

## GROUP 11C

# ENGINE MECHANICAL <3.8L ENGINE>

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**GENERAL DESCRIPTION**

M1111000100419

The 6G75 (3.8 L) engine is a six-cylinder engine. The cylinder numbers are assigned as 1-3-5 for the right bank and 2-4-6 for the left bank from the front of the engine (timing belt side). This engine is fired in the order of 1-2-3-4-5-6 cylinders.

ITEMS		SPECIFICATIONS	
Type		V type, overhead cam shaft	
Number of cylinders		6	
Bore mm (in)		95.0 (3.74)	
Stroke mm (in)		90.0 (3.54)	
Total displacement cm <sup>3</sup> (cu. in)		3,828 (233.6)	
Compression ratio		10.0	
Firing order		1-2-3-4-5-6	
Valve timing	Intake valve	Opens (BTDC)	7°
		Closes (ABDC)	61°
	Exhaust valve	Opens (BBDC)	61°
		Closes (ATDC)	15°
Lubrication system		Pressure feed, full-flow filtration	
Oil pump type		Trochoid type	

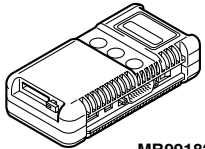
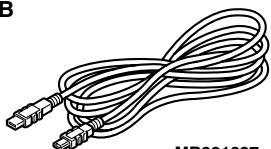
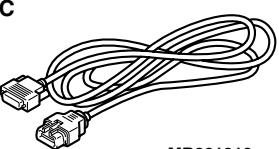
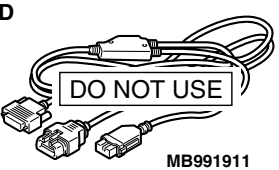
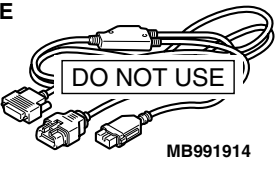
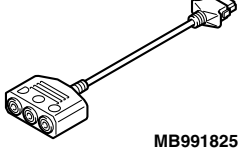
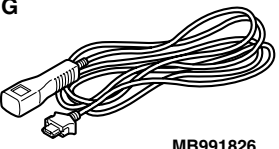
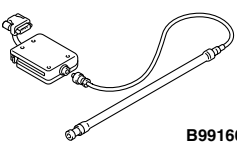
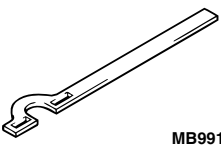
## ENGINE DIAGNOSIS

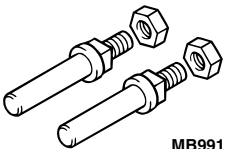
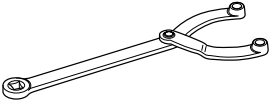
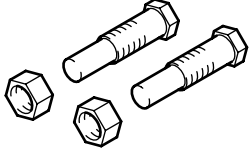
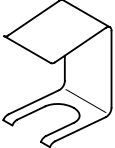
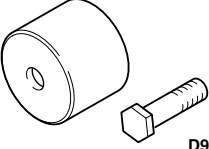

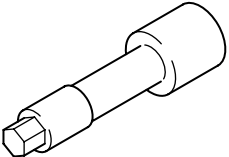
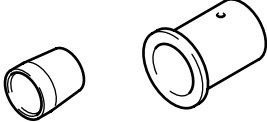
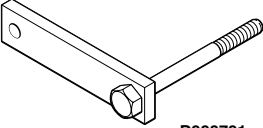
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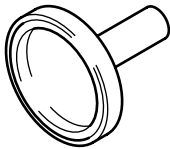
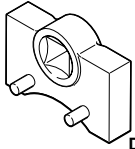

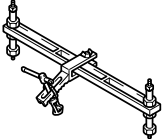
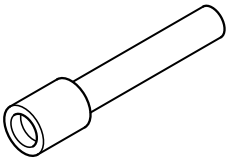
<b>SYMPTOMS</b>	<b>PROBABLE CAUSE</b>	<b>REMEDY</b>
Compression is too low	Blown cylinder head gasket	Replace the gasket.
	Worn or damaged piston rings	Replace the rings.
	Worn piston or cylinder	Repair or replace the piston and/or the cylinder block.
	Worn or damaged valve seat	Repair or replace the valve and/or the seat ring
Drop in engine oil pressure	Engine oil level is too low	Check the engine oil level.
	Malfunction of engine oil pressure switch	Replace the engine oil pressure switch.
	Clogged oil filter	Install a new filter.
	Worn oil pump gears or cover	Replace the gears and/or the cover.
	Thin or diluted engine oil	Change the engine oil to the correct viscosity.
	Stuck (opened) oil relief valve	Repair the relief valve.
	Excessive bearing clearance	Replace the bearings.
Engine oil pressure too high	Stuck (closed) oil relief valve	Repair the relief valve.
Noisy valves	Malfunction of lash adjuster (including entry of air into high pressure chamber)	Check the lash adjuster.
	Thin or diluted engine oil (low engine oil pressure)	Change the engine oil.
	Worn or damaged valve stem or valve guide	Replace the valve and/or the guide.
Connecting rod noise/main bearing noise	Insufficient oil supply	Check the engine oil level.
	Thin or diluted engine oil	Change the engine oil.
	Excessive bearing clearance	Replace the bearings.

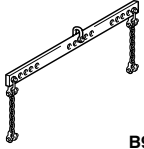
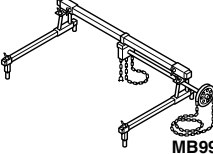
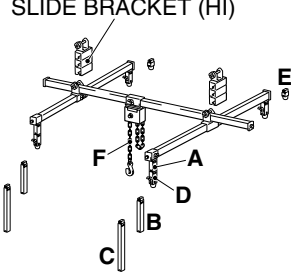
## SPECIAL TOOLS

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TOOL	TOOL NUMBER AND NAME	SUPERSESSON	APPLICATION
<p>A</p>  <p>MB991824</p> <p>B</p>  <p>MB991827</p> <p>C</p>  <p>MB991910</p> <p>D</p>  <p>MB991911</p> <p>E</p>  <p>MB991914</p> <p>F</p>  <p>MB991825</p> <p>G</p>  <p>MB991826 MB991958</p>	<p>MB991958 Scan tool (MUT-III sub assembly) A: MB991824 Vehicle communication interface (V.C.I.) B: MB991827 MUT-III USB cable C: MB991910 MUT-III main harness A (Vehicles with CAN communication system) D: MB991911 MUT-III main harness B (Vehicles without CAN communication system) E: MB991914 MUT-III main harness C (for Daimler Chrysler models only) F: MB991825 MUT-III measurement adapter G: MB991826 MUT-III trigger harness</p>	<p>MB991824-KIT <i>NOTE: G: MB991826 MUT-III Trigger Harness is not necessary when pushing V.C.I. ENTER key.</i></p>	<ul style="list-style-type: none"> <li>• Drive belt tension check</li> <li>• Ignition timing check</li> <li>• Curb idle speed check</li> <li>• Idle mixture check</li> <li>• Erasing the diagnostic trouble code</li> </ul> <p><b>CAUTION</b> For vehicles with CAN communication, use MUT-III main harness A to send simulated vehicle speed. If you connect MUT-III main harness B instead, the CAN communication does not function correctly.</p>
 <p>B991668</p>	<p>MB991668 Belt tension meter set</p>	<p>Tool not available</p>	<p>Drive belt tension check [used together with scan tool (MUT-III sub assembly)]</p>
 <p>MB991800</p>	<p>MB991800 Pulley holder</p>	<p>MB991800-01</p>	<p>Holding the crankshaft pulley</p>

TOOL	TOOL NUMBER AND NAME	SUPERSESSION	APPLICATION
 <p align="center">MB991802</p>	MB991802 Pin B	MB991802-01	Holding the crankshaft pulley
 <p align="center">B990767</p>	MB990767 End yoke holder	MB990767-01	Holding the camshaft sprocket
	MD998715 Crankshaft pulley holder pin	MIT308239	Holding the camshaft sprocket
 <p align="center">D998443</p>	MD998443 Auto-lash adjuster holder	MD998443-01	Holding the auto-lash adjuster
 <p align="center">D998713</p>	MD998713 Camshaft oil seal installer	MD998713-01	Press-in of the camshaft oil seal
 <p align="center">B991559</p>	MB991559 Camshaft oil seal adapter installer	MB991559-01	Press-fitting the camshaft oil seal (left bank side)
	MD998051 Cylinder head bolt wrench	MD998051-01 or General service tool	Cylinder head bolt removal and installation
	MD998717 Crankshaft front oil seal installer	MD998717-01	Press-in of the crankshaft front oil seal
 <p align="center">D998781</p>	MD998781 Flywheel stopper	General service tool	Securing the drive plate

TOOL	TOOL NUMBER AND NAME	SUPERSESSION	APPLICATION
	MD998718 Crankshaft rear oil seal installer	MD998718-01	Press-fitting the crankshaft rear oil seal
 <p>D998767</p>	MD998767 Tension pulley socket wrench	MD998752-01	Timing belt tension adjustment
	MD998769 Crankshaft pulley spacer	General service tool	Rotating the crankshaft when installing the timing belt
 <p>AC204024</p>	MD998772 Valve spring compressor	General service tool	Compressing valve spring
	MD998774 Valve stem seal installer	MD998774-01	Valve stem seal installer

TOOL	TOOL NUMBER AND NAME	SUPERSESION	APPLICATION
 <p align="center">B991454</p>	MB991454 Engine hanger balancer	MZ203827-01	When the engine hanger is used: Supporting the engine assembly during removal and installation of the transaxle assembly  <i>NOTE: Special tool MB991454 is a part of engine hanger attachment set MB991453.</i>
 <p align="center">MB991895</p>	MB991895 Engine hanger	Tool not available	
<p>SLIDE BRACKET (HI)</p>  <p align="center">B991928</p>	MB991928 Engine hanger A: MB991929 Joint (50) ×2 B: MB991930 Joint (90) ×2 C: MB991931 Joint (140) ×2 D: MB991932 Foot (standard) ×4 E: MB991933 Foot (short) ×2 F: MB991934 Chain and hook assembly	Tool not available	

**ON-VEHICLE SERVICE****DRIVE BELT TENSION CHECK AND  
ADJUSTMENT**

M1111003100496

Refer to GROUP 00, Maintenance Service – Drive Belts  
(Check Condition) [P.00-45](#).

**IGNITION TIMING CHECK**

M1111001701075

**Required Special Tool:**

MB991958: Scan Tool (MUT-III Sub Assembly)

- MB991824: V.C.I.
- MB991827: MUT-III USB Cable
- MB991910: MUT-III Main Harness A

1. Before inspection, set the vehicle in the following condition:

- Engine coolant temperature: 80 – 95°C (176 – 203°F)
- Lights and all accessories: OFF
- Transaxle: P range

*NOTE: Vehicles for Canada, the headlight, taillight, etc. remain lit even when the lighting switch is in "OFF" position but this is no problem for checks.*

**⚠ CAUTION**

To prevent damage to scan tool MB991958, always turn the ignition switch to the "LOCK" (OFF) position before connecting or disconnecting scan tool MB991958.

2. Connect scan tool MB991958 to the data link connector.
3. Set the timing light to the power supply line (terminal No. 1) of the ignition coil No. 1.

*NOTE: The power supply line is looped and also longer than the other ones.*

4. Start the engine and run it at idle.
5. Check that the idle speed is approximately 680 r/min.
6. Select scan tool MB991958 actuator test "item number 17".
7. Check that basic ignition timing is within the standard value.

**Standard value: 5° BTDC ± 3°**

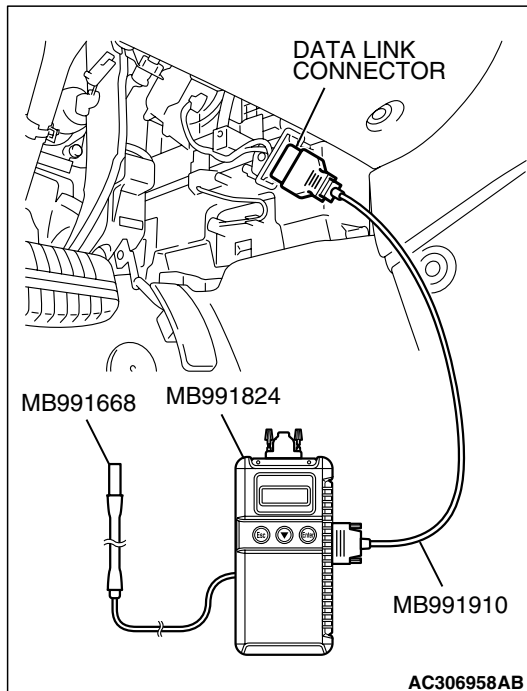
8. If the basic ignition timing is not within the standard value, check the following items:
  - Diagnostic output
  - Timing belt cover and crankshaft position sensor installation conditions
  - Crankshaft sensing blade condition

**⚠ CAUTION**

If the actuator test is not canceled, the forced drive will continue for 27 minutes. Driving in this state could lead to engine failure.

9. Press the clear key on scan tool MB991958 (select forced drive stop mode), and cancel the actuator test.
10. Check that the actual ignition timing is at the standard value.

**Standard value: Approximately 10° BTDC**





*NOTE: Ignition timing fluctuates about  $\pm 7^\circ$  Before Top Dead Center, even under normal operating condition.*

*NOTE: It is automatically further advanced by about  $5^\circ$  to  $10^\circ$  Before Top Dead Center at higher altitudes.*

## CURB IDLE SPEED CHECK

M1111003501044

### Required Special Tool:

MB991958: Scan Tool (MUT-III Sub Assembly)

- MB991824: V.C.I.
- MB991827: MUT-III USB Cable
- MB991910: MUT-III Main Harness A

1. Before inspection, set the vehicle in the following condition:

- Engine coolant temperature:  $80 - 95^\circ\text{C}$  ( $176 - 203^\circ\text{F}$ )
- Lights and all accessories: OFF
- Transmission: P range

*NOTE: Vehicles for Canada, the headlight, taillight, etc. remain lit even when the lighting switch is in "OFF" position but this is no problem for checks.*

### **CAUTION**

To prevent damage to scan tool MB991958, always turn the ignition switch to the "LOCK" (OFF) position before connecting or disconnecting scan tool MB991958.

2. Connect scan tool MB991958 to the data link connector.
3. Check the basic ignition timing.

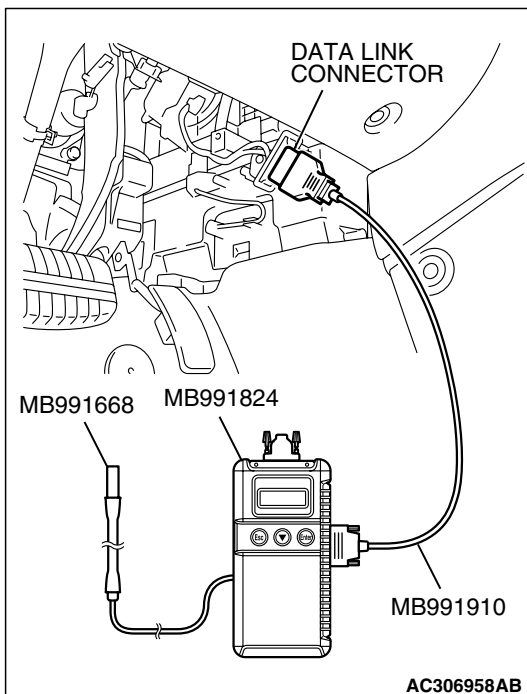
**Standard value:  $5^\circ$  BTDC  $\pm 3^\circ$**

4. Start the engine.
5. Run the engine at idle for 2 minutes.
6. Check the idle speed. Select item number 22 and take a reading of the idle speed.

**Curb idle speed:  $680 \pm 100$  r/min**

*NOTE: The idle speed is controlled automatically by the idle air control system.*

7. If the idle speed is outside the standard value, refer to GROUP 13B, Multiport Fuel Injection (MFI) <3.8L Engine> – Multiport Fuel Injection (MFI) Diagnosis – Symptom Chart [P.13B-38](#).



## IDLE MIXTURE CHECK

**Required Special Tool:**

MB991958: Scan Tool (MUT-III Sub Assembly)

- MB991824: V.C.I.
- MB991827: MUT-III USB Cable
- MB991910: MUT-III Main Harness A

1. Before inspection, set the vehicle in the following condition:
  - Engine coolant temperature: 80 – 95°C (176 – 203°F)
  - Lights and all accessories: OFF
  - Transmission: P range

*NOTE: Vehicles for Canada, the headlight, taillight, etc. remain lit even when the lighting switch is in "OFF" position but this is no problem for checks.*

**⚠ CAUTION**

To prevent damage to scan tool MB991958, always turn the ignition switch to the "LOCK" (OFF) position before connecting or disconnecting scan tool MB991958.

2. Connect scan tool MB991958 to the data link connector.
3. Check that the basic ignition timing is within the standard value.

**Standard value: 5° BTDC ± 3°**

4. Start the engine and increase the engine speed to 2,500 r/min for 2 minutes.
5. Set the CO, HC tester.
6. Check the CO contents and the HC contents at idle.

**Standard value:**

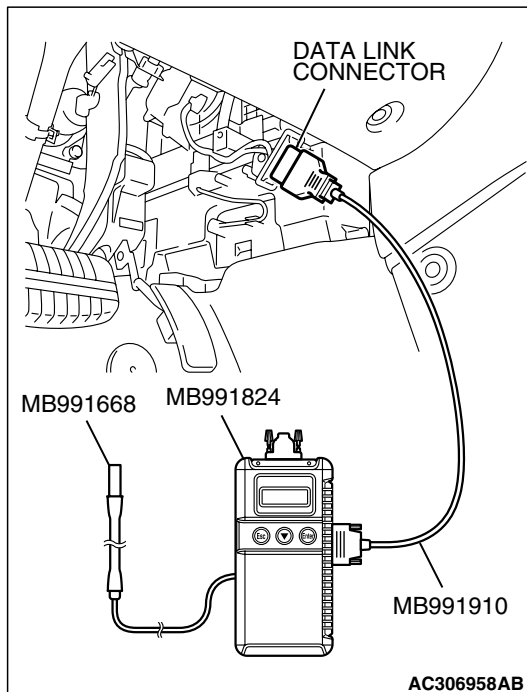
**CO contents: 0.5% or less**

**HC contents: 100 ppm or less**

7. If the CO and HC contents do not remain inside the standard value, check the following items:

*NOTE: Replace the catalytic converter when the CO and HC contents do not remain inside the standard value, even though the result of the inspection is normal for all items.*

- Diagnostic output
- Closed-loop control (When the closed-loop control is carried out normally, the output signal of the heated oxygen sensor changes between 0 – 400 mV and 600 – 1,000 mV at idle.)
- Fuel pressures
- Injector
- Ignition coil, spark plug
- EGR system and EGR valve leak
- Evaporative emission system
- Compression pressure



## COMPRESSION PRESSURE CHECK

### Required Special Tool:

MB991958: Scan Tool (MUT-III Sub Assembly)

- MB991824: V.C.I.
- MB991827: MUT-III USB Cable
- MB991910: MUT-III Main Harness A

1. Before inspection, check that the engine oil, starter and battery are normal. Also, set the vehicle in the following condition:

- Engine coolant temperature: 80 – 95°C (176 – 203°F)
- Lights and all accessories: OFF
- Transmission: P range

*NOTE: Vehicles for Canada, the headlight, taillight, etc. remain lit even when the lighting switch is in "OFF" position but this is no problem for checks.*

2. Remove all of the ignition coils and spark plugs.

3. Disconnect the crankshaft position sensor connector.

*NOTE: Doing this will prevent the engine control module from carrying out ignition and fuel injection.*

### **⚠ WARNING**

**Keep your distance from the spark plug hole when cranking. Oil, fuel, etc., may spray out from the spark plug hole and may cause serious injury.**

4. Cover the spark plug hole with a shop towel etc., during cranking. After the engine has been cranked, check for foreign material adhering to the shop towel.

