

## GROUP 11A

# ENGINE MECHANICAL

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**GENERAL DESCRIPTION**

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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)	
Engine displacement cm <sup>3</sup> (cu. in)		1,997 (121.9)	
Compression ratio		8.8	
Firing order		1-3-4-2	
Valve timing	Intake valve	Opens (BTDC)	17°
		Closes (ABDC)	59°
	Exhaust valve	Opens (BBDC)	57°
		Closes (ATDC)	15°

**ENGINE DIAGNOSIS**

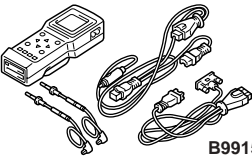
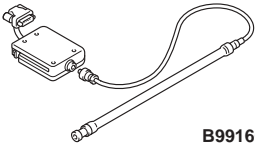
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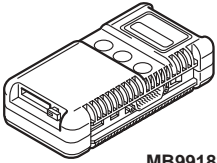
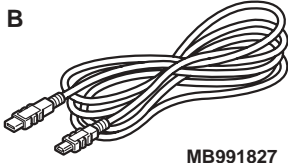
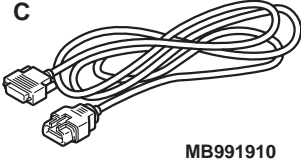
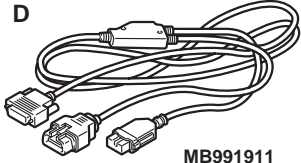
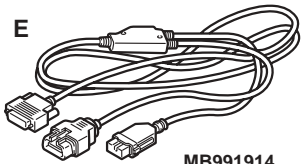
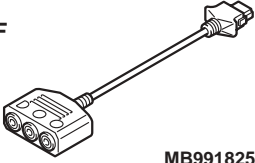
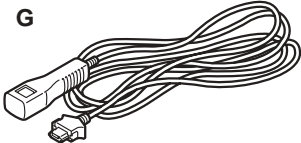
SYMPTOM	PROBABLE CAUSE	REMEDY
Compression is too low	Blown cylinder head gasket	Replace the gasket.
	Worn or damaged piston rings	Replace the rings.
	Worn piston or cylinder	Repair or replace the piston and/or the cylinder block.
	Worn or damaged valve seat	Repair or replace the valve and/or the seat ring.
	Worn or damaged valve guide	Replace the valve guide.
Drop in oil pressure	Engine oil level is too low	Check the engine oil level.
	Malfunction of oil pressure switch	Replace the 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.
Oil pressure too high	Stuck (closed) oil relief valve	Repair the relief valve.

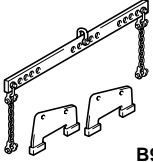
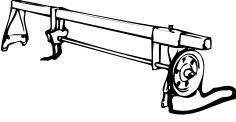
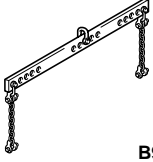
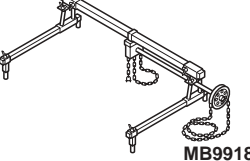
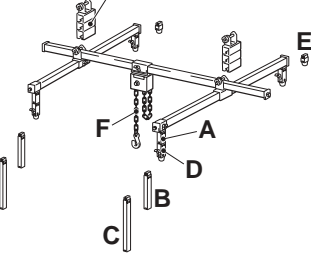
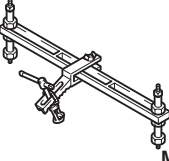
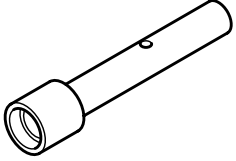
<b>SYMPTOM</b>	<b>PROBABLE CAUSE</b>	<b>REMEDY</b>
Noisy valves	Malfunction of lash adjuster (including entry of air into high pressure chamber)	Check the lash adjuster.
	Thin or diluted engine oil (low oil pressure)	Change the engine oil. Be sure to use the correct viscosity.
	Worn or damaged valve 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 oil pressure	Refer to 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) Loose transaxle mount bracket Loose engine mount bracket Loose center member	Retighten.
	Broken transaxle mount insulator Broken engine mount insulator Broken engine roll stopper insulator	Replace.

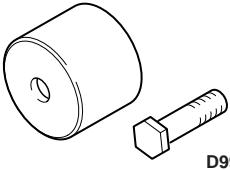
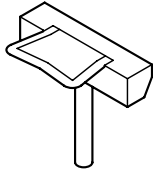
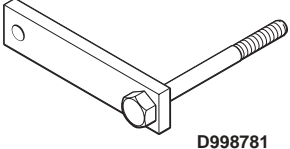
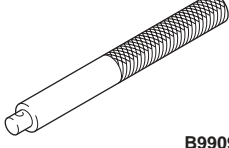
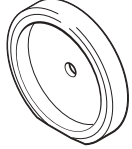
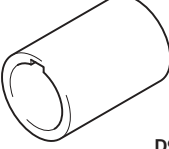
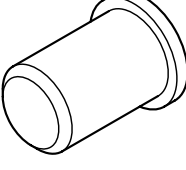
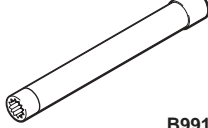
## SPECIAL TOOLS

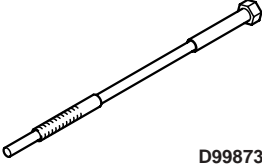
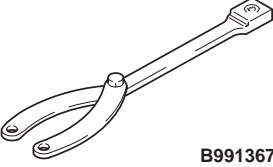
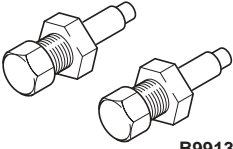
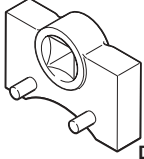
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<b>TOOL</b>	<b>TOOL NUMBER AND NAME</b>	<b>SUPERSESSION</b>	<b>APPLICATION</b>
 B991502	MB991502 Scan tool (MUT-II)	MB991496-OD	<ul style="list-style-type: none"> <li>• Drive belt tension check</li> <li>• Ignition timing check</li> <li>• Idle speed check</li> </ul>
 B991668	MB991668 Belt tension meter set	Tool not available	Drive belt tension check (used together with scan tool)

TOOL	TOOL NUMBER AND NAME	SUPERSESION	APPLICATION
<p>A</p>  <p>MB991824</p> <p>B</p>  <p>MB991827</p> <p>C</p>  <p>MB991910</p> <p>D</p>  <p>MB991911</p> <p>E</p>  <p>MB991914</p> <p>F</p>  <p>MB991825</p> <p>G</p>  <p>MB991826 MB991958</p>	<p>MB991958 Scan tool (MUT-III sub assembly) A: MB991824 Vehicle communication interface (V.C.I.) B: MB991827 MUT-III USB cable C: MB991910 MUT-III main harness A (Vehicles with CAN communication system) D: MB991911 MUT-III main harness B (Vehicles without CAN communication system) E: MB991914 MUT-III main harness C (for Chrysler models only) F: MB991825 MUT-III adapter Harness G: MB991826 MUT-III trigger harness</p>	<p>–</p>	<ul style="list-style-type: none"> <li>• Drive belt tension check</li> <li>• Ignition timing check</li> <li>• Idle speed check</li> </ul>

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

TOOL	TOOL NUMBER AND NAME	SUPERSESION	APPLICATION
 <p>D998713</p>	<p>MD998713 Camshaft oil seal installer</p>	<p>MD998713-01</p>	<p>Camshaft oil seal installation</p>
 <p>D998727</p>	<p>MD998727 Oil pan remover</p>	<p>MD998727-01</p>	<p>Oil pan removal</p>
 <p>D998781</p>	<p>MD998781 Flywheel stopper</p>	<p>General service tool</p>	<p>Supporting the flywheel</p>
 <p>B990938</p>	<p>MB990938 Installer bar</p>	<p>MB990938-01</p>	<p>Crankshaft rear oil seal installation</p>
 <p>D998776</p>	<p>MD998776 Crankshaft rear oil seal installer</p>	<p>MD998776-01</p>	
 <p>D998285</p>	<p>MD998285 Crankshaft front oil seal guide</p>	<p>MD998285-01</p>	<p>Crankshaft front oil seal installation</p>
	<p>MD998375 Crankshaft front oil seal installer</p>	<p>MD998375-01</p>	
 <p>B991654</p>	<p>MB991654 Cylinder head bolt wrench (12)</p>	<p>General service tool</p>	<p>Removal and installation of cylinder head bolt</p>

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

## ON VEHICLE SERVICE

### DRIVE BELT TENSION CHECK

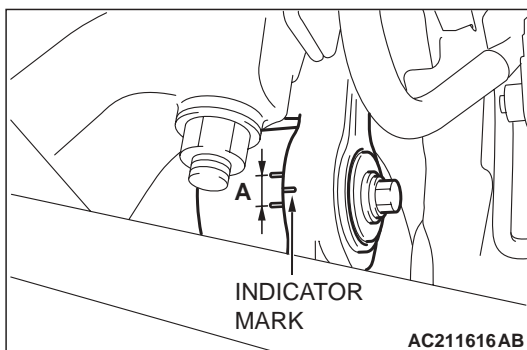
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#### CAUTION

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-26.](#))

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



## AUTO-TENSIONER CHECK

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## OPERATION CHECK

1. Turn OFF the engine from the idle state then check to see that the drive belt is not protruding from the pulley width of the auto-tensioner.
2. Remove the drive belt.(Refer to [P.11A-26.](#))
3. 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. Turn the auto-tensioner to the left and right to check and see that there is no threading.
4. If there are any problems in the procedure 1 or 3, replace the auto-tensioner.(Refer to [P.11A-50.](#))
5. Install the drive belt.(Refer to [P.11A-26.](#))



## FUNCTION CHECK

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

## When using scan tool MB991502

## Required Special Tools:

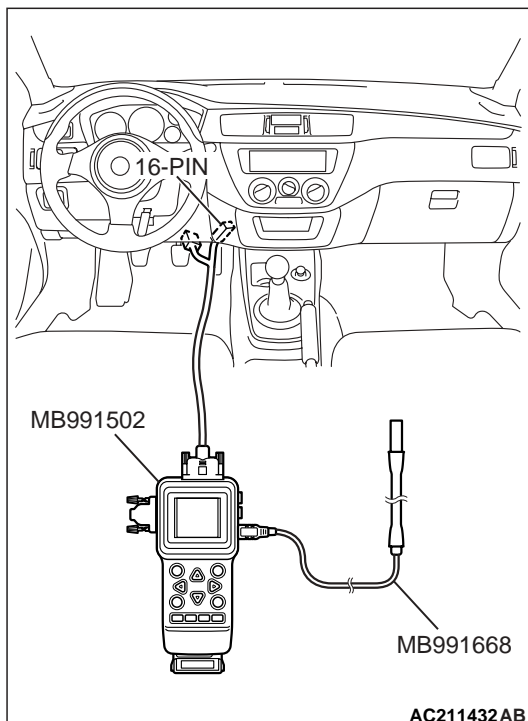
- MB991502: Scan Tool (MUT-II)
- MB991668: Belt Tension Meter Set

1. Check the drive belt tension. (Refer to [P.11A-26.](#))
2. Measure the drive belt tension vibration frequency by the following procedures:

**CAUTION**

To prevent damage to scan tool MB991502, always turn the ignition switch to the "LOCK" (OFF) position before connecting or disconnecting scan tool MB991502.

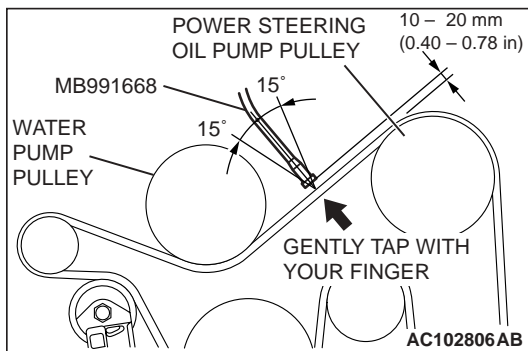
- (1) Connect special tool MB991668 to scan tool MB991502.
- (2) Connect the scan tool MB991502 to the data link connector.
- (3) Turn the ignition switch to ON position, and select "BELT TENSION" on the menu screen.





**CAUTION**

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



- (4) Hold special tool MB991668 to the middle of the drive belt between the pulleys (at the place indicated by arrow), approximately 10 – 20 mm (0.40 – 0.78 inch) away from the rear surface of the belt so that it is perpendicular to the belt (within an angle of  $\pm 15$  degree).
- (5) Gently tap the middle of the belt between the pulleys (the place indicated by the arrow) with your finger as shown in the illustration, and measure that the vibration frequency of the belt is within the standard value.

**Standard value: 110 – 144 Hz**

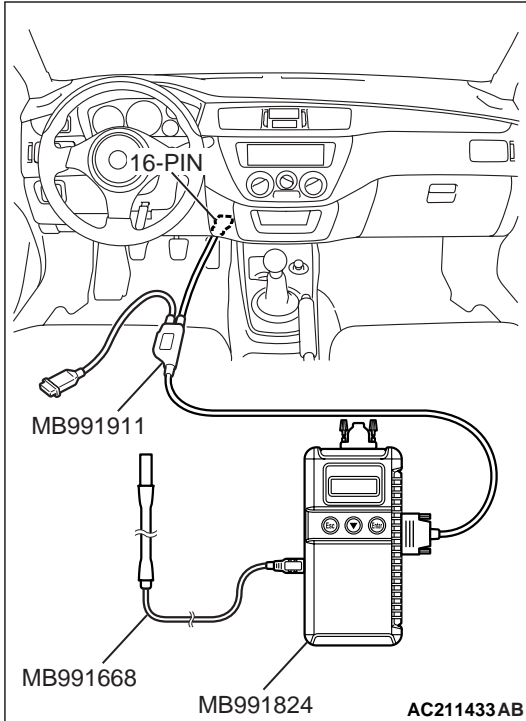
3. If not within the standard value, replace the auto-tensioner. (Refer to [P.11A-26.](#))

**When using scan tool MB991958**

**Required Special Tools:**

- MB991668: Belt Tension Meter Set
- MB991958: Scan Tool (MUT-III Sub Assembly)
  - MB991824: V.C.I.
  - MB991911: Main Harness B

1. Check the drive belt tension. (Refer to [P.11A-7.](#))
2. Measure the drive belt tension vibration frequency by the following procedures:



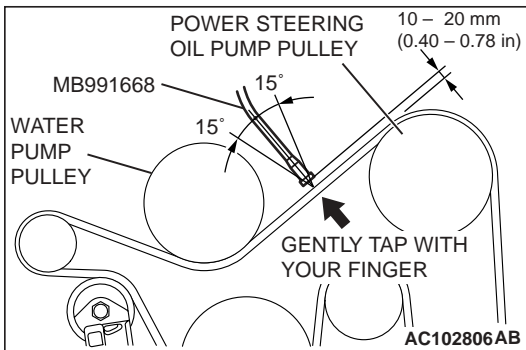
**CAUTION**

To prevent damage to scan tool MB991824, always turn the ignition switch to the "LOCK" (OFF) position before connecting or disconnecting scan tool MB991824.

- (1) Connect special tool MB991668 to scan tool MB991824.
- (2) Connect scan tool MB991911 to scan tool MB991824.
- (3) Connect scan tool MB991911 to the data link connector.
- (4) Turn the ignition switch to the "ON" position and select "Belt Tension Measurement" from the menu scan tool MB991824 screen.

**CAUTION**

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



- (5) Hold special tool MB991668 to the middle of the drive belt between the pulleys (at the place indicated by arrow), approximately 10 – 20 mm (0.40 – 0.78 inch) away from the rear surface of the belt so that it is perpendicular to the belt (within an angle of  $\pm 15$  degree).
- (6) Gently tap the middle of the belt between the pulleys (the place indicated by the arrow) with your finger as shown in the illustration, and measure that the vibration frequency of the belt is within the standard value.

**Standard value: 110 – 144 Hz**

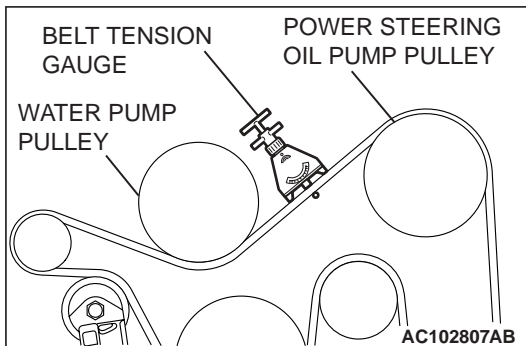
3. If not within the standard value, replace the auto-tensioner. (Refer to P.11A-50.)

**When using a tension gauge**

1. Check the drive belt tension. (Refer to P.11A-7.)
2. Use a belt tension gauge in the middle of the belt between the pulleys (at the place indicated by the arrow) to measure that the belt tension is within the standard value.

**Standard value: 245 – 412 N**

3. If not within the standard value, replace the auto-tensioner. (Refer to P.11A-50.)



## IGNITION TIMING CHECK

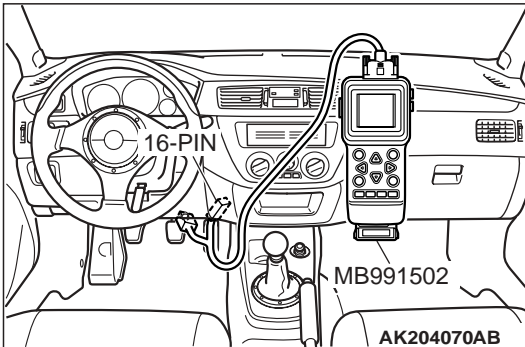
### Required Special Tools:

- MB991502: Scan Tool (MUT-II)
- MB991958: Scan Tool (MUT-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 MB991502 or MB991958, always turn the ignition switch to the "LOCK" (OFF) position before connecting or disconnecting scan tool MB991502 or MB991958.



2. Connect scan tool MB991502 or 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 850 r/min.
6. Select scan tool MB991502 or 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**

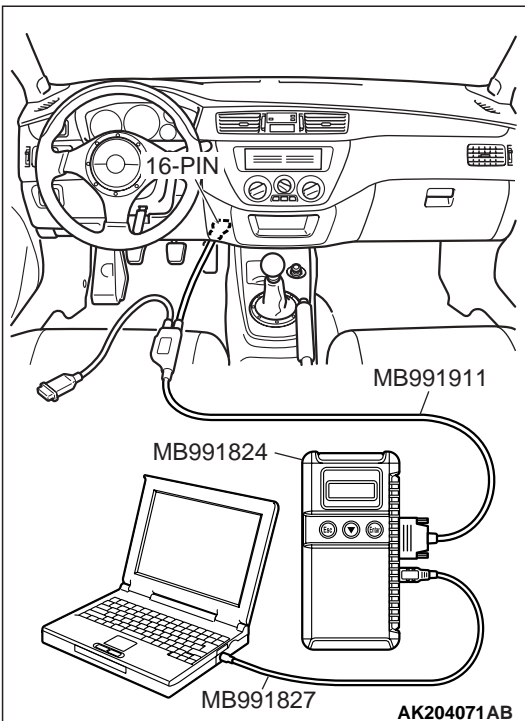
If the actuator test is not canceled, the forced drive will continue for 27 minutes. Driving in this state could lead to engine failure.

