

GENERAL INFORMATION

Items			4M41
Total displacement ml			3,200
Bore × Stroke mm			98.5 × 105
Compression ratio			17
Camshaft arrangement			DOHC
Number of valve	Intake		8
	Exhaust		8
Valve timing	Intake	Opening	BTDC 13°
		Closing	ABDC 31°
	Exhaust	Opening	BBDC 55°
		Closing	ATDC 17°
Fuel system			Distribution type injection pump
Rocker arm			Roller type

SERVICE SPECIFICATIONS

Items			Standard value	Limit
Alternator drive belt (When inspection)	Vibration frequency Hz		122 – 161	–
	Tension N		207 – 363	–
	Deflection mm <Reference>		8.0 – 11.0	–
Alternator drive belt (When adjustment)	Vibration frequency Hz		122 – 136	–
	Tension N		207 – 259	–
	Deflection mm <Reference>		10.0 – 11.0	–
Alternator drive belt (When replacement)	Vibration frequency Hz		149 – 161	–
	Tension N		311 – 363	–
	Deflection mm <Reference>		8.0 – 9.0	–
A/C compressor drive belt (When inspection)	Vibration frequency Hz	A	169 – 189	–
		B	111 – 124	–
	Tension N	A	285 – 355	–
	Deflection mm <Reference>	A	7.0 – 8.0	–
A/C compressor drive belt (When adjustment)	Vibration frequency Hz	A	169 – 189	–
		B	111 – 124	–
	Tension N	A	285 – 355	–
	Deflection mm <Reference>	A	7.0 – 8.0	–
A/C compressor drive belt (When replacement)	Vibration frequency Hz	A	207 – 223	–
		B	135 – 146	–
	Tension N	A	425 – 500	–
	Deflection mm <Reference>	A	6.0 – 6.5	–
Valve clearance(at cold engine) mm	Intake valve		0.1	–
	Exhaust valve		0.15	–

Items	Standard value	Limit
Injection timing	4°BTDC	–
Idle speed r/min	750 ± 20	–
Compression pressure kPa–r/min	2,844–240	Min. 2,256–240
Compression pressure difference of all cylinder kPa	–	Max. 294

NOTE

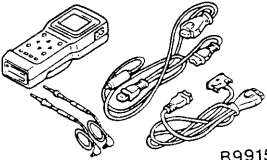
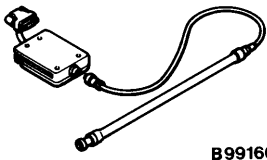
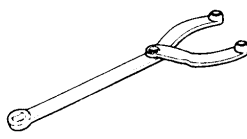
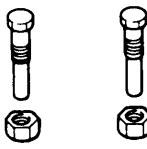
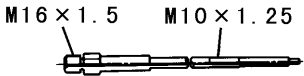
A: Between A/C compressor pulley and tension pulley

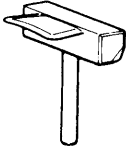
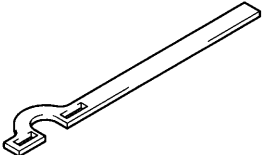
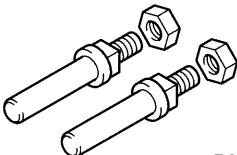
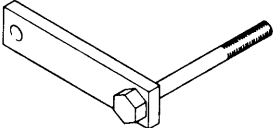
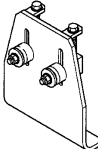
B: Between A/C compressor pulley and crankshaft pulley

SEALANTS AND ADHESIVES

Items	Specified Sealants	Remarks
Oil pan cover rubber	3M ATD Part No. 8155 or equivalent	Quick fix adhesive
Engine cover insulator		
Contact surface between timing gear case and crankcase assembly	3M ATD Part No. 8660 or equivalent	Semi-drying sealant
Oil pan	MITSUBISHI GENUINE PART MD970389 or equivalent	
Timing gear case		

SPECIAL TOOLS

Tool	Number	Name	Use
 B991502	MB991502	MUT-II sub-assembly	<ul style="list-style-type: none"> • Drive belt tension measurement • Fuel injection timing check and adjustment • Idle speed check
 B991668	MB991668	Belt tension meter set	Drive belt tension measurements (Use with MUT-II)
	MB990767	Endyoke holder	Crankshaft pulley holding
	MD998754	Pulley holder pin	
 MH063494	MH063494	Compression gauge adapter	Compression pressure check

Tool	Number	Name	Use
	MD998727	Oil pan remover	Oil pan removal
 B991800	MB991800	Pulley holder	Crankshaft pulley holding
 B991802	MB991802	Pin B	
	MD998781	Flywheel stopper	Flywheel<M/T> or drive plate<A/T> holding
	MH063490	Cam sprocket holder kit	Camshaft sprocket holding

ON-VEHICLE SERVICE

DRIVE BELT TENSION CHECK AND ADJUSTMENT

ALTERNATOR DRIVE BELT TENSION CHECK AND ADJUSTMENT

1. Check the drive belt tension by the following procedures.

Standard value:

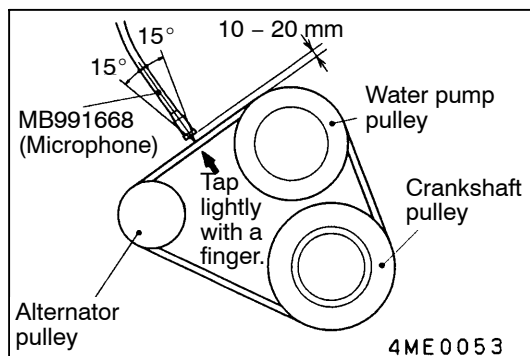
Item	During inspection	During adjustment	During replacement
Vibration frequency Hz	122 – 161	122 – 136	149 – 161
Tension N	207 – 363	207 – 259	311 – 363
Deflection mm <Reference>	8.0 – 11.0	10.0 – 11.0	8.0 – 9.0

<When using MUT-II>

- (1) Connect the MUT-II to the special tool (MB991668).
- (2) Connect the MUT-II to the diagnosis connector.

Caution

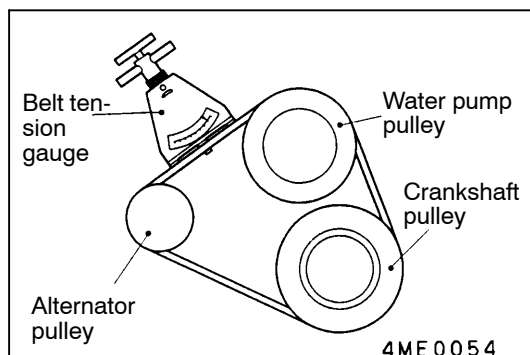
Always turn the ignition switch to LOCK (OFF) position before disconnecting or connecting the MUT-II.



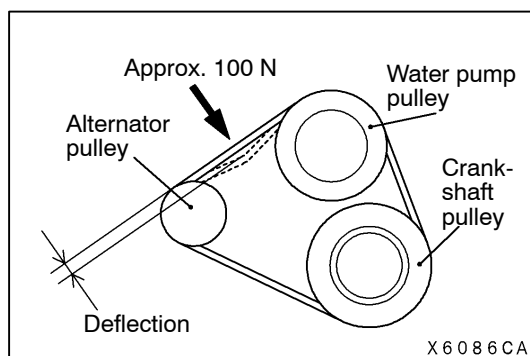
- (3) Turn the ignition switch to ON, and select the “Belt tension measurement” on the menu screen.
- (4) Hold a microphone to the middle of the drive belt between the pulleys (at the place indicated by the arrow), approximately 10 – 20 mm away from the rear surface of the belt and so that it is perpendicular to the belt (within an angle of $\pm 15^\circ$).
- (5) Gently tap the middle of the belt between the pulleys (the place indicated by the arrow) with your finger as shown in the illustration, and check that the vibration frequency of the belt is within the standard value.

Caution

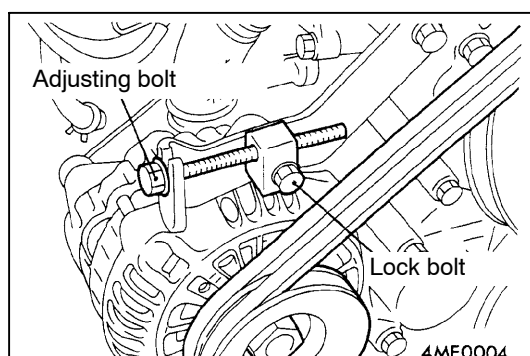
- 1) The temperature of the surface of the belt should be as close to normal temperature as possible.
- 2) Do not allow any contaminants such as water or oil to get onto the microphone.
- 3) If strong gusts of wind blow against the microphone or if there are any loud sources of noise nearby, the values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

**<When using a tension gauge>**

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

**<When checking the deflection>**

Apply approx. 100 N of force to the middle of the drive belt between the pulleys (at the place indicated by the arrow) and check that the amount of deflection is within the standard value.

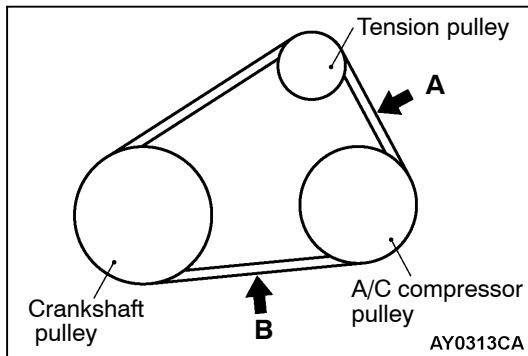


2. If not within the standard value, adjust the belt tension by the following procedure.

- (1) Loosen the pivot nut.
- (2) Loosen the lock bolt.
- (3) Turn the adjusting bolt to adjust the belt deflection.
- (4) Tighten the lock bolt and pivot nut to the specified torque.
- (5) Crank the engine clockwise one turn or more, and then check the belt tension.

Caution

These V belts must always be replaced as a set, being careful to keep them clear of oil or grease.



A/C COMPRESSOR DRIVE BELT TENSION CHECK AND ADJUSTMENT

1. Check the drive belt tension by the following procedures.

Standard value:

Item		During inspection	During adjustment	During replacement
Vibration frequency Hz	A	169 – 189	169 – 189	207 – 223
	B	111 – 124	111 – 124	135 – 146
Tension N	A	285 – 355	285 – 355	425 – 500
Deflection mm <Reference>	A	7.0 – 8.0	7.0 – 8.0	6.0 – 6.5

<When using MUT-II>

Gently tap the center of the belt between the pulleys (arrows A and B), and check that the belt vibration frequency is within the standard value.

NOTE

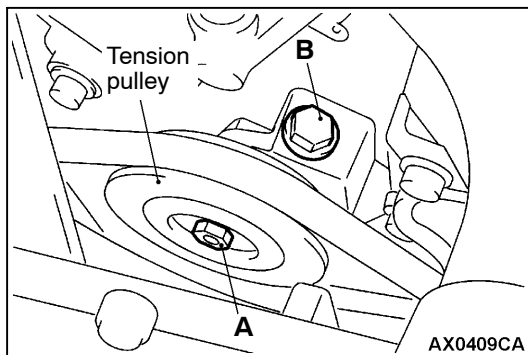
For the vibration frequency measurement using the MUT-II, refer to P.11D-5.

<When using a tension gauge>

Place a belt tension gauge at the center between the pulleys (arrow A) to check the belt tension is within the standard value.

<When checking the deflection>

Apply approx. 100 N of pressure against the location between the pulleys shown by the arrow A in the illustration and then measure the deflection.



