the engine timing special tool, the camshaft tool into the camshaft slot, and use bolts to fix it.

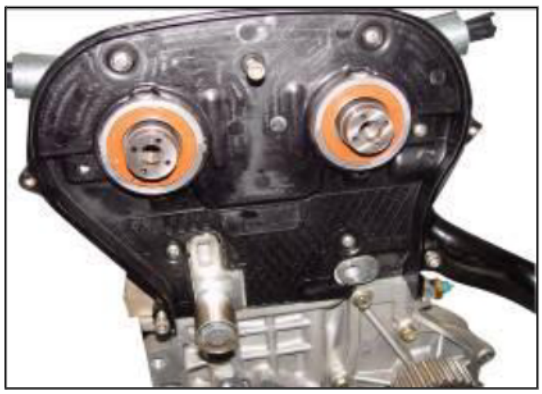


PDF created with pdfFactory Pro trial version www.pdffactory.com

5) Use torque wrench to remove the air intake and exhaust camshaft pulleys.

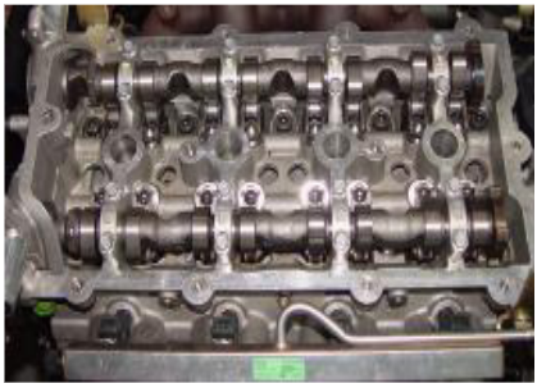


6) Dismantle the back cover of timing belt.



7) Dismantle the air intake and exhaust camshaft bearing caps in turn, and place them well in order.

Note: The second, third, fourth and fifth camshaft bearing caps are marked with I1, I2, I3, I4 (E1, E2, E3, E4), which stands for the corresponding bearing cap of 1, 2, 3, 4 cylinder respectively.



8) Take out the camshaft and hydraulic tappet.

9) Dismantle the valve spring. Use special tool to dismantle the valve spring.

10) Use special valve oil seal tool to dismantle the old valve oil seal.

PDF created with pdfFactory Pro trial version www.pdffactory.com

2.2.3 Check

1) Check the valve spring.

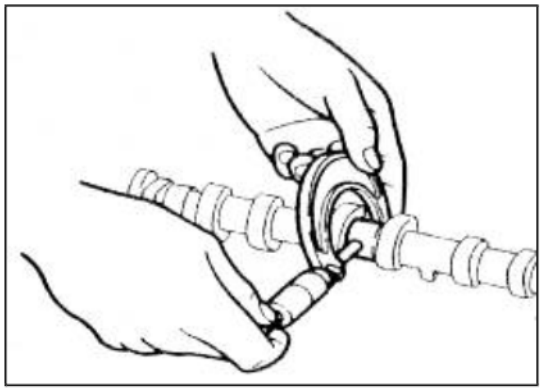
Use caliper rule to check the free length of valve spring and the length specified in special pressure.

	Standard Value(mm)	Limit value(mm)
Free length	47.7	
Length of 620N	32	

Replace with the new valve spring if the measured value exceeds the limit value.

2) Check camshaft

Use micrometer caliper to measure the diameter of camshaft.

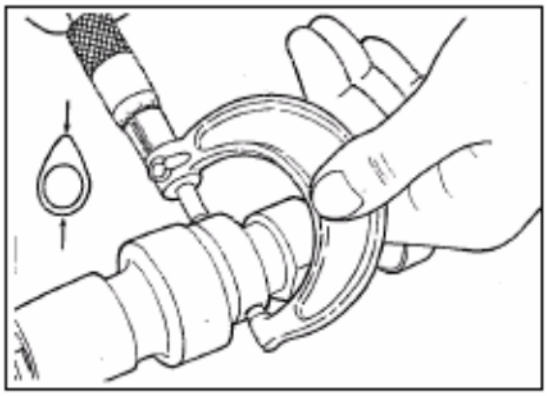


	Standard value(mm)	Limit value (mm)
Diameter	0.15	0.20

Replace with the new camshaft if the measured value exceeds the limit value.

3) Check the camshaft

Use micrometer caliper to measure the length of camshaft.



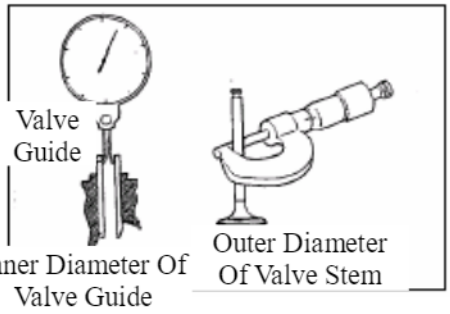
	Standard value (mm)	Limit value （mm）
Intake camshaft	0.15	0.20
Exhaust camshaft	0.15	0.20

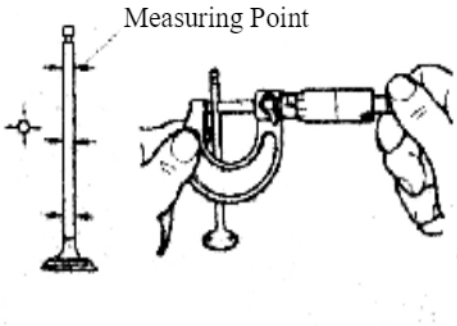
Replace with the new camshaft if the measured value exceeds the limit value.

PDF created with pdfFactory Pro trial version www.pdffactory.com

4) Check the diameter of value stem

a: Use micrometer caliper to measure the diameter of valve stem.

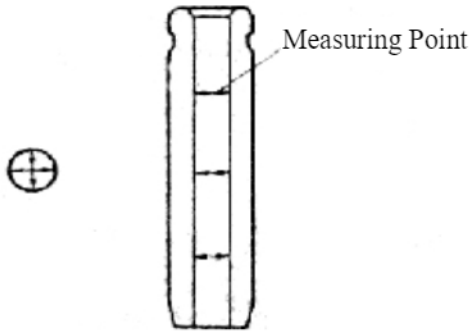




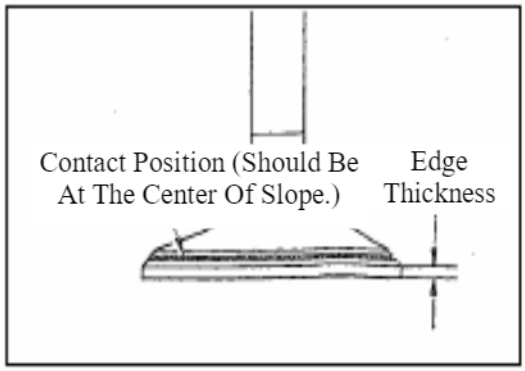
B: Use inner micrometer guage to measure the inner diameter of valve guide.

C: Calculate the difference of measured value and the clearance.

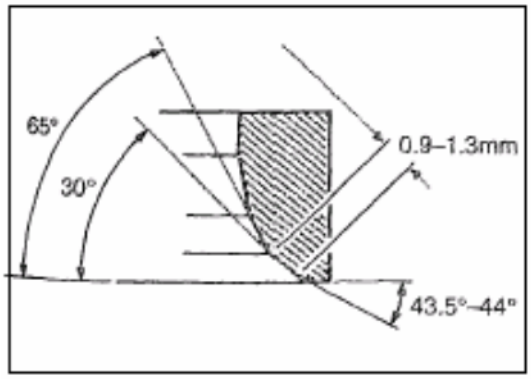
If they exceed the specified limit values, the value or guide shall be replaced more necessarily.



