



Contents

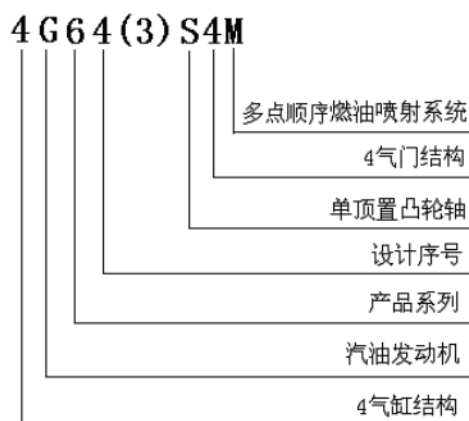
Chapter 1 Overview.....	3
I. Technical Data.....	3
II. Special Tools.....	8
Chapter 2 Structural Features of Engine.....	12
Chapter 3 Admission Gear.....	23
I. Timing Gear Belt.....	23
II. Rocker and Camshaft.....	32
III. Cylinder Cover and Valve.....	36
Chapter 4 Crank Gear.....	42
Chapter 5 Lubricating System.....	54
Chapter 6 Cooling System.....	62

Chapter 1 Overview

Engine used in Chery Tiggo car is MITSUBISHI 4G64 (2.4L) and 4G63 (2.0L) model engine, which adapt single-overhead-camshaft, 4-cylinder 16-valve and multi-point sequential injection.

I. Technical Data

1. Engine Mode Number Indication



多点顺序喷射系统: Multi-point sequential injection

4 气门结构: 4 valve structure

单顶置凸轮轴: Single-overhead-camshaft

设计序号: Design serial number

产品系列: Product serial

汽油发动机: Gasoline engine

4 气缸结构: 4 cylinder structure

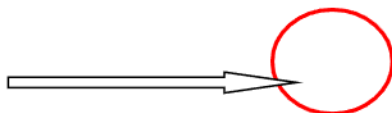
2.Engine Number Position





Engine

No.



3. Related Engine Data

Item	Specification	
	4G63 S4 MPI	4G64 S4 MPI
Engine type	Four cylinder in-line, 4 stroke, water-cooled, single-overhead-camshaft, 16 valve multi-point sequential injection	
Cylinder number	4	4
Combustion chamber	Ridge chamber	Ridge chamber
Total displacement ml	1,997	2,351
Cylinder diameter mm	85.0	86.5
Stroke mm	88.0	100.0
Output power kw	92 (6000r/min)	95 (5500r/min)
Max torque N.m	167.7	198.1
Compression ratio	10	9
Lubrication system	Pressure supply, full filter	Pressure supply, full filter
Fuel pump type	Gear type	Gear type
Water pump type	Centrifugal impeller	Centrifugal impeller

4. Maintenance Standard

UOM: mm

Item				Standard Value	Usage Limit Value
Engine gear belt	Tensioner arm protrusion			12	—
	Tensioner arm depression (98~196N)			≤1	—
Camshaft	Cam height	Air-in	4G63	37.50	37.00
		Air-out	4G63	36.99	36.49
	Shaft diameter			45.0	
Cylinder cover	Lower surface flatness			0.03	0.2
	Surface grinding limit* total grinding of cylinder body and cylinder cover			—	* 0.2
	Full height			119.9—120.1	
				97.4	≤99.4
Valve	Edge thickness	Air-in		1.0	0.5



Item			Standard Value	Usage Limit Value
	Air-out		1.2	0.7
	Valve rod diameter		6.0	—
	Crest clearance between valve rod and duct	Air-in	0.02—0.05	0.10
		Air-out	0.03—0.07	0.15
	Inclination angle		45°—45.5°	—
	Height	Air-in	112.30	111.80
		Air-out	114.11	113.61
Valve spring	Free height		51.0	50.0
	Pre-loading force/Operation height	Km/mm	27.2/44.2	—
	Verticality		≤2°	≤4°
Valve duct	Contact bandwidth		0.9—1.3	—
	Internal diameter		6.0	—
	External diameter		11.0	—
	Depression depth		14.0	—
	Valve rod protrusion height		49.3	49.8
Engine oil pump	Side clearance	Driving gear	0.08—0.14	—
		Driven gear	0.06—0.12	—
Piston	Piston clearance		0.02—0.04	—
Piston ring	Lateral clearance	No.1 ring	0.02—0.06	0.1
		No.2 ring	0.02—0.06	0.1
	End clearance	No.1 ring	0.25—0.35	0.8
		No.2 ring	0.40—0.55	0.8
		Oil ring	0.10—0.40	1.0
Piston pin	External diameter		22.0	—
	Depressing force (Kg)		755—1750	—
	Depressing temperature		Room temperature	—
Crank	Crank pin clearance		0.02—0.05	0.1
Connecting rod	Bigger end clearance		0.10—0.25	0.4
Crank	Axial clearance		0.05—0.18	0.25
	Main axle diameter		57	—
	Connecting axle diameter		45	—
	Main axle diametral clearance		0.02—0.04	0.1
Cylinder body	Upper surface flatness		0.05	0.1
	Upper surface grinding limit*Total grinding of cylinder body and cylinder cover		—	* 0.2
	Full height 4G63		284±0.1	—
	Internal diameter of cylinder hole 4G63		85.00—85.03	—



Item		Standard Value	Usage Limit Value
Cylinder body	Cylinder hole cylindricity	0.01	——
Motor	Rotor coil resistance	3—5	——
Cylinder Cover	Secondary processing size of valve conduit installation hole (air-in and air-out valve) enlargement	0.05 O.S.	11.05—11.07
		0.25 O.S.	11.25—11.27
		0.50 O.S.	11.50—11.52
	Secondary processing size of air-in valve seating hole enlargement	0.30 O.S.	34.435—34.455
		0.60 O.S.	34.735—34.755
	Secondary processing size of air-out valve seating hole enlargement	0.30 O.S.	31.935—31.955
		0.60 O.S.	32.235—32.255

Remarks:

O.S.: Enlarged diameter

5. Tightening torque

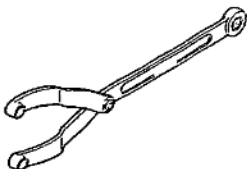
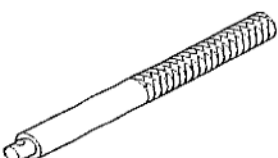
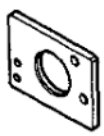
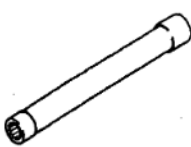
Tightened Part	Torque (kgf .M)
Alternator, Ignition system	
Water pump belt gear	0.9
Adjusting bolt	1.0
Locking bolt	2.2
Alternator bracket screw bolt	2.4
Alternator center axle nut	4.5
Crank belt gear	2.5
Ignition coil	1.0
Spark piston	2.5
Camshaft position sensor cylinder	2.2
Camshaft position sensor bracket	1.4
Camshaft position sensor	1.0
Timing Belt	
Protruded screw bolt on timing belt cover	1.1
Tensioner wheel screw bolt	4.9
Tensioner arm screw bolt	2.2
Automatic tensioner screw bolt	2.4
Central belt wheel screw bolt	3.6
Tensioner bracket	4.9
Timing belt rear cover	1.1
Timing belt indicator	0.9
Engine oil pump belt gear	5.5
Screw bolt of crank belt gear	12.0

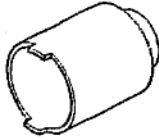
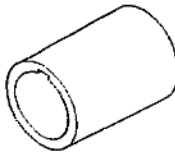
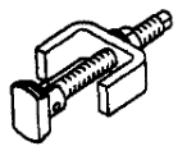
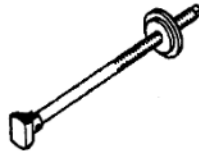
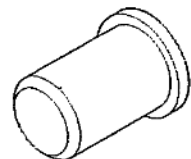
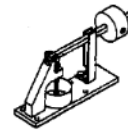
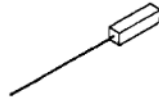
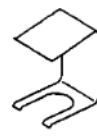


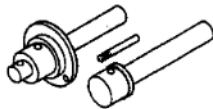
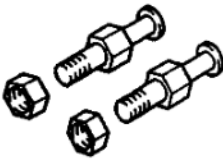
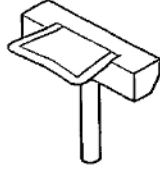
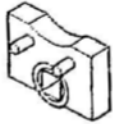
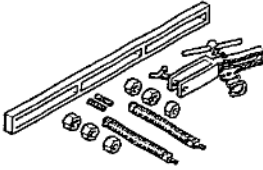
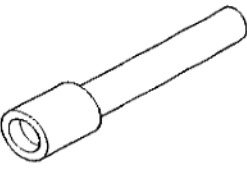
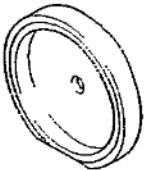
Tensioner "B"	1.9
Belt gear of balance axle	4.6
Screw bolt of camshaft belt gear	9.0
Belt gear of balance axle	4.6
Fuel System	
Throttle	1.9
EGR valve	2.2
Injector and distribution pipe	1.2
Fuel oil return pipe	0.9
Fuel pressure regulator	0.9
Intake Manifold	
Screw bolt of engine flying rings	1.9
Engine coolant temperature sensor	3.0
Connecting bolt of outflow pipe	2.0
Manifold bolt	2.0
Coolant temperature sensor	1.1
Manifold bracket	1.4
Exhaust Manifold	
Screw bolt of emission manifold cover	1.4
Screw bolt of inflow duct joint	2.4
Exhaust manifold nut (M8)	3.0
Exhaust manifold nut (M10)	5.0
Screw bolt of coolant bypass duct joint	2.4
Screw bolt of coolant duct component	1.3
Thermostat housing bolt	2.4
Water pump screw bolt	1.4
Rocker and Camshaft	
Rocker cover screw bolt	0.4
Screw bolt of rocker and camshaft assembly	3.2
Trust bearing cover bolt	1.9
Cylinder Cover and Valve	
Cylinder cover bolt	2.0+90°+90°
Front cover & Engine oil pump	
Drain plug	4.5
Oil pan	0.7
Screw bolt and nut of oil strainer	1.9
Oil pressure switch	1.0

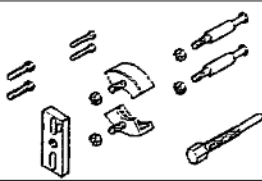
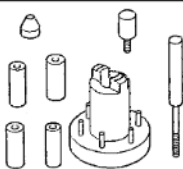
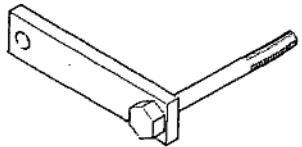
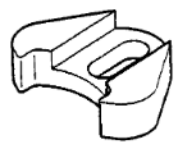
Pressure relief plug	4.5
Screw bolt of oil cleaner bracket	1.9
Front cover bolt	2.4
Plug	2.4
Flange bolt	3.7
Engine oil pump cover bolt	1.6
Engine oil pump cover screw	1.0
Piston and Connecting Rod Assembly	
Connecting rod nut	2.0+90°~100°
Crank, Cylinder Body, Flywheel	
Flywheel screw bolt	13.5
Installation screw bolt of rear cover	1.1
Installation screw bolt of bell jar	0.9
Installation screw bolt of oil seal cover	1.1
Screw bolt of main bearing cover	2.5+90°~100°
Throttle Body	
Bracket screw bolt	0.5
Throttle Position Sensor	0.35
Screw bolt of idle speed air valve	0.35
Idle speed adjustment bolt and installation nut	0.3

II. Special Tools

Tool	Number	Name	Purpose
	MB990767	Spanner for crankshaft belt gear	Use MD998719 when fixing camshaft belt gear
	MB990938	Handle	Use it together with MD998776 to install crankshaft rear oil seal.
	MB991603	Balance axle bearing puller limiter	Use it with MD998372 together to disassemble reverse balance axle rear bearing and install guiding limiter.
	MB991654	Cylinder cover bolt spanner (12)	Disassemble and assemble cylinder cover bolt.

Tool	Number	Name	Purpose
	MD998162	Plug spanner	Disassemble and assemble front cover plug cock.
	MD998285	Crankshaft front oil seal duct	MD998375 Use MD998375 to install crankshaft front oil seal
	MD998371	Balance axle bearing puller	Disassemble reverse balance axle front bearing
	MD998372	Balance axle bearing puller	Disassemble reverse balance axle rear bearing
	MD998375	Crank shaft front oil seal installer	Install crankshaft front oil seal
	MD998440	Leakage check tester	Leakage test for hydraulic post.
	MD998441	Hydraulic post keeper	Exhaust air from hydraulic post
	MD998442	hydraulic post wiring	Exhaust air from hydraulic post
	MD998443	hydraulic post keeper	Use it when disassembling or assembling rocker shaft component

Tool	Number	Name	Purpose
	MD998705	Balance axle bearing installer	Install balance axle front and rear bearing.
	MD998713	Camshaft oil seal installer	Install camshaft oil seal
	MD998719	Fixing pin for belt gear	Use MB990767 to fix camshaft belt gear.
	MD998727	Oil pan remover	Disassemble oil pan
	MD998735	Valve spring compressor	Disassemble and assemble valve and related parts
	MD998767	Tensioner puller sleeve	Timing belt tension adjustment
	MD998772	Valve spring compressor	Disassemble and assemble valve and related parts
	MD998774	Valve oil seal installer	Install valve oil seal
	MD998776	Crankshaft rear oil seal installer	MB990938 Use MB990938 to install crankshaft rear oil seal.

Tool	Number	Name	Purpose
	MD998778	Crankshaft belt gear puller	Disassemble crankshaft belt gear
	MD998780	Piston disassembling and assembling tool	Disassemble and assemble piston pin.
	MD998781	Flywheel stopper	Fix flywheel and driving disk
	MD998783	Plug spanner fixer	Disassemble and assemble front cover plug
	MD998785	Timing belt gear stopper	Keep balance axle belt gear.

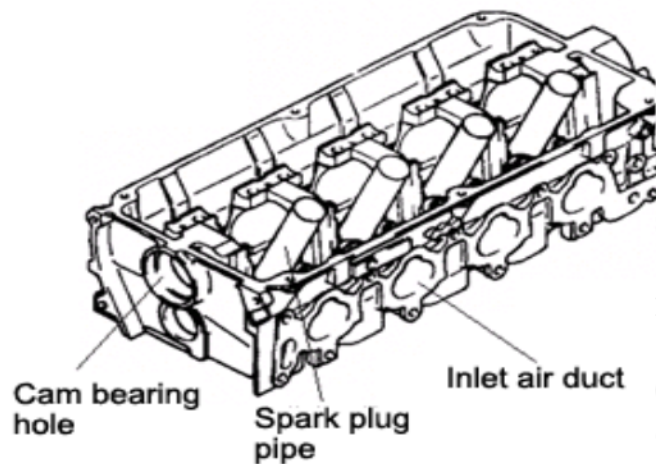


Chapter 2 Engine Structure

Features

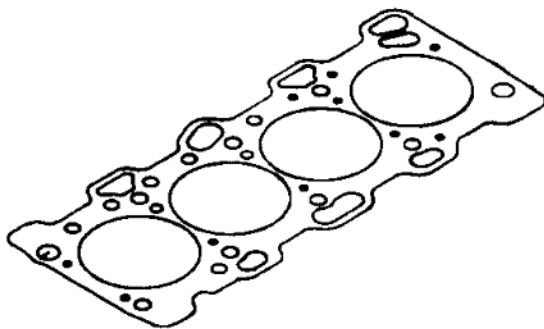
1. Cylinder Cover Structure

Features

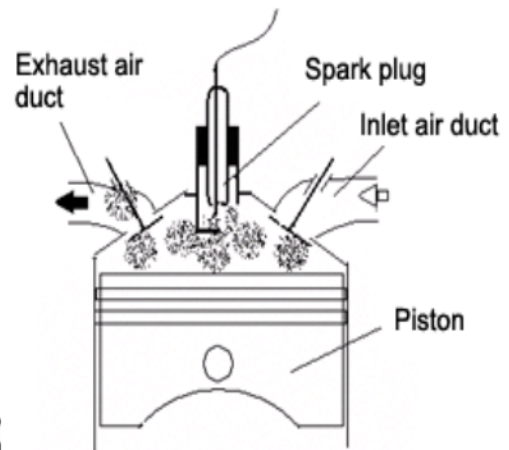


Cam bearing hole
Spark plug pipe
Inlet air duct

2. Cylinder Cushion Structure



3. Spark Plug Position



Exhaust air duct
Spark plug
Inlet air duct
Piston

Cylinder cover is made of horniness aluminium alloy, which is firstly low-pressure-molten and then machining.

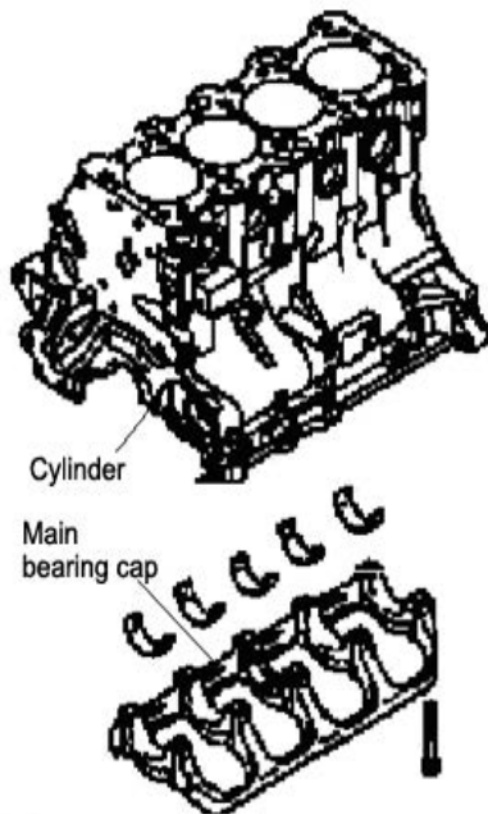
Four-valve structure is applied and its advantage is increasing emission channel area and decreasing valve movement inertia.

Agile fiberboard structure is applied. Many 1.5mm-diameter through holes are pressed in the steel board and fiber liquid mixture is filtered through steel board. And then sealant is sprayed on both sides of agile broad and the important part is additionally sprayed with seal thread.

Spark plug is located in the center of chamber, which may let flame reach each chamber corner at almost the same time.



4. Cylinder Main Bearing Cap



Cylinder
Main bearing cap

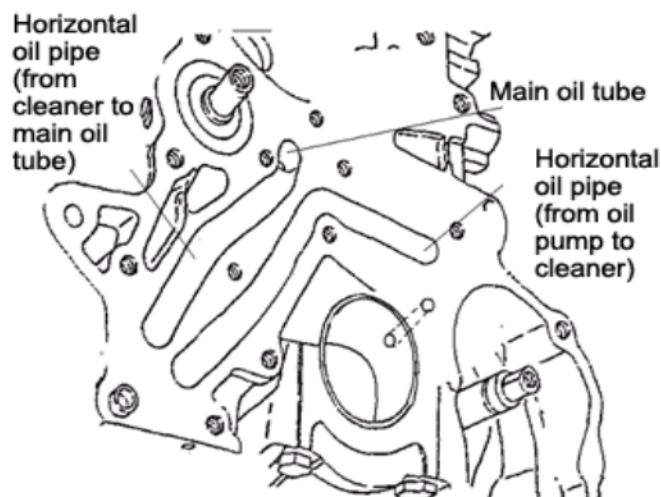
Main oil tube

Horizontal oil pipe (from cleaner to main oil tube)

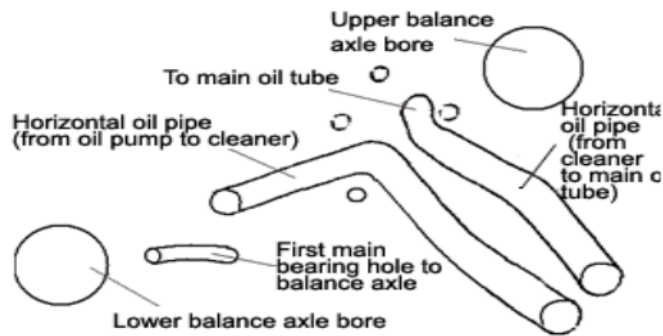
Horizontal oil pipe (from oil pump to cleaner)

Integrated main bearing cap is applied, which may increase engine operation rigidity, observe and distribute efficiently periodic viable force generated by crank running, and ensure engine stable and smooth running at high speed, large load or large torque.

5. Oil Tube Features



1、Modular oil pipe is applied. (The whole oil pipe consists of the half oil pipe cast on cylinder body and the other half on front end cover)



Upper balance axle bore

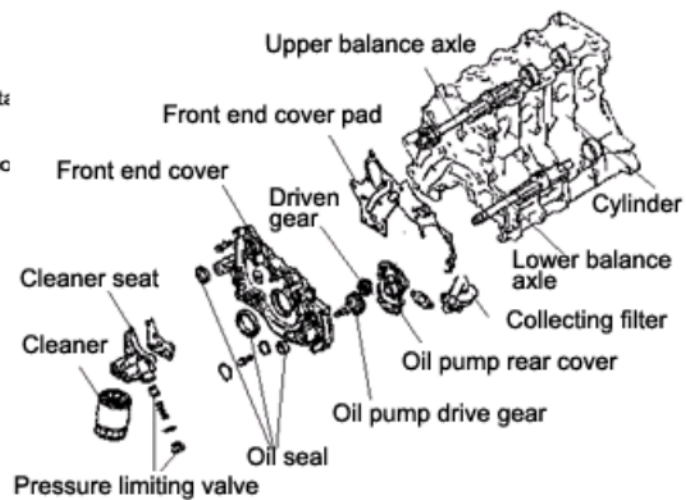
To main oil tube

Horizontal oil pipe (from oil pump to cleaner)

Horizontal oil pipe (from cleaner to main oil tube)

First main bearing hole to balance axle

Lower balance axle bore



Upper balance axle

Front end cover pad

Front end cover

Cleaner seat

Cleaner

Pressure limiting valve

Driven gear

Oil seal

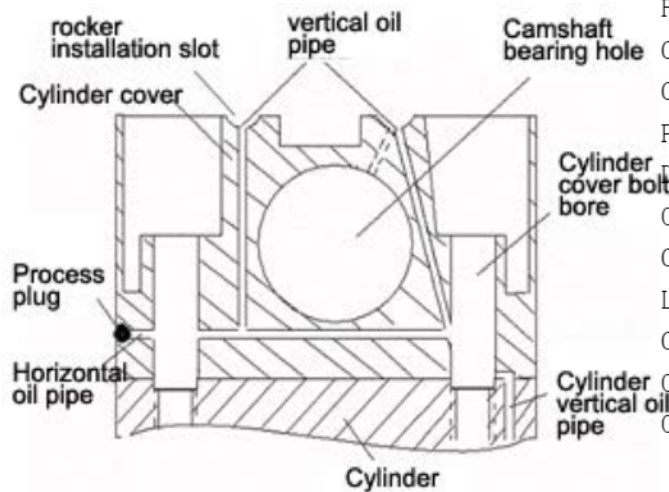
Cylinder

Lower balance axle

Collecting filter

Oil pump rear cover

Oil pump drive gear



rocker installation slot

vertical oil pipe

Cylinder cover

Camshaft bearing hole

Cylinder cover bolt bore

Process plug

Horizontal oil pipe

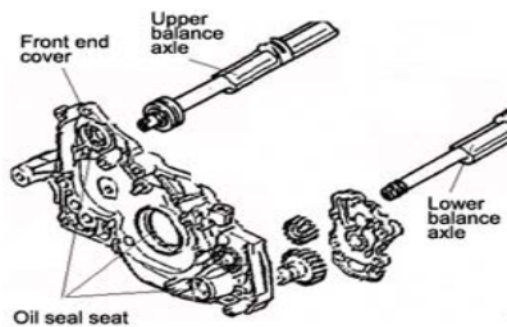
Cylinder vertical oil pipe

Cylinder

2. There is a vertical oil pipe in the rear end of cylinder cover, which provides lubricant to air distribution mechanism.

