

GROUP 11C

ENGINE MECHANICAL <3.8L ENGINE>

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GENERAL DESCRIPTION

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

ITEMS			SPECIFICATIONS
Type			V type, overhead camshaft
Number of cylinders			6
Bore mm (in)			95.0 (3.74)
Stroke mm (in)			90.0 (3.54)
Total displacement cm ³ (cu. in)			3,828 (233.6)
Compression ratio			10.5
Firing order			1-2-3-4-5-6
Valve timing	Intake valve	Opens (BTDC)	-2° <Low speed cam A>
			0° <Low speed cam B>
			15° <High speed cam>
		Closes (ABDC)	50° <Low speed cam A>
			52° <Low speed cam B>
			69° <High speed cam>
Exhaust valve	Opens (BBDC)	57°	
	Closes (ATDC)	19°	
Lubrication system			Pressure feed, full-flow filtration
Oil pump type			Trochoid type

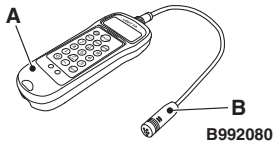
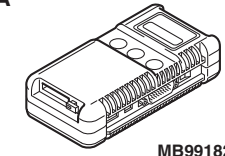
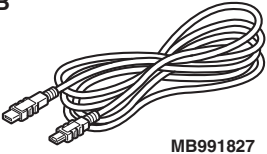
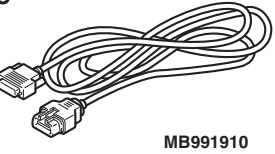
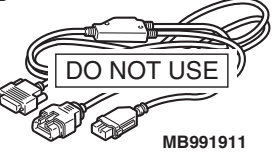
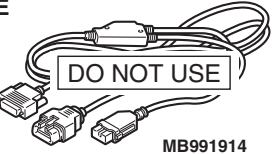
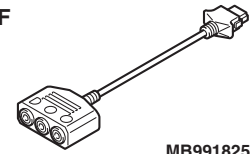
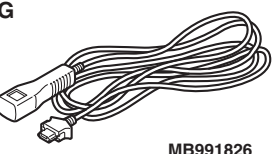
ENGINE DIAGNOSIS

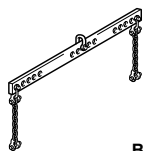
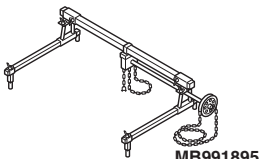
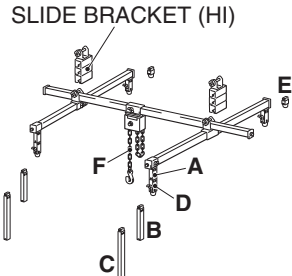
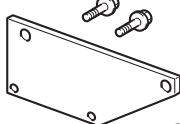
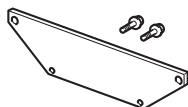
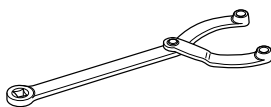
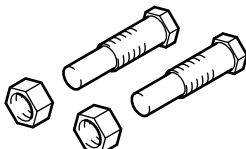
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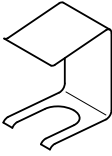
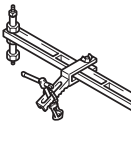
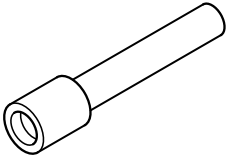
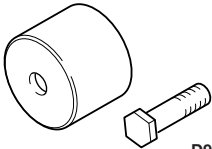
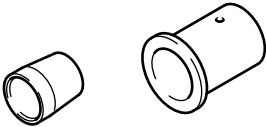
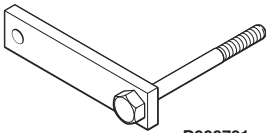
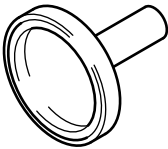
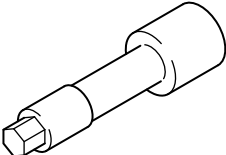
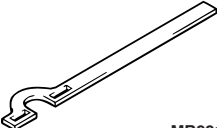
SYMPTOMS	PROBABLE CAUSE	REMEDY
Compression is too low	Blown cylinder head gasket	Replace the gasket.
	Worn or damaged piston rings	Replace the rings.
	Worn piston or cylinder	Repair or replace the piston and/or the cylinder block.
	Worn or damaged valve seat	Repair or replace the valve and/or the seat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

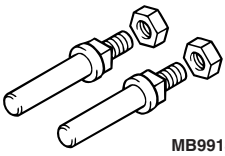
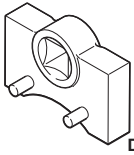
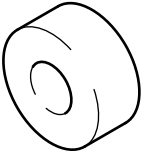
SPECIAL TOOLS

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TOOL	TOOL NUMBER AND NAME	SUPERSESSSION	APPLICATION
	MB992080 Belt tension meter set A: MB992081 Belt tension meter B: MB992082 Microphone assembly	Tool not available	Drive belt tension check
      	MB991958 Scan tool (M.U.T.-III sub assembly) A: MB991824 Vehicle communication interface (V.C.I.) B: MB991827 M.U.T.-III USB cable C: MB991910 M.U.T.-III main harness A (Vehicles with CAN communication system) D: MB991911 M.U.T.-III main harness B (Vehicles without CAN communication system) E: MB991914 M.U.T.-III main harness C (for Chrysler models only) F: MB991825 M.U.T.-III adapter harness G: MB991826 M.U.T.-III trigger harness	MB991824-KIT <i>NOTE: G: MB991826 M.U.T.-III Trigger Harness is not necessary when pushing V.C.I. ENTER key.</i>	<div style="border: 1px solid black; padding: 2px; display: inline-block;">CAUTION</div> For vehicles with CAN communication, use M.U.T.-III main harness A to send simulated vehicle speed. If you connect M.U.T.-III main harness B instead, the CAN communication does not function correctly. <ul style="list-style-type: none"> • Ignition timing check • Curb idle speed check • Idle mixture check • Erasing the diagnostic trouble code

TOOL	TOOL NUMBER AND NAME	SUPERSESION	APPLICATION
 B991454	MB991454 Engine hanger balancer	MZ203827-01	When the engine hanger is used: Supporting the engine assembly during removal and installation of the transaxle assembly <i>NOTE: Special tool MB991454 is a part of engine hanger attachment set MB991453.</i>
 MB991895	MB991895 Engine hanger	Tool not available	
 B991928	MB991928 Engine hanger A: MB991929 Joint (50) ×2 B: MB991930 Joint (90) ×2 C: MB991931 Joint (140) ×2 D: MB991932 Foot (standard) ×4 E: MB991933 Foot (short) ×2 F: MB991934 Chain and hook assembly	Tool not available	
 MB992012	MB992012 Engine hanger plate A	General service tool	Supporting the engine assembly tool
 MB992013	MB992013 Engine hanger plate B	General service tool	
 B990767	MB990767 Front hub and flange yoke holder	MB990767-01	Holding the camshaft sprocket
	MD998715 Crankshaft pulley holder pin	MIT308239	Holding the camshaft sprocket

TOOL	TOOL NUMBER AND NAME	SUPERSESSSION	APPLICATION
 D998443	MD998443 Auto-lash adjuster holder	MD998443-01	Holding the auto-lash adjuster
 AC204024	MD998772 Valve spring compressor	General service tool	Compressing valve spring
	MB991999 Valve stem seal installer	-	Valve stem seal installer
 D998713	MD998713 Camshaft oil seal installer	MD998713-01	Press-in of the camshaft oil seal
	MD998717 Crankshaft front oil seal installer	MD998717-01	Press-in of the crankshaft front oil seal
 D998781	MD998781 Flywheel stopper	General service tool	Securing the flywheel <M/T> or A/T drive plate <A/T>
	MD998718 Crankshaft rear oil seal installer	MD998718-01	Press-fitting the crankshaft rear oil seal
	MD998051 Cylinder head bolt wrench	MD998051-01 or General service tool	Cylinder head bolt removal and installation
 MB991800	MB991800 Pulley holder	MB991800-01	Holding the crankshaft pulley

TOOL	TOOL NUMBER AND NAME	SUPERSESION	APPLICATION
	MB991802 Pin B	MB991802-01	Holding the crankshaft pulley
	MD998767 Tension pulley socket wrench	MD998752-01	Timing belt tension adjustment
	MD998769 Crankshaft pulley spacer	General service tool	Rotating the crankshaft when installing the timing belt

ON-VEHICLE SERVICE

DRIVE BELT (FOR GENERATOR, POWER STEERING OIL PUMP AND AIR CONDITIONING) TENSION CHECK AND ADJUSTMENT

M1111003102447

GENERATOR DRIVE BELT TENSION CHECK

CAUTION

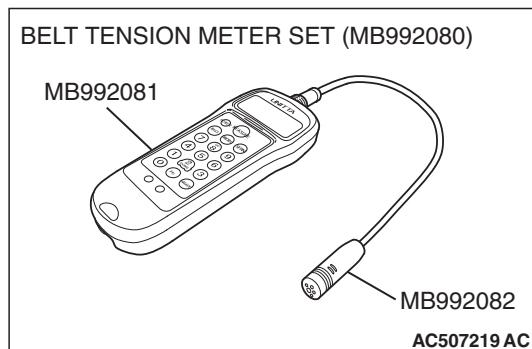
- When checking the drive belt tension, make sure that the engine is cold.
- Check the drive belt tension after turning the crankshaft clockwise one turn or more.

<WHEN USING SPECIAL TOOL MB992080: RECOMMENDATION>

Required Special Tools:

- MB992080: Belt tension meter set
 - MB992081: Belt tension meter
 - MB992082: Microphone assembly

1. Connect the special tool MB992082 to the special tool MB992081 of the Special tool MB992080.
2. Press the "POWER" button to turn on the power supply.
3. Press the numeral key of "1" and check that "No.1" appears on the upper left of the display and that the following numeric values are displayed for individual items (M, W, and S):
 - M 000.9 g/m
 - W 010.0 mm/R
 - S 0100 mm



If numeric values have not been entered (new tool), set them according to the belt specifications as shown below. Once you set them, you do not have to set them again. The settings remain undeleted even after battery replacement.

NOTE: This operation is to temporarily set the preset data such as the belt specifications, because if the measurement is taken without input of the belt specifications, conversion to tension value (N) cannot be made, resulting in judgement of error.

<Setting procedure>

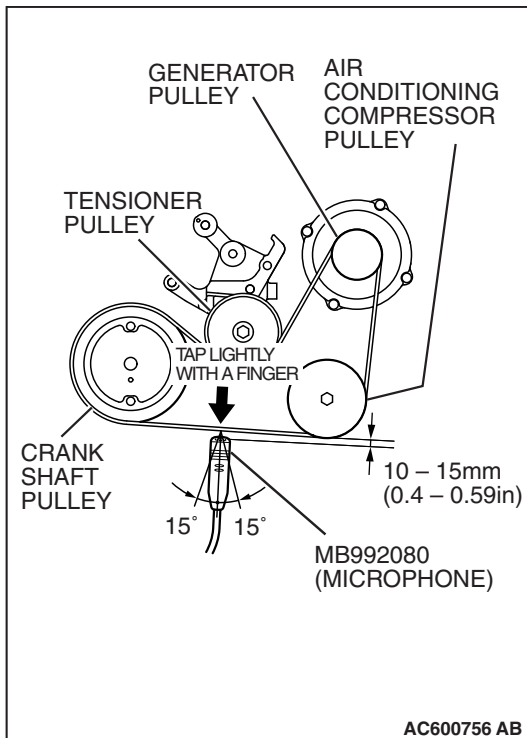
- (1) Press down the "MASS" button till the belt mass select display appears.
 - (2) Press the "UP" or "DOWN" button to select "01 1.5GT 0.9" and press the "MEASURE" button to decide it. Check to ensure that "M 000.9 g/m" is displayed.
 - (3) Press the "WIDTH" button to change to the belt width input display.
 - (4) Press number keys 0, 1, 0, and 0 sequentially, and press the "SELECT" button to apply them. Check to ensure that "W 010.0 mm/R" appears on the display.
 - (5) Press the "SPAN" button to change to the span length input display.
 - (6) Press number keys 0, 1, 0, and 0 sequentially, and press the "SELECT" button to apply them. Check to ensure that "S 0100 mm" appears on the display.
4. Press "Hz" button twice to change the display to the frequency display (Hz).

⚠ CAUTION

- 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 MB992080 to the middle of the drive belt between the pulleys (at the place indicated by arrow), approximately 10 – 15 mm (0.4 – 0.59 inch) away from the rear surface of the belt so that it is perpendicular to the belt (within an angle of ± 15 degree).
6. Press the "MEASURE" button.
7. 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.

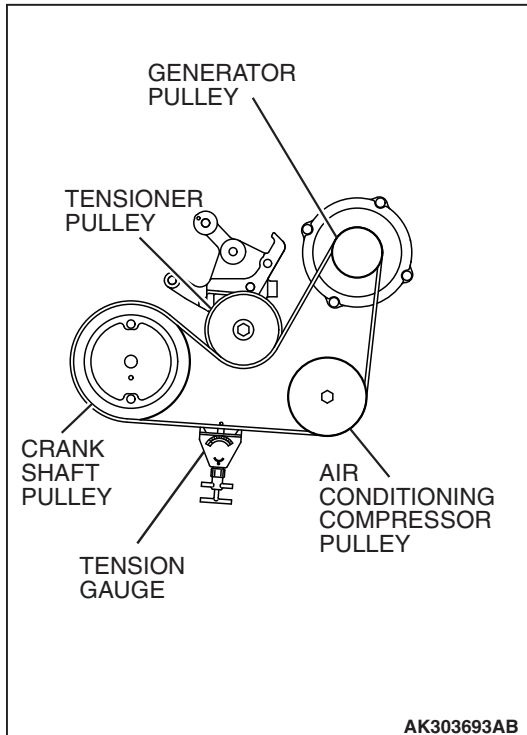
Standard value: 143 – 169 Hz



<WHEN USING THE TENSION GAUGE>

Use a belt tension gauge to check that the belt tension is within the standard value.

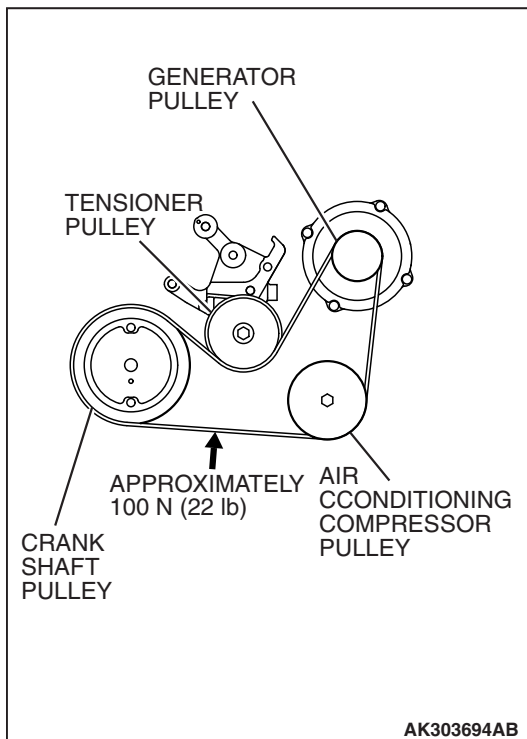
Standard value: 490 – 686 N (110 – 154 pounds)



<BELT DEFLECTION CHECK>

Apply approximately 100 N (22 pounds) of force to the middle of the drive belt between the pulleys (at the place indicated by the arrow) and check that the amount of deflection is within the standard value.

Standard value: 8.4 – 10.7 mm (0.33 – 0.42 inch)



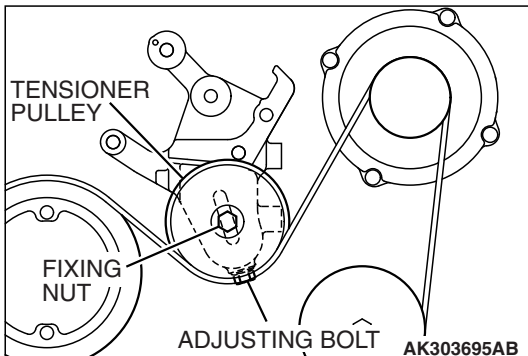
**GENERATOR DRIVE BELT TENSION
ADJUSTMENT**

If the vibration frequency, tension or deflection is outside the standard value, adjust by the following procedure.

1. Loosen the tensioner pulley fixing nut.
2. With the tensioner pulley fixing nut temporarily tightened to 15 ± 5 N·m (11 ± 4 ft-lb), set the belt tension or deflection amount to the standard value using the adjusting bolt.

Standard value:

ITEM	DURING ADJUSTMENT	DURING REPLACEMENT
Vibration frequency Hz	150 – 163	180– 202
Tension N (lb)	539 – 637 (121 – 143)	785 – 981 (176 – 221)
Deflection (Reference) mm (in)	8.9 – 10.1 (0.35 – 0.40)	6.2 – 7.5 (0.24 – 0.30)



3. Tighten the tension pulley fixing nut.

Tightening torque: 49 ± 10 N·m (36 ± 7 ft-lb)

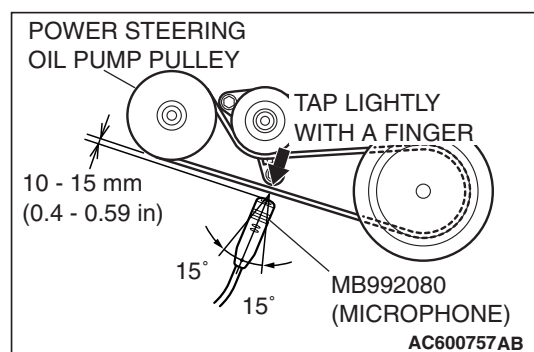
4. When the belt tension is adjusted by measuring the belt deflection, adjust it with a tool for vibration frequency measurement or tension measurement afterward.

**POWER STEERING DRIVE BELT TENSION
CHECK****⚠ CAUTION**

- When checking the drive belt tension, make sure that the engine is cold.
- Check the drive belt tension after turning the crankshaft clockwise one turn or more.

**<WHEN USING SPECIAL TOOL MB992080:
RECOMMENDATION>****Required Special Tools:**

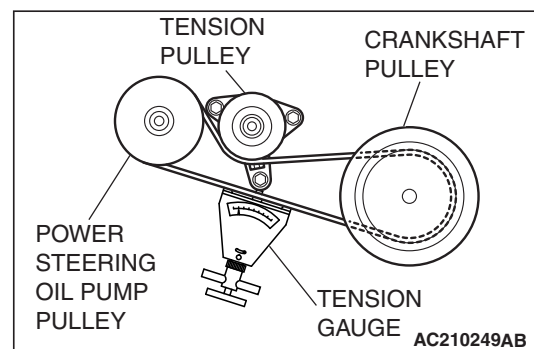
- MB992080: Belt tension meter set
 - MB992081: Belt tension meter
 - MB992082: Microphone assembly



With your finger tip lightly tap the center of the drive belt between the pulleys in the location shown by the arrow in the illustration and then measure the belt vibration frequency.

Standard value: 124 – 160 Hz

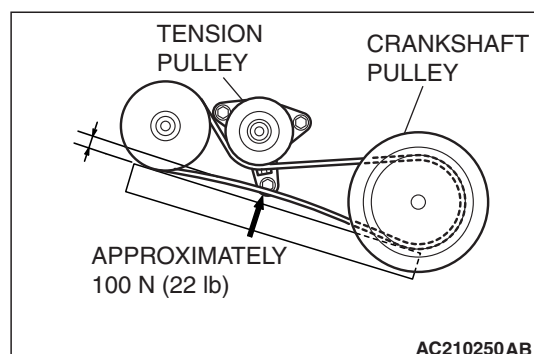
NOTE: Refer to generator drive belt tension check, for information regarding the vibration frequency measurement method using special tool MB992080.



<WHEN USING A TENSION GAUGE>

Use a belt tension gauge to check that the belt tension is within the standard value.

Standard value: 294 – 490 N (66 – 110 pounds)



<BELT DEFLECTION CHECK>

Apply approximately 100 N (22 pounds) of force to the middle of the drive belt between the pulleys (at the place indicated by the arrow) and check that the amount of deflection is within the standard value.

Standard value: 12.3 – 16.2 mm (0.48 – 0.64 inch)

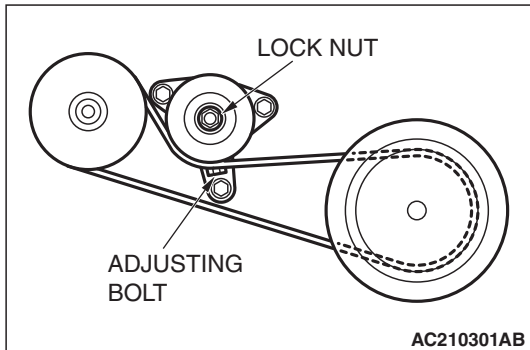
**POWER STEERING DRIVE BELT TENSION
ADJUSTMENT**

If the vibration frequency, tension or deflection is outside the standard value, adjust by the following procedure.

1. Loosen the tensioner pulley lock nut.
2. Adjust the belt tension to the standard value by turning the adjusting bolt. The tension will increase when turning the adjusting bolt clockwise, and decrease when turning counterclockwise.

Standard value:

ITEM	DURING ADJUSTMENT	DURING REPLACEMENT
Vibration frequency Hz	134 – 151	160 – 189
Tension N (lb)	343 – 441 (77 – 99)	490 – 686 (110 – 154)
Deflection (Reference) mm (in)	13.2 – 15.1 (0.52 – 0.59)	9.6 – 12.3 (0.38 – 0.48)



3. Tighten the lock nut to the specified torque.

Tightening torque: 49 ± 9 N·m (36 ± 7 ft-lb)

4. Tighten the adjusting bolt.

Tightening torque: 5.0 ± 1.0 N·m (44 ± 9 in-lb)

⚠ CAUTION

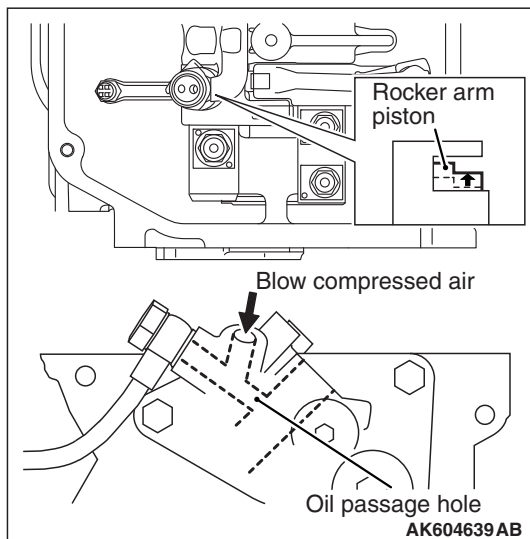
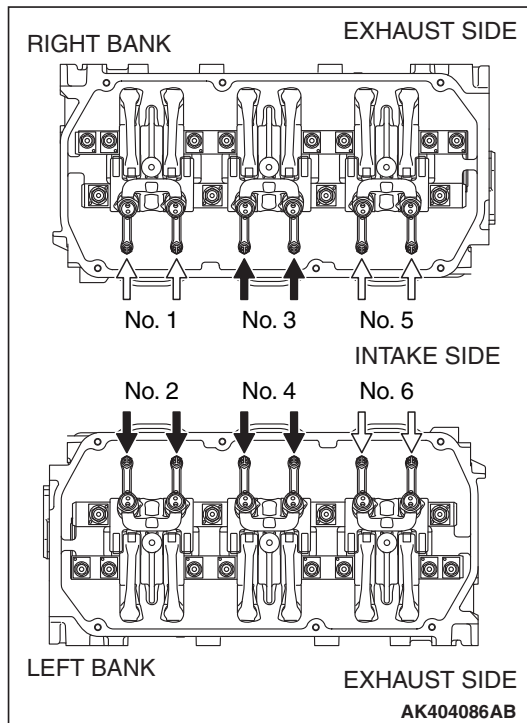
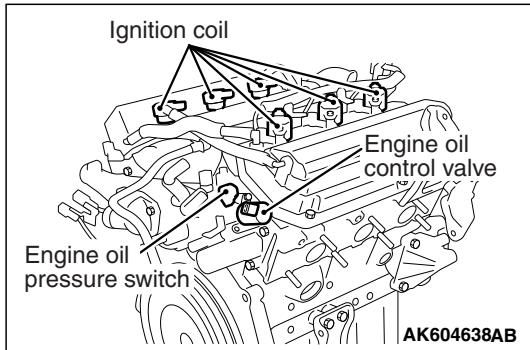
Check after turning the crankshaft one or more rotations clockwise.

