

# ***SERVICE MANUAL***



**4G64S4M**

**GASOLINE ENGINE**

# Preface

This manual is specially made for those who engage in automobile maintenance and repairing. Following general rules of system division of vehicles (engine, clutch, etc.), this manual adopts the division methods by major assembly. In order to describe all parts belonging to an assembly, assemblies are further divided into several parts.

Brief introductions, specifications, main points of adjustments, mounting and dismounting, assembling and disassembling of the assembly components are covered in this manual. On the top of the first page of all assemblies are the content, through which the needed information can be easily found.

All explanations and specifications in this manual is the latest till the date of printing.

GENERAL 00

ENGINE 11

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# General Contents

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Guide on Using the Manual

Maintaining Steps

(1) Profile plots are provided for you to understand the installation of each component.

(2) Use reference number of the parts to show operation steps, mark the parts that can not be used repeatedly (marked as **N**) and the tightening torque.

Dismantling Steps: Corresponding number of parts to the number in the figure of composing parts to show the dismantling steps.

Disassembly Steps: Corresponding number of parts to the number in the figure of composing parts to show the disassembly steps.

Mounting Steps: Mounting steps should be indicated when the mounting may not in the reverse order with dismantling steps. Otherwise, the mounting steps can be omitted.

Assembly Steps: Mounting steps should be indicated when the mounting may not in the reverse order with dismantling steps. Otherwise, the mounting steps can be omitted.

Division of Notes for Maintaining

When there are notes for maintaining, standard value and usage of special tools, detailed explanation is given.

A

: Indicates “Notes for dismantling or disassembly” available.

A

: Indicates “Notes for mounting or assembly” available.

Marks for Lubricant, Sealant and Adhesive

Indicate in the figure of composing parts the location where lubricant, smearing or supplying of sealant and adhesive are to be applied.

.....Lubricating grease

[Means all-purpose lubricating grease if not specially indicated otherwise.]

.....Sealant or adhesive

.....Engine oil or gear oil

Grouping name

Section Name

Page

Engine – Front cover, Oil pump

11-33

Front Cover, Oil Pump

Dismantling and Mounting

Stands for part that may not be used repeatedly

1.4Kg.m

1.9 Kg.m

stands for tightening torque

Smear the engine oil on all the movement parts while assembling

Dismantle steps:

E

1. oil filter

2. oil drain plug

3. oil plug washer

4. oil pan

5. oil filter screen

6. oil filter screen washer

7. overflow valve plug

8. overflow valve string

9. overflow valve core

10. oil seal

11. oil pump shell

12. O-ring

13. oil pump shell cover

14. outer rotor

15. inner rotor

These numbers are corresponding to the numbers in the steps of dismantling, disassembly, mounting and assembly.

9EN0040

Disassembly notes:

A

Oil pan disassembly

After you take down the bolt , disassembly the oil pan with special tool.

These English letters corresponds to the letters in the steps of dismantling, mounting, disassembly and assembly.

Explanations are given for the maintaining essentials and notes for dismantling and mounting, disassembly and assembly.

MD998727

DILD583

MD998727

DILD584

ENGINE MODEL

| VEHICLE MODEL | ENGINE    |              |                               |
|---------------|-----------|--------------|-------------------------------|
|               | MODEL     | DISPLACEMENT | TYPE                          |
| HOVER CUV     | 4G64-D-Y7 | 2,351 ML     | FOUR CYLINDERS, IN-LINE, SOHC |

## Tightening Torque

The common tightening torque is shown in the list.

Tightening torque of special parts is shown at the beginning of each group.

### Tightening torque of bolts and nuts

| Diameter of bolt | Thread pitch | Torque (Kg. M)            |             |              |             |             |
|------------------|--------------|---------------------------|-------------|--------------|-------------|-------------|
|                  |              | Bolt (with spring washer) |             |              | Valve bolt  |             |
|                  |              | Head mark 4               | Head mark 7 | Head mark 10 | Head mark 4 | Head mark 7 |
| M6               | 1.0          | —                         | 0.9         | 1.3          | —           | 1.1         |
| M8               | 1.25         | 1.1                       | 1.8         | 3.0          | 1.4         | 2.4         |
| M10              | 1.25         | 2.0                       | 3.4         | 6.0          | 3.0         | 5.0         |
| M12              | 1.25         | 3.6                       | 6.2         | 10.8         | 5.5         | 9.0         |

### Tightening torque of taper thread

| Thread Dimension |      | Torque (Kg. M) |                  |
|------------------|------|----------------|------------------|
|                  |      | Light alloy    | Cast iron, steel |
| NPTF             | 1/16 | 0.5 – 0.8      | 0.8 – 1.2        |
| PT               | 1/8  | 0.8 – 1.2      | 1.5 – 2.2        |
| PT               | 1/4  | 2.0 – 3.0      | 3.5 – 4.5        |
| NPTF             | 1/4  | 2.0 – 3.0      | 3.5 – 4.5        |
| PT               | 3/8  | 4.0 – 5.5      | 5.5 – 7.5        |
| PT               | 1/2  | 7.0 – 10.0     | 12.0 – 16.0      |

## Sealant (FIPG)

Sealant is used on many parts of the engine and gearbox. The using of sealant is for the purpose of adequately sealing, therefore, much attention should be paid to the dosage, position and the surface of sealant. Insufficient dosage of sealant may result in leakage, while superfluous dosage of sealant may result in the overflow of sealant and jam the passage of water or oil, or narrow the passage. So, in order to avoid leaking on the mounting surface, it is absolutely necessary to keep the correct dosage that may keep from disconnection.

FIPG used in the engine is of Room Temperature Vulcanizing (RTV) and is provided in the way of 100-gram tube (Piece No. MD970389, for engine use). RTV may vulcanize after reaction with the water content in the air; therefore, it is usually used on the metal end face.

## Disassembly

Components assembled with sealant may be disassembled without using a special method. However, in some cases, it is necessary to lightly hit the components with a mallet or similar tools so as to break sealant on the coupling face, or use a smooth thin sealant knife to hit into the joint face gently without damaging the coupling face. When dismounting the engine oil pan, use special tool for dismounting oil pan (MD998727).

## Cleaning of Sealing Surfaces

Remove rubbish on the sealing surface with a sealant knife or a steel wire brush. Be sure the sealing surface is flat and smooth, and there isn't any oil stain or foreign object on it. Remember to remove the sealant inside the mounting hole and the threaded holes.

## Essentials for Smearing

Matters to be taken into consideration while assembling components with FIPG.

Smear sealant equally within the prescribed diameter to cover around the mounting hole. Sealant that is not yet vulcanized can be removed. After the installation, the sealant should be sufficiently vulcanized (approximately 1 hour or so). Do not apply oil on the smeared part or wet or startup the engine during this period.

# Engine

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## General

| Items                    |               |     | Specifications                          |
|--------------------------|---------------|-----|---|
|                          |               |     | 4G64 S4 MPI                             |
| Type                     |               |     | In-line OHV, SOHC                       |
| Number of Cylinders      |               |     | 4                                       |
| Combustion Chamber       |               |     | Single Pitch Roof                       |
| Total Displacement    ml |               |     | 2,351                                   |
| Cylinder Bore    mm      |               |     | 86.5                                    |
| Stroke    mm             |               |     | 100.0                                   |
| Compression Ratio        |               |     | 9.5                                     |
| Valve Timing             | Intake valve  | On  | 18° before top dead center              |
|                          |               | Off | 53 ° after bottom dead center           |
|                          | Exhaust valve | On  | 50 ° before bottom dead center          |
|                          |               | Off | 18 ° after top dead center              |
| Lubrication system       |               |     | Compression supply, full flow filtering |
| Type of oil pump         |               |     | Gear type                               |
| Cooling system           |               |     | Water cooling forced circulation        |
| Type of water pump       |               |     | Centrifugal impeller                    |

## Specifications

### Maintenance Standard

Unit: mm

| Items                     |  |                  | Standard Value   | Limit Value    |
|---------------------------|--|------------------|------------------|----------------|
| Generator<br>Toothed-belt | Convex value of tensioner arm                                  |                  | 12               | ——             |
|                           | Press-in value of tensioner arm (98~196N)                      |                  | $\leq 1$         | ——             |
| Camshaft                  | Height of cam  | Air intake       | 37.39            | 36.89          |
|                           |  | 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 bol                                    | 97.4             | $\leq 99.4$      |                |
| Valve                     | Edge thickness   | Intake           | 1.0              | 0.5            |
|                           |  | Exhaust          | 1.2              | 0.7            |
|                           | Diameter of valve stem   |                  | 6.0              | ——             |
|                           | Radial clearance between valve stem and valve guide            | Intake           | 0.02 – 0.05      | 0.10           |
|                           |  | Exhaust          | 0.03 – 0.07      | 0.15           |
|                           | Inclination  |                  | 45° – 45.5°      | ——             |
|                           | Height   | Intake           | 112.30           | 111.80         |
|                           |  | Exhaust          | 114.11           | 113.61         |
| Valve Spring              | Free Height  |                  | 51.0             | 50.0           |
|                           | Working pre-tightening force/Working depth Kg/mm               |                  | 27.2/44.2        | ——             |
|                           | Verticality  |                  | $\leq 2^\circ$   | $\leq 4^\circ$ |
| 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            |

|                | Items   |           | Standard Value  | Limit Value |
|----------------|---|-----------|-----------------|-------------|
| 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         |
| Cylinder Block | Planeness of top surface  |           | 0.05            | 0.1         |
|                | Top surface lapping limit*Total lapping   |           | —               | * 0.2       |
|                | of cylinder block and head  |           |                 |             |
|                | Total Height  |           | 290 ± 0.1       | —           |
|                | Minor diameter of cylinder hole   |           | 86.50 ~ 86.53   | —           |
| Cylinder Block | Cylindricity of cylinder hole   |           | 0.01            | —           |
| Generator      | Resistance of rotor coil  |           | 3 – 5           | —           |
| Cylinder Head  | Secondary processing dimension of the enlarging of mounting hole of valve guides (intake valve and exhaust valve) | 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 dimension of the enlarging of round hole of intake valve seat                                | 0.30 O.S. | 34.435 – 34.455 |             |
|                |   | 0.60 O.S. | 34.735 – 34.755 |             |
|                | Secondary processing dimension of the enlarging of round hole of exhaust valve seat                               | 0.30 O.S. | 31.935 – 31.955 |             |
|                |   | 0.60 O.S. | 32.235 – 32.255 |             |

Remarks:

O.S.: Diameter increased

## Tightening Torque

| Fastening Location                              | Torque (Kg.M)   |
|---|-----------------|
| Generator and Ignition System                   |                 |
| Fastening bolt of AC generator                  | 2.4             |
| Stay bolt                                       | 2.4             |
| Pivot nut                                       | 2.3             |
| Crankshaft pulley bolt                          | 2.5             |
| Spark plug                                      | 2.5             |
| Ignition coil bolt                              | 1.1             |
| Timing toothed-belt                             |                 |
| Lower front cover of timing toothed-belt        | 1.1             |
| Tensioning pulley bolt                          | 4.9             |
| Tensioning wheel arm bolt                       | 2.2             |
| Automatic tensioning wheel bolt                 | 2.4             |
| Central pulley bolt                             | 3.6             |
| Tensioning wheel bracket                        | 4.9             |
| Rear cover of timing toothed-belt               | 1.1             |
| Timing belt indicator                           | 0.9             |
| Toothed-belt wheel of oil pump                  | 5.5             |
| Crankshaft toothed-belt wheel bolt              | 12.0            |
| Tensioner “B”                                   | 1.9             |
| Toothed-belt wheel of balancing shaft           | 4.6             |
| Camshaft toothed-belt wheel bolt                | 9.0             |
| Toothed-belt wheel of balancing shaft           | 4.6             |
| Fuel System                                     |                 |
| Throttle  | 1.9             |
| Fuel distributing pipe assembly                 | 1.2             |
| Intake manifold                                 |                 |
| Eye bolt of engine                              | 1.9             |
| Cooling water temperature sensor plug of engine | 3.0             |
| Water outlet port coupling bolt                 | 2.0             |
| Intake manifold bolt                            | 2.0             |
| Water temperature sensor                        | 3.0             |
| Exhaust manifold                                |                 |
| Exhaust manifold cover bolt                     | 1.4             |
| Water inlet port coupling bolt                  | 2.4             |
| Exhaust manifold nut (M8)                       | 3.0             |
| Exhaust manifold nut (M10)                      | 5.0             |
| Cooling water bypass pipe connector bolt        | 2.4             |
| Cooling water pipe assembly bolt                | 1.3             |
| Thermostat shell bolt                           | 2.4             |
| Water pump bolt                                 | 1.4             |
| Rocker Arm and Camshaft                         |                 |
| Rocker cover bolt                               | 0.4             |
| Rocker arm and camshaft assembly bolt           | 3.2             |
| Thrust cover screw                              | 1.9             |
| Cylinder head and valve                         |                 |
| Cylinder head bolt                              | 2.0 + 90° + 90° |

| Fastening Location                                   | Torque (Kg.M)    |
|--|------------------|
| Front cover and oil pump                             |                  |
| Oil drain plug                                       | 4.5              |
| Oil pan  | 0.7              |
| Oil suction filter bolt and nut                      | 1.9              |
| Oil pressure switch                                  | 1.0              |
| Pressure relief plug                                 | 4.5              |
| Oil suction filter bracket bolt                      | 1.9              |
| Front cover bolt                                     | 2.4              |
| Plug   | 2.4              |
| Flange bolt  | 3.7              |
| Oil pump cover bolt                                  | 1.6              |
| Oil pump cover screw                                 | 1.0              |
| Piston and connecting rod assembly                   |                  |
| Connecting rod nut                                   | 2.0 + 90° ~ 100° |
| Crankshaft, cylinder block, flywheel and drive board |                  |
| Flywheel bolt  | 13.5             |
| Rear cover board mounting bolt                       | 1.1              |
| Oil-seal retainer mounting bolt                      | 1.1              |
| Main bearing cap bolt                                | 2.5 + 90° ~ 100° |

## A New Tightening Method — Bolt Tightening at Plasticity Area

A new tightening method — bolt tightening at plasticity area will be used in some parts of engine. Different from traditional tightening method, the use limit stated herein shall be followed while tightening the bolts.

- This method shall be applied to the following bolts:

- (1) Cylinder head bolt
- (2) Main bearing cap bolt
- (3) Connecting rod bolt


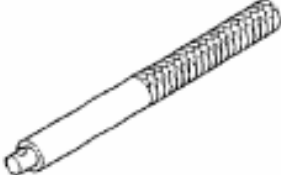
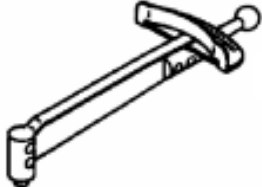

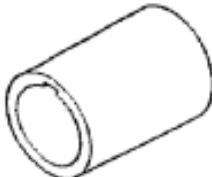


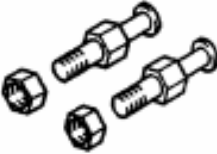
- Tightening method:


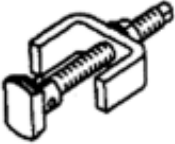


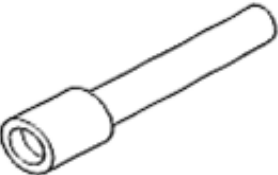


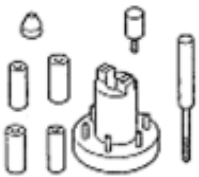
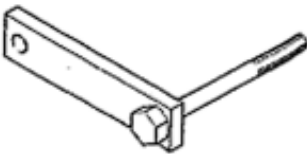

Screw the bolt till the prescribed torque is reached, then tighten another 90~100° (for cylinder head bolt, 2 90° is needed). When the area is different, the method is also different. The methods stated herein shall be followed.

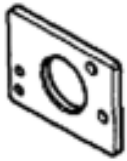
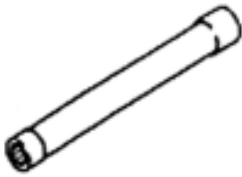


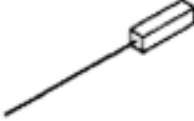

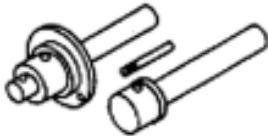


## Sealant

| Applying Location                   | Model to Use                             |
|-------------------------------------|--|
| Water outlet port coupling          | MD970389 or the equivalent               |
| Cooling water bypass pipe connector | MD970389 or the equivalent               |
| Oil pressure switch                 | 3M ATD No.8660 or the equivalent         |
| Oil pan                             | MD970389 or the equivalent               |
| Oil-seal retainer                   | MD970389 or the equivalent               |
| Water temperature sensor            | 3M NUT LOCKING No.4171 or the equivalent |

## SPECIAL TOOLS

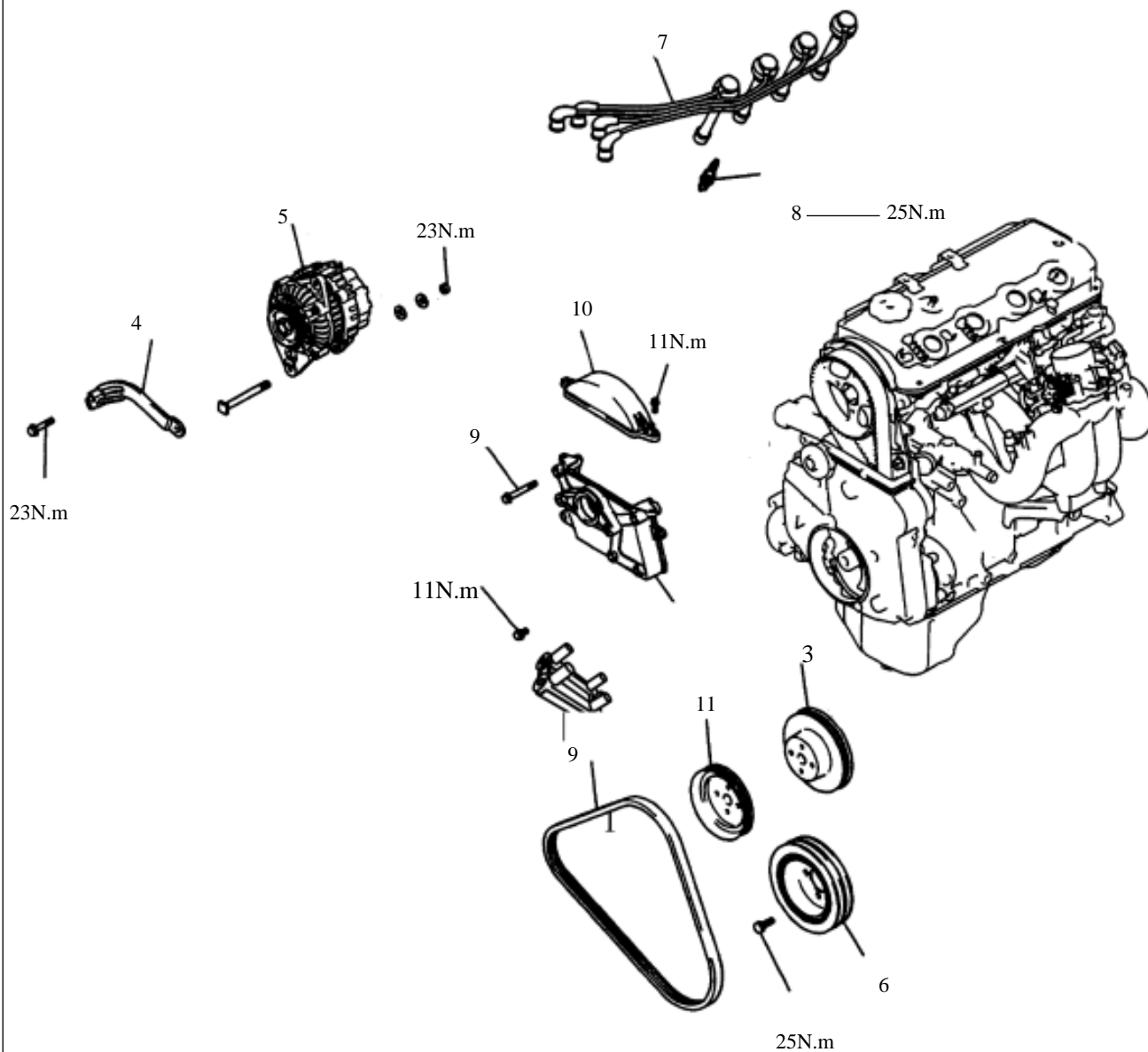
| Tools   | REF. NO. | NAME                                | PURPOSE   |
|---|----------|-------------------------------------|---|
|    | MB990767 | CRANKSHAFT PULLEY WRENCH            | Use MD998719 for Fastening camshaft toothed-belt wheel        |
|    | MB990938 | HANDLE                              | Use together with MD998776                                    |
|    | MD990685 | TORQUE WRENCH                       | Use MD998767 for timing toothed-belt tensioning               |
|   | MD998162 | SCREW-PLUG WRENCH                   | Disassembly and mounting of front cover plug                  |
|  | MD998285 | CRANKSHAFT FRONT OIL SEAL GUIDE     | Use MD998375 for mounting of crankshaft front oil seal        |
|  | MD998375 | CRANKSHAFT FRONT OIL SEAL ASSEMBLER | Mounting of crankshaft front oil seal                         |
|  | MD998713 | CAMSHAFT OIL SEAL ASSEMBLER         | Mounting of camshaft oil seal                                 |
|  | MD998719 | PULLEY FIXING PIN                   | Use MB990767 for the fastening of camshaft toothed-belt wheel |

| Tools   | REF. NO. | NAME                                 | PURPOSE   |
|---|----------|--------------------------------------|---|
|    | MD998727 | OIL PAN DETACHER                     | Disassembly of oil pan                                    |
|    | 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 | S C R E W - P L U G WRENCH FIXER     | Disassembly and mounting of front cover screw-plug        |

| Tools   | REF. NO. | NAME                              | PURPOSE  |
|---|----------|-----------------------------------|--|
|    | MB991603 | BALANCING SHAFT BEARING PULLER    | Guide limit for disassembly and assembly of reverse balancing shaft rear bearing (used with MD998372 together) |
|    | MB991654 | CYLINDER HEAD BOLT WRENCH         | Disassembly and mounting of cylinder head bolt   |
|    | MD998440 | LEAKAGE-DETECTING TESTER          | Hydraulic lifter leakage-detect test   |
|    | MD998441 | HYDRAULIC LIFTER RETAINER         | Air exhausting of hydraulic lifter   |
|  | MD998442 | HYDRAULIC LIFTER WIRE             | Air exhausting of hydraulic lifter   |
|  | MD998443 | HYDRAULIC LIFTER RETAINER         | Hydraulic lifter retainer while removing and mounting rocker shaft assembly                                    |
|  | MD998705 | BALANCING SHAFT BEARING INSTALLER | Mounting of reverse balancing shaft front & rear bearing   |
|  | MD998785 | TIMING TOOTHED-BELT STOPPER       | Retaining of balancing shaft toothed-belt wheel  |
|  | MD998767 | TENSIONER PULLING STEEVE          | Adjusting tension of timing belt   |



## AC GENERATOR AND IGNITION SYSTEM DISASSEMBLY AND MOUNTING

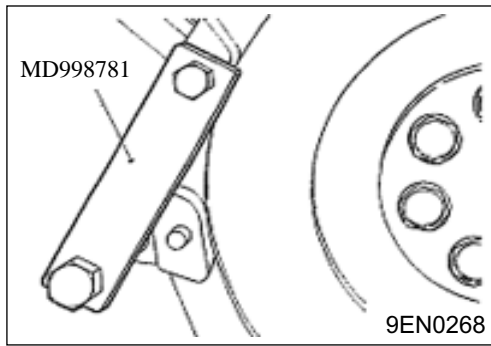


### Disassembly Procedure

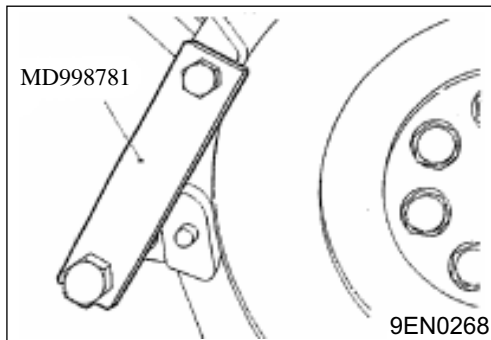
- 1. driving belt
- 2. water pump pulley
- 3. power steering pump pulley
- 4. AC generator support
- 5. AC generator

6. crankshaft pulley

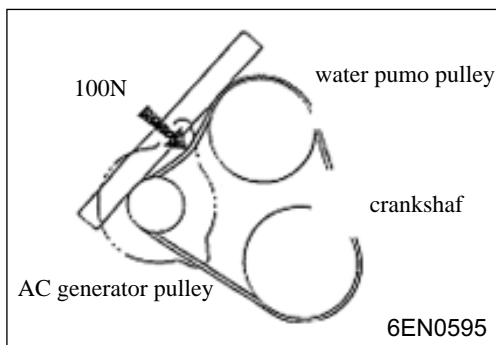
- 7. spark plug cable
- 8. spark plug
- 9. ignition coil
- 10. front top cover of timing toothed-belt
- 11. ignition coil bracket

**NOTES FOR DISASSEMBLY****◻AD◻ DISASSEMBLY OF CRANKSHAFT BOLT**

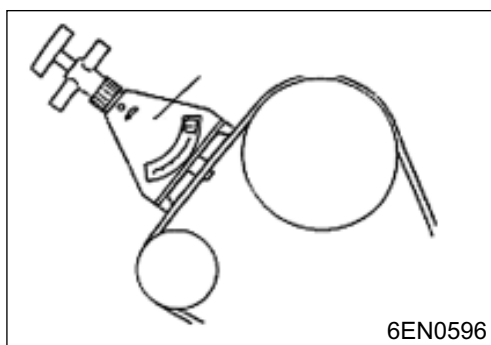
- (1) Fasten flywheel with special tools
- (2) Disassemble crankshaft bolt.

**NOTES FOR MOUNTING****◼D◼ MOUNTING OF CRANKSHAFT BOLT**

- (1) Fasten flywheel with special tools.
- (2) Mount crankshaft bolt.

