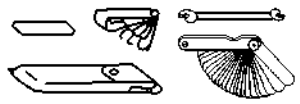
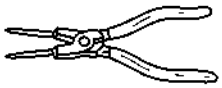
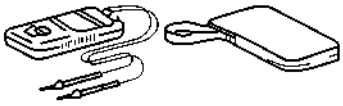
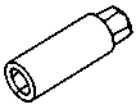
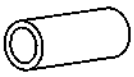
CONTENTS

CHAPTER 2 PREPARATIONS FOR MAINTENANCE

1 Special service tools

Special purpose tool	Name of tool	Special purpose tool	Name of tool
	Kit for engine adjustment		Pincers for clip ring
	Yuanzheng X-431 diagnostic instrument		Oil sealing knife for oil sump
	Spanner for oil filter		Oil pressure switch sleeve
	Spark plug sleeve		Compressor for piston ring

2 Servicing materials

Name of material	Explanation for purpose
Letai 243 or equivalent product	Oil pressure switch
Letai 587 or equivalent product	Housing of camshaft, cylinder head, cylinder head semicircular plug, discharge outlet, thermostat seat
Letai 962T or equivalent product	Spark plug tube
Letai 5699 or equivalent product	Oil sump

3 Lubricant

Item	Volume	Brand of lubricant
Engine oil		
Replace the oil filter	3.5 L	Class SJ or higher than class SJ, 10W-40 or 5W-30
Do not replace the oil filter	3.0 L	Class SJ or higher than class SJ, 10W-40 or 5W-30

(Continue)

Fastening parts	Qty./Specifications of bolts	Proscribed torque (N·m)
Oil dipstick socket assembly — connecting water pipe	1 – M6×12	9±2
Fan pulley — Water pump assembly	4 – M6×12	9±2
Generator support — cylinder head	2 – M8×25	26±3
	1 – M8×30	
Lower cover of timing toothed belt — oil pump	3 – M6×20	9±2
Timing gear pulley — exhaust camshaft	1 – M10×1.25×22	60±5
Absorbed pulley assembly — crankshaft	1 – M12×1.25×31	127±10
Tensioner bolt — cylinder block	1 – M10×1.25×40	45±3
Upper and middle covers of timing toothed belt — cylinder block, cylinder head	5 – M6×20	9±2
	1 – M6×25	
Acorn nut, air filter holder — cylinder head cover	M6	10±2
Ignition coil holder — cylinder head	3 – M8×16	18±3
Ignition coil — ignition coil holder	4 – M6×45 (Hollow head)	9±2
Rear/front hook of the engine — cylinder head	2 – M10×1.25×18	30±5
Thermostat seat — cylinder head	1 – M8×35	22±3
	2 – M8 nut	
Thermostat cover (water inlet pipe) — thermostat seat	2 – M6×20	9±2
Water discharge pipe — cylinder head	2 – M8×20	22±3
Lower body of intake manifold — cylinder head	7 – M8×28	20±3
	2 – M8	
Fuel rail assembly — lower body of intake manifold	2 – M8×16	15±3
Upper body of intake manifold — lower body of intake manifold	4 – M8×28	20±3
	1 – M8×30	
Intake manifold supporter — cylinder body	1 – M10×1.25×18	40±5
	1 – M8×16	20±5
Shutter body assembly — intake manifold	4 – M6×50	9±2
Exhaust manifold — cylinder head	5 – M10	35±5

