GROUP 11A

ENGINE MECHANICAL

CONTENTS

WARNINGS REGARDING SERVICING OF SUPPLEMENTAL RESTRAINT SYSTEM (SRS) EQUIPPED VEHICLES

⚠ WARNING

- ***Improper service or maintenance of any component of the SRS, or any SRS-related component, can lead to personal injury or death to service personnel (from inadvertent firing of the air bag) or to the driver and passenger (from rendering the SRS inoperative).***
- ***Service or maintenance of any SRS component or SRS-related component must be performed only at an authorized MITSUBISHI dealer.***
- ***MITSUBISHI dealer personnel must thoroughly review this manual, and especially its GROUP 52B - Supplemental Restraint System (SRS) before beginning any service or maintenance of any component of the SRS or any SRS-related component.***

NOTE

The SRS includes the following components: SRS air bag control unit, SRS warning light, front impact sensors, driver's and passenger's (front) air bag modules, knee air bag module, side-airbag module, curtain air bag module, side impact sensors, seat belt pre-tensioners, clock spring, and interconnecting wiring. Other SRS-related components (that may have to be removed/installed in connection with SRS service or maintenance) are indicated in the table of contents by an asterisk (*).

GENERAL INFORMATION

M1111000101304

The 4B11 (2.0 L) engine is an in-line four-cylinder engine. The cylinder numbers are assigned as 1-2-3-4 from the front of the engine (timing belt side). The firing order is 1-3-4-2.

ITEMS			SPECIFICATIONS
Type			In-line DOHC
Number of cylinders			4
Bore mm (in)			86 (3.39)
Stroke mm (in)			86 (3.39)
Total displacement cm^3 (cu. in)			1,998 (121.9)
Compression ratio			9.0
Firing order			1-3-4-2
Valve timing	Intake valve	Opens (BTDC)	10° –35°
		Closes (ABDC)	62° –37°
	Exhaust valve	Opens (BBDC)	44° –9°
		Closes (ATDC)	0° –35°

ENGINE DIAGNOSIS

M1111000700392

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	Adjust valve clearance
	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.

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SYMPTOMS	PROBABLE CAUSE	REMEDY
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.

SERVICE SPECIFICATIONS

M1112000301389

Item		Standard value	Limit
Drive belt tension	Vibration frequency Hz (Reference)	98 –124	–
	Tension N (lb) (Reference)	248 –400 (56 – 90)	–
Valve clearance (at cold) mm (in)	Intake valve	0.20 ±0.03 (0.008 ±0.0012)	–
	Exhaust valve	0.03 ±0.03 (0.012 ±0.0012)	–
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		700 ±100	–
Compression pressure (200 r/min) kPa (psi)		1,090 (158)	Minimum 650 (95)
Compression pressure difference of all cylinder kPa (psi)		–	100 (14)
Intake manifold vacuum at curb idle kPa (in Hg)		–	Minimum 60 (18)

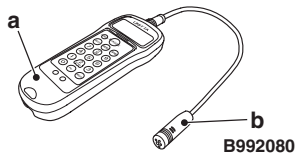
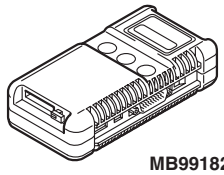
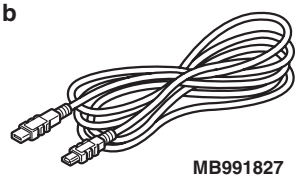
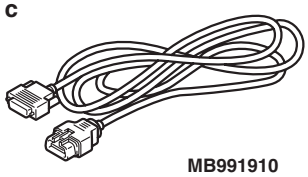
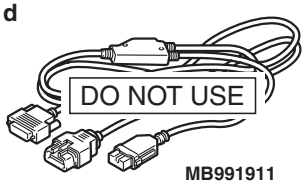
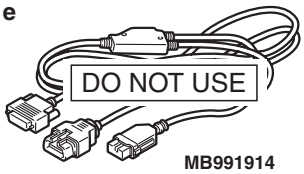
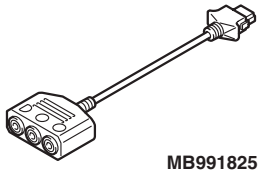
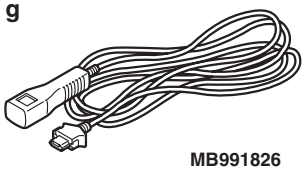
SEALANTS

M1112000501242

Item	Specified sealant
Rocker cover (matching area of the cylinder head and the timing chain case assembly)	Three bond 1217G (Mitsubishi Genuine Part No.1000A923), Three bond 1227D
Engine oil pan	Three bond 1217G (Mitsubishi Genuine Part No.1000A923), Three bond 1227D, Three bond 1207F (Mitsubishi Genuine Part No.MD970389), LOCTITE 5971, LOCTITE 5970, LOCTITE 5900
Flywheel bolt	Three bond 1324 or equivalent
Crankshaft rear oil seal case	Three bond 1227D, LOCTITE 5971
Cylinder head gasket (matching area of the cylinder block and the cylinder head)	Three bond 1217G (Mitsubishi Genuine Part No.1000A923)
Timing chain case assembly	Three bond 1217G (Mitsubishi Genuine Part No.1000A923)

SPECIAL TOOLS

M1112000601926

Tool	Tool number and name	Supersession	Application
	MB992080 Belt tension meter set a: MB9912081 Belt tension meter b: MB992082 Mic assembly	Tool not available	Drive belt tension (frequency) measurement
a  b  c  d  e  f  g 	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 Daimler Chrysler models only) f: MB991825 M.U.T.-III adapter harness g: MB991826 M.U.T.-III trigger harness	MB991824-KIT *NOTE: MB991826 M.U.T.-III Trigger Harness is not necessary when pushing V.C.I. ENTER key.*	**⚠ CAUTION** **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.** • Standard ignition timing check • Idle speed check

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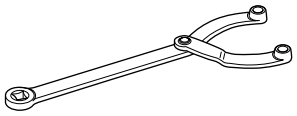
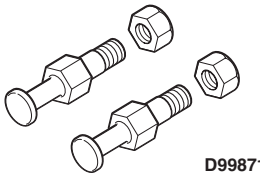
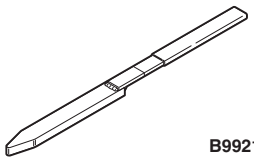
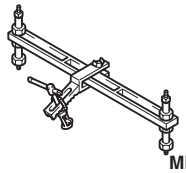
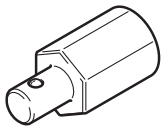
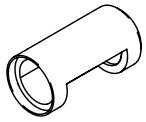
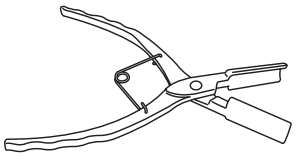
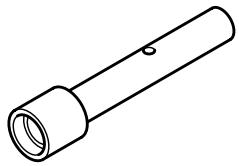
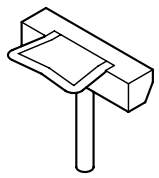
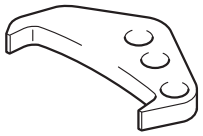
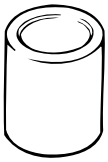
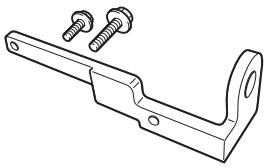
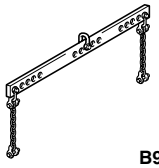
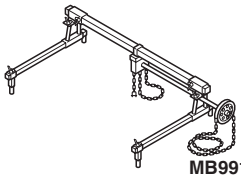
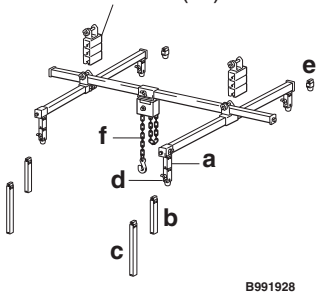
Tool	Tool number and name	Supersession	Application
 B990767	MB990767 Front hub and flange yoke holder	MB990767-01	Holding the camshaft sprocket
 D998719	MD998719 Pin	MIT308239	
 B992103	MB992103 Chain tension release bar	–	Camshaft and camshaft sprocket assembly (exhaust side) removal
 MD998772	MD998772 Valve spring compressor	General service tool	Valve spring compression
 B992090	MB992090 Retainer holder attachment	–	
	MB992089 Retainer holder C	–	
	MB992085 Valve stem seal pliers	–	Valve stem seal removal
	MD998737 Valve stem seal installer	MD998737-01	Valve stem seal press-fitting

Tool	Tool number and name	Supersession	Application
 D998727	MD998727 Oil pan FIPG cutter	MD998727-01	Oil pan removal
 MB991883	MB991883 Flywheel stopper	General service tool	Supporting the flywheel
	MB991448 Bush remover and installer base	MB991448-01	Press-fitting the crankshaft front oil seal
 B992201	MB992201 Engine hanger plate	–	Support of engine and transaxle assembly
 B991454	MB991454 Engine hanger balancer	MZ203827-01	Support of engine assembly
 MB991895	MB991895 Engine hanger	Tool not available	
Slide bracket (HI)  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	

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ON-VEHICLE SERVICE

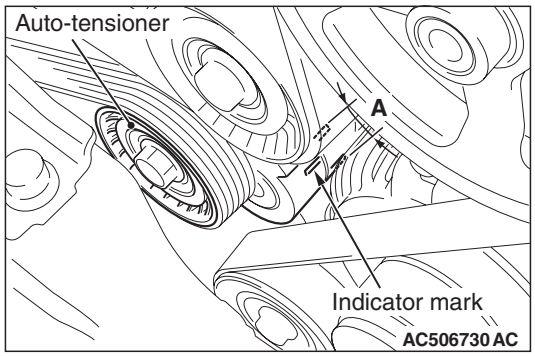
DRIVE BELT TENSION CHECK

M1111003102254

1. Remove the radiator condenser tank. (Refer to GROUP 14, Radiator P.14-31).

⚠ CAUTION

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



2. Make sure that the indicator mark on the auto-tensioner is within the area marked with A in the illustration.
3. If the mark is out of the area A, replace the drive belt (Refer to P.11A-21).

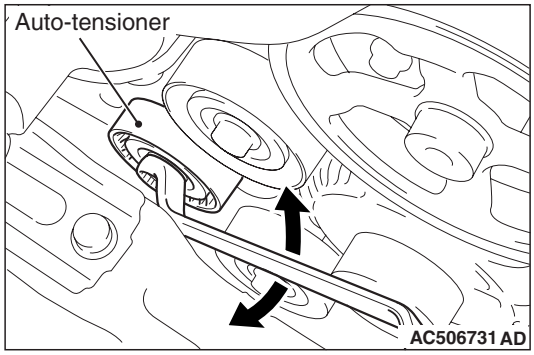
   NOTE: The drive belt tension check is not necessary as the auto-tensioner is adopted.
4. Install the radiator condenser tank. (Refer to GROUP 14, Radiator P.14-31).

AUTO-TENSIONER CHECK

M1111003001384

OPERATION CHECK

1. Stop the engine from the idle state.
2. Remove the radiator condenser tank. (Refer to GROUP 14, Radiator P.14-31).
3. Check that the drive belt is not protruding from the pulley width of the auto-tensioner.
4. Remove the drive belt (Refer to P.11A-21).



5. Rotate the pulley bolt of the auto-tensioner clockwise and counterclockwise with an offset wrench [45°, a long offset wrench (5/8 x 11/16 inches) recommended] to check for binding.
6. If there are any problems in the procedure 3 or 5, replace the auto-tensioner. (Refer to P.11A-69).
7. Install the drive belt. (Refer to P.11A-21).
8. Install the radiator condenser tank. (Refer to GROUP 14, Radiator P.14-31).

FUNCTION CHECK

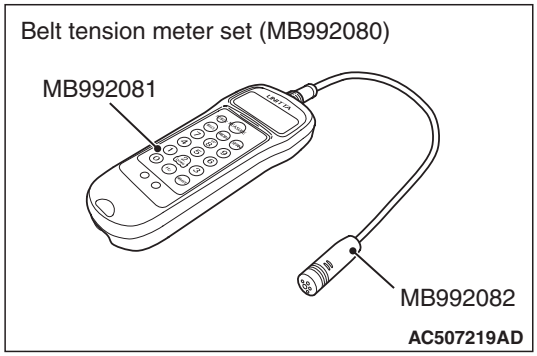
The auto-tensioner can be checked whether it is in good condition by checking its tension.

<When the vibration frequency is measured: Recommendation>

Required Special Tools:

- MB992080: Belt Tension Meter Set
  - MB992081: Belt Tension Meter
  - MB992082: Mic Assembly

1. Check the tension of the drive belt. (Refer to P.11A-8).



2. Check the tension of the drive belt in the following procedures.
   (1) Connect special tool microphone assembly (MB992082) to special tool belt tension meter (MB992081) of special tool belt tension meter set (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.

   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.
   (4) Press "Hz" button twice to change the display to the frequency display (Hz).

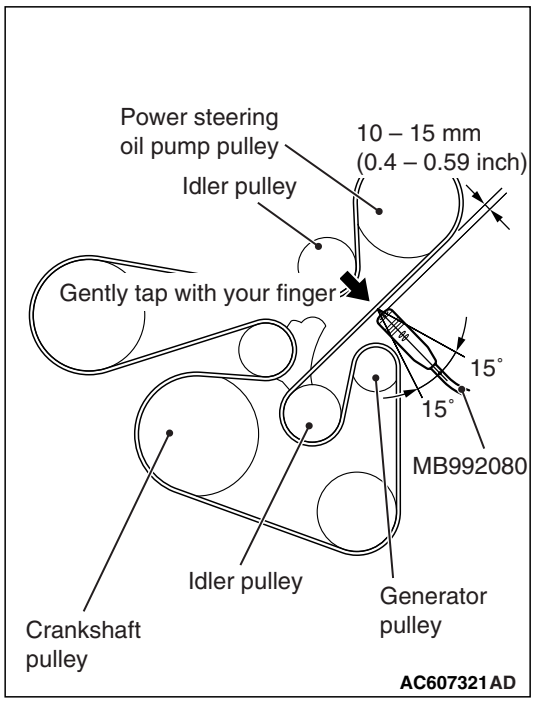
⚠ CAUTION

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

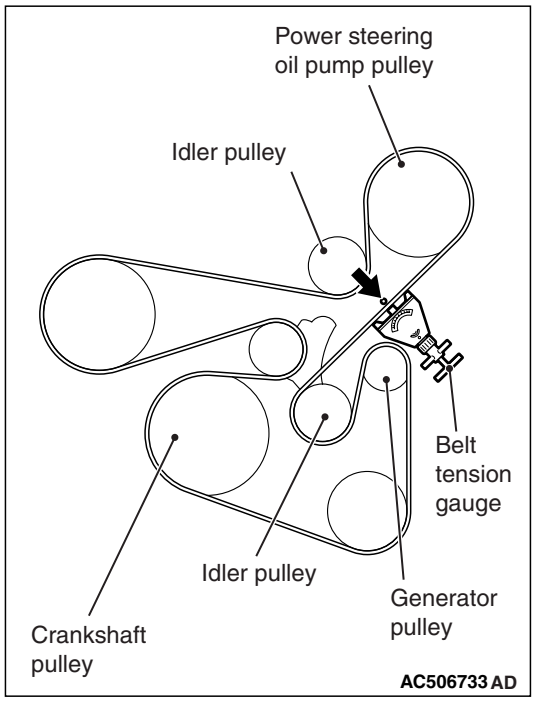
   (5) Hold special tool MB992080 to the middle of the belt between the pulleys (at the place indicated by arrow) where it does not contact the belt (approximately 10 –15 mm (0.4 –0.59 inch) away from the rear surface of the belt) so that it is perpendicular to the belt (within an angle of ±15 degree).
   (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 check that the vibration frequency of the belt is within the standard value.

   Standard value: 98 –124 Hz

   NOTE: To take the measurement repeatedly, tap the belt again.
   (8) Press and hold the "POWER" button to turn off the power supply.



3. If not within the standard value, replace the auto-tensioner. (Refer to P.11A-69).



<When using a tension gauge>

1. Check the tension of the drive belt. (Refer to P.11A-8).
2. Use a belt tension gauge in the middle of the belt between the pulleys shown in the figure (at the place indicated by the arrow) to check that the belt tension is within the standard value.

   Standard value: 248 –400 N (56 –90 lb)
3. If not within the standard value, replace the auto-tensioner. (Refer to P.11A-69).

VALVE CLEARANCE CHECK AND ADJUSTMENT

M1111001501093

Refer to GROUP00, General –Maintenance service –Intake And Exhaust Valve Clearance (Inspect And Adjust)

IGNITION TIMING CHECK

M1111001702216

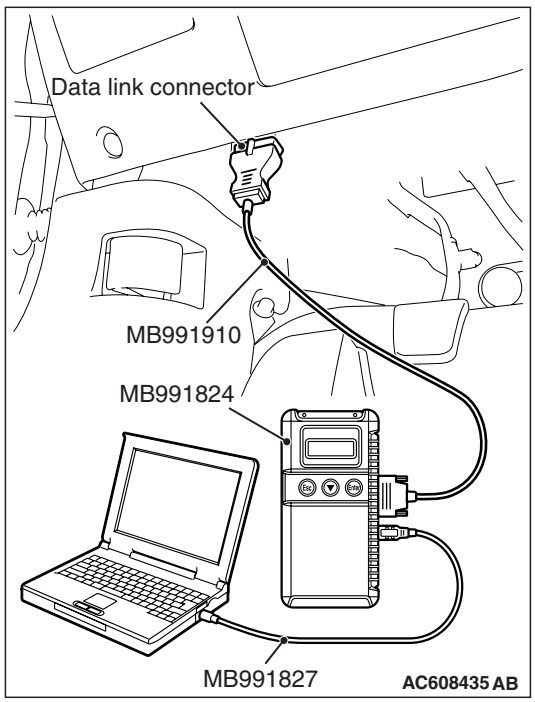
Required Special Tool:

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

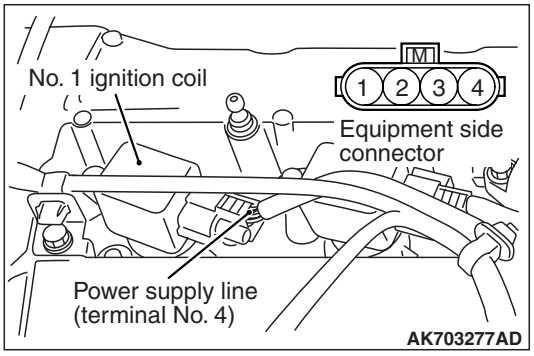
1. Before inspection, set the vehicle in the following condition:
   - Engine coolant temperature: 80 –95° C (176 –203° F)
   - Lights and all accessories: OFF
   - Transaxle: Neutral (P range on vehicles with TC-SST)

   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. Connect scan tool MB991958 to the data link connector.



3. Set the timing light to the power supply line (terminal No. 4) of the ignition coil No. 1.
4. Start the engine and run it at idle.
5. Check that the idle speed is approximately 700 r/min.
6. Select 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, refer to GROUP 13A, Multiport Fuel Injection (MFI) – Multiport Fuel Injection (MFI) Diagnosis –Symptom Chart P.13A-48.

⚠ 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 ±7° Before Top Dead Center, even under normal operating condition.

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

    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.

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⚠ 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.

12. Disconnect scan tool MB991958 from the data link connector.

CURB IDLE SPEED CHECK

M1111003502069

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

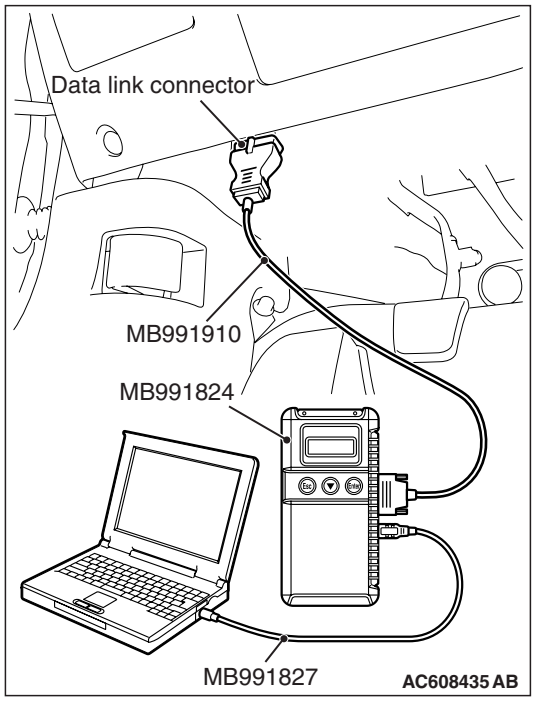
1. Before inspection, set the vehicle in the following condition:
   - Engine coolant temperature: 80 –95° C (176 –203° F)
   - Lights and all accessories: OFF
   - Transaxle: Neutral (P range on vehicles with TC-SST)

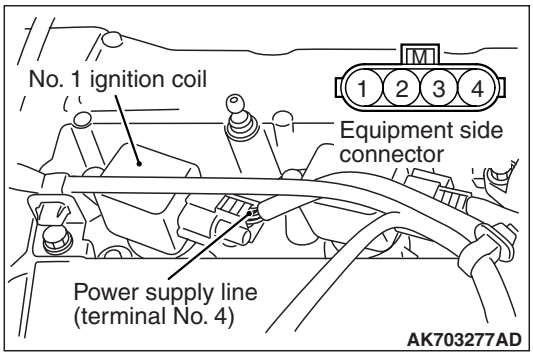
   NOTE: On vehicles for Canada, the headlight, taillight, etc. remain lit even when the lighting switch is in "OFF" position but this is no problem for checks.

⚠ 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. Connect scan tool MB991958 to the data link connector.





3. Set the timing light to the power supply line (terminal No. 4) of the ignition coil No. 1.
4. Start the engine.
5. Run the engine at idle for 2 minutes.
6. Check the actual ignition timing is at the standard value.

   Standard value: Approximately 10° BTDC

   NOTE: Ignition timing fluctuates about ±7°, 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.
7. Check the idle speed. Select item number 2 and take a reading of the idle speed.

   Curb idle speed: 700 ±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 13A, Multiport Fuel Injection (MFI) –Multiport Fuel Injection (MFI) Diagnosis –Symptom Chart P.13A-48.
9. Remove the timing light.

⚠ 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.

10. Disconnect scan tool MB991958 from the data link connector.

IDLE MIXTURE CHECK

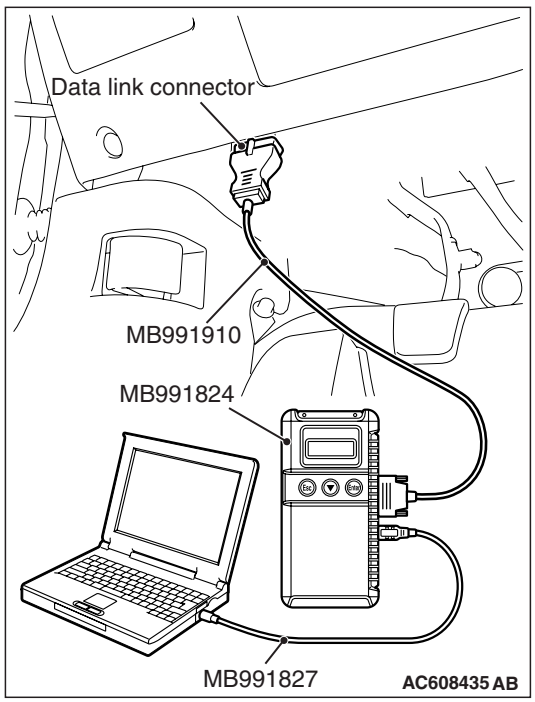
M1111002101441

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

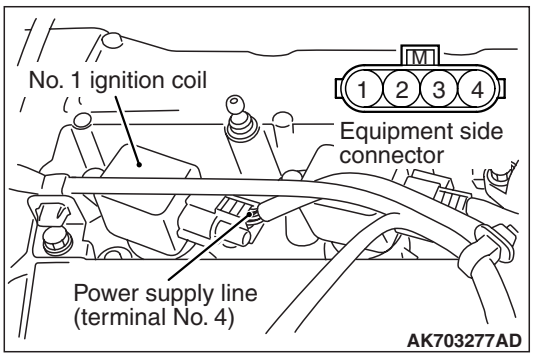
1. Before inspection, set the vehicle in the following condition:
- Engine coolant temperature: 80 –95° C (176 –203° F)
- Lights and all accessories: OFF
- Transaxle: Neutral (P range on vehicles with TC-SST)

   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. Connect scan tool MB991958 to the data link connector.



3. Set the timing light to the power supply line (terminal No. 4) of the ignition coil No. 1.
4. Start the engine and let it run at idle.
5. Check that the actual ignition timing is at the standard value.

   Standard value: Approximately 10° BTDC

   NOTE: Ignition timing fluctuates about ±7°, 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.
6. Run the engine and increase the engine speed to 2,500 r/min for 2 minutes.
7. Set the CO, HC tester.
8. Check the CO contents and the HC contents at idle.

   Standard value:
   CO contents: 0.5% or less
   HC contents: 100 ppm or less
9. If there is a deviation from the standard value, inspect the MFI system (Refer to GROUP 13A –Multiport Fuel Injection (MFI) –Multiport Fuel Injection (MFI) Diagnosis –Symptom Chart P.13A-48)
10. Remove the timing light.

⚠ 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.

11. Disconnect scan tool MB991958 from the data link connector.

COMPRESSION PRESSURE CHECK

M1111002602278

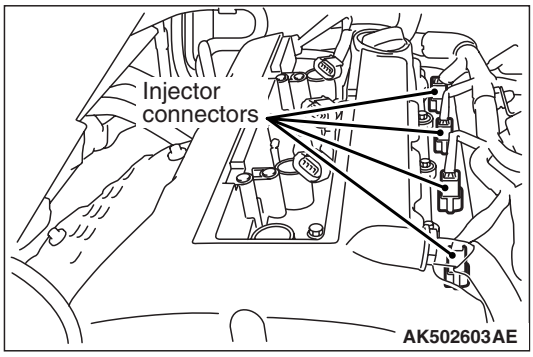
Required Special Tool:

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
   - Transaxle: Neutral (P range on vehicles with TC-SST)

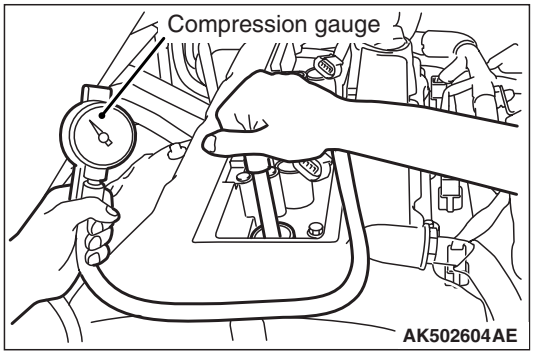
   NOTE: On vehicles for Canada, the headlight, taillight, etc. remain lit even when the lighting switch is in "OFF" position but this is no problem for checks.
2. Remove all of the ignition coils and spark plugs.
3. Disconnect the all of the injector connectors.



⚠ WARNING

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

4. Cover the spark plug hole with a shop towel etc., after the engine has been cranked, check that no foreign material is adhering to the shop towel.



5. Set compression gauge to one of the spark plug holes.
6. Crank the engine with the throttle valve fully open and measure the compression pressure.

