

## GENERAL INFORMATION

Items			4M40
Total displacement ml			2,835
Bore x Stroke mm			95 x 100
Compression ratio			21
Combustion chamber			Swirl type
Camshaft arrangement			SOHC
Number of valve		Intake	4
		Exhaust	4
Valve timing	Intake	Opening	BTDC 19°
		Closing	ABDC 53°
	Exhaust	Opening	BBDC 60°
		Closing	ATDC 16°
Fuel system			Distribution type injection pump

## SERVICE SPECIFICATIONS

Items			Standard value	Limit
Alternator drive belt (When inspection)	Vibration frequency Hz		103 – 132	—
	Tension N		294 – 490	—
	Deflection mm <Reference>		8.0 – 11.0	—
Alternator drive belt (When adjustment)	Vibration frequency Hz		111 – 125	—
	Tension N		343 – 441	—
	Deflection mm <Reference>		9.0 – 11.0	—
Alternator drive belt (When replacement)	Vibration frequency Hz		132 – 156	—
	Tension N		490 – 686	—
	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		285 – 355	—
	Deflection mm <Reference>		7.0 – 8.0	—
A/C compressor drive belt (When adjustment)	Vibration frequency Hz	A	169 – 189	—
		B	111 – 124	—
	Tension N		285 – 355	—
	Deflection mm <Reference>		7.0 – 8.0	—
A/C compressor drive belt (When replacement)	Vibration frequency Hz	A	207 – 223	—
		B	135 – 146	—
	Tension N		425 – 500	—
	Deflection mm <Reference>		6.0 – 6.5	—

Items		Standard value	Limit
Valve clearance (at hot engine) mm	Intake valve	0.25	–
	Exhaust valve	0.35	–
Injection timing		9°ATDC	–
Stroke of injection pump plunger mm		1 ± 0.03	–
Idle speed r/min		750 ± 100	–
Compression pressure kPa–r/min		2,843–280	Min. 2,256–280
Compression pressure difference of all cylinder kPa		–	Max. 294

## NOTE

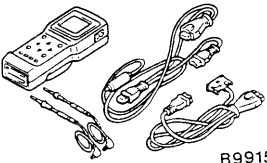
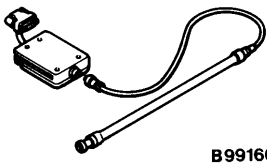
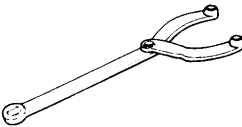
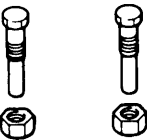
A: Between A/C compressor pulley and tension pulley

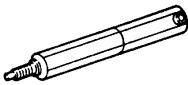
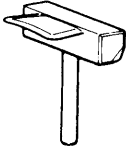
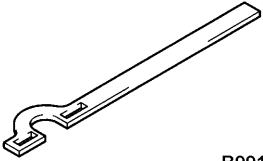
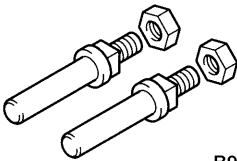
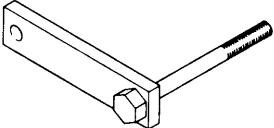
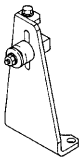
B: Between A/C compressor pulley and crankshaft pulley

## SEALANTS

Items	Specified Sealants	Remarks
Contact surface between timing gear case and crankcase assembly	3M ATD Part No. 8660 or equivalent	Semi-drying sealant
Oil pressure switch		
Camshaft end seal		
Rocker cover gasket		
Oil pan	MITSUBISHI GENUINE PART MD970389 or equivalent	
Timing gear case		

## SPECIAL TOOLS

Tool	Number	Name	Use
 B991502	MB991502	MUT-II sub-assembly	Drive belt tension measurements
 B991668	MB991668	Belt tension meter set	
	MB990767	Endyoke holder	Crankshaft pulley holding
	MD998754	Pulley holder pin	

Tool	Number	Name	Use
	MH063302	Prestroke measuring adapter	Injection timing adjustment
	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
 H062381	MH062381	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:**

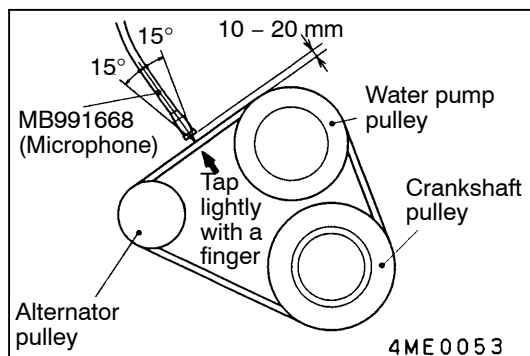
Item	During inspection	During adjustment	During replacement
Vibration frequency Hz	103 – 132	111 – 125	132 – 156
Tension N	294 – 490	343 – 441	490 – 686
Deflection mm <Reference>	8.0 – 11.0	9.0 – 11.0	8.0 – 9.0

#### <When using MUT-II>

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

#### Caution

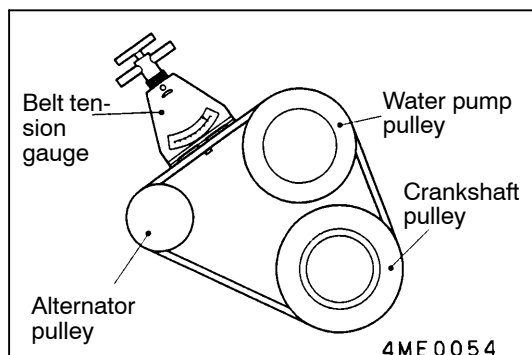
**Always turn the ignition switch to LOCK (OFF) position before disconnecting or connecting the MUT-II.**



- (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.

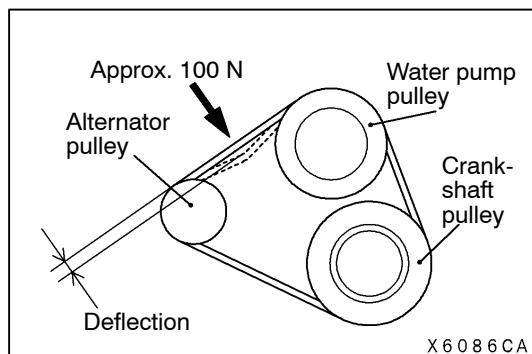
#### Caution

- 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.



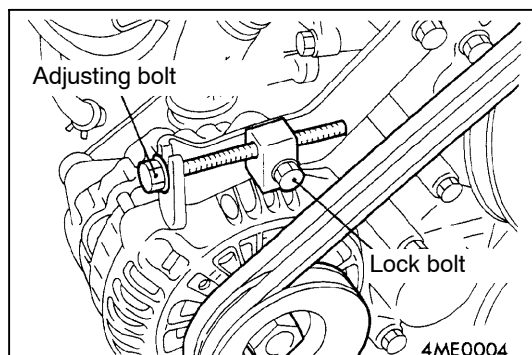
#### <When using a tension gauge>

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.

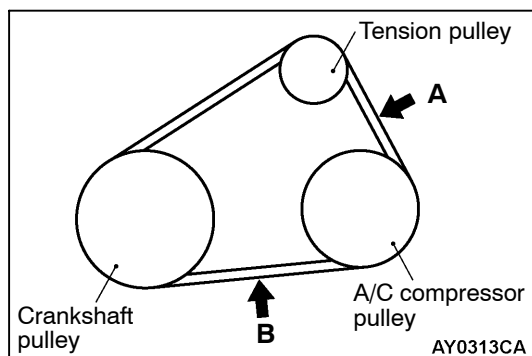


2. If not within the standard value, adjust the belt tension by the following procedure.

- (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 <VEHICLES WITH A/C>

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

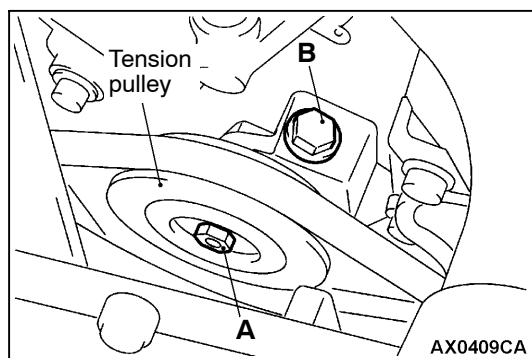
For the vibration frequency measurement using the MUT-II, refer to P.11C-5.

#### <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:  $44 \pm 10$  N·m**

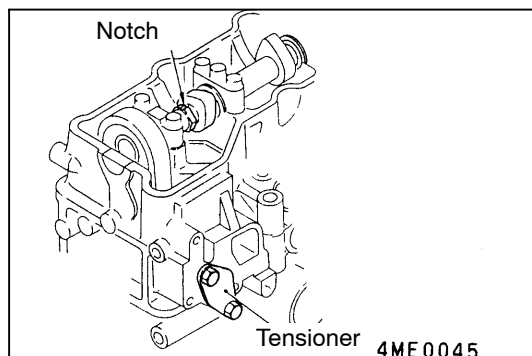
- (4) Check the belt tension, and readjust if necessary.

#### Caution

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

## VALVE CLEARANCE CHECK AND ADJUSTMENT

1. Warm up the engine until the engine coolant temperature reaches 80 to 95°C.
2. Remove the rocker cover.
3. Remove the glow plug plate and all of the glow plugs from the cylinder head.



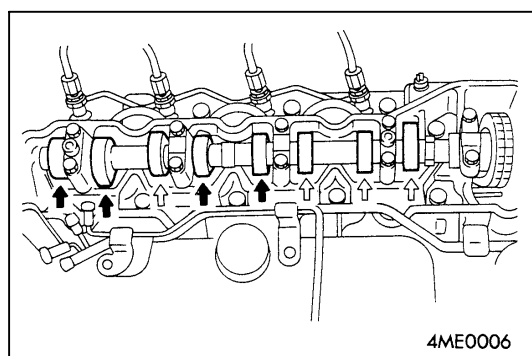
4. Align the notch of the crankshaft pulley with the "0" timing mark to set the No.1 or No.4 cylinder to the compression top dead centre position.

### Caution

**Never turn the crankshaft anticlockwise (the opposite direction) as the tensioner, which adjust the timing chain tension at the timing gear, may be damaged. If so, remove and reinstall the tensioner.**

### NOTE

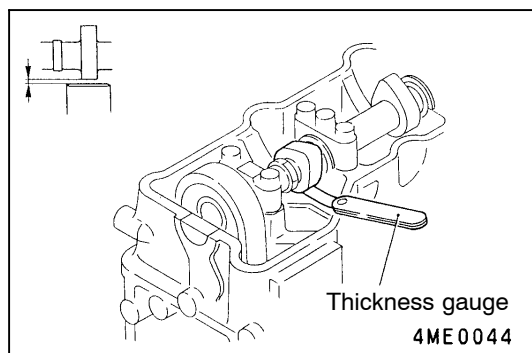
If the notch on the camshaft is pointing directly upwards, the No.1 cylinder will be at the compression top dead centre position. If the crankshaft is then turned once, the No.4 cylinder will then be at the compression top dead centre position.



5. Check the valve clearances at the places by arrows in the illustration by the following procedure.

White arrow: When No.1 cylinder is at compression top dead centre position

Black arrow: When No.4 cylinder is at compression top dead centre position



- (1) Use a thickness gauge to measure the valve clearance.

### Standard value:

**Intake side 0.25 mm**

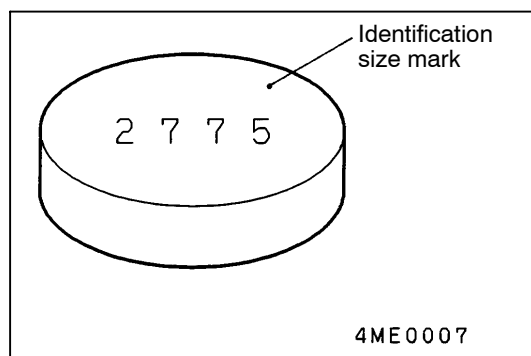
**Exhaust side 0.35 mm**

### NOTE

There should be certain amount of resistance against the thickness gauge when taking the measurements. If the thickness gauge is moving too smoothly, a correct measurement cannot be obtained.