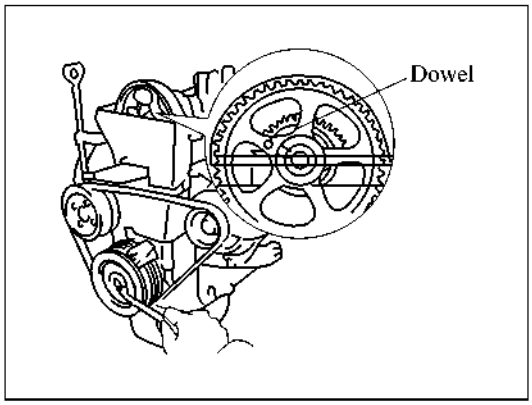


Figure 4 – 2 – 11 Align the Assembling Symbols on Gear

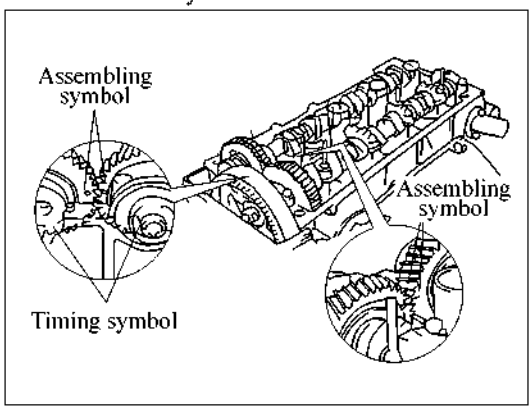


Figure 4 – 2 – 12 Timing Symbols on Gear

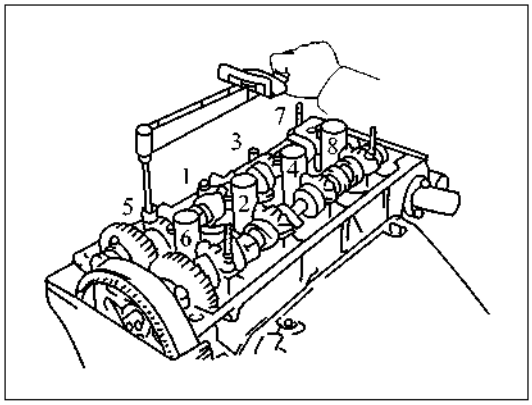


Figure 4 – 2 – 13 Tighten the Bearing Cap Bolts

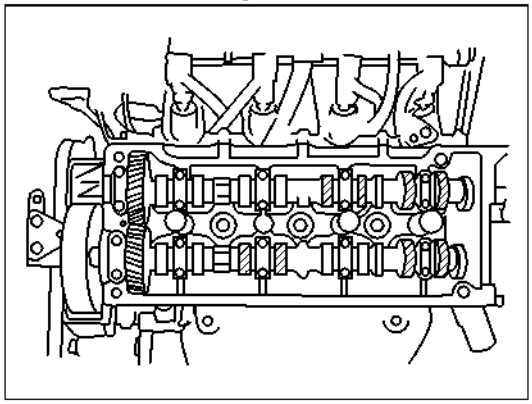


Figure 4 – 2 – 14 Check the Valve Clearance

5.5.1 Turn camshaft pulley and fix the exhaust camshaft until its dowel is a little higher than the upper surface of cylinder head.

5.5.2 Daub the multi – purpose lubricant on the stop part of camshaft.

5.5.3 Align the assembling symbol on each gear (see Figure 4 – 2 – 11) and let the inlet camshaft gear engaged with the exhaust camshaft gear.

5.5.4 Tighten the inlet camshaft to the bearing swivel and let the gears engaged with each other.

○ Attention: Above angle allows that the cam lobes of No. 1 and No. 3 cylinder of inlet camshaft can uniform drive their valve tappet.

5.5.5 Install 4 bearing cap on they own position.

5.5.6 Daub a thin film of engine oil on bearing cap bolt end and thread.

5.5.7 Tighten 8 bearing cap bolts at a few times evenly according to the sequence shown as Figure 4 – 2 – 13.

5.5.8 Remove the bolt for maintenance.

5.5.9 The arrow must be frontward when install No. 1 bearing cap.

▽ Caution: If the matching of No. 1 bearing cap is not very good, using screwdriver to prize and separate the cylinder head and camshaft gear so that drive the camshaft gear rearward.

5.5.10 Daub a thin film of engine oil on bearing cap bolt end and thread.

5.5.11 Tighten 2 bearing cap bolts at a few times alternately.

Torque: 13 N · m.

5.6 Recheck the valve clearance. See Figure 4 – 2 – 14.

(See Page 13 please)

