
ENGINE

ENGINE <F9Q1>

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11C-2 ENGINE <F9Q1> – General/General Information/Service Specifications

GENERAL

OUTLINE OF CHANGE

The following maintenance service points have been established to correspond to the adoption of the F9Q1 engine.

GENERAL INFORMATION

Items		Specification	
Total displacement mL		1,870	
Bore × Stroke mm		80 × 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	

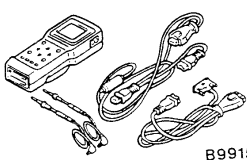
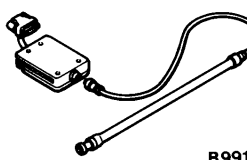

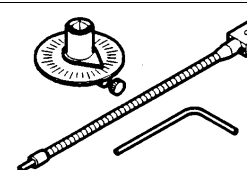
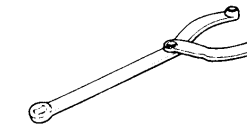
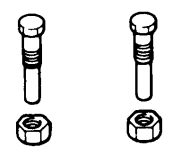
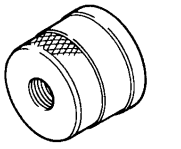
SERVICE SPECIFICATIONS

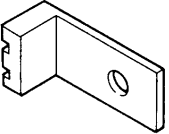
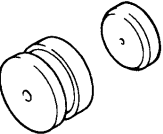
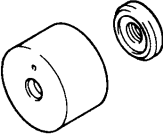
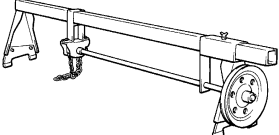
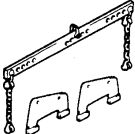
Items			Standard value	Limit
Valve clearance (at cold) mm	When checking	Intake valve	0.15 – 0.25	–
		Exhaust valve	0.35 – 0.45	–
	When adjusting	Intake valve	0.20	–
		Exhaust valve	0.40	–
Idle speed r/min			750 ± 10	–
Compression pressure (250 – 400 r/min) kPa			–	Min. 2,000
Compression pressure difference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

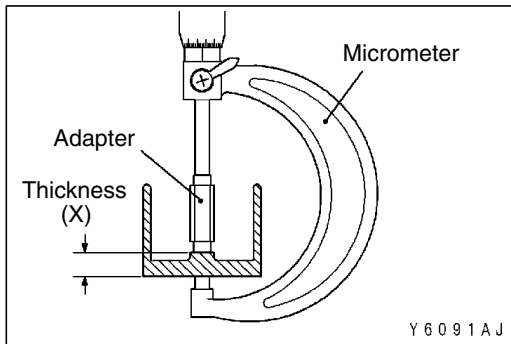
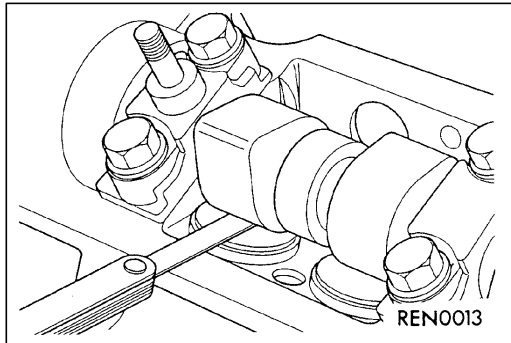
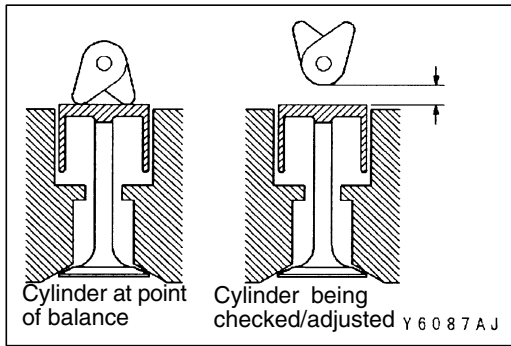
SEALANTS

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
	GENERAL SERVICE TOOL MZ203827	Engine lifter	Supporting the engine assembly during removal and installation of the transmission
 <p data-bbox="342 1104 414 1121">B991453</p>	MB991453	Engine hanger assembly	



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 13D – 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. 2000 kPa

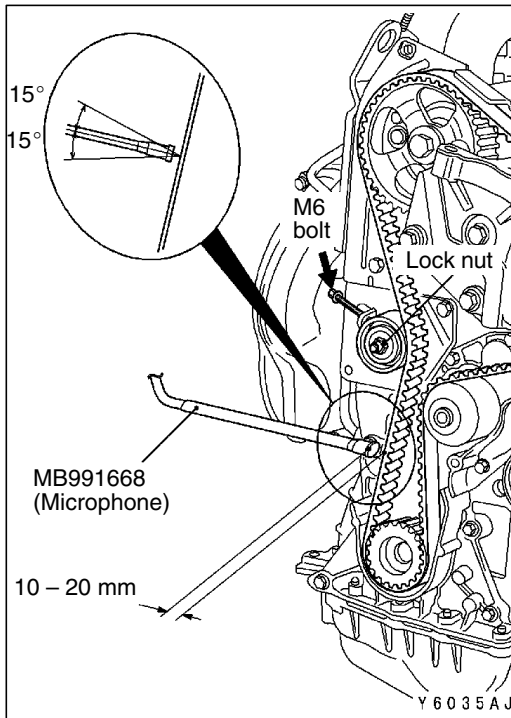
7. Measure the compression pressure for all cylinders, and check that the pressure differences of the cylinders are below the limit.