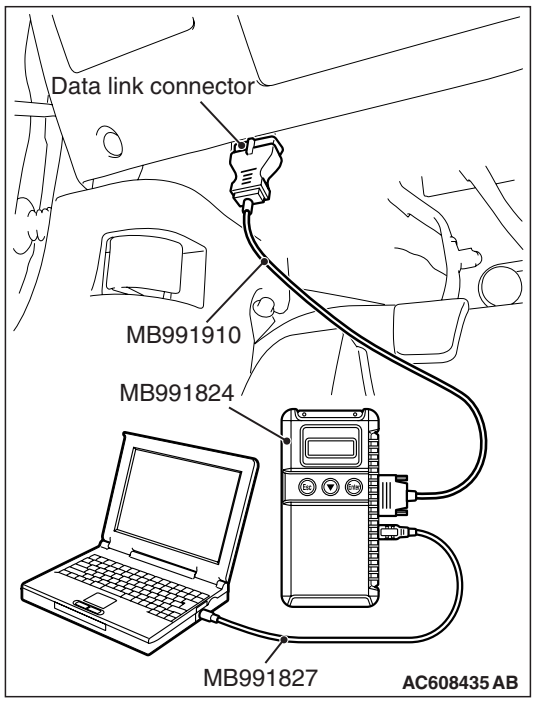
   Standard value (at engine speed of 200 r/min): 1,090 kPa (158 psi)
   Limit (at engine speed of 200 r/min): Minimum 650 kPa (95 psi)
7. Measure the compression pressure for all the cylinders, and check that the pressure differences of the cylinders are below the limit.

   Limit: Maximum 100 kPa (14 psi)
8. If there is a cylinder with compression or a compression difference that is outside the limit, pour a small amount of engine oil through the spark plug hole, and repeat the operations in steps from 5 to 7.

(1) If the compression increases after oil is added, the cause of the malfunction is a worn or damaged piston ring and/or cylinder inner surface.
(2) If the compression does not rise after oil is added, the cause is a burnt or defective valve seat, or pressure is leaking from the gasket.

9. Connect the all of the injector connector.
10. Install the spark plugs and ignition coils.
11. Use the scan tool MB991958 to erase the diagnosis codes.

NOTE: This will erase the diagnosis code resulting from the injector connectors being disconnected.



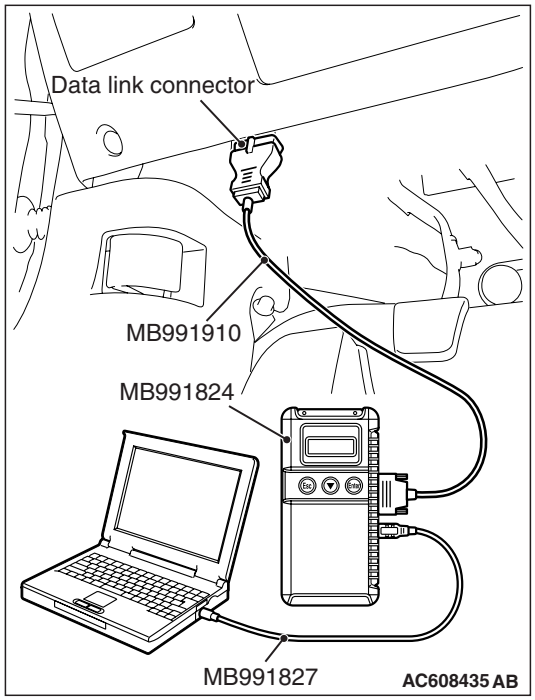
MANIFOLD VACUUM CHECK

M1111002701711

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 TC-SST)

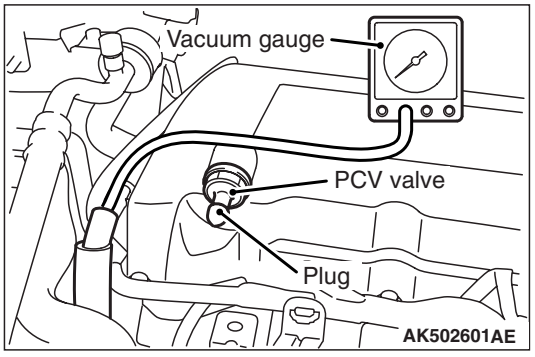
NOTE: On vehicles for Canada, the headlight, taillight, etc. remain lit even when the lighting switch is in "OFF" position but this is no problem for checks.



⚠ 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. Connect 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 off the ignition switch.
7. Remove the vacuum gauge and then connect the ventilation hose to the PCV valve.

⚠ 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.

8. Disconnect scan tool MB991958 from the data link connector.

TIMING CHAIN ELONGATION VISUAL CHECK

M1111005200024

NOTE: When the timing chain elongates more than the specified length, the diagnosis code No. P0012, variable valve timing (VVT) advanced-angle value abnormal, is output. Unless the diagnosis code No. P0012, therefore, is output, the visual check is unnecessary.

NOTE: Unless the work using the following scan tool MB991958 is correctly carried out due to the malfunction of ECM, carry out the check whether or not the diagnosis code exists.

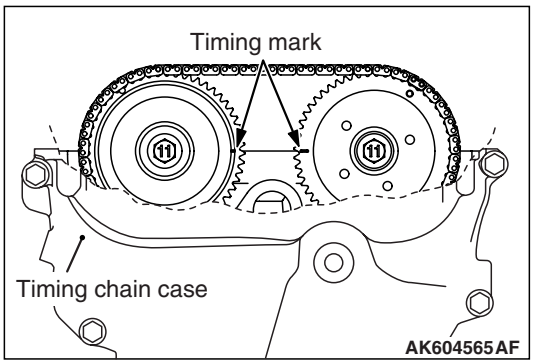
- *Storing the learning value regarding the amount of timing chain elongation before the ECM replacement*
- *Writing the learning value into the new ECM after the ECM replacement*

1. Remove all the ignition coils.
2. Remove the cylinder head cover.
3. Remove the upper chain guide.

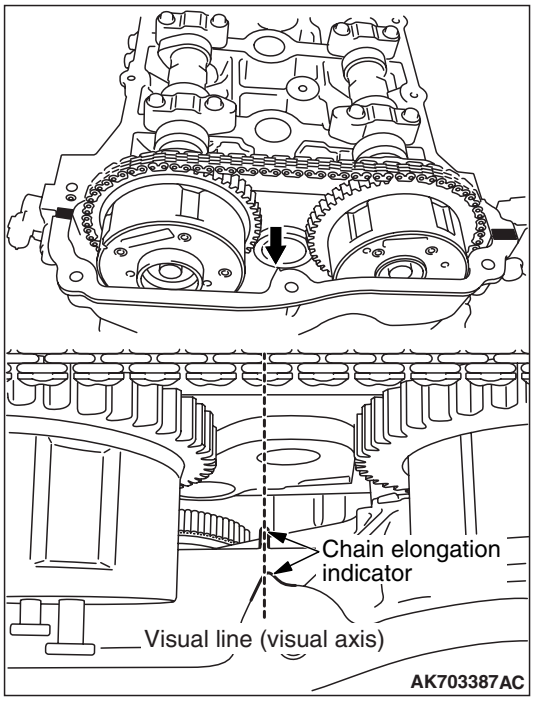
⚠ CAUTION

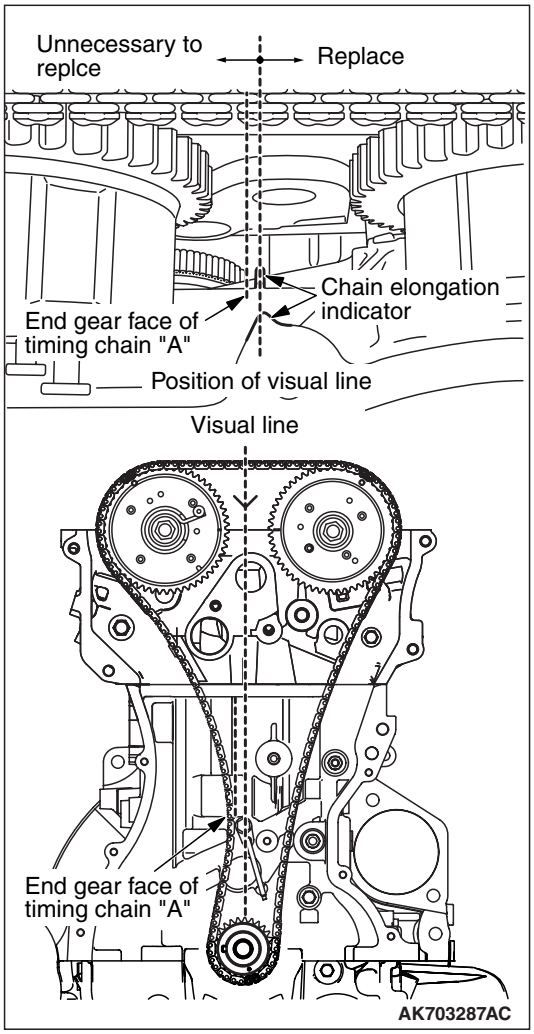
Always rotate the crankshaft clockwise.

4. Rotating the crankshaft clockwise, align the timing mark of camshaft sprocket with the point on the upper plane of cylinder head shown in the illustration. As a result of this, the No.1 cylinder is positioned at the compression TDC.

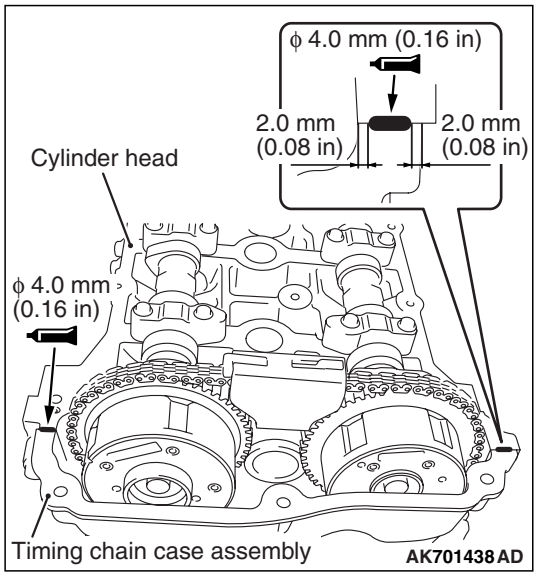


5. Look at the inside of timing chain case with one eye in the direction of arrow shown in the illustration. Fix the eye line at the point where the top axis line of the chain elongation indicator at the front side of timing chain case is overlapped with that of the chain elongation indicator at the reverse side of timing chain case.





6. Check the end top point "A" of timing chain cross section surface and the point of chain elongation indicator which is fixed in Step 5. When the end top point "A" of timing chain is positioned at the left-hand side of chain elongation indicator, it is unnecessary to replace the timing chain because the timing chain is within the specified length. When the end top point "A" of timing chain is positioned at the right-hand side of chain elongation indicator, it is necessary to replace the timing chain because the timing chain elongates more than the specified length.



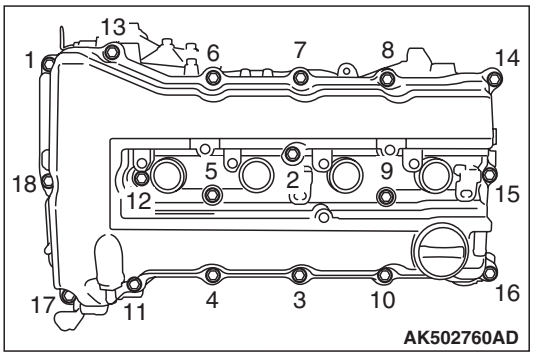
7. Install the upper chain guide.

⚠ CAUTION

- **Completely clean the old FIPG remaining in the clearance between the mating parts.**
- **Install the cylinder head cover within 3 minutes of applying the liquid gasket.**

8. Apply a 4 mm diameter bead of liquid gasket to the point shown in the illustration.

   Liquid gasket: THREE BOND 1217G or equivalent product.



9. Installing the cylinder head cover, tighten the tightening bolt according to the following procedures.
   a. Temporarily tighten the tightening bolt in the order shown in the illustration.
      Tightening torque: 3.0 ±1.0 N· m
   b. Tighten the tightening bolt to the specified torque in the order shown in the illustration.
      Tightening torque: 5.5 ±0.5 N· m
10. Install the ignition coil.
11. Use the scan tool MB991958 to select the timing chain maintenance. Initialize the learning value. Refer to GROUP00, General –Precautions before service –Timing chain maintenance P.00-33.

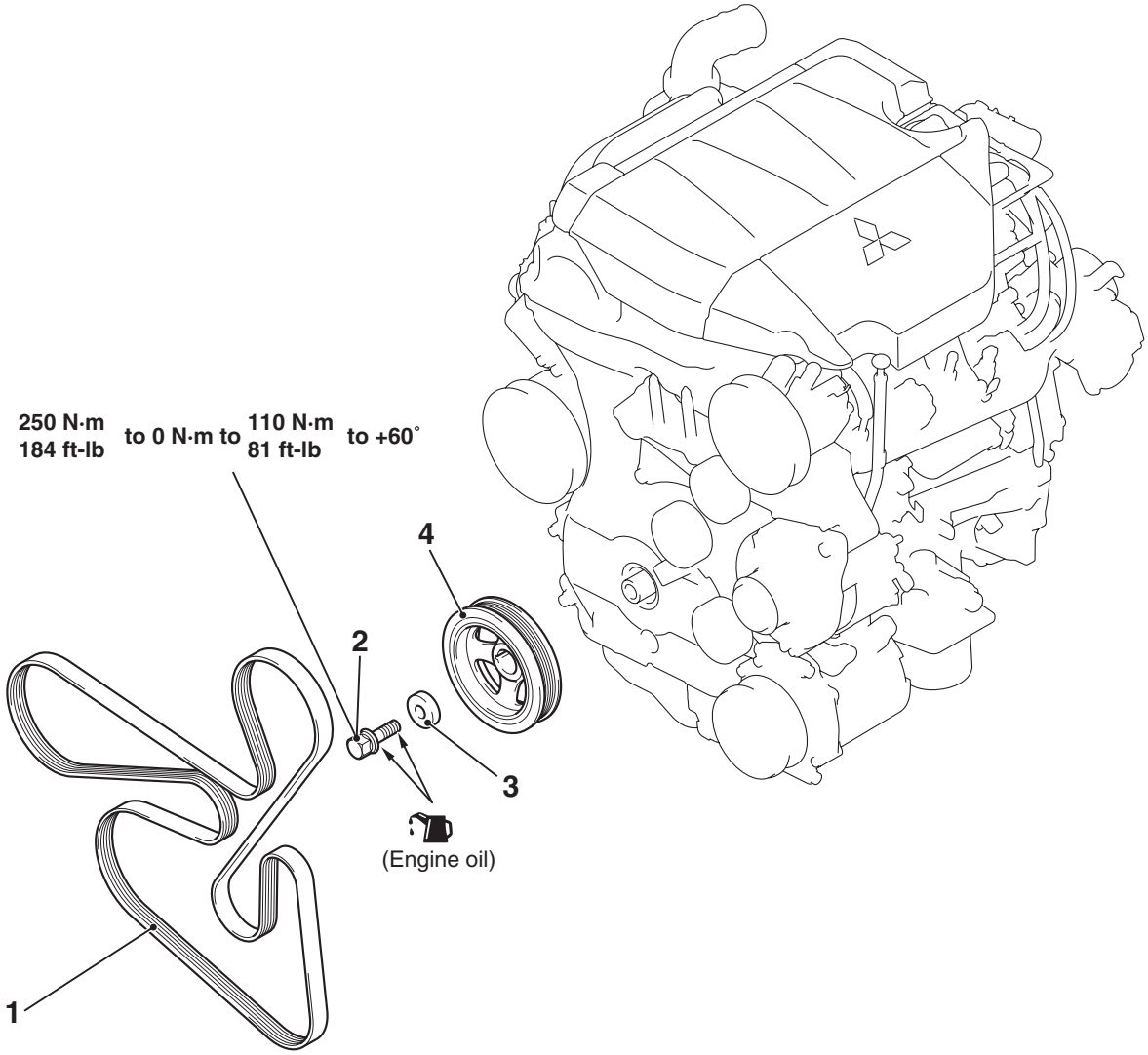
NOTE: Carry out the initialization even if the amount of timing chain elongation is normal. As a result of this, it is necessary to replace the timing chain before the timing chain interferes with the other components when the next warning lamp illuminates or the diagnosis code No. P0012 is output.

CRANKSHAFT PULLEY

REMOVAL AND INSTALLATION

M1112001602052

Pre-removal operation	Post-installation operation
• Engine Room Under Cover Front A, B, Engine Room Under Cover Center and Engine Room Side Cover (RH) Removal (Refer to GROUP 51, Under Cover P.51-16). • Radiator Condenser Tank Bracket Removal (Refer to GROUP 14, Radiator P.14-31).	• Drive Belt Tension Check (Refer to P.11A-8). • Radiator Condenser Tank Bracket Installation (Refer to GROUP 14, Radiator P.14-31). • Engine Room Under Cover Front A, B, Engine Room Under Cover Center and Engine Room Side Cover (RH) Installation (Refer to GROUP 51, Under Cover P.51-16).



AC704354AC

Removal steps

<<**A**>> >>**B**<< 1. Drive belt
<<**B**>> >>**A**<< 2. Crankshaft pulley center bolt
<<**B**>> >>**A**<< 3. Crankshaft pulley washer

Removal steps (Continued)

- Engine mounting bracket (Refer to GROUP 32, Engine Mounting P.32-4)

>>**A**<< 4. Crankshaft pulley

Required Special Tools:

- MB990767: Front Hub and Flange End Yoke Holder
- MD998719: Pin

TSB Revision

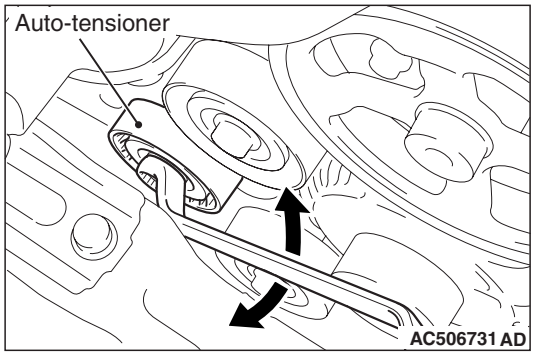
REMOVAL SERVICE POINTS

<<A>> DRIVE BELT REMOVAL

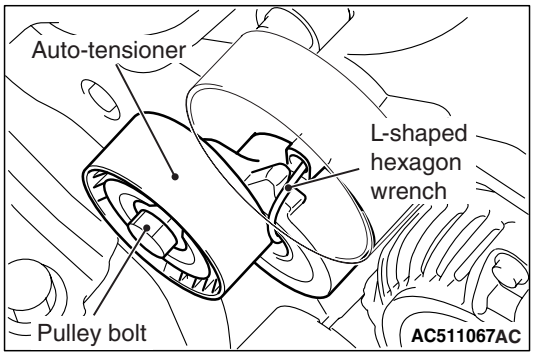
To introduce the serpentine drive system with the drive belt auto-tensioner, the following operations will be required.

⚠ CAUTION

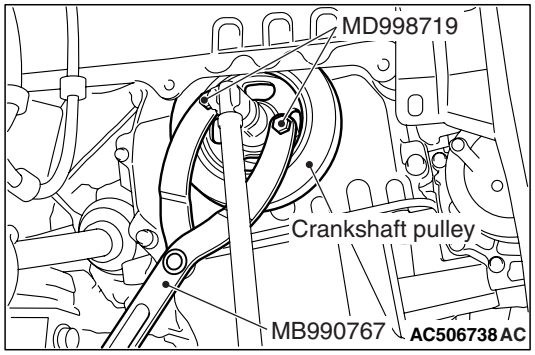
To reuse the drive belt, draw an arrow indicating the rotating direction on the back of the belt using chalk to install the same direction.



1. Rotate the pulley bolt of the auto-tensioner counterclockwise with an offset wrench [45°, a long offset wrench (5/8 x 11/16 inches) recommended] and insert the hexagon wrench into the auto-tensioner hole to fix the auto-tensioner.
2. Remove the drive belt.



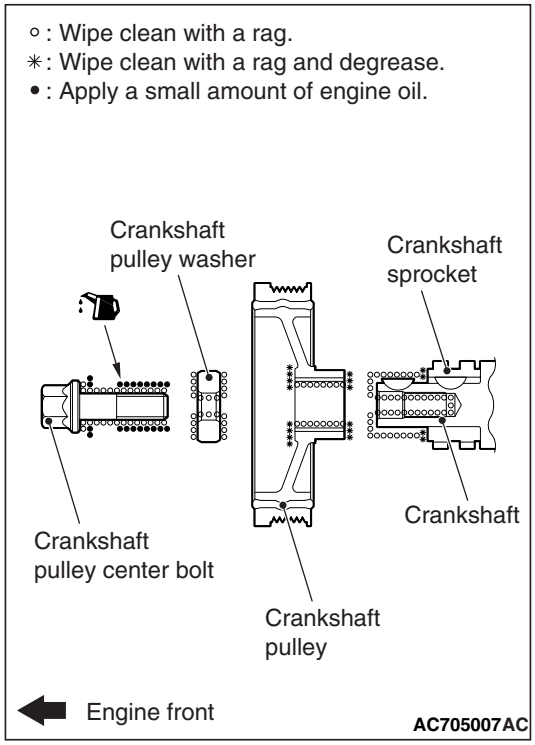
<<B>> CRANKSHAFT PULLEY CENTER BOLT/CRANKSHAFT PULLEY WASHER REMOVAL



1. Hold the crankshaft drive sprocket with special tools MB990767 and MD998719.
2. Loosen the crankshaft pulley center bolt and remove the crankshaft pulley center bolt and crankshaft pulley washer.

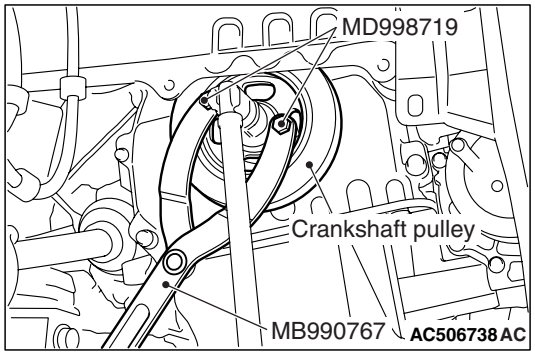
INSTALLATION SERVICE POINTS

>>A<< CRANKSHAFT PULLEY/CRANKSHAFT PULLEY WASHER/CRANKSHAFT PULLEY CENTER BOLT INSTALLATION

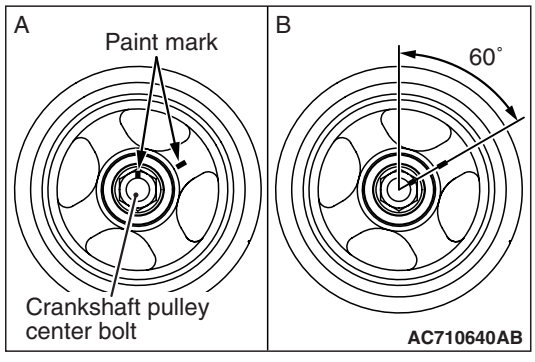


1. Wipe off the dirt on the crankshaft and the crankshaft pulley as shown in the figure using a rag.
2. Wipe off the dirt on the crankshaft sprocket, the crankshaft and the crankshaft pulley as shown in the figure using a rag, and then degrease them.

   NOTE: Degrease them to prevent drop in the friction coefficient of the pressed area, which is caused by oil adhesion.
3. Install the crankshaft pulley.
4. Wipe off the dirt on the crankshaft pulley washer and the crankshaft pulley center bolt as shown in the figure using a rag.
5. Apply an adequate and minimum amount of engine oil to the threads of the crankshaft pulley center bolt and the lower area of the flange.



6. Hold the crankshaft pulley with special tools MB990767 and MD998719 in the same manner as removal.
7. Tighten the crankshaft pulley center bolt according to the following procedure.
   (1) Tighten the crankshaft pulley center bolt to the specified torque 250 N· m (184 ft-lb).
   (2) Loosen the crankshaft pulley center bolt fully.
   (3) Tighten the crankshaft pulley center bolt to the specified torque 110 N· m (81 ft-lb).



   (4) As shown in the illustration "A," apply the paint mark to the crankshaft pulley on the extended line of the corner adjacent to the one of the crankshaft pulley center bolt corners.

⚠ CAUTION

- **When the tightening angle is smaller than the specified tightening angle, the appropriate tightening capacity cannot be secured.**
- **When the tightening angle is larger than the specified tightening angle, remove the bolt to start from the beginning again according to the procedure.**

   (5) Tighten the crankshaft pulley center bolt by 60° once more. Make sure the paint mark of crankshaft pulley center bolt is aligned with the paint mark of crankshaft pulley as shown in the illustration "B."

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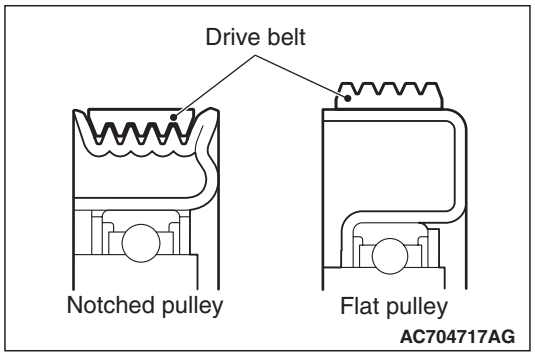
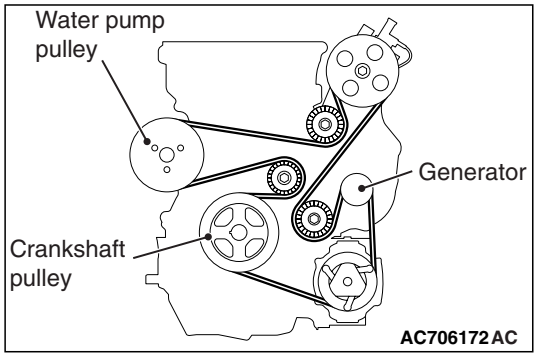
>>B<< DRIVE BELT INSTALLATION

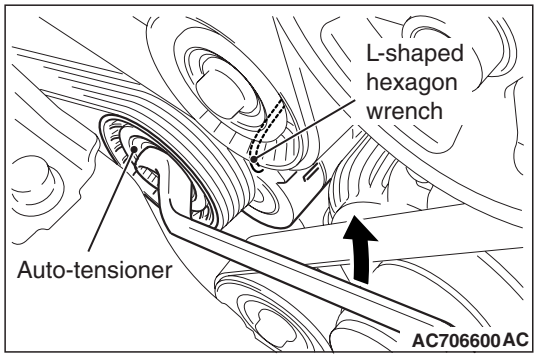
⚠ CAUTION

- **To reuse the drive belt, install it by aligning the arrow mark on the backside of belt marked at the removal with the rotating direction.**
- **Check that the notches of the notched pulley and the notches of the drive belt are fit correctly.**
- **Check that the drive belt is installed in the center of the flat surface of the flat pulley.**





1. Install the drive belt to each pulley as shown in the figure.



2. Set an offset wrench [45 °, a long offset wrench (5/8 x 11/16 inches) recommended] to the pulley bolt of the auto-tensioner. Then, rotate the auto-tensioner counterclockwise and remove the L-shaped hexagon wrench fixing the auto-tensioner.
3. Apply tension to the drive belt while slowly turning the auto-tensioner clockwise.

