ENGINE

CONTENTS

ENGINE <4G6-GDI> 11A

ENGINE <4G6-MPI> 11C

ENGINE
<4G6-GDI>

CONTENTS

GENERAL 3
Outline of Changes 3
GENERAL INFORMATION 3
SERVICE SPECIFICATIONS 3
SEALANTS 3
SPECIAL TOOLS 4
ON-VEHICLE SERVICE 5
Compression Pressure Check 5
CAMSHAFT AND CAMSHAFT OIL SEAL 6
CYLINDER HEAD GASKET 12
TIMING BELT AND TIMING BELT B 15

GENERAL

OUTLINE OF CHANGES

The following service procedures have been added due to the introduction of the 4G64-GDI engine with variable valve timing. The other items are the same as before.

- The valve timing has been reviewed due to the introduction of the variable valve timing mechanism.
- The compression ratio has been changed.

GENERAL INFORMATION

Items			4G64-GDI with variable valve timing
Compression ratio			10.8
Valve timing	Intake	Opening	BTDC 22° – –3°
		Closing	ABDC 50° – 75°
	Exhaust	Opening	BBDC 56°
		Closing	ATDC 24°

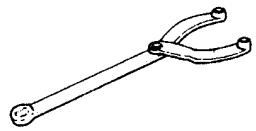
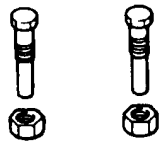
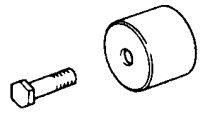
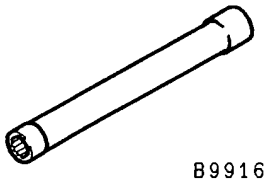
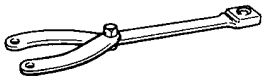
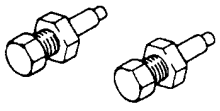
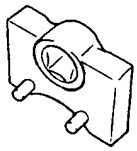
SERVICE SPECIFICATIONS

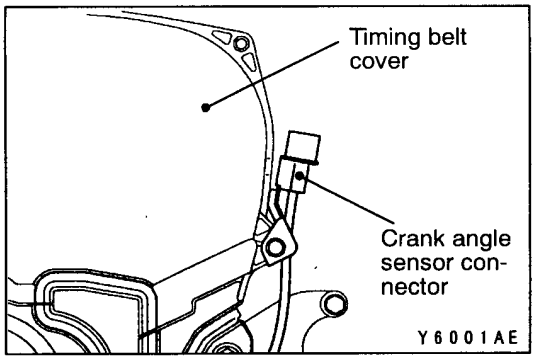
Items	Standard value	Limit
Cylinder head bolt shank length mm	–	99.4
Auto-tensioner push rod movement mm	Within 1	–
Timing belt tension torque Nm (Reference value)	2.5	–
Auto-tensioner rod protrusion amount mm	3.8 – 4.5	–

SEALANTS

Items	Specified sealants	Remarks
Beam camshaft cap Cylinder head	3M ATD Part No.8660 or equivalent	–
Cam position sensor support	MITSUBISHI GENUINE PART MD970389 or equivalent	Semi-drying sealant

SPECIAL TOOLS

Tool	Number	Name	Use
	MB990767	End yoke holder	Holding the camshaft sprocket (exhaust side)
	MD998719 or MD998754	Crankshaft pulley holder pin	
	MD998713	Camshaft oil seal installer	Press-in of the camshaft oil seal
 B991654	MB991654	Cylinder head bolt wrench	Removal and installation of cylinder head bolt
	MB991367	Special spanner	Holding the crankshaft sprocket
 B991385	MB991385	Pin	
	MD998767	Tension pulley socket wrench	Timing belt tension adjustment



ON-VEHICLE SERVICE

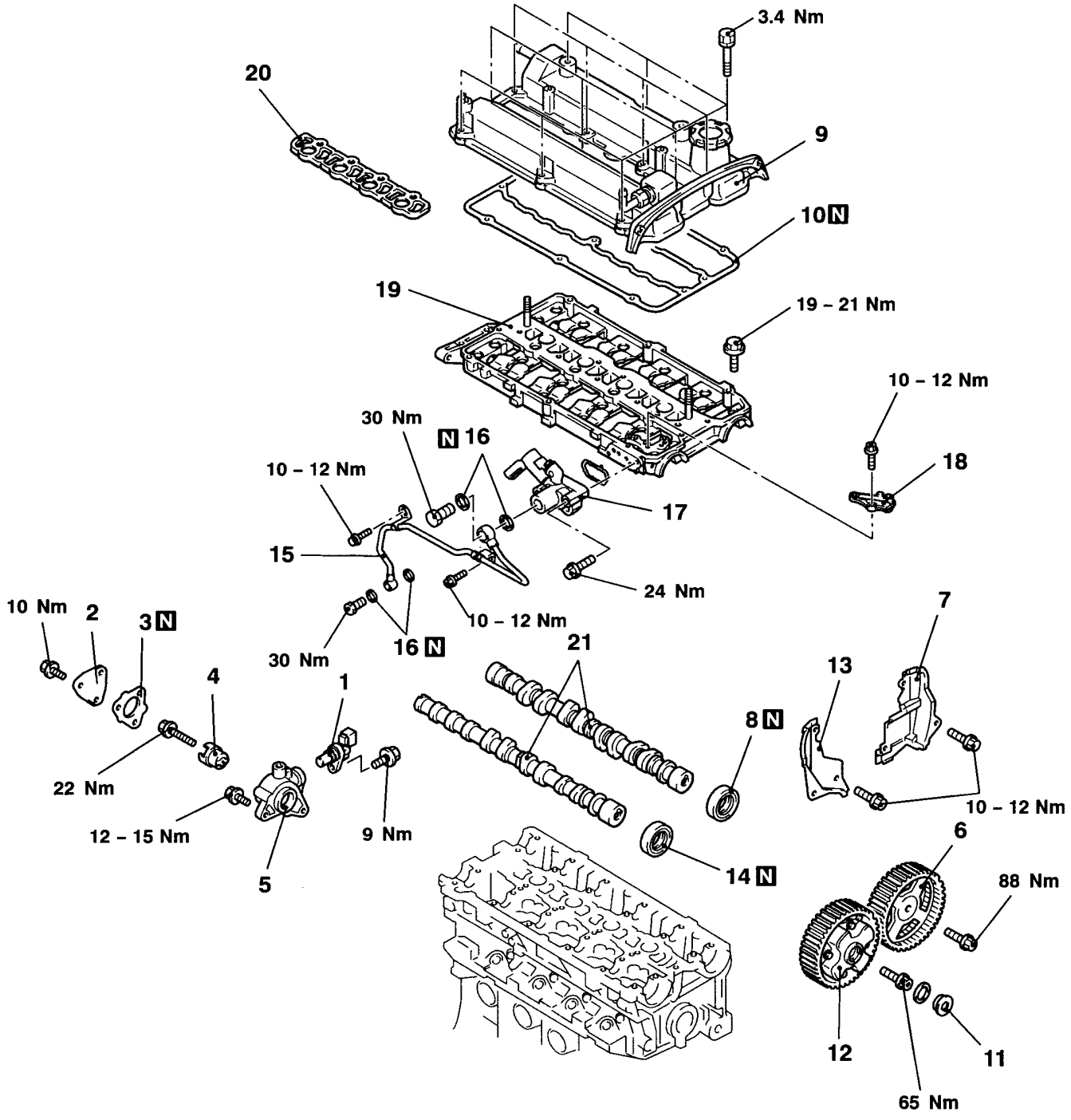
COMPRESSION PRESSURE CHECK

The crank angle sensor has been relocated. Its checking procedure is the same as before.

CAMSHAFT AND CAMSHAFT OIL SEAL

REMOVAL AND INSTALLATION

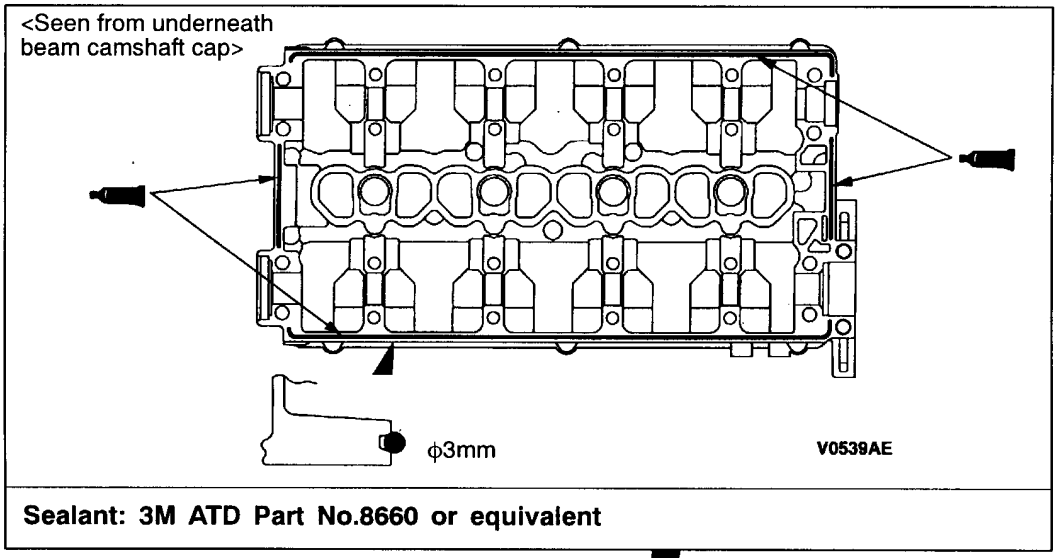
Pre-removal and Post-installation Operation
- Air Cleaner Assembly Removal and Installation
- Engine Coolant Draining and Supplying
- Intake Manifold Removal and Installation (Refer to GROUP 15.)
- Fuel Pump (High Pressure) and Pump camshaft case Removal and Installation (Refer to GROUP 13A.)
- Timing Belt Removal and Installation (Refer to P.11A-15.)

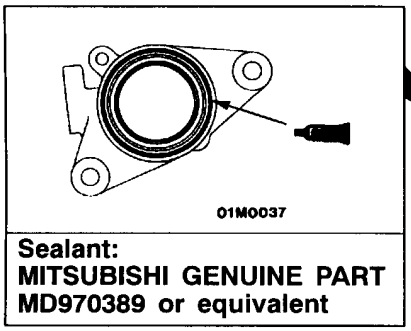


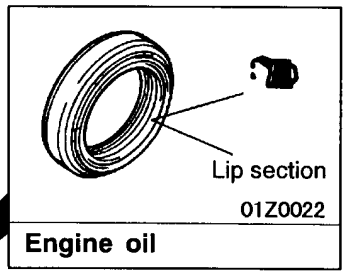
Removal steps

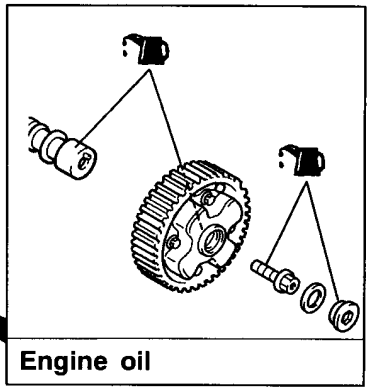
1. Cam position sensor
2. Cover
3. Gasket
▶F◀ 4. Camshaft position sensing cylinder
5. Camshaft position sensor support
◀A▶ ▶E◀ 6. Camshaft sprocket (exhaust side)
7. Timing belt rear cover (exhaust side)
▶C◀ 8. Camshaft oil seal (exhaust side)
9. Rocker cover
10. Rocker cover gasket
◀B▶ 11. Plug cap
◀C▶ ▶D◀ 12. V.V.T. sprocket
13. Timing belt rear cover (intake side)
▶C◀ 14. Camshaft oil seal (intake side)
15. Oil pipe
16. Gasket
17. Oil control valve assembly
18. Oil delivery body
▶B◀ 19. Beam camshaft cap
20. Beam camshaft cap gasket
▶A◀ 21. Camshaft