2. If not within the standard value, adjust the belt tension by the following procedure.

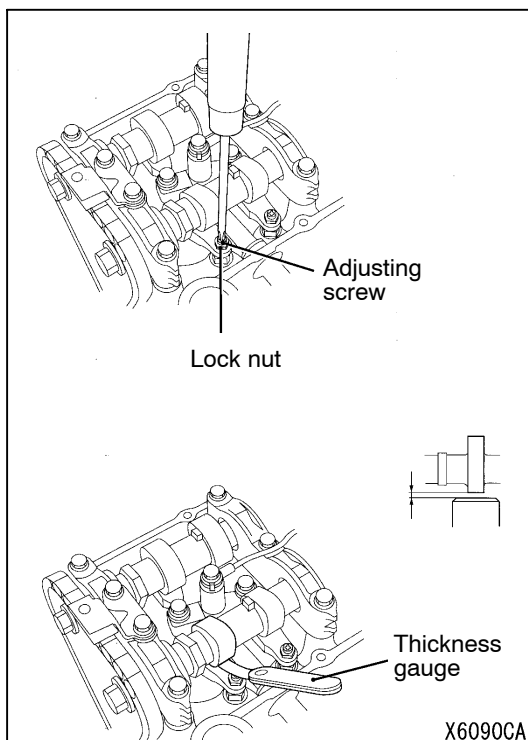
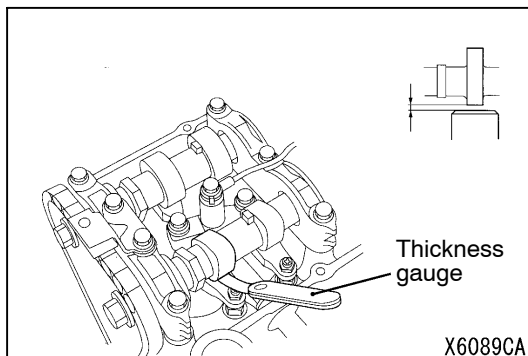
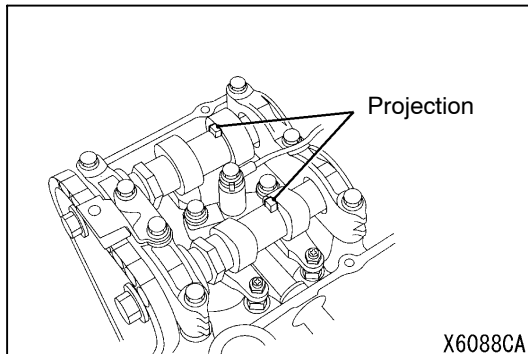
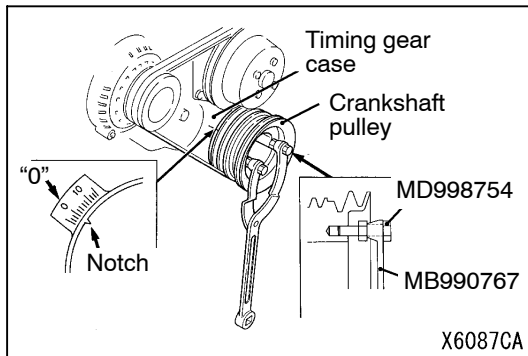
- (1) Loosen the tension pulley securing bolt A.
- (2) Use the adjusting bolt B to adjust the belt deflection.
- (3) Tighten the securing bolt A to the specified torque.

Tightening torque: 44 ± 10 N·m

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

Caution

When checking the belt tension, turn the crankshaft clockwise one turn or more.



VALVE CLEARANCE CHECK AND ADJUSTMENT

NOTE

The valve clearance check and adjustment should be done when the engine is cold.

1. Remove the rocker cover.
2. Remove all the glow plugs.
3. Use the special tool to turn the crankshaft clockwise, and align the notch on the crankshaft pulley with timing mark "0" to set the No.1 cylinder or No.4 cylinder to the top dead centre of its compression stroke.

Caution

Never turn the crankshaft anticlockwise, or the tensioner for adjusting the timing chain tension at the timing gear can be damaged.

If it is turned anticlockwise, once remove the tensioner and reinstall.

NOTE

If the projection on the camshaft faces up, the No.1 cylinder is on the top dead centre of its compression stroke. When the crankshaft is turned just one more turn, the No.4 cylinder is at top dead centre.

4. When the No.1 or No.4 piston is on the top dead centre of its compression stroke, use a thickness gauge to measure the valve clearance indicated by the circle in the table below.

When the No.1 cylinder is at compression top dead centre:

Cylinder No.	1	2	3	4
Intake	○	○	—	—
Exhaust	○	—	○	—

When the No.4 cylinder is at compression top dead centre:

Cylinder No.	1	2	3	4
Intake	—	—	○	○
Exhaust	—	○	—	○

Standard value:

Intake side 0.1 mm

Exhaust side 0.15 mm

NOTE

If the thickness gauge is inserted and pulled out with resistance, its reading will be accurate.

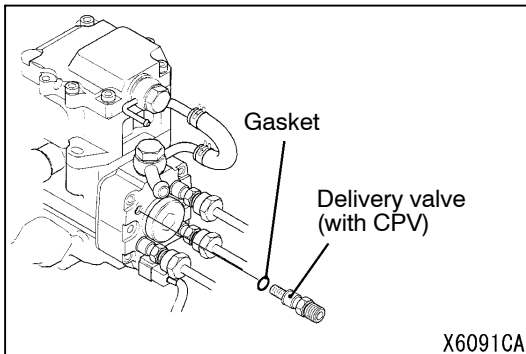
If the thickness gauge can be inserted and pulled out smoothly without resistance, its reading will be inaccurate.

5. If not at the standard value, adjust by the following procedure.
 - (1) Loosen the lock nut, and tighten the adjusting screw so that the thickness gauge can be passed with a slight drag.

- (2) After adjustment, tighten the lock nut to the specified torque while preventing the adjusting screw from turning with a screwdriver.

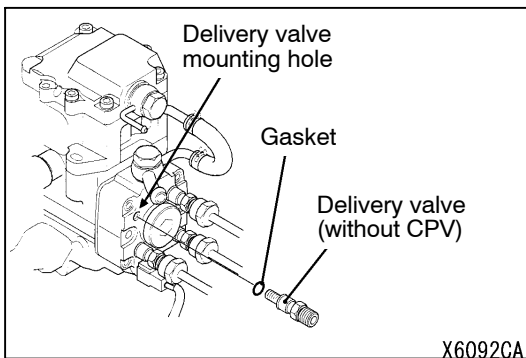
Tightening torque: 9.5 ± 0.5 N·m

- (3) Measure the valve clearance again, and check that it is at the standard value.



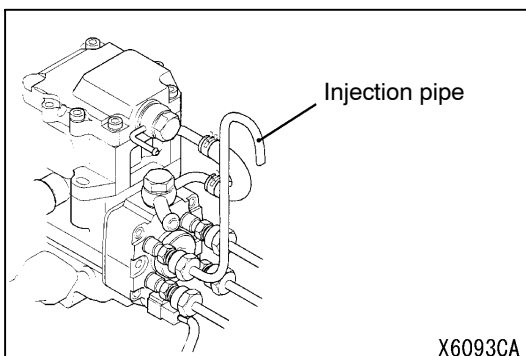
INJECTION TIMING CHECK AND ADJUSTMENT

1. Warm up the engine.
2. Remove all the glow plugs.
3. Remove the No.1 cylinder delivery valve (with CPV) and gasket of the injection pump.

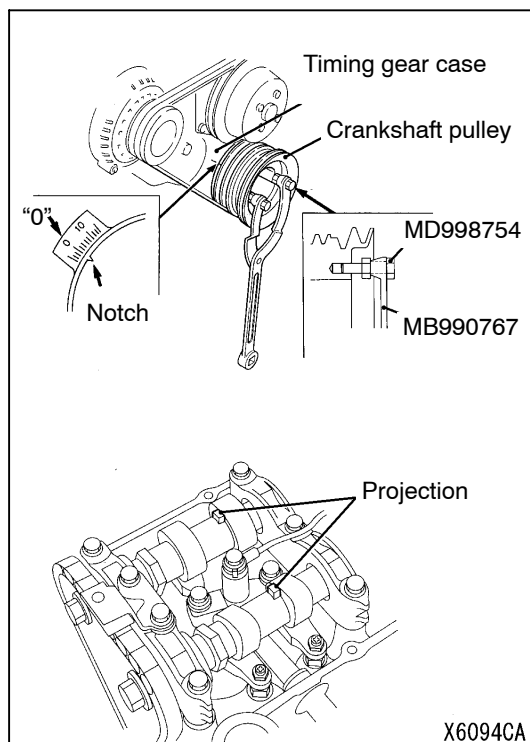


4. Install the gasket (ME741133) and delivery valve (without: MH063483) to the injection pump delivery valve mounting hole, and tighten them to the specified torque.

Tightening torque: 49 ± 5 N·m



5. Install an old the auxiliary injection pipe to the delivery valve. Cut out the open end of the injection pipe, and bend it down so as to observe the fuel flow.



6. Use the special tool to turn the crankshaft clockwise, align the notch on the crankshaft pulley with the "0" timing mark to set the No.1 cylinder to the top dead centre of its compression stroke.

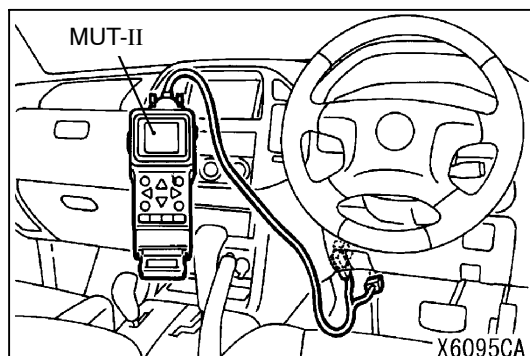
Caution

Never turn the crankshaft anticlockwise, or the tensioner for adjusting the timing chain tension at the timing gear can be damaged. If it is turned anticlockwise, once remove it and reinstall.

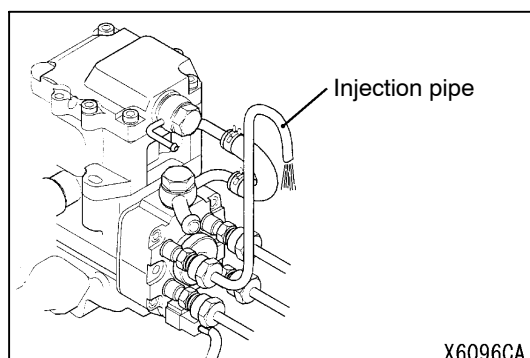
NOTE

Remove the filler cap, and check the camshaft condition. If the camshaft projection faces up, the No.1 cylinder is on top dead center of its compression stroke.

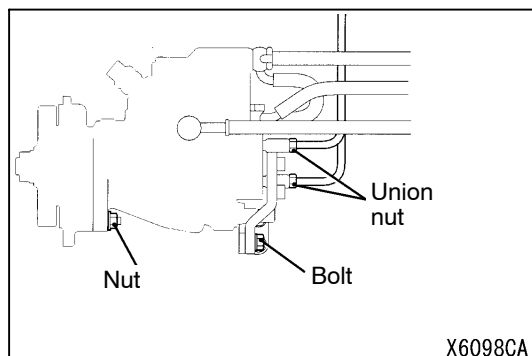
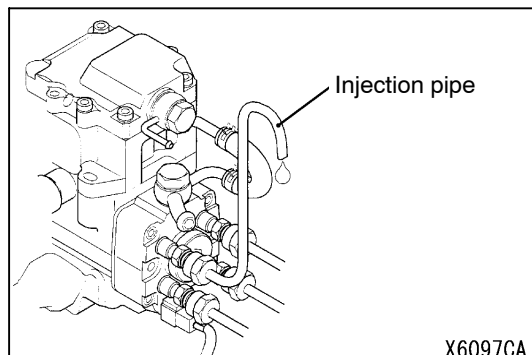
7. Turn the crankshaft pulley clockwise, and set the No.1 cylinder to 30° BTDC of its compression stroke.



8. Turn the ignition switch to the LOCK (OFF) position, and connect the diagnosis connector to the MUT-II.
9. Turn the ignition switch ON.
10. Carry out the actuator test (No.34) on MUT-II.



11. Supply the fuel by operating the fuel filter hand pump, and turn the engine clockwise while allowing the fuel to flow through the injection pipe.



12. If the fuel flow through the injection pipe decreases, turn the engine more slowly. Then stop turning the engine when the fuel flow stops completely. Check the fuel injection timing during this condition.

Standard value: 4°BTDC

13. If not at the standard value, adjust by the following procedure.

- (1) Loose the fuel injection pipe union nut, the injection pump securing bolt and nut in that order.