9. Press the clear key on scan tool MB991502 or 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 ± 7° 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

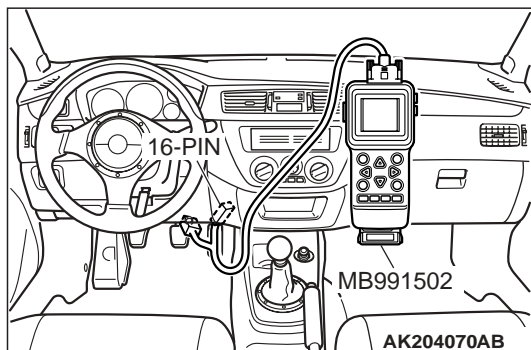
## Required Special Tools:

- MB991502: Scan Tool (MUT-II)
- MB991958: Scan Tool (MUT-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 MB991502 or MB991958, always turn the ignition switch to the "LOCK" (OFF) position before connecting or disconnecting scan tool MB991502 or MB991958.



2. Connect scan tool MB991502 or MB991958 to the data link connector.
3. Confirm basic ignition timing is within the standard value. (Refer to Ignition Timing Check [P.11A-11.](#))

**Standard value: 5° BTDC ± 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.

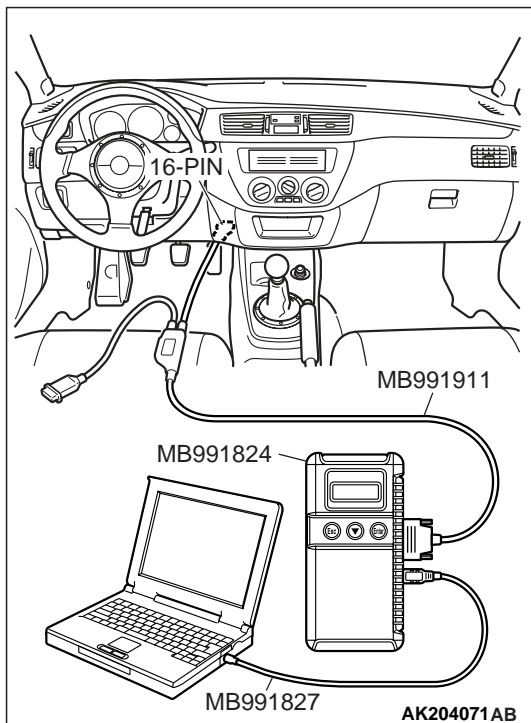
**Standard value:**

**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 control 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

### Required Special Tools:

- MB991502: Scan Tool (MUT-II)
- MB991958: Scan Tool (MUT-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 MB991502 or MB991958, always turn the ignition switch to the "LOCK" (OFF) position before connecting or disconnecting scan tool MB991502 or MB991958.

2. Connect scan tool MB991502 or MB991958 to the data link connector.
3. Confirm basic ignition timing is within the standard value. (Refer to Ignition Timing Check [P.11A-11.](#))

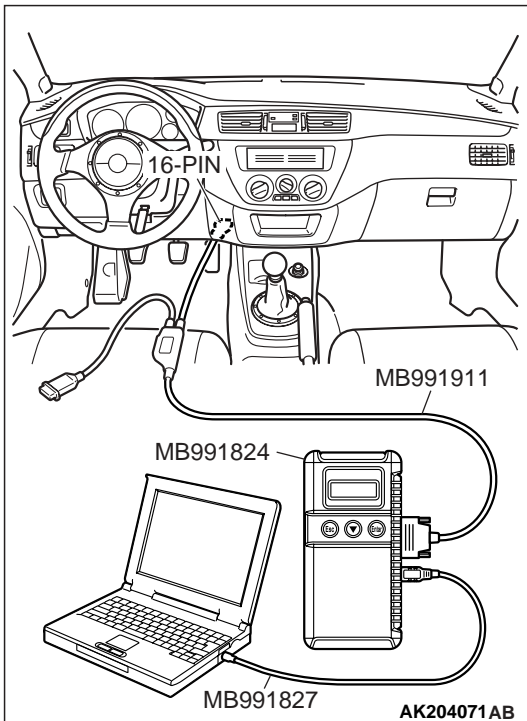
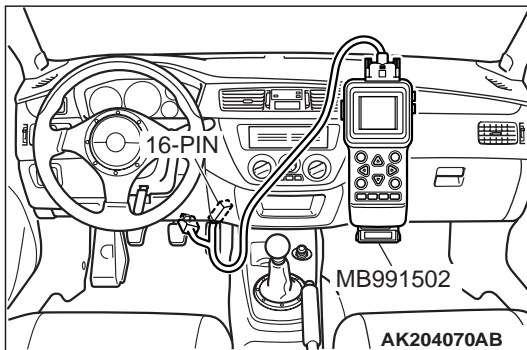
**Standard value: 5° BTDC ± 3°**

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: 850 ± 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, Diagnosis – Symptom Chart [P.13A-27.](#)





## COMPRESSION PRESSURE CHECK

M1111002600421

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): 1,128 kPa (163 psi)**

**Minimum limit (at engine speed of 250 r/min): 951 kPa (138 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)**

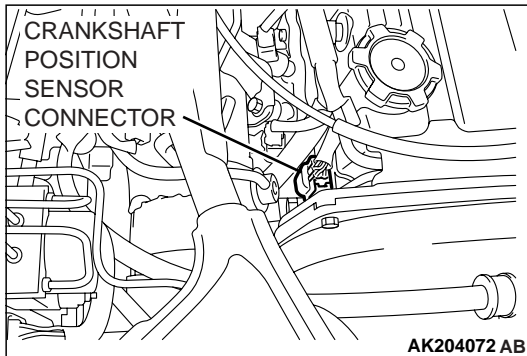
9. If there is a cylinder with compression or a compression difference that is outside the limit, pour a small amount of engine oil through the spark plug hole, and repeat the operations in steps 6 to 8.
  - (1) If the compression increases after oil is added, the cause of the malfunction is a worn or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

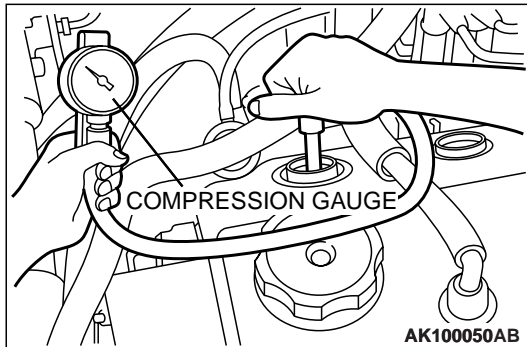
11. Install the spark plugs and spark plug cables.

12. Use the scan tool to erase the diagnostic trouble codes.

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

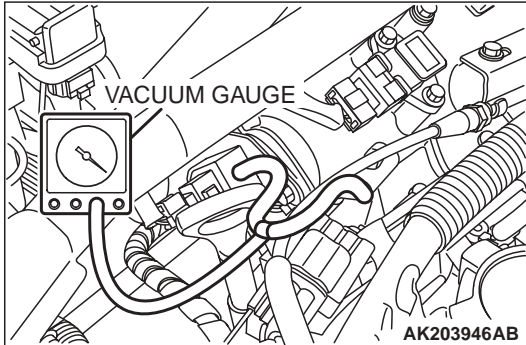


AK204072 AB



AK100050 AB

*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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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. Connect an engine tachometer.
3. Attach a tee-fitting joint to the vacuum hose between the fuel pressure solenoid and the intake manifold plenum, and connect a vacuum gauge.
4. Start the engine and check that idle speed is within specification. Then check the vacuum gauge reading.

**Idle speed: 850 ± 100 r/min**

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

## LASH ADJUSTER CHECK

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If an abnormal noise (chattering noise) is heard by malfunction of the lash adjuster immediately after starting the engine and does not disappear, it might be 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-32.) 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.)
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-32.)

### 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.*

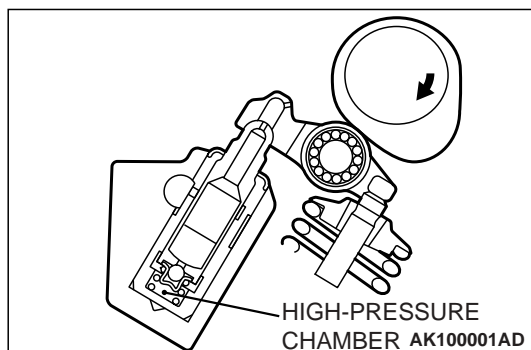
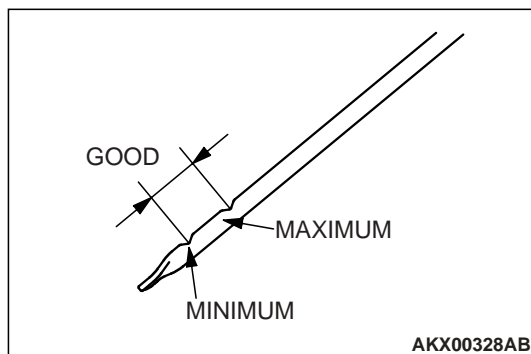
*NOTE: In the above cases, abnormal noise can be eliminated by bleeding the lash adjuster system.*

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.*

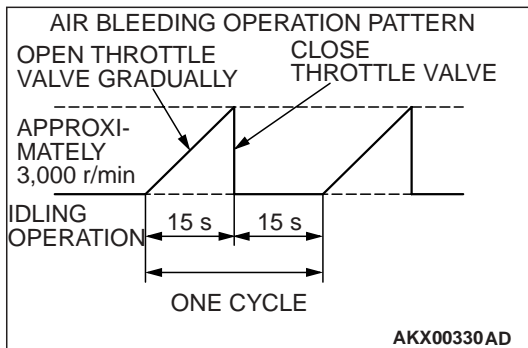
*NOTE: If the engine oil level is higher than specification, oil may be stirred by the crankshaft, causing oil to be mixed with air creating aerated (foaming) oil.*

*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**

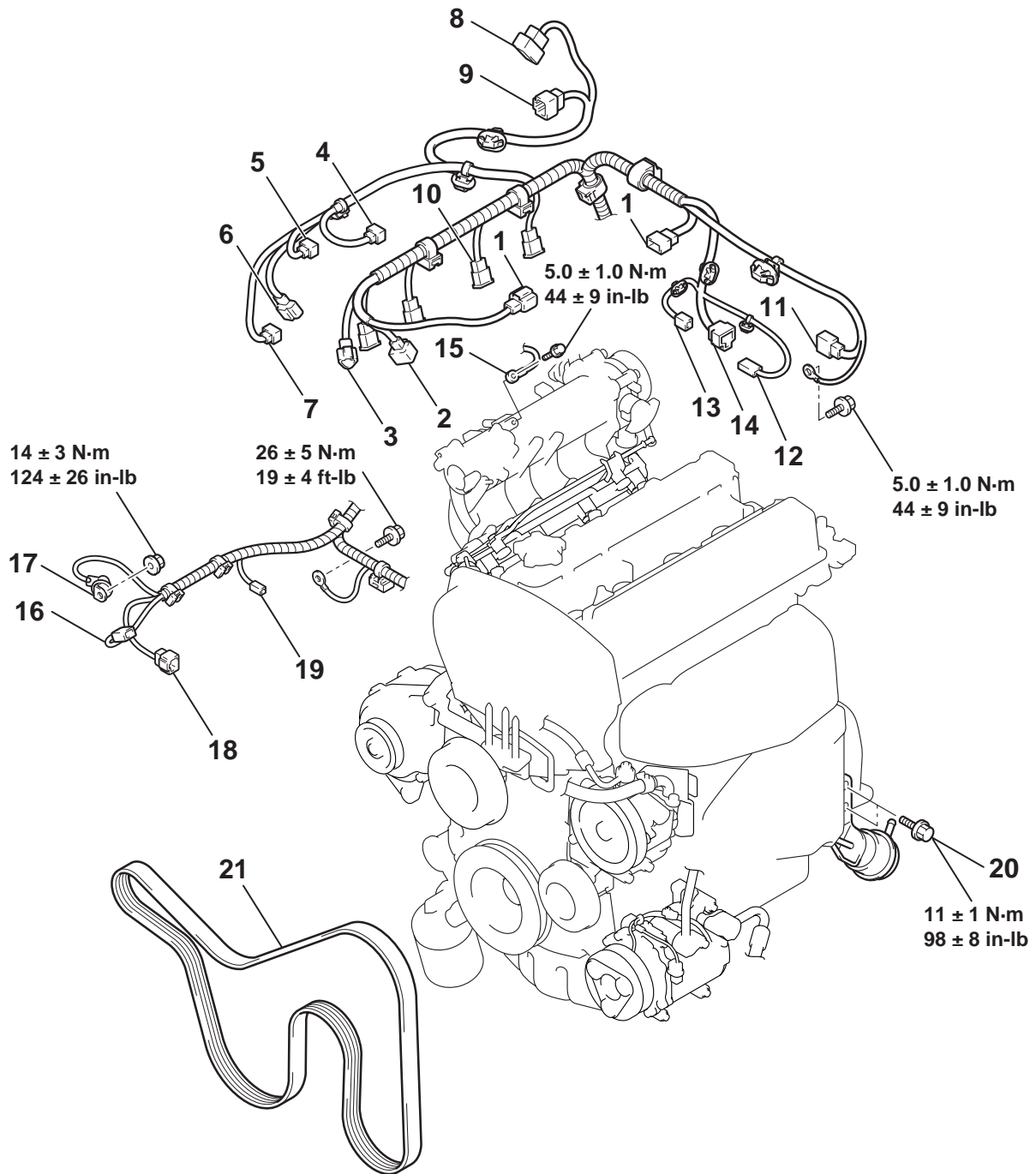
- If the vehicle is equipped with the Brembo™ disc brake, during maintenance, take care not to contact the parts or tools to the caliper because the paint of caliper will be scratched.
- \*: indicates parts which should be temporarily tightened, and then fully tightened with the engine weight applied 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-765.]
- 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.14-18.)
- Strut Tower Bar Removal (Refer to GROUP 42, Strut Tower Bar.)
- 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-28.)
- Radiator Assembly Removal (Refer to GROUP 14, Radiator P.14-22.)
- Front Axle Crossmember Bar Removal (Refer to GROUP 32, Engine Roll Stopper and Centermember P.32-6.)
- Front Exhaust Pipe Removal (Refer to GROUP 15, Exhaust Pipe and Main Muffler P.15-23.)
- Air Outlet Fitting Removal (Refer to GROUP 15, Exhaust Manifold and Turbocharger P.15-16.)

**Post-installation Operation**

- Air Outlet Fitting Installation (Refer to GROUP 15, Exhaust Manifold and Turbocharger P.15-16.)
- Front Exhaust Pipe Installation (Refer to GROUP 15, Exhaust Pipe and Main Muffler P.15-23.)
- Front Axle Crossmember Bar Installation (Refer to GROUP 32, Engine Roll Stopper and Centermember P.32-6.)
- Radiator Assembly Installation (Refer to GROUP 14, Radiator P.14-22.)
- Rocker Cover Center Cover Installation (Refer to P.11A-28.)
- 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.)
- Engine Coolant Refilling (Refer to GROUP 14, On-vehicle Service – Engine Coolant Replacement P.14-18.)
- Engine Oil Refilling (Refer to GROUP 12, On-vehicle Service – Engine Oil Replacement P.12-3.)
- Drive Belt Tension Check (Refer to P.11A-7.)
- 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 DIFFERENTIAL PRESSURE SENSOR CONNECTOR
5. FUEL PRESSURE SOLENOID CONNECTOR
6. KNOCK SENSOR CONNECTOR
7. EVAPORATIVE EMISSION PURGE SOLENOID CONNECTOR

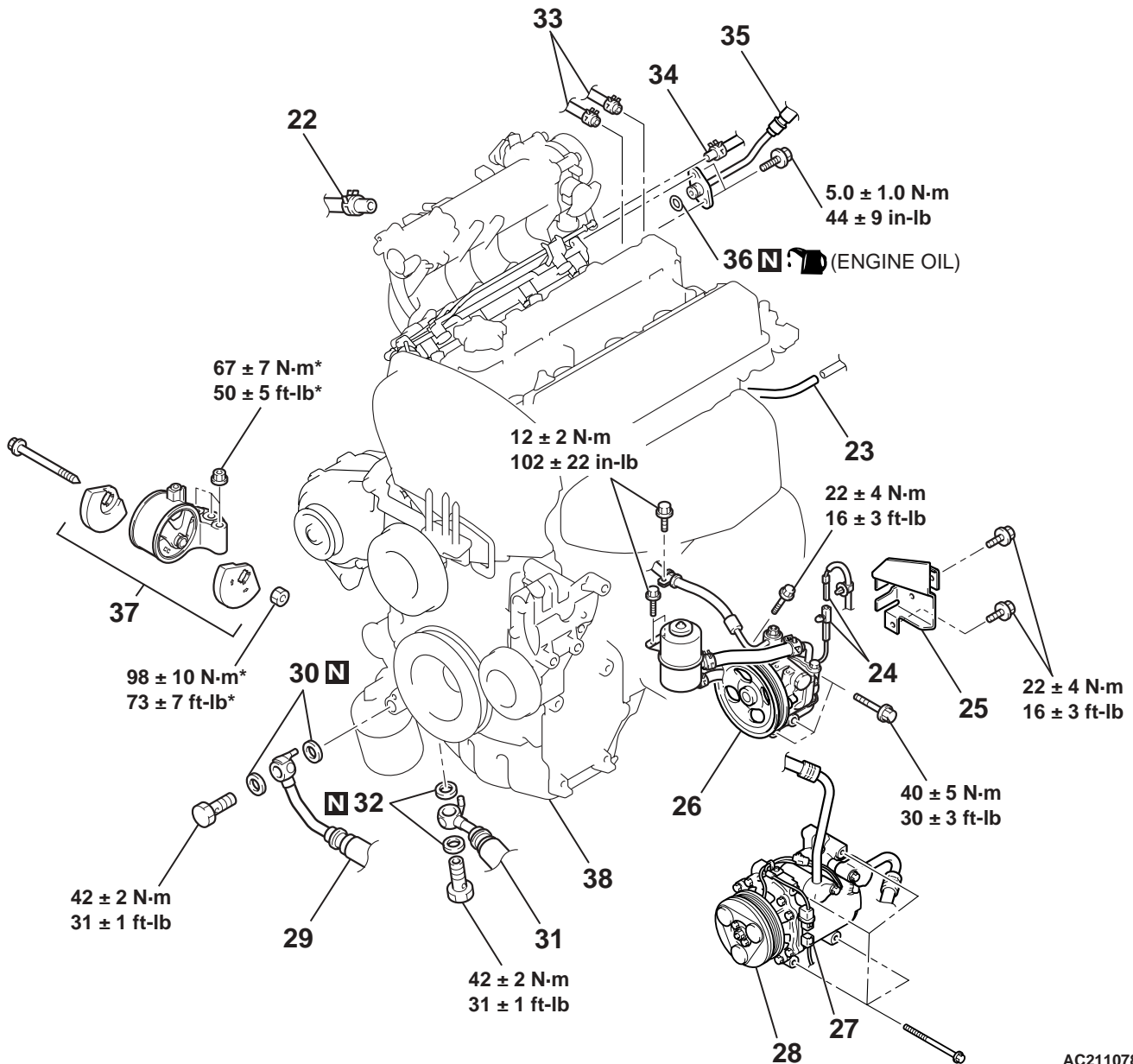
**REMOVAL STEPS (Continued)**

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

**REMOVAL STEPS (Continued)**

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

<<A>>



**REMOVAL STEPS**

- 22. BRAKE BOOSTER VACUUM HOSE CONNECTION
- 23. PURGE HOSE CONNECTION

**REMOVAL STEPS (Continued)**

- 24. POWER STEERING PRESSURE SWITCH CONNECTOR
- 25. POWER STEERING OIL PUMP HEAT PROTECTOR

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**REMOVAL STEPS (Continued)**

- <<B>> 26. POWER STEERING OIL PUMP, BRACKET AND RESERVOIR ASSEMBLY
- 27. A/C COMPRESSOR CONNECTOR
- <<B>> 28. A/C COMPRESSOR AND CLUTCH ASSEMBLY
- 29. ENGINE OIL COOLER FEED HOSE CONNECTION
- 30. ENGINE OIL COOLER TUBE GASKETS
- 31. ENGINE OIL COOLER RETURN HOSE CONNECTION
- 32. ENGINE OIL COOLER TUBE GASKETS
- 33. HEATER WATER HOSES CONNECTION
- 34. FUEL RETURN LINE HOSE CONNECTION
- >>D<< 35. FUEL HIGH-PRESSURE HOSE CONNECTION
- >>D<< 36. O-RING
  - TRANSFER ASSEMBLY (REFER TO GROUP 22A, TRANSFER ASSEMBLY [P.22A-15.](#))
- <<C>> >>C<< • TRANSAXLE ASSEMBLY
- <<D>> >>B<< 37. ENGINE FRONT MOUNTING BRACKET AND CUSHION STOPPERS ASSEMBLY
- <<E>> >>A<< 38. ENGINE ASSEMBLY

**Required Special Tools:**

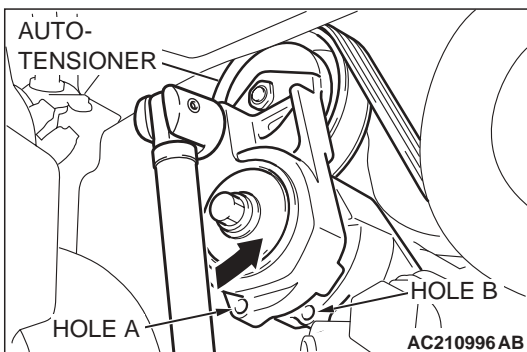
- MB991453: Engine Hanger Assembly
- MB991928: Engine Hanger
- MB991454: Engine Hanger Balancer
- MZ203827: Engine Lifter
- MB991895: Engine Hanger

**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.

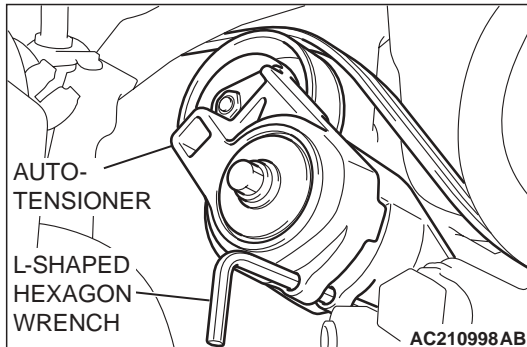
1. Securely insert the spindle handle or ratchet handle with a 12.7mm (1/2-inch) insertion angle into the jig hole of the auto-tensioner, and turn the auto-tensioner counterclockwise until it hits the stopper.