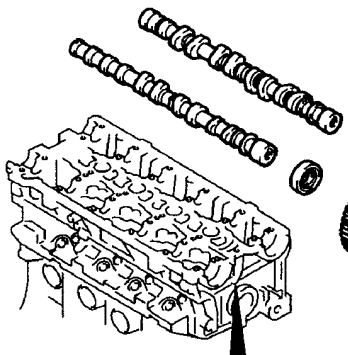
Lubrication points

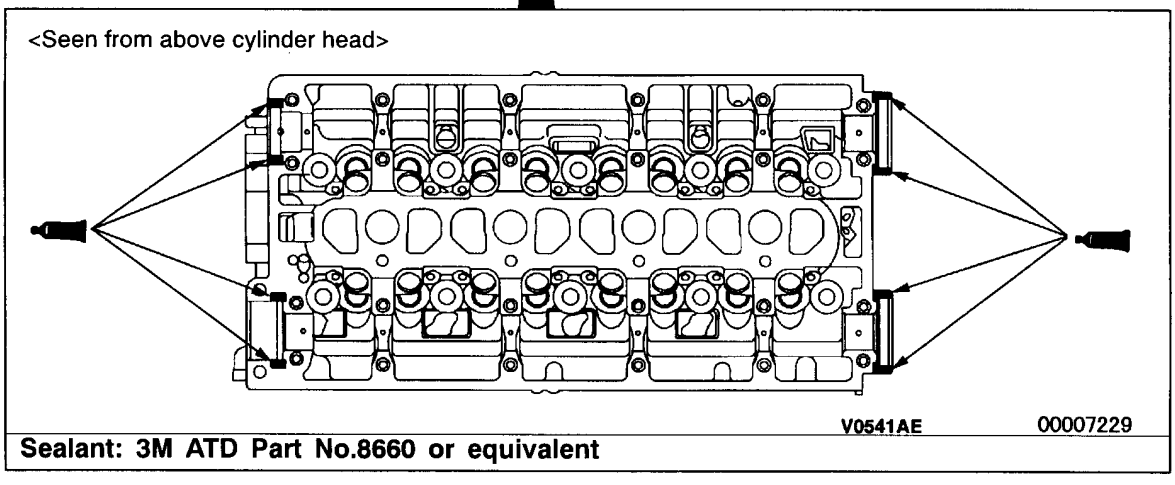


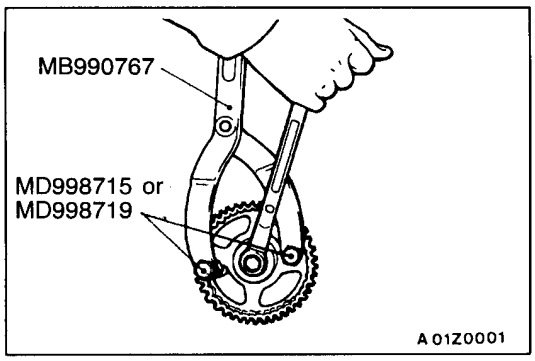






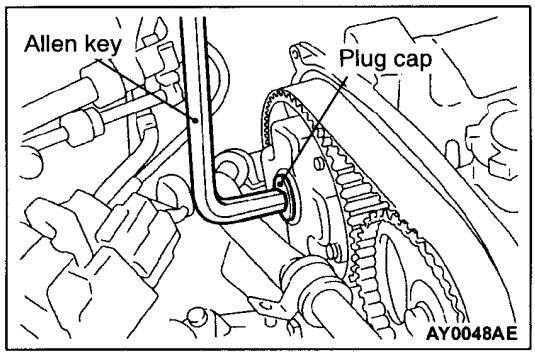






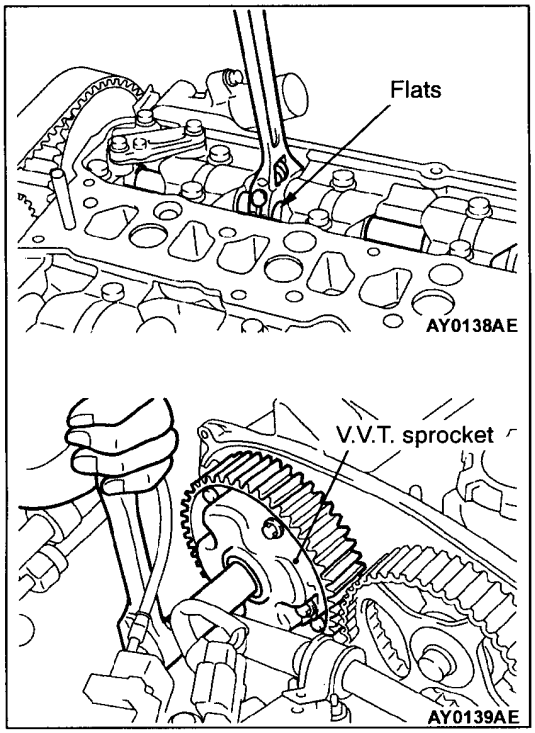
REMOVAL SERVICE POINTS

◀A▶ CAMSHAFT SPROCKET (EXHAUST SIDE) REMOVAL



◀B▶ PLUG CAP REMOVAL

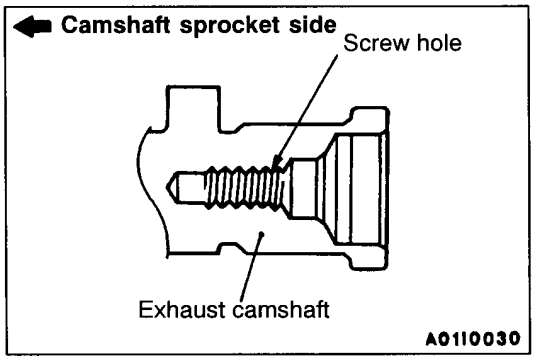
Use a 14-mm Allen key to remove the plug cap.



◀C▶ V.V.T. SPROCKET REMOVAL

Use a wrench to hold the flats of the camshaft. Remove the V.V.T. sprocket mounting bolt to remove the V.V.T. sprocket.

Caution
If a tool is used to hold the V.V.T. sprocket itself, the sprocket will be damaged.

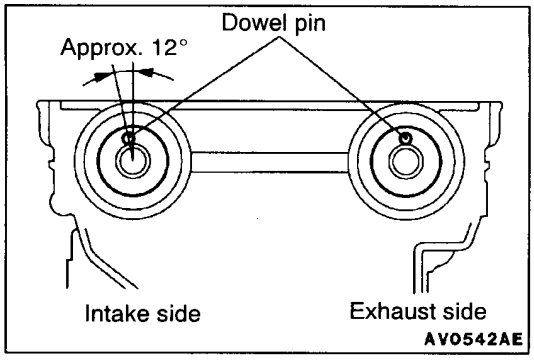


INSTALLATION SERVICE POINTS

▶A◀ CAMSHAFT INSTALLATION

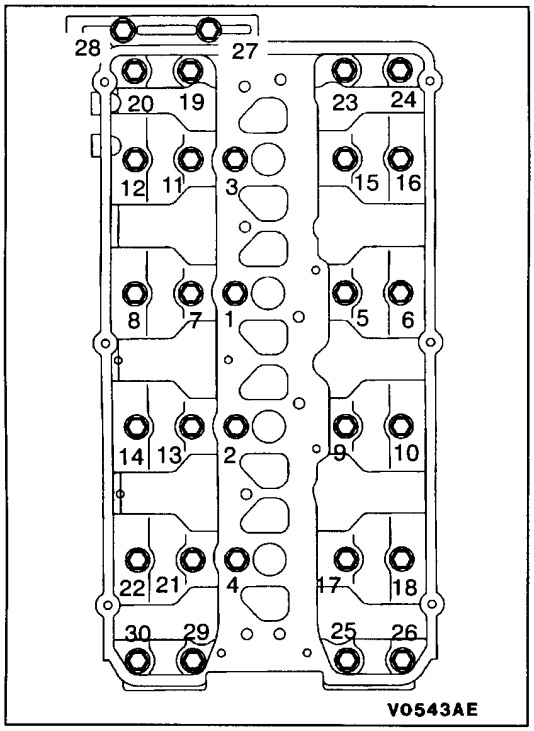
1. Apply engine oil to journals and cams of the camshafts.
2. Install the camshafts on the cylinder head.

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.



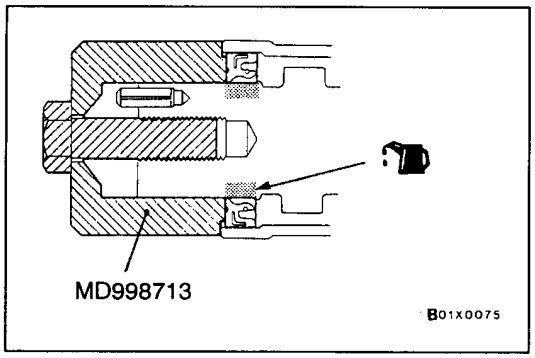
▶B◀ BEAM CAMSHAFT CAP INSTALLATION

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



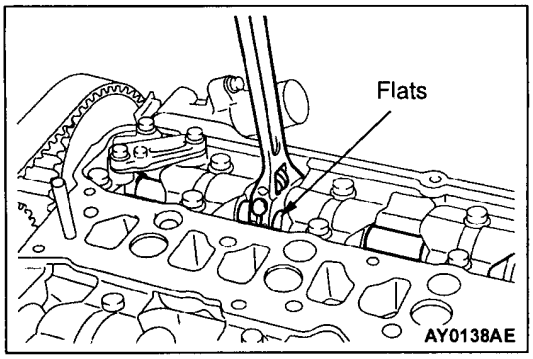
2. Tighten the beam camshaft cap mounting bolts to the specified torque in the order shown in the illustration.

   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◀ V.V.T. SPROCKET INSTALLATION

1. Apply engine oil to the ends of the camshaft and V.V.T. sprocket. Then install the V.V.T. sprocket to the camshaft while aligning the sprocket dowel hole with the camshaft dowel pin.
2. Hold the flats of the camshaft using a wrench. Then confirm that the V.V.T. sprocket does not rotate.

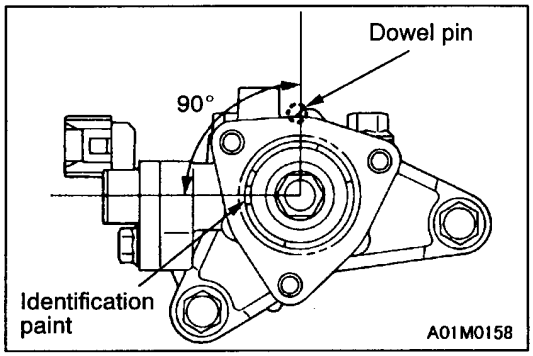
   NOTE
   This work should be done, because you can not confirm visually that the camshaft dowel pin is inserted in the sprocket dowel hole.
3. Apply engine oil to the thread and seating surface of the V.V.T. sprocket mounting bolt. Then hold the camshaft in the same manner as removal, and tighten the bolt to the specified torque.

   Tightening torque: 65 Nm

▶E◀ 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



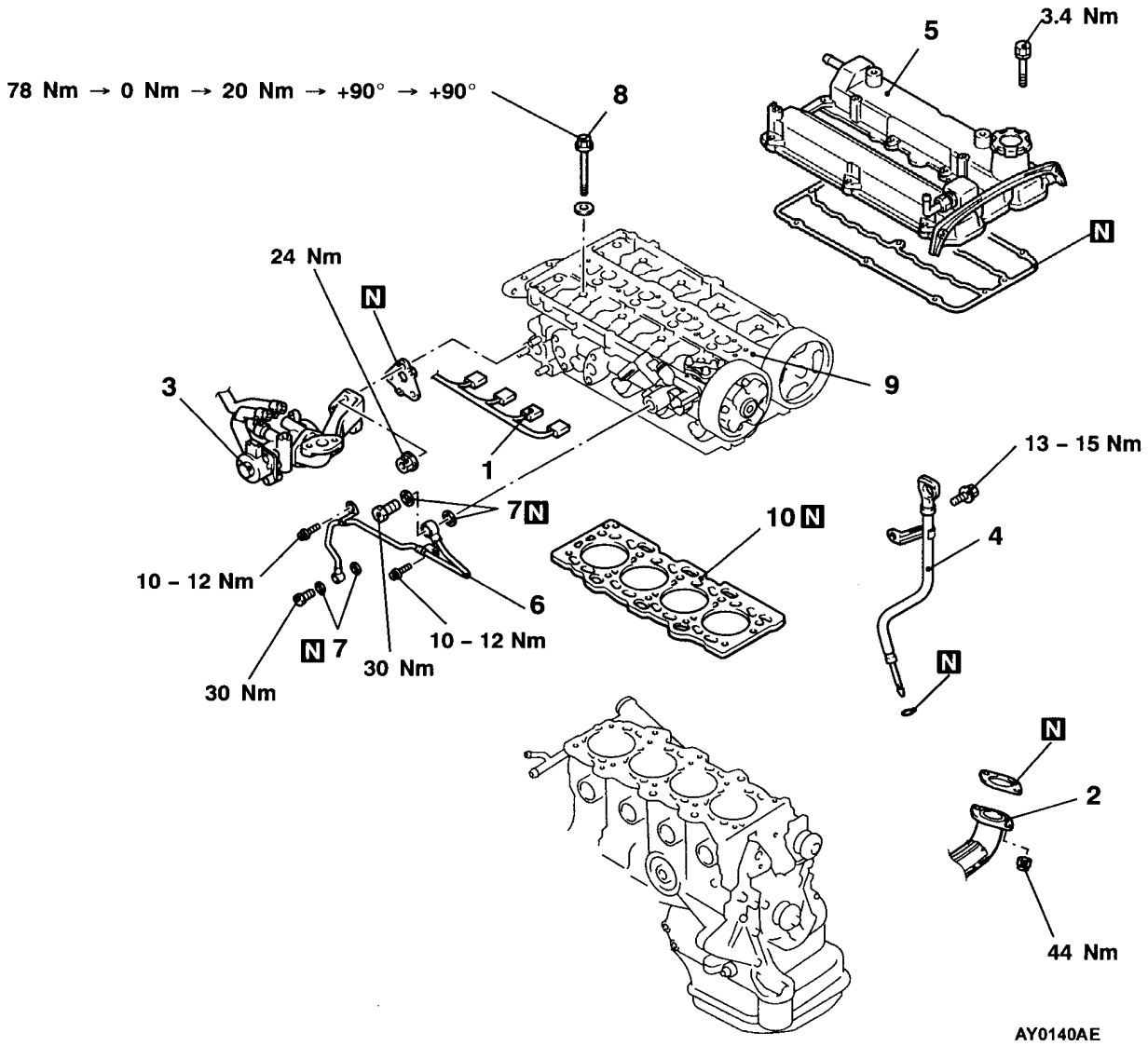
▶F◀ CAM POSITION SENSING CYLINDER INSTALLATION

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

CYLINDER HEAD GASKET

REMOVAL AND INSTALLATION

Pre-removal and Post-installation Operation
- Fuel Discharge Prevention <Pre-removal only>
- Engine Coolant Draining and Supplying
- Engine Oil Draining and Supplying
- Intake Manifold Removal and Installation (Refer to GROUP 15.)
- Fuel Pump (High Pressure) and Pump camshaft case Removal and Installation (Refer to GROUP 13A.)
- Thermostat Case Assembly Removal and Installation
- Timing Belt Removal and Installation (Refer to P.11A-15.)



