

# ENGINE OVERHAUL <1.8L>

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11309000371

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## GENERAL INFORMATION

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## GENERAL SPECIFICATION

Descriptions		Specifications	
Type		In-line OHV, SOHC	
Number of cylinders		4	
Combustion chamber		Pentroof type	
Total displacement dm <sup>3</sup> (cu.in.)		1,834 (111.9)	
Cylinder bore mm (in.)		81.0 (3.19)	
Piston stroke mm (in.)		89.0 (3.50)	
Compression ratio		9.5	
Number of valve		Intake	8
		Exhaust	8
Valve timing	Intake valve	Opens (BTDC)	6°
		Closes (ABDC)	54°
	Exhaust valve	Opens (BBDC)	54°
		Closes (ATDC)	6°
Lubrication system		Pressure feed, full-flow filtration	
Oil pump type		Trochoid type	
Cooling system		Water-cooled forced circulation	
Water pump type		Centrifugal impeller type	

## SPECIFICATIONS

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## SERVICE SPECIFICATIONS

Items		Standard value	Limit
<b>Rocker arms and camshaft</b>			
Camshaft cam height mm (in.)	Intake	37.11 (1.46)	36.61 (1.44)
	Exhaust	37.15 (1.46)	36.65 (1.44)
<b>Cylinder head and valve</b>			
Cylinder head flatness of gasket surface mm (in.)		Less than 0.03 (.0012)	0.2 (.008)
Cylinder head grinding limit of gasket surface mm (in.) *Total resurfacing depth of both cylinder head and cylinder block		-	0.2* (.008)
Cylinder head overall height mm (in.)		119.9 - 120.1 (4.720 - 4.728)	-
Cylinder head bolt shank length mm (in.)		-	96.4 (17.23)
Valve stem O.D. mm (in.)		6.0 (.234)	-
Valve stem-to-guide clearance mm (in.)	Intake	0.02 - 0.05 (.0008 - .0020)	0.10 (.0039)
	Exhaust	0.05 - 0.09 (.0020 - .0035)	0.15 (.0059)
Valve face angle		45° - 45.5°	-
Valve margin mm (in.)	Intake	1.0 (.039)	0.5 (.020)
	Exhaust	1.3 (.051)	0.8 (.031)
Valve stem projection mm (in.)	Intake	49.30 (1.9409)	49.80 (1.9606)
	Exhaust	49.35 (1.9429)	49.85 (1.9626)
Overall valve length mm (in.)	Intake	110.15 (4.337)	109.65 (4.317)
	Exhaust	113.70 (4.476)	113.20 (4.457)
Valve spring free height mm (in.)		50.9 (2.00)	49.9 (1.96)
Valve spring load/installed height N/mm (lbs./in.)		216/44.2 (59/1.74)	-
Valve spring squareness		Max. 2°	4°
Valve seat contact width mm (in.)		0.9 - 1.3 (.035 - .051)	-
Valve guide I.D. mm (in.)		6.0 (.234)	-
Valve guide projection mm (in.)		14.0 (.551)	-
<b>Oil pump and oil pan</b>			
Oil pump tip clearance mm (in.)		0.06 - 0.18 (.0024 - .0071)	-
Oil pump side clearance mm (in.)		0.04 - 0.10 (.0016 - .0039)	-
Oil pump body clearance mm (in.)		0.10 - 0.18 (.0039 - .0071)	0.35 (.0138)
<b>Piston and connecting rod</b>			
Piston O.D. mm (in.)		81.0 (3.19)	-
Piston ring side clearance mm (in.)	No.1	0.03 - 0.07 (.0012 - .0028)	0.1 (.0039)
	No.2	0.02 - 0.06 (.0008 - .0024)	0.1 (.0039)
Piston ring end gap mm (in.)	No.1	0.25 - 0.40 (.0098 - .0157)	0.8 (.031)
	No.2	0.40 - 0.55 (.0157 - .0217)	0.8 (.031)
	Oil ring	0.20 - 0.60 (.0078 - .0236)	1.0 (.039)

Items	Standard value	Limit
Piston pin O.D. mm (in.)	19.0 (.75)	-
Piston pin press-in load [at room temperature] N (lbs.)	4900 - 14700 (1.1020 - 3.3070)	-
Crankshaft pin oil clearance mm (in.)	0.02 - 0.05 (.0008 - .0020)	0.1 (.004)
Connecting rod big end side clearance mm (in.)	0.10 - 0.25 (.0039 - .0098)	0.4 (.016)
<b>Crankshaft and cylinder block</b>		
Crankshaft end play mm (in.)	0.05 - 0.25 (.0020 - .0098)	0.4 (.016)
Crankshaft journal O.D. mm (in.)	50 (1.97)	-
Crankshaft pin O.D. mm (in.)	45 (1.77)	-
Crankshaft journal oil clearance mm (in.)	0.02 - 0.02 (.0008 - .0016)	0.1 (.004)
Cylinder block gasket surface flatness mm (in.)	0.05 (.0020)	0.1 (.004)
Cylinder block gasket surface grinding limit mm (in.)	-	0.2 (.008)
Cylinder block overall height mm (in.)	263.5 (10.374)	-
Cylinder bore I.D. mm (in.)	81.0 (3.19)	-
Cylinder bore cylindricity mm (in.)	0.01 (.0004) or less	-
Piston-to-cylinder clearance mm (in.)	0.02 - 0.04 (.0008 - .0016)	-
Bearing cap bolt shank length mm (in.)	-	71.1 (2.799)

## REWORK DIMENSIONS

Items	Standard value	
<b>Cylinder head and valves</b>		
Oversize valve guide hole diameter mm (in.)	0.05 O.S.	11.05 - 11.07 (.4350 - .4358)
	0.25 O.S.	11.25 - 11.27 (.4429 - .4337)
	0.50 O.S.	11.50 - 11.52 (.4528 - .4535)
Oversize intake valve seat hole diameter mm (in.)	0.30 O.S.	31.80 - 31.83 (1.2520 - 1.2531)
	0.60 O.S.	32.10 - 32.13 (1.2638 - 1.2650)
Oversize exhaust valve seat hole diameter mm (in.)	0.30 O.S.	29.30 - 29.32 (1.1535 - 1.1543)
	0.60 O.S.	29.60 - 29.62 (1.1654 - 1.1661)

NOTE  
O.S.: Oversize diameter

**TORQUE SPECIFICATIONS**

Items	Nm	ft.lbs.
<b>Generator and ignition system</b>		
Ignition coil	10	7
Spark plug	25	18
Crankshaft bolt	181	131
Generator brace (M10)	49	35
Generator brace (M8)	23	17
Lock bolt	23	17
Adjusting bolt	10	7
Generator pivot nut	44	32
Ignition failure sensor	23	17
Cam position sensor	9	7
Cam position sensor support	13	9
Cam position sensing cylinder	21	15
<b>Timing belt</b>		
Camshaft sprocket bolt	88	64
Crank angle sensor	9	6
Timing belt rear cover	11	8
Timing belt tensioner	23	17
Engine support bracket, right	49	35
Timing belt cover	11	8
<b>Fuel system and emission system</b>		
Fuel return pipe	9	7
Fuel rail	12	9
Fuel pressure regulator	9	7
EGR Valve	22	16
Throttle body	19	14
Vacuum hose and pipe assembly	11	8
<b>Intake manifold and exhaust manifold</b>		
Manifold differential pressure sensor	5	4
Exhaust manifold (M10)	29	21
Exhaust manifold (M8)	18	13
Exhaust manifold bracket	19	14
Engine hanger	18	9
Oil dipstick guide	14	10
Exhaust manifold cover	13	9
Intake manifold	20	15
Intake manifold stay	30	22

Items	Nm	ft.lbs.
<b>Water pump and water hose</b>		
Water pump	24	17
Water inlet pipe	14	10
Thermostat case	24	17
Water inlet fitting	18	14
Water outlet fitting	14	10
Engine coolant temperature gauge unit	10	7
Engine coolant temperature sensor	29	21
<b>Rocker arms and camshaft</b>		
Rocker arm shaft	31	22
Rocker cover	4	3
<b>Cylinder head and valves</b>		
Cylinder head bolt [74 Nm (54 ft.lbs.) and then completely loosen finally tighten]	20 + 90° + 90°	15 + 90° + 90°
<b>Oil pump and oil pan</b>		
Oil pump cover	10	7
Front case	14	10
Relief plug	44	32
Oil screen	19	14
Oil pan	7	5
Drain plug	39	28
Oil pressure switch	10	7
<b>Piston and connecting rod</b>		
Connecting rod cap nut	20 + 90° to 100°	15 + 90° to 100°
<b>Crankshaft and cylinder block</b>		
Bearing cap bolt	25 + 90° to 100°	18 + 90° to 100°
Oil seal case	11	8
Bell housing cover	9	7
Rear plate	11	8
Drive plate bolt	98	71
Flywheel bolt	98	71

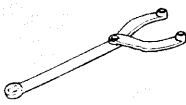
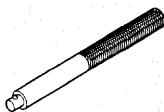
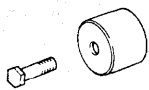


## SEALANT

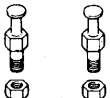

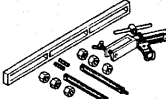
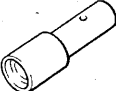

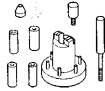
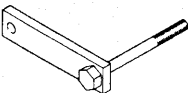
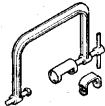
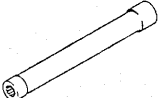
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Items	Specified sealant	Quantity
Water pump	Mitsubishi Genuine Part No.MD970389 or equivalent	As required
Thermostat case	Mitsubishi Genuine Part No.MD970389 or equivalent	As required
Engine coolant temperature sensor	3M Nut Locking Part No.4171 or equivalent	As required
Engine coolant temperature gauge unit	3M ATD Part No.8660 or equivalent	As required
Oil pressure switch	3M ATD Part No.8660 or equivalent	As required
Water outlet fitting	Mitsubishi Genuine Part No.MD970389 or equivalent	As required
Front case	Mitsubishi Genuine Part No.MD970389 or equivalent	As required
Oil pan	Mitsubishi Genuine Part No.MD970389 or equivalent	As required
Oil seal case	Mitsubishi Genuine Part No.MD970389 or equivalent	As required
Drive plate bolt	3M Nut Locking Part No.4171 or equivalent	As required
Flywheel bolt	3M Nut Locking Part No.4171 or equivalent	As required
Cam position sensor support	Mitsubishi Genuine Part No.MD970389 or equivalent	As required


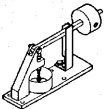

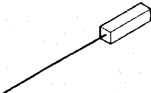

## SPECIAL TOOLS

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Tool	Tool number and name	Supersession	Application
	MB990767 End yoke holder Use with MD998719	MB990767-01 Use with MIT308239	Holding camshaft sprocket when loosening or torquing bolt
	MB990938 Handle	MB990938-01	Installation of crankshaft rear oil seal
	MD998713 Camshaft oil seal installer	MD998713-01	Installation of camshaft oil seal
	MD998716 Crankshaft wrench	MD998716-01	Turning crankshaft
	MD998717 Crankshaft front oil seal installer	MD998717-01	Installation of crankshaft front oil seal

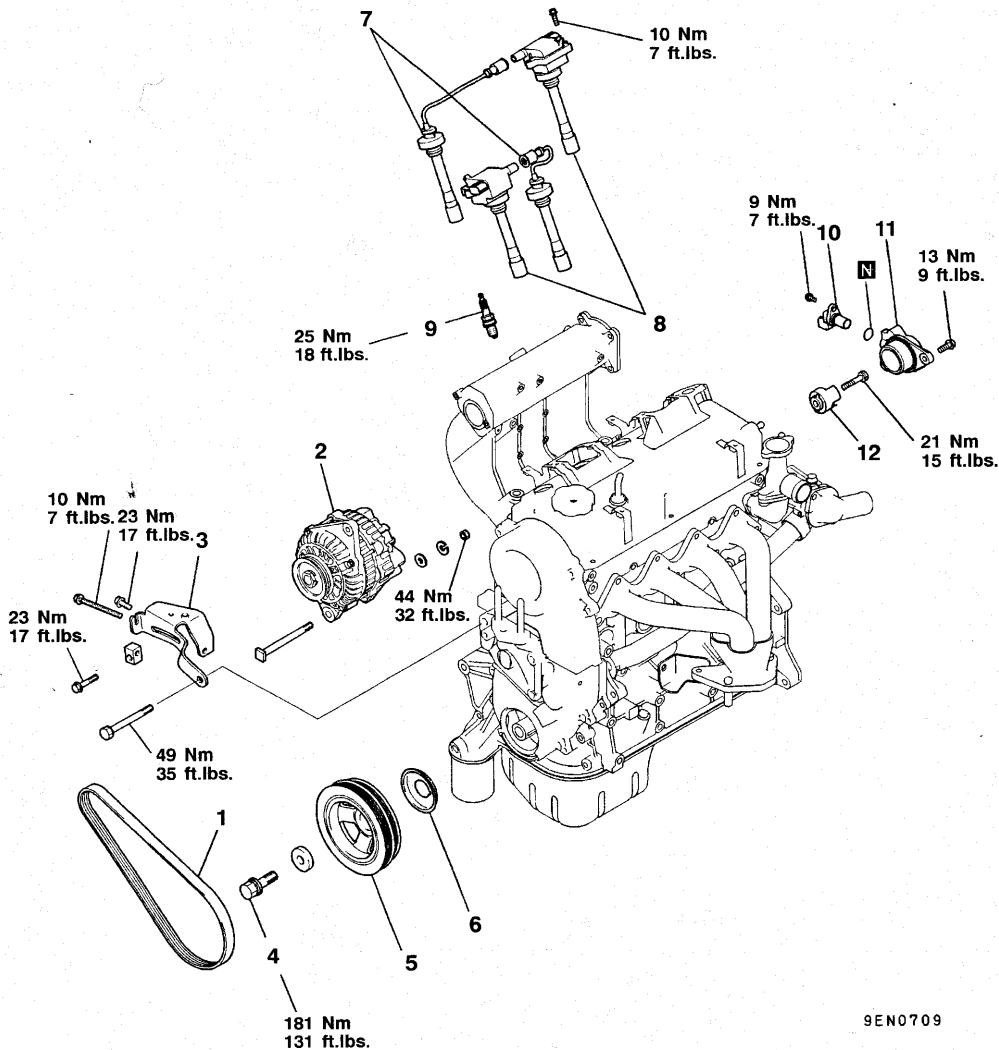
Tool	Tool number and name	Supersession	Application
	MD998719 Pulley holding pins (2)	MIT308239	Holding camshaft sprocket when loosening or torquing bolt
	MD998727 Oil pan remover	-	Removal of oil pan
	MD998772 Valve spring compressor	General service tool	Compressing valve spring
	MD998774 Valve stem seal installer	-	Installation of valve stem seal
	MD998776 Crankshaft rear oil seal installer Use with MB990938	Use with MB990938-01	Installation of crankshaft rear oil seal
	MD998780 Piston pin setting tool	MIT216941	Removal and installation of piston pin
	MD998781 Flywheel stopper	-	Holding flywheel
	MD998735 Valve spring compressor	MD998735-01	Compression of valve spring
	MB991653 Cylinder head bolt wrench	-	Loosening and torquing of cylinder head bolt



Tool	Tool number and name	Supersession	Application
	MB991659 Guide D	-	Removal of piston pin (Use with MD998780)
	MD998440 Leak down tester	-	Leak down test of lash adjuster
	MD998441 Lash adjuster retainer	-	Air bleeding of lash adjuster
	MD998442 Air bleed wire		Air bleeding of lash adjuster
	MD998443 Lash adjuster holder (8)	MD998443-01	Supporting lash adjuster to prevent it from falling when rocker arm shaft assembly is removed or installed.