5. Set compression gauge to one of the spark plug holes.

6. Crank the engine with the throttle valve fully open and measure the compression pressure.

**Standard value (at engine speed of 200 r/min): 1,550 kPa (225 psi)**

**Minimum limit (at engine speed of 200 r/min): 1,110 kPa (161 psi)**

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

**Limit: 98 kPa (14 psi)**

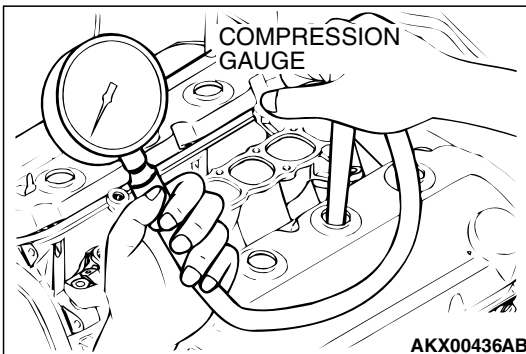
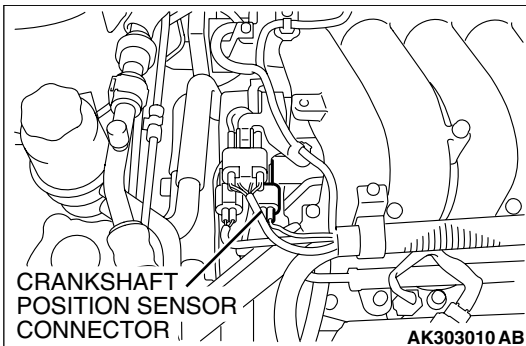
8. If there is a cylinder with compression or a compression difference that is outside the limit, pour a small amount of engine oil through the spark plug hole, and repeat the operations in steps 6 to 8.

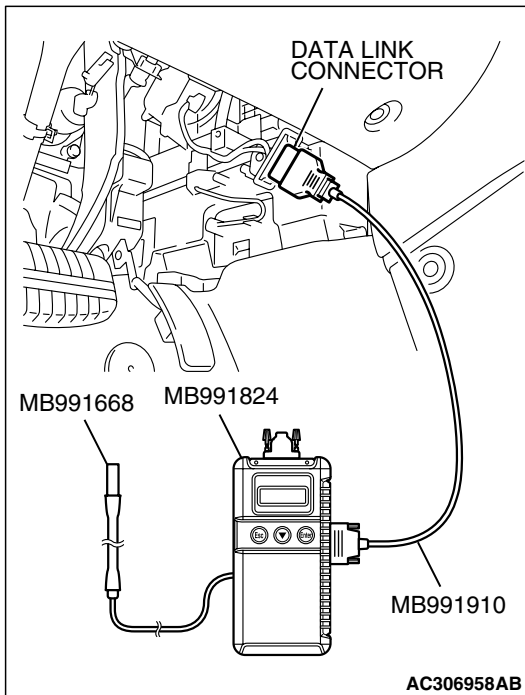
(1) If the compression increases after oil is added, the cause of the malfunction is a worn or damaged piston ring and/or cylinder inner surface.

(2) If the compression does not rise after oil is added, the cause is a burnt or defective valve seat, or pressure is leaking from the gasket.

9. Connect the crankshaft position sensor connector.

10. Install the spark plugs and ignition coils.





- Use the scan tool MB991958 to erase the diagnostic trouble codes.

*NOTE: This will erase the diagnostic trouble code resulting from the crankshaft position sensor connector being disconnected.*

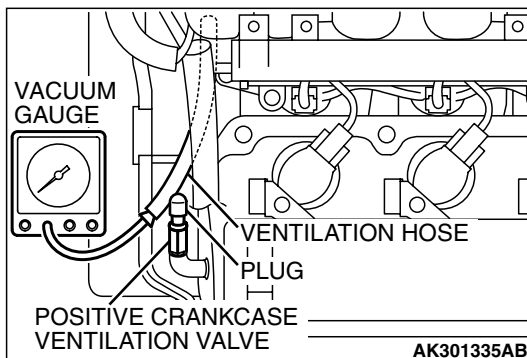
## MANIFOLD VACUUM CHECK

M1111002700848

- Start the engine and allow it to warm up until the temperature of the engine coolant reaches 80 – 95°C (176 – 203°F).
- Connect an engine tachometer.
- Disconnect the ventilation hose from the positive crankcase ventilation (PCV) valve, and connect a vacuum gauge to the ventilation hose.
- Plug the PCV valve.
- Start the engine and check that idle speed is within specification. Then check the vacuum gauge reading.

**Idle speed: 680 ± 100 r/min**

**Minimum limit: 60 kPa (18 in Hg)**



## LASH ADJUSTER CHECK

M1111002900400

If an abnormal noise (chattering noise) suspected to be caused by malfunction of the lash adjuster is produced immediately after starting the engine and does not disappear, perform the following check.

*NOTE: An abnormal noise due to malfunction of the lash adjuster is produced immediately after starting the engine and changes with the engine speed, irrespective of the engine load. If, the abnormal noise is not produced immediately after starting the engine or does not change with the engine speed, or it changes with the engine load, the lash adjuster is not the cause for the abnormal noise.*

*NOTE: When the lash adjuster is malfunctioning, the abnormal noise is rarely eliminated by continuing the warming-up of the engine at idle speed.*

*However, the abnormal noise may disappear only when seizure is caused by oil sludge in the engine whose oil is not maintained properly.*

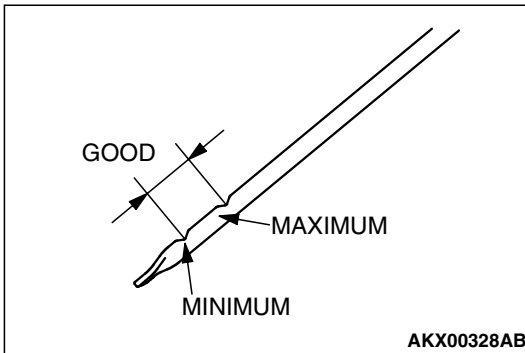
1. Start the engine.
2. Check if the abnormal noise produced immediately after starting the engine, changes with the change in the engine speed.  
If the abnormal noise is not produced immediately after starting the engine or it does not change with the engine speed, the lash adjuster is not the cause for the noise. Therefore, investigate other causes. The abnormal noise is probably caused by some other parts than the engine proper if it does not change with the engine speed. (In this case, the lash adjuster is in good condition.)
3. With the engine idling, change the engine load (shift from N to D range, for example) to make sure that there is no change in the level of abnormal noise.  
If there is a change in the level of abnormal noise, suspect a tapping noise due to worn crankshaft bearing or connecting rod bearing (In this case, the lash adjuster is in good condition.).
4. After completion of warm-up, run the engine at idle to check for abnormal noise.  
If the noise is reduced or disappears, clean the lash adjuster (Refer to GROUP 11D, Engine Overhaul <3.8L Engine> – Rocker Arms and Camshaft – Inspection [P.11D-27](#)). As it is suspected that the noise is due to seizure of the lash adjuster. If there is no change in the level of the abnormal noise, proceed to step 5.
5. Run the engine to bleed the lash adjuster system (Refer to [P.11C-13](#)).
6. If the abnormal noise does not disappear after air bleeding operation, clean the lash adjuster (Refer to GROUP 11D, Engine Overhaul <3.8L Engine> – Rocker Arms and Camshaft – Inspection [P.11D-27](#)).

### **Bleeding lash adjuster system**

*NOTE: Parking the vehicle on a grade for a long time may decrease oil in the lash adjuster, causing air to enter the high pressure chamber when starting the engine.*

*NOTE: After parking for many hours, oil may run out from the oil passage and take time before oil is supplied to the lash adjuster, causing air to enter the high pressure chamber.*

*NOTE: In the above cases, abnormal noise can be eliminated by bleeding the lash adjuster system.*

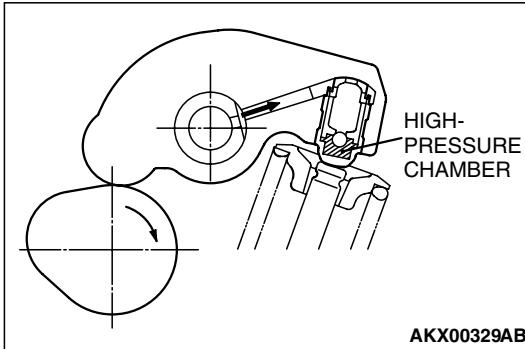


1. Check engine oil and add or change oil if required.

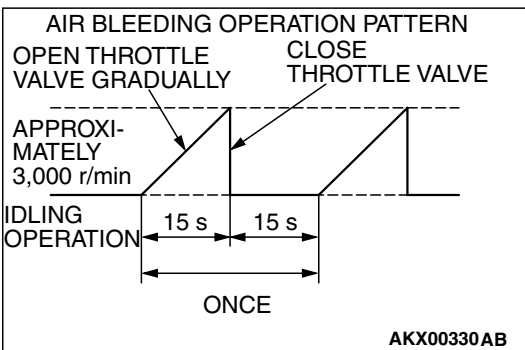
*NOTE: If the engine oil level is low, air is sucked from the oil screen, causing air to enter the oil passage.*

*NOTE: If the engine oil level is higher than specification, oil may be stirred by the crankshaft, causing oil to be mixed with a large quantity of air.*

*NOTE: If oil is deteriorated, air is not easily separated from oil, increasing the quantity of air contained in oil.*



*NOTE: If air mixed with oil enters the high pressure chamber inside the lash adjuster from the above causes, air in the high pressure chamber is compressed excessively while the valve is opened, resulting in an abnormal noise when the valve closes. This is the same phenomenon as that observed when the valve clearance has become excessive. The lash adjuster can resume normal function when air entered the lash adjuster is removed.*



2. Idle the engine for one to three minutes to warm it up.
3. Repeat the operation pattern, shown in left figure, at no load to check for abnormal noise. (Usually the abnormal noise is eliminated after repetition of the operation 10 to 30 times. If, however, no change is observed in the level of abnormal noise after repeating the operation more than 30 times, suspect that the abnormal noise is due to some other factors.)
4. After elimination of abnormal noise, repeat the operation shown in left figure five more times.
5. Run the engine at idle for one to three minutes to make sure that the abnormal noise has been eliminated.

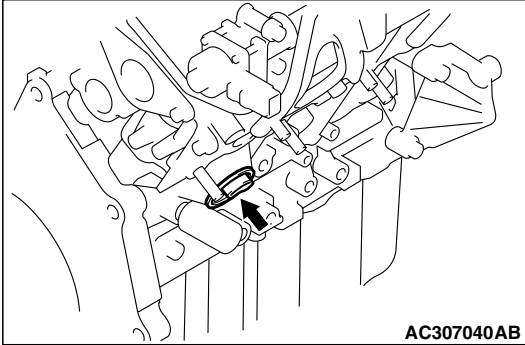
**CYLINDER BLOCK HEATER UNIT CHECK**

M1111004800034

1. Remove the cylinder block heater cover. (Refer to [P.11C-54](#)).
2. Disconnect cylinder block heater unit connector, and measure the resistance at cylinder block heater unit.

**Standard value: 19 – 30  $\Omega$**

3. If not within the standard value, replace the cylinder block heater unit. (Refer to [P.11C-54](#)).



## ENGINE ASSEMBLY

## REMOVAL AND INSTALLATION

M1112001000894

**⚠ CAUTION**

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

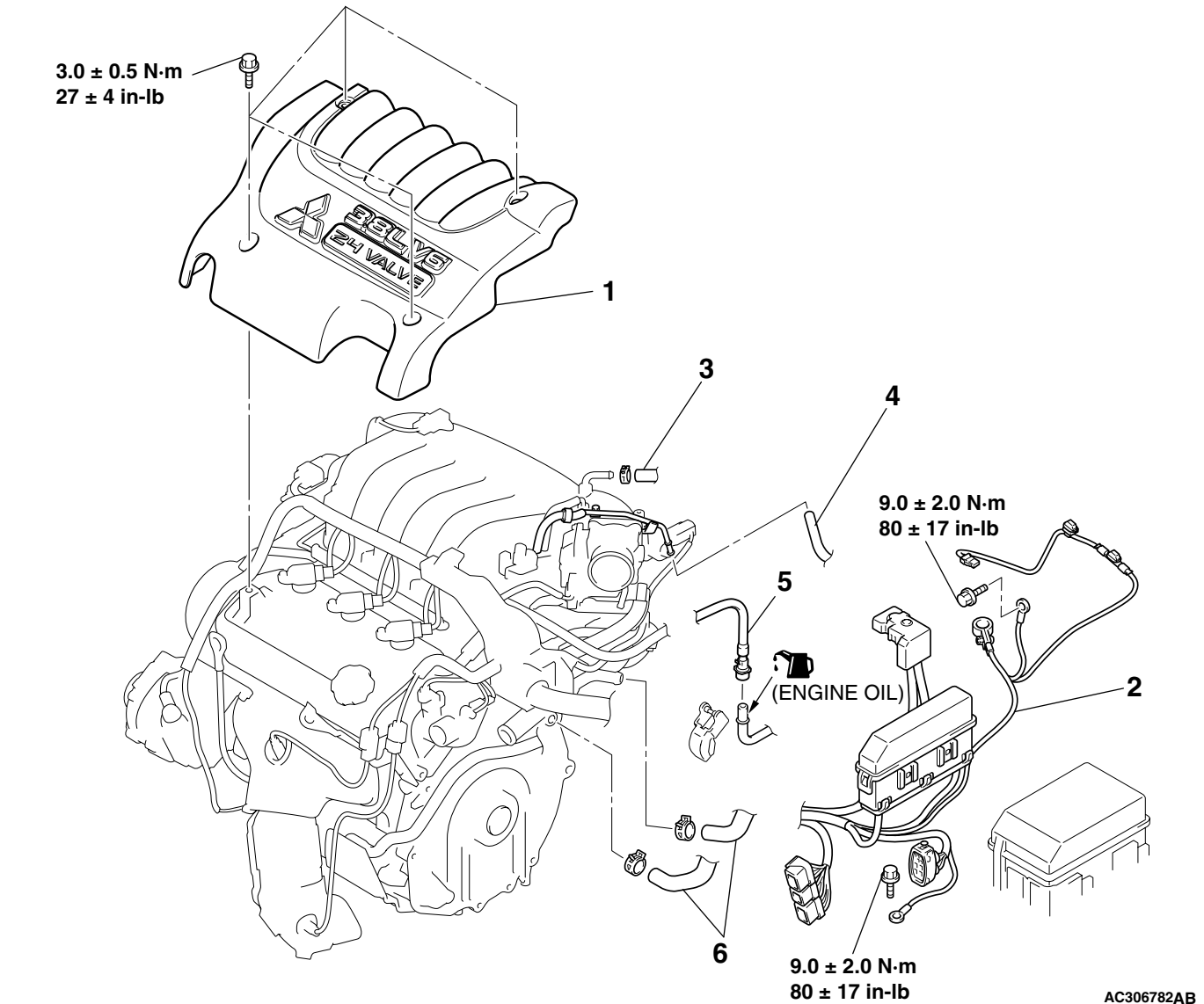
**Pre-removal Operation**

- Under Cover Removal (Refer to GROUP 51, Under Cover P.51-11.)
- Fuel Line Pressure Reduction [Refer to GROUP 13B, On-vehicle Service – Fuel Pump Relay Disconnection (How to Reduce Pressurized Fuel Lines) P.13B-1181.]
- Engine Coolant Draining (Refer to GROUP 14, On-vehicle Service – Engine Coolant Replacement P.14-7.)
- Engine Oil Draining (Refer to GROUP 12, On-vehicle Service – Engine Oil Replacement P.12-3.)
- Hood Removal (Refer to GROUP 42, Hood P.42-8.)
- Powertrain Control Module (PCM) Removal (Refer to GROUP 13B, Powertrain Control Module (PCM) P.13B-1192.)
- Air Cleaner Removal (Refer to GROUP 15, Air Cleaner P.15-4.)
- Front Exhaust Pipe Removal (Refer to GROUP 15, Exhaust Pipe and Main Muffler P.15-20.)
- Strut Tower Bar Removal (Refer to GROUP 42, Strut Tower Bar P.42-12.)
- Battery and Battery Tray Removal
- Radiator Grille Removal (Refer to GROUP 51, Radiator Grille P.51-5.)

**Post-installation Operation**

- Right Bank Exhaust Manifold Installation (Refer to GROUP 15, Exhaust Manifold P.15-16.)
- Radiator Grille Installation (Refer to GROUP 51, Radiator Grille P.51-5.)
- Battery and Battery Tray Installation
- Strut Tower Bar Installation (Refer to GROUP 42, Strut Tower Bar P.42-12.)
- Air Cleaner Installation (Refer to GROUP 15, Air Cleaner P.15-4.)
- Front Exhaust Pipe Installation (Refer to GROUP 15, Exhaust Pipe and Main Muffler P.15-20.)
- Powertrain Control Module (PCM) Installation (Refer to GROUP 13B, Powertrain Control Module (PCM) P.13B-1192.)
- Hood Installation (Refer to GROUP 42, Hood P.42-8.)
- Drive Belt Tension Check (Refer to P.11C-8.)
- Engine Oil Refilling (Refer to GROUP 12, On-vehicle Service – Engine Oil Replacement P.12-3.)
- Engine Coolant Refilling (Refer to GROUP 14, On-vehicle Service – Engine Coolant Replacement P.14-7.)
- Fuel Leak Check
- Under Cover Installation (Refer to GROUP 51, Under Cover P.51-11.)





