

## GROUP 11A

# ENGINE MECHANICAL

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## GENERAL INFORMATION

M1111000100356

Item		4G63
Total displacement mL		1,997
Bore × Stroke mm		85 × 88
Compression ratio		10.0
Compression chamber		Pentroof
Camshaft arrangement		DOHC
Number of valve	Intake	8
	Exhaust	8
Valve timing	Intake opening	BTDC 17°
	Intake closing	ABDC 51°
	Exhaust opening	BBDC 57°
	Exhaust closing	ATDC 13°
Fuel system		Electronically controlled multipoint fuel injection
Rocker arm		Roller type
Auto-lash adjuster		Equipped

## SERVICE SPECIFICATIONS

M1112000300234

Item		Standard value	Limit
Drive belt tension	Vibration frequency Hz (Reference)	110 – 144	–
	Tension N (Reference)	245 – 412	–
Basic ignition timing		5° BTDC ± 2°	–
Ignition timing		Approximately 10° BTDC	–
Idle speed r/min		750 ± 100	–
CO contents %		0.5 or less	–
HC contents ppm		100 or less	–
Compression pressure kPa-r/min		1,370 – 250	930 – 250
Compression pressure difference of all cylinders kPa		–	Maximum 98
Intake manifold vacuum kPa		–	Minimum 60
Cylinder head bolt nominal length mm		–	99.4
Balancer timing belt tension (When adjusted)	Deflection mm	5 – 7	–
Balancer timing belt tension (When replaced)	Deflection mm	5 – 7	–

Item		Standard value	Limit
Balancer timing belt tension (When checked)	Deflection mm	5 – 10	–
Timing belt tensioner adjuster rod protrusion amount mm		3.8 – 4.5	–
Timing belt tensioner adjuster rod movement mm		Within 1	–

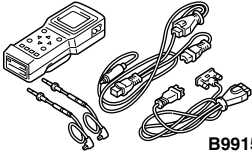
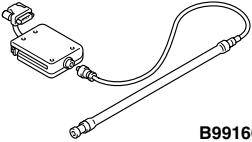
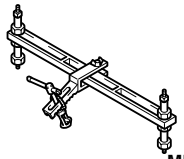
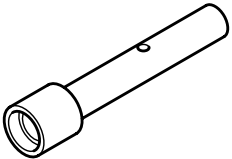
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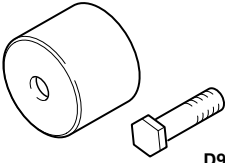
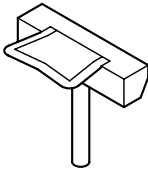
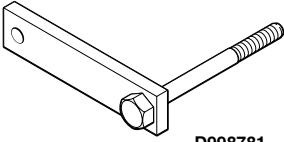
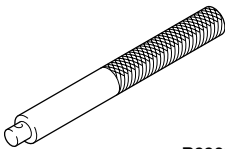
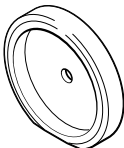
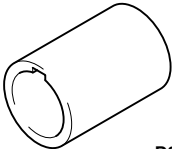
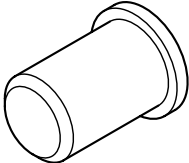
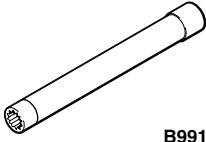
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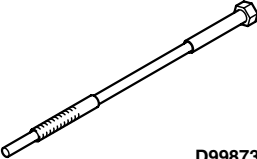
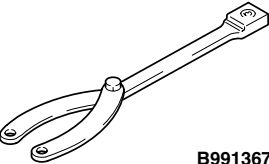
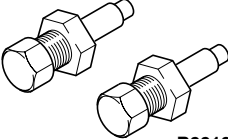
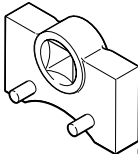
Item	Specified Sealant	Remark
Cylinder head	MITSUBISHI GENUINE PART MD970389 or equivalent	Semi-drying sealant
Camshaft position sensor support		
Rocker cover		
Camshaft end seal	3M ATD Part No.8660 or equivalent	
Rocker cover gasket	MITSUBISHI GENUINE PART MD970389 or equivalent	
Engine oil pan <2WD>		
Engine upper oil pan <4WD>		
Engine lower oil pan <4WD>		

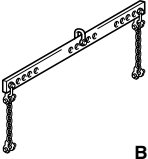
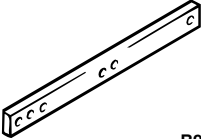
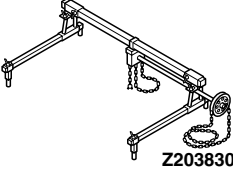
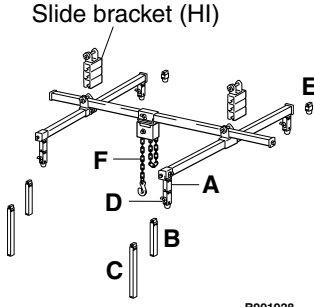
## SPECIAL TOOLS

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Tool	Number	Name	Use
 B991502	MB991502	MUT-II sub assembly	<ul style="list-style-type: none"> <li>• Drive belt tension check</li> <li>• Checking the ignition timing</li> <li>• Checking the idle speed</li> </ul>
 B991668	MB991668	Belt tension meter set	Drive belt tension check (used together with MUT-II)
 MD998772	MD998772	Valve spring compressor	Compressing valve spring
	MD998737	Valve stem seal installer	Valve stem seal installation

Tool	Number	Name	Use
 D998713	MD998713	Camshaft oil seal installer	Camshaft oil seal installation
 D998727	MD998727	Oil pan remover	Oil pan removal <2WD>
 D998781	MD998781	Flywheel stopper	Supporting the flywheel
 B990938	MB990938	Installer bar	Crankshaft rear oil seal installation
 D998776	MD998776	Crankshaft rear oil seal installer	
 D998285	MD998285	Crankshaft front oil seal guide	
 MD998375	MD998375	Crankshaft front oil seal installer	Crankshaft front oil seal installation
 B991654	MB991654	Cylinder head bolt wrench (12)	

Tool	Number	Name	Use
 <p>D998738</p>	MD998738	Adjusting bolt	Supporting the timing belt tensioner arm and timing belt tensioner adjuster
 <p>B991367</p>	MB991367	Special spanner	Holding the crankshaft camshaft drive sprocket
 <p>B991385</p>	MB991385	Pin	
 <p>D998767</p>	MD998767	Tensioner wrench	Valve timing belt tension adjustment

Tool	Number	Name	Use
 B991454	MB991454	Engine hanger balancer	When the engine hanger is used: Supporting the engine assembly during removal and installation of the transmission assembly  <i>NOTE: Special tool MB991454 is a part of engine hanger attachment set MB991453.</i>
 B991527	MB991527	Hanger	
 Z203830	MB991895	Engine hanger	
 B991928	MB991928 A: MB991929 B: MB991930 C: MB991931 D: MB991932 E: MB991933 F: MB991934	Engine hanger A: Joint (50) × 2 B: Joint (90) × 2 C: Joint (140) × 2 D: Foot (standard) × 4 E: Foot (short) × 2 F: Chain and hook assembly	

## ON-VEHICLE SERVICE

### DRIVE BELT TENSION CHECK

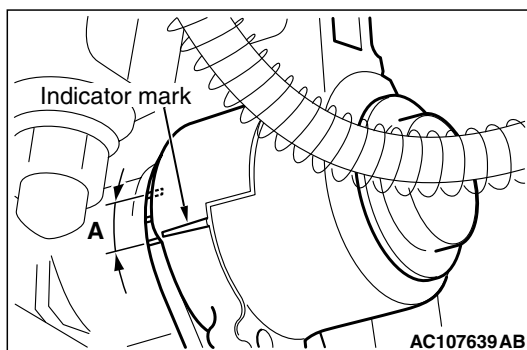
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#### CAUTION

Check the drive belt tension after turning the crankshaft clockwise one turn or more.

- If the mark is out of the area, replace the drive belt. (Refer to [P.11A-13.](#))

*NOTE: The drive belt tension check is not necessary as auto-tensioner is adopted.*



- Make sure that the indicator mark is within the area marked with A in the illustration.

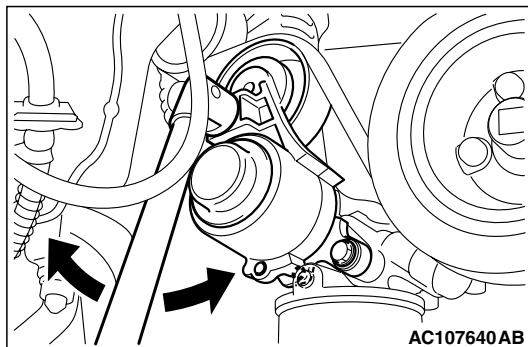
## AUTO-TENSIONER CHECK

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### CAUTION

### OPERATION CHECK

1. Turn OFF the engine from the idle state then check to see that the drive belt is not protruding from the pulley width of the auto-tensioner.
2. Remove the drive belt.(Refer to [P.11A-13.](#))



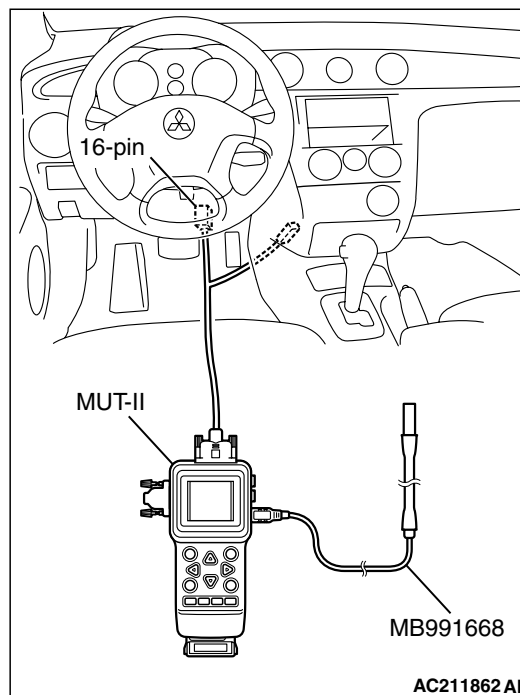
3. Securely insert the spindle handle or ratchet handle with a 12.7 mm insertion angle into the jig hole of the auto tensioner. Turn the auto-tensioner to the left and right to check and see that there is no threading.
4. If there are any problems in the procedure 1 or 3, replace the auto-tensioner.(Refer to [P.11A-35.](#))
5. Install the drive belt.(Refer to [P.11A-13.](#))

### FUNCTION CHECK

You can verify if the auto-tensioner is defective or not by checking the drive belt tension.

#### When using MUT-II

1. Check the drive belt tension. (Refer to [P.11A-6.](#))
2. Measure the drive belt tension vibration frequency by the following procedures:

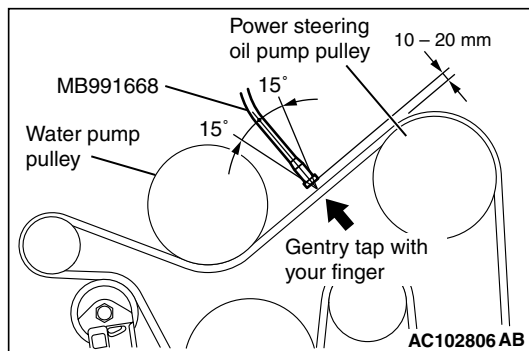


**To prevent damage to MUT-II, always turn the ignition switch to the "LOCK" (OFF) position before connecting or disconnecting MUT-II.**

- (1) Connect special tool belt tension meter set (MB991668) to the MUT-II.
- (2) Connect the MUT-II to the diagnosis connector.
- (3) Turn the ignition switch to ON position, and select "BELT TENSION" on the menu screen.

**CAUTION**

- The temperature of the surface of the belt should be as close to normal temperature as possible.
- Do not allow any contaminants such as water or oil to get onto the microphone.
- 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.
- 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.
- Do not take the measurement while the vehicle's engine is running.



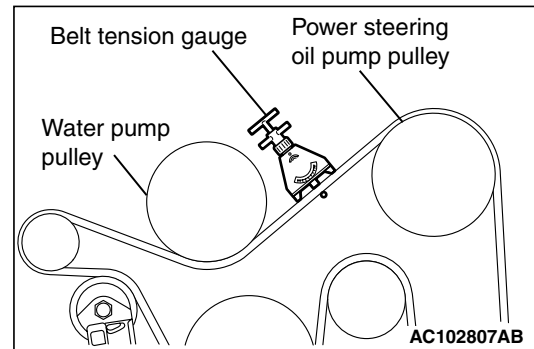
- (4) Hold special tool belt tension meter set (MB991668) to the middle of the drive belt between the pulleys (at the place indicated by arrow), approximately 10 – 20 mm away from the rear surface of the belt so that it is perpendicular to the belt (within an angle of  $\pm 15$  degree).
- (5) Gently tap the middle of the belt between the pulleys (the place indicated by the arrow) with your finger as shown in the illustration, and measure that the vibration frequency of the belt is within the standard value.

**Standard value: 110 – 144 Hz**

3. If not within the standard value, replace the auto-tensioner. (Refer to [P.11A-35](#).)

**When using a tension gauge**

1. Check the drive belt tension. (Refer to [P.11A-6](#).)



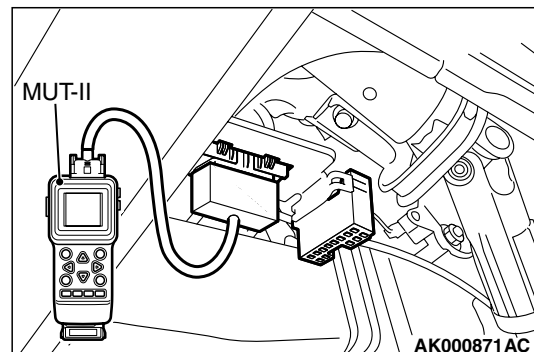
2. Use a belt tension gauge in the middle of the belt between the pulleys (at the place indicated by the arrow) to measure that the belt tension is within the standard value.

**Standard value: 245 – 412 N**

3. If not within the standard value, replace the auto-tensioner. (Refer to [P.11A-35](#).)

**IGNITION TIMING CHECK**

M1111001700425



1. Before inspection, set the vehicle to the pre-inspection condition.
2. Turn the ignition switch to the "LOCK" (OFF) position and then connect the MUT-II to the diagnosis connector.
3. Connect a timing light.
4. Start the engine and let it run at idle.
5. Use the MUT-II to measure engine idle speed and check that it is within the standard value.

**Standard value: 750  $\pm$  100 r/min**

6. Select No. 17 of the MUT-II Actuator test.
7. Check that basic ignition timing is within the standard value.

**Standard value: 5° BTDC  $\pm$  2°**

8. If the basic ignition timing is outside the standard value, inspect the MPI system (Refer to [P.13A-12](#), GROUP 13A – Troubleshooting – Inspection chart for diagnosis code).



**CAUTION**

If the test is not cancelled, a forced driving will continue for 27 minutes. Driving under this condition may damage the engine.

9. Press the MUT-II clear key (Select a forced driving cancel mode) to release the Actuator test.
10. Check that ignition timing is at the standard value.

**Standard value: approximately 10° BTDC**

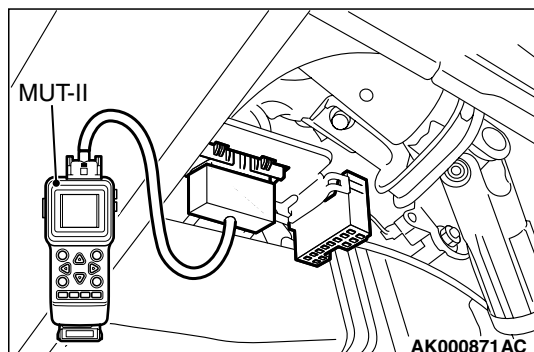
**NOTE:**

- The ignition timing may fluctuate within  $\pm 7^\circ$  BTDC. This is normal.
- In higher altitude, the ignition timing is more advanced than the standard value by approximately 5°.

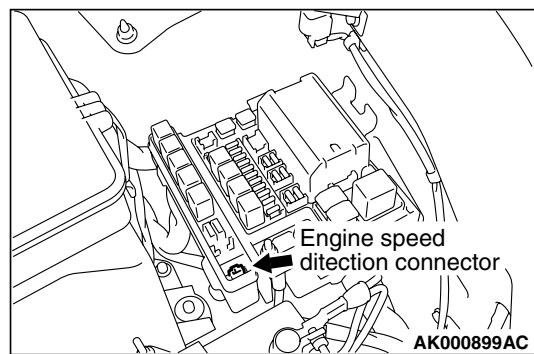
11. Remove the timing light.
12. Turn off the ignition switch and then remove the MUT-II.

**IDLE SPEED CHECK**

M1111003500472



1. Before inspection, set the vehicle to the pre-inspection condition.
2. Turn the ignition switch to "LOCK" (OFF) position.
3. Connect the MUT-II to the diagnosis connector or connect a tachometer to the engine speed detection connector.
4. Connect a timing light.



5. Start the engine and let it run at idle.
  6. Check that ignition timing is at the standard value.
- Standard value: approximately 10° BTDC**
7. Check the idle speed.

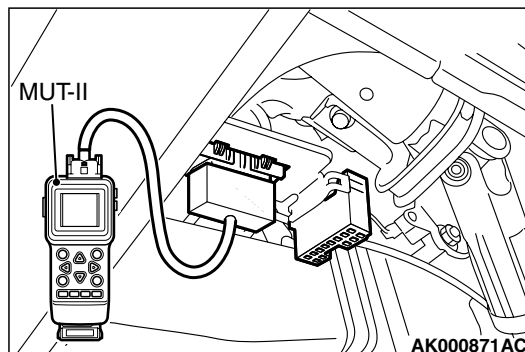
**Standard value: 750  $\pm$  100 r/min**

**NOTE:**

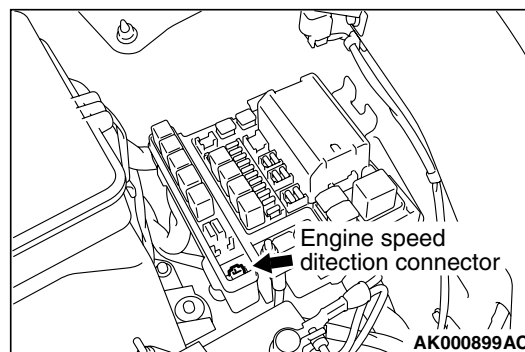
- The idle speed is controlled automatically by the idle speed control system.
  - When using the MUT-II, select item No. 22 and take a reading of the idle speed.
8. If the idle speed is outside the standard value, inspect the MPI system (Refer to P.13A-12, GROUP 13A – Troubleshooting – Inspection chart for diagnosis code).

**IDLE MIXTURE CHECK**

M1111002100255



1. Before inspection, set the vehicle to the pre-inspection condition.
2. Turn the ignition switch to "LOCK" (OFF) position.
3. Connect the MUT-II to the diagnosis connector or connect a tachometer to the engine speed detection connector.
4. Connect a timing light.



5. Start the engine and let it run at idle.
  6. Check that ignition timing is at the standard value.
- Standard value: approximately 10° BTDC**
7. Run the engine at 2,500 r/min for 2 minutes.
  8. Set the CO, HC tester.
  9. Check the CO contents and the HC contents at idle.

**Standard value**

**CO contents: 0.5 % or less**

**HC contents: 100 ppm or less**

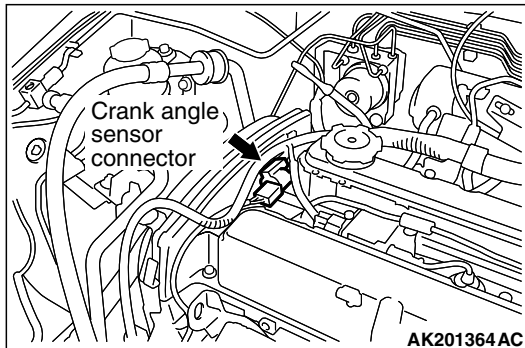
10. If there is a deviation from the standard value, check the following items:

- Diagnosis output
- Fuel pressure
- Injector
- Ignition coil, spark plug cable, spark plug
- EGR control system
- Evaporative emission control system
- Compression pressure

*NOTE: Replace the three way catalyst when the CO and HC contents are not within the standard value, even though the result of the inspection is normal on all items.*

## COMPRESSION PRESSURE CHECK

M1111002600465



1. Before inspection, set the vehicle to the pre-inspection condition.
2. Disconnect the spark plug cables.
3. Remove all of the spark plugs.
4. Disconnect the crank angle sensor connector.

*NOTE: Doing this will prevent the engine-ECU<M/T> or engine-A/T-ECU<A/T> from carrying out ignition and fuel injection.*

### CAUTION

- **Keep away from the spark plug hole when cranking.**
  - **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 spark plug hole, which is dangerous.**
5. Cover the spark plug hole with a shop towel etc., and after the engine has been cranked, check that no foreign material is adhering to the shop towel.
  6. Set compression gauge to one of the spark plug holes.
  7. Crank the engine with the throttle valve fully open and measure the compression pressure.

**Standard value (at engine speed of 250 r/min):**

**1,370 kPa**

**Limit (at engine speed of 250 r/min):**  
**Minimum 930 kPa**

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

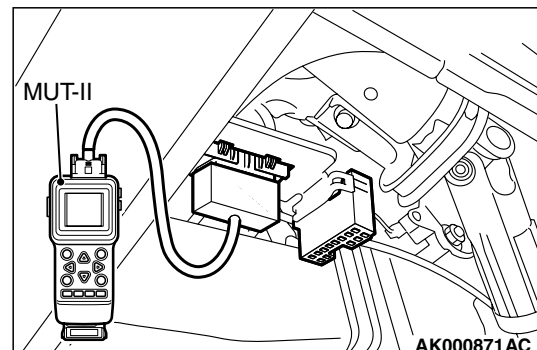
**Limit: Maximum 98 kPa**

9. 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 spark plug hole, and repeat the operations in steps from (6) to (8).
  - (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 dose not rise after oil is added, the cause is a burnt or defective valve seat, or pressure is leaking from the gasket.
10. Connect the crank angle sensor connector.
11. Install the spark plugs and spark plug cables.
12. Use the MUT-II to erase the diagnosis codes.