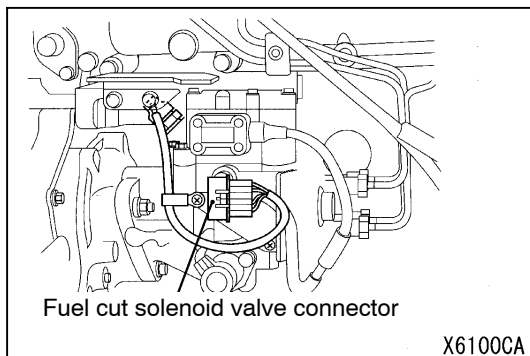
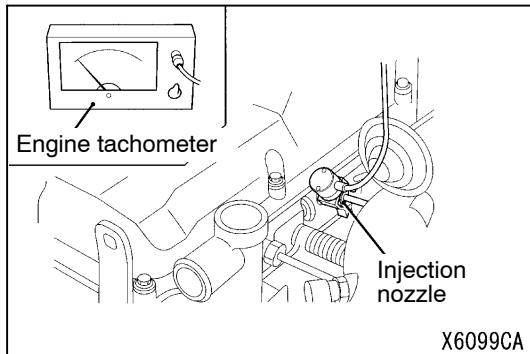
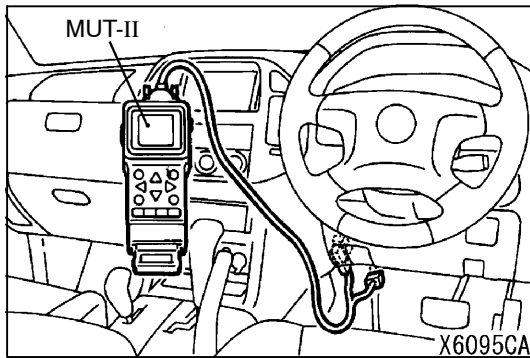
Caution

- 1) **When the union nut is loosened, use a open end wrench to prevent the delivery valve holder from rotating with it.**
- 2) **Do not remove the bolt and nut at this time.**
- (2) Tile the injection pump housing to the left or the right to adjust.
- (3) Tile the injection pump mounting nut and bolt temporarily.
- (4) Repeat steps 9 – 12 to check that the injection timing is correct.
- (5) Tile the injection pump mounting nut and bolt securely.
- (6) Loose the fuel injection pipe union nut securely.

Caution

Hold the delivery pipe holder with a open end wrench when tightening the union nut.

14. Remove the special tool.
15. Install the delivery valve (with CPV) and the new gasket.
16. Install the glow plugs.



IDLE SPEED CHECK

1. Set the vehicle to the pre-inspection condition.
2. Turn the ignition switch to LOCK (OFF), and connect the diagnosis connector to the MUT-II.
If the MUT-II is not used, connect an engine tachometer to the injection nozzle or the pipe.
3. Start the engine, and let it run at idle.
4. Check the idle speed.

Standard value: 750 ± 20 r/min

5. If the idle speed is not within the standard value, refer to 13D – Troubleshooting to check the electronic controlled fuel injection system.

NOTE

The idle speed is controlled by the engine-ECU.

COMPRESSION PRESSURE CHECK

1. Check that the engine oil, the starter motor and the battery is in good condition. In addition, set the vehicle to the pre-inspection condition.
2. Remove all the glow plugs.
3. Disconnect the fuel cut solenoid valve connector.

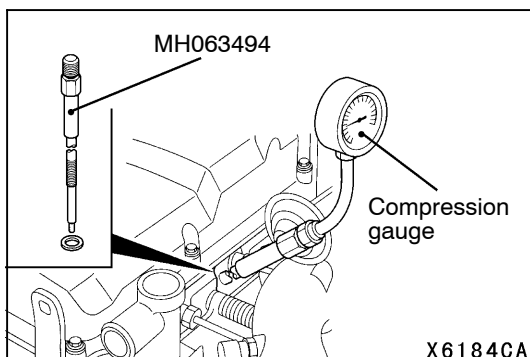
NOTE

Doing this will prevent carrying out fuel injection.

4. Plug the glow plug mounting holes with a shop towel, crank the engine, and then check that the shop towel is not contaminated with foreign material.

Caution

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



5. Install the special tool to the glow plug mounting holes, and install the compression gauge.
6. Measure the compression pressure while cranking the engine.

Standard value: 2,844 kPa – 240 r/min

Limit value: Min. 2,256 kPa – 240 r/min

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

Limit: Max. 294 kPa

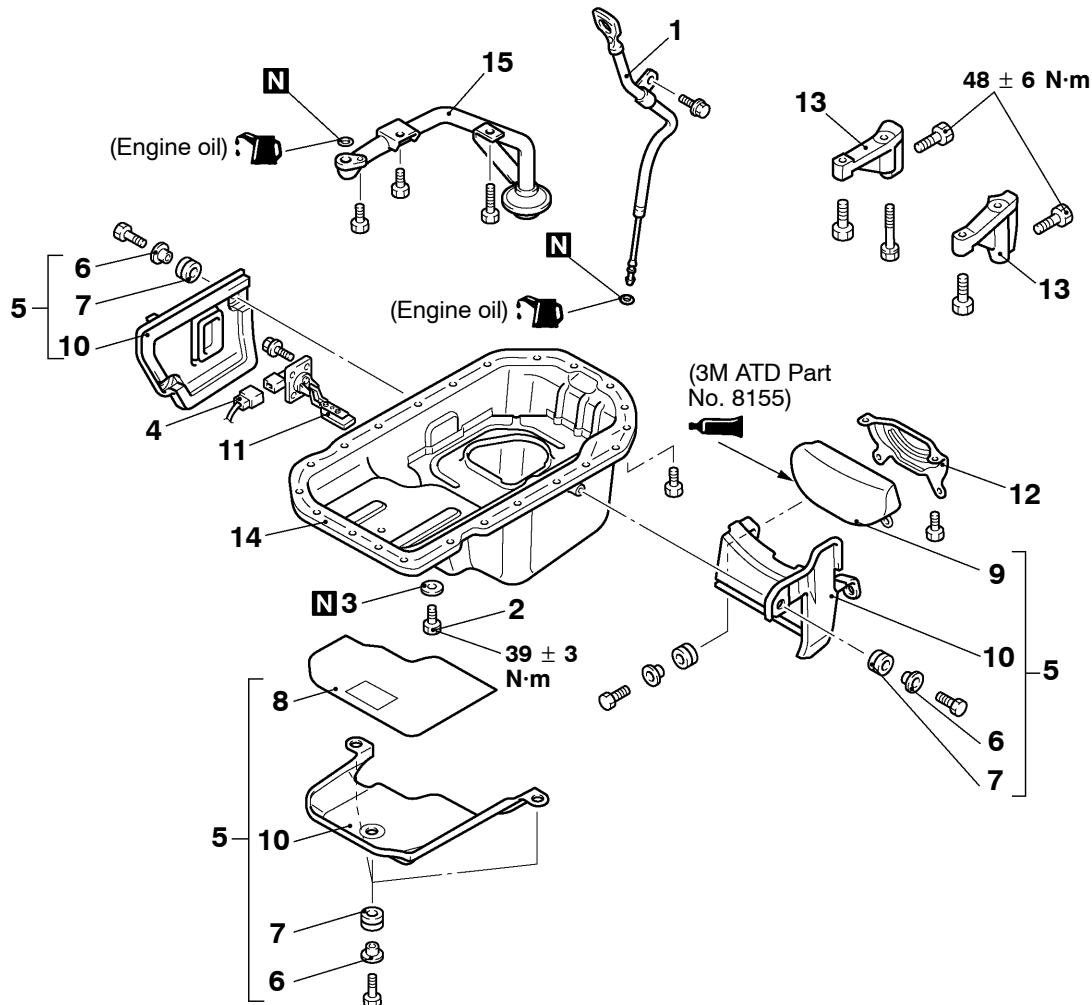
8. If there is a cylinder which compression or compression difference is outside the limit, pour a small amount of engine oil through the glow plug hole, and repeat the operations in steps 6 – 7.
 - (1) If the compression increases after the oil is added, the cause of the malfunction is a worn or damaged piston ring and /or cylinder inner surface.
 - (2) If the compression does not rise after the oil is added, the cause is a burnt or defective valve seat, or pressure is leaking from the gasket.
9. Connect the fuel cut solenoid valve connector.
10. Install the glow plugs.

OIL PAN AND OIL SCREEN

REMOVAL AND INSTALLATION

Pre-removal and Post-installation Operation

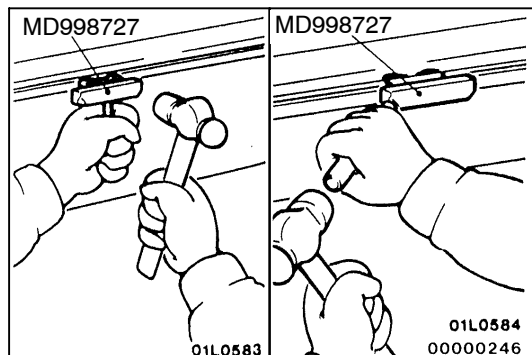
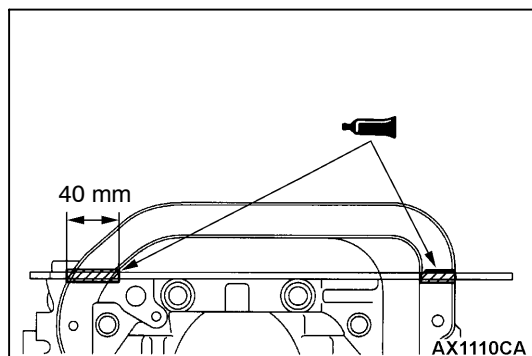
- Skid Plate and Under Cover Removal and Installation
- Engine Oil Draining and Refilling
(Refer to GROUP 12 – On-vehicle Service.)
- Differential Gear Oil Draining and Refilling
(Refer to GROUP 26 – On-vehicle Service.)
- Front Differential and No.2 Crossmember Assembly
Removal and Installation
(Refer to GROUP 11A – Oil Pan and Oil Screen.)



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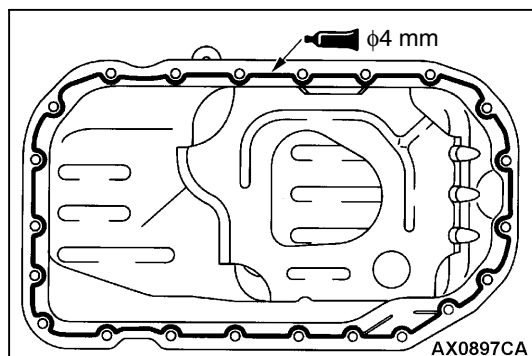
Removal steps

- B◄
1. Engine oil level gauge and guide assembly
 2. Drain plug
 3. Drain plug gasket
 4. Engine oil level sensor connector
 5. Oil pan cover assembly
 6. Insulator collar
 7. Insulator
 8. Oil pan rubber
 9. Rubber
 10. Oil pan cover
 11. Engine oil level sensor
 12. Dust cover
 13. Stiffener
 14. Oil pan
 15. Oil screen
- ◄A► ►A◄

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

1. Clean the gasket mating surfaces of the oil pan, the timing gear case and the crankcase assembly with a scraper or a wire brush.
2. Apply the specified sealant to the mating surface of the timing gear case and crankcase.

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



3. Apply a continuous bead of the specified sealant to the the oil pan mating surface as shown.

Specified sealant:

MITSUBISHI GENUINE PART MD970389 or equivalent

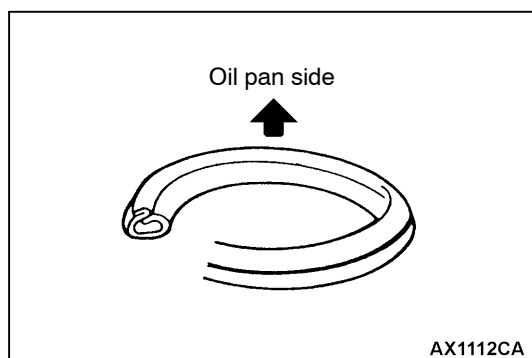
4. After applying the sealant, install the oil pan within 15 minutes.

Caution

- (1) When installing the oil pan, be careful not to disturb the sealant.
- (2) Whenever the oil pan mounting bolts are loosened or tightened again after the oil pan installation, always apply the sealant again.
- (3) After the oil pan is installed, wait for at least one hour, and then start the engine.

▶B◀ DRAIN PLUG GASKET INSTALLATION

Always replace the gasket with a new one so that it faces the direction shown.

