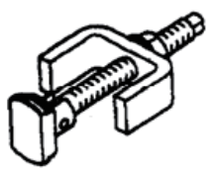
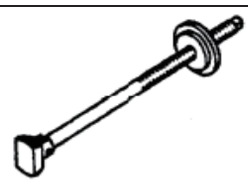
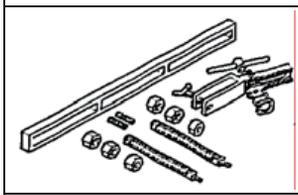
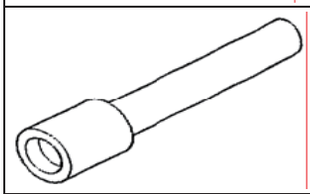
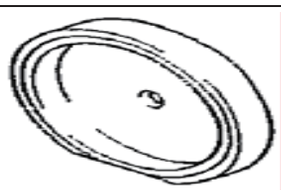
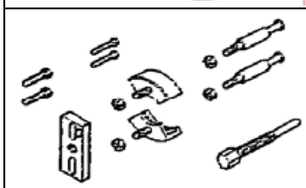
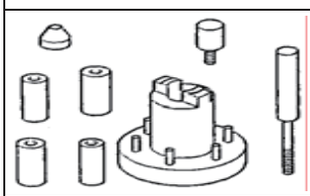
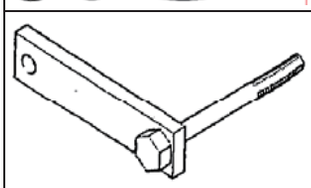
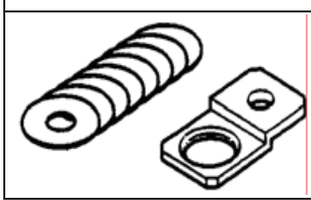
Specifications

