

ENGINE

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ENGINE <4G9>	11A
ENGINE <F9Q>	11C



ENGINE <4G9>

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GDI

GENERAL

OUTLINE OF CHANGES

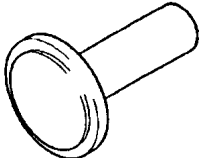
Due to the changes below, the following service procedures have been established. Other procedures are the same as before.

- The resin intake manifold is adopted.
- The fuel system is changed.

SEALANTS

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

SPECIAL TOOL

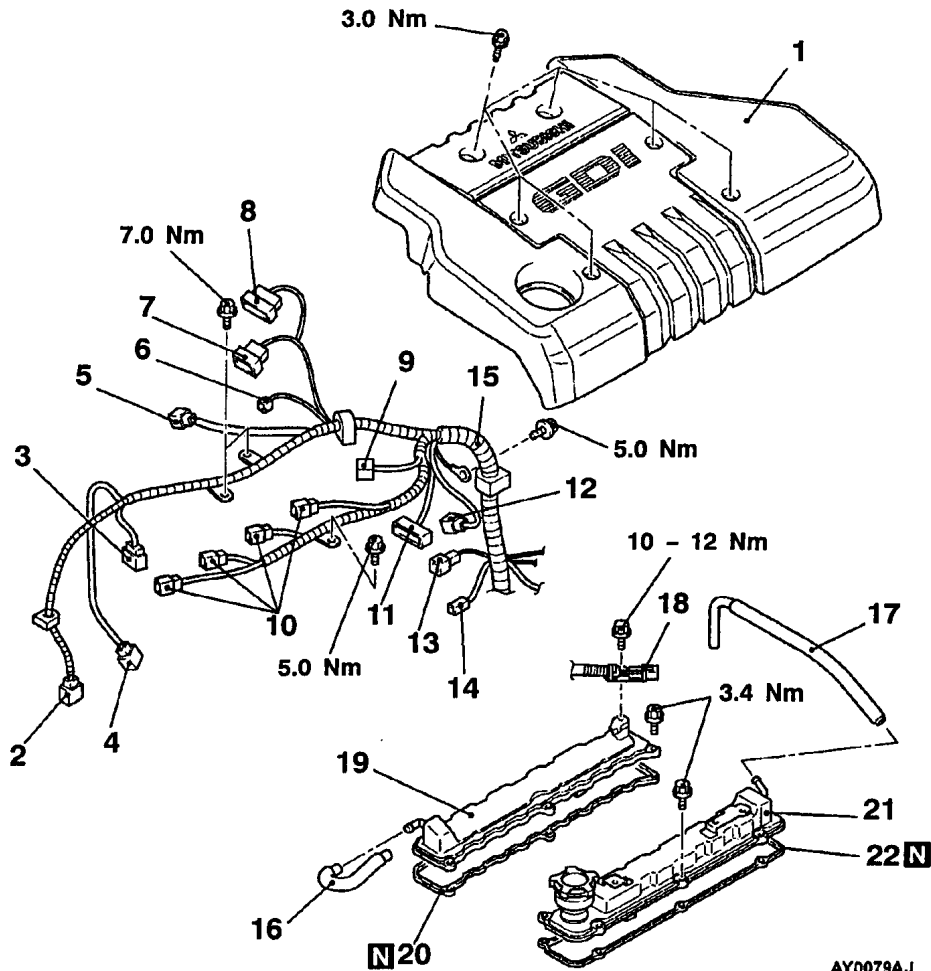
Tool	Number	Name	Use
	MD998762	Circular packing installer	Press-fitting the circular packing

CAMSHAFT AND CAMSHAFT OIL SEAL

REMOVAL AND INSTALLATION

Pre-removal and Post-Installation Operation

- Prevention of Fuel Discharge <before removal only>
- Fuel Leak Check <after installation only>
- Air Bleeding the High Pressure Fuel Path <after installation only>
- [Refer to GROUP 13A - Fuel Pump (High pressure).]
- Under Cover Removal and Installation
- Engine Coolant Draining and Supplying
- Air Intake Hose Removal and Installation

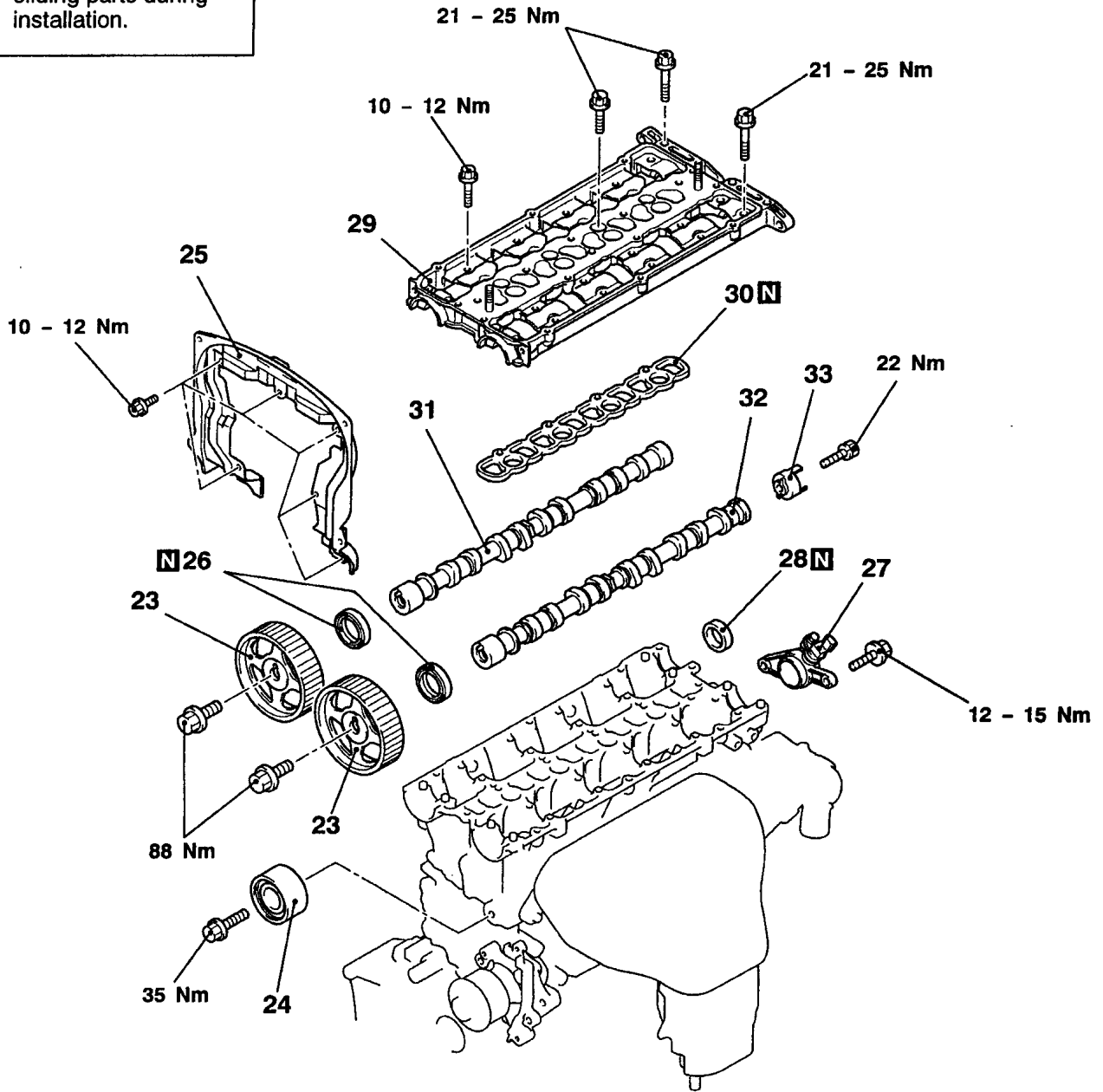


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Removal steps

1. Engine cover
2. Crank angle sensor connector
3. Fuel pressure sensor
4. Oxygen sensor (front) connector
5. Control wiring harness and EGR wiring harness combination connector
6. Purge control solenoid valve connector
7. Throttle position sensor connector
8. Throttle valve control servo connector
9. Control wiring harness and injector wiring harness combination connector
10. Ignition coil connector
11. Ignition failure sensor connector
12. Camshaft position sensor connector
13. Engine coolant temperature sensor connector
14. Engine coolant temperature gauge unit connector
15. Control wiring harness
16. PCV hose
17. Breather hose
 - Ignition coil (Refer to GROUP 16.)
 - Intake manifold (Refer to GROUP 15.)
 - Timing belt
18. Connector bracket (injector wiring harness)
19. Rocker cover (intake side)
20. Rocker cover gasket
21. Rocker cover (exhaust side)
22. Rocker cover gasket

Apply engine oil to all sliding parts during installation.

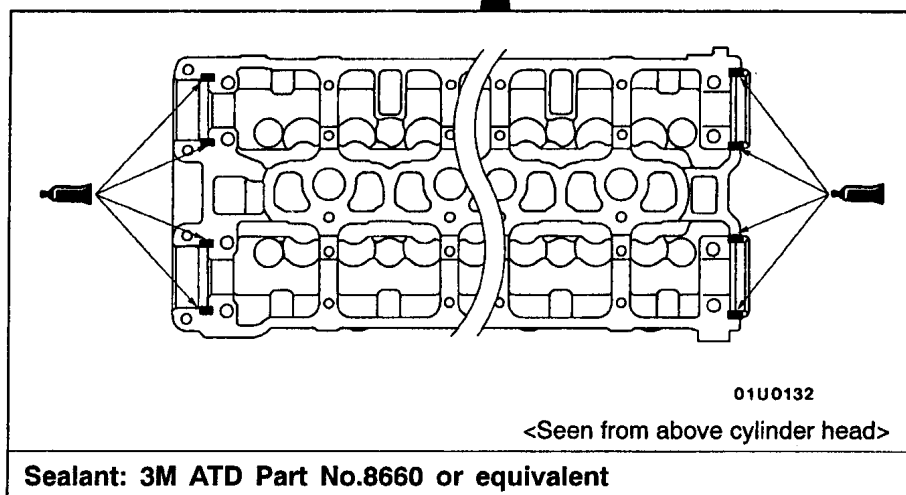
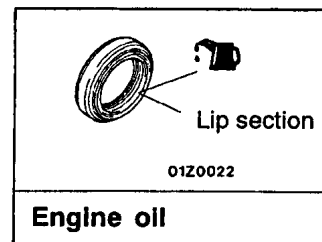
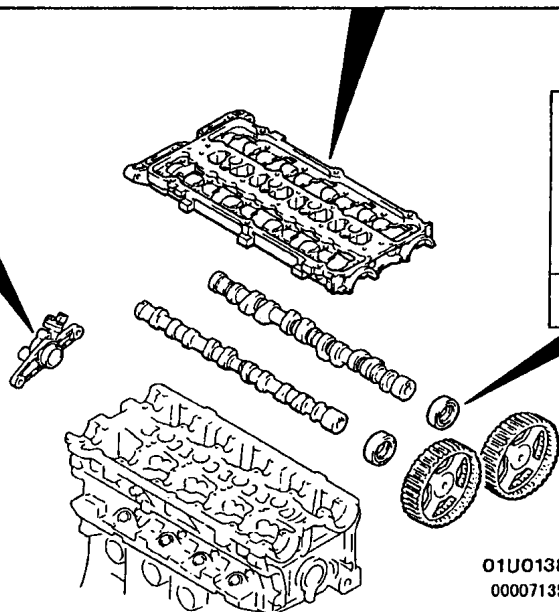
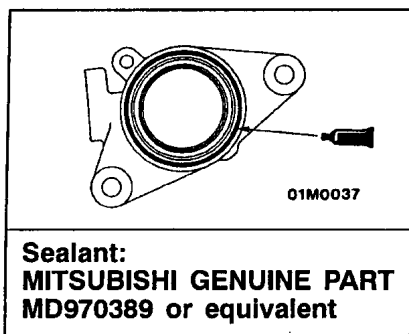
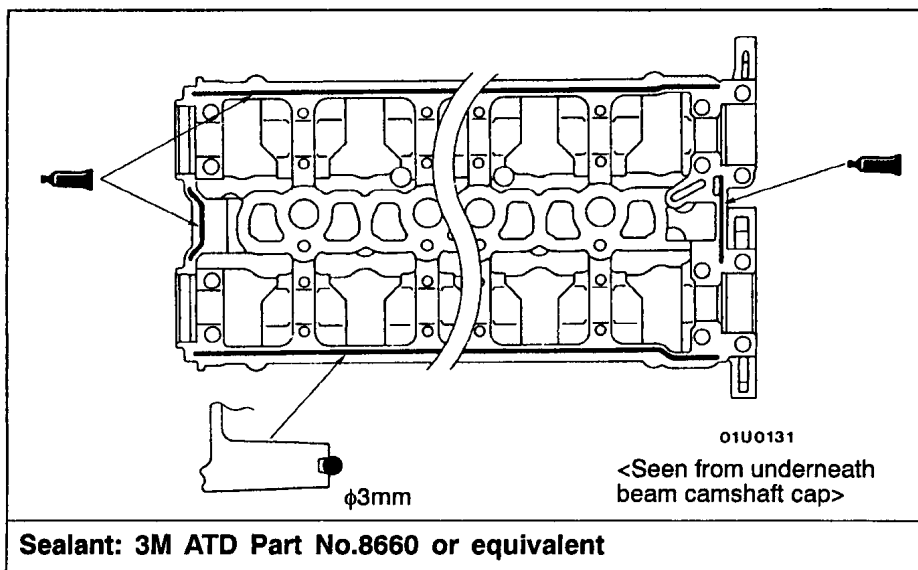


