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CHAPTER 1 Technical Parameters of Engine

1 Specification

1.1 Technical specification

Model	DA465Q-1A2/D	
Mode	Four cylinders. Four stroke. Water-cooling. Inline. .Breadthways. Overhead camshaft. EFI	
Bore	65.5mm	
Stroke	78mm	
Pressure ratio	9. 0: 1	
Displacement	1051ml	
Nominal power	38.5kW (5200 r/min) [gross power]	
MAX torque	83N•m (3000 ~ 3500r/min) [gross power]	
MIX fuel consumption	275g/kw•h [gross power]	
Nominal RPM	5200r/min	
Idle speed	850±50r/min	
Emissions	Idle speed	CO≤0.5% HC≤100PPm DB11/044-1999
	High idle speed	CO≤0.3% HC≤100PPm DB11/044-1999
	Mode	CO≤2.2 g/km HC+NO _x ≤0.5g/km EC 96
Strays	GB 14023-2000	
Steering	Anticlockwise (From opposite)	
Spark advance angle	6° ~ 7° [idle model]	
Spark order	1 - 3 - 4 - 2	
Oil pressure	0.294 ~ 0.539MPa (3.0 ~ 5.5kgf/cm ²) 3000r/min	
Dimensions length×width×height	Inclusive transmission	776×609×656.7mm
	Not inclusive transmission	396×609×656.7mm
Weight	Not inclusive transmission	98kg
Fuel	90#(RON90) or more GB19730-99 unleaded gasoline	
Oil	Environmental temperature > - 20□	SF15W/40
	< - 20□	SF5W/30
Coolant quantity	4.5L	



Oil quantity	3.5L
Transmission oil	Base on local temperature; select GL-4、 or GL-5 Transmission oil ; quantity : 2.1 L
Suction filter	Dry type
Spark	F6RTC
Generator	Silicon rectify generator
Start-mode	Electric start-up
Cooling method	Pump circulation water-cooling
Lubricating method	Pressure and splash compound

1.2 Oil pump

3000rpm	294 - 539kpa
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1.3 Specification of fastener

Application	Specification
Engine	Metric(N.m)
Pulley bolt	95 + (30°- 45°)
Stretching pulley accessories bolt	26±4
Camshaft bracket cover bolt	8±2
Camshaft timing pulley bolt	45±5
Connect rod bearing cap bolt	28 ~ 32
Coolant temperature sensor	Max 20
Crankshaft main bearing cap bolt	43-48
Cylinder head bolt	55-60
Engine flywheel bolt	40-45
Exhaust manifold nut	18-23
Engine mounting bracket set bolt	25±2.5
Knock sensor bolt	15-25
Intake manifold nut	18-23
Oil filter	12-16
Oil pan bolt	4-5
Oil pan drain plug	20-25
Oil pressure sensor	12-15
Oxygen sensor	40-60
Oil pump bolt	8-10
Spark plug	20-30
Left overhang of connecting front frame side member	50±5
Engine left overhang gasket of connecting transmission	40±5



Engine rear overhang and vehicle body	100±5
Engine rear overhang and bracket	100±5
Engine right overhang and vehicle body	50±2.5
Engine right overhang and bracket	100±5

2 Engine lubricant

Viscosity of oil is decided by outer temperature of gasoline or diesel engine, it is acceptable for engine temperature to be much higher or lower than given temperature in a short time. It is necessary for the user not to make the engine working at high speed for a long time and it is necessary for the user not to make the engine overloaded, if the temperature exceeding the limit or the user uses low-viscosity oil such as SAE 5W-30.

Regulations

C = Conventional engine oil

NT=New Technological oil

Classification of viscosity — ACEA/API grade					
Engine oil	SAE	Scope of Temperature		Grade of Quality	
		From	To	ACEA Standard	API Standard
Conventional Engine oil	5W—30	-20	+20	A1/B1 A2/B2	SH SJ/CE CF
	10W—30	-20	+20	A1/B1 A2/B2	SH SJ/CD CE
	10W—40	-20	>+40	A2/B2 A3/B3	SH SJ/CD CE
	10W—50	-20	>+40	A2/B2 A3/B3	SH SJ/CE CF
	10W—60	-20	>+40	A2/B2 A3/B3	SH SJ/CE CF
	15W—40	-15	>+40	A2/B2 A3/B3	SH SJ/CE CF
	15W—50	-15	>+40	A2/B2	SG/CD
	20W—40	-10	>+40	A2/B2	SF SG/CD
	20W—50	-10	>+40	A2/B2	SF SG/CD
NT- New technique	10W—30	-20	>+40	A3/B3	SJ/CF
	10W—40	-20	>+40	A3/B3	SJ/CF
	5W—30	<-30	>+40	A3/B3	SJ/CF
	5W—40	<-30	>+40	A3/B3	SJ/CF
	5W—50	<-30	>+40	A3/B3	SJ/CF



	0W—30	<-30	>+40	A3/B3	SJ/CF
	0W—40	<-30	>+40	A3/B3	SJ/CF

Notice:

It is applicable only under the circumstance of ACEA and API standard being listed
ACEA standard can not replace API standard, on the contrary ,API standard can take the place of ACEA standard.

Viscosity is not equal to quality.

CHAPTER 2 Diagnosis of the Engine

I Engine pressure test.

It can make sure the condition of piston ring 、 valve and cylinder head gasket to carry out compression pressure test for the engine cylinder.

- 1 The storage battery must be up to the standard of normal voltage or close to the normal voltage if you want the operational temperature of engine to be normal.
- 2 Turn off the engine.
- 3 Stop ignition.
- 4 Stop fuel system.
- 5 Remove out all spark plugs.
- 6 Remove out vacuum pipe in throttle valve body.
- 7 Lock the throttle valve to be open with a limit stop.
- 8 Check the cylinder pressure according to the following steps:

You shall fix the pressure gauge in spark-plug hole, while the engine working along with the starter, you should make the testing cylinders finish 4 compression strokes at least. You shall examine and record the readings of every stroke pressure gauge, then throw out the pressure gauge, as to the other cylinders, repeat above-mentioned steps to carry out the pressure test.

- 9 Record all pressure readings of all cylinders

Standard pressure of cylinder: 1.32Mpa (Rotational speed of engine shall be no less than 300r/min), pressure of every cylinder shall be no less than 1.10Mpa , pressure difference

between any two cylinders shall be no more than 0.098Mpa.

- 10 Example of possible testing results are introduced as follows:

- a Pressure of all cylinders shall be steadily improved to approach the stipulated pressure promptly, when the pressure is tested to be normal
- b It is probably due to piston ring if pressure of the first stroke is too low, but it is showing a tendency to go up in the afterwards strokes but not reaching the normal standard yet ,or the pressure goes up obviously after three times being infected with oil.



- c It is probably due to valve if pressure of the first stroke is too low and it remains low in afterwards strokes or the pressure keep the former state after being injected with oil.
- d It is probably due to cylinder head gasket if pressure of two neighboring cylinders is too low or there is some coolant in the crankcase.
- 11 Remove the limit stop from throttle valve plate
- 12 Install vacuum pipe to throttle valve body
- 13 Install spark plug

II General introduction to diagnosis of engine noise

Notice: Comparing with sound of other engines, you should make sure that you are not giving a lot of trouble to maintain the normal one, because some engines have normal special noise out of consideration of design.

The following 4 factors shall be considered when you make diagnosis of engine noise:

- Classification of noise
- Conditions for noise to happen
- Frequency for noise to happen
- Position for noise to happen in the engine

Noise of engine is usually synchronous with engine speed(results from connecting rod or piston)or half of engine speed(valve train).You should try to make sure frequency of the noise.

1 Main bearing noise

Noise results from main bearing damage or wear is just like the sound of thud or knocking , it happens once every circle that the engine rotate, the noise comes to maximum when the engine works with heavy load, knock of interval knocking sound which is much more piercing than the main bearing wear noise, shows that clearance of crankshafts is too big.

The following conditions can lead to main bearing noise:

- The pressure of oil pump is too low.
- The oil is too thin or/and the oil filter is too dirty.
- The clearance of main bearing is too big.
- The end clearance of crankshaft is too big.
- The shaft journal of crankshaft is out of round.
- Belt tension is too high.
- Crankshaft pulley is not tight enough.
- Main bearing cover is not tight enough.
- Driving belt pills.

2 Connecting rod bearing noise

Sound of knocking is generated at all speed under the condition of connecting rod bearing being damaged or wear ,connecting rod noise and knocking sound of piston or looseness of piston pin may be confused together easily in early stage of connecting rod bearing damage, knocking sound of connecting rod will become louder along with engine speeding up, this noise comes to maximum while decelerating.

The following circumstances can be the cause of noise:

- Bearing clearance is too big.
- Crankshaft connecting rod journal wear
- The oil is too thin or/and oil filter is too dirty
- Oil pressure is too low
- The shaft journal of crankshaft connecting rod is out of round.
- Connecting rod malposition
- Connecting rod nut fixed torque is not correct
- Bearing shell is not correct or bearing shell is malposition

3 Piston noise

It is hard to distinguish the noise generated by piston pin or connecting rod, loose of piston pin may result in sharp double knocking sound, usually, it can be heard when the engine is idling or the engine speeds up suddenly then slow down; the piston pin will be ticking slightly if the piston is installed not properly, the noise becomes more obvious if the engine works without heavy load; too much clearance between piston and cylinder liner will result in sound of knocking the cylinder from inside, this kind of noise is similar to metal knocking sound, just like the piston slap the cylinder shell from inside during the process of stroke. Engine noise slowing down after warming up is a sign for piston to slap cylinder, there is too much clearance between piston and cylinder liner when the engine is cold, sound of slapping is much louder.

The following circumstance can lead to piston noise:

- Piston pin wear or too loose
- Piston pin is installed not properly.
- There are too much clearance between piston and cylinder liner.
- Lubrication is not enough.
- The carbon deposit at piston crown knocks cylinder head.
- Piston ring groove wear or fracture
- Piston fracture
- Connecting rod malposition
- Piston ring wear or damage
- The clearance of piston ring groove is too big.
- The clearance of piston ring ends is not enough.
- Piston malposition is at a angle of 180 degree
- The shape of piston skirt is not correct.

4 Flywheel noise

Check whether or not the flywheel is loose or cracked according to the following steps:

4.1 Drive the vehicle at the speed of 32 km/h.

4.2 Turn off the engine

The flywheel may be loosened or damaged if you hear the kind of pinging sound, this kind of pinging sound comes to maximum while decelerating. Bearing knocking sound can result from looseness of bolts. It depends on stability of idling to generated how much slapping sound when the engine is idling at high speed, the noise can be made or can not be made if transmission drive put into gear. Check the connecting bolts between transmission and flywheel, crankshaft and flywheel first, before make sure whether or not there is some

relationship between the knock and bearing.

5 Valve train noise

Valve train malfunction can be shown by means of slight slapping sound of any frequency or frequency is equal to half of engine speed, the noise will go up along with acceleration of the engine.

First, warm up the engine before judging the valve train noise, so as to make the engine parts expand to normal state. Listen to engine noise under the circumstance of engine cover being shut.

Remove out the rocker arm head ,make sure the parts of valve train which result in noise with stethoscope, if the noise of valve train is abnormal. The cause of noise are introduced as follows:

- Valve spring fracture, resiliency of valve spring is not enough.
- Valve is blocked or curved
- Rocker is curved
- The cam of camshaft is damaged or poor performance.
- Lubrication of valve train is not good or oil pressure is too low.
- The clearance of valve stem and valve guide pipe is too big.
- Valve guide pipe wear
- Push rod wear
- Valve rocker wear
- Bolt of valve rocker fracture
- Auxiliary parts of valve rocker is too loose or wearing.

III Diagnosis of engine noise

1 Exhaust gear

Symptom	Cause of malfunction/ Troubleshooting
Vibration or quack noise of exhaust system	Looseness or malposition of exhaust parts, you can carry out the following procedures: 1 Align the joints. 2 Fasten the joints. 3 Check to see whether or not exhaust lifting hook , mounting bracket and clamp are damaged.
Waste gas leak or noise	The following conditions can result in waste gas leak or noise: ● Exhaust parts joints or connection leak. ● Tighten clip or connecting parts to regulated torque. ● Installation of exhaust system is not correct or malposition. ● Align and tighten the clip. ● There are some cracks on the exhaust manifold. ● Leakage between exhaust manifolds or between the cylinder heads. ● Fasten the exhaust manifold on the cylinder head according



	to the regulation ● Tighten or replace exhaust manifold washer. ● Exhaust expansion connection parts damage or wear. ● Replace parts if necessary. ● Exhaust pipe is burned or rusty. ● Replace the exhaust pipe if necessary. ● Muffler is damaged or burned. ● Replace the muffler assembly. ● Exhaust clip and/or bracket are damaged or loosened. ● Replace the parts if necessary.
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2 Valve train

Symptom	Cause of malfunction/Troubleshooting
There is some noise while idling, the noise becomes louder when the rotational speed is much higher.	This kind of noise has nothing to do with malfunction of tappet, it becomes more obvious under low gear speed of 10-15 km/h, this kind of noise sounds just like ticktack, the following condition can result in this kind of noise: ● Valve end or Valve rocker gasket wear ● Clearance of valve stem and valve guide is too big. ● Radial run-out of valve seat is too remarkable. ● Radial run-out of valve working surface is too remarkable. ● Malposition of valve spring 1 Rock the engine until the nosing valve depart from the valve seat. 2 Rotate valve spring and valve 3 If the noise is corrected, check the valve spring to see whether or not it is in malposition. If the malposition exceeds the limit, replace the valve spring.
Driving at high-speed, there is some noise, while driving at low-speed, the noise disappears.	High-speed driving noise may result from the following condition: Oil level is too high. If oil level is higher than FULL (full mark), crankshaft balancer will stir the oil into foams, when the foam is pumped into the tappet, the



	tappet will make noise. Make the oil being put in correct oil level. Oil level is too low. If oil level is lower than ADD(add mark),the atmosphere will be pumped in by oil pump, it will result in tappet noise, add oil if necessary. ● Oil pump filter screen is bent or too loosened.
Noise which has nothing to do with engine speed.	Check the following circumstances: ● Lubricating system of rocker. ● Rocker ball wear. ● Rocker is bent or damaged. ● Valve rocker is too loosened or damaged.