Maintenance Standard

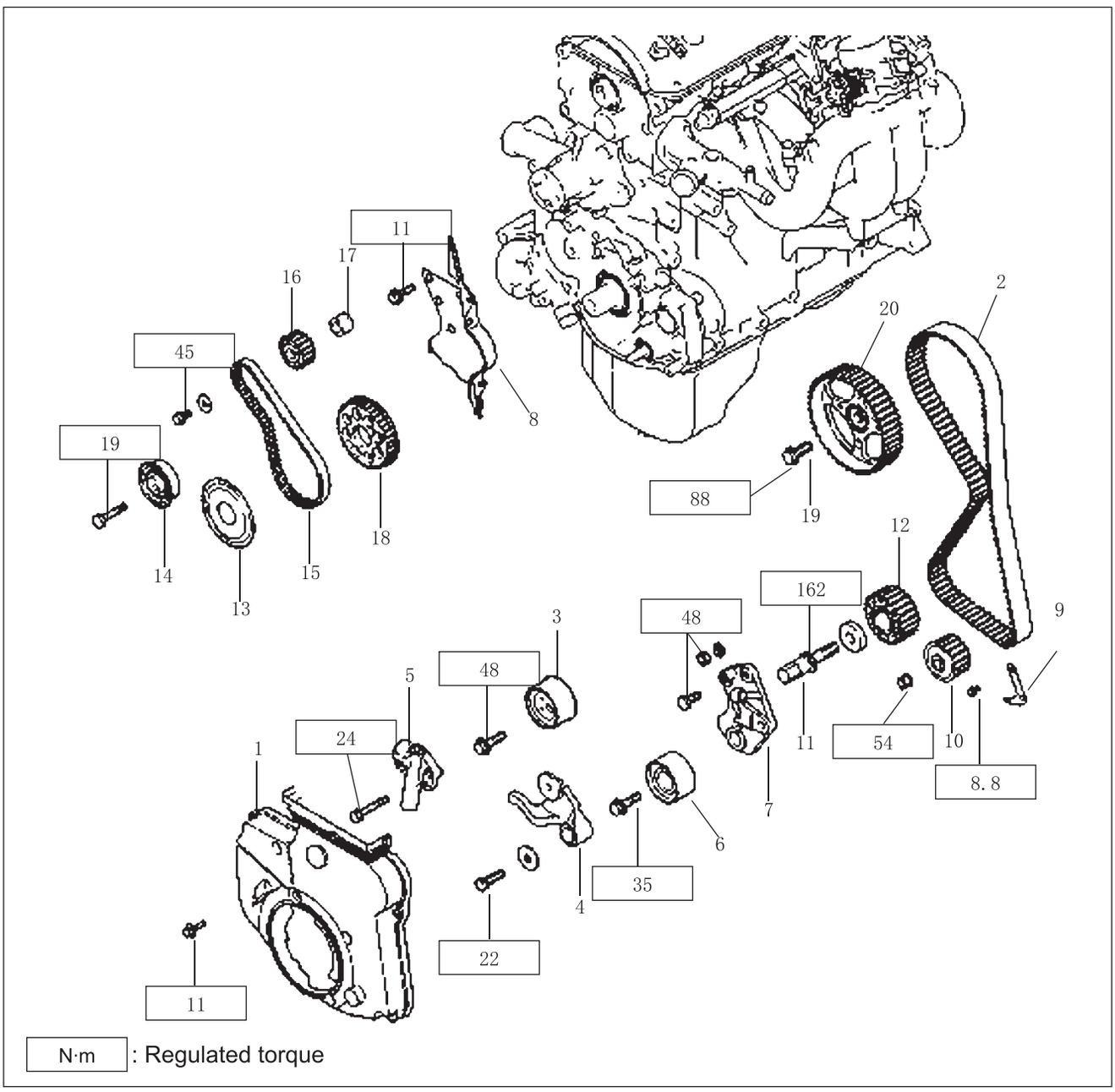
Unit：mm

Items			Standard Value	Limit Value
Generator Toothed-belt	Convex value of tensioner arm		12	——
	Press-in value of tensioner arm (98~196N)		≤1	——
Camshaft	Height of cam	Air intake	37.20	36.70
		Air exhaust	36.83	36.33
	Shaft diameter		45.0	
Cylinder Head	Planeness of Bottom Surface		0.03	0.2
	Surface lapping limit*Total lapping of cylinder block and head		——	* 0.2
	Total height		119.9—120.1	
	Length of cylinder head bolt		97.4	≤99.4
Valve	Edge thickness	Air intake	1.0	0.5
		Air exhaust	1.2	0.7
	Diameter of valve stem		6.0	——
	Radial clearance between valve stem and valve guide	Air intake	0.02—0.05	0.10
		Air exhaust	0.03—0.07	0.15
	Inclination		45°—45.5°	——
	Height	Air intake	112.30	111.80
		Air exhaust	114.11	113.61
Valve Spring	Free Height		51.0	50.0
	Working pretightening force/Working depth Kg/mm		267/433	——
	Verticality		≤2°	≤4°
Valve Guide	Contact width		0.9—1.3	——
	Minor diameter		6.0	——
	Major diameter		11.0	——
	Indentation depth		14.0	——
	Convex value of valve stem		49.3	49.8
Oil Pump	Lateral clearance	Driving gear	0.08—0.14	——
		Driven gear	0.06—0.12	——
Piston	Piston clearance		0.02—0.04	——
Piston Ring	Lateral clearance	Ring No.1	0.02—0.06	0.1
		Ring No.2	0.02—0.06	0.1
	End clearance	Ring No.1	0.25—0.35	0.8
		Ring No.2	0.40—0.55	0.8
		Oil control ring	0.10—0.40	1.0
Piston Pin	Major diameter		22.0	——
	Indentation force Kg.		755—1750	——
	Indentation temperature		Room temperature	——
Crankshaft	Internal clearance of crankshaft pin		0.02—0.05	0.1
Connecting Rod	Lateral clearance on big end		0.10—0.25	0.4
Crankshaft	Axial clearance		0.05—0.18	0.25
	Main shaft diameter		57	——
	Connecting rod shaft diameter		45	——
	Radial clearance of main shaft		0.02—0.04	0.1

Tools	REF. NO.	NAME	PURPOSE
	MD998371	BALANCING SHAFT BEARING PULLER	Disassembly of reverse balancing shaft front bearing
	MD998372	BALANCING SHAFT BEARING PULLER	Disassembly of reverse balancing shaft rear bearing
	MD998772	VALVE SPRING	Disassembly and mounting of valve and related spare parts
	MD998774	VALVE OIL SEAL ASSEMBLER	Mounting of valve oil seal
	MD998776	CRANKSHAFT REAR OIL SEAL ASSEMBLER	Use MB990938 for mounting of crankshaft rear oil seal
	MD998778	CRANKSHAFT TOOTHED-BELT WHEEL PULLER	Disassembly of crankshaft toothed-belt wheel
	MD998780	PISTON INSTALLATION TOOL	Disassembly of piston pin
	MD998781	FLYWHEEL STOPPER	Fastening flywheel and driving plate
	MD998783	SCREW-PLUG WRENCH FIXER	Disassembly and mounting of front cover screw-plug

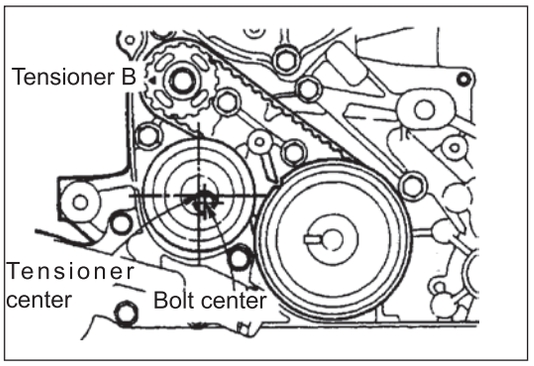
TIMING TOOTHED-BELT

DISASSEMBLY AND MOUNTING

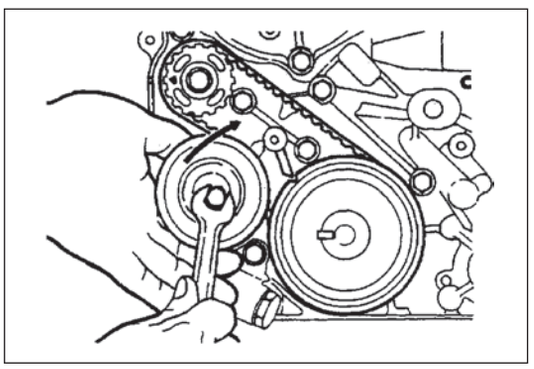


DISASSEMBLY PROCUDURE

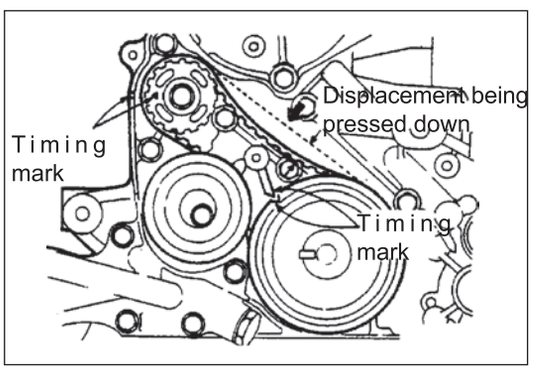
1.FRONT LOWER COVER OF TIMING THOOTHED-BELT
<<A>> >>H<< 2.TIMING TOOTHED-BELT
3.TENSIONING PULLEY
4.TENSIONING ARM
>>G<< 5.AUTOMATIC TENSIONER
6.CENTRUAL PULLEY
7.TENSIONING PULLEY BRACKET
8.REAR COVER OF TIMING TOOTHED-BELT
9.TIMING TOOTHED-BELT INDICATOR
<<B>> >>F<< 10.OIL PUMP TOOTHED-BET WHEEL
<<C>> >>E<< 11.CRAKSHAFT BOLT**
<<D>> 12.CRANKSHAFT TOOTHED-BELT WHEEL
13.FLANGE
14.TENSIONER B
<<E>> >>D<< 15.TIMING TOOTHED-BELT B
<<F>> >>C<< 16.BALANCING SHAFT TOOTHED-BELT WHEEL
>>B<< 17.SPACER
<<G>> 18.CRANKSHAFT TOOTHED-BELT WHEEL B
<<H>> >>A<< 19.CAMSHAFT TOOTHED-BELT BOLT
20.CAMSHAFT TOOTHED-BELT WHEEL