# GENERATOR AND IGNITION SYSTEM

## REMOVAL AND INSTALLATION



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### Removal steps

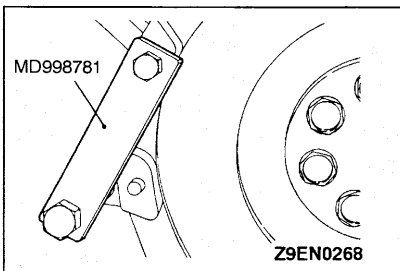
1. Drive belt
2. Generator
3. Generator brace
4. Crankshaft bolt
5. Crankshaft pulley
6. Front flange

7. Spark plug cable
8. Ignition coil
9. Spark plug
10. Cam position sensor
11. Cam position sensor support
12. Cam position sensing cylinder



**REMOVAL SERVICE POINT****◀A▶ CRANKSHAFT BOLT REMOVAL**

- (1) Lock the flywheel or drive plate in position using the special tool shown in the illustration, then loosen the crankshaft bolt.

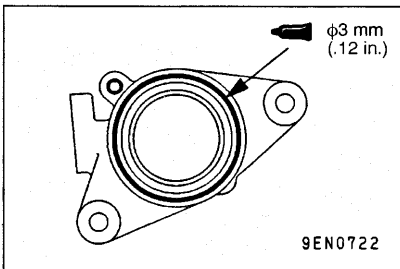
**INSTALLATION SERVICE POINTS****▶A◀ CAM POSITION SENSOR SUPPORT INSTALLATION**

- (1) Clean the sealant application surfaces of cam position sensor support and cylinder head.
- (2) Apply a 3 mm (.12 in.) diameter bead of sealant to the area shown in the illustration. Be sure to install the sensor support within 15 minutes after applying sealant.

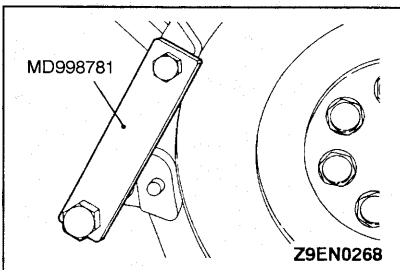
**Specified sealant:**

**Mitsubishi Genuine Part No. MD970389 or equivalent.**

- (3) After installation, wait at least one hour. Never start the engine or let engine oil touch the adhesion surface during that time.

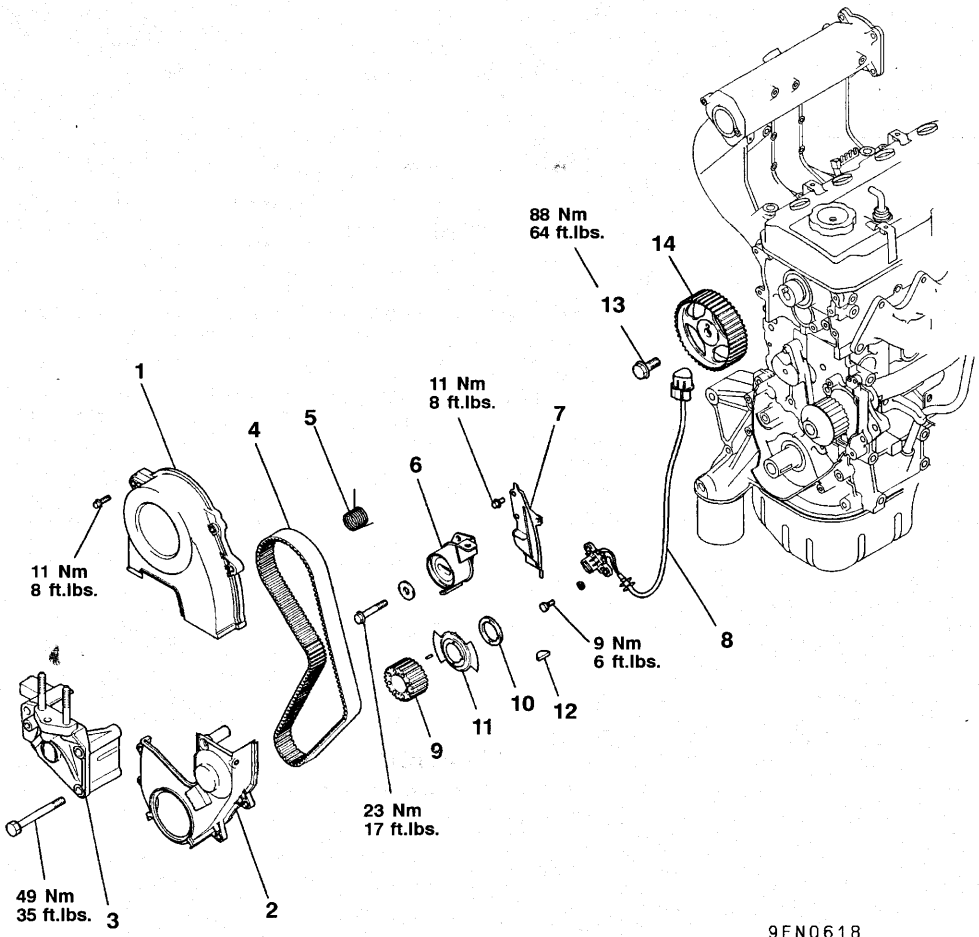
**▶B◀ CRANKSHAFT BOLT INSTALLATION**

- (1) Lock the flywheel or drive plate in position using the special tool shown in the illustration, then tighten the crankshaft bolt.



# TIMING BELT

## REMOVAL AND INSTALLATION

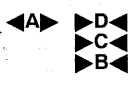


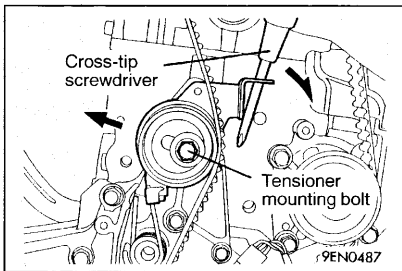
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### Removal steps

1. Timing belt front upper cover
2. Timing belt front lower cover
3. Engine support bracket, right
4. Timing belt
5. Tensioner spring
6. Timing belt tensioner
7. Timing belt rear cover

8. Crankshaft angle sensor
9. Crankshaft sprocket
10. Crankshaft spacer
11. Crankshaft sensing plate
12. Crankshaft key
13. Camshaft sprocket bolt
14. Camshaft sprocket

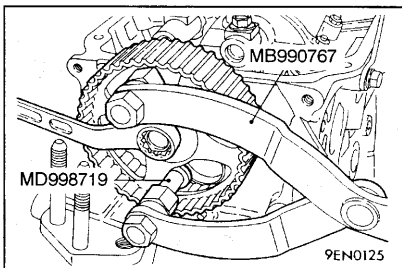
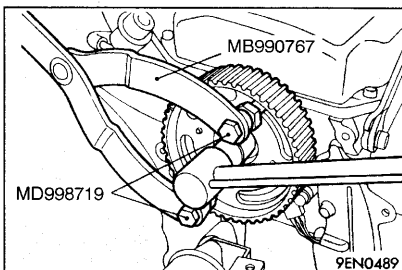
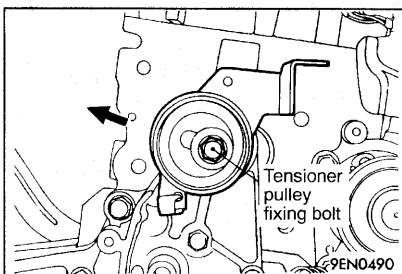


**REMOVAL SERVICE POINTS****◀A▶ TIMING BELT REMOVAL**

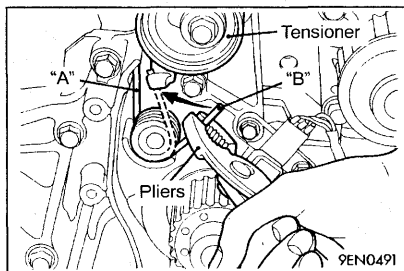
- (1) Mark the belt running direction for reference in reinstallation.
- (2) Loosen the tensioner mounting bolt.
- (3) Insert a cross-tip screwdriver into the hole of the tensioner arm as shown illustration.
- (4) Move the screwdriver all the way in the direction of the arrow, and tighten the tensioner mounting bolt to hold this position.
- (5) Remove the timing belt.

**NOTE**

- (1) Water oil on the belt shortens its life drastically, so the removed timing belt, sprocket, and tensioner must be kept free from oil and water. Do not immerse parts in cleaning solvent.
- (2) If there is oil or water on any part, check the front case oil seal, camshaft oil seal and water pump for leaks.

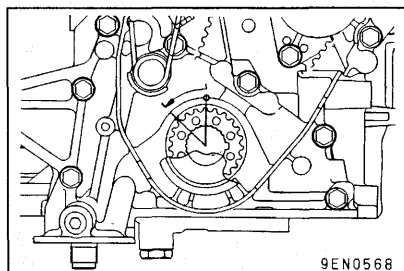
**◀B▶ CAMSHAFT SPROCKET BOLT LOOSENING****INSTALLATION SERVICE POINTS****▶A▶ CAMSHAFT SPROCKET BOLT TIGHTENING****▶B▶ TIMING BELT TENSIONER INSTALLATION**

- (1) Install the timing belt tensioner in the illustrated position, and then tighten the tensioner mounting bolt.



### ►C◀ TENSIONER SPRING INSTALLATION

- (1) Install the tensioner spring onto the boss of the front case, and then hook the spring end "A" (shorter one) to the front case rib.
- (2) Grip the spring end "B" (longer one), and then hook it onto the tensioner arm.

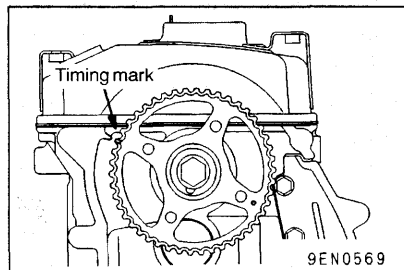


### ►D◀ TIMING BELT INSTALLATION

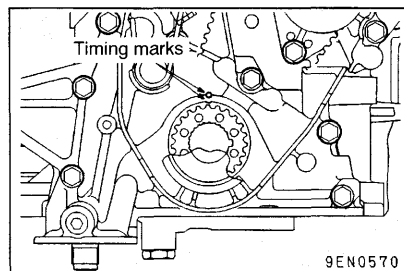
- (1) Align the crankshaft sprocket timing mark with the timing mark on the front case, and then rotate the crankshaft sprocket three teeth counterclockwise.

#### Caution

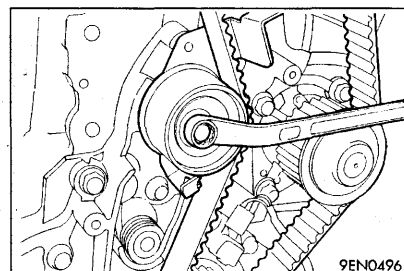
**Aligning the timing marks positions the piston to the top dead center. Then, if the camshaft turns, the valves might interfere and damage the pistons.**



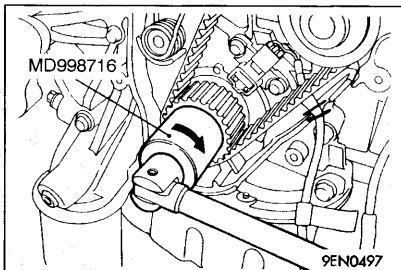
- (2) Align the camshaft sprocket timing mark with the timing mark on the cylinder head.



- (3) Rotate the crankshaft sprocket three teeth counterclockwise, and align the crankshaft sprocket timing mark with the timing mark on the front case.
- (4) Keeping the tension side of the timing belt tight, fit the timing belt onto the crankshaft sprocket, water pump sprocket, camshaft sprocket and tensioner puller in that order.



- (5) Slightly loosen the timing belt tensioner bolt to tension the belt by a force of the tensioner spring.

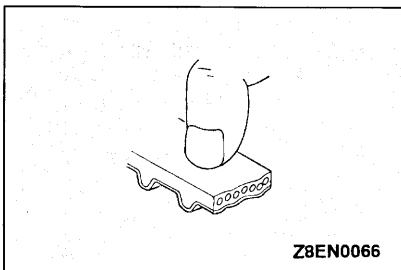


- (6) Turn the crankshaft twice in the clockwise direction.

### Caution

This procedure utilizes the camshaft's driving torque to apply tension evenly to the timing belt. Be sure to turn the crankshaft as described above. Do not turn the crankshaft counterclockwise.

- (7) Check that the timing marks are correctly aligned.  
 (8) Tighten the timing belt tensioner locking bolt to the specified torque.



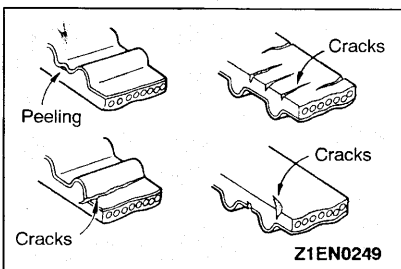
## INSPECTION

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### TIMING BELT

Check the timing belt closely. Replace the belt with a new one if any of the following defects are evident:

- (1) Hardened backing rubber (the backing rubber is glossy, non-elastic, and so hard that scratching with fingernails leaves no mark.)

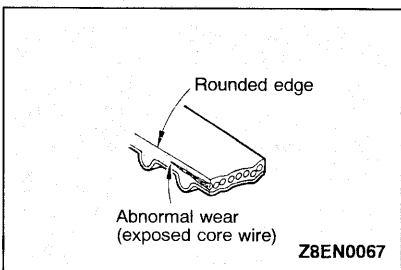


- (2) Surface cracks on the backing rubber.

- (3) Cracks or peeling of the canvas.

- (4) Cracks on the tooth bottom.

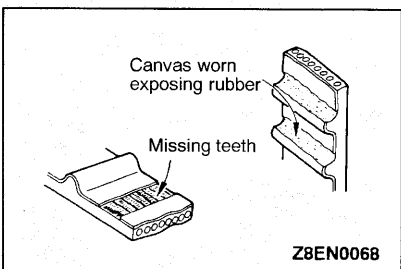
- (5) Cracks on the belt sides.



- (6) Abnormal wear on the belt sides.

### NOTE

The sides of the belt are normal if they are sharp as if cut by a knife.

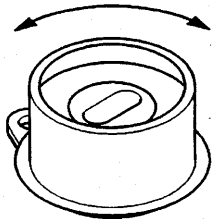


- (7) Abnormal wear on teeth.

Initial stage: Canvas worn (fluffy canvas fibers, rubbery texture gone, white discoloration, canvas texture indistinct)

Final stage: Canvas worn, exposing rubber (tooth width reduced)

- (8) Missing teeth.



1EN0538

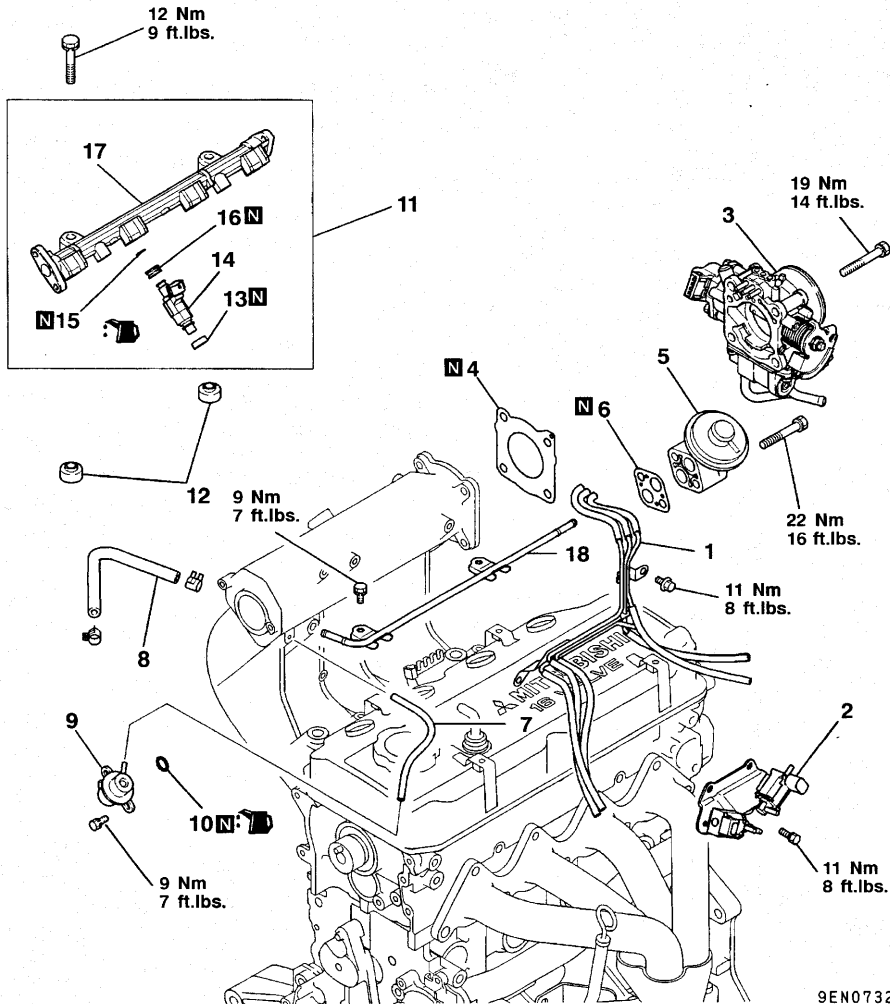
**TENSIONER PULLER**

- (1) Check the pulley for smooth rotation, without play and are not noisy.