**⚠ CAUTION**

To reuse the drive belt, draw an arrow indicating the rotating direction (to the right) 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.



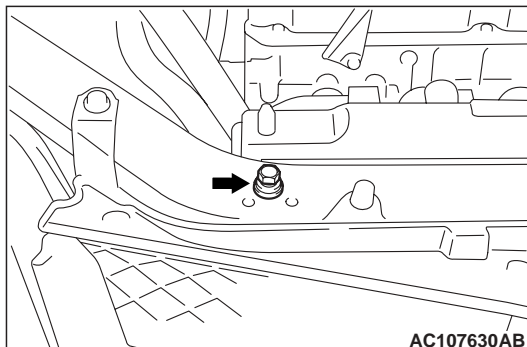
### <<B>> POWER STEERING OIL PUMP, BRACKET AND RESERVOIR ASSEMBLY/ A/C COMPRESSOR AND CLUTCH ASSEMBLY REMOVAL

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.*

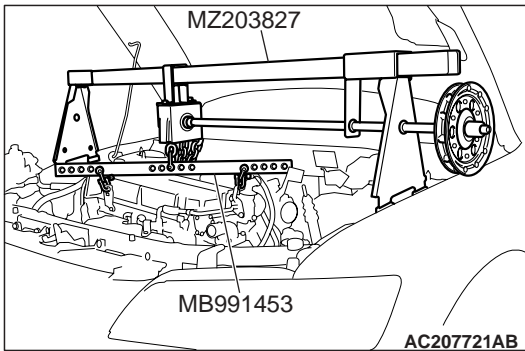
### <<C>> TRANSAXLE ASSEMBLY REMOVAL

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-21.)

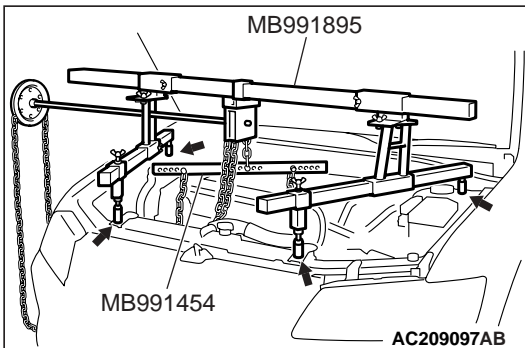


### <<D>> ENGINE FRONT MOUNTING BRACKET AND CUSHION STOPPERS ASSEMBLY REMOVAL

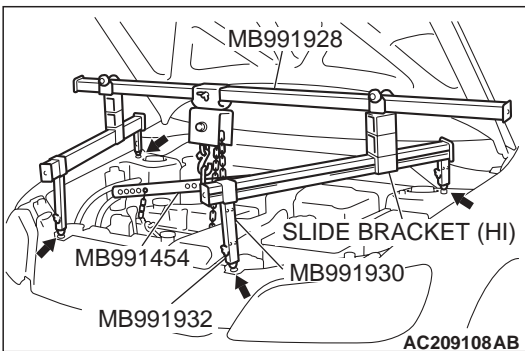
1. Support the engine with a garage jack.
2. Remove the following special tool.



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

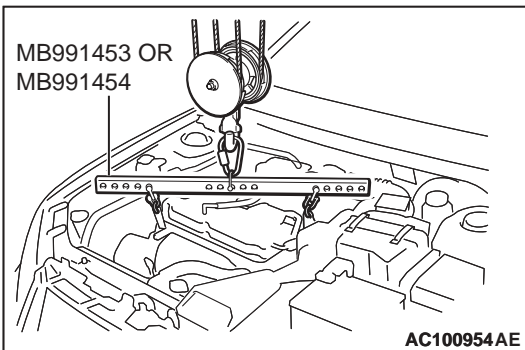


- (2) <Engine hanger (special tool MB991895) is used>  
Remove special tool MB991895.



- (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 front mounting bracket mounting nuts and bolt, and remove the engine front mounting bracket and cushion stoppers assembly.

### <<E>> ENGINE ASSEMBLY REMOVAL

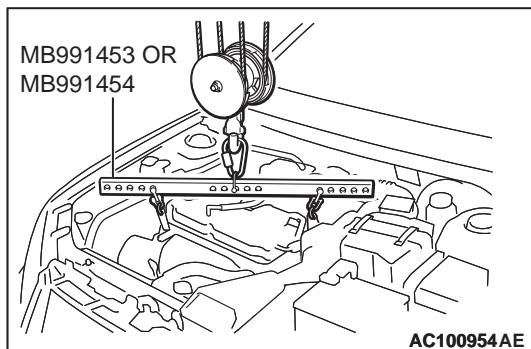
After checking that all cables, hoses and wiring harness connectors and so on are disconnected from the engine, lift the chain block slowly to remove the engine assembly upward from the engine compartment.



**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 FRONT MOUNTING BRACKET AND CUSHION STOPPERS ASSEMBLY INSTALLATION**

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

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

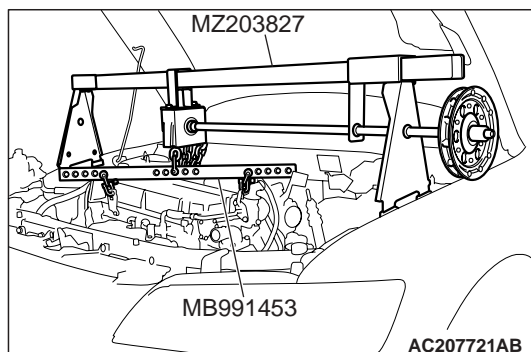
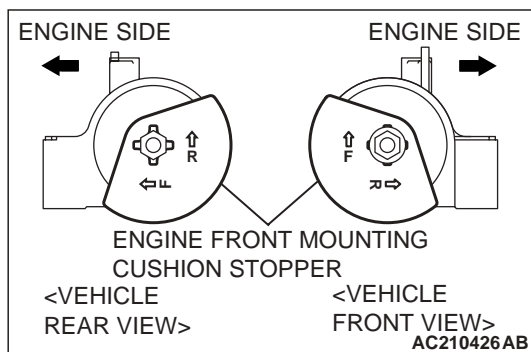
2. Place a garage jack against the engine oil pan with a piece of wood in between, and install the engine front mounting bracket and cushion stoppers while adjusting the position of the engine.

3. Support the engine assembly with a garage jack.

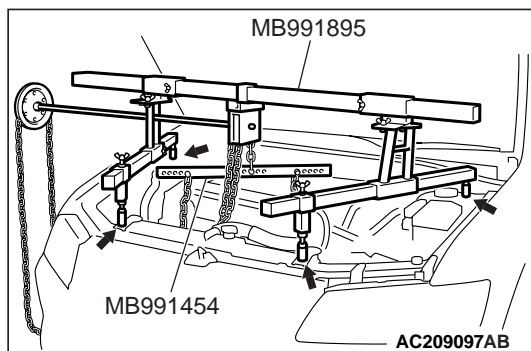
4. Remove the chain block.

5. Use the following special tool as during removal to support the engine.

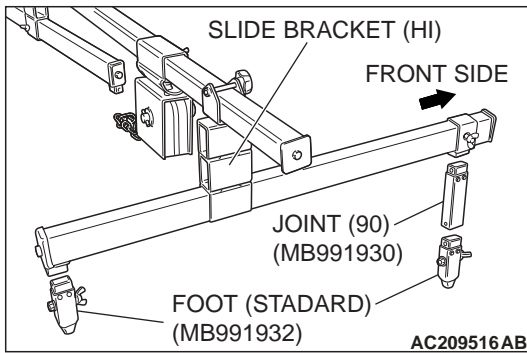
- (1) <Engine lifter (special tool MZ203827) is used>  
Set special tool MZ203827.



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





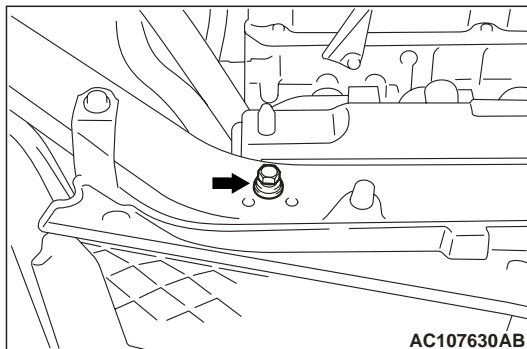
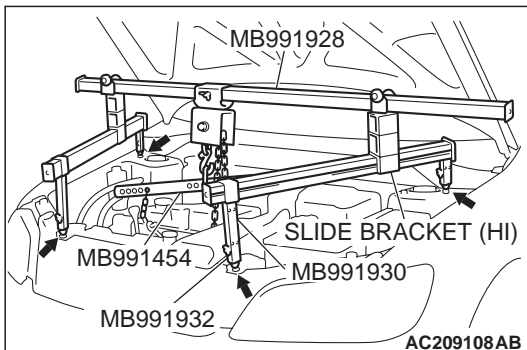


(3) <Engine hanger (special tool MB991928) is used>

a. Set 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-21.)
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, 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 ± 1.0 N·m (44 ± 9 in-lb)**

# CRANKSHAFT PULLEY

## REMOVAL AND INSTALLATION

M1112001600335

**CAUTION**

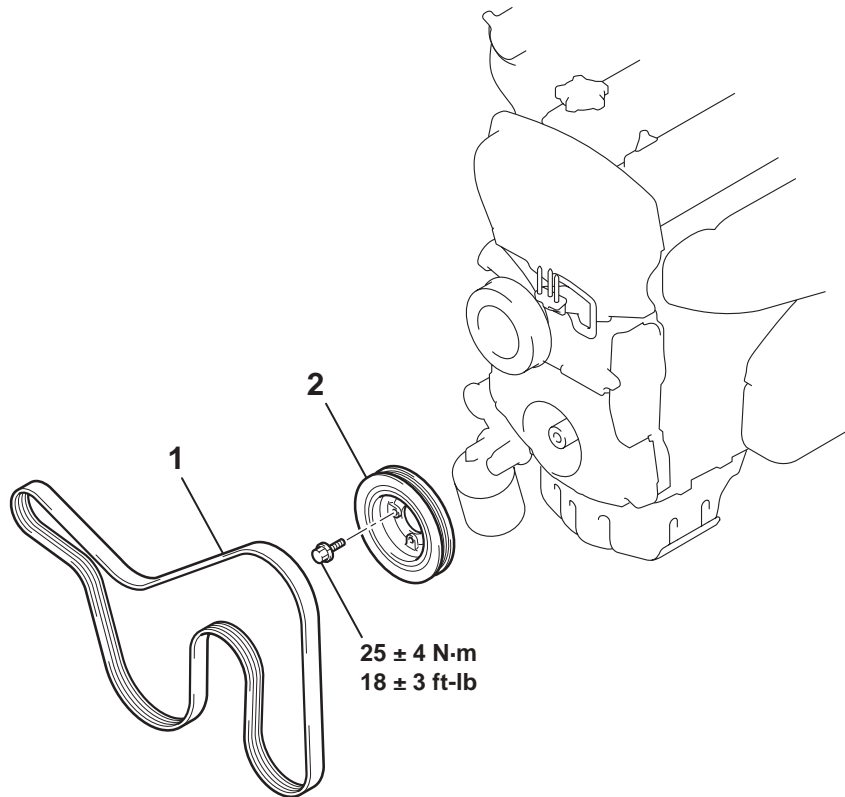
If the vehicle is equipped with the Brembo™ disc brake, during maintenance, take care not to contact the parts or tools to the caliper because the paint of caliper will be scratched.

**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-7.)
- Side Cover Installation
- Under Cover Installation (Refer to GROUP 51, Front Bumper P.51-2.)



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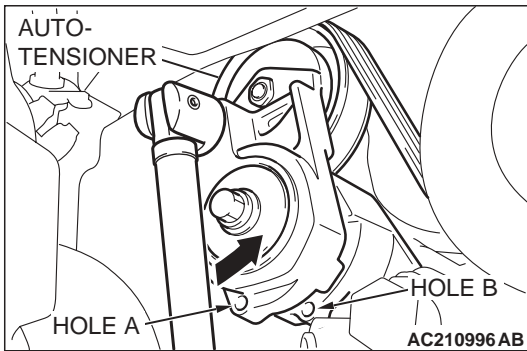
&lt;&lt;A&gt;&gt;

**REMOVAL STEPS**

1. DRIVE BELT
2. CRANK SHAFT DAMPER PULLEY

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

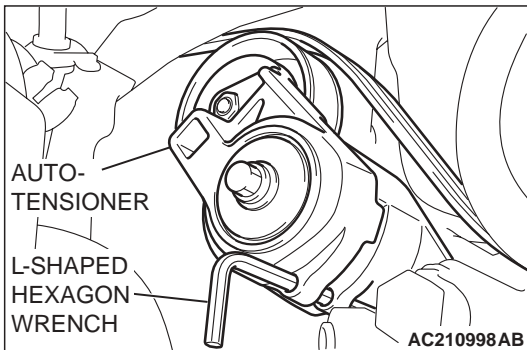
The following operations will be needed due to the serpentine drive system with the drive belt auto-tensioner.



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 (to the right) 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**

M1112006600147

**⚠ CAUTION**

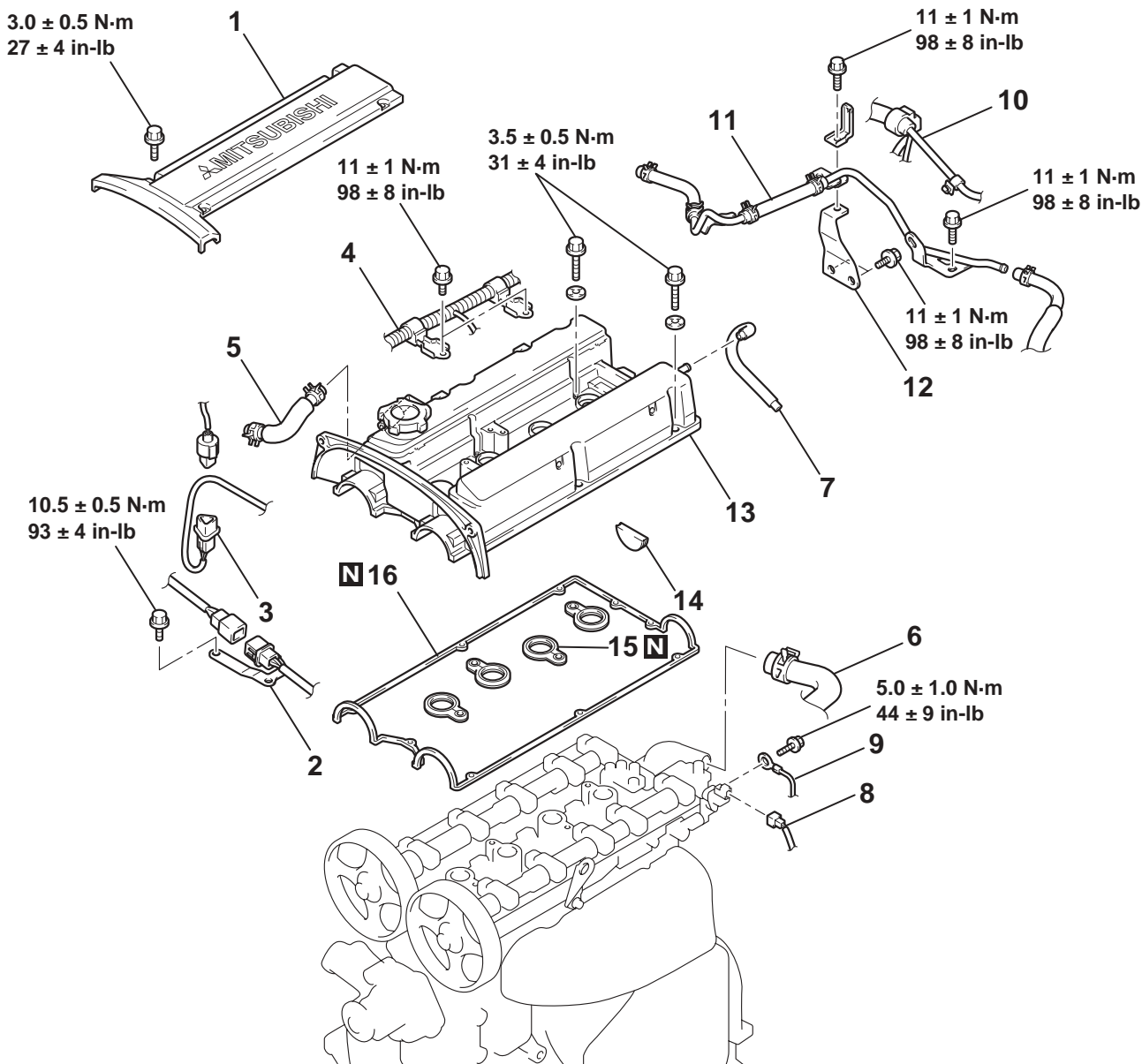
- If the vehicle is equipped with the Brembo™ disc brake, during maintenance, take care not to contact the parts or tools to the caliper because the paint of caliper will be scratched.
- \*Remove and assemble the marked parts in each cylinder unit.