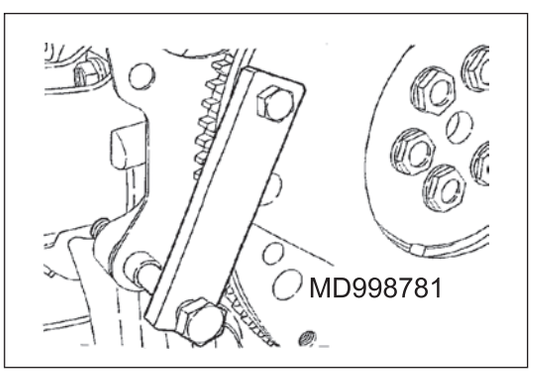
3. Ensure that the centers of tensioner wheel and the bolt are as shown in the figure.



4. While applying force to the tensioner side of timing toothed-belt with your finger, move tensioner B in the direction of the arrow. At this moment, screw up the bolt to fixup tensioner B. Don't let the shaft rotate together with toothed-belt wheel thus while screwing up the bolt, otherwise the toothed-belt will be too tight.

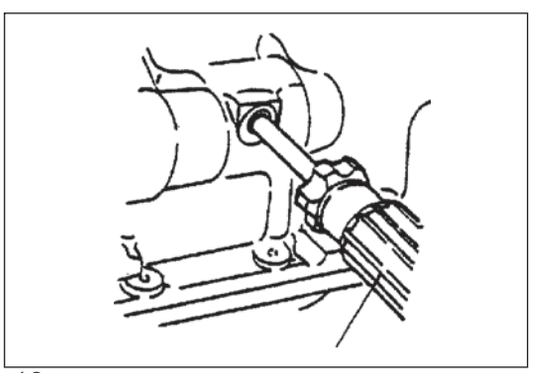


5. Confirm to align the mark on the toothed-belt with the mark on the front cover
6. Press down the central part of the tensioner side of timing toothed-belt B with your forefinger. The toothed-belt is to be pressed down by 5~7mm.



