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# ENGINE

## <4G6-GDI>

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## GENERAL

### OUTLINE OF CHANGE

The following service procedures have been added to correspond to the addition of the 4G64-GDI engine.

### GENERAL INFORMATION

Items			4G64-GDI
Total displacement mL			2,350
Bore × Stroke mm			86.5 × 100.0
Compression ratio			11.5
Combustion chamber			Pentroof + ball-in-piston
Camshaft arrangement			DOHC
Number of valve	Intake		8
	Exhaust		8
Valve timing	Intake	Opening	BTDC 16°
		Closing	ABDC 60°
	Exhaust	Opening	BBDC 56°
		Closing	ATDC 16°
Fuel system			Electronically controlled multipoint fuel injection
Rocker arm			Roller type
Auto-lash adjuster			Equipped

### SERVICE SPECIFICATIONS

Items			Standard value	Limit
Alternator drive belt tension	Vibration frequency Hz	When checked	189 – 232	–
		When a used belt is installed	201 – 222	–
		When a new belt is installed	241 – 276	–
	Tension N	When checked	392 – 588	–
		When a used belt is installed	441 – 539	–
		When a new belt is installed	637 – 833	–
	Deflection (Reference value) mm	When checked	6.7 – 9.0	–
		When a used belt is installed	7.2 – 8.4	–
		When a new belt is installed	5.0 – 6.4	–

Items			Standard value	Limit
Power steering oil pump and A/C compressor drive belt tension	Vibration frequency Hz	When checked	108 – 132	–
		When a used belt is installed	114 – 126	–
		When a new belt is installed	137 – 157	–
	Tension N	When checked	392 – 588	–
		When a used belt is installed	441 – 539	–
		When a new belt is installed	637 – 834	–
	Deflection (Reference value) mm	When checked	11.7 – 15.3	–
		When a used belt is installed	12.5 – 14.3	–
		When a new belt is installed	8.8 – 11.0	–
Basic ignition timing			5° BTDC ± 3°	–
Ignition timing			Approx. 20° BTDC*1	–
Idle speed r/min	M/T	600 ± 100*2	–	
	A/T	650 ± 100	–	
CO contents %			0.5 or less	–
HC contents ppm			100 or less	–
Compression pressure kPa – r/min			1,570 – 300	1,210 – 300
Compression pressure difference of all cylinder kPa			–	Max. 100
Intake manifold vacuum kPa			–	Min. 56*3
Cylinder head bolt shank length mm			–	99.4
Timing belt B tension mm			5 – 7	–
Auto-tensioner push rod movement mm			Within 1	–
Timing belt tension torque Nm (Reference value)			3.5	–
Auto-tensioner rod protrusion amount mm			3.8 – 4.5	–

**NOTE**

\*1: Indicates the value measured within 4 minutes since the engine was started.

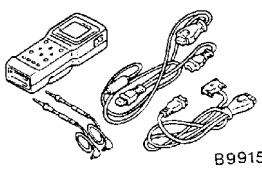
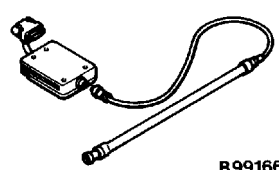
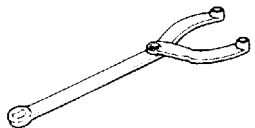
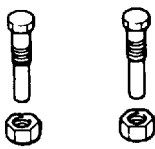
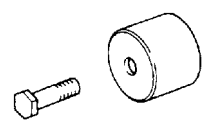
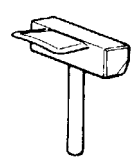
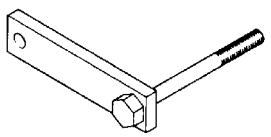
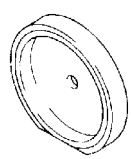
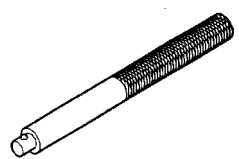
\*2: Varies depending on the transmission oil temperature. For details, refer to P.11D-10.

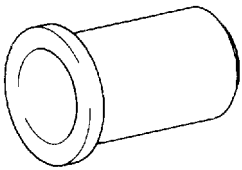
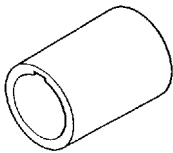
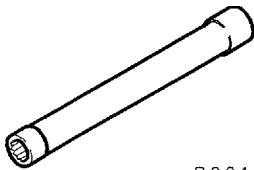
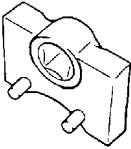
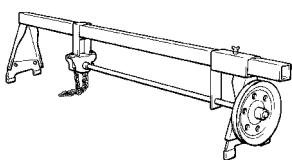
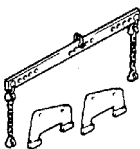
\*3: Indicates the value when more than 4 minutes have passed since the engine was started.

**SEALANTS**

Items	Specified sealants	Remarks
Beam camshaft cap Cylinder head	3M ATD Part No.8660 or equivalent	–
Cam position sensor support Oil pan	MITSUBISHI GENUINE PART MD970389 or equivalent	Semi-drying sealant
Flywheel or drive plate bolt	3M Stud Locking 4170 or equivalent	–

## SPECIAL TOOLS

Tool	Number	Name	Use
 B991502	MB991502	MUT-II sub assembly	<ul style="list-style-type: none"> <li>Measuring the drive belt tension</li> <li>Checking the ignition timing</li> <li>Checking the idle speed</li> <li>Erasing diagnosis code</li> </ul>
 B991668	MB991668	Belt tension meter set	Measuring the drive belt tension (used together with the MUT-II)
	MB990767	End yoke holder	<ul style="list-style-type: none"> <li>Holding the camshaft sprocket</li> <li>Holding the crankshaft sprocket</li> </ul>
	MD998719 or MD998754	Crankshaft pulley holder pin	<ul style="list-style-type: none"> <li>Holding the camshaft sprocket</li> <li>Holding the crankshaft sprocket</li> </ul>
	MD998713	Camshaft oil seal installer	Press-in of the camshaft oil seal
	MD998727	Oil pan remover	Removal of oil pan
	MD998781	Flywheel stopper	Securing the flywheel
	MD998776	Crankshaft rear oil seal installer	Press-in of the crankshaft rear oil seal
	MB990938	Handle	Press-in of the crankshaft rear oil seal

Tool	Number	Name	Use
	MD998382	Crankshaft front oil seal installer	Installation of crankshaft front oil seal
	MD998285	Crankshaft front oil seal guide	
 B991654	MB991654	Cylinder head bolt wrench	Cylinder head bolt removal and installation
	MD998767	Tension pulley socket wrench	Timing belt tension adjustment
	GENERAL SERVICE TOOL MZ203827	Engine lifter	Supporting the engine assembly during removal and installation of the transmission
 B991453	MB991453	Engine hanger assembly	

## ON-VEHICLE SERVICE

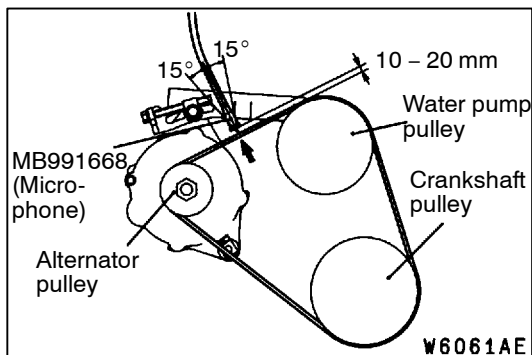
### DRIVE BELT TENSION CHECK AND ADJUSTMENT

#### ALTERNATOR DRIVE BELT TENSION CHECK

Check the drive belt tension in the following procedure.

#### Standard value:

Vibration frequency Hz	189 – 232
Tension N	392 – 588
Deflection (Reference value) mm	6.7 – 9.0

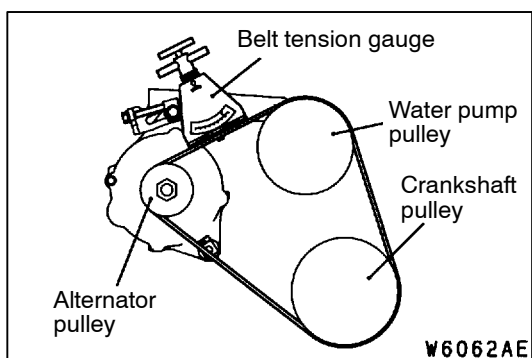


#### <When using the MUT-II>

1. Connect the special tool (belt tension meter set) to the MUT-II.
2. Connect the MUT-II to the diagnosis connector.
3. Turn the ignition switch to ON and select "Belt Tension Measurement" from the menu screen.
4. Hold the microphone to the middle of the drive belt between the pulleys (at the place indicated by the arrow), about 10 – 20 mm away from the rear surface of the belt and so that it is perpendicular to the belt (within an angle of  $\pm 15^\circ$ ).
5. Gently tap the middle of the belt between the pulleys (the place indicated by the arrow) with your finger as shown in the illustration, and check that the vibration frequency of the belt is within the standard value.

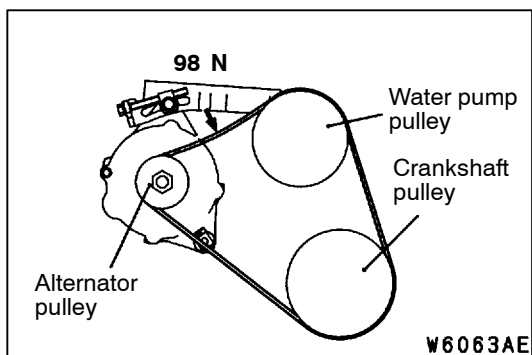
#### Caution

- (1) The temperature of the surface of the belt should be as close as possible to normal temperature.
- (2) Do not let any contaminants such as water or oil get onto the microphone.
- (3) If strong gusts of wind blow against the microphone or if there are any loud sources of noise nearby, the values measured by the microphone may not correspond to actual values.
- (4) If the microphone is touching the belt while the measurement is being made, the values measured by the microphone may not correspond to actual values.
- (5) Do not take the measurement while the vehicle's engine is running.



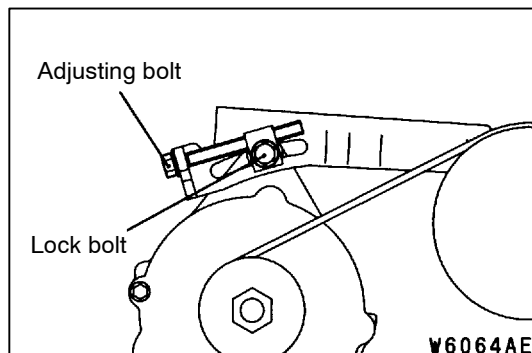
#### <When using a tension gauge>

Use a belt tension gauge to check that the belt tension is within the standard value.



#### <Belt deflection check>

Apply 98 N of force to the middle of the drive belt between the pulleys (at the place indicated by the arrow) and check that the amount of deflection is within the standard value.

**ALTERNATOR DRIVE BELT TENSION ADJUSTMENT**

1. Loosen the nut of the alternator pivot bolt.
2. Loosen the lock bolt.
3. Use the adjusting bolt to adjust the belt tension and belt deflection to the standard values.

**Standard value:**

Items	When a used belt is installed	When a new belt is installed
Vibration frequency Hz	201 – 222	241 – 276
Tension N	441 – 539	637 – 833
Deflection (Reference value) mm	7.2 – 8.4	5.0 – 6.4

4. Tighten the nut of the alternator pivot bolt.

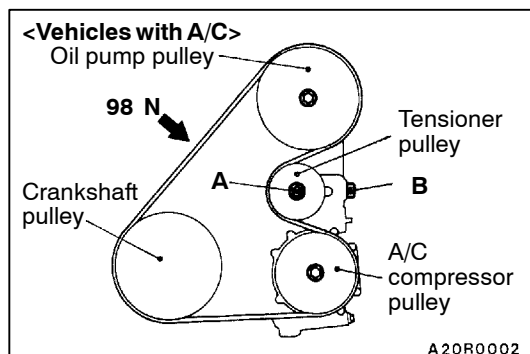
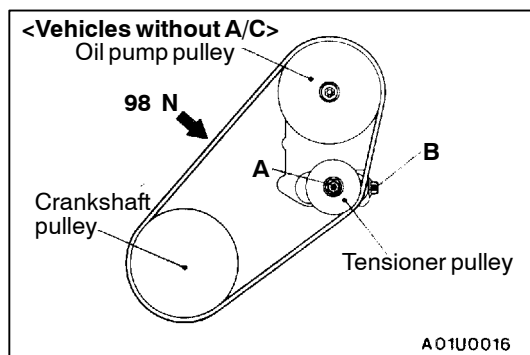
**Tightening torque: 49 Nm**

5. Tighten the lock bolt.

**Tightening torque: 22 Nm**

6. Tighten the adjusting bolt.

**Tightening torque: 5 Nm**



## POWER STEERING OIL PUMP AND AIR CONDITIONER COMPRESSOR DRIVE BELT TENSION CHECK AND ADJUSTMENT

1. Check if the belt tension is within the standard value using one of the methods below.

### Standard value:

Items	When checked	When a used belt is installed	When a new belt is installed
Vibration frequency Hz	108 – 132	114 – 126	137 – 157
Tension N	392 – 588	441 – 539	637 – 834
Deflection (Reference value) mm	11.7 – 15.3	12.5 – 14.3	8.8 – 11.0

### <When measuring the vibration frequency>

With your finger tip lightly tap the centre of the belt between the pulleys in the location shown by the arrow in the illustration and then measure the belt vibration frequency.