**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.14-18.](#))
- 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-50.](#))

**Post-installation Operation**

- Valve Timing Belt Installation (Refer to [P.11A-50.](#))
- 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.14-18.](#))
- Drive Belt Tension Check (Refer to [P.11A-7.](#))
- 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.](#))



AC211071AP

**REMOVAL STEPS**

1. ROCKER COVER CENTER COVER
  - SPARK PLUG CABLES AND IGNITION COILS (REFER TO GROUP 16, IGNITION COIL P.16-39.)
2. HEATED OXYGEN SENSOR (FRONT) CONNECTOR
3. CRANKSHAFT POSITION SENSOR CONNECTOR
4. CONTROL WIRING HARNESS CONNECTION
5. ROCKER COVER PCV HOSE
6. RADIATOR UPPER HOSE CONNECTION

**REMOVAL STEPS (Continued)**

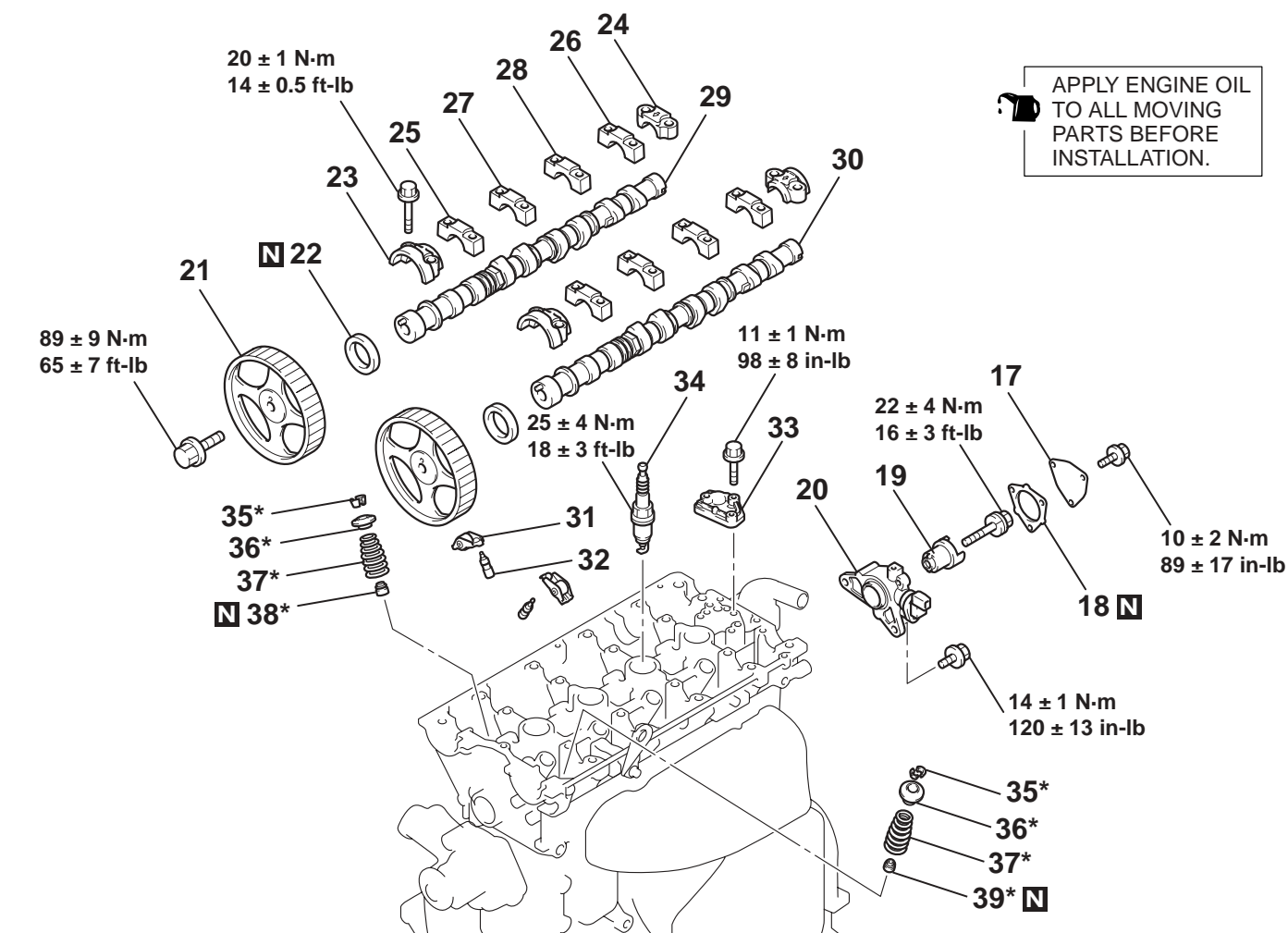
7. ROCKER COVER BREATHER HOSE
8. CAMSHAFT POSITION SENSOR CONNECTOR
9. GROUND TERMINAL
10. CONTROL WIRING HARNESS CONNECTION
11. VACUUM HOSE AND PIPE ASSEMBLY
12. VACUUM PIPE BRACKET
13. ROCKER COVER
14. CAMSHAFT END SEAL
15. SPARK PLUG HOLE GASKETS
16. ROCKER COVER GASKET

<<A>> >>N<<

>>M<<

>>L<<

>>K<<



AC211072AZ

**REMOVAL STEPS**

- 17. CAMSHAFT POSITION SENSOR SUPPORT COVER
- 18. CAMSHAFT POSITION SENSOR SUPPORT COVER GASKET
- >>J<< 19. CAMSHAFT POSITION SENSING CYLINDER
- >>K<< 20. CAMSHAFT POSITION SENSOR SUPPORT
- <<B>> >>H<< 21. CAMSHAFT SPROCKETS
- >>G<< 22. CAMSHAFT OIL SEALS
- >>F<< 23. CAMSHAFT BEARING CAPS, FRONT
- >>F<< 24. CAMSHAFT BEARING CAPS, REAR
- >>F<< 25. CAMSHAFT BEARING CAPS, NUMBER 2
- >>F<< 26. CAMSHAFT BEARING CAPS, NUMBER 5

**REMOVAL STEPS (Continued)**

- >>F<< 27. CAMSHAFT BEARING CAPS, NUMBER 3
- >>F<< 28. CAMSHAFT BEARING CAPS, NUMBER 4
- >>E<< 29. INLET CAMSHAFT
- >>E<< 30. EXHAUST CAMSHAFT
- >>D<< 31. ROCKER ARMS
- >>D<< 32. ROCKER ARM LASH ADJUSTERS
- 33. OIL DELIVERY BODY
- 34. SPARK PLUGS
- <<C>> >>C<< 35. VALVE SPRING RETAINER LOCKS
- >>B<< 36. VALVE SPRING RETAINERS
- >>A<< 37. VALVE SPRINGS
- >>A<< 38. INLET VALVE STEM SEALS
- >>A<< 39. EXHAUST VALVE STEM SEALS

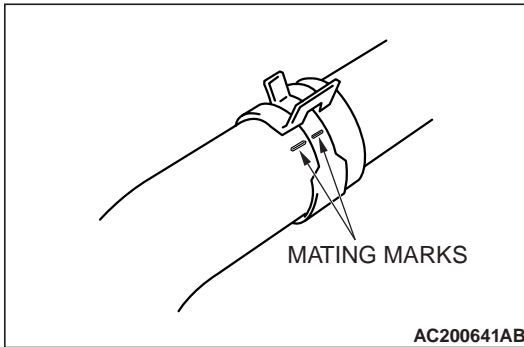
**Required Special Tools:**

- MD998713: Camshaft Oil Seal Installer
- MD998737: Valve Stem Seal Installer
- MD998772: Valve Spring Compressor

## REMOVAL SERVICE POINTS

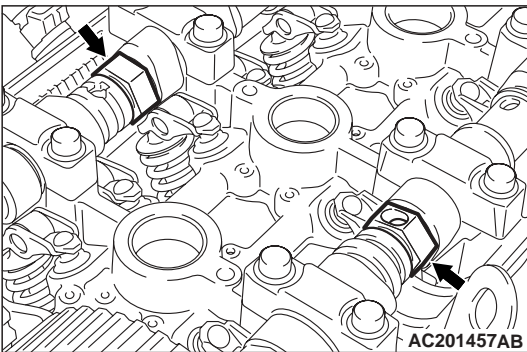
### <<A>> RADIATOR UPPER HOSE DISCONNECTION

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.

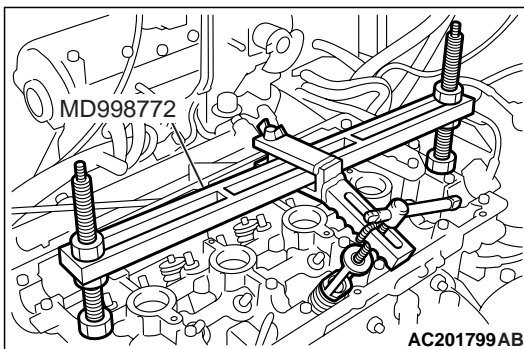


### <<C>> VALVE SPRING RETAINER LOCKS REMOVAL

#### **⚠ 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.



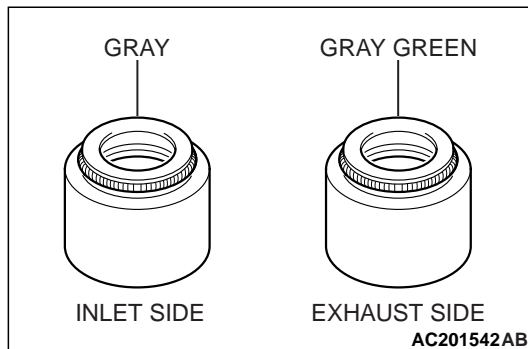
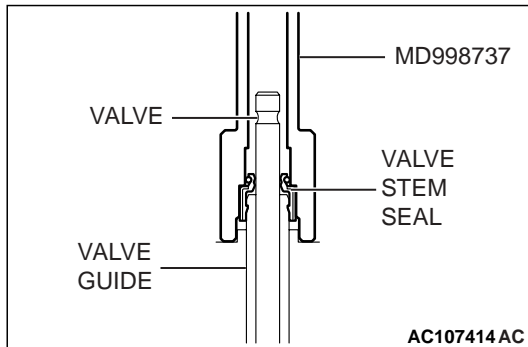
## INSTALLATION SERVICE POINTS

## &gt;&gt;A&lt;&lt; EXHAUST VALVE STEM SEALS/INLET VALVE STEM SEALS INSTALLATION

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

**⚠ CAUTION**

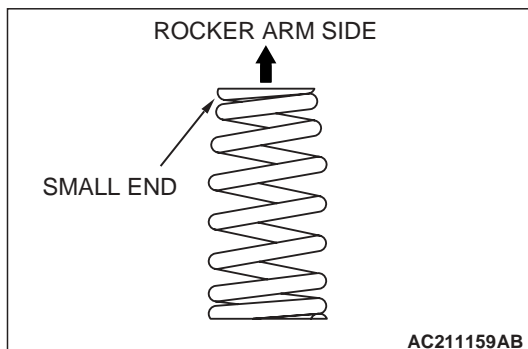
- Valve stem seals cannot be reused.
  - The special tool MD998737 must be used to install the valve stem seal. Improper installation could result in oil leaking past the valve guide.
2. Use special tool MD998737 to fill a new valve stem seal in the valve guide using the valve stem area as a guide.



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

## &gt;&gt;B&lt;&lt; VALVE SPRINGS INSTALLATION

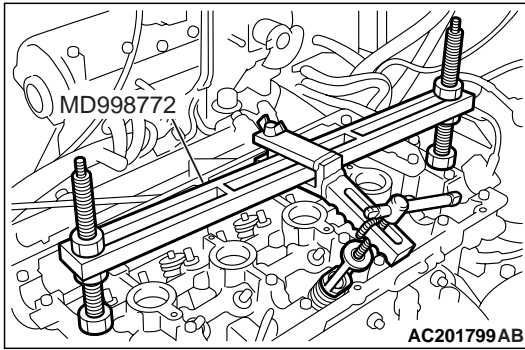
The small end of the valve spring should face the rocker arm.





**>>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-32.)

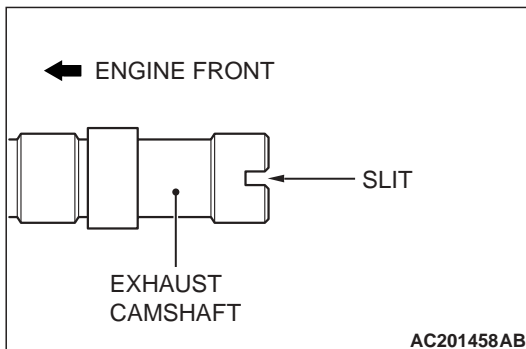
**>>E<< EXHAUST CAMSHAFT/INLET CAMSHAFT INSTALLATION**

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

**⚠ CAUTION**

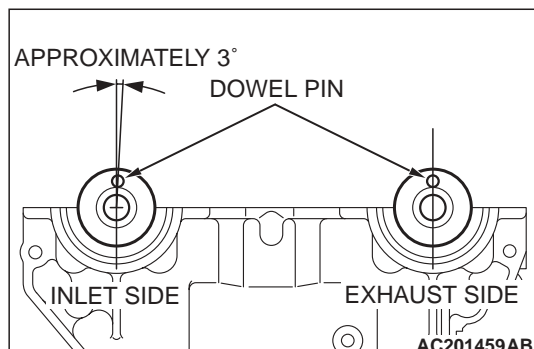
Do not install wrong camshaft at the side of inlet or exhaust. The exhaust camshaft has a slit at the rear surface.

3. Install the camshaft to the cylinder head.



**>>F<< CAMSHAFT BEARING CAPS, 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.

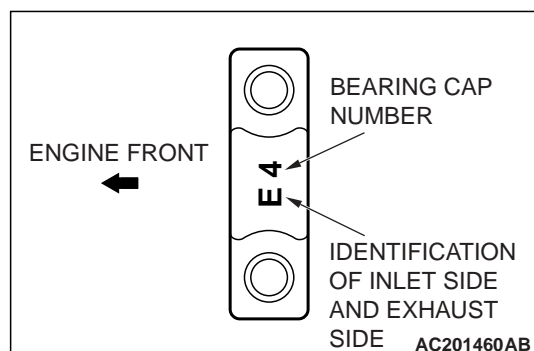


2. Since the shape of camshaft bearing caps number 2 – 5 is identical, check the identification marks so that the bearing cap No., inlet side, or exhaust side cannot be mistaken to install to the direction as shown in the illustration.

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

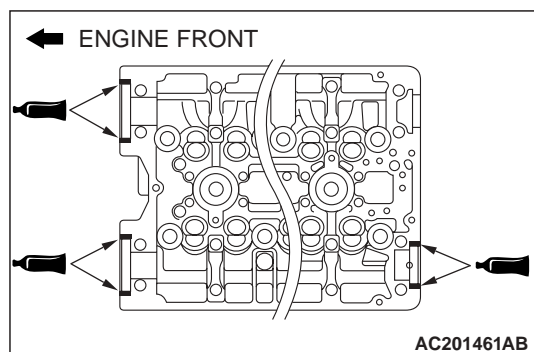
**I: Inlet side**

**E: Exhaust side**



3. Apply sealant to the positions (6 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.

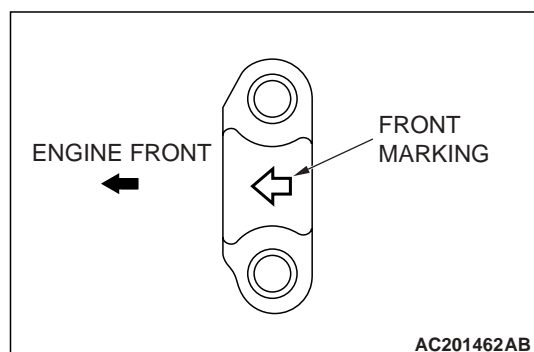
5. Check the identification marks on the camshaft bearing caps, front so that inlet side and exhaust side cannot be mistaken in the same way as that of bearing caps number 2 – 5.

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 ± 1 N·m (14 ± 0.5 ft-lb)**

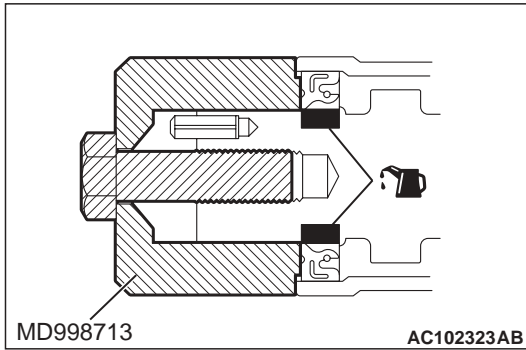
7. Ensure that the rocker arms are installed properly.

*NOTE: Remove an excess of sealant completely.*



>>G<< CAMSHAFT OIL SEALS INSTALLATION

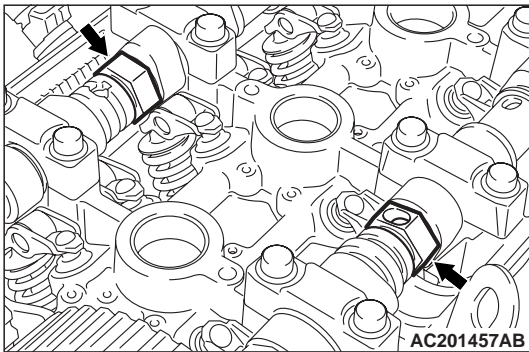
1. Apply engine oil to the entire inner diameter of the oil seal lip.
2. Use special tool MD998713 to press-fit the oil seals.



>>H<< CAMSHAFT SPROCKETS INSTALLATION

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

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



>>I<< CAMSHAFT POSITION SENSOR SUPPORT INSTALLATION

1. Remove sealant from the camshaft position sensor support and cylinder head surfaces.
2. Apply the sealant to the camshaft position sensor support flange in a continuous bead as shown in the illustration.

**Specified sealant: 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.*

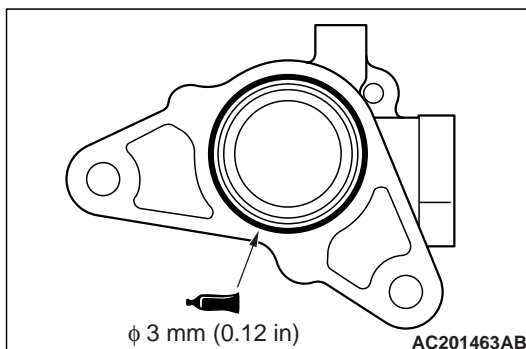
3. Install the camshaft position sensor support to the cylinder head.