3 Abnormal noise diagnosis of engine

Symptom	Cause of malfunction/Troubleshooting
There is some knocking sound while starting ,but only continue several seconds.	Oil viscosity is not suitable. Use suitable oil viscosity according to estimated temperature, see the maintenance and lubrication for reference.
knocking continue 2-3 minutes while engine is cold	Engine cold start pinking sound usually disappears when the specified cylinder secondary ignition circuits connect the ground. Check the engine to see if it is under the following circumstances: ● Crankshaft balancer or drive pulley is loose or broken. ● Tighten or replace parts if necessary ● Clearance of piston and cylinder liner is too big. Check the parts of piston, replace if necessary ● Connecting rod is bent



Knocking noise while idling heat start	Check the engine to see if it is under the following circumstances: ● Driving belt wear ● Check tension , replace driving belt if necessary. ● The compressor of air condition system ● Replace parts if necessary . ● Oil viscosity is not suitable. ● Use oil with suitable viscosity according to estimated temperature, see maintenance and lubrication for reference. ● Piston pin clearance is too big. ● Replace piston and piston pin if necessary. ● Calibrate location of connecting rod ● Check connecting rod, replace if necessary. ● Clearance of piston and cylinder liner is not enough. ● Bore cylinder , install new piston ● Adjust looseness or torque of crankshaft balancer. ● Replace wearing parts ● Make sure that the direction of piston pin is right. ● Install piston correctly.
Slight pinking sound while heat start.	Check to see if the engine is under the following conditions: ● Detonation or ignition knock ● See engine control system for reference. ● Exhaust manifold leak gas. ● Fasten bolt or replace gasket ● Clearance of connecting rod bearing is too big. ● Replace connecting rod bearing if necessary
Severe knocking sound	Check to see if the engine is under the following



while increasing the torque.	circumstances: ● Crankshaft balancer or pulley nave is broken. ● Replace parts if necessary ● Transmission belt of auxiliary is too tight or there are some scratching marks on it. ● Replace driving belt if necessary ● Flywheel is broken. ● Replace flywheel ● Clearance of crankshaft main bearing is too big. ● Replace parts if necessary. ● Clearance of connecting rod bearing is too big. ● Replace parts if necessary
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4 Diagnosis of driving belt noise

Step	Operation	Yes	No
The following circumstances indicate that there is whispering noise: ● There is a high pitch noise when drive belt or pulley rotate every circle. ● It usually happens in cold and damp morning. ● Sprinkle some water on the drive belt for confirmation, the noise should stop immediately.			
1	Check to see whether or not the belt pulley is malposition. Check to see if there are any belt pulleys are malposition?	To step2	To step3
2	Fix position of the belt pulley which is malposition once again, to see whether or not there is still any whispering noise?	To step3	System normal
3	Check to see whether or not the bracket is bent or broken. Are there any bent or broken bracket?	To step4	To step5
4	Replace the bent or broken bracket Is there any whispering noise?	To step5	System normal
5	Check to see whether or not the fastener is loose or lost. Is there any loose or lost fasteners?	To step6	System normal
6	Fasten any loose fasteners. Lost fastener should be replaced immediately.	To step7	System normal



	See the specification of fastener for reference. Is there still any whispering noise?		
7	Check to see whether or not the belt pulley flange is bent. Is there any bent belt pulley flange?	To step8	To step9
8	Replace belt pulley. Is there any whispering noise?	To step9	System normal
9	Check to see if there are severe hollowness exceeding 1/3 depth of the belt groove. Is there any severe hollowness?	To step10	—
10	Replace driving belt. See the “Replacement of driving belt” for reference.	—	System normal

5 Screaming noise of driving belt

Step	Operation	Yes	No
Definition: The following circumstances indicate there are some screaming noise. ● Sharp noise usually happens in the multi-rib driving belt result from driving belt slipping. ● Blocking or sliding phenomenon of A/C system compressor connecting throttle happens when driving belt is overloaded, there is some noise.			
1	Check to see whether or not the belt pulley is malposition. Is there any malposition belt pulley?	To step3	To step2
2	Check to see whether or not the length of driving belt is correct. See “Replacement of driving belt” for reference. Is the length of driving belt is correct or not?	To step4	To step5
3	Repair it or replace with new parts according to the request. Is the maintenance completed?	System normal	—
4	Make a test to see whether or not the tensioner works normally. Does the driving tensioner work normally?	To step3	To step5
5	Check to see whether or not the size of belt pulley is correct. Check to see if the size of all belt pulley is correct or not.	To step6	To step3
6	Check to see if the bearing is blocked badly or	To step3	System normal



	whether or not there are some blocked bearing.		
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6 Hooting noise of driving belt

Step	Operation	Yes	No
Definition: Successive high pitch noise can be generated because of bearing malfunction.			
1	Check to see whether or not there is some damage of accessories bearing. Is there any noise resulting from the bearing?	To step2	System normal
2	Install new parts according to the request. Is the maintenance completed?	System normal	—

7 Rumbling noise of driving belt

Step	Operation	Yes	No
Definition: Low and deep slapping noise may be resulted from malposition of driving belt. This kind of noise happens while idling cold . One low-frequency noise can be heard when the driving belt rotate every one circle.			
1	Check to see whether or not there is any severe hollowness. Is there any severe hollowness exceeding 1/3 depth of the belt rib?	To step2	System normal
2	Clean belt pulley of driving belt. Is the maintenance completed?	System normal	To step3
3	Install new driving belt, see “replacement of driving belt” for reference. Is the maintenance completed?	System normal	—

8 Diagnosis of driving belt vibration

Step	Operation	Yes	No
Definition: Vibration has something to do with the engine speed, vibration may be sensitive to the accessories load.			
1	Check to see whether or not the driving belt is wearing, damaged, accumulated dusts or losing reinforcement. Is there any damage or wear of the driving belt?	To step2	To step3
2	Replace the parts accordingly, see the replacement of transmission belt” for reference. do you finish the maintenance?	To step3	—
3	Check to see whether or not the fastener is loose or lost.	To step4	To step5



	Is there any loose or lost fastener?		
4	Fasten it or replace new parts according to the actual request. Is the maintenance completed?	System normal	—
5	Check to see whether or not the belt pulley is damaged or bent. Is there any damage of driving belt?	To step6	To step7
6	Repair it or replace with new parts according to the need. Is the maintenance completed?	System normal	—
7	Check to see whether or not the tensioner works normally. Does the tensioner work normally or not?	To step9	To step8
8	Replace it accordingly, see “Replacement of tensioner of driving belt” for reference. Is the maintenance completed?	System normal	—
9	Check to see whether or not the bracket is loose, bent or broken. Is there any loose or bent or broken bracket?	To step10	System normal
10	Repair it or replace bracket if necessary. Is the maintenance completed?	System normal	—

9 Diagnosis of driving belt out of position

Step	Operation	Yes	No
Definition: The following circumstances may result in driving belt out of position.			
1	Check to see whether or not the belt pulley is malposition or bent. Is the belt pulley malposition?	To step2	To step3
2	Replace belt pulley of malposition or being bent. Is the driving belt out of position or not?	To step3	System normal
3	Check to see whether or not the bracket is bent or broken. Is there any bent or broken brackets?	To step4	To step5
4	Replace the damaged bracket. Is the driving belt out of position or not?	To step5	System normal
5	Check to see whether or not the fastener is loose or lost. Is there any loose or lost fasteners?	To step6	To step7
6	Replace lost fastener , fasten it according to the regulations. See “Specification of fastener” for reference. Is the driving belt still out of position or not?	To step7	System normal
7	Check to see whether or not the pulley of power steering-wheel pump is malposition.	To step8	To step9



	Is the pulley of power steering-wheel pump is malposition or not?		
8	<u>Realign or replace pulley of power steering-wheel pump .</u> <u>See “Replacement of pulley of power steering-wheel pump” for reference.</u> <u>Is the driving belt still out of position or not?</u>	To step9	System normal
9	Check to see whether or not the transmission belt is damaged. Is the driving belt damaged or not?	To step10	To step11
10	Replace driving belt Is the driving belt still out of position?	To step11	System normal
11	Check to see whether or not the tensioner of driving belt works normally. Is the operation of tensioner of driving belt normal or not?	—	To step12
12	Replace the tensioner of driving belt, see “Replacement of tensioner of driving belt” for reference. Is the driving belt still out of position?	—	System normal

10 Diagnosis of driving belt severe damage and wear

Step	Operation	Yes	No
Definition: Driving belt outside reinforcing rib wear results from installation of driving belt is not correct.			
1	Check to see whether or not the reinforcing driving belt accord with the guide slot of belt pulley?	—	To step2
2	Replace the driving belt. See “Replacement of driving belt” for reference. Is the maintenance completed?	System normal	—

11 Diagnosis of engine misfire

Check	Operation
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The following diagnosis touches upon the common problems or possible causes.
 You can fix a breakdown through adjustment and maintenance or replacement according to the request, after carrying out the correct diagnosis.
 This malfunction diagnosis schedule will be helpful for diagnosing engine misfire resulting from mechanism problems such as camshaft malfunction, bearing wear or being damage and connecting rod being bent.
 This schedule doesn't include the driving elements malfunction such as injector malfunction.
 Check the motive system inside diagnosis system
 You should check the initial information first, then contrast the specified classification while carrying out the basic diagnosis of engine misfire according to this schedule.

Initial check	1. Check the following conditions with eyes: ● Engine flywheel or crankshaft pulley looseness or installation is not correct. ● There are some damaged or malpositioned parts of driving system. 2. Listen to the inside of engine to see whether or not there is any abnormal noise. 3. Check to see whether or not the oil pressure of engine is suitable 4. Check to see whether or not the oil consumption is too much. 5. Check to see whether or not the coolant consumption of engine is too much. 6. Do compression test for the engine.
Inlet manifold leak	Inlet manifold which generates vacuum leakage will cause misfire of engine Check the following conditions: ● Vacuum hose pipe installation is not correct or damaged ● There are something wrong with the inlet manifold or gasket or installation is not correct ● There are some cracks or damage in the inlet manifold, throttle or gasket installation is not correct. ● Inlet manifold warp ● The sealing surface of cylinder head warp or being damaged.
Coolant consumption	Coolant consumption may be but not certain result in engine over heated Check the following circumstances: ● Coolant leak ● Cylinder head gasket fault ● Cylinder head warp ● There are some cracks on the cylinder head. ● Engine body is damaged. ● The length of cylinder head bolt is not correct.
Fuel consumption	1 Fuel consumption may be but not certain result in engine misfire. 2 Remove out spark plug and check to see whether or not there is any oil stain in the spark plug. 3 Carry out cylinder pressure test or cylinder leakage test.



	4 Check the following conditions if the cylinder pressure test shows that there is any damage of valve or valve guide: ● Valve stem seal wear, chip or installation is not properly. ● Valve guide wear ● Valve stem wear ● Valve or valve seat wear or burnt. 5 Check the following conditions if the test indicating piston ring wear or being damaged: ● Piston ring fracture or installation is not correct. ● End clearance of piston ring is too big. ● Bore wear or taper is too big. ● Cylinder is damaged. ● Piston is damaged.
There is some abnormal noise inside the engine.	1 Make sure if the noise accords with the rotational speed of crankshaft or camshaft while the engine is working. 2 The timing lamp sounds twice every flash ,that is the rotational speed of crankshaft; the timing lamp sounds just once every flash ,that is the rotational speed of camshaft. 3 Check the following circumstance if the noise is the same as the frequency of camshaft rotational speed: ● Valve train missing or loose. ● Valve rocker wear or looseness ● Malfunction of valve spring ● Valve being bent or being burnt ● Cam of camshaft wear ● Check to see if timing belt or pulley wear or being damaged. 4 Check the following conditions if the frequency of knock is the same as the crankshaft rotational speed: ● The main bearing of crankshaft or connecting rod bearing wear ● Piston or cylinder wear ● Piston or piston pin wear ● Malfunction of connecting rod. ● There is too much Carbon deposit on piston crown
There is no abnormal noise inside the engine.	1 Check to see if the timing belt or pulley is wear or installed not properly. 2 Remove valve rocker cover of engine side whose cylinder is misfiring. 3 Check the following conditions: ● The bolt of valve rocker is too loose ● Push rod is bent ● Malfunction of valve spring ● Valve wear or installation is not good. ● Cam of camshaft wear

IV Fuel consumption

1 General description

Engine oil consumption of engine refers to amount of oil used, never to confuse fuel consumption and oil leakage of oil pan and cylinder head.

Engine oil is used for:

- 1.1 Depart the contacting surface away with oil film, prevent dry friction.
- 1.2 Conduct heat generated from friction
- 1.3 Bring the residue after burning away.

It is necessary to consume certain amount of oil in order to achieve above-mentioned aims, in other words, it is not realistic to find a engine without oil consumption.

Generally speaking, amount of oil consumption is small, it is ok to add a little oil during the period of replacing oil, even though you may not add the oil. Of course, you must add the oil if oil level is lower than the minimum mark of oil consumption indicator.

Also, you should make sure that fuel level is not higher than maximum mark, otherwise oil consumption will be more.

Generally speaking, oil consumption becomes stable after the vehicle driving several kilometre therefore, oil consumption measurement shall be carried out after vehicle driving 7500 km. Before measurement, you should make sure that the engine doesn't lose fuel because of leakage.

Dipstick is used only for the purpose of inspection not for measurement. The engine must be turned off at least 2 minutes before checking oil level, it may be the cause of manufacturing tolerance if you add enough oil but the level is not reaching the maximum. It shows that oil is overused if vehicle driving 100 km consuming more than 0.075 L oil, causes and solutions of oil being overused are introduced as follows:

- Oil consumption indicator doesn't have good function. Please make vehicle level, check oil level and spend some time to make the oil subside.
- Oil viscosity is not suitable. Please use recommended SAE according to local temperature.
- Successive high-speed driving
- Heavy load drawing, such as towed vehicle. Please decrease oil mileage .
- The performance of ventilation system of crankcase is not effective.
- Oil leak. Please fasten bolts if necessary, replace gasket and seal gasket if necessary.
- Valve guide or oil seal wear or lost. Please install enlarge sized valve and/or new oil seal.
- Piston ring fracture or wear
- Piston ring or seat is installed not properly or correctly
- Installation or assembly of piston is not good.
- Cylinder head gasket and oil outlet hole is blocked.

2 Measuring method of fuel consumption

- 2.1 Make vehicle level when checking, temperature of engine is not less than 80 °C.
- 2.2 Make engine idling before draining the engine fuel.
- 2.3 Turn off the engine immediately after drainage, record the drainage time (3 minutes) with chronograph, test should show that drainage should be completed within 3

minutes.

- 2.4 Displace oil to state of guttate.
- 2.5 Cool the engine oil of displacement to 20 °C for 1 to 2 hours.
- 2.6 Measure oil amount after cooling with measuring graduated flask . Refill enough new oil accordingly. You should subtract 0.25 litre fuel because the oil filter is not replaced.
- 2.7 These oil is enough for the driver to drive at least 500 km/350 miles. The driver should keep his/her own normal route and driving style.
- 2.8 Repeat above-mentioned procedures from 1 to 4 afterwards, drainage time is the same.
- 2.9 Consumption amount of oil in graduated flask is oil consumption or mileage consumption of engine.

3. Diagnosis and test of fuel pressure

The following conditions may cause low temperature of oil or oil without pressure. If oil level is too low, fill the oil to the oil level of the indicator.

Oil pressure switch is not correct or the performance is not good. Please replace the switch.

oil viscosity is not correct or oil being diluted

- Please use new oil with suitable viscosity according to estimated temperature.
- Please use new oil if the old one being diluted.
- Oil pump wear or too dirty ,clean or replace the oil pump.
- Oil filter is blocked. Please replace the oil filter.
- There are some holes in the connecting rod oil dipper. Please replace the connecting rod oil dipper.
- There are too much clearance between the bearings. Please replace the bearing.
- There are some holes in the passage or the passage being blocked. Please repair or replace the engine block.
- Oil groove plug lost or not properly installed. Please install or maintain it if necessary.
- Pressure regulating valve is blocked. Please check the pressure regulating valve to see whether or not it is blocked in the hole, check to see whether or not there are some scores and fins in the hole.
- Valve guide wear. Repair if necessary.

Start the engine under the running temperature of more than 80 °C.

Take off the oil pressure switch.

Oil pressure test, see the arrows in screw hole.

