
ENGINE 6G7 SERIES

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NOTES

GENERAL INFORMATION**GENERAL SPECIFICATIONS**

| | | | |
|---|---------------|-------------------------------------|-----|
| Descriptions | | 6G72-SOHC | |
| Type | | 60° OHV, SOHC | |
| Number of cylinders | | 6 | |
| Combustion chamber | | Compact type | |
| Total displacement dm ³ | | 2.972 | |
| Cylinder bore mm | | 91.1 | |
| Piston stroke mm | | 76.0 | |
| Compression ratio | | 8.9 | |
| Valve timing (Camshaft identification mark: 1) | Intake valve | Opens (BTDC) | 15° |
| | | Closes (ABDC) | 53° |
| | Exhaust valve | Opens (BBDC) | 53° |
| | | Closes (ATDC) | 15° |
| Lubrication system | | Pressure feed, full-flow filtration | |
| Oil pump type | | Trochoid type | |
| Cooling system | | Water-cooled forced circulation | |
| Water pump type | | Centrifugal impeller type | |

1. SPECIFICATIONS

SERVICE SPECIFICATIONS

| Items | | Standard | Limit |
|--|---------|----------------|------------|
| Timing belt | | | |
| Auto-tensioner rod length mm | | 3.8 - 5.0 | - |
| Auto-tensioner rod projection length mm | | 12 | - |
| Auto-tensioner rod pushed-in amount (when pushed with a force of 98 - 196 N) mm | | 1.0 or less | - |
| Rocker arms and camshaft | | | |
| Camshaft cam height mm (Identification mark: 1) | Intake | 37.71 | 37.21 |
| | Exhaust | 37.14 | 36.64 |
| Camshaft journal outside diameter mm | | 45 | - |
| Lash adjuster leak down time [diesel fuel at 15 - 20°C] seconds/mm | | 4 - 20/1.0 | - |
| Cylinder head and valves | | | |
| Cylinder head flatness of gasket surface mm | | Less than 0.03 | 0.2 |
| Cylinder head grinding limit of gasket surface mm (Total resurfacing depth of both cylinder head and cylinder block) | | - | 0.2 |
| Cylinder head overall height mm | | 120 | - |
| Valve thickness of valve head (margin) mm | Intake | 1.0 | 0.5 |
| | Exhaust | 1.2 | 0.7 |
| Valve overall height mm | Intake | 112.30 | 111.80 |
| | Exhaust | 114.11 | 113.61 |
| Valve stem outside diameter mm | Intake | 6.0 | - |
| | Exhaust | 6.0 | - |
| Valve thickness to valve guide clearance mm | Intake | 0.02 - 0.04 | 0.10 |
| | Exhaust | 0.04 - 0.06 | 0.15 |
| Valve face angle mm | | 45° - 45.5° | - |
| Valve spring free length mm | | 51.0 | 50.0 |
| Valve spring load/installed height N/mm | | 267/44.2 | - |
| Valve spring out-of-squareness | | 2° or less | Maximum 4° |
| Valve seat valve contact width mm | | 0.9 - 1.3 | - |
| Valve guide inside diameter mm | | 6.0 | - |
| Valve guide projection from cylinder head upper surface mm | | 14 | - |
| Valve stem projection mm | | 49.3 | 49.8 |
| Oil pan and oil pump | | | |
| Oil pump tip clearance mm | | 0.06 - 0.18 | - |

| Items | | Standard | Limit |
|--|--------------------|----------------|-------|
| Oil pump side clearance mm | | 0.04 - 0.10 | - |
| Oil pump body clearance mm | | 0.10 - 0.18 | 0.35 |
| Piston and connecting rod | | | |
| Piston outside diameter mm | | 91.1 | - |
| Piston ring to ring groove clearance mm | No. 1 | 0.03 - 0.07 | 0.1 |
| | No. 2 | 0.02 - 0.06 | 0.1 |
| Piston ring end gap mm | No. 1 | 0.30 - 0.45 | 0.8 |
| | No. 2 | 0.45 - 0.60 | 0.8 |
| | Oil ring side rail | 0.20 - 0.60 | 1.0 |
| Piston pin outside diameter mm | | 22.0 | - |
| Piston pin press-in load N (Room temperature) | | 7,350 - 17,200 | - |
| Crankshaft pin oil clearance mm | | 0.02 - 0.05 | 0.1 |
| Connecting rod big end side clearance mm | | 0.10 - 0.25 | 0.4 |
| Crankshaft, flywheel and drive plate | | | |
| Crankshaft end play mm | | 0.05 - 0.25 | 0.3 |
| Crankshaft journal outside diameter mm | | 60 | - |
| Crankshaft pin outside diameter mm | | 50 | - |
| Crankshaft journal oil clearance mm | | 0.02 - 0.05 | 0.1 |
| Piston to cylinder clearance mm | | 0.02 - 0.04 | - |
| Cylinder block flatness of gasket surface mm | | 0.05 | 0.1 |
| Cylinder block grinding limit of gasket surface mm (Total resurfacing depth of both cylinder head and cylinder block) | | - | 0.2 |
| Cylinder block overall height mm | | 210.5 | - |
| Cylinder bore inside diameter mm | | 91.1 | - |
| Cylindricity mm | | 0.01 | - |

REWORK DIMENSIONS

| Items | | Standard value | Limit |
|--|------------------------|----------------|-------|
| Oversize rework dimensions of valve guide hole mm | 0.05 Oversize diameter | 11.05 - 11.07 | - |
| | 0.25 Oversize diameter | 11.25 - 11.27 | - |
| | 0.50 Oversize diameter | 11.50 - 11.52 | - |
| Oversize rework dimensions of intake valve seat hole mm | 0.3 Oversize diameter | 34.30 - 34.33 | - |
| | 0.6 Oversize diameter | 34.60 - 34.63 | - |
| Oversize rework dimensions of exhaust valve seat hole mm | 0.3 Oversize diameter | 31.80 - 31.83 | - |
| | 0.6 Oversize diameter | 32.10 - 32.13 | - |

TORQUE SPECIFICATIONS

| Items | Nm |
|--|-----|
| Alternator | |
| Drive belt tensioner pulley nut | 49 |
| Crankshaft bolt | 181 |
| Alternator pivot nut | 44 |
| Alternator bolt M8 | 21 |
| Alternator bolt M10 | 48 |
| Dipstick tube | 13 |
| Air intake plenum | |
| Air intake plenum stay bolt M8 | 17 |
| Air intake plenum stay bolt M10 | 35 |
| Accelerator cable bracket | 4 |
| Bracket | 11 |
| Throttle body bolt | 11 |
| Air intake plenum bolt and nut | 17 |
| Exhaust gas recirculation valve bolt | 21 |
| Exhaust gas recirculation pipe bolt | 17 |
| Exhaust gas recirculation pipe flare nut | 56 |
| Ignition system | |
| Spark plugs | 25 |
| Distributor | 23 |
| Timing belt | |
| Timing belt cover bolt M6 | 11 |
| Timing belt cover bolt M8 | 13 |
| Engine support bracket | 44 |
| Crankshaft angle sensor bolt | 9 |
| Auto tensioner bolt | 23 |
| Tensioner pulley bolt | 48 |
| Tensioner arm bolt | 44 |
| Idler pulley bolt | 44 |
| Camshaft sprocket bolt | 88 |
| Bracket | 23 |
| Timing belt rear cover bolt | 13 |

| Items | Nm |
|---------------------------------------|-----|
| Intake manifold | |
| Engine coolant temperature gauge unit | 11 |
| Engine coolant temperature sensor | 29 |
| Heater pipe bolt | 18 |
| Water outlet fitting bolt | 18 |
| Water inlet fitting bolt | 18 |
| Thermostat housing bolt | 18 |
| Water pipe bolt | 13 |
| Delivery pipe | 11 |
| Intake manifold bolt | 21 |
| Fuel pipe bolt | 8.8 |
| Fuel pressure regulator bolt | 8.8 |
| Exhaust manifold | |
| Heat protector bolt | 13 |
| Exhaust manifold bolt | 49 |
| Engine hanger | 35 |
| Oil level gauge guide bolt | 13 |
| Water pump bolt M8 | 23 |
| Water pump bolt M10 | 41 |
| Rocker arms and camshaft | |
| Rocker cover bolt | 3.4 |
| Rocker shaft bolt | 31 |
| Thrust case bolt | 12 |
| Cylinder head and valve | |
| Cylinder head bolt | 108 |
| Oil pan and oil pump | |
| Oil pressure switch | 9.8 |
| Oil filter bracket bolt M8 | 23 |
| Oil filter bracket bolt M10 | 41 |
| Drain plug | 39 |
| Oil pan, lower bolt | 11 |
| Cover bolt | 11 |

| | |
|---|-----|
| Items | Nm |
| Oil pan, upper bolt | 5.9 |
| Baffle plate bolt (oil pan side) | 11 |
| Baffle plate bolt (cylinder block side) | 9.8 |
| Oil screen bolt | 18 |
| Relief plug | 44 |
| Oil pump case bolt | 13 |
| Oil pump cover bolt | 9.8 |
| Piston and connecting rod | |
| Connecting rod cap | 51 |
| Crankshaft, flywheel and drive plate | |
| Flywheel bolt | 74 |
| Drive plate bolt | 74 |
| Rear plate bolt | 11 |
| Oil seal case bolt | 11 |
| Bearing cap bolt | 93 |

SEALANTS

| Description | Specified sealant | Quantity |
|---------------------------------------|--------------------------------------|-------------|
| Engine coolant temperature gauge unit | 3M ATD Part No. 8660 | As required |
| Engine coolant temperature sensor | 3M Nut Locking Part No. 4171 | As required |
| Oil pressure switch | 3M ATD Part No. 8660 | As required |
| Oil pan | MITSUBISHI GENUINE Part No. MD970389 | As required |
| Oil pump case | MITSUBISHI GENUINE Part No. MD970389 | As required |
| Oil seal case | MITSUBISHI GENUINE Part No. MD970389 | As required |

FORM-IN-PLACE GASKET

The engine has several areas where the form-in-place gasket (FIPG) is in use. To ensure that the gasket fully serves its purpose, it is necessary to observe some precautions when applying the gasket. Bead size, continuity and location are of paramount importance. Too thin a bead could cause leaks. Too thick a bead, on the other hand, could be squeezed out of location, causing blocking or narrowing of the fluid feed line. To eliminate the possibility of leaks from a joint, therefore, it is absolutely necessary to apply the gasket evenly without a break, while observing the correct bead size.

The FIPG used in the engine is a room temperature vulcanisation (RTV) type and is supplied in a 100-gram tube (Part No. MD970389 or MD997110). Since the RTV hardens as it reacts with the moisture in the atmospheric air, it is normally used in the metallic flange areas. The FIPG, Part No. MD970389, can be used for sealing both engine oil and coolant, while Part No. MD997110 can only be used for engine oil sealing.

Disassembly

The parts assembled with the FIPG can be easily disassembled without use of a special method. In some cases, however, the sealant between the joined surfaces may have to be broken by lightly striking with a mallet or similar tool. A flat and thin gasket scraper may be lightly hammered in between the joined surfaces. In this case, however, care must be taken to prevent damage to the joined surfaces.

Surface Preparation

Thoroughly remove all substances deposited on the gasket application surfaces, using a gasket scraper or wire brush. Check to ensure that the surfaces to which the FIPG is to be applied is flat. Make sure that there are no oils, greases and foreign substances deposited on the application surfaces. Do not forget to remove the old sealant remaining in the bolt holes.


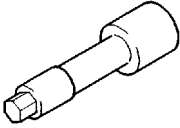
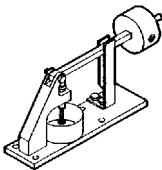

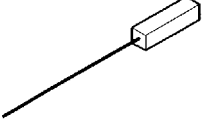
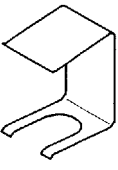
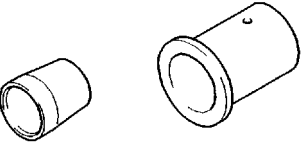
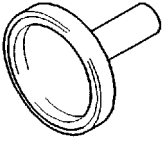
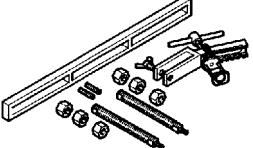
Form-in-Place Gasket Application (FIPG)

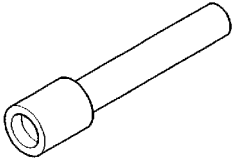
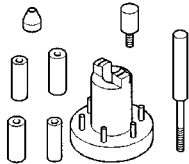
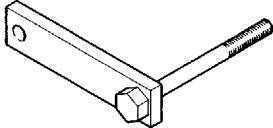
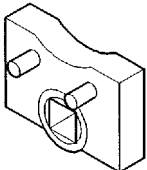
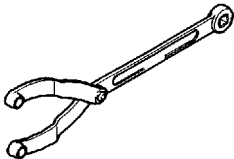
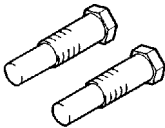
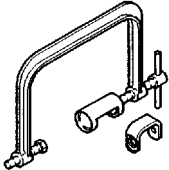

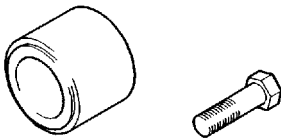
When assembling parts with the FIPG, you must observe some precautions, but the procedure is very simple as in the case of a conventional pre-cut gasket.

Applied FIPG bead should be of the specified size and without breaks. Also be sure to encircle the bolt hole circumference with a completely continuous bead. The FIPG can be wiped away unless it is hardened. While the FIPG is still moist (in less than 15 minutes), mount the parts in position. When the parts are mounted, make sure that the gasket is applied to the required area only.

The FIPG application procedure may vary on different areas. Observe the procedure described in the text when applying the FIPG.

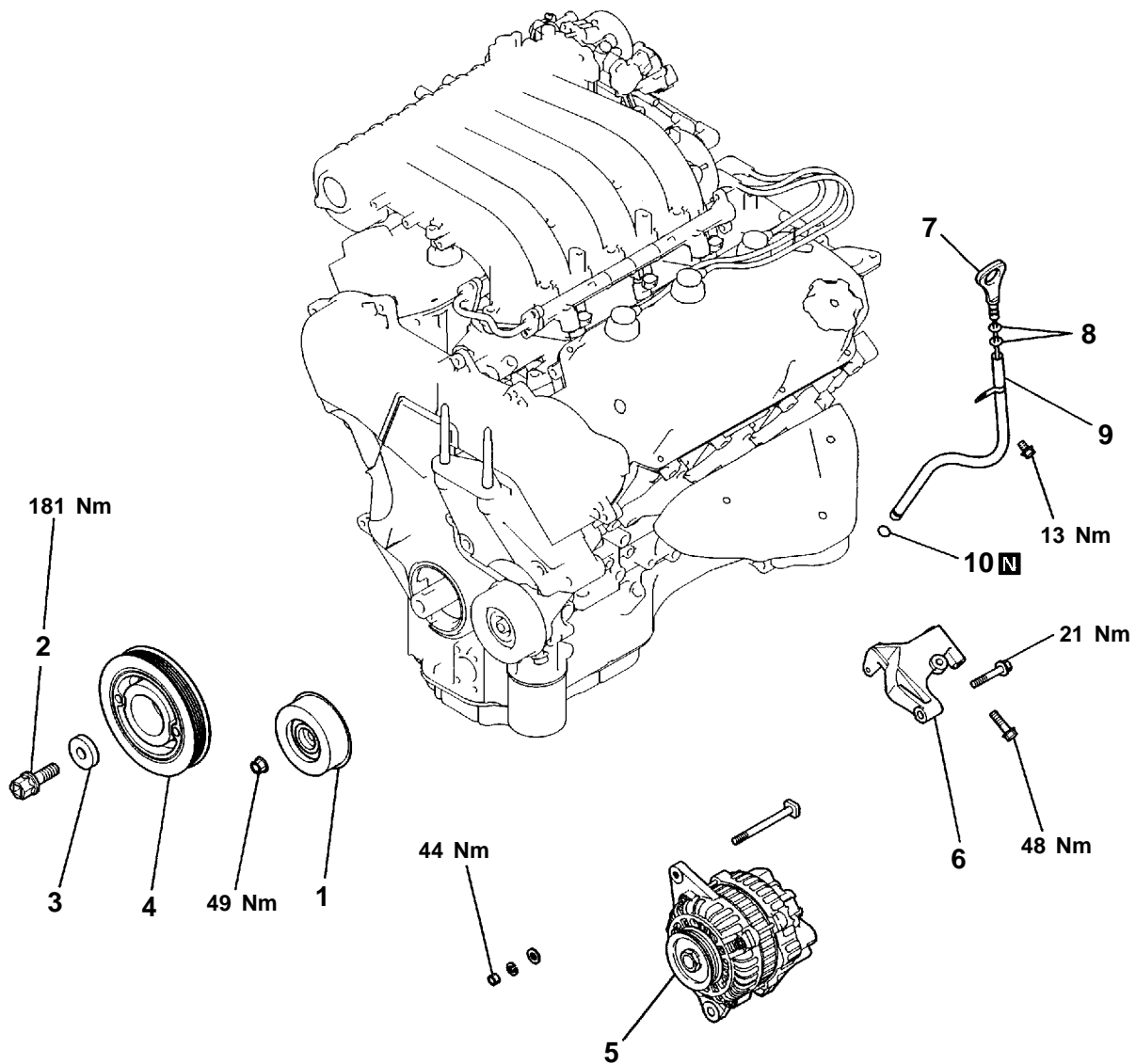
2. SPECIAL TOOLS

| Tool | Number | Name | Use |
|---|----------|-------------------------------------|--|
|  | MB991559 | Camshaft oil seal installer adaptor | Installation of camshaft oil seal (on left bank) (Used in combination with MD998713) |
|  | MD998051 | Cylinder head bolt wrench | Loosening and tightening of cylinder head bolt |
|  | MD998440 | Leak-down tester | Leak-down test of lash adjuster |
|  | MD998441 | Lash adjuster | Air bleeding of lash adjuster retainer |
|  | MD998442 | Air bleed wire | Air bleeding of lash adjuster |
|  | MD998443 | Auto-lash adjuster holder | Holding of the lash adjuster to prevent it from falling when rocker shaft assembly is removed or installed |
|  | MD998717 | Crankshaft front oil seal | Installation of crankshaft front oil seal installer |
|  | MD998718 | Crankshaft rear oil seal installer | Press fitting crankshaft rear oil |
|  | MD998772 | Valve spring compressor | Compressing of the valve springs |

| Tool | Number | Name | Use |
|---|----------|---------------------------------|--|
|  | MD998774 | Valve stem seal installer | Installation of valve stem seal |
|  | MD998780 | Piston pin setting tool | Removal and installation of piston pin |
|  | MD998781 | Flywheel stopper | Holding flywheel or drive plate |
|  | MD998767 | Tensioner pulley | Adjustment of timing belt tension |
|  | MB990767 | End yoke holder | Holding camshaft sprocket (Used in combination with MD998715) |
|  | MD998715 | Pulley holder pin | Holding camshaft sprocket (Used in combination with MB990767) |
|  | MD998735 | Valve spring compressor adaptor | Compressing the valve springs |
|  | MD998769 | Crank pulley spacer | Cranking the crankshaft to install timing belt |
|  | MD998713 | Camshaft oil seal installer | Installation of camshaft oil seal |