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

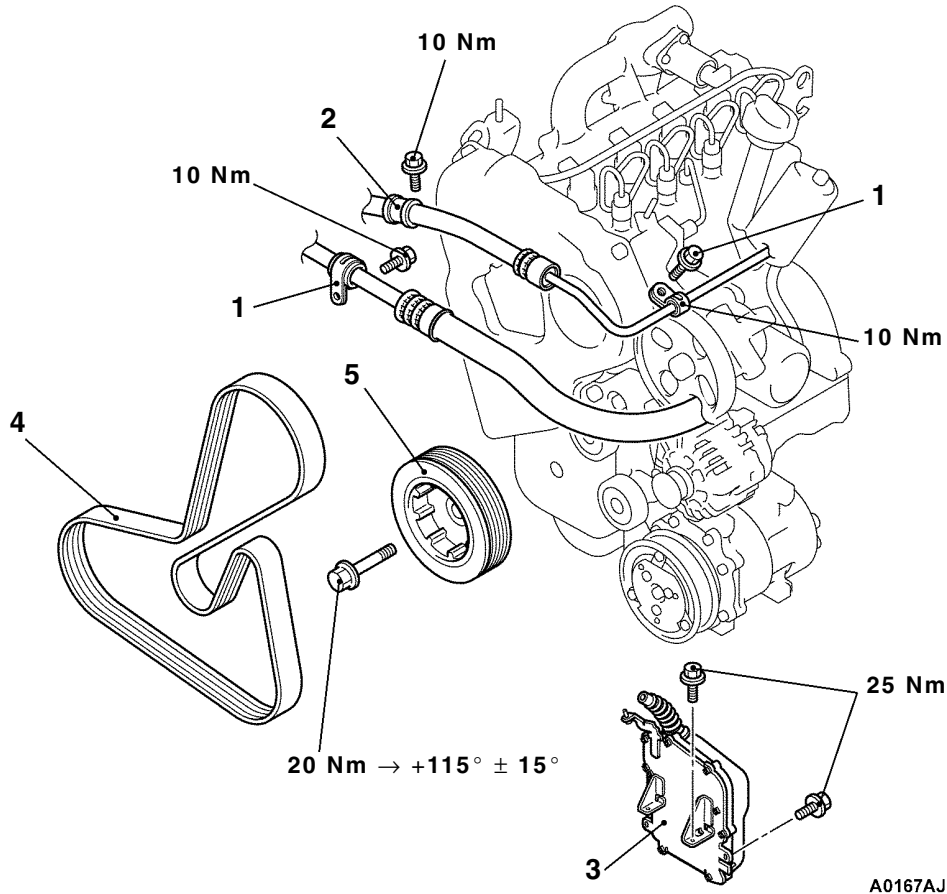
Caution

- (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

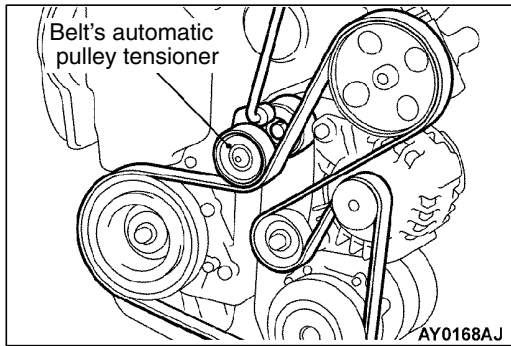


3. Engine-ECU assembly
4. Drive belt
5. Crankshaft pulley

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.

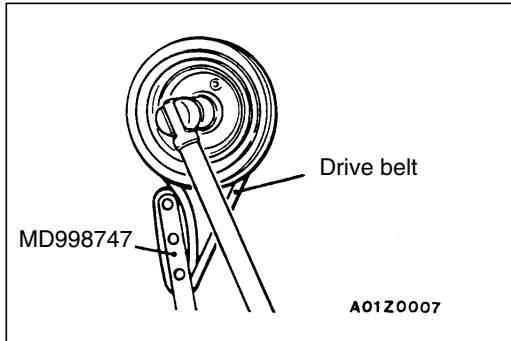


◀B▶ DRIVE BELT REMOVAL

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

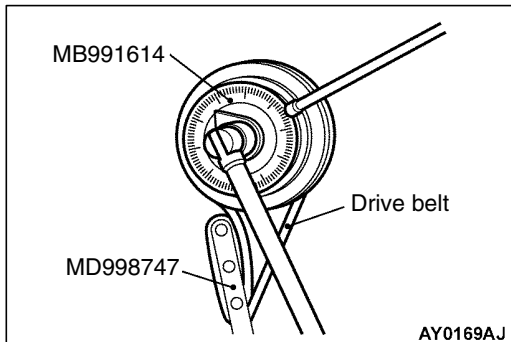
Do not use the removed drive belt again. Always make sure to replace the used drive belt with a new one.



◀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

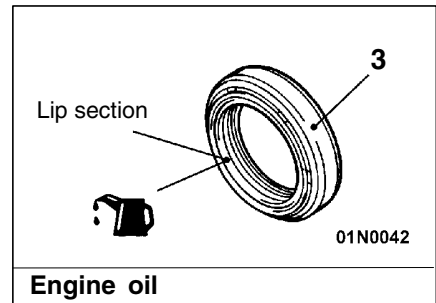
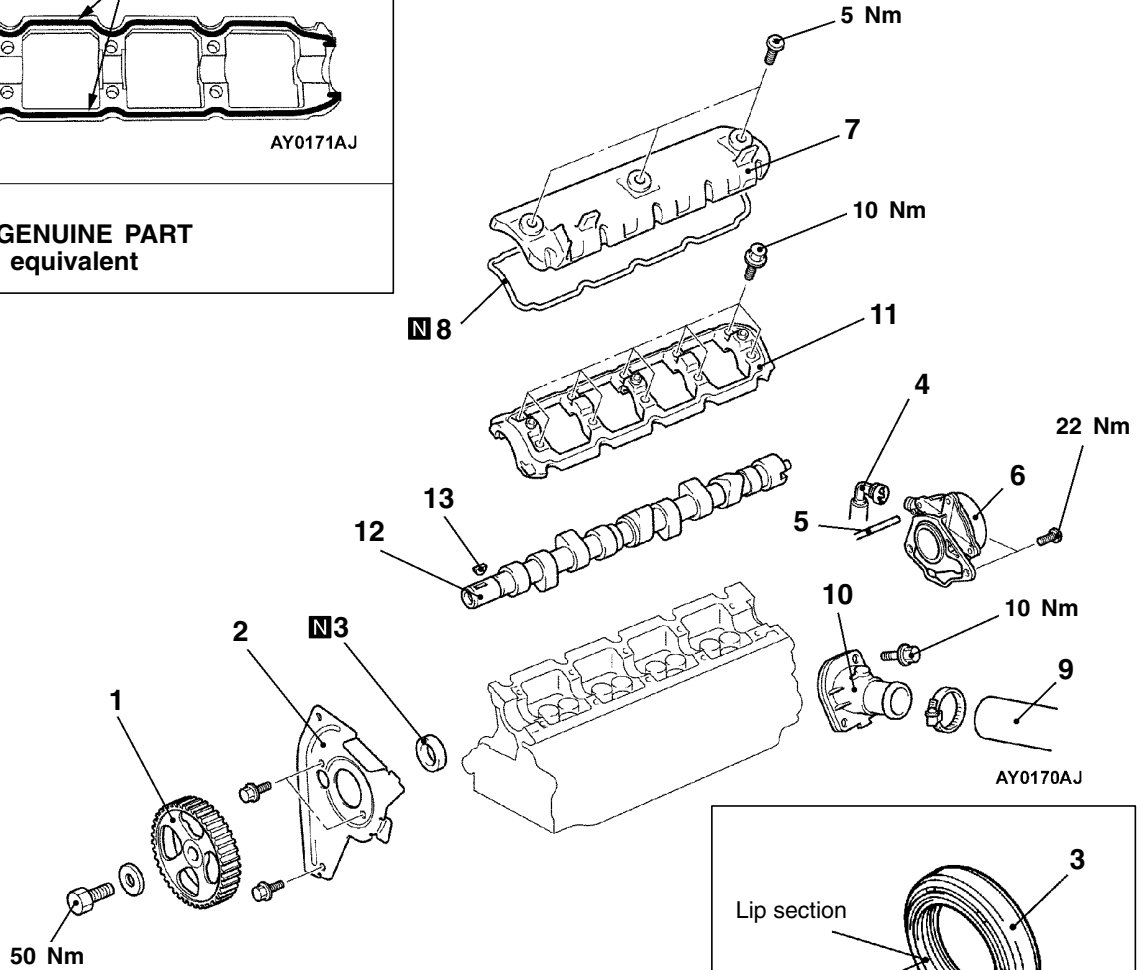
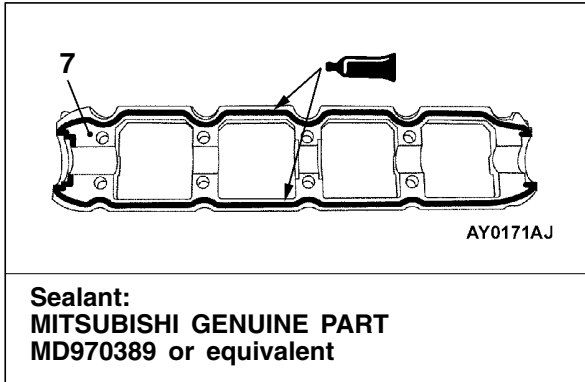
1. Use the special tool to hold the crankshaft pulley.
2. Tighten the crankshaft pulley mounting bolt to 20 Nm.
3. Place the special tool in a wrench to tighten the crankshaft pulley mounting bolt to $115^\circ \pm 15^\circ$.