CAMSHAFT

REMOVAL AND INSTALLATION

M1112007800508

Pre-removal operation	Post-installation operation
• Engine Room Under Cover Front A, B and Engine Room Side Cover (RH) Removal (Refer to GROUP 51, Under Cover P.51-16). • Air Cleaner Assembly Removal (Refer to GROUP 15, Air Cleaner P.15-10). • Charge Air Cooler Intake Hose A, B and Charge Air Cooler Intake Pipe A Removal (Refer to GROUP 15, Charge Air Cooler P.15-15). • Strut Tower Bar Removal (Refer to GROUP 42A, Strut Tower Bar P.42A-15). • Ignition Coil Removal (Refer to GROUP 16, Ignition System –Ignition Coil P.16-39).	• Ignition Coil Installation (Refer to GROUP 16, Ignition System –Ignition Coil P.16-39). • Strut Tower Bar Installation (Refer to GROUP 42A, Strut Tower Bar P.42A-15). • Charge Air Cooler Intake Hose A, B and Charge Air Cooler Intake Pipe A Installation (Refer to GROUP 15, Charge Air Cooler P.15-15). • Air Cleaner Assembly Installation (Refer to GROUP 15, Air Cleaner P.15-10). • Engine Room Under Cover Front A, B and Engine Room Side Cover (RH) Installation (Refer to GROUP 51, Under Cover P.51-16).

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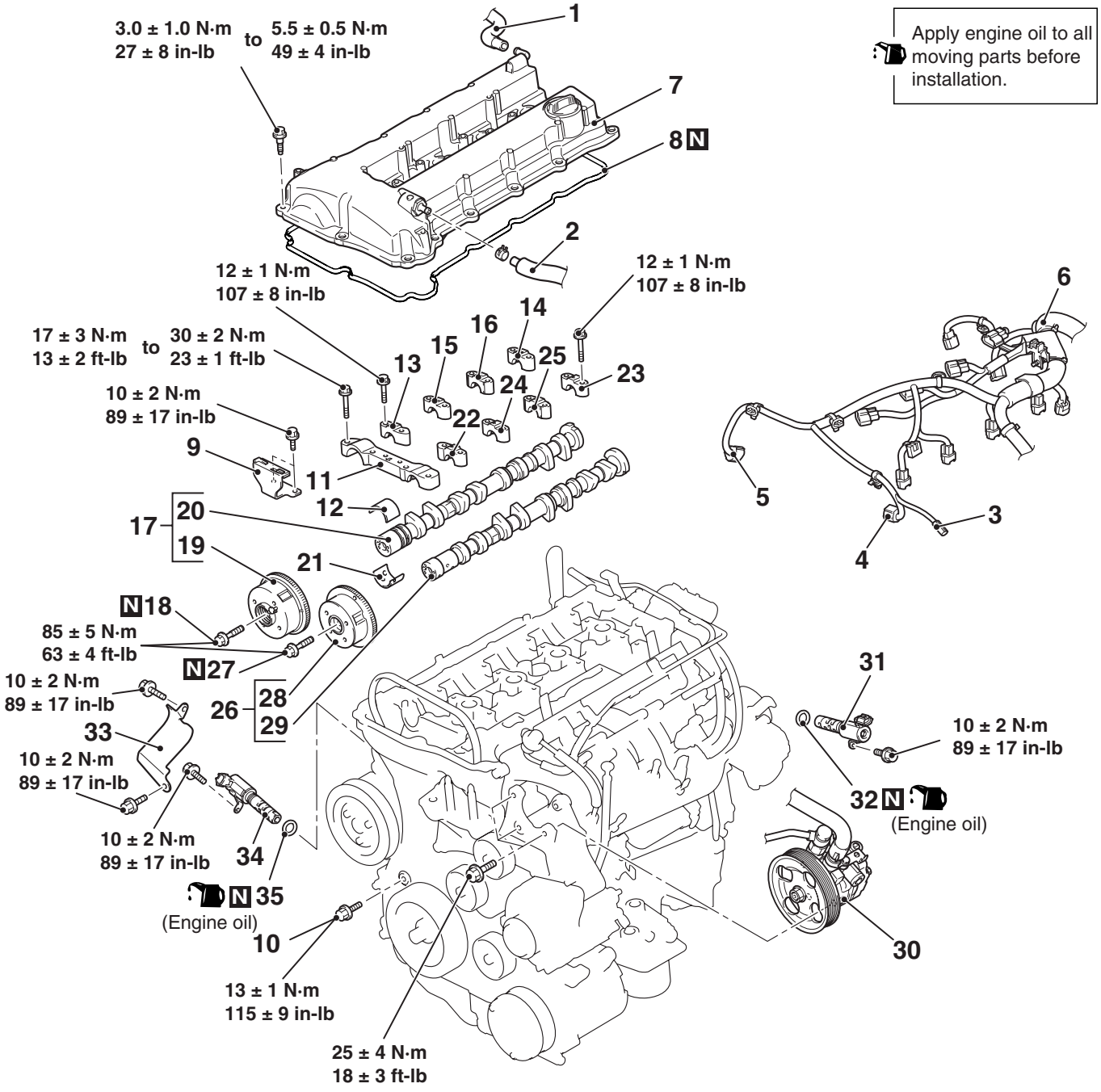

AC708206AC

Camshaft removal steps

1. Breather hose connection
2. PCV hose connection
3. Power steering fluid pressure switch connector connection
4. Intake oil feeder control valve connector connection
5. Exhaust oil feeder control valve connector connection
6. Control harness connection

<<A>> >>G<<

7. Rocker cover assembly
8. Rocker cover gasket

<<B>>

Camshaft removal steps

- Cylinder No. 1 compression top dead center setting (only at removal)
- Valve clearance adjustment (Refer to P.11A-10). (only at installation)

9. Timing chain upper guide
10. Service hole bolt

<<C>>

- Camshaft and camshaft sprocket assembly (exhaust side) removal preparatory operation (only at removal)

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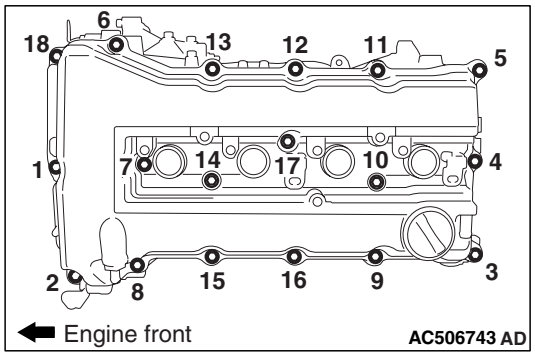
			Camshaft removal steps
<<**D**>>	>>**F**<<	11.	Front camshaft bearing cap assembly
	>>**E**<<	12.	Camshaft bearing
<<**E**>>	>>**D**<<	13.	Oil feeding camshaft bearing cap (exhaust side)
<<**E**>>	>>**D**<<	14.	Camshaft bearing cap (exhaust side)
<<**E**>>	>>**D**<<	15.	Camshaft bearing cap (exhaust side)
<<**E**>>	>>**D**<<	16.	Thrust camshaft bearing cap (exhaust side)
<<**F**>>	>>**E**<<	17.	Camshaft and camshaft sprocket assembly (exhaust side)
<<**G**>>	>>**B**<<	18.	Camshaft sprocket bolt
	>>**B**<<	19.	Camshaft sprocket (exhaust side)
	>>**B**<<	20.	Camshaft (exhaust side)
	>>**E**<<	21.	Camshaft bearing
<<**E**>>	>>**D**<<	22.	Oil feeding camshaft bearing cap (intake side)
<<**E**>>	>>**D**<<	23.	Camshaft bearing cap (intake side)
<<**E**>>	>>**D**<<	24.	Camshaft bearing cap (intake side)
<<**E**>>	>>**D**<<	25.	Thrust camshaft bearing cap (intake side)
	>>**C**<<	26.	Camshaft and camshaft sprocket assembly (intake side)
<<**G**>>	>>**B**<<	27.	Camshaft sprocket bolt
	>>**B**<<	28.	Camshaft sprocket (intake side)
	>>**B**<<	29.	Camshaft (intake side)
			Intake oil feeder control valve removal steps
		4.	Intake oil feeder control valve connector connection
		•	Drive belt (Refer to P.11A-21)
<<**H**>>		30.	Power steering oil pump assembly
<<**I**>>	>>**A**<<	31.	Intake oil feeder control valve
	>>**A**<<	32.	O-ring
			Exhaust oil feeder control valve removal steps
		5.	Exhaust oil feeder control valve connector connection
		33.	Exhaust oil feeder control valve heat protector
<<**I**>>	>>**A**<<	34.	Exhaust oil feeder control valve
	>>**A**<<	35.	O-ring

Required Special Tool:

- MB992103: Chain Tension Release Bar

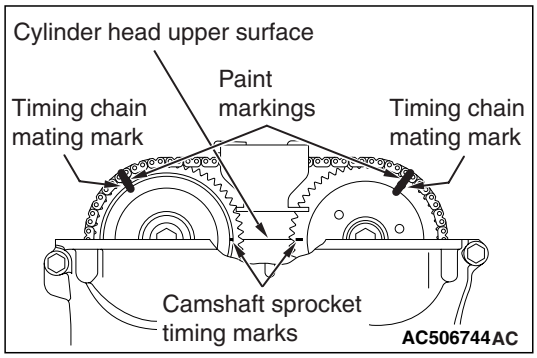
REMOVAL SERVICE POINTS

<<A>> ROCKER COVER ASSEMBLY REMOVAL



Loosen the rocker cover assembly mounting bolts in the order of number shown in the figure, and remove the rocker cover assembly.

<<B>> CYLINDER NO. 1 COMPRESSION TOP DEAD CENTER SETTING



⚠ CAUTION

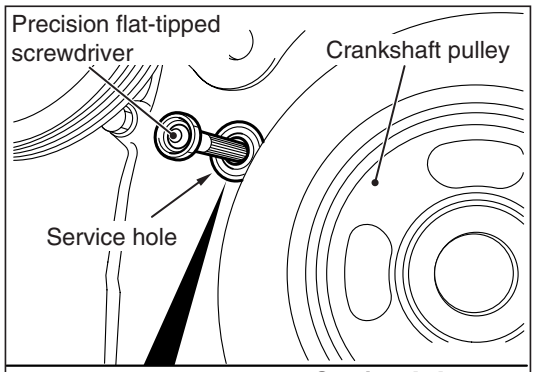
Turn the crankshaft clockwise.

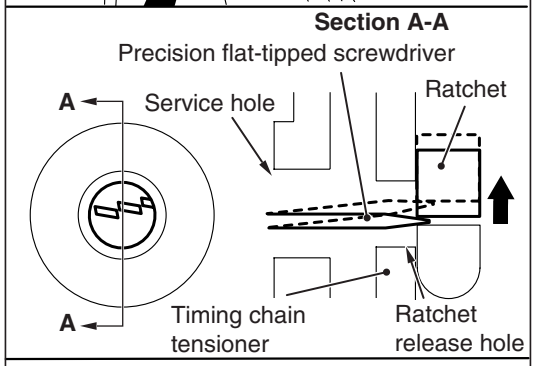
1. Turn the crankshaft clockwise so that the camshaft sprocket timing marks become horizontal to the cylinder head upper surface, and set the cylinder No. 1 to the top dead center of compression. At this time, check that the crankshaft pulley timing mark is in the 0-degree position of the ignition timing indicator of the timing chain case assembly.
2. Put paint marks on both the camshaft sprocket and timing chain at the position of camshaft sprocket timing chain mating mark (circular hole).

<<C>> CAMSHAFT AND CAMSHAFT SPROCKET ASSEMBLY (EXHAUST SIDE) REMOVAL PREPARATORY OPERATION

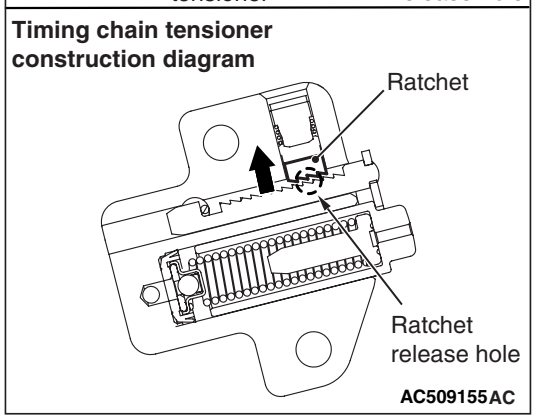
1. Insert a precision flat-tipped screwdriver through the service hole of the timing chain case, press up the timing chain tensioner ratchet to unlock, and keep the timing chain tensioner with that state.

   NOTE: Lightly press down the tail end of the precision flat-tipped screwdriver to press up the tip of the precision flat-tipped screwdriver inserted to the timing chain tensioner to unlock.



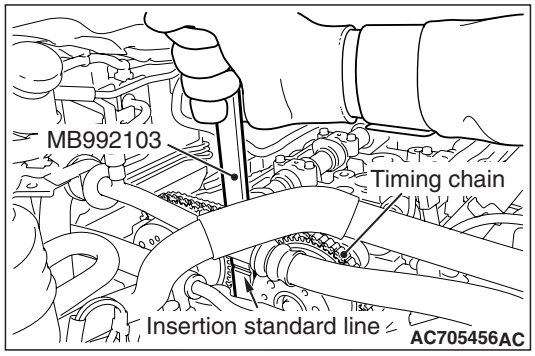


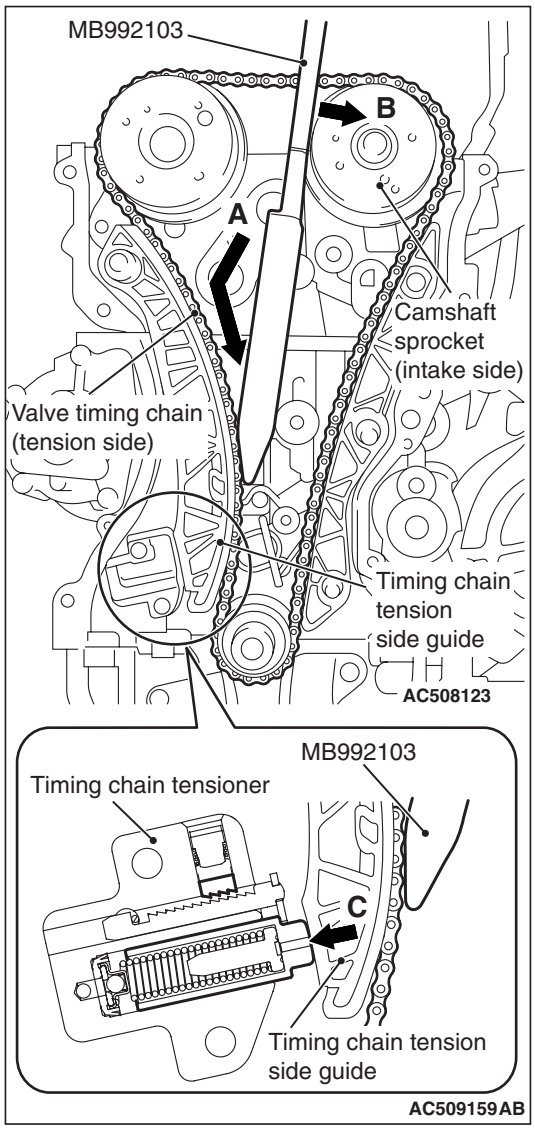
Timing chain tensioner construction diagram



⚠ CAUTION

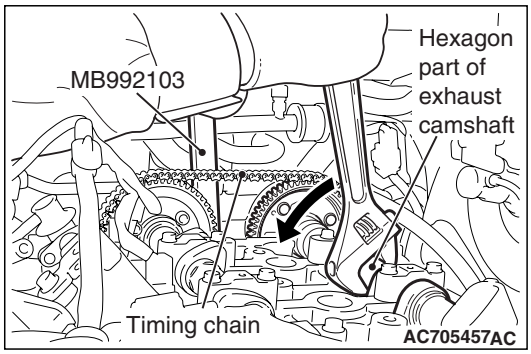
- **When inserting special tool MB992103 into the timing chain case assembly inside, pay attention to the position of the timing chain to avoid damage to the timing chain and timing chain tension side guide. Do not insert the special tool beyond its insertion guideline.**
- **If unlocking the timing chain tensioner is insufficient, the special tool cannot be inserted to the insertion guideline. Do not insert the special tool forcibly, follow Step 1 again to unlock the timing chain tensioner and insert the special tool.**





2. With the timing chain tensioner unlocked, insert special tool MB992103 inside the timing chain case assembly along the tension side of the timing chain until the insertion guide line aligns with the upper surface of the timing chain case assembly (Figure A).

   NOTE: With the timing chain tensioner unlocked, insert the special tool along the tension side of the timing chain, according to the special tool top shape. The special tool can be inserted smoothly to the position where the special tool insertion guide line aligns with the timing chain case assembly top surface (Figure B), and the spread timing chain tension side guide can be held (Figure C).
3. With the special tool inserted up to the insertion guide line, press the special tool against the intake side camshaft sprocket and spread and hold the timing chain tension side guide.
4. Remove the flat-tipped precision screwdriver unlocking the timing chain tensioner.

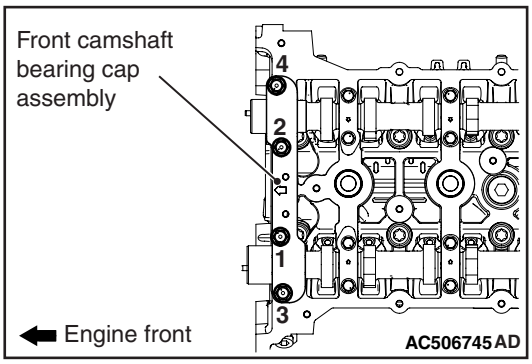


⚠ CAUTION

The timing chain may snag on by other parts. After sagging the timing chain, never rotate the crankshaft.

5. With the timing chain tension side guide spread, hook the special tool over the hexagon part of the camshaft on the exhaust side, and turn the camshaft clockwise to apply slack to the timing chain between the camshaft sprockets.

<<D>> FRONT CAMSHAFT BEARING CAP ASSEMBLY REMOVAL



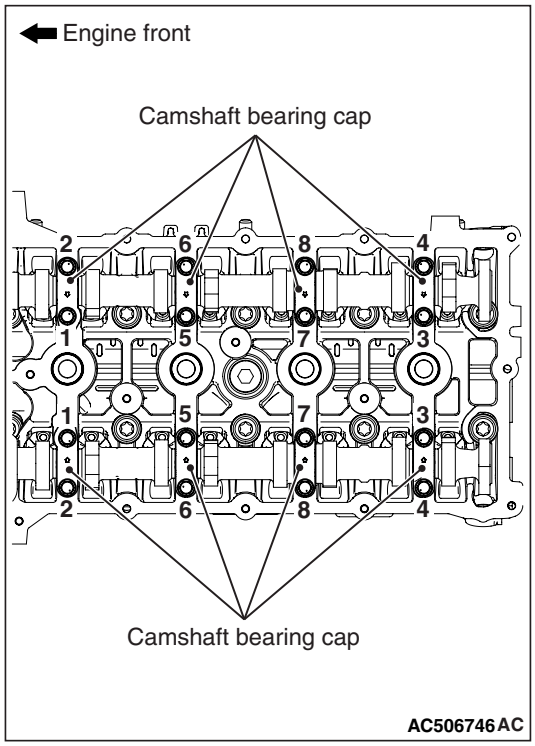
Loosen the mounting bolts of front camshaft bearing cap in the order of number shown in the figure, and remove the front camshaft bearing cap assembly.

<<E>> OIL FEEDING CAMSHAFT BEARING CAP/CAMSHAFT BEARING CAP/THRUST CAMSHAFT BEARING CAP REMOVAL

⚠ CAUTION

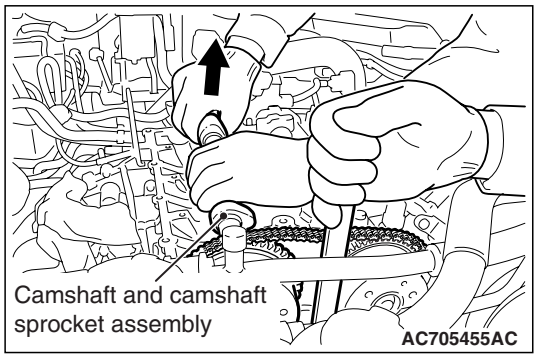
When the camshaft bearing cap mounting bolts are loosened at once, the mounting bolts jump out by the spring force and the threads are damaged. Always loosen the mounting bolts in four or five steps.

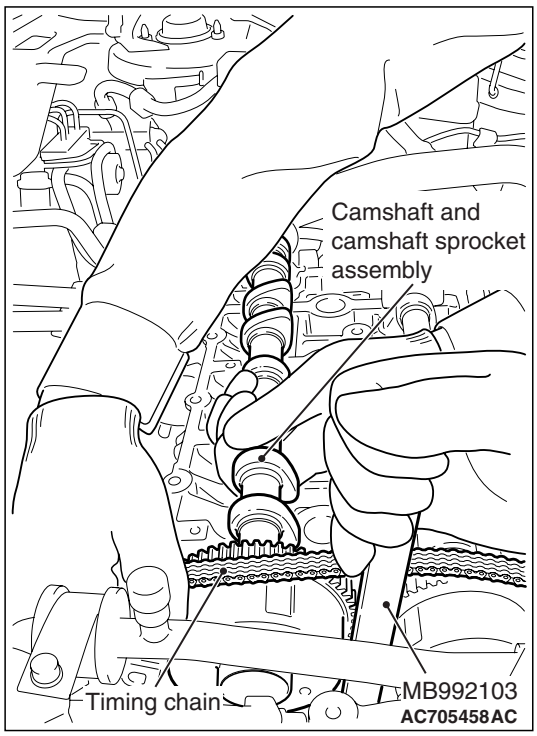
Loosen the mounting bolts of the camshaft bearing caps in the order of number shown in the figure in four or five steps, and remove the camshaft bearing caps.



<<F>> CAMSHAFT AND CAMSHAFT SPROCKET ASSEMBLY (EXHAUST SIDE) REMOVAL

1. Raise slightly the transaxle side of the camshaft and camshaft sprocket assembly (exhaust side) by using the slack of the timing chain, and remove from the cam bearing.

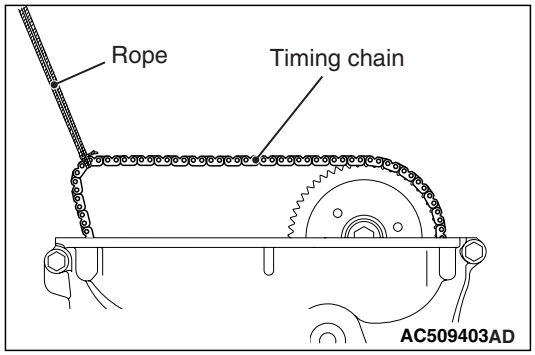




2. Remove the timing chain from the camshaft and camshaft sprocket assembly (exhaust side) toward the timing chain case assembly, and remove the camshaft and camshaft sprocket assembly (exhaust side) toward the transaxle.
3. Remove special tool MB992103 inserted into the timing chain case assembly.

⚠ CAUTION

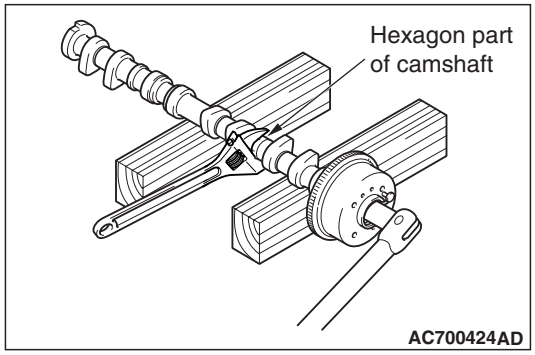
The timing chain may snag on other parts. After removing the camshaft and camshaft sprocket assembly, never rotate the crankshaft.



4. After removing the camshaft and camshaft sprocket assembly (exhaust side), hang up the timing chain with a rope to prevent the timing chain from falling into the timing chain case assembly.

<<G>> CAMSHAFT SPROCKET/CAMSHAFT REMOVAL

Hold the flats of the camshaft with a monkey wrench. Loosen the camshaft sprocket mounting bolts and remove the camshaft sprocket from the camshaft.



<<H>> POWER STEERING OIL PUMP ASSEMBLY REMOVAL

1. With the hose installed, remove the power steering oil pump assembly from the bracket.
2. Tie the removed power steering oil pump assembly with a string at a position where it will not interfere with the removal and installation of oil control valve.

<<I>> OIL FEEDER CONTROL VALVE REMOVAL

⚠ CAUTION

After removal of the oil feeder control valve, be careful to prevent dust from getting into the oil passage in the cylinder head.

INSTALLATION SERVICE POINTS

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

⚠ CAUTION

When installing the oil control valve, be careful to avoid damage to the O-ring.

Apply engine oil to the O-ring of the oil feeder control valve and install the oil feeder control valve to the cylinder head.

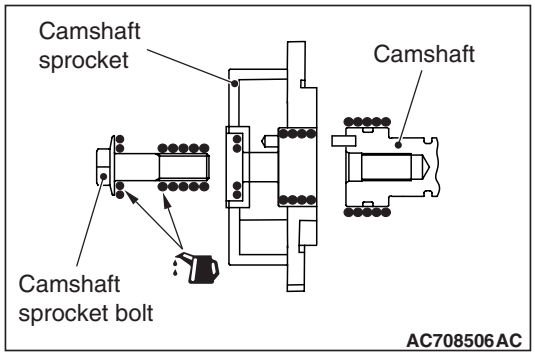
>>B<< CAMSHAFT/CAMSHAFT SPROCKET INSTALLATION

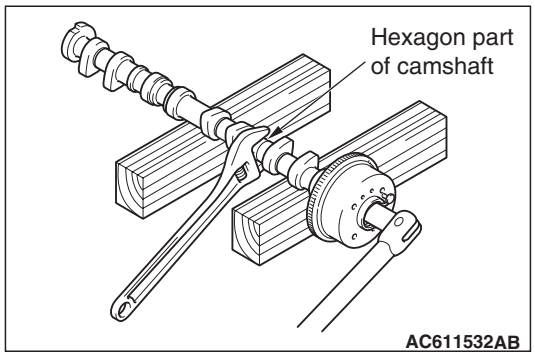
⚠ CAUTION

The camshaft sprocket bolt cannot be reused.

Install the camshaft and camshaft sprocket assembly as follows.

1. Check that the knock pin is set to the right overhead position.
2. an adequate and minimum amount of engine oil to the outer of the camshaft edge and the entire insertion area around camshaft sprocket assembly.
3. Set the knock pin hole of camshaft sprocket assembly to the right overhead position, and slowly insert it into the camshaft assembly to the specified position.
4. Install the camshaft sprocket to the camshaft.
5. Apply an adequate and minimum amount of engine oil to the thread of the camshaft sprocket bolt and the lower area of the flange.

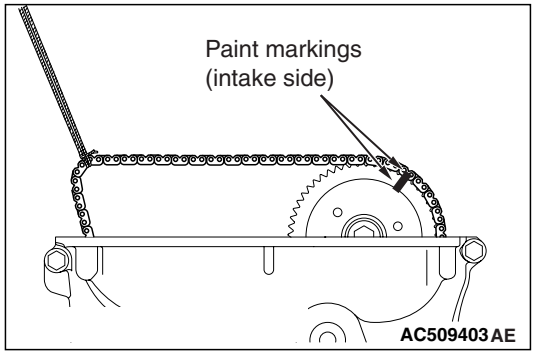




6. Clamp the flats of the camshaft and fix it in the same manner as removal.
7. Tighten the camshaft sprocket bolt to the specified torque.