5. Check the belt vibration frequency, tension or deflection amount, and readjust if necessary.
6. When the belt tension is adjusted by measuring the belt deflection, adjust it with a tool for vibration frequency measurement or tension measurement afterward.

VALVE CLEARANCE CHECK AND ADJUSTMENT

M1111001501543

Refer to GROUP00, General – Maintenance service – Intake And Exhaust Valve Clearance (Inspect And Adjust) [P.00-52](#).



ROCKER ARM PISTON OPERATION CHECK <INTAKE SIDE>

M1111051000249

1. Remove all of the ignition coils.
2. Remove the rocker cover.
3. Remove the engine oil control valve.
4. Remove the engine oil pressure switch.
5. Turn the crankshaft clockwise until the notch on the crankshaft pulley is lined up with the "T" mark on the lower cover of timing belt.
6. Move the rocker arms on the No.1 and No.4 cylinders up and down by hand to determine which cylinder has its piston at the top dead center on the compression stroke.

NOTE: The rocker arm piston operation check can be performed on rocker arms indicated by white arrow mark when the No. 1 cylinder piston is at the top dead center on the compression stroke, and on rocker arms indicated by black arrow mark when the No. 4 cylinder piston is at the top dead center on the compression stroke.

7. While shutting up the oil passage hole at the depth of the engine oil control valve's installation hole by finger not to leak air, blow compressed air into the engine oil pressure switch's installation hole by air blowgun. At this time, confirm that the rocker arm piston can operate.

NOTE: To fully confirm the check, prevent the compression air from leaking as much as possible by bind vinyl tape to the end of air blowgun. The compression air pressure is required more than 620 kPa (90 psi).

8. Turn the crankshaft clockwise until the notch on the crankshaft pulley is lined up with the "T" mark on the lower cover of timing belt.
9. Confirm the rest of the rocker arm pistons under the procedure 7.
10. When the rocker arm piston does not operate, replace the rocker arm assy.

11. Install the engine oil pressure switch and the engine oil control valve. (Refer to Camshaft and Valve Stem Seal – Removal and Installation P.11C-34.)
12. Install the rocker cover.
13. Install all of the ignition coils.

IGNITION TIMING CHECK

M1111001702807

Required Special Tool:

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

- MB991824: V.C.I.
- MB991827: M.U.T.-III USB Cable
- MB991910: M.U.T.-III Main Harness A

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

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

⚠ CAUTION

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

2. Turn the ignition switch to the "LOCK" (OFF) position and connect the scan tool MB991958 to the data link connector.
3. Set a timing light to the terminal No. 1 power supply line (black-yellow) of the ignition coil No. 4.

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

4. Start the engine and run it at idle.
5. Check that the idle speed is approximately 680 r/min.
6. Select the scan tool MB991958 actuator test "item number 11".
7. Check that basic ignition timing is within the standard value.

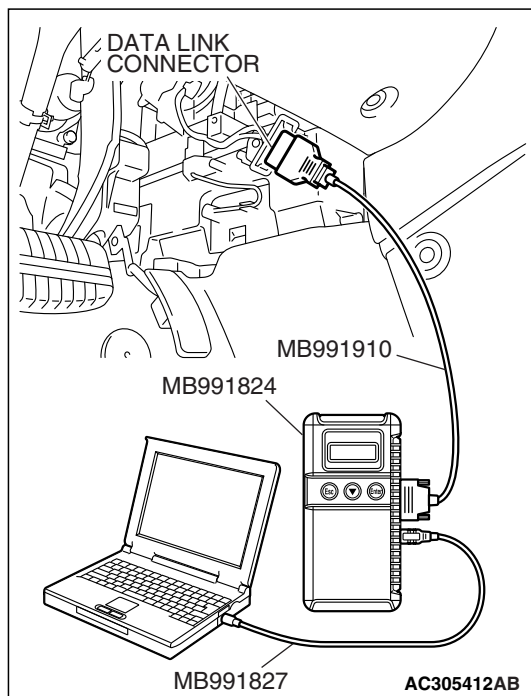
Standard value: 5° BTDC ± 3°

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

⚠ CAUTION

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

9. Cancel the setting mode of the scan tool MB991958.



10. Check that the actual ignition timing is at the standard value.

Standard value: Approximately 10° BTDC

NOTE: Ignition timing fluctuates about $\pm 7^\circ$, even under normal operating condition.

NOTE: It is automatically further advanced by about 5° from 10° Before Top Dead Center at higher altitudes.

NOTE: Wait till approximately 1 minute passes after the engine started, and check the ignition timing when the engine stabilized.

11. Remove the timing light.

12. Turn the ignition switch to the "LOCK" (OFF) position and disconnect the scan tool MB991958 from the data link connector.

CURB IDLE SPEED CHECK

M1111003502843

Required Special Tool:

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

- MB991824: V.C.I.
- MB991827: M.U.T.-III USB Cable
- MB991910: M.U.T.-III Main Harness A

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

- Engine coolant temperature: 80 – 95°C (176 – 203°F)
- Lights and all accessories: OFF
- Transmission: Neutral (P range on vehicle with A/T)

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

CAUTION

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

2. Turn the ignition switch to the "LOCK" (OFF) position and connect the scan tool MB991958 to the data link connector.

3. Set a timing light to the terminal No. 1 power supply line (black-yellow) of the ignition coil No. 4.

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

4. Start the engine.

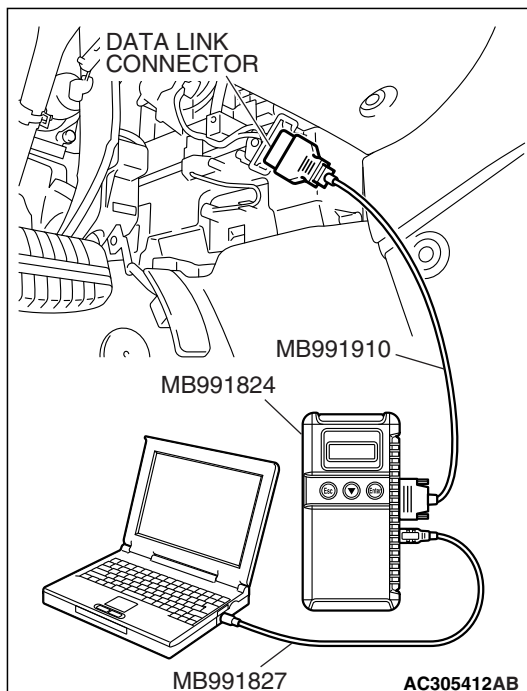
5. Run the engine at idle for 2 minutes.

6. Check the actual ignition timing.

Standard value: Approximately 10° BTDC

NOTE: ignition timing fluctuates $\pm 7^\circ$, even under normal operating condition.

NOTE: It is automatically further advanced by about 5° from 10° Before Top Dead Center at higher altitudes.



7. Check the idle speed. Select item number 2 and take a reading of the idle speed.

Curb idle speed: 680 ± 100 r/min

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

8. If the idle speed is outside the standard value, refer to GROUP 13B, Multiport Fuel Injection (MFI) <3.8L Engine> – Multiport Fuel Injection (MFI) Diagnosis – Symptom Chart [P.13B-49](#).
9. Remove the timing light.
10. Turn the ignition switch to the "LOCK" (OFF) position and disconnect the scan tool MB991958 from the data link connector.

IDLE MIXTURE CHECK

M1111002101571

Required Special Tool:

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

- MB991824: V.C.I.
- MB991827: M.U.T.-III USB Cable
- MB991910: M.U.T.-III Main Harness A

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

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

⚠ CAUTION

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

2. Turn the ignition switch to the "LOCK" (OFF) position and connect the scan tool MB991958 to the data link connector.
3. Start the engine and increase the engine speed to 2,500 r/min for 2 minutes.
4. Check that the actual ignition timing is within the standard value.

Standard value: Approximately 10 ° BTDC

NOTE: ignition timing fluctuates ±7°, even under normal operating condition.

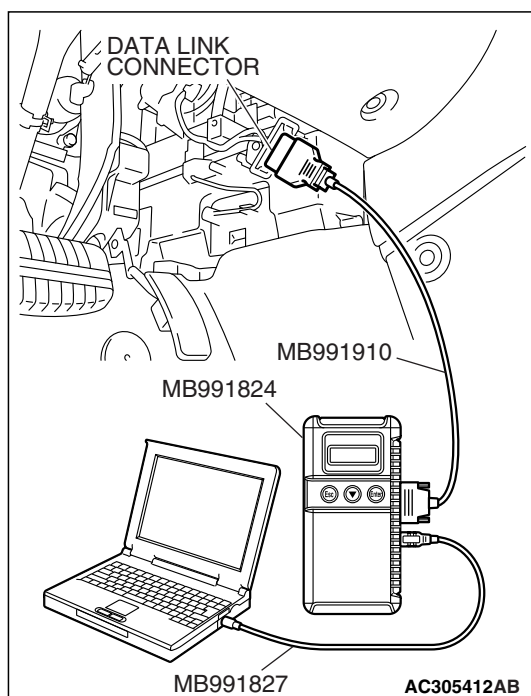
NOTE: It is automatically further advanced by about 5° from 10° Before Top Dead Center at higher altitudes.

5. Set a CO, HC tester.
6. Check the CO contents and the HC contents at idle.

Standard value:

CO contents: 0.5% or less

HC contents: 100 ppm or less



7. If the CO and HC contents do not remain inside the standard value, refer to GROUP 13B, Multiport Fuel Injection (MFI) <3.8L Engine> – Multiport Fuel Injection (MFI) Diagnosis – Symptom Chart [P.13B-49](#).
8. Remove the timing light and CO, HC tester.
9. Turn the ignition switch to the "LOCK" (OFF) position and disconnect the scan tool MB991958 from the data link connector.

COMPRESSION PRESSURE CHECK

M1111002602405

Required Special Tool:

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

- MB991824: V.C.I.
- MB991827: M.U.T.-III USB Cable
- MB991910: M.U.T.-III Main Harness A

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

- Engine coolant temperature: 80 – 95°C (176 – 203°F)
- Lights and all accessories: OFF
- Transmission: Neutral (P range on vehicle with A/T)

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

2. Turn the ignition switch to the "LOCK" (OFF) position.
3. Remove all of the ignition coils and spark plugs.
4. Disconnect the crankshaft position sensor connector.

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

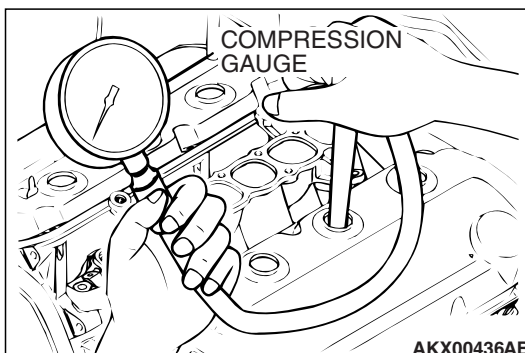
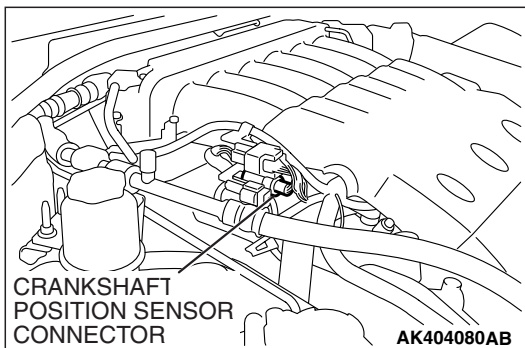
WARNING

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 hole with a shop towel etc., during cranking. After the engine has been cranked, check for foreign material adhering to the shop towel.
6. Set compression gauge to one of the spark plug holes.
7. Crank the engine and measure the compression pressure.

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

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

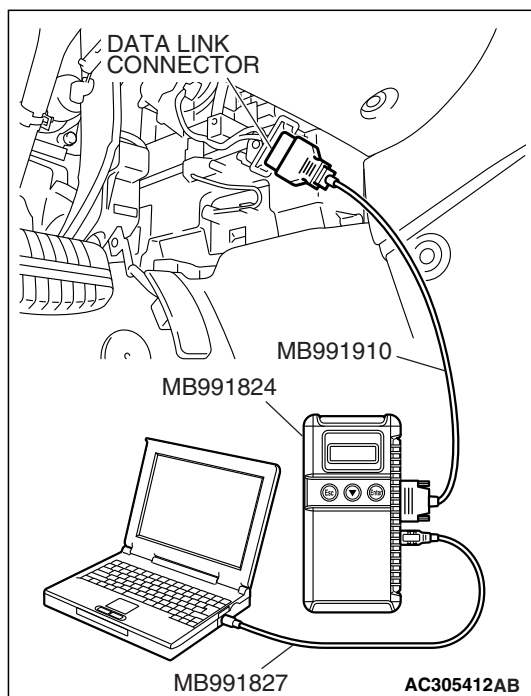


8. Measure the compression pressure for all the cylinders, and check that the pressure differences of the cylinders are below the limit.

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 ignition coils.
12. Use the scan tool MB991958 to erase the diagnostic trouble codes.

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



MANIFOLD VACUUM CHECK

M1111002702208

Required Special Tool:

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

- MB991824: V.C.I.
- MB991827: M.U.T.-III USB Cable
- MB991910: M.U.T.-III Main Harness A

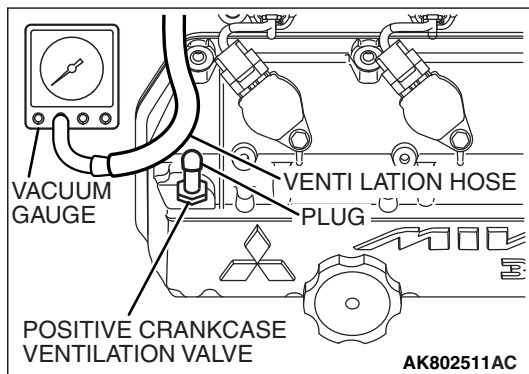
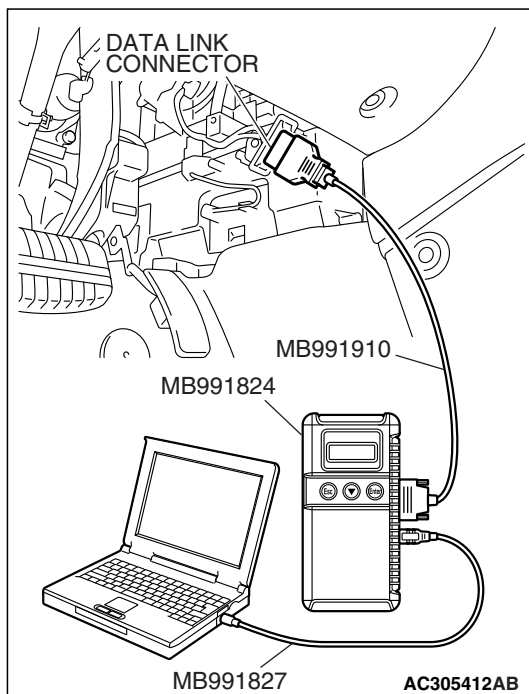
1. Before inspection, set the vehicle in the following condition:
 - Engine coolant temperature: 80 – 95°C (176 – 203°F)
 - Lights and all accessories: OFF
 - Transaxle: Neutral (P range on vehicles with A/T)

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

CAUTION

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

2. Turn the ignition switch to the "LOCK" (OFF) position and connect the scan tool MB991958 to the data link connector.



3. Disconnect the ventilation hose from the positive crankcase ventilation (PCV) valve, and then connect a vacuum gauge to the ventilation hose. Plug the PCV valve.
4. Start the engine and check that idle speed is approximately 700 r/min.
5. Check the intake manifold vacuum.
Limit: Minimum 60 kPa (18 in Hg)
6. Turn the ignition switch to the "LOCK" (OFF) position.
7. Remove the vacuum gauge and then connect the ventilation hose to the PCV valve.
8. Disconnect scan tool MB991958 from the data link connector.

LASH ADJUSTER CHECK <EXHAUST SIDE>

M1111002901005

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

NOTE: The lash adjuster is installed in exhaust side only.

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

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

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

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

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

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

1. Start the engine.
2. Check if the abnormal noise produced immediately after starting the engine, changes with the change in the engine speed.

If the abnormal noise is not produced immediately after starting the engine or it does not change with the engine speed, the lash adjuster is not the cause for the noise.

Therefore, investigate other causes. The abnormal noise is probably caused by some other parts than the engine proper if it does not change with the engine speed. (In this case, the lash adjuster is in good condition.)

3. With the engine idling, change the engine load (shift from N to D range, for example) to make sure that there is no change in the level of abnormal noise.

If there is a change in the level of abnormal noise, suspect a tapping noise due to worn crankshaft bearing or connecting rod bearing (In this case, the lash adjuster is in good condition.).

4. After completion of warm-up, run the engine at idle to check for abnormal noise.
If the noise is reduced or disappears, clean the lash adjuster (Refer to GROUP 11D, Engine Overhaul <3.8L Engine> – Rocker Arms and Camshaft – Inspection [P.11D-38](#)). As it is suspected that the noise is due to seizure of the lash adjuster. If there is no change in the level of the abnormal noise, proceed to step 5.
5. Run the engine to bleed the lash adjuster system (Refer to [P.11C-22](#)).
6. If the abnormal noise does not disappear after air bleeding operation, clean the lash adjuster (Refer to GROUP 11D, Engine Overhaul <3.8L Engine> – Rocker Arms and Camshaft – Inspection [P.11D-38](#)).

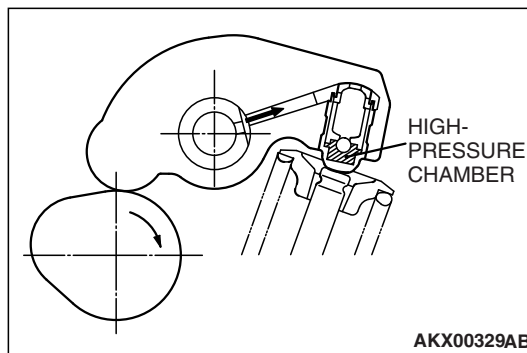
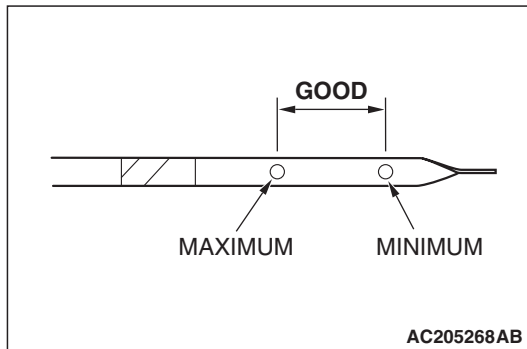
Bleeding lash adjuster system

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

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

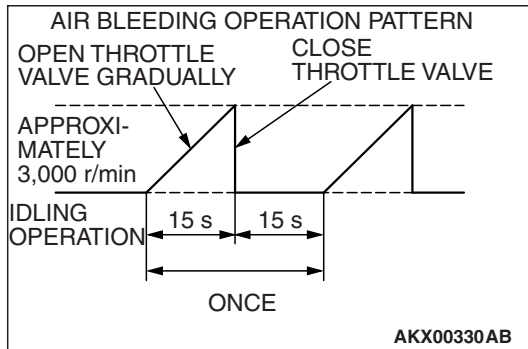
NOTE: If the engine oil level is higher than specification, oil may be stirred by the crankshaft, causing oil to be mixed with a large quantity of air.

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



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

2. Idle the engine for one to three minutes to warm it up.



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

ENGINE ASSEMBLY

REMOVAL AND INSTALLATION

M1112001003815

⚠ CAUTION

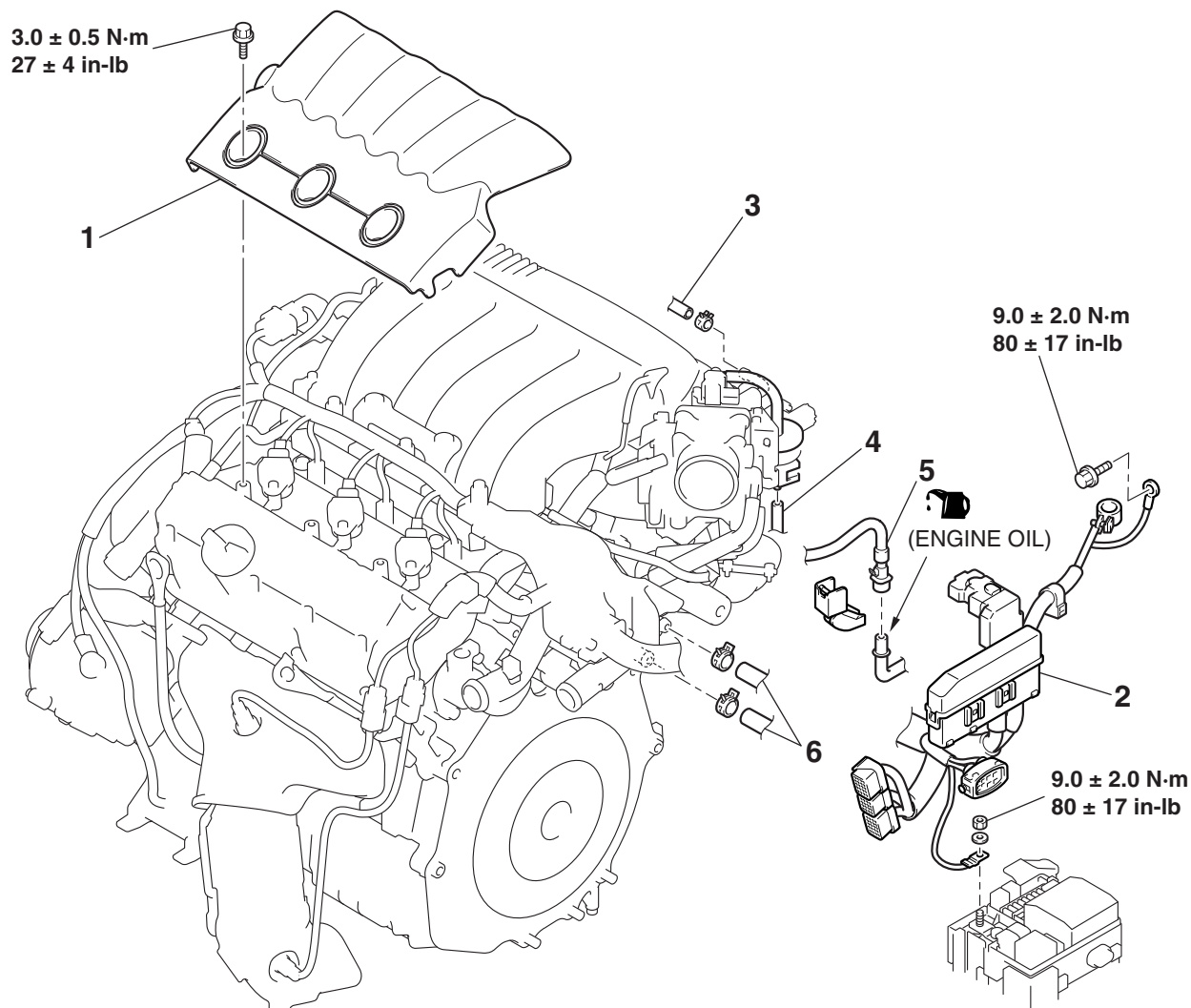
- When the engine assembly replacement is performed, use scan tool MB991958 to initialize the learning value (Refer to GROUP 00, Initialization Procedure for Learning Value in MFI Engine [P.00-30](#)).
- *: indicates parts which should be temporarily tightened, and then fully tightened with the engine weight applied on the vehicle body.