CAMSHAFT AND CAMSHAFT OIL SEAL

REMOVAL AND INSTALLATION

Pre-removal and Post-installation Operation

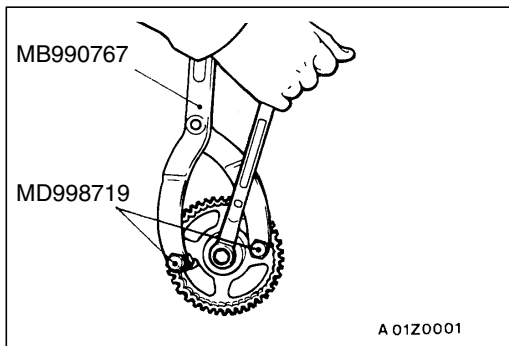
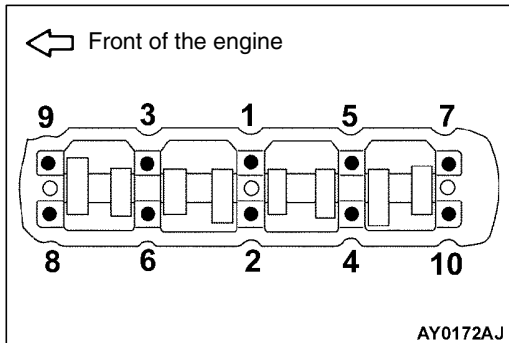
- Engine Coolant Draining and Supplying (Refer to GROUP 14 – On-vehicle Service.)
- Air Cleaner Removal and Installation (Refer to GROUP 15.)
- Timing Belt Removal and Installation (Refer to P.11C-18.)



Removal steps

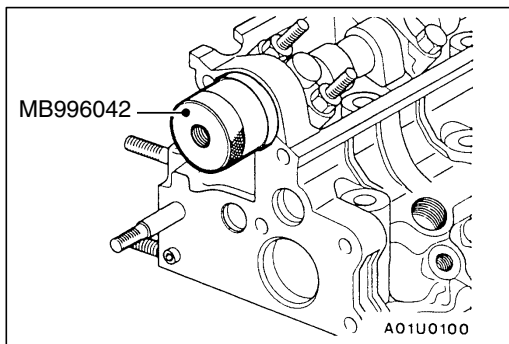
- ◀A▶ ▶C▶ 1. Camshaft sprocket
- ▶B▶ 2. Timing belt under cover upper
- 3. Camshaft oil seal
- 4. Brake booster vacuum hose connection
- 5. Vacuum hose connection
- 6. Vacuum pump assembly

- ▶A▶ 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

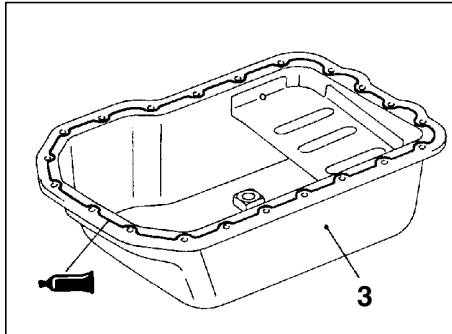
Use the special tool to secure the camshaft sprocket in the same way as during removal, and then tighten the bolt to the specified torque.

OIL PAN

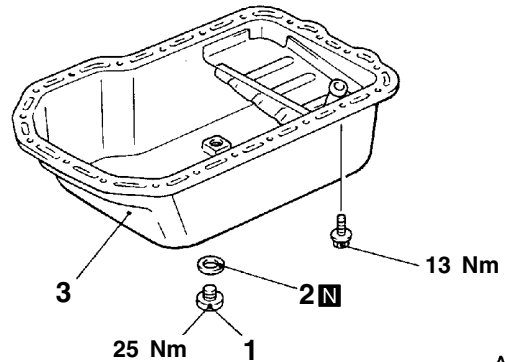
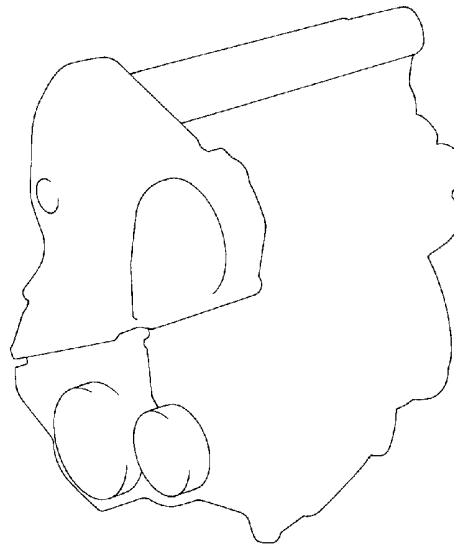
REMOVAL AND INSTALLATION