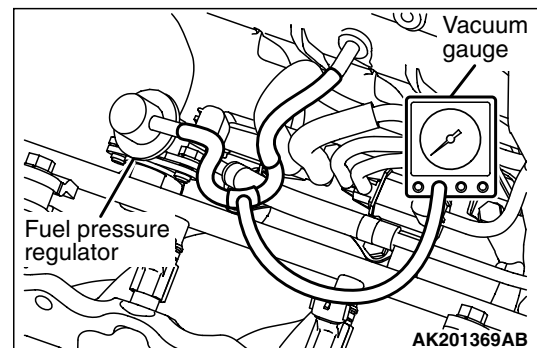
*NOTE: This will erase the diagnosis code resulting from the crank angle sensor connector being disconnected.*

## MANIFOLD VACUUM CHECK

M1111002700417



1. Before inspection, set the vehicle to the pre-inspection condition.
2. Turn the ignition switch to "LOCK" (OFF) position.
3. Connect a tachometer or connect the MUT-II to the diagnosis connector.



4. Attach a three-way joint to the vacuum hose between the fuel pressure regulator and the air intake plenum, and connect a vacuum gauge.
5. Start the engine and check that idle speed is within the standard valve.

**Standard value: 750 ± 100 r/min**

6. Check the intake manifold vacuum.

**Limit: Minimum 60 kPa**

7. Turn off the ignition switch.
8. Remove the vacuum gauge and the three-way joint, and then connect the vacuum hose.
9. Remove the engine tachometer or the MUT-II.

## LASH ADJUSTER CHECK

M1111002900336

If an abnormal noise (knocking) that seems to be coming from the lash adjuster is heard after starting the engine and does not stop, carry out the following check.

### NOTE:

- The abnormal noise which is caused by a problem with the lash adjusters is generated after the engine is started, and will vary according to the engine speed. However, this noise is not related to the actual engine load.

Because of this, if the noise does not occur immediately after the engine is started, if it does not change in accordance with the engine speed, or if it changes in accordance with the engine load, the source of the noise is not the lash adjusters.

- If there is a problem with the lash adjusters, the noise will almost never disappear, even if the engine has been run at idle to let it warm up.

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

1. Start the engine.
2. Check that the noise occurs immediately after the engine is started, and that the noise changes in accordance with changes in the engine speed.

If the noise does not occur immediately after the engine is started, or if it does not change in accordance with the engine speed, the problem is not being caused by the lash adjusters, so check for some other cause of the problem. Moreover, if the noise does not change in accordance with the engine speed, the cause of the problem is probably not with the engine (In these cases, the lash adjusters are normal).

3. While the engine is idling, check that the noise level does not change when the engine load is varied (for example, by shifting from N to D).

If the noise level changes, the cause of the noise is probably parts striking because of worn crankshaft bearings or connecting rod bearings (In such cases, the lash adjusters are normal).

4. After the engine has warmed up, run it at idle and check if any noise can be heard.

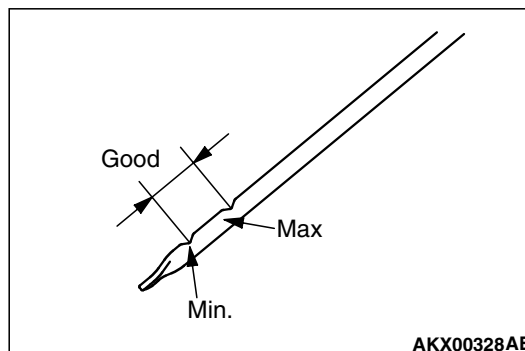
If the noise has become smaller or disappeared, oil sludge could make the lash adjusters stick. Clean the lash adjusters (Refer to GROUP 11D – Rocker Arms and Camshaft – Rocker Arms and Camshaft Inspection P.11B-33). If not improved, go to step 5.

5. Bleed air from the lash adjusters (Refer to P.11A-11).
6. If the noise has not disappeared even after the air bleeding, clean the lash adjusters (Refer to GROUP 11D – Rocker Arms and Camshaft – Rocker Arms and Camshaft Inspection P.11B-33).

## <LASH ADJUSTER AIR BLEEDING>

### NOTE:

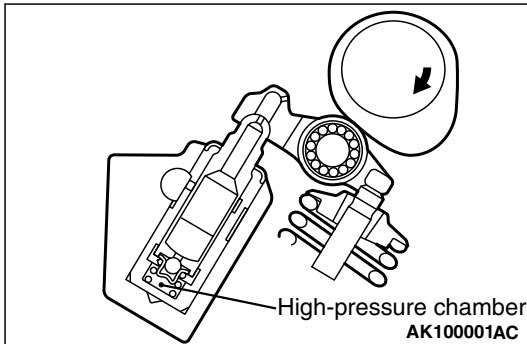
- If the vehicle is parked on a slope for a long period of time, the amount of oil inside the lash adjuster will decrease, and air may get into the high pressure chamber when starting the engine.
- After parking the vehicle for long periods, the oil drains out of the oil passage, and it takes time for the oil to be supplied to the lash adjuster, so air can get into the high-pressure chamber.
- If either of the above situations occur, the abnormal noise can be eliminated by bleeding the air from inside the lash adjusters.



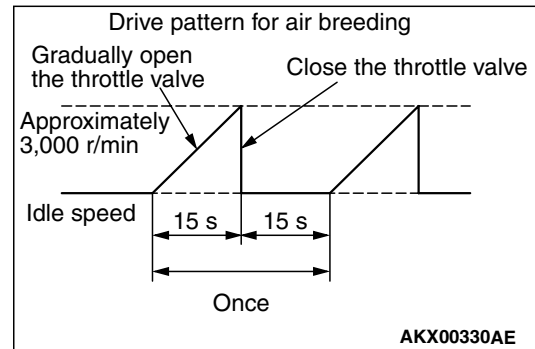
1. Check the engine oil and replenish or replace the oil if necessary.

## NOTE:

- If there is an only small amount of oil, air will be drawn in through the oil screen and will get into the oil passage.
- If the amount of oil is greater than normal, then the oil will being mixed by the crankshaft and a large amount of air may get mixed into the oil.
- If the oil is degenerated, air and oil will not separate easily in oil, and the amount of air mixed into the oil will increase.



- If the air which has been mixed in with the oil due to any of the above reasons gets into the high pressure chamber of the lash adjuster, the air inside the high pressure chamber will be compressed when the valve is open and the lash adjuster will over-compress, resulting in abnormal noise when the valve close. This is the same effect as if the valve clearance is adjusted to be too large by mistake. If the air inside the lash adjusters is then released, the operation of the lash adjusters will return to normal.



2. Run the engine at idle for 1 – 3 minutes to let it warm up.
3. With no load on the engine, repeat the drive pattern shown in the illustration above and check if the abnormal noise disappears (The noise should normally disappear after 10 – 30 repetitions, but if there is no change in the noise level after 30 repetitions or more, the problem is probably not due to air inside the lash adjusters).
4. After the noise has disappeared, repeat the drive pattern shown in the illustration above a further 5 times.
5. Run the engine at idle for 1 – 3 minutes and check that the noise has disappeared.

# CRANKSHAFT PULLEY

## REMOVAL AND INSTALLATION

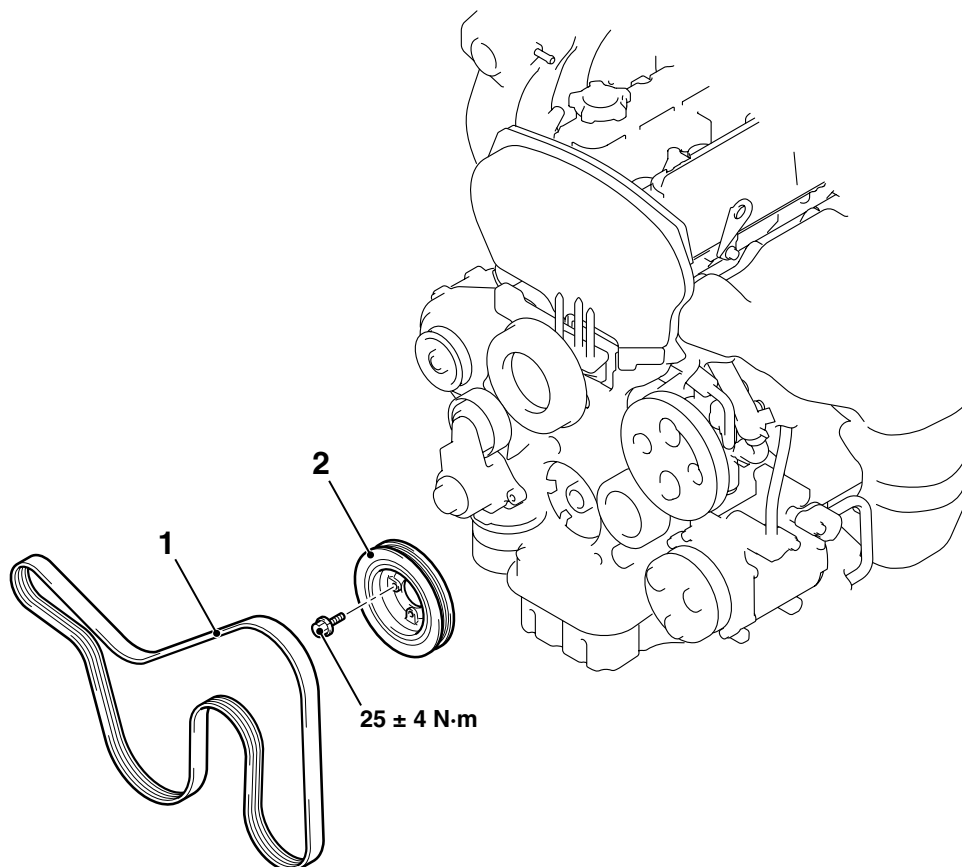
M1112001600409

### Pre-removal Operation

- Under Cover Removal (Refer to GROUP 51, Under Cover [P.51-18](#)).

### Post-installation Operation

- Drive Belt Tension Check (Refer to [P.11A-6](#)).
- Under Cover Installation (Refer to GROUP 51, Under Cover [P.51-18](#)).



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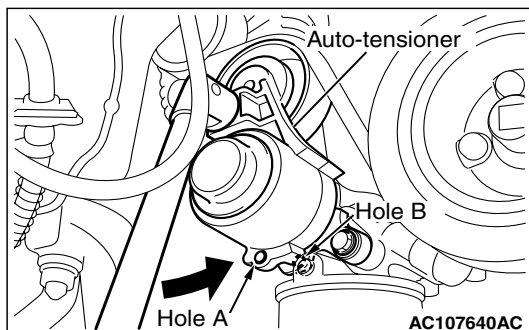
<<A>>

### Removal steps

1. Drive belt
2. Crank shaft damper pulley

**REMOVAL SERVICE POINT****<<A>> DRIVE BELT REMOVAL**

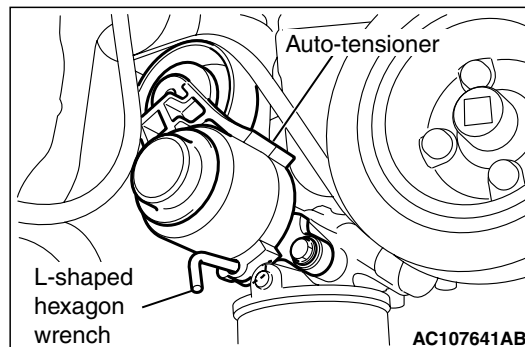
The following operations will be needed due to the serpentine drive system with the drive belt auto-tensioner.



1. Securely insert the spindle handle or ratchet handle with a 12.7 mm insertion angle into the jig hole of the auto-tensioner, and turn the auto-tensioner anti-clockwise until it hits the stopper.

**⚠ CAUTION**

To reuse the drive belt, draw an arrow indicating the rotating direction (clockwise) on the back of the belt using chalk.



2. Align hole A with hole B, insert an L-shaped hexagon wrench, etc. to fix and then remove the drive belt.

# CAMSHAFT AND VALVE STEM SEAL

## REMOVAL AND INSTALLATION

M1112006600211

### CAUTION

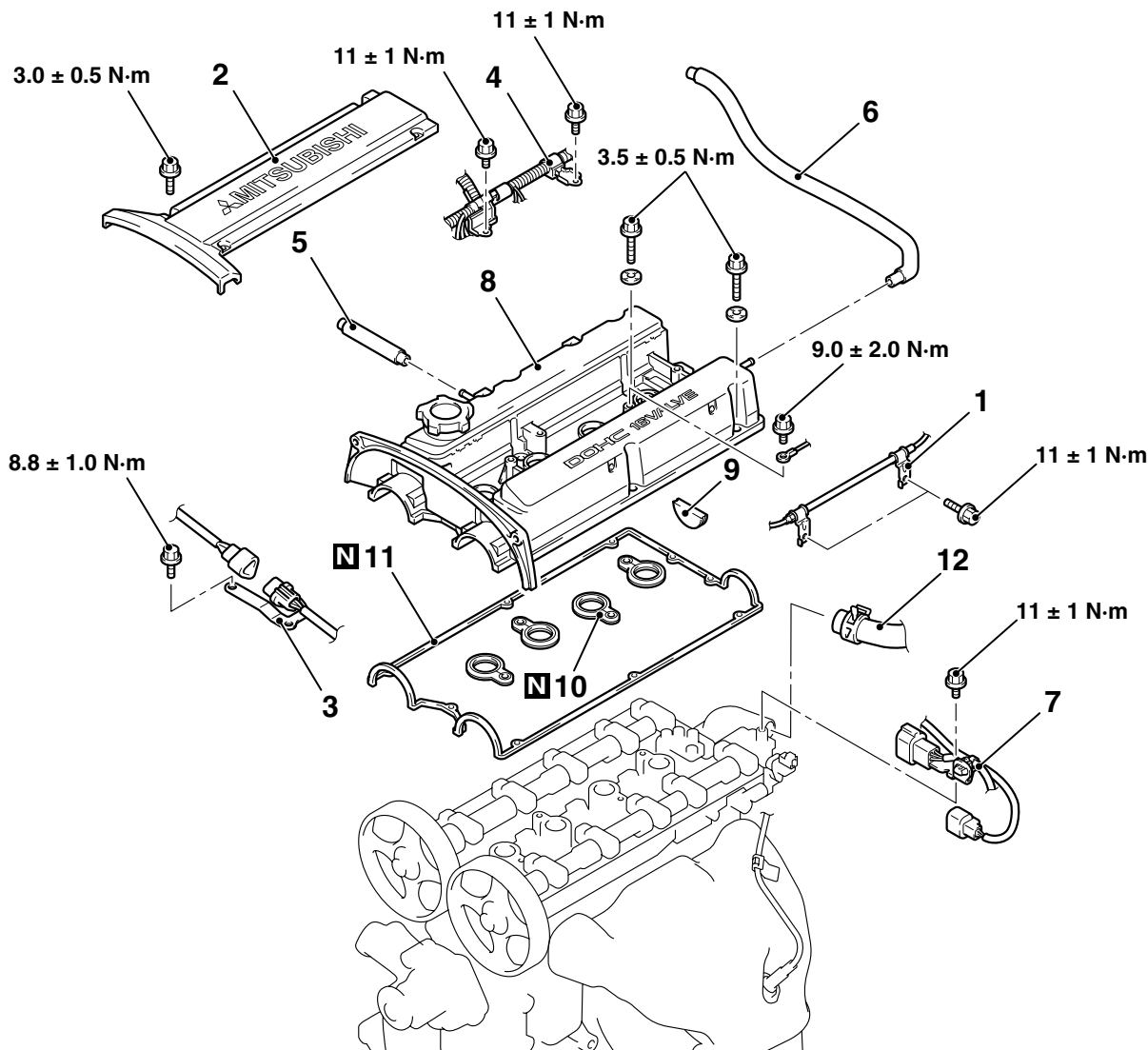
\*Remove and assemble the marked parts in each cylinder unit.

#### Pre-removal Operation

- Engine Coolant Draining (Refer to GROUP 14, On-vehicle Service – Engine Coolant Replacement [P.14-15](#)).
- Air Cleaner and Air Cleaner Bracket Removal (Refer to GROUP 15, Air Cleaner [P.15-3](#)).
- Battery and Battery Tray Removal
- Valve Timing Belt Removal (Refer to [P.11A-35](#)).

#### Post-installation Operation

- Valve Timing Belt Installation (Refer to [P.11A-35](#)).
- Battery and Battery Tray Installation
- Air Cleaner and Air Cleaner Bracket installation (Refer to GROUP 15, Air Cleaner [P.15-3](#)).
- Engine Coolant Refilling (Refer to GROUP 14, On-vehicle Service – Engine Coolant Replacement [P.14-15](#)).
- Drive Belt Tension Check (Refer to [P.11A-6](#)).



AC300538 AB

#### Removal steps

1. Accelerator cable connection
2. Rocker cover centre cover
3. Crank angle sensor connector
4. Control wiring harness connection
  - Spark plug cables and ignition coils (Refer to GROUP 16, Ignition Coil [P.16-32](#)).

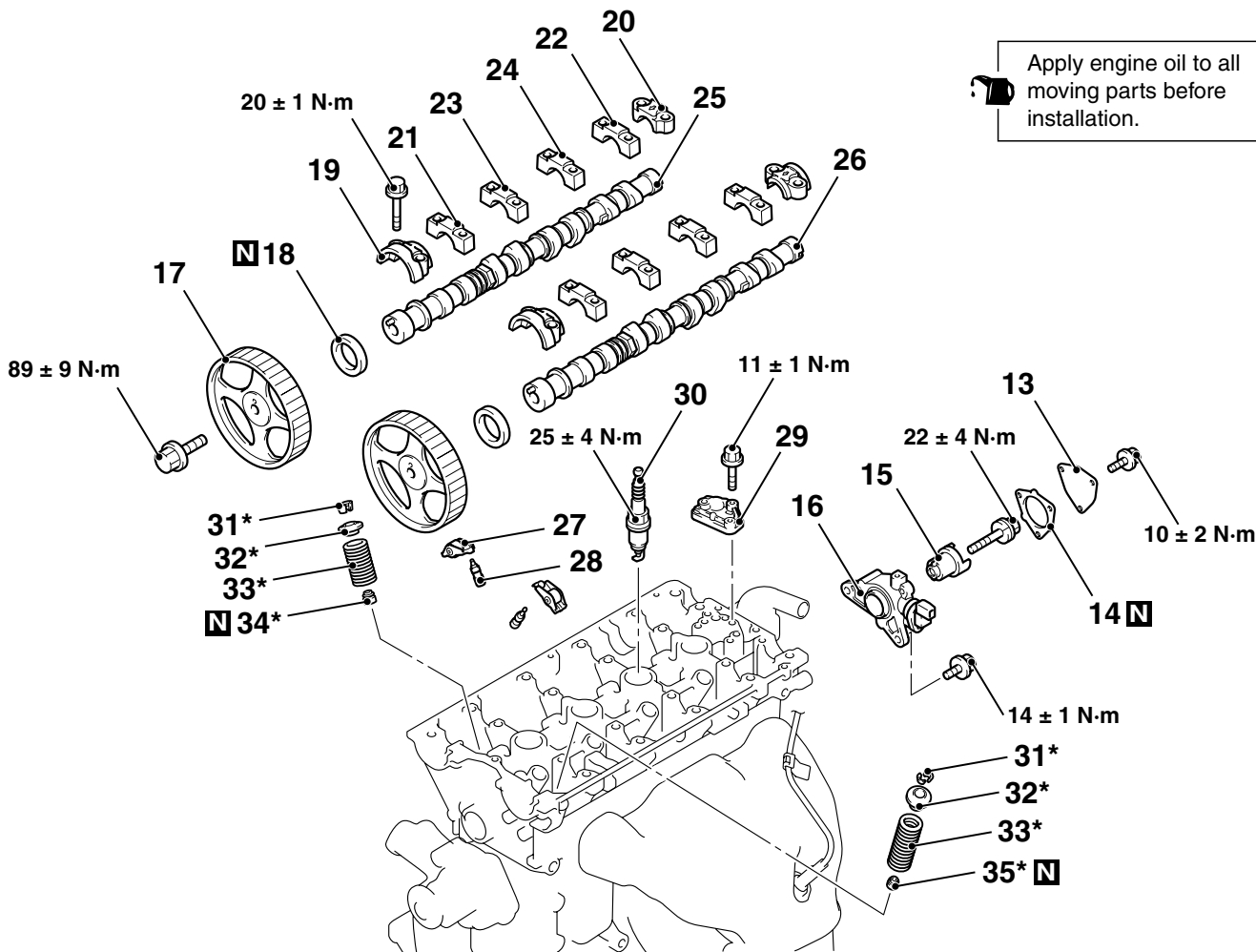
>>N<<  
>>M<<

#### Removal steps (Continued)

5. Rocker cover PCV hose
6. Rocker cover breather hose
7. Control wiring harness connection
8. Rocker cover
9. Camshaft end seal
10. Spark plug hole gaskets

## Removal steps (Continued)

- >>L<< 11. Rocker cover gasket  
<<A>> >>K<< 12. Radiator upper hose connection



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## Removal steps

13. Camshaft position sensor support cover  
14. Camshaft position sensor support cover gasket  
>>J<< 15. Camshaft position sensing cylinder  
>>I<< 16. Camshaft position sensor support  
<<B>> >>H<< 17. Camshaft sprockets  
>>G<< 18. Camshaft oil seals  
>>F<< 19. Camshaft bearing caps, front  
>>F<< 20. Camshaft bearing caps, rear  
>>F<< 21. Camshaft bearing caps, No.2  
>>F<< 22. Camshaft bearing caps, No.5  
>>F<< 23. Camshaft bearing caps, No.3

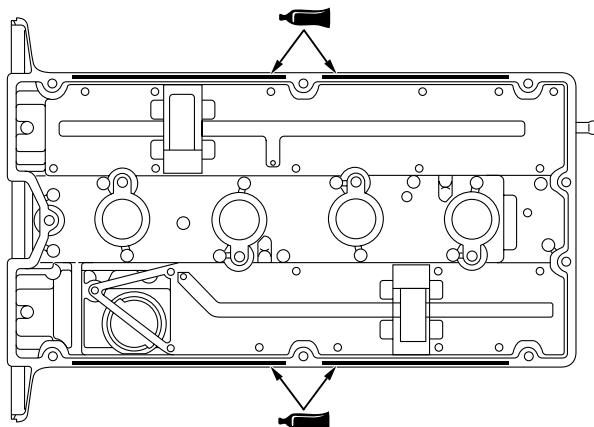
## Removal steps (Continued)

- >>F<< 24. Camshaft bearing caps, No.4  
>>E<< 25. Inlet camshaft  
>>E<< 26. Exhaust camshaft  
>>D<< 27. Rocker arms  
>>D<< 28. Rocker arm lash adjusters  
>>C<< 29. Oil delivery body  
<<C>> >>C<< 30. Spark plugs  
>>B<< 31. Valve spring retainer locks  
>>A<< 32. Valve spring retainers  
>>A<< 33. Valve springs  
>>A<< 34. Inlet valve stem seals  
>>A<< 35. Exhaust valve stem seals