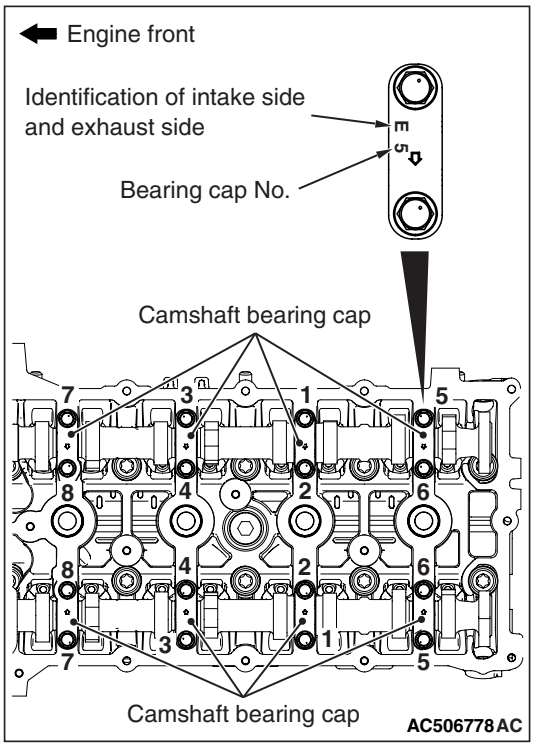
Tightening torque: 85 ±5 N· m (63 ±4 ft-lb)

>>C<< CAMSHAFT AND CAMSHAFT SPROCKET ASSEMBLY (INTAKE SIDE) INSTALLATION



1. Align the intake side paint mark of the timing chain which was put at removal with the paint mark of the intake side camshaft sprocket, and install the camshaft sprocket to the timing chain.
2. Install the camshaft and camshaft sprocket assembly (intake side) to the cylinder head.

>>D<< THRUST CAMSHAFT BEARING CAP/CAMSHAFT BEARING CAP/OIL FEEDING CAMSHAFT BEARING CAP/CAMSHAFT BEARING INSTALLATION



1. Install the camshaft bearing caps to the cylinder heads.

   NOTE: Because the thrust camshaft bearing cap and camshaft bearing cap are the same in shape, check the bearing cap number and additionally its symbol to identify the intake and exhaust sides for correct installation.
2. Tighten each camshaft bearing cap mounting bolt to the specified torque in the order of number shown in the figure in two or three steps.

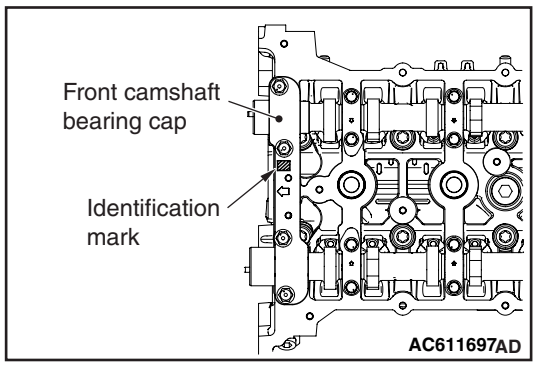
Tightening torque: 12 ±1 N· m (107 ±8 in-lb)

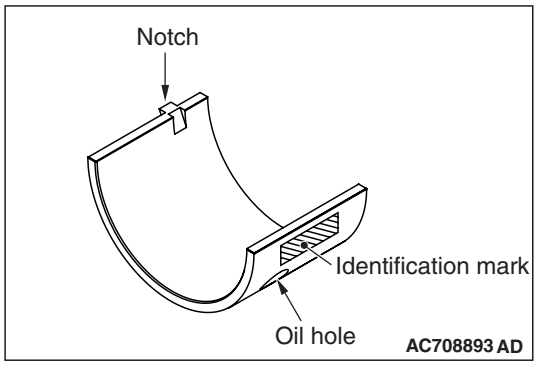
>>E<< CAMSHAFT BEARING/CAMSHAFT AND CAMSHAFT SPROCKET ASSEMBLY (EXHAUST SIDE) INSTALLATION

⚠ CAUTION

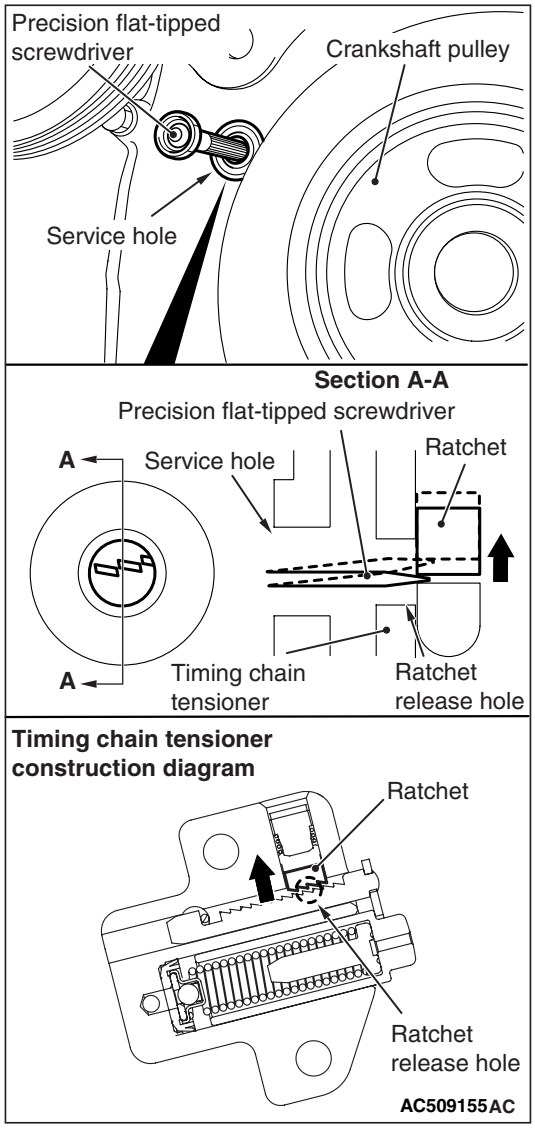
Be careful not to drop the camshaft bearing.

1. When replacing the camshaft bearing, according to the identification mark of front camshaft bearing cap in the table below, select a camshaft bearing with the corresponding size. Note that the identification mark of camshaft bearing is stamped on the place shown in the figure.





Front camshaft bearing cap		Camshaft bearing identification mark
Identification mark	Journal diameter mm (in)	
1	40.000 - 40.008 (1.5748 - 1.5751)	1
2	40.008 - 40.016 (1.5751 - 1.5754)	2
3	40.016 - 40.024 (1.5754 - 1.5757)	3

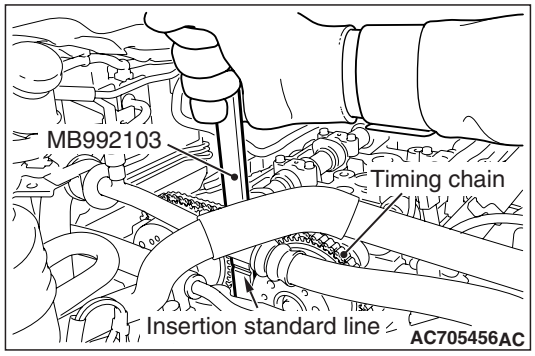


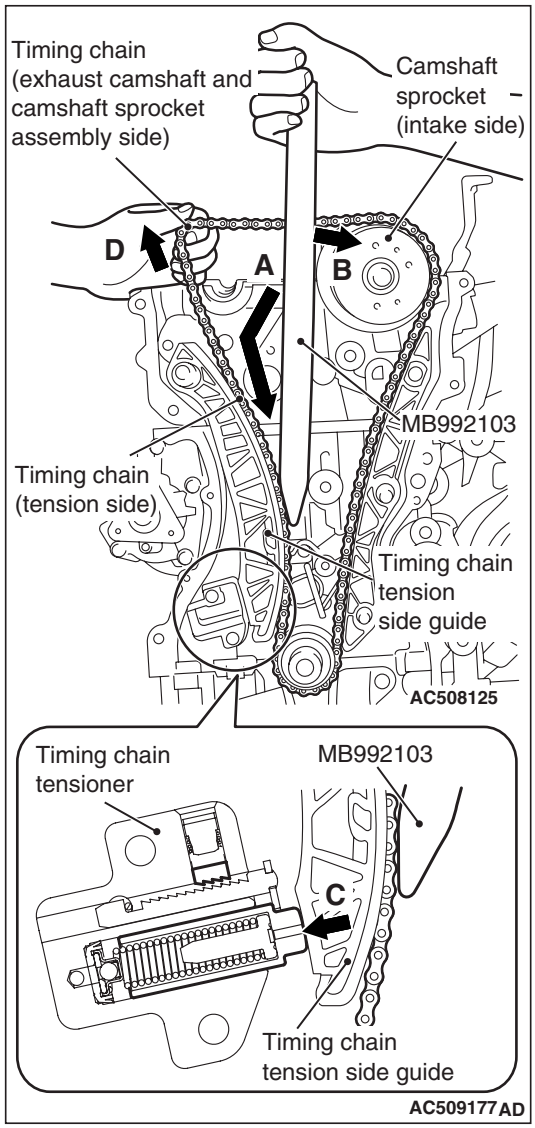
2. In the same manner as removal, insert the precision flat-tipped screwdriver through the service hole of the timing chain case, press up the ratchet of timing chain tensioner to unlock, and hold the unlocked timing chain tensioner.

   NOTE: Lightly press down the tail end of the precision flat-tipped screwdriver to press up the tip of the precision flat-tipped screwdriver inserted to the timing chain tensioner to unlock.

⚠ CAUTION

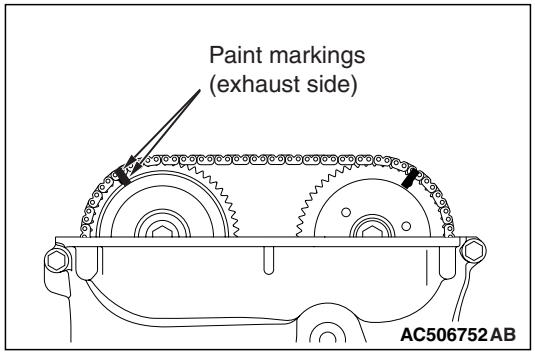
- **When inserting special tool MB992103 into the timing chain case assembly, pay attention to the position of the timing chain to avoid damage to the timing chain and timing chain tension side guide. Do not insert the special tool beyond its insertion guideline.**
- **If unlocking the timing chain tensioner is insufficient, the special tool cannot be inserted to the insertion guideline. Do not insert the special tool forcibly, follow Step 2 again to unlock the timing chain tensioner and insert the special tool.**





3. With the timing chain tensioner unlocked, insert special tool MB992103 inside the timing chain case assembly along the tension side of the timing chain until the insertion guide line aligns with the upper surface of the timing chain case assembly (Figure A).

   NOTE: With the timing chain tensioner unlocked, insert the special tool along the tension side of the timing chain, according to the special tool top shape. The special tool can be inserted smoothly to the position where the special tool insertion guideline aligns with the timing chain case assembly top surface, and the spread timing chain tension side guide can be hold.
4. With the special tool inserted up to the insertion guide line, press the special tool against the intake side camshaft sprocket (Figure B) and spread and hold the timing chain tension side guide (Figure C).
5. Remove the flat-tipped precision screwdriver unlocking the timing chain tensioner.
6. Pull up the camshaft and camshaft sprocket assembly (exhaust side) mounting area of the timing chain (Figure D) to provide allowance for easy installation of the camshaft and camshaft sprocket assembly (exhaust side) to the timing chain.



⚠ CAUTION

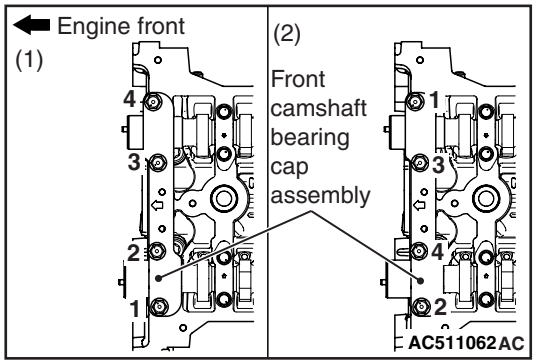
When installing the camshaft and camshaft sprocket assembly (exhaust side), be careful not to let the camshaft bearing which is installed to the front cam bearing deviate from its position.

7. Align the exhaust side paint mark of the timing chain which was put at removal with the paint mark of the exhaust side camshaft sprocket, and install the timing chain to the camshaft sprocket.
8. Install the camshaft and camshaft sprocket assembly (exhaust side) to the cylinder head.
9. Remove the special tool inserted into the timing chain case assembly inside.

>>F<< FRONT CAMSHAFT BEARING CAP ASSEMBLY INSTALLATION

⚠ CAUTION

When the mounting bolts are tightened with the front camshaft bearing cap tilted, the front camshaft bearing cap is damaged. Install the front camshaft bearing cap properly to the cylinder head and camshaft.



1. Install the front camshaft bearing cap to the cylinder head, and temporarily tighten the camshaft bearing front cap to the specified torque in the order of the figure (1).

   Tightening torque: 17 ±3 N· m (13 ±2 ft-lb)

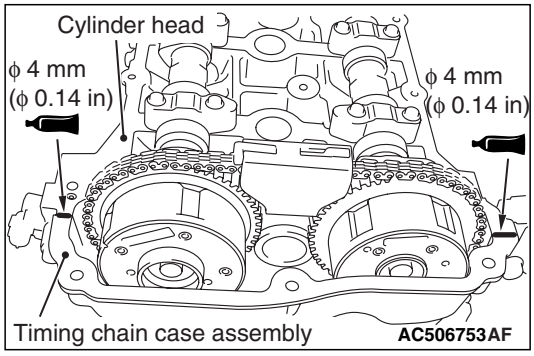
2. Tighten the front camshaft bearing cap again to the specified torque in the order of the figure (2).

   Tightening torque: 30 ±2 N· m (23 ±1 ft-lb)

3. After installing the front camshaft bearing cap, check that the paint marks of camshaft sprocket and of timing chain, the timing mark of crankshaft pulley, and the T-mark position of ignition timing indicator are aligned correctly.

>>G<< ROCKER COVER ASSEMBLY INSTALLATION

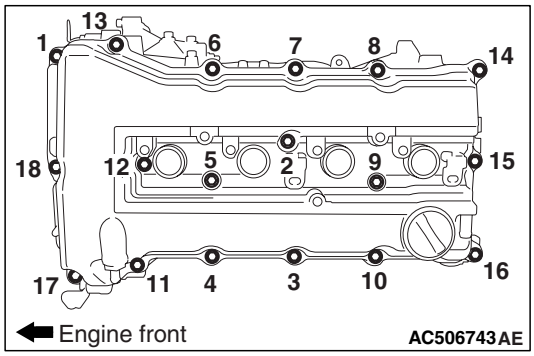
1. Wipe off the sealant on the mating surface of the rocker cover assembly and the cylinder head and timing chain case assembly, and degrease the surface where the sealant is applied by white gasoline or the like.



2. Apply sealant to the joint between the cylinder head and timing chain case assembly as shown in the figure and install the rocker cover assembly to the cylinder head.

   Specified sealant: Three bond 1217G or equivalent

   NOTE: Install the rocker cover assembly within 3 minutes after the application of sealant.



3. Tighten the rocker cover assembly mounting bolts to the specified torque in the order of number shown in the figure.

   Tightening torque: 3.0 ±1.0 N· m (27 ±8 in-lb)

4. Tighten again the rocker cover assembly mounting bolts to the specified torque in the order of number shown in the figure.

   Tightening torque: 5.5 ±0.5 N· m (49 ±4 in-lb)

VALVE STEM SEAL

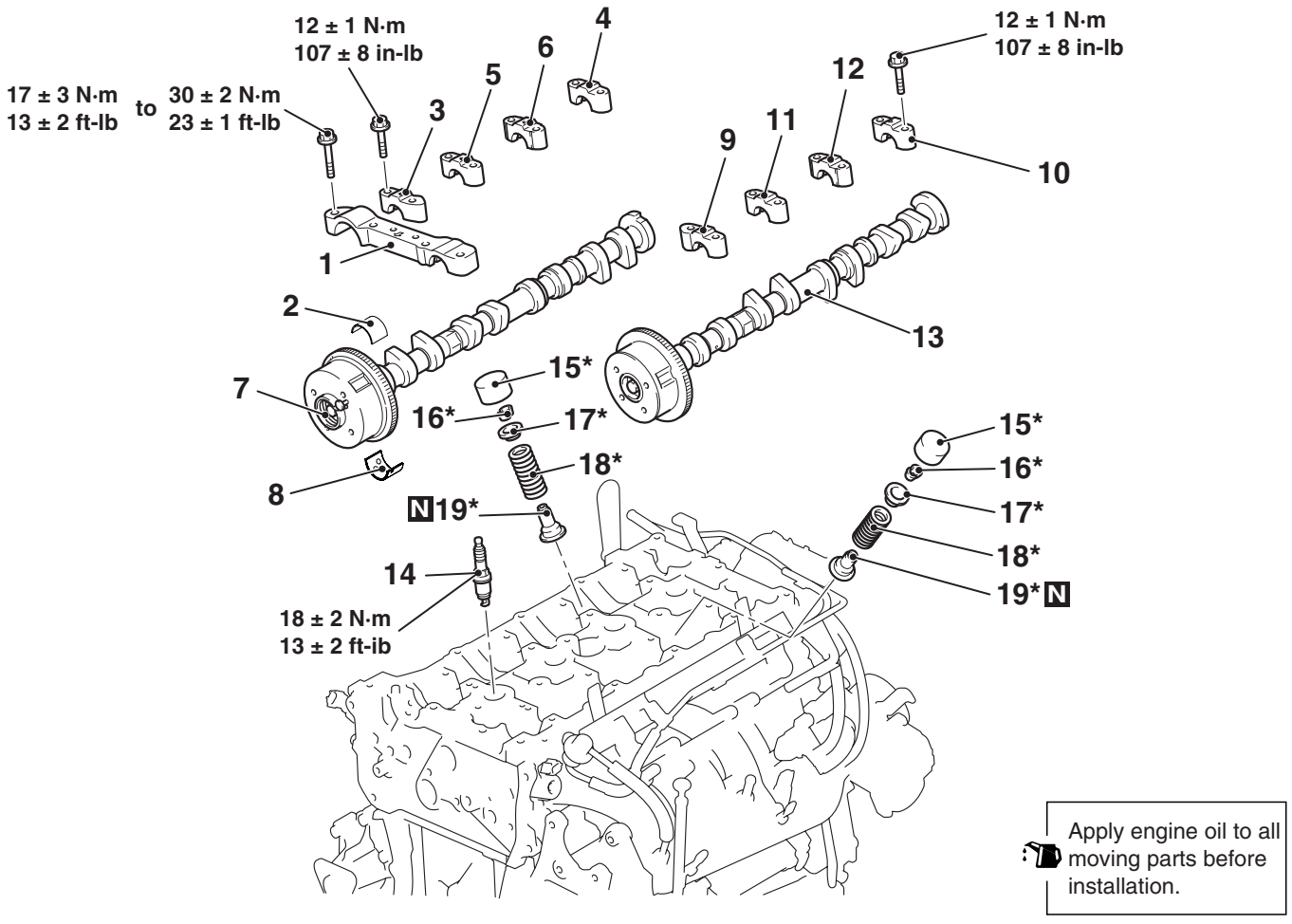
REMOVAL AND INSTALLATION

M1112008100472

⚠ CAUTION

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

Pre-removal operation	Post-installation operation
• Engine Room Under Cover Front A, B, Engine Room Under Cover Center and Engine Room Side Cover (RH) Removal (Refer to GROUP 51, Under Cover P.51-16). • Engine Oil Draining (Refer to GROUP 12, On-vehicle Service –Engine Oil Replacement P.12-5). • Rocker Cover Assembly Removal (Refer to P.11A-25). • Engine Oil Pan Removal (Refer to P.11A-51). • Timing Chain Removal (Refer to P.11A-69).	• Timing Chain Installation (Refer to P.11A-69). • Engine Oil Pan Installation (Refer to P.11A-51). • Valve Clearance Check (Refer to P.11A-10). • Rocker Cover Assembly Installation (Refer to P.11A-25). • Engine Oil Refilling (Refer to GROUP 12, On-vehicle Service –Engine Oil Replacement P.12-5). • Engine Room Under Cover Front A, B, Engine Room Under Cover Center and Engine Room Side Cover (RH) Installation (Refer to GROUP 51, Under Cover P.51-16).



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Removal steps

<<A>>	>>G<<	1.	Front camshaft bearing cap assembly
	>>F<<	2.	Camshaft bearing
<<B>>	>>E<<	3.	Oil feeding camshaft bearing cap (exhaust side)
<<B>>	>>E<<	4.	Camshaft bearing cap (exhaust side)
<<B>>	>>E<<	5.	Camshaft bearing cap (exhaust side)

Removal steps (Continued)

<<B>>	>>E<<	6.	Thrust camshaft bearing cap (exhaust side)
	>>F<<	7.	Camshaft and camshaft sprocket assembly (exhaust side)
	>>F<<	8.	Camshaft bearing
<<B>>	>>E<<	9.	Oil feeding camshaft bearing cap (intake side)
<<B>>	>>E<<	10.	Camshaft bearing cap (intake side)
<<B>>	>>E<<	11.	Camshaft bearing cap (intake side)

TSB Revision

Removal steps (Continued)

<<B>> >>E<< 12. Thrust camshaft bearing cap (intake side)
13. Camshaft and camshaft sprocket assembly (intake side)
14. Spark plug
<<C>> >>D<< 15. Valve tappet
<<D>> >>C<< 16. Valve spring retainer lock
17. Valve spring retainer
>>B<< 18. Valve spring
<<E>> >>A<< 19. Valve stem seal

Required Special Tools:

- MD998772: Valve Spring Compressor
- MB992089: Retainer Holder C
- MB992090: Retainer Holder Attachment
- MB992085: Valve Stem Seal Pliers
- MD998737: Valve Stem Seal Installer

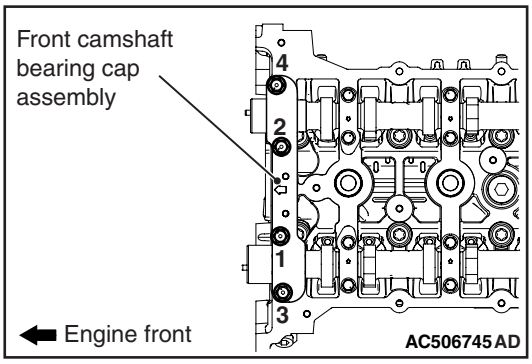
REMOVAL SERVICE POINTS

<<A>> FRONT CAMSHAFT BEARING CAP ASSEMBLY REMOVAL

⚠ CAUTION

Be careful not to drop the camshaft bearing.

Loosen the mounting bolts of front camshaft bearing cap in the order of number shown in the figure, and remove the front camshaft bearing cap assembly.

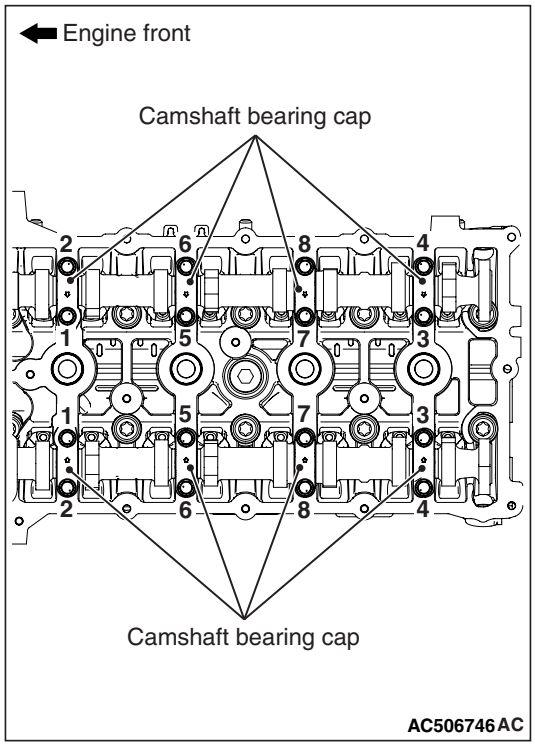


<<B>> OIL FEEDING CAMSHAFT BEARING CAP/CAMSHAFT BEARING CAP/THRUST CAMSHAFT BEARING CAP REMOVAL

⚠ CAUTION

When the camshaft bearing cap mounting bolts are loosened at once, the mounting bolts jump out by the spring force and the threads are damaged. Always loosen the mounting bolts in four or five steps.

Loosen the mounting bolts of the camshaft bearing caps in the order of number shown in the figure in four or five steps, and remove the camshaft bearing caps.

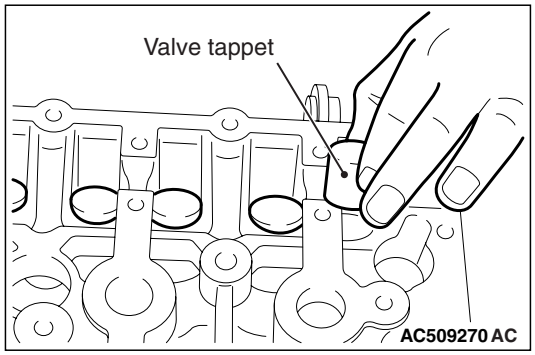


<<C>> VALVE TAPPET REMOVAL

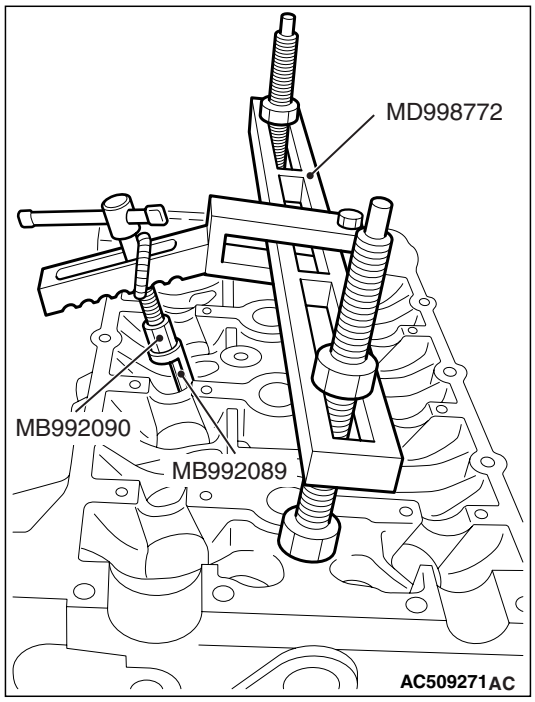
⚠ CAUTION

- **Do not use pliers or other tools to remove the valve tappets. Always remove them by hand.**
- **When reusing the removed valve tappet, it has to be installed in the same position as before. Be sure to put a tab that shows the original installation position on the valve tappet when storing it.**

Remove all of the valve tappets by hand.



