GROUP 11A

ENGINE MECHANICAL

CONTENTS

SERVICE SPECIFICATIONS

M1112000302906

Item		Standard value	Limit
Drive belt tension	Vibration frequency Hz (Reference)	115 – 156	–
	Tension N (Reference)	234 – 421	–
Valve clearance (at cold) mm	Intake valve	0.20 ± 0.03	–
	Exhaust valve	0.30 ± 0.03	–
Basic ignition timing		5° BTDC ± 3°	–
Ignition timing		Approximately 10° BTDC	–
Idle speed r/min	4B11	650 ± 100	–
	4B12	750 ± 100	–
CO contents %		0.3 or less	–
HC contents ppm		200 or less	–
Compression pressure (at engine speed of 200 r/min) kPa	4B11	1,470	Minimum 1,000
	4B12	1,440	Minimum 1,000
Compression pressure difference of all cylinders kPa		–	Maximum 98
Intake manifold vacuum kPa		–	Minimum 60

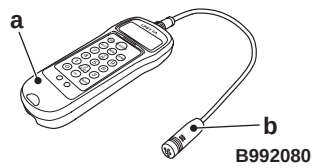
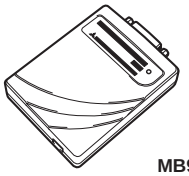
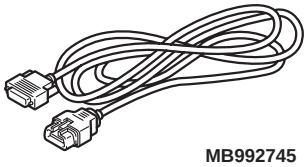
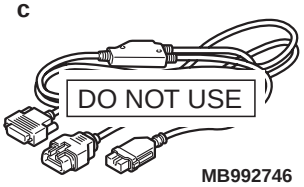
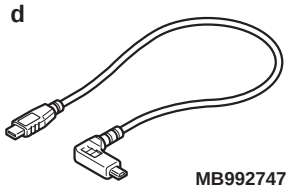
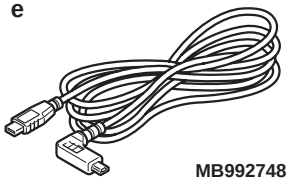
SEALANTS

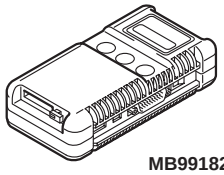
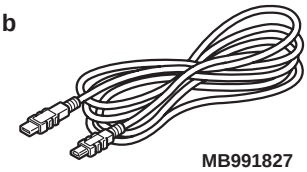
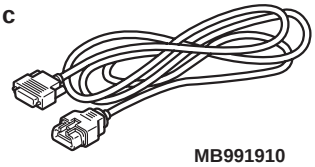
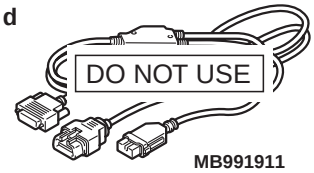
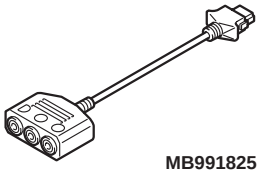
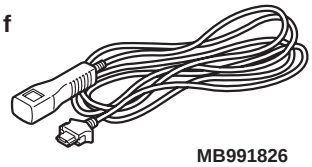
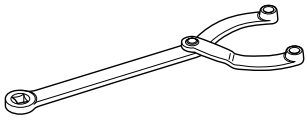
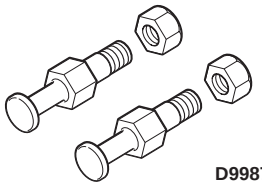
M1112000502751

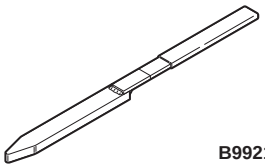
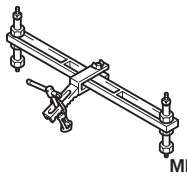
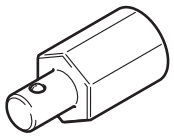
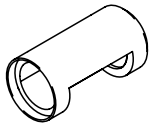
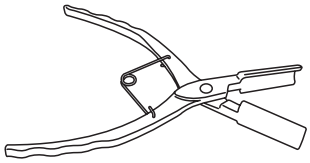
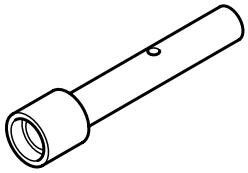
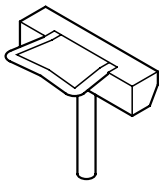
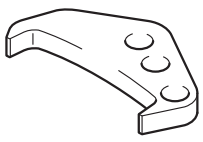
Item	Specified sealant
Rocker cover assembly (matching area of the cylinder head assembly and the timing chain case assembly)	ThreeBond 1217G (MITSUBISHI MOTORS GENUINE Part No.1000A923), ThreeBond 1227D, LOCTITE 5900 or equivalent
Engine oil pan	ThreeBond 1217G (MITSUBISHI MOTORS GENUINE Part No.1000A923), ThreeBond 1227D, ThreeBond 1207F (MITSUBISHI MOTORS GENUINE Part No.1000A992), LOCTITE 5970, LOCTITE 5900 or equivalent
Drive plate mounting bolt	ThreeBond 1324 or equivalent
Cylinder block (matching area of the cylinder head assembly, cylinder head gasket and the timing chain case assembly)	ThreeBond 1217G (MITSUBISHI MOTORS GENUINE Part No.1000A923), LOCTITE 5900 or equivalent
Timing chain case assembly	

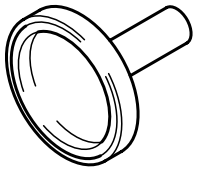
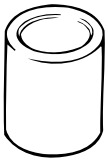
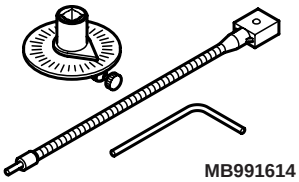
SPECIAL TOOLS

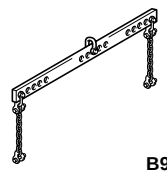
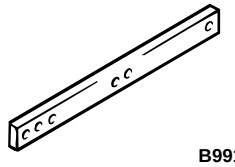
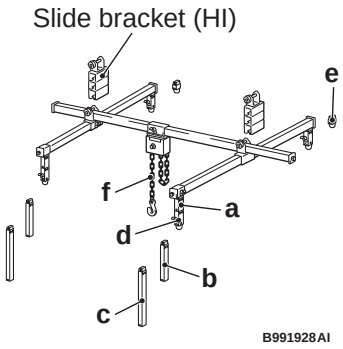
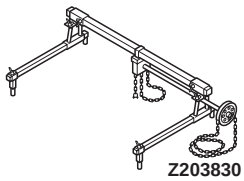
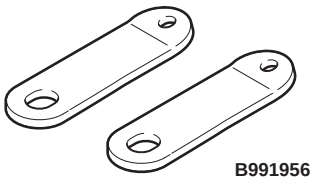
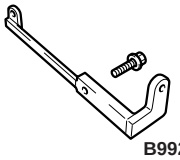
M1112000603212

Tool	Number	Name	Use
 B992080	MB992080 a: MB992081 b: MB992082	Belt tension meter set a: Belt tension meter b: Microphone assembly	Alternator and others belt tension check
a  MB992744 b  MB992745 c  MB992746 d  MB992747 e  MB992748 ACB05421AB	a. MB992744 b. MB992745 c. MB992746 d. MB992747 e. MB992748	a. Vehicle communication interface-Lite (V.C.I.-Lite) b. V.C.I.-Lite main harness A (for vehicles with CAN communication) c. V.C.I.-Lite main harness B (for vehicles without CAN communication) d. V.C.I.-Lite USB cable short e. V.C.I.-Lite USB cable long	• Checking the ignition timing • Checking the idle speed

Tool	Number	Name	Use
a  MB991824 b  MB991827 c  MB991910 d  MB991911 e  MB991825 f  MB991826 MB991955	MB991955 a: MB991824 b: MB991827 c: MB991910 d: MB991911 e: MB991825 f: MB991826	M.U.T.-III sub assembly a: Vehicle communication interface (V. C. I.) b: M.U.T.-III USB cable c: M.U.T.-III main harness A (Vehicles with CAN communication system) d: M.U.T.-III main harness B (Vehicles without CAN communication system) e: M.U.T.-III adapter harness f: M.U.T.-III trigger harness	**⚠ 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.** • Checking the ignition timing • Checking the idle speed
 B990767	MB990767	Front hub and flange yoke holder	Holding the crankshaft pulley
 D998719	MD998719	Pin	

Tool	Number	Name	Use
 B992103	MB992103	Chain tension release bar	Camshaft and camshaft sprocket assembly (exhaust side) removal
 MD998772	MD998772	Valve spring compressor	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	Valve stem seal press-fitting
 D998727	MD998727	Oil pan FIPG cutter	Engine oil pan removal
 MB991883	MB991883	Flywheel stopper	Supporting the drive plate

Tool	Number	Name	Use
	MD998718	Crankshaft rear oil seal installer	Press-fitting the crankshaft rear oil seal
	MB991448	Bush remover and installer base	Press-fitting the crankshaft front oil seal
 MB991614	MB991614	Angle gauge	Balancer shaft and oil pump module bolt installation

Tool	Number	Name	Use
 B991454	MB991454	Engine hanger balancer	Support of engine assembly *NOTE:* • *For the engine hanger balancer (MB991454), use a chain only.* • *Engine hanger balancer (MB991454) is a part of the engine hanger assembly (MB991453).*
 B991527	MB991527	Hanger	
 B991928AI	MB991928 a: MB991929 b: MB991930 c: MB991931 d: MB991932 e: MB991933 f: MB991934	Engine hanger a: Joint (50) × 2 b: Joint (90) × 2 c: Joint (140) × 2 d: Foot (standard) × 4 e: Foot (short) × 2 f: Chain and hook assembly	
 Z203830	MB991895	Engine hanger	
 B991956	MB991956	Engine hanger plate	
 B992853	MB992853	Engine hanger plate	

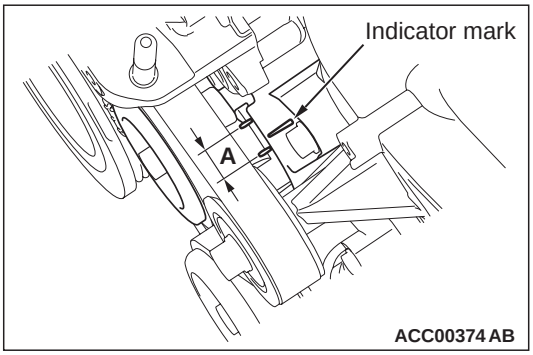
ON-VEHICLE SERVICE

DRIVE BELT TENSION CHECK

M1111003103752

⚠ CAUTION

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



1. Make sure that the indicator mark on the drive belt auto-tensioner is within the area marked with A in the illustration.
2. If the mark is out of the area A, replace the drive belt (Refer to P.11A-16).

   NOTE: The drive belt tension adjustment is not necessary as the drive belt auto-tensioner is adopted.

DRIVE BELT AUTO-TENSIONER CHECK

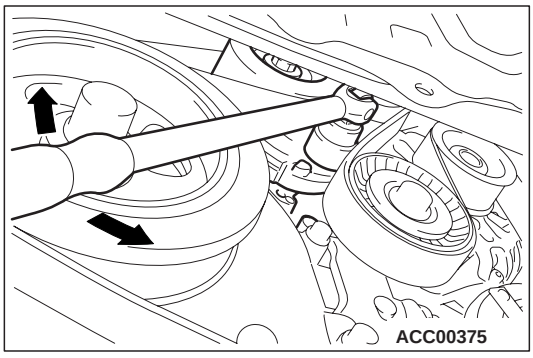
M1111003003476

OPERATION CHECK

1. Stop the engine from the idle state.
2. Check that the drive belt are not protruding from the pulley width of drive belt auto-tensioner.
3. Remove the drive belt (Refer to P.11A-16).

⚠ WARNING

Be sure to set the tool to the hexagonal part securely to prevent the tool from falling off because the tension of the auto-tensioner is high.



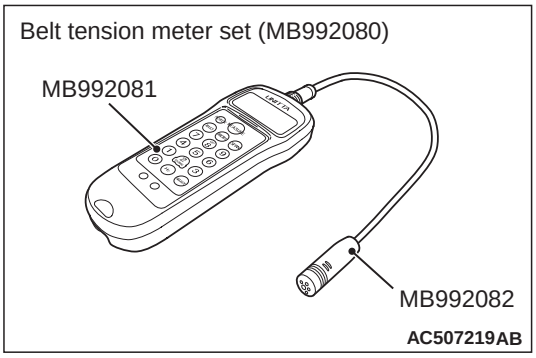
4. Securely set the tool to the hexagonal part of the auto-tensioner.
5. Check that no binding is present by turning the auto-tensioner in the left and right directions.
6. If there are any problems in the procedure 2 or 5, replace the drive belt auto-tensioner (Refer to P.11A-50).
7. Install the drive belt (Refer to P.11A-16).

FUNCTION CHECK

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

<When the vibration frequency is measured: Recommendation>

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



2. Connect special tool microphone assembly (MB992082) to special tool belt tension meter (MB992081) of special tool belt tension meter set (MB992080).
3. Press the "POWER" button to turn on the power supply.
4. Press number key "1". Check to ensure that "No. 01" appears on the upper left of the display and that the following numeric values are displayed for individual items ("M", "W", and "S"):

   M 000.9 g/m

   W 010.0 mm/R

   S 0100 mm

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

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

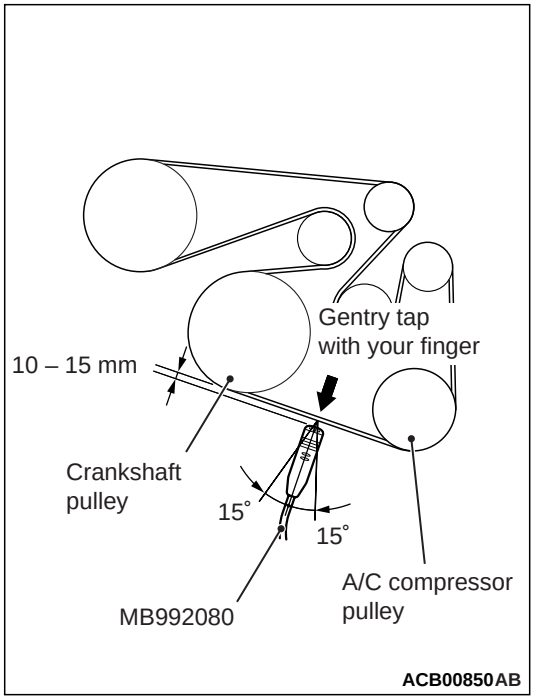
<Setting procedure>

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

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

⚠ CAUTION

- **When measuring, make sure that the engine is cold.**
- **Measure after turning the crankshaft clockwise one turn or more.**
- **Do not let any contaminants such as water or oil get onto the microphone.**
- **If strong gusts of wind blow against the microphone or if there is 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.**



6. Hold special tool MB992080 to the middle of the drive belt between the pulleys (at the place indicated by arrow) where it does not contact the drive belt (approximately 10 – 15 mm away from the rear surface of the belt) so that it is perpendicular to the drive belt (within an angle of ± 15°).
7. Press the "MEASURE" button.
8. Gently tap the middle of the drive belt between the pulleys (the place indicated by the arrow) with your finger as shown in the illustration.
9. Check that the vibration frequency of the drive belt is within the standard value.

Standard value (Reference): 115 – 156 Hz

NOTE: To take the measurement repeatedly, fillip the drive belt again.

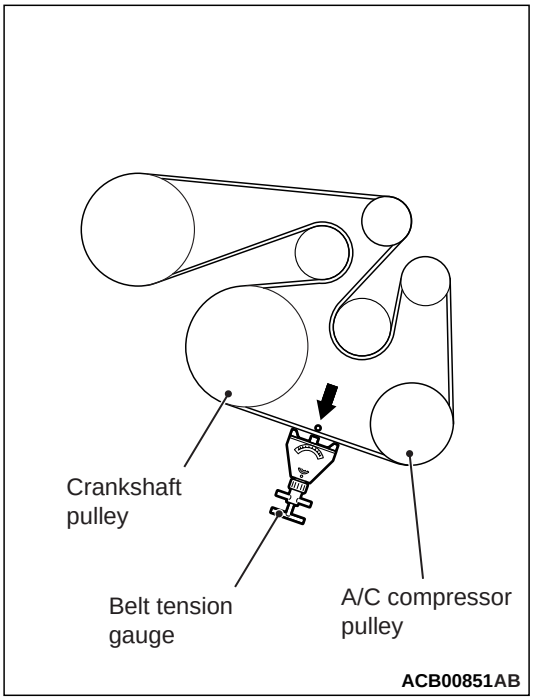
10. After the completion of the measurement, press and hold the "POWER" button to turn off the power supply.
11. If not within the standard value, replace the drive belt auto-tensioner (Refer to P.11A-50).

<When tension is measured>

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

⚠ CAUTION

- **When measuring, make sure that the engine is cold.**
- **Measure after turning the crankshaft clockwise one turn or more.**



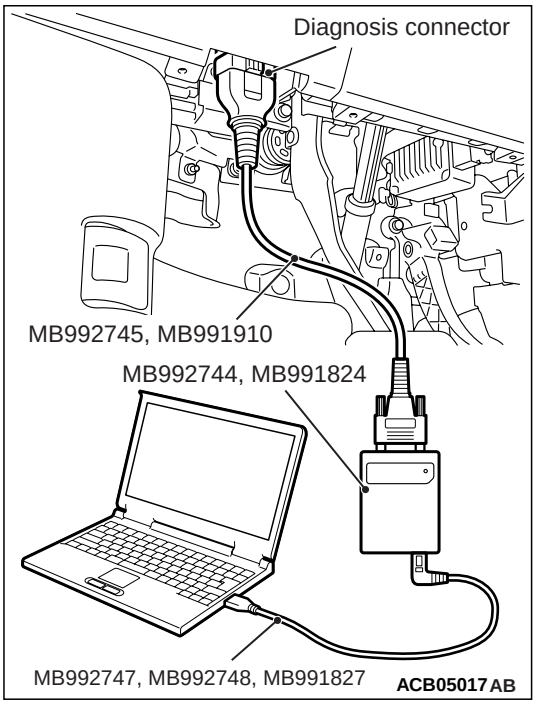
2. Use a belt tension gauge in the middle of the drive belt between the pulleys shown in the figure (at the place indicated by the arrow) to check that the drive belt tension is within the standard value.

Standard value (Reference): 234 – 421 N

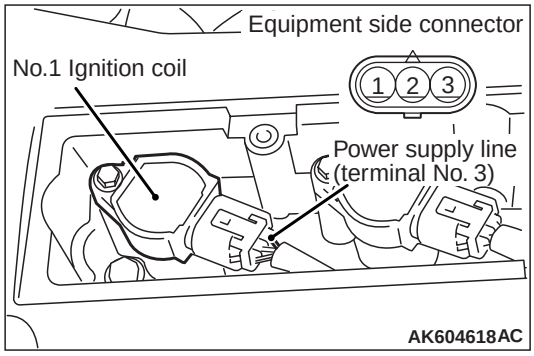
3. If not within the standard value, replace the drive belt auto-tensioner (Refer to P.11A-50).

IGNITION TIMING CHECK

M1111001703242



1. Before inspection, set the vehicle to the pre-inspection condition.
2. Turn the ignition switch to the "LOCK" (OFF) position and then connect the M.U.T.-III to the diagnosis connector.



3. Set the timing light to the power supply line (terminal No. 3) of the ignition coil No. 1.
4. Start the engine and let it run at idle.
5. Select item No. 2 on the M.U.T.-III to measure engine idle speed and check that it is approximately 650 r/min<4B11> or 750 r/min<4B12>.
6. Select item No. 11 (actuator test function) on the M.U.T.-III, and set the ignition timing to the basic ignition timing.
7. Check that basic ignition timing is within the standard value.

Standard value: 5° BTDC ± 3°

8. If the basic ignition timing is outside the standard value, inspect the MPI system (Refer to GROUP 13A – Troubleshooting – Inspection chart for trouble symptom).

⚠ CAUTION

If the test is not cancelled, a forced driving will continue for 27 minutes. Driving under this condition may damage the engine.

9. Cancel the actuator test function item No. 11, Basic ignition timing set mode, on the M.U.T-III.
10. Check that ignition timing is at the standard value.

Standard value: approximately 10° BTDC

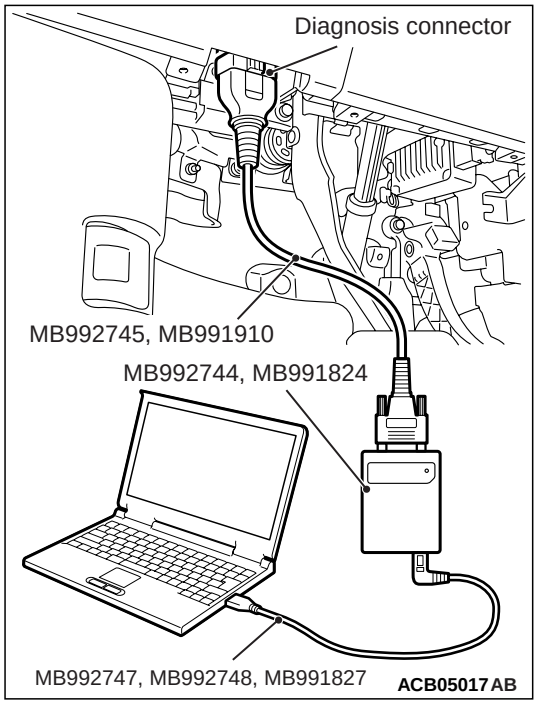
NOTE:

- *The ignition timing may fluctuate within ±7°. This is normal.*
- *In higher altitude, the ignition timing is more advanced than the standard value by approximately 5°.*
- *Wait till approximately 1 minute passes after the engine started, and check the ignition timing when the engine stabilized.*

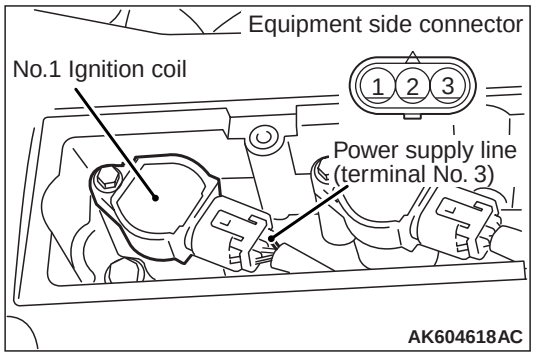
11. Remove the timing light.
12. Turn the ignition switch to the "LOCK" (OFF) position and then disconnect the M.U.T.-III.

IDLE SPEED CHECK

M1111003503329



1. Before inspection, set the vehicle to the pre-inspection condition.
2. Turn the ignition switch to "LOCK" (OFF) position.
3. Connect the M.U.T.-III to the diagnosis connector.



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

Standard value: approximately 10° BTDC

NOTE:

- *The ignition timing may fluctuate within ±7°. This is normal.*
- *In higher altitude, the ignition timing is more advanced than the standard value by approximately 5°.*
- *Wait till approximately 1 minute passes after the engine started, and check the ignition timing when the engine stabilized.*

7. Check the idle speed.

Standard value:
650 ± 100 r/min <4B11>
750 ± 100 r/min <4B12>

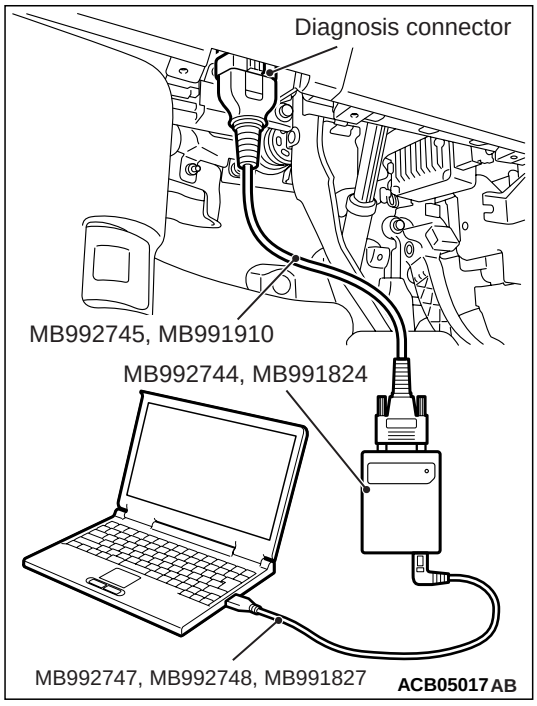
NOTE:

- *The idle speed is controlled automatically by the idle speed control system.*
- *When using the M.U.T.-III, select item No. 2 and take a reading of the idle speed.*

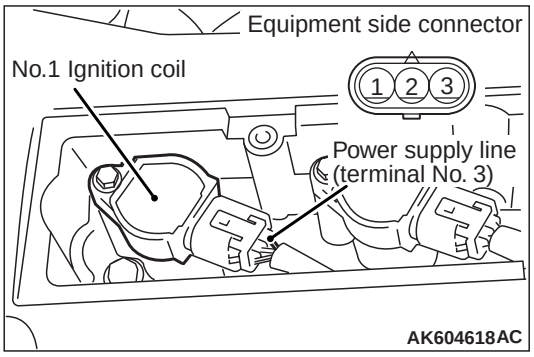
8. If the idle speed is outside the standard value, inspect the MPI system (Refer to GROUP 13A – Troubleshooting – Inspection chart for trouble symptom).
9. Remove the timing light.
10. Turn the ignition switch to the "LOCK" (OFF) position and then disconnect the M.U.T.-III.

IDLE MIXTURE CHECK

M1111002102295



1. Before inspection, set the vehicle to the pre-inspection condition.
2. Turn the ignition switch to "LOCK" (OFF) position.
3. Connect the M.U.T.-III to the diagnosis connector.



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

   Standard value: approximately 10° BTDC

   NOTE:
   - *The ignition timing may fluctuate within ±7°. This is normal.*
   - *In higher altitude, the ignition timing is more advanced than the standard value by approximately 5°.*
   - *Wait till approximately 1 minute passes after the engine started, and check the ignition timing when the engine stabilized.*
7. Run the engine at 2,000 – 3,000 r/min for 2 minutes.
8. Set the CO, HC tester.
9. Check the CO contents and the HC contents at idle.

   Standard value
   CO contents: 0.3 % or less
   HC contents: 200 ppm or less
10. If there is a deviation from the standard value, inspect the MPI system (Refer to GROUP 13D – Troubleshooting – Inspection chart trouble symptom).
11. Remove the HC, CO tester and timing light.
12. Turn the ignition switch to the "LOCK" (OFF) position and then disconnect the M.U.T-III.

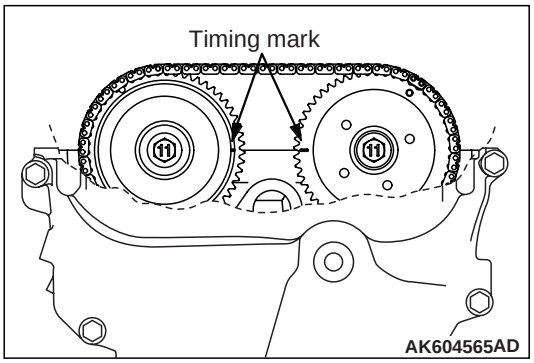
VALVE CLEARANCE CHECK AND ADJUSTMENT

M1111001502182

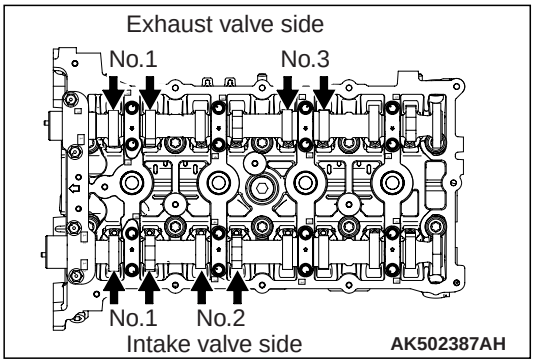
NOTE: Perform the valve clearance check and adjustment at the engine cold state.

1. Remove all ignition coils.
2. Remove the cylinder head cover.

⚠ CAUTION
Turn the crankshaft always clockwise.

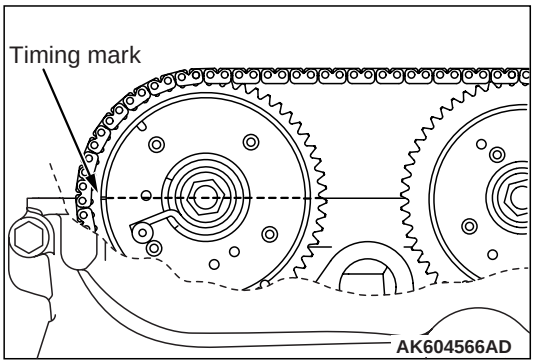


3. Turn the crankshaft clockwise, and align the timing mark on the exhaust camshaft sprocket against the upper face of the cylinder head as shown in Figure. Therefore, No.1 cylinder goes to the compression top dead centre.

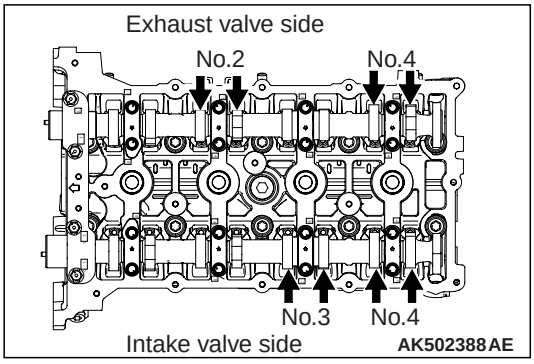


4. Using a thickness gauge, measure the valve clearance with the arrow shown in Figure. If deviated from the standard value, make note for the valve clearance.