# FUEL AND EMISSION CONTROL SYSTEM

## REMOVAL AND INSTALLATION



9E0732

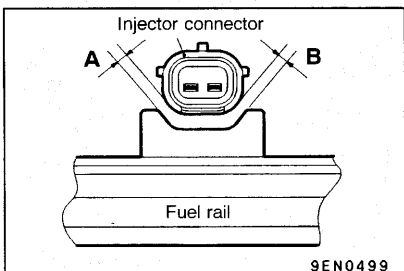
### Removal steps

- |                       |  |  |
|-----------------------|--|--|
| <p>▶C◀</p> <p>▶B◀</p> | <ol style="list-style-type: none"> <li>1. Vacuum hose and pipe assembly</li> <li>2. Solenoid valve assembly</li> <li>3. Throttle body</li> <li>4. Gasket</li> <li>5. EGR valve</li> <li>6. EGR valve gasket</li> <li>7. Vacuum hose</li> <li>8. Fuel hose</li> <li>9. Fuel pressure regulator</li> </ol> | <ol style="list-style-type: none"> <li>10. O-ring</li> <li>11. Fuel rail and injector</li> <li>12. Insulator</li> <li>13. Insulator</li> <li>14. Injector</li> <li>15. O-ring</li> <li>16. Grommet</li> <li>17. Fuel rail</li> <li>18. Fuel return pipe</li> </ol> |
|-----------------------|--|--|

## INSTALLATION SERVICE POINTS

### ►A◄ INJECTORS INSTALLATION

(1) Fit a new O-ring and grommet onto the injector.



- (2) Apply clean engine oil or gasoline to the injector O-ring.
- (3) Fit the injector onto the fuel rail, turning it to the left and right as it goes in.
- (4) Check that the injector rotates smoothly.
- (5) Check that the clearance between the injector connector and the fuel rail is uniform ( $A = B$ ).

### ►B◄ FUEL PRESSURE REGULATOR INSTALLATION

- (1) Apply a drop of clean engine oil to the O-ring, then insert the fuel pressure regulator into the fuel rail, being careful not to damage the O-ring.

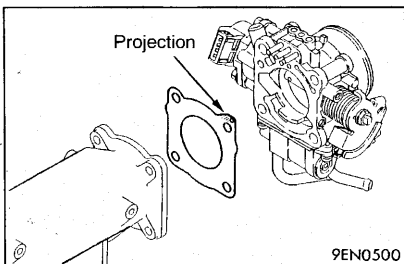
#### Caution

**Do not let engine oil get into the fuel rail.**

- (2) Check that the fuel pressure regulator rotates smoothly. If it does not rotate smoothly, the O-ring may be binding. If this occurs, remove the fuel pressure regulator, check the O-ring for damage, then re-insert the regulator into the fuel rail.

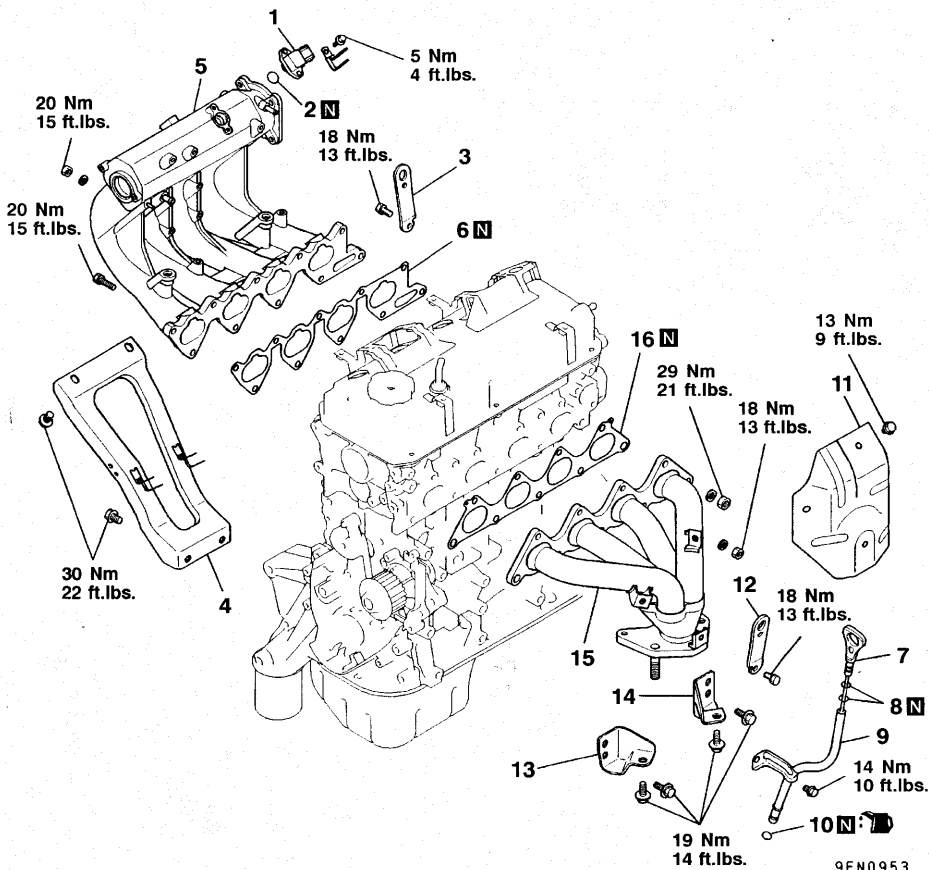
### ►C◄ GASKET INSTALLATION

- (1) Position the projection as shown in the illustration.

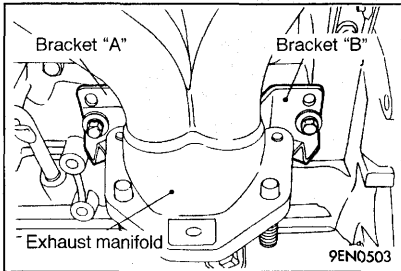


## INTAKE AND EXHAUST MANIFOLDS

## REMOVAL AND INSTALLATION

**Removal steps**

1. Manifold differential pressure sensor
2. O-ring
3. Engine hanger
4. Intake manifold stay
5. Intake manifold
6. Intake manifold gasket
7. Oil dipstick
8. O-ring
9. Oil dipstick guide
10. O-ring
11. Exhaust manifold cover
12. Engine hanger
13. Exhaust manifold bracket A
14. Exhaust manifold bracket B
15. Exhaust manifold
16. Exhaust manifold gasket



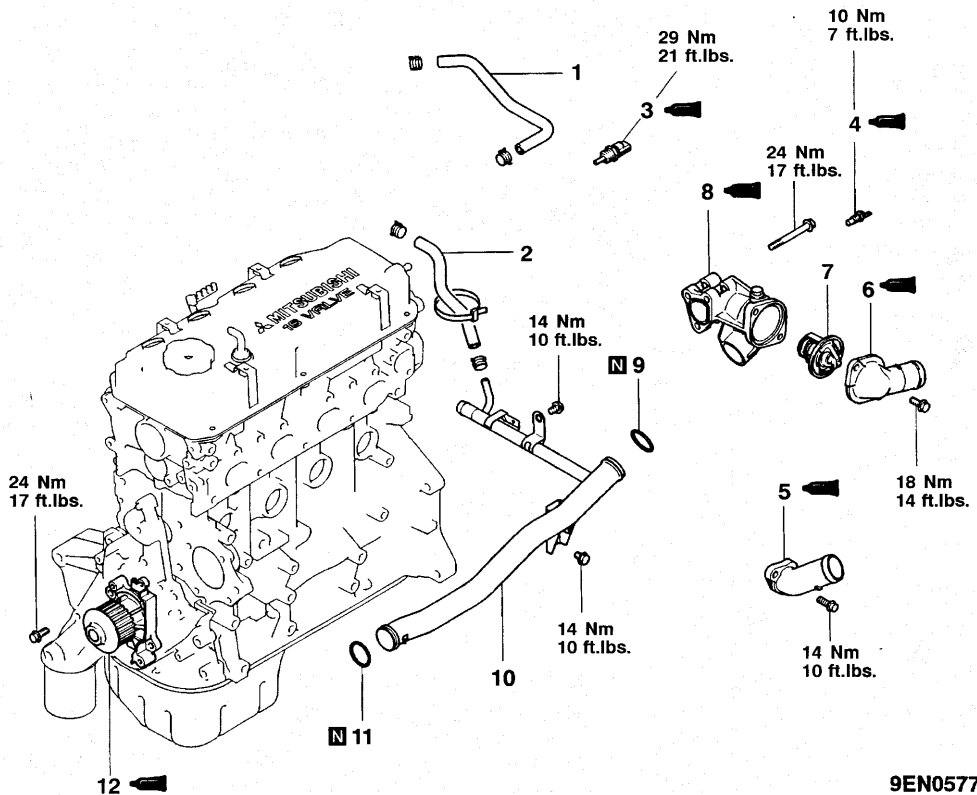
## INSTALLATION SERVICE POINT

### ▶A◀ EXHAUST MANIFOLD/BRACKET INSTALLATION

- (1) Install the exhaust manifold brackets "A" and "B" as shown in the illustration, and finger tighten each bolt.
- (2) Tighten the all bolts to the specified torque.

# WATER PUMP AND WATER HOSE

## REMOVAL AND INSTALLATION



9EN0577

### Removal steps

- 1. Water hose A
- 2. Water hose B
- ▶G▶ 3. Engine coolant temperature sensor
- ▶F▶ 4. Engine coolant temperature gauge unit
- ▶E▶ 5. Water outlet fitting
- 6. Water inlet fitting

- ▶D▶ 7. Thermostat
- ▶C▶ 8. Thermostat case
- ▶B▶ 9. O-ring
- ▶B▶ 10. Water inlet pipe
- ▶B▶ 11. O-ring
- ▶A▶ 12. Water pump

## INSTALLATION SERVICE POINTS

### ▶A◀ WATER PUMP INSTALLATION

- (1) Clean the sealant application surfaces of the water pump case and cylinder block.
- (2) Apply a 3 mm (.12 in.) diameter bead of sealant to the area shown in the illustration. Be sure to install the water pump within 15 minutes after applying sealant.

#### Specified sealant:

**Mitsubishi Genuine Part No.MD970389 or equivalent**

- (3) After installation, wait at least one hour. Never start the engine or let coolant touch the adhesion surface during that time.

### ▶B◀ WATER INLET PIPE/O-RING INSTALLATION

- (1) Replace the water inlet pipe O-ring with new ones, then apply water to the O-rings so that they can be inserted easily into the cylinder block and the thermostat case.

#### Caution

1. Never apply any oil or grease to the O-ring.
2. Secure the water pipe after the thermostat case has been installed.

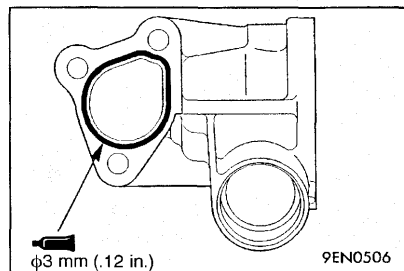
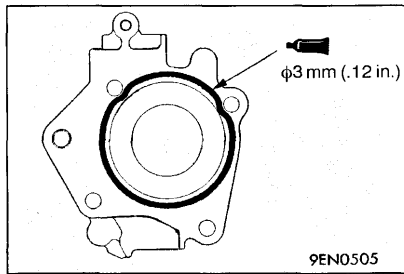
### ▶C◀ THERMOSTAT CASE INSTALLATION

- (1) Clean the sealant application surfaces of the thermostat case and cylinder head.
- (2) Apply a 3 mm (.12 in.) diameter bead of sealant to the area shown in the illustration. Be sure to install the thermostat case within 15 minutes after applying sealant.

#### Specified sealant:

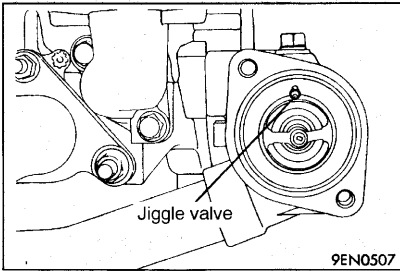
**Mitsubishi Genuine Part No.MD970389 or equivalent**

- (3) After installation, wait at least one hour. Never start the engine or let coolant touch the adhesion surface during that time.



**►D◄ THERMOSTAT INSTALLATION**

- (1) Install the thermostat so that the jiggle valve is at the top.

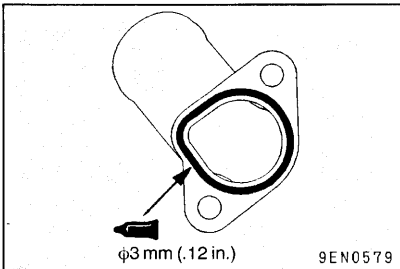
**►E◄ OUTLET FITTING INSTALLATION**

- (1) Clean the sealant application surfaces of the fittings and cylinder head.
- (2) Apply a 3 mm (.12 in.) diameter bead of sealant to the area shown in the illustration. Be sure to install the fitting within 15 minutes after applying sealant.

**Specified sealant:**

**Mitsubishi Genuine Part No.MD970389 or equivalent**

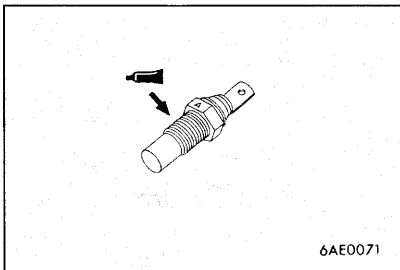
- (3) After installation, wait at least one hour. Never start the engine or let coolant touch the adhesion surface during that time.

**►F◄ ENGINE COOLANT TEMPERATURE GAUGE UNIT INSTALLATION**

- (1) When reusing the gauge unit, clean its thread.
- (2) Apply the specified sealant to the threads.

**Specified sealant:**

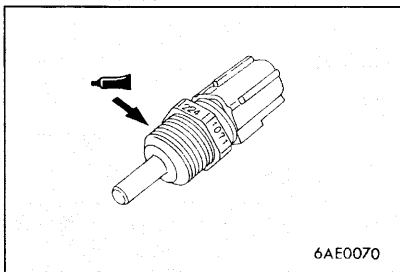
**3M Nut Locking Part No.4171 or equivalent**

**►G◄ ENGINE COOLANT TEMPERATURE SENSOR INSTALLATION**

- (1) When reusing the sensor, clean its thread.
- (2) Apply the specified sealant to the threads.