>>E<< TIGHTENING OF CRANKSHAFT BOLT

1. Fixup flywheel with special tools;
2. Mount crankshaft bolt.

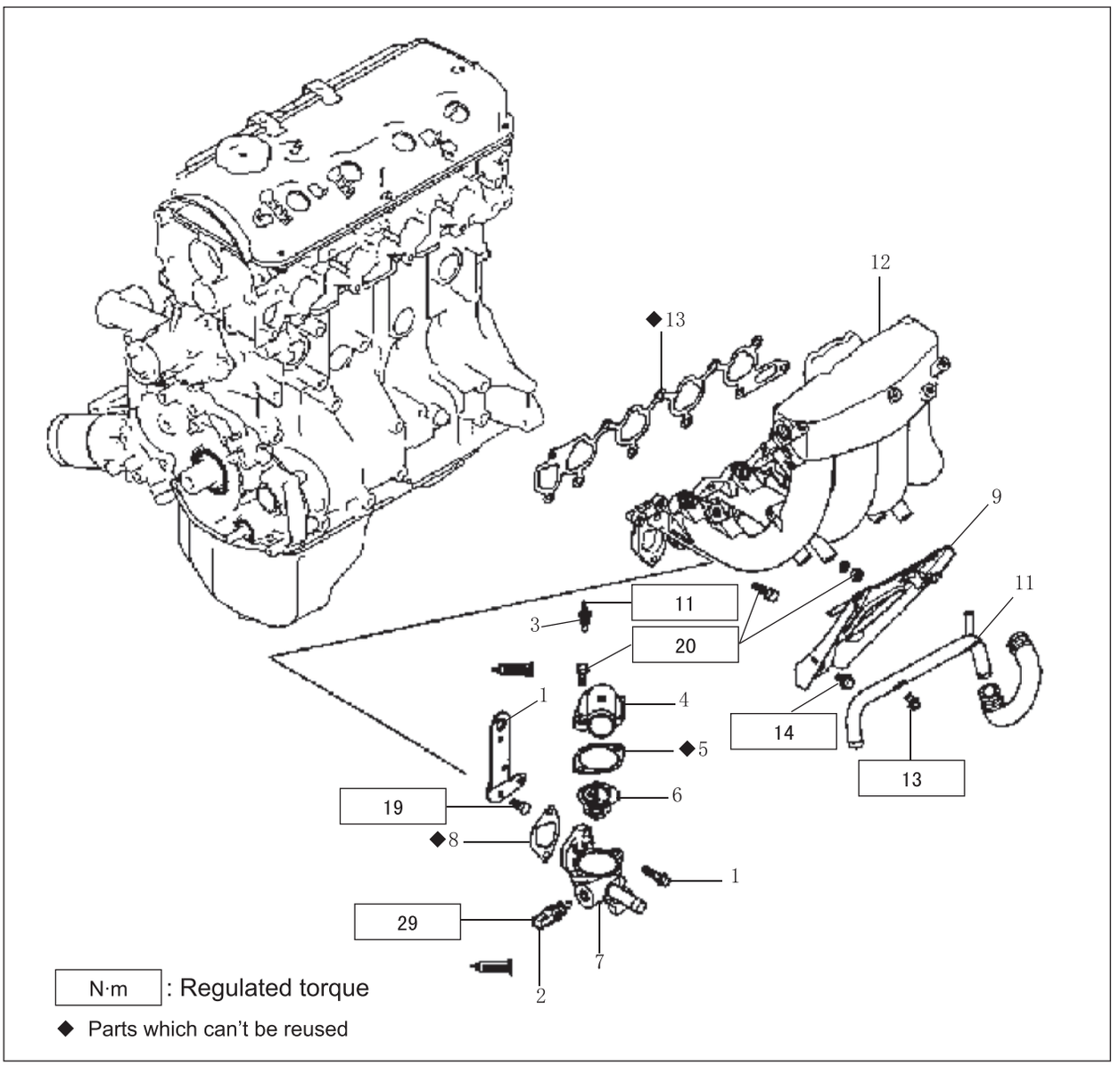


>>F<< MOUNTING OF OIL PUMP TOOTHED-BELT WHEEL

1. Insert cross point screwdriver into the plug hole on the left side of cylinder block to prevent balancing shaft from rotating.
2. Mount oil pump toothed-belt wheel.
3. Smear engine oil on the coupling face of nut and bearing.
4. Screw up the nut according to the specified torque.

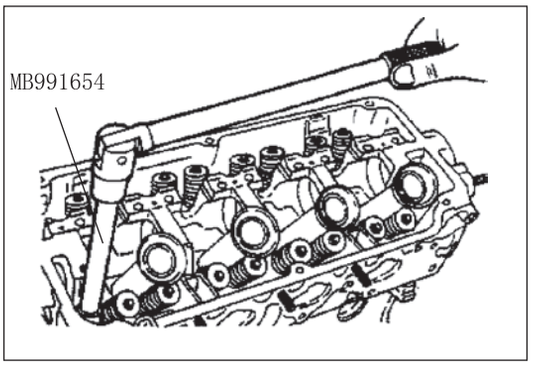
INTAKE MANIFOLD

DISASSEMBLY AND MOUNTING



Disassembly procedure

	1.	Engine Link Ring
>>A<<	2.	Engine Water Temprature Sensor
>>B<<	3.	Engine water-temperature induction plug
	4.	Water Outlet
	5.	Gasket
	6.	Thermostat
	7.	Thermostat housing
	8.	Gasket
	9.	Intake Manifold Bracket
	10.	Water pipe
	11.	Heater pipe
	12.	Intake manifold
	13.	Intake Manifold Gasket



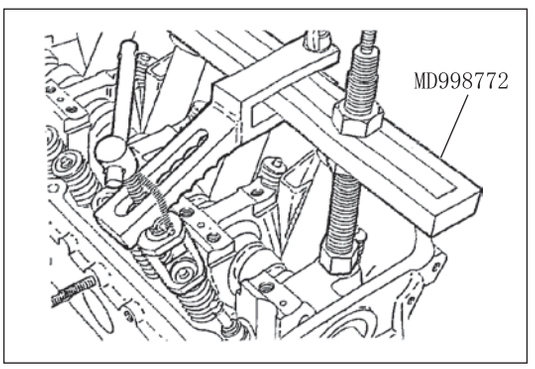
Notice on Disassembly

Notices after Disassembly

The disassembled parts should be sorted as per the cylinder number and the intake/exhaust parts.

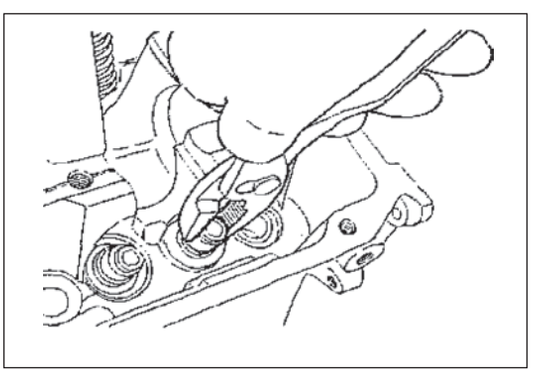
<<A>> Dismantle of Cylinder head Bolts

1. Loosen the bolts of each cylinder heads with SST. The looseness should be even and gradual.



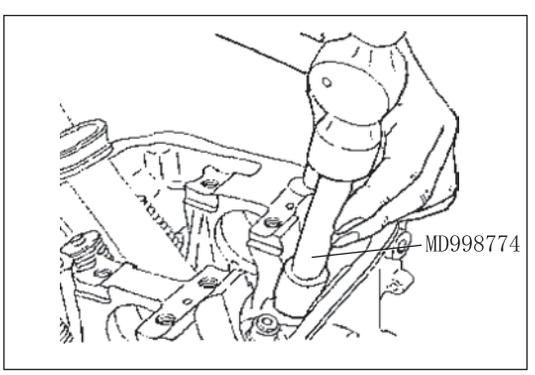
<<B>> DismDismantle of Valve Lock Clamp

1. The dismantled parts such as the valve and spring should be marked with the cylinder number and signboard of mounting position and kept well so as to prepare the later reuse in assembly.



<<C>> Dismantle of Valve Oil Seal

1. The valve oil seal must not be reused.



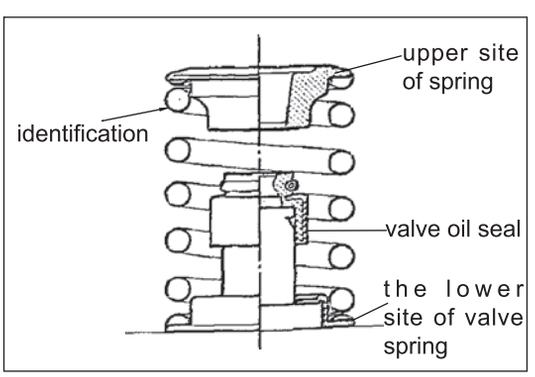
Notice on Assembly

>>A<< Mount of Valve Oil Seal

1. Mount the lower site of valve spring.
2. Mount the valve oil on the valve guide with SST tools. Incorrect mount will lead to leakage.