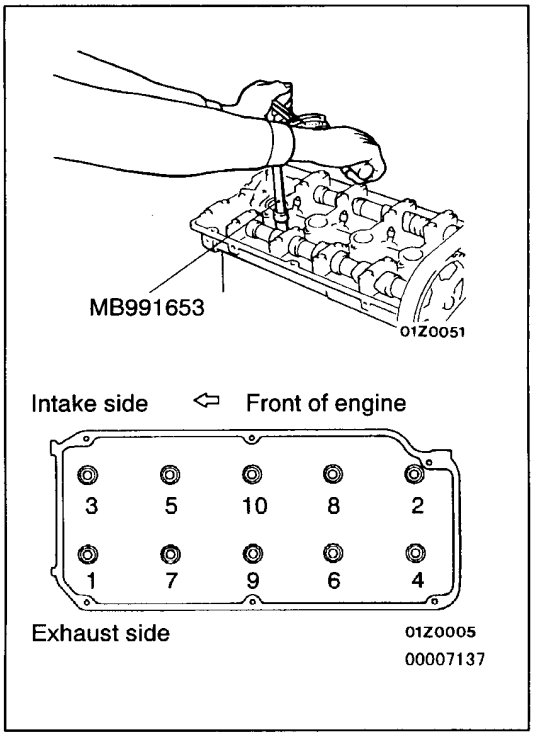
Removal steps

1. Injector harness connector
2. Front exhaust pipe connection
3. EGR valve and stay assembly
4. Engine oil level gauge
5. Rocker cover
6. Oil pipe
7. Gasket

◀A▶ ▶B◀ 8. Cylinder head bolt

9. Cylinder head assembly

▶A◀ 10. Cylinder head gasket



REMOVAL SERVICE POINT

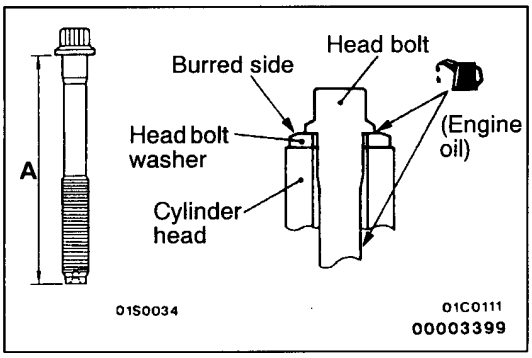
◀A▶ CYLINDER HEAD BOLT REMOVAL

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

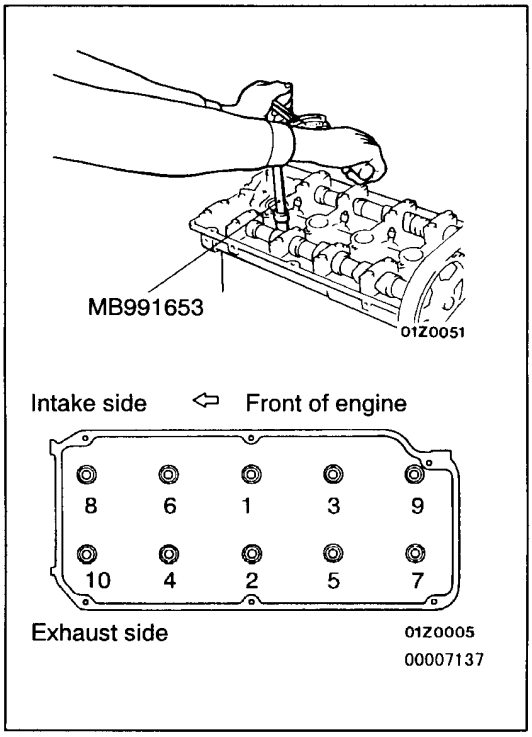
▶A◀ CYLINDER HEAD GASKET INSTALLATION

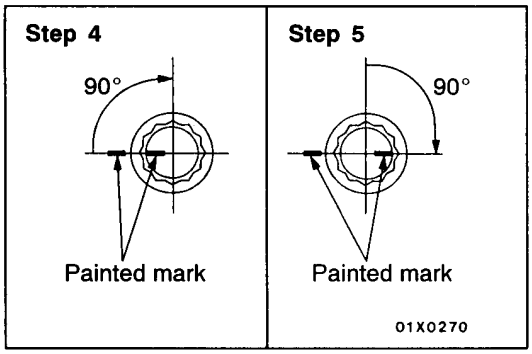
1. Wipe off all oil and grease from the gasket mounting surface.
2. Install so that the shapes of the cylinder head holes match the shapes of the respective cylinder head gasket holes.



▶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 burred 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

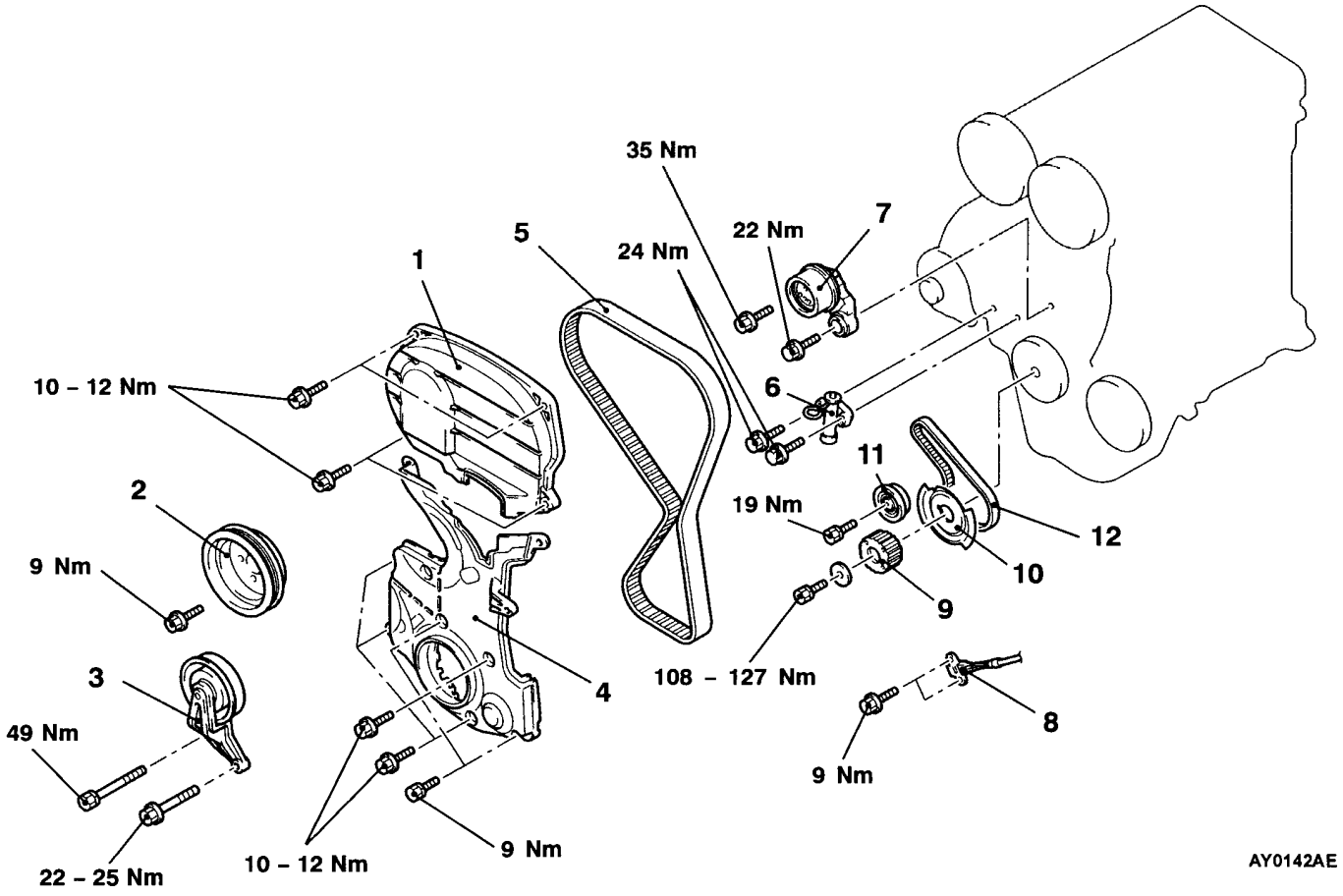
(1) Always make a tightening angle just 90°. If it is less than 90°, the head bolt will be loosened.

(2) If it is more than 90°, remove the head bolt and repeat the procedure from step 1.

TIMING BELT AND TIMING BELT B

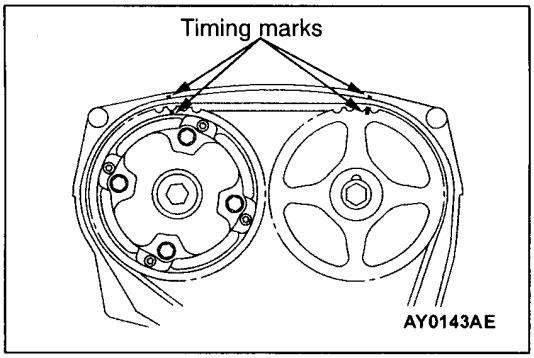
REMOVAL AND INSTALLATION

Pre-removal and Post-installation Operation
- Engine Cover Removal and Installation
- Under Cover Removal and Installation
- Crankshaft Pulley Removal and Installation
- Engine Mount Bracket Removal and Installation



Removal steps

1. Timing belt front upper cover
2. Water pump pulley
3. Idler pulley assembly
4. Timing belt front lower cover
▶E◀ • Timing belt tension adjustment
◀A▶ ▶D◀ 5. Timing belt
▶C◀ 6. Auto tensioner
7. Tensioner pulley assembly
8. Crankshaft position sensor
◀B▶ ▶B◀ 9. Crankshaft sprocket
▶B◀ 10. Crankshaft sensing blade
▶A◀ 11. Timing belt B tensioner
◀C▶ ▶A◀ 12. Timing belt B

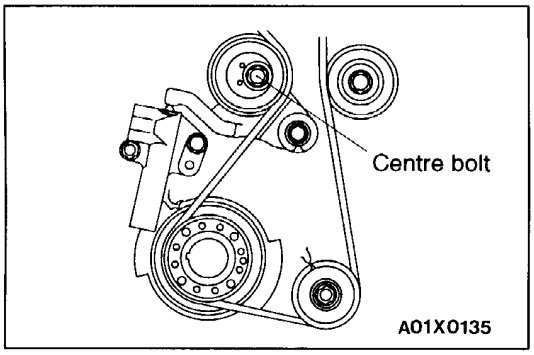


REMOVAL SERVICE POINT

◀A▶ TIMING BELT REMOVAL

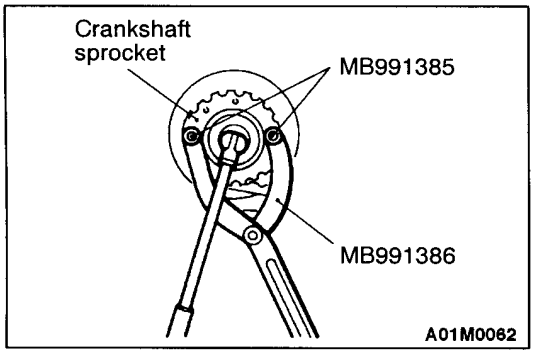
1. Turn the crankshaft clockwise (right turn) to align each timing mark and to set the No. 1 cylinder at compression top dead centre.

   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.

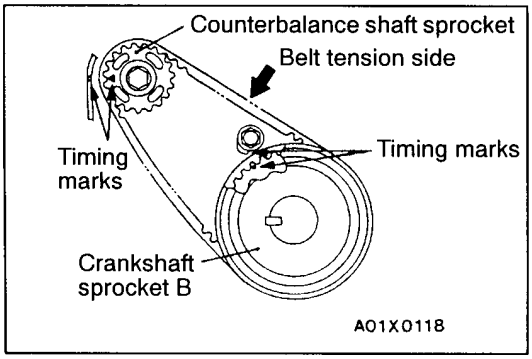
   Caution
   If the timing belt is to be re-used, use chalk to mark (on its flat side) an arrow indicating the clockwise direction.



◀B▶ CRANKSHAFT SPROCKET REMOVAL

◀C▶ TIMING BELT B REMOVAL

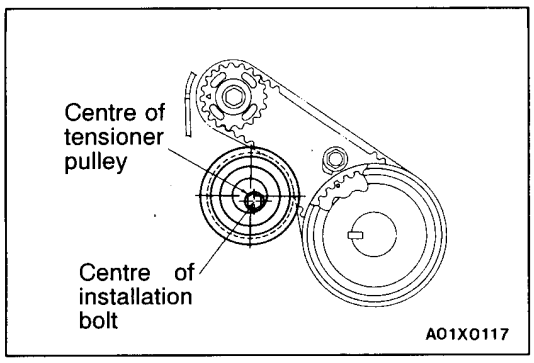
Caution
If timing belt B is to be re-used, use chalk to mark it with an arrow on its flat side indicating the turning direction (to the right).



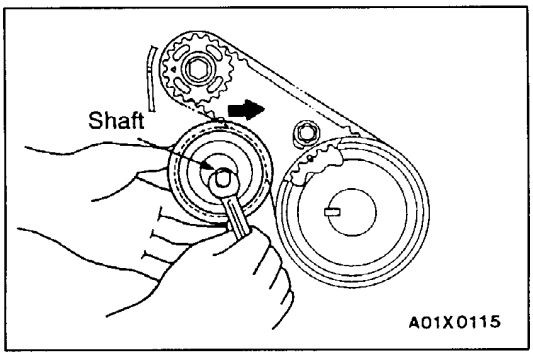
INSTALLATION SERVICE POINTS

▶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.

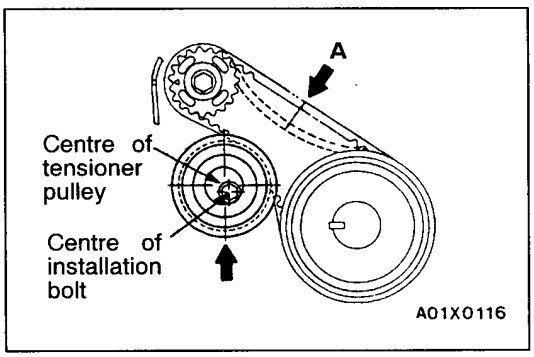


2. Adjust the tension of timing belt B by the following procedure.
   (1) Temporarily fix the timing belt B tensioner such that the centre of the tensioner pulley is to the left and above the centre of the installation bolt, and temporarily attach the tensioner pulley so that the flange is toward the front of the engine.



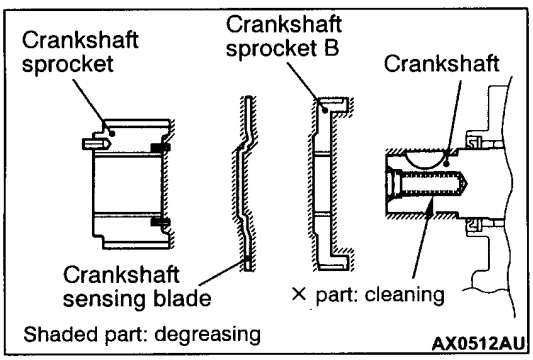
   (2) Holding the timing belt B tensioner up with your finger in the direction of the arrow, place pressure on the timing belt so that the tension side of the belt is taut. Now tighten the bolt to fix the tensioner.

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.

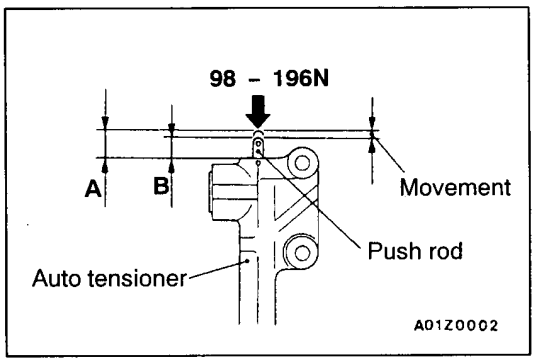
Standard value: 5 – 7 mm



▶B◀ CRANKSHAFT SENSING BLADE/CRANKSHAFT SPROCKET INSTALLATION

1. To prevent the crankshaft bolt from loosening, degrease the seating surfaces of the crankshaft, crankshaft sensing blade and crankshaft sprocket.
2. Install the crankshaft sensing blade in the direction shown.
3. Apply the minimum amount of engine oil to the seat surface and thread of the crankshaft bolt.
4. Hold the crankshaft sprocket as same as for removal, and then tighten the bolt to the specified torque.