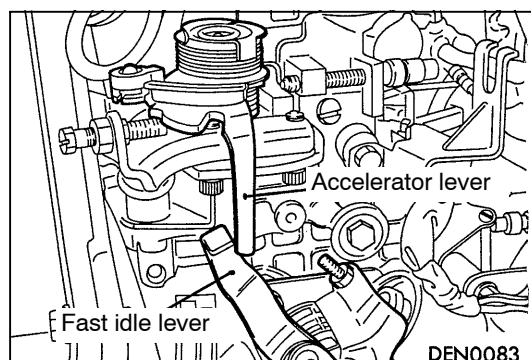
- (2) Re-measure places which are outside the standard value, and make a note of these measurements.
- (3) Use the measured values as a reference for selecting adjustment shims which will bring the incorrect valve clearance to the standard value.

**Adjustment shims = Thickness of installed shims  
+ (measured value – Standard value)**



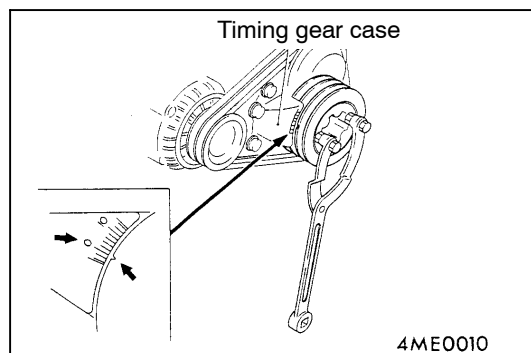
#### NOTE

- The thicknesses of the adjustment shims are between 2.250 – 3.150 mm (37 types which increase in thickness by 0.025 mm)
  - Size identification mark: "2775" = 2.775 mm thickness
- (4) Remove the camshaft and install the shim which was selected in step 3.
  - (5) Re-measure the valve clearances and check that they are all at the standard value.
  6. Turn the crankshaft once to align the notch of the crankshaft pulley with the timing mark "0."
  7. Check and adjust the other valve clearances according to the step 5.

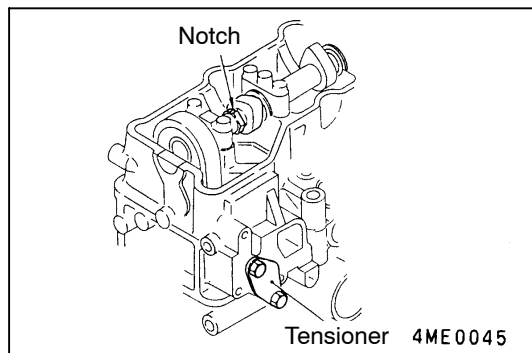


## INJECTION TIMING CHECK AND ADJUSTMENT

1. Warm up the engine until the engine coolant temperature is 80 – 95°C.
2. Remove all of the glow plugs.
3. Align the notch of the crankshaft pulley with the "0" to set the No.1 cylinder to the compression top dead centre position.



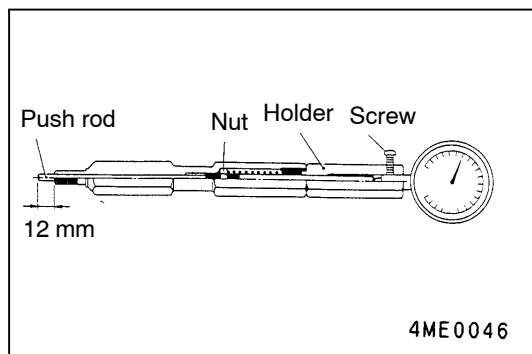


**Caution**

Be sure not to turn the crankshaft in anti-clockwise as this can cause a damage of the tensioner which adjust the timing chain tension at timing gear. If the crankshaft is turned in the anti-clockwise, remove the tensioner and re-install it.

**NOTE**

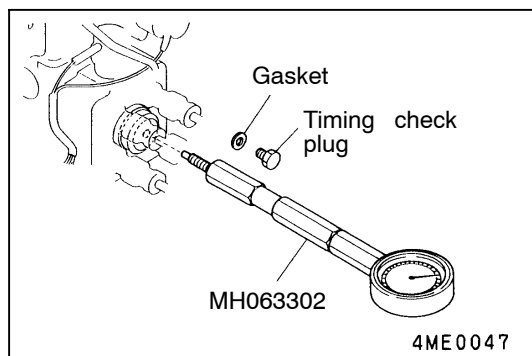
Remove the filler cap, and check the condition of the camshaft. If the projection on the camshaft faces up, the No.1 cylinder is at compression top dead centre.



4. Before installation of special tool, make sure that push rod is protruding by 12 mm.

**NOTE**

Notch of push rod can be adjusted with an inner nut.



5. Connect the dial gauge to the special tool.
6. Put the dial gauge on the push rod until its needle starts to move, and hold the dial gauge using the securing screw.

**NOTE**

Hold the dial gauge within 0.5 mm after its needle has moved.

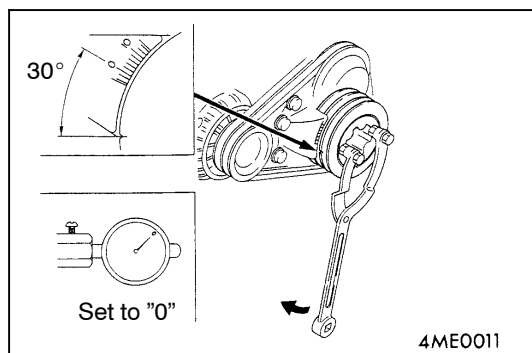
7. Remove the timing check plug of the injection pump and the gasket, and then install the special tool.

**NOTE**

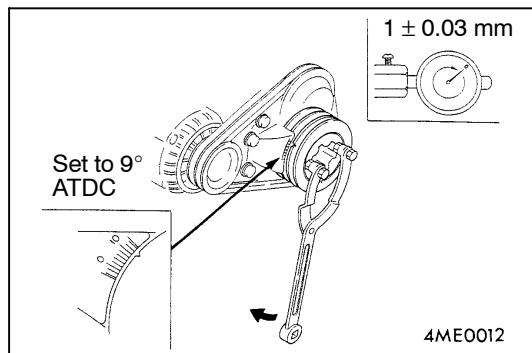
- (1) Check that the timing check plug is attached to the gasket which was removed.
- (2) If it is not attached, it may have fallen down or still be attached to the pump, so it should be checked.
8. Hold the special tool at the position where the dial gauge needle starts to move.

**NOTE**

The special tool can be turned within one turn if the dial gauge is difficult to read.

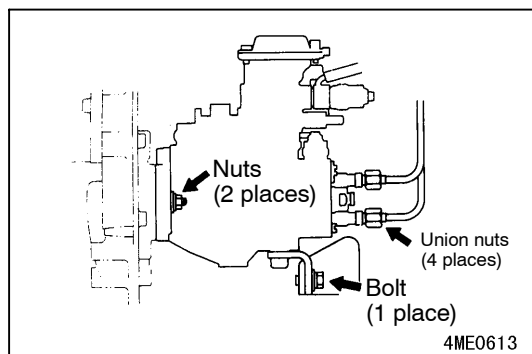


9. Turn the crankshaft one more in the clockwise direction to set the No.1 cylinder approximately 30° before compression top dead centre.
10. Set the needle of the dial gauge to 0.
11. Check that the needle doesn't move even if the crankshaft is turned slightly (2 – 3°) in both clockwise and anti-clockwise direction.



12. Turn the crankshaft in the clockwise direction to align the crankshaft notch to 9° ATDC.
13. Check that the value indicated on the dial gauge is at the standard value.

**Standard value: 1 ± 0.03 mm**

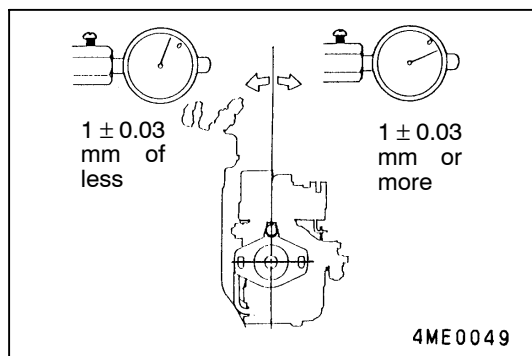


14. If the needle is outside the standard value, adjust the injection timing by the following procedure.

- (1) Loosen the injection pipe union nuts (4 places) and the injection pump fixing bolts and nuts in that order. (Don't remove the bolts and nuts.)

**Caution**

**When loosening the union nuts, hold the delivery valve holders with a spanner so that they don't turn at the same time.**



- (2) Tilt the injection pump to the left and right and adjust the needle on the dial gauge so that the display value is uniform.
- (3) Provisionally tighten the mounting nuts and bolt of the injection pump.
- (4) Repeat steps 9 – 13 to check if the adjustment has been made correctly.
- (5) Tighten the mounting nuts and bolt securely.
- (6) Tighten the injection pipe union nuts securely.

**Caution**

**When tightening the union nuts, hold the delivery valve holders with a spanner so that they don't turn at the same time.**

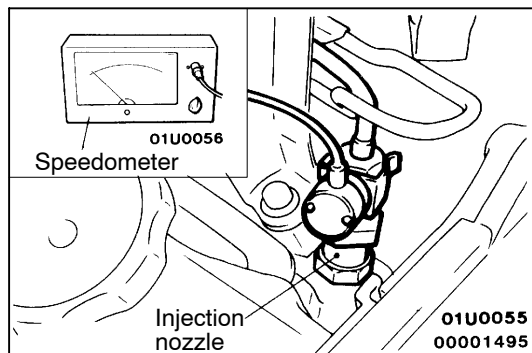
15. Remove the special tool.
16. Install a new gasket to the timing check plug.
17. Tighten the timing check plug securely.

## IDLE SPEED CHECK AND ADJUSTMENT

**NOTE**

Check that the injection timing is normal.

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



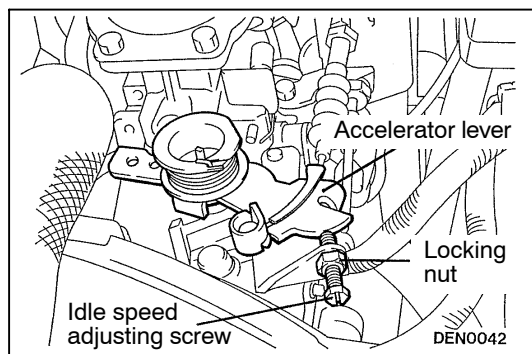
2. Connect the speedometer to the injection nozzle or the injection pipe.

**Caution**

**When the speedometer is connected to the injection pipe, the pipe mounting clamps should all be removed.**

3. Start the engine and run it at idle.
4. Check the idle speed.

**Standard value: 750 ± 100 r/min**



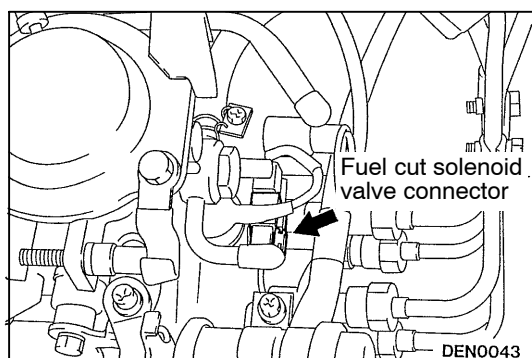
5. If not within the standard value, loosen idle adjusting screw lock nut and adjust the idle speed by rotating adjusting screw. And tighten locking nut.

## COMPRESSION PRESSURE CHECK

1. Before inspection, set the vehicle to the pre-inspection condition.
2. Remove all of the glow plugs.

**Caution**

**Be careful not to subject the glow plugs to any shocks.**



3. Disconnect the fuel cut solenoid valve connector.

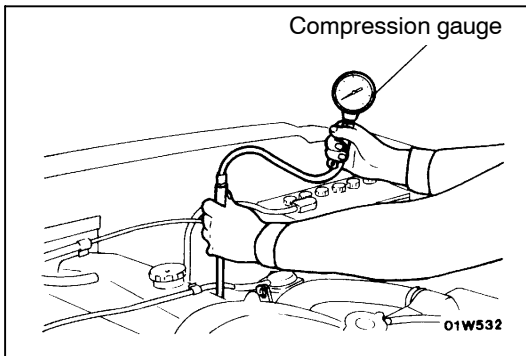
**NOTE**

Doing this will prevent carrying out fuel injection.