3. ALTERNATOR

REMOVAL AND INSTALLATION



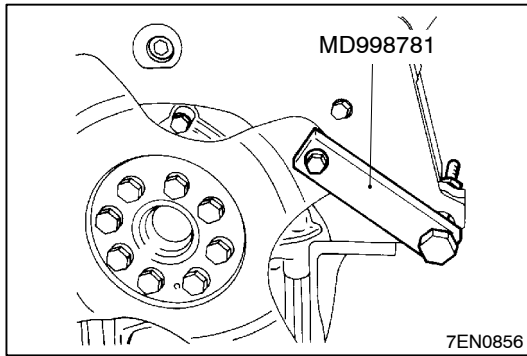
7EN1030

Removal steps



1. Tensioner pulley
2. Crankshaft bolt
3. Washer
4. Crankshaft pulley
5. Alternator

6. Alternator bracket
7. Dip stick
8. O-ring
9. Dip stick tube
10. O-ring



REMOVAL SERVICE POINTS

◀A▶ CRANKSHAFT BOLT

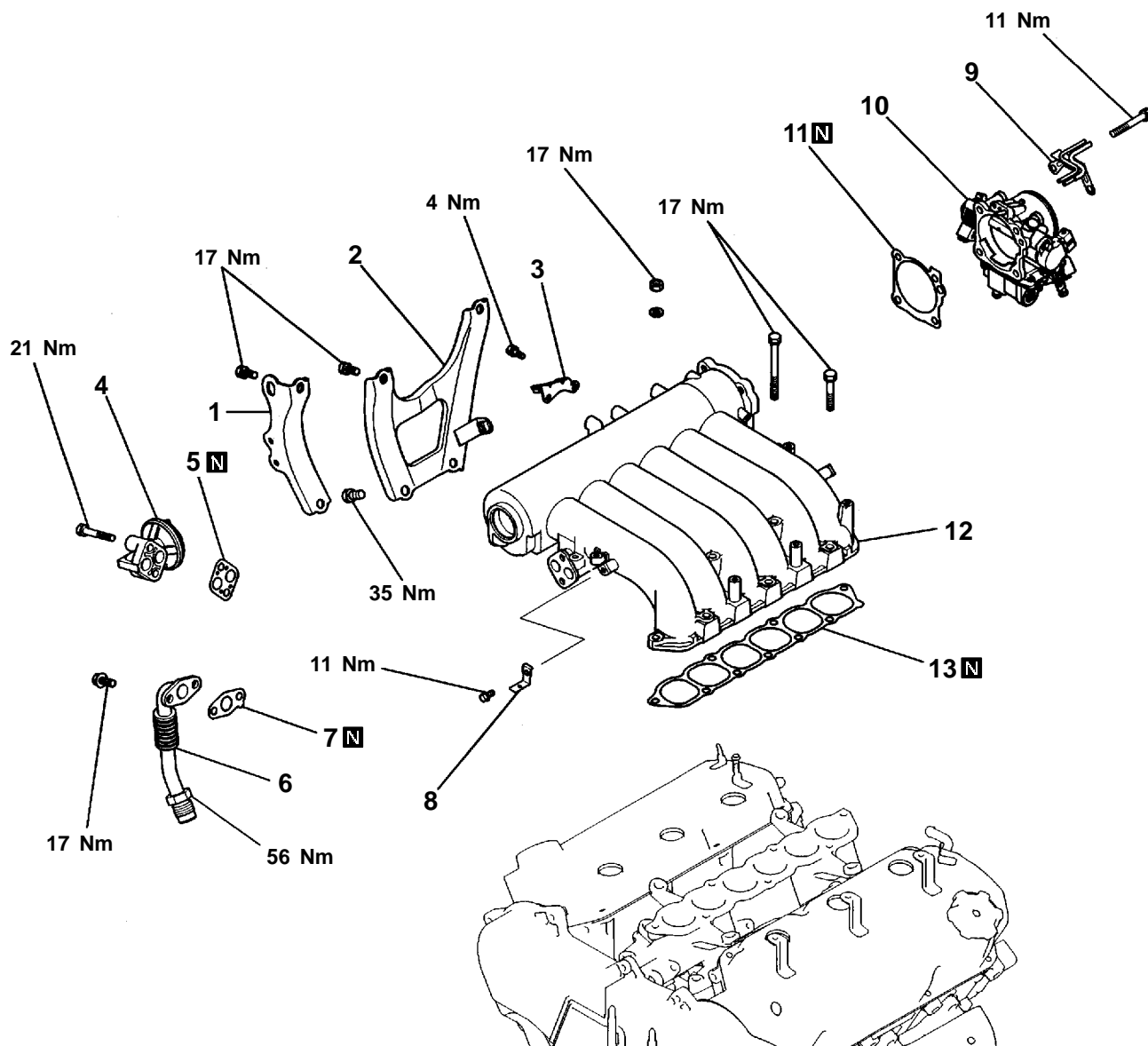
- (1) With the Special Tool fixed to the drive plate or flywheel remove the crankshaft bolt.

INSTALLATION SERVICE POINTS

▶A◀ CRANKSHAFT BOLT

- (1) With the Special Tool fixed to the drive plate or flywheel install the crankshaft bolt.

4. AIR INTAKE PLENUM REMOVAL AND INSTALLATION

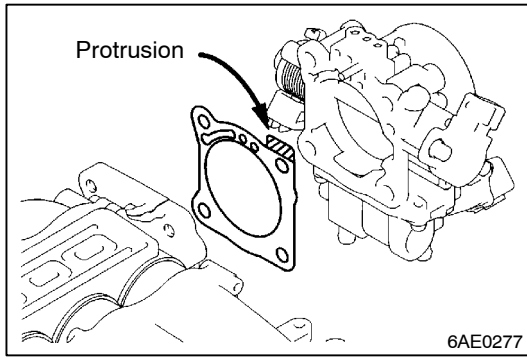


7EN1031

Removal steps

1. Air intake plenum stay, front
2. Air intake plenum stay, rear
3. Accelerator cable bracket
4. EGR valve
5. EGR valve gasket
6. EGR pipe
7. EGR pipe gasket

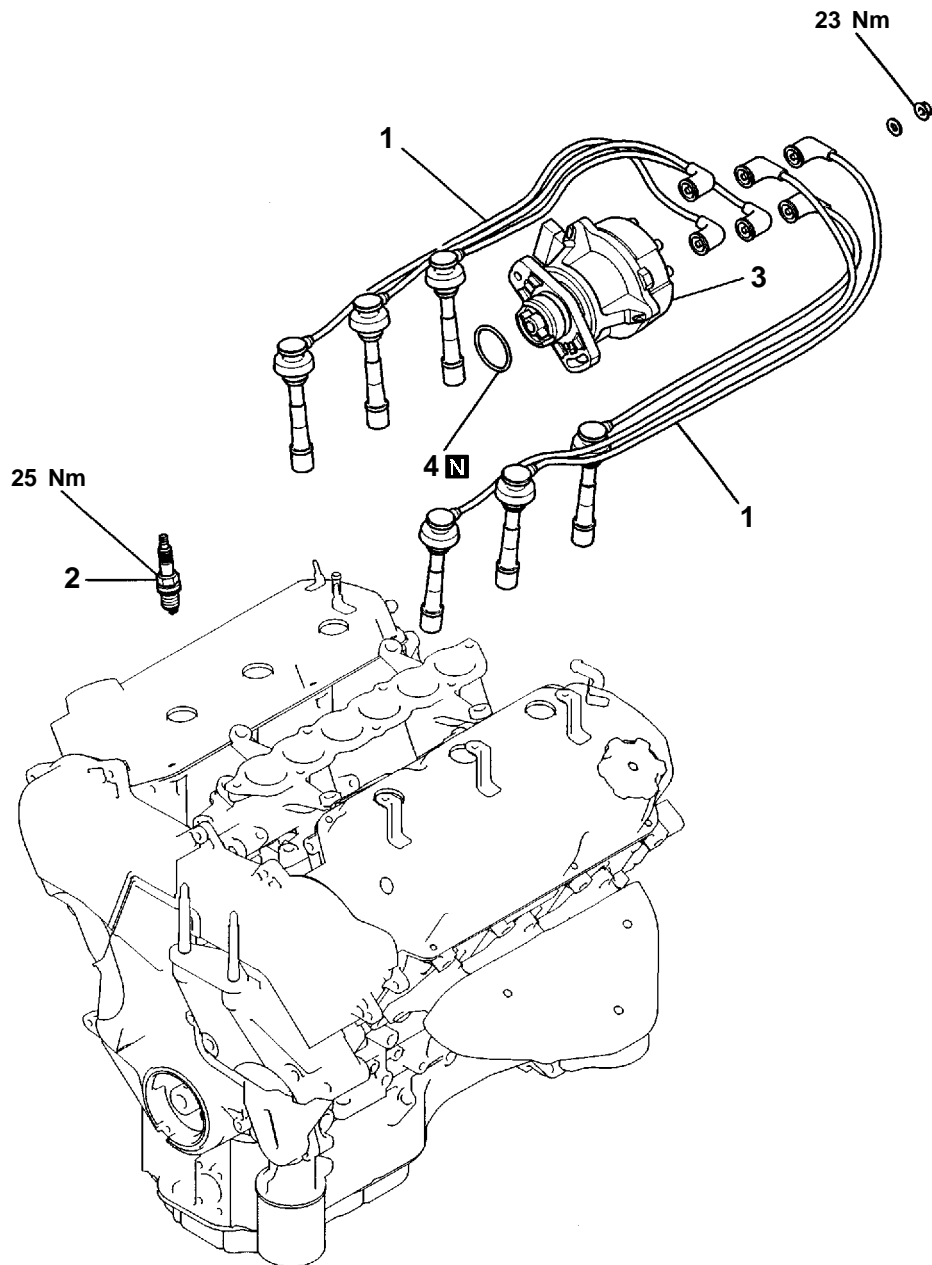
8. Connector bracket
9. Vacuum pipe
10. Throttle body
- ▶◀ 11. Throttle body gasket
12. Air intake plenum
13. Air intake plenum gasket

**INSTALLATION SERVICE POINTS****▶A◀ THROTTLE BODY GASKET**

(1) Install gasket with protrusion as illustrated.

5. IGNITION SYSTEM

REMOVAL AND INSTALLATION



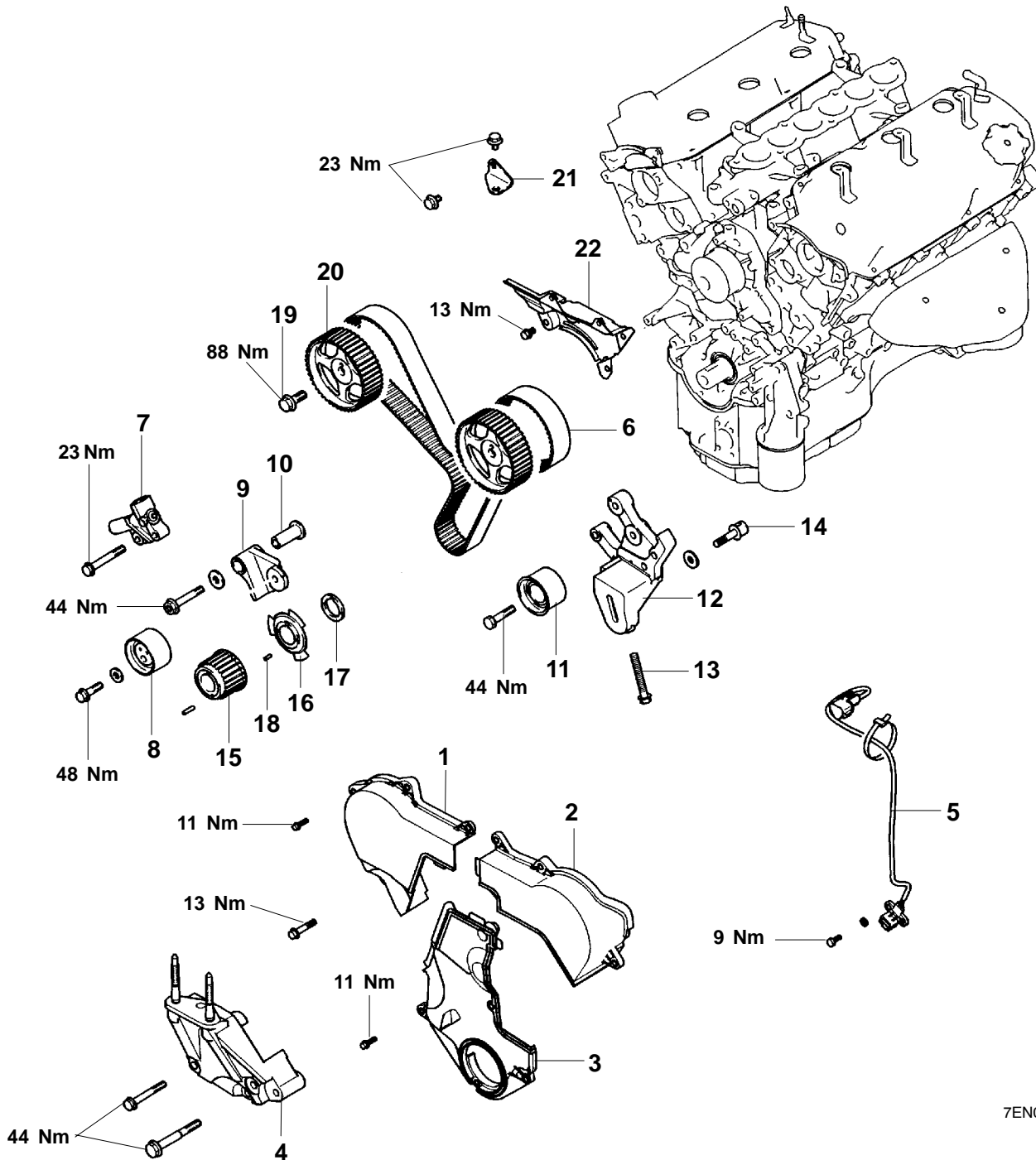
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Removal steps

1. Spark plug cable
2. Spark plug
3. Distributor
4. O-ring

6. TIMING BELT

REMOVAL AND INSTALLATION

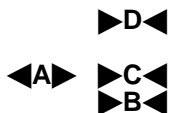


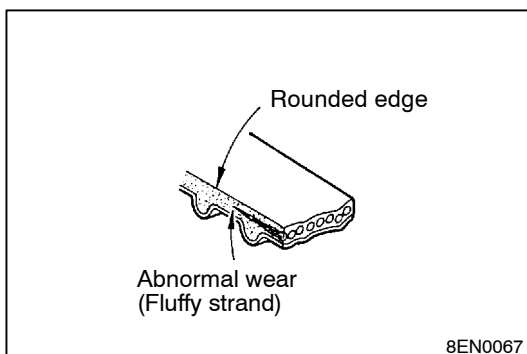
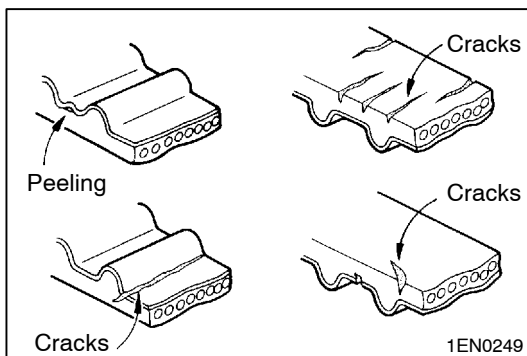
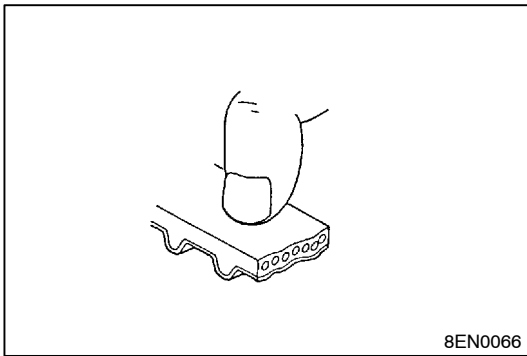
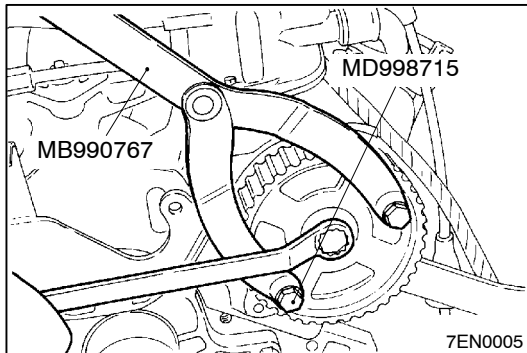
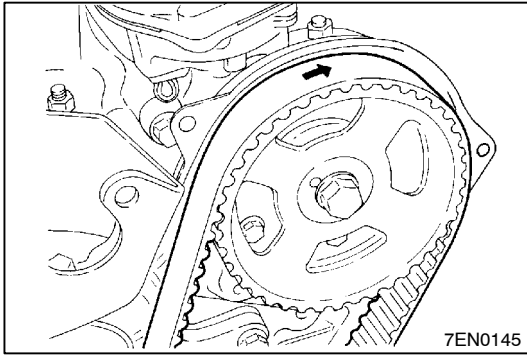
7EN0862

Removal steps

1. Timing belt front upper cover, rear
2. Timing belt front upper cover, front
3. Timing belt front lower cover
4. Engine support bracket
5. Crank angle sensor
6. Timing belt
7. Automatic tensioner
8. Tensioner pulley
9. Tensioner arm
10. Shaft
11. Idler pulley

12. Idler pulley adjusting bracket
13. Adjusting bolt
14. Adjusting stud
15. Crankshaft sprocket
16. Sensing blade
17. Crankshaft spacer
18. Crankshaft key
19. Camshaft sprocket bolt
20. Camshaft sprocket
21. Bracket
22. Timing belt rear cover





REMOVAL SERVICE POINTS

◀A▶ TIMING BELT

- (1) When the timing belt is to be reused, in order to allow re-installation of the belt so that it travels in the same direction as before it was removed, mark the direction of travel with an arrow before removing it.

Caution

- As water or oil on the belt can seriously reduce its usable life, ensure that the timing belt, sprocket, and tensioner stay clean and dry while removed, and never wash them. Parts that have become too dirty should be replaced.
- When any of the parts are oily, check to see whether there are any oil leaks in any of the oil seals or the camshaft oil seal on the front of the engine.

◀B▶ CAMSHAFT SPROCKET BOLT

- (1) Using the Special Tool, hold the camshaft sprocket.
- (2) Remove the camshaft sprocket bolt.

INSPECTION

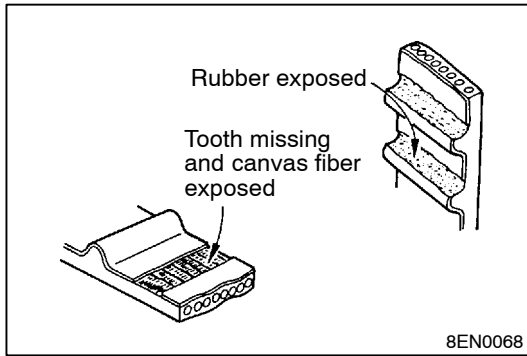
TIMING BELT

Check the belt in detail. If the following is evident, replace the belt.

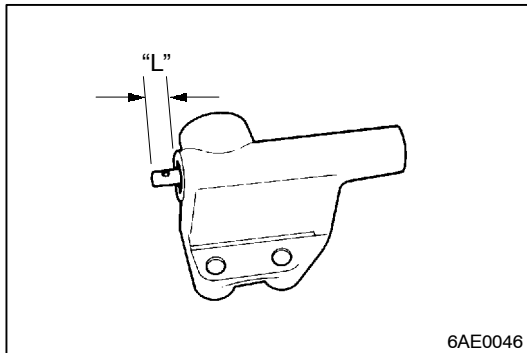
- (1) Hardened back surface rubber.
Back surface glossy, non-elastic and so hard that even if a finger nail is forced into it, no mark is produced.
- (2) Cracked back surface rubber.
- (3) Cracked or separated canvas.
- (4) Cracked tooth bottom.
- (5) Cracked side of belt.
- (6) Side of belt badly worn.

NOTE

Normal belt should have clear-cut sides as if cut with a sharp knife.



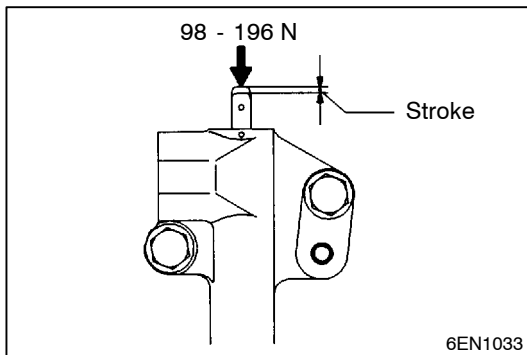
- (7) Badly worn teeth.
Initial stage:
Canvas is worn (fluffy canvas fibres are visible, rubber is gone and colour has changed to white. Canvas texture is not clear).
Last stage:
Canvas is worn out and rubber exposed and its width is reduced.
- (8) Missing tooth.



AUTO-TENSIONER

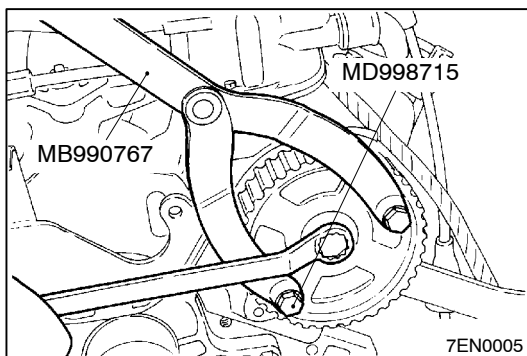
- (1) Check for oil leaks. If oil leaks are evident, replace the auto-tensioner.
- (2) Check the rod end for wear or damage and replace the auto-tensioner if necessary.
- (3) Measure the rod projection length "L". If the reading is outside the standard value, replace the auto-tensioner.

Standard value "L": 12 mm



- (4) Press the rod by a force of 98 to 196 N and measure the rod stroke. If the measured value exceeds the standard value, replace the tensioner.