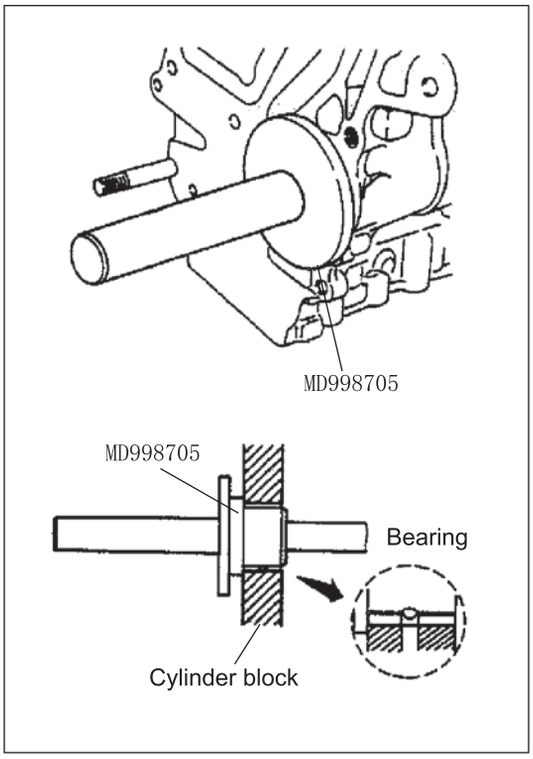
   Notice:

   The valve oil seal must not be reused.



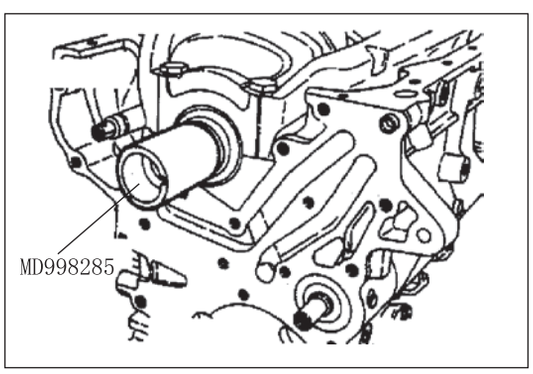
>>B<< Mount of Valve Spring

1. The valve spring shall be mounted in such way that the spring end with identification color faces the upper site of the valve spring.



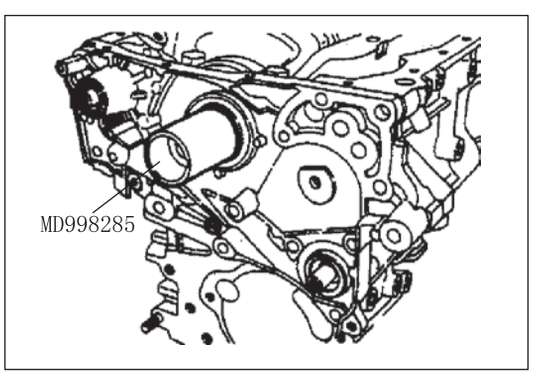
>>C<< Mount of Front Bearing of Balancing Shaft

1. Mount the front bearing with SST.

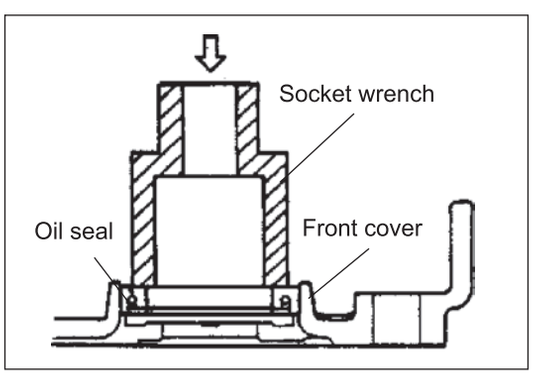


>>D<< Mount of Front Cover

1. Mount the SST on the front end of the crankshaft and coat the engine oil on the face of outer circumference of the SST, then mount on the front cover.

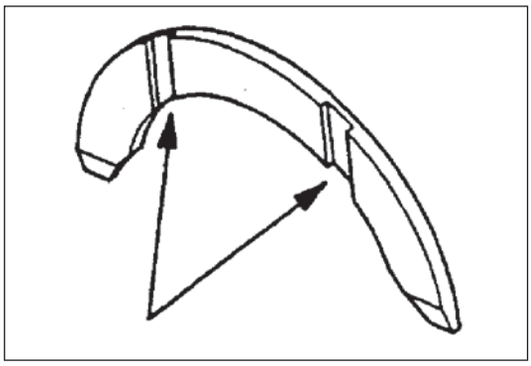


2. Mount on the front cover assembly with a new front gasket, and tighten the flange bolts temporarily (excluding the bolts of oil filter that must be tightened).



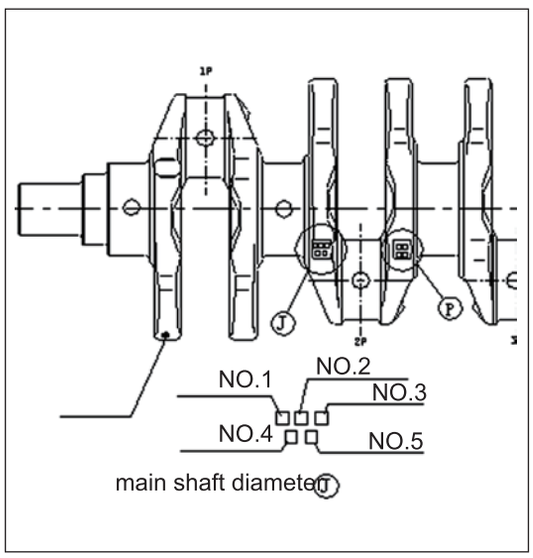
>>E<< Mount of Oil Seal of Balancing Shaft

1. Press the oil seal into the front cover with the socket wrench.



>>A<< Mount of Thrusting Bearing of Crankshaft

1. Mount the thrusting bearing of crankshaft (2 sheets) on the 3rd main shaft hole of cylinder block. Coat a little engine oil on the surface of thrusting bearing to facilitate the mount.
2. The thrusting bearing side with groove should face to the handle arm of the crankshaft.