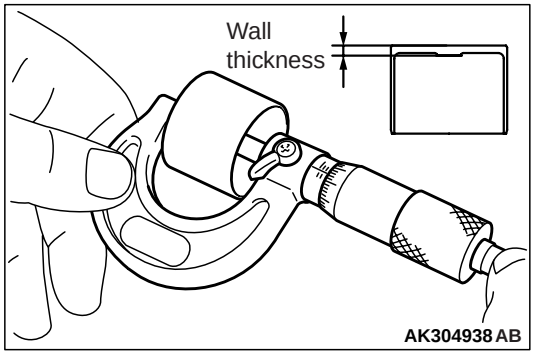
   Standard value:
   Intake valve 0.20 ± 0.03 mm
   Exhaust valve 0.30 ± 0.03 mm



5. Turn the crankshaft clockwise 360 degrees, and put the timing mark on the exhaust camshaft sprocket in position shown in Figure. Therefore, No.4 cylinder goes to the compression top dead centre.



6. Check the valve clearance with the arrow shown in Figure. In the same procedure as 4.
7. If the valve clearance is deviated from the standard value, remove the camshaft and the valve tappet. For the camshaft removal, refer to Camshaft Removal and Installation P.11A-19.



8. Using a micrometer, measure the thickness of the removed valve tappet.
9. Calculate the thickness of the newly installed valve tappet through the following equation.

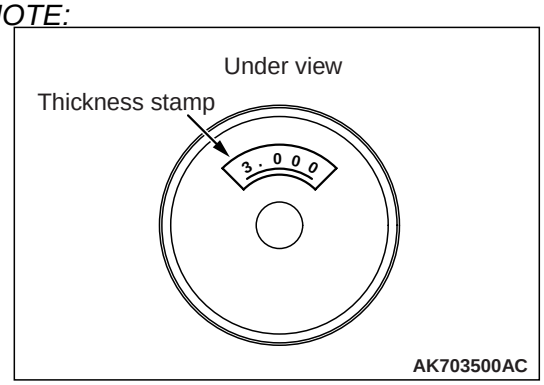
   A: thickness of newly installed valve tappet

   B: thickness of removed valve tappet

   C: measured valve clearance

   Equation
   Intake valve: A = B + (C − 0.20 mm)
   Exhaust valve: A = B + (C − 0.30 mm)

   NOTE:



   The valve tappet ranges 3,000 − 3,690 mm and has 47 types per 0.015 mm. The thickness below a decimal point is stamped on the reverse side of the valve tappet.

10. Install the valve tappet selected through the procedure 9, and put the camshaft in position. For the camshaft installation, refer to Camshaft Removal and Installation P.11A-19.
11. After installing the timing chain, measure the valve clearance using the procedure 3 to 6. Confirm the clearance is within the standard value.

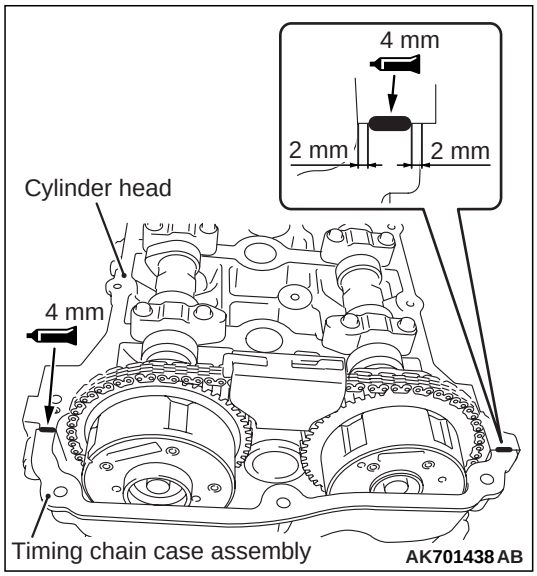
⚠ CAUTION
Completely remove all the old liquid gasket, which might be remaining among the components.

12. Remove any liquid gasket remaining on the cylinder head cover, the timing chain case and the cylinder head.

13.Using white gasoline and so on, degrease the cylinder head cover, timing chain case and cylinder head.

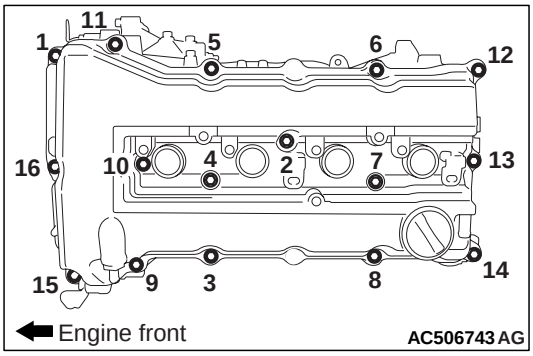
⚠ CAUTION

The cylinder head cover should be installed within 3 minutes of applying liquid gasket.



14.Apply a 4 mm bead of liquid gasket as illustrated.

Specified sealant:
ThreeBond 1217G or equivalent



15. Install the cylinder head cover and tighten the tightening bolts using the following procedures.
    (1) Temporarily tighten to the following torque in order shown in the illustration.

    Tightening torque: 3.0 ± 1.0 N·m

    (2) Tighten to the specified torque in order shown in the illustration.

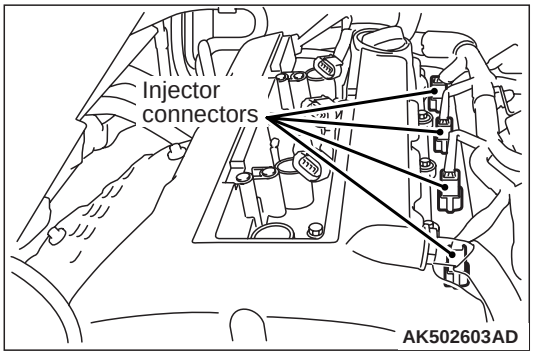
    Specified torque: 5.5 ± 0.5 N·m

16.Install the ignition coils.

COMPRESSION PRESSURE CHECK

M1111002604155

1. Before inspection, set the vehicle to the pre-inspection condition.
2. Disconnect the ignition coil connectors and then remove all of the ignition coils and spark plugs.

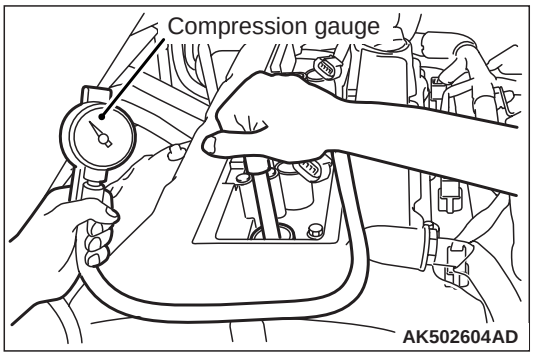


3. Disconnect the all of the injector connectors.

⚠ CAUTION

- **Keep away from the spark plug hole when cranking.**
- **If compression is measured with water, oil, fuel, etc., that has come from cracks inside the cylinder, these materials will become heated and will gush out from the spark plug hole, which is dangerous.**

4. Cover the spark plug hole with a shop towel etc., and 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.

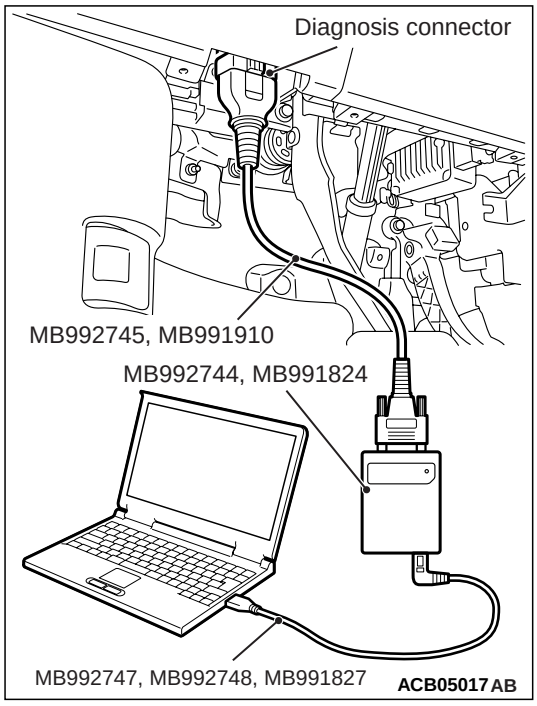
    Standard value (at engine speed of 200 r/min):
    1,470 kPa <4B11>
    1,440 kPa <4B12>

    Limit (at engine speed of 200 r/min):
    Minimum 1,000 kPa

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

    Limit: Maximum 98 kPa

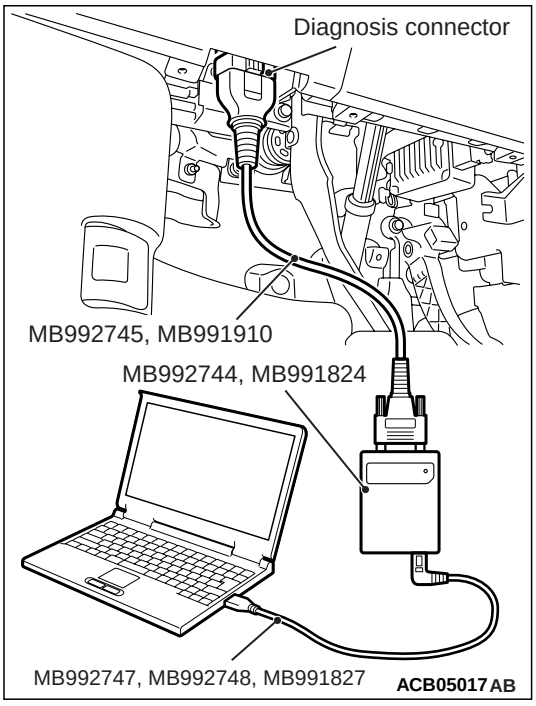
8. If there is a cylinder with compression or a compression difference that is outside the limit, pour a small amount of engine oil through the spark plug hole, and repeat the operations in steps from 5 to 7.
   (1) If the compression increases after oil is added, the cause of the malfunction is a worn 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 injector connector.
10. Install the spark plugs and spark plug cables.



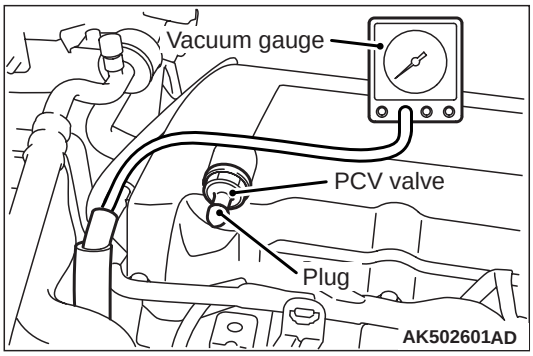
11. Use the M.U.T.-III to erase the diagnosis codes.
    NOTE: This will erase the diagnosis code resulting from the injector connectors being disconnected.

MANIFOLD VACUUM CHECK

M1111002702587



1. Before inspection, set the vehicle to the pre-inspection condition.
2. Turn the ignition switch to "LOCK" (OFF) position.
3. Connect the M.U.T.-III to the diagnosis connector.



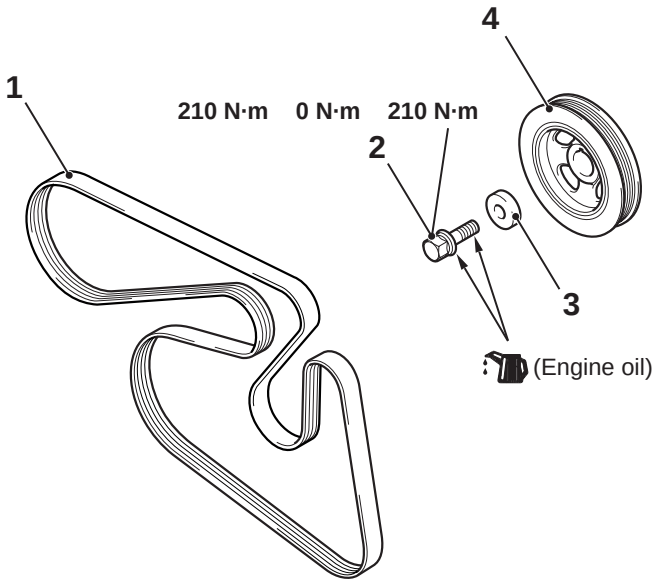
4. Disconnect the ventilation hose from the positive crankcase ventilation (PCV) valve, and then connect a vacuum gauge to the ventilation hose. Plug the PCV valve.
5. Start the engine and check that idle speed is approximately 650 r/min<4B11> or 750 r/min<4B12>.
6. Check the intake manifold vacuum.
   Limit: Minimum 60 kPa
7. Turn off the ignition switch.
8. Remove the vacuum gauge and then connect the ventilation hose to the PCV valve.
9. Disconnect the M.U.T.-III.

CRANKSHAFT PULLEY

REMOVAL AND INSTALLATION

M1112001604821

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).	• Drive Belt Tension Check (Refer to P.11A-8). • Engine Room Under Cover Front A, B and Engine Room Side Cover (RH) Installation (Refer to GROUP 51 – Under Cover).



ACB00863AB

Removal steps

<<**A**>>	>>**B**<<	1.	Drive belt
<<**B**>>	>>**A**<<	2.	Crankshaft pulley centre bolt
<<**B**>>	>>**A**<<	3.	Crankshaft pulley washer
<<**B**>>	>>**A**<<	4.	Crankshaft pulley

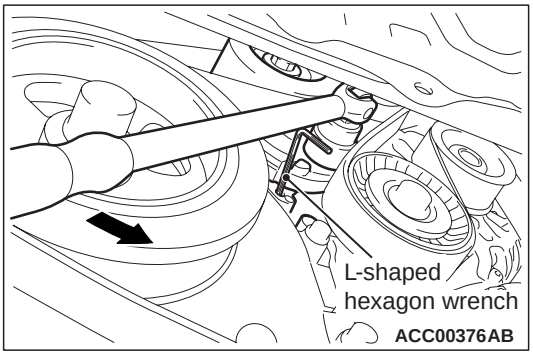
REMOVAL SERVICE POINTS

<<A>> DRIVE BELT REMOVAL

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

⚠ WARNING

Be sure to set the tool to the hexagonal part securely to prevent the tool from falling off because the tension of the auto-tensioner is high.



ACC00376AB

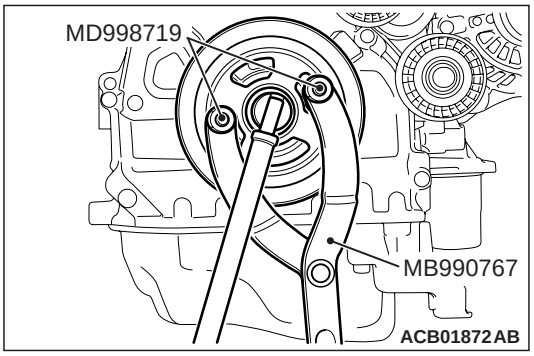
1. Securely set the tool to the hexagonal part of the auto-tensioner.
2. Rotate the auto-tensioner anti-clockwise.
3. Insert the L-shaped hexagon wrench into the auto-tensioner hole to fix the auto-tensioner.

⚠ 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.

4. Remove the drive belt.

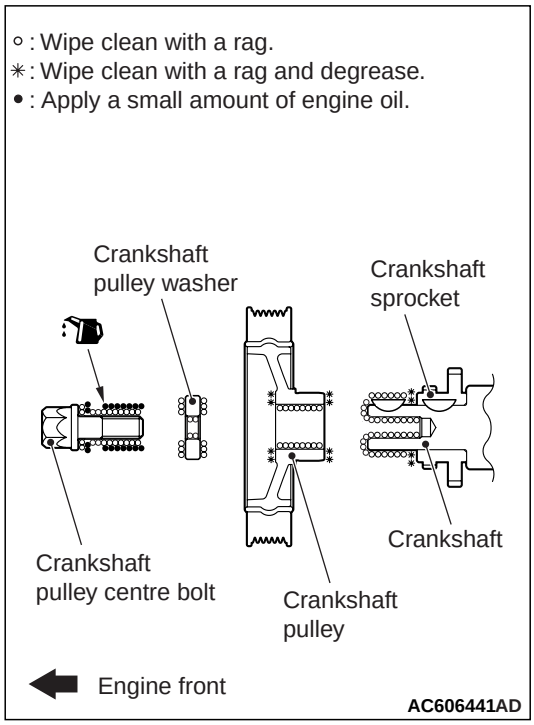
<<B>> CRANKSHAFT PULLEY CENTRE BOLT/CRANKSHAFT PULLEY WASHER/CRANKSHAFT PULLEY REMOVAL



1. Use the following special tools to support the crankshaft pulley:
   - Front hub and flange yoke holder (MB990767)
   - Pin (MD998719)
2. Loosen the crankshaft pulley centre bolt and remove the crankshaft pulley washer and crankshaft pulley.

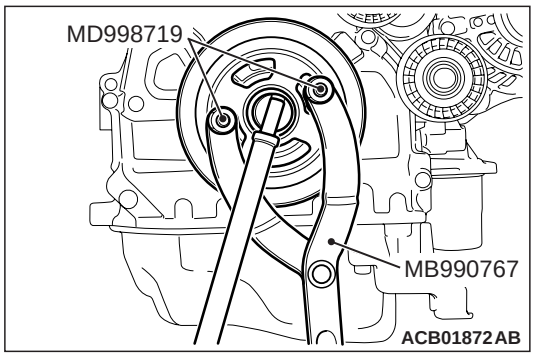
INSTALLATION SERVICE POINTS

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



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

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



5. Use the following special tools as during removal to support the crankshaft pulley:

- Front hub and flange yoke holder (MB990767)
- Pin (MD998719)

6. Tighten the crankshaft pulley centre bolt to the specified torque.

   Tightening torque: 210 N·m

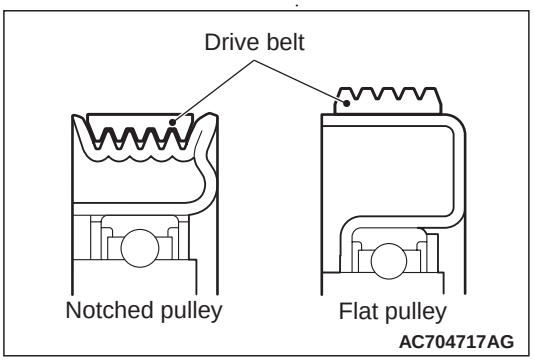
7. Loosen the crankshaft pulley centre bolt fully.
8. Tighten the crankshaft pulley centre bolt to the specified torque again.

   Tightening torque: 210 N·m

>>B<< DRIVE BELT INSTALLATION

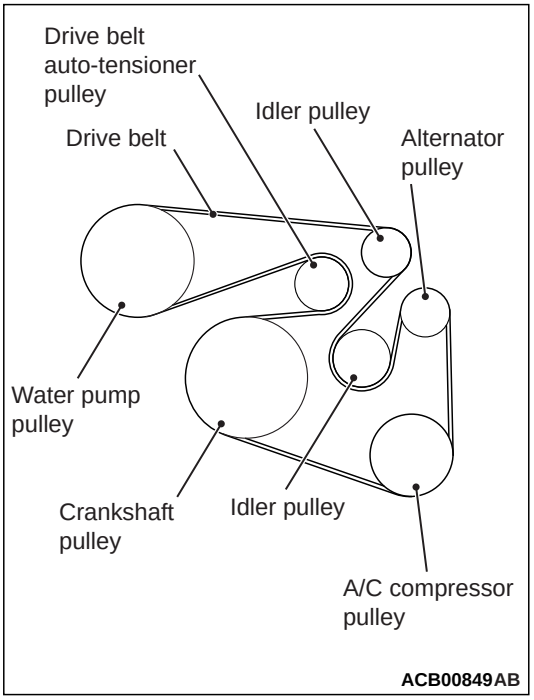
⚠ CAUTION

- **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.

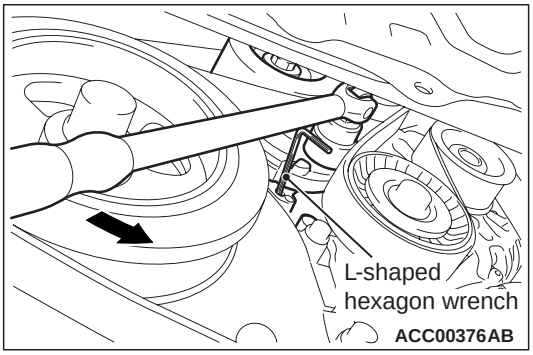
- **Check that the drive belt is installed in the centre of the flat surface of the flat pulley.**



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

⚠ WARNING

Be sure to set the tool to the hexagonal part securely to prevent the tool from falling off because the tension of the auto-tensioner is high.



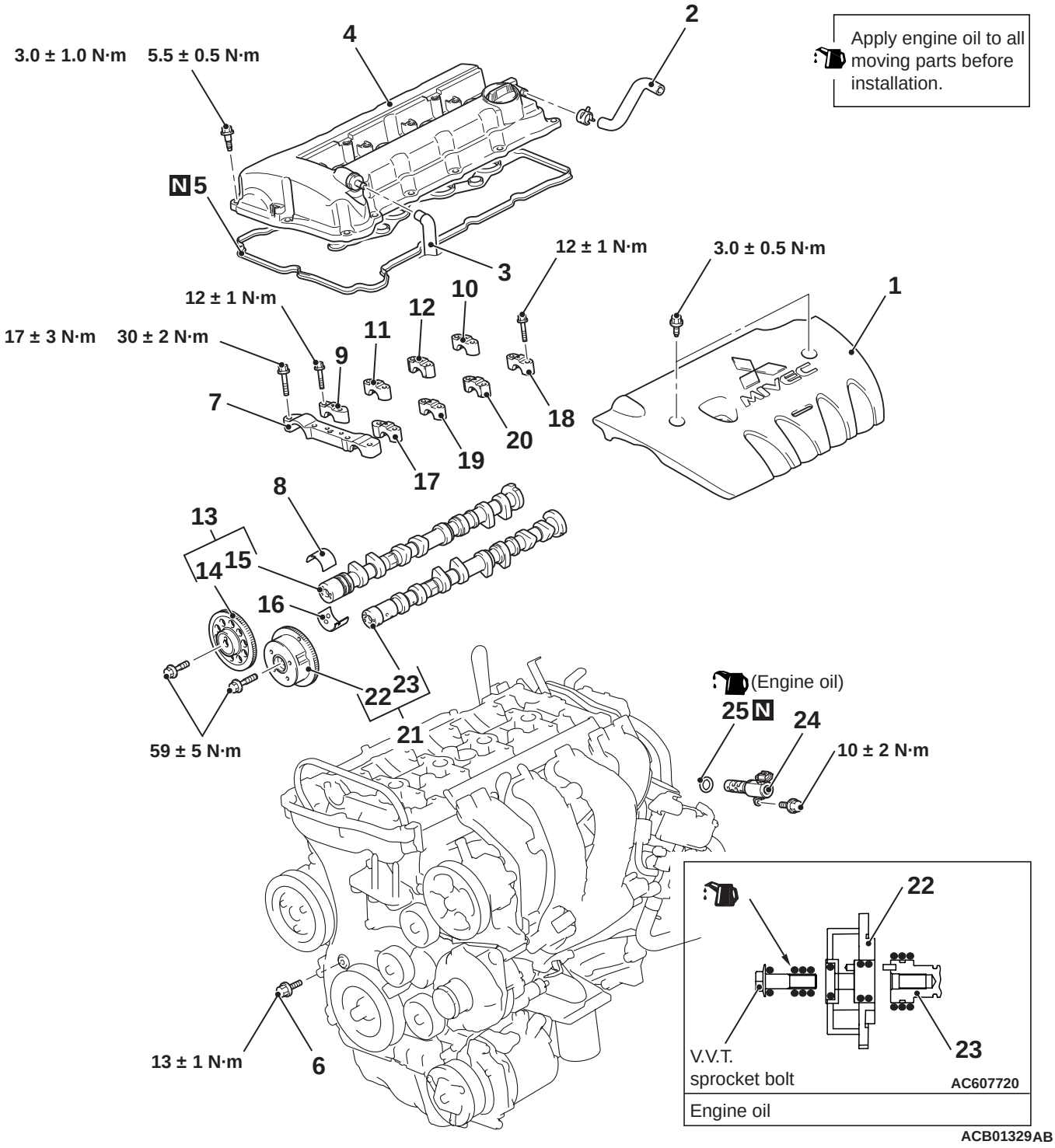
2. Securely set the tool to the hexagonal part of the auto-tensioner.
3. Rotate the auto-tensioner anti-clockwise and remove the L-shaped hexagon wrench fixing the auto-tensioner.
4. Apply tension to the drive belt while slowly turning the auto-tensioner clockwise.

CAMSHAFT

REMOVAL AND INSTALLATION

M1112023100866

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). • Air Cleaner Assembly Removal (Refer to GROUP 15 – Air Cleaner).	• Air Cleaner Assembly Installation (Refer to GROUP 15 – Air Cleaner). • Engine Room Under Cover Front A, B and Engine Room Side Cover (RH) Installation (Refer to GROUP 51 – Under Cover).



Camshaft removal steps

1. Engine upper cover
- Ignition coil (Refer to GROUP 16 – Ignition System, Ignition Coil)
2. Breather hose
3. PCV hose connection
- Control wiring harness connection

<<A>> >>G<< 4. Rocker cover assembly
5. Rocker cover gasket
<<B>> • No.1 cylinder compression top dead centre setting <only at removal>.
- Valve clearance adjustment (Refer to P.11A-12) <only at installation>.

6. Service hole bolt
<<C>> • Camshaft and camshaft sprocket assembly (exhaust side) removal preparatory operation <only at removal>.
<<D>> >>F<< 7. Camshaft bearing front cap assembly
>>E<< 8. Camshaft bearing
<<E>> >>D<< 9. Camshaft bearing oil feeding cap (exhaust side)
<<E>> >>D<< 10. Camshaft bearing cap (exhaust side)
<<E>> >>D<< 11. Camshaft bearing cap (exhaust side)
<<E>> >>D<< 12. Camshaft bearing thrust cap (exhaust side)
<<F>> >>E<< 13. Camshaft and camshaft sprocket assembly (exhaust side)
<<G>> >>B<< 14. Exhaust camshaft sprocket
<<G>> >>B<< 15. Camshaft (exhaust side)
>>E<< 16. Camshaft bearing
<<E>> >>D<< 17. Camshaft bearing oil feeding cap (inlet side)
<<E>> >>D<< 18. Camshaft bearing cap (inlet side)
<<E>> >>D<< 19. Camshaft bearing cap (inlet side)
<<E>> >>D<< 20. Camshaft bearing thrust cap (inlet side)
>>C<< 21. Camshaft and camshaft sprocket assembly (inlet side)
<<G>> >>B<< 22. Inlet V.V.T. sprocket assembly
<<G>> >>B<< 23. Camshaft (inlet side)

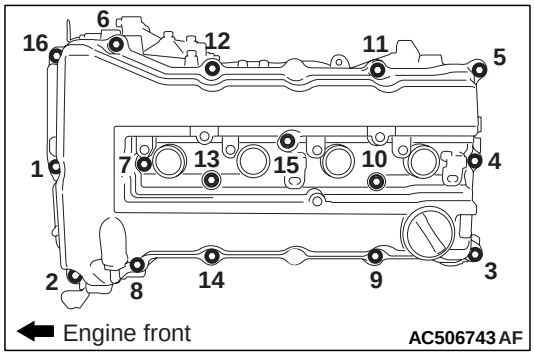
Oil feeder control valve removal steps

1. Engine upper cover

<<H>> >>A<< 24. Oil feeder control valve (OCV) inlet
>>A<< 25. O-ring

REMOVAL SERVICE POINTS

<<A>> ROCKER COVER ASSEMBLY REMOVAL

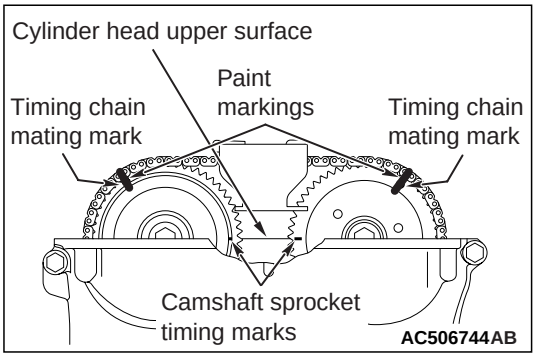


Loosen the rocker cover assembly mounting bolts in the order of number shown in the figure, and remove the rocker cover assembly.

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

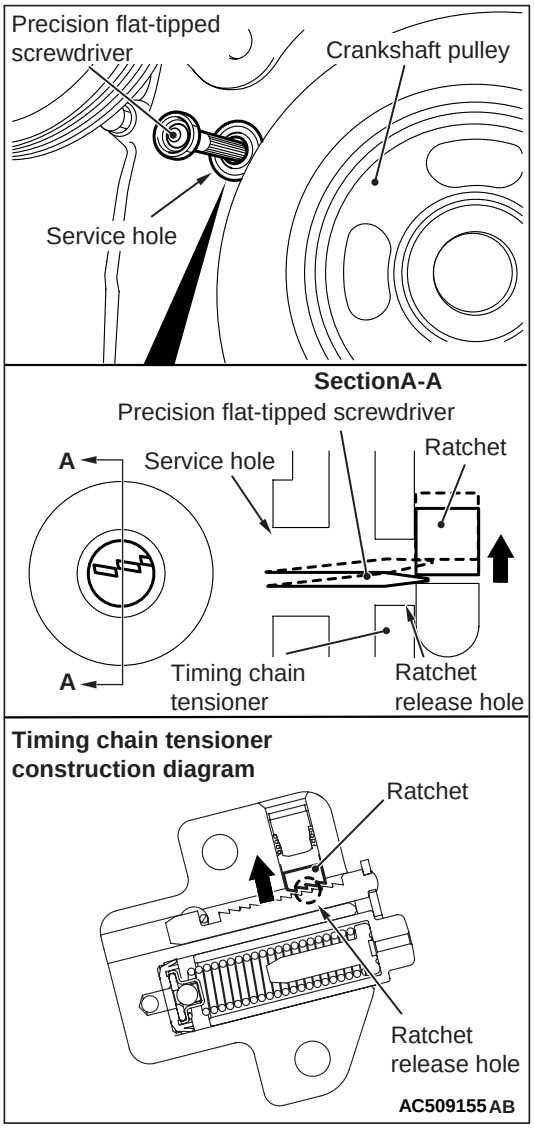
⚠ CAUTION

Never turn the crankshaft anti-clockwise.