4. Cover the glow plug holes 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 holes when cranking.
- (2) If compression is measured with water, oil, fuel, etc., that has come from cracks inside the cylinder, these materials will become heated and will gush out from 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.

**Standard value: 2,843 kPa – 280 r/min**

**Limit: min. 2,256 kPa – 280 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**

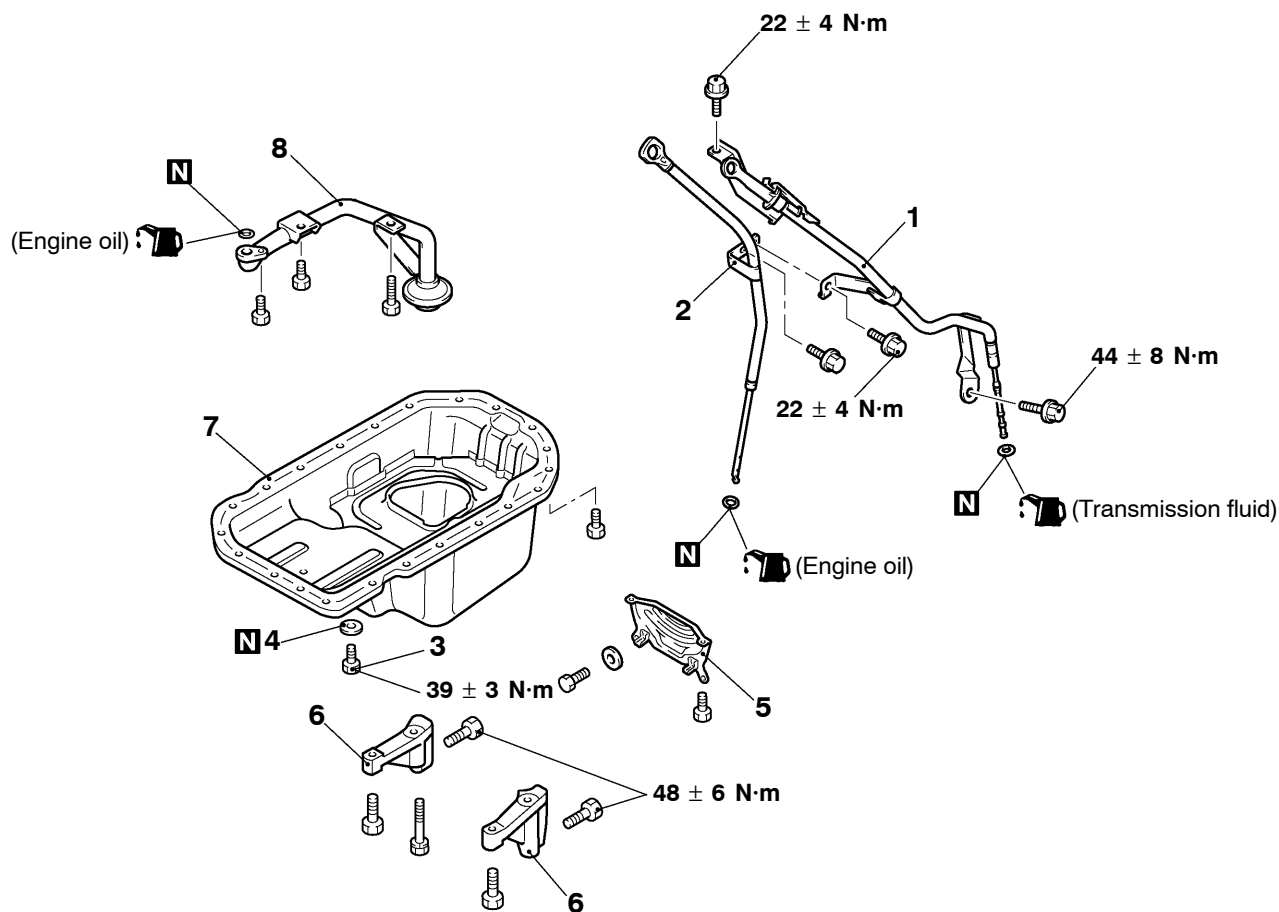
8. If there is a cylinder with compression or a compression difference that is outside the limit, pour a small amount of engine oil through the glow plug hole, and repeat the operations in steps 6 and 7.
  - (1) If the compression increases after oil is added, the cause of the malfunction is a worn or 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. 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.)

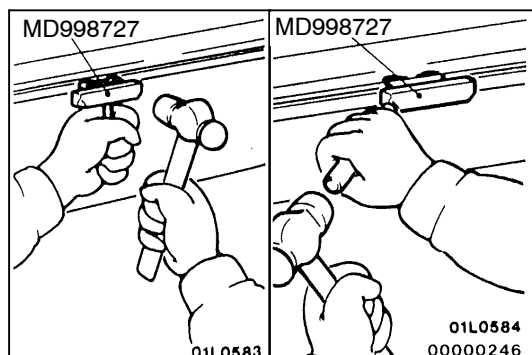
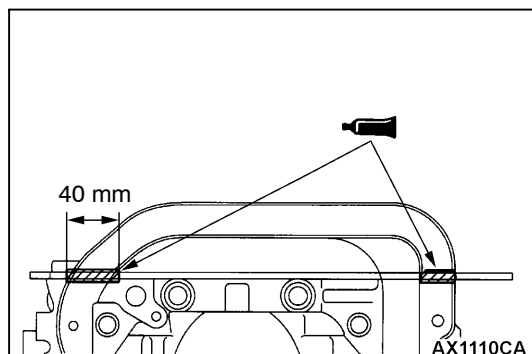


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**Removal steps**

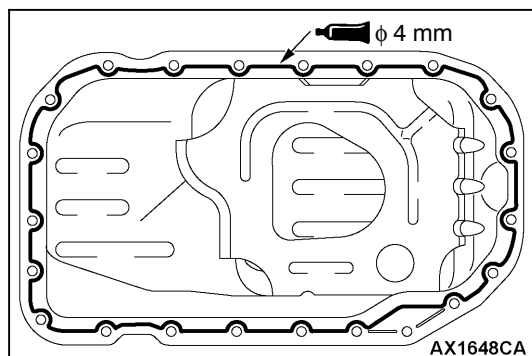
1. A/T oil level gauge and guide assembly <A/T>
2. Engine oil level gauge and guide assembly
3. Drain plug

4. Drain plug gasket
5. Dust cover
6. Stiffener
7. Oil pan
8. Oil screen

**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**

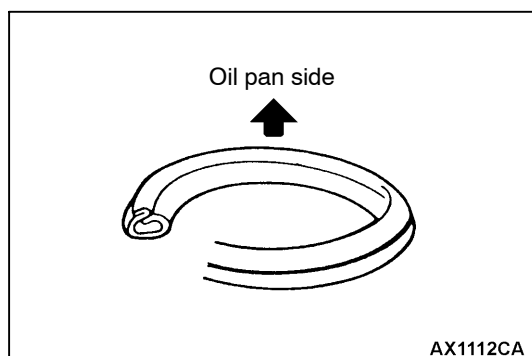
4. After applying the sealant, install the oil pan within 15 minutes.

**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**

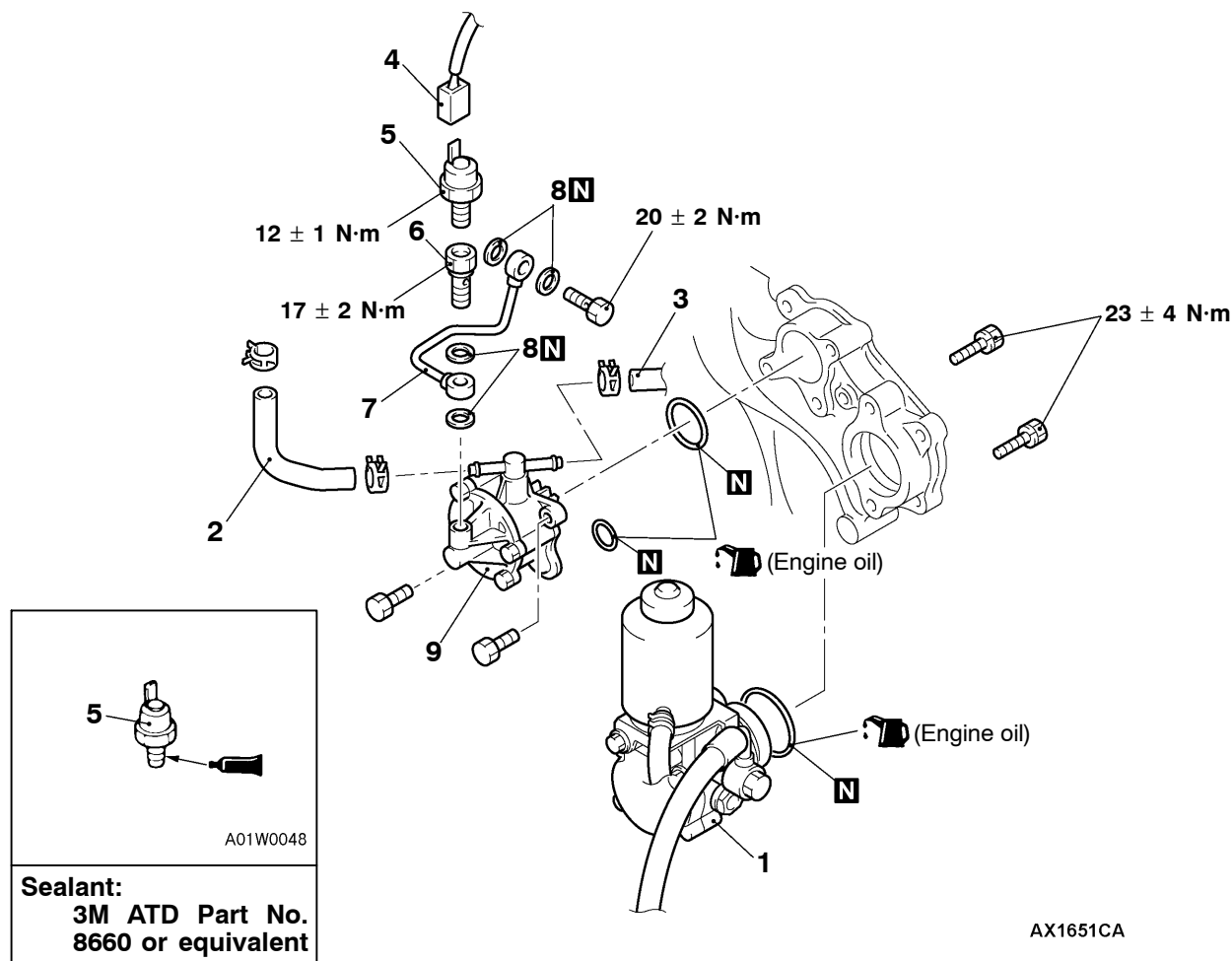
- Check oil pan for cracks.
- Check oil pan sealant-coated surface for damage and deformation.
- Check oil screen for cracked, clogged or damaged wire net and pipe.