>>B<< Mount of crankshaft bearing

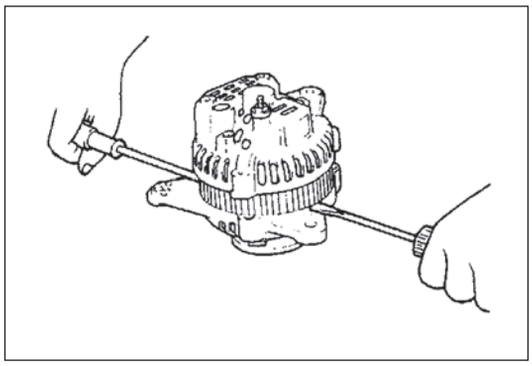
1. Select the bearing that meets the dimension of crankshaft main journal as per the form below.

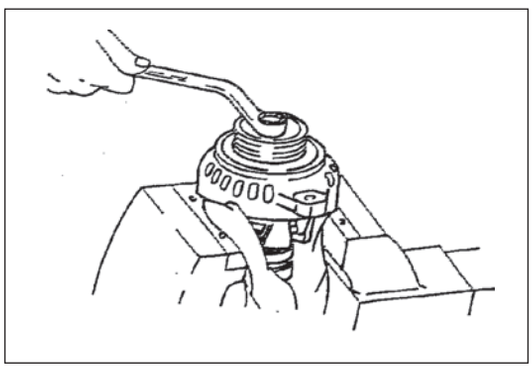
Combination of crankshaft main journal and main shaft aperture				Identification No.1;No2;No4;No5	Identification No.3
Crankshaft main journal			Identification mark of main shaft aperture		
Groups	IdentificationNo.	Diameter (mm)			
I	0	56.994－57.000	0	1	0
			1	2	1
			2	3	2
II	1	56.988－56.994	0	2	1
			1	3	2
			2	4	3
III	2	56.982－56.988	0	3	2
			1	4	3
			2	5	4

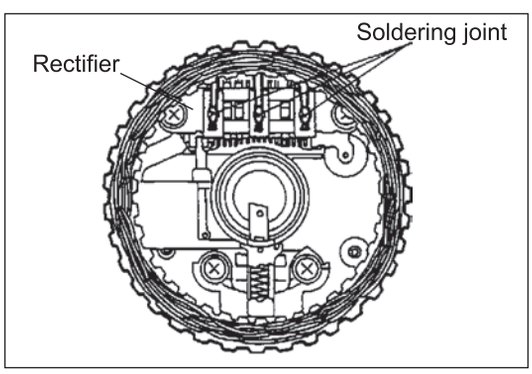
Bearing Selection, for instance:

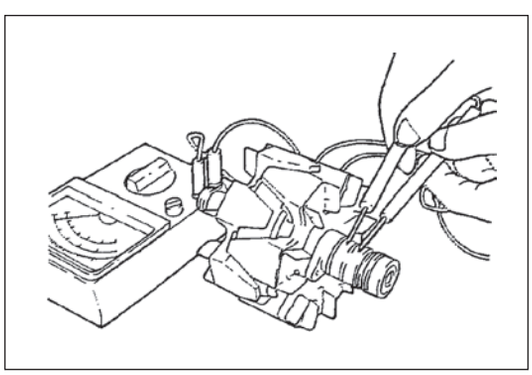
In case the identification mark for main shaft aperture is “0”, select the Bearings of No. 1,2, 4 and 5 with identification mark “2” or the No. 3 bearing with identification mark “1”.

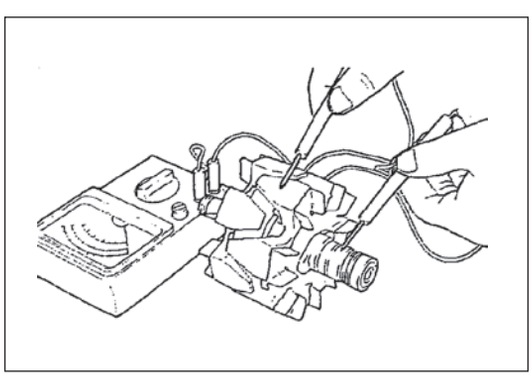
In case there is no identification No. on the crankshaft, measure the main journal and select the corresponding bearing as per the measured value.











NOTES FOR DISASSEMBLY

SEPARATION OF STATOR AND FRONT CAP

1. Insert the screwdriver into the gap between front cap and stator to separate the front cap from the stator.
2. If it is hard to separate them, lightly hit the front cap with a plastic hammer and prize it with screwdriver at the same time.

   NOTES:

   Don't insert the screwdriver too deep lest the stator winding is damaged.

<<A>> DISASSEMBLY OF GENERATOR PULLEY AND ITS FAN

1. With the pulley end upwards, disassemble the pulley after fixing the rotor with a bench clamp.

   NOTES:

   Do not damage the rotor.

<<B>> DISASSEMBLY OF STATOR ASSEMBLY, ADJUSTOR AND BRUSH STAND

1. Knock down the stator with an electric iron (180～250W), such operation should be finished within 4 seconds lest heat is conducted to the diode.
2. While disassembling rectifier from adjustor, burn off the part welded to the rectifier with the electric iron.

   ● *Ensure no t to conduct the heat generated by the electric iron to the diode for a long time.*

   ● *Do not let the diode pin overburden forces.*

CHECK

ROTOR

1. Check whether the rotor winding is switched into conduction and confirm conduction exists between the slip-rings. Meassure the resistence of the rotor. If the resistence is too low, it means the circuit is short. If there exists non-conduction or short circuit, replace the rotor assembly.

   Standard value: 3±0.5Ω

2. Grounding of rotor winding. Check if it is insulated between the slip-ring and iron core, if not, replace the rotor assembly.