<<D>> VALVE SPRING RETAINER LOCK REMOVAL



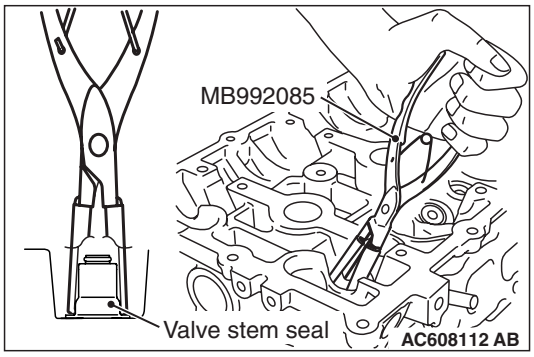
1. Screw in special tool MB992090 to special tool MD998772 and assemble special tool MB992089.

⚠ CAUTION

When removing the valve spring retainer lock, leave the piston of the 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.

2. Install special tool MD998772 (with special tools MB992090 and MB992089 attached) to the cylinder head and compress the valve spring. Then, remove the valve spring retainer lock.

<<E>> VALVE STEM SEAL REMOVAL



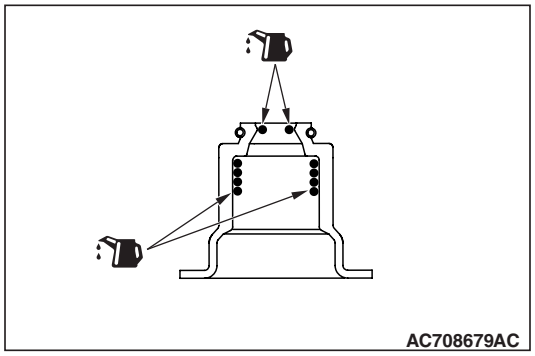
Use special tool MB992085 to grip the base of the stem seal (where the outside diameter is larger) securely, and remove it by twisting it to the left and right.

INSTALLATION SERVICE POINTS

>>A<< VALVE STEM SEAL INSTALLATION

⚠ CAUTION

- **Valve stem seals cannot be reused.**
- **Do not damage the wall of the tappet hole when installing the valve stem seal.**
- **Special tool MD998737 must be used to install the valve stem seal. Improper installation of the valve stem seal could result in oil leaking past the valve guide.**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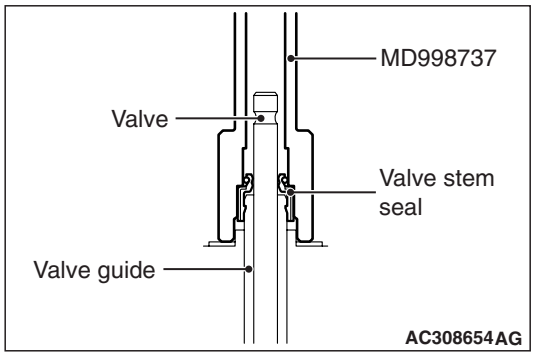
1. Apply a small amount of engine oil to the press-fit part and lip part of the new valve stem seal.



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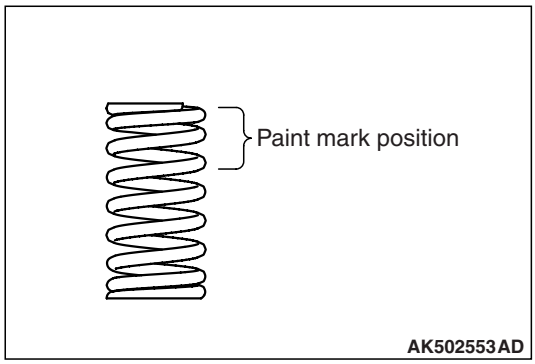
2. Use special tool MD998737 to press-fit a new valve stem seal in the valve guide using the valve stem area as a guide.

>>B<< VALVE SPRING INSTALLATION

Install the valve spring so that the painted side faces toward the camshaft.



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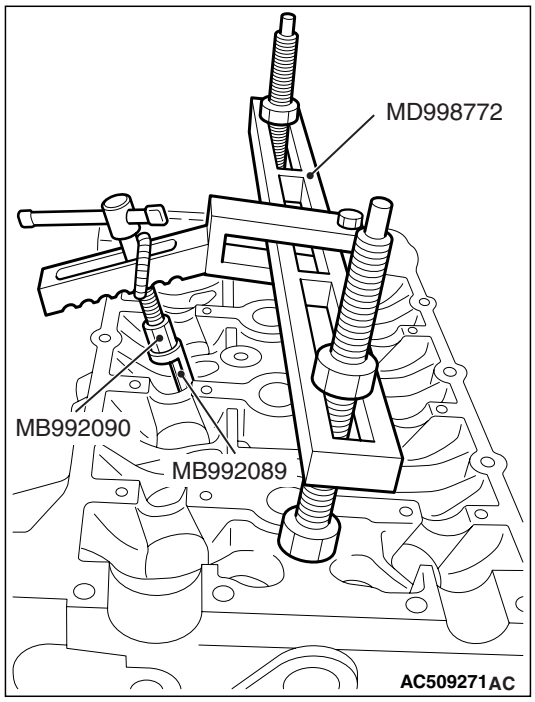
>>C<< VALVE SPRING RETAINER LOCK INSTALLATION



In the same manner as removal, use special tool MD998772 with special tool MB992090 and special tool MB992089 attached to compress the valve spring, and install the valve spring retainer lock.

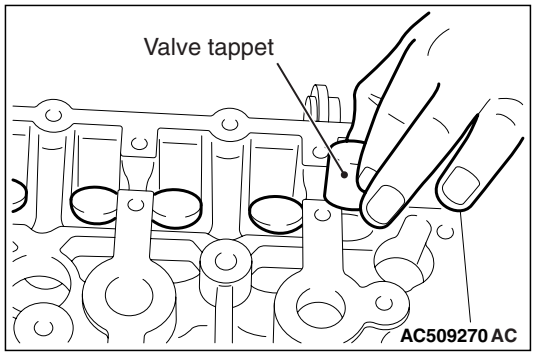
>>D<< VALVE TAPPET INSTALLATION

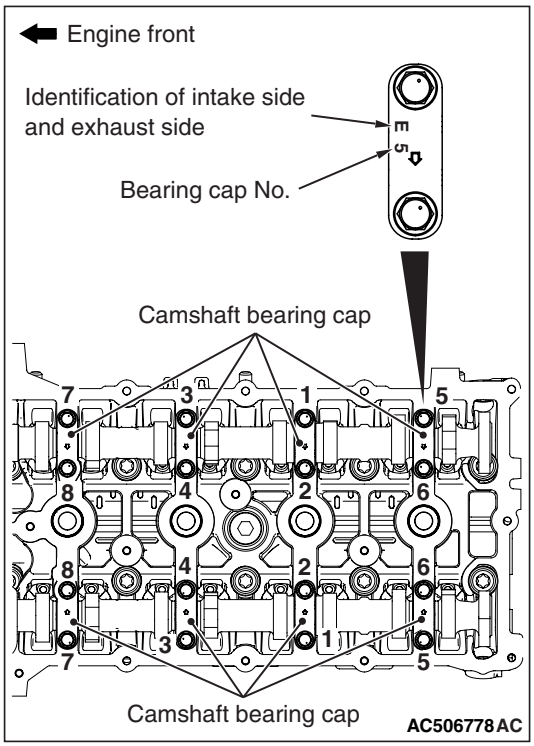
1. Apply a small amount of engine oil to the valve tappets.

⚠ CAUTION

Be sure to install the valve tappets in the same position as before.

2. Install the valve tappet to the cylinder head.





>>E<< THRUST CAMSHAFT BEARING CAP/CAMSHAFT BEARING CAP/OIL FEEDING CAMSHAFT BEARING CAP INSTALLATION

1. Install the camshaft bearing caps to the cylinder heads.

   NOTE: Because the thrust camshaft bearing cap and camshaft bearing cap are the same in shape, check the cap number and additionally its symbol to identify the intake and exhaust sides for correct installation.

2. Tighten each camshaft bearing cap to the specified torque in the order of number shown in the figure in two or three steps.

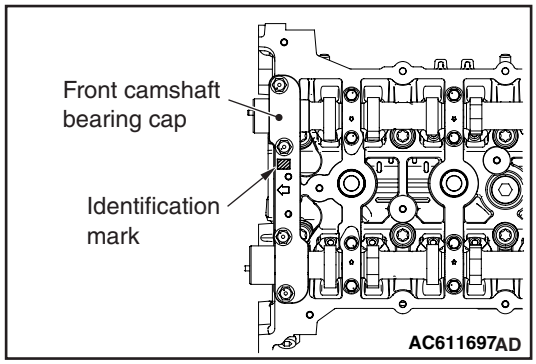
   Tightening torque: 12 ±1 N· m (107 ±8 in-lb)

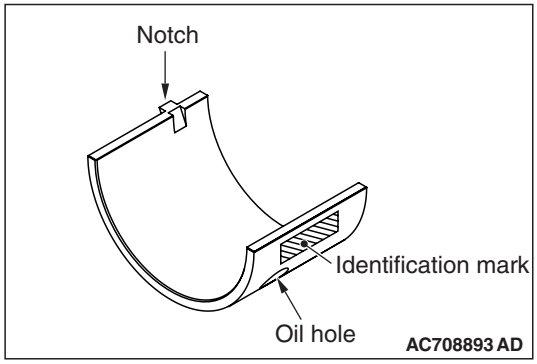
>>F<< CAMSHAFT BEARING/CAMSHAFT AND CAMSHAFT SPROCKET ASSEMBLY (EXHAUST SIDE) INSTALLATION

⚠ CAUTION

- **Be careful not to drop the camshaft bearing.**
- **When installing the camshaft and camshaft sprocket assembly (exhaust side), be careful not to let the camshaft bearing which is installed to the front cam bearing deviate from its position.**

When replacing the camshaft bearing, according to the identification mark of front camshaft bearing cap in the table below, select a camshaft bearing with the corresponding size. Note that the identification mark of camshaft bearing is stamped on the place shown in the figure.



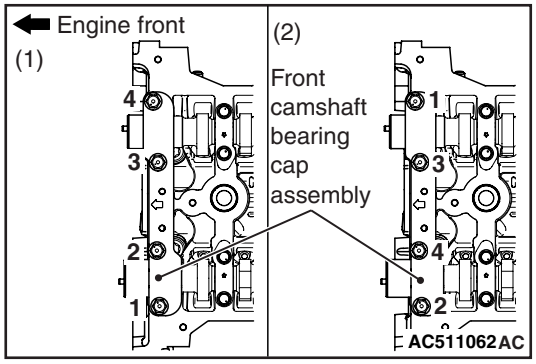


Front camshaft bearing cap		Camshaft bearing identification mark
Identification mark	Journal diameter mm (in)	
1	40.000 - 40.008 (1.5748 - 1.5751)	1
2	40.008 - 40.016 (1.5751 - 1.5754)	2
3	40.016 - 40.024 (1.5754 - 1.5757)	3

>>G<< FRONT CAMSHAFT BEARING CAP ASSEMBLY INSTALLATION

⚠ CAUTION

When the mounting bolts are tightened with the front camshaft bearing cap tilted, the front camshaft bearing cap is damaged. Install the front camshaft bearing cap properly to the cylinder head and camshaft.



1. Install the front camshaft bearing cap to the cylinder head, and temporarily tighten the front camshaft bearing cap to the specified torque in the order of the figure (1).

   Tightening torque: 17 ±3 N· m (13 ±2 ft-lb)

2. Tighten the front camshaft bearing cap again to the specified torque in the order of the figure (2).

   Tightening torque: 30 ±2 N· m (23 ±1 ft-lb)

OIL PAN

REMOVAL AND INSTALLATION

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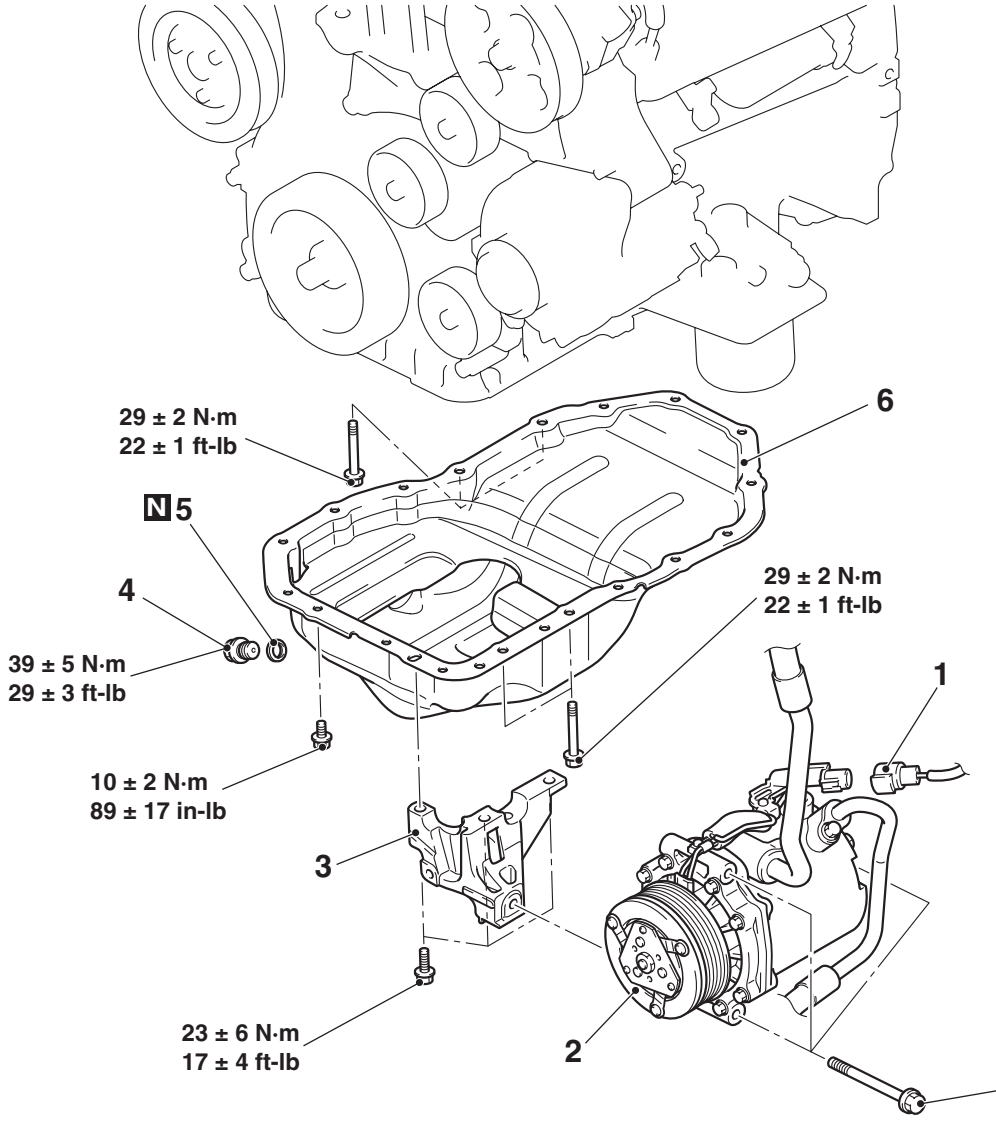
Pre-removal operation	Post-installation operation
• Engine Room Under Cover Front A, B, Engine Room Under Cover Center and Engine Room Side Cover (RH) Removal (Refer to GROUP 51, Under Cover P.51-16). • Engine Oil Draining (Refer to GROUP 12, On-vehicle Service –Engine Oil Replacement P.12-5). • Drive Belt Removal (Refer to P.11A-21).	• Drive Belt Installation (Refer to P.11A-21). • Engine Oil Refilling (Refer to GROUP 12, On-vehicle Service –Engine Oil Replacement P.12-5). • Engine Room Under Cover Front A, B, Engine Room Under Cover Center and Engine Room Side Cover (RH) Installation (Refer to GROUP 51, Under Cover P.51-16).



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Removal steps

1. A/C compressor assembly connector connection

<<A>> >>C<< 2. A/C compressor and clutch assembly

Removal steps (Continued)

3. A/C compressor bracket
4. Engine oil pan drain plug

>>B<< 5. Engine oil pan drain plug gasket

<<B>> >>A<< 6. Engine oil pan

Required Special Tool:

- MD998727: Oil Pan FIPG Cutter

TSB Revision

REMOVAL SERVICE POINTS

<<A>> A/C COMPRESSOR AND CLUTCH ASSEMBLY REMOVAL

1. Remove the A/C compressor and clutch assembly together with the hose from the bracket.
2. Tie the removed A/C compressor and clutch assembly with a string at a position where they will not interfere with the removal and installation of engine oil pan.

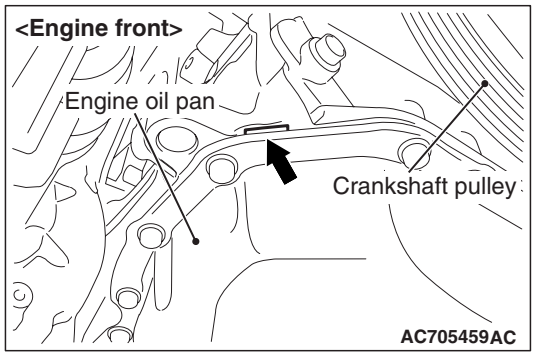
<<B>> ENGINE OIL PAN REMOVAL

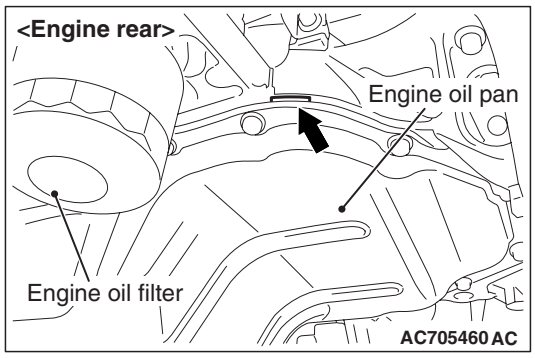
1. Remove the engine oil pan mounting bolts.

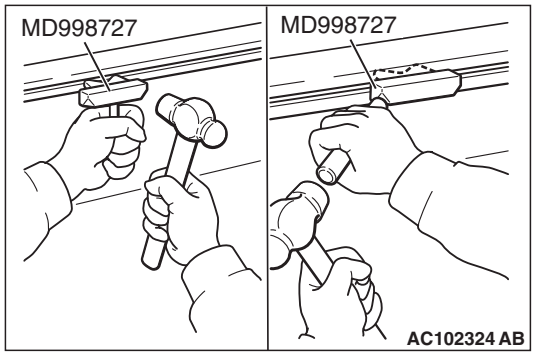
⚠ CAUTION

Do not forcibly drive in special tool MD998727 to avoid damage to the engine oil pan seal surface of cylinder block assembly.

2. Insert special tool MD998727 from the engine oil pan removal groove of the cylinder block assembly.
3. Lightly tap the special tool with a hammer to slide the oil pan seal surface, cut off the liquid gasket, and remove the engine oil pan.

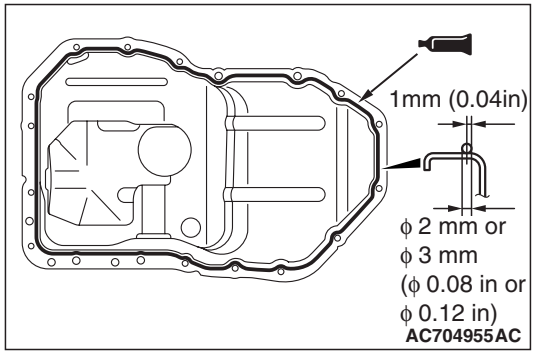






INSTALLATION SERVICE POINTS

>>A<< ENGINE OIL PAN INSTALLATION



1. Remove all the traces of sealant adhering to the engine oil pan and cylinder block assembly using a remover or others. Then, degrease them using quick-drying degreasing agent (white gasoline).
2. Apply the sealant without any gap to the mating surface of engine oil pan as shown in the figure. Within three minutes, install the engine oil pan to the cylinder block assembly.

   Specified sealant: Three bond 1217G or equivalent

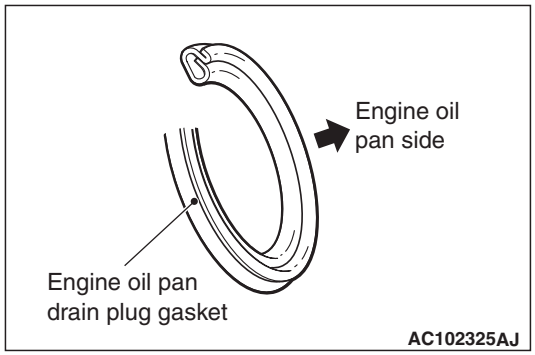
⚠ CAUTION

Do not apply oil or water to the sealant-applied area or start up the engine within 2 hours after the installation of the engine oil pan.

3. Tighten the engine oil pan mounting bolts to the specified torque.

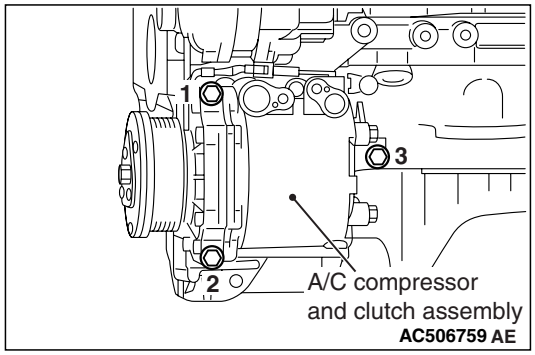
   Tightening torque:
   M6: 10 ±2 N· m (89 ±17 in-lb)
   M8: 29 ±2 N· m (22 ±1 ft-lb)

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



Replace the engine oil pan drain plug gasket with a new one. Install the new gasket in the direction shown in the illustration.

>>C<< A/C COMPRESSOR AND CLUTCH ASSEMBLY INSTALLATION



Tighten A/C compressor and clutch assembly mounting bolts to the specified torque in the order of number shown in the illustration.

Tightening torque: 23 ±6 N· m (17 ±4 ft-lb)

INSPECTION

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

CRANKSHAFT OIL SEAL

REMOVAL AND INSTALLATION

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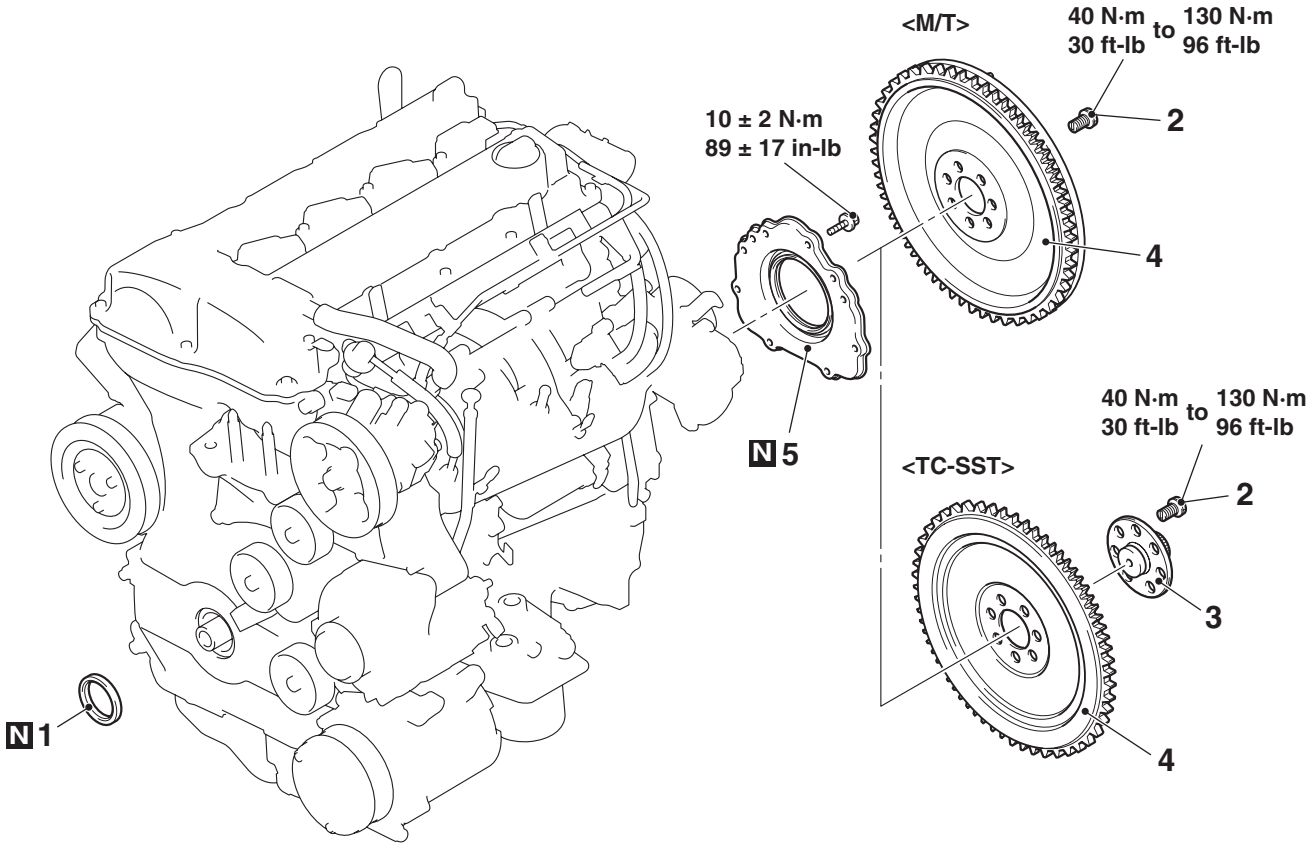

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Crankshaft front oil seal removal steps

- Crankshaft pulley (Refer to P.11A-21)

>>C<< 1. Crankshaft front oil seal

Crankshaft rear oil seal removal steps

- Transaxle assembly (Refer to GROUP 22A, Transaxle Assembly P.22A-127<M/T>), (Refer to GROUP 22C, Transaxle Assembly P.22C-341<TC-SST>)

<<A>> >>B<< 2. Flywheel bolts
>>B<< 3. Flywheel hub <TC-SST>
>>B<< 4. Flywheel
>>A<< 5. Crankshaft rear oil seal case assembly

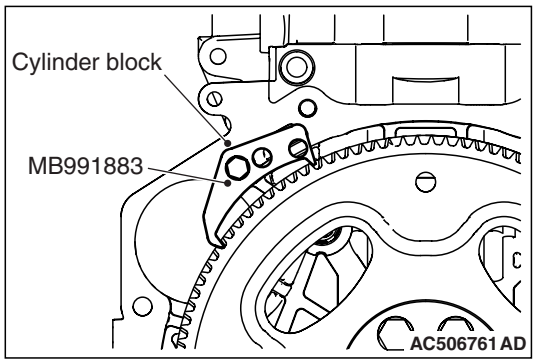
Required Special Tools:

- MB991883: Flywheel Stopper
- MB991448: Bush Remover And Installer Base

TSB Revision

REMOVAL SERVICE POINT

<<A>> FLYWHEEL BOLTS REMOVAL



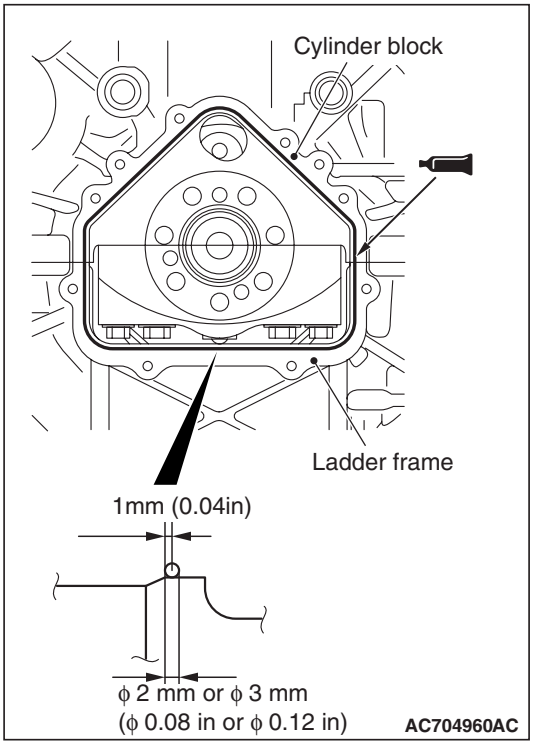
Fix the flywheel using special tool MB991883, and loosen the flywheel bolts.

