

# MITSUBISHI

## ENGINE 6A1 SERIES (E-W)

### WORKSHOP MANUAL

#### FOREWORD

This Workshop Manual contains procedures for removal, disassembly, inspection, adjustment, reassembly and installation, etc. for service mechanics.

All information, illustrations and product descriptions contained in this manual are current as at the time of publication. We, however, reserve the right to make changes at any time without prior notice or obligation.

Engine ..... **11A**

#### FILING INSTRUCTION

Please keep these manual pages in the binder No. BN890001.

File these pages according to the signs "Added", "Revised" and "Deleted" on the "List of effective pages" which are interpreted below.

**Added:**

File the pages with this sign additionally in your manual.

**Revised, Deleted:**

Replace the existing pages with the corresponding pages with this sign.

Missing sheets will be supplied upon request.



## INTRODUCTION

### EXPLANATION OF MANUAL CONTENTS

#### Maintenance and Servicing Procedures

- (1) A diagram of the component parts is provided near the front of each section in order to give the reader a better understanding of the installed condition of component parts.
  - (2) The numbers provided within the diagram indicate the sequence for maintenance and servicing procedures.  
**N** : Indicates a non-reusable part.  
The tightening torque is provided where applicable.
- Removal steps:  
The part designation number corresponds to the number in the illustration to indicate removal steps.
  - Disassembly steps:  
The part designation number corresponds to the number in the illustration to indicate disassembly steps.
  - Installation steps:  
Specified in case installation is impossible in reverse order of removal steps. Omitted if installation is possible in reverse order of removal steps.
  - Reassembly steps:  
Specified in case reassembly is impossible in reverse order of disassembly steps. Omitted if reassembly is possible in reverse order of disassembly steps.





#### Classification of Major Maintenance/Service Points

When there are major points relative to maintenance and servicing procedures (such as essential maintenance and service points, maintenance and service standard values, information regarding the use of special tools, etc.), these are arranged together as major maintenance and service points and explained in detail.

- ◀A▶** : Indicates that there are essential points for removal or disassembly.  
**▶A◀** : Indicates that there are essential points for installation or reassembly.

#### Symbols for Lubrication, Sealants and Adhesives

Information concerning the locations for lubrication and for application of sealants and adhesives is provided, by using symbols, in the diagram of component parts, or on the page following the component parts page, and explained.

-  : Grease (multipurpose grease unless there is a brand or type specified)
-  : Sealant or adhesive
-  : Brake fluid, automatic transmission fluid or air conditioner compressor oil
-  : Engine oil or gear oil

# INTRODUCTION

Indicates the group title.

Indicates the section title.

Indicates the group number.

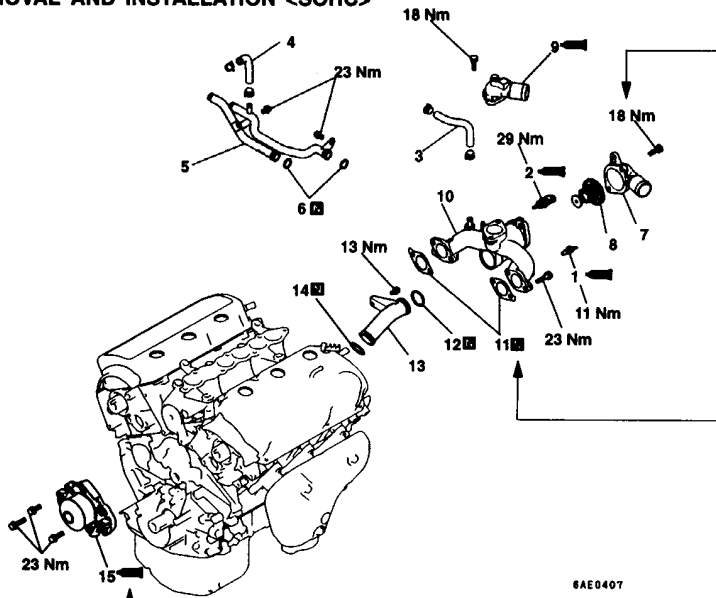
Indicates the section number.

Indicates the page number.

6A1 ENGINE (E-W) - Water Pump and Water Pipe 11A-7-1

## 7. WATER PUMP AND WATER PIPE

### REMOVAL AND INSTALLATION <SOHC>



Denotes tightening torque.

Denotes non-reusable part.

This number corresponds to the number appearing in "Removal steps", "Disassembly steps", "Installation steps" or "Reassembly steps".

#### Removal steps

- ▶F◀ 1.Engine coolant temperature gauge unit
- ▶E◀ 2.Engine coolant temperature sensor
- ▶ 3.Water hose
- ▶ 4.Water hose
- ▶ 5.Heater pipe
- ▶ 6.O-ring
- ▶D◀ 7.Water inlet fitting
- ▶ 8.Thermostat

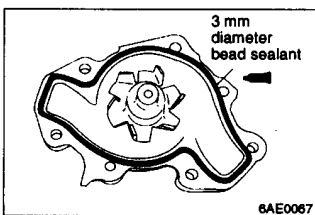
- ▶C◀ 9.Water outlet fitting
- ▶ 10.Thermostat housing
- ▶B◀ 11.Gasket
- ▶B◀ 12.O-ring
- ▶B◀ 13.Water pipe
- ▶A◀ 14.O-ring
- ▶ 15.Water pump

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Operating procedures, cautions, etc. on removal, installation, disassembly and reassembly are described.

#### INSTALLATION SERVICE POINTS

- ▶A◀ SEALANT APPLICATION TO WATER PUMP
- Specified sealant:  
Mitsubishi Genuine Part No. MD970389 or equivalent



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**11A-0-2**

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**NOTES**

**GENERAL INFORMATION****GENERAL SPECIFICATIONS**

Descriptions			6A12	6A13
Type			60° V, OHV, DOHC (for each bank)	60° V, OHV, SOHC (for each bank)
Number of cylinders			6	6
Combustion chamber			Pentroof type	Pentroof type
Total displacement dm <sup>3</sup>			1,998	2,498
Cylinder bore mm			78.4	81.0
Piston stroke mm			69.0	80.8
Compression ratio			10.0	9.5* <sup>1</sup> or 9.0* <sup>2</sup>
Valve timing	Intake valve	Opens (BTDC)	15° (Low-speed cam) 37.5° (High-speed cam)	15°
		Closes (ABDC)	41° (Low-speed cam) 82.5° (High-speed cam)	53°
	Exhaust valve	Opens (BBDC)	41° (Low-speed cam) 75° (High-speed cam)	53°
		Closes (ATDC)	15° (Low-speed cam) 30° (High-speed cam)	15°
Lubrication system			Pressure feed, full-flow filtration	Pressure feed, full-flow filtration
Oil pump type			Trochoid type	Trochoid type
Cooling system			Water-cooled forced circulation	Water-cooled forced circulation
Water pump type			Centrifugal impeller type	Centrifugal impeller type

**NOTE**

\*1: Europe and Hong Kong

\*2: GCC and Export

# 1. SPECIFICATIONS

## SERVICE SPECIFICATIONS

Items		Standard value	Limit	
<b>Timing belt</b>				
Auto tensioner rod projection mm		12.0	–	
Auto tensioner rod pushed-in amount (when pushed with a force of 98 – 196 N) mm		1.0 or less	–	
<b>Rocker arm and camshaft &lt;SOHC&gt;</b>				
Camshaft cam height mm	Intake	35.20	34.70	
	Exhaust	34.70	34.20	
Camshaft journal diameter mm		45	–	
<b>Rocker cover and camshaft &lt;MIVEC&gt;</b>				
Camshaft cam height mm	Intake	(Low-speed cam)	34.34	33.84
		(High-speed cam)	36.46	35.96
	Exhaust	(Low-speed cam)	34.40	33.90
		(High-speed cam)	35.86	35.36
Camshaft journal diameter mm		26	–	
Valve clearance mm	Intake	0.10	–	
	Exhaust	0.13	–	
<b>Cylinder head and valve</b>				
Flatness of cylinder head gasket surface mm		–	–	
Cylinder head gasket surface grinding limit (including grinding of cylinder block gasket surface) mm		Less than 0.03	–	
Cylinder head overall height mm	SOHC	119.9 – 120.1	–	
	MIVEC	119.6 – 119.8	–	
Cylinder head bolt nominal length mm		–	96.4	
Valve margin mm	Intake	1.0	0.5	
	Exhaust	1.3	0.8	
Valve stem diameter mm		6.0	–	
Valve stem-to-guide clearance mm	Intake	0.02 – 0.05	0.10	
	Exhaust	0.04 – 0.07	0.15	
Valve face angle mm		45° – 45.5°	–	
Valve stem projection mm	SOHC	48.45	48.95	
	MIVEC	48.40	48.90	

Items		Standard value	Limit	
Overall valve length mm	Intake	SOHC	113.02	112.52
		MIVEC	112.37	111.87
	Exhaust	SOHC	115.32	114.82
		MIVEC	110.74	110.74
Valve spring free height mm	SOHC		49.9	48.9
	MIVEC		51.5	50.5
Valve spring load/installed height N/mm	SOHC		265/43.4	–
	MIVEC		255/44.5	–
Valve spring squareness		2°	4°	
Valve seat contact width mm		0.9 – 1.3	–	
Valve guide internal diameter mm		6.6	–	
Valve guide projection mm	SOHC		14.0	–
	MIVEC		19.0	–
<b>Oil pump case and oil pan</b>				
Oil pump tip clearance mm		0.06 – 0.18	–	
Oil pump side clearance mm		0.04 – 0.10	–	
Oil pump body clearance mm		0.10 – 0.18	0.35	
<b>Piston and connecting rod</b>				
Piston outside diameter mm	6A12		78.4	–
	6A13		81.0	–
Piston ring side clearance mm	No.1 ring		0.02 – 0.06	–
	No.2 ring		0.02 – 0.06	–
Piston ring end gap mm	No.1 ring		0.20 – 0.35	0.8
	No.2 ring		0.35 – 0.50	0.8
	No.3 ring		0.20 – 0.50	1.0
Piston pin outside diameter mm		19.0	–	
Piston pin press-in load (at room temperature) N		4,900 – 14,700	–	
Crankshaft pin oil clearance mm		0.02 – 0.05	0.1	
Connecting rod big end side clearance mm		0.10 – 0.25	0.4	
<b>Crankshaft, cylinder block, flywheel and drive plate</b>				
Crankshaft end play mm		0.05 – 0.25	0.4	



Items		Standard value	Limit
Crankshaft journal diameter mm	6A12	53.0	–
	6A13	56.0	–
Crankshaft pin diameter mm	6A12	43.0	–
	6A13	51.0	–
Crankshaft journal oil clearance mm		0.02 – 0.04	0.1
Cylinder block gasket surface flatness mm		0.05	–
Cylinder block gasket surface grinding limit (including grinding of cylinder head gasket surface) mm		–	0.2
Cylinder block overall height mm	6A12	190.0	–
	6A13	209.0	–
Cylinder block cylindricity mm		0.01 or less	–
Cylinder block internal diameter mm	6A12	78.4	–
	6A13	81.0	–
Bearing cap bolt nominal length mm		–	71.1
Piston-to-cylinder clearance mm		0.02 – 0.04	–

## REWORK DIMENSIONS

Item		Standard	
<b>Cylinder head and valves</b>			
Cylinder head oversize valve guide hole diameter mm	0.05 O.S.	11.05 – 11.07	
	0.25 O.S.	11.25 – 11.27	
	0.50 O.S.	11.50 – 11.52	
Oversize intake valve seat ring hole diameter mm	SOHC	0.3 O.S.	29.80 – 29.82
		0.6 O.S.	30.10 – 30.12
	MIVEC	0.3 O.S.	32.30 – 23.32
		0.6 O.S.	32.60 – 32.62
Oversize exhaust valve seat ring diameter mm	SOHC	0.3 O.S.	27.80 – 27.82
		0.6 O.S.	28.10 – 28.12
	MIVEC	0.3 O.S.	29.80 – 29.82
		0.6 O.S.	30.10 – 30.12

**TORQUE SPECIFICATION**

Items	Nm
<b>Alternator and drive belt</b>	
Alternator pivot nut	44
Alternator bolt	21
Oil level gauge guide	23
Tensioner pulley	15
Engine hanger	23
Tensioner pulley bracket A	45
Crankshaft bolt	182
Engine cover	3
<b>Timing belt</b>	
Timing belt front cover	11
Engine support bracket	49
Angle sensor	9
Angle sensor connector bracket	11
Tensioner pulley	48
Tensioner arm	24
Auto tensioner	21
Camshaft sprocket bolt	88
Idler pulley	35
Timing belt rear cover	11
Angle sensor connector bracket	11
<b>Fuel and emission control parts</b>	
Air intake plenum stay	18
Connector bracket	11
EGR valve	22
Throttle body	12
Air intake plenum	18
Delivery pipe	12
Fuel pipe	9
Fuel pressure regulator	9
Alternator bracket	23

Items	Nm
<b>Ignition system</b>	
Spark plug	25
Water cover (SOHC)	11
Distributor (SOHC)	13
Ignition failure sensor (MIVEC)	10
Condenser bracket assembly (MIVEC)	5
Ignition coil (MIVEC)	10
<b>Water pump and water pipe</b>	
Engine hanger (MIVEC)	11
Engine coolant temperature gauge unit	11
Engine coolant temperature sensor	29
Heater pipe (SOHC)	23
Water inlet fitting	18
Water outlet fitting	18
Thermostat housing	23
Water pipe	13
Water pump	23
<b>Intake manifold and exhaust manifold</b>	
Intake manifold	17
Heat protector	13
Exhaust manifold stay	44
Exhaust manifold	49
<b>Rocker arm and camshaft &lt;SOHC&gt;</b>	
Rocker cover	4
Rocker arm and rocker shaft	31
Thrust case	24
<b>Rocker arm and camshaft &lt;MIVEC&gt;</b>	
Rocker cover	4
Oil control valve holder	9
Cam cap	24
Bearing cap M6	11
Bearing cap M8	24

Items	Nm
Arm spring holder	11
<b>Rocker arm and rocker shaft cap &lt;MIVEC&gt;</b>	
Rocker shaft cap	11
<b>Cylinder head and valves</b>	
Cylinder head bolt	20 + 120° + 120°
<b>Oil pan and oil pump</b>	
Oil pressure switch	10
Oil filter cover	21
Water hose	30
Bolt	68
Drain plug	39
Oil level sensor	9
Oil pan	7
Oil screen	19
Baffle plate	9
Relief plug	44
Oil pump case	14
Oil pump case cover	12
<b>Piston and connecting rod</b>	
Connecting rod	18 + 90° – 100°
<b>Crankshaft, cylinder block, flywheel and drive plate</b>	
Detonation sensor	23
Idler pulley bracket	35
Flywheel bolt	98
Drive plate bolt	98
Rear plate	11
Bell housing cover	9
Oil seal case	11
Bearing cap bolt	25 + 90° – 100°

## NEW TIGHTENING METHOD – BY USE OF BOLTS TO BE TIGHTENED IN PLASTIC AREA

A new type of bolts, to be tightened in plastic area, is currently used in some parts of the engine. The tightening method for the bolts is different from the conventional one. Be sure to observe the method described in the text when tightening the bolts.

Service limits are provided for the bolts. Make sure that the service limits described in the text are strictly observed.

- Areas where the bolts are in use:
  - (1) Cylinder head bolts
  - (2) Main bearing cap bolts
  - (3) Connecting rod cap bolts
- Tightening Method  
After tightening the bolts to the specified torque, tighten them another 90° to 100°, or 240° (twice 120°). The tightening method varies on different areas. Observe the tightening method described in the text.

## SEALANTS

Item	Specified sealant	Quantity
Water pump	Mitsubishi Genuine Part No. MD970389 or equivalent	As required
Water outlet fitting*	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
Camshaft bearing	3M ATD Part No. 8660 or equivalent	As required
Cam cap	3M ATD Part No. 8660 or equivalent	As required
Oil control valve	3M ATD Part No. 8660 or equivalent	As required
Camshaft holder*	Mitsubishi Genuine Part No. MD970389 or equivalent	As required
Rocker cover	3M ATD Part No. 8660 or equivalent	As required
Oil pump case*	Mitsubishi Genuine Part No. MD970389 or equivalent	As required
Oil pan*	Mitsubishi Genuine Part No. MD970389 or equivalent	As required
Oil pressure switch	3M ATD Part No. 8660 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

\*: parts sealed by foam-in-place gasket (FIPG)

## FORM-IN-PLACE GASKET (FIPG)

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. For removal of the oil pan, the special tool "Oil Pan Remover" (MD998727) is available. Be sure to use the special tool to remove the oil pan.

### 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 remained in the bolt holes.


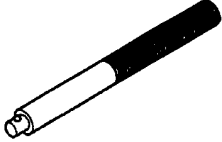
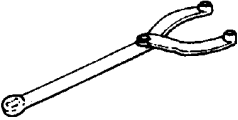
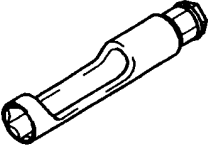
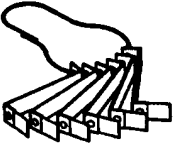
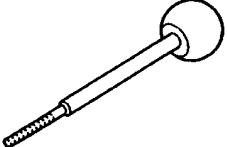
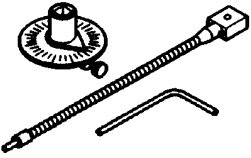
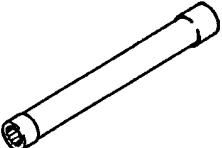

### Form-in-Place Gasket Application

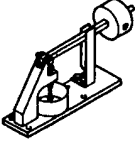

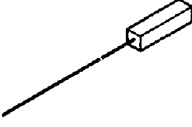
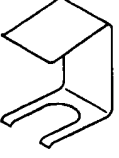
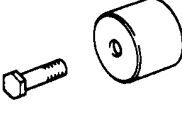
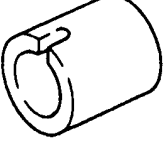
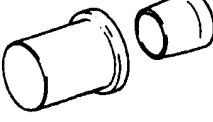
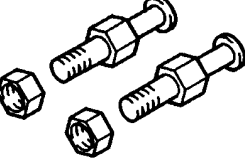

When assembling parts with the FIPG, you must observe some precautions, but the procedure is very simple as in the case of a conventional pre-cut gasket.

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. In addition, do not apply any oil or water to the sealing locations or start the engine until a sufficient amount of time (about one hour) has passed after installation is completed.

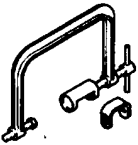
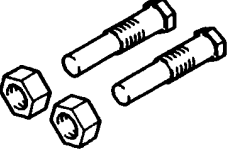
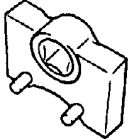
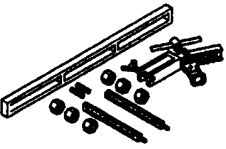
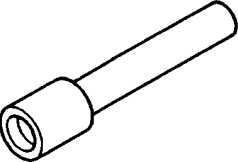
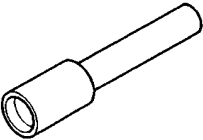
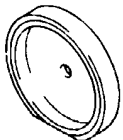

The FIPG application procedure may vary on different areas. Observe the procedure described in the text when applying the FIPG.

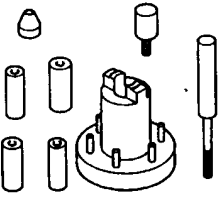
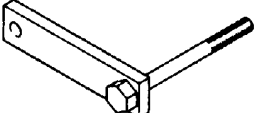
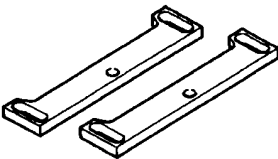
## 2. SPECIAL TOOLS

Tool	Number	Name	Use
	MB990685	Torque wrench	Adjustment of timing belt tension
	MB990938	Handle	Use with MD998776
	MB990767	Crankshaft pulley holder	Holding camshaft sprocket when loosening and tightening of bolt. Use with MD998719
	MB991477	Valve adjusting wrench	Adjustment of valve clearance (MIVEC)
	MB991478	Valve adjusting wrench feeler gauge set	Adjustment of valve clearance (MIVEC)
	MB991479	Rocker arm piston checker	Adjustment of valve clearance (MIVEC)
	MB991614	Angle gauge	Tightening cylinder head bolt
	MB991653	Cylinder head bolt wrench	Tightening and loosening of cylinder head bolt
	MB991659	Guide D	Removal of piston pin (Use with MD998780)

Tool	Number	Name	Use
	MD998440	Leak-down tester	Leak-down test of lash adjuster
	MD998441	Lash adjuster retainers	Air bleeding of lash adjuster
	MD998442	Air bleed wire	Air bleeding of lash adjuster
	MD998443	Lash adjuster holder	Retainer for holding lash adjuster in rocker arm at time of removal and installation of rocker arm and rocker shaft assembly
	MD998713	Camshaft oil seal installer	Installation of camshaft oil seal
	MD998716	Crankshaft wrench	Rotation of crankshaft when installing piston and timing belt.
	MD998717	Crankshaft front oil seal installer	Installation of crankshaft front oil seal
	MD998719	Pulley holder pin (2)	Use with MB990767
	MD998727	Oil pan remover	Removal of oil pan

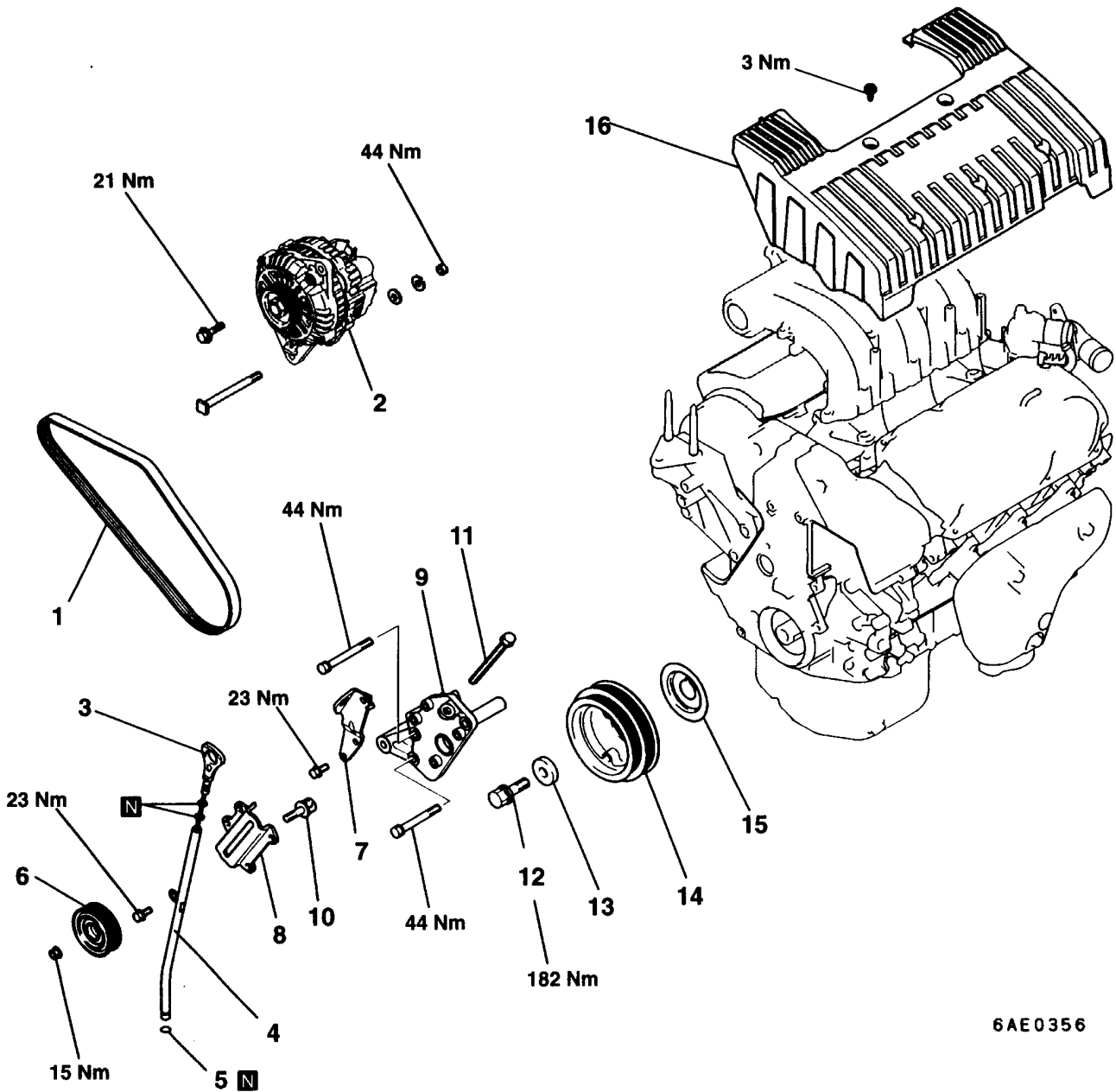


Tool	Number	Name	Use
	MD998735	Valve spring compressor	Compression of valve spring
	MD998754	Pin	Use with MB990767
	MD998767	Tensioner pulley socket wrench	Adjustment of timing belt tension
	MD998772	Valve spring compressor	Removal and installation of valve and related parts
	MD998774	Valve stem seal installer	Installation of valve stem seal
	MD998775	Valve stem seal installer	Installation of valve stem seal
	MD998776	Crankshaft rear oil seal installer	Installation of crankshaft rear oil seal Use with MB990938
	MD998777	Camshaft oil seal installer adapter	Installation of camshaft oil seal

Tool	Number	Name	Use
 A technical drawing of a setting tool for a piston pin. It consists of a central cylindrical component with a flange at the bottom, surrounded by several smaller cylindrical parts and a long thin rod.	MD998780	SETTING TOOL Piston pin	Removal and installation of piston pin
 A technical drawing of a flywheel stopper, which is a long, thin metal bar with a hook-like end.	MD998781	Flywheel stopper	Holding flywheel and drive plate
 A technical drawing of a valve spring compressor adapter, showing two long, thin metal bars with notches at one end.	MD998784	Valve spring compressor adapter	Compression of valve spring (MIVEC) (Use with MD998772)

### 3. DRIVE BELT

#### REMOVAL AND INSTALLATION <SOHC>



6AE0356

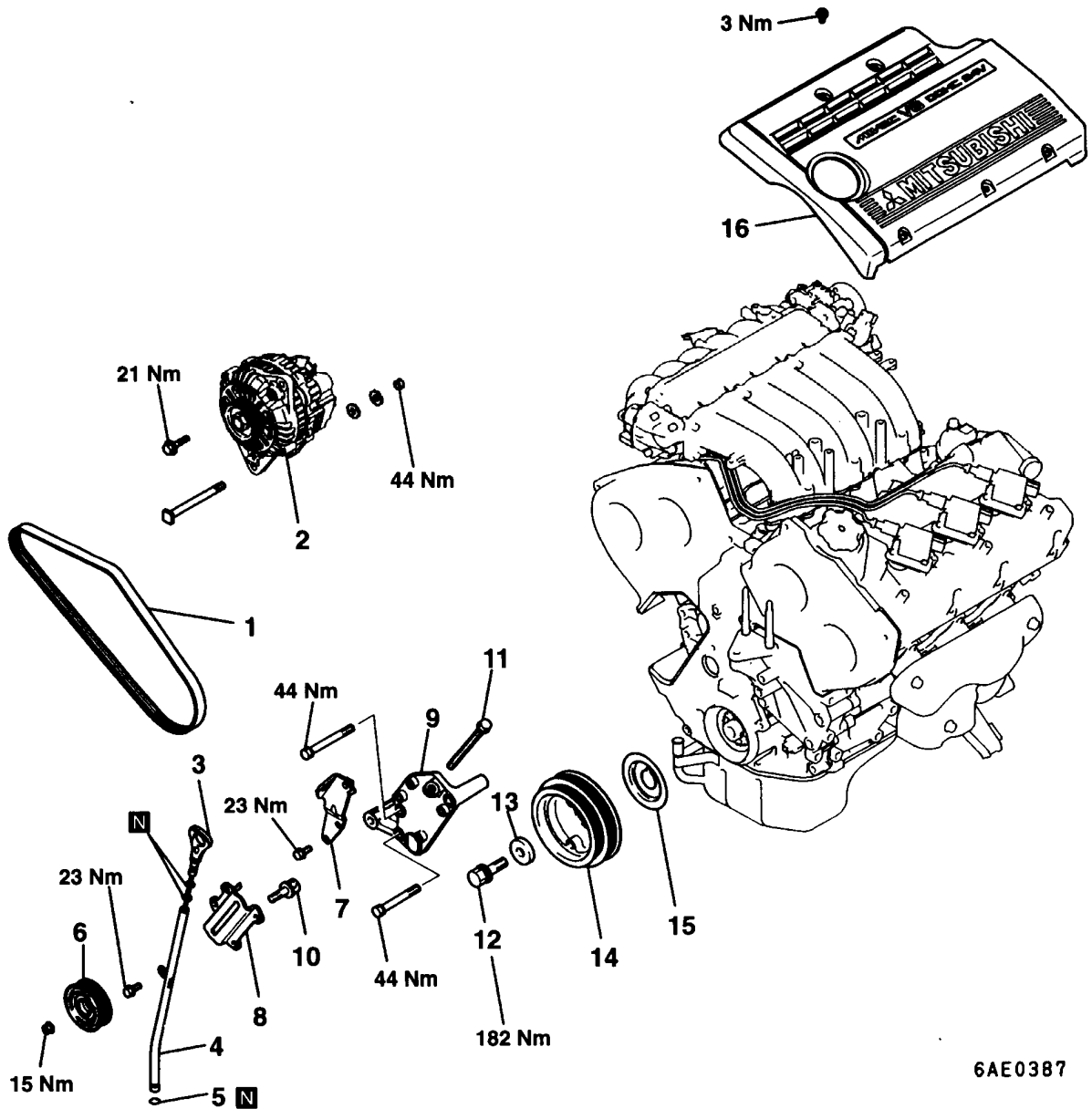
#### Removal steps

1. Drive belt
2. Alternator
3. Oil level gauge (dipstick)
4. Oil level gauge guide
5. O-ring
6. Tensioner pulley
7. Engine hanger
8. Tensioner pulley bracket A

9. Tensioner pulley bracket B
10. Adjusting stud
11. Adjusting bolt
12. Crankshaft bolt
13. Special washer
14. Crankshaft pulley
15. Flange
16. Engine cover