1. Turn the crankshaft clockwise so that the camshaft sprocket timing marks become horizontal to the cylinder head upper surface, and set the No.1 cylinder to the top dead centre of compression. At this time, check that the crankshaft pulley timing mark is in the "T" mark position of the ignition timing indicator of the timing chain case assembly.
2. Put paint marks on both the camshaft sprocket and valve 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

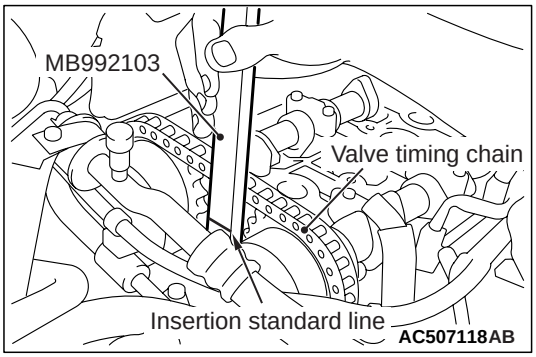


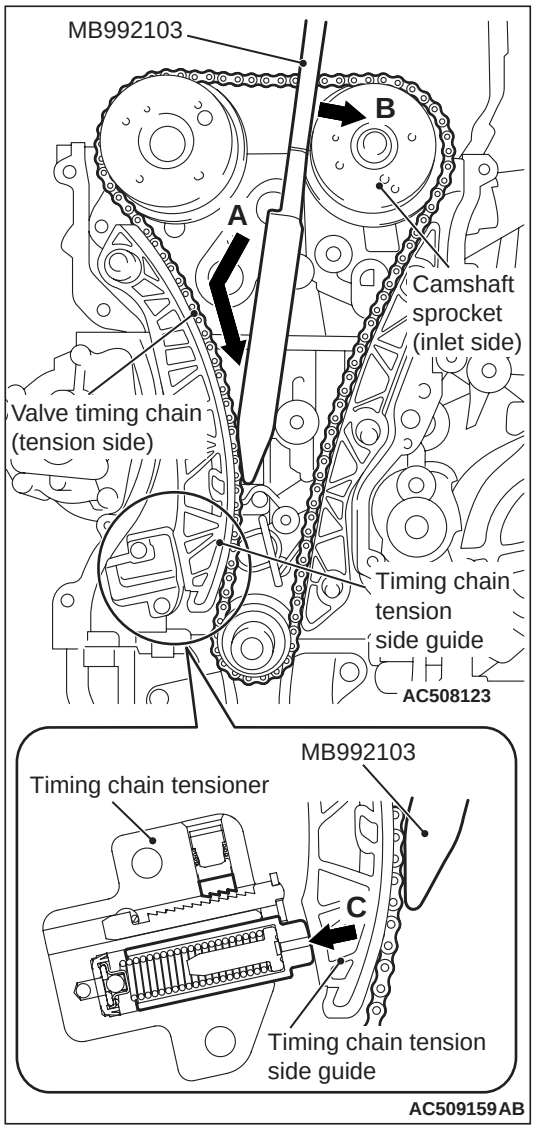
1. Insert a precision flat-tipped screwdriver through the service hole of the timing chain case, press up the timing chain tensioner ratchet to unlock, and keep the timing chain tensioner with that state.

   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.

⚠ CAUTION

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





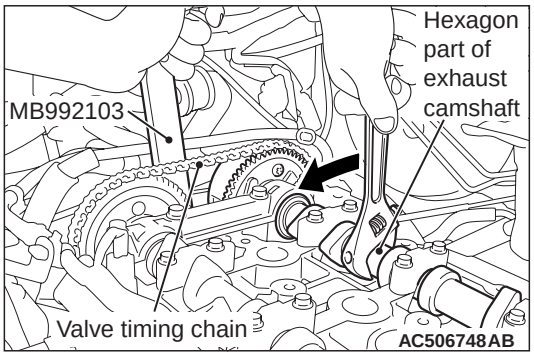
2. With the timing chain tensioner unlocked, insert special tool chain tension release bar (MB992103) from the timing chain case assembly inside along the tension side of the valve timing chain until the insertion guide line aligns with the upper surface of the timing chain case assembly (A in the figure).

NOTE: With the timing chain tensioner unlocked, insert the special tool MB992103 along the tension side of the valve timing chain, according to the special tool MB992103 top shape. The special tool MB992103 can be inserted smoothly to the position where the special tool MB992103 insertion guideline aligns with the timing chain case assembly top surface (B in the figure), and the spread timing chain tension side guide can be hold (C in the figure).

3. With the special tool MB992103 inserted up to the insertion guide line, press the special tool MB992103 against the inlet side camshaft sprocket and spread and hold the timing chain tension side guide.
4. Remove the precision flat-tipped screwdriver unlocking the timing chain tensioner.

⚠ CAUTION

The valve timing chain may be bitten by other parts. After sagging the valve timing chain, never rotate the crankshaft.

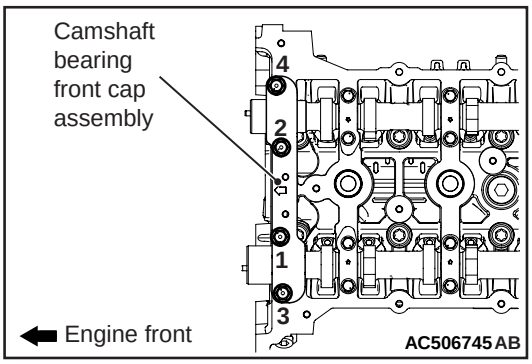


5. With the timing chain tension side guide spread, hook the special tool MB992103 over the hexagon part of the camshaft on the exhaust side, and turn the camshaft clockwise to apply slack to the valve timing chain between the camshaft sprockets.

<<D>> CAMSHAFT BEARING FRONT CAP ASSEMBLY REMOVAL

⚠ CAUTION

Be careful not to drop the camshaft bearing.

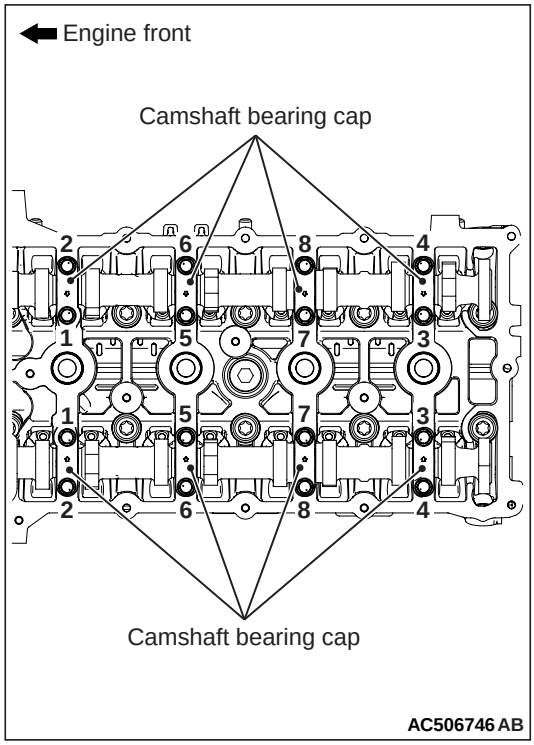


Loosen the camshaft bearing front cap mounting bolts in the order of number shown in the figure, and remove the camshaft bearing front cap assembly.

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

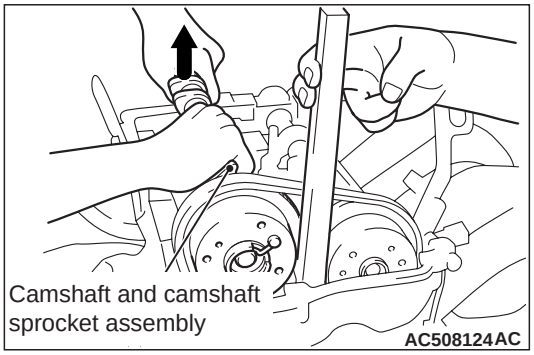
⚠ CAUTION

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.

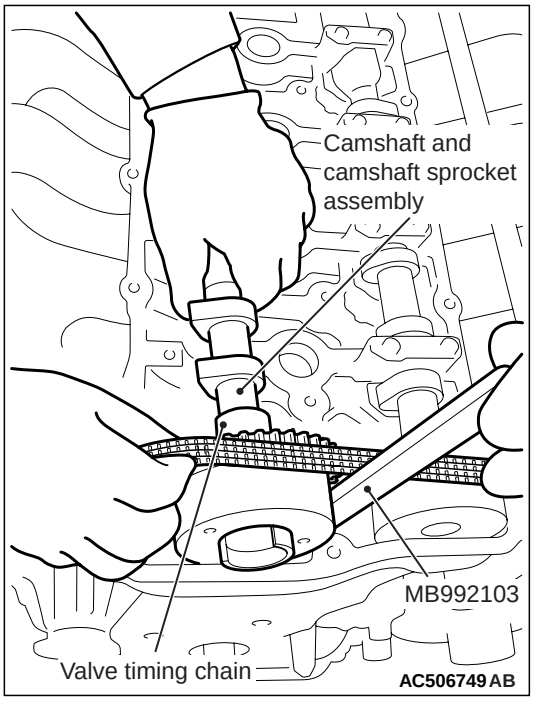


Loosen the camshaft bearing cap mounting bolts in the order of number shown in the figure in four or five steps, and remove the camshaft bearing caps.

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

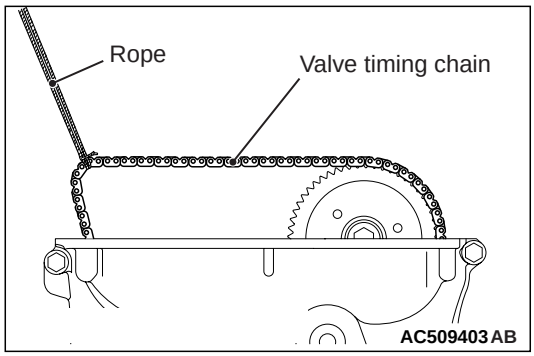


1. Raise slightly the transmission side of the camshaft and camshaft sprocket assembly (exhaust side) by using the slack of the valve timing chain, and remove from the cam bearing.



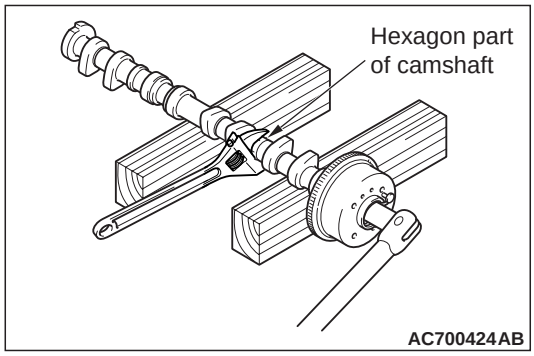
2. Remove the valve timing chain from the camshaft and camshaft sprocket assembly (exhaust side) toward the timing chain case assembly, and remove the camshaft and camshaft sprocket assembly (exhaust side) toward the transmission.
3. Remove special tool chain tension release bar (MB992103) inserted into the timing chain case assembly inside.

⚠ CAUTION
The valve timing chain may be bitten by 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 valve timing chain with a rope to prevent the valve timing chain from falling into the timing chain case assembly.

<<G>> SPROCKET/CAMSHAFT REMOVAL



Hold the hexagon part of the camshaft with a monkey wrench. Loosen the sprocket mounting bolt and remove the sprocket from the camshaft.

<<H>> 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

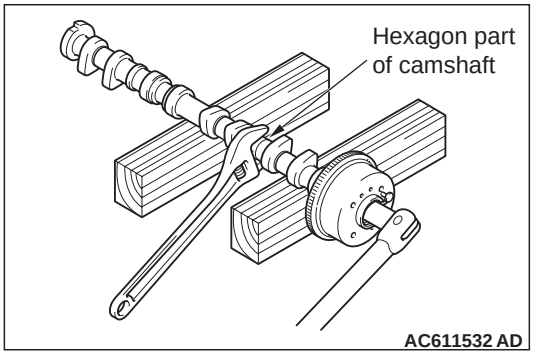
>>A<< O-RING/OIL FEEDER CONTROL VALVE INSTALLATION

⚠ CAUTION

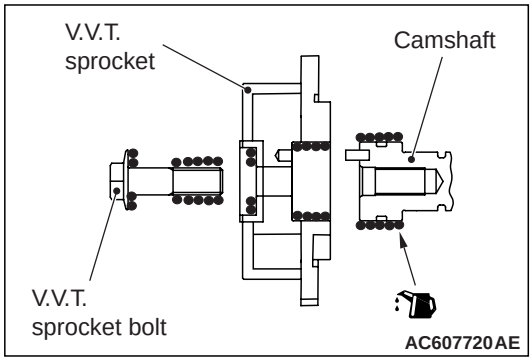
When installing the oil feeder control valve, be careful to avoid damage to the O-ring.

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/SPROCKET INSTALLATION



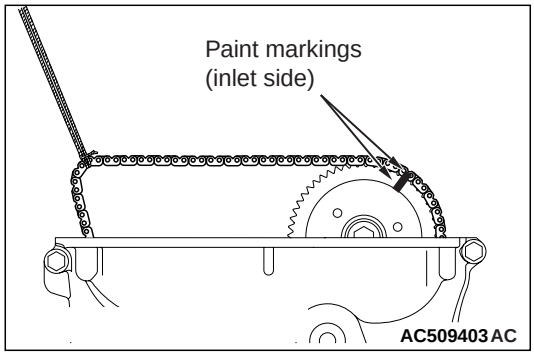
1. Use a monkey wrench to secure the hexagon part of the camshaft in the same manner as removal.



2. Apply an adequate and minimum amount of engine oil to the positions shown of the camshaft and inlet V.V.T. sprocket assembly.
3. Install the sprocket to the camshaft.
4. Apply an adequate and minimum amount of engine oil to the inlet V.V.T. sprocket bolt.
5. Tighten the sprocket bolt to the specified torque.

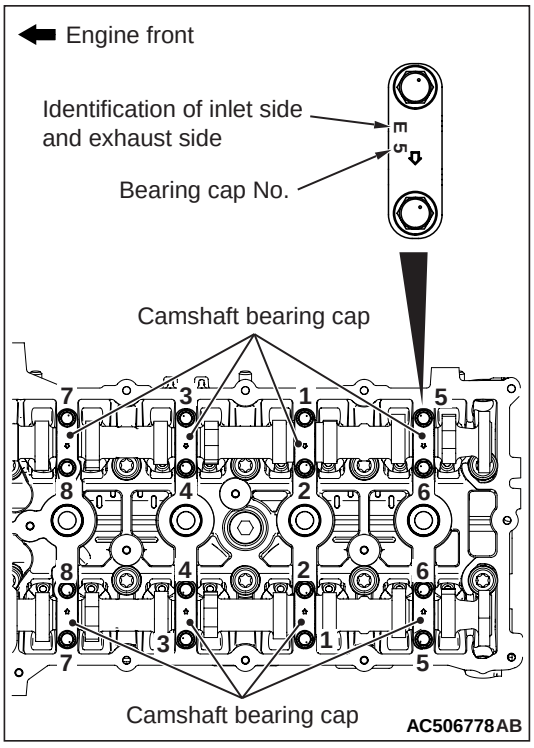
   Tightening torque: 59 ± 5 N·m

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



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

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



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

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

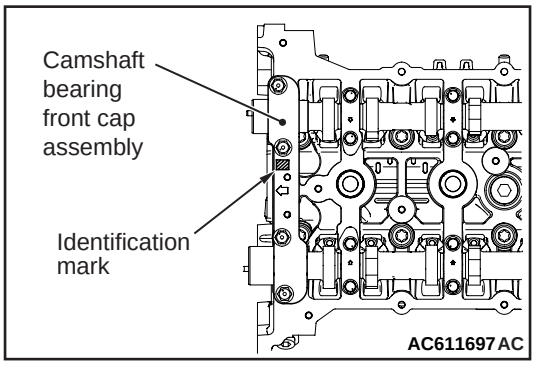
2. Tighten each camshaft bearing cap mounting bolts to the specified torque in the order of number shown in the figure in two or three steps.

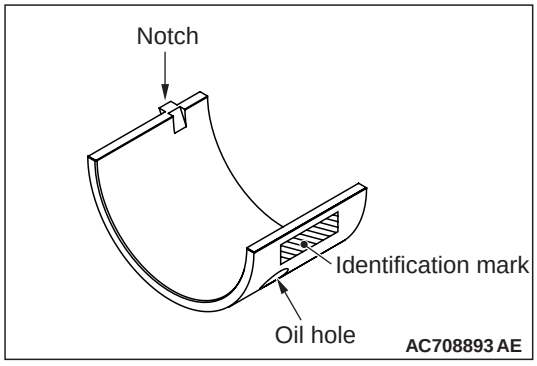
   Tightening torque: 12 ± 1 N·m

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

⚠ CAUTION

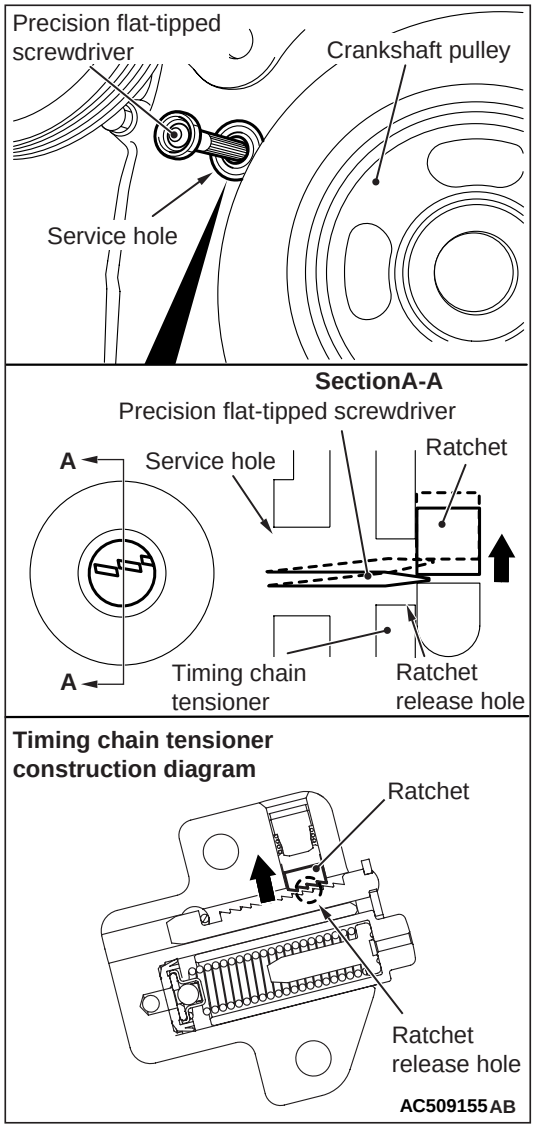
- **Be careful not to drop the camshaft bearing.**
- **When installing the camshaft and camshaft sprocket assembly (exhaust side), be careful not to let the camshaft bearing which is installed to the front cam bearing deviate from its position.**





1. When replacing the camshaft bearing, select a camshaft bearing in relevant size according to the camshaft bearing front cap assembly identification mark in the table below. The camshaft bearing identification mark is stamped at the position shown in the figure.

Camshaft bearing front cap assembly		Camshaft bearing identification mark
Identification mark	Journal diameter mm	
1	40.000 – 40.008	1
2	40.008 – 40.016	2
3	40.016 – 40.024	3

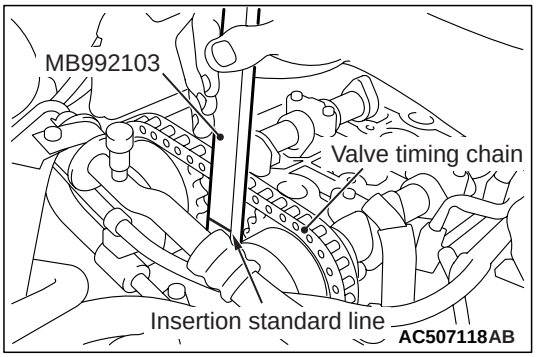


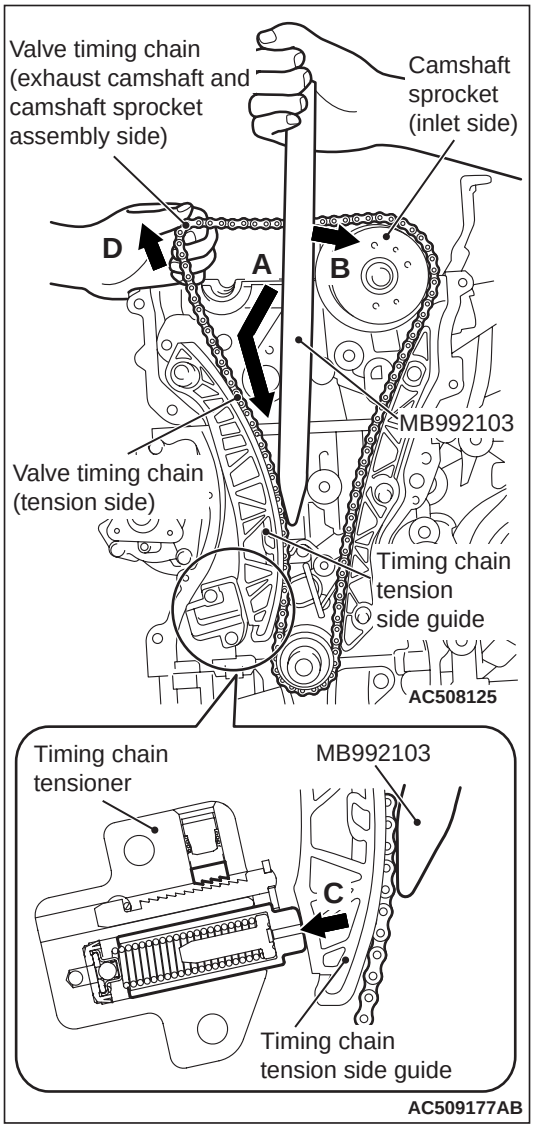
2. In the same manner as removal, insert the precision flat-tipped screwdriver through the service hole of the timing chain case, press up the ratchet of timing chain tensioner to unlock, and hold the unlocked timing chain tensioner.

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





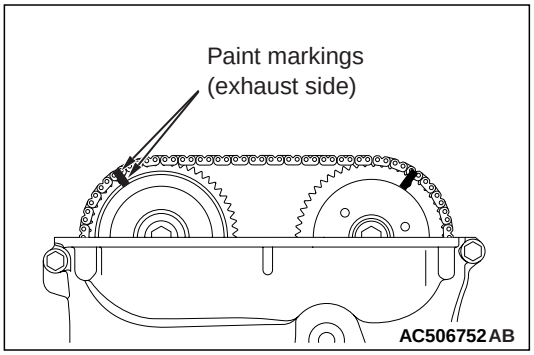
3. With the timing chain tensioner unlocked, insert special tool chain tension release bar (MB992103) from the timing chain case assembly inside along the tension side of the valve timing chain until the insertion guide line aligns with the upper surface of the timing chain case assembly (A in the figure).

NOTE: With the timing chain tensioner unlocked, insert the special tool MB992103 along the tension side of the valve timing chain, according to the special tool MB992103 top shape. The special too MB992103 can be inserted smoothly to the position where the special tool MB992103 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 MB992103 inserted up to the insertion guide line, press the special tool MB992103 against the inlet side camshaft sprocket (B in the figure) and spread and hold the timing chain tension side guide (C in the figure).
5. Remove the precision flat-tipped screwdriver unlocking the timing chain tensioner.
6. Pull up the camshaft and camshaft sprocket assembly (exhaust side) mounting area of the valve timing chain (D in the figure) to provide allowance for easy installation of the camshaft and camshaft sprocket assembly (exhaust side) to the valve 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.

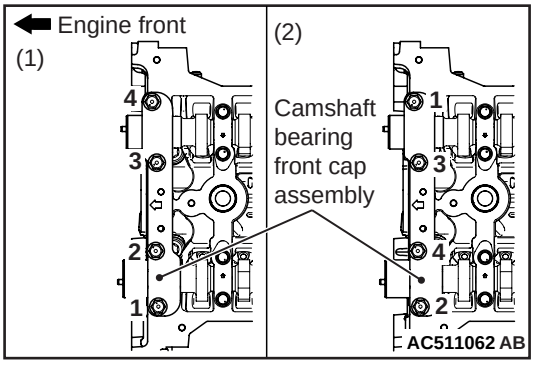


7. Align the exhaust side paint mark of the valve timing chain which was put at removal with the paint mark of the exhaust side camshaft sprocket, and install the valve timing chain to the camshaft sprocket.
8. Install the camshaft and camshaft sprocket assembly (exhaust side) to the cylinder head.
9. Remove the special tool MB992103 inserted into the timing chain case assembly inside.

>>F<< CAMSHAFT BEARING FRONT CAP ASSEMBLY INSTALLATION

⚠ CAUTION

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



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

   Tightening torque: 17 ± 3 N·m

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

   Tightening torque: 30 ± 2 N·m

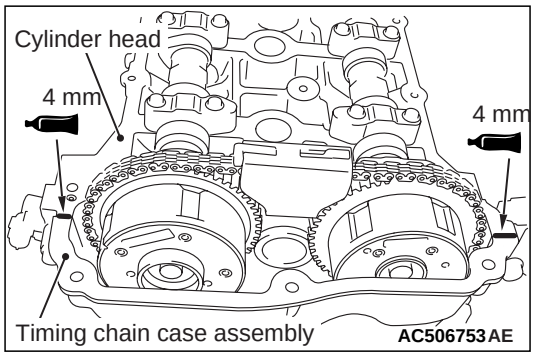
3. After the camshaft bearing font cap installation, check that the paint markings of the camshaft sprocket and the timing chain and the timing mark of the crankshaft pulley and the "T" mark position of ignition timing indicator are aligned respectively.

>>G<< ROCKER COVER ASSEMBLY INSTALLATION

1. Remove the sealant from the joints between the rocker cover assembly and cylinder head and timing chain case assembly, and degrease the surface where the sealant is applied by white gasoline or the like.

⚠ CAUTION

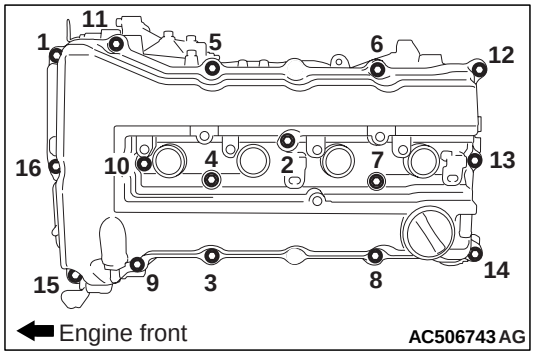
After the installation, until a sufficient period of time (one hour or more) elapses, do not apply the oil or water to the sealant application area or start the engine.



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: ThreeBond 1217G or equivalent

NOTE: Install the rocker cover assembly immediately 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

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

VALVE STEM SEAL

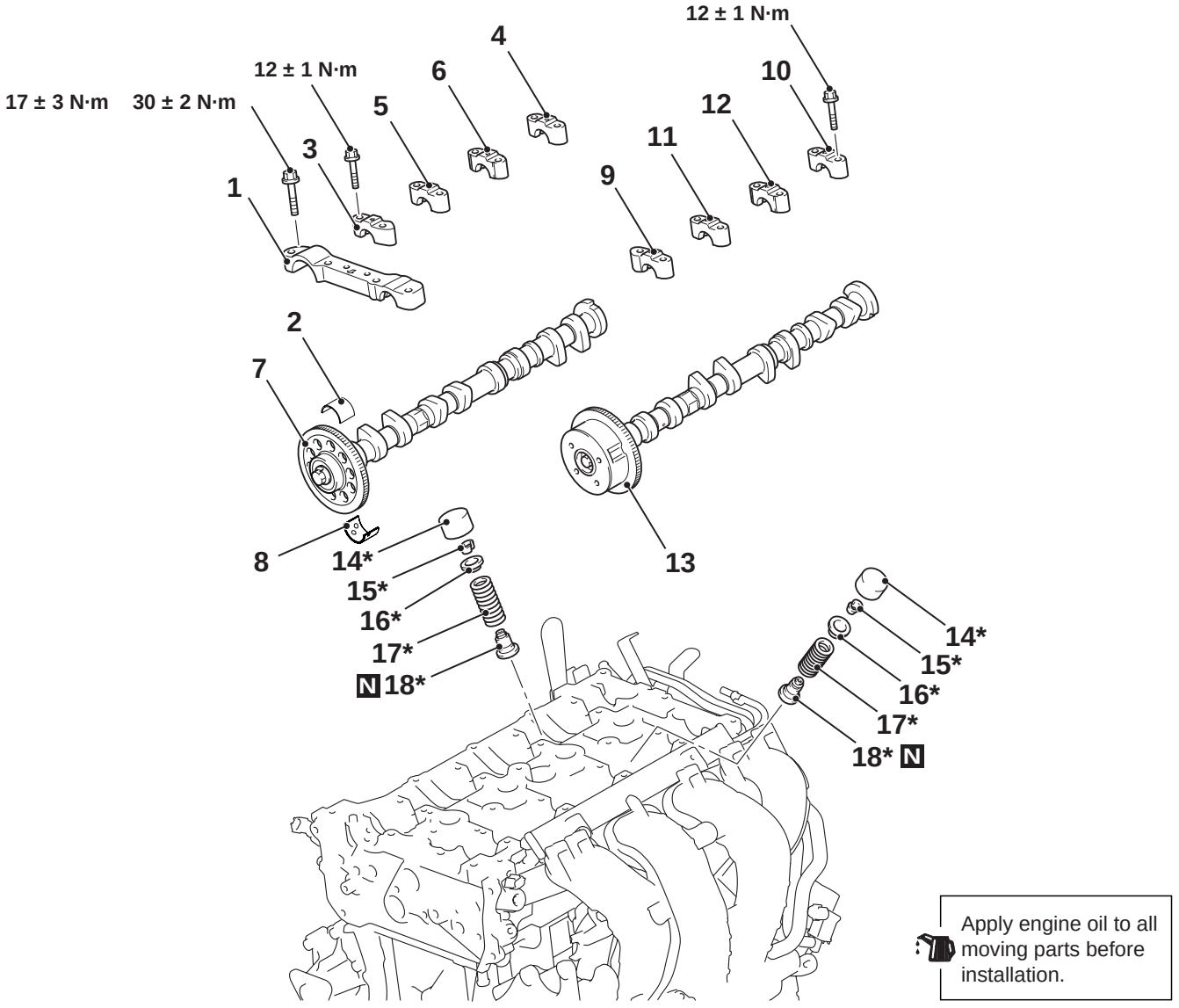
REMOVAL AND INSTALLATION

M1112008101787

⚠ CAUTION

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

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). • Engine Oil Draining (Refer to GROUP 12 – On-vehicle Service, Engine Oil Replacement). • Rocker Cover Assembly Removal (Refer to P.11A-19). • Engine Oil Pan Removal (Refer to P.11A-36). • Valve Timing Chain Removal (Refer to P.11A-50).	• Valve Timing Chain Installation (Refer to P.11A-50). • Engine Oil Pan Installation (Refer to P.11A-36). • Valve Clearance Check (Refer to P.11A-12). • Rocker Cover Assembly Installation (Refer to P.11A-19). • Engine Oil Refilling (Refer to GROUP 12 – On-vehicle Service, Engine Oil Replacement). • Engine Room Under Cover Front A, B and Engine Room Side Cover (RH) Installation (Refer to GROUP 51 – Under Cover).