Tightening torque: 108 – 127 Nm

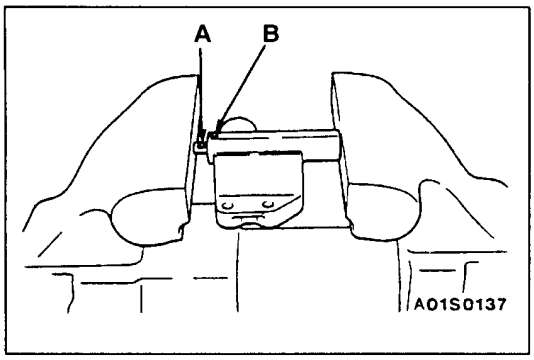


▶C◀ AUTO TENSIONER INSTALLATION

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.

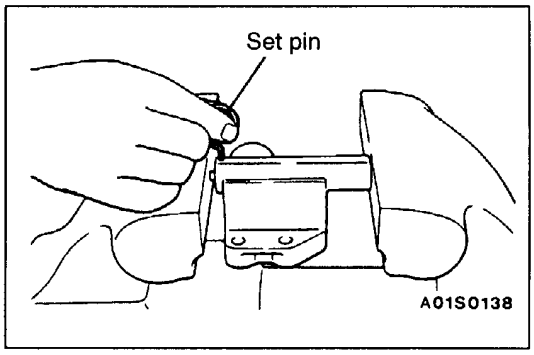
Standard value: Within 1 mm
A: Length when it is free (not pressed)
B: Length when it is pressed
A – B: Movement

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.

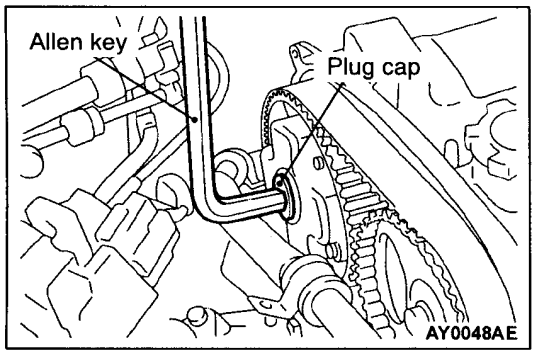
Caution
If the compression speed is too fast, the rod may become damaged, so be sure to carry out this operation slowly.



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

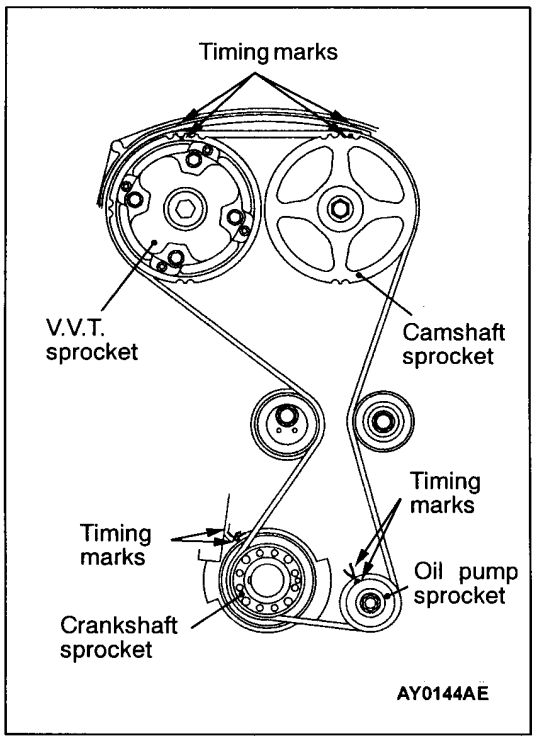
NOTE
When replacing the auto tensioner with a new part, the pin will be in the auto tensioner.

5. Install the auto tensioner to the engine.

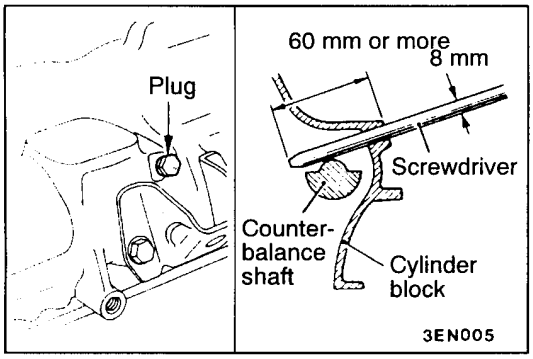


▶D◀ TIMING BELT INSTALLATION

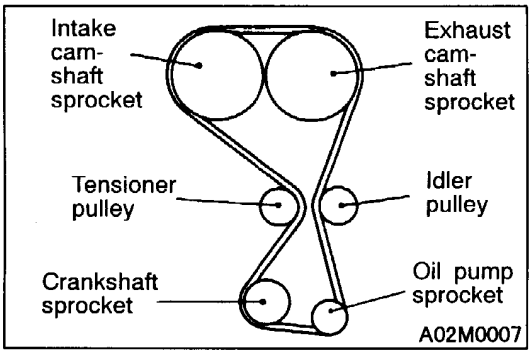
1. Use a 14-mm Allen key to remove the plug cap.



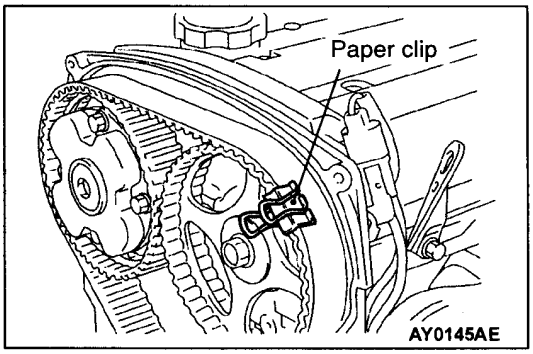
2. Align the timing marks on the camshaft sprocket, crankshaft sprocket and oil pump sprocket.



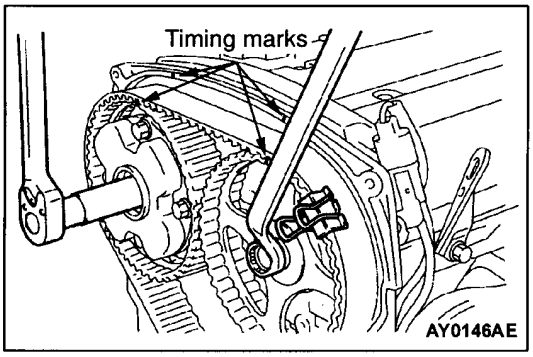
3. After aligning the timing mark on the oil pump sprocket, remove the cylinder block plug and insert a Phillips screwdriver with a diameter of 8 mm, and check to be sure that the screwdriver goes in 60 mm or more. If the screwdriver will only go in 20 – 25 mm before striking the counterbalance shaft, 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.



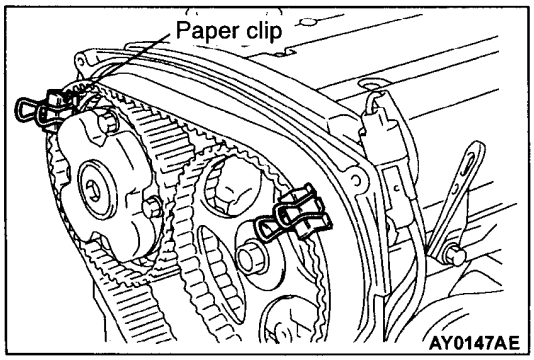
4. Install the timing belt by the following procedure. Take care not to slacken the belt at the tension side.
   (1) Install the timing belt to the crankshaft sprocket, oil pump sprocket and idler pulley in that order.,



   (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.



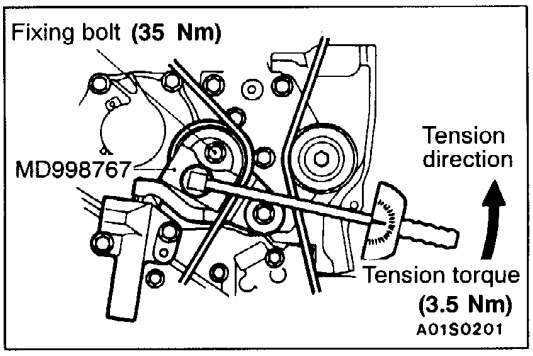
   (3) Place the timing belt on the V.V.T. sprocket while using two wrenches to align the timing marks.



   (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.

5. Install the plug cap to the V.V.T. sprocket.
6. 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.
7. Check to be sure that all timing marks are aligned.
8. Adjust the timing belt tension.

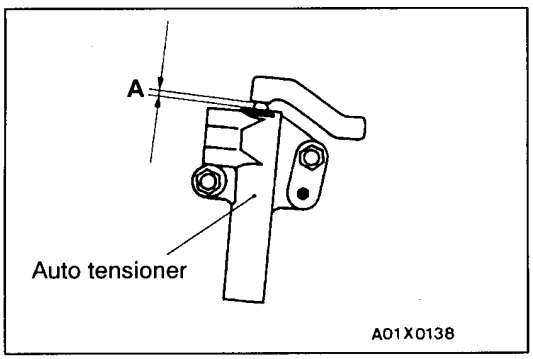


▶F◀ TIMING BELT TENSION ADJUSTMENT

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
<4G6-MPI>

CONTENTS

GENERAL 2
Outline of Changes 2
SERVICE SPECIFICATIONS 2
SEALANTS 2
SPECIAL TOOLS 3
ON-VEHICLE SERVICE 4
Drive Belt Tension Check and Adjustment 4
CRANKSHAFT PULLEY 6
CAMSHAFT AND CAMSHAFT OIL SEAL 7
OIL PAN 10
CRANKSHAFT OIL SEAL 12
CYLINDER HEAD GASKET 14
TIMING BELT 17
TIMING BELT B 21
ENGINE ASSEMBLY 24

GENERAL

OUTLINE OF CHANGES

The following service procedures have been established in line with the addition of vehicles with 4G63-MPI engine. <SPACE WAGON>

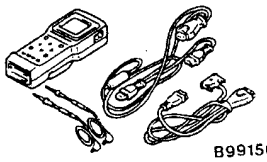
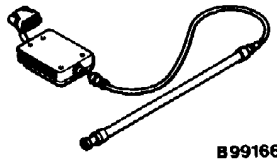
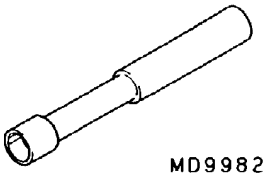
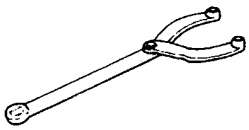
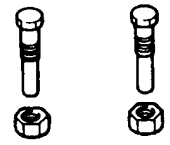
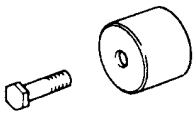
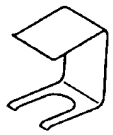
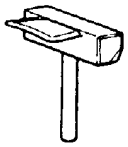
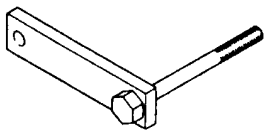
SERVICE SPECIFICATIONS

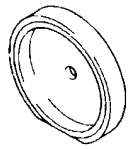
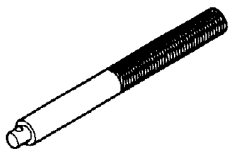
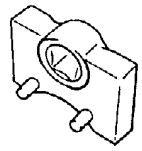
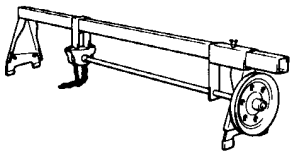
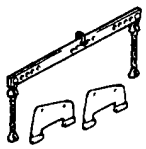
Items		Standard value	Limit
Power steering oil pump and A/C compressor drive belt (When inspection)	Vibration frequency Hz	108 – 132	–
	Tension N	392 – 588	–
	Deflection (Reference) mm	11.7 – 15.3	–
Power steering oil pump and A/C compressor drive belt (When adjustment)	Vibration frequency Hz	114 – 126	–
	Tension N	441 – 539	–
	Deflection (Reference) mm	12.5 – 14.3	–
Power steering oil pump and A/C compressor drive belt (When replacement)	Vibration frequency Hz	137 – 157	–
	Tension N	637 – 834	–
	Deflection (Reference) mm	8.8 – 11.0	–
Cylinder head bolt shank length mm		–	99.4
Auto-tensioner push rod movement mm		Within 1	–
Timing belt tension torque Nm (Reference)		3.5	–
Auto-tensioner rod protrusion amount mm		3.8 – 4.5	–
Timing belt B tension mm		5 – 7	–

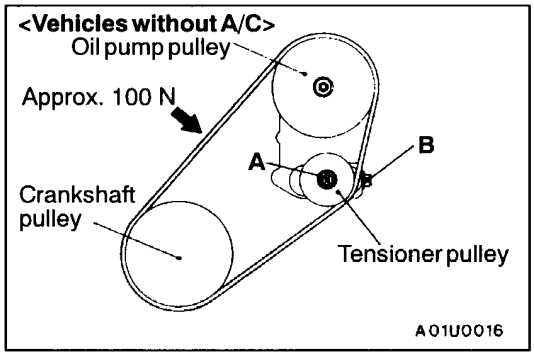
SEALANTS

Items	Specified sealants	Remarks
Oil pan Thermostat case	MITSUBISHI GENUINE PART MD970389 or equivalent	Semi-drying sealant
Flywheel bolt	3M Stud Locking 4170 or equivalent	–

SPECIAL TOOLS

Tool	Number	Name	Use
 B991502	MB991502	MUT-II sub assembly	• Measuring the drive belt tension
 B991668	MB991668	Belt tension meter set	Measuring the drive belt tension (used together with the MUT-II)
 MD998299	MD998299	MAS screwdriver	Adjustment of the mixture adjusting screw <Vehicles without catalytic converter>
	MB990767	End yoke holder	• Holding the camshaft sprocket • Holding the crankshaft sprocket
	MD998719 or MD998754	Crankshaft pulley holder pin	• Holding the camshaft sprocket • Holding the crankshaft sprocket
	MD998713	Camshaft oil seal installer	Press-in of the camshaft oil seal
	MD998443	Auto-lash adjuster holder	Supporting of auto-lash adjuster
	MD998727	Oil pan remover	Removal of oil pan
	MD998781	Flywheel stopper	Securing the flywheel or drive plate

Tool	Number	Name	Use
	MD998776	Crankshaft rear oil seal installer	Press-in of the crankshaft rear oil seal
	MB990938	Handle	Press-in of the crankshaft rear oil seal
	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	

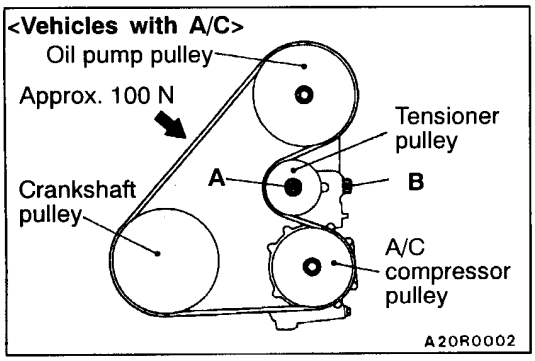


ON-VEHICLE SERVICE

DRIVE BELT TENSION CHECK AND ADJUSTMENT

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	During inspection	During adjustment	During replacement
Vibration frequency Hz	108 – 132	114 – 126	137 – 157
Tension N	392 – 588	441 – 539	637 – 834
Deflection (Reference) 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 '99 SPACE RUNNER/SPACE WAGON Workshop Manual (Pub. No. PWDE9104) GROUP 11A – On-vehicle service 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 approx. 100 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.