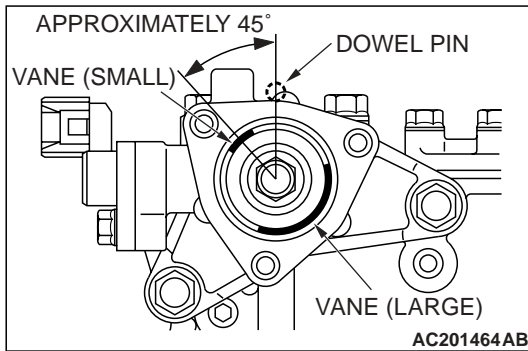
**CAUTION**

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

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

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





### >>J<< 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.

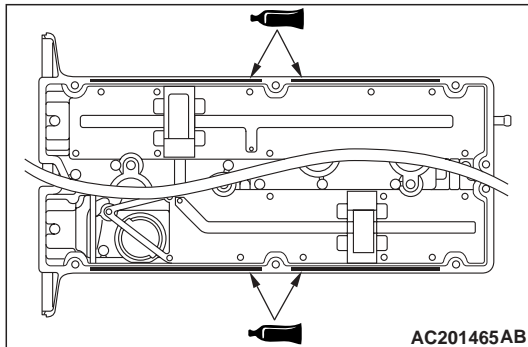
**Tightening torque:  $22 \pm 4$  N·m ( $16 \pm 3$  ft·lb)**

### >>K<< ROCKER COVER GASKET INSTALLATION

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

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

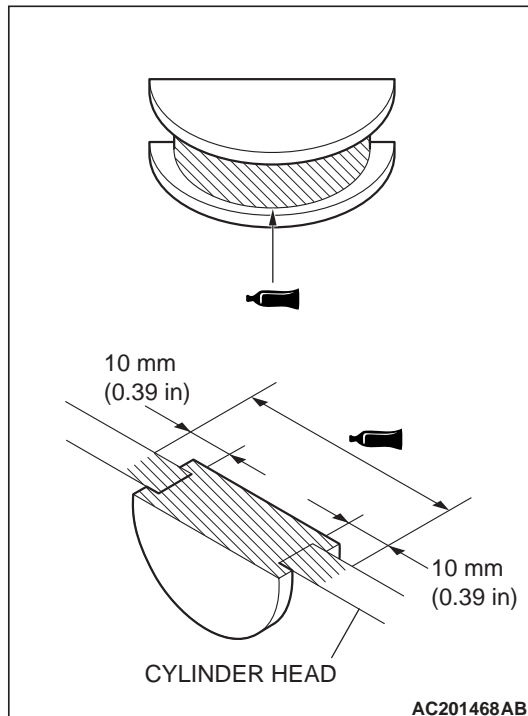
3. Install the rocker cover gasket to the rocker cover.



### >>L<< CAMSHAFT END SEAL INSTALLATION

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

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



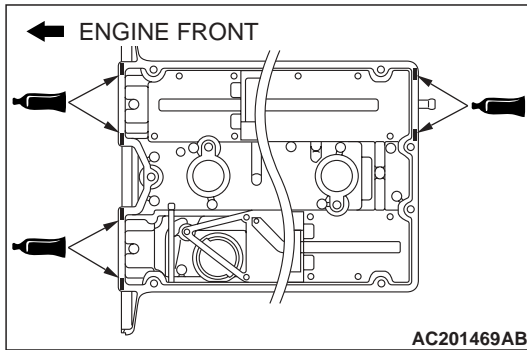
**>>M<< ROCKER COVER INSTALLATION**

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

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

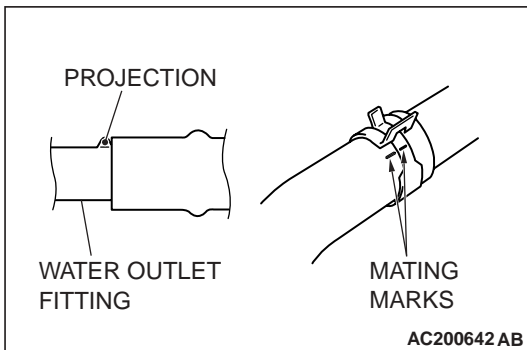
2. Install the rocker cover to the cylinder head.
3. Tighten the rocker cover mounting bolts to the specified torque.

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



**>>N<< RADIATOR UPPER HOSE CONNECTION**

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

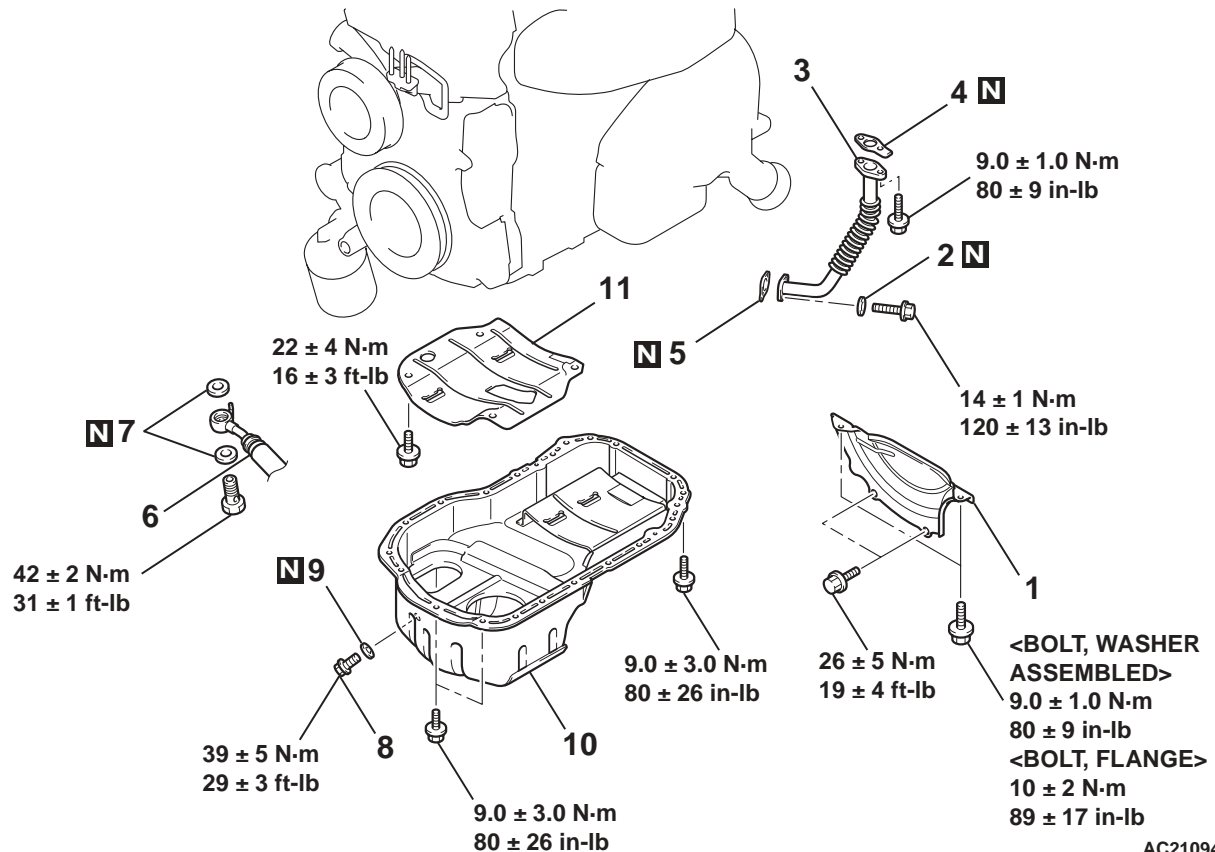


# OIL PAN

## REMOVAL AND INSTALLATION

M1112002800495

<p><b>Pre-removal Operation</b></p> <ul style="list-style-type: none"> <li>• Under Cover Removal (Refer to GROUP 51, Front Bumper P.51-2.)</li> <li>• Engine Oil Draining (Refer to GROUP 12, On-vehicle Service – Engine Oil Replacement P.12-3.)</li> <li>• Front Axle Crossmember Bar Removal (Refer to GROUP 32, Engine Roll Stopper and Centermember P.32-6.)</li> <li>• Front Exhaust Pipe Removal (Refer to GROUP 15, Exhaust Pipe and Main Muffler P.15-23.)</li> <li>• Starter Assembly Removal (Refer to GROUP 16, Starter Motor Assembly P.16-24.)</li> </ul>	<p><b>Post-installation Operation</b></p> <ul style="list-style-type: none"> <li>• Starter Assembly Installation (Refer to GROUP 16, Starter Motor Assembly P.16-24.)</li> <li>• Front Exhaust Pipe Installation (Refer to GROUP 15, Exhaust Pipe and Main Muffler P.15-23.)</li> <li>• Front Axle Crossmember Bar Installation (Refer to GROUP 32, Engine Roll Stopper and Centermember P.32-6.)</li> <li>• Engine Oil Refilling (Refer to GROUP 12, On-vehicle Service – Engine Oil Replacement P.12-3.)</li> <li>• Under Cover Installation (Refer to GROUP 51, Front Bumper P.51-2.)</li> </ul>
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AC210942AB

**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 Remover

## REMOVAL SERVICE POINT

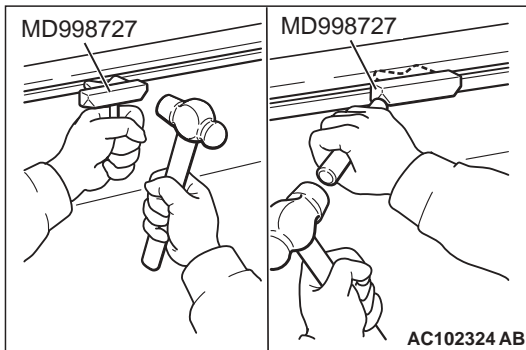
### <<A>> ENGINE OIL PAN REMOVAL

1. Remove the engine oil pan mounting bolts.

#### **⚠ CAUTION**

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

2. Remove the engine oil pan using special tool MD998727.



## INSTALLATION SERVICE POINTS

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

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

**Specified sealant: 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.*

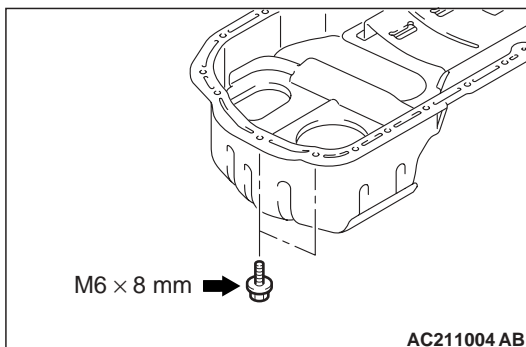
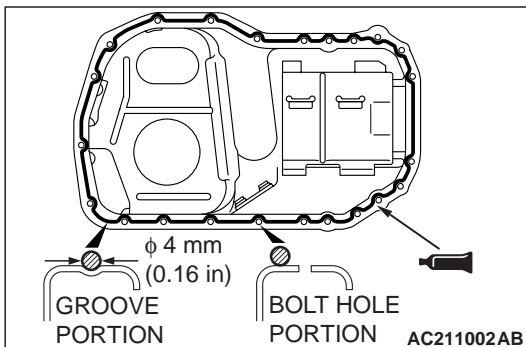
3. Assemble the engine oil pan to the cylinder block.

#### **⚠ CAUTION**

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

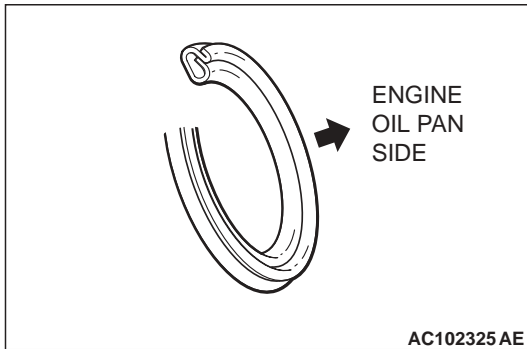
4. Tighten the engine oil pan mounting bolts to the specified torque. Be careful when installing, as the oil pan mounting bolts (indicated in the illustration) have different lengths from the other bolts.

**Tightening torque: 9.0 ± 3.0 N·m (80 ± 26 in-lb)**



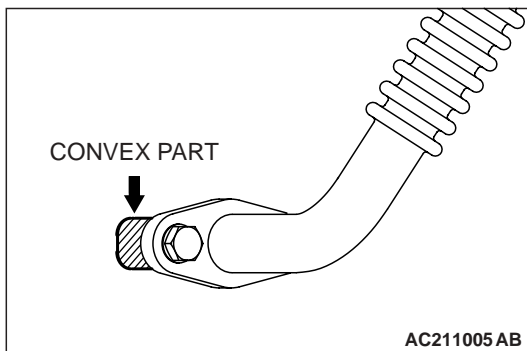
**>>B<< ENGINE OIL PAN DRAIN PLUG GASKET  
INSTALLATION**

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

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

Oil return tube gasket should be replaced with a new one, and 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**

M1112002900180

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



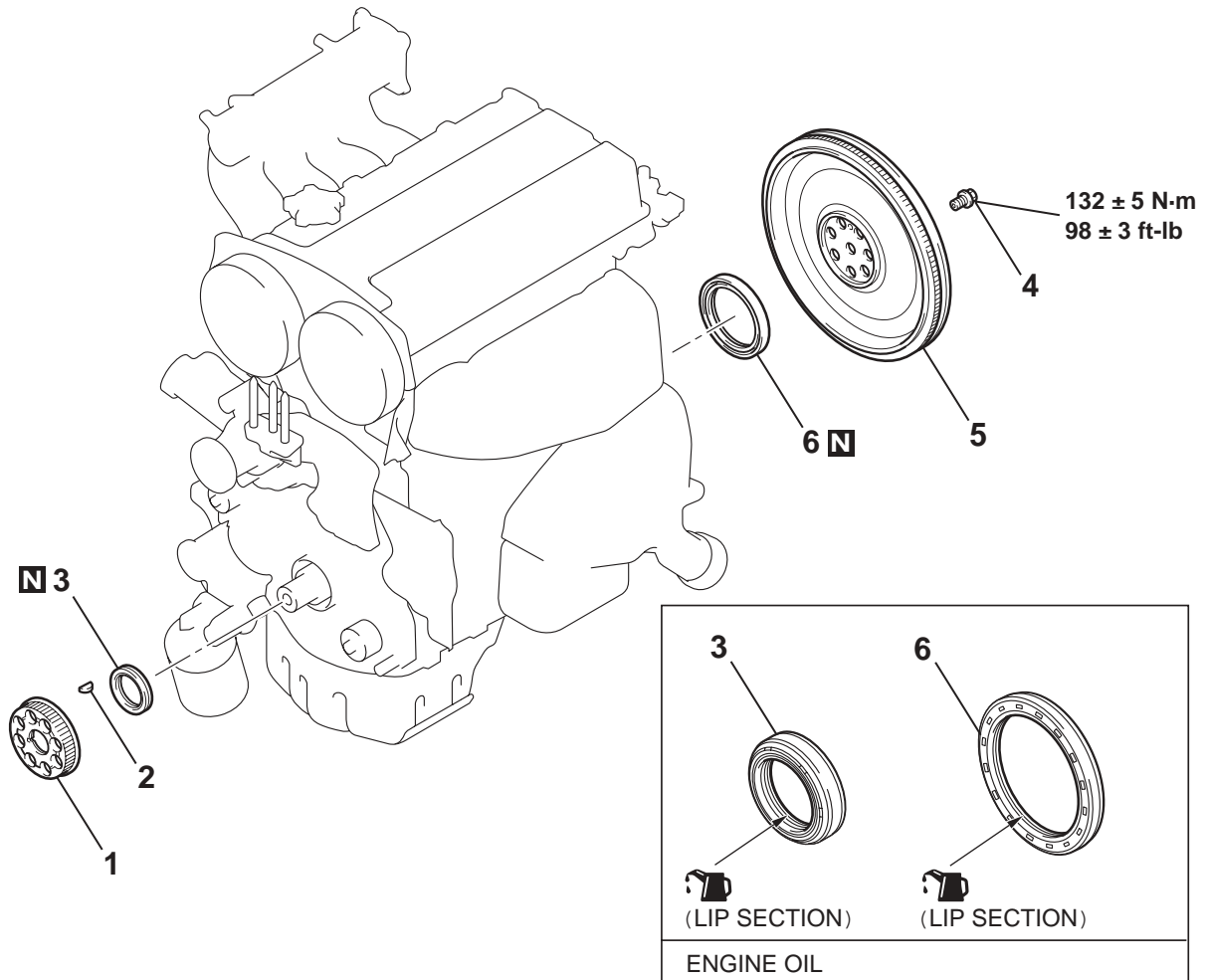
# CRANKSHAFT OIL SEAL

## REMOVAL AND INSTALLATION

M1112003100217

**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-50.)
- >>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-15.)
  - TRANSAXLE ASSEMBLY (REFER TO GROUP 22A, TRANSAXLE ASSEMBLY P.22A-21.)
- <<A>> >>B<< 4. FLYWHEEL BOLTS
5. FLYWHEEL ASSEMBLY
- >>A<< 6. CRANKSHAFT REAR OIL SEAL

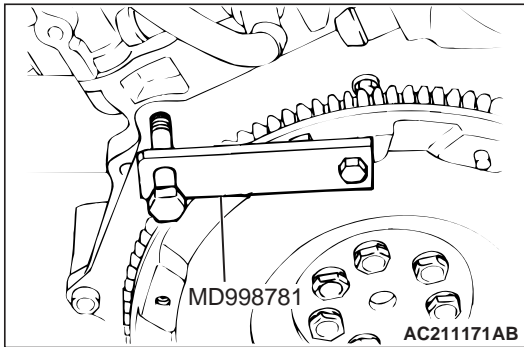
### Required Special Tools:

- 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

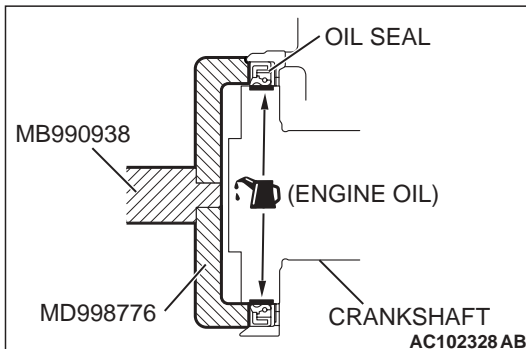
1. Use special tool MD998781 to secure the flywheel.
2. Remove the flywheel mounting bolts.



## INSTALLATION SERVICE POINTS

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

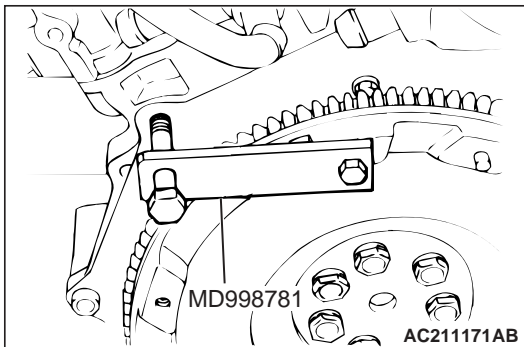
1. Apply a small amount of engine oil to the entire inner diameter of the oil seal lip.
2. Use special tools MB990938 and MD998776 to press-fit the oil seal.



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

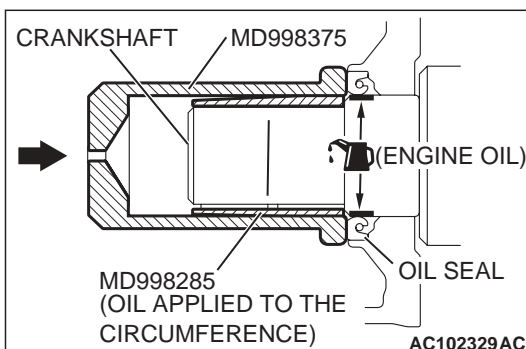
1. Use special tool MD998781 to secure the flywheel in the same manner as removal.
2. Tighten the flywheel mounting bolts to the specified torque.