### NOTE

Refer to P.11D-6 for information regarding the vibration frequency measurement method using MUT-II.

### <When measuring the tension>

Use a belt tension gauge to measure the belt tension.

### <When measuring the deflection>

Apply 98 N of pressure against the location between the pulleys shown by the arrow in the illustration and then measure the deflection.

2. If the tension or deflection is outside the standard value, adjust by the following procedure.

- (1) Loosen tensioner pulley fixing nut A.
- (2) Adjust the amount of belt deflection using adjusting bolt B.
- (3) Tighten fixing nut A.

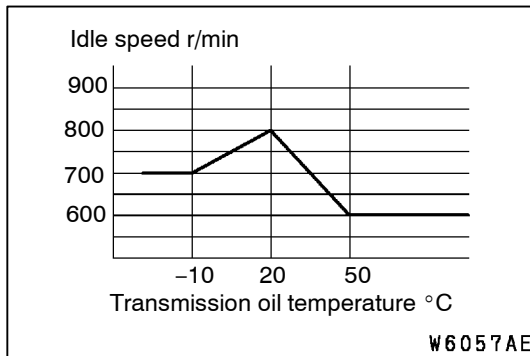
### Tightening torque: 25 Nm

- (4) Check the belt deflection amount and tension, and readjust if necessary.

### Caution

**Check after turning the crankshaft once or more clockwise (right turn).**





## IGNITION TIMING CHECK

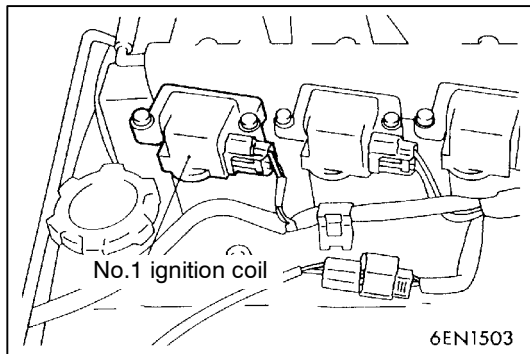
1. Before inspection, set the vehicle to the pre-inspection condition.

For vehicles with manual transmission, drive the vehicle for 15 minutes or more to warm the engine, and then carry out the checking while the transmission oil temperature is more than 50°C.

### NOTE

The idle speed in vehicles with manual transmission varies as shown in the illustration in accordance with the transmission oil temperature.

2. Turn off the ignition switch and then connect the MUT-II to the diagnosis connector.



3. Set the timing light to the power supply line (terminal No.1) of the ignition coil No.1.

### NOTE

The power supply line is looped and also longer than the other ones.

4. Start the engine and let it run at idle.
5. Use the MUT-II to measure engine idle speed and check that it is within the standard value.

### Standard value:

Items	Idle speed r/min
M/T	600 ± 100 (700 ± 100)*
A/T	650 ± 100 (700 ± 100)*

### NOTE

\*: Indicates the values when more than 4 minutes have passed since the idling condition was started.

6. Select No.17 of the MUT-II Actuator test.

### NOTE

At this time, the engine speed will become approximately 700 r/min.

7. Check that basic ignition timing is within the standard value.

### Standard value: 5° BTDC ± 3°

8. If the basic ignition timing is outside the standard value, inspect the GDI system while referring to GROUP 13I – Troubleshooting.

9. Press the MUT-II clear key (Select a forced driving cancel mode) to release the Actuator test.

**Caution**

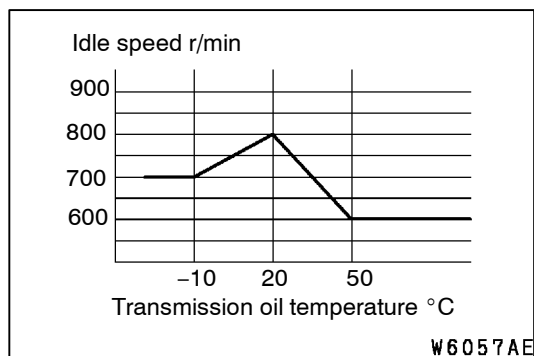
**If the test is not cancelled, a forced driving will continue for 27 minutes. Driving under this condition may damage the engine.**

10. Check that ignition timing is at the standard value.

**Standard value: approx. 20° BTDC**

**NOTE**

- (1) The ignition timing will become approximately 5° BTDC after more than 4 minutes have passed since the basic ignition timing set mode was released.
  - (2) The ignition timing may fluctuate within  $\pm 7^\circ$  BTDC. This is normal.
  - (3) In higher altitude, the ignition timing is more advanced than the standard value by approximately 5 degree.
11. Remove the timing light.
  12. Turn off the ignition switch and then remove the MUT-II.



## IDLE SPEED CHECK

1. Before inspection, set the vehicle to the pre-inspection condition.  
For vehicles with manual transmission, drive the vehicle for 15 minutes or more to warm the engine, and then carry out the checking while the transmission oil temperature is more than 50°C.

**NOTE**

The idle speed in vehicles with manual transmission varies as shown in the illustration in accordance with the transmission oil temperature.

2. Turn off the ignition switch and then connect the MUT-II to the diagnosis connector.
3. Check the basic ignition timing.

**NOTE**

Refer to P.11D-9 concerning the check procedure of the basic ignition timing.

**Standard value: 5° BTDC  $\pm$  3°**

4. Run the engine at idle for 2 minutes.

5. Check the idle speed. Select item No. 22 and take a reading of the idle speed.

**Standard value:**

Items	Idle speed r/min
M/T	600 ± 100 (700 ± 100)*
A/T	650 ± 100 (700 ± 100)*

**NOTE**

- (1) \*: Indicates the values when more than 4 minutes have passed since the idling condition was started.
  - (2) The idle speed is controlled automatically by the idle speed control system.
6. If the idle speed is outside the standard value, inspect the GDI components by referring to GROUP 13I – Troubleshooting.

**IDLE MIXTURE CHECK**

1. Before inspection, set the vehicle to the pre-inspection condition.
2. Connect the MUT-II to the diagnosis connector.
3. Check that the basic ignition timing is within the standard value.

**NOTE**

Refer to P.11D-10 concerning the check procedure of the basic ignition timing.

**Standard value: 5° BTDC ± 3°**

4. Run the engine at 2,500 r/min for 2 minutes.
5. Set the CO, HC tester.
6. Check the CO contents and the HC contents at idle.

**NOTE**

This measurement should be performed in less than approximately 4 minutes since the engine speed become the idle speed.

**Standard value**

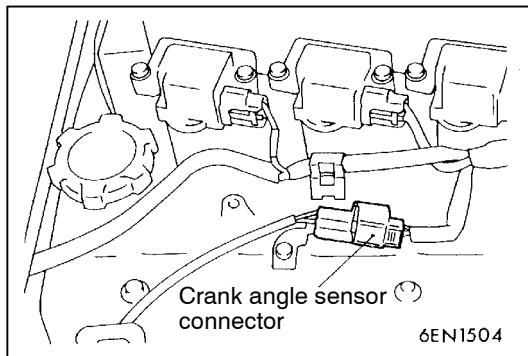
**CO contents: 0.5% or less**

**HC contents: 100 ppm or less**

7. If there is a deviation from the standard value, check the following items:
  - Diagnosis output
  - Fuel pressure
  - Injector
  - Ignition coil, spark plug
  - EGR control system
  - Evaporative emission control system
  - Compression pressure

**NOTE**

Replace the three way catalyst when the CO and HC contents are not within the standard value, even though the result of the inspection is normal on all items.



## COMPRESSION PRESSURE CHECK

1. Before inspection, check that the engine oil, starter and battery are normal. In addition, set the vehicle to the pre-inspection condition.
2. Remove all of the ignition coils and spark plugs.
3. Disconnect the crank angle sensor connector.

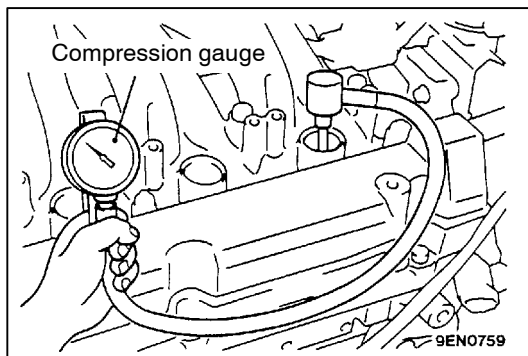
### NOTE

Doing this will prevent the engine-ECU from carrying out ignition and fuel injection.

4. Cover the spark plug hole with a shop towel etc., and after the engine has been cranked, check that no foreign material is adhering to the shop towel.

### Caution

- (1) **Keep away from the spark plug hole when cranking.**
- (2) **If compression is measured with water, oil, fuel, etc., that has come from cracks inside the cylinder, these materials will become heated and will gush out from the spark plug hole, which is dangerous.**



5. Set compression gauge to one of the spark plug holes.
6. Crank the engine with the throttle valve fully open and measure the compression pressure.

**Standard value (at engine speed of 300 r/min):**  
**1,570 kPa**

**Limit (at engine speed of 300 r/min):**  
**Min. 1,210 kPa**

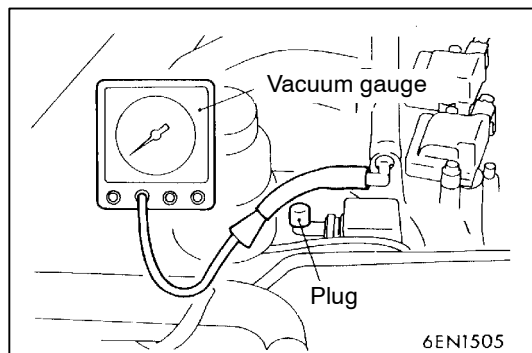
7. Measure the compression pressure for all the cylinders, and check that the pressure differences of the cylinders are below the limit.

**Limit: Max. 100 kPa**

8. If there is a cylinder with compression or a compression difference that is outside the limit, pour a small amount of engine oil through the spark plug hole, and repeat the operations in steps 6 and 7.
  - (1) If the compression increases after oil is added, the cause of the malfunction is a worn or damaged piston ring and/or cylinder inner surface.
  - (2) If the compression does not rise after oil is added, the cause is a burnt or defective valve seat, or pressure is leaking from the gasket.
9. Connect the crank angle sensor connector.
10. Install the spark plugs and ignition coils.
11. Use the MUT-II to erase the diagnosis codes.

### NOTE

This will erase the diagnosis code resulting from the crank angle sensor connector being disconnected.



## MANIFOLD VACUUM CHECK

1. Before inspection, set the vehicle to the pre-inspection condition.
2. Disconnect the ventilation hose from the positive crankcase ventilation (PCV) valve, and then connect a vacuum gauge to the ventilation hose.
3. Check the intake manifold vacuum while the engine is idling.

**Limit: Min. 56 kPa**

## LASH ADJUSTER CHECK

If an abnormal noise (knocking) that seems to be coming from the lash adjuster is heard after starting the engine and does not stop, carry out the following check.

### NOTE

- (1) The abnormal noise which is caused by a problem with the lash adjusters is generated after the engine is started, and will vary according to the engine speed. However, this noise is not related to the actual engine load.

Because of this, if the noise does not occur immediately after the engine is started, if it does not change in accordance with the engine speed, or if it changes in accordance with the engine load, the source of the noise is not the lash adjusters.

- (2) If there is a problem with the lash adjusters, the noise will almost never disappear, even if the engine has been run at idle to let it warm up.

The only case where the noise might disappear is if the oil in the engine has not been looked after properly and oil sludge has caused the lash adjusters to stick.

1. Start the engine.
2. Check that the noise occurs immediately after the engine is started, and that the noise changes in accordance with changes in the engine speed.

If the noise does not occur immediately after the engine is started, or if it does not change in accordance with the engine speed, the problem is not being caused by the lash adjusters, so check for some other cause of the problem. Moreover, if the noise does not change in accordance with the engine speed, the cause of the problem is probably not with the engine. (In these cases, the lash adjusters are normal.)

3. While the engine is idling, check that the noise level does not change when the engine load is varied (for example, by shifting from N → D).