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



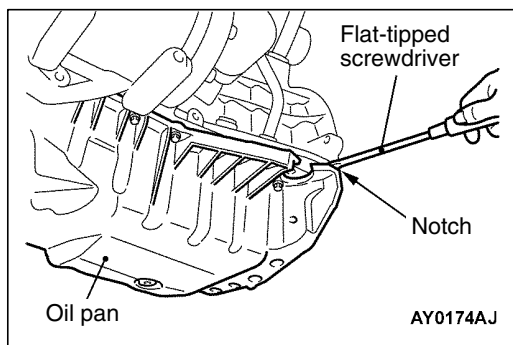
Sealant:
MITSUBISHI GENUINE PART
MD970389 or equivalent



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Removal steps

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



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REMOVAL SERVICE POINT

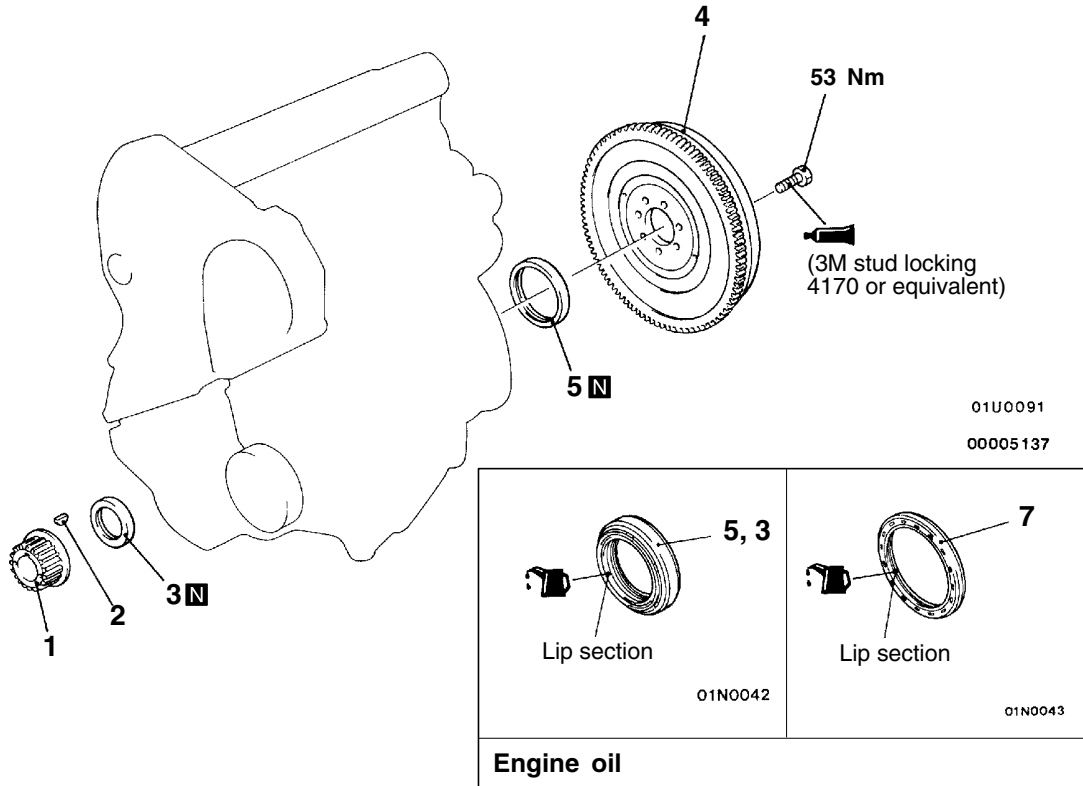
◀A▶ OIL PAN REMOVAL

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



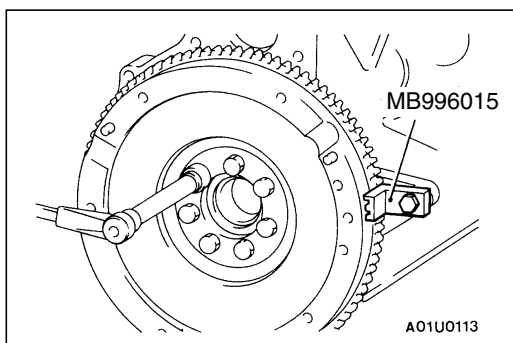
Crankshaft front oil seal removal steps

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



Crankshaft rear oil seal removal steps

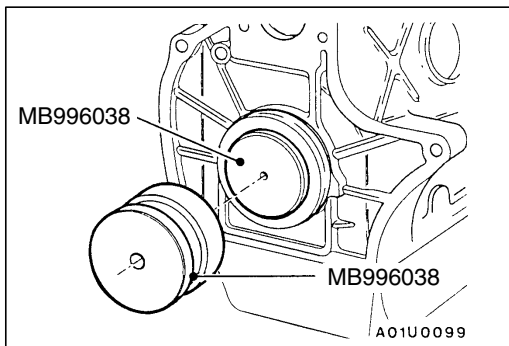
- Transmission assembly (Refer to GROUP 22.)
- Clutch cover and disc
- 4. Flywheel assembly
- 5. Crankshaft rear oil seal



REMOVAL SERVICE POINT

◀B▶ 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).