Pre-removal Operation

- Under Cover Removal (Refer to GROUP 51, Under Cover [P.51-8](#)).
- Fuel Line Pressure Reduction [Refer to GROUP 13B, On-vehicle Service – Fuel Pump Relay Disconnection (How to Reduce Pressurized Fuel Lines) [P.13B-1278](#)].
- Engine Coolant Draining (Refer to GROUP 14, On-vehicle Service – Engine Coolant Replacement [P.14-22](#)).
- Engine Oil Draining (Refer to GROUP 12, On-vehicle Service – Engine Oil Replacement [P.12-3](#)).
- Hood Removal (Refer to GROUP 42, Hood [P.42-9](#)).
- ECM <M/T> or PCM <A/T> Removal (Refer to GROUP 13B, Engine Control Module (ECM) and Powertrain Control Module (PCM) [P.13B-1291](#)).
- Air Cleaner Removal (Refer to GROUP 15, Air Cleaner [P.15-5](#)).
- Front Exhaust Pipe Removal (Refer to GROUP 15, Exhaust Pipe and Main Muffler [P.15-26](#)).
- Strut Tower Bar Removal (Refer to GROUP 42, Strut Tower Bar [P.42-14](#)).
- Battery, Battery Tray and Battery Bracket Removal

Post-installation Operation

- Right Bank Exhaust Manifold Installation (Refer to GROUP 15, Exhaust Manifold [P.15-20](#)).
- Battery, Battery Tray and Battery Bracket Installation
- Strut Tower Bar Installation (Refer to GROUP 42, Strut Tower Bar [P.42-14](#)).
- Front Exhaust Pipe Installation (Refer to GROUP 15, Exhaust Pipe and Main Muffler [P.15-26](#)).
- Air Cleaner Installation (Refer to GROUP 15, Air Cleaner [P.15-5](#)).
- ECM <M/T> or PCM <A/T> Installation (Refer to GROUP 13B, Engine Control Module (ECM) and Powertrain Control Module (PCM) [P.13B-1291](#)).
- Hood Installation (Refer to GROUP 42, Hood [P.42-9](#)).
- Drive Belt Tension Check and Adjustment (Refer to [P.11C-7](#)).
- 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.14-22](#)).
- Fuel Leak Check
- Under Cover Installation (Refer to GROUP 51, Under Cover [P.51-8](#)).



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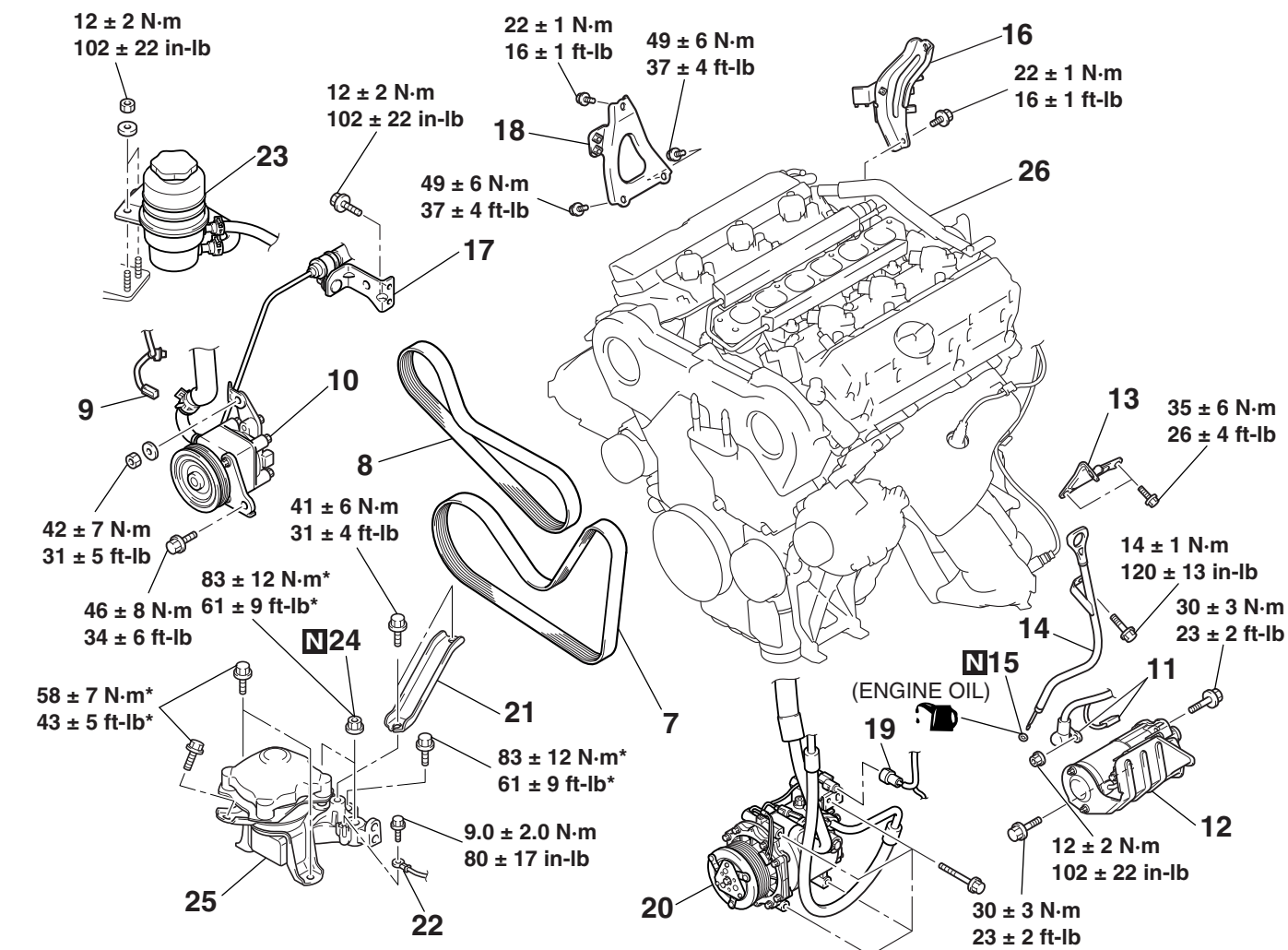
REMOVAL STEPS

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

<<A>> >>C<<

REMOVAL STEPS (Continued)

- DRIVE SHAFT (REFER TO GROUP 26, DRIVE SHAFT ASSEMBLY [P.26-14](#)).
- EXHAUST MANIFOLD (RIGHT BANK) (REFER TO GROUP 15, EXHAUST MANIFOLD [P.15-20](#)).
- RADIATOR (REFER TO GROUP 14, RADIATOR [P.14-26](#)).



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- | | | | | |
|-------|---|-------|----------------------|--|
| | • INTAKE MANIFOLD PLENUM (REFER TO GROUP 15, INTAKE MANIFOLD PLENUM P.15-7). | <<E>> | | 17. POWER STEERING PRESSURE HOSE CLAMP BRACKET |
| | 7. GENERATOR DRIVE BELT | <<F>> | | 18. INTAKE MANIFOLD PLENUM STAY (REAR) |
| | 8. POWER STEERING OIL PUMP DRIVE BELT | | • TRANSAXLE ASSEMBLY | |
| | 9. POWER STEERING PRESSURE SWITCH CONNECTOR | <<G>> | | 19. A/C COMPRESSOR ASSEMBLY CONNECTOR |
| <<D>> | 10. POWER STEERING OIL PUMP | | | 20. A/C COMPRESSOR ASSEMBLY |
| | 11. STARTER CONNECTOR AND TERMINAL | | | 21. ENGINE MOUNTING STAY |
| <<E>> | 12. STARTER ASSEMBLY | | | 22. GROUNDING CABLE CONNECTION |
| <<E>> | 13. ENGINE HANGER | | | 23. POWER STEERING OIL RESERVOIR |
| | 14. ENGINE OIL DIPSTICK ASSEMBLY | <<H>> | >>B<< | 24. SELF-LOCKING NUTS |
| | 15. O-RING | | | 25. ENGINE FRONT MOUNTING BRACKET |
| <<E>> | 16. THROTTLE BODY STAY | <<I>> | >>A<< | 26. ENGINE ASSEMBLY |

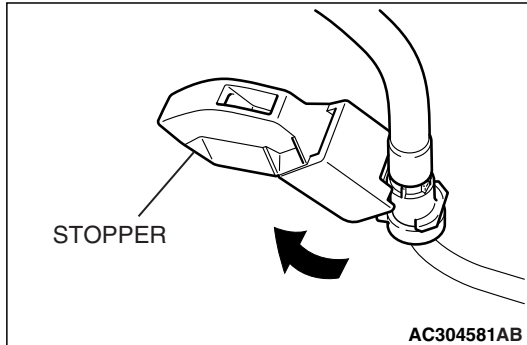
Required Special Tools:

- MB991454: Engine Hanger Balancer
- MB991895: Engine Hanger
- MB991928: Engine Hanger
- MB992012: Engine Hanger Plate A
- MB992013: Engine Hanger Plate B

REMOVAL SERVICE POINTS

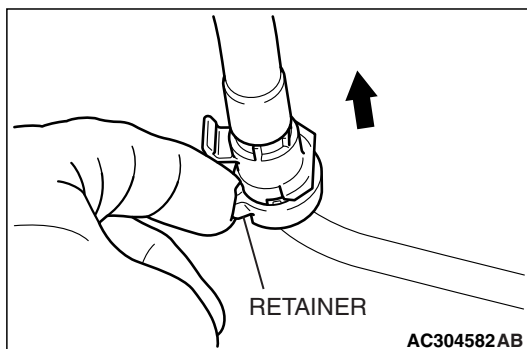
<<A>> FUEL HIGH-PRESSURE HOSE DISCONNECTION

1. Remove the fuel high-pressure hose stopper.



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

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

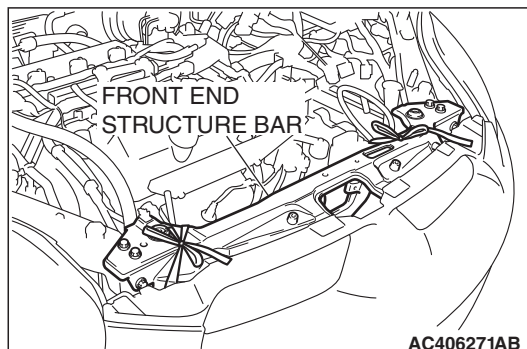


<> EXHAUST MANIFOLD (RIGHT BANK) REMOVAL

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

<<C>> RADIATOR REMOVAL

Secure the A/C condenser and front end structure bar with a cord in a location where it does not interfere engine assembly removal.

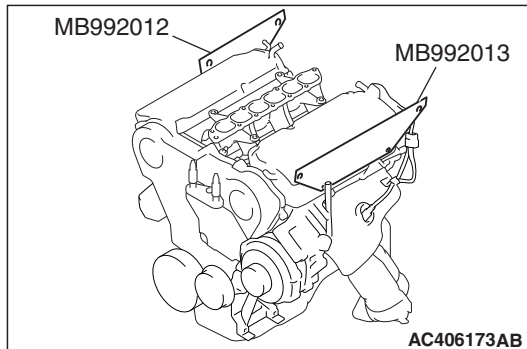


<<D>> POWER STEERING OIL PUMP REMOVAL

1. Remove the power steering oil pump from the engine with the hose attached.
2. Place the removed power steering oil pump in a place where it will not interfere when removing and installing the engine assembly, and secure it with a cord or wire.

<<E>> ENGINE HANGER/ENGINE OIL DIPSTICK ASSEMBLY/THROTTLE BODY STAY/INTAKE MANIFOLD PLENUM STAY (REAR) REMOVAL

After removing the intake manifold plenum stay (rear), throttle body stay, engine oil dipstick assembly and engine hanger, set special tools MB992012 and MB992013 to each cylinder head.

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

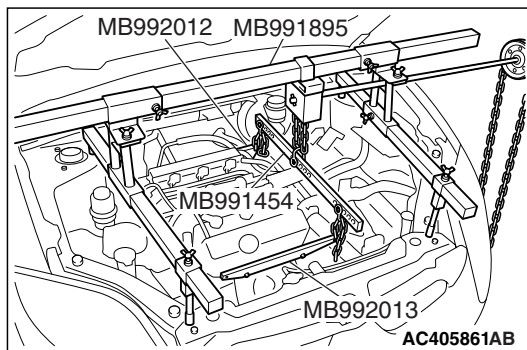
Remove the transaxle assembly. (M/T: Refer to GROUP 22A, Manual Transaxle Assembly [P.22A-19](#), A/T: Refer to GROUP 23A, Automatic Transaxle Assembly [P.23A-418](#)).

<<G>> A/C COMPRESSOR ASSEMBLY REMOVAL

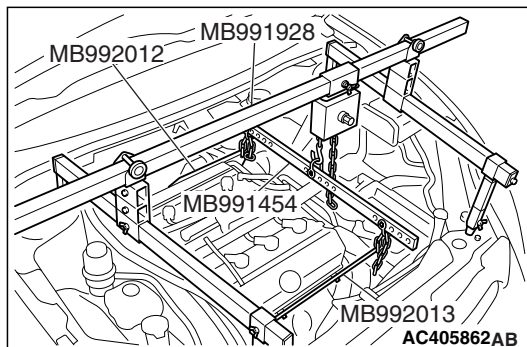
1. Remove the compressor from the compressor bracket with the hose still attached.
2. Place the removed A/C compressor where it will not interfere when removing and installing the engine assembly, and secure it with a cord or wire.

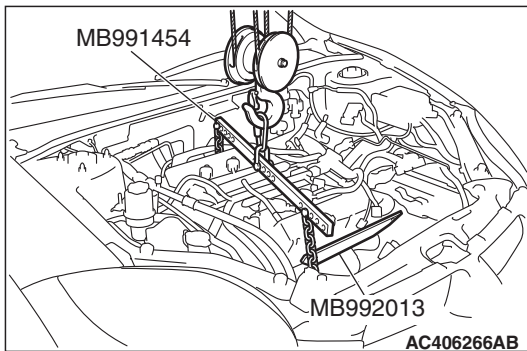
<<H>> ENGINE FRONT MOUNTING BRACKET REMOVAL

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



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





4. Remove special tool MB991454 and hook it again as shown. then, hold the engine assembly with the chain block, etc.
5. Place a garage jack against the engine oil pan with a piece of wood in between so that the weight of the engine is no longer being applied to the engine mount.
6. Loosen the engine mount mounting nuts and bolts, and remove the engine mount.

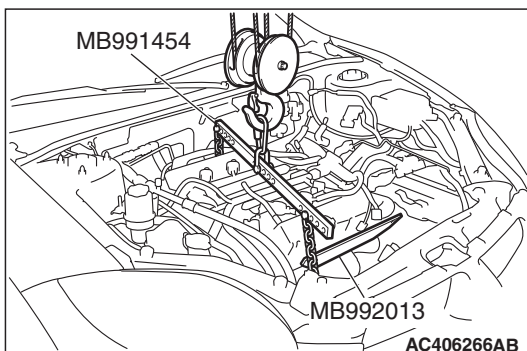
<<I>> ENGINE ASSEMBLY REMOVAL

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

INSTALLATION SERVICE POINTS

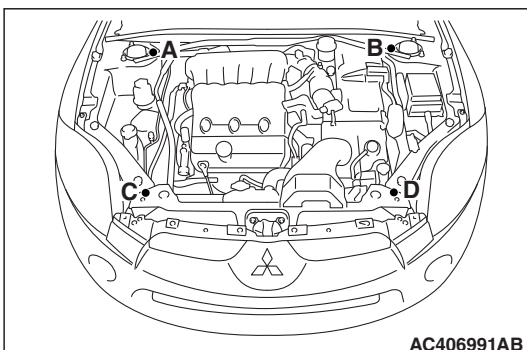
>>A<< ENGINE ASSEMBLY INSTALLATION

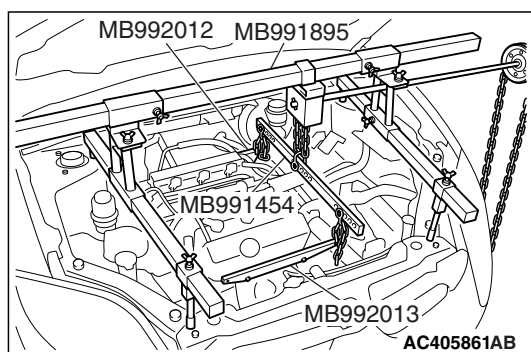
Install the engine assembly, being careful not to pinch the cables, hoses or wiring harness connectors.



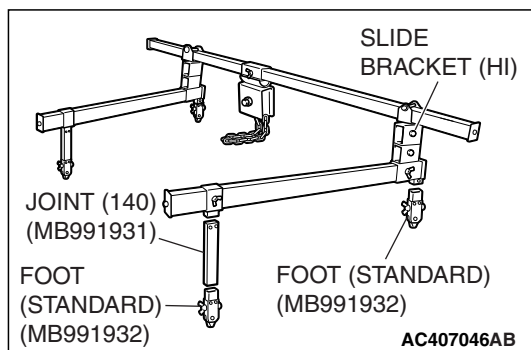
>>B<< ENGINE FRONT MOUNTING BRACKET INSTALLATION

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



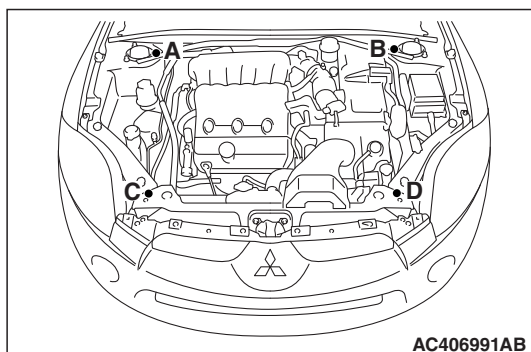


- (2) Remove special tool MB991454 and hook it again as shown. Then, set special tool MB991454 to hold the engine assembly.

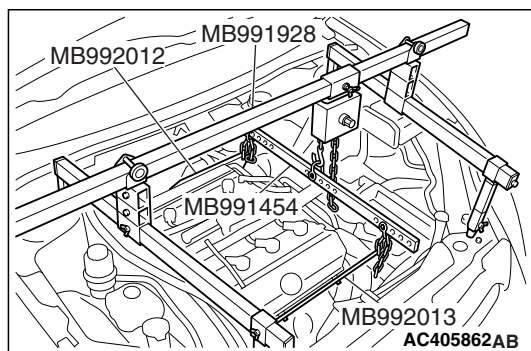


5. <Engine hanger MB991928 is used>

- (1) Assemble special tool MB991928. (Set following parts to the base hanger.)
- SLIDE BRACKET (HI)
 - FOOT (STANDARD) (MB991932)
 - JOINT (140) (MB991931)



- (2) Set special tool MB991928 to the strut mounting nuts (A and B) and front end structure bar assembling bolts (A and B) and (C and D) as shown.



- (3) Remove special tool MB991454 and hook it again as shown. Then, set special tool MB991454 to hold the engine assembly.

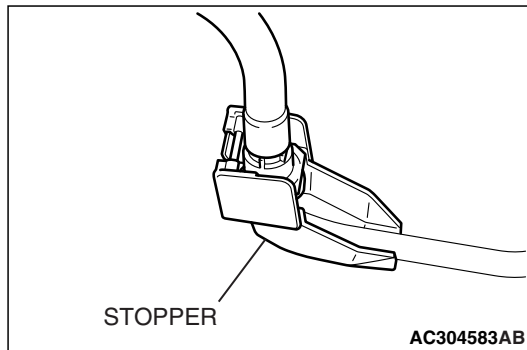
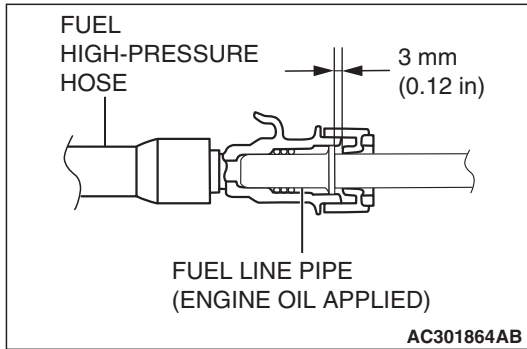
NOTE: Adjust the engine hanger balance by sliding the slide bracket (HI).

>>C<< FUEL HIGH-PRESSURE HOSE CONNECTION

CAUTION

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

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



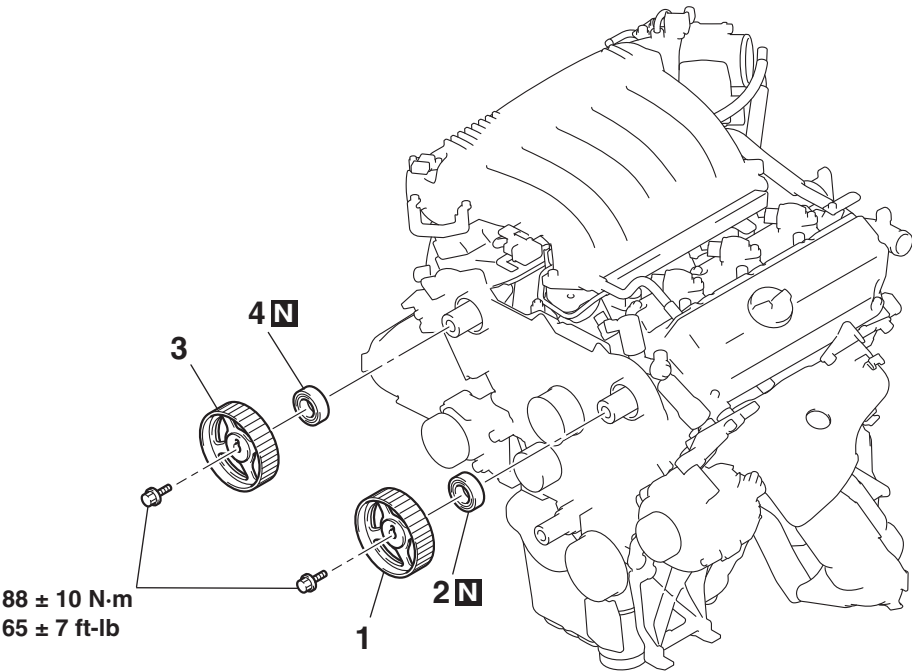
CAMSHAFT OIL SEAL

REMOVAL AND INSTALLATION

M1112002200374

Pre-removal and Post-installation Operation

- Timing Belt Removal and Installation (Refer to P.11C-65).