The front end cover is made of molten horniness aluminum metal. Oil pump and cleaner system are located on the front end cover's board. The cover board itself is front housing of oil pump.

6. Front End Cover Features



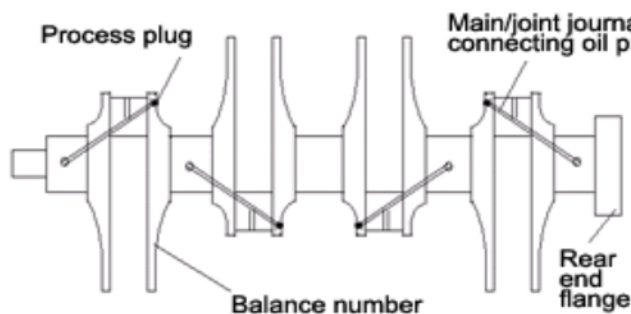
Front end cover

Upper balance axle

Oil seal seat

Lower balance axle

7. Crank Connecting Rod Mechanism

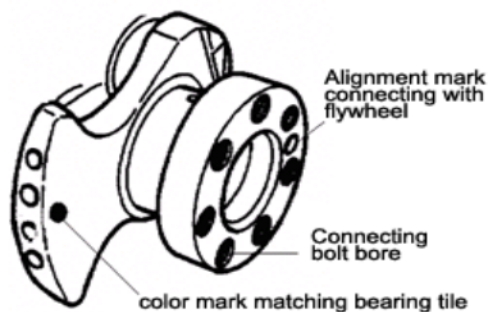


Process plug

Main/joint journal connecting oil pipe

Balance number

Rear end flange



Alignment mark connecting with flywheel

Connecting bolt bore

color mark matching bearing tile

Front crank oil seal, oil pump seal and upper

balance axle oil seal are pressed and fixed on front cover board.

The cylinder front end is combined as horizontal oil pipe and there is an oil pipe to lubricate the rear bearing of lower balance axle.

Both upper and lower balance axles are supported by front end cover board. Lower balance axle is also driven axle of oil pump.

Crankshaft is made of forged carbon steel, which surface is machining processed

The location of crankshaft oil pipe is as shown.

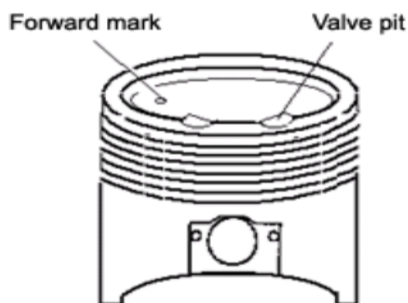
Crankshaft is full-balance type, that is $\text{Balance Number} = \text{Number of Cylinders} \times 2$.

The rotary radius of crankshaft main axle center and crankshaft pin center is separately 88/2 (4G63), 100/2 (4G64) .

Main axle diameter/57mm、Connecting rod diameter/45mm (The diameter of 4G63 and 64 is same);

The rear end flange is thickened as oil seal top and don't impact it. Seven flywheel bolts are part distributed and there is a flywheel locking pin.

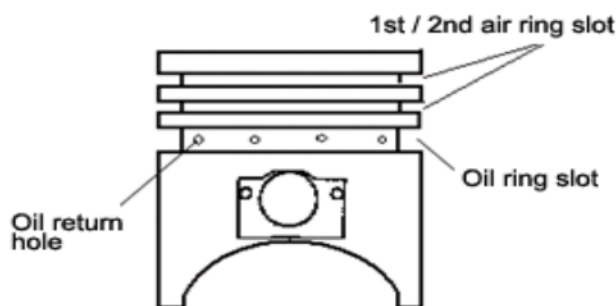
8. Piston Structure Features



Forward mark
Valve pit

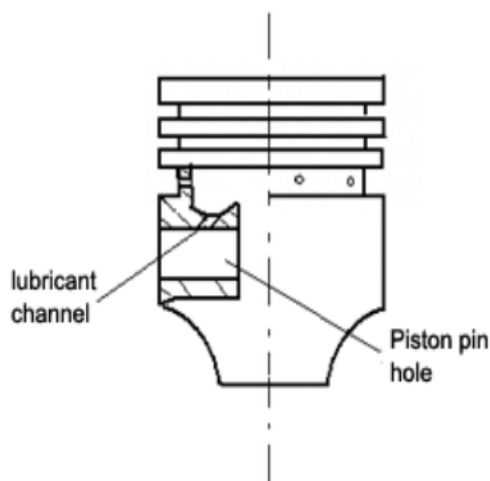
It is made of molten horniness aluminum, which has been surface processed.

There is a roundness concave on the top, which makes chamber compacted, decreases F/V value, reduces nocuousness emission, increases power and decreases oil consumption. There is valve pit on the right side of piston, which makes chamber structure more impacted.



1st / 2nd air ring slot
Oil return hole
Oil ring slot

There are two air ring slots and one oil ring slot. A oil return hole is drilled in the oil ring slot, which lubricate piston pin mating and reduce dynamic pressure of oil ring.

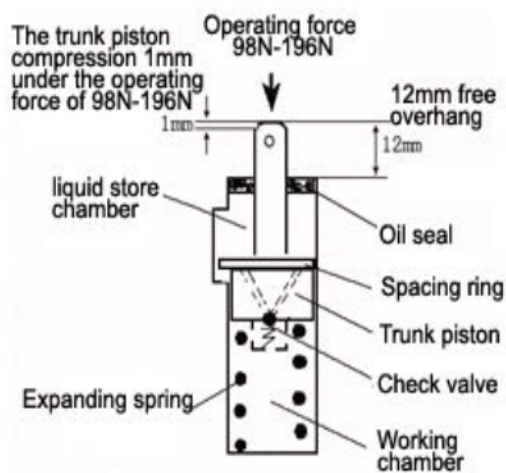
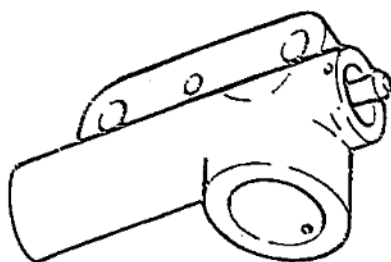


lubricant channel
Piston pin hole

There is oil slot in the inside upper of piston pin seating, which collect splash oil to lubricate piston pin mating



9. Automatic Tensioner



Operating force 98N-196N

The trunk piston compression 1mm under

the operating force of 98N-196N

12mm free overhang

liquid store chamber

Oil seal

Spacing ring

Trunk piston

Check valve

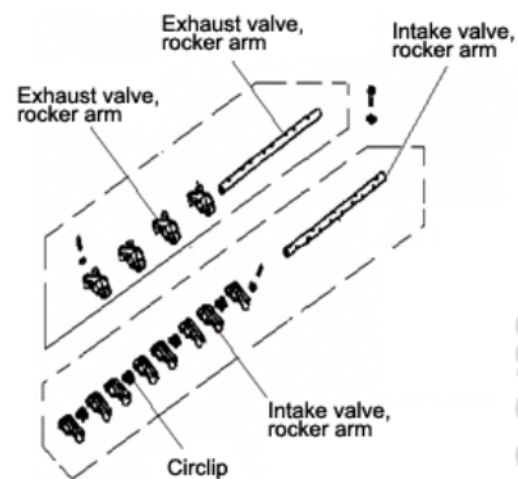
Expanding spring

Working chamber

10. Air

Distribution

Mechanism



Exhaust valve, rocker arm

Exhaust valve, rocker arm

Intake valve, rocker arm

Circlip

Intake valve,

rocker arm

Automatic tensioner is to

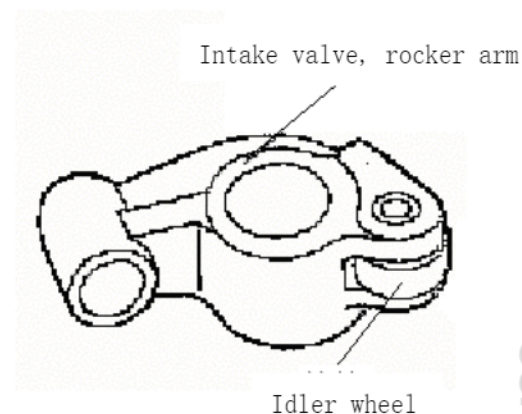
make timing belt tensioned.

In an operation cycle, the

belt tension is not

constant and changing periodically. With usage time increasing and belt aging, tensioner may be tensioned automatically to prevent belt sliding and affect engine air distribution phase.

latter will inject incoming oil from rocker to lubricate air distribution mechanism.

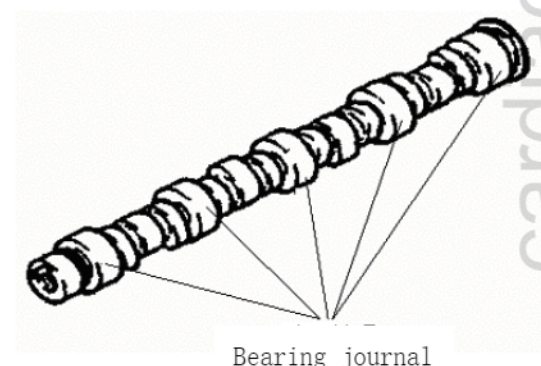


Intake valve, rocker arm

Idler wheel

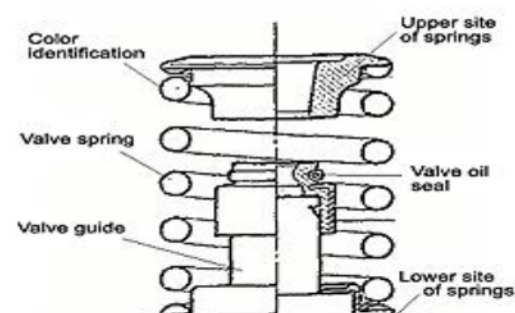
The two hollow rocker of oil hole can neither be exchanged nor be reversely installed.

Eight intake valve, rocker arms are divided into group A and B without exchange. Four exhaust valve, rocker arms are exchangeable. The intake/exhaust valve, rocker arms are made of aluminum metal, which may decrease weight, reduce crankshaft cam load, extend its life time and improve engine performance and fuel economics. There are oil pipe and oil injection hole, which are supported by hydraulic pole in intake/exhaust valve, rocker arms. The



Bearing journal

Bearing journal



Upper site of springs

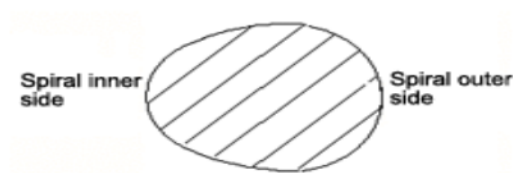
Color identification

Valve spring

Valve guide

Valve oil seal

Lower site of springs



Spiral inner side

Spiral outer side

The valve spring is non-isometry structure, which may prevent sympathetic vibration and rupture. Please notice that the color-marked should be upwards and the larger-distant is upwards.

Spring section is elliptoid, which surface is shot blasting processed to improve fatigue resistance.

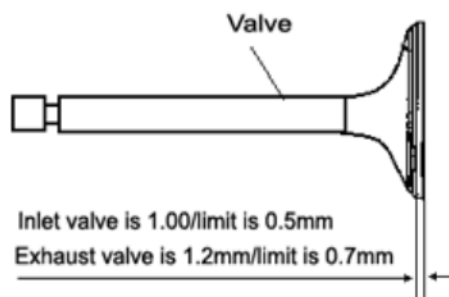
Idler wheel rocker arm is adopted in the rocker arm so as to reduce the abrasion between camshaft cam and rocker arm

Camshaft is made of spheroidal graphite iron, of 5-point bearing and no special bearing.



Working surface width

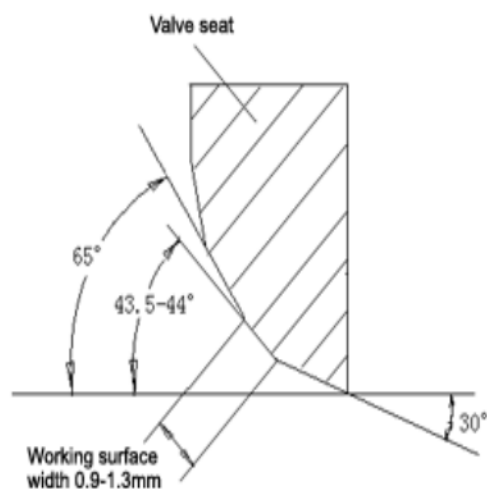
0.9-1.3mm



Valve

Inlet valve is 1.00/limit is 0.5mm

Exhaust valve is 1.2mm/limit is 0.7mm



Valve seat

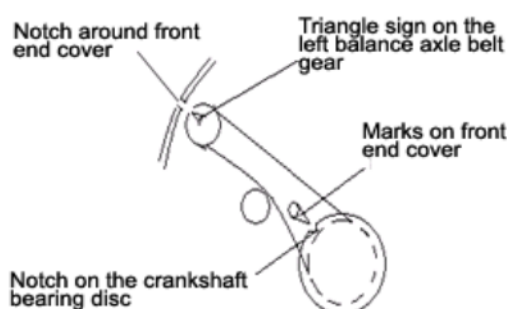
The valve is of umbrella structure. The intake valve is similar to the exhaust valve, but the size of the former is a little bigger than the later. Each cylinder is of four-valve structure, which may improve emission efficiency, decrease weight and inertia resistance and extend the life time of valve and valve seat. Besides it, it is of benefit for spark plug allocation, which improve burning efficiency and reduce injurant emission and fuel consumption.

Valve oil seal is of steel-shelf and rubber-ring-spring tension structure. The

11. Timing Gears Train

Upper Balance Axle Belt

Fitting Mark



Notch around front end cover

Triangle sign on the left balance axle
belt gear

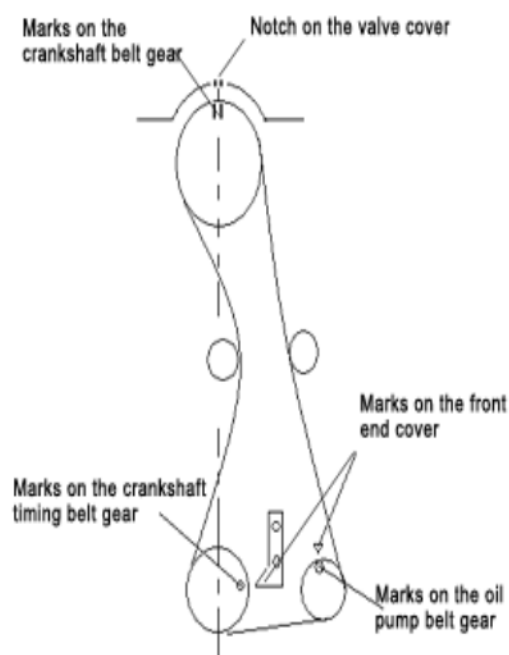
Marks on front end cover

Notch on the crankshaft bearing disc

There is an independent transmission belt on the upper-left balance axle. Tension wheel B is located on the loosened side, which is to adjust belt tension manually. The teeth number of drive gear is 38 teeth and the teeth number of driven gear is 19.

Please note that align the marks of crankshaft B belt gear and front end cover and the marks of upper-left balance axle belt gear and front end cover when installing left balance axle belt gear, which is as shown.

Timing Belt Fitting Mark



Marks on the crankshaft belt
gear

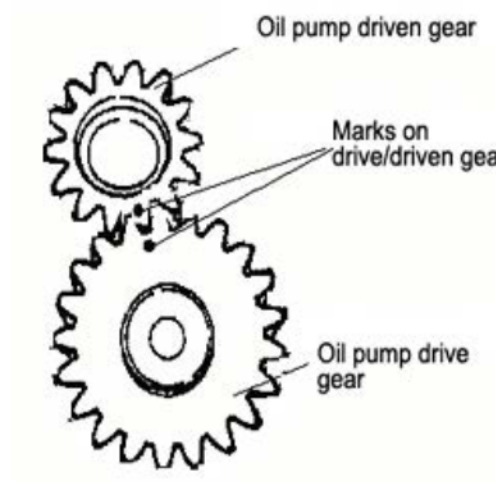
Notch on the valve cover

Marks on the front end cover

Marks on the crankshaft timing
belt gear

Marks on the oil pump belt gear

Oil Pump Gears Mark



Please align the marks of drive/driven gears when installing oil pump gears as shown.

Oil pump driven gear

Marks on drive/driven gear

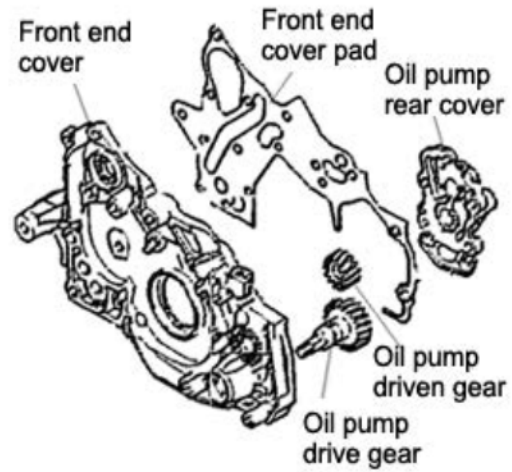
Oil pump drive gear

Please note that align the marks of camshaft belt gear and valve cover, the marks of crankshaft timing belt gear and front end cover and the marks of oil pump belt gear and front end cover when installing timing belt. (The 60mm-length screw drive must be inserted into the lower balance test hole, otherwise turn around oil pump belt gear and then align timing mark.)

12. Lubrication

System Structure

Features



Front end cover

Front end cover pad

Oil pump rear cover

Oil pump driven gear

Oil pump drive gear

Driven gear

Drive gear

Oil pump rear cover

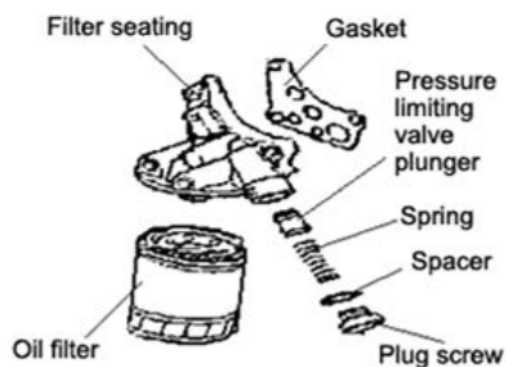
Front end cover

Oil cleaner seat

Oil cleaner

Collecting filter

Low oil housing



Filter seating

Gasket

Pressure limiting valve plunger

Spring

Spacer

Oil filter

Plug screw

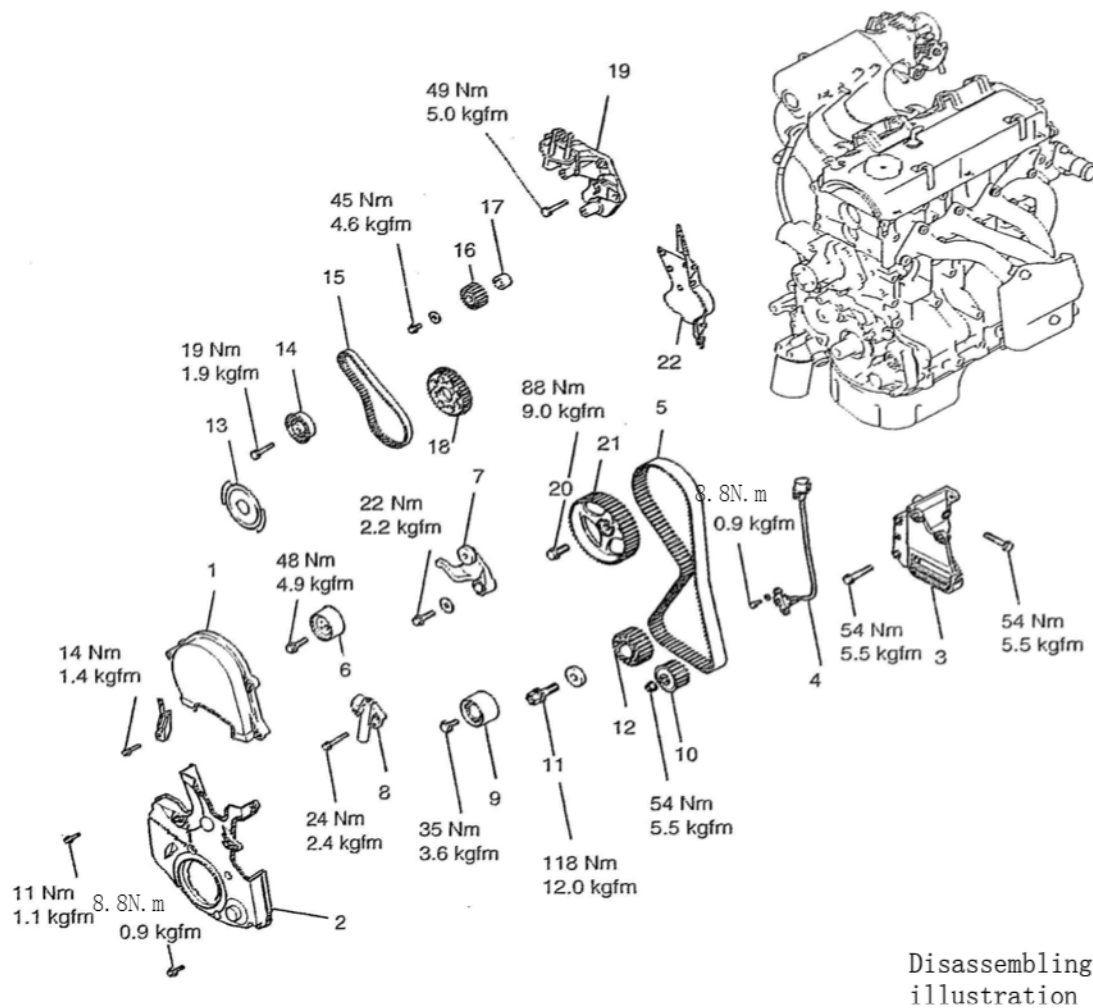
External gear oil pump is applied and its oil supply performance is better than current rotor pump. The efficiency of external gear pump is high, that is, the efficiency of oil supply is proportional to the speed, which may satisfy large-load oil supply requirement. However, if rotor pump speed increase, the oil pump efficiency will increase at low speed, but it will drop gradually when the speed reach mid-speed as shown, which will cause lack of large-load oil supply. Therefore, large load

should be considered when designing rotor pump, but it will consume power during low loading.