D: Check the contact bandwidth of valve.



E: Check the valve seat insert.



PDF created with pdfFactory Pro trial version www.pdffactory.com

		Standard value	Limit value
Outer diameter of valve stem (mm)	IN	¢ 5.98±0.008	
	EX	¢ 5.96±0.008	
Inner diameter of valve guide (mm)	IN	¢ 5.4±0.1	
	EX	¢ 5.4±0.1	
Clearance (mm)	IN	0.02	
	EX	0.04	
Thickness of value top （mm）	IN	0.3±0.15	
	EX	0.3±0.15	

2.2.3 Installation

The installing steps are reverse to those for removal.

Note:

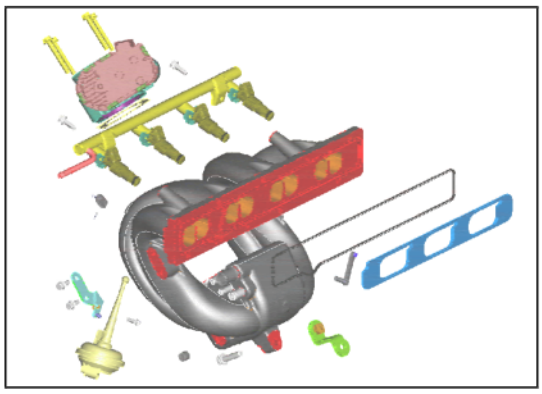
1) Dismantle the valve springs in two groups with 1st and 4th cylinders in one group, 2nd and 3rd cylinders in the other group. When the piston runs tothe top dead center of 1st and 4th pistons, you should dismantle the valve springs of the 1st and 4th cylinders, replace the valve oil seal, and mount valve springs immediately. When the piston runs to the top dead center of2nd and 3rd cylinders, you should replace the valve oil seal. Thus, you can prevent the valve from falling into the cylinders, reducing unnecessary troubles.

2) Apply engine lubricant onto the oil seal lip when installing the valve oil seal.

PDF created with pdfFactory Pro trial version www.pdffactory.com

SECTION II INTRODUCTION TO NEW ENGINE TECHNOLOGIES——CBR& VVT

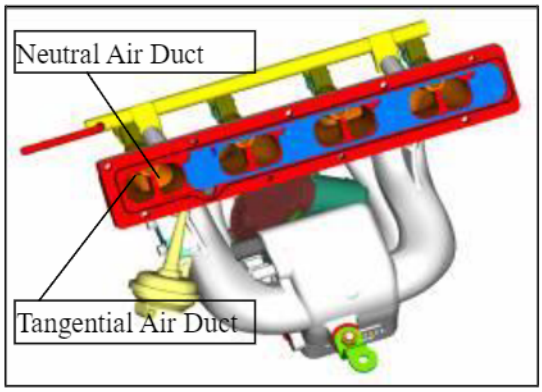
1. CBR PROFILE



CBR principle and structure

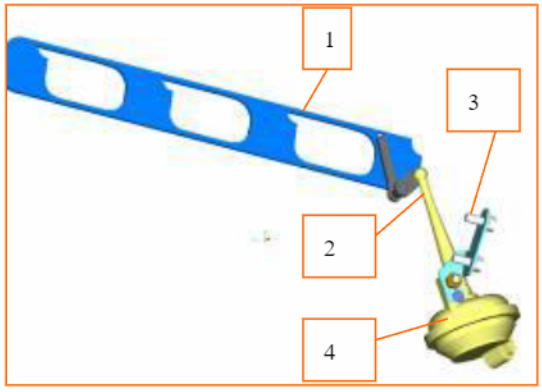
By controlling the organization modes of air flow (eddy flow and turbulent flow), CBR (Controlled Bum Rate) can improve the burn rate, reduce displacement, and boost the economical efficiency of fuel.

This engine adopts sliding plate CBR.



- When the engine operates at low speed, the vacuum actuator shall drag the sliding plate to move towards the direction shown in the figure by use of rocker assembly, and the neutral air passage shall be shut off basically (there is only a gap on the top right corner). The mixing of oil mist and air mainly depends on the eddy flow of air intake provided by tangential air duct, thus improving the combustion status.
- When the engine operates at high speed, CBR control valve shall cut off the vacuum condition of vacuum actuator; thanks to the spring functions, the sliding plate shall return to the position illustrated in the figure, and the neutral air duct shall also be opened, which increases the turbulent flow of air intake and improve the maximum power.

Structure of sliding plate



1) Sliding plate
2) Rocker and shaft assembly
3) Bracket
4) Vacuum actuator

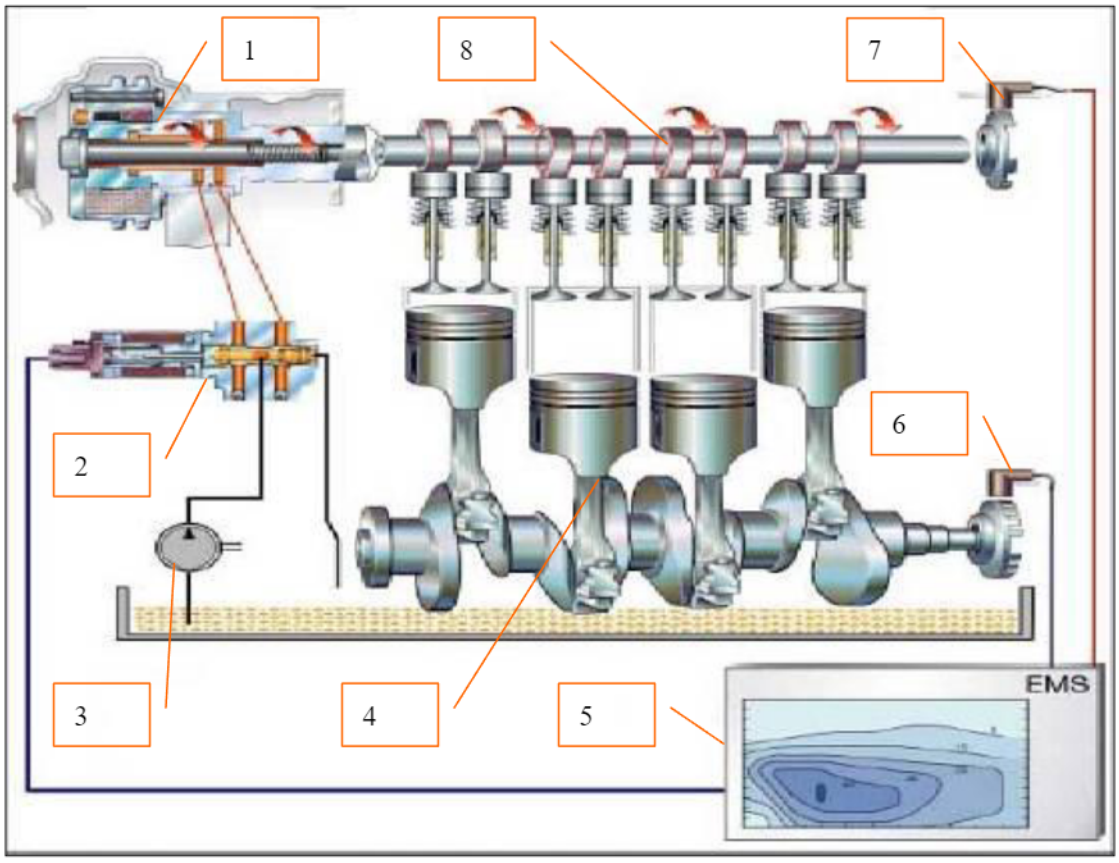
PDF created with pdfFactory Pro trial version www.pdffactory.com