# VACUUM PUMP

## REMOVAL AND INSTALLATION

### Pre-removal and Post-installation Operation

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



### Removal steps



1. Power steering oil pump assembly
2. Vacuum hose
3. Brake booster vacuum hose connection  
<L.H. drive vehicles without ABS>
4. Oil pressure switch connector

5. Oil pressure switch
6. Connector
7. Vacuum pump oil pipe
8. Vacuum pump oil pipe gasket
9. Vacuum pump assembly

## REMOVAL SERVICE POINT

### ◀A▶ POWER STEERING OIL PUMP ASSEMBLY REMOVAL

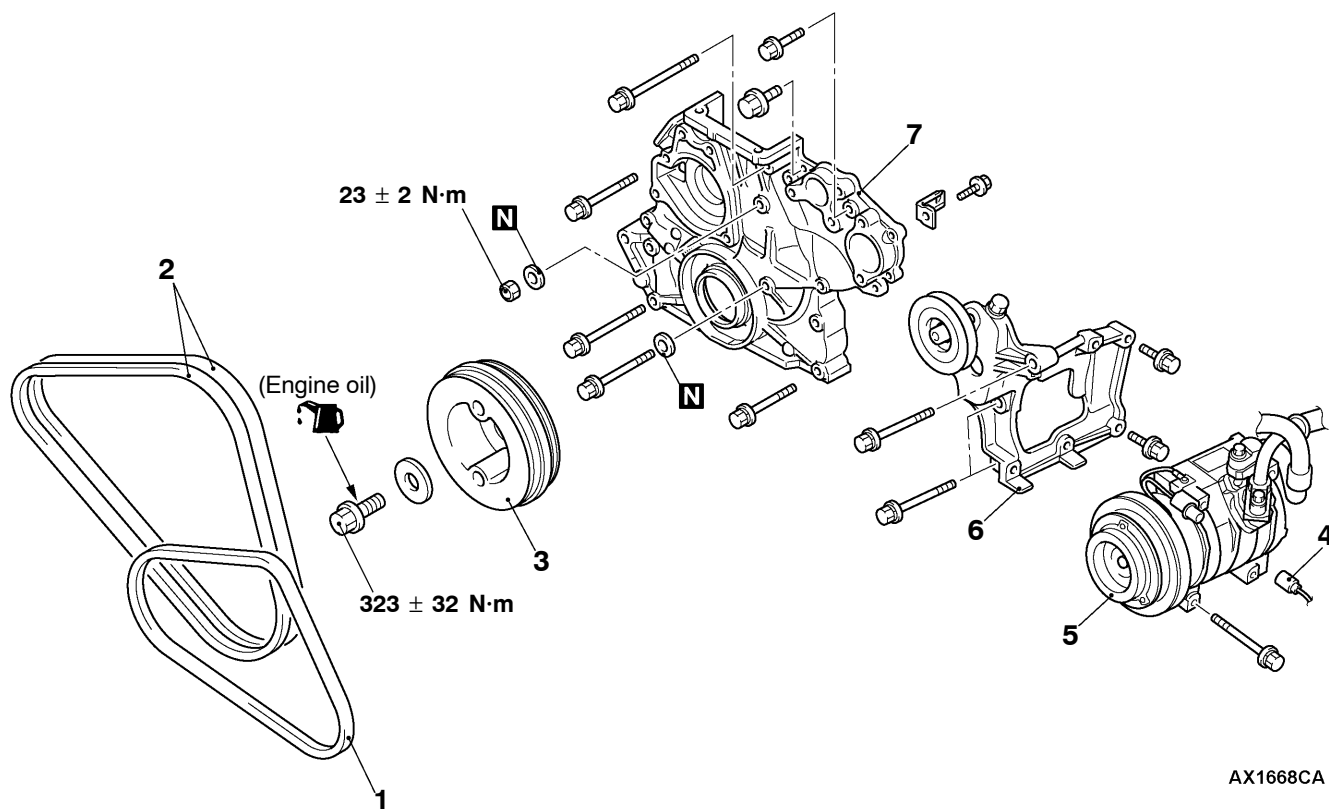
1. Remove the power steering oil pump assembly from the timing gear case with its hoses still attached.
2. Support the oil pump aside with a cord.

## TIMING CHAIN

## 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 13C – On-vehicle Service.)
- Drive Belt Tension Check and Adjustment  
(Refer to P.11C-5.) <Post-installation operation>
- Camshaft Removal and Installation  
(Refer to P.11C-22.)
- Cooling Fan and Fan Clutch Assembly Removal and Installation (Refer to GROUP 14.)
- Vacuum Pump Removal and Installation  
(Refer to P.11C-16.)
- Oil Pan Removal and Installation (Refer to P.11C-14.)



AX1668CA

**Removal steps**

◀A▶

1. A/C compressor drive belt  
<Vehicles with A/C>

◀B▶

2. Alternator drive belt

◀C▶

3. Crankshaft pulley

- Alternator (Refer to GROUP 16.)
- Water pump (Refer to GROUP 14.)
- Cylinder Head Assembly  
(Refer to P.11C-26.)

4. A/C compressor connector  
<Vehicles with A/C>

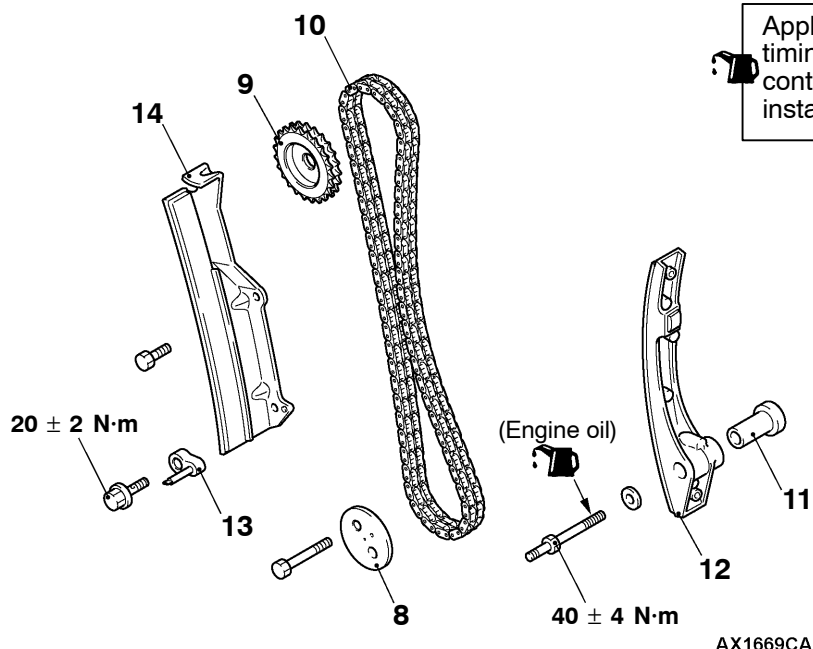
5. A/C compressor  
<Vehicles with A/C>

6. A/C compressor bracket and tension pulley assembly <Vehicles with A/C>

▶B▶

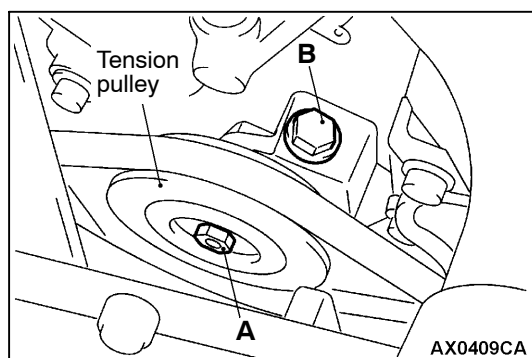
7. Timing gear case





- ▶A◀ 8. Idler washer
- ▶A◀ 9. Camshaft sprocket
- ▶A◀ 10. Timing chain
- 11. Tension lever shaft

- 12. Tension lever
- 13. Oil jet
- 14. Guide plate



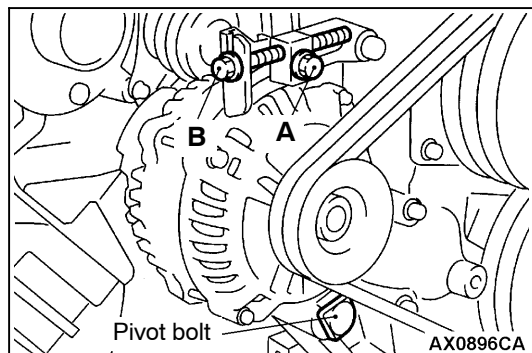
## REMOVAL SERVICE POINTS

### ◀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.

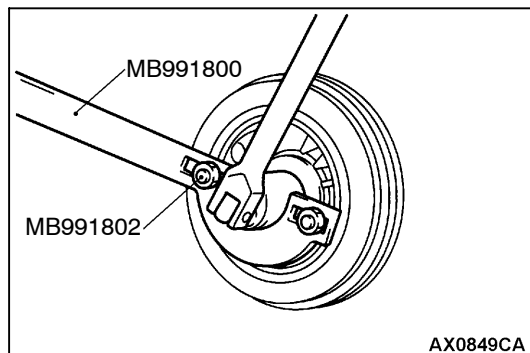


### ◀B▶ ALTERNATOR DRIVE BELT REMOVAL

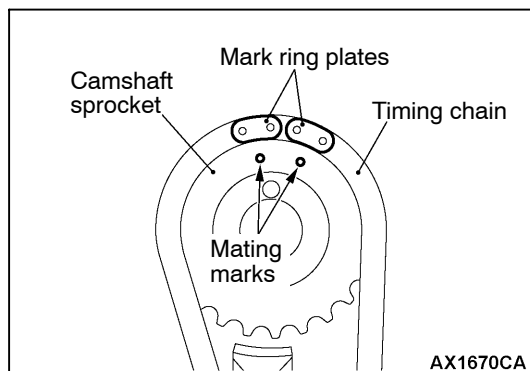
1. Loosen the alternator pivot bolt, nut and the securing bolt A.
2. Loosen the adjusting bolt B to remove the belts.

#### 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

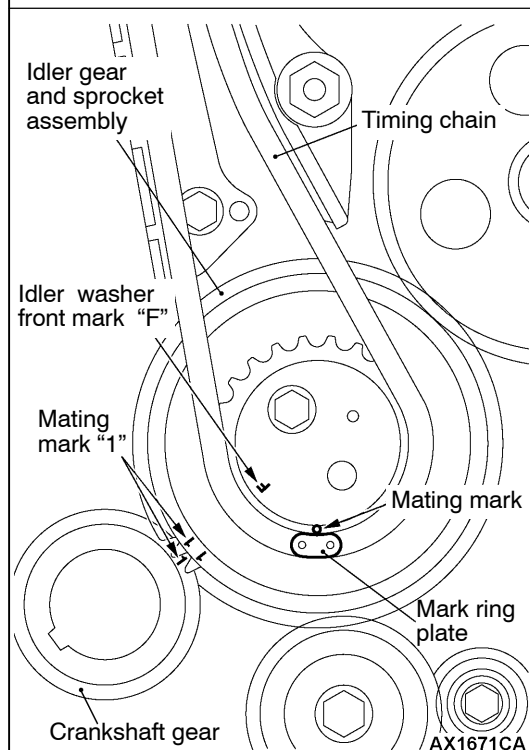
### ▶A▶ TIMING CHAIN/CAMSHAFT SPROCKET/IDLER WASHER INSTALLATION

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 brilliant white 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 the 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. The idler washer front mark "F" must face toward the front of the engine.