6 Exhaust

Adjust the valve clearance

6.1 Take out the shim.

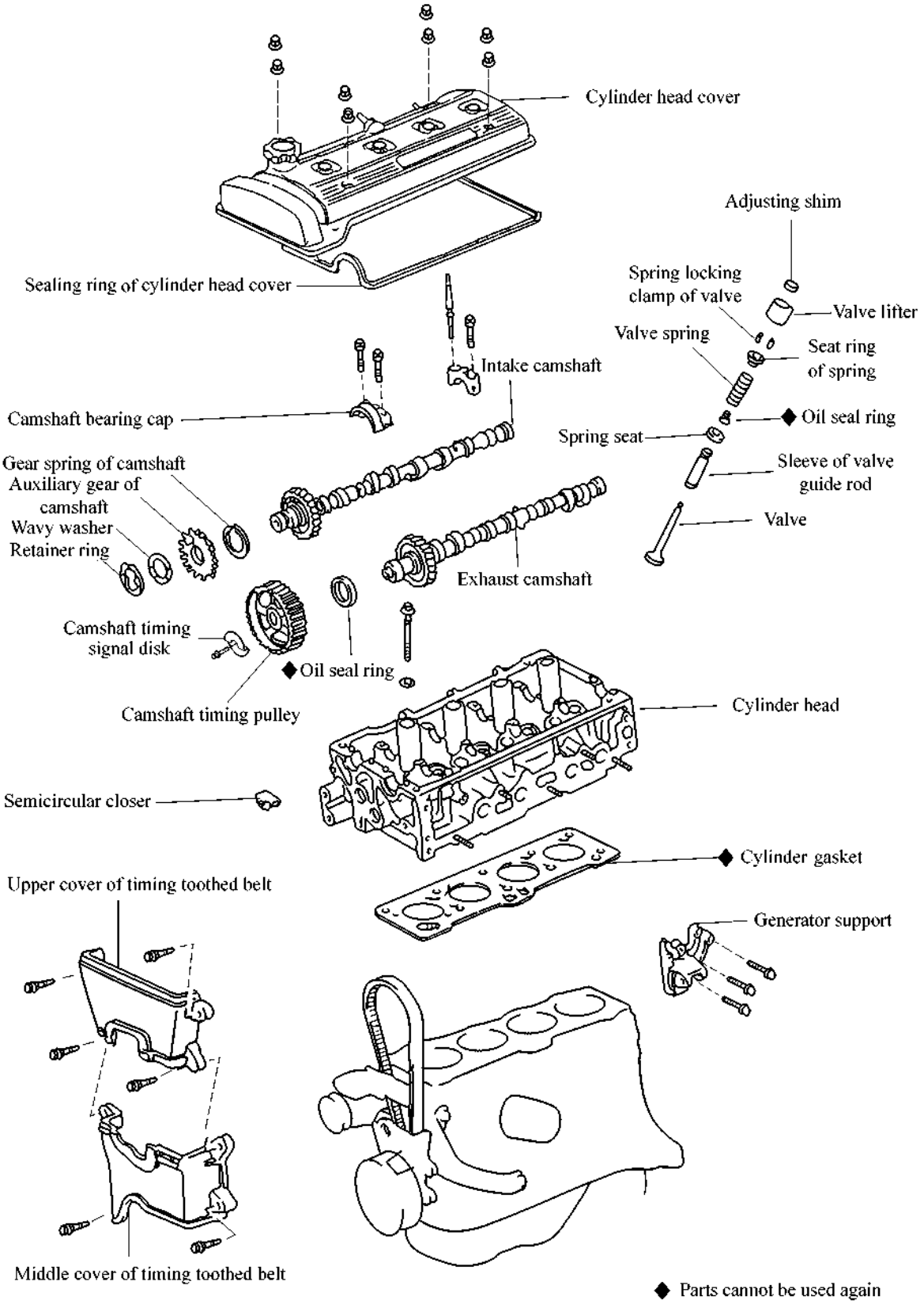


Figure 4 – 5 – 2 Parts Disassembling Ddrawing of the Cylinder Head

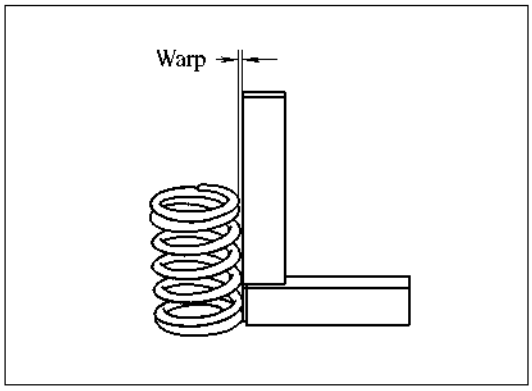


Figure 4 – 5 – 54 Check the Valve Spring

8 Check the valve spring

8.1 Measure the verticality of valve spring by one steel square. See Figure 4 – 5 – 54.

Maximum angle (for reference): 2°.

Replace the valve spring if the angle larger than maximum value.

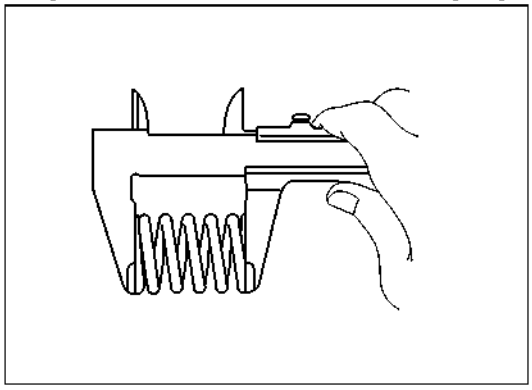


Figure 4 – 5 – 55 Measure the Free Length of Valve Spring

8.2 Measure the free length of valve spring by vernier caliper. See Figure 4 – 5 – 55.

Free length: 38.57mm.

Replace the valve spring if the free length cannot meet prescribed requirement.

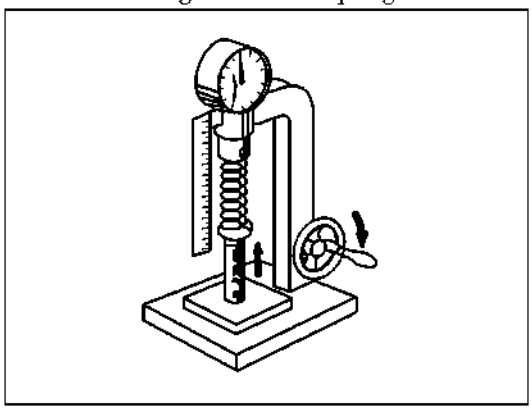


Figure 4 – 5 – 56 Measure the Pulling Force of the Valve Spring

8.3 Measure the pulling force of the valve spring at prescribed installing length by spring detector. See Figure 4 – 5 – 56.

Installing pulling force at the length of 31.7mm: 166 N ± 13.5 N.

Replace the valve spring if the installing pulling force cannot meet prescribed requirement.

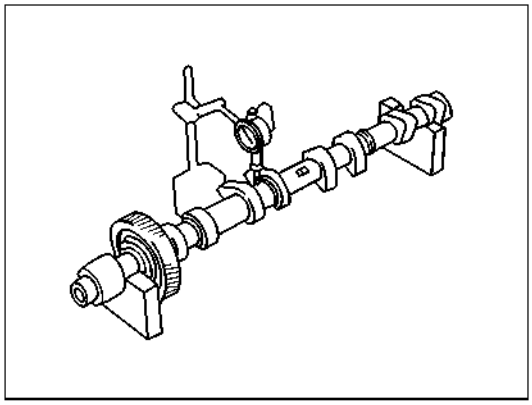


Figure 4 – 5 – 57 Check the Camshaft And Bearing

9 Check the camshaft and bearing

9.1 Check the radial jumpiness of camshaft

9.1.1 Put the camshaft on V – block.

9.1.2 Measure the radial jumpiness of camshaft at its middle journal by micrometer. See Figure 4 – 5 – 57.

Maximum circle radial jumpiness: 0.03mm.

Replace the camshaft if measured circle radial jumpiness is larger than the maximum value.