INSTALLATION SERVICE POINTS

>>A<< CRANKSHAFT REAR OIL SEAL CASE ASSEMBLY INSTALLATION

1. Remove all the traces of sealant adhering to the cylinder block and ladder frame using a remover or others. Then, degrease them using quick-drying degreasing agent (white gasoline).
2. Apply the sealant without any gap to the cylinder block and ladder frame as shown in the figure. Within three minutes, install the crankshaft rear oil seal case assembly.

   Specified sealant: Three bond 1227D or equivalent
3. Apply a small amount of engine oil to the entire inner diameter of the oil seal lip, and install the crankshaft rear oil seal case assembly.



⚠ CAUTION

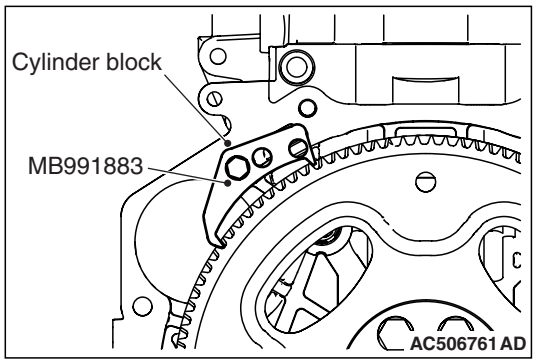
Do not apply oil or water to the sealant-applied area or start up the engine within 2 hours after the installation of the crankshaft rear oil seal.

4. Tighten the crankshaft rear oil seal case assembly mounting bolts to the specified torque.

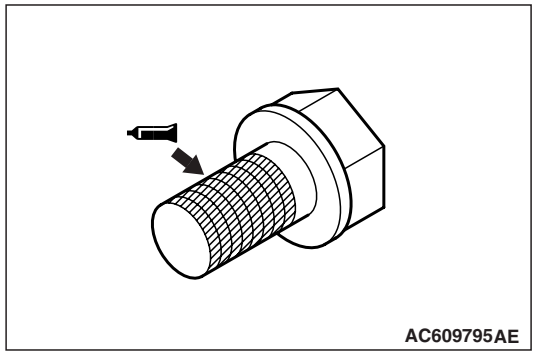
   Tightening torque: 10 ±2 N· m (89 ±17 in-lb)

>>B<< FLYWHEEL/FLYWHEEL HUB <TC-SST>/FLYWHEEL BOLTS INSTALLATION

1. Remove the engine oil and deposits from the flywheel bolt threads, crankshaft tapped hole, and flywheel.
2. Install the flywheel and flywheel hub <TC-SST> to the crankshaft.

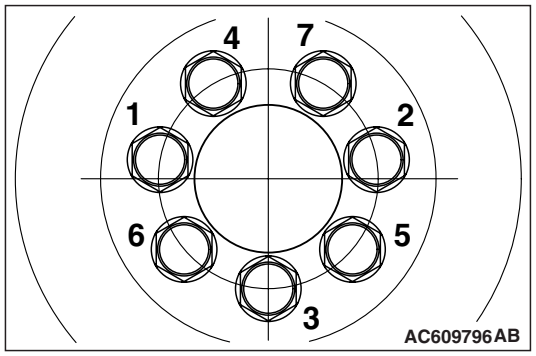


3. Use special tool MB991883 to secure the flywheel assembly in the same manner as removal.



4. Apply a small amount of engine oil to the bearing surfaces of flywheel bolts and crankshaft tapped hole, and apply the sealant to the bolt threads of flywheel.

Specified sealant: Three bond 1324 or equivalent



5. Tighten flywheel bolts to temporary torque 40 N· m (30 ft-lb) in the order shown in the illustration.
6. Tighten flywheel bolts to specified torque in the order shown in the illustration.

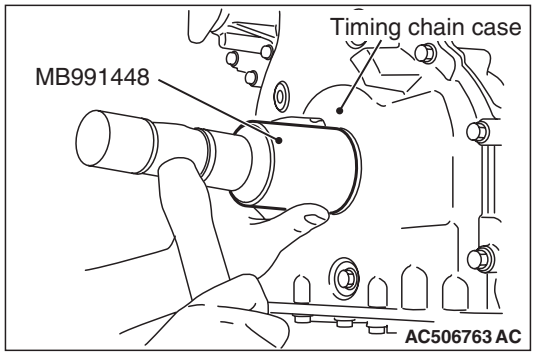
Tightening torque: 130 N· m (96 ft-lb)

>>C<< CRANKSHAFT FRONT OIL SEAL INSTALLATION

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

⚠ CAUTION

When installing the crankshaft oil seal, be careful to avoid damage to the crankshaft front oil seal.



2. Using special tool MB991448, press in the crankshaft front oil seal up to the chamfered surface of timing chain case.

CYLINDER HEAD GASKET

REMOVAL AND INSTALLATION

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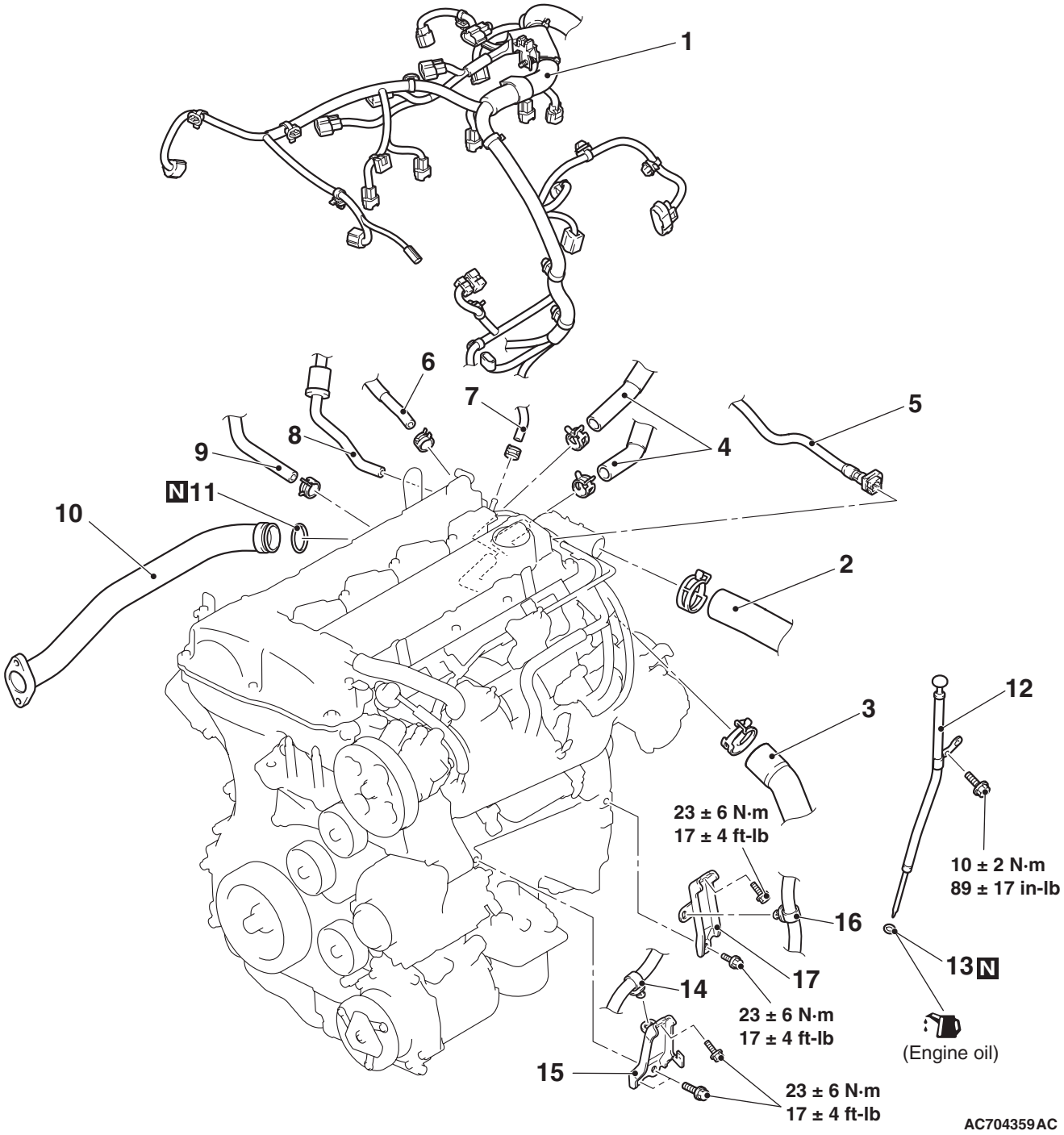
Pre-removal operation	Post-installation operation
• Fuel Line Pressure Reduction [Refer to GROUP 13A, On-vehicle Service –Fuel Pump Connector Disconnection (How to Reduce Pressurized Fuel Lines) P.13A-901]. • Engine Room Under Cover Front A, B, Engine Room Under Cover Center and Engine Room Side Cover (RH) Removal (Refer to GROUP 51, Under Cover P.51-16). • Engine Coolant Draining (Refer to GROUP 14, On-vehicle Service –Engine Coolant Replacement P.14-17). • Air Cleaner Assembly Removal (Refer to GROUP 15, Air Cleaner P.15-10). • Charge Air Cooler Intake Hose A, B and Charge Air Cooler Intake Pipe A Removal (Refer to GROUP 15, Charge Air Cooler P.15-15). • Ignition Coil Removal (Refer to GROUP 16, Ignition System –Ignition Coil P.16-39). • Strut Tower Bar Removal (Refer to GROUP 42A, Strut Tower Bar P.42A-15). • Exhaust Manifold and Turbocharger Assembly Removal (Refer to GROUP 15, Exhaust Manifold and Turbocharger Assembly P.15-16). • Throttle Body Assembly Removal (Refer to GROUP 13A, Throttle Body Assembly P.13A-918). • Water Pump Removal (Refer to GROUP 14, Water Pump P.14-25).	• Water Pump Installation (Refer to GROUP 14, Water Pump P.14-25). • Throttle Body Assembly Installation (Refer to GROUP 13A, Throttle Body Assembly P.13A-918). • Exhaust Manifold and Turbocharger Assembly Installation (Refer to GROUP 15, Exhaust Manifold and Turbocharger Assembly P.15-16). • Strut Tower Bar Installation (Refer to GROUP 42A, Strut Tower Bar P.42A-15). • Ignition Coil Installation (Refer to GROUP 16, Ignition System –Ignition Coil P.16-39). • Charge Air Cooler Intake Hose A, B and Charge Air Cooler Intake Pipe A Installation (Refer to GROUP 15, Charge Air Cooler P.15-15). • Air Cleaner Assembly Installation (Refer to GROUP 15, Air Cleaner P.15-10). • Engine Coolant Refilling (Refer to GROUP 14, On-vehicle Service –Engine Coolant Replacement P.14-17). • Fuel Leak Check • Engine Room Under Cover Front A, B, Engine Room Under Cover Center and Engine Room Side Cover (RH) Installation (Refer to GROUP 51, Under Cover P.51-16).

TSB Revision



Removal steps

1. Control wiring harness connection
2. Radiator upper hose connection
3. Radiator lower hose connection
4. Heater hose connection

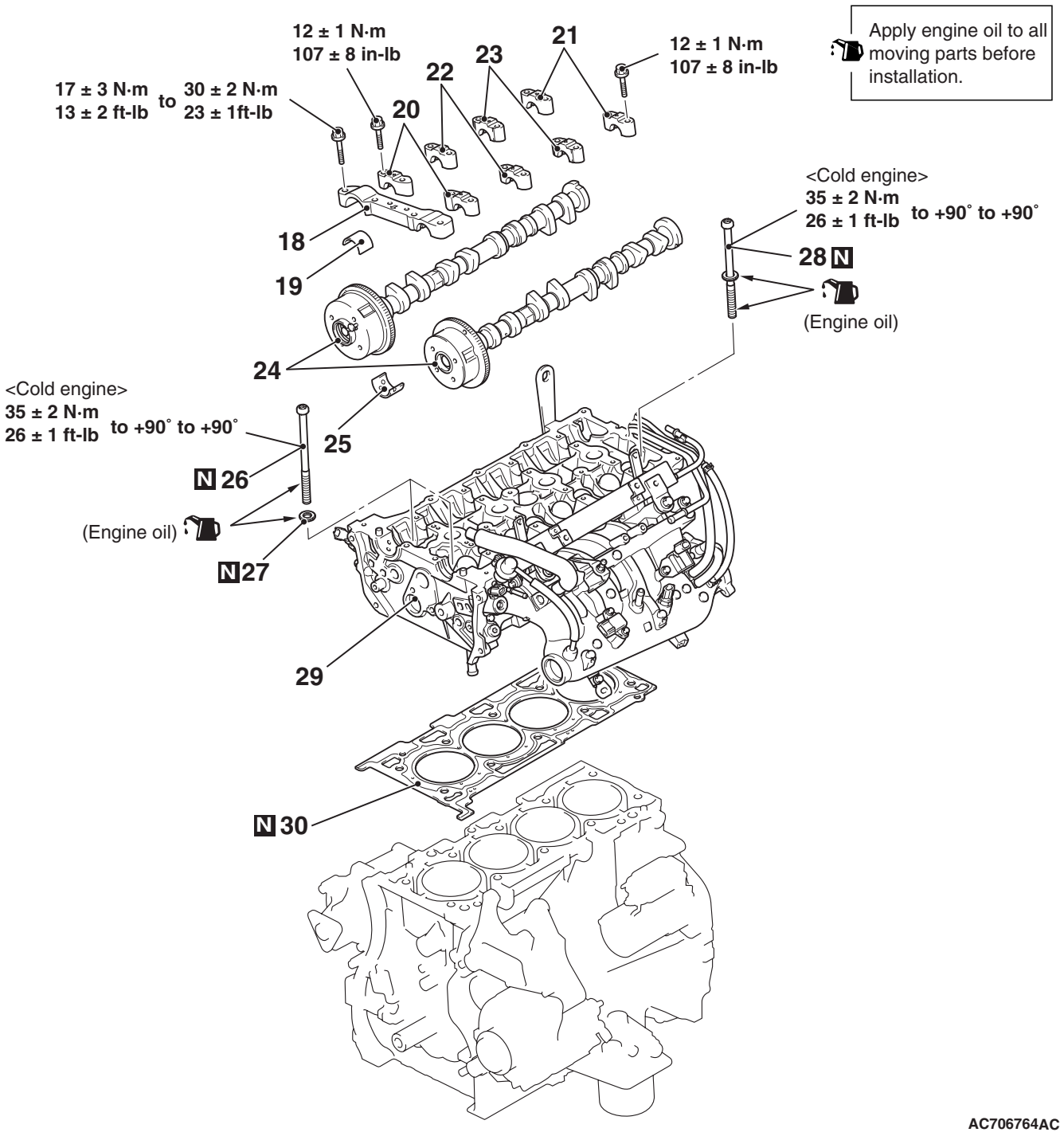
<<A>> >>F<< 5. Fuel high-pressure hose connection

6. Fuel return hose connection
7. Turbocharger by-pass valve purge hose connection
8. Canister vacuum hose connection

Removal steps (Continued)

9. Brake booster vacuum hose connection
10. Water pump intake pipe
11. O-ring
12. Engine oil level gauge
13. O-ring
14. Starter wiring harness clamp
15. Intake manifold stay (front)
16. Starter wiring harness clamp
17. Intake manifold stay (rear)

TSB Revision



Removal steps

- Valve timing chain (Refer to P.11A-69)

<<B>> >>E<< 18. Front camshaft bearing cap assembly
>>C<< 19. Camshaft bearing
<<C>> >>D<< 20. Oil feeding camshaft bearing cap
<<C>> >>D<< 21. Camshaft bearing cap
<<C>> >>D<< 22. Camshaft bearing cap
<<C>> >>D<< 23. Thrust camshaft bearing cap

Removal steps (Continued)

>>C<< 24. Camshaft and camshaft sprocket assembly
>>C<< 25. Camshaft bearing
<<D>> >>B<< 26. Cylinder head bolt
<<D>> >>B<< 27. Cylinder head bolt washer
<<D>> >>B<< 28. Cylinder head bolt and washer assembly
>>A<< 29. Cylinder head assembly
>>A<< 30. Cylinder head gasket

TSB Revision

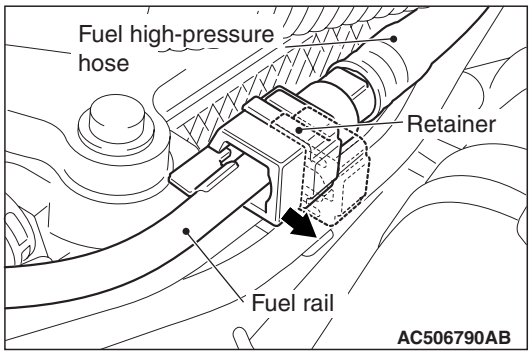
Required Special Tools:

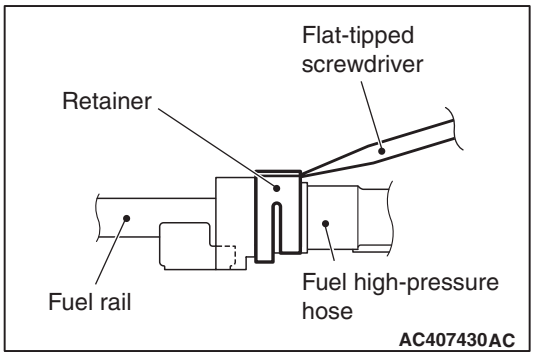
- MB991454: Engine Hanger Balancer
- MB991895: Engine Hanger
- MB991928: Engine Hanger

REMOVAL SERVICE POINTS

<<A>> FUEL HIGH-PRESSURE HOSE DISCONNECTION

1. Follow the steps below to unlock the fuel high-pressure hose connector.

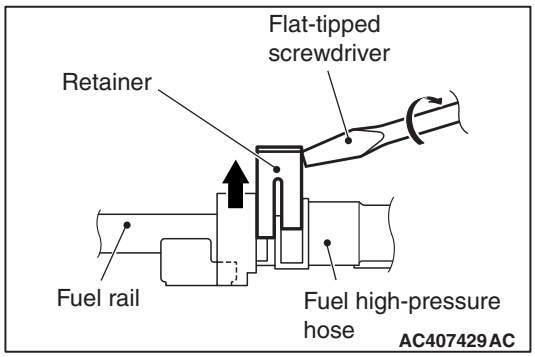




(1) Insert a flat-tipped screwdriver [6 mm (0.24 inch) wide and 1 mm (0.04inch) thick] into the retainer of the fuel high-pressure hose connector.

⚠ CAUTION

When pushing up the retainer of the fuel high-pressure hose connector, pay attention to avoid damage to the retainer.



(2) Turn the flat-tipped screwdriver inserted into the retainer by 90 degrees to push up the retainer and unlock the fuel high-pressure hose connector.

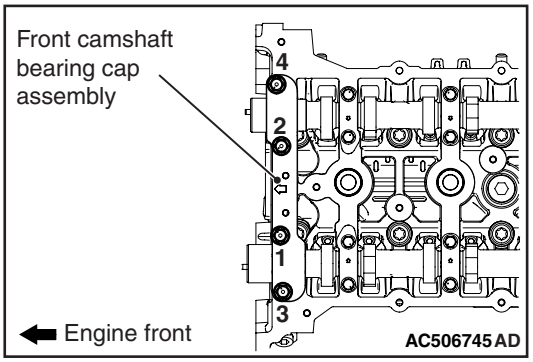
2. Remove the fuel high-pressure hose.

<<B>> FRONT CAMSHAFT BEARING CAP ASSEMBLY REMOVAL

⚠ CAUTION

Be careful not to drop the camshaft bearing.

Loosen the mounting bolts of front camshaft bearing cap in the order of number shown in the figure, and remove the front camshaft bearing cap assembly.

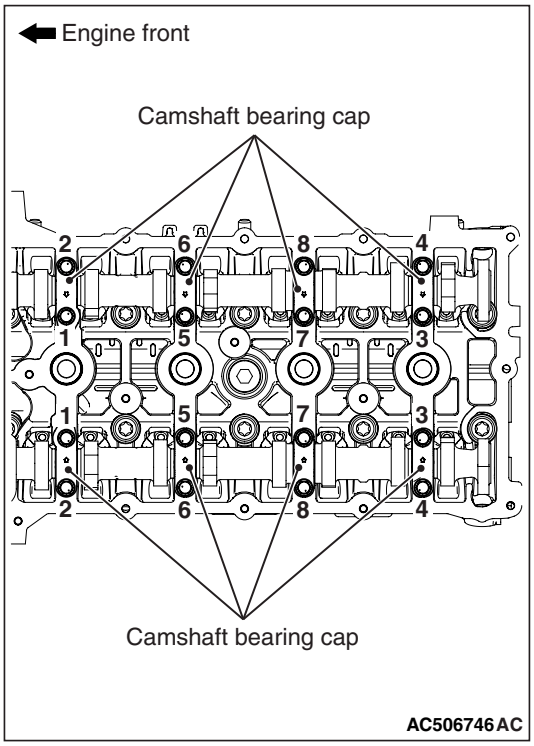


<<C>> OIL FEEDING CAMSHAFT BEARING CAP/CAMSHAFT BEARING CAP/THRUST CAMSHAFT BEARING CAP REMOVAL

⚠ CAUTION

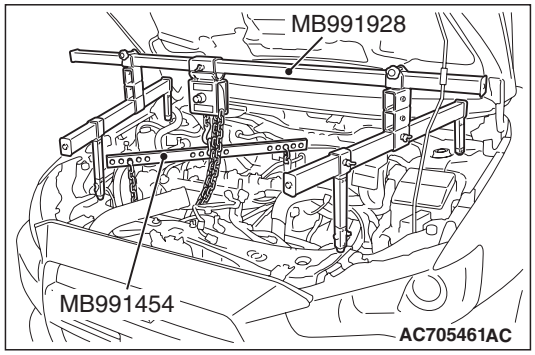
When the camshaft bearing cap mounting bolts are loosened at once, the mounting bolts jump out by the spring force and the threads are damaged. Always loosen the mounting bolts in four or five steps.

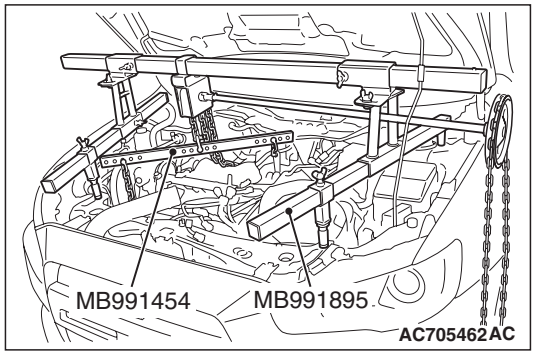
Loosen the mounting bolts of the camshaft bearing caps in the order of number shown in the figure in four or five steps, and remove the camshaft bearing caps.



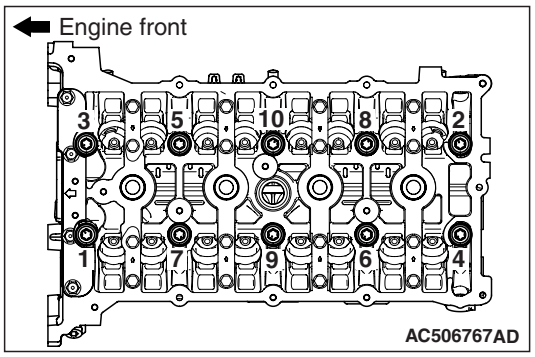
<<D>> CYLINDER HEAD BOLT/CYLINDER HEAD BOLT WASHER/CYLINDER HEAD BOLT AND WASHER ASSEMBLY REMOVAL

1. Temporarily install the engine oil pan which was removed at the valve timing chain removal (Refer to P.11A-51).
2. Place a garage jack against the engine oil pan with a piece of wood in between to support the engine and transaxle assembly.
3. Remove special tool MB991928 or MB991895 which was installed for supporting the engine and transaxle assembly when the valve timing chain was removed.





4. Loosen and remove the bolts in two or three steps in the order of number shown in the figure.



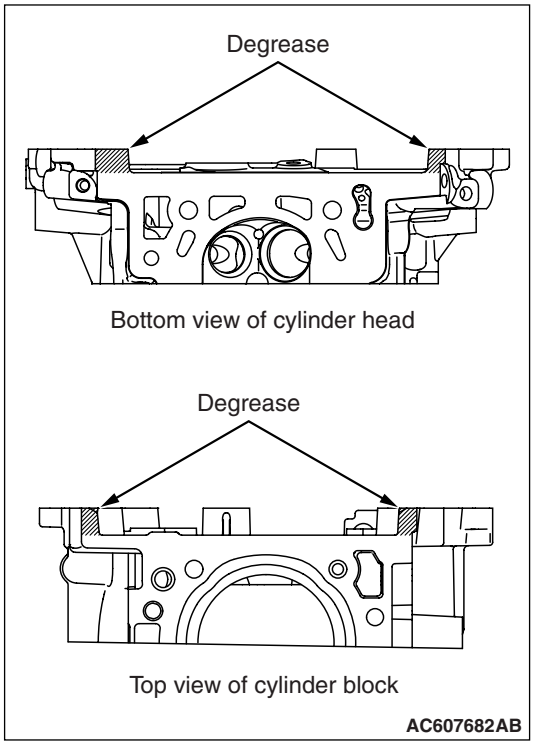
INSTALLATION SERVICE POINTS

>>A<< CYLINDER HEAD GASKET/CYLINDER HEAD ASSEMBLY INSTALLATION

⚠ CAUTION

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

1. Remove the sealant and grease on the top surface of cylinder block and on the bottom surface of the cylinder head. Then, use the quick-drying degreasing agent (white gasoline) to degrease the sealant application surface.