**INSPECTION**

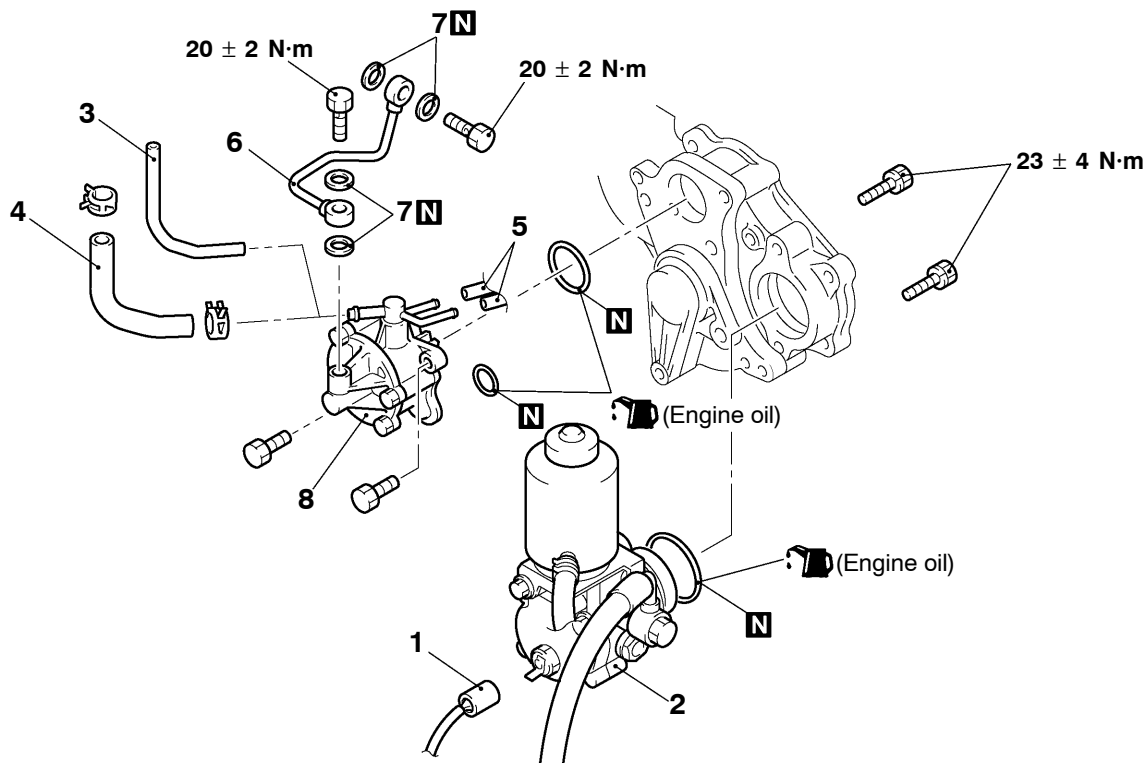
- Check oil pan for cracks.
- Check oil pan sealant-coated surface for damage and deformation.
- Check oil screen for cracked, clogged or damaged wire net and pipe.

VACUUM PUMP

REMOVAL AND INSTALLATION

Pre-removal and Post-installation Operation

- Engine Cover Removal and Installation
(Refer to P.11D-23.)
- Battery and Battery Tray Removal and Installation
- Engine Oil Check and Refill
(Refer to GROUP 12 – On-vehicle Service.)
<Post-installation operation>



AX1653CA

Removal steps

1. Power steering oil pressure switch connector
2. Power steering oil pump assembly
3. Vacuum hose <Vehicles with ABS>
4. Vacuum hose <Vehicles without ABS>
5. Vacuum hose connection
6. Vacuum pump oil pipe
7. Vacuum pump oil pipe gasket
8. Vacuum pump assembly

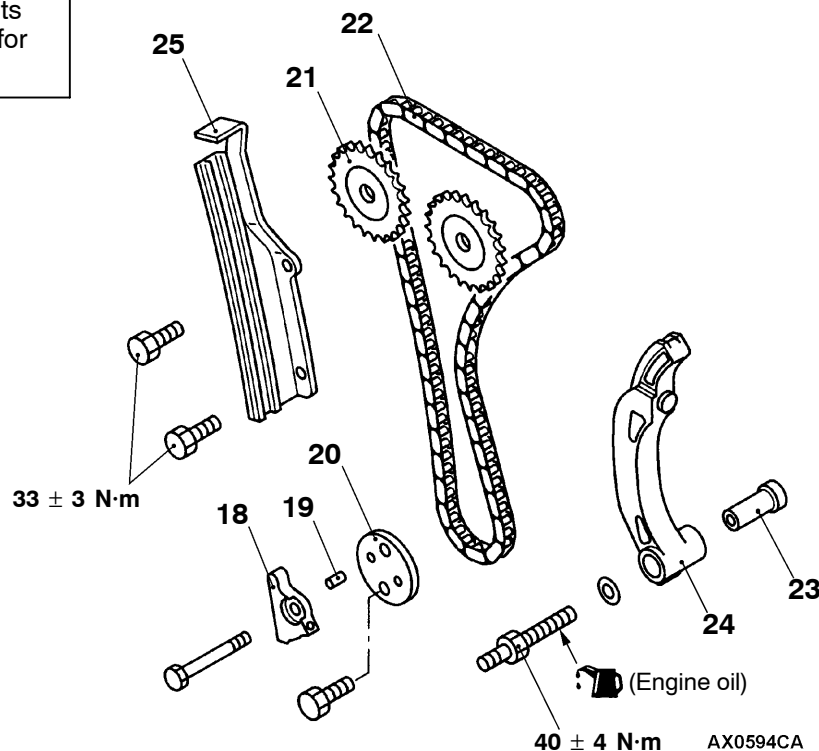


REMOVAL SERVICE POINT

◀A▶ POWER STEERING OIL PUMP ASSEMBLY REMOVAL

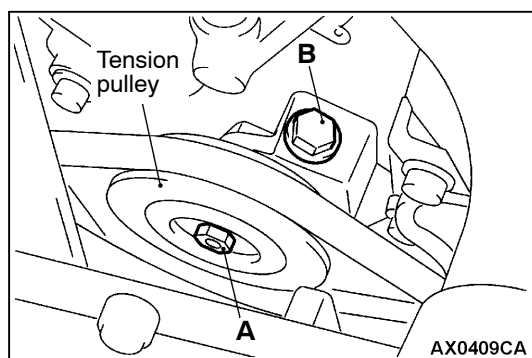
1. Remove the power steering oil pump assembly from the timing gear case with its hoses still attached.
2. Support the oil pump aside with a cord.

Apply engine oil to the timing chain and its contact surfaces for installation.



- ▶A◀ 18. Oil jet
- ▶A◀ 19. Spring pin
- ▶A◀ 20. Idler washer
- ▶A◀ 21. Camshaft sprocket

- ▶A◀ 22. Timing chain
- ▶A◀ 23. Tension lever shaft
- ▶A◀ 24. Tension lever
- ▶A◀ 25. Guide plate



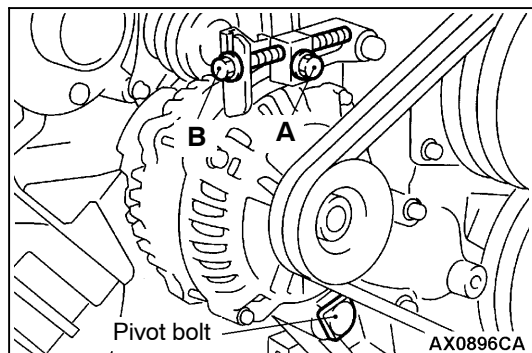
REMOVAL SERVICE POINTS

◀A▶ A/C COMPRESSOR DRIVE BELT REMOVAL

1. Loosen the tension pulley securing bolt A.
2. Loosen the adjusting bolt B to remove the belt.

Caution

To reuse the drive belt, mark its running direction (clockwise direction) on the belt back side with a chalk.

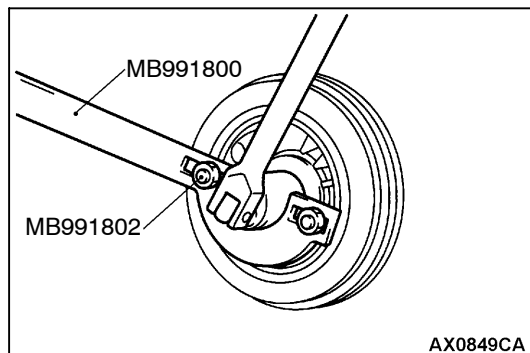


◀B▶ ALTERNATOR DRIVE BELT REMOVAL

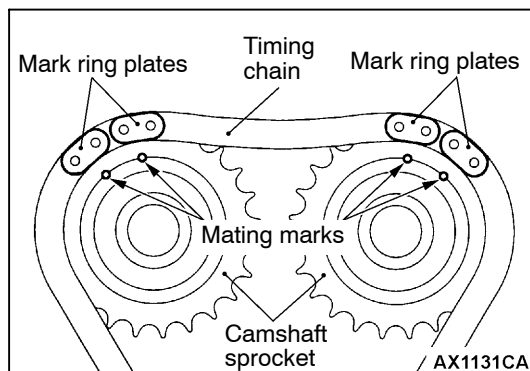
1. Loosen the alternator pivot bolt, nut and the securing bolt A.
2. Loosen the adjusting bolt B to remove the belts.

Caution

- (1) To reuse the drive belts, mark its running direction (clockwise direction) on the belt backside with a chalk.
- (2) To replace the drive belts, always replace them as a set.



◀C▶ CRANKSHAFT PULLEY REMOVAL



INSTALLATION SERVICE POINTS

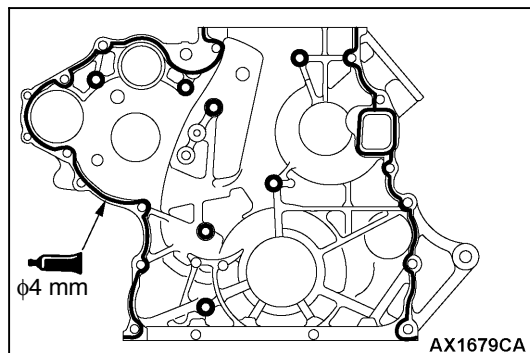
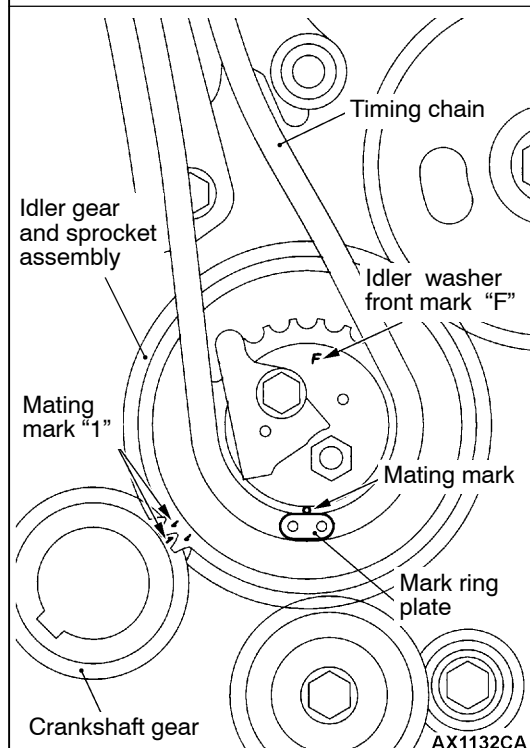
▶A◀ TIMING CHAIN/CAMSHAFT SPROCKET/IDLER WASHER/SPRING PIN/OIL JET INSTALLATION

1. Check that the mating mark on the idler gear and sprocket assembly is aligned with mating mark "1" on the crankshaft gear.
2. Align the mating mark on the idler gear and sprocket assembly with the dark blue mark ring plate on the timing chain.

Caution

Note that the timing chain has one mark ring plate for the idler gear and sprocket assembly side, and two mark ring plates for each camshaft sprocket.

3. Align the mark ring plates with the camshaft sprocket mating marks.
4. Tie up the timing chain and the camshaft sprocket with a cord to prevent the mating mark misalignment.
5. Install the idler washer, the spring pin and the oil jet. The idler washer front mark "F" must face toward the front of the engine.



▶B◀ TIMING GEAR CASE/BEARING BLOCK ASSEMBLY INSTALLATION

1. Clean the timing gear case and the front plate mating surfaces with a scraper or a wire brush.
2. Apply a continuous bead of the specified sealant to the timing gear case mating surface as shown.