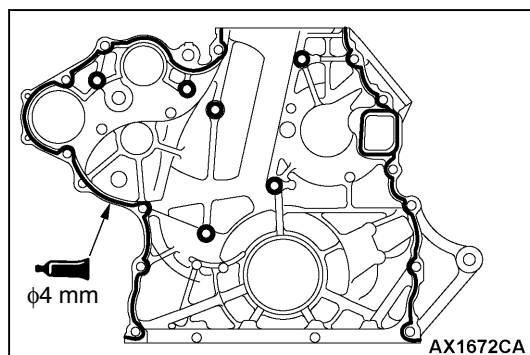


### ▶B▶ TIMING GEAR CASE INSTALLATION

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**

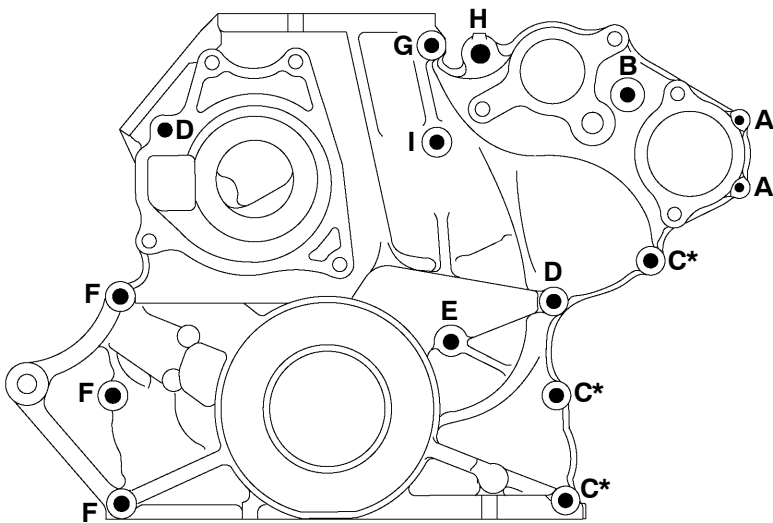


3. After applying the sealant, install the gear case within 15 minutes.

**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 at the shown positions.

Timing gear case



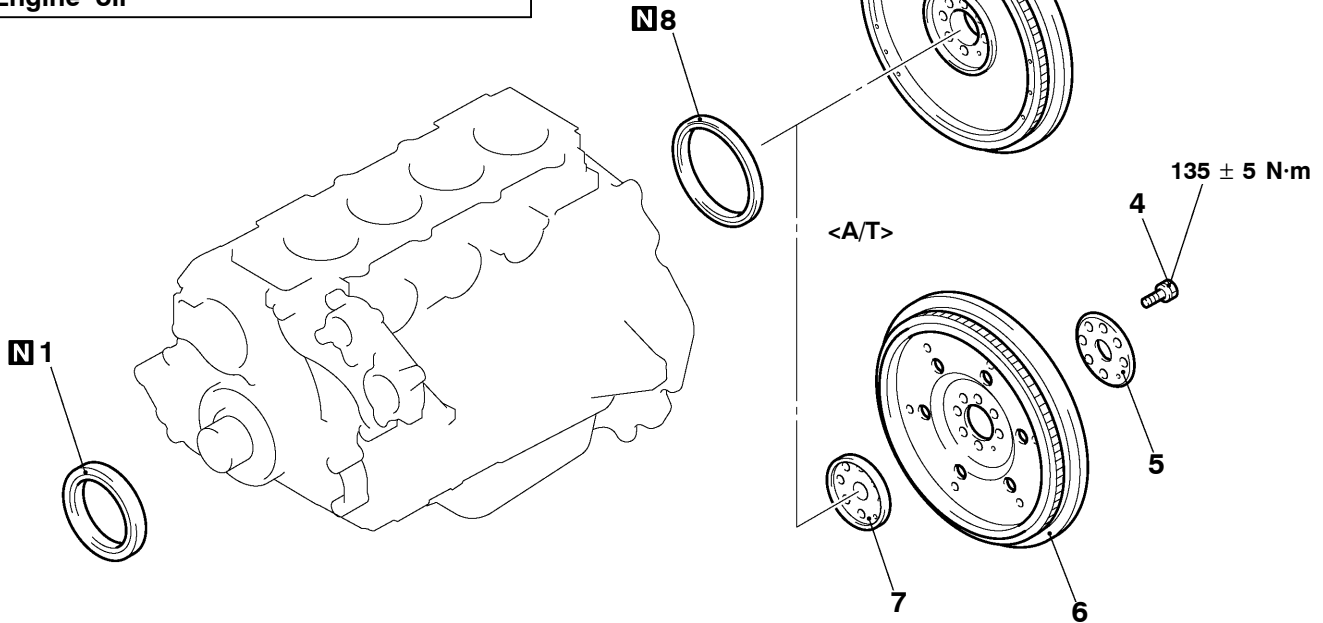
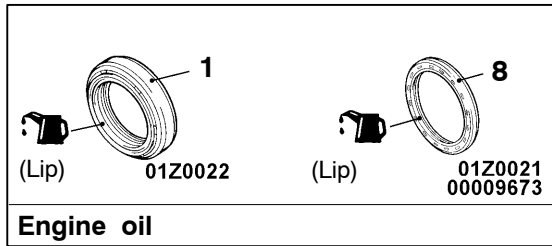
AX1673CA

Name	Symbol	Size mm (d × l)	Name	Symbol	Size mm (d × l)
Flange bolt	A	6 × 16	Flange bolt	F	8 × 85
	B	8 × 50		G	8 × 90
	C*	8 × 60		H	10 × 35
	D	8 × 75	Cap nut	I	–
	E	8 × 80			

d=Nominal diameter  
l=Nominal length  
\*: Vehicles without A/C

## CRANKSHAFT OIL SEAL

### REMOVAL AND INSTALLATION



AX1638CA

#### Crankshaft front oil seal removal steps

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



#### Crankshaft rear oil seal removal steps

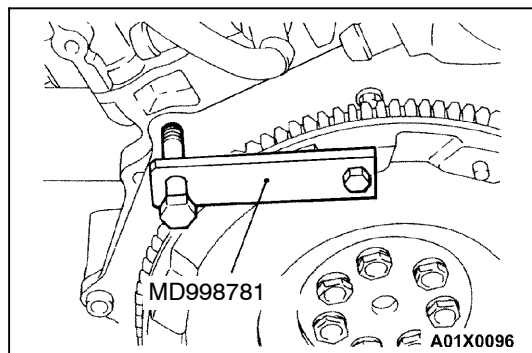
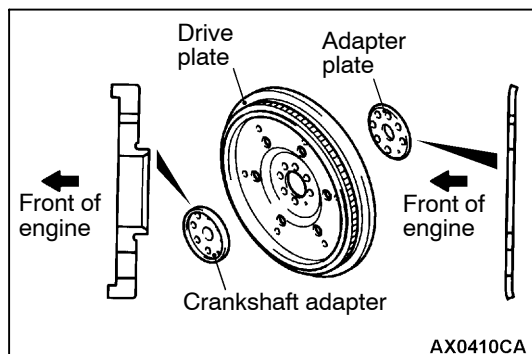
&lt;M/T&gt;

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

&lt;A/T&gt;

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

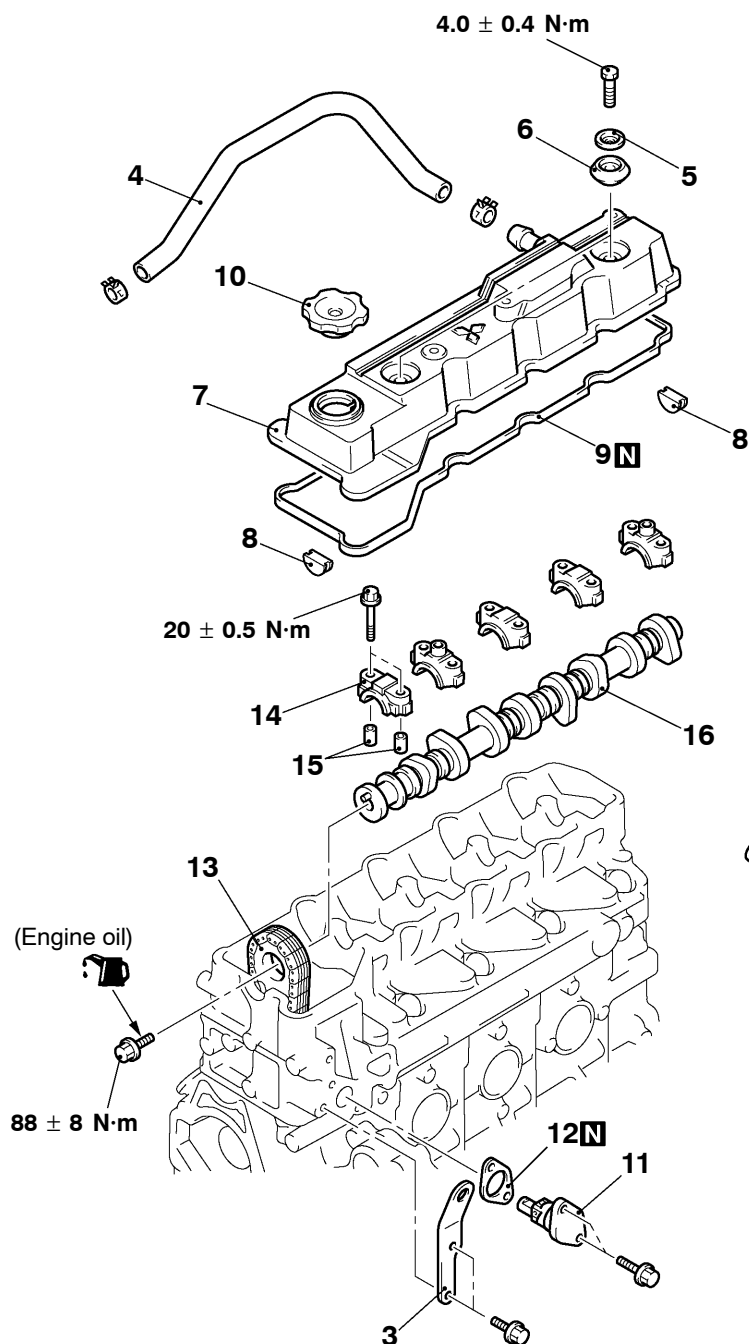


**REMOVAL SERVICE POINT****◀A▶ FLYWHEEL BOLT/DRIVE PLATE BOLT REMOVAL****INSTALLATION SERVICE POINT****▶A◀ CRANKSHAFT ADAPTER/DRIVE PLATE/ADAPTER PLATE INSTALLATION**

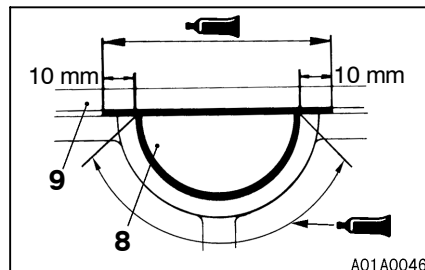
Assemble the crankshaft adapter and the adapter plate to the drive plate as shown, and then install the drive plate assembly into the crankshaft.

**CAMSHAFT****REMOVAL AND INSTALLATION****Pre-removal and Post-installation Operation**

- Air Cleaner Removal and Installation (Refer to GROUP 15.)
- Air Intake Hose and Pipe Assembly Removal and Installation (Refer to GROUP 15 – Intake Manifold and Exhaust Manifold, Turbocharger <4M40>.)

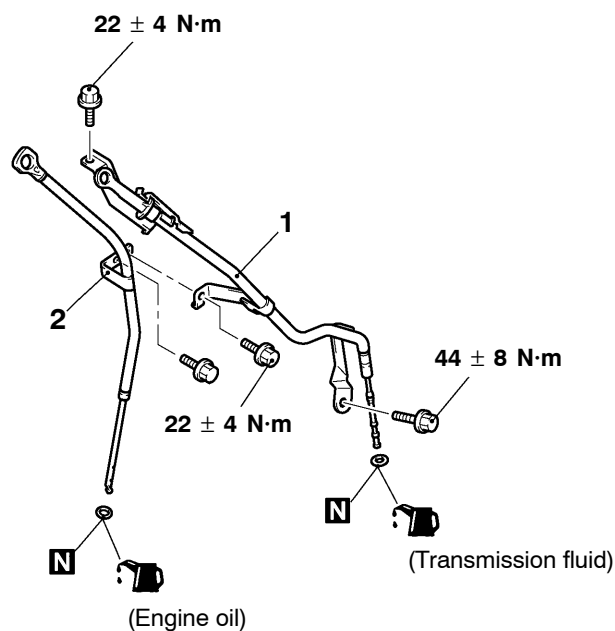


Apply engine oil to all moving parts during installation.