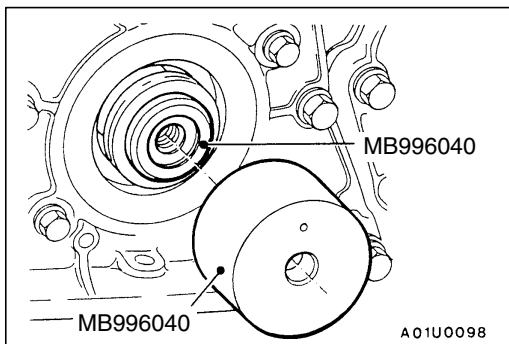
►B◄ FLYWHEEL ASSEMBLY INSTALLATION

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

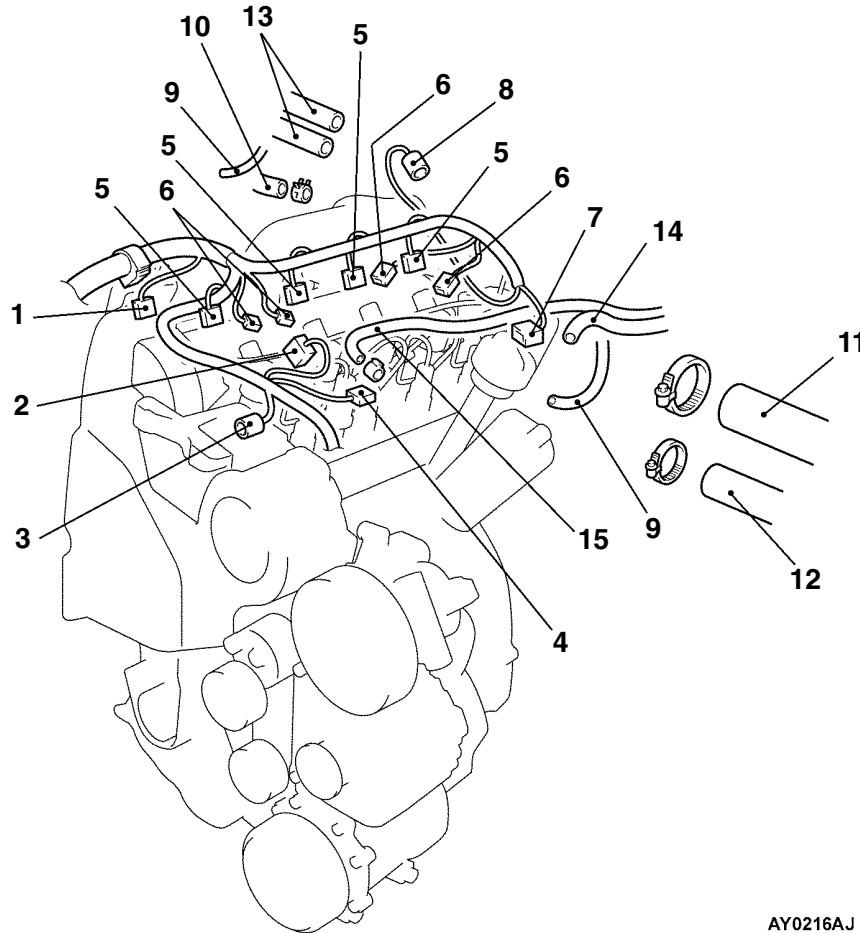


►C◄ CRANKSHAFT FRONT OIL SEAL INSTALLATION

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.)
- Fuel Line Air Bleeding <After Installation Only> (Refer to GROUP 13C – On-vehicle Service.)

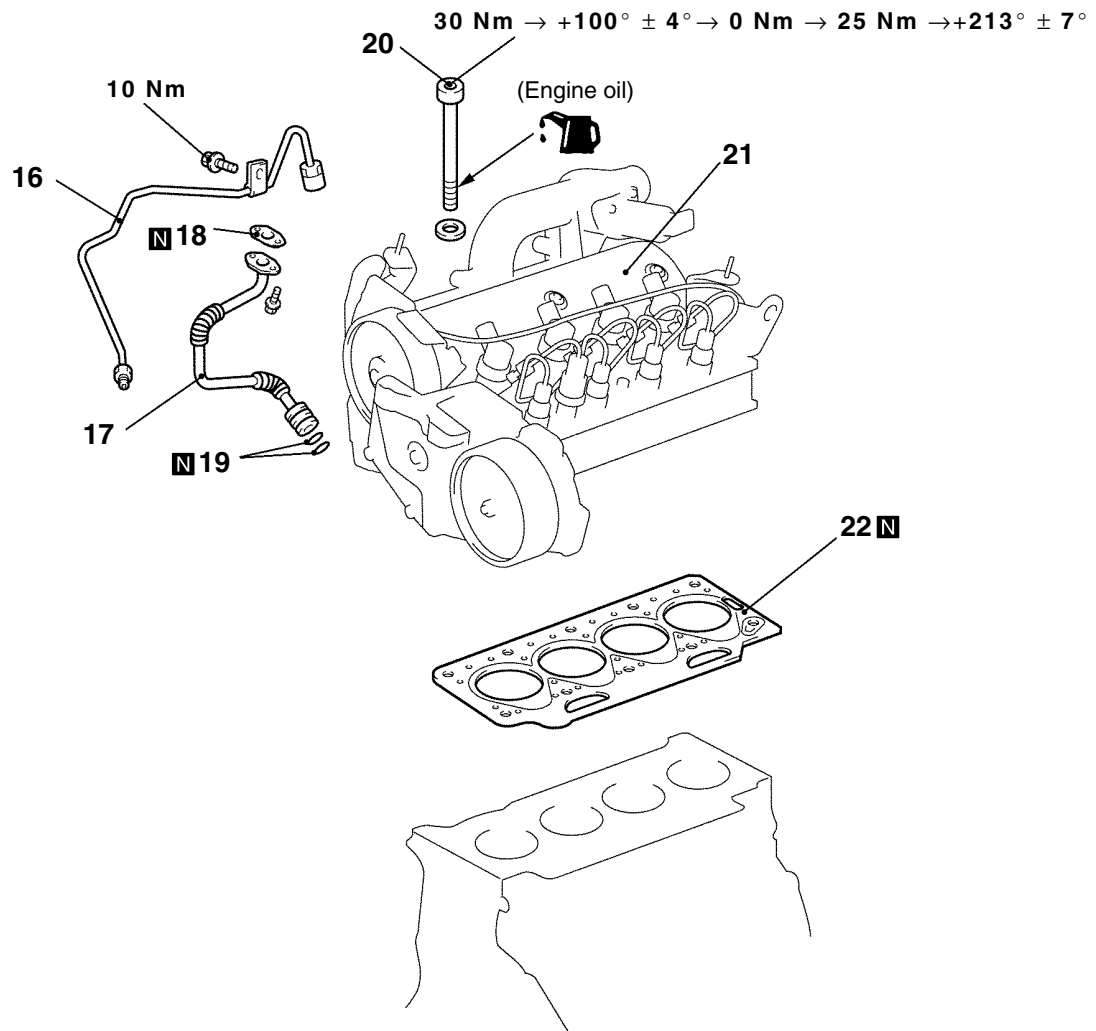


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Removal steps

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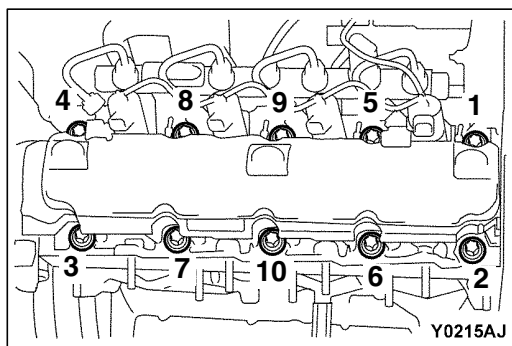
- 16. Oil pipe assembly
- 17. Oil return pipe assembly
- 18. Oil return pipe gasket
- 19. O-ring

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

REMOVAL SERVICE POINTS

◀B▶ 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.