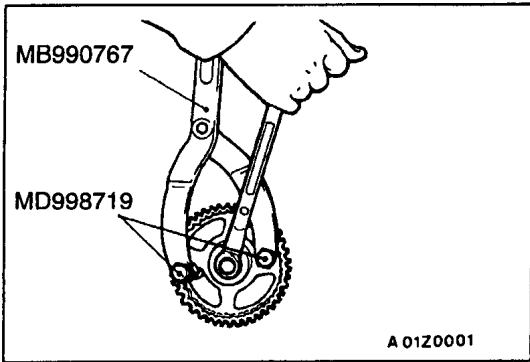
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- ◀A▶ ▶E▶ 23. Camshaft sprocket
- ▶D▶ 24. Idler pulley
- ▶D▶ 25. Timing belt rear upper cover
- ▶C▶ 26. Camshaft oil seal
- ▶C▶ 27. Camshaft position sensor support
- ▶C▶ 28. Circular packing

- Fuel pump (high pressure) assembly (Refer to GROUP 13A.)
- ▶B▶ 29. Beam camshaft cap
- ▶A▶ 30. Beam camshaft cap gasket
- ▶A▶ 31. Camshaft (intake side)
- ▶A▶ 32. Camshaft (exhaust side)
- ▶A▶ 33. Camshaft position sensing cylinder

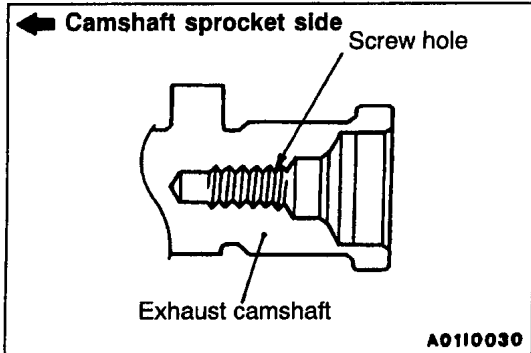
Lubrication points





REMOVAL SERVICE POINT

◀A▶ CAMSHAFT SPROCKET REMOVAL



INSTALLATION SERVICE POINTS

▶A◀ CAMSHAFT INSTALLATION

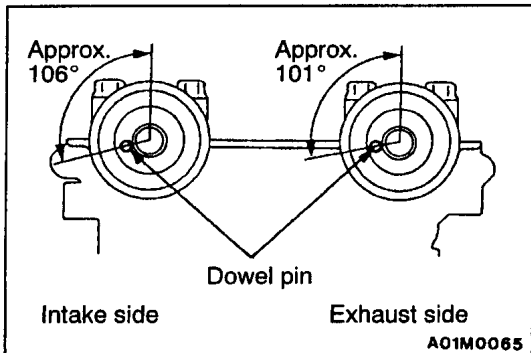
1. Apply engine oil to journals and cams of the camshafts.
2. Install the camshafts on the cylinder head.

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

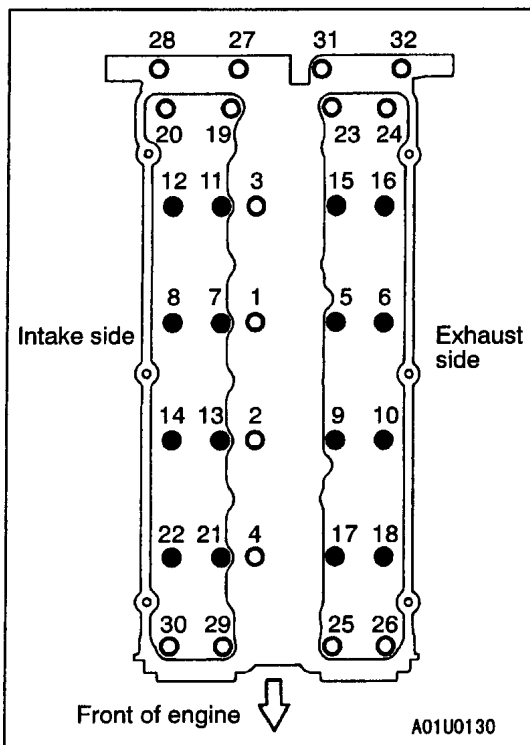
1. Place the camshaft dowel pin as shown in the illustration.

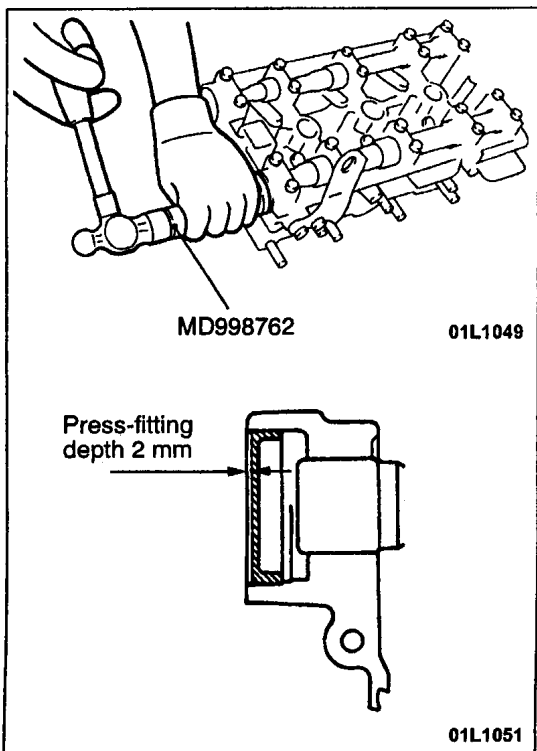


2. Tighten the beam camshaft cap mounting bolts to the specified torque in the order shown in the illustration.

Tightening torque:

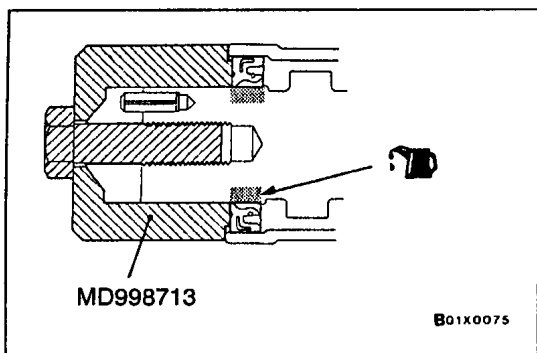
- : 10 – 12 Nm
- : 21 – 25 Nm





►C◄ CIRCULAR PACKING INSTALLATION

Use the special tool to press-fit the circular packing as shown in the illustration.



►D◄ 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.

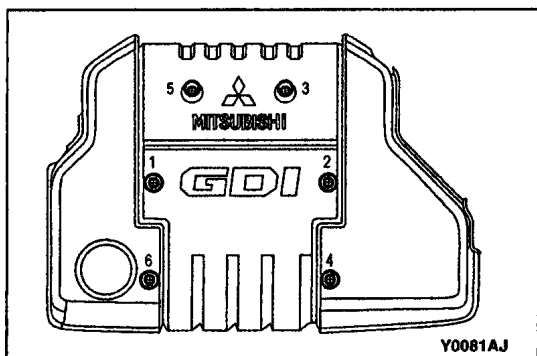
►E◄ CAMSHAFT SPROCKET INSTALLATION

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.

►F◄ ENGINE COVER INSTALLATION

1. Temporarily tighten the mounting bolt in the order of the numbers shown in the illustration so that the engine cover can move easily by hand.
2. Tighten the mounting bolt to the specified torque in the order of the numbers shown in the illustration.

Tightening torque: 3.0 Nm

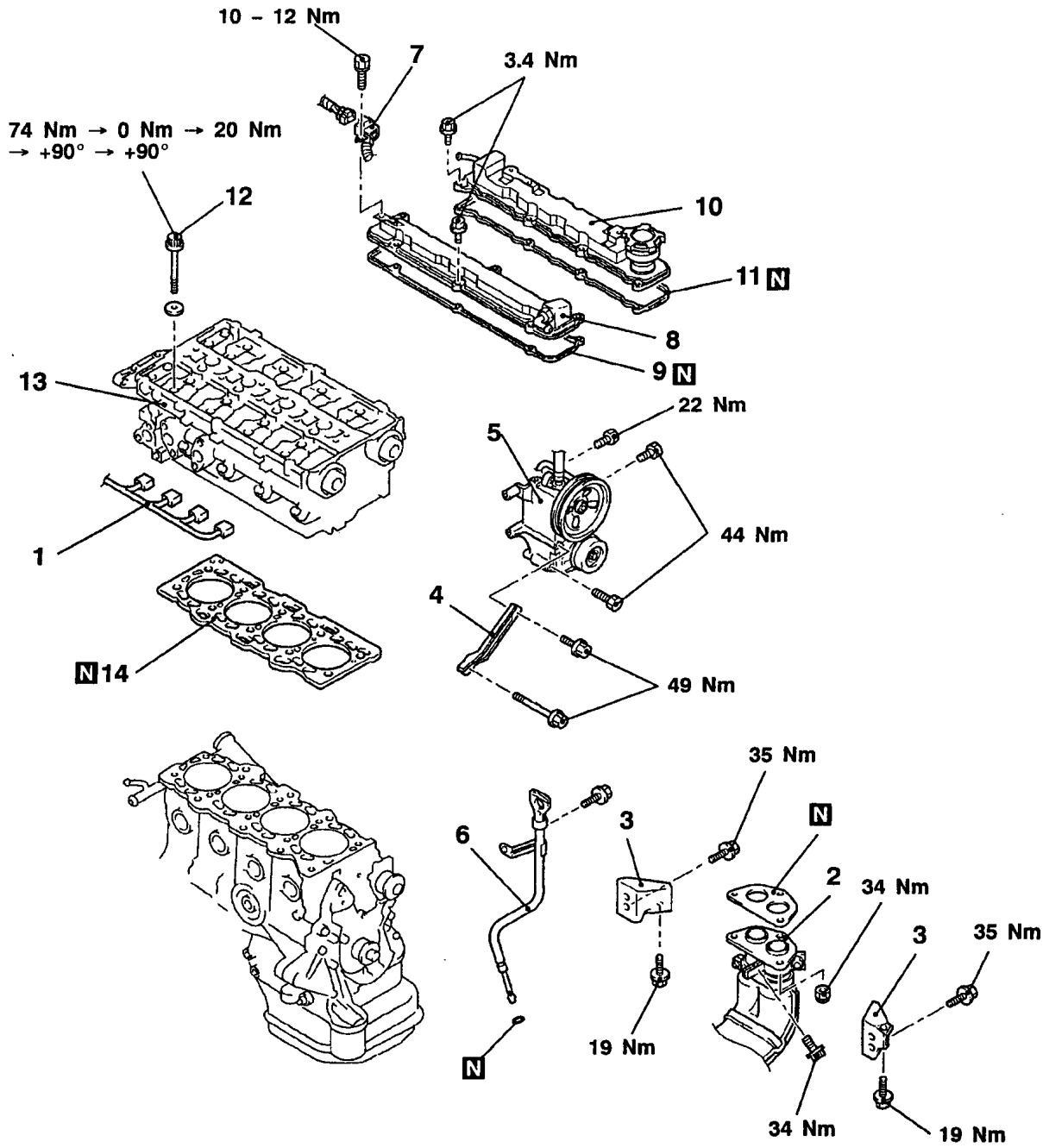


CYLINDER HEAD GASKET

REMOVAL AND INSTALLATION

Pre-removal and Post-Installation Operation

- Engine Cover Removal and Installation (Refer to P.11A-4.)
- Prevention of Fuel Discharge <before removal only>
- Fuel Leak Check <after installation only>
- Air Bleeding the High Pressure Fuel Path<after installation only>
[Refer to GROUP 13A – Fuel Pump (High-pressure).]
- Under Cover Removal and Installation
- Engine Coolant Draining and Supplying
- Engine Oil Draining and Supplying
- Air Intake Hose Removal and Installation
- Intake Manifold Removal and Installation (Refer to GROUP 15.)
- Fuel Pump (high-pressure) Assembly Removal and Installation (Refer to GROUP 13A.)
- Timing Belt Rear Upper Cover Removal and Installation
- Thermostat Case Assembly and Radiator upper hose Removal and Installation (Refer to GROUP 14 – Water Hose and Water Pipe.)



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Removal steps

- | | |
|---|--|
| <ul style="list-style-type: none"> 1. Injector harness connector 2. Front exhaust pipe connection 3. Exhaust manifold bracket 4. Power steering oil pump bracket stay 5. Power steering oil pump and bracket assembly 6. Engine oil level gauge assembly 7. Connector bracket (injector wiring harness) 8. Rocker cover (intake side) | <ul style="list-style-type: none"> 9. Rocker cover gasket 10. Rocker cover (exhaust side) 11. Rocker cover gasket 12. Cylinder head bolt 13. Cylinder head assembly 14. Cylinder head gasket |
|---|--|



NOTE
Removal and installation service points are the same as before.