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Removal steps

<<A>>	>>F<<	1.	Camshaft bearing front cap assembly
	>>E<<	2.	Camshaft bearing
<<B>>	>>D<<	3.	Camshaft bearing oil feeding cap (exhaust side)
<<B>>	>>D<<	4.	Camshaft bearing cap (exhaust side)
<<B>>	>>D<<	5.	Camshaft bearing cap (exhaust side)
<<B>>	>>D<<	6.	Camshaft bearing thrust cap (exhaust side)
	>>E<<	7.	Camshaft and camshaft sprocket assembly (exhaust side)
	>>E<<	8.	Camshaft bearing
<<B>>	>>D<<	9.	Camshaft bearing oil feeding cap (inlet side)
<<B>>	>>D<<	10.	Camshaft bearing cap (inlet side)
<<B>>	>>D<<	11.	Camshaft bearing cap (inlet side)
<<B>>	>>D<<	12.	Camshaft bearing thrust cap (inlet side)
		13.	Camshaft and camshaft sprocket assembly (inlet side)
		•	Spark plug (Refer to GROUP 16 – Ignition System, Ignition Coil).
<<C>>	>>C<<	14.	Valve tappet
<<D>>	>>B<<	15.	Valve spring retainer lock
		16.	Valve spring retainer
		17.	Valve spring
<<E>>	>>A<<	18.	Valve stem seal

REMOVAL SERVICE POINTS

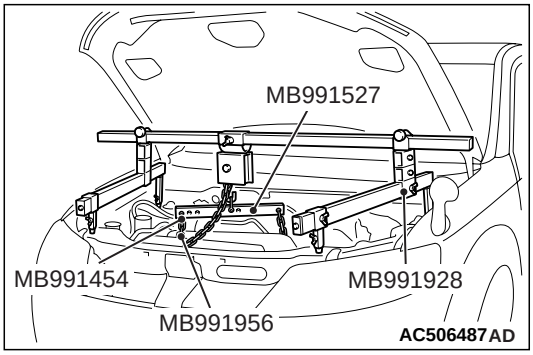
<<A>> CAMSHAFT BEARING FRONT CAP ASSEMBLY REMOVAL

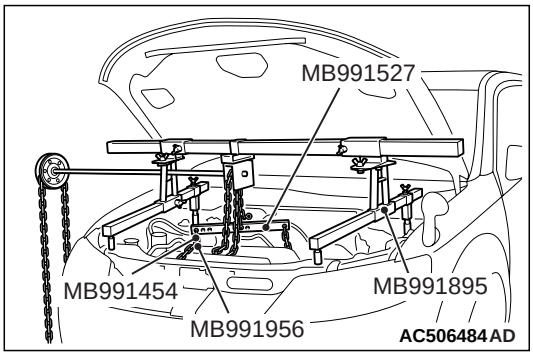
1. Temporarily install the engine oil pan which was removed at the valve timing chain removal (Refer to P.11A-36).

⚠ CAUTION

When supporting the engine and transmission assembly with a garage jack, be careful not to deform the engine oil pan.

2. Place a garage jack against the engine oil pan with a piece of wood in between to support the engine and transmission assembly.

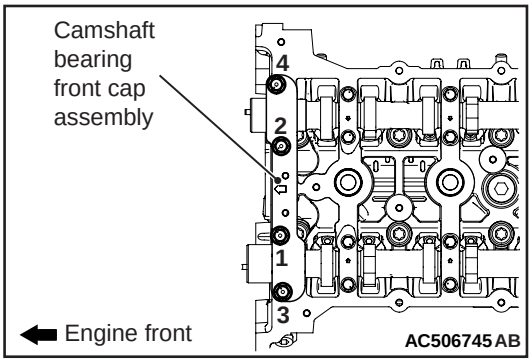




3. Remove special tool engine hanger (MB991928 or MB991895) which was installed for supporting the engine and transmission assembly when the valve timing chain was removed.

⚠ CAUTION

Be careful not to drop the camshaft bearing.

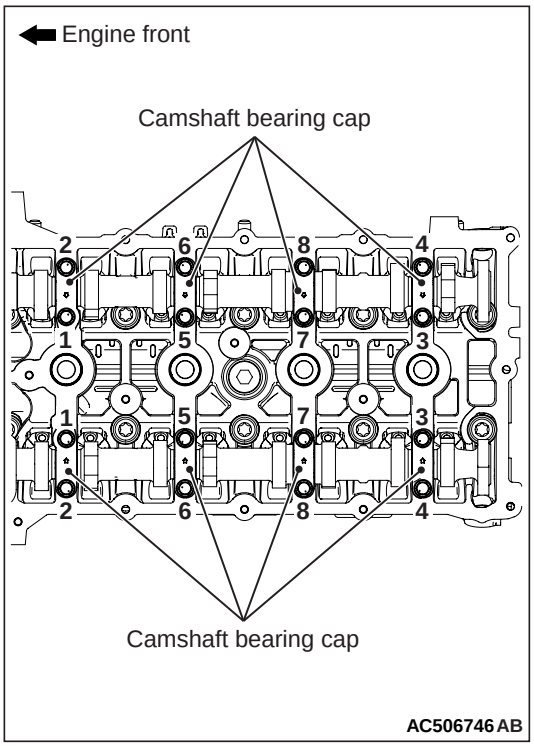


4. Loosen the camshaft bearing front cap mounting bolts in the order of number shown in the figure, and remove the camshaft bearing front cap assembly.

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

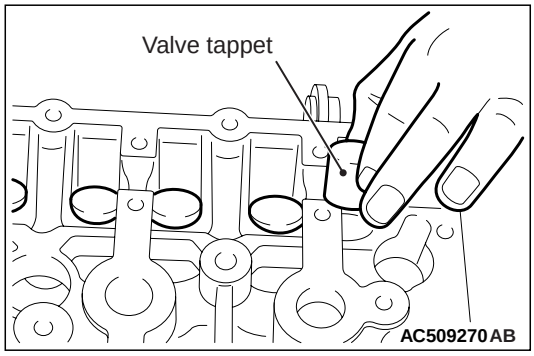


Loosen the camshaft bearing cap mounting bolts in the order of number shown in the figure in four or five steps, and remove the camshaft bearing caps.

<<C>> VALVE TAPPET REMOVAL

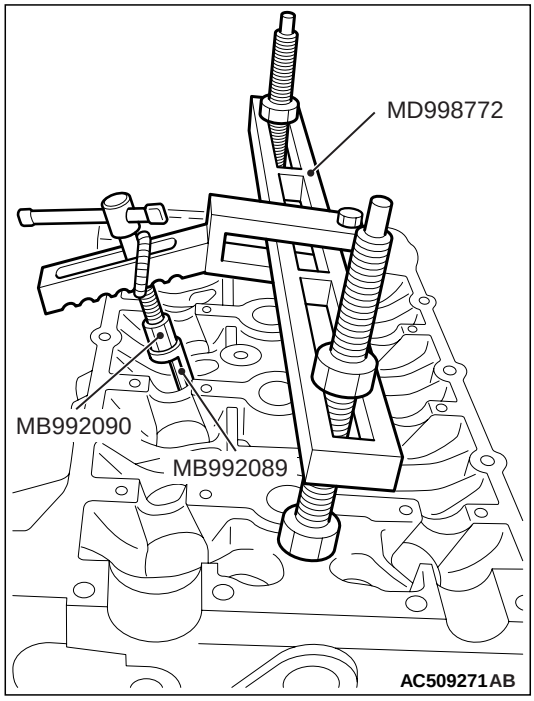
⚠ CAUTION

- **Do not use pliers or other tools to remove the valve tappets. Always remove them by hands.**
- **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 hands.

<<D>> VALVE SPRING RETAINER LOCK REMOVAL



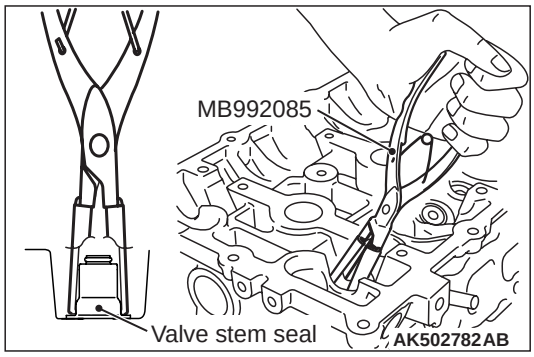
1. Screw in special tool retainer holder attachment (MB992090) to special tool valve spring compressor (MD998772), and assemble special tool retainer holder C (MB992089).

⚠ CAUTION

When removing the valve spring retainer lock, leave the piston of the cylinder in the TDC (Top Dead Centre) 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 valve stem seal pliers (MB992085) to nip the base of the stem seal (where the outside diameter is larger) securely, and remove it by twisting it to the left and right.

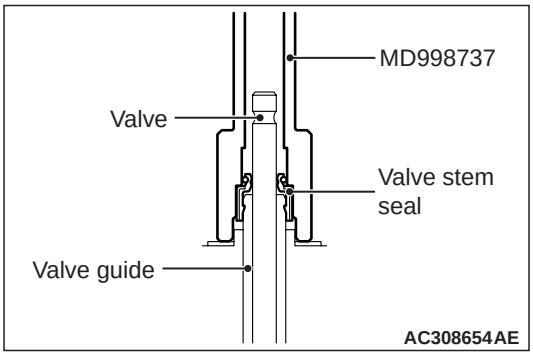
INSTALLATION SERVICE POINTS

>>A<< VALVE STEM SEAL INSTALLATION

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

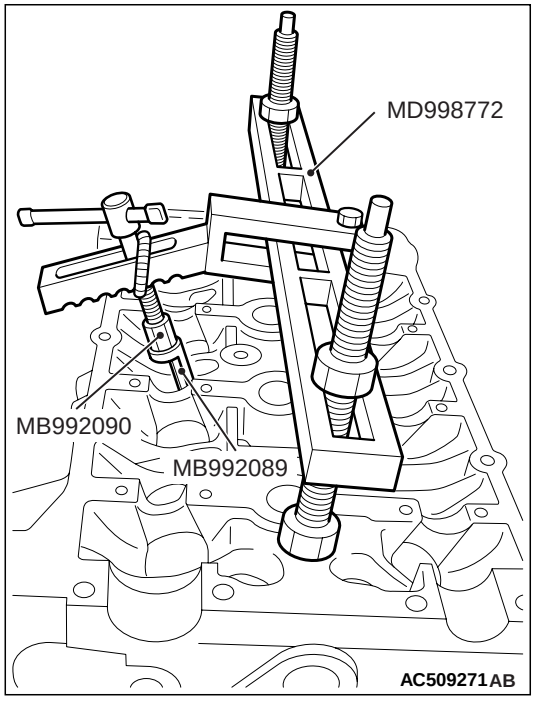
⚠ CAUTION

- **Valve stem seals cannot be reused.**
- **Do not damage the wall of the tappet hole when installing the valve stem seal.**
- **Special tool valve stem seal installer (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.**



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

>>B<< VALVE SPRING RETAINER LOCK INSTALLATION



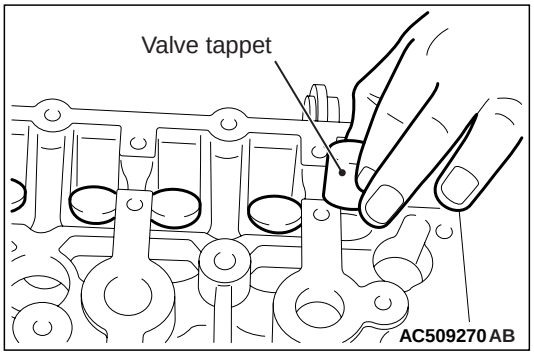
In the same manner as removal, use special tool valve spring compressor (MD998772) with special tool retainer holder attachment (MB992090) and special tool retainer holder C (MB992089) attached to compress the valve spring, and install the valve spring retainer lock.

>>C<< VALVE TAPPET INSTALLATION

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

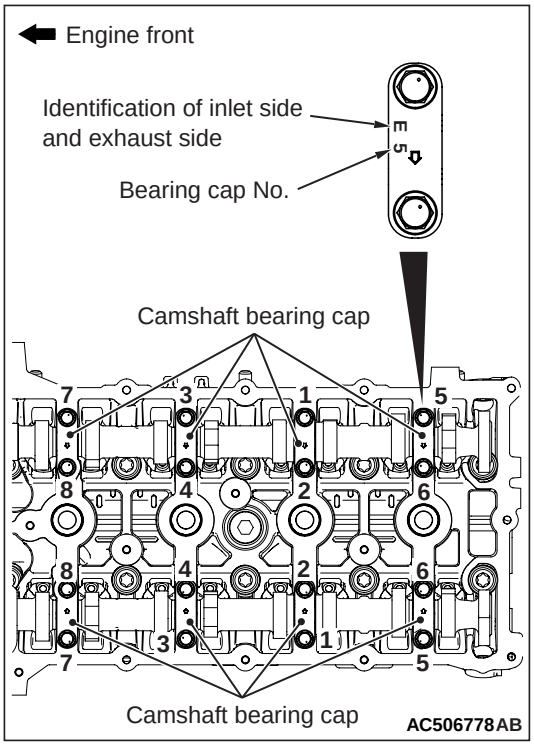
⚠ CAUTION

- **Do not use pliers or other tools to install the valve tappets. Always install them by hand.**
- **Be sure to install the valve tappets in the same position as before.**



2. Install the valve tappet to the cylinder head by hand.

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



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

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

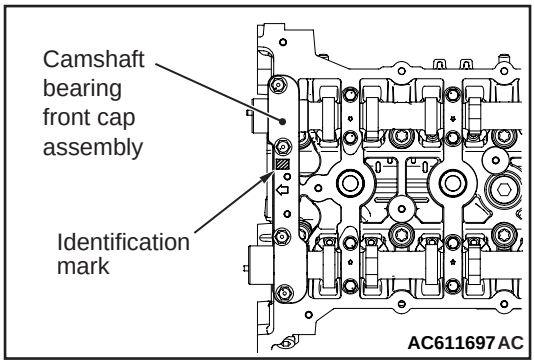
2. Tighten each camshaft bearing cap mounting bolts to the specified torque in the order of number shown in the figure in two or three steps.

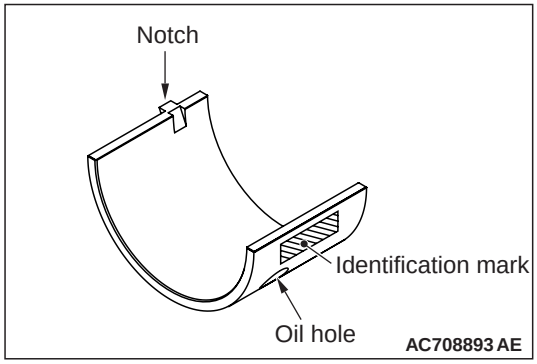
   Tightening torque: 12 ± 1 N·m

>>E<< 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.**





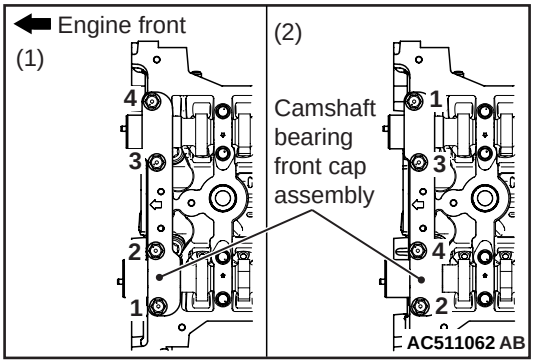
When replacing the camshaft bearing, select a camshaft bearing in relevant size according to the camshaft bearing front cap identification mark in the table below. Identification mark of the camshaft bearing is painted in the position shown in the figure.

Camshaft		Camshaft bearing identification mark
Identification mark	Journal diameter mm	
1	40.000 – 40.008	1
2	40.008 – 40.016	2
3	40.016 – 40.024	3

>>F<< CAMSHAFT BEARING FRONT CAP ASSEMBLY INSTALLATION

⚠ CAUTION

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

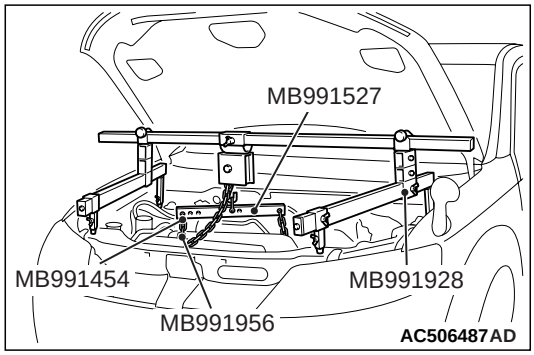


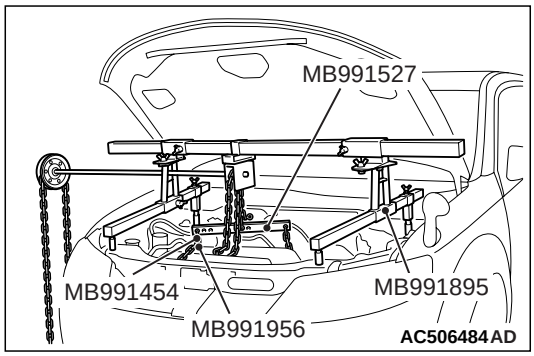
1. Install the camshaft bearing front cap to the cylinder head, and temporarily tighten the camshaft bearing front cap mounting bolts to the specified torque in the order shown in the figure (1).

   Tightening torque: 17 ± 3 N·m

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

   Tightening torque: 30 ± 2 N·m





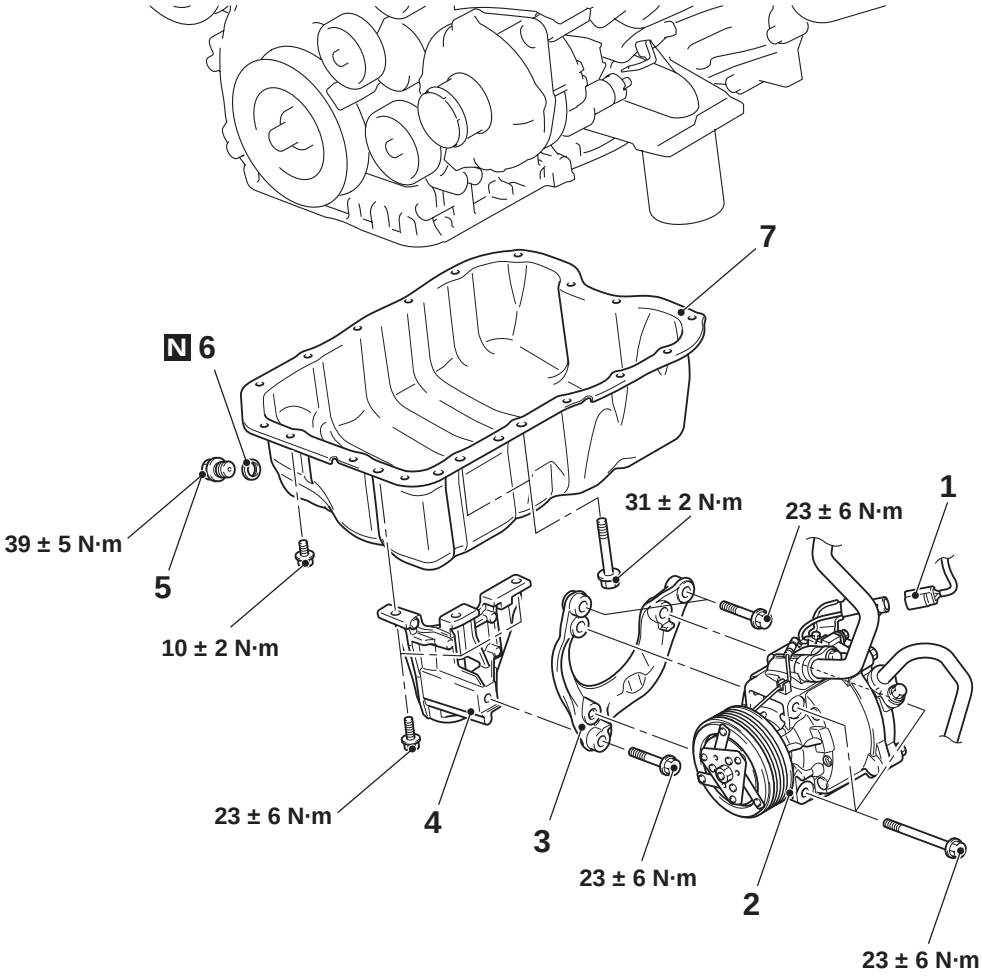
3. Install special tool engine hanger (MB991928 or MB991895) which was installed for supporting the engine and transmission assembly when the valve timing chain was removed (Refer to P.11A-50).
4. Remove the garage jack which supports the engine and transmission assembly.
5. Remove the engine oil pan installed temporarily.

OIL PAN

REMOVAL AND INSTALLATION

M1112002803416

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). • Engine Oil Draining (Refer to GROUP 12 – On-vehicle Service, Engine Oil Replacement). • Alternator and Others Belt Removal (Refer to P.11A-16).	• Alternator and Others Belt Installation (Refer to P.11A-16). • Engine Oil Refilling (Refer to GROUP 12 – On-vehicle Service, Engine Oil Replacement). • Engine Room Under Cover Front A, B and Engine Room Side Cover (RH) Installation (Refer to GROUP 51 – Under Cover).



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Removal steps

1. A/C compressor and clutch connector connection
<<**A**>> >>**B**<< 2. A/C compressor and clutch assembly
3. A/C compressor bracket A
4. A/C compressor bracket B
5. Engine oil pan drain plug
6. Engine oil pan drain plug gasket
<<**B**>> >>**A**<< 7. Engine oil pan

REMOVAL SERVICE POINTS

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

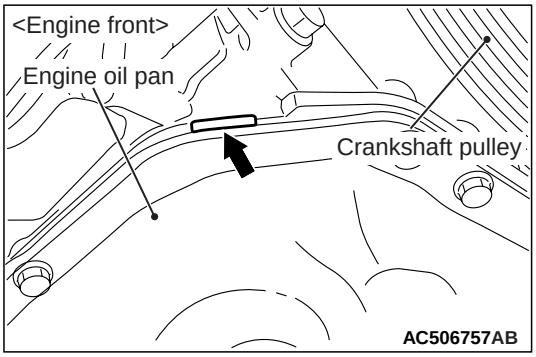
1. Remove the A/C compressor and clutch assembly together with the hose from the bracket.
2. Tie the removed A/C compressor and clutch assembly with a string at a position where they will not interfere with the removal and installation of engine oil pan.

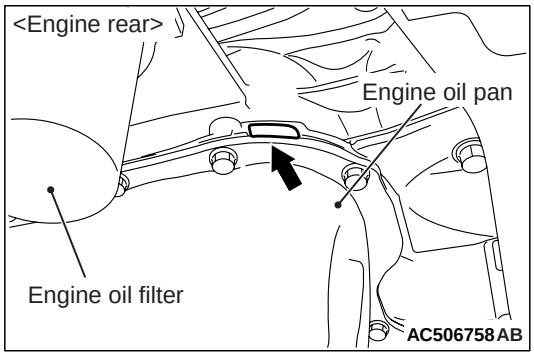
<<B>> ENGINE OIL PAN REMOVAL

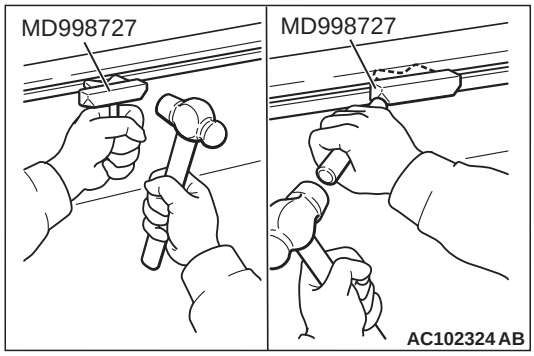
1. Remove the engine oil pan mounting bolts.

⚠ CAUTION

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





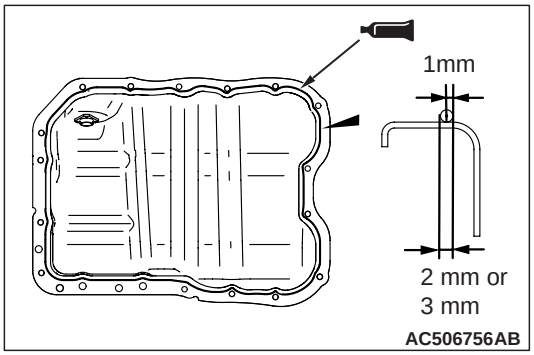


2. Insert special tool oil pan FIPG cutter (MD998727) from the engine oil pan removal groove of the cylinder block assembly.
3. Lightly tap the special tool (MD998727) with a hammer to slide the engine oil pan seal surface, cut off the liquid gasket, and remove the engine oil pan.

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.



2. Apply the sealant without any gap to the mating surface of engine oil pan as shown in the figure, and install the engine oil pan to the cylinder block assembly.

   Specified sealant: ThreeBond 1217G or equivalent

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

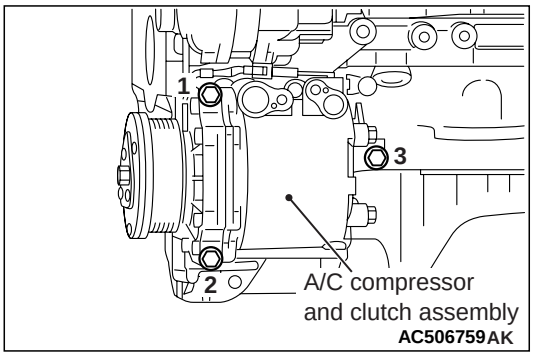
⚠ CAUTION

After the installation, until a sufficient period of time (one hour or more) elapses, do not apply the oil or water to the sealant application area or start the engine.

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

   Tightening torque:
   M6: 10 ± 2 N·m
   M8: 29 ± 2 N·m

>>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

INSPECTION

M1112002900920

- 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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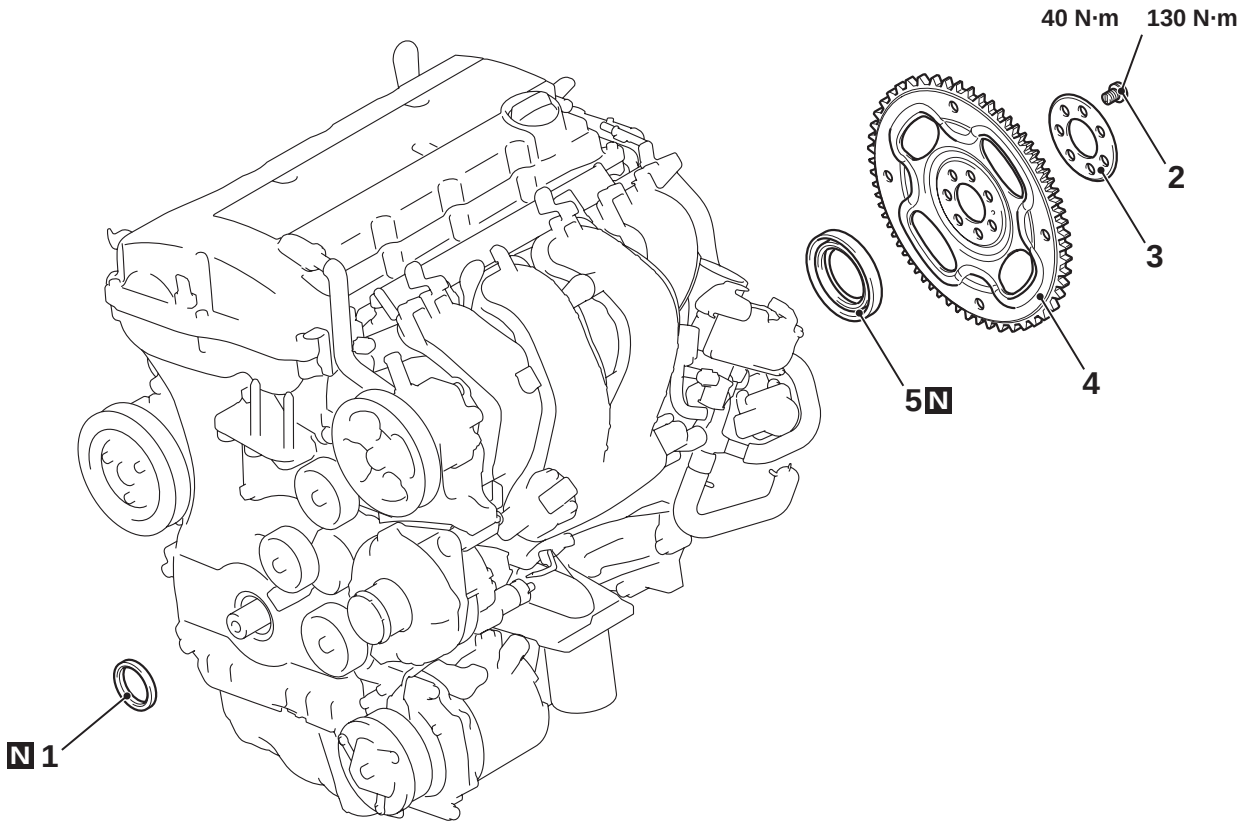

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Crankshaft front oil seal removal steps

- Crankshaft pulley (Refer to P.11A-16.)