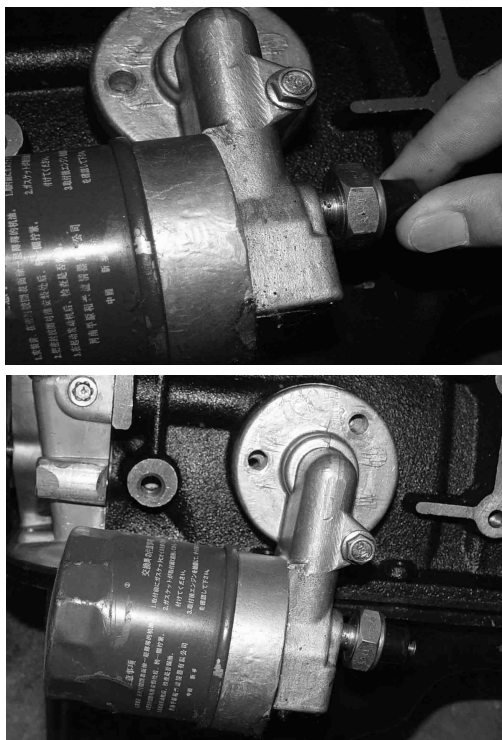
Measure oil pressure 0.294-0.539 Mpa (3000 r/min)

Take off oil manometer and adaptor.

Install oil pressure switch properly.

Fill enough oil to maximum of oil gauge.

Notice: Oil temperature is decided by corresponding engine load, the temperature can be 150 °C under extremely heavy load.



V Diagnosis of oil leakage

Maintain, replace the parts or seal the gasket surface after finding out the leak position before maintenance.

1. Determine the leakage oil whether or not are listed as follows with eyes:

- Engine oil
- Transmission oil l
- Power steering oil
- Brake fluid
- Other oil or liquor

Check with eyes:

- 1 Make vehicle temperature normal.
- 2 Park the vehicle on a big paper or clean surface, wait a few minutes, check to see if there are some leaking drops.
- 3 Identify classification of leakage and possible positions.
- 4 Check the suspicious position with eyes, use a mirror if necessary.
- 5 Check the joint or parts which are damaged to see if there is some leakage.
- 6 Continue according to the following procedures if you can not make sure the leakage position.
 - (1) Completely clean the whole engine and its surrounding parts.
 - (2) Drive the vehicle for several miles at different speed under normal temperature.
 - (3) Park the vehicle on a big paper or clean surface.
 - (4) Wait for a few minutes, check to see if there are some leaking drops.
 - (5) Identify classification of drops and possible position of leakage.



(6) Check suspicious position with eyes, use a mirror if necessary.

(7) Judge the possible cause of leakage.

Adopt powder method if you can not make sure the cause of leakage yet.

2 Powder method

2.1 Completely clean the whole engine and its surrounding parts.

2.2 Smear children's talcum powder on the suspicious position.

2.3 Driving vehicles for several miles at different speed under normal temperature.

2.4 Identify classification of liquid, make sure the possible position of leakage, in accordance with powder changing color position.

2.5 Check the suspicious positions with eyes, check the position not easy to see ,with the help of a mirror.

2.6 See the possibilities of leakage for reference if necessary.

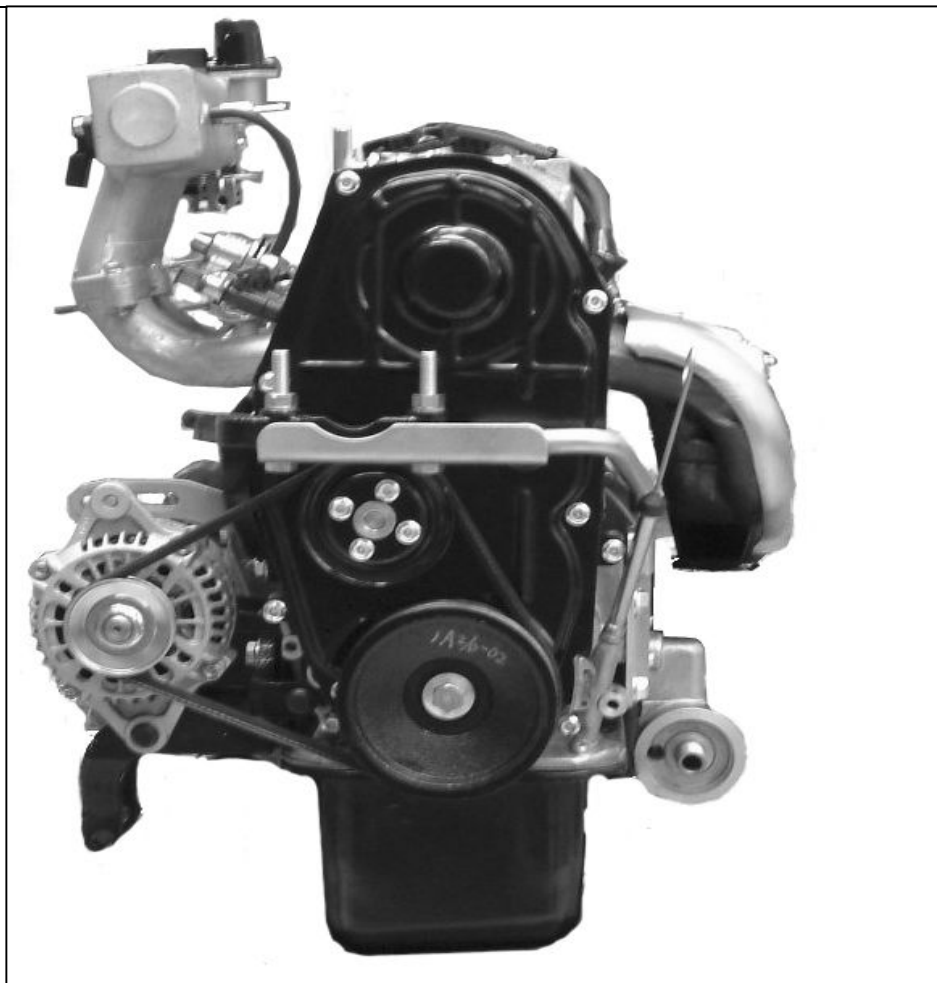
3 Possibilities of leakage.

Check vehicle to see whether or not it is under the following conditions:

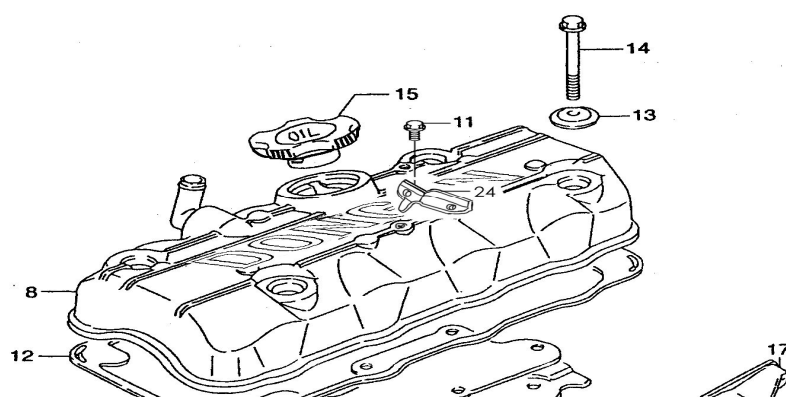
- Liquid level is higher than the recommended level.
- Pressure of liquid is higher than the recommended pressure.
- Oil filter core or pressure by-pass valve is blocked or the performance is not good.
- Ventilation system of engine is blocked or the performance is disabled.
- Fastener is not good or damaged.
- Parts fracture or there are some holes in the parts.
- Sealant or gasket is not suitable.
- Installation of sealant or gasket is not good.
- Sealant and Gasket is damaged or wear.
- Seal surface is damaged or wear.

chapter 3 Assembly Outline Illustration

I Front end view of engine



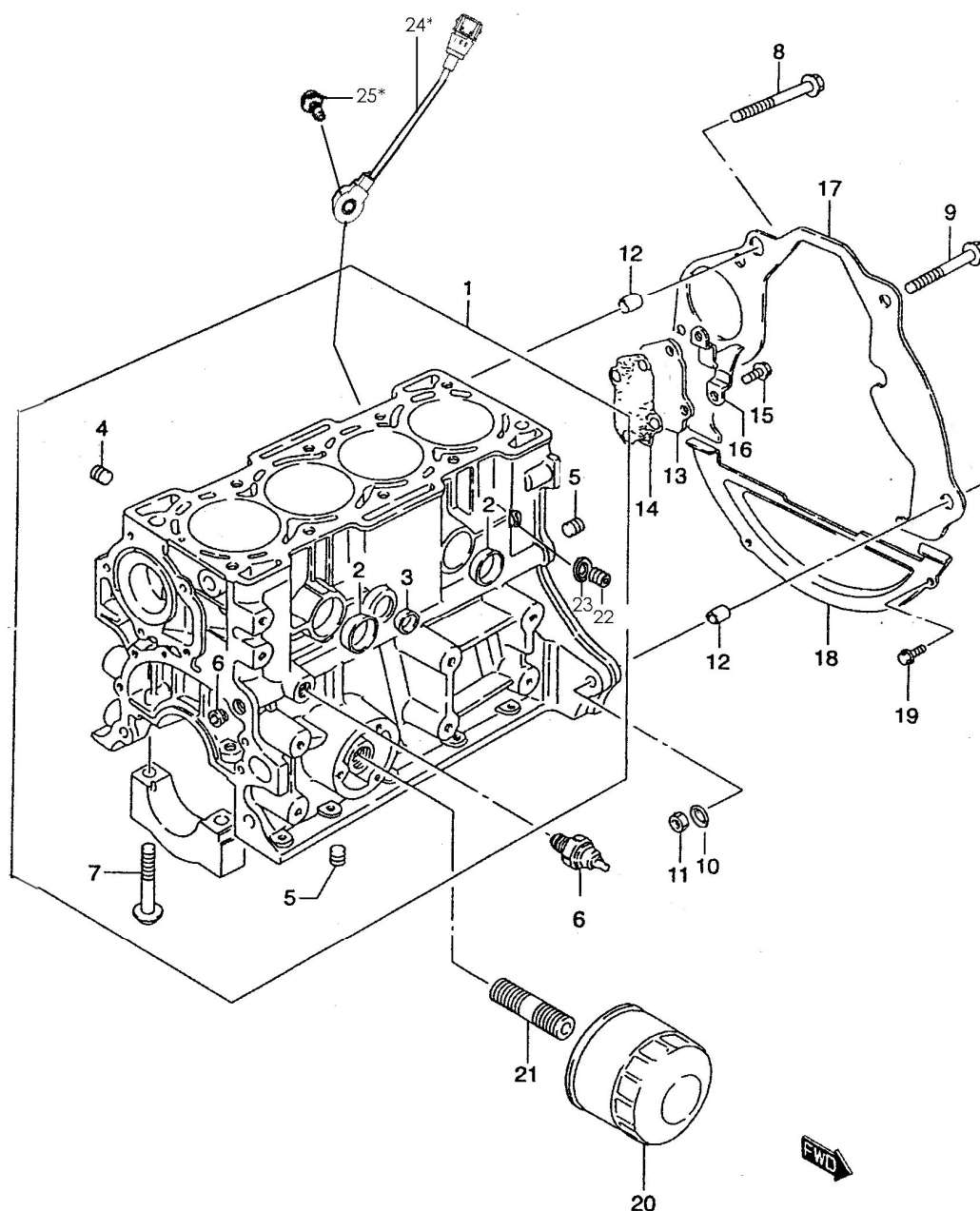
II. Cylinder head





1 cylinder head 2 valve guide bushing 3 restricted flow valve 4 bowl shape plug 5
cylinder head gasket 6 locating bush 7 bolt 8 valve chamber cover 9 baffle 10
gasket 11 screw 12 gasket 13 gasket assy 14 screw 15 oil filler cap 16 spark 17
distributor built-up connection 18 gasket 19 cylindrical roller 20 bolt 21 bolt 22
intake valve seat 23 exhaust valve seat 24 rubber-tube bracket

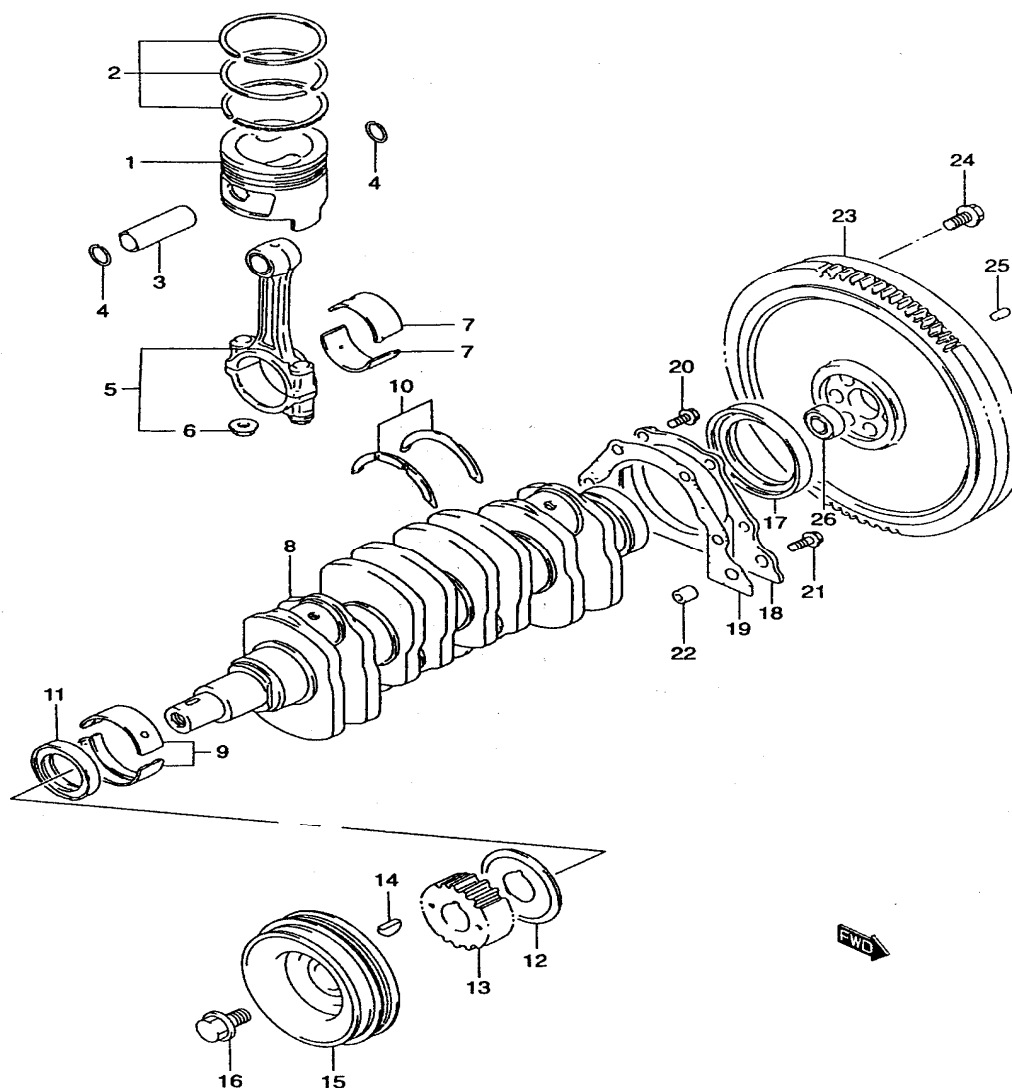
III. Cylinder block



1 cylinder block assy 2 bowl shape plug;
3 bowl shape plug ; 4 plug ; 5 plug ; 6 oil
pressure sensor ; 7 bolt ; 8 bolt ; 9 bolt ;
10 washer ; 11 nut ; 12 locating bush ; 13
Water jacket cover ; 14 Water jacket

gasket ; 15 screw ; 16 timing bracket ; 17
upper baffle 18 front baffle assy 19
bolt 20 oil filter assy 21 join screw pipe
22 water jacket plug 23 gasket 24
knock sensor 25 screw