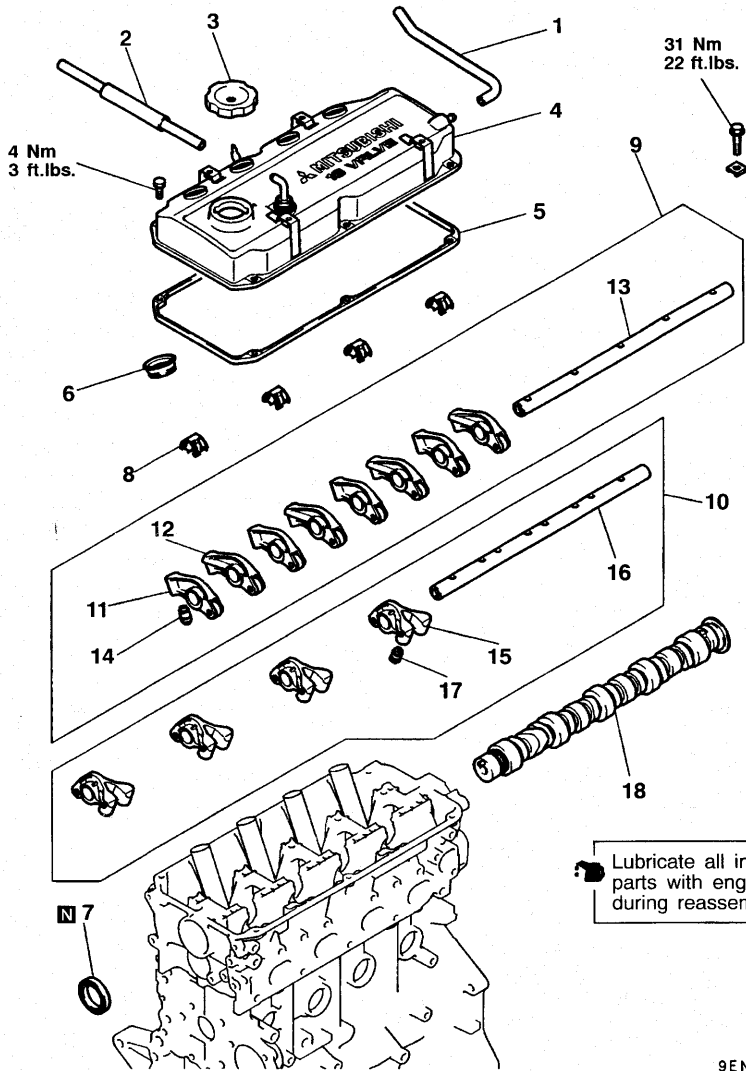
**Specified sealant:**

**3M ATD Part No.8660 or equivalent**



# ROCKER ARMS AND CAMSHAFT

## REMOVAL AND INSTALLATION



Lubricate all internal parts with engine oil during reassembly.

9EN0856

### Removal steps

1. Breather hose
2. P.C.V. hose
3. Oil filler cap
4. Rocker cover
5. Rocker cover gasket
6. Oil seal
7. Oil seal
8. Rocker arm spring
9. Rocker arms and rocker arm shaft (Intake)

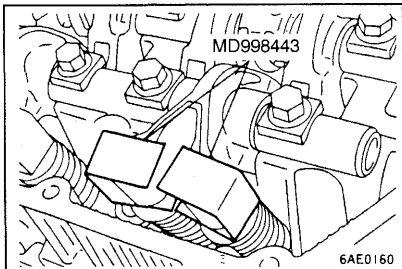
◀A▶

10. Rocker arms and rocker arm shaft (Exhaust)
11. Rocker arm B
12. Rocker arm A
- ▶B◀ 13. Rocker arm shaft
- ▶A◀ 14. Lash adjuster
- ▶B◀ 15. Rocker arm C
- ▶A◀ 16. Rocker arm shaft
- ▶A◀ 17. Lash adjuster
18. Camshaft

▶E◀  
▶D◀  
▶C◀

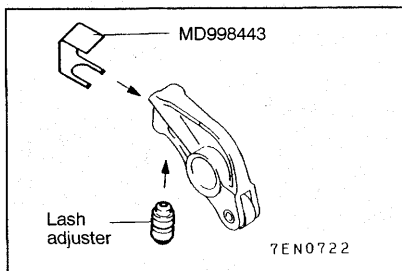
▶A◀



**REMOVAL SERVICE POINT****◀▶ ROCKER ARM AND ROCKER ARM SHAFT REMOVAL****Caution**

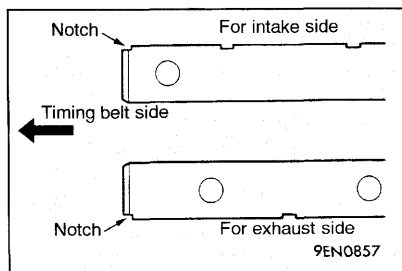
If the lash adjuster is re-used, clean the lash adjuster. (Refer to 11D-26.)

- (1) Set special tool MD998443 to prevent the lash adjuster coming free and falling to the floor.

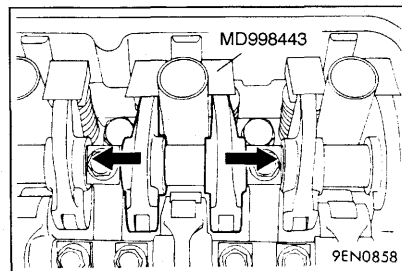
**INSTALLATION SERVICE POINTS****▶◀ LASH ADJUSTER INSTALLATION****Caution**

If the lash adjuster is re-used, clean the lash adjuster. (Refer to 11D-26.)

- (1) Fit the lash adjuster onto the rocker arm without allowing diesel fuel to spill out. Fit special tool MD998443 to prevent the lash adjuster coming free and falling to the floor.

**▶◀ ROCKER ARM SHAFT INSTALLATION**

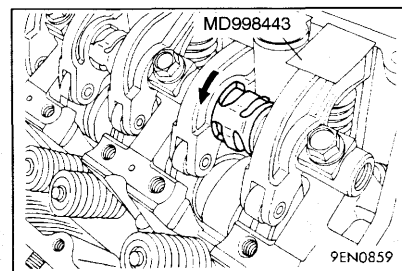
- (1) Install the rocker arm shafts, place the end with notched side toward the timing belt side as shown.

**▶◀ ROCKER ARMS AND ROCKER ARM SHAFT INSTALLATION**

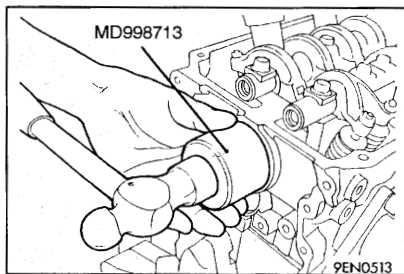
- (1) Move the rocker arms in the directions shown in the illustration before tightening the rocker arm shaft bolts.

**NOTE**

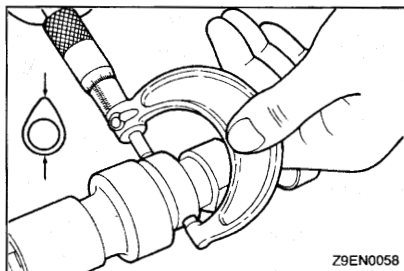
Move the rocker arms until they touch the rocker arm shaft mounting bosses on the cylinder head.

**▶◀ ROCKER ARM SPRING INSTALLATION**

- (1) Insert the rocker arm spring at an angle to the spark plug guide and then install it so that it is at a right angle to the guide.
- (2) Remove the special tools from rocker arms.



## ►◀ OIL SEAL INSTALLATION



## INSPECTION

11300550400

### CAMSHAFT

- (1) Measure the cam height and replace the camshaft if any height exceeds the specified limit.

#### Standard value:

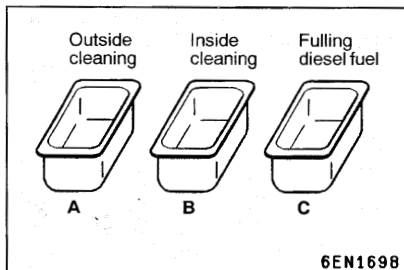
Intake: 37.11 mm (1.46 in.)

Exhaust: 37.15 mm (1.46 in.)

#### Limit:

Intake: 36.61 mm (1.44 in.)

Exhaust: 36.65 mm (1.44 in.)

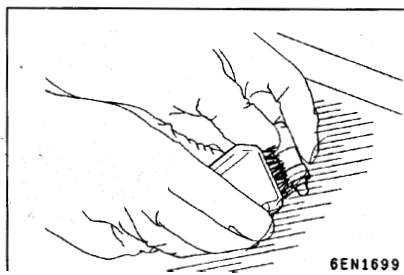


## LASH ADJUSTERS

### Caution

1. The lash adjusters are precision-engineered mechanisms. Do not allow them to become contaminated by dirt or other foreign substances.
2. Do not attempt to disassemble the lash adjusters.
3. Use only fresh diesel fuel to clean the lash adjusters.

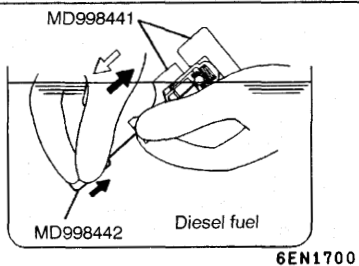
- (1) Prepare three containers and approximately five liters of diesel fuel. Into each container, pour enough diesel fuel to completely cover a lash adjuster when it is standing upright. Then, perform the following steps with each lash adjuster.



- (2) Place the lash adjuster in container A and clean its outside surface.

### NOTE

Use a nylon brush if deposits are hard to remove.



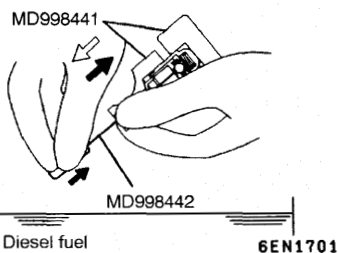
- (3) Fit special tool MD998441 onto the lash adjuster.
- (4) While gently pushing down the internal steel ball using special tool MD998442, move the plunger through 5 to 10 strokes until it slides smoothly. In addition to eliminating stiffness in the plunger, this operation will removed dirty oil.

**Caution**

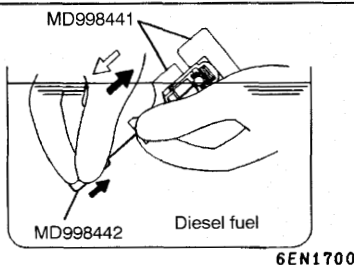
The steel ball spring is extremely weak, so the lash adjuster's functionality may be lost if the air bleed wire is pushed in hard.

**NOTE**

If the plunger remains stiff or the mechanism appears otherwise abnormal, replace the lash adjuster.



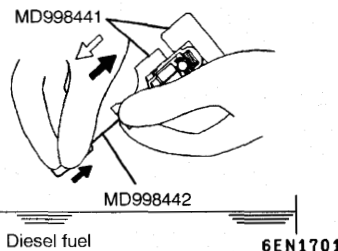
- (5) Remove the lash adjuster from the container. Then, push down the steel ball gently and push the plunger to eliminate diesel fuel from the pressure chamber.



- (6) Fit special tool MD998441 onto the lash adjuster.
- (7) Place the lash adjuster in container B. Then, gently push down the internal steel ball using special tool MD998442 and move the plunger through 5 to 10 strokes until it slides smoothly. This operation will clean the lash adjuster's pressure chamber.

**Caution**

The steel ball spring is extremely weak, so the lash adjuster's functionality may be lost if the air bleed wire is pushed in hard.



- (8) Remove the lash adjuster from the container. Then, push down the steel ball gently and push the plunger to eliminate diesel fuel from the pressure chamber.

- (9) Place the lash adjuster in container C. Then, gently push down the internal steel ball using special tool MD998442.

**Caution**

Do not use container C for cleaning. If cleaning is performed in container C, foreign matter could enter the pressure chamber when the chamber is filled with diesel fuel.

- (10) Stand the lash adjuster with its plunger at the top, then push the plunger downward firmly until it moves through its greatest possible stroke. Return the plunger slowly, then release the steel ball and allow the pressure chamber to fill with diesel fuel.
- (11) Remove special tool MD998441.

- (12) Remove the lash adjuster from the container, then stand the lash adjuster with its plunger at the top. Push the plunger firmly and check that it does not move. Also, check that the lash adjuster's height matches that of a new lash adjuster.

**NOTE**

If lash adjuster contracts, perform the operations (9) through (12) again to fill it with diesel fuel completely. Replace the lash adjuster if it still contracts after performing these steps.

- (13) Set the lash adjuster on the special tool MD998440 (leak down tester).
- (14) After the plunger has moved downward slightly [0.2 to 0.5 mm (.008 - .019 in.)], measure the time taken for it to move downward by a further 1 mm (.04 in.).

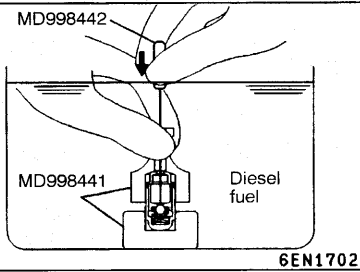
**Standard value:**

3 - 20 seconds/1 mm (.04 in.)  
[with diesel fuel at 15 to 20°C (59 - 68°F)]

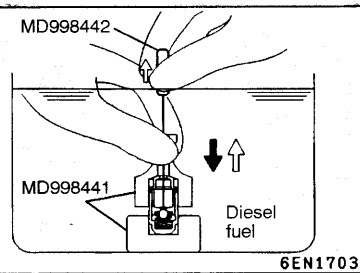
**NOTE**

Replace the lash adjuster if the time measurement is out of specification.

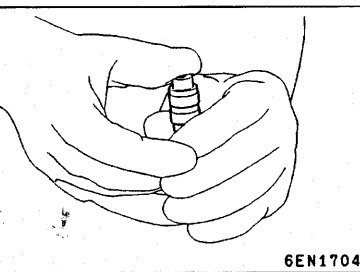
- (15) Fit special tool MD998442 onto the lash adjuster.
- (16) Place the lash adjuster in container C again, then gently push down the internal steel ball using special tool MD998442.
- (17) Stand the lash adjuster with its plunger at the top, then push the plunger downward firmly until it moves through its greatest possible stroke. Return the plunger slowly, then release the steel ball and allow the pressure chamber to fill with diesel fuel.
- (18) Remove special tool MD998441.



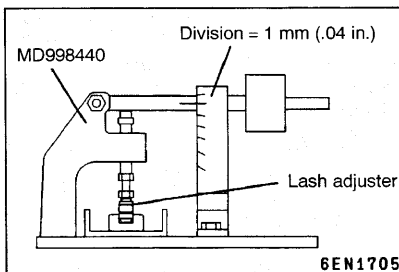
6EN1702



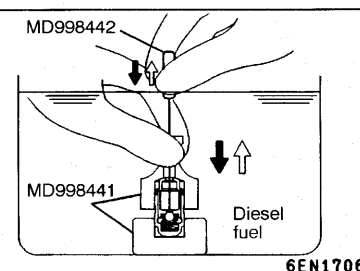
6EN1703



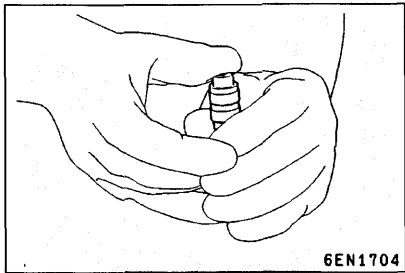
6EN1704



6EN1705



6EN1706



- (19) Remove the lash adjuster from the container, then stand the lash adjuster with its plunger at the top. Push the plunger firmly and check that it does not move. Also, check that the lash adjuster's height matches that of a new lash adjuster.