>>C<< 1. Crankshaft front oil seal

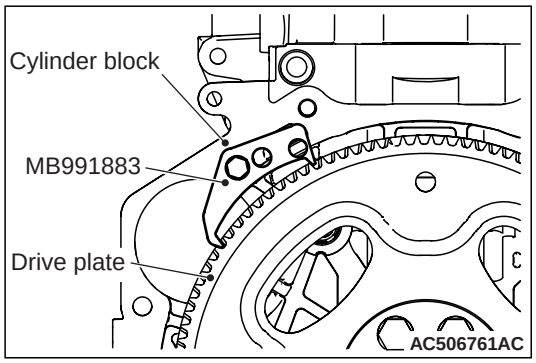
Crankshaft rear oil seal removal steps

- Transmission assembly (Refer to GROUP 23A - Transmission Assembly .)

<<A>> >>B<< 2. Drive plate bolt
>>B<< 3. Drive plate adapter plate
>>B<< 4. Drive plate
>>A<< 5. Crankshaft rear oil seal

REMOVAL SERVICE POINTS

<<A>> DRIVE PLATE BOLT REMOVAL

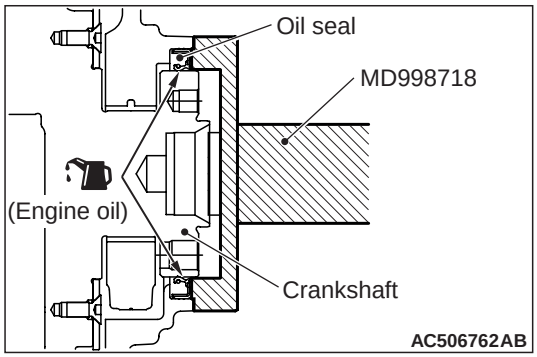


Fix the drive plate using the flywheel stopper (Special Tool: MB991883), and loosen the drive plate bolts.

INSTALLATION SERVICE POINTS

>>A<< CRANKSHAFT REAR OIL SEAL INSTALLATION

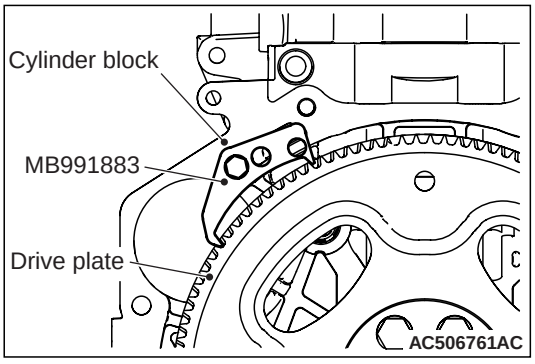
1. Apply a small amount of engine oil to the entire inner diameter of the oil seal lip.



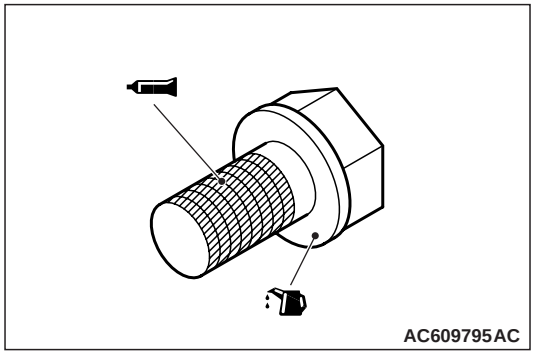
2. Using the crankshaft rear oil seal installer (Special tool: MD998718), press in the crankshaft rear oil seal up to the cylinder block assembly end surface.

>>B<< DRIVER PLATE/DRIVE PLATE ADAPTER PLATE/DRIVE PLATE BOLT INSTALLATION

1. Remove the engine oil and deposits from the drive plate bolt threads, crankshaft tapped hole, and drive plate.
2. Install the drive plate and drive plate adapter plate to the crankshaft.

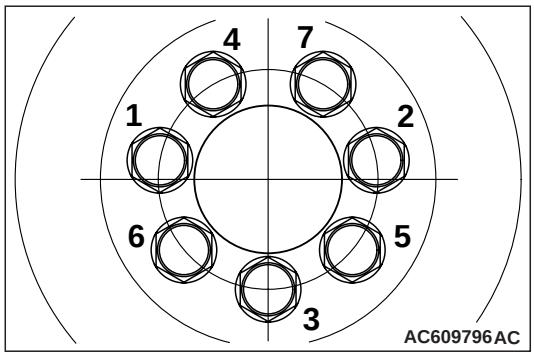


3. In the same way as with removal, fix the drive plate using a flywheel stopper (Special tool: MB991883).



4. Apply a small amount of engine oil to the drive plate bolt bearing surface, and apply the sealant to the drive plate bolt threads.

   Specified sealant: ThreeBond 1324 or equivalent



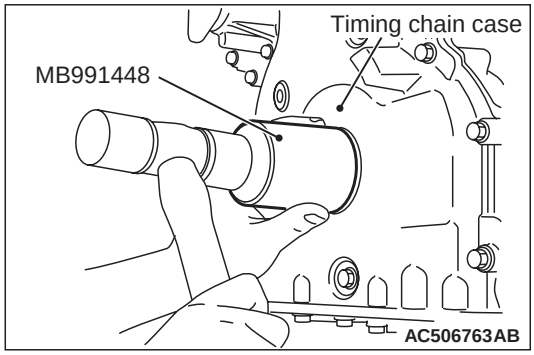
5. Tighten the drive plate bolt to the specified torque 40 N·m in the order of the number shown in the figure.
6. After tightening to the specified torque, tighten the drive plate bolt again to the specified torque 130 N·m in the order of the number shown in the figure.

>>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.



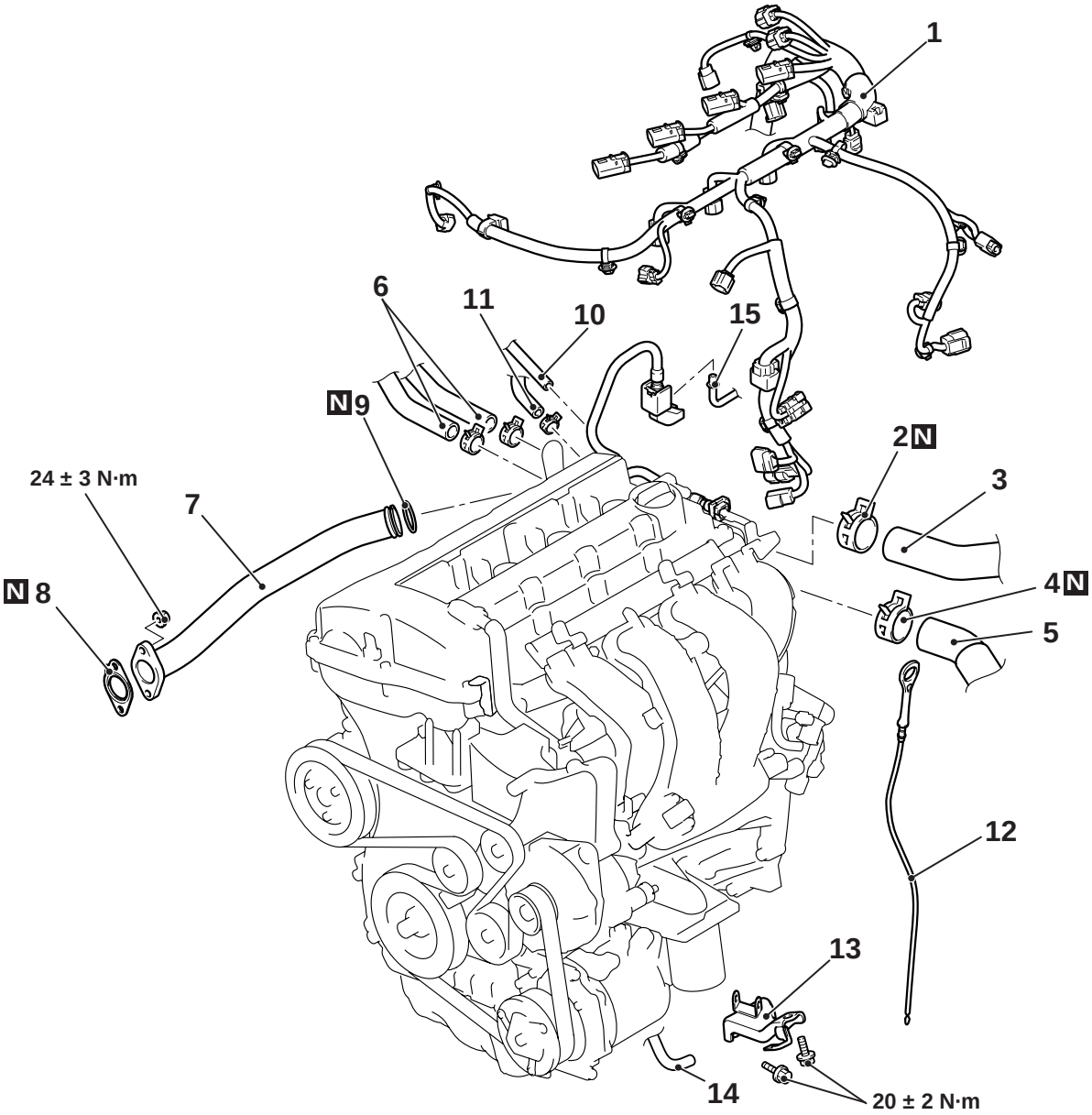
2. Using a bush remover and installer base (Special tool: MB991448), press in the crankshaft front oil seal up to the chamfered surface of timing chain case.

CYLINDER HEAD GASKET

REMOVAL AND INSTALLATION

M1112004005218

Pre-removal Operation	Post-installation Operation
• Fuel Line Pressure Reduction (Refer to GROUP 13A – On-vehicle Service, How to Reduce Pressurized Fuel Lines). • Engine Room Under Cover Front A, B, D and Engine Room Side Cover (RH) Removal (Refer to GROUP 51 – Under Cover). • Engine Coolant Draining (Refer to GROUP 14 – On-vehicle Service, Engine Coolant Replacement). • Air Cleaner Intake Hose and Air Cleaner Assembly Removal (Refer to GROUP 15 – Air Cleaner). • Ignition Coil Removal (Refer to GROUP 16 – Ignition System, Ignition Coil). • Exhaust Manifold Removal (Refer to GROUP 15 – Exhaust Manifold). • Throttle Body Assembly Removal (Refer to GROUP 13A – Throttle Body Assembly). • Thermostat Case Removal (Refer to GROUP 14 – Water Hose and Water Pipe).	• Thermostat Case Installation (Refer to GROUP 14 – Water Hose and Water Pipe). • Throttle Body Assembly Installation (Refer to GROUP 13D – Throttle Body Assembly). • Exhaust Manifold Installation (Refer to GROUP 15 – Exhaust Manifold). • Ignition Coil Installation (Refer to GROUP 16 – Ignition System, Ignition Coil). • Air Cleaner Intake Hose and Air Cleaner Assembly Installation (Refer to GROUP 15 – Air Cleaner). • Engine Coolant Refilling (Refer to GROUP 14 – On-vehicle Service, Engine Coolant Replacement). • Engine Room Under Cover Front A, B, D and Engine Room Side Cover (RH) Installation (Refer to GROUP 51 – Under Cover). • Fuel Leak Check.

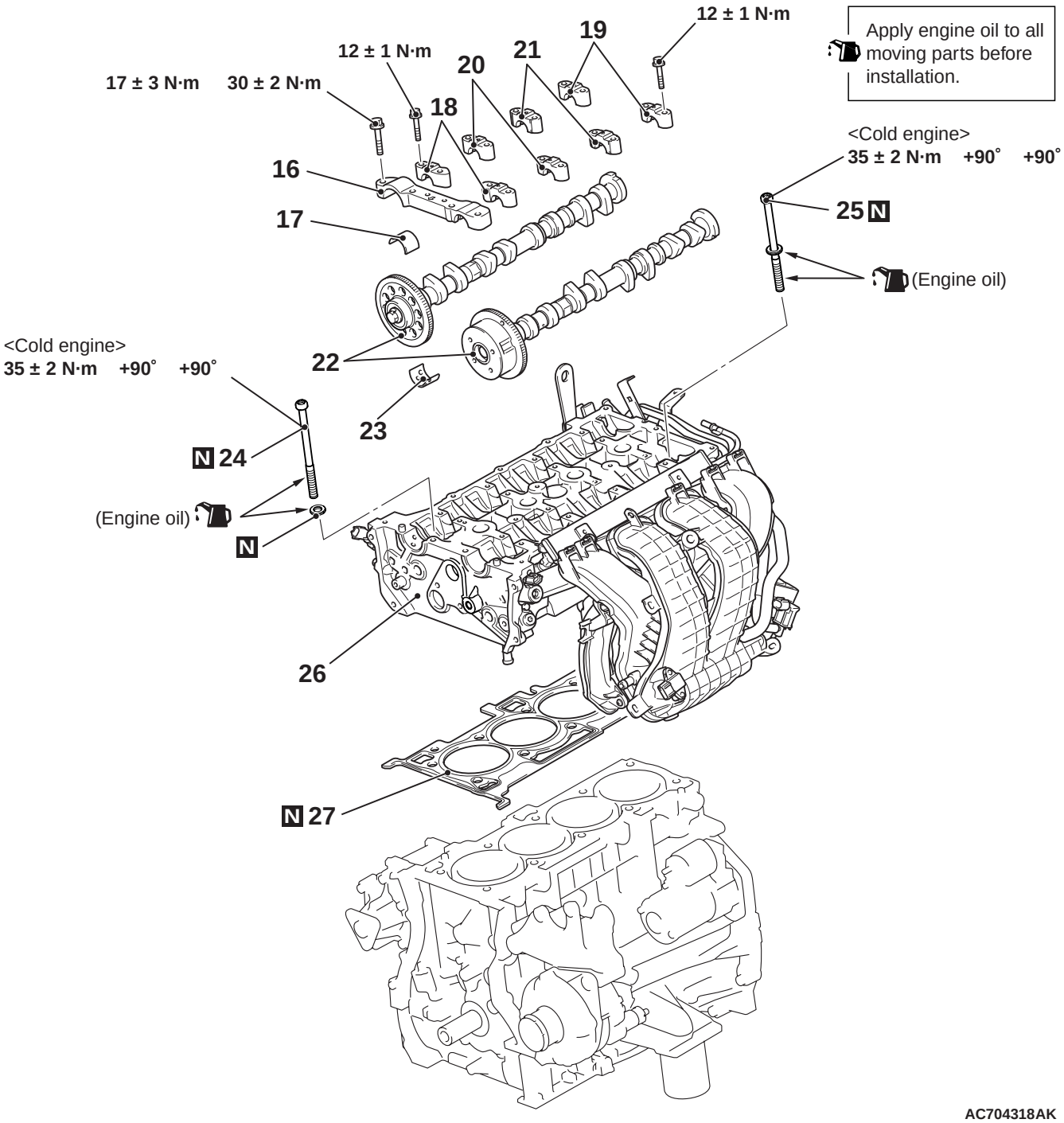


Removal steps

1. Control wiring harness connection
<<A>> >>G<< 2. Hose clip
<<A>> >>G<< 3. Radiator upper hose connection
<<A>> >>G<< 4. Hose clip
<<A>> >>G<< 5. Radiator lower hose connection
6. Heater hose connection
7. Water pump line pipe
8. Cooling water line gasket
9. O-ring

Removal steps (Continued)

10. Canister vacuum hose connection
11. Brake booster vacuum hose connection
12. Engine oil level gauge
13. Inlet manifold stay
14. Rocker cover PCV hose connection
<<B>> >>F<< 15. Fuel high-pressure hose connection



Removal steps

- Valve timing chain (Refer to P.11A-50)

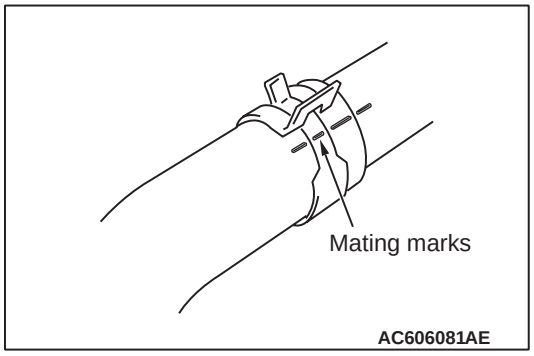
<<C>> >>E<< 16. Camshaft bearing front cap assembly
>>C<< 17. Camshaft bearing
<<D>> >>D<< 18. Camshaft bearing oil feeding cap
<<D>> >>D<< 19. Camshaft bearing cap
<<D>> >>D<< 20. Camshaft bearing cap

Removal steps (Continued)

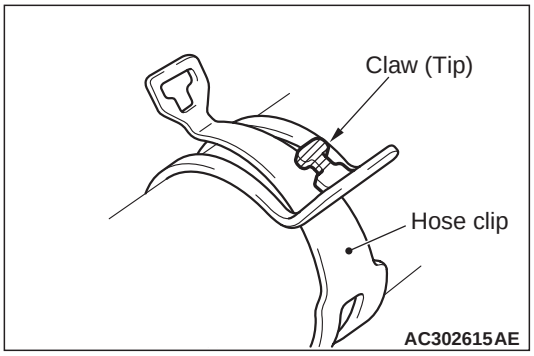
<<D>> >>D<< 21. Camshaft bearing thrust cap
>>C<< 22. Camshaft and camshaft sprocket assembly
>>C<< 23. Camshaft bearing
<<E>> >>B<< 24. Cylinder head bolt
<<E>> >>B<< 25. Cylinder head bolt assembly
>>A<< 26. Cylinder head assembly
>>A<< 27. Cylinder head gasket

REMOVAL SERVICE POINTS

<<A>> HOSE CLIP/RADIATOR HOSE DISCONNECTION



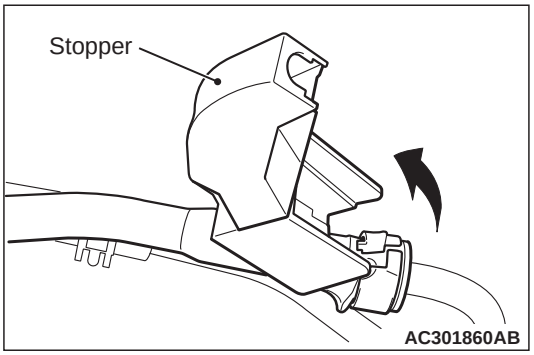
1. Make mating marks on the radiator hose and the hose clip as shown to install them in the original position.



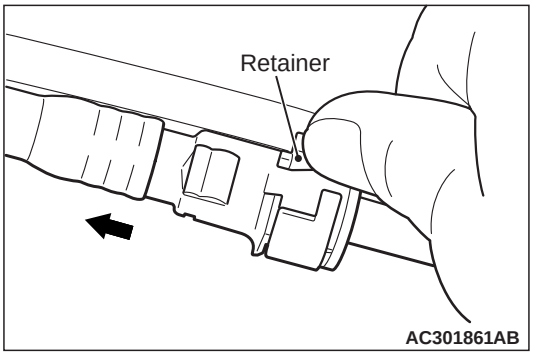
2. Break off the tip of hose clip claw and spread out the hose clip, then disconnect the radiator lower hose.

   NOTE: If there is a hose clip claw, the hose clip cannot spread to capacity because the claw contacts the hose clip.

<<B>> FUEL HIGH-PRESSURE HOSE REMOVAL



1. Remove the stopper of the fuel high-pressure hose.



2. Raise the retainer of the fuel high-pressure hose and pull out the fuel high-pressure hose in the direction shown in the figure.

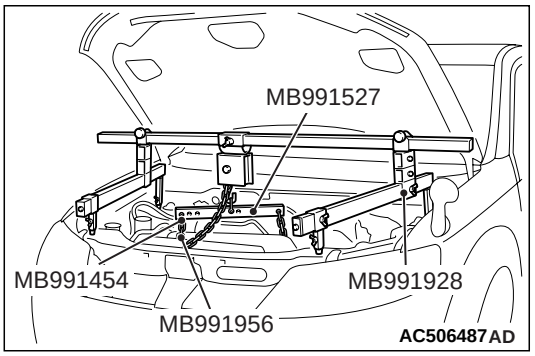
   NOTE: If the retainer is released, install it securely after removing the fuel high-pressure hose.

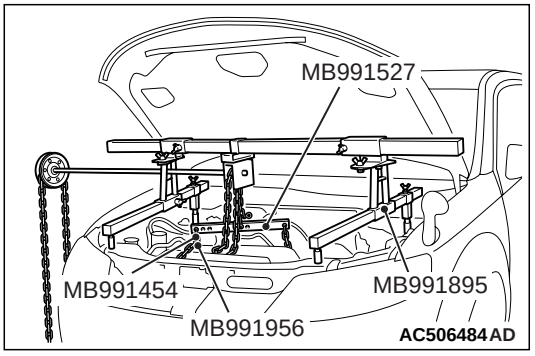
<<C>> CAMSHAFT BEARING FRONT CAP ASSEMBLY REMOVAL

1. Temporarily install the engine oil pan which was removed at the valve timing chain removal (Refer to P.11A-36).

⚠ CAUTION
When supporting the engine and transmission assembly with a garage jack, be careful not to deform the engine oil pan.

2. Place a garage jack against the engine oil pan with a piece of wood in between to support the engine and transmission assembly.

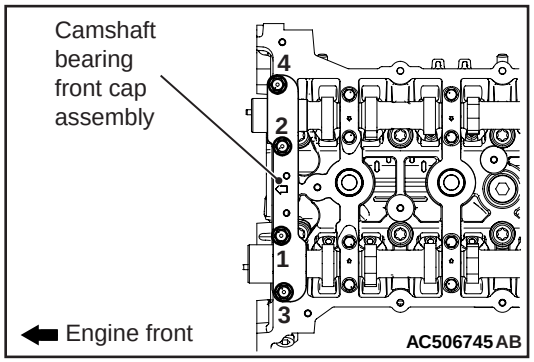




3. Remove special tool engine hanger (MB991928 or MB991895) which was installed for supporting the engine and transmission assembly when the valve timing chain was removed.

⚠ CAUTION

Be careful not to drop the camshaft bearing.

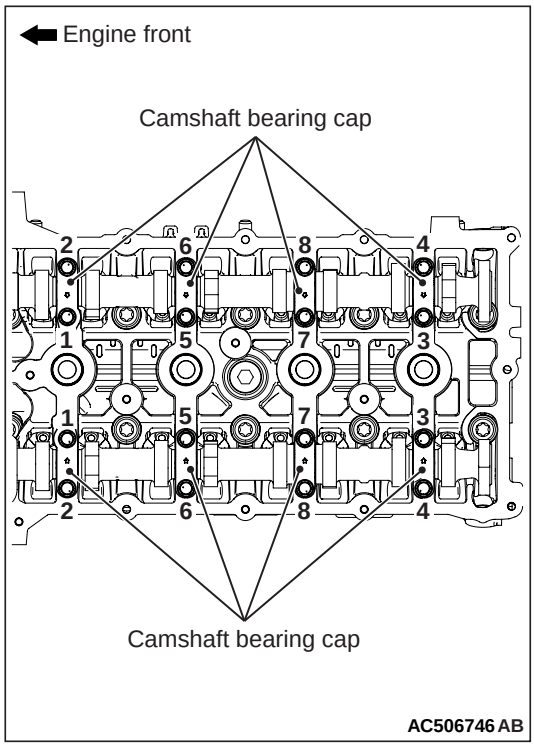


Loosen the camshaft bearing front cap mounting bolts in the order of number shown in the figure, and remove the camshaft bearing front cap assembly.

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

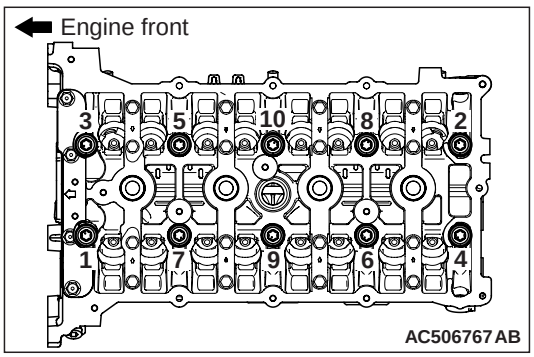
⚠ CAUTION

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

<<E>> CYLINDER HEAD BOLT/CYLINDER HEAD BOLT ASSEMBLY REMOVAL



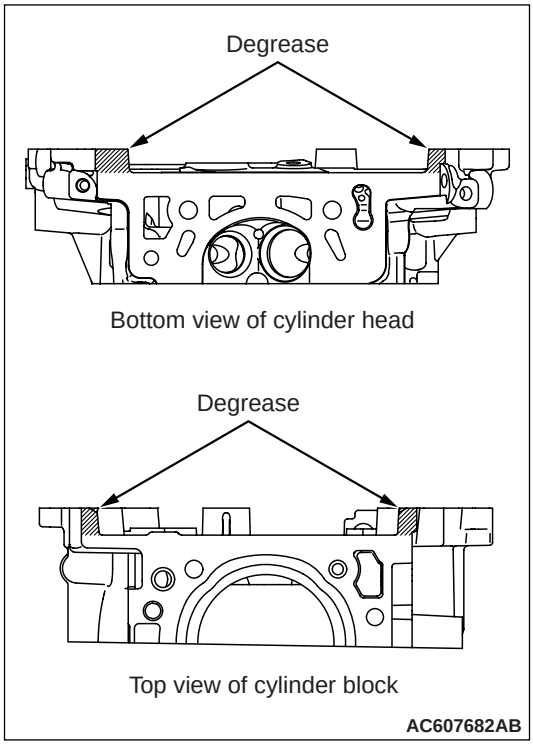
Loosen and remove the bolts in two or three steps in the order of number shown in the figure.

INSTALLATION SERVICE POINTS

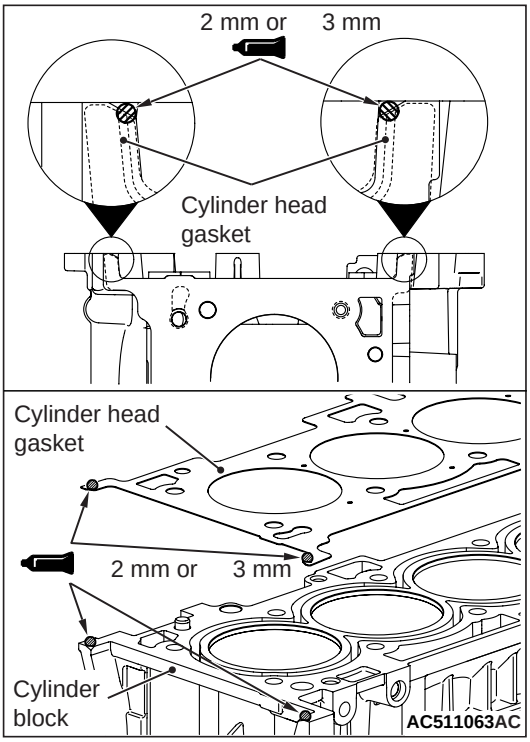
>>A<< CYLINDER HEAD GASKET/CYLINDER HEAD ASSEMBLY INSTALLATION

⚠ CAUTION

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



1. Wipe off the sealant and grease on the top surface of the cylinder block and the bottom surface of the cylinder head, and degrease the surface where the sealant is applied.



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

   Specified sealant: Three bond 1217G or equivalent

3. Install the cylinder head gasket to the cylinder block.

   NOTE:
   - *Install the cylinder head gasket immediately after the application of sealant.*
   - *When the cylinder head 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 the cylinder head gasket as shown.

   Specified sealant: Three bond 1217G or equivalent

⚠ CAUTION

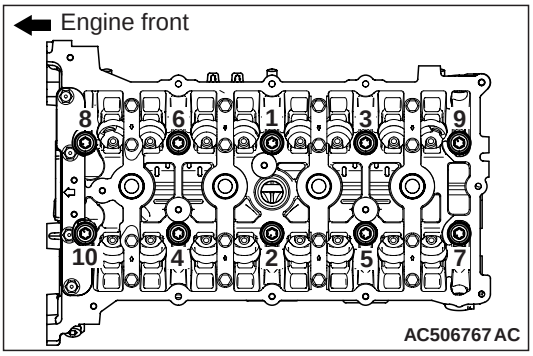
After the installation, until a sufficient period of time (one hour or more) elapses, do not apply the engine oil or water to the sealant application area or start the engine.