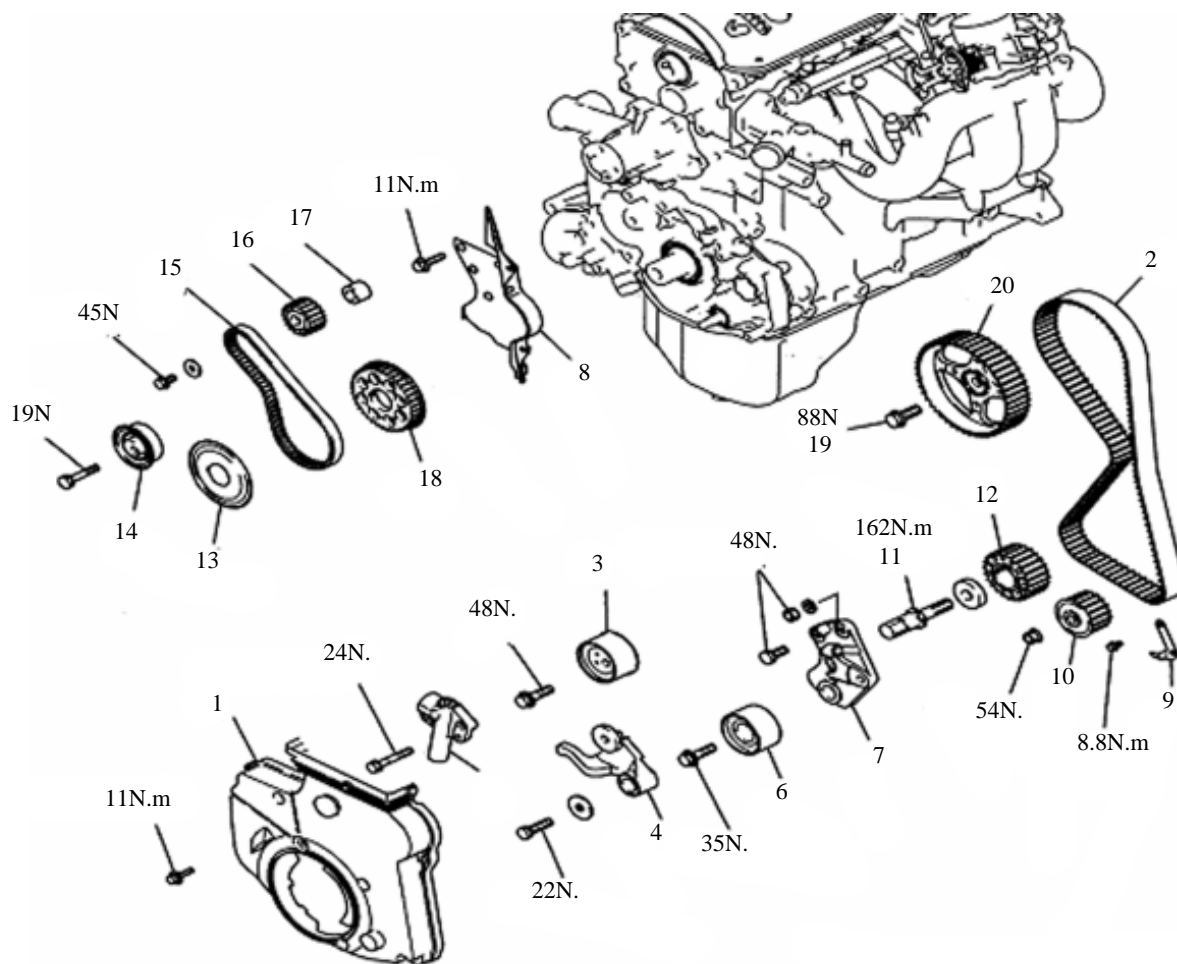
**◼E◼ ADJUST DRIVING BELT TENSION TO STANDARD VALUE WITH DEFLECTION INDICATOR OR TENSION GAUGE****STANDARD VALUE**

|                |             |
|----------------|-------------|
| NEW BELT ..... | 5.5 – 7.5mm |
| OLD BELT ..... | 7.5 – 8.5mm |

**STANDARD VALUE**

|                |           |
|----------------|-----------|
| NEW BELT ..... | 50 – 70KG |
| OLD BELT ..... | 35 – 45KG |

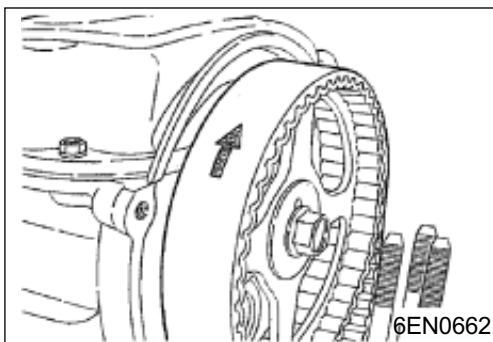
## TIMING TOOTHED-BELT DISASSEMBLY AND MOUNTING



6EN1769

### Disassembly Procudure

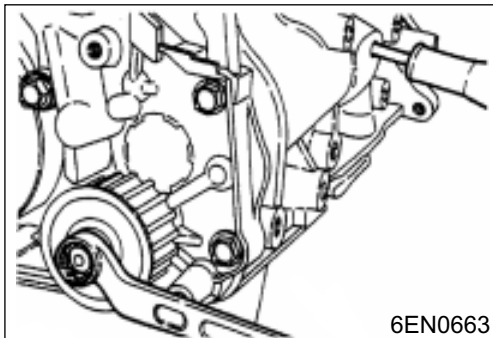
- |  |  |
|--|--|
| 1. front lower cover of timing thoothed-belt | 11. crakshaft bolt**                   |
| 2. timing toothed-belt                       | 12. crankshaft toothed-belt wheel      |
| 3. temsioning pulley                         | 13. flange                             |
| 4. tensioning arm                            | 14. tensioner B                        |
| 5. automatic tensioner                       | 15. timing toothed-belt B              |
| 6. centrual pulley                           | 16. balancing shaft toothed-belt wheel |
| 7. tensioning pulley bracket                 | 17. spacer                             |
| 8. rear cover of timing toothed-belt         | 18. crankshaft toothed-belt wheel B    |
| 9. timing toothed-belt indicator             | 19. camshaft toothed-belt bolt         |
| 10. oil pump toothed-bet wheel               | 20. camshaft toothed-belt wheel        |

**NOTES FOR DISASSEMBLY****◇A◇ DISASSEMBLY OF TIMING TOOTHED-BELT**

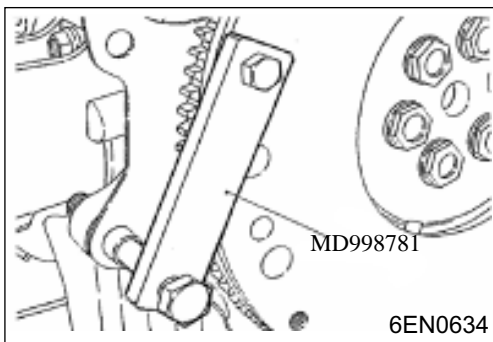
- (1) Record the rotation direction of toothed-belt for correct re-mounting.

**Notes:**

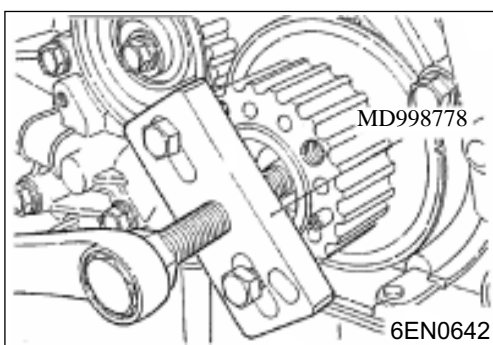
- Adhering of water or grease to the toothed-belt will sharply shorten its service life. So, after disassembly, try your best to avoid the toothed-belt, toothed-belt wheel and tensioner from being contaminated and adhered by water or grease. No need to clean these parts. Replace it if it is seriously contaminated.
- In case water or grease is found on these parts, check the front cover oil-seal, camshaft oil-seal and water pump if there exist leakage.

**◇B◇ DISASSEMBLY OF OIL PUMP TOOTHED-BELT WHEEL**

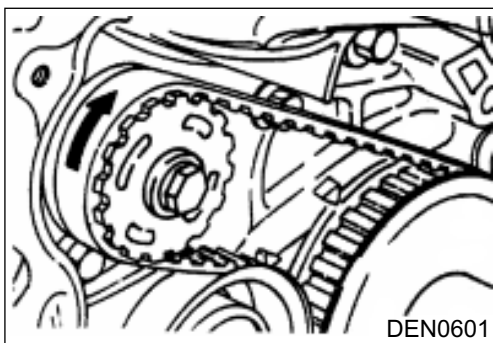
- (1) Assemble the cock on the cylinder block.
- (2) Insert a cross point screwdriver of 8mm diameter to fasten the balancing shaft on the left side.
- (3) Disassemble oil pump toothed-belt wheel nut.
- (4) Disassemble oil pump toothed-belt wheel.

**DISASSEMBLY OF CRANKSHAFT BOLT**

- ◇C◇ (1) Fasten the flywheel with special tools.
- (2) **NOTES FOR DISASSEMBLY**  
**DISASSEMBLY OF TIMING TOOTHED-BELT**

**◇D◇ DISASSEMBLY OF CRANKSHAFT TOOTHED-BELT WHEEL**

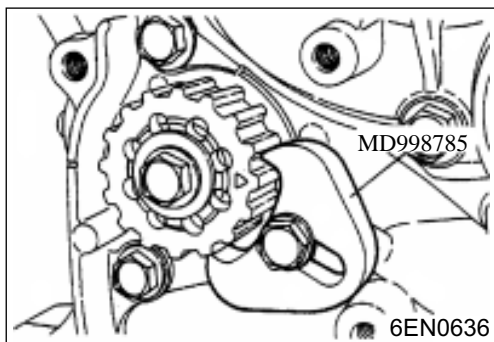
- (1) In case difficult to disassemble due to adhesion, use special tools.

**◇E◇ DISASSEMBLY OF TIMING TOOTHED-BELT WHEEL B**

- (1) Record the rotation direction of toothed-belt for correct re-mounting.

**Notes:**

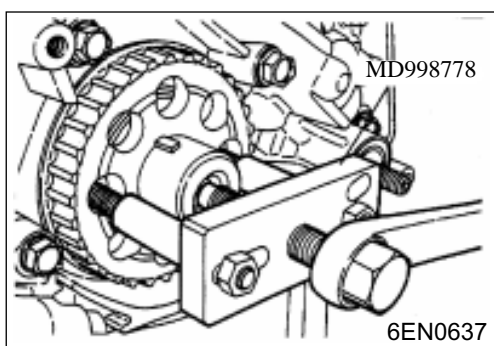
- Adhering of water or grease to the toothed-belt will sharply shorten its service life. So, after disassembly, try your best to avoid the toothed-belt, toothed-belt wheel and tensioner from being contaminated and adhered by water or grease. No need to clean these parts. Replace it if it is seriously contaminated.



- In case water or grease is found on these parts, check the front cover oil-seal, camshaft oil-seal and water pump to see if there exist leakage.

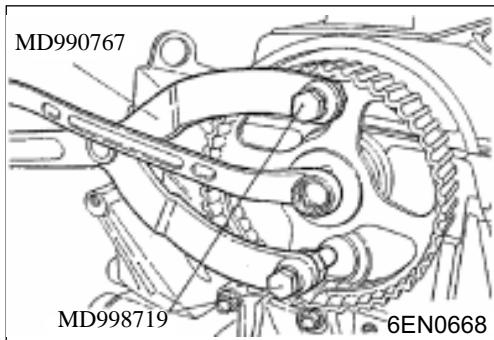
#### ◇F◇ DISASSEMBLY OF BALANCING SHAFT TOOTHED-BELT WHEEL

- (1) Fasten balancing shaft toothed-belt wheel with the tools as shown in the figure.
- (2) Disassemble the balancing shaft toothed-belt wheel.



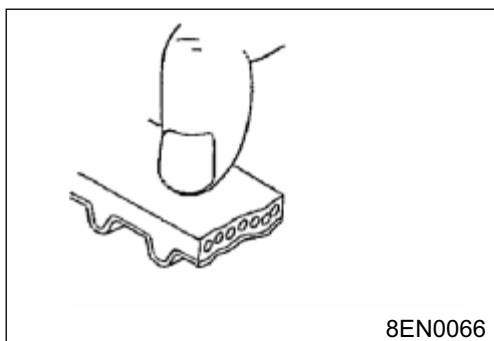
#### ◇G◇ DISASSEMBLY OF CRANKSHAFT TOOTHED-BELT WHEEL B

- (1) In case difficult to disassemble due to adhesion, use special tools.



#### ◇H◇ DISASSEMBLY OF CAMSHAFT TOOTHED-BELT WHEEL BOLT

- (1) Fasten camshaft timing toothed-belt wheel with special tools.
- (2) Disassemble camshaft toothed-belt wheel bolt.

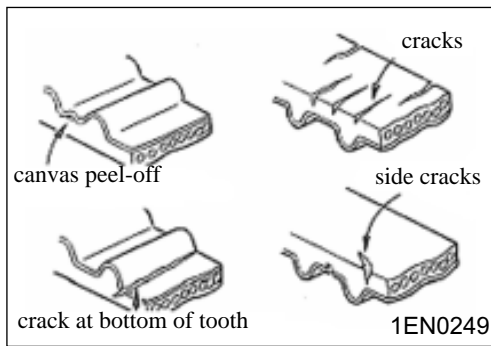


### CHECK

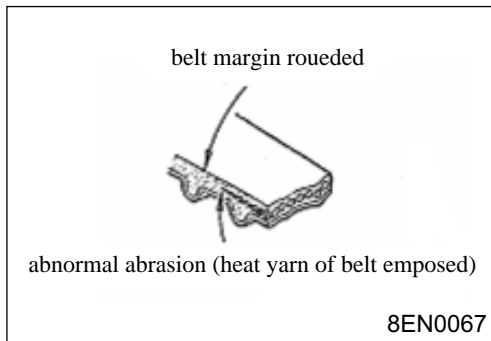
#### TIMING TOOTHED-BELT WHEEL

Carefully check each part of the toothed-belt and replace a new toothed-belt in case of the following damages:

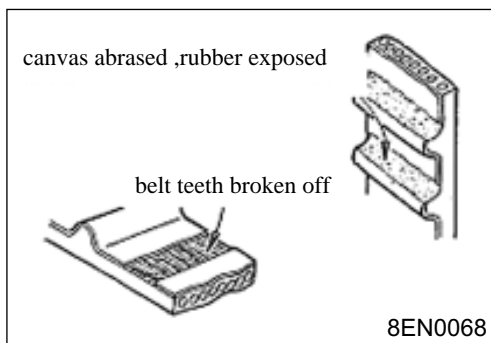
- (1) The back rubber is aged and glistened, no trail left after scraping with a finger nail, and no elasticity;



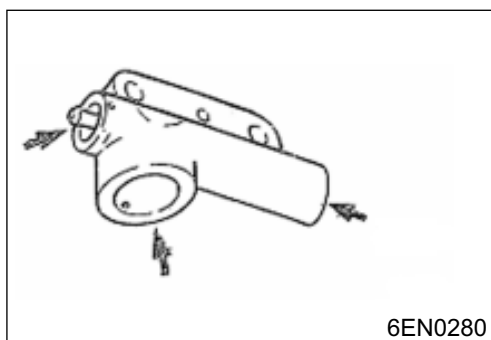
- (2) There are cracks on the surface of back rubber;
- (3) There are cracks and peel-off on the surface of canvas
- (4) There are cracks at the bottom of the tooth
- (5) There are cracks on the side face of toothed-belt



- (6) The side face of toothed-belt is abnormally abraded. The normal situation is the side face is as level as being cut with a sharp knife

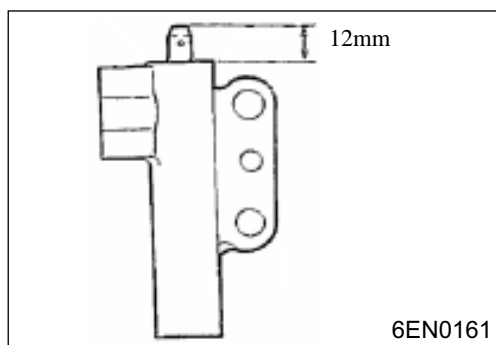


- (7) Abnormal abrasion on the tooth surface.
- (8) Teeth broken off.



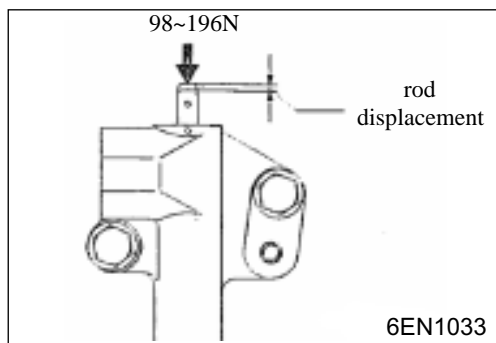
#### AUTOMATIC TENSIONER

- (1) Check automatic tensioner to see if there is leakage and replace with a new one if necessary.
- (2) Check if there is abrasion or damages on the rod end and replace with a new one if necessary.



- (3) The overhang length of measuring rod. Replace if not conform to standard.

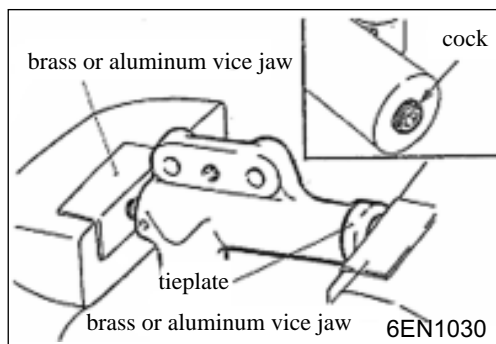
Standard value : 12mm



- (4) Measure the amount of displacement while pressing down the rod with a force of 98~196N.

- (5) Replace the automatic tensioner if the displacement of rod is at least 1mm lesser than the value as measured in item (3).

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

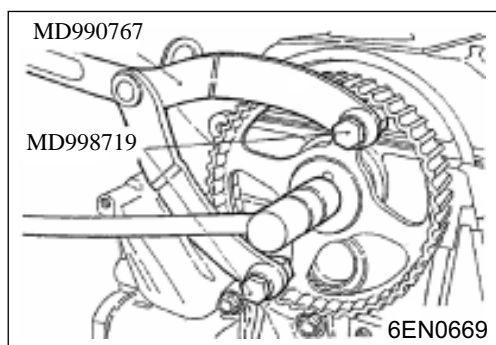


- (6) Clamp automatic tensioner with a soft jaw plier.

#### Notes:

•Because there is screw-plug outshot at the bottom of automatic tensioner, a flat bearing plate should be inserted between the plier and the screw-plug to avoid them from direct contacting.

- (7) Rotate handle of plier to thrust in the rod of automatic tensioner. Replace automatic tensioner if it can be easily thrust in. Certain resistance should be apperceived while thrusting in.



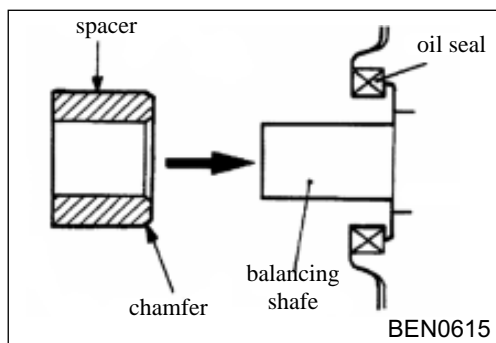
## NOTES FOR MOUNTING

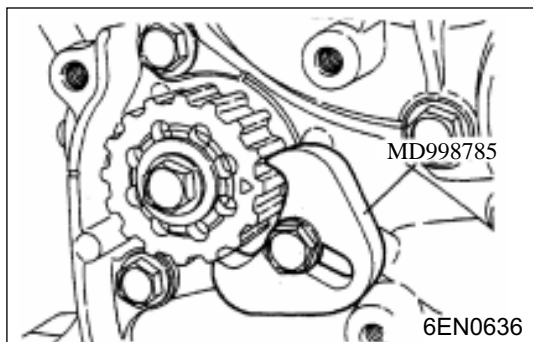
### ◇A◇ TIGHTENING OF CAMSHAFT TOOTHED-BELT WHEEL BOLT

- (1) Fixup camshaft toothed-belt wheel with special tools.
- (2) Tighten the camshaft toothed-belt wheel bolt to the specified torque.

### ◇B◇ MOUNTING OF SPACER

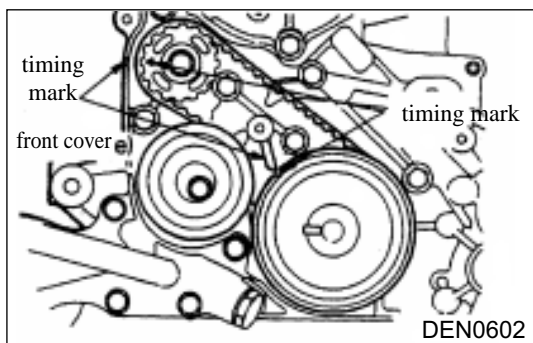
- (1) While mounting the spacer, the side with chamfer should be towards oil-seal.





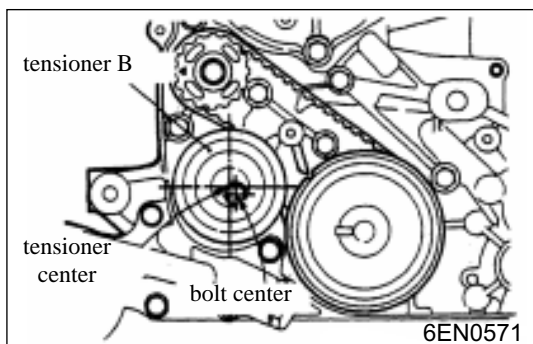
### ◇C◇ TOOTHED-BELT WHEEL

- (1) Fixup balancing shaft toothed-belt wheel with the tools as shown in the figure.
- (2) Tighten the bolt to the specified torque.

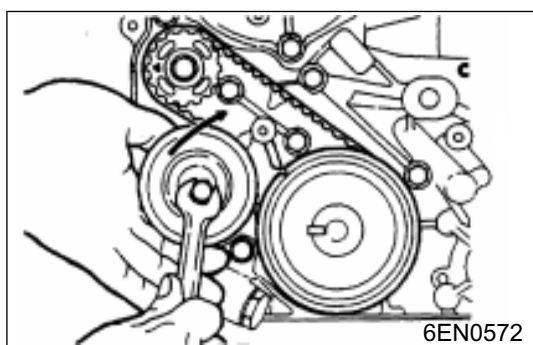


### ◇D◇ MOUNTING OF TIMING TOOTHED-BELT B

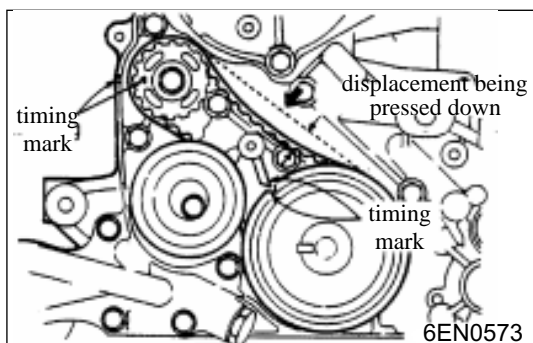
- (1) Align the marks of crankshaft toothed-belt wheel B and balancing toothed-belt wheel separately.
- (2) Mount timing toothed-belt onto the crankshaft toothed-belt wheel B and balancing shaft toothed-belt wheel. The tensioning side should remain tightened.



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

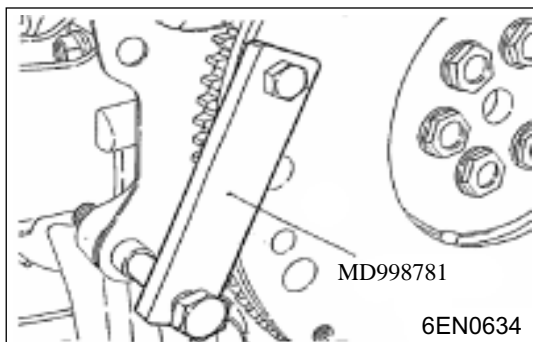


- (4) While applying force to the tensioner side of timing toothed-belt with your finger, move tensioner B in the direction of the arrow. At this moment, screw up the bolt to fixup tensioner B. Don't let the shaft rotate together with toothed-belt wheel thus while screwing up the bolt, otherwise the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



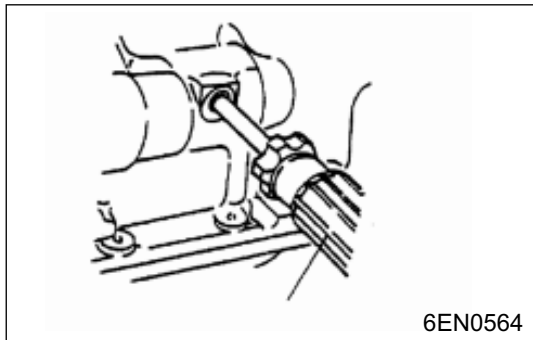
- (5) Confirm to align the mark on the toothed-belt with the mark on the front cover
- (6) Press down the central part of the tensioner side of timing toothed-belt B with your forefinger. The toothed-belt is to be pressed down by 5~7mm.





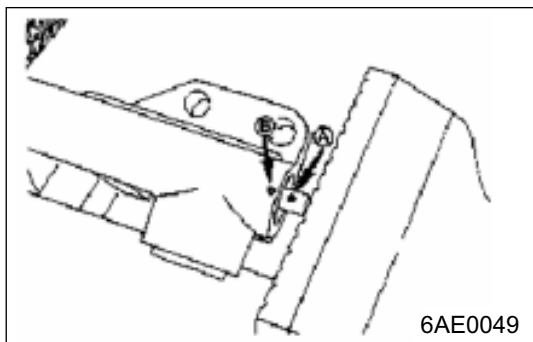
#### Ⓔ TIGHTENING OF CRANKSHAFT BOLT

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



#### Ⓕ 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.

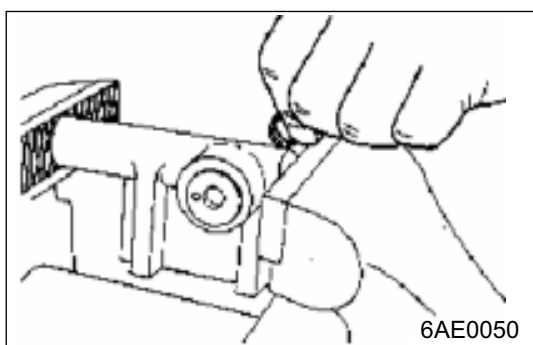


#### Ⓖ MOUNTING OF AUTOMATIC TENSIONER

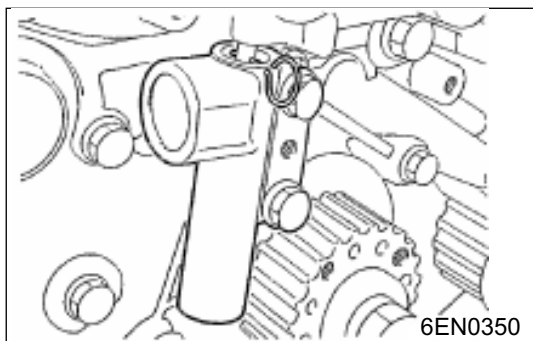
- (1) If the rod of automatic tensioner is extruded, the following procedures should be taken to retract it.
- (2) Clamp automatic tensioner with a soft jaw plier.

##### Notes:

- Because there is screw-plug outshot at the bottom of automatic tensioner, a flat bearing plate should be inserted between the plier and the screw-plug to avoid them from direct contacting.



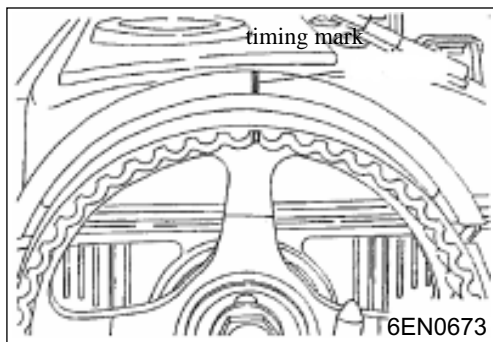
- (3) Use a plier to push it in slowly until hole Ⓐ on the rod and hole Ⓑ on the oil cylinder is aligned.



- (4) Insert steel wire (diameter is 1.4mm) into the aligned holes.
- (5) Disassemble the automatic tensioner with a plier.
- (6) Mount the automatic tensioner onto the front cover, then screw up the bolt according to the specified torque.