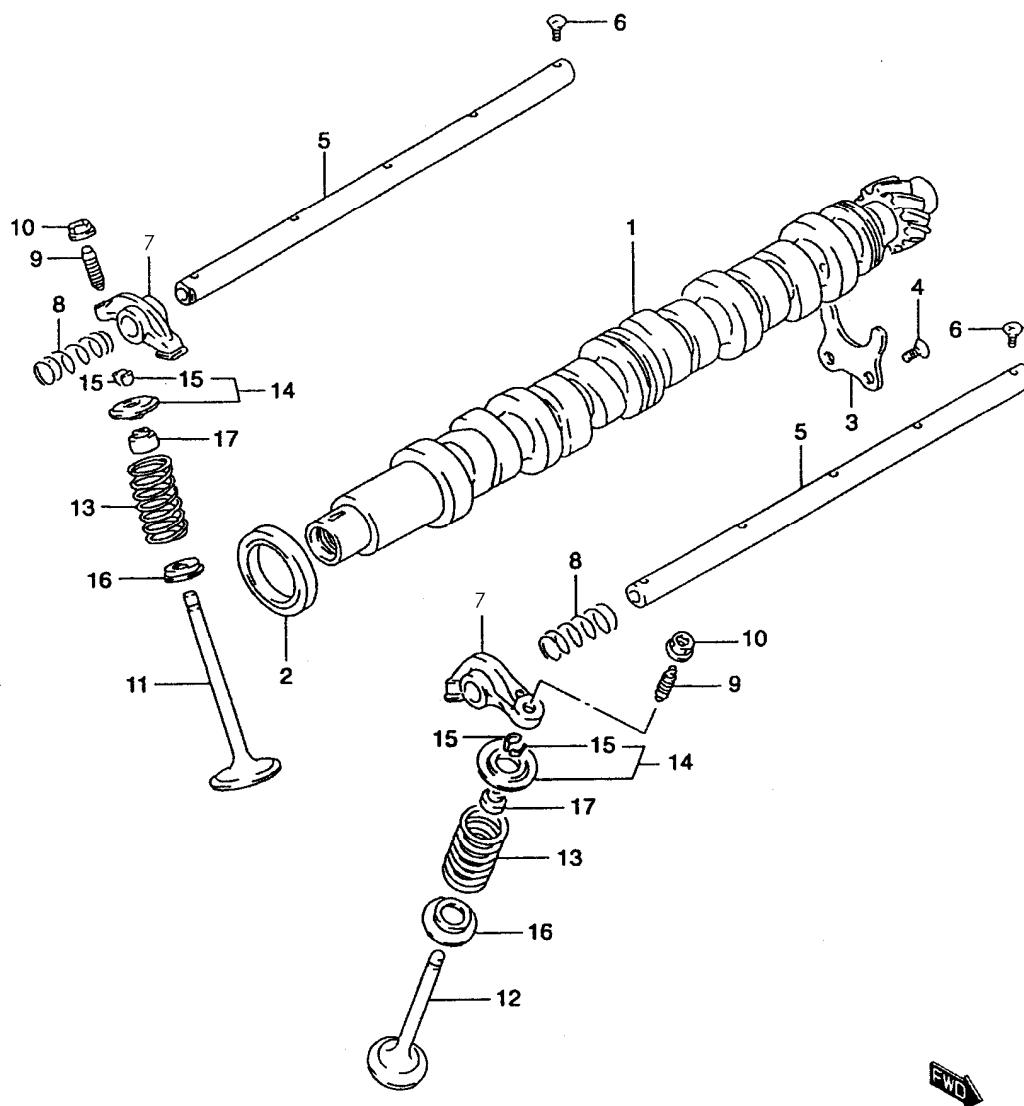
IV. Crankshaft , piston and connecting rod assembly



1.piston 2-1.No.1piston ring
 2-2. No.2 piston ring
 2-3.piston oil ring assembly 3.piston pin
 4.piston pin lock ring 5.connecting rod
 6.nut 7.connecting rod bearing shell
 8.crankshaft 9.main bearing shell
 10 crankshaft thrust washer 11. crankshaft
 front oil seal

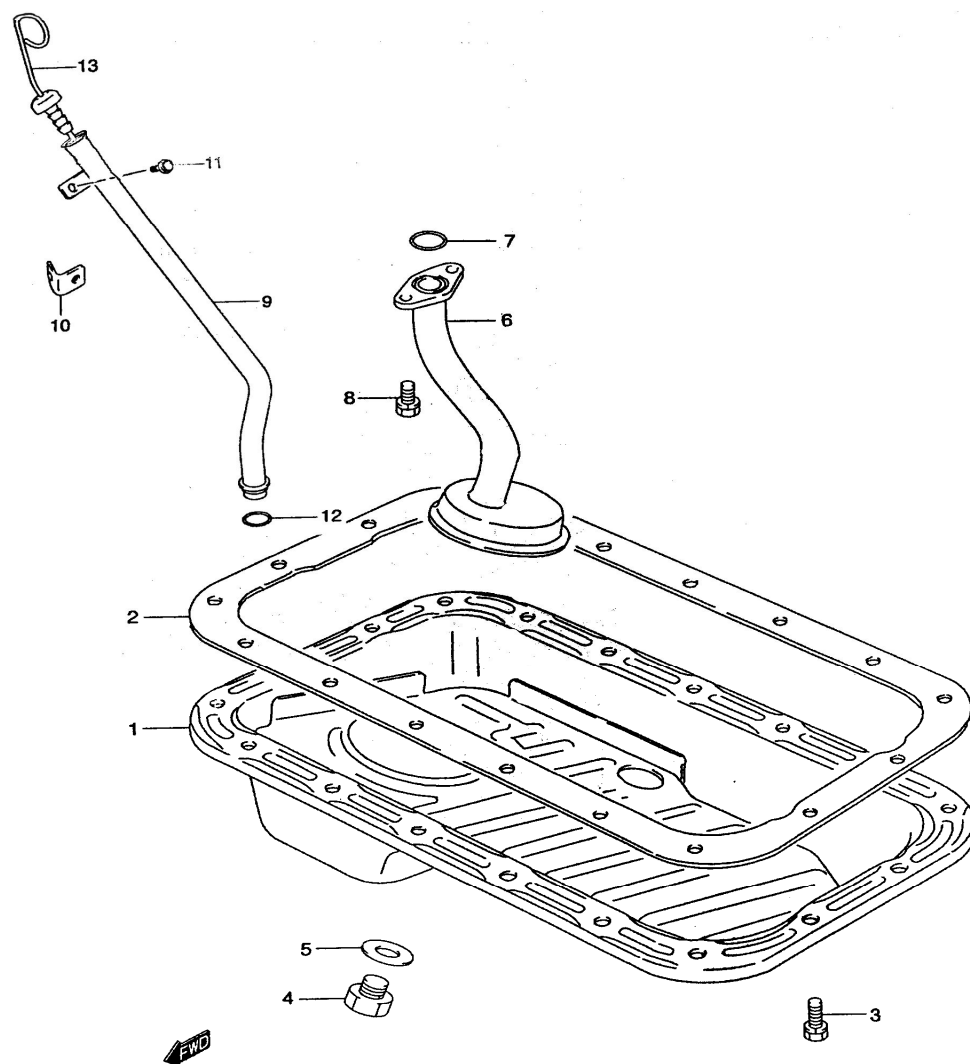
12.shield ring 13.crankshaft gear
 14.woodruff key 15.crankshaft pulley
 16.fastening screw 17.crankshaft rear oil
 seal 18 rear oil seal retainer 19.gasket
 20.screw 21.screw 22.locating sleeve
 23.flywheel 24 screw
 25. cylindrical roller
 26.bearing

V. Camshaft , valve and rocker



1 camshaft 2 cup ring seal 3 camshaft thrust baffle 4 screw 5 valve rocker shaft 6 screw 7- valve rocker 8 spring 9 adjusting screw 10 nut 11 intake valve 12 exhaust valve 13 valve spring 14 spring seat 15 valve circlip 16 gasket 17 valve oil seal

VI. Oil pan



1. oil pan assembly
2. oil pan gasket
3. screw
4. oil drain plug
5. gasket
6. oil strainer

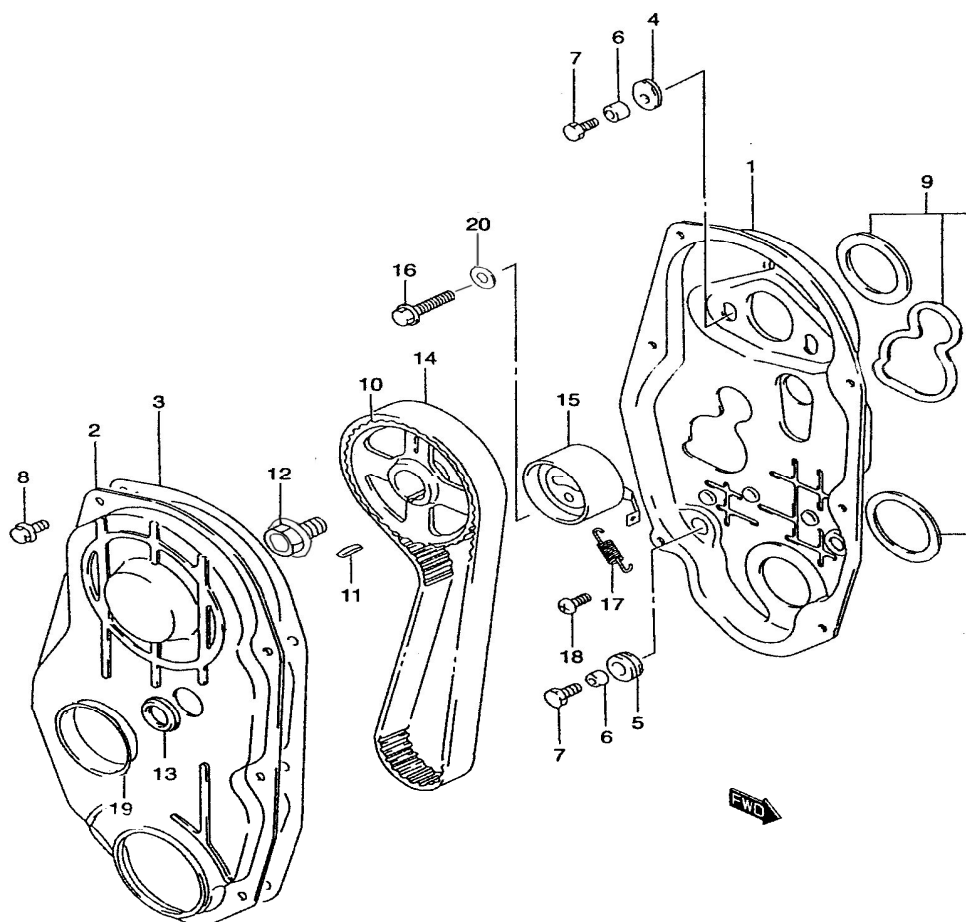
7. rubber ring
8. screw
9. oil dipstick guide
- 10 oil dipstick guide bracket
- 11 screw



12 “o” ring

13 oil dipstick assembly

VII. Timing belt, outside cover and inside cover assembly



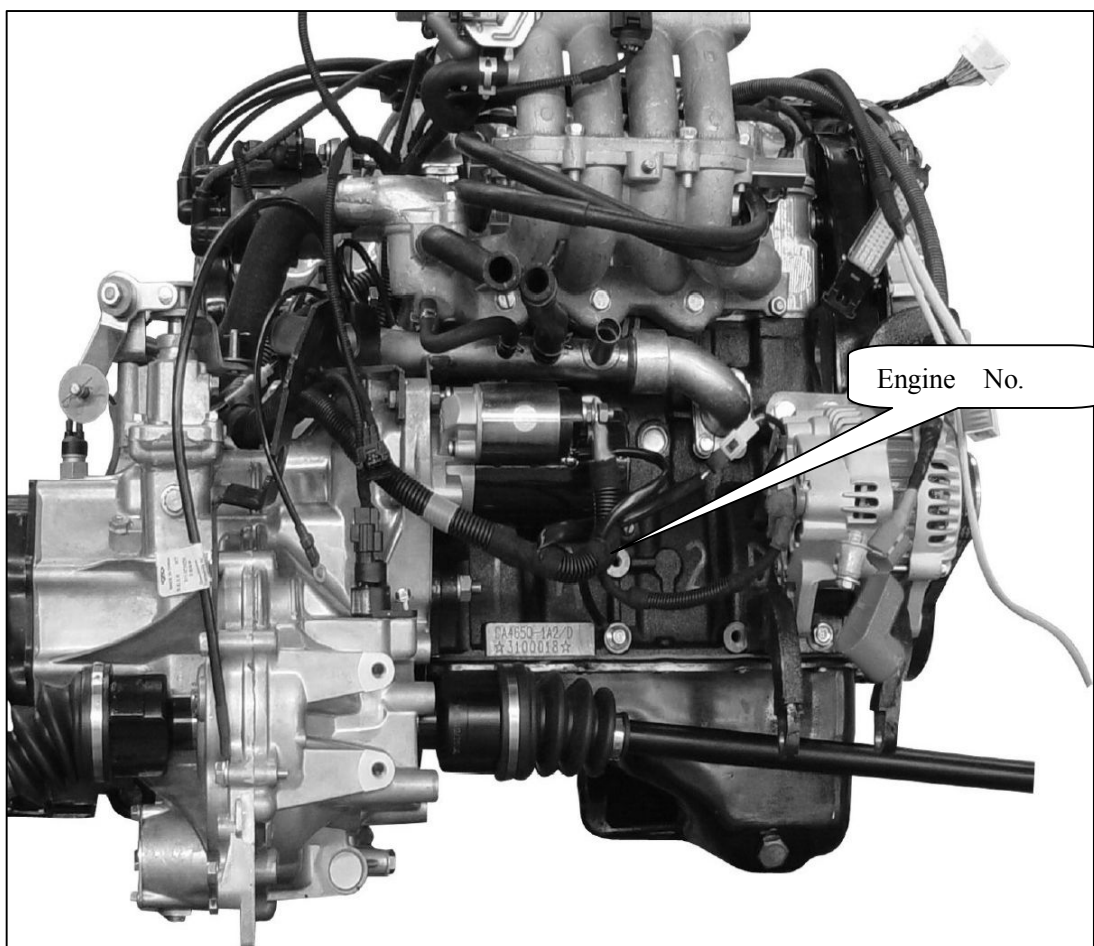
1 timing belt inside cover assembly

2 outer cap 3 rubber pad 4 flat rubber
ring 5 rubber ring 6 liner 7 screw
8 screw 9 sponge gasket 10 camshaft

timing pulley 11 woodruff key 12
screw 13 peep hole blockage 14 timing
belt 15 tensioner 16 screw 17 tension

spring 18 screw 19 gasket 20 washer

VIII. Engine identification



Chapter 4 Maintenance of Intake Pipe

I procedures of disassemble

1 Dismount the cable of negative pole from battery.

2 Disconnect wire plug from intake temperature sensor.

3 Remove intake hose and crankshaft ventilation pipe from throttle body and intake pressure-stabilized box.

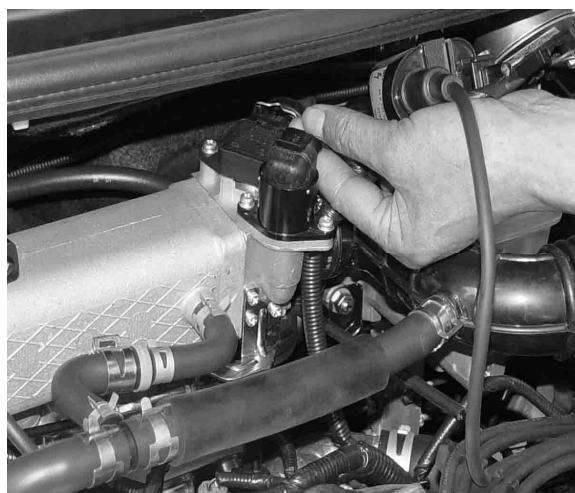
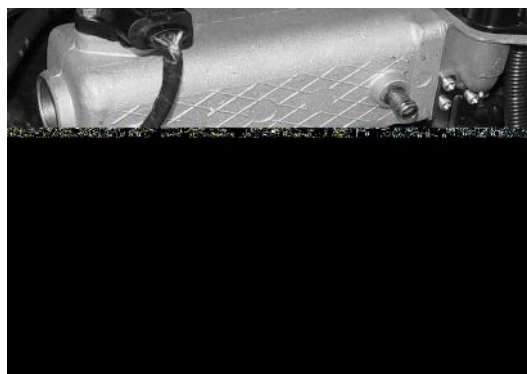
4 Pull the throttle bracing wire out of intake pipe assembly, that is to say, take the throttle bracing wire off the intake pipe bracket by means of loosening the ball inserter with circlip.