**REMOVAL STEPS**

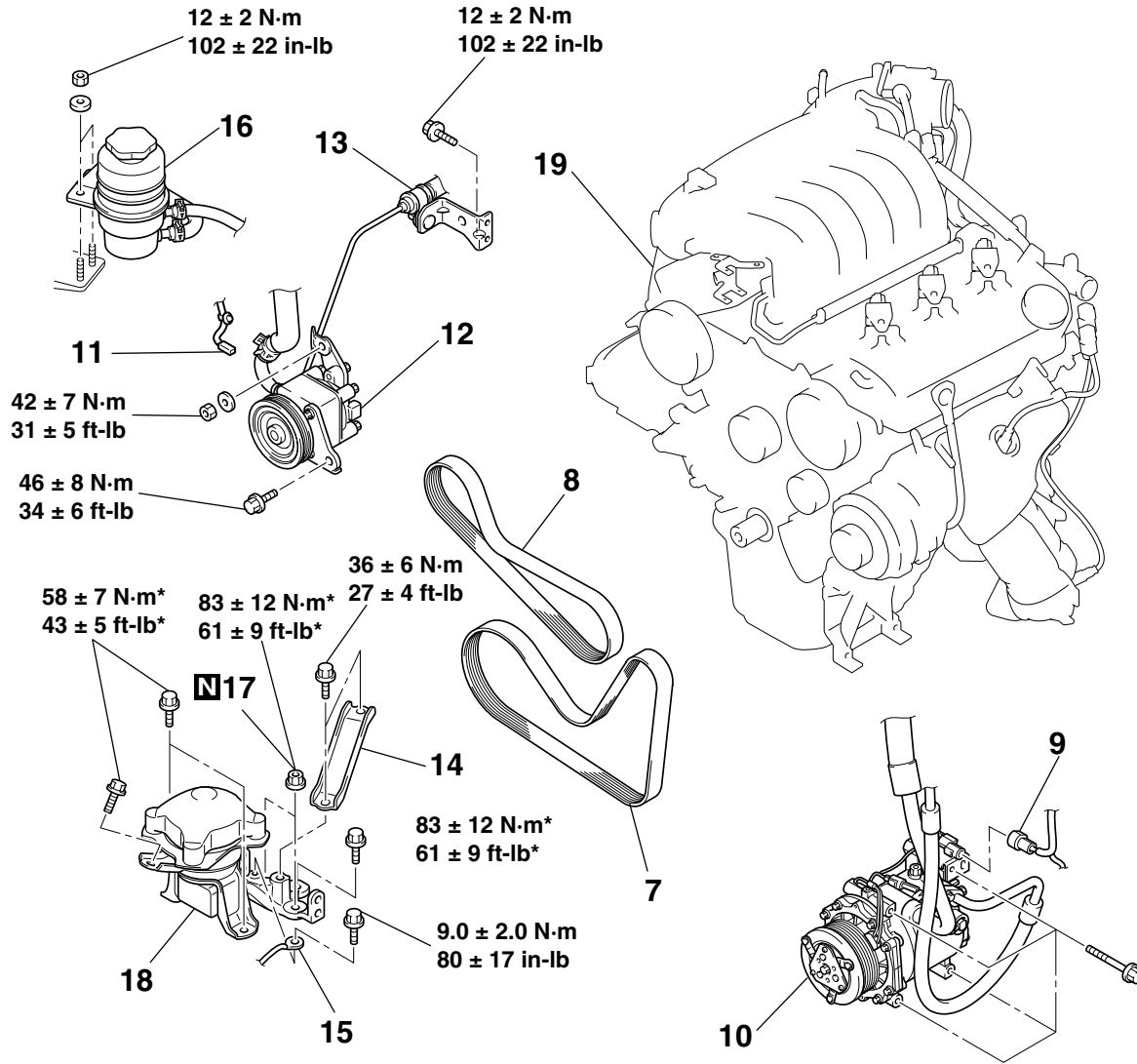
1. ENGINE COVER
2. CONTROL WIRING HARNESS CONNECTION
3. VACUUM HOSE CONNECTION
4. PURGE HOSE CONNECTION
5. FUEL HIGH-PRESSURE HOSE CONNECTION
6. HEATER HOSE CONNECTION

**REMOVAL STEPS (Continued)**

- DRIVE SHAFT (REFER TO GROUP 26, DRIVE SHAFT ASSEMBLY P.26-13.)
- EXHAUST MANIFOLD (RH) (REFER TO GROUP 15, EXHAUST MANIFOLD P.15-16.)

<<A>> >>C<<

<<B>>



AC306783AB

- |       |   |             |  |
|-------|---|-------------|--|
| <<C>> | 7. GENERATOR DRIVE BELT                           | <<F>>       | • TRANSAXLE ASSEMBLY (REFER TO GROUP 23A, TRANSAXLE ASSEMBLY <F4A5A>P.23A-395 .) |
| <<D>> | 8. POWER STEERING OIL PUMP DRIVE BELT             |             | 14. ENGINE MOUNTING STAY   |
| <<E>> | 9. A/C COMPRESSOR ASSEMBLY CONNECTOR              | <<G>> >>B<< | 15. GROUNDING CABLE CONNECTION   |
|       | 10. A/C COMPRESSOR ASSEMBLY                       | <<H>> >>A<< | 16. POWER STEERING OIL RESERVOIR   |
|       | 11. POWER STEERING PRESSURE SWITCH CONNECTOR      |             | 17. SELF-LOCKING NUTS  |
|       | 12. POWER STEERING OIL PUMP                       |             | 18. ENGINE FRONT MOUNTING BRACKET  |
|       | 13. POWER STEERING PRESSURE HOSE CLAMP BRACKET    |             | 19. ENGINE ASSEMBLY  |
|       | • RADIATOR (REFER TO GROUP 14, RADIATOR P.14-11.) |             |  |

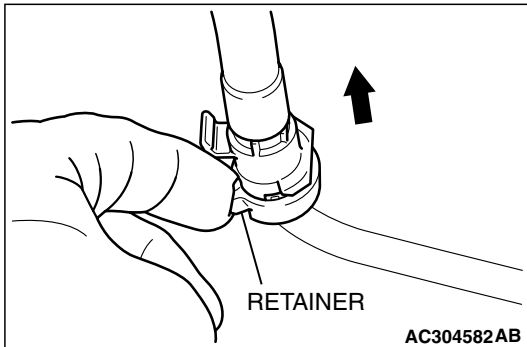
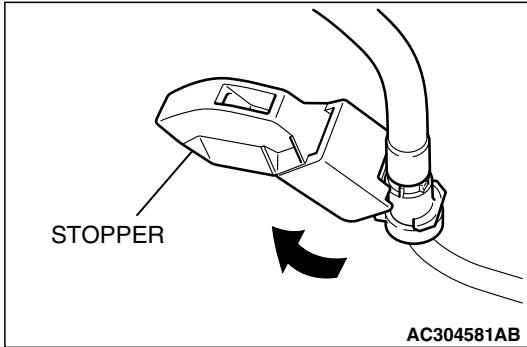
**Required Special Tools:**

- MB991454: Engine Hanger Balancer
- MB991895: Engine Hanger
- MB991928: Engine Hanger

## REMOVAL SERVICE POINTS

### <<A>> FUEL HIGH-PRESSURE HOSE REMOVAL

1. Remove the fuel high-pressure hose stopper.



2. Remove the fuel high-pressure hose in the direction shown in the figure while the retainer is pulled up.

*NOTE: If the retainer is released, install it after removing the fuel high-pressure hose.*

### <<B>> EXHAUST MANIFOLD (RH) REMOVAL

Do not remove the center exhaust pipe, and pull out the exhaust manifold (RH) between the crossmember and cylinder block.

### <<C>> A/C COMPRESSOR ASSEMBLY REMOVAL

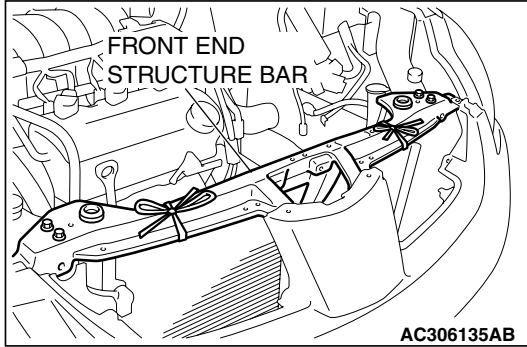
Remove the compressor from the compressor bracket with the hose still attached.

*NOTE: Place the removed A/C compressor where it will not be a hindrance when removing and installing the engine assembly, and secure it with a cord or wire.*

### <<D>> POWER STEERING OIL PUMP REMOVAL

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

*NOTE: Place the removed power steering oil pump in a place where it will not be a hindrance when removing and installing the engine assembly, and secure it with a cord or wire.*

**<<E>> RADIATOR REMOVAL**

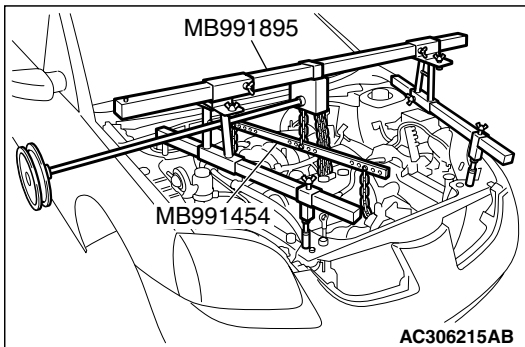
1. Assemble the front end structure bar removed temporarily and hang the condenser assembly with a cord.

**<<F>> TRANSAXLE ASSEMBLY REMOVAL**

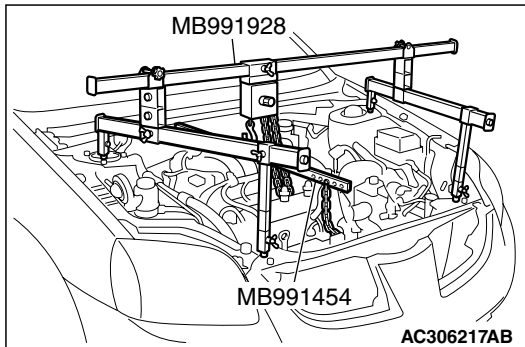
Remove the transaxle assembly. (Refer to GROUP 23A, Transaxle assembly <F4A5A>P.23A-395 ).

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

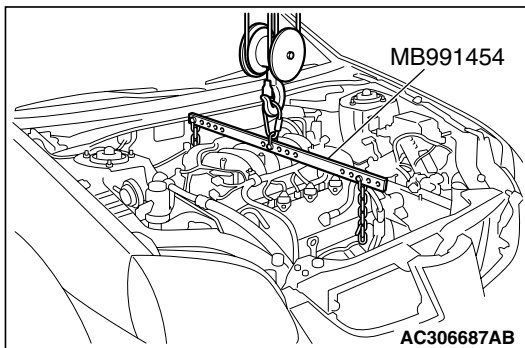
1. Support the engine with a garage jack.
2. <Engine hanger MB991895 is used>  
Remove special tool MB991895.



3. <Engine hanger MB991928 is used>  
Remove special tool MB991928.



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



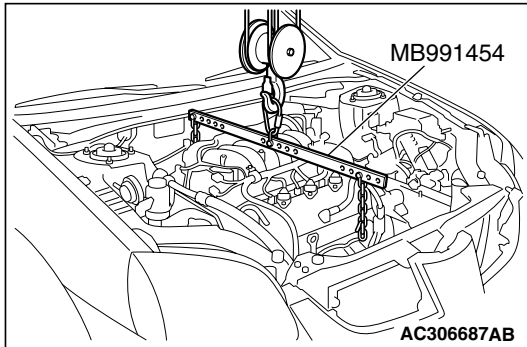
## <<H>> ENGINE ASSEMBLY REMOVAL

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

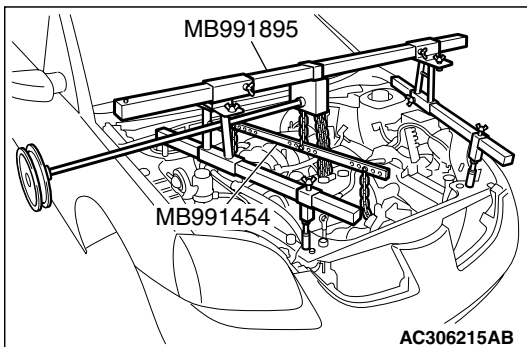
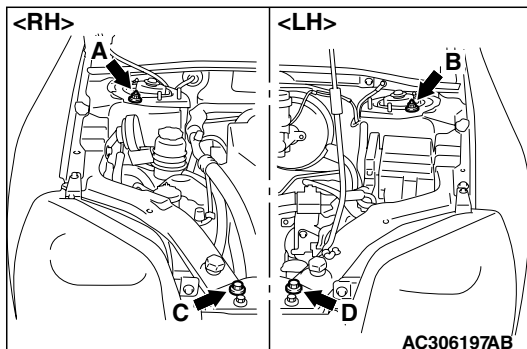
### >>A<< ENGINE ASSEMBLY INSTALLATION

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

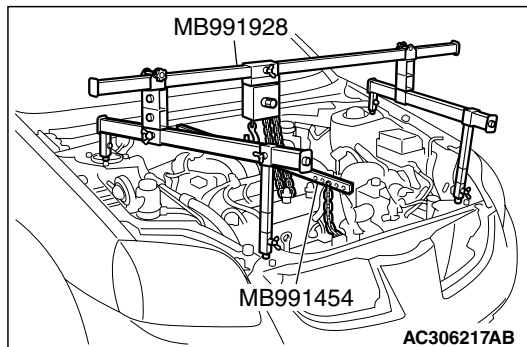
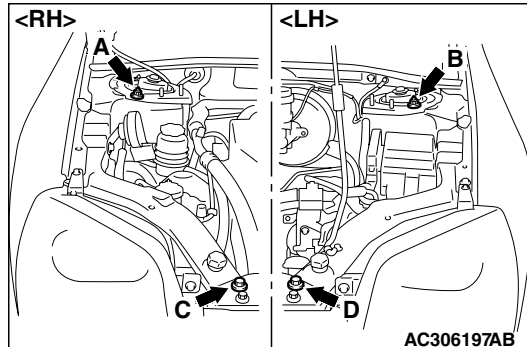
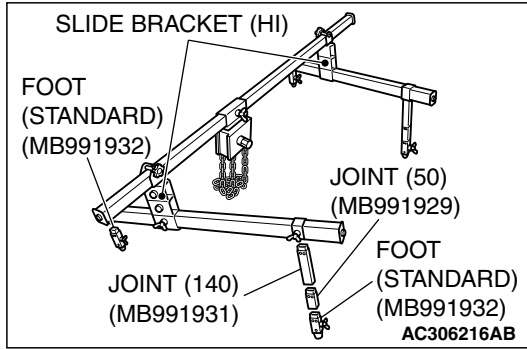


### >>B<< ENGINE FRONT MOUNTING BRACKET INSTALLATION

1. Place a garage jack against the engine oil pan with a piece of wood in between, and install the engine mount while adjusting the position of the engine.
2. Support the engine assembly with a garage jack.
3. Remove the chain block.
4. <Engine hanger MB991895 is used>
  - (1) Set special tool MB991895 to the front fender assembling bolts (A and B) and (C and D) as shown.



- (2) Set special tool MB991454 to hold the engine assembly.



## 5. &lt;Engine hanger MB991928 is used&gt;

(1) Assemble special tool MB991928. (Set following parts to the base hanger.)

- SLIDE BRACKET (HI)
- FOOT (STANDARD) (MB991932)
- JOINT (50) (MB991929)
- JOINT (140) (MB991931)

(2) Set special tool MB991928 to the front fender assembling bolts (A and B) and (C and D) as shown.

(3) Set special tool MB991454 to hold the engine assembly.

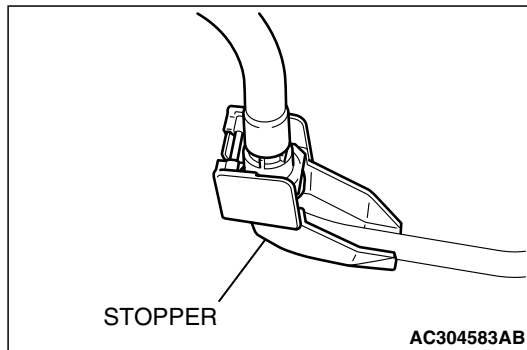
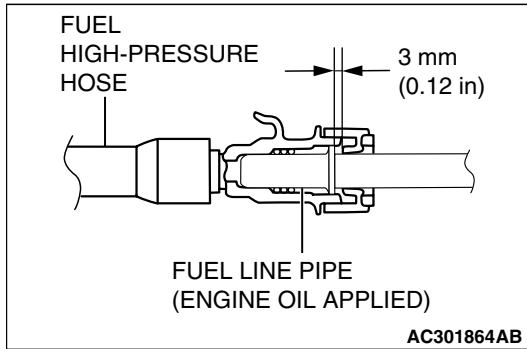
*NOTE: Adjust the engine hanger balance by sliding the slide bracket (HI).*

## >>C<< FUEL HIGH-PRESSURE HOSE INSTALLATION

### CAUTION

After connecting the fuel high-pressure hose, slightly pull it to ensure that it is installed securely. Also confirm that there is a play approximately 3 mm (0.12 inch). Then install the stopper securely.

Apply a small amount of engine oil to the fuel line pipe and then install the fuel high-pressure hose.

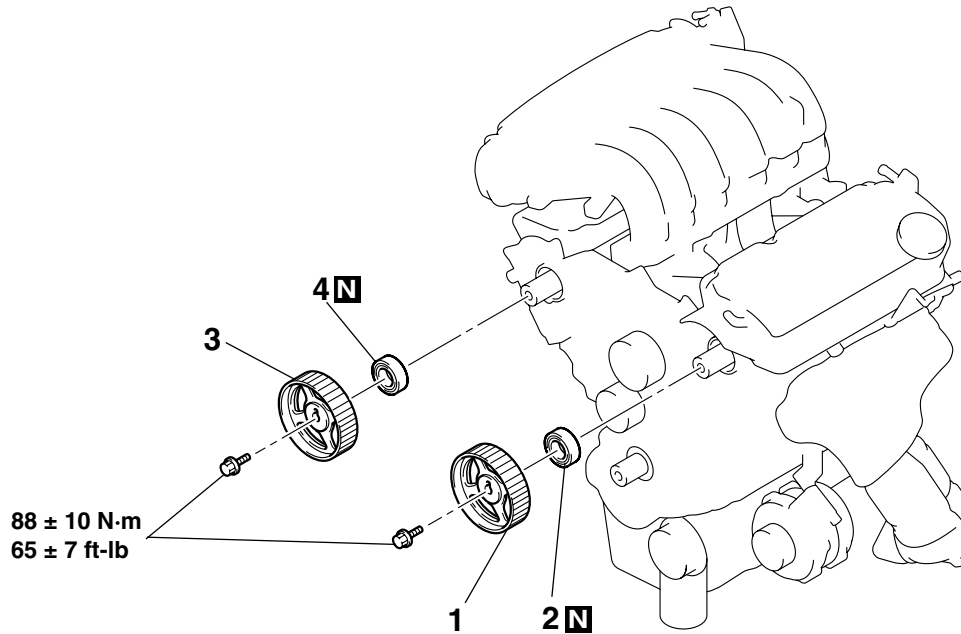


# CAMSHAFT OIL SEAL

## REMOVAL AND INSTALLATION

M1112002200170

**Pre-removal and Post-installation Operation**  
Timing Belt Removal and Installation (Refer to P.11C-48.)



AC205540AB

- REMOVAL STEPS**
- <<A>> >>B<< 1. LEFT BANK CAMSHAFT SPROCKET
- <<B>> >>A<< 2. CAMSHAFT OIL SEAL

- REMOVAL STEPS (Continued)**
- <<A>> >>B<< 3. RIGHT BANK CAMSHAFT SPROCKET
- <<B>> >>A<< 4. CAMSHAFT OIL SEAL

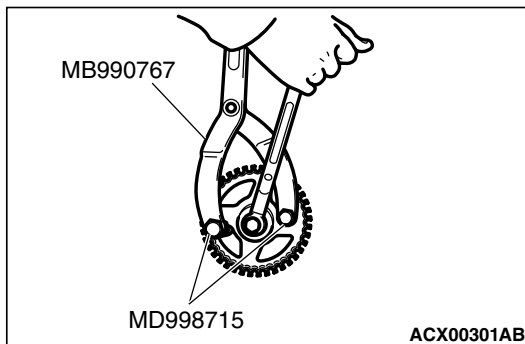
**Required Special Tools:**

- MB990767: End Yoke Holder
- MD998713: Camshaft Oil Seal Installer
- MB991559: Camshaft Oil Seal Adapter Installer
- MD998715: Crankshaft Pulley Holder Pin

**REMOVAL SERVICE POINTS**

**<<A>> CAMSHAFT SPROCKET REMOVAL**

Use special tools MD998715 and MB990767 to remove the camshaft sprocket.