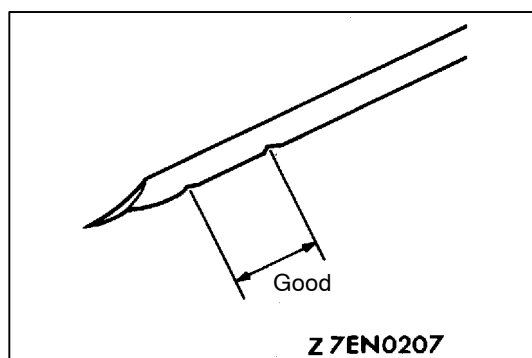
If the noise level changes, the cause of the noise is probably parts striking because of worn crankshaft bearings or connecting rod bearings. (In such cases, the lash adjusters are normal.)

4. After the engine has warmed up, run it at idle and check if any noise can be heard.  
If the noise has become smaller or disappeared, oil sludge could make the lash adjusters stick. Clean the lash adjusters. (Refer to the Engine Workshop Manual.) If not improved, go to step 5.
5. Bleed air from the lash adjusters.
6. If the noise has not disappeared even after the air bleeding, clean the lash adjusters. (Refer to the Engine Workshop Manual.)

#### <LASH ADJUSTER AIR BLEEDING>

##### NOTE

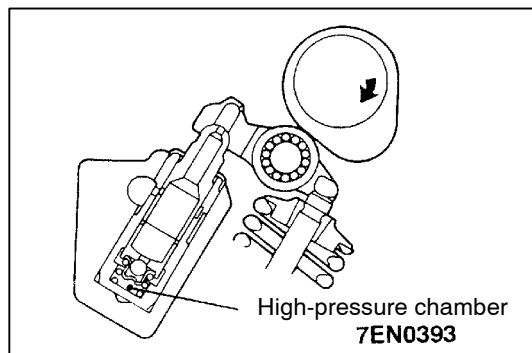
- (1) If the vehicle is parked on a slope for a long period of time, the amount of oil inside the lash adjuster will decrease, and air may get into the high pressure chamber when starting the engine.
- (2) After parking the vehicle for long periods, the oil drains out of the oil passage, and it takes time for the oil to be supplied to the lash adjuster, so air can get into the high pressure chamber.
- (3) If either of the above situations occur, the abnormal noise can be eliminated by bleeding the air from inside the lash adjusters.



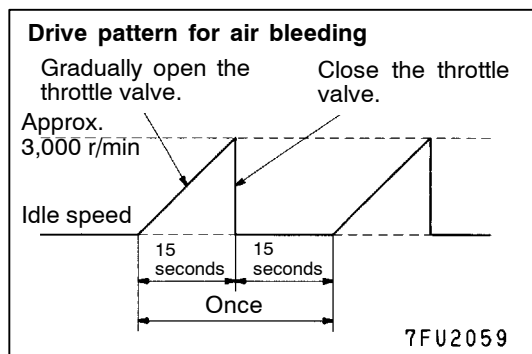
1. Check the engine oil and replenish or replace the oil if necessary.

##### NOTE

- (1) If there is a only small amount of oil, air will be drawn in through the oil screen and will get into the oil passage.
- (2) If the amount of oil is greater than normal, then the oil will being mixed by the crankshaft and a large amount of air may get mixed into the oil.
- (3) If the oil is degenerated, air and oil will not separate easily in oil, and the amount of air mixed into the oil will increase.



- (4) If the air which has been mixed in with the oil due to any of the above reasons gets into the high pressure chamber of the lash adjuster, the air inside the high pressure chamber will be compressed when the valve is open and the lash adjuster will over-compress, resulting in abnormal noise when the valve closes. This is the same effect as if the valve clearance is adjusted to be too large by mistake. If the air inside the lash adjusters is then released, the operation of the lash adjusters will return to normal.



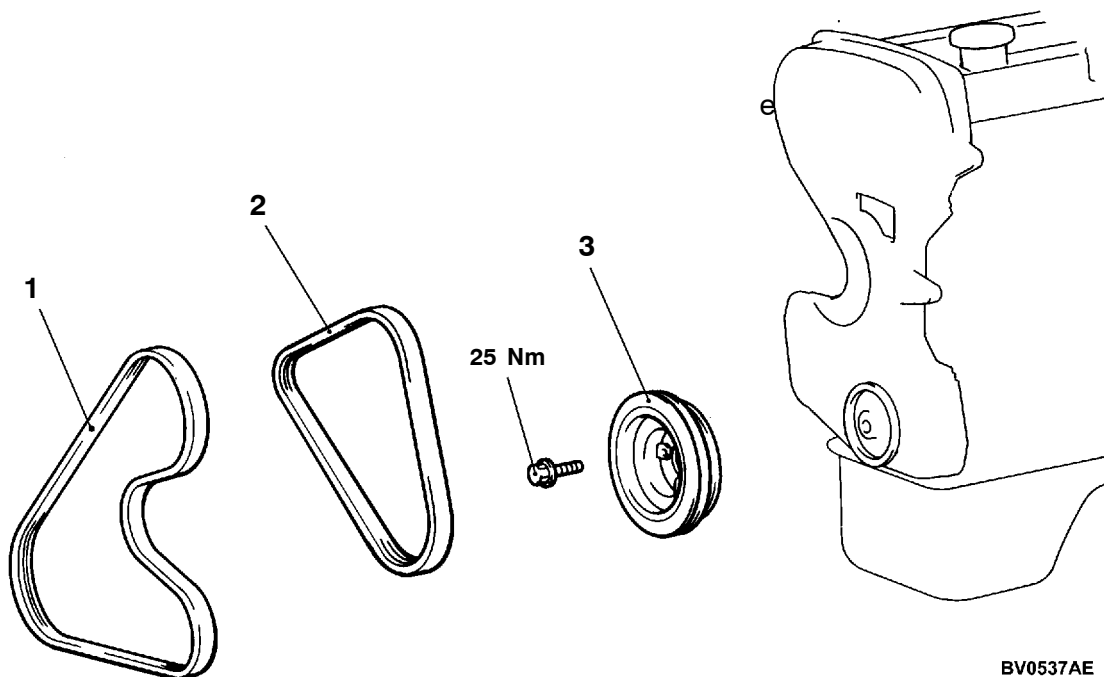
2. Run the engine at idle for 1 – 3 minutes to let it warm up.
3. With no load on the engine, repeat the drive pattern shown in the illustration at left and check if the abnormal noise disappears. (The noise should normally disappear after 10 – 30 repetitions, but if there is no change in the noise level after 30 repetitions or more, the problem is probably not due to air inside the lash adjusters.)
4. After the noise has disappeared, repeat the drive pattern shown in the illustration at left a further 5 times.
5. Run the engine at idle for 1 – 3 minutes and check that the noise has disappeared.

## CRANKSHAFT PULLEY

### REMOVAL AND INSTALLATION

**Pre-removal Operation**  
Under Cover Removal**Post-installation Operation**

- Drive Belt Tension Adjustment (Refer to P.11D-5.)
- Under Cover Installation

**Removal steps**

1. Drive belt (Power steering and A/C)

2. Drive belt (Alternator)
3. Crankshaft pulley



# CAMSHAFT AND CAMSHAFT OIL SEAL

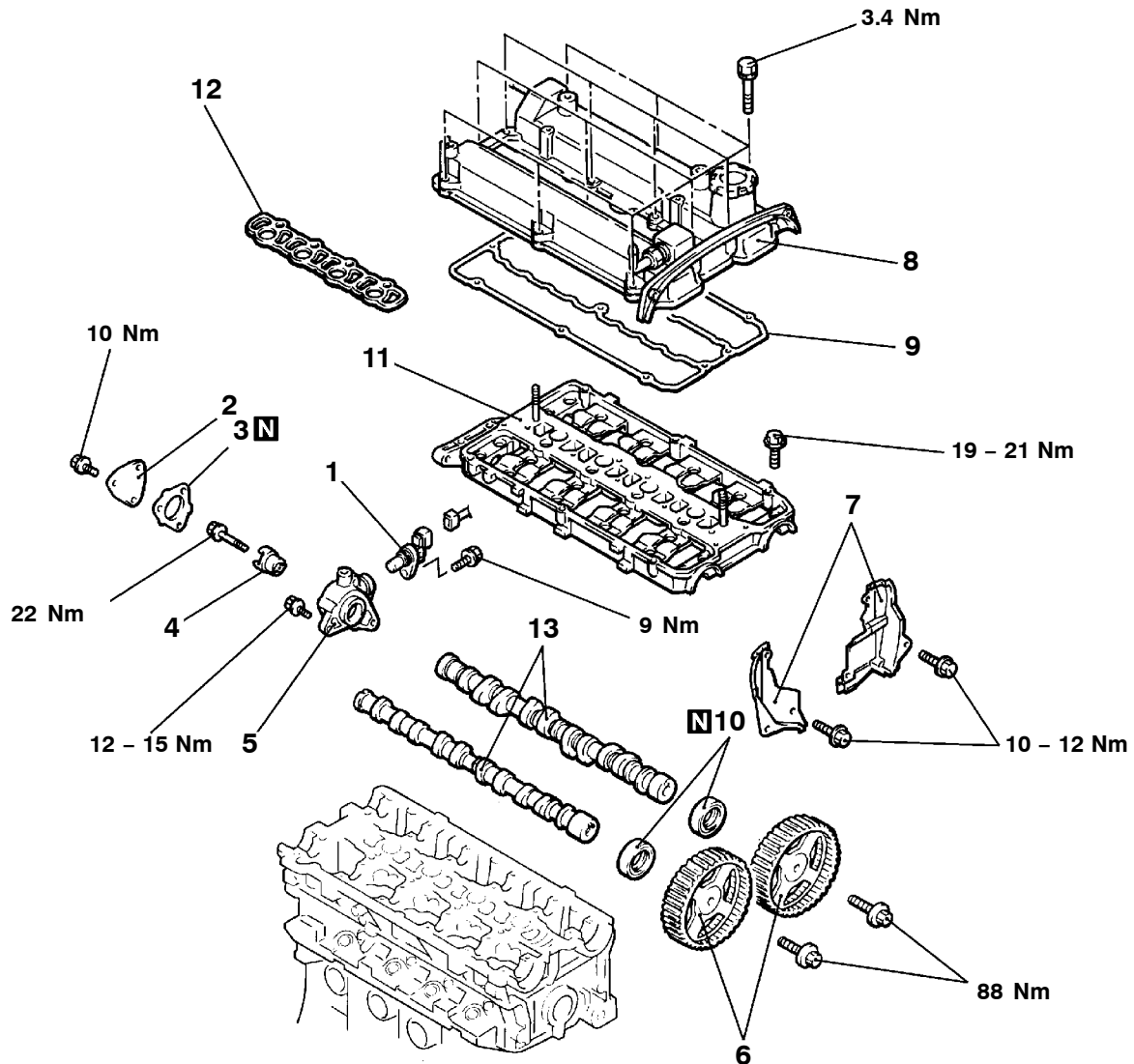
## REMOVAL AND INSTALLATION

### Pre-removal Operation

- Air Intake Hose Assembly Removal
- Timing Belt Removal (Refer to P.11D-29.)
- Engine Coolant Draining
- Intake Manifold Removal (Refer to GROUP 15.)
- Fuel Pump (High Pressure) Removal (Refer to GROUP 13I.)

### Post-installation Operation

- Fuel Pump (High Pressure) Installation (Refer to GROUP 13I.)
- Intake Manifold Installation (Refer to GROUP 15.)
- Timing Belt Installation (Refer to P.11D-29.)
- Air Intake Hose Assembly Installation
- Engine Coolant Supplying
- Drive Belt Tension Adjustment (Refer to P.11D-6.)