A01A0046

**Sealant:**  
**3M ATD Part No. 8660**  
**or equivalent**



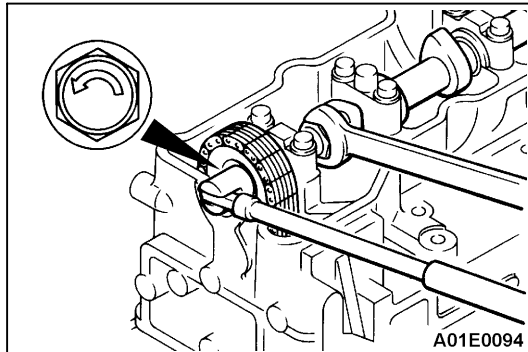
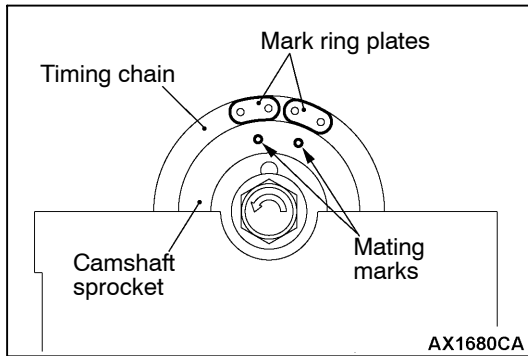
AX1687CA

## Removal steps

1. A/T oil level gauge and guide assembly<A/T>
2. Engine oil level gauge and guide assembly
3. Engine hanger
4. Breather hose
5. Rocker cover washer
6. Rocker cover seal
7. Rocker cover
8. Camshaft end seal

9. Rocker cover gasket
10. Oil filler cap
  - Valve clearance adjustment  
(Refer to P.11C-8.)
11. Chain tensioner
12. Chain tensioner gasket
13. Camshaft sprocket
14. Camshaft cap
15. Cylinder head bush
16. Camshaft





## REMOVAL SERVICE POINT

### ◀A▶ CAMSHAFT SPROCKET REMOVAL

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

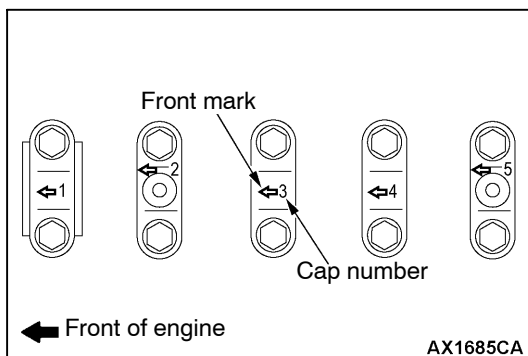
#### Caution

**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 CAP INSTALLATION

1. The cap numbers are enbossed on the top of the camshaft caps. Install the camshaft caps in that order so that their front marks face the direction shown.
2. Tighten the camshaft cap mounting bolts to the specified torque.

**Tightening torque:  $20 \pm 0.5$  N·m**

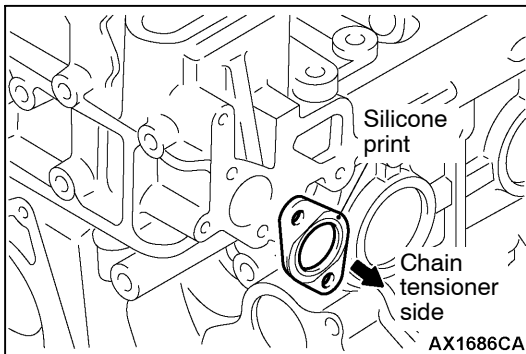
**►B◄ CAMSHAFT SPROCKET INSTALLATION**

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:  $88 \pm 8$  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.

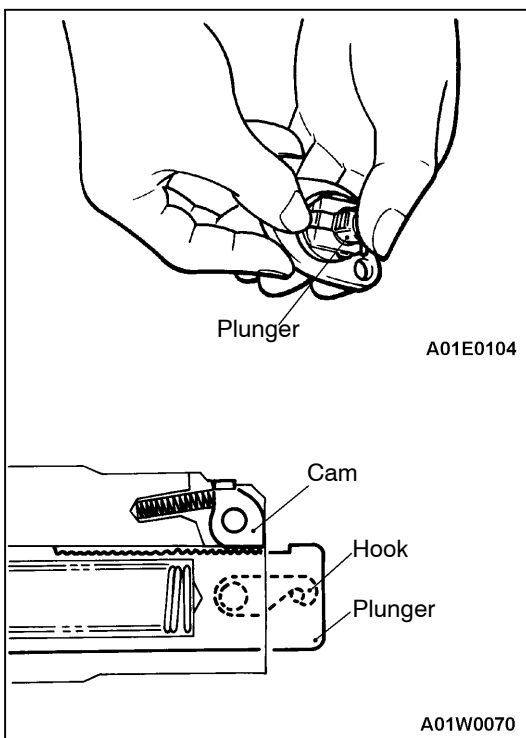
3. Turn the crankshaft clockwise.

**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.



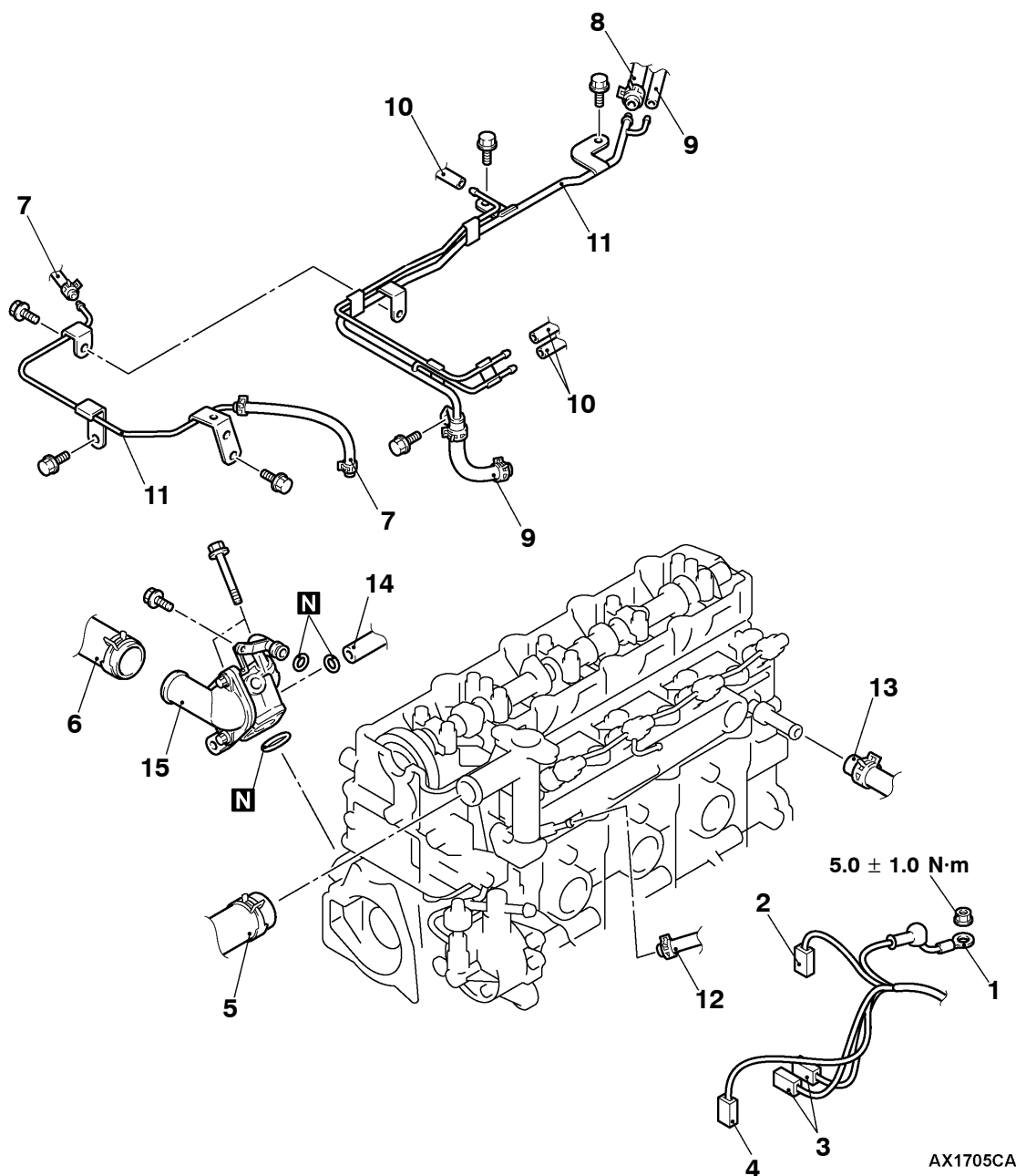


## CYLINDER HEAD GASKET

### REMOVAL AND INSTALLATION

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

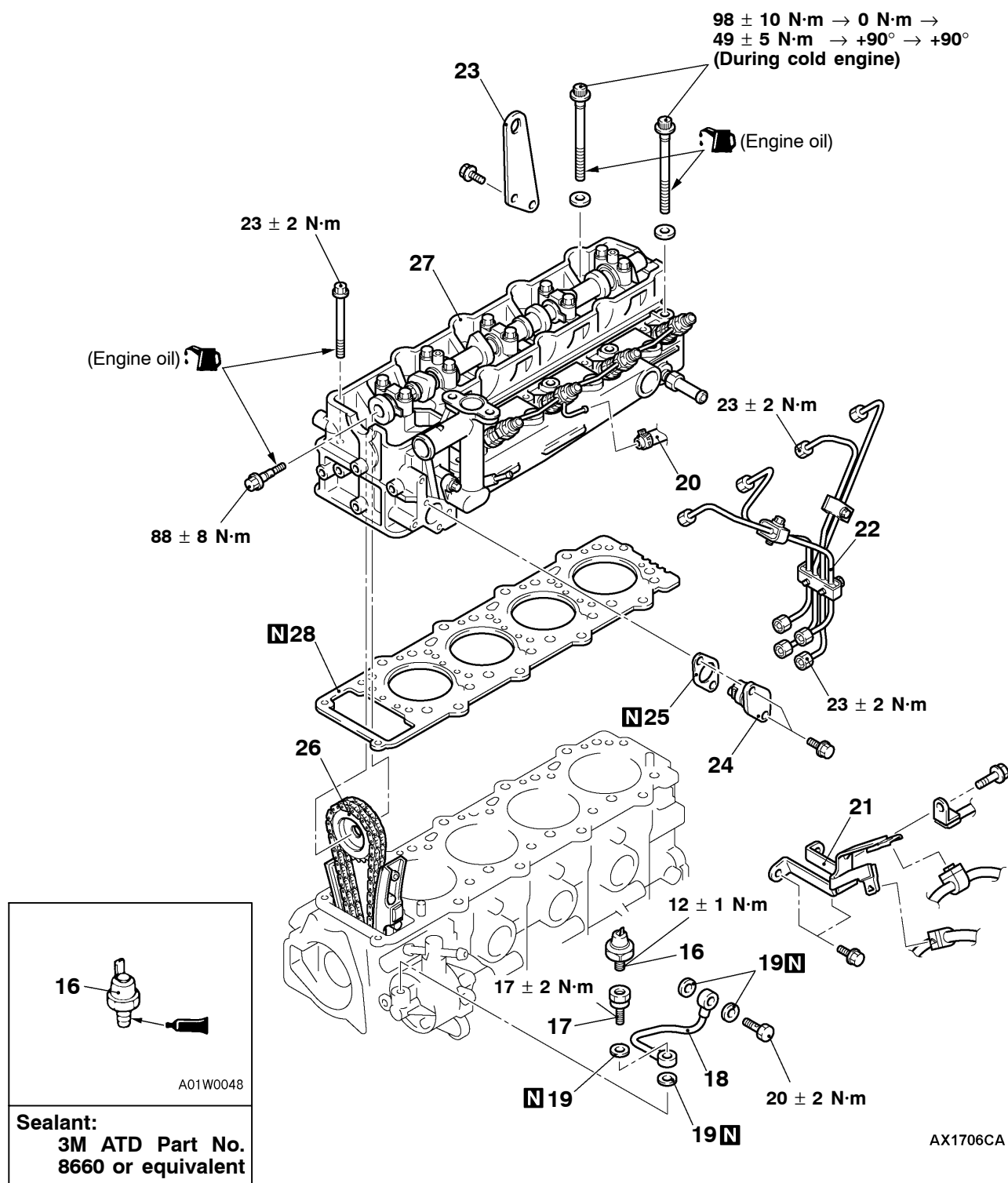
- Engine Coolant Drain and Refill  
(Refer to GROUP 14 – On-vehicle Service.)
- Engine Oil Check and Refill  
(Refer to GROUP 12 – On-vehicle Service.)  
<Post-installation operation>
- Fuel Line Air-bleeding  
(Refer to GROUP 13C – On-vehicle Service.)  
<Post-installation operation>
- Drive Belt Tension Check and Adjustment  
(Refer to P.11C-5.) <Post-installation operation>
- Rocker Cover Gasket Removal and Installation  
(Refer to P.11C-22.)
- Fuel Filter Removal and Installation  
(Refer to GROUP 13E.)
- Cooling Fan and Fan Clutch Assembly Removal and Installation (Refer to GROUP 14.)