5. Install the cylinder head assembly.

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

1. Replace a cylinder head bolts with a new one.

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 cylinder head bolt threads and the washers.

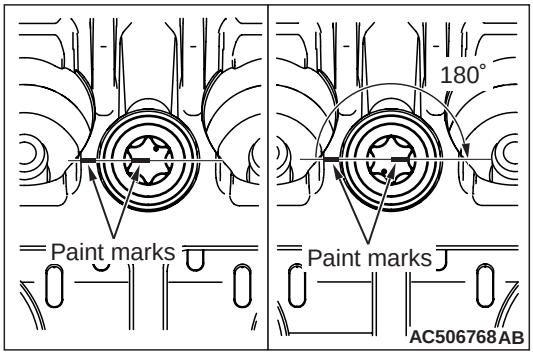


4. Tighten the cylinder head bolts by the following procedure (plastic region angular tightening method).
   (1) Tighten the cylinder head bolts to the specified torque in the order shown in the figure in two or three steps.

   Tightening torque: 35 ± 2 N·m

⚠ CAUTION

- **The cylinder head bolt is not tightened sufficiently if the tightening angle is less than a 180 degrees angle.**
- **If the tightening angle exceeds the standard specification, remove the cylinder head bolt and repeat the installation steps from Step 1.**

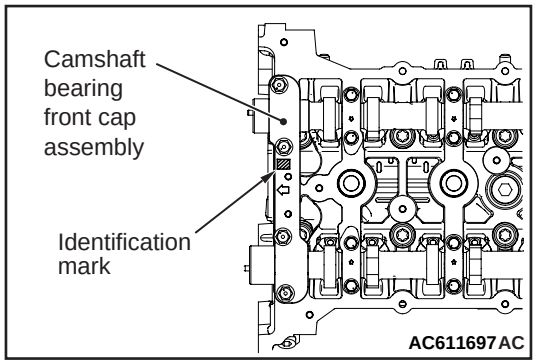


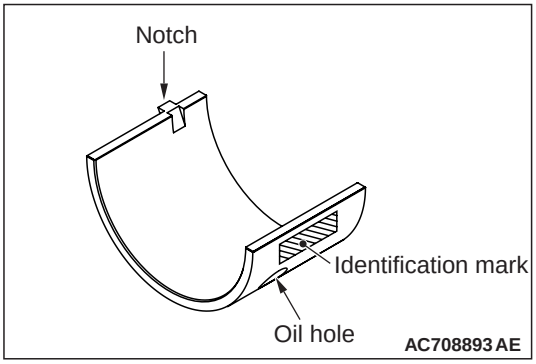
   (2) Put a paint mark on the cylinder head bolt head and cylinder head, tighten to 180 ± 2 degrees in the order shown in the figure, and check that the paint mark on the cylinder head bolt head aligns with the paint mark on the cylinder head.

>>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.**

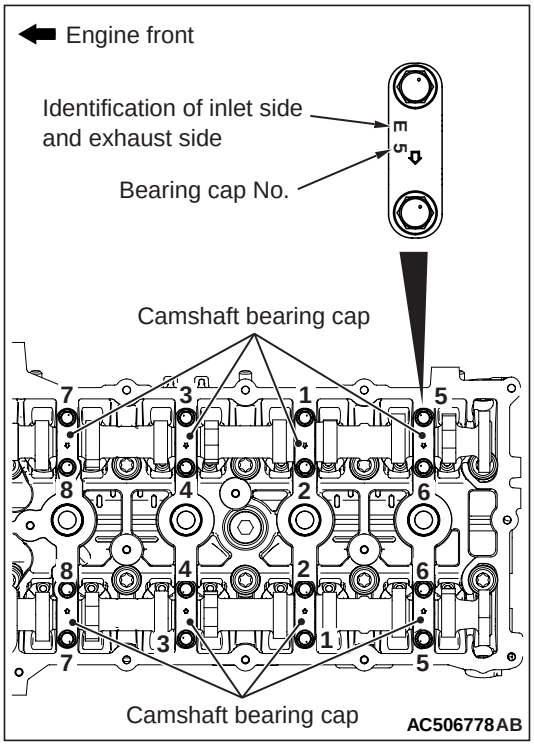




When replacing the camshaft bearing, select a camshaft bearing in relevant size according to the camshaft bearing front cap identification mark in the table below. Identification mark of the camshaft bearing is painted in the position shown in the figure.

Camshaft		Camshaft bearing identification mark
Identification mark	Journal diameter mm	
1	40.000 – 40.008	1
2	40.008 – 40.016	2
3	40.016 – 40.024	3

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



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

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

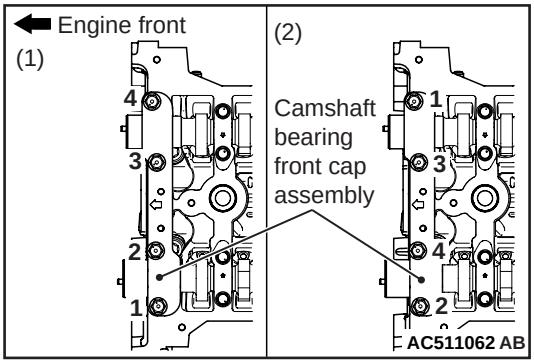
2. Tighten each camshaft bearing cap mounting bolts to the specified torque in the order of number shown in the figure in two or three steps.

   Tightening torque: 12 ± 1 N·m

>>E<< CAMSHAFT BEARING FRONT CAP ASSEMBLY INSTALLATION

⚠ CAUTION

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

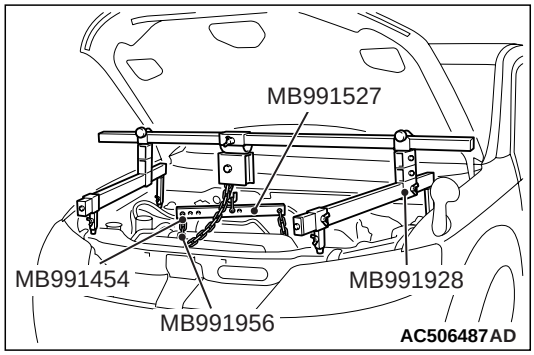


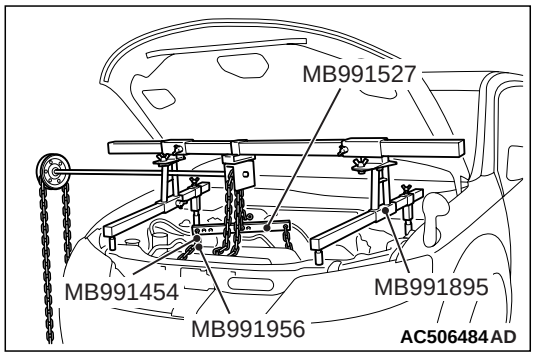
1. Install the camshaft bearing front cap to the cylinder head, and temporarily tighten the camshaft bearing front cap mounting bolts to the specified torque in the order shown in the figure (1).

   Tightening torque: 17 ± 3 N·m

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

   Tightening torque: 30 ± 2 N·m



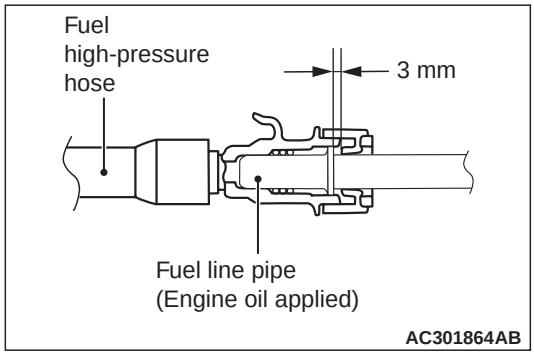


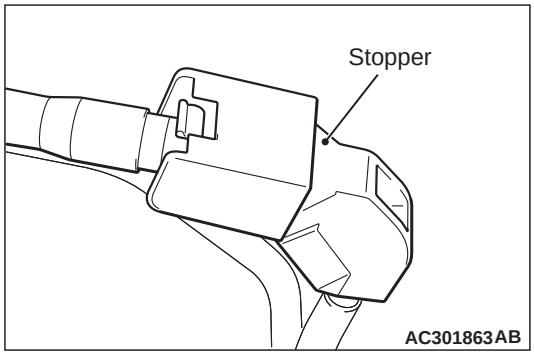
3. Install special tool engine hanger (MB991928 or MB991895) which was installed for supporting the engine and transmission assembly when the valve timing chain was removed (Refer to P.11A-50).
4. Remove the garage jack which supports the engine and transmission assembly.
5. Remove the engine oil pan installed temporarily.

>>F<< FUEL HIGH-PRESSURE HOSE INSTALLATION

⚠ CAUTION

After connecting the fuel high-pressure hose, slightly pull it in the pull-out direction to check that it is installed firmly. In addition, check that there is approximately 3-mm play. After the check, install the stopper securely.





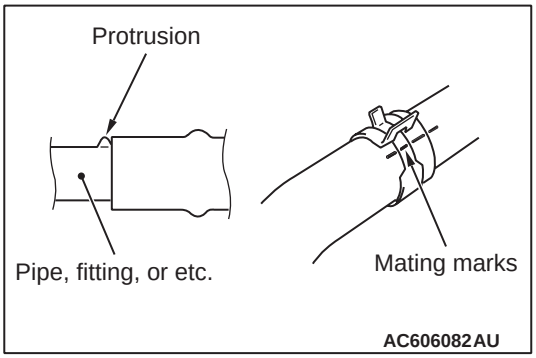
Apply a small amount of engine oil to the fuel line pipe, and install the fuel high-pressure hose.

>>G<< RADIATOR HOSE/HOSE CLIP CONNECTION

⚠ CAUTION

Never reuse the hose clip whose claw is broken off to prevent the rusting.

1. Make mating mark on a new hose clip in the same position as the remove one.



2. Insert the radiator hose until the protrusion of the pipe.
3. Align the mating marks on the radiator hose and hose clip.
4. Remove the hose clip claw and shorten the hose clip, then install the radiator hose.

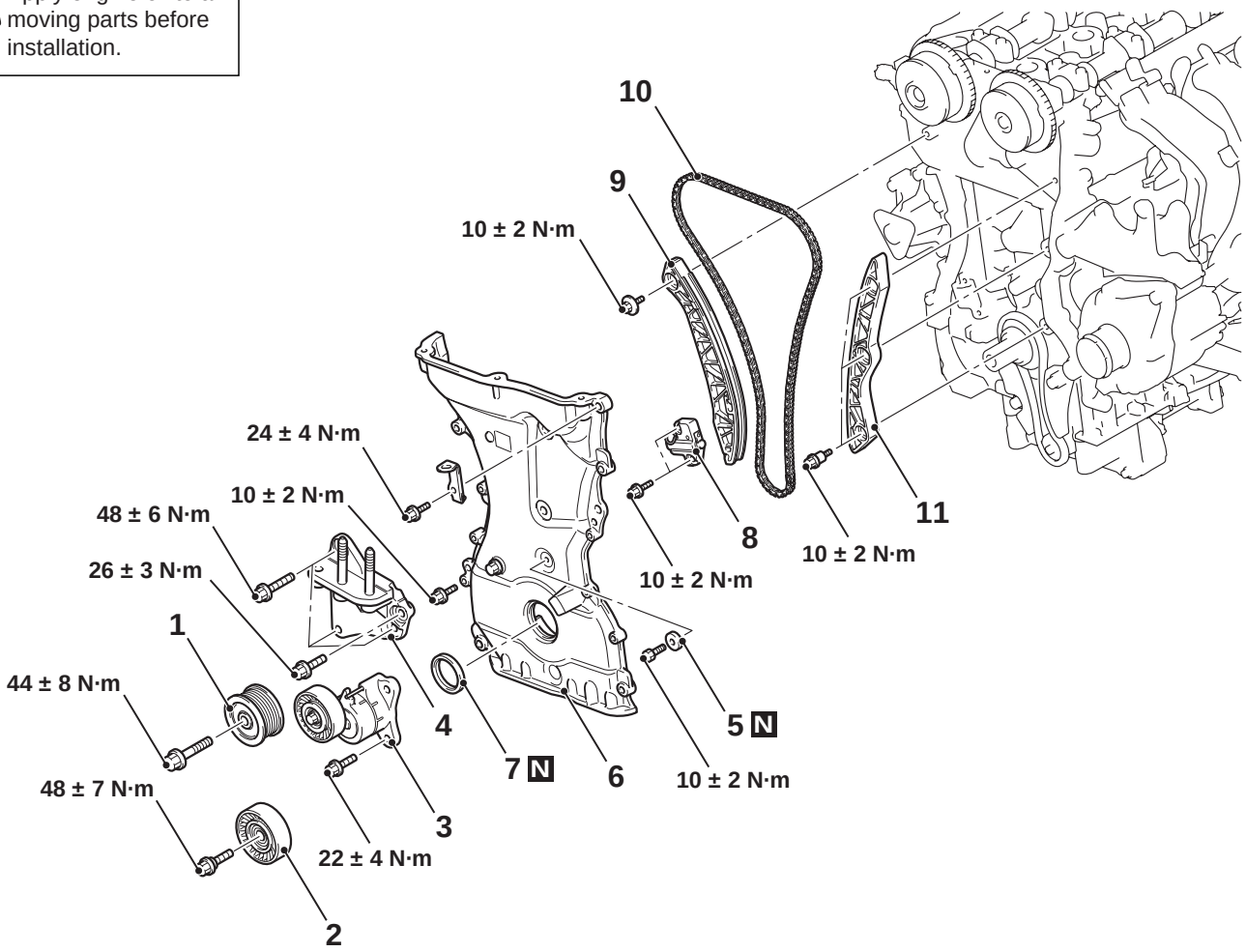
TIMING CHAIN

REMOVAL AND INSTALLATION

M1112007202041

Pre-removal Operation	Post-installation Operation
• Engine Room Under Cover Front A, B, D and Engine Room Side Cover (RH) Removal (Refer to GROUP 51 – Under Cover). • Engine Oil Draining (Refer to GROUP 12 – On-vehicle Service, Engine Oil Replacement). • Rocker Cover Assembly Removal (Refer to P.11A-19). • Engine Oil Pan Removal (Refer to P.11A-36).	• Engine Oil Pan Installation (Refer to P.11A-36). • Rocker Cover Assembly Installation (Refer to P.11A-19). • Engine Oil Refilling (Refer to GROUP 12 – On-vehicle Service, Engine Oil Replacement). • Engine Room Under Cover Front A, B, D and Engine Room Side Cover (RH) Installation (Refer to GROUP 51 – Under Cover).

Apply engine oil to all moving parts before installation.



AC904716 AC

Removal steps

<<A>>
- Crankshaft pulley (Refer to P.11A-16)

>>E<<
1. Water pump pulley
2. Idler pulley
3. Alternator drive belt auto-tensioner

<<B>>
- Engine and transmission assembly holding
- Engine mounting bracket (Refer to GROUP 32 – Engine Mounting)

Removal steps (Continued)

4. Cylinder block engine front mounting bracket
5. Gasket

<<C>> >>D<<
6. Timing chain case assembly

>>C<<
7. Crankshaft front oil seal

<<D>> >>B<<
8. Timing chain tensioner
9. Timing chain tension side guide

>>A<<
10. Valve timing chain
11. Timing chain loose side guide

REMOVAL SERVICE POINTS

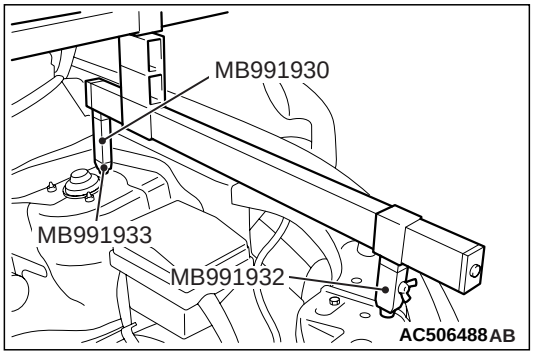
<<A>> CRANKSHAFT PULLEY REMOVAL

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

<<B>> ENGINE AND TRANSMISSION ASSEMBLY HOLDING

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

1. <When special tool engine hanger (MB991928) is used>
   (1) Assemble special tool engine hanger (MB991928) (Set the following parts on the base hanger).
- Slide bracket (HI)
- Foot x 2 (standard) (MB991932)
- Foot x 2 (short) (MB991933)
- Joint x 2 (90) (MB991930)

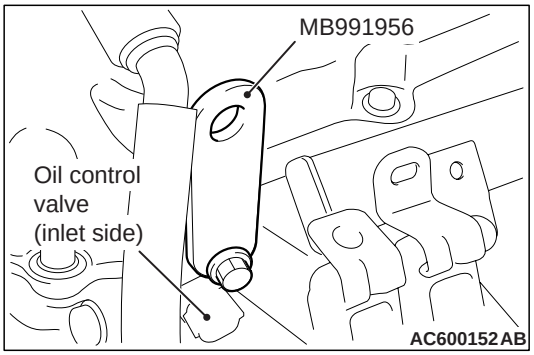


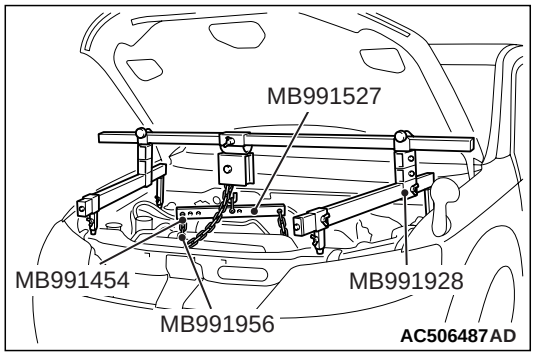
   (2) Set the foot of the special tools (MB991930, MB991932 and MB991933) as shown in the figure.

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

⚠ CAUTION

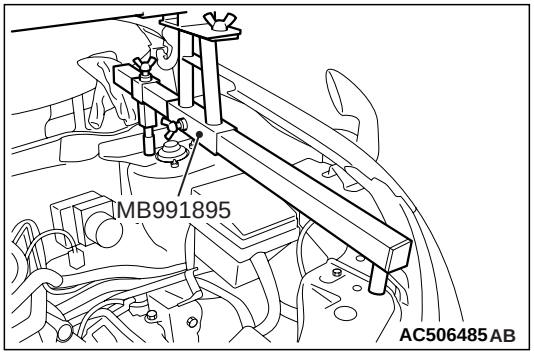
Place a rag between special tool engine hanger (MB991895) and the windshield to prevent the special tool (MB991895) from interfering with the windshield.

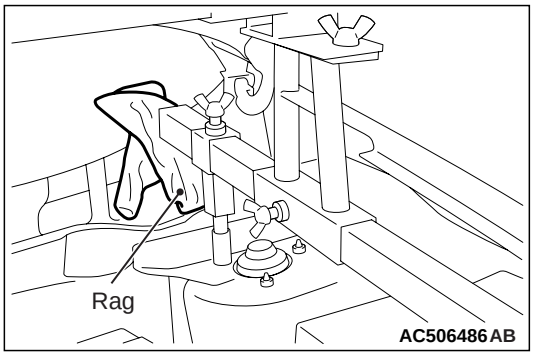




   (3) Install special tool engine hanger plate (MB991956) to the cylinder head, and set special tool hanger (MB991527) and the chains of special tool engine hanger balancer (MB991454) to the engine assembly to hold the engine and transmission assembly.

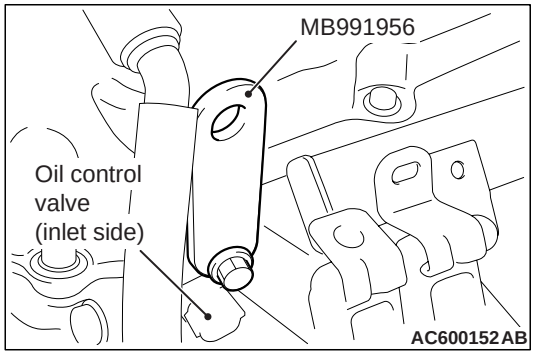
2. <When special tool engine hanger (MB991895) is used>

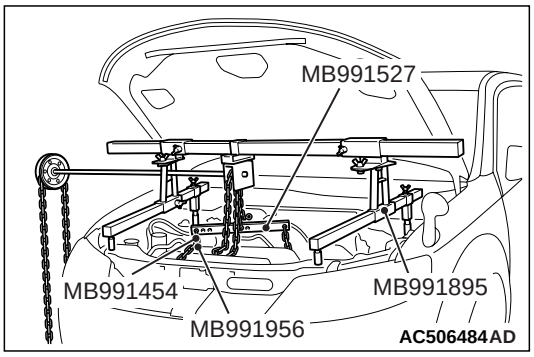




(1) Set the foot of special tool engine hanger (MB991895) as shown in the figure.

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



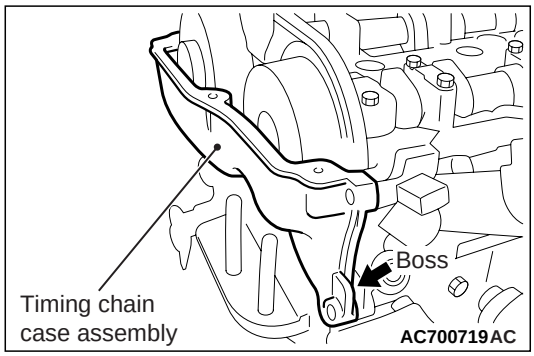


(2) Install special tool engine hanger plate (MB991956) to the cylinder head, and set special tool hanger (MB991527) and the chains of special tool engine hanger balancer (MB991454) to the engine assembly to hold the engine and transmission assembly.

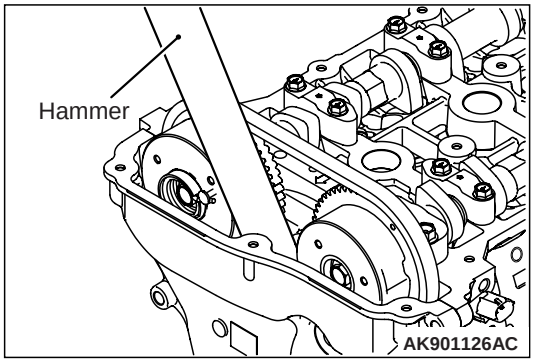
<<C>> TIMING CHAIN CASE ASSEMBLY REMOVAL

⚠ 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.



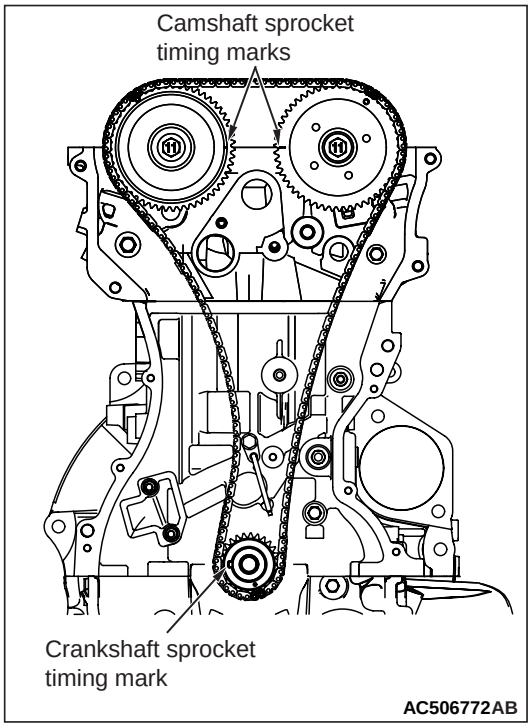
2. If the sealant cannot be peeled off easily, insert a wooden hammer shank into the timing chain case assembly inside as shown in the figure, pry slightly, and remove the timing chain case assembly from the cylinder head and cylinder block.

<<D>> TIMING CHAIN TENSIONER REMOVAL

1. Temporarily install the crankshaft pulley to the crankshaft.

⚠ CAUTION

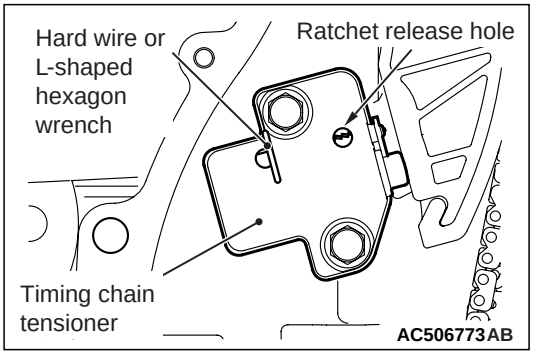
Turn the crankshaft clockwise.



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 centre of compression.

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

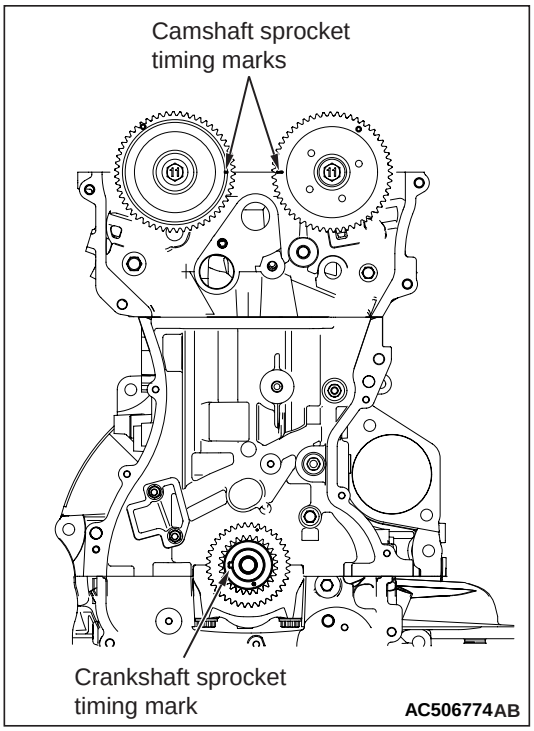
3. Remove the crankshaft pulley installed temporarily.



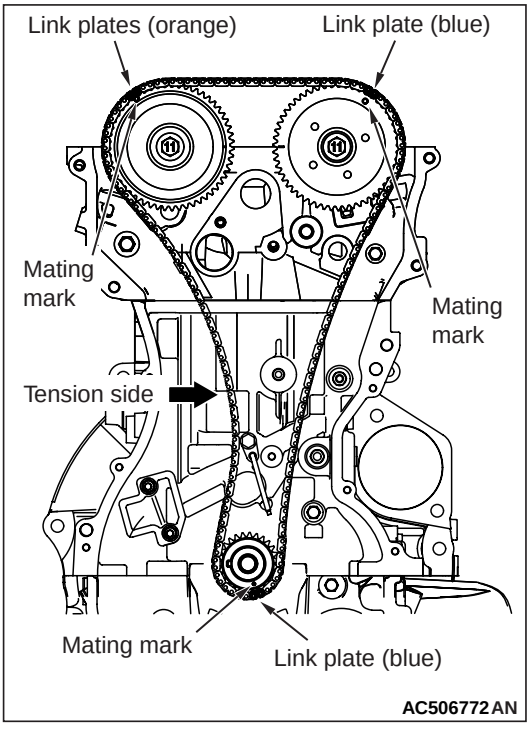
4. Using a precision flat-tipped screwdriver, release the ratchet of timing chain tensioner.
5. Compress the plunger of timing chain tensioner and insert hard wire (such as the piano wire) or the L-shaped hexagon wrench (1.5 mm) to fix the plunger of the timing chain tensioner.
6. Remove the timing chain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

INSTALLATION SERVICE POINTS

>>A<< VALVE TIMING CHAIN INSTALLATION

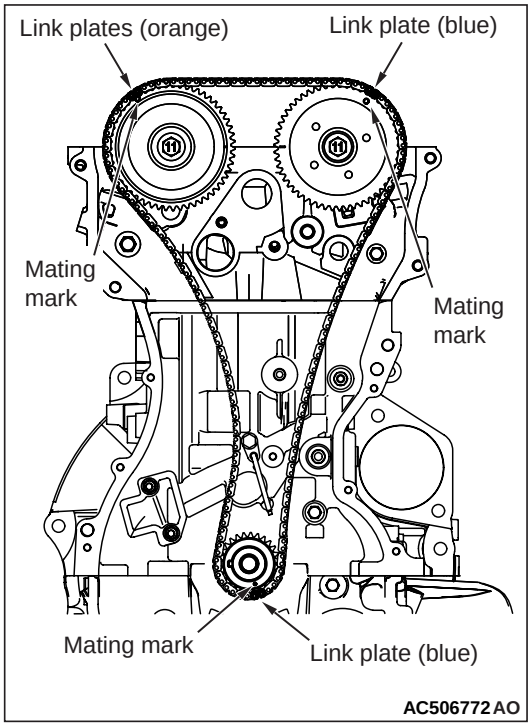


1. Set the timing marks of the camshaft sprockets and the crankshaft sprocket as shown in the figure.

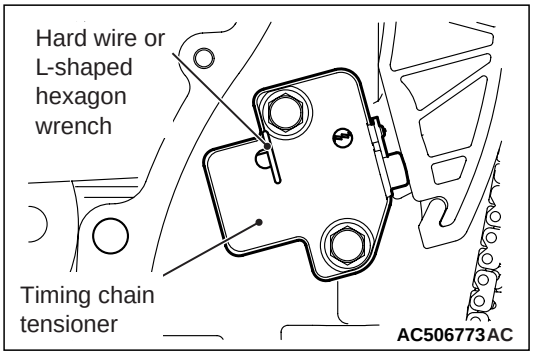


2. Align each sprocket timing chain mating mark with the link plate (orange or blue) of valve timing chain to avoid slack of the valve timing chain tension side, and install the valve timing chain to the sprockets.