REMOVAL AND INSTALLATION <MIVEC>



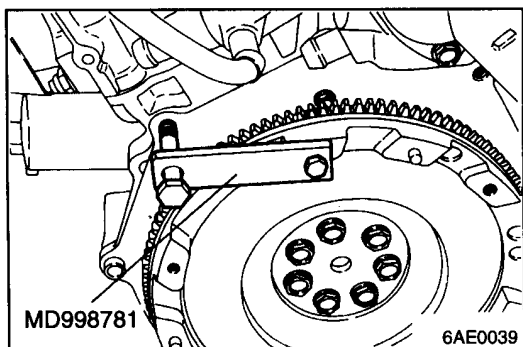
6AE0387

**Removal steps**

1. Drive belt
2. Alternator
3. Oil level gauge (dipstick)
4. Oil level gauge guide
5. O-ring
6. Tensioner pulley
7. Engine hanger
8. Tensioner pulley bracket A

9. Tensioner pulley bracket B
10. Adjusting stud
11. Adjusting bolt
12. Crankshaft bolt
13. Special washer
14. Crankshaft pulley
15. Flange
16. Engine cover



**REMOVAL SERVICE POINTS****◀A▶ CRANKSHAFT PULLEY BOLT REMOVAL**

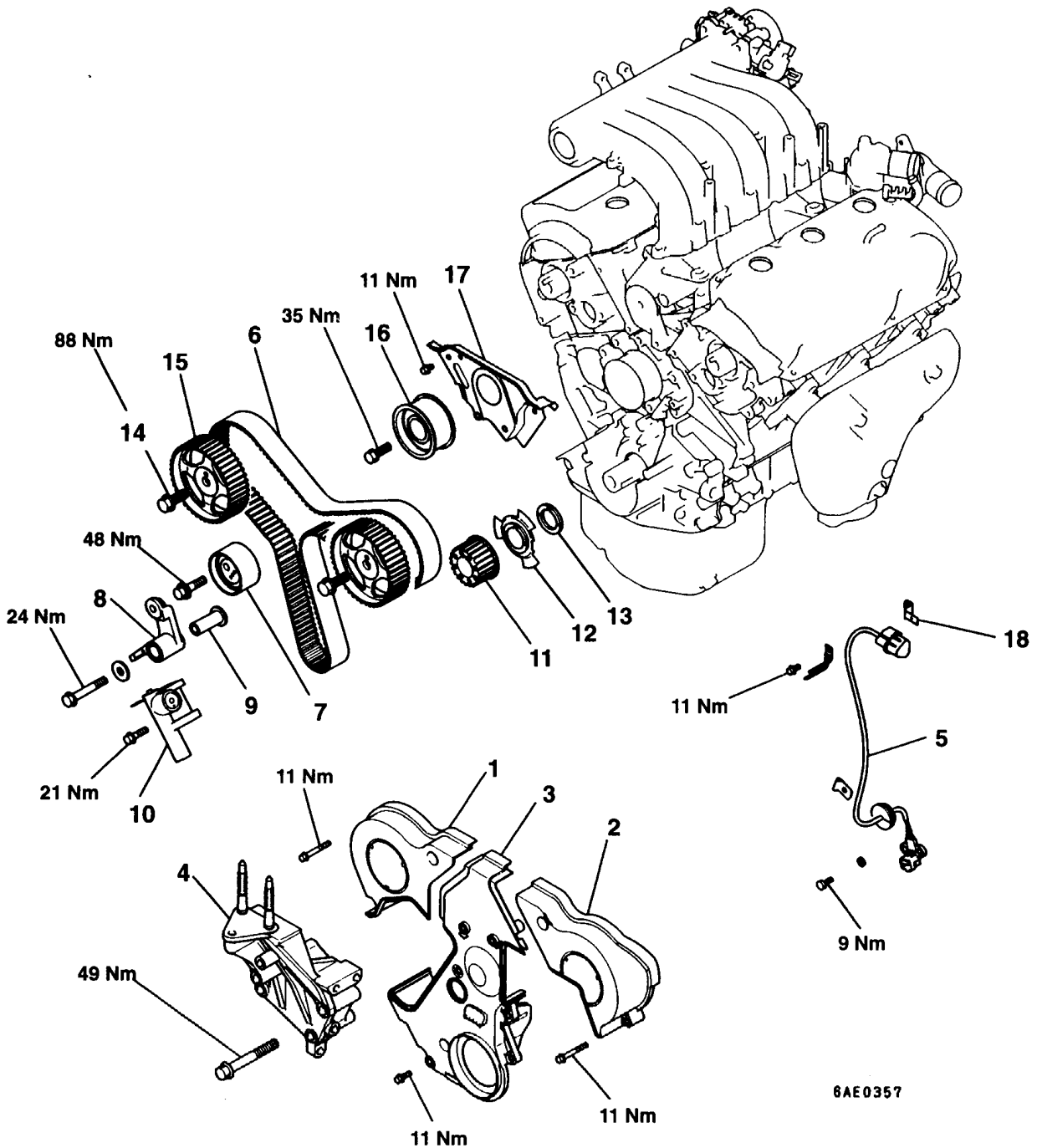
- (1) Hold the flywheel or drive plate in position with the special tool before removing the crankshaft pulley bolts.

**INSTALLATION SERVICE POINTS****▶A◀ CRANKSHAFT PULLEY BOLT INSTALLATION**

- (1) Hold the flywheel or drive plate in position with the special tool before installing the crankshaft pulley bolts.

### 4. TIMING BELT

#### REMOVAL AND INSTALLATION <SOHC>



6AE0357

#### Removal steps

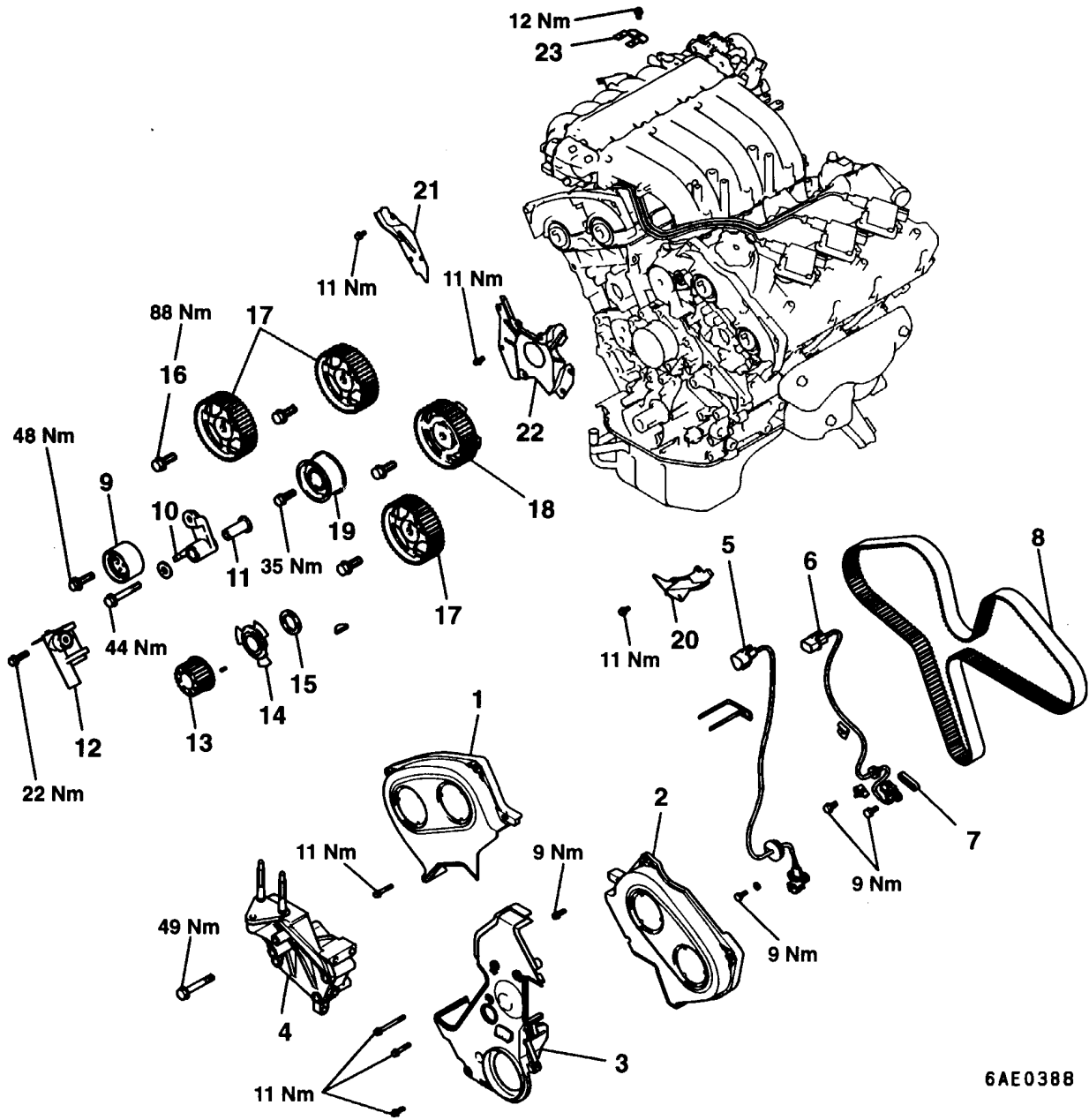
1. Timing belt front cover, upper right
2. Timing belt front cover, upper left
3. Timing belt front cover, lower
4. Engine support bracket
5. Angle sensor
6. Timing belt
7. Tensioner pulley
8. Tensioner arm
9. Tensioner spacer

◀A▶ ▶C▶

- ▶B▶ 10. Auto tensioner
11. Crankshaft sprocket
12. Sensing plate
13. Crankshaft spacer

- ▶B▶ ▶A▶ 14. Camshaft sprocket bolt
15. Camshaft sprocket
16. Idler pulley
17. Timing belt rear cover, center
18. Connector bracket

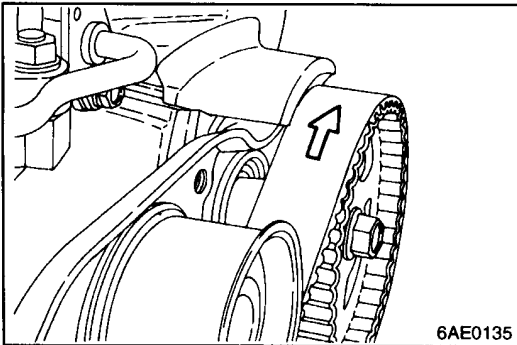
REMOVAL AND INSTALLATION <MIVEC>



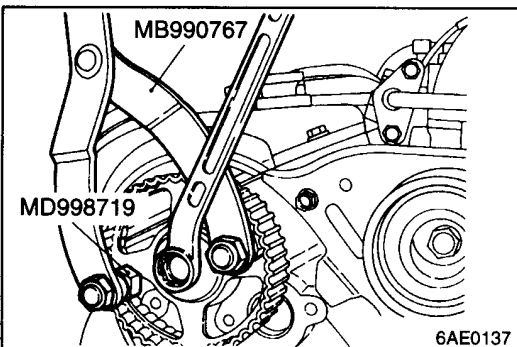
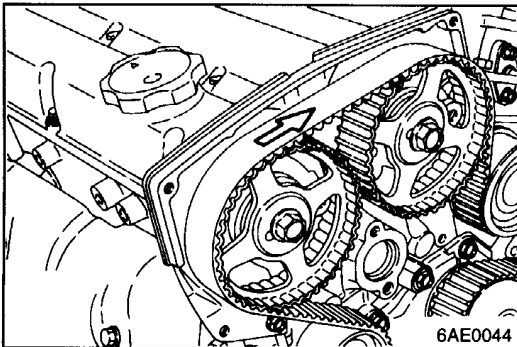
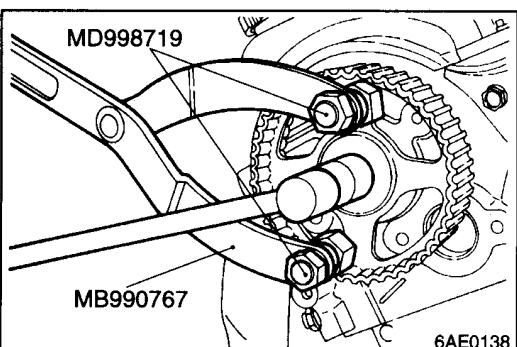
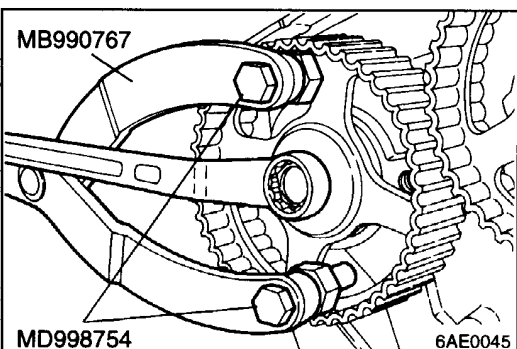
6AE0388

**Removal steps**

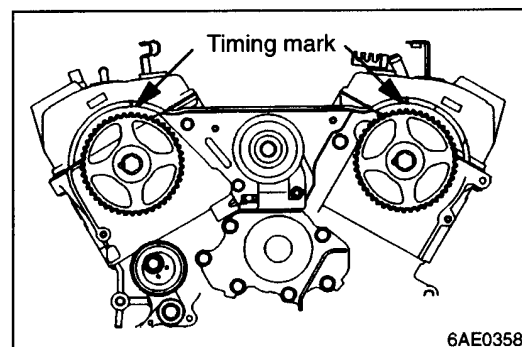
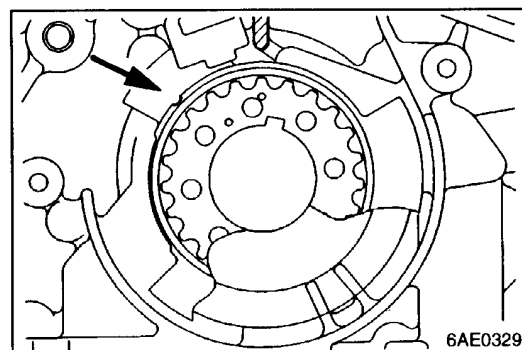
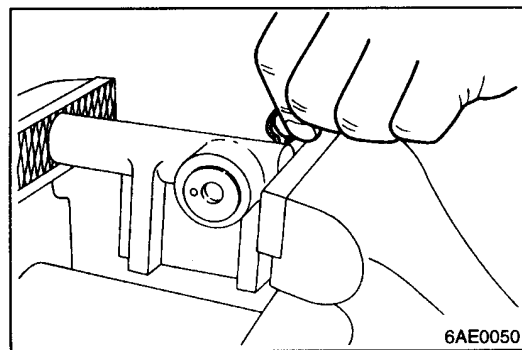
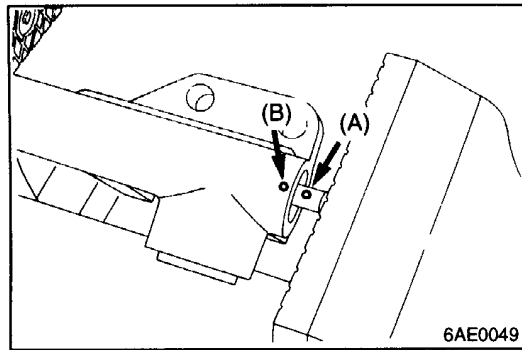
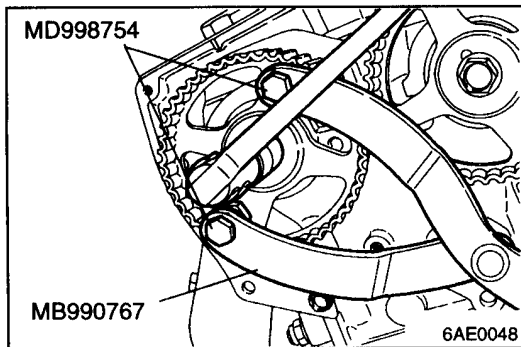
- |   |  |
|---|--|
| <p>1. Timing belt front cover, upper right</p> <p>2. Timing belt front cover, upper left</p> <p>3. Timing belt front cover, lower</p> <p>4. Engine support bracket</p> <p>5. Angle sensor</p> <p>6. Angle sensor</p> <p>7. Spacer</p> <p>8. Timing belt</p> <p>9. Tensioner pulley</p> <p>10. Tensioner arm</p> <p>11. Tensioner spacer</p> <p>12. Auto tensioner</p> | <p>13. Crankshaft sprocket</p> <p>14. Sensing plate</p> <p>15. Washer</p> <p>16. Camshaft sprocket bolt</p> <p>17. Camshaft sprocket</p> <p>18. Camshaft sprocket with sensing plate</p> <p>19. Idler pulley</p> <p>20. Timing belt rear cover, left</p> <p>21. Timing belt rear cover, right</p> <p>22. Timing belt rear cover, center</p> <p>23. Connector bracket</p> |
|---|--|

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

- (1) Mark the belt running direction for reference in reinstallation.
- (2) Loosen the bolt that secures the tensioner pulley to remove the timing belt.

**◀B▶ CAMSHAFT SPROCKET BOLT REMOVAL****INSTALLATION SERVICE POINTS****▶A▶ CAMSHAFT SPROCKET BOLT INSTALLATION**





### ►B◄ AUTO TENSIONER SETTING

- (1) Set the auto tensioner in a vice, while 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 1.4 mm wire in the set hole.
- (4) Remove the auto tensioner from the vice.

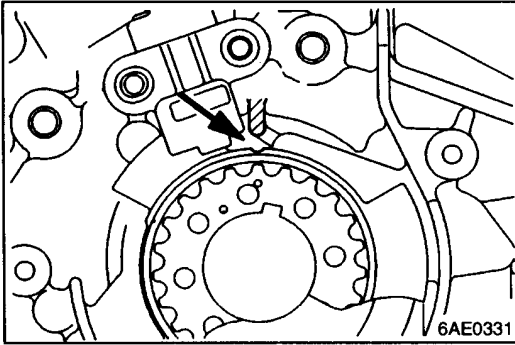
### ►C◄ TIMING BELT INSTALLATION

- (1) Turn the crankshaft sprocket so that its timing mark will be away from the mating timing mark by approx. three teeth.

#### Caution

- If the timing marks are aligned, the piston is brought to the TDC. When the camshaft is turned under this condition, the valves may interfere with the piston.

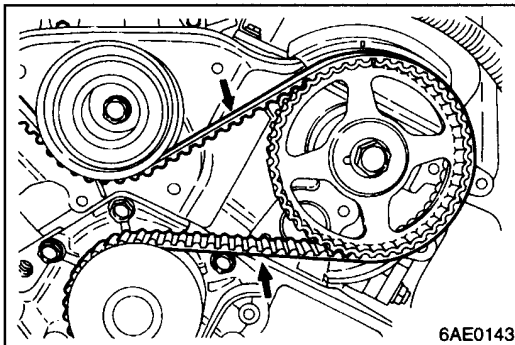
- (2) Bring the timing marks of the camshaft sprockets as shown in the illustration.



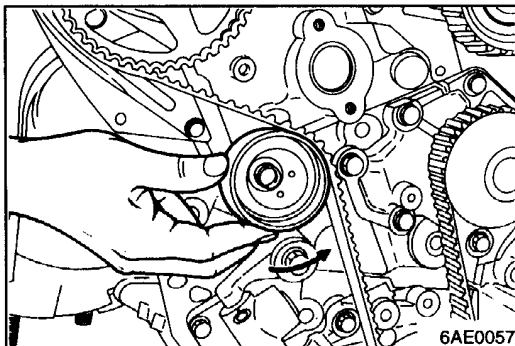
- (3) Align the timing mark on the crankshaft sprocket with that on the cylinder block side.
- (4) Fit the timing belt on the sprockets in the following order:
  - 1) Fit the timing belt on the crankshaft sprocket and then, while giving tension to the belt, fit it on the water pump sprocket.
  - 2) Fit the belt on the left bank camshaft sprocket.
  - 3) Fit the belt on the idler pulley while keeping it tight.
  - 4) Align the timing mark on the right bank camshaft sprocket with the mark on the cylinder block, and then fit the belt on the camshaft sprocket.

#### Caution

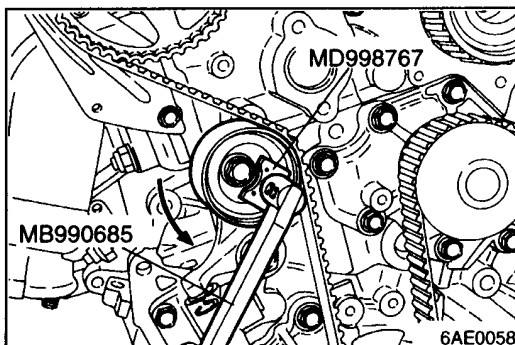
- **The camshaft sprockets are prone to rotate. Avoid giving excessive tension to the timing belt when it is fitted.**



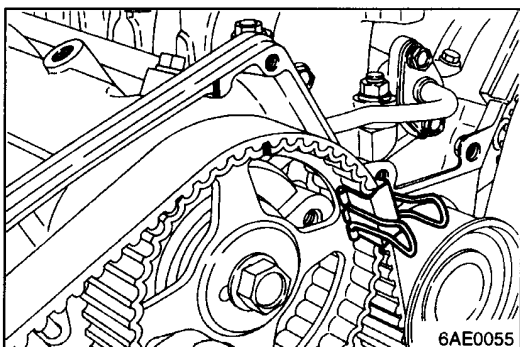
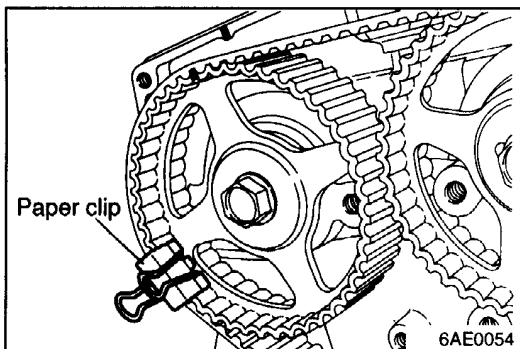
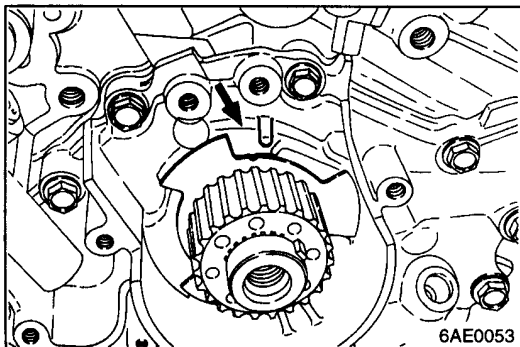
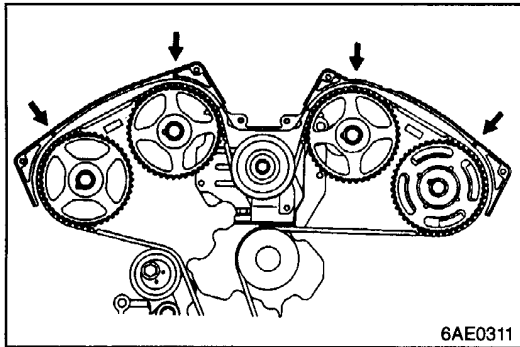
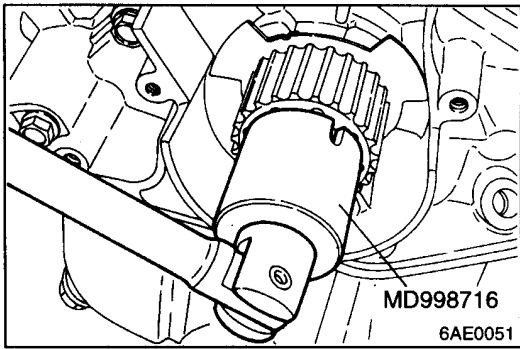
- 5) Make sure that the left bank portion of the belt is not slack when the belt is fitted on the tensioner pulley. If it is slack, remove the belt and fit it again beginning with the first step.



- (5) Move the tensioner pulley in the direction of the arrow and hold it in raised position by tightening the tensioner pulley bolt.
- (6) Check that all timing marks are aligned correctly.
- (7) Turn the crankshaft counterclockwise a quarter turn.
- (8) Turn back the crankshaft clockwise until the timing marks align again.



- (9) Install the special tool and a torque wrench of 0 – 5 Nm to the tensioner pulley.
- (10) Torque the tensioner pulley to 3 Nm with the torque wrench.
- (11) While holding the tensioner pulley, tighten the center bolt to specification.
- (12) Turn the crankshaft clockwise 2 turns and let it stand for about 5 minutes.



### ►D◄ TIMING BELT INSTALLATION

- (1) Turn the crankshaft sprocket so that its timing mark will be away from the mating timing mark by approx. three teeth.

#### Caution

- If the timing marks are aligned, the piston is brought to the TDC. When the camshaft is turned under this condition, the valves may interfere with the piston.

- (2) Bring the timing marks of the camshaft sprockets as shown in the illustration.

#### Caution

- If one of the camshaft sprockets on the right bank is turned with the timing mark on the other sprocket aligned, there may be danger for the intake and exhaust valves to interfere with each other.

- (3) Align the timing mark on the crankshaft sprocket with the mating timing mark, and then turn the crankshaft counterclockwise by one tooth.

- (4) Place the timing belt over the sprockets in the following method.

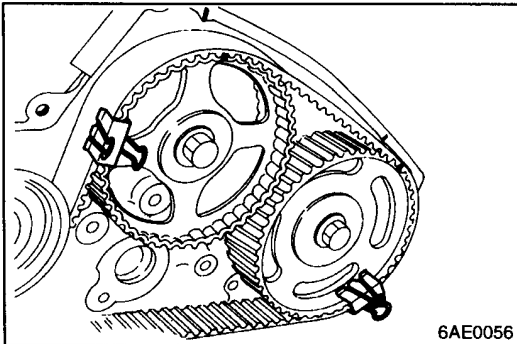
#### Caution

- The camshaft sprockets on the right bank can turn very easily because of the valve spring tension. Use care not to allow your fingers to get caught between the sprockets.

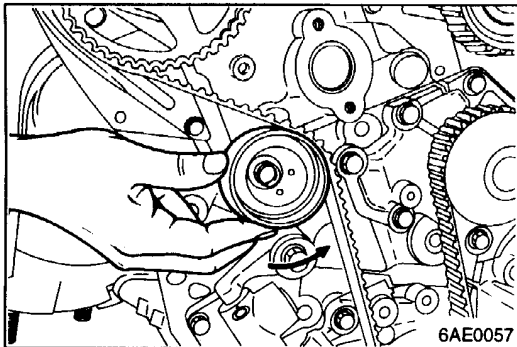
- 1) Align the timing mark of the right bank exhaust camshaft sprocket with the mating timing mark and hold the timing belt on the sprocket with a paper clip.
- 2) Align the timing mark of the intake camshaft sprocket and place the timing belt around that sprocket. Then, clip the belt at the location shown.

#### Caution

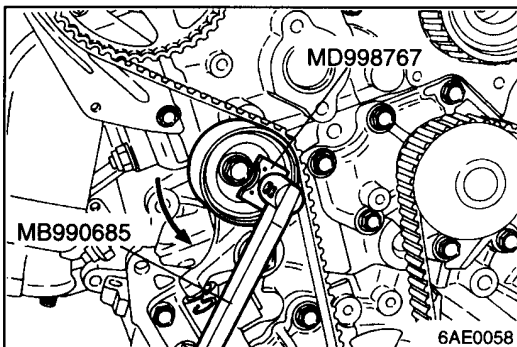
- The camshaft sprockets can turn easily and do not give excessive tension to the timing belt.
- 3) Place the timing belt around the idler pulley.



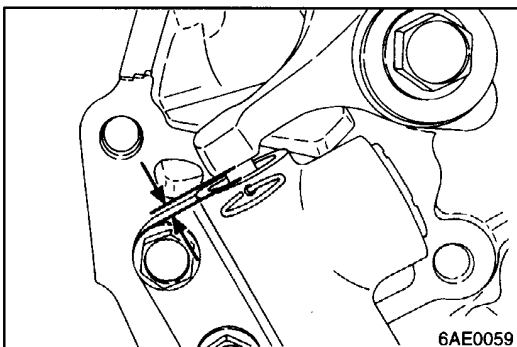
- 4) On the left bank, make sure that the timing marks of the camshaft sprockets are aligned and then hold the timing belt on these sprockets with paper clips.
- 5) Place the timing belt around the water pump pulley.
- 6) Place the timing belt around the crankshaft sprocket.
- 7) Place the timing belt around the tensioner pulley.



- (5) Move the tensioner pulley in the direction of the arrow and hold it in raised position by tightening the tensioner pulley bolt.
- (6) Check that all timing marks are aligned correctly.
- (7) Turn the crankshaft counterclockwise a quarter turn.
- (8) Turn back the crankshaft clockwise until the timing marks align again.



- (9) Install the special tool and a torque wrench of 0 – 5 Nm to the tensioner pulley.
- (10) Torque the tensioner pulley to 3 Nm with the torque wrench.
- (11) While holding the tensioner pulley, tighten the center bolt to specification.
- (12) Turn the crankshaft clockwise 2 turns and let it stand for about 5 minutes.



- (13) Make sure that the wire, which has been inserted when installing the auto tensioner, can be removed easily. Belt tension should be acceptable if the wire can be easily removed. Remove the wrench. The belt tension can also be verified by checking the protrusion amount of the auto tensioner rod which should conform to the following.

**Standard value: 3.8 – 4.5 mm**

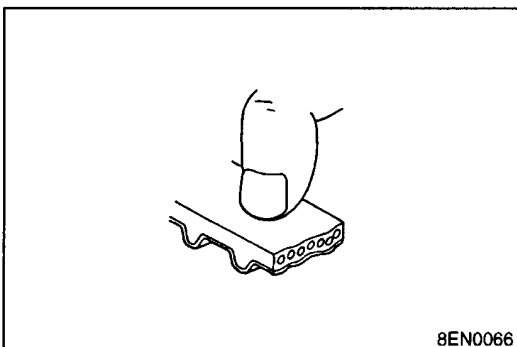
- (14) If the wire cannot be removed easily or the rod protrusion is not up to specification, repeat steps (9) through (12) to obtain the correct tension.