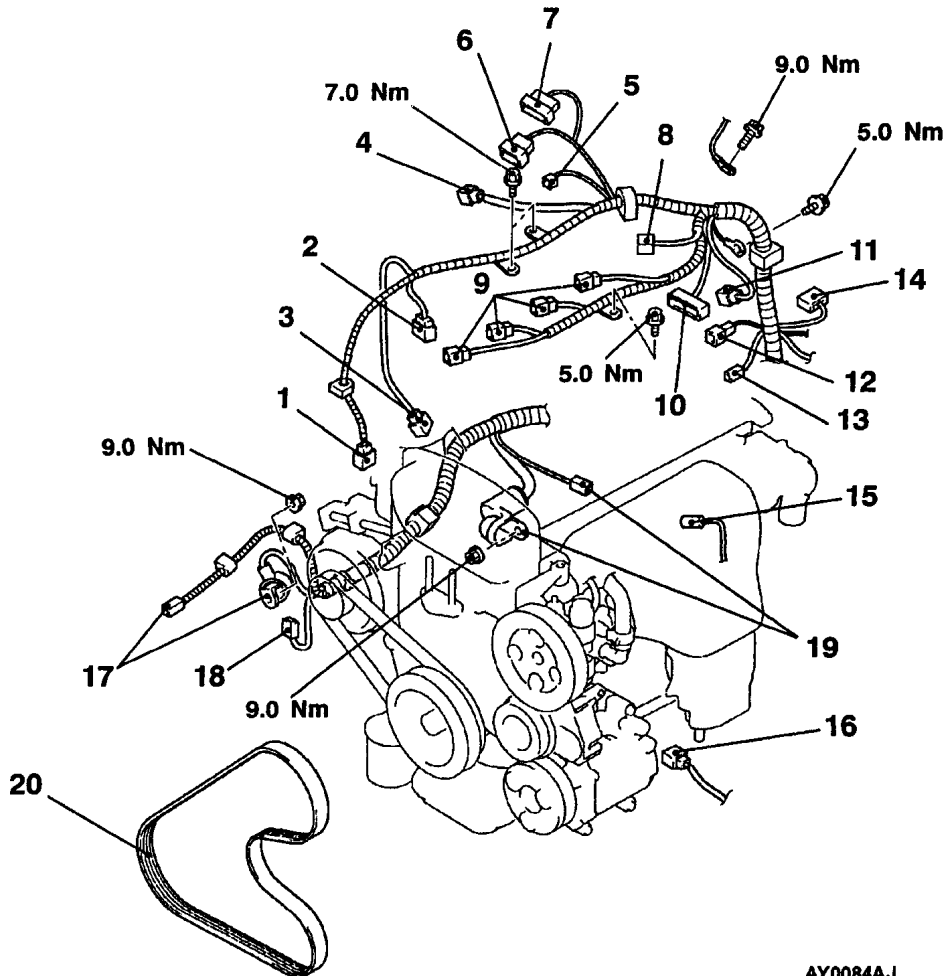
◀A▶

ENGINE ASSEMBLY

REMOVAL AND INSTALLATION

Pre-removal and Post-Installation Operation

- Engine Cover Removal and Installation (Refer to P.11A-4.)
- Prevention of Fuel Discharge <before removal only>
- Air Bleeding the High Pressure Fuel Path <after installation only> [Refer to GROUP 13A – Fuel Pump (High pressure).]
- Fuel Leak Check <after installation only>
- Drive Belt Tension Adjustment
- Under Cover Removal and Installation
- Air Cleaner Removal and Installation
- Hood Removal and Installation
- Radiator Assembly Removal (Refer to GROUP 14.)



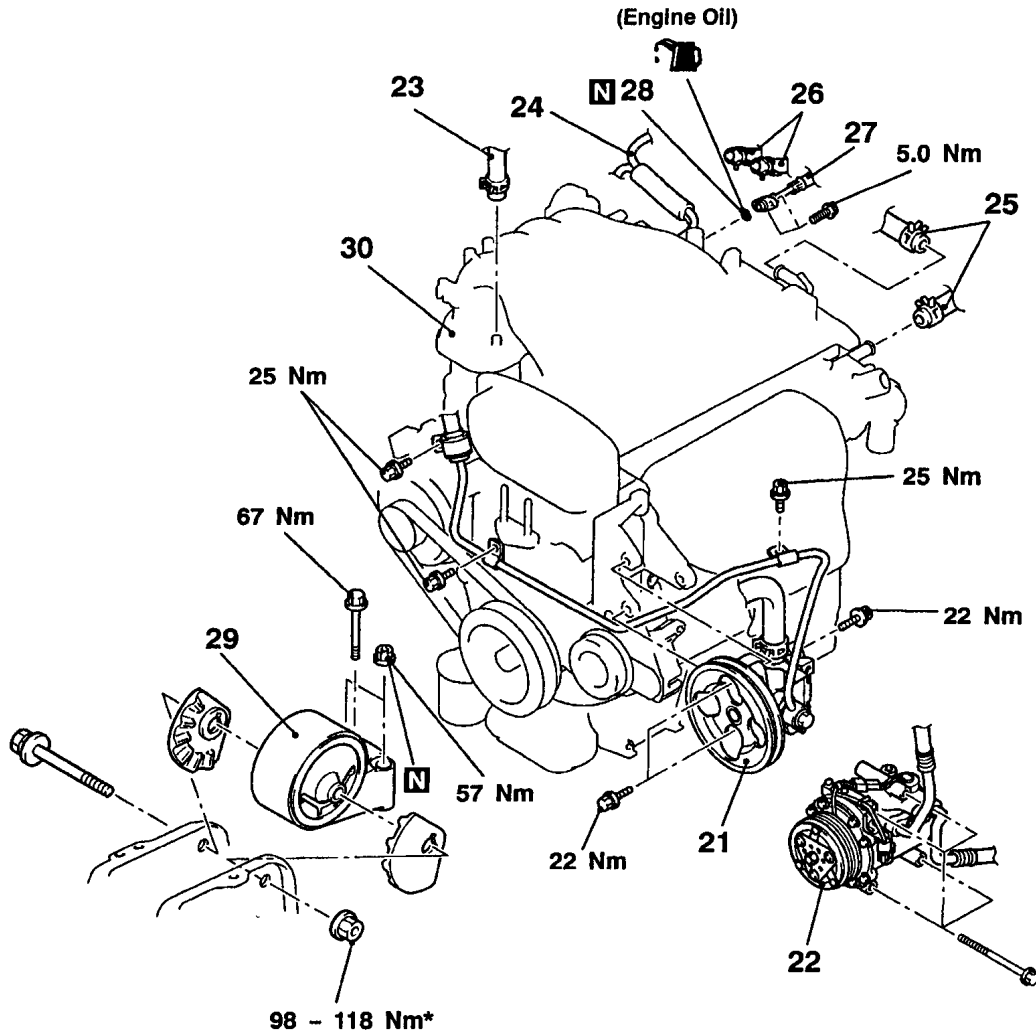
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Removal steps

1. Crank angle sensor connector
2. Fuel pressure sensor
3. Oxygen sensor (front) connector
4. Control wiring harness and EGR wiring harness combination connector
5. Purge control solenoid valve connector
6. Throttle position sensor connector
7. Throttle valve control servo connector
8. Control wiring harness and injector wiring harness combination connector
9. Ignition coil connector
10. Ignition failure sensor connector
11. Camshaft position sensor connector
12. Engine coolant temperature sensor connector
13. Engine coolant temperature gauge unit connector
14. Detonation sensor connector
15. Power steering oil pressure switch connector
16. A/C compressor connector
17. Alternator connector
18. Engine oil pressure switch connector
19. Starter connector
20. Drive belt (Power steering and A/C)

Caution

Mounting locations marked by * should be provisionally tightened, and then fully tightened when the body is supporting the full weight of the engine.



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- 21. Power steering oil pump
- 22. A/C compressor
- 23. Brake booster vacuum hose connection
- 24. Vacuum hose connection
- 25. Heater hoses connection
- 26. Fuel return hoses connection
- 27. High-pressure fuel hose connection



- 28. O-ring
- Transmission assembly



- 29. Engine mount Bracket
- 30. Engine assembly



NOTE

Removal and installation service points which are not listed in this manual are the same as before.

INSTALLATION SERVICE POINTS**►C◄ O-RING/HIGH-PRESSURE FUEL HOSE
INSTALLATION**

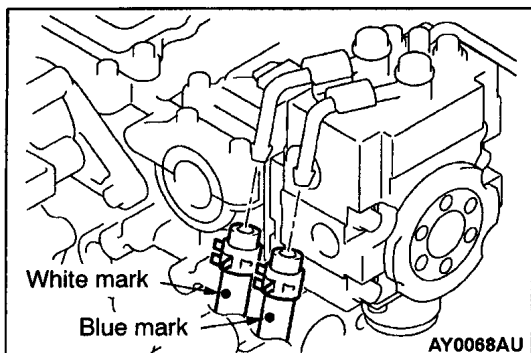
1. Apply a small amount of new engine oil to the O-ring.

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.
4. Tighten to the specified torque.

Specified torque: 5.0 Nm

**►D◄ FUEL RETURN HOSES INSTALLATION**

Install so that the identification marks of the fuel return hoses are at the positions shown in the illustration.

MPI

GENERAL

OUTLINE OF CHANGE

The following service adjustment procedures have been changed. Other procedures are the same as before.

- Auto-lash adjusters have been adopted.
- The valve timing has been changed.

GENERAL INFORMATION

Items			4G92-MPI
Valve timing	Intake	Opening	BTDC 12°
		Closing	ABDC 46°
	Exhaust	Opening	BBDC 46°
		Closing	ATDC 12°
Auto-lash adjuster			equipped

ON-VEHICLE SERVICE

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.

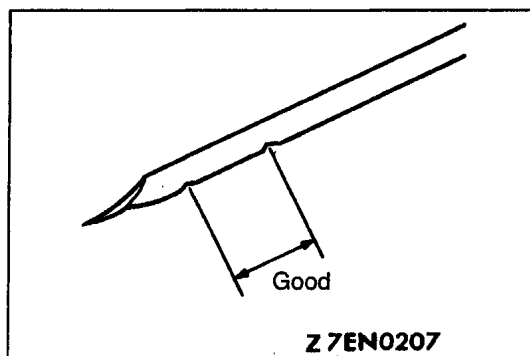
The only case where the noise might disappear is if the oil in the engine has not been looked after properly and oil sludge has caused the lash adjusters to stick.

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.

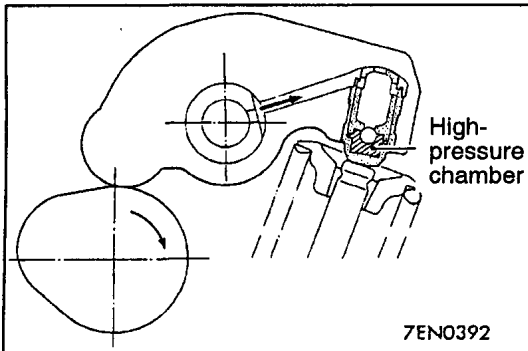


1. Check the engine oil and replenish or replace the oil if necessary.

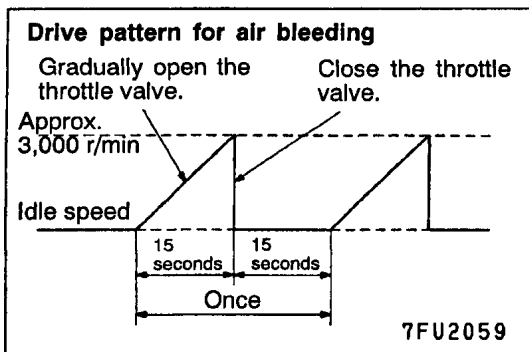
NOTE

- (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 be 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.

ENGINE <F9Q>

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11C-2 ENGINE <F9Q> – General/General Information/Service Specifications

GENERAL

OUTLINE OF CHANGE

The following maintenance service points have been established to correspond to the adoption of the F9Q engine.

GENERAL INFORMATION

Items		Specification	
Total displacement mL		1,870	
Bore x Stroke mm		80 x 93	
Compression ratio		19	
Combustion chamber		Direct injection type	
Camshaft arrangement		SOHC	
Number of valve	Intake	4	
	Exhaust	4	
Valve timing	Intake	Opening	3° BTDC
		Closing	21° ABDC
	Exhaust	Opening	46° BBDC
		Closing	6° BTDC
Fuel system		Common rail fuel injection	

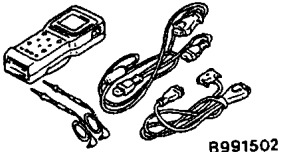
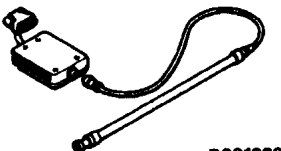
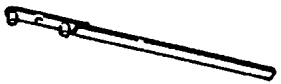
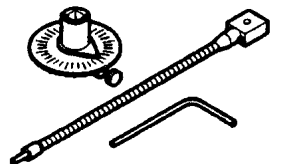
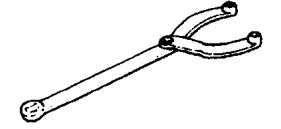
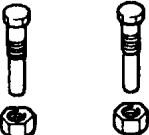
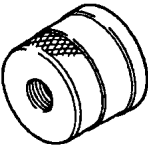
SERVICE SPECIFICATIONS

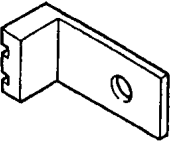
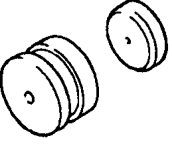
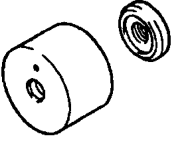
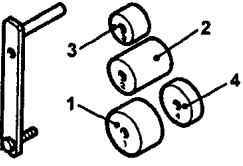
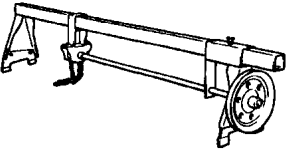
Items			Standard value	Limit
Valve clearance (at cold) mm	When checking	Intake valve	0.15 – 0.25	–
		Exhaust valve	0.35 – 0.45	–
	When adjusting	Intake valve	0.20	–
		Exhaust valve	0.40	–
Idle speed r/min			750 ± 10	–
Compression pressure (250 – 400 r/min) kPa			–	Min. 2,000
Compression pressure difference of all cylinder kPa			–	Max. 400
Timing belt frequency Hz			90 ± 15	–