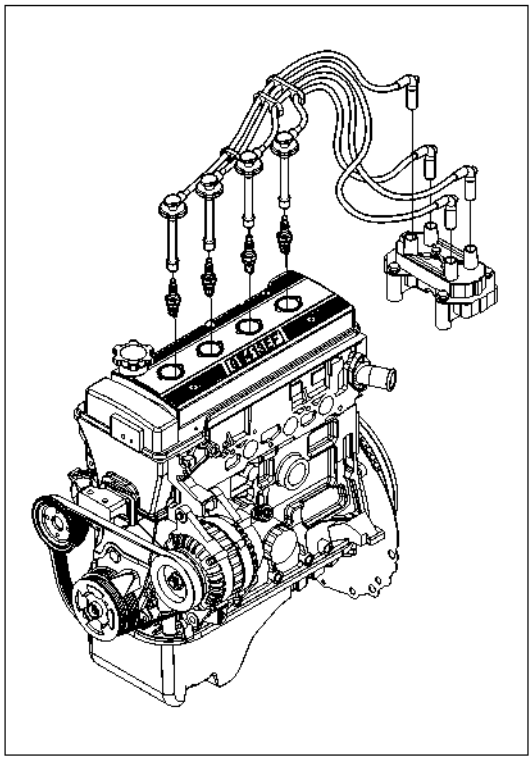


Figure 4 – 5 – 93 Assemble the Spark Plug

12 Assemble the spark plug

Assemble 4 spark plugs using 16 mm spanner of spark plug. See Figure 4 – 5 – 93.

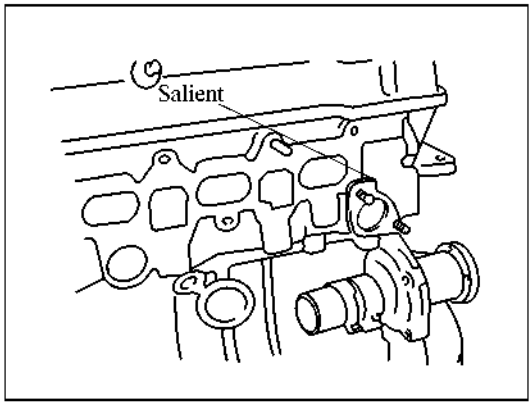


Figure 4 – 5 – 94 Assemble the Connecting Water Conduit

13 Assemble the connecting water conduit

13.1 Place a new washer on the cylinder head and the salient is upward. See Figure 4 – 5 – 94.

13.2 Connect the rubber hose to water pump.

13.3 Tighten the connecting water conduit with 2 nuts.

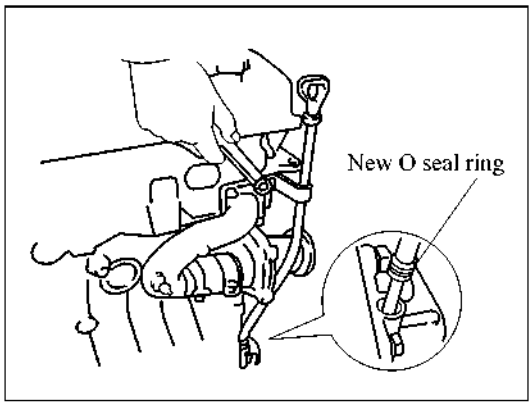


Figure 4 – 5 – 95 Assemble the Oil Dipstick And Its Socket

14 Assemble the oil dipstick socket and dipstick

14.1 Install the new O – seal ring on the dipstick socket. See Figure 4 – 5 – 95.

14.2 Push the dipstick socket and dipstick and fix them with bolt.

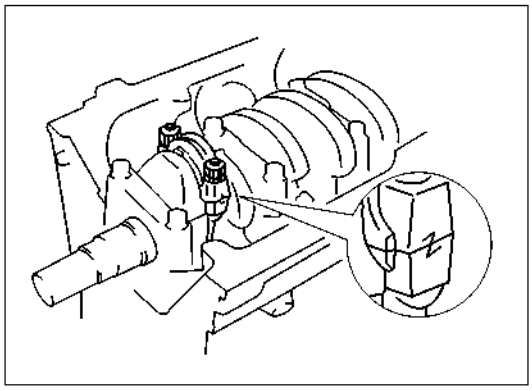


Figure 4 – 6 – 13 Disassemble the Cap And Nuts of the Connecting Rod

15 Disassemble the connecting rod cap

15.1 To ensure the reassembling correctly, check the matching symbol on the connecting rod and its cap. See Figure 4 – 6 – 13.

15.2 Remove the nuts of connecting rod cap.

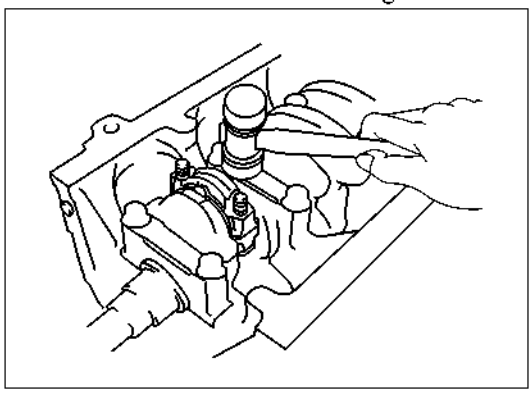


Figure 4 – 6 – 14 Tap the Bolts of Connecting Rod by Hammer Lightly

15.3 Use plastic hammer to tap the connecting rod bolts and lift the connecting rod cap upward. See Figure 4 – 6 – 14.

○ Attention: Keep lower bearing liner embed in connecting rod cap.