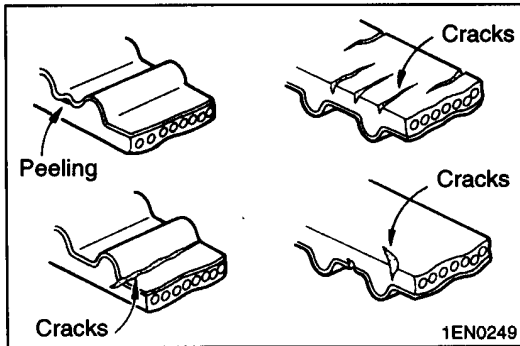
## INSPECTION

### TIMING BELT

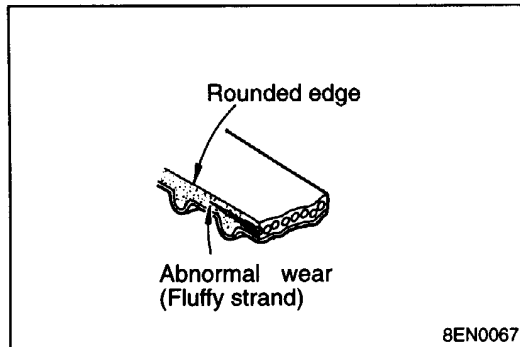
Replace belt if any of the following conditions exist.

- (1) Hardening of back rubber.  
Back side is glossy without resilience and leaves no indent when pressed with fingernail.

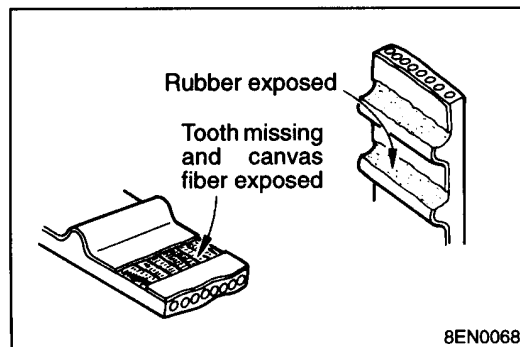




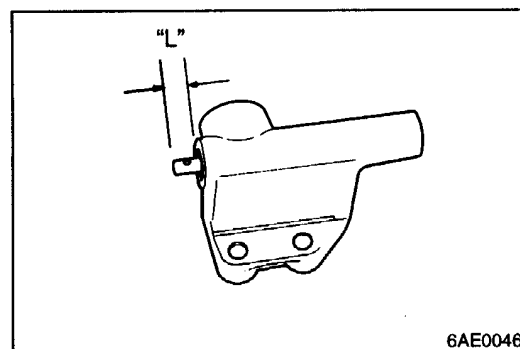
- (2) Cracks on rubber back.
- (3) Cracks or peeling of canvas.
- (4) Cracks on tooth bottom.
- (5) Cracks or belt sides.



- (6) Abnormal wear of belt sides. The sides are normal if they are sharp as if cut by a knife.



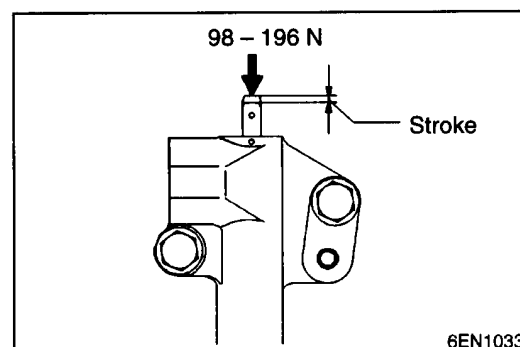
- (7) Abnormal wear on teeth.
- (8) Missing tooth.



**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**

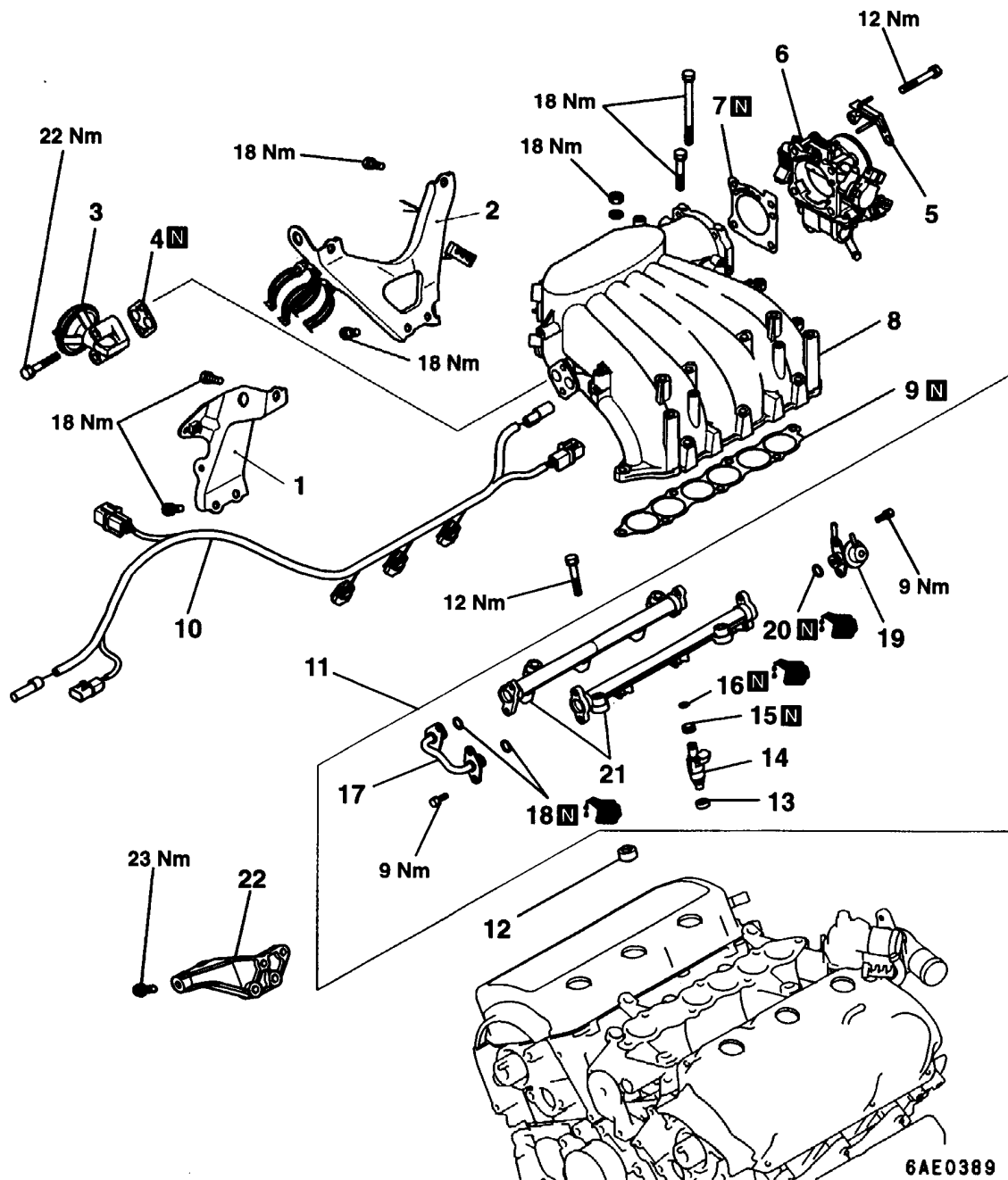


- (4) Press the rod by a force of 98 to 196 N and measure the rod stroke. If the measured value exceeds the standard value, replace the tensioner.

**Standard value: 1 mm or less**

## 5. FUEL AND EMISSION CONTROL PARTS

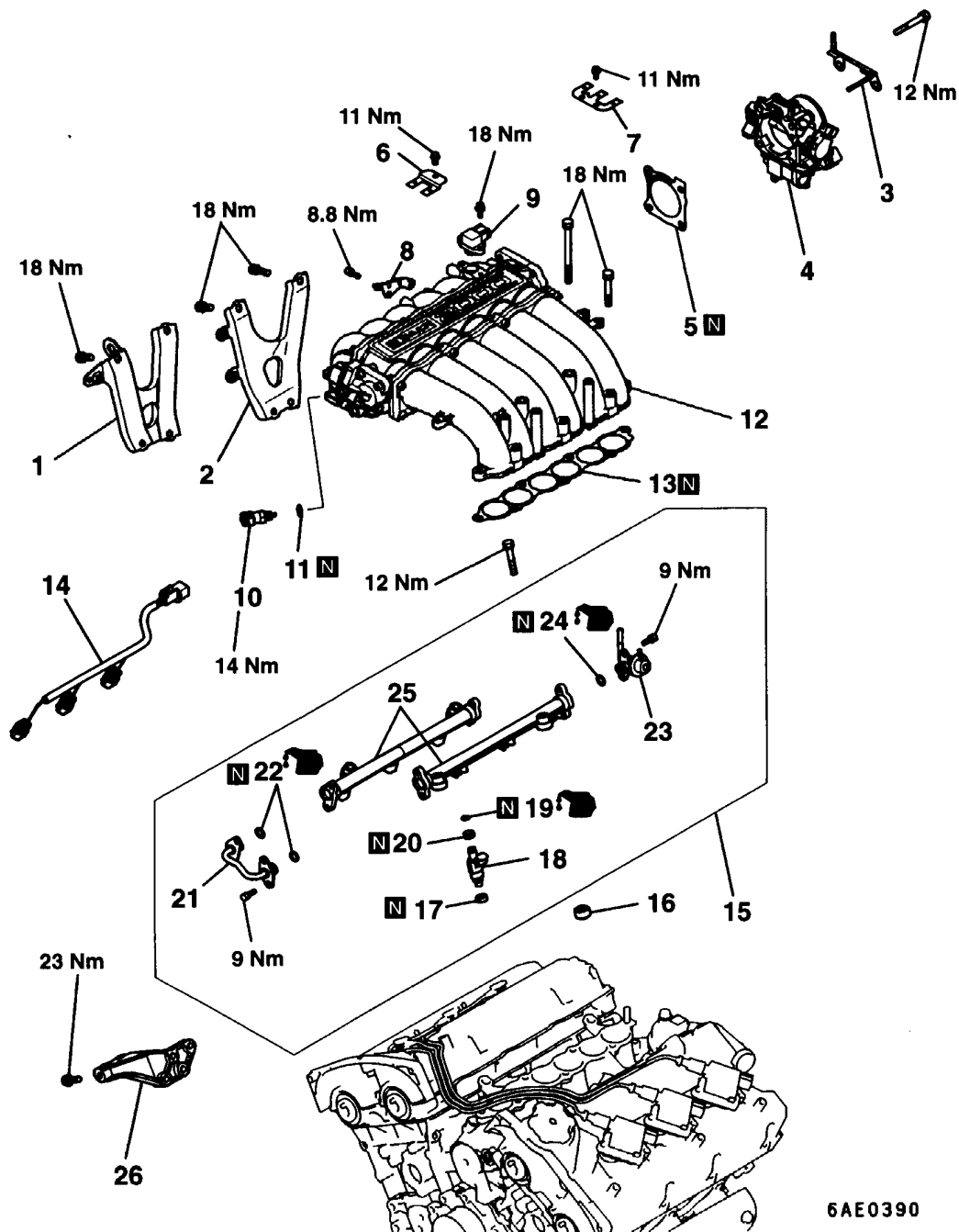
## REMOVAL AND INSTALLATION &lt;SOHC&gt;



## Removal steps

- |  |   |
|--|---|
| <p>▶C◀</p> <ol style="list-style-type: none"> <li>1. Air intake plenum stay, front</li> <li>2. Air intake plenum stay, rear</li> <li>3. EGR valve</li> <li>4. Gasket</li> <li>5. Vacuum pipe</li> <li>6. Throttle body</li> <li>7. Gasket</li> <li>8. Air intake plenum</li> <li>9. Gasket</li> <li>10. Control harness</li> <li>11. Delivery pipe and injector</li> </ol> | <p>▶B◀</p> <ol style="list-style-type: none"> <li>12. Insulator</li> <li>13. Insulator</li> <li>14. Injector</li> <li>15. Grommet</li> <li>16. O-ring</li> <li>17. Fuel pipe</li> <li>18. O-ring</li> <li>▶A◀ 19. Fuel pressure regulator</li> <li>20. O-ring</li> <li>21. Delivery pipe</li> <li>22. Alternator bracket</li> </ol> |
|--|---|

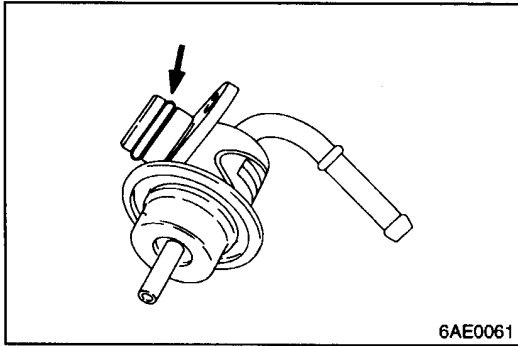
REMOVAL AND INSTALLATION <MIVEC>



6AE0390

**Removal steps**

- |  |   |
|--|---|
| <p>▶C◀</p> <ol style="list-style-type: none"> <li>1. Air intake plenum stay, front</li> <li>2. Air intake plenum stay, rear</li> <li>3. Vacuum pipe</li> <li>4. Throttle body</li> <li>5. Gasket</li> <li>6. Connector bracket</li> <li>7. Connector bracket</li> <li>8. Accelerator cable bracket</li> <li>9. Ignition failure sensor</li> <li>10. Air temperature sensor</li> <li>11. Gasket</li> <li>12. Air intake plenum</li> <li>13. Gasket</li> </ol> | <p>▶B◀</p> <ol style="list-style-type: none"> <li>14. Control harness</li> <li>15. Delivery pipe and injector</li> <li>16. Insulator</li> <li>17. Insulator</li> <li>18. Injector</li> <li>19. Grommet</li> <li>20. O-ring</li> <li>21. Fuel pipe</li> <li>22. O-ring</li> <li>▶A◀</li> <li>23. Fuel pressure regulator</li> <li>24. O-ring</li> <li>25. Delivery pipe</li> <li>26. Alternator bracket</li> </ol> |
|--|---|



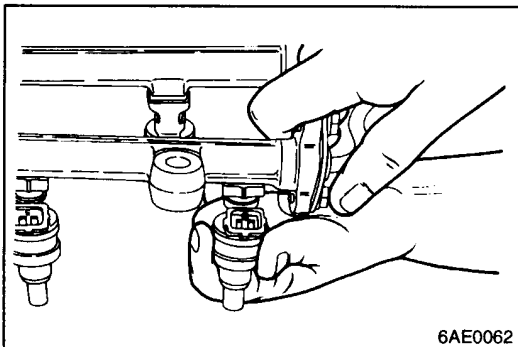
## INSTALLATION SERVICE POINTS

### ▶A◀ FUEL PRESSURE REGULATOR INSTALLATION

- (1) Apply spindle oil or gasoline to the new O-ring installed on the fuel pressure regulator.
- (2) Insert the fuel pressure regulator in the delivery pipe.
- (3) Make sure that the fuel pressure regulator turns smoothly; then align the threaded holes and tighten the regulator bolts to specification.

#### Caution

- If the regulator does not turn smoothly, the O-ring probably gets caught somewhere in the delivery pipe. In such a case, remove the fuel pressure regulator and reinsert it into the delivery pipe. Check it again for smooth rotation before securing.



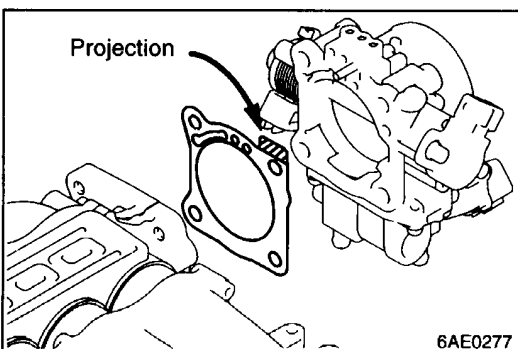
### ▶B◀ INJECTOR INSTALLATION

- (1) Install new grommet and O-ring on the injector.
- (2) Apply spindle oil or gasoline to the O-ring of the injector.
- (3) While turning the injector in both directions, install it in the delivery pipe.
- (4) Make sure that the injector turns smoothly.

#### Caution

- If the injector does not turn smoothly, the O-ring probably gets caught somewhere in the delivery pipe. In such a case, remove the injector and reinsert it into the delivery pipe. Check it again for smooth rotation.

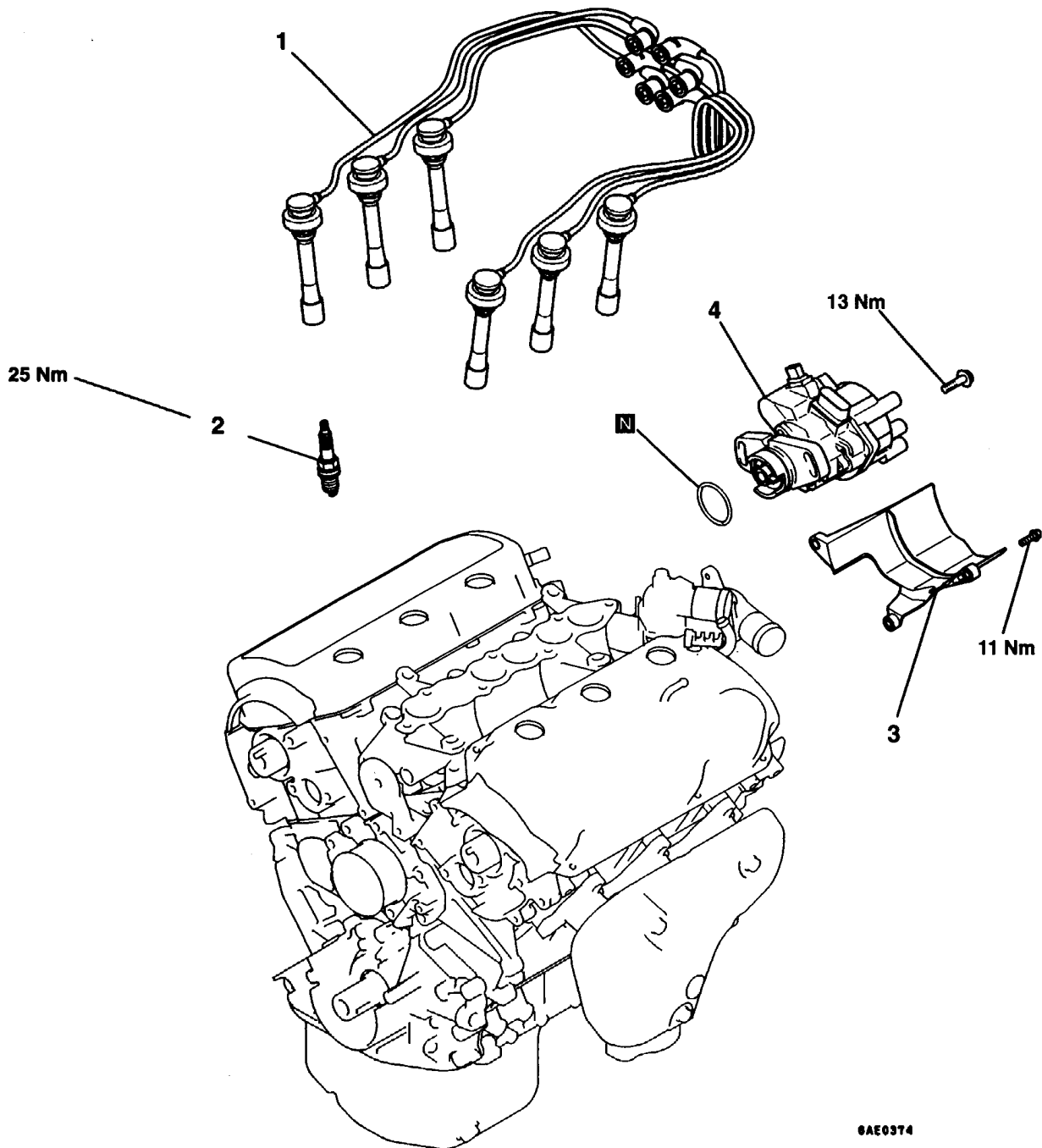
- (5) On the right bank, align the marks on the injector and delivery pipe.



### ▶C◀ GASKET INSTALLATION

- (1) Locate the projection on the gasket as shown.

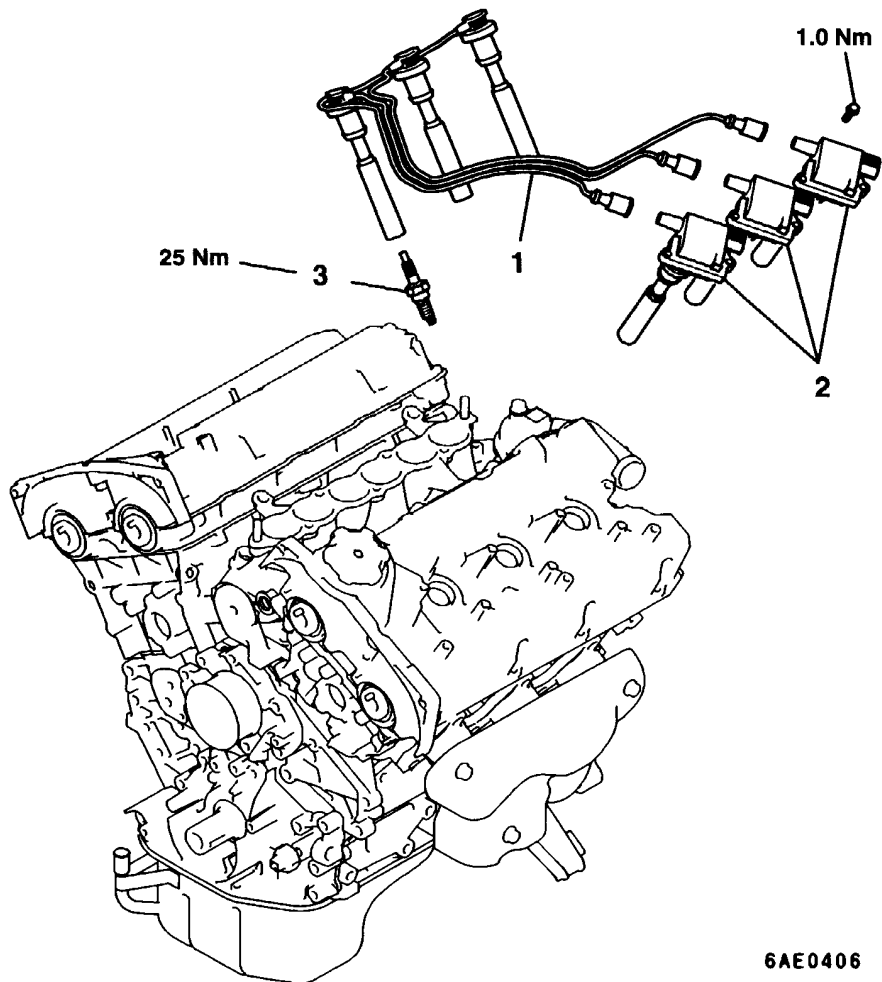


**IGNITION SYSTEM****REMOVAL AND INSTALLATION <SOHC>****Removal steps**

1. Spark plug cable
2. Spark plug
3. Water cover
4. Distributor



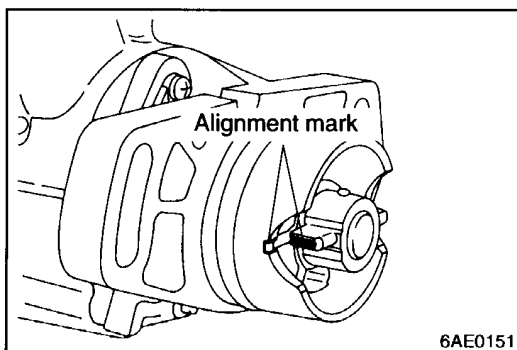
## REMOVAL AND INSTALLATION &lt;MIVEC&gt;



6AE0406

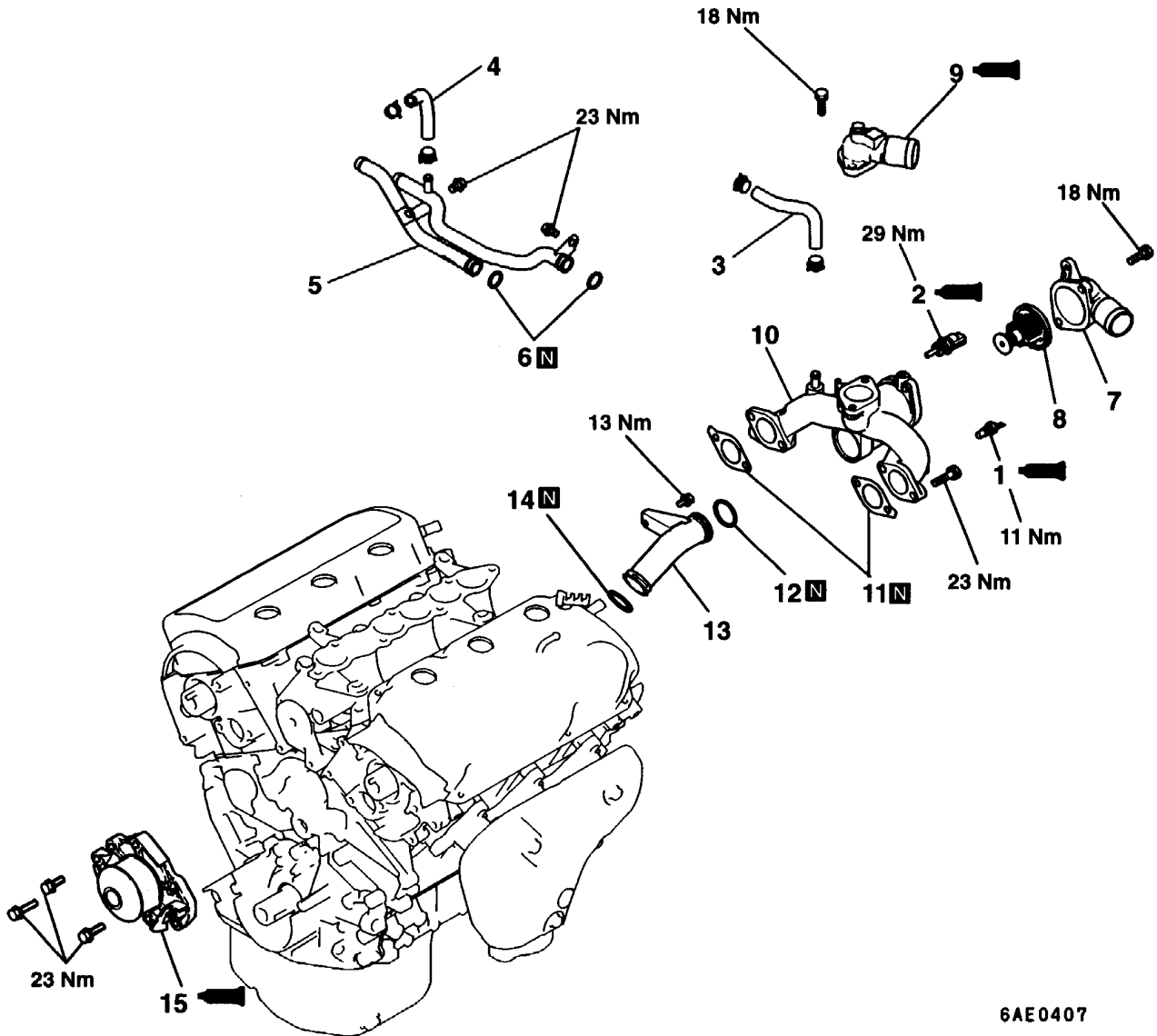
**Removal steps**

1. Spark plug cable
2. Ignition coil
3. Spark plug

**INSTALLATION SERVICE POINT****▶◀ DISTRIBUTOR INSTALLATION**

- (1) Turn the crankshaft clockwise to bring the No. 1 cylinder piston to the compression stroke top dead center.
- (2) Align the mark on the distributor housing with the mark on the coupling.
- (3) Install the distributor while aligning the coupling key with the keyway in the camshaft end.