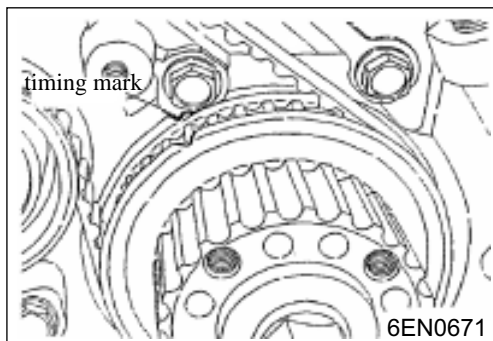
##### Notes:

- Left the steel wire inside the automatic tensioner.

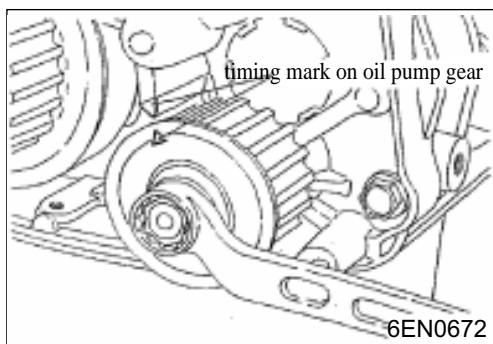


#### ⚙️ HD MOUNTING OF TIMING TOOTHED-BELT

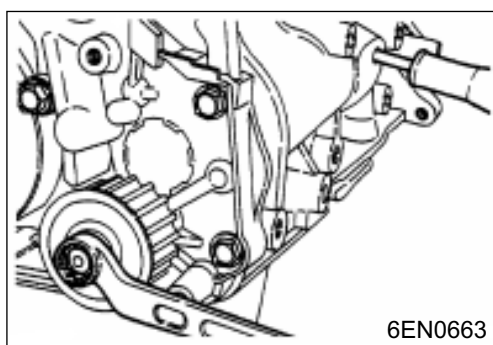
- (1) Confirm the timing toothed-belt tensioner is properly mounted.
- (2) Align the timing mark on the camshaft toothed-belt wheel with the mark on the cylinder head.



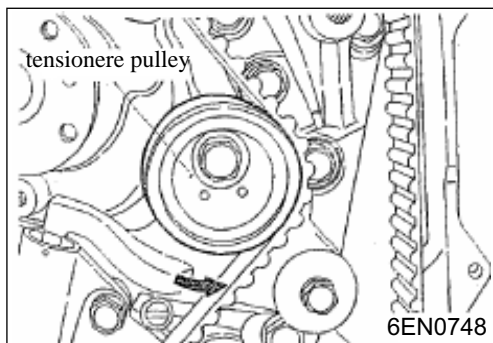
- (3) Align the timing mark on the crankshaft toothed-belt wheel with the mark on the front cover.



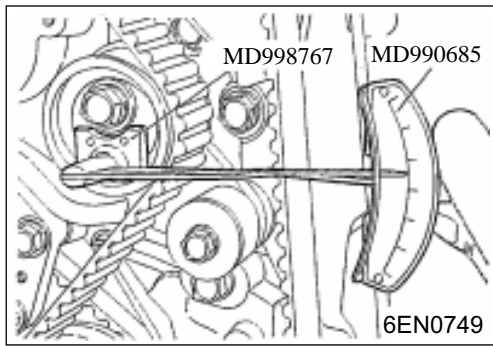
- (4) Align the timing mark on the oil pump toothed-belt wheel with its accordant mark.



- (5) Disassemble plug from cylinder block, then insert cross point screwdriver (diameter: 8mm) into the hole. Going over 60mm inwards means the timing mark is aligned; incase of failure to go more than 20~25 inwards, you should turn the oil pump toothed-belt wheel 180°
- (6) Connect timing toothed-belt to crankshaft pulley, central pulley, camshaft toothed-belt wheel and tensioner pulley in turn.



- (7) Uplift the tensioner pulley in the arrow direction, then screw down the central bolt.



- (8) Verify that all timing marks are in a line.
- (9) Remove the screwdriver inserted at step (5) and mount the plug.
- (10) Turn camshaft 1/4 circle counter-clockwise, then turn it clockwise until all timing marks come into line again.
- (11) Assemble the special tools socket wrench and torque wrench onto the tensioner pulley, then screw down the central bolt of tensioner pulley.

**Notes:**

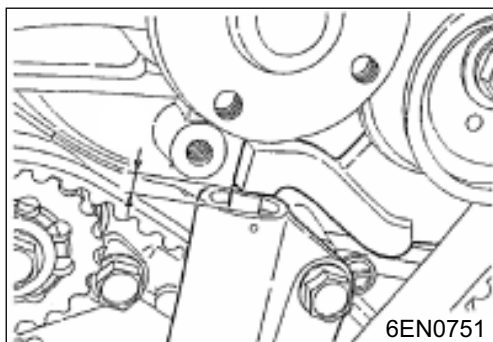
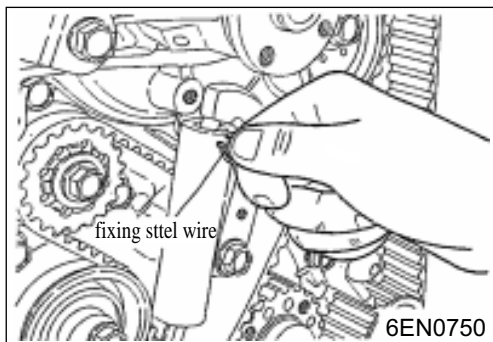
If special tools are unavailable, an ordinary torque wrench capable of measuring the torque of 0~0.3 kg may be used.

- (12) Use the torque wrench to screw down to a torque of 0.26~0.27 kg.m.
- (13) While holding the tensioner pulley with special tools and torque wrench, screw down the central bolt till the standard value is reached.
- (14) Place the crankshaft for about 15 minutes after turning it 2 circles clock-wise. Then check if the fixing steel wire of automatic tensioner can glide freely.

**Notes:**

In case the steel wire can not glide freely, repeat the above steps before step (10) till the steel wire can glide.

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

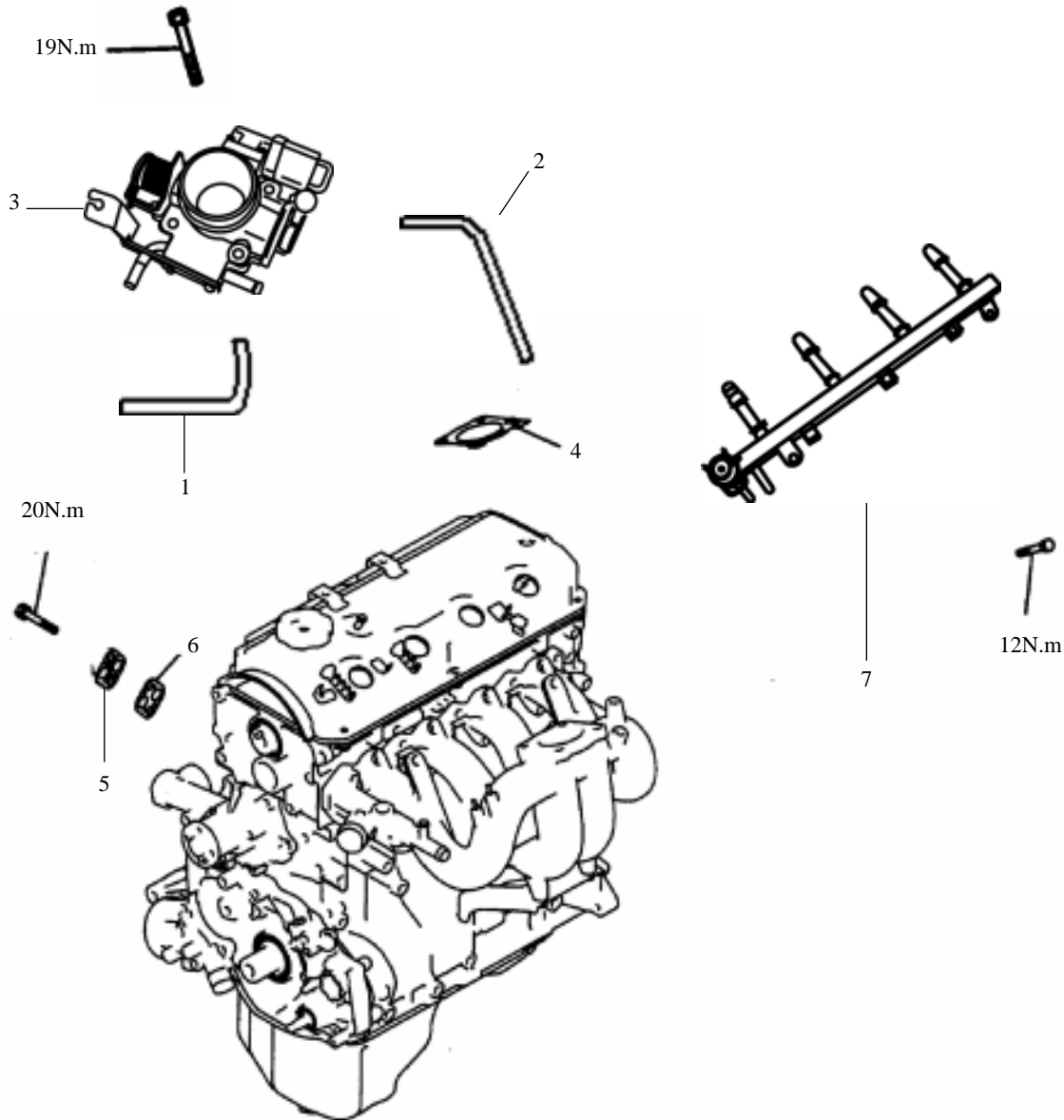


- (16) Measure the distance “A” (between tensioner arm and automatic tensioner body).

Standard value: 3.8 – 4.5mm

## FUEL SYSTEM

### DISASSEMBLY AND MOUNTING



#### Disassembly Procedure

1. water pipe
2. water pipe
3. throttle body
4. cushion
5. cover
6. cushion
7. fuel distribution pipe assembly

#### Notes for Mounting

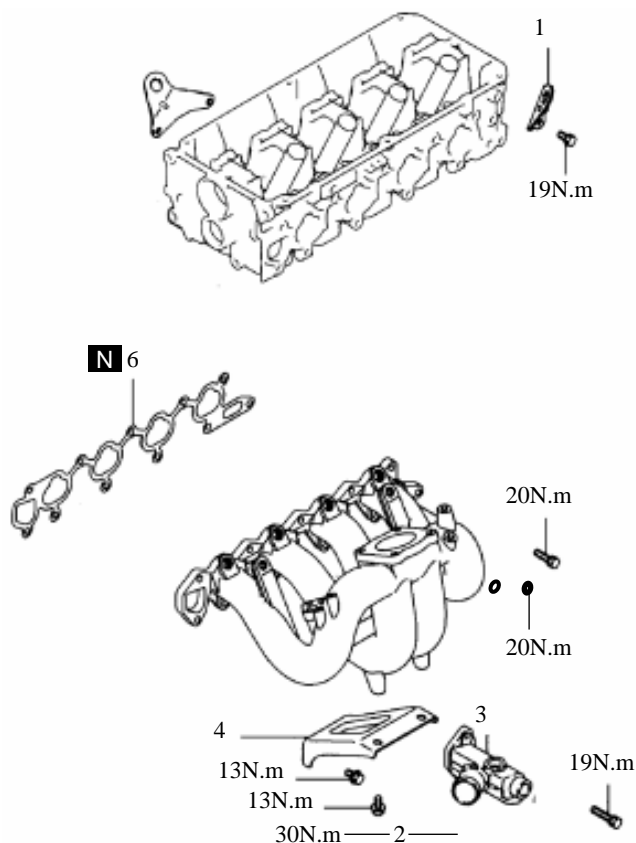


##### Mounting of Fuel Distribution Assembly

Before mounting fuel distribution assembly, carefully lubricate the matching face of the manifold or the O-ring with mineral lubricating oil, align the center lines of the injector and the mounting hole, then insert the intake manifold. Finally, screw down the bolt according to the specified tightening torque.

- (1) Mineral lubricating oil: ISO 10 (10 cSt at 40° )
- (2) Prevent lubricant from entering into the injector while using lubricant.

## INTAKE MANIFOLD DISASSEMBLY AND MOUNTING



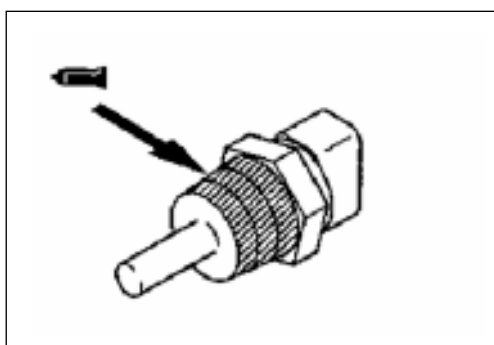
### Disassembly Procedure



1. engine Link Ring
3. water Outlet
5. intake manifold



2. engine Water Temperature Sensor
4. intake Manifold Bracket
6. intake Manifold Gasket



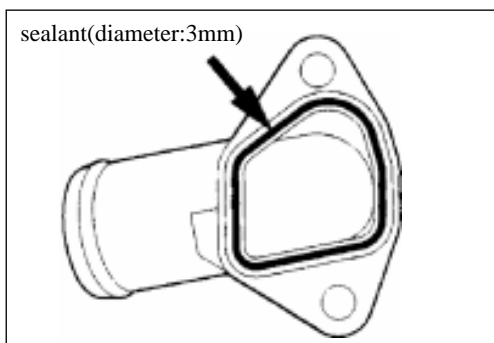
### NOTES FOR MOUNTING



#### APPLICATION OF SEALANT FOR ENGINE WATER TEMPERATURE SENSOR

Sealant Specification:

3M Nut locking parts No.4171 or the equivalent.

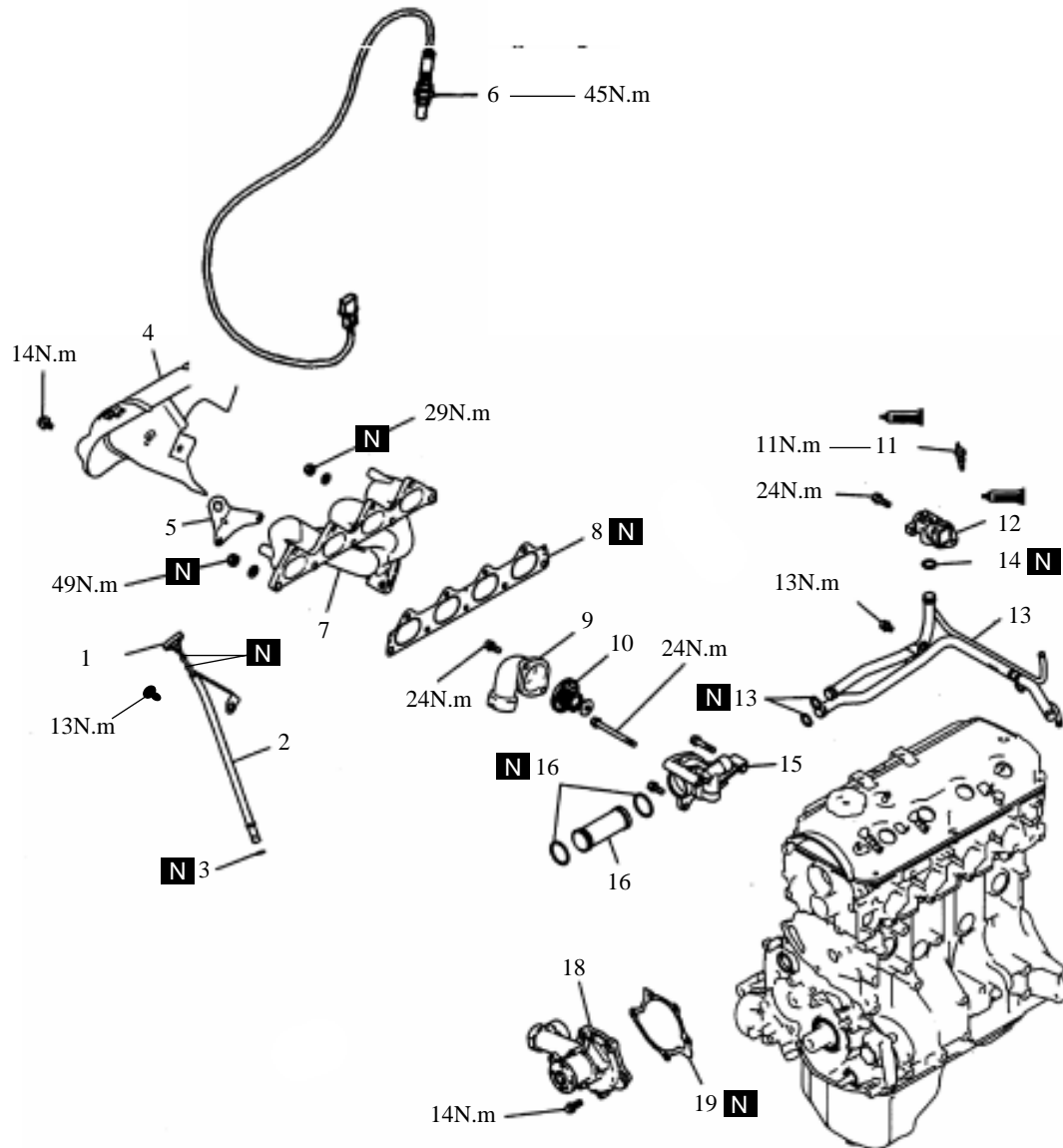


#### APPLICATION OF SEALANT FOR WATER OUTLET

Sealant Specification:

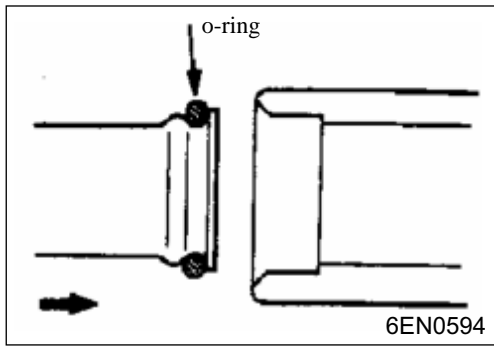
Genuine MITSUBISHI brand parts No.MD970389 or the equivalent.

## EXHAUST MANIFOLD, WATER PUMP DISASSEMBLY AND MOUNTING



### Disassembly Procedure

- |                            |       |                                    |
|----------------------------|-------|------------------------------------|
| 1. oil level gauge         |       | 11. water temperature sensing plug |
| 2. oil level gauge tube    | ◆ B ◆ | 12. bypass water pipe fitting      |
| 3. o-ring                  | ◆ A ◆ | 13. water pipe assembly            |
| 4. heat shield             | ◆ A ◆ | 14. water pipe O-ring              |
| 5. engine link ring        |       | 15. thermostat casing              |
| 6. oxygen sensor           | ◆ A ◆ | 16. water inlet                    |
| 7. exhaust manifold        | ◆ A ◆ | 17. o-ring                         |
| 8. exhaust manifold gasket |       | 18. water pump                     |
| 9. water inlet             |       | 19. water pump gasket              |
| 10. thermostat             |       |                                    |



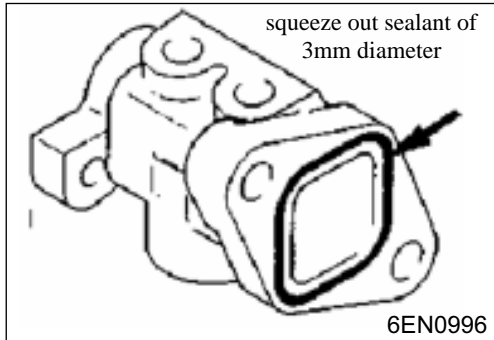
## NOTES FOR MOUNTING

### ■A■ MOUNTING OF O RING SEAL

(1) Wet O ring seal with water in order to assemble.

#### Notes:

There shouldn't be any oil or lubricating grease on the surface of O ring seal.



### ■B■ MOUNTING OF BYPASS WATERPIPE CONNECTOR

#### Sealant Specification:







Genuine MITSUBISHI brand parts No.MD970389 or the equivalent.

#### Notes:

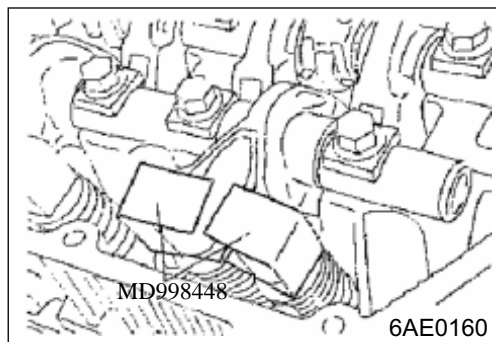
- (1) Swiftly mount bypass water pipe connector while sealant is still wet (within 15 minutes).
- (2) May not add oil on the sealing part within 1 hour or so after mounting.

Smear engine oil on all moving parts while mounting

6EN1762

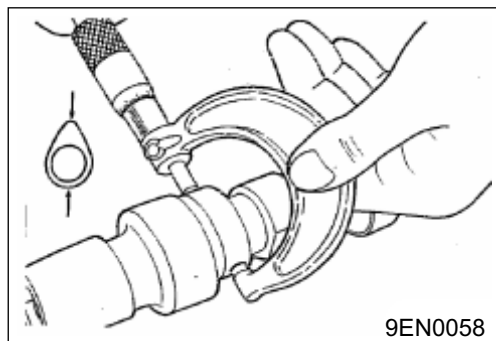
- |   |                               |  |                                 |
|---|-------------------------------|--|---------------------------------|
| 1.  | air hose                      | 12.  | A rocker arm A                  |
| 2.  | PCV hose                      | 13.  | B rocker arm B                  |
| 3.  | pressure control valve        | 14.  | rocker shaft (air intake side)  |
| 4.  | pressure control valve gasket |  15. | hydraulic lifter                |
| 5.  | oil filler cap                | 16.  | rocker arm C                    |
| 6.  | rocker arm cover              | 17.  | rocker shaft (air exhaust side) |
| 7.  | rocker arm cover gasket       |  18. | hydraulic lifter                |
| 8.  | oil seal                      |  19. | oil seal                        |
|  9.  | rocker arm and rocker shaft   | 20.  | thrust cover                    |
|  10. | rocker arm and rocker shaft   | 21.  | o-ring                          |
|  11. | rocker shaft spring           | 22.  | camshaft                        |





### NOTES FOR DISASSEMBLY

- ⚠ (1) Before disassemble the rocker arm and rocker shaft assembly, use the tools as shown in the figure to prevent hydraulic lifter from falling.



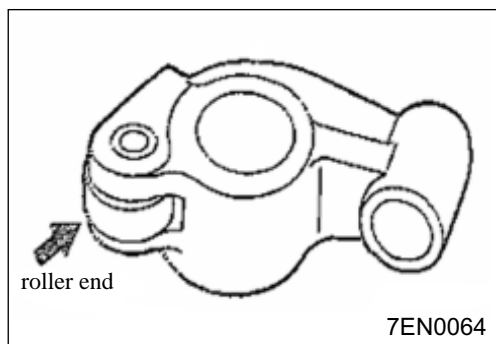
### CHECK

#### CAMSHAFT

- (1) Measure the height of camshaft

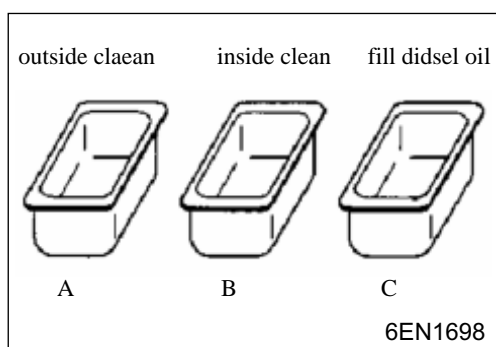
Standard value and operating limit are as follows:

|             | Type      | Standard value | Limit value |
|-------------|-----------|----------------|-------------|
| Air intake  | 4G64-D-L3 | 37.39          | 36.89       |
| Air exhaust | 4G64-D-L3 | 36.83          | 36.33       |



#### ROCKER ARM

- (1) Check the roller surface, in case of existence of any trace indicates there are damages or blockades, the rocker arm should be replaced.
- (2) Check if the roller can rotate smoothly. If not or slacked, the rocker arm should be replaced.
- (3) Check the inside diameter. In case of damages or blockages, the rocker arm should be replaced.



#### HYDRAULIC LIFTER

##### NOTES:

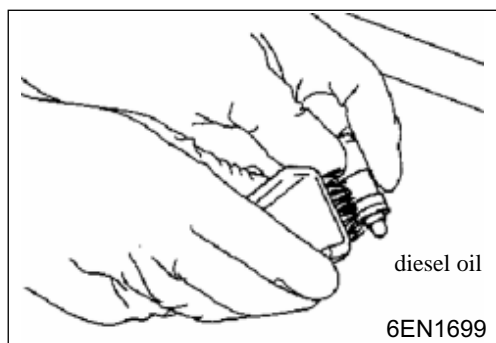
1. Hydraulic lifter is a precise part. There shouldn't be any dust and foreign body, etc.
2. Do not disassemble the hydraulic lifter.
3. Clean the hydraulic lifter with clean diesel oil.

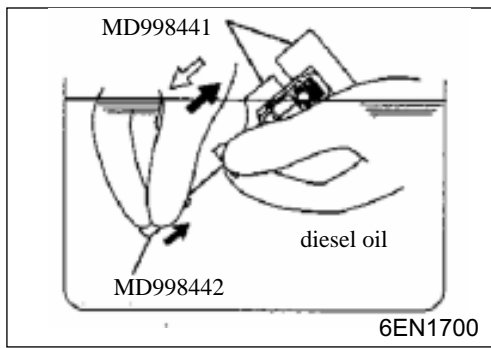
- (1) Prepare 3 vessels and about 5 litres of diesel oil. Pour enough diesel oil into each vessel until the erect hydraulic lifter is submerged, then take the following steps to operate the hydraulic lifter:

- (2) Put the hydraulic lifter into vessel A to clean its external surface.

##### NOTES:

Use a nylon brush to remove hard attachments.



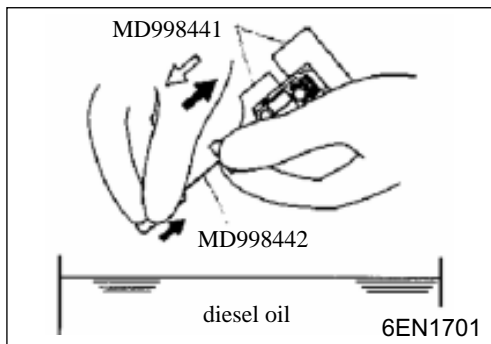


- (3) Mount the special tool MD998441 onto the hydraulic lifter.
- (4) Use the special tool MD998442 to lightly expel the steel ball inside the lifter and make it move 5-10 strokes until it can move smoothly. Additionally, it can also eliminate resistance of the plunger. Such operation can remove dirty oil.

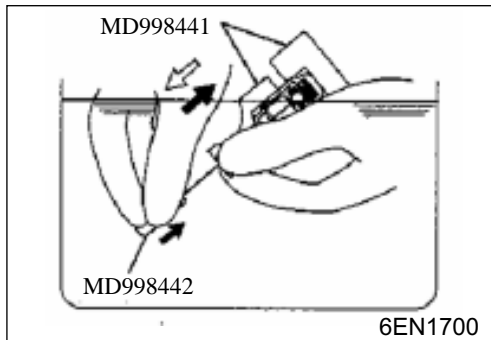
**NOTES:**

Since the steel ball spring is extremely soft, so do not overexert while impelling steel ball with air leak wire lest the hydraulic lifter is damaged.