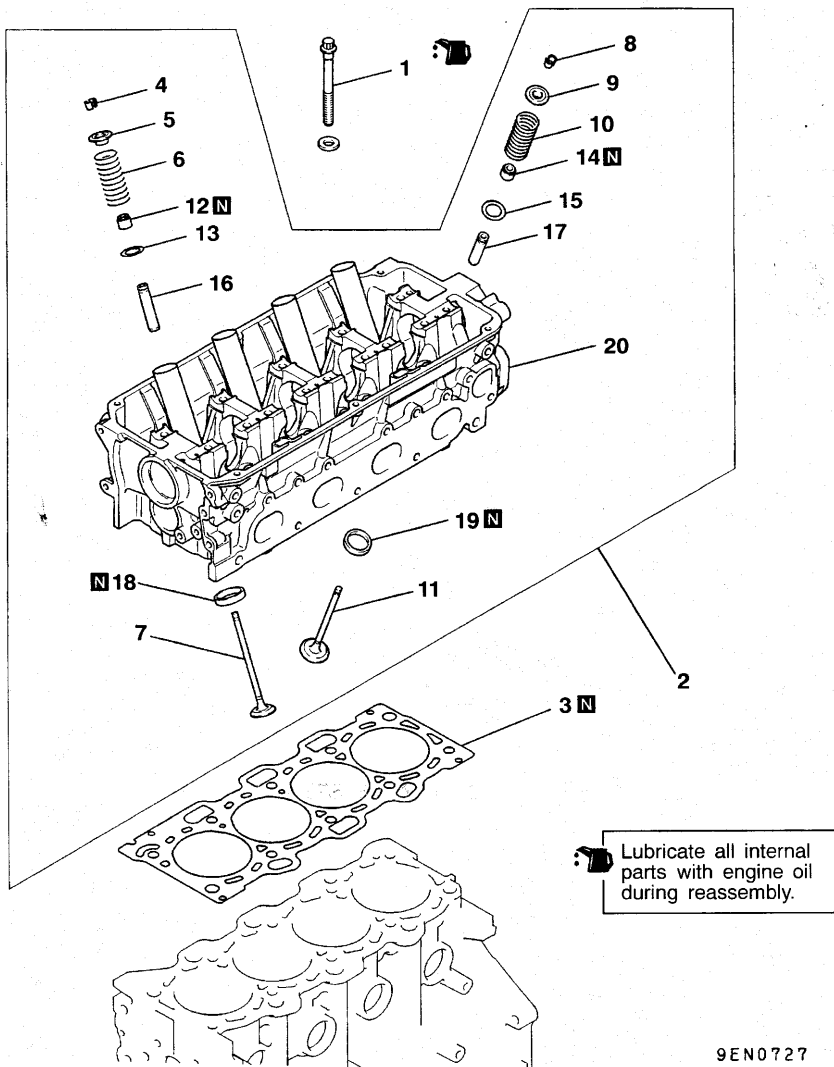
#### NOTE

If lash adjuster contracts, perform the operations (15) through (19) again to fill it with diesel fuel completely. Replace the lash adjuster if it still contracts after performing these steps.

- (20) Stand the lash adjuster upright to prevent diesel fuel spilling out. Do not allow the lash adjuster to become contaminated by dirt or other foreign matter. Fit the lash adjuster onto the engine as soon as possible.

## CYLINDER HEAD AND VALVES

## REMOVAL AND INSTALLATION



## Removal steps

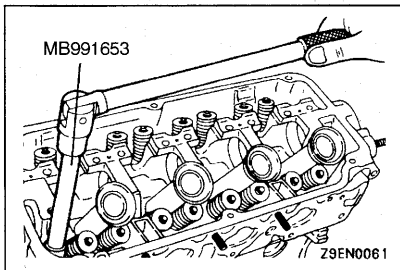
- ◀A▶ ▶D▶ 1. Cylinder head bolt  
 ▶B▶ ▶C▶ 2. Cylinder head assembly  
 ▶B▶ ▶C▶ 3. Cylinder head gasket  
 ▶B▶ ▶C▶ 4. Retainer lock  
 ▶B▶ ▶C▶ 5. Valve spring retainer  
 ▶B▶ ▶C▶ 6. Valve spring  
 ▶B▶ ▶C▶ 7. Exhaust valve  
 ▶B▶ ▶C▶ 8. Retainer lock  
 ▶B▶ ▶C▶ 9. Valve spring retainer  
 ▶B▶ ▶C▶ 10. Valve spring

- ▶C▶ ▶A▶ 11. Intake valve  
 ▶C▶ ▶A▶ 12. Valve stem seal  
 ▶C▶ ▶A▶ 13. Valve spring seal  
 ▶C▶ ▶A▶ 14. Valve stem seal  
 ▶C▶ ▶A▶ 15. Valve spring seat  
 ▶C▶ ▶A▶ 16. Exhaust valve guide  
 ▶C▶ ▶A▶ 17. Intake valve guide  
 ▶C▶ ▶A▶ 18. Exhaust valve seat  
 ▶C▶ ▶A▶ 19. Intake valve seat  
 ▶C▶ ▶A▶ 20. Cylinder head

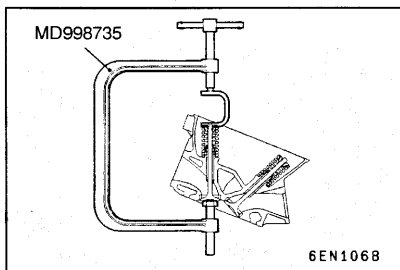
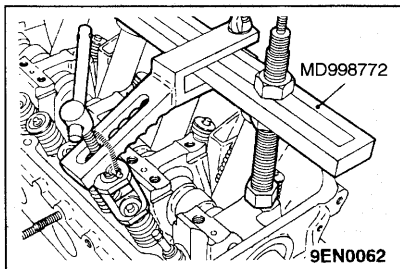
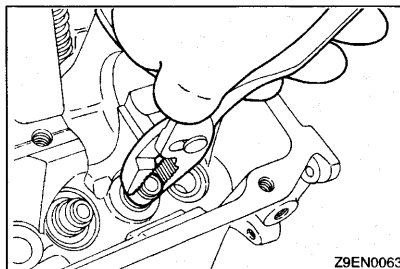
9EN0727

**REMOVAL SERVICE POINTS****◀A▶ CYLINDER HEAD BOLT REMOVAL**

- (1) Loosen the cylinder head bolts using the special tool.

**◀B▶ RETAINER LOCK REMOVAL**

- (1) Tag removed valves, springs and other components, noting their cylinder numbers and locations to facilitate reassembly. Store these components safely.

**◀C▶ VALVE STEM SEAL REMOVAL**

**INSTALLATION SERVICE POINTS****►A◄ VALVE STEM SEAL INSTALLATION**

- (1) Install the valve spring seat.
- (2) Install a new valve stem seal using the special tool shown in the illustration.

**Caution**

1. Do not reuse removed valve stem seals.
2. The valve stem seal must be installed using the correct special tool. Incorrect installation could result in oil leaking past the valve guide.

**►B◄ VALVE SPRING INSTALLATION**

- (1) Install the valve spring so that the painted end is on the rocker arm side.

**►C◄ RETAINER LOCK INSTALLATION**

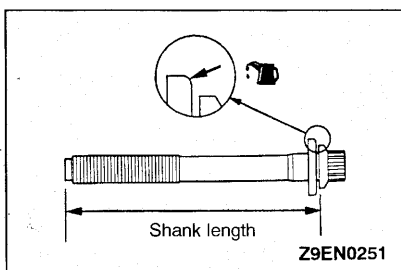
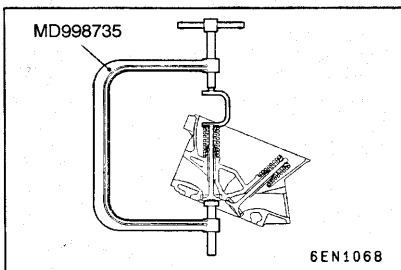
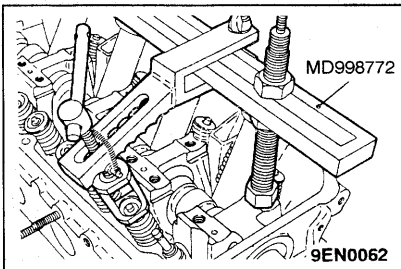
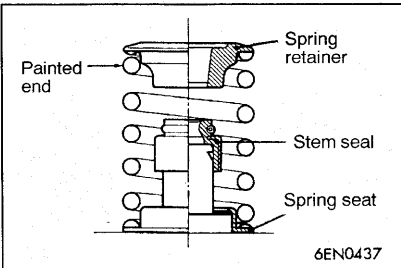
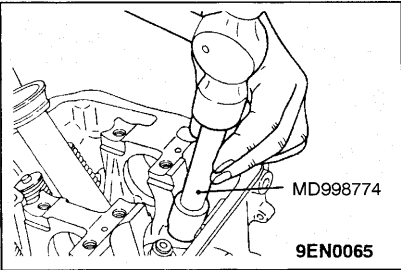
- (1) The valve spring, if excessively compressed, causes the bottom end of retainer to be in contact with the stem seal, and damage it.

**►D◄ CYLINDER HEAD BOLT INSTALLATION**

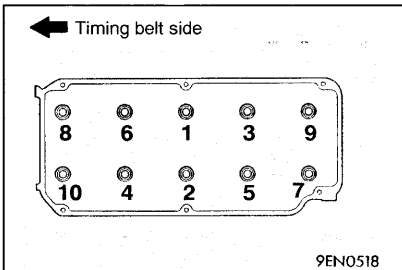
- (1) Before reusing the cylinder head bolt, measure that its shank length does not exceed the specified limit. Replace the bolt if this measurement exceeds the limit.

**Limit: Max. 96.4 mm (17.23 in.)**

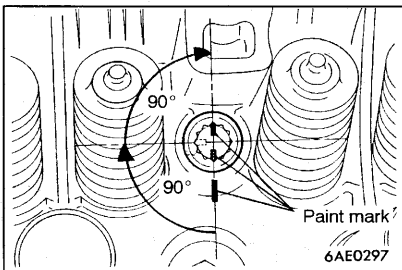
- (2) Fit the washer as shown.
- (3) Apply engine oil to the bolt thread and washer.







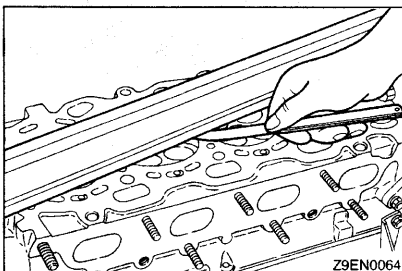
- (4) Tighten the bolts in the sequence shown until each is torqued to 74 Nm (54 ft.lbs.) using the special tool (MB991653).
- (5) Loosen all bolts fully.
- (6) Retighten the bolts in the sequence shown until each is torqued to 20 Nm (15 ft.lbs.).
- (7) Make paint marks on the cylinder head bolt heads and cylinder head as shown.
- (8) In accordance with the tightening sequence, tighten each bolt by 90° (1/4 turn).
- (9) Tighten each bolt by further 90° (1/4 turn) and check that the paint marks on the bolt head and cylinder head are aligned.



### Caution

If the bolts are tightened by an angle of less than 90° (1/4 turn), they may not hold the cylinder head with sufficient strength.

If the bolts are tightened by an angle exceeding 90°, completely remove them and repeat the installation procedure.



### INSPECTION

11300700195

#### CYLINDER HEAD

- (1) Before cleaning the cylinder head, check it for water leaks, gas leaks, cracks, and other damage.
- (2) Remove all oil, water scale, sealant, and carbon. After cleaning the oil passages, blow air through them to verify that they are not blocked.
- (3) Check the cylinder head gasket surface for flatness by using a straight edge and feeler gauge.

**Standard value: 0.03 mm (.0012 in.)**

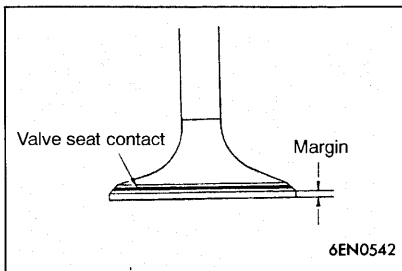
**Limit: 0.2 mm (.008 in.)**

- (4) If flatness exceeds the specified limit, grind the gasket surface to specification.

**Grinding limit: \*0.2 mm (.008 in.)**

\*Includes/combined with cylinder block grinding

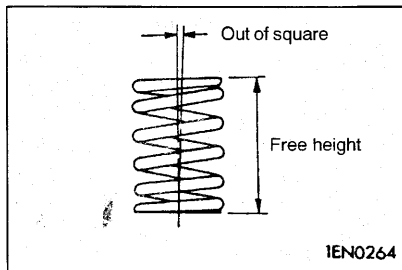
**Cylinder head height (Specification when new):**  
119.9 - 120.1 mm (4.720 - 4.728 in.)

**VALVE**

- (1) Check the valve face for correct contact. If contact is uneven or incomplete, reface the valve seat.
- (2) If the margin is less than specified, replace the valve.

**Standard value:****Intake:** 1.0 mm (.039 in.)**Exhaust:** 1.3 mm (.051 in.)**Limit:****Intake:** 0.5 mm (.020 in.)**Exhaust:** 0.8 mm (.031 in.)

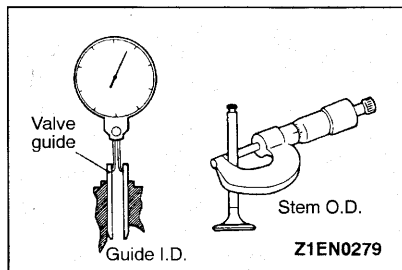
- (3) Measure the valve length. If the measurement is less than specified, replace the valve.

**Standard value:****Intake:** 110.15 mm (4.337 in.)**Exhaust:** 113.70 mm (4.476 in.)**Limit:****Intake:** 109.65 mm (4.317 in.)**Exhaust:** 113.20 mm (4.457 in.)**VALVE SPRING**

- (1) Measure the valve spring free height. If the measurement is less than specified, replace spring.

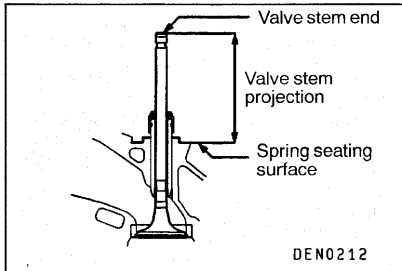
**Standard value:** 50.9 mm (2.00 in.)**Limit:** 49.9 mm (1.96 in.)

- (2) Measure the squareness of the spring. If the measurement is less than specified, replace the spring.

**Standard value:** 2° or less**Limit:** 4°**VALVE GUIDE**

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

**Standard value:****Intake:** 0.02 - 0.05 mm (.0008 - .0020 in.)**Exhaust:** 0.05 - 0.09 mm (.0020 - .0035 in.)**Limit:****Intake:** 0.10 mm (.0039 in.)**Exhaust:** 0.15 mm (.0059 in.)

**VALVE SEAT**

- (1) Assemble the valve, then measure the valve stem projection between the end of the valve stem and the spring seating surface. If the measurement exceeds the specified limit, replace the valve seat.

**Standard value:**

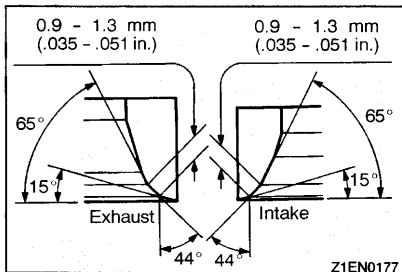
**Intake: 49.30 mm (1.9409 in.)**

**Exhaust: 49.35 mm (1.9429 in.)**

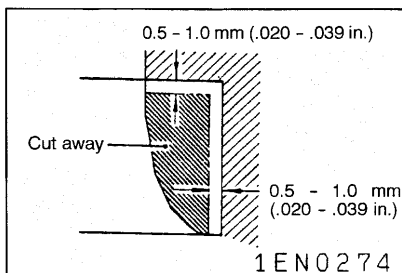
**Limit**

**Intake: 49.80 mm (1.9606 in.)**

**Exhaust: 49.85 mm (1.9626 in.)**

**VALVE SEAT RECONDITIONING PROCEDURE**

- (1) Before correcting the valve seat, check the clearance between the valve guide and valve. If necessary, replace the valve guide.
- (2) Using the appropriate special tool or seat grinder, correct the valve seat to achieve the specified seat width and angle.
- (3) After correcting the valve seat, lap the valve and valve seat using lapping compound. Then, check the valve stem projection (refer to VALVE SEAT in INSPECTION).

**VALVE SEAT REPLACEMENT PROCEDURE**

- (1) Cut the valve seat to be replaced from the inside to reduce the wall thickness. Then, remove the valve seat.
- (2) Rebore the valve seat hole in the cylinder head to match the selected oversize valve seat diameter.