2. Apply the sealant to the top surface of cylinder block as shown in the figure.

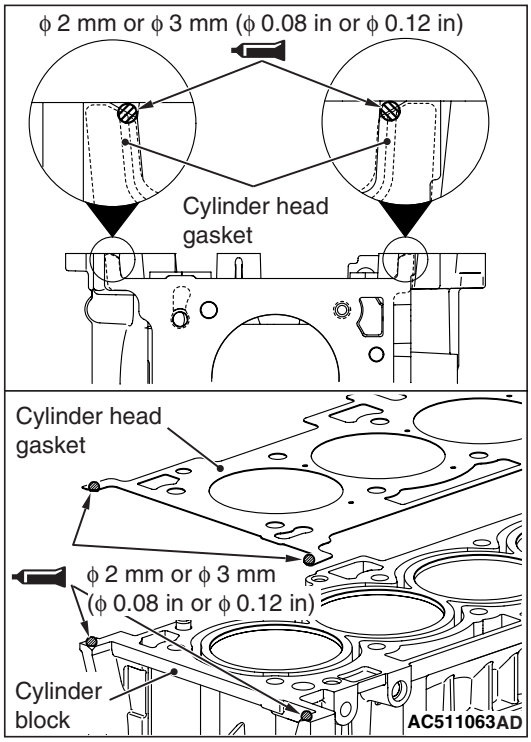
   Specified sealant: Three bond 1217G

3. Within three minutes after the sealant application, install the cylinder head gasket to the cylinder block.

   NOTE: When the cylinder gasket is installed to the cylinder block, check that the sealant is securely applied to the bead line of the cylinder head gasket.

4. Apply the sealant to the top surface of cylinder head gasket as shown in the figure.

   Specified sealant: Three bond 1217G



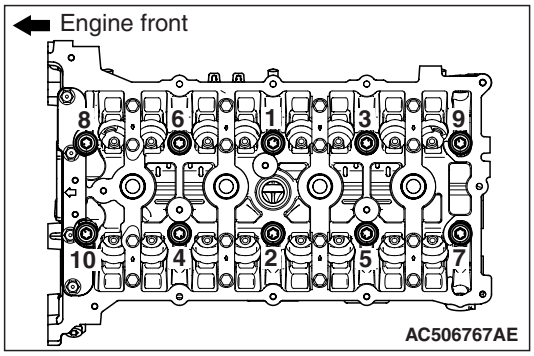
⚠ CAUTION

Within two hours after the cylinder head assembly installation, do not apply oil or water to the sealant application area or start the engine.

5. Within three minutes after the sealant application, install the cylinder head assembly.

>>B<< CYLINDER HEAD BOLT AND WASHER ASSEMBLY/CYLINDER HEAD BOLT WASHER/CYLINDER HEAD BOLT INSTALLATION

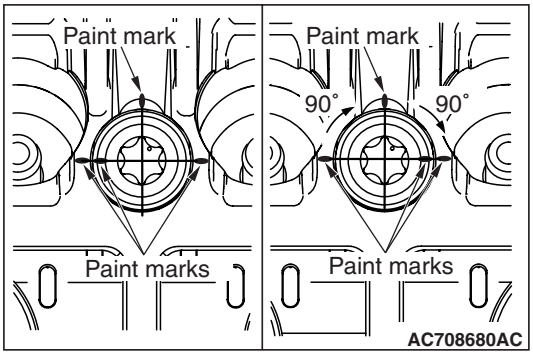
1. Replace the cylinder head bolt and washer with new ones.
2. For two bolts of the timing chain side, the washer can be removed from the bolt. Install the washer, with its sag facing upward, to the bolts.
3. Apply a small amount of engine oil to the thread of the bolts and to the washers.
4. Tighten the bolts by the following procedure (plastic region angular tightening method).
   (1) Tighten the bolts to 35 ±2 N· m (26 ±1 ft-lb) in the order of number shown in the figure.

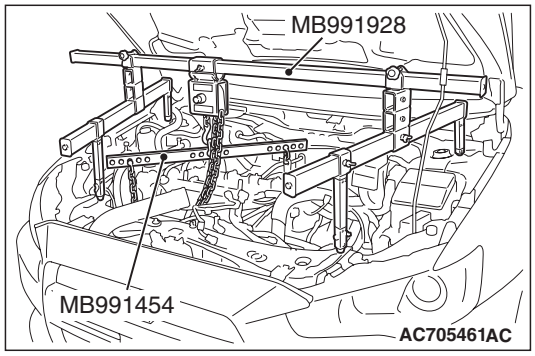


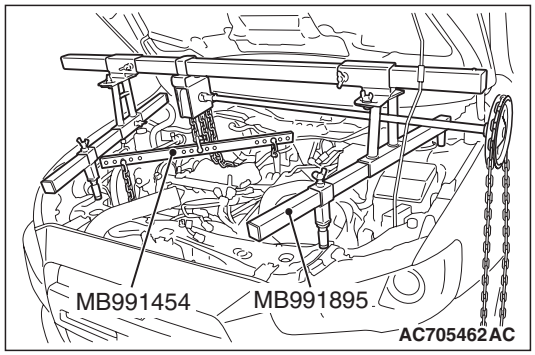
⚠ CAUTION

- **When the tightening angle is smaller than the specified tightening angle, the appropriate tightening capacity cannot be secured.**
- **When the tightening angle is larger than the specified tightening angle, remove the bolt to start from the beginning again according to the procedure.**

   (2) Apply paint marks to the head of cylinder head bolt and the cylinder head.
   (3) Tighten the cylinder head to 90° in the tightening order. Additionally tighten to 90°, and check that the paint mark on the cylinder head bolt is aligned with the paint mark on the cylinder head.







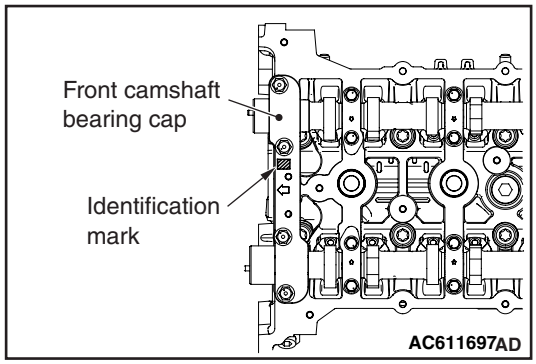
5. Install special tool MB991928 or MB991895 which was installed for supporting the engine and transaxle assembly when the valve timing chain was removed (Refer to P.11A-69).
6. Remove the garage jack which supports the engine and transaxle assembly.
7. Remove the engine oil pan installed temporarily.

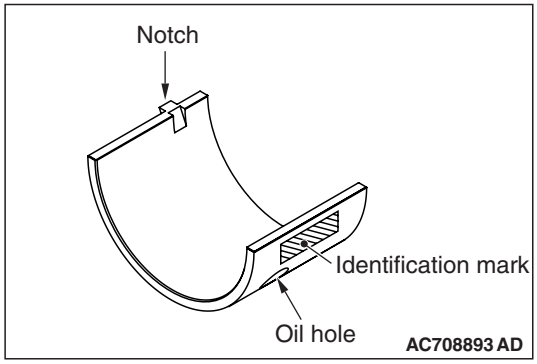
>>C<< CAMSHAFT BEARING/CAMSHAFT AND CAMSHAFT SPROCKET ASSEMBLY INSTALLATION

⚠ CAUTION

- **Be careful not to drop the camshaft bearing.**
- **When installing the camshaft and camshaft sprocket assembly (exhaust side), be careful not to let the camshaft bearing which is installed to the front cam bearing deviate from its position.**

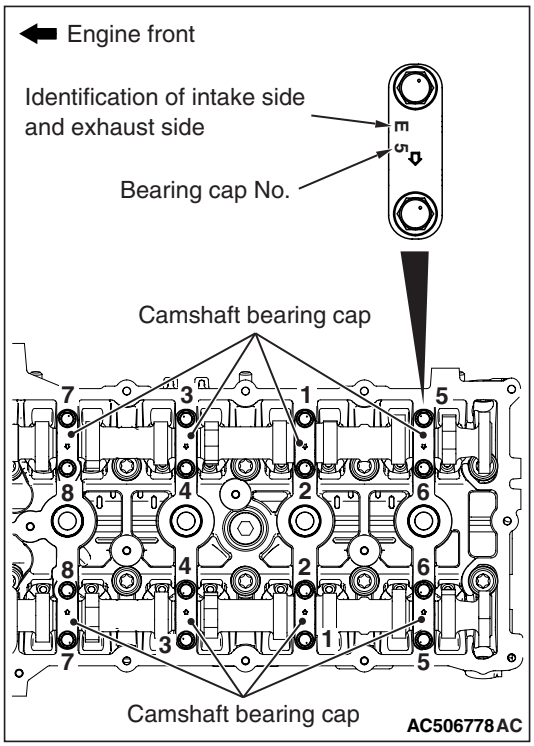
When replacing the camshaft bearing, according to the identification mark of front camshaft bearing cap in the table below, select a camshaft bearing with the corresponding size. Note that the identification mark of camshaft bearing is stamped on the place shown in the figure.





Front camshaft bearing cap		Camshaft bearing identification mark
Identification mark	Journal diameter mm (in)	
1	40.000 - 40.008 (1.5748 - 1.5751)	1
2	40.008 - 40.016 (1.5751 - 1.5754)	2
3	40.016 - 40.024 (1.5754 - 1.5757)	3

>>D<< THRUST CAMSHAFT BEARING CAP/CAMSHAFT BEARING CAP/OIL FEEDING CAMSHAFT BEARING CAP INSTALLATION



1. Install the camshaft bearing caps to the cylinder heads.

   NOTE: Because the thrust camshaft bearing cap and camshaft bearing cap are the same in shape, check the bearing cap number and additionally its symbol to identify the intake and exhaust sides for correct installation.

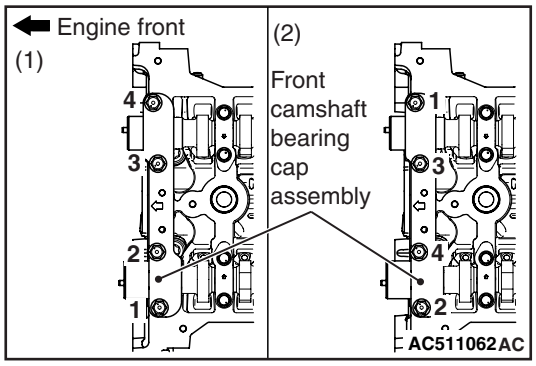
2. Tighten each camshaft bearing cap mounting bolt to the specified torque in the order of number shown in the figure in two or three steps.

   Tightening torque: 12 ±1 N· m (107 ±8 in-lb)

>>E<< FRONT CAMSHAFT BEARING CAP ASSEMBLY INSTALLATION

⚠ CAUTION

When the mounting bolts are tightened with the front camshaft bearing cap tilted, the front camshaft bearing cap is damaged. Install the front camshaft bearing cap properly to the cylinder head and camshaft.



1. Install the front camshaft bearing cap to the cylinder head, and temporarily tighten the front camshaft bearing cap to the specified torque in the order of the figure (1).

   Tightening torque: 17 ±3 N· m (13 ±2 ft-lb)

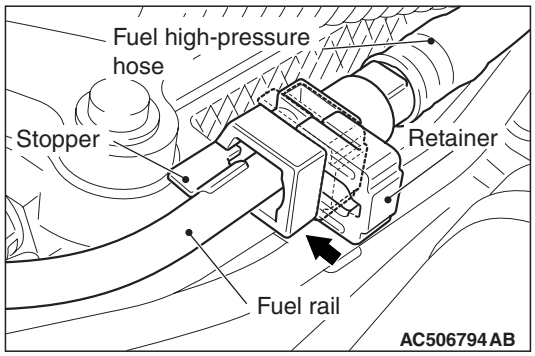
2. Tighten the front camshaft bearing cap again to the specified torque in the order of the figure (2).

   Tightening torque: 30 ±2 N· m (23 ±1 ft-lb)

>>F<< FUEL HIGH-PRESSURE HOSE CONNECTION

⚠ CAUTION

- **When pushing in the retainer of the fuel high-pressure hose connector, pay attention to avoid damage to the retainer.**
- **After the installation of the fuel high-pressure hose, slightly pull the fuel high-pressure hose to check that it is connected securely. At this time, also check that there is approximately 1 mm (0.04inch) play.**



1. Securely insert the fuel rail stopper into the fuel high-pressure hose connector groove to install the fuel high-pressure hose to the fuel rail.
2. Push in the retainer of the fuel high-pressure hose connector to lock the fuel high-pressure hose and fuel rail.

TIMING CHAIN

REMOVAL AND INSTALLATION

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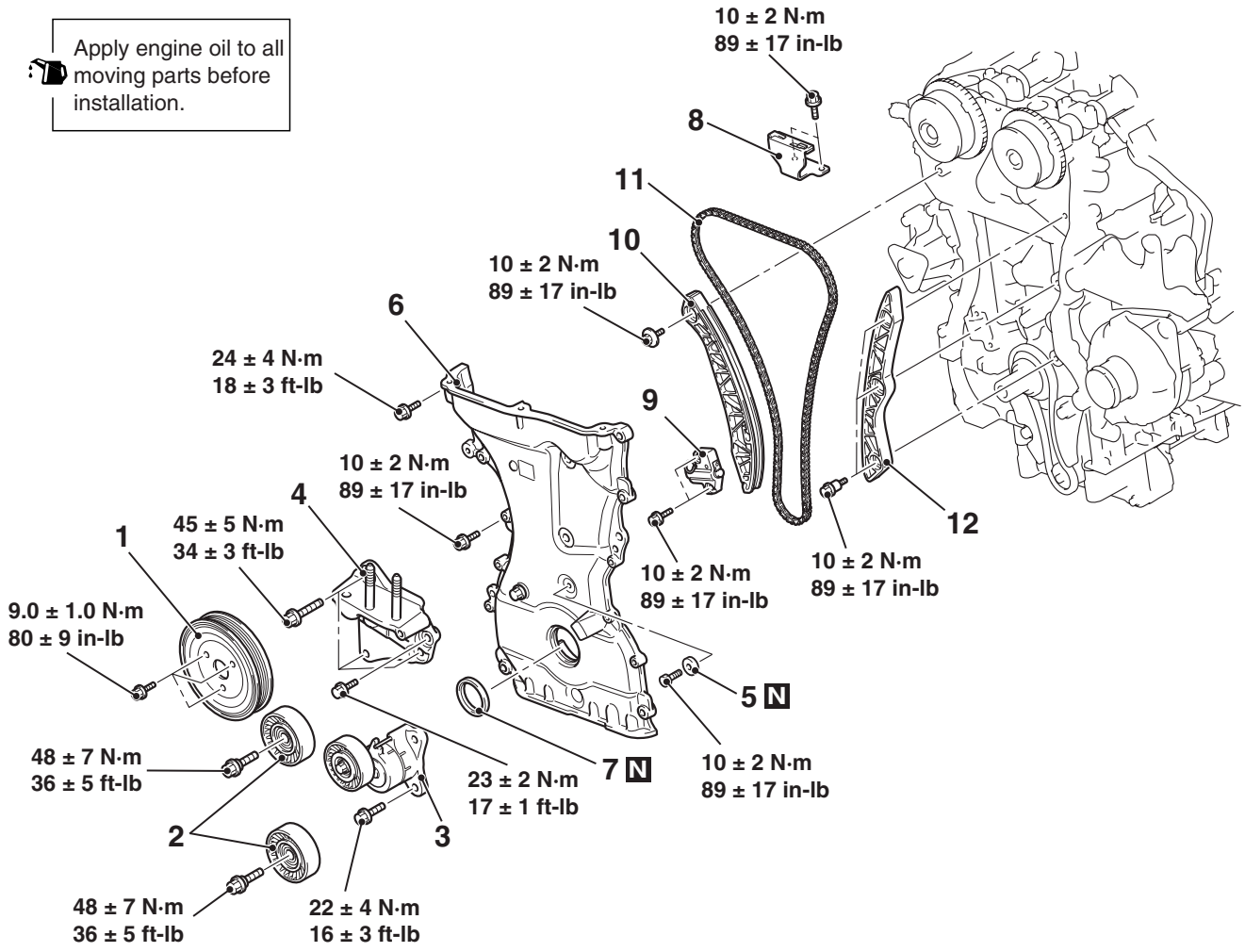
Pre-removal operation	Post-installation operation
• Engine Room Under Cover Front A, B, Engine Room Under Cover Center and Engine Room Side Cover (RH) Removal (Refer to GROUP 51, Under Cover P.51-16). • Strut Tower Bar Removal (Refer to GROUP 42A, Strut Tower Bar P.42A-15). • Rocker Cover Assembly Removal (Refer to P.11A-25). • Engine Oil Pan Removal (Refer to P.11A-51).	• Engine Oil Pan Installation (Refer to P.11A-51). • Rocker Cover Assembly Installation (Refer to P.11A-25). • Engine Oil Refilling (Refer to GROUP 12, On-vehicle Service –Engine Oil Replacement P.12-5). • Strut Tower Bar Installation (Refer to GROUP 42A, Strut Tower Bar P.42A-15). • Engine Room Under Cover Front A, B, Engine Room Under Cover Center and Engine Room Side Cover (RH) Installation (Refer to GROUP 51, Under Cover P.51-16).



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Removal steps

<<A>>
- Power steering oil pump assembly (Refer to GROUP 37, Power Steering Oil Pump P.37-38)
- Headlight support panel cover (Refer to GROUP 51, Front Bumper Assembly and Radiator Grille P.51-3)

<<B>>
- Engine and transaxle assembly holding

<<C>>
- Engine mounting bracket (Refer to GROUP 32, Engine Mounting P.32-4)
- Crankshaft pulley (Refer to P.11A-21)

>>E<<
1. Water pump pulley
2. Idler pulley
3. Auto-tensioner
4. Cylinder block engine front mounting bracket

TSB Revision

Removal steps (Continued)

5. Gasket
<<E>> >>D<< 6. Timing chain case assembly
>>C<< 7. Crankshaft front oil seal
8. Timing chain upper guide
<<F>> >>B<< 9. Timing chain tensioner
10. Timing chain tension side guide
>>A<< 11. Timing chain
12. Timing chain loose side guide

Required Special Tools:

- MB991454: Engine Hanger Balancer
- MB991895: Engine Hanger
- MB991928: Engine Hanger
- MB991448: Bush Remover And Installer Base

REMOVAL SERVICE POINTS

<<A>> POWER STEERING OIL PUMP ASSEMBLY REMOVAL

1. Remove the power steering oil pump assembly with hose on it.
2. Tie the removed power steering oil pump with a string at a position where it will not interfere with the removal and installation of timing chain.

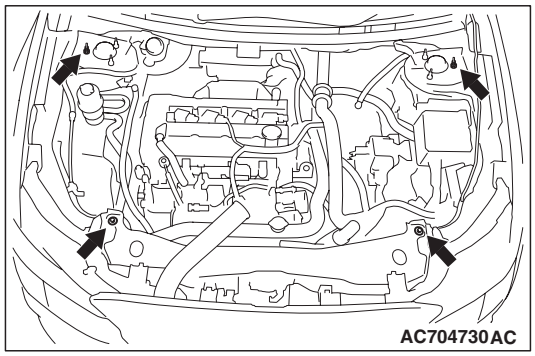
<<B>> ENGINE AND TRANSAXLE ASSEMBLY HOLDING

Install a special tool for holding the engine and transaxle assembly.

1. <Engine hanger MB991928 is used>
   (1) Assemble the engine hanger (special tool MB991928). Set the following parts on the base hanger.
   - Slide bracket (HI)
   - Foot x 4 (standard) (MB991932)
   - Joint x 2 (140) (MB991931)

   (2) Set the foot of the special tool as shown in the figure.

   NOTE: Slide the slide bracket (HI) to adjust the engine hanger balance.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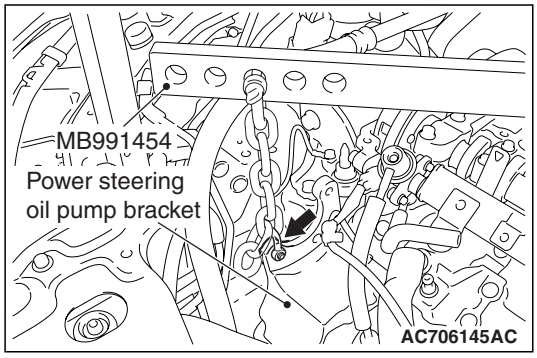
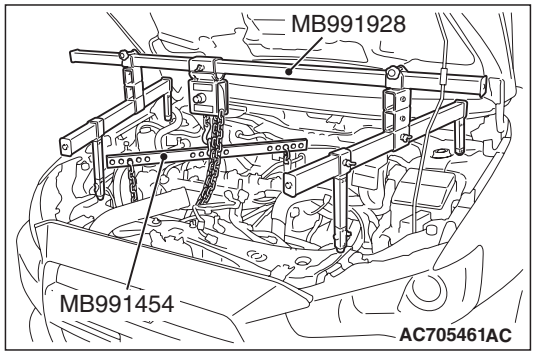
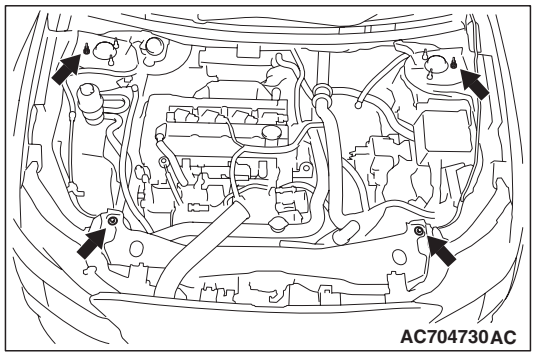


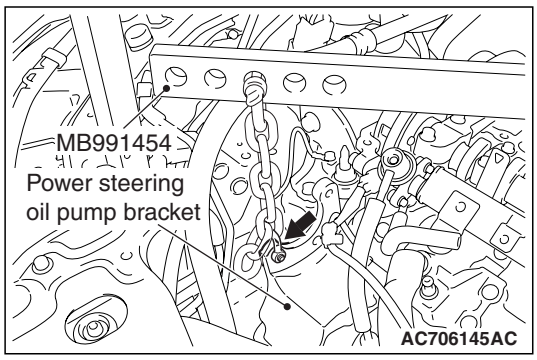
(3) Mount special tool MB991454 to the power steering oil pump bracket and the engine hanger, and set it to special tool MB991928 to support the engine and transaxle assembly.



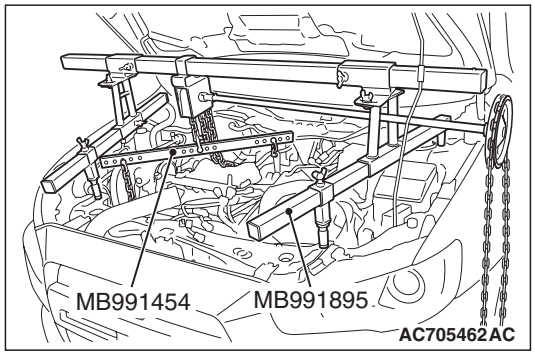
2. <Engine hanger MB991895 is used>
   (1) Set the foot of special tool MB991895 as shown in the figure.

   NOTE: Slide the foot to adjust the engine hanger balance.





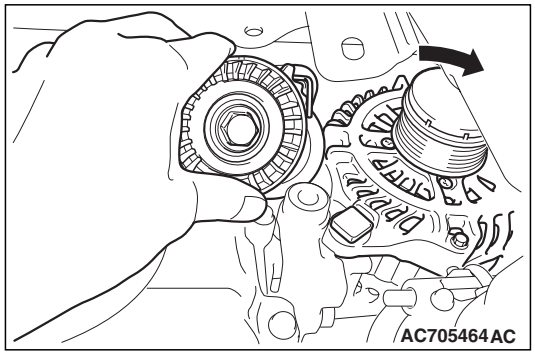
(2) Mount special tool MB991454 to the power steering oil pump bracket and the engine hanger, and set it to special tool MB991895 to support the engine and transaxle assembly.



<<C>> CRANKSHAFT PULLEY REMOVAL

When removing the crankshaft pulley, slightly loosen the water pump pulley mounting bolts before removal of the drive belt.

<<D>> AUTO-TENSIONER REMOVAL



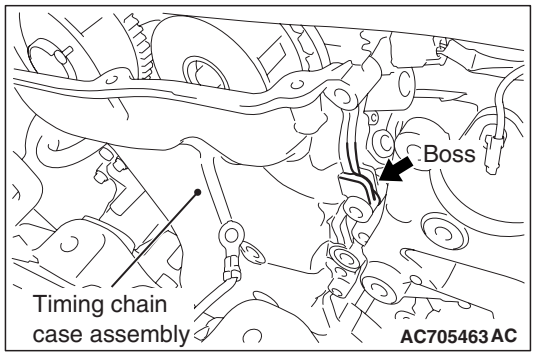
Loosen the mounting bolt of generator assembly lower part, and remove the mounting bolt of generator assembly upper part. Slide the generator assembly, and remove the auto-tensioner.

<<E>> TIMING CHAIN CASE ASSEMBLY REMOVAL

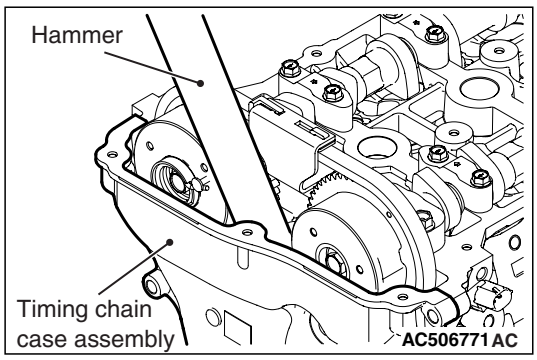
⚠ CAUTION

If the adhesive strength of sealant on the timing chain case assembly is so strong that the boss may be damaged by peeling off, do not peel it off forcibly.

1. After removing the timing chain case assembly mounting bolts, slightly pry the boss of the timing chain case assembly shown in the figure using a flat-tipped screwdriver, and remove the timing chain case assembly from the cylinder head and cylinder block.

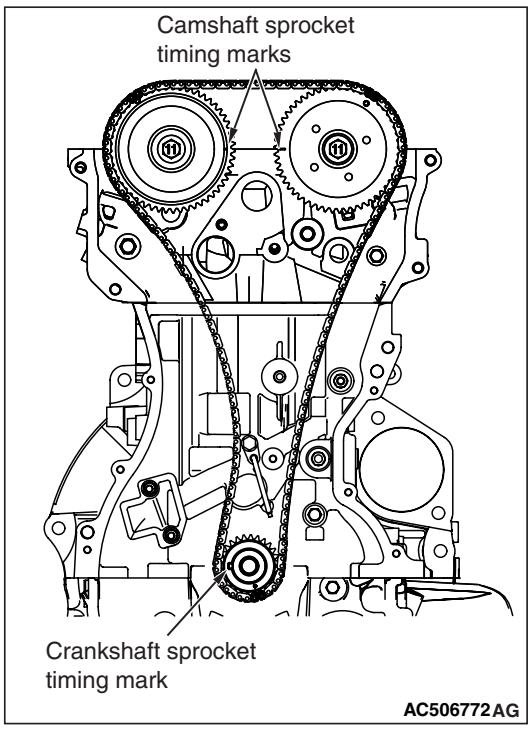


2. If the sealant cannot be peeled off easily, insert a wooden hammer shank into the timing chain case assembly inside as shown in the figure, pry slightly, and remove the timing chain case assembly from the cylinder head and cylinder block.



<<F>> TIMING CHAIN TENSIONER REMOVAL

1. Temporarily install the crankshaft pulley to the crankshaft.



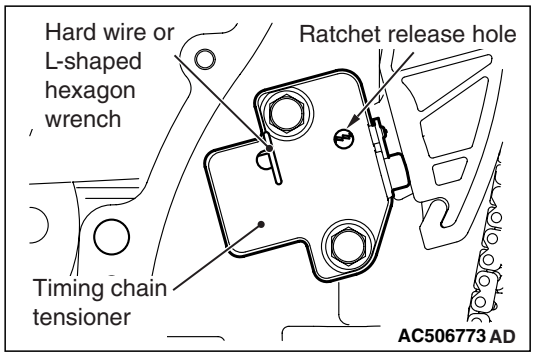
⚠ CAUTION

Turn the crankshaft clockwise.