5 Loosen vacuum pipe of vacuum booster .

6 Remove power source plug from injector.

7 Pull out power source plug of coolant temperature sensor.

8 Remove power source plug from power source plug of step motor and throttle position sensor



9 Remove power source plug of idle vacuum valve and record wire path.

10 loosen and block up the fuel pipe , clamp

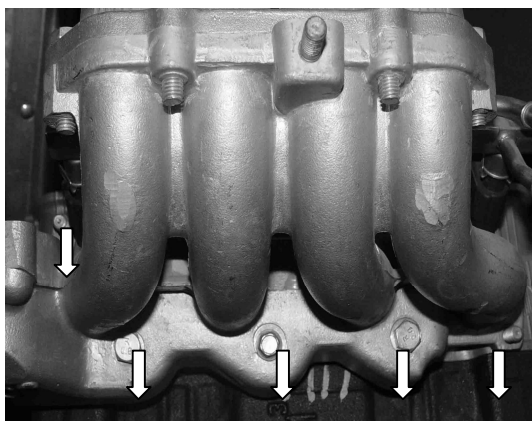
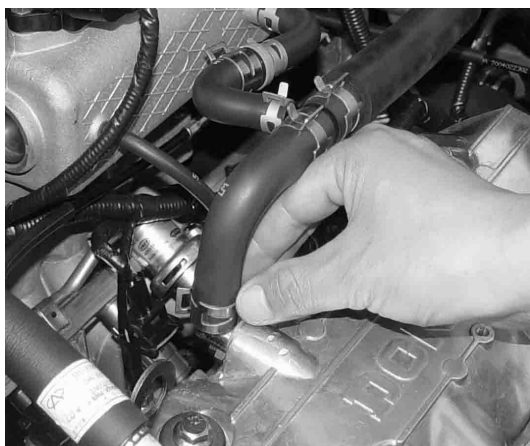
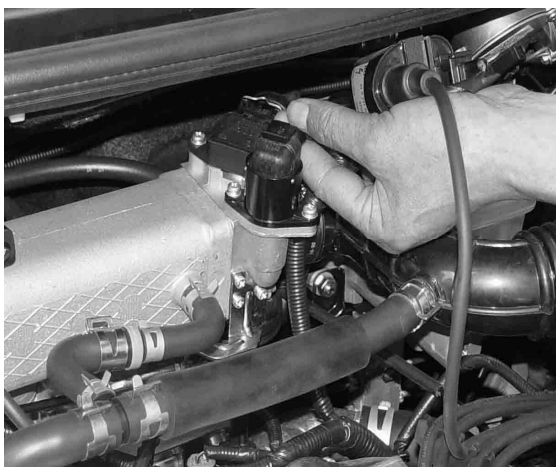
the fuel pipe with spring clamp after making marks.

11. Remove all kinds of hose from intake pipe assembly

12. Remove construction bolt of intake manifold.

13. Remove intake manifold and gasket from cylinder for clean.

Clean intake manifold and cylinder head gasket



II Procedures of installation

1 Use the new gasket between the intake manifold and cylinder head.

2 Position fix and installation must be accurate.

3 Connect warm blow hose and vacuum valve with intake and intake manifold.

4 Reconnect fuel pipe after making mark.

5 Connect throttle position sensor plug.

6 Connect idle vacuum valve plug.

7 Connect power source of injector.

8 Connect power source of coolant temperature sensor.

9 Pay attention to the wire path.

10 Connect vacuum booster and intake pipe.

11 Install throttle bracing wire and driving belt of accessories

13 Connect intake hose and crankshaft vent pipe to intake pipe

14 Connect temperature sensor connector.

15 Connect battery negative pole.

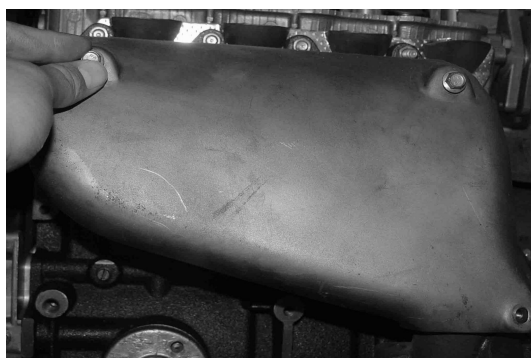
16 Exhaust the cooling system.



Chapter 5 Replacement of

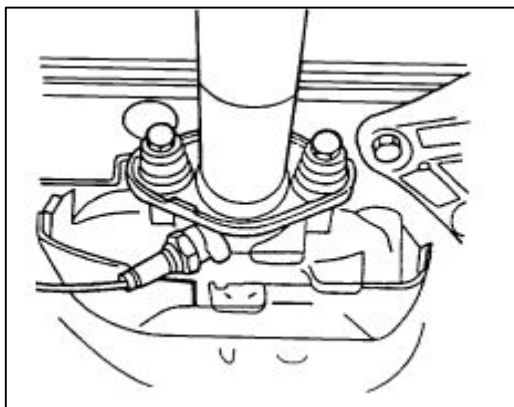
I Procedures of disassemble

- 1 Lift vehicle, remove the protective plate of engine oil pan
- 2 Remove exhaust pipe from exhaust manifold.
- 3 Loosen and remove oxygen sensor from exhaust manifold.
- 4 Lower the vehicle, remove protective shield of exhaust pipe.
- 5 Loosen nut of exhaust manifold.
- 6 Disconnect exhaust manifold and gasket.



II. Procedures of installation

- 1 Connect exhaust manifold and a new gasket to the cylinder head.
- 2 Screw the nut on to the bolt, you should use new nut, tighten it closely.
- 3 Connect exhaust pipe to exhaust manifold.
- 4 Cover protective shield exhaust manifold.
- 5 Preheat exhaust manifold.
- 6 Install oxygen sensor to exhaust manifold.
- 7 Connect power source of oxygen sensor



Chapter 6 Replacement of Camshaft Bracket Cover

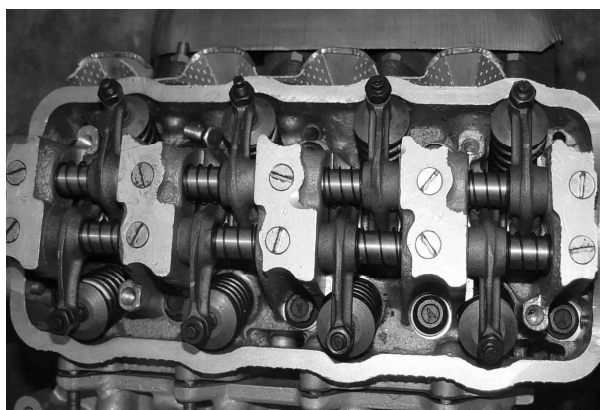
I Procedures of disassemble

- 1 Take off venting hose between throttle body and camshaft bracket cover.
- 2 Loosen camshaft cover bolt in requested order.
- 3 Take off camshaft cover



II Procedures of installation

- 1 Reinstall camshaft bracket cover with new gasket.
- 2 Bolt on and tighten it in proper order accordingly.
- 3 Reconnect venting hose



Chapter 7 Replacement of Timing Belt

Install timing belt according to following order :

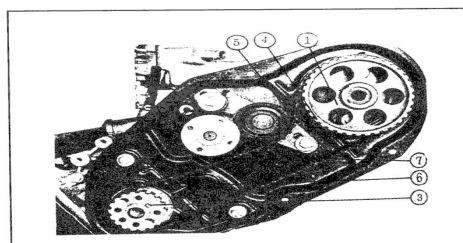
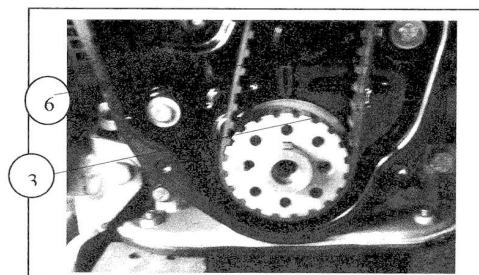
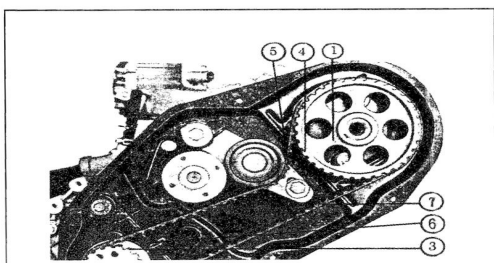
1) Connect the tensioner assembly to torsion spring to the pump(in front of rear cover),fasten the bolts and nuts until the tensioner assembly is easy for you to move.
Notice: You should make sure that every screw and nut is loosened during the process of above-mentioned work, for the purpose of camshaft and pulley can rotate freely.

2) There are a dot □ on radial line mark □ of camshaft timing belt pulley and another dot □ on belt rear cover. Run belt pulley to align dot □ and dot □.

3) There is a dot□ on belt rear cover. Run crankshaft to align dot □ and dot □.

Tensioner bolt tighten torque	14.71 ~ 22.56N·m (1.5 ~ 2.3kg·m)
-------------------------------	-------------------------------------

4) Two timing belt pulleys are aligned with each other. Under the circumstances of belt being tightened, install the timing belt according to the illustration of □

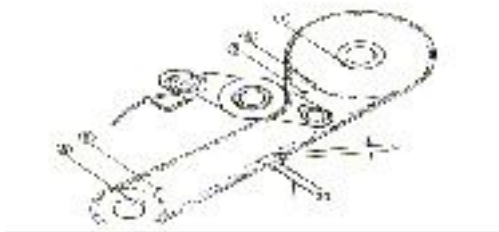


5) After installation of belt, put up one end of torsion spring on the tension bracket, put up the other end of torsion spring on water pump screw, the spring tune-up the belt through self own tension, adjust the bolts and screws to regulated value.

Turn crankshaft two circles clockwise and adjust the tensioner bolts and screws to the

regulated value.

Notice: Smear GY-340 anaerobic glue on the screw thread of the tensioner bolts. Fasten the adjusting bolts first, then fasten the torsion bolt.



Notice: After installation of tensioner, turn crankshaft two circles clockwise and check if marks □□□□ aligned with key groove

□ to a straight line after installing tensioner. Repeat above-mentioned steps until accord request.

6) Press belt between camshaft and crankshaft by hand to make sure that tension is in the regulated scope.

(L) timing belt tension	5.5 ~ 6.5
	mm

7) Adjust belt tension to the regulated scope, then adjust clearance of every valve to the regulated value.

Chapter 8 Replacement of Cylinder Head

I procedures of disassemble

- 1 Take off fuel pump relay mounted under the instrument meter plate.
- Notice: Make the engine working for 5 seconds in order reduce the pressure of system, collect and clean up the fuel.
- 2 Disconnect negative pole cable of battery
- 3 Take off air filter and hose.
- 4 Remove cover of coolant reservoir.
- 5 Remove low pressure hose of radiator and collect the coolant
- 6 Remove all hoses and cables which connect the cylinder head and intake manifold.
- 7 Remove ignition coil
- 8 Disconnect the harness of exhaust pipe and exhaust manifold
- 9 Disconnect oxygen sensor harness connector and take off exhaust manifold
- 10 Take off timing belt, see the illustration for reference.
- 11 Take off camshaft timing gear, see the illustration for reference.
- 12 Remove set bolt from timing belt rear cover

The order is to loosen 1/4 circle, then to loosen 1/2 circle, remove the cylinder head completely, fasten the bolts

13 Take off camshaft bracket

14 Remove rocker , rocker seat and rocker shaft

Notice: Don't confuse in order that you can install it to the right position afterwards.

15 Take off the cylinder head, see the contents of relevant chapters for reference.

II procedures of installation

Attention:

Clean cylinder head completely, remove the old gasket, wipe the dirt and residue away. Clean cylinder body surface and piston top

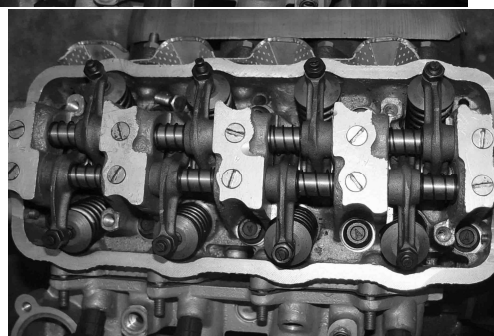
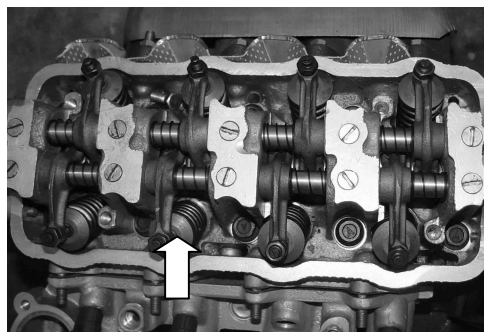
1 Install a new gasket of cylinder .

Make sure that the upper mark of gasket is upwards and in the front side of the engine.

2 Fasten cylinder head and cylinder body.

The fastening bolts order is: from the

- front to the rear, intake side 6237, exhaust side 5148.
- 3 Install camshaft.
 - 4 Install rocker shaft and rocker.
 - 5 Smear mixture of sealing agent on the placing side of crankshaft.
 - 6 Install cylinder head set bolt, tighten the bolts accordingly.
 - 7 Install timing belt rear cover set bolt and fasten the bolts.
 - 8 Install camshaft timing gear and bolt, fixture.
 - 9 Install timing belt, see the illustration for reference.
 - 10 Install exhaust manifold and gasket.
 - 11 Install oxygen sensor to exhaust manifold, make it connected with the wires.
 - 12 Install exhaust pipe.
 - 13 Install fuel pipe to fuel rail.
 - 14 Connect ignition coil harness to ignition module connector.
 - 15 Install hose that connect cylinder head and intake manifold, then connect harness.
 - 16 Connect low pressure hose to radiator.
 - 17 Fill the coolant in the cooling system, see relevant content of article 6.3.
 - 18 Install air filter and intake hose, then connect temperature sensor to harness.
 - 19 Connect negative pole cable of battery.



Chapter 9 Replacement of Sealing Washer of Valve Spring

I Procedures of disassemble

- 1 Remove cylinder accordingly.
- 2 Remove valve lock from cylinder head assembly.
- 3 Take off valve spring baffle.
- 4 Take off valve spring.
- 5 Take off valve oil seal of valve stem.
- 6 Take off valve.