**7. WATER PUMP AND WATER PIPE  
REMOVAL AND INSTALLATION <SOHC>**

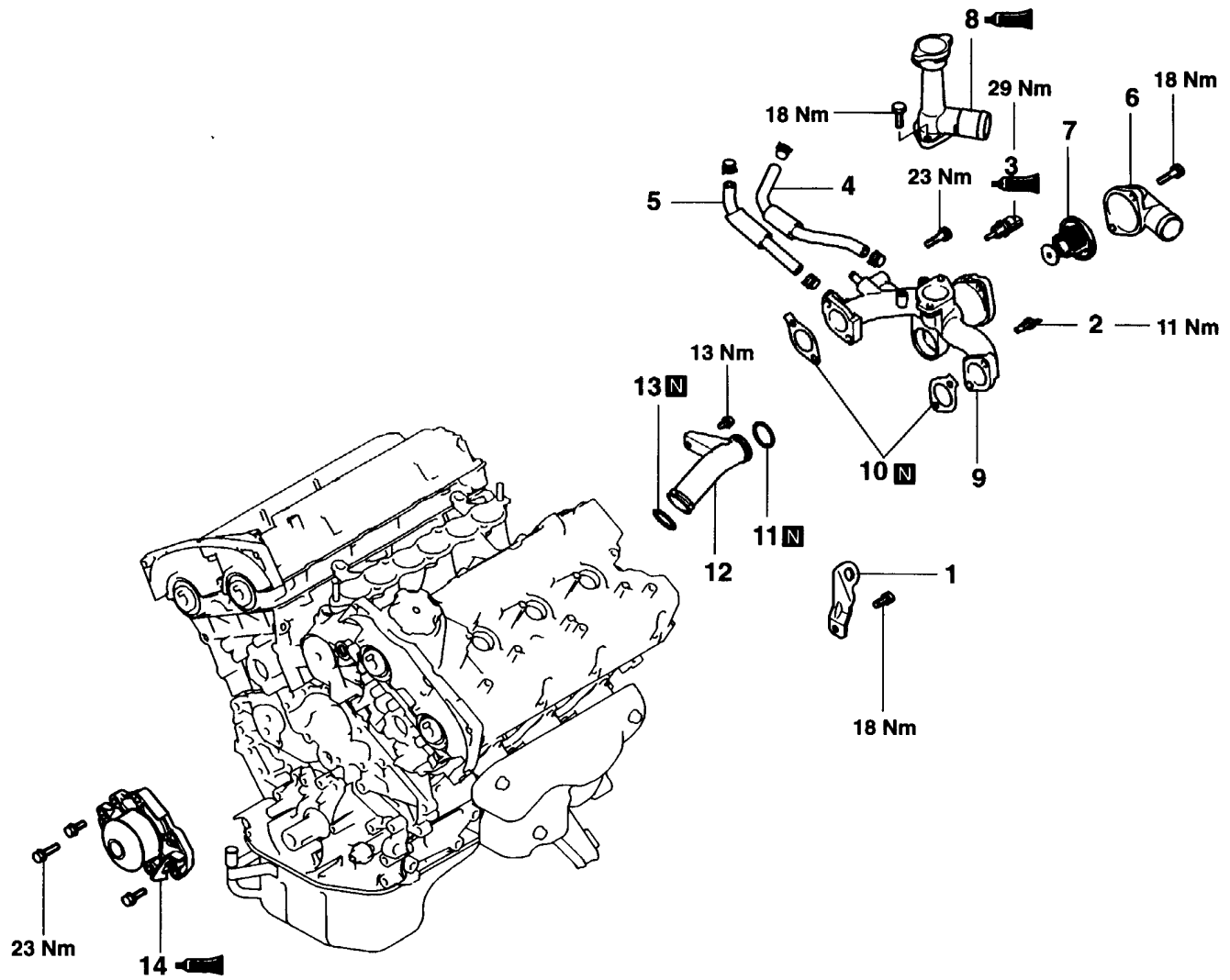


6AE0407

**Removal steps**

- |  |   |
|--|---|
| <p>▶F◀ 1. Engine coolant temperature gauge unit</p> <p>▶E◀ 2. Engine coolant temperature sensor</p> <p>3. Water hose</p> <p>4. Water hose</p> <p>5. Heater pipe</p> <p>6. O-ring</p> <p>7. Water inlet fitting</p> | <p>▶D◀ 8. Thermostat</p> <p>▶C◀ 9. Water outlet fitting</p> <p>10. Thermostat housing</p> <p>11. Gasket</p> <p>▶B◀ 12. O-ring</p> <p>▶B◀ 13. Water pipe</p> <p>▶B◀ 14. O-ring</p> <p>▶A◀ 15. Water pump</p> |
|--|---|

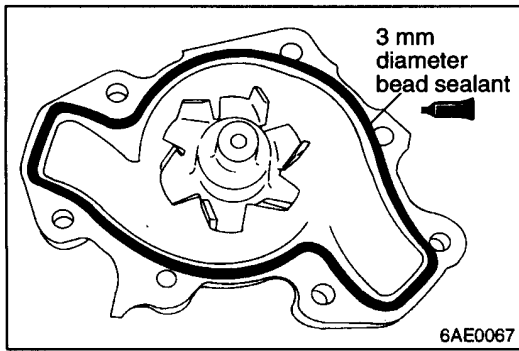
REMOVAL AND INSTALLATION <MIVEC>



6AE0280

**Removal steps**

- |   |  |
|---|--|
| <ul style="list-style-type: none"> <li>▶F◀ 1. Engine hanger</li> <li>▶E◀ 2. Engine coolant temperature gauge unit</li> <li>▶E◀ 3. Engine coolant temperature sensor</li> <li>▶D◀ 4. Water hose</li> <li>▶D◀ 5. Water hose</li> <li>▶D◀ 6. Water inlet fitting</li> <li>▶D◀ 7. Thermostat</li> </ul> | <ul style="list-style-type: none"> <li>▶C◀ 8. Water outlet fitting</li> <li>▶C◀ 9. Thermostat housing</li> <li>▶B◀ 10. Gasket</li> <li>▶B◀ 11. O-ring</li> <li>▶B◀ 12. Water pipe</li> <li>▶B◀ 13. O-ring</li> <li>▶A◀ 14. Water pump</li> </ul> |
|---|--|

**INSTALLATION SERVICE POINTS****▶A◀ SEALANT APPLICATION TO WATER PUMP**

Specified sealant:

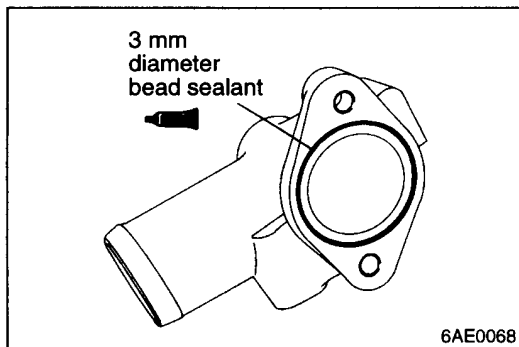
Mitsubishi Genuine Part No. MD970389 or equivalent

**▶B◀ WATER PIPE / O-RING INSTALLATION**

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

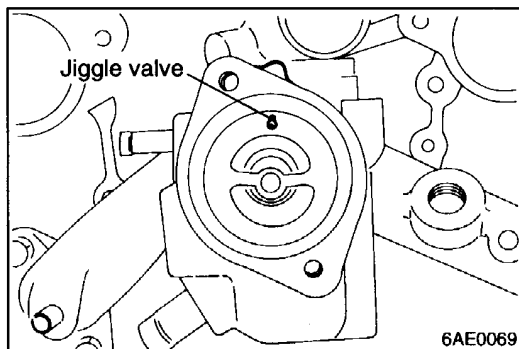
**Caution**

- Keep the O-ring free of oil or grease.
- Secure the water pipe after the thermostat housing has been installed.

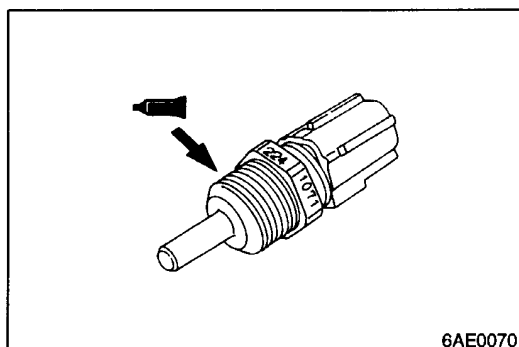
**▶C◀ SEALANT APPLICATION TO WATER OUTLET FITTING**

Specified sealant:

Mitsubishi Genuine Part No. MD970389 or equivalent

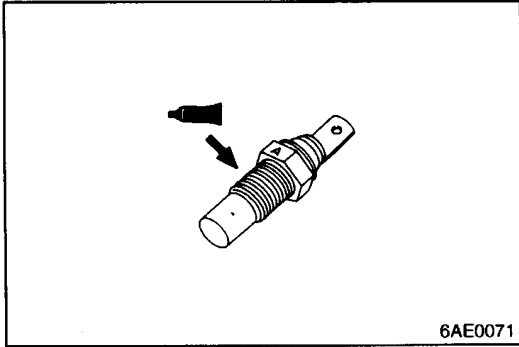
**▶D◀ THERMOSTAT INSTALLATION**

(1) Install the thermostat so that the jiggle valve will be located in the thermostat housing as shown.

**▶E◀ SEALANT APPLICATION TO ENGINE COOLANT TEMPERATURE SENSOR**

Specified sealant:

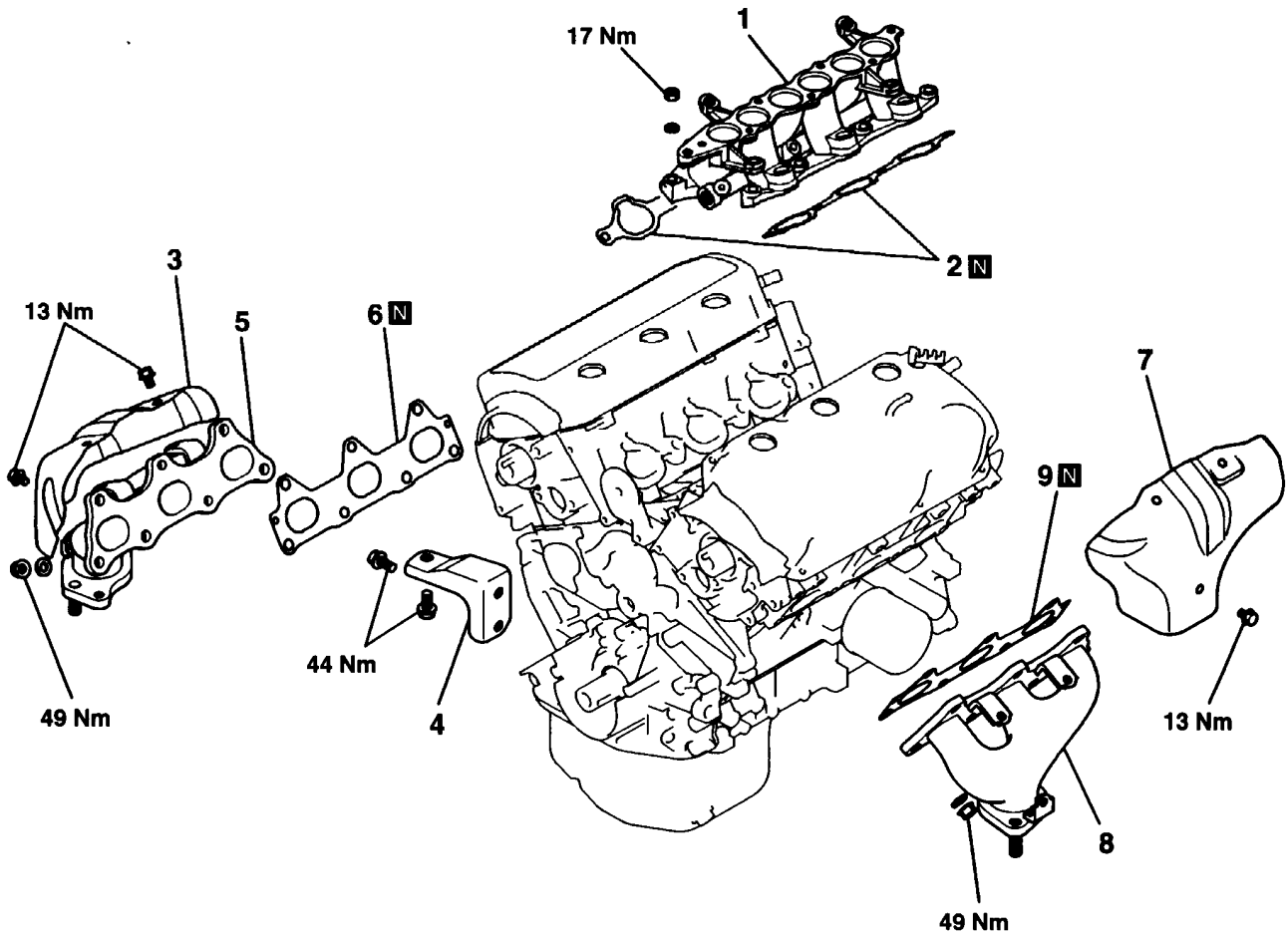
3M Nut locking Part No. 4171 or equivalent



**▶F◀ SEALANT APPLICATION TO ENGINE COOLANT  
TEMPERATURE GAUGE UNIT**

**Specified sealant:  
3M ATD Part No. 8660 or equivalent**

## 8. INTAKE MANIFOLD AND EXHAUST MANIFOLD REMOVAL AND INSTALLATION <SOHC>



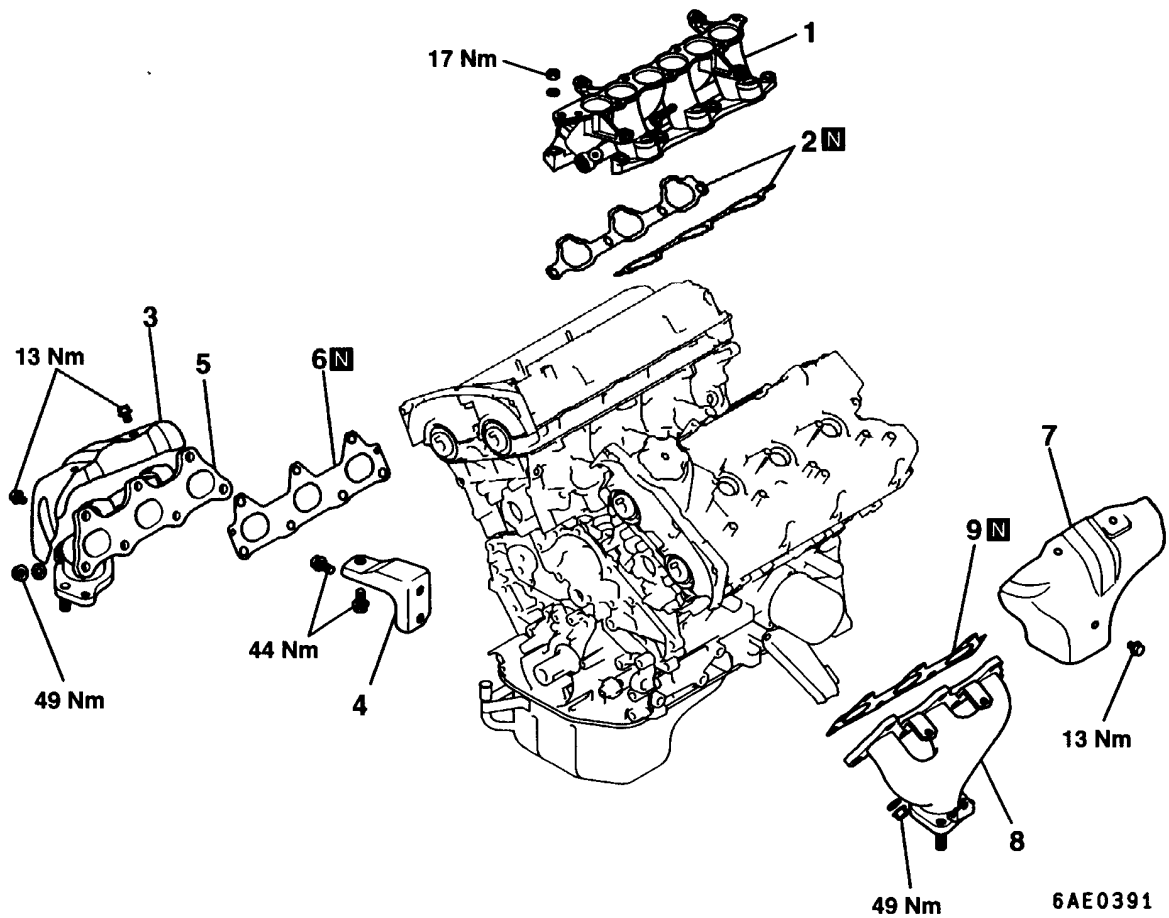
6AE0362

### Removal steps

1. Intake manifold
2. Gasket
3. Heat protector, right
4. Exhaust manifold stay
5. Exhaust manifold, right
6. Gasket
7. Heat protector, left
8. Exhaust manifold, left
9. Gasket

# 11A-8-2 6A1 ENGINE (E-W) – Intake Manifold and Exhaust Manifold

## REMOVAL AND INSTALLATION <MIVEC>

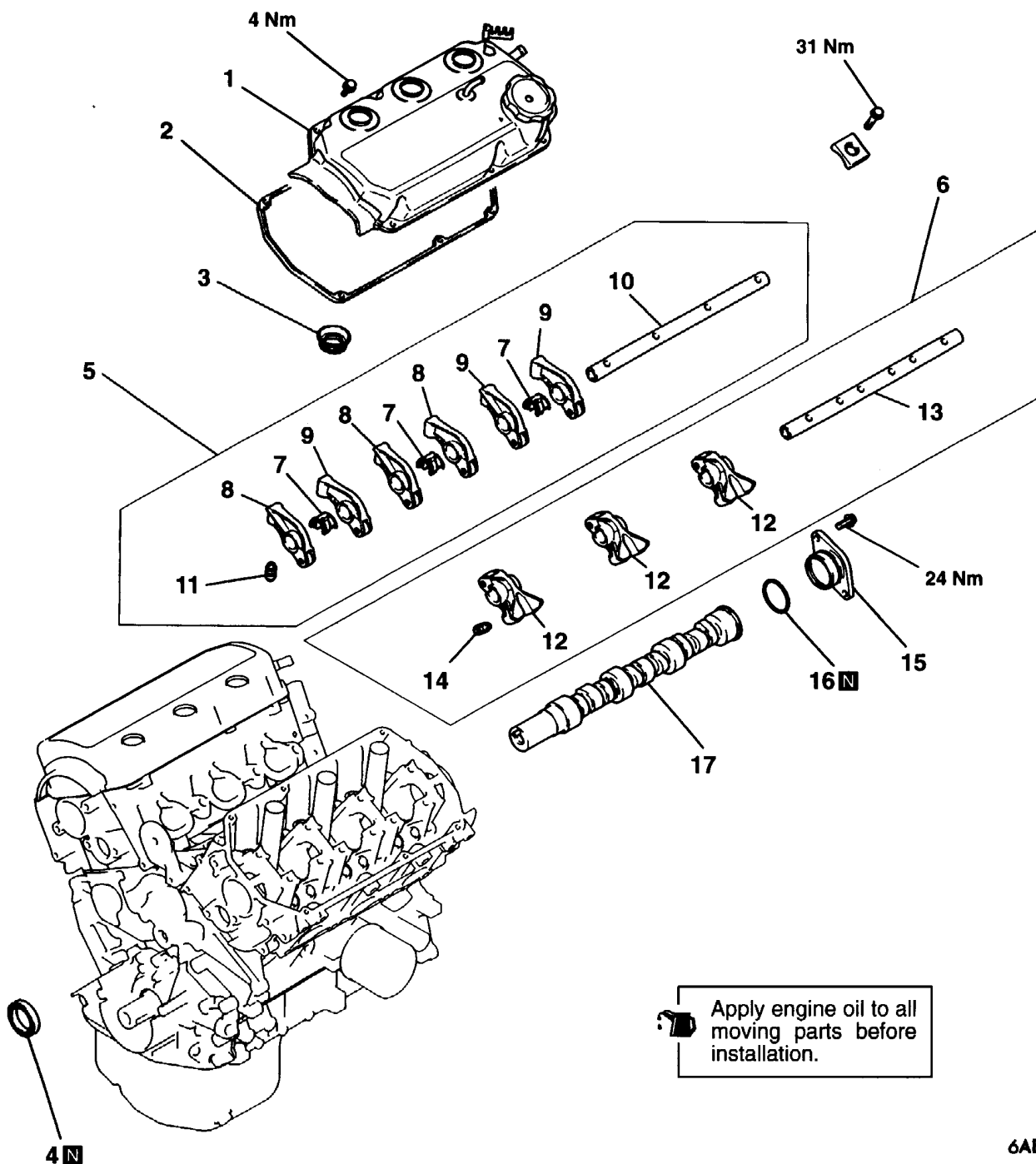


### Removal steps

1. Intake manifold
2. Gasket
3. Heat protector, right
4. Exhaust manifold stay
5. Exhaust manifold, right
6. Gasket
7. Heat protector, left
8. Exhaust manifold, left
9. Gasket



9. ROCKER ARM AND CAMSHAFT <SOHC>



Apply engine oil to all moving parts before installation.

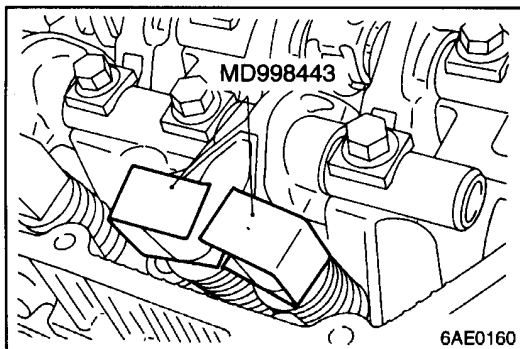
6AE0336

Removal steps

1. Rocker cover
2. Rocker cover gasket
3. Oil seal
4. Oil seal
5. Rocker arm and rocker shaft
6. Rocker arm and rocker shaft
7. Rocker shaft spring
8. Rocker arm A
9. Rocker arm B



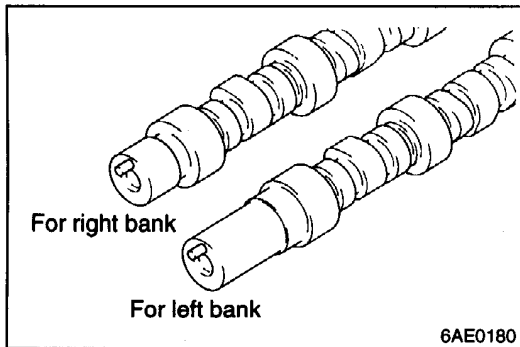
10. Rocker arm shaft
- ▶B◀ 11. Lash adjuster
- ▶B◀ 12. Rocker arm C
- ▶B◀ 13. Rocker arm shaft
- ▶B◀ 14. Lash adjuster
- ▶A◀ 15. Thrust case
- ▶A◀ 16. O-ring
- ▶A◀ 17. Camshaft



## REMOVAL SERVICE POINT

### ◀▶ ROCKER ARMS AND ROCKER ARM SHAFTS REMOVAL

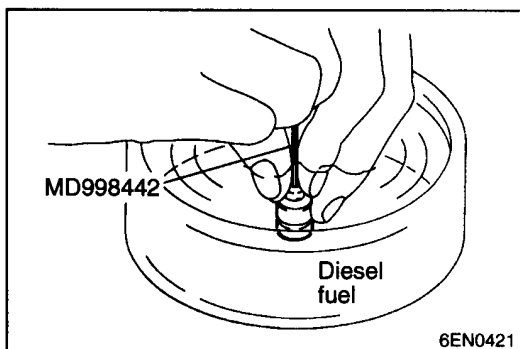
Before removing rocker arms and shafts assembly, install the special tool as illustrated to prevent adjuster from dropping.



## INSTALLATION SERVICE POINTS

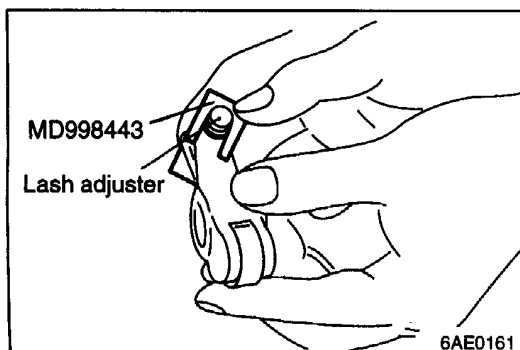
### ▶▶ CAMSHAFT INSTALLATION

- (1) Apply engine oil to journals and cams of the camshaft before installation.  
Be sure to install the correct camshafts on the correct bank.  
Do not confuse the intake camshaft with the exhaust one.

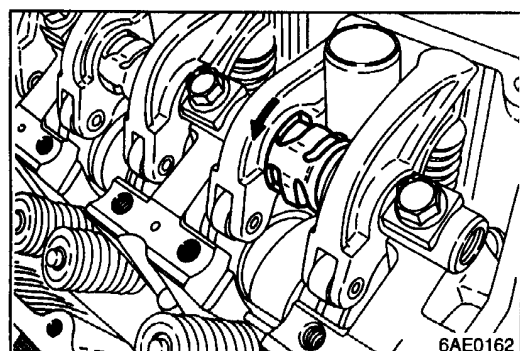


### ▶▶ LASH ADJUSTER INSTALLATION

- (1) Immerse the lash adjuster in clean diesel fuel.
- (2) Using the special tool (air bleed wire), move the plunger up and down 4 or 5 times while pushing down lightly on the check ball in order to bleed out the air.



- (3) Insert the lash adjuster to rocker arm, being careful not to spill the diesel fuel. Then use the special tool to prevent adjuster from falling while installing it.

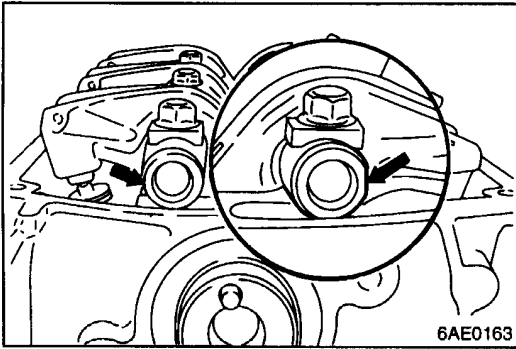


### ▶▶ ROCKER SHAFT SPRING / ROCKER ARMS AND ROCKER ARM SHAFT INSTALLATION

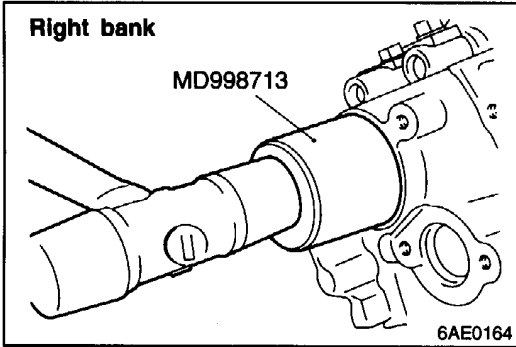
- (1) Temporarily tighten the rocker shaft with the bolt so that all rocker arms on the inlet valve side do not push the valves.
- (2) Fit the rocker shaft spring from the above and position it so that it is right angles to the plug guide.

#### NOTE

Install the rocker shaft spring before installing the exhaust side rocker arms and rocker arm shaft.

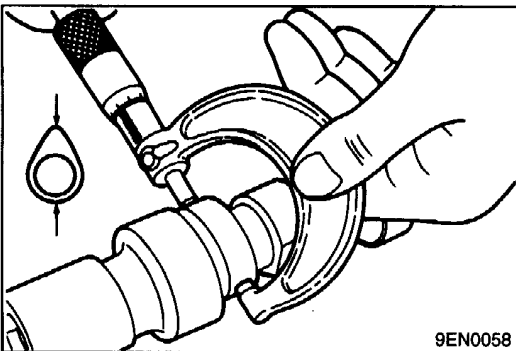
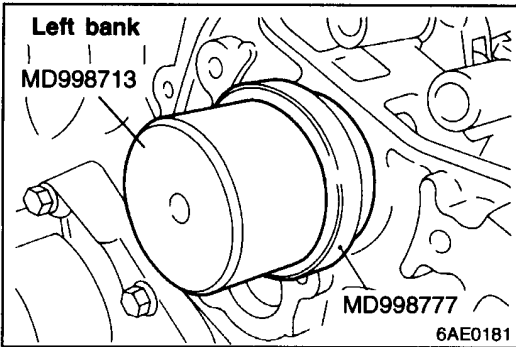


- (3) Remove the special tool for securing the lash adjuster.
- (4) Make sure that the notch in the rocker arm shaft is in the direction as illustrated.



**►D◄ CAMSHAFT OIL SEAL INSTALLATION**

- (1) When installing the left bank camshaft oil seal, use the special tool to prevent interference with the knock pin.



**INSPECTION**

**CAMSHAFT**

- (1) Measure the cam height (lobe diameter) and, if the limit is exceeded, replace the camshaft.

**Standard value:**

35.20 mm	.....	Intake side
34.91 mm	.....	Exhaust side

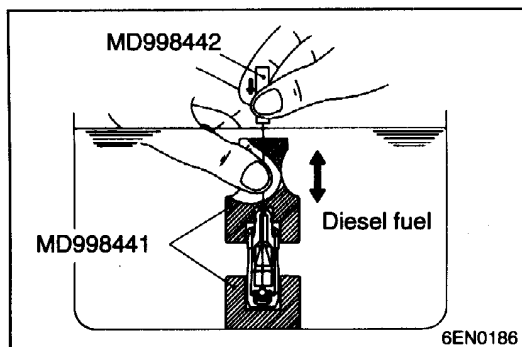
**Limit:**

34.70 mm	.....	Intake side
34.41 mm	.....	Exhaust side

## 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.

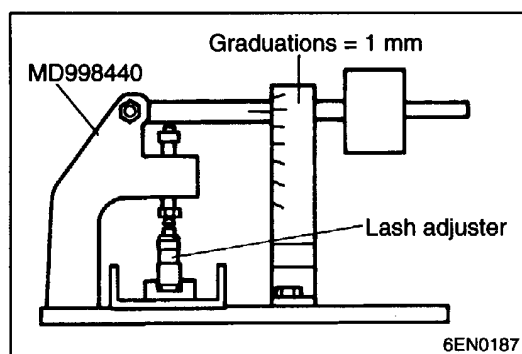


- (1) Immerse the lash adjuster in clean diesel fuel.
- (2) While lightly pushing down inner steel ball using the special tool (Air bleed wire MD998442), move the plunger up and down four or five times to bleed air. Use of the special tool (Retainer MD998441) helps facilitate the air bleeding of the 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

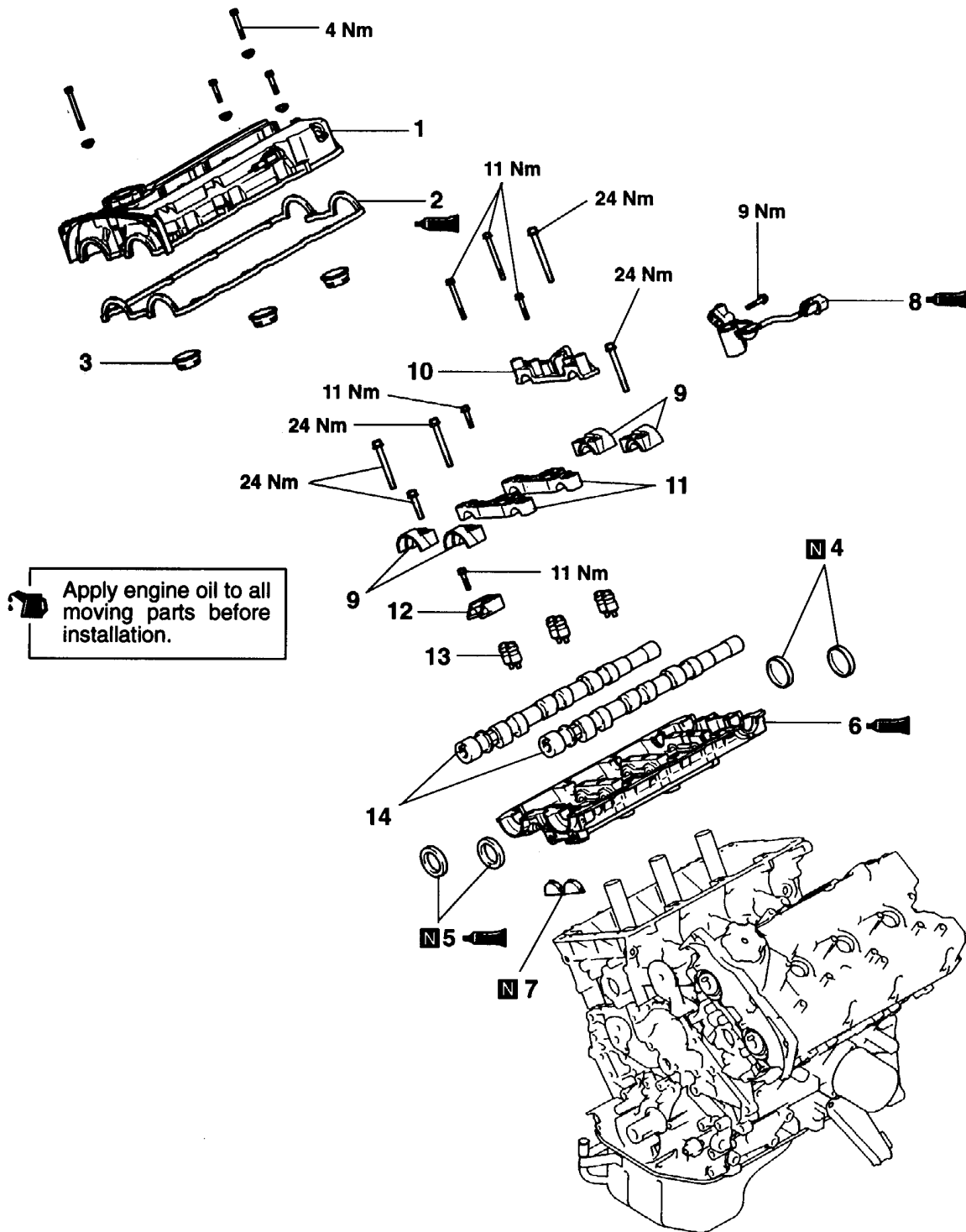
- Upon completion of air bleeding, hold lash adjuster upright to prevent inside diesel fuel from spilling.