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



## &gt;&gt;C&lt;&lt; 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.

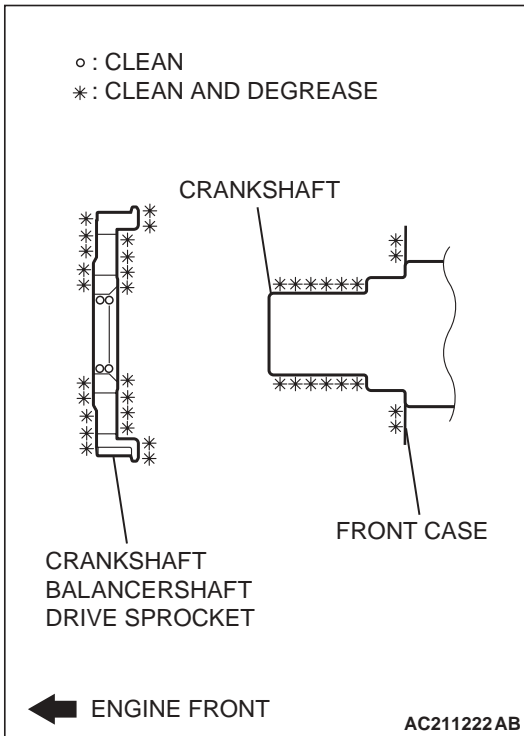


>>D<< CRANKSHAFT BALANCER SHAFT DRIVE SPROCKET INSTALLATION

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

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**⚠ CAUTION**

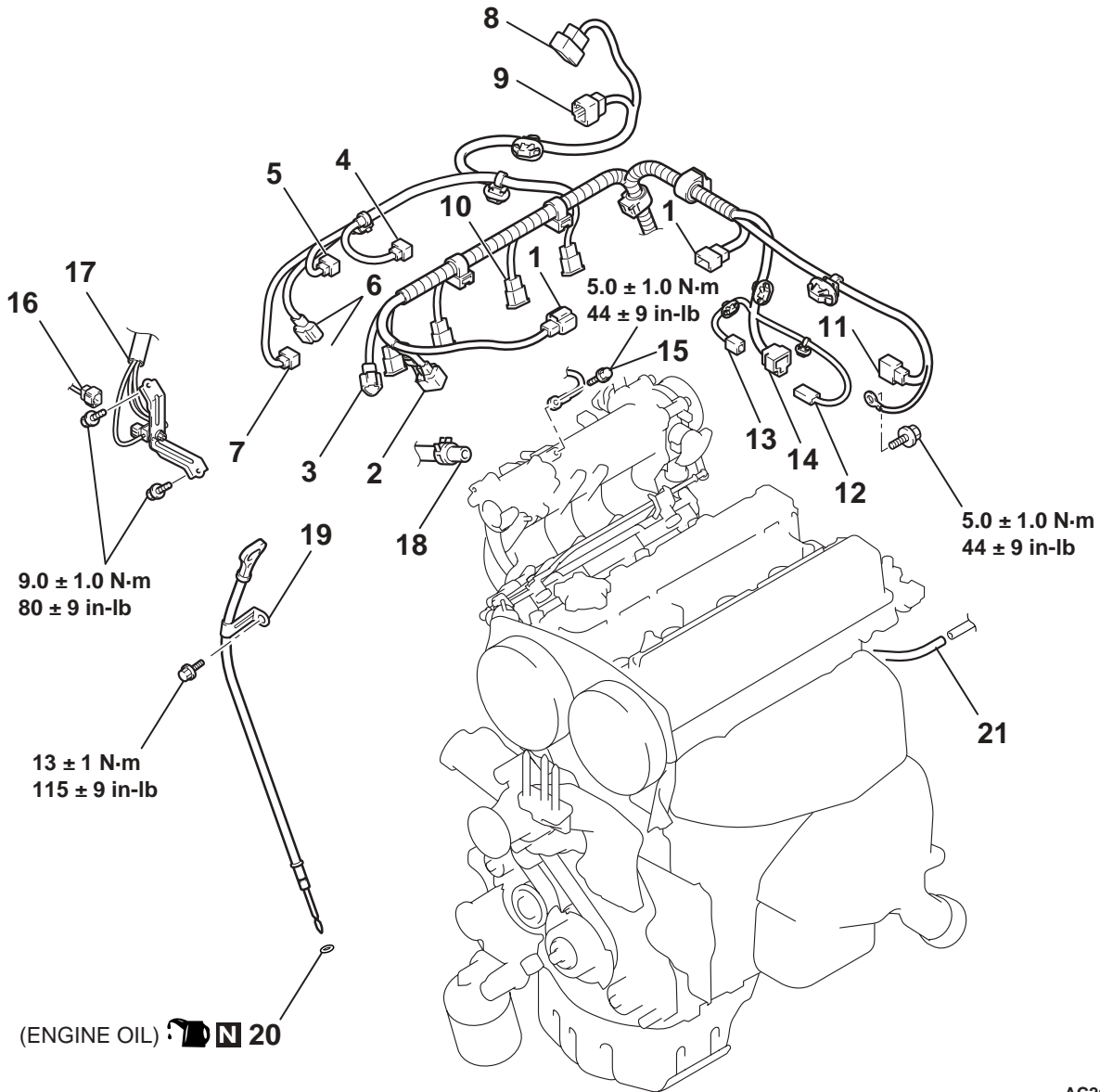
If the vehicle is equipped with the Brembo™ disc brake, during maintenance, take care not to contact the parts or tools to the caliper because the paint of caliper will be scratched.

**Pre-removal Operation**

- Fuel Line Pressure Reduction [Refer to GROUP 13A, On-vehicle Service – Fuel Pump Connector Disconnection (How to Reduce Pressurized Fuel Lines) [P.13A-765.](#)]
- 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.14-18.](#))
- 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.)
- 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-28.](#))
- Radiator Assembly Removal (Refer to GROUP 14, Radiator [P.14-22.](#))
- Front Axle Crossmember Bar Removal (Refer to GROUP 32, Engine Roll Stopper and Centermember [P.32-6.](#))
- Front Exhaust Pipe Removal (Refer to GROUP 15, Exhaust Pipe and Main Muffler [P.15-23.](#))
- Starter Assembly Removal (Refer to GROUP 16, Starter Motor Assembly [P.16-24.](#))
- Valve Timing Belt Removal (Refer to [P.11A-50.](#))

**Post-installation Operation**

- Valve Timing Belt Installation (Refer to [P.11A-50.](#))
- 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.15-23.](#))
- Front Axle Crossmember Bar Installation (Refer to GROUP 32, Engine Roll Stopper and Centermember [P.32-6.](#))
- Radiator Assembly Installation (Refer to GROUP 14, Radiator [P.14-22.](#))
- Rocker Cover Center Cover Installation (Refer to [P.11A-28.](#))
- 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.)
- 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.14-18.](#))
- Drive Belt Tension Check (Refer to [P.11A-7.](#))
- 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. IGNITION COIL CONNECTORS
2. HEATED OXYGEN SENSOR (FRONT) CONNECTOR
3. CRANKSHAFT POSITION SENSOR CONNECTOR
4. MANIFOLD DIFFERENTIAL PRESSURE SENSOR CONNECTOR
5. FUEL PRESSURE SOLENOID CONNECTOR
6. KNOCK SENSOR CONNECTOR
7. EVAPORATIVE EMISSION PURGE SOLENOID CONNECTOR
8. THROTTLE POSITION SENSOR CONNECTOR
9. IDLE AIR CONTROL MOTOR CONNECTOR
10. INJECTOR CONNECTORS

**REMOVAL STEPS (Continued)**

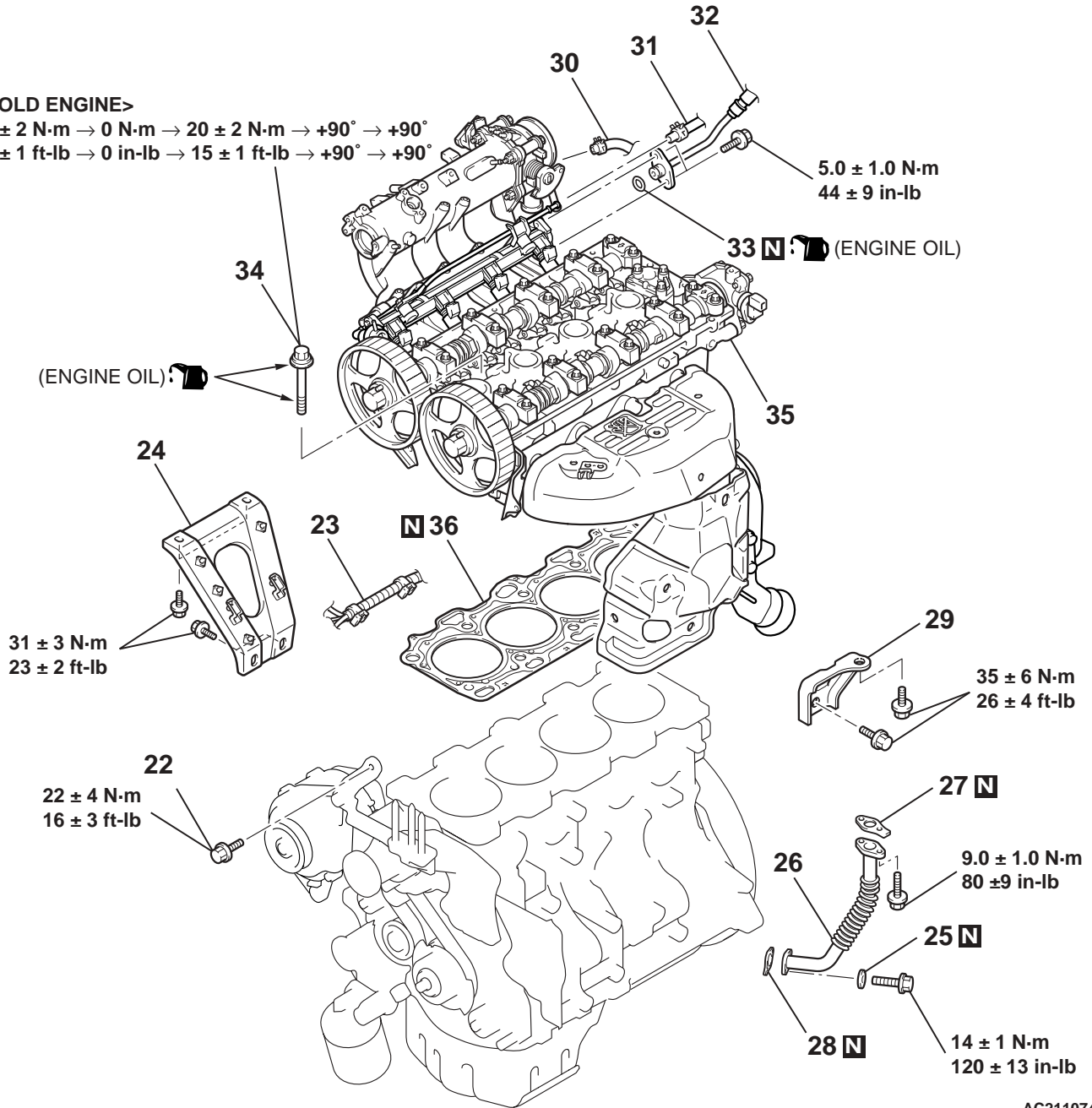
11. CAMSHAFT POSITION SENSOR CONNECTOR
12. ENGINE COOLANT TEMPERATURE GAUGE UNIT CONNECTOR
13. ENGINE COOLANT TEMPERATURE SENSOR CONNECTOR
14. CONTROL WIRING HARNESS AND TRANSAXLE WIRING HARNESS COMBINATION
15. GROUND CABLE CONNECTION
16. EGR VACUUM REGULATOR SOLENOID VALVE CONNECTOR
17. EGR VACUUM REGULATOR SOLENOID VALVE AND BRACKET ASSEMBLY
18. BRAKE BOOSTER VACUUM HOSE CONNECTION

**REMOVAL STEPS (Continued)**

19. ENGINE OIL DIPSTICK AND DIPSTICK GUIDE
20. O-RING
21. PURGE HOSE CONNECTION

<COLD ENGINE>

78 ± 2 N·m → 0 N·m → 20 ± 2 N·m → +90° → +90°  
58 ± 1 ft·lb → 0 in·lb → 15 ± 1 ft·lb → +90° → +90°



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**REMOVAL STEPS**

22. GENERATOR BRACE BOLT
23. BATTERY WIRING HARNESS CONNECTION
24. INLET MANIFOLD STAY
25. GASKET
26. OIL RETURN TUBE
27. OIL RETURN TUBE GASKET
28. OIL RETURN TUBE GASKET
29. TURBOCHARGER BRACKET

>>D<<

**REMOVAL STEPS (Continued)**

- WATER OUTLET FITTING AND THERMOSTAT CASE ASSEMBLY (REFER TO GROUP 14, WATER HOSE AND PIPE P.14-29.)
  - ROCKER COVER (REFER TO P.11A-28.)
30. WATER RETURN HOSE CONNECTION

**REMOVAL STEPS (Continued)**

- 31. FUEL RETURN LINE HOSE CONNECTION
- >>C<< 32. FUEL HIGH-PRESSURE HOSE CONNECTION
- >>C<< 33. O-RING
- <<A>> >>B<< 34. CYLINDER HEAD BOLTS
- 35. CYLINDER HEAD ASSEMBLY
- >>A<< 36. CYLINDER HEAD GASKET

**Required Special Tool:**

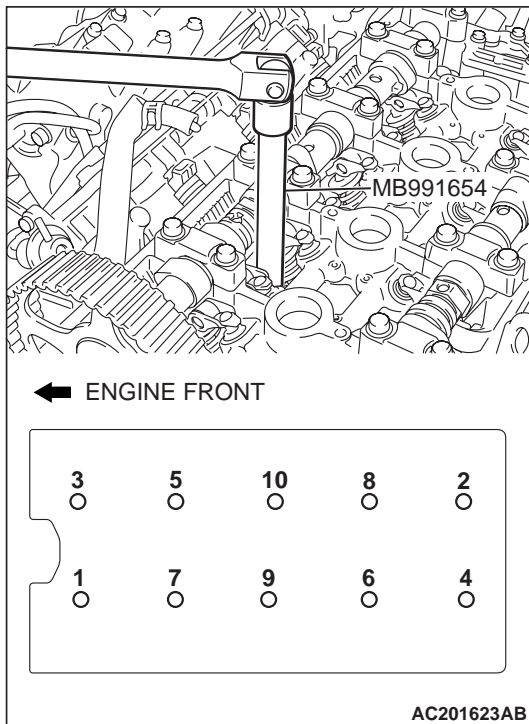
- MB991654: Cylinder Head Bolt Wrench (12)

**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 of the numbers shown in the illustration.

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



**INSTALLATION SERVICE POINTS**

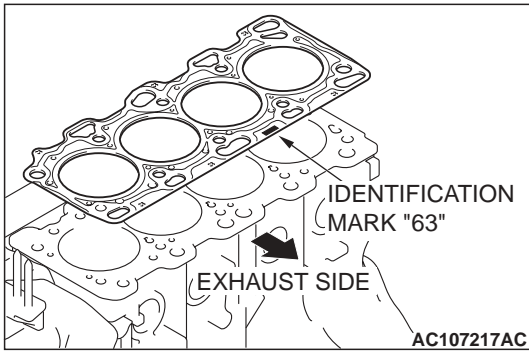
**>>A<< CYLINDER HEAD GASKET INSTALLATION**

**⚠ CAUTION**

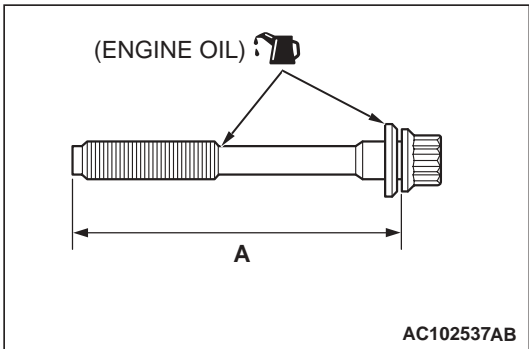
**Do not allow any foreign materials to get into the coolant passages, oil passages and cylinder.**

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





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

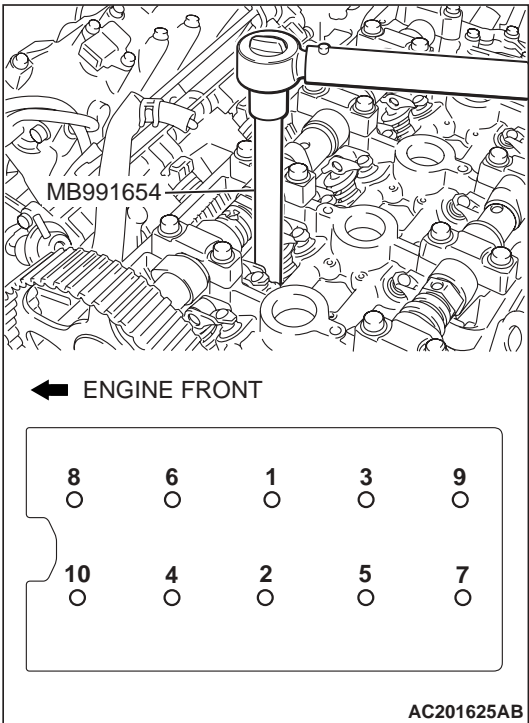


**>>B<< CYLINDER HEAD BOLTS INSTALLATION**

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

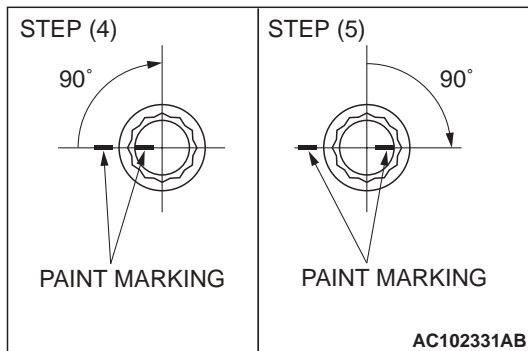
**Limit (A): 99.4 mm (3.91 inches)**

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.