2.VVT PROFILE

VVT Principle

VVTi is the abbreviation of variable valve timing with intelligent. During the operation of engine, the valve opening time is called as valve timing. When the engine operates at different rotation speeds, we need different valve timings to provide the optimal valve closing control, so that the power and combustion efficiency can achieve the best effect. For this purpose, we shall install VVTi mechanism onto the camshaft controlling the air intake valve to regulate valve timing. The VVTi system installed on the air intake camshaft of engine is equipped with oil- pressure clutch device between the camshaft and drive sprocket, which can alter the rotation phase difference between the air intake camshaft and drive sprocket. The controlled oil pressure mechanism connects with the engine oil system, and can be regulated by solenoid valve and control loop. When the engine operates at different rotation speeds, there are different angles between the camshaft and sprocket, which facilitates the air intake valve to open and close at different times in an effort to achieve variable valve timing. On the other hand, when the engine operates at different rotation speeds, abundant and appropriate oil gas can be supplied to generate mighty power.

When the car engine equipped with VVT-I system fails abnormally, ECUs controlled by the engine shall automatically lock the preset parameter value (come-home function), ensuring the driver to drive the car to the maintenance station. This kind of engine lodges a strictly demand for the quality of petroleum and lubricant; therefore, you must adopt the standard materials in compliance with the stipulations of original car manufacturer in order to avoid unnecessary damages.

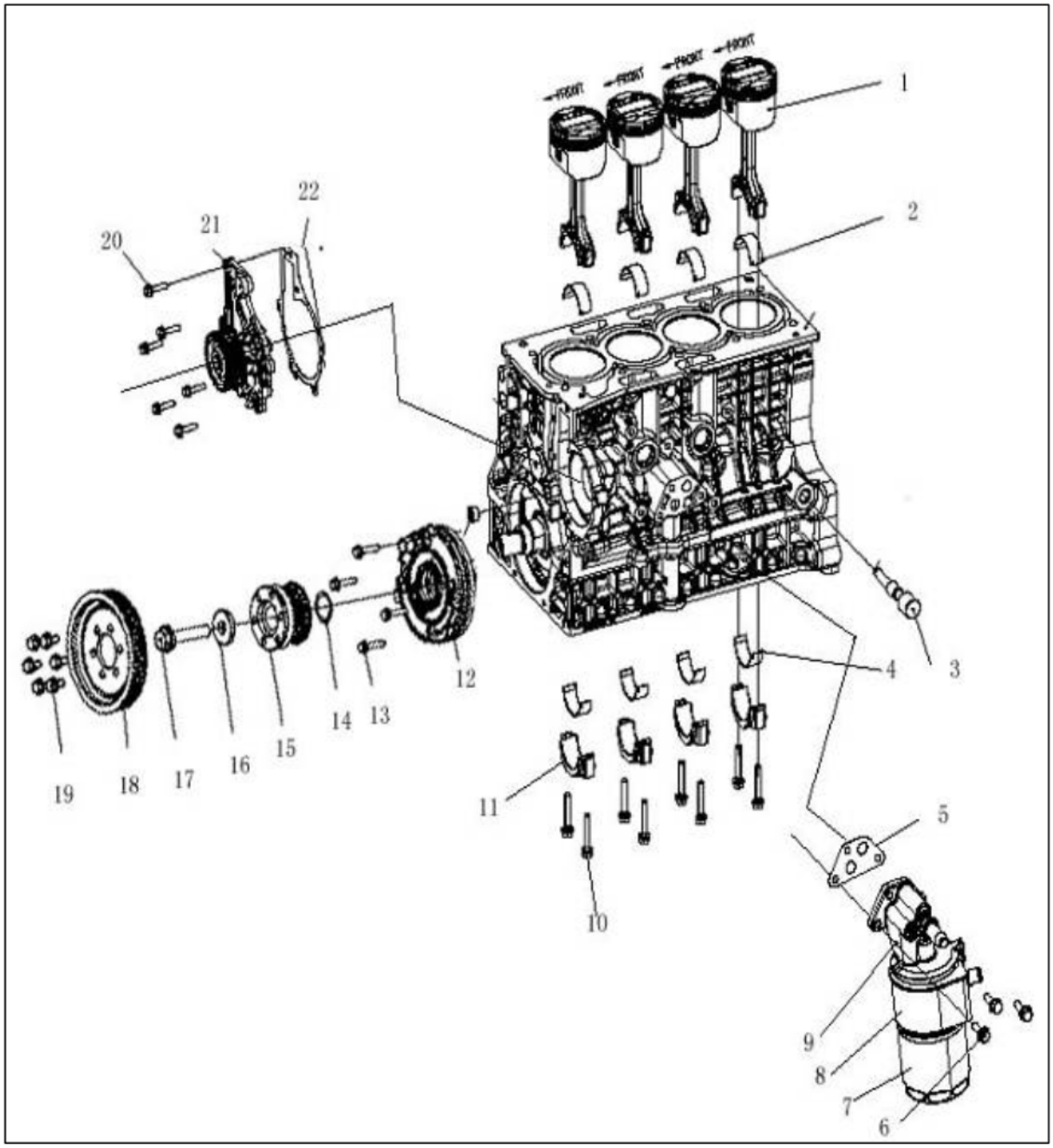


PDF created with pdfFactory Pro trial version www.pdffactory.com

1. Camshaft Phaser Assembly
2. Control Valve-Camshaft Phaser Assembly
3. Oil Pump Assembly
4. Engine Piston
5. Engine ECU
6. Crankshaft Position Sensor
7. Camshaft Position Sensor
8. Camshaft