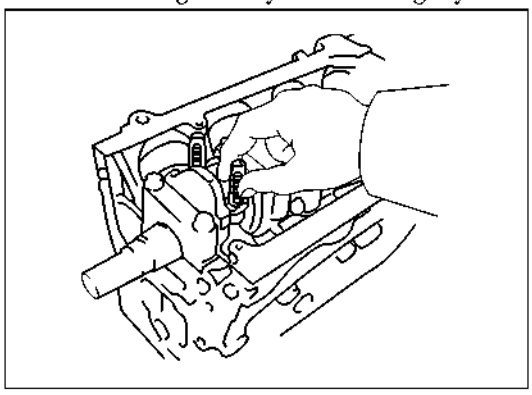


Figure 4 – 6 – 15 Ring a Short Hose on the Bolts of Connecting Rod

15.4 To avoid damaging the crankshaft, use a short hose to ring the bolt of connecting rod. See Figure 4 – 6 – 15.

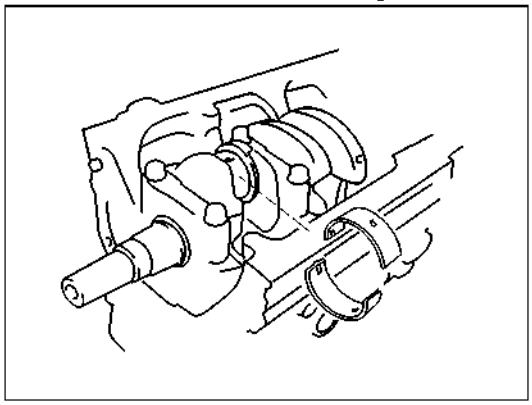


Figure 4 – 6 – 16 Clear the Connecting Rod Journal And Bearing Liner

15.5 Clear the connecting rod journal and bearing liner. See Figure 4 – 6 – 16.

15.6 Check whether or not the connecting rod journal and bearing liner have rough holes and nicks.

Replace the bearing liner if there is damaged of crank pin and bearing liner. Grind or replace crankshaft if necessary.

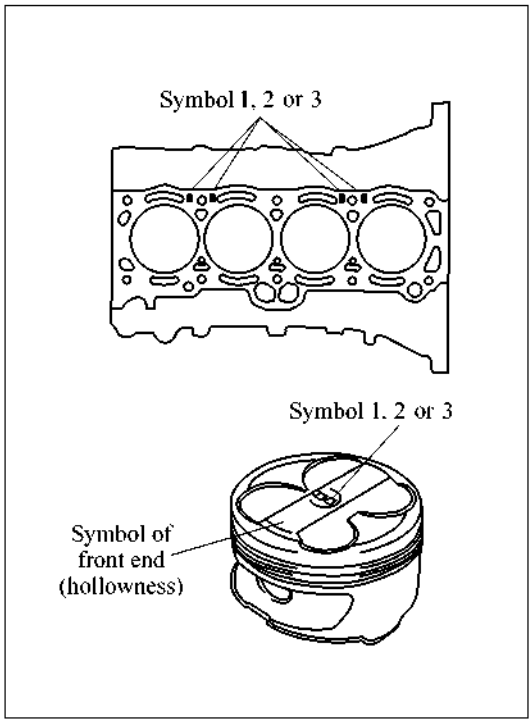


Figure 4 – 6 – 36 Select the Piston the Diameter Is the Same as Cylinder Bore

9.1.2 Subtract measured piston diameter from cylinder hole bore.

Replace whole set of four pistons and re – boring four cylinders if the clearance is larger than maximum value. Replace the cylinder block if necessary.

○ Attention: If new cylinder block will be used, select the piston the diameter is the same as cylinder bore.

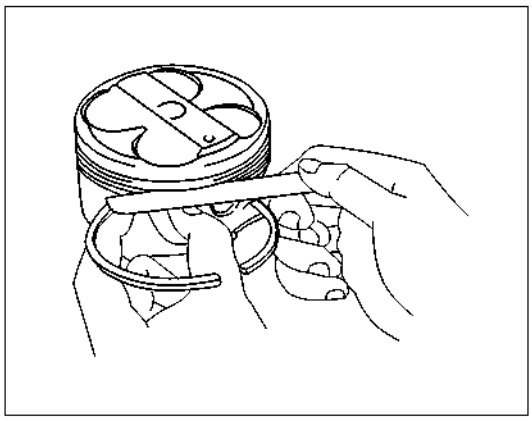


Figure 4 – 6 – 37 Check the Clearance of Piston Ring Groove

9.2 Check the clearance of piston ring groove

Check the clearance between new piston ring and ring groove wall. See Figure 4 – 6 – 37.

Clearance of piston groove:

The first groove: 0.02 ~ 0.06 mm.

The second groove: 0.02 ~ 0.06 mm.

Replace the piston if clearance is larger than maximum value.