Specified sealant:

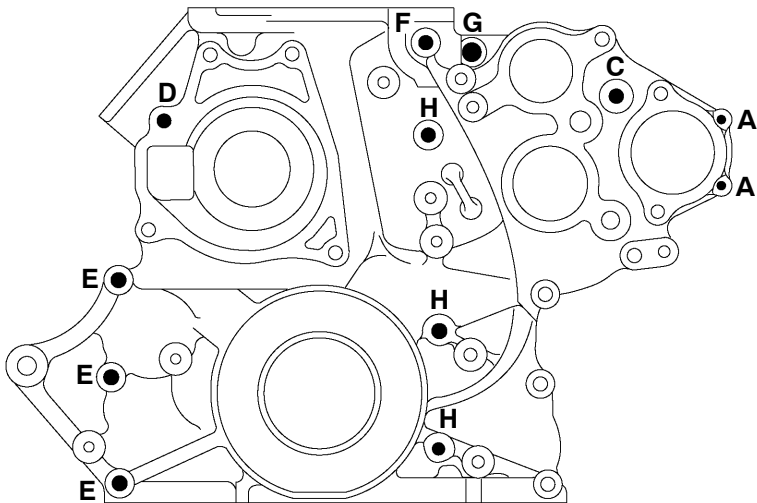
mitsubishi GENUINE PART MD970389 or equivalent

3. After applying the sealant, install the gear case within 15 minutes.

Caution

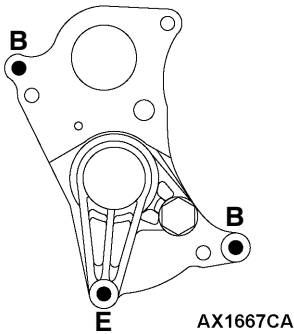
- (1) When installing the oil pan, be careful not to disturb the sealant.
- (2) Whenever the timing gear case mounting bolts are loosened or tightened again after the timing gear case installation, always apply the sealant again.
- (3) After the oil pan is installed, wait for at least one hour, and then start the engine.
4. Install the mounting nuts and bolts to the timing gear case and the bearing block assembly at the shown positions.

Timing gear case



AX1666CA

Bearing block assembly



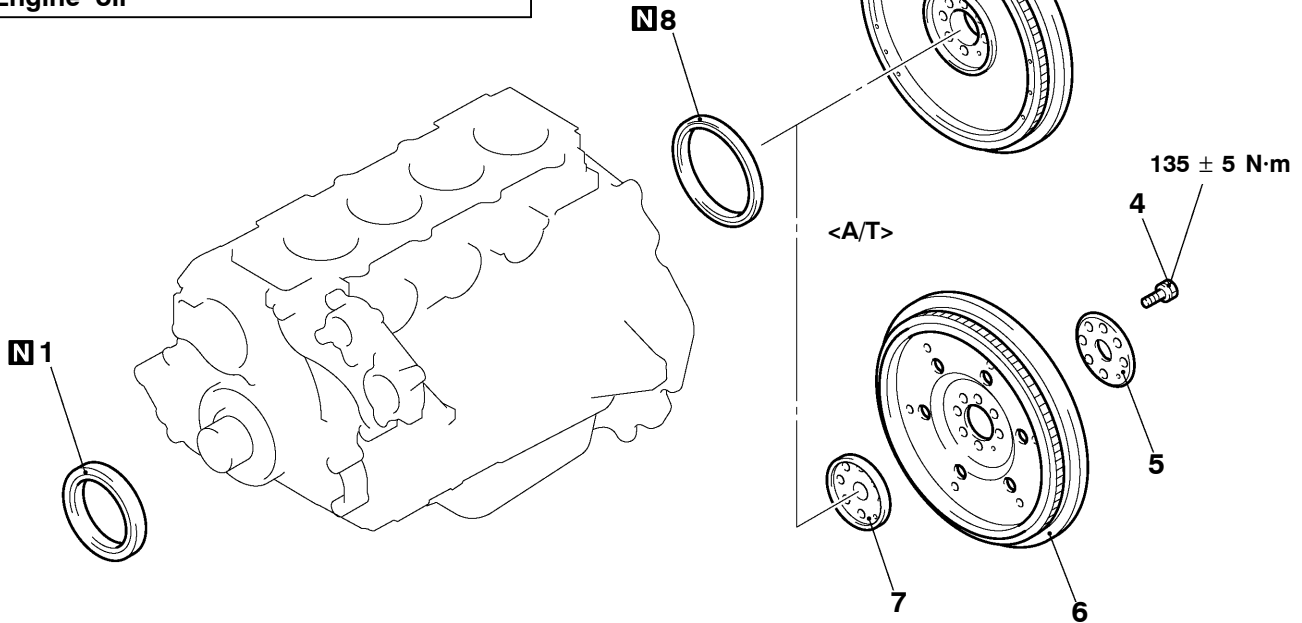
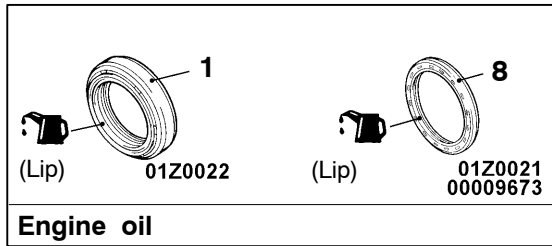
AX1667CA

Name	Symbol	Size mm (d × l)	Name	Symbol	Size mm (d × l)
Flange bolt	A	6 × 20	Flange bolt	E	8 × 85
	B	8 × 30		F	8 × 90
	C	8 × 50		G	10 × 35
	D	8 × 75	Cap nut	H	–

d=Nominal diameter
l=Nominal length

CRANKSHAFT OIL SEAL

REMOVAL AND INSTALLATION



AX1638CA

Crankshaft front oil seal removal steps

- Crankshaft pulley
(Refer to P.11D-17.)
1. Crankshaft front oil seal



Crankshaft rear oil seal removal steps

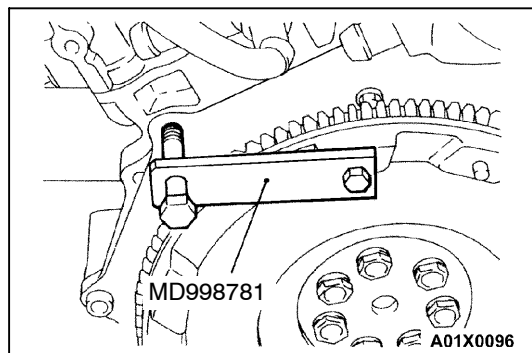
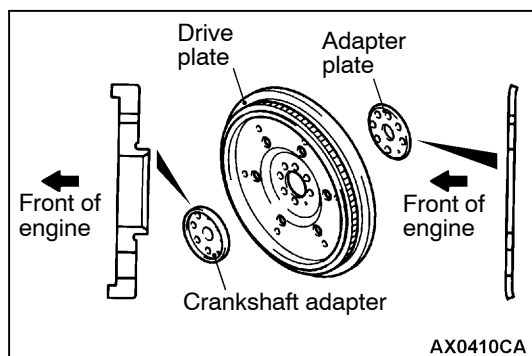
<M/T>

- Transmission assembly
(Refer to GROUP 22.)
2. Flywheel bolt
3. Flywheel
8. Crankshaft rear oil seal

<A/T>

- Transmission assembly
(Refer to GROUP 23.)
4. Drive plate bolt
5. Adapter plate
6. Drive plate
7. Crankshaft adapter
8. Crankshaft rear oil seal



**REMOVAL SERVICE POINT****◀A▶ FLYWHEEL BOLT/DRIVE PLATE BOLT REMOVAL****INSTALLATION SERVICE POINT****▶A◀ CRANKSHAFT ADAPTER/DRIVE PLATE/ADAPTER PLATE INSTALLATION**

Assemble the crankshaft adapter and the adapter plate to the drive plate as shown, and then install the drive plate assembly into the crankshaft.

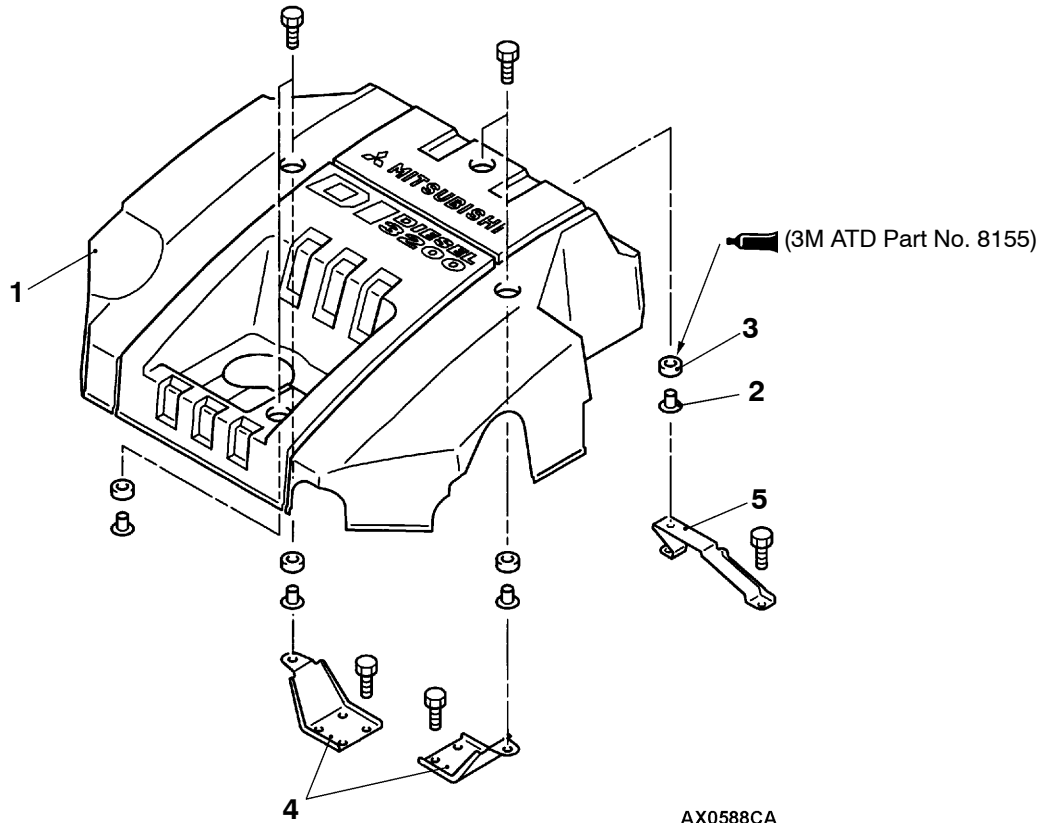
CAMSHAFT

REMOVAL AND INSTALLATION

Post-installation Operation

Fuel Line Air-bleeding

(Refer to GROUP 13D – On-vehicle Service.)