Oil filter seating and pressure limiting valve – Pressure limiting valve is of plunger spring structur

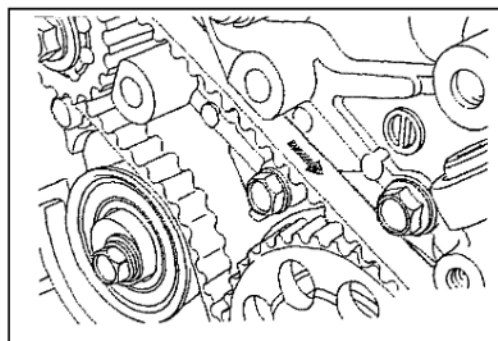
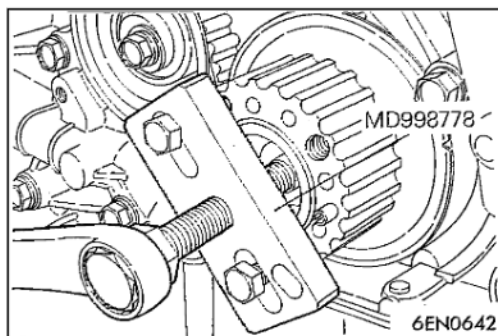
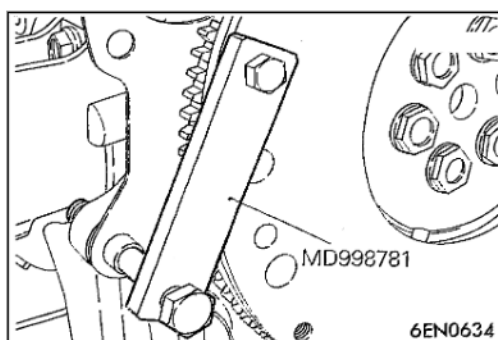
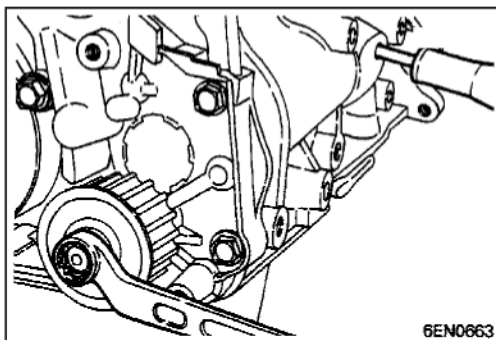
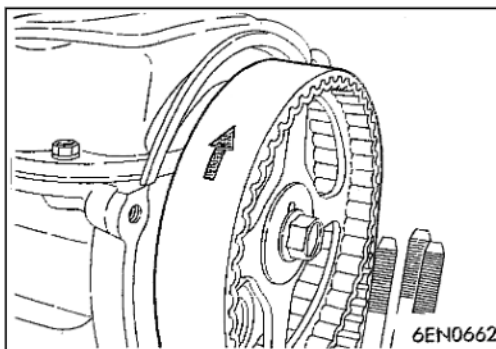
Chapter 3 Valve gear

I. Timing belt



Disassembling steps

- | | |
|-----------------------------------|---------------------------------------|
| 1. front upper cap of timing belt | 12. crankshaft |
| 2. front lower cap of timing belt | timing pulley |
| 3. power steering bracket | 13. flange |
| 4. crankshaft position sensor | 14. tensioner B |
| 5. timing belt | 15. timing belt B |
| 6. tensioning gear | 16. pulley of upper balance shaft |
| 7. tensioner arm | 17. bushing |
| 8. automatic tensioner | 18. crankshaft |
| 9. idler | timing pulley B |
| 10. oil pump pulley | 19. right bracket component of engine |
| 11. crankshaft screw bolt | 20. screw bolt of camshaft pulley |
| | 21. camshaft timing pulley |



1 Disassembling Notice

● Disassembling of timing belt

Remember the rotation direction of belt in order to avoid any error when reassembling.

Caution:

- 1) If there is water or grease on the belt, the lifecycle of belt will be decreased rapidly. So, after disassembling, take care not to have water or grease adhere to and pollute the belt, the pulley, and the tensioner. Do not clean these parts. When they are seriously polluted, please replace them with new ones.

2) If water or grease is found in these parts, please check whether there is any leakage in the oil seal of front cover, the oil seal of camshaft and water pump.

● Disassembling of oil pump pulley

- (1) Disassemble the plug cock on the cylinder side.
- (2) Insert an 8mm-diameter cross-ended screwdriver to fasten the left side balance shaft.
- (3) Disassemble the screw nut of oil pump pulley.
- (4) Disassemble the oil pump pulley.

● Disassembling of crankshaft screw bolt (Disassembling of flywheel)

- (1) Fix the driving board or flywheel with special tool.
- (2) Disassemble the crankshaft screw bolt. Support the driving board or flywheel with special tool.

● Disassembling of crankshaft pulley

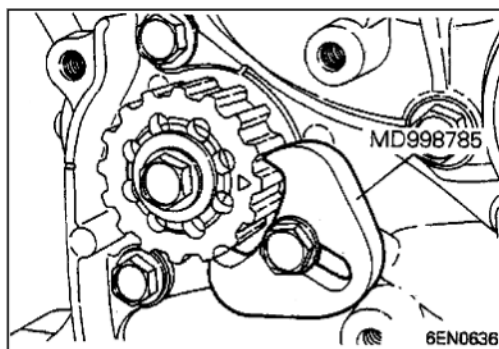
If it is difficult to disassemble due to the reason of adhering, please apply special tool.

● Disassembling of timing belt B

- (1) Remember the rotation direction of belt to avoid any error when reassembling.

Notice:

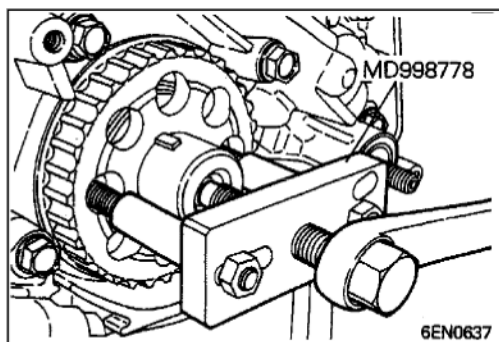
If there is water or grease on the belt, the lifecycle of belt will be decreased rapidly. So, after disassembling, take care not to have water or grease adhere to and pollute the belt, the pulley, and the tensioner. Do not clean these parts. When they are seriously polluted, please replace them with new ones.



(2) If water or grease is found in these parts, please check whether there is any leakage in the oil seal of front cover, the oil seal of camshaft and water pump.

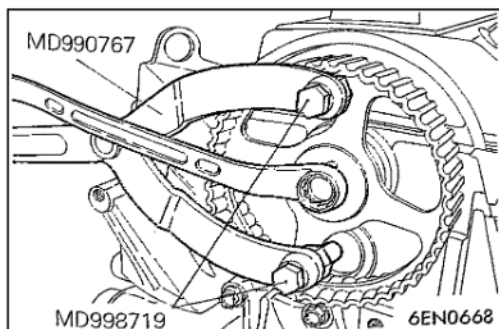
● Disassembling of pulley of upper balance shaft

- (1) Apply tool as shown in the illustration to fix the pulley of balance gear.
- (2) Disassemble the pulley of upper balance shaft.



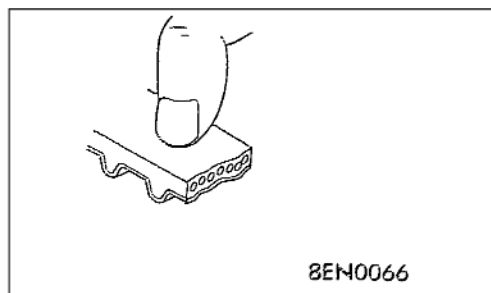
● Disassembling of crankshaft pulley B

- (1) If it is difficult to disassemble due to the reason of adhering, please apply special tool.



● Disassembling of camshaft pulley screw bolts

- (1) Fix the camshaft timing pulley with special tool.
- (2) Disassemble the screw bolts of camshaft pulley.



2 Check

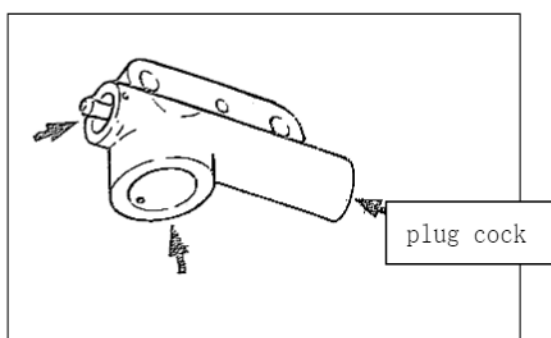
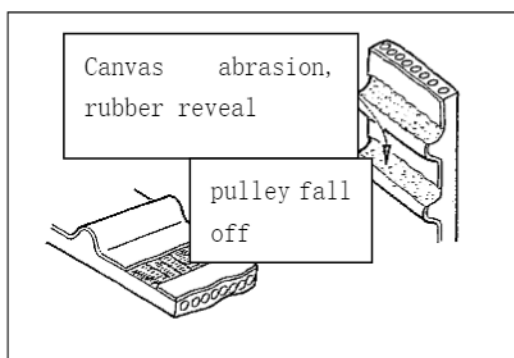
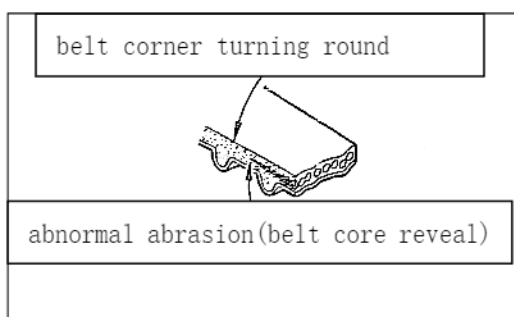
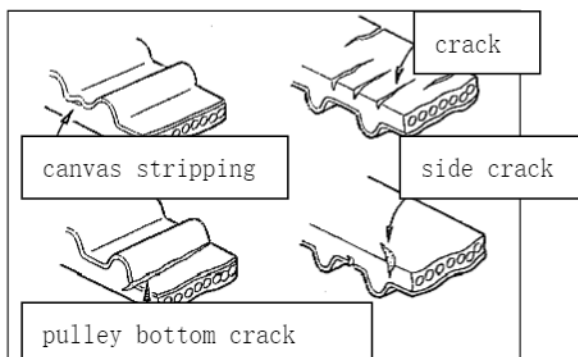
● Timing belt

Check every part of the belt carefully, if there is any damage as the following, please replace with new one.

- (1) The back rubber is aging and glistening. There is no crack when fingernail scratches it and there is no flexibility.
- (2) There is crack in the back rubber.
- (3) There is crack and stripping in the canvas.
- (4) There is crack at the bottom of pulley.
- (5) There is crack in the side of pulley.
- (6) Abnormal abrasion in the side of pulley. When the side of belt is as smooth as surface of one cut by sharp knife, it is normal.
- (7) Abnormal abrasion in the part of pulley.
- (8) Teeth off.

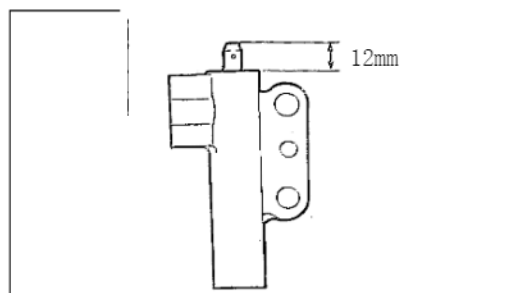
● Automatic tensioner

- (1) Check the leakage of automatic tensioner. Replace with a new one when necessary.
- (2) Check if there is any abrasion or damage at the end of the rod. Replace with a new one when necessary.



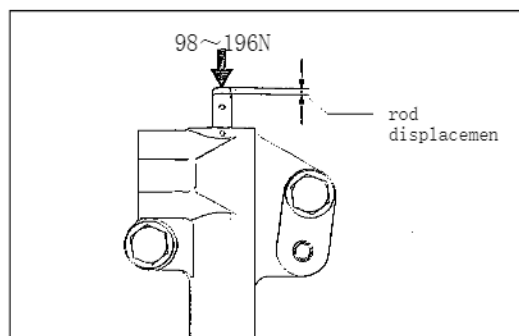


y • Tiggo(T11) Engine Section



- (3) Measure the stretch of the rod. If it is not conformed to the standard, replace the automatic tensioner with a new one.

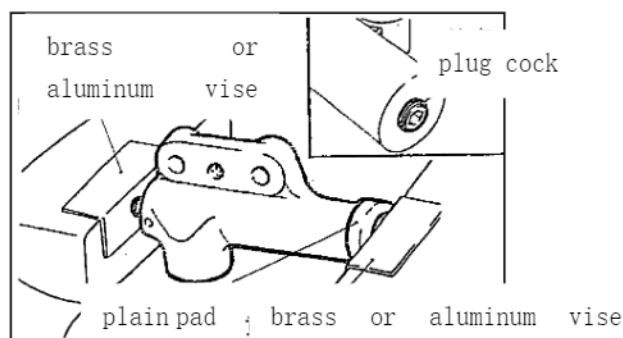
Standard value: 12mm



- (4) Press down the rod with a power of 98~196N and measure the rod displacement.

- (5) If the rod displacement is 1mm larger than the value measured in the (3) item, the automatic tensioner should be replaced.

Standard value: $\leq 1\text{mm}$

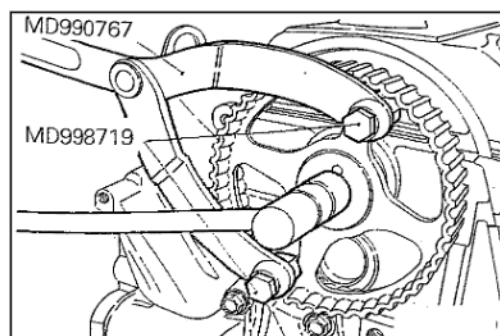


- (6) Fasten the automatic tensioner with vises which has soft opening.

Caution:

- As there is screw bolt stretching out at the bottom of automatic tensioner, a plain pad should be inserted between the vises and screw bolt to avoid their direct contact.

- (7) Rotate the handle of vises to push the rod of automatic tensioner in. If it is easy to push in, please replace the automatic tensioner with a new one. It should be felt as if there is some resistance when you push in the rod.



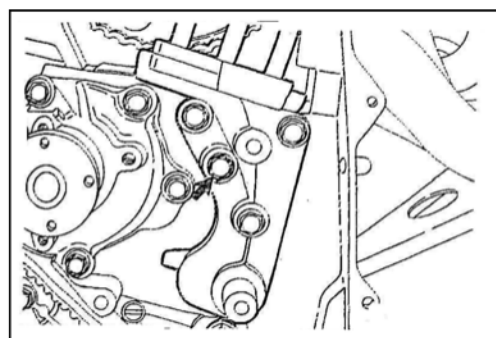
3 Installation Notice

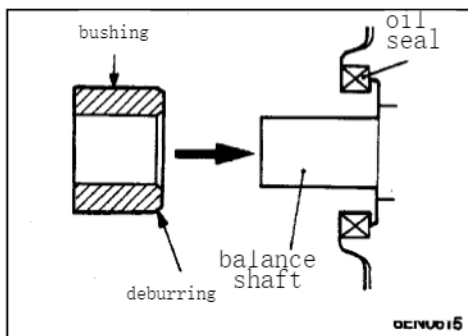
- Fasten bolt of camshaft pulley

- (1) Fix the camshaft pulley with special tool.
- (2) Fasten the bolt of camshaft pulley to the assigned torque.

- Installation of engine bracket base

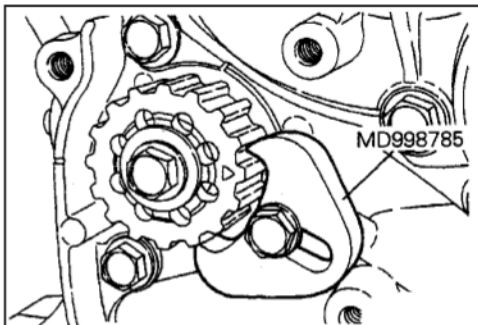
- (1) Before starting fastening, apply sealant to the bolt part as shown in the illustration.





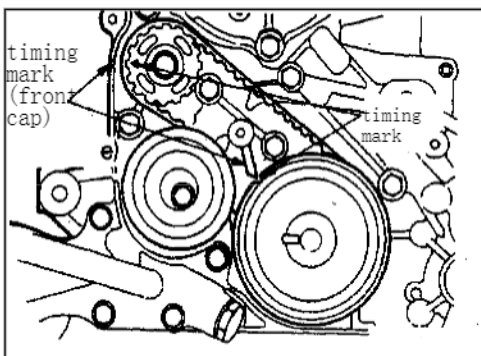
- Installation of bushing in upper balance shaft

(1) When installing the bushing, place the side with deburring to the direction of oil seal.



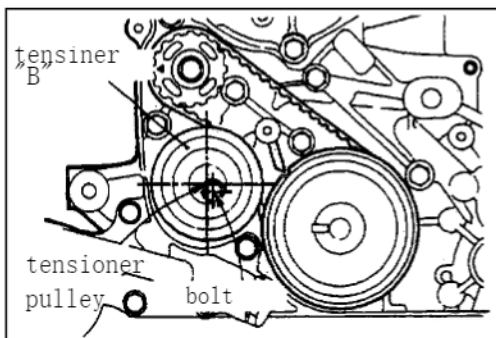
- Installation of pulley in upper balance shaft

- (1) Fix pulley in the balance shaft with a tool as shown in the illustration.
- (2) Fasten the bolt to assigned torque.



- Installation of timing belt B

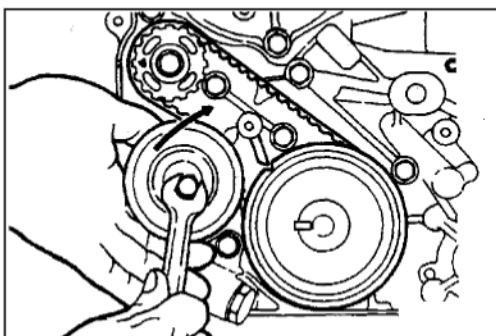
- (1) Align the marks on the crankshaft pulley and balance shaft pulley with the marks on the front cover respectively.
- (2) Install timing belt B in the crankshaft pulley and balance shaft pulley. There should not be loose in the tensioner side.

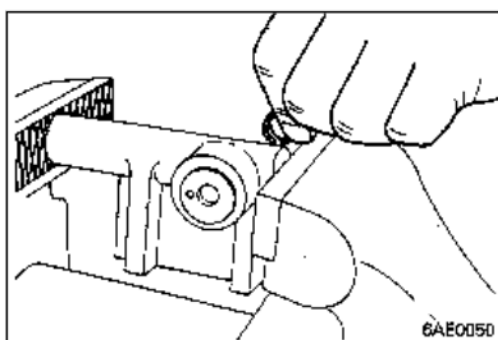
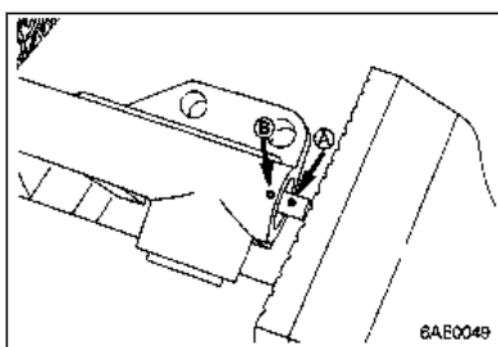
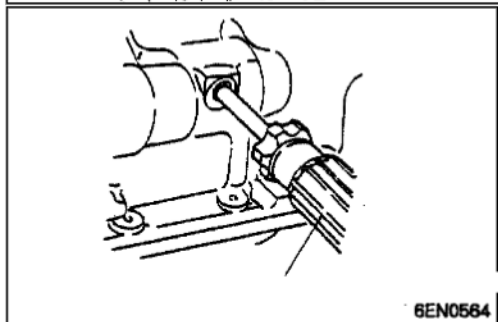
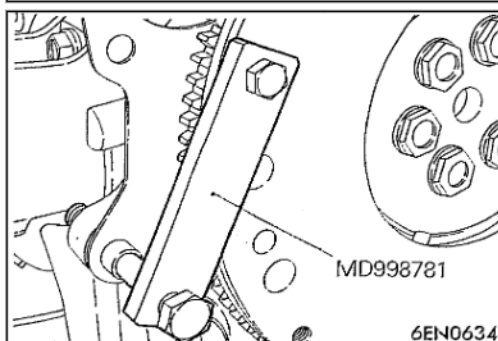
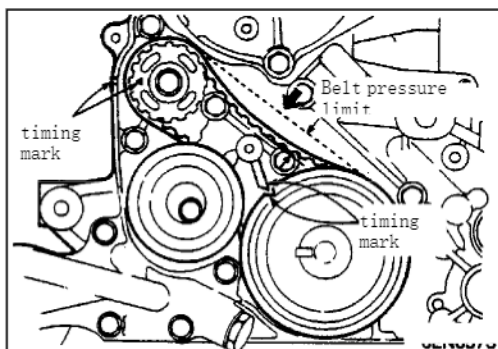


- (3) Make sure that the position of tensioner center and bolt center as shown in the illustration.

- (4) While putting power on the side of timing belt tensioner with finger, move tensioner B according to the arrow. Now fasten the screw bolt to fix tensioner B.

Caution: When fastening the bolt, do not keep the axle revolve with the pulley in case that the belt gets too tight.





- (5) Ensure to keep the marks in the pulley and the front cover aligned.
- (6) Press the central part in the side of tensioner of the timing belt B with the index finger, with the pressure limit of 5~7mm.

● Fasten the crankshaft bolt

- (1) Fix the flywheel with special tool.
- (2) Install crankshaft bolt.

● Installation of pulley in oil pump

- (1) Insert cross-ended screwdriver to the left side of hole in the cylinder to prevent turning of balance shaft.
- (2) Install pulley of oil pump.
- (3) Apply oil to the combining side of screw nut and bearing.
- (4) Fasten the screw nut with a torque of 54Nm.

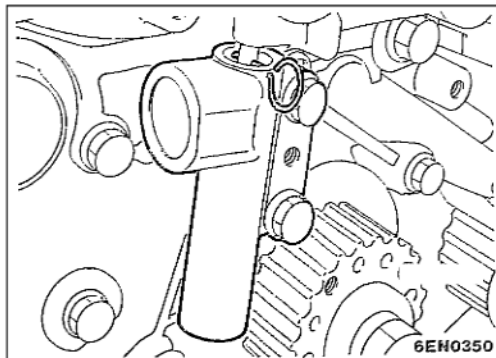
● Installation of automatic tensioner

- (1) If the automatic tensioner is in the stretching position, it should be drawn back according to the following steps.
- (2) Fasten the automatic tensioner with vises that have soft opening.

Caution:

- As there is a stretching screw plug at the bottom of automatic tensioner, a plain pad should be inserted between the vises and the screw plug to prevent their direct contact.

- (3) Slowly push the vises in until the rod ① hole and oil tank ② gets aligned.
- (4) Insert the steel wire(diameter 1.4mm) to the aligned hole.
- (5) Disassemble the automatic tensioner from the vises.



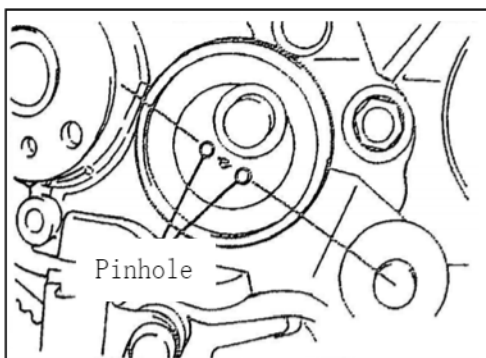
- (6) Install the automatic tensioner in the front cover, fastening the bolt with a torque of 24Nm.

Caution:

- Leave the steel wire in the automatic tensioner.

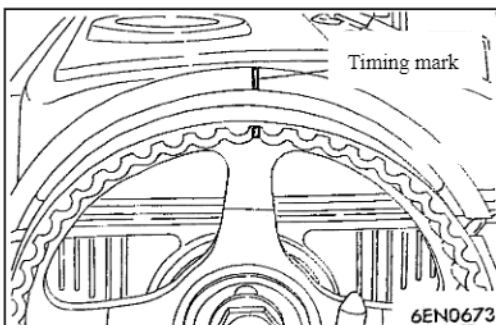
● Installation of tensioning pulley

- (1) Install the tensioning pulley and keep the two pin holes in a vertical line.