REMOVAL SERVICE POINTS

◀B▶ CYLINDER HEAD BOLT REMOVAL

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

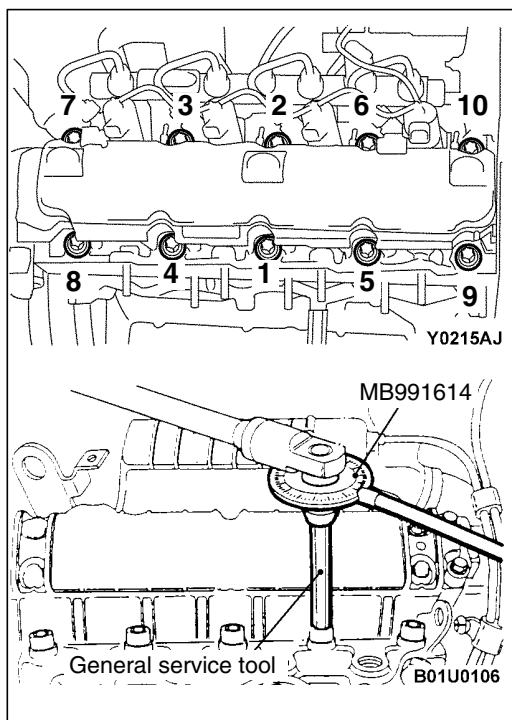
Caution

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

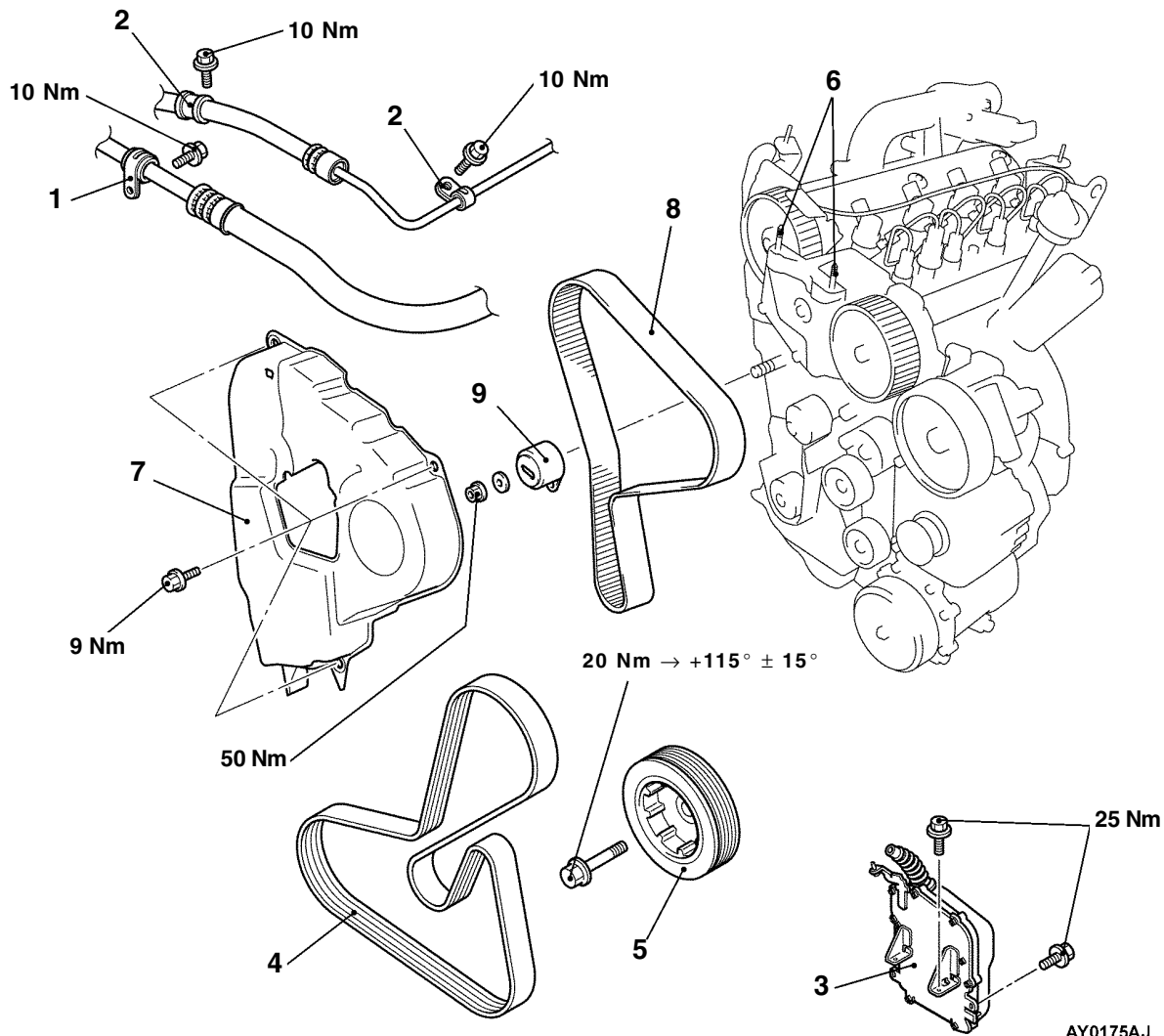
The cylinder head bolt will be extended if the cylinder head is tightened. If the cylinder head bolt is tightened too much, replace it with a new one instead of tightening it again.

TIMING BELT

REMOVAL AND INSTALLATION

Pre-removal and Post-installation Operation

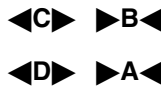
- Under Cover Removal and Installation
- Engine Mount Bracket Removal and Installation (Refer to GROUP 32.)



Removal steps

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

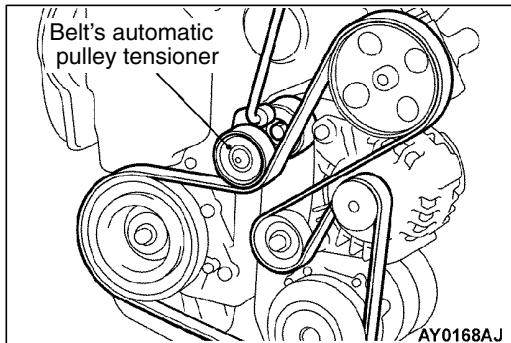
5. Stud bolt
6. Crankshaft pulley
7. Timing belt cover
8. Timing belt
9. Timing belt tensioner pulley



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

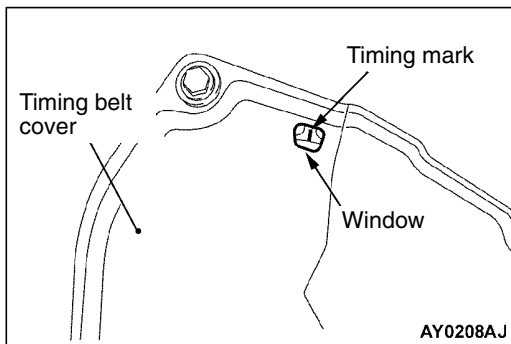
Remove the engine-ECU assembly with the harness attached and hold it in the location where the removal of drive belt cannot be hindered.