SECTION III SHORT ENGINE

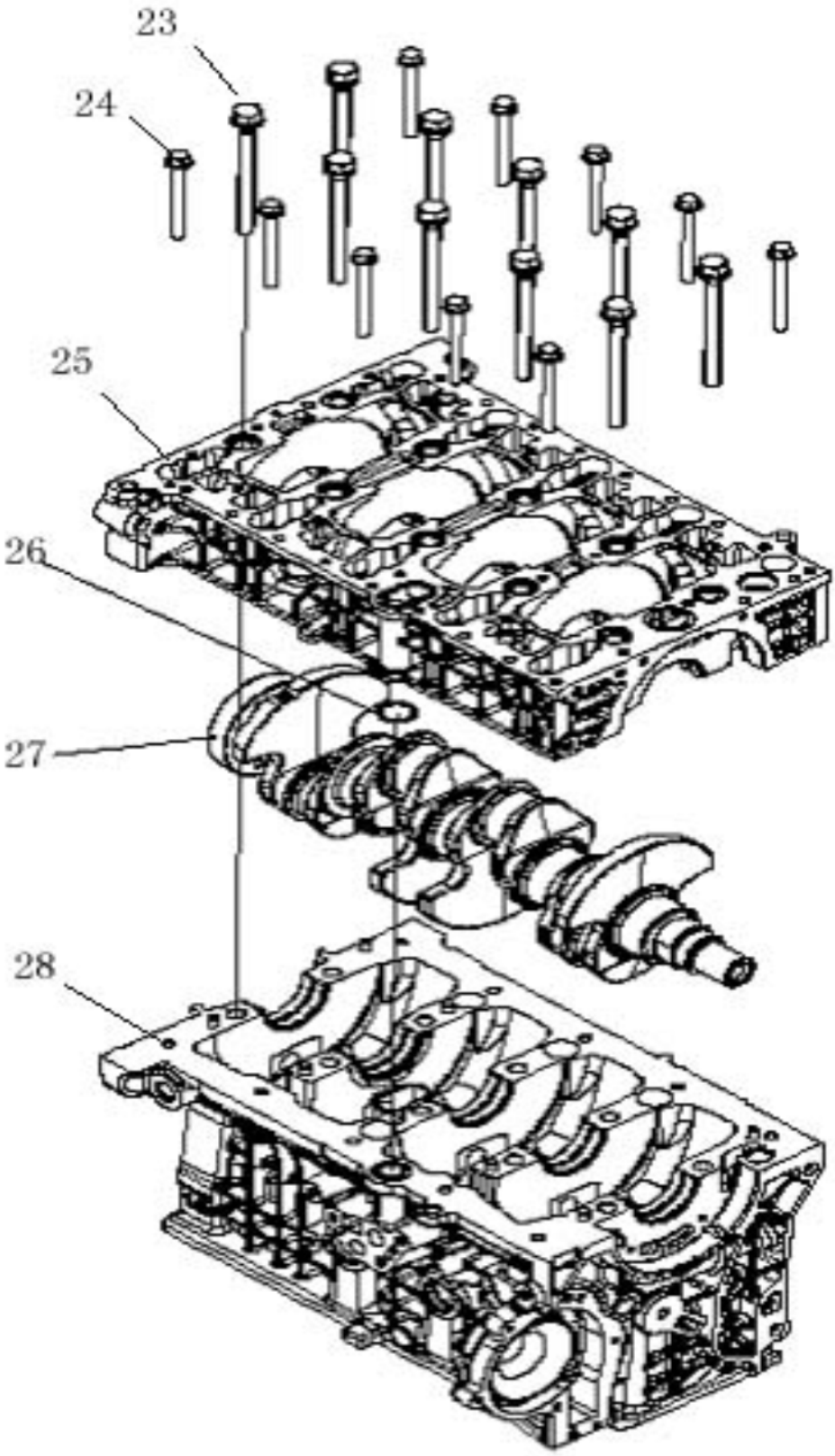
I. STRUCTURE DIAGRAM



PDF created with pdfFactory Pro trial version www.pdffactory.com

1. Piston
2. Connecting Rod Upper Bearing
3. Timing Hole Plug
4. Connecting Rod Lower Bearing
5. Pad
6. Bolt (M)
7. Oil Filter
8. Oil Cooler
9. Oil Filter Seat
10. Connecting Rod Bolt
11. Connecting Rod Bearing Cap
12. Oil Pump
13. Bolt
14. Gasket
15. Crankshaft Timing belt pulley
16. Gasket
17. Bolt
18. Crankshaft Pulley
19. Bolt
20. Bolt
21. Coolant pump
22. Coolant Pump Gasket

PDF created with pdfFactory Pro trial version www.pdffactory.com



23. Crankshaft Main Bearing Bolt
24. Frame Bolt
25. Frame
26. O-Type Ring
27. Crankshaft
28. Cylinder Block

PDF created with pdfFactory Pro trial version www.pdffactory.com

II. MAINTENANCE

1. Replacement of Oil Pan

1.1 Needed tools and auxiliary materials 10# open end wrench, 10#, 15#, 17# sleeves, ratchet wheel, ratchet rod, Le Tai 5901 Glue and engine oil.

1.2 Process of Replacement

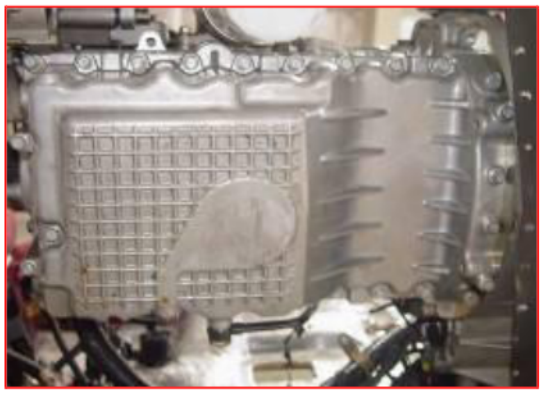
1.2.1 Process of removal

1) Loosen the oil discharge bolt of oil pan to discharge the engine oil.



Note: Engine oil should be stored in special container. And Pay attention to environment protection.

2) Use 10#open end wrench and 10 # sleeve to dismantle the fixed bolt of oil pan (18 M7×25, 3 7×40 and 4 M7×95).

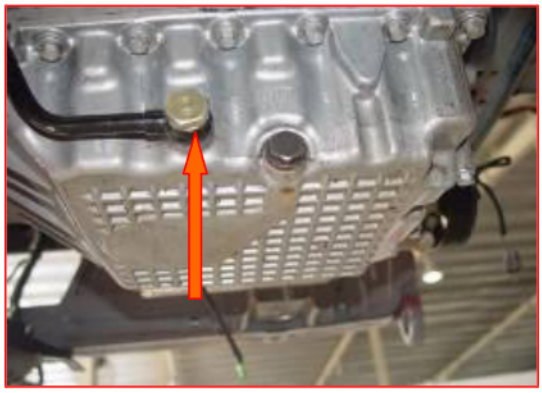


3) Use 17# sleeve wrench to dismantle the bolts (2 pieces, black) connecting the oil pan and transmission housing.



PDF created with pdfFactory Pro trial version www.pdffactory.com

4) Use 15# sleeve wrench to dismantle the bolts connecting the oil return pipe of PVC valve and oil pan



5) Use rubber pestle to knock the edge of oil pan, and dismantle the oil pan.

Note: Pay more attention to safety precaution, since the oil pan may fall down during the knocking process.

6) Use right-angled tools to clean up the old Le Tai Glue stained onto the engine frame.

Note: Do not scuff the frame surface.



1.2.2 Installation

1) Apply Le Tai 5910 Glue onto the connection surface of engine frame edges and oil pan to close up the oil pan, and then mount fixed bolts for oil pan.

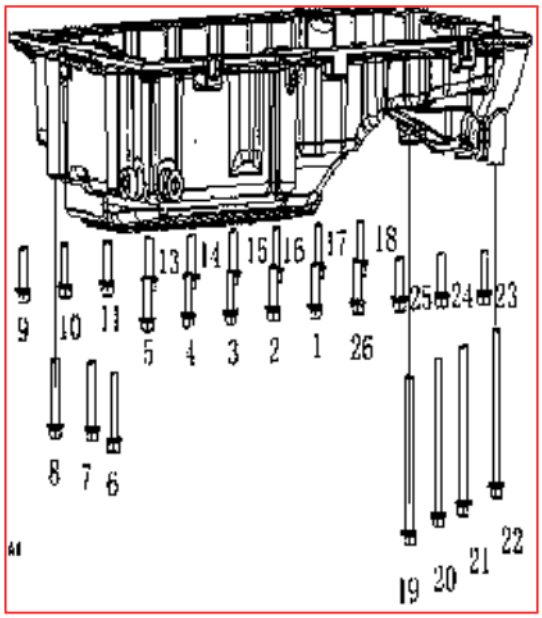
Note: Spread glue to the inner of hole for installing bolt on the oil pan!