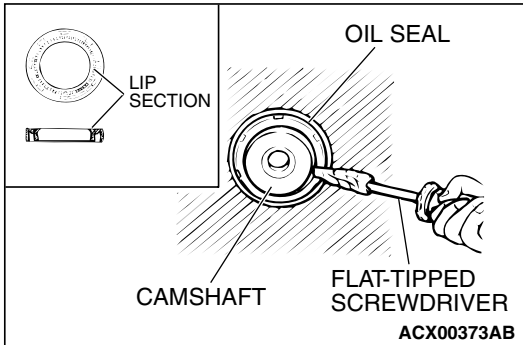
### <<B>> CAMSHAFT OIL SEAL REMOVAL

1. Make a notch in the oil seal lip section with a knife, etc.

**⚠ CAUTION**

Be careful not to damage the camshaft and the cylinder head.

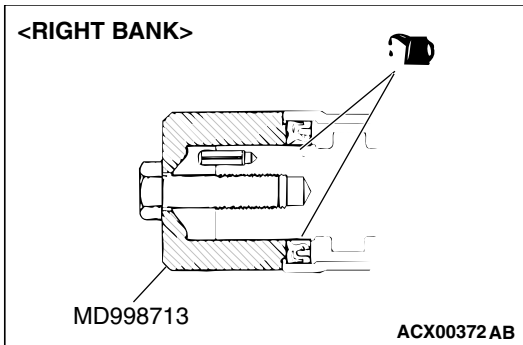
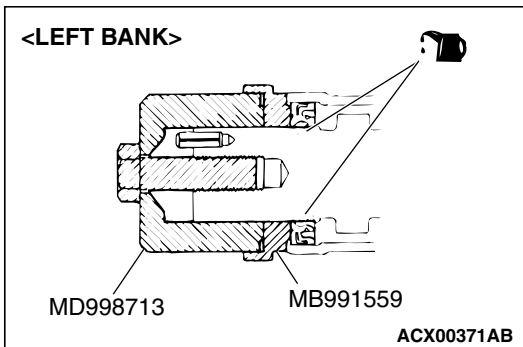
2. Cover the end of a flat-tipped screwdriver with a shop towel and insert into the notched section of the oil seal, and pry out the oil seal to remove it.



### INSTALLATION SERVICE POINTS

#### >>A<< CAMSHAFT OIL SEAL INSTALLATION

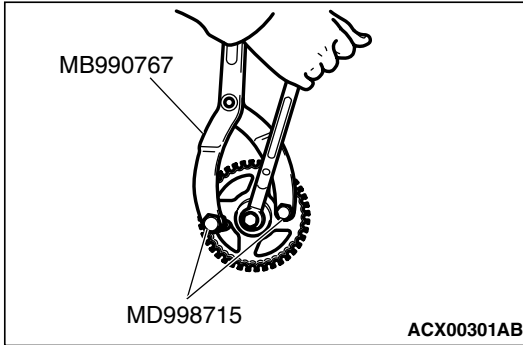
1. Apply engine oil to the camshaft oil seal lip.
2. Use special tools MD998713 and MB991559 to press-fit the camshaft oil seal.



## &gt;&gt;B&lt;&lt; CAMSHAFT SPROCKET INSTALLATION

1. Use special tools MD998715 and MB990767 in the same way as during removal to install the camshaft sprocket.
2. Tighten the camshaft sprocket mounting bolt to the specified torque.

**Tightening torque:  $88 \pm 10$  N·m ( $65 \pm 7$  ft-lb)**



# CAMSHAFT AND VALVE STEM SEAL

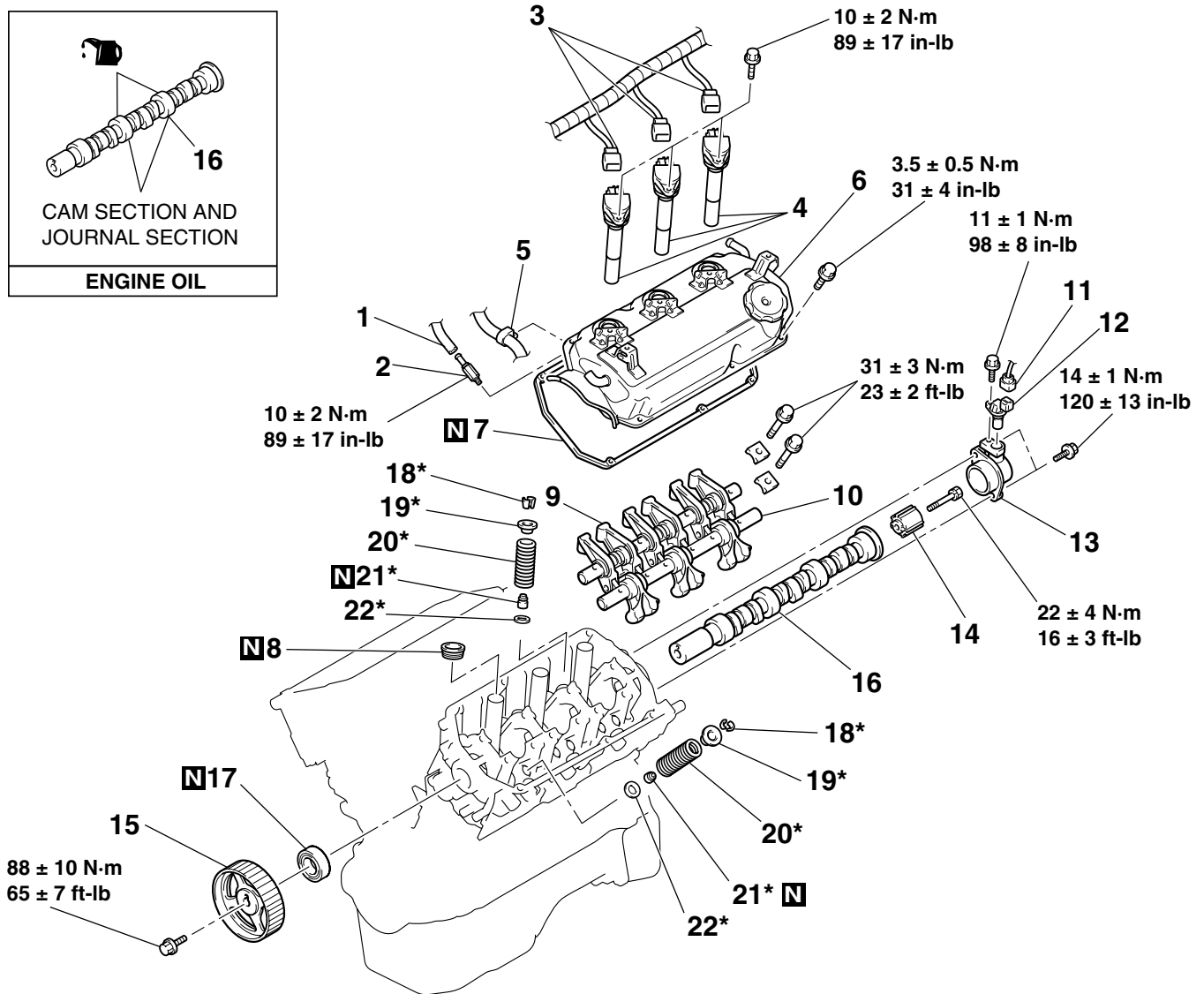
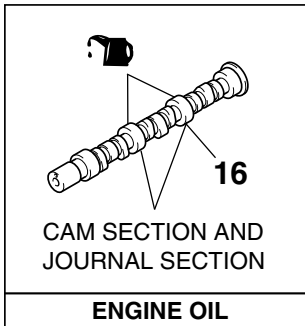
## REMOVAL AND INSTALLATION

M1112006600299

**CAUTION**

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

<LEFT BANK>



AC307922AB

**CAMSHAFT REMOVAL STEPS**

- TIMING BELT (REFER TO P.11C-48.)
- THERMOSTAT HOUSING (REFER TO GROUP 14, WATER HOSE AND WATER PIPE P.14-24.)
- 1. PCV HOSE CONNECTION
- 2. PCV VALVE
- 3. IGNITION COIL CONNECTOR
- 4. IGNITION COIL
- 5. ENGINE CONTROL WIRING HARNESS CLAMP

**CAMSHAFT REMOVAL STEPS**

- 6. ROCKER COVER
- 7. ROCKER COVER GASKET
- 8. SPARK PLUG GUIDE OIL SEAL
- 9. ROCKER ARM, SHAFT AND LASH ADJUSTER ASSEMBLY (INTAKE SIDE)
- 10. ROCKER ARM, SHAFT AND LASH ADJUSTER ASSEMBLY (EXHAUST SIDE)
- 11. CAMSHAFT POSITION SENSOR CONNECTOR
- 12. CAMSHAFT POSITION SENSOR

**CAMSHAFT REMOVAL STEPS**

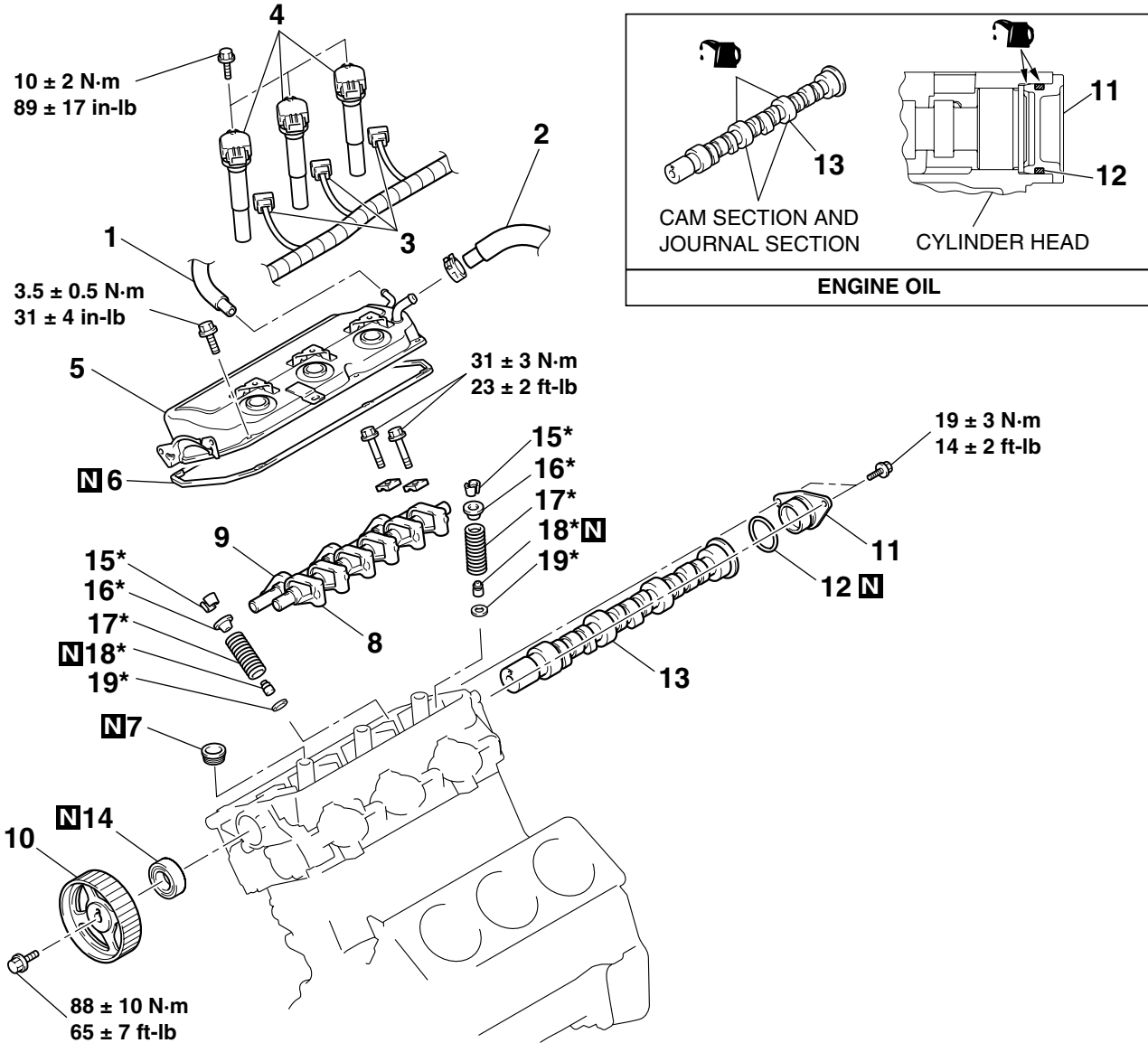
**VALVE STEM SEAL REMOVAL STEPS (Continued)**

- |       |  |  |       |                        |   |
|-------|--|--|-------|------------------------|---|
|       | 13. CAMSHAFT POSITION SENSOR SUPPORT   |  |       | 6. ROCKER COVER        |   |
|       | 14. CAMSHAFT POSITION SENSING CYLINDER |  |       | 7. ROCKER COVER GASKET |   |
| <<B>> | >>F<<                                  | 15. CAMSHAFT SPROCKET                  | <<A>> | >>D<<                  | 8. SPARK PLUG GUIDE OIL SEAL                                    |
|       |  | 16. CAMSHAFT                           |       |                        | 9. ROCKER ARM, SHAFT AND LASH ADJUSTER ASSEMBLY (INTAKE SIDE)   |
| <<C>> | >>E<<                                  | 17. CAMSHAFT OIL SEAL                  |       |                        | 10. ROCKER ARM, SHAFT AND LASH ADJUSTER ASSEMBLY (EXHAUST SIDE) |
|       |  | <b>VALVE STEM SEAL REMOVAL STEPS</b>   | <<A>> | >>D<<                  | • SPARK PLUG (REFER TO GROUP 16, IGNITION COIL P.16-41.)        |
|       |  | • ENGINE COVER (REFER TO P.11C-16.)    |       |                        |   |
|       |  | 1. PCV HOSE CONNECTION                 | <<D>> | >>C<<                  | 18. VALVE SPRING RETAINER LOCK                                  |
|       |  | 2. PCV VALVE                           |       |                        | 19. VALVE SPRING RETAINER                                       |
|       |  | 3. IGNITION COIL CONNECTOR             |       | >>B<<                  | 20. VALVE SPRING  |
|       |  | 4. IGNITION COIL                       |       | >>A<<                  | 21. VALVE STEM SEAL   |
|       |  | 5. ENGINE CONTROL WIRING HARNESS CLAMP |       |                        | 22. VALVE SPRING SEAT   |

**Required Special Tools:**

- MB990767: End Yoke Holder
- MD998443: Auto-lash Adjuster Holder
- MB991559: Camshaft Oil Seal Adapter Installer
- MD998713: Camshaft Oil Seal Installer
- MD998715: Crankshaft Pulley Holder Pin
- MD998772: Valve Spring Compressor
- MD998774: Valve Stem Seal Installer

<RIGHT BANK>



AC307923AB

**CAMSHAFT REMOVAL STEPS**

- INTAKE MANIFOLD PLENUM (REFER TO GROUP 15, INTAKE MANIFOLD PLENUM P.15-6.)
  - TIMING BELT (REFER TO P.11C-48.)
  - BATTERY AND BATTERY TRAY
  - HEATER HOSE AND WATER HOSE (REFER TO GROUP 14, WATER HOSE AND WATER PIPE P.14-24.)
  - THROTTLE BODY STAY (REFER TO GROUP 13B, THROTTLE BODY ASSEMBLY P.13B-1190.)
1. BREATHER HOSE CONNECTION
  2. BLOW-BY HOSE CONNECTION
  3. IGNITION COIL CONNECTOR
  4. IGNITION COIL

**CAMSHAFT REMOVAL STEPS**

- |             |  |
|-------------|--|
|             | 5. ROCKER COVER  |
|             | 6. ROCKER COVER GASKET   |
|             | 7. SPARK PLUG GUIDE OIL SEAL                                   |
| <<A>> >>D<< | 8. ROCKER ARM, SHAFT AND LASH ADJUSTER ASSEMBLY (INTAKE SIDE)  |
| <<A>> >>D<< | 9. ROCKER ARM, SHAFT AND LASH ADJUSTER ASSEMBLY (EXHAUST SIDE) |
| <<B>> >>F<< | 10. CAMSHAFT SPROCKET  |
|             | 11. THRUST CASE  |
|             | 12. O-RING   |
|             | 13. CAMSHAFT   |
| <<C>> >>E<< | 14. CAMSHAFT OIL SEAL  |

**VALVE STEM SEAL REMOVAL STEPS**

- INTAKE MANIFOLD PLENUM (REFER TO GROUP 15, INTAKE MANIFOLD PLENUM P.15-6.) <<A>> >>D<<
- TIMING BELT FRONT UPPER COVER, RIGHT (REFER TO P.11C-48.) <<A>> >>D<<
- 1. BREATHER HOSE CONNECTION
- 2. BLOW-BY HOSE CONNECTION
- 3. IGNITION COIL CONNECTOR
- 4. IGNITION COIL <<D>> >>C<<
- 5. ROCKER COVER
- 6. ROCKER COVER GASKET >>B<<
- 7. SPARK PLUG GUIDE OIL SEAL >>A<<

**VALVE STEM SEAL REMOVAL STEPS (Continued)**

- 8. ROCKER ARM, SHAFT AND LASH ADJUSTER ASSEMBLY (INTAKE SIDE)
- 9. ROCKER ARM, SHAFT AND LASH ADJUSTER ASSEMBLY (EXHAUST SIDE)
- SPARK PLUG (REFER TO GROUP 16, IGNITION COIL P.16-41.)
- 15. VALVE SPRING RETAINER LOCK
- 16. VALVE SPRING RETAINER
- 17. VALVE SPRING
- 18. VALVE STEM SEAL
- 19. VALVE SPRING SEAT

**Required Special Tools:**

- MB990767: End Yoke Holder
- MD998443: Auto-lash Adjuster Holder
- MB991559: Camshaft Oil Seal Adapter Installer
- MD998713: Camshaft Oil Seal Installer
- MD998715: Crankshaft Pulley Holder Pin
- MD998772: Valve Spring Compressor
- MD998774: Valve Stem Seal Installer

**REMOVAL SERVICE POINTS**

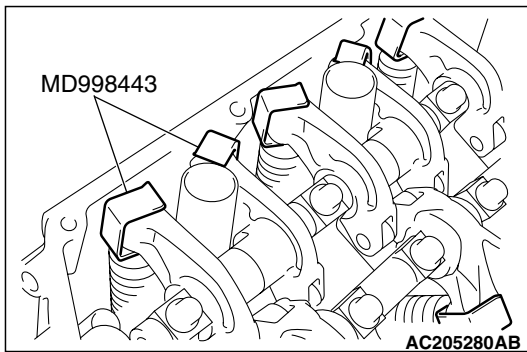
**<<A>> ROCKER ARM AND SHAFT ASSEMBLY REMOVAL**

1. Install special tool MD998443 as shown in the illustration so that the lash adjusters will not fall out.

**CAUTION**

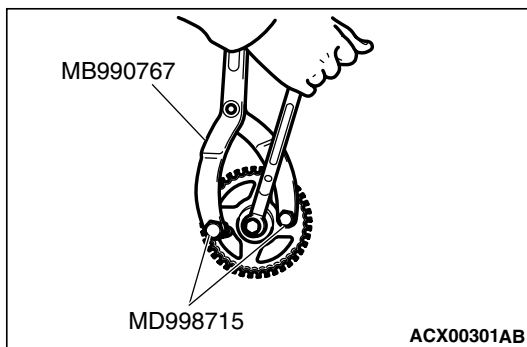
**Never disassemble the rocker arm and shaft assembly.**

2. Loosen the rocker arm and shaft assembly mounting bolt, and then remove the rocker arm and shaft assembly with the bolt still attached.