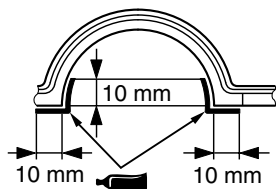
# LUBRICATION AND SEALING POINTS

<The bottom view of the rocker cover>



Sealant: MITSUBISHI GENUINE PART MD970389 or equivalent

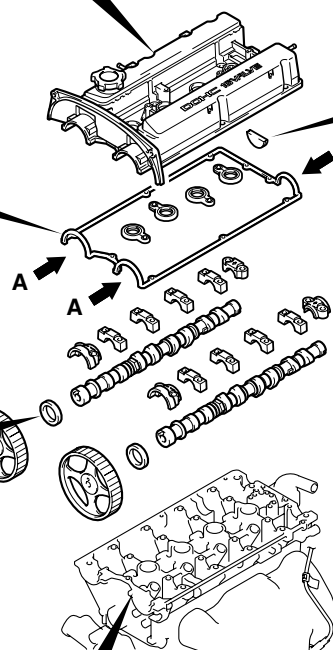
<View A>



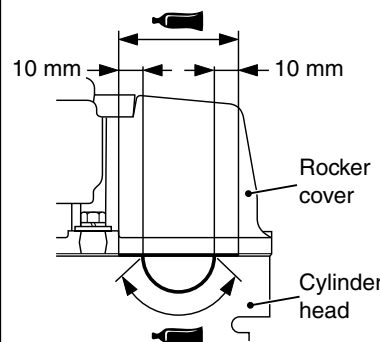
Sealant:  
MITSUBISHI GENUINE  
PART MD970389 or  
equivalent



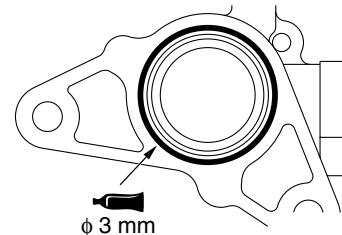
Engine oil



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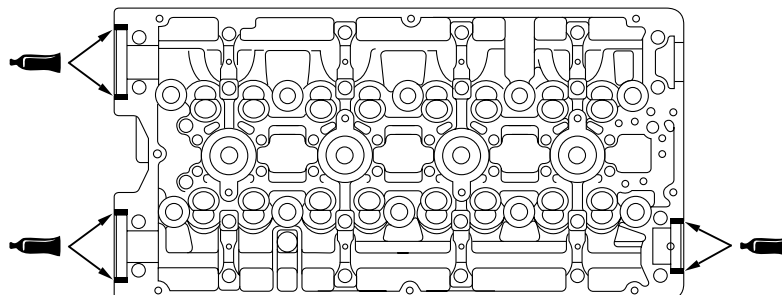


Sealant: 3M ATD Part No.8660  
or equivalent

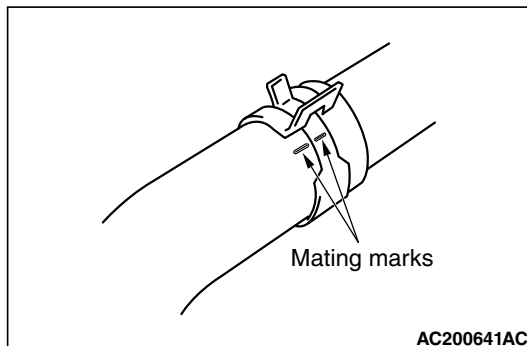


Sealant: MITSUBISHI GENUINE  
PART MD970389 or equivalent

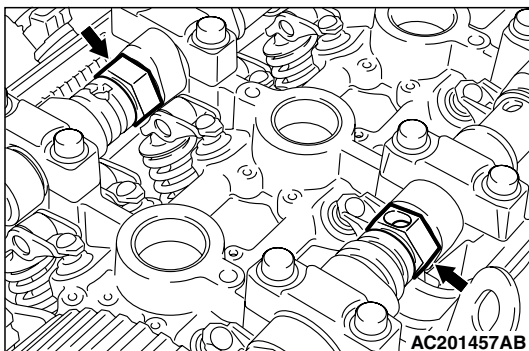
<Top view of cylinder head>



Sealant: MITSUBISHI GENUINE PART MD970389 or equivalent

**REMOVAL SERVICE POINTS****<<A>> RADIATOR UPPER HOSE  
DISCONNECTION**

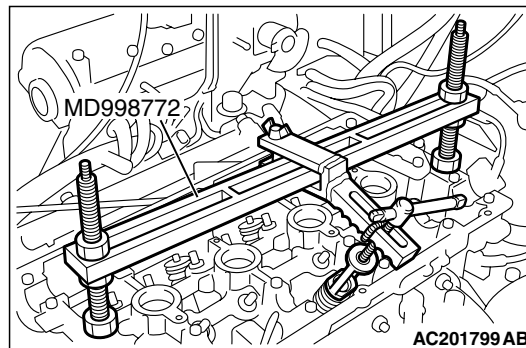
Make mating marks on the radiator hose and the hose clamp. Disconnect the radiator hose.

**<<B>> CAMSHAFT SPROCKETS REMOVAL**

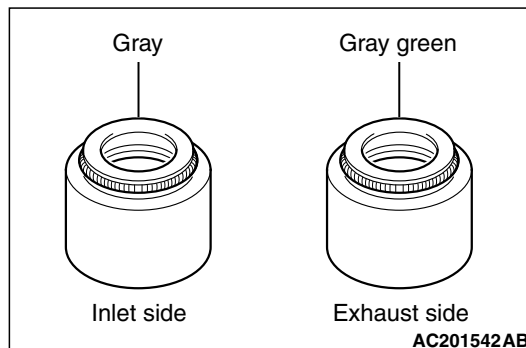
1. Hold the hexagon part of the camshaft with a wrench.
2. Loosen the camshaft sprocket mounting bolts and remove the camshaft sprocket.

**<<C>> VALVE SPRING RETAINER LOCKS  
REMOVAL****⚠ CAUTION**

When removing valve spring retainer locks, leave the piston of each cylinder in the TDC (Top Dead Centre) position. The valve may fall into the cylinder if the piston is not properly in the TDC position.



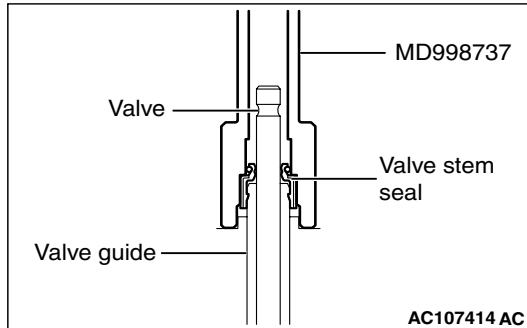
Use special tool valve spring compressor (MD998772) to compress the valve spring, remove the valve spring retainer locks.

**INSTALLATION SERVICE POINTS****>>A<< EXHAUST VALVE STEM SEALS/INLET  
VALVE STEM SEALS INSTALLATION**

1. Check the valve stem seal colour to identify the inlet side or exhaust side.
2. Apply a small amount of engine oil to the valve stem seals.

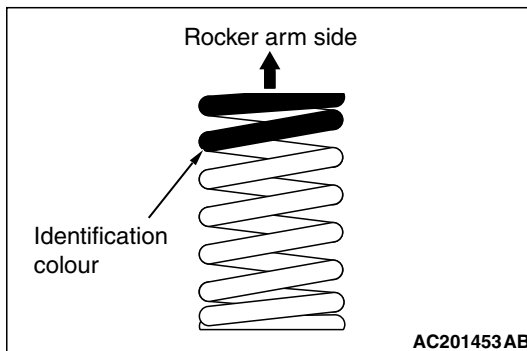
**CAUTION**

- Valve stem seals cannot be reused.
- The special tool valve stem seal installer (MD998737) must be used to install the valve stem seal. Improper installation could result in oil leaking past the valve guide.



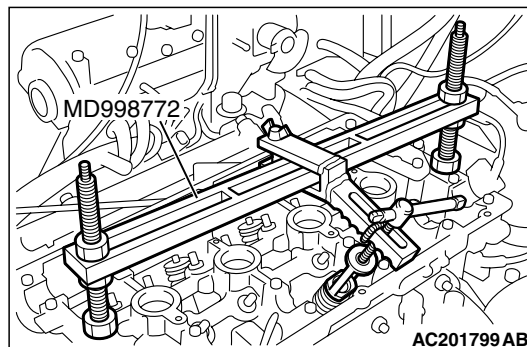
3. Use special tool to fill a new valve stem seal in the valve guide using the valve stem area as a guide.

**>>B<< VALVE SPRINGS INSTALLATION**



Install the valve springs with its identification colour painted end facing the rocker arm.

**>>C<< VALVE SPRING RETAINER LOCKS INSTALLATION**



Use special tool valve spring compressor (MD998772) to compress the valve spring in the same manner as removal.

**>>D<< ROCKER ARM LASH ADJUSTERS INSTALLATION**

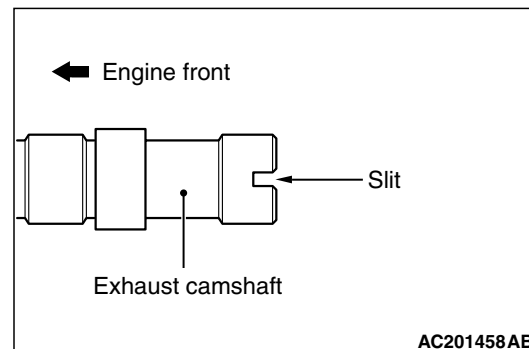
**CAUTION**

If the rocker arm lash adjuster is reused, always clean and check it before installation. (Refer to GROUP 11B, Rocker Arms and Camshaft – Inspection).

**>>E<< EXHAUST CAMSHAFT/INLET CAMSHAFT INSTALLATION**

1. Remove sealant remained on the cylinder head.
2. Apply engine oil to the cam and the journal of the camshaft.

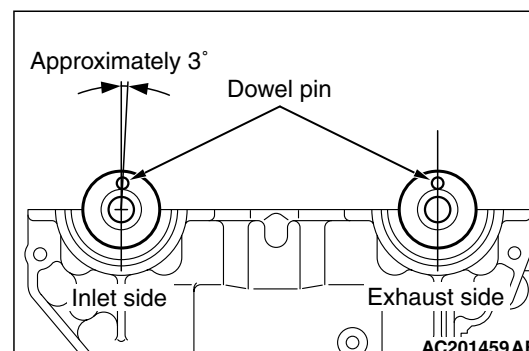
**CAUTION**



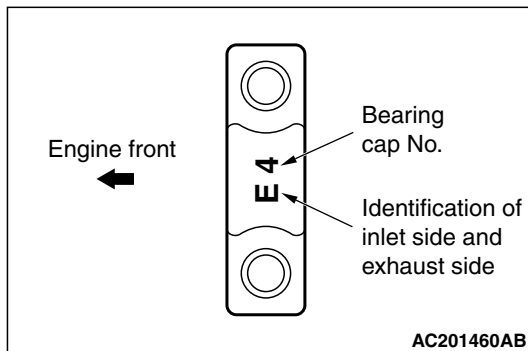
Do not install wrong camshaft at the side of inlet or exhaust. The exhaust camshaft has a slit at the rear surface.

3. Install the camshaft to the cylinder head.

**>>F<< CAMSHAFT BEARING CAPS, NO. 4/ CAMSHAFT BEARING CAPS, NO. 3/CAMSHAFT BEARING CAPS, NO. 5/CAMSHAFT BEARING CAPS, NO. 2/CAMSHAFT BEARING CAPS, REAR/ CAMSHAFT BEARING CAPS, FRONT INSTALLATION**



1. Set the dowel pin of the camshaft to the position as shown in the illustration.

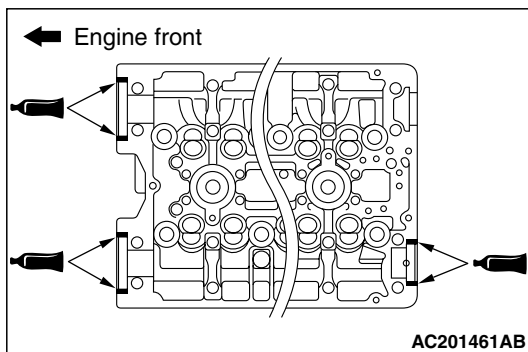


2. Since the shape of camshaft bearing caps No.2 – 5 is identical, check the identification marks so that the bearing cap No., inlet side, or exhaust side cannot be mistaken to install to the direction as shown in the illustration.

**Identification mark (engraved on the front and bearing caps No.2 – 5)**

**I: Inlet side**

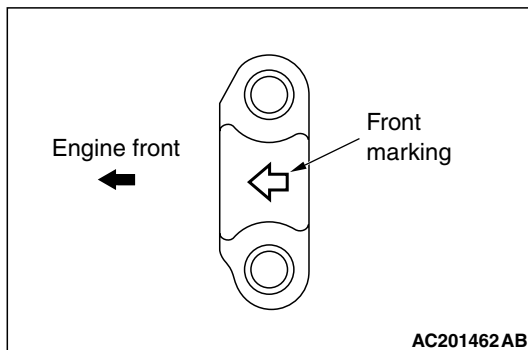
**E: Exhaust side**



3. Apply sealant to the positions (6 areas) of the upper side of the cylinder head as shown in the illustration.

**Specified sealant: MITSUBISHI GENUINE PART MD970389 or equivalent**

**NOTE:** Install the camshaft bearing caps, rear and camshaft bearing caps, front within 15 minutes after applying liquid gasket.



4. Position the camshaft bearing caps, rear in the direction as shown in the illustration for installation.

5. Check the identification marks on the camshaft bearing caps, front so that inlet side and exhaust side cannot be mistaken in the same way as that of bearing caps No.2 – 5.

**⚠ CAUTION**

**Then wait at least one hour. Never start the engine or let engine oil or coolant touch the adhesion surface during that time.**

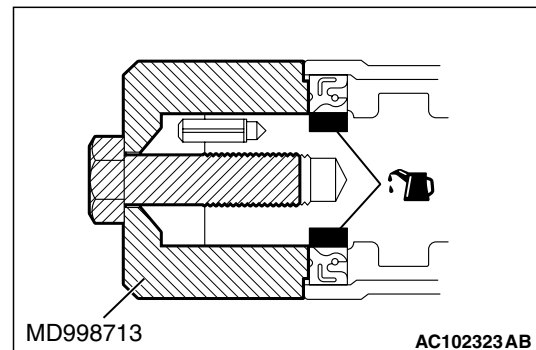
6. Tighten the bearing cap mounting bolts increasing the pressure in 2 to 3 times and finally tighten to the specified torque.

**Tightening torque:  $20 \pm 1$  N·m**

7. Ensure that the rocker arms are installed properly.

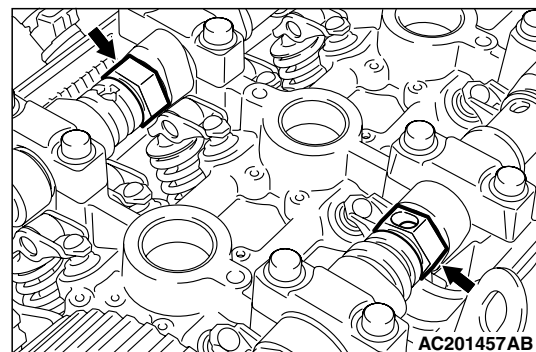
**NOTE:** Remove an excess of sealant completely.

**>>G<< CAMSHAFT OIL SEALS INSTALLATION**



1. Apply engine oil to the entire inner diameter of the oil seal lip.
2. Use special tool camshaft oil seal installer (MD998713) to press-fit the oil seals.

**>>H<< CAMSHAFT SPROCKETS INSTALLATION**

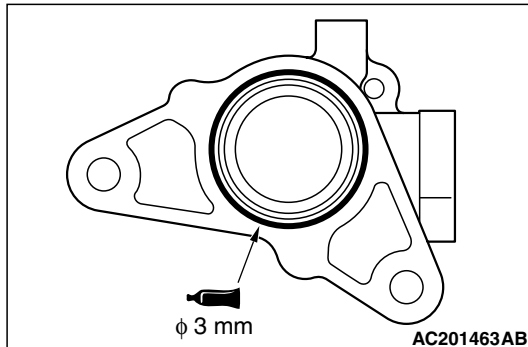


1. Hold the hexagon part of the camshaft with a wrench in the same manner as removal.
2. Tighten the camshaft sprocket mounting bolts to the specified torque.

**Tightening torque:  $89 \pm 9$  N·m**

### >>I<< CAMSHAFT POSITION SENSOR SUPPORT INSTALLATION

1. Remove sealant from the camshaft position sensor support and cylinder head surfaces.



2. Apply the sealant to the camshaft position sensor support flange in a continuous bead as shown in the illustration.

**Specified sealant: MITSUBISHI GENUINE PART MD970389 or equivalent**

*NOTE: Install the camshaft position sensor support within 15 minutes after applying liquid gasket.*

3. Install the camshaft position sensor support to the cylinder head.

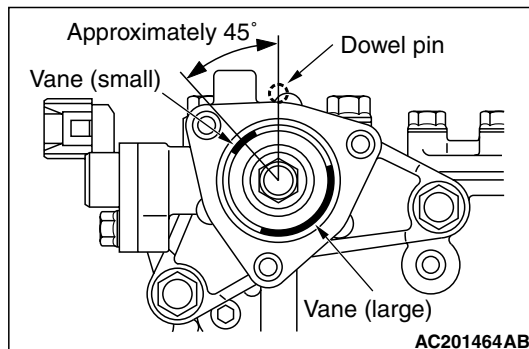
#### **CAUTION**

**Then wait at least one hour. Never start the engine or let engine oil or coolant touch the adhesion surface during that time.**

4. Tighten the camshaft position sensor support mounting bolts to the specified torque.

**Tightening torque:  $14 \pm 1$  N·m**

### >>J<< CAMSHAFT POSITION SENSING CYLINDER INSTALLATION



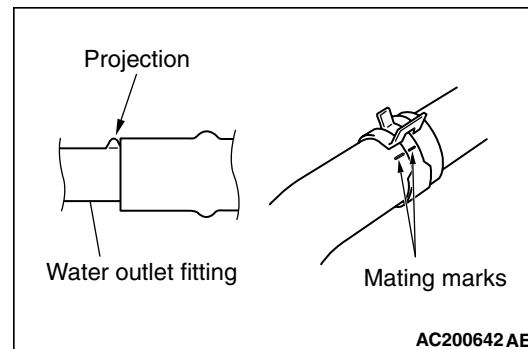
1. Set the dowel pin of the exhaust camshaft to the position (No.1 cylinder at compression TDC) as shown in the illustration.

*NOTE: Use the force of the exhaust valve spring to rotate anti-clockwise.*

2. Install the vane (small) of the camshaft position sensing cylinder at an angle of approximately 45 degrees to the position of the dowel pin of the exhaust camshaft.
3. Tighten the camshaft position sensing cylinder mounting bolts to the specified torque.

**Tightening torque:  $22 \pm 4$  N·m**

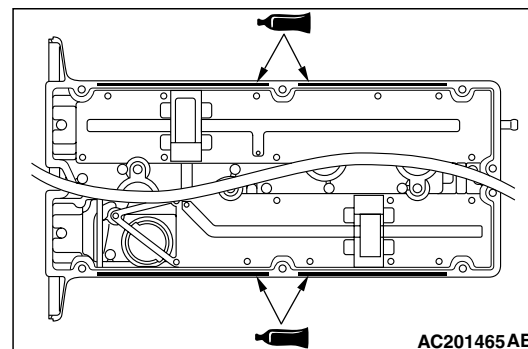
### >>K<< RADIATOR UPPER HOSE CONNECTION



1. Insert each hose as far as the projection of the water outlet fitting.
2. Align the mating marks on the radiator hose and hose clamp, and then connect the radiator hose.

### >>L<< ROCKER COVER GASKET INSTALLATION

1. Remove sealant remained on the rocker cover.



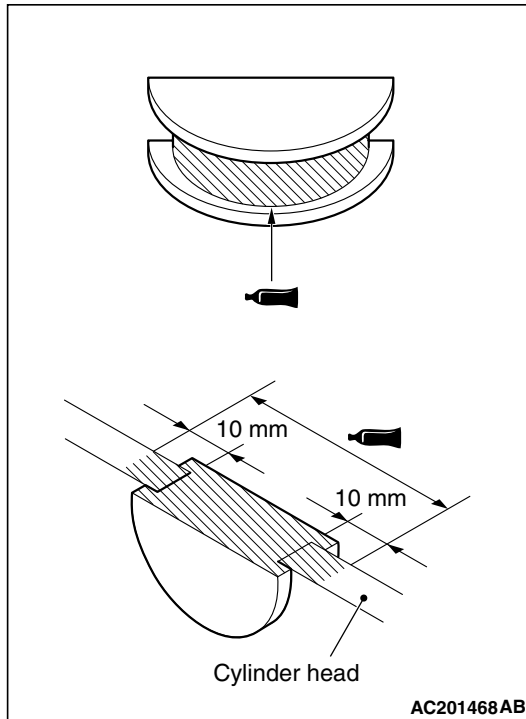
2. Apply sealant to the positions (4 areas) of the lower side of the rocker cover as shown in the illustration.

**Specified sealant: MITSUBISHI GENUINE PART MD970389 or equivalent**

*NOTE: Install the rocker cover gasket within 15 minutes after applying liquid gasket.*

3. Install the rocker cover gasket to the rocker cover.

## &gt;&gt;M&lt;&lt; CAMSHAFT END SEAL INSTALLATION

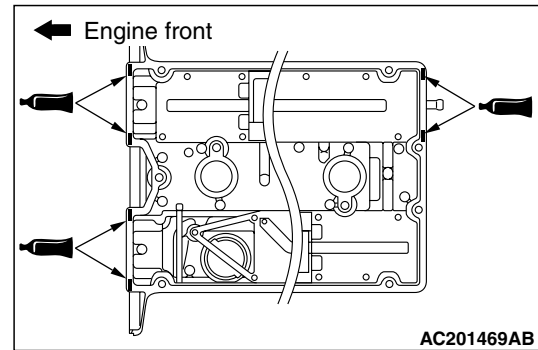


Apply sealant to the positions of the camshaft end seal as shown in the illustration and install to the cylinder head.