2. Turn the crankshaft clockwise to align the sprocket timing marks as shown in the figure and set the cylinder No. 1 to the top dead center of compression stroke.

   NOTE: At this time, it is not necessary that the link plate (blue) of the timing chain always aligns with each sprocket timing mark.

3. Remove the crankshaft pulley installed temporarily.

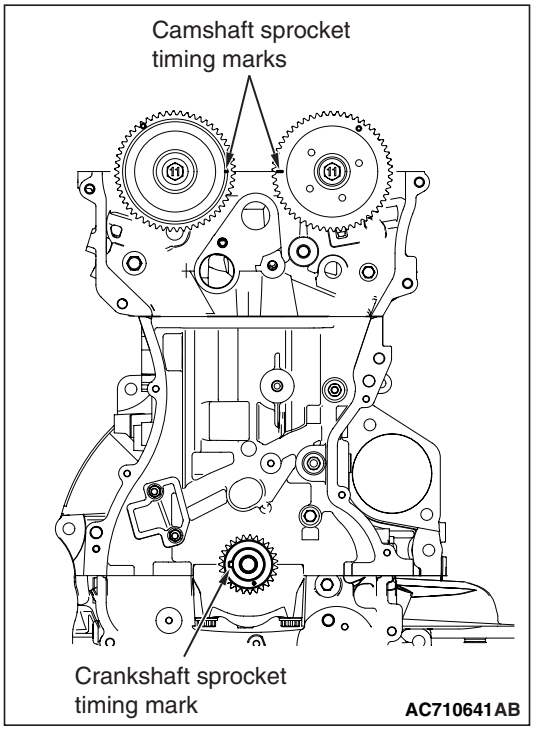


4. Using a flat-tipped precision screwdriver, release the ratchet of timing chain tensioner.
5. Compress the plunger of timing chain tensioner and insert hard wire (such as piano wire) or the L-shaped hexagon wrench (1.5 mm[0.05 inch]) to fix the plunger of the timing chain tensioner.
6. Remove the timing chain tensioner.

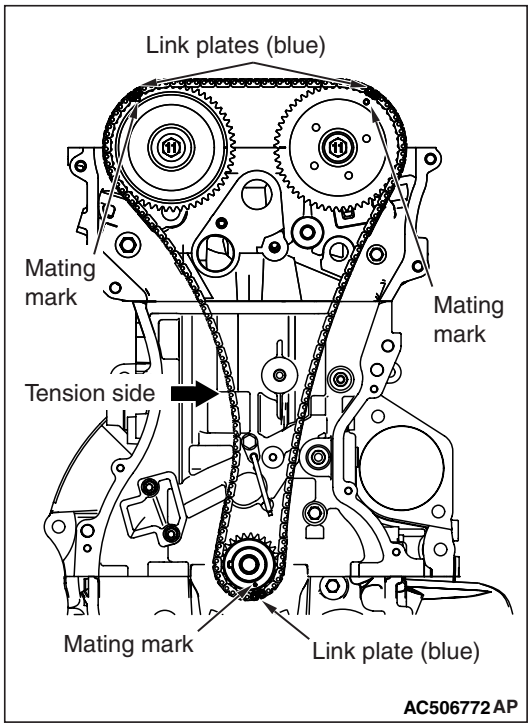
INSTALLATION SERVICE POINTS

>>A<< TIMING CHAIN INSTALLATION

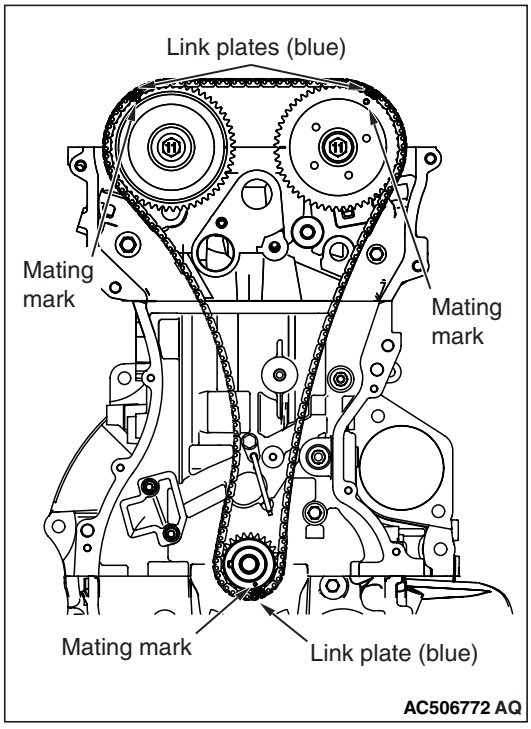
1. Set the timing marks of the camshaft sprockets and the crankshaft sprocket as shown in the figure.



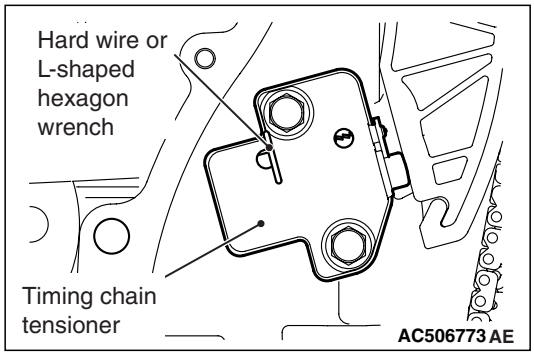
2. Align each sprocket timing chain mating mark with the link plate (blue) of timing chain to avoid slack of the timing chain tension side, and install the timing chain to the sprockets.



>>B<< TIMING CHAIN TENSIONER INSTALLATION



1. Check that the sprocket timing chain mating marks align with the link plates (blue) of the timing chain, and install the timing chain tensioner to the cylinder block.



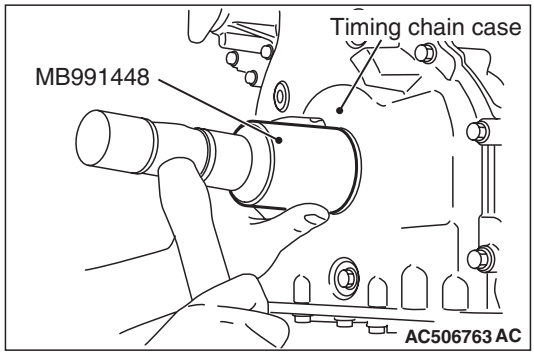
2. Remove the hard wire or L-shaped hexagon wrench fixing the plunger of the timing chain tensioner to apply tension to the timing chain.

>>C<< CRANKSHAFT FRONT OIL SEAL INSTALLATION

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

⚠ CAUTION

When installing the crankshaft oil seal, be careful to avoid damage to the crankshaft front oil seal.



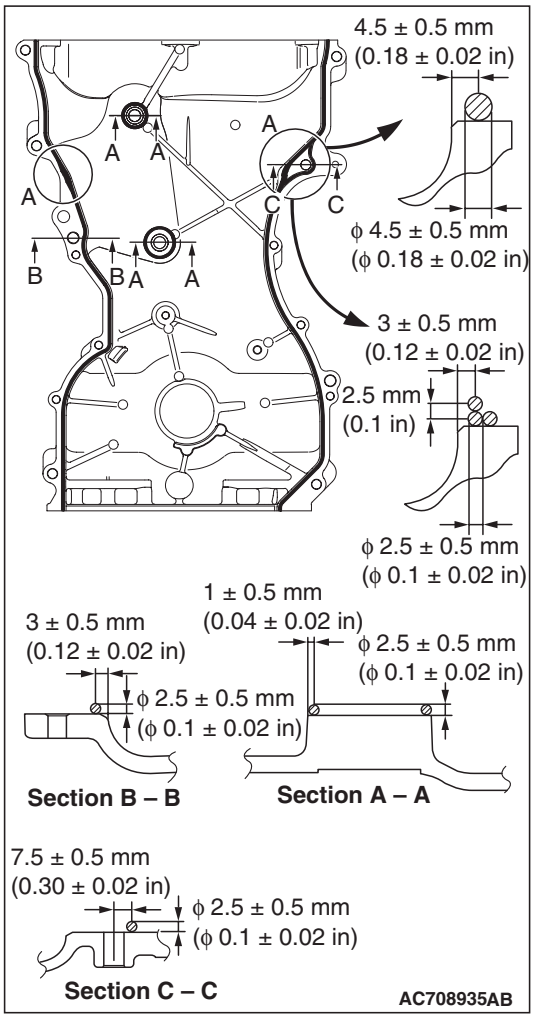
2. Using special tool MB991448, press in the crankshaft front oil seal up to the chamfered surface of timing chain case.

>>D<< TIMING CHAIN CASE ASSEMBLY INSTALLATION

⚠ CAUTION

- **Be sure to remove the sealant remaining in the mounting hole, O-ring groove, and gap between parts.**
- **Use the quick-drying degreasing agent (white gasoline) to degrease, then check that no grease is remaining on the sealant application area.**
- **After degreasing with the quick-drying degreasing agent (white gasoline), never touch the degreased area with fingers.**

1. Remove all the traces of sealant adhering to the timing chain case assembly installation surfaces of timing chain case assembly, cylinder block, and cylinder head. Then, degrease the surfaces with the quick-drying degreasing agent (white gasoline).
2. Remove all the sealant adhering to the gasket between the cylinder head and cylinder block (three-surface aligned part). Then, degrease the surfaces with the quick-drying degreasing agent (white gasoline).
3. As for the three-surface aligned part that is indicated in Step 2 above, the engine oil oozes from the cylinder head gasket. Thus, quickly apply the sealant to it after degreasing.



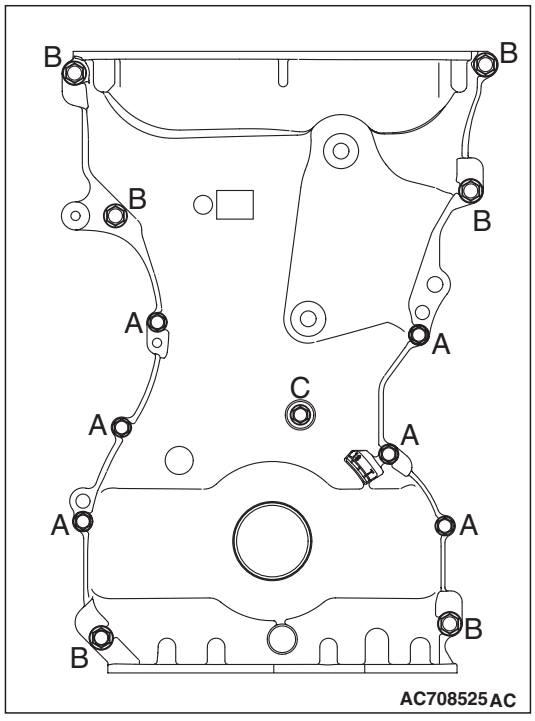
4. To the timing chain case assembly mating surface, apply the sealant with a width of 2.5 ±0.5 mm (0.1 ±0.02 inch) and without a gap. However, with the "A" shown in the figure, apply the sealant with overlapping the diameter of 4.5 ±0.5 mm (0.18 ±0.02 inch) or 2.5 ±0.5 mm (0.1 ±0.02 inch) as shown in the figure.

Specified sealant: Three bond 1217G

⚠ CAUTION

- **If the sealant contacts any other part during installation of the timing chain case assembly, apply sealant again before installing the timing chain case assembly.**
- **Within two hours after the timing chain case assembly installation, do not apply oil or water to the sealant application area or start the engine.**

5. Within three minutes after the application of sealant, install the timing chain case assembly to the cylinder block and cylinder head so that the sealant does not contact other parts.



6. To the installation positions shown in the figure, tighten the timing chain case assembly mounting bolts to the specified torque shown below.

Bolt (symbol)	Thread diameter x Length mm	Tightening torque
Flange bolt (A)	M6 × 25	10 ±2 N· m (89 ± 17 in-lb)
Flange bolt (B)	M8 × 28	24 ±4 N· m (18 ±2 ft-lb)
Bolt (C)	M6 × 25	10 ±2 N· m (89 ± 17 in-lb)

>>E<< WATER PUMP PULLEY INSTALLATION

Temporarily tighten the water pump pulley mounting bolts. Then, tighten them to the specified torque after the installation of drive belt.

Tightening torque: 9.0 ±1.0 N· m (80 ±9 in-lb)

ENGINE ASSEMBLY

REMOVAL AND INSTALLATION

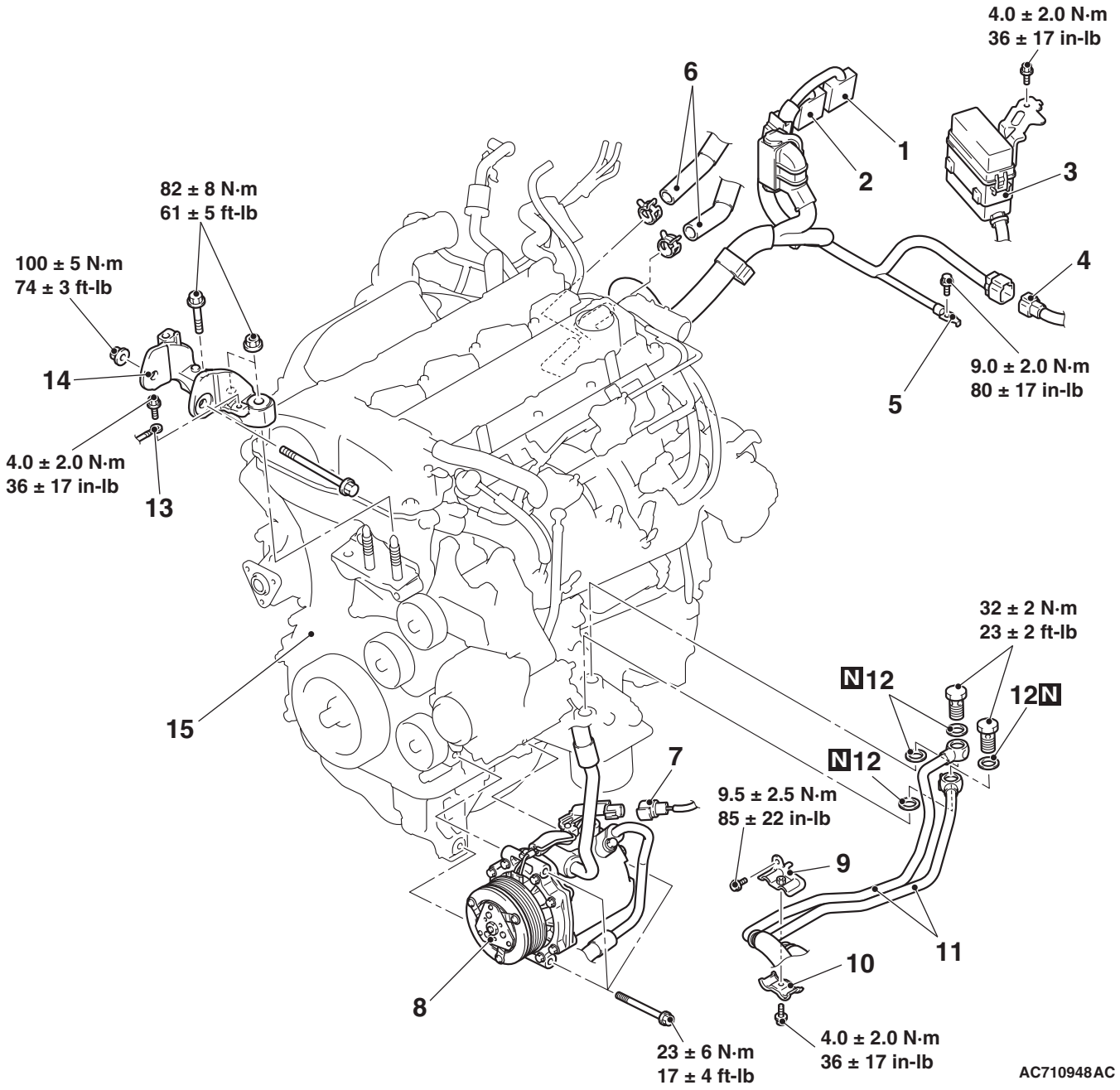
M1112001004216

⚠ CAUTION

- **When the engine assembly is replaced, initialize the learned value using scan tool. (Refer to GROUP 00, Precautions before Service –and Initialization Procedure of MFI Engine Learned Value P.00-31)**
- **Before replacing the steering wheel assembly and driver's air bag module assembly, always refer to GROUP 52B –Service Precautions P.52B-25, and Air Bag Module(s) and Clock Spring P.52B-386. Also, position the front wheels in a straight ahead direction, and remove the ignition key. If you fail to do this, clock spring for SRS may get damage, making the SRS (air bag) inoperative, and it may cause a serious injury to the driver.**
- **After adjusting the wheel alignment, always perform calibration to make the ASC-ECU learn the neutral position of the steering wheel sensor. (Refer to GROUP 35C, On-vehicles Service –Steering Wheel Sensor Calibration P.35C-267)**

Pre-removal operation	Post-installation operation
• Fuel Line Pressure Reduction [Refer to GROUP 13A, On-vehicle Service –Fuel Pump Connector Disconnection (How to Reduce Pressurized Fuel Lines) P.13A-901]. • Engine Room Under Cover Front A, B, Engine Room Under Cover Center and Engine Room Side Cover Removal (Refer to GROUP 51, Under Cover P.51-16). • Engine Coolant Draining (Refer to GROUP 14, On-vehicle Service –Engine Coolant Replacement P.14-17). • Engine Oil Draining (Refer to GROUP 12, On-vehicle Service –Engine Oil Replacement P.12-5). • Air Cleaner Assembly Removal (Refer to GROUP 15, Air Cleaner P.15-10). • Charge Air Cooler Intake Hose A, B and Charge Air Cooler Intake Pipe A Removal (Refer to GROUP 15, Charge Air Cooler P.15-15). • Engine Control Harness Connector Bracket Removal (Refer to GROUP 54A, Battery P.54A-10).	• Engine Control Harness Connector Bracket Installation (Refer to GROUP 54A, Battery P.54A-10). • Charge Air Cooler Intake Hose A, B and Charge Air Cooler Intake Pipe A Installation (Refer to GROUP 15, Charge Air Cooler P.15-15). • Air Cleaner Assembly Installation (Refer to GROUP 15, Air Cleaner P.15-10). • Engine Oil Refilling (Refer to GROUP 12, On-vehicle Service –Engine Oil Replacement P.12-5). • Engine Coolant Refilling (Refer to GROUP 14, On-vehicle Service –Engine Coolant Replacement P.14-17). • Fuel Leak Check • Engine Room Under Cover Front A, B, Engine Room Under Cover Center and Engine Room Side Cover Installation (Refer to GROUP 51, Under Cover P.51-16).

TSB Revision



Removal steps

- Power steering oil pump assembly (Refer to GROUP 37, Power Steering Oil Pump P.37-38)

1. Joint connector (CAN 4) connection <TC-SST>
2. Front wiring harness and control wiring harness combination
3. Relay box
4. Front wiring harness and control wiring harness combination
5. Grounding connection
6. Heater hose connection
7. A/C compressor assembly connector

<<A>> >>B<<

Removal steps (Continued)

8. A/C compressor and clutch assembly
9. Engine oil cooler hose bracket
10. Engine oil cooler line clamp
11. Engine oil cooler hose connection
12. Gasket

- Hood assembly (Refer to GROUP 42A, Hood P.42A-7)
- Radiator condenser tank bracket (Refer to GROUP 14, Radiator P.14-31)
- Fuel pump resistor (Refer to GROUP 13A, Engine Control Resistor P.13A-919)

13. Grounding cable connection

TSB Revision

Removal steps (Continued)

- Transaxle assembly (Refer to GROUP 22A, Transaxle Assembly P.22A-127<M/T>), (Refer to GROUP 22C, Transaxle Assembly P.22C-339<TC-SST>)

<<B>> >>A<< 14. Engine mounting bracket
<<B>> >>A<< 15. Engine assembly

Required Special Tools:

- MB991454: Engine Hanger Balancer
- MB991895: Engine Hanger
- MB991928: Engine Hanger
- MB992201: Engine Hanger Plate

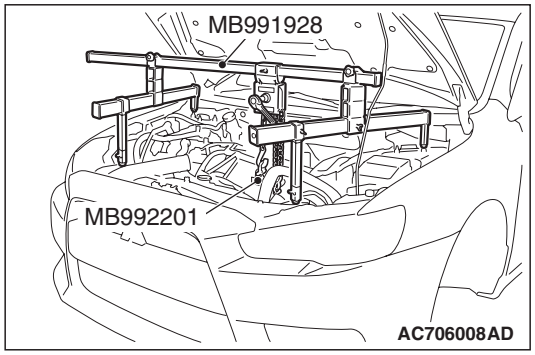
REMOVAL SERVICE POINTS

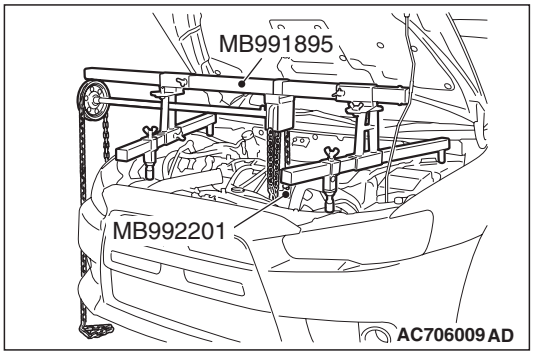
<<A>> A/C COMPRESSOR AND CLUTCH ASSEMBLY REMOVAL

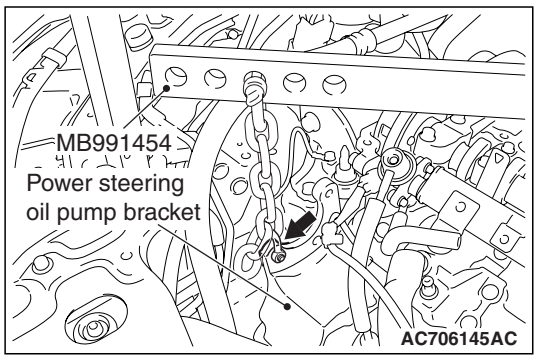
1. Remove the A/C compressor and clutch assembly together with the hose from the bracket.
2. Tie the removed A/C compressor and clutch assembly with a string at a position where it will not interfere with the removal and installation of engine assembly.

<<B>> ENGINE MOUNTING BRACKET/ENGINE ASSEMBLY REMOVAL

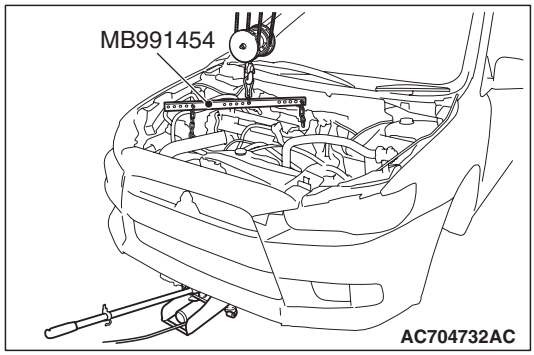
1. Place a garage jack against the engine oil pan with a piece of wood in between to support the engine assembly.
2. When the transaxle assembly is removed, remove special tool MB991928 or MB991895 which supports the engine assembly.







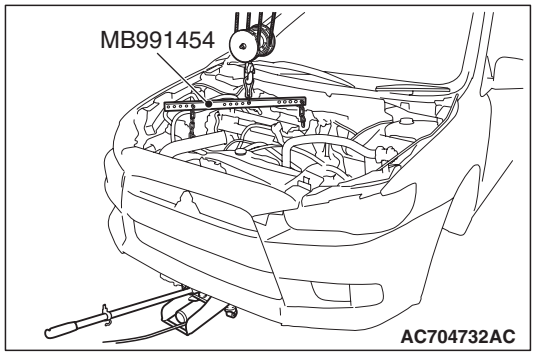
3. Set special tool MB991454 to the engine hanger and the power steering oil pump bracket.



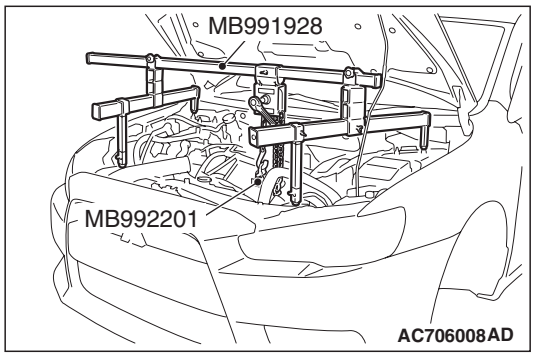
4. Hold the engine assembly with a chain block.
5. Place a garage jack against the engine oil pan with a piece of wood in between, and remove the engine mounting bracket while adjusting the position of the engine.
6. After checking that all cables, hoses and wiring harness connectors and so on are disconnected from the engine, lift the engine assembly slowly with the chain block to remove the engine assembly upward from the engine compartment.

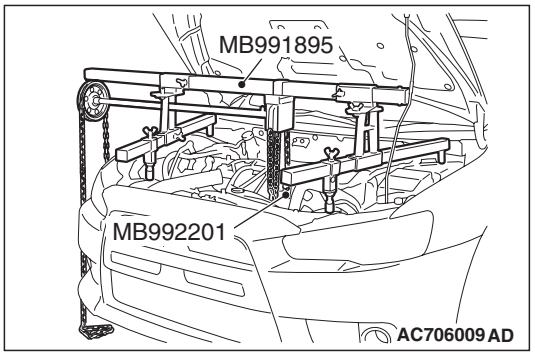
INSTALLATION SERVICE POINTS

>>A<< ENGINE ASSEMBLY/ENGINE MOUNTING BRACKET INSTALLATION



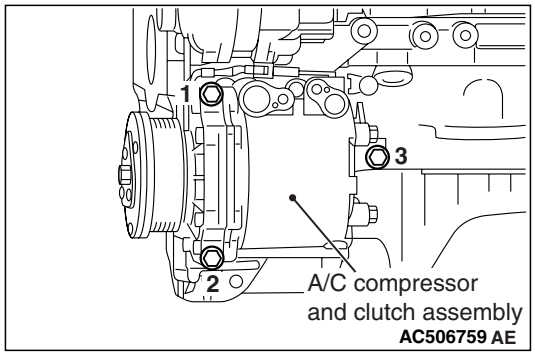
1. Set special tool MB991454 and a chain block to the engine assembly.
2. Install the engine assembly, being careful not to pinch the cables, hoses or wiring harness connectors.
3. Place a garage jack against the engine oil pan with a piece of wood in between, and install the engine mounting bracket while adjusting the position of the engine.
4. Remove the chain block.





5. Install special tool MB991928 or MB991895 which is used during installation of transaxle assembly to hold the engine assembly. (Refer to GROUP 22A, Transaxle Assembly P.22A-127<M/T>), (Refer to GROUP 22C, Transaxle Assembly P.22C-341<TC-SST>)

>>B<< A/C COMPRESSOR AND CLUTCH ASSEMBLY INSTALLATION



Tighten A/C compressor and clutch assembly mounting bolts to the specified torque in the order of number shown in the illustration.

Tightening torque: 23 ±6 N·m (17 ±4 ft-lb)