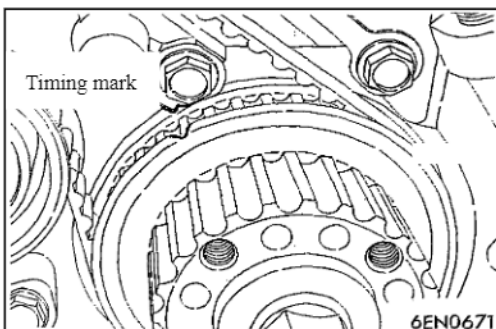


● Installation of timing belt

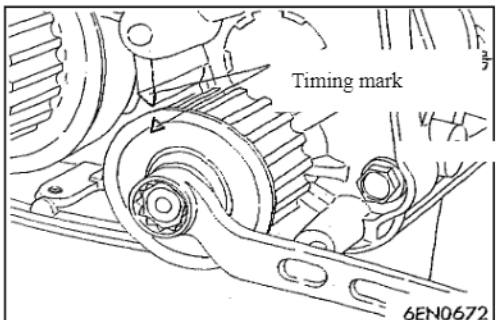
- (1) Make sure that the belt tensioner is installed properly.
- (2) Make the timing mark in the camshaft pulley and that in the cylinder cover aligned.

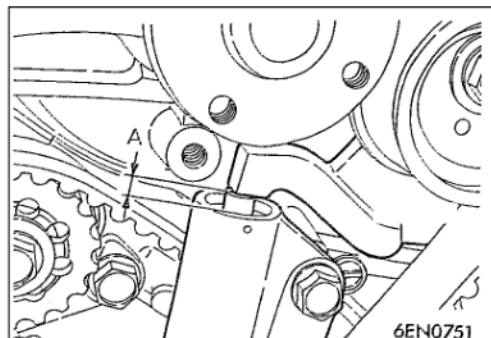
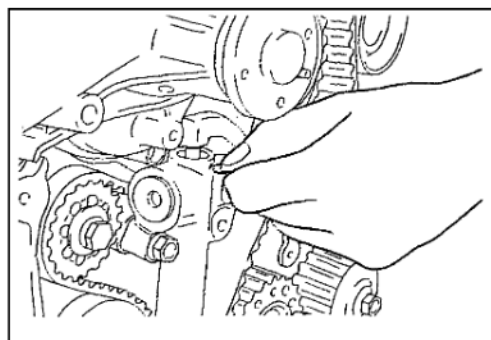
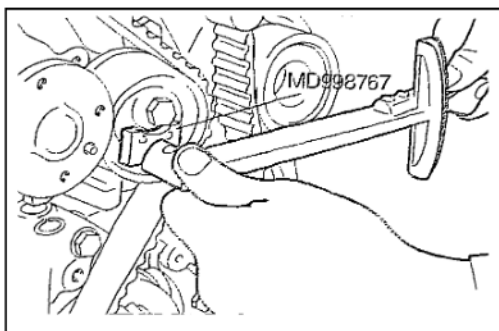
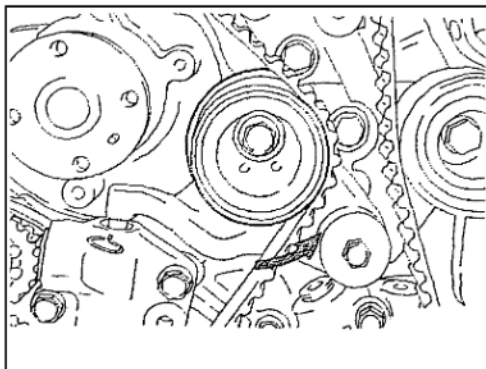
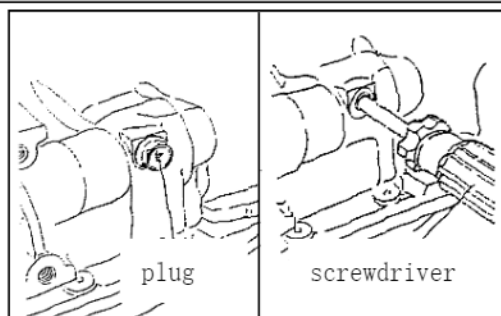


- (3) Make the timing mark in the crankshaft pulley and that in the front cover aligned.



- (4) Keep the timing mark in the oil pump pulley and its conforming mark aligned.





(5) Disassemble the plug from the cylinder block and then insert the cross-ended screwdriver (diameter of 8mm) to the hole. If it could be inserted more than 60mm in, it means that the timing marks are aligned. If the range that could not be inserted above 20~25mm, the oil pump pulley should be turned for one revolution and the timing marks should be then aligned. Again check if the screwdriver could be inserted over 60mm. Keep the screwdriver in the inserting position until the installation of belt finishes.

(6) Connect the timing belt to the crankshaft pulley, middle pulley, camshaft pulley and tensioner pulley in turn.

(7) Raise the pulley of the tensioner to the direction of arrow and then fasten the central bolt.

(8) Make sure that all the timing marks are aligned.

(9) Disassemble the screwdriver inserted in step (5) and fix the plug.

(10) Rotate counterclockwise the crankshaft for a quarter of revolution until all the timing marks again get aligned.

(11) Install the special tools socket wrench and torque wrench to the tensioner pulley and then loosen the central bolt in the pulley of tensioner.

Remarks:

If special tools could not be applied, a general torque wrench that could measure a torque of 0 to 0.5 KgM may be used.

(12) Fasten to the torque of 3.5N.m (0.35 KgM) with a torque wrench.

(13) While keeping the tensioner pulley with special tool and torque, fasten the central bolt to standard value.

(14) Rotate clockwise the crankshaft two revolutions and lay it for about 15 minutes. Then check whether the fixing steel wire of automatic tensioner could slide freely.

Remarks:

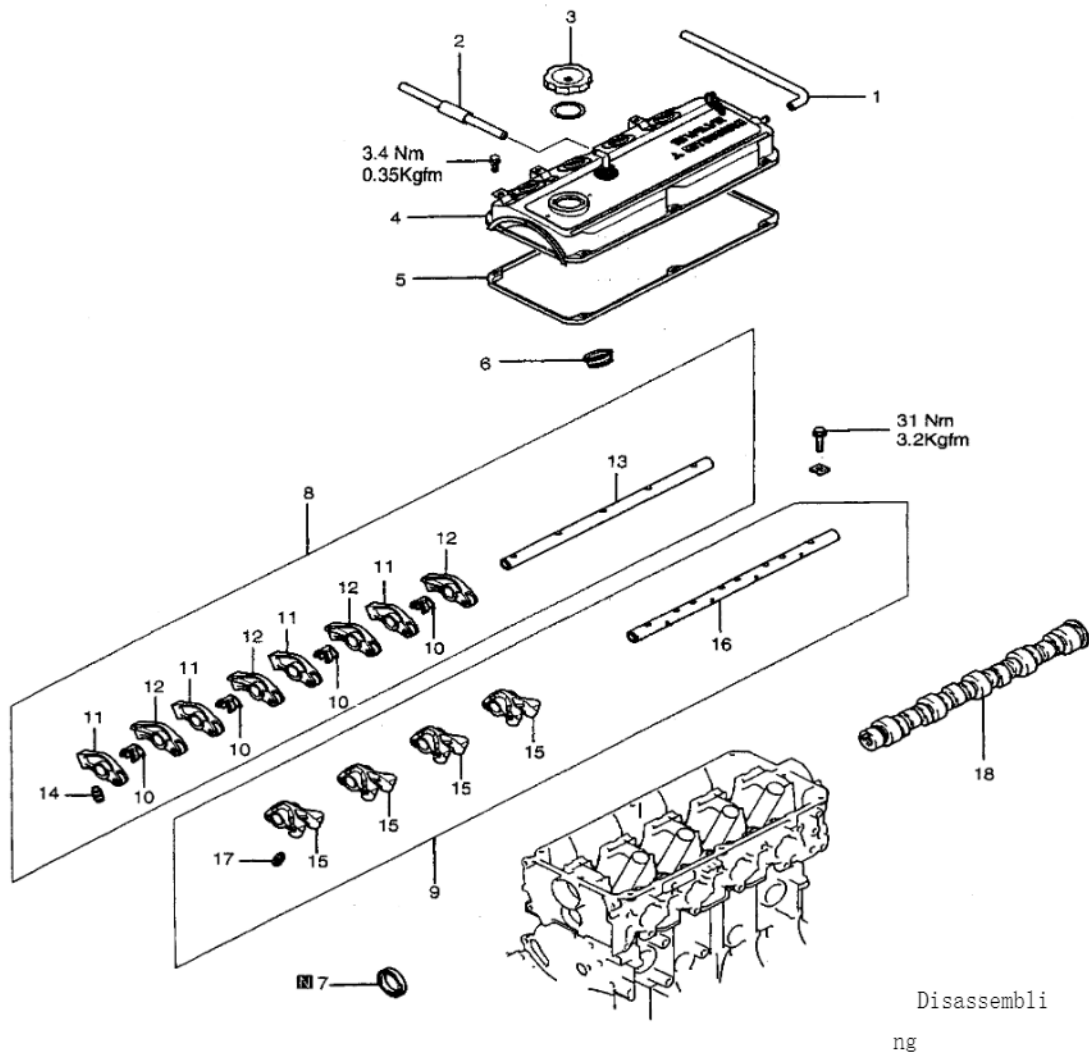
If the steel wire could not slide freely, repeatedly do the steps after (10) until the steel wire slides.

(15) Take off the fixing steel wire of automatic tensioner.

(16) Measure the distance "A" (between the tensioner arm and the automatic tensioner itself).

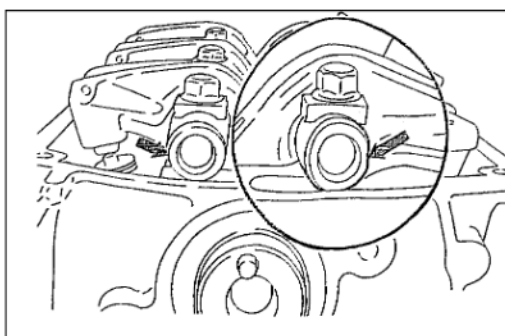
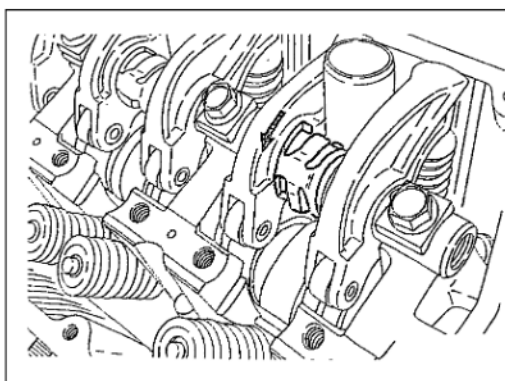
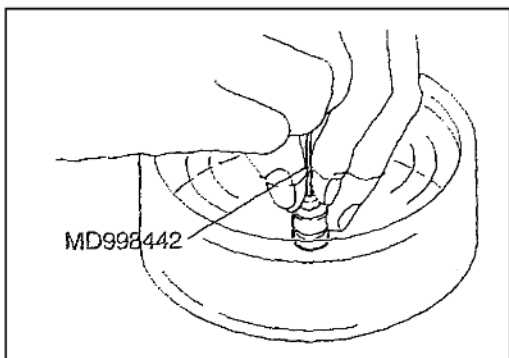
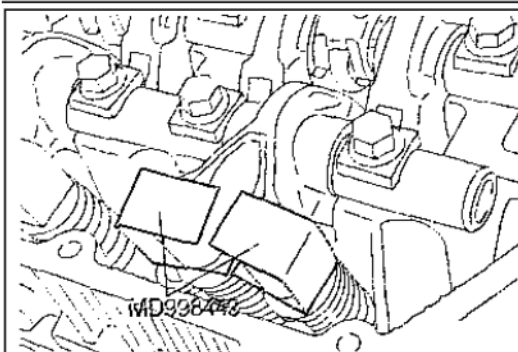
Standard value: 3.8—4.5mm

II. Rocker arm and camshaft



Disassembling steps

1. air flow tube
2. P.C.V. tube
3. fuel filler cap
4. rocker arm cap
5. pad of rocker arm cap
6. oil seal
7. oil seal
8. rocker arm and rocker shaft
9. rocker arm and rocker shaft
10. rocker shaft spring
11. rocker arm A
12. rocker arm B
13. rocker shaft(intake side)
14. hydraulic erect post
15. rocker arm C
16. rocker shaft(exhaust side)
17. hydraulic erect post
18. camshaft



1. Disassembling Notice

● Disassembling of rocker arm and rocker shaft

- (1) Before disassembling the rocker arm and rocker arm shaft assembly, install the special tools as shown in the illustration to prevent dropping of hydraulic erect post.

2. Installation Notice

● installation of hydraulic erect post

- (1) Soak the hydraulic erect post in clean diesel oil.
- (2) With the special tool "exhaust steel wire", while slightly pressing the steel ball of check valve, move the plunger up and down for four to five times to exhaust the air.

Caution: As the rigid ball spring is especially soft, do not push the steel ball too violently with exhaust steel wire in case any damage to the hydraulic erect post.

It is easy to exhaust air from the hydraulic erect post installed by rocker arm with a **keeper** (special tool).

- (3) Insert the hydraulic erect post into the rocker arm, being careful to avoid diesel oil overflow. Then apply special tool to prevent the dropping of hydraulic erect post during the installation.

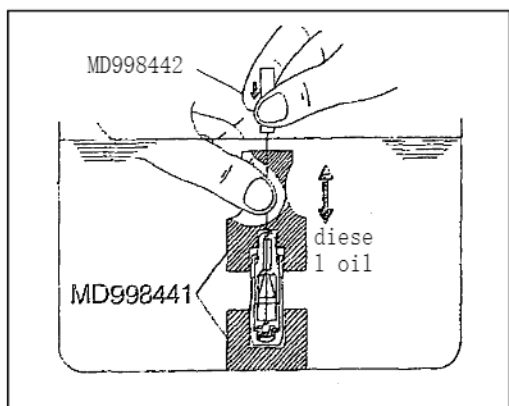
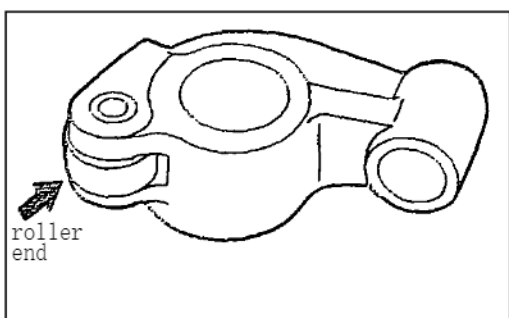
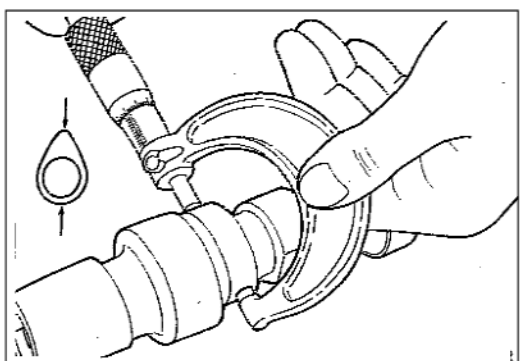
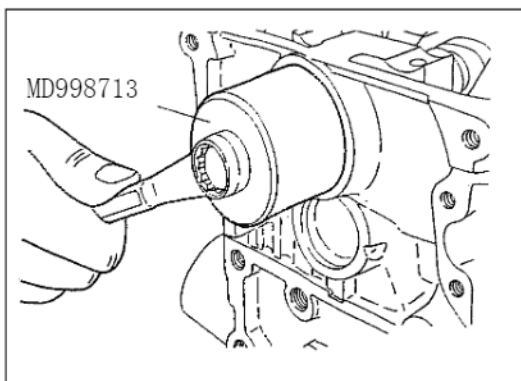
● Installation of rocker shaft spring, rocker arm and rocker shaft

- (1) Fasten the intake rocker shaft with a bolt temporarily until no rocker arm push and press the valve.
- (2) Assemble the rocker shaft spring from the upper until it is vertical with the duct of spark plug.

Caution: The rocker shaft spring should be installed first and then tighten the bolt of exhaust rocker arm.

- (3) Disassemble the special tool for keep the hydraulic erect post.
- (4) Make sure that the position of cutting opening in the rocker shaft is in that shown in the illustration.

Caution: The oil hole in the rocker shaft should be aligned with the cylinder block to ensure a correct installation position.



● Installation of camshaft oil seal

Install the oil seal of camshaft with special tool

3. Check

● camshaft

(1) Measure the height of cam

The standard value and usage limit value are as follows.

4G64:

	standard value	usage limit value
intake	37.39	36.89
exhaust	37.14	36.64

4G63:

	standard value	usage limit value
intake	37.50	37
exhaust	37.14	36.49

● Rocker arm

(1) Check the surface of the roller. If there is any trace, there must be some damage or check and the rocker arm should be replaced.

(2) Check whether the roller could revolve smoothly and evasively. If it could not revolve smoothly and evasively or is a bit loose, the rocker arm should be replaced.

(3) Check the internal diameter. If there is some damage or lock is checked, the rocker arm should be replaced.

● Test on the return leakage of hydraulic erect post

Caution:

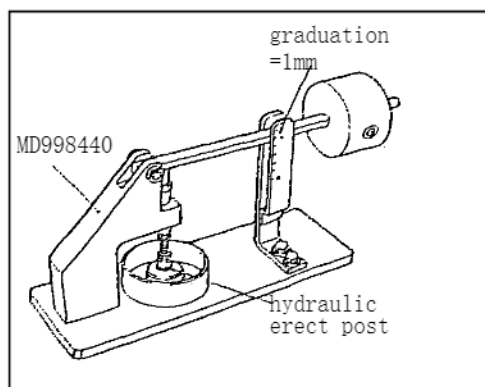
• The hydraulic erect post is a precision spare part. There should not be any dust or foreign matter on its surface

• It is not allowed to disassemble the hydraulic erect post.

• It is required to use clean diesel oil to clean the hydraulic erect post.

(1) Soak the hydraulic erect post in clean diesel oil.

With the special tool (MD998442), while pressing the steel ball in the inner side, exhaust the air by moving the plunger up and down for four to five times. It is easy to exhaust air from the hydraulic erect post installed by rocker arm.



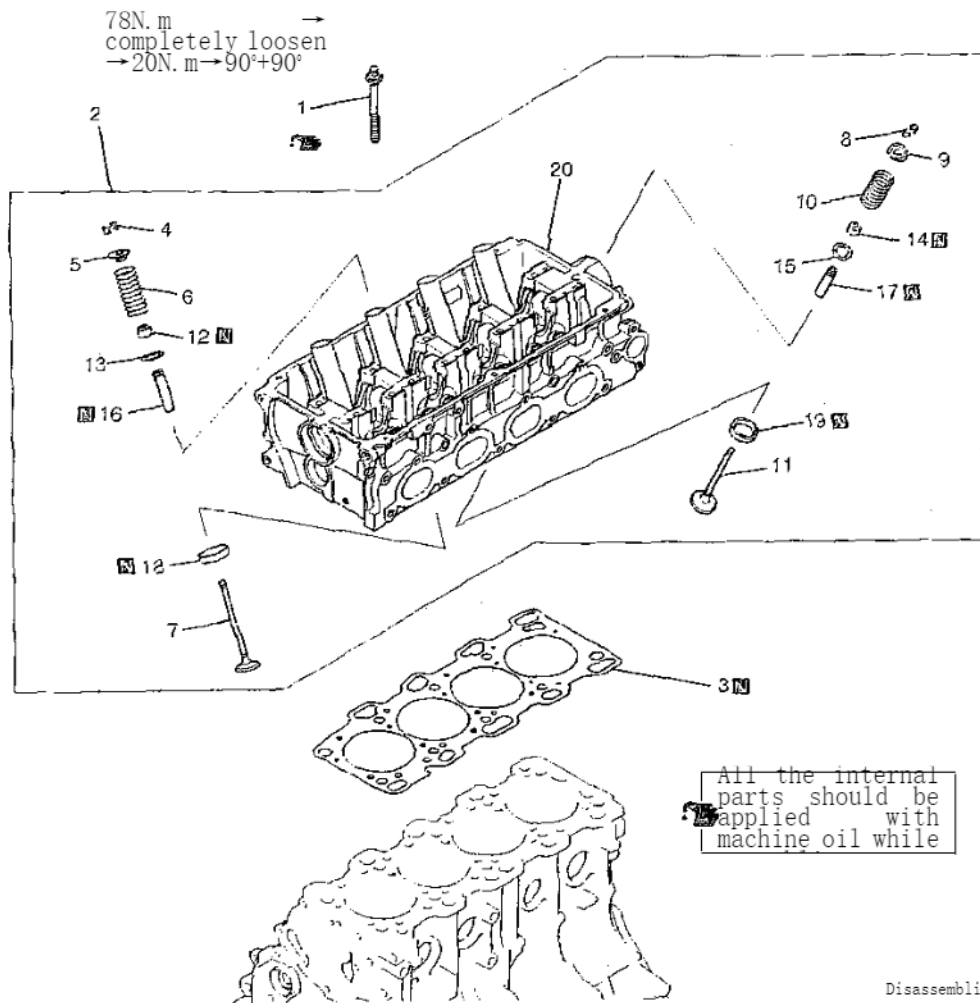
- (3) Disassemble the special tool (MD998442) and check whether the plunger could be pressed. If it is not easy to press the plunger, the hydraulic erect post is normal. If it is easy to press the plunger to the end, the hydraulic erect post should be exhausted again and then be checked again. If the plunger is still loose, the hydraulic erect post should be replaced.

Caution:

- After the exhaust of air, the hydraulic erect post should be kept erect to avoid outflow of the internal diesel oil.
- (4) After the exhaust, the hydraulic erect post should be installed in special tool (return leakage tester).
- (5) When the plunger sinks a little (0.2~0.5mm), measure the time it needs to sink a second 1mm. If the measurement value is not conformed to the standard value, replace the hydraulic erect post.