If the plunger can't move smoothly or mechanical devices seem abnormal, replace the hydraulic lifter.



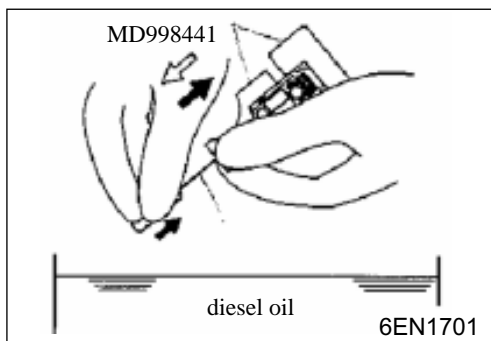
- (5) Take the hydraulic lifter out of the vessel, then lightly expel the steel ball and move the plunger, remove diesel oil away from pressure chamber.



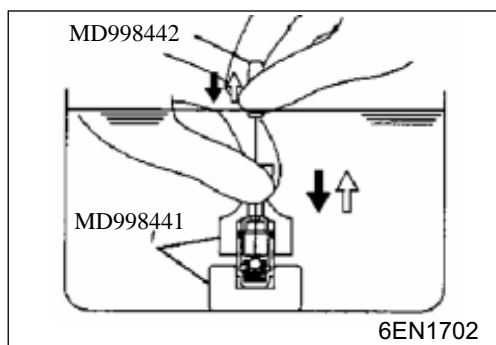
- (6) Mount the special tool MD998441 onto the hydraulic lifter.
- (7) Put the hydraulic lifter into vessel B, then use the special tool MD998442 to lightly expel the steel ball inside the lifter and make it move 5-10 strokes until it can move smoothly. Such operation can clean the pressure chamber of hydraulic lifter.

**NOTES:**

Since the steel ball spring is extremely soft, so do not overexert while impelling steel ball with air leak wire lest the hydraulic lifter is damaged.



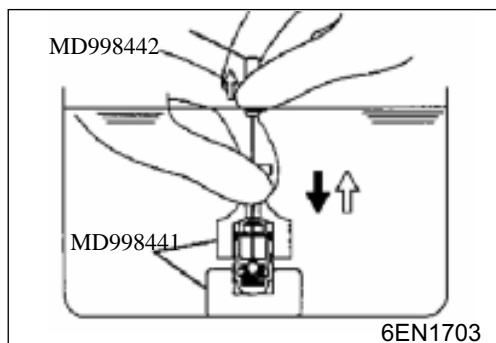
- (8) Take the hydraulic lifter out of the vessel, then lightly expel the steel ball and move the plunger, remove oil away from pressure chamber.



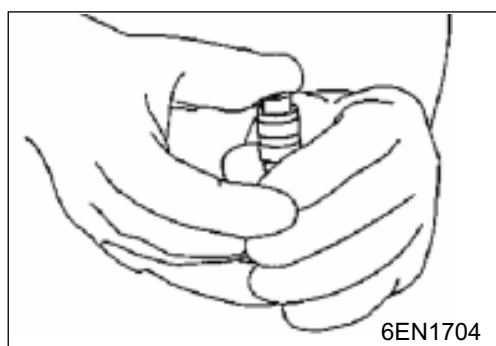
- (9) Put the hydraulic lifter into vessel C, then use the special tool MD998442 to lightly expel the steel ball inside the lifter.

**NOTES:**

Don't clean the hydraulic lifter in vessel C. Otherwise foreign body may enter the pressure chamber which is full of oil.



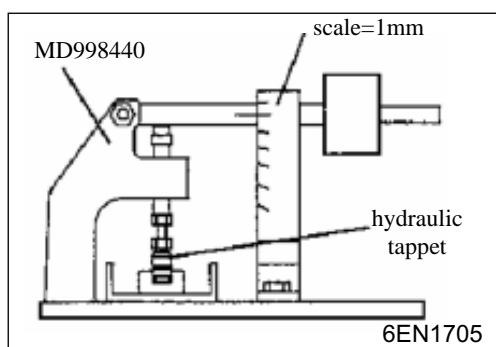
- (10) Stick the hydraulic lifter up straight with its plunger at the top, stably move the plunger downwards to its maximum stroke, then pull it back slowly, and then release the steel ball to make the pressure chamber full of diesel oil.
- (11) Remove the special tool MD998441.



- (12) Take the hydraulic lifter out of the vessel, stick it up straight with its plunger at the top, stably impel the plunger until it can't move any more. Check and compare the height difference between the plunger and the new hydraulic lifter.

**NOTES:**

If the hydraulic lifter becomes shorter, repeat step (9) to (12) and fully fill the hydraulic lifter with diesel oil. If it still becomes shorter after repetition of these steps, replace the hydraulic lifter.

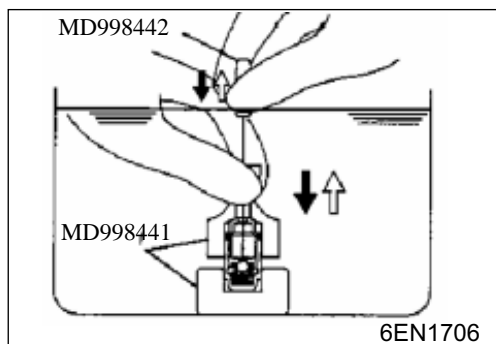


- (13) Mount the hydraulic lifter onto the special tool.
- (14) After the plunger sink down (0.2~0.5mm), measure the time taken for the plunger to sink down another 1mm.

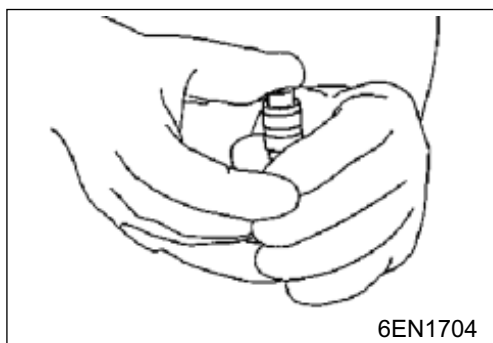
**Standard value:** 3~20 sec./1mm ( use the diesel oil with a temperature of 15~20°C )

**Notes:**

If the measured value doesn't conform to the standard, replace the hydraulic lifter.



- (15) Mount the special tool MD998441 onto the hydraulic lifter.
- (16) Put the hydraulic lifter into vessel C again, then lightly impel the steel ball inside the lifter downwards with special tool MD998442.
- (17) Stick the hydraulic lifter up straight with its plunger at the top, stably move the plunger downwards to its maximum stroke, then pull it back slowly, and then release the steel ball to make the pressure chamber full of diesel oil.
- (18) Remove the special tool MD998441.



- (19) Take the hydraulic lifter out of the vessel, stick it up straight with its plunger at the top, stably impel the plunger until it can't move any more. Check and compare the height difference between the plunger and the new hydraulic lifter.

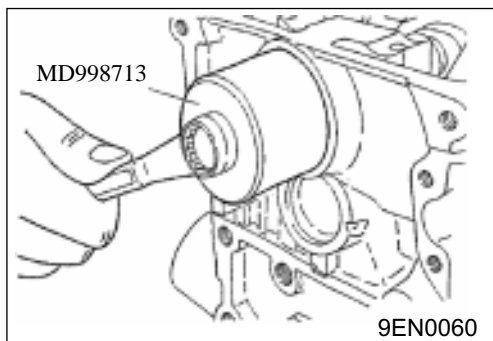
**NOTES:**

If the hydraulic lifter becomes shorter, repeat step (15) to (19) and fully fill the hydraulic lifter with diesel oil. If it still becomes shorter after repetition of these steps, replace the hydraulic lifter.

- (20) Keep the hydraulic lifter vertical lest the diesel oil overflows. Prevent the hydraulic lifter from being contaminated by dirt or foreign body and mount the hydraulic lifter onto the engine as quickly as possible.

## NOTES FOR MOUNTING

### ■ A ■ MOUNTING OF OIL SEAL

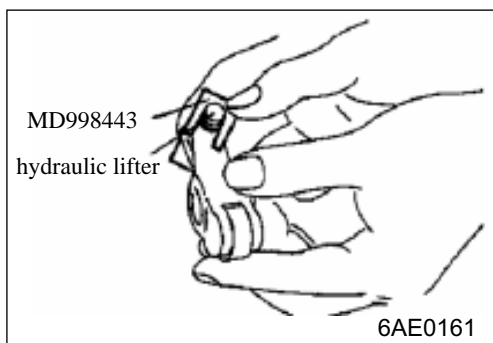


### ■ B ■ MOUNTING OF HYDRAULIC LIFTER

- (1) Insert the hydraulic lifter into the rocker arm (be careful not let diesel oil overflow), then use the special tool to prevent it from falling.

**NOTES:**

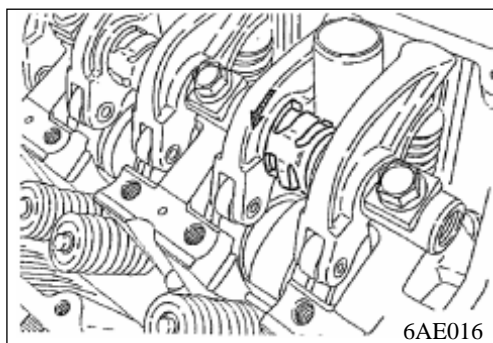
If the hydraulic lifter is used repeatedly, it must be cleaned.



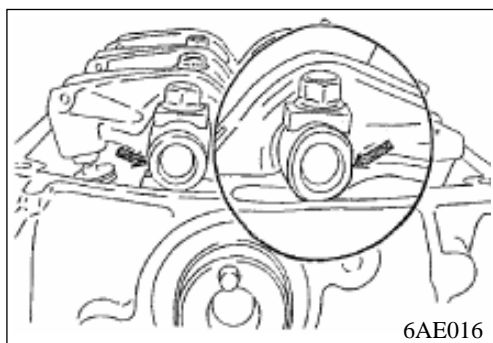
### ■ C ■ MOUNTING OF ROCKER SHAFT SPRING, ROCKER ARM AND ROCKER SHAFT

- (1) Temporarily screw down the intake rocker shaft with bolt until the rocker arm doesn't push and press the valve.
- (2) Mount the rocker arm spring from the top and make it perpendicular to the spark plug guide.

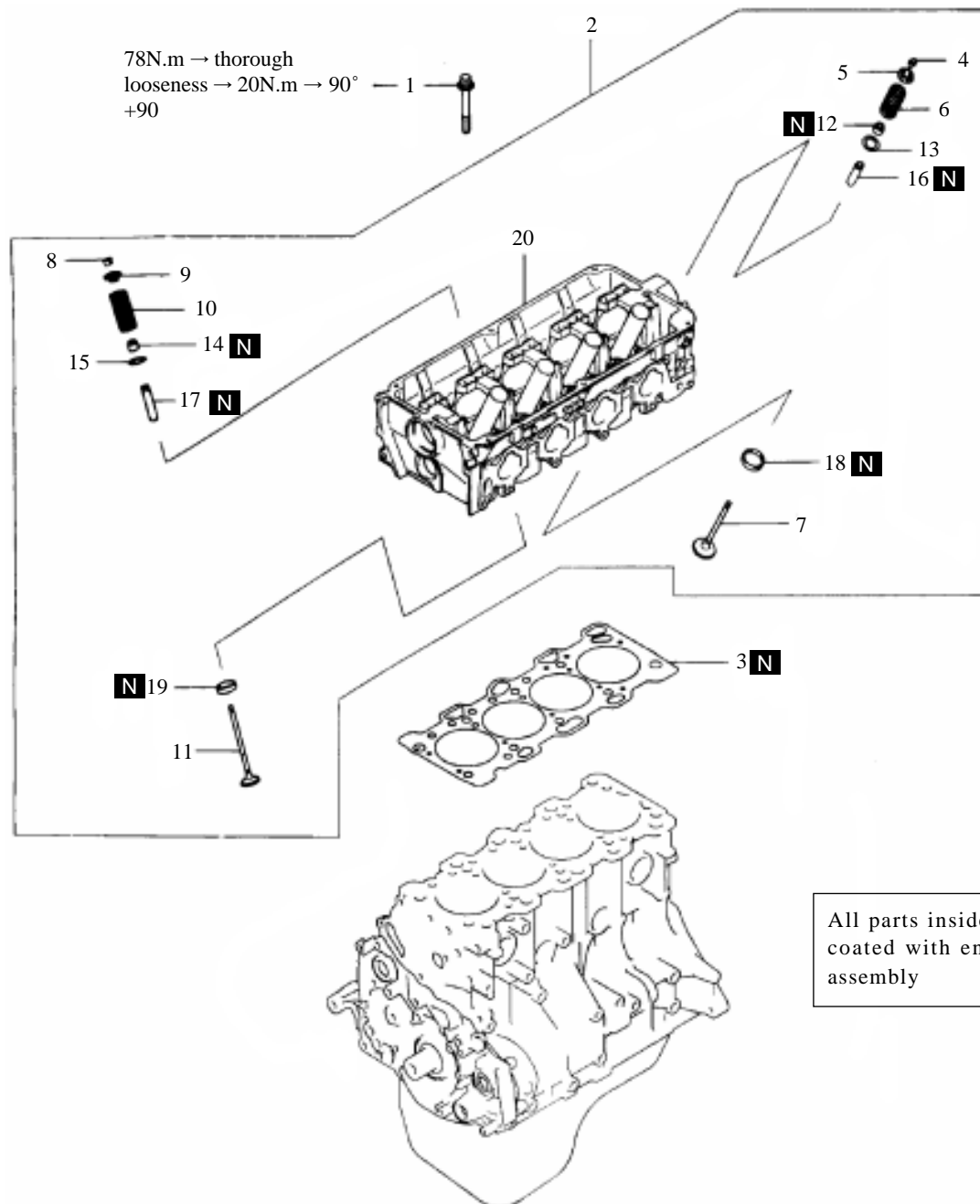
**NOTES:** You should mount rocker shaft spring first, and then the exhaust rocker arm and rocker shaft.



- (3) Remove the special tool which is mounted for the purpose of holding the hydraulic lifter.
- (4) Confirm that the cutting edge on the rocker shaft is in the location as shown in the figure.



## CYLINDER HEAD AND VALVE DISASSEMBLY AND ASSEMBLY

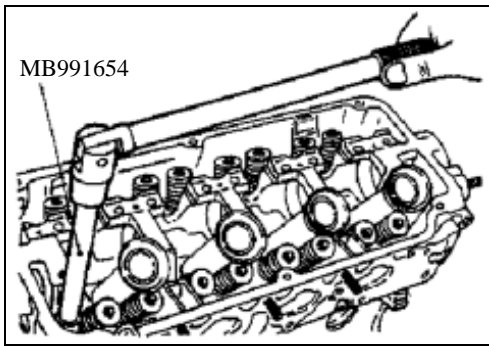


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### Disassembly Procedure

- ◇A◇ ■D■ 1. cylinder head bolts
- 2. cylinder head cluster
- 3. head gasket
- ◇B◇ ■C■ 4. valve lock clamp
- 5. upper site of valve spring
- B■ 6. valve spring
- 7. inlet valve
- ◇B◇ ■C■ 8. valve lock clamp
- 9. upper site of valve spring
- B■ 10. valve spring

- 11. exhaust valve
- ◇C◇ ■A■ 11. valve oil seal
- 12. valve spring seat
- ◇C◇ ■A■ 13. valve spring
- 14. valve spring seat
- 15. inlet valve guide
- 16. exhaust valve guide
- 17. inlet valve seat
- 18. exhaust valve seat
- 19. cylinder head

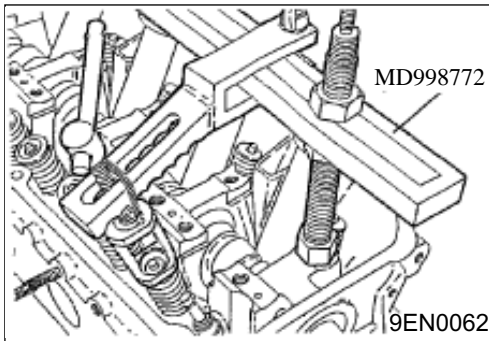


## Notices after Disassembly

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

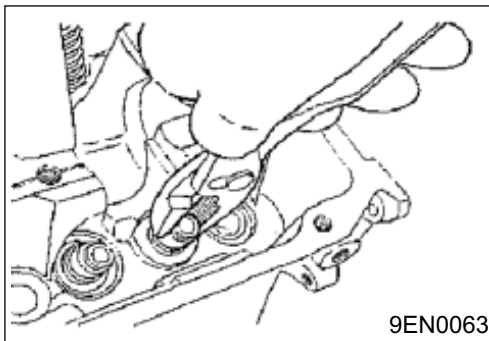
### ◇A◇ Dismantle of Cylinder head Bolts

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



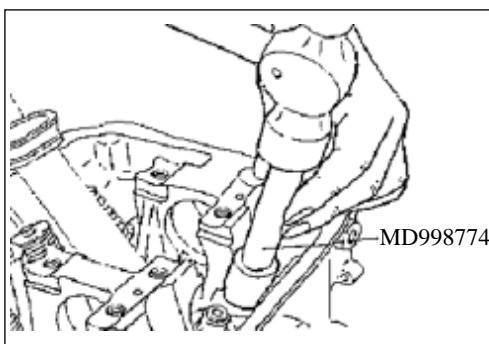
### ◇B◇ Dism Dismantle of Valve Lock Clamp

- (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.

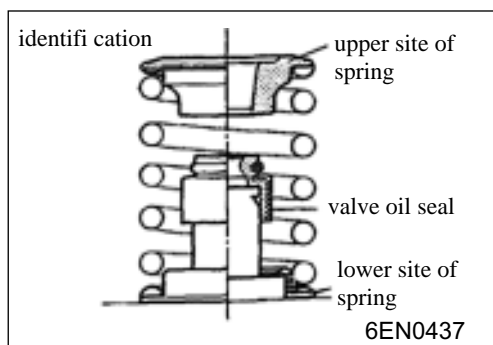


### ■A■ Mount of Valve Oil Seal

- (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.

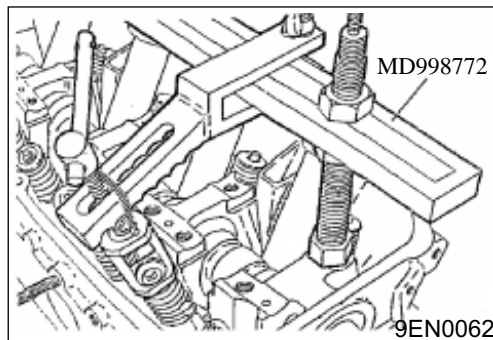
Notice:

- The valve oil seal must not be reused.



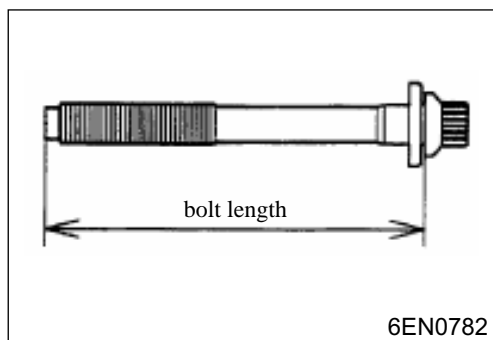
### Mount of Valve Spring

- (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.



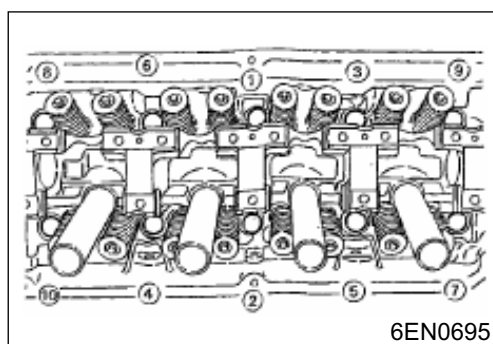
### Mount of Valve Lock Clamp

- (1) In case the valve spring is over compressed, it will contact the bottom of the valve spring and thus damage the valve oil seal.

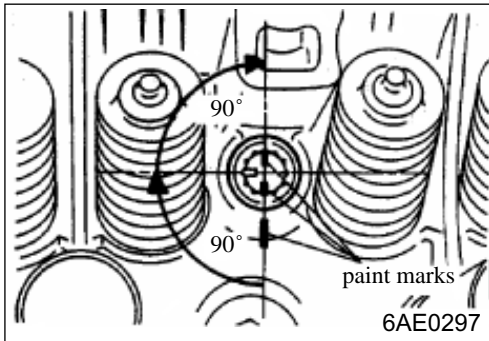


### Mount of Cylinder head Bolts

- (1) When assembling the bolts of cylinder head, the bolt length should be identified to meet the limit value, otherwise, change the bolts.  
Limit Value (A): 99.4 mm (Max)
- (2) Coat the engine oil on the threaded part of the bolts and on the gasket.



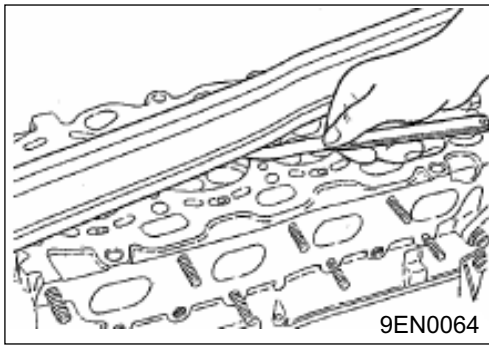
- (3) Tighten the bolts in the tightening order to the specified torque with SST (MB991654).  
Tightening Moment: 78N.m
- (4) Loosen all parts thoroughly.
- (5) Tighten the bolts with the torque of 20N.m in the tightening order.



- (6) Mark a straight line with paint on the heads of cylinder head bolts and the cylinder head.
- (7) Tighten the cylinder head bolts by  $90^\circ$  in tightening order.
- (8) Tighten the bolts by another  $90^\circ$ , ensuring the paint marks on the heads of cylinder head bolts and the cylinder head should be in alignment.

**Notice:**

- If the screwing angle of the bolt is less than  $90^\circ$ , correct tightening moment cannot be expected. Therefore, sufficient importance should be attached to whether the screwing angle is correct when tightening the bolts.
- In case the bolts are over tightened, they should be loosened thoroughly and then re-tighten them from Step (1).



### Inspection on Cylinder head

- (1) Inspect the Planeness of the surface of cylinder head with ruler and feeler.  
Standard value: 0.03mm  
Limit value: 0.2mm
- (2) The deformation should be corrected by grinding in case it exceeds the limit value.  
Grinding limit value:  $\pm 0.2$ mm  
• Total grinding amount of the cylinder head with the cylinder block together.  
Height of cylinder head (standard value for the new): 119.9~120.1mm

### Valve

- (1) Check whether work faces of valve contact correctly. If not, polish the valve applied and regrinding it. The contact face of valve seat should be in consistency with the center of work face of the valve.

- (2) In case the edge thickness exceeds the limit value, change the valve.

Standard edge thickness value:

Intake value ..... 1.0 mm

Exhaust value ..... 1.2 mm

Application limit value:

Intake value ..... 0.5 mm

Exhaust value ..... 0.7 mm

- (3) Measure the total valve height, in case it is less than the limit value, change the valve.

Standard value:

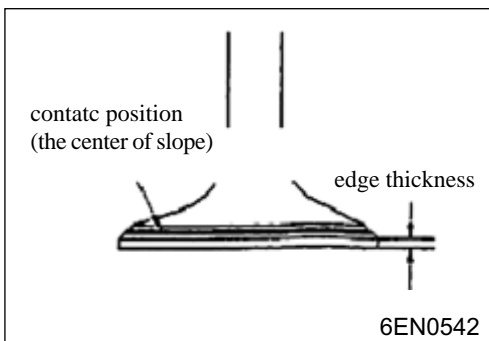
Intake value ..... 112.30mm

Exhaust Value ..... 114.11mm

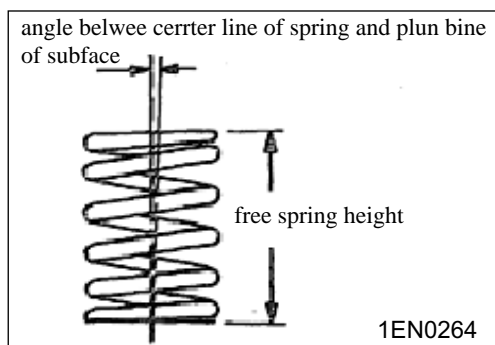
Limit Value:

Intake value ..... 111.80mm

Exhaust Value ..... 113.61mm







### Valve Spring

- (1) Measure the free spring height, in case it is less than the limit value, change the spring.

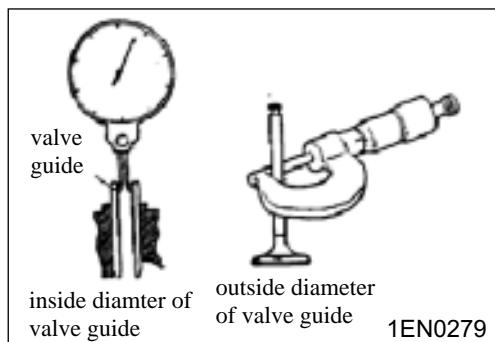
Standard value: 51.0 mm

Limit value: 50.0 mm

- (2) Measure the perpendicularity of the center line with the surface of the spring, if the gradient exceeds the limit, change the spring.

Standard value:  $\leq 2^\circ$

Limit value:  $4^\circ$



### Valve Guide

- (1) Measure the clearance between the valve guide and the valve stem, if the clearance exceeds the limit value, Change the valve guide or valve or both of them.

Standard value:

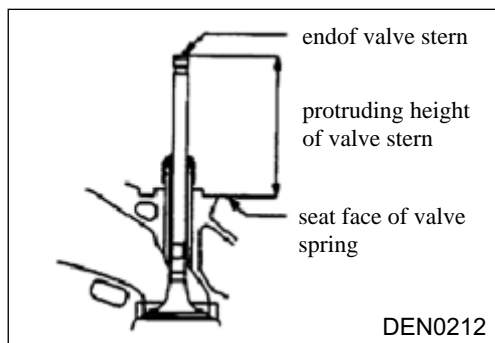
Intake value ..... 0.02 – 0.05mm

Exhaust value ..... 0.03 – 0.07mm

Limit value:

Intake value ..... 0.10mm

Exhaust value ..... 0.15mm



### Valve Seat

- (1) Assemble the valve and measure the protruding height of the valve stem between the end of valve stem and valve spring seat. In case the measured value exceeds the specified limit, change the valve seat.

Standard value:

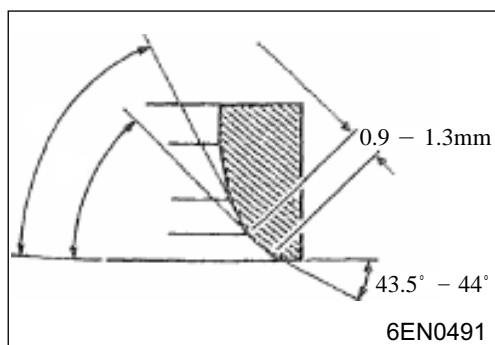
Intake value ..... 49.30mm

Exhaust valve ..... 49.30mm

Limit value:

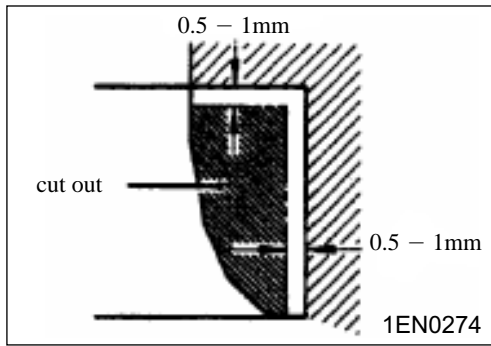
Intake value ..... 49.80mm

Exhaust valve ..... 49.80mm



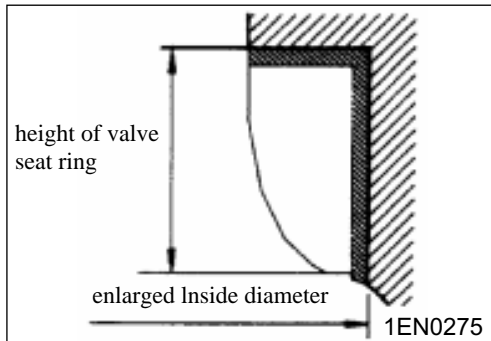
### Main Points on Trimming of Valve Seat

- (1) Before trimming the valve seat, check the clearance between the valve guide and the valve rod, conduct the trimming where necessary.
- (2) Trim the width and angle of the valve seat to the specified value with the Muller.
- (3) Grind the valve seat with the corresponding valve with grinding paste after trimming the valve seat. Then check the protruding height of the valve stem (refer to inspection items of valve seat).