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

*NOTE: Install the camshaft end seal within 15 minutes after applying liquid gasket.*

## &gt;&gt;N&lt;&lt; ROCKER COVER INSTALLATION



1. Apply sealant to the positions of the rocker cover gasket (6 areas) as shown in the illustration.

**Specified sealant: MITSUBISHI GENUINE PART MD970389 or equivalent**

*NOTE: Install the rocker cover within 15 minutes after applying liquid gasket.*

2. Install the rocker cover to the cylinder head.

**CAUTION**

**Then wait at least one hour. Never start the engine or let engine oil or coolant touch the adhesion surface during that time.**

3. Tighten the rocker cover mounting bolts to the specified torque.

**Tightening torque:  $3.5 \pm 0.5$  N·m**

# OIL PAN

## REMOVAL AND INSTALLATION <2WD>

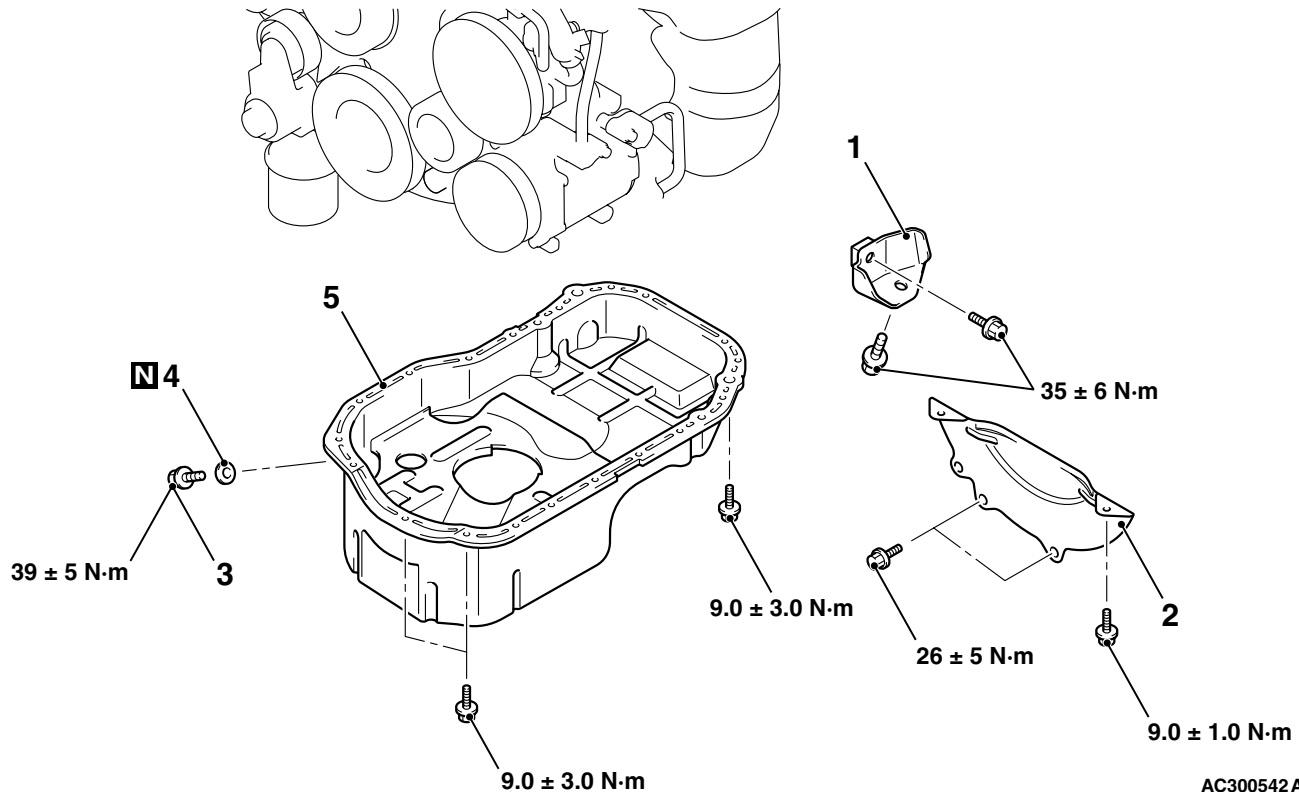
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### Pre-removal Operation

- Under Cover Removal (Refer to GROUP 51, Under Cover [P.51-18](#)).
- Engine Oil Draining (Refer to GROUP 12, On-vehicle Service – Engine Oil Replacement [P.12-3](#)).
- Front Exhaust Pipe Removal (Refer to GROUP 15, Exhaust Pipe and Main Muffler [P.15-8](#)).

### Post-installation Operation

- Front Exhaust Pipe Installation (Refer to GROUP 15, Exhaust Pipe and Main Muffler [P.15-8](#)).
- Engine Oil Refilling (Refer to GROUP 12, On-vehicle Service – Engine Oil Replacement [P.12-3](#)).
- Under Cover Installation (Refer to GROUP 51, Under Cover [P.51-18](#)).



AC300542 AB

### Removal steps

1. Exhaust manifold bracket
2. Flywheel housing front lower cover
3. Engine oil pan drain plug

### Removal steps (Continued)

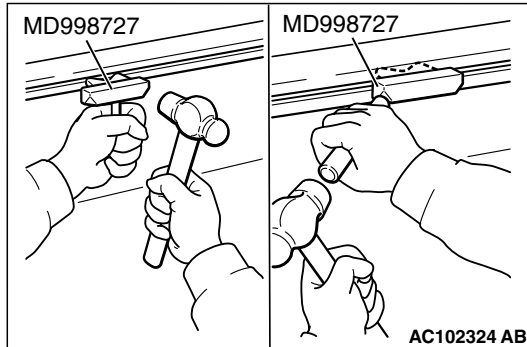
- >>B<< 4. Engine oil pan drain plug gasket
- <<A>> >>A<< 5. Engine oil pan

**REMOVAL SERVICE POINT****<<A>> ENGINE OIL PAN REMOVAL**

1. Remove the engine oil pan mounting bolts.

**⚠ CAUTION**

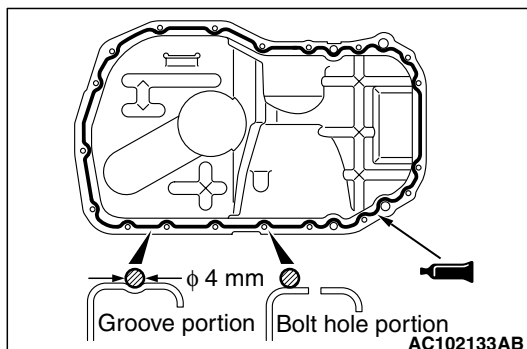
Perform this slowly to avoid deformation of the engine oil pan flange.



2. Remove the engine oil pan using special tool oil pan remover (MD998727).

**INSTALLATION SERVICE POINTS****>>A<< ENGINE OIL PAN INSTALLATION**

1. Remove sealant from the engine oil pan and cylinder block surfaces.



2. Apply a bead of the sealant to the cylinder block mating surface of the engine oil pan as shown.

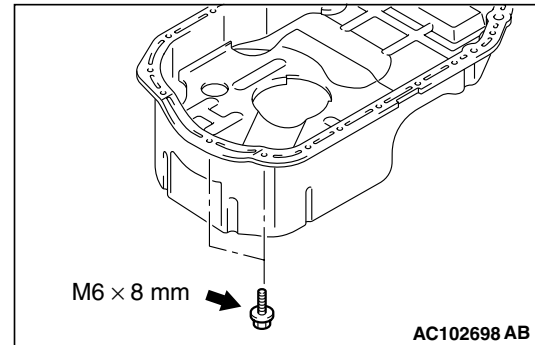
**Specified sealant: MITSUBISHI GENUINE PART MD970389 or equivalent**

*NOTE: Install the engine oil pan within 15 minutes after applying sealant.*

3. Assemble the engine oil pan to the cylinder block.

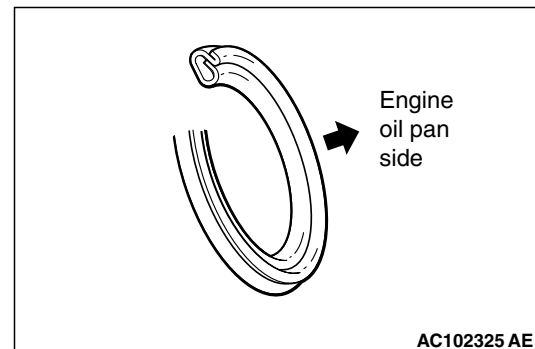
**⚠ CAUTION**

Then wait at least one hour. Never start the engine or let engine oil or coolant touch the sealant surface during that time.



4. Tighten the engine oil pan mounting bolts to the specified torque. Be careful when installing, as the oil pan mounting bolts (indicated in the illustration) have different lengths from the other bolts.

**Tightening torque:  $9.0 \pm 3.0$  N·m**

**>>B<< ENGINE OIL PAN DRAIN PLUG GASKET INSTALLATION**

Replace the gasket with a new gasket. Install the new gasket in the direction shown in the illustration.



## REMOVAL AND INSTALLATION <4WD>

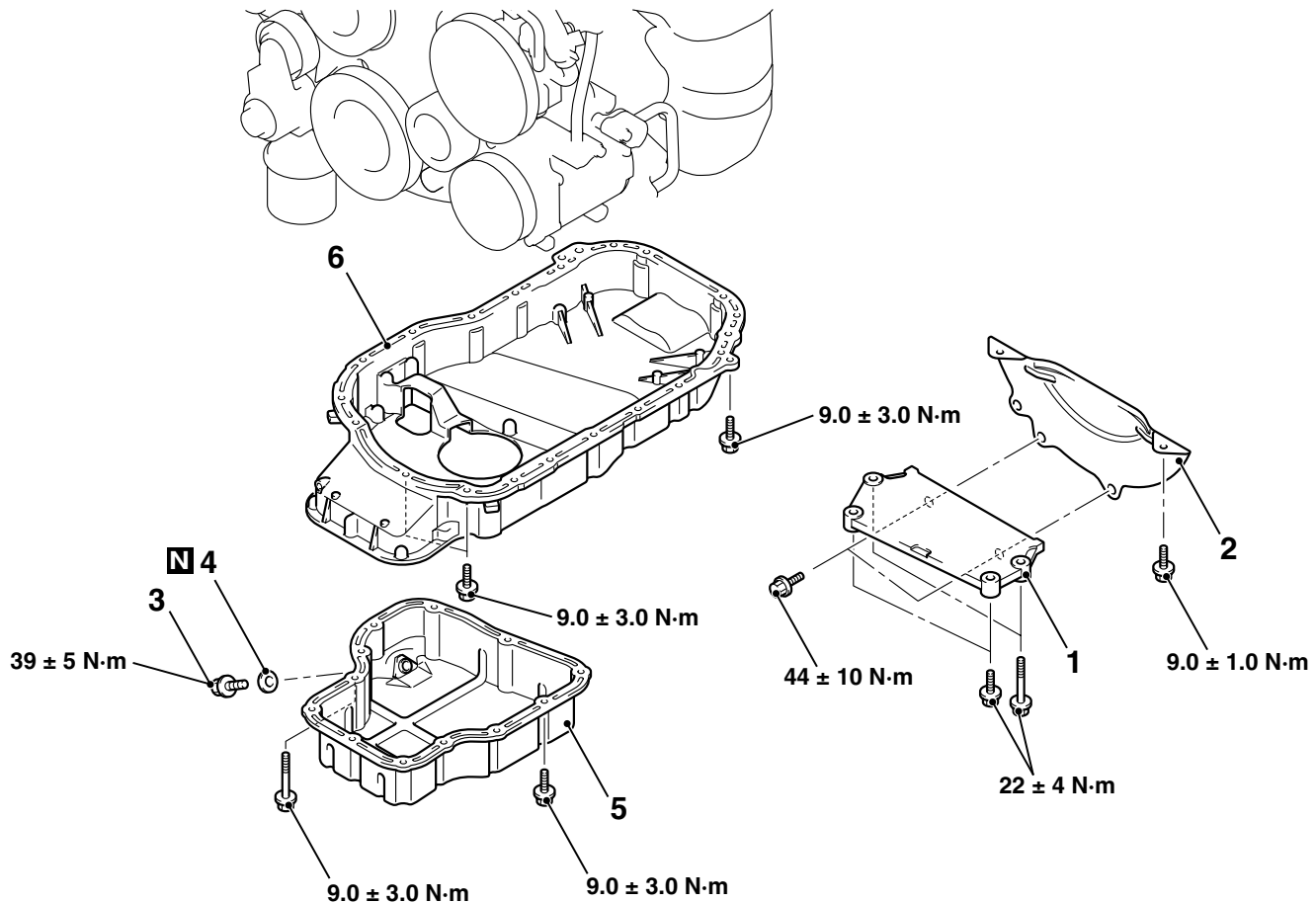
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### Pre-removal Operation

- Under Cover Removal (Refer to GROUP 51, Under Cover [P.51-18](#)).
- Engine Oil Draining (Refer to GROUP 12, On-vehicle Service – Engine Oil Replacement [P.12-3](#)).
- Front Exhaust Pipe Removal (Refer to GROUP 15, Exhaust Pipe and Main Muffler [P.15-8](#)).
- Centre Member Removal (Refer to GROUP 32, Engine Roll Stopper and Centre Member [P.32-6](#)).

### Post-installation Operation

- Centre Member Installation (Refer to GROUP 32, Engine Roll Stopper and Centre Member [P.32-6](#)).
- Front Exhaust Pipe Installation (Refer to GROUP 15, Exhaust Pipe and Main Muffler [P.15-8](#)).
- Engine Oil Refilling (Refer to GROUP 12, On-vehicle Service – Engine Oil Replacement [P.12-3](#)).
- Under Cover Installation (Refer to GROUP 51, Under Cover [P.51-18](#)).



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### Removal steps

- >>D<< 1. Transmission housing front lower cover stay
2. Flywheel housing front lower cover
3. Engine oil pan drain plug
- >>C<< 4. Engine oil pan drain plug gasket

### Removal steps (Continued)

- <<A>> >>B<< 5. Engine lower oil pan
- <<B>> >>A<< 6. Engine upper oil pan

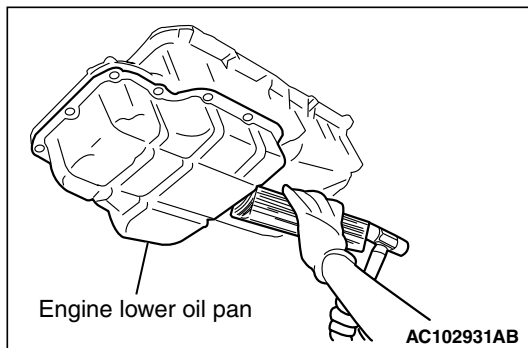
## REMOVAL SERVICE POINTS

## &lt;&lt;A&gt;&gt; ENGINE LOWER OIL PAN REMOVAL

1. Remove the engine lower oil pan mounting bolts.

**CAUTION**

Do not use special tool oil pan remover (MD998727). The engine upper oil pan is made of aluminium and this tool will damage it.



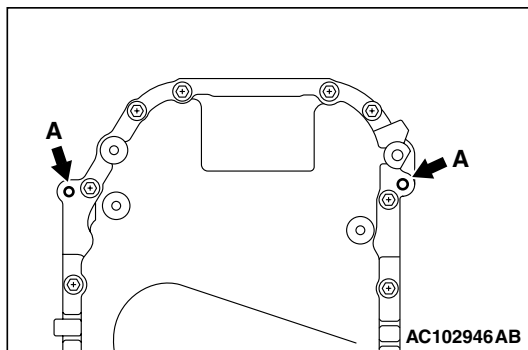
2. Apply a piece of wood to the lower oil pan and strike it with a hammer to remove the engine lower oil pan.

## &lt;&lt;B&gt;&gt; ENGINE UPPER OIL PAN REMOVAL

1. Remove the engine upper oil pan mounting bolts.

**CAUTION**

Do not use special tool oil pan remover (MD998727). The engine upper oil pan is made of aluminium and this tool will damage it.

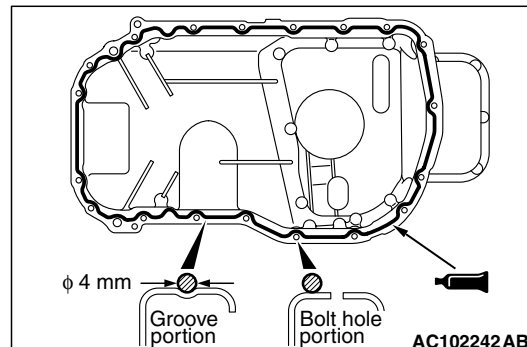


2. Screw in the bolt into bolt hole A in the location shown. Then lift the upper oil pan and remove it.

## INSTALLATION SERVICE POINTS

## &gt;&gt;A&lt;&lt; ENGINE UPPER OIL PAN INSTALLATION

1. Remove sealant from the engine upper oil pan and cylinder block surfaces.



2. Apply a bead of the sealant to the mating surface of the engine upper oil pan as shown.

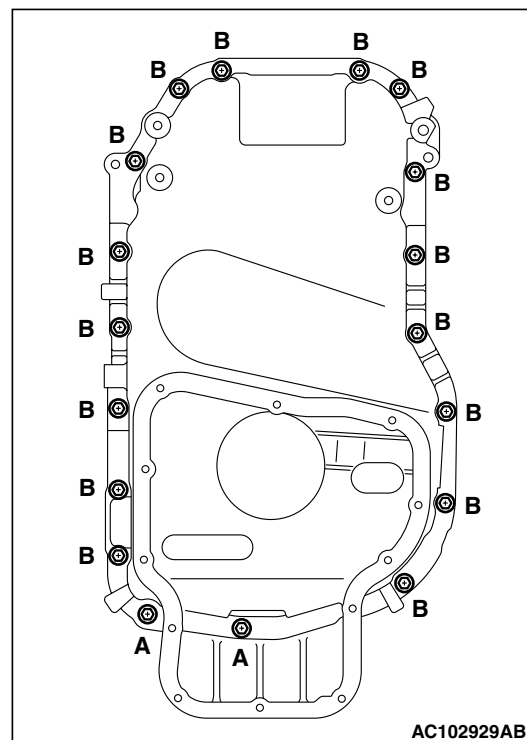
**Specified sealant: MITSUBISHI GENUINE PART MD970389 or equivalent**

*NOTE: Install the engine upper oil pan within 15 minutes after applying sealant.*

3. Assemble the engine upper oil pan to the cylinder block.

**CAUTION**

Then wait at least one hour. Never start the engine or let engine oil or coolant touch the sealant surface during that time.



4. Insert the bolts to the engine upper oil pan as shown, and tighten them to the specified torque.

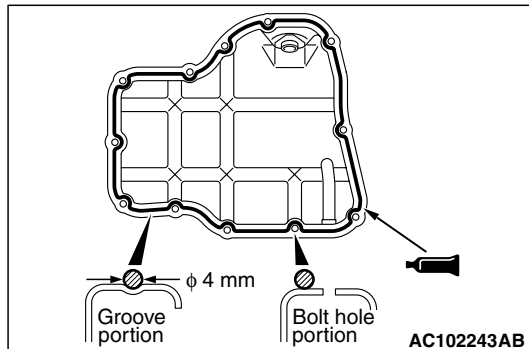
Name	Symbol	Quantity	Size mm (D × L)
Flange bolt	A	2	M6 × 16
	B	16	M6 × 18

NOTE: D: Nominal diameter, L: Nominal length

Tightening torque:  $9.0 \pm 3.0$  N·m

### >>B<< ENGINE LOWER OIL PAN INSTALLATION

1. Remove sealant from the engine lower oil pan and engine upper oil pan.



2. Apply a bead of the sealant to the mating surface of the engine lower oil pan as shown.

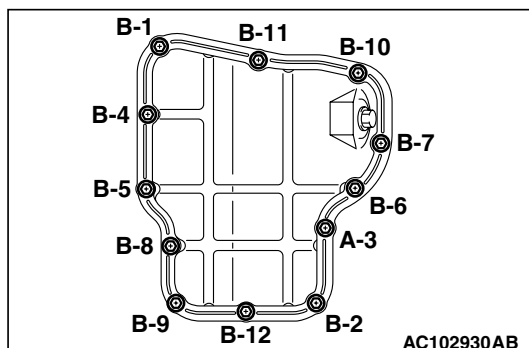
**Specified sealant: MITSUBISHI GENUINE PART MD970389 or equivalent**

NOTE: Install the engine lower oil pan within 15 minutes after applying sealant.

3. Assemble the engine lower oil pan to the engine upper oil pan.

#### ⚠ CAUTION

Then wait at least one hour. Never start the engine or let engine oil or coolant touch the sealant surface during that time.



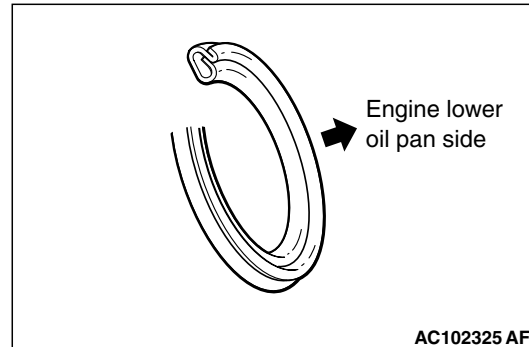
4. Insert the bolts to the engine lower oil pan as shown, and tighten them to the specified torque in the order shown.

Name	Symbol	Quantity	Size mm (D × L)
Flange bolt	A	1	M6 × 75
	B	11	M6 × 10

NOTE: D: Nominal diameter, L: Nominal length

Tightening torque:  $9.0 \pm 3.0$  N·m

### >>C<< ENGINE OIL PAN DRAIN PLUG GASKET INSTALLATION



Replace the gasket with a new one. Install the new gasket in the direction shown in the illustration.

### >>D<< TRANSMISSION HOUSING FRONT LOWER COVER STAY INSTALLATION

Install the transmission housing front lower cover stay in the following order.