**Intake valve seat hole diameter**

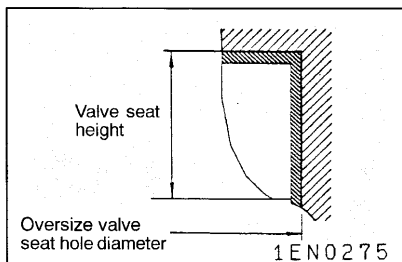
**0.3 O.S.: 31.80 - 31.83 mm (1.2520 - 1.2531 in.)**

**0.6 O.S.: 32.10 - 31.13 mm (1.2638 - 1.2650 in.)**

**Exhaust valve seat hole diameter**

**0.3 O.S.: 29.30 - 29.32 mm (1.1535 - 1.1543 in.)**

**0.6 O.S.: 29.60 - 29.62 mm (1.1654 - 1.1661 in.)**



- (3) Prevent galling of the cylinder head bore by cooling the valve seat with liquid nitrogen before press-fitting it.
- (4) Correct the valve seat to achieve the specified width and angle (refer to VALVE SEAT RECONDITIONING PROCEDURE).

**VALVE GUIDE REPLACEMENT PROCEDURE**

- (1) Using a press, push the valve guide out toward the cylinder block side.
- (2) Rebore the valve guide hole in the cylinder head to match the oversize valve guide that is to be fitted.

**Caution**

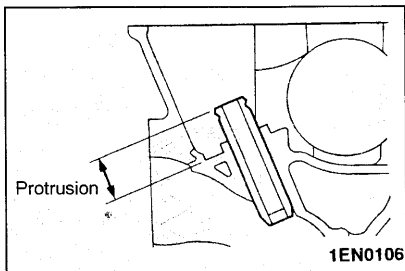
**Do not install a valve guide of the same size again.**

**Valve guide hole diameters in cylinder head**

**0.05 O.S.: 11.05 - 11.07 mm (.4350 - .4358 in.)**

**0.25 O.S.: 11.25 - 11.27 mm (.4429 - .4337 in.)**

**0.50 O.S.: 11.50 - 11.52 mm (.4528 - .4535 in.)**



- (3) Press-fit the valve guide until it projects by the specified amount.

**Caution**

1. The valve guide must be installed from the upper side of the cylinder head.
2. The valve guides differ in length on the intake and exhaust sides.


**VALVE GUIDE LENGTH**

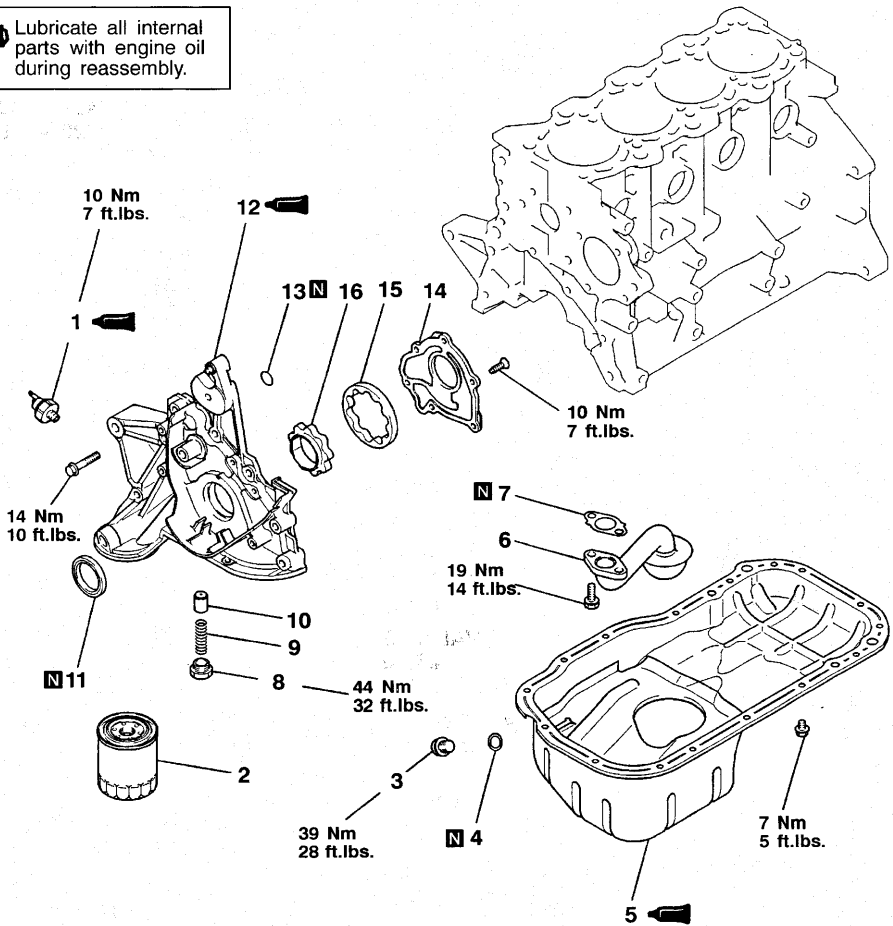
**INTAKE: 45.5 mm (1.791 in.)**

**EXHAUST: 50.5 mm (1.988 in.)**

- (4) After press-fitting the valve guide, insert a new valve and check that it slides smoothly.








# OIL PUMP AND OIL PAN REMOVAL AND INSTALLATION






 Lubricate all internal parts with engine oil during reassembly.



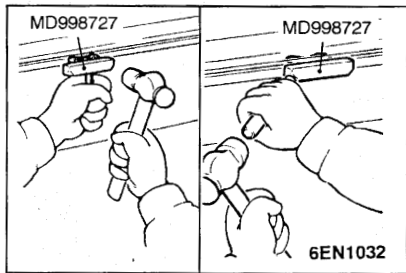
9EN0728

### Removal steps

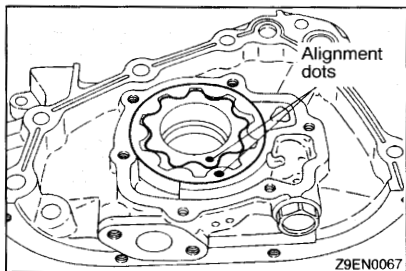
-  1. Oil pressure switch
-  2. Oil filter
-  3. Drain plug
-  4. Gasket
-  5. Oil pan
-  6. Oil screen
-  7. Oil screen gasket
-  8. Relief plug

-  9. Relief spring
-  10. Relief plunger
-  11. Oil seal
-  12. Front case
-  13. O-ring
-  14. Oil pump case cover
-  15. Outer rotor
-  16. Inner rotor

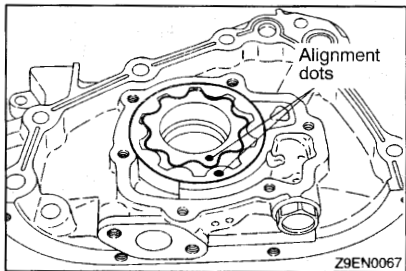


**REMOVAL SERVICE POINTS****◀A▶ OIL PAN REMOVAL**

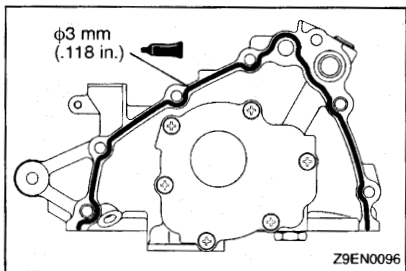
- (1) Remove the oil pan mounting bolts.
- (2) Knock the special tool between the oil pan and cylinder block as shown in the illustration.
- (3) Tapping the side of the special tool, slide the tool along the oil pan/cylinder block seal and thus remove the oil pan.

**◀B▶ OUTER ROTOR/INNER ROTOR REMOVAL**

- (1) Make alignment dots on the outer and inner rotors for reference in reassembly.

**INSTALLATION SERVICE POINTS****▶A◀ INNER ROTOR/OUTER ROTOR INSTALLATION**

- (1) Apply engine oil to the rotors. Then, install the rotors ensuring that the alignment dots made at disassembly are properly aligned.

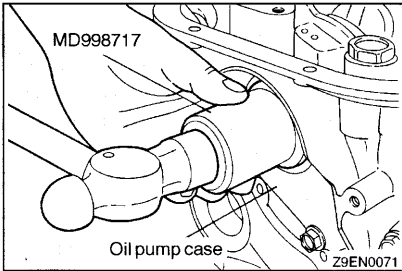
**▶B◀ FRONT CASE INSTALLATION**

- (1) Clean the sealant application surfaces on the cylinder block and front case.
- (2) Apply a 3 mm (.12 in) diameter bead of sealant to the area shown. Be sure to install the front case within 15 minutes after applying sealant.

**Specified sealant:**

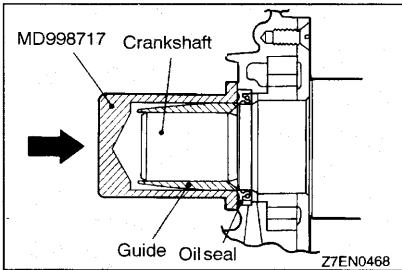
**Mitsubishi Genuine Part No.MD970389 or equivalent**

- (3) Tighten the front case bolts to the specified torque.
- (4) After installation, wait at least one hour. Never start the engine or let engine oil touch the adhesion surface during that time.



### ►C◄ FRONT OIL SEAL INSTALLATION

- (1) Place the special tool on the crankshaft front end and apply engine oil to the its outer diameter.
- (2) Apply engine oil to the oil seal lip, then push the oil seal along the guide by hand until it touches the front case. Tap the oil seal into place using the special tool.



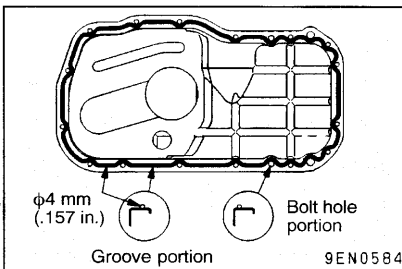
### ►D◄ OIL PAN INSTALLATION

- (1) Clean the mating surfaces of the oil pan and cylinder block.
- (2) Apply a 4 mm (.16 in.) diameter bead of sealant to the oil pan flange. Be sure to install the oil pan within 15 minutes after applying sealant.

#### Specified sealant:

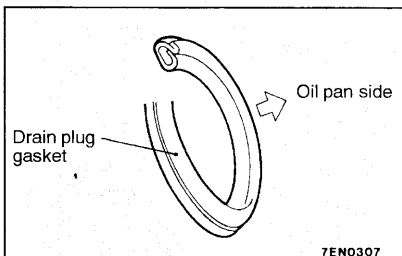
**Mitsubishi Genuine Part No.MD970389 or equivalent**

- (3) Tighten the oil pan bolts to the specified torque.
- (4) After installation, wait at least one hour. Never start the engine or let engine oil touch the adhesion surface during that time.



### ►E◄ DRAIN PLUG GASKET INSTALLATION

- (1) Replace the drain plug gasket with a new one. Fit the new gasket as shown.



### ▶F◀ OIL FILTER INSTALLATION

- (1) Clean the filter mounting surfaces on the front case.
- (2) Apply clean engine oil to the O-ring of the oil filter.
- (3) Screw on the oil filter until its O-ring is seated on the mounting surface. Then, give the oil filter one further turn.

#### Caution

The oil filter must be tightened using a commercially available filter wrench. If the filter is tightened by hand only, it will be insufficiently torqued, resulting in oil leaks.

### ▶G◀ OIL PRESSURE SWITCH INSTALLATION

- (1) Apply the specified sealant to the threads of the switch.

#### Specified sealant:

3M ATD Part No.8660 or equivalent

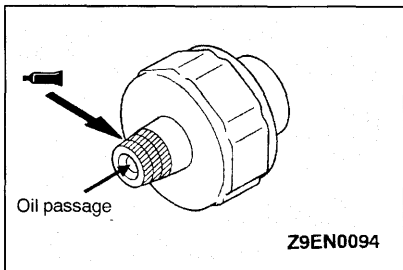
#### Caution

Use care not to allow the sealant to plug the oil passage.

- (2) Install and tighten the switch to the specified torque by using a socket wrench and torque wrench.

#### Caution

If the switch is tightened with a spanner or offset wrench, an over-torque may be applied and the switch to be damaged.





11300820099

**INSPECTION****OIL PUMP**

- (1) Fit the rotors into the front case.
- (2) Check the tip clearance, using a feeler gauge.

**Standard value: 0.06 - 0.18 mm (.0024 - .0071 in.)**

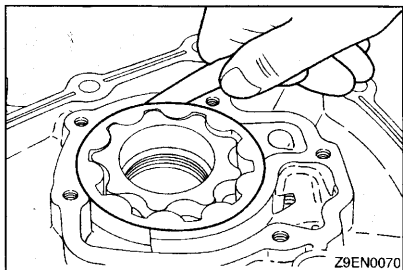
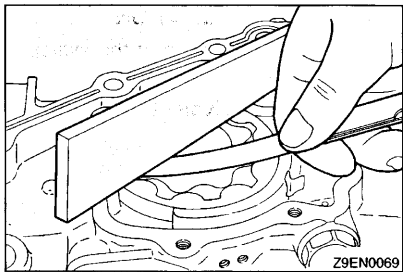
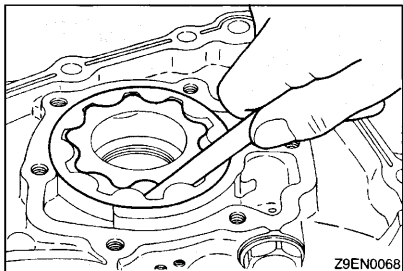
- (3) Check the side clearance, using a straight and feeler gauge.

**Standard value: 0.04 - 0.10 mm (.0016 - .0039 in.)**

- (4) Check the body clearance, using a feeler gauge.


**Standard value: 0.10 - 0.18 mm (.0039 - .0071 in.)**

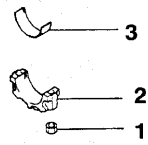
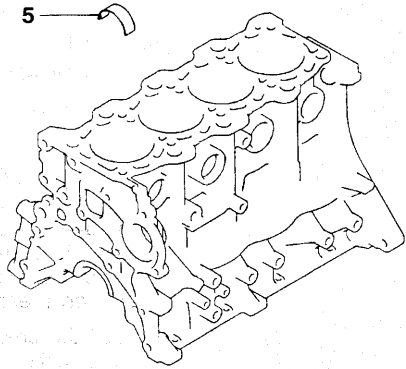
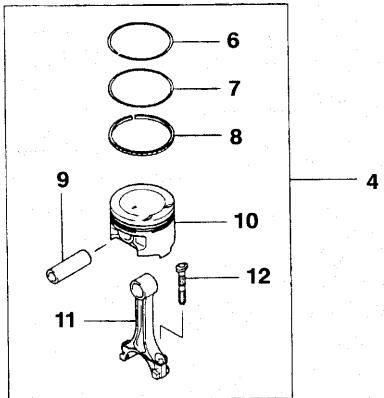
**Limit: 0.35 mm (.0138 in.)**



# PISTON AND CONNECTING ROD







## REMOVAL AND INSTALLATION





 Lubricate all internal parts with engine oil during reassembly.

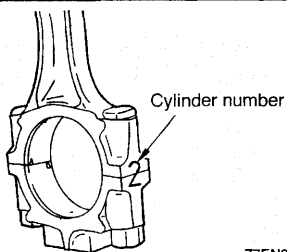


Z9EN0043

### Removal steps

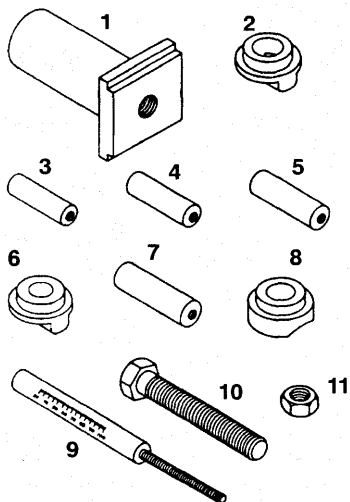
-   1. Nut
-  2. Connecting rod cap
-  3. Connecting rod bearing
-  4. Piston and connecting rod
-  5. Connecting rod bearing
-  6. Piston ring No.1

-  7. Piston ring No.2
-  8. Oil ring
-  9. Piston pin
-  10. Piston
- 11. Connecting rod
- 12. Bolt

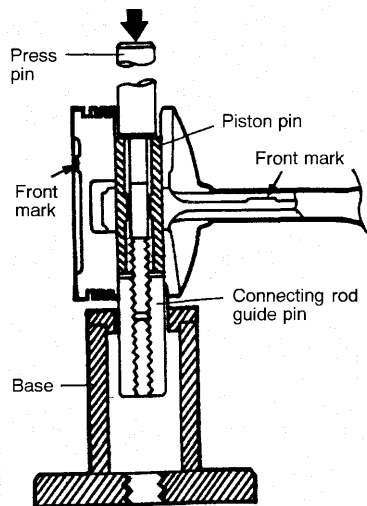


Z7EN0448

Piston pin setting tool MIT216941



Z7EN0425



7EN0979

**REMOVAL SERVICE POINTS****◀A▶ CONNECTING ROD CAP REMOVAL**

- (1) Mark the cylinder number on the side of the connecting rod big end for correct reassembly.
- (2) Keep the removed connecting rods, caps, and bearings in order according to the cylinder number.