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### Removal steps

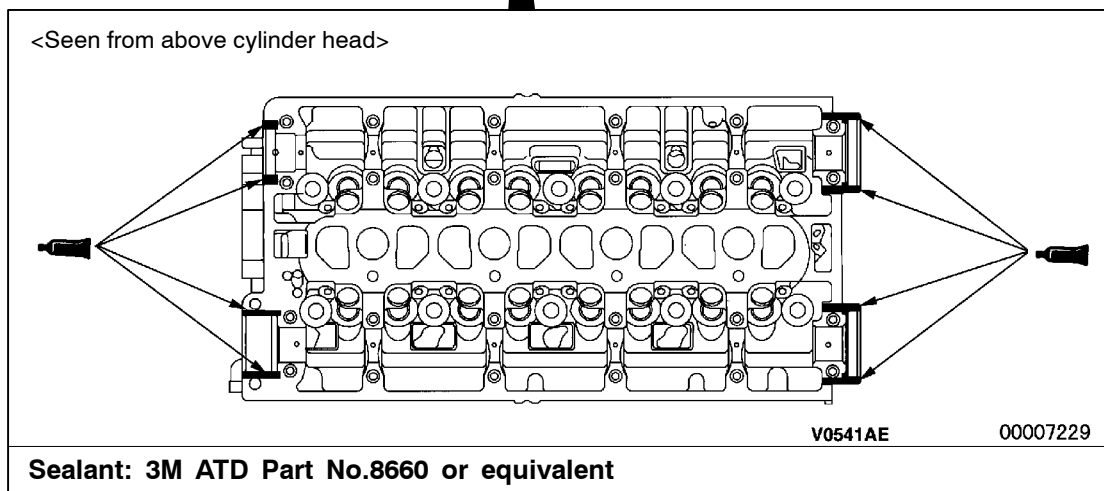
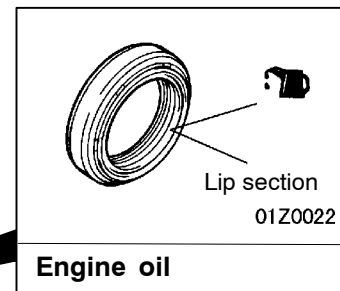
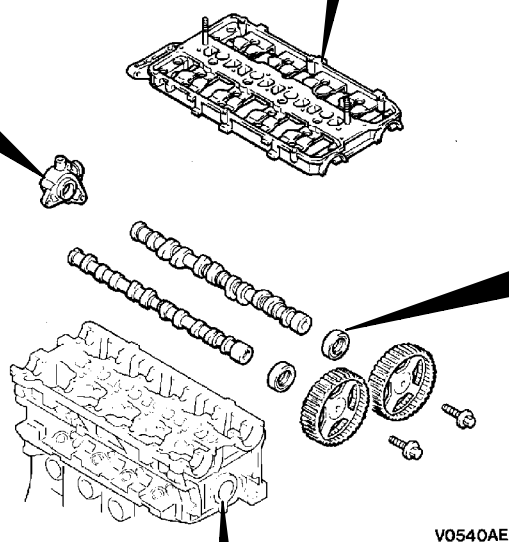
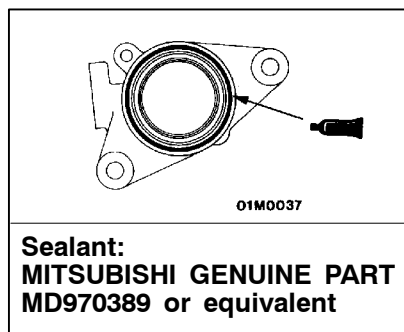
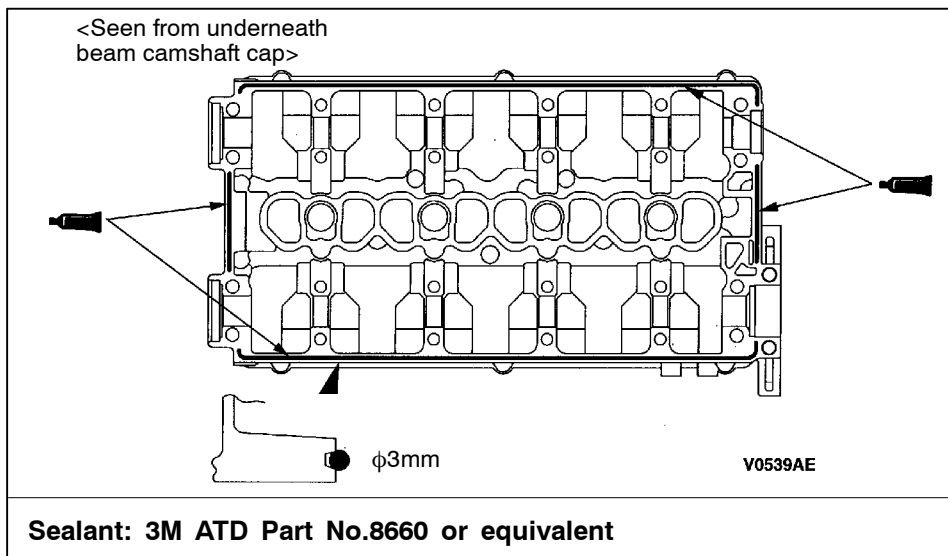
1. Cam position sensor
2. Cover
3. Gasket
4. Camshaft position sensing cylinder
5. Camshaft position sensor support
6. Camshaft sprocket
7. Timing belt rear cover

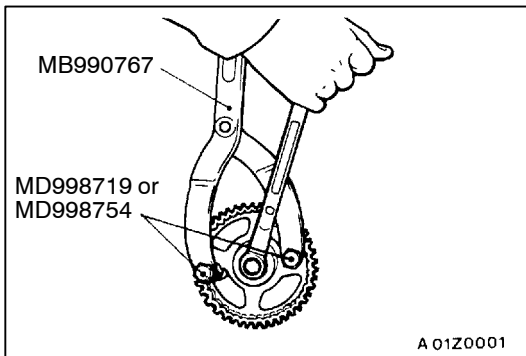
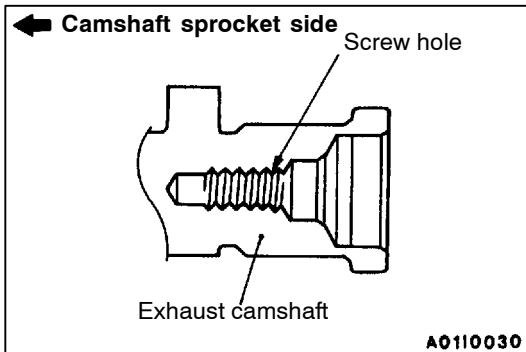
8. Rocker cover
9. Rocker cover gasket
10. Camshaft oil seal
11. Beam camshaft cap
12. Beam camshaft cap gasket
13. Camshaft

◀E▶  
◀A▶ ▶D▶

▶C▶  
▶B▶  
▶A▶

## Lubrication points

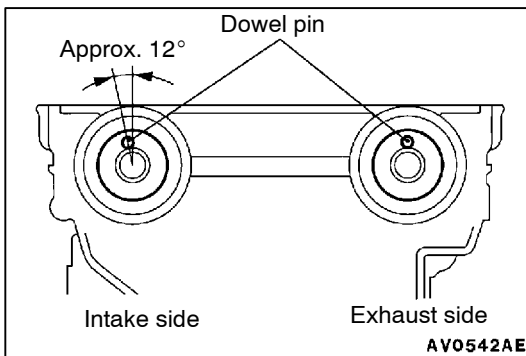


**REMOVAL SERVICE POINTS****◀A▶ CAMSHAFT SPROCKET REMOVAL****INSTALLATION SERVICE POINTS****▶A◀ CAMSHAFT INSTALLATION**

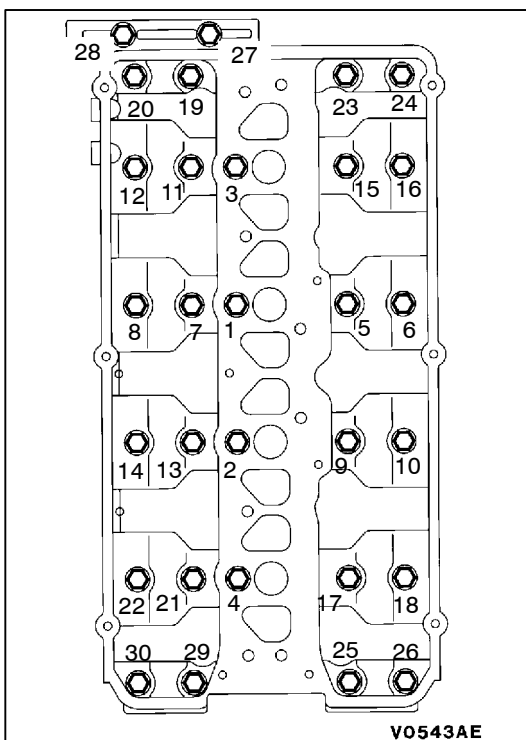
1. Apply engine oil to journals and cams of the camshafts.
2. Install the camshafts on the cylinder head.

**Caution**

Be careful not to confuse the intake camshaft with the exhaust one. There is a screw hole for the cam position sensing cylinder mounting bolt on the exhaust-side camshaft.

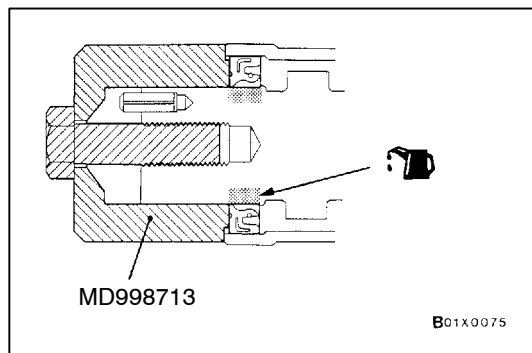
**▶B◀ BEAM CAMSHAFT CAP INSTALLATION**

1. Place the camshaft dowel pin as shown in the illustration.



2. Tighten the beam camshaft cap mounting bolts to the specified torque in the order shown in the illustration.

**Tightening torque: 19 – 21 Nm**

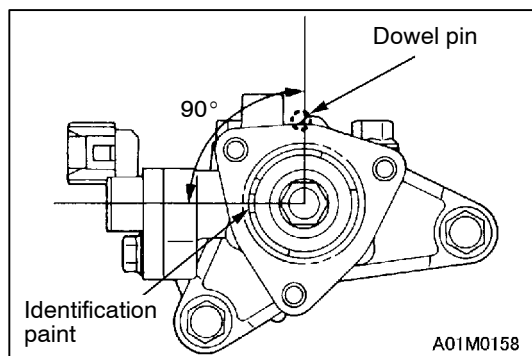
**►C◄ CAMSHAFT OIL SEAL INSTALLATION**

1. Apply engine oil to the entire circumference of the oil seal lip.
2. Press-fit the oil seal as shown in the illustration.

**►D◄ CAMSHAFT SPROCKET INSTALLATION**

Use the special tool to secure the camshaft sprocket in the same way as during removal, and then tighten the bolt to the specified torque.

**Tightening torque: 88 Nm**

**►E◄ CAM POSITION SENSING CYLINDER INSTALLATION**

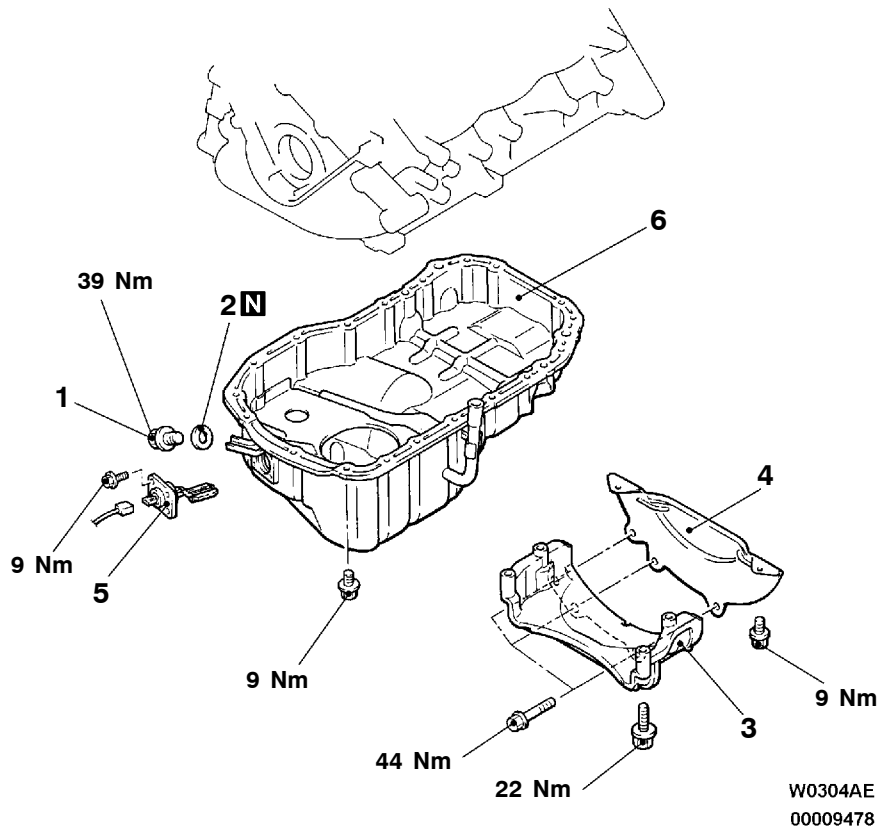
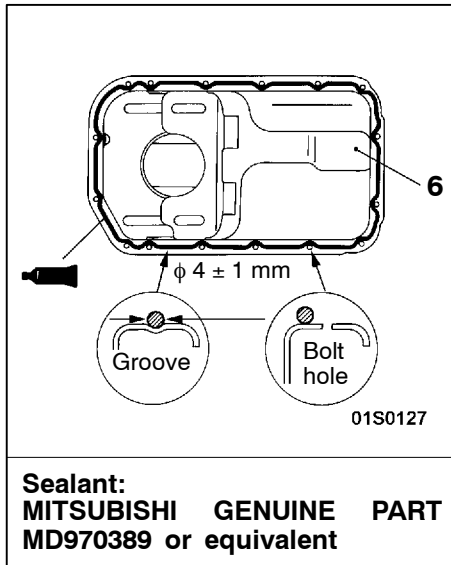
Position the identification paint of cam position sensing cylinder as shown in the illustration.