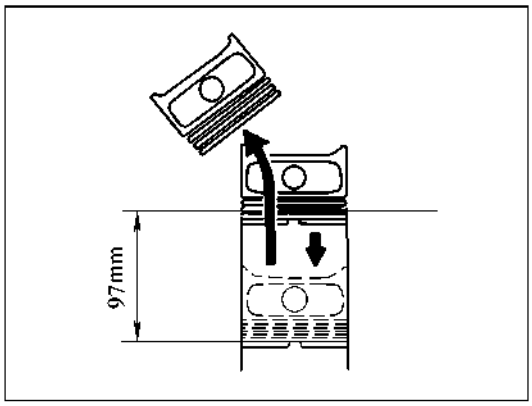


Figure 4 – 6 – 38 Check the Opening Clearance of Piston Ring

9.3 Check the opening clearance of piston ring

9.3.1 Inset the piston ring into cylinder hole.

9.3.2 Push piston ring to exceed its bottom a little using piston and the distance is 97 mm from this position to top of cylinder block. See Figure 4 – 6 – 38.

Trouble status	MI control	Trouble information memory
Casual but unconfirmed	Do not change MI status	Continuous monitor trouble code output via mode 7 Incontinuous monitor results output via mode 6
Casual but repaired	Do not change MI status	Cancel corresponding information inside ECU memory
Confirmed but un – repaired	Enable MI light for trouble relevant emission Do not enable MI for trouble need to repair but no affect on emission Wink MI for trouble relevant damage catalytic converter	Trouble code and corresponding frozen memory information output via mode 2 Trouble code output via mode 3
Confirmed but before confirmed for repair	Do not change MI status	
Confirmed but after confirmed for repair	Black out MI light	Trouble after repaired and no happened during heat the engine cycle for more than 40 times, please cancel the trouble code and the time it happened as well as the frozen memory information

3 Trouble indicator (MI)

MI is a trouble indicator. It can remind the driver clearly when any part connected with the diagnosis system on automobile and emission exhaust or OBD system has trouble. MI is the indicator light that can be shown at the panel and its shape meet revenant standard.

The activation of MI light should be followed the principle:

(1) MI will light when switch on ignition of automobile but the engine still stop.

(2) OBD system will light MI to remind the driver for overhauling if the system exists confirmed relevant emission trouble (except for fire trouble caused catalytic converter damaged).

(3) MI winks at the frequency of 1 Hz immediately once the engine fired to prescribed level of the factory so that possible damage catalytic converter.

The black out of MI light should be followed the principle:

(1) MI will black out after 3 s when engine started and no trouble existed early.

(2) Mi should be switch to its earlier status if there is no possibility that the engine may fire to damage catalytic converter the fire cannot damage catalytic converter when the speed and load of engine changed.

(3) For all of other trouble for continuous three operation cycles, MI will black out if relevant active MI monitor system detects trouble not any longer, and has not detect other trouble that may cause individual active MI trouble.

4 Trouble code

OBD system must has the function to identify the area possible existed trouble and store the information into memory of ECU with code according to the rule of law. SAE and ISO standardize the diagnosis code, the code consists of 5 characters such as P0112.

(Continue)

Order	Trouble code	Trouble explanation
92	P0694	Control circuit of cooling fan relay is short circuit to power supply (high speed)
93	P0704	Clutch pedal switch signal is incorrect
94	P1336	Safety monitoring torque of electronic shutter limits action
95	P1545	Difference between actual position and target position of electronic shutter exceeds limit
96	P1558	Opening resistance of electronic shutter is too large
97	P1559	Electronic shutter self – educated process is fault
98	P1564	System voltage cannot meet the self – educated condition of electronic shutter
99	P1565	Lower limit position initialization self – educated of electronic shutter is fault
100	P1568	Returning resistance of electronic shutter is too large
101	P1579	Self – educated condition of electronic shutter cannot be met
102	P1604	Gain adjusting self – educated of electronic shutter is fault
103	P1610	No code for theft – proof key
104	P1611	Theft – proof code of key is wrong
105	P1612	Communication between theft – proof instrument and ECU breaks off
106	P1613	Communication between theft – proof instrument and ECU breaks off
107	P1614	CMOS chip inside theft – proof key is fault
108	P1651	Driving class circuit of SVS light is open circuit
109	P2106	Driving class of electronic shutter is fault
110	P2122	Signal voltage of electronic accelerator pedal position sensor 1 is too low
111	P2123	Signal voltage of electronic accelerator pedal position sensor 1 is too high
112	P2127	Signal voltage of electronic accelerator pedal position sensor 2 is too low
113	P2128	Signal voltage of electronic accelerator pedal position sensor 2 is too high
114	P2138	Signal of electronic accelerator pedal position sensor is reasonless
115	P2177	Closed loop control self – educated value of air – fuel ratio exceeds upper limit (mid – load)
116	P2178	Closed loop control self – educated value of air – fuel ratio exceeds lower limit (mid – load)
117	P2187	Closed loop control self – educated value of air – fuel ratio exceeds upper limit (lower – load)
118	P2188	Closed loop control self – educated value of air – fuel ratio exceeds lower limit (lower – load)
119	P2195	Upriver oxygen sensor is aging
120	P2196	Upriver oxygen sensor is aging
121	P2270	Downriver oxygen sensor is aging
122	P2271	Downriver oxygen sensor is aging

1.5 Points for attention during installation

Intake pressure temperature sensor is installed on the intake manifold of the engine. Pressure connecting tube and temperature sensor all are outshoot of intake manifold and seal from atmosphere by one large O – seal ring.

If suitable way can be adopted to install them on automobile (take out pressure from intake manifold, decline the pressure connecting tube downward and so on), it can ensure that there is no condensate water on pressure sense organ.

The hole drill and fix on intake manifold must be implement according to drawings so that to ensure long – term sealing and to anti – corrode by medium.

The reliability of connection joint depends not only on the size of parts, but also has great relationship of harness, material quality and its precision.