**◀B▶ PISTON PIN REMOVAL**

Item No.	Part No.	Description
1	MIT310134	Base
2	MIT310136	Piston Support
3	MIT310137	Connecting Rod Guide Pin
4	MIT310138	Connecting Rod Guide Pin
5	MIT310139	Connecting Rod Guide Pin
6	MIT310140	Piston Support
7	MIT310141	Connecting Rod Guide Pin
8	MIT310142	Piston Support
9	MIT48143	Press Pin
10	216943	Stop Screw
11	10396	Nut

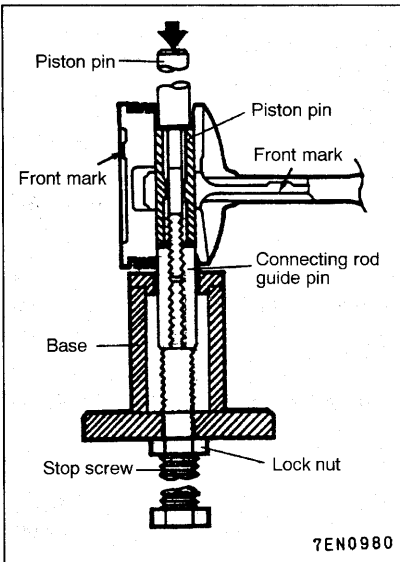
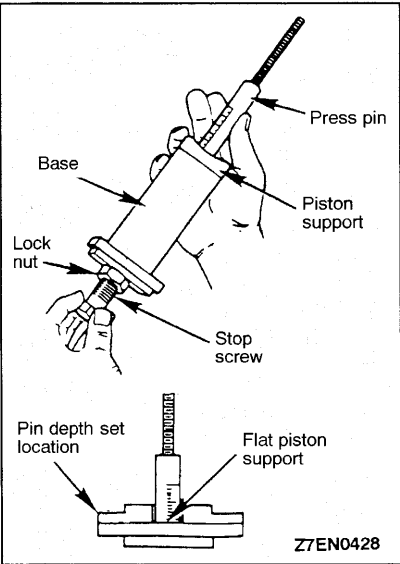
- (1) Remove the stop screw from the base.
  - (2) Select the correct piston support for your application (See above). Fit the piston support onto the base. Place the base on press support blocks.
  - (3) Insert the press pin through the piston pin hole. Select the correct connecting rod guide pin (See above). Thread the guide pin onto the threaded portion of the press pin.
  - (4) Position the piston assembly on the piston support in the press. With the press pin up as shown in Figure 4, insert the guide pin through the hole in the piston and through the hole in the piston support.
  - (5) Press the piston pin out of the assembly.
- IMPORTANT: To avoid piston damage,**
- The piston support must seat squarely against the piston.
  - Verify that the piston pin will slide through the hole in the piston support.
- (6) Remove the piston pin from the press pin.

## INSTALLATION SERVICE POINTS

### ▶A◀ PISTON PIN INSTALLATION

- (1) Thread the stop screw and lock nut assembly into the base. Fit the correct piston support on top of the base. Insert the press pin, threaded end up, into the hole in the piston support until the press pin touches the stop screw.
- (2) Using the markings on the press pin, adjust the stop screw to the depth as shown below.

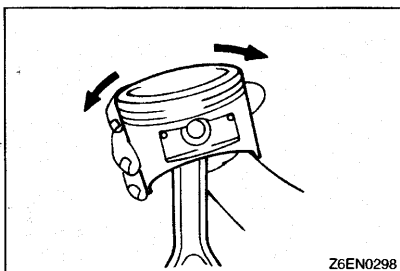
**Depth: Refer to the operating instructions on the special tool.**

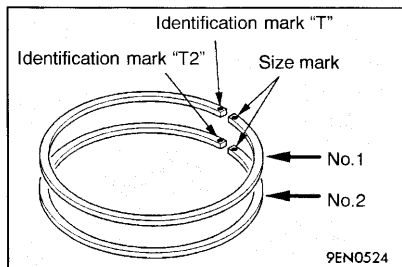
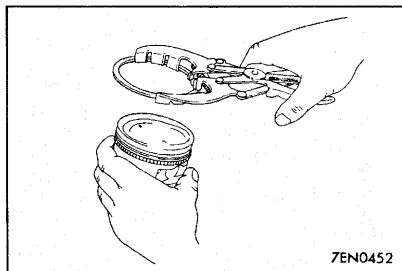
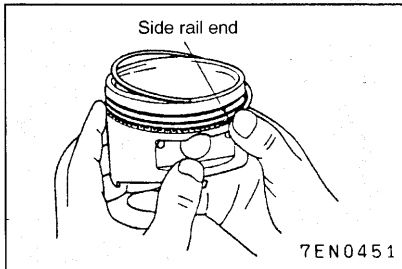
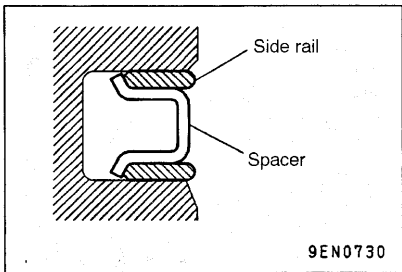


- (3) Place the base on press support blocks.
- (4) Slide the piston pin over the threaded end of the press pin, and thread the correct guide pin up against it.
- (5) Coat the piston pin with oil, and with the connecting rod held in position, slide the guide pin through the piston and connecting rod.
- (6) Press the piston pin through the connecting rod until the guide pin contacts the stop screw.
- (7) Remove the piston assembly from the base. Remove the guide pin and press pin from the assembly.

**IMPORTANT: Due to production tolerance variations, it is necessary to visually inspect the piston pin depth after installation to verify that the piston pin is centered. Adjust if necessary.**

- (8) Check that the piston moves smoothly.





### ►B◀ OIL RING INSTALLATION

- (1) Fit the oil ring spacer into the piston ring groove. Then fit the upper and lower side rails.

#### NOTE

- (1) The spacer and side rails may be fitted in either direction. No distinction is made between top and bottom.
- (2) Spacer and side rail sizes are color-coded as follows:

Size	Identification color
Standard size	None
0.50 mm O.S.	Blue
1.00 mm O.S.	Yellow

To install a side rail, fit one end of the rail into the groove, then press the rest of the rail into position by hand as shown.

#### Caution

**Do not fit side rails using a piston ring expander since they may break.**

- (2) After installing the side rails, check that they move smoothly in both directions.

### ►C◀ PISTON RING NO.2/PISTON RING NO.1 INSTALLATION

- (1) Using a ring expander, fit ring No.2 and ring No.1 with their identification marks facing upward (on the piston crown side).

#### Identification mark:

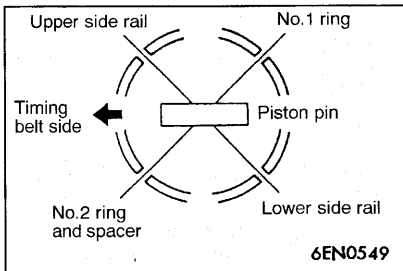
**No.1 ring: T**

**No.2 ring: T2**

#### NOTE

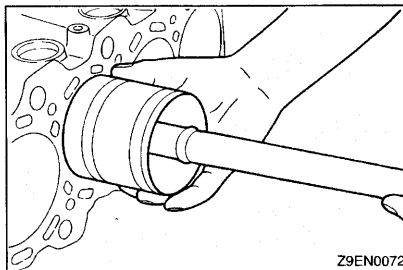
The piston ring is stamped with the following size mark.

Size	Size mark
Standard size	None
0.50 mm O.S.	50
1.00 mm O.S.	100

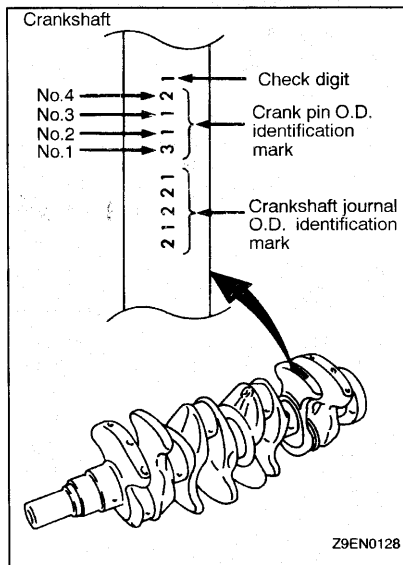


### ►D◄ PISTON AND CONNECTING ROD ASSEMBLY INSTALLATION

- (1) Apply oil to the piston, piston ring, and oil ring.
- (2) Align the gaps of the piston rings and oil rings (side rails and spacer) as shown.
- (3) With the piston crown's front arrow mark pointing toward the timing belt side, press the piston and connecting rod assembly into the cylinder from the top of the cylinder.



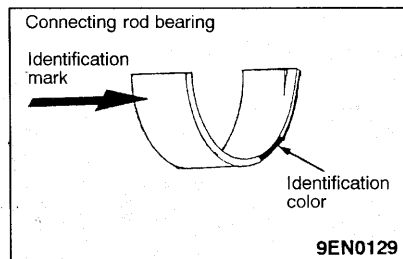
- (4) Compress the piston rings tightly with a suitable ring compression tool, then press the piston and connecting rod fully into the cylinder. Do not strike the piston hard since the piston rings may break and the crank pin may be nicked.

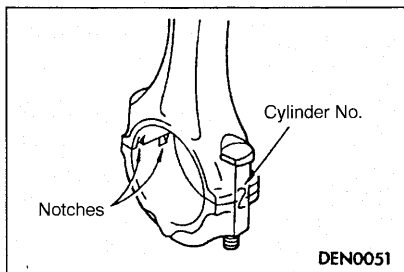


### ►E◄ CONNECTING ROD BEARING INSTALLATION

- (1) When replacing the bearings and/or crankshaft, read off the identification mark on the crankshaft (as illustrated), and select a bearing according to the following table.

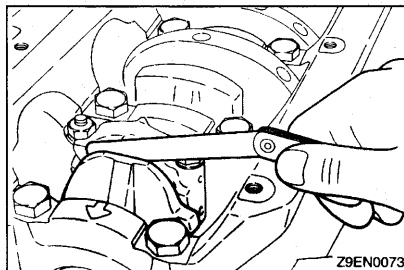
Crankshaft pin O.D.	Connecting rod bearing	
Identification mark	Identification mark	Identification color
1	S1	Brown
2	S2	Black
3	S3	Green





### ►F◀ CONNECTING ROD CAP INSTALLATION

- (1) Aligning the marks made during disassembly, fit the bearing cap onto the connecting rod. If the connecting rod is new and has no index mark, ensure that the bearing locking notches are both on the same side.



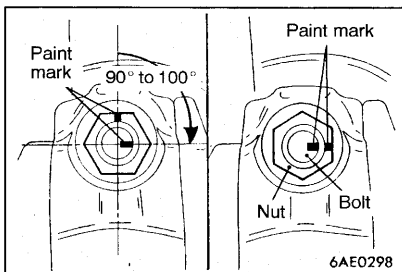
- (2) Check that the connecting rod big end side clearance confirms with specification.

**Standard value: 0.10 - 0.25 mm (.0039 - .0098 in.)**

**Limit: 0.4 mm (.016 in.)**

### ►G◀ CONNECTING ROD CAP NUT TIGHTENING

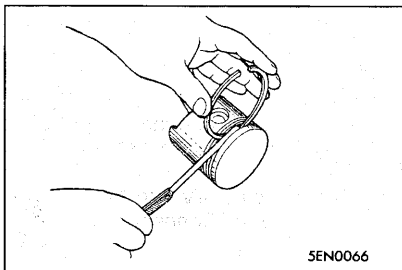
- (1) Since the connecting rod cap bolts and nuts are torqued using the plastic area tightening method, the bolts should be examined BEFORE reuse. If the bolt threads are "necked down", the bolt should be replaced. Necking can be checked by running a nut with your fingers the full length of the bolt threads. If the nut does not run down smoothly, the bolt should be replaced.
- (2) Before installation of each nut, apply engine oil to the nut.
- (3) Install each nut to the bolt and finger-tighten it. Then tighten the nuts alternately to install the cap properly.
- (4) Tighten the nuts to a torque of 20 Nm (15 ft.lbs.).



- (5) Make a paint mark on the head of each nut.
- (6) Make a paint mark on the bolt end at the position 90° to 100° from the paint mark made on the nut in the direction of tightening the nut.
- (7) Give a 90° to 100° turn to the nut and make sure that the paint mark on the nut and that on the bolt are in alignment.

### Caution

1. If the nut is turned less than 90°, proper fastening performance may not be expected. When tightening the nut, therefore, be careful to give a sufficient turn to it.
2. If the nut is overtightened (exceeding 100°), loosen the nut completely and then retighten it by repeating the tightening procedure from step (1).



### INSPECTION

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#### PISTON RING

- (1) Check for side clearance.  
If the limit is exceeded, replace the ring or piston, or both.

#### Standard value:

No.1: 0.03 - 0.07 mm (.0012 - .0028 in.)

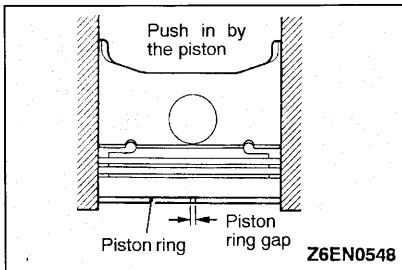
No.2: 0.02 - 0.06 mm (.0008 - .0024 in.)

#### Limit:

No.1: 0.1 mm (.0039 in.)

No.2: 0.1 mm (.0039 in.)





- (2) Install the piston ring into the cylinder bore. Force the ring down with a piston, the piston crown being in contact with the ring, to correctly position it at right angles to the cylinder wall. Then, measure the end gap with a feeler gauge. If the end gap is excessive, replace the piston ring.

**Standard value:**

No.1: 0.25 - 0.40 mm (.0098 - .0157 in.)

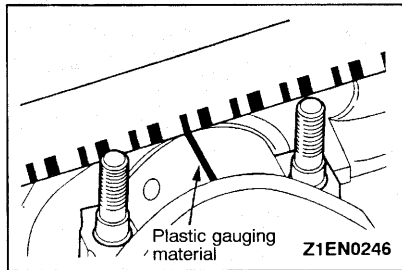
No.2: 0.40 - 0.55 mm (.0157 - .0217 in.)

**Oil:** 0.20 - 0.60 mm (.0078 - .0236 in.)

**Limit:**

No.1, No.2: 0.8 mm (.031 in.)