## OIL PAN

## REMOVAL AND INSTALLATION

**Pre-removal and Post-installation Operation**

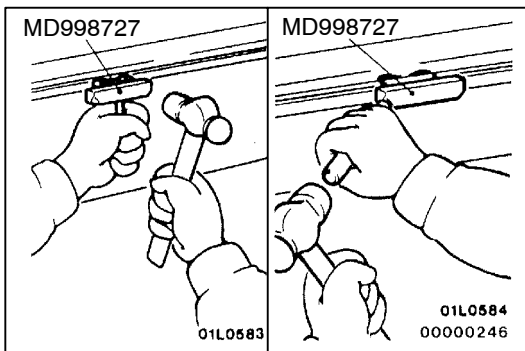
- Under Cover Removal and Installation
- Engine Oil Draining and Supplying (Refer to GROUP 12 – On-vehicle Service.)
- Oil Level Gauge Removal and Installation
- Front Exhaust Pipe Removal and Installation

**Removal steps**

- A◄
1. Drain plug
  2. Drain plug gasket
  3. Transmission stay



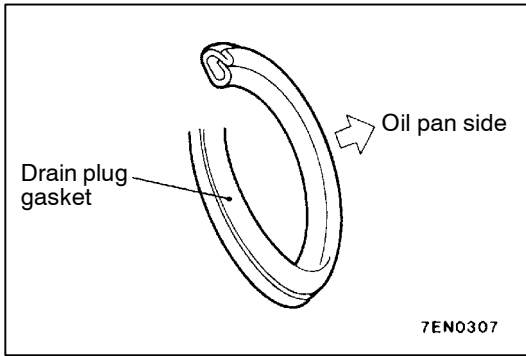
4. Bell housing cover
5. Oil level sensor
6. Oil pan

**REMOVAL SERVICE POINT****◄A► OIL PAN REMOVAL**

After removing the oil pan mounting bolts, remove the oil pan with the special tool and a brass bar.

**Caution**

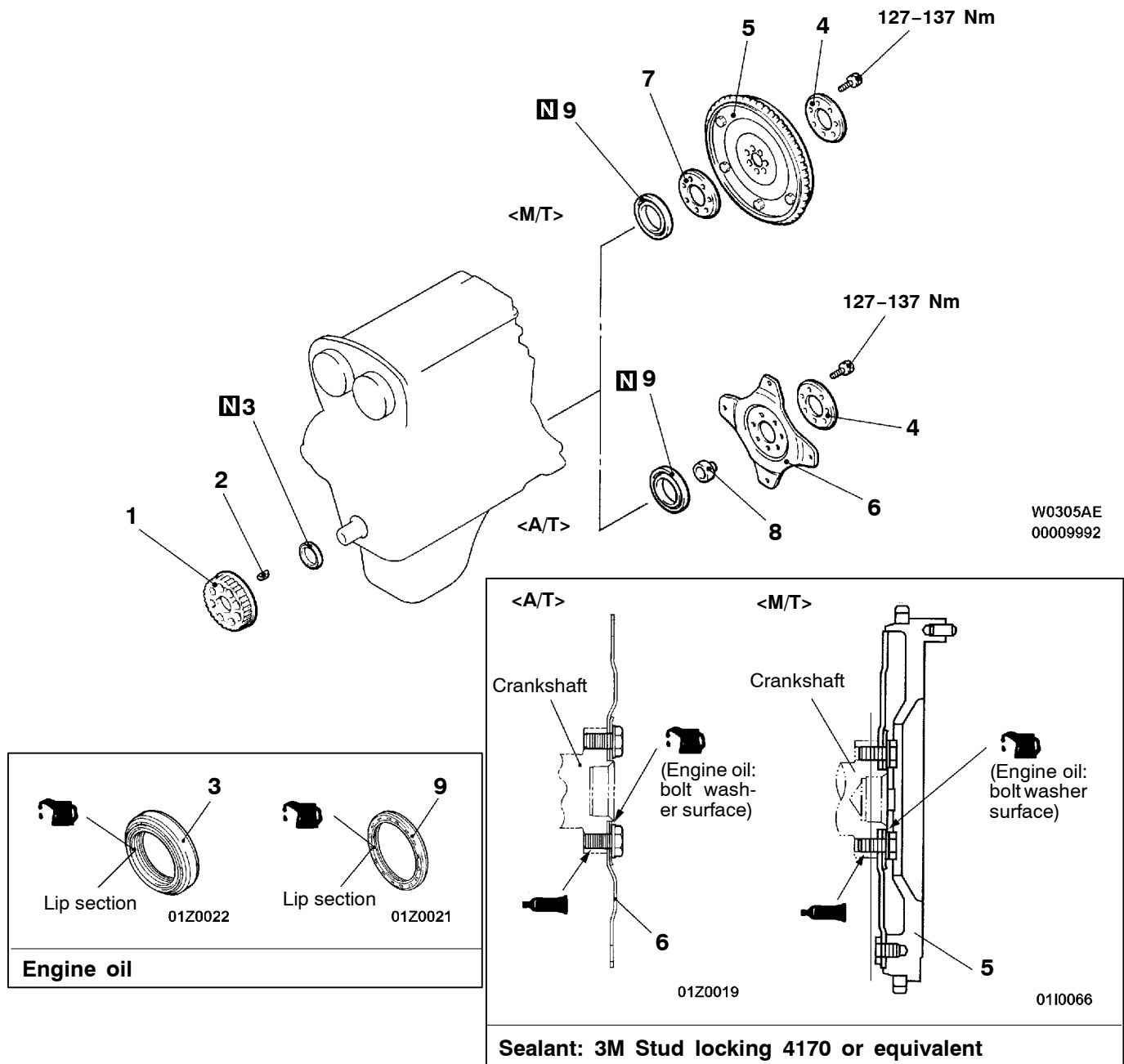
Perform this slowly to avoid deformation of the oil pan flange.

**INSTALLATION SERVICE POINT****►A◄ DRAIN PLUG GASKET INSTALLATION**

Install the drain plug gasket in the direction so that it faces as shown in the illustration.

# CRANKSHAFT OIL SEAL

## REMOVAL AND INSTALLATION



### Crankshaft front oil seal removal steps

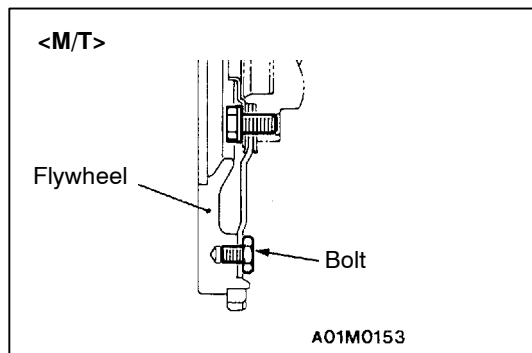
- Timing belt (Refer to P.11D-29.)
- 1. Crankshaft sprocket B
- 2. Key
- 3. Crankshaft front oil seal



### Crankshaft rear oil seal removal steps

- Transmission assembly
- Clutch cover and disc <M/T>
- 4. Adapter plate
- 5. Flywheel <M/T>
- 6. Drive plate <A/T>
- 7. Adapter plate <M/T>
- 8. Crankshaft bushing <A/T>
- 9. Crankshaft rear oil seal



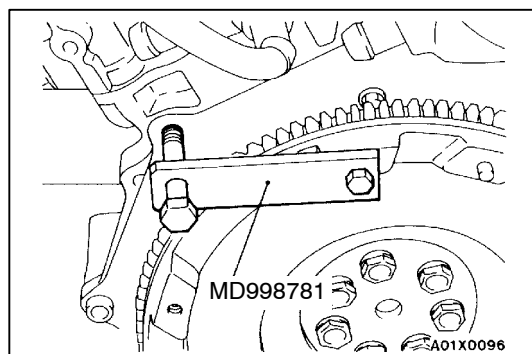


## REMOVAL SERVICE POINTS

### ◀A▶ TRANSMISSION ASSEMBLY REMOVAL

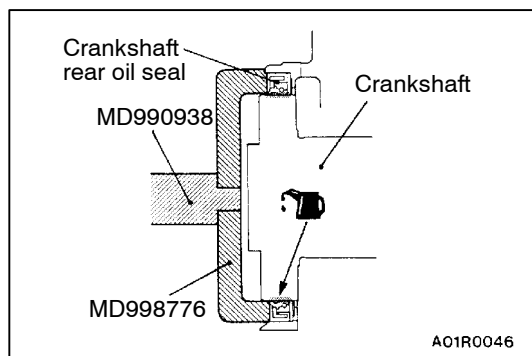
#### Caution

For vehicles with manual transmission, do not remove the flywheel mounting bolt shown by the arrow. If this bolt is removed, the flywheel will become out of balance and damaged.



### ◀B▶ ADAPTER PLATE/FLYWHEEL <M/T>/DRIVE PLATE <A/T> REMOVAL

Use the special tool to secure the flywheel or drive plate, and remove the bolts.



## INSTALLATION SERVICE POINTS

### ▶A◀ CRANKSHAFT REAR OIL SEAL INSTALLATION

1. Apply a small amount of engine oil to the entire circumference of the oil seal lip.
2. Install the oil seal by tapping it as far as the chamfered position of the oil seal case as shown in the illustration.

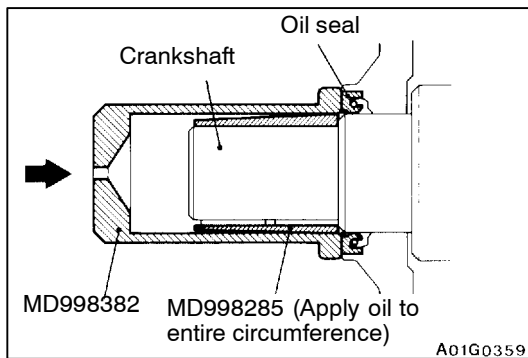


**►B◄ DRIVE PLATE <A/T>/FLYWHEEL <M/T>/ADAPTER PLATE INSTALLATION**

1. Clean off all sealant, oil and other substances which are adhering to the threaded bolts, crankshaft thread holes and the flywheel or drive plate.
2. Apply oil to the bearing surface of the flywheel or drive plate bolts.
3. Apply oil to the crankshaft thread holes.
4. Apply sealant to the threaded mounting holes.

**Specified sealant: 3M Stud locking 4170 or equivalent**

5. Use the special tool to hold the flywheel or drive plate in the same manner as removal, and install the bolt.

**►C◄ CRANKSHAFT FRONT OIL SEAL INSTALLATION**

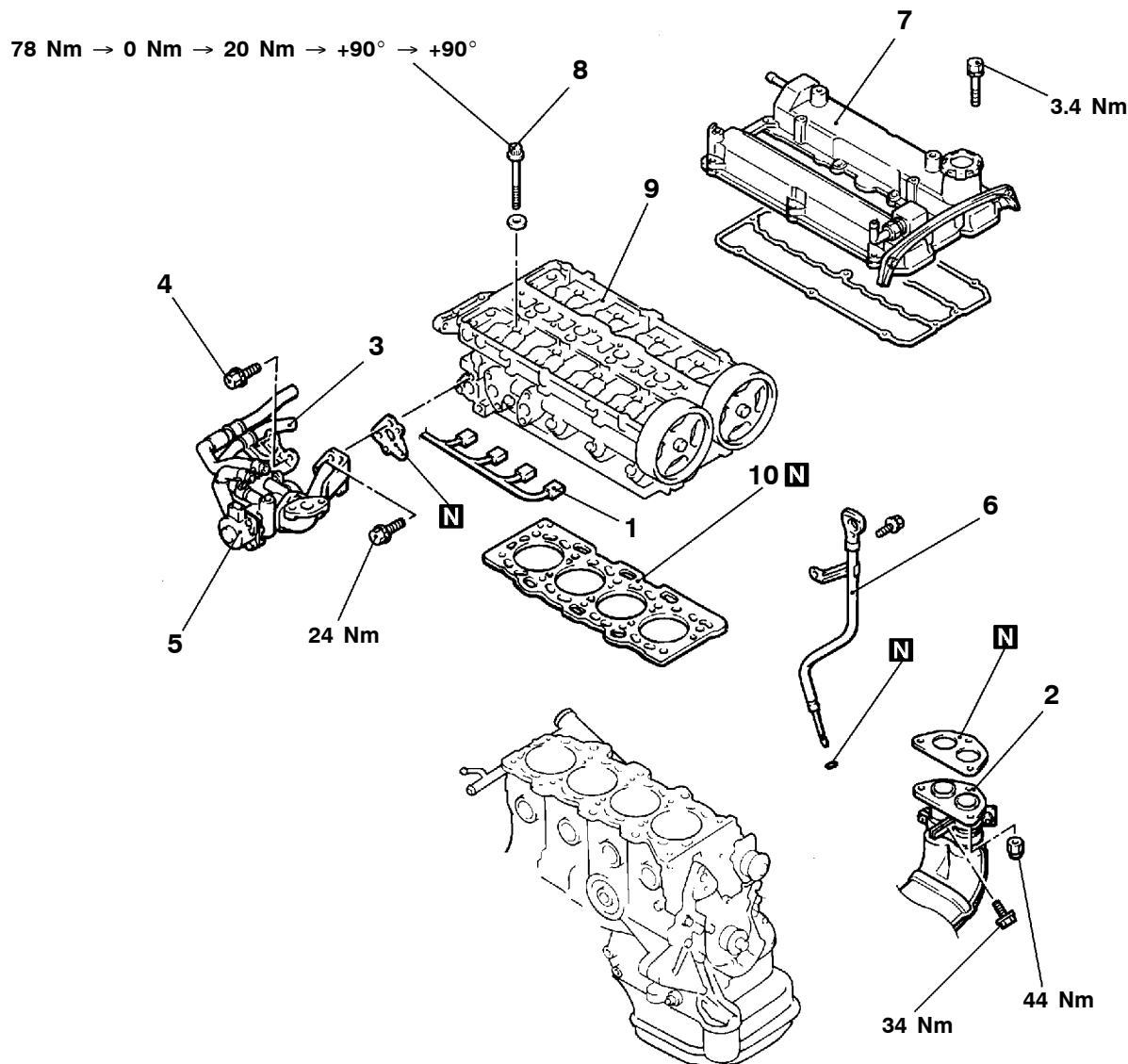
1. Apply a small amount of engine oil to the entire circumference of the oil seal lip.
2. Use the special tool to press-fit the oil seal unit it is flush with the oil seal case.