1. Tighten the engine side four mounting bolts to the specified torque.

**Tightening torque:  $22 \pm 4$  N·m**

2. Tighten the transmission side two mounting bolts to the specified torque.

**Tightening torque:  $44 \pm 10$  N·m**

### INSPECTION

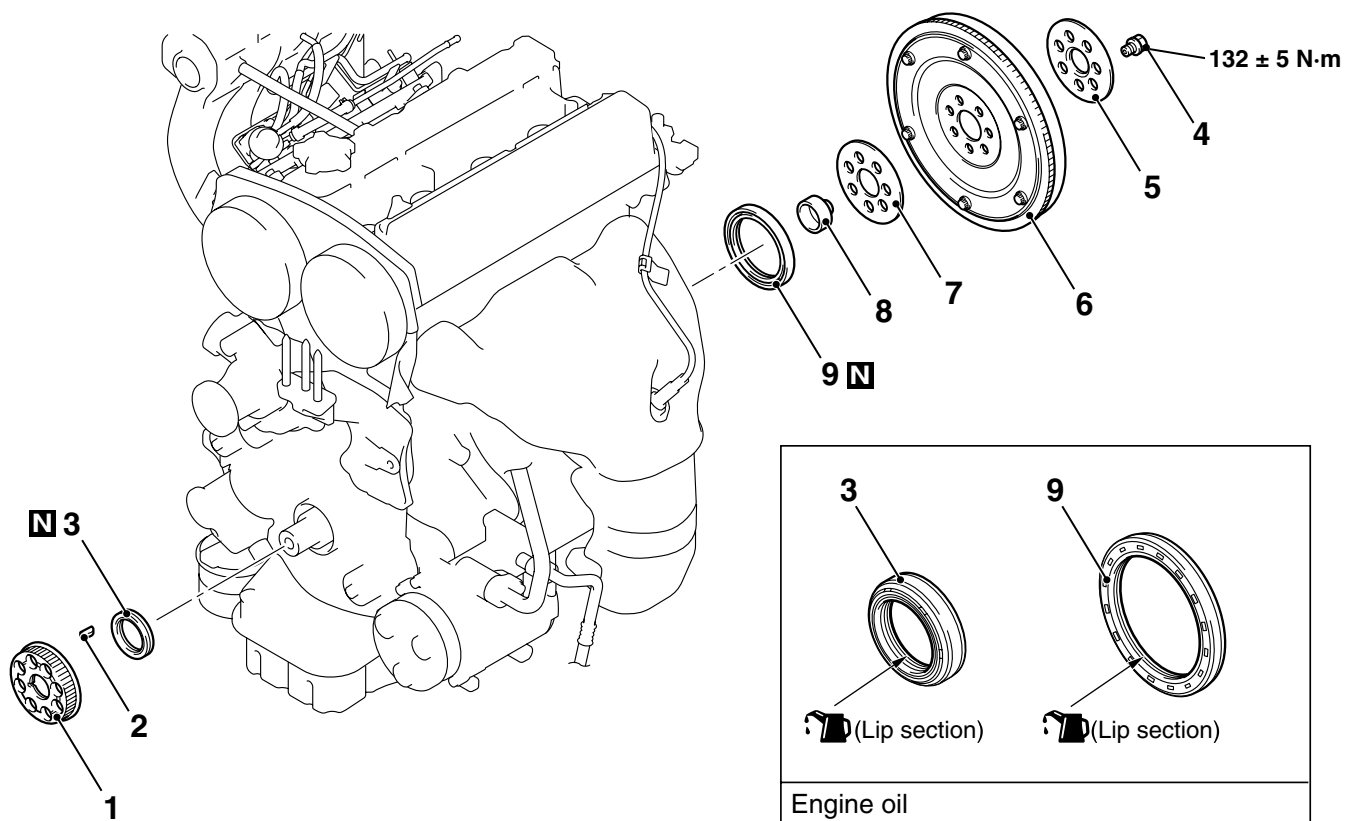
M1112002900210

- Check the oil pan for cracks.
- Check the oil pan sealant-coated surface for damage and deformation.

## CRANKSHAFT OIL SEAL

## REMOVAL AND INSTALLATION

M1112003100273



AC300544 AB

**Crankshaft front oil seal removal steps**

- Valve timing belt, balancer timing belt (Refer to [P.11A-35](#)).
- >>D<< 1. Crankshaft balancer shaft drive sprocket
- >>C<< 2. Crankshaft key
- >>C<< 3. Crankshaft front oil seal

&lt;&lt;A&gt;&gt;

&lt;&lt;B&gt;&gt;

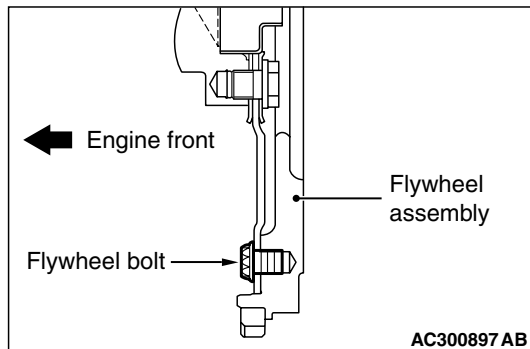
**Crankshaft rear oil seal removal steps**

- Transmission assembly
- >>B<< 4. Flywheel bolts
- >>B<< 5. Flywheel adapter plate
- >>B<< 6. Flywheel assembly
- >>B<< 7. Flywheel adapter plate
- >>B<< 8. Crankshaft bush
- >>A<< 9. Crankshaft rear oil seal

## REMOVAL SERVICE POINTS

### <<A>> TRANSMISSION ASSEMBLY REMOVAL

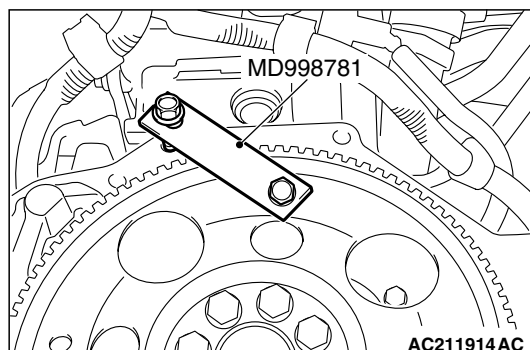
#### ⚠ CAUTION



**Do not remove the flywheel bolt shown by the arrow. If this bolt is removed, the flywheel assembly will become out of balance and damaged.**

Refer to GROUP 22A, Transmission Assembly P.22A-10.

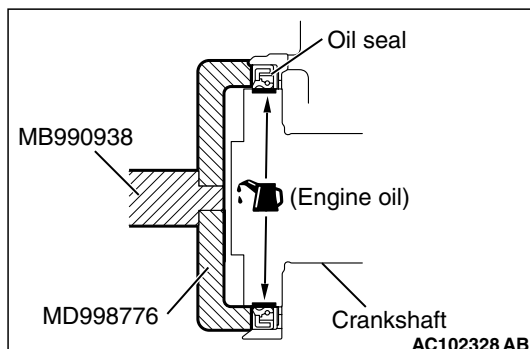
### <<B>> FLYWHEEL BOLTS REMOVAL



1. Use special tool flywheel stopper (MD998781) to secure the flywheel.
2. Remove the flywheel bolts.

## INSTALLATION SERVICE POINTS

### >>A<< CRANKSHAFT REAR OIL SEAL INSTALLATION

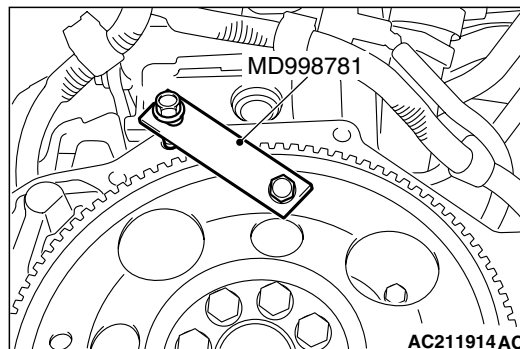


1. Apply a small amount of engine oil to the entire inner diameter of the oil seal lip.

2. Use the following special tools to press-fit the oil seal.

- Installer bar (MB990938)
- Crankshaft rear oil seal installer (MD998776)

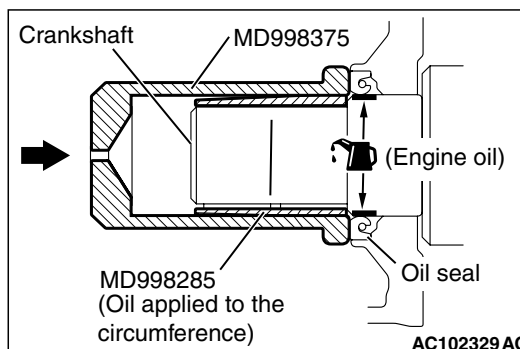
### >>B<< FLYWHEEL BOLTS INSTALLATION



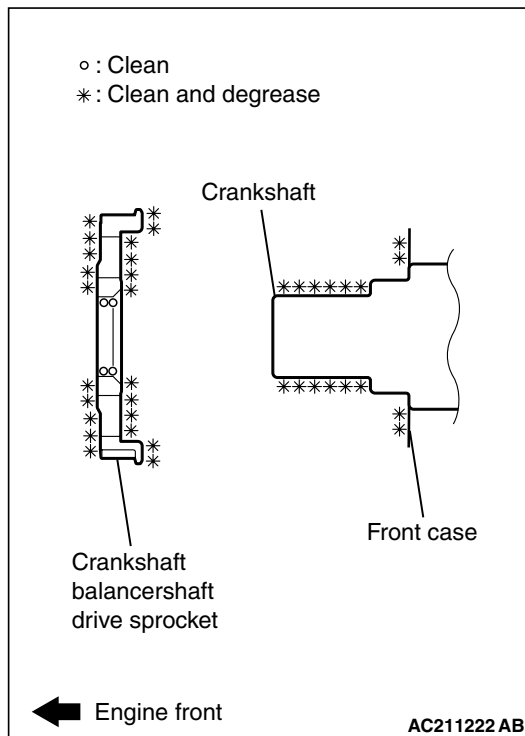
1. Use special tool flywheel stopper (MD998781) to secure the flywheel in the same manner as removal.
2. Tighten the flywheel bolts to the specified torque.

**Tightening torque:  $132 \pm 5$  N·m**

### >>C<< CRANKSHAFT FRONT OIL SEAL INSTALLATION



1. Apply a small amount of engine oil to the entire inner diameter of the oil seal lip.
2. Apply a small amount of engine oil to the outer diameter of special tool crankshaft front oil seal guide (MD998285) and install it to the crankshaft.
3. Use special tool crankshaft front oil seal installer (MD998375) to press-fit the oil seal.

>>D<< CRANKSHAFT BALANCER SHAFT DRIVE  
SPROCKET INSTALLATION

1. Clean or degrease the front case, the crankshaft and the crankshaft balancer shaft drive sprocket as shown.

*NOTE: Also clean the degreased surfaces.*

2. Install the crankshaft balancer shaft drive sprocket in the direction shown in the illustration.

## CYLINDER HEAD GASKET

## REMOVAL AND INSTALLATION

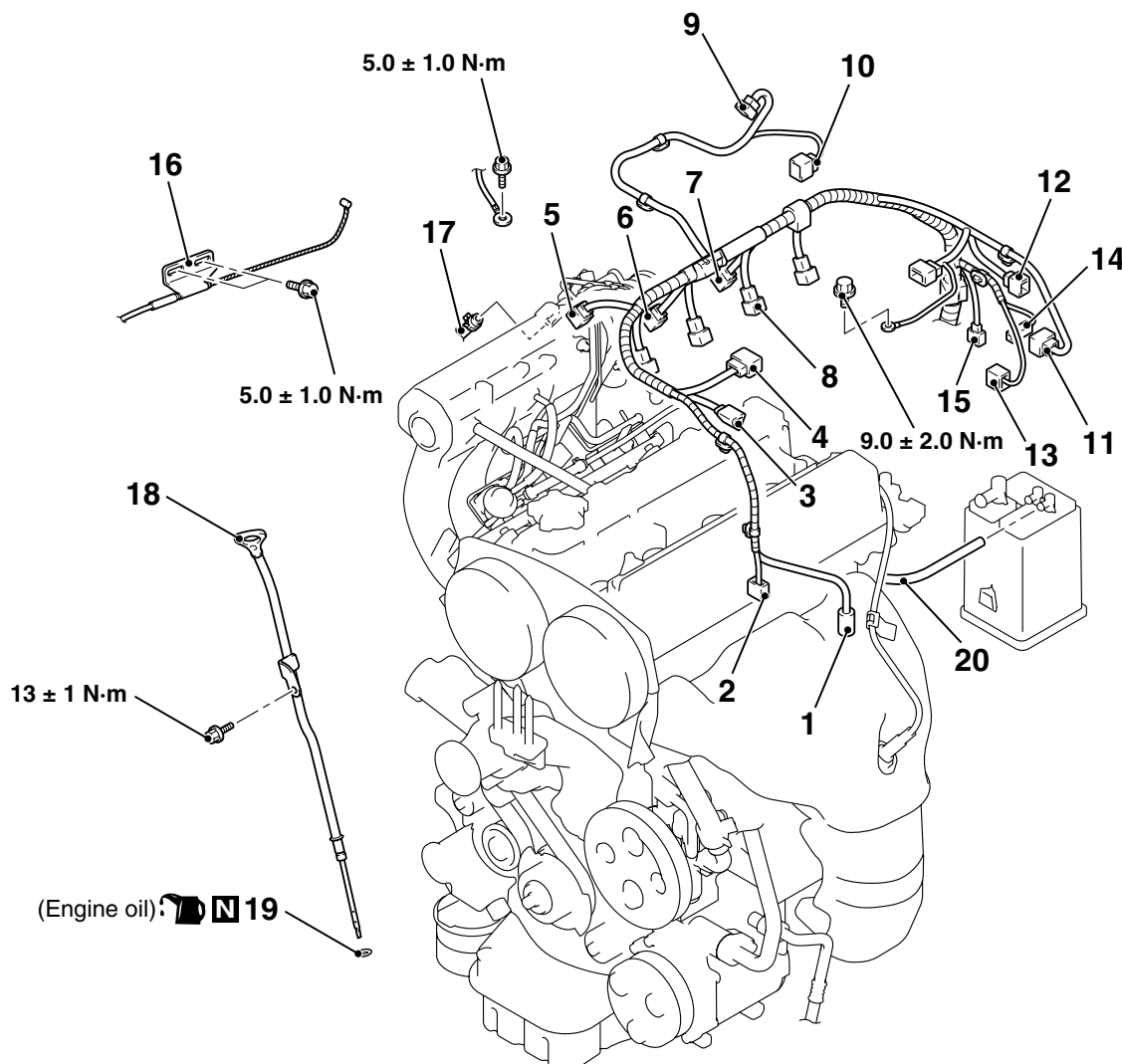
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**Pre-removal Operation**

- Fuel Line Pressure Reduction [Refer to GROUP 13A, On-vehicle Service – Fuel Pump Connector Disconnection (How to Reduce Pressurized Fuel Lines) [P.13A-310](#).]
- Under Cover Removal (Refer to GROUP 51, Under Cover [P.51-18](#)).
- Engine Oil Draining (Refer to GROUP 12, On-vehicle Service – Engine Oil Replacement [P.12-3](#)).
- Engine Coolant Draining (Refer to GROUP 14, On-vehicle Service – Engine Coolant Replacement [P.14-15](#)).
- Air Cleaner and Air Cleaner Bracket Removal (Refer to GROUP 15, Air Cleaner [P.15-3](#)).
- Battery Removal
- Rocker Cover Centre Cover Removal (Refer to [P.11A-15](#)).
- Valve Timing Belt Removal (Refer to [P.11A-35](#)).

**Post-installation Operation**

- Valve Timing Belt Installation (Refer to [P.11A-35](#)).
- Rocker Cover Centre Cover Installation (Refer to [P.11A-15](#)).
- Battery Installation
- Air Cleaner and Air Cleaner Bracket installation (Refer to GROUP 15, Air Cleaner [P.15-3](#)).
- Engine Coolant Refilling (Refer to GROUP 14, On-vehicle Service – Engine Coolant Replacement [P.14-15](#)).
- Engine Oil Refilling (Refer to GROUP 12, On-vehicle Service – Engine Oil Replacement [P.12-3](#)).
- Accelerator Cable Adjustment (Refer to GROUP 17, On-vehicle Service – Accelerator Cable Check and Adjustment [P.17-3](#)).
- Drive Belt Tension Check (Refer to [P.11A-6](#)).
- Under Cover Installation (Refer to GROUP 51, Under Cover [P.51-18](#)).
- Fuel Leak Check



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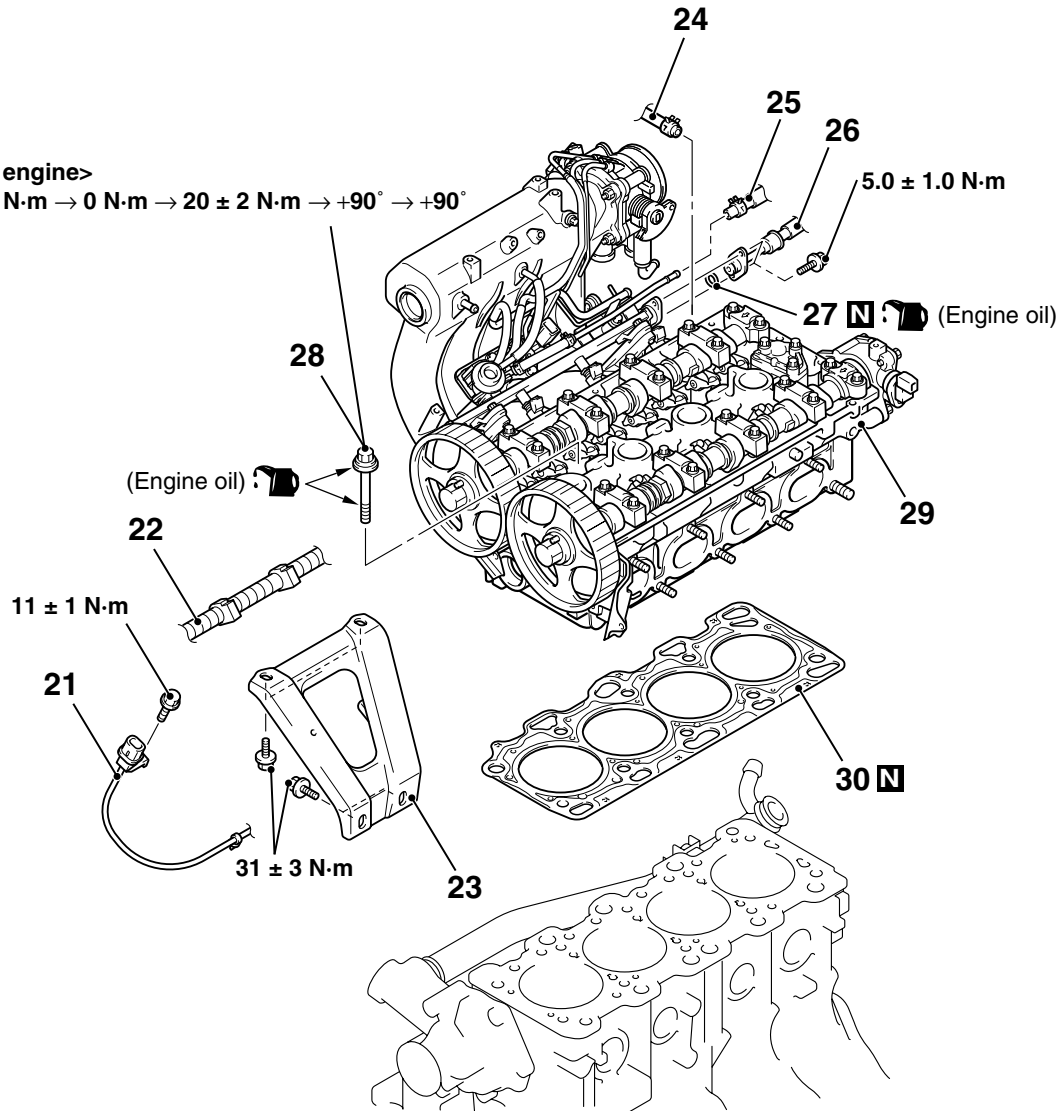
### Removal steps

1. A/C compressor connector
2. Power steering fluid pressure switch connector
3. Crank angle sensor connector
4. Ignition coil connectors
5. Detonation sensor connector
6. Purge control solenoid valve connector
7. EGR control solenoid valve connector
8. Injector connectors
9. Throttle position sensor connector
10. Idle speed control servo connector
11. Camshaft position sensor connector

### Removal steps (Continued)

12. Oxygen sensor connector
13. Engine coolant temperature sensor connector
14. Engine coolant temperature gauge unit connector
15. Capacitor connector
16. Accelerator cable connection
17. Brake booster vacuum hose connection
18. Engine oil level gauge and guide assembly
19. O-ring
20. Canister vacuum hose connection

&lt;Cold engine&gt;

 $78 \pm 2 \text{ N}\cdot\text{m} \rightarrow 0 \text{ N}\cdot\text{m} \rightarrow 20 \pm 2 \text{ N}\cdot\text{m} \rightarrow +90^\circ \rightarrow +90^\circ$ 

AC300546 AB

**Removal steps**

21. Detonation sensor connection
22. Battery wiring harness connection
23. Inlet manifold stay
  - Exhaust manifold (Refer to GROUP 15, Exhaust Manifold [P.15-6](#)).
  - Water outlet fitting and thermostat case assembly (Refer to GROUP 14, Water Hose and Water Pipe [P.14-21](#)).
  - Rocker cover (Refer to [P.11A-15](#)).
24. Heater water hose connection

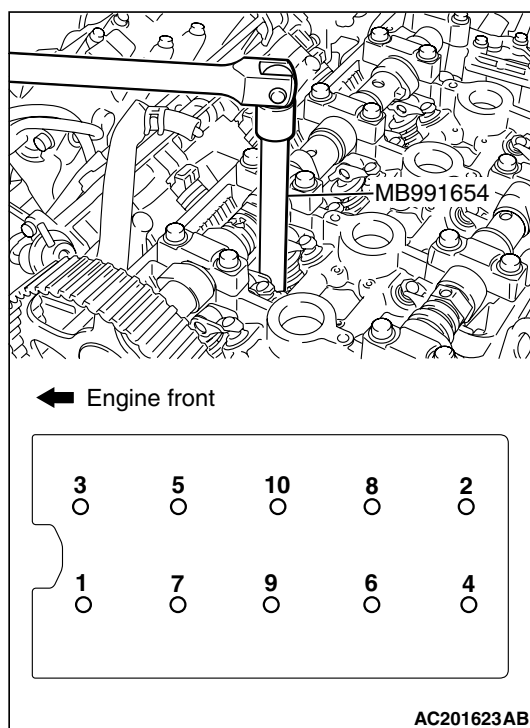
**Removal steps (Continued)**

- |       |  |
|-------|--|
| >>C<< | 25. Fuel return line hose connection   |
| >>C<< | 26. Fuel high-pressure hose connection |
| >>B<< | 27. O-ring                             |
| >>A<< | 28. Cylinder head bolts                |
|       | 29. Cylinder head assembly             |
|       | 30. Cylinder head gasket               |



## REMOVAL SERVICE POINT

### <<A>> CYLINDER HEAD BOLTS REMOVAL



Using special tool cylinder head bolt wrench (MB991654), loosen the cylinder head bolts in two or three steps in the order of the numbers shown in the illustration.

**NOTE:** If the cylinder head bolts cannot be pulled out due to the washer being trapped in the valve spring, raise the bolt slightly, then remove it while holding it by using a magnet.