### Main Points in Change of Valve Seat

- (1) Cut out part of the valve seat to be changed so as to thin and remove it.



- (2) Trim the valve seat holes on the cylinder head as per the outside diameter of the enlarged valve seat.

### Diameter of valve seat ring:

|                    |                          |               |
|--------------------|--------------------------|---------------|
| Inlet valve seat   | Enlarged dimension: 0.30 | 34.435-34.455 |
|                    | Enlarged dimension: 0.60 | 34.735-34.755 |
| Exhaust valve seat | Enlarged dimension: 0.30 | 31.935-31.955 |
|                    | Enlarged dimension: 0.60 | 32.235-32.255 |

- (3) Before assembling the valve seat ring, heat the cylinder head to 250 or so, or cool the valve seat ring in the liquid nitrogen so as to prevent it from being seizing in the cylinder head.
- (4) Trim the valve seat to the specified width and angle with the milling cutter of valve seat (refer to the Main Points for Trimming of Valve Seat)

### Main Points for Change of Valve Guide

- (1) Press the valve guide out toward the cylinder block with the presser.
- (2) Process the valve guide hole of the cylinder head to make it reach the dimension of the enlarged valve guide to be mounted.

### Notice:

Do not apply the new valve guide with same dimension with the dismantled one.

### Diameter of valve guide hole on cylinder head:

Dimension plus 0.05: 11.05-11.068

Dimension plus 0.25: 1.25-11.268

Dimension plus 0.50: 1.50-11.518

- (3) Press the valve guide as shown in the figure until its protrusion meets the specification.

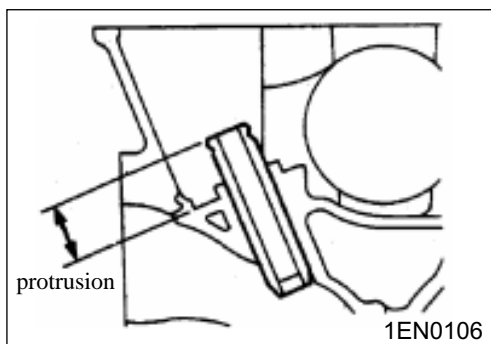
Standard value: 14mm  $\pm$  0.3

### Notice:

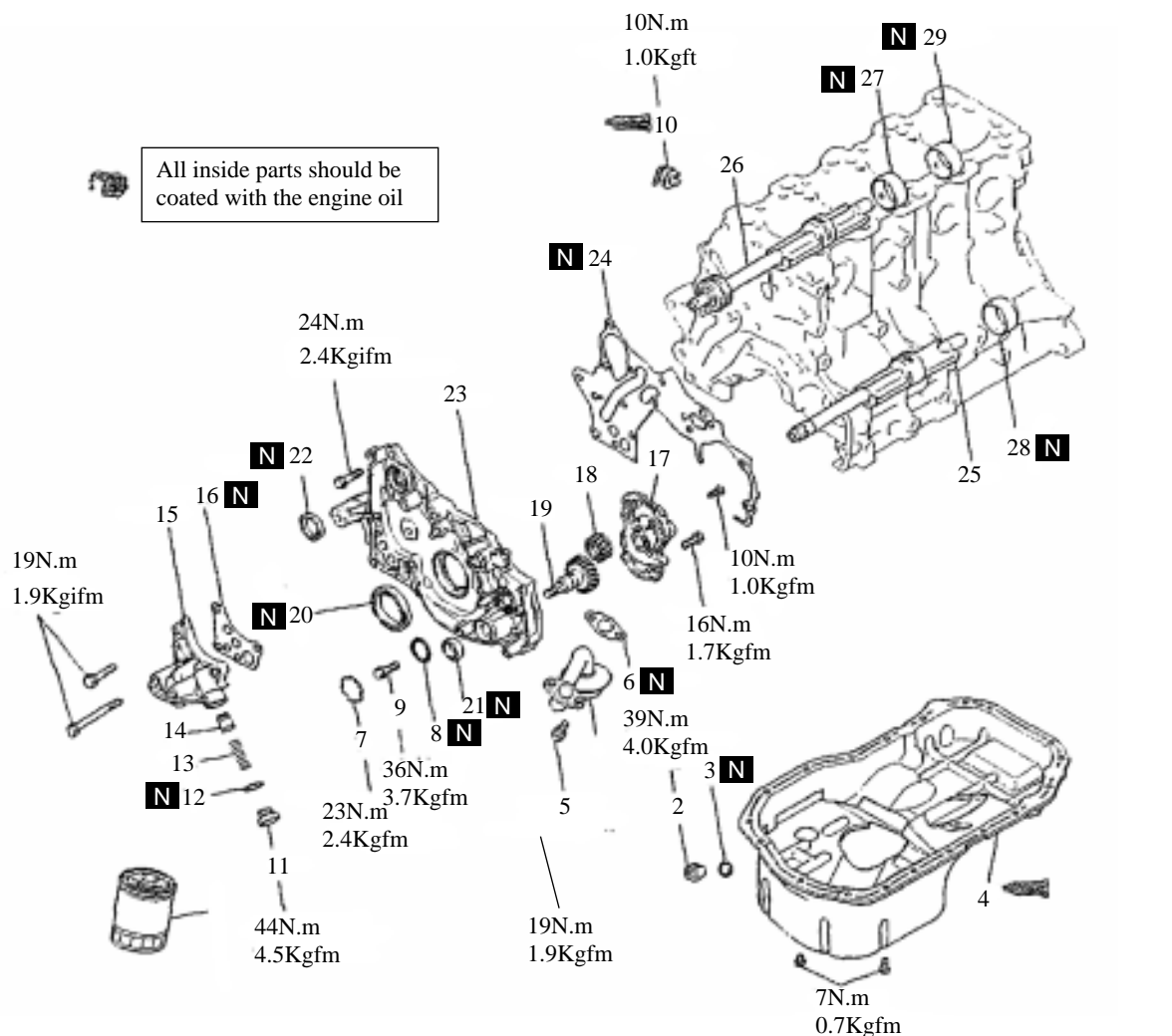
Press down the valve guide from the superface of the cylinder head.

The length of the inlet valve guide is different from that of the exhaust valve guide. (inlet valve: 45.5, exhaust valve: 50.5)

- (4) Inset the new valve after mounting the valve guide and inspect whether it can move smoothly.

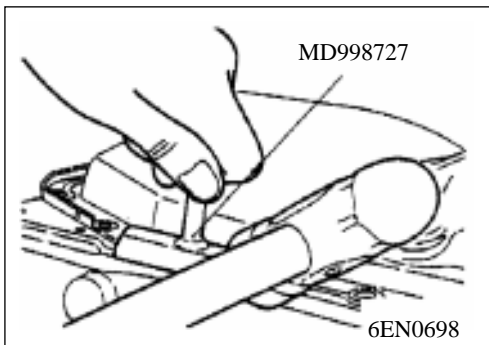


## FRONT COVER, OIL PUMP, BALANCE SHAFT ,OIL PAN DISMANTLE AND ASSEMBLY



### Disassembly Process

- |     |   |                                  |  |
|-----|---|----------------------------------|--|
| ◆N◆ | 1. lubricating oil filter                 | 16. washer of oil filter bracket |  |
|     | 2. drain plug                             | 17. lubricating pump cover       |  |
| ◆M◆ | 3. drain plug washer                      | ◆H◆                              | 18. driven gear of lubricating pump            |
| ◇A◇ | ◆L◆ 4. oil sump                           | ◆H◆                              | 19. driving gear of lubricating pump           |
|     | 5. oil collector and filter               | ◆G◆                              | 20. front oil seal of crankshaft               |
| ◇B◇ | ◆K◆ 6. washer of oil collector and filter | ◆F◆                              | 21. oil seal of lubricating pump               |
|     | 7. plug                                   | ◆E◆                              | 22. oil seal of balancing shaft                |
| ◇C◇ | ◆J◆ 8. o-ring                             | ◆D◆                              | 23. front cover                                |
|     | ◆I◆ 9. flange bolt                        |                                  | 24. front cover washer                         |
|     | 10. oil pressure switch                   |                                  | 25. left balancing shaft                       |
|     | 11. relieve pug                           |                                  | 26. right balancing shaft                      |
|     | 12. gasket                                | ◇D◇                              | ◆C◆ 27. front bearing of right balancing shaft |
|     | 13. pressure relief spring                | ◇E◇                              | ◆B◆ 28. left balancing shaft bearing           |
|     | 14. pressure relief plunger               | ◇E◇                              | ◆A◆ 29. rear bearing of right balancing shaft  |
|     | 15. oil filter bracket                    |                                  |  |



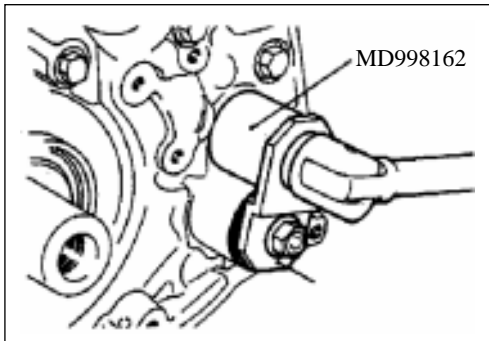
## Main Points of Disassembly

### ⌘A⌘ Disassembly of Oil Sump

- (1) Disassemble all of the bolts of oil sump.
- (2) Tap the SST into the clearance between the cylinder block and the oil sump.

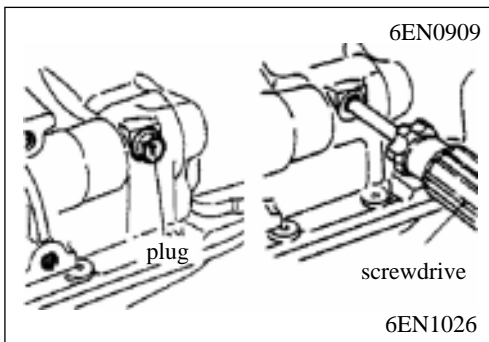
Notice:

Do not replace the SST with screwdriver or chisel, otherwise the oil sump will deform and leak oil.



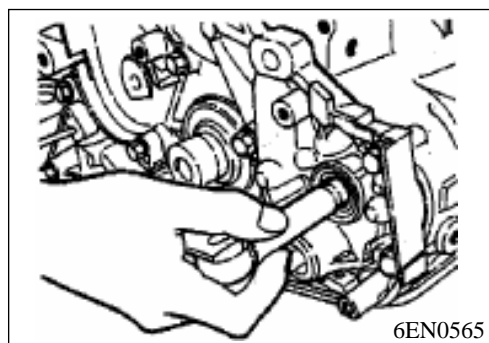
### ⌘B⌘ Disassembly of Plug

- (1) In case the plug is over tight, tap it lightly with hand hammer for two or three times, and it will become loose.

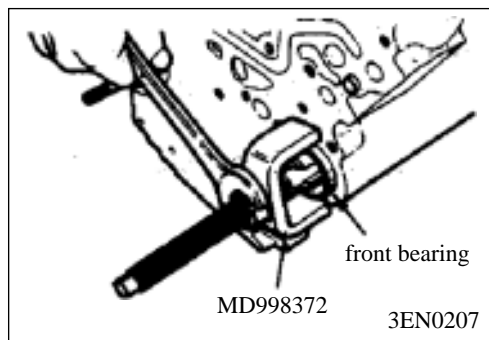


### ⌘C⌘ Disassembly of Flange Bolt

- (1) Tear down the plug from the side of cylinder block.
- (2) Insert the screwdriver (with pole diameter of 8mm) in the plug hole to fasten the balancing shaft.



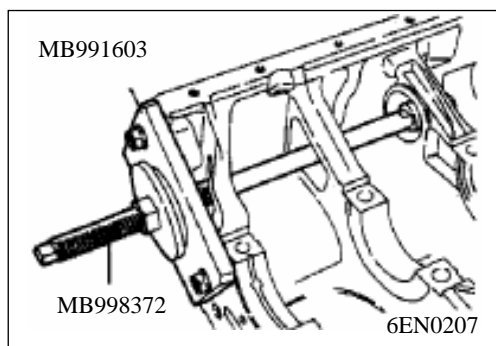
- (3) Loosen the flange bolts



### ⌘D⌘ Disassembly of Front bearing of Right Balancing shaft

- (1) Dismantle the front bearing of the right balancing shaft from the cylinder block with the SST.

Remark: The front bearing must be dismantled first, otherwise, the puller for rear bearing cannot be applied.



### Disassembly of Rear Bearing of Balancing Shaft

- (1) Tear down the rear bearing of the left balancing shaft from the cylinder block with SST.

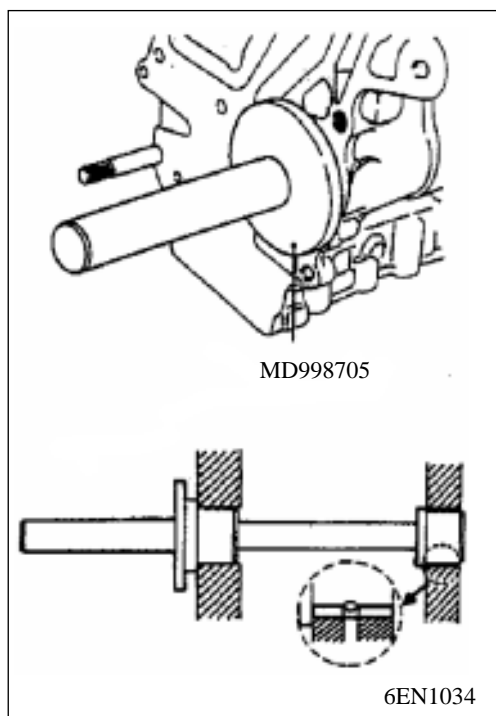
Remark: The SST (MB991603) should be mounted in front of the cylinder block when dismantling the rear bearing of the left balancing shaft.

## Main Points in Assembly



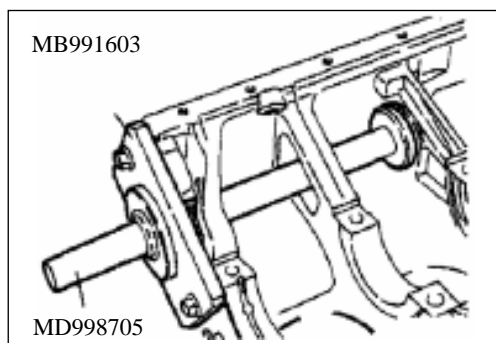
### Mount of Rear Bearing of Right Balancing Shaft

- (1) Coat the engine oil at the outside of the bearing.
- (2) Mount the right rear bearing with SST. The oil hole of the bearing should be confirmed in alignment with that on the cylinder block.



### Mount of Rear Bearing of Left Balancing Shaft

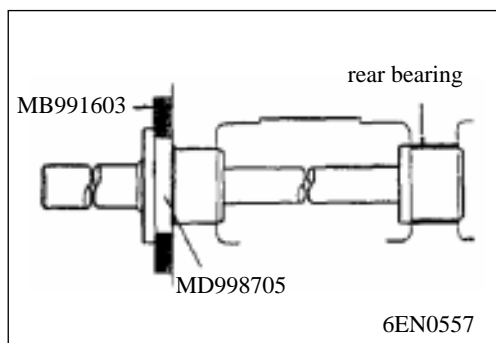
- (1) Mount the SST (guide plate) on the cylinder block.
- (2) Coat the engine oil at the outer circumference of rear bearing and the inside of the bearing hole of the cylinder block.

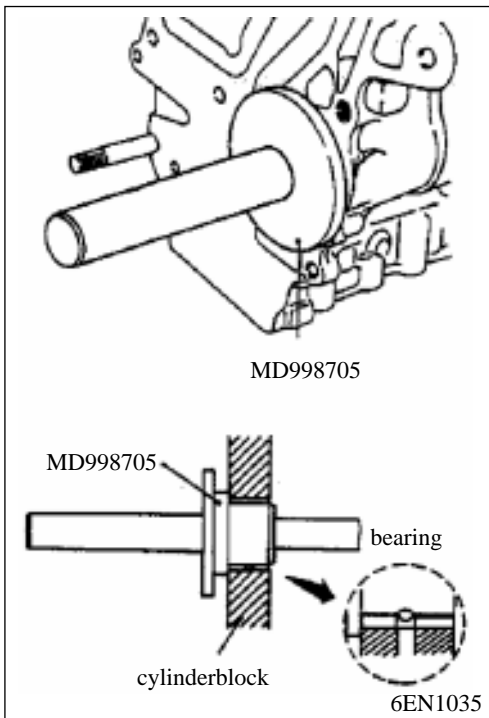


- (3) Mount the rear bearing with SST.

Remark:

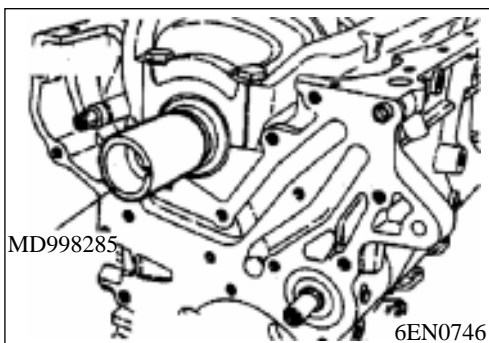
There is no engine oil in the left rear bearing hole.





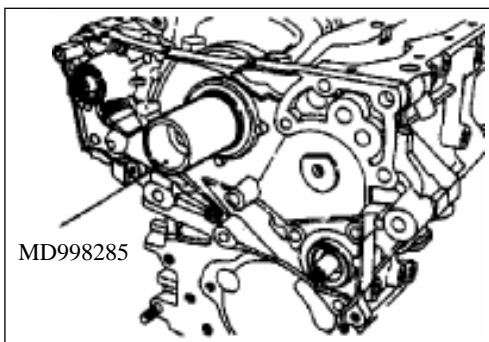
### ■C■ Mount of Front Bearing of Balancing Shaft

- (1) Mount the front bearing with SST.

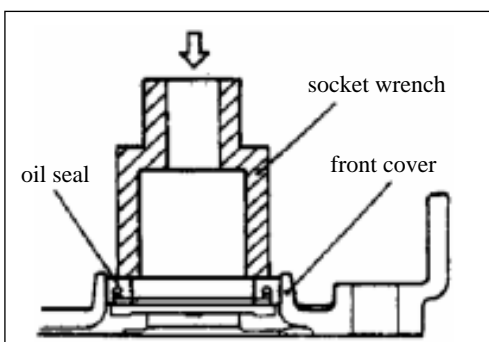


### ■D■ Mount of Front Cover

- (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.

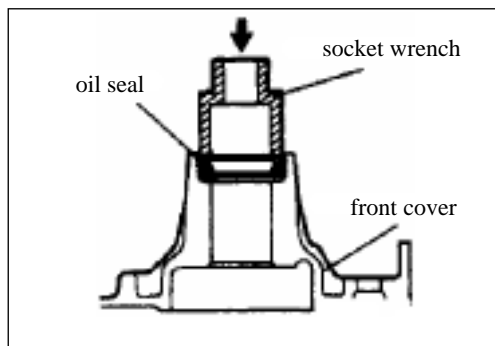


- (2) Mount on the front cover assembly with a new front gasket, and tighten the flange bolts temporarily (excluding the bolts of oil filter that must be tightened).



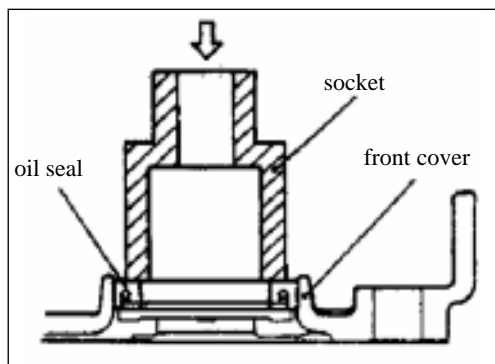
### ■E■ Mount of Oil Seal of Balancing Shaft

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



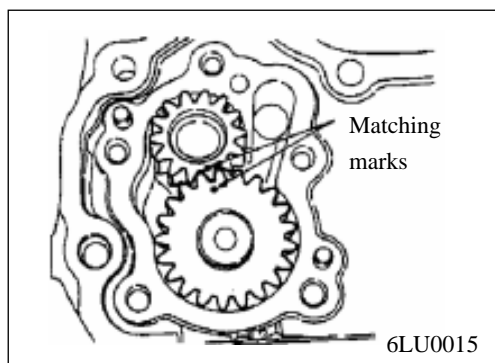
#### ◆F◆ Mount of Oil Seal of Lubricating Pump

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



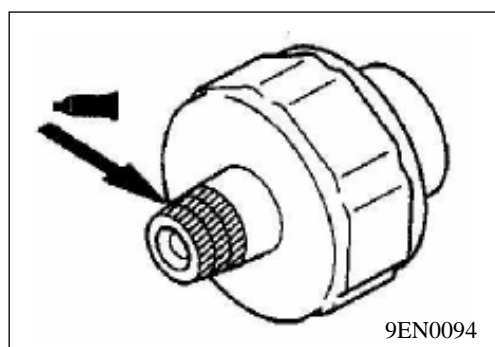
#### ◆G◆ Mount of Front Oil Seal of Crankshaft

- (1) Mount the front oil seal of crankshaft on the front cover with SST.



#### ◆H◆ Mount of Driven/Driving Gear of Oil Pump

- (1) Coat the engine oil on the surface of the gear and align the matching marks



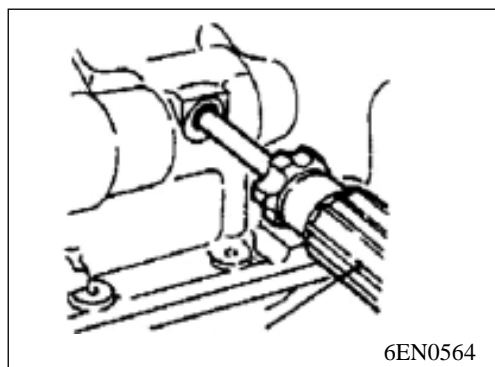
#### ◆I◆ Coat Sealant on Oil Pressure Switch

- (1) Coat the sealant on the threaded part of the oil pressure switch and mount the switch with SST.

Specified Sealant: 3M ATD Par No. 8660 or corresponding substitute

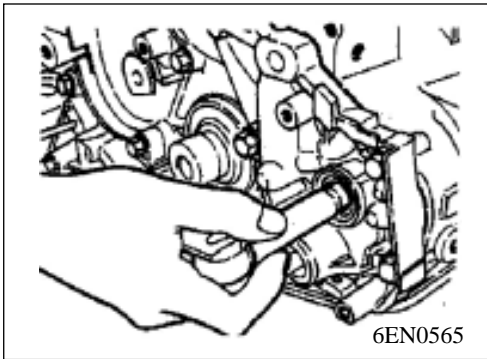
Notice:

- Keep the end of the threaded part clean and do not coat it with sealant.
- Do not over tighten the bolts.

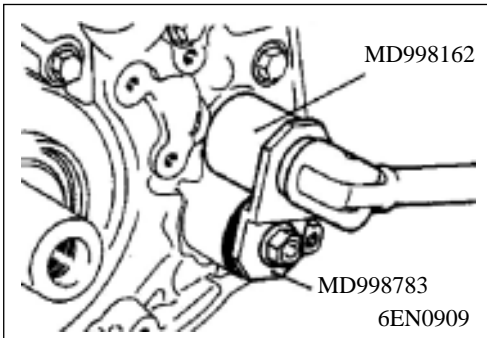


#### ◆J◆ Mount of Flange Bolt

- (1) Insert the cross screwdriver in the hole at left side of cylinder block to lock the balancing shaft.

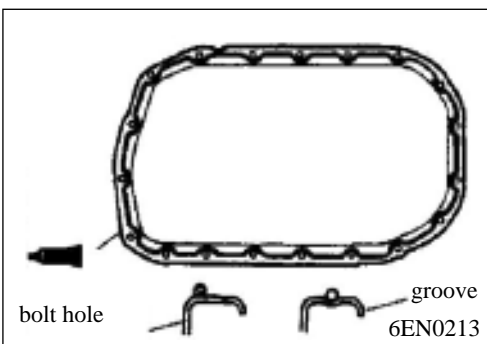


- (2) Tighten the flange bolt with specified torque and ensure the driven gear of oil pump is fastened on the left balancing shaft.



#### Mount of Plug

- (1) Mount the new O-ring in the grooves at the front cover.
- (2) Mount the plug with SST and tighten it to the specified torque.



#### Mount of Oil Sump

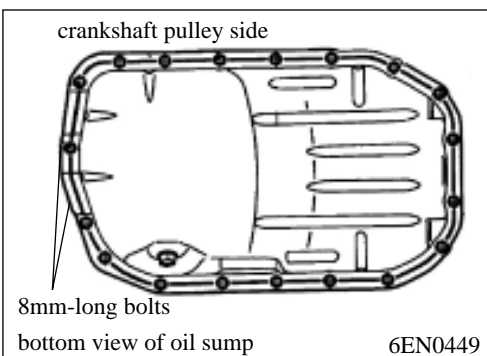
- (1) Clean the matching face of the oil sump and the cylinder block thoroughly.
- (2) Coat the sealant of 4 mm in diameter on the full circumference of the oil sump flange.

Specified Sealant:

Genuine Mitsubishi brand Sealant MD970389 or the equivalents.

Remark:

- (1) The oil sump must be mounted at the moment the sealant is still humid (15 min or so).
- (2) The sealing part should not be stained by the humid oil within 1 hour after the mount.
- (3) Confirm the length and mounting place of the bolt.

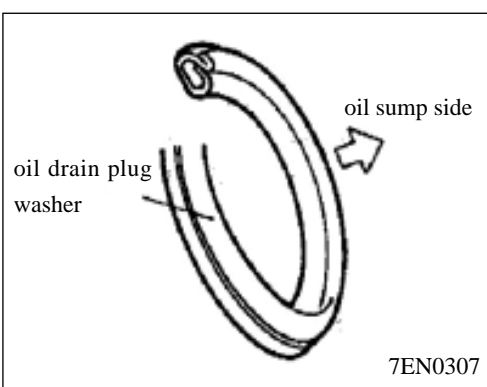


#### Mount of Oil Drain Plug

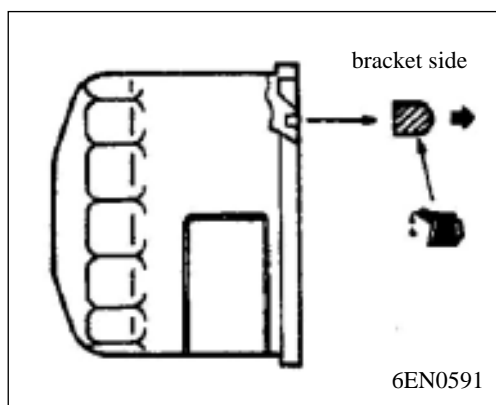
- (1) Mount the oil drain plug in the direction shown in the figure.