II Cleaning

Clean the combustion chamber. It is necessary to put a special brush in the drilling machine for check and inspection

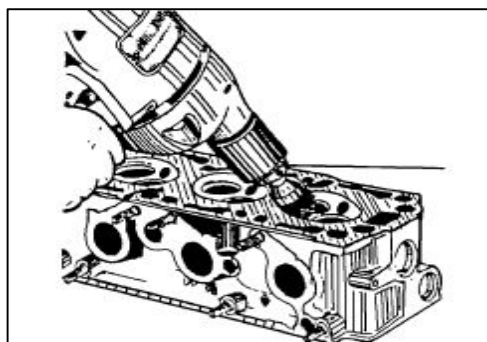
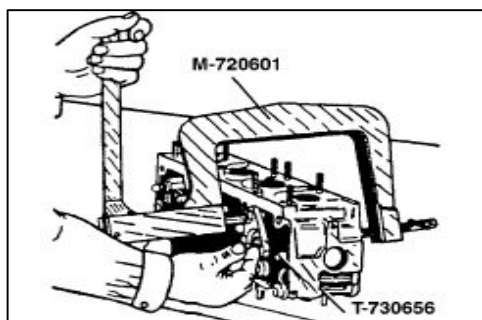
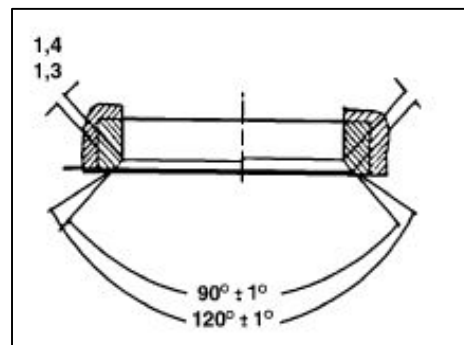
- 1 Check exhaust pipe and combustion chamber whether or not there are some cracks
- 2 Check to see whether or not there are burning trail on the valve top, check to see whether or not there are some cracks in the surface and check to see if there are some damage of the valve rod.
- 3 Check the clearance between the valve rod and guide, measure the diameter of valve rod in upper, middle and lower position with microscope, different value between guide and valve rod is the distance of them.
- 4 If the distance is not within the scope of

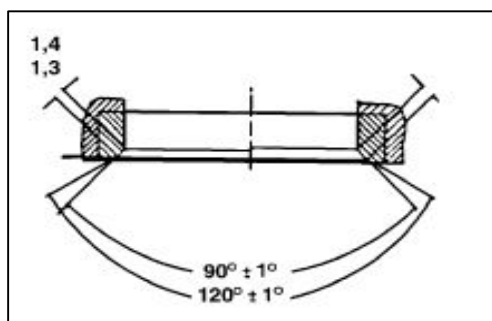
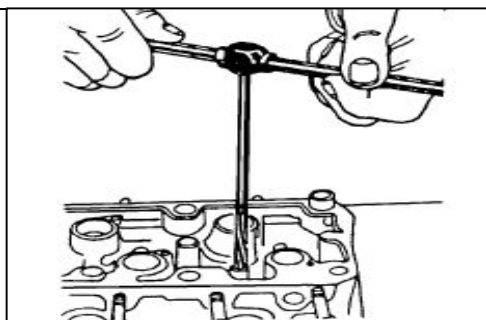
0.020-0.050 mm, intake and exhaust
0.030 and 0.060 mm, you should enlarge
the hole in order that you can install the
valve of much larger size.

- 5 Check the concentricity of maximal ring and minimal ring of valve seat.

standard:0.05 mm

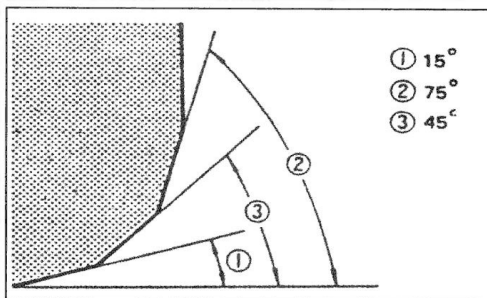
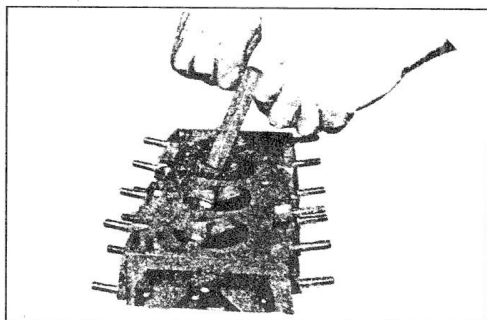
Width of intake and exhaust valve should be 1.3-1.5 mm





III Repair of valve seat :

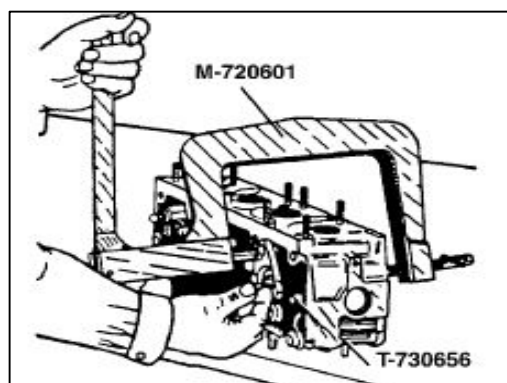
If the valve seat cannot touch the valve equably or touch width is not in standard scale, the valve and valve seat must be repaired by grinding, cutting and polishing.



- 1 Exhaust valve seat: Use the taper ryer to cut 3 times as shown in figure. First cut at a angle of 15°, Then 75° and then 45° to create ideal touch width
- 2 Angle of exhaust valve seat
- 3 Intake valve seat: cutting sequence is the same as the sequence of exhaust valve seat, but cutting angle is different, shown as the following illustration:

IV Procedures of installation

- 1 Install valve.
- 2 Install valve stem seal.
- 3 Install spring.
- 4 Install valve spring damper.
- 5 Install valve lock.
- 6 Install cylinder head as the following illustration.



3 Install one side of piston pin by means of

Chapter 10 Replacement of

I Procedures of disassemble

See content of relevant chapters for reference

1. Take off cylinder head accordingly.
- 2 Wipe residue and dust of cylinder head away with rag.
- 3 Take off the oil drain plug of to let oil drop out.
- 4 Take off oil pan
- 5 Take off oil pan gasket.
- 6 Disconnect the connecting rod bearing cover and bearing.

Notice: Ensure bearing and bearing cover of every connecting rod being in correspondence with each other.

- 7 Take the piston connecting rod assembly off the cylinder.
- 8 Take off piston pin from assembly with remover.

9 Remove connecting rod from piston.

10 Measure the clearance between piston and cylinder

standard:0.040-0.050 mm

Notice: It is necessary to prepare enlarged standard sized piston of 0.25 mm and 0.50 mm.

II Procedures of installation

- 1 Install connecting rod to piston
- 2 Install piston and piston pin according to the following steps:

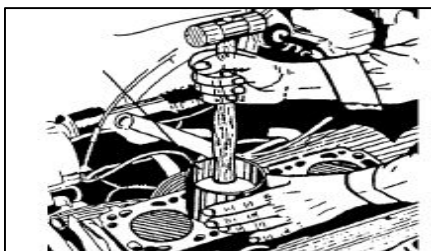
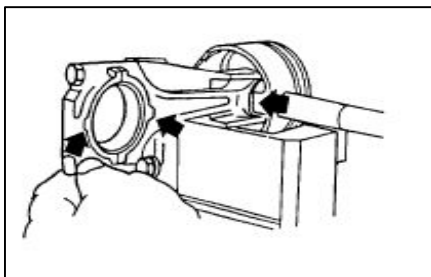
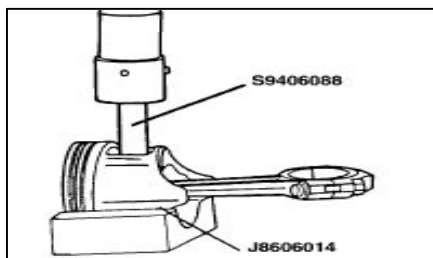
Heat the connecting rod in piston pin hole at the temperature between 280°C and

320°C, it is best for you to put the rod in the oil to carry out this procedure, cool the piston pin in dry ice, tighten the heated connecting rod with vice.

Piston

making the piston lean against the connecting rod, then stuff the piston pin properly, you must make sure the installation of piston pin ring is correct.

- 4 Connect connecting rod assembly to cylinder body, arrow head of piston should face the front side of engine.





Notice: Put oil to surface of piston ring and cylinder hole, at the same time, install connecting rod.

- 6 Install connecting rod upper bearing shell, put oil only on the side which is facing the crank, push the connecting rod until it is in the right position of the crank.
 - 7 Install connecting rod cover on the lower bearing shell, put oil on the side which is facing the crank for lubricating.
 - 8 Put new bolt on the connecting rod, it is not necessary to screw the bolt
 - 9 Rotate the crankshaft for several circles, make alignment of the connecting rod totally, then tighten the connecting rod bolt and fix the connecting rod bolt.
connecting rod bolt 27.46-31.38 N.m
 - 10 Install oil pan, you shall be sure to keep in mind to use tight glue for tightening the oil pan bolt 10N.m
 - 11 Install oil drain plug
 - 12 Install cylinder head accordingly
- Notice: Use oil of SAE 10W30 for the engine.

III Replacement of piston ring

Procedures of disassemble

- 1 Take the connecting rod assembly of the piston away accordingly
- 2 Take piston ring out.
- 3 Clean the smooth surface of piston, get rid of the grease remained in pin hole and fillisters with suitable scraper.

Check and measure

- 1 Check stem of fillisters of the piston or skirt of the piston to see whether or not there are some fractures.
- 2 Check piston ring
- 3 Check piston crown to see whether or not there are some deformation, damage or rusteaten.

4. Put the circlip in the cylinder and use the piston to push it in cylinder wall at a bank angle of 90 degree, in accordance with corresponding measured distance between piston ring ends.

Item		Standard	Limit
Inside Ring gap	No.1	0.03 ~ 0.07 mm	0.12 mm
	No.2	0.02 ~ 0.06 mm	0.10 mm

- 5 Install the piston ring on the piston according to the sequence of location of clearance, that is to say the split of every ring should be staggered at a angle of 180 degrees.

- 6 Measure the distance between ring and groove of ring to see whether or not the following data is true:

upper compression ring 0.05mm

lower compression ring 0.04mm

- 7 Measure the distance between piston ring end, put the piston in the cylinder, push it to the bottom of cylinder, it is necessary to replace the piston ring if the measuring value exceed the limit.

Procedures of installation

Install the piston accordingly

Item		Standard (mm)	Limit
Piston ring Open gap	Air ring	0.15-0.35	0.7mm
	Oil ring	0.30-0.90	1.8mm

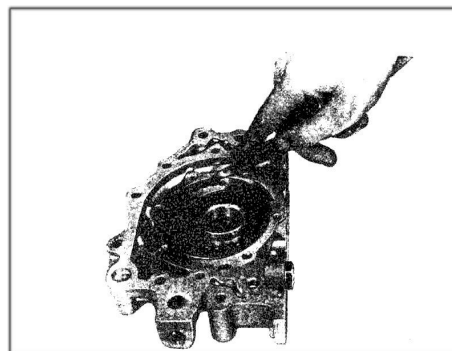
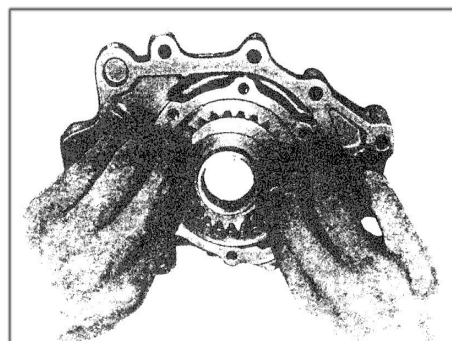
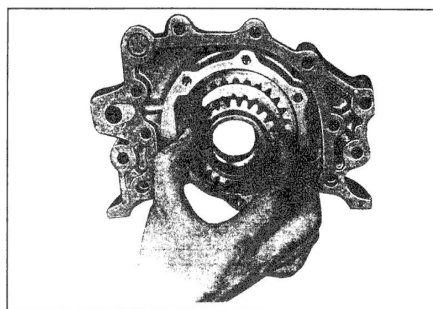


CHAPTER 11 Replacement

I Procedures of disassemble

- 1 Take off timing gear of camshaft, shown as the illustration.
- 2 Take off crankshaft timing gear.
- 3 Take off set bolt of timing belt rear cover.
- 4 Take off rear cover of timing belt.
- 5 Take the oil drain plug of oil pan away and let oil flow out.
- 6 Remove oil pressure indication switch.
- 7 Remove exhaust pipe.
- 8 Remove oil pan.
- 9 Take suction oil pipe of oil pump away.
- 10 Remove the oil pump by means of loosening the bolt of oil pump.
- 11 Remove oil pump cover.
- 12 Take off inside teeth gear.
- 13 Take off outside teeth gear.

of Oil Pump



II Inspection of oil pump

Standard of radial clearance between inside

wheel gear and crescent caliper: 0.60 ~

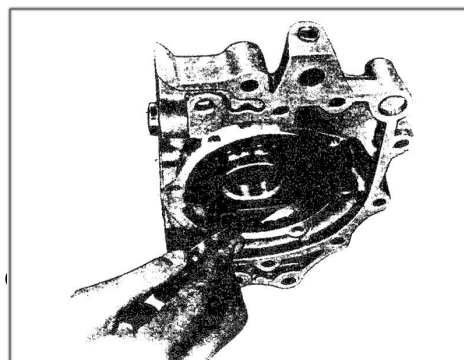
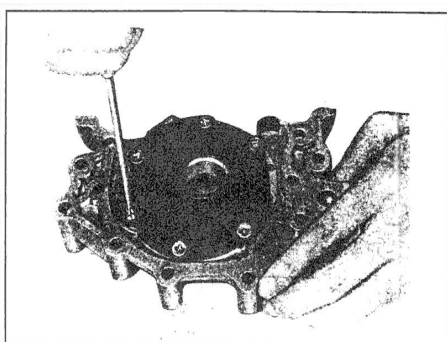
0.80mm

Standard of radial clearance between
outside wheel gear and crescent caliper:

0.25 ~ 0.40mm

Outside wheel gear and pump body
clearance

limit : 0.3mm



8 Install camshaft timing gear according to the illustration.

Attention: Align the oil level, fill SAE 10 W 30 oil in the engine.

Side clearance

Use thickness gauge, make sure the side clearance, in accordance with data between thickness gauge and gear, shown as blow:

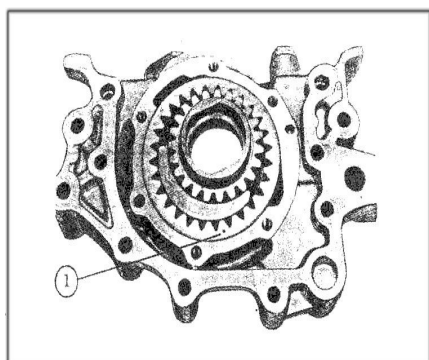
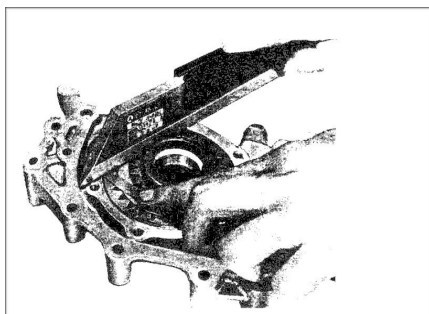
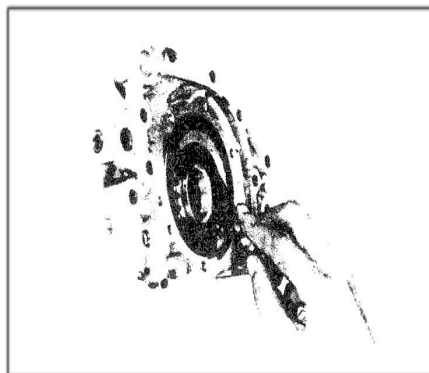
limit : 0.17mm

III Installation of oil pump

Parts of disassemble should be cleaned, you should satisfy the following requests when installing the oil pump:

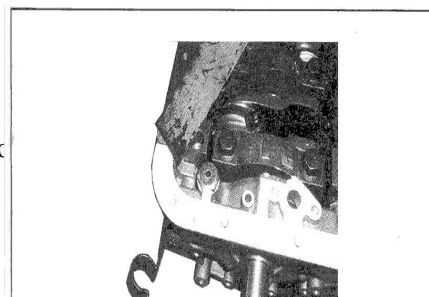
- 1) There is a dot mark  on the outside wheel gear. The dot mark should face outwards when installing the outside wheel gear to the pump body. Shown as blow:
- 2) You should use new sealing gasket when installing the oil pump to the crankcase. You should smear the HZ-1213 oilproof silicon fluid sealant . The surface should be cleaned before you smear.