**Removal steps**

1. Glow plug connector
2. Engine coolant temperature sensor connector
3. Engine coolant temperature switch connector
4. Oil pressure switch connector
- Drive belt (Refer to P.11C-17.)
5. Radiator upper hose connection
6. Radiator lower hose connection
7. Boost hose connection
8. Brake booster vacuum hose connection
- <R.H. drive vehicles without ABS>
9. Vacuum hose connection

10. EGR vacuum hose connection  
<Vehicles with EGR>
11. Injection pump boost pipe and hose, vacuum pump pipe and hose assembly
  - Turbocharger, exhaust manifold and intake manifold (Refer to GROUP 15.)
12. Water hose connection  
<Vehicles with EGR>
13. Heater hose connection
  - Alternator brace (Refer to GROUP 16.)
14. Heater return pipe connection
15. Bypass pipe, thermostat case and cover assembly



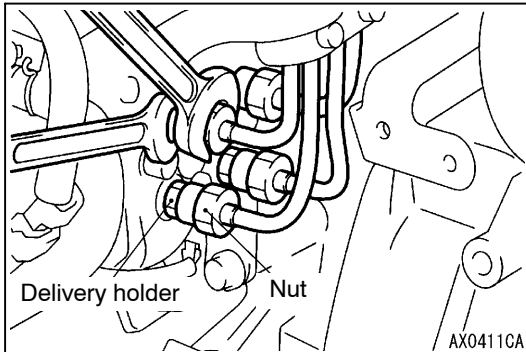


16. Oil pressure switch  
17. Connector  
18. Vacuum pump oil pipe  
19. Vacuum pump oil pipe gasket  
20. Fuel hose connection  
21. Harness bracket  
22. Injection pipe

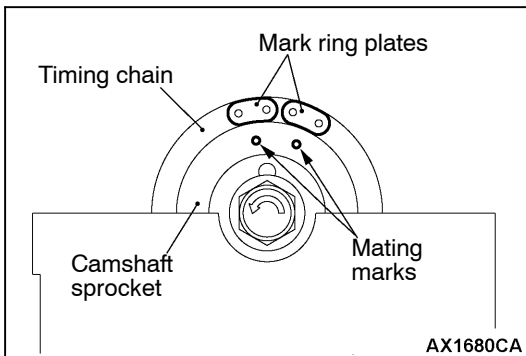
23. Engine hanger  
24. Chain tensioner  
25. Chain tensioner gasket  
26. Camshaft sprocket  
27. Cylinder head assembly  
28. Cylinder head gasket

**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▶ INJECTION PIPE REMOVAL**

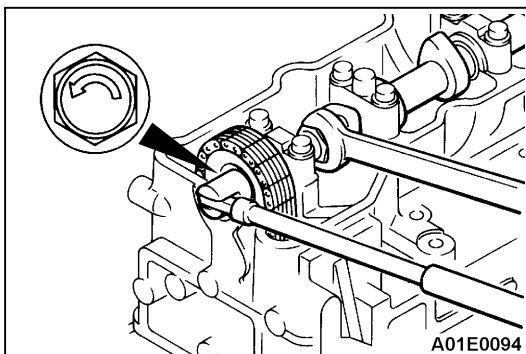
When loosening the nuts at both ends of injection pipe, hold the delivery holder (for pump side) and the injection nozzle assembly (for nozzle side) with a wrench and loosen nut.

**◀C▶ CAMSHAFT SPROCKET REMOVAL**

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

**Caution**

**Never turn the crankshaft anticlockwise.**

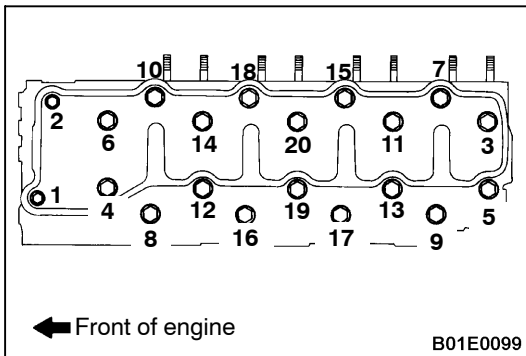


2. Hold the hexagonal part of the camshaft with an open end wrench, loosen the camshaft sprocket bolts, and then remove the camshaft sprockets with the timing chain still attached.

**Caution**

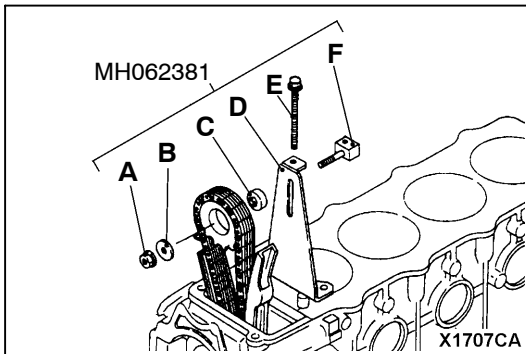
- (1) Use the timing chain to prevent the camshaft from turning.
- (2) The camshaft sprocket bolt is left threaded, so the arrow indicating its tightening direction is marked on the bolt head. To loosen this bolt, turn the bolt to the opposite direction of the arrow.
- (3) The timing chain must be attached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

3. Tie up the timing chain and the camshaft sprocket with a cord to prevent the mating mark misalignment.



### ◀D▶ 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 MH062381: Cam sprocket holder kit components

- A: Nut
- B: Washer
- C: Spacer
- D: Adjust plate
- E: Bolt
- F: Nut

### INSTALLATION SERVICE POINTS

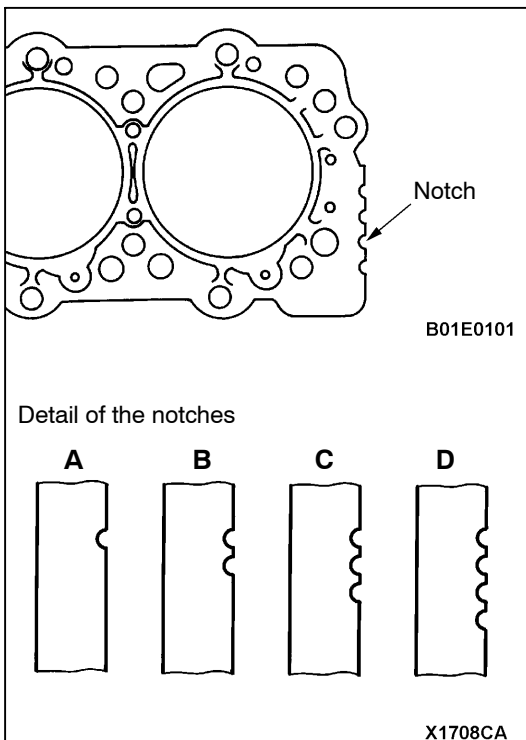
#### ▶A◀ CYLINDER HEAD GASKET INSTALLATION

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 1.35 mm)	ME200751
B (Thickness after tightening the bolts 1.40 mm)	ME200752
C (Thickness after tightening the bolts 1.45 mm)	ME200753
D (Thickness after tightening the bolts 1.50 mm)	ME200754

#### 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.)

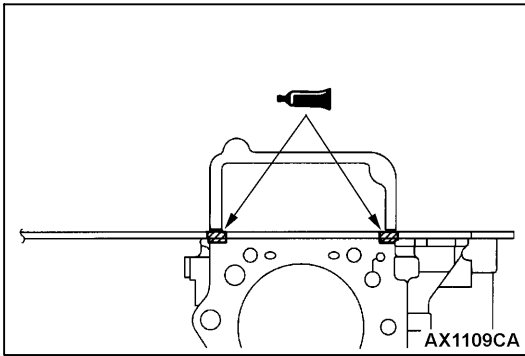


#### ▶B◀ CYLINDER HEAD ASSEMBLY INSTALLATION

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.

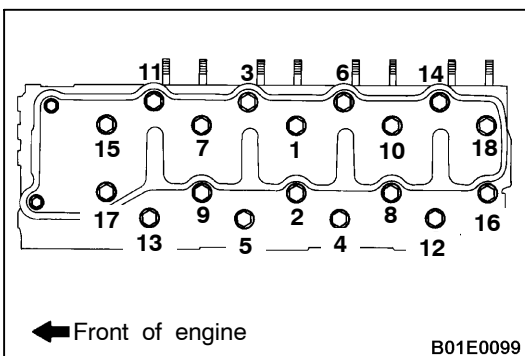
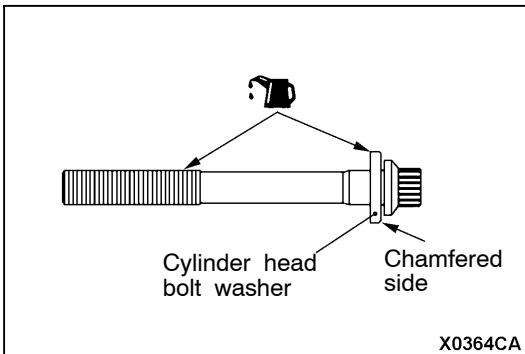
(3) After the oil pan is installed, wait for at least one hour, and then start the engine.

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).

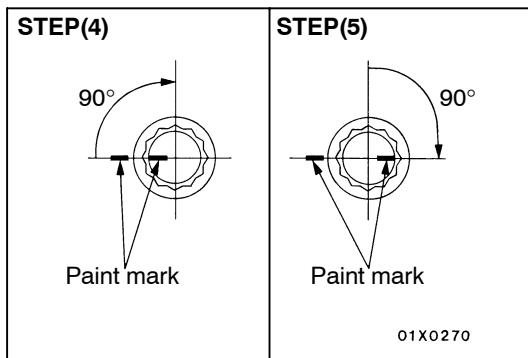
- (1) Tighten the cylinder head bolts in the shown sequence to  $98 \pm 10$  N·m.

**Bolt size: Nominal diameter×length mm**

**Except 3, 6, 11, 14: 12×105**

**3, 6, 11, 14: 12×125**

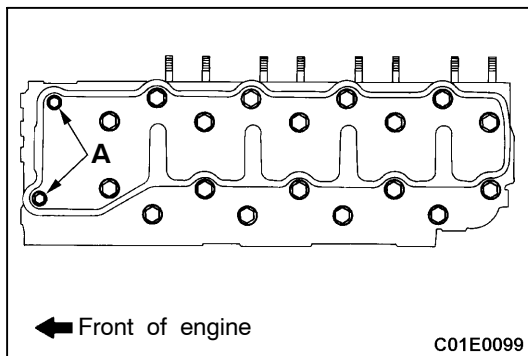
- (2) Loosen the cylinder head bolts completely in the reverse of the shown sequence.
- (3) Tighten the cylinder head bolts in the shown order to  $49 \pm 5$  N·m.



- (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  $23 \pm 2$  N·m.

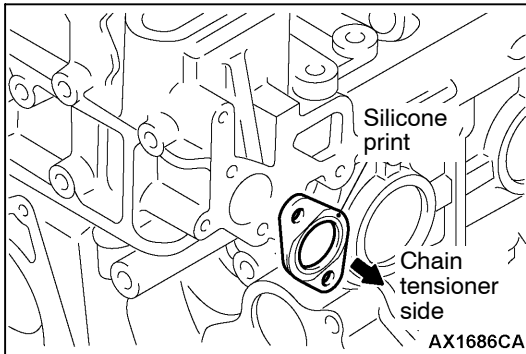
### ►C◀ CAMSHAFT SPROCKET INSTALLATION

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:  $88 \pm 8$  N·m**

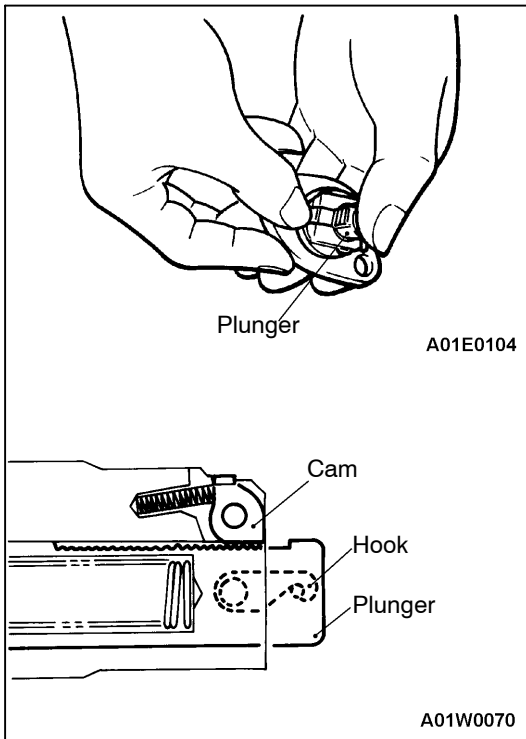
#### Caution

- (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.