1.6 Trouble phenomena and analysis method

Trouble phenomena: Shut off, incorrect idling and so forth.

General reasons: ① there is abnormal high voltage or reverse large current during utilization; ② servicing damages the vacuum element.

Points for attention during maintenance: Forbidden using high – pressure air to impact vacuum element during maintenance; check whether or not the output voltage and current of the engine are correct during replacement of sensor if found trouble.

Simple test method:

Part of temperature sensor: (remove the joint) Set the digital multi – meter to ohm position, connect two test pins with the pin 1 and pin 2 of the sensor respectively, the rated resistance at 20℃ is 2.5 kΩ ±5%, other corresponding resistance are shown in Figure 6 – 4 – 6. Simulative method can be used for measure, for example, using a hair dryer to send wind to sensor (with some distance) and observe the change of sensor's resistance, the resistance should decrease.

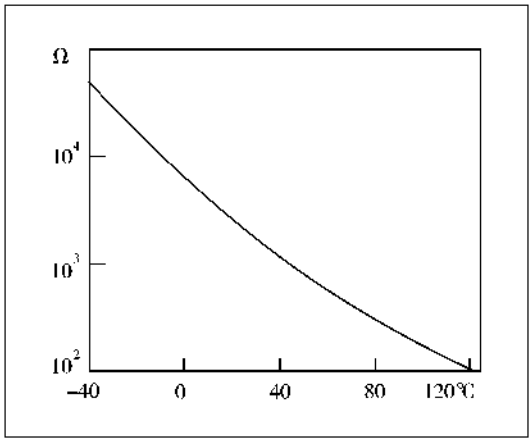


Figure 6 – 4 – 6 Resistance Characteristic Curve of Coolant Temperature Sensor (NTC)

Part of pressure sensor: (connect the joint) Set the digital multi – meter to direct voltage position, connect the black test pin with ground and red test pin with the pin 3 and pin 4 of the sensor respectively. At idling speed, pin 3 and pin 4 should have around 5 V and 1.3 V reference voltage respectively (concrete value is depending on vehicle model); at the status without load, slowly open the shutter, little change will be for pin 4; rapidly open the shutter, the voltage of pin 4 will instant be 4 V for pin 4 (concrete value is depending on vehicle model) and then decrease to 1.5 V (concrete value is depending on vehicle model).

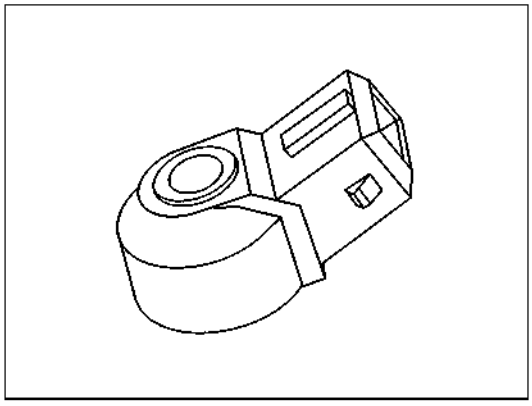


Figure 6 – 4 – 7 Knocking Sensor Without Cable

2 Knocking sensor

2.1 Sketch and pin

Sketch: Knocking sensor is shown as Figure 6 – 4 – 7.

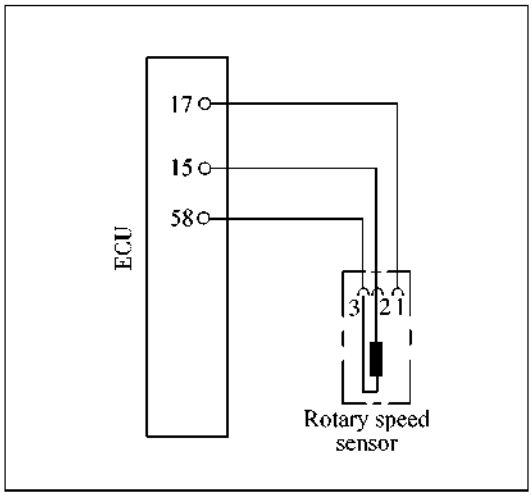


Figure 6 – 4 – 19 Inductive Rotary Speed Sensor Circuit

Inductive rotary speed sensor circuit is shown as Figure 6 – 4 – 19.

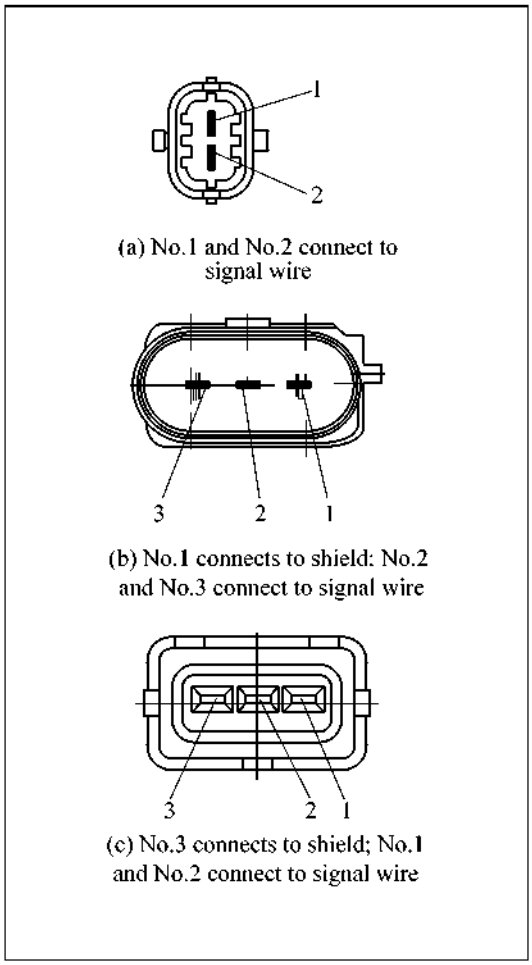


Figure 6 – 4 – 20 Connect the Signal Wire

Pin: there are two kinds of pins of the inductive rotary speed sensors for ME7. 9. 7 electronic control system. See Figure 6 – 4 – 20.