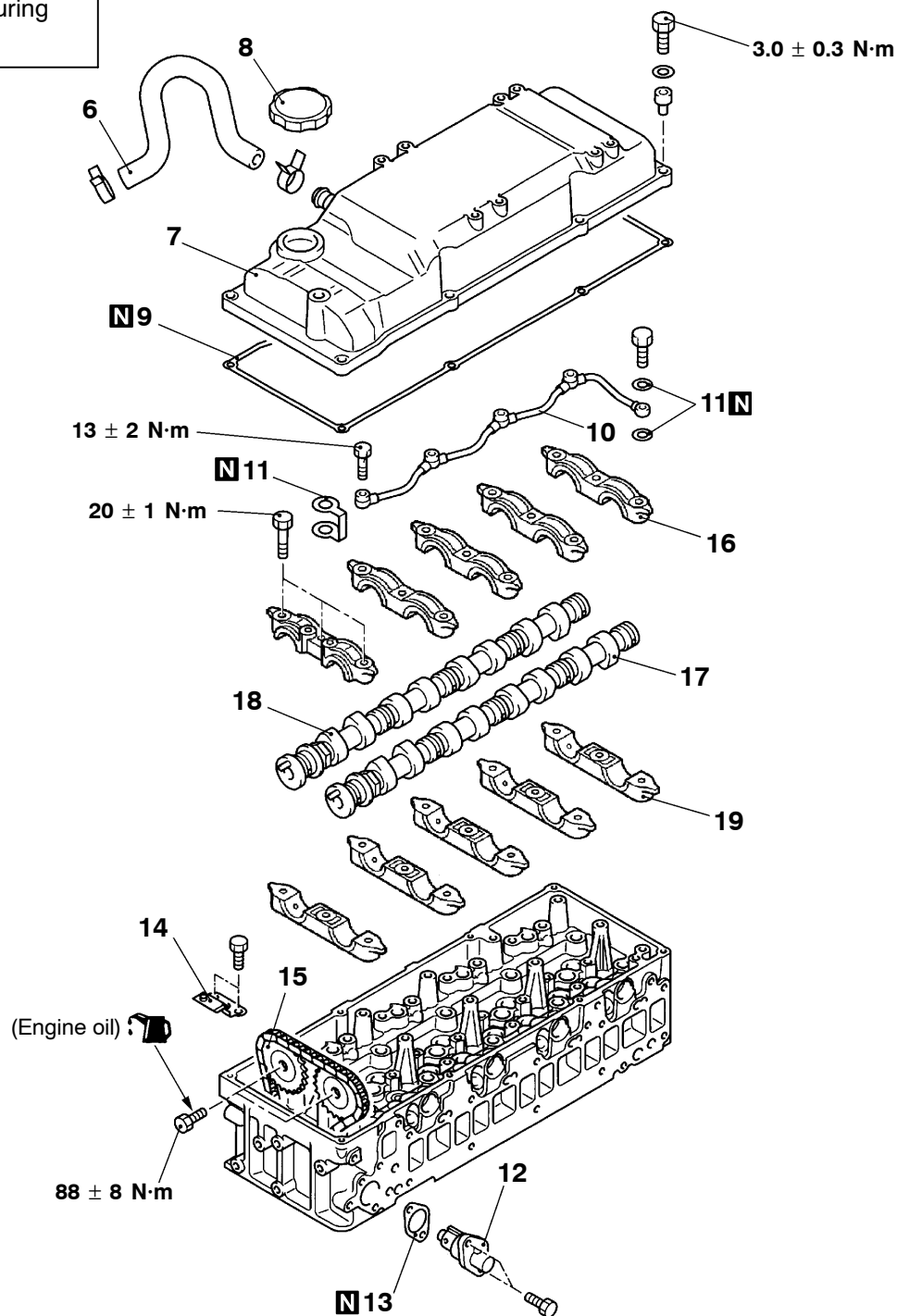


Removal steps

1. Engine cover assembly
2. Insulator collar
3. Insulator
4. Engine cover bracket
5. Engine cover bracket

- Air cleaner (Refer to GROUP 15.)
- EGR valve and pipe assembly (Refer to GROUP 15 – Intake Manifold and Throttle Body <4M41>.)

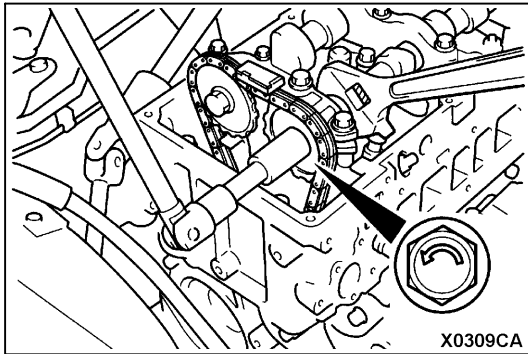
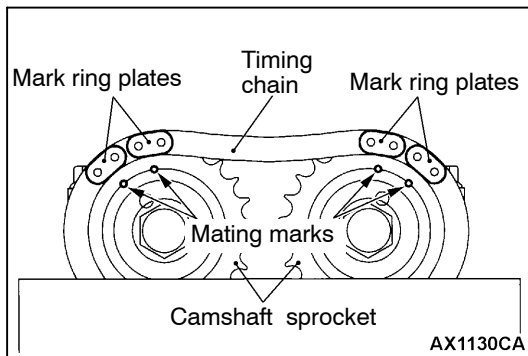
Apply engine oil to all moving parts during installation.



AX0589CA

- 6. Breather hose
- 7. Rocker cover
- 8. Oil filler cap
- 9. Rocker cover gasket
- 10. Fuel leak-off pipe
- 11. Fuel leak-off pipe gasket
- Valve clearance adjustment
(Refer to P.11D-8.)

- ▶D◀ 12. Chain tensioner
- ▶C◀ 13. Chain tensioner gasket
- ◀A▶ 14. Upper guide plate
- ▶B◀ 15. Camshaft sprocket
- ▶A◀ 16. Camshaft cap
- 17. Intake camshaft
- 18. Exhaust camshaft
- ▶A◀ 19. Camshaft holder



REMOVAL SERVICE POINT

◀A▶ CAMSHAFT SPROCKET REMOVAL

1. Turn the crankshaft clockwise, align the mating marks on the camshaft sprocket with the dark blue mark ring plates on the timing chain to set No.1 cylinder to TDC of its compression stroke.

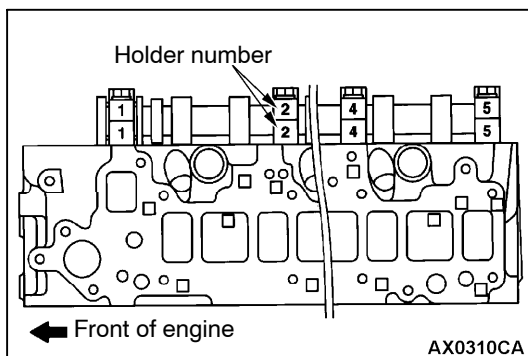
Caution

Never turn the crankshaft anticlockwise.

2. Hold the hexagonal part of the camshaft with an open end wrench, loosen the camshaft sprocket bolts, and then remove the camshaft sprockets with the timing chain still attached.

Caution

- (1) Use the timing chain to prevent the camshaft from turning.
 - (2) The camshaft sprocket bolt is left threaded, so the arrow indicating its tightening direction is marked on the bolt head. To loosen this bolt, turn the bolt to the opposite direction of the arrow.
 - (3) The timing chain must be attached to the camshaft sprockets.
3. Tie up the timing chain and the camshaft sprocket with a cord to prevent the mating mark misalignment.



INSTALLATION SERVICE POINTS

▶A◀ CAMSHAFT HOLDER/CAMSHAFT CAP INSTALLATION

The holder numbers are stamped on the camshaft holders and the camshaft caps, so install them in that order and tighten to the specified torque.

Tightening torque: 20 ± 1 N·m

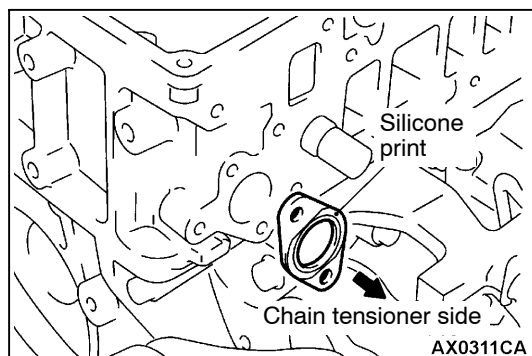
►B◄ CAMSHAFT SPROCKET INSTALLATION

1. Install the camshaft sprockets to the camshafts with the timing chain still attached.
2. Hold the hexagonal part of the camshaft with an open end wrench in the same manner as removal.
3. Apply a small amount of engine oil to the camshaft sprocket bolt thread and the flange, and then tighten to the specified torque.

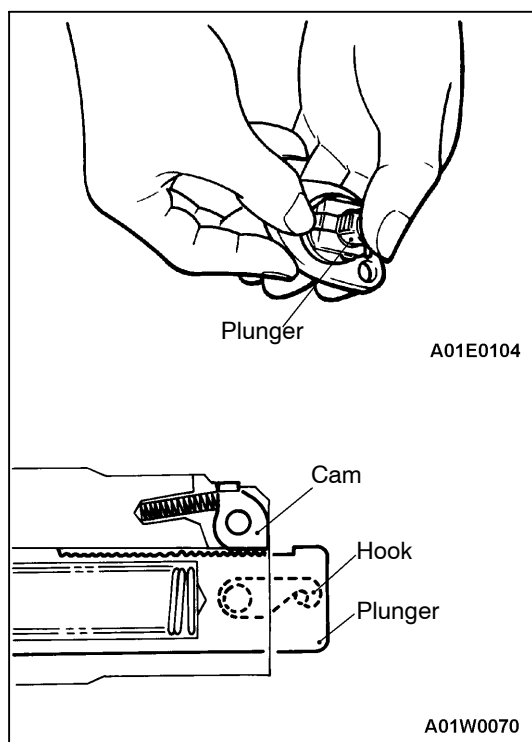
Tightening torque: 88 ± 8 N·m

Caution

- (1) Use the timing chain to prevent the camshaft from turning.
- (2) The camshaft sprocket bolt is left threaded, so the arrow indicating its tightening direction is marked on the bolt head.

**►C◄ CHAIN TENSIONER GASKET INSTALLATION**

Place the chain tensioner gasket with its silicone print facing toward the chain tensioner side.

**►D◄ CHAIN TENSIONER INSTALLATION**

1. Bend up the tab as shown to push in the plunger, and lock it with the hook.
2. Install the chain tensioner to the cylinder head.

Caution

To install the chain tensioner, always push in the plunger. If you fail to do this, the timing chain will be excessively tensioned, causing damage.

3. Turn the crankshaft clockwise.

Caution

If the crankshaft is turned anticlockwise after the chain tensioner is installed, the plunger will be excessively tensioned, causing the plunger to go beyond the cam inside the chain tensioner.

NOTE

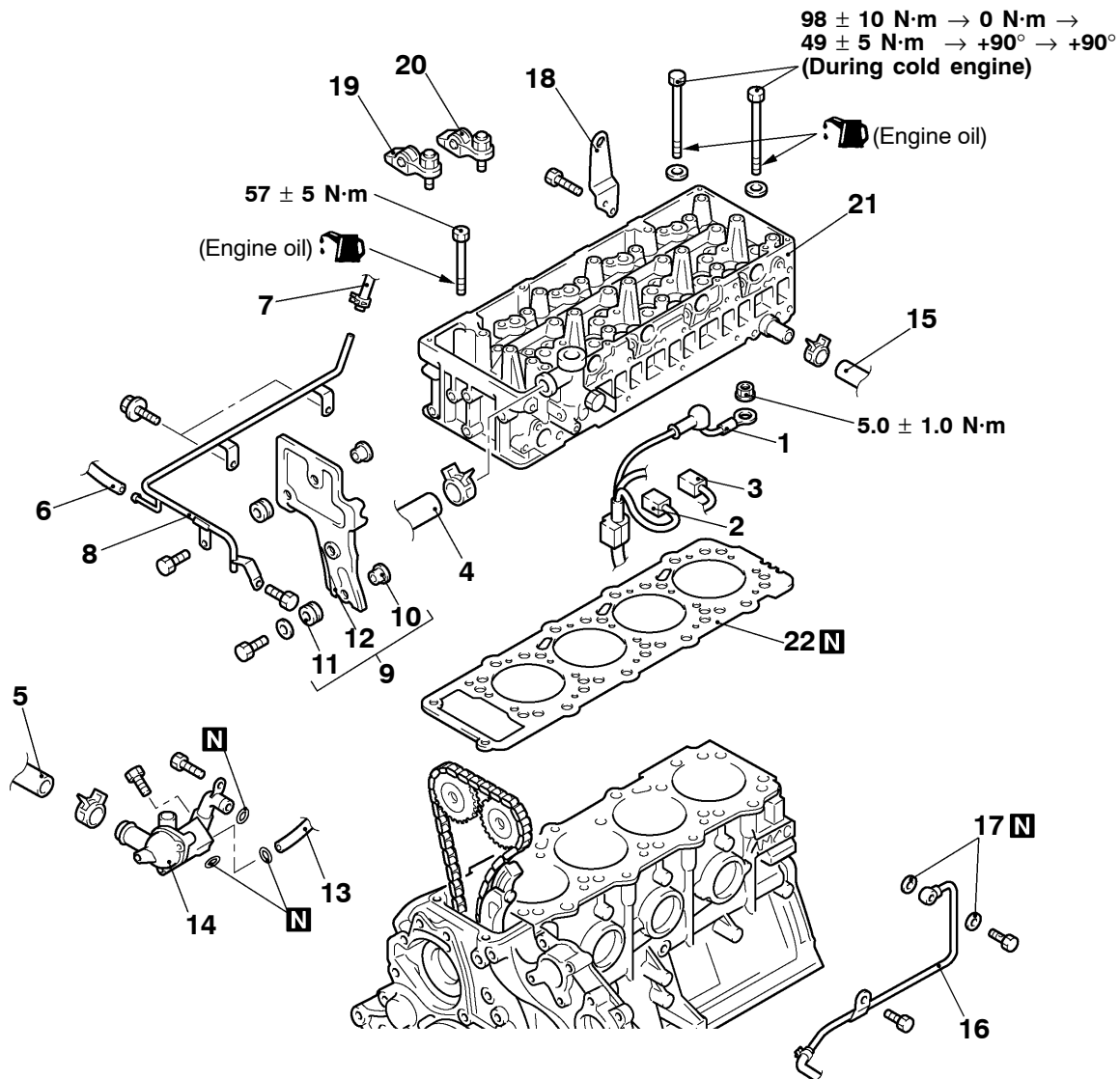
If the crankshaft is turned clockwise after the chain tensioner is installed, the plunger is automatically unhooked. Then its internal ratchet mechanism adjusts the timing chain tension.