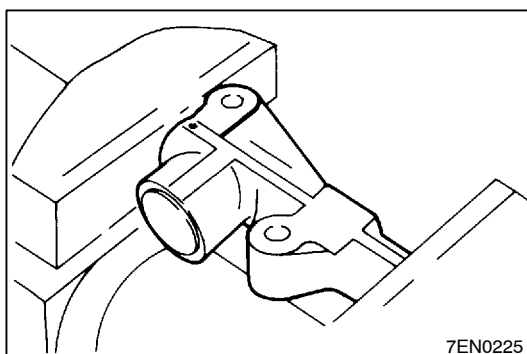
Standard value "L": 1 mm or less



INSTALLATION SERVICE POINTS

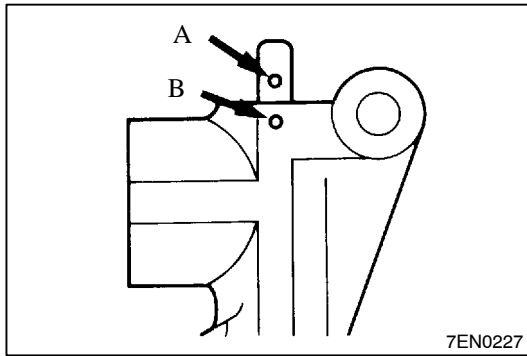
►A◄ CAMSHAFT SPROCKET BOLT

- (1) Using the Special Tool, hold the camshaft sprocket.
- (2) Torque the camshaft sprocket bolt to the specified torque.



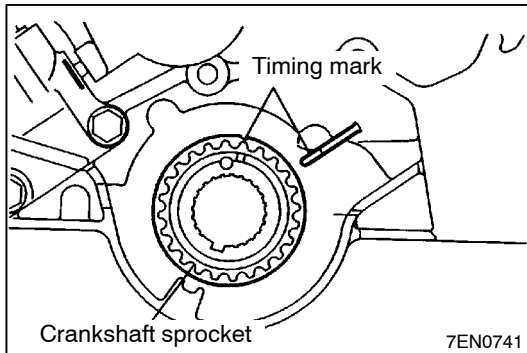
►B◄ AUTO-TENSIONER

- (1) If the auto-tensioner rod is fully extended, set it in the retracted position by the following procedure.
 - 1 Set the auto-tensioner in a vice, making sure it is not tilted.



- 2 Slowly close the vice to force the rod in until the set hole (A) of the rod is lined up with the set hole (B) of the cylinder.
- 3 Insert a metal wire (1.4 mm in diameter) into the set holes.
- 4 Remove the auto-tensioner from the vice.

- (2) Install the auto tensioner on the cylinder block through the oil pump case.

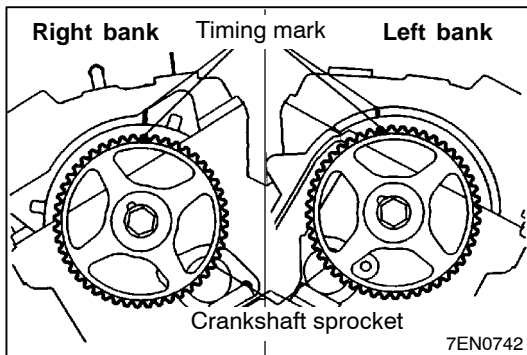


▶◀ TIMING BELT

- (1) Turn the crankshaft sprocket to position its timing mark 3 teeth away from the timing mark on the crankcase. (That is, slightly lower the No. 1 piston from the top dead centre on the compression stroke.)

Caution

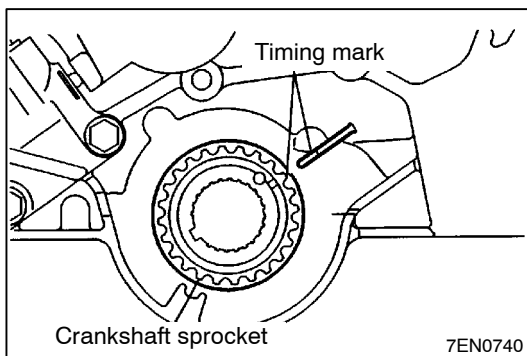
- If the camshaft sprocket is turned with the piston at the top dead centre on the compression stroke, valves may interfere with the piston.



- (2) Align the timing marks for the left bank camshaft sprocket.
- (3) Align the timing marks for the right bank camshaft sprocket.

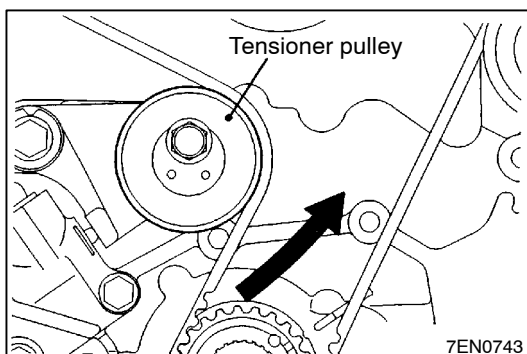
Caution

- The camshaft sprocket may turn un-intentionally due to the valve spring tension. Take care not to injure your fingers.

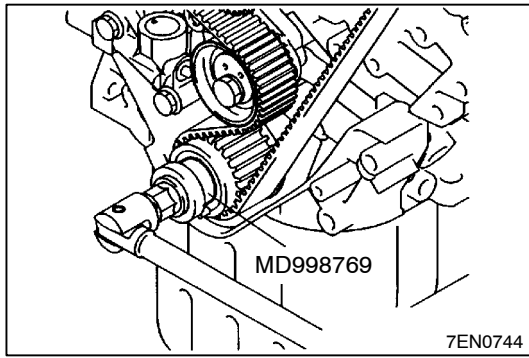


- (4) Align timing marks for the crankshaft sprocket.
- (5) Install the timing belt over the sprockets in the following sequence.

- 1 Place the timing belt over the crankshaft. While applying tension to the belt, set it over the idler pulley.
- 2 Place the belt over the left bank camshaft sprocket.
- 3 While applying tension to the belt, place it over the water pump pulley.
- 4 Place the belt over the right bank camshaft sprocket.
- 5 Place the belt over the tensioner pulley.



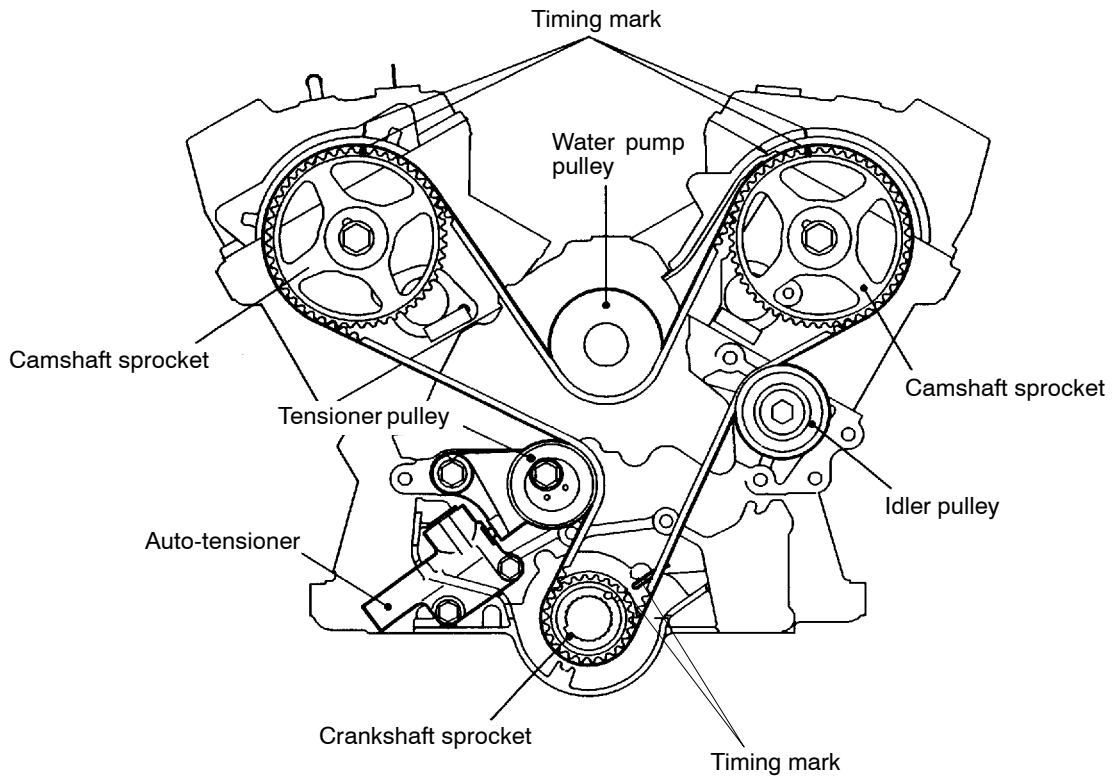
- (6) While pressing the tensioner pulley lightly against the timing belt, temporarily tighten its centre bolt.
- (7) Check that all timing marks are in alignment.



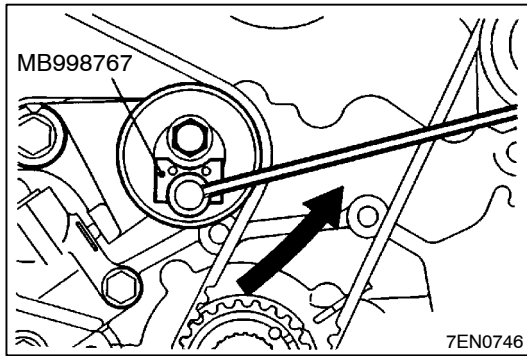
- (8) Using the Special Tool, turn the crankshaft counter-clockwise a quarter turn, then turn it clockwise and align the timing marks. Make sure that all timing marks are in alignment.

Right bank

Left bank



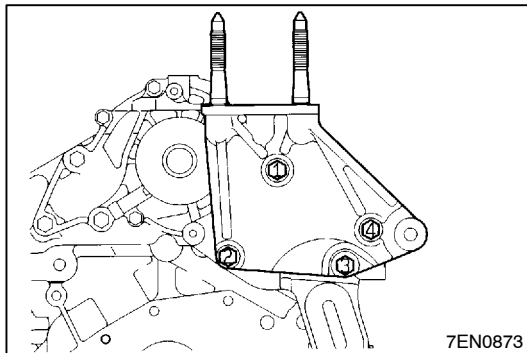
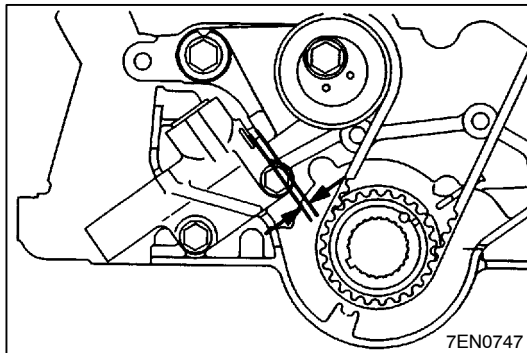
7EN0745



- (9) Set the Special Tool and a torque wrench on the tensioner pulley.
- (10) Torque the tensioner pulley to 4.4 Nm.
- (11) While holding the tensioner pulley, tighten its centre bolt to the specified torque.
- (12) Turn the crankshaft 2 turns clockwise and let it stand for approx. 5 minutes.
- (13) Remove the wire, which was inserted when installing the tensioner, from the auto tensioner. If it can be removed easily, the timing belt tension is correct. Make sure that the auto tensioner rod projection is within specification.

Standard value: 3.8 - 5.0 mm

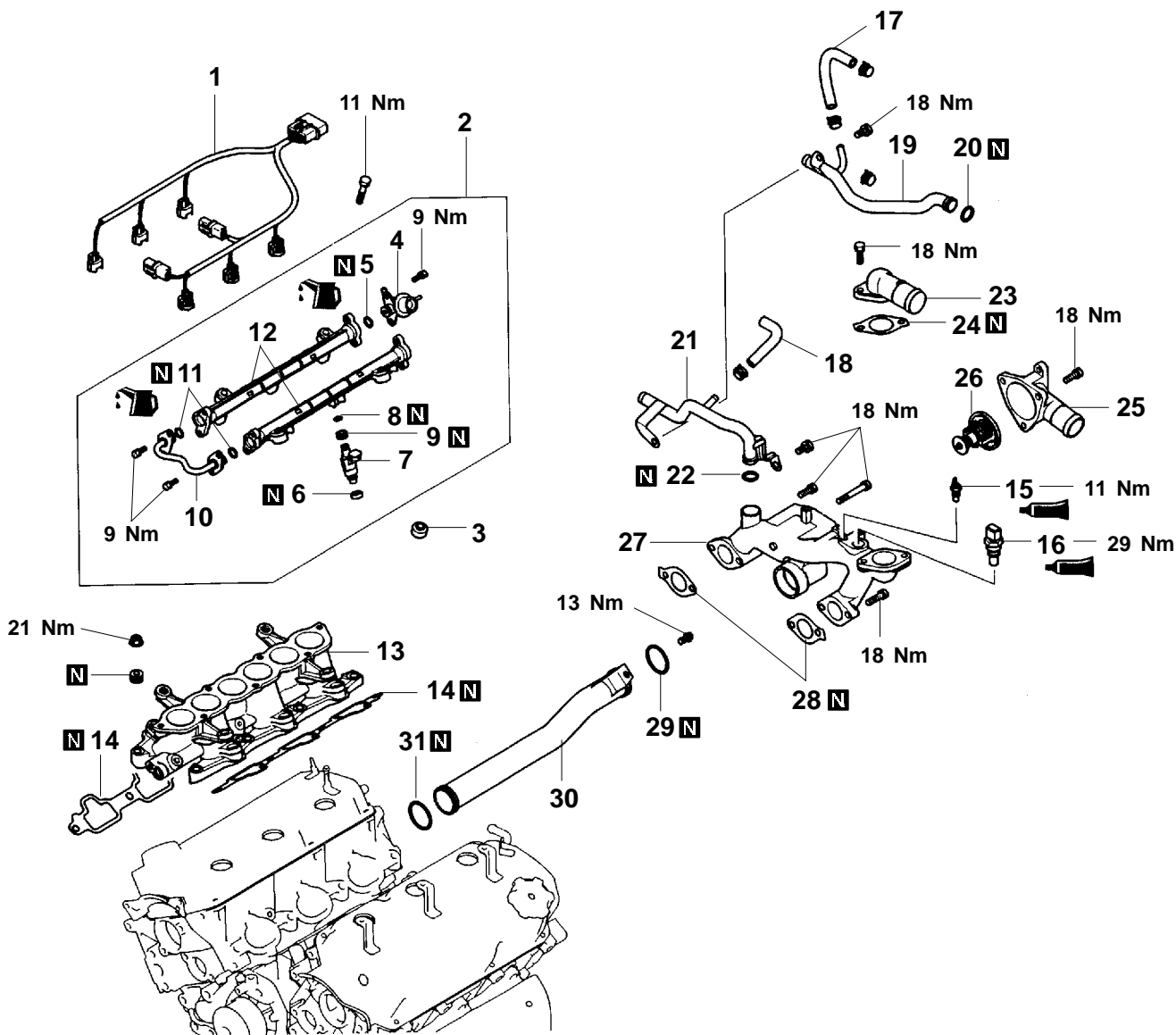
- (14) If the wire cannot be removed easily or the rod protrusion is not to specification, repeat steps 9 through 12 to obtain the correct tension.



►D◄ ENGINE SUPPORT BRACKET

- (1) Tighten bolts to specified torque in the sequence shown.

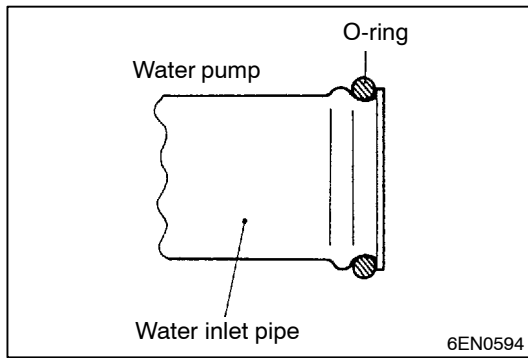
7. INTAKE MANIFOLD REMOVAL AND INSTALLATION



7EN0874

Removal steps

- | | | | |
|-----|---|-----|---|
| | 1. Engine harness | | ▶D◀ 16. Engine coolant temperature sensor |
| | 2. Injector and delivery pipe | | 17. Water hose |
| | 3. Insulator | | 18. Water hose |
| ▶H◀ | 4. Fuel pressure regulator | ▶C◀ | 19. Heater inlet pipe |
| | 5. O-ring | ▶A◀ | 20. O-ring |
| | 6. Insulator | ▶C◀ | 21. Heater inlet pipe |
| ▶G◀ | 7. Injector | ▶A◀ | 22. O-ring |
| | 8. O-ring | | 23. Water outlet fitting |
| | 9. Grommet | | 24. Water outlet fitting gasket |
| | 10. Fuel pipe | | 25. Water inlet fitting |
| | 11. O-ring | ▶B◀ | 26. Thermostat |
| | 12. Delivery pipe | | 27. Thermostat housing |
| ▶F◀ | 13. Intake manifold | | 28. Thermostat housing gasket |
| | 14. Intake manifold gasket | ▶A◀ | 29. O-ring |
| ▶E◀ | 15. Engine coolant temperature gauge unit | | 30. Water pipe |
| | | ▶A◀ | 31. O-ring |



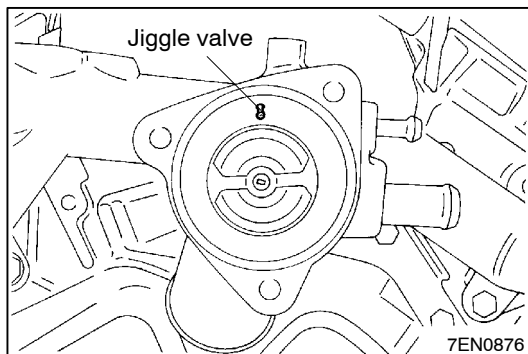
INSTALLATION SERVICE POINTS

▶A◀ O-RING / WATER PIPE

- (1) Wet the O-ring (with water) to facilitate assembly.

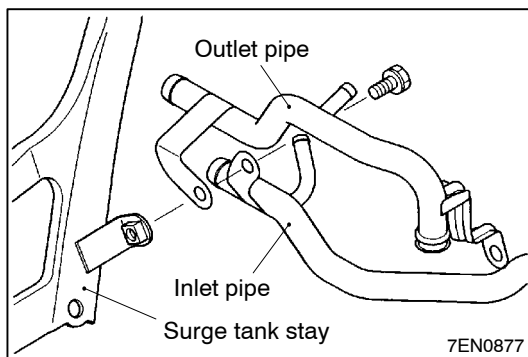
Caution

- Keep the O-ring of oil or grease.



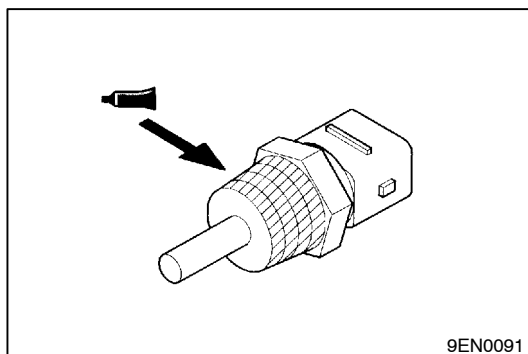
▶B◀ THERMOSTAT

- (1) Install the thermostat in the thermostat case with its jiggle valve located at the top position.



▶C◀ HEATER INLET AND OUTLET PIPES

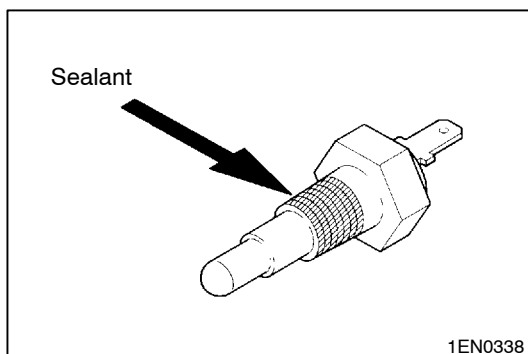
- (1) Attach the outlet and inlet pipes in this order, one on the top of the other.