2) Fasten the bolt. Firstly fasten it slightly to press fit, and then fasten it up to the specified torque.

Fastening method for bolt:

a: Firstly screw in the oil pan bolt, and let it not be pre-fastened.

b: Pre-fasten the bolt from the central part



PDF created with pdfFactory Pro trial version www.pdffactory.com

clockwise.

c: Fasten the bolt up to specified torque from the central part to both sides clockwise. （As the figure illustrated）.

Torque: 15±3NM

3) Fill engine oil up to specified volume.

2 Replacement of Oil Strainer

2.1 Needed tools and auxiliary materials

10#open end wrench, 10#, 15#, 17# sleeves, ratchet wheel, ratchet rod Le Tai 5901 Glue,engine oil.

2.2 Process of replacement

2.2.1 Process of removal

1) Dismantle oil pan (removal method is shown in the “replacement of oil pan”).

2) Use 10# sleeve wrench to dismantle the bolts (8 pieces) connecting the oil strainer and engine frame.



3) Pull out the oil strainer carefully.

2.2.2 Installation

1) Spin the nozzle of engine oil strainer into the frame carefully.

2) Mount the 8 bolts for the strainer and fasten them.

Note: All bolts should be pasted with Le Tai 243 Glue.

Torque: 8±3Nm

3) Installation of oil pan (detailed methods are shown in the installation of oil pan).

PDF created with pdfFactory Pro trial version www.pdffactory.com

3 Replacement of Piston, Piston Ring, Piston Pin and Connecting Rod Bearing

3.1 Needed tools and auxiliary materials

10#open end wrench, 10#,15#,17# sleeves, ratchet wheel , ratchet rod, Le Tai 5901 Glue,engine oil, torque wrench, special piston mounting tools, feeler gauge, clearance gauge, micrometer caliper

3.2 Process of replacement

3.2.1 Process of removal

1) Dismantle the timing belt (detailed methods are shown in the section of timing belt assembly in the " replacement of timing belt").

2) Dismantle the oil pan (detailed methods are shown in the section of " replacement of oil pan ").

3) Dismantle the cylinder head(detailed methods are shown in the" removal of cylinder head").

4) Dismantle the oil strainer(detailed methods are shown in the "replacement of oil strainer".

5) Loosen the bolts of connecting rod big end.



6) Dismantle the lower cover of connecting rod journal.



PDF created with pdfFactory Pro trial version www.pdffactory.com

7) Use wood stem to uplift the connecting rod and piston slightly, and then dismantle the piston and connecting rod assembly.



8) Take down the piston ring.

9) Take down the retainer ring of piston pin, and pull out the piston pin.

Note: Since the tension force of retainer ring is very strong, you should do the removal work carefully in order to avoid hurting person.

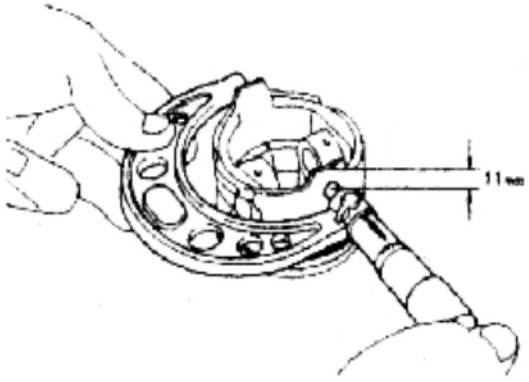


3.2.2 Inspection

I. Check the piston

1) Check the piston diameter.

Use micrometer caliper to carry out measurement at the position 11mm away from the lower part of piston skirt section a and along the vertical direction of piston pin.



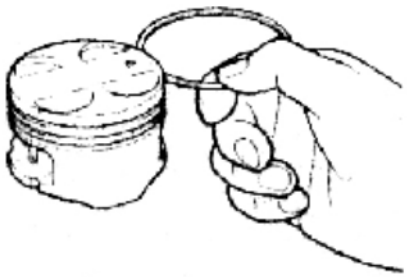
Cylinder No.	Standard Size	Wearing Limit
1	80.46±0.009	
2	80.46±0.009	
3	80.46±0.009	
4	80.46±0.009	

Please replace the piston when it exceeds the wearing limit.

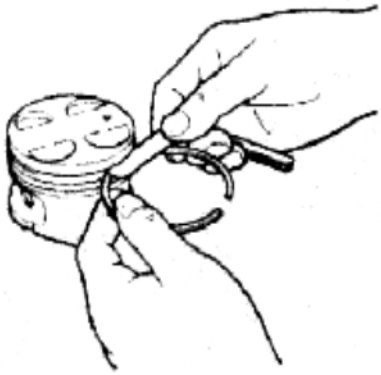
PDF created with pdfFactory Pro trial version www.pdffactory.com

2) Check the clearance between piston ring and ring slot.

a. Use piston ring to clean up the carbon deposit in the ring slot.



b. Use feeler gauge to measure the clearance between the piston ring and ring slot.

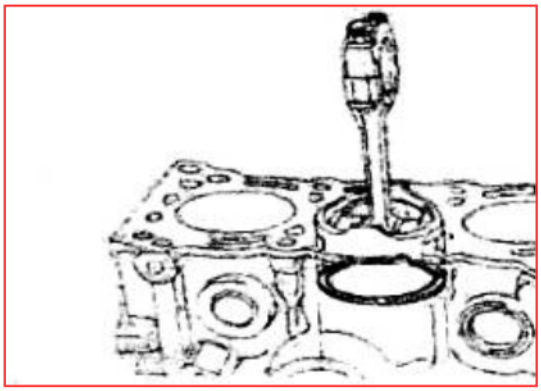


	Standard value(mm)	Wearing limit (mm)
First ring	0.04--0.08	
Second ring	0.01--0.025	

If the measured clearance exceeds wearing limit, please replace it with new piston.

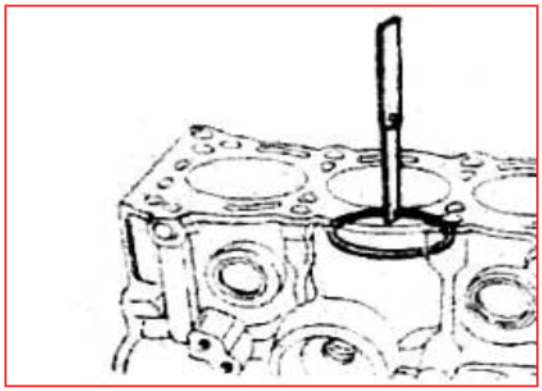
3) Check the end clearance of piston ring

a. Put the piston ring at the position 45mm below the top surface of cylinder aperture, and push the piston ring into cylinder with piston.