**<<B>> CAMSHAFT SPROCKET REMOVAL**

Use special tools MD998715 and MB990767 to remove the camshaft sprocket.



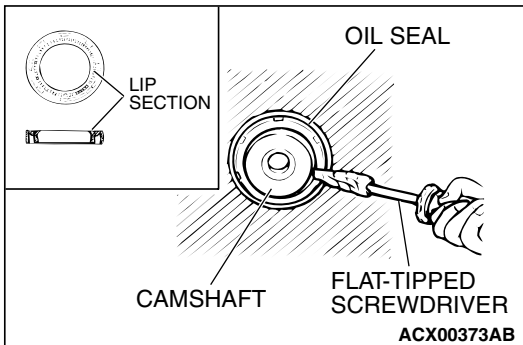
### <<C>> CAMSHAFT OIL SEAL REMOVAL

1. Make a notch in the oil seal lip section with a knife, etc.

**⚠ CAUTION**

Be careful not to damage the camshaft and the cylinder head.

2. Cover the end of a flat-tipped screwdriver with a shop towel and insert into the notched section of the oil seal, and pry out the oil seal to remove it.

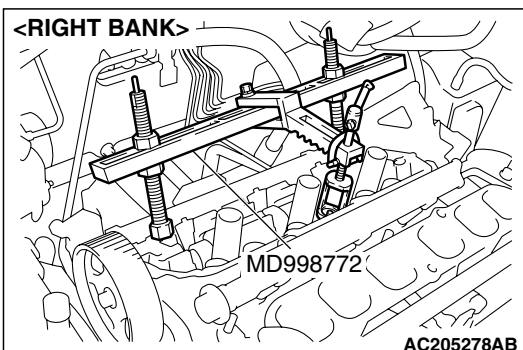
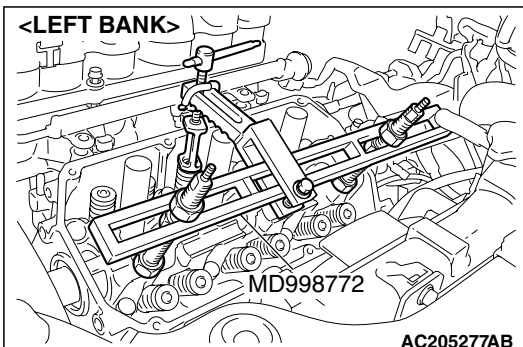


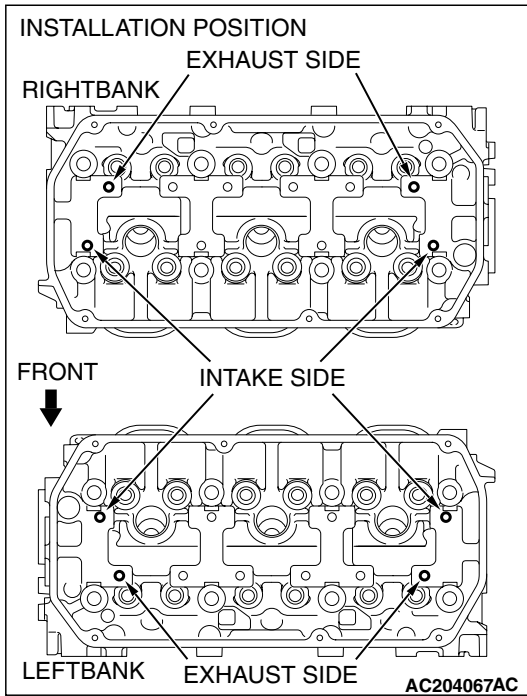
### <<D>> VALVE SPRING RETAINER LOCK REMOVAL

**⚠ CAUTION**

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

Use special tool MD998772 to compress the valve spring, and remove the valve spring retainer locks.





*NOTE: Installation position of valve spring compressor special tool (MD998772) is different between exhaust side and intake side.*

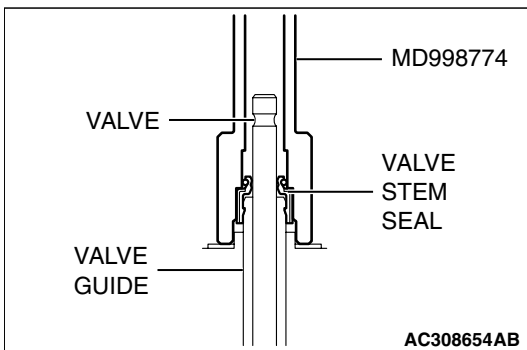
### INSTALLATION SERVICE POINTS

#### >>A<< VALVE STEM SEAL INSTALLATION

1. Apply a small amount of engine oil to the valve stem seal.

**⚠ CAUTION**

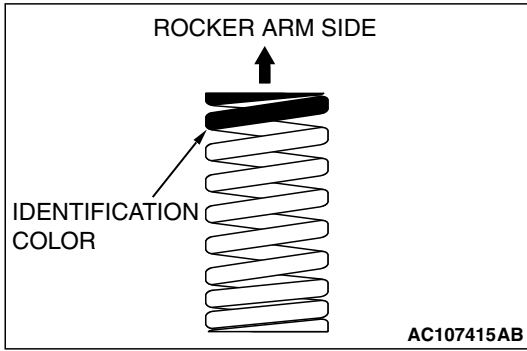
- Valve stem seals cannot be reused.
  - Special tool MD998774 must be used to install the valve stem seal. Improper installation could result in oil leaking past the valve guide.
2. Use special tool MD998774 to fill a new valve stem seal in the valve guide using the valve stem area as a guide.





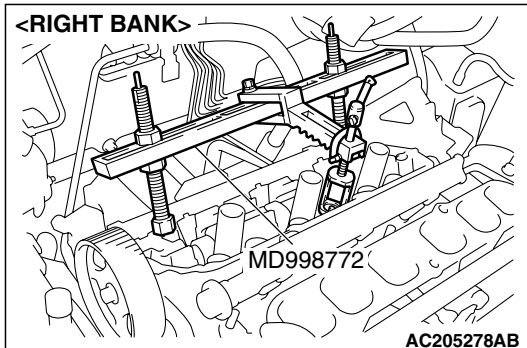
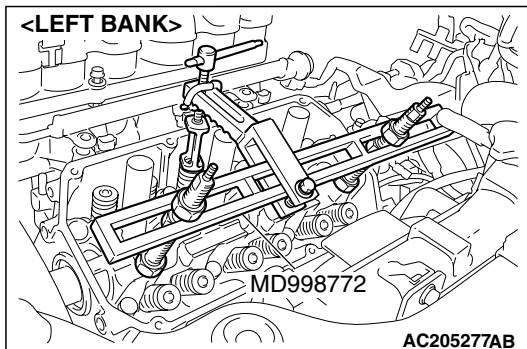
**>>B<< VALVE SPRING INSTALLATION**

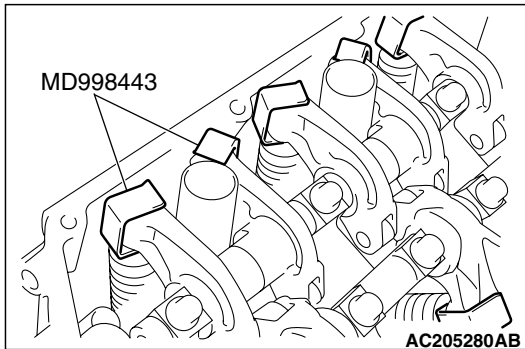
Install the valve spring with its identification color painted end facing the rocker arm.



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

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

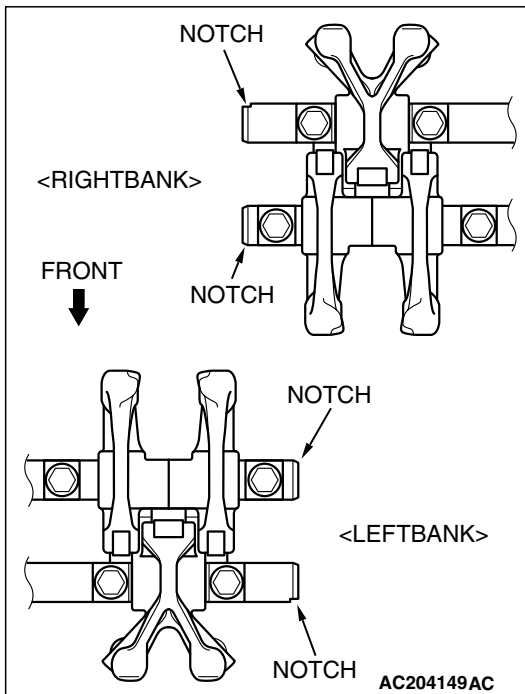


>>D<< ROCKER ARM AND SHAFT ASSEMBLY  
INSTALLATION

1. Install the rocker arm, shaft and lash adjuster assembly.
2. Tighten the mounting bolts to the specified torque.

**Tightening torque:  $31 \pm 3$  N·m ( $23 \pm 2$  ft·lb)**

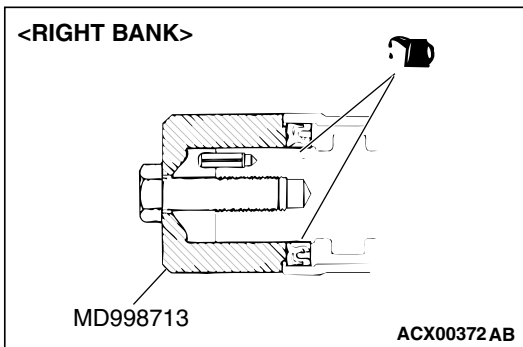
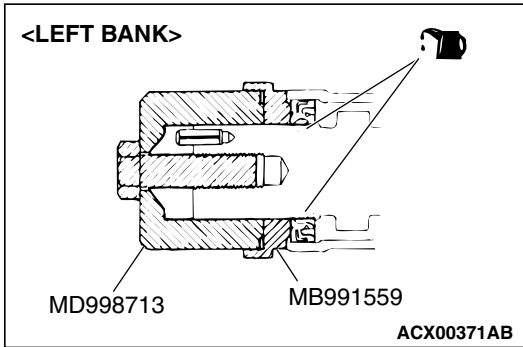
3. Remove special tool MD998443.



4. Check that notches in the each rocker shaft are facing the direction shown in the illustration.

**>>E<< CAMSHAFT OIL SEAL INSTALLATION**

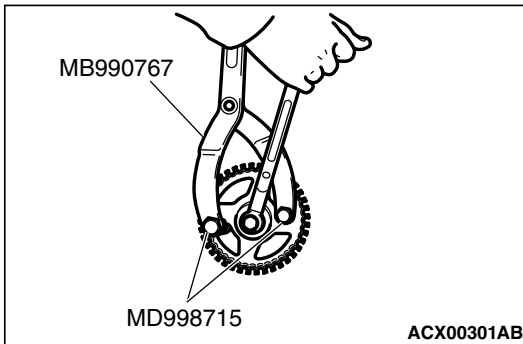
1. Apply engine oil to the camshaft oil seal lip.
2. Use special tools MD998713 and MB991559 to press-fit the camshaft oil seal.



**>>F<< CAMSHAFT SPROCKET INSTALLATION**

1. Use special tools MD998715 and MB990767 in the same way as during removal to install the camshaft sprocket.
2. Tighten the camshaft sprocket mounting bolt to the specified torque.

**Tightening torque:  $88 \pm 10$  N·m ( $65 \pm 7$  ft-lb)**



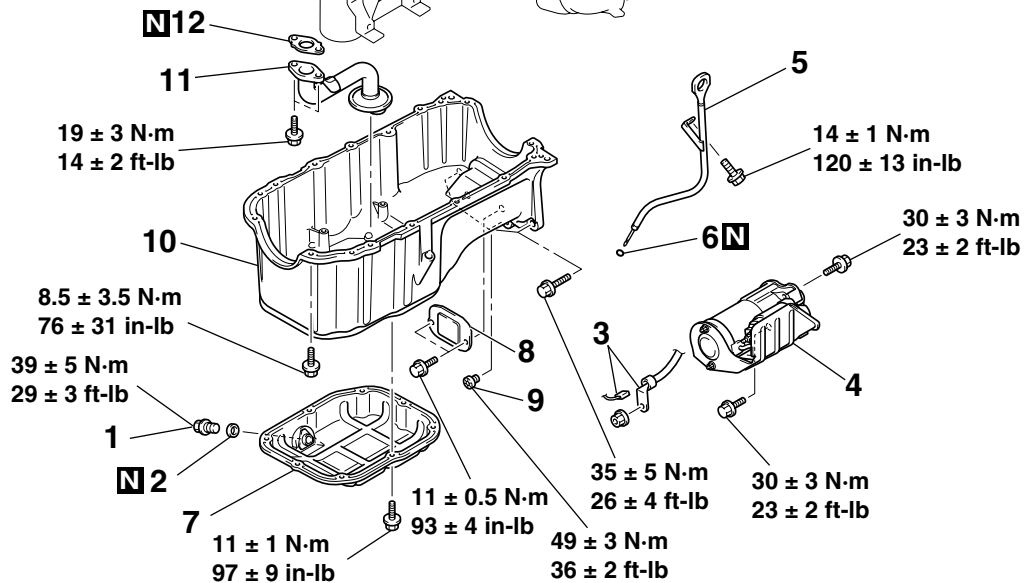
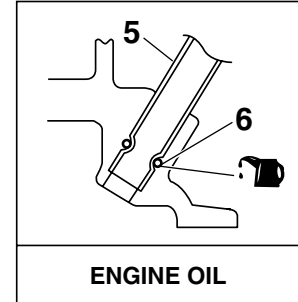
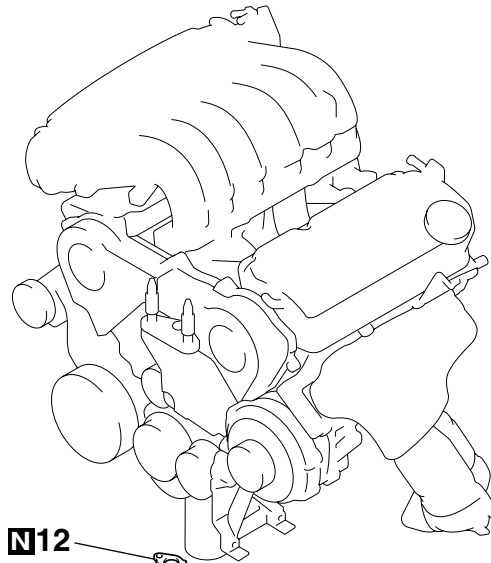
# OIL PAN AND OIL SCREEN

## REMOVAL AND INSTALLATION

M112002500193

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

- Under Cover Removal and Installation (Refer to GROUP 51, Under Cover P.51-11.)
- Engine Oil Draining and Refilling (Refer to GROUP 12, On-vehicle Service P.12-3.)



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**REMOVAL STEPS**

1. ENGINE OIL PAN DRAIN PLUG
2. ENGINE OIL PAN DRAIN PLUG GASKET
3. STARTER CONNECTOR
4. STARTER ASSEMBLY
5. ENGINE OIL DIPSTICK ASSEMBLY
6. O-RING
7. ENGINE LOWER OIL PAN

**REMOVAL STEPS (Continued)**

- FRONT NO.1 EXHAUST PIPE (REFER TO GROUP 15, EXHAUST PIPE AND MAIN MUFFLER P.15-20)
- 8. COVER
- 9. TORQUE CONVERTER CONNECTING BOLT
- 10. ENGINE UPPER OIL PAN
- 11. OIL SCREEN
- 12. GASKET

<<A>> >>B<<

<<B>>

<<C>> >>A<<

## REMOVAL SERVICE POINT

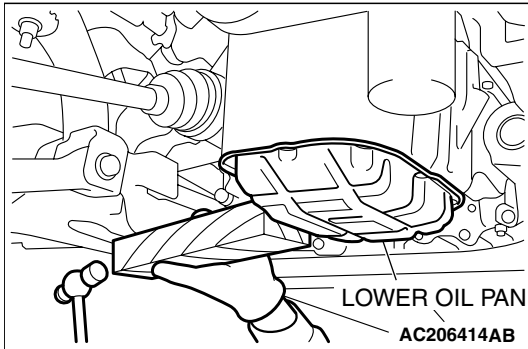
### <<A>> ENGINE LOWER OIL PAN REMOVAL

1. Remove the engine lower oil pan mounting bolts.

**⚠ CAUTION**

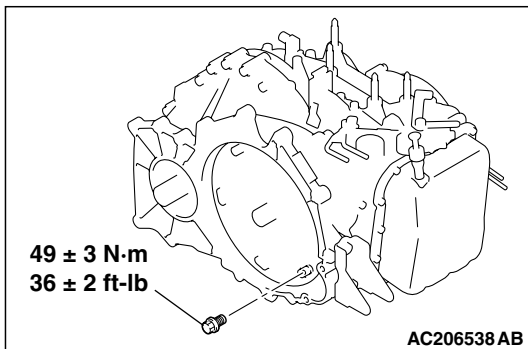
Do not use oil pan remover special tool (MD998727). The engine upper oil pan is made of aluminum and this tool will damage it.

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



### <<B>> TORQUE CONVERTER CONNECTING BOLT REMOVAL

Remove the one torque converter connecting bolt as shown.



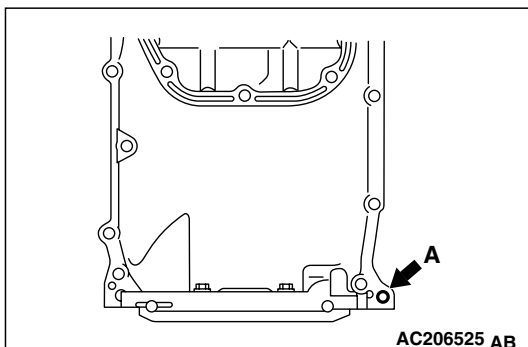
### <<C>> ENGINE UPPER OIL PAN REMOVAL

1. Remove the engine upper oil pan mounting bolts.

**⚠ CAUTION**

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

2. Screw in the bolt (M10) into bolt hole A in the location shown. Then lift the upper oil pan and remove it.



INSTALLATION SERVICE POINTS

>>A<< ENGINE UPPER OIL PAN INSTALLATION

1. Remove sealant from the oil pan and cylinder block mating surfaces.
2. Degrease the sealant-coated surface and the engine mating surface.
3. Apply a bead of the sealant to the cylinder block mating surface of the engine oil pan as shown.