CYLINDER HEAD GASKET

REMOVAL AND INSTALLATION

Pre-removal and Post-installation Operation

- Engine Coolant Drain and Refill
(Refer to GROUP 14 – On-vehicle Service.)
- Engine Oil Check and Refill
(Refer to GROUP 12 – On-vehicle Service.)
<Post-installation operation>
- Fuel Line Air-bleeding
(Refer to GROUP 13D – On-vehicle Service.)
<Post-installation operation>
- Drive Belt Tension Check and Adjustment
(Refer to P.11D-5.) <Post-installation operation>
- Camshaft Removal and Installation
(Refer to P.11D-23.)
- Cooling Fan and Fan Clutch Assembly Removal and Installation (Refer to GROUP 14.)
- Intake Manifold Removal and Installation
(Refer to GROUP15.)
- Turbocharger and Exhaust Manifold Removal and Installation (Refer to GROUP15.)



AX1637CA

Removal steps

- | | |
|---|--|
| <p>1. Glow plug connector</p> <p>2. Engine coolant temperature gauge unit connector</p> <p>3. Engine coolant temperature sensor connector</p> <p>• Drive belt (Refer to P.11D-17.)</p> <p>4. Radiator upper hose connection</p> <p>5. Radiator lower hose connection</p> <p>6. Free-wheeling hub solenoid valve vacuum hose connection</p> <p>7. Brake booster vacuum hose connection <Vehicles without ABS></p> <p>8. Vacuum pipe</p> <p>9. Timing gear case cover assembly</p> <p>10. Insulator collar</p> <p>11. Insulator</p> | <p>12. Timing gear case cover</p> <p>• Alternator brace (Refer to GROUP 16.)</p> <p>▶C◀ 13. Heater return pipe connection</p> <p>▶C◀ 14. Bypass pipe, thermostat case and cover assembly</p> <p>15. Heater hose connection</p> <p>16. Fuel return pipe connection</p> <p>17. Fuel return pipe gasket</p> <p>18. Engine hanger</p> <p>19. Short rocker, adjusting screw and lock nut assembly</p> <p>20. Long rocker, adjusting screw and lock nut assembly</p> <p>◀B▶ ▶B◀ 21. Cylinder head assembly</p> <p>▶A◀ 22. Cylinder head gasket</p> |
|---|--|

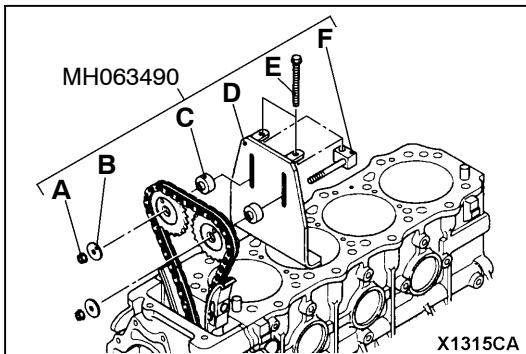
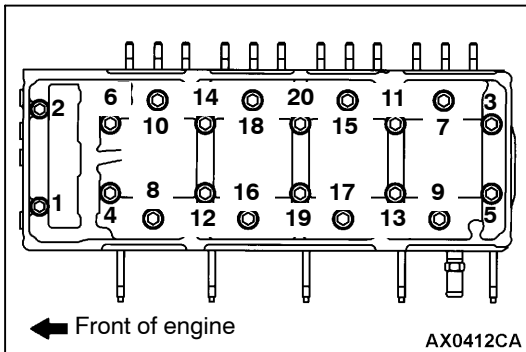


REMOVAL SERVICE POINTS**◀A▶ RADIATOR UPPER HOSE/RADIATOR LOWER HOSE DISCONNECTION**

Align the mating marks on the radiator hose and the hose clamp, and then disconnect the hose.

◀B▶ CYLINDER HEAD ASSEMBLY REMOVAL

1. Loosen the cylinder head bolts in the shown sequence progressively, and then remove the cylinder head bolts.
2. Lift the cylinder head assembly straight without removing the timing chain from the camshaft sprocket.



3. After the cylinder head assembly has been removed, use the special tool to hold the camshaft sprocket to prevent the timing chain from sliding off.

Special tool MH063490: Camshaft sprocket holder kit components

- A—Two nuts
- B—Two washers
- C—Two spacers
- D—One adjust plate
- E—Two bolts
- F—Two nuts

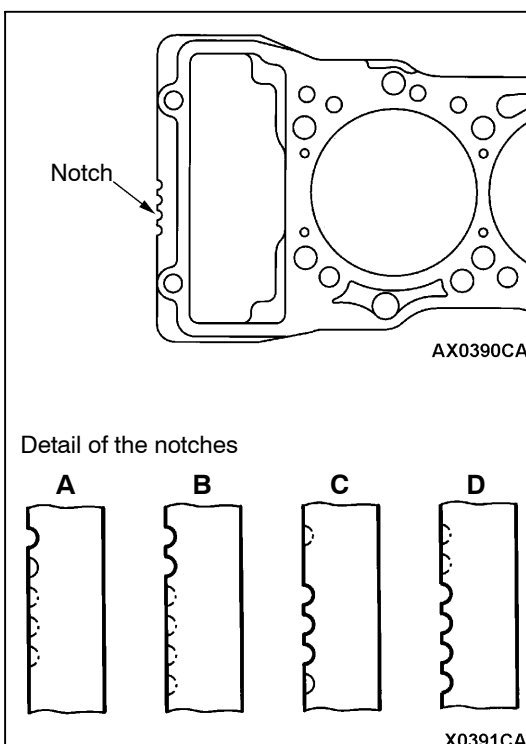
INSTALLATION SERVICE POINTS**▶A◀ CYLINDER HEAD GASKET INSTALLATION**

To replace the cylinder head gasket only, select a gasket of correct specification according to the table below.

Notch specification	Part number
A(Thickness after tightening the bolts 0.70 mm)	ME204037
B(Thickness after tightening the bolts 0.75 mm)	ME204038
C(Thickness after tightening the bolts 0.80 mm)	ME204039
D(Thickness after tightening the bolts 0.85 mm)	ME204040

Caution

The thickness of the original cylinder head gasket is selected according to the protrusion amount of the piston. Therefore, if the piston or the connecting rod is replaced, the protrusion amount may be changed. Always select a correct gasket by measuring the protrusion amount. (For details, refer to the Engine Workshop Manual.)

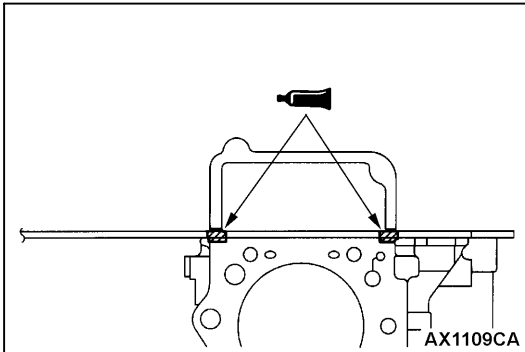


►B◄ CYLINDER HEAD ASSEMBLY INSTALLATION

1. Select a cylinder head gasket of correct specification.
2. Clean the cylinder head assembly, the timing gear case, and the crankcase assembly mating surfaces with a scraper or a wire brush.

Caution

Do not allow foreign material to enter the engine coolant or oil passages and the cylinder.



3. Apply the specified sealant to the upper side of the mating surface between the timing gear case and the crankcase assembly.

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

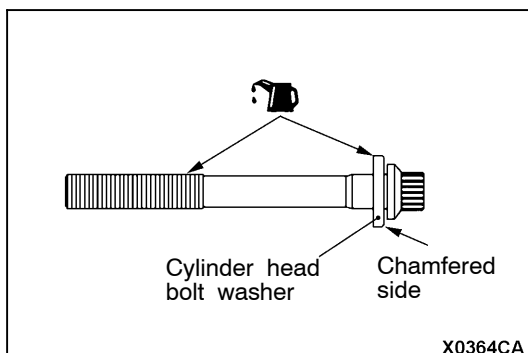
4. Immediately after applying the sealant, use the cylinder head gasket to install the cylinder head assembly to the crankcase.

Caution

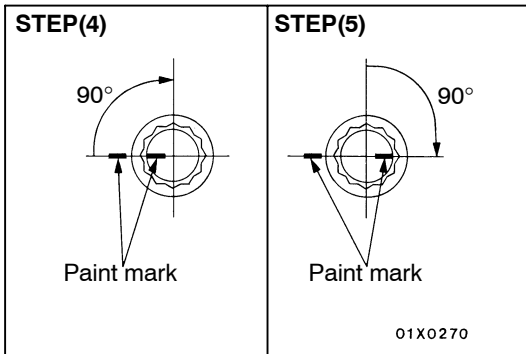
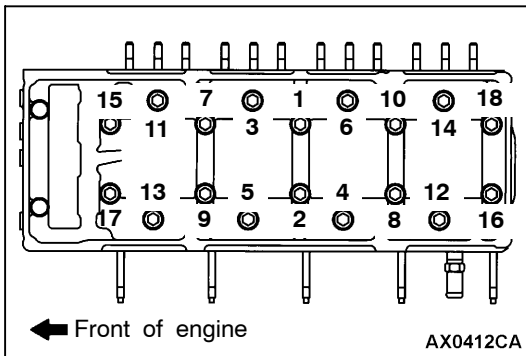
- (1) When installing the oil pan, be careful not to disturb the sealant.
 - (2) Whenever the cylinder head bolts are loosened after the cylinder head is installed, always apply the sealant again.
 - (3) After the oil pan is installed, wait for at least one hour, and then start the engine.
5. The cylinder head bolt can be reused three times. Before installing the bolt, mark the bolt head by a punch to indicate how many times the bolt is used.

Caution

If three marks have been already stamped, the bolt can't be reused and must be replaced with a new one.



6. Install the cylinder head bolt washer to the cylinder head bolt so that the washer chamfered side faces as shown.
7. Apply a small amount of engine oil to the cylinder head bolt thread and the washer.



8. Tighten the cylinder head bolts according to the following procedure (angle-tightening procedure).

- (1) Tighten the cylinder head bolts in the shown sequence to 98 ± 10 N·m.

Bolt size: Nominal diameter×length mm

Except 3, 6, 11, 14: 12×118

3, 6, 11, 14: 12×133

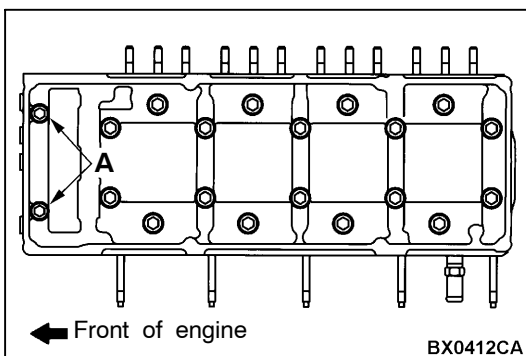
- (2) Loosen the cylinder head bolts completely in the reverse of the shown sequence.
(3) Tighten the cylinder head bolts in the shown order to 49 ± 5 N·m.

- (4) Mark the cylinder head bolts and the cylinder head with paint, and then tighten the bolts in the shown sequence to 90° .

- (5) Tighten the bolts in the shown sequence to additional 90° , and check that the paint marks on the cylinder head bolts are flush with the paint marks on the cylinder head.

Caution

- 1) If the tightening angle is less than 90° , the bolt is loose.
- 2) If the tightening angle is more than 90° , loosen the bolt and repeat the procedure from step 2.



- (6) Apply a small amount of engine oil to the thread and the flange of bolts A, and tighten them to A to 57 ± 5 N·m.