>>B<< TIMING CHAIN TENSIONER INSTALLATION



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

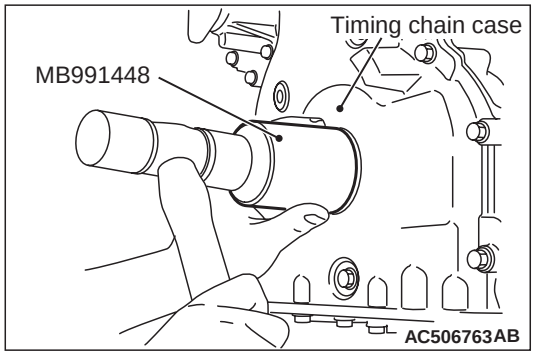


2. Remove the hard wire or L-shaped hexagon wrench fixing the plunger of the timing chain tensioner to apply tension to the valve timing chain.

>>C<< CRANKSHAFT FRONT OIL SEAL INSTALLATION

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

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

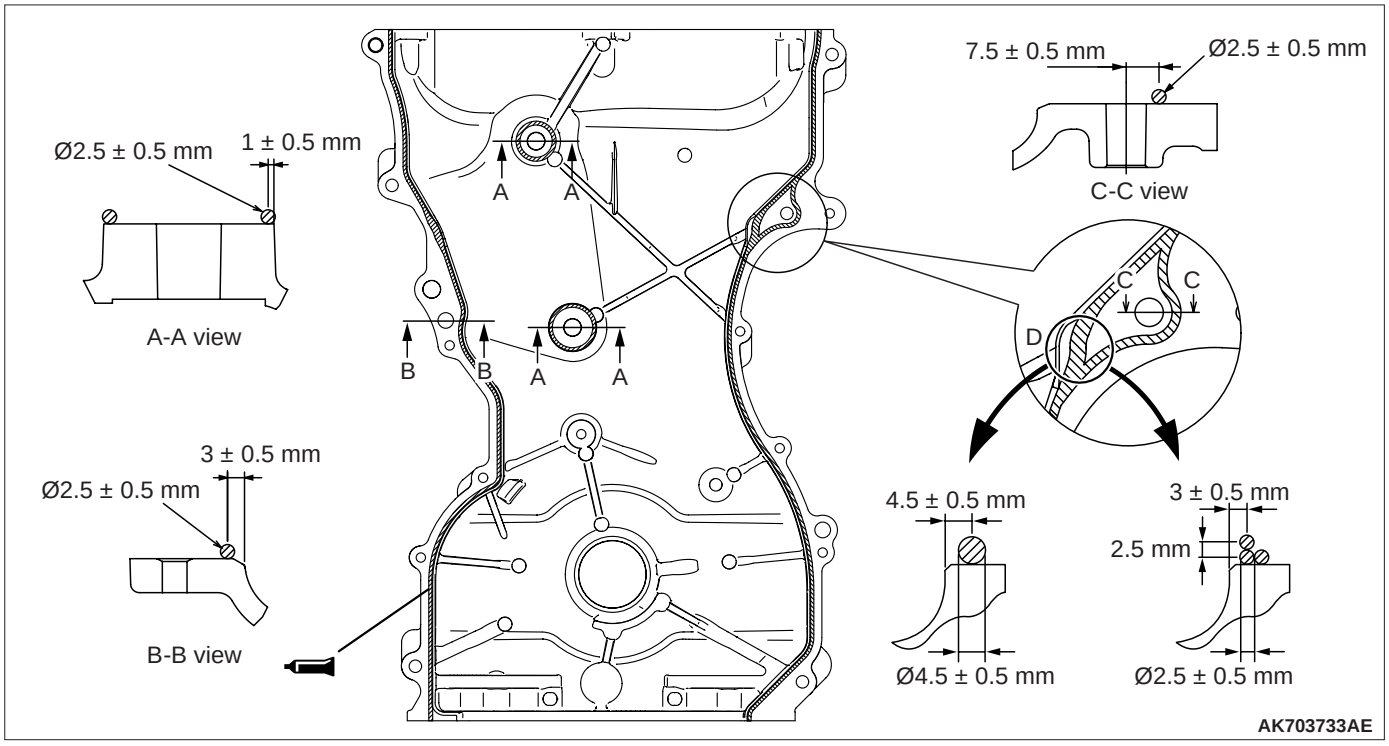


2. Using special tool bush remover and installer base (MB991448), press in the crankshaft front oil seal up to the chamfered surface of timing chain case.

>>D<< TIMING CHAIN CASE ASSEMBLY INSTALLATION

⚠ CAUTION
- **Be sure to remove the sealant inside the mounting holes and the O-ring grooves.**
- **After degreasing with degreasing agent, check that there is no oil on the surface where the sealant is applied.**
- **After degreasing with degreasing agent, never touch the degreased area with fingers.**

1. Remove sealant from the timing chain case assembly and the timing chain case assembly mounting surface of the cylinder block and the cylinder head, and degrease the surface where the sealant is applied.
2. Remove all the sealant adhering to the gasket between the cylinder head and cylinder block (three-surface aligned part.) Then, degrease the surfaces.
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. Apply a bead of the sealant to the timing chain case assembly mounting surface. The bead diameter should be 2.5 ± 0.5 mm. Overlap the part "A" with the diameter of 4.5 ± 0.5 mm or 2.5 ± 0.5 mm as shown in the figure, and apply the sealant.

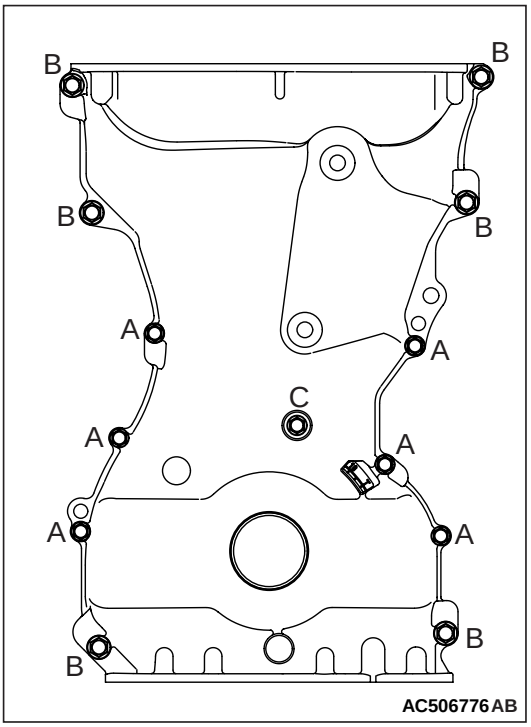
   Specified sealant: Three bond 1217G or equivalent

⚠ 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.**
- **After the installation, until a sufficient period of time (one hour or more) elapses, do not apply the oil or water to the sealant application area or start the engine.**

5. Install the timing chain case assembly to the cylinder block and cylinder head so that the sealant does not contact other parts.

   NOTE: Install the timing chain case assembly immediately after applying sealant.



6. Insert the bolts to the timing chain case assembly as shown, and tighten them to the specified torque.

Name	Symbol	Quantity	Size mm (D × L)
Flange bolt	A	6	M6 × 25
	B	6	M8 × 30
Bolt	C	1	M6 × 25

NOTE: D: Nominal diameter, L: Nominal length

Tightening torque:
A, C: 10 ± 2 N·m
B: 24 ± 4 N·m

>>E<< WATER PUMP PULLEY INSTALLATION

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

Tightening torque: 9.0 ± 1.0 N·m

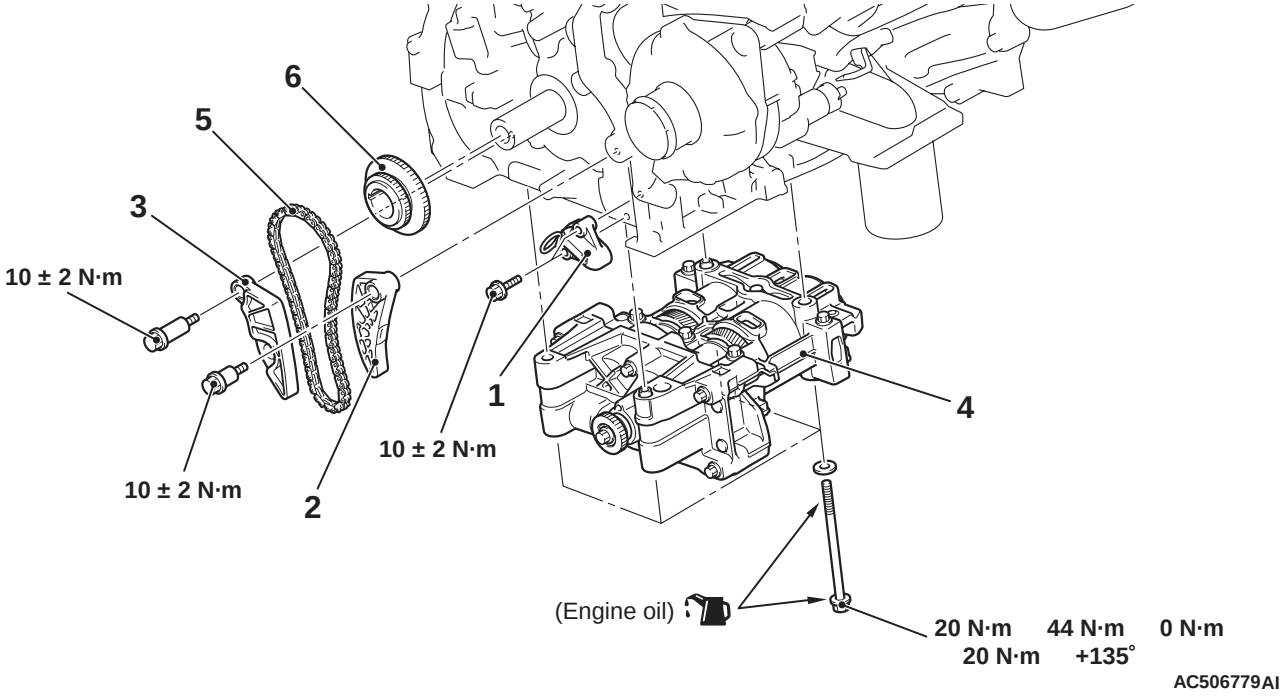
BALANCER TIMING CHAIN, BALANCER SHAFT AND OIL PUMP MODULE <4B12>

REMOVAL AND INSTALLATION

M1112008500306

Pre-removal and Post-installation Operation
- Valve Timing Chain Removal and Installation (Refer to P.11A-50).

Apply engine oil to all moving parts before installation.



Removal steps

<<A>> >>B<< 1. Timing chain tensioner
2. Balancer timing chain guide
3. Balancer timing chain guide

Removal steps (Continued)

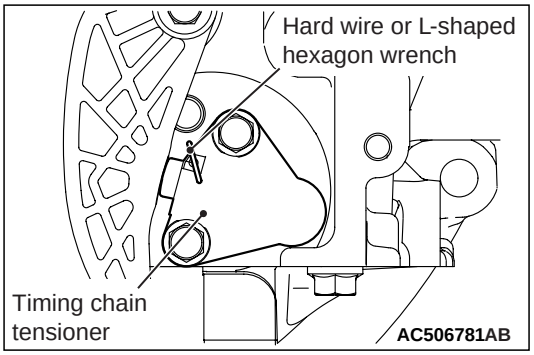
>>A<< 4. Balancer shaft and oil pump module
>>A<< 5. Balancer timing chain
>>A<< 6. Crankshaft sprocket

REMOVAL SERVICE POINT

<<A>> TIMING CHAIN TENSIONER REMOVAL

⚠ CAUTION

Securely install the plunger of the timing chain tensioner. Otherwise, it may pop out.

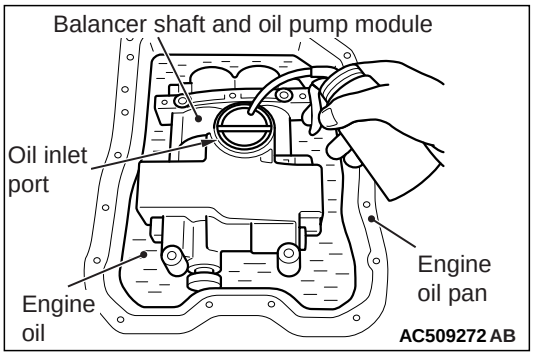


1. Press the balancer timing chain against the timing chain tensioner, compress the plunger of the timing chain tensioner and insert hard wire (piano wire, etc.) or L-shaped hexagon wrench (1.5 mm) to fix the plunger of the timing chain tensioner.
2. Remove the timing chain tensioner.

INSTALLATION SERVICE POINTS

>>A<< CRANKSHAFT SPROCKET/BALANCER TIMING CHAIN/BALANCER SHAFT AND OIL PUMP MODULE INSTALLATION

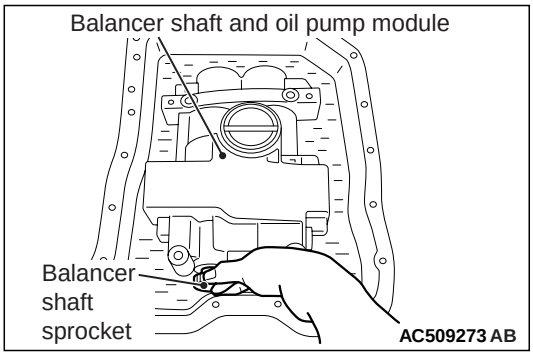
1. When installing the new balancer shaft and oil pump module, apply oil to the oil pump in the balancer shaft and oil pump module and the balancer shaft bearing as follows.



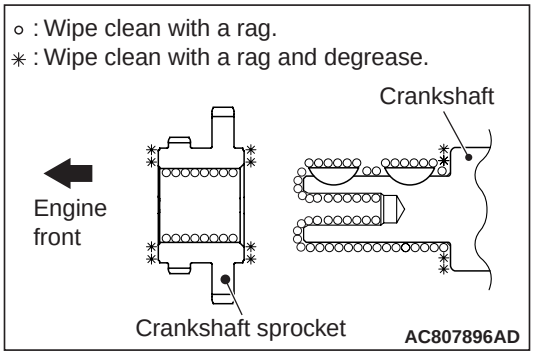
(1) Clean the inside of the removed engine oil pan, and put the balancer shaft and oil pump module into the engine oil pan with its oil inlet port facing up.

(2) Pour new engine oil until two-thirds of the balancer shaft and oil pump module is soaked.

(3) Fill the engine oil (approximately 50 mL) into the balancer shaft and oil pump module from the oil inlet port.

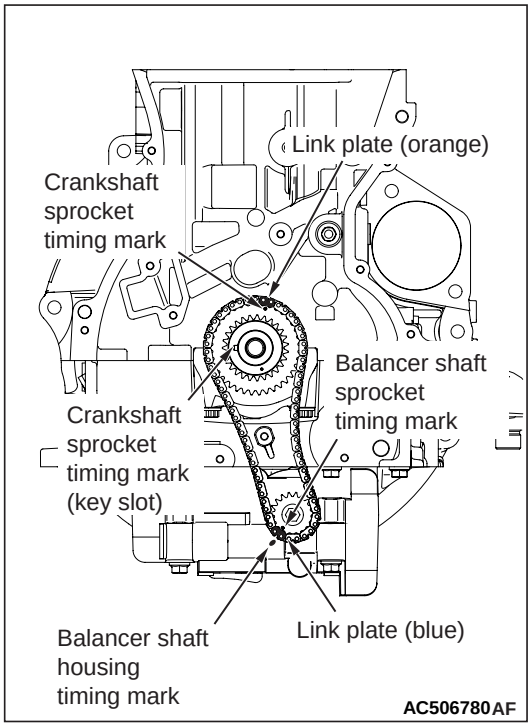


(4) Turn the balancer shaft sprocket of the balancer shaft and oil pump module clockwise four rotations or more to apply the engine oil to the entire area of the oil pump and the balancer shaft bearing.

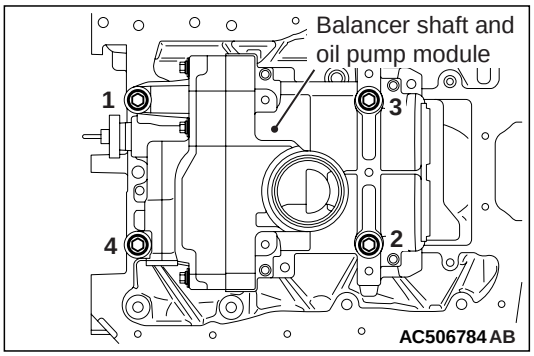


2. Wipe the dirt on the crankshaft sprocket and the crankshaft using a rag, and then remove the grease from the portion shown in the illustration.

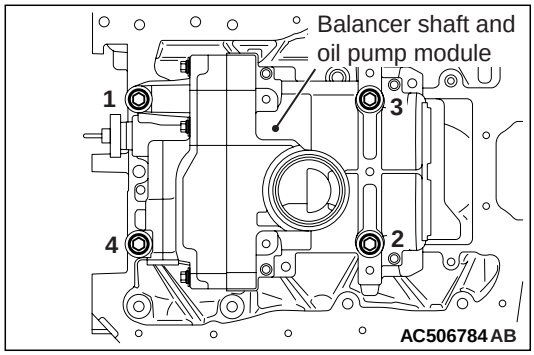
   NOTE: Remove grease to prevent a drop in the coefficient of friction of the pressing portion caused by adhesion of oil.

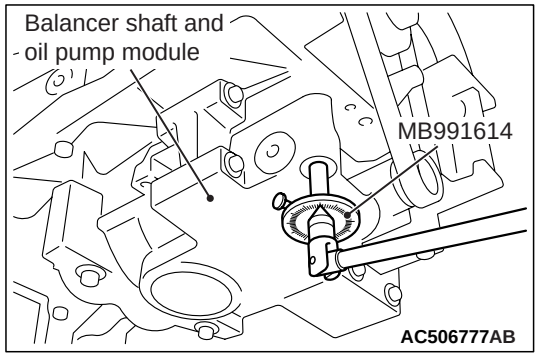


3. With the link marks (orange and blue) of balancer timing chain aligned with the timing marks of balancer sprocket and crankshaft sprocket, install the balancer shaft and oil pump module together with the balancer timing chain and crankshaft sprocket as one unit to the cylinder block. At this time, securely bring the balancer shaft and oil pump module into contact with the rudder frame mounting area.
4. Apply an adequate and minimum amount of engine oil to the threads and bearing surfaces of the balancer shaft and oil pump module bolts.



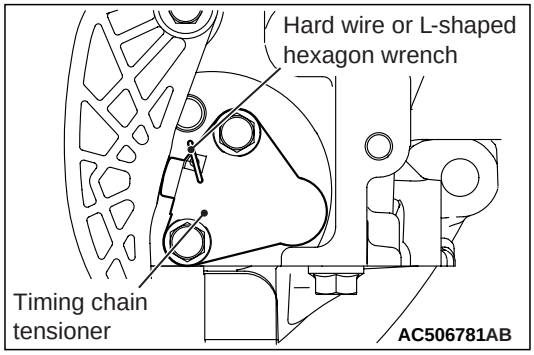
5. Tighten the balancer shaft and oil pump module bolts to the specified torque of 20 N·m in the order of number shown in the figure.
6. Retighten the balancer shaft and oil pump module bolts to the specified torque of 44 N·m in the order of number shown in the figure.
7. Loosen each balancer shaft and oil pump module bolt fully in the reverse sequence to that shown.
8. Tighten the balancer shaft and oil pump module bolts to the specified torque of 20 N·m in the order of number shown in the figure.





9. After tightening to the specified torque, tighten the balancer shaft and oil pump module bolts to 135 degrees, using special tool angle gauge (MB991614), in the order of number shown in the figure.

>>B<< TIMING CHAIN TENSIONER INSTALLATION



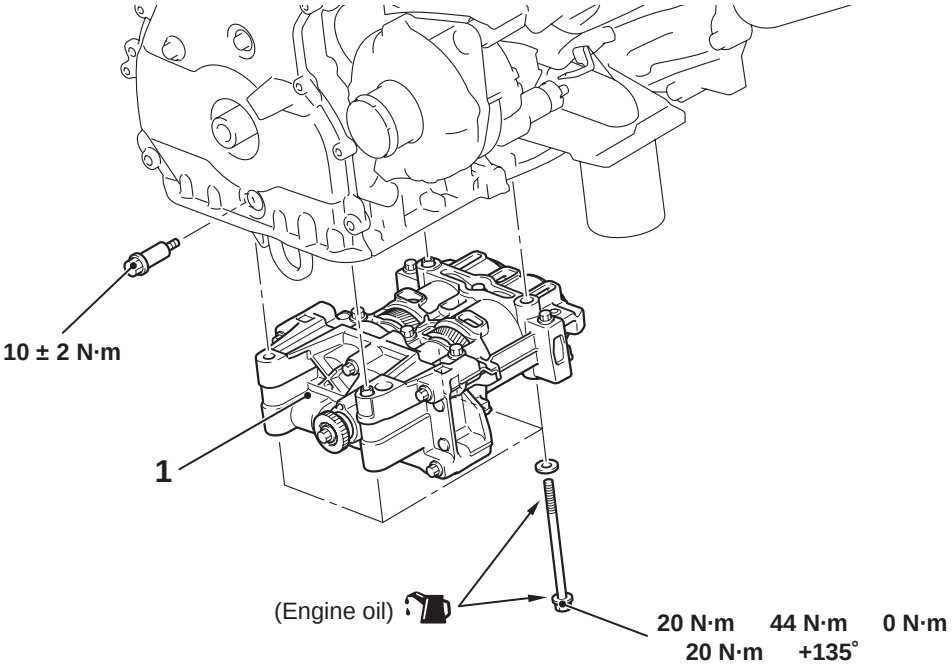
1. Install the timing chain tensioner to the cylinder block.
2. Remove the hard wire or L-shaped hexagon wrench fixing the plunger of the timing chain tensioner to apply tension to the balancer timing chain.

BALANCER SHAFT AND OIL PUMP MODULE <4B12>

REMOVAL AND INSTALLATION

M1112008900274

Pre-removal and Post-installation Operation
- Engine Oil Pan Removal and Installation (Refer to P.11A-36).



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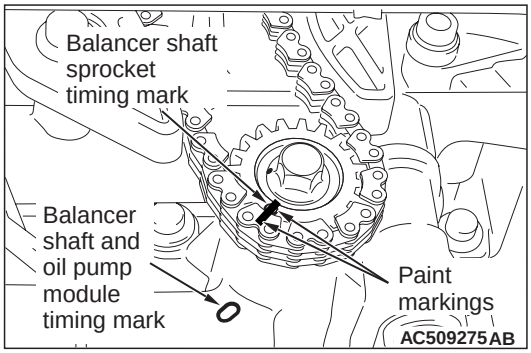
			Removal step
<<**A**>>	>>**A**<<	1.	Balancer shaft and oil pump module

REMOVAL SERVICE POINT

<<A>> BALANCER SHAFT AND OIL PUMP MODULE REMOVAL

⚠ CAUTION
- **Turn the crankshaft clockwise.**
- **Never turn the crankshaft after the cylinder No. 1 or No. 4 is set to the top dead centre of compression.**

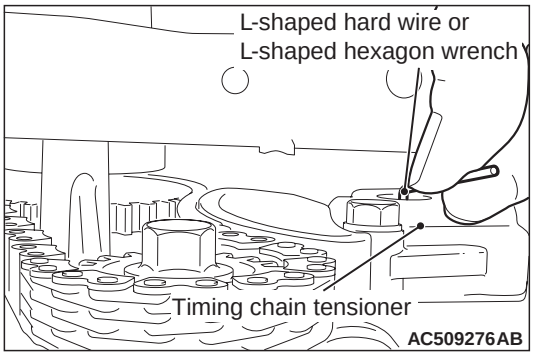


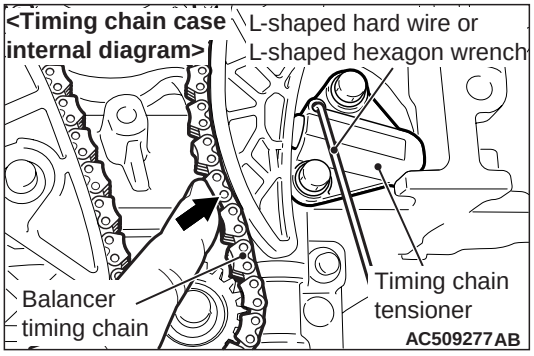
AC509275AB

1. Turn the crankshaft clockwise to align the timing mark of the balancer shaft sprocket with the timing mark of the balancer shaft and oil pump module, and set the cylinder No. 1 or No. 4 to the top dead centre of compression.
2. Put paint marks on the balancer shaft sprocket timing mark and balancer timing chain.

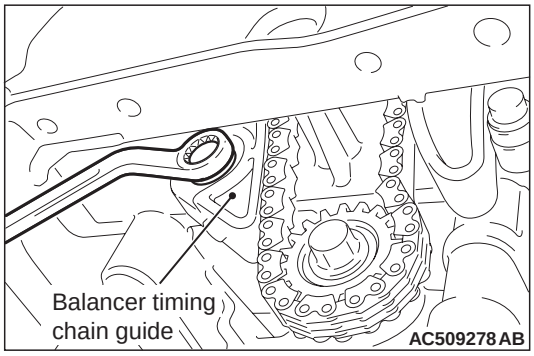
⚠ CAUTION

Securely install the plunger of the timing chain tensioner. Otherwise, it may pop out.

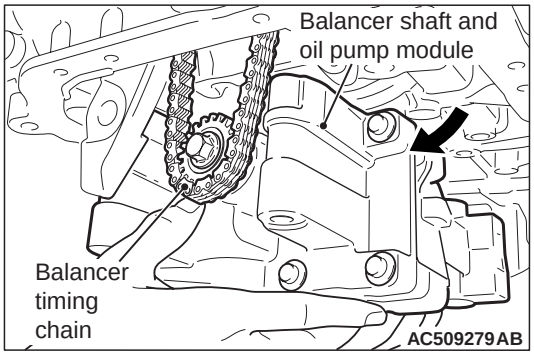




3. Press the balancer timing chain against the timing chain tensioner, compress the plunger of the timing chain tensioner and insert L-shaped hard wire (piano wire of ϕ1.5 mm) or L-shaped hexagon wrench (1.5 mm) to the plunger fixing hole of the timing chain tensioner from under the timing chain case, and fix the plunger of the timing chain tensioner.



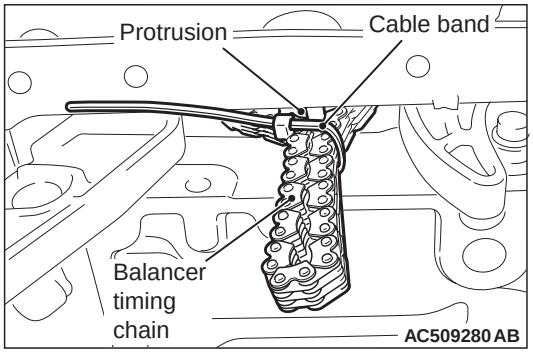
4. Use a wrench to remove the mounting bolt at the lower side of the balancer timing chain guide shown in the figure so that the balancer timing chain guide is unrestricted.
5. Support the balancer shaft and oil pump module with a hand, and remove the balancer shaft and oil pump module mounting bolt.



6. Remove the balancer shaft and oil pump module from the rudder frame with the balancer timing chain attached, and move it to the centre of the engine.
7. Remove the balancer timing chain from the balancer shaft and oil pump module, and remove the balancer shaft and oil pump module.

⚠ CAUTION

When the tooth jump of the balancer timing chain from the crankshaft sprocket occurs, the timing between the balancer shaft and the oil pump module becomes off, resulting in the abnormal engine vibration. Be sure that the tooth jump will not occur.

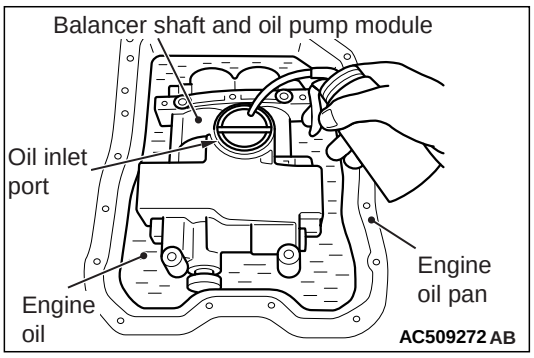


8. After the balancer shaft and oil pump module is removed, using a cable band, tie the balancer timing chain at the protrusion of the rudder frame to prevent the tooth jump of balancer timing chain from the crankshaft sprocket.

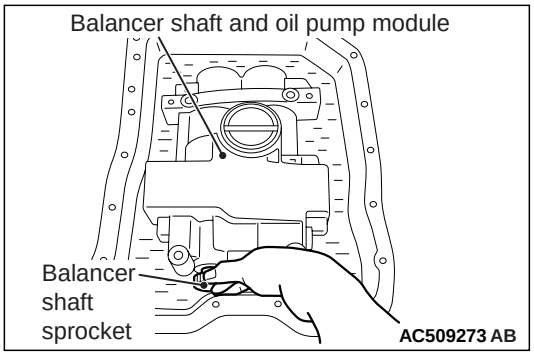
INSTALLATION SERVICE POINT

>>A<< BALANCER SHAFT AND OIL PUMP MODULE INSTALLATION

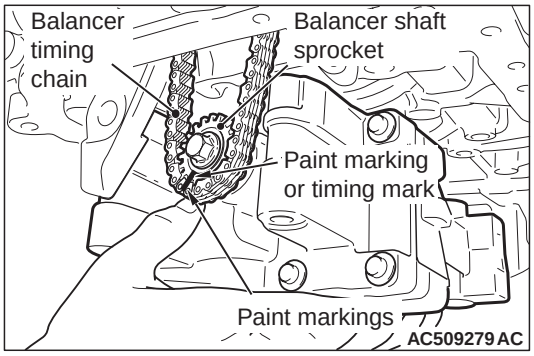
1. When installing the new balancer shaft and oil pump module, apply oil to the oil pump in the balancer shaft and oil pump module and the balancer shaft bearing as follows.