- (4) After air bleeding, set lash adjuster on the special tool (Leak down tester MD998440).
- (5) After plunger has gone down somewhat [0.2 – 0.5 mm], measure time taken for it to go down 1 mm. Replace if measured time is out of specification.

**Standard value: 4 – 20 seconds/1 mm**  
**[Diesel fuel at 15 – 20°C (59 – 68°F)]**

## 10. ROCKER COVER AND CAMSHAFT <MIVEC>

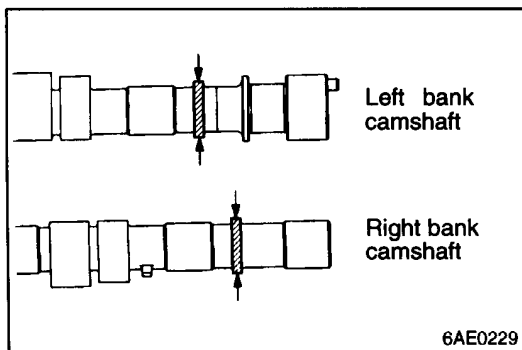


Apply engine oil to all moving parts before installation.

- Removal steps**
- ▶G◀ 1. Rocker cover
  - ▶G◀ 2. Rocker cover gasket
  - ▶G◀ 3. Oil seal
  - ▶F◀ 4. Circuit packing
  - ▶E◀ 5. Oil seal
  - ▶D◀ 6. Camshaft holder
  - ▶D◀ 7. Semi-circular packing

- ▶C◀ 8. Oil control valve
- ▶B◀ 9. Cam cap
- ▶B◀ 10. Oil control valve holder
- ▶B◀ 11. Camshaft bearing cap
- ▶A◀ 12. Arm spring holder
- ▶A◀ 13. Arm spring
- ▶A◀ 14. Camshaft

6AE0315

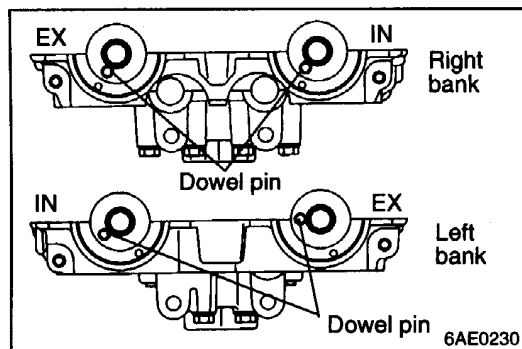


### INSTALLATION SERVICE POINT

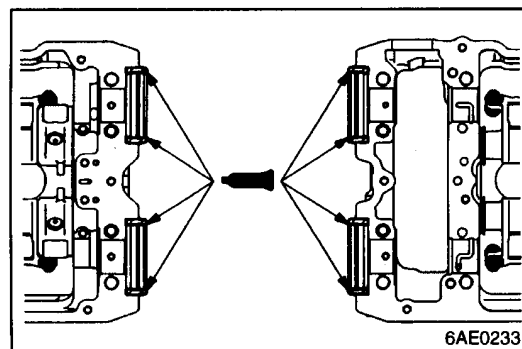
#### ▶A◀ CAMSHAFT INSTALLATION

- (1) Intake valve camshaft and exhaust valve camshaft can be identified by their diameters at the portions indicated in the illustration.

**Intake valve camshaft: 25 mm**  
**Exhaust valve camshaft: 30 mm**



- (2) Before installing each camshaft, apply engine oil to its journals and cams.
- (3) The camshaft dowel pins must be positioned as shown in the illustration.

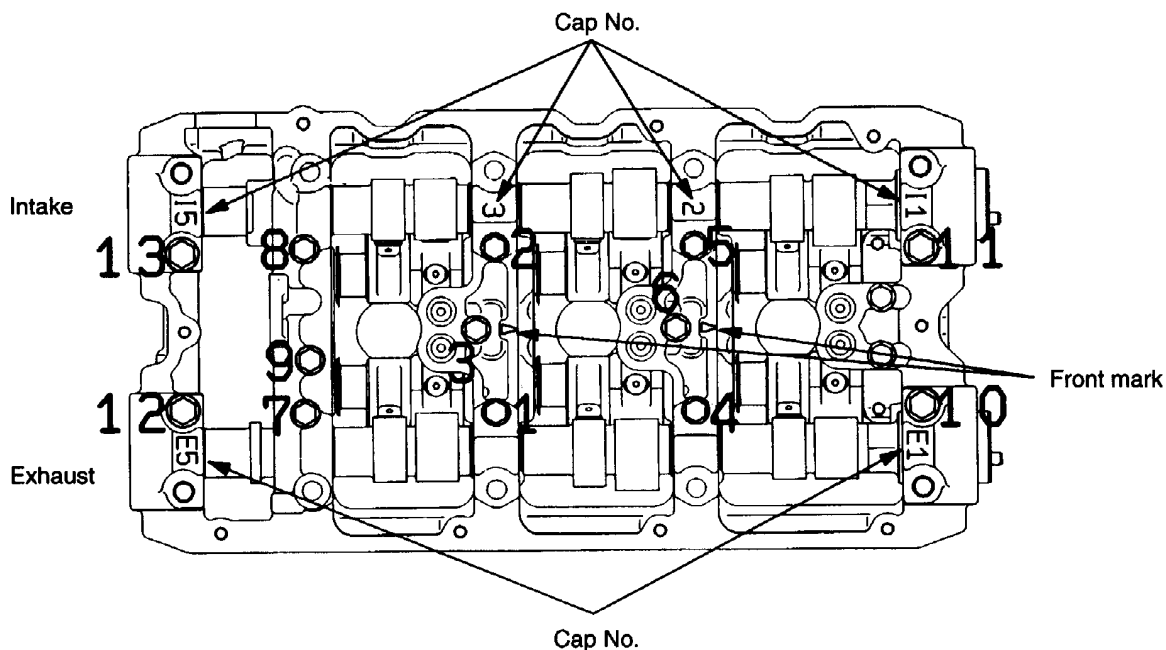


#### ▶B◀ CAMSHAFT BEARING CAP / CAM CAP INSTALLATION

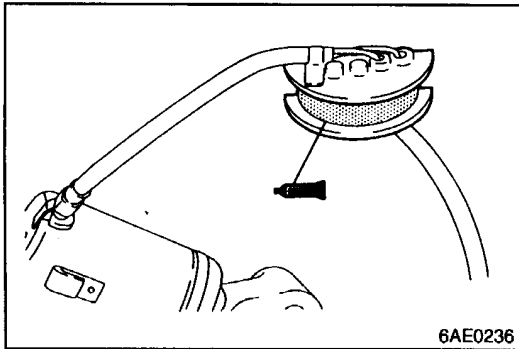
- (1) Apply sealant to the illustrated points of the camshaft holders.

**Specified sealant:**  
**3M ATD part No. 8660 or equivalent**

- (2) Install the bearing caps and cam caps correctly according to the "I" (intake) and "E" (exhaust) marks as well as the stamped cap numbers and front marks.
- (3) Tighten the bolts in the sequence of the numbers shown in the illustration.



6AE0308

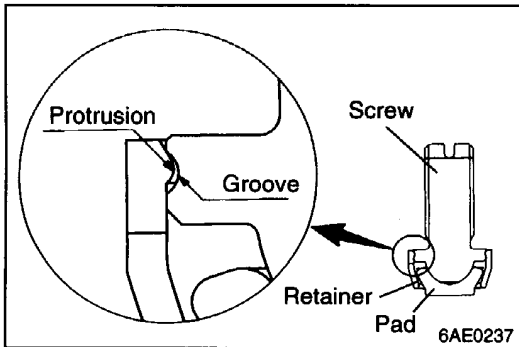


►C◄ OIL CONTROL VALVE INSTALLATION

- (1) Apply the specified sealant to the area shown.

Specified sealant:

3M ATD Part No. 8660 or equivalent

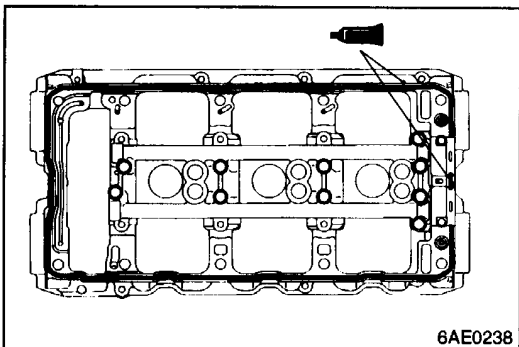


►D◄ SEMI-CIRCULAR PACKING / CAMSHAFT HOLDER INSTALLATION

- (1) Make sure that the retainer of each adjusting screw is fitted correctly.

Caution

- If the protrusion on the retainer is not correctly fitted in the groove of the screw, the pad could slip off the retainer.



- (2) Apply 3 mm thick bead of foam-in-place gasket (FIPG) to the gasket surface of the camshaft holder.

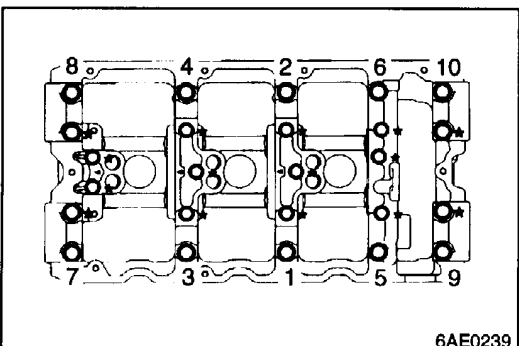
Caution

- Since the FIPG could cause blocking of engine oil passages, be careful not to apply FIPG to other locations than specified.

Specified sealant:

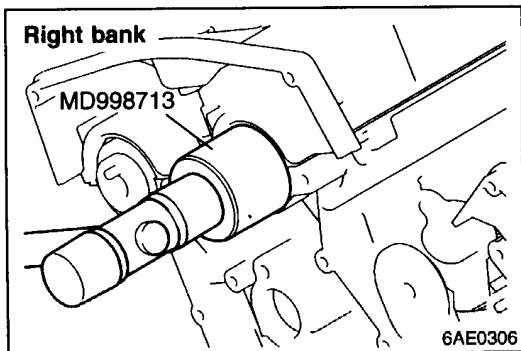
Mitsubishi Genuine Part No. MD970389 or equivalent

- (3) Install the semi-circular packings.  
 (4) Raise the rocker arms until the rollers come into contact with the cams, and install the camshaft holder.



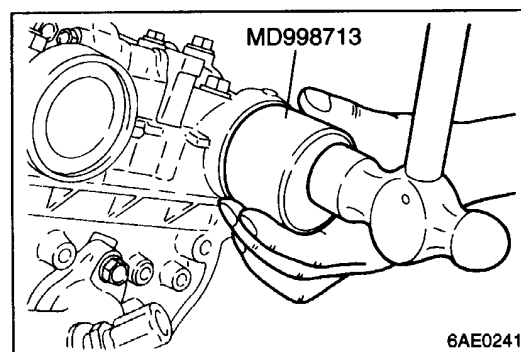
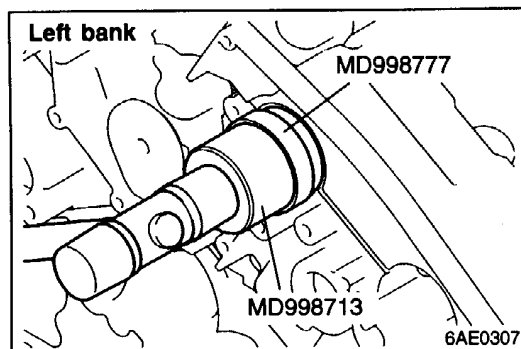
- (5) Tighten the bolts in the order indicated in the illustration.  
 (6) Check the torque of the ★-marked bolts. See section ►B◄ for the checking order.  
 (7) Verify that the pad of each adjusting screw is in place.

# 11A-10-4 6A1 ENGINE (E-W) – Rocker Cover and Camshaft <MIVEC>

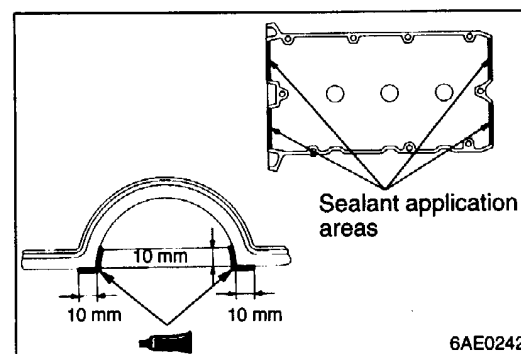


## ►E◄ CAMSHAFT OIL SEAL INSTALLATION

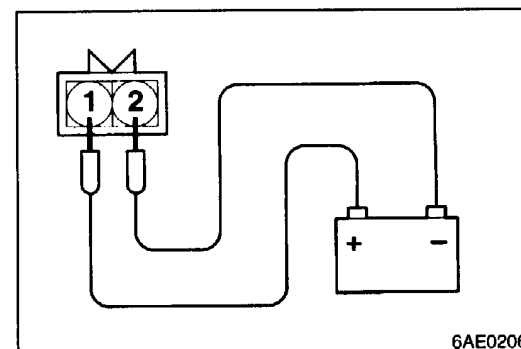
- (1) When installing the left bank camshaft oil seal, use the special tool to prevent interference with the knock pin.



## ►F◄ CIRCULAR PACKING INSTALLATION



## ►G◄ ROCKER COVER INSTALLATION

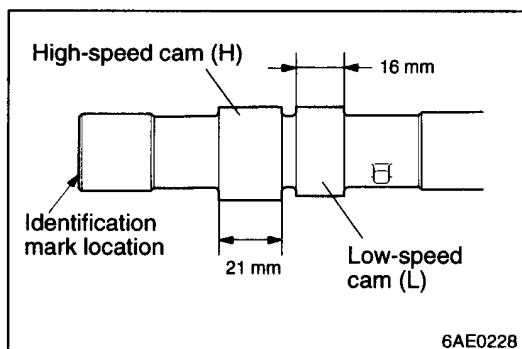
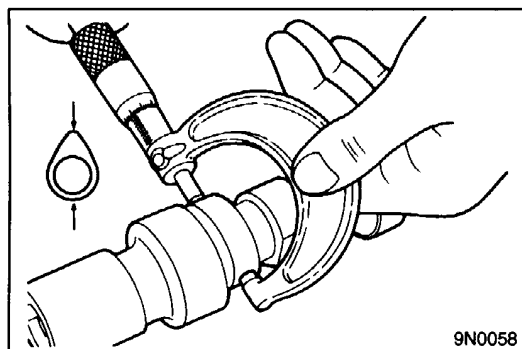
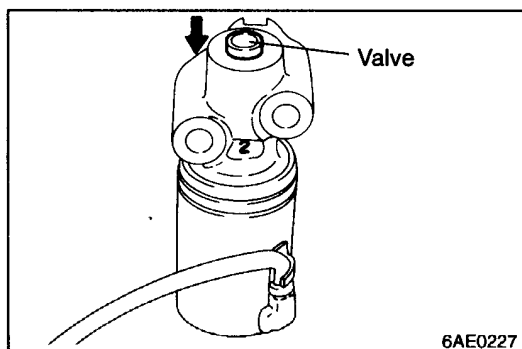


## INSPECTION

### OIL CONTROL VALVE

- (1) Connect a 12VDC power supply between terminals (1) and (2) of the oil control valve and check if the valve operates smoothly.





### CAMSHAFT

- (1) Measure the cam heights. If the specified limit is exceeded, replace the camshaft.

#### NOTE

Each camshaft has an identification mark on its rear end surface.

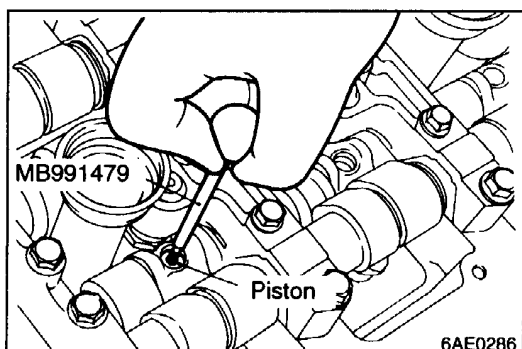
( ): Identification mark		Standard value	Limit
IN (3)	L	34.34 mm	33.84 mm
	H	36.46 mm	35.96 mm
EX (C)	L	34.40 mm	33.90 mm
	H	35.86 mm	35.36 mm

### VALVE CLEARANCE ADJUSTMENT

#### NOTE

Adjust the valve clearance for each cylinder and for both intake and exhaust valves with the piston at the compression stroke top dead center.

- (1) Bring the No. 1 cylinder piston into the compression stroke top dead center.



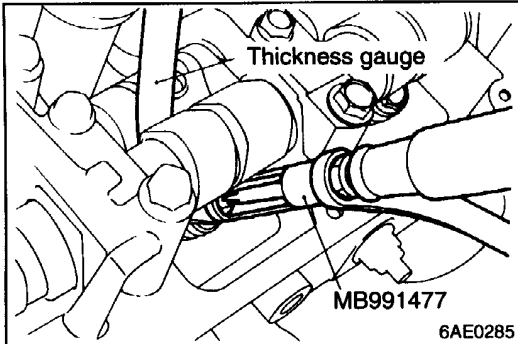
- (2) Use the special tool to loosen the adjusting screw.
- (3) Insert a thickness gauge of the thickness specified below between the low-speed cam (narrow cam) and roller.

**Intake** ..... 0.10 mm  
**Exhaust** ..... 0.13 mm

- (4) Screw in one of the two adjusting screws until it comes into contact with the valve (when the turning torque changes).

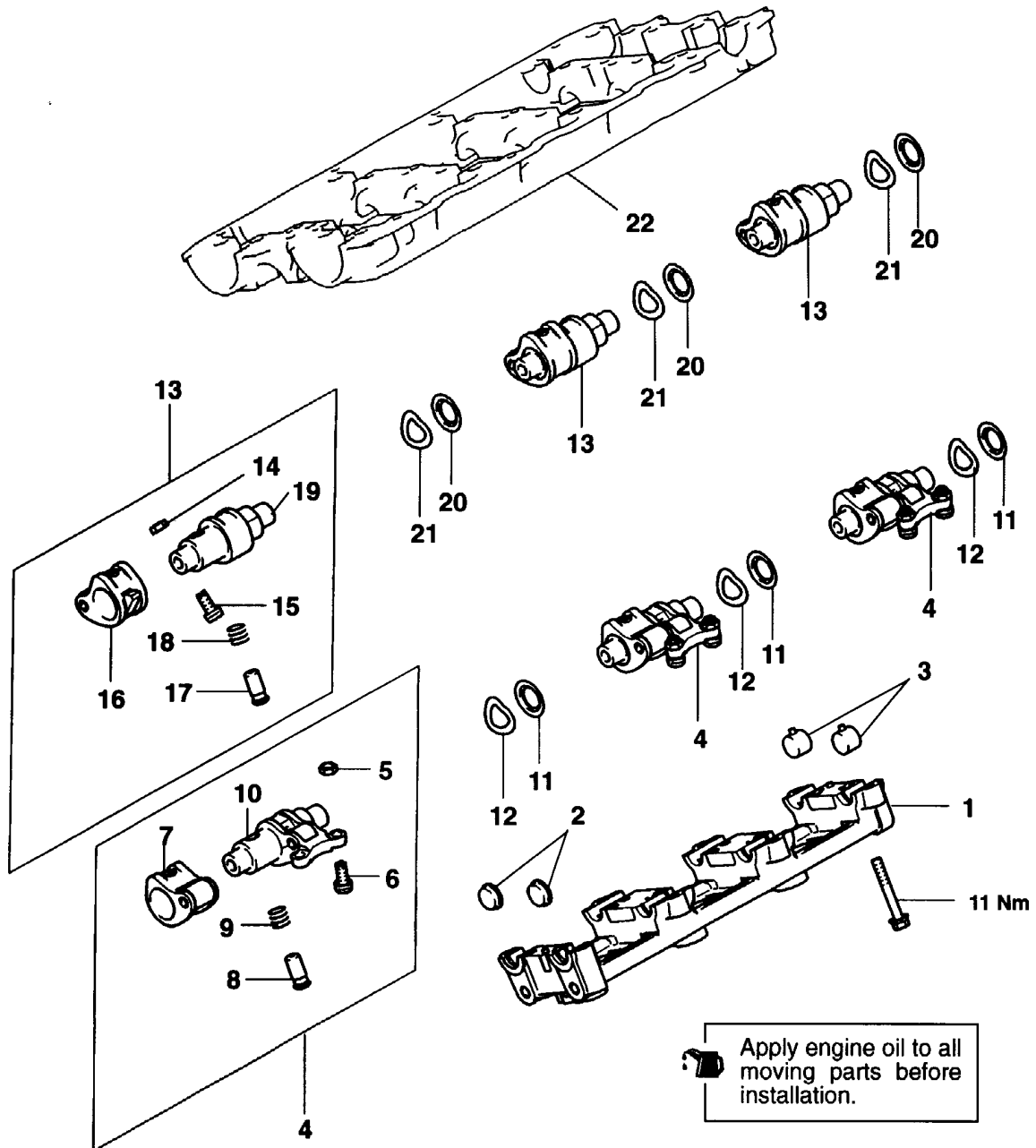
## 11A-10-6 6A1 ENGINE (E-W) – Rocker Cover and Camshaft <MIVEC>

- (5) Screw in the other adjusting screw until it comes into contact with the valve (when the turning torque changes), and then tighten the lock nut.
- (6) Loosen the adjusting screw that was screwed in first slightly (until the turning torque becomes almost zero). Screw in the adjusting screw until it comes into contact with the valve again (when the turning torque changes) and tighten the lock nut.
- (7) Remove the thickness gauge.



- (8) Screw the special tool into the top of piston of the rocker arm "H", and pull up the tool to make sure that the piston can be lifted smoothly by hand.
- (9) Perform valve clearance adjustments for other cylinders by turning every time the crankshaft through 120° (60° in camshaft sprocket angle) and following the above steps (2) through (8). Perform the adjustments in the following order of cylinder number:  
No. 2 → No. 3 → No. 4 → No. 5 → No. 6

## 11. ROCKER ARM AND ROCKER SHAFT CAP &lt;MIVEC&gt;

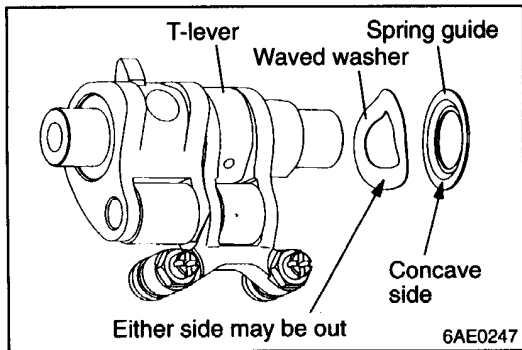


6AE0300

**Removal steps**

- B◄
1. Rocker shaft cap
  2. Seal cap A
  3. Seal cap C
  4. Intake rocker arm assembly A
  5. Nut
  6. Adjusting screw
  7. Intake rocker arm H
  8. Piston H
  9. Piston spring H
  10. Intake T-lever
- A◄
11. Spring guide

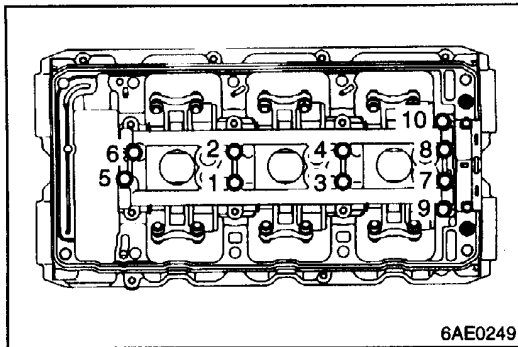
12. Wave washer
  13. Exhaust rocker arm assembly A
  14. Nut
  15. Adjusting screw
  16. Exhaust rocker arm H
  17. Piston H
  18. Piston spring H
  19. Exhaust T-lever L
- A◄
20. Spring guide
  21. Wave washer
  22. Camshaft holder



## INSTALLATION SERVICE POINTS

### ▶A◀ SPRING GUIDE INSTALLATION

- (1) Install the spring guide with the concave side toward the rocker arm. The waved washer may be installed with either side out.

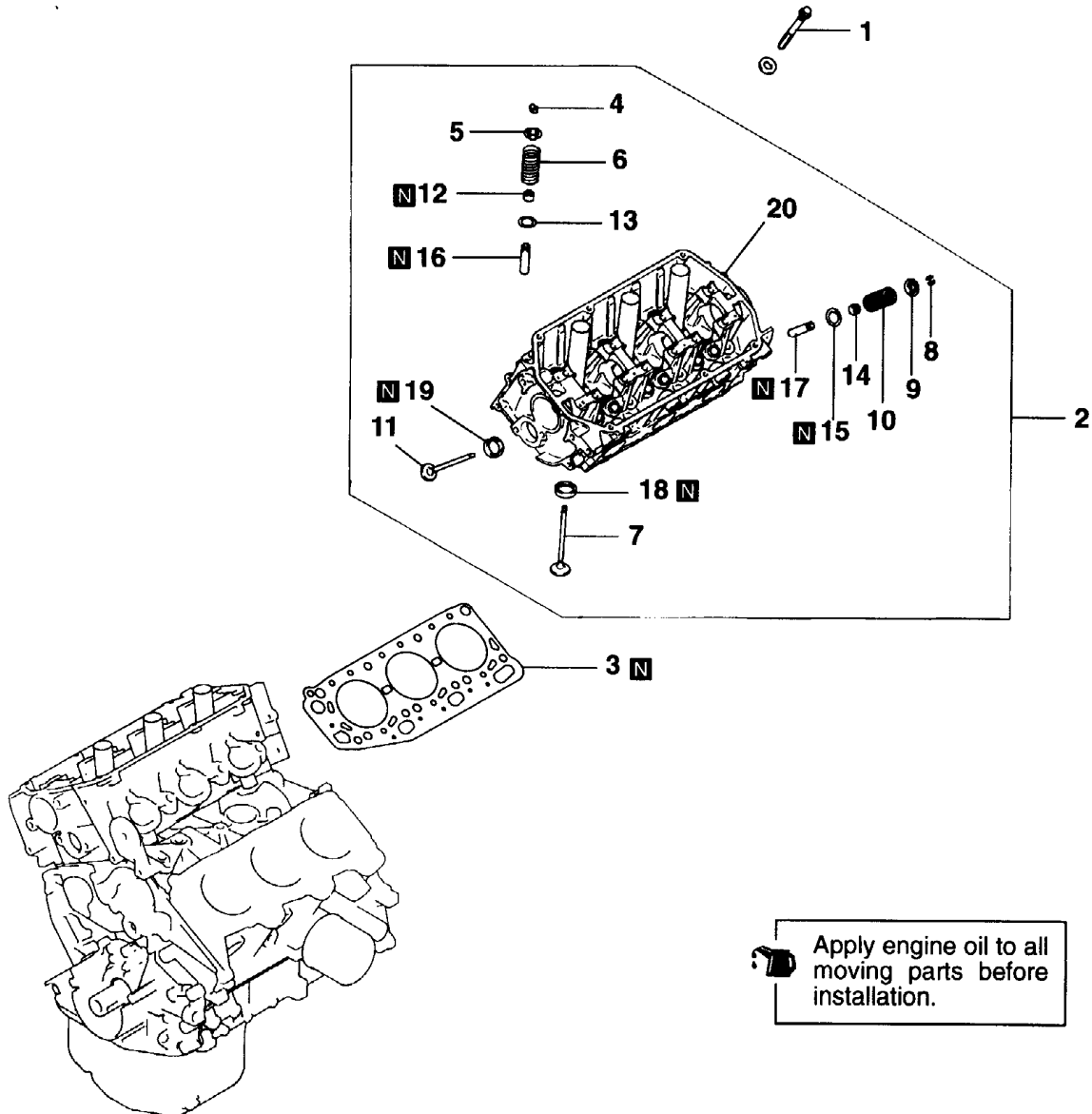


### ▶B◀ ROCKER SHAFT CAP INSTALLATION

- (1) Tighten the bolts in the sequence shown.
- (2) Make sure that each rocker arm moves smoothly.

## 12. CYLINDER HEAD AND VALVES

### REMOVAL AND INSTALLATION <SOHC>



Apply engine oil to all moving parts before installation.