Notice: You should lubricate the oil seal mouth before installation.



IV Procedures of installation

- 1 Install oil pump and tighten bolt
- 2 Install oil pump suck oil pipe and make it fastened.
- 3 Install oil pan and oil drain plug
- 4 Install exhaust pipe
- 5 Install oil pressure switch and tighten it.
- 6 Install timing belt rear cover
- 7 Install crankshaft timing gear



Chapter 12 Replacement of Rear Oil Seal of Engine Flywheel and Crankshaft

I Procedures of disassemble

- 1 Disconnect the transmission assembly, see the relevant explanation of Chapter 7.
- 2 Start ring gear, lock-up flywheel.
- 3 Disconnect clutch, see the relevant explanation of Chapter 7
- 4 Take off bolt and flywheel.
- 5 Remove bracket bolt of crankshaft rear oil seal.
- 6 Take off oil seal, install new oil seal.
- 7 Notice: Smear the oil on the mouth of oil seal lip when installing the new oil seal, be careful of installation.

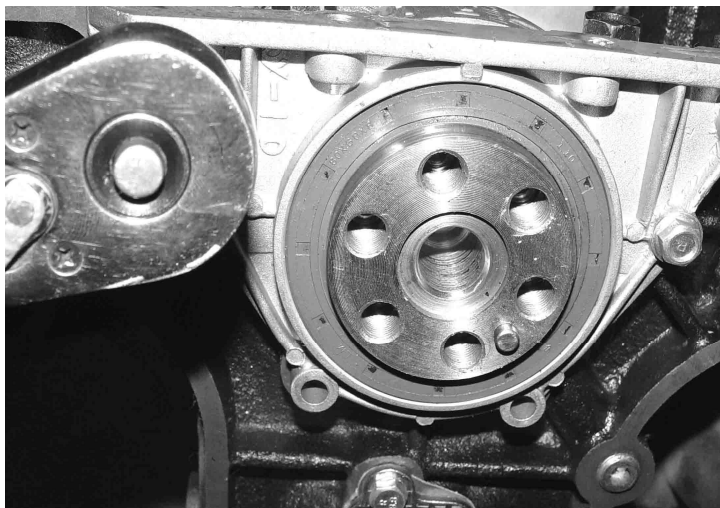
II Procedures of installation

- 1 Install new rear oil seal of crankshaft.

Attention:

Smear Silicon oil on the sealing surface of new sealing washer, then fix it on the shield, in order to prevent the sealing surface from being damaged, you should turn the sealing washer into the shield, place the shield on the crankshaft journal and press it to be flat, place the press cover pipe on the shield and press the sealing washer until it is aligned with the cylinder block side.

- 2 Clean the contact surface of crankshaft and flywheel
- 3 Install flywheel, tighten bolt
- 4 Install the clutch, see the relevant explanation of Chapter 7 for reference.
- 5 Install engine and transmission, see the relevant explanation of Chapter 7 for reference.



Chapter 13 Replacement of Crankshaft

I procedures of disassemble

- 1 Remove engine and transmission assembly from vehicle
 - 2 Remove transmission from engine , put it on the bracket.
 - 3 Remove oil drain plug of oil pan to drain oil and collect the oil.
 - 4 Remove engine oil pan.
 - 5 Remove oil pump, see the accordingly explanations.
 - 6 Remove engine clutch.
 - 7 Remove engine flywheel.
 - 8 Make mark for main bearing and connecting rod bearing.
 - 9 Loosen connecting rod bolt and remove connecting rod bearing cover.
 - 10 Loosen main bearing bolt and take off bearing cover.
 - 11 Take off crankshaft.
 - 12 Take off upper main being shell.
- Attention: Don't confuse the bearing shell.

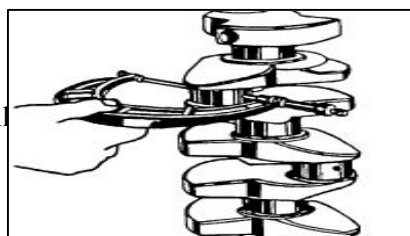
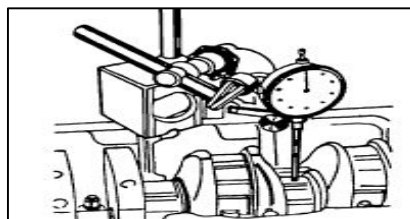
II Clean and check

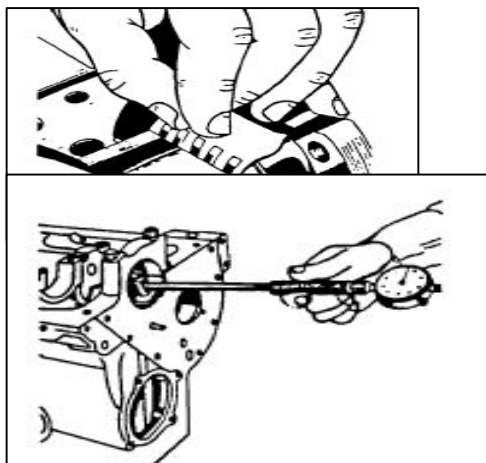
- 1 Clean the parts and dry the parts.
- 2 Check to see whether or not there are some defects such as scoring, unevenness or others default in the journal.



to the following methods.

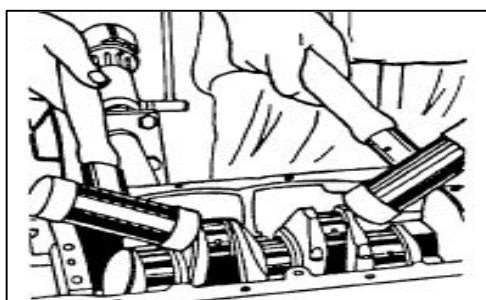
- 2 Lift the crankshaft with 1 and 5 bearing with shell of engine body.
- 3 Install a dial gauge with touching pin on the place of 3 in the bearing, total reading is $360\ \mu\text{m}$,the maximum is $0.03\ \text{mm}$
Maximum taper of observing journal can be: $0.005\ \text{mm}$, Maximum roundness of observing journal can be: $0.004\ \text{mm}$
- 4 Observe journal and diameter of crankshaft and check to see which is ok, if the value of diameter is not in the scope of the form, you should polish the crankshaft once more or replace the crankshaft.
- 5 Please use plastic gauge, if you want to check the distance between the bearing and shell.
- 6 If there is no plastic gauge, take away the crankshaft, put on the bearing cover with shell and diameter of corresponding journal .Difference between the two values is the distance between journal and shell.





IV Procedures of installation

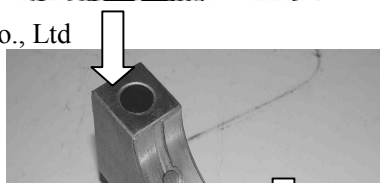
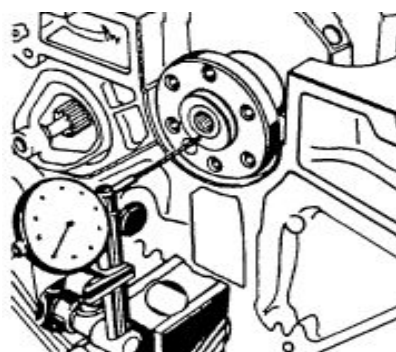
- 1 Install upper shell of main bearing to engine cylinder, lubricate the side which face the journal.
- 2 Install crankshaft to engine body
- 3 Install the main bearing cover with bottom shell, lubricate the side facing the journal.
Attention: Installation of bearing cover should be in accordance with the mark made when dismantling.



- 4 Install main bearing bolt, don't fasten it
- 5 Knock the two ends of crankshaft with a plastic rod, mainly in order to adjust the rear surface of thrust bearing, then fasten the bolts.

V Measurement

- 1 Measure axial clearance of crankshaft as the following methods.
- 2 Install a dial gauge with sensing pin and the sensing pin contact crankshaft end face.
- 3 Move the crankshaft along its direction with a screwdriver, pay attention to the readings of dial gauge, the regulated clearance is :0.13-0.28mm.
- 4 Install connecting rod to crankshaft
Notice: Use lubricant only on the side facing the crankshaft handle when install the shell of connecting rod bearing, push the connecting rod until it is in the position of crank.
- 5 Lubricate the surface of lower shell of crank facing the crankshaft, when installing the connecting rod bearing cover.
- 6 Install connecting rod bearing cover bolt, but don't fasten it.
- 7 Turn the crankshaft for several circles ,make align.
- 8 Install engine flywheel and bolt, see the relevant Chapters.
- 11 Install clutch.
- 12 Install the oil pump ,see the explanation.
- 13 Install the engine oil pan, see the explanation.
- 14 Tighten oil drain plug, see the explanation.
- 15 Install the transmission to the engine, see Chapter 7.
- 16 Install engine and transmission to vehicle, see the explanation.



Chapter 14 Replacement of Engine Body

I procedures of disassemble

- 1 Remove engine from vehicle accordingly.
- 2 Fix the engine assembly on the bracket.
- 3 Take off the piston and connecting rod assembly of engine accordingly.
- 4 Take off crankshaft.
- 5 Clean the engine body thoroughly.
- 6 Check to see whether or not there are some cracks or wear in the engine block.

II Repair cylinder

If cylinder block of engine can be still used while there are something wrong with the cylinder after inspection, so you can repair the cylinder by means of polishing the inside .After performance of polishing the cylinder, the cylinder shall be able to have a capacity of larger piston.

Polishing of cylinder

Notice: Some of above-mentioned procedures can be omitted , judgment of necessity depends on result of inspection before repair.

You must use fine hone stones to polish the stones, it is not good to make the polishing too smooth, it only needs slight smoothness for helpful lubrication. cylinder after

grinding, you use rough particles stones first, then use fine particles Put the hone stone in the cylinder and make the hone stone close to the cylinder wall as possible as you can, you rotate the hone stone around, connect a 19mm electric drill to the stone, make the stone rotating inside the cylinder, make the stone turning up and down slowly to the full until it can rotate freely.

Put appropriate amount of kerosene in the cylinder in order to keep the hone stone and cylinder wall clean and lubricated, continue to polish it and repeat the procedures until you get requested diameter.

Notice: Stop polishing frequently to put the piston in the cylinder to check whether or not the distance is appropriate, clean the cylinder thoroughly before putting the piston in. The engine block should be cleaned thoroughly after repair.

III Procedures of installation

- 1 Install the crankshaft accordingly.
- 2 Install transmission rod of piston assembly accordingly.
- 3 Install engine assembly to the vehicle accordingly.



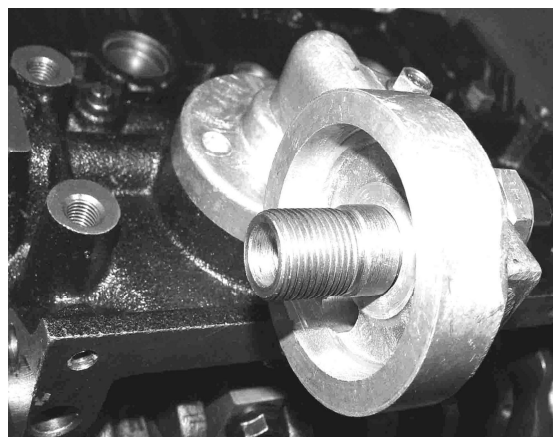
CHAPTER 15 Replacement of Oil Cleaner

I procedures of disassemble

- 1 Loosen oil cleaner with SST
- 2 Collect the oil.
- 3 Check oil level of engine , tune up if necessary.

II Procedures of installation

- 1 Lubricate the sealing washer of oil cleaner with oil slightly, tighten the bolt by hand.
- 2 Check the oil level of engine, tune up if necessary.
- 3 Lubricate the sealing washer of oil cleaner with oil slightly, tighten the bolt by hand.



CHAPTER 16 Cooling System

I Maintenance guide

Drainage and refilling of cooling system

Proportion of ethylene-glycol is definite, so as to ensure at least 50% of ethylene-glycol solution being used for all emission ports and air holes of engine block ,during the process of coolant drainage and washing.

Volume of cooling system for 1.1 liter engine is 4.8 -5.0 liter, listed volume during the procedure of refilling, including extra amount of atmosphere drained and remained in cooling system after static refilling. According to correct filling proportion and the following procedures, it will ensure that density of ethylene-glycol is 50% in the cooling system, so as to simplify the refilling work, see the radiator volume of static refilling for reference, at least every 5 years or driving 240000 km , taking the first arrival for standard, the engine cooling system should be drained and refilled with fresh coolant accordingly.

Caution: Make sure that pressure temperature of cooling system is much higher than solution boiling point in the radiator while preventing boiling at the same time. To avoid the damage of being burned, do not remove the cap while the engine and radiator are still hot, because it will lead the solution boiling and having explosive force probably, resulting in solution rejecting to the engine wing and hurting the user who remove the cap.

Notice: It must be sure that you should use regulated coolant, if you don't use regulated brand of coolant ,time of replacing the engine coolant should be shortened ,that is

driving 50000 km or 24 months.

Drainage

Notice: It is not right to drain the coolant to the full, unless when you remove the water pump. You should pay attention that this procedure will increase the amount of coolant for diluting the dangerous waste materials.

1 Keep vehicle level.

2 Remove reservoir tank cap according to the following procedures after the engine is cooled. Turn the cap to detent slowly, anticlockwise. Don't give the pressure cap pressure while turning. It will be fizzing while draining the remaining air, you should continue to turn the radiator cap anticlockwise, until you open it.

Notice: Retrieve and store the old coolant in the old reservoir tank at regular intervals, that procedure greatly increase the amount of coolant for diluting the dangerous waste materials.

1 Put the drain tray under vehicle to collect the old coolant.

2 Loosen the outlet hose clamp mounted on the left side of radiator back, remove outlet hose of radiator

3 Loosen the hose which coolant tank to manifold inlet port, remove tank and hose. It is enough to remove the bottom radiator pipe and tank hose only if you carry out drainage partly.

Attention: Make appropriate dispose of old coolant, don't put the old coolant into the sewer. Ethylene-glycol antifreeze is a kind of extreme poisonous chemical agent. It is illegal to dispose the ethylene -glycol in



the sewer or groundwater for it will destroy the ecological environment.

4 Refilling after draining the coolant from cooling system

Attention: Don't use cooling system sealant or similar sealant unless there are some regulated exceptions, it will prevent coolant from flowing in the cooling system and engine parts, coolant block will result in engine too hot or cooling system and engine parts assembly being damaged.