**◀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

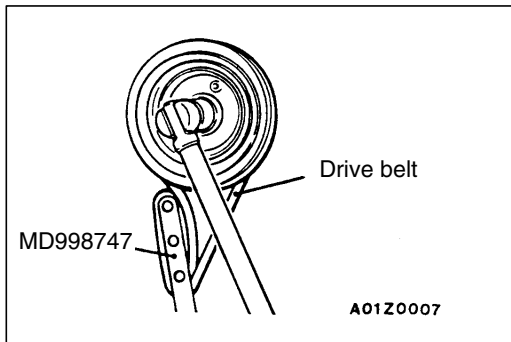
Do not use the removed drive belt again. Always make sure to replace the used drive belt with a new one.

**◀C▶ CRANKSHAFT PULLEY REMOVAL**

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

Caution

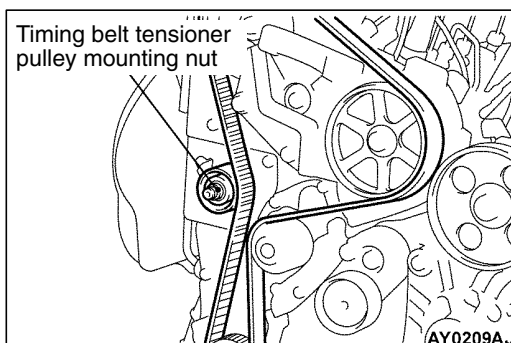
The crankshaft must always be turned clockwise.



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

Caution

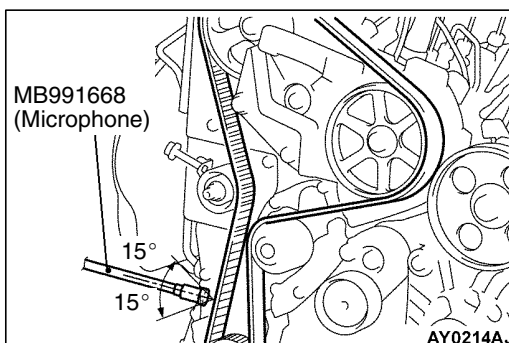
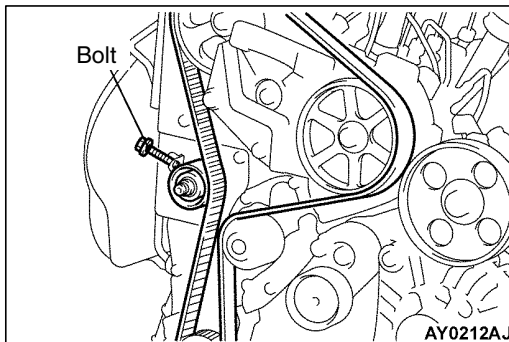
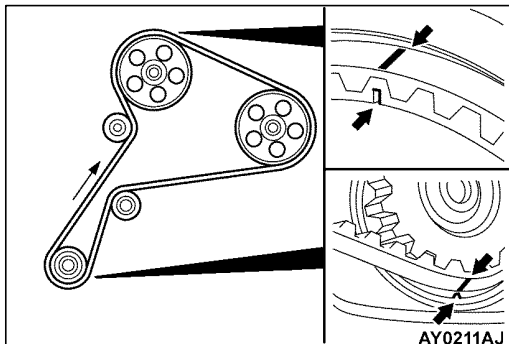
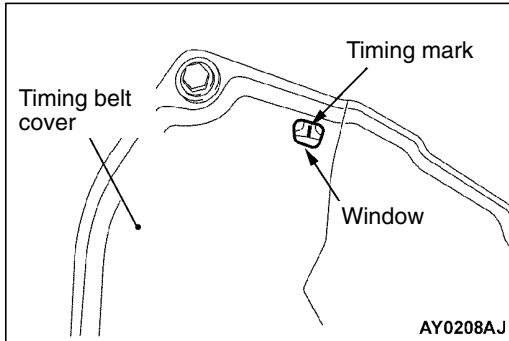
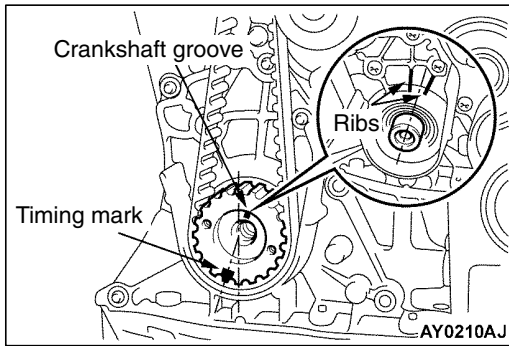
1. **This drive belt will get damaged. Do not use the engine's drive belt.**
2. **Never use a damaged drive belt.**
3. **When the crankshaft pulley mounting bolt is loosened, be careful not to miss the timing mark while turning the crankshaft pulley.**

**◀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

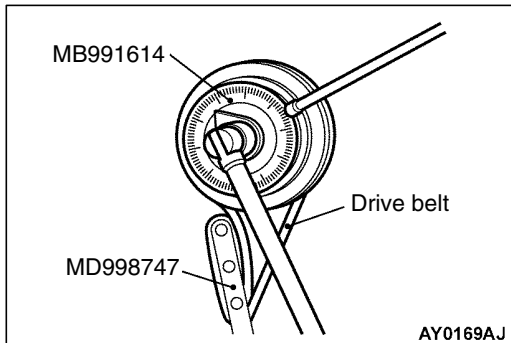
▶◀ TIMING BELT INSTALLATION

1. Turn the crankshaft clockwise to align the crankshaft groove with the center 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 center 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. 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 center between the camshaft sprocket and the crankshaft sprocket and hole it perpendicular to the belt (approximate inclination of $\pm 15^\circ$ or less).

- (5) Pluck the center position of the belt between the camshaft sprocket and the crankshaft sprocket to measure the vibration frequency of the belt.