AC406176 AB

- <<A>> >>B<<

1. LEFT BANK CAMSHAFT SPROCKET
- <> >>A<<

2. CAMSHAFT OIL SEAL

- <<A>> >>B<<

3. RIGHT BANK CAMSHAFT SPROCKET
- <> >>A<<

4. CAMSHAFT OIL SEAL

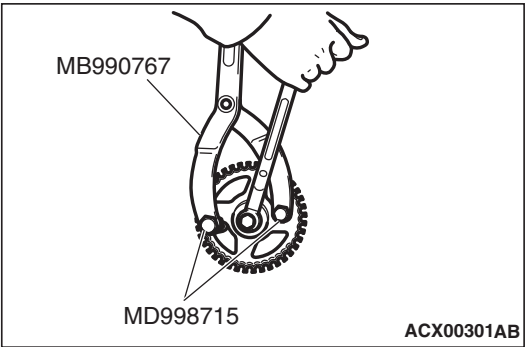
Required Special Tools:

- MB990767: Front Hub and Flange Yoke Holder
 - MD998713: Camshaft Oil Seal Installer
- MD998715: Crankshaft Pulley Holder Pin

REMOVAL SERVICE POINTS

<<A>> CAMSHAFT SPROCKET REMOVAL

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



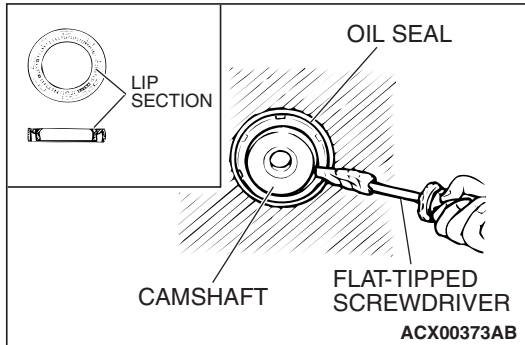
<> CAMSHAFT OIL SEAL REMOVAL

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

CAUTION

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

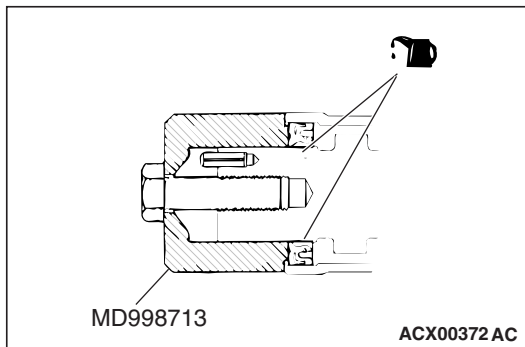
2. Cover the end of a flat-tipped screwdriver with a shop towel and insert into the notched section of the oil seal, and pry out the oil seal to remove it.



INSTALLATION SERVICE POINTS

>>A<< CAMSHAFT OIL SEAL INSTALLATION

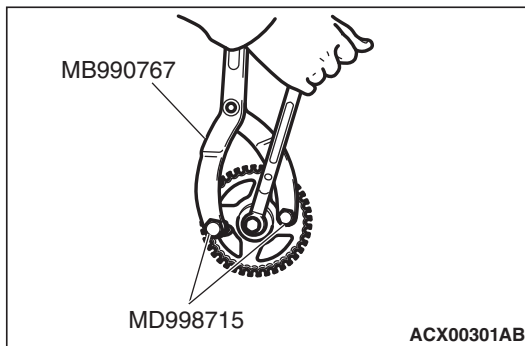
1. Apply engine oil to the camshaft oil seal lip.
2. Use special tool MD998713 to press-fit the camshaft oil seal.



>>B<< CAMSHAFT SPROCKET INSTALLATION

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

Tightening torque: 88 ± 10 N·m (65 ± 7 ft-lb)



CAMSHAFT AND VALVE STEM SEAL

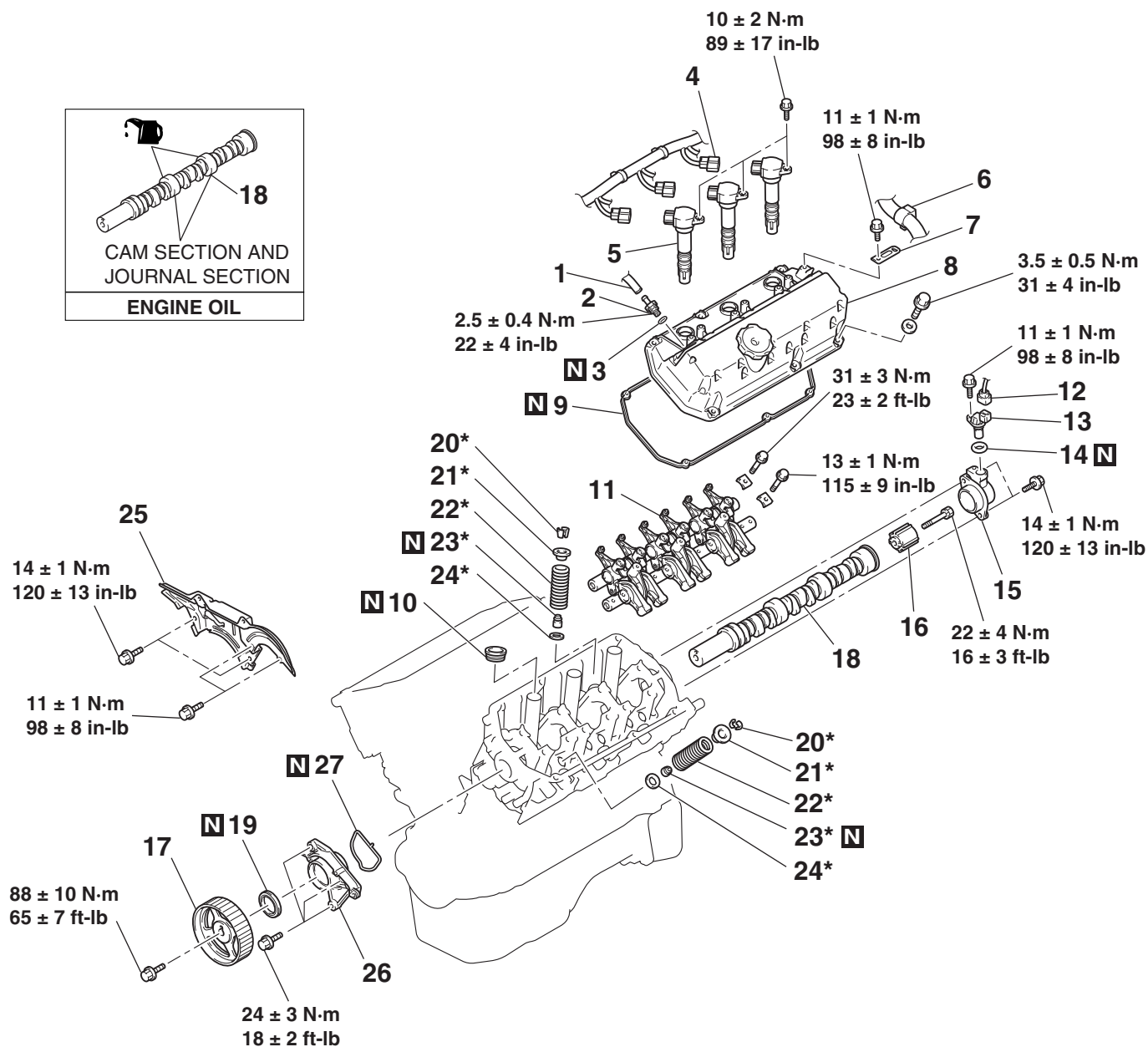
REMOVAL AND INSTALLATION

M1112006602154

CAUTION

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

<LEFT BANK>



AC808324AB

CAMSHAFT REMOVAL STEPS

- TIMING BELT (REFER TO [P.11C-65](#)).
 - THERMOSTAT HOUSING (REFER TO GROUP 14, WATER HOSE AND WATER PIPE [P.14-40](#)).
1. PCV HOSE CONNECTION
 2. PCV VALVE
 3. O-RING

CAMSHAFT REMOVAL STEPS

4. IGNITION COIL CONNECTOR
5. IGNITION COIL
6. ENGINE CONTROL WIRING HARNESS CLAMP
7. HARNESS BRACKET
8. ROCKER COVER
9. ROCKER COVER GASKET
10. SPARK PLUG GUIDE OIL SEAL

CAMSHAFT REMOVAL STEPS

- | | | |
|--|-------|--|
| <<A>> | >>H<< | 11. ROCKER ARM AND SHAFT ASSEMBLY |
| | | 12. CAMSHAFT POSITION SENSOR CONNECTOR |
| | | 13. CAMSHAFT POSITION SENSOR |
| | | 14. O-RING |
| | >>K<< | 15. CAMSHAFT POSITION SENSOR SUPPORT |
| 16. CAMSHAFT POSITION SENSING CYLINDER | | |
| <> | | >>J<< |
| | | 18. CAMSHAFT |
| <<C>> | >>I<< | 19. CAMSHAFT OIL SEAL |

VALVE STEM SEAL REMOVAL STEPS

- | | | |
|-------|-------|---|
| | | 1. PCV HOSE CONNECTION |
| | | 2. PCV VALVE |
| | | 3. O-RING |
| | | 4. IGNITION COIL CONNECTOR |
| | | 5. IGNITION COIL |
| | | 6. ENGINE CONTROL WIRING HARNESS CLAMP |
| | | 8. ROCKER COVER |
| | | 9. ROCKER COVER GASKET |
| | | 10. SPARK PLUG GUIDE OIL SEAL |
| <<A>> | >>H<< | 11. ROCKER ARM AND SHAFT ASSEMBLY |
| | | • SPARK PLUG (REFER TO GROUP 16, IGNITION COIL P.16-44). |
| <<D>> | >>G<< | 20. VALVE SPRING RETAINER LOCK |
| | | 21. VALVE SPRING RETAINER |
| | >>F<< | 22. VALVE SPRING |
| | >>E<< | 23. VALVE STEM SEAL |
| | | 24. VALVE SPRING SEAT |

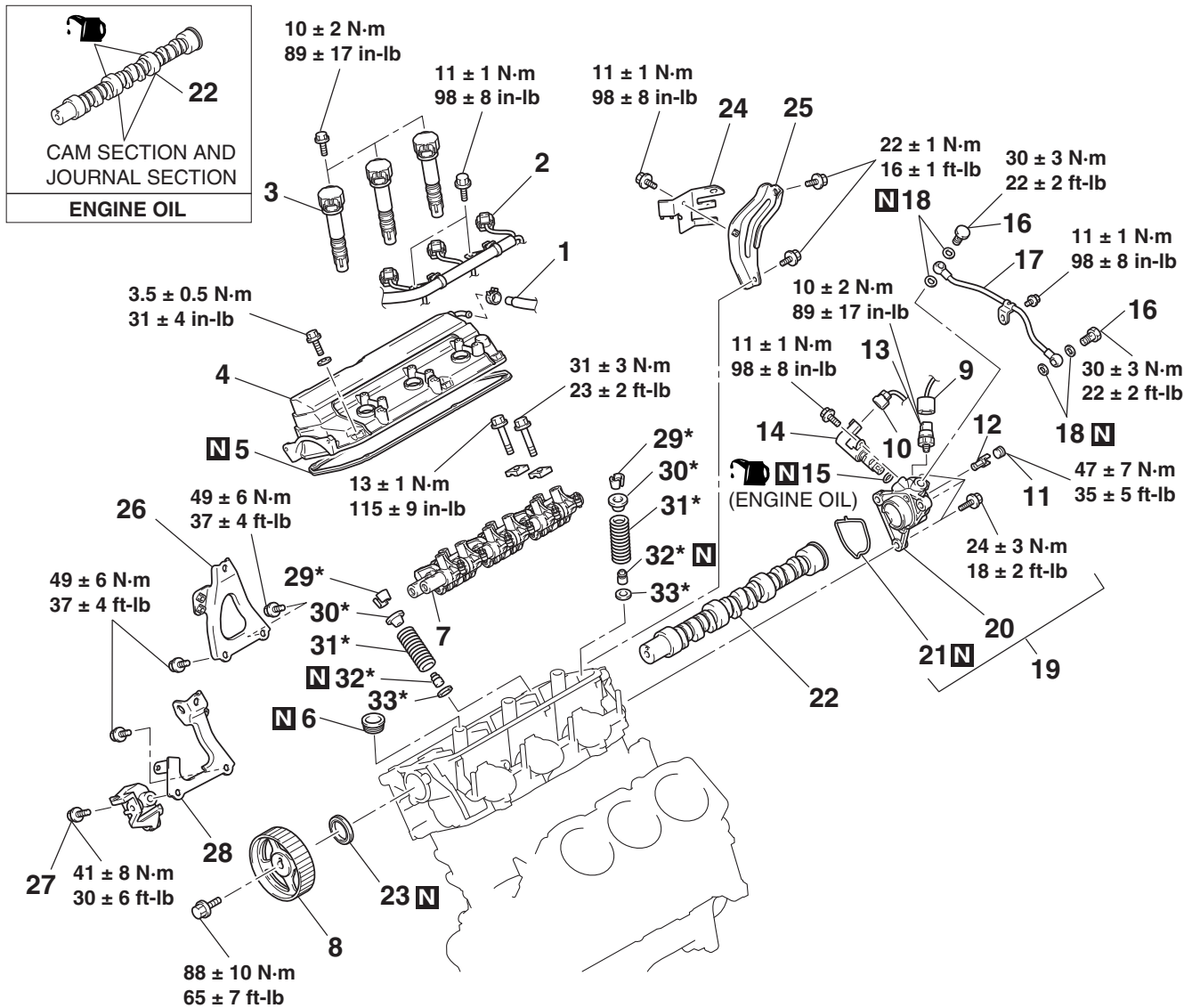
CAMSHAFT OIL SEAL CASE REMOVAL STEPS

- | | | |
|-------|-------|---|
| | | • TIMING BELT (REFER TO P.11C-65). |
| <> | >>J<< | 17. CAMSHAFT SPROCKET |
| | | 25. TIMING BELT REAR CENTER COVER |
| | >>A<< | 26. CAMSHAFT OIL SEAL CASE |
| | >>A<< | 27. CAMSHAFT OIL SEAL CASE GASKET |

Required Special Tools:

- | | |
|--|--|
| • MB990767: Front Hub and Flange Yoke Holder | • MD998715: Crankshaft Pulley Holder Pin |
| • MD998443: Auto-lash Adjuster Holder | • MD998772: Valve Spring Compressor |
| • MD998713: Camshaft Oil Seal Installer | • MB991999: Valve Stem Seal Installer |

<RIGHT BANK>



AC808325AB

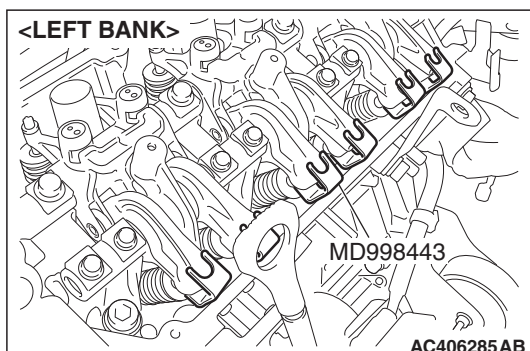
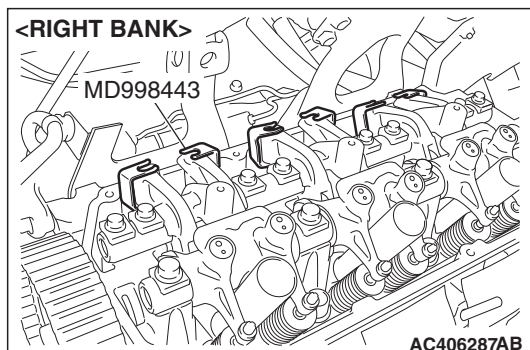
VALVE STEM SEAL REMOVAL STEPS (Continued)

- [illegible]

Required Special Tools:

- MB990767: Front Hub and Flange Yoke Holder
- MD998443: Auto-lash Adjuster Holder
- MD998713: Camshaft Oil Seal Installer
- MD998715: Crankshaft Pulley Holder Pin
- MD998772: Valve Spring Compressor
- MB991999: Valve Stem Seal Installer

REMOVAL SERVICE POINTS

<<A>> ROCKER ARM AND SHAFT ASSEMBLY
REMOVAL

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

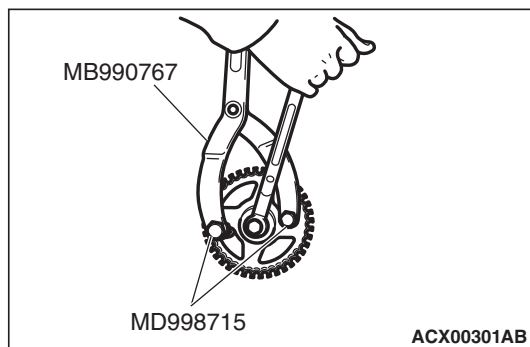
CAUTION

Never disassemble the rocker arm and shaft assembly.

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

<> CAMSHAFT SPROCKET REMOVAL

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



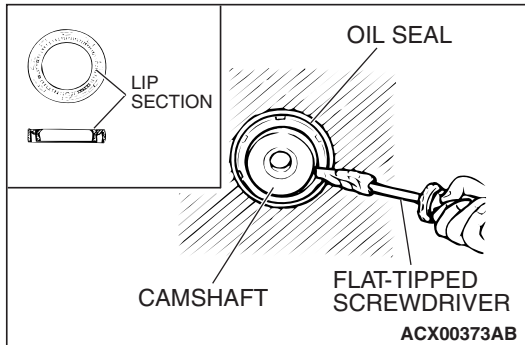
<<C>> CAMSHAFT OIL SEAL REMOVAL

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

CAUTION

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

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

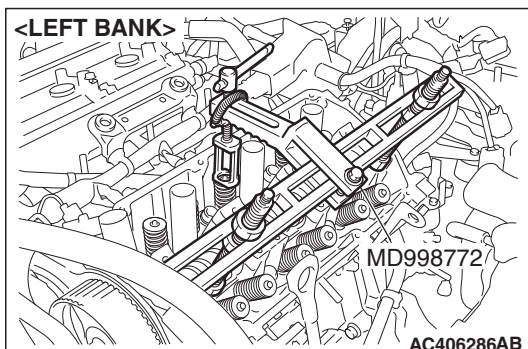
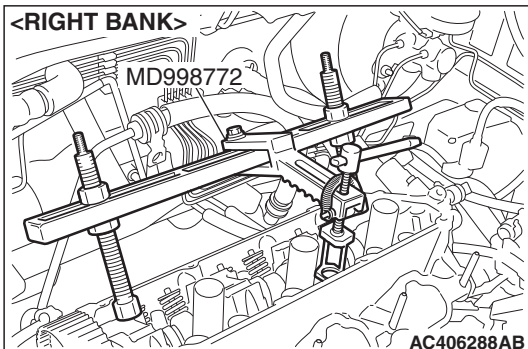


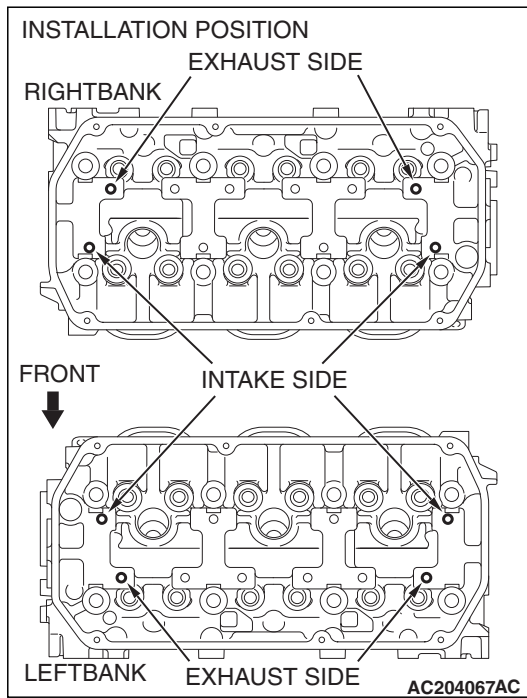
<<D>> VALVE SPRING RETAINER LOCK REMOVAL

CAUTION

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

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





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

INSTALLATION SERVICE POINTS

>>A<< CAMSHAFT OIL SEAL CASE GAS- KET/CAMSHAFT OIL SEAL CASE/OIL FEEDER CONTROL VALVE HOUSING GASKET/OIL FEEDER CONTROL VALVE HOUSING INSTALLA- TION

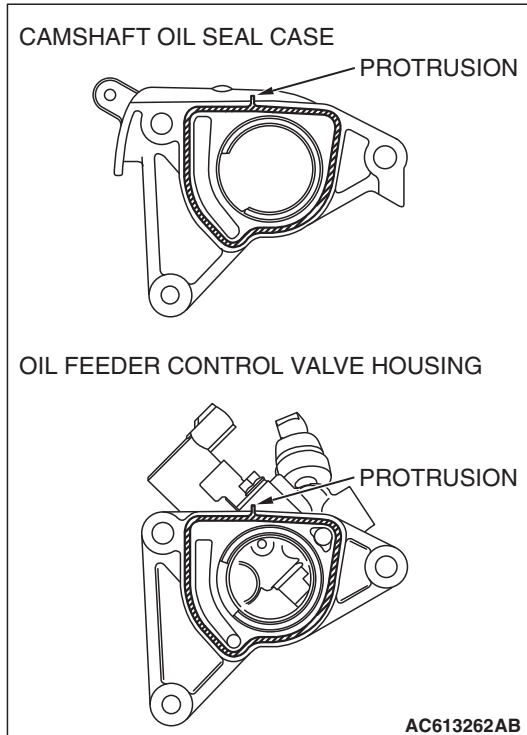
1. Install the camshaft oil seal case gasket and oil feeder control valve housing gasket as their protrusions are in the direction shown.

CAUTION

- Be careful that any foreign materials does not get into the oil passages.
- Thoroughly confirm that there is not any foreign materi-
als on the mating surfaces.

2. Install the camshaft oil seal case and oil feeder control valve housing to the cylinder head.
3. Tighten the mounting bolt to the specified torque.

Tightening torque: 24 ± 3 N·m (18 ± 2 ft-lb)



>>B<< GASKET/OIL FEEDER CONTROL VALVE PIPE/ EYE BOLT INSTALLATION

CAUTION

Install the oil feeder control valve pipe as follows so that the pipe is not deformed.

1. Install a gasket to one of oil feeder control valve pipes and tighten the eye bolt by hand.
2. Install a gasket to the other oil feeder control valve pipe and tighten the eye bolt to the specified torque.

Tightening torque: 30 ± 3 N·m (22 ± 2 ft-lb)

3. Tighten the eye bolt which is temporarily tightened by step 1 to the specified torque.

Tightening torque: 30 ± 3 N·m (22 ± 2 ft-lb)

4. Tighten the oil feeder control valve pipe mounting bolt to the specified torque.

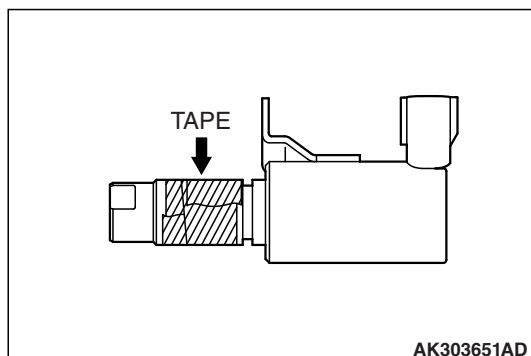
Tightening torque: 11 ± 1 N·m (98 ± 8 in-lb)

>>C<< O-RING/ENGINE OIL CONTROL VALVE
INSTALLATION CAUTION

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

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

Tightening torque: 11 ± 1 N·m (98 ± 8 in-lb)

>>D<< ENGINE OIL PRESSURE SWITCH
INSTALLATION

1. Remove sealant from the engine oil pressure switch and cylinder head surfaces.
2. Apply sealant to the thread of the engine oil pressure switch as shown.

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

NOTE: Install the engine oil pressure switch immediately after applying sealant.