▶D◀ APPLICATION OF SEALANT TO ENGINE COOLANT TEMPERATURE SENSOR

Specified sealant:

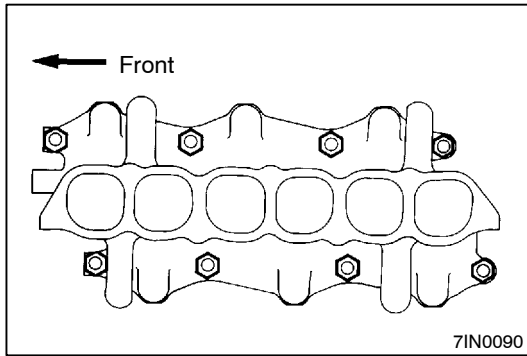
3M Nut Locking Part No. 4171 or equivalent



▶E◀ SEALANT APPLICATION TO ENGINE COOLANT TEMPERATURE GAUGE UNIT

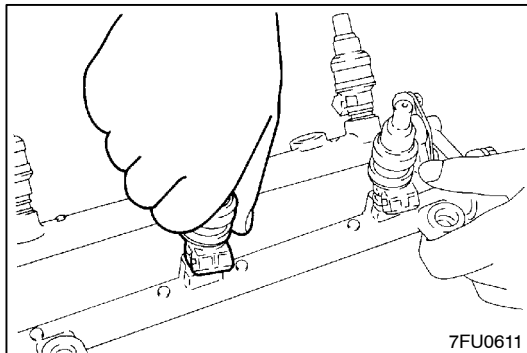
Specified sealant:

3M ATD Part No. 8660 or equivalent



►F◄ INTAKE MANIFOLD

- (1) Tighten the nuts on the right bank to 5 - 8 Nm.
- (2) Tighten the nuts on the left bank to the specified torque. Then tighten the nuts on right bank to the specified torque.
- (3) Tighten the nuts on the left bank and those on the right bank again in that order.



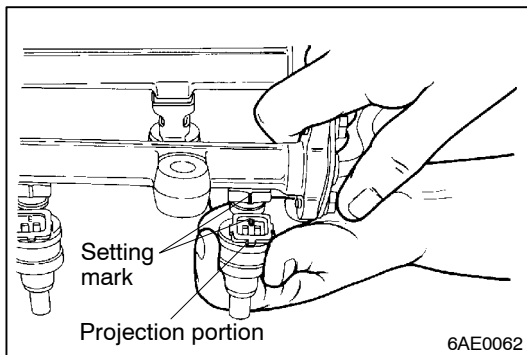
►G◄ INJECTOR

- (1) Apply a small amount of engine oil to the O-ring.

Caution

- Take care to prevent the engine oil from entering the delivery pipe.

- (2) Install the injector into the delivery pipe and turn it right and left.
- (3) Make sure the injector turns smoothly. If not, the O-ring may be caught. Remove the injector and check for damage to the O-ring, then re-insert it and confirm that it turns smoothly.
- (4) When installing the injector, set the delivery pipe setting mark and the injector projecting portion.



►H◄ FUEL PRESSURE REGULATOR

- (1) Apply a small amount of new engine oil to the O-ring, then insert the fuel pressure regulator into the delivery pipe, taking care not to damage the O-ring.

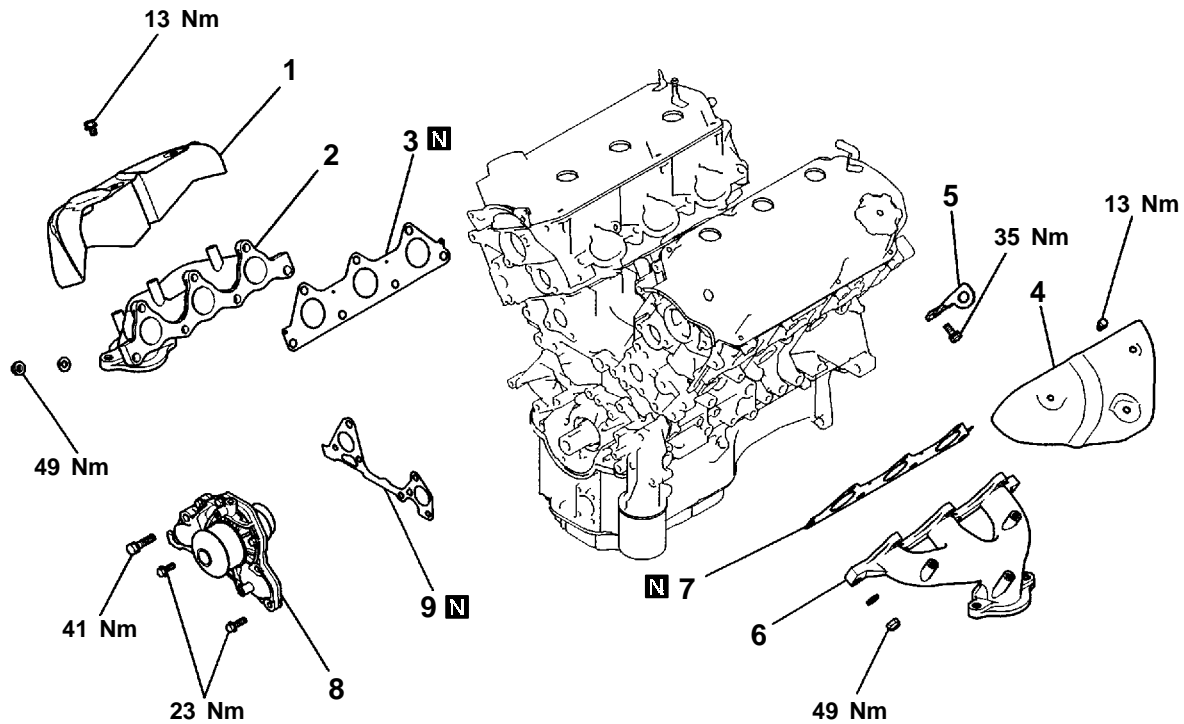
Caution

- Take care to prevent engine oil from entering the delivery pipe.

- (2) Make sure the regulator turns smoothly. If not, the O-ring may be caught. Remove the regulator and check for damage to the O-ring, then re-insert it into the delivery pipe and confirm that it turns smoothly.

8. EXHAUST MANIFOLD & WATER PUMP

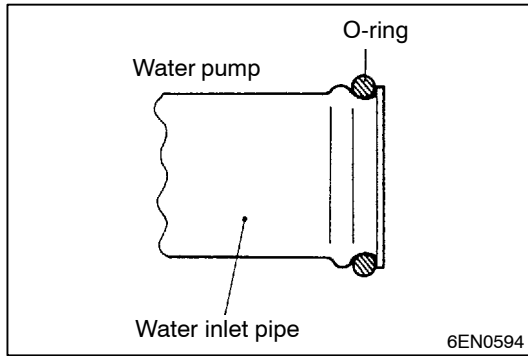
REMOVAL AND INSTALLATION



7EN0966

Removal steps

- | | | | |
|-----|--|------------|--|
| ▶B◀ | <ol style="list-style-type: none"> 1. Heat protector, rear 2. Exhaust manifold, rear 3. Exhaust manifold gasket, rear 4. Heat protector, front 5. Engine lift bracket | ▶B▶ ▶A▶ | <ol style="list-style-type: none"> 6. Exhaust manifold, front 7. Exhaust manifold gasket, front 8. Water pump 9. Water pump gasket |
|-----|--|------------|--|



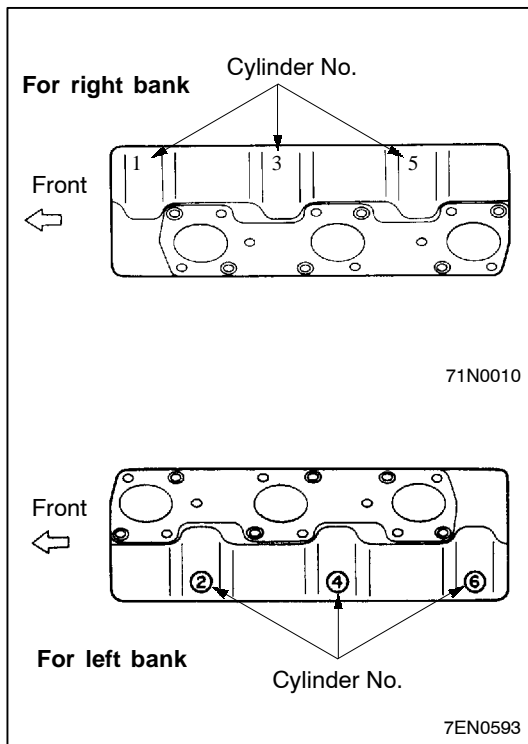
INSTALLATION SERVICE POINTS

▶A◀ O-RING / WATER PIPE

- (1) Wet the O-ring (with water) to facilitate assembly.

Caution

- Keep the O-ring free of oil grease.

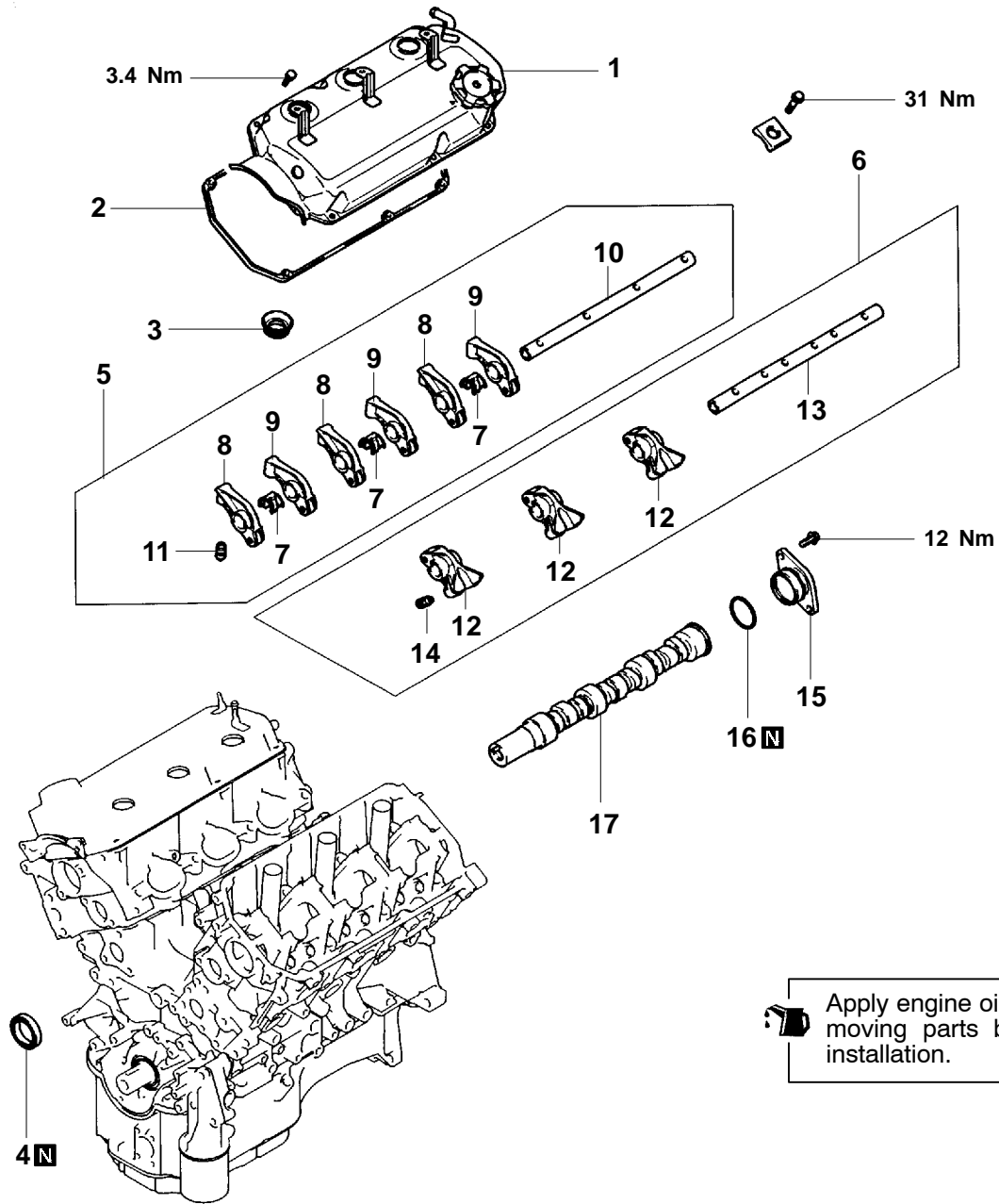


▶B◀ EXHAUST MANIFOLD GASKET

- (1) Install gaskets with number 1, 3 and 5 embossed on their top side to the right bank (exhaust manifold (B) side) and install those with number 2, 4 and 6 to the left bank (exhaust manifold (A) side).
- (2) Torque the nuts to 30 Nm.

9. ROCKER ARMS AND CAMSHAFT

REMOVAL AND INSTALLATION



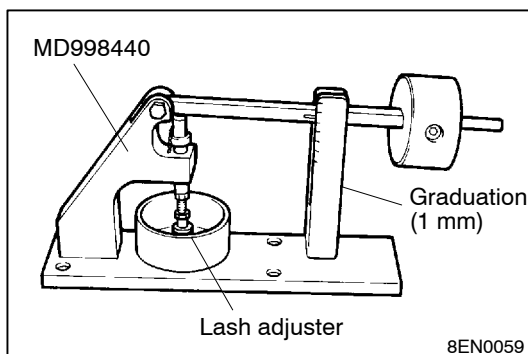
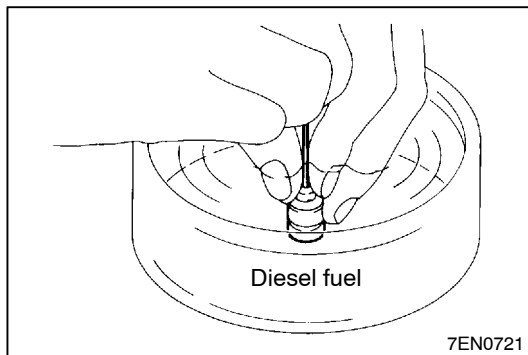
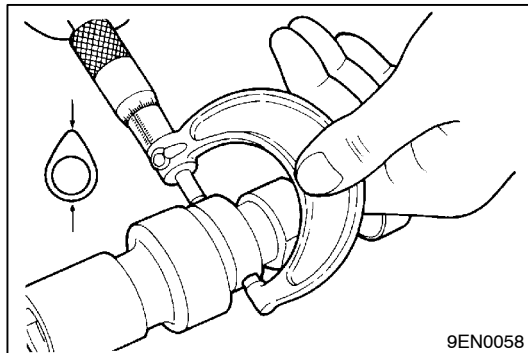
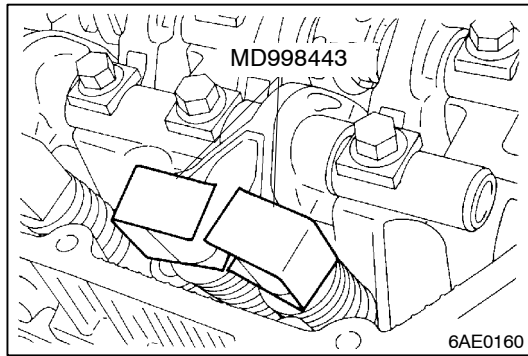
Apply engine oil to all moving parts before installation.

7EN0879

Removal steps

- 1. Rocker cover
- 2. Gasket
- 3. Oil seal
- 4. Oil seal
- 5. Rocker arms, Rocker arm shaft
- 6. Rocker arms, Rocker arm shaft
- 7. Rocker shaft spring
- 8. Rocker arm "A"
- 9. Rocker arm "B"

- ▶C◀ 10. Rocker arm shaft
- ▶B◀ 11. Lash adjuster
- ▶C◀ 12. Rocker arm "C"
- ▶B◀ 13. Rocker arm shaft
- ▶B◀ 14. Lash adjuster
- ▶A◀ 15. Thrust case (left bank)
- ▶A◀ 16. O-ring (left bank)
- ▶A◀ 17. Camshaft



REMOVAL SERVICE POINTS

◀A▶ LASH ADJUSTER

- (1) Before removing the rocker arms and rocker arm shafts, install the Special Tools to prevent the lash adjusters from falling off.

INSPECTION

CAMSHAFT

- (1) Measure the cam height.

Standard value:

IN: 37.71 mm

EX: 37.14 mm

Limit:

IN: 37.21 mm

EX: 36.64 mm

LASH ADJUSTER LEAK DOWN TEST

Caution

- The lash adjuster is a precision part. Keep it free from dust and other foreign matters.
- Do not disassemble lash adjuster. When cleaning lash adjuster, use clean diesel fuel only.

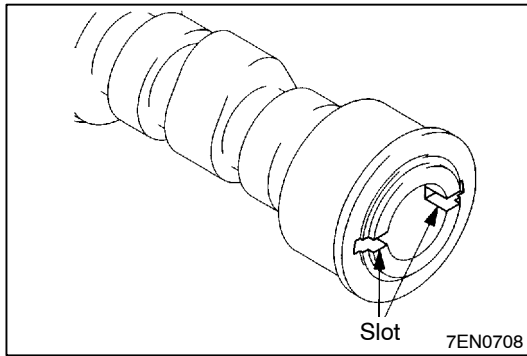
- (1) Immerse the lash adjuster in clean diesel fuel.
- (2) While lightly pushing down inner steel ball using the Special Tool (Air bleed wire MD998442), move the plunger up and down four or five times to bleed air. Use of the Special Tool (Retainer MD998441) helps facilitate the air bleeding of the rocker arm mounted type lash adjuster.
- (3) Remove the Special Tool (Air bleed wire MD998442) and press the plunger. If the plunger is hard to be pushed in, the lash adjuster is normal. If the plunger can be pushed in all the way readily, bleed the lash adjuster again and test again if the plunger is still loose, replace the lash adjuster.

Caution

- Upon completion of air bleeding, hold lash adjuster upright to prevent inside diesel fuel from spilling.
- (4) After air bleeding, set lash adjuster on the Special Tool (Leak down tester MD998440).
 - (5) After plunger has gone down between 0.20 to 0.50 mm, measure time taken for it to go down a further 1 mm. Replace if measured time is out of specification.

Standard value: 4 - 20 seconds/1 mm

<Diesel fuel at 15 - 20°C>



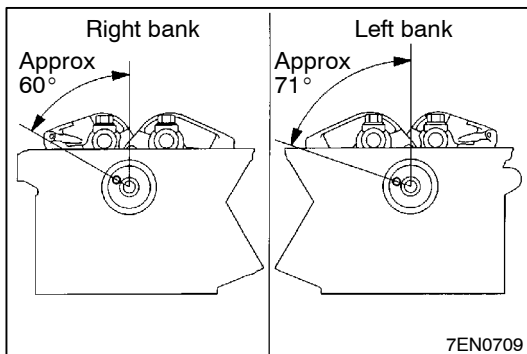
INSTALLATION SERVICE POINTS

►A◄ CAMSHAFT

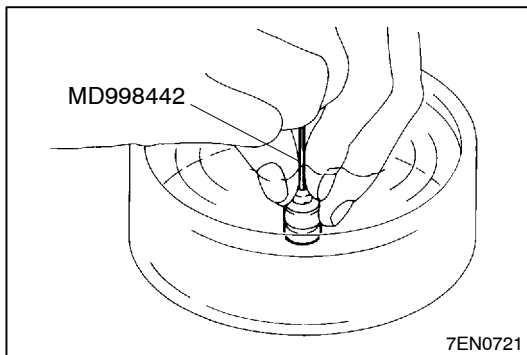
- (1) Before attaching the camshafts, apply engine oil to the journals and cams.
Take care not to confuse the right bank and left bank camshafts.

NOTE

The right bank camshaft has 4-mm-wide slits in the rear end surface.

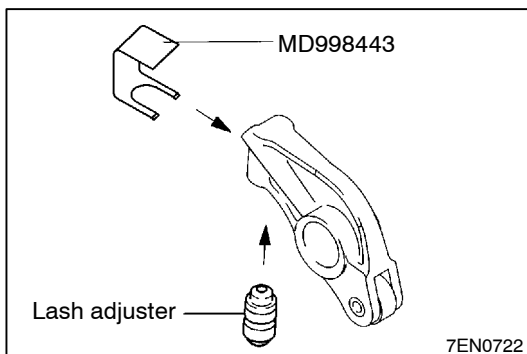


- (2) Make sure the camshaft dowel pin is at the location shown.

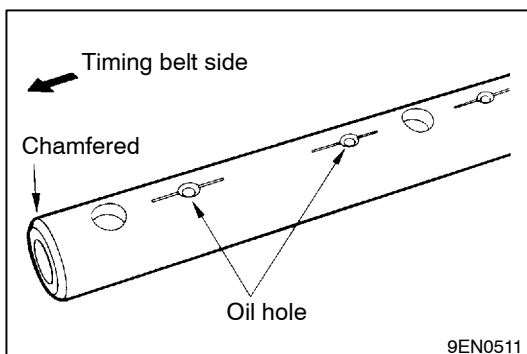


►B◄ LASH ADJUSTER

- (1) Immerse the lash adjuster in clean diesel fuel No. 2.
- (2) While pushing down the inside steel ball with the special air bleeding wire tool, move the plunger up and down four or five times to evacuate air from the lash adjuster.