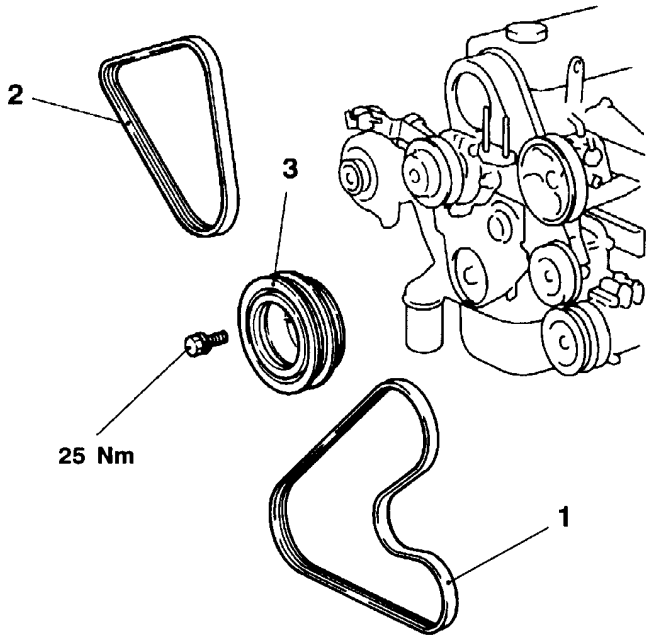
   Caution
   Check after turning the crankshaft once or more clockwise (right turn).

CRANKSHAFT PULLEY

REMOVAL AND INSTALLATION

Pre-removal Operation
Under Cover Removal

Post-installation Operation
- Drive Belt Tension Adjustment (Refer to P.11C-4.)
- Under Cover Installation



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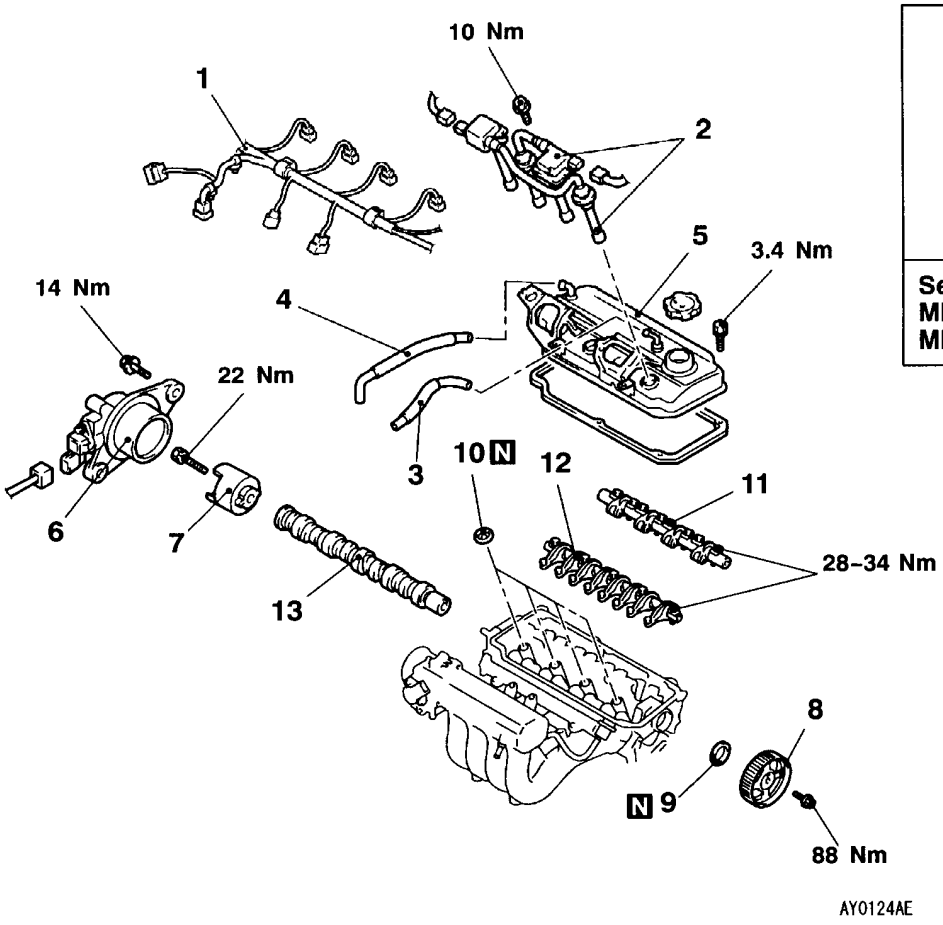
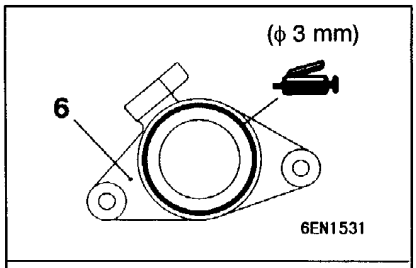
Removal steps
1. Drive belt (Power steering and A/C)
2. Drive belt (Alternator)
3. Crankshaft pulley

CAMSHAFT AND CAMSHAFT OIL SEAL

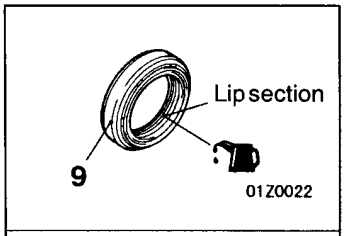
REMOVAL AND INSTALLATION

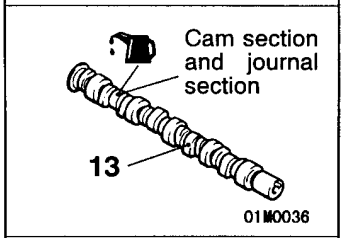
Pre-removal and Post-installation Operation
- Air Cleaner Removal and Installation
- Timing Belt Removal and Installation (Refer to P.11C-17.)





Sealant:
MITSUBISHI GENUINE PART
MD970389 or equivalent





Engine oil

Removal steps

1. Control harness connection
2. Spark plug cable and ignition coil
3. PCV hose
4. Breather hose
5. Rocker cover
6. Camshaft position sensor support
7. Camshaft position sensing cylinder

◀A▶ ▶C◀ 8. Camshaft sprocket

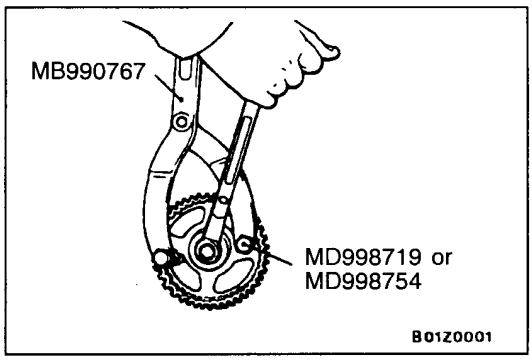
▶B◀ 9. Camshaft oil seal

10. Spark plug guide oil seal

◀B▶ ▶A◀ 11. Rocker arm and shaft assembly (intake side)

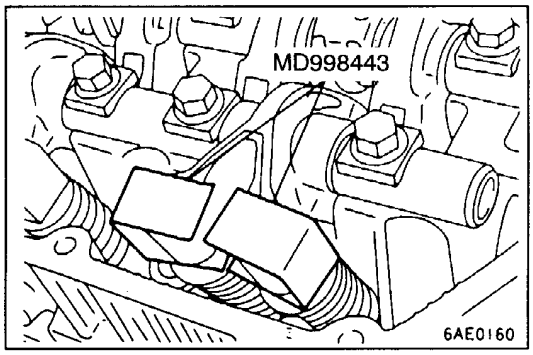
◀B▶ ▶A◀ 12. Rocker arm and shaft assembly (exhaust side)

13. Camshaft



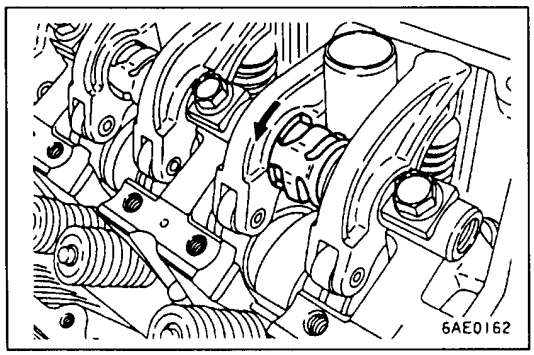
REMOVAL SERVICE POINTS

◀A▶ CAMSHAFT SPROCKET REMOVAL



◀B▶ ROCKER ARM AND SHAFT ASSEMBLY REMOVAL

Before removing the rocker arm and shaft assembly, install the special tools as shown in the illustration so that the lash adjusters will not fall out.

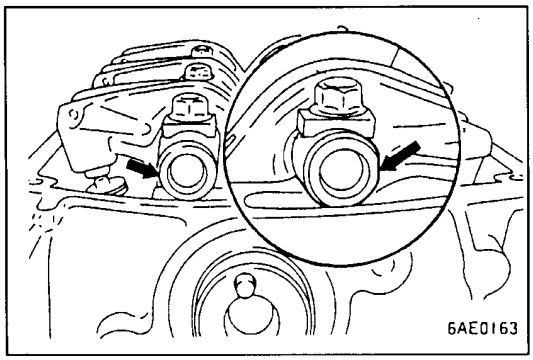


INSTALLATION SERVICE POINTS

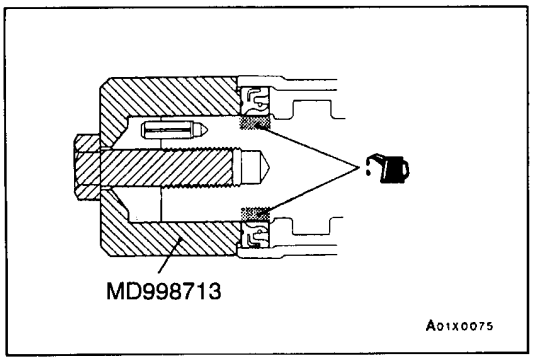
▶A◀ ROCKER ARM AND SHAFT ASSEMBLY INSTALLATION

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 rocker arm and rocker arm shaft on the exhaust side.
3. Remove the special tool for fixing the lash adjuster.



4. Confirm that the rocker shaft notch is in the direction shown in the diagram.



▶B◀ CAMSHAFT OIL SEAL INSTALLATION

1. Apply engine oil to the camshaft oil seal lip.
2. Use the special tool to press-fit the camshaft oil seal.

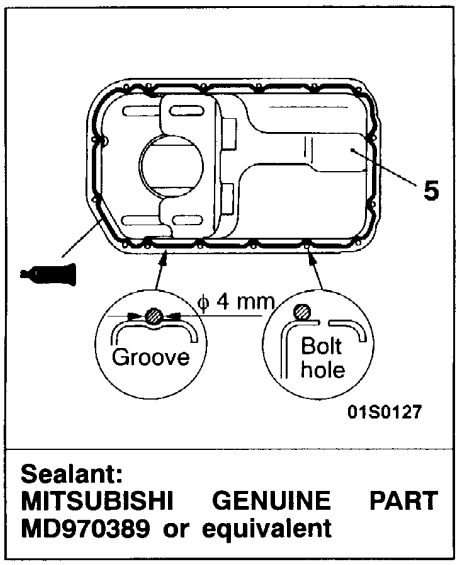
▶C◀ CAMSHAFT SPROCKET INSTALLATION

Use the special tool to stop the camshaft sprocket from turning in the same way as was done during removal, and then tighten the bolts to the specified torque.

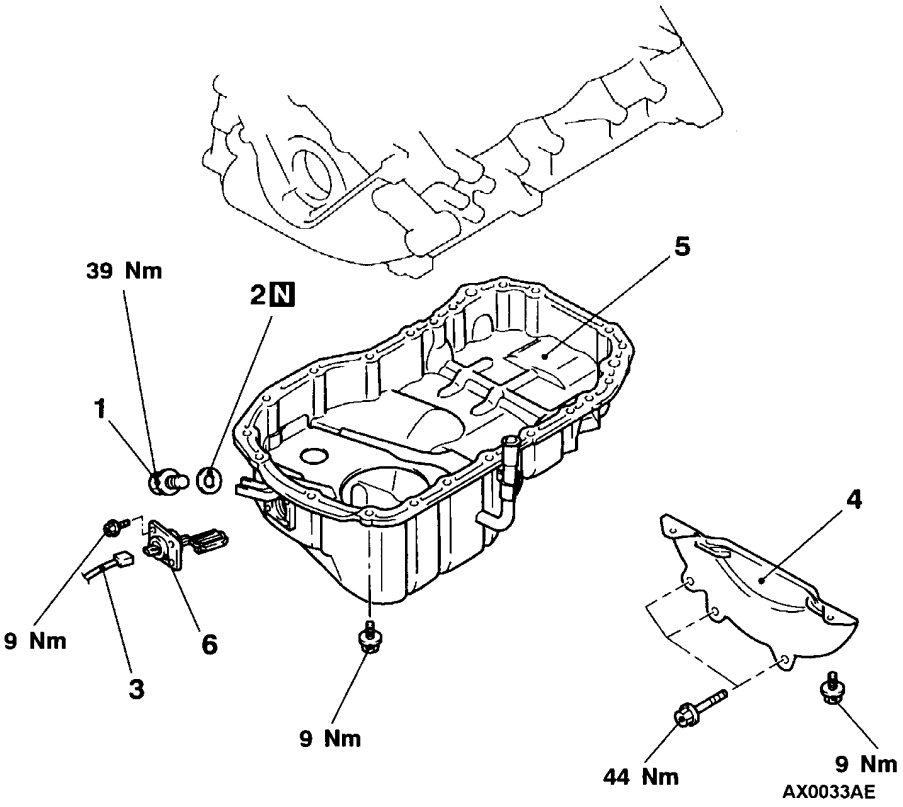
OIL PAN

REMOVAL AND INSTALLATION

Pre-removal and Post-installation Operation
- Under Cover Removal and Installation
- Engine Oil Draining and Supplying
- Oil Level Gauge Removal and Installation
- Front Exhaust Pipe Removal and Installation

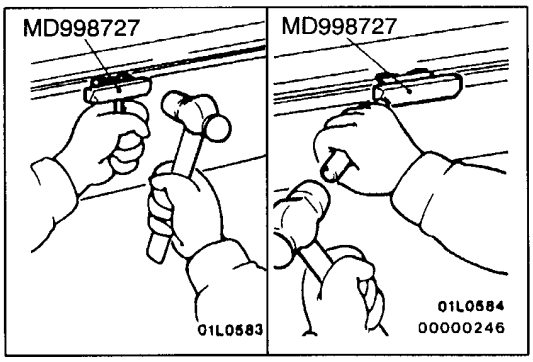


Sealant:
MITSUBISHI GENUINE PART MD970389 or equivalent



Removal steps

1. Drain plug
▶A◀ 2. Drain plug gasket
3. Harness connector
4. Bell housing cover
◀A▶ 5. Oil pan
6. Oil level sensor

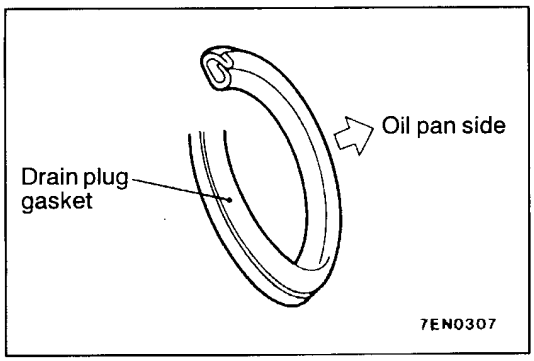


REMOVAL SERVICE POINT

◀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.