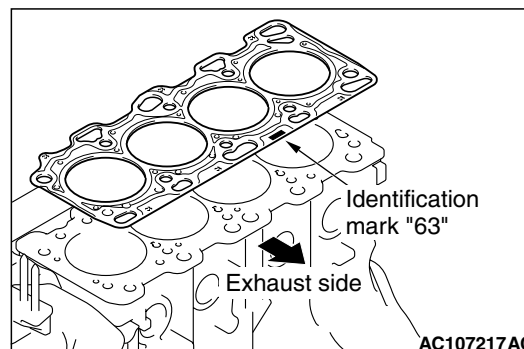
## INSTALLATION SERVICE POINTS

### >>A<< CYLINDER HEAD GASKET INSTALLATION

#### **CAUTION**

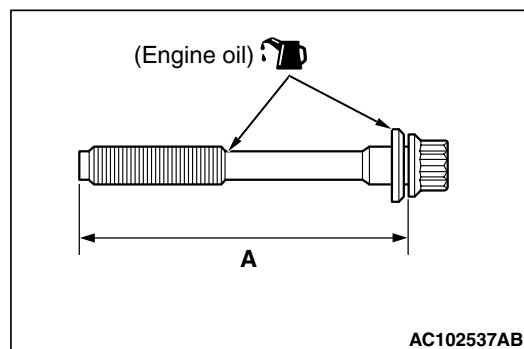
Do not allow any foreign materials to get into the coolant passages, oil passages and cylinder.

1. Remove the gasket from the cylinder head and cylinder block.



2. Assemble to the cylinder block so the cylinder head gasket identification mark "63" is at the top surface and on the exhaust side.

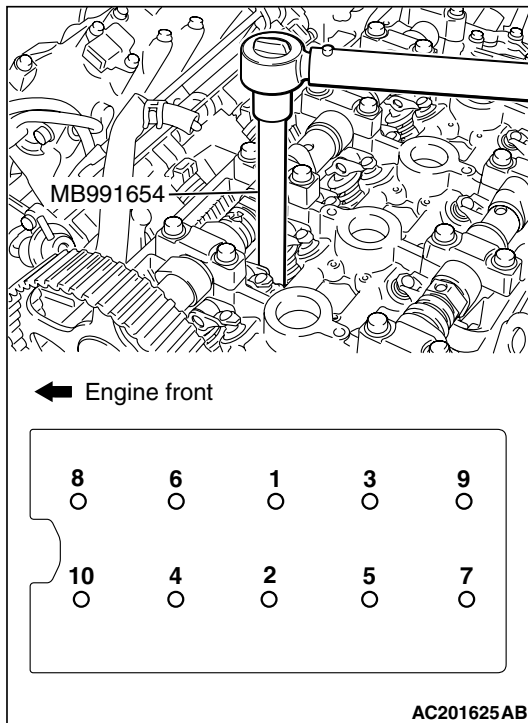
### >>B<< CYLINDER HEAD BOLTS INSTALLATION



1. Check that the nominal length of each cylinder head bolt meets the limit. If it exceeds the limit, replace the bolt with a new one.

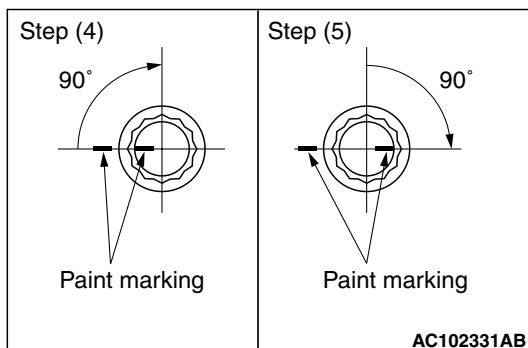
**Limit (A): 99.4 mm**

2. Apply a small amount of engine oil to the thread of the bolts and to the washers.



3. Use special tool cylinder head bolt wrench (MB991654) to tighten the cylinder head bolts as follows:

- (1) Tighten the cylinder head bolts to  $78 \pm 2$  N·m in the order shown.
- (2) Loosen the bolts fully in the reverse order of that shown.
- (3) Tighten the cylinder head bolts to  $20 \pm 2$  N·m in the order shown.



- (4) Apply a paint mark to the heads of the cylinder head bolts and cylinder head, then tighten 90 degree angle as shown.

### ⚠ CAUTION

The bolt is not tightened sufficiently if the bolt is tightened less than 90 degree angle.

- (5) Tighten the bolt an additional 90 degree angle as shown. Then check to see that the paint mark on the head of the cylinder head bolts and the paint mark on the cylinder head are aligned.
- (6) If tightening the bolt 90 degree angle results in moving the paint mark on the bolt past the paint mark on the cylinder head, remove the bolt and start over from step 1.

### >>>C<<< O-RING/FUEL HIGH-PRESSURE HOSE INSTALLATION

### ⚠ CAUTION

Do not let any engine oil get into the delivery pipe.

1. Apply a small amount of new engine oil to the O-ring.
2. Turning the fuel high-pressure hose to the right and left, install it to the delivery pipe, while being careful not to damage the O-ring. After installing, check that the hose turns smoothly.
3. If the hose does not turn smoothly, the O-ring is probably being clamped. Disconnect the fuel high-pressure hose and check the O-ring for damage. After this, re-insert it to the delivery pipe and check that the hose turns smoothly.
4. Tighten the fuel high-pressure hose mounting bolts to the specified torque.

**Tightening torque:  $5.0 \pm 1.0$  N·m**

# TIMING BELT

## REMOVAL AND INSTALLATION

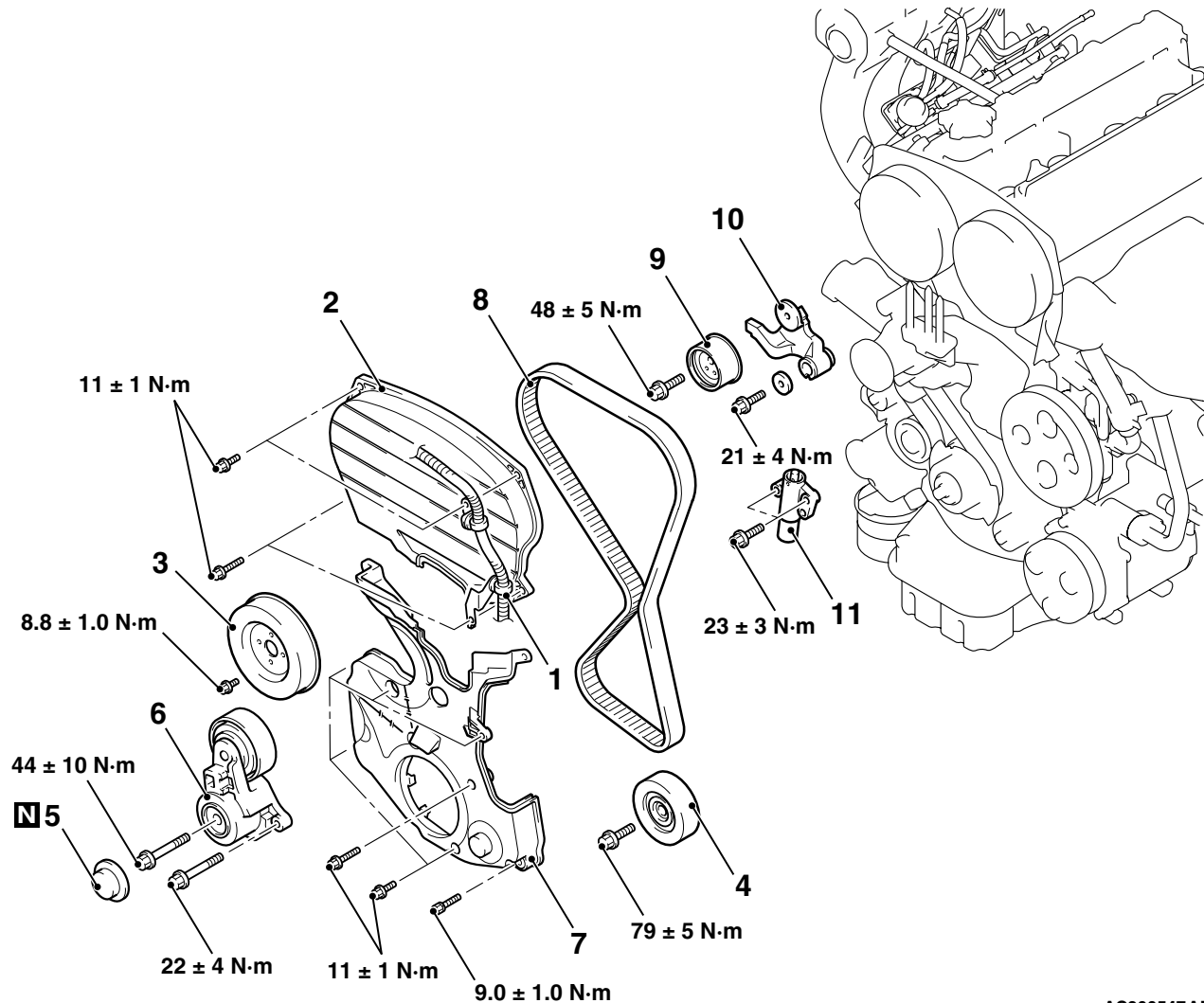
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### Pre-removal Operation

- Under Cover Removal (Refer to GROUP 51, Under Cover [P.51-18](#)).
- Crankshaft Shaft Damper Pulley Removal (Refer to [P.11A-13](#)).

### Post-installation Operation

- Crankshaft Shaft Damper Pulley Installation (Refer to [P.11A-13](#)).
- Drive Belt Tension Check (Refer to [P.11A-6](#)).
- Under Cover Installation (Refer to GROUP 51, Under Cover [P.51-18](#)).



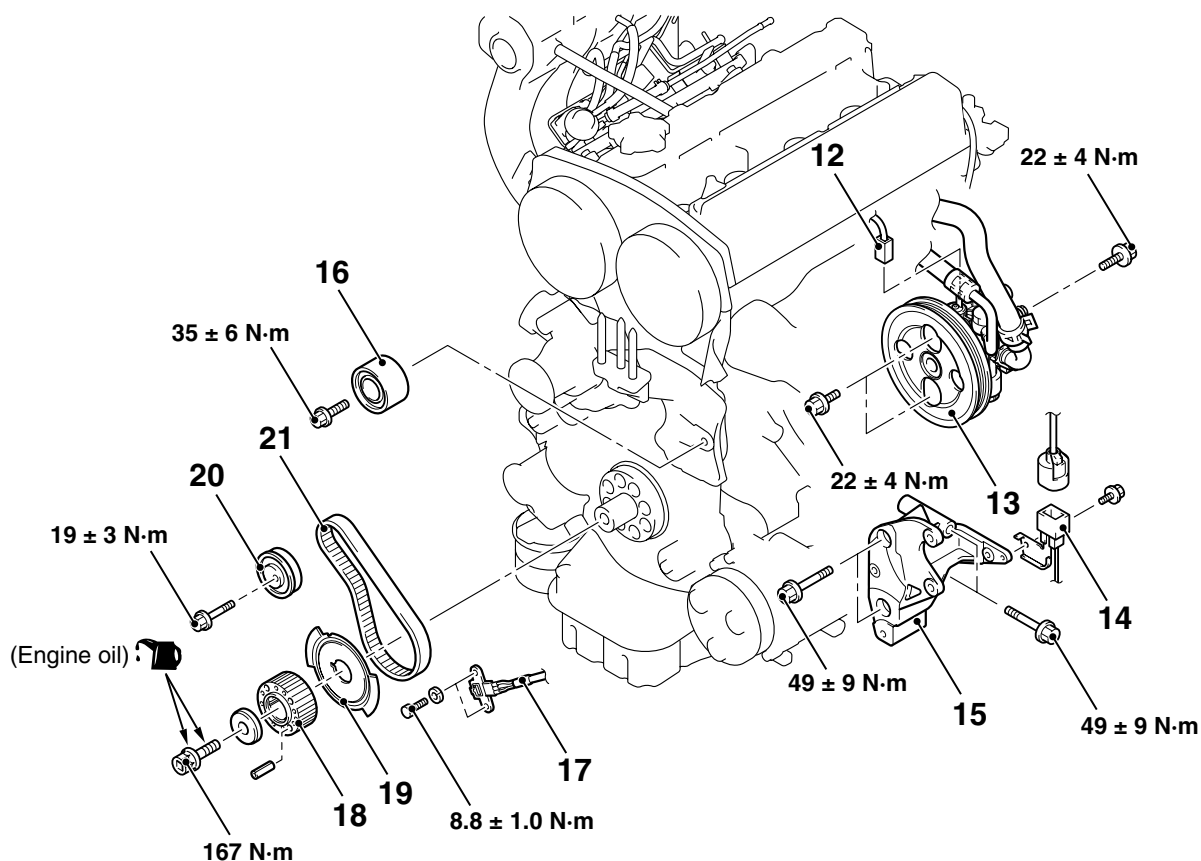
AC300547AB

### Removal steps

1. Control wiring harness connection
2. Timing belt upper cover
3. Water pump pulley
4. Idler pulley
5. End cap
6. Auto-tensioner
7. Timing belt lower cover

### Removal steps (Continued)

- Engine front mounting bracket (Refer to GROUP 32, Engine Mount [P.32-3](#)).
- Valve timing belt tension adjustment
- 8. Valve timing belt
- 9. Timing belt tensioner pulley
- 10. Timing belt tensioner arm
- 11. Timing belt tensioner adjuster



AC300548 AB

**Removal steps**

&lt;&lt;B&gt;&gt;

12. Power steering fluid pressure switch connector
13. Power steering oil pump assembly
14. A/C compressor connector
15. Power steering oil pump bracket
16. Timing belt idler pulley
17. Crank angle sensor

**Removal steps (Continued)**

&lt;&lt;C&gt;&gt;

&gt;&gt;C&lt;&lt;

&gt;&gt;C&lt;&lt;

&gt;&gt;B&lt;&lt;

&gt;&gt;A&lt;&lt;

&lt;&lt;D&gt;&gt;

&gt;&gt;A&lt;&lt;

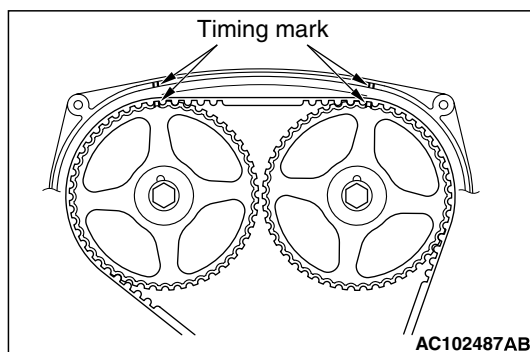
18. Crankshaft camshaft drive sprocket
19. Crankshaft angle sensing blade
- Balancer timing belt tension adjustment
20. Balancer timing belt tensioner
21. Balancer timing belt

**REMOVAL SERVICE POINTS**

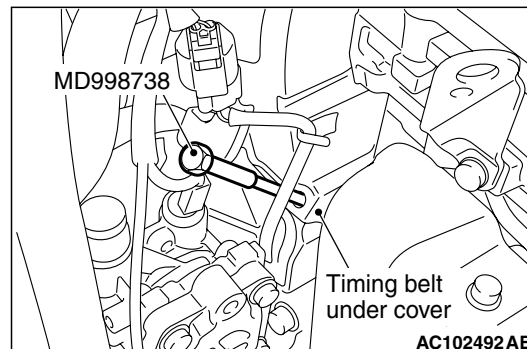
## &lt;&lt;A&gt;&gt; VALVE TIMING BELT REMOVAL

**CAUTION**

Never turn the crankshaft anti-clockwise.



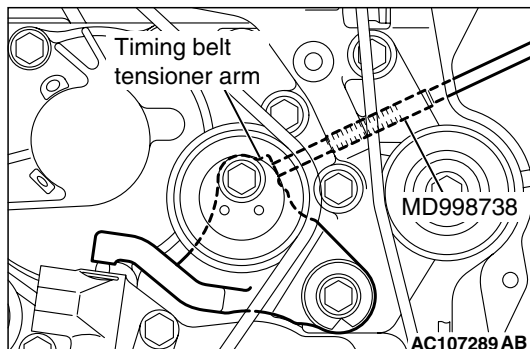
1. Turn the crankshaft clockwise, align each timing mark to set No.1 cylinder to TDC of its compression stroke.



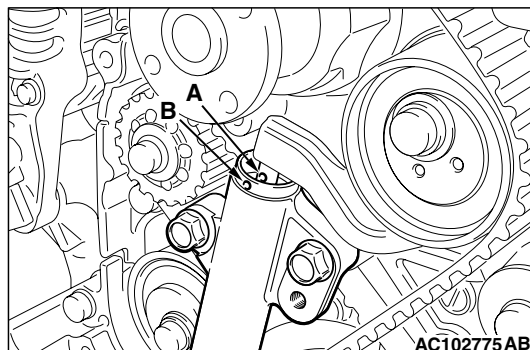
2. Remove the timing belt under cover rubber plug and then set the special tool adjusting bolt (MD998738).

**⚠ CAUTION**

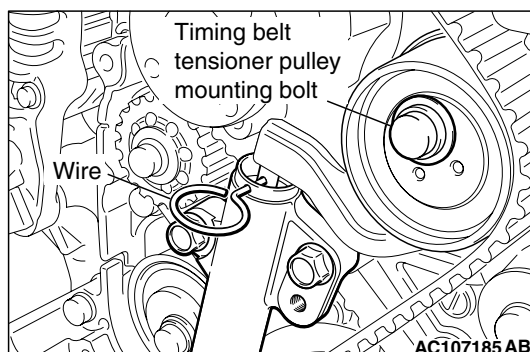
The special tool can be gradually installed at a rate of a 30 degree turn per second. If it is screwed in all at once, the timing belt tensioner adjuster rod will not easily retract and the special tool may bend.



3. Screw in the special tool until it comes in contact with the timing belt tensioner arm.



4. Gradually screw in the special tool. Then align the timing belt tensioner adjuster rod set hole A with the timing belt tensioner adjuster cylinder set hole B.



5. Insert a wire, etc. in the set hole.

**⚠ CAUTION**

To reuse the valve timing belt, draw an arrow indicating the rotating direction (clockwise) on the back of the belt using chalk.

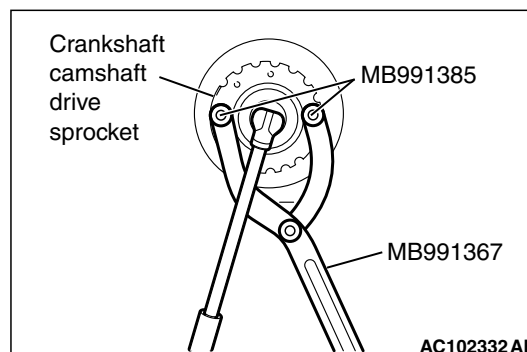
6. After removal of adjusting bolt special tool, loosen the timing belt tensioner pulley mounting bolt and remove the valve timing belt.

**<<B>> POWER STEERING OIL PUMP ASSEMBLY REMOVAL**

With the hose installed, remove the power steering oil pump assembly from the bracket.

*NOTE: Secure the removed power steering oil pump assembly with cord or rope at a position where they will not interfere with the removal of the balancer timing belt.*

**<<C>> CRANKSHAFT CAMSHAFT DRIVE SPROCKET REMOVAL**



1. Use the following special tools to support the crankshaft camshaft drive sprocket.
  - Special spanner (MB991367)
  - Pin (MB991385)
2. Loosen the crankshaft pulley centre bolt and remove the crankshaft camshaft drive sprocket.

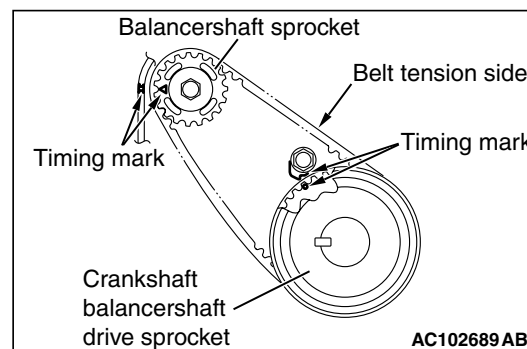
**<<D>> BALANCER TIMING BELT REMOVAL**

**⚠ CAUTION**

To reuse the balancer timing belt, draw an arrow indicating the rotating direction (clockwise) on the back of the belt using chalk.

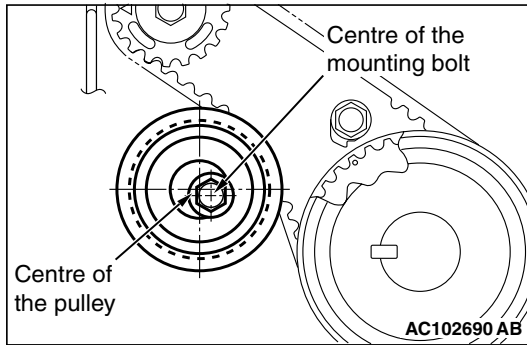
**INSTALLATION SERVICE POINTS**

**>>A<< BALANCER TIMING BELT/BALANCER TIMING BELT TENSIONER INSTALLATION**



1. Ensure that the crankshaft balancershaft drive sprocket timing marks and balancershaft sprocket timing marks are aligned.

2. Install the balancer timing belt on the crankshaft balancershaft drive sprocket and balancershaft sprocket. There should be no slack on the tension side.

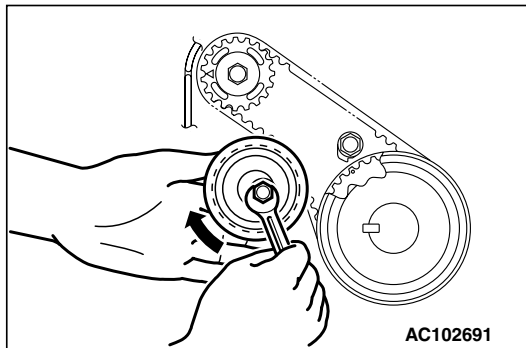


3. Assemble and temporarily fix the centre of the pulley of the balancer timing belt tensioner so that it is at the top left from the centre of the mounting bolt, and the pulley flange is at the front-side of the engine.
4. Adjust the balancer timing belt tension.

### >>B<< BALANCER TIMING BELT TENSION ADJUSTMENT

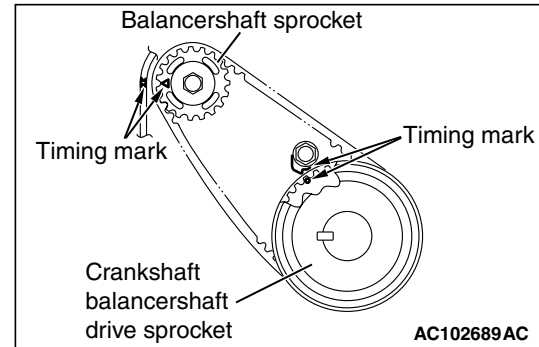
#### ⚠ CAUTION

When tightening the mounting bolt, ensure that the tensioner does not rotate with the bolt. Allowing it to rotate with the bolt can cause excessive tension of the belt.