- (3) Taking care not to spill the diesel fuel, install the lash adjuster into the rocker arm and attach a special tool to prevent it from falling out.



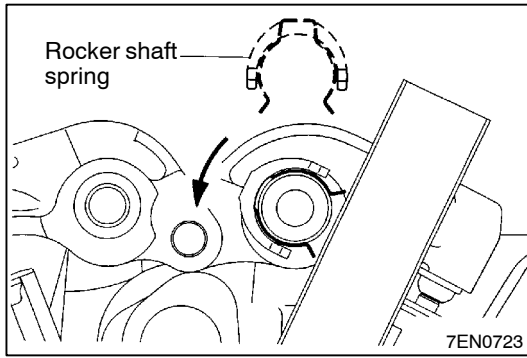
►C◄ ROCKER ARM SHAFT

- (1) The end with the larger chamfer is at the right on the front bank and at the left on the rear bank.

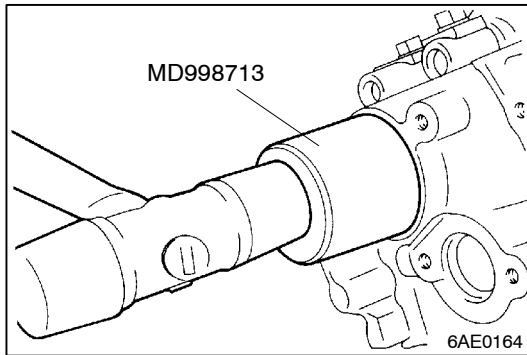
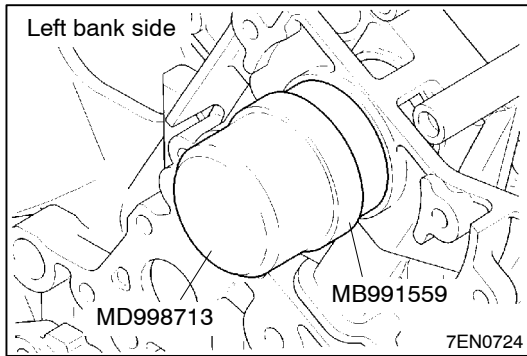
NOTE

The side with the four bolt holes is on the intake side.

- (2) The side with the oil holes is on the lower side (cylinder head side).

**►D◄ ROCKER SHAFT SPRING**

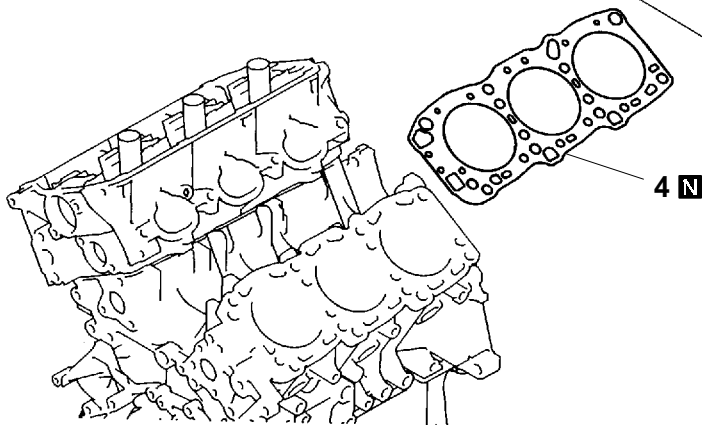
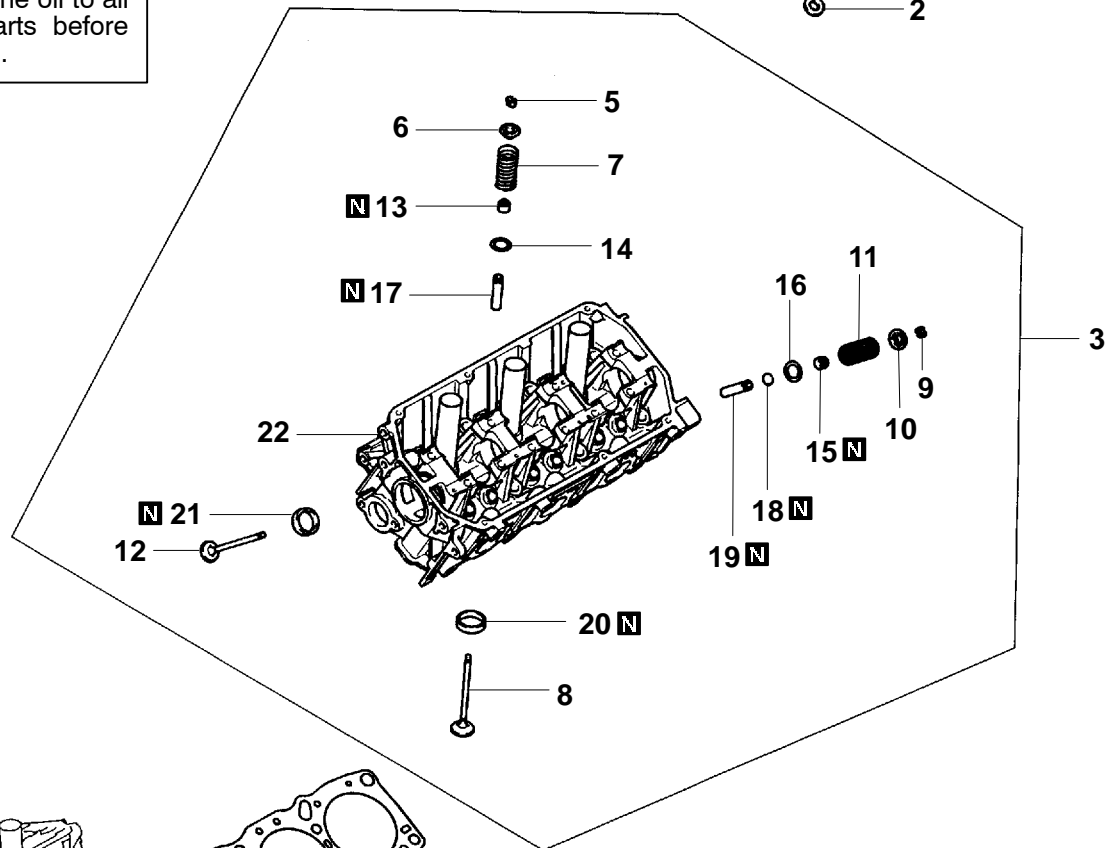
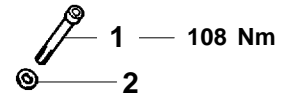
- (1) Insert the rocker shaft spring at a slant with respect to the spark plug guide and install it normal to the guide.

**►E◄ OIL SEAL**

10. CYLINDER HEAD AND VALVES

REMOVAL AND INSTALLATION

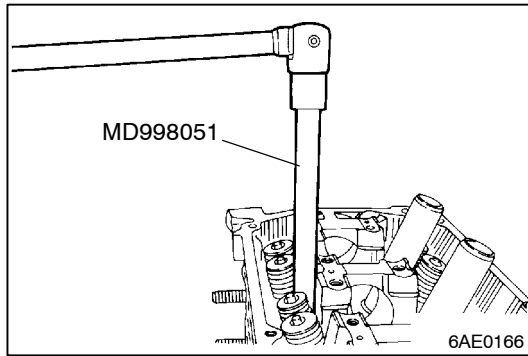
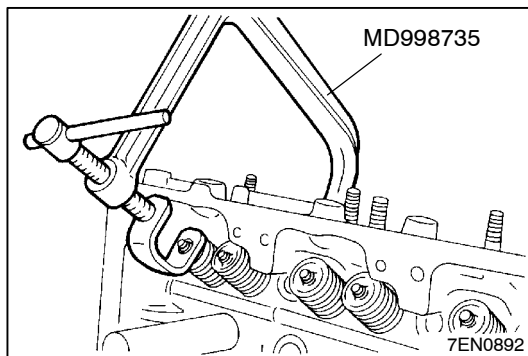
Apply engine oil to all moving parts before installation.



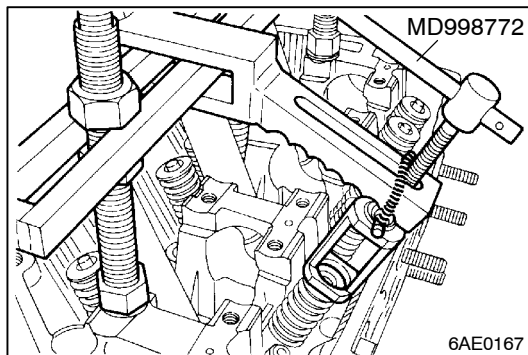
7EN0915

Removal steps

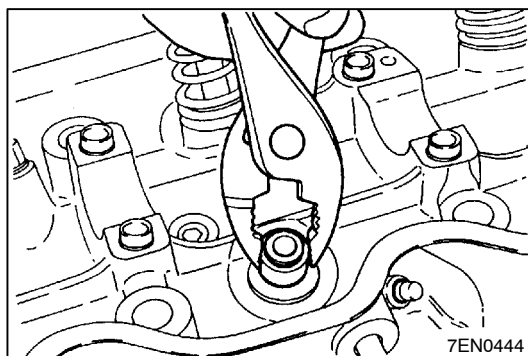
- | | | | | | |
|---------|---------------------------|---------|--|--|-------------------------|
| ◀A▶ | 1. Cylinder head bolt | | | | |
| | 2. Washer | | | | |
| | 3. Cylinder head assembly | | | | |
| | 4. Cylinder head gasket | | | | |
| ◀B▶ ▶C▶ | 5. Retainer lock | ◀C▶ ▶A▶ | | | 12. Exhaust valve |
| | 6. Valve spring retainer | | | | 13. Valve stem seal |
| | 7. Valve spring | ◀C▶ ▶A▶ | | | 14. Valve spring seat |
| | 8. Intake valve | | | | 15. Valve stem seal |
| ◀B▶ ▶C▶ | 9. Retainer lock | | | | 16. Valve spring seat |
| | 10. Valve spring retainer | | | | 17. Intake valve guide |
| | 11. Valve spring | | | | 18. Snap ring |
| | | | | | 19. Exhaust valve guide |
| | | | | | 20. Intake valve seat |
| | | | | | 21. Exhaust valve seat |
| | | | | | 22. Cylinder head |

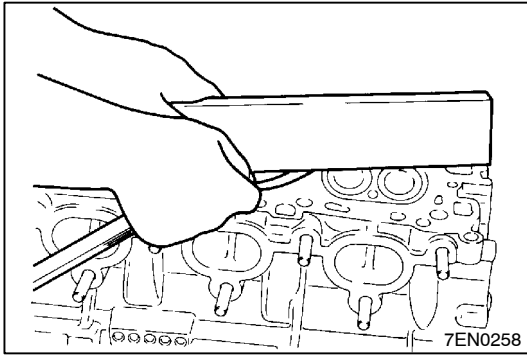
**REMOVAL SERVICE POINTS****◀A▶ CYLINDER HEAD BOLT****◀B▶ RETAINER LOCK**

- (1) Attach a tag with the cylinder No. and mounting location to the detached valves, springs and other parts and store them for reassembly.

**◀C▶ VALVE STEM SEAL****Caution**

- Do not reuse the stem seal.





INSPECTION

CYLINDER HEAD

- (1) Check the cylinder head for water leaks, gas leaks, damage or cracks before washing it.
- (2) Completely remove oil, fur, sealer, carbon and the like. After washing the oil passages, blow air through them to make sure they are not clogged.
- (3) To ensure flatness of the cylinder head bottom surface, measure the distortion of the surface using a straight edge and a thickness gauge. When the distortion exceeds the specifications, correct by grinding the surface.

Standard values of bottom surface distortion:
Within 0.03 mm

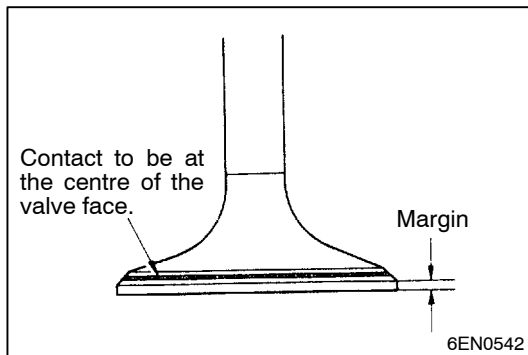
Limit: 0.2 mm

Grinding limit: 0.2 mm

Height of the cylinder head: 120 mm

Caution

- The cylinder head bottom surface may be ground to within 0.2 mm of the mating cylinder block.



VALVES

- (1) When contact between the valve and the valve seat is improper, unbalanced or nonexistent, correct the valve seat.
- (2) Change the valve when the margin doesn't meet the specifications.

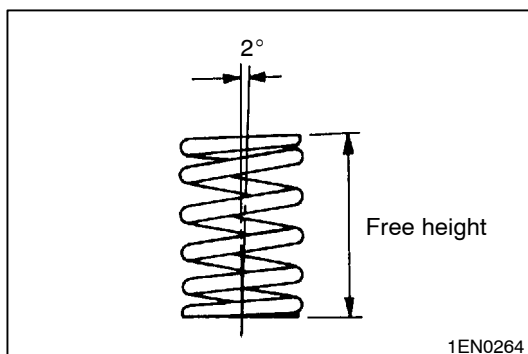
Standard value: Intake 1.0 mm
 Exhaust 1.2 mm

Limit: Intake 0.5 mm
 Exhaust 0.7 mm

- (3) Measure the total length of the valve. If the measured value is below the limit, change the valve.

Standard value: Intake 112.30 mm
 Exhaust 114.11 mm

Limit: Intake 111.80 mm
 Exhaust 113.61 mm



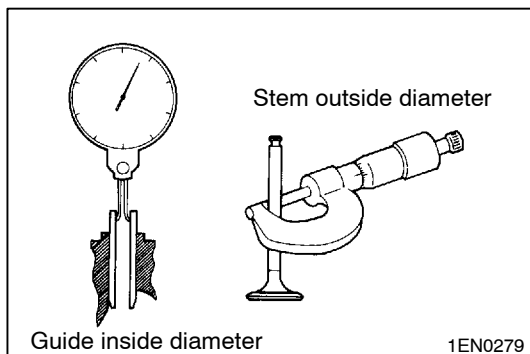
VALVE SPRING

- (1) Measure the free height of the valve spring. When the measured value exceeds the specified limit, change the valve spring.

Standard value: 51.0 mm
Limit: 50.0 mm

- (2) Measure the perpendicularity of the valve spring. When the measured value exceeds the specified limit, change the valve spring.

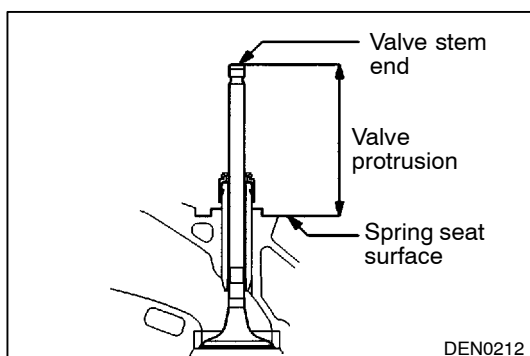
Standard value: 2° max.
Limit: 4°

**VALVE GUIDE**

- (1) Measure the clearance between the valve guide and the valve stem. When the clearance exceeds the specified limit, change the valve guide or the valve or both.

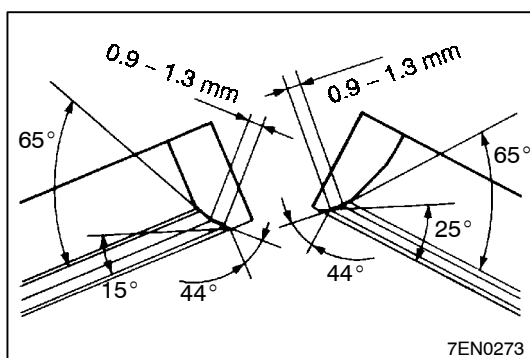
Standard value: Intake 0.02 - 0.04 mm
Exhaust 0.04 - 0.06 mm

Limit: Intake 0.10 mm
Exhaust 0.15 mm

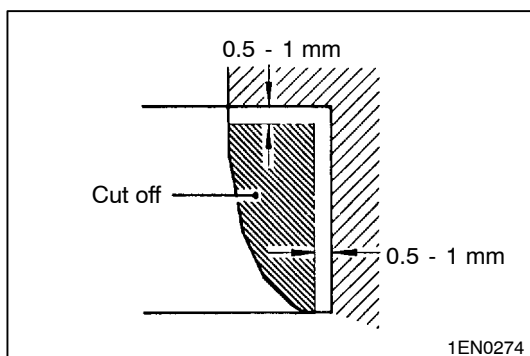
**VALVE SEAT**

- (1) Assemble the valve, and with it pressed down on the valve seat measure the part of the valve which protrudes from the spring seat surface. The length measured should be between the spring seat surface and the valve stem end. If the measured value exceeds the limit, change the valve.

Standard value: 49.3 mm
Limit: 49.8 mm

**VALVE SEAT RECONDITIONING PROCEDURE**

- (1) Check the clearance between the valve guide and the valve, and if necessary, change the valve guide before correcting the valve seat.
- (2) Correct so that the valve seat width and angle are as specified in the figure at left.
- (3) After making the corrections, apply lapping compound and adjust the valve and valve seat.

**VALVE SEAT REPLACEMENT PROCEDURE**

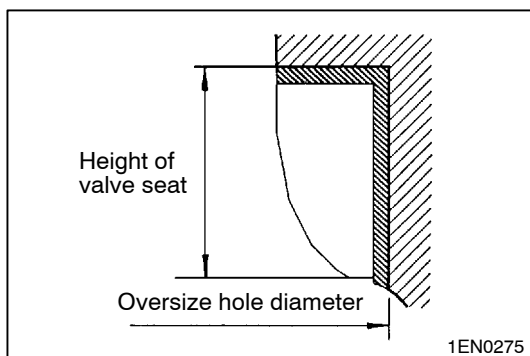
- (1) Cut off the inside of the valve seat to reduce its thickness before pulling out the valve seat.
- (2) Adjust the valve cylinder hole in the cylinder head to the diameter of the oversize valve seat to be press fitted.

Intake valve seat hole diameter

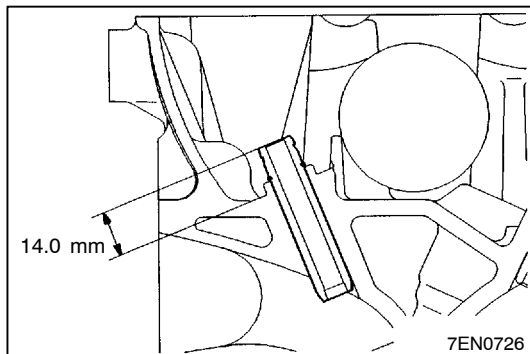
| | |
|-----------|------------------|
| 0.30 O.S. | 34.30 - 34.33 mm |
| 0.60 O.S. | 34.60 - 34.63 mm |

Exhaust valve seat hole diameter

| | |
|-----------|------------------|
| 0.30 O.S. | 31.80 - 31.83 mm |
| 0.60 O.S. | 32.10 - 32.13 mm |



- (3) When press fitting a valve seat, cool it using liquid nitrogen so as not to gall the cylinder head inside diameter.
- (4) Machine the valve seat.
- (5) See "Valve seat reconditioning procedure."



VALVE GUIDE REPLACEMENT PROCEDURE

- (1) Remove the snap ring from the exhaust valve guide.
- (2) Pull out to the cylinder block side using a press.
- (3) Machine the valve guide hole in the cylinder head to match the oversize valve guide to be press fitted.

Caution

- Do not press fit another valve guide of the same size.

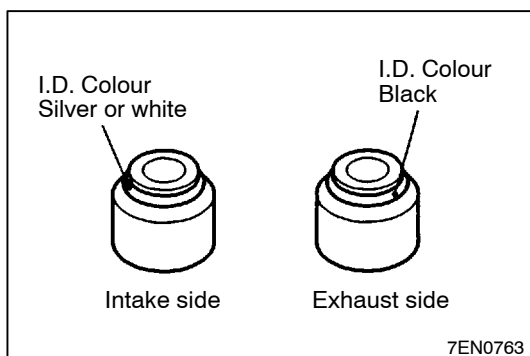
Diameter of the valve guide hole

| | |
|-----------|------------------|
| 0.05 O.S. | 11.05 - 11.07 mm |
| 0.25 O.S. | 11.25 - 11.27 mm |
| 0.50 O.S. | 11.50 - 11.52 mm |

- (4) Press fit the valve guide until the projection is 14.0 mm, as shown.

NOTE

- Press fit the valve guide from the top surface of the cylinder head.
- Pay attention to the difference in the valve guide length (45.5 mm for the intake side valve guide and 50.5 mm for the exhaust side valve guide).
- After press fitting the valve guide, insert a new valve and check the contact between the valve guide and the valve.