PDF created with pdfFactory Pro trial version www.pdffactory.com

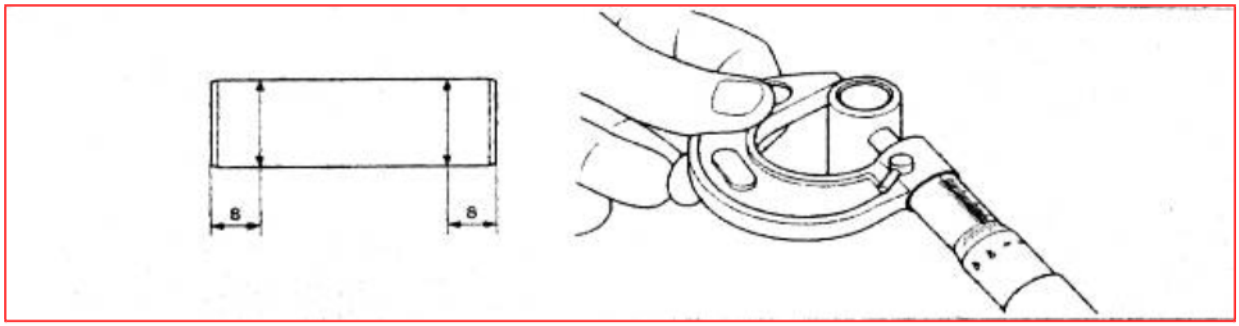
b. Use feeler gauge to measure the orifice.



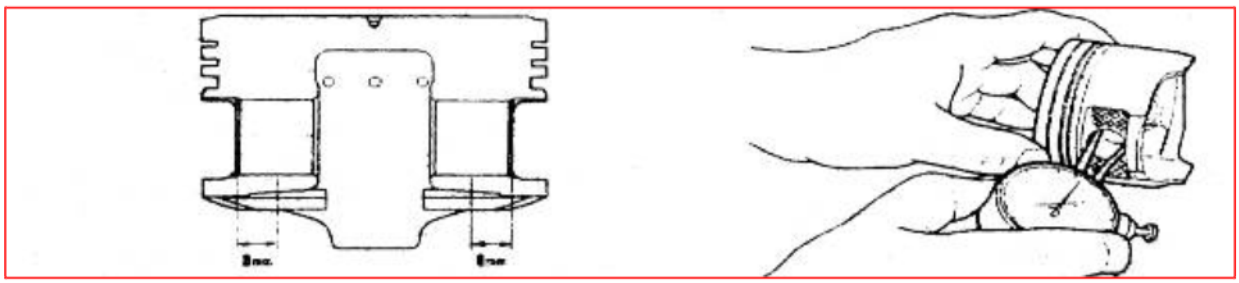
	Standard value (mm)	Limit (mm)
First ring	0.2-0.4	
Second ring	0.4-0.6	
Oil ring	0.2-0.9	

4) Check the piston pin and the diameter of piston pin

a. Use micrometer caliper to measure the outer edges of the part shown in the following figure, and select the maximum value as the diameter size of piston pin.



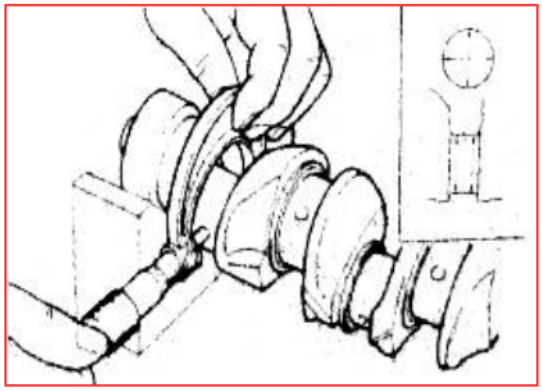
b. Use inner micrometer caliper to measure the outer edges of the parts of the piston pin hole shown in the following figure, and select the minimum value as the diameter size of piston pin hole.



PDF created with pdfFactory Pro trial version www.pdffactory.com

	Standard size	Wearing limit
Clearance between piston pin and piston pin hole	0.002-0.013	

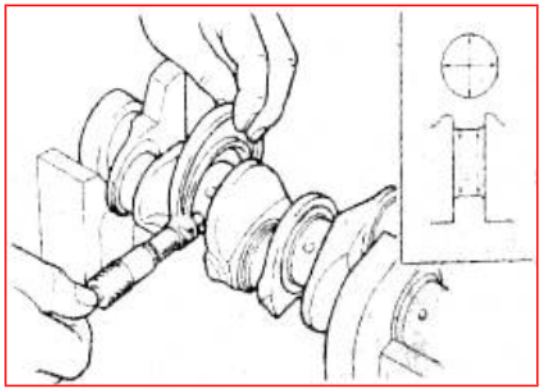
5) Check the connecting rod journal and the connecting rod bearing.



a. Check the diameter of connecting rod journal.

Use micrometer caliper to measure the connecting rod journal.

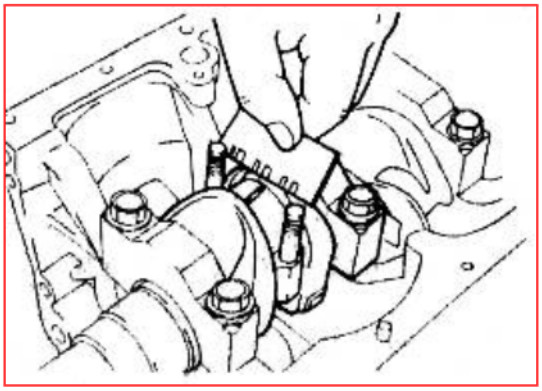
Rotate the crankshaft for 90°, and carry out measurement.



Calculate the roundness and cylindericity after two measurements.

	Standard value	Wearing limit
Diameter		
Roundness		
Cylindericity		

b. Check the radial clearance of connecting rod bearing.

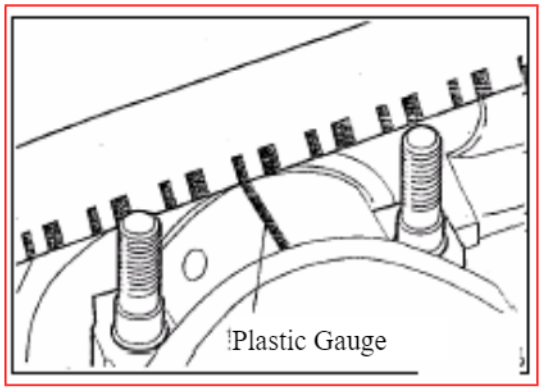


Use clearance gauge to measure the radial clearance of connecting rod bearing. Firstly clean the connecting rod journal and connecting rod bearing, and then put the clearance gauge onto the journal, and fasten the bearing bush to specified torque.

Note: The crankshaft should not be rotated during this process.

PDF created with pdfFactory Pro trial version www.pdffactory.com

Loosen the connecting rod bolt, dismantle the bearing cap; and use the measuring rule on the clearance gauge packaging bag to measure the width of the widest portion of the flattened clearance gauge, and get the clearance value.



	Standard value	Wearing limit
clearance	0.15	0.50

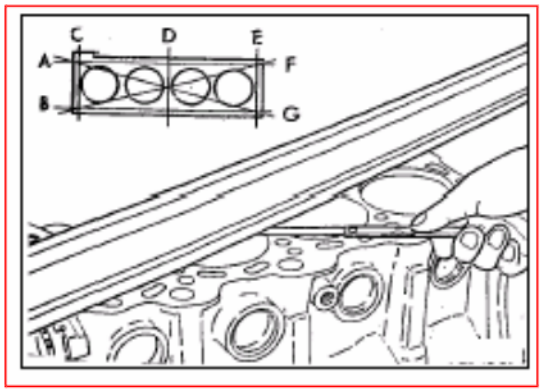
If the measured clearance exceeds limit, you should replace the connecting rod bearing.