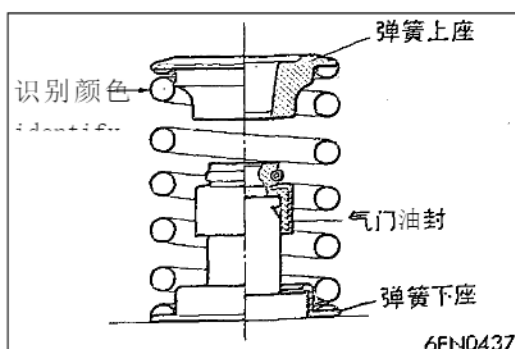
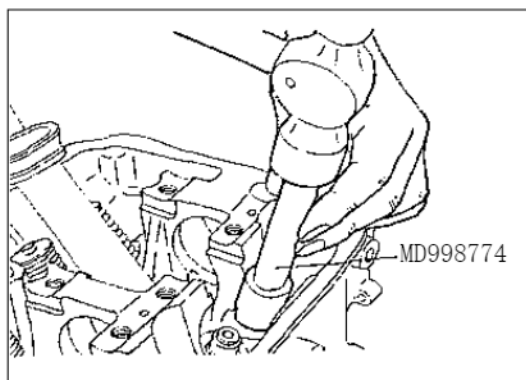
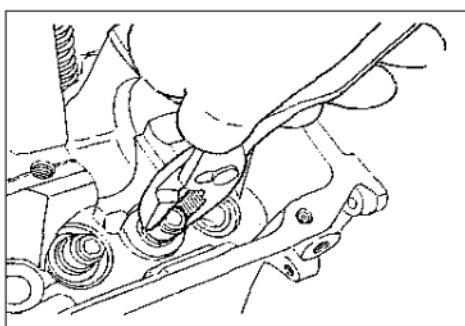
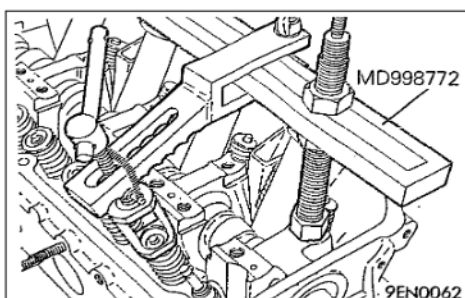
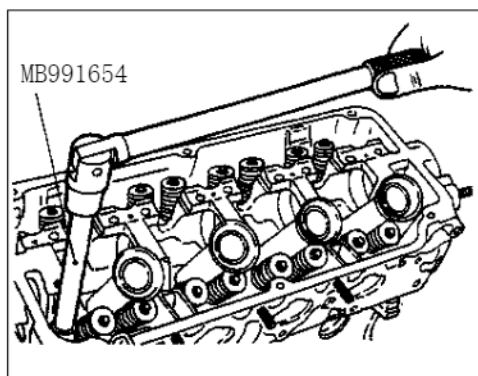
Standard value: 4 ~ 20seconds/1mm
(applying diesel oil of 15~20℃)

III. Disassembling and assembling of cylinder cover, valve



Disassembling steps

1. bolt for cylinder cover
2. components for cylinder cover
3. cylinder gasket
4. lock for valve spring retainer
5. upper valve spring retainer
6. compression spring for valve
7. intake valve
8. lock for valve spring retainer
9. upper valve spring retainer
10. compression spring for valve
11. exhaust valve
12. valve oil seal
13. valve spring retainer
14. valve oil seal
15. valve spring retainer
16. duct for intake valve
17. duct for exhaust valve
18. seat for intake valve
19. seat for exhaust valve
20. cylinder cover



Disassembling Notice

1、Cautions after disassembling

The parts disassembled must be placed according to the cylinder numbers and intake/exhaust area respectively.

- Disassembling of the bolt of cylinder cover

(1) Loosen the bolts on every cylinder cover with special tool. It should be loosened evenly and gradually.

- Disassembling of lock for valve spring retainer

(1) The disassembled parts such as valve and spring should be marked with cylinder No. and installation position, and should be kept well for use in the assembling.

- Disassembling of valve oil seal

(1) Valve oil seal should not be used repeatedly.

Installation Notice

- Installation of valve oil seal

(1) Install the lower retainer of valve spring.

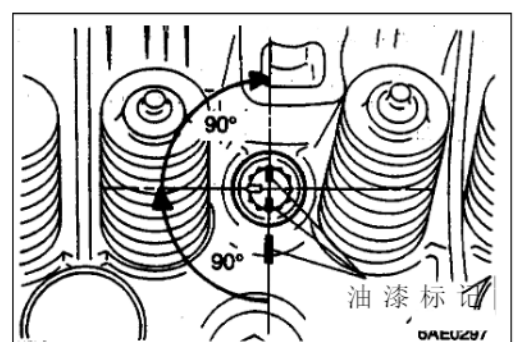
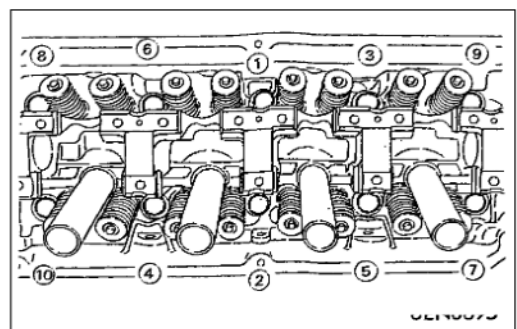
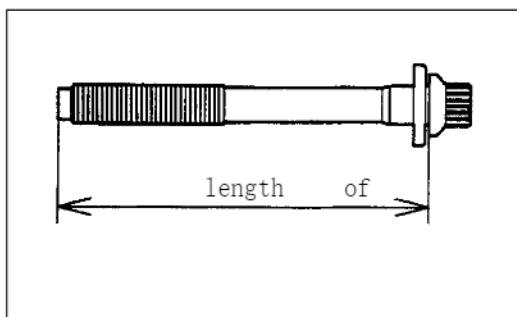
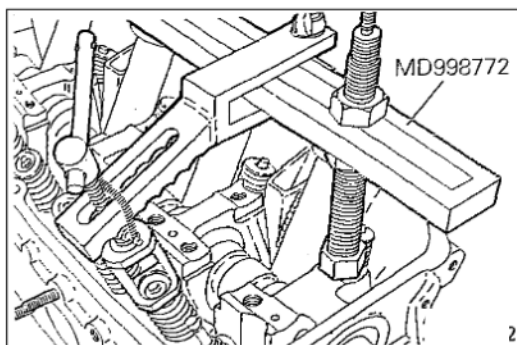
(2) Install the valve oil seal in the valve duct with special tool. Improper installation may cause leakage.

Caution:

- Valve oil seal should not be used repeatedly.

- Installation of valve spring

(1) When installing the valve spring, the end with identifying color should be faced to the upper retainer for valve spring.



● Installation of lock for valve spring retainer

(1) If the valve spring is excessively compressed, the bottom of upper valve spring retainer will contact with it and will damage the valve oil seal.

(2) Install the spring lock with special tool.

● Installation of bolt for cylinder cover

(1) When assembling the bolt for the cylinder cover, make sure that the length of bolt is suitable to the limited value. If it is larger than the limited value, the bolt should be replaced.

Limit value (A): maximum 99.4mm

(2) Apply some machine oil to the rippling part of bolt and washer.

(3) According to the fastening sequence, tighten the bolts to the assigned torque with special tool (MB991654).

Fasten torque: 78N.m

(4) Completely loosen all the bolts.

(5) According to the fastening sequence again, tighten the bolt with a torque of 20N.m

(6) Make a lined painting mark in the bolt end of cylinder cover and the cylinder cover.

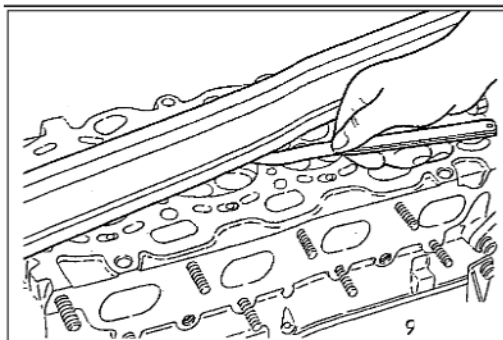
(7) Tighten the bolt of cylinder cover for 90° according to the fastening sequence.

(8) Further tighten the bolt for 90° and make sure that the painting mark in the bolt end of cylinder cover and that in the cylinder cover aligned.

Caution:

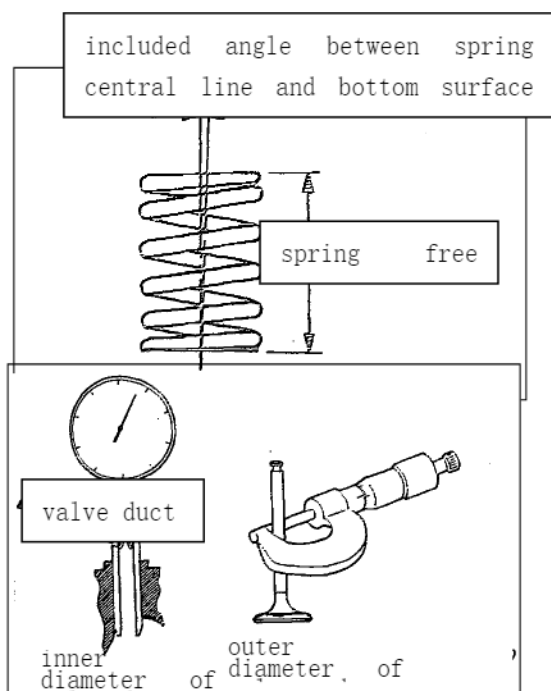
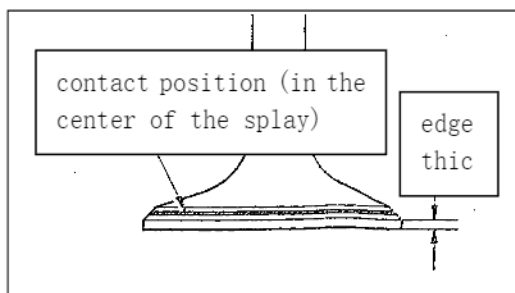
● If the tightening angle of bolt is smaller than 90°, the correct tightening torque is not expected. So while tightening, the correct tightening angle must be paid much attention to.

● When the bolt is excessively tightened, it should be fully loosened and then begin to be tightened again from step (1).



*Together with the abrasion of cylinder block.

Height of cylinder cover (standard value of new part): 119.9~120.1mm



3、Check

● Cylinder cover

- (1) Check the flatness of the bottom of cylinder cover with straightedge and plug gauge.
Standard value: 0.03mm
Limit value: 0.2mm
- (2) When the distortion exceeds the limit value, modification by abrasion is needed.
Abrasion limit value: * 0.2mm

● valve

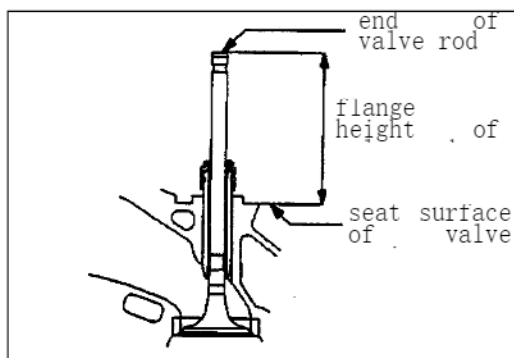
- (1) Check whether the working surfaces of valve are contacted properly. If the contact is improper, abrade again with valve polishing machine. The contacting side of valve seat should be conformed to the center of valve working surface.
- (2) If the edge thickness exceeds the usage limit value, the valve should be replaced.
Edge thickness standard value:
intake.....1.0mm
exhaust.....1.2mm
Usage limit value: intake.....0.5mm
exhaust.....0.7mm
- (3) Measure the total height of valves. If it is smaller than the limit value, the valve should be replaced.
Standard value:
intake: 112.30mm
exhaust.....114.11mm
Limit value: intake.....111.80mm
exhaust.....113.61mm

● Valve spring

- (1) Check the free height of the valve spring. If it is smaller than the limit value, it should be replaced.
Standard value: 51.0mm
Limit value: 50.0mm
- (2) Check the verticality of spring central line and the bottom surface. If the gradient exceeds the limit value, it should be replaced.
Standard value: $\leq 2^\circ$
Limit value: 4°

● Valve duct

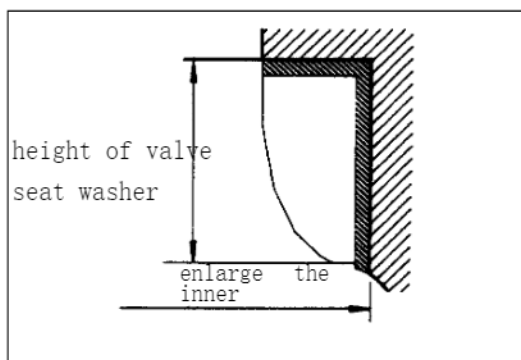
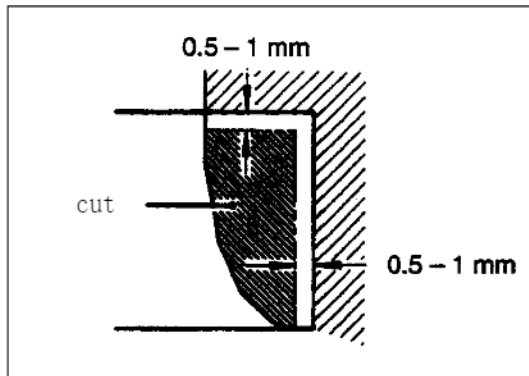
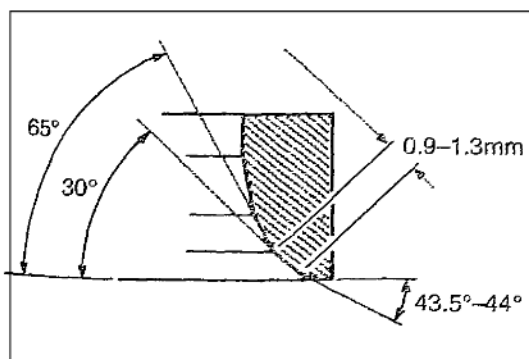
- (1) Check the clearance between the valve duct and the valve rod. When the clearance exceeds the limit value, the valve duct or the valve or both of them should be replaced.
Standard value: intake 0.02 — 0.05mm
exhaust.....0.03—0.07mm
Limit value: intake.....0.10mm
exhaust.....0.15mm



- (1) Assemble the valve and measure the flange height of valve rod between the end of valve rod and seat surface of valve spring. If the measurement value exceeds the assigned limit value, the valve seat should be replaced.

Standard value: intake.....49.30mm
exhaust.....49.30mm

Limit value: intake.....49.80mm
exhaust 49.80mm



● Points for maintaining the valve seat

- (1) Before maintaining the valve seat, check the clearance between the valve duct and the valve rod. Maintain after replacement of valve duct if necessary.
- (2) Repair the width and angle of the valve seat until their adjustment to the assigned value with abrasion machine.
- (3) After repairing the valve seat, rub the valve and the valve seat in pairs with rubbing cream. Then check the flange height of valve rod. (Refer to the checking item of valve seat).

● Points for changing valve seat

- (1) Cut a part of the to-be-replaced valve seat from the inner side to make it thinner and then remove it.
- (2) Repair and adjust the seat hole in cylinder cover according to the outer diameter of the enlarged valve seat.

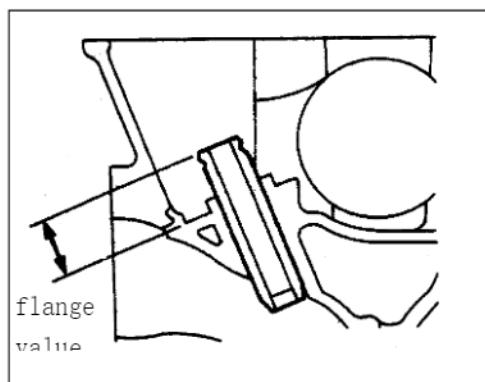
Diameter of valve seat washer

intake	enlargement size 0.30	34.435-34.455
valve seat	enlargement size 0.60	34.735-34.755
exhaust	enlargement size 0.30	31.935-31.955
valve seat	enlargement size 0.60	32.235-32.255

- (3) Before assemble the valve seat washer, heat the cylinder cover to the temperature of about 250°C, or cool the valve seat washer in the liquid nitrogen in order to engage inside the cylinder cover.

- (4) Repair and adjust the valve seat to the assigned width and angle with a valve seat milling cutter. (Refer to Points for maintaining the valve seat).

● valve seat



Points for changing of valve duct

- (1) Press out the valve duct to the direction of cylinder with **press machine**.
- (2) Modify the valve duct hole of cylinder cover until the hole diameter gets to the size of enlarged valve duct to be installed.

◦ Caution:

Do not use a new valve duct with the same size as the disassembled valve duct.

Duct hole diameter of valve in the cylinder cover.

enlarge size 0.05:	11.05-11.068
enlarge size 0.25:	11.25-11.268
enlarge size 0.50:	11.50-11.518

- (3) As shown in the illustration, press the valve duct to the assigned flange value.

Standard value: 14mm

Caution:

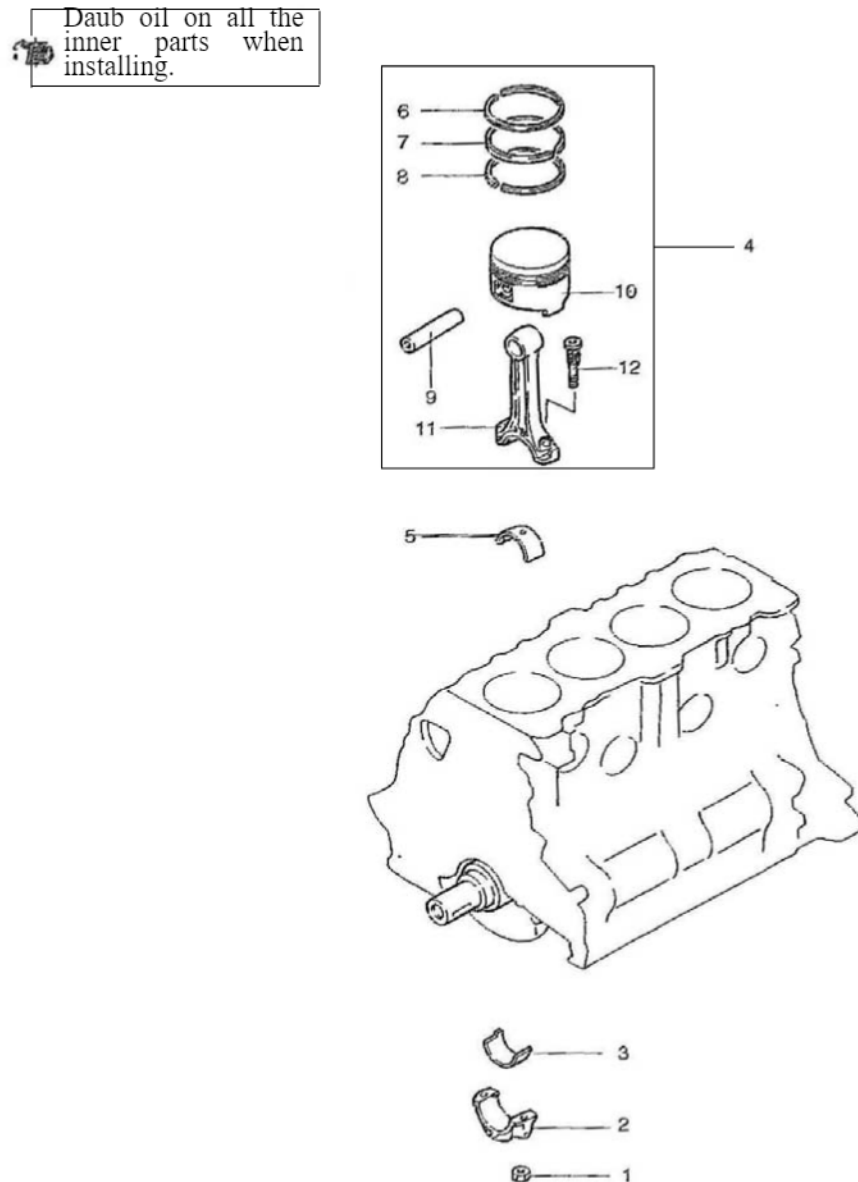
- Press the valve duct from the top surface of cylinder head.
- the length of intake valve duct and exhaust valve duct are different. (Intake valve: 45.5, exhaust valve: 50.5)

- (4) After installation of valve duct, insert the new valve and check if it could move smoothly.

Chapter 4 Crank Connecting Rod Mechanism

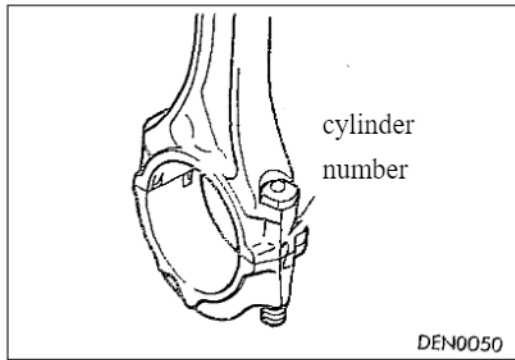
1、Piston and connecting rod component

Daub oil on all the inner parts when installing.



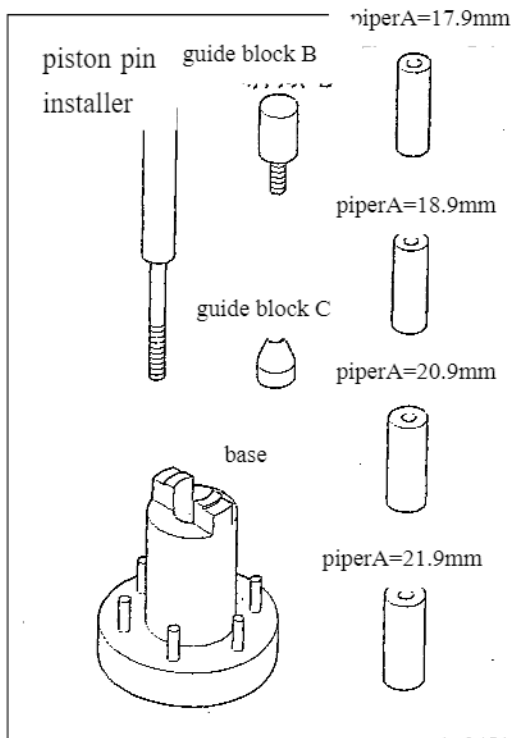
Disassembling steps

1. Connecting rod nut 2. Connecting rod cap 3. Connecting rod bearing
4. Piston and connecting rod component
5. Connecting rod bearing 6. No.1 compression ring 7. No.2 compression ring 8. Oil control ring
9. Piston pin 10. Piston 11. Connecting rod 12. Connecting rod bolt



Disassemble

- (1) Mark cylinder number on the side of connecting rod big end to prepare for correct installation.
- (2) Take turns putting connecting rod, connecting rod cap and connecting rod bearing away, according to cylinder number.



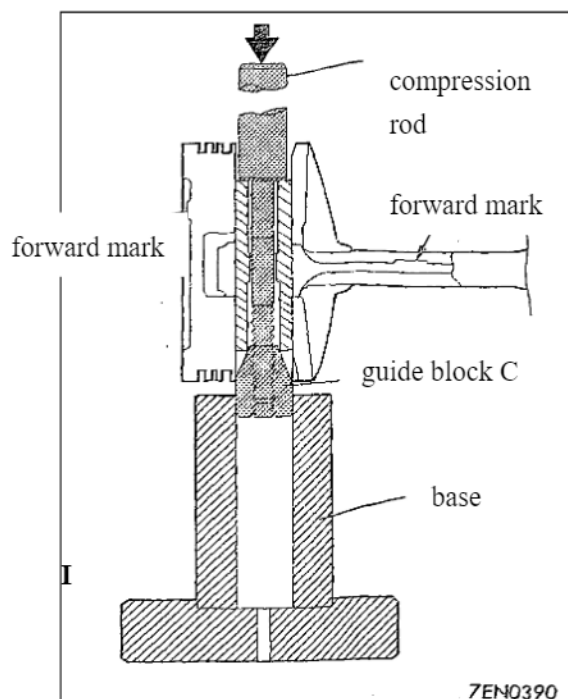
Piston Pin Disassemble

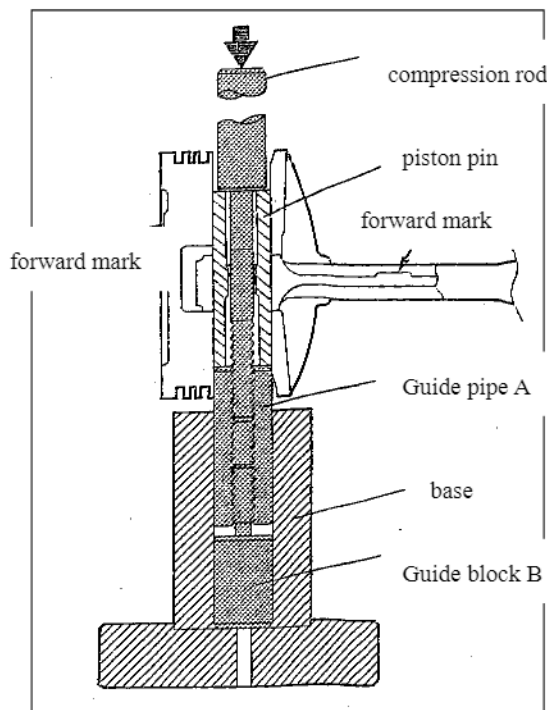
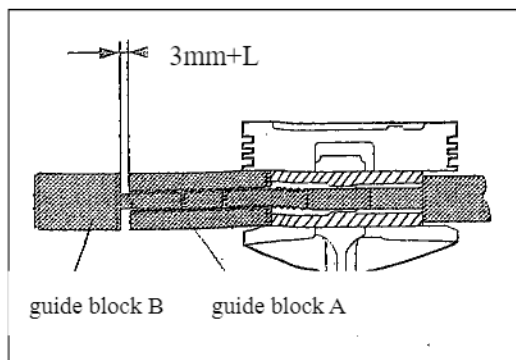
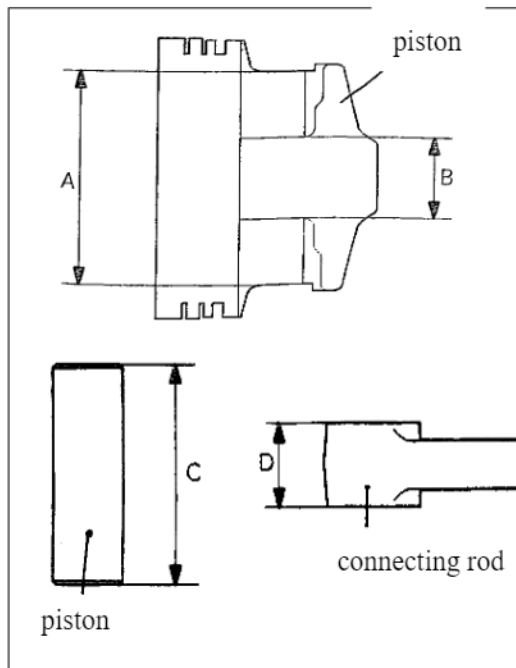
- (1) After inserting compression rod of the special tool from the top of piston marked with the arrowhead, install guide block C in the top of compression rod.
- (2) Keep forward mark of piston upward. Install piston and connecting rod component in base of piston pin installer (special tool).