Notice:

The mount in wrong direction will cause oil leakage.







#### Mount of Oil Filter

- (1) Clean the mounting face of the oil filter bracket.
- (2) Coat the engine oil on the O-ring of oil filter.
- (3) Screw in the oil filter, when the O-ring contacts the mounting face, screw another 3/4 round (tightening moment: 1.4 kg.m)

## Inspection

### Front Cover

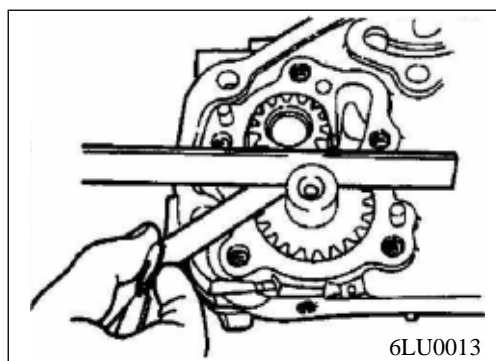
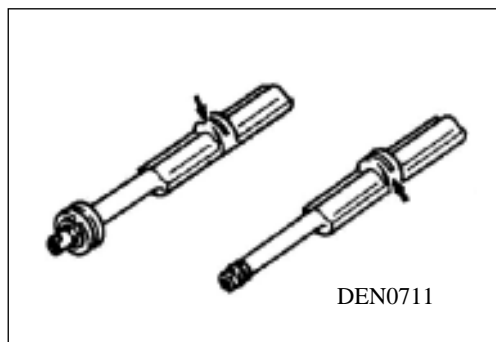
- (1) Check whether the oil hole is blocked, and clean it where necessary.
- (2) Inspect whether there is abrasion, damage or sintering at the front bearing of left balancing shaft, if any, change the front cover.
- (3) Check whether the front cover has crack or other damages, if it has, change the front cover assembly.

### Oil Seal

- (1) Check whether the lip of oil seal has abrasion or damage. Change the oil seal if necessary.
- (2) Check whether the lip of oil seal has deterioration. Change the oil seal where necessary.

### Balancing Shaft

- (1) Check whether the oil hole is blocked.
- (2) Inspect whether the journal has sintering or damage, or whether it interferences with the bearing. Change the balancing shaft, bearing or the front cover assembly in case any defect is found.



### Lubricating Oil Pump

- (1) Mount the gear of oil pump on the front cover, and then rotate the gear to check whether it can runs smoothly and fixedly.
- (2) Ensure the contact face of the front cover and the gear flanks of oil pump cover has no lophodont abrasion.
- (3) Check the side clearance.


#### Standard value:

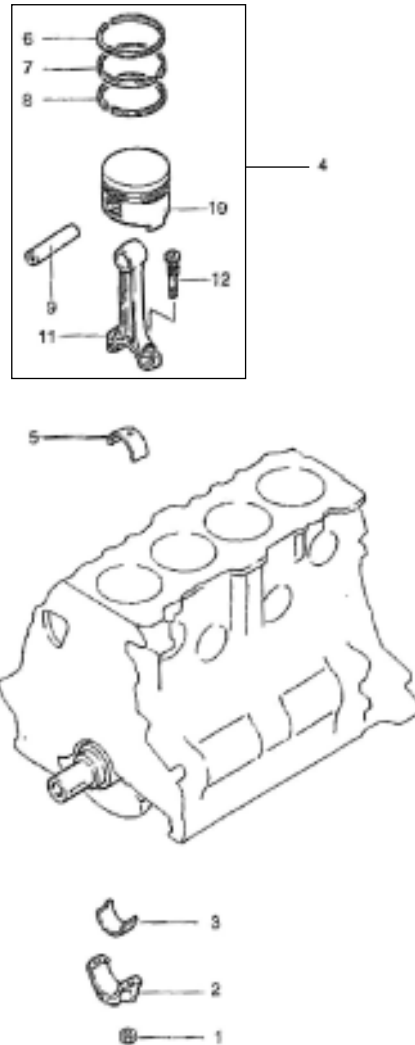
Driving gear: 0.08-0.14mm

Driven gear: 0.06-0.12mm

### Piston and Connecting Rod

## DISASSEMBLY AND ASSEMBLY

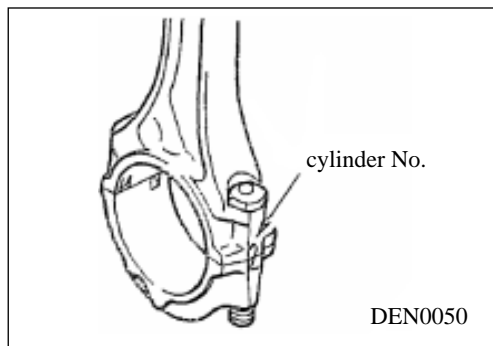
 All inside parts must be coated with engine oil



6EN0526

### Disassembly Procedure

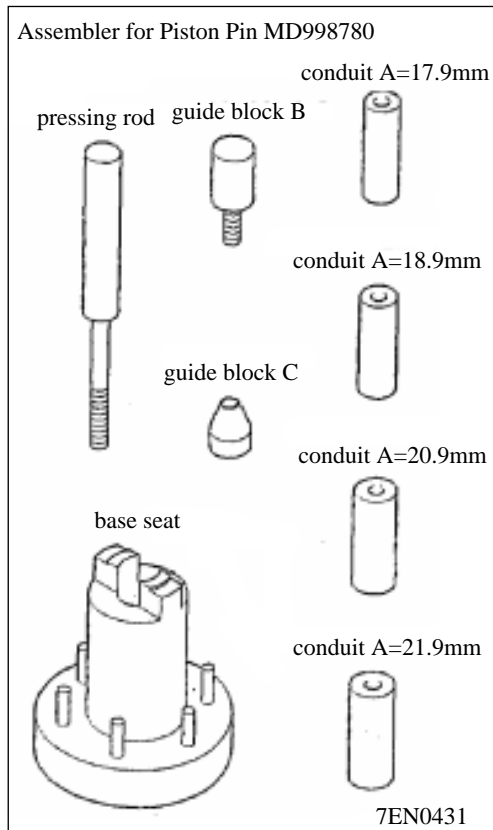
- ◆G◆ 1. connecting rod nut
- ◇A◇ ◆F◆ 2. connecting rod cap
- ◆E◆ 3. connecting rod bearing
- ◆D◆ 4. piston and connecting rod cluster
- ◆E◆ 5. connecting rod bearing
- ◆C◆ 6. first air ring
- ◆C◆ 7. second air ring
- ◆B◆ 8. oil ring
- ◇B◇ ◆A◆ 9. piston pin
- 10. piston
- 11. connecting rod
- 12. connecting rod bolt



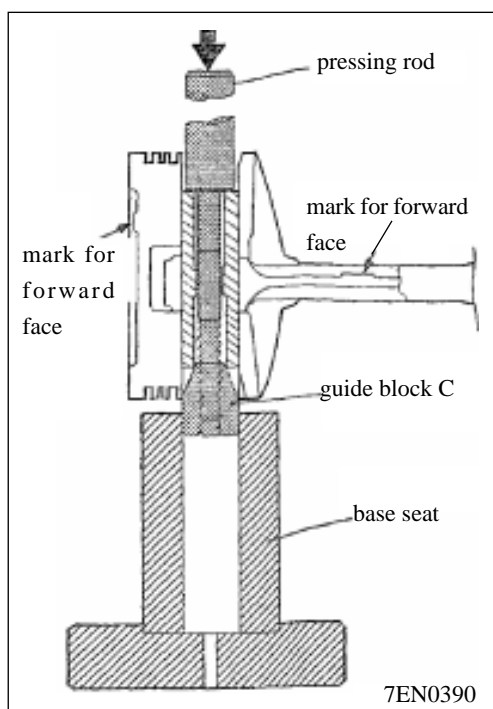
## Main Points in Disassembly

### Ⓐ Disassembly of Connecting Rod Cap

- (1) Mark the cylinder No. on the side face of the larger end of the connecting rod so as to ensure the correct assembly.
- (2) Put aside the dismantled connecting rod, connecting rod cap and connecting rod bearing in order as per the cylinder No. marked on.



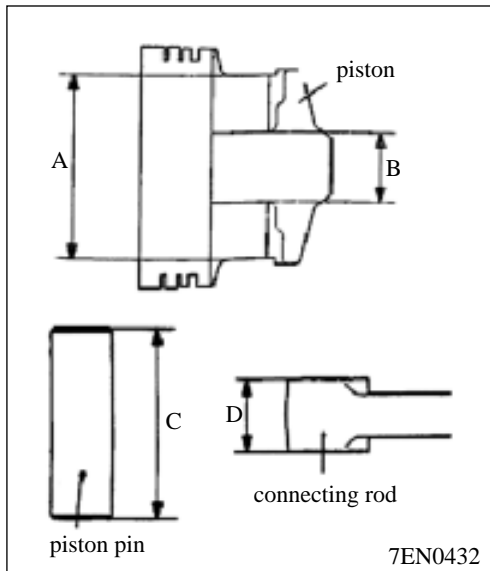
### Ⓑ Disassembly of Piston Pin



- (1) Insert the SST of compression bar from the side with arrow mark at the piston top, then mount the guide block C at the end of compression bar.
- (2) Keep the mark for forward face of the piston to face upwardly, and mount the piston and connecting rod cluster on the base seat (SST) of the assembler of piston pin.
- (3) Press the piston pin out with the pressure.

#### Notice:

Put aside the dismantled piston, piston pin and connecting rod as per the cylinder No. marked on.

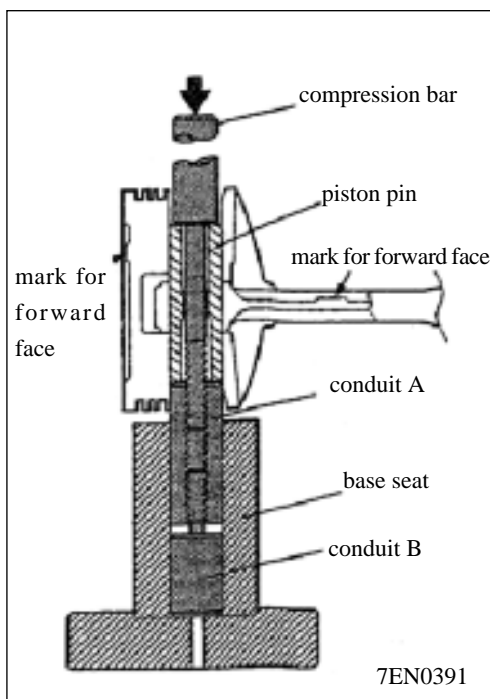
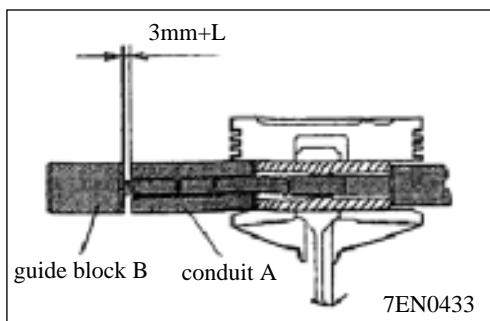


## Main Points for Mount

### Mount of Piston Pin

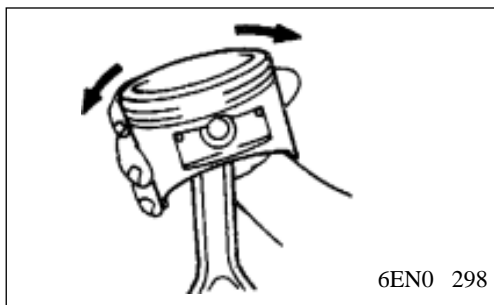
- (1) Measure the following dimensions of the piston, piston pin and connecting rod;
  - A) Length of inserting hole of the piston pin;
  - B) Width between the keyway
  - C) Length of piston pin
  - D) Width of smaller end of connecting rod.
- (2) Calculate the dimension L by substituting the letters in the below formula with the measured dimensions:  

$$L = [(A - C) - (B - D)] / 2$$
- (3) Insert the SST of compression bar in the piston pin and mount the conduit A at the end of compression bar.
- (4) Conduct the assembly in such way that the mark for forward face on the piston is in the same direction with that of the connecting rod.
- (5) Coat the engine oil on the outside diameter of the piston pin.
- (6) Encase the piston pin, connecting rod and conduit cluster assembled as Step (3) in the piston pin hole at the side with mark for forward face with conduit A.
- (7) Screw the guide block B in the conduit A and ensure the clearance between the guide block B and the guide block A is the value of the sum of L calculated in Step (2) plus 3 mm..

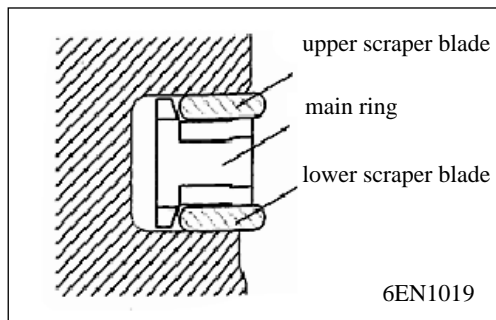


- (8) Maintain the state that the mark for forward face of piston faces upwardly, and mount the piston and connecting rod cluster on the base seat of the assembler of piston pin.
- (9) Press in the piston pin with pressure. If the pressure force is less than the standard value, Change the piston pin and the piston cluster, or/and change the connecting rod.

Standard value: 750 ~ 1750kg



(10) Check whether the piston can rotate freely.



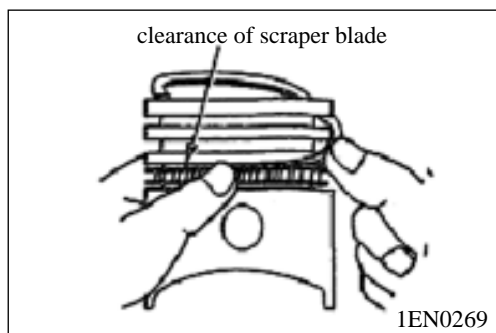
#### Mount of oil ring

(1) Put the main ring of oil ring in the oil ring groove.

Remark:

1. The scraper blade and the main ring has the specified upper./lower face.
2. The new main ring and scraper are colorful to identify its dimension.

| Dimension      | Identification Color |
|----------------|----------------------|
| Standard value | None                 |
| 0.50mm larger  | Red                  |
| 1.00mm larger  | Yellow               |



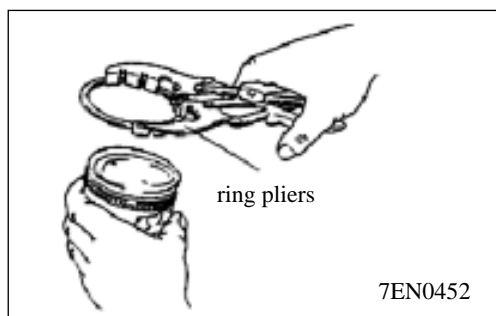
(2) Put in the upper scraper blade. When mounting the scraper blade, press one end of the scraper blade in the piston oil ring groove, then press the remaining part of scraper blade in the oil ring groove shown as the figure by thumb.

Different from other piston ring, the use of ring pliers to expand the scraper blade will break the scraper blade.

Notice:

Do not use the ring pliers to expand the scraper blade.

- (3) Mount the lower scraper blade in the same procedure of Step (2).
- (4) The scraper blade should be confirmed whether can rotate freely to left and right after the mount.



#### Mount of First and Second Air Ring

(1) The first air ring should be mounted after the second air ring is mounted with the ring pliers.

Remark:

1. There is identification mark at the ring end.

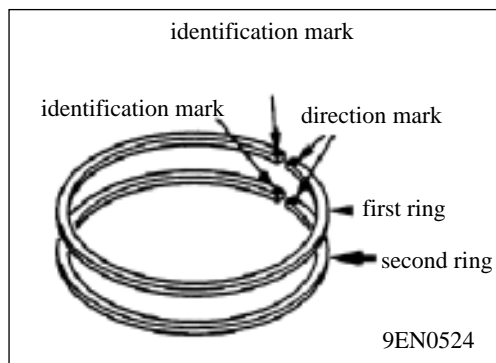
Identification mark:

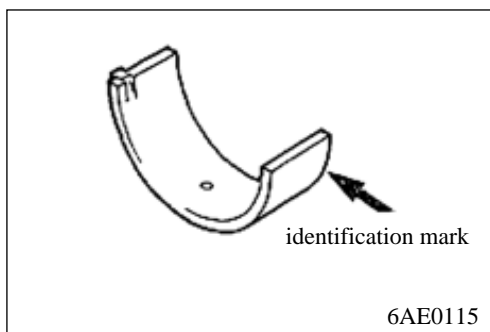
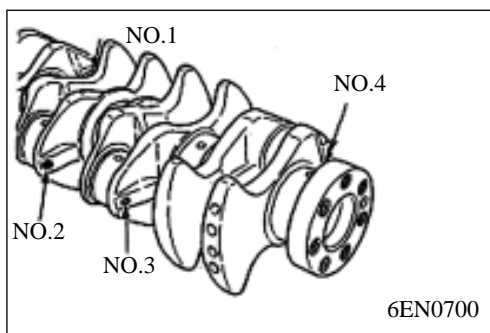
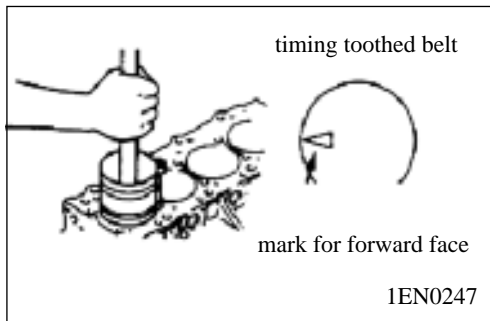
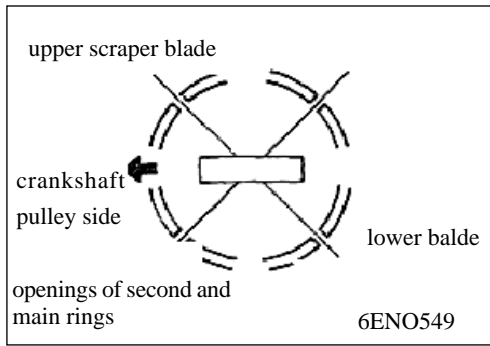
First ring.....1R

Second ring.....2R

2. Mount the piston ring and be sure the identification mark should face upwardly to the top of the piston.
3. The dimension marks of piston ring are as follows:

| Dimension      | Dimension mark |
|----------------|----------------|
| Standard value | None           |
| 0.50mm larger  | 50             |
| 1.00mm larger  | 100            |





### Mount of Piston and Connecting Rod Cluster

- (1) Coat enough engine oil on the piston, air ring and oil ring.
- (2) Adjust the openings of the air ring and oil ring (scraper blade and the main ring) to the place shown in the figure.
- (3) Rotate the crankshaft until the crank pin locates the position of the cylinder hole.

- (4) Threaded protective device should be adopted on the connecting rod bolt before the insertion of the piston and connection rod cluster in the cylinder. Carefulness is needed not to damage the crank pin.
- (5) Insert the piston and connecting rod cluster in the cylinder with the suitable press fitting SST for piston ring.

#### Notice:

There is a mark for forward face on the top of piston, which should direct to the front of the engine (timing toothed belt side).

### Mount of Connecting rod bearing

Where the bearing is needed to change, it should be selected and mounted as per the following procedure.

- (1) Measure the outside diameter of the crank pin and determine which group it belongs as per the following form, the crankshaft to be maintained should be marked at the position shown in the figure with color paint to identify its dimension.
- (2) The identification mark of the connecting rod is printed at the position shown in the figure.

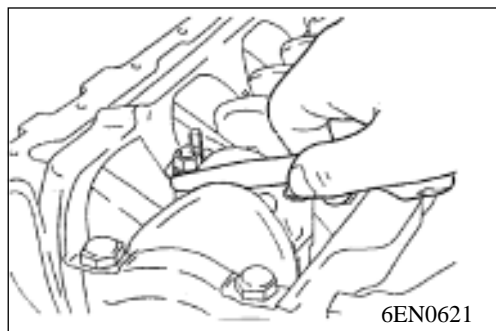
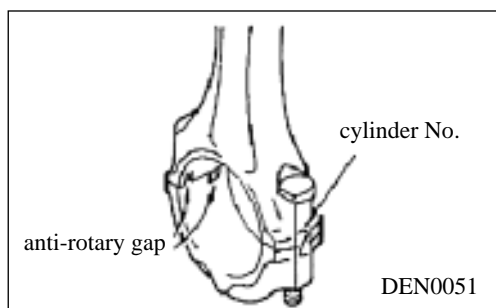
| Crank pin |                      |                       | Connecting rod bearing |                      |                |
|-----------|----------------------|-----------------------|------------------------|----------------------|----------------|
| Group     | Identification color | Outside diameter (mm) | Identification mark    | Identification color | Thickness (mm) |
| I         | Yellow               | 44.995 ~ 45.000       | 1                      | Yellow               | 1.487 ~ 1.491  |
| II        | None                 | 44.985 ~ 44.995       | 2                      | None                 | 1.491 ~ 1.495  |
| III       | White                | 44.980 ~ 44.985       | 3                      | Blue                 | 1.495 ~ 1.499  |

Inside diameter of connecting rod; 48.000 ~ 48.015mm

- (3) Select the bearing from the group determined as per the Step (1) and (2).

#### Bearing Selection, for example:

In case the outside diameter of the crank pin is measured as 44.996mm, it belongs to the Group 1 in the above form. If the repairing element for crankshaft needs to be changed, inspect the identification color coated on the new crank pin. If the color is yellow, the crank pin should belong to the first group, therefore, the connecting rod bearing marked with “1” should be selected.



### ■F■ Mount of Connecting Rod Cap

- (1) When mounting the connecting rod cap, align the marks made in disassembly well, if mounting the new member without mark, the anti-rotary gap shown in the figure should be mounted at the same side

- (2) Be sure the axial clearance at the larger end of connecting rod is suitable.

Standard value: 0.10~0.25mm

Limit value: 0.4mm

### ■G■ Mount of Connecting Rod Nut

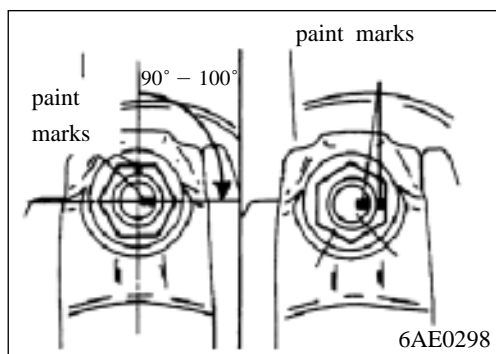
Notice:

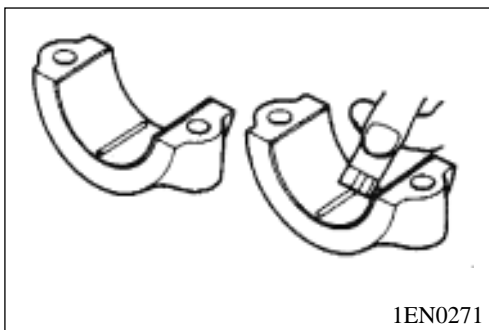
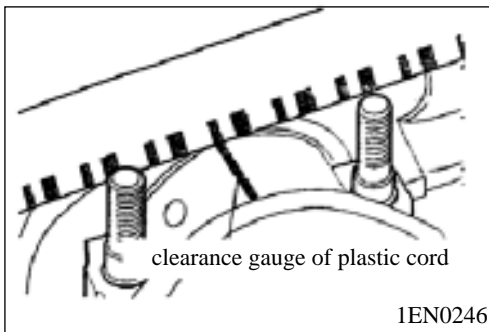
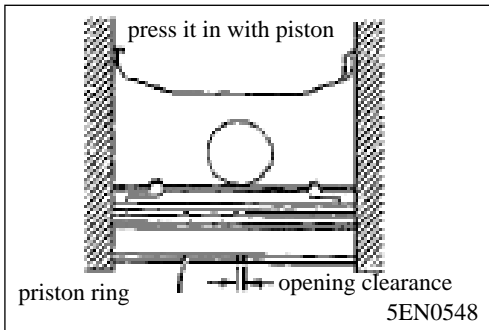
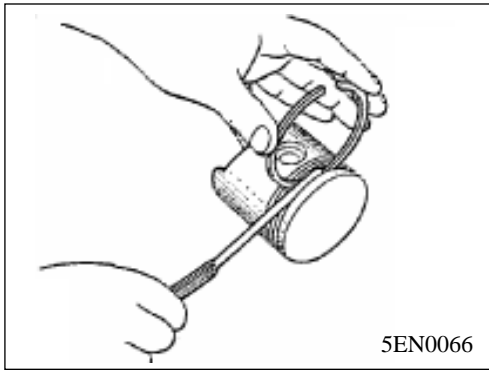
- In case the cylinder head is mounted before the mount of connecting rod cap, dismantle the spark plug and then mount on the connecting rod cap nut.

- (1) The connecting rod bolts and nuts should be tightened with the method of tightening bolt at plastic zone. Before reusing the bolt, check whether the bolt is expanded. Inspection method: tighten the nut to the threaded part of the bolt by hand until it passes the full thread. In case the nut cannot be screwed down to the bottom, it can be judged the threaded part of the bolt may be protracted, change the bolt on such condition.
- (2) Coat the oil on the threaded part and the seat face of the nut before tightening the nut.
- (3) Tighten the nut on the bolt by hand and then screw the nuts down in turns so as to assemble the connecting rod cap correctly.
- (4) Tighten the nut with the torque of 20N.M.
- (5) Coat the paint mark on each nut head.
- (6) Make paint mark on the bolt at the position 90~100° forward from the paint mark at nut head.
- (7) Tighten the nut by a angle of 90~100° , until the marks on the nut and the bolt are in alignment.

Notice:

- If the screwing angle is less than 90° , the tightening property specified is cannot be guaranteed. Therefore, attention should be paid to the screwing angle when tightening.
- In case the nut is over tightened, (the screwing angle is more than 100° ), loosen it thoroughly, and then re-tighten it from the Step (1).





## Inspection

### Piston Ring

- (1) Check whether the piston ring has damage, over abrasion or breakage, if it has, change it, in the case of changing the piston, the piston ring needs to be changed too.
- (2) Check the clearance between the piston ring and the piston ring groove, if it is over large, change the piston ring or the both parts.

Standard value: 0.02 ~ 0.06mm

Limit value: 0.1mm

- (3) Put the piston ring in the cylinder and locate it with the crown face of the piston, then measure the opening clearance with the feeler. If the opening clearance is over large, change the piston ring.

Standard value:

First ring...0.25 ~ 0.35mm

Second ring...0.40 ~ 0.55mm

Oil ring...0.10 ~ 0.40mm

Limit value:

First and second ring...0.8mm

Oil ring...1.0mm

### Play of Crank Pin (clearance gauge of plastic cord)

- (1) Clear away the oil on the journal and bearing of the connecting rod thoroughly.
- (2) Cut the clearance gauge of plastic cord in the length that is the same with the bearing width, and then put them on the crank handle and parallel them with the axial center line.