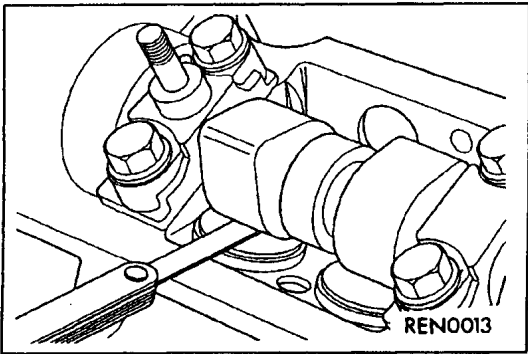
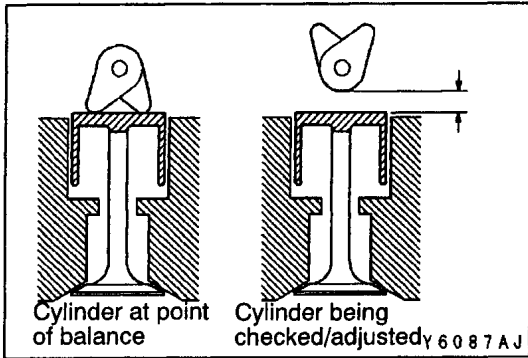
SEALANTS

Item	Specified sealant	Remark
Oil pan	MITSUBISHI GENUINE PART MD970389 or equivalent	Semi-drying sealant
Beam cam cap		
Fly wheel bolt	3M stud locking 4170 or equivalent	Anaerobic sealant

SPECIAL TOOLS

Tool	Number	Name	Use
 B991502	MB991502	MUT-II sub assembly	<ul style="list-style-type: none"> Measuring the drive belt tension Checking the idle speed
 B991668	MB991668	Belt tension meter set	Measuring the drive belt tension (Used together with the MUT-II)
	MD998747	Crankshaft pulley holder	Holding the crankshaft pulley
	MB991614	Angle gauge	<ul style="list-style-type: none"> Tightening of the crankshaft pulley bolt Tightening of the cylinder head bolts
	MB990767	End yoke holder	Holding the camshaft sprocket
	MD998719	Crankshaft pulley holder pin	
	MB996042	Oil seal installer	Installation of camshaft oil seal

Tool	Number	Name	Use
	MB996015	Flywheel stopper	Locking the flywheel
	MB996038	Oil seal installer	Installation of the crankshaft rear oil seal
	MB996040	Oil seal installer	Installation of the crankshaft front oil seal
	MB996048	Belt pretensioner 1, 2, 3: cover 4: washer	Timing belt tension adjustment
	GENERAL SERVICE TOOL MZ203827	Engine lifter	Supporting the engine assembly during removal and installation of the transmission



ON-VEHICLE SERVICE

VALVE CLEARANCE CHECK AND ADJUSTMENT

- The valve clearances have to be checked/adjusted in the following sequence.

Cylinder at point of balance	Cylinder being checked/adjusted
1	4
2	3
3	2
4	1

- Measure the valve clearance.

Standard value:

Cold engine	Checking	Adjusting
Intake valve mm	0.15 – 0.20	0.20
Exhaust valve mm	0.35 – 0.45	0.40

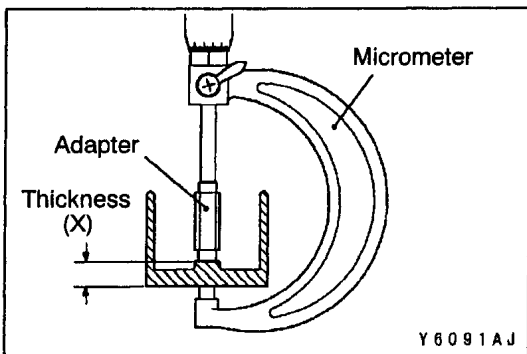
- If the valve clearance is outside the standard value, adjust by replacing the tappets using the following procedure.
- Re-measure the places which were outside the standard value, and make a note of the measurement value.

- Measure the thickness of the tappet (X) with a micrometer.
- Select a tappet which will bring the valve clearance to then standard value based on the measurement value.

$$\text{Thickness of tappet for adjustment} = \text{Thickness of tappet installed during inspection (X)} + (\text{measurement value} - \text{standard value})$$

NOTE

- Measure the thickness of the tappet pad with a micrometer.
 - Always use new tappets.
 - Tappets are available in thickness from 7.550 mm to 8.150 mm, increasing by increments of 0.025 mm.
- Remove the camshaft, and then install the selected tappet.
 - Install the camshaft.
 - After rotating the camshaft once, check that the valve clearances are at the standard values.



IDLE SPEED CHECK

1. Before inspection, set the vehicle to the pre-inspection condition.
2. Turn the ignition switch to the "LOCK" (OFF) position and connect the MUT-II to the diagnosis connector.
3. Start the engine and check that the idle speed is at the standard value.

Standard value: 750 ± 10 r/min

4. If the idle speed is not at the standard value, refer to GROUP 13E – Troubleshooting.

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. Disconnect the all injector connector.

NOTE

Doing this will prevent carrying out fuel injection.

3. Remove all of the glow plugs.
4. Cover the glow 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 glow plug hole when cranking.**
- (2) **If compression is measured with water, oil, fuel, etc., that has come from cranks inside the cylinder, these materials will become heated and will gush out from glow plug hole, which is dangerous.**

5. Set compression gauge to one of the glow plug holes.
6. Crank the engine and measure the compression pressure.

Limit: Min. 2,000 kPa

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

Limit: Max. 400 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 glow 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. Install the glow plugs.
10. Connect the injector connectors.

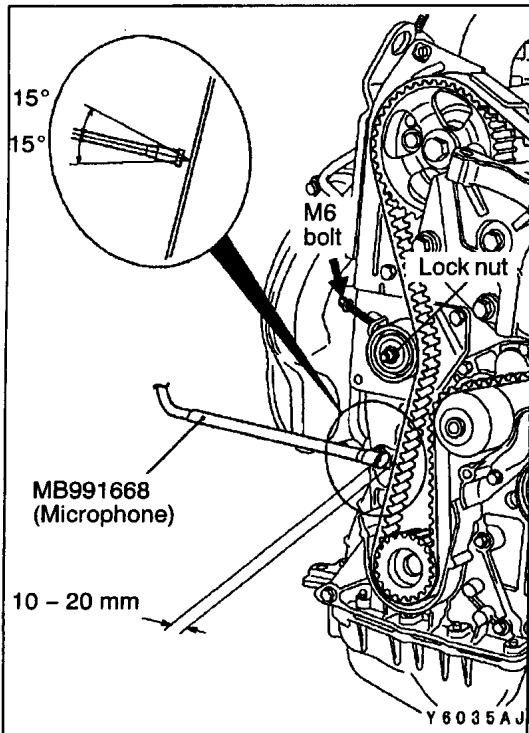
TIMING BELT TENSION ADJUSTMENT

1. Connect the special tool (belt tension meter set) to the MUT-II.
2. Connect the MUT-II to the diagnosis connector.
3. Remove the timing belt cover.
4. Turn the crankshaft clockwise to set the No. 1 cylinder to top dead compression centre.
5. Turn the ignition switch to "ON" position and select "Belt tension measurement" from the MUT-II menu screen.
6. Slacken the lock nut of the timing belt tensioner.
7. Tension the timing belt with the aid of an M6 bolt.
8. As shown in the illustration, keep the microphone (MB991668) 10 to 20 mm away from the back side of the belt perpendicularly (within an inclination of ± 15 degrees).
9. With your finger tip lightly tap the centre of the belt between the tensioner and crankshaft sprocket in the location shown by the arrow in the illustration to check whether the belt frequency is within the standard value.

Standard value: 90 ± 15 Hz

Caution

- (1) Measure when the belt surface temperature is close to room temperature.
- (2) Make sure that the water or oil, etc., does not get on the microphone.
- (3) If a strong wind blows or noise is made close to the microphone during measure, the meter will show a value that differs from the actual value.
- (4) If the measurement is taken with the microphone touching the belt, the meter will show a value that differs from the actual value.
- (5) Do not measure while the engine is running.

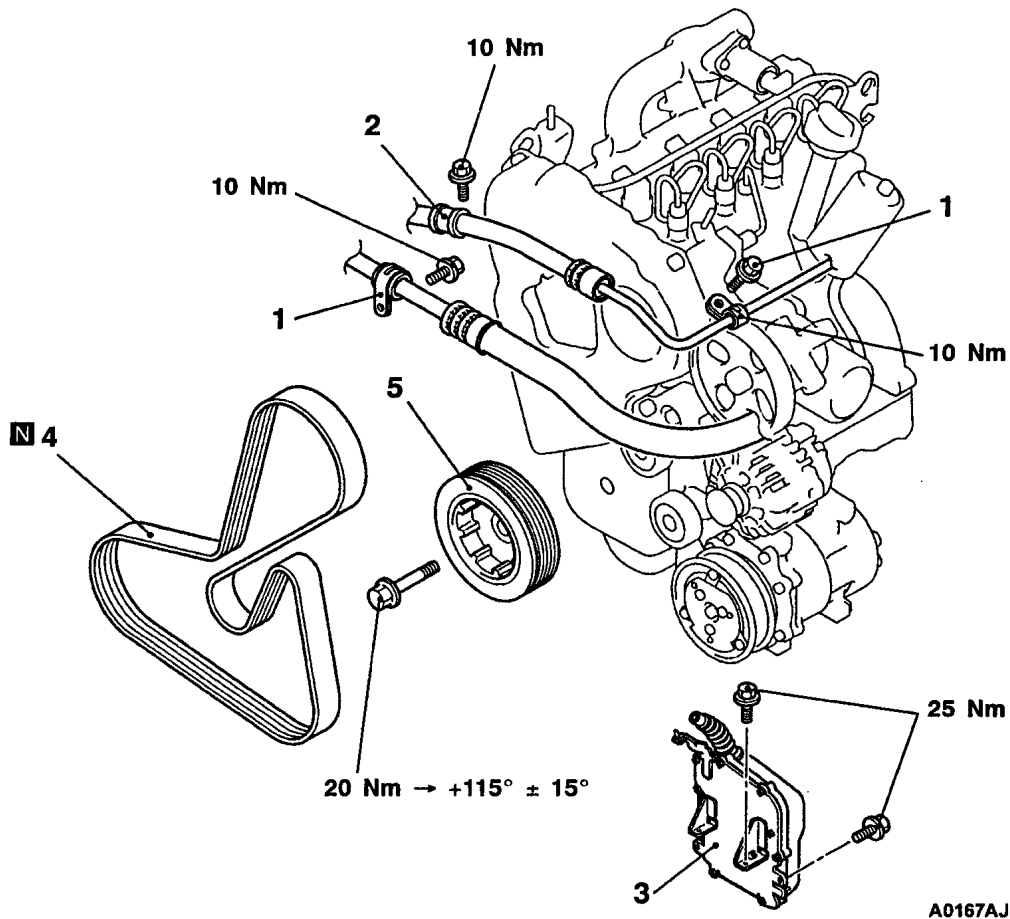


CRANKSHAFT PULLEY

REMOVAL AND INSTALLATION

Pre-removal and Post-Installation Operation

- Under Cover Removal and Installation



Removal steps

1. A/C suction hose clamp
2. Power steering pressure hose clamp

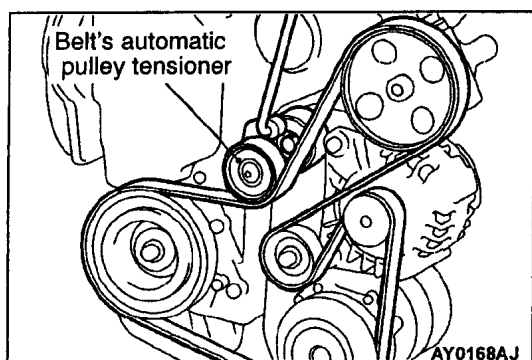


3. Engine-ECU assembly
4. Drive belt
5. Crankshaft pulley

REMOVAL SERVICE POINTS

◄A► ENGINE-ECU ASSEMBLY REMOVAL

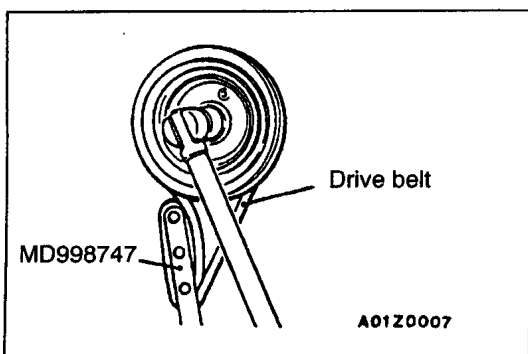
Remove the engine-ECU assembly with the harness attached to hold in the location where the removal of drive belt cannot be hindered.

**◀B▶ DRIVE BELT REMOVAL**

1. Loosen the belt's automatic pulley tensioner mounting bolt.
2. Hook 16 mm wrench to the protrusion of the belt's automatic pulley tensioner and turn the belt's automatic pulley tensioner clockwise to remove the drive belt.

Caution

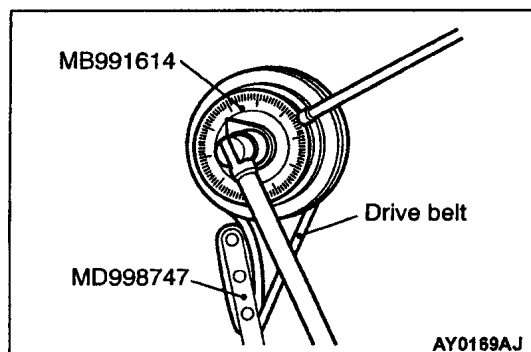
Do not use the removed drive belt again. Always make sure to replace the used drive belt with a new one.