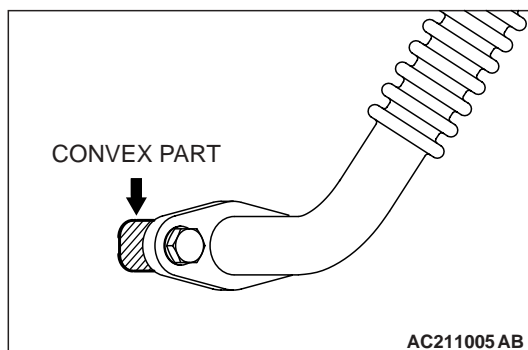
1. Apply a small amount of new engine oil to the O-ring.
2. Turning the fuel high-pressure hose to the right and left, install it to the fuel rail, while being careful not to damage the O-ring. After installing, check that the hose turns smoothly.
3. If the hose does not turn smoothly, the O-ring is 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**

Oil return tube gasket should be replaced with a new one, and 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.*



# TIMING BELT

## REMOVAL AND INSTALLATION

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**CAUTION**

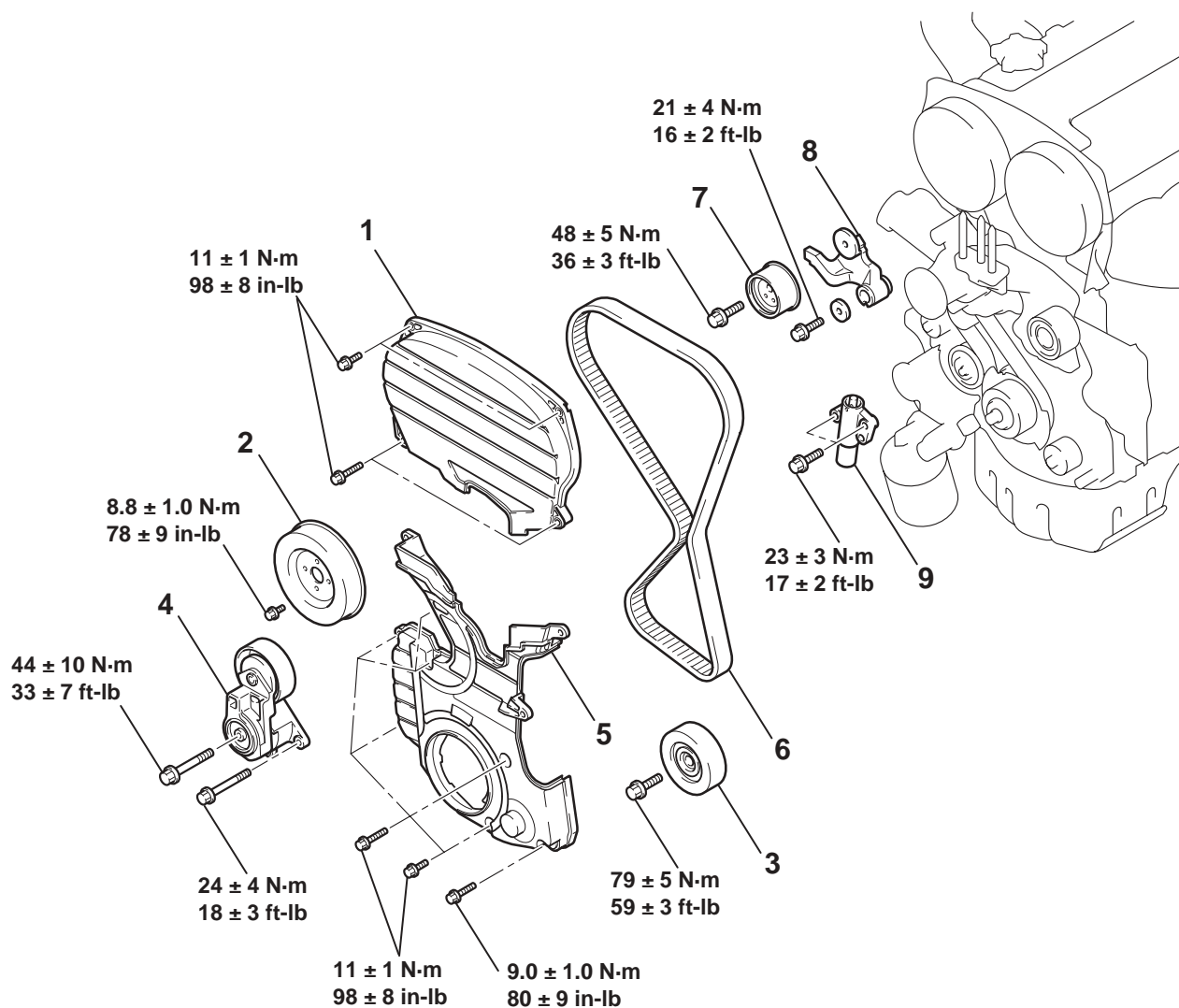
If the vehicle is equipped with the Brembo™ disc brake, during maintenance, take care not to contact the parts or tools to the caliper because the paint of caliper will be scratched.

**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-26.)
- Front Axle Crossmember Bar Removal (Refer to GROUP 32, Engine Roll Stopper and Centermember P.32-6.)
- Front Exhaust Pipe Removal (Refer to GROUP 15, Exhaust Pipe and Main Muffler P.15-23.)

**Post-installation Operation**

- Front Exhaust Pipe Installation (Refer to GROUP 15, Exhaust Pipe and Main Muffler P.15-23.)
- Front Axle Crossmember Bar Installation (Refer to GROUP 32, Engine Roll Stopper and Centermember P.32-6.)
- Crankshaft Shaft Damper Pulley Installation (Refer to P.11A-26.)
- Drive Belt Tension Check (Refer to P.11A-7.)
- Side Cover Installation
- Under Cover Installation (Refer to GROUP 51, Front Bumper P.51-2.)



**REMOVAL STEPS**

1. TIMING BELT UPPER COVER
2. WATER PUMP PULLEY
3. IDLER PULLEY

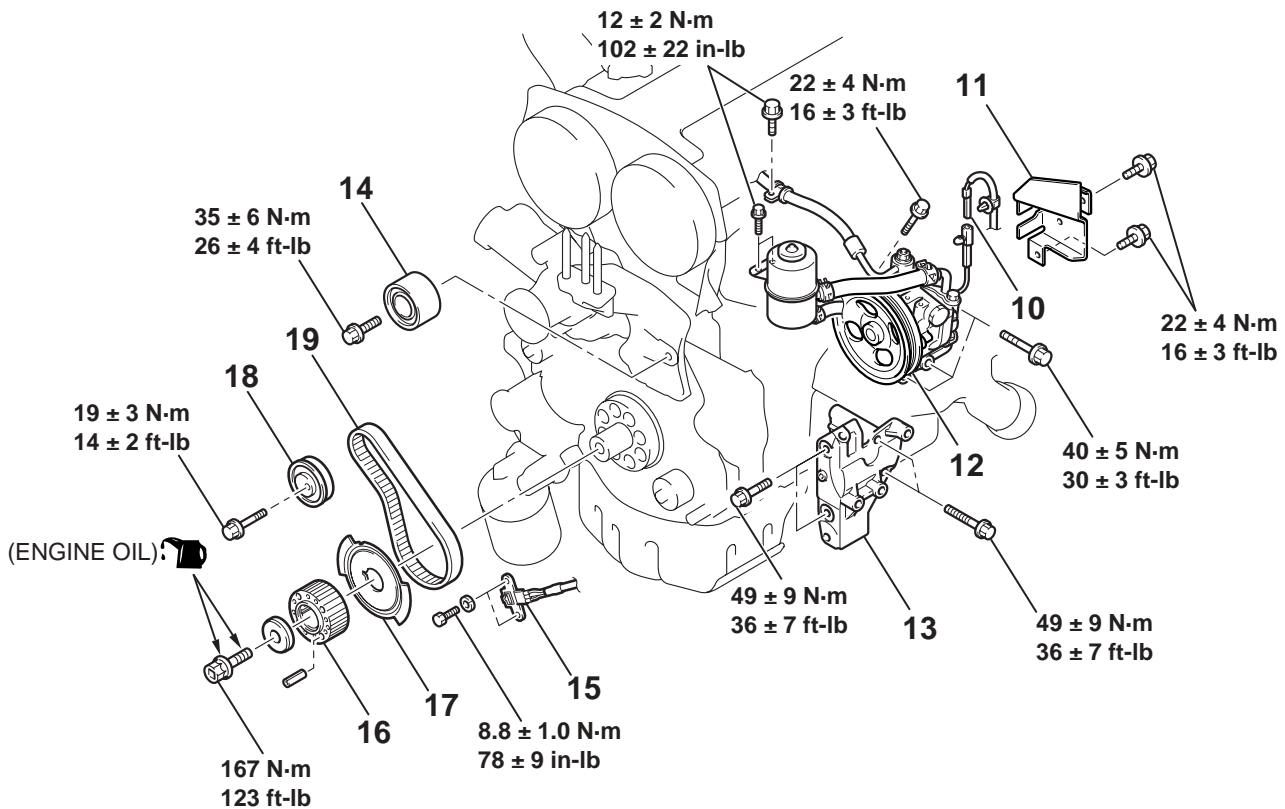
**REMOVAL STEPS (Continued)**

4. AUTO-TENSIONER
5. TIMING BELT LOWER COVER

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**REMOVAL STEPS (Continued)**

- ENGINE FRONT MOUNTING BRACKET (REFER TO GROUP 32, ENGINE MOUNT P.32-3.)
- >>G<< • VALVE TIMING BELT TENSION ADJUSTMENT
- <<A>> >>F<< 6. VALVE TIMING BELT
- >>E<< 7. TIMING BELT TENSIONER PULLEY
- 8. TIMING BELT TENSIONER ARM
- >>D<< 9. TIMING BELT TENSIONER ADJUSTER



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**REMOVAL STEPS**

- 10. POWER STEERING PRESSURE SWITCH CONNECTOR
- 11. POWER STEERING OIL PUMP HEAT PROTECTOR
- <<B>> 12. POWER STEERING OIL PUMP, BRACKET AND RESERVOIR ASSEMBLY
- 13. POWER STEERING OIL PUMP BRACKET
- 14. TIMING BELT IDLER PULLEY

**REMOVAL STEPS (Continued)**

- 15. CRANKSHAFT POSITION SENSOR
- <<C>> >>C<< 16. CRANKSHAFT CAMSHAFT DRIVE SPROCKET
- >>C<< 17. CRANKSHAFT ANGLE SENSING BLADE
- >>B<< • BALANCER TIMING BELT TENSION ADJUSTMENT
- >>A<< 18. BALANCER TIMING BELT TENSIONER
- <<D>> >>A<< 19. BALANCER TIMING BELT

**Required Special Tools:**

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

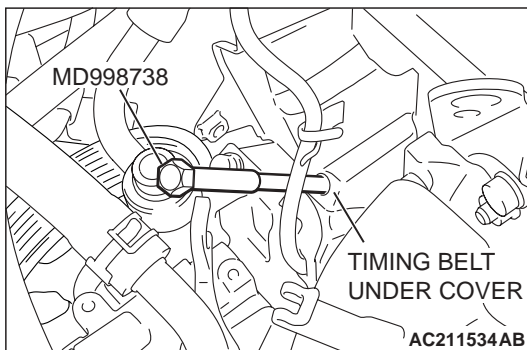
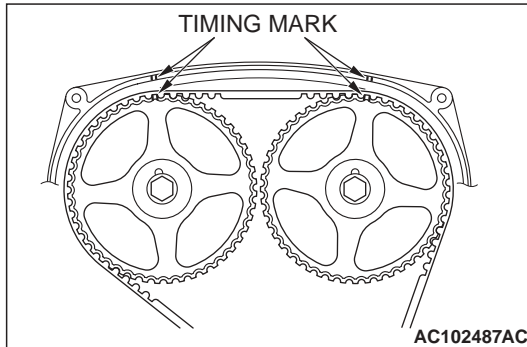
## REMOVAL SERVICE POINTS

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

**⚠ CAUTION**

Never turn the crankshaft counterclockwise.

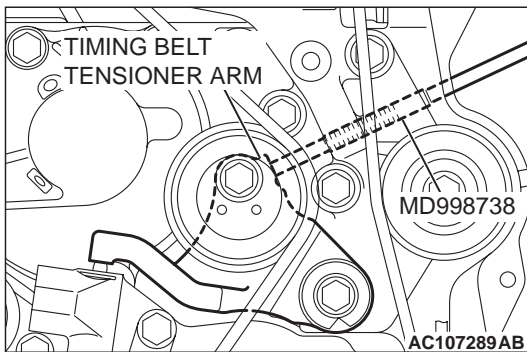
1. Turn the crankshaft clockwise, align each timing mark to set number 1 cylinder to TDC of its compression stroke.



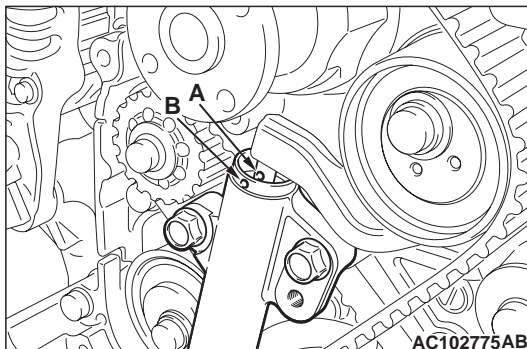
2. Remove the timing belt under cover rubber plug and then set the special tool MD998738.

**⚠ CAUTION**

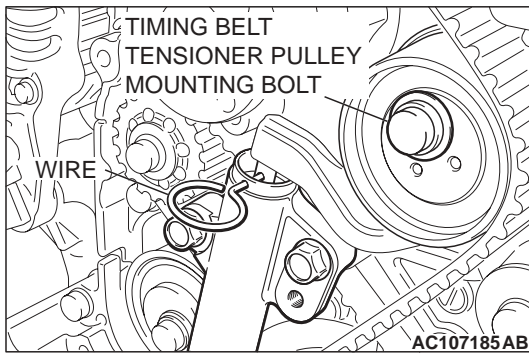
The special tool MD998738 can be gradually installed at a rate of a 30 degree turn per second. If it is screwed in all at once, the timing belt tensioner adjuster rod will not easily retract and the special tool MD998738 may bend.



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, etc.in the set hole.

**⚠ CAUTION**

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

6. After removal of adjusting bolt special tool MD998738, loosen the timing belt tensioner pulley mounting bolt and remove the valve timing belt.

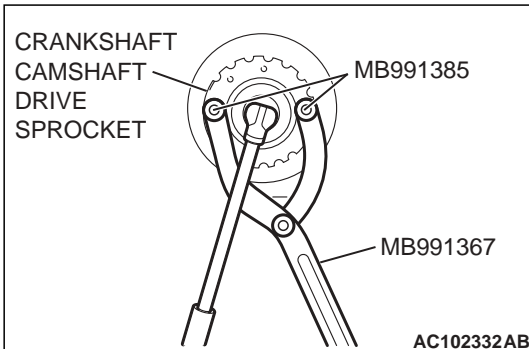
**<<B>> POWER STEERING OIL PUMP, BRACKET AND RESERVOIR ASSEMBLY REMOVAL**

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**

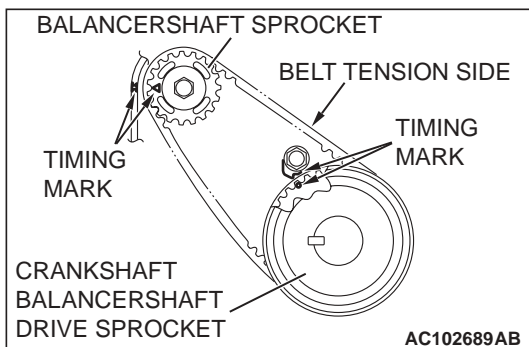
**⚠ CAUTION**

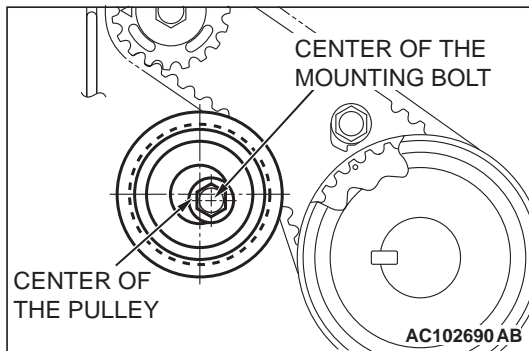
To reuse the balancer timing belt, draw an arrow indicating the rotating direction (clockwise) on the back of the belt using chalk.

**INSTALLATION SERVICE POINTS**

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

1. Ensure that the crankshaft balancer shaft drive sprocket timing marks and balancer shaft sprocket timing marks are aligned.
2. Install the balancer timing belt on the crankshaft balancer shaft drive sprocket and balancer shaft 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.

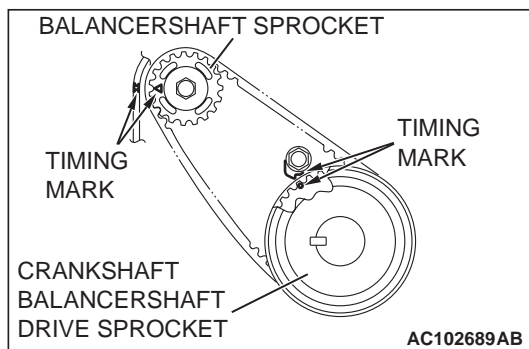
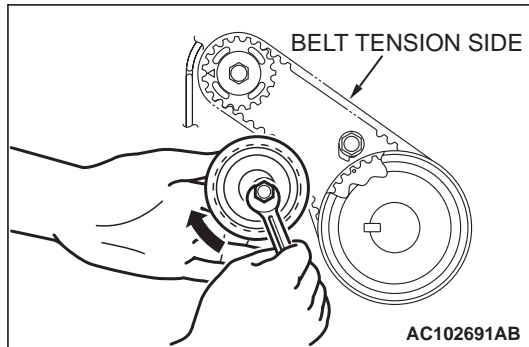
### >>B<< BALANCER TIMING BELT TENSION ADJUSTMENT

#### **⚠ CAUTION**

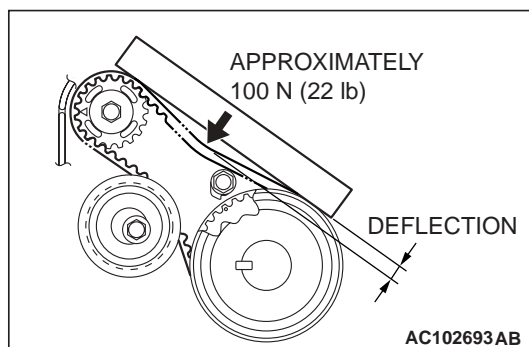
When tightening the mounting bolts, ensure that the tensioner does not rotate with the bolts. Allowing it to rotate with the bolts can cause excessive tension of the belt.

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

**Tightening torque:  $19 \pm 3$  N·m ( $14 \pm 2$  ft-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.

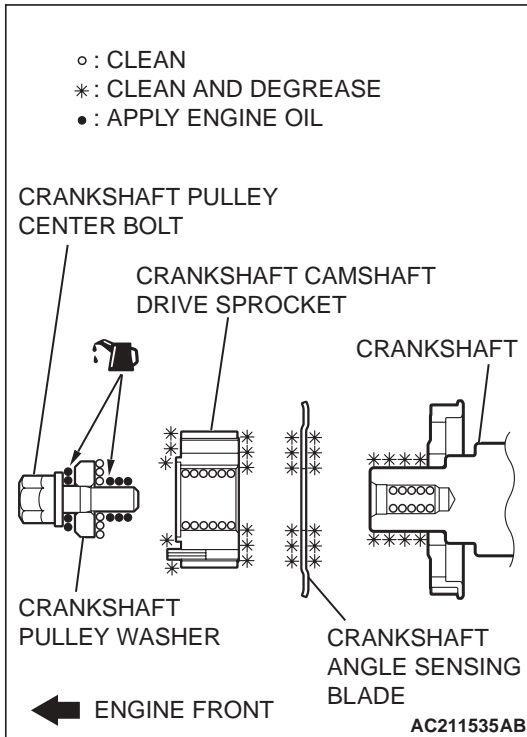


**>>C<< CRANKSHAFT ANGLE SENSING  
BLADE/CRANKSHAFT CAMSHAFT DRIVE SPROCKET  
INSTALLATION**

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

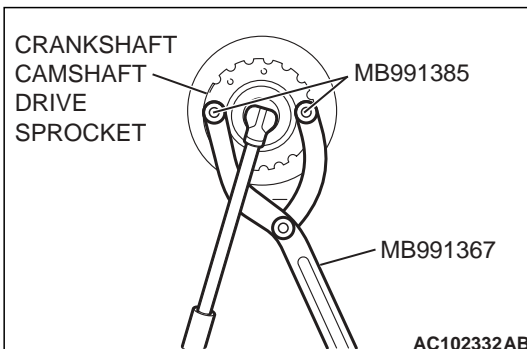
*NOTE: Also clean the degreased surfaces.*

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)**



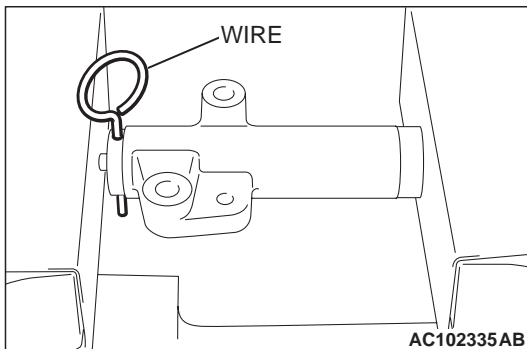
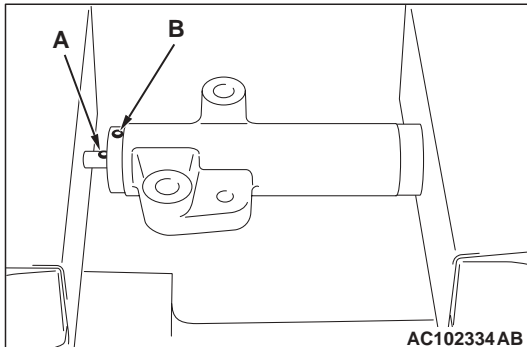
**>>D<< TIMING BELT TENSIONER ADJUSTER  
INSTALLATION**

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 into the aligned set hole.