- (3) Mount on the connecting rod cap carefully and tighten the nut as per the specified torque.
- (4) Dismantle the connecting rod cap carefully.
- (5) Measure the max width of the flattened plastic cord with the gauging ruler printed on the package bag of the clearance gauge of plastic cord, thus obtaining the clearance value.

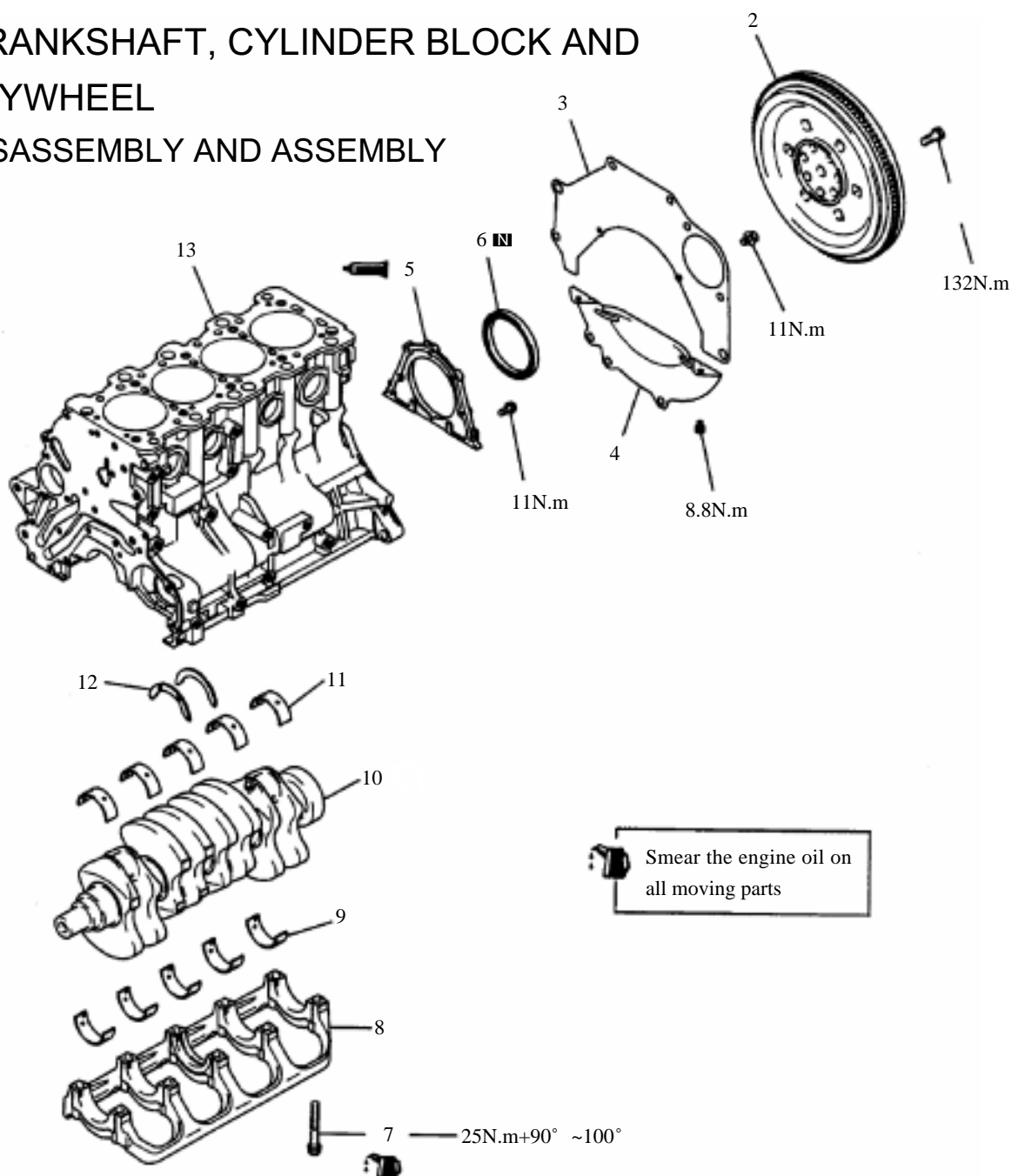
Standard value: 0.02 ~ 0.05mm

Limit value: 0.1mm



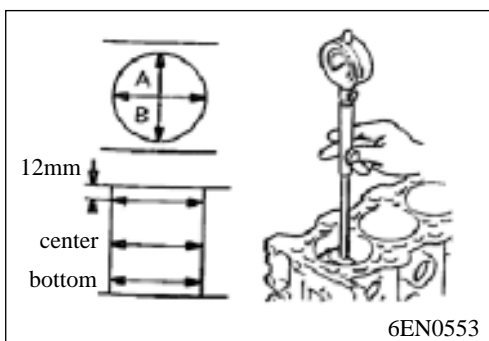
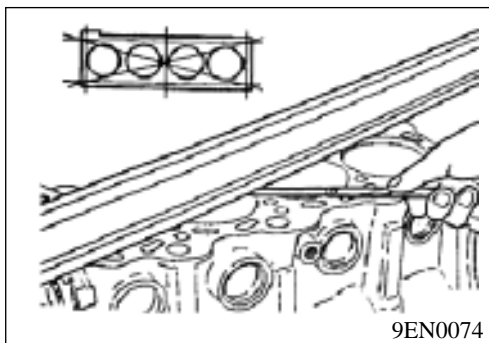
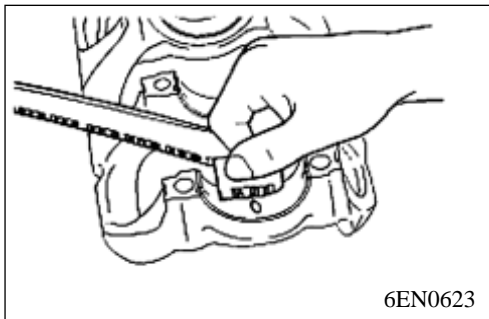
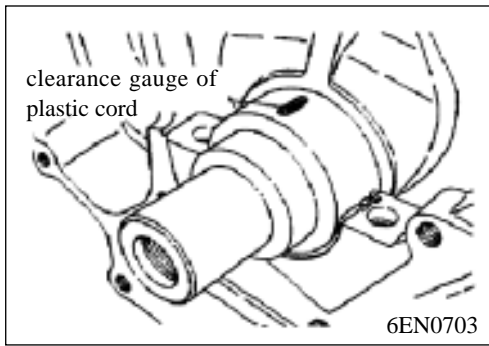
# CRANKSHAFT, CYLINDER BLOCK AND FLYWHEEL

## DISASSEMBLY AND ASSEMBLY



### Disassembly Procedure

- |                          |                                  |
|--------------------------|----------------------------------|
| 1. flywheel bolt         | 8. main bearing cap              |
| 2. flywheel              | 9. low bearing of crankshaft     |
| 3. rear cover plate      | 10. crankshaft                   |
| 4. bell jar              | 11. bearing on crankshaft        |
| 5. rear oil seal cap     | 12. thrust bearing of crankshaft |
| 6. oil seal              | 13. cylinder block               |
| 7. main bearing cap bolt |                                  |



## Inspection

### Measurement for Crankshaft Play (clearance gauge of plastic cord)

- (1) Clean the oil on the main journal and the inner race of bearing.
- (2) Mount the crankshaft.
- (3) Cut the clearance gauge of plastic cord in the length that is the same with the width of bearing, then put them on the crankshaft journal and ensure them are parallel with the axial center line.
- (4) Mount the main bearing cap carefully and tighten the bolts as per the specified torque.
- (5) Tear down the main bearing cap.
- (6) Measure the Max width of the flattened plastic cord with the gauging ruler printed on the package bag of the clearance gauge of plastic cord, thus acquiring the clearance value.

Standard value: 0.02 ~ 0.04mm

Limit value: 0.1mm

## Cylinder Block

- (1) Conduct a visual observation for defects such as scoring, rust and corrosion, etc. or conduct an inspection with the fluid testing agent. In case the cylinder block has obvious defect, repair or change it.
- (2) Check the plane on cylinder block for warp with ruler and feeler, and be sure there should be no washer scraps or other alien materials on the surface.

Standard value: 0.05mm

Limit value: 0.1mm

- (3) In case the cylinder block has over large warp, change or correct it within the permitted range.

Grinding limit: 0.2 mm

The max sum of thicknesses of the cylinder block and cylinder head that is permitted to cut out is 0.2 mm.

Height of cylinder block (new): 290mm

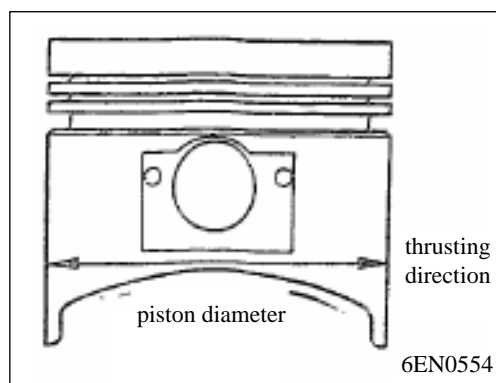
- (4) Check whether the cylinder wall has scoring or the cylinder is seized, in case the requirement is not met, correct (enlarge the dimension) or change them.

- (5) Measure the inner cylinder and cylindricity of the cylinder with the cylinder gauge, the cylinder should be corrected by enlarging the diameter on condition the abrasion is serious, and change the piston and piston ring. Measurement positions are shown in the figure below.

Standard value:

Inside diameter of cylinder: 86.50 ~ 86.53MM

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



## Re-boring of Cylinder Diameter

- (1) The diameter for the enlarged piston should be determined according to the max cylinder diameter.

Identification of piston diameter

| dimension | Identification mark |
|-----------|---------------------|
| Plus 0.50 | 0.50                |
| Plus 1.00 | 1.00                |

Remark: Dimension mark is printed on the top of piston.

- (2) Measure the diameter of the cylinder to be used, the measurement should be conducted in the thrusting direction shown in the figure below.
- (3) Calculate the reparation dimension of the cylinder diameter according to the outside diameter of the piston.

Reparation dimension = outside diameter of piston + (clearance between piston and cylinder) – 0.02 mm (hone grinding)

- (4) Repair each cylinder to the dimension of reparation.

Notice:

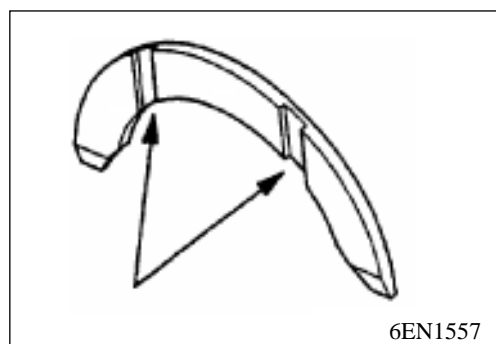
When honing the cylinder, in order to prevent the error caused by the increased temperature, conduct the reparation as the order below: No.2 → No.4 → No.1 → No.3

- (5) Hone the cylinder to its final diameter (piston diameter + clearance between the piston and cylinder).
- (6) Check the clearance between the piston and the cylinder.

Standard value: 0.02~0.04mm

Remark:

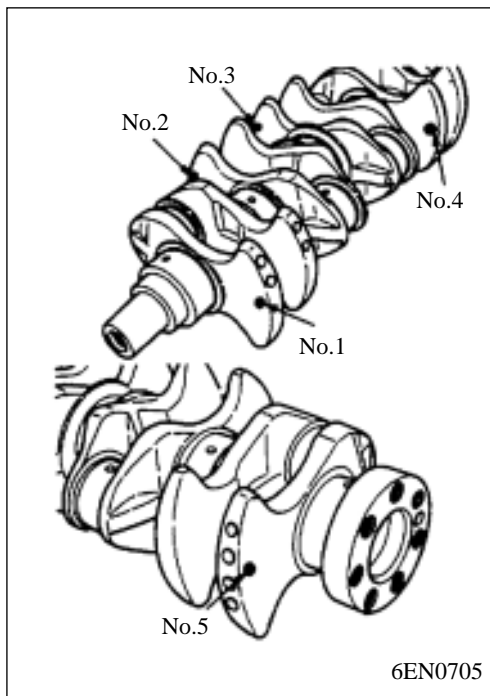
When repairing the cylinder, the four cylinders should be in the same dimension, do not only enlarge one cylinder.



## Main Points of Mount

### 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.

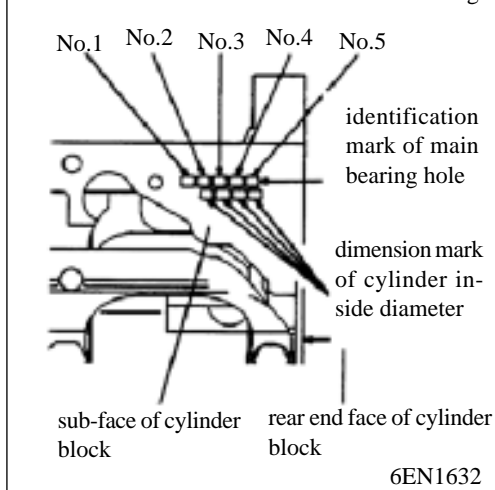


### Mount of crankshaft bearing

- (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 marks and colors for bearings of Journal 1,2 and 5 | Identification marks and colors for bearings of No 3 journal |
|--|----------------------|-----------------|--|---|--|
| Crankshaft main journal  |                      |                 | Identification mark of main shaft aperture |   |  |
| Groups   | Identification color | Diameter (mm)   |  |   |  |
| I  | Yellow               | 56.994 – 57.000 | 0  | 1 Green   | 0 Black  |
|  |                      |                 | 1  | 2 Yellow  | 1 Green  |
|  |                      |                 | 2  | 3 None  | 2 Yellow   |
| II   | None                 | 56.988 – 56.994 | 0  | 2 Yellow  | 1 Green  |
|  |                      |                 | 1  | 3 None  | 2 Yellow   |
|  |                      |                 | 2  | 4 Blue  | 3 None   |
| III  | White                | 56.982 – 56.988 | 0  | 3 None  | 2 Yellow   |
|  |                      |                 | 1  | 4 Blue  | 3 None   |
|  |                      |                 | 2  | 5 Red   | 4 Blue   |

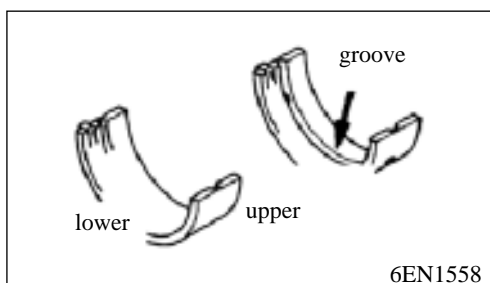
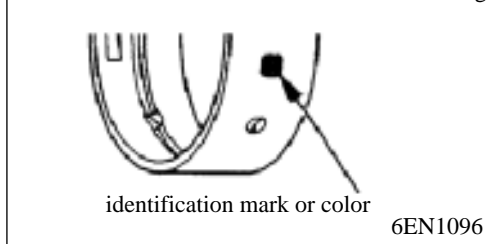
identification mark for dimension of main bearing



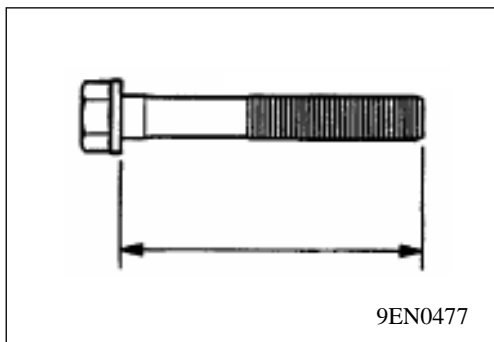
### Bearing Selection, for instance:

- In case the identification color of the crankshaft main journal is “yellow”, and the identification mark for main shaft aperture is “1”, select the Bearings of No. 1,2, 4 and 5 with identification mark “2” and identification color “yellow” or the No. 3 bearing with identification mark “1” and identification color “green”.
- In case there is no identification paint on the crankshaft, measure the main journal and select the corresponding bearing as per the measured value.

identification mark or color for crankshaft bearing



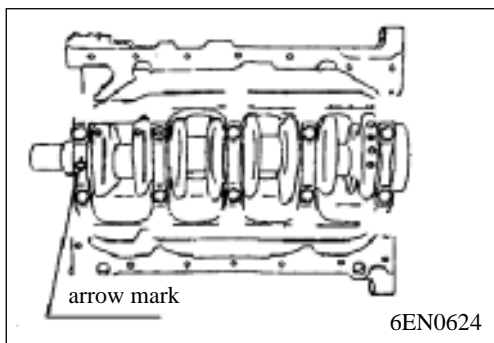
- (2) Mount the bearing with groove at the side of cylinder block.
- (3) Mount the bearing without groove at the side of main bearing cap



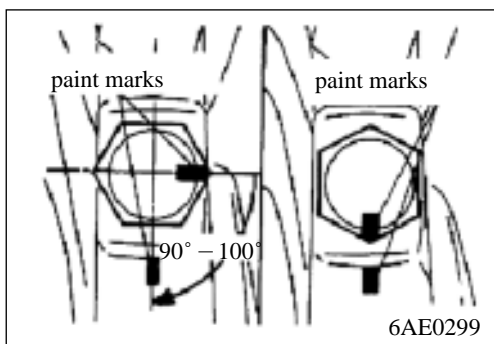
### ●C● Mount of Main Bearing Cap/ Main Bearing Bolt

- (1) Mount the main bearing cap with the arrow mark thereof directing to the side of timing toothed belt.
- (2) Be sure the length of bolt is less than the limit value before mounting the main bearing cap bolt. In case it is larger than the limit value, change the bolt.

Limit value (A): 71.7 mm



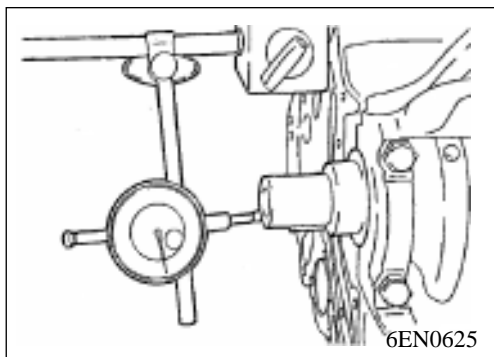
- (3) Coat the engine oil on the threaded part and seat face of the bolt.
- (4) Tighten the main bearing cap bolt with the torque of 25N.m as per the specified sequence.



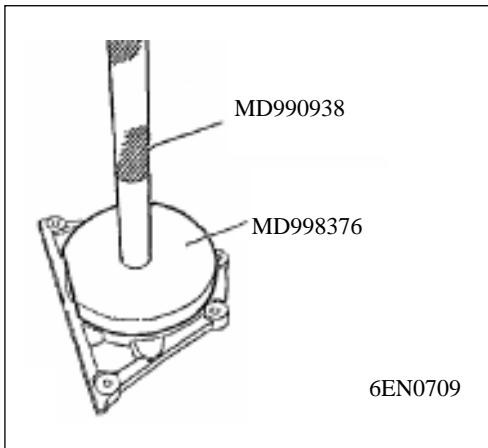
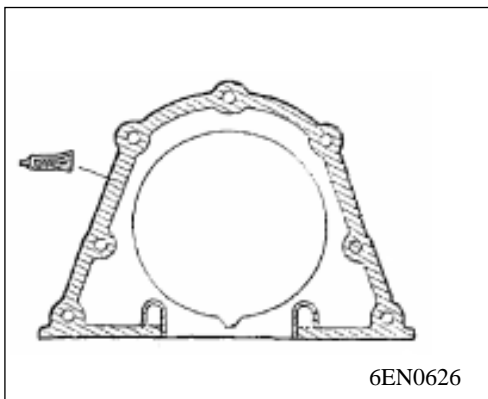
- (5) Make paint mark on each bolt head.
- (6) Screw down the paint mark at the position of the main bearing cap by 90~100° forward from the paint mark on bolt.
- (7) Tighten each bolt by 90~100° in the above specified sequence until the paint marks on the bolts are in alignment with that on the main bearing cap.

### Notice:

- If the screwing angle is less than 90° , the tightening property specified is cannot be guaranteed. Therefore, attention should be paid to the screwing angle when tightening.
- In case the nut is over tightened, (the screwing angle is more than 100° ), loosen it thoroughly, and then re-tighten it from the Step (1).



- (8) Ensure the crankshaft can rotate smoothly after the main bearing cap is well mounted, and inspect the axial clearance. In case the axial clearance exceeds the application limit value, change the No.3 crankshaft thrusting bearing.
- Standard value; 0.05~0.18mm
- Limit value: 0.25mm

**●D● Mount of Oil Seal****●E● Mount of Rear Oil Seal Cover**

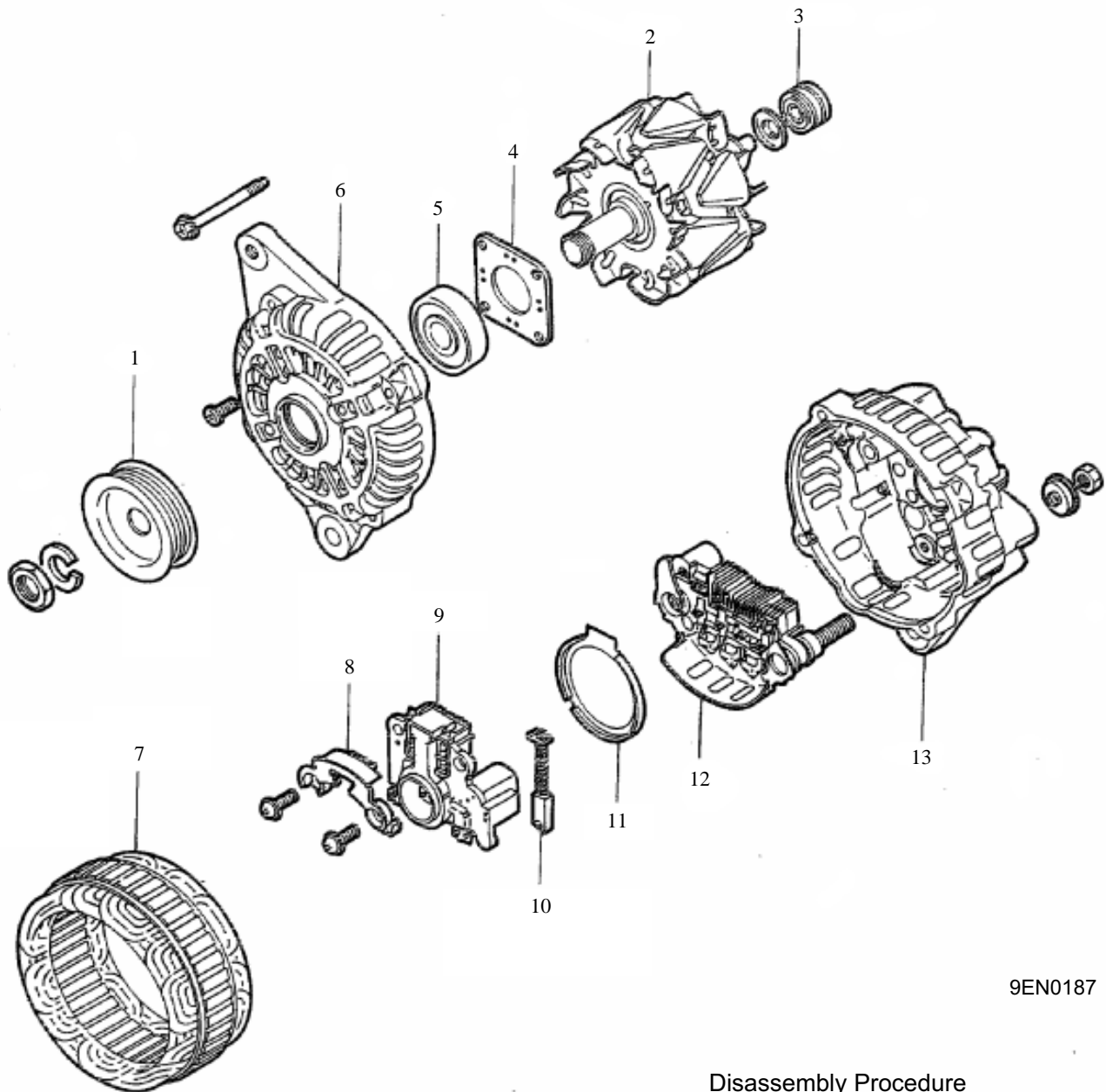
Specified sealant

Brand: Genuine Mitsubishi brand sealant MD970389 or the equivalents.

Notice:

- (1) The rear oil seal cover should be mounted quickly on the condition the sealant is not dry ( $\leq 15$  min).
- (2) Keep the sealing area free from the lubricant and coolant for 1 hours or so after the mount.

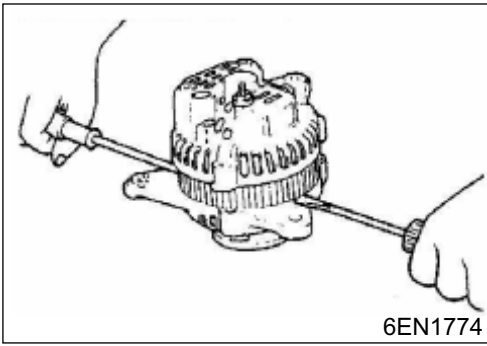
## AC GENERATOR DISASSEMBLY AND ASSEMBLY



9EN0187

### Disassembly Procedure

- ⌞A⌟ ■ A ■ 1. generator pulley  
 ■ A ■ 2. rotor assembly  
 3. rear bearing  
 4. bearing block  
 5. front bearing  
 6. front cap  
 ⌞B⌟ 7. stator assembly  
 8. retaining plate  
 9. adjustor and brush stand  
 10. brush  
 11. ring  
 12. rectifier assembly  
 13. rear cap



## NOTES FOR DISASSEMBLY

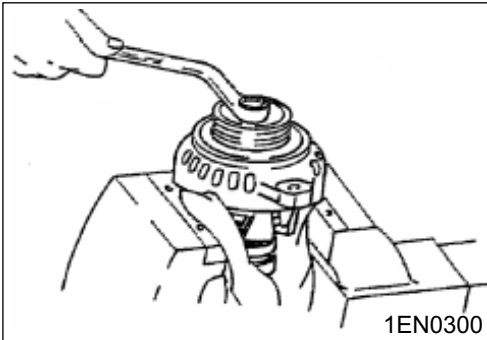
### SEPARATION OF STATOR AND FRONT CAP

- (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.

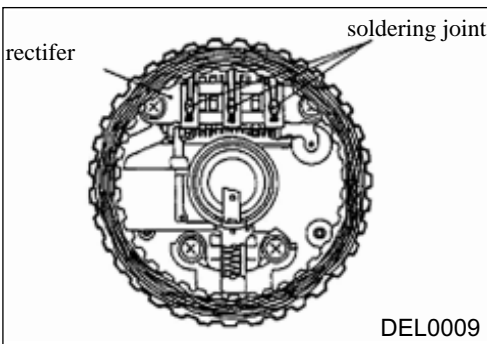
### Ⓐ DISASSEMBLY OF GENERATOR PULLEY AND ITS FAN



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

#### NOTES:

- Do not damage the rotor.

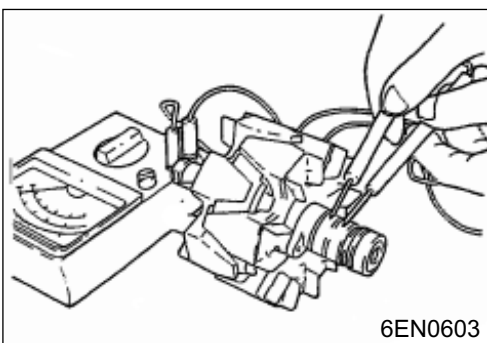


### Ⓑ DISASSEMBLY OF STATOR ASSEMBLY, ADJUSTOR AND BRUSH STAND

- (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 not to conduct the heat generated by the electric iron to the diode for a long time.
  - Do not let the diode pin overburden forces.