**◀C▶ CRANKSHAFT PULLEY REMOVAL****Caution**

1. This drive belt will get damaged. Do not use the engine's drive belt.
2. Never use a damaged drive belt.

INSTALLATION SERVICE POINT**▶A◀ CRANKSHAFT PULLEY INSTALLATION**

1. Use the special tool to hold the crankshaft pulley.
2. Tighten the crankshaft pulley mounting bolt to 20 Nm.
3. Place the special tool in a wrench to tighten the crankshaft pulley mounting bolt to $115^\circ \pm 15^\circ$.

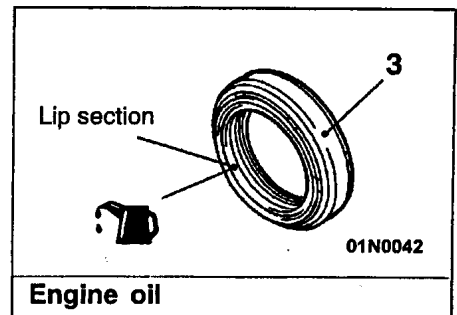
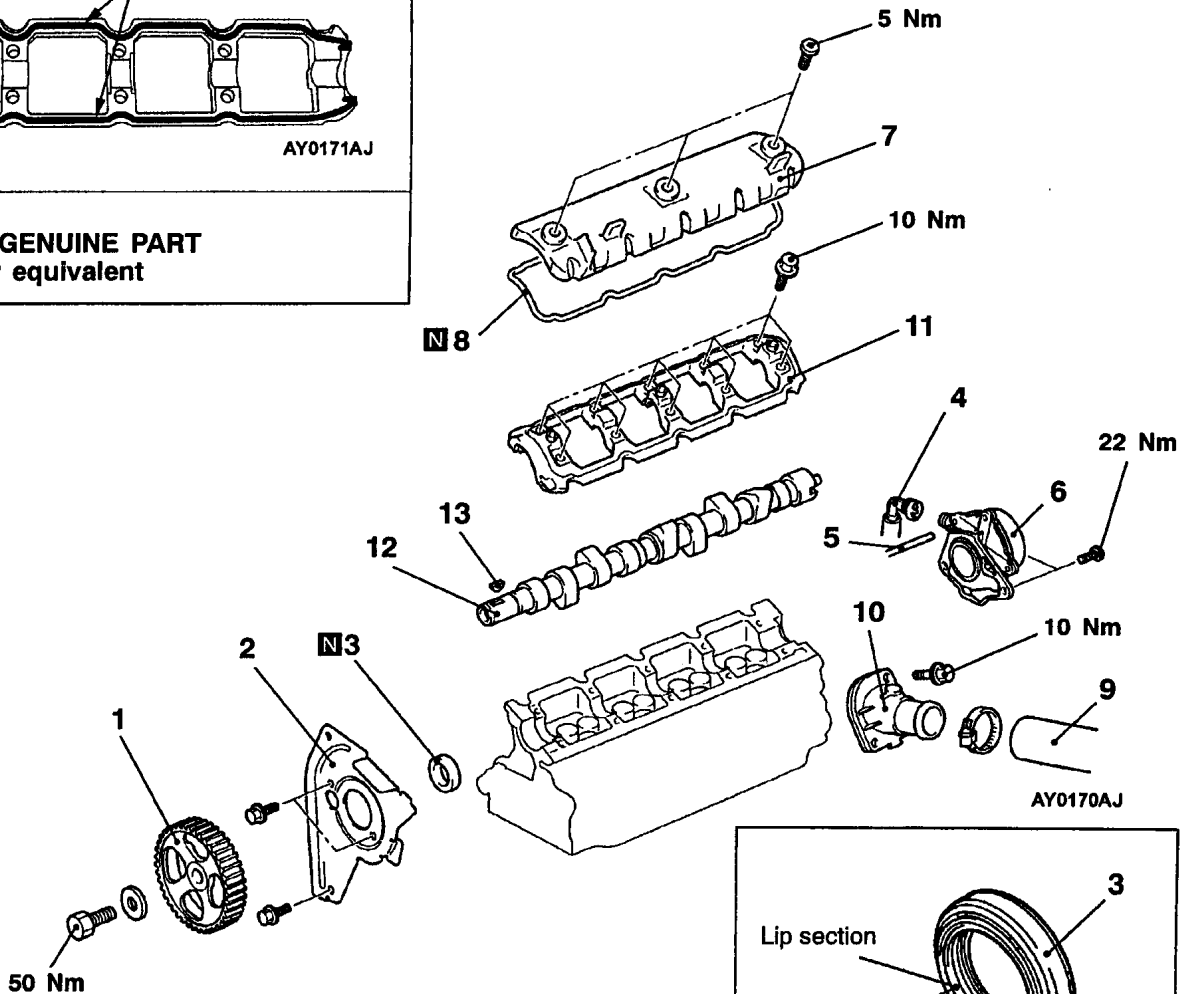
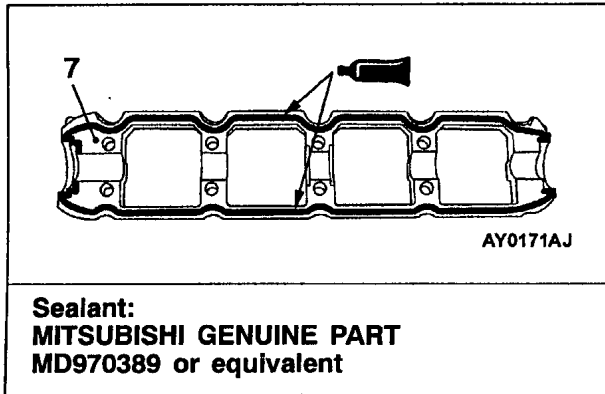


CAMSHAFT AND CAMSHAFT OIL SEAL

REMOVAL AND INSTALLATION

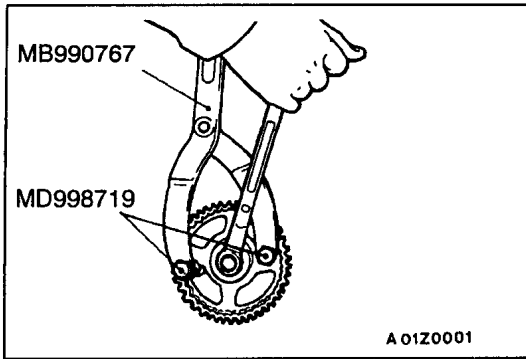
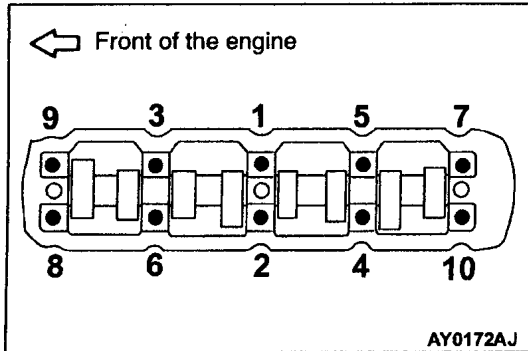
Pre-removal and Post-installation Operation

- Engine Coolant Draining and Supplying (Refer to GROUP 14 - On-vehicle Service.)
- Air Cleaner Removal and Installation (Refer to GROUP 15.)
- Timing Belt Removal and Installation (Refer to P.11C-18.)



Removal steps

- | | | |
|---------------------------|---|--|
| <p>◀A▶ ▶C▶</p> <p>▶B▶</p> | <ol style="list-style-type: none"> 1. Camshaft sprocket 2. Timing belt under cover upper 3. Camshaft oil seal 4. Brake booster vacuum hose connection 5. Vacuum hose connection 6. Vacuum pump assembly | <p>▶A▶</p> <ol style="list-style-type: none"> 7. Rocker cover 8. Rocker cover gasket 9. Radiator upper hose connection 10. Water inlet fitting 11. Beam camshaft cap 12. Camshaft 13. Key |
|---------------------------|---|--|

**REMOVAL SERVICE POINT****◀A▶ CAMSHAFT SPROCKET REMOVAL****INSTALLATION SERVICE POINTS****▶A▶ BEAM CAMSHAFT CAP INSTALLATION**

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

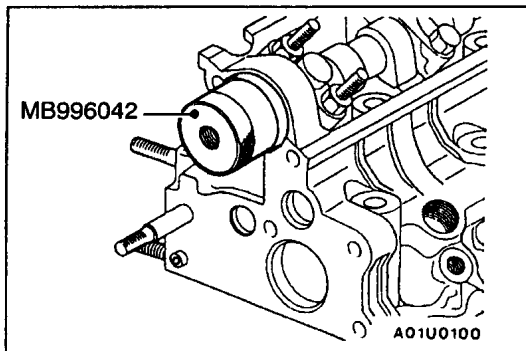
Tightening torque: 10 Nm

▶B▶ CAMSHAFT OIL SEAL INSTALLATION

1. Coat the lip of the oil seal with a thin layer of engine oil.
2. Tape off the camshaft.
3. Locate the oil seal over the camshaft.
4. Fit the oil seal with the special tool.

▶C▶ CAMSHAFT SPROCKET INSTALLATION

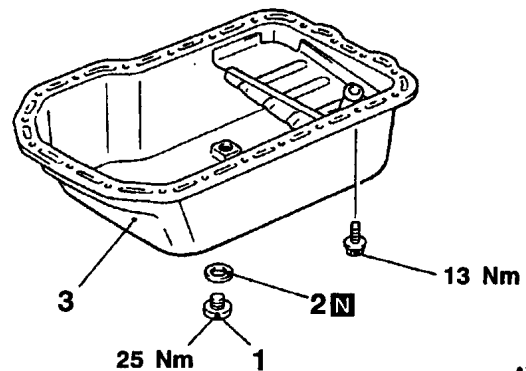
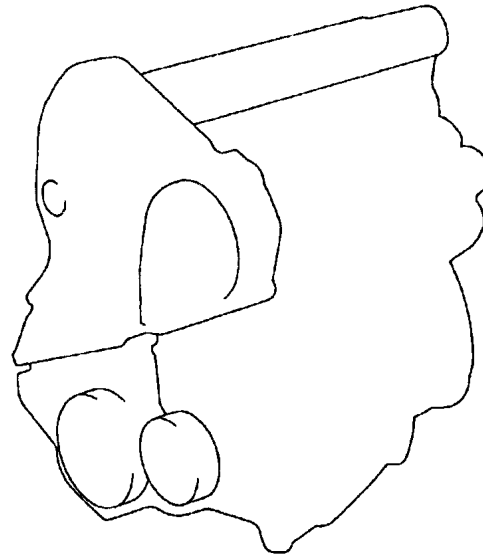
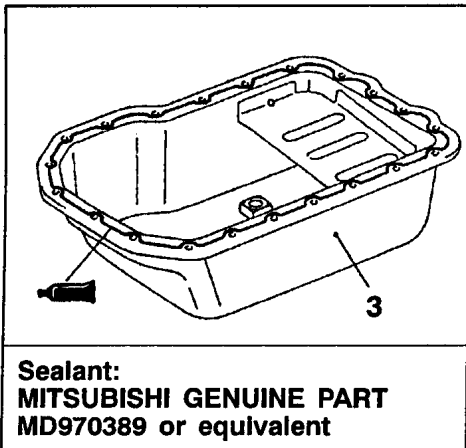
Use the special tool to secure the camshaft sprocket in the same way as during removal, and then tighten the bolt to the specified torque.



OIL PAN

REMOVAL AND INSTALLATION

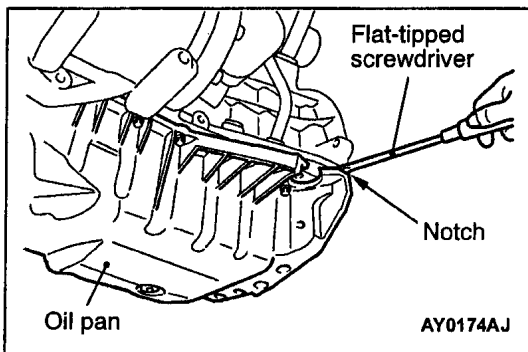
- Pre-removal and Post-installation Operation**
- Under Cover Removal and Installation
 - Engine Oil Draining and Supplying (Refer to GROUP 12 – On-vehicle Service.)
 - Oil Level Gauge Removal and Installation



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Removal steps

1. Drain plug
2. Drain plug gasket
3. Oil pan



REMOVAL SERVICE POINT

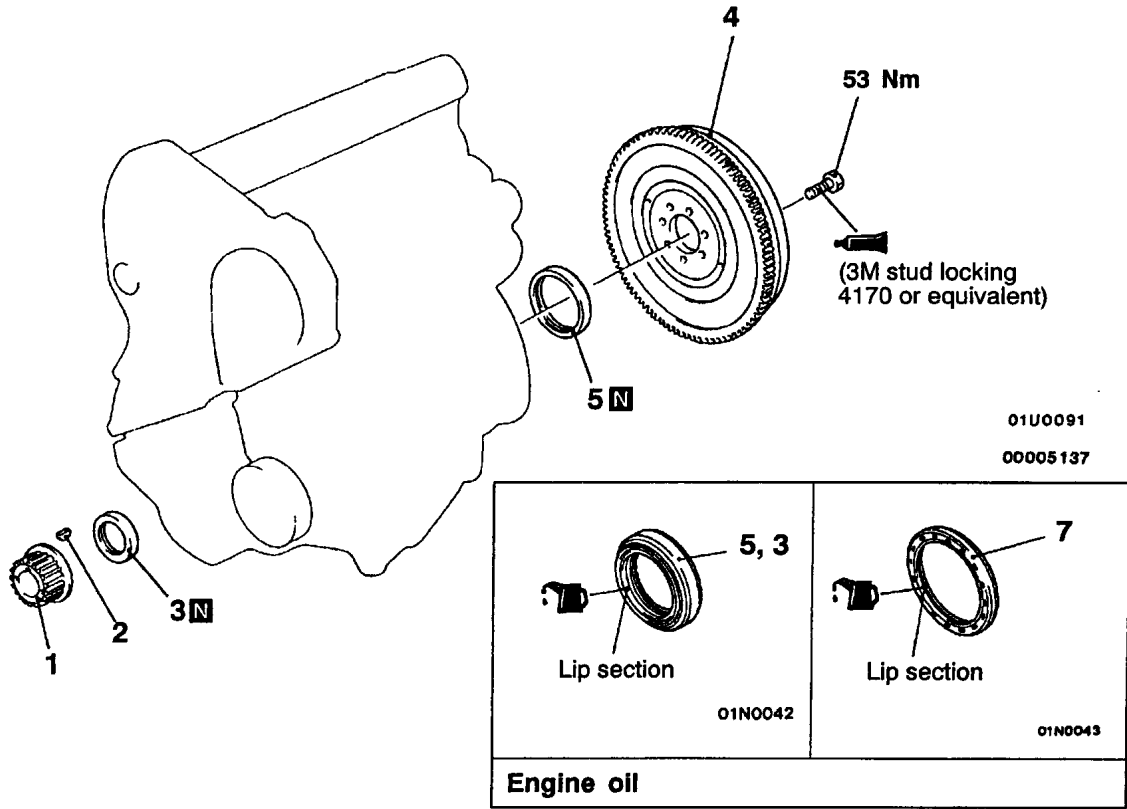
◀A▶ OIL PAN REMOVAL

Insert a flat-tipped screwdriver into the notch of the oil pan, and turn it to remove the oil pan.