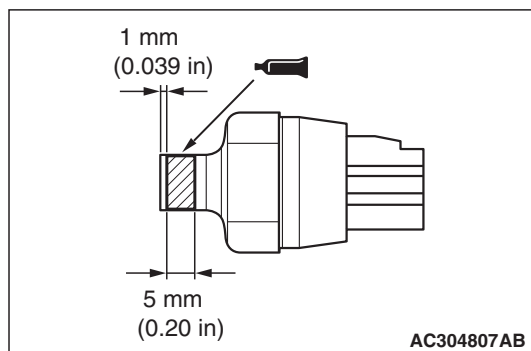
3. Install the engine oil pressure switch to the oil feeder control valve housing.

 CAUTION

After installing the parts, wait at least one hour. Never start the engine or let engine oil or water touch the sealant application area during that time.

4. Tighten the engine oil pressure switch to the specified torque.

Tightening torque: 10 ± 2 N·m (89 ± 17 in-lb)



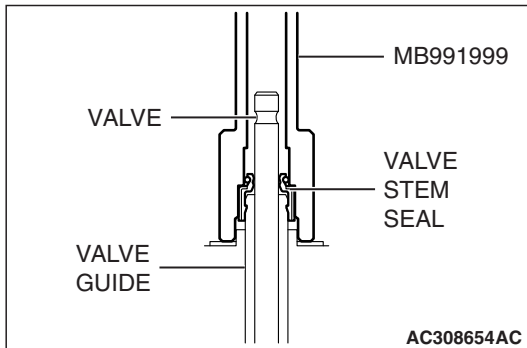
>>E<< VALVE STEM SEAL INSTALLATION

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

CAUTION

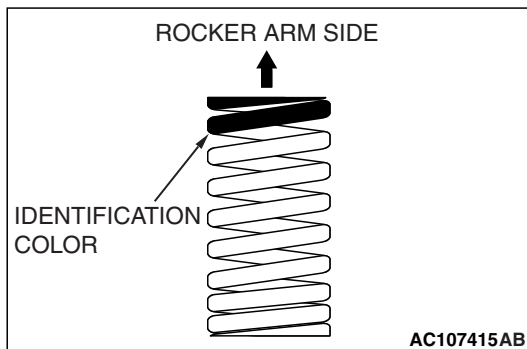
- Valve stem seals cannot be reused.
- Special tool MB991999 must be used to install the valve stem seal. Improper installation could result in oil leaking past the valve guide.

2. Use special tool MB991999 to fill a new valve stem seal in the valve guide using the valve stem area as a guide.



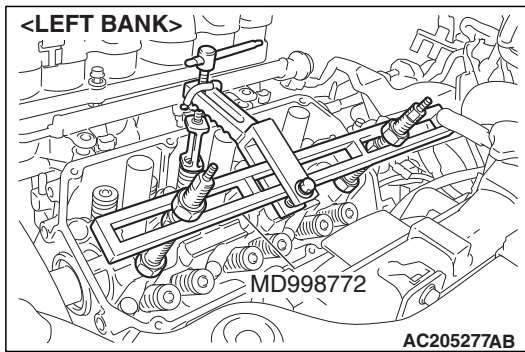
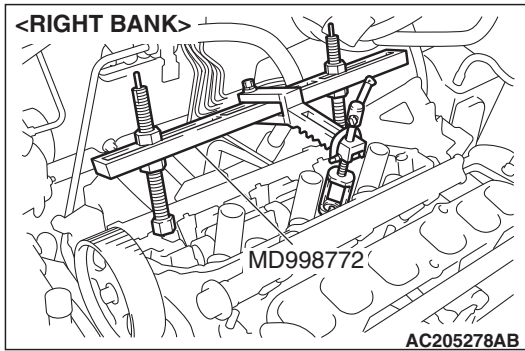
>>F<< VALVE SPRING INSTALLATION

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

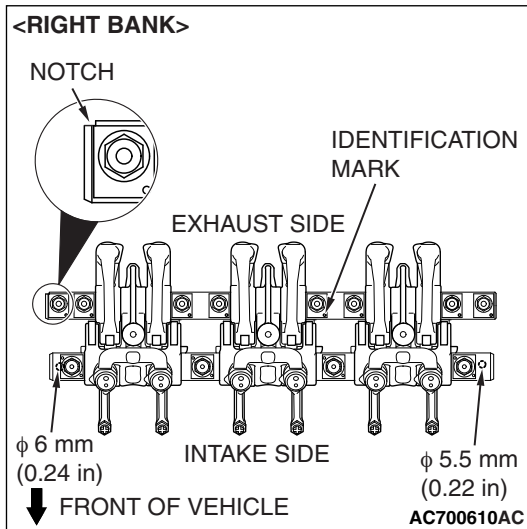


>>G<< VALVE SPRING RETAINER LOCK
INSTALLATION

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



>>H<< ROCKER ARM AND SHAFT ASSEMBLY INSTALLATION

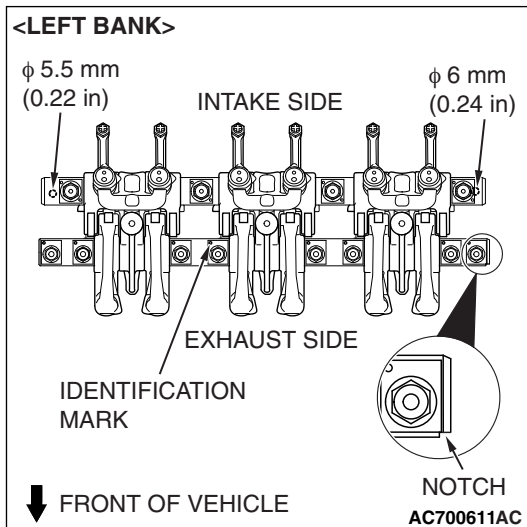


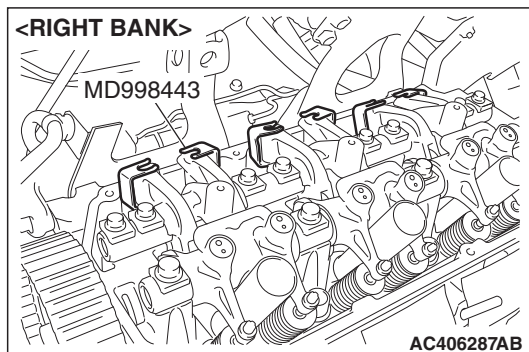
1. Install the intake side rocker arm and shaft assembly so that the ϕ 6 mm (0.24inch) and ϕ 5.5 mm (0.22 inch) holes of rocker arm shaft face the cylinder head side.
2. Tighten the intake side rocker arm shaft mounting bolts to the specified torque.

Tightening torque: 31 ± 3 N·m (23 ± 2 ft-lb)

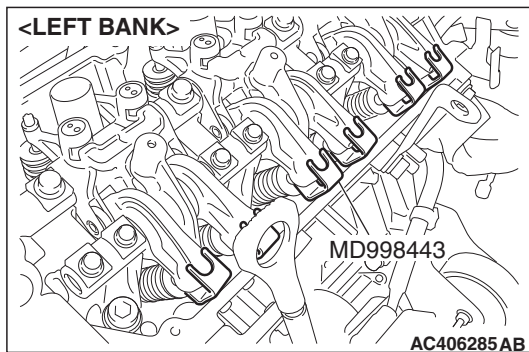
3. Install the exhaust side rocker arm and shaft assembly so that the notch of rocker arm shaft is located as shown in the figure.
4. Check that the identification mark of exhaust side rocker shaft cap is located as shown in the figure.
5. Tighten the exhaust side rocker arm shaft mounting bolts to the specified torque.

Tightening torque: 13 ± 1 N·m (115 ± 9 in-lb)



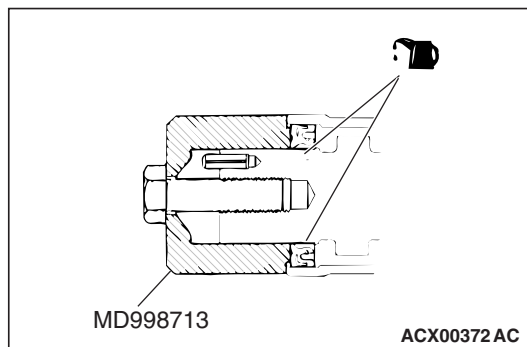


6. Remove special tool MD998443.



>>I<< CAMSHAFT OIL SEAL INSTALLATION

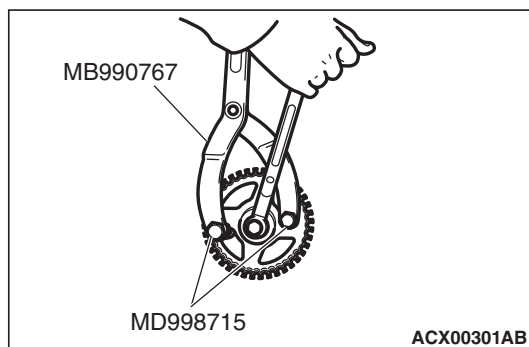
1. Apply engine oil to the camshaft oil seal lip.
2. Use special tool MD998713 to press-fit the camshaft oil seal.



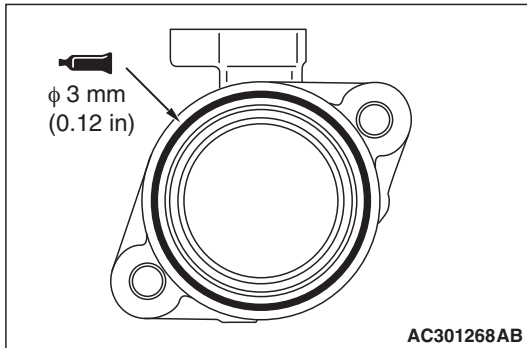
>>J<< CAMSHAFT SPROCKET INSTALLATION

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

Tightening torque: 88 ± 10 N·m (65 ± 7 ft-lb)



>>K<< CAMSHAFT POSITION SENSOR SUPPORT INSTALLATION



1. Remove old sealant from the camshaft position sensor support and cylinder head surfaces.
2. Apply 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 immediately after applying sealant.

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

CAUTION

After installing the parts, wait at least one hour. Never start the engine or let engine oil or water touch the sealant application area during that time.

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

Tightening torque: $14 \pm 1 \text{ N}\cdot\text{m}$ ($120 \pm 13 \text{ in}\cdot\text{lb}$)

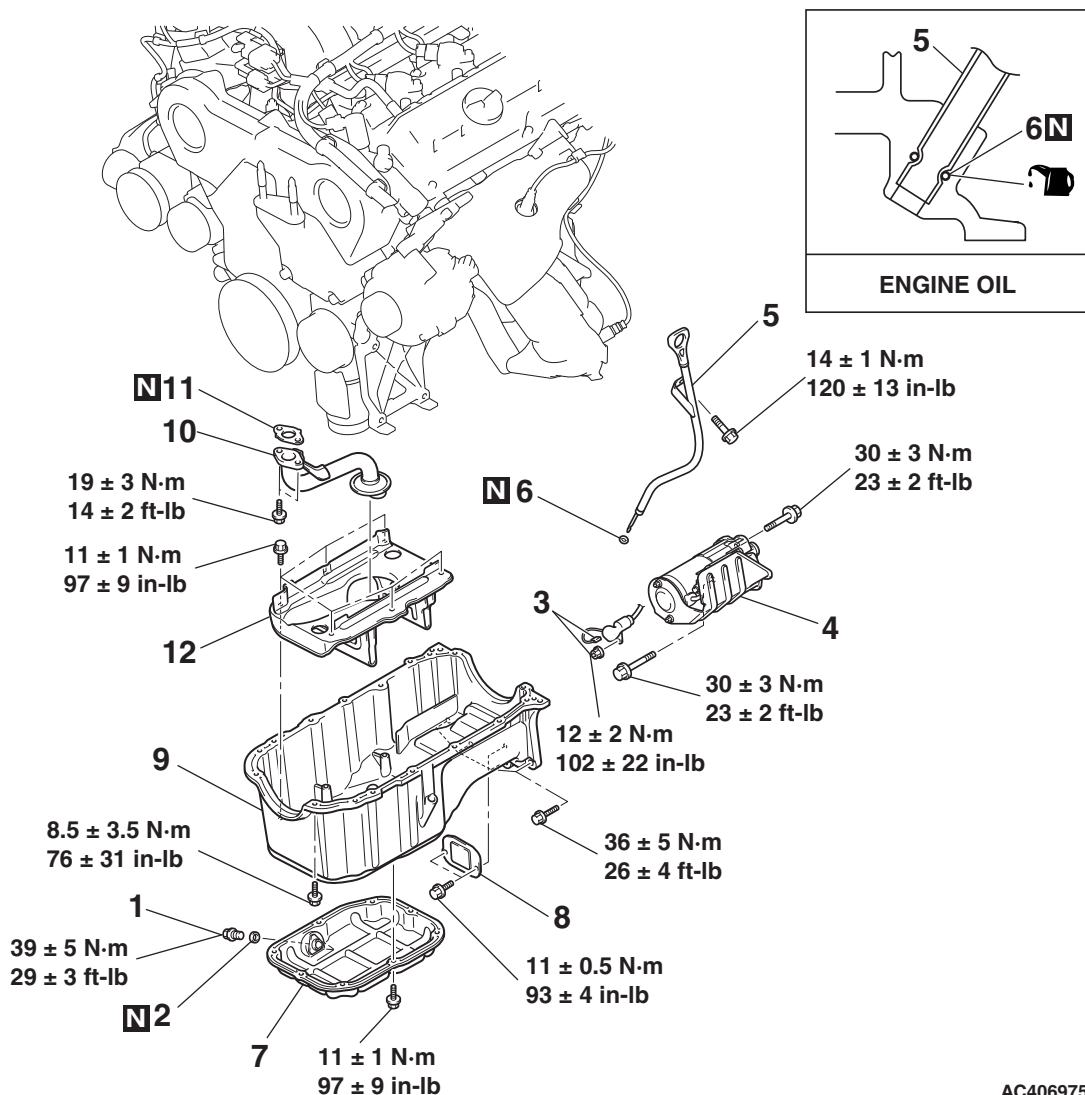
OIL PAN AND OIL SCREEN

REMOVAL AND INSTALLATION <M/T>

M1112002500502

Pre-removal and Post-installation Operation

- Under Cover Removal and Installation (Refer to GROUP 51, Under Cover P.51-8).
- Engine Oil Draining and Refilling (Refer to GROUP 12, On-vehicle Service P.12-3).



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REMOVAL STEPS

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

REMOVAL STEPS (Continued)

- FRONT NO.1 EXHAUST PIPE (REFER TO GROUP 15, EXHAUST PIPE AND MAIN MUFFLER P.15-26).
8. COVER
 9. ENGINE UPPER OIL PAN
 10. OIL SCREEN
 11. GASKET
 12. BAFFLE PLATE

<> >>A<<

<<A>> >>B<<

REMOVAL SERVICE POINTS

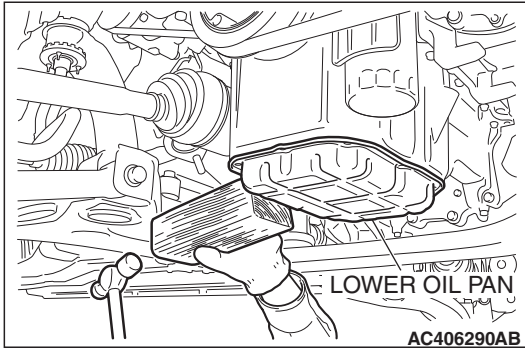
<<A>> ENGINE LOWER OIL PAN REMOVAL

1. Remove the engine lower oil pan mounting bolts.

⚠ CAUTION

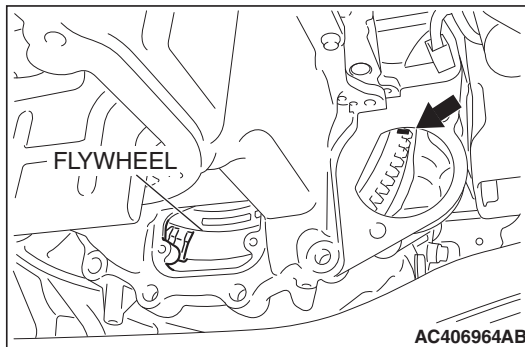
Do not use oil pan remover special tool (MD998727). The engine upper oil pan is made of aluminum and this tool will damage it.

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



<> ENGINE UPPER OIL PAN REMOVAL

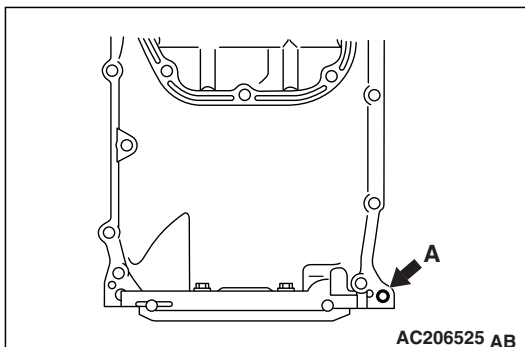
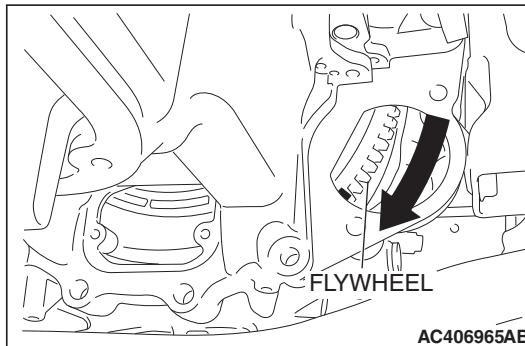
1. Align the recessed area in the flywheel with the location shown. Mark the flywheel.



2. Turn the crankshaft so that the mark is positioned as shown.
3. Remove the engine upper oil pan mounting bolts.

⚠ CAUTION

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

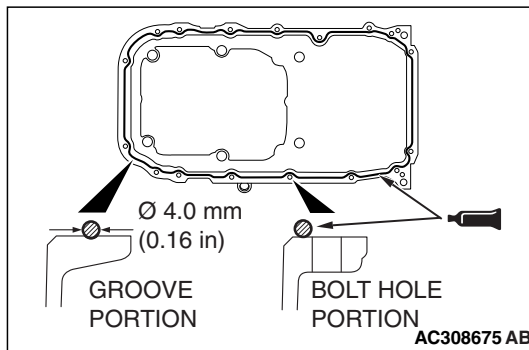
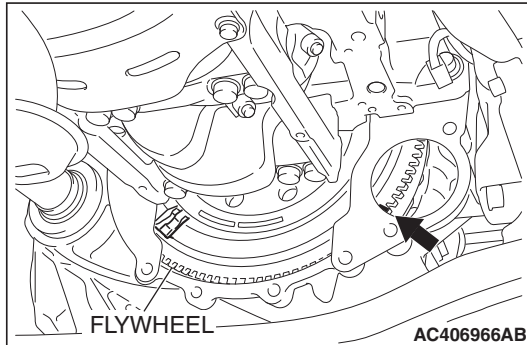


4. Screw in the bolt (M10) into bolt hole A in the location shown. Then lift the upper oil pan and remove it.

INSTALLATION SERVICE POINTS

>>A<< ENGINE UPPER OIL PAN INSTALLATION

1. Remove old sealant from the oil pan and cylinder block mating surfaces.
2. Degrease the sealant-coated surface and the engine mating surface.
3. Check that the recessed area in the flywheel and the mark is positioned as shown.



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

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

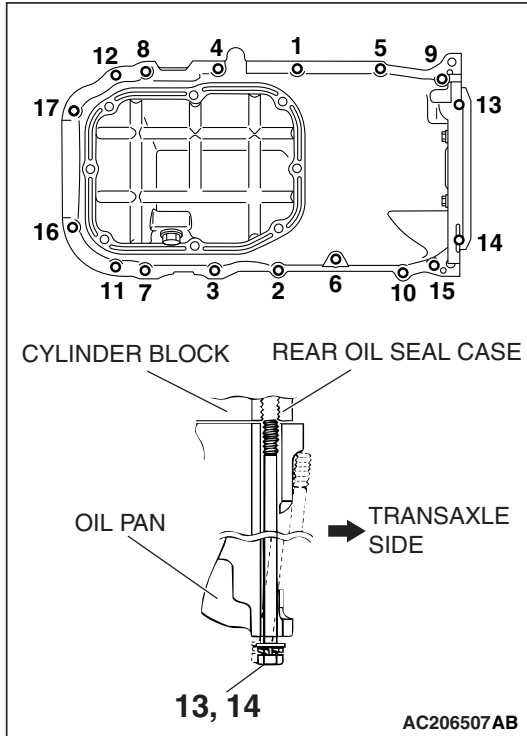
NOTE: Install the engine upper oil pan immediately after applying sealant.

5. Install the engine upper oil pan to the cylinder block.

⚠ CAUTION

- The bolt holes for bolts 13 and 14 in the illustration are cut away on the transaxle side. Be careful not to insert these bolts at an angle.
- After installing the parts, wait at least one hour. Never start the engine or let engine oil or water touch the sealant application area during that time.

6. Tighten the bolts in the order shown in the illustration.



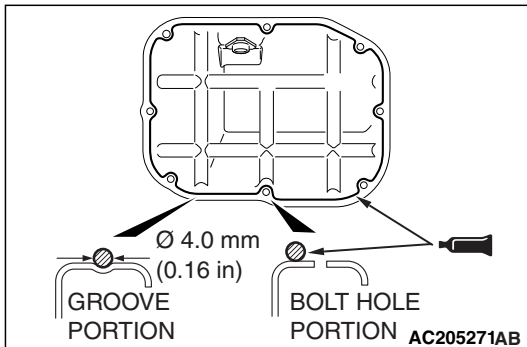
>>B<< ENGINE LOWER OIL PAN INSTALLATION

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

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

NOTE: Install the engine lower oil pan immediately after applying sealant.

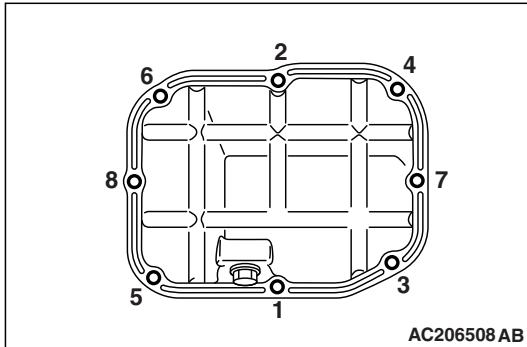
3. Install the engine lower oil pan to the engine upper oil pan.



⚠ CAUTION

After installing the parts, wait at least one hour. Never start the engine or let engine oil or water touch the sealant application area during that time.