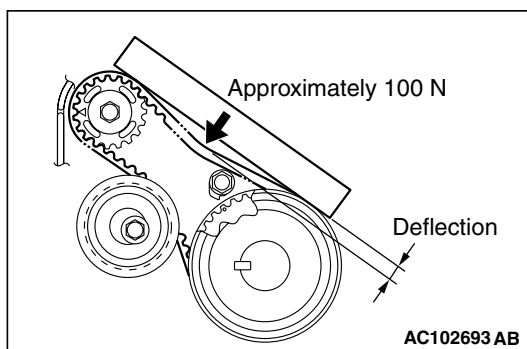


1. With your fingers, lift the balancer timing belt tensioner in the direction of the arrow. Apply pressure of  $3.0 \pm 0.4$  N·m to the balancer timing belt. Tighten the assembling bolt to the specified torque. Then, fix the balancer timing belt tensioner.

**Tightening torque:  $19 \pm 3$  N·m**



2. Turn the crankshaft clockwise two turns to set No.1 cylinder to TDC of its compression stroke and check that the sprocket timing marks are aligned.



3. Apply a pressure of approximately 100N at the centre (arrow area) between the sprocket as shown, then inspect whether the belt deflection is within the standard value.

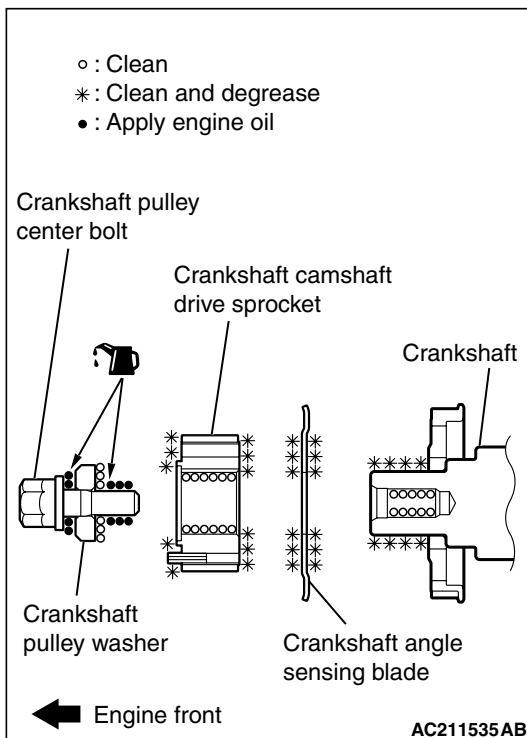
**Standard value:**

**At adjustment: 5 – 7 mm**

**At replacement: 5 – 7 mm**

4. If not within the standard value, adjust the belt tension again.

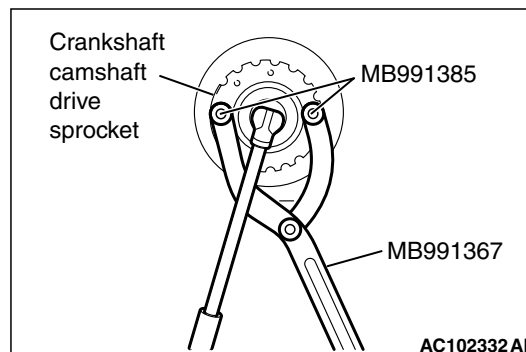
### >>C<< CRANKSHAFT ANGLE SENSING BLADE/ CRANKSHAFT CAMSHAFT DRIVE SPROCKET INSTALLATION



1. Clean or degrease the crankshaft, the crankshaft angle sensing blade, the crankshaft camshaft drive sprocket and crankshaft pulley washer as shown.

**NOTE:** Also clean the degreased surfaces.

2. Install the crankshaft angle sensing blade and crankshaft camshaft drive sprocket in the direction shown.
3. Place the larger chamfer side of the crank shaft pulley washer in the direction shown and then assemble on the crankshaft pulley centre bolt.
4. Apply some engine oil to the crankshaft pulley centre bolt bearing surface and screw.



5. Use the following special tool as during removal to support the crankshaft camshaft drive sprocket.
  - Special spanner (MB991367)
  - Pin (MB991385)
6. Tighten the crankshaft pulley centre bolts to the specified torque.

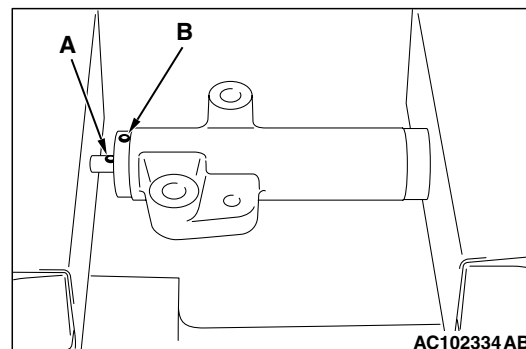
**Tightening torque: 167 N·m**

### >>D<< TIMING BELT TENSIONER ADJUSTER INSTALLATION

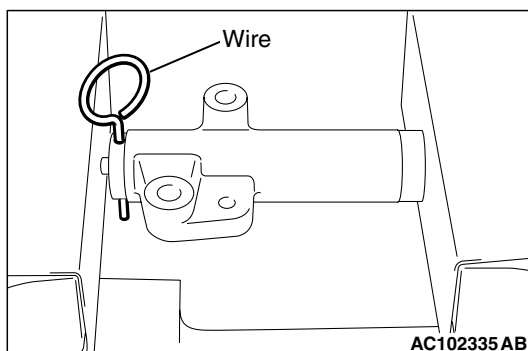
1. Install according to the following procedures when the timing belt tensioner adjuster rod is fully extended.

#### **CAUTION**

**If the compression is too fast, the procedure may damage the rod.**



- (1) Slowly compress the timing belt tensioner adjuster rod using a press or vice, then align the set hole A of the rod with set hole B of the timing belt tensioner adjuster cylinder.



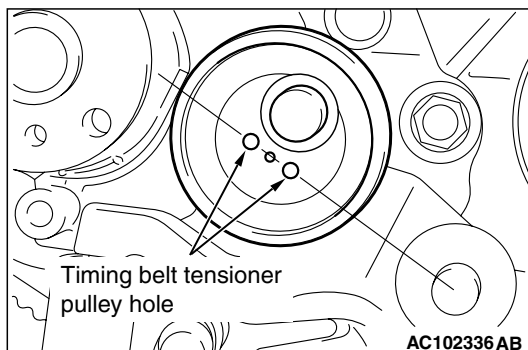
(2) Insert a wire or pin into the aligned set hole.

*NOTE: When replacing the timing belt tensioner adjuster with new parts, the timing belt tensioner adjuster is set with a pin.*

2. Assemble the timing belt tensioner adjuster to the engine, then tighten the assembling bolt to the specified torque. Do not remove the wire or pin until the tension of the valve timing belt is adjusted.

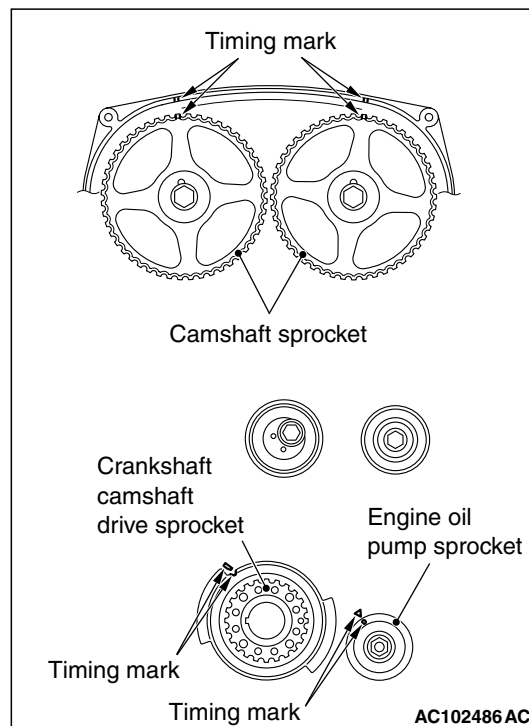
**Tightening torque:  $23 \pm 3$  N·m**

### >>E<< TIMING BELT TENSIONER PULLEY INSTALLATION

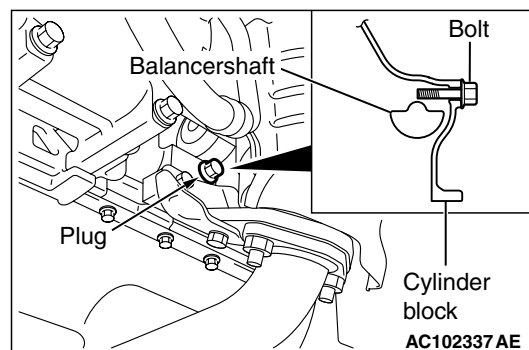


Temporarily tighten the timing belt tensioner pulley as shown.

### >>F<< VALVE TIMING BELT INSTALLATION



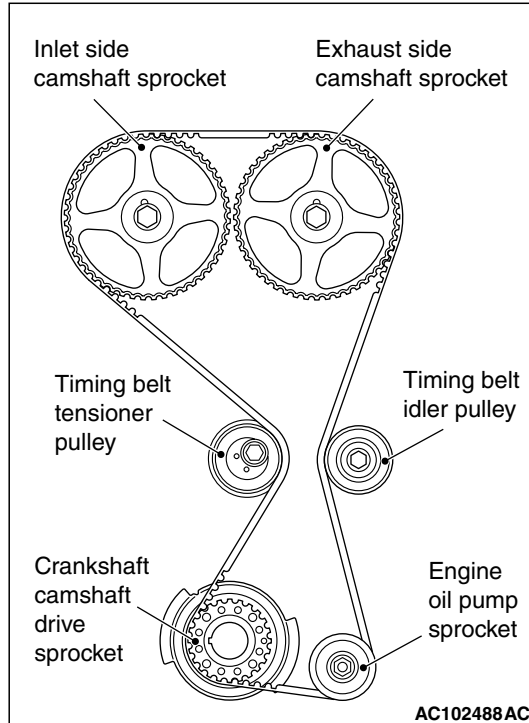
1. Align the timing marks on the camshaft sprocket, crankshaft camshaft drive sprocket and engine oil pump sprocket.



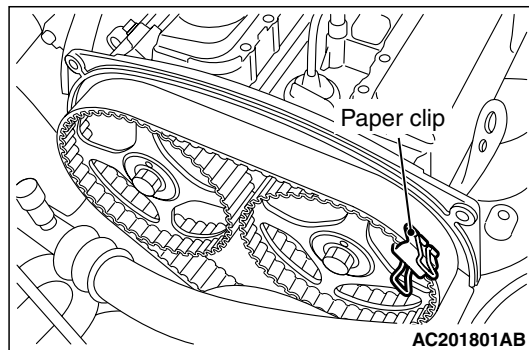
2. Adjust the timing mark of the engine oil pump sprocket. Unplug the cylinder block plug. Insert a bolt (M6 sectional width 10 mm, minor diameter 45 mm) from the plug hole and then check. If the bolt comes in contact with the balancer shaft turn the sprocket one rotation. Re-adjust the timing mark and then check to see that the bolt fits. Do not remove the bolt until the valve timing belt is assembled.



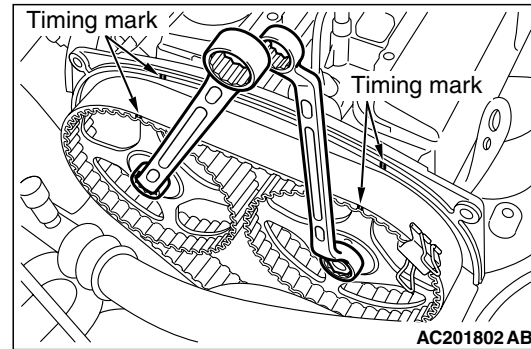
3. Install the valve timing belt as follows:



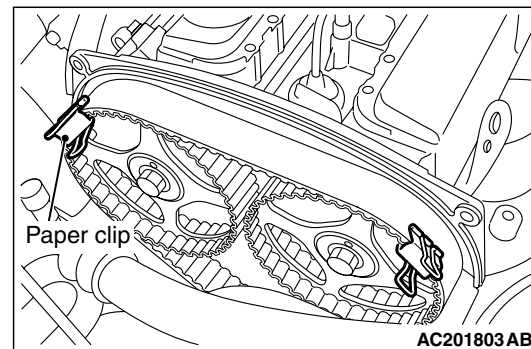
- (1) Pass the valve timing belt around the crankshaft camshaft drive sprocket, the engine oil pump sprocket and the timing belt idler pulley in that order.



- (2) Pass the valve timing belt around the exhaust-side camshaft sprocket, and hold the valve timing belt with paper clip.



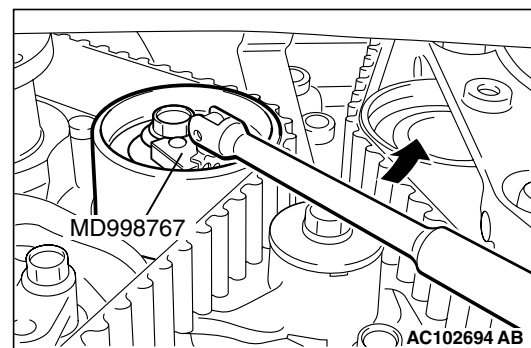
- (3) Use two wrenches to align the timing mark on the rocker cover with that on the camshaft sprocket. Pass the valve timing belt around the inlet-side camshaft sprocket.



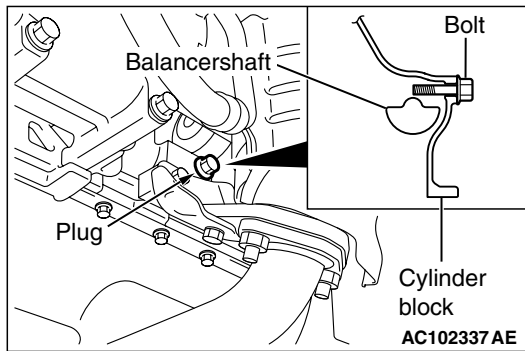
- (4) Hold the valve timing belt with paper clips.  
(5) Pass the valve timing belt around the timing belt tensioner pulley.

**CAUTION**  
Incorporate the valve timing belt. Then apply reverse rotation (anti-clockwise rotation) pressure to the cam shaft sprocket. Re-check to see that each timing mark is aligned while the tension side of the belt is tight.

- (6) Remove the two paper clips.



4. Turn the timing belt tensioner in the direction shown using special tool tensioner wrench (MD998767) to apply tension to the valve timing belt. Then pre-tighten the timing belt tensioner pulley.  
5. Check that the timing marks are aligned.

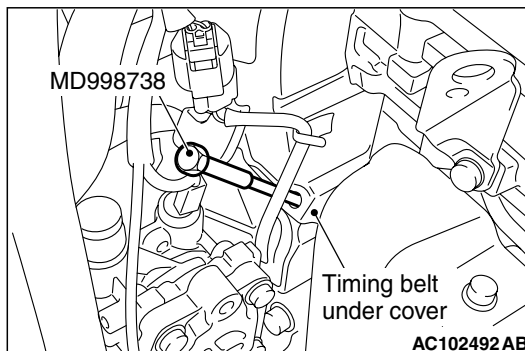


6. Remove the bolt inserted in Step 2 above, then assemble the cylinder block plug.
7. Tighten the cylinder block plug to the specified torque.

**Tightening torque:  $30 \pm 3$  N·m**

8. Adjust the valve timing belt tension.

### >>G<< VALVE TIMING BELT TENSION ADJUSTMENT



1. Set special tool adjusting bolt (MD998738) when removing the valve timing belt.

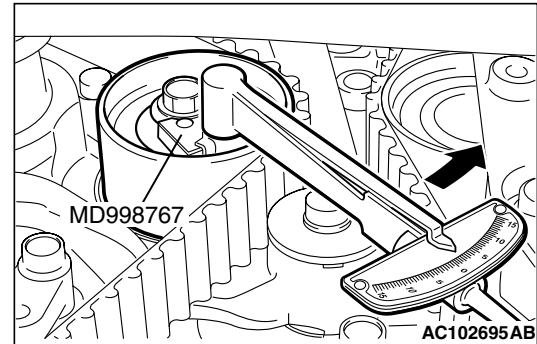
#### **CAUTION**

**Always screw in special tool by hand, since use of a spanner or other tools may damage the wire or pin inserted in the timing belt tensioner adjuster.**

2. Gradually screw in special tool until the wire or pin inserted in the timing belt tensioner adjuster lightly moves.
3. Turn the crankshaft 1/4 turn anti-clockwise.
4. Turn the crankshaft in the clockwise direction until you align each timing mark to set No.1 cylinder to TDC of its compression stroke.
5. Loosen the timing belt tensioner pulley mounting bolt.

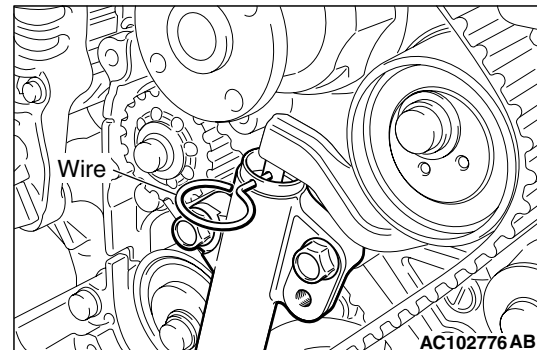
#### **CAUTION**

**When tightening the mounting bolt, ensure that the timing belt tensioner pulley does not rotate with the bolt. Allowing it to rotate with the bolt can cause deficient tension of the belt.**

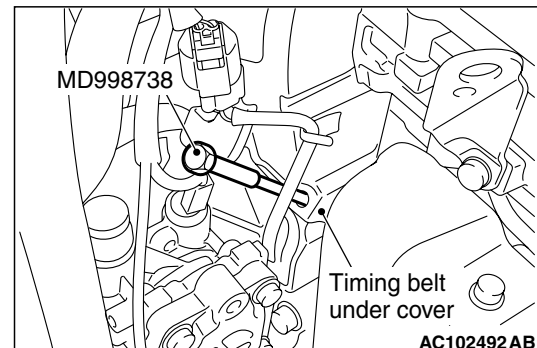


6. With special tool tensioner wrench (MD998767) and torque wrench, apply tension torque 3.5 N·m, and tighten the timing belt tensioner pulley mounting bolt to the specified torque.

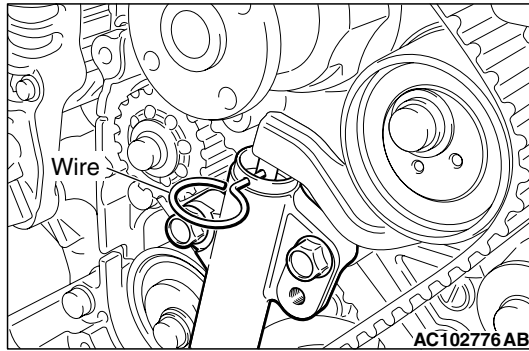
**Tightening torque:  $48 \pm 5$  N·m**



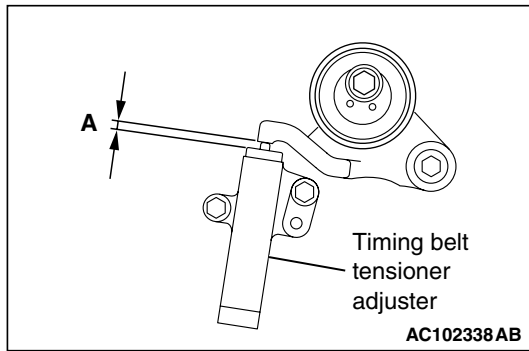
7. Remove wire or pin inserted to timing belt tensioner.



8. Remove the special tool adjusting bolt (MD998738), and install the rubber plug to the timing belt under cover.
9. Rotate the crankshaft clockwise two turns, and leave it for about 15 minutes.



10. Insert wire or pin removed in Step 7 again, and ensure that it can be pulled out easily. When wire or pin can be easily removed, appropriate tension is applied on timing belt. In this case, remove wire or pin.



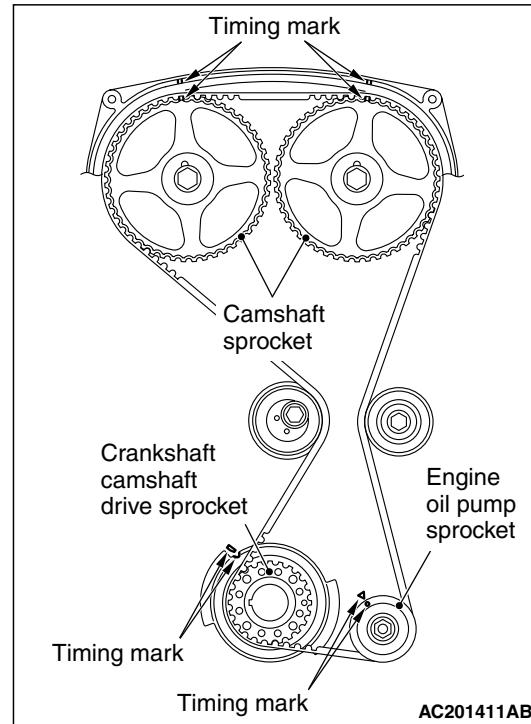
If the projection of timing belt tensioner adjuster rod is within the standard value, appropriate tension is applied.

**Standard value (A): 3.8 – 4.5 mm**

11. If wire or pin cannot be easily pulled out, repeat Step 1 through Step 9 to reach proper valve timing belt tension.

**CAUTION**

Always check the tightening torque of the crank shaft pulley centre bolt when turning the crack shaft pulley centre bolt anti-clockwise. Retighten if it is loose.



12. Check again that the timing marks on sprockets are aligned.

**>>H<< END CAP INSTALLATION**

**CAUTION**

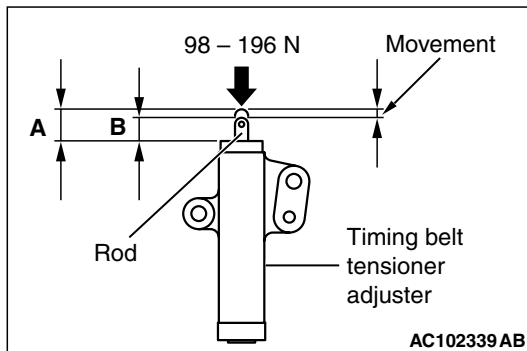
Always replace the end cap with new parts since there may be fall-off or sealing defect if the end cap is re-used.

**INSPECTION**

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**TIMING BELT TENSIONER ADJUSTER CHECK**

1. Check for oil leak from seal, and replace it if leak is detected.
2. Check for wear or damage at the top of the rod. Replace it, if required.



3. Hold the timing belt tensioner adjuster by hand, and press the top end of the rod onto the metal (e.g. cylinder block) under a pressure of 98 – 196 N to measure the movement of the rod.