☆ Deceleration regulation: when decelerating and parking, it gradually slows down to the target idle speed of stationary state.

IV. Knock Control Logic

- The knock control function is used for eliminating possible knocks during the engine combustion in order to optimize both engine power performance and fuel economy.
- MT20 system can take independent knock control of all the cylinders.
- Working conditions of knock control:
  - ☆ The engine keeps running for more than 2s;
  - ☆ The engine revolution is above 800rpm;
  - ☆ MAP > 40 kPa
- Knock control mode:
  - ☆ Steady state knock control: in case of a knock, the system will quickly retard the ignition advance angle to eliminate the knock.
  - ☆ Transient state knock control: the knock is likely to occur at the time of sharp acceleration, and the system will automatically retard the ignition advance angle in order to avoid any violent knock beyond the limit.
  - ☆ Adaptive knock control: in case that the engine runs after its wear, the system will automatically make adaptive adjustment to the ignition advance angle to prevent any violent knock.

V. Over-speed, Deceleration and fuel-spill & fuel-cutoff Control

- In any case, whenever the engine revolution exceeds the system preset maximum revolution, the system will cut off fuel supply to stop the revolution from increasing unlimitedly for the purpose of protecting the engine and preventing “runaway”; the system will immediately resume fuel supply in case the revolution is below the maximum revolution limit indicated by the system.
- When the engine is in normal operation, the driver releases the accelerator pedal, the vehicle will coast and reversely drive the engine, at which time the vehicle does not require the engine to provide power; however, for the throttle valve is fully closed, such little intake air will result in bad combustion of engine and further increasing harmful emissions, so the system will cut off fuel supply at this time to highly reduce the possibility of harmful emissions and improve fuel economy.
- If the engine fails to start for several times, there will be residual unburned gasoline in engine cylinders, which is commonly called “flooded engine”. In this case, the driver may push the accelerator pedal to the bottom to start the engine, and the system will automatically apply a rather lean air/fuel ratio to drain the excessive gasoline in the cylinders during the engine running.

VI. Plug-in Air-conditioning (A/C) Control

- ECM monitors A/C request input and A/C evaporator temperature sensor input, and controls A/C clutch compressor even in case of A/C relay. The system automatically identifies PnP A/C system.
- A/C working conditions:
  - ☆ The engine keeps running for more than 5s.
  - ☆ Only when the engine revolution is above 600rpm but below 6200rpm, A/C will start.
  - ☆ After A/C and evaporator starts, the engine target idle speed will increase by 150rpm.
  - ☆ The intake temperature is above 3.75℃.
  - ☆ The water-cooling system temperature is above 3.75℃.
  - ☆ Only when the water-cooling system temperature is below 106℃, the compressor will start.
  - ☆ The A/C compressor will switch off when the water-cooling system temperature exceeds 108℃.
  - ☆ The A/C compressor will switch off when the front A/C evaporator temperature is below 2.25℃.

II. Function and Principle

- ECM is a microprocessor using single-chip (SCM) as the core. It is used to process the data from different sensors on the vehicle, judge the working condition of engine and take an accurate control over the engine by using the actuators.
- Auxiliary system control function: immobilizer system, cooling fan system, A/C system, etc.
- Installation: ECM should be installed in the driving cab or the engine compartment. And, its housing should not be grounded.

III. Failure Criteria

Important note: All the following criteria are based on the fact that the functions of vehicle, wiring harness and other system components are normal.

- ECM fault: The system is unable to communicate with the external;
- Immobilizer locking: The immobilizer was once connected; it can be used again just after unlocking.
- Signal input system fault: The signal input system fails to receive signals.
- Alternator regulator fault: Over-high output voltage causes collateral damage to the ECM.
- Output control system fault: The internal driver of ECM is damaged, and as a result, the driver actuator does not work.

Engine Revolution & Crankshaft Position Sensor

Schematic diagram

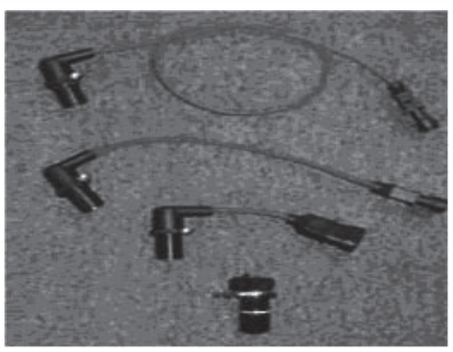


Fig. 3-2 Crankshaft Position Sensor

Fig. 3-3 58X Revolution Signal Gear

I. Product Features

- Working temperature: -40 ~ 165℃
- Working clearance: 0.25 ~ 1.75 mm
- Output: 400 mV@60 RPM
- Coil resistance: 560Ω
- Coil inductance: 190mH@1kHz

II. Function and Principle

The engine revolution & crankshaft position sensor, as a magnetoelectric sensor, is installed close to the crankshaft and works together with 58X ring gear on the crankshaft. When the crankshaft rotates, the crest and tooth space of 58X ring gear respectively pass through the sensor with different distances, and the sensor detects an alternative reluctance which generates an alternative output signal, then ECM utilizes this signal to determine both crankshaft position and revolution.

Knock Sensor

Schematic diagram

Fig. 3-7 Knock Sensor

I. Product Features

- Output signal:

Frequency	Output Signal
5kHz	17~37mV/g
8kHz	+15% higher than that at 5kHz
13kHz	+30% higher than that at 5kHz
18kHz	twice of that at 13kHz

in any case >17mV/g

- Frequency response range: 3~18kHz
- Capacitance: 1,480~2,220pf@25℃@1000Hz
- Resistance: >1MΩ@ 25℃
- Working temperature: -40~150℃

II. Function and Principle

- The knock sensor, as a piezoelectric vibration sensor, is installed on the sensitive part of engine cylinder body and used to detect the engine knock. ECM detects the knock intensity through the knock sensor and then modifies the ignition advance angle to take efficient control over engine knock and optimize engine power performance, fuel economy and emission level. The system uses the frequency response knock sensor, and ECM filters the received signals; the sensor signal intensity is relatively weak, so the lead wire should use the shielded wire.
- Connecting terminals: A- signal; B- ground via the shield;
- Installation: The knock sensor is installed on the part sensitive to engine knock.