►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

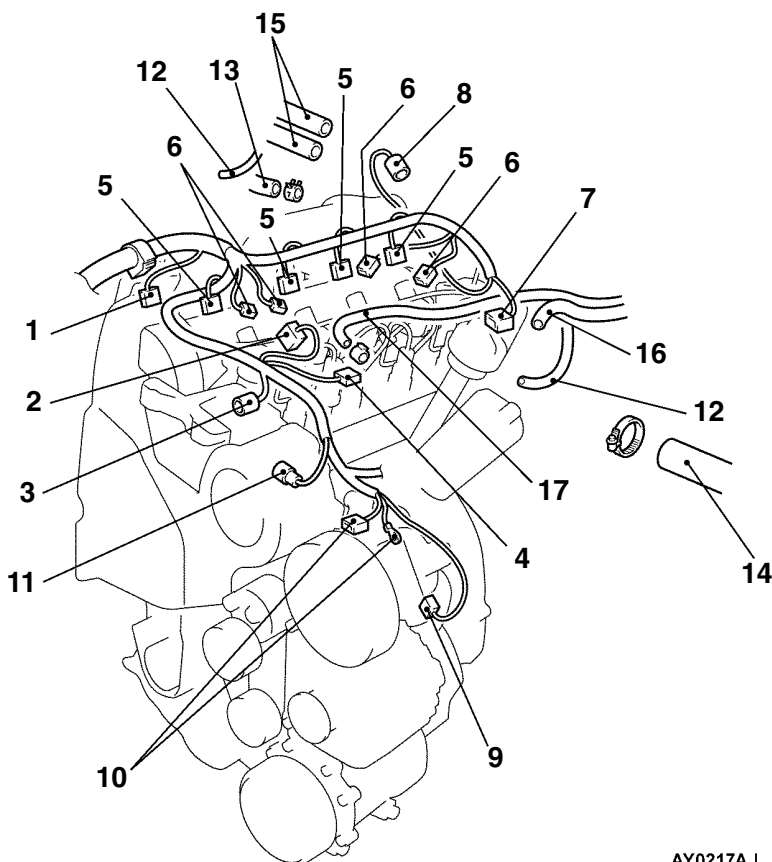
REMOVAL AND INSTALLATION

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.)
- Fuel Line Air Bleeding <After Installation Only> (Refer to GROUP 13C – On-vehicle Service.)

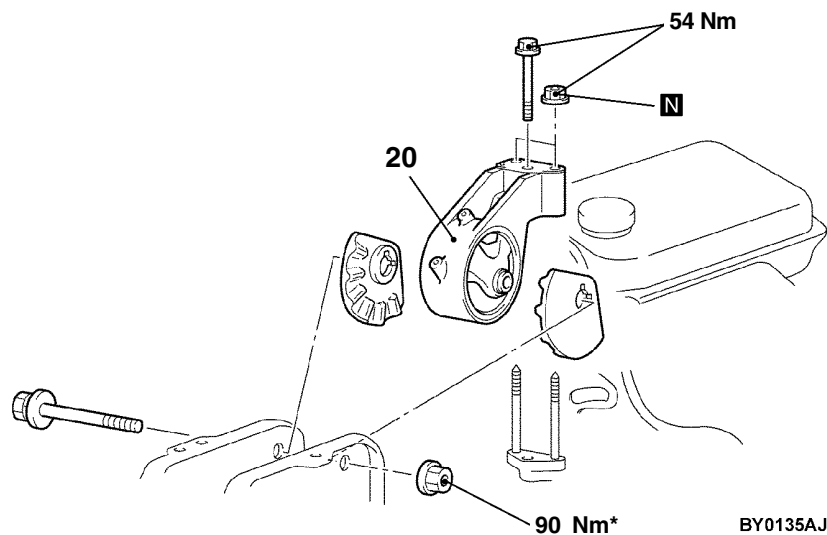
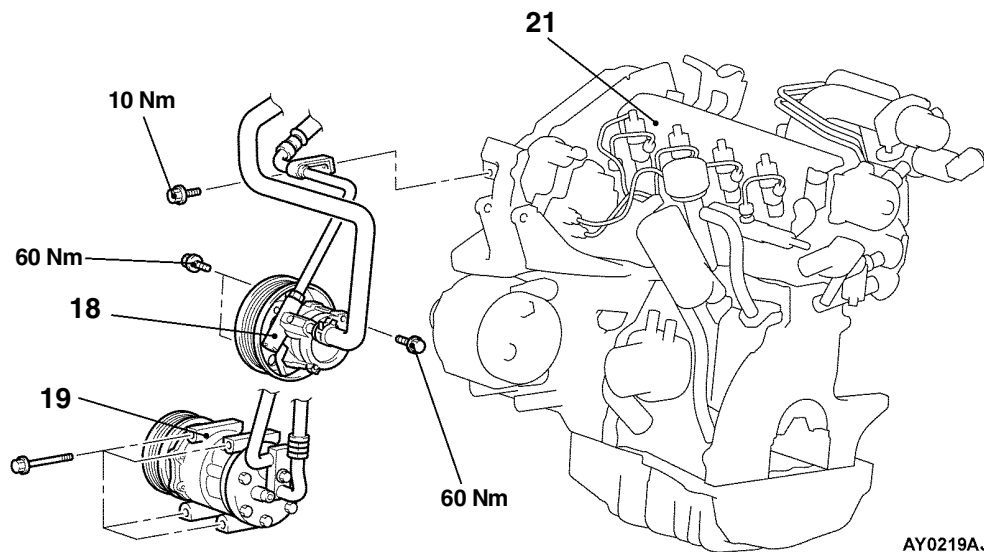


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Removal steps

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. A/C compressor connector
10. Alternator connector
11. Oil pressure switch connector
12. Vacuum hose connection
13. Brake booster vacuum hose connection
14. Water hose connection
15. Heater hose connection
16. Fuel return hose connection
17. Fuel supply hose connection





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

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

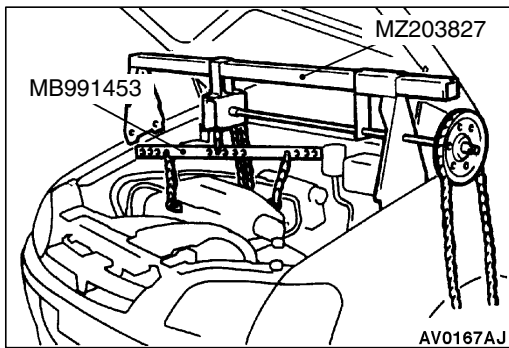
After disconnecting the fuel return hose and the fuel supply hose, put the cover at the end of the fuel line to prevent the foreign objects from entering.

◀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.

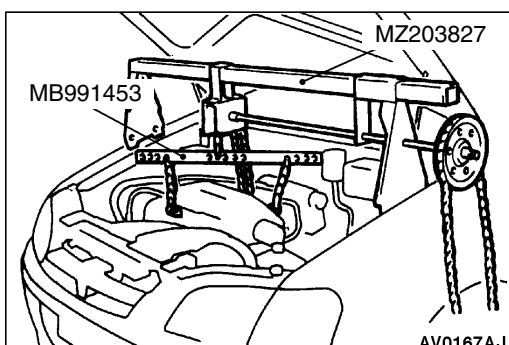
◀E▶ ENGINE ASSEMBLY REMOVAL

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.