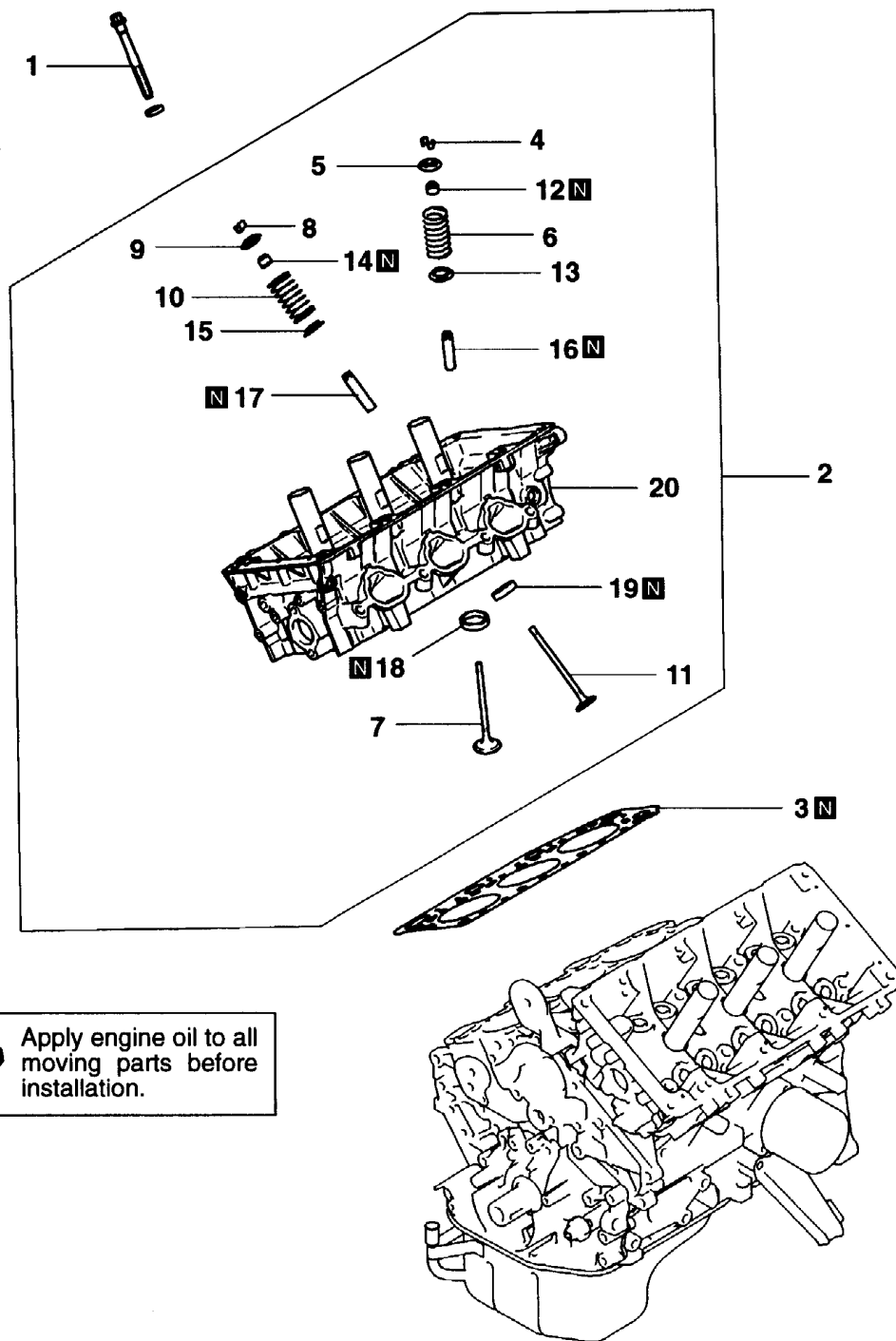
6AE0165

#### Removal steps

- ◀A▶ ▶D▶ 1. Cylinder head bolt
- ▶B▶ ▶C▶ 2. Cylinder head
- ▶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. Intake valve
- ▶B▶ ▶C▶ 8. Retainer lock
- ▶B▶ ▶C▶ 9. Valve spring retainer
- ▶B▶ ▶C▶ 10. Valve spring

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

REMOVAL AND INSTALLATION <MIVEC>



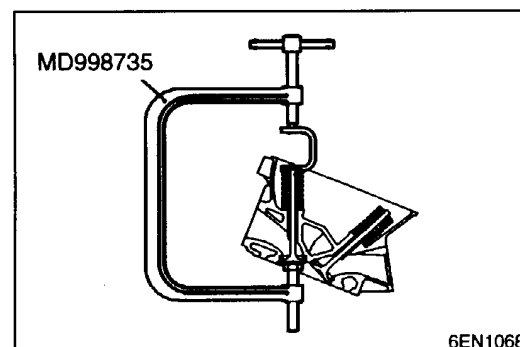
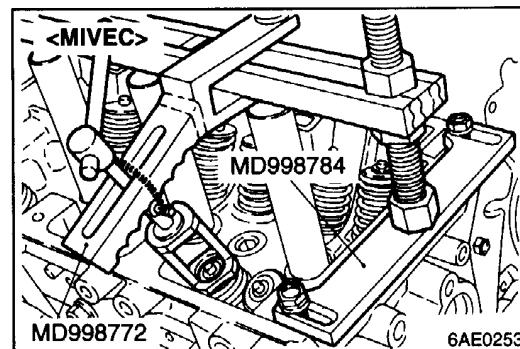
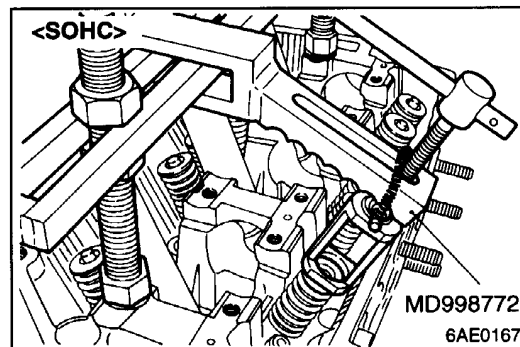
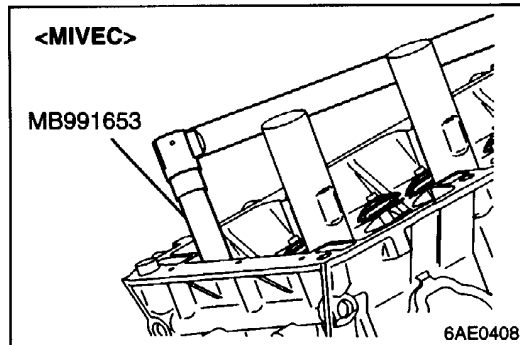
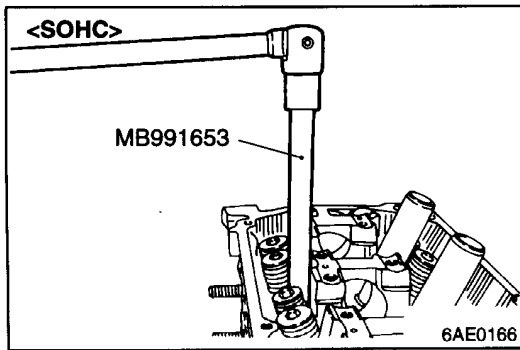
Apply engine oil to all moving parts before installation.

Removal steps

- ◀A▶ ▶D▶ 1. Cylinder head bolt
- ▶A▶ ▶D▶ 2. Cylinder head
- ◀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. Intake valve
- ▶B▶ ▶C▶ 8. Retainer lock
- ▶B▶ ▶C▶ 9. Valve spring retainer
- ▶B▶ ▶C▶ 10. Valve spring

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

6AE0314

**REMOVAL SERVICE POINTS****PRECAUTION FOR REMOVED PARTS**

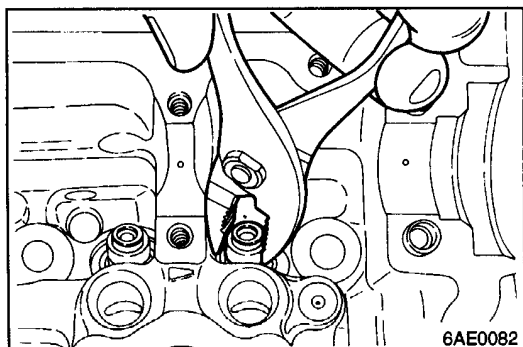
Keep removed parts in order according to the cylinder number and intake/exhaust side.

**◀A▶ CYLINDER HEAD BOLT REMOVAL**

- (1) Using the special tool, loosen the cylinder head bolts. Loosen evenly, little by little.

**◀B▶ RETAINER LOCK REMOVAL**

- (1) Store removed valves, springs and other parts, tagged to indicate their cylinder Nos. and location for reassembly.

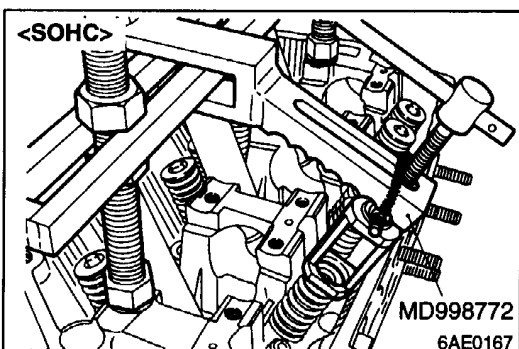
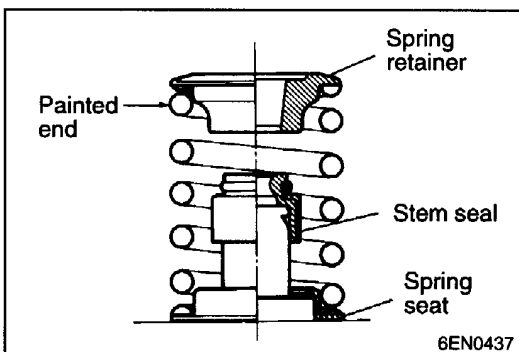
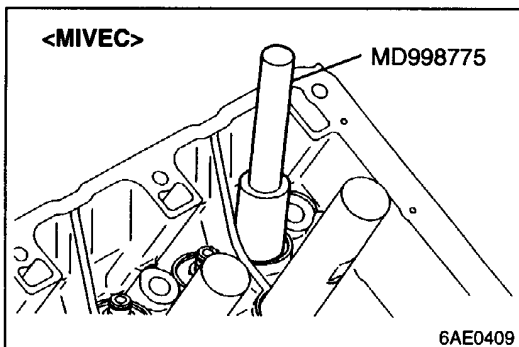
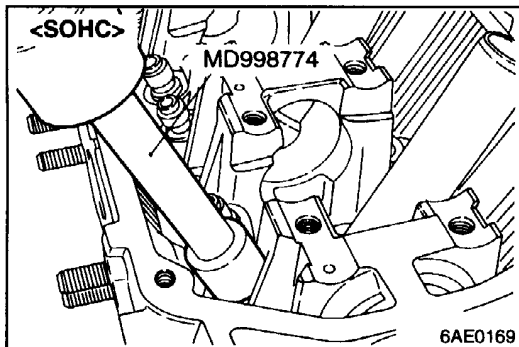
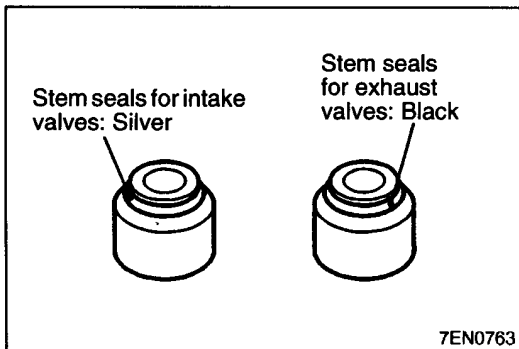
**◀C▶ VALVE STEM SEAL REMOVAL**

- (1) Do not reuse removed valve stem seals.

**◀D▶ VALVE HANDLING PRECAUTIONS**

- (1) Sodium reacts violently with water or moisture generation heat and liberating hydrogen. It must be handled with utmost care because otherwise the following dangerous conditions may result:  
Loss of eyesight if sodium gets in eyes.  
Burns if sodium contact skin.  
Fire hazard.
- (2) Handling of Sodium-filled Exhaust Valves  
Sodium-filled exhaust valves are not dangerous and may be handled in the same way as ordinary valves unless they are broken.  
Never try to break the valves and expose sodium to the air. When worn exhaust valves are to be discarded, have them disposed of by a salvage company equipped with special disposal system, notifying them that the valves contain sodium.  
Should the exhaust valves be broken, neutralize sodium using the method described below, and discard the valves in the same way as ordinary valves.
- (3) How to Neutralize Sodium  
Place a container filled with more than 10 liters of water in a well ventilated large space.  
Wear rubber gloves and goggles, and carefully take out broken valves from the cylinder head.  
Put a broken valve in the water-filled container and quickly get away from the container at least 2 or 3 m (6.6 or 10 ft.)





## INSTALLATION SERVICE POINTS

### ▶A◀ VALVE STEM SEAL INSTALLATION

- (1) Install the valve spring seat.
- (2) Use the special tool to fit a new stem seal on the valve guide.

#### NOTE

Valve stem seals for intake valves are different from those for exhaust valves. They are identified by colors of their spring sections as follows:

- Stem seals for intake valves: Silver
- Stem seals for exhaust valves: Black

#### Caution

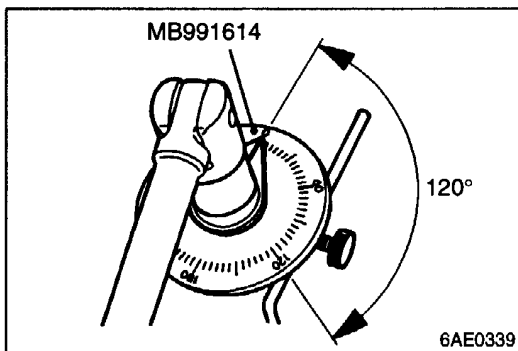
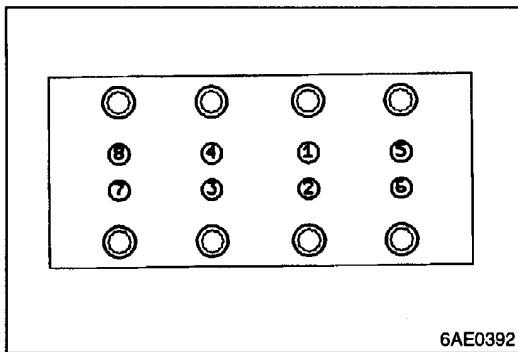
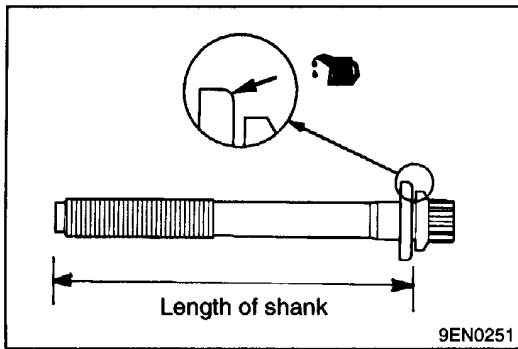
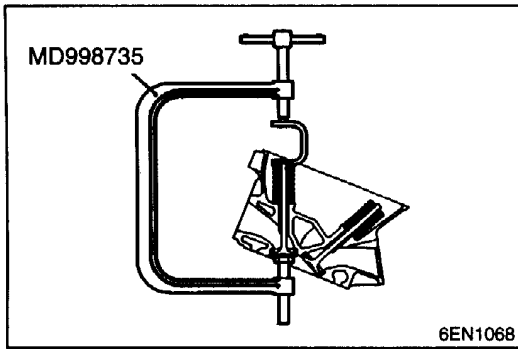
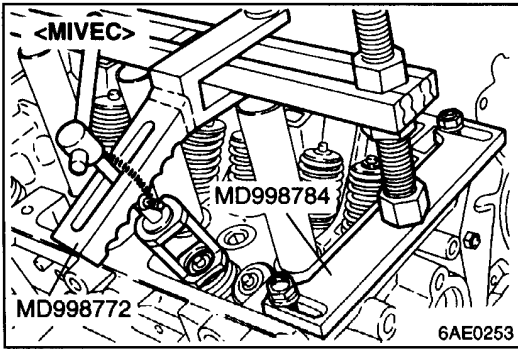
- Do not reuse the valve stem seal.
- Always use the special tool to install the valve stem seal. If the seal is improperly fitted, engine oil may work its way down along the valve stem.

### ▶B◀ VALVE SPRING INSTALLATION

- (1) Install the valve spring with the painted end 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, and damage, the stem seal.



**▶◀ CYLINDER HEAD BOLT INSTALLATION**

- (1) When installing the cylinder head bolts, check that the shank length of each bolt meets the limit. If the limit is exceeded, replace the bolts.

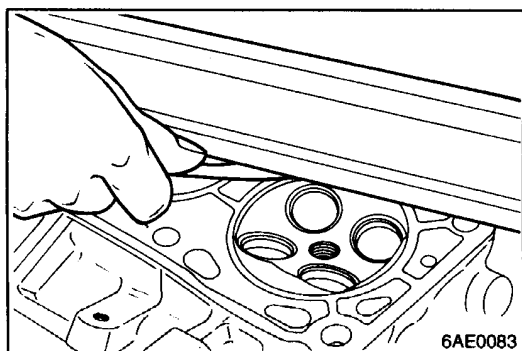
**Limit: max. 96.4 mm**

- (2) Install the washers as illustrated.
- (3) Apply engine oil to the bolt threads and washers.
- (4) Retighten the loosened bolts to a torque of 20 Nm in the specified tightening sequence.

- (5) Make paint marks on the cylinder head bolts and cylinder head.
- (6) Give a 120° turn to the bolts in the specified tightening sequence.

**Caution**

- If the bolts are tightened by an angle of less than 120°, they may not hold the cylinder head with sufficient strength.
- If a bolt is overtightened, completely remove all the bolts and carry out the installation procedure again from step (1).



## INSPECTION

### CYLINDER HEAD

- (1) Check the cylinder head gasket surface for flatness by using a straightedge and thickness gauge.

**Standard value: 0.03 mm**

**Limit: 0.2 mm**

- (2) If the service limit is exceeded, correct to meet the specification.

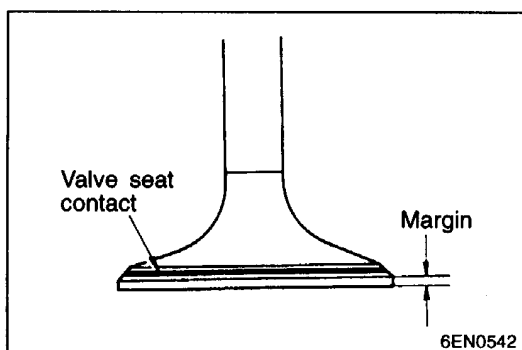
**Grinding limit: \*0.2 mm**

\*Includes/combined with cylinder block grinding

**Cylinder head height (Specification when new):**

**119.9 – 120.1 mm <SOHC>**

**119.6 – 119.8 mm <MIVEC>**



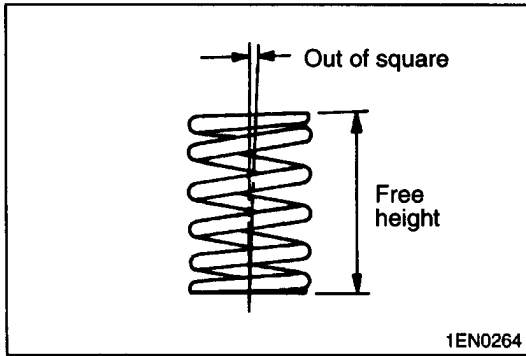
### VALVE

- (1) Check the valve face for correct contact. If incorrect, reface using a valve refacer. Valve should make a uniform contact with the seat at the centre of valve face.
- (2) If the margin is smaller than the service limit, replace the valve.

	Standard value mm	Limit mm
Intake	1.0	0.5
Exhaust	1.3	0.8

- (3) Measure the overall height of the valve. If the specified limit is exceeded, replace the valve.

		Standard value mm	Limit mm
Intake	SOHC	113.02	112.52
	MIVEC	112.37	111.87
Exhaust	SOHC	115.32	114.82
	MIVEC	110.74	110.74



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**VALVE SPRING**

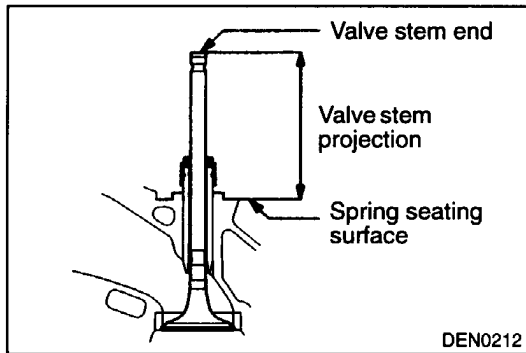
- (1) Measure the valve spring's free height. If the measurement is less than specified, replace the spring.

	Standard value mm	Limit mm
SOHC	49.9	48.9
MIVEC	51.5	50.5

- (2) Measure the squareness of the spring. If the measurement exceeds the specified limit, replace the spring.

**Standard value: 2° or less**

**Limit: 4°**

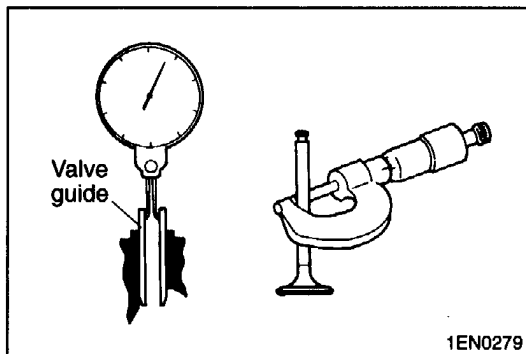


DEN0212

**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 mm	Limit mm
SOHC	48.45	48.95
MIVEC	48.40	48.90



1EN0279

**VALVE GUIDE**

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

**Standard value:**

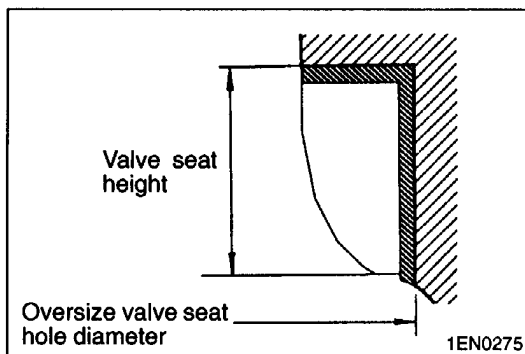
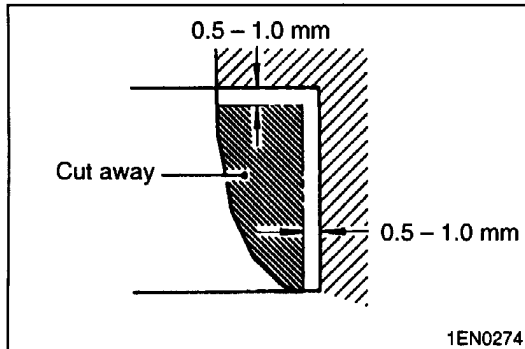
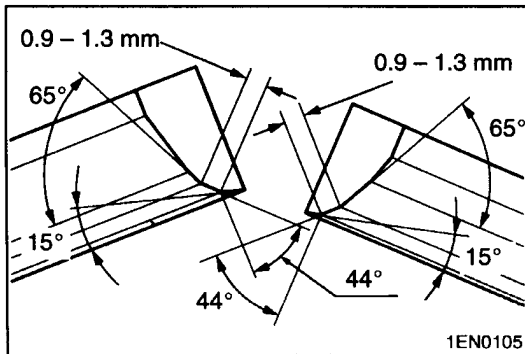
**Intake: 0.02 – 0.05 mm**

**Exhaust: 0.04 – 0.07 mm**

**Limit:**

**Intake: 0.10 mm**

**Exhaust: 0.15 mm**



### VALVE SEAT RECONDITIONING PROCEDURE

- (1) Before correcting the valve seat, check the clearance between the valve guide and valve. If necessary, replace the valve and/or 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 thin the wall thickness. Then, remove the valve seat.
- (2) Rebore the valve seat hole in the cylinder head to a selected oversize valve seat diameter.

#### Intake valve seat hole diameter

0.3 O.S. <SOHC>	29.80 – 29.82 mm
<MIVEC>	32.30 – 32.32 mm
0.6 O.S. <SOHC>	30.10 – 30.12 mm
<MIVEC>	32.60 – 32.62 mm

#### Exhaust valve seat hole diameter

0.3 O.S. <SOHC>	27.80 – 27.82 mm
<MIVEC>	29.80 – 29.82 mm
0.6 O.S. <SOHC>	28.10 – 28.12 mm
<MIVEC>	30.10 – 30.12 mm

- (3) Before fitting the valve seat, either heat the cylinder head up to approximately 250°C or cool the valve seat in liquid nitrogen, to prevent the cylinder head bore from galling.
- (4) Correct the valve seat to the specified width and angle.

### VALVE GUIDE REPLACEMENT

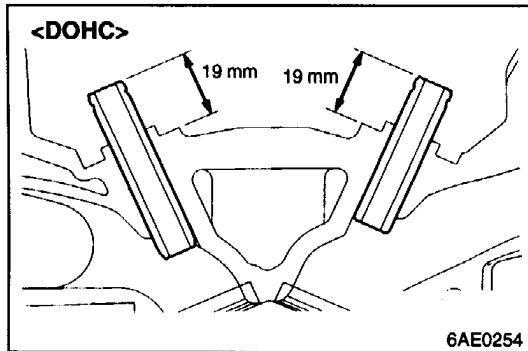
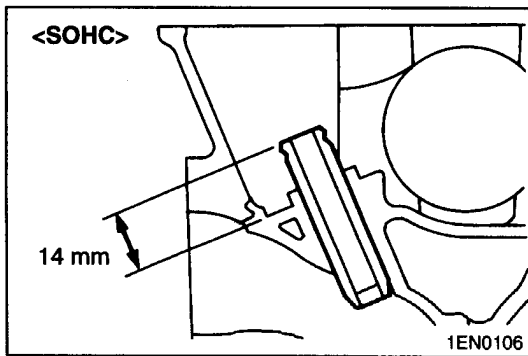
- (1) Force the valve guide out toward the cylinder block using a press.
- (2) Machine the valve guide hole in the cylinder head to the size of the oversize valve guide to be installed.

#### Caution

- Do not use the valve guide of the same size as the removed one.

#### Valve guide hole diameters in cylinder head

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

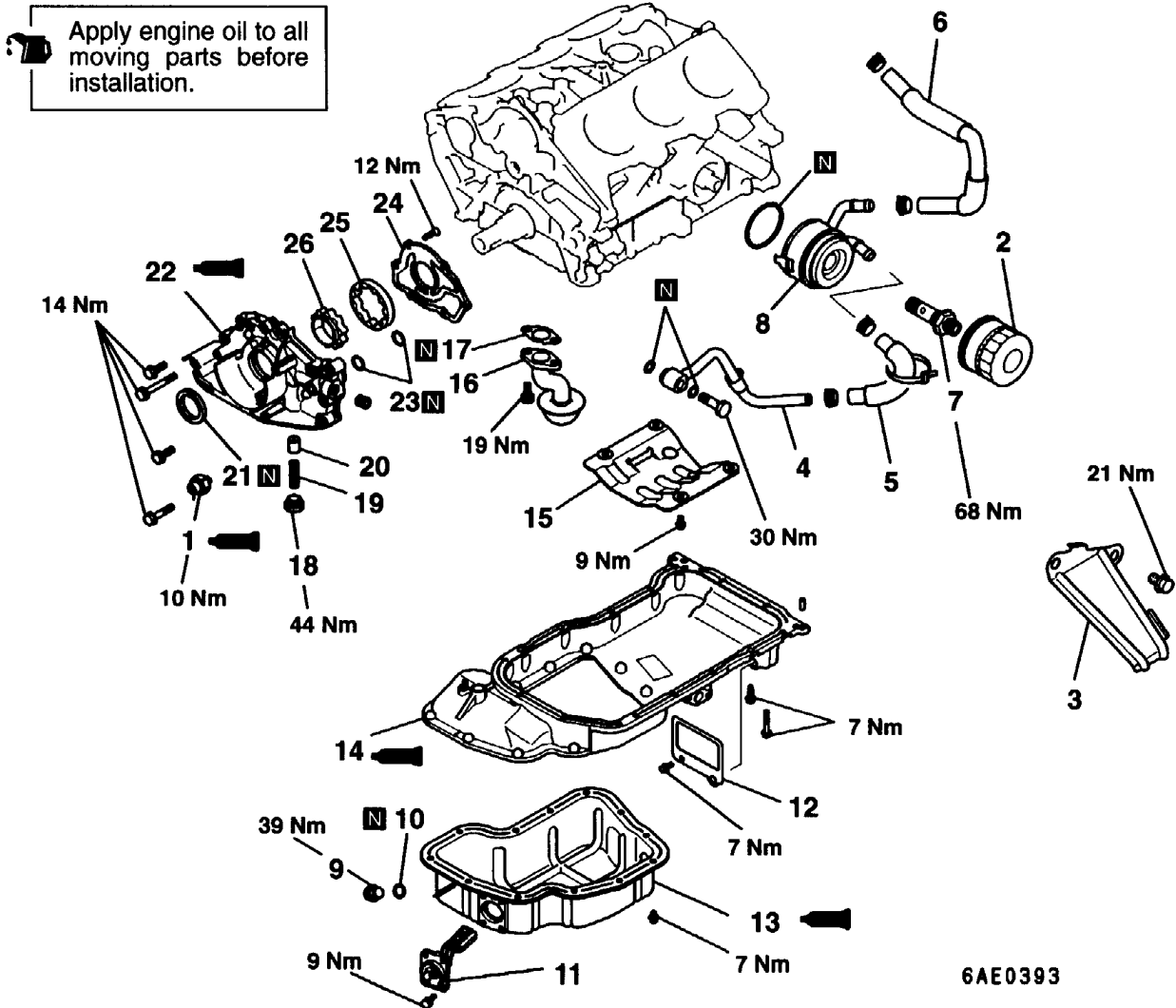


- (3) Press-fit the valve guide until it protrude specified value (SOHC: 14 mm, DOHC: 19 mm) as shown in the illustration.