Note: When replacing bearing bushing, you should use the specified brand and model of the same manufacturer.

6) Check the flatness of the cylinder block surface.

a: Clean the cylinder block surface.

b: Use ruler and feeler gauge to check whether the cylinder block surface is warped or not.



	Standard value	Limit value
warping amount	0.04	

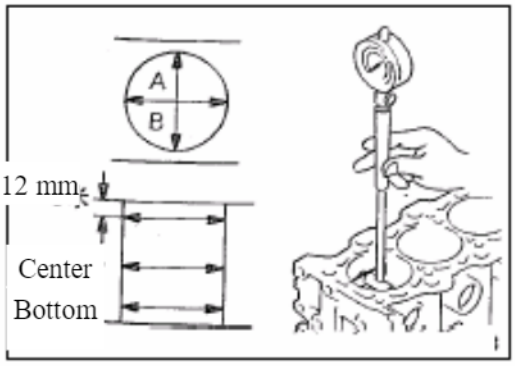
C: If the warping amount is excessive, please rectify it.

If it exceeds the limit, please replace the cylinder block.

The maximum summation of the permitted worn thickness of the cylinder block and cylinder head is:

PDF created with pdfFactory Pro trial version www.pdffactory.com

7) Check the cylinder block



a: Check whether there is scuffing or piston scraping on the cylinder wall. If the defect exits, please dissection the cylinder or and set with bushing or replace it.

b: Use cylinder gauge to measure the inner diameter and cylindericity.

	Standard value	Limit value
Cylindericity		

Cylindericity=max. cylinder diameter-min. cylinder diameter.

Measure the cylinder diameter in the A and B directions, and calculate the cylindericity in the two directions and select the max value.

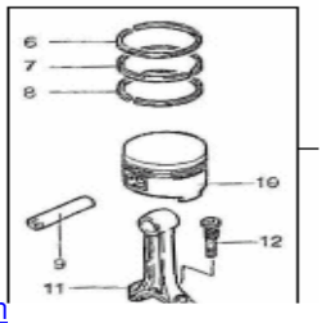
3.2.3 Installation

1) Apply oil onto the piston pin and in the piston pin hole, and use piston pin to connect the piston with the connecting rod, and then mount the piston pin circlip.



2) Mount piston ring. Mount all the rings onto the piston according to the sequence: the bushing ring of oil control ring upper and lower blades, second air ring, first air ring. Observe the piston ring direction when mounting various rings: those with "TOP" onto it shall be positioned upwards. Form an angle by crossing the two blades and the bushing ring, with the closed angle at the bushing ring joint pointing at the piston top, and the first ring and second ring intersecting with the blades for 1200.





PDF created with pdfFactory Pro trial version www.pdffactory.com

3) Mount the connecting rod upper bearing and connecting rod together.

Note: The bearing notch should be in alignment with the notch on the connecting rod.



4) Apply engine lubricant onto the engine cylinder, use special tools to clamp the piston ring, and use wood handle to slightly knock on the piston head so as to mount the piston connecting rod assembly.

Note: The end of the connecting rod with points should point at the 1st engine cylinder, and be consistent with the direction of arrow at the piston top surface.





5) Mount the connecting rod lower bearing and connecting rod cap together, and apply engine lubricant onto the bearing.

Note: The bearing notch should be in alignment with the connecting rod notch.

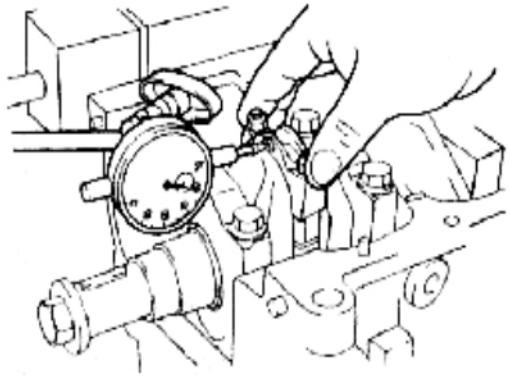
6) Latch on the connecting rod cap and fasten the bolt.

Torque: 25±3N•m, and then screw it for 90°±5°.



PDF created with pdfFactory Pro trial version www.pdffactory.com

7) Check the axial clearance of connecting rod Use micrometer caliper or feeler gauge to measure the axial clearance.



	Standard value（mm）	Limit value (mm)
Clearance	0.15	0.50

8) Mount oil strainer.

9) Mount oil pan.

10) Mount cylinder.

11) Mount timing belt.

4.Replacement of Front crankshaft oil seal

4.1 Needed tools and auxiliary materials

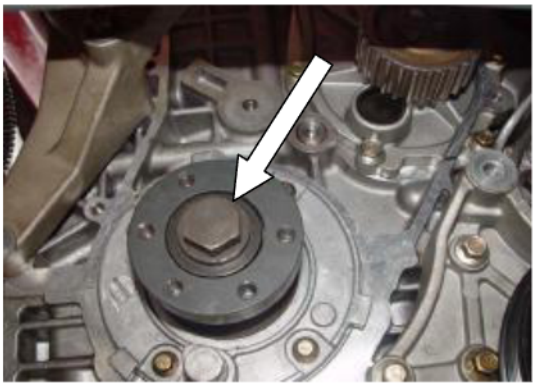
Ratchet wheel, ratchet rod, 13#, 15#, 17#, 22# sleeves, 13#open end wrench, allen wrench, engine lubricant, special tools for assembly oil seal.

4.2 Process of replacement

4.2.1 Process of removal

1) Dismantle the timing belt (detailed Process of removals are shown in the "replacement of timing belt").

2) Shift the car into the 5th gear and step on the brake, use torque wrench to dismantle the bolts connecting the timing belt pulley and crankshaft, and then take down the timing belt pulley.



Torque: 130±10, and then screw for 65°±5°.

PDF created with pdfFactory Pro trial version www.pdffactory.com

3) Use slot-head screwdriver to pry out the old oil seal

Note: Be careful when dismantling the oil seal, and avoid scuffing the oil seal seat ring.

4.2.2 Installation

1) Clean up the dirt and stain on the oil seal seat ring, and apply a layer of lubricant onto the seat ring.

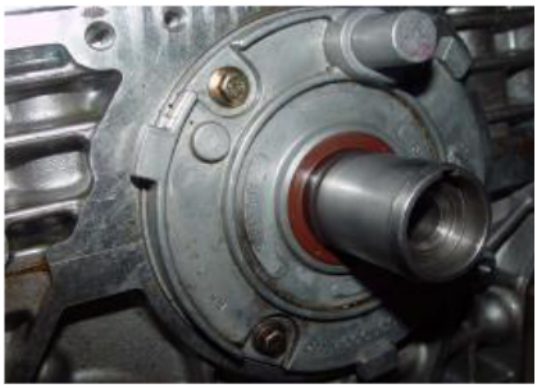
2) Apply a layer of engine lubricant onto the oil seal lip.



3) Fit the lubricant-applied new oil seal into special tool.



4) Press the oil seal into the oil seal seat ring carefully, and use hammer to knock it to the specified position.