III. Failure Criteria

Important note: All the following criteria are based on the fact that the functions of vehicle, wiring harness and other system components are normal.

- Read out the fault diagnosed by the system with the diagnostic instrument.
- The signal wire in the wiring harness is not a shielded wire or the shield of this shielded wire is not well grounded.

Ignition Coil

Schematic diagram

Fig. 3-11 Ignition Coil

I. Product Features

- Primary coil resistance: 0.52 ± 0.05 Ω
- Secondary coil resistance: 9,840 ± 980 Ω
- Working voltage range: 6~16V
- Primary coil charging time: 3.36 mS
- Primary coil interruption current peak value: 9.5 A
- Secondary coil output voltage: >=34 kV
- Minimum Zener energy: 30 mJ
- Minimum duration of ignition: 0.8 mS
- Tightening torque: 8-12 N•M

II. Function and Principle

- The ignition coil assy consists of two groups of coils and each group provides ignition energy for the spark plug of two cylinders with 360° crank angle. The ignition occurs upon the piston reaching the compression stroke TDC (top dead center) and the exhaust stroke TDC. For the cylinder close to the exhaust stroke TDC is with low air pressure and high temperature, a small amount of ignition energy can cause the electrode breakdown and ignite, which is called redundant ignition; however, for the cylinder at the compression stroke TDC with relatively large air intensity and high pressure, a large amount of ignition energy is needed for the ignition of its spark plug so that the air mixture spark rapidly, which is called efficient ignition.
- Connecting terminals: A- the driver of cylinders 2-3; B- +12V; C- the driver of cylinders 1-4.
- Installation: The ignition coil is installed in the engine compartment. Pay attention to the radio interference shielding.

III. Failure Criteria

Important note: All the following criteria are based on the fact that the functions of vehicle, wiring harness and other system components are normal.

- When the vehicle is not running, drive the ignition coil to operate by means of the diagnostic instrument and check the ignition condition of each cylinder to identify the fault of ignition coil and relevant circuits.

Three-way Catalytic Converter

Schematic diagram

Fig. 3-19 Three-way Catalytic Converter

I. Product Features

- Optimum working temperature: 375~800℃ (short-time withstand temperature: 950℃)
- Optimum working air/fuel ratio: 14.6~14.7

II. Function and Principle

- The three-way catalytic converter is used to convert the harmful gas exhaust from the engine into environmental-friendly gas before releasing into the atmosphere;
- The internal structure of three-way catalytic converter is designed by means of honeycomb pipe with noble metal (e.g. platinum, rhodium and palladium, etc.) coating on its wall as catalytic reaction enzyme.
- The power loss of three-way catalytic converter is about 3~4%.
- Installation: The three-way is connected in series between the exhaust manifold and the muffler, in rear of the oxygen sensor.

III. Failure Criteria

- The three-way catalytic converter fails to work due to heavy metal (e.g. lead and manganese, etc.), phosphorous or sulfur damages.
- The three-way catalytic converter fails to work due to high-temperature burning-out (e.g. single engine cylinder misfire).
- External force impact or quenching impact makes the carrier broken.
- The three-way catalytic converter is clogged by external objects (e.g. burnt engine oil in the engine).
- If the three-way catalytic converter is clogged, it may cause the engine not to start or powerless acceleration. At this time, the intake manifold pressure is abnormally high.

5. The method of diagnosis through experience:

☆ Improve the ability in troubleshooting by continuously accumulating experience from the troubleshooting practices.

☆ Make judgment through flexibly using former experience according to the similarities and differences of fault symptoms.

☆ For special and typical faults, be sure to make a summary and record the success and failure of troubleshooting for experience optimization.

6. The method of diagnosis through logical reasoning:

☆ Make fault analysis and reason about the fault according to testing data and the working principle of system.

☆ It is required to have a better understanding of the working principles and functions of engine, electronic fuel injection system (EFIS) and system components.

☆ For some faults, it is necessary to make logical reasoning and analysis.

7. The method of diagnosis through backward logical reasoning:

☆ Supposing that a part is at fault, identify the symptoms through backward reasoning.

☆ Accumulate and summarize the fault symptoms of damaged parts to help you find out the fault point rapidly.

8. The method of diagnosis through flow chart analysis:

☆ This method is applicable to relatively complex faults.

☆ Operate according to a given flow chart to find out the fault point.

☆ Other methods may be used during operation to help you make analysis and judgment.

II. The Method of Troubleshooting by Module

The method of troubleshooting by module means the troubleshooting method in which inspections are carried out in an optimized sequence, including vehicle inspection module, fuel supply system module, ignition system module, intake system module, exhaust system module and component diagnosis module. Through inspecting these modules, the fault points caused by the EFIS can be basically identified.

1. Vehicle inspection module

Step 1: Cool down the vehicle, the key switch is set to “ON” position and the engine keeps stationary (for about 30s)

Inspection Item	System State and Limit Value
Fault code display	None
Engine trouble lamp	On
Battery cell voltage	11.5 ~ 13V
Coolant temperature sensor	Normal temperature
Intake temperature sensor	Ambient temperature
Intake manifold absolute pressure sensor	Ambient pressure (plain: about 100kPa)
Working range of throttle position sensor	0 ~ 99.6%
Oxygen sensor	< 200 mV (heating mode) ≈ 450 ± 10 mV (non-heating mode)
Idle air control valve	40~159 steps

Step 2: Idle speed inspection (after starting, preheat the engine to the normal water temperature) – low idle speed

Inspection Item	System State and Limit Value
Engine trouble lamp	Off
Fault code display	None
Coolant temperature	80 ~ 94℃
Battery cell voltage	13.5 ~ 14.5 V