**Caution**

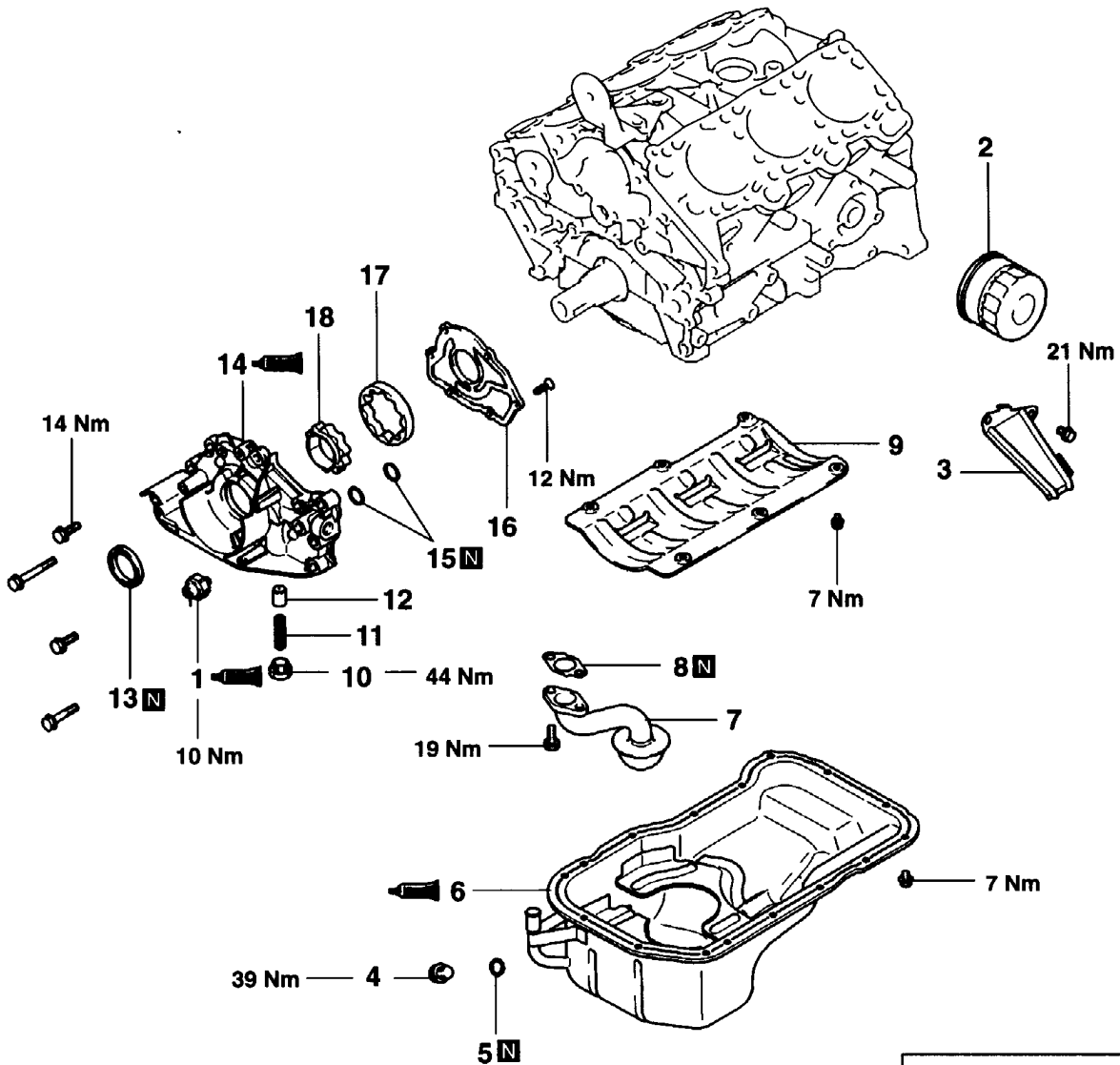
- Press the valve guide from the cylinder head top surface.
  - Valve guide for intake valve and that for exhaust valve are different in length. (45.5 mm for intake valve; 50.5 mm for exhaust valve)
- (4) After the valve guide has been installed, insert a new valve to check for smooth sliding motion.

### 13. OIL PUMP CASE AND OIL PAN REMOVAL AND INSTALLATION <SOHC>



- Removal steps**
- ▶I▶▶H▶ 1. Oil pressure switch
  - ▶H▶▶H▶ 2. Oil filter
  - ▶H▶▶H▶ 3. Oil filter cover
  - ▶H▶▶H▶ 4. Water hose (for Europe and GCC)
  - ▶H▶▶H▶ 5. Water pipe (for Europe and GCC)
  - ▶H▶▶H▶ 6. Water pipe (for Europe and GCC)
  - ▶H▶▶H▶ 7. Bolt (for Europe and GCC)
  - ▶G▶▶H▶ 8. Oil cooler (for Europe and GCC)
  - ▶F▶▶H▶ 9. Drain plug
  - ▶F▶▶H▶ 10. Gasket
  - ▶F▶▶H▶ 11. Oil level sensor (For Europe)
  - ▶F▶▶H▶ 12. Cover
  - ▶D▶▶H▶ 13. Oil pan lower
  - ▶D▶▶H▶ 14. Oil pan upper
  - ▶D▶▶H▶ 15. Baffle plate
  - ▶D▶▶H▶ 16. Oil screen
  - ▶D▶▶H▶ 17. Gasket
  - ▶D▶▶H▶ 18. Relief plug
  - ▶D▶▶H▶ 19. Relief spring
  - ▶D▶▶H▶ 20. Relief plunger
  - ▶C▶▶H▶ 21. Oil seal
  - ▶B▶▶H▶ 22. Oil pump case
  - ▶B▶▶H▶ 23. O-ring
  - ▶B▶▶H▶ 24. Oil pump case cover
  - ▶A▶▶H▶ 25. Outer rotor
  - ▶A▶▶H▶ 26. Inner rotor

REMOVAL AND INSTALLATION <MIVEC>



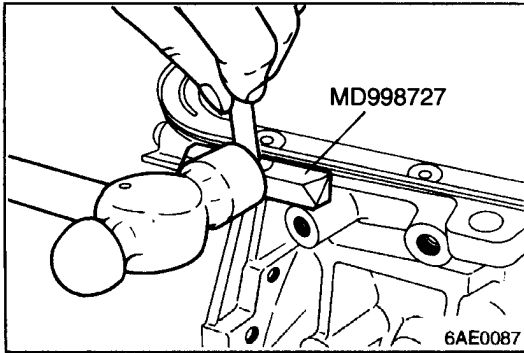
Apply engine oil to all moving parts before installation.

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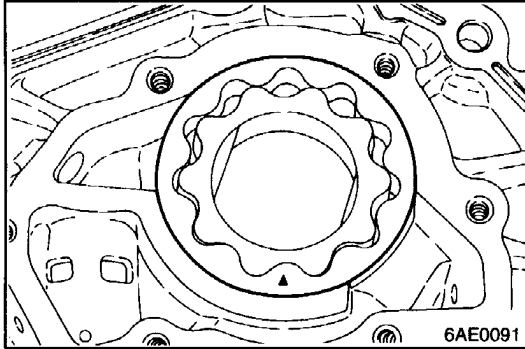
Removal steps

- |  |  |  |   |
|--|--|--|---|
| <p>                 &lt;A&gt; &lt;F&gt; &lt;E&gt; &lt;H&gt;             </p> | <p>                 1. Oil pressure switch<br/>                 2. Oil filter<br/>                 3. Oil filter cover<br/>                 4. Drain plug<br/>                 5. Gasket<br/>                 6. Oil pan<br/>                 7. Oil screen<br/>                 8. Gasket<br/>                 9. Buffle plate             </p> | <p>                 10. Relief plug<br/>                 11. Relief spring<br/>                 12. Relief plunger<br/>                 &lt;C&gt; &lt;B&gt; &lt;A&gt; &lt;A&gt;             </p> | <p>                 13. Oil seal<br/>                 14. Oil pump case<br/>                 15. O-ring<br/>                 16. Oil pump case cover<br/>                 17. Outer rotor<br/>                 18. Inner rotor             </p> |
|--|--|--|---|

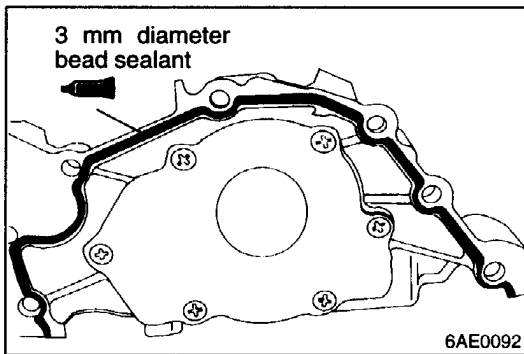


**REMOVAL SERVICE POINT****◀A▶ OIL PAN REMOVAL**

- (1) Knock the special tool deeply between the oil pan and the cylinder block.
- (2) Hitting the side of the special tool, slide the special tool along the oil pan to remove it.

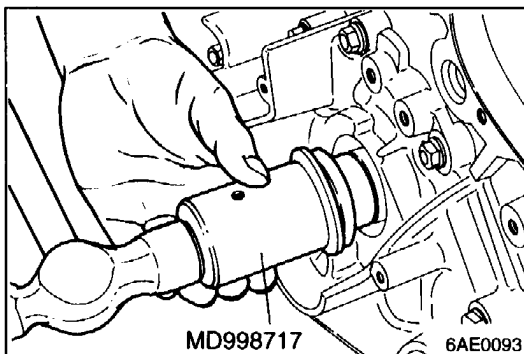
**INSTALLATION SERVICE POINTS****▶A◀ INNER ROTOR / OUTER ROTOR INSTALLATION**

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

**▶B◀ SEALANT APPLICATION TO OIL PUMP CASE**

Specified sealant:

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

**▶C◀ OIL SEAL INSTALLATION**

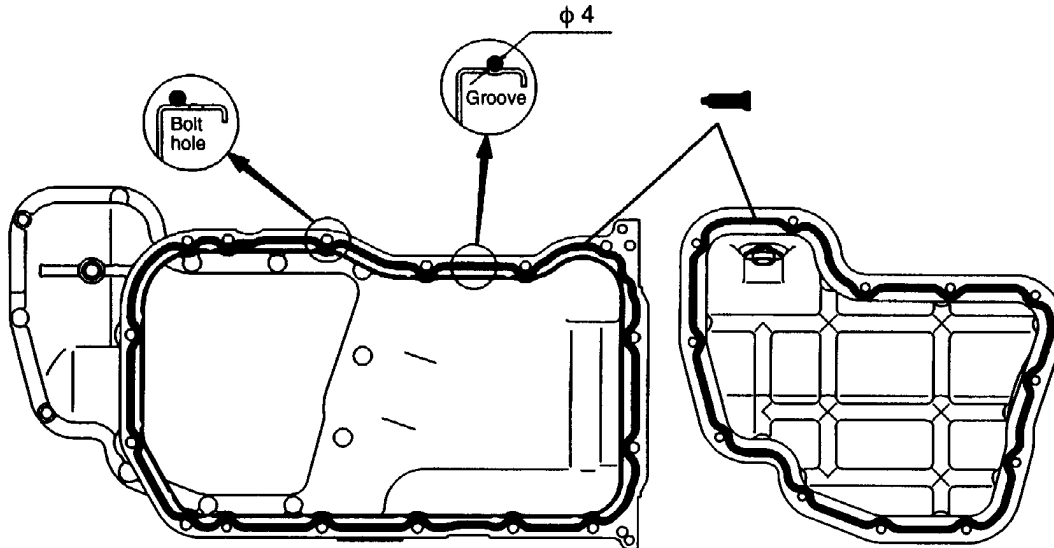
- (1) Apply engine oil to the oil seal lip. Using the special tool, knock the oil seal into the oil pump case.

**►D◄ OIL PAN INSTALLATION <SOHC>**

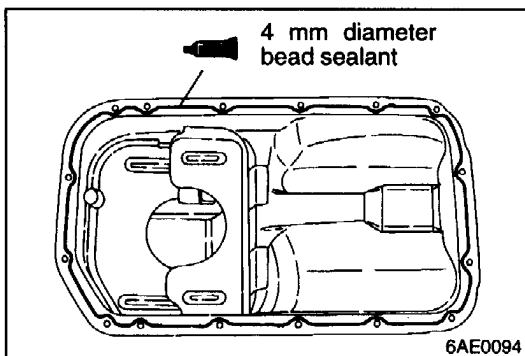
- (1) Clean the cylinder block and oil pan gasket application surfaces.
- (2) Install the oil pan within 15 minutes after FIPG has been applied to the entire flange surfaces of the oil pan.

**Specified sealant:**

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



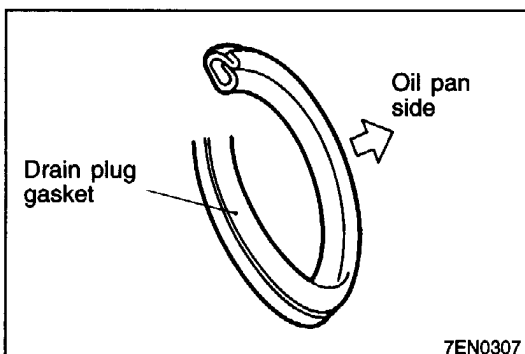
6AE0366

**►E◄ OIL PAN INSTALLATION <MIVEC>**

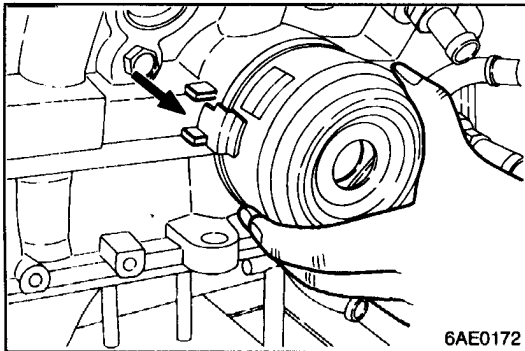
- (1) Clean the cylinder block and oil pan gasket application surfaces.
- (2) Install the oil pan within 15 minutes after FIPG has been applied to the entire flange surfaces of the oil pan.

**Specified sealant:**

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

**►F◄ DRAIN PLUG GASKET INSTALLATION**

Install the drain plug gasket in the shown direction.



### ▶G◀ OIL COOLER INSTALLATION

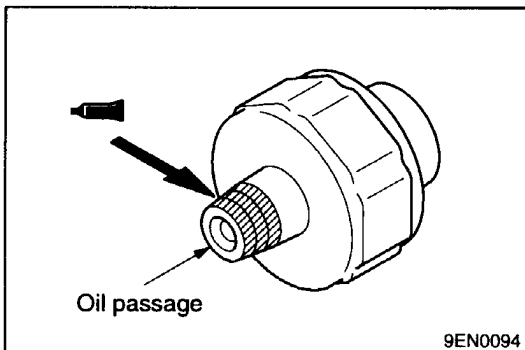
- (1) Install the oil cooler, with the oil cooler's positioning projection positioned against the rib on cylinder block.

### ▶H◀ OIL FILTER INSTALLATION

- (1) Clean the surfaces of the cylinder block on which the oil filter is to be mounted.
- (2) Apply engine oil to the O-ring of the oil filter.
- (3) Turn down the oil filter until the O-ring contacts the cylinder block surface, and then give the oil filter one more turn (or tighten with a 16 Nm torque).

#### NOTE

For MD135737 oil filter, the tightening torque should be 14 Nm.



### ▶I◀ SEALANT APPLICATION TO SEALANT TO OIL PRESSURE SWITCH

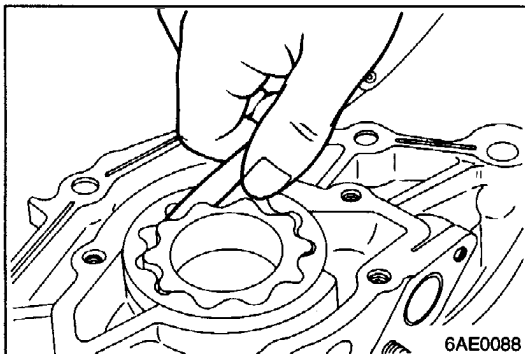
- (1) Apply sealant to the threads of the switch.

#### Specified sealant:

3M ATD Part No. 8660 or equivalent

#### Caution

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

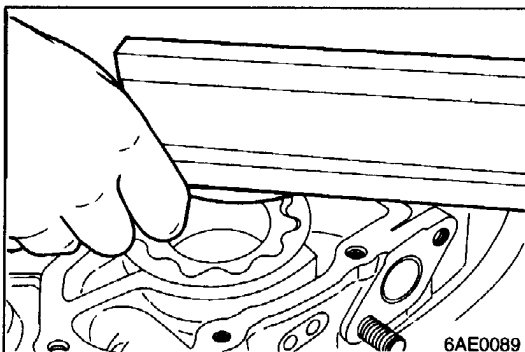


## INSPECTION

### OIL PUMP

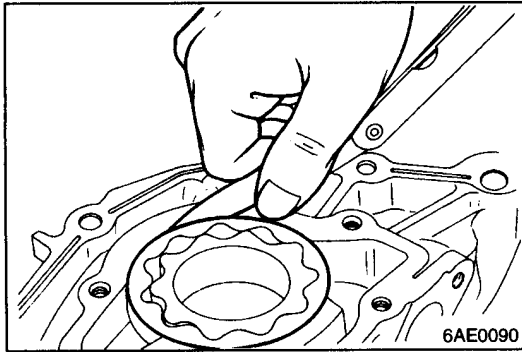
- (1) Check the tip clearance.

Standard value: 0.06 – 0.18 mm



- (2) Check the side clearance.

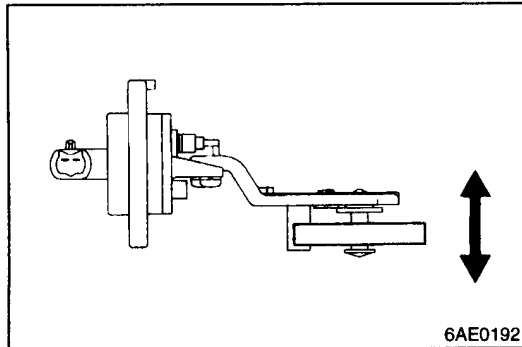
Standard value: 0.04 – 0.10 mm



- (3) Check the body clearance.

**Standard value: 0.10 – 0.18 mm**

**Limit: 0.35 mm**



#### OIL LEVEL SENSOR (FOR EUROPE)

- (1) Put the oil level sensor in the oil, then move the float up and down with the oil at a temperature either lower than 40°C or higher than 80°C, and check for continuity.

40°C

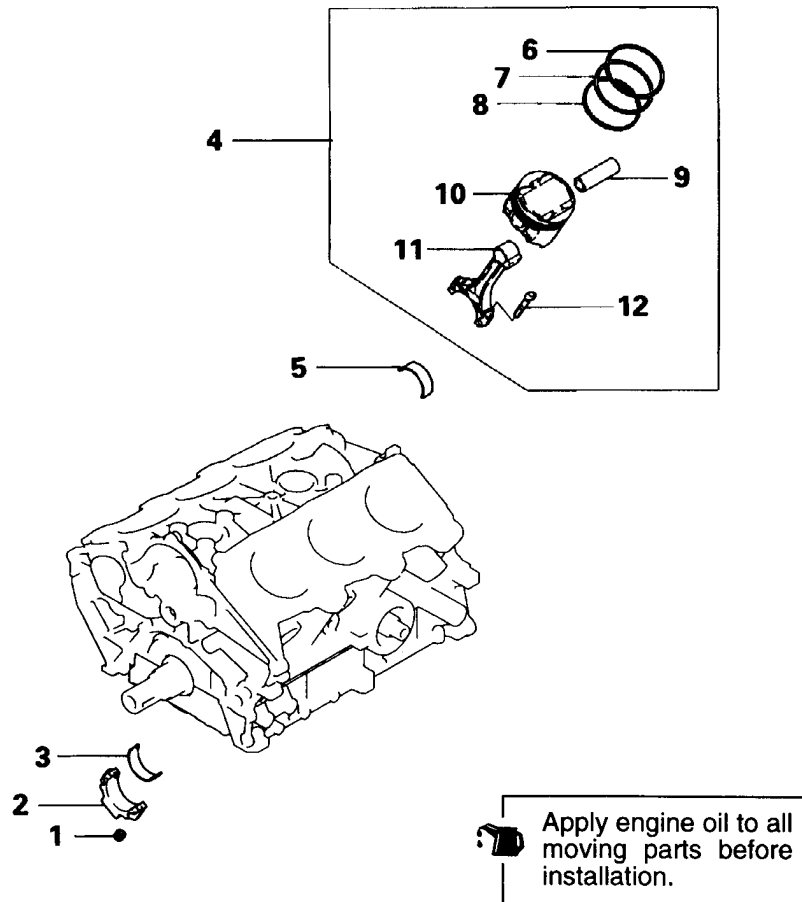
Float position	Switch ON/OFF
Condition when down	ON (continuity)
Condition when up	ON (continuity)

80°C

Float position	Switch ON/OFF
Condition when down	OFF (no continuity)
Condition when up	ON (continuity)

# 14. PISTON AND CONNECTING ROD

## REMOVAL AND INSTALLATION

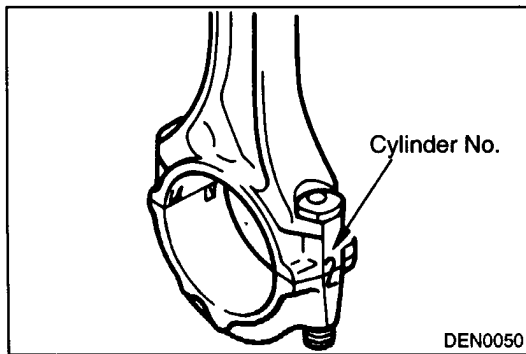


6AE0095

### Removal steps

- ◀A▶ G 1. Nut
- ▶F▶ 2. Connecting rod cap
- ▶E▶ 3. Connecting rod bearing
- ▶D▶ 4. Piston and connecting rod
- ▶E▶ 5. Connecting rod bearing
- ▶C▶ 6. Piston ring No.1

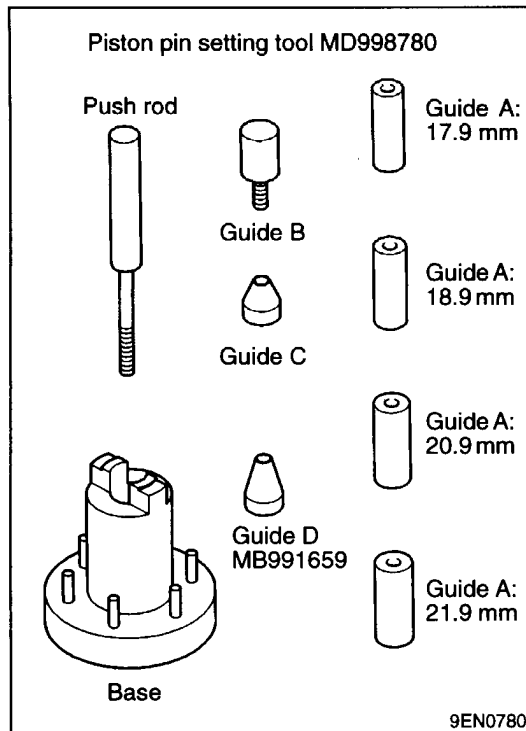
- ▶C▶ 7. Piston ring No.2
- ▶B▶ 8. Oil ring
- ▶A▶ 9. Piston pin
- ▶A▶ 10. Piston
- ▶A▶ 11. Connecting rod
- ▶A▶ 12. Bolt



## REMOVAL SERVICE POINTS

### ◀A▶ CONNECTING ROD CAP REMOVAL

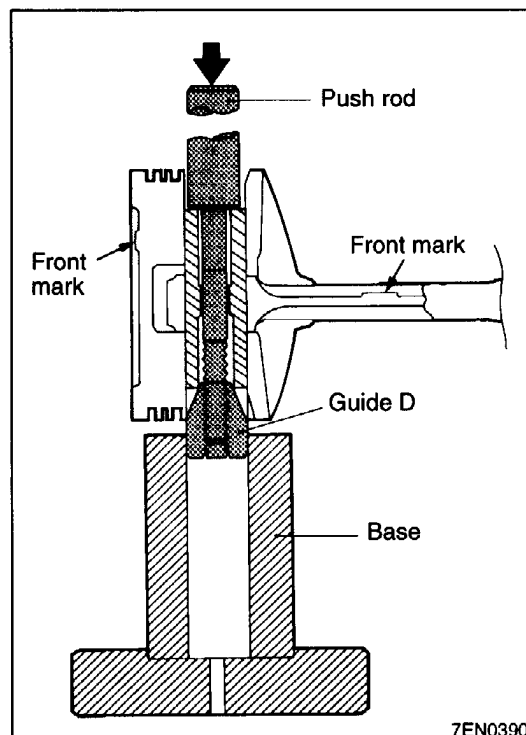
- (1) Mark the large end of the connecting rod with the cylinder number for use during reassembly.



### ◀B▶ PISTON PIN REMOVAL

Piston pin setting tool (MD998780) consists of the parts shown in the illustration at left.

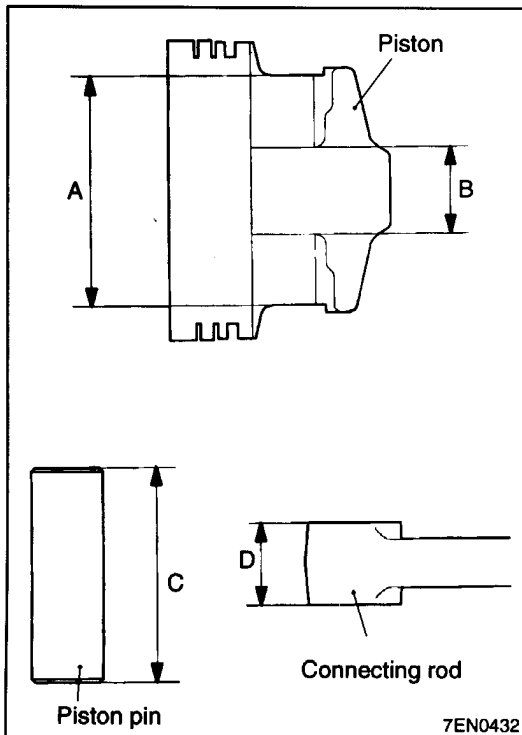
To remove the piston pin, Guide D (MB991659) is also used in combination with the Piston pin setting tool.



- (1) Insert the Push Rod (special tool) into the piston from the side on which the front mark is stamped in the piston head, and attach the guide D to the push rod end.
- (2) Place the piston and connecting rod assembly on the Piston Pin Setting Base (special tool) with the front mark facing upward.
- (3) Using a press, remove the piston pin.

#### NOTE

Keep the disassembled pistons, piston pins and connecting rods in order according to the cylinder number.



## INSTALLATION SERVICE POINTS

### ▶A◀ PISTON PIN INSTALLATION

- (1) Measure the following dimensions of the piston, piston pin and connecting rod.

A: Piston pin insertion hole length

B: Distance between piston bosses

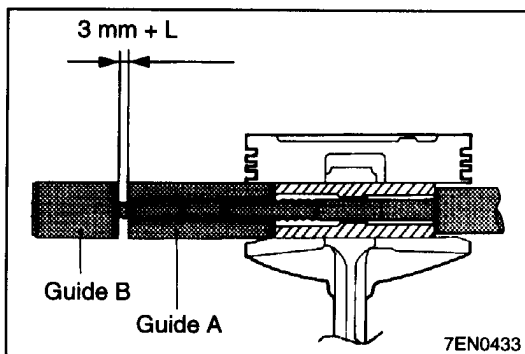
C: Piston pin length

D: Connecting rod small end width

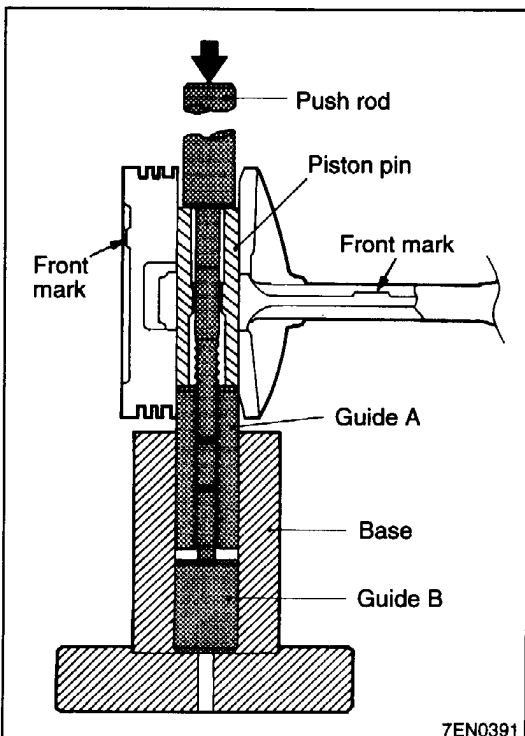
- (2) Calculate the following formula by substituting the measured values.

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

- (3) Insert the Push Rod (special tool) into the piston pin and attach the guide A to the push rod end.
- (4) Assemble the connecting rod in the piston with their front marks facing the same direction.
- (5) Apply engine oil to the entire periphery of the piston pin.
- (6) Insert the piston pin, push rod and guide A assembly having assembled in step (3) from the guide A side into the piston pin hole on the front marked side.

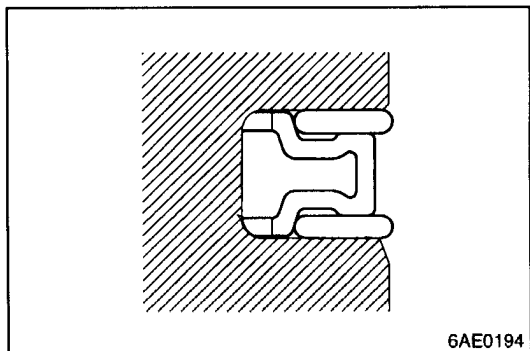


- (7) Screw the guide B into the guide A until the gap between both guides amounts to the value L obtained in step (2) plus 3 mm.



- (8) Place the piston and connecting rod assembly onto the piston setting base with the front marks directed upward.
- (9) Press-fit the piston pin using a press.  
If the press-fitting force required is less than the standard value, replace the piston and piston pin set or/and the connecting rod.

**Standard value: 5,000 – 15,000 N**



▶B◀ OIL RING INSTALLATION

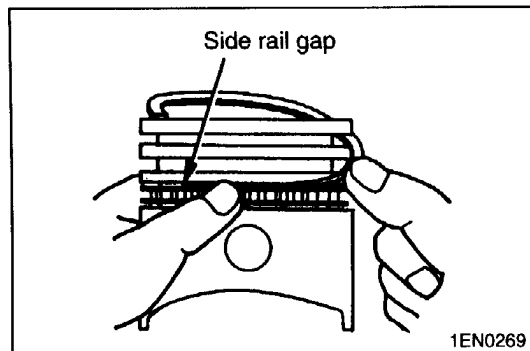
- (1) Fit the oil ring spacer into the piston ring groove.

NOTE

The side rails and spacer may be installed in either direction.

- (2) Install the upper side rail.