Caution

Because the upper oil pan used is made from aluminium, the oil pan remover (MB998727) should not be used.

**CRANKSHAFT OIL SEAL
REMOVAL AND INSTALLATION**



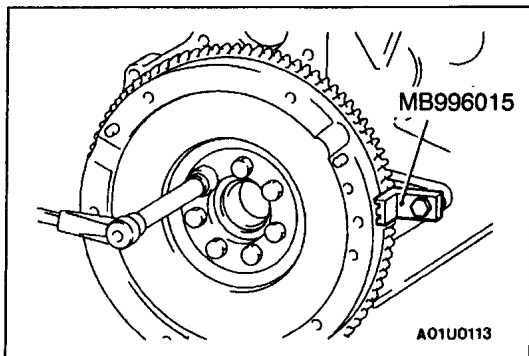
Crankshaft front oil seal removal steps

- Timing belt (Refer to P.11C-18.)
- 1. Crankshaft sprocket
- 2. Key
- 3. Crankshaft front oil seal



Crankshaft rear oil seal removal steps

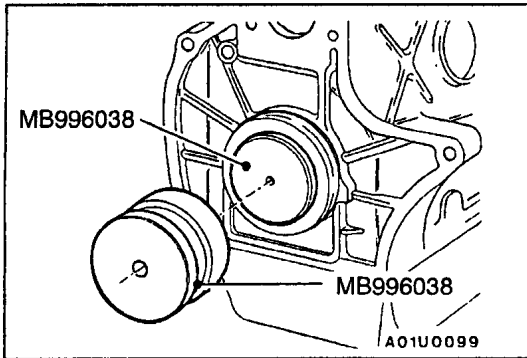
- Transmission assembly (Refer to GROUP 22.)
- Clutch cover and disc
- 4. Flywheel assembly
- 5. Crankshaft rear oil seal



REMOVAL SERVICE POINT

◀A▶ FLYWHEEL ASSEMBLY REMOVAL

Use the special tool to secure the flywheel and remove the bolts.



INSTALLATION SERVICE POINTS

►A◄ CRANKSHAFT REAR OIL SEAL INSTALLATION

1. Coat the lip of the oil seal with a thin layer of engine oil.
2. Locate the special tool (installer guide) over the crankshaft.
3. Locate the oil seal over the guide.
4. Fit the oil seal with special tool (installer).

►B◄ FLYWHEEL ASSEMBLY INSTALLATION

1. Clean off all sealant, oil and other substances which are adhering to the threaded bolts, crankshaft thread holes and the flywheel.
2. Apply sealant to the threaded mounting bolts.

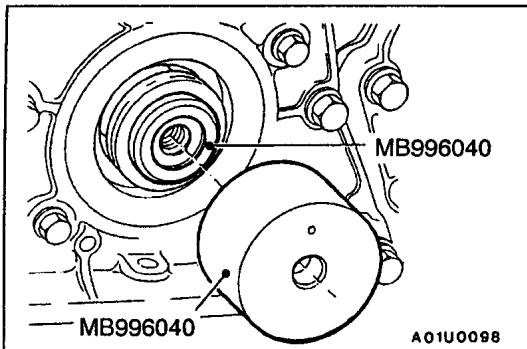
Specified sealant: 3M Stud locking 4170 or equivalent

3. Use the special tool to secure the flywheel, and then tighten the bolts to the specified torque.

Tightening torque: 53 Nm

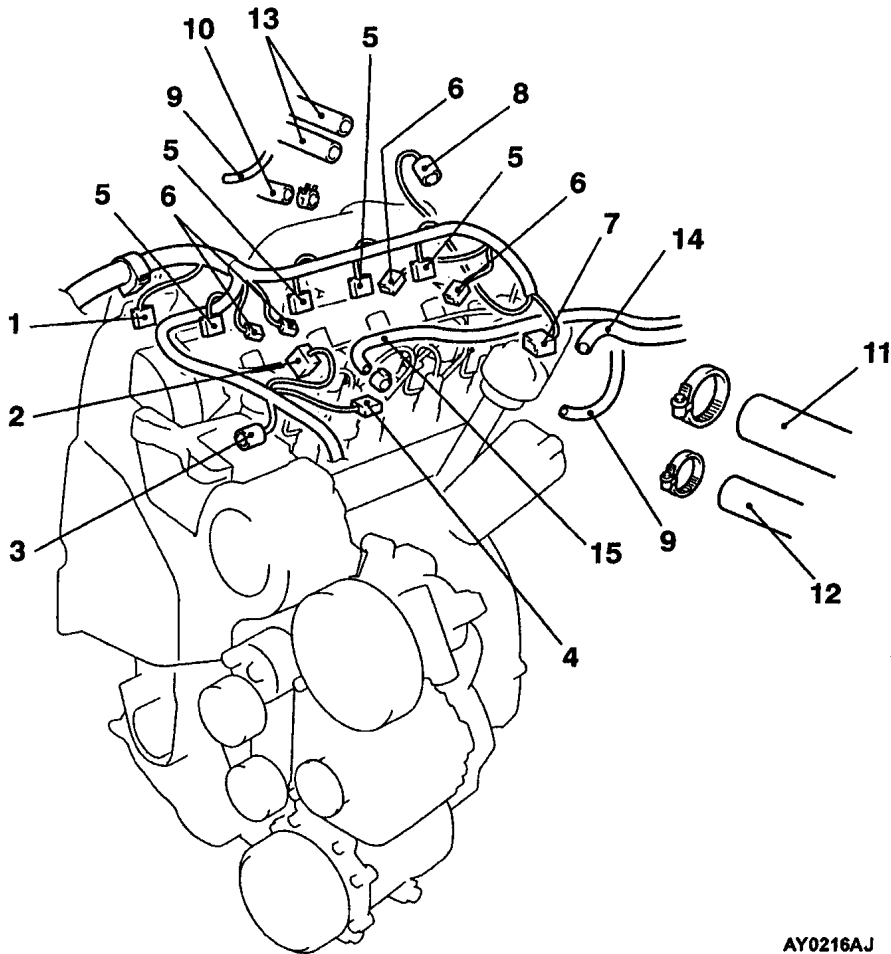
►C◄ CRANKSHAFT FRONT OIL SEAL INSTALLATION

1. Coat the lip of the oil seal with a thin layer of engine oil.
2. Locate the special tool (installer guide) over the crankshaft.
3. Locate the oil seal over the guide.
4. Fit the oil seal with special tool (installer).



CYLINDER HEAD GASKET**REMOVAL AND INSTALLATION****Pre-removal and Post-installation Operation**

- Engine Coolant Draining and Supplying (Refer to GROUP 14 – On-vehicle Service.)
- Engine Oil Draining and Supplying (Refer to GROUP 12 – On-vehicle Service.)
- Timing Belt Removal and Installation (Refer to P.11C-18.)
- Air Cleaner and Air Intake Hose Removal and Installation (Refer to GROUP 15.)
- Catalytic Converter Removal and Installation (Refer to GROUP 15 – Exhaust Pipe and Main Muffler.)

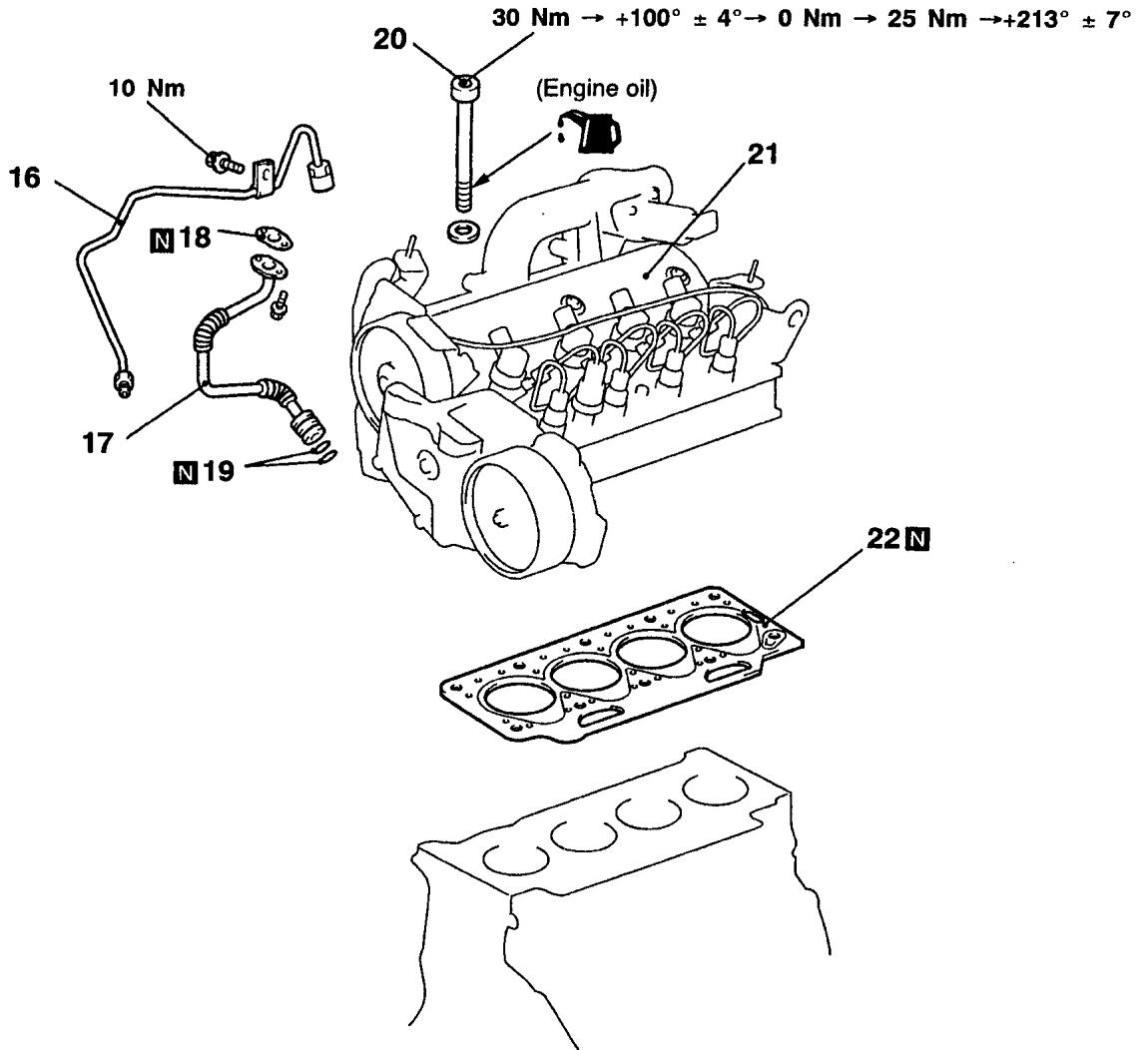


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Removal steps

1. Camshaft position sensor connector
2. Fuel pressure sensor connector
3. Fuel high pressure pump connector
4. Fuel temperature sensor connector
5. Fuel injector connector
6. Glow plug connector
7. Water temperature sensor connector
8. EGR valve connector
9. Vacuum hose connection
10. Brake booster vacuum hose connection
11. Radiator upper hose connection
12. Water hose connection
13. Heater hose connection
14. Fuel return hose connection
15. Fuel supply hose connection





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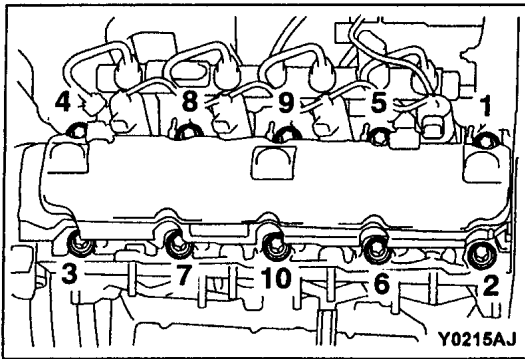
- 16. Oil pipe assembly
- 17. Oil return pipe assembly
- 18. Oil return pipe gasket
- 19. O-ring

- ◀B▶ ▶B◀ 20. Cylinder head bolt
- ▶A◀ 21. Cylinder head assembly
- ▶A◀ 22. Cylinder head gasket

REMOVAL SERVICE POINTS

◀A▶ FUEL RETURN HOSE CONNECTION/FUEL SUPPLY HOSE CONNECTION REMOVAL

After disconnecting the fuel return hose and the fuel supply hose, put the cover at the end of the fuel line to prevent foreign objects from entering.