**Standard value: Within 1 mm**

**A: Length when it is free (not pressed)**

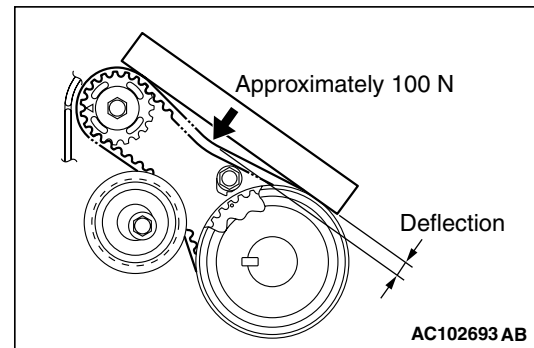
**B: Length when it is pressed**

**A – B: Movement**

4. If the measured value is out of the standard value, replace the timing belt tensioner adjuster.

## BALANCER TIMING BELT TENSION CHECK

Check the balancer timing belt tension as follows:



1. Apply a pressure of approximately 100 N at the centre (arrow area) between the sprocket as shown then inspect whether the deflection is within the standard value.

**Standard value: 5 – 10 mm**

2. If not within the standard value, adjust the belt tension. (Refer to [P.11A-35](#)).

# ENGINE ASSEMBLY

## REMOVAL AND INSTALLATION

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### CAUTION

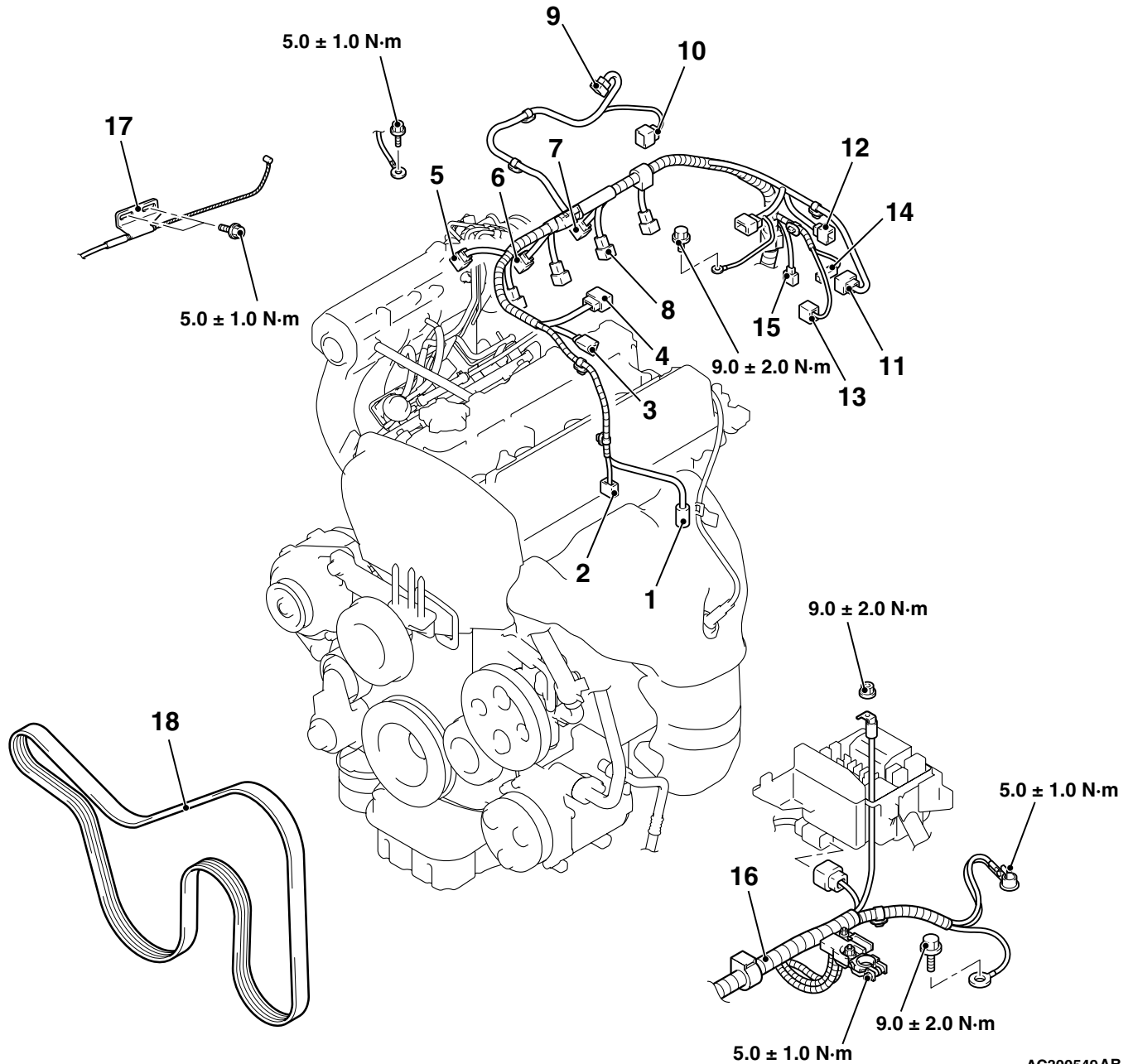
\*: indicates parts which should be temporarily tightened, and then fully tightened with the engine weight applied on the vehicle body.

#### Pre-removal Operation

- Fuel Line Pressure Reduction [Refer to GROUP 13A, On-vehicle Service – Fuel Pump Connector Disconnection (How to Reduce Pressurized Fuel Lines) [P.13A-310](#).]
- Hood Removal (Refer to GROUP 42, Hood [P.42-4](#)).
- Under Cover Removal (Refer to GROUP 51, Under Cover [P.51-18](#)).
- Engine Oil Draining (Refer to GROUP 12, On-vehicle Service – Engine Oil Replacement [P.12-3](#)).
- Engine Coolant Draining (Refer to GROUP 14, On-vehicle Service – Engine Coolant Replacement [P.14-15](#)).
- Air Cleaner and Air Cleaner Bracket Removal (Refer to GROUP 15, Air Cleaner [P.15-3](#)).
- Battery and Battery Tray Removal
- Rocker Cover Centre Cover Removal (Refer to [P.11A-15](#)).
- Radiator Assembly Removal (Refer to GROUP 14, Radiator [P.14-23](#)).
- Front Exhaust Pipe Removal (Refer to GROUP 15, Exhaust Pipe and Main Muffler [P.15-8](#)).
- Starter Assembly Removal (Refer to GROUP 16, Starter Motor Assembly [P.16-18](#)).

#### Post-installation Operation

- Starter Assembly Installation (Refer to GROUP 16, Starter Motor Assembly [P.16-18](#)).
- Front Exhaust Pipe Installation (Refer to GROUP 15, Exhaust Pipe and Main Muffler [P.15-8](#)).
- Radiator Assembly Installation (Refer to GROUP 14, Radiator [P.14-23](#)).
- Battery and Battery Tray Installation
- Rocker Cover Centre Cover Installation (Refer to [P.11A-15](#)).
- Air Cleaner and Air Cleaner Bracket installation (Refer to GROUP 15, Air Cleaner [P.15-3](#)).
- Engine Coolant Refilling (Refer to GROUP 14, On-vehicle Service – Engine Coolant Replacement [P.14-15](#)).
- Engine Oil Refilling (Refer to GROUP 12, On-vehicle Service – Engine Oil Replacement [P.12-3](#)).
- Accelerator Cable Adjustment (Refer to GROUP 17, On-vehicle Service – Accelerator Cable Check and Adjustment [P.17-3](#)).
- Drive Belt Tension Check (Refer to [P.11A-6](#)).
- Under Cover Installation (Refer to GROUP 51, Under Cover [P.51-18](#)).
- Hood Installation (Refer to GROUP 42, Hood [P.42-4](#)).
- Fuel Leak Check



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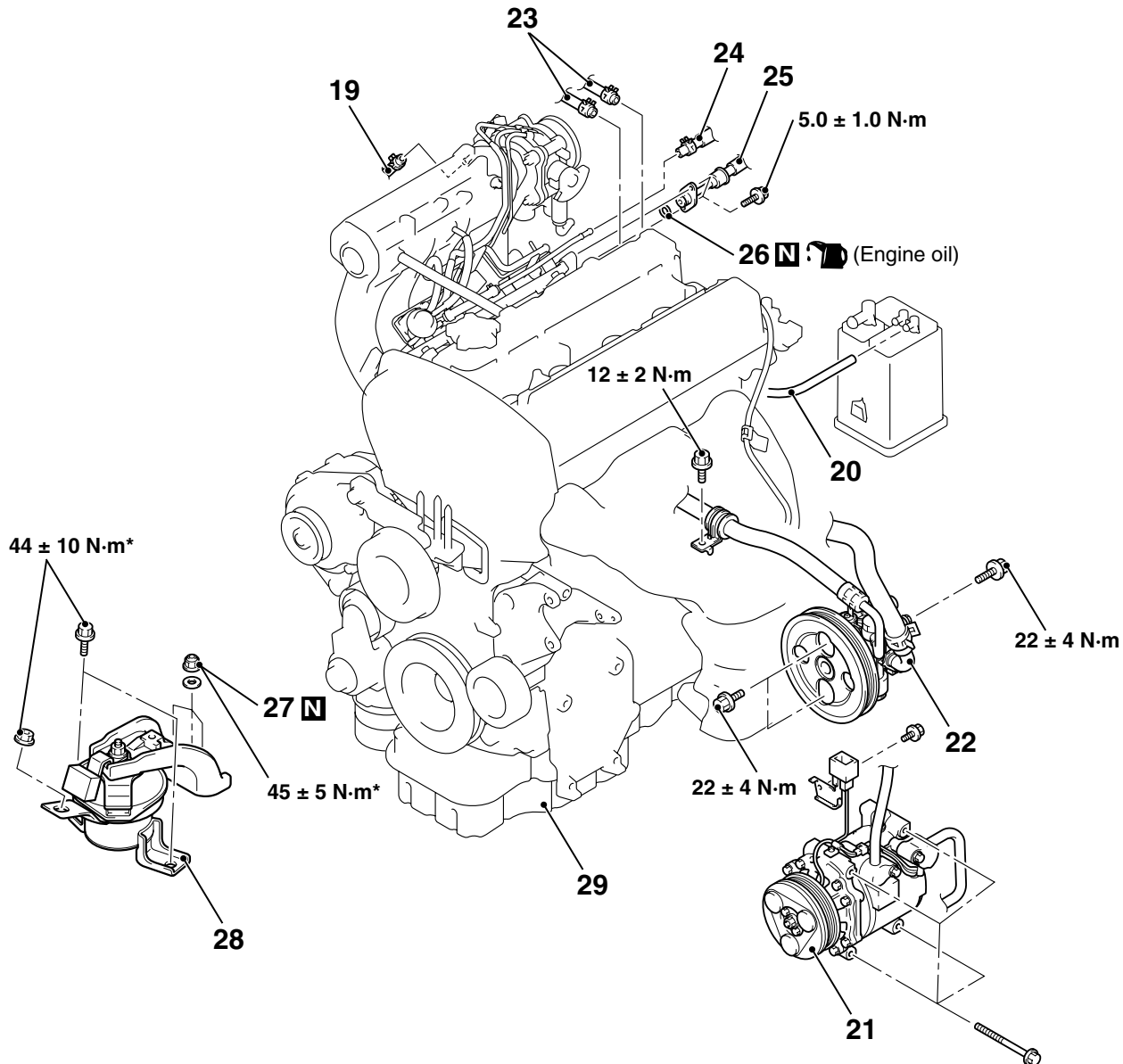
**Removal steps**

1. A/C compressor connector
2. Power steering fluid pressure switch connector
3. Crank angle sensor connector
4. Ignition coil connectors
5. Detonation sensor connector
6. Purge control solenoid valve connector
7. EGR control solenoid valve connector
8. Injector connectors
9. Throttle position sensor connector

&lt;&lt;A&gt;&gt;

**Removal steps (Continued)**

10. Idle speed control servo connector
11. Camshaft position sensor connector
12. Oxygen sensor connector
13. Engine coolant temperature sensor connector
14. Engine coolant temperature gauge unit connector
15. Capacitor connector
16. Battery wiring harness connection
17. Accelerator cable connection
18. Drive belt



**Removal steps**

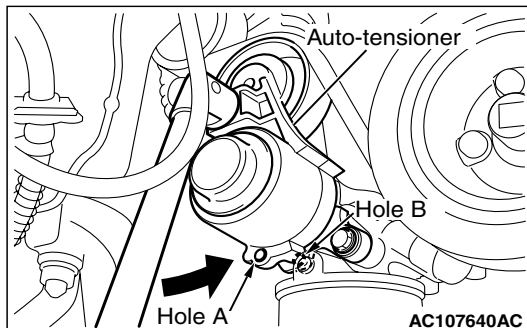
- <<B>>
- <<B>>
19. Brake booster vacuum hose connection
  20. Canister vacuum hose connection
  21. A/C compressor and clutch assembly
  22. Power steering oil pump assembly
  23. Heater water hoses connection
  24. Fuel return line hose connection

**Removal steps (Continued)**

- >>E<<
- >>E<<
- >>D<<
- >>C<<
- <<D>>
- <<E>>
- >>B<<
- >>A<<
25. Fuel high-pressure hose connection
  26. O-ring
  - Transmission assembly
  27. Self-locking nuts
  28. Engine front mounting bracket
  29. Engine assembly

**REMOVAL SERVICE POINTS****<<A>> DRIVE BELT REMOVAL**

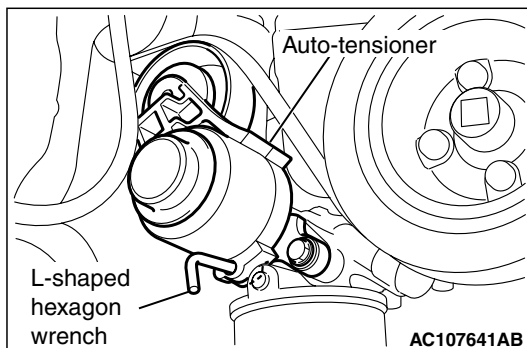
The following operations will be needed due to the serpentine drive system with the drive belt auto-tensioner.



1. Securely insert the spindle handle or ratchet handle with a 12.7 mm insertion angle into the jig hole of the auto-tensioner, and turn the auto-tensioner anti-clockwise until it hits the stopper.

**⚠ CAUTION**

To reuse the drive belt, draw an arrow indicating the rotating direction (clockwise) on the back of the belt using chalk.

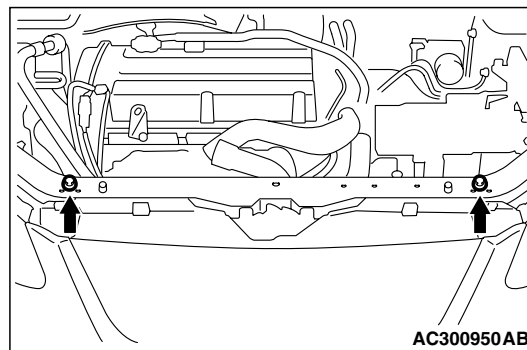


2. Align hole A with hole B, insert an L-shaped hexagon wrench, etc. to fix and then remove the drive belt.

**<<B>> A/C COMPRESSOR AND CLUTCH ASSEMBLY/POWER STEERING OIL PUMP ASSEMBLY REMOVAL**

With the hose installed, remove the A/C compressor and clutch assembly, and power steering oil pump assembly from the bracket.

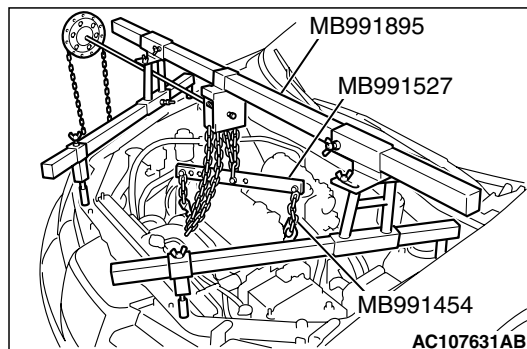
*NOTE: Secure the removed A/C compressor and clutch assembly, and power steering oil pump assembly with cord or rope at a position where they will not interfere with the removal of the engine assembly.*

**<<C>> TRANSMISSION ASSEMBLY REMOVAL**

1. Pre-tighten the 2 bolts on the car to assemble the radiator support upper insulator to set the special tools engine hanger MB991895 or engine hanger MB991928.
2. Remove the transmission assembly (Refer to GROUP 22A, Transmission Assembly P.22A-10).

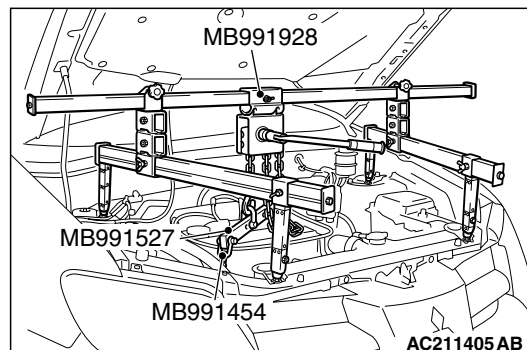
**<<D>> ENGINE FRONT MOUNTING BRACKET REMOVAL**

1. Support the engine with a garage jack.
2. Remove the following special tool.



- (1) <Special tool engine hanger (MB991895) is used>

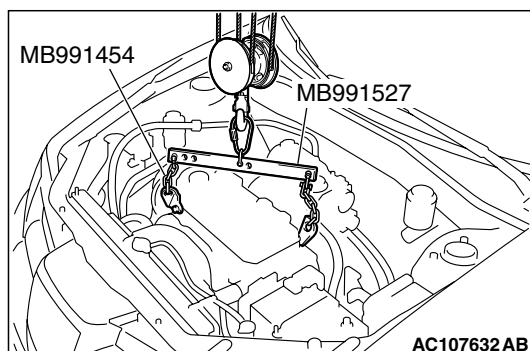
Remove special tool MB991895.



- (2) <Special tool engine hanger (MB991928) is used>

Remove special tool MB991928.





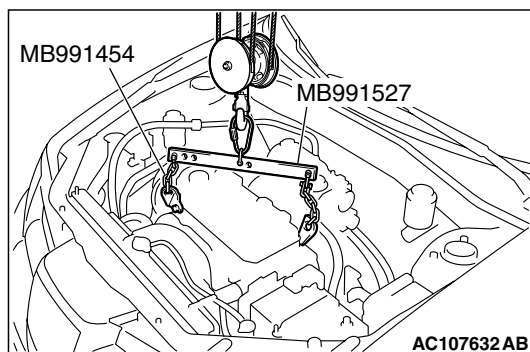
3. Hold the engine assembly with a chain block, etc.
4. Place a garage jack against the engine oil pan with a piece of wood in between so that the weight of the engine assembly is no longer being applied to the engine front mounting bracket.
5. Loosen the engine front mounting bracket mounting nuts and bolt, and remove the engine front mounting bracket.

### <<E>> ENGINE ASSEMBLY REMOVAL

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

## INSTALLATION SERVICE POINTS

### >>A<< ENGINE ASSEMBLY INSTALLATION

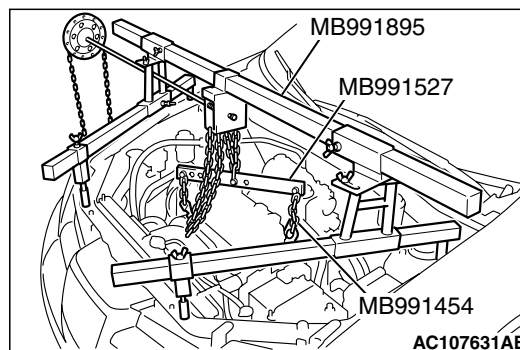


Install the engine assembly, being careful not to pinch the cables, hoses or wiring harness connectors.

### >>B<< ENGINE FRONT MOUNTING BRACKET INSTALLATION

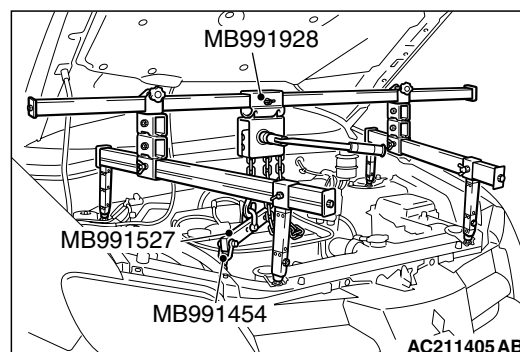
1. Place a garage jack against the engine oil pan with a piece of wood in between, and install the engine front mounting bracket while adjusting the position of the engine.

2. Support the engine assembly with a garage jack.
3. Remove the chain block.
4. Use the following special tool as during removal to support the engine.



- (1) <Special tool engine hanger (MB991895) is used>

Set special tool MB991895. (Refer to GROUP 22A, Transmission Assembly P.22A-10).



- (2) <Special tool engine hanger (MB991928) is used>

Set special tool MB991928 (Refer to GROUP 22A, Transmission Assembly P.22A-10).

### >>C<< SELF-LOCKING NUTS INSTALLATION

#### CAUTION

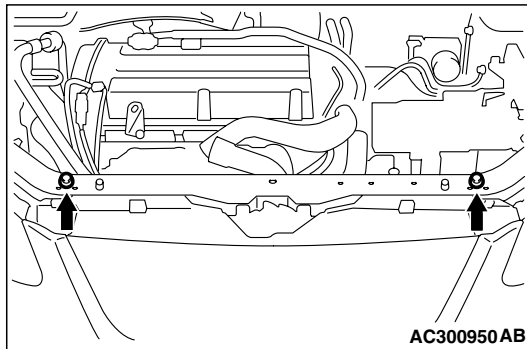
**Do not tighten the self-locking nuts while the engine is hot.**

Tighten the self-locking nuts to the specified torque while the engine is cold.

**Tightening torque: 45 ± 5 N·m**

### >>D<< TRANSMISSION ASSEMBLY INSTALLATION

1. Install the transmission assembly (Refer to GROUP 22A, Transmission Assembly P.22A-10).



2. Remove from the car the 2 bolts, to assemble the radiator support upper insulator.

### >>E<< O-RING/FUEL HIGH-PRESSURE HOSE INSTALLATION

#### CAUTION

Do not let any engine oil get into the delivery pipe.

1. Apply a small amount of new engine oil to the O-ring.
2. Turning the fuel high-pressure hose to the right and left, install it to the delivery pipe, while being careful not to damage the O-ring. After installing, check that the hose turns smoothly.
3. If the hose does not turn smoothly, the O-ring is probably being clamped. Disconnect the fuel high-pressure hose and check the O-ring for damage. After this, re-insert it to the delivery pipe and check that the hose turns smoothly.
4. Tighten the fuel high-pressure hose mounting bolts to the specified torque.

**Tightening torque:  $5.0 \pm 1.0$  N·m**