## CYLINDER HEAD GASKET

## REMOVAL AND INSTALLATION

**Pre-removal and Post-installation Operation**

- Fuel Discharge Prevention (Refer to GROUP 13I – On-vehicle Service.) <Pre-removal only>
- Engine Coolant Draining and Supplying (Refer to GROUP 14 – On-vehicle Service.)
- Engine Oil Draining and Supplying (Refer to GROUP 12 – On-vehicle Service.)
- Intake Manifold Removal and Installation (Refer to GROUP 15.)
- Fuel Pressure Regulator (High Pressure) and Fuel Pump (High Pressure) Removal and Installation (Refer to GROUP 13I.)
- Thermostat Case Assembly Removal and Installation (Refer to GROUP 14 – Water Hose and Pipe.)
- Timing Belt Removal and Installation (Refer to P.11D-29.)

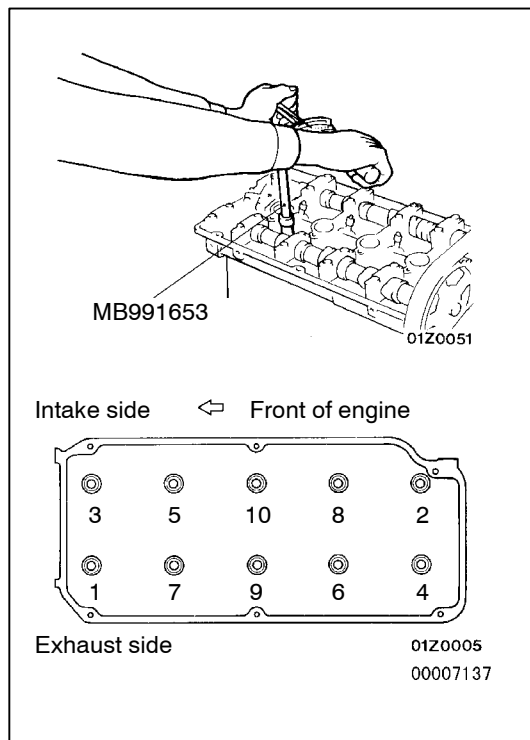


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**Removal steps**

1. Injector harness connector
2. Front exhaust pipe connection
3. Water hose connection
4. Water pipe assembly mounting bolt
5. EGR valve and stay assembly

6. Engine oil level gauge
7. Rocker cover
8. Cylinder head bolt
9. Cylinder head assembly
10. Cylinder head gasket

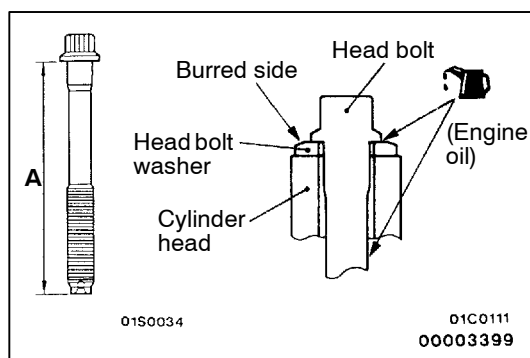
**REMOVAL SERVICE POINT****◀A▶ CYLINDER HEAD BOLT REMOVAL**

Use the special tool to loosen the bolts in two or three steps in the order of the numbers shown in the illustration, and then remove the bolts.

If the washer is caught on valve spring and the bolt is not removed, pull up the bolt slightly and remove the bolt while tilting the washer by using a magnet, etc.

**INSTALLATION SERVICE POINTS****▶A◀ CYLINDER HEAD GASKET INSTALLATION**

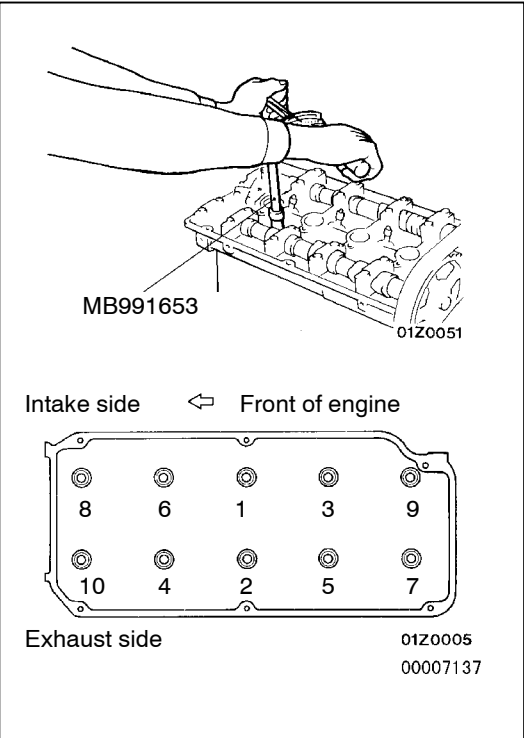
1. Wipe off all oil and grease from the gasket mounting surface.
2. Install so that the shapes of the cylinder head holes match the shapes of the respective cylinder head gasket holes.

**▶B◀ CYLINDER HEAD BOLT INSTALLATION**

1. When installing the cylinder head bolts, the length below the head of the bolts should be within the limit. If it is outside the limit, replace the bolts.

**Limit (A): 99.4 mm**

2. The head bolt washer should be installed with the burled side caused by tapping out facing upwards.
3. Apply a small amount of engine oil to the thread section and the washer of the cylinder head bolt.

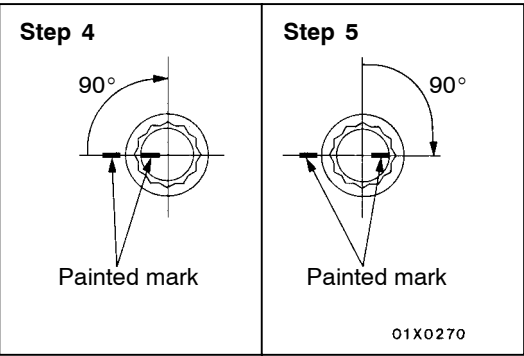


4. Tighten the bolts by the following procedure.

Step	Operation	Remarks
1	Tighten to 78 Nm.	Carry out in the order shown in the illustration.
2	Fully loosen.	Carry out in the reverse order of that shown in the illustration.
3	Tighten to 20 Nm.	Carry out in the order shown in the illustration.
4	Tighten 90° of a turn.	In the order shown in the illustration. Mark the head of the cylinder head bolt and cylinder head by paint.
5	Tighten 90° of a turn.	In the order shown in the illustration. Check that the painted mark of the head bolt is lined up with that of the cylinder head.

**Caution**

1. Always make a tightening angle just 90°. If it is less than 90°, the head bolt will be loosened.
2. If it is more than 90°, remove the head bolt and repeat the procedure from step 1.

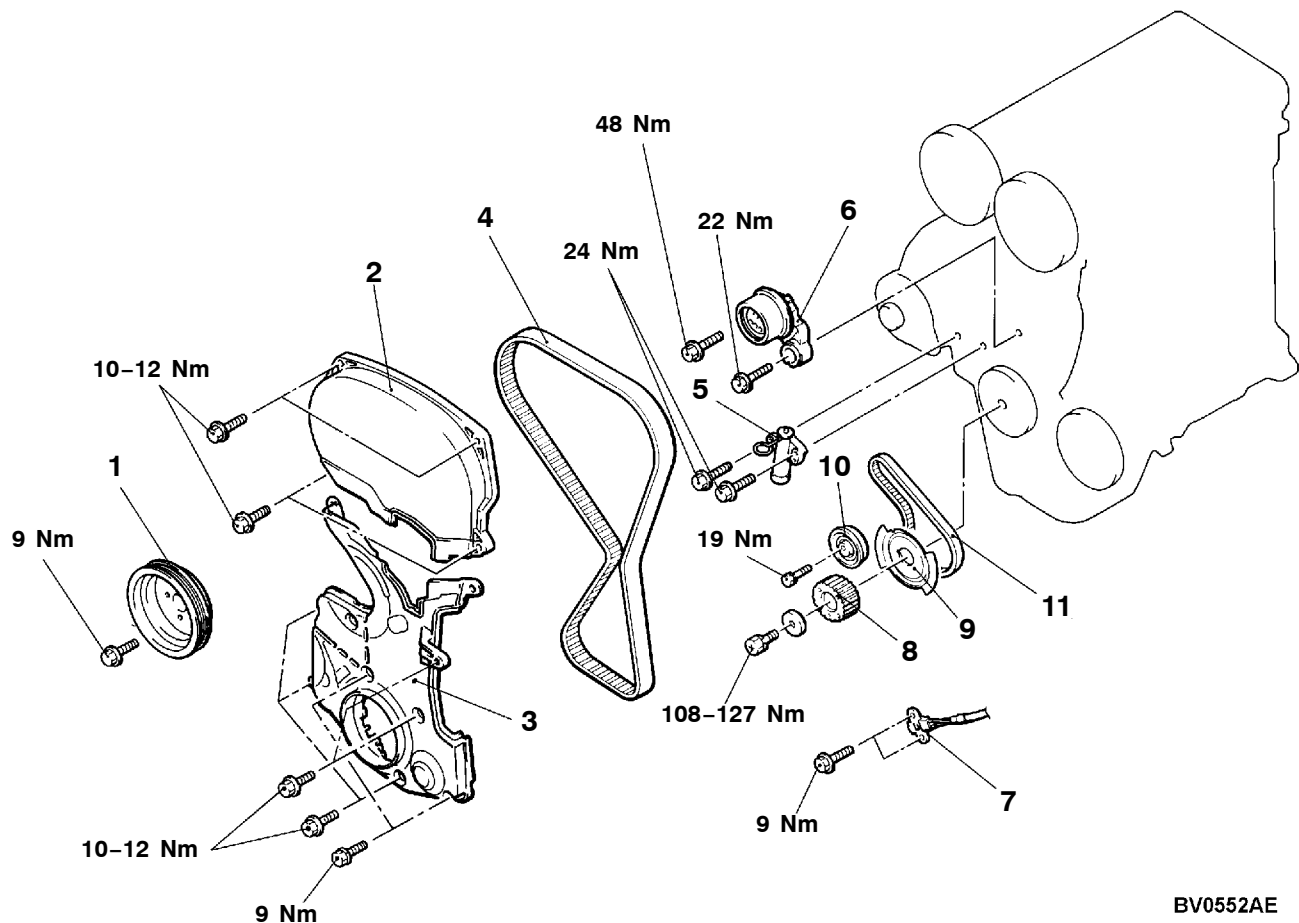


## TIMING BELT AND TIMING BELT B

## REMOVAL AND INSTALLATION

**Pre-removal and Post-installation Operation**

- Engine Cover Removal and Installation
- Under Cover Removal and Installation
- Crankshaft Pulley Removal and Installation (Refer to P.11D-16.)
- Engine Mount Bracket Removal and Installation