**Specified sealant: 3M™ AAD Part No.8672, 8704, 3M™ AAD Part No.8679/8678 or equivalent**

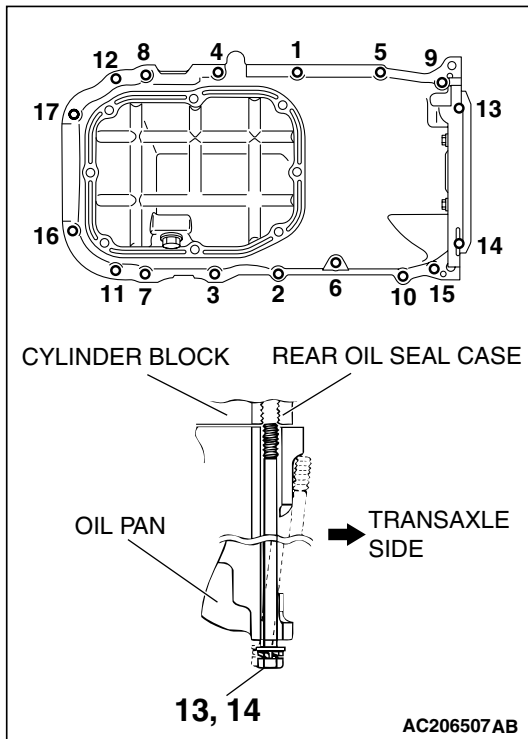
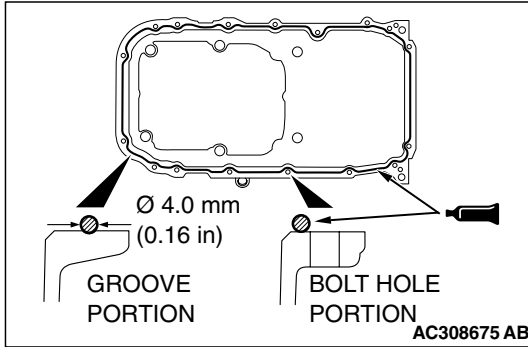
*NOTE: The sealant should be applied in a continuous bead approximately 4.0 mm (0.16 inch) in diameter.*

4. Assemble the oil pan to the cylinder block within 15 minutes after applying the sealant.

**CAUTION**

The bolt holes for bolts 13 and 14 in the illustration are cut away on the transaxle side. Be careful not to insert these bolts at an angle.

5. Tighten the bolts in order of the numbers shown in the illustration.



### >>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: 3M™ AAD Part No.8672, 8704, 3M™ AAD Part No.8679/8678 or equivalent**

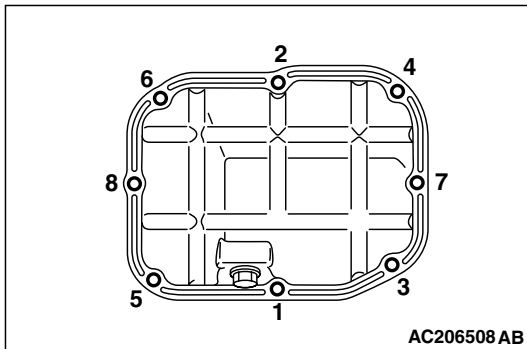
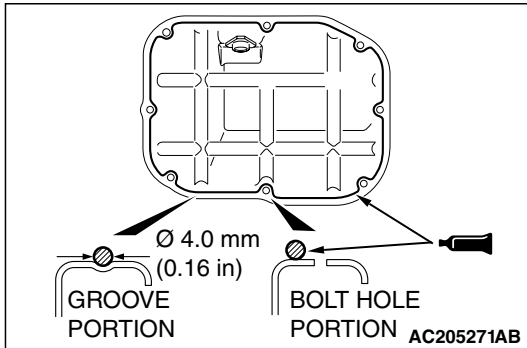
*NOTE: Install the engine lower oil pan within 15 minutes after applying sealant.*

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. Tighten the bolts in order of the numbers shown in the illustration.



### INSPECTION

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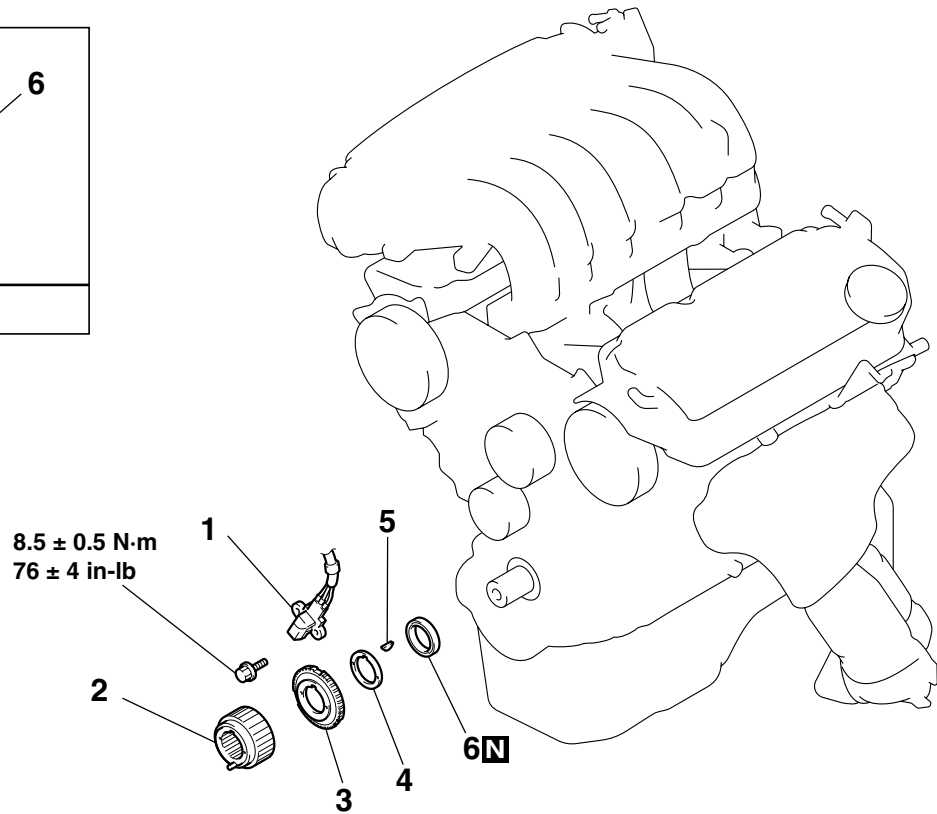
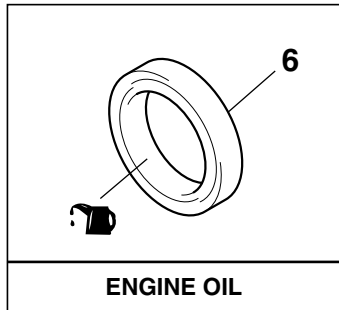
- Check the oil pan for cracks.
- Check the oil pan sealant-coated surface for damage and deformation.
- Check the oil screen for cracked, clogged or damaged wire net and pipe.

# CRANKSHAFT OIL SEAL

## REMOVAL AND INSTALLATION <FRONT OIL SEAL>

M1112003400478

**Pre-removal and Post-installation Operation**  
Timing Belt Removal and Installation (Refer to P.11C-48.)



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**REMOVAL STEPS**

1. CRANKSHAFT POSITION SENSOR
- >>B<< 2. CRANKSHAFT SPROCKET
- >>B<< 3. CRANKSHAFT SENSING BLADE

**REMOVAL STEPS (Continued)**

- >>B<< 4. CRANKSHAFT SPACER
5. KEY
- >>A<< 6. CRANKSHAFT FRONT OIL SEAL

**Required Special Tool:**

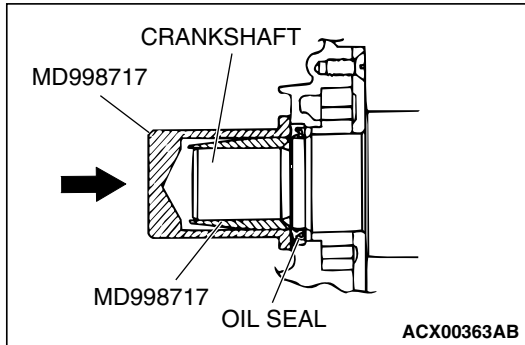
MD998717: Crankshaft Front Oil Seal Installer



### INSTALLATION SERVICE POINTS

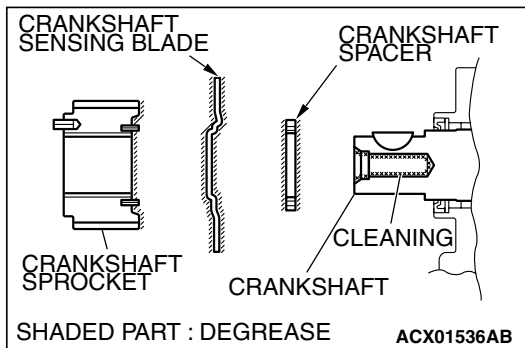
#### >>A<< CRANKSHAFT FRONT OIL SEAL INSTALLATION

1. Apply a small amount of engine oil to the oil seal lip and then insert.
2. Using special tool MD998717, tap the oil seal into the front case.



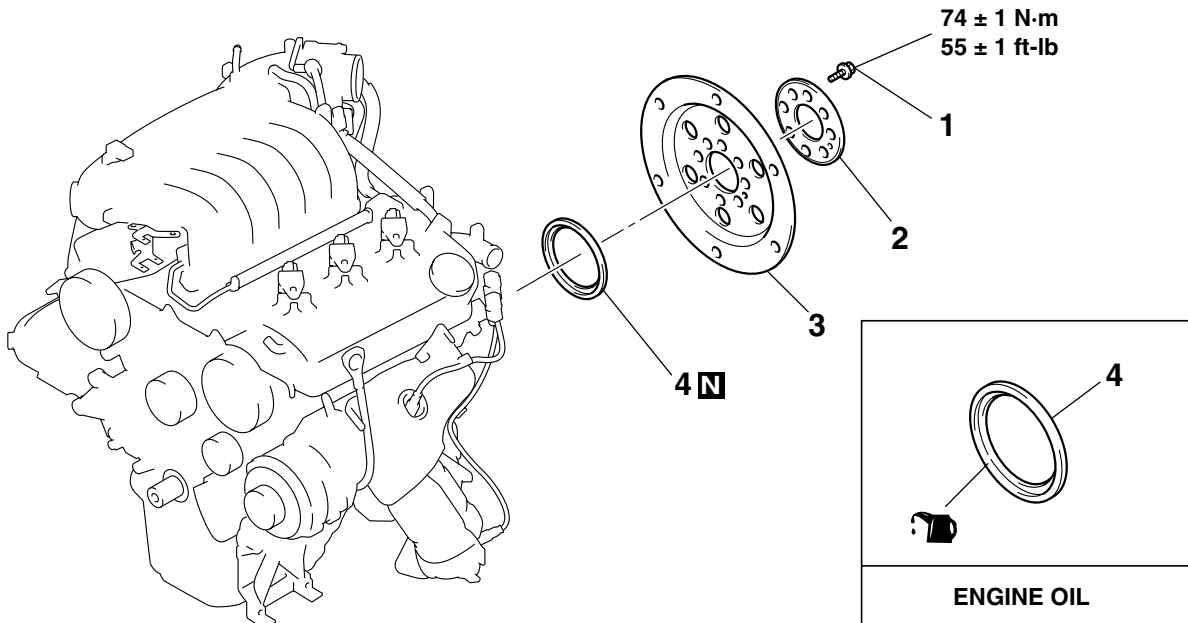
#### >>B<< CRANKSHAFT SPACER / CRANKSHAFT SENSING BLADE / CRANKSHAFT SPROCKET INSTALLATION

To prevent the crankshaft pulley mounting bolt from loosening, degrease or clean the crankshaft, the crankshaft spacer, the crankshaft sensing blade and the crankshaft at the shown positions.



REMOVAL AND INSTALLATION <REAR OIL SEAL>

**Pre-removal and Post-installation Operation**  
Transaxle Assembly Removal and Installation (Refer to GROUP 23A, Transaxle <F4A4B>P.23A-395 , <F4A5A>P.23A-395 .)



- <<A>> >>B<<
- REMOVAL STEPS**
1. DRIVE PLATE BOLTS
  2. ADAPTOR PLATE

- >>A<<
- REMOVAL STEPS (Continued)**
3. DRIVE PLATE
  4. CRANKSHAFT REAR OIL SEAL

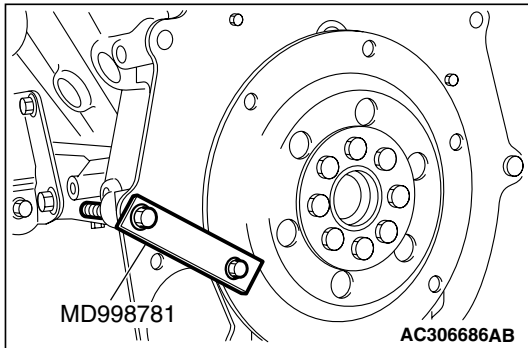
**Required Special Tools:**

- MD998718: Crankshaft Rear Oil Seal Installer
- MD998781: Flywheel Stopper

## REMOVAL SERVICE POINT

### <<A>> DRIVE PLATE BOLTS REMOVAL

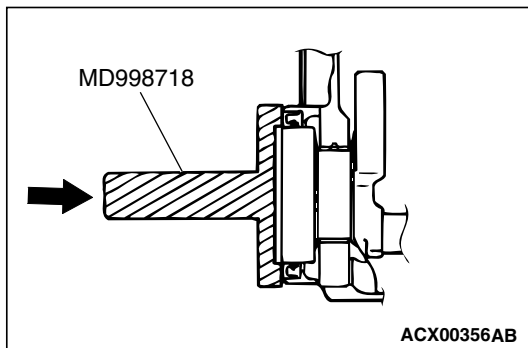
Use special tool MD998781 to secure the drive plate and remove the drive plate bolts.



## INSTALLATION SERVICE POINTS

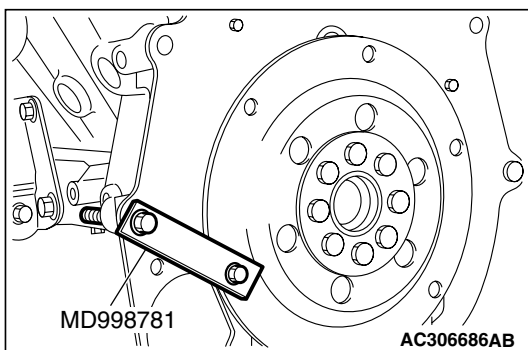
### >>A<< CRANKSHAFT REAR OIL SEAL INSTALLATION

1. Apply a small amount of engine oil to the entire circumference of the oil seal lip.
2. Use special tool MD998718 to tap in the oil seal as shown in the illustration.



### >>B<< DRIVE PLATE BOLTS INSTALLATION

Use special tool MD998781 in the same way as during removal to install the drive plate bolts.



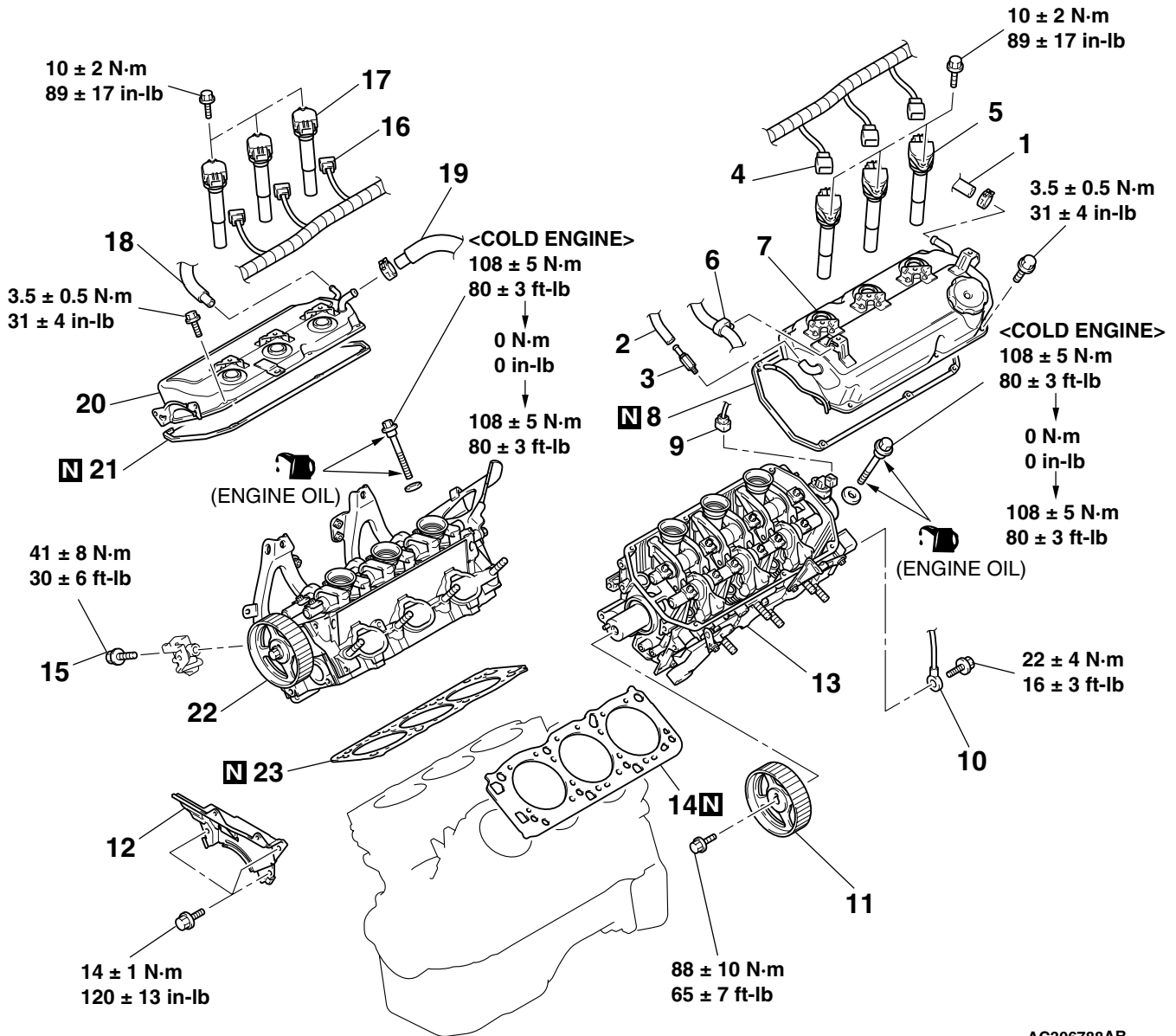
# CYLINDER HEAD GASKET

## REMOVAL AND INSTALLATION

M1112004000804

### Pre-removal and Post-installation Operation

- Intake Manifold Removal and Installation (Refer to GROUP 15, Intake Manifold P.15-11.)
- Exhaust Manifold Removal and Installation (Refer to GROUP 15, Exhaust Manifold P.15-16.)
- Timing Belt Removal and Installation (Refer to P.11C-48.)
- Thermostat Housing Removal and Installation (Refer to GROUP 14, Water Hose and Water Pipe P.14-24.)
- Generator Removal and Installation (Refer to GROUP 16, Generator Assembly P.16-16.)