INSTALLATION SERVICE POINTS

▶A◀ VALVE STEM SEAL

- (1) Attach a valve spring seat.
- (2) Attach a new stem seal to the valve guide with the Special Tool.

NOTE

Pay attention to the difference between the intake side and exhaust side valve stem seals.

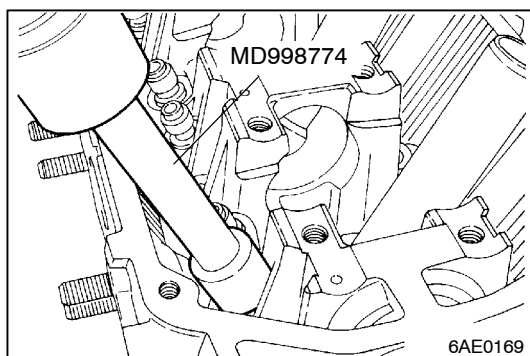
Identifying colour at the valve stem seal portion

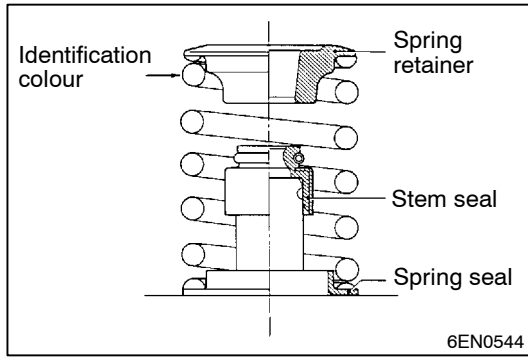
Intake side: Silver or white

Exhaust side: Black

Caution

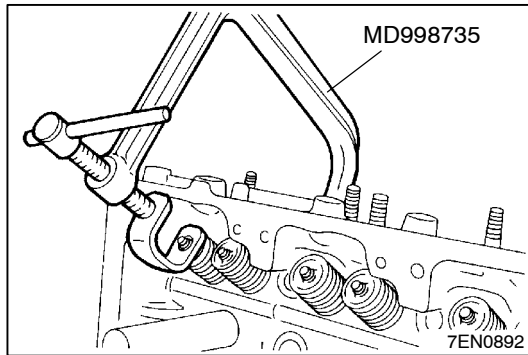
- Do not reuse valve stem seals.
- Always use the Special Tool to install valve stem seals. Improper installation will cause oil leaks.





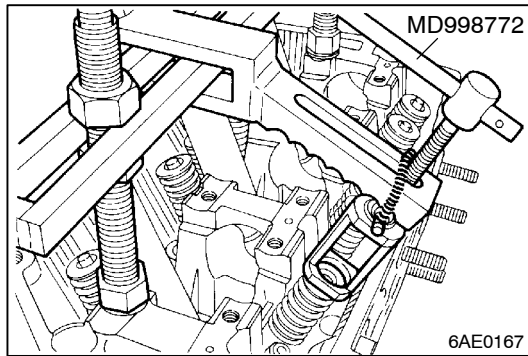
►B◄ VALVE SPRING

- (1) Install the valve spring painted red side up.



►C◄ VALVE RETAINER LOCK

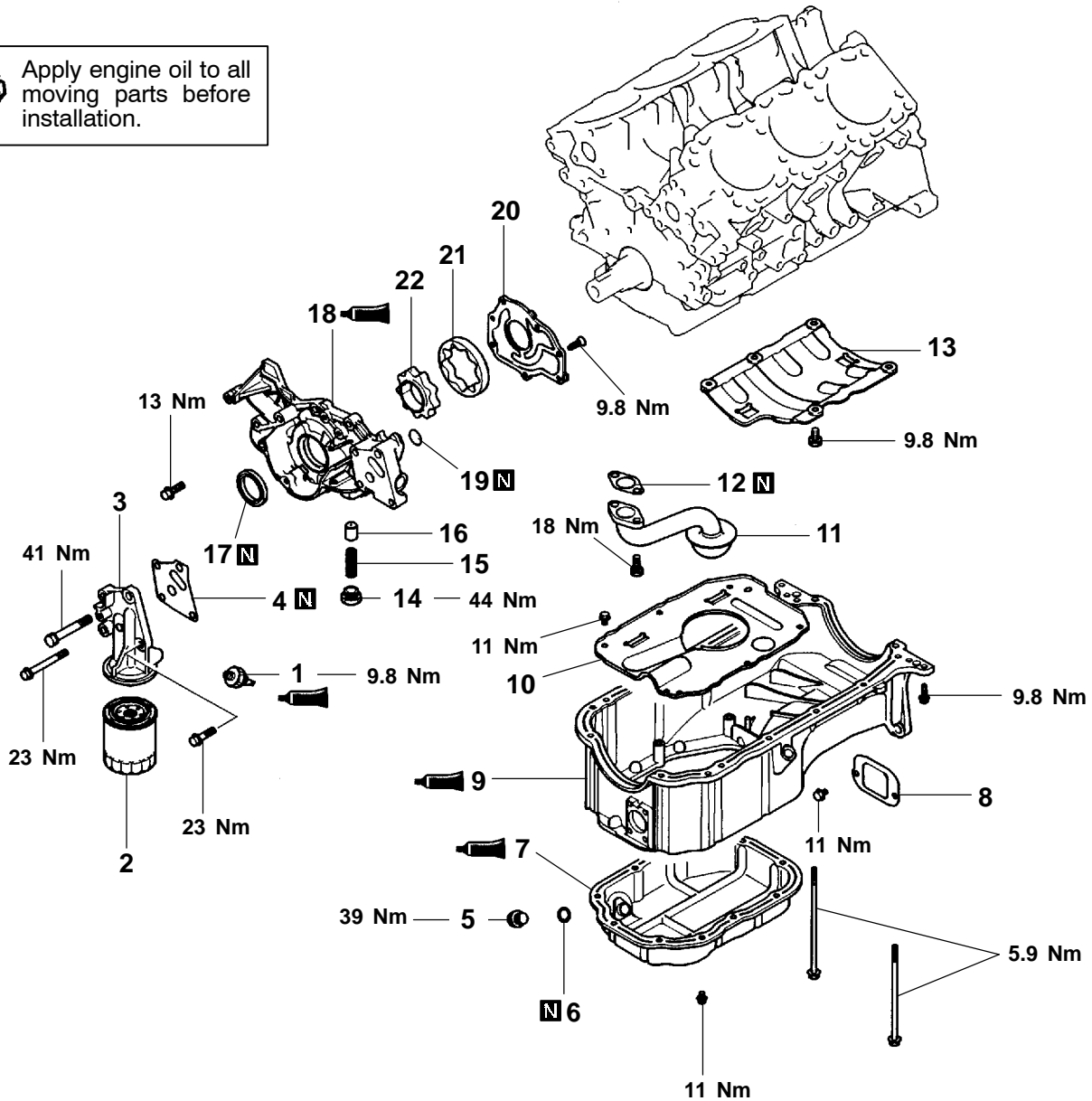
- (1) Using Special Tool install the valve retainer lock.



11. OIL PAN AND OIL PUMP

REMOVAL AND INSTALLATION

Apply engine oil to all moving parts before installation.



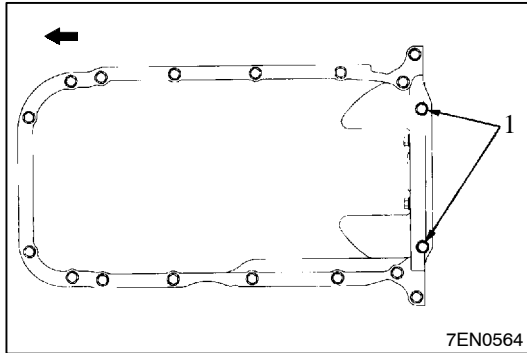
7EN0893

Removal steps

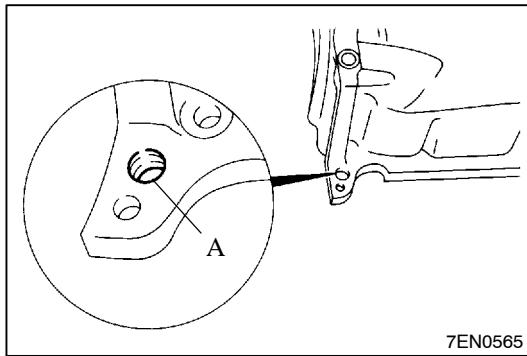
- | | | | |
|-----|------------------------------|-----|--------------------------|
| ▶G▶ | 1. Oil pressure switch | ▶C▶ | 12. Oil screen gasket |
| ▶F▶ | 2. Oil filter | ▶B▶ | 13. Baffle plate |
| | 3. Oil filter bracket | | 14. Plug |
| | 4. Oil filter bracket gasket | | 15. Relief spring |
| | 5. Drain plug | | 16. Relief plunger |
| | 6. Drain plug gasket | ▶C▶ | 17. Oil seal |
| ▶A▶ | 7. Oil pan, lower | ▶B▶ | 18. Oil pump case |
| | 8. Cover | | 19. O-ring |
| ▶B▶ | 9. Oil pan, upper | ▶C▶ | 20. Oil pump cover |
| | 10. Baffle plate | ▶A▶ | 21. Oil pump outer rotor |
| | 11. Oil screen | ▶A▶ | 22. Oil pump inner rotor |

REMOVAL SERVICE POINTS**◀A▶ OIL PAN (LOWER)**

- (1) Apply wood to the oil pan side and remove the oil pan lower with a plastic hammer.

**◀B▶ OIL PAN (UPPER)**

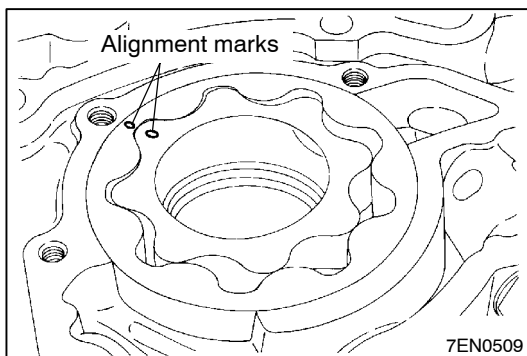
- (1) Detach the bolt (1) shown at left.
- (2) Detach all other bolts.



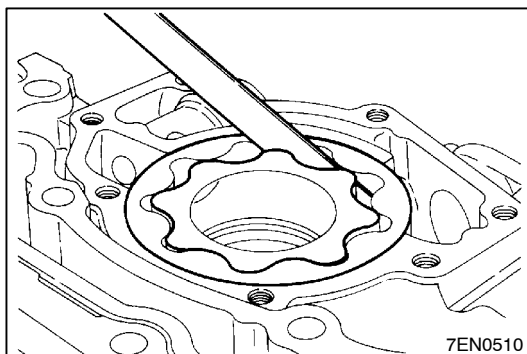
- (3) Screw a bolt into bolt hole A shown (at both ends) to remove the oil pan.

Caution

- Do not use a scraper or special tool to remove the oil pan.

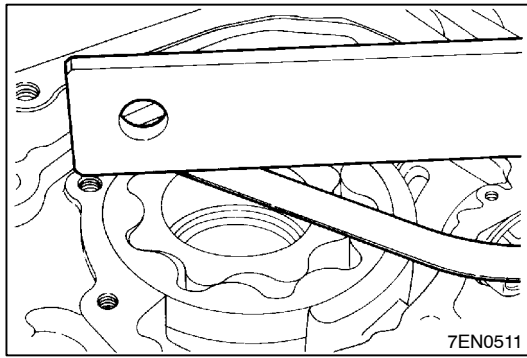
**◀C▶ OIL PUMP OUTER AND INNER ROTORS**

- (1) Draw a setting mark on the oil pump outer and inner rotors to facilitate reassembly.

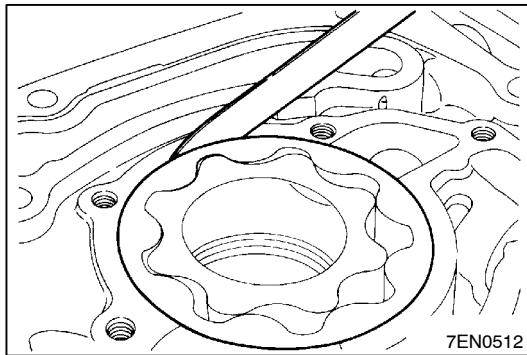
**INSPECTION****OIL PUMP**

- (1) Check for tip clearance.

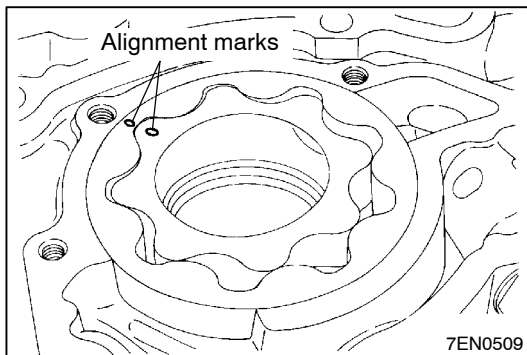
Standard value: 0.06 - 0.18 mm



- (2) Check for side clearance.
Standard value: 0.04 - 0.10 mm



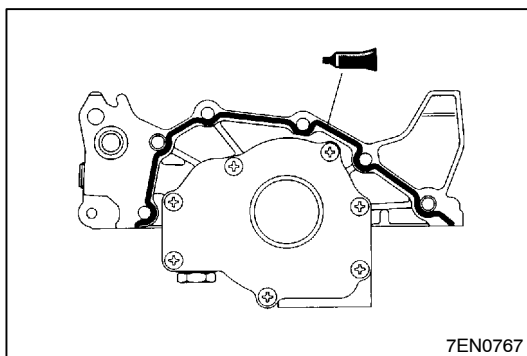
- (3) Check for body clearance.
Standard value: 0.10 - 0.18 mm
Limit: 0.35 mm



INSTALLATION SERVICE POINTS

▶A◀ OIL PUMP INNER AND OUTER ROTORS

- (1) Install the oil pump outer rotor in the proper direction using the setting mark drawn on it before disassembly.
 Apply engine oil over the entire rotor surface.

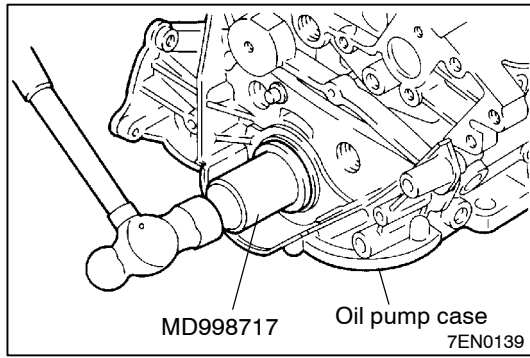


▶B◀ OIL PUMP CASE

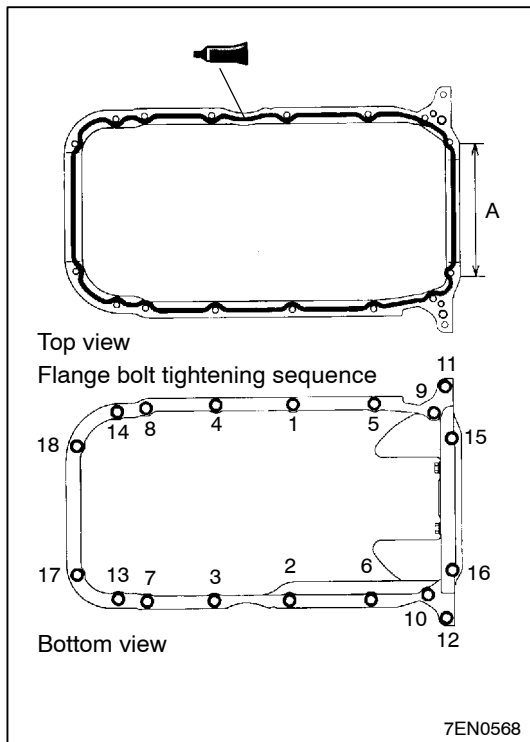
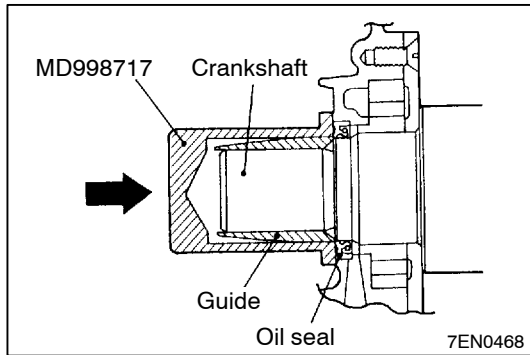
- (1) Remove the old liquid gasket from the cylinder block (oil pump mounting surface) and from the oil pump.
 (2) Squeeze out about 3 mm of liquid gasket (FIPG) and coat the coating surface with it.

Specified sealant:

MITSUBISHI GENUINE Part No. MD970389 or equivalent



▶C◀ OIL SEAL



▶D◀ OIL PAN (UPPER)

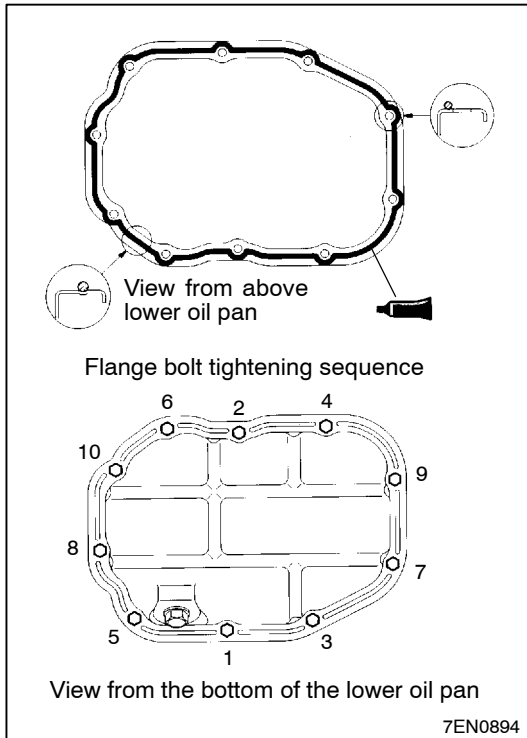
- (1) Clean the gasket coating surfaces of the cylinder block and the oil pan upper.
- (2) Squeeze out a 4 mm bead of liquid gasket and coat the coating surface with it.

NOTE

During attachment of the oil pan upper, the sealer must not be expelled from the flange portion of the oil pan for distance A as shown.

Liquid gasket:

MITSUBISHI GENUINE Part No. MD970389 or equivalent

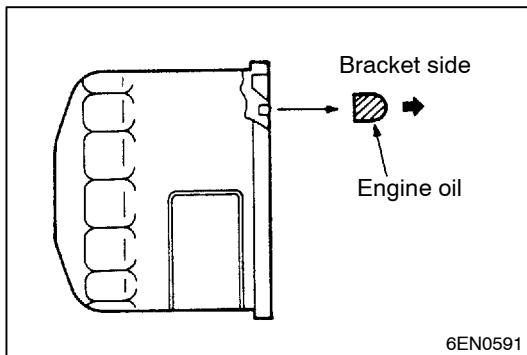


►E◄ OIL PAN (LOWER)

- (1) Clean the gasket coating surfaces of the oil pan upper and the oil pan lower.
- (2) Squeeze out a 4 mm bead of liquid gasket and coat the coating surface with it.

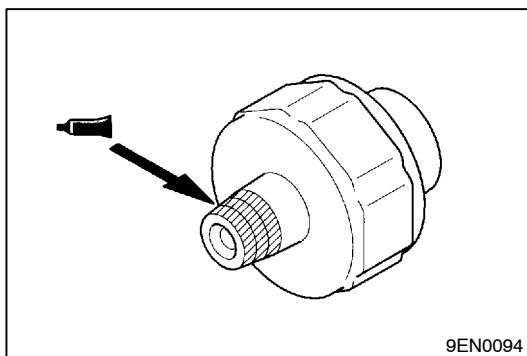
Liquid gasket:

MITSUBISHI GENUINE Part No. MD970389 or equivalent



►F◄ OIL FILTER

- (1) Clean the oil filter attaching surface on the side of the cylinder block.
- (2) Apply engine oil to the O-ring for the oil filter.
- (3) Screw in the oil filter and from the point at which the O-ring contacts the oil filter attaching surface, tighten it by about one turn (at approx. 14 Nm).