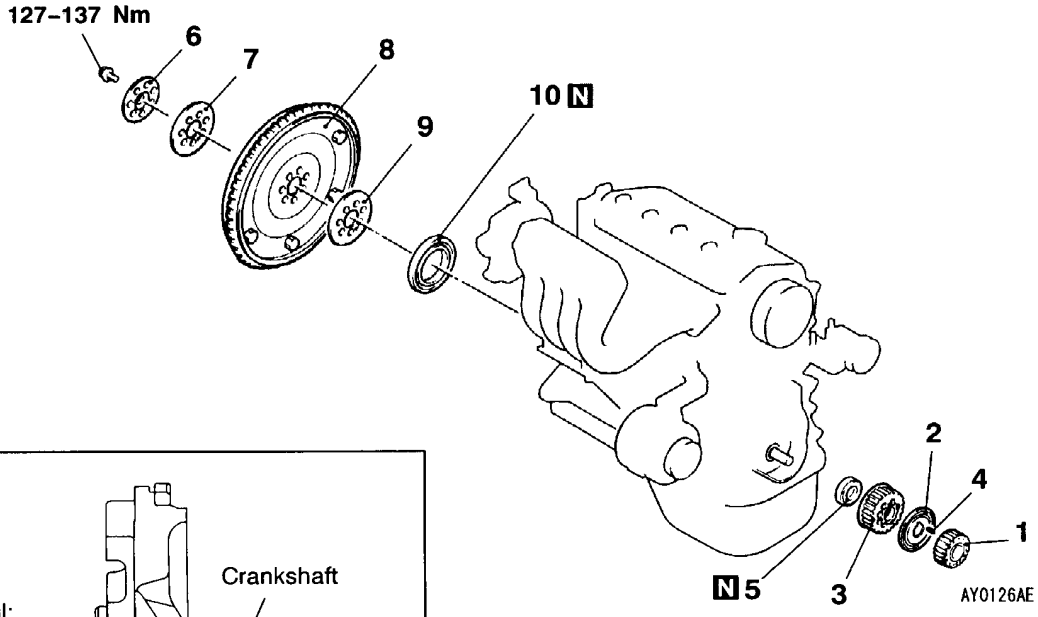
INSTALLATION SERVICE POINT

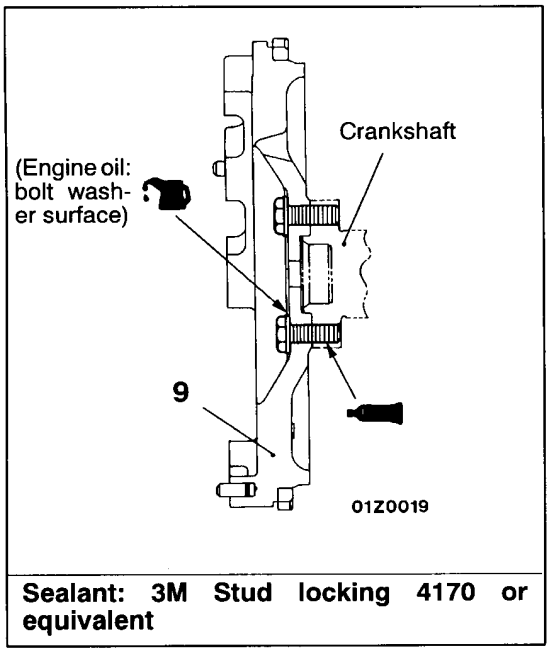
▶A◀ DRAIN PLUG GASKET INSTALLATION

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

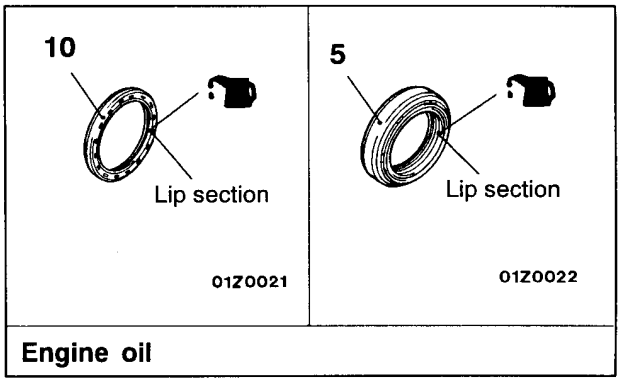
CRANKSHAFT OIL SEAL

REMOVAL AND INSTALLATION





Sealant: 3M Stud locking 4170 or equivalent



Engine oil

Crankshaft front oil seal removal steps

- Timing belt (Refer to P.11C-17.)
- Timing belt B (Refer to P.11C-21.)
- Crank angle sensor (Refer to GROUP 16.)

1. Crankshaft sprocket
2. Flange
3. Crankshaft sprocket B
4. Key

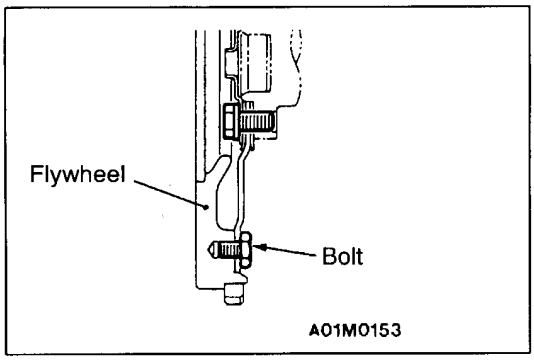
▶C◀ 5. Crankshaft front oil seal

Crankshaft rear oil seal removal steps

- Oil pan (Refer to P.11C-10.)

◀A▶
- Transmission assembly
- Clutch cover and disc

◀B▶ ▶B◀ 6. Plate
◀B▶ ▶B◀ 7. Adapter plate
◀B▶ ▶B◀ 8. Flywheel
◀B▶ ▶B◀ 9. Adapter plate
▶A◀ 10. Crankshaft rear oil seal

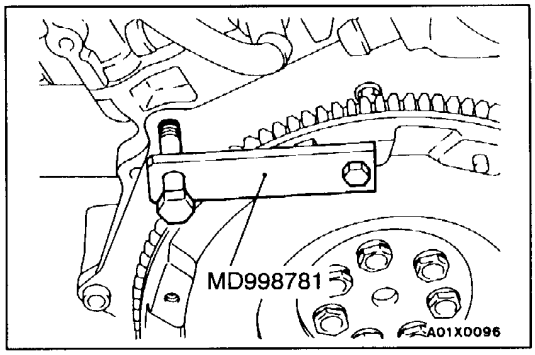


REMOVAL SERVICE POINTS

◀A▶ TRANSMISSION ASSEMBLY REMOVAL

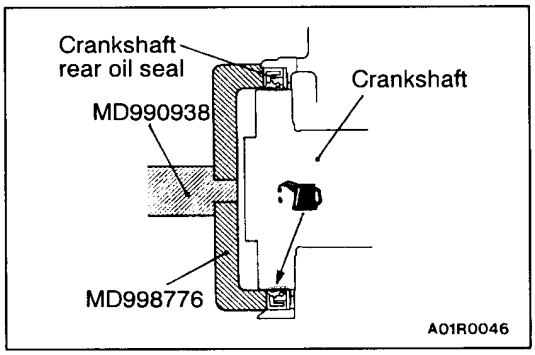
Refer to '99 SPACE RUNNER/SPACE WAGON Workshop Manual (Pub. No. PWDE9803) GROUP 22.

Caution
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▶ PLATE/ADAPTER PLATE/FLYWHEEL 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 mount 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◀ FLYWHEEL/ADAPTER PLATE/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.

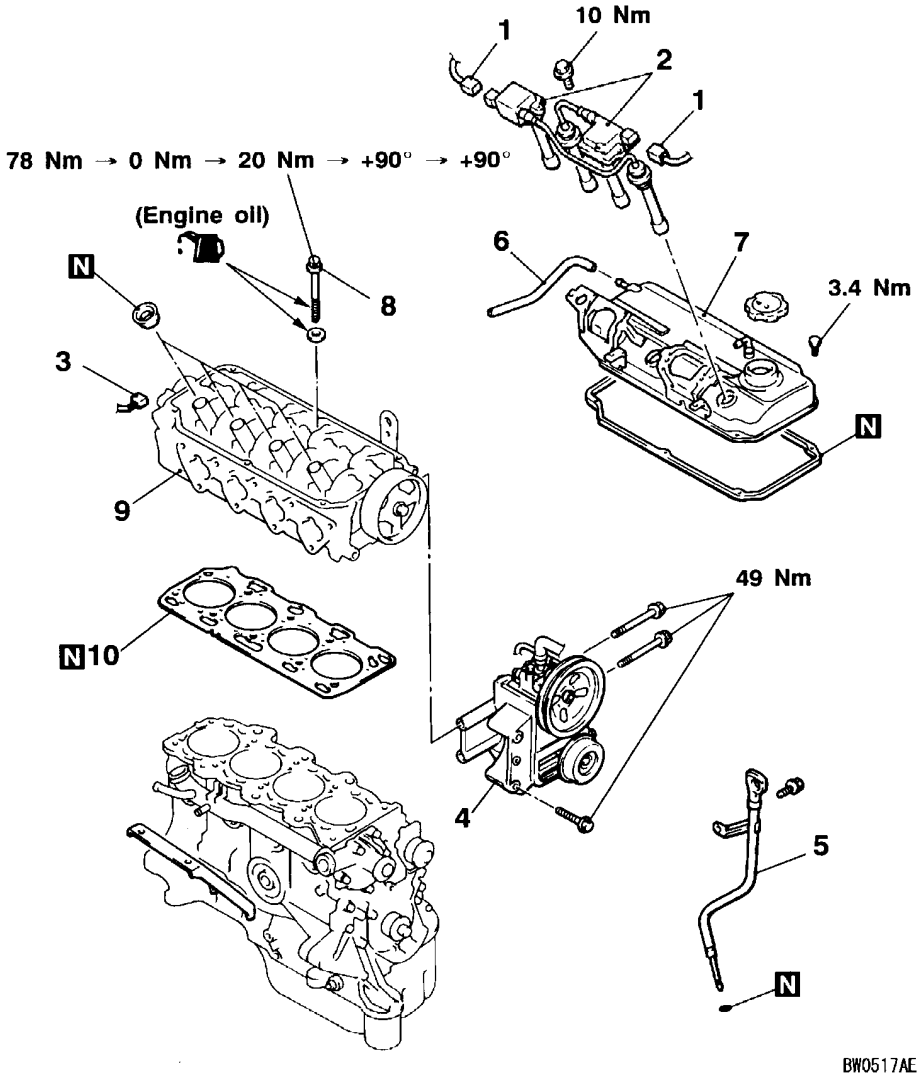
▶C◀ CRANKSHAFT FRONT OIL SEAL INSTALLATION

1. Apply a small amount of engine oil to the entire circumference of the oil seal lip.
2. 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 13D – On-vehicle Service.) <Pre-removal only>
- Engine Coolant Draining and Supplying
- Engine Oil Draining and Supplying
- Intake Manifold Removal and Installation (Refer to GROUP 15.)
- Exhaust Manifold Removal and Installation (Refer to GROUP 15.)
- Thermostat Case Assembly Removal and Installation (Refer to GROUP 14 – Water Hose and Pipe.)
- Timing Belt Removal and Installation (Refer to P.11C-17.)



Removal steps

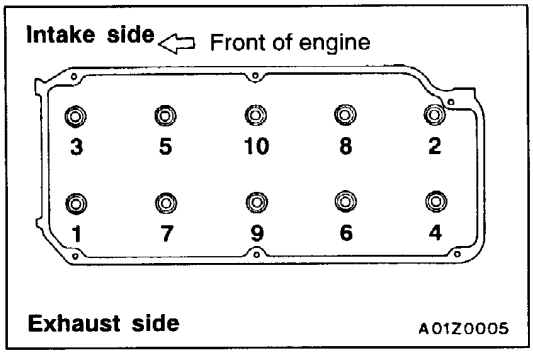
1. Ignition coil connector
2. Ignition coil assembly
3. Camshaft position sensor connector
◀A▶ 4. Power steering oil pump and bracket assembly
5. Engine oil level gauge
6. Breather hose
7. Rocker cover
◀B▶ ▶B◀ 8. Cylinder head bolt
9. Cylinder head assembly
▶A◀ 10. Cylinder head gasket

REMOVAL SERVICE POINTS

◀A▶ POWER STEERING OIL PUMP AND BRACKET ASSEMBLY 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 cylinder head assembly, and tie it with a cord.