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### REMOVAL STEPS

1. BLOW-BY HOSE CONNECTION
2. PCV HOSE CONNECTION
3. PCV VALVE
4. IGNITION COIL CONNECTOR

### REMOVAL STEPS (Continued)

5. IGNITION COIL
6. ENGINE CONTROL WIRING HARNESS CLAMP
7. ROCKER COVER
8. ROCKER COVER GASKET

**REMOVAL STEPS (Continued)**

**REMOVAL STEPS (Continued)**

- 9. CAMSHAFT POSITION SENSOR CONNECTOR
- 10. GROUNDING
  - ENGINE OIL DIPSTICK ASSEMBLY
- <<A>> >>C<< 11. CAMSHAFT SPROCKET
- 12. TIMING BELT REAR CENTER COVER
- <<B>> >>B<< 13. LEFT BANK CYLINDER HEAD ASSEMBLY
- 14. CYLINDER HEAD GASKET

- POWER STEERING OIL PUMP ASSEMBLY (REFER TO GROUP 37, POWER STEERING OIL PUMP ASSEMBLY P.37-56.)
- 15. POWER STEERING OIL PUMP BRACKET BOLT
- 16. IGNITION COIL CONNECTOR
- 17. IGNITION COIL
- 18. BREATHER HOSE CONNECTION
- 19. BLOW-BY HOSE CONNECTION
- 20. ROCKER COVER
- 21. ROCKER COVER GASKET
- <<B>> >>B<< 22. RIGHT BANK CYLINDER HEAD ASSEMBLY
- >>A<< 23. CYLINDER HEAD GASKET

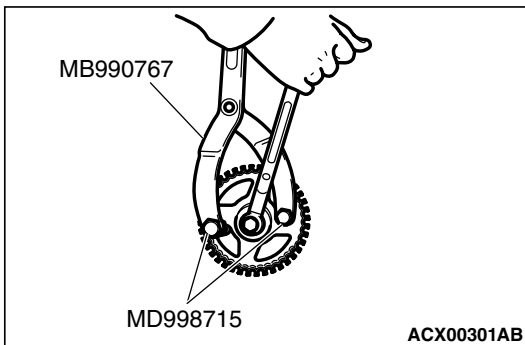
**Required Special Tools:**

- MD998051: Cylinder Head Bolt Wrench
- MB990767: End Yoke Holder
- MD998715: Crankshaft Pulley Holder Pin

**REMOVAL SERVICE POINTS**

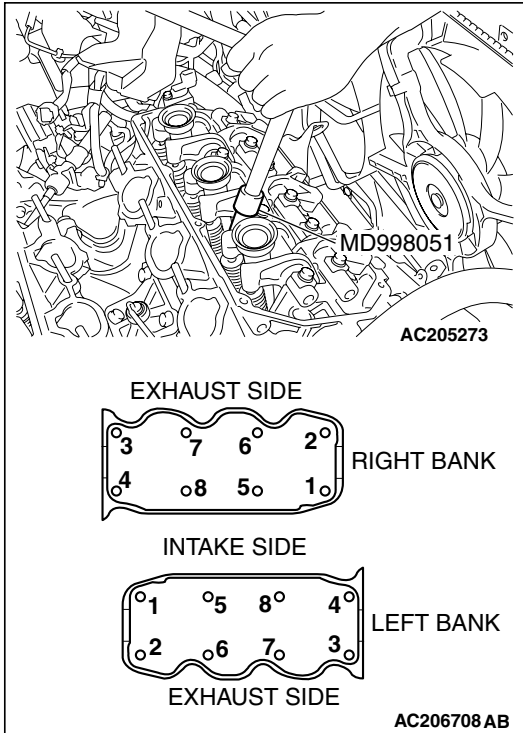
**<<A>> CAMSHAFT SPROCKET REMOVAL**

Use special tools MD998715 and MB990767 to remove the camshaft sprocket.



**<<B>> CYLINDER HEAD ASSEMBLY REMOVAL**

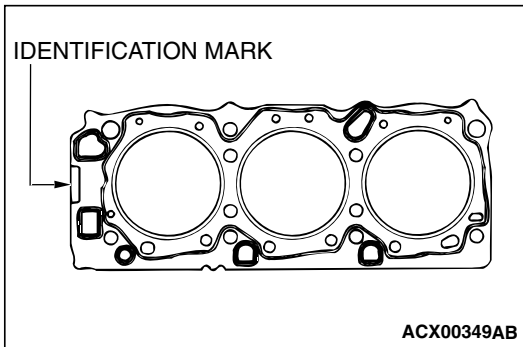
Use special tool MD998051 to loosen each bolt two or three steps in the order shown in the illustration.



**INSTALLATION SERVICE POINTS**

**>>A<< CYLINDER HEAD GASKET INSTALLATION**

1. Degrease the cylinder head and cylinder block gasket mounting surfaces.
2. Make sure that the gasket has the proper identification mark for the engine.
3. Lay the cylinder head gasket on the cylinder block with the identification mark at the front top.



## >>B<< CYLINDER HEAD ASSEMBLY INSTALLATION

### ⚠ CAUTION

Be careful that no foreign material gets into the cylinder, coolant passages or oil passages. Engine damage may result.

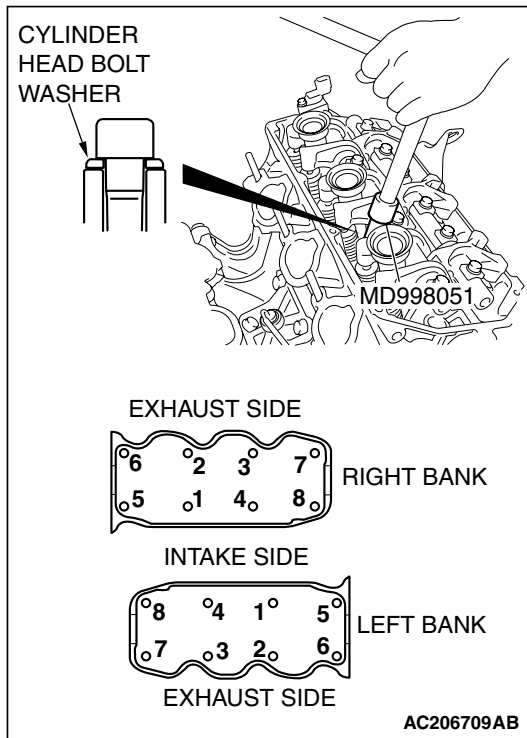
1. Use a scraper to clean the gasket surface of the cylinder head assembly.

### ⚠ CAUTION

Install the head bolt washers with the beveled side facing upwards as shown in the illustration.

2. Using special tool MD998051 and a torque wrench, tighten the bolts to the specified torque in the order shown in the illustration. (in two or three cycles)

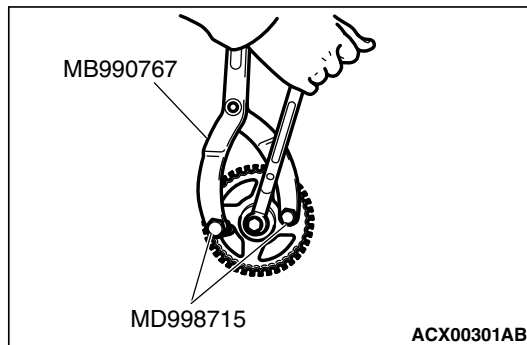
**Tightening torque:  $108 \pm 5 \text{ N}\cdot\text{m}$  ( $80 \pm 3 \text{ ft}\cdot\text{lb}$ ) →  $0 \text{ N}\cdot\text{m}$  ( $0 \text{ in}\cdot\text{lb}$ ) →  $108 \pm 5 \text{ N}\cdot\text{m}$  ( $80 \pm 3 \text{ ft}\cdot\text{lb}$ )**



## >>C<< CAMSHAFT SPROCKET INSTALLATION

1. Use special tools MD998715 and MB990767 in the same way as during removal to install the camshaft sprocket.
2. Tighten the camshaft sprocket mounting bolt to the specified torque.

**Tightening torque:  $88 \pm 10 \text{ N}\cdot\text{m}$  ( $65 \pm 7 \text{ ft}\cdot\text{lb}$ )**



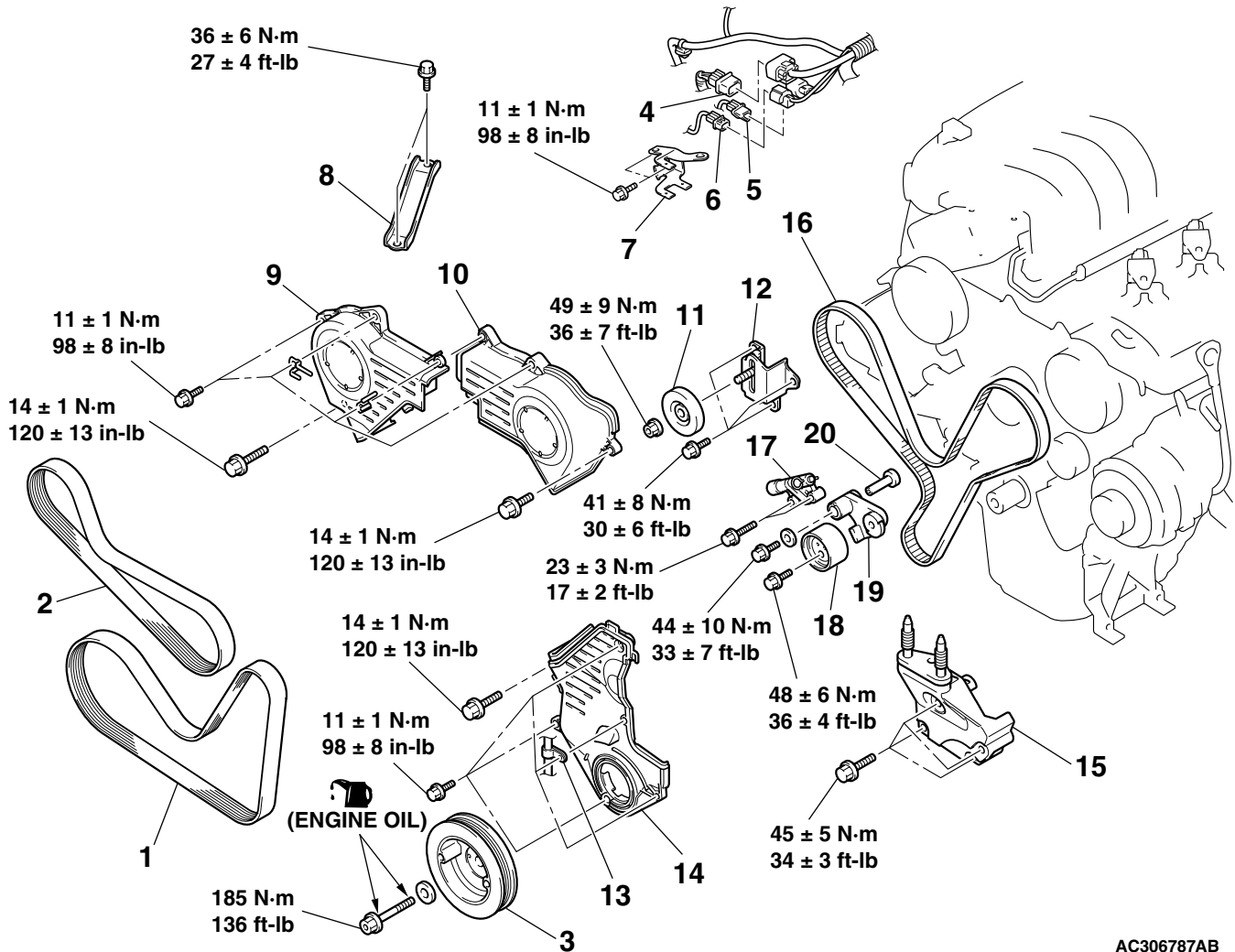
# TIMING BELT

## REMOVAL AND INSTALLATION

M112004300775

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

- Engine Cover Removal and Installation (Refer to P.11C-16.)
- Under Cover Removal and Installation (Refer to GROUP 51, Under Cover P.51-11.)
- Side Under Cover Removal and Installation (Refer to GROUP 51, Under Cover P.51-11.)



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**REMOVAL STEPS**

1. GENERATOR DRIVE BELT
2. POWER STEERING OIL PUMP DRIVE BELT
3. CRANKSHAFT PULLEY
4. CONTROL WIRING HARNESS AND INJECTOR WIRING HARNESS COMBINATION CONNECTOR
5. KNOCK SENSOR CONNECTOR
6. CRANKSHAFT POSITION SENSOR CONNECTOR
7. CONNECTOR BRACKET

**REMOVAL STEPS (Continued)**

8. ENGINE MOUNT STAY
9. TIMING BELT FRONT UPPER COVER, RIGHT
10. TIMING BELT FRONT UPPER COVER, LEFT
11. TENSIONER PULLEY
12. TENSIONER BRACKET
13. CRANKSHAFT POSITION SENSOR HARNESS CLAMP
14. TIMING BELT LOWER COVER



**REMOVAL STEPS (Continued)**

- ENGINE FRONT MOUNTING BRACKET (REFER TO GROUP 32, ENGINE MOUNTING P.32-4.)
- 15. ENGINE SUPPORT BRACKET
- <<B>> >>B<< 16. TIMING BELT
- >>A<< 17. AUTO-TENSIONER
- 18. TENSIONER PULLEY
- 19. TENSIONER ARM
- 20. SHAFT

**Required Special Tools:**

- MB991800: Pulley Holder
- MB991802: Pin B
- MD998767: Tension Pulley Socket Wrench
- MD998769: Crankshaft Pulley Spacer

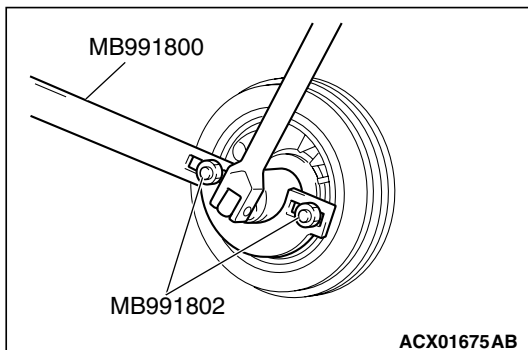
**REMOVAL SERVICE POINTS**

**<<A>> CRANKSHAFT PULLEY REMOVAL**

**⚠ CAUTION**

Use only the specified special tools, or a damaged pulley damper could result.

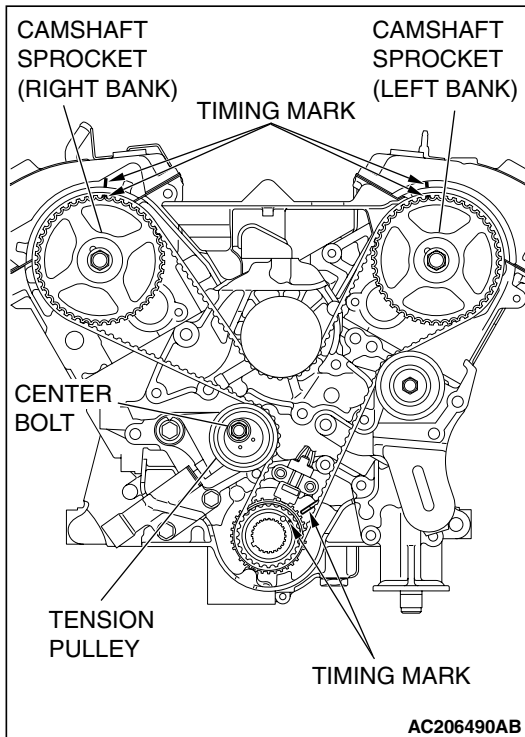
Use special tools MB991800 and MB991802 to remove the crankshaft pulley from the crankshaft.



## &lt;&lt;B&gt;&gt; TIMING BELT REMOVAL

**⚠ CAUTION****Never turn the crankshaft counterclockwise.**

1. Turn the crankshaft clockwise to align each timing mark and to set the number 1 cylinder to compression top dead center.
2. If the timing belt is to be reused, chalk an arrow on the flat side of the belt, indicating the clockwise direction.
3. Loosen the center bolt of the tensioner pulley, then remove the timing belt.



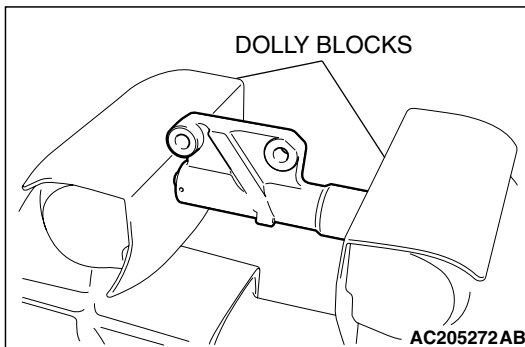
## INSTALLATION SERVICE POINTS

## &gt;&gt;A&lt;&lt; AUTO-TENSIONER INSTALLATION

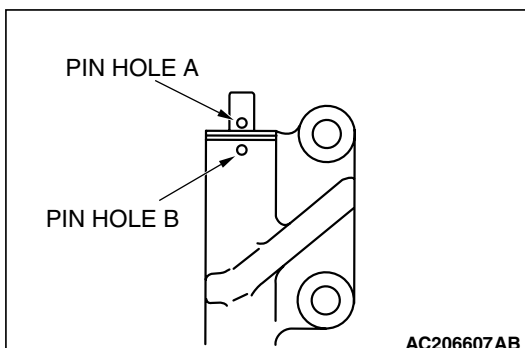
1. If the auto-tensioner rod remains fully extended, set according to the following procedure.

**⚠ CAUTION****Place the auto-tensioner perpendicular to the jaws of the vice.**

- (1) Place two dolly blocks in a vice as shown in the illustration, and then place the auto-tensioner in the vice.

**⚠ CAUTION****Never compress the pushrod too fast, or it may be damaged.**

- (2) Slowly compress the pushrod of the auto-tensioner until pin hole A in the pushrod is aligned with pin hole B in the cylinder.
- (3) Insert the setting pin into the pin holes once they are aligned.

*NOTE: If replacing the auto-tensioner, the pin will already be inserted into the pin holes of the new part.*

**⚠ CAUTION**

Do not remove the setting pin from the auto-tensioner.

- (4) Install the auto-tensioner to the engine.

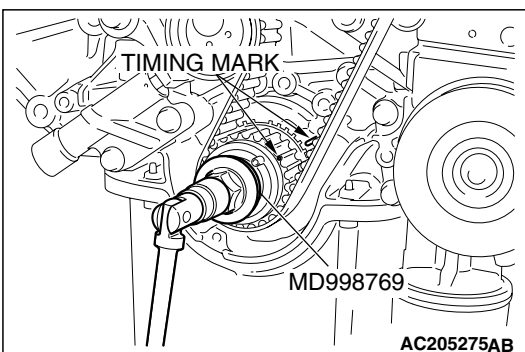
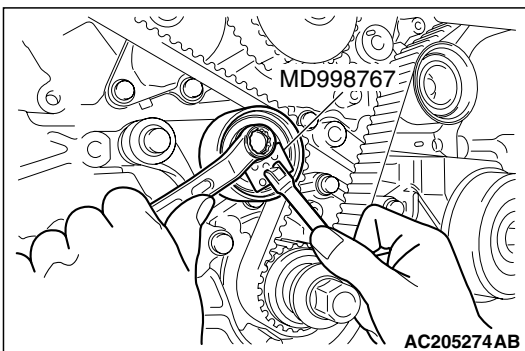
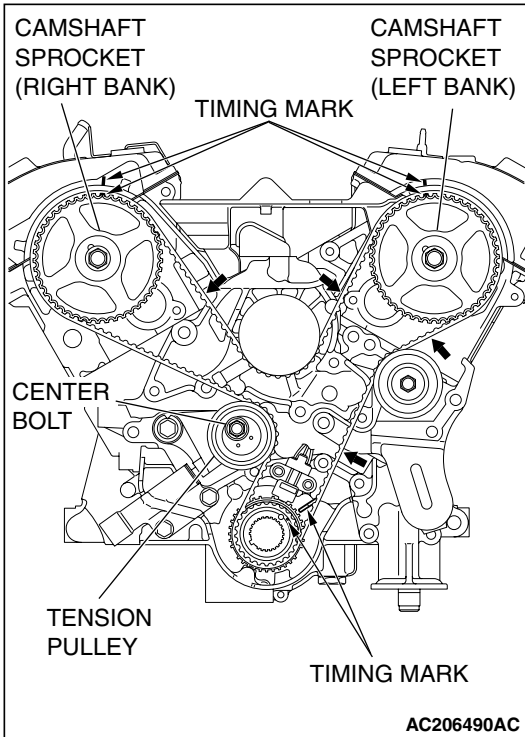
**>>B<< TIMING BELT INSTALLATION**

1. Align the timing marks on the camshaft sprockets with those on the rocker cover and the timing mark on the crankshaft sprocket with that on the engine block as shown in the illustration.