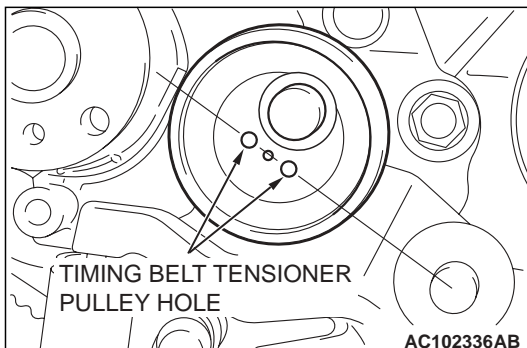
*NOTE: When replacing the timing belt tensioner adjuster with new parts, the timing belt tensioner adjuster is set with a pin.*

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**

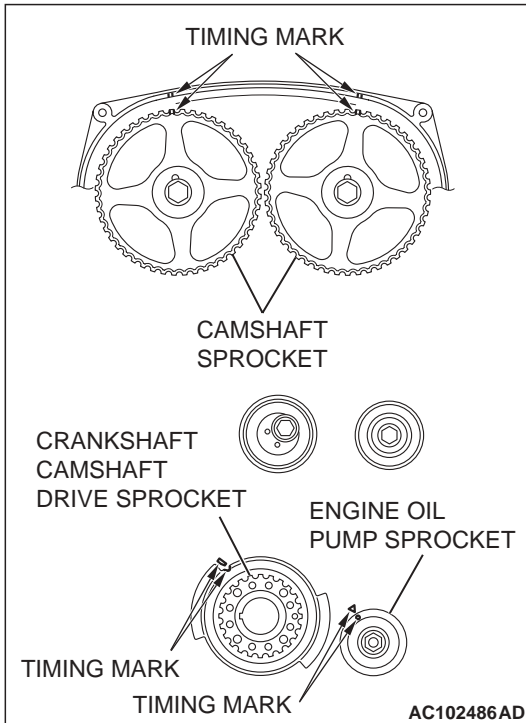
Temporarily tighten the timing belt tensioner pulley as shown.



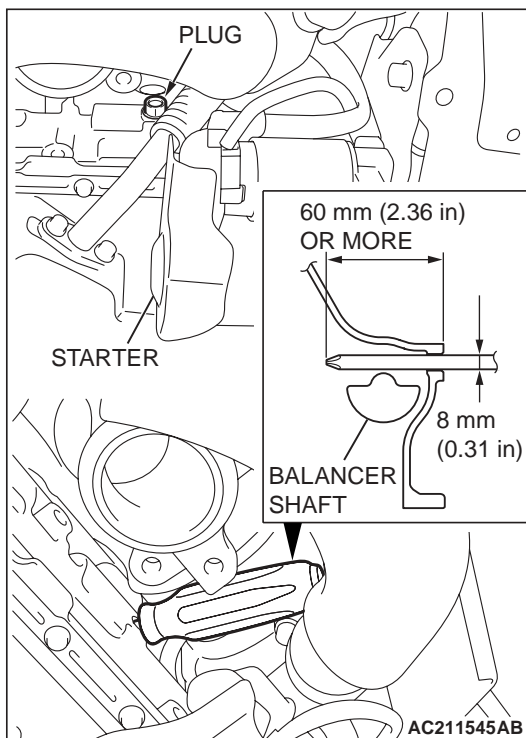


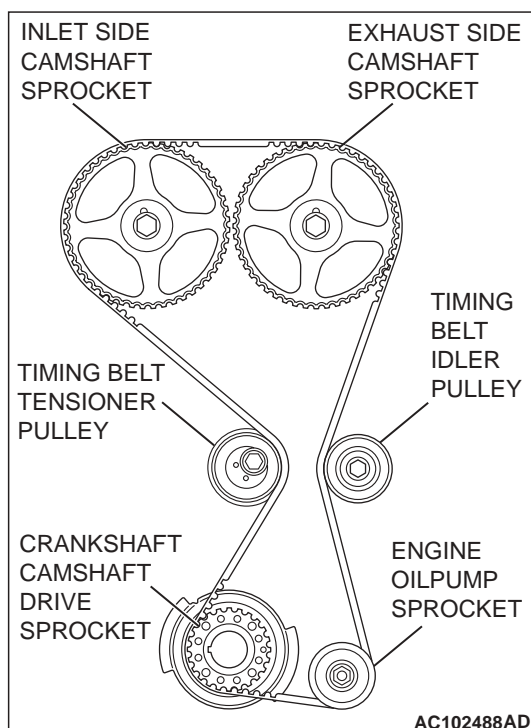
>>F<< VALVE TIMING BELT INSTALLATION

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

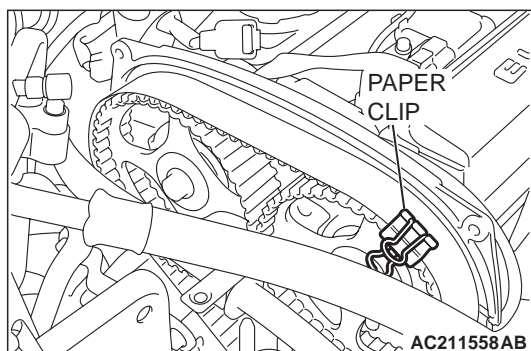


2. After aligning the timing marks of the engine oil pump sprocket, remove the cylinder block plug and insert a Phillips screw driver with a shaft diameter of 8 mm (0.31 inch) through the plug hole to check that the shaft of the screw driver can be inserted for 60 mm (2.36 inches) or more. If the screw 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 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:

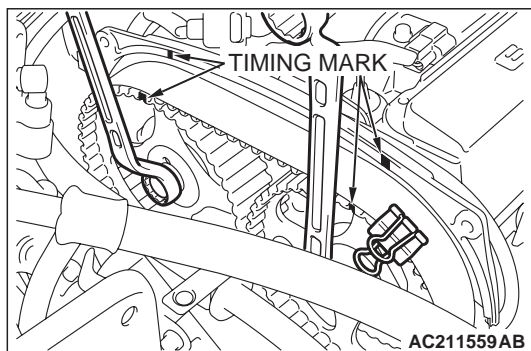




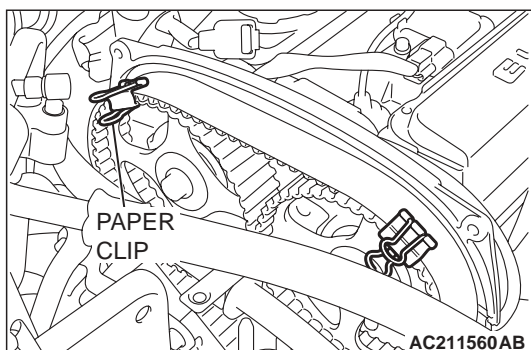
- (1) Pass the valve timing belt around the crankshaft camshaft drive sprocket, the engine oil pump sprocket and the timing belt idler pulley in that order.



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



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

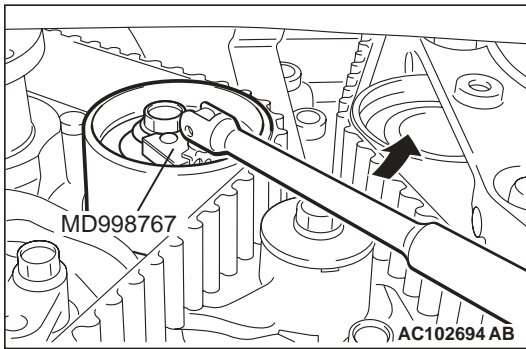


- (4) Hold the valve timing belt with paper clips.
- (5) Pass the valve timing belt around the timing belt tensioner pulley.

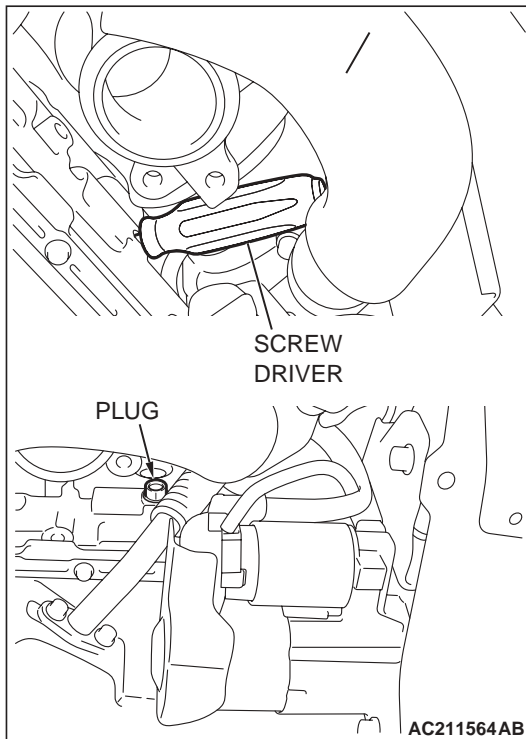
**⚠ CAUTION**

**Incorporate the valve timing belt. Then apply reverse rotation (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.**

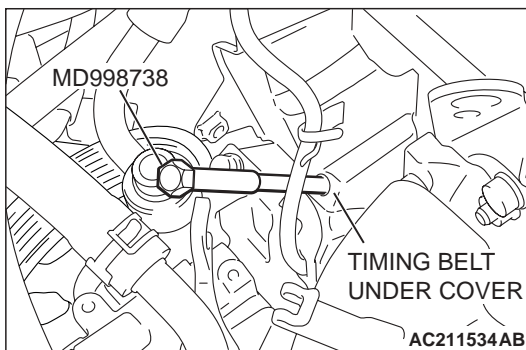
- (6) Remove the two paper clips.



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 ± 3 N·m (23 ± 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, since use of a spanner or other tools may damage the wire or pin inserted in the timing belt tensioner adjuster.**

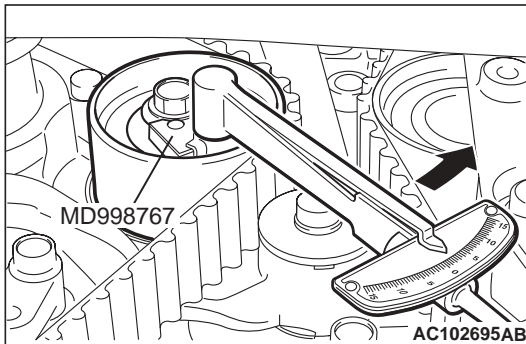
2. Gradually screw in special tool MD998738 until the wire or pin inserted in the timing belt tensioner adjuster lightly moves.
3. Turn the crankshaft 1/4 turn counterclockwise.
4. Turn the crankshaft in the clockwise direction until you align each timing mark to set number 1 cylinder to TDC of its compression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

**⚠ CAUTION**

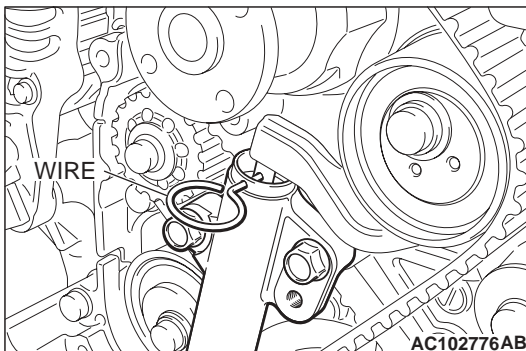
When tightening the mounting bolts, ensure that the timing belt tensioner pulley does not rotate with the bolts. Allowing it to rotate with the bolts can cause deficient tension of the belt.

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.

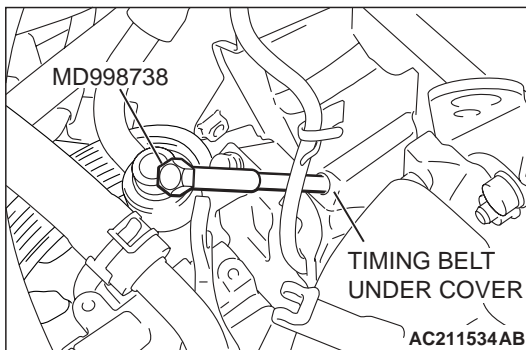
**Tightening torque: 48 ± 5 N·m (36 ± 3 ft-lb)**



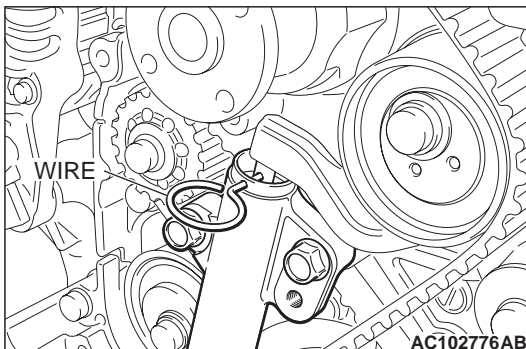
7. Remove wire or pin inserted to timing belt tensioner.

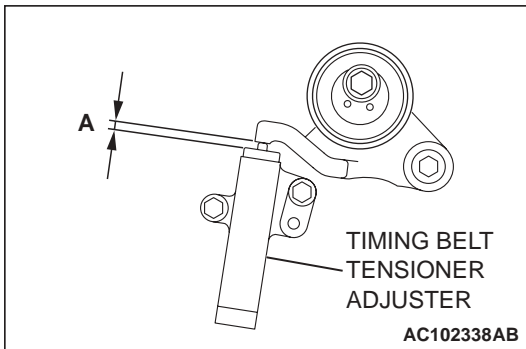


8. Remove the special tool MD998738, and install the rubber plug to the timing belt under cover.
9. Rotate the crankshaft clockwise two turns, and leave it for about 15 minutes.



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.





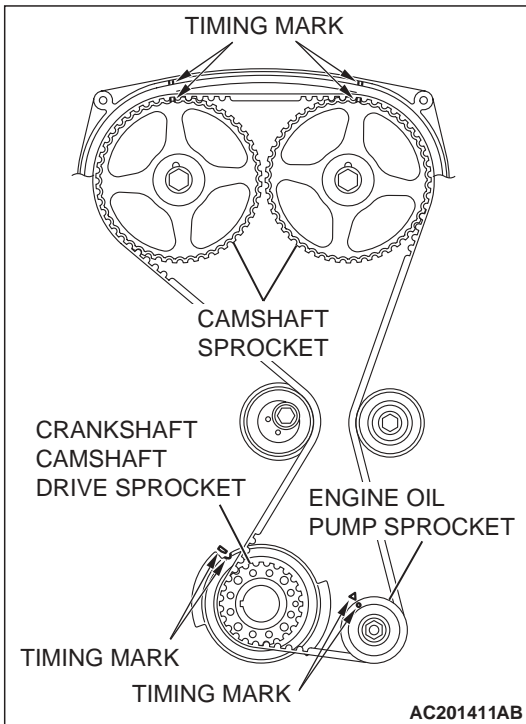
If the projection of timing belt tensioner adjuster rod is within the standard value, appropriate tension is applied.

**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 crack shaft pulley center bolt counterclockwise. Re-tighten if it is loose.**



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

**INSPECTION**

M1112004400299

**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.

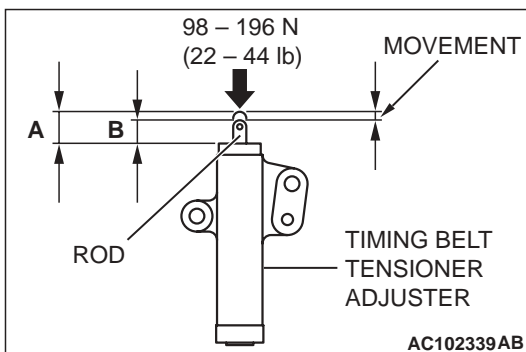
**Standard value: Within 1 mm (0.039 inch)**

**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.



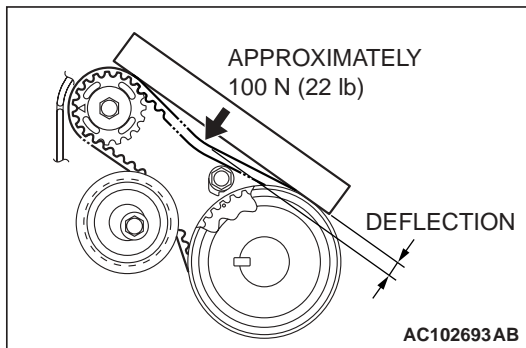
**BALANCER TIMING BELT TENSION CHECK**

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-50.](#))



## SPECIFICATIONS

### FASTENER TIGHTENING SPECIFICATIONS

M11111003800280

ITEM		SPECIFICATION
<b>Camshaft and valve stem seal</b>		
Camshaft bearing cap bolt		20 ± 1 N·m (14 ± 0.5 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		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)
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)
Vacuum pipe bracket 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>		
Cylinder head bolt <Cold engine>		78 ± 2 N·m → 0 N·m → 20 ± 2 N·m → +90° → +90° (58 ± 1 ft-lb → 0 in-lb → 15 ± 1 ft-lb → +90° → +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)
Fuel high-pressure hose bolt		5.0 ± 1.0 N·m (44 ± 9 in-lb)
Generator brace bolt		22 ± 4 N·m (16 ± 3 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 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)
Turbocharger bracket bolt		35 ± 6 N·m (26 ± 4 ft-lb)
<b>Engine assembly</b>		
Engine front mounting bracket and cushion stopper nut (flange nut, self locking)	M10	67 ± 7 N·m (50 ± 5 ft-lb)

ITEM		SPECIFICATION
Engine front mounting bracket 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)
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)



ITEM		SPECIFICATION
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**

M1111000300510

ITEM		STANDARD 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		850 ± 100	–
Compression pressure (250 r/min) kPa (psi)		1,128 (163)	Minimum 951 (138)
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**

M1111000500332

ITEM	SPECIFIED SEALANT
Camshaft end seal	Specified sealant: 3M™ AAD Part No. 8672, 3M™ AAD Part No. 8679/8678 or equivalent
Camshaft position sensor support	
Cylinder head	

# 11A-66

## ENGINE MECHANICAL SPECIFICATIONS

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ITEM	SPECIFIED SEALANT
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
Rocker cover gasket	