1 Tighten clip of radiator vent hose

2 Reinstall after draining the waste water away, clean the reservoir tank with water.

Attention:

Add ethylene-glycol coolant ratified for use by Chery Company while refilling, you should use mixture of 50% ethylene-glycol and 50% drinking water to fill in the cooling system ,if it is not necessary to wash the system, refilling instead.

3 Refill the cooling system slowly through coolant tank, according to the following procedures.

3.1 Add mixture of 50% ethylene-glycol and 50% drinking water until the coolant is in the position between maximum mark and minimum mark of the coolant tank.

3.2 Check to see whether or not the coolant is in the position between maximum mark and minimum mark of the reservoir tank once more after two minutes, continue to add the solution until it achieve the standard

3.3 Start the engine for warming up ,make the coolant flowing from the radiator so as to get rid of the air of engine cooling system ,check to see whether or not the coolant is in the position between maximum and minimum mark of the reservoir tank, continue to add until it is up to the standard.

4 Install reservoir tank cap, make sure that the arrow on it is showing no difference with the direction of coolant overflow pipe.

5 Carry out heating and cooling the engine for three times, then examine the engine anti-icing function of engine coolant with refractometer and heat hydrometer to make sure that it has appropriate anti-icing ability.19□-35⁰F protection. Abstract some mixture of coolant from the reservoir tank for the use of examination.

Washing

Washing engine cooling system:

Washing procedures

Various of methods and equipments can be used to wash the cooling system. If you want to use special equipment such as circle washing apparatus, please see the manufacturer's directions for reference.

Cleaning of radiator

Caution: Don't spray the water to the hot radiator, hot gas generated will injure you or other people.

Attention: Cooling fin is necessary for good performance of heat conduction, don't brush the fin, in case the fin will be damaged and function of heat conduction is not good.

Attention: You can clean the radiator fin with compression atmosphere or water, the pressure shall not exceed 150kpa, it will damage the radiator while the pressure exceeding 150 kpa, clean front side of radiator once every year. Clean front side of condenser, blow and wash the small worms and tree leaves away from it with compressed air through the radiator, blow from the back side towards front, you can use water pipe to pour the water in through the radiator, you wash with water only when the engine doesn't work and being cooled.

II Replacement of top radiator pipe procedures of disassemble

1 Empty cooling system parts, see the illustration

2 Remove intake hose of thermostat cover

3 Remove intake hose of radiator

4 Remove intake hose

procedures of installation

1 Install the intake hose to the right position aligning the hose mark.

2 Connect intake hose and radiator

3 Connect intake hose and thermostat cover

4 Refill coolant, see the illustrations.

III Replacement of bottom radiator pipe

procedures of disassemble

1 Empty the cooling system, see the illustrations.

2 Remove vent hose from engine cooling manifold

3 Remove vent hose of radiator

4 Remove vent hose

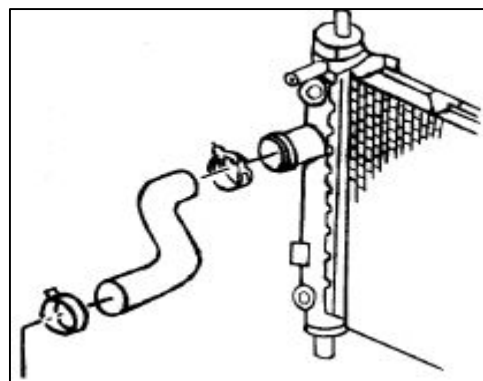
procedures of installation

1 Install the bottom radiator pipe properly, aligning the hose mark.

2 Connect vent hose to the radiator.

3 Connect vent hose and engine cooling manifold

4 Refill the cooling system, see the illustrations.



IV Replacement of cooling fan

procedures of disassemble

Caution: Electric fan of engine cover will rotate , injure you and other people even if the engine is not working, you should be far away from the electric fan of engine cover.

Caution: To avoid casualty or vehicle damage, you should replace the fan board or outer cover if they are broken or damaged.

1 Disconnect the power supply cooling fan.

2 Remove fan cover construction bolt from radiator.

3 Remove engine cooling fan.

procedures of installation

1 Install cooling fan

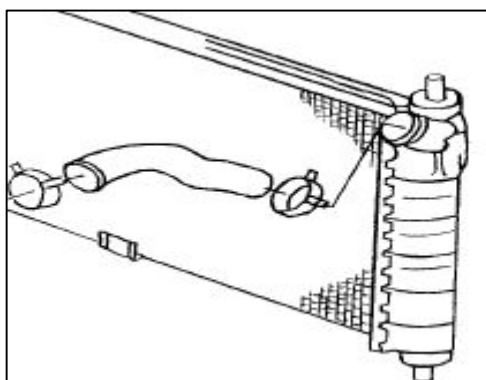
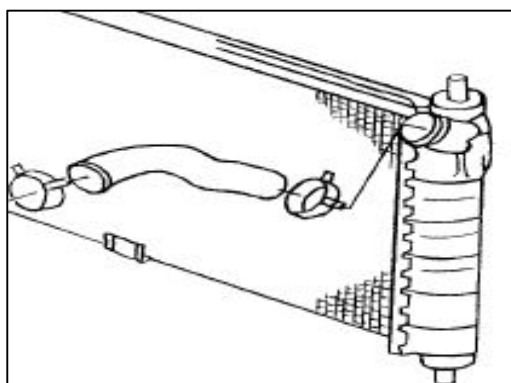
Notice: See cautions and relevant remarks concerning fastener.

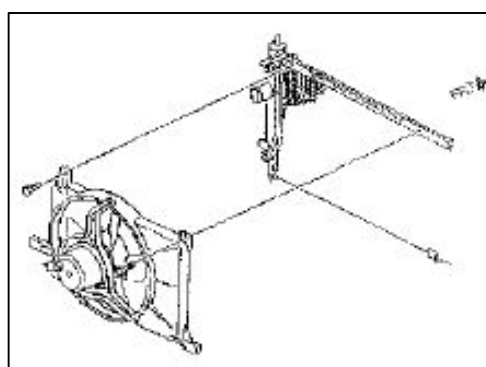
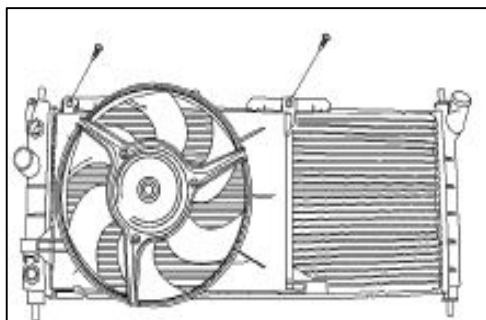
2 Install fan erection bolt

Fasten the nut to: 3.5-4.5 N.m

3 Connect cooling fan power

4 Check to see whether or not fan motor works normally.

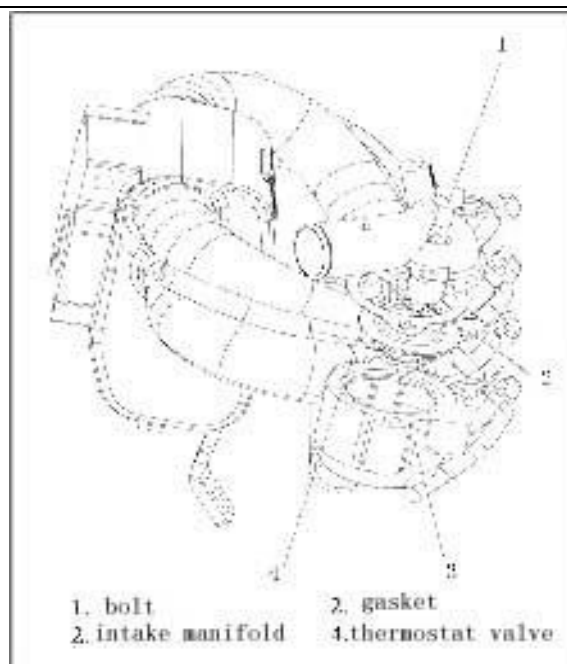




V Replacement of thermostat

procedures of disassemble

- 1 Remove timing belt see illustration of timing belt removal for reference.
- 2 Remove camshaft timing pulley ,see illustration of camshaft timing belt removal for reference.
- 3 Remove timing belt housing bolt and rear cover of timing belt
- 4 Loosen and remove thermostat bolt.
- 5 Remove thermostat



procedures of installation

- 1 Install thermostat and new gasket, tighten the bolt if necessary.

Notice: Place the gasket properly on the entrance.

- 2 Tighten the bolt

- 3 Connect hose to the thermostat.

- 4 Connect intake hose to thermostat shell.

- 5 Install timing belt housing rear cover.

- 6 Install camshaft timing pulley, see the installation illustration of camshaft timing pulley for reference.

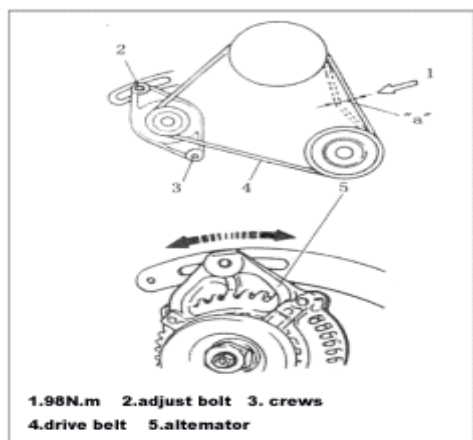
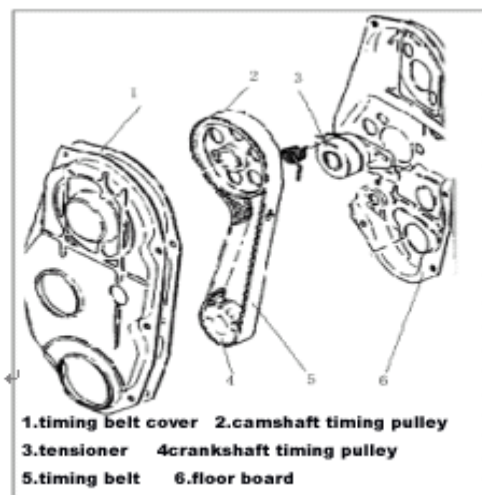
- 7 Install timing belt, see the installation illustration of timing belt for reference.

HINT: Add drinking water and 3.3 liter radiator protective liquid in the system, drain the air of the engine body away.

VI Replacement of water pump

procedures of disassemble

- 1 Remove timing belt, see the **disassemble** illustration for reference.
- 2 Remove camshaft timing pulley, see the **disassemble** illustration of camshaft timing pulley for reference.
- 3 Remove time pinion from crankshaft, see relative content for reference.
- 4 Loosen bolt of timing belt tensioner and remove timing belt tensioner
- 5 Remove rear cover of the timing belt.
- 6 Disconnect lower hose of radiator and collect coolant
- 7 Loosen water pump bolt and remove water pump.



procedures of installation

- 1 Install new sealing washer, parts serial number is 9158173, lubricate the parts with silicon oxide grease, parts serial number is 9309994.
- 2 Connect water pump to the engine body, don't bolt to the regulated torque.
- 3 Connect lower hose of radiator
- 4 Install rear cover of timing belt housing.
- 5 Install time pinion on the crankshaft.
- 6 Install camshaft timing pulley to the camshaft, see the installation illustration of camshaft timing pulley for reference.
- 7 Install timing belt, see the installation and connection illustration for reference, during this operational process, bolt the water pump to the regulated torque and fasten it after tune-up timing belt tension roller.

Water pump bolt: 7 ± 3 mm

Attention: Add drinking water and 3.3 liter radiator protective liquid, parts serial number is 9985451

Remove water lamp mounted on the top of temperature regulation valve, drain the air of engine body away, start the engine to make it idle running at a speed of 900 rpm after system recovery.

VII Replacement of radiator

procedures of disassemble

- 1 Remove air filter and air passage assembly, see the content of engine control system for reference.
 - 2 Loosen up and down water pipe
- Removal: Drain certain proportion of coolant (about 0.5 liter) away and collect it, remove the condenser case (including hose), then loosen the upper end of water inlet pipe of the radiator, so as to pull the baffler cover and fan motor out, see the following illustration for reference:

Loosen 2 bolts:

Loosen wire harness and take out fan assembly

Loosen 4 bolts and pull out the fan



Procedures of installation

- 1 Install radiator to lower bracket.
- 3 Connect radiator upper hose.
- 4 Connect radiator lower hose.
- 5 Connect coolant overflow hose.



Pay attention to the notices relating to fastener.

6 Install radiator bracket and bolt

Bolt to 6.0—8.0 Nm

7 Install cooling fan.

8 Refill the cooling system.

9 Install air filter and pipe assembly.

10 Check leakage.

VIII Explanation and operation

1 Cooling system operation

cooling system

Cooling system makes engine keep appropriate temperature under all working conditions of engine, when the coolant temperature is low, the fan operates slowly to help the engine warm up.

Cooling system is composed of a radiator, coolant reclaiming system, cooling fan, thermostat, water pump cover and driving belt.

Cooling system needs all components working normally, coolant is pumped from the radiator by water pump, it will be recycling in inlet manifold and cylinder head of engine body through coolant housing, then it comes back to the radiator, there, cooling system will make some of the coolant lead to the heater core from hose for being heated and unfroze. Reservoir tank is integrated with radiator, reservoir tank retrieve the coolant which expand outwards when the temperature is high and keep suitable coolant level, along with cooling and contraction of coolant, coolant is



absorbed in the radiator for sake of vacuum.

2 Cooling recycling system

Water pump is driven by belt, coolant flow in water pump from left bottom side of radiator, coolant is pumped into the peripheral empty cavity of cylinder liner through coolant tubes in the shell of the cylinder. Coolant flow in cylinder head coolant tubes through cylinder head gasket hole, then flow in the sub-branch system of thermostat. Tubes of inlet manifold lead coolant to the thermostat, when the thermostat is shut off, cold engine coolant can't return to the radiator to carry out recycling, preheat the engine quickly. When engine is preheated to the full, the thermostat is open to let coolant flow into water inlet housing mounted on the upper right position of the radiator. The recycling is performed when coolant becomes cold gradually after flowing in the water outlet housing mounted on the left side of radiator through level core tubes.

3 Cooling fan relay

As to information and diagnosis condition of cooling fan relay, you can see the cooling fan illustration for reference

4 Coolant temperature control system switch

The switch control the voltage of cooling fan relay, as to the position which relay make the fan running at a high speed and diagnosis, under the condition of coolant temperature exceed 95 °C and 102 °C, you can see electric system of engine.

5 Explanation of coolant

Notice: You can add antifreeze agent in order to raise boiling point of the coolant, but solidifying point will be effected if you

add excessive coolant, you are not allowed to use antifreeze solution exceeding 70, because it will freeze from this point, temperature will go up rapidly, pure antifreeze will freeze when the temperature is -22 °C (-8 °F). You can comply with direction of draining and refilling the cooling system, you are only allowed to use certain coolant regulated by Chery Company while adding or replacing the coolant, 50% and 50% mixture of ethylene-glycol and drinking water will provide the following protection:

- Provide -39 °C antifreeze protection
- Provide 131 °C boiling point protection
- Prevent rust and corrosion
- Keep appropriate engine temperature
- Make the warning light and thermostat work normally

6 Explanation of coolant reclaim system

Reservoir tank

Reservoir tank is the transparent tank just like common windscreen gasket cleaner canister, reservoir tank is integrated with radiator through hose, it collects the overflow coolant when the coolant temperature is high, otherwise these coolant will flow out of the cooling system, level of coolant should be on or much higher than the position of overflow hose in the tank.