GROUP 11A

ENGINE MECHANICAL

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GENERAL INFORMATION

M1111000100572

Item			Specification
Total displacement mL			2,378
Bore × Stroke mm			87 × 100
Compression ratio			9.5
Compression chamber			Pentroof
Camshaft arrangement			SOHC
Number of valve	Intake		8
	Exhaust		8
Valve timing	Intake valve	Open (BTDC)	0° <low speed cam A>
			2° <low speed cam B>
			20° <High speed cam>
		Closes (ABDC)	46° <low speed cam A>
			48° <low speed cam B>
			72° <High speed cam>
	Exhaust valve	Open (BTDC)	54°
		Closes (ABDC)	21°
Fuel system			Electronically controlled multipoint fuel injection
Rocker arm			Roller type

SERVICE SPECIFICATIONS

M1112000300579

Item				Standard value	Limit
Drive belt tension	Vibration frequency Hz (Reference)	Except vehicles for Hong Kong, Singapore, Australia and New Zealand		109 – 145	–
		Vehicles for Hong Kong, Singapore, Australia and New Zealand		113 – 145	–
	Tension N (Reference)	Except vehicles for Hong Kong, Singapore, Australia and New Zealand		331 – 577	–
		Vehicles for Hong Kong, Singapore, Australia and New Zealand		340 – 555	–
Valve clearance (at hot) mm			Intake valve	0.20	–
			Exhaust valve	0.30	–
Basic ignition timing				5° BTDC ±3°	–
Ignition timing				Approximately 10° BTDC	–
Idle speed r/min				700 ±100	–
CO contents %				0.5 or less	–
HC contents ppm				100 or less	–
Compression pressure kPa-r/min				1,560 – 200	1,130 – 200

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Item		Standard value	Limit
Compression pressure difference of all cylinders kPa		–	Maximum 98
Intake manifold vacuum kPa		–	Minimum 60
Cylinder head bolt nominal length mm		–	99.4
Balancer timing belt tension (When adjusted)	Deflection mm	5 – 7	–
Balancer timing belt tension (When replaced)	Deflection mm	5 – 7	–
Balancer timing belt tension (When checked)	Deflection mm	5 – 10	–
Timing belt tensioner adjuster rod protrusion amount mm		3.8 – 4.5	–
Timing belt tensioner adjuster rod movement mm		Within 1	–

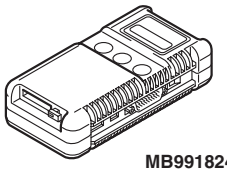
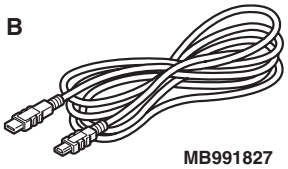
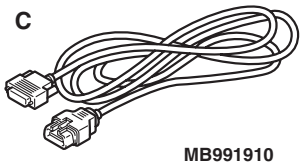
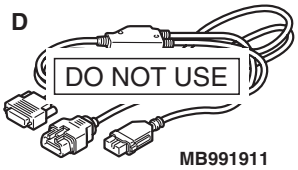