**Oil:** 1.0 mm (.039 in.)

**CRANKSHAFT PIN OIL CLEARANCE (PLASTIC GAUGING MATERIAL METHOD)**

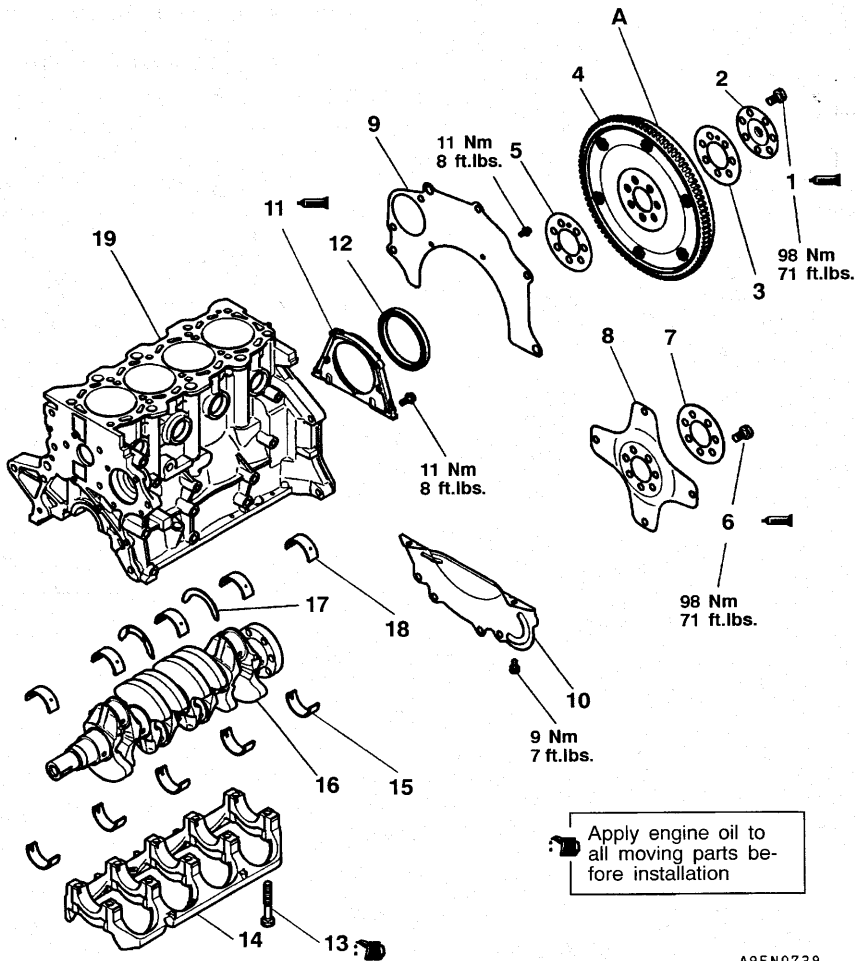
- (1) Remove oil from the crankshaft pin and connecting rod bearing.
- (2) Cut the plastic gauging material to the same length as the width of bearing and place it on crankshaft pin in parallel with its axis.
- (3) Install the connecting rod cap carefully and tighten the nuts to the specified torque. (See "Connecting rod cap nut tightening" procedure.)
- (4) Carefully remove the connecting rod cap.
- (5) Measure the width of the plastic gauging material at its widest part by using a scale printed on its package.

**Standard value:** 0.02 - 0.05 mm (.0008 - .0020 in.)

**Limit:** 0.1 mm (.004 in.)

# CRANKSHAFT AND CYLINDER BLOCK

## REMOVAL AND INSTALLATION



### Removal steps

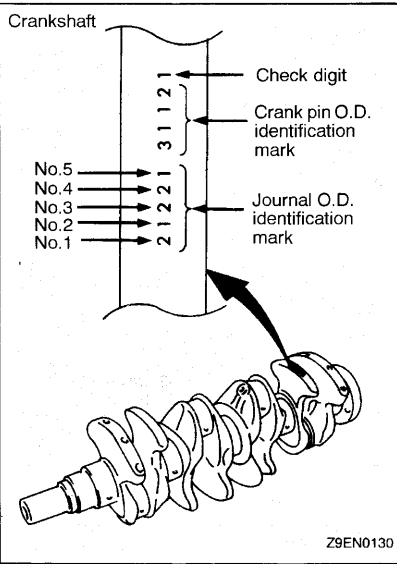
- ▶E◀ 1. Flywheel bolt <M/T>
- ▶E◀ 2. Plate <M/T>
- ▶E◀ 3. Adapter plate <M/T>
- ▶E◀ 4. Flywheel (Non-disassemblable parts) <M/T>
- ▶E◀ 5. Adapter plate <M/T>
- ▶E◀ 6. Drive plate bolt <A/T>
- ▶E◀ 7. Adapter plate <A/T>
- ▶E◀ 8. Drive plate <A/T>
- ▶E◀ 9. Rear plate
- ▶E◀ 10. Bell housing cover
- ▶D◀ 11. Rear oil seal case
- ▶C◀ 12. Rear oil seal
- ▶B◀ 13. Bearing cap bolt

- ▶B◀ 14. Bearing cap
- ▶A◀ 15. Crankshaft bearing, lower
- ▶A◀ 16. Crankshaft
- ▶A◀ 17. Thrust plate
- ▶A◀ 18. Crankshaft bearing, upper
- ▶A◀ 19. Cylinder block

### Caution

Do not remove any of the bolts "A" of the flywheel shown in the illustration. The balance of the flexible type flywheel is adjusted in an assembled condition. Removing the bolt, therefore, can cause the flexible flywheel to be out of balance, giving damage to the flywheel.

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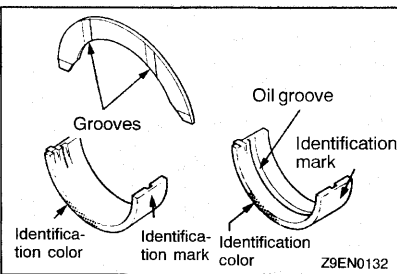
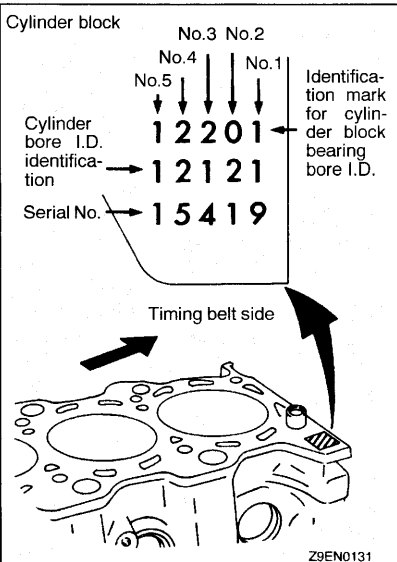


**INSTALLATION SERVICE POINTS**

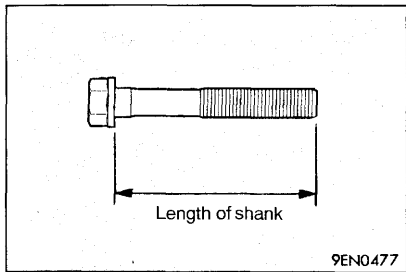
**▶◀ CRANKSHAFT BEARING INSTALLATION**

(1) When replacing the bearings, crankshaft and/or cylinder block, read off the identification mark on the crankshaft and cylinder block (as illustrated), and select a bearing according to the following table.

Crankshaft journal O.D.	Cylinder block bearing bore I.D.	Crankshaft bearing	
Identification mark	Identification mark	Identification mark	Identification color
1	0	S1	Brown
	1	S2	Black
	2	S3	Green
2	0	S2	Black
	1	S3	Green
	2	S4	Yellow
3	0	S3	Green
	1	S4	Yellow
	2	S5	Red



- (2) Install bearings having an oil groove to the cylinder block.
- (3) Install bearings having no oil groove onto the bearing caps.
- (4) Install the thrust bearings at the No.3 upper bearing with the grooved side toward the crankshaft web.

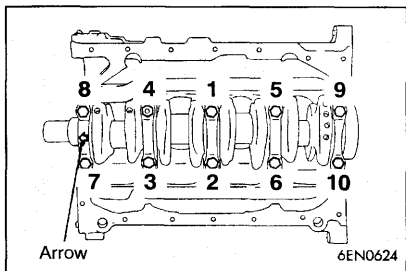


### ▶◀ BEARING CAP/BEARING CAP BOLT INSTALLATION

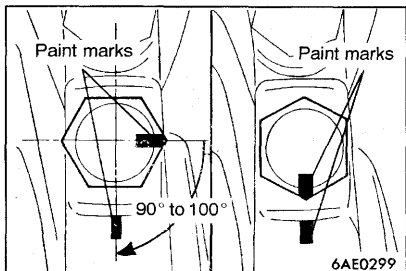
- (1) Install the bearing cap so their arrow is positioned on the timing belt side.
- (2) When reusing the bearing cap bolt, measure that its shank length does not exceed the specified limit. Replace the bolt if this measurement exceeds the limit.

**Limit: max. 71.1 mm (2.799 in.)**

- (3) Apply engine oil to the bolt thread and flange of the bolt.



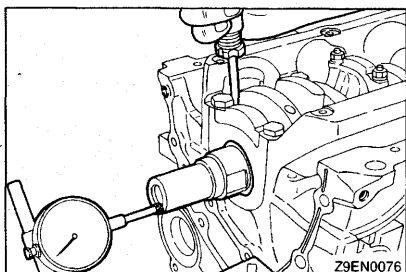
- (4) Tighten the bearing cap bolts to 25 Nm (18 ft.lbs.) torque in the sequence shown.



- (5) Make a paint mark on the head of each bolt.
- (6) Make a paint mark on the bearing cap at the position 90° to 100° from the paint mark on the bolt head in the direction of tightening the bolt.
- (7) Give a 90° to 100° turn to the bolt in the tightening sequence. Make sure that the paint mark on the bolt and that on the bearing cap are in alignment.

#### Caution

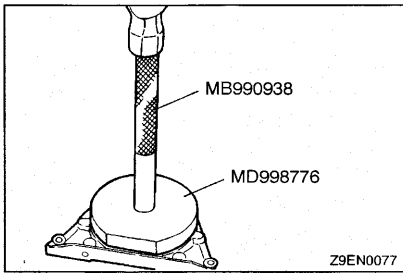
1. If the bolt is turned less than 90°, proper fastening performance may not be expected. When tightening the bolt, therefore, be careful to give a sufficient turn to it.
2. If the bolt is overtightened (exceeding 100°), loosen the bolt completely and then retighten it by repeating the tightening procedure from step (1).



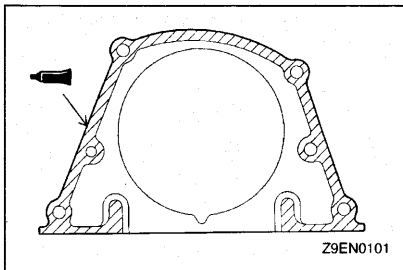
- (8) Check that the crankshaft rotates smoothly.
- (9) Measure the end play in the crankshaft. If the measurement exceeds the specified limit, replace the crankshaft bearings.

**Standard value: 0.05 - 0.25 mm (.0020 - .0098 in.)**

**Limit: 0.4 mm (.016 in.)**



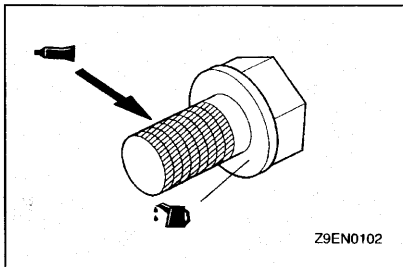
### ►C◀ REAR OIL SEAL INSTALLATION



### ►D◀ SEALANT APPLICATION TO OIL SEAL CASE

Specified sealant:

**Mitsubishi Genuine Part No.MD970389 or equivalent**



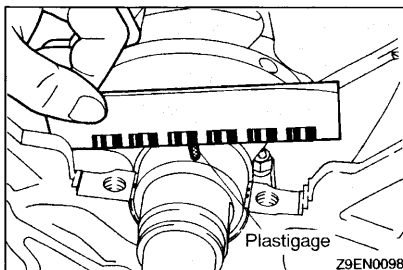
### ►E◀ DRIVE PLATE BOLT/FLYWHEEL BOLT INSTALLATION

- (1) Remove all the remaining sealant from bolts and thread holes of crankshaft.
- (2) Apply engine oil to the flange of bolt.
- (3) Apply engine oil into the thread holes of crankshaft.
- (4) Apply specified sealant to the thread of bolt.

Specified sealant:

**3M Nut Locking Part No.4171 or equivalent**

- (5) Tighten the bolts to specified torque.

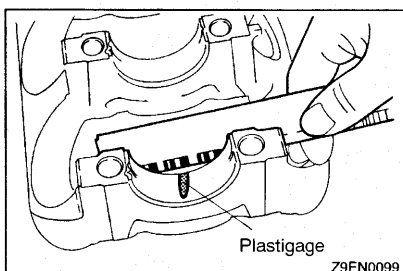


### INSPECTION

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#### CRANKSHAFT JOURNAL OIL CLEARANCE (PLASTIGAGE METHOD)

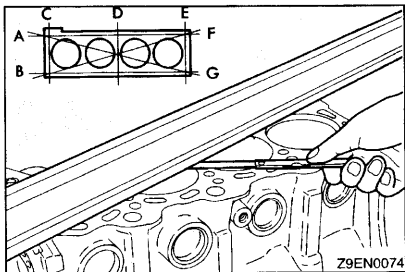
- (1) Remove oil from the crankshaft journal and the crankshaft bearing.
- (2) Install the crankshaft.
- (3) Cut the Plastigage to the same length as the width of bearing and place it on the journal in parallel with its axis.



- (4) Install the crankshaft bearing cap carefully and tighten the bolts to the specified torque.
- (5) Carefully remove the crankshaft bearing cap.
- (6) Measure the width of the Plastigage at its widest part by using a scale printed on the Plastigage package.

**Standard value: 0.02 - 0.04 mm (.0008 - .0016 in.)**

**Limit: 0.1 mm (.004 in.)**



**CYLINDER BLOCK**

- (1) Visually check for cracks, rust, and corrosion, and inspect the cylinder block using a flaw detecting agent. Rectify defects where possible or replace the cylinder block.
- (2) Ensure that the top surface is free of gasket chips and other foreign material. Check the cylinder block top surface for distortion using a straight edge and feeler gauge.

**Standard value: 0.05 mm (.0020 in.) or less**

**Limit: 0.1 mm (.004 in.)**

- (3) If the distortion is excessive, correct within the allowable limit or replace.

**Grinding limit: 0.2 mm (.008 in.)**

**The total thickness of the stock allowed to be removed from cylinder block and mating cylinder head 0.2 mm (.008 in.) at maximum.**

**Cylinder block height (when new):  
263.5 mm (10.374 in.)**

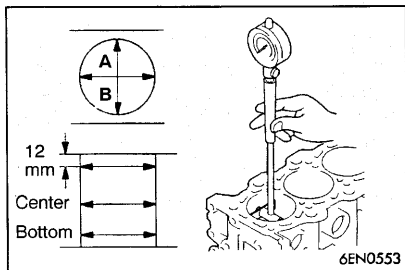
- (4) Check the cylinder walls for cracks and seizure marks. If defects are evident, bore all the cylinders to oversize or replace the cylinder block.

- (5) Using a cylinder gauge, measure each cylinder bore and cylindricity. If any cylinder is severely worn, bore all the cylinders to oversize and replace the piston and piston rings accordingly. Take measurements at the points shown.

**Standard value:**

**Cylinder bore I.D.: 81.0 mm (3.19 in.)**

**Cylindricity: 0.01 mm (.0004 in.) or less**



**BORING CYLINDER**

- (1) Oversize pistons should be based on the largest bore cylinder.

**Piston size identification**

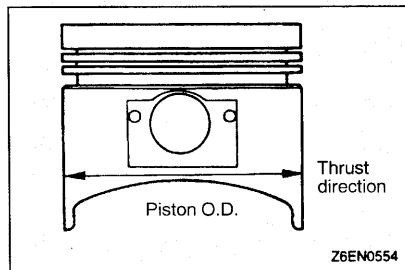
Size	Identification mark
0.50 mm O.S.	0.50
1.00 mm O.S.	1.00

**NOTE**

The size mark is stamped on the piston top.

- (2) Measure the 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 (.0008 in.) (honing margin)**



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

**Caution**

**To prevent distortion caused by heat increased during boring, bore the cylinders in the following order: No.2, No.4, No.1, No.3.**

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

**Standard value:**

**0.02 - 0.04 mm (.0008 - .0016 in.)**

**NOTE**

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