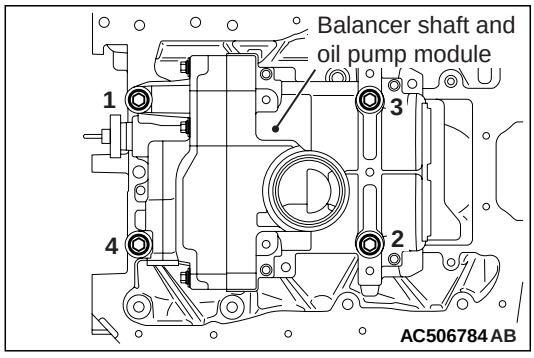
   (1) Clean the inside of the removed engine oil pan, and put the balancer shaft and oil pump module into the engine oil pan with its oil inlet port facing up.
   (2) Pour new engine oil until two-thirds of the balancer shaft and oil pump module is soaked.
   (3) Fill the engine oil (approximately 50 mL) into the balancer shaft and oil pump module from the oil inlet port.



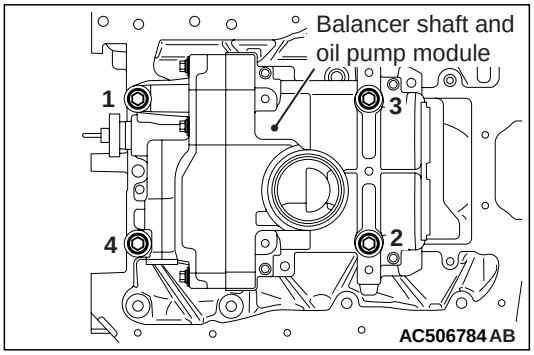
   (4) Turn the balancer shaft sprocket of the balancer shaft and oil pump module clockwise four rotations or more to apply the engine oil to the entire area of the oil pump and the balancer shaft bearing.
2. Remove the cable band installed to prevent the tooth jump of the balancer timing chain from the crankshaft sprocket from the balancer timing chain.

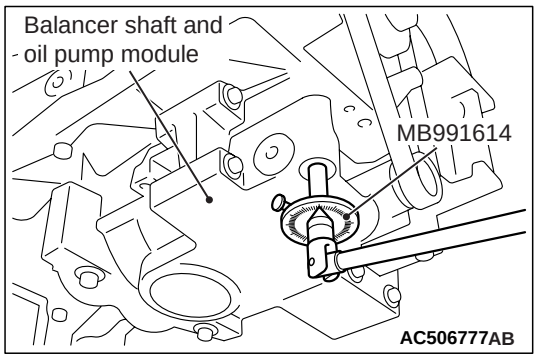


3. Regarding the prevention of the tooth jump of the balancer timing chain, install the balancer shaft sprocket to the balancer timing chain with aligning the paint marking of the balancer shaft sprocket (the timing mark of the new balancer shaft and oil pump module) with that of the balancer timing chain.
4. With the paint marking of the balancer timing chain aligned with that of the balancer sprocket (the timing mark of the new balancer shaft and oil pump module), install the balancer shaft and oil pump module to the rudder frame. Securely bring the balancer shaft and oil pump module into contact with the rudder frame mounting area.
5. Apply an adequate and minimum amount of engine oil to the threads and bearing surfaces of the balancer shaft and oil pump module bolts.



6. Tighten the balancer shaft and oil pump module bolts to the specified torque 20 N·m in the order of number shown in the figure.
7. Tighten the balancer shaft and oil pump module bolts again to the specified torque 44 N·m in the order of number shown in the figure.
8. Loosen the balancer shaft and oil pump module bolts fully in the reverse sequence to that shown.
9. Tighten the balancer shaft and oil pump module bolts to the specified torque 20 N·m in the order of number shown in the figure.





10. After tightening to the specified torque, tighten the balancer shaft and oil pump module bolts to 135 degrees, using special tool angle gauge (MB991614), in the order of number shown in the figure.
11. Tighten the mounting bolt of the balancer timing chain lower with the standard torque.

    Tightening torque: 10 ± 2 N·m

12. Remove the plunger of the timing chain tensioner using the L-shaped hard wire (ϕ1.5 mm piano wire, etc.) or L-shaped hexagon wrench (1.5 mm).

ENGINE ASSEMBLY

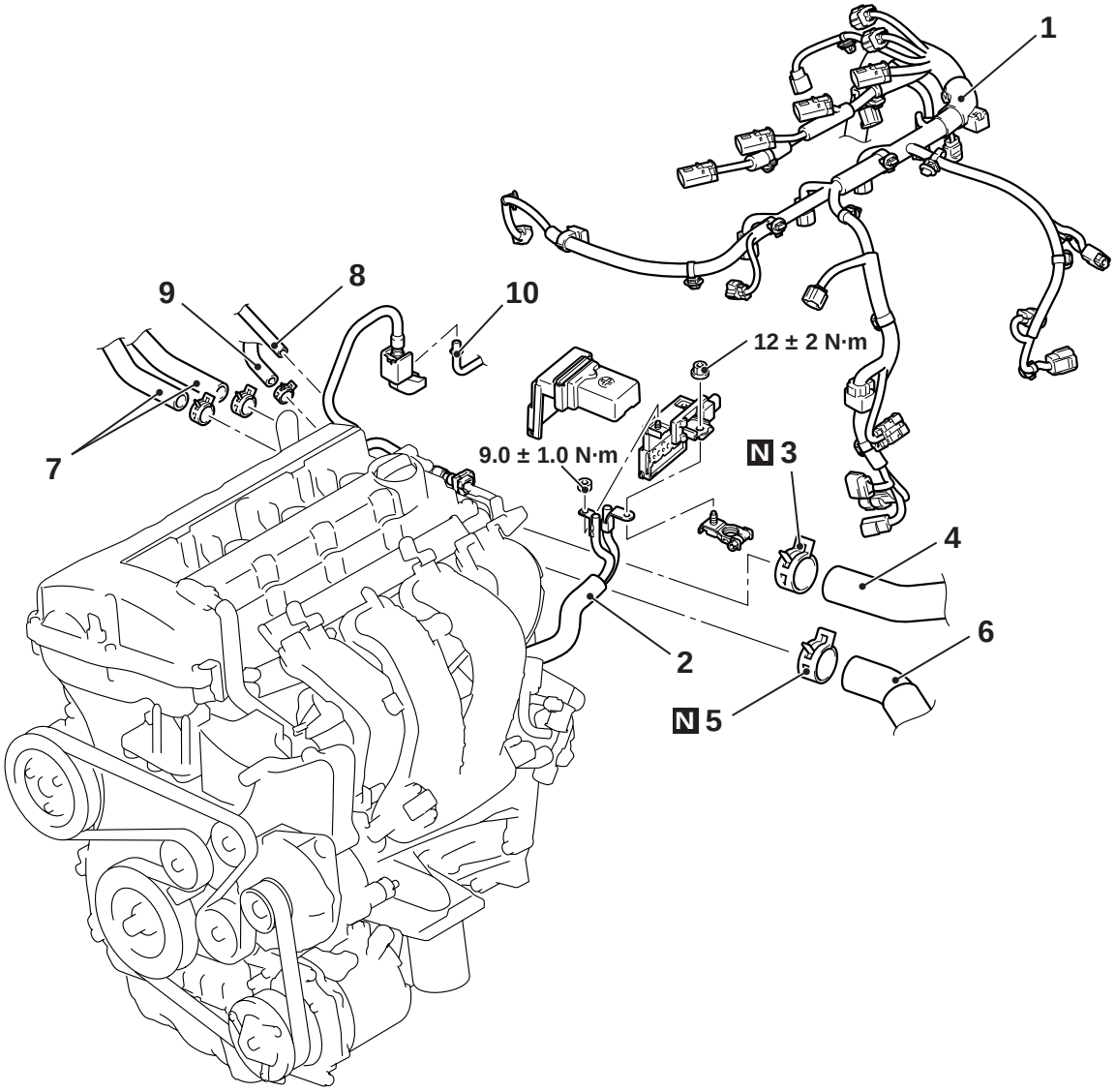
REMOVAL AND INSTALLATION

M1112001007000

⚠ CAUTION

When the engine assembly is replaced, initialise the learned value using M.U.T.-III (Refer to GROUP 00 – Precautions before Service, and Initialisation Procedure of MPI Engine Learned Value).

Pre-removal Operation	Post-installation Operation
• Hood Removal (Refer to GROUP 42A – Hood) <LH drive vehicles>. • Hood Removal (Refer to GROUP 42A – Hood) <RH drive vehicles>. • Fuel Line Pressure Reduction (Refer to GROUP 13A – On-vehicle Service, How to Reduce Pressurized Fuel Lines). • Engine Room Under Cover Front A, B, D and Engine Room Side Cover (RH) Removal (Refer to GROUP 51 – Under Cover). • Engine Coolant Draining (Refer to GROUP 14 – On-vehicle Service, Engine Coolant Replacement). • Engine Oil Draining (Refer to GROUP 12 – On-vehicle Service, Engine Oil Replacement). • Transmission Fluid Draining (Refer to GROUP 23A – On-vehicle Service, CVT Fluid Replacement). • Transfer Oil Draining (Refer to GROUP 23A – On-vehicle Service, Transfer Oil Replacement). • Engine Cover Removal (Refer to P.11A-19). • Air Cleaner Intake Hose and Air Cleaner Assembly Removal (Refer to GROUP 15 – Air Cleaner). • Battery and Battery Tray Removal (Refer to GROUP 54A – Battery). • Engine-ECU Removal (Refer to GROUP 13A – Engine-ECU). • Exhaust Manifold Removal (Refer to GROUP 15 – Exhaust Manifold). • Alternator and Others Belt Removal (Refer to P.11A-16).	• Alternator and Others Belt Installation (Refer to P.11A-16). • Exhaust Manifold Installation (Refer to GROUP 15 – Exhaust Manifold). • Engine-ECU Installation (Refer to GROUP 13A – Engine-ECU). • Battery and Battery Tray Installation (Refer to GROUP 54A – Battery). • Air Cleaner Intake Hose and Air Cleaner Assembly Installation (Refer to GROUP 15 – Air Cleaner). • Engine Cover Installation (Refer to P.11A-19). • Transfer Oil Refilling (Refer to GROUP 23A – On-vehicle Service, Transfer Oil Replacement). • Transmission Fluid Refilling (Refer to GROUP 23A – On-vehicle Service, CVT Fluid Replacement). • Engine Oil Refilling (Refer to GROUP 12 – On-vehicle Service, Engine Oil Replacement). • Engine Coolant Refilling (Refer to GROUP 14 – On-vehicle Service, Engine Coolant Replacement). • Alternator and Others Belt Tension Check (Refer to P.11A-8). • Engine Room Under Cover Front A, B, D and Engine Room Side Cover (RH) Installation (Refer to GROUP 51 – Under Cover). • Fuel Leak Check. • Hood Installation (Refer to GROUP 42A – Hood) <LH drive vehicles>. • Hood Installation (Refer to GROUP 42A – Hood) <RH drive vehicles>.



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Removal steps

1. Control wiring harness connection
2. Battery cable connection

<<A>> >>F<< 3. Hose clip

<<A>> >>F<< 4. Radiator upper hose connection

<<A>> >>F<< 5. Hose clip

<<A>> >>F<< 6. Radiator lower hose connection

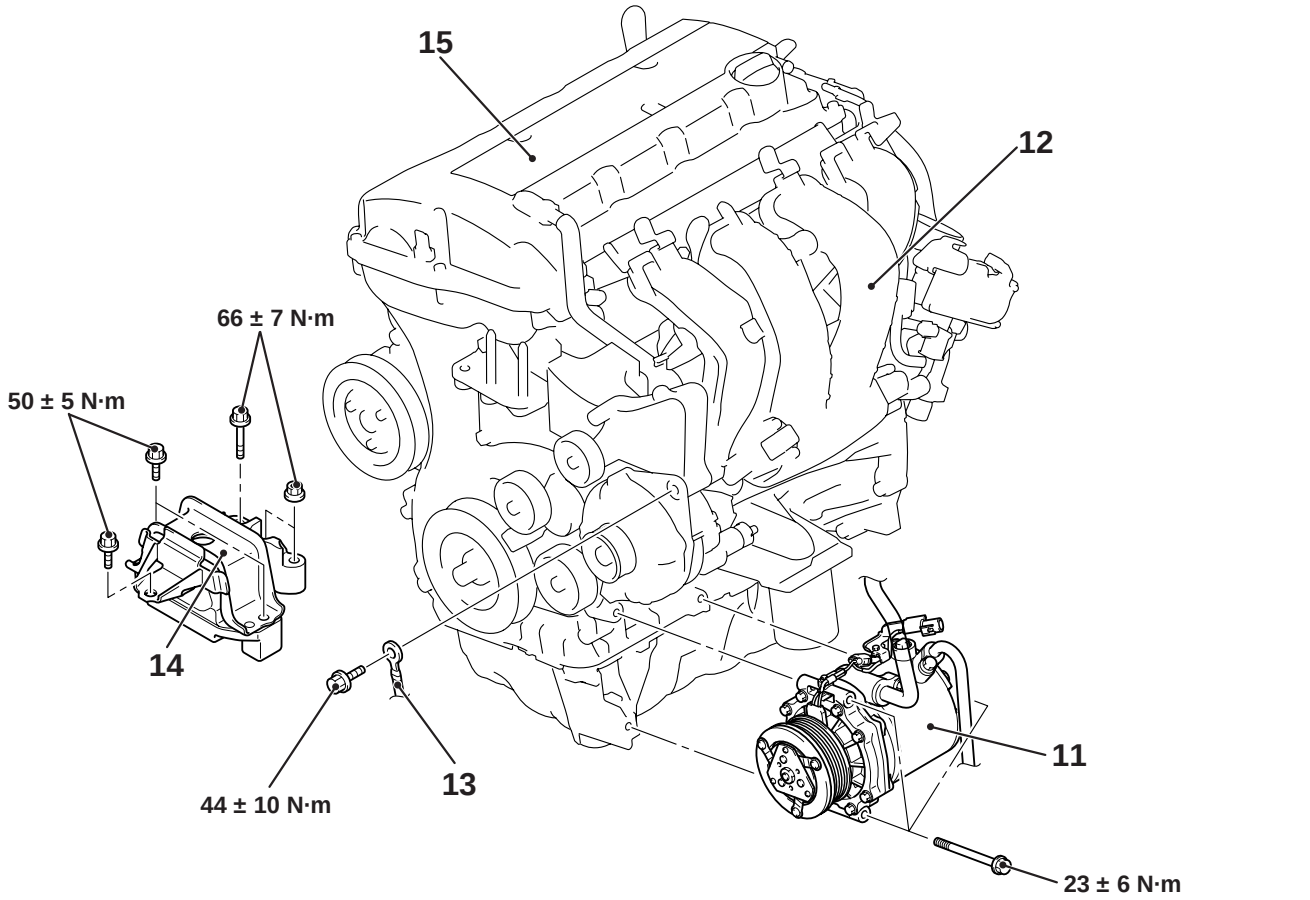
7. Heater hose connection

Removal steps (Continued)

8. Canister vacuum hose connection
9. Brake booster vacuum hose connection

<<B>> >>E<< 10. Fuel high-pressure hose connection

- Alternator and others belt (Refer to P.11A-16)

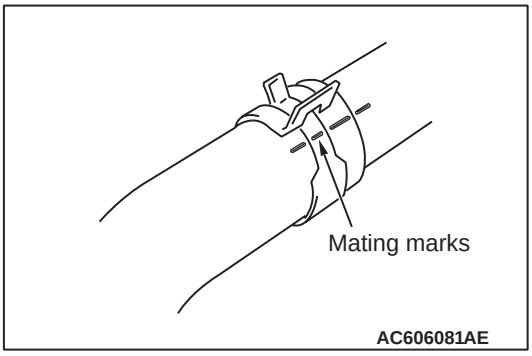


Removal steps

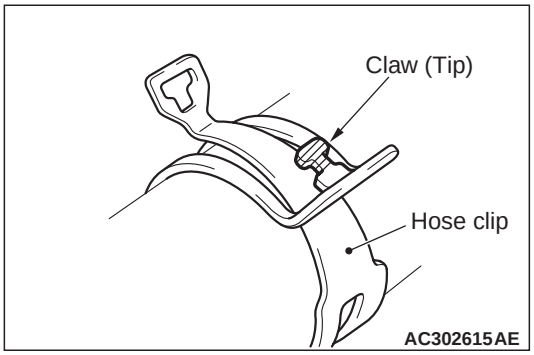
<<**C**>>	>>**D**<<	11.	A/C compressor and clutch assembly
		12.	Inlet manifold assembly (Refer to GROUP 15 – Inlet Manifold)
		•	Transmission assembly (Refer to GROUP 23A – Transmission Assembly).
	>>**C**<<	13.	Earth cable connection
<<**D**>>	>>**B**<<	14.	Engine mounting bracket
<<**E**>>	>>**A**<<	15.	Engine assembly

REMOVAL SERVICE POINTS

<<A>> HOSE CLIP/RADIATOR HOSE DISCONNECTION



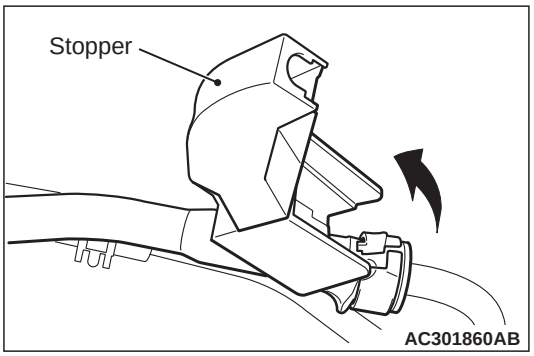
1. Make mating marks on the radiator hose and the hose clip as shown to install them in the original position.



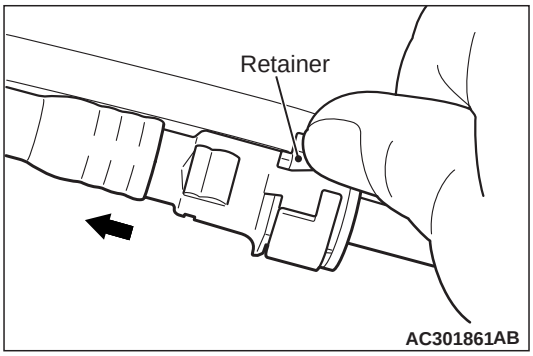
2. Break off the tip of hose clip claw and spread out the hose clip, then disconnect the radiator lower hose.

   NOTE: If there is a hose clip claw, the hose clip cannot spread to capacity because the claw contacts the hose clip.

<<B>> FUEL HIGH-PRESSURE HOSE REMOVAL



1. Remove the stopper of the fuel high-pressure hose.



2. Raise the retainer of the fuel high-pressure hose and pull out the fuel high-pressure hose in the direction shown in the figure.

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

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

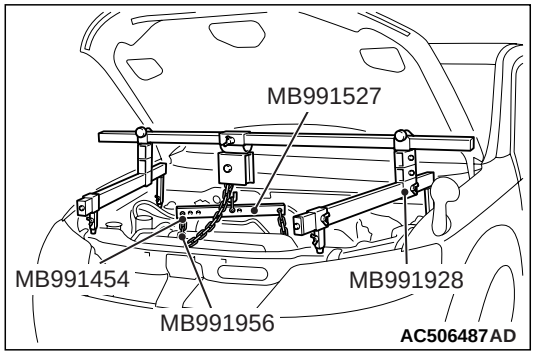
1. Remove the A/C compressor and clutch assembly together with the hose from the bracket.
2. Tie the removed A/C compressor and clutch assembly with a string at a position where it will not interfere with the removal and installation of engine assembly.

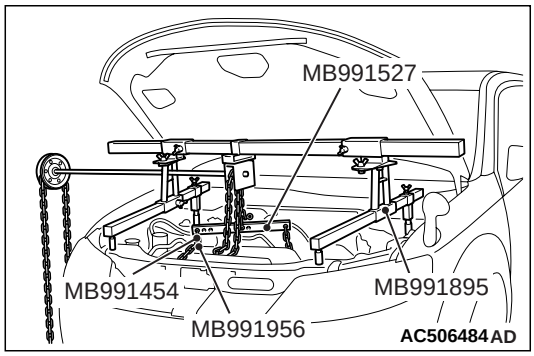
<<D>> ENGINE MOUNTING BRACKET REMOVAL

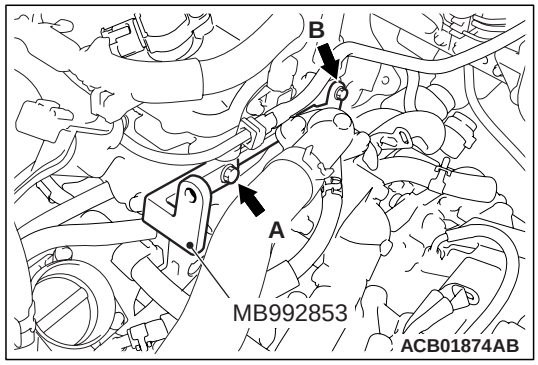
⚠ CAUTION

When supporting the engine and transmission assembly with a garage jack, be careful not to deform the engine oil pan.

1. Place a garage jack against the engine oil pan with a piece of wood in between to support the engine assembly.

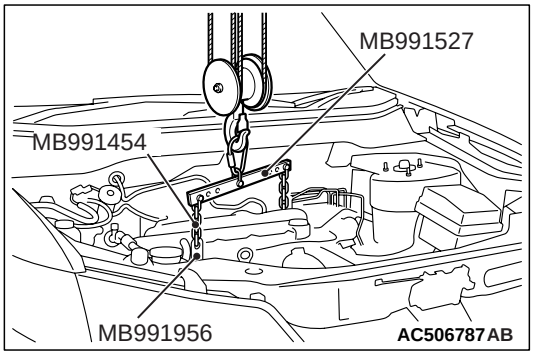






2. Remove special tools engine hanger (MB991928 or MB991895) and engine hanger plate (MB992853) which was installed for supporting the engine assembly when the transmission assembly was removed (Refer to GROUP 23A – Transmission Assembly).
3. Operate a garage jack so that the engine weight is not applied to the engine mounting bracket, and remove the engine mounting bracket.

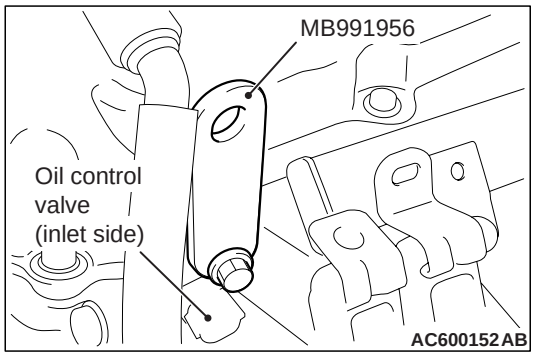
<<E>> ENGINE ASSEMBLY REMOVAL

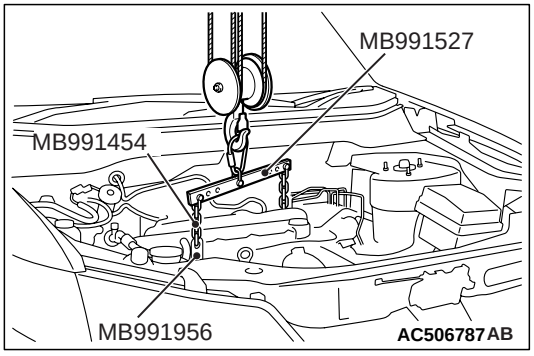


After checking that all cables, hoses and wiring harness connectors and so on are disconnected from the engine, lift the engine assembly slowly with the chain block to remove the engine assembly upward from the engine compartment.

INSTALLATION SERVICE POINTS

>>A<< ENGINE ASSEMBLY INSTALLATION





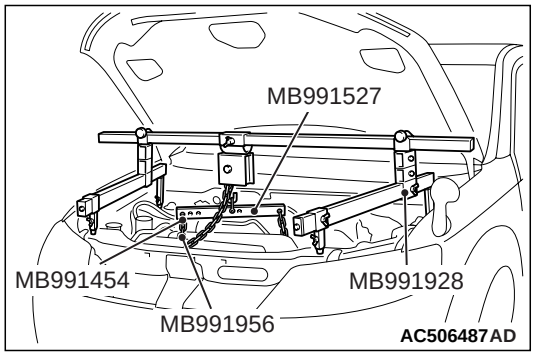
1. Install special tool engine hanger plate (MB991956) to the cylinder head, and set special tool hanger (MB991527) and the chains of special tool engine hanger balancer (MB991454) to the engine assembly to hold the engine assembly.
2. Install the engine assembly, being careful not to pinch the cables, hoses, or wiring harness connectors.

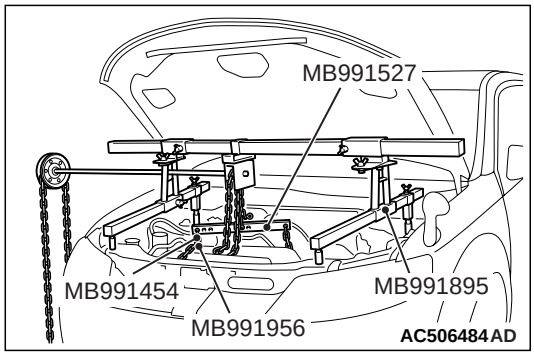
>>B<< ENGINE MOUNTING BRACKET INSTALLATION

⚠ CAUTION

When supporting the engine and transmission assembly with a garage jack, be careful not to deform the engine oil pan.

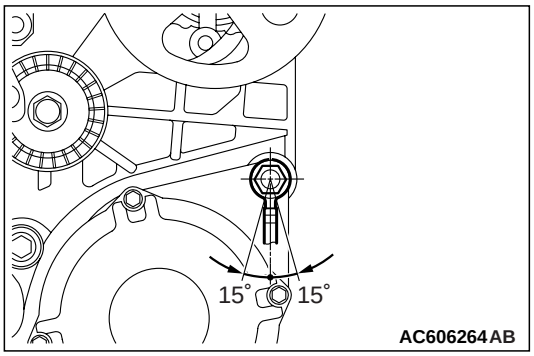
1. Place a garage jack against the engine oil pan with a piece of wood in between, and install the engine mounting bracket while adjusting the position of the engine.





2. Install special tool engine hanger (MB991928 or MB991895) which is used during installation of transmission assembly to hold the engine assembly (Refer to GROUP 23A – Transmission Assembly).
3. Remove the garage jack which supports the engine assembly.

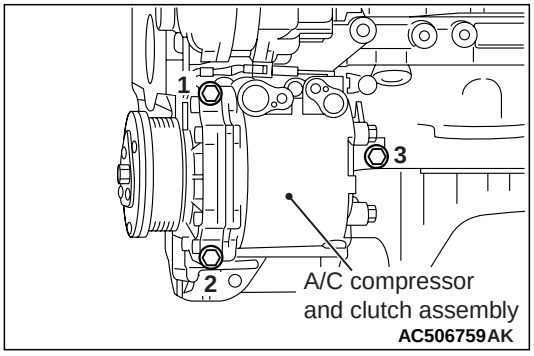
>>C<< EARTH CABLE CONNECTION



1. Install the earth cable in the direction shown in the illustration.
2. Tighten the alternator mounting bolt to the specified torque.

Tightening torque: 44 ± 10 N·m

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



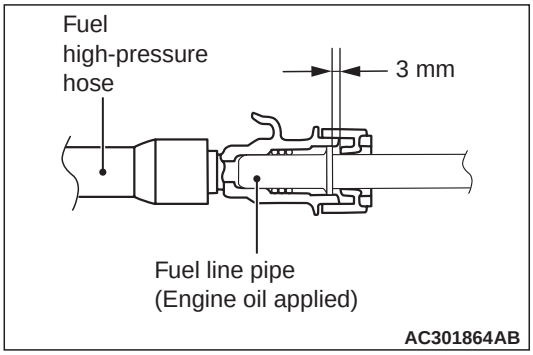
Tighten A/C compressor and clutch assembly mounting bolts to the specified torque in the order of number shown in the illustration.

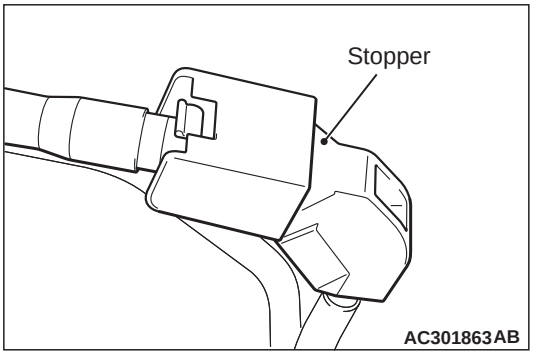
Tightening torque: 23 ± 6 N·m

>>E<< FUEL HIGH-PRESSURE HOSE INSTALLATION

⚠ CAUTION

After connecting the fuel high-pressure hose, slightly pull it in the pull-out direction to check that it is installed firmly. In addition, check that there is approximately 3-mm play. After the check, install the stopper securely.





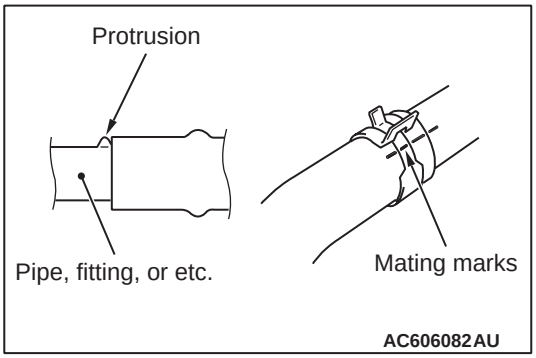
Apply a small amount of engine oil to the fuel line pipe, and install the fuel high-pressure hose.

>>F<< RADIATOR HOSE/HOSE CLIP CONNECTION

⚠ CAUTION

Never reuse the hose clip whose claw is broken off to prevent the rusting.

1. Make mating mark on a new hose clip in the same position as the remove one.



2. Insert the radiator hose until the protrusion of the pipe.
3. Align the mating marks on the radiator hose and hose clip.
4. Remove the hose clip claw and shorten the hose clip, then install the radiator hose.