◀B▶ CYLINDER HEAD BOLT REMOVAL

Loosen the cylinder head bolt in the order of the illustrated numbers in two or three stages for removal.

Caution

Do not use the removed cylinder head bolt again. Always replace the used cylinder head bolt with a new one.

INSTALLATION SERVICE POINTS

▶A▶ CYLINDER HEAD GASKET INSTALLATION

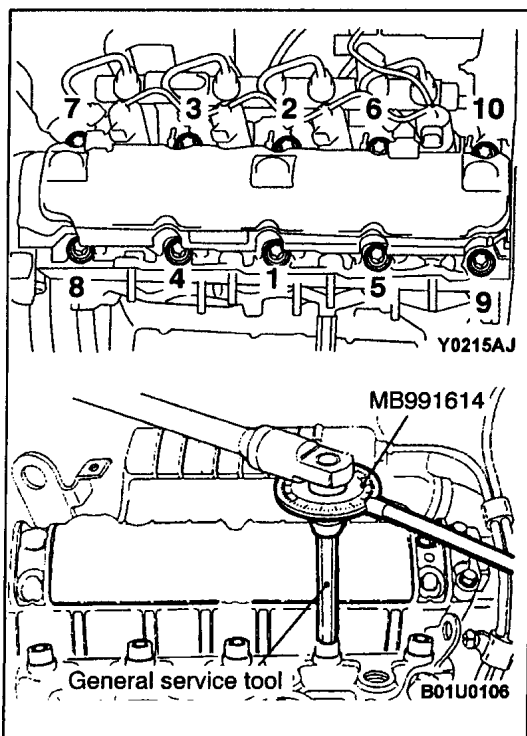
1. Wipe off all oil and grease from the gasket mounting surface.
2. Install so that the shapes of the cylinder head holes match the shapes of the respective cylinder head gasket holes.

▶B▶ CYLINDER HEAD BOLT INSTALLATION

1. Tighten the new cylinder head bolt in the order of the illustrated numbers to 30 Nm.
2. Place the special tool in a wrench to tighten the cylinder head bolt in the order of the illustrated numbers to $100^\circ \pm 4^\circ$.
3. Wait for approximately 3 minutes until the cylinder head gasket fits in the cylinder head and the cylinder block.
4. Loosen the illustrated number 1 and 2 bolts completely.
5. Tighten the illustrated number 1 and 2 bolts to 25 Nm.
6. Place the special tool in a wrench to tighten the illustrated number 1 and 2 bolts to $213^\circ \pm 7^\circ$.
7. Divide the rest of the bolts into pairs: Number 3 and 4 bolts, number 5 and 6 bolts, number 7 and 8 bolts, number 9 and 10 bolts. And tighten them as a pair according to the procedures 3, 4, and 5.

Caution

The cylinder head bolt will be extended if the cylinder head is tightened. If the cylinder head bolt is tightened too much, replace it with a new one instead of tightening it again.

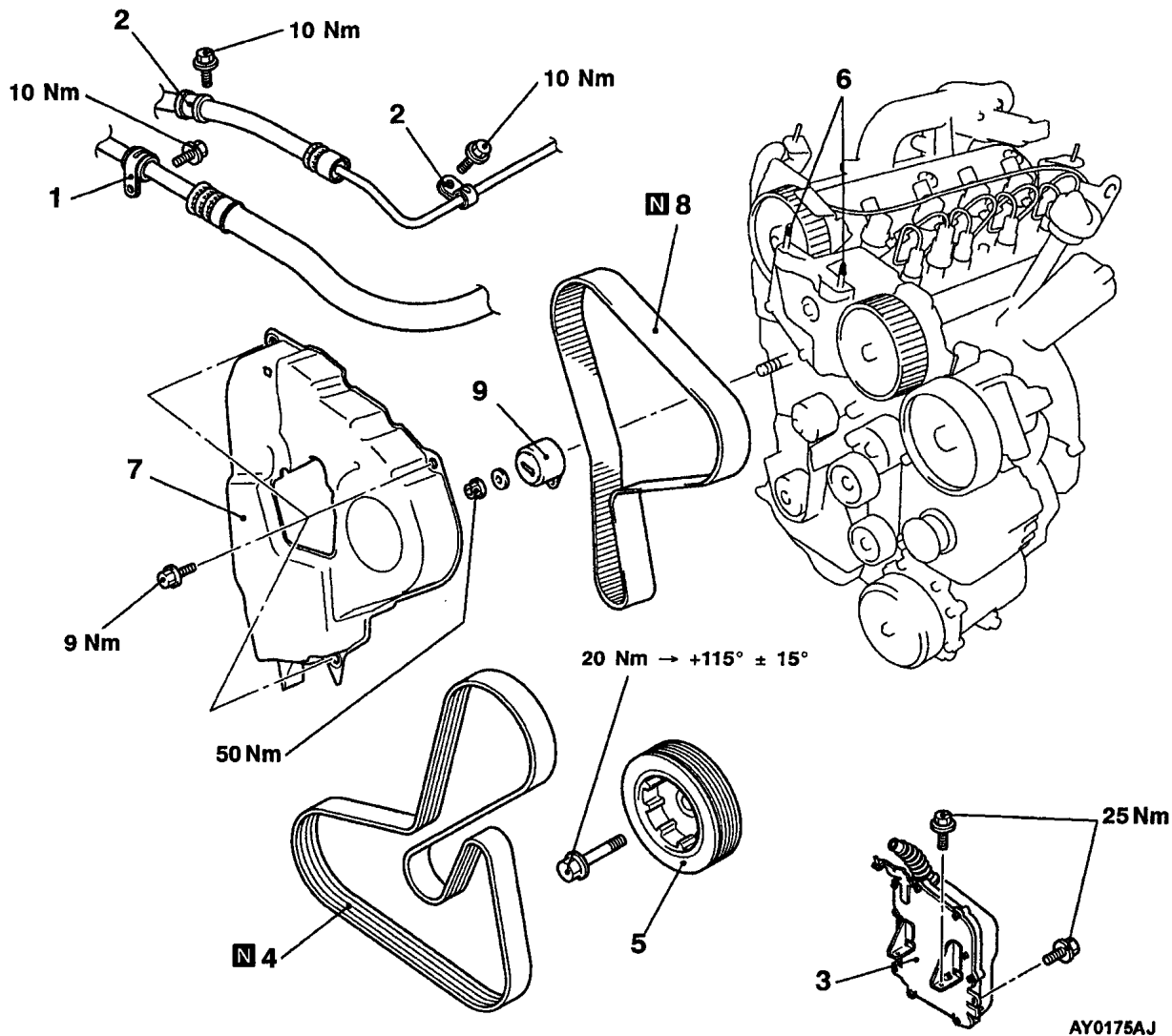


TIMING BELT

REMOVAL AND INSTALLATION

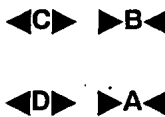
Pre-removal and Post-Installation Operation

- Under Cover Removal and Installation
- Engine Mount Bracket Removal and Installation (Refer to GROUP 32.)



Removal steps

1. A/C suction hose clamp
2. Power steering pressure hose clamp
3. Engine-ECU assembly
4. Drive belt



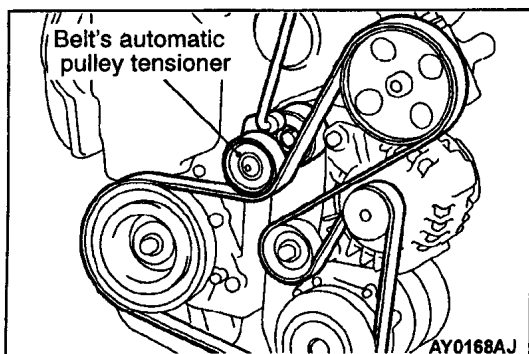
5. Crankshaft pulley
6. Stud bolt
7. Timing belt cover
8. Timing belt
9. Timing belt tensioner pulley



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REMOVAL SERVICE POINTS**◀A▶ ENGINE-ECU ASSEMBLY REMOVAL**

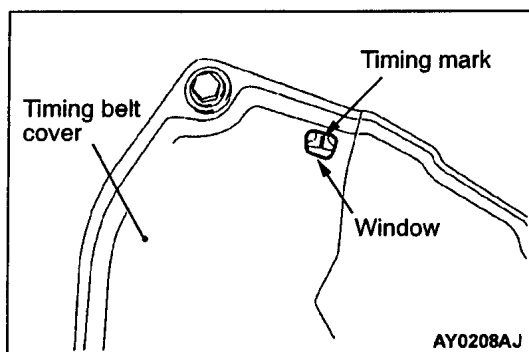
Remove the engine-ECU assembly with the harness attached and hold it in the location where the removal of drive belt cannot be hindered.

**◀B▶ DRIVE BELT REMOVAL**

1. Loosen the belt's automatic pulley tensioner mounting bolt.
2. Hook 16 mm wrench to the protrusion of the belt's automatic pulley tensioner and turn the belt's automatic pulley tensioner clockwise to remove the drive belt.

Caution

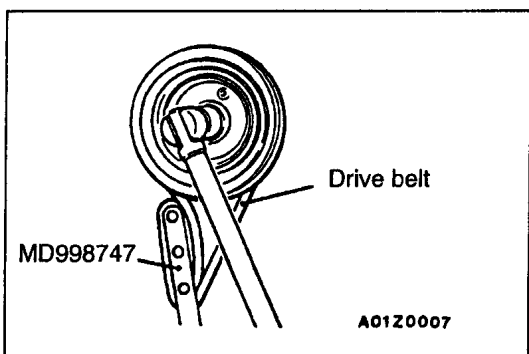
Do not use the removed drive belt again. Always make sure to replace the used drive belt with a new one.

**◀C▶ CRANKSHAFT PULLEY REMOVAL**

1. Turn the crankshaft clockwise to align the timing mark of the camshaft sprocket with the centre of the window of the timing belt cover.

Caution

The crankshaft must always be turned clockwise.



2. Use the special tool to hold the crankshaft pulley, loosen the crankshaft pulley mounting bolt, and remove the crankshaft pulley.

Caution

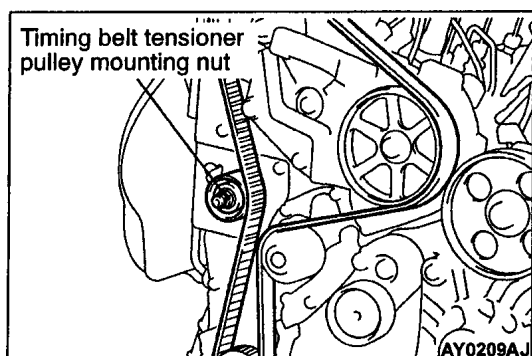
1. **This drive belt will get damaged. Do not use the engine's drive belt.**
2. **Never use a damaged drive belt.**
3. **When the crankshaft pulley mounting bolt is loosened, be careful not to miss the timing mark while turning the crankshaft pulley.**

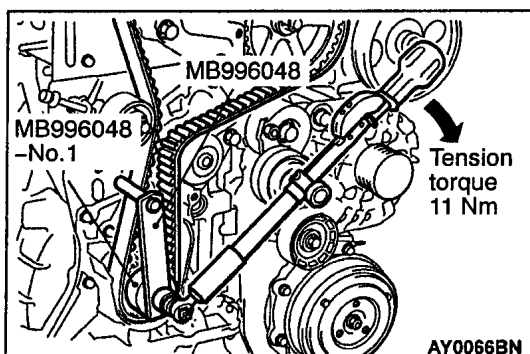
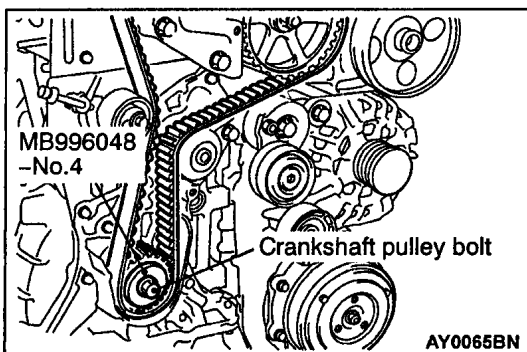
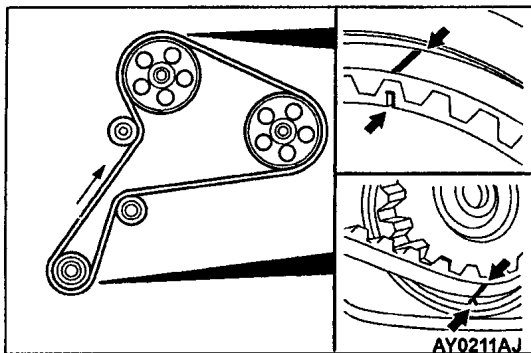
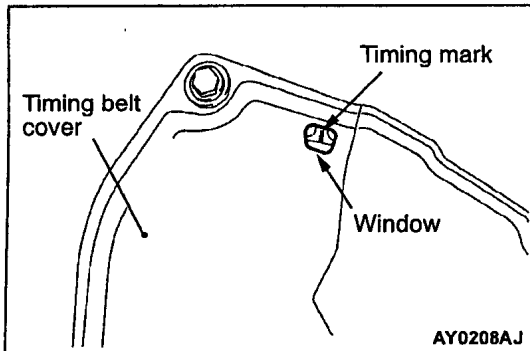
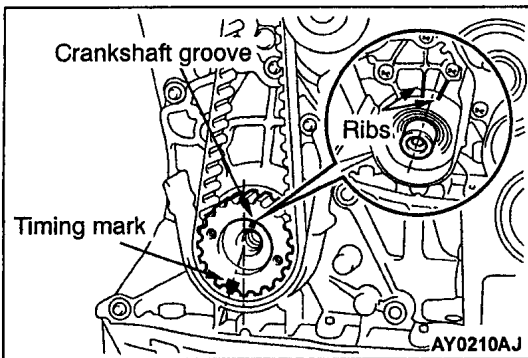
◀D▶ TIMING BELT REMOVAL

Loosen the timing belt tensioner pulley mounting nut to remove the timing belt.