### ►D◄ CHAIN TENSIONER GASKET INSTALLATION

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



### ►E◄ 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.

### ►F◄ INJECTION PIPE INSTALLATION

When tightening nuts at both ends of injection pipe, hold the delivery holder (for pump side) and the injection nozzle assembly (for nozzle side) with a wrench in the same manner as removal, and tighten the nuts to the specified torque.

**Tightening torque:  $23 \pm 2$  N·m**

### ►G◄ 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.



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

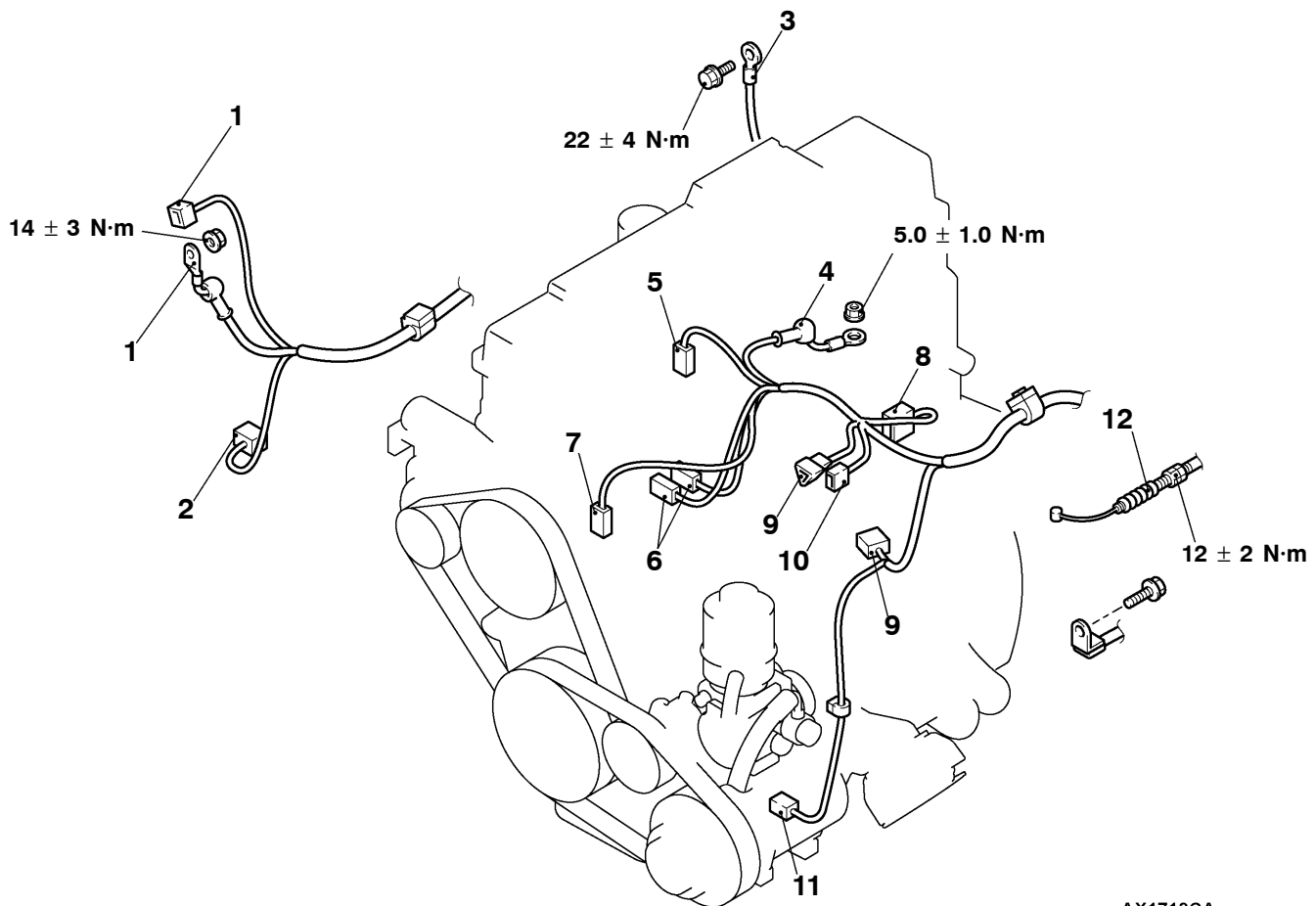
1. Insert the hose up to the convex part of the thermostat cover and water outlet pipe.
2. Align the mating marks on the radiator hose and the hose clamp, and then install the hose.

## 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.)
- Accelerator Cable Adjustment (Refer to GROUP 17 – On-vehicle Service.)
- Fuel Line Air-bleeding (Refer to GROUP 13C – On-vehicle Service.)
- A/C Compressor Drive Belt Tension Check and Adjustment <Vehicles with A/C> (Refer to P.11C-5.) <Post-installation operation>
- Hood Removal and Installation (Refer to GROUP 42.)
- Fuel Filter Removal and Installation (Refer to GROUP 13E.)
- Air Cleaner Removal and Installation (Refer to GROUP 15.)
- Air Intake Hose and Pipe Assembly Removal and Installation (Refer to GROUP 15 – Intake Manifold and Exhaust Manifold, Turbocharger <4M40>.)
- Intercooler Air Pipe Removal and Installation (Refer to GROUP 15 – Intercooler.)
- Cooling Fan and Fan Clutch Assembly Removal and Installation (Refer to GROUP 14.)
- Radiator Removal and Installation (Refer to GROUP 14.)



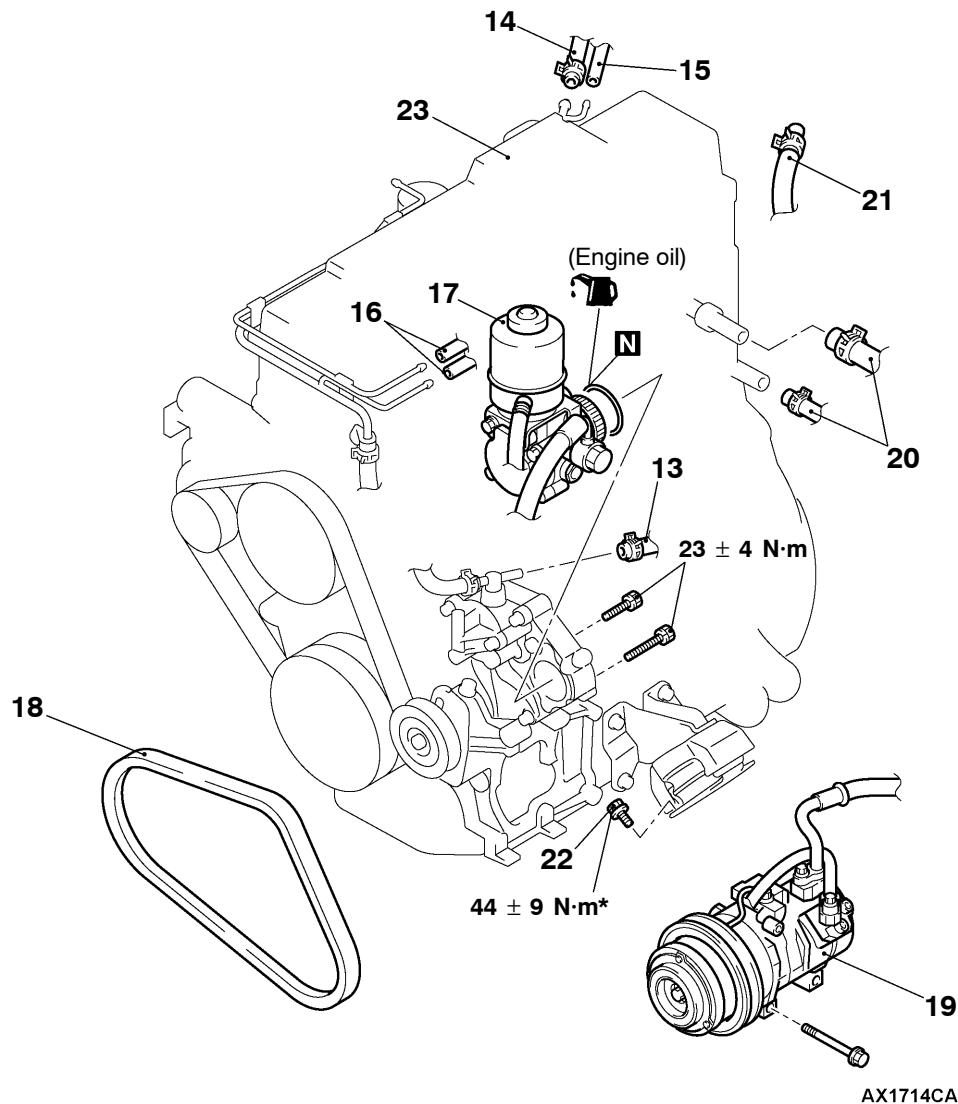
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**Removal steps**

1. Alternator connector
2. Free-wheeling hub engage switch connector
3. Earth cable connection
4. Glow plug connector
5. Engine coolant temperature sensor connector
6. Engine coolant temperature switch connector
7. Oil pressure switch connector
8. Fuel cut valve controller connector <Vehicles with immobilizer system>
9. Injection pump connector
10. Lever position switch connector <A/T-vehicles with A/C>
11. A/C compressor connector <Vehicles with A/C>
12. Accelerator cable connection

**Caution**

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



13. Brake booster vacuum hose connection  
<L.H. drive vehicles without ABS>  
14. Brake booster vacuum hose connection  
<R.H. drive vehicles without ABS>  
15. Vacuum hose connection  
16. EGR vacuum hose connection  
<Vehicles with EGR>  
17. Power steering oil pump assembly  
18. A/C compressor drive belt  
<Vehicles with A/C>

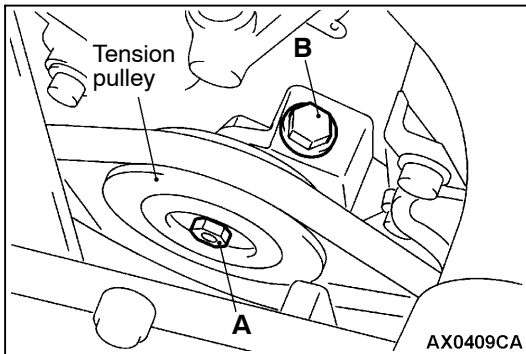


19. A/C compressor  
<Vehicles with A/C>  
20. Heater hose connection  
21. Fuel return hose connection  
• Glow plug relay and solenoid valve assembly  
• Transmission assembly  
(M/T: Refer to GROUP 22.)  
(A/T: Refer to GROUP 23.)  
22. Engine mount insulator mounting bolt  
23. Engine assembly



**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**

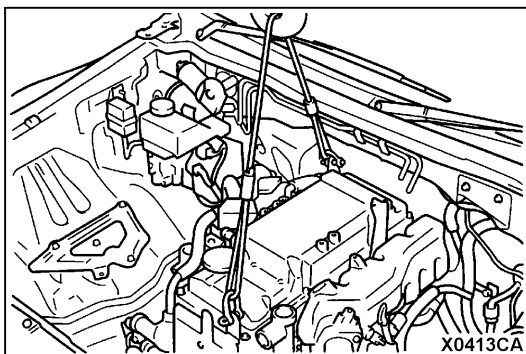
1. Loosen the tension pulley securing bolt A.
2. Loosen the adjusting bolt B to remove the belt.

**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.