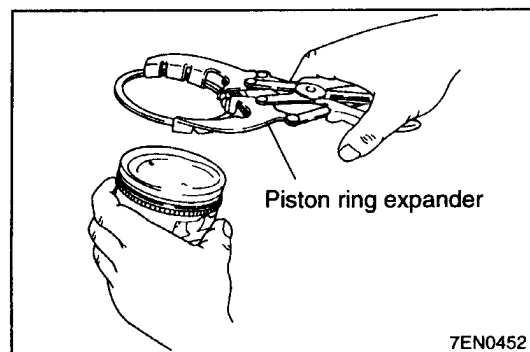
To install the side rail, first fit one end of the rail into the piston groove, then press the remaining portion into position by finger. See illustration.



NOTE

Do not use piston ring expander when installing side rail. Use of ring expander to expand the side rail end gap can break the side rail, unlike other piston rings.

- (3) Install the lower side rail in the same procedure as described in step (2).
- (4) Make sure that the side rails move smoothly in either direction.



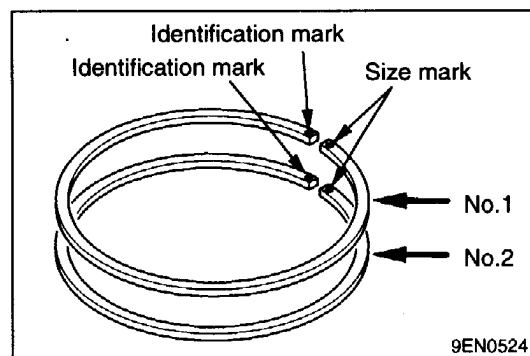
▶C◀ PISTON RING NO. 2 / PISTON RING NO. 1 INSTALLATION

- (1) Using piston ring expander, Install the piston rings with their side having identification marks facing up.

Identification mark:

No. 1 ring: T

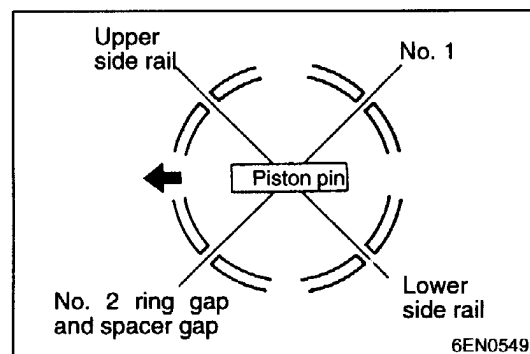
No. 2 ring: 2T



NOTE

The piston ring is stamped with the following size mark.

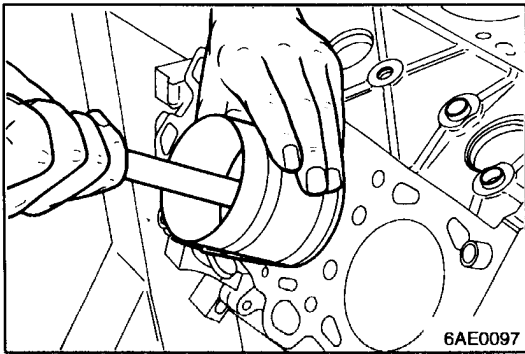
Size	Size mark
Standard size	None
0.50 mm O.S.	50
1.00 mm O.S.	100



▶D◀ PISTON AND CONNECTING ROD INSTALLATION

- (1) Liberally coat engine oil on the circumference of the piston, piston ring, and oil ring.
- (2) Arrange the piston ring and oil ring gaps (side rail and spacer) as shown in the figure.
- (3) Rotate crankshaft so that the crank pin is on center of the cylinder bore.

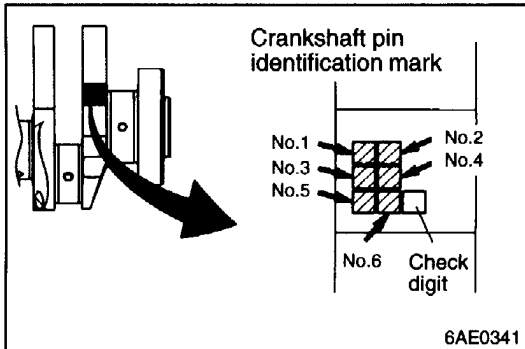




- (4) Use suitable thread protectors on connecting rod bolts before inserting piston and connecting rod assembly into cylinder block. Care must be taken not to nick crank pin.
- (5) Using a suitable piston ring compressor tool, install piston and connecting rod assembly into the cylinder block.

**Caution**

- Insert the front mark (arrow) on the top of the piston so it faces the engine front (timing belt side).

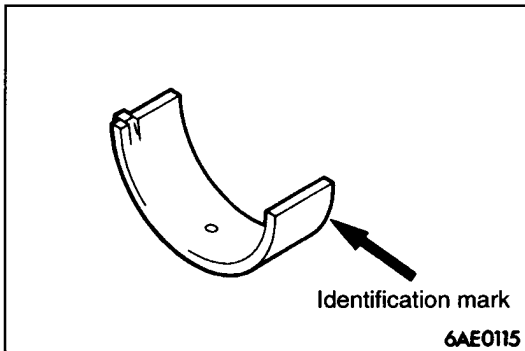


**►E◄ CONNECTING ROD BEARINGS INSTALLATION**

- (1) When the bearings are to be replaced, select correct ones and install them in the correct positions according to the identification marks stamped on the crankshaft.

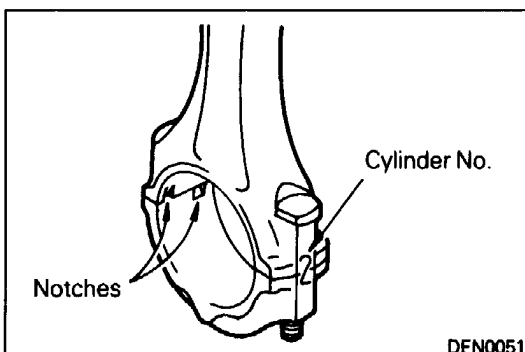
<6A12>

Crankshaft pin		Connecting rod bearing
Identification mark	Outer diameter mm	Identification mark
I	42.995 – 43.000	1
II	42.985 – 42.995	2
III	42.980 – 42.985	3



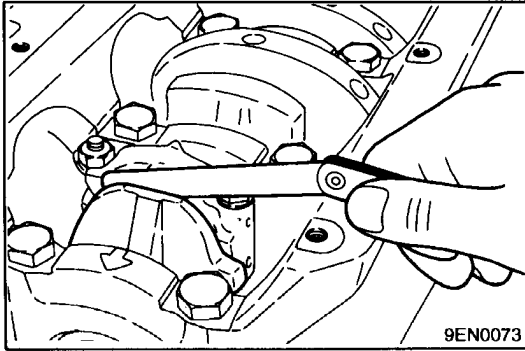
<6A13>

Crankshaft pin		Connecting rod bearing
Identification mark	Outer diameter mm	Identification mark
I	50.995 – 51.000	1
II	50.985 – 50.995	2
III	50.980 – 50.985	3



**►F◄ CONNECTING ROD CAP INSTALLATION**

- (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.



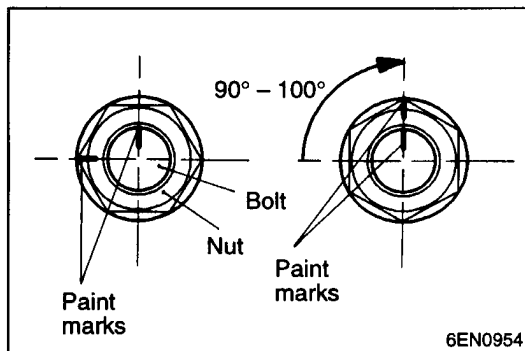
- (2) Check if the thrust clearance in the connecting rod big end is correct.

**Standard value: 0.10 – 0.25 mm**

**Limit: 0.4 mm**

#### ►G◄CONNECTING ROD CAP NUT INSTALLATION

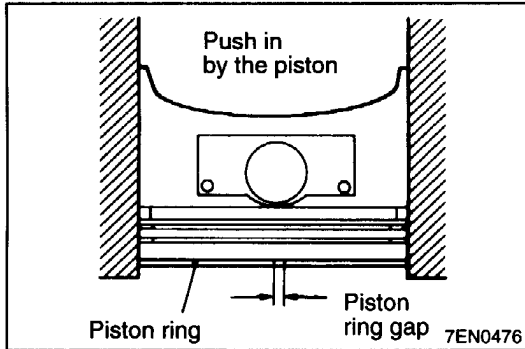
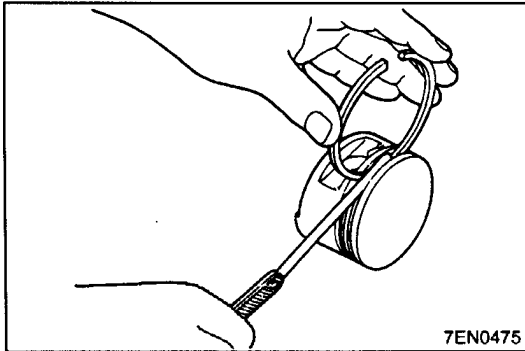
- (1) Since the connecting rod bolts and nuts are torqued using a new procedure they should be examined **BEFORE** reuse. If the bolt threads are “necked down” the bolts should be replaced.  
Necking can be checked by running a nut with fingers to the full length of the bolt’s thread. If the nut does not run down smoothly, the bolt should be replaced.



- (2) Before installation of each nut, apply engine oil to the threaded portion and bearing surface of the nut.  
(3) Install each nut to the bolt and tighten it finger tight. Then tighten the nuts alternately to install the cap properly.  
(4) Tighten the nuts to a torque of 18 Nm.  
(5) Make a paint mark on the head of each nut.  
(6) Make a paint mark on the bolt 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

- If the nuts are tightened by an angle of less than 90°, they may not hold the caps with sufficient strength.
- If a nut is tightened by an angle exceeding 100°, completely remove all the nuts and carry out the installation procedure again from step (1).



## INSPECTION

### PISTON RING

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

#### Standard value:

No. 1	0.03 – 0.07 mm
No. 2	0.02 – 0.06 mm

#### Limit:

No. 1	0.1 mm
No. 2	0.1 mm

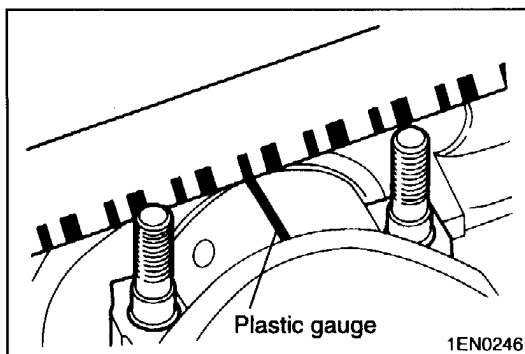
Install the piston ring into the cylinder bore. Force it down with a piston, its crown being in contact with the ring, to correctly position it at right angles to the cylinder wall. Then, measure the end gap with a feeler gauge. If the ring gap is excessive, replace piston ring.

#### Standard value:

No. 1	0.25 – 0.40 mm
No. 2	0.40 – 0.55 mm
Oil	0.10 – 0.35 mm

#### Limit:

No. 1, No. 2	0.8 mm
Oil	1.0 mm



### CRANKSHAFT PIN OIL CLEARANCE (PLASTIC GAUGE METHOD)

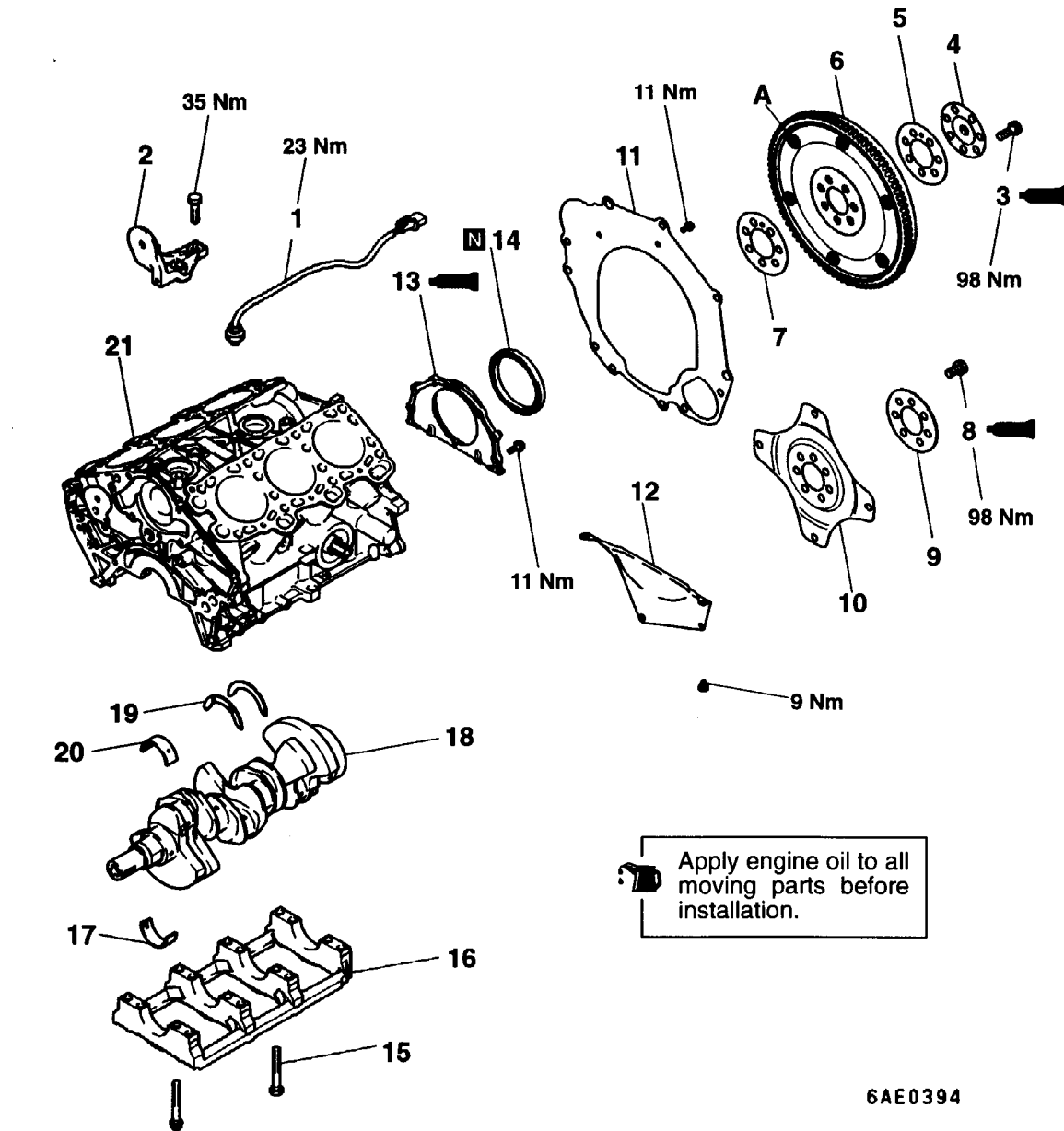
- (1) Remove oil from crankshaft pin and connecting rod bearing.
- (2) Cut the plastic gauge to the same length as the width of bearing and place it on crankshaft pin in parallel with its axis.
- (3) Install the connecting rod cap carefully and tighten the bolts to specified torque.
- (4) Carefully remove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

**Standard value:** 0.02 – 0.05 mm

**Limit:** 0.1 mm

# 15. CRANKSHAFT, CYLINDER BLOCK, FLYWHEEL AND DRIVE PLATE

## REMOVAL AND INSTALLATION



6AE0394

### Removal steps

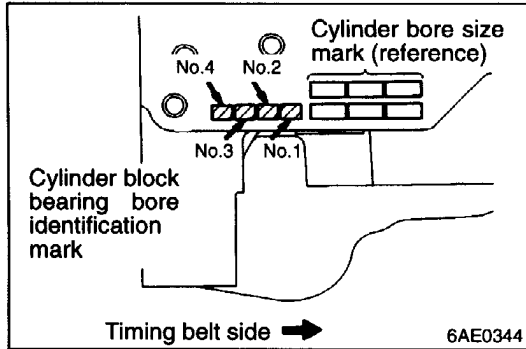
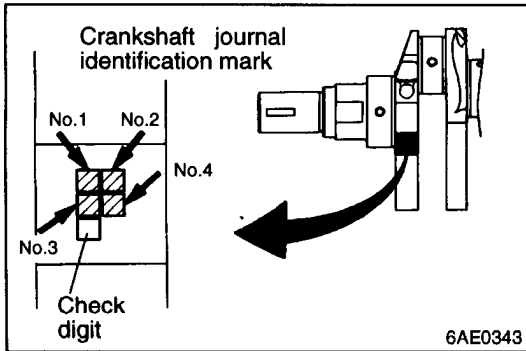
- 1. Detonation sensor
- 2. Idler pulley bracket <M/T>
- ▶E◀ 3. Flywheel bolt <M/T>
- 4. Plate <M/T>
- 5. Adapter plate <M/T>
- 6. Flexible flywheel <M/T>
- 7. Adapter plate <M/T>
- ▶E◀ 8. Drive plate bolt <A/T>
- 9. Adapter plate <A/T>
- 10. Drive plate <A/T>
- 11. Rear plate
- 12. Bell housing cover <MIVEC>
- ▶D◀ 13. Oil seal case
- ▶C◀ 14. Oil seal
- ▶B◀ 15. Bearing cap bolt

- ▶B◀ 16. Bearing cap
- ▶A◀ 17. Crankshaft bearing, lower
- 18. Crankshaft
- ▶A◀ 19. Thrust bearing
- ▶A◀ 20. Crankshaft bearing, upper
- 21. Cylinder block

### Caution

On the flexible wheel equipped engines, do not remove any of the bolts "A" of the flywheel shown in the illustration.

The balance of the flexible 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.



**INSTALLATION SERVICE POINTS**

**▶A◀ CRANKSHAFT BEARING INSTALLATION**

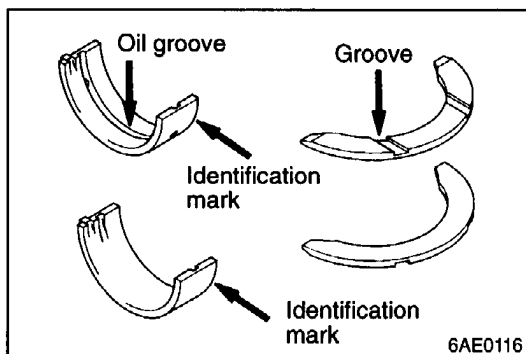
(1) When replacing bearing, select a one of proper size according to the identification marks stamped on both crankshaft and cylinder block.

<6A12>

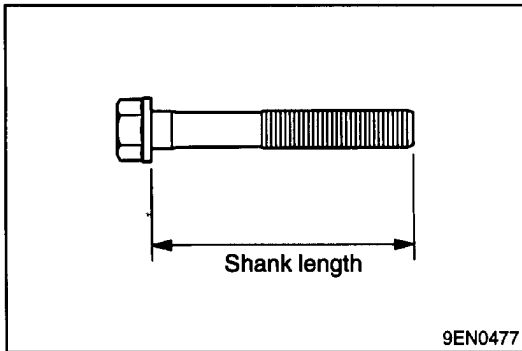
Crankshaft Journal		Cylinder Block Bearing Bore		Crankshaft Bearing
Identification mark	Outer diameter mm	Identification mark	Inner diameter mm	Identification mark
1	52.994 – 53.000	0	57.000 – 57.006	1
		1	57.006 – 57.012	2
		2	57.012 – 57.018	3
2	52.998 – 52.994	0	57.000 – 57.006	2
		1	57.006 – 57.012	3
		2	57.012 – 57.018	4
3	52.982 – 52.988	0	57.000 – 57.006	3
		1	57.006 – 57.012	4
		2	57.012 – 57.018	5

<6A13>

Crankshaft Journal		Cylinder Block Bearing Bore		Crankshaft Bearing
Identification mark	Outer diameter mm	Identification mark	Inner diameter mm	Identification mark
1	55.994 – 56.000	0	60.000 – 60.006	1
		1	60.006 – 60.012	2
		2	60.012 – 60.018	3
2	55.998 – 55.994	0	60.000 – 60.006	2
		1	60.006 – 60.012	3
		2	60.012 – 60.018	4
3	55.982 – 55.988	0	60.000 – 60.006	3
		1	60.006 – 60.012	4
		2	60.012 – 60.018	5



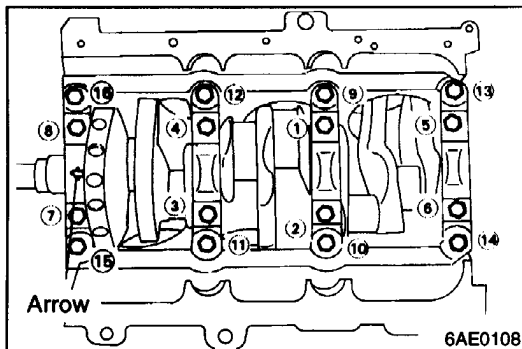
- (2) Install the bearings having an oil groove to the cylinder block.
- (3) Install the bearings having no oil groove to the bearing caps.
- (4) Install the thrust bearings at the No. 3 upper bearing with the grooved side toward the crank web.



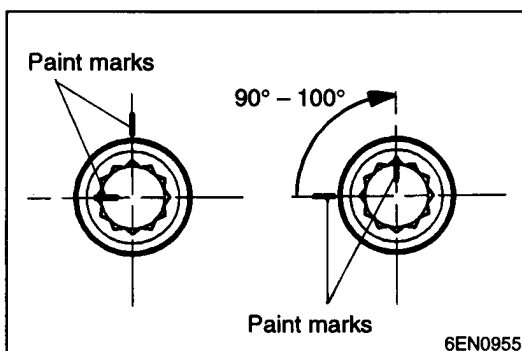
### ▶B◀ BEARING CAP / BEARING CAP BOLT INSTALLATION

- (1) Install the bearing caps so that their arrows are positioned on the timing belt side.
- (2) When installing the bearing cap bolts, check that the shank length of each bolt meets the limit. If the limit is exceeded, replace the bolt.

**Limit: max. 71.1 mm**



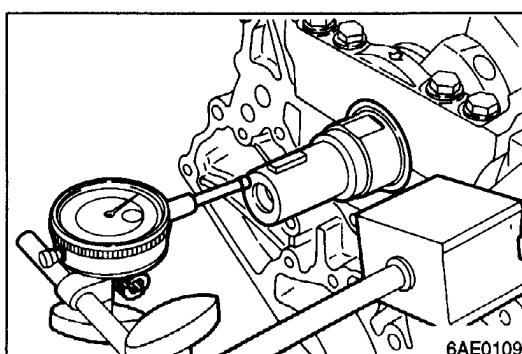
- (3) Apply engine oil to the threaded portion and bearing surface of the bolt.
- (4) Tighten the bearing cap bolts to 25 Nm torque in the tightening sequence.



- (5) Make a paint mark on the head of each nut.
- (6) Make a paint mark on the area around the bolt bearing surface at location 90° to 100° in the direction of tightening the bolt.
- (7) Give a 90° to 100° turn to the bolts in the tightening sequence. Make sure that the paint mark on the bolt and that on the area around the bolt bearing surface are in alignment.

#### Caution

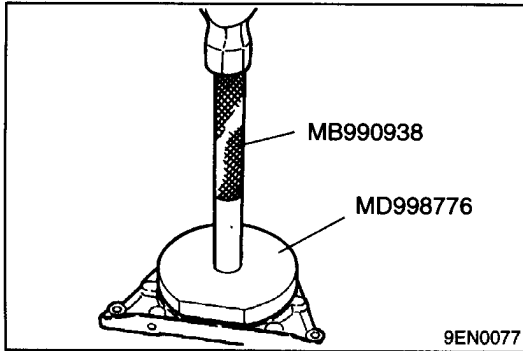
- If the bolts are tightened by an angle of less than 90°, they may not hold the cap with sufficient strength.
- If a bolt is tightened by an angle exceeding 100°, completely remove all the bolts and carry out the installation procedure again from step (1).



- (8) After installing the bearing caps, make sure that the crankshaft turns smoothly and the end play is correct. If the end play exceeds the limit, replace crankshaft bearings.

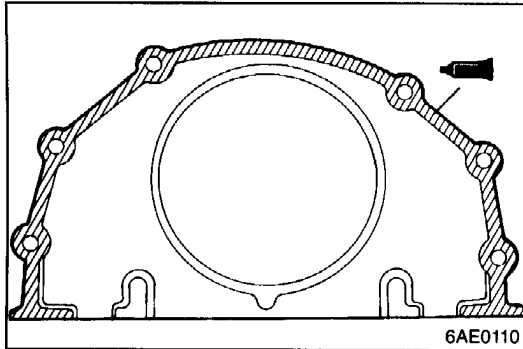
**Standard value: 0.05 – 0.25 mm**

**Limit: 0.4 mm**



### ▶C◀ OIL SEAL INSTALLATION

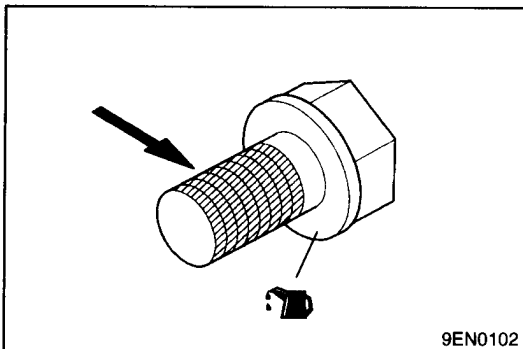
- (1) Apply engine oil to oil seal lip.



### ▶D◀ APPLICATION OF OIL SEAL CASE

#### Specified sealant:

Mitsubishi Genuine Part No. MD970389 or equivalent



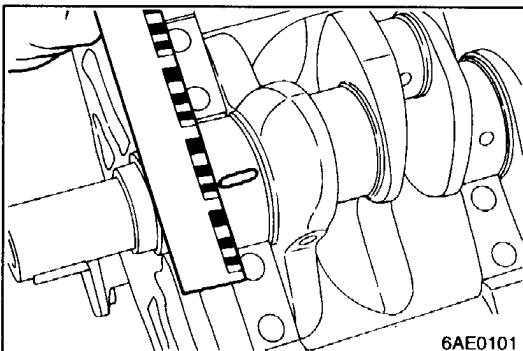
### ▶E◀ DRIVE PLATE BOLT / FLYWHEEL BOLT INSTALLATION

- (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 bolts.

#### Specified sealant:

3M Nut Locking Part No. 4171 or equivalent

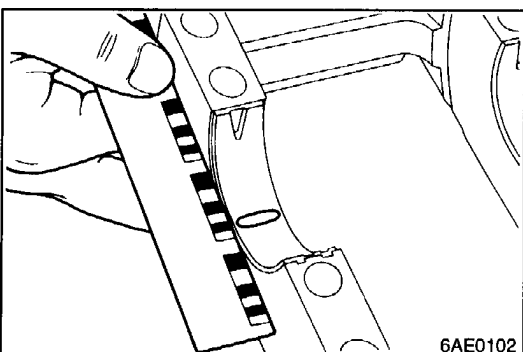
- (5) Tighten the bolts to specified torque.



### INSPECTION

#### CRANKSHAFT OIL CLEARANCE (PLASTIC GAUGE METHOD)

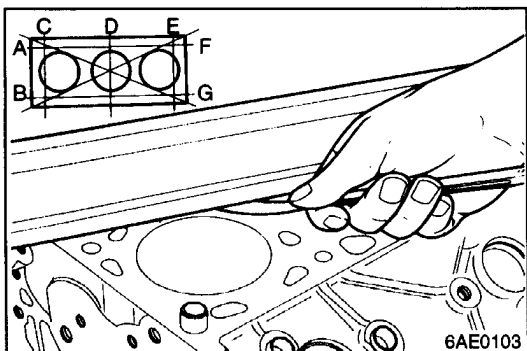
- (1) Remove oil from crankshaft journal and crankshaft bearing.
- (2) Install the crankshaft.
- (3) Cut the plastic gauge to the same length as the width of bearing and place it on journal in parallel with its axis.



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

Standard value: 0.02 – 0.04 mm

Limit: 0.1 mm



### CYLINDER BLOCK

- (1) Using a straightedge and feeler gauge, check the block top surface for warpage. Make sure that the surface is free from gasket chips and other foreign matter.

**Standard value: 0.05 mm or less**

**Limit: 0.1 mm**

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

**Grinding limit: 0.2 mm**

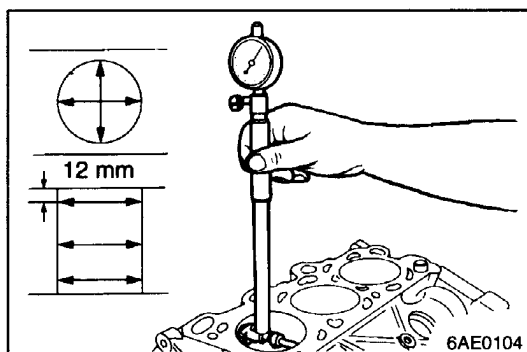
**The total thickness of the stock allowed to be removed from cylinder block and mating cylinder head is 0.2 mm at maximum.**

**Cylinder block height (when new):**

**6A12      190 mm**

**6A13      209 mm**

- (3) Check cylinder walls for scratches and seizure. If defects are evident, correct (bored to oversize) or replace.



- (4) Using cylinder gauge, measure the cylinder bore and cylindricity. If worn badly, correct cylinder to an oversize and replace piston and piston rings. Measure at the points shown in illustration.

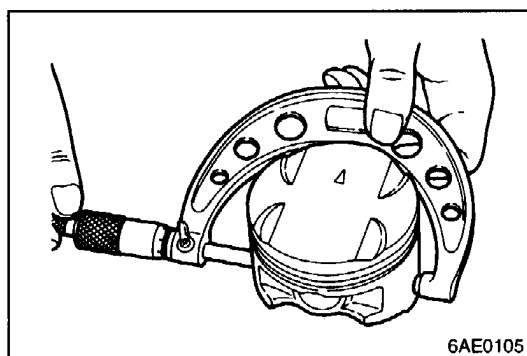
**Standard value:**

**Cylinder I.D.:**

**6A12      78.40 – 78.43 mm**

**6A13      81.00 – 81.03 mm**

**Out-of-roundness and taper of cylinder bore:  
0.01 mm or less**



### 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 piston top.

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

**Caution**

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

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

- (6) Check 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 same oversize. Do not bore only one cylinder to an oversize.