Caution

Do not use the removed timing belt again. Always replace the used timing belt with a new one.

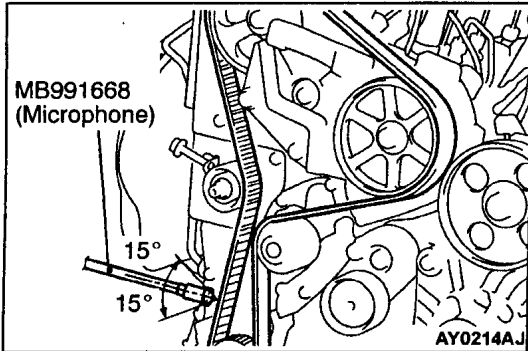
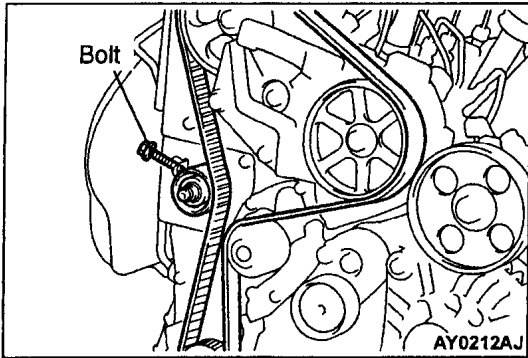




INSTALLATION SERVICE POINTS

▶A◀TIMING BELT INSTALLATION

1. Turn the crankshaft clockwise to align the crankshaft groove with the centre of the two ribs of the crankshaft closure cover. Furthermore, confirm that the timing mark of the crankshaft sprocket is a tooth off to the left of the perpendicular shaft in the engine.
2. Confirm that the timing mark of the camshaft sprocket aligns with the centre of the window of the timing belt cover.
3. Fit the timing belt so that the lines on the belt are aligned with the marks on the crankshaft and camshaft sprockets.
4. Install No.4 washer of special tool MB996048 and the crankshaft pulley bolt to the crankshaft.
5. Install No.1 cover of special tool MB996048 to the crankshaft pulley bolt, and use a torque wrench to tension the timing belt to 11 Nm.
6. Remove special tool MB996048 and No.1 cover.

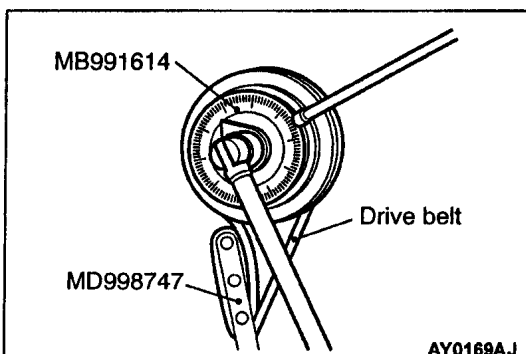


7. Place the bolt in the timing belt tensioner pulley to tighten the bolt so that the timing belt tension becomes the standard value.
Use the MUT-II to measure the timing belt tension.

Standard value: 90 ± 15 Hz

The Measurement Method of Timing Belt Tension

- (1) Connect the special tool (MB991668) to the MUT-II.
 - (2) Connect the MUT-II to the diagnosis connector.
 - (3) Turn the ignition switch to the on position to select "Belt tension measurement" in the menu.
 - (4) Place the microphone 10 to 20 mm behind the belt located in the centre between the camshaft sprocket and the crankshaft sprocket and hold it perpendicular to the belt (approximate inclination of $\pm 15^\circ$ or less).
 - (5) Pluck the centre position of the belt between the camshaft sprocket and the crankshaft sprocket to measure the vibration frequency of the belt.
8. After adjusting the vibration frequency, tighten the tensioner pulley bolt to 10 Nm.
 9. Rotate the crankshaft clockwise, and align the timing marks.
 10. Tension the timing belt to 11 Nm in the same manner as step 5.
 11. Measure the vibration frequency of the the timing belt in the same manner as step 7, and check that it is within the standard value. If not within the standard value, adjust the timing belt again.
- Standard value: 90 ± 15 Hz**
12. Tighten the tensioner pulley bolt to 50 Nm, and remove No.4 washer of special tool MB996048 and the crankshaft pulley bolt.



►B◀ CRANKSHAFT PULLEY INSTALLATION

1. Use the special tool to hold the crankshaft pulley as shown in the removal procedures.
2. Tighten the crankshaft pulley mounting bolt to 20 Nm.
3. Place the special tool in a wrench to tighten the crankshaft pulley mounting bolt to $115^\circ \pm 15^\circ$.

ENGINE ASSEMBLY

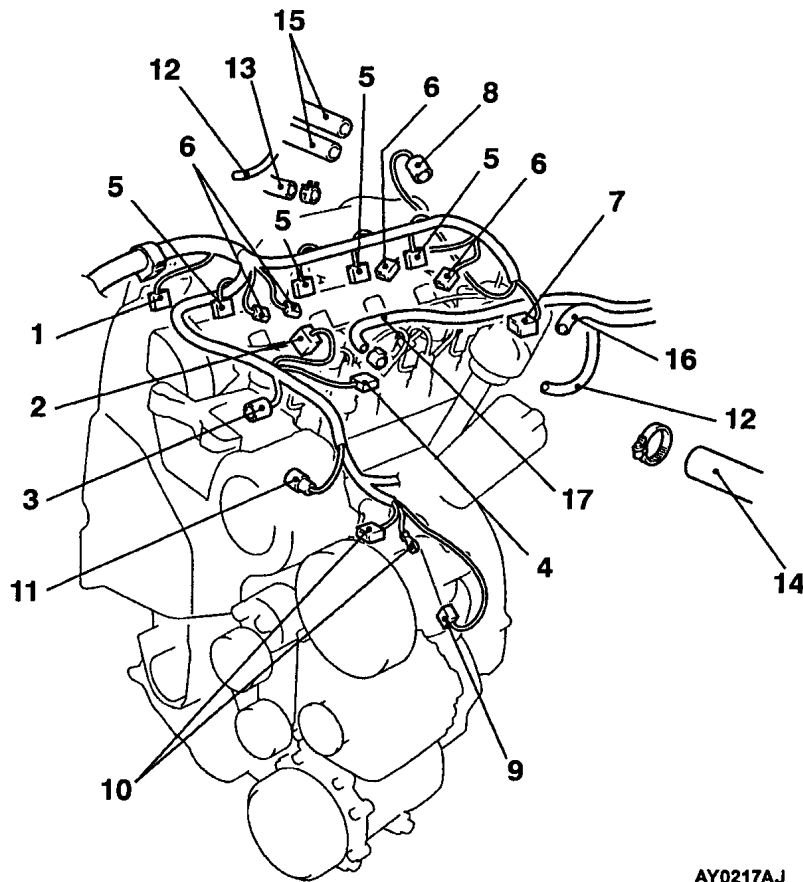
REMOVAL AND INSTALLATION

Caution

Mounting locations marked by * should be provisionally tightened, and then fully tightened when the body is supporting the full weight of the engine.

Pre-removal and Post-installation Operation

- Hood Removal and Installation
- Under Cover Removal and Installation
- Engine Coolant Draining and Supplying (Refer to GROUP 14 – On-vehicle Service.)
- Air Cleaner Removal and Installation (Refer to GROUP 15.)
- Inter Cooler and Inter Cooler Hose Removal and Installation (Refer to GROUP 15.)
- Front Exhaust Pipe Removal and Installation (Refer to GROUP 15.)
- Drive Belt Removal and Installation (Refer to P.11C-8.)

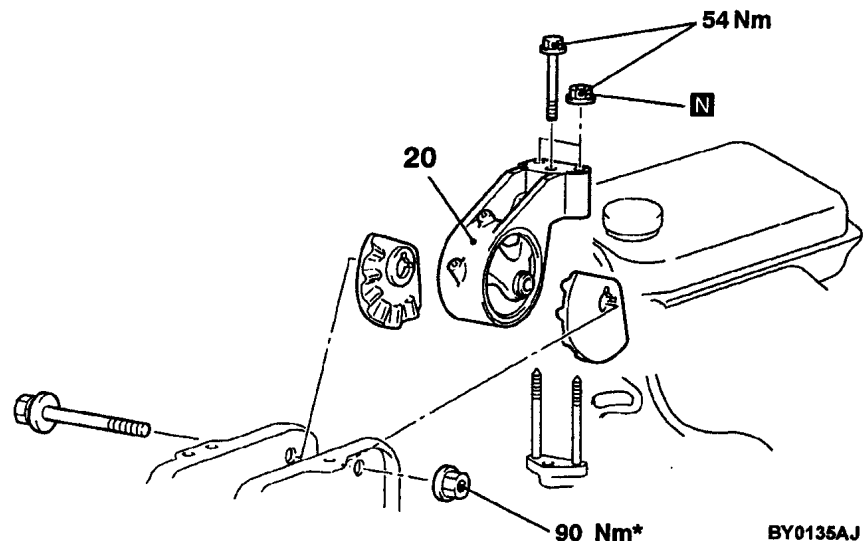
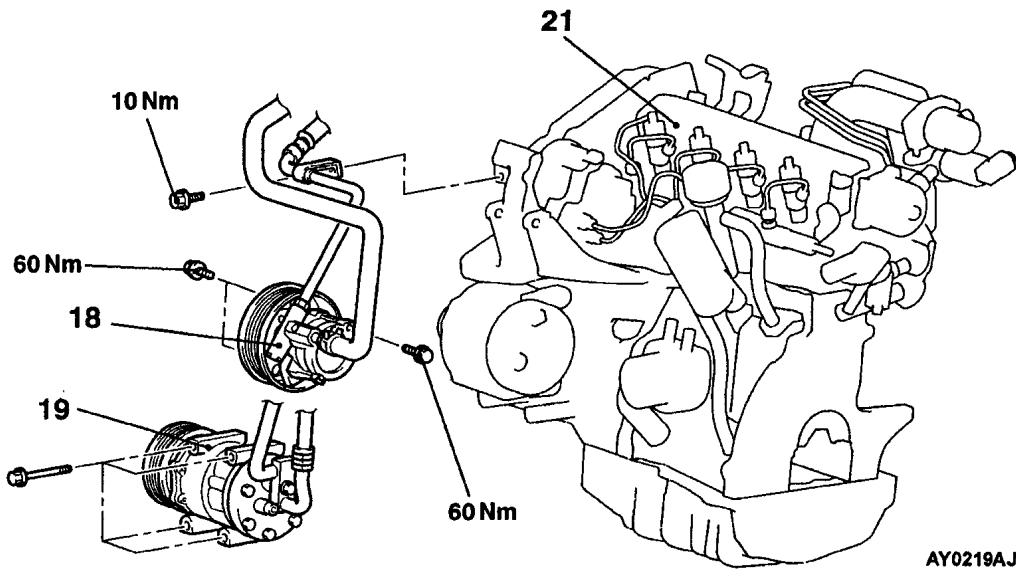


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Removal steps

- | | |
|--|--|
| 1. Camshaft position sensor connector | 10. Alternator connector |
| 2. Fuel pressure sensor connector | 11. Oil pressure switch connector |
| 3. Fuel high pressure pump connector | 12. Vacuum hose connection |
| 4. Fuel temperature sensor connector | 13. Brake booster vacuum hose connection |
| 5. Fuel injector connector | 14. Water hose connection |
| 6. Glow plug connector | 15. Heater hose connection |
| 7. Engine coolant temperature sensor connector | 16. Fuel return hose connection |
| 8. EGR valve connector | 17. Fuel supply hose connection |
| 9. A/C compressor connector | |





18. Power steering oil pump
 19. A/C compressor
 • Transmission assembly
 (Refer to GROUP 22.)



20. Engine mount bracket
 21. Engine assembly

REMOVAL SERVICE POINTS

◀A▶ FUEL RETURN HOSE CONNECTION/FUEL SUPPLY HOSE CONNECTION REMOVAL

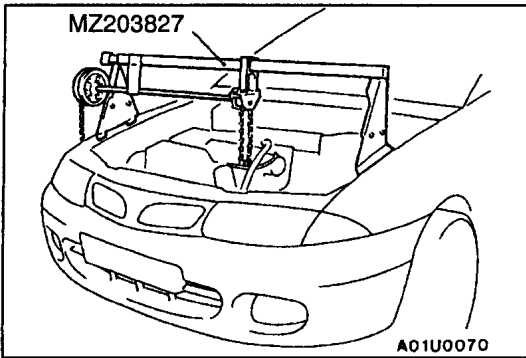
After disconnecting the fuel return hose and the fuel supply hose, put the cover at the end of the fuel line to prevent the foreign objects from entering.

◀B▶ POWER STEERING OIL PUMP REMOVAL

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

NOTE

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



◀C▶ 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.

◀D▶ 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.

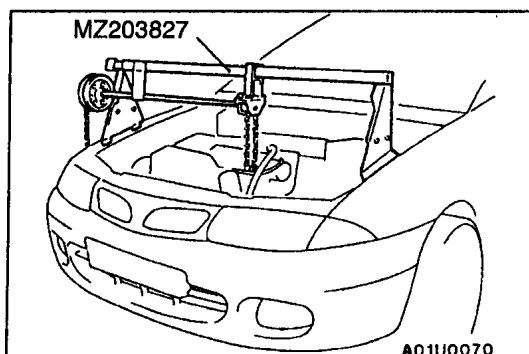
◀E▶ ENGINE ASSEMBLY REMOVAL

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