◀B▶ CYLINDER HEAD BOLT REMOVAL

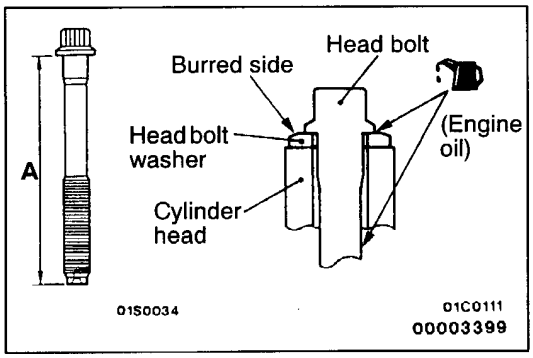
Loosen the bolts in 2 or 3 steps in order of the numbers shown in the illustration, and remove the cylinder head assembly.

Caution
Because the plug guides cannot be replaced by themselves, be careful not to damage or deform the plug guides when removing the cylinder head bolts.

INSTALLATION SERVICE POINTS

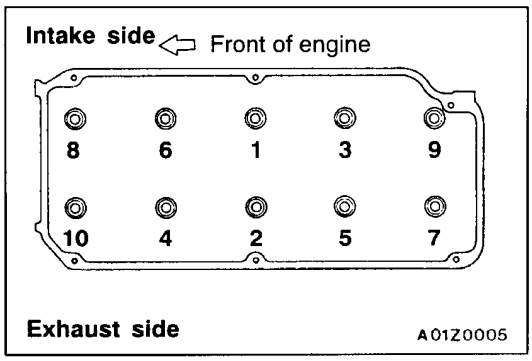
▶A◀ CYLINDER HEAD GASKET INSTALLATION

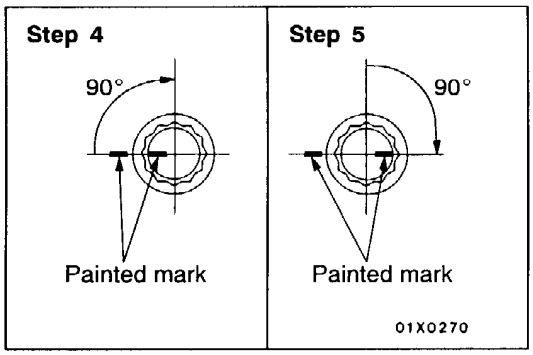
1. Wipe off all oil and grease from the gasket mounting surface.
2. Install so that the shapes of the cylinder head holes match the shapes of the respective cylinder head gasket holes.



▶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 burred 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.

▶C◀ HIGH-PRESSURE FUEL HOSE INSTALLATION

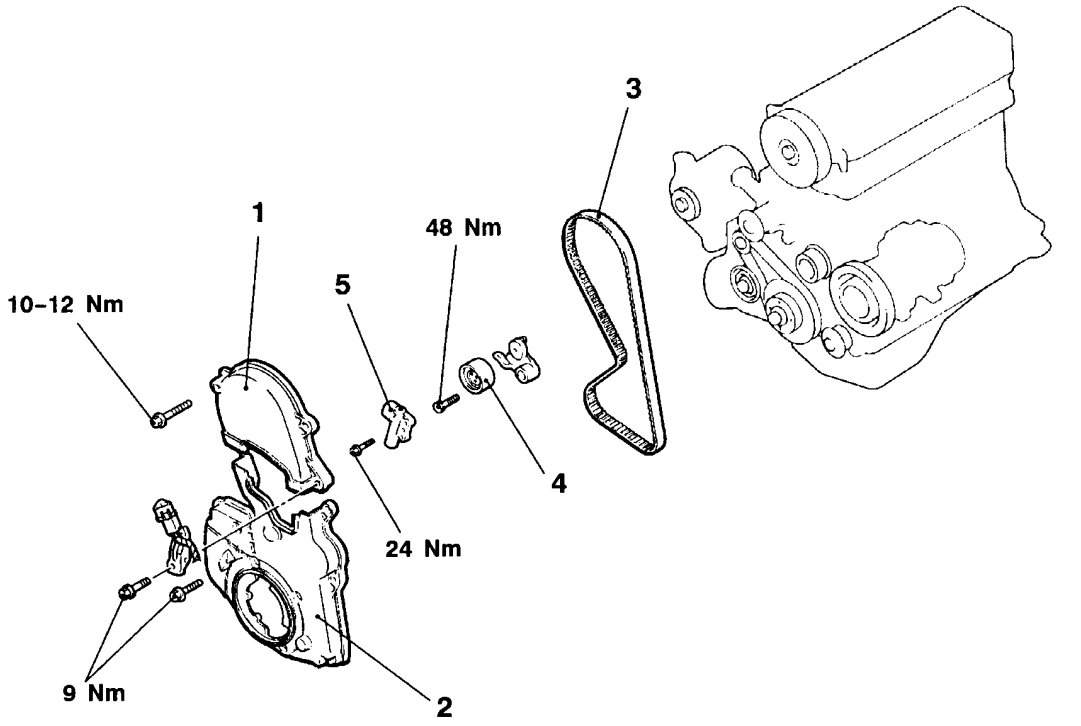
1. Apply a small amount of new engine oil to the O-ring.

   Caution
   Do not let any engine oil get into the delivery pipe.
2. While turning the high-pressure fuel hose to the right and left, install the delivery pipe, while being careful not to damage the O-ring. After installing, check that the hose turns smoothly.
3. If the hose does not turn smoothly, the O-ring is probably being clamped. Disconnect the high-pressure fuel hose and check the O-ring for damage. After this, re-insert the delivery pipe and check that the hose turns smoothly.

TIMING BELT

REMOVAL AND INSTALLATION

Pre-removal and Post-installation Operation
- Crankshaft Pulley Removal and Installation (Refer to P.11C-6.)
- Engine Mount Bracket Removal and Installation



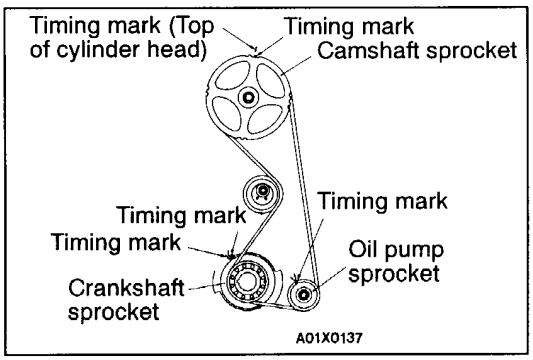
Removal steps

1. Timing belt upper cover
2. Timing belt lower cover

▶C◀ • Timing belt tension adjustment <Post-installation only>

◀A▶ ▶B◀ 3. Timing belt
4. Tension pulley

▶A◀ 5. Auto tensioner

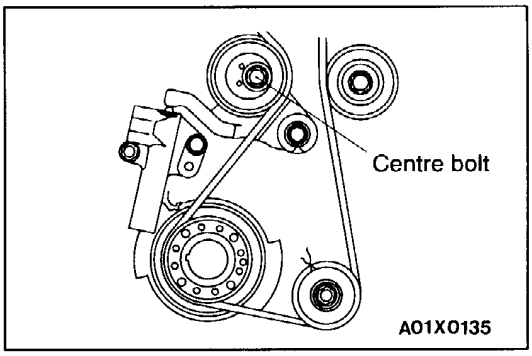


REMOVAL SERVICE POINT

◀A▶ TIMING BELT REMOVAL

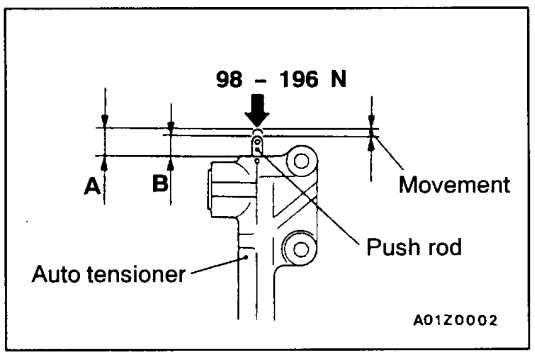
1. Turn the crankshaft clockwise (right turn) to align each timing mark and to set the No. 1 cylinder at compression top dead centre.

   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.



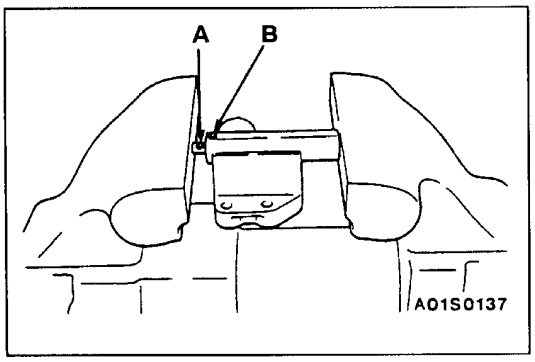
INSTALLATION SERVICE POINTS

▶A◀ 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.

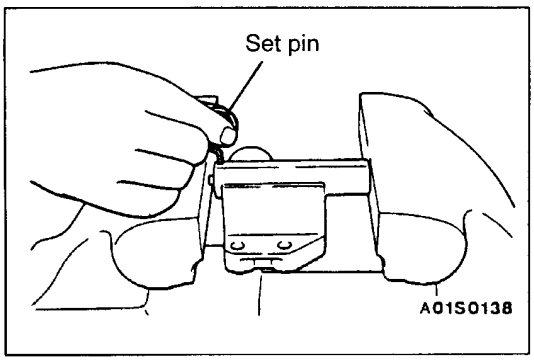
   Standard value: Within 1 mm
   A: Length when it is free (not pressed)
   B: Length when it is pressed
   A – B: Movement

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.

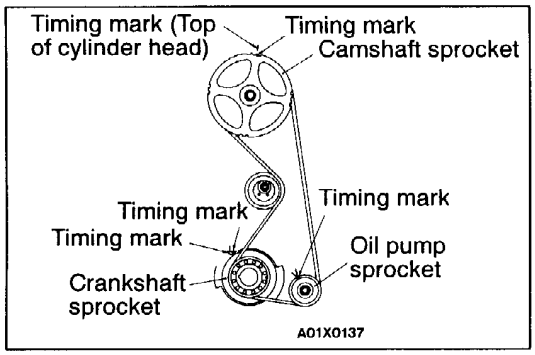
   Caution
   If the compression speed is too fast, the rod may become damaged, so be sure to carry out this operation slowly.



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

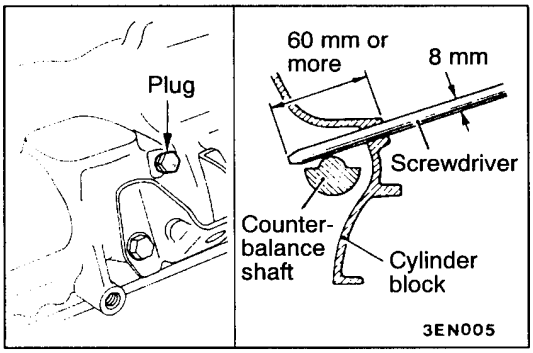
   NOTE
   When replacing the auto tensioner with a new part, the pin will be in the auto tensioner.

5. Install the auto tensioner to the engine.

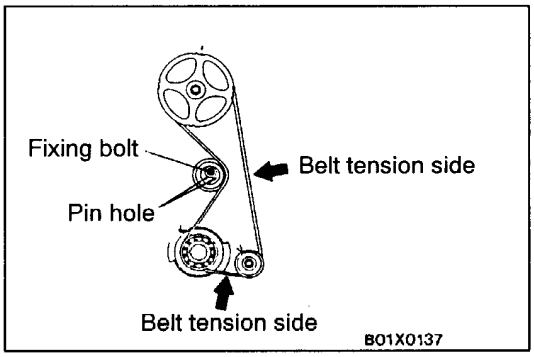


▶B◀ TIMING BELT INSTALLATION

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



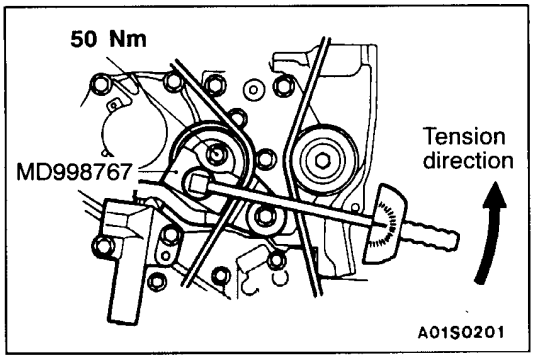
2. After aligning the timing mark on the oil pump sprocket, remove the cylinder block plug and insert a Phillips screwdriver with a diameter of 8 mm, and check to be sure that the screwdriver goes in 60 mm or more. If the screwdriver will only go in 20 – 25 mm before striking the counterbalance shaft, 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 belt to the crankshaft sprocket, oil pump sprocket and camshaft sprocket in that order, so that there is no slackness in the belt tension.

   Caution
   If the timing belt is re-used, install so that the arrow marked on it at time of removal is pointing in the clockwise direction.

4. Set the tension pulley so that the pin holes are at the top, press the tension pulley lightly against the timing belt, and then provisionally tighten the fixing bolt.
5. Adjust the timing belt tension.

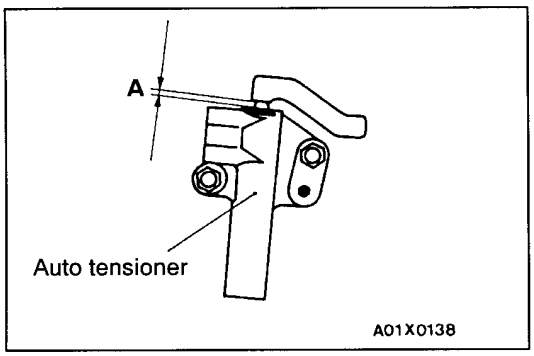


▶C◀ TIMING BELT TENSION ADJUSTMENT

1. After turning the crankshaft 1/4 of a revolution in the anti-clockwise 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.