4. Tighten the bolts in the order shown in the illustration.

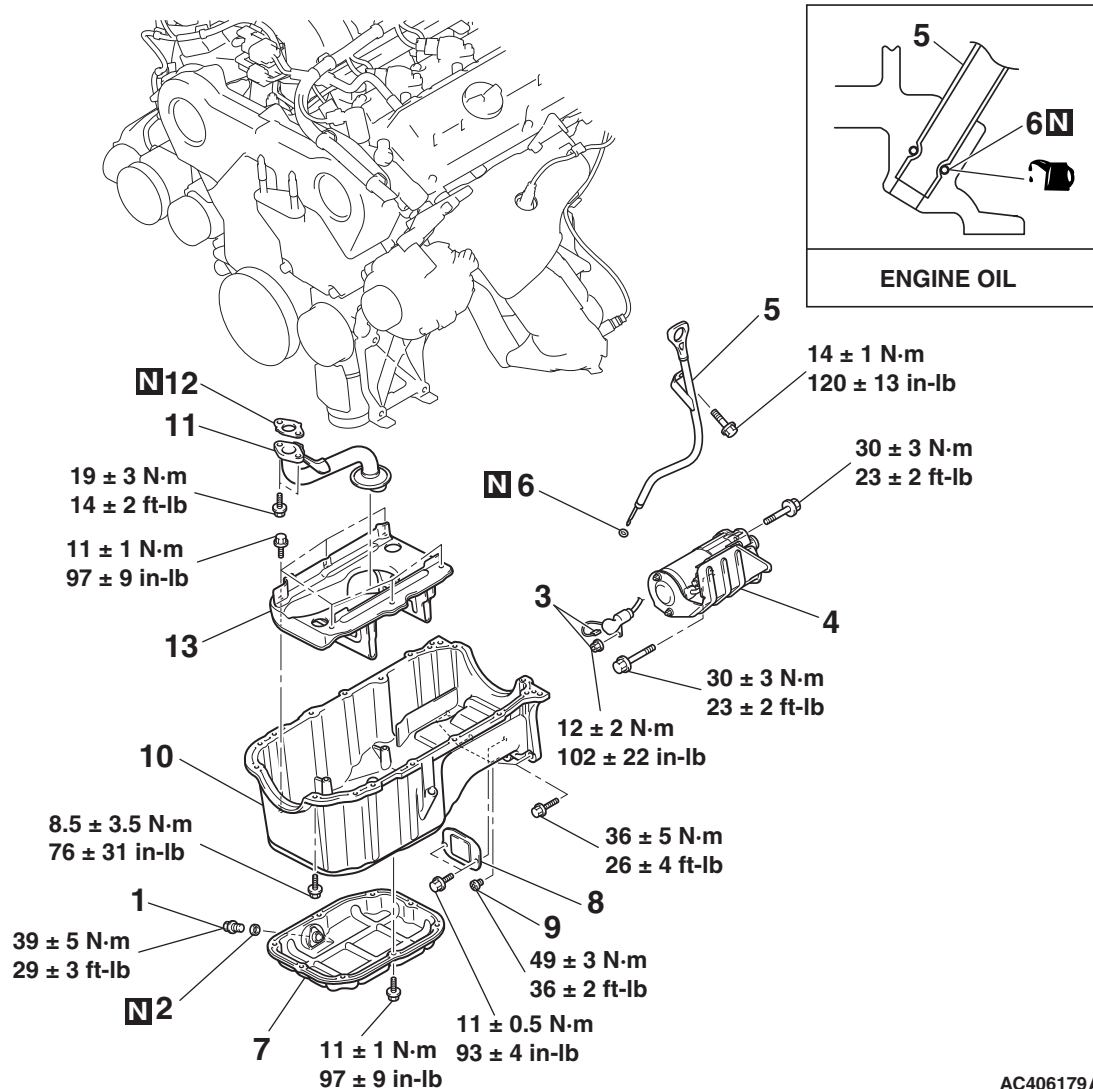


REMOVAL AND INSTALLATION <A/T>

M1112002500513

Pre-removal and Post-installation Operation

- Under Cover Removal and Installation (Refer to GROUP 51, Under Cover P.51-8).
- Engine Oil Draining and Refilling (Refer to GROUP 12, On-vehicle Service P.12-3).



AC406179AB

REMOVAL STEPS

- ENGINE OIL PAN DRAIN PLUG
- ENGINE OIL PAN DRAIN PLUG GASKET
- STARTER CONNECTOR AND TERMINAL
- STARTER ASSEMBLY
- ENGINE OIL DIPSTICK ASSEMBLY
- O-RING
- ENGINE LOWER OIL PAN

REMOVAL STEPS (Continued)

- FRONT NO.1 EXHAUST PIPE (REFER TO GROUP 15, EXHAUST PIPE AND MAIN MUFFLER P.15-26).
- 8. COVER
- 9. TORQUE CONVERTER CONNECTING BOLT
- 10. ENGINE UPPER OIL PAN
- 11. OIL SCREEN
- 12. GASKET
- 13. Baffle Plate

<<A>> >>B<<

<>

<<C>> >>A<<

REMOVAL SERVICE POINTS

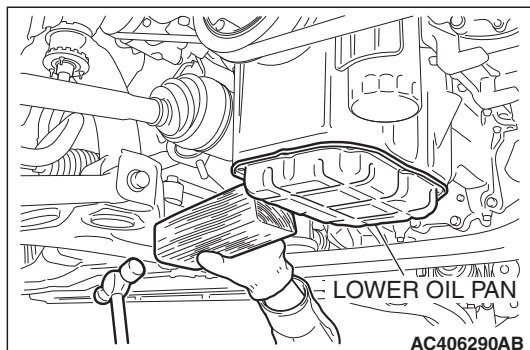
<<A>> ENGINE LOWER OIL PAN REMOVAL

1. Remove the engine lower oil pan mounting bolts.

⚠ CAUTION

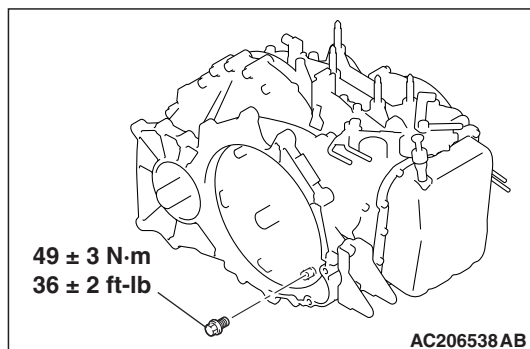
Do not use oil pan remover special tool (MD998727). The engine upper oil pan is made of aluminum and this tool will damage it.

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



<> TORQUE CONVERTER CONNECTING BOLT REMOVAL

Remove the one torque converter connecting bolt as shown.



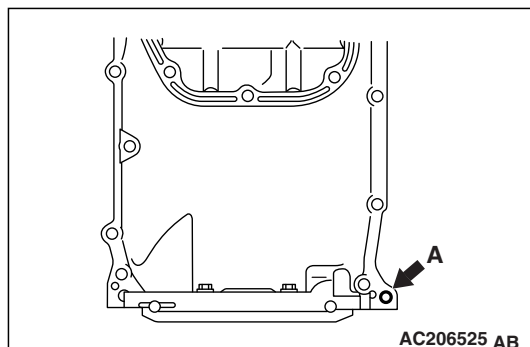
<<C>> ENGINE UPPER OIL PAN REMOVAL

1. Remove the engine upper oil pan mounting bolts.

⚠ CAUTION

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

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



INSTALLATION SERVICE POINTS

>>A<< ENGINE UPPER OIL PAN INSTALLATION

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

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

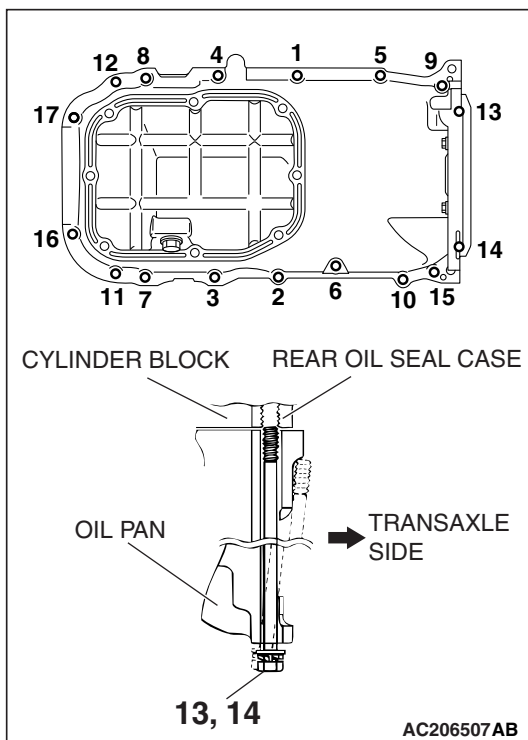
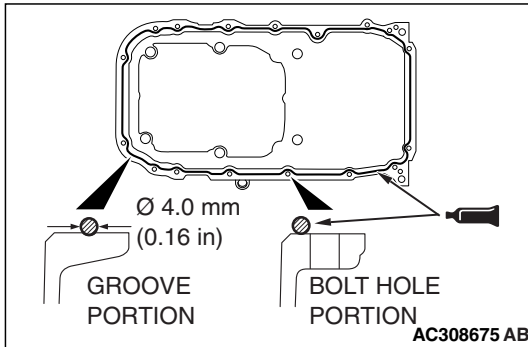
NOTE: Install the engine upper oil pan immediately after applying sealant.

4. Install the engine upper oil pan to the cylinder block.

CAUTION

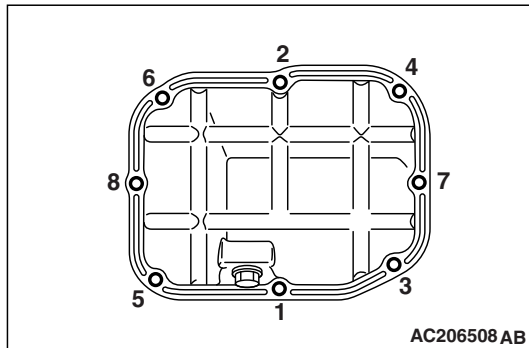
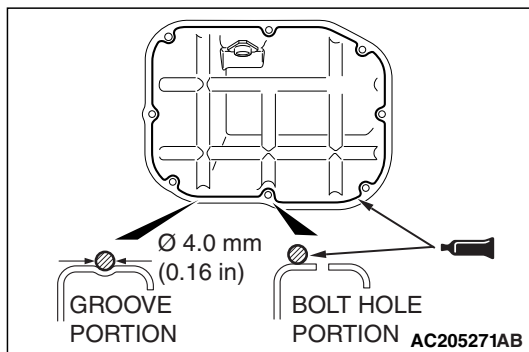
- The bolt holes for bolts 13 and 14 in the illustration are cut away on the transaxle side. Be careful not to insert these bolts at an angle.
- After installing the parts, wait at least one hour. Never start the engine or let engine oil or water touch the sealant application area during that time.

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



>>B<< ENGINE LOWER OIL PAN INSTALLATION

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



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

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

NOTE: Install the engine lower oil pan immediately after applying sealant.

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

CAUTION

After installing the parts, wait at least one hour. Never start the engine or let engine oil or water touch the sealant application area during that time.

4. Tighten the bolts in the order shown in the illustration.

INSPECTION

M1112002600156

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

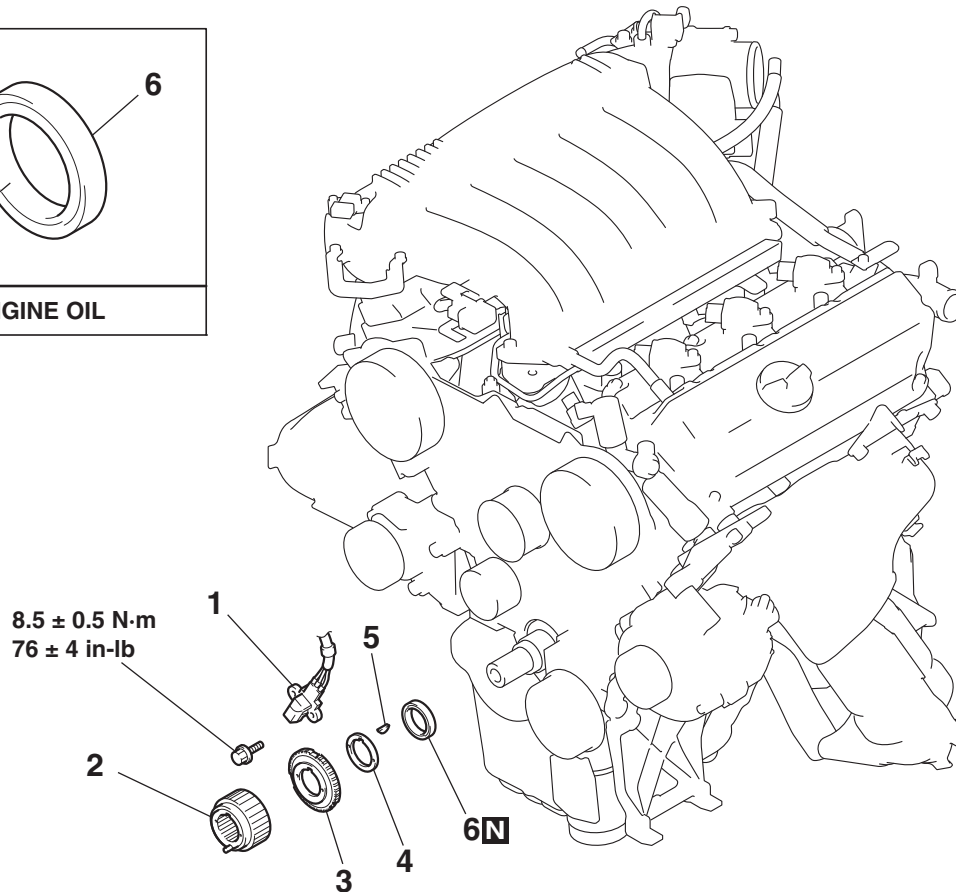
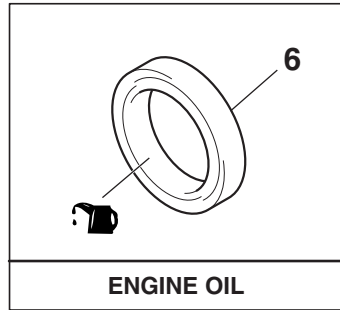
CRANKSHAFT OIL SEAL

REMOVAL AND INSTALLATION <FRONT OIL SEAL>

M1112003400564

Pre-removal and Post-installation Operation

- Timing Belt Removal and Installation (Refer to P.11C-65).



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REMOVAL STEPS

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

REMOVAL STEPS (Continued)

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

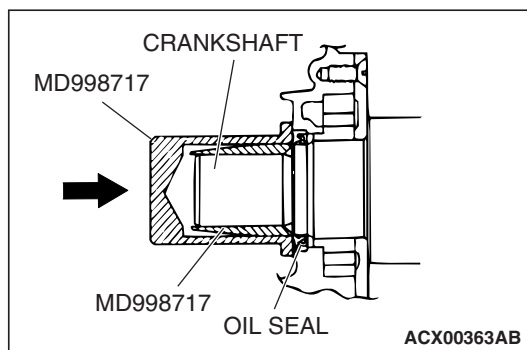
Required Special Tool:

- MD998717: Crankshaft Front Oil Seal Installer

INSTALLATION SERVICE POINTS

>>A<< CRANKSHAFT FRONT OIL SEAL INSTALLATION

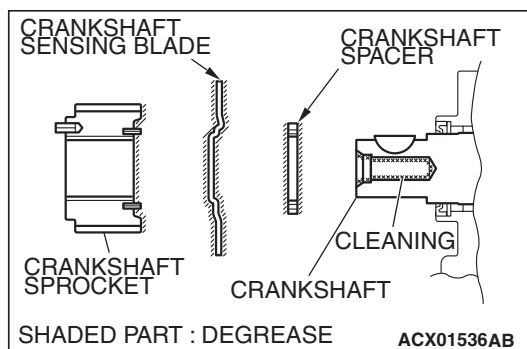
1. Apply a small amount of engine oil to the oil seal lip and then insert the o-ring.



2. Using special tool MD998717, tap the oil seal into the front case.

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

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

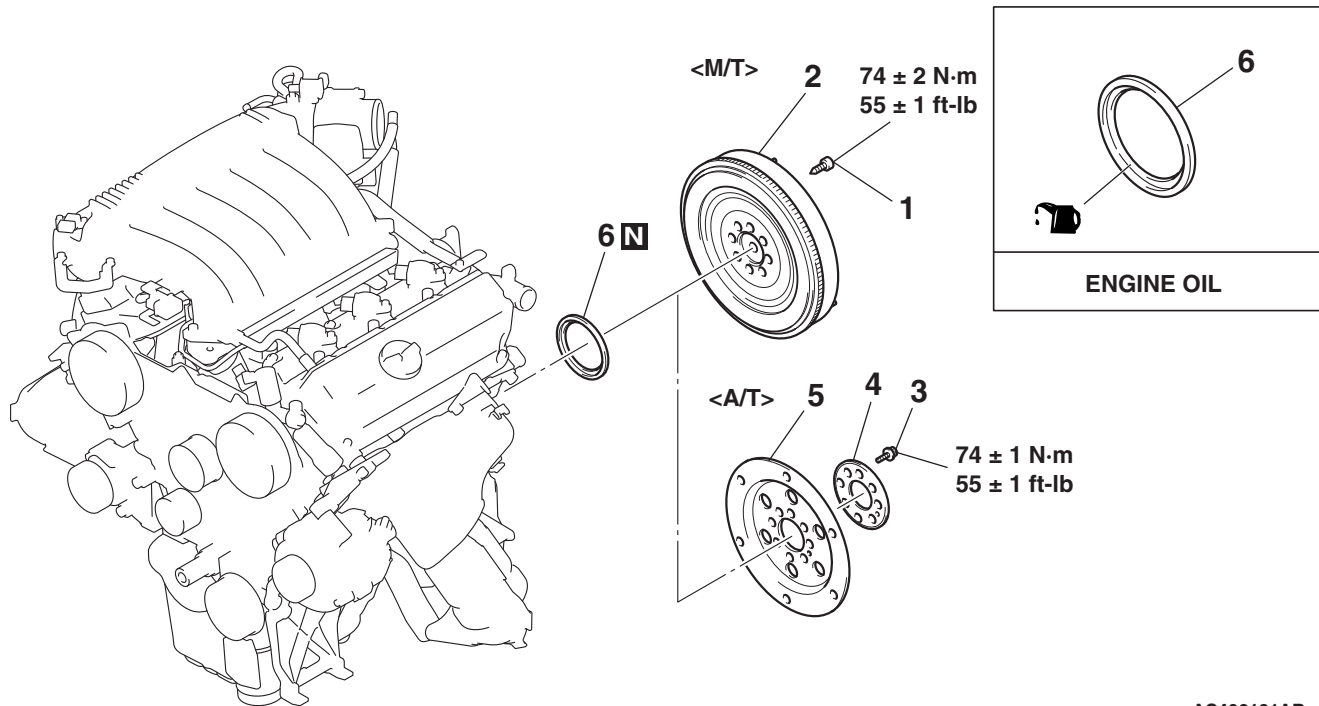


REMOVAL AND INSTALLATION <REAR OIL SEAL>

M1112003700714

Pre-removal and Post-installation Operation

- Manual Transaxle Assembly Removal and Installation (Refer to GROUP 22A, Transaxle <M/T> [P.22A-19](#)).
- Clutch Cover and Clutch Disc Removal and Installation (Refer to GROUP 21C, Clutch [P.21C-2](#)).
- Automatic Transaxle Assembly Removal and Installation (Refer to GROUP 23A, Transaxle <A/T> [P.23A-418](#)).



AC406181AB

- REMOVAL STEPS <M/T>**
- <<A>> >>B<< 1. FLYWHEEL BOLTS
2. FLYWHEEL
- >>A<< 6. CRANKSHAFT REAR OIL SEAL

- REMOVAL STEPS <A/T>**
- <<A>> >>B<< 3. DRIVE PLATE BOLTS
4. ADAPTOR PLATE
5. DRIVE PLATE
- >>A<< 6. CRANKSHAFT REAR OIL SEAL

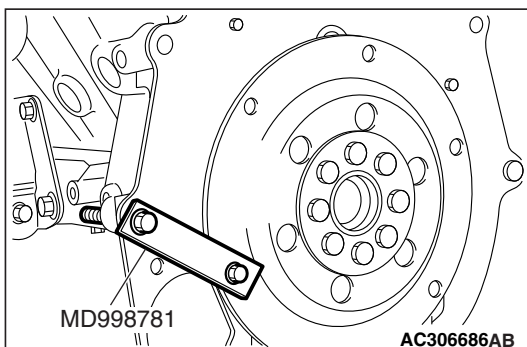
Required Special Tools:

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

REMOVAL SERVICE POINT

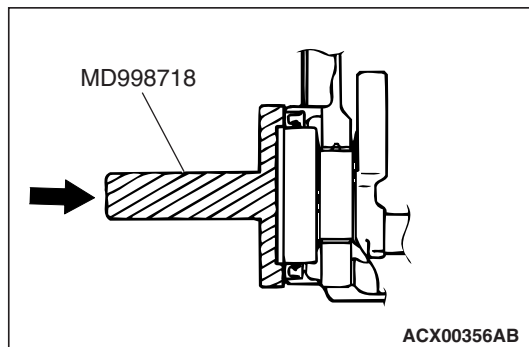
<<A>> FLYWHEEL BOLTS/DRIVE PLATE BOLTS REMOVAL

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

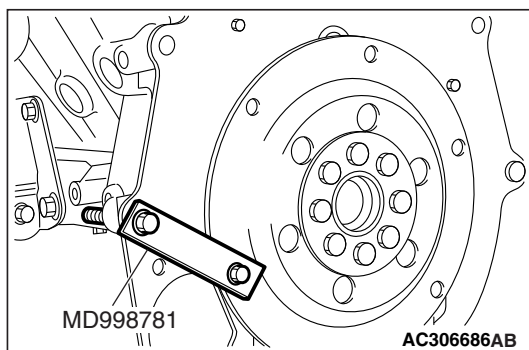


INSTALLATION SERVICE POINTS**>>A<< CRANKSHAFT REAR OIL SEAL INSTALLATION**

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

**>>B<< DRIVE PLATE BOLTS/FLYWHEEL BOLTS INSTALLATION**

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



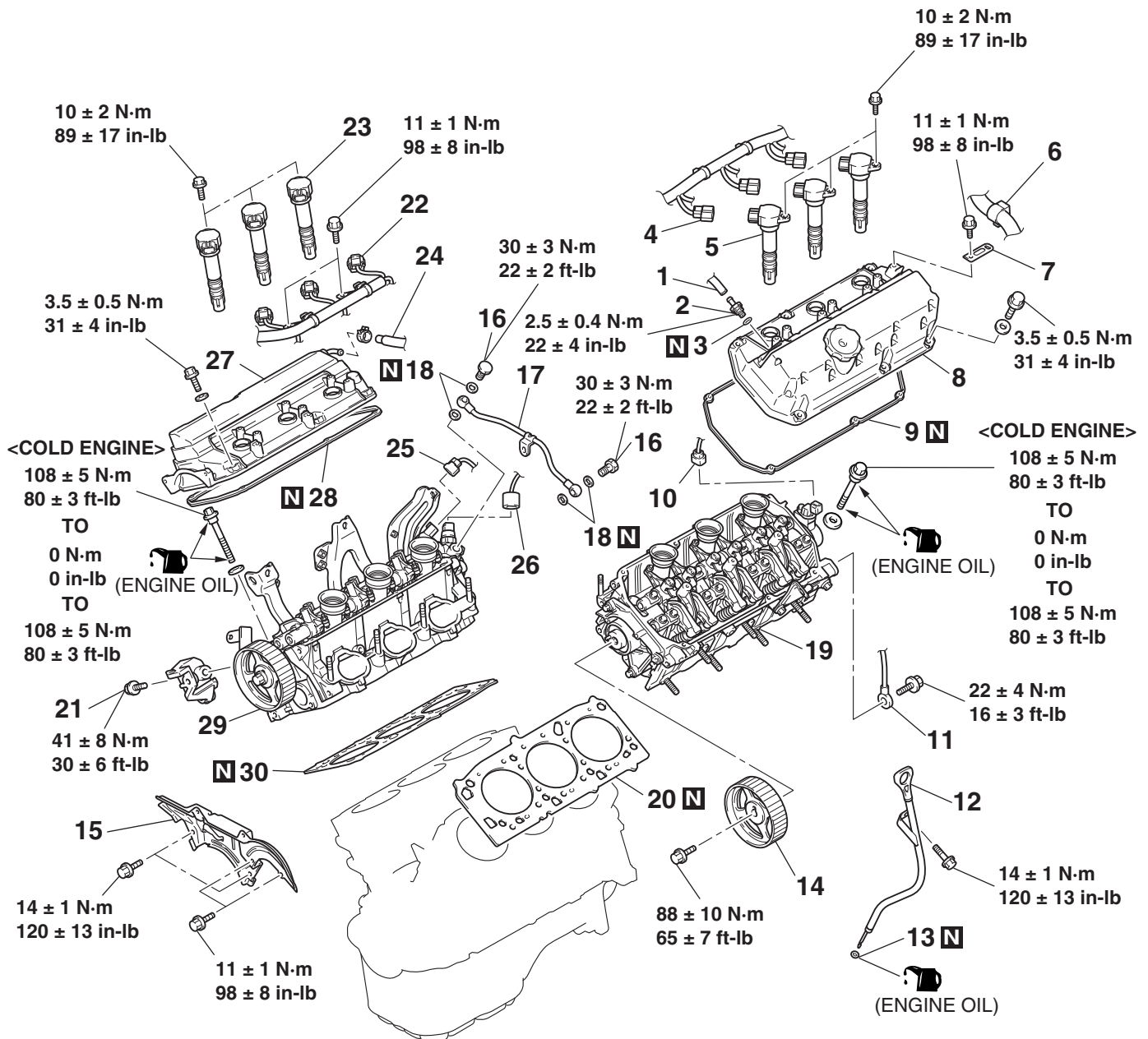
CYLINDER HEAD GASKET

REMOVAL AND INSTALLATION

M1112004003847

Pre-removal and Post-installation Operation

- Intake Manifold Removal and Installation (Refer to GROUP 15, Intake Manifold P.15-14).
- Exhaust Manifold Removal and Installation (Refer to GROUP 15, Exhaust Manifold P.15-20).
- Timing Belt Removal and Installation (Refer to P.11C-65).
- Thermostat Housing Removal and Installation (Refer to GROUP 14, Water Hose and Water Pipe P.14-40).
- Generator Removal and Installation (Refer to GROUP 16, Generator Assembly P.16-14).