This system adopts the pin shown as Figure 6 – 4 – 20 (b) according to the definition of the two kinds of pins.

4. 2 Installation position

Inductive rotary speed sensor is installed at the rear flywheel plane of the engine.

4. 3 Working principle

Cooperated with pulse disk, inductive rotary speed sensor provides rotary speed message of the engine and TDC message of crankshaft in the ignition system without distributor. Inductive rotary speed sensor consists of a permanent magnet and the coil outside of the permanent magnet. Pulse disk is a tooth disk, it has 60 teeth formerly, but now there is a lack of two teeth. Pulse disk is installed on crankshaft and rotated following crankshaft. When tooth tip passes closed to the end of inductive rotary speed sensor, the pulse disk made of ferromagnetic material will cut the magnetic line of the permanent magnet inside inductive rotary speed sensor, and produce inductive voltage inside the coil as the rotary speed signal output.

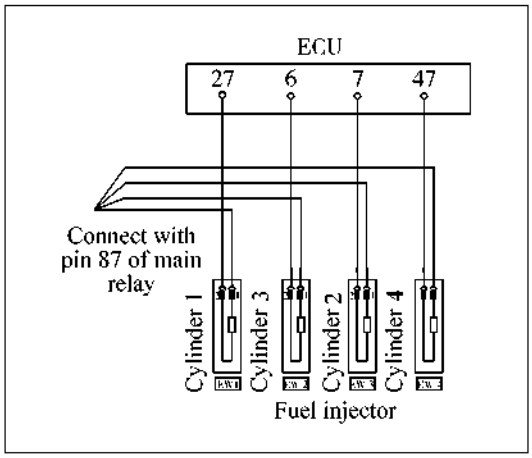


Figure 6 – 4 – 34 Circuit of Electromagnetic Fuel Injector

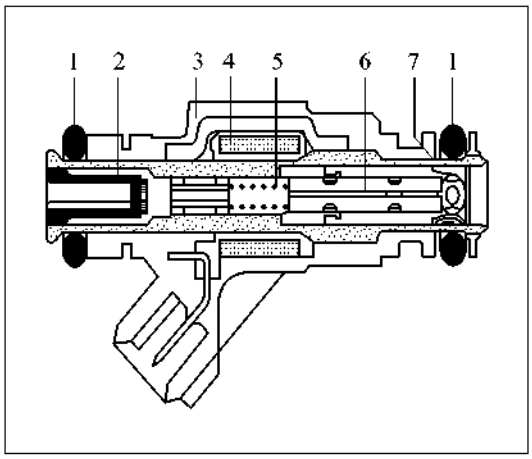


Figure 6 – 4 – 35 Section of Electromagnetic Fuel Injector

1 – O – seal ring; 2 – Screen; 3 – Injector body with electric plug; 4 – Coil; 5 – spring; 6 – Valve needle with coil gag bit; 7 – Valve seat with orifice plate

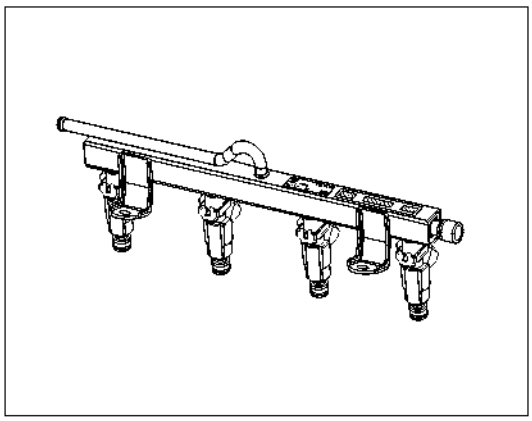


Figure 6 – 4 – 36 Injector on Fuel Distribution Manifold

Pin: each fuel injector has two pins. Among them, one pin with " + " at one side of housing is for connecting with the pin 87 of main relay; another is for connecting with the pin 27, pin 6, pin 7 and pin 47 of ECU respectively. See Figure 6 – 4 – 34.

8.2 Installation position

Electromagnetic fuel injector is installed at the intake manifold closed to intake valve. See Figure 6 – 4 – 36.

8.3 Working principle

ECU emits electric pulse to the coil of injector and forms magnetic field force. When the magnetic field force increases up to overcome the composition of forces of return spring pressure, needle valve gravity and friction, needle valve begins to lift and begin the fuel injection course. When close the fuel injection pulse, the pressure of return spring will cause the needle valve closing again.

Type of model EV6 electromagnetic fuel injector:

(1) Long type and standard type depending on length.

(2) B type (single hole single beam), C type (4 holes taper) and E type (4 hole dual – beam) depending on spray shape.

Type selection depends on the engine and the structure of intake manifold.