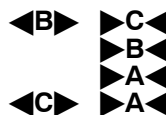


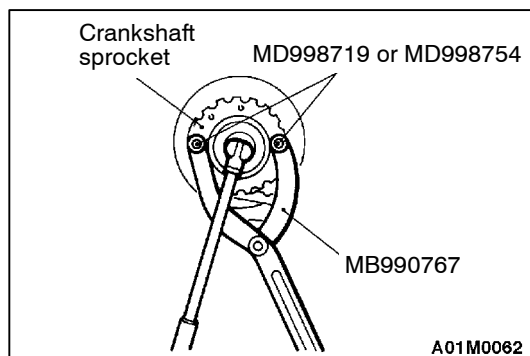
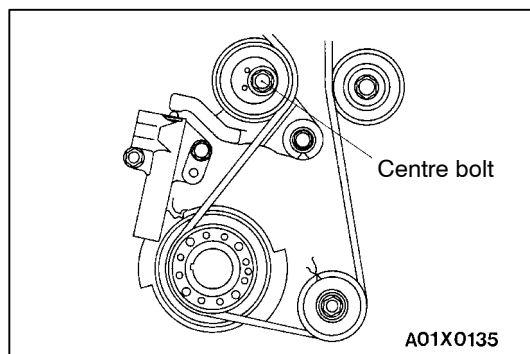
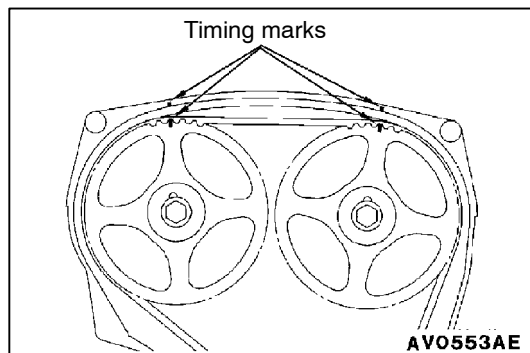
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**Removal steps**

1. Water pump pulley
2. Timing belt front upper cover
3. Timing belt front lower cover
- Timing belt tension adjustment
4. Timing belt
5. Auto tensioner

6. Tensioner pulley assembly
7. Crankshaft position sensor
8. Crankshaft sprocket
9. Crankshaft sensing blade
10. Timing belt B tensioner
11. Timing belt B





## REMOVAL SERVICE POINT

### ◀A▶ TIMING BELT REMOVAL

1. Turn the crankshaft clockwise (right turn) to align each timing mark and to set the No. 1 cylinder at compression top dead centre.

#### Caution

The crankshaft should always be turned only clockwise.

2. Loosen the tension pulley centre bolt.
3. Move the tension pulley to the water pump side, and then remove the timing belt.

#### Caution

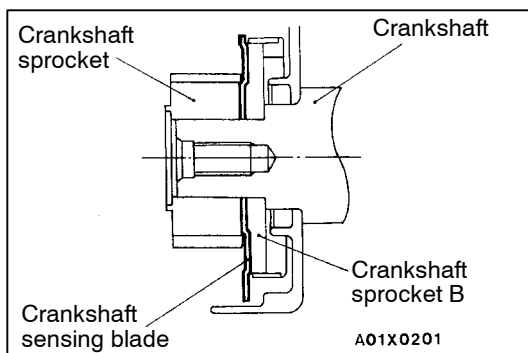
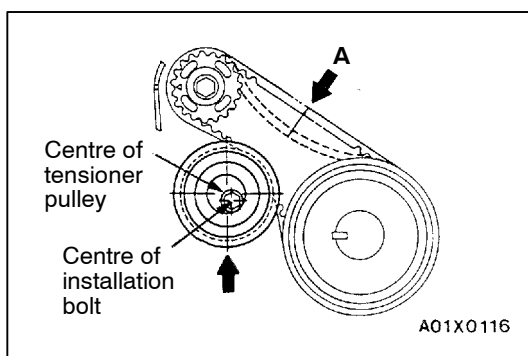
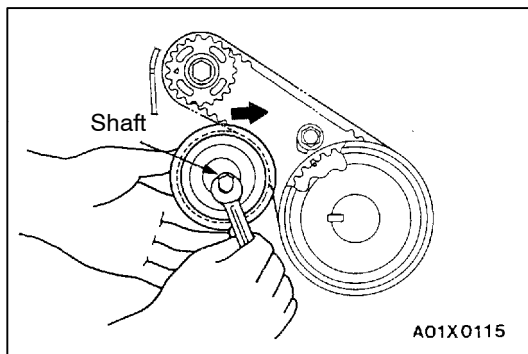
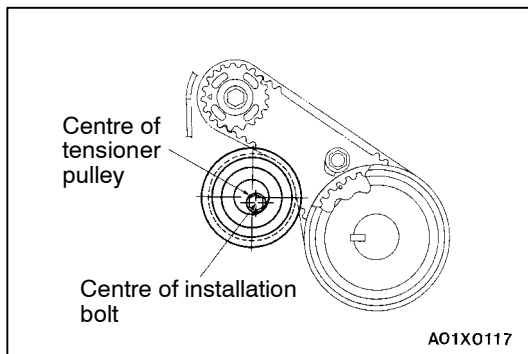
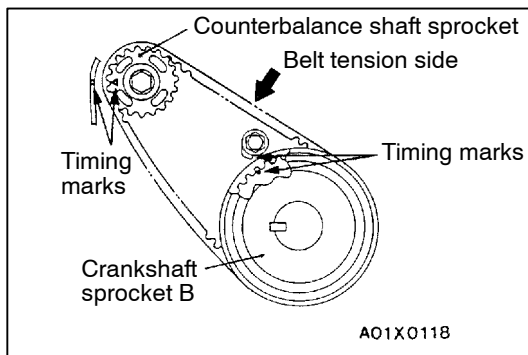
If the timing belt is to be re-used, use chalk to mark (on its flat side) an arrow indicating the clockwise direction.

### ◀B▶ CRANKSHAFT SPROCKET REMOVAL

### ◀C▶ TIMING BELT B REMOVAL

#### Caution

If timing belt B is to be re-used, use chalk to mark it with an arrow on its flat side indicating the turning direction (to the right).



## INSTALLATION SERVICE POINTS

### ►A◀ TIMING BELT B/TIMING BELT B TENSIONER INSTALLATION

1. Install timing belt B by the following procedure.
  - (1) Ensure that crankshaft sprocket B timing mark and the counterbalance shaft sprocket timing mark are aligned.
  - (2) Fit timing belt B over crankshaft sprocket B and the counterbalance shaft sprocket. Ensure that there is no slack in the belt.
2. Adjust the tension of timing belt B by the following procedure.
  - (1) Temporarily fix the timing belt B tensioner such that the centre of the tensioner pulley is to the left and above the centre of the installation bolt, and temporarily attach the tensioner pulley so that the flange is toward the front of the engine.
  - (2) Holding the timing belt B tensioner up with your finger in the direction of the arrow, place pressure on the timing belt so that the tension side of the belt is taut. Now tighten the bolt to fix the tensioner.

#### Caution

When tightening the bolt, ensure that the tensioner pulley shaft does not rotate with the bolt. Allowing it to rotate with the bolt can cause excessive tension on the belt.

3. To ensure that the tension is correct, depress the belt (point A) with a finger. If not, adjust.

Standard value: 5 – 7 mm

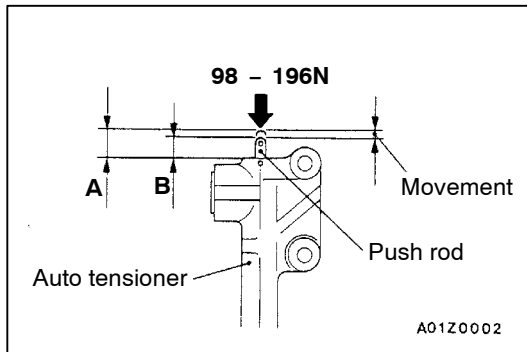
### ►B◀ CRANKSHAFT SENSING BLADE INSTALLATION

Confirm the installation direction of crankshaft sensing blade and install it as shown in the illustration.

### ►C◄ CRANKSHAFT SPROCKET INSTALLATION

1. Apply the minimum amount of engine oil to the seat surface and thread of the crankshaft bolt.
2. Hold the crankshaft sprocket as same as for removal, and then tighten the bolt to the specified torque.

**Tightening torque: 108 – 127 Nm**



### ►D◄ AUTO TENSIONER INSTALLATION

1. Apply 98 – 196 N force to the auto tensioner by pressing it against a metal (cylinder block, etc.), and measure the movement of the push rod.

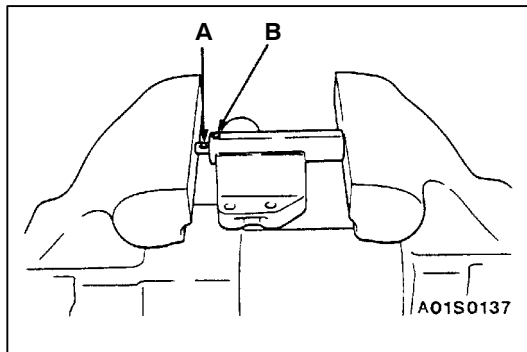
**Standard value: Within 1 mm**

**A: Length when it is free (not pressed)**

**B: Length when it is pressed**

**A – B: Movement**

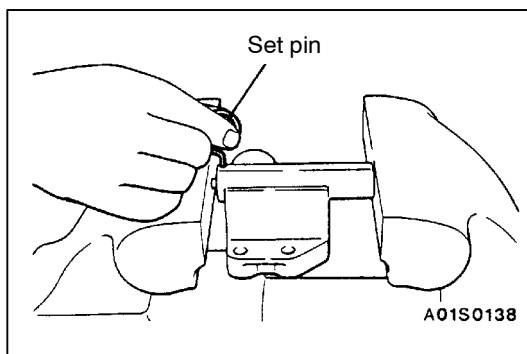
2. If it is out of the standard value, replace the auto tensioner.



3. Use a press or vice to gently compress the auto tensioner push rod until pin hole A of the push rod and pin hole B of the tensioner cylinder are aligned.

#### **Caution**

**If the compression speed is too fast, the rod may become damaged, so be sure to carry out this operation slowly.**



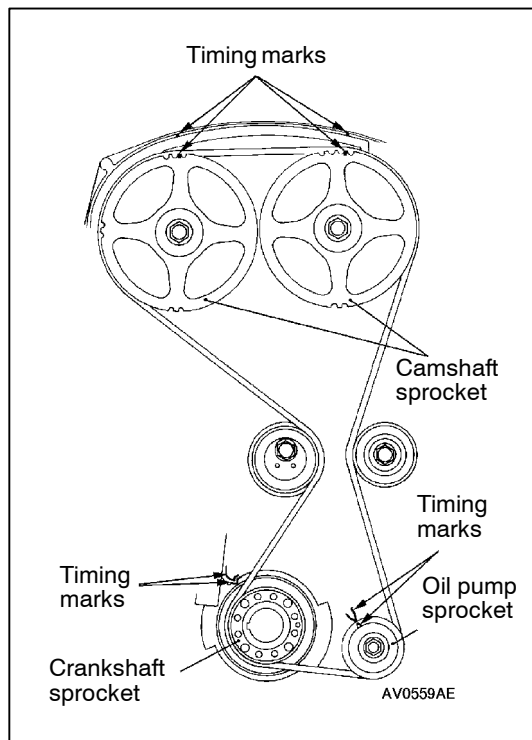
4. Once the holes are aligned, insert the set pin.

#### **NOTE**

When replacing the auto tensioner with a new part, the pin will be in the auto tensioner.

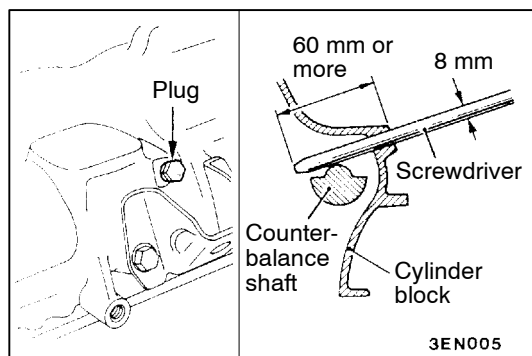
5. Install the auto tensioner to the engine.



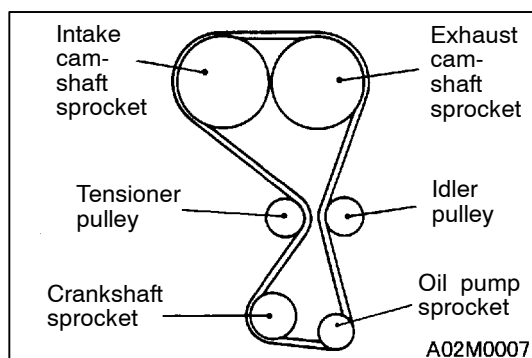


### ►E◄ TIMING BELT INSTALLATION

1. Align the timing marks on the camshaft sprocket, crankshaft sprocket and oil pump sprocket.

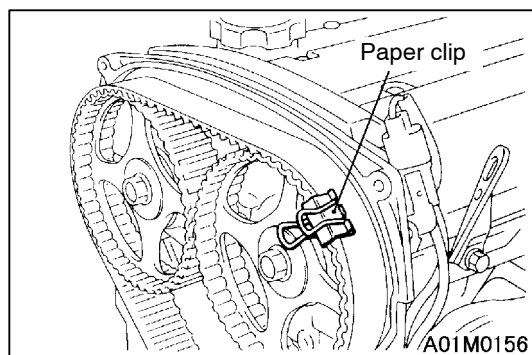


2. After aligning the timing mark on the oil pump sprocket, remove the cylinder block plug and insert a Phillips screwdriver with a diameter of 8 mm, and check to be sure that the screwdriver goes in 60 mm or more. If the screwdriver will only go in 20 – 25 mm before striking the counterbalance shaft, turn the sprocket once, realign the timing mark and check that the screwdriver goes in 60 mm or more. The screwdriver should not be taken out until the timing belt is installed.