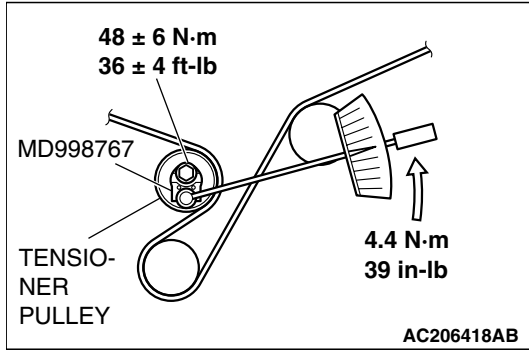
**⚠ CAUTION**

The camshaft sprocket (right bank) can turn easily due to the spring force applied, so be careful not to get your fingers caught.

2. Install the timing belt by the following procedure so that there is no deflection in the timing belt between each sprocket and pulley.
  - (1) Crankshaft sprocket
  - (2) Idler pulley
  - (3) Camshaft sprocket (Left bank)
  - (4) Water pump pulley
  - (5) Camshaft sprocket (Right bank)
  - (6) Tensioner pulley
3. Turn the camshaft sprocket (Right bank) counterclockwise until the tension side of the timing belt is firmly stretched. Check all the timing marks again.
4. Use special tool MD998767 to push the tensioner pulley into the timing belt, then temporarily tighten the center bolt.



5. Use special tool MD998769 to turn the crankshaft 1/4 turn counterclockwise, then turn it again clockwise until the timing marks are aligned.

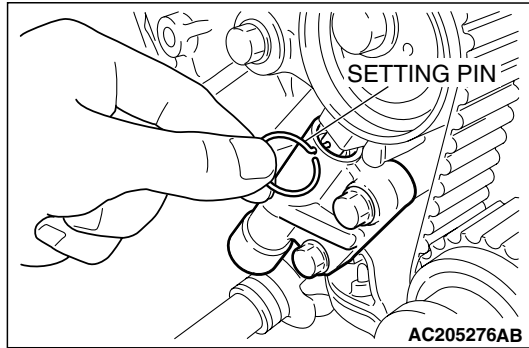
**⚠ CAUTION**

When tightening the center bolt, be careful that the tensioner pulley does not turn with the bolt.

6. Loosen the center bolt of the tensioner pulley. Use special tool MD998767 and a torque wrench to apply the tension torque to the timing belt as shown in the illustration. Then tighten the center bolt to the specified torque.

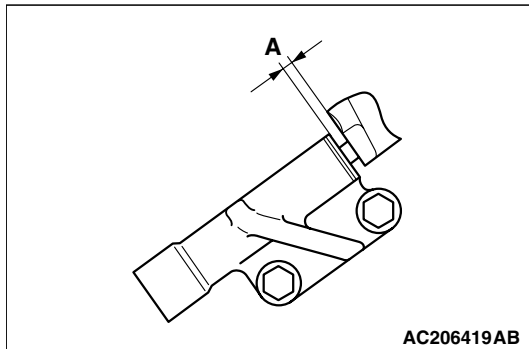
**Standard value: 4.4 N·m (39 in-lb) <Timing belt tension torque>**

**Tightening torque: 48 ± 6 N·m (36 ± 4 ft-lb)**



7. Remove the setting pin that has been inserted into the auto-tensioner.

8. Turn the crankshaft clockwise twice to align the timing marks.

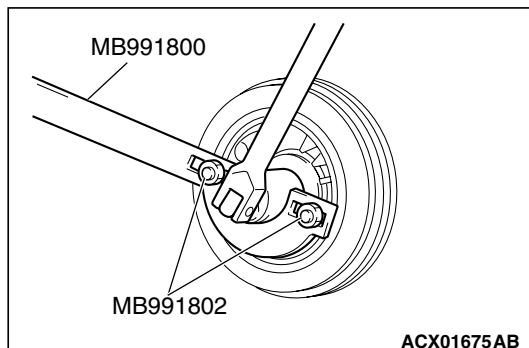


9. Wait for at least five minutes, then check that the auto-tensioner pushrod extends within the standard value range.

**Standard value (A): 4.8 – 6.0 mm (0.19 – 0.24 inch)**

10. If not, repeat the operation in steps 1 to 8 above.

11. Check again that the timing marks of the sprockets are aligned.

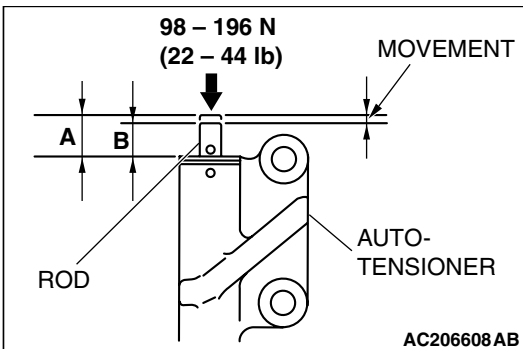
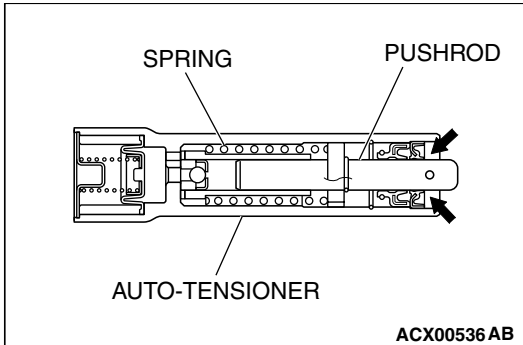
**>>>C<<< CRANKSHAFT PULLEY INSTALLATION**

Use special tools MB991800 and MB991802 to install the crankshaft pulley.

INSPECTION

AUTO-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. While holding the auto-tensioner with your hand, press the end of the pushrod against a metal surface (such as the cylinder block) with a force of 98 – 196 N (22 – 44 pound) and measure how far the pushrod is pushed in.

**Standard value: Within 1 mm (0.04 inch)**

**A: Length when no force is applied**

**B: Length when force is applied**

**A – B: Movement in**

4. If the measured value is out of the standard value, replace the auto-tensioner adjuster.

# CYLINDER BLOCK HEATER UNIT

## REMOVAL AND INSTALLATION

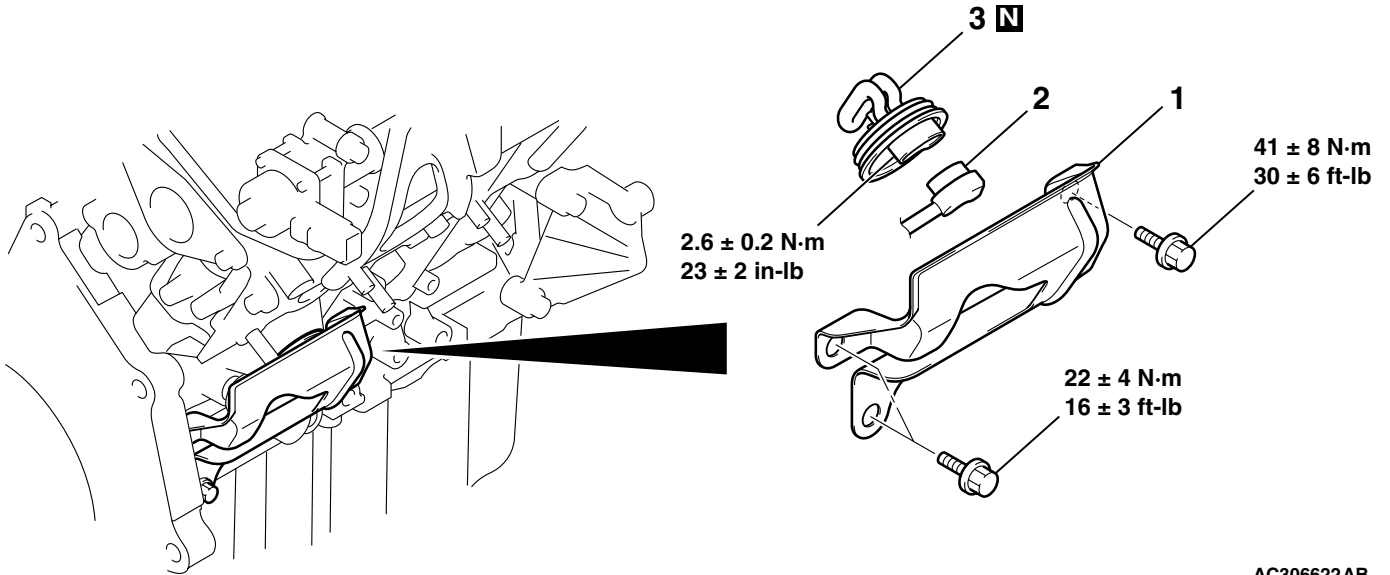
M1112006900029

**Pre-removal Operation**

- Front No.1 Exhaust Pipe Removal (Refer to GROUP 15, Exhaust Pipe and Main Muffler P.15-20).
- Front No.2 Exhaust Pipe Removal (Refer to GROUP 15, Exhaust Pipe and Main Muffler P.15-20).

**Post-installation Operation**

- Front No.2 Exhaust Pipe Installation (Refer to GROUP 15, Exhaust Pipe and Main Muffler P.15-20).
- Front No.1 Exhaust Pipe Installation (Refer to GROUP 15, Exhaust Pipe and Main Muffler P.15-20).



AC306622AB

**REMOVAL STEPS**

1. CYLINDER BLOCK HEATER COVER

**REMOVAL STEPS (Continued)**

2. CYLINDER BLOCK HEATER UNIT CONNECTOR
3. CYLINDER BLOCK HEATER UNIT

<<A>> >>A<<

## REMOVAL SERVICE POINT

### <<A>> CYLINDER BLOCK HEATER UNIT REMOVAL

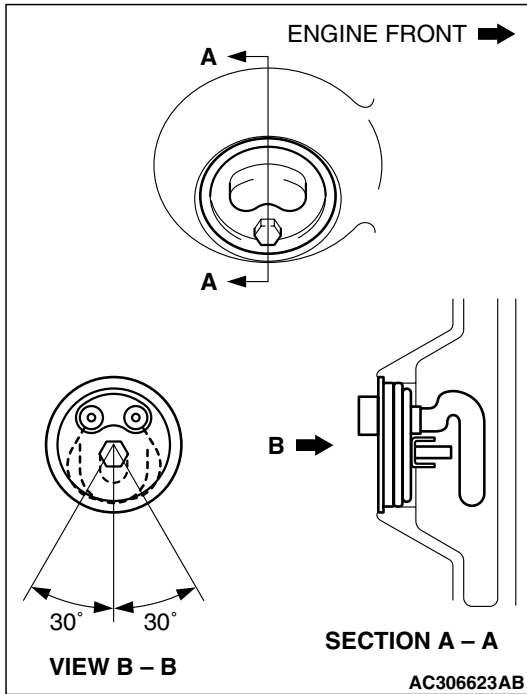
Remove the cylinder block heater unit by using a flat-tipped screwdriver.

## INSTALLATION SERVICE POINT

### >>A<< CYLINDER BLOCK HEATER UNIT INSTAL- LATION

1. Install the cylinder block heater unit to the cylinder block within the range as shown.
2. Tighten the cylinder block heater unit mounting bolt to the specified torque.

**Tightening torque:  $2.6 \pm 0.2$  N·m ( $23 \pm 2$  in-lb)**



## SPECIFICATIONS

## FASTENER TIGHTENING SPECIFICATIONS

M1111003800387

ITEM		SPECIFICATION
<b>Camshaft and valve stem seal</b>		
Camshaft position sensing cylinder bolt		22 ± 4 N·m (16 ± 3 ft-lb)
Camshaft position sensor support bolt		14 ± 1 N·m (120 ± 13 in-lb)
Camshaft position sensor bolt		11 ± 1 N·m (98 ± 8 in-lb)
Camshaft sprocket bolt		88 ± 10 N·m (65 ± 7 ft-lb)
Ignition coil bolt		10 ± 2 N·m (89 ± 17 in-lb)
PCV valve		10 ± 2 N·m (89 ± 17 in-lb)
Rocker cover bolt		3.5 ± 0.5 N·m (31 ± 4 in-lb)
Rocker shaft bolt		31 ± 3 N·m (23 ± 2 ft-lb)
Thrust case bolt		19 ± 3 N·m (14 ± 2 ft-lb)
<b>Camshaft oil seal</b>		
Camshaft sprocket bolt		88 ± 10 N·m (65 ± 7 ft-lb)
<b>Crankshaft oil seal</b>		
A/T drive plate bolt		74 ± 1 N·m (55 ± 1 ft-lb)
Crankshaft position sensor bolt		8.5 ± 0.5 N·m (76 ± 4 in-lb)
<b>Cylinder block heater unit</b>		
Cylinder block heater unit		2.6 ± 0.2 N·m (23 ± 2 in-lb)
Cylinder block heater cover bolt	M10	22 ± 4 N·m (16 ± 3 ft-lb)
	M12	41 ± 8 N·m (30 ± 6 ft-lb)
<b>Cylinder head gasket</b>		
Camshaft sprocket bolt		88 ± 10 N·m (65 ± 7 ft-lb)
Cylinder head bolt <Cold engine>		108 ± 5 N·m (80 ± 3 ft-lb) → 0 N·m (0 in-lb) → 108 ± 5 N·m (80 ± 3 ft-lb)
Grounding connecting bolt		22 ± 4 N·m (16 ± 3 ft-lb)
Ignition coil bolt		10 ± 2 N·m (89 ± 17 in-lb)
Power steering oil pump bracket connecting bolt		41 ± 8 N·m (30 ± 6 ft-lb)
Rocker cover bolt		3.5 ± 0.5 N·m (31 ± 4 in-lb)
Timing belt rear center cover bolt		14 ± 1 N·m (120 ± 13 in-lb)
<b>Engine assembly</b>		
Engine cover bolt		3.0 ± 0.5 N·m (27 ± 4 in-lb)
Engine front mounting bracket bolt	M10	58 ± 7 N·m (43 ± 5 ft-lb)
Engine front mounting bracket bolt and nut	M12	83 ± 12 N·m (61 ± 9 ft-lb)
Engine front mounting stay bolt		36 ± 6 N·m (27 ± 4 ft-lb)
Grounding bolt		9.0 ± 2.0 N·m (80 ± 17 in-lb)
Grounding cable bolt		9.0 ± 2.0 N·m (80 ± 17 in-lb)
Power steering oil pump bolt		46 ± 8 N·m (34 ± 6 ft-lb)



<b>ITEM</b>		<b>SPECIFICATION</b>
Power steering oil pump nut		42 ± 7 N·m (31 ± 5 ft-lb)
Power steering pressure hose clamp bracket bolt		12 ± 2 N·m (102 ± 22 in-lb)
Power steering oil reservoir connecting bolt		12 ± 2 N·m (102 ± 22 in-lb)
<b>Oil pan and oil screen</b>		
Cover bolt		11 ± 0.5 N·m (93 ± 4 in-lb)
Engine oil dipstick bolt		14 ± 1 N·m (120 ± 13 in-lb)
Engine lower oil pan bolt		11 ± 1 N·m (97 ± 9 in-lb)
Engine oil pan drain plug		39 ± 5 N·m (29 ± 3 ft-lb)
Engine upper oil pan bolt		8.5 ± 3.5 N·m (76 ± 31 in-lb)
Engine upper oil pan to torque converter bolt		35 ± 5 N·m (26 ± 4 ft-lb)
Oil screen bolt		19 ± 3 N·m (14 ± 2 ft-lb)
Starter bolt		30 ± 3 N·m (23 ± 2 ft-lb)
Torque converter connecting bolt		49 ± 3 N·m (36 ± 2 ft-lb)
<b>Timing belt</b>		
Auto-tensioner bolt		23 ± 3 N·m (17 ± 2 ft-lb)
Crankshaft pulley center bolt		185 N·m (136 ft-lb)
Engine mount stay bolt		36 ± 6 N·m (27 ± 4 ft-lb)
Engine support bracket bolt		45 ± 5 N·m (34 ± 3 ft-lb)
Harness bracket bolt		11 ± 1 N·m (98 ± 8 in-lb)
Tensioner arm bolt		44 ± 10 N·m (33 ± 7 ft-lb)
Tensioner bracket bolt		41 ± 8 N·m (30 ± 6 ft-lb)
Tensioner pulley bolt		48 ± 6 N·m (36 ± 4 ft-lb)
Tensioner pulley nut		49 ± 9 N·m (36 ± 7 ft-lb)
Timing belt lower cover bolt (bolt, flange)	M6	11 ± 1 N·m (98 ± 8 in-lb)
Timing belt lower cover bolt (bolt, washer assembled)	M10	14 ± 1 N·m (120 ± 13 in-lb)
Timing belt upper cover bolt (bolt, flange)	M6	11 ± 1 N·m (98 ± 8 in-lb)
	M8	14 ± 1 N·m (120 ± 13 in-lb)

## SERVICE SPECIFICATIONS

M1111000300747

ITEM		STANDARD VALUE	LIMIT
Drive belt tension	Vibration frequency Hz (Reference)	87 – 119	–
	Tension N (Reference)	226 – 422	–
Basic ignition timing at idle		5° BTDC ± 3°	–
Actual ignition timing at curb idle		Approximately 10° BTDC	–
CO contents %		0.5 or less	–
HC contents ppm		100 or less	–
Curb idle speed r/min		680 ± 100	–
Compression pressure (200 r/min) kPa (psi)		1,550 (225)	Minimum 1,110 (161)
Compression pressure difference of all cylinder kPa (psi)		–	98 (14)
Intake manifold vacuum at curb idle kPa (in Hg)		–	Minimum 60 (18)
Cylinder block heater unit internal resistance Ω		19 – 30	–
Auto-tensioner pushrod movement mm (in)		Within 1.0 (0.04)	–
Timing belt tension torque N·m (in-lb)		4.4 (39)	–
Auto tensioner rod protrusion amount mm (in)		4.8 – 6.0 (0.19 – 0.24)	–

## SEALANTS

M1111000500365

ITEM	SPECIFIED SEALANT
Engine oil pan	3M™ AAD Part No.8672, 8704, 3M™ AAD Part No.8679/8678 or equivalent