►G◄ OIL PRESSURE SWITCH


Sealer: 3M ATD Part No. 8660 or equivalent

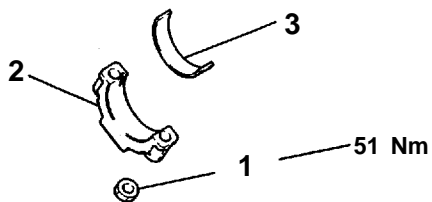
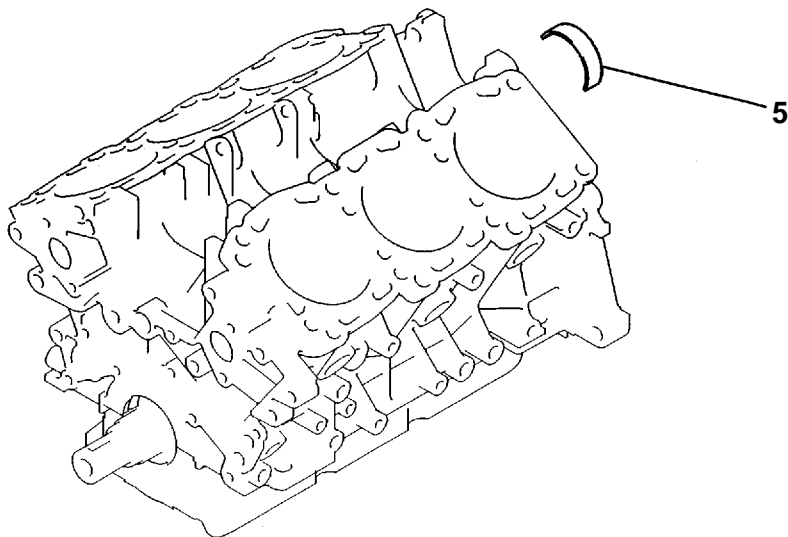
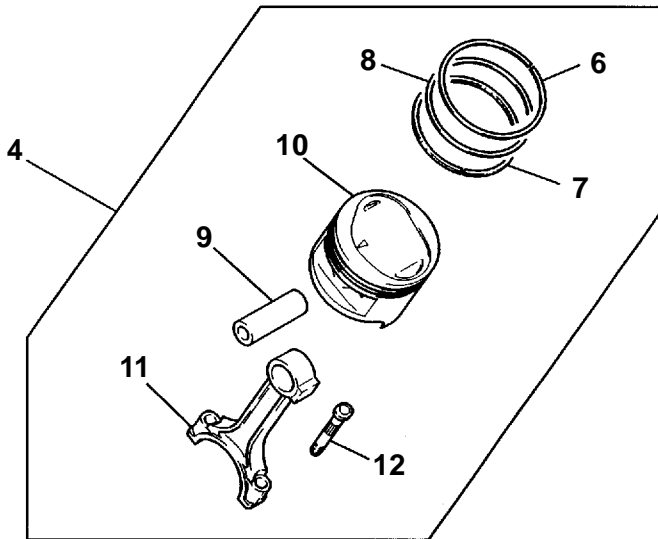
NOTE

- Sealer must not extend beyond the tip of the thread portion.
- Take care not to tighten the switch too much.

12. PISTON AND CONNECTING ROD

REMOVAL AND INSTALLATION

 Apply engine oil to all moving parts before installation.

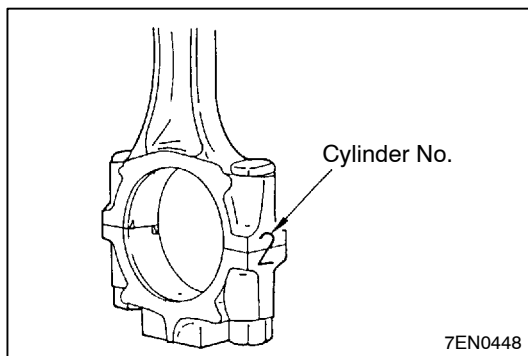


7EN0424

Removal steps

- ◀A▶ ▶E▶ 1. Connecting rod cap nut
- ▶D▶ 2. Connecting rod cap
- ▶D▶ 3. Connecting rod bearing, lower
- ▶D▶ 4. Piston and connecting rod assembly
- ▶C▶ 5. Connecting rod bearing, upper
- ▶C▶ 6. Piston ring No. 1

- ▶C▶ ▶B▶ ▶A▶ 7. Piston ring No. 2
- ▶B▶ 8. Oil ring
- ▶B▶ 9. Piston pin
- ▶A▶ 10. Piston
- ▶A▶ 11. Connecting rod
- ▶A▶ 12. Connecting rod cap bolt



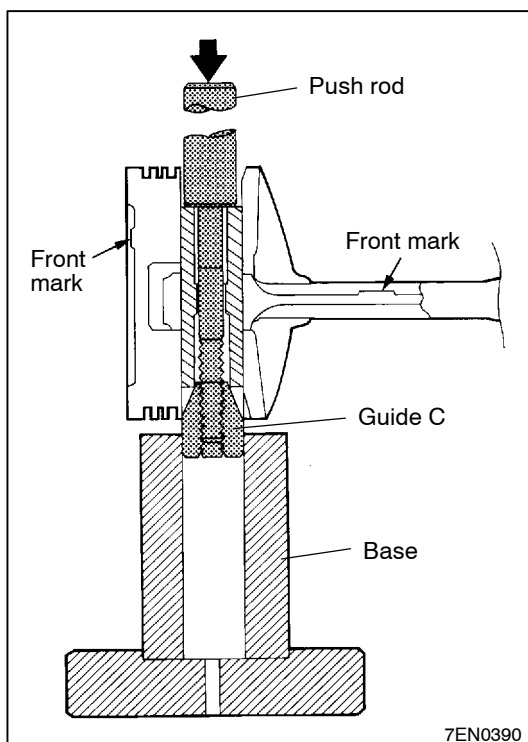
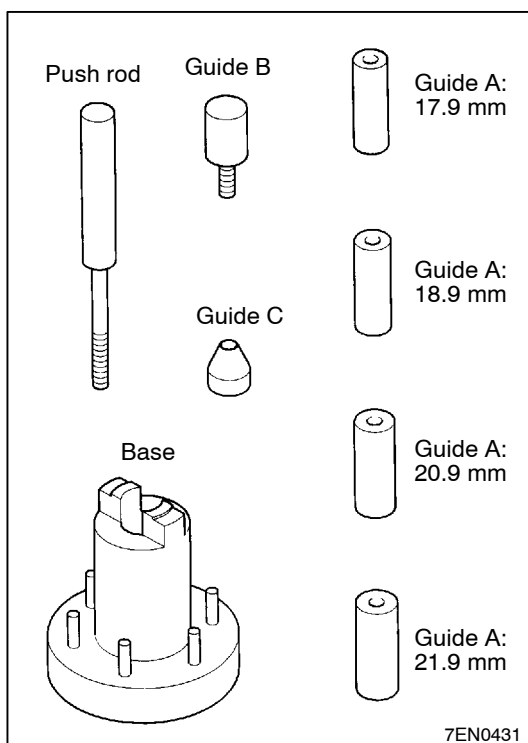
REMOVAL SERVICE POINTS

◀A▶ CONNECTING ROD CAP

- (1) Enter the cylinder No. on the side of the large end of the connecting rod to facilitate reassembly.

◀B▶ PISTON PIN

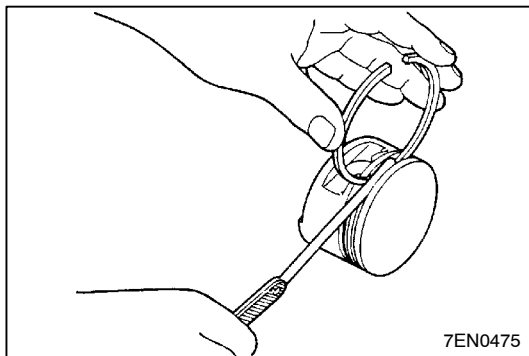
The special piston pin setting tool (MD998780) consists of the parts shown at left.



- (1) Insert the special push rod tool from the front marked (arrow) side of the piston side and attach guide C.
- (2) Set the piston and connecting rod assembly to the special tool piston pin setting base such that the front mark on the piston faces upward.
- (3) Pull out the piston pin with a press.

NOTE

After pulling out the piston pin, place the piston, the piston pin, and the connecting rod in order for each cylinder number.



7EN0475

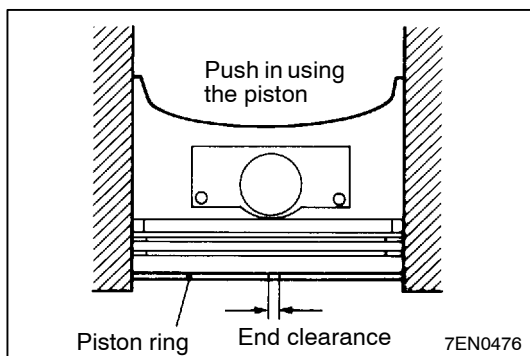
INSPECTION

PISTON RING

- (1) Check the clearance between the piston ring and the ring groove. If it exceeds the specified limit, change the ring or the piston and piston ring.

Standard values: No. 1 0.03 - 0.07 mm
No. 2 0.02 - 0.06 mm

Limit: 0.1 mm



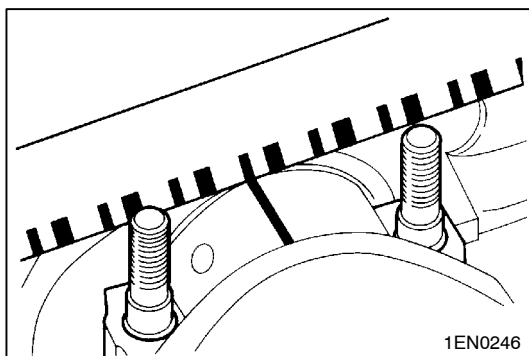
7EN0476

- (2) Place the piston ring in the cylinder bore, push it in by applying the piston head side, and make sure it is square. Then measure the clearance at the ring ends with a thickness gauge.

Change the piston ring if the clearance at the ring end is excessive.

Standard values: No. 1 0.30 - 0.45 mm
No. 2 0.45 - 0.60 mm
Oil 0.20 - 0.60 mm

Limit: No. 1 0.8 mm
No. 2 0.8 mm
Oil 1.0 mm



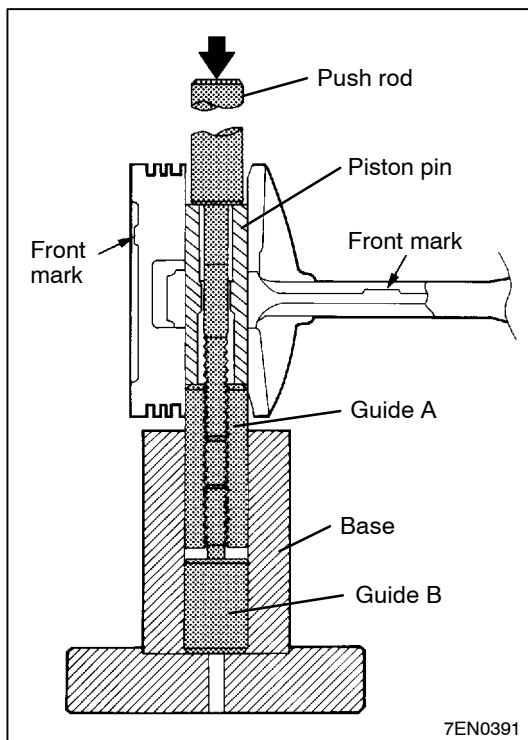
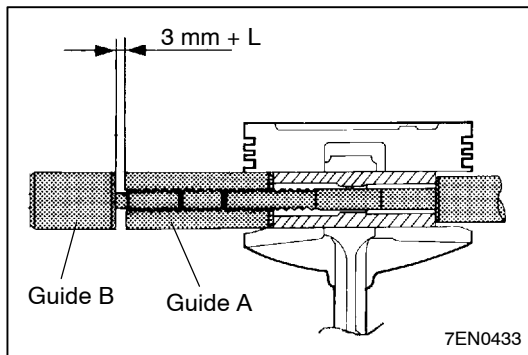
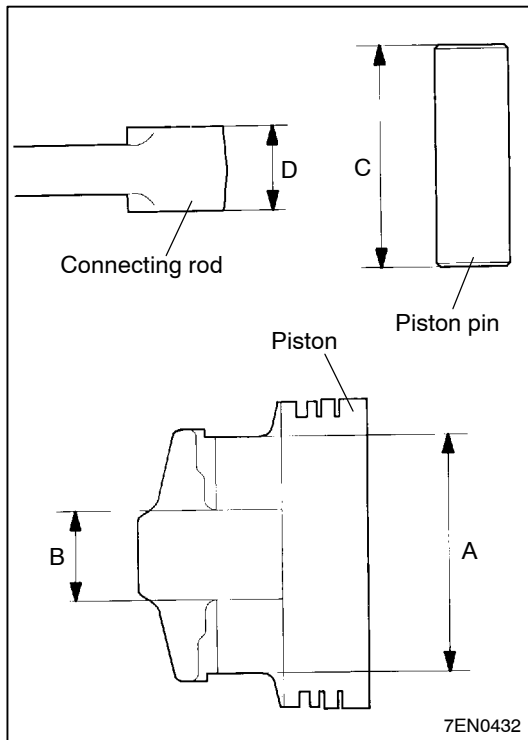
1EN0246

CRANKSHAFT PIN OIL CLEARANCE (PLASTIGAUGE METHOD)

- (1) Drain oil from the crankshaft pin and the connecting rod bearing.
- (2) Place a piece of Plastigauge the length of the bearing width on the crankshaft pin straight along the pin centre.
- (3) Gently place the connecting rod cap on top and tighten the bolt to the specified torque.
- (4) Detach the bolt and gently remove the connecting rod cap.
- (5) Measure the width of the crushed Plastigauge (at the widest point) using the scale printed on the Plastigauge package.

Standard value: 0.02 - 0.05 mm

Limit: 0.1 mm



INSTALLATION SERVICE POINTS

▶A◀ PISTON PIN

- (1) Measure the dimensions of the following parts and portions:
 - A: Piston pin mounting portion
 - B: Distance between piston bosses
 - C: Piston pin
 - D: Connecting rod
- (2) Calculate by substituting each measured value into the following equation:

$$L = \frac{(A - C) - (B - D)}{2}$$

- (3) Insert the special push rod tool into the piston pin and attach guide A to it.
- (4) Combine the piston and the connecting rod, matching their front marks.
- (5) Apply engine oil to the outer periphery of the piston pin.
- (6) Insert the side of the piston pin guide A attached per Step (3) into the pin hole from the side of the piston containing the front mark.
- (7) Screw guide B into guide A until they are distance L (obtained per Step (2) above) plus 3 mm apart as shown.
- (8) Use special tools to set the piston pin to a special tool piston setting base with the front mark of the piston facing up.
- (9) Press fit the piston pin with a press. When the load required for press fitting the piston pin is below the standard value, change the piston pin (piston assembly) or the connecting rod or both.

Standard values: 7,350 - 17,200 N

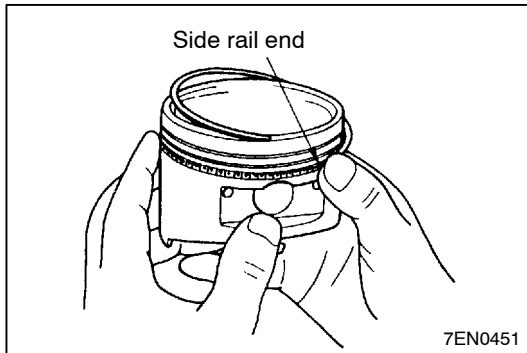
▶B◀ OIL RING

- (1) Install the oil ring spacer into the piston ring groove. Next install the upper side rail into the piston ring groove, and then install the lower side rail.

NOTE

- There is no distinction between the upper and lower surfaces of the side rail and spacer.
- The spacer and side rail (new part) are painted the following colour to enable size identification.

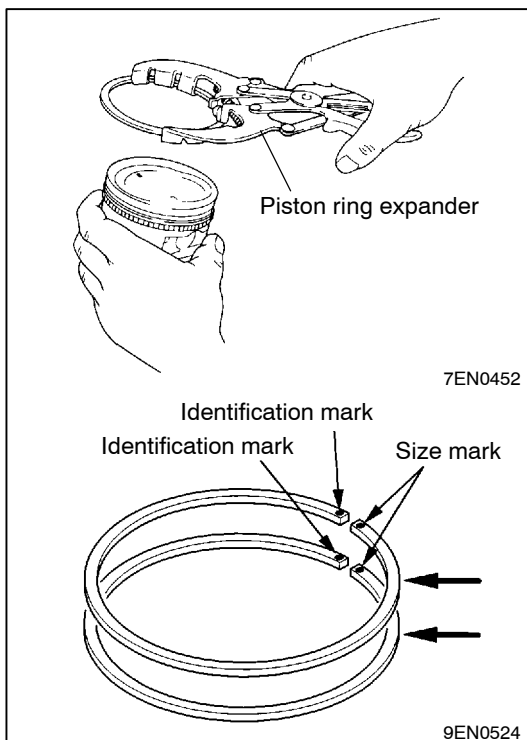
| Side rail | Identification colour |
|--------------|-----------------------|
| S.T.D. | None |
| 0.50 mm O.S. | Blue |
| 1.00 mm O.S. | Yellow |



- (2) The side rail can be inserted easily into the piston groove by first inserting one end and then pushing the rail into place while turning it by hand as shown.

Caution

- **The side rail may break if a ring expander is used.**
- (3) After installation into the piston, make sure the side rail turns smoothly in either direction.

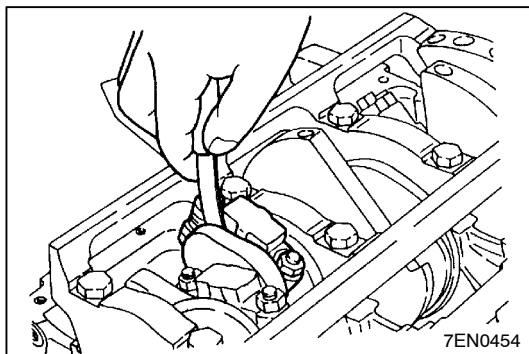
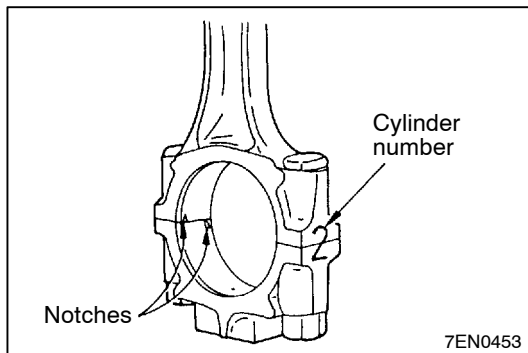
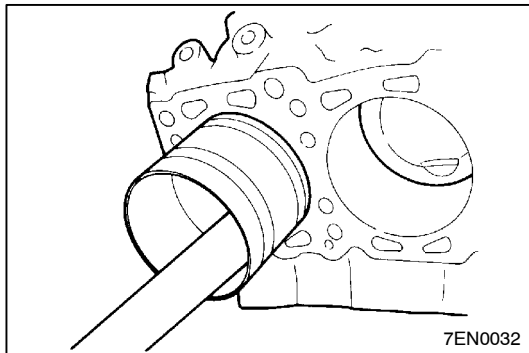
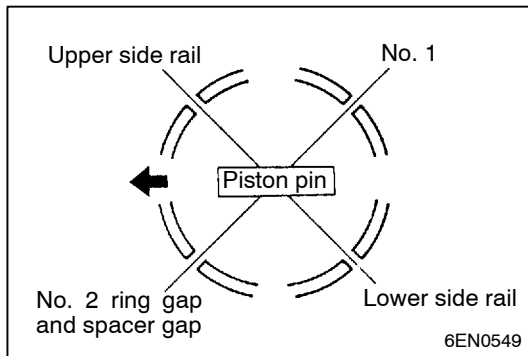


▶C◀ PISTON RING NO. 2 / PISTON RING NO. 1

- (1) Using piston ring expander, fit No. 2 and then No. 1 piston ring into position.

NOTE

- Note the difference in shape between No. 1 and No. 2 piston rings.
- Install piston rings No. 1 and No. 2 with their side having marks facing up (on the piston crown side).



►D◄ PISTON AND CONNECTING ROD

- (1) Liberally coat the circumference of the piston, piston ring, and oil ring with engine oil.
- (2) Arrange the piston ring and oil ring gaps (side rail and spacer) as shown in the figure.
- (3) Rotate the crankshaft so that the crank pin is positioned at the centre line of the cylinder bore.
- (4) Use suitable thread protectors on connecting rod bolts before inserting piston and connecting rod assembly into cylinder block.
- (5) Using a suitable piston ring compressor tool, install piston and connecting rod assembly into cylinder block.

Caution

- Install the piston with the front mark (arrow mark) on the top of the piston facing towards the engine front (timing belt side).

►E◄ CONNECTING ROD CAP

- (1) Mate the correct bearing cap with the correct connecting rod by checking with the alignment marks marked during disassembly. If a new connecting rod is used which has no alignment mark, position the notches for locking the bearing on the same side.
- (2) Check if the thrust clearance in the connecting rod big end is correct.