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REMOVAL STEPS

1. PCV HOSE CONNECTION
 2. PCV VALVE
 3. O-RING
 4. IGNITION COIL CONNECTOR
 5. IGNITION COIL
 6. ENGINE CONTROL WIRING HARNESS CLAMP
 7. HARNESS BRACKET
 8. ROCKER COVER
 9. ROCKER COVER GASKET
 10. CAMSHAFT POSITION SENSOR CONNECTOR
 11. GROUNDING
 12. ENGINE OIL DIPSTICK ASSEMBLY
 13. O-RING
 14. CAMSHAFT SPROCKET
 15. TIMING BELT REAR CENTER COVER
 16. EYE BOLT
 17. OIL FEEDER CONTROL VALVE PIPE
 18. GASKET

<<A>> >>D<<

>>C<<

>>C<<

>>C<<

<>

>>B<<

>>A<<

<>

>>B<<

>>A<<

REMOVAL STEPS (Continued)

19. LEFT BANK CYLINDER HEAD ASSEMBLY
 20. CYLINDER HEAD GASKET
 • POWER STEERING OIL PUMP ASSEMBLY (REFER TO GROUP 37, POWER STEERING OIL PUMP ASSEMBLY P.37-56).
 21. POWER STEERING OIL PUMP BRACKET BOLT
 22. IGNITION COIL CONNECTOR
 23. IGNITION COIL
 24. BREATHER HOSE CONNECTION
 25. ENGINE OIL CONTROL VALVE CONNECTOR
 26. ENGINE OIL PRESSURE SWITCH CONNECTOR
 27. ROCKER COVER
 28. ROCKER COVER GASKET
 29. RIGHT BANK CYLINDER HEAD ASSEMBLY
 30. CYLINDER HEAD GASKET

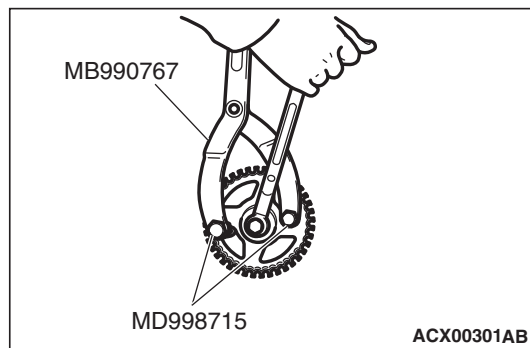
Required Special Tools:

- MB990767: Front Hub and Flange Yoke Holder
- MD998051: Cylinder Head Bolt Wrench
- MD998715: Crankshaft Pulley Holder Pin

REMOVAL SERVICE POINTS

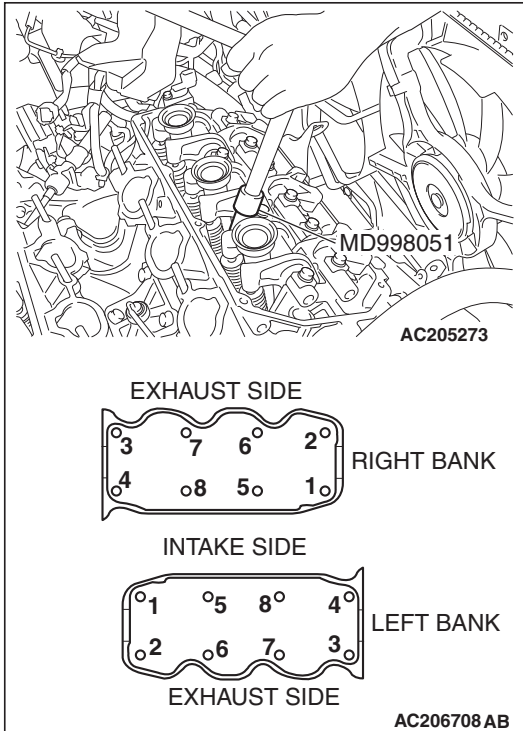
<<A>> CAMSHAFT SPROCKET REMOVAL

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



<> CYLINDER HEAD ASSEMBLY REMOVAL

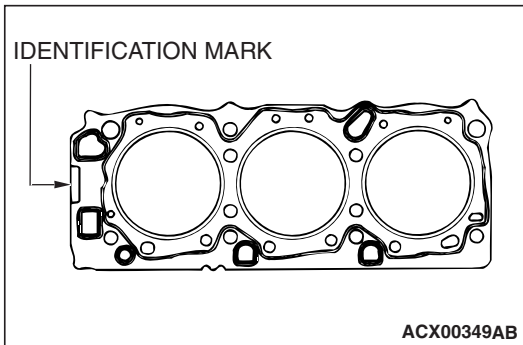
Use special tool MD998051 to loosen each bolt in two or three steps in the order shown in the illustration.



INSTALLATION SERVICE POINTS

>>A<< CYLINDER HEAD GASKET INSTALLATION

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

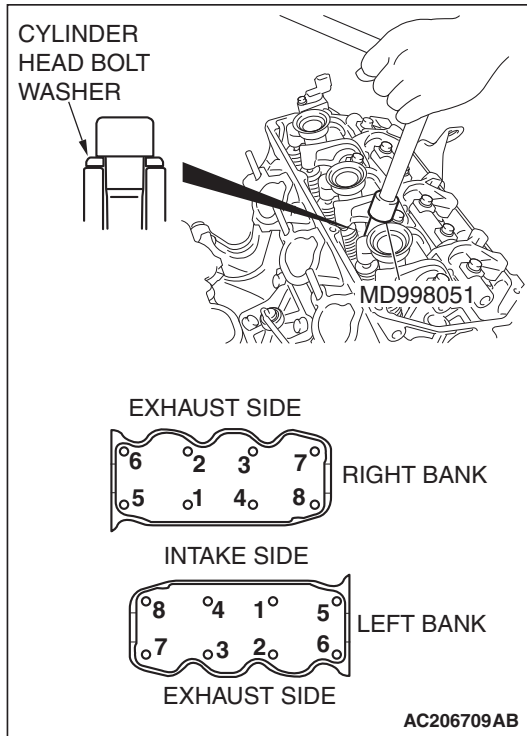


>>B<< CYLINDER HEAD ASSEMBLY INSTALLATION

⚠ CAUTION

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

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

**⚠ CAUTION**

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

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

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

>>C<< GASKET/OIL FEEDER CONTROL VALVE PIPE/ EYE BOLT INSTALLATION**⚠ CAUTION**

Install the oil feeder control valve pipe as follows so that the pipe is not deformed.

- Install a gasket to one of oil feeder control valve pipes and tighten the eye bolt by hand.
- Install a gasket to the other oil feeder control valve pipe and tighten the eye bolt to the specified torque.

Tightening torque: $30 \pm 3 \text{ N}\cdot\text{m}$ ($22 \pm 2 \text{ ft}\cdot\text{lb}$)

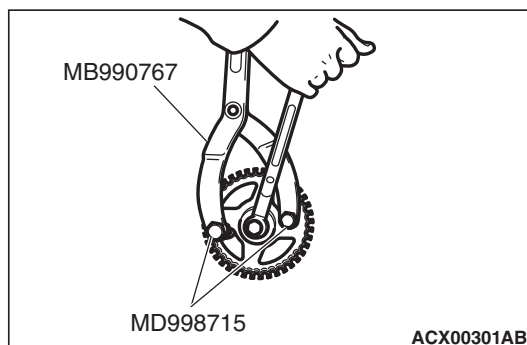
- Tighten the eye bolt which is temporarily tightened by step 1 to the specified torque.

Tightening torque: $30 \pm 3 \text{ N}\cdot\text{m}$ ($22 \pm 2 \text{ ft}\cdot\text{lb}$)

>>D<< CAMSHAFT SPROCKET INSTALLATION

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

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



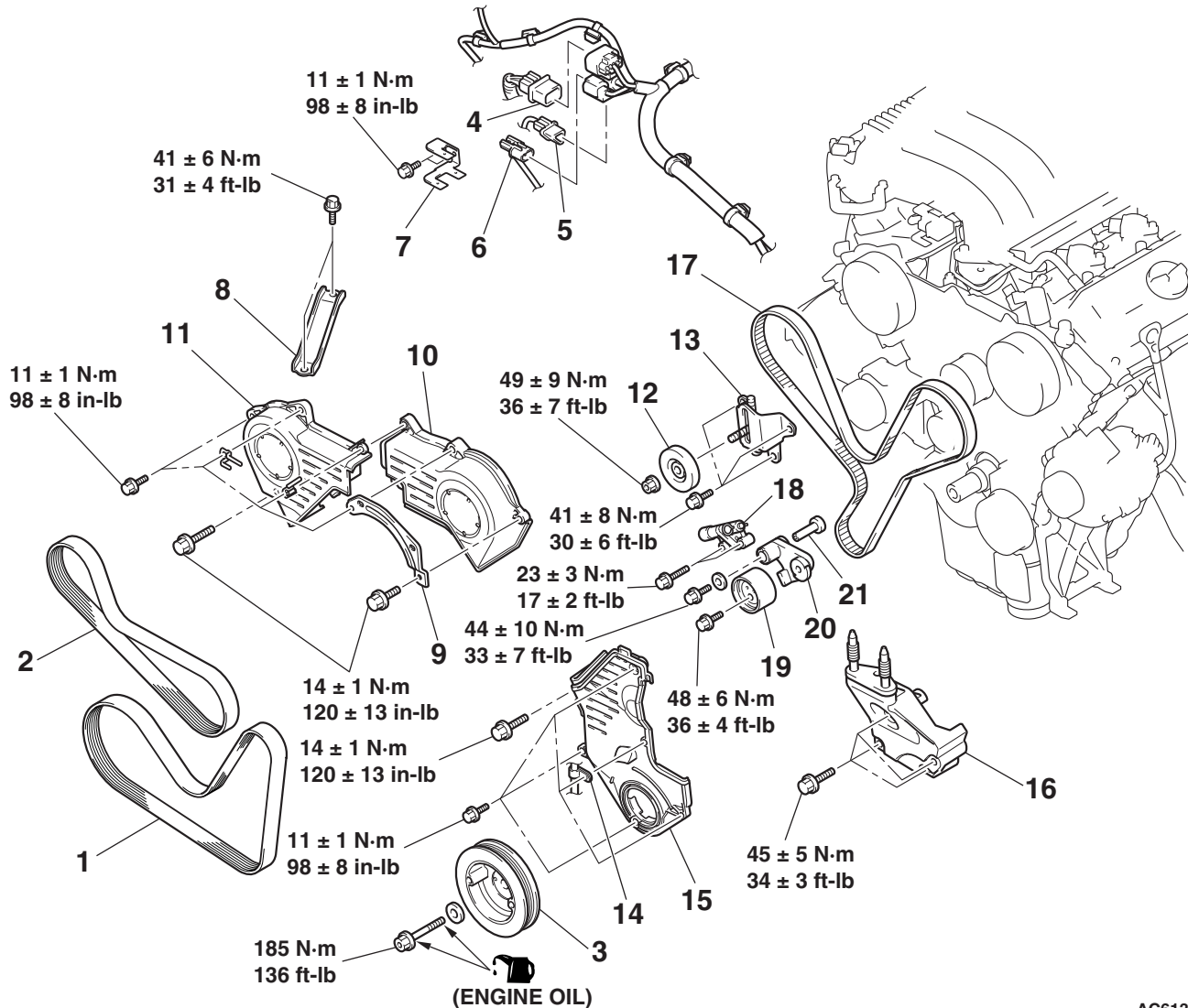
TIMING BELT

REMOVAL AND INSTALLATION

M1112004302061

Pre-removal and Post-installation Operation

- Engine Cover Removal and Installation (Refer to P.11C-24).
- Under Cover Removal and Installation (Refer to GROUP 51, Under Cover P.51-8).
- Side Under Cover Removal and Installation (Refer to GROUP 51, Under Cover P.51-8).



AC613154AB

REMOVAL STEPS

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

REMOVAL STEPS (Continued)

6. CRANKSHAFT POSITION SENSOR CONNECTOR
7. CONNECTOR BRACKET
8. ENGINE MOUNTING STAY
9. CONNECTOR BRACKET
10. TIMING BELT FRONT UPPER COVER, LEFT
11. TIMING BELT FRONT UPPER COVER, RIGHT
12. TENSIONER PULLEY

<<A>> >>E<<

REMOVAL STEPS (Continued)

13. TENSIONER BRACKET
 14. CRANKSHAFT POSITION
 SENSOR HARNESS CLAMP
 15. TIMING BELT LOWER COVER
 • ENGINE FRONT MOUNTING
 BRACKET (REFER TO GROUP
 32, ENGINE MOUNTING [P.32-4](#)).
 16. ENGINE SUPPORT BRACKET
 <> >>D<< 17. TIMING BELT *2
 <> >>C<< 17. TIMING BELT *1

REMOVAL STEPS (Continued)

- >>B<< 18. AUTO-TENSIONER *2
 >>A<< 18. AUTO-TENSIONER *1
 19. TENSIONER PULLEY
 20. TENSIONER ARM
 21. SHAFT

NOTE:

*1: In case that the amount of rod protrusion is 5 mm with the set pin inserted.

*2: In case that the amount of rod protrusion is 1 mm with the set pin inserted.

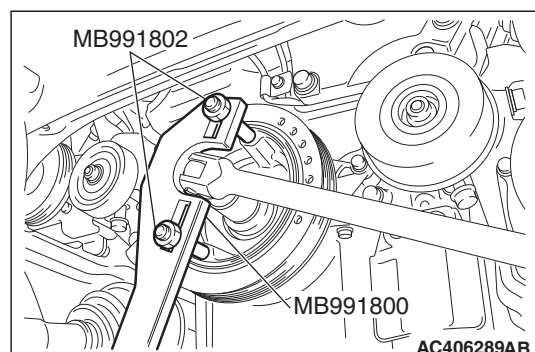
Required Special Tools:

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

REMOVAL SERVICE POINTS**<<A>> CRANKSHAFT PULLEY REMOVAL****⚠ CAUTION**

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

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

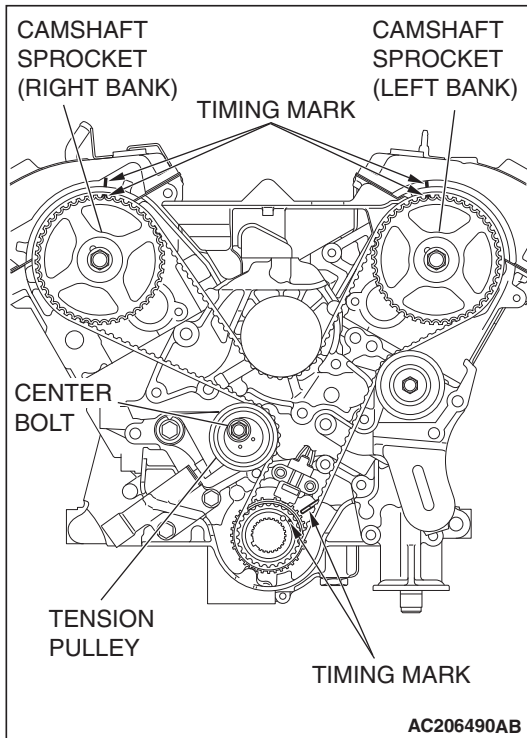


<> TIMING BELT REMOVAL

CAUTION

Never turn the crankshaft counterclockwise.

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



INSTALLATION SERVICE POINTS

>>A<< AUTO-TENSIONER INSTALLATION

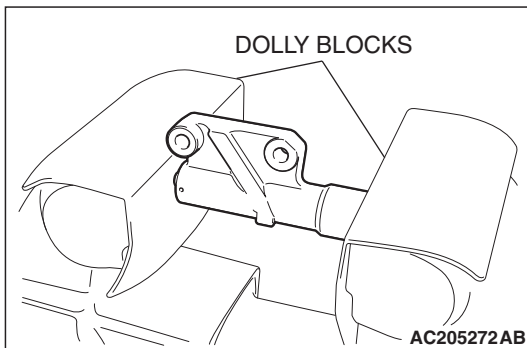
<In case that the amount of rod protrusion is 5 mm with the set pin inserted.>

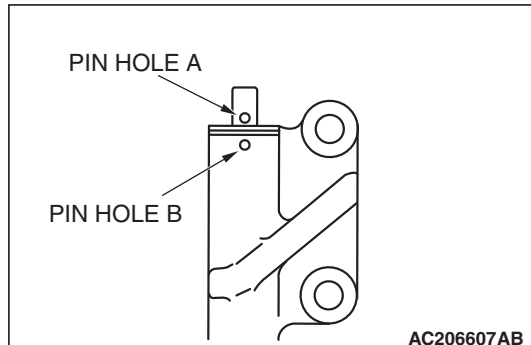
1. If the auto-tensioner rod remains fully extended, set according to the following procedure.

CAUTION

Place the auto-tensioner perpendicular to the jaws of the vice.

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



**⚠ CAUTION**

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

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

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

⚠ CAUTION

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

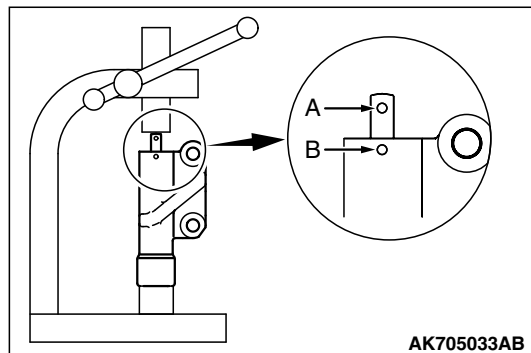
- (4) Install the auto-tensioner to the engine.

>>B<< AUTO-TENSIONER INSTALLATION

<In case that the amount of rod protrusion is 1 mm with the set pin inserted.>

⚠ CAUTION

- If the lateral type press is used, the appropriate air bleeding is not carried out. Always use longitudinal type press.
- To prevent damage to the auto tensioner, do not apply the load of 5,000N (1,124 lb) or more.
- To prevent damage to the auto tensioner, do not press the rod below the cylinder end plane.



1. Set the auto tensioner to the longitudinal type press as shown in the illustration.
2. Push in the rod little by little with the longitudinal type press until set hole A in the rod is aligned with hole B in the cylinder.

⚠ CAUTION

To prevent the air from being incorporated, keep the auto tensioner with its rod upward after the air bleeding.

3. Insert the set pin into the set holes. This auto-tensioner setting pin will be used during timing belt alignment.

>>C<< TIMING BELT INSTALLATION

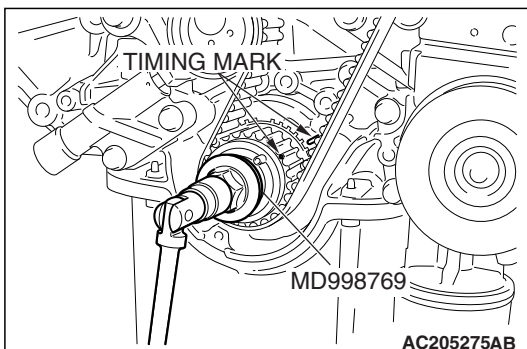
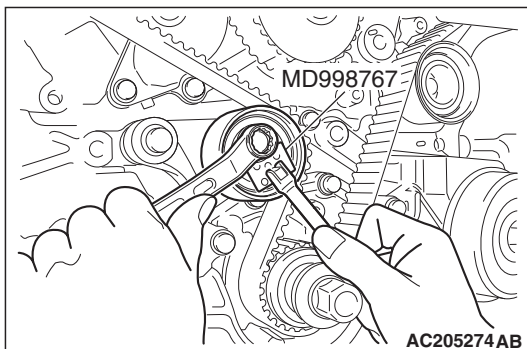
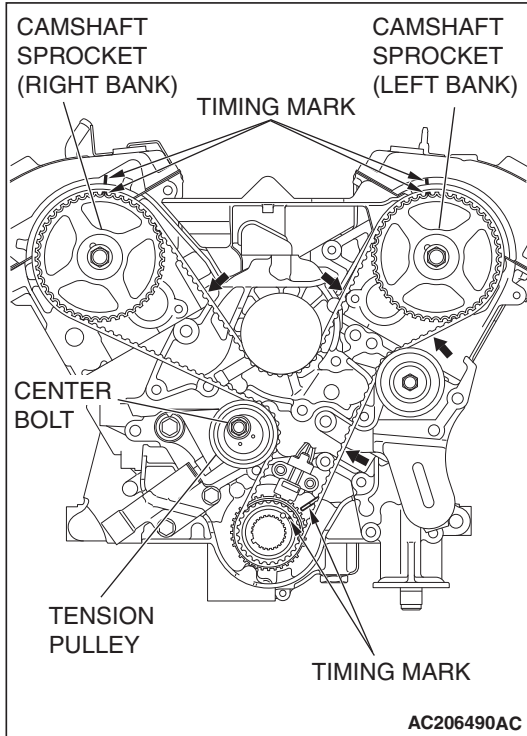
<In case that the amount of rod protrusion is 5 mm with the set pin inserted.>

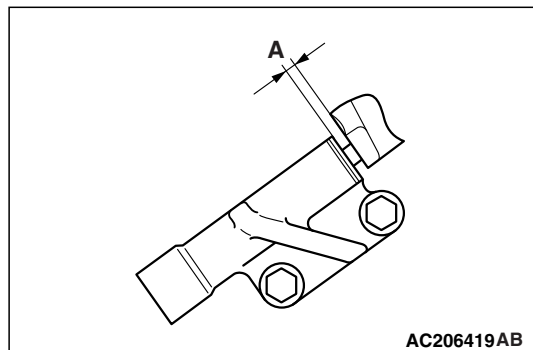
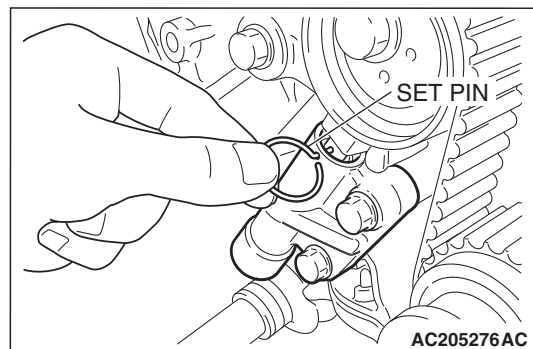
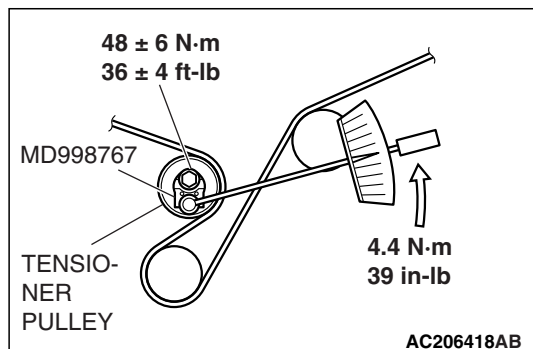
1. Align the timing marks on the camshaft sprockets with those on the rocker cover and the timing mark on the crankshaft sprocket with that on the engine block as shown in the illustration.