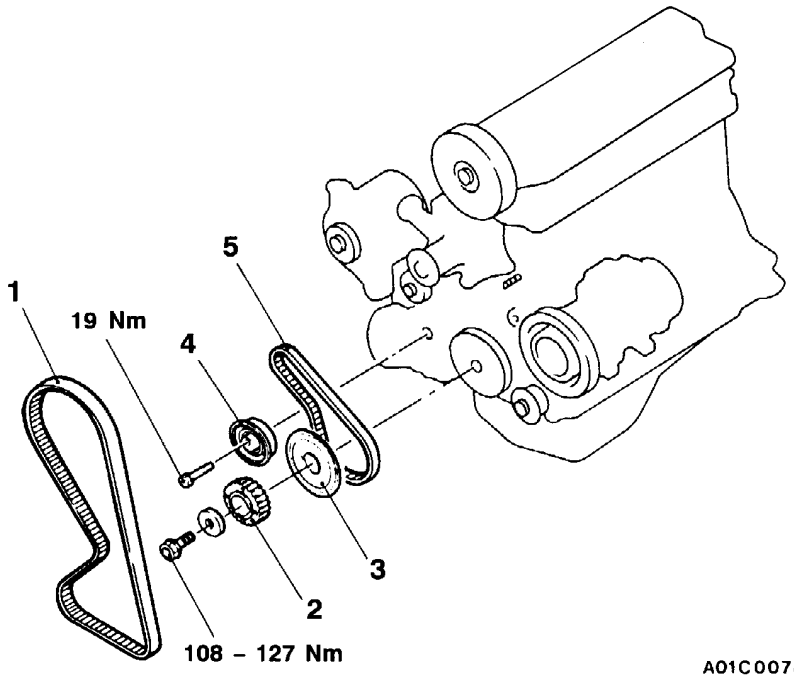
3. Turn the crankshaft two revolutions in the clockwise direction so that the timing marks are aligned. After leaving it for 15 minutes, measure the amount of protrusion of the auto tensioner.

   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.

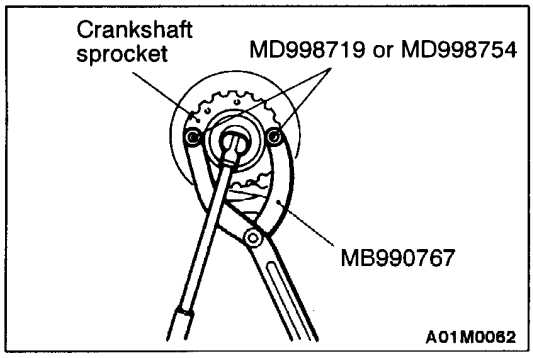
TIMING BELT B

REMOVAL AND INSTALLATION



Removal steps

1. Timing belt (Refer to P.11C-17.)
◀A▶ ▶C◀ 2. Crankshaft sprocket
▶B◀ 3. Flange
4. Timing belt B tensioner
◀B▶ ▶A◀ 5. Timing belt B

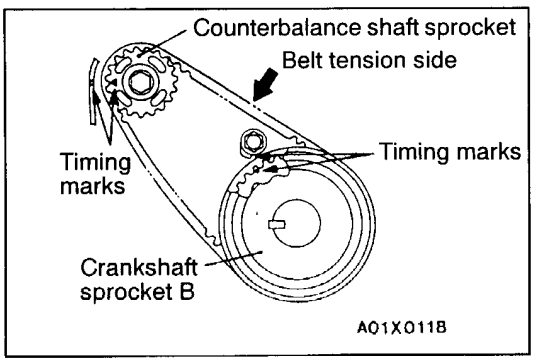


REMOVAL SERVICE POINTS

◀A▶ CRANKSHAFT SPROCKET REMOVAL

◀B▶ TIMING BELT B REMOVAL

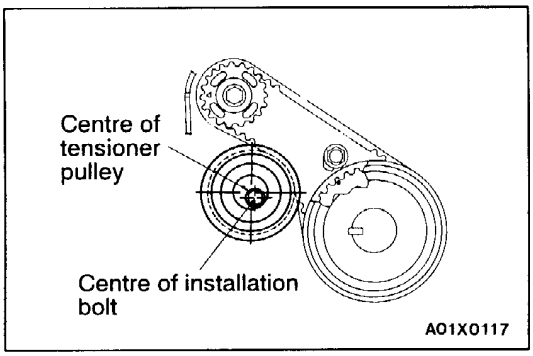
Caution
If timing belt "B" is to be re-used, use chalk to mark it with an arrow on its flat side indicating the turning direction (to the right).



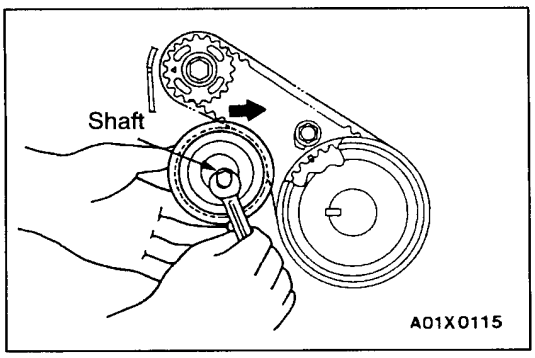
INSTALLATION SERVICE POINTS

▶A◀ TIMING BELT B INSTALLATION, ADJUSTMENT

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.

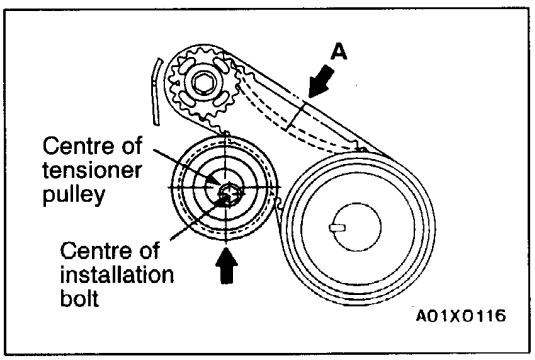


2. Adjust the tension of timing belt "B" by the following procedure.
   (1) Temporarily fix the timing belt "B" tensioner such that the centre of the tensioner pulley is to the left and above the centre of the installation bolt, and temporarily attach the tensioner pulley so that the flange is toward the front of the engine.



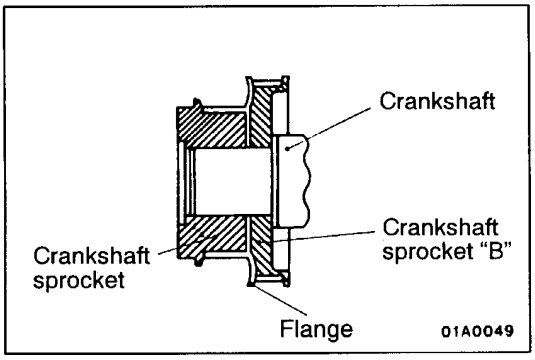
   (2) Holding the timing belt "B" tensioner up with your finger in the direction of the arrow, place pressure on the timing belt so that the tension side of the belt is taut. Now tighten the bolt to fix the tensioner.

   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.



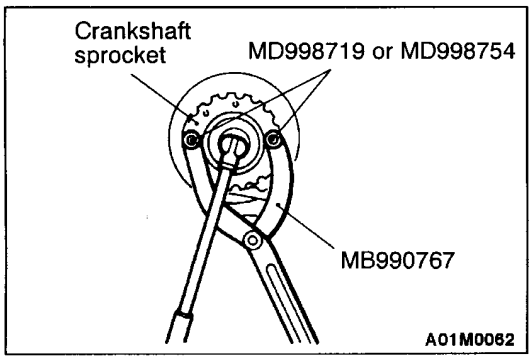
3. To ensure that the tension is correct, depress the belt (point A) with a finger. If not, adjust.

   Standard value: 5 – 7 mm



▶B◀ FLANGE INSTALLATION

When installing, make sure the direction is correct. See figure.



▶C◀ CRANKSHAFT SPROCKET INSTALLATION

NOTE

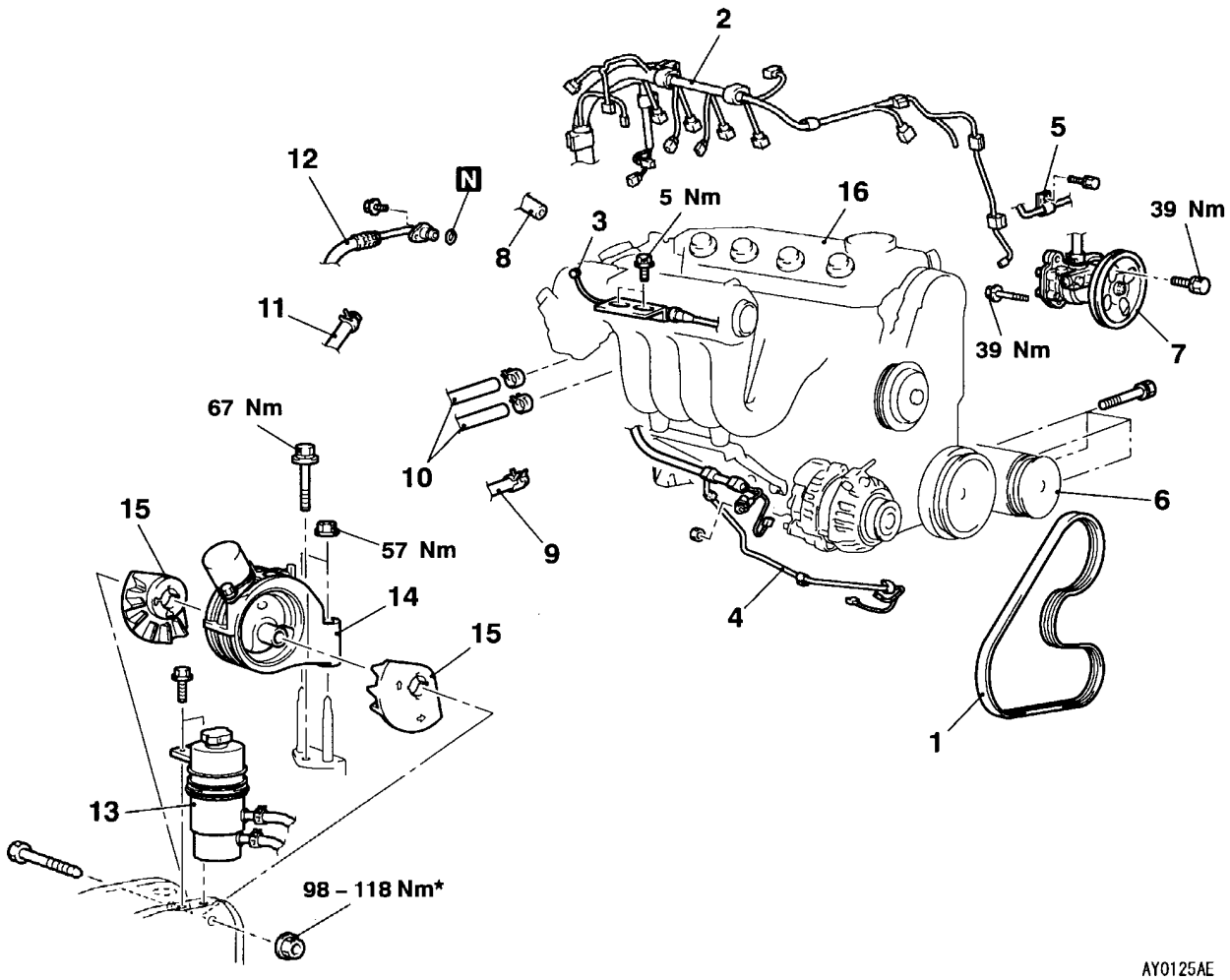
Apply the minimum amount of engine oil to the bearing surface and thread of the crankshaft bolt.

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 13D - On-vehicle Service.) <Pre-removal only>
- Engine Cover Removal and Installation
- Under Cover Removal and Installation
- Engine Coolant Draining and Supplying
- Hood Removal and Installation
- Transmission Assembly Removal and Installation
- Drive Belt Tension Adjustment (Refer to P.11C-4.) <Post-installation only>
- Accelerator Cable Adjustment <Post-installation only>



Removal steps

1. Drive belt (Power steering and A/C)
2. Engine harness connector
3. Accelerator cable connection
4. Battery harness connector
5. Power steering hose clamp
6. A/C compressor ◀A▶ ◀B▶
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. Power steering oil reservoir
14. Engine mount bracket ◀C▶ ▶C◀
15. Engine mount stopper ▶B◀
16. Engine assembly ◀D▶ ▶A◀

REMOVAL SERVICE POINTS

◀A▶ A/C COMPRESSOR REMOVAL

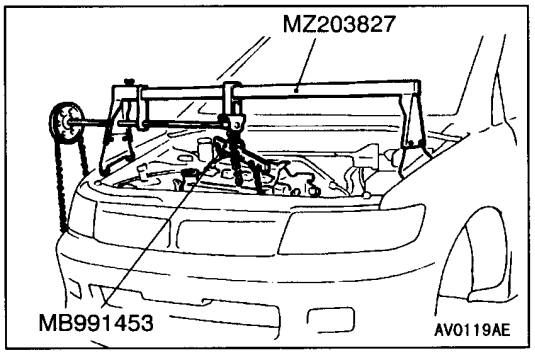
Disconnect the A/C compressor connector and remove the compressor from the compressor bracket with the hose still attached.

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

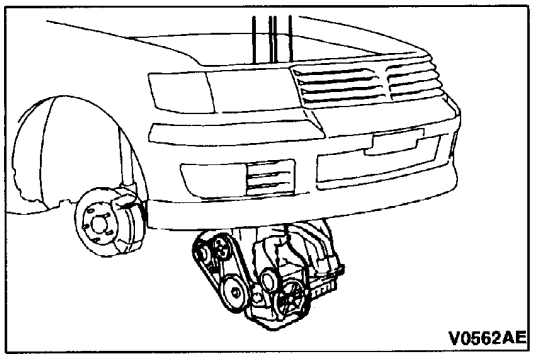
Remove the power steering oil pump and bracket assembly from the engine with the hose attached.

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.



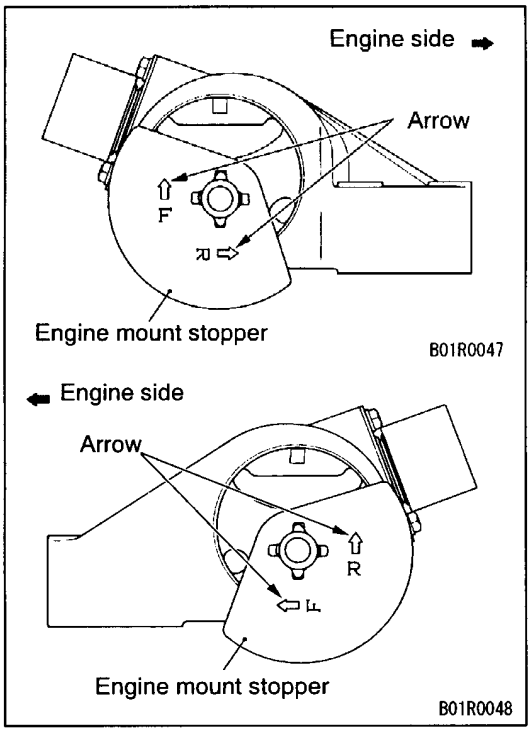
◀D▶ ENGINE ASSEMBLY REMOVAL

After checking that all cables, hoses and harness connectors, etc., are disconnected from the engine, lower the chain block slowly to remove the engine assembly downward 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.