►C◄ BYPASS PIPE, THERMOSTAT CASE AND COVER ASSEMBLY/HEATER RETURN PIPE INSTALLATION

Install the O-rings into the pipes and the thermostat case grooves, apply water to the outer circumference of the O-ring and the inside surface of the pipe, and then press in the O-rings.

Caution

Never get engine oil or grease on the O-rings.

**►D◄ RADIATOR LOWER HOSE/RADIATOR UPPER
HOSE CONNECTION**

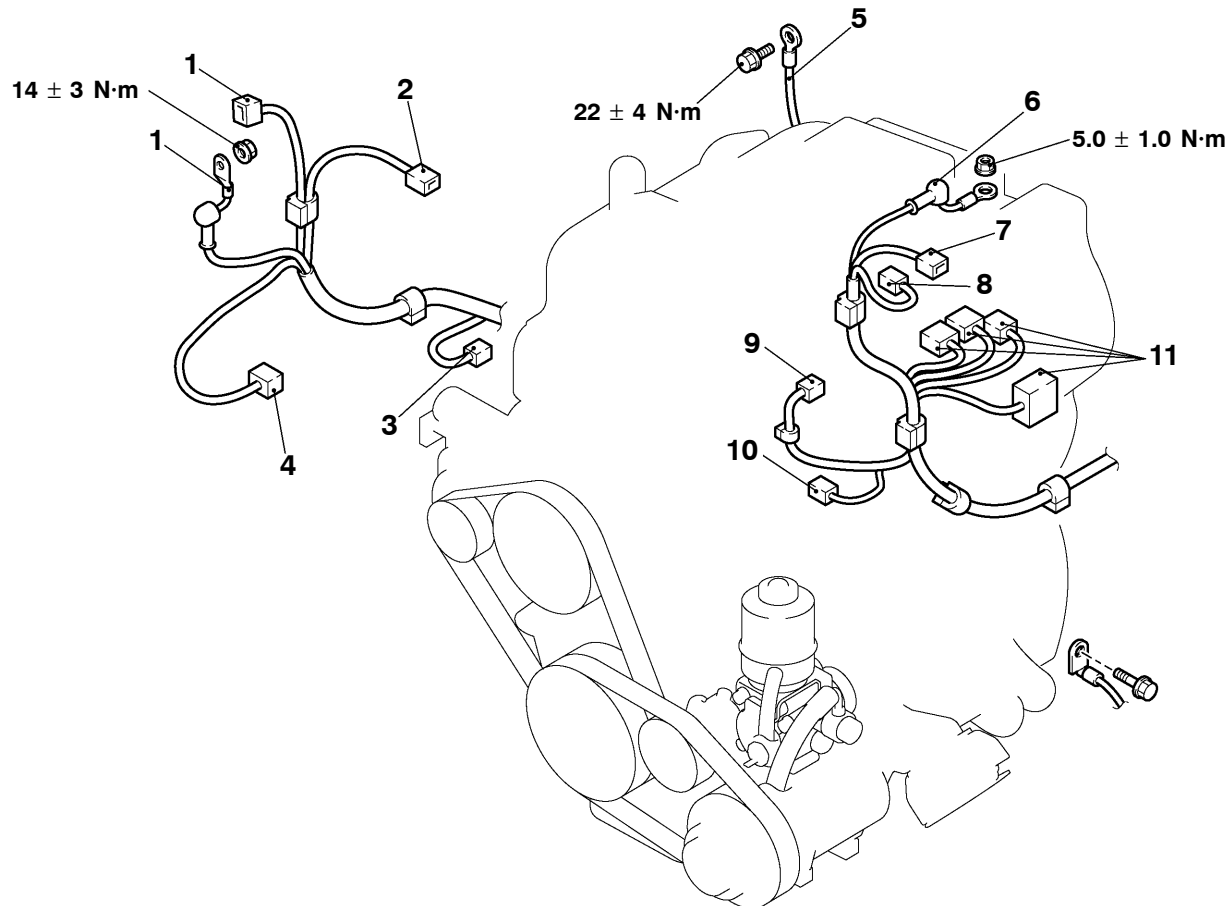
1. Insert the hose up to the convex part of the thermostat cover and water outlet pipe.
2. Align the mating marks on the radiator hose and the hose clamp, and then install the hose.

ENGINE ASSEMBLY

REMOVAL AND INSTALLATION

Pre-removal and Post-installation Operation

- Engine Coolant Drain and Refill (Refer to GROUP 14 – On-vehicle Service.)
- Under Cover and Skid Plate Removal and Installation
- Engine Oil Draining and Refilling (Refer to GROUP 12 – On-vehicle Service.)
- Fuel Line Air-bleeding (Refer to GROUP 13D – On-vehicle Service.)
- A/C Compressor Drive Belt Tension Check and Adjustment (Refer to P.11D-7.) <Post-installation operation>
- Hood Removal and Installation (Refer to GROUP 42.)
- Engine Cover Removal and Installation (Refer to P.11D-23.)
- Fuel Filter Removal and Installation (Refer to GROUP 13E.)
- Air Cleaner Removal and Installation (Refer to GROUP 15.)
- Cooling Fan and Fan Clutch Assembly Removal and Installation (Refer to GROUP 14.)
- Radiator Removal and Installation (Refer to GROUP 14.)



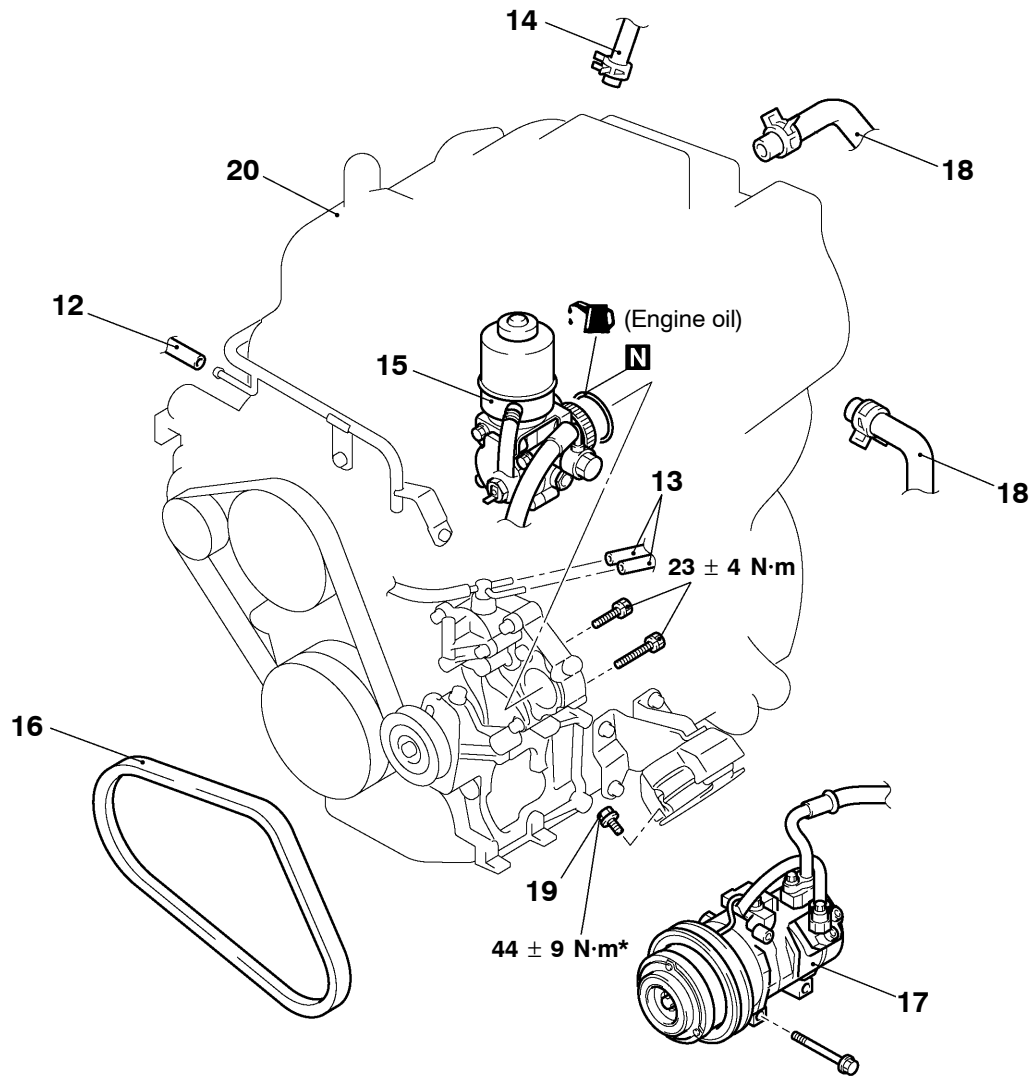
AX1640CA

Removal steps

- Intercooler air pipe (Refer to GROUP 15 – Intercooler.)
- 1. Alternator connector
- 2. Oil pressure switch connector
- 3. Engine oil level sensor connector
- 4. Free-wheeling hub engage switch connector
- 5. Earth cable connection
- EGR valve and pipe assembly (Refer to GROUP 15 – Intake Manifold and Throttle Body <4M41>.)
- 6. Glow plug connector
- 7. Boost air temperature sensor connector
- 8. Engine coolant temperature gauge unit connector
- 9. Power steering oil pressure switch connector
- 10. A/C compressor connector
- 11. Injection pump connector

Caution

*: indicates parts which should be temporarily tightened, and then fully tightened with the engine weight applied on the vehicle body.



AX1655CA

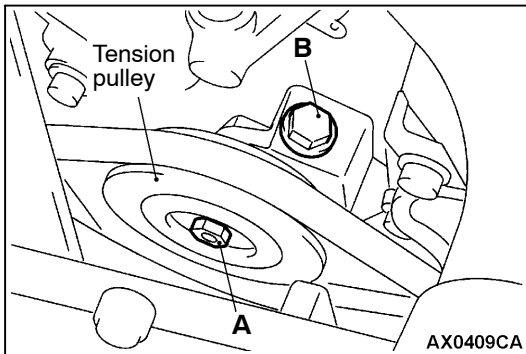
12. Free-wheeling hub solenoid valve vacuum hose connection
 13. Vacuum hose connection
 14. Brake booster vacuum hose connection <Vehicles without ABS>
 15. Power steering oil pump assembly
 16. A/C compressor drive belt
 17. A/C compressor

18. Heater hose connection
 • Glow plug relay and solenoid valve assembly
 • Transmission assembly (M/T: Refer to GROUP 22.) (A/T: Refer to GROUP 23.)
 19. Engine mount insulator mounting bolt
 20. Engine assembly



REMOVAL SERVICE POINTS**◀A▶ POWER STEERING OIL PUMP ASSEMBLY REMOVAL**

1. Remove the power steering oil pump assembly from the timing gear case with its hoses still attached.
2. Suspend the power steering oil pump with a cord out of the way.

**◀B▶ A/C COMPRESSOR DRIVE BELT REMOVAL**

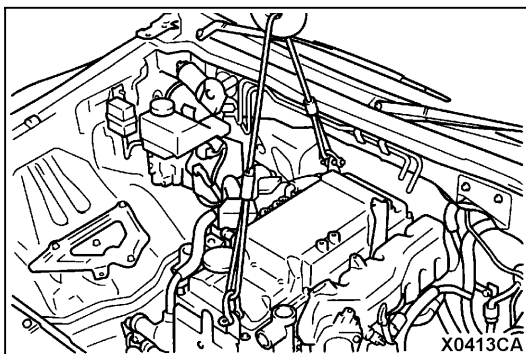
1. Loosen the tension pulley securing bolt A.
2. Loosen the adjusting bolt B to remove the belt.

Caution

To reuse the drive belt, mark its running direction (clockwise direction) on the belt back side with a chalk.

◀C▶ A/C COMPRESSOR REMOVAL

1. Remove the A/C compressor from the bracket with its refrigerant hoses still attached.
2. Suspend the A/C compressor with a cord out of the way.

**◀D▶ ENGINE ASSEMBLY REMOVAL**

1. Make sure that all the cables, hoses and harness connectors are disconnected.
2. Use a chain block to support and lift the engine assembly carefully.

INSTALLATION SERVICE POINT**▶A◀ ENGINE ASSEMBLY INSTALLATION**

Lower the engine assembly into the engine compartment, being careful not to pinch the cables, hoses or harness connectors.