- (3) Force piston pin out with pressure.

Caution:

Take turns putting piston, piston pin and connecting rod disassembled away according to cylinder number.





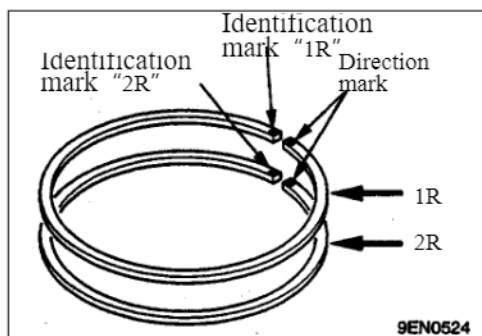
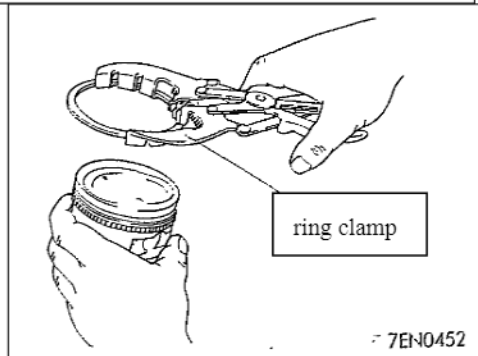
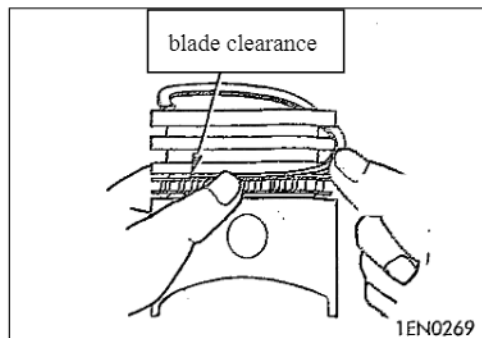
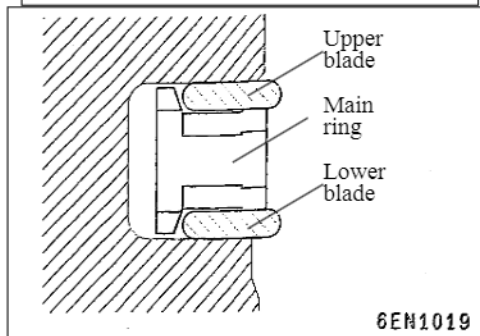
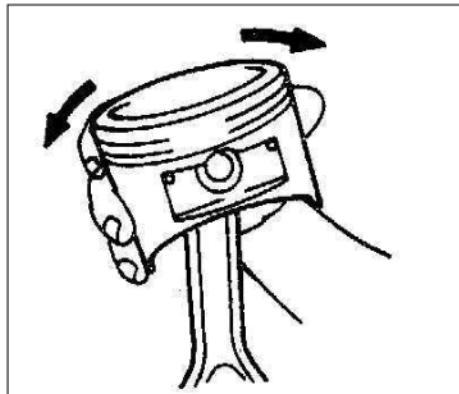
Installation Notice

Piston Pin Installation

- (1) Measure the following sizes of piston, piston pin and connecting rod.
A: Length of inserting piston pin in the hole.
B: Width of pin sockets
C: Length of piston pin
D: Width of small end of connecting rod.
- (2) Put measured sizes above into following formula to calculate L.
$$L = [(A - C) - (B - D)] / 2$$
- (3) After inserting compression rod of the special tool into piston pin, install pipe A in the top of compression rod.
- (4) Install forward marks of piston and connecting rod towards the same direction.
- (5) Daub engine oil on the external diameter of piston pin
- (6) Through Pipe A, insert compression rod, piston pin and pipe component installed according to (3) into piston pin hole from the side of forward mark.
- (7) Screw on guide block B into guide pipe A to make clearance value between guide block A and guide block B equal to the value of Value L got from (3) plus 3mm.
- (8) Keep forward mark of piston upward. Install piston and connecting rod component in base of piston pin installer.
- (9) Force piston Pin in under pressure. When the pressure is less than standard value, replace piston pin and piston component and/or replace connecting rod.

standard value: 7350~17200N

freely.



Oil Control Ring Installation

- (1) Put the main ring of oil control ring into oil ring groove.

Remarks:

1. There's no difference of upper and lower surface between **blade** and main ring.
2. New blade and new main ring shall be colored to distinguish their sizes.

Size	Identification color
Standard	Nil
Increase 0.50mm	<i>Red</i>
Increase 1.00mm	Yellow

- (2) Put upper blade. When installing blade, force one side of blade into piston oil ring groove. Then force the rest parts of blade into oil ring groove with the thumb as shown. Expanding blade with ring clamp will break it off and make it differed from other piston rings.

Caution:

Don't use ring clamp to install blade

- (3) Install lower blade in accordance with Step (2).
- (4) Ensure if blade can turn from the left to the right freely after installing blade.

Installation of No.1 compression ring and No.2 compression ring

- (1) After installing No.2 compression ring, install No.1 compression ring with ring clamp.

Remarks:

1. There's the identification mark on the top of the ring.

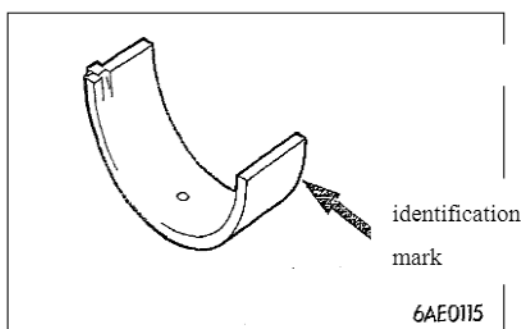
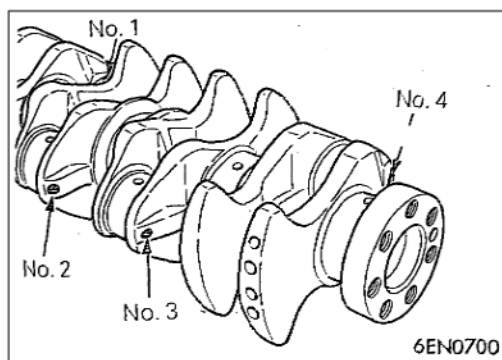
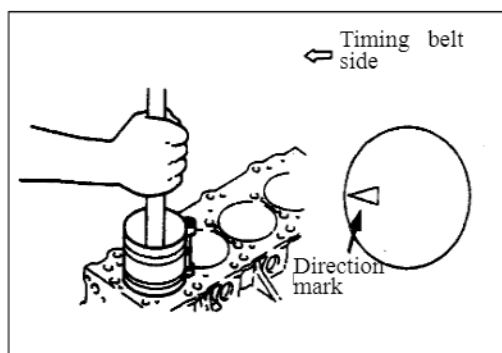
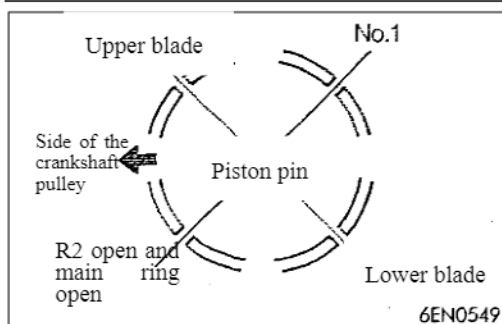
Identification mark

No.1 ring.....1R

No.2 ring.....2R

2. When installing piston ring, keep the mark upwards and towards the top of piston.
3. Size marks of piston shown as the following.

Size	Size mark
Standard	Nil
Increase 0.50mm	50
Increase 1.00mm	100



Piston and Connecting Rod Component Installation

- (1) Daub enough engine oil on piston, compression ring and oil control ring.
- (2) Adjust open position of compression ring and oil control ring (blade and main ring) to the position as shown.
- (3) Rotate crankshaft to make crank pin located in the middle of cylinder
- (4) Before inserting piston and connecting rod component into cylinder, proper screw-mounted protector is applied in connecting rod bolt. Be careful and don't damage crank pin.
- (5) Use suitable piston ring compressor to insert piston and connecting rod component into cylinder.

Caution:

- There's a forward mark on the top of piston, make it point to straight position of the engine (the side of timing belt).

Connecting Rod Bearing Installation

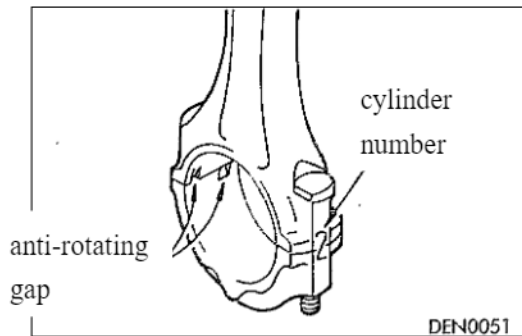
If it is necessary to replace bearing, choose and install bearing according to the following steps.

- (1) Measure external diameter of crank pin and confirm the groups according to the following table. As crankshaft for maintenance, distinguish sizes by painting color in the position as shown.
- (2) Identification mark of connecting rod bearing is imprinted in the position as shown.

Groups	Crank pin		Connecting rod bearing		
	Identification color	External diameter (mm)	Identification mark	Identification color	Thickness (mm)
I	Yellow	44.995~45.000	1	Yellow	1.487~1.491
II	Nil	44.985~44.995	2	Nil	1.491~1.495
III	White	44.980~44.985	3	Blue	1.495~1.499

Internal diameter of connecting rod: 48.000~48.015mm

- (3) Choose bearing in the table above, according to groups assured in (1) and (2).
Examples for choosing bearing:
If measurement value of external diameter of crankshaft pin is 44.996mm, it shall be Group 1 in the table above. If replacing crankshaft of maintenance, check identification color applied on new crankshaft pin. If it's yellow, crankshaft pin shall be Group 1 and choose connecting rod bearing of which identification mark is 1.



Installation of Connecting Rod Cap

- (1) When installing connecting rod cap, check marks of disassembling. If installing new parts which have no marks, install anti-rotating gap as shown on one side.

- (2) Ensure if axial clearance of big end of connecting rod is suitable.

Standard value: 0.10~0.25mm

Limit value: 0.4mm

Connecting Rod Nut Installation

Caution:

- Before installing connecting rod cap, disassemble spark plug and install connecting rod nut, if having installed cylinder cap.

- (1) As for connecting rod nut and bearing, plastic-zone screw-on method shall be adopted. Before reusing the bearing, check if the bearing is expanded. Checking method: screw nuts into screw thread of bearing with fingers till the whole length of screw thread. If nuts can't be screwed on smoothly, screw thread may be expanded and bearing should be replaced.

- (2) Before screwing nuts on, daub oil on screw thread of nuts and seat surface.

- (3) Screw nuts into bearing with fingers and screw nuts on alternatively to install connecting rod cap correctly.

- (4) Screw nuts on by torque of 20N. M.

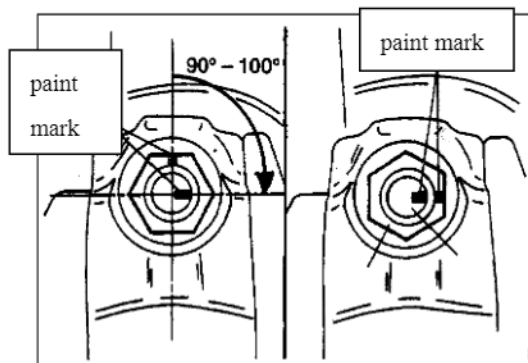
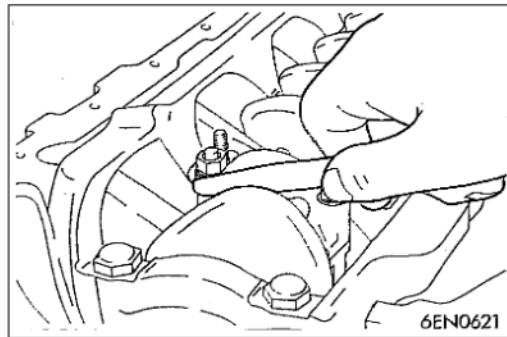
- (5) Daub paint mark on every nut head.

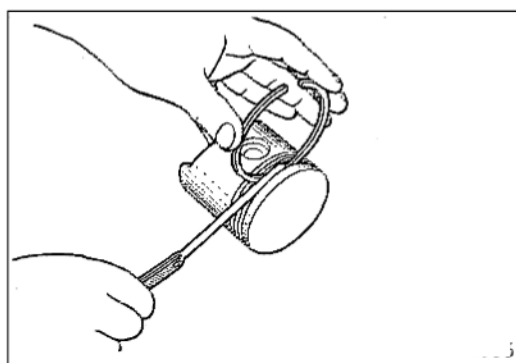
- (6) Daub paint mark on bolts of which the position is from paint mark on every nut head to screwing direction of $90^{\circ} \sim 100^{\circ}$ and note down the paint mark.

- (7) Screw nuts on from $90^{\circ} \sim 100^{\circ}$ until marks on nuts and bearing are aligned.

Caution:

- If screwing angle is less than 90° , screwing specified capability can't be assured. When screwing it on, notice screwing angle.
- If screwing nuts are excessively tightened (exceed angle of 100°), screw nuts off totally. And restart to screw nuts from step 1





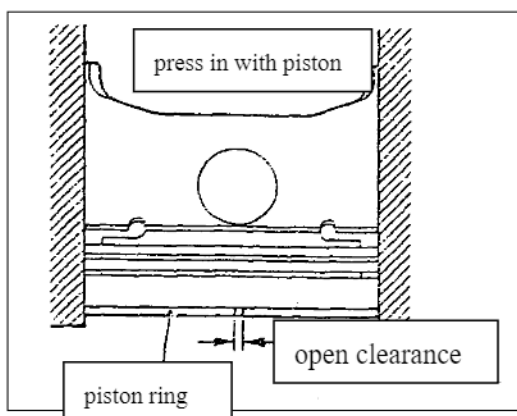
Check

Piston ring

- (1) Check if there's damage, excessive wear and breach on piston ring. If any, replace it. If replacing piston, it is necessary to replace piston ring.
- (2) Check clearance between piston ring and piston ring groove. If it's too wide, replace piston ring or both of them.

Standard value: 0.02~0.06mm

Limit value: 0.1mm



- (3) Put piston ring into cylinder. After using top surface of piston to put it away, measure open clearance with clearance gauge. When open clearance is too wide, replace piston ring.

Standard value:

No.1 ring...0.25~0.35mm

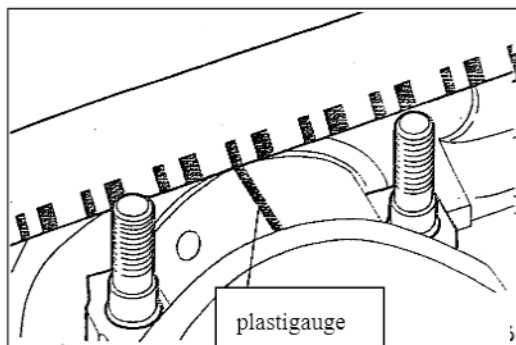
No.2 ring...0.40~0.55mm

Oil control ring...0.10~0.40mm

Limit value:

No.1 ring and No.1 ring...0.8mm

Oil control ring...1.0mm

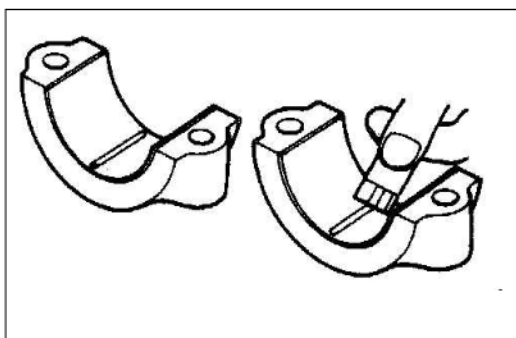


Oil clearance of crank pin (Plastigauge)

- (1) Clean the oil on connecting rod neck and bearing out.
- (2) Divide plastigauge into the same length of rearing width and put it on crank pin and make it parallel to axle center line.
- (3) Install connecting rod cap carefully, and screw nuts on according to the regulated torque.
- (4) Disassemble connecting rod cap carefully.
- (5) Use measuring rule imprinted on the package of plastigauge to measure the width of the widest part of staved plastic line and get clearance value.

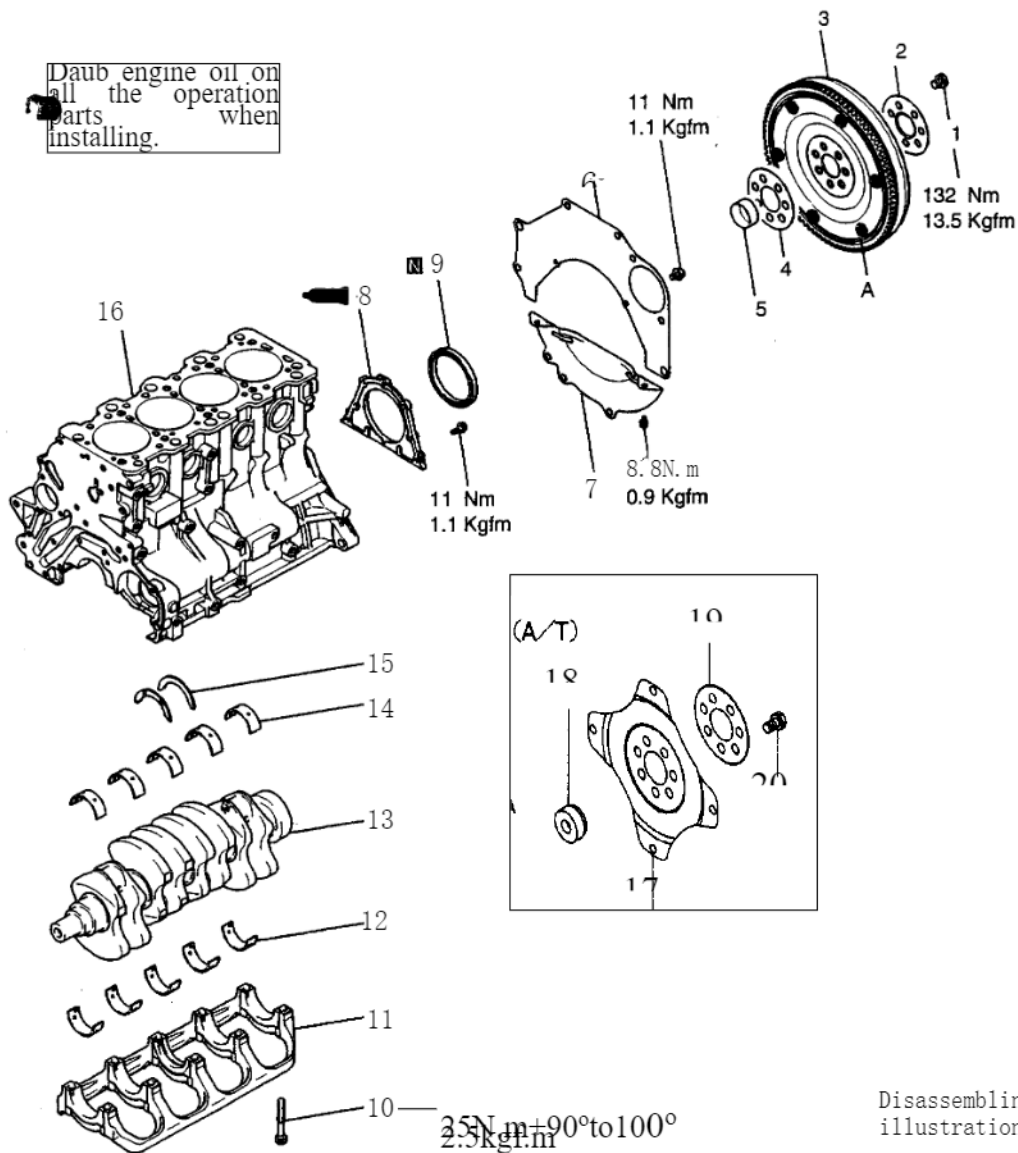
Standard value: 0.02~0.05mm

Limit value: 0.1mm



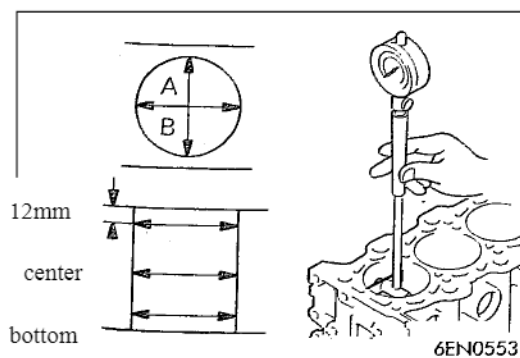
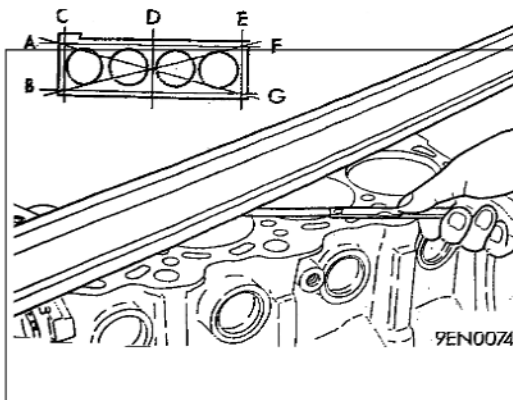
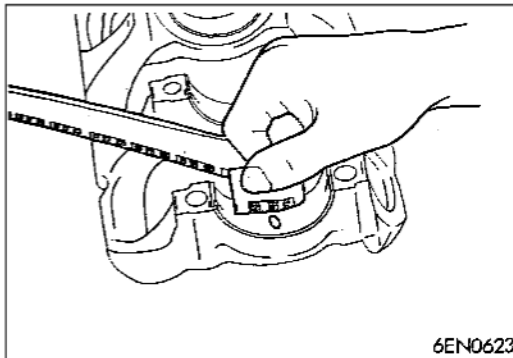
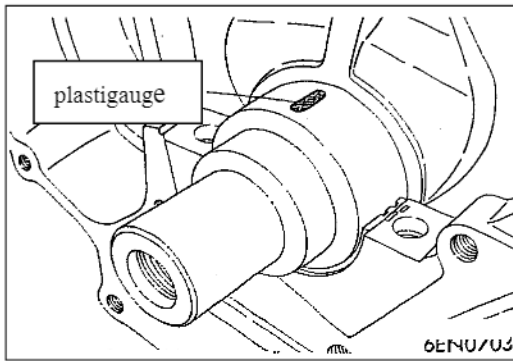
2 、 Crankshaft, cylinder block and flywheel

Daub engine oil on all the operation parts when installing.