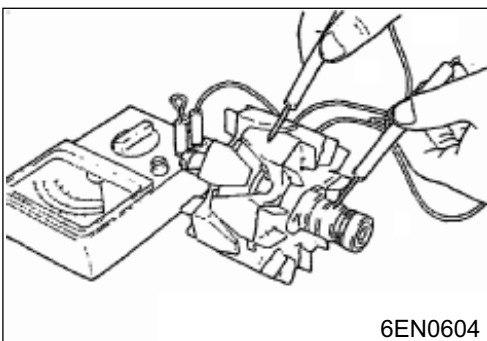
## CHECK

### ROTOR



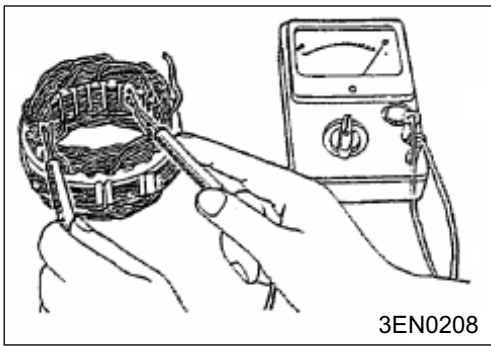
- (1) Check whether the rotor winding is switched into conduction and confirm conduction exists between the slip-rings. Measure the resistance of the rotor. If the resistance is too low, it means the circuit is shorted. If there exists non-conduction or short circuit, replace the rotor assembly.

Standard value:  $3 \pm 0.5 \Omega$



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

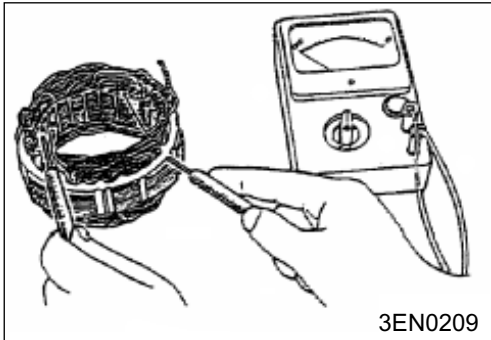




3EN0208

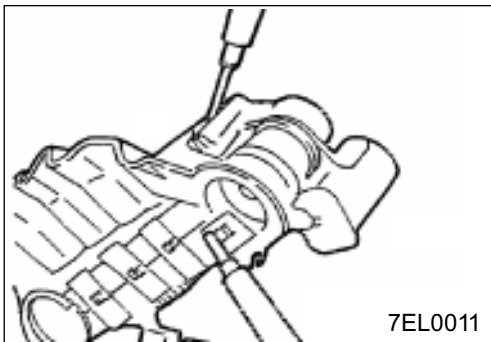
### STATOR

- (1) Conduct on stator examination over the stator and confirm whether the conduction exists with the lead-wire of the winding, if not, replace the stator assembly.



3EN0209

- (2) Check the grounding of stator winding. Confirm whether conduction exists between the winding and stator iron core, if yes, replace the stator assembly.

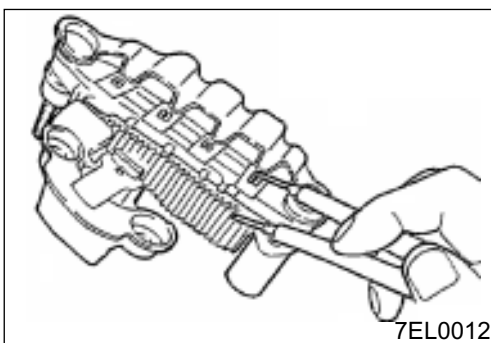


7EL0011

### RECTIFIER

- (1) Check the positive rectifier

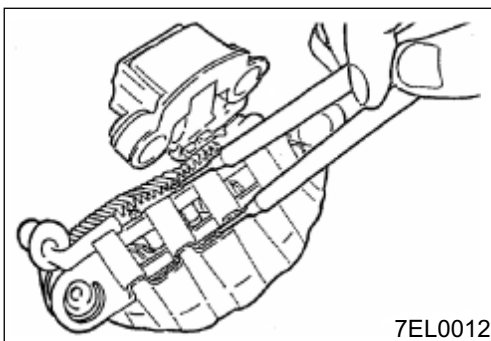
Check whether conduction exists between the positive rectifier and the wiring terminals of stator windings with a multimeter. If conduction exists in two direction, the diode is breakdown, the rectifier assembly should be replaced.



7EL0012

- (2) Check the negative rectifier

Check whether conduction exists between the negative rectifier and the wiring terminals of stator windings. If conduction exists in two direction, the diode is breakdown, the rectifier assembly should be replaced.

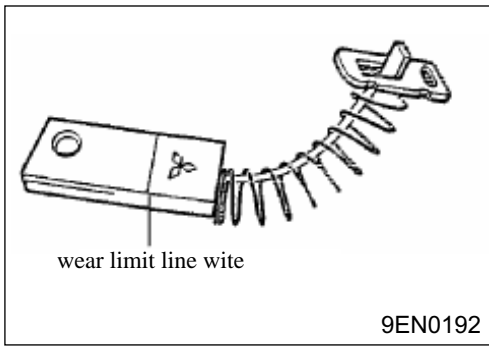


7EL0012

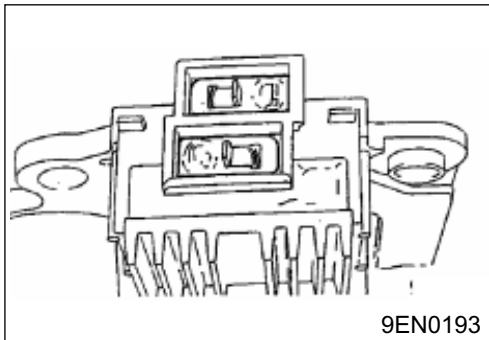
- (3) Check diodes group (3 diodes)

Connect the two ends of the diode to the ammeter, check whether these three diodes are switched into conduction.

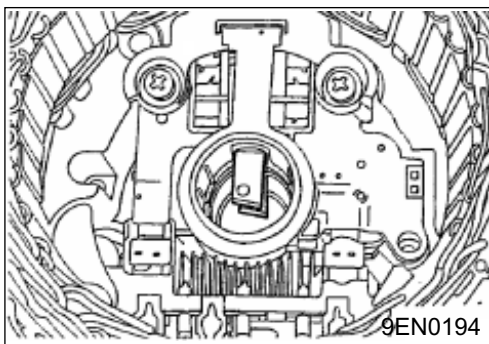
If conduction doesn't exist bidirectionally, the diodes are damaged, and the radiator assembly should be replaced.

**BRUSH**

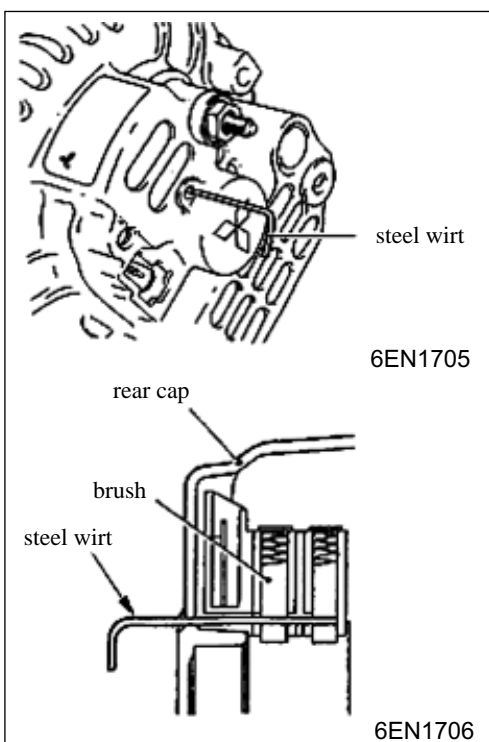
- (1) If the brush is worn out to the wear limit line, replace brush by taking the following steps:



- (2) The brush may be taken off by burning off the soldering joint of the brush lead-wire.



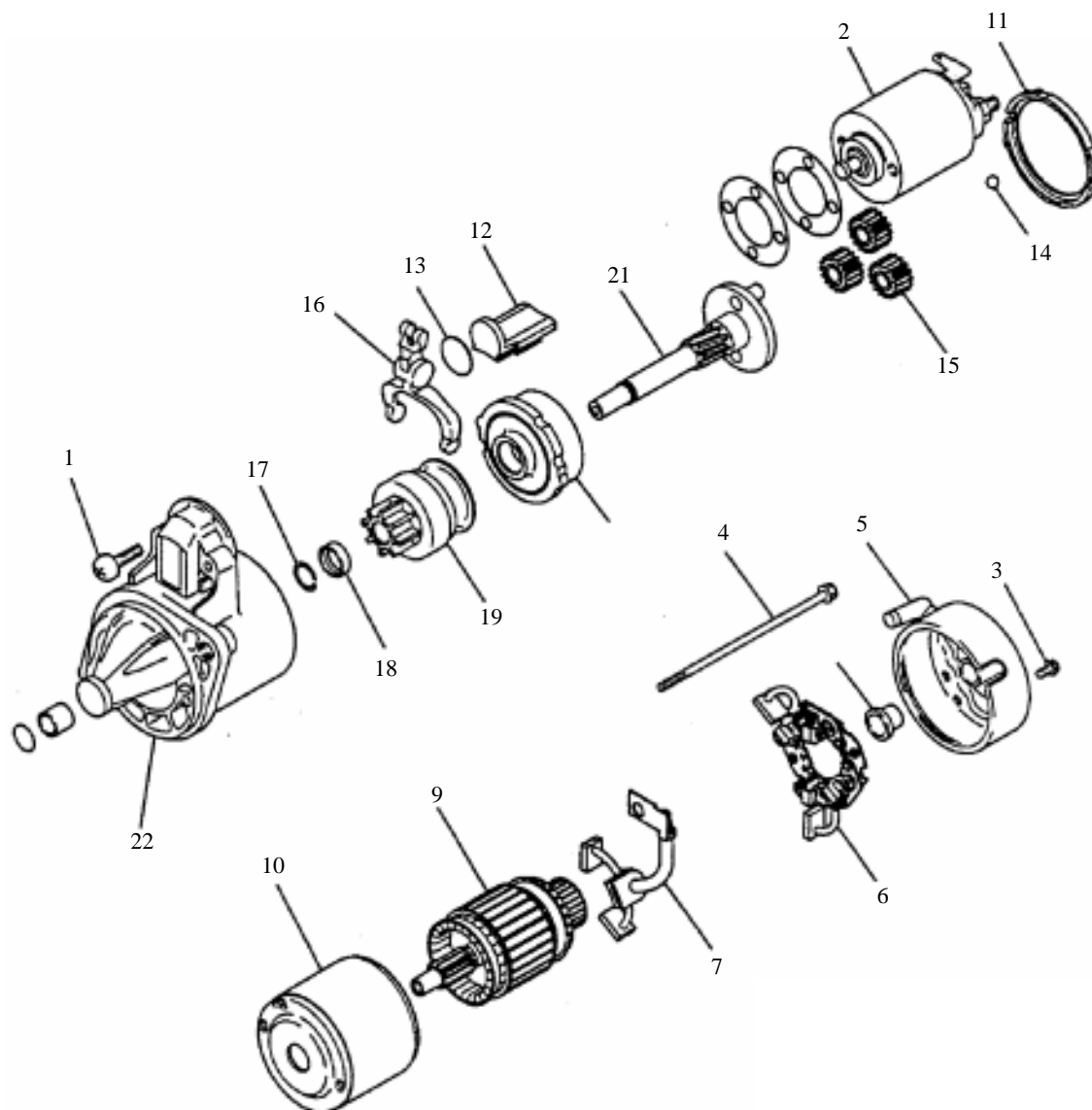
- (3) While mounting new brush, you should burn on the brush lead-wire with the brush being pressed into the brush holder.

**NOTES FOR ASSEMBLY****■ A ■ MOUNTING OF ROTOR**

- (1) Before mounting the rotor onto the rear cap, insert a steel wire into the small hole on the rear cap to lift the mounted rotor, and then pull out the steel wire.

# STARTER

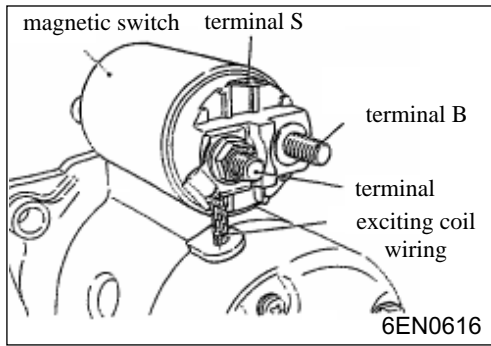
## DISASS0.EMBL Y AND ASSEMBLY



6EN1412

### Disassembly Process

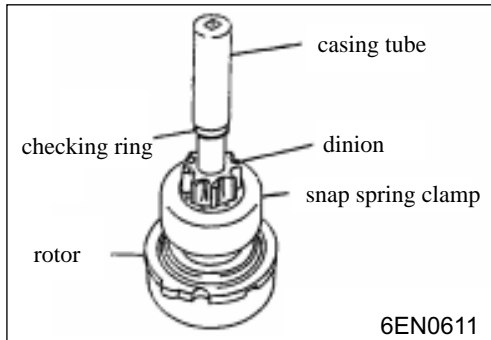
- |                     |                            |
|---------------------|----------------------------|
| 1. bolt             | 12. washer B               |
| ⊠A⊠ 2. magnet valve | 13. plate                  |
| 3. bolt             | ⊠B⊠ 14. ball               |
| 4. bolt             | 15. planetary gear         |
| 5. rear carrier     | 16. rod                    |
| 6. brush holder     | ⊠C⊠ ⊠A⊠ 17. snap spring    |
| 7. brush            | ⊠C⊠ ⊠A⊠ 18. checking ring  |
| 8. rear bearing     | 19. free engine clutch     |
| ⊠B⊠ 9. rotor        | 20. inner gear             |
| 10. yoke assembly   | 21. planetary gear carrier |
| 11. washer A        | 22. front carrier          |



## ESSENTIALS FOR DISASSEMBLY

### ◇A◇ DISASSEMBLY OF MAGNET VALVE

- (1) Knock down exciting coil from terminal M of the magnet valve.

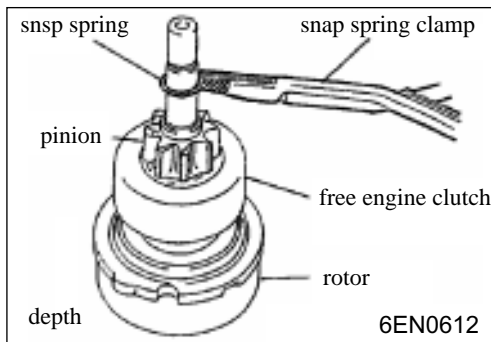


### ◇B◇ DISASSEMBLY OF ROTOR AND BALL

- (1) Do not drop the ball mounted on the end of bearing while disassemble the rotor.

### ◇C◇ DISASSEMBLY OF SNAP SPRING AND CHECKING RING

- (1) Push and press the checking ring to the free engine clutch with a proper casing tube to separate it from the snap spring.



- (2) Dismantle the snap spring with a snap spring clamp first, then disassemble the checking ring and free engine clutch.

## CLEANING OF STARTER COMPONENTS

- (1) Don't clean the components in detergent. Immerging the yoke and exciting coil assembly or rotor into detergent may damage their insulation property.
- (2) When these components are contaminated, use a piece of cloth to clean them.
- (3) The driving parts may neither be immersed into detergent. Because free engine clutches have been lubricated before leaving factory, if you clean them in detergent, the lubricant inside the clutch may be washed off.
- (4) The driving part should be cleaned with a brush dipped with detergent, and towed off with cloth.

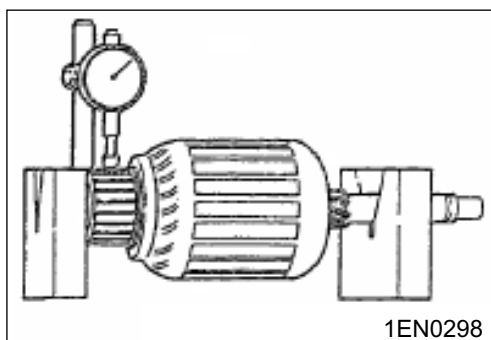
## CHECK

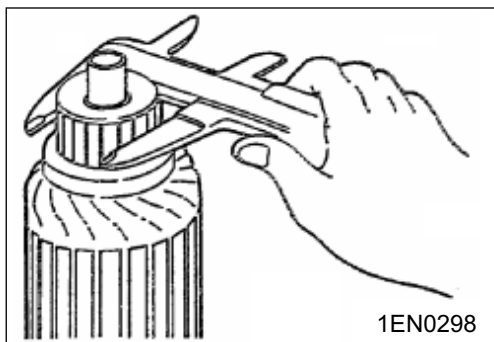
### COMMUTATOR

- (1) Put the rotor on a pair of V-blocks, check its radial jumping with a dial gage.

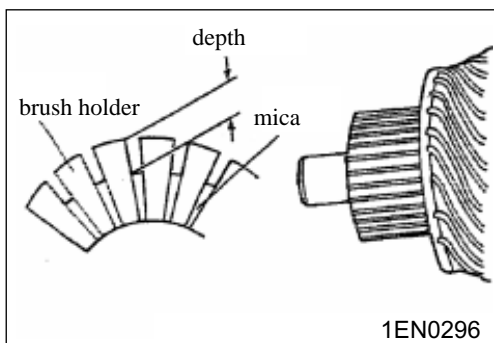
Standard value: 0.5mm

Limit value: 0.1mm

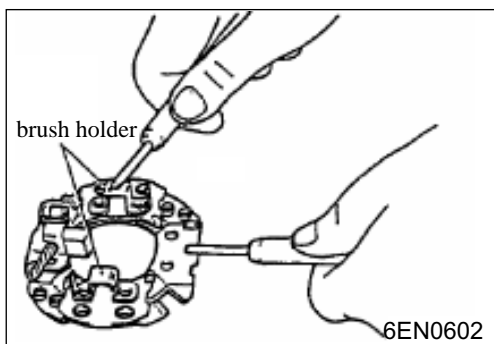




- (2) Check the outside diameter of the . commutator  
 Standard value: 29.4mm  
 Limit value: 28.4mm

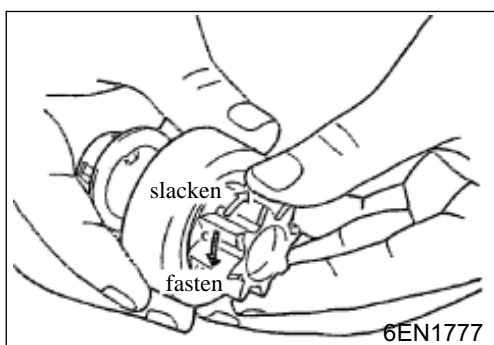


- (3) Check the drop depth of mica between commutator separators.  
 Standard value: 0.5mm  
 Limit value: 0.2mm



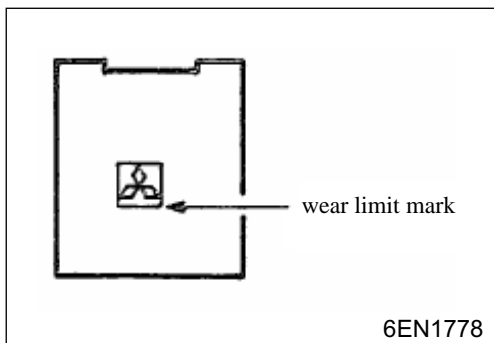
#### BRUSH HOLDER

- (1) Check whether conduction exists between brush holder plate and brush holder, if not, it is normal.



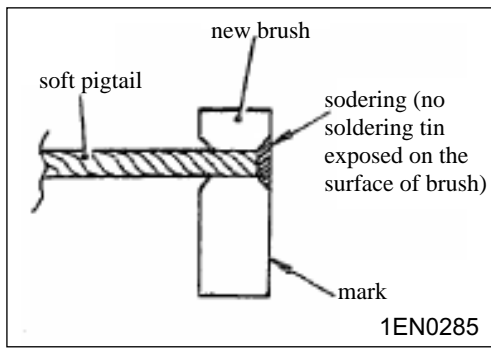
#### FREE ENGINE CLUTCH

- (1) Confirm that the pinion is resisted when rotating to the left while smoothly rotated when turning right.  
 (2) Check the wearing and damages of the pinion.

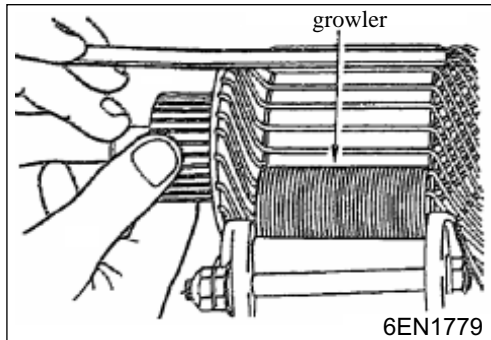


#### BRUSH

- (1) Check the roughness of the contact surface of brush and commutator and the length of brush.  
 Limit value: Wear limit mark  
 (2) While rectifying the contact surface or changing new brush, you may wrap a piece of sand paper around the commutator.



- (3) While crumbing worn battery with a plier, be careful not to damage the soft pigtail.
- (4) In order to make soldering tin easy to be adhered, scrape the soft pigtail end with a piece of sand paper.
- (5) Insert soft pigtail into the new brush hole and burn it on and be sure no soldering tin exposed on the surface of brush.

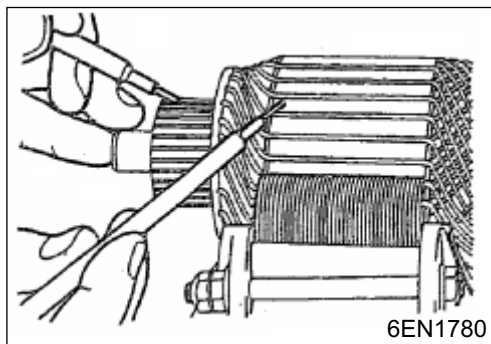


#### DETECT SHORT CIRCUIT OF ROTOR WINDING

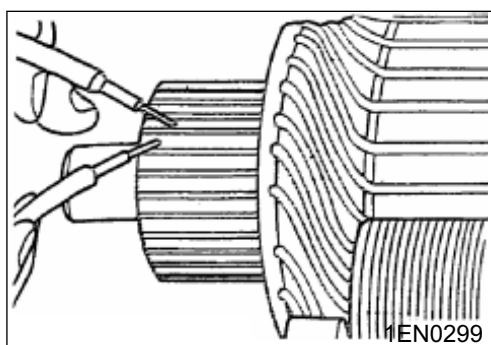
- (1) Put the rotor onto the growler.
- (2) Place the tagger above the rotor and keep it parallel to the central axis of the rotor, slowly rotate the rotor and observe the tagger. If it is not magnetized and doesn't vibrate, the rotor is normal.

#### NOTES:

- CONDUCTING DETECTION AFTER COMPLETELY CLEANING THE SURFACE OF ROTOR.

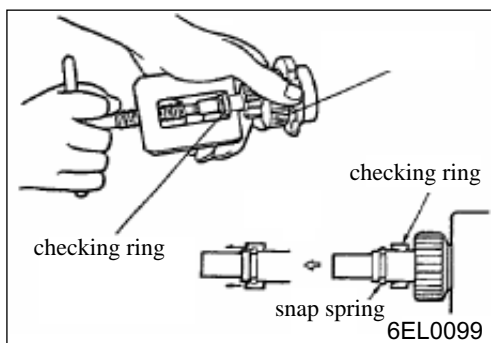


- (3) Check the insulation between commutator separators and the iron core of rotor. If conduction fails, it's normal.



#### DETECT OPEN CIRCUIT OF WROTOR INDING

- (1) Check whether conduction exists between all commutator segment, if yes, its normal.

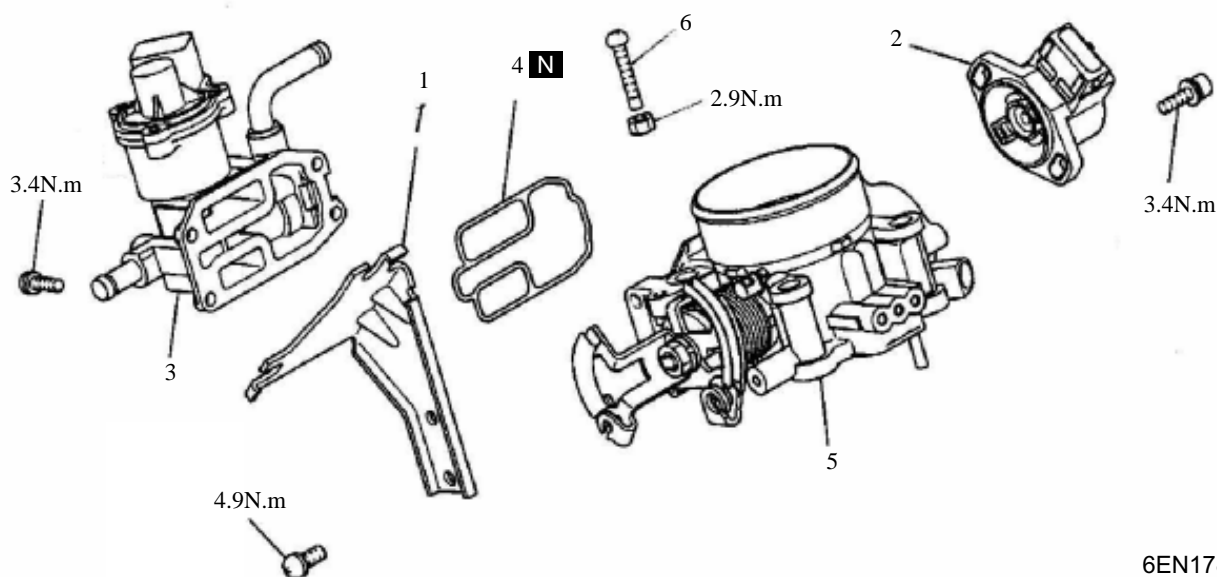


#### NOTES FOR ASSEMBLY

- ◆ A ◆ MOUNTING OF CHECKING RING AND SNAP SPRING

- (1) Use a proper tool to pull the checking ring from across the snap spring towards it.

## THROTTLE BODY DISASSEMBLY AND ASSEMBLY



6EN1782

### Disassembly Procedure

1. holder
2. throttle position transducer
3. idle air valve
4. o-ring
5. throttle body
6. SAS speed adjusting screw SAS

### Remarks

1. SAS has been adjusted before leaving factory, so no adjustment is needed.
2. In case the fixed SAS is dismantled by chance, the speed adjusting screw of throttle should be fixed up again.
3. In case the throttle speed adjusting screw is dismantled by chance, it should be readjusted.

## CLEANING OF THROTTLE BODY COMPONENTS

1. Clean all throttle body components.

Don't use detergent to clean the following components:

- Throttle position transducer
- Idle speed control body assembly

If these components are immersed into detergent, their insulation property will be damaged.

Only cloth may be used to clean them.

2. Check whether the vacuum port or passage is jammed. Clean the vacuum passage with compressed air.



improving little by little everyday

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Version number: 06-06-01/01