PDF created with pdfFactory Pro trial version www.pdffactory.com

5 Replacement of Oil Pump

5.1 Needed tools and auxiliary materials

A set of big sleeve tools, a set of small sleeve tools, and a set of open end wrenches

5.2 Process of replacement

5.2.1 Process of removal

1) Dismantle the timing belt(detailed methods are shown in the “removal of engine timing belt”).

2) Shift the car into 5th gear and step on the brake, and dismantle the timing belt pulley.

3) Use 10# sleeve to dismantle the fixed bolt of oil pump, and remove the oil pump.



Torque: 8+3NM

4) Pry out the oil seal.

5) Clean the seat ring of oil pump.

5.2.2 Installation

1) Apply oil onto the oil pump gasket.

2) Mount the oil pump into the seat ring of oil pump.

Note: The bulging portion of oil pump should point downward.

When the position is not correct, the bolt cannot be screwed in.

3) Mount oil seal.

4) Mount other components.

6 Replacement of Crankshaft Rear Oil Seal

6.1 Needed tools and auxiliary materials

A set of sleeve tools, a slot head screwdriver, a small crane, engine oil.

6.2 Process of removal

PDF created with pdfFactory Pro trial version www.pdffactory.com

1) Lift down the engine assembly from the car(detailed methods are shown in the "lifting and installation of engine assembly".

2) Dismantle he clutch pressure plate.

3) Dismantle the flywheel. Firstly use special tool to clamp the flywheel, and then use sleeve wrench to dismantle the fixed bolts.

4) Use slot head screwdriver to pry out the old oil seal.

Note: Avoid scuffing the oil seal seat ring.



6.2 Installation

1) Clean the oil seal seat ring. Use clean gauze to suck some engine oil to clean up the foreign substances in the oil seal seat ring.



2) Apply a layer of oil onto the front oil seal lip of crankshaft equally. Fit the oil seal onto the special tool, and then press it into the oil seal seat ring.



3) Install flywheel and clutch pressure plate, and assemble the engine into the car.

Torque: 25±5N.M, and then screw for 30°±5°.

PDF created with pdfFactory Pro trial version www.pdffactory.com

7 Replacement of Crankshaft and Thrust Washer

7.1 Needed tools and auxiliary materials

A set of open end wrenches, a set of sleeve tools, one small crane, Le Tai glue, engine oil, feeler gauge and micrometer guage.

7.2 Process of removal

1) Lift down the engine (detailed methods are shown in the "lifting and installation of engine").

2) Discharge the engine oil.

3) Dismantle the engine timing belt (detailed methods are shown in the " replacement of timing belt").

4) Dismantle the engine accessories such as engine A/C compressor, power steering pump and bracket.(detailed methods are shown in the "replacement of engine accessories").

5) Dismantle the engine cylinder head assembly (detailed methods are shown in the "replacement of cylinder head").

6) Dismantle the clutch pressure plate, flywheel and timing belt pulley.

7) Dismantle the oil pan and oil strainer.(detailed methods are shown in the " replacement of oil span and strainer".

8) Dismantle the piston connecting rod assemblies of four cylinders, place them well in order.

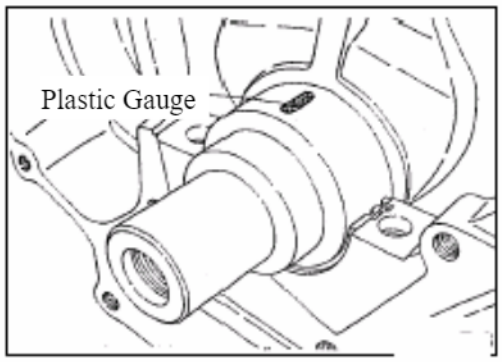
9) Dismantle the oil pump assembly

10) Dismantle the lower frame of cylinder block, and then you can take out the crankshaft and thrust washer.

PDF created with pdfFactory Pro trial version www.pdffactory.com

7.3 Check

1) Check the oil clearance of crankshaft main journal.



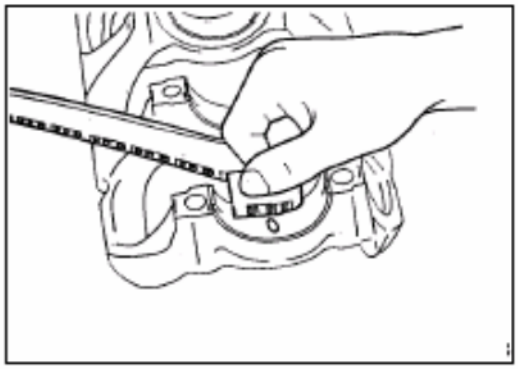
a) Clean the journal and bearing bushing.

b) Installation of crankshaft

c) Cut the plastic gauge to make it have the same length with that of the bearing, and then put it onto the crankshaft journal to make it parallel with the central line of shaft.

d) Install the master bearing cap carefully, and fasten the bolts to specified torque.

e) Dismantle the master bearing cap carefully.



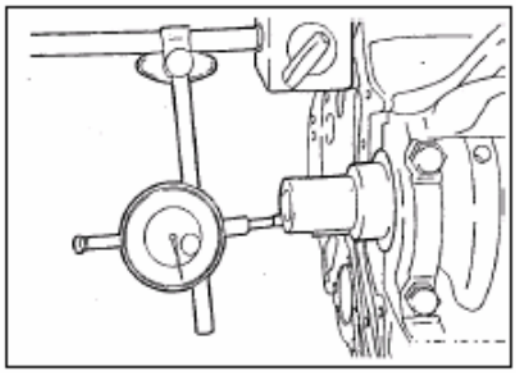
f) Use the measuring rule on the packaging bag of plastic gauge to measure the width of the widest portion of flattened plastic wire, and get the clearance value.

	Standard value	Limit value
Clearance	0.022	0.058

If the clearance value exceeds the limit value, please replace the bearing bushing.

Note: When replacing the bearing bushing, you must replace the whole group of bearing bushings.

2) Measure the axial clearance of crankshaft After mounting the crankshaft, you can use micrometer guage to measure the axial clearance.



	Standard value	Limit value
Clearance	0.07	0.265

If the measured value exceeds the limit value, please replace the thrust washer.

PDF created with pdfFactory Pro trial version www.pdffactory.com

7.4 Installation

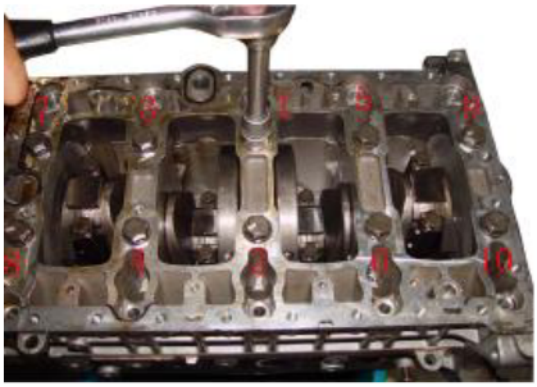
1) Clean up the short engine, and apply engine lubricant.

2) Install the crankshaft correctly, and mount the thrust washer in proper position.

3) Latch on the cylinder block frame, and fasten the crankshaft fixed bolts.



The fastening sequence is illustrated in the figure.



Torque:

4) Mount the bolts onto the frame periphery, and fasten them.

Torque:

5) Mount oil strainer, oil pan, front and rear oil seals of crankshaft and oil pump.

6) Mount engine accessories, lift and install the engine onto the car, mount water pipe, and insert all electrical plugs.

PDF created with pdfFactory Pro trial version www.pdffactory.com