Disassembling steps

1. Screw rearing of flywheel<M/T>
2. Jointing board<M/T>
3. Flexible flywheel<M/T>
4. Jointing board<M/T>
5. Crankshaft bushing<M/T>
6. Rear cover board
7. Bell housing
8. Rear oil seal cap
9. Rear oil seal
10. Main bearing cap bolt
11. Main bearing cap
12. Lower bearing of crankshaft
13. Crankshaft
14. Upper bearing of crankshaft
15. Crankshaft thrust rearing
16. Cylinder block
17. Drive board <A/T>
18. Crankshaft sleeve <A/T>



Oil clearance of crankshaft (Plastigauge)

- (1) Clean the oil on main journal and internal diameter of bearing out.
- (2) Install crankshaft.
- (3) Divide plastigauge into the same length of bearing width and put it on crankshaft journal and make it parallel to axle center line.
- (4) Install main bearing cap carefully, and screw nuts on according to the regulated torque.
- (5) Disassemble main bearing cap carefully.
- (6) Use measuring rule imprinted on the package of plastigauge to measure the width of the widest part of staved plastic line and get clearance value.

Standard value: 0.02~0.04mm

Limit value: 0.1mm

Cylinder block

- (1) Observe if there are defects like scratch, rust and corrosion with eyes. Use defect detector to check breach. If any, fix or replace it.
- (2) Check if the surface of cylinder block warps and assure there's no pad scraps or other foreign matters.

Standard value: 0.05mm

Limit value: 0.1mm

- (3) If warping excessively, revise or replace it within the permitting range.

Abrasive limit: 0.2mm

Maximum sum of abrasive thickness of cylinder block and cylinder cap permitted is 0.2mm.

Height of cylinder block(new):
4G63 284mm, 4G64 290mm

- (4) Check if there's scratch and cylinder sticking. If it's disqualified, revise (increase the size) or replace it.
- (5) Check internal diameter of cylinder and cylindricity with cylinder bore gauge.

Revise cylinder according to increased diameter, replace piston and piston ring if wearing badly. Checking position as shown.

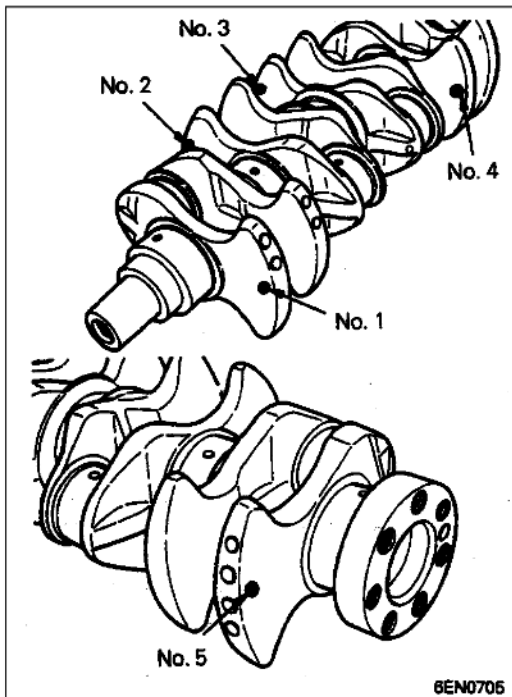
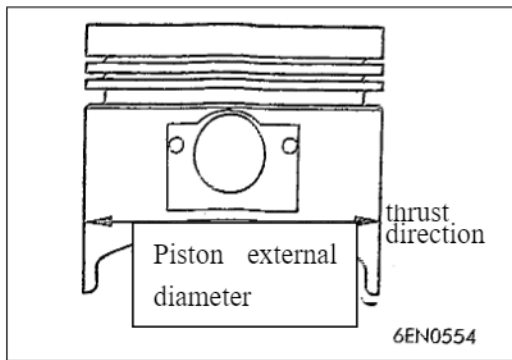
Standard value:

internal diameter of cylinder

4G63 85.00~85.03mm

4G64 86.50~86.53mm

Cylindricity: $\leq 0.01\text{mm}$



Cylinder reboring

(1). Choose diameter of piston increased according to the maximum cylinder bore.

Identification of piston sizes

Size	Identification mark
Increase 0.50	0.50
Increase 1.00	1.00

Note: Imprint size marks on the top of piston

(1). External diameter of piston used in the measurement should be measured in the thrust direction as shown.

(2). According to measuring value of external diameter of piston, calculate the size of cylinder reboring.

size of cylinder reboring = external diameter of piston + (clearance between piston and cylinder) - 0.02mm (Abrasive capacity)

(1) Rebore every cylinder bore to size of cylinder reboring

Notice: **When boring out cylinder, process according to the following procedures to avoid errors because of temperature raising :No. 2→No. 4→No. 1→No. 3**

(2) Cylinder bore which is abrasive to the ultimate. (diameter of piston + clearance between piston and cylinder)

(3) Check clearance between piston and cylinder

Standard value: 0.02~0.04mm

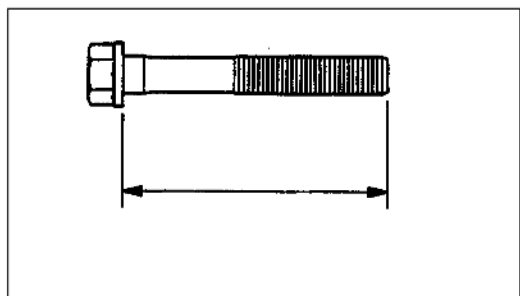
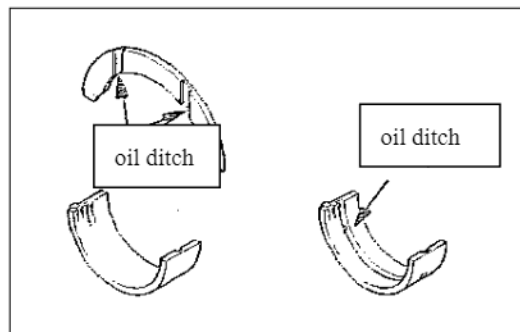
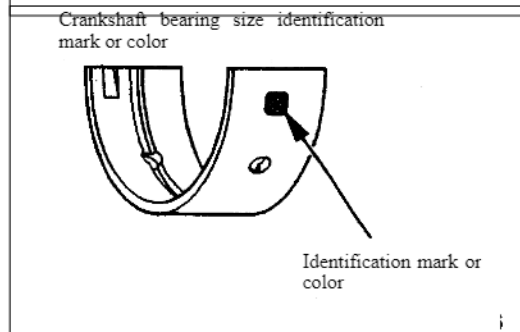
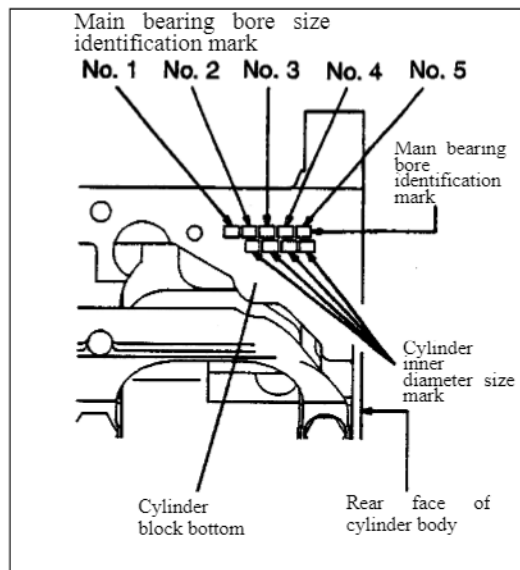
Remarks: When boring out cylinder, four cylinders should be bored in the same size which is increased, instead of only bore one cylinder.

Installation notice

Installation of crankshaft bearing

(1) Choose bearings that conform to crankshaft main journal according to the following table.

Combination of crankshaft main journal and spindle bore				Identification mark and color of No. 1, 2, 4, 5 journal bearing	Identification mark and color of No. 3 journal bearing
Crankshaft main journal			Identification mark of spindle bore		
Groups	Identification color	External diameter (mm)			
I	Yellow	56.994—57.000	0	1、green	0、black
			1	2、yellow	1、green
			2	3、nil	2、yellow
II	Nil	56.988—56.994	0	2、yellow	1、green
			1	3、nil	2、yellow
			2	4、blue	3、nil
III	White	56.982—56.988	0	3、nil	2、yellow
			1	4、blue	3、nil
			2	5、red	4、blue



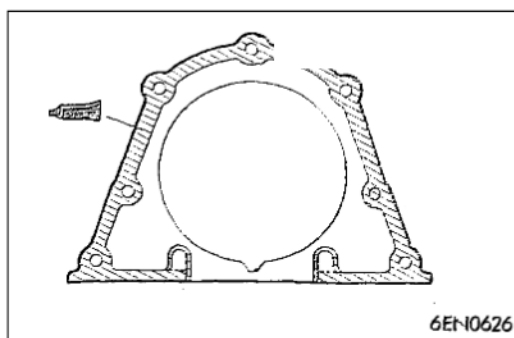
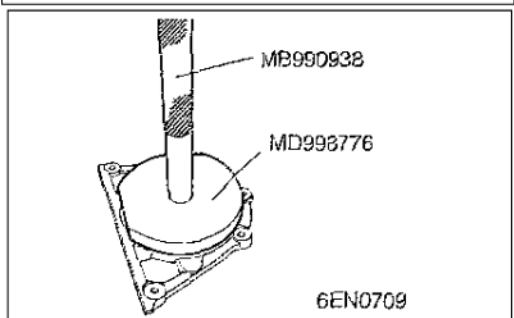
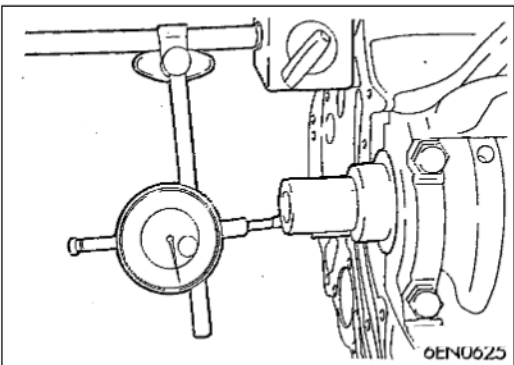
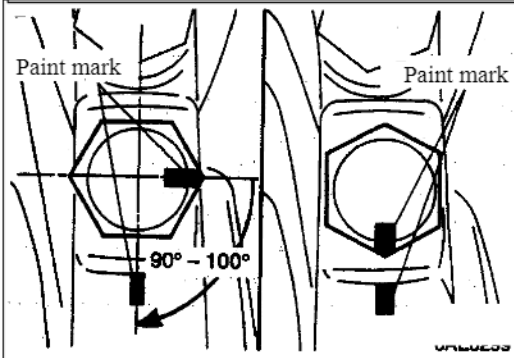
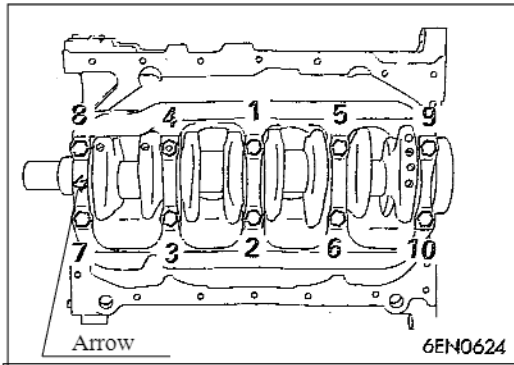
Examples for bearings choosing

- If identification color of crankshaft main journal is yellow and identification mark of spindle bore is "1", choose the No. 1,2,4,5 bearing of which identification mark is "2" and identification color is "yellow" and No.3 bearing of which identification mark is "1" and identification color is "green".
- If there's no identification paint color on crankshaft, measure main journal and choose corresponding groups of bearing according to measurement value.

- (2) Install bearing with grooves on one side of cylinder block.
- (3) Install bearing without grooves on one side of main bearing cap.
- (4) Install two of thrust bearing of crankshaft in No. 3 main bearing hole of cylinder block. For convenient installation, apply a little oil on the surface of thrust bearing.
- (5) One side of thrust bearing with groove should face towards crankshaft crank arm.

Main bearing cap and main bearing cap bolt installation

- (1) Install arrowhead of main bearing cap towards the side of timing belt.
- (2) Before screwing main bearing cap bolt on, assure that length of bolts is less than value limit. If not, replace the bolt.
Limit value (A): 71.1mm
- (3) Daub oil on screw thread of nuts and seat surface.
- (4) Screw main bearing cap bolt on by torque of 25N.M, according to regulated order.



- (5) Daub paint mark on every nut head.
- (6) Daub paint mark on the main bearing cap of which the position is from paint mark on bolts to screwing direction of $90^{\circ} \sim 100^{\circ}$
- (7) Screw nuts on from $90^{\circ} \sim 100^{\circ}$ regulated in the picture above, according to screwing order till paint mark on bolts aligns paint mark on main bearing cap.

Notice:

- If screwing angle is less than 90° , screwing specified capability can't be assured. When screwing it on, pay much attention to screwing angle.
- If screwing nuts are excessively tightened (exceed angle of 100°), screw nuts off totally. And restart to screw nuts from Step 1.

- (8) After installing main bearing cap, assure if crankshaft can turn smoothly and check axial clearance. If axial clearance exceeds usage limit value, replace NO.3 crankshaft thrust bearing of crankshaft.

Standard value: 0.05~0.18mm

Limit value: 0.25mm

Oil seal installation

Rear oil seal cap installation

Specified sealant:

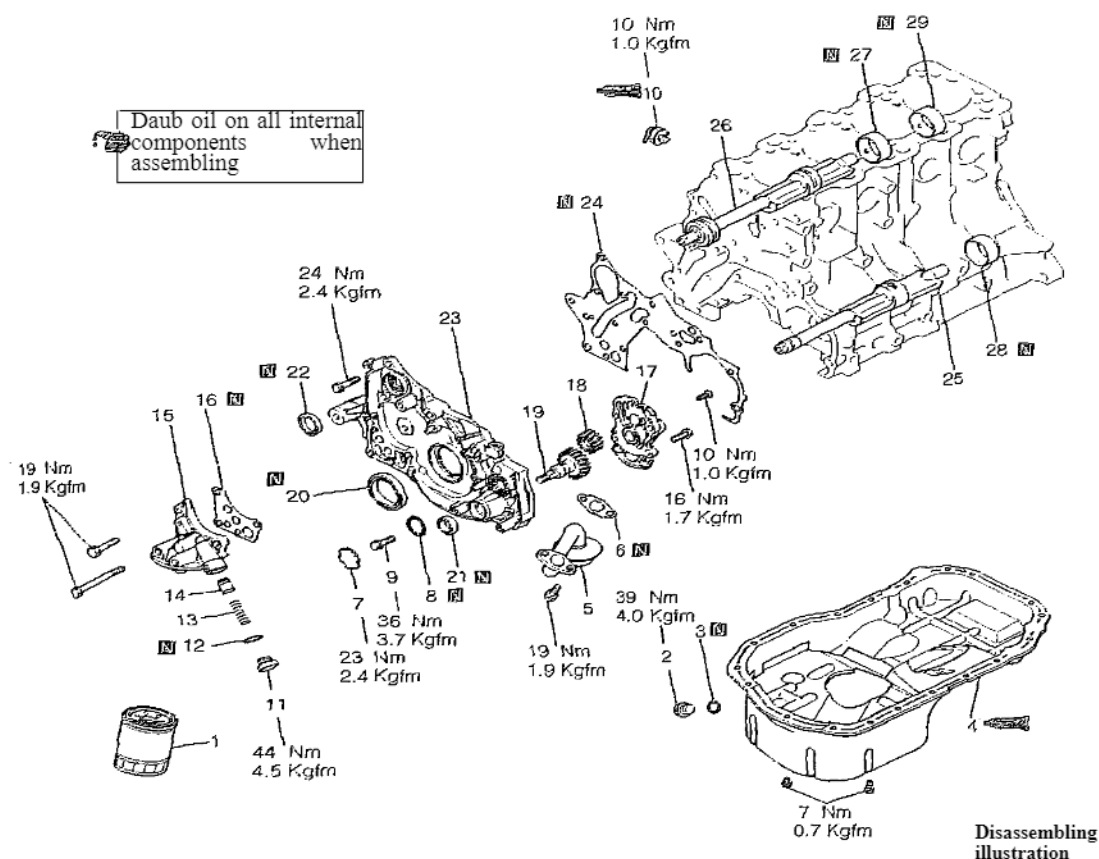
Brand: **Mitsubishi pure components**
MD970389 or corresponding equivalents.

Notices:

- (1) Ensure rear oil seal cap is installed quickly when sealant is still wet. (≤ 15 min)
- (2) After installing, keep sealed area away from lubricate grease and coolant for one hour.

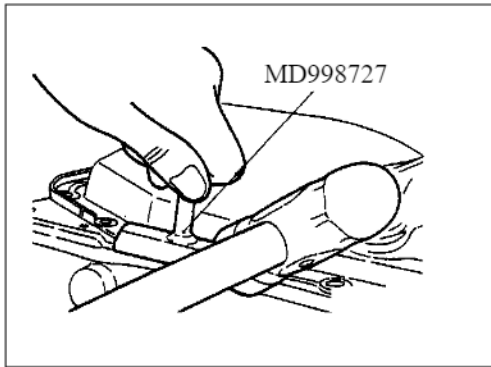
Chapter 5 Lubrication System

Front cover, oil pump, balance axle and oil pan



Disassembling Steps

1. Oil cleaner
2. Oil drain plug
3. Oil drain plug cushion
4. Oil pan
5. Oil collect filter
6. Oil collect filter cushion
7. Plug
8. O-shape ring
9. Flange bolt
10. Oil pressure switch
11. Pressure relief plug
12. Seal cushion
13. Pressure relief spring
14. Pressure-relief plunger
15. Oil cleaner bracket
16. Oil cleaner bracket cushion
17. Oil pump cover
18. Oil pump driven gear
19. Oil pump drive gear
20. Crankshaft front oil seal
21. Oil pump oil seal
22. Balance axle oil seal
23. Front cover
24. Front cover cushion
25. Left balance axle
26. Right balance axle
27. Right balance axle front bearing
28. Left balance axle bearing
29. Right balance axle rear bearing



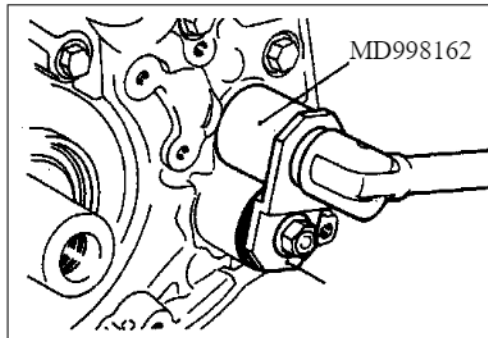
Disassemble Notice

Oil pan disassemble

- (1) Disassemble all oil pan bolts
- (2) Insert special tool between cylinder body and oil pan.

Remarks:

Do not use screwdriver or chisel instead of special tool, otherwise the edge of oil pan may be distorted and oil leakage will occur.

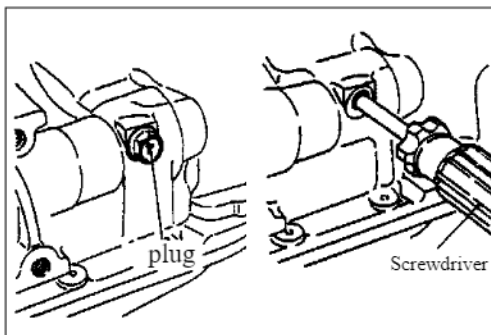


Plug disassemble

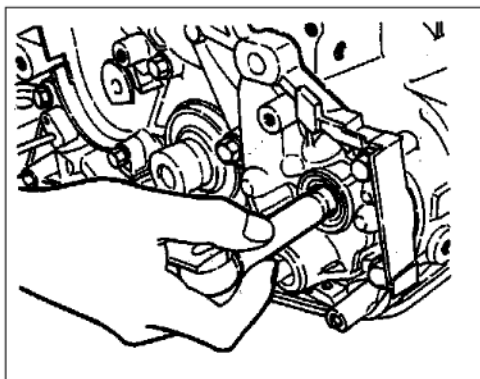
Disassemble plug cock with special tool. If plug is tightened, tap the plug top with hammer several times and the plug will loose.

Flange bolt disassemble

- (1) Disassemble plug from cylinder body.
- (2) Insert cross screwdriver (pole diameter is 8mm) into the plug hole and lock balance axle.



- (3) Loosen flange bolt

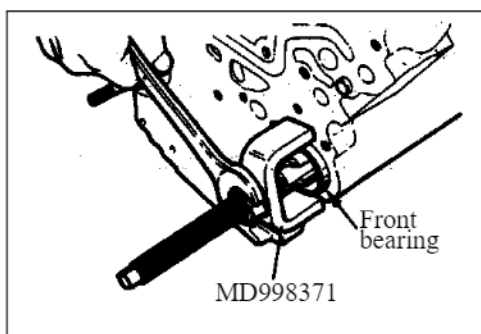


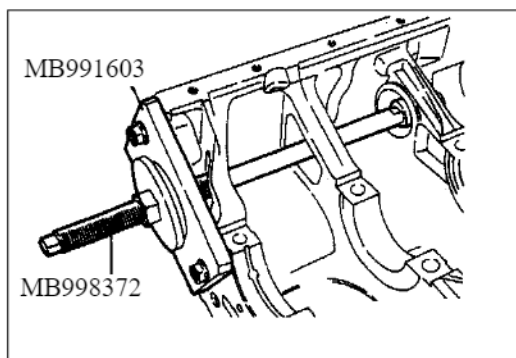
Right balance axle front bearing disassemble

- (1) Disassemble balance axle right-front bearing with special tool from cylinder body.

Remarks:

Front bearing must be disassembled firstly. If it is not disassembled, rear bearing puller can not be used.



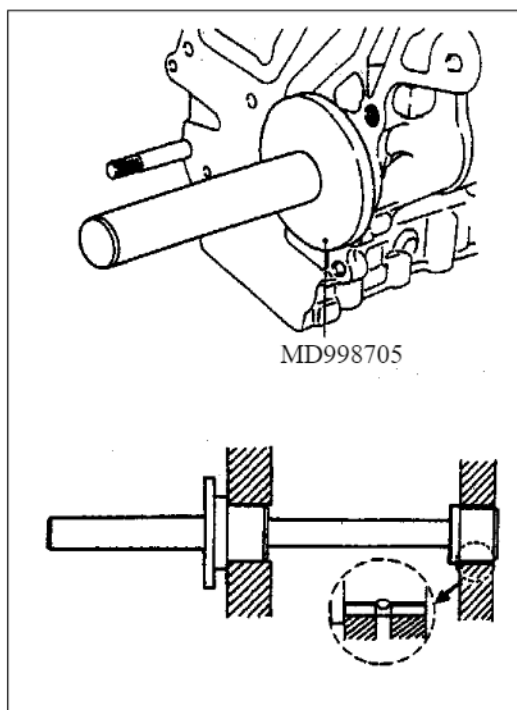


Balance axle rear bearing disassemble

Disassemble left balance axle rear bearing with special tool from cylinder body.