⚠ CAUTION

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

2. Install the timing belt by the following procedure so that there is no deflection in the timing belt between each sprocket and pulley.
 - (1) Crankshaft sprocket
 - (2) Idler pulley
 - (3) Camshaft sprocket (Left bank)
 - (4) Water pump pulley
 - (5) Camshaft sprocket (Right bank)
 - (6) Tensioner pulley
3. Turn the camshaft sprocket (Right bank) counterclockwise until the tension side of the timing belt is firmly stretched. Check all the timing marks again.
4. Use special tool MD998767 to push the tensioner pulley into the timing belt, then temporarily tighten the center bolt.
5. Use special tool MD998769 to turn the crankshaft 1/4 turn counterclockwise, then turn it again clockwise until the timing marks are aligned.



**⚠ CAUTION**

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

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

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

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

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

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

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

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

10. If not, repeat steps 1 through 8 above.

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

>>D<< TIMING BELT INSTALLATION

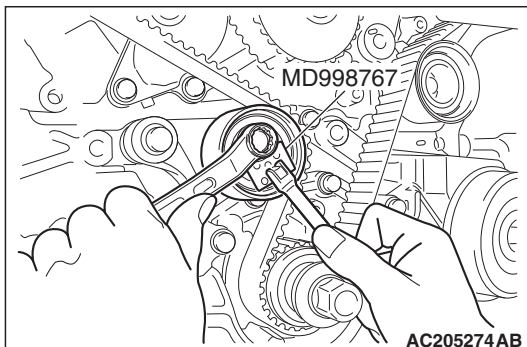
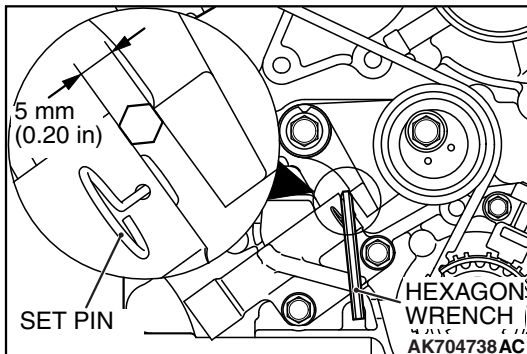
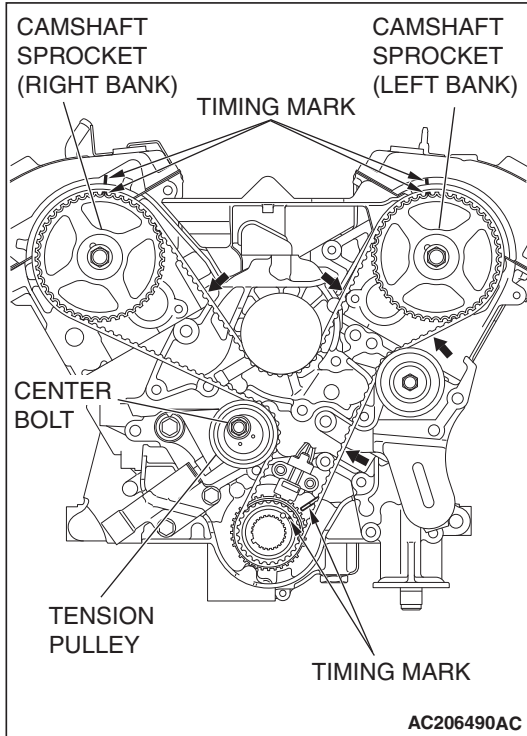
<In case that the amount of rod protrusion is 1 mm with the set pin inserted.>

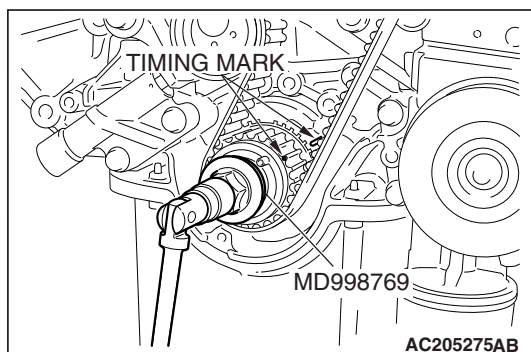
1. Align the timing marks on the camshaft sprockets with those on the rocker cover and the timing mark on the crankshaft sprocket with that on the engine block as shown in the illustration.

⚠ CAUTION

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

2. Install the timing belt by the following procedure so that there is no deflection in the timing belt between each sprocket and pulley.
 - (1) Crankshaft sprocket
 - (2) Idler pulley
 - (3) Camshaft sprocket (Left bank)
 - (4) Water pump pulley
 - (5) Camshaft sprocket (Right bank)
 - (6) Tensioner pulley
3. Turn the camshaft sprocket (Right bank) counterclockwise until the tension side of the timing belt is firmly stretched. Check all the timing marks again.
4. Insert the hexagonal wrench having the width of 5 mm (0.20 inch) between the auto-tensioner and tensioner arm.
5. Inserting the hexagonal wrench, use special tool MD998767 to push the tensioner pulley into the timing belt, then temporarily tighten the center bolt.

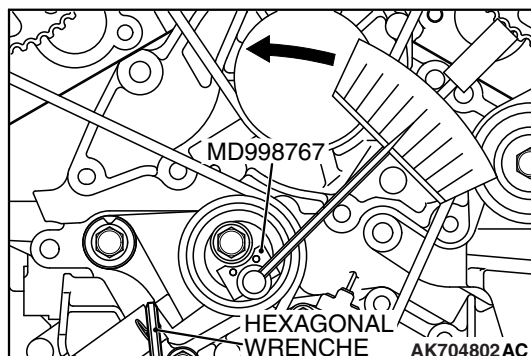




6. Use special tool MD998769 to turn the crankshaft 1/4 turn counterclockwise, then turn it again clockwise until the timing marks are aligned.

CAUTION

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



7. Inserting the hexagonal wrench, loosen the center bolt of the tensioner pulley. Use special tool MD998767 and a torque wrench to apply the tension torque to the timing belt as shown in the illustration. Then tighten the center bolt to the specified torque.

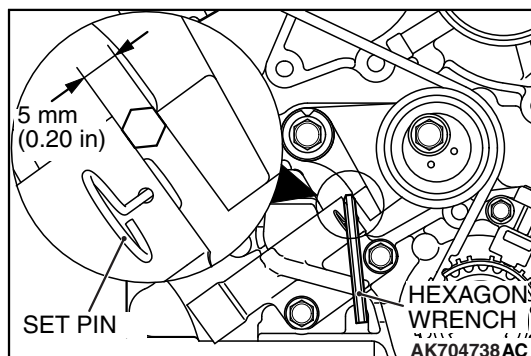
Standard value: 4.4 N·m (39 in-lb) <Timing belt tension torque>

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

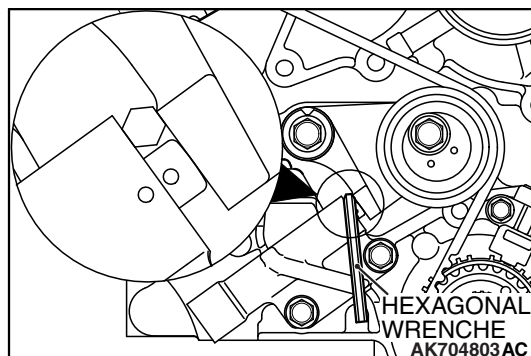
CAUTION

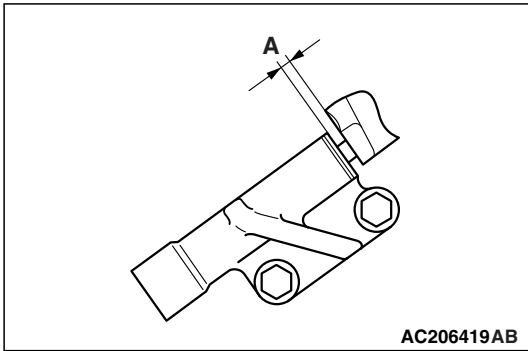
If the hexagonal wrench is removed first, the timing belt would possibly become loose and come off the tooth.

8. Remove the set pin that has been inserted into the auto-tensioner.



9. Pull out the hexagonal wrench.
10. Turn the crankshaft clockwise twice to align the timing marks.



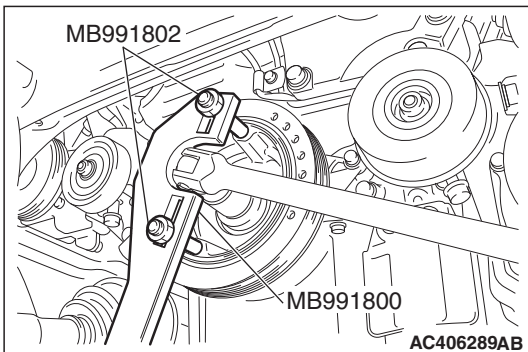


11.Wait for at least five minutes, then check that the auto-tensioner pushrod extends within the standard value range.

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

12.If not, repeat steps 1 through 10 above.

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



>>E<< CRANKSHAFT PULLEY INSTALLATION

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

INSPECTION

M1112004401021

AUTO-TENSIONER CHECK

1. Check for oil leak from seal, and replace it if leak is detected.
2. Check for wear or damage at the top of the rod. Replace it, if required.
3. While holding the auto-tensioner with your hand, press the end of the pushrod against a metal surface (such as the cylinder block) with a force of 98 – 196 N (22 – 44 pounds) and measure how far the pushrod is pushed in.

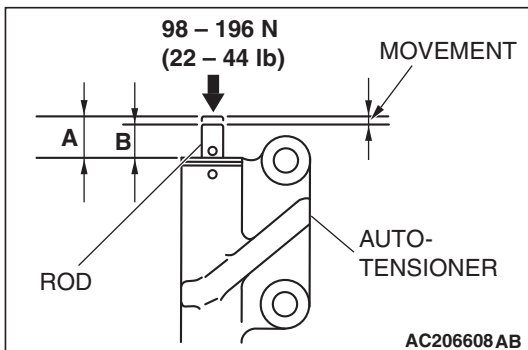
Standard value: Within 1 mm (0.04 inch)

A: Length when no force is applied

B: Length when force is applied

A – B: Movement in

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



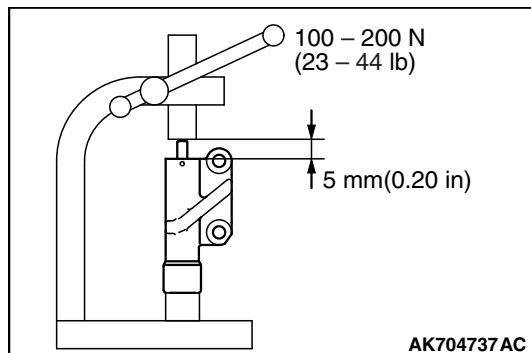
**AIR BLEEDING PROCEDURE OF
AUTO-TENSIONER**

<In case that the amount of rod protrusion is 1 mm with the set pin inserted.>

When the auto tensioner is not kept with its rod upward, or when the set pin having $\phi 2$ mm (0.08 inch) is pulled out before the installation to the engine, carry out the air bleeding as follows.

⚠ CAUTION

- If the lateral type press is used, the appropriate air bleeding is not carried out. Always use longitudinal type press.
- To prevent damage to the auto tensioner, do not apply the load of 5,000N (1,124 lb) or more.
- To prevent damage to the auto tensioner, do not press the rod below the cylinder end plane.



1. Set the auto tensioner to the longitudinal type press as shown in the illustration.
2. Slowly press down the rod, two or three times, to the cylinder end plane.
3. When the rod protrusion has approximately 5 mm (0.20 inch), apply the load of 100 – 200N (23 – 44 lb). Check whether the auto tensioner has sufficient stiffness.
4. If the auto tensioner does not have sufficient stiffness, replace the auto tensioner.

⚠ CAUTION

To prevent the air from being incorporated, keep the auto tensioner with its rod upward after the air bleeding.

5. Slowly pressing down the rod, insert the set pin having $\phi 2$ mm (0.08 inch) through the hole to fix the auto tensioner.

SPECIFICATIONS

FASTENER TIGHTENING SPECIFICATIONS

M1112005800160

ITEM		SPECIFICATION
Camshaft and valve stem seal		
Camshaft oil seal case bolt		24 ± 3 N·m (18 ± 2 ft-lb)
Camshaft position sensing cylinder bolt		22 ± 4 N·m (16 ± 3 ft-lb)
Camshaft position sensor bolt		11 ± 1 N·m (98 ± 8 in-lb)
Camshaft position sensor support bolt		14 ± 1 N·m (120 ± 13 in-lb)
Camshaft sprocket bolt		88 ± 10 N·m (65 ± 7 ft-lb)
Cylinder head plug		47 ± 7 N·m (35 ± 5 ft-lb)
Engine oil control valve bolt		11 ± 1 N·m (98 ± 8 in-lb)
Engine oil pressure switch		10 ± 2 N·m (89 ± 17 in-lb)
Harness bracket bolt		11 ± 1 N·m (98 ± 8 in-lb)
Ignition coil bolt		10 ± 2 N·m (89 ± 17 in-lb)
Intake manifold plenum stay bolt		49 ± 6 N·m (37 ± 4 ft-lb)
Oil feeder control valve housing bolt		24 ± 3 N·m (18 ± 2 ft-lb)
Oil feeder control valve pipe bolt		11 ± 1 N·m (98 ± 8 in-lb)
Oil feeder control valve pipe eye bolt		30 ± 3 N·m (22 ± 2 ft-lb)
PCV valve		2.5 ± 0.4 N·m (22 ± 4 in-lb)
Power steering oil pump bracket connecting bolt		41 ± 8 N·m (30 ± 6 ft-lb)
Rocker cover bolt		3.5 ± 0.5 N·m (31 ± 4 in-lb)
Rocker shaft bolt (Intake side)		31 ± 3 N·m (23 ± 2 ft-lb)
Rocker shaft bolt (Exhaust side)		13 ± 1 N·m (115 ± 9 in-lb)
Throttle body stay bolt		22 ± 1 N·m (16 ± 1 ft-lb)
Timing belt rear center cover bolt	M6	11 ± 1 N·m (98 ± 8 in-lb)
	M8	14 ± 1 N·m (120 ± 13 in-lb)
Camshaft oil seal		
Camshaft sprocket bolt		88 ± 10 N·m (65 ± 7 ft-lb)
Crankshaft oil seal		
A/T drive plate bolt		74 ± 1 N·m (55 ± 1 ft-lb)
Crankshaft position sensor bolt		8.5 ± 0.5 N·m (76 ± 4 in-lb)
Flywheel bolt		74 ± 2 N·m (55 ± 1 ft-lb)
Cylinder head gasket		
Camshaft sprocket bolt		88 ± 10 N·m (65 ± 7 ft-lb)
Cylinder head bolt <Cold engine>		108 ± 5 N·m (80 ± 3 ft-lb) to 0 N·m (0 in-lb) to 108 ± 5 N·m (80 ± 3 ft-lb)
Engine oil dipstick bolt		14 ± 1 N·m (120 ± 13 in-lb)
Grounding connecting bolt		22 ± 4 N·m (16 ± 3 ft-lb)
Harness bracket bolt		11 ± 1 N·m (98 ± 8 in-lb)
Ignition coil bolt		10 ± 2 N·m (89 ± 17 in-lb)

ITEM		SPECIFICATION
Oil feeder control valve pipe eye bolt		30 ± 3 N·m (22 ± 2 ft-lb)
PCV valve		2.5 ± 0.4 N·m (22 ± 4 in-lb)
Power steering oil pump bracket connecting bolt		41 ± 8 N·m (30 ± 6 ft-lb)
Rocker cover bolt		3.5 ± 0.5 N·m (31 ± 4 in-lb)
Timing belt rear center cover bolt	M6	11 ± 1 N·m (98 ± 8 in-lb)
	M8	14 ± 1 N·m (120 ± 13 in-lb)
Engine assembly		
Engine cover bolt		3.0 ± 0.5 N·m (27 ± 4 in-lb)
Engine front mounting bracket bolt	M10	58 ± 7 N·m (43 ± 5 ft-lb)
Engine front mounting bracket bolt and nut	M12	83 ± 12 N·m (61 ± 9 ft-lb)
Engine mounting stay bolt		41 ± 6 N·m (31 ± 4 ft-lb)
Engine hanger bolt		35 ± 6 N·m (26 ± 4 ft-lb)
Engine oil dipstick bolt		14 ± 1 N·m (120 ± 13 in-lb)
Grounding bolt and nut		9.0 ± 2.0 N·m (80 ± 17 in-lb)
Grounding cable bolt		9.0 ± 2.0 N·m (80 ± 17 in-lb)
Intake manifold plenum stay (rear) bolt	M8	22 ± 1 N·m (16 ± 1 ft-lb)
	M10	49 ± 6 N·m (37 ± 4 ft-lb)
Power steering oil pump bolt		46 ± 8 N·m (34 ± 6 ft-lb)
Power steering oil pump nut		42 ± 7 N·m (31 ± 5 ft-lb)
Power steering oil reservoir connecting nut		12 ± 2 N·m (102 ± 22 in-lb)
Power steering pressure hose clamp bracket bolt		12 ± 2 N·m (102 ± 22 in-lb)
Starter bolt		30 ± 3 N·m (23 ± 2 ft-lb)
Starter terminal nut		12 ± 2 N·m (102 ± 22 in-lb)
Throttle body stay bolt		22 ± 1 N·m (16 ± 1 ft-lb)
Oil pan and oil screen		
Baffle plate bolt		11 ± 1 N·m (97 ± 9 in-lb)
Cover bolt		11 ± 0.5 N·m (93 ± 4 in-lb)
Engine oil dipstick bolt		14 ± 1 N·m (120 ± 13 in-lb)
Engine lower oil pan bolt		11 ± 1 N·m (97 ± 9 in-lb)
Engine oil pan drain plug		39 ± 5 N·m (29 ± 3 ft-lb)
Engine upper oil pan bolt		8.5 ± 3.5 N·m (76 ± 31 in-lb)
Engine upper oil pan to torque converter bolt		36 ± 5 N·m (26 ± 4 ft-lb)
Oil screen bolt		19 ± 3 N·m (14 ± 2 ft-lb)
Starter bolt		30 ± 3 N·m (23 ± 2 ft-lb)
Starter terminal nut		12 ± 2 N·m (102 ± 22 in-lb)
Torque converter connecting bolt <A/T>		49 ± 3 N·m (36 ± 2 ft-lb)
Timing belt		
Auto-tensioner bolt		23 ± 3 N·m (17 ± 2 ft-lb)
Crankshaft pulley center bolt		185 N·m (136 ft-lb)
Engine mounting stay bolt		41 ± 6 N·m (31 ± 4 ft-lb)

ITEM		SPECIFICATION
Engine support bracket bolt		45 ± 5 N·m (34 ± 3 ft-lb)
Harness bracket bolt		11 ± 1 N·m (98 ± 8 in-lb)
Tensioner arm bolt		44 ± 10 N·m (33 ± 7 ft-lb)
Tensioner bracket bolt		41 ± 8 N·m (30 ± 6 ft-lb)
Tensioner pulley bolt		48 ± 6 N·m (36 ± 4 ft-lb)
Tensioner pulley nut		49 ± 9 N·m (36 ± 7 ft-lb)
Timing belt lower cover bolt (bolt, flange)	M6	11 ± 1 N·m (98 ± 8 in-lb)
Timing belt lower cover bolt (bolt, washer assembled)	M10	14 ± 1 N·m (120 ± 13 in-lb)
Timing belt upper cover bolt (bolt, flange)	M6	11 ± 1 N·m (98 ± 8 in-lb)
	M8	14 ± 1 N·m (120 ± 13 in-lb)

SERVICE SPECIFICATIONS

M1112000301141

ITEM		STANDARD VALUE	LIMIT
Generator drive belt tension (When checked)	Vibration frequency Hz	143 – 169	–
	Tension N (lb)	490 – 686 (110 – 154)	–
	Deflection (Reference) mm (in)	8.4 – 10.7 (0.33 – 0.42)	–
Generator drive belt tension (When adjusted)	Vibration frequency Hz	150 – 163	–
	Tension N (lb)	539 – 637 (121 – 143)	–
	Deflection (Reference) mm (in)	8.9 – 10.1 (0.35 – 0.40)	–
Generator drive belt tension (When replaced)	Vibration frequency Hz	180 – 202	–
	Tension N (lb)	785 – 981 (176 – 221)	–
	Deflection (Reference) mm (in)	6.2 – 7.5 (0.24 – 0.30)	–
Power steering drive belt tension (When checked)	Vibration frequency Hz	124 – 160	–
	Tension N (lb)	294 – 490 (66 – 110)	–
	Deflection (Reference) mm (in)	12.3 – 16.2 (0.48 – 0.64)	–
Power steering drive belt tension (When adjusted)	Vibration frequency Hz	134 – 151	–
	Tension N (lb)	343 – 441 (77 – 99)	–
	Deflection (Reference) mm (in)	13.2 – 15.1 (0.52 – 0.59)	–
Power steering drive belt tension (When replaced)	Vibration frequency Hz	160 – 189	–
	Tension N (lb)	490 – 686 (110 – 154)	–
	Deflection (Reference) mm (in)	9.6 – 12.3 (0.38 – 0.48)	–

ITEM	STANDARD VALUE	LIMIT
Intake valve clearance (at cold) mm (in)	0.10 (0.004)	–
Basic ignition timing at idle	5°BTDC ± 3°	–
Actual ignition timing at curb idle	Approximately 10° BTDC	–
CO contents %	0.5 or less	–
HC contents ppm	100 or less	–
Curb idle speed r/min	680 ± 100	–
Compression pressure (200 r/min) kPa (psi)	1,550 (225)	Minimum 1,110 (161)
Compression pressure difference of all cylinder kPa (psi)	–	98 (14)
Intake manifold vacuum at curb idle kPa (in Hg)	–	Minimum 60 (18)
Timing belt tension torque N·m (in-lb)	4.4 (39)	–
Auto tensioner rod protrusion amount mm (in)	4.8 – 6.0 (0.19 – 0.24)	–
Auto-tensioner pushrod movement mm (in)	Within 1.0 (0.04)	–

SEALANTS

M1112000500573

ITEM	SPECIFIED SEALANT
Camshaft position sensor support	3M™ AAD Part No.8672, 3M™ AAD Part No.8679/8678 or equivalent
Engine oil pressure switch	
Engine upper oil pan	3M™ AAD Part No.8672, 8704, 3M™ AAD Part No.8679/8678 or equivalent
Engine lower oil pan	