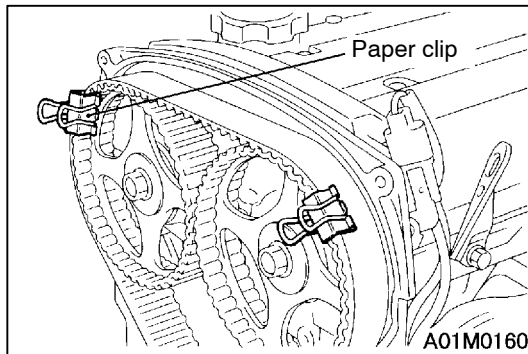
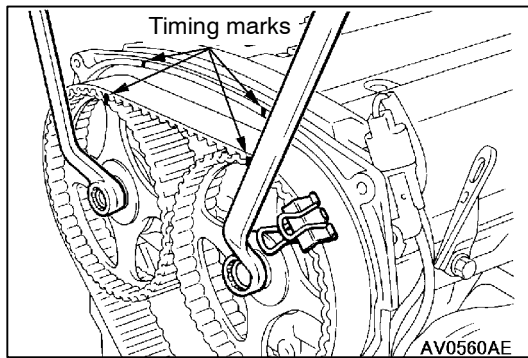


3. Install the timing belt by the following procedure. Take care not to slacken the belt at the tension side.

- (1) Install the timing belt to the crankshaft sprocket, oil pump sprocket and idler pulley in that order.,



- (2) Place the timing belt on the exhaust-side camshaft sprocket, and hold it in the position shown in the illustration with a paper clip.



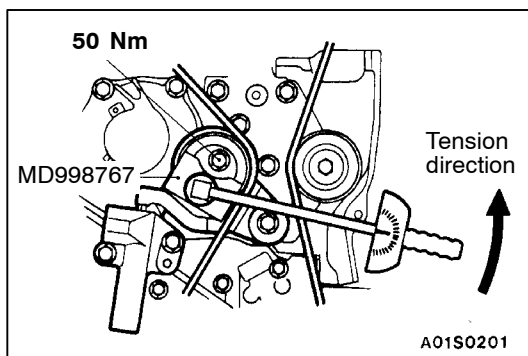
- (3) Place the timing belt on the intake-side sprocket while using two wrenches to align the timing marks.

- (4) Hold the belt in the position shown in the illustration with another paper clip.
- (5) Place the timing belt on the tensioner pulley.
- (6) Remove the two paper clips.

#### Caution

**After installing the timing belt, apply force to turn the camshaft sprocket in the reverse direction, and recheck to be sure that the belt is fully tensioned and that each timing mark is in the proper position.**

4. Set the tension pulley so that the pin holes of centre bolt are at the bottom, press the tension pulley lightly against the timing belt, and then provisionally tighten the centre bolt.
5. Check to be sure that all timing marks are aligned.
6. Adjust the timing belt tension.



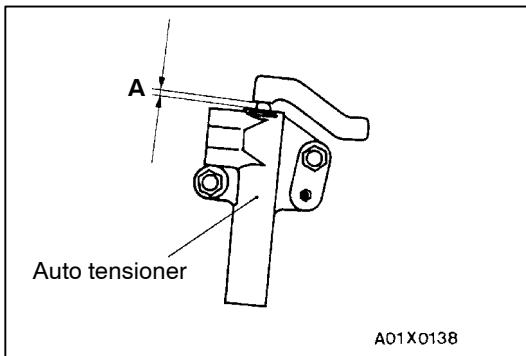
#### ►F◄ TIMING BELT TENSION ADJUSTMENT

1. After turning the crankshaft 1/4 of a revolution in the anticlockwise direction, turn it in the clockwise direction until the timing marks are aligned.
2. Loosen the tension pulley fixing bolt, and then use the special tool and a torque wrench to tighten the fixing bolt to the specified torque while applying tension to the timing belt.

**Standard value: 3.5 Nm <Timing belt tension torque>**

#### Caution

**When tightening the fixing bolt, make sure that the tension pulley does not turn with the bolt.**



3. Turn the crankshaft two revolutions in the clockwise direction so that the timing marks are aligned. After leaving it for 15 minutes, measure the amount of protrusion of the auto tensioner.

**Standard value (A): 3.8 – 4.5 mm**

4. If the amount of protrusion is outside the standard value, repeat the operation in steps (1) to (3).
5. Check again to be sure that the timing marks of each sprocket are aligned.

# ENGINE ASSEMBLY

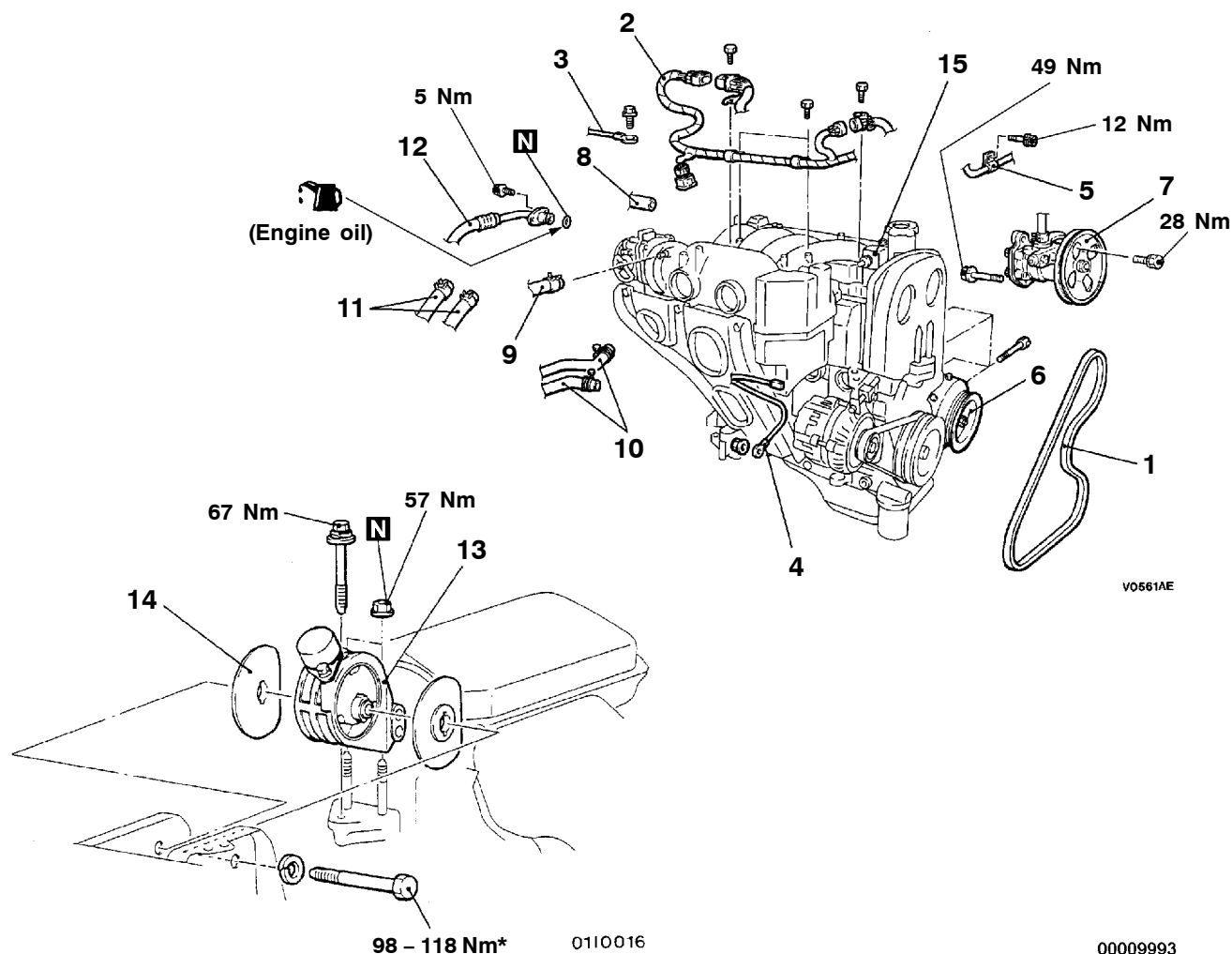
## REMOVAL AND INSTALLATION

### Caution

Mounting locations marked by \* should be provisionally tightened, and then fully tightened after placing the vehicle horizontally and loading the full weight of the engine on the vehicle body.

#### Pre-removal and Post-installation Operation

- Fuel Discharge Prevention (Refer to GROUP 13I – On-vehicle Service.) <Pre-removal only>
- Engine Cover Removal and Installation
- Under Cover Removal and Installation
- Engine Coolant Draining and Supplying (Refer to GROUP 14 – On-vehicle Service.)
- Hood Removal and Installation
- Transmission Assembly Removal and Installation
- Drive Belt Tension Adjustment (Refer to P.11D-6.) <Post-installation only>



### Removal steps

1. Drive belt (Power steering and A/C)
2. Engine harness connector
3. Earth cable connection
4. Alternator connector
5. Power steering hose clamp
6. A/C compressor
7. Power steering oil pump
8. Vacuum hose connection
9. Brake booster vacuum hose connection
10. Heater hose connection
11. Fuel return hose connection
12. Fuel pressure hose connection
13. Engine mount bracket
14. Engine mount stopper
15. Engine assembly



**REMOVAL SERVICE POINTS****◀A▶ A/C COMPRESSOR REMOVAL**

Disconnect the A/C compressor connector and remove the compressor from the compressor bracket with the hose still attached.

**NOTE**

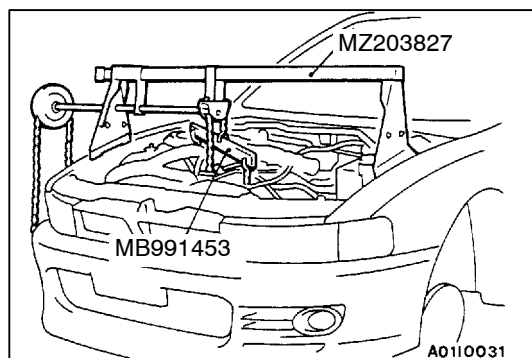
Place the removed A/C compressor where it will not be a hindrance when removing and installing the engine assembly, and tie it with a cord.

**◀B▶ POWER STEERING OIL PUMP REMOVAL**

Remove the power steering oil pump and bracket assembly from the engine with the hose attached.

**NOTE**

Place the removed power steering oil pump in a place where it will not be a hindrance when removing and installing the engine assembly, and tie it with a cord.

**◀C▶ ENGINE MOUNT BRACKET REMOVAL**

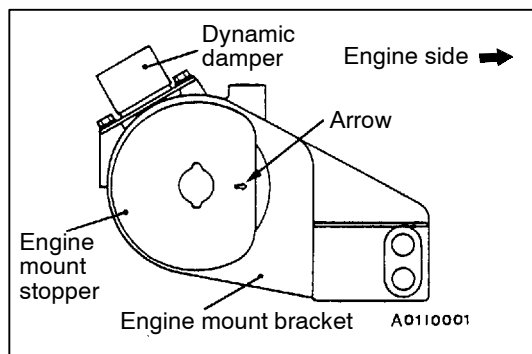
1. Support the engine with a garage jack.
2. Remove the special tool which was attached when the transmission assembly was removed.
3. Hold the engine assembly with a chain block or similar tool.
4. Place a garage jack against the engine oil pan with a piece of wood in between, jack up the engine so that the weight of the engine is no longer being applied to the engine mount bracket, and then remove the engine mount bracket.

**◀D▶ ENGINE ASSEMBLY REMOVAL**

After checking that all cables, hoses and harness connectors, etc., are disconnected from the engine, lift the engine assembly away from the engine compartment.

**INSTALLATION SERVICE POINTS****►A◄ ENGINE ASSEMBLY INSTALLATION**

Install the engine assembly, checking that the cables, hoses, and harness connectors are not clamped.

**►B◄ ENGINE MOUNT STOPPER INSTALLATION**

Clamp the engine mount stopper so that the arrow points in the direction as shown in the diagram.

**►C◄ ENGINE MOUNT BRACKET INSTALLATION**

1. Place a garage jack against the engine oil pan with a piece of wood in between, and install the engine mount bracket while adjusting the position of the engine.
2. Support the engine with the garage jack.
3. Remove the chain block and support the engine assembly with the special tool.