Remarks:

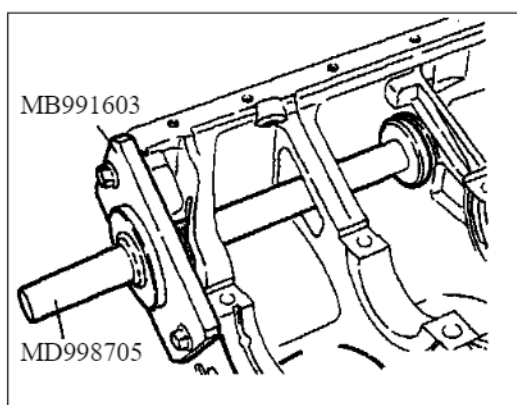
Special tool (MB991603) should be installed in front of cylinder body when disassembling left balance axle rear bearing.



Installation Notice

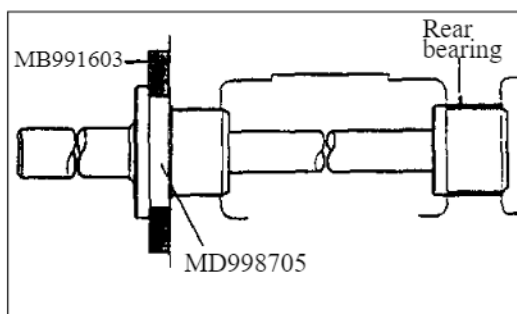
Right balance axle rear bearing installation

- (1) Daub oil on bearing surface.
- (2) Install right rear bearing with special tool. Make sure that oil holes on bearing and cylinder body are aligned.



Left balance axle rear bearing installation

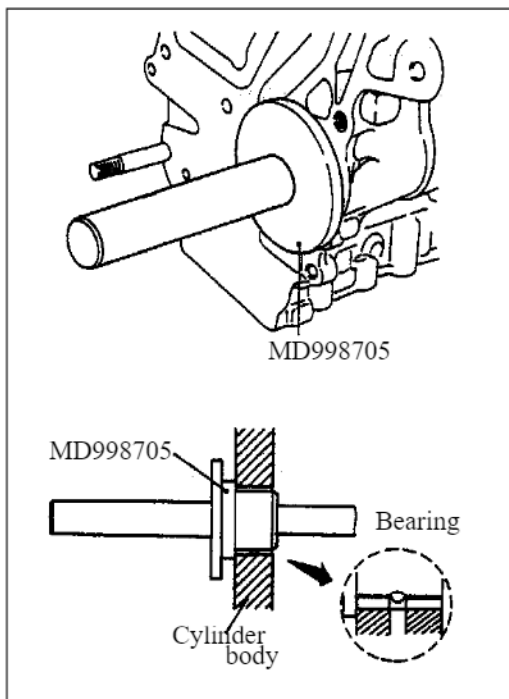
- (1) Install special tool (conducting board) on cylinder body.
- (2) Daub oil on rear bearing edges and inside cylinder body bearing holes.



- (3) Install rear bearing with special tool

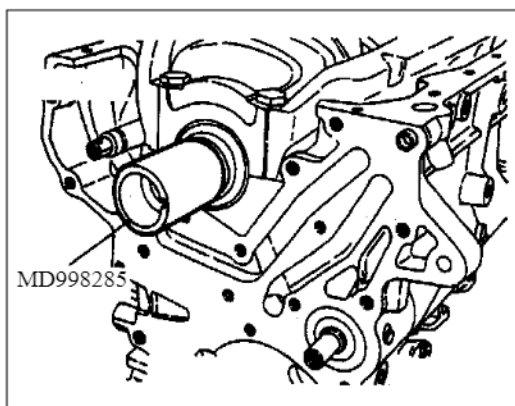
Remarks:

There is no oil hole in left rear bearing.



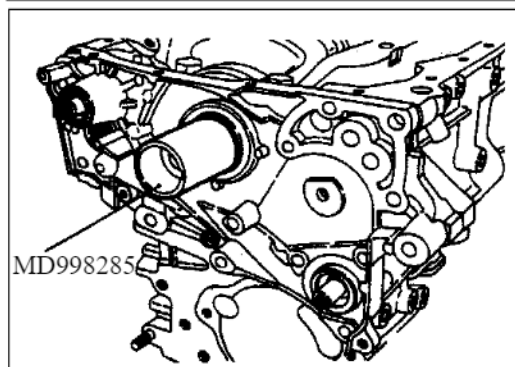
Balance axle front bearing installation

Install front bearing with special tool

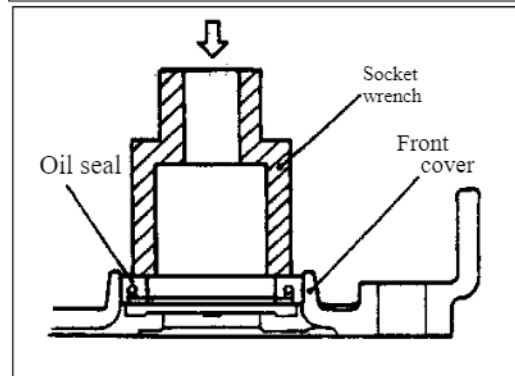


Front cover installation

(1) Install special tool on crankshaft front end .
daub oil slightly on the exterior circle surface of special tool and then install front cover



(2) Use new front cover oil seal cushion and install front cover component. Tighten flange bolt temporarily (Except for oil cleaner bracket locking bolt)



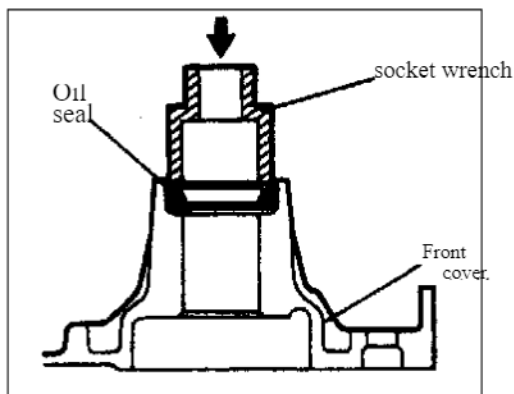
Balance axle oil seal installation

Press oil seal into front cover with socket wrench.



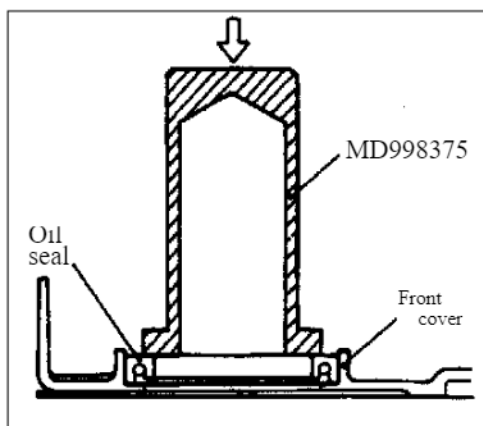
Maintenance Manual for Chery•Oriental Son

Engine Section



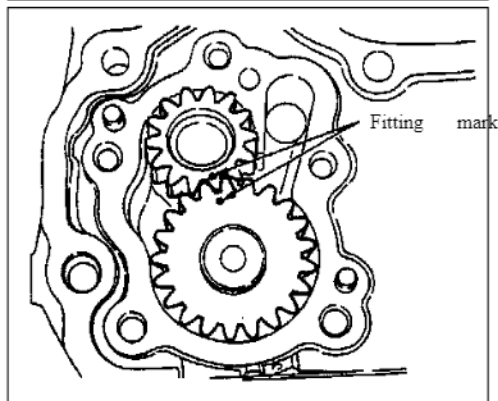
Oil pump oil seal installation

Press oil seal into front cover with socket wrench.



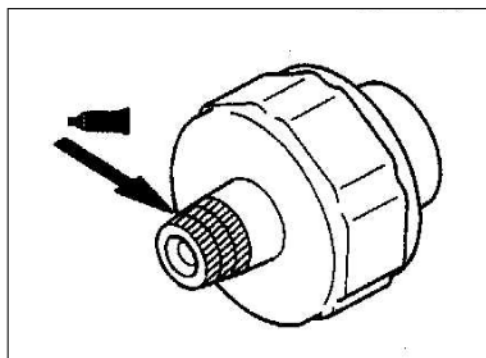
Crankshaft front oil seal installation

Install crankshaft oil seal on front cover with special tool.



Oil pump driven/drive gear installation

Daub oil on gear surface and align the fitting marks.



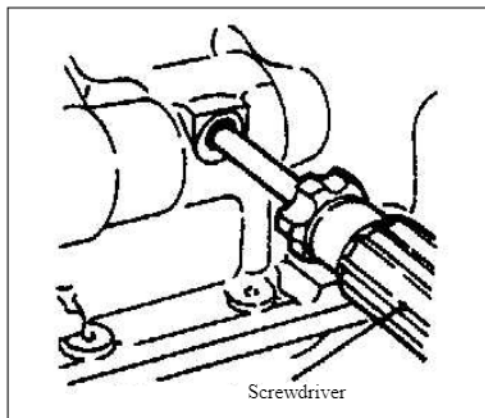
Daub sealant on oil pressure switch

Daub sealant on oil pressure switch screw thread parts and then install the said switch with special tool.

Special sealant: 3M ATV or relevant equivalents.

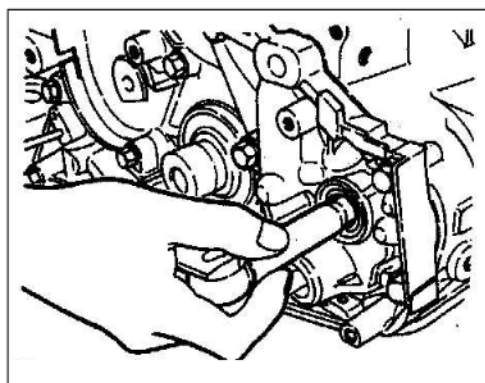
Caution:

- Keep the top of screw thread clean and do not daub sealant.
- Excessive tightening should be avoided.

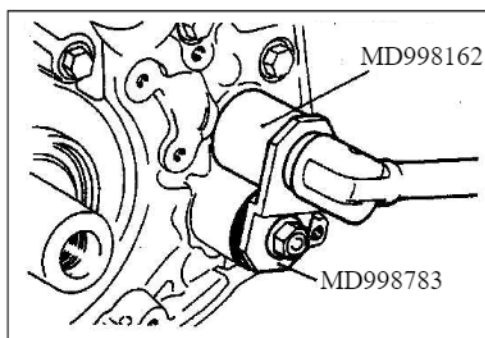


Flange bolt installation

- (1) Insert cross screwdriver into the hole in the left side of cylinder body and lock balance axle.

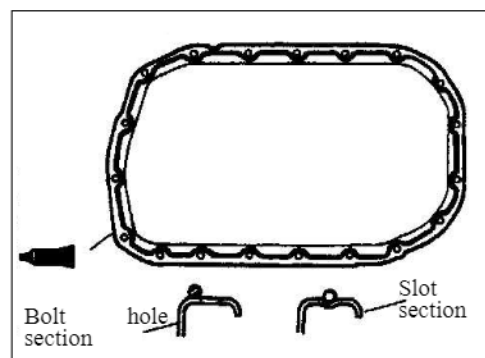


- (2) Tighten flange bolt with specified torque to ensure driven gear of oil pump is fixed on left balance axle.



Plug installation

- (1) Install O-shape ring in front cover slot.
- (2) Install plug with special tool and tight it to specified torque.



Oil pan installation

- (1) Keep the fitting surface of oil pan and cylinder body clean.
- (2) Daub 4mm-diameter sealant on the edge of oil pan flange surface.

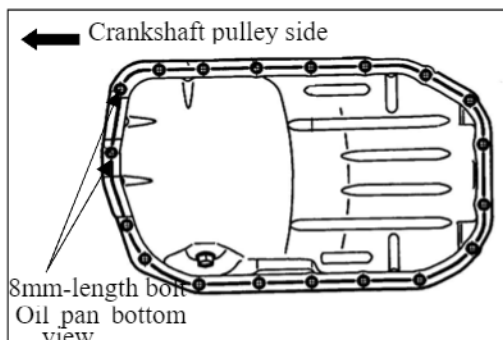
Specified sealant:

Mitsubishi pure product MD970389 or relevant equivalents.

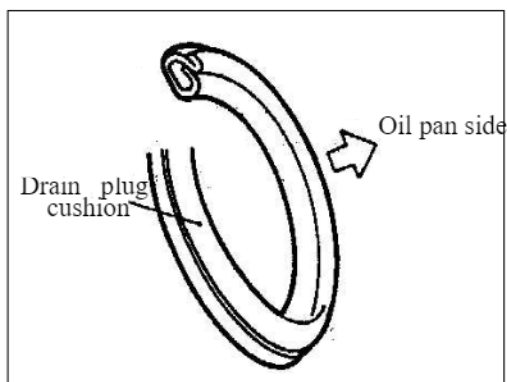
Remarks:

- (1) Install oil pan quickly when sealant is still wet (about 15 minutes)
- (2) Do not make the sealed part bedewed

with oil in an hour or so after installation.



- (3) Confirm the bolt length and their installation locations are a little different.

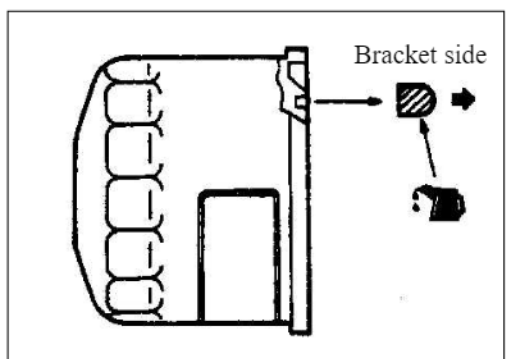


Drain plug cushion installation

Install drain plug cushion according to the direction as shown.

Caution:

The incorrect installation direction may result in oil leakage.



Oil cleaner installation

- (1) Make installation surface of oil cleaner bracket clean.
- (2) Daub engine oil on O-shape ring of oil cleaner.
- (3) Screw on oil cleaner. When the O-shape ring reaches installation surface, screw 3/4 cycle further. (Tighten torque: 1.4kg.m)

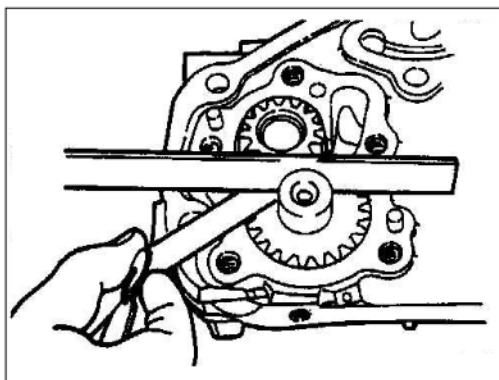
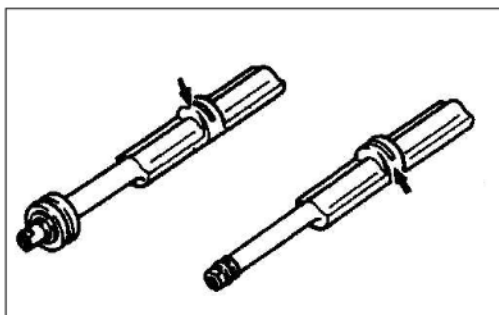
Check

Front cover

- (1) Check if oil hole is jammed. If necessary, clear it up.
- (2) Check if there is abrasion, damnification or sinter on left balance axle front bearing. If necessary, replace front cover.
- (3) Check if there is crack or other damnification. If any, replace front cover component.

Oil seal

- (1) Check if there is abrasion or damnification on oil seal lip. If necessary, replace oil seal.
- (2) Check if there is deterioration on oil seal lip. If necessary, replace oil seal.



Balance axle

- (1) Check if oil hole is jammed.
- (2) Check if there is sinter, damnification or **interposition of bearing**. If any badness, replace balance axle, bearing or front cover component.

Oil pump

- (1) Install oil pump gear on front cover and then screw on the gear. Check if it can rotate smoothly and is tightened.
- (2) Ensure there is no **ridge shape abrasion** on the contact surface of front cover and oil pump cover gear surface.
- (3) Check side clearance.

Standard value:

Drive gear	0.08-0.14mm
Driven gear	0.06-0.12mm



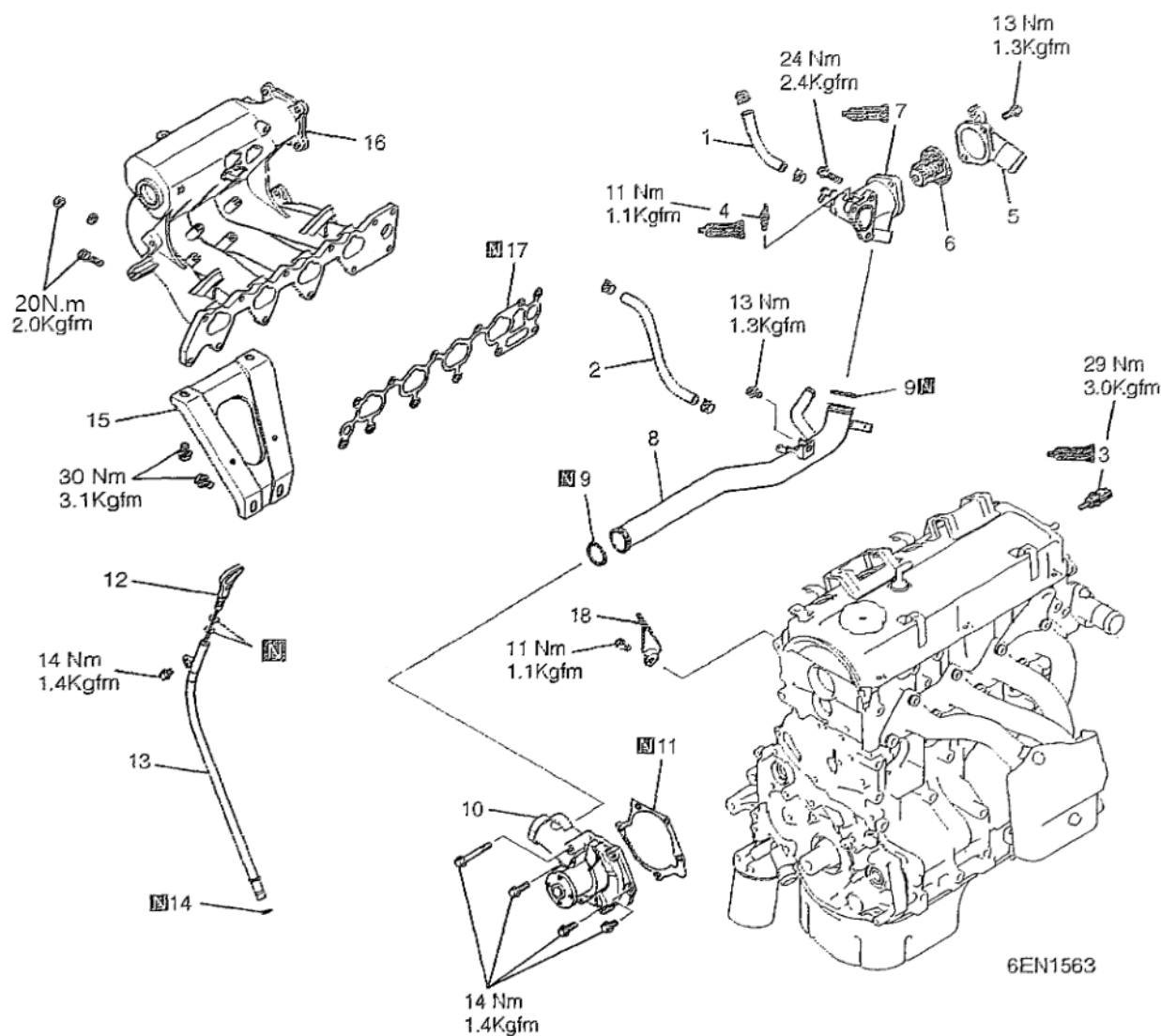
Maintenance Manual for Chery•Oriental Son

Engine Section



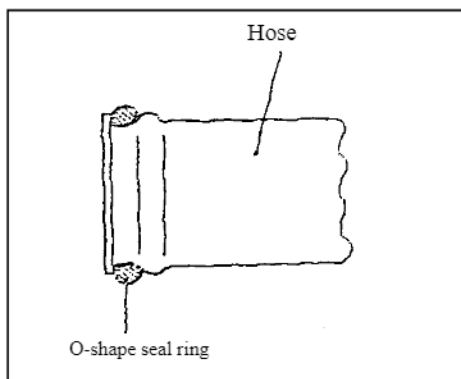
Chapter 6 Cooling System

Intake Manifold, Water Pump



Remove Steps:

1. Water soft tube
2. Water soft tube
3. Engine coolant temperature sensor
4. Engine coolant induction plug
5. Inflow tube joint
6. Thermostat
7. Thermostat shell
8. Inflow Tube
9. O-shape seal ring
10. Water pump
11. Water pump seal ring
12. Oil gauge
13. Oil gauge duct
14. O-shape seal ring
15. Manifold bracket
16. Intake manifold
17. Manifold gasket
18. Engine flying ring



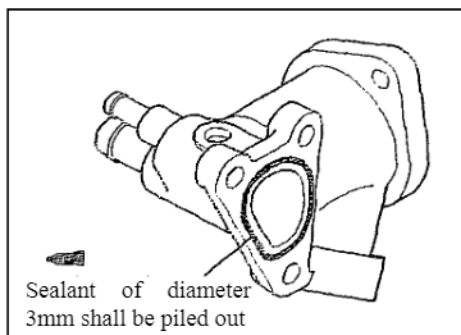
Installation Notice

O-shape seal installation

(1) Make seal ring wet to install it easily.

Caution:

There must be no engine oil or lubricate grease on seal ring.



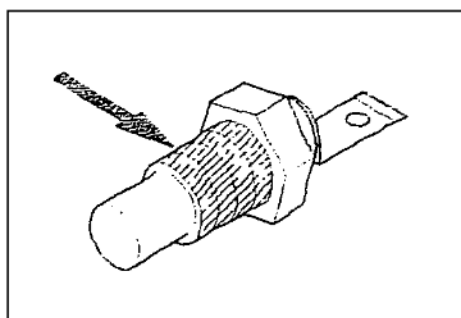
Daub thermostat shell with sealant

Specific sealant:

Component of Mitsubishi brand 3M ATD or equivalent.

Note:

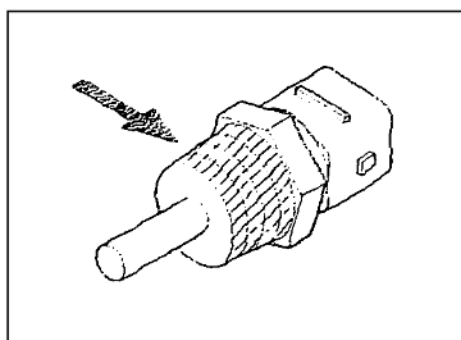
- (1) Thermostat shell should be installed immediately when the sealant is still wet (in 15 minutes).
- (2) Don't daub oil on the sealed part in about 1 hour after installation.



Daub engine coolant induction plug with sealant

Specific sealant:

3M ATD or equivalent



Daub engine coolant temperature sensor with sealant

Specific sealant:

3M ATD nut fastening or equivalent