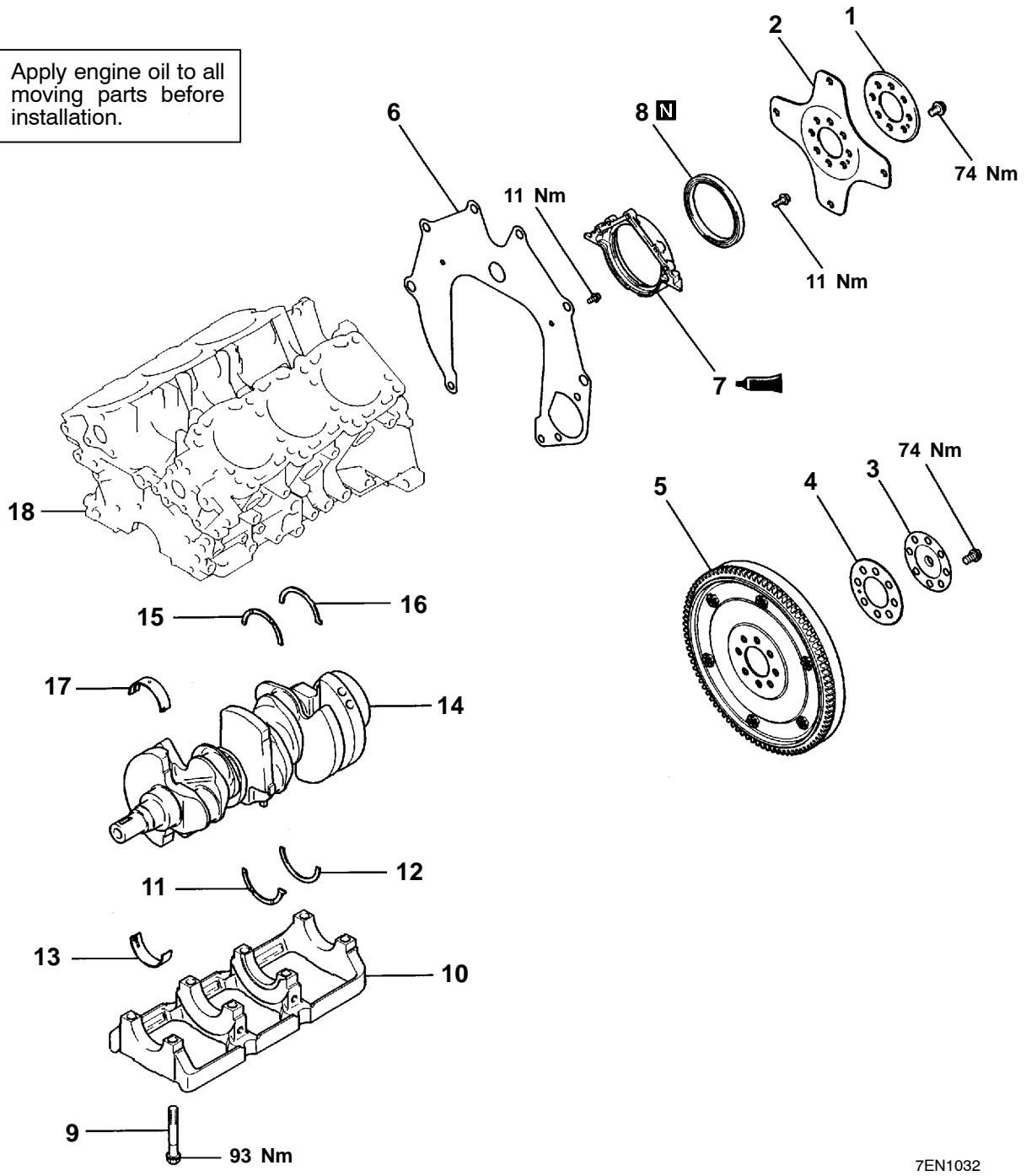
Standard value: 0.10 - 0.25 mm

Limit: 0.4 mm

13. CRANKSHAFT, FLYWHEEL AND DRIVE PLATE

REMOVAL AND INSTALLATION

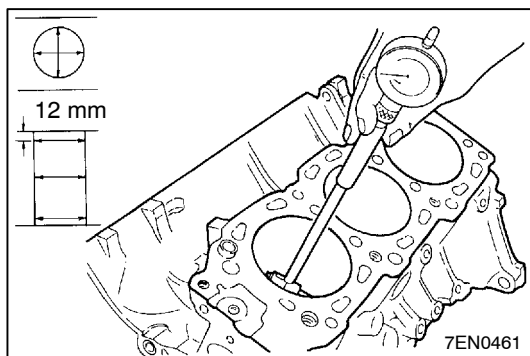
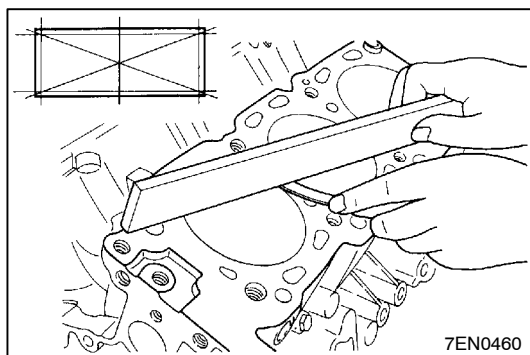
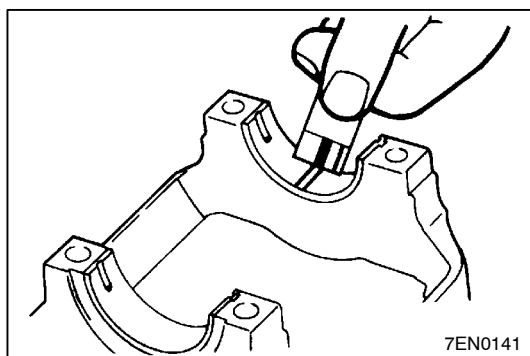
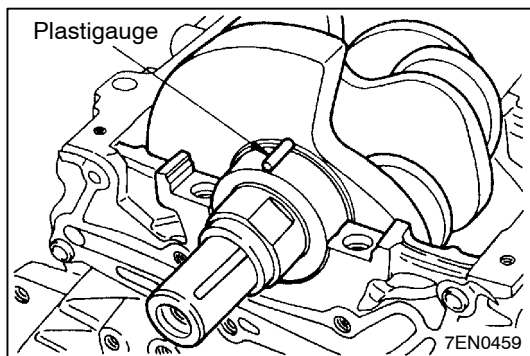
Apply engine oil to all moving parts before installation.



7EN1032

Removal steps

- | | |
|---------------------|------------------------------------|
| 1. Adaptor plate | ▶B◀ 10. Bearing cap |
| 2. Drive plate | ▶A◀ 11. Thrust bearing (A) |
| 3. Plate | ▶A◀ 12. Thrust bearing (B) |
| 4. Adaptor plate | ▶A◀ 13. Crankshaft bearing (lower) |
| 5. Flywheel | ▶A◀ 14. Crankshaft |
| 6. Rear plate | ▶A◀ 15. Thrust bearing (B) |
| 7. Oil seal case | ▶A◀ 16. Thrust bearing (A) |
| 8. Oil seal | ▶A◀ 17. Crankshaft bearing (upper) |
| 9. Bearing cap bolt | ▶A◀ 18. Cylinder block |



INSPECTION

CRANKSHAFT OIL CLEARANCE (PLASTIGAUGE METHOD)

NOTE

If the oil clearance exceeds the limit, replace the bearing, and crankshaft if necessary.

This crankshaft oil clearance can be measured easily by using a plastic gauge, as follows:

- 1 Remove oil and grease and any other foreign material from crankshaft journal and bearing inner surface.
- 2 Install the crankshaft.
- 3 Cut the plastigauge to the same length as the width of bearing and place it on journal in parallel with its axis.
- 4 Gently place the crankshaft bearing cap over it and tighten the bolts to the specified torque.
- 5 Remove the bolts and gently remove the crankshaft bearing cap.
- 6 Measure the width of the crushed plastic gauge at its widest section by using a scale printed on the plastigauge package.

Standard values: 0.02 - 0.04 mm

Limit: 0.1 mm

CYLINDER BLOCK

- (1) Visually check for scratches, rust and corrosion. Also use flaw detecting agents and the like to check for cracks. If there are any defects, rectify the cylinder block.
- (2) Measure the flatness of the cylinder block top surface with a straight edge and a thickness gauge. During measurement, the cylinder block top surface must be free from gasket pieces and the like.

Standard values: 0.05 mm

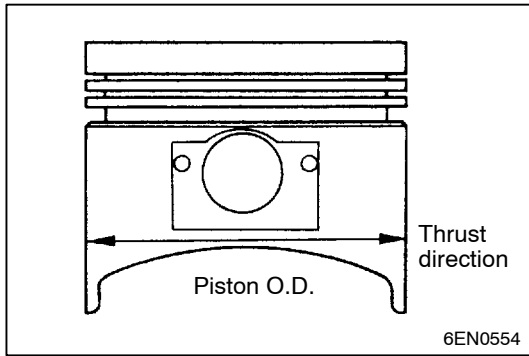
Limit: 0.1 mm

- (3) Check for scratches or seizure of the cylinder wall. If there are any defects, correct (bore it a oversize) or change the cylinder block.
- (4) Measure the inside diameter and the ovality of the cylinder. If the cylinder is overly worn, correct it to a larger size and change the pistons and the piston rings.

Standard value:

Cylinder inside diameter 91.1 mm

Ovality: 0.01 mm



BORING CYLINDER

- (1) Oversize pistons to be used should be determined on the basis of the largest bore cylinder.

Piston size identification

| Size | Identification mark |
|--------------|---------------------|
| 0.50 mm O.S. | 0.50 |
| 1.00 mm O.S. | 1.00 |

NOTE

Size mark is stamped on the piston top.

- (2) Measure outside diameter of piston to be used. Measure it in thrust direction as shown.
- (3) Based on the measured piston O.D., calculate the boring finish dimension.

Boring finish dimension = Piston O.D. + (Clearance between piston O.D. and cylinder) - 0.02 mm (honing margin)

- (4) Bore all cylinders to the calculated boring finish dimension.

Caution

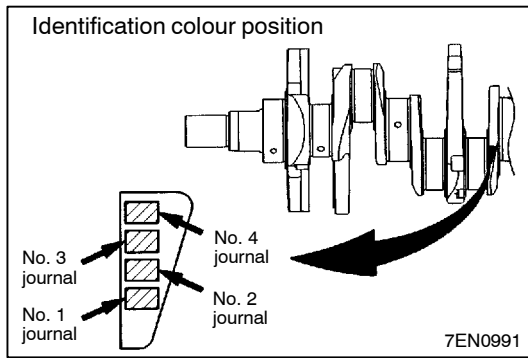
- To prevent distortion that may result from temperature rise during honing, bore cylinders, in the order of No. 1, No. 2, No. 3, No. 4, No. 5 and No. 6.

- (5) Hone to the final finish dimension (Piston O.D. + clearance between piston O.D. and cylinder.)
- (6) Check the clearance between piston and cylinder.

**Clearance between piston and cylinder:
0.02 - 0.04 mm**

NOTE

When boring cylinders, finish all of four cylinders to the same oversize. Do not bore only one cylinder to an oversize.

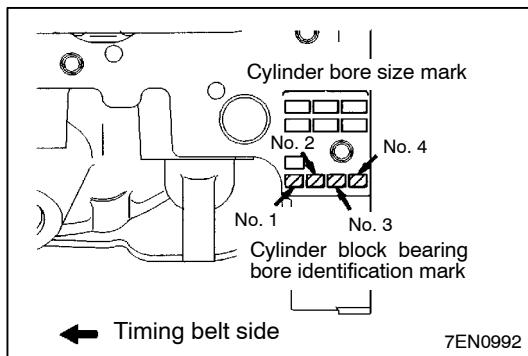


INSTALLATION SERVICE POINTS

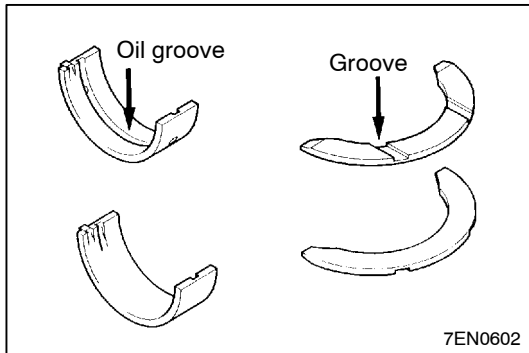
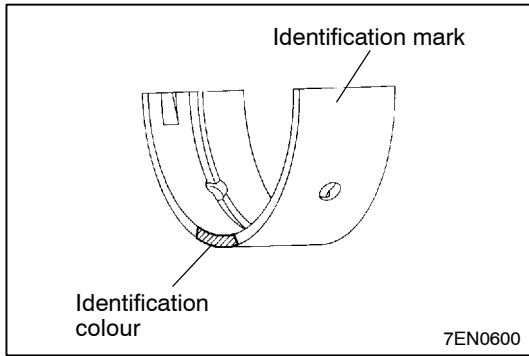
▶A◀ CRANKSHAFT BEARING

When bearing replacement is required, select and install the correct bearing by the following procedure.

- (1) Measure the crankshaft journal diameter and confirm its classification from the following table. In the case of a crankshaft supplied as a service part, identification colours/marks of its journals are painted/stamped at the positions shown in the illustration.
- (2) The cylinder block bearing bore diameter identification marks are stamped at the position shown in the illustration from left to right, beginning at No. 1.



| Combination of crankshaft journal diameter and cylinder block bearing bore diameter | | | | Cylinder block bearing bore diameter identification mark | Bearing identification colour or identification mark (for service part) |
|---|-----------------------|--------------|-----------------|--|---|
| Crankshaft journal | | | | | |
| Classification | Identification colour | | O.D. mm | | |
| | Production part | Service part | | | |
| 1 | None | Yellow, 0 | 59.994 - 60.000 | I | Pink, 1 |
| | | | | II | Red, 2 |
| | | | | III | Green, 3 |
| 2 | None | None, 1 | 59.988 - 59.994 | I | Red, 2 |
| | | | | II | Green, 3 |
| | | | | III | Black, 4 |
| 3 | None | White, 2 | 59.982 - 59.988 | I | Green, 3 |
| | | | | II | Black, 4 |
| | | | | III | Brown, 5 |



- (3) Select the correct bearing from the above table on the basis of the identification data confirmed at steps 1 and 2.

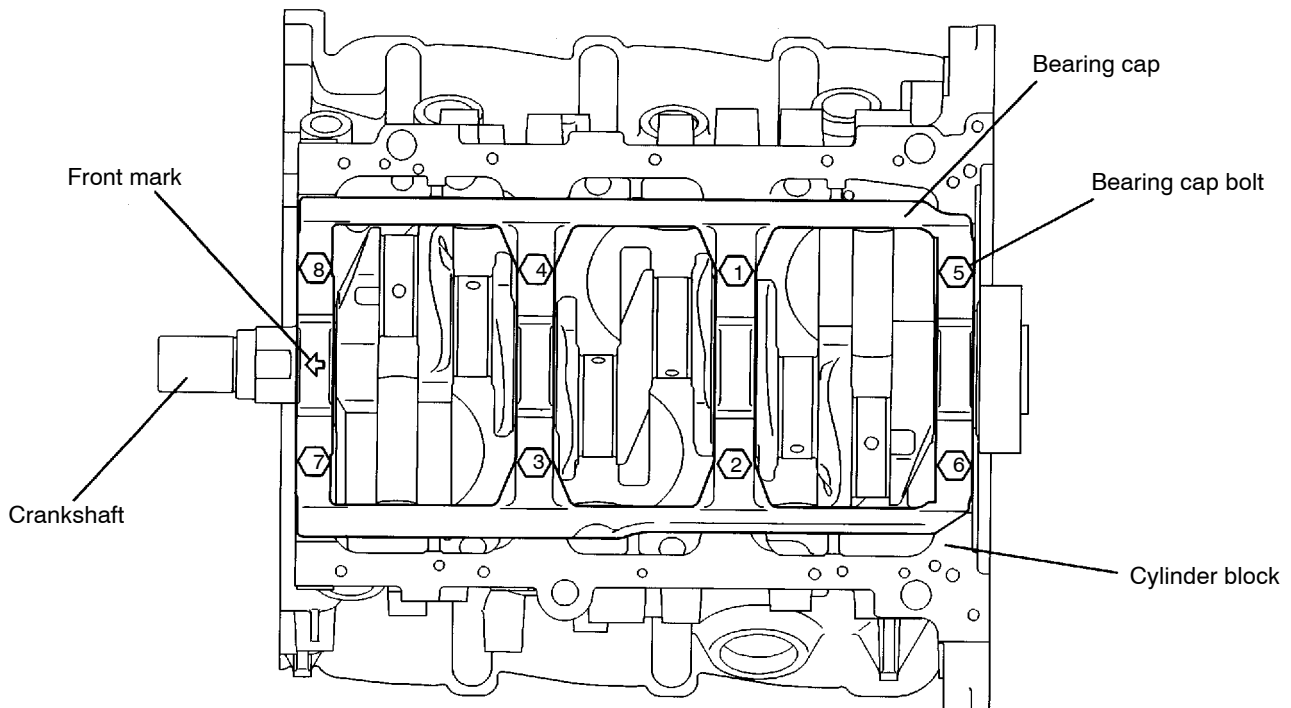
Example

- If the measured value of a crankshaft journal outer diameter is 59.996 mm, the journal is classified as "1" in the table.
In case the crankshaft is also replaced by a spare part, check the identification colours of the journals painted on the new crankshaft. If the colour is yellow, for example, the journal is classified as "1".
- Next, check the cylinder block bearing bore identification mark stamped on the cylinder block. If it is "1", read the "Bearing identification colour" column to find the identification colour of the bearing to be used. In this case, it is "pink".

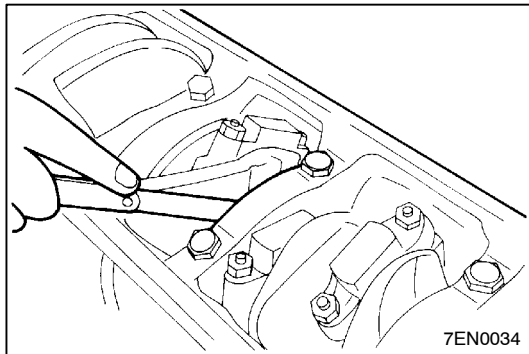
- (4) Install the bearing halves with oil groove on the cylinder block side.
- (5) Install the bearing halves without oil groove on the bearing cap side.
- (6) Install the thrust bearings on both sides of the No. 3 bearing with the grooves facing outward.

►B◄ BEARING CAP / BEARING BOLT

- (1) Attach the bearing cap on the cylinder block as shown in the figure.
- (2) Tighten the bearing cap bolts to the specified torque in the sequence shown in the figure.
- (3) Check that the crankshaft rotates smoothly.



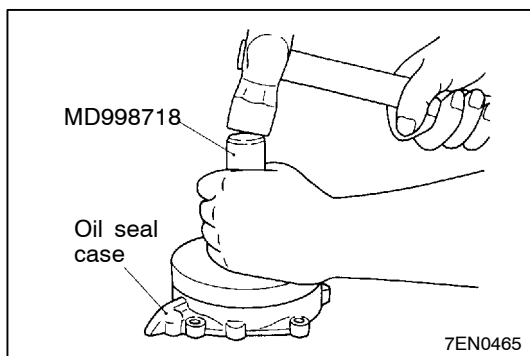
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- (4) Check the end play. If it exceeds the limit value, replace the thrust bearing.

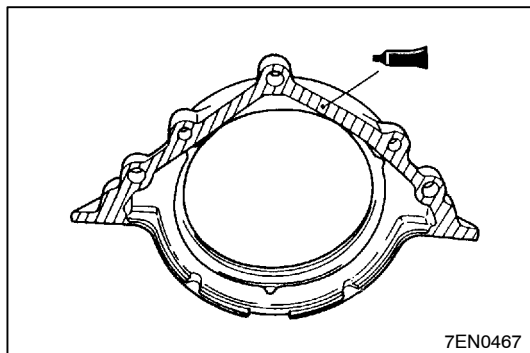
Standard value: 0.05 - 0.25 mm

Limit: 0.3 mm



▶C◀ CRANKSHAFT REAR OIL SEAL

- (1) Using the Special Tool, press-fit a new crankshaft rear oil seal into the seal case.



▶D◀ OIL SEAL CASE

- (1) Squeeze out a 3 mm bead of liquid gasket (FIPG) and apply it to the coating surface.

Liquid gasket:

mitsubishi GENUINE Part No. MD970389

NOTES