

## GROUP 11A

# ENGINE MECHANICAL

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## GENERAL DESCRIPTION

M1111000100958

The 4G63 (2.0L) engine is an in-line four-cylinder engine. The cylinder numbers are assigned as 1 - 2 - 3 - 4 from the front of the engine (timing belt side). This engine's firing order is 1, 3, 4, 2.

| ITEMS                                       |               |               | SPECIFICATIONS                      |
|---|---------------|---------------|-------------------------------------|
| Type  |               |               | In-line DOHC                        |
| Number of cylinders                         |               |               | 4                                   |
| Bore mm (in)                                |               |               | 85 (3.35)                           |
| Stroke mm (in)                              |               |               | 88 (3.46)                           |
| Total displacement cm <sup>3</sup> (cu. in) |               |               | 1,997 (121.9)                       |
| Compression ratio                           |               |               | 8.8                                 |
| Firing order                                |               |               | 1 - 3 - 4 - 2                       |
| Counterbalance shaft                        |               |               | Equipped                            |
| Valve timing                                | Intake valve  | Opens (BTDC)  | 0° – 30°                            |
|   |               | Closes (ABDC) | 80° – 50°                           |
|   | Exhaust valve | Opens (BBDC)  | 58°                                 |
|   |               | Closes (ATDC) | 18°                                 |
| Lubrication                                 |               |               | Pressure feed, full-flow filtration |
| Oil pump type                               |               |               | Involute gear type                  |

## ENGINE DIAGNOSIS

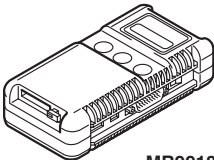
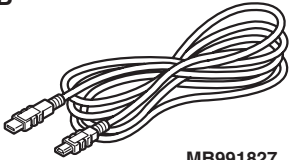

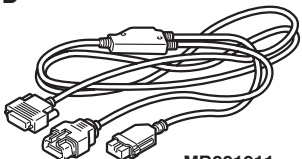
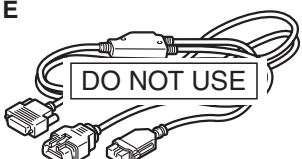
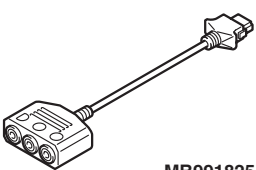
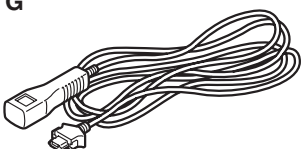
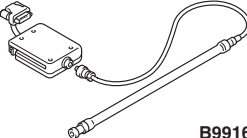
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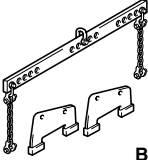
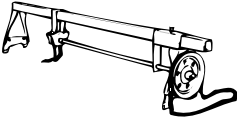
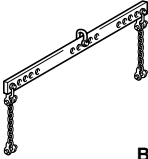
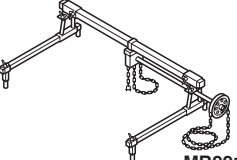
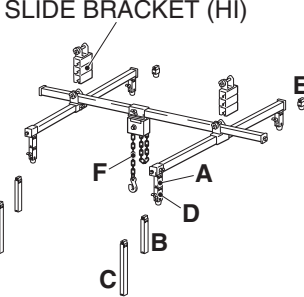
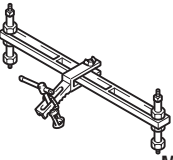
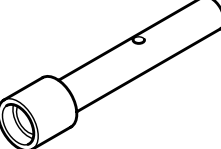
| SYMPTOM                      | PROBABLE CAUSE                            | REMEDY   |
|------------------------------|---|--|
| Compression is too low       | Blown cylinder head gasket                | Replace the gasket.  |
|                              | Worn or damaged piston rings              | 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.            |
|                              | Worn or damaged valve guide               | Replace the valve guide.                                     |
| 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. Be sure to use the correct viscosity. |
|                              | Stuck (open) 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.                                     |

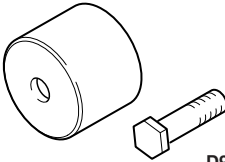
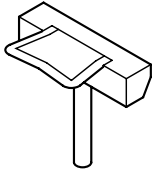
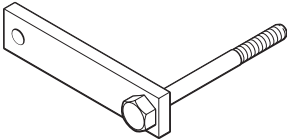
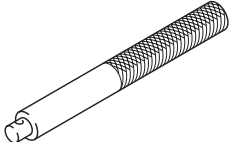
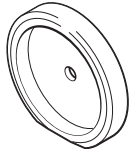
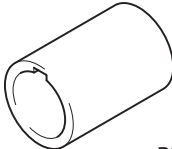
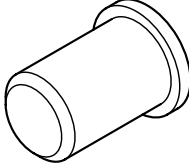
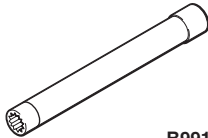
| <b>SYMPTOM</b>                          | <b>PROBABLE CAUSE</b>   | <b>REMEDY</b>  |
|---|---|--|
| Noisy valves                            | Malfunction of lash adjuster (including entry of air into high pressure chamber)  | Check the lash adjuster.                                     |
|   | Thin or diluted engine oil (low engine oil pressure)  | Change the engine oil. Be sure to use the correct viscosity. |
|   | 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.                                  |
|   | Low engine oil pressure   | Refer to engine oil pressure drop symptoms above.            |
|   | Thin or diluted engine oil  | Change the engine oil. Be sure to use the correct viscosity. |
|   | Excessive bearing clearance   | Replace the bearings.  |
| Noisy timing belt                       | Incorrect belt tension  | Adjust the belt tension and/or replace the timing belt.      |
| Excessive engine rolling and vibration  | Loose engine roll stopper (Front, Rear)<br>Loose transaxle mount bracket<br>Loose engine mount bracket<br>Loose center member | Retighten.   |
|   | Broken transaxle mount insulator<br>Broken engine mount insulator<br>Broken engine roll stopper insulator                     | Replace.   |

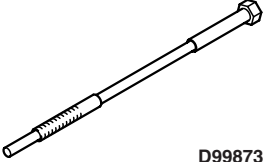
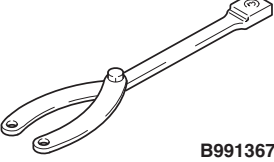
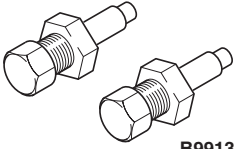
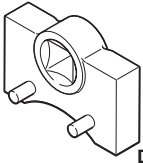
## SPECIAL TOOLS

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| TOOL  | TOOL NUMBER AND NAME   | SUPERSESSION  | APPLICATION  |
|---|--|---|--|
| <p><b>A</b></p>  <p>MB991824</p> <p><b>B</b></p>  <p>MB991827</p> <p><b>C</b></p>  <p>MB991910</p> <p><b>D</b></p>  <p>MB991911</p> <p><b>E</b></p>  <p>MB991914</p> <p><b>F</b></p>  <p>MB991825</p> <p><b>G</b></p>  <p>MB991826<br/>MB991958</p> | <p>MB991958<br/>A: MB991824<br/>B: MB991827<br/>C: MB991910<br/>D: MB991911<br/>E: MB991914<br/>F: MB991825<br/>G: MB991826<br/>M.U.T.-III sub assembly<br/>A: Vehicle communication interface (V.C.I.)<br/>B: M.U.T.-III USB cable<br/>C: M.U.T.-III main harness A (Vehicles with CAN communication system)<br/>D: M.U.T.-III main harness B (Vehicles without CAN communication system)<br/>E: M.U.T.-III main harness C (for Daimler Chrysler models only)<br/>F: M.U.T.-III measurement adapter<br/>G: M.U.T.-III trigger harness</p> | <p>MB991824-KIT<br/><i>NOTE: G: MB991826 M.U.T.-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> </ul> <p><b>CAUTION</b><br/>M.U.T.-III main harness B (MB991911) should be used. M.U.T.-III main harness A and C should not be used for this vehicle.</p> |
|  <p>B991668</p>  | <p>MB991668<br/>Belt tension meter set</p>   | <p>Tool not available</p>   | <p>Drive belt tension check (used together with scan tool &lt;M.U.T.-III Sub Assembly&gt;)</p>   |

| TOOL  | TOOL NUMBER AND NAME   | SUPERSESION          | APPLICATION  |
|---|--|----------------------|--|
| <br>B991453    | MB991453<br>Engine hanger assembly   | MZ203827-01          | When the engine hanger is used: Supporting the engine assembly during removal and installation of the transaxle assembly<br><br><i>NOTE: Special tool MB991454 is a part of engine hanger attachment set MB991453.</i> |
| <br>MZ203827   | GENERAL SERVICE TOOL MZ203827<br>Engine lifter   | MZ203827-01          |  |
| <br>B991454    | MB991454<br>Engine hanger balancer   | MZ203827-01          |  |
| <br>MB991895  | MB991895<br>Engine hanger  | —                    |  |
| <br>B991928  | MB991928<br>Engine hanger<br>A: MB991929<br>Joint (50) × 2<br>B: MB991930<br>Joint (90) × 2<br>C: MB991931<br>Joint (140) × 2<br>D: MB991932<br>Foot (standard) × 4<br>E: MB991933<br>Foot (short) × 2<br>F: MB991934<br>Chain and hook assembly | —                    |  |
| <br>MD998772 | MD998772<br>Valve spring compressor  | General service tool | Compressing valve spring   |
|              | MD998737<br>Valve stem seal installer  | MD998737-01          | Valve stem seal installation   |

| TOOL   | TOOL NUMBER AND NAME                            | SUPERSESION          | APPLICATION                            |
|--|---|----------------------|--|
| <br>D998713   | MD998713<br>Camshaft oil seal installer         | MD998713-01          | Camshaft oil seal installation         |
| <br>D998727   | MD998727<br>Oil pan FIPG cutter                 | MD998727-01          | Oil pan removal                        |
| <br>D998781   | MD998781<br>Flywheel stopper                    | General service tool | Supporting the flywheel                |
|              | MB990938<br>Installer bar                       | MB990938-01          | Crankshaft rear oil seal installation  |
| <br>D998776 | MD998776<br>Crankshaft rear oil seal installer  | MD998776-01          |  |
| <br>D998285 | MD998285<br>Crankshaft front oil seal guide     | MD998285-01          |  |
|             | MD998375<br>Crankshaft front oil seal installer | MD998375-01          | Crankshaft front oil seal installation |
| <br>B991654 | MB991654<br>Cylinder head bolt wrench (12)      | General service tool |  |

| TOOL   | TOOL NUMBER AND NAME         | SUPERSESSION         | APPLICATION   |
|--|------------------------------|----------------------|---|
|  <p align="center">D998738</p>  | MD998738<br>Adjusting bolt   | General service tool | Supporting the timing belt tensioner arm and timing belt tensioner adjuster |
|  <p align="center">B991367</p>  | MB991367<br>Special spanner  | MB991367-01          | Holding the crankshaft sprocket   |
|  <p align="center">B991385</p>  | MB991385<br>Pin              | MIT217213            |   |
|  <p align="center">D998767</p> | MD998767<br>Tensioner wrench | MD998752-01          | Valve timing belt tension adjustment  |

## ON-VEHICLE SERVICE

## DRIVE BELT TENSION CHECK

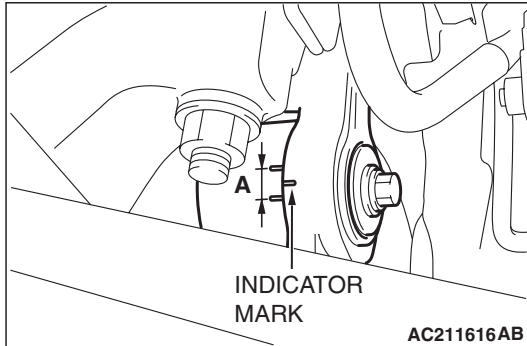
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**⚠ CAUTION**

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

1. Make sure that the indicator mark is within the area marked with A in the illustration.
2. If the mark is out of the area, replace the drive belt. (Refer to P.11A-23.)

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



## IGNITION TIMING CHECK

M1111001701365

**Required Special Tool:**

MB991958: Scan Tool (M.U.T.-III Sub Assembly)

- MB991824: V.I.C.
- MB991827: USB Cable
- MB991911: Main Harness B

1. Before inspection, set vehicle to the following conditions:
  - Engine coolant temperature: 80 – 95° C (176 – 203° F)
  - Lights and all accessories: OFF
  - Transaxle: Neutral

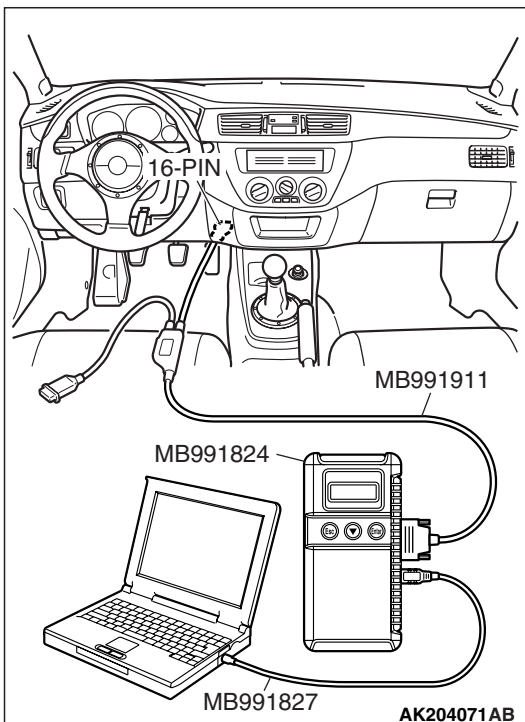
**⚠ CAUTION**

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 up a timing light.
4. Start the engine and run it at idle.
5. Check that the idle speed is approximately 800 r/min.
6. Select scan tool MB991958 MFI 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:
  - Is the MFI system diagnostic trouble code is 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 5° 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° to 10° Before Top Dead Center at higher altitudes.*

**IDLE MIXTURE CHECK**

M1111002100460

**Required Special Tool:**

MB991958: Scan Tool (M.U.T.-III Sub Assembly)

- MB991824: V.I.C.
- MB991827: USB Cable
- MB991911: Main Harness B

1. Before inspection, set vehicle to the following conditions:
  - Engine coolant temperature: 80 – 95°C (176 – 203°F)
  - Lights and all accessories: OFF
  - Transaxle: Neutral

**⚠ 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. Confirm basic ignition timing is within the standard value. (Refer to Ignition Timing Check [P.11A-8.](#))

**Standard value: 5° BTDC  $\pm$  3°**

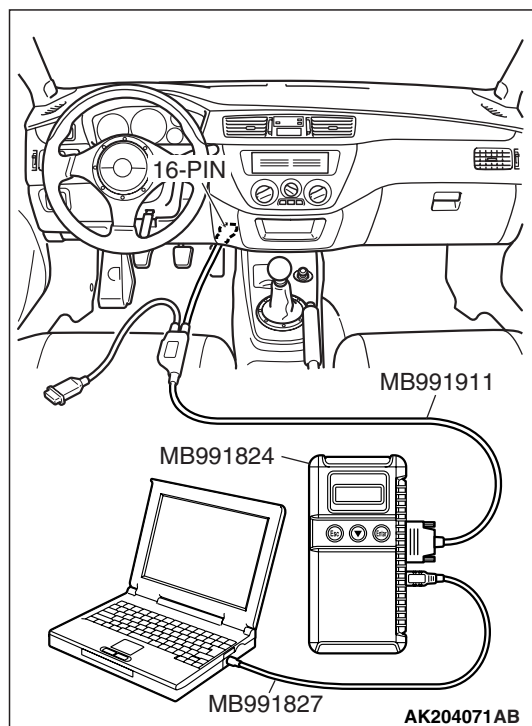
4. Increase engine speed to 2,500 r/min for 2 minutes.
5. Set the CO/HC tester.
6. Check the CO and HC contents at idle.

**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:
  - If the MFI system diagnostic trouble code is 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 pressure
  - Injector(s)
  - Ignition coil, spark plug cable, spark plug
  - EGR system and EGR valve leak
  - Evaporative emission system
  - Compression pressure



*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.*

## CURB IDLE SPEED CHECK

M1111003501248

### Required Special Tool:

MB991958: Scan Tool (M.U.T.-III Sub Assembly)

- MB991824: V.I.C.
- MB991827: USB Cable
- MB991911: Main Harness B

1. Before inspection, set vehicle to the following conditions:
  - Engine coolant temperature: 80 – 95° C (176 – 203° F)
  - Lights and all accessories: OFF
  - Transaxle: Neutral

### ⚠ 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. Confirm basic ignition timing is within the standard value. (Refer to Ignition Timing Check [P.11A-8.](#))

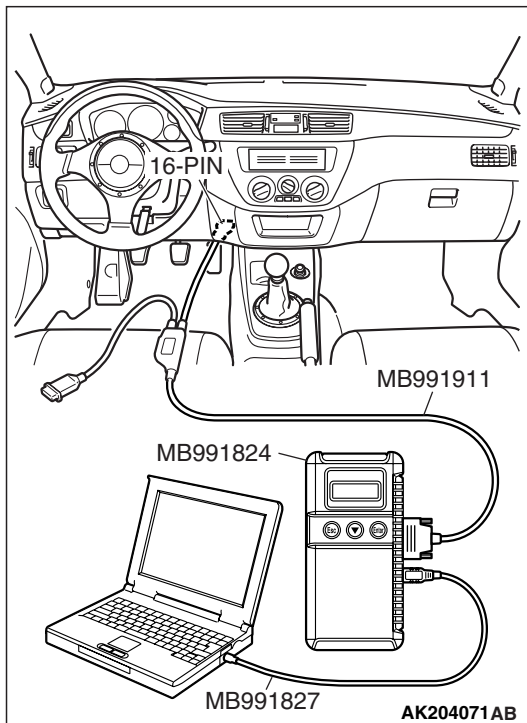
**Standard value: 5° BTDC ± 3°**

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

**Curb idle speed: 800 ± 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 13A, Multiport Fuel Injection (MFI) –Multiport Fuel Injection (MFI) Diagnosis –Symptom Chart [P.13A-44.](#)



## COMPRESSION PRESSURE CHECK

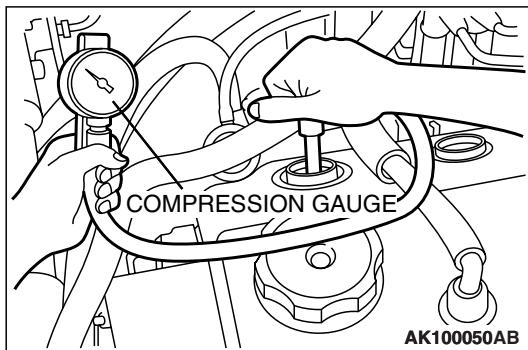
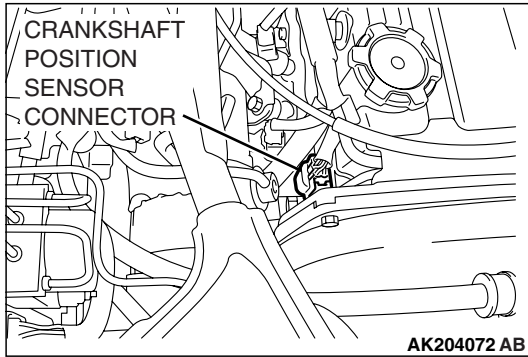
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### Required Special Tool:

MB991958: Scan Tool (M.U.T.-III Sub Assembly)

- MB991824: V.I.C.
- MB991827: USB Cable
- MB991911: Main Harness B

1. Before inspection, check that the engine oil, starter and battery are normal. Also, set the vehicle to the following conditions:
  - Engine coolant temperature: 80 – 95° C (176 – 203° F)
  - Lights, and all accessories: OFF
  - Transaxle: Neutral
2. Disconnect the spark plug cables.



3. Remove all of the spark plugs.
4. 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.**

5. Cover the spark plug holes with a shop towel etc. Crank the engine for a few seconds to clear debris from around the spark plug holes. After the engine has been cranked, check for foreign material adhering to the shop towel.
6. Install the 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): 1,000 kPa (145 psi)**

**Minimum limit (at engine speed of 250 r/min): 637 kPa (92 psi)**

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

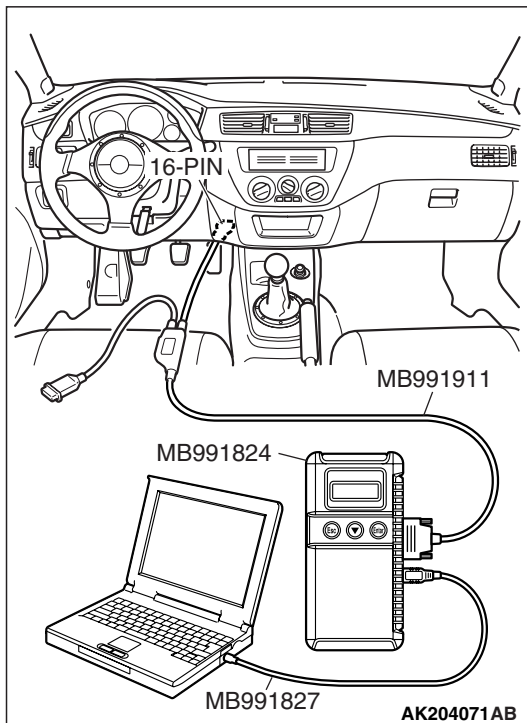
**Limit: 98 kPa (14 psi)**

9. If there is a cylinder with compression difference 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.

10. Connect the crankshaft position sensor connector.

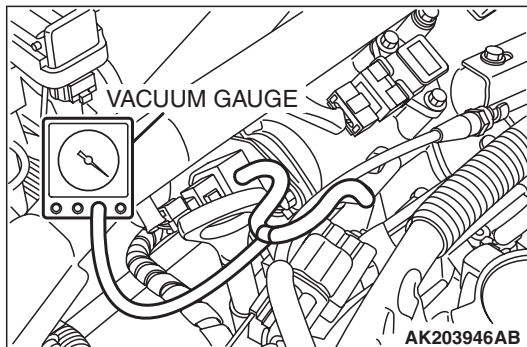
11. Install the spark plugs and spark plug cables.



12. 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.*

*NOTE: If the negative (–) cable has been disconnected from the battery terminal in order to erase the diagnostic trouble code, operate the engine at idle for approximately 10 minutes after restarting.*



## MANIFOLD VACUUM CHECK

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- Before inspection, check that the engine oil, starter and battery are normal. Also, set the vehicle to the following conditions:
  - Engine coolant temperature: 80 – 95° C (176 – 203° F)
  - Lights, and all accessories: OFF
  - Transaxle: Neutral
- Connect an engine tachometer.
- Attach a tee-fitting joint to the vacuum hose between the fuel pressure solenoid and the intake manifold plenum, and connect a vacuum gauge.
- Start the engine and check that idle speed is within specification. Then check the vacuum gauge reading.

**Idle speed: 800 ± 100 r/min**

**Minimum limit: 51 kPa (15 in Hg)**

## LASH ADJUSTER CHECK

M1111002900518

If an abnormal noise (chattering noise) is heard because of a malfunctioning lash adjuster immediately after starting the engine and does not disappear, suspect the lash adjusters. 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 running 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.*

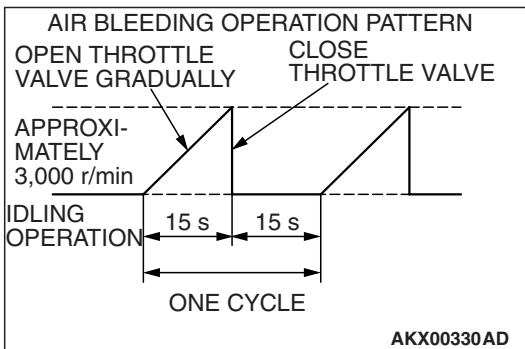
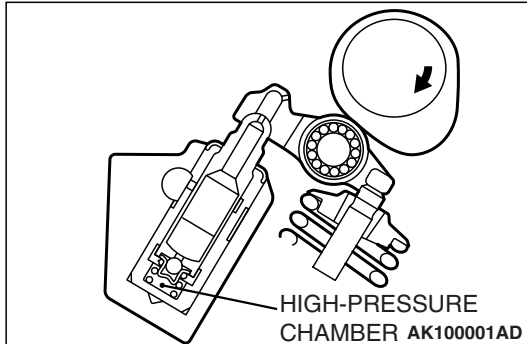
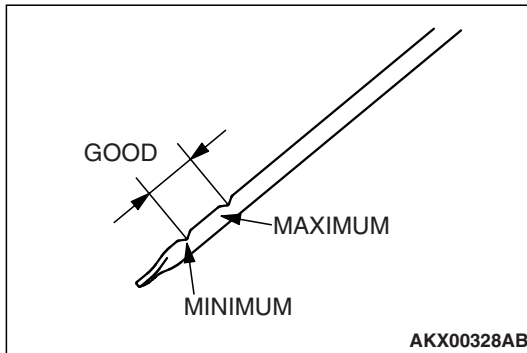
1. Start the engine.
2. Check if the abnormal noise produced immediately after starting the engine changes with the change in the engine speed.  
If the abnormal noise is not produced immediately after starting the engine or it does not change with the engine speed, the lash adjuster is not the cause 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 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 11B, Engine Overhaul –Rocker Arms and Camshaft –Inspection [P.11B-39](#).) It is suspected that the noise is due to collapse 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.11A-13](#).)
6. If the abnormal noise does not disappear after air bleeding operation, clean the lash adjuster (Refer to GROUP 11B, Engine Overhaul –Rocker Arms and Camshaft –Inspection [P.11B-39](#).)

## BLEEDING LASH ADJUSTER SYSTEM

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

*NOTE: After parking for many hours, oil may drain 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. Add or change oil as 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 air creating aerated (foaming) oil.*

*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 being 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.



# ENGINE ASSEMBLY

## REMOVAL AND INSTALLATION

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### CAUTION

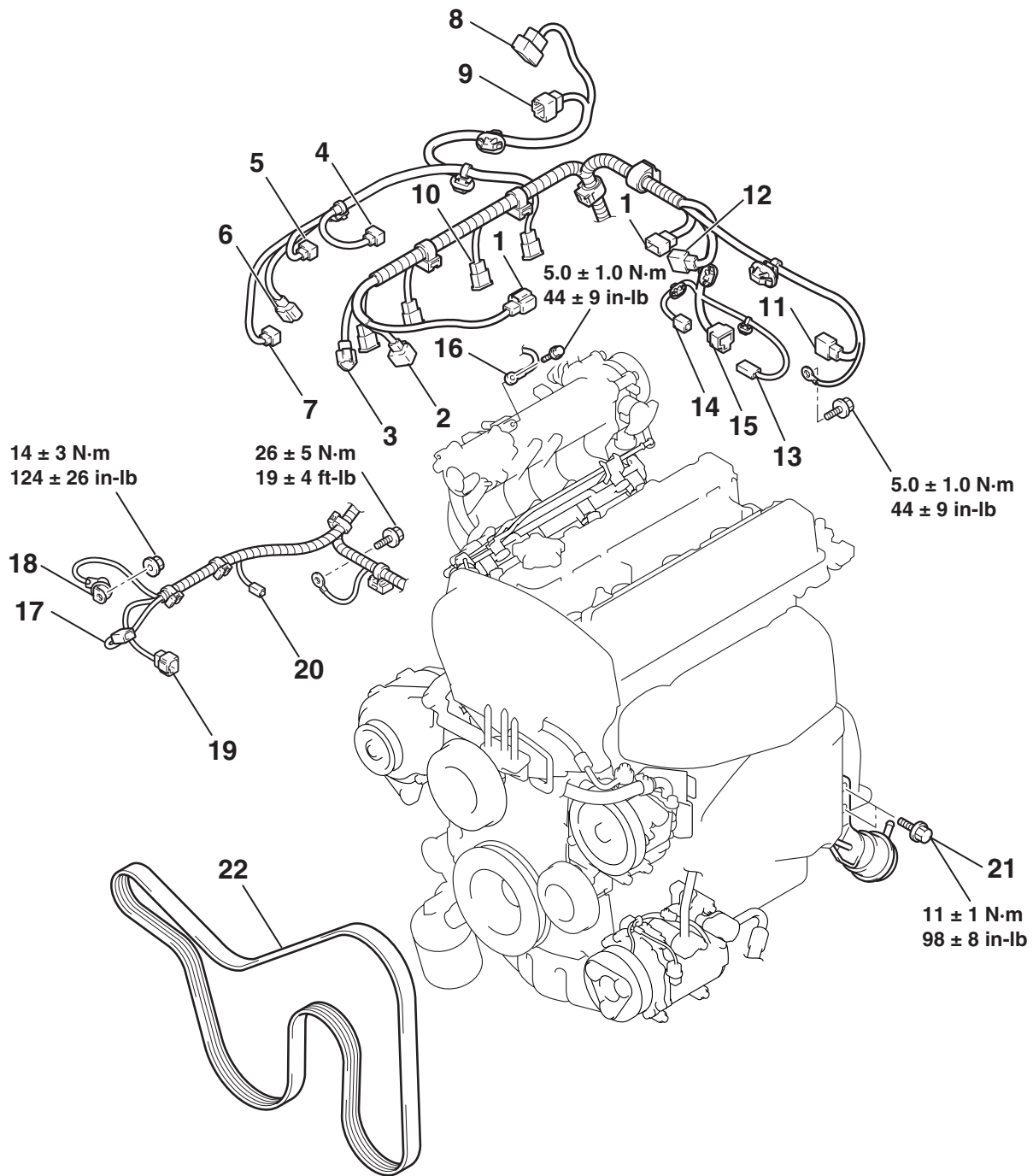
- When the engine assembly replacement is performed, use scan tool MB991958 to initialize the learning value (Refer to GROUP 00, Initialization Procedure for Learning Value in MFI Engine [P.00-22](#)).
- If the vehicle is equipped with the Brembo™ disc brake, during maintenance, take care not to contact the parts or tools to the caliper because the paint of caliper will be scratched.
- \*: 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-868](#).]
- Hood Removal (Refer to GROUP 42, Hood [P.42-7](#).)
- Under Cover Removal (Refer to GROUP 51, Front Bumper [P.51-2](#).)
- Side Cover Removal
- 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.14-19](#).)
- Strut Tower Bar Removal (Refer to GROUP 42, Strut Tower Bar [P.42-12](#).)
- Air Cleaner Assembly Removal (Refer to GROUP 15, Air Cleaner [P.15-7](#).)
- Air Pipe C, Air Pipe B and Air Hose A Removal (Refer to GROUP 15, Charge Air Cooler [P.15-8](#).)
- Battery and Battery Tray Removal
- Accelerator Cable Removal (Refer to GROUP 17, Accelerator Cable and Pedal [P.17-5](#).)
- Rocker Cover Center Cover Removal (Refer to [P.11A-25](#).)
- Radiator Assembly Removal (Refer to GROUP 14, Radiator [P.14-23](#).)
- Front Axle Crossmember Bar Removal (Refer to GROUP 32, Engine Roll Stopper and Centermember [P.32-7](#).)
- Front Exhaust Pipe Removal (Refer to GROUP 15, Exhaust Pipe and Main Muffler [P.15-17](#).)
- Air Outlet Fitting Removal (Refer to GROUP 15, Exhaust Manifold and Turbocharger [P.15-13](#).)

#### Post-installation Operation

- Air Outlet Fitting Installation (Refer to GROUP 15, Exhaust Manifold and Turbocharger [P.15-13](#).)
- Front Exhaust Pipe Installation (Refer to GROUP 15, Exhaust Pipe and Main Muffler [P.15-17](#).)
- Front Axle Crossmember Bar Installation (Refer to GROUP 32, Engine Roll Stopper and Centermember [P.32-7](#).)
- Radiator Assembly Installation (Refer to GROUP 14, Radiator [P.14-23](#).)
- Rocker Cover Center Cover Installation (Refer to [P.11A-25](#).)
- Accelerator Cable Installation (Refer to GROUP 17, Accelerator Cable and Pedal [P.17-5](#).)
- Battery and Battery Tray Installation
- Air Pipe C, Air Pipe B and Air Hose A Installation (Refer to GROUP 15, Charge Air Cooler [P.15-8](#).)
- Air Cleaner Assembly Installation (Refer to GROUP 15, Air Cleaner [P.15-7](#).)
- Strut Tower Bar Installation (Refer to GROUP 42, Strut Tower Bar [P.42-12](#).)
- Engine Coolant Refilling (Refer to GROUP 14, On-vehicle Service –Engine Coolant Replacement [P.14-19](#).)
- Engine Oil Refilling (Refer to GROUP 12, On-vehicle Service –Engine Oil Replacement [P.12-3](#).)
- Drive Belt Tension Check (Refer to [P.11A-8](#).)
- Side Cover Installation
- Under Cover Installation (Refer to GROUP 51, Front Bumper [P.51-2](#).)
- Accelerator Cable Adjustment (Refer to GROUP 17, On-vehicle Service – Accelerator Cable Check and Adjustment [P.17-4](#).)
- Hood Installation (Refer to GROUP 42, Hood [P.42-7](#).)
- Fuel Leak Check



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**REMOVAL STEPS**

1. IGNITION COIL CONNECTORS
2. HEATER OXYGEN SENSOR (FRONT) CONNECTOR
3. CRANKSHAFT POSITION SENSOR CONNECTOR
4. MANIFOLD ABSOLUTE PRESSURE SENSOR CONNECTOR
5. FUEL PRESSURE SOLENOID CONNECTOR
6. KNOCK SENSOR CONNECTOR
7. EVAPORATIVE EMISSION PURGE SOLENOID CONNECTOR

**REMOVAL STEPS (Continued)**

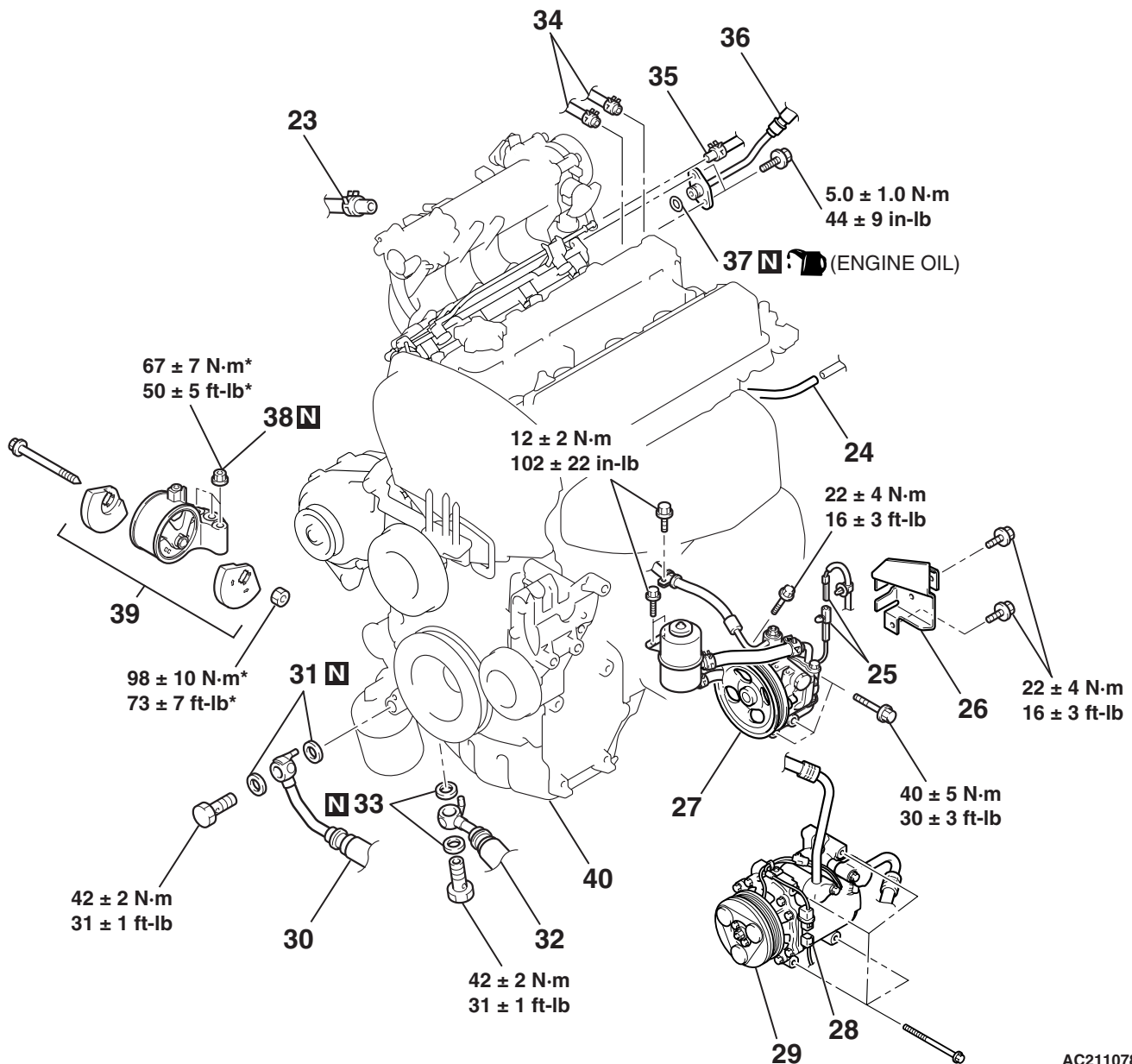
8. THROTTLE POSITION SENSOR CONNECTOR
9. IDLE AIR CONTROL MOTOR CONNECTOR
10. INJECTOR CONNECTORS
11. EXHAUST CAMSHAFT POSITION SENSOR CONNECTOR
12. INLET CAMSHAFT POSITION SENSOR CONNECTOR
13. ENGINE COOLANT TEMPERATURE GAUGE UNIT CONNECTOR



**REMOVAL STEPS (Continued)**

14. ENGINE COOLANT  
TEMPERATURE SENSOR  
CONNECTOR
15. CONTROL WIRING HARNESS  
AND TRANSAXLE WIRING  
HARNESS COMBINATION
16. GROUND CABLE CONNECTION
17. GENERATOR CONNECTOR
18. GENERATOR TERMINAL
19. EGR VACUUM REGULATOR  
SOLENOID VALVE CONNECTOR
20. ENGINE OIL PRESSURE SWITCH  
CONNECTOR
21. TURBOCHARGER WASTEGATE  
ACTUATOR BOLTS
22. DRIVE BELT

<<A>>



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**REMOVAL STEPS**

23. BRAKE BOOSTER VACUUM HOSE CONNECTION
24. PURGE HOSE CONNECTION
25. POWER STEERING PRESSURE SWITCH CONNECTOR
26. POWER STEERING OIL PUMP HEAT PROTECTOR
- <<B>> 27. POWER STEERING OIL PUMP, BRACKET AND RESERVOIR ASSEMBLY
28. A/C COMPRESSOR CONNECTOR <VEHICLE WITH A/C>
- <<B>> 29. A/C COMPRESSOR AND CLUTCH ASSEMBLY <VEHICLE WITH A/C>
30. ENGINE OIL COOLER FEED HOSE CONNECTION
31. ENGINE OIL COOLER TUBE GASKETS

**REMOVAL STEPS (Continued)**

32. ENGINE OIL COOLER RETURN HOSE CONNECTION
33. ENGINE OIL COOLER TUBE GASKETS
34. HEATER WATER HOSES CONNECTION
35. FUEL RETURN LINE HOSE CONNECTION
- >>D<< 36. FUEL HIGH-PRESSURE HOSE CONNECTION
- >>D<< 37. O-RING
- TRANSFER ASSEMBLY (REFER TO GROUP 22A, TRANSFER ASSEMBLY [P.22A-223](#)<W5M51>, [P.22A-225](#)<W6MAA>.)
  - TRANSAXLE ASSEMBLY
- <<C>> >>C<< 38. SELF-LOCKING NUTS
- <<D>> >>B<< 39. ENGINE MOUNTING INSULATOR AND CUSHION STOPPERS ASSEMBLY
- <<D>> >>B<< 39. ENGINE MOUNTING INSULATOR AND CUSHION STOPPERS ASSEMBLY
- <<E>> >>A<< 40. ENGINE ASSEMBLY

**Required Special Tools:**

- MB991453: Engine Hanger Assembly
- MB991454: Engine Hanger Balancer
- MB991895: Engine Hanger
- MB991928: Engine Hanger
- MZ203827: Engine Lifter

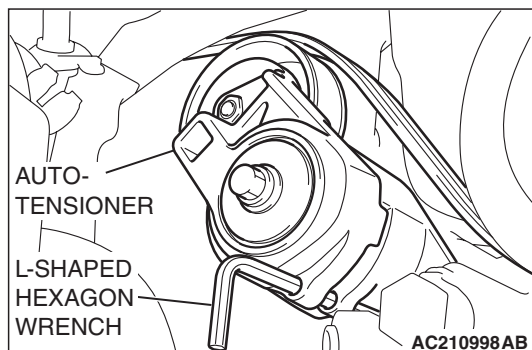
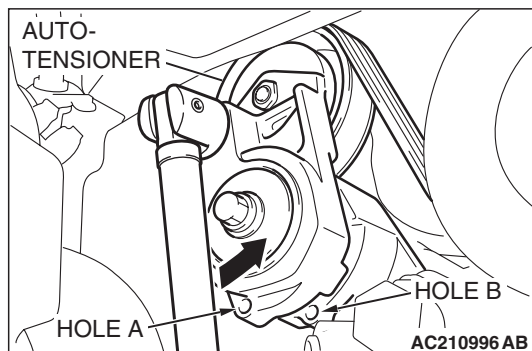
**REMOVAL SERVICE POINTS****<<A>> DRIVE BELT REMOVAL**

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 12.7mm (1/2-inch) insertion angle into the jig hole of the auto-tensioner, and turn the auto-tensioner counterclockwise 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, etc.



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

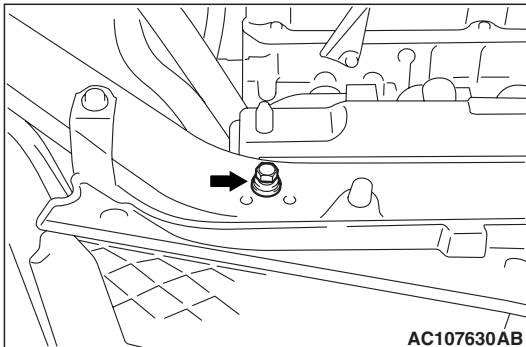
**<<B>> POWER STEERING OIL PUMP, BRACKET  
AND RESERVOIR ASSEMBLY/ A/C  
COMPRESSOR AND CLUTCH ASSEMBLY  
<VEHICLE WITH A/C> REMOVAL**

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

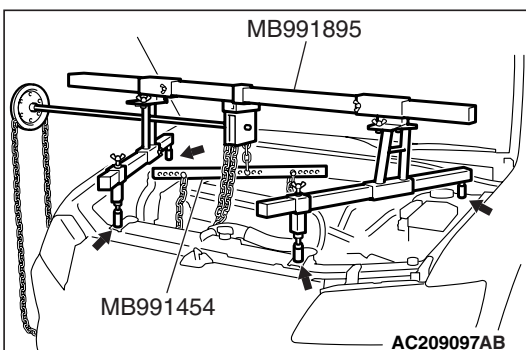
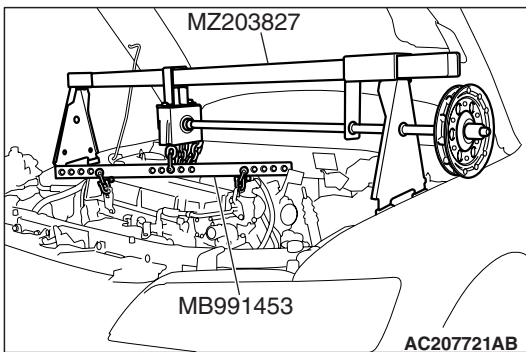
*NOTE: Secure the removed power steering oil pump assembly, and A/C compressor and clutch assembly with cord or rope at a position where they will not interfere with the removal of the engine assembly.*

**<<C>> TRANSAXLE ASSEMBLY REMOVAL**

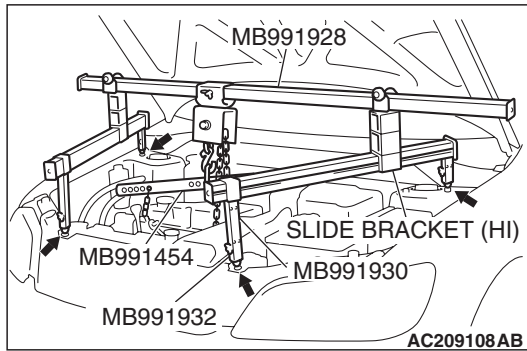
1. Pre-tighten the 2 bolts on the car to assemble the radiator support upper insulator to set the special tools MZ203827, MB991895 or MB991928.
2. Remove the transaxle assembly. (Refer to GROUP 22A – Transaxle Assembly [P.22A-228](#)<W5M51>, [P.22A-232](#)<W6MAA>.)

**<<D>> SELF-LOCKING NUTS/ENGINE  
MOUNTING INSULATOR AND CUSHION  
STOPPERS ASSEMBLY REMOVAL**

1. Support the engine with a garage jack.
2. Remove the following special tool.  
(1) <Engine lifter (special tool MZ203827) is used>  
Remove special tool MZ203827.

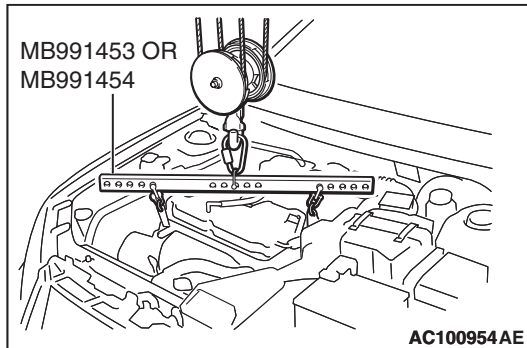


- (2) <Engine hanger (special tool MB991895) is used>  
Remove special tool MB991895.



(3) <Engine hanger (special tool MB991928) is used>  
Remove the base hanger and the following tool.

- Slide bracket (HI)
- Foot (standard) (MB991932)
- Joint (90) (MB991930)



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 mounting insulator mounting nuts and bolt. Remove the engine mounting insulator and cushion stopper assembly.

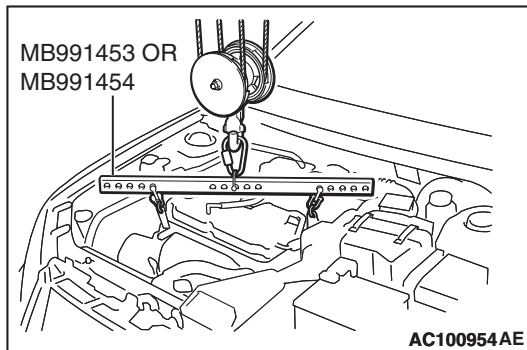
## <<E>> ENGINE ASSEMBLY REMOVAL

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.

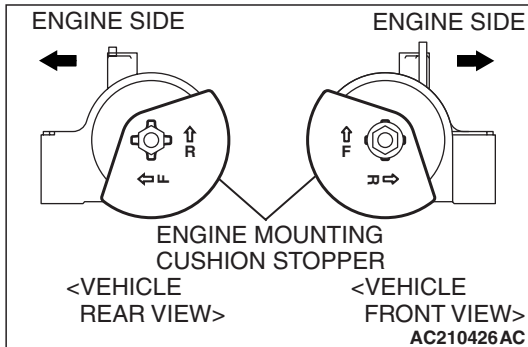
## INSTALLATION SERVICE POINTS

### >>A<< ENGINE ASSEMBLY INSTALLATION

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



## >>B<< ENGINE MOUNTING INSULATOR AND CUSHION STOPPERS ASSEMBLY/SELF-LOCKING NUTS INSTALLATION

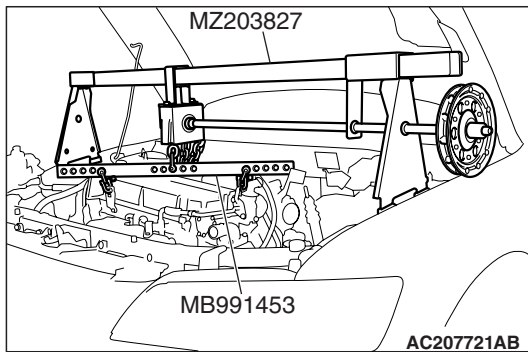


1. Arrow marks on the engine mounting cushion stopper should face the shown direction.

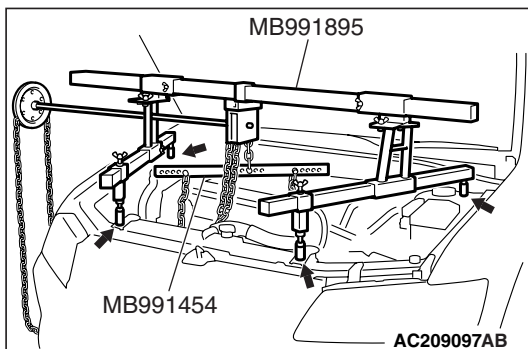
*NOTE: Disregard F and R stamped as a shared part.*

2. Place a garage jack against the engine oil pan with a piece of wood in between. Install the engine mounting insulator and cushion stoppers while adjusting the position of the engine.
3. Support the engine assembly with a garage jack.
4. Remove the chain block.
5. Use the following special tool as during removal to support the engine.

- (1) <Engine lifter (special tool MZ203827) is used>  
Set special tool MZ203827.

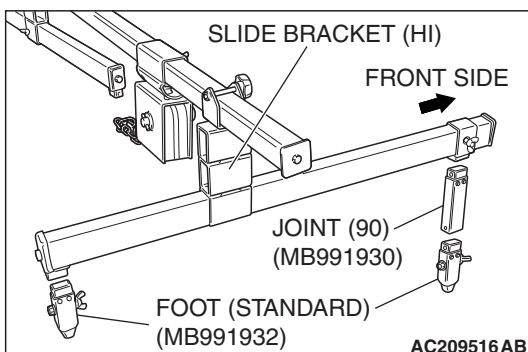


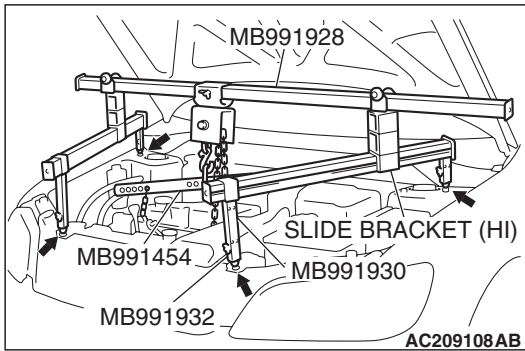
- (2) <Engine hanger (special tool MB991895) is used>  
Set special tool MB991895.



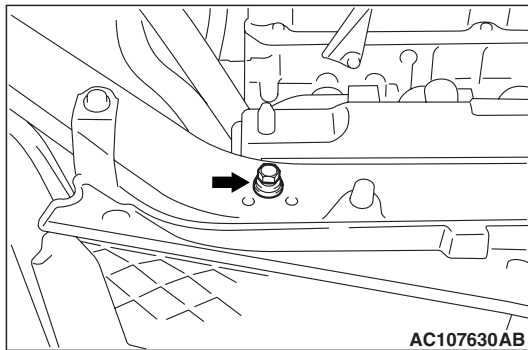
- (3) <Engine hanger (special tool MB991928) is used>  
a. Set the following parts to the base hanger.

- Slide bracket (HI)
- Foot (standard) (MB991932)
- Joint (90) (MB991930)





- b. Set special tool MB991928.



## >>C<< TRANSAXLE ASSEMBLY INSTALLATION

1. Install the transaxle assembly. (Refer to GROUP 22A – Transaxle Assembly [P.22A-228<W5M51>](#), [P.22A-232<W6MAA>](#).)
2. Remove from the car the 2 bolts, to assemble the radiator support upper insulator.

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

### **⚠ CAUTION**

**Do not let any engine oil get into the fuel rail.**

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 fuel rail, 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 fuel rail and check that the hose turns smoothly.
4. Tighten the fuel high-pressure hose mounting bolts to the specified torque.

**Tightening torque:  $5.0 \pm 1.0 \text{ N} \cdot \text{m}$  ( $44 \pm 9 \text{ in-lb}$ )**

# CRANKSHAFT PULLEY

## REMOVAL AND INSTALLATION

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**⚠ CAUTION**

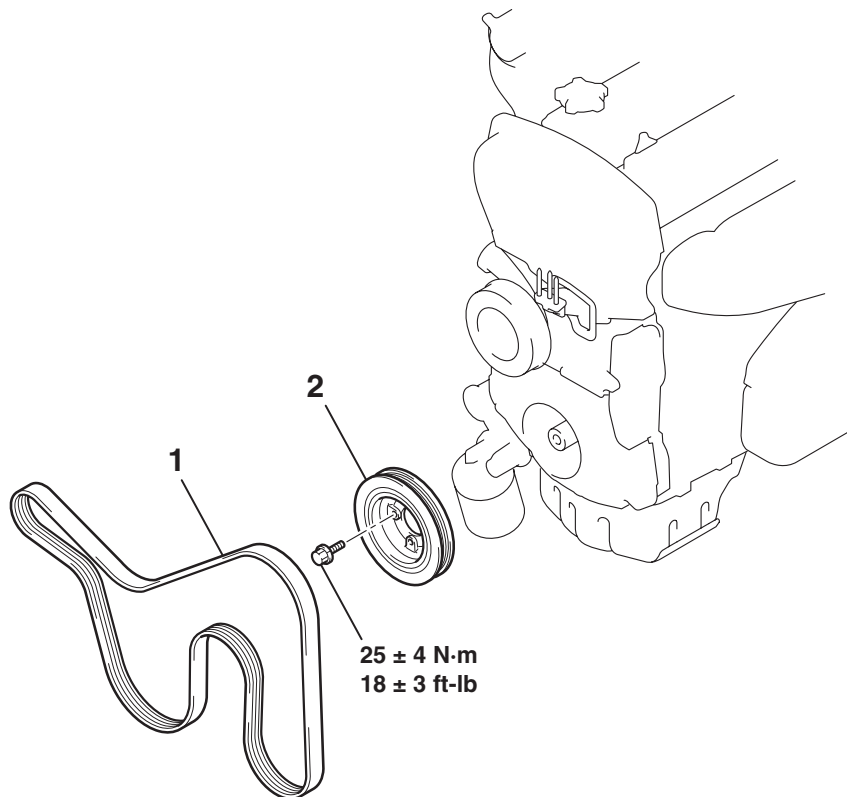
If the vehicle is equipped with the Brembo™ disc brake, during maintenance, take care not to contact the parts or tools to the caliper because the paint of caliper will be scratched.

**Pre-removal Operation**

- Under Cover Removal (Refer to GROUP 51, Front Bumper P.51-2.)
- Side Cover Removal

**Post-installation Operation**

- Drive Belt Tension Check (Refer to P.11A-8.)
- Side Cover Installation
- Under Cover Installation (Refer to GROUP 51, Front Bumper P.51-2.)



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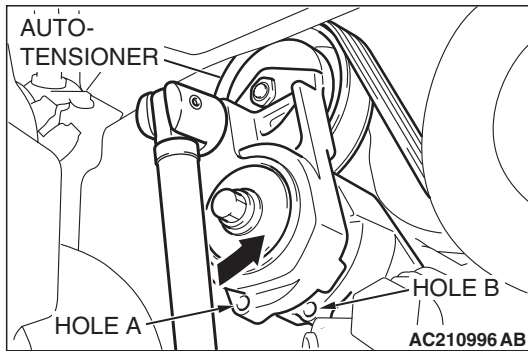
**REMOVAL STEPS**

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.

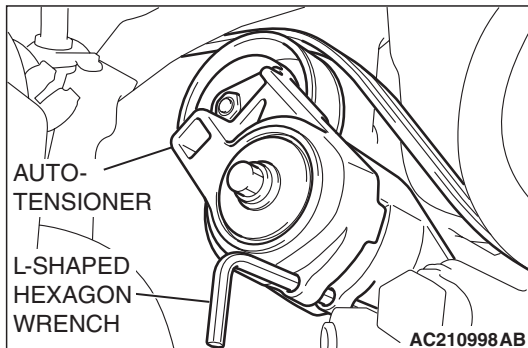




1. Securely insert the spindle handle or ratchet handle with a 12.7mm (1/2-inch) insertion angle into the jig hole of the auto-tensioner, and turn the auto-tensioner counterclockwise until it hits the stopper.

**⚠ CAUTION**

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



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

M1112006601098

### CAUTION

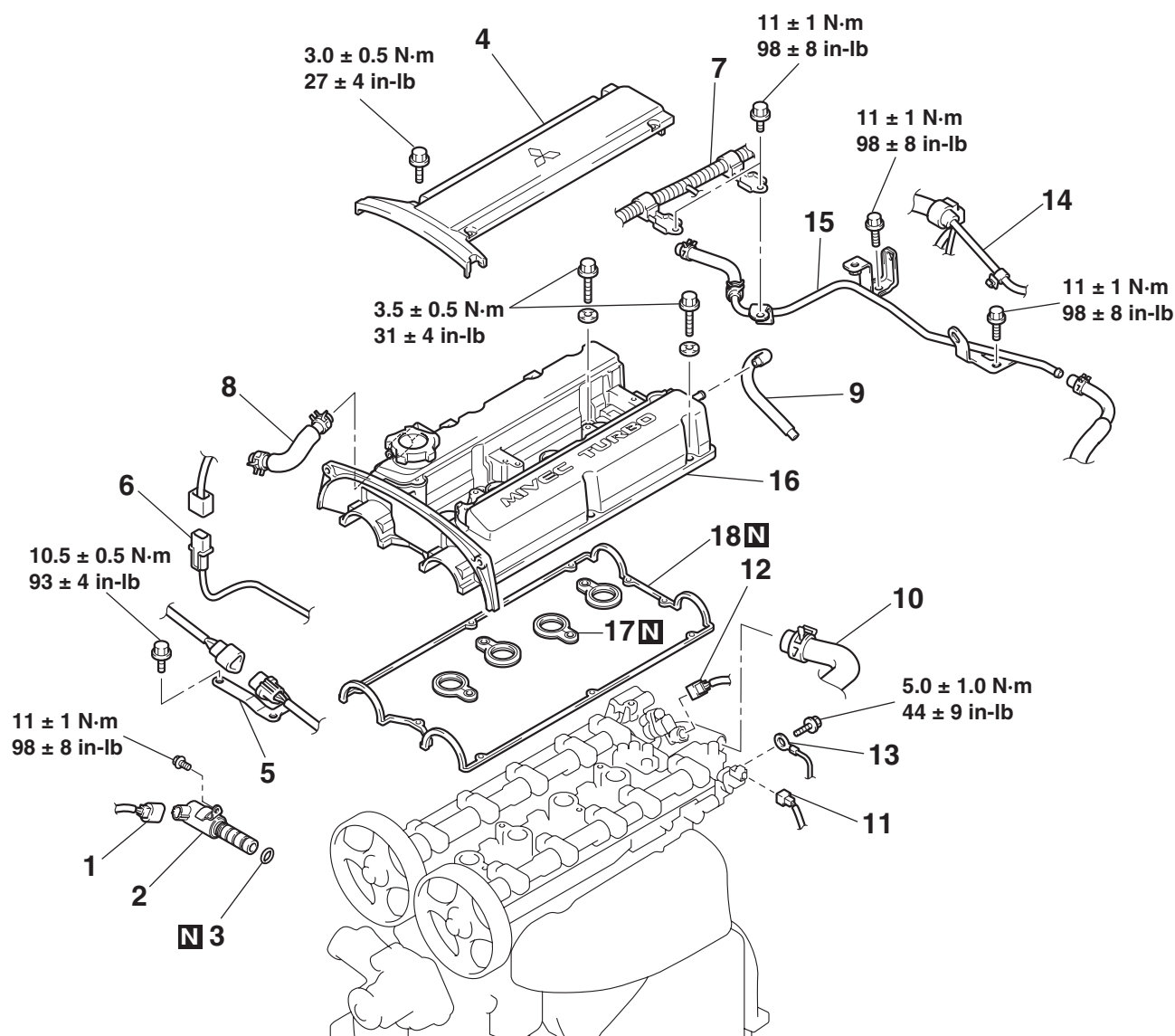
- If the vehicle is equipped with the Brembo™ disc brake, during maintenance, take care not to contact the parts or tools to the caliper because the paint of caliper will be scratched.
- \*Remove and assemble the marked parts in each cylinder unit.

#### Pre-removal Operation

- Under Cover Removal (Refer to GROUP 51, Front Bumper [P.51-2.](#))
- Side Cover Removal
- Engine Coolant Draining (Refer to GROUP 14, On-vehicle Service – Engine Coolant Replacement [P.14-19.](#))
- Air Duct Removal (Refer to GROUP 15, Air Cleaner [P.15-7.](#))
- Air Pipe C Removal (Refer to GROUP 15, Charge Air Cooler [P.15-8.](#))
- Accelerator Cable Removal (Refer to GROUP 17, Accelerator Cable and Pedal [P.17-5.](#))
- Valve Timing Belt Removal (Refer to [P.11A-48.](#))

#### Post-installation Operation

- Valve Timing Belt Installation (Refer to [P.11A-48.](#))
- Accelerator Cable Installation (Refer to GROUP 17, Accelerator Cable and Pedal [P.17-5.](#))
- Air Pipe C Installation (Refer to GROUP 15, Charge Air Cooler [P.15-8.](#))
- Air Duct Installation (Refer to GROUP 15, Air Cleaner [P.15-7.](#))
- Engine Coolant Refilling (Refer to GROUP 14, On-vehicle Service – Engine Coolant Replacement [P.14-19.](#))
- Drive Belt Tension Check (Refer to [P.11A-8.](#))
- Side Cover Installation
- Under Cover Installation (Refer to GROUP 51, Front Bumper [P.51-2.](#))
- Accelerator Cable Adjustment (Refer to GROUP 17, On-vehicle Service – Accelerator Cable Check and Adjustment [P.17-4.](#))



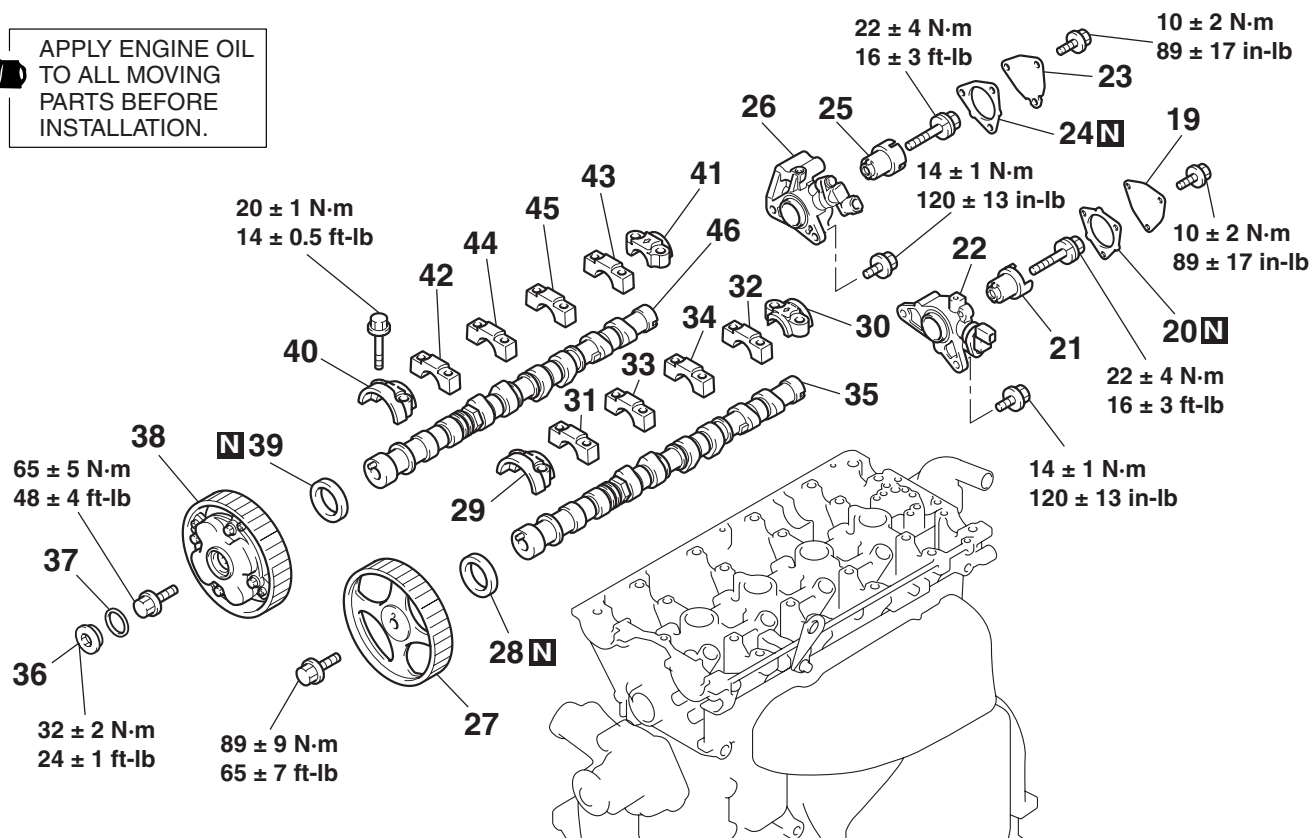
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**REMOVAL STEPS**

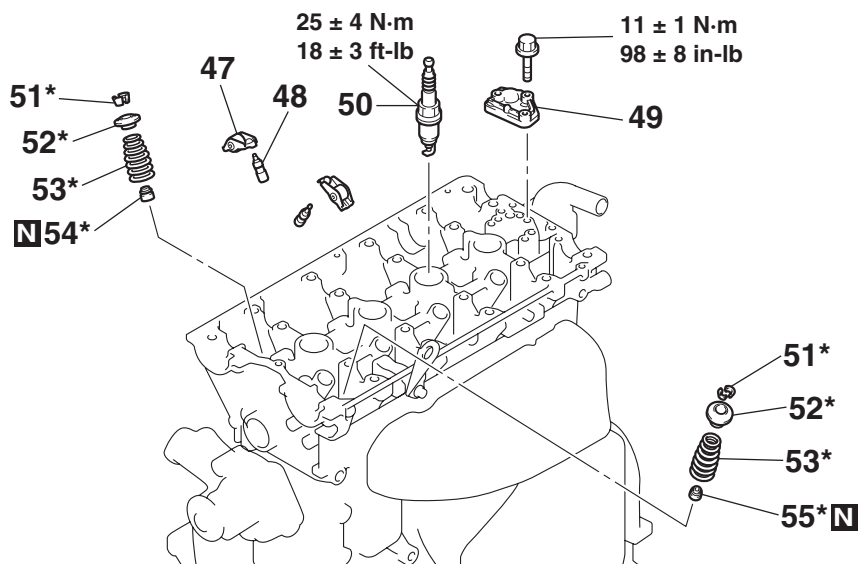
1. OIL FEEDER CONTROL VALVE CONNECTOR
- >>O<< 2. OIL FEEDER CONTROL VALVE
- >>O<< 3. O-RING
4. ROCKER COVER CENTER COVER
- SPARK PLUG CABLES AND IGNITION COILS (REFER TO GROUP 16, IGNITION COIL P.16-39.)
5. HEATED OXYGEN SENSOR (FRONT) CONNECTOR
6. CRANKSHAFT POSITION SENSOR CONNECTOR
7. CONTROL WIRING HARNESS CONNECTION
8. ROCKER COVER PCV HOSE

**REMOVAL STEPS (Continued)**

9. ROCKER COVER BREATHER HOSE
- <<A>> >>N<< 10. RADIATOR UPPER HOSE CONNECTION
11. CAMSHAFT POSITION SENSOR CONNECTOR (EXHAUST SIDE)
12. CAMSHAFT POSITION SENSOR CONNECTOR (INLET SIDE)
13. GROUND TERMINAL
14. CONTROL WIRING HARNESS CONNECTION
15. VACUUM HOSE AND PIPE ASSEMBLY
- >>M<< 16. ROCKER COVER
17. SPARK PLUG HOLE GASKETS
18. ROCKER COVER GASKET



| REAR ENGINE |   | FRONT ENGINE |                                    |
|-------------|---|--------------|------------------------------------|
|             | 19. CAMSHAFT POSITION SENSOR SUPPORT COVER            | >>F<<        | 30. CAMSHAFT BEARING CAP, REAR     |
|             | 20. CAMSHAFT POSITION SENSOR SUPPORT COVER GASKET     | >>F<<        | 31. CAMSHAFT BEARING CAP, No.2     |
| >>L<<       | 21. CAMSHAFT POSITION SENSING CYLINDER (EXHAUST SIDE) | >>F<<        | 32. CAMSHAFT BEARING CAP, No.5     |
| >>J<<       | 22. CAMSHAFT POSITION SENSOR SUPPORT                  | >>F<<        | 33. CAMSHAFT BEARING CAP, No.3     |
|             | 23. CAMSHAFT POSITION SENSOR SUPPORT COVER            | >>E<<        | 34. CAMSHAFT BEARING CAP, No.4     |
|             | 24. CAMSHAFT POSITION SENSOR SUPPORT COVER GASKET     |              | 35. EXHAUST CAMSHAFT               |
| >>K<<       | 25. CAMSHAFT POSITION SENSING CYLINDER (INLET SIDE)   | <<B>> >>H<<  | 36. CAMSHAFT SPROCKET CAP          |
| >>J<<       | 26. CAMSHAFT POSITION SENSOR SUPPORT                  |              | 37. WASHER                         |
| <<B>> >>I<< | 27. CAMSHAFT SPROCKET (EXHAUST SIDE)                  | >>G<<        | 38. CAMSHAFT SPROCKET (INLET SIDE) |
| >>G<<       | 28. CAMSHAFT OIL SEAL                                 | >>F<<        | 39. CAMSHAFT OIL SEAL              |
| >>F<<       | 29. CAMSHAFT BEARING CAP, FRONT                       |              | 40. CAMSHAFT BEARING CAP, FRONT    |
|             |   | >>F<<        | 41. CAMSHAFT BEARING CAP, REAR     |
|             |   | >>F<<        | 42. CAMSHAFT BEARING CAP, No.2     |
|             |   | >>F<<        | 43. CAMSHAFT BEARING CAP, No.5     |
|             |   | >>F<<        | 44. CAMSHAFT BEARING CAP, No.3     |
|             |   | >>F<<        | 45. CAMSHAFT BEARING CAP, No.4     |
|             |   | >>E<<        | 46. INLET CAMSHAFT                 |



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**REMOVAL STEPS**

- >>D<<
- 47. ROCKER ARMS
  - 48. ROCKER ARM LASH ADJUSTERS
  - 49. OIL DELIVERY BODY
  - 50. SPARK PLUGS

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

**REMOVAL STEPS (Continued)**

- 51. VALVE SPRING RETAINER LOCKS
- 52. VALVE SPRING RETAINERS
- 53. VALVE SPRINGS
- 54. INLET VALVE STEM SEALS
- 55. EXHAUST VALVE STEM SEALS

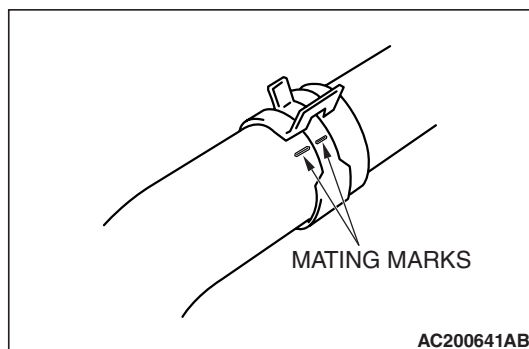
**Required Special Tools:**

- MD998713: Camshaft Oil Seal Installer
- MD998737: Valve Stem Seal Installer

- MD998772: Valve Spring Compressor

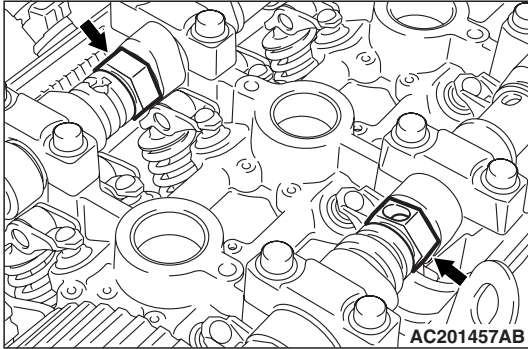
**REMOVAL SERVICE POINTS****<<A>> RADIATOR UPPER HOSE DISCONNECTION**

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.

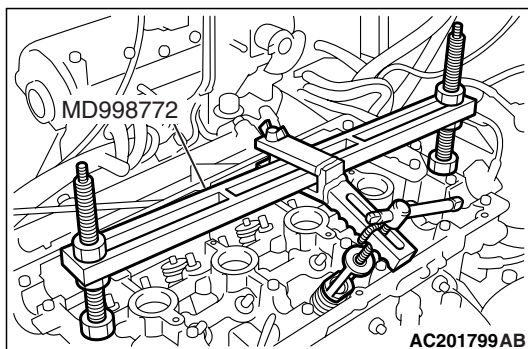


### <<C>> VALVE SPRING RETAINER LOCKS REMOVAL

#### ⚠ CAUTION

When removing valve spring retainer locks, leave the piston of each cylinder in the TDC (Top Dead 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, remove the valve spring retainer locks.



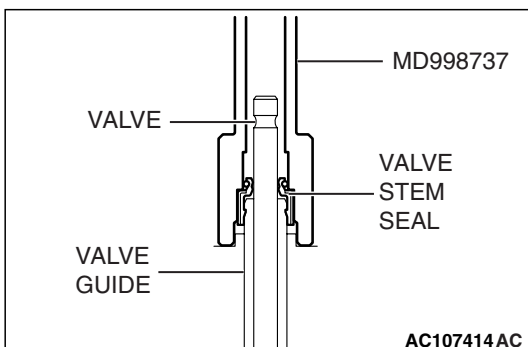
### INSTALLATION SERVICE POINTS

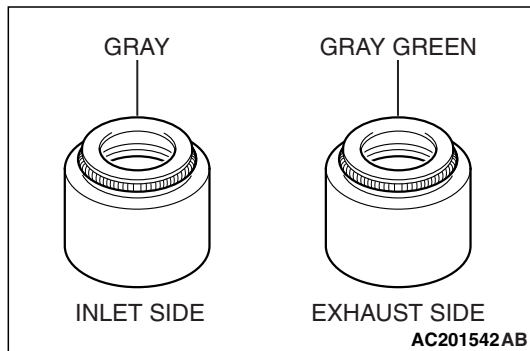
#### >>A<< EXHAUST VALVE STEM SEALS/INLET VALVE STEM SEALS INSTALLATION

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

#### ⚠ CAUTION

- Valve stem seals cannot be reused.
  - The special tool MD998737 must be used to install the valve stem seal. Improper installation could result in oil leaking past the valve guide.
2. Use special tool MD998737 to fill a new valve stem seal in the valve guide using the valve stem area as a guide.

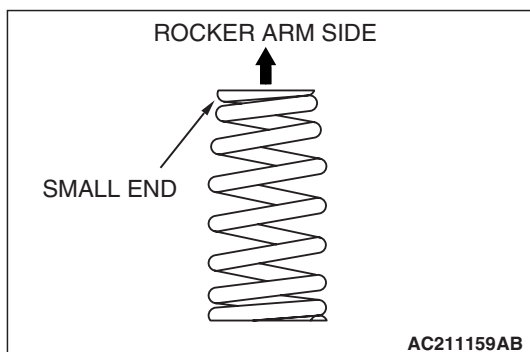




*NOTE: Check the valve stem seal color to identify the inlet side or exhaust side.*

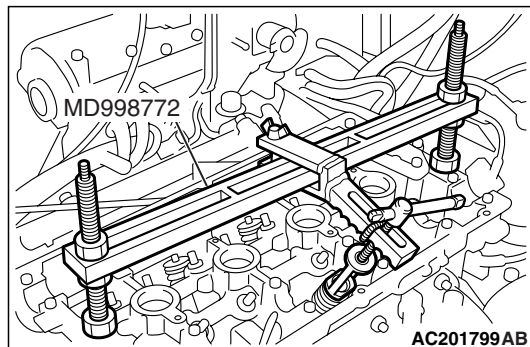
### >>B<< VALVE SPRINGS INSTALLATION

The small end of the valve spring should face the rocker arm.



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

Use special tool 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 [P.11B-39.](#))

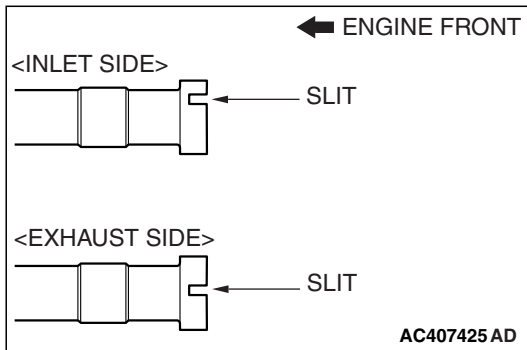
## >>E<< EXHAUST CAMSHAFT/INLET CAMSHAFT INSTALLATION

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

### CAUTION

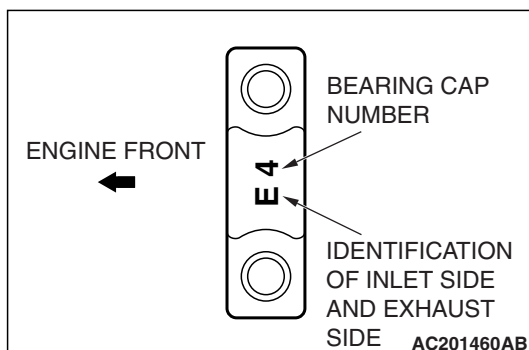
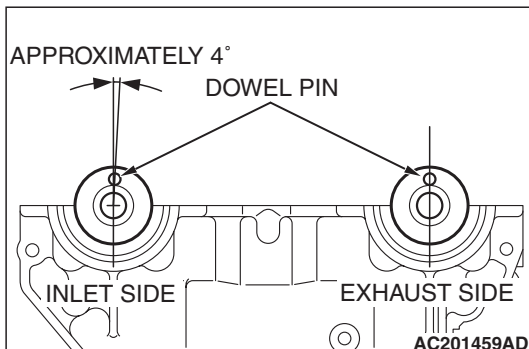
Do not install wrong camshaft on the side of inlet or exhaust. The exhaust camshaft has a slit at the rear surface.

3. Install the camshaft to the cylinder head.



## >>F<< CAMSHAFT BEARING CAPS, NUMBER 4/CAMSHAFT BEARING CAPS, NUMBER 3/CAMSHAFT BEARING CAPS, NUMBER 5/CAMSHAFT BEARING CAPS, NUMBER 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.

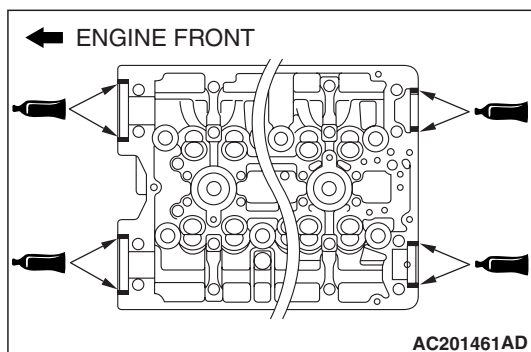


2. Since the shape of camshaft bearing caps number 2 –5 is identical, check the identification marks so that the bearing cap No., inlet side, or exhaust side is installed in the direction shown in the illustration.

**Identification mark (engraved on the front and bearing caps number 2 – 5)**

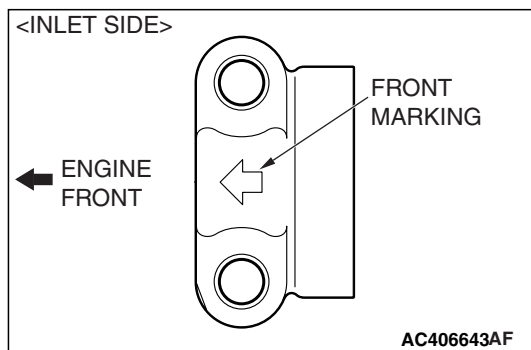
**I: Inlet side**

**E: Exhaust side**



3. Apply sealant to the positions (8 areas) of the upper side of the cylinder head as shown in the illustration.

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

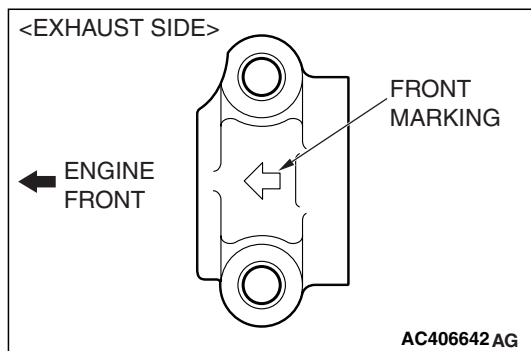


4. Position the camshaft bearing caps, rear in the direction as shown in the illustration for installation.
5. Check the identification marks on the camshaft bearing caps, front so that inlet side and exhaust side is installed in the same way as that of bearing caps number 2 – 5.
6. Tighten the bearing 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 ( $14 \pm 0.5$  ft-lb)**

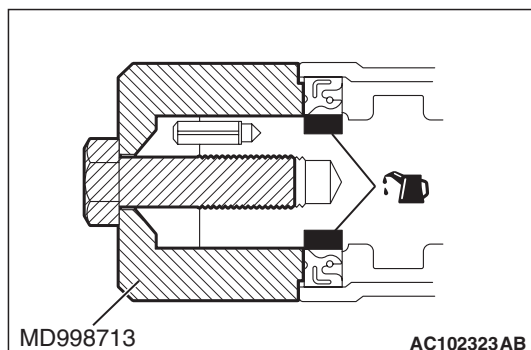
7. Ensure that the rocker arms are installed properly.

*NOTE: Remove an excess sealant completely.*



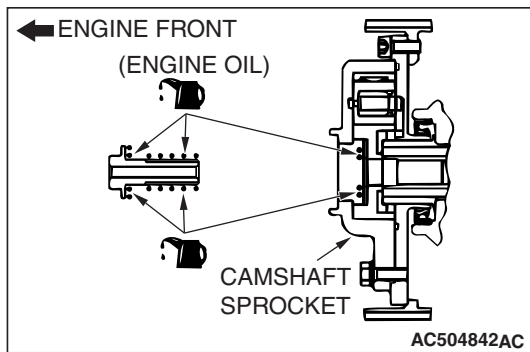
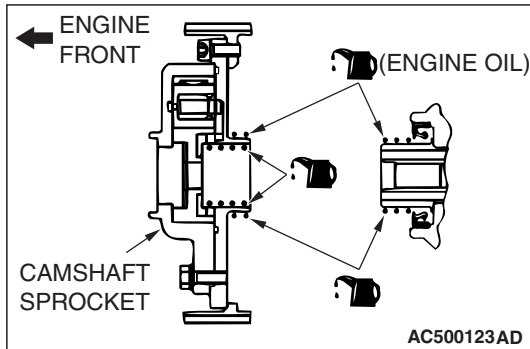
## >>G<< CAMSHAFT OIL SEALS INSTALLATION

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





## >>H<< CAMSHAFT SPROCKET (INLET SIDE) INSTALLATION



1. Apply engine oil to the top end of the camshaft and the camshaft mounting location of the camshaft sprocket.
2. Align the dowel pin hole on the camshaft sprocket with the dowel pin of the camshaft. Then, install the camshaft sprocket to the camshaft.
3. Hold the flats of the camshaft with a wrench, and check that the camshaft sprocket does not rotate.

*NOTE: This operation is carried out because it is impossible to visually check that the dowel pin of the camshaft is inserted into the dowel pin hole of the camshaft sprocket.*

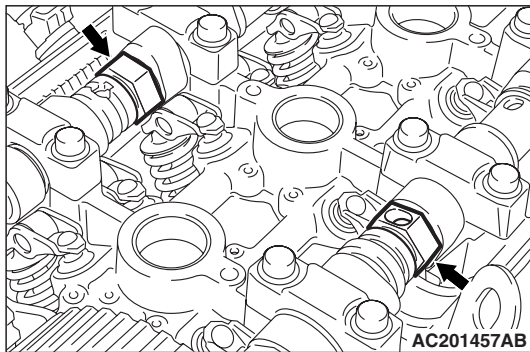
4. Apply engine oil to the thread and the bearing surface of the camshaft sprocket mounting bolts. Then, hold the camshaft with a wrench in the same way as removal and tighten the bolts to the specified torque.

**Tightening torque:  $65 \pm 5$  N·m ( $48 \pm 4$  ft-lb)**

## >>I<< 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.

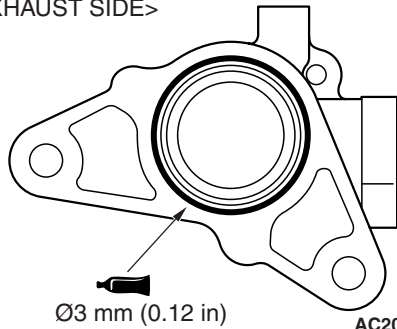
**Tightening torque:  $89 \pm 9$  N·m ( $65 \pm 7$  ft-lb)**



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

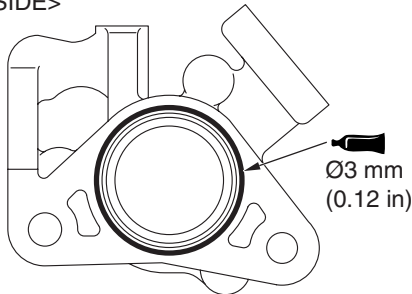
1. Remove sealant from the camshaft position sensor support and cylinder head surfaces.

&lt;EXHAUST SIDE&gt;



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&lt;INLET SIDE&gt;



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

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

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

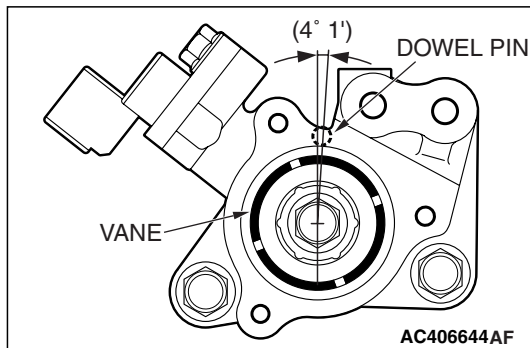
4. Tighten the camshaft position sensor support mounting bolts to the specified torque.

**Tightening torque:  $14 \pm 1$  N·m ( $120 \pm 13$  in-lb)**

### >>K<< CAMSHAFT POSITION SENSING CYLINDER (INLET SIDE) INSTALLATION

1. Set the dowel pin of the inlet camshaft to the position (No.1 cylinder at compression TDC) as shown in the illustration.
2. Tighten the camshaft position sensing cylinder mounting bolts to the specified torque.

**Tightening torque:  $22 \pm 4$  N·m ( $16 \pm 3$  ft-lb)**



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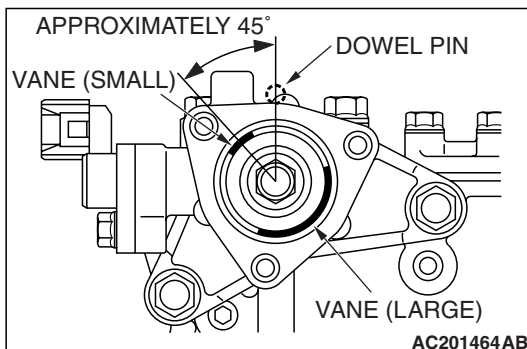
### >>L<< CAMSHAFT POSITION SENSING CYLINDER INSTALLATION

1. Set the dowel pin of the exhaust camshaft to the position (number 1 cylinder at compression TDC) as shown in the illustration.

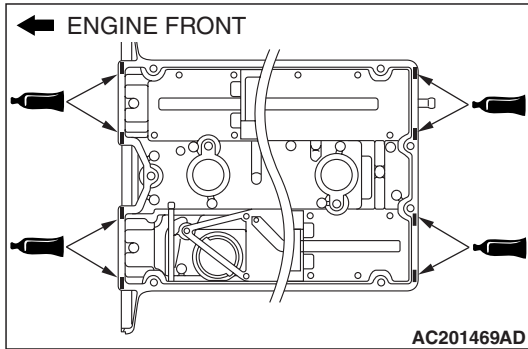
*NOTE: Use the force of the exhaust valve spring to rotate counterclockwise.*

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 ( $16 \pm 3$  ft-lb)**



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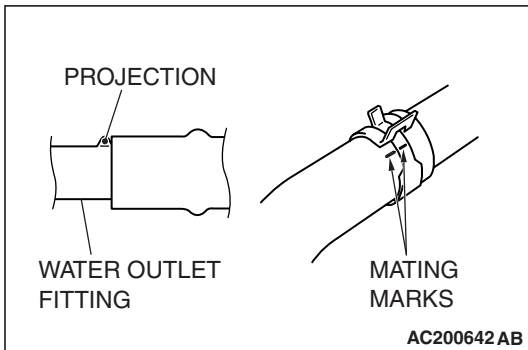
### >>M<< ROCKER COVER INSTALLATION

1. Apply sealant to the positions of the rocker cover gasket (8 areas) as shown in the illustration.

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

2. Install the rocker cover to the cylinder head.
3. Tighten the rocker cover mounting bolts to the specified torque.

**Tightening torque:  $3.5 \pm 0.5$  N·m ( $31 \pm 4$  in-lb)**



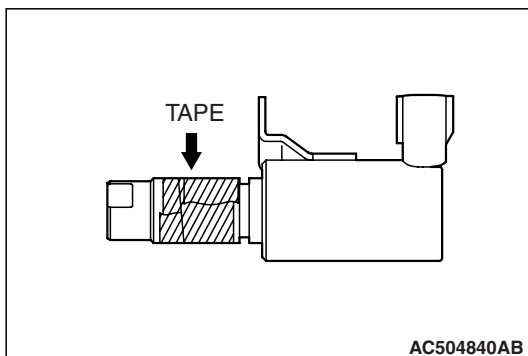
### >>N<< RADIATOR UPPER HOSE CONNECTION

1. Insert each hose until it contacts the projection on the water outlet fitting.
2. Align the mating marks on the radiator hose and hose clamp, and then secure the radiator hose.

### >>O<< O-RING/OIL FEEDER CONTROL VALVE INSTALLATION

#### CAUTION

- Never re-use the O-ring.
- Before installing O-ring, wind the tape with the soft adhesion (sealing tape) around the oil passages cut-out area of engine oil control valve to prevent the damage. If the O-ring is damaged, it can be the cause of oil leak.



1. Apply a small amount of engine oil to the O-ring and then install it to the oil control valve.
2. Assemble the engine oil control valve to the cylinder head.
3. Tighten the engine oil control valve mounting bolt to the specified torque.

**Tightening torque:  $11 \pm 1$  N·m ( $98 \pm 8$  in-lb)**

## OIL PAN

## REMOVAL AND INSTALLATION

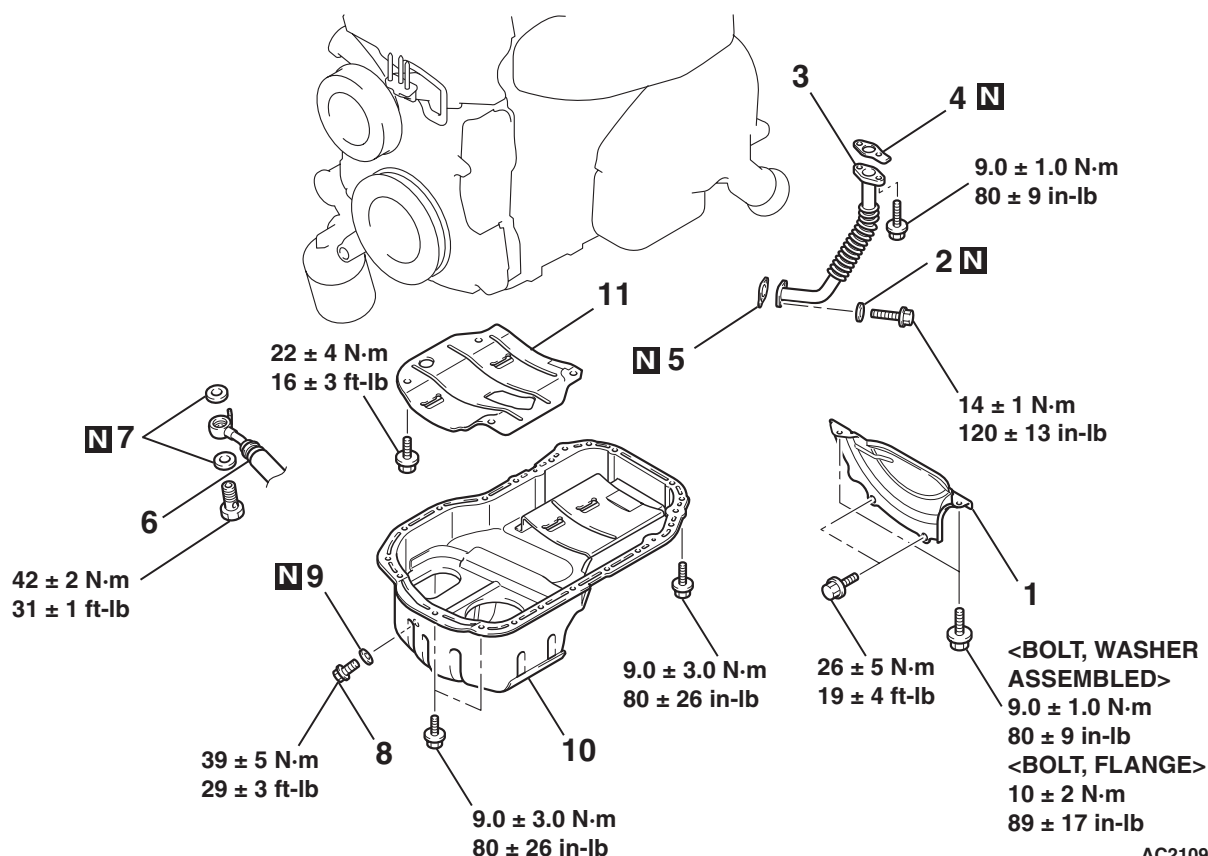
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**Pre-removal Operation**

- Under Cover Removal (Refer to GROUP 51, Front Bumper P.51-2.)
- Engine Oil Draining (Refer to GROUP 12, On-vehicle Service –Engine Oil Replacement P.12-3.)
- Front Axle Crossmember Bar Removal (Refer to GROUP 32, Engine Roll Stopper and Centermember P.32-7.)
- Front Exhaust Pipe Removal (Refer to GROUP 15, Exhaust Pipe and Main Muffler P.15-17.)
- Starter Assembly Removal (Refer to GROUP 16, Starter Motor Assembly P.16-24.)

**Post-installation Operation**

- Starter Assembly Installation (Refer to GROUP 16, Starter Motor Assembly P.16-24.)
- Front Exhaust Pipe Installation (Refer to GROUP 15, Exhaust Pipe and Main Muffler P.15-17.)
- Front Axle Crossmember Bar Installation (Refer to GROUP 32, Engine Roll Stopper and Centermember P.32-7.)
- Engine Oil Refilling (Refer to GROUP 12, On-vehicle Service –Engine Oil Replacement P.12-3.)
- Under Cover Installation (Refer to GROUP 51, Front Bumper P.51-2.)



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**REMOVAL STEPS**

1. FLYWHEEL HOUSING FRONT LOWER COVER
2. GASKET
3. OIL RETURN TUBE
4. OIL RETURN TUBE GASKET
- >>C<< 5. OIL RETURN TUBE GASKET
6. ENGINE OIL COOLER RETURN HOSE

**REMOVAL STEPS (Continued)**

7. ENGINE OIL COOLER TUBE GASKETS
8. ENGINE OIL PAN DRAIN PLUG
- >>B<< 9. ENGINE OIL PAN DRAIN PLUG GASKET
- <<A>> >>A<< 10. ENGINE OIL PAN
11. CYLINDER BLOCK BAFFLE PLATE

**Required Special Tool:**

- MD998727: Oil Pan FIPG cutter

## REMOVAL SERVICE POINT

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

1. Remove the engine oil pan mounting bolts.

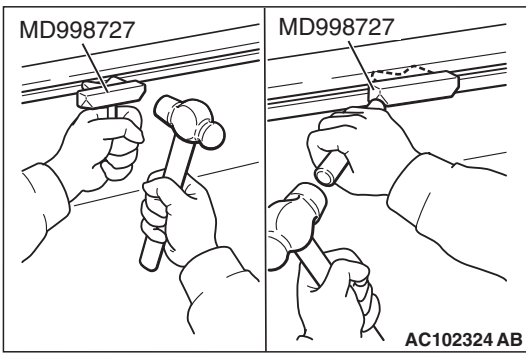
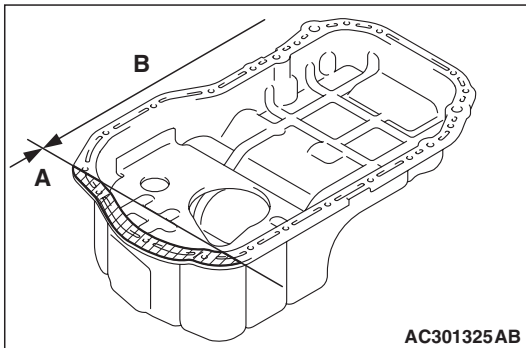
#### **⚠ CAUTION**

Do not use special tool MD998727 in area A of the engine oil pan. Using the special tool in area A may cause deformation of the front case because the front case is made of aluminum.

2. Tap special tool MD998727 into the range (B) between the cylinder block and the engine oil pan, and then slide the tool sideways.

*NOTE: If any sounding parts interfere with the removal, there is no need to use special tool MD998727.*

3. Remove the engine oil pan.



## INSTALLATION SERVICE POINTS

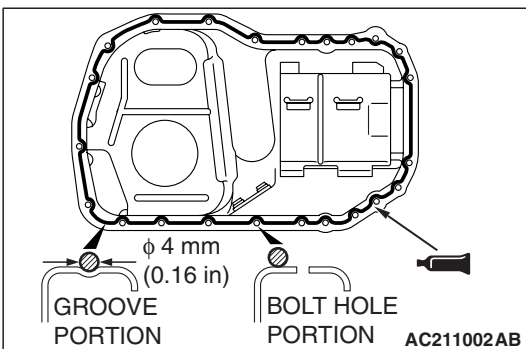
### >>A<< ENGINE OIL PAN INSTALLATION

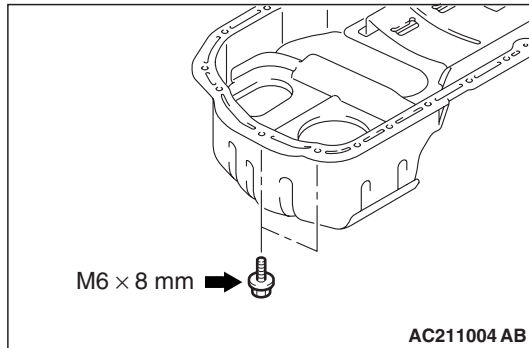
1. Remove old sealant from the engine oil pan and cylinder block surfaces.
2. Apply a bead of the sealant to the cylinder block mating surface of the engine oil pan as shown.

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

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

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

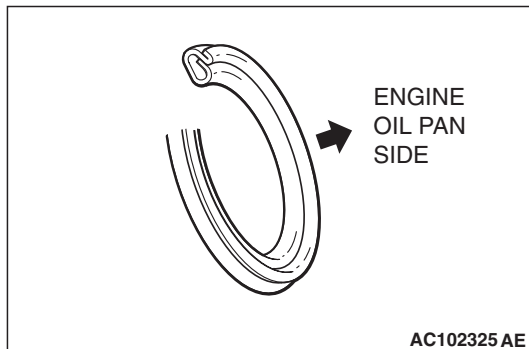


**⚠ CAUTION**

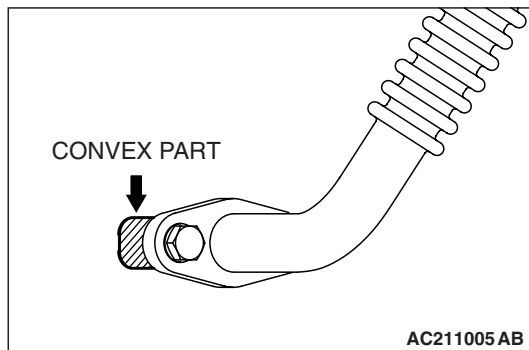
Wait at least one hour. Never start the engine or let engine oil or coolant touch the sealant surface during this time.

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:  $9.0 \pm 3.0 \text{ N} \cdot \text{m}$  ( $80 \pm 26 \text{ in-lb}$ )**

**>>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.

**>>C<< OIL RETURN TUBE GASKET INSTALLATION**

The oil return tube gasket should be replaced with a new one. Set the convex part to the position as shown in the illustration for installation.

*NOTE: There is no specific direction indicated for installing the turbocharger side of the oil return tube gasket.*

**INSPECTION**

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

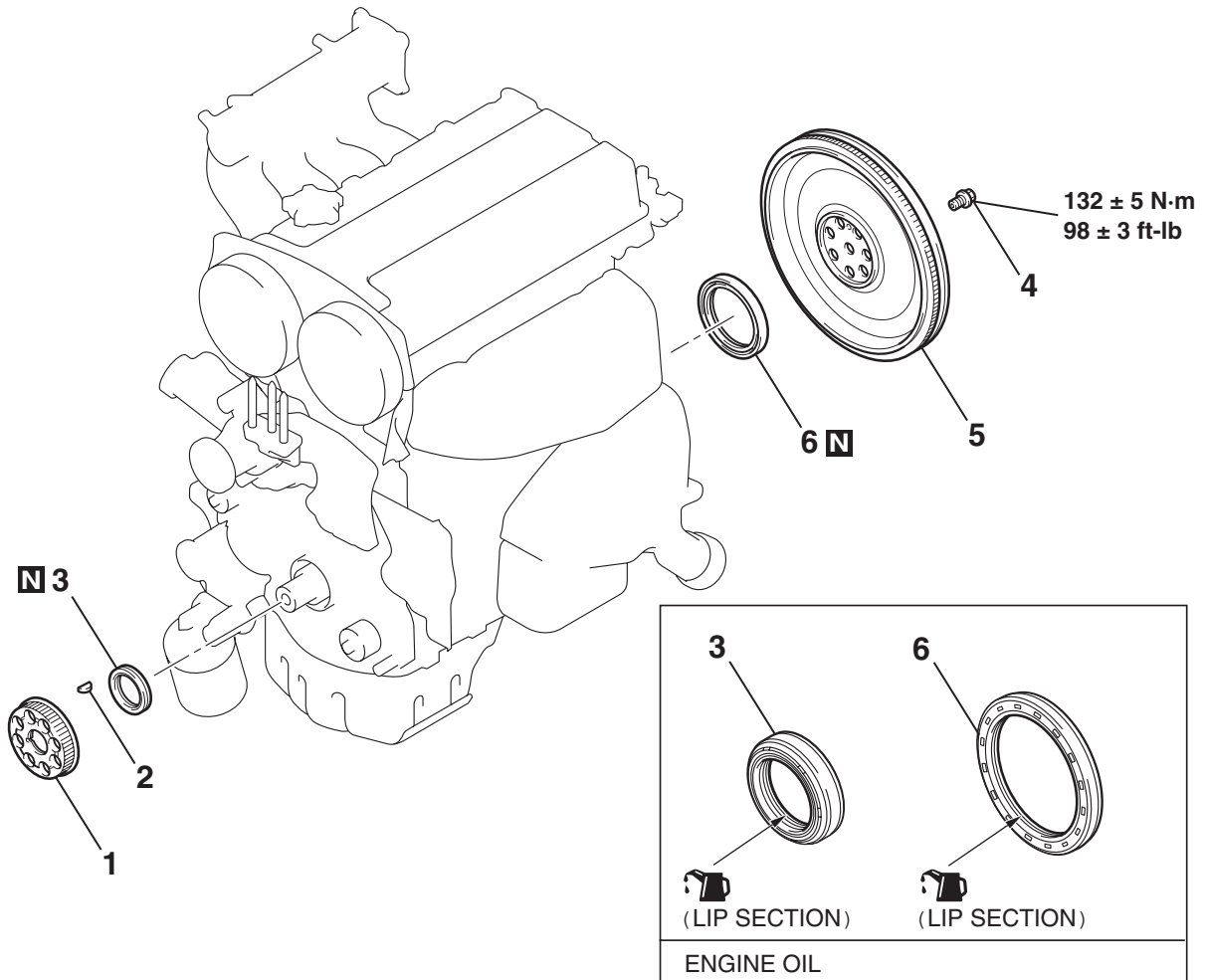
# CRANKSHAFT OIL SEAL

## REMOVAL AND INSTALLATION

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**CAUTION**

If the vehicle is equipped with the Brembo™ disc brake, during maintenance, take care not to contact the parts or tools to the caliper because the paint of caliper will be scratched.



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**CRANKSHAFT FRONT OIL SEAL  
REMOVAL STEPS**

- VALVE TIMING BELT, BALANCER TIMING BELT (REFER TO [P.11A-48.](#))
- >>D<< 1. CRANKSHAFT BALANCER SHAFT DRIVE SPROCKET
2. CRANKSHAFT KEY
- >>C<< 3. CRANKSHAFT FRONT OIL SEAL

**CRANKSHAFT REAR OIL SEAL  
REMOVAL STEPS**

- TRANSFER ASSEMBLY (REFER TO GROUP 22A, TRANSFER ASSEMBLY [P.22A-223](#)<W5M51>, [P.22A-225](#)<W6MAA>.)
  - TRANSAXLE ASSEMBLY (REFER TO GROUP 22A, TRANSAXLE ASSEMBLY [P.22A-228](#)<W5M51>, [P.22A-232](#)<W6MAA>.)
- <<A>> >>B<< 4. FLYWHEEL BOLTS
5. FLYWHEEL ASSEMBLY
- >>A<< 6. CRANKSHAFT REAR OIL SEAL

**Required Special Tools:**

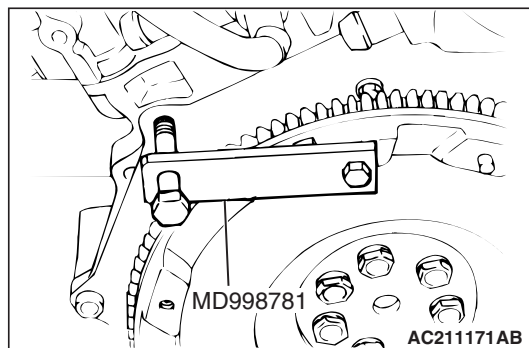
- MB990938: Installer Bar
- MD998285: Crankshaft Front Oil Seal Guide
- MD998375: Crankshaft Front Oil Seal Installer
- MD998776: Crankshaft Rear Oil Seal Installer
- MD998781: Flywheel Stopper



## REMOVAL SERVICE POINT

## &lt;&lt;A&gt;&gt; FLYWHEEL BOLTS REMOVAL

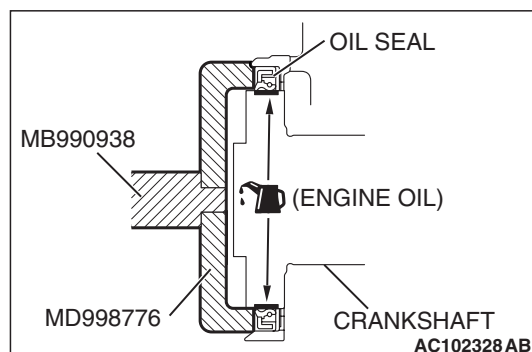
1. Use special tool MD998781 to secure the flywheel.
2. Remove the flywheel mounting bolts.



## INSTALLATION SERVICE POINTS

## &gt;&gt;A&lt;&lt; CRANKSHAFT REAR OIL SEAL INSTALLATION

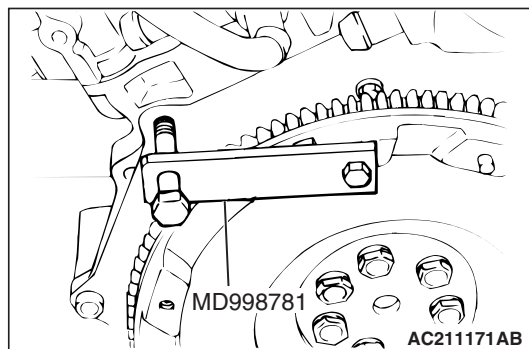
1. Apply a small amount of engine oil to the entire inner diameter of the oil seal lip.
2. Use special tools MB990938 and MD998776 to press-fit the oil seal.



## &gt;&gt;B&lt;&lt; FLYWHEEL BOLTS INSTALLATION

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

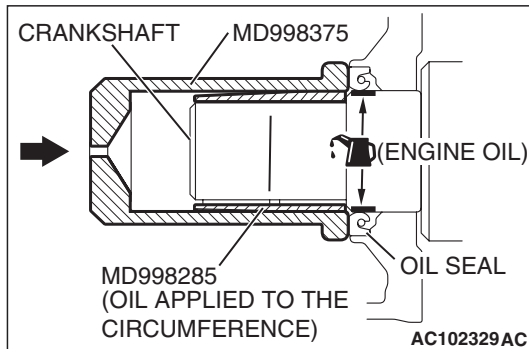
**Tightening torque: 132 ± 5 N·m (98 ± 3 ft-lb)**





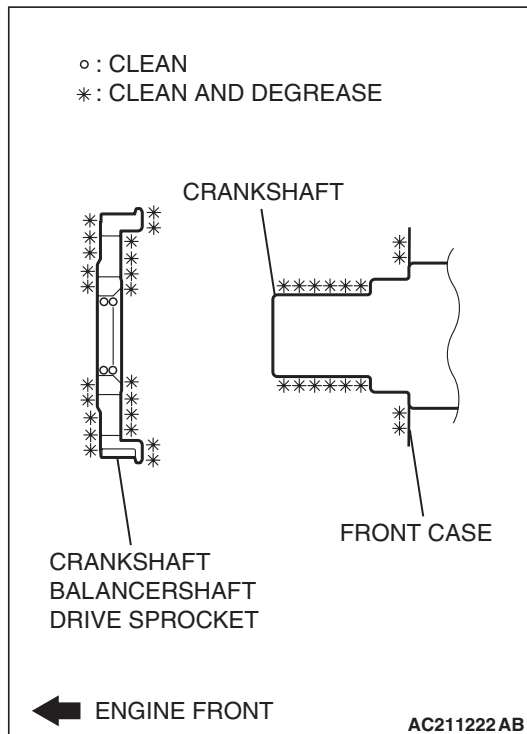
## >>C<< CRANKSHAFT FRONT OIL SEAL INSTALLATION

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 MD998285 and install it to the crankshaft.
3. Use special tool 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

M1112004001755

**⚠ CAUTION**

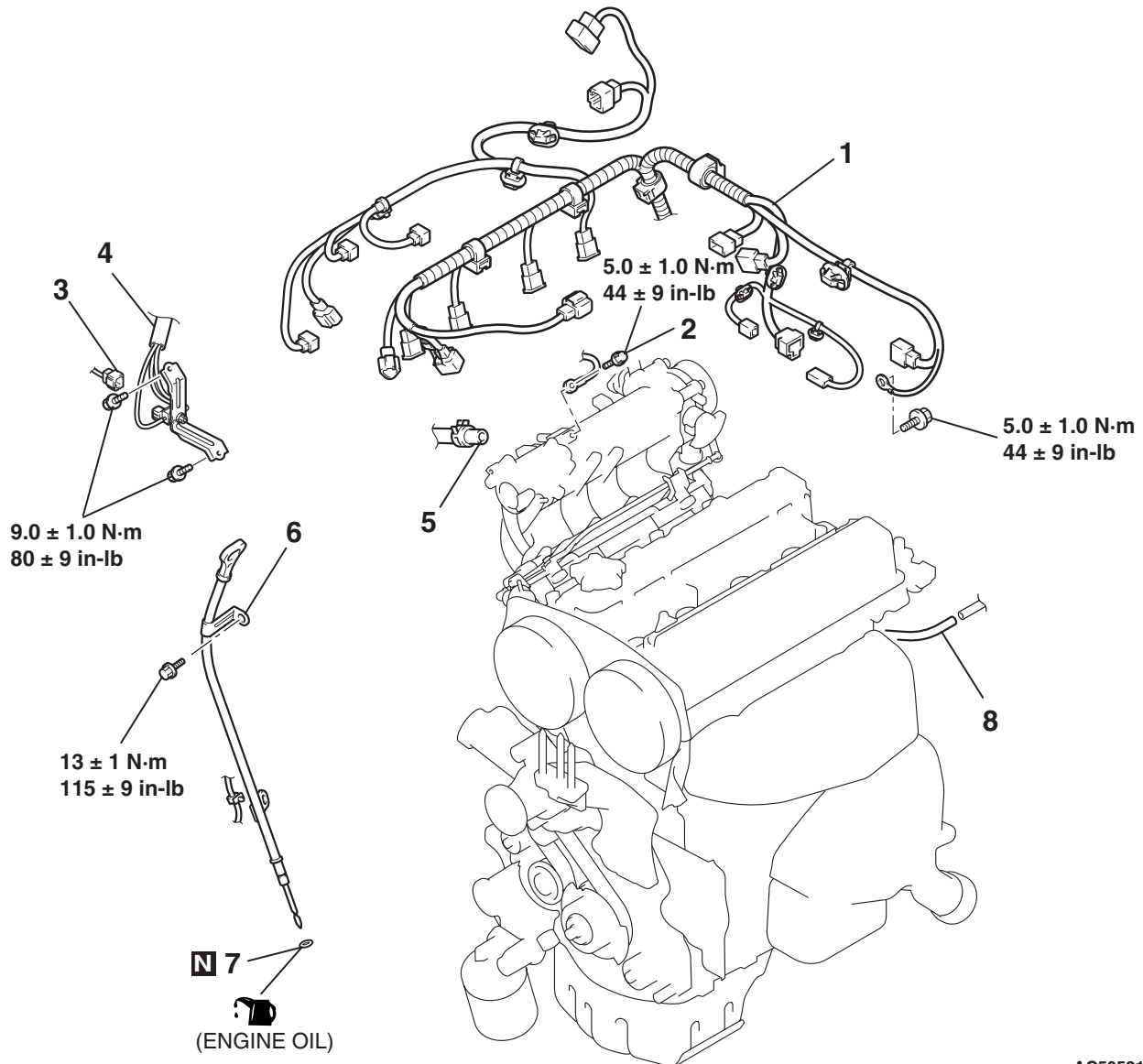
If the vehicle is equipped with the Brembo™ disc brake, during maintenance, take care not to contact the parts or tools to the caliper because the paint of caliper will be scratched.

**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-868.](#)]
- Under Cover Removal (Refer to GROUP 51, Front Bumper [P.51-2.](#))
- Side Cover Removal
- Engine Coolant Draining (Refer to GROUP 14, On-vehicle Service – Engine Coolant Replacement [P.14-19.](#))
- Engine Oil Draining (Refer to GROUP 12, On-vehicle Service – Engine Oil Replacement [P.12-3.](#))
- Strut Tower Bar Removal (Refer to GROUP 42, Strut Tower Bar [P.42-12.](#))
- Air Cleaner Assembly Removal (Refer to GROUP 15, Air Cleaner [P.15-7.](#))
- Air Hose E, Air Pipe C and Air Hose D Removal (Refer to GROUP 15, Charge Air Cooler [P.15-8.](#))
- Battery Removal
- Accelerator Cable Removal (Refer to GROUP 17, Accelerator Cable and Pedal [P.17-5.](#))
- Rocker Cover Center Cover Removal (Refer to [P.11A-25.](#))
- Radiator Assembly Removal (Refer to GROUP 14, Radiator [P.14-23.](#))
- Front Axle Crossmember Bar Removal (Refer to GROUP 32, Engine Roll Stopper and Centermember [P.32-7.](#))
- Front Exhaust Pipe Removal (Refer to GROUP 15, Exhaust Pipe and Main Muffler [P.15-17.](#))
- Starter Assembly Removal (Refer to GROUP 16, Starter Motor Assembly [P.16-24.](#))
- Valve Timing Belt Removal (Refer to [P.11A-48.](#))

**Post-installation Operation**

- Valve Timing Belt Installation (Refer to [P.11A-48.](#))
- Starter Assembly Installation (Refer to GROUP 16, Starter Motor Assembly [P.16-24.](#))
- Front Exhaust Pipe Installation (Refer to GROUP 15, Exhaust Pipe and Main Muffler [P.15-17.](#))
- Front Axle Crossmember Bar Installation (Refer to GROUP 32, Engine Roll Stopper and Centermember [P.32-7.](#))
- Radiator Assembly Installation (Refer to GROUP 14, Radiator [P.14-23.](#))
- Rocker Cover Center Cover Installation (Refer to [P.11A-25.](#))
- Accelerator Cable Installation (Refer to GROUP 17, Accelerator Cable and Pedal [P.17-5.](#))
- Battery Installation
- Air Hose E, Air Pipe C and Air Hose D Installation (Refer to GROUP 15, Charge Air Cooler [P.15-8.](#))
- Air Cleaner Assembly Installation (Refer to GROUP 15, Air Cleaner [P.15-7.](#))
- Strut Tower Bar Installation (Refer to GROUP 42, Strut Tower Bar [P.42-12.](#))
- 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.14-19.](#))
- Drive Belt Tension Check (Refer to [P.11A-8.](#))
- Side Cover Installation
- Under Cover Installation (Refer to GROUP 51, Front Bumper [P.51-2.](#))
- Accelerator Cable Adjustment (Refer to GROUP 17, On-vehicle Service – Accelerator Cable Check and Adjustment [P.17-4.](#))
- Fuel Leak Check



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### REMOVAL STEPS

1. CONTROL WIRING HARNESS CONNECTION
2. GROUND CABLE CONNECTION
3. EGR VACUUM REGULATOR SOLENOID VALVE CONNECTOR
4. EGR VACUUM REGULATOR SOLENOID VALVE AND BRACKET ASSEMBLY

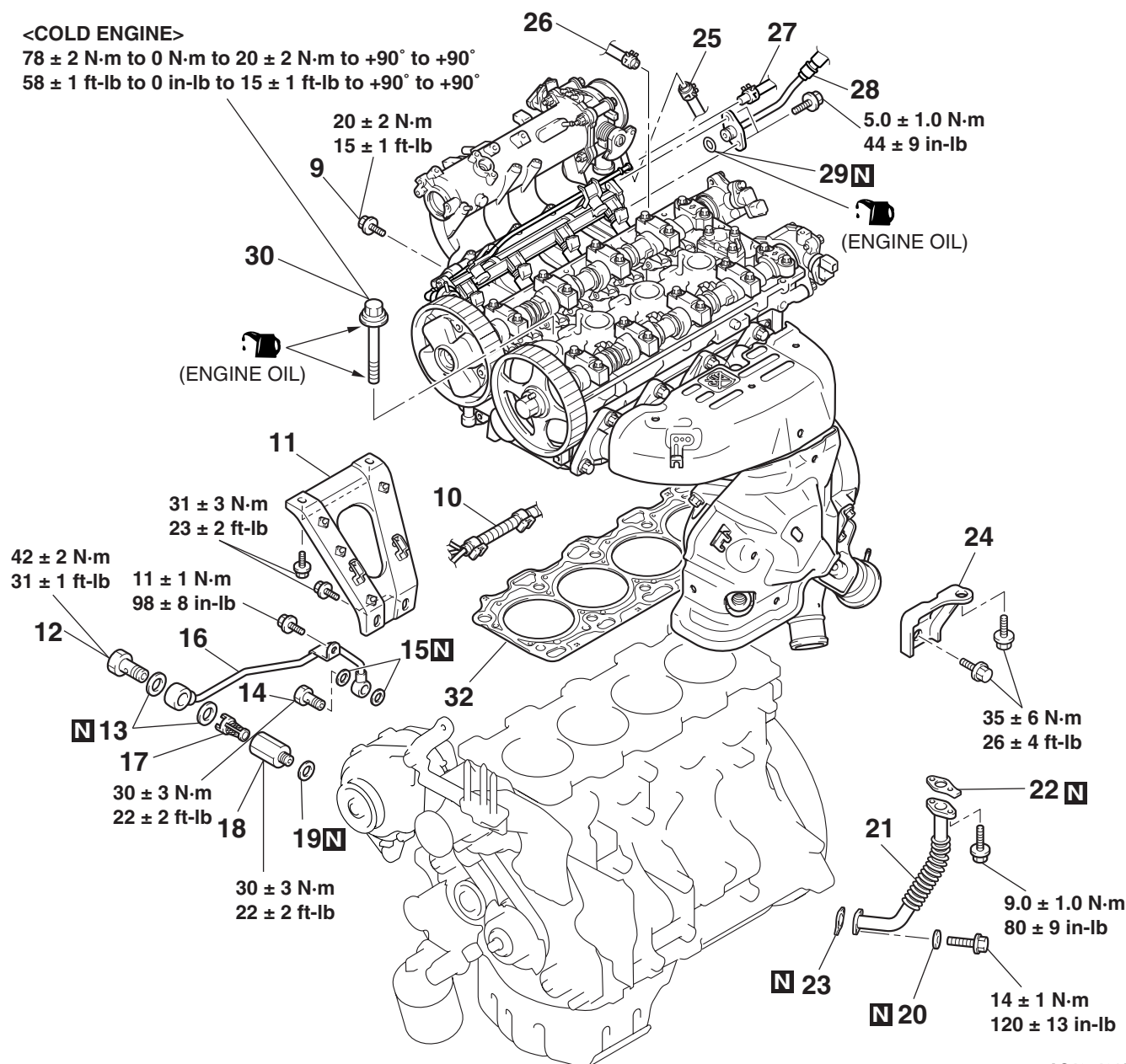
### REMOVAL STEPS (Continued)

5. BRAKE BOOSTER VACUUM HOSE CONNECTION
6. ENGINE OIL DIPSTICK AND DIPSTICK GUIDE
7. O-RING
8. PURGE HOSE CONNECTION

## &lt;COLD ENGINE&gt;

78 ± 2 N·m to 0 N·m to 20 ± 2 N·m to +90° to +90°

58 ± 1 ft-lb to 0 in-lb to 15 ± 1 ft-lb to +90° to +90°



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## REMOVAL STEPS

9. GENERATOR BRACE BOLT  
10. BATTERY WIRING HARNESS CONNECTION  
11. INLET MANIFOLD STAY  
>>E<< 12. EYE BOLT  
13. GASKET  
14. CHECK VALVE ASSEMBLY  
15. GASKET  
16. OIL FEEDER CONTROL VALVE PIPE  
17. FILTER  
18. OIL PIPE JOINT  
19. GASKET  
20. GASKET  
21. OIL RETURN TUBE  
22. OIL RETURN TUBE GASKET  
>>D<< 23. OIL RETURN TUBE GASKET

## REMOVAL STEPS (Continued)

24. TURBOCHARGER BRACKET  
• WATER OUTLET FITTING AND THERMOSTAT CASE ASSEMBLY (REFER TO GROUP 14, WATER HOSE AND PIPE P.14-29.)  
• ROCKER COVER (REFER TO P.11A-25.)  
25. WATER RETURN HOSE CONNECTION  
26. HEATER HOSE CONNECTION  
27. FUEL RETURN LINE HOSE CONNECTION  
>>C<< 28. FUEL HIGH-PRESSURE HOSE CONNECTION  
>>C<< 29. O-RING  
<<A>> >>B<< 30. CYLINDER HEAD BOLTS

**REMOVAL STEPS (Continued)**

31. CYLINDER HEAD ASSEMBLY  
>>A<< 32. CYLINDER HEAD GASKET

**Required Special Tool:**

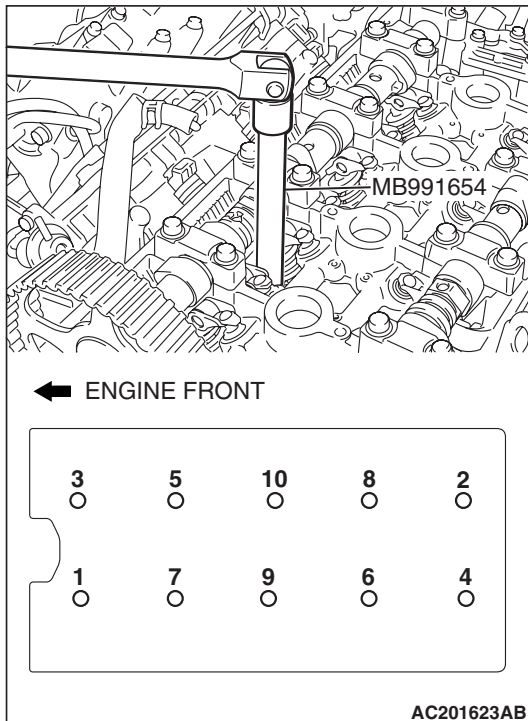
- MB991654: Cylinder Head Bolt Wrench (12)

**REMOVAL SERVICE POINT**

**<<A>> CYLINDER HEAD BOLTS REMOVAL**

Using special tool MB991654, loosen the cylinder head bolts in two or three steps in the order 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.*



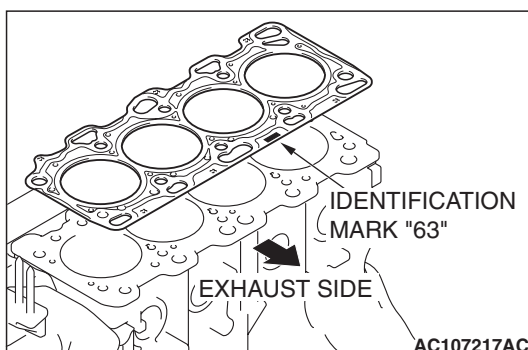
**INSTALLATION SERVICE POINTS**

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

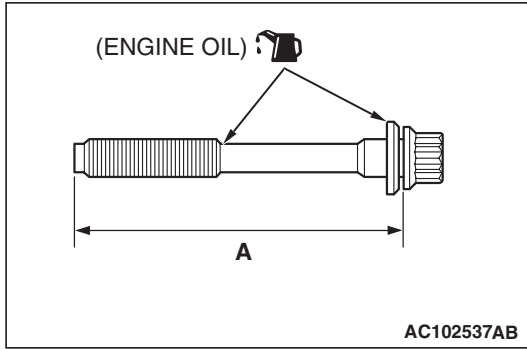
**⚠ CAUTION**

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.



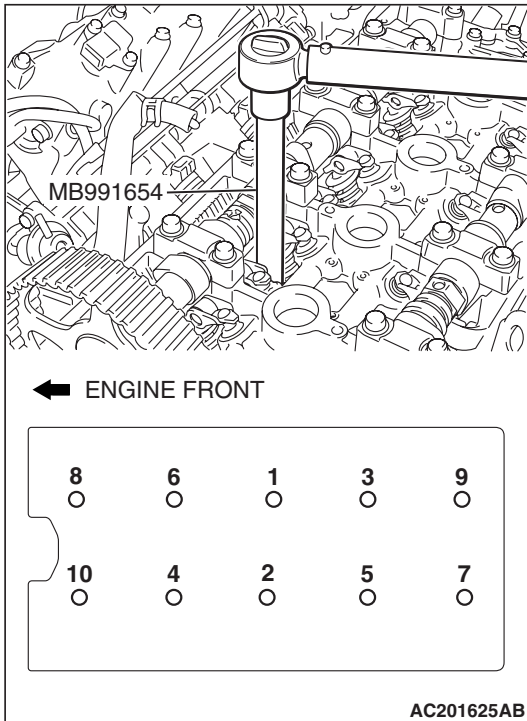
## &gt;&gt;B&lt;&lt; CYLINDER HEAD BOLTS INSTALLATION



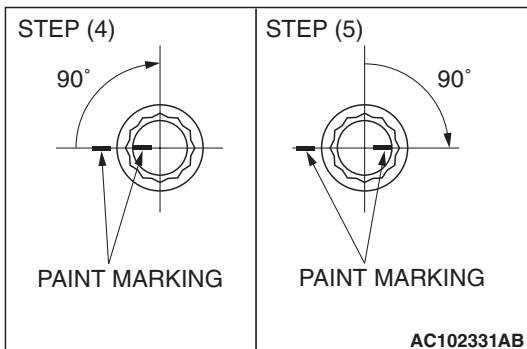
1. Check that the nominal length of each cylinder head bolt meets the limit. If it exceeds the limit, replace the bolt with a new one.

**Limit (A): 99.4 mm (3.91 inches)**

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



3. Use special tool MB991654 to tighten the cylinder head bolts as follows:
  - (1) Tighten the cylinder head bolts to  $78 \pm 2$  N·m ( $58 \pm 1$  ft-lb) 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 ( $15 \pm 1$  ft-lb) 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 fuel rail.**

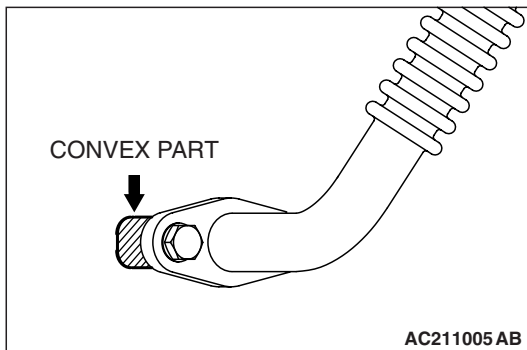
1. Apply a small amount of new engine oil to the O-ring.
2. Turning the fuel high-pressure hose to the right and left, install it onto the fuel rail, while being careful not to damage the O-ring. After installing, check that the hose turns smoothly.
3. If the hose does not turn smoothly, the O-ring is probably being clamped. Disconnect the fuel high-pressure hose and check the O-ring for damage. After this, re-insert it to the fuel rail 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 ( $44 \pm 9$  in-lb)**

## >>D<< OIL RETURN TUBE GASKET INSTALLATION

The oil return tube gasket should be replaced with a new one. Set the convex part to the position shown in the illustration.

*NOTE: There is no specific direction indicated for installing the turbocharger side of the oil return tube gasket.*



## >>E<< EYE BOLT INSTALLATION

### CAUTION

**When tightening the eye bolt, hold the oil pipe joint with a spanner so that it does not rotate with the eye bolt.**



## TIMING BELT

## REMOVAL AND INSTALLATION

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**CAUTION**

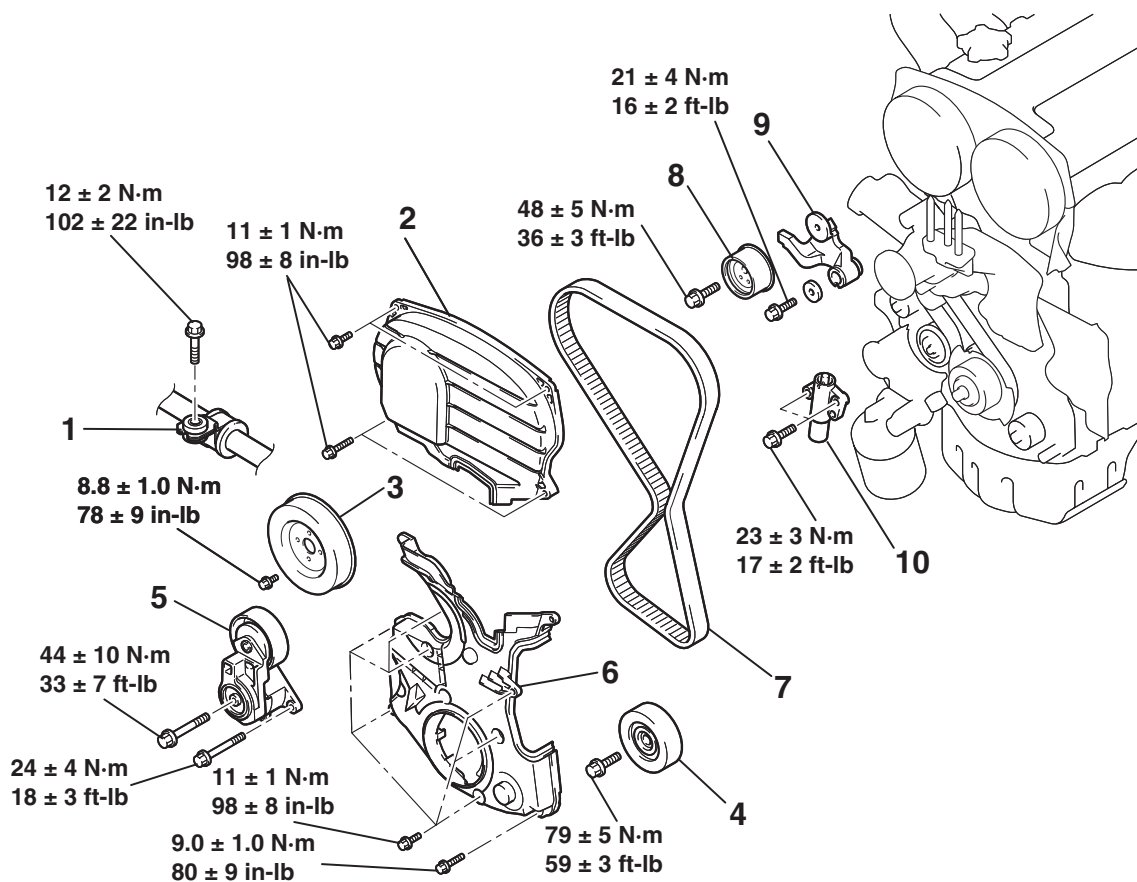
If the vehicle is equipped with the Brembo™ disc brake, during maintenance, take care not to contact the parts or tools to the caliper because the paint of caliper will be scratched.

**Pre-removal Operation**

- Under Cover Removal (Refer to GROUP 51, Front Bumper P.51-2.)
- Side Cover Removal
- Crankshaft Shaft Damper Pulley Removal (Refer to P.11A-23.)
- Front Axle Crossmember Bar Removal (Refer to GROUP 32, Engine Roll Stopper and Centermember P.32-7.)
- Front Exhaust Pipe Removal (Refer to GROUP 15, Exhaust Pipe and Main Muffler P.15-17.)

**Post-installation Operation**

- Front Exhaust Pipe Installation (Refer to GROUP 15, Exhaust Pipe and Main Muffler P.15-17.)
- Front Axle Crossmember Bar Installation (Refer to GROUP 32, Engine Roll Stopper and Centermember P.32-7.)
- Crankshaft Shaft Damper Pulley Installation (Refer to P.11A-23.)
- Drive Belt Tension Check (Refer to P.11A-8.)
- Side Cover Installation
- Under Cover Installation (Refer to GROUP 51, Front Bumper P.51-2.)



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**REMOVAL STEPS**

1. POWER STEERING PRESSURE HOSE CONNECTION
2. TIMING BELT UPPER COVER
3. WATER PUMP PULLEY
4. IDLER PULLEY
5. AUTO-TENSIONER
6. TIMING BELT LOWER COVER
- ENGINE MOUNTING INSULATOR (REFER TO GROUP 32, ENGINE MOUNT P.32-3.)

&gt;&gt;G&lt;&lt;

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

&gt;&gt;F&lt;&lt;

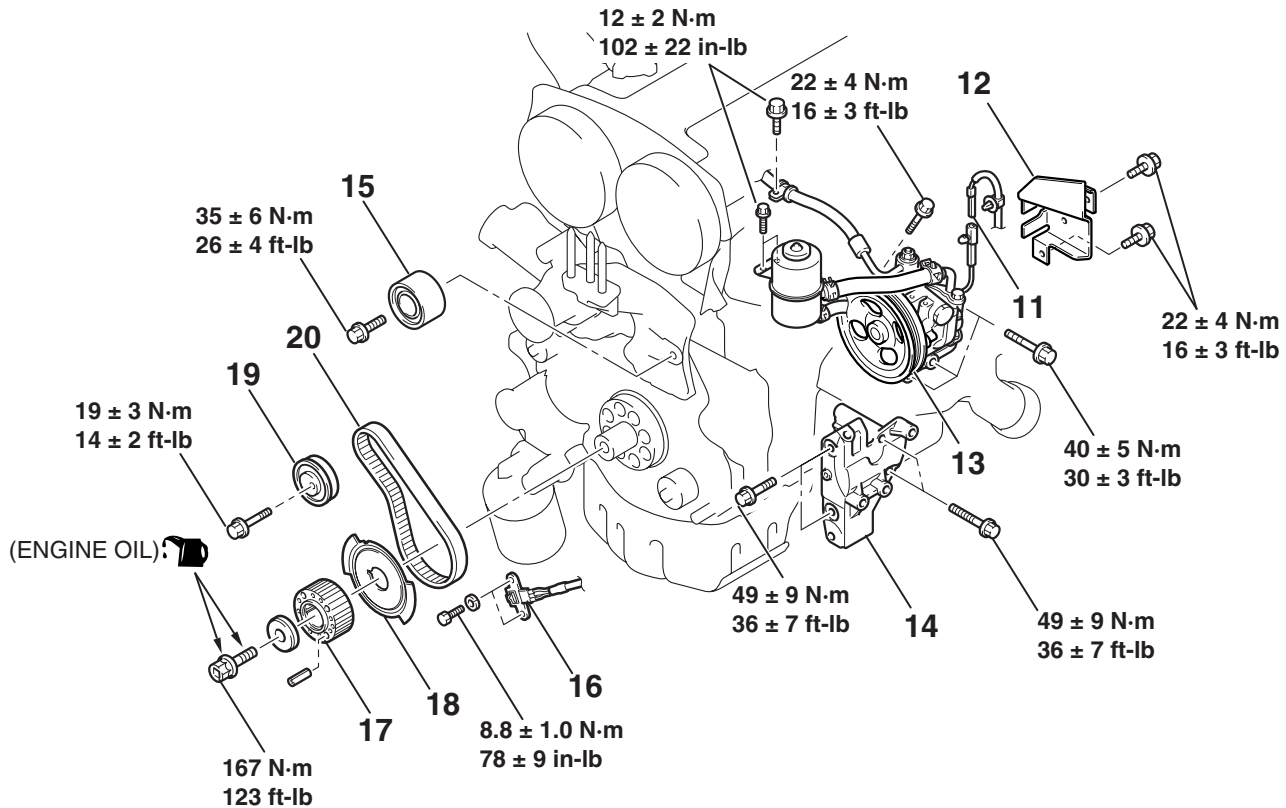
&gt;&gt;E&lt;&lt;

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

**REMOVAL STEPS (Continued)**

- VALVE TIMING BELT TENSION ADJUSTMENT
- 7. VALVE TIMING BELT
- 8. TIMING BELT TENSIONER PULLEY
- 9. TIMING BELT TENSIONER ARM
- 10. TIMING BELT TENSIONER ADJUSTER





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#### REMOVAL STEPS

11. POWER STEERING PRESSURE SWITCH CONNECTOR
12. POWER STEERING OIL PUMP HEAT PROTECTOR
13. POWER STEERING OIL PUMP, BRACKET AND RESERVOIR ASSEMBLY
14. POWER STEERING OIL PUMP BRACKET
15. TIMING BELT IDLER PULLEY

#### REMOVAL STEPS (Continued)

16. CRANKSHAFT POSITION SENSOR
17. CRANKSHAFT CAMSHAFT DRIVE SPROCKET
18. CRANKSHAFT ANGLE SENSING BLADE
19. BALANCER TIMING BELT TENSIONER
20. BALANCER TIMING BELT

#### Required Special Tools:

- MB991367: Special Spanner
- MB991385: Pin
- MD998738: Adjusting Bolt
- MD998767: Tensioner Wrench

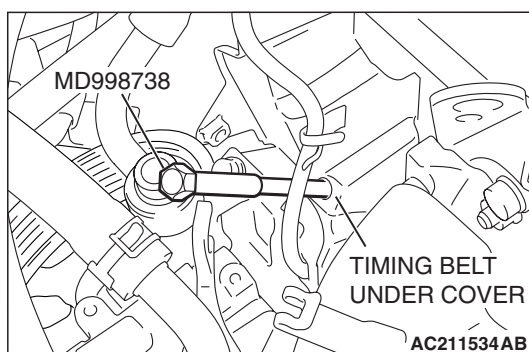
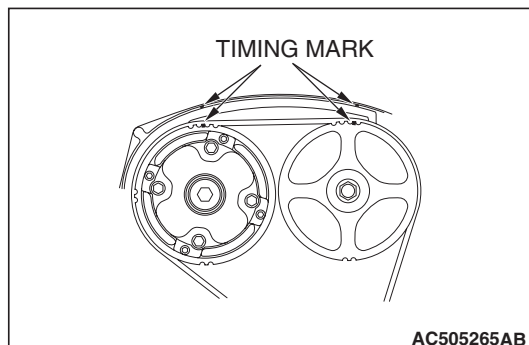
## REMOVAL SERVICE POINTS

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

**⚠ CAUTION**

**Never turn the crankshaft counterclockwise.**

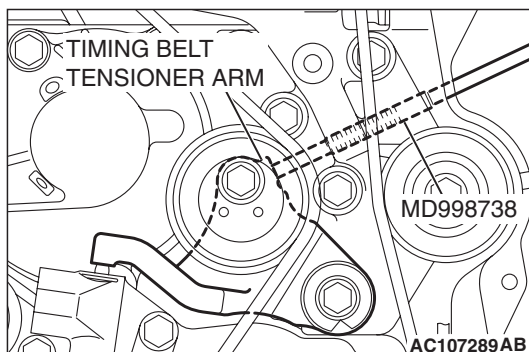
1. Turn the crankshaft clockwise, align each timing mark to set number 1 cylinder to TDC of its compression stroke.



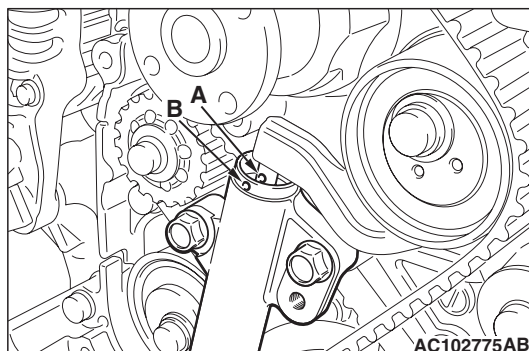
2. Remove the timing belt under cover rubber plug and then set the special tool MD998738.

**⚠ CAUTION**

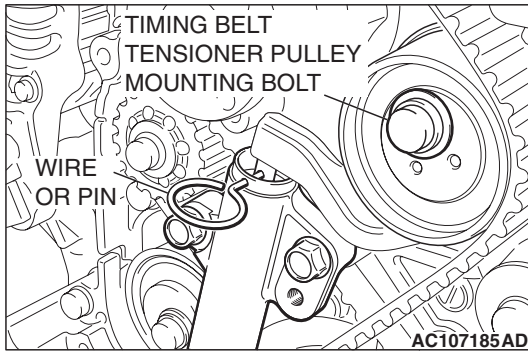
**The special tool MD998738 can be gradually installed at a rate of a 30 degree turn per second. If it is screwed in all at once, the timing belt tensioner adjuster rod will not easily retract and the special tool MD998738 may bend.**



3. Screw in the special tool MD998738 until it comes in contact with the timing belt tensioner arm.



4. Gradually screw in the special tool MD998738. 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 or pin in the set hole.

**⚠ CAUTION**

For reinstallation of 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 MD998738, loosen the timing belt tensioner pulley mounting bolt and remove the valve timing belt.

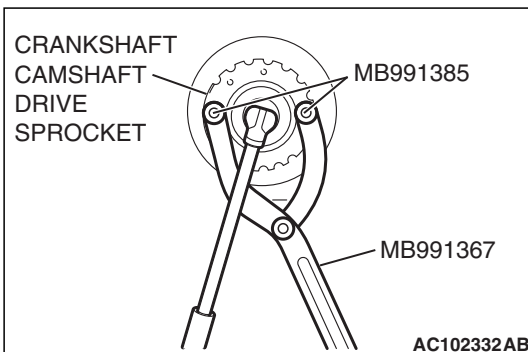
## <<B>> POWER STEERING OIL PUMP, BRACKET AND RESERVOIR ASSEMBLY REMOVAL

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. Hold the crankshaft camshaft drive sprocket with special tools MB991367 and MB991385.
2. Loosen the crankshaft pulley center bolt and remove the crankshaft camshaft drive sprocket.

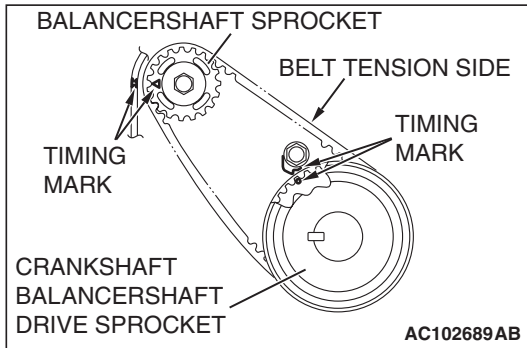


## <<D>> BALANCER TIMING BELT REMOVAL

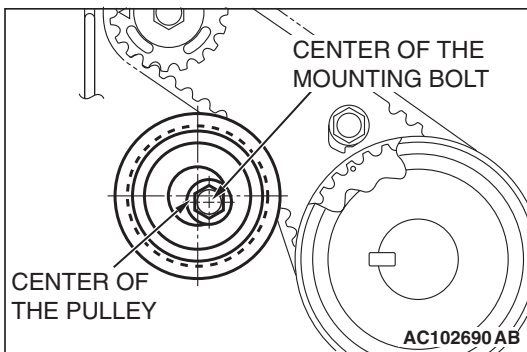
**⚠ CAUTION**

For reinstallation of 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.



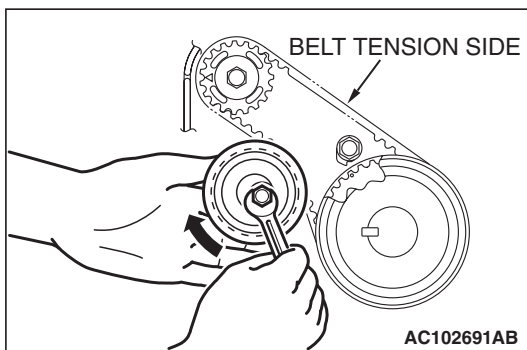
3. Assemble and temporarily fix the center of the pulley of the balancer timing belt tensioner so that it is at the top left from the center of the assembling bolt, and the pulley flange is at the front-side of the engine.
4. Adjust the balancer timing belt tension.

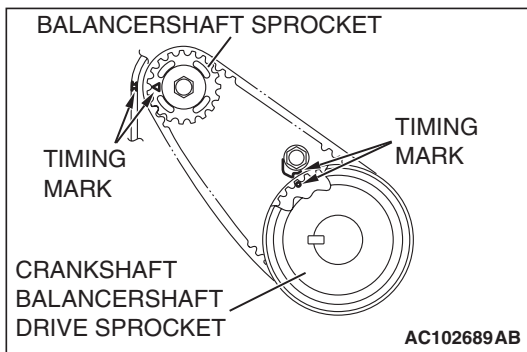
>>B<< BALANCER TIMING BELT TENSION  
ADJUSTMENT**⚠ CAUTION**

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

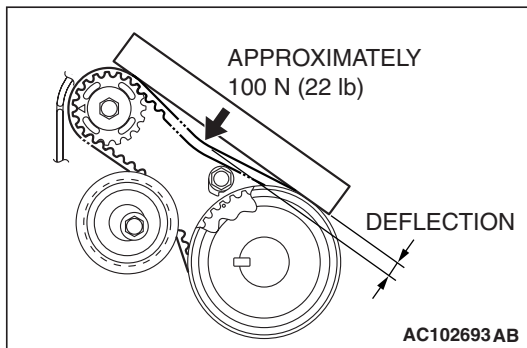
1. With your fingers, lift the balancer timing belt tensioner in the direction of the arrow. Apply pressure of  $[3.0 \pm 0.4 \text{ N} \cdot \text{m} (26 \pm 4 \text{ in} \cdot \text{lb})]$  to the balancer timing belt. Tighten the assembling bolt to the standard torque. Then, fix the balancer timing belt tensioner.

**Tightening torque:  $19 \pm 3 \text{ N} \cdot \text{m} (14 \pm 2 \text{ ft} \cdot \text{lb})$**





2. Turn the crankshaft clockwise two turns to set number 1 cylinder to TDC of its compression stroke and check that the sprocket timing marks are aligned.



3. Apply a pressure of approximately 100N (22 pounds) at the center (arrow area) between the sprocket as shown, then inspect whether the belt deflection is within the standard value.

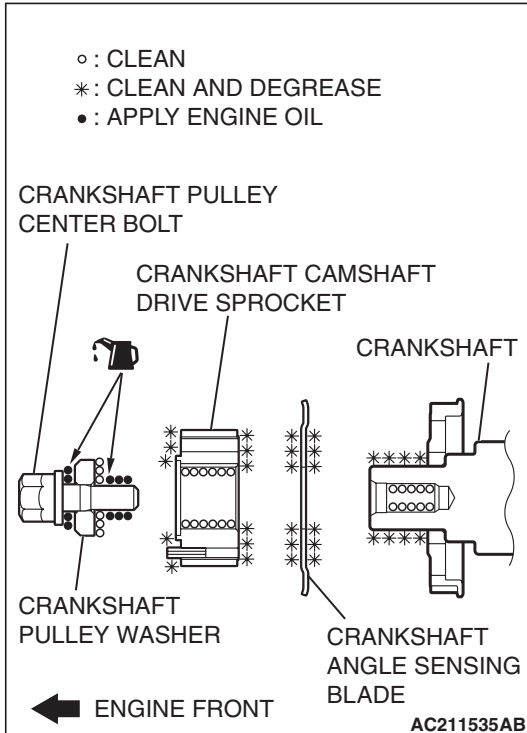
**Standard value:**

**At adjustment: 5 – 7 mm (0.20 – 0.27 inch)**

**At replacement: 5 – 7 mm (0.20 – 0.27 inch)**

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

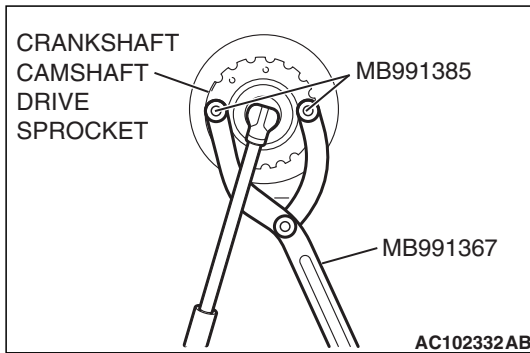
## >>C<< CRANKSHAFT ANGLE SENSING BLADE/CRANKSHAFT CAMSHAFT DRIVE SPROCKET INSTALLATION



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 center bolt.
4. Apply some engine oil to the crankshaft pulley center bolt bearing surface and screw.



5. Hold the crankshaft camshaft drive sprocket with special tools MB991367 and MB991385 in the same manner as removal.
6. Tighten the crankshaft pulley center bolts to the specified torque.

**Tightening torque: 167 N·m (123 ft-lb)**

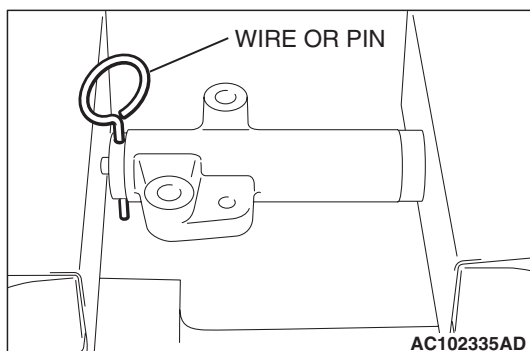
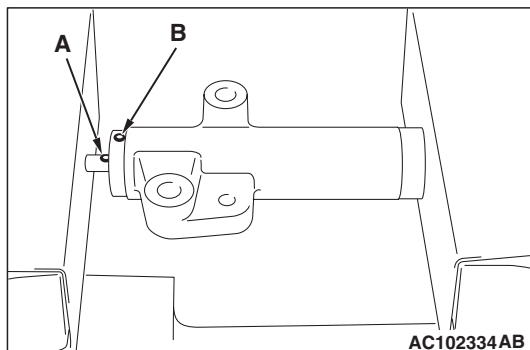
## >>D<< TIMING BELT TENSIONER ADJUSTER INSTALLATION

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.

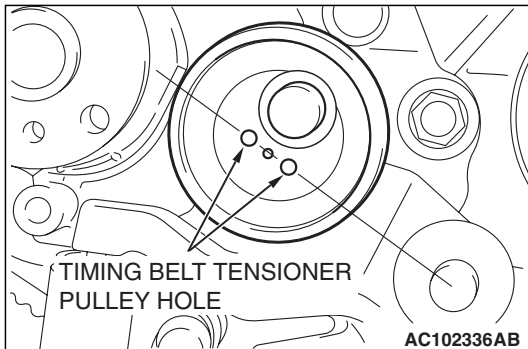
*NOTE: When replacing the timing belt tensioner adjuster with new parts, the timing belt tensioner adjuster is set with a pin.*

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

**Tightening torque: 23 ± 3 N·m (17 ± 2 ft-lb)**

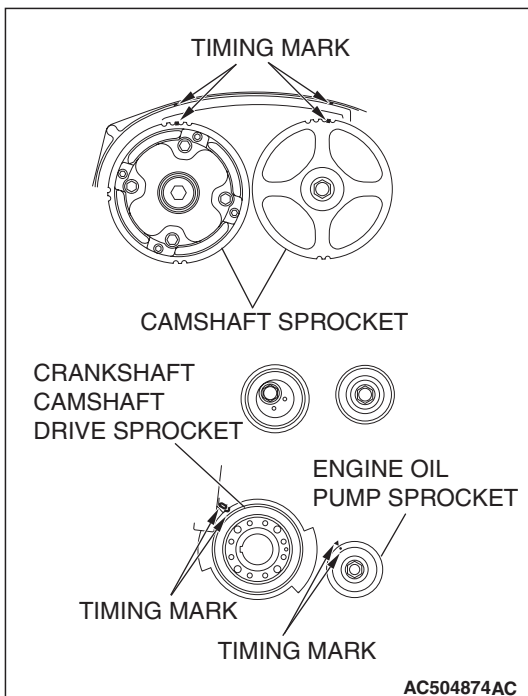
## >>E<< TIMING BELT TENSIONER PULLEY INSTALLATION

Temporarily tighten the timing belt tensioner pulley as shown.

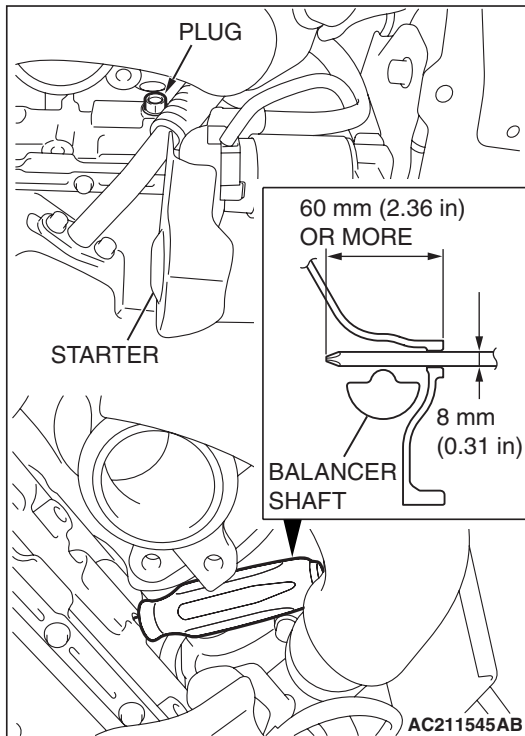


## >>F<< VALVE TIMING BELT INSTALLATION

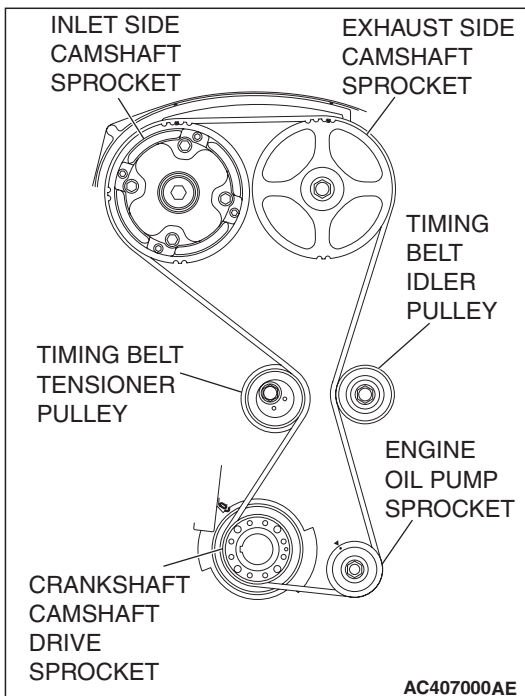
1. Align the timing marks on the camshaft sprocket, crankshaft camshaft drive sprocket and engine oil pump sprocket.



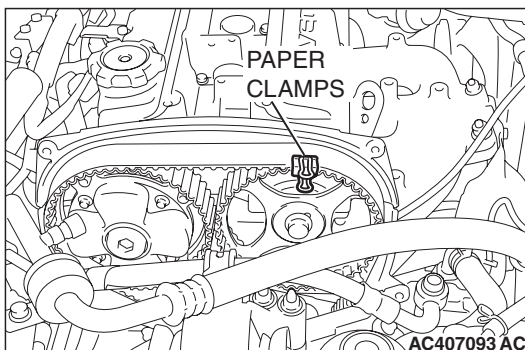




2. After aligning the timing marks of the engine oil pump sprocket, remove the cylinder block plug and insert a Phillips screw driver with a shaft diameter of 8 mm (0.31 inch) through the plug hole to check that the shaft of the screw driver can be inserted for 60 mm (2.36 inches) or more. If the screw driver makes contact with the balancer shaft and can be inserted for only 20 – 25 mm (0.79 – 0.98 inch), turn the engine oil pump sprocket for one round and align timing marks again to check that screw driver can be inserted for 60 mm (2.36 inches) or more. Do not take the screw driver out before completing installation of the valve timing belt.
3. Install the valve timing belt as follows:

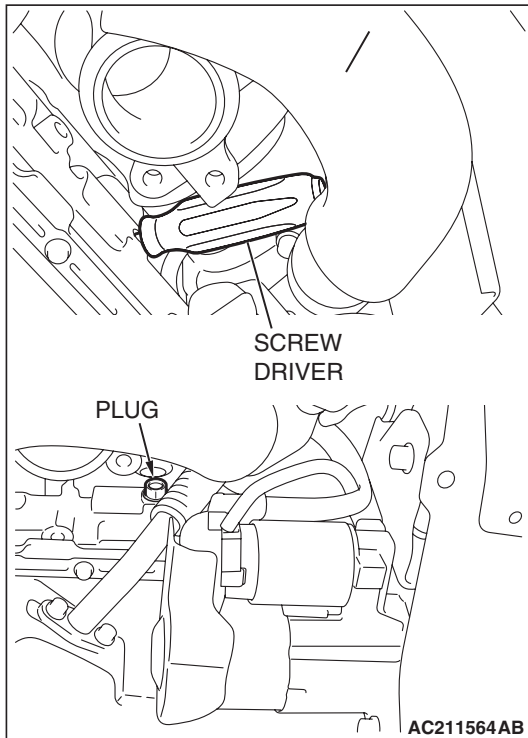
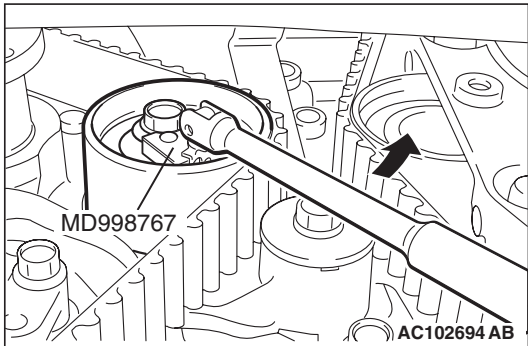
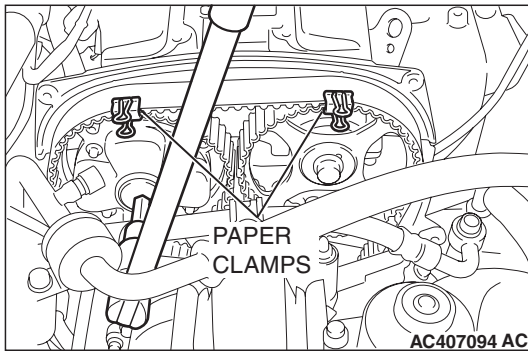


- (1) Pass the valve timing belt around the crankshaft camshaft drive sprocket, the engine oil pump sprocket and the timing belt idler pulley in that order.



- (2) Pass the timing belt around the camshaft sprocket (exhaust side), and hold it with paper clamps in the location shown in the figure.



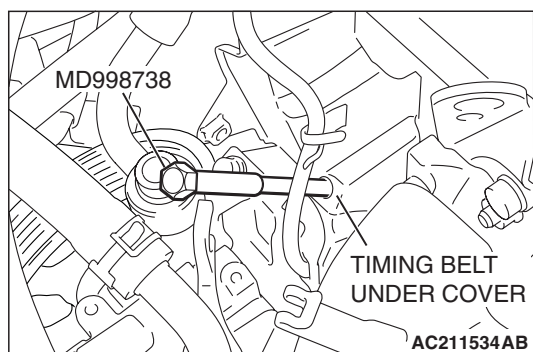


- (3) Use a wrench to align the timing mark on the rocker cover with that on the camshaft sprocket. Pass the timing belt around the camshaft sprocket (inlet side).
- (4) Pass the timing belt around the tensioner pulley.

**CAUTION**

**Install the valve timing belt. Then apply reverse rotation (counterclockwise 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.**

- (5) Remove the two paper clamps.
4. Turn the timing belt tensioner in the direction shown using special tool 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 Phillips screw driver 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 ( $23 \pm 2$  ft-lb)**
8. Adjust the valve timing belt tension.



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

1. Set special tool MD998738 when removing the valve timing belt.

### ⚠ CAUTION

**Always screw in special tool MD998738 by hand. Use of a spanner or other tools may damage the wire or pin inserted in the timing belt tensioner adjuster.**

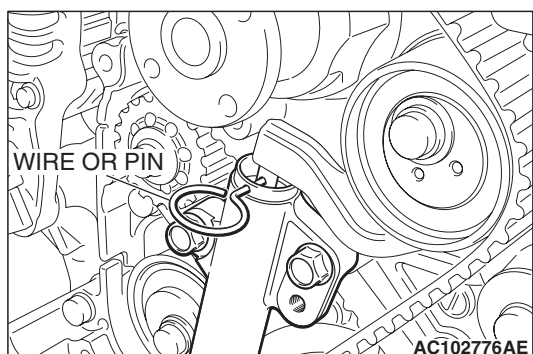
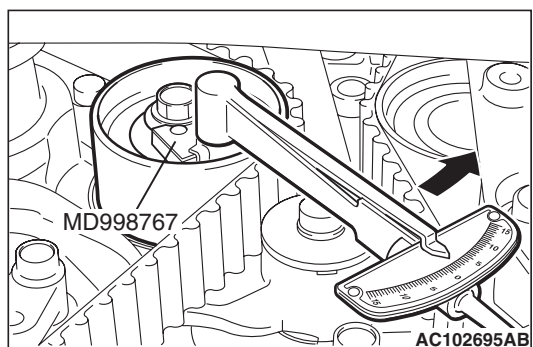
2. Gradually screw in special tool MD998738 until the wire or pin inserted in the timing belt tensioner adjuster lightly moves.
3. Turn the crankshaft 1/4 turn counterclockwise.
4. Turn the crankshaft in the clockwise direction until you align each timing mark to set number 1 cylinder to TDC of its compression stroke.
5. Loosen the timing belt tensioner pulley mounting bolt.

### ⚠ CAUTION

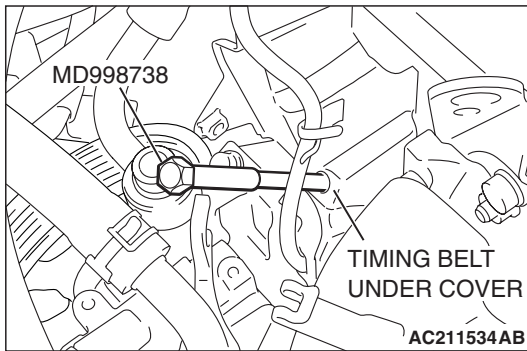
**When tightening the mounting bolts, ensure that the timing belt tensioner pulley does not rotate with the bolts. Allowing it to rotate with the bolts can cause deficient tension of the belt.**

6. With special tool MD998767 and torque wrench, apply tension torque [3.5 N·m (31 in-lb)], and tighten the timing belt tensioner pulley mounting bolt to the specified torque.

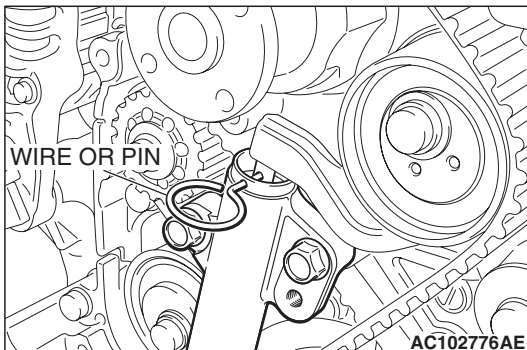
**Tightening torque: 48 ± 5 N·m (36 ± 3 ft-lb)**



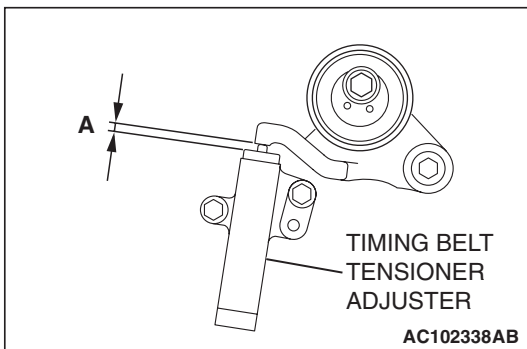
7. Remove wire or pin inserted to timing belt tensioner.



8. Remove the special tool 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.

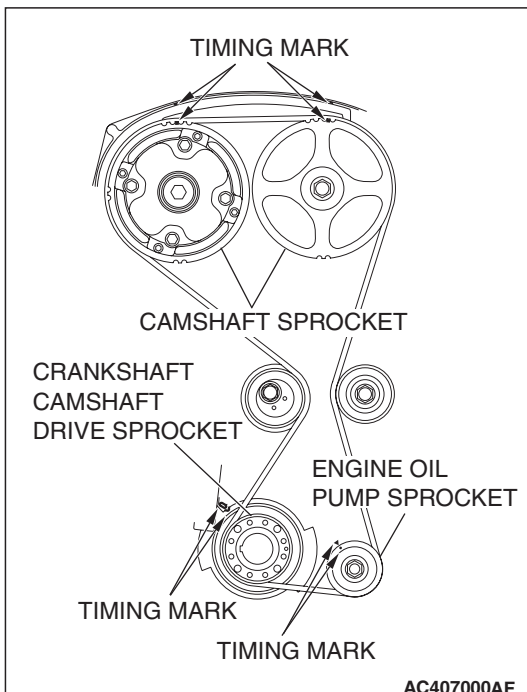
**Standard value (A): 3.8 – 4.5 mm (0.15 – 0.17 inch)**

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 center bolt when turning the crank shaft pulley center bolt counterclockwise. Re-tighten if it is loose.**

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



## INSPECTION

## 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 (22 – 44 pounds) to measure the movement of the rod.

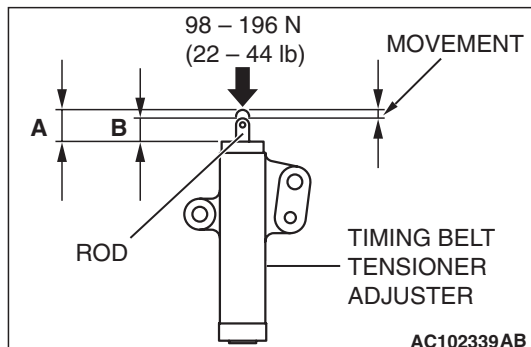
**Standard value: Within 1 mm (0.039 inch)**

**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.



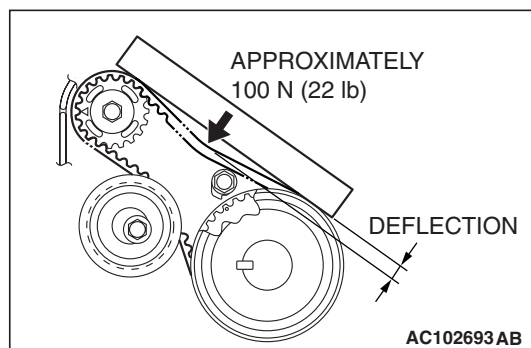
## BALANCER TIMING BELT TENSION CHECK

Check the balancer timing belt tension as follows:

1. Apply a pressure of approximately 100N (22 pounds) at the center (arrow area) between the sprocket as shown then inspect whether the deflection is within the standard value.

**Standard value: 5 – 10 mm (0.20 – 0.39 inch)**

2. If not within the standard value, adjust the belt tension.  
(Refer to [P.11A-48.](#))



## SPECIFICATIONS

## FASTENER TIGHTENING SPECIFICATIONS

M11111003800581

| ITEM  |    | SPECIFICATION   |
|---|----|---|
| <b>Camshaft and valve stem seal</b>           |    |   |
| Camshaft bearing cap bolt                     |    | 20 ± 1 N· m (14 ± 0.5 ft-lb)  |
| Camshaft sprocket cap                         |    | 32 ± 2 N· m (24 ± 1 ft-lb)  |
| 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 support cover bolt   |    | 10 ± 2 N· m (89 ± 17 in-lb)   |
| Camshaft sprocket bolt (inlet side)           |    | 65 ± 5 N· m (48 ± 4 ft-lb)  |
| Camshaft sprocket bolt (exhaust side)         |    | 89 ± 9 N· m (65 ± 7 ft-lb)  |
| Control wiring harness bracket bolt           |    | 11 ± 1 N· m (98 ± 8 in-lb)  |
| Ground terminal bolt (control wiring harness) |    | 5.0 ± 1.0 N· m (44 ± 9 in-lb)   |
| Heated oxygen sensor (front) bolt             |    | 10.5 ± 0.5 N· m (93 ± 4 in-lb)  |
| Oil delivery body bolt                        |    | 11 ± 1 N· m (98 ± 8 in-lb)  |
| Oil feeder control valve bolt                 |    | 11 ± 1 N· m (98 ± 8 in-lb)  |
| Rocker cover bolt                             |    | 3.5 ± 0.5 N· m (31 ± 4 in-lb)   |
| Rocker cover center cover bolt                |    | 3.0 ± 0.5 N· m (27 ± 4 in-lb)   |
| Spark plug                                    |    | 25 ± 4 N· m (18 ± 3 ft-lb)  |
| Vacuum pipe bolt                              |    | 11 ± 1 N· m (98 ± 8 in-lb)  |
| <b>Crankshaft oil seal</b>                    |    |   |
| Flywheel bolt                                 |    | 132 ± 5 N· m (98 ± 3 ft-lb)   |
| <b>Crankshaft pulley</b>                      |    |   |
| Crankshaft damper pulley bolt                 |    | 25 ± 4 N· m (18 ± 3 ft-lb)  |
| <b>Cylinder head gasket</b>                   |    |   |
| Check valve assembly                          |    | 30 ± 3 N· m (22 ± 2 ft-lb)  |
| Cylinder head bolt <Cold engine>              |    | 78 ± 2 N· m to 0 N· m to 20 ± 2 N· m to + 90° to + 90°<br>(58 ± 1 ft-lb to 0 in-lb to 15 ± 1 ft-lb to + 90° to + 90°) |
| EGR solenoid valve and bracket assembly bolt  |    | 9.0 ± 1.0 N· m (80 ± 9 in-lb)   |
| Engine oil dipstick guide bolt                |    | 13 ± 1 N· m (115 ± 9 in-lb)   |
| Eye bolt                                      |    | 42 ± 2 N· m (31 ± 1 ft-lb)  |
| Fuel high-pressure hose bolt                  |    | 5.0 ± 1.0 N· m (44 ± 9 in-lb)   |
| Generator brace bolt                          |    | 20 ± 2 N· m (15 ± 1 ft-lb)  |
| Ground cable bolt                             |    | 5.0 ± 1.0 N· m (44 ± 9 in-lb)   |
| Ground terminal bolt (control wiring harness) |    | 5.0 ± 1.0 N· m (44 ± 9 in-lb)   |
| Inlet manifold stay bolt                      |    | 31 ± 3 N· m (23 ± 2 ft-lb)  |
| Oil feeder control valve pipe bolt            |    | 11 ± 1 N· m (98 ± 8 in-lb)  |
| Oil return tube bolt (bolt, flange)           | M6 | 14 ± 1 N· m (120 ± 13 in-lb)  |
| Oil return tube bolt (bolt, washer assembled) | M6 | 9.0 ± 1.0 N· m (80 ± 9 in-lb)   |

| ITEM   |     | SPECIFICATION                  |
|--|-----|--------------------------------|
| Turbocharger bracket bolt  |     | 35 ± 6 N· m (26 ± 4 ft-lb)     |
| <b>Engine assembly</b>   |     |                                |
| Engine mounting insulator and cushion stopper nut (flange nut, self locking) | M10 | 67 ± 7 N· m (50 ± 5 ft-lb)     |
| Engine mounting insulator and cushion stopper nut (nut, assembled)           | M12 | 98 ± 10 N· m (73 ± 7 ft-lb)    |
| Engine oil cooler line eye bolt  |     | 42 ± 2 N· m (31 ± 1 ft-lb)     |
| Fuel high-pressure hose bolt   |     | 5.0 ± 1.0 N· m (44 ± 9 in-lb)  |
| Generator terminal nut   |     | 14 ± 3 N· m (124 ± 26 in-lb)   |
| Ground cable bolt  |     | 5.0 ± 1.0 N· m (44 ± 9 in-lb)  |
| Ground terminal bolt (battery wiring harness)                                |     | 26 ± 5 N· m (19 ± 4 ft-lb)     |
| Ground terminal bolt (control wiring harness)                                |     | 5.0 ± 1.0 N· m (44 ± 9 in-lb)  |
| Power steering oil pressure hose bolt  |     | 12 ± 2 N· m (102 ± 22 in-lb)   |
| Power steering oil pump and bracket assembly bolt                            | M8  | 22 ± 4 N· m (16 ± 3 ft-lb)     |
|  | M10 | 40 ± 5 N· m (30 ± 3 ft-lb)     |
| Power steering oil pump heat protector bolt                                  |     | 22 ± 4 N· m (16 ± 3 ft-lb)     |
| Power steering oil reservoir bolt  |     | 12 ± 2 N· m (102 ± 22 in-lb)   |
| Turbocharger wastegate actuator bolt   |     | 11 ± 1 N· m (98 ± 8 in-lb)     |
| <b>Oil pan</b>   |     |                                |
| Cylinder block baffle bolt   |     | 22 ± 4 N· m (16 ± 3 ft-lb)     |
| Engine oil cooler line eye bolt  |     | 42 ± 2 N· m (31 ± 1 ft-lb)     |
| Engine oil pan bolt  |     | 9.0 ± 3.0 N· m (80 ± 26 in-lb) |
| Engine oil pan drain plug  |     | 39 ± 5 N· m (29 ± 3 ft-lb)     |
| Flywheel housing front lower cover bolt (bolt, flange)                       | M6  | 10 ± 2 N· m (89 ± 17 in-lb)    |
| Flywheel housing front lower cover bolt (bolt, flange)                       | M10 | 26 ± 5 N· m (19 ± 4 ft-lb)     |
| Flywheel housing front lower cover bolt (bolt, washer assembled)             | M6  | 9.0 ± 1.0 N· m (80 ± 9 in-lb)  |
| Oil return tube bolt (bolt, flange)  | M6  | 14 ± 1 N· m (120 ± 13 in-lb)   |
| Oil return tube bolt (bolt, washer assembled)                                | M6  | 9.0 ± 1.0 N· m (80 ± 9 in-lb)  |
| <b>Timing belt</b>   |     |                                |
| Auto-tensioner bolt (bolt, flange)   | M8  | 24 ± 4 N· m (18 ± 3 ft-lb)     |
| Auto-tensioner bolt (bolt, washer assembled)                                 | M10 | 44 ± 10 N· m (33 ± 7 ft-lb)    |
| Balancer timing belt tensioner bolt  |     | 19 ± 3 N· m (14 ± 2 ft-lb)     |
| Crankshaft position sensor bolt  |     | 8.8 ± 1.0 N· m (78 ± 9 in-lb)  |
| Crankshaft pulley center bolt  |     | 167 N· m (123 ft-lb)           |
| Cylinder block plug  |     | 30 ± 3 N· m (23 ± 2 ft-lb)     |
| Idler pulley bolt  |     | 79 ± 5 N· m (59 ± 3 ft-lb)     |
| Power steering oil pressure hose bolt  |     | 12 ± 2 N· m (102 ± 22 in-lb)   |
| Power steering oil pump and bracket assembly bolt                            | M8  | 22 ± 4 N· m (16 ± 3 ft-lb)     |
|  | M10 | 40 ± 5 N· m (30 ± 3 ft-lb)     |
| Power steering oil pump bracket bolt   |     | 49 ± 9 N· m (36 ± 7 ft-lb)     |

| ITEM  |    | SPECIFICATION                 |
|---|----|-------------------------------|
| Power steering oil pump heat protector bolt           |    | 22 ± 4 N· m (16 ± 3 ft-lb)    |
| Power steering oil reservoir bolt                     |    | 12 ± 2 N· m (102 ± 22 in-lb)  |
| Timing belt idler pulley bolt                         |    | 35 ± 6 N· m (26 ± 4 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) | M6 | 9.0 ± 1.0 N· m (80 ± 9 in-lb) |
| Timing belt tensioner adjuster bolt                   |    | 23 ± 3 N· m (17 ± 2 ft-lb)    |
| Timing belt tensioner arm bolt                        |    | 21 ± 4 N· m (16 ± 2 ft-lb)    |
| Timing belt tensioner pulley bolt                     |    | 48 ± 5 N· m (36 ± 3 ft-lb)    |
| Timing belt upper cover bolt (bolt, flange)           | M6 | 11 ± 1 N· m (98 ± 8 in-lb)    |
| Water pump pulley bolt                                |    | 8.8 ± 1.0 N· m (78 ± 9 in-lb) |

## SERVICE SPECIFICATIONS

M1111000300985

| ITEM   |                                    | STANDARD<br>VALUE       | LIMIT            |
|--|------------------------------------|-------------------------|------------------|
| Drive belt tension   | Vibration frequency Hz (Reference) | 110 – 144               | –                |
|  | Tension N (Reference)              | 245 – 412               | –                |
| Actual ignition timing at idle                               |                                    | Approximately 5° BTDC   | –                |
| Basic ignition timing at idle                                |                                    | 5° BTDC ± 3°            | –                |
| CO content%  |                                    | 0.5 or less             | –                |
| HC contents ppm  |                                    | 100 or less             | –                |
| Curb idle speed r/min  |                                    | 800 ± 100               | –                |
| Compression pressure (250 r/min) kPa (psi)                   |                                    | 1,000 (145)             | Minimum 637 (92) |
| Intake manifold vacuum at curb idle kPa (in Hg)              |                                    | –                       | Minimum 51 (15)  |
| Cylinder head bolt nominal length mm (in)                    |                                    | –                       | 99.4 (3.91)      |
| Balancer timing belt tension (When adjusted)                 | Deflection mm (in)                 | 5 – 7 (0.20 – 0.27)     | –                |
| Balancer timing belt tension (When replaced)                 | Deflection mm (in)                 | 5 – 7 (0.20 – 0.27)     | –                |
| Balancer timing belt tension (When checked)                  | Deflection mm (in)                 | 5 – 10 (0.20 – 0.39)    | –                |
| Timing belt tensioner adjuster rod protrusion amount mm (in) |                                    | 3.8 – 4.5 (0.15 – 0.17) | –                |
| Timing belt tensioner adjuster rod movement mm (in)          |                                    | Within 1 (0.039)        | –                |

SEALANTS

M1111000500451

| ITEM                             | SPECIFIED SEALANT  |
|----------------------------------|--|
| Camshaft position sensor support | Specified sealant: 3M™ AAD Part No. 8672, 3M™ AAD Part No. 8679/8678 or equivalent       |
| Cylinder head                    |  |
| Engine oil pan                   | Specified sealant: 3M™ AAD Part No. 8672, 8704, 3M™ AAD Part No. 8679/8678 or equivalent |
| Rocker cover                     | Specified sealant: 3M™ AAD Part No. 8672, 3M™ AAD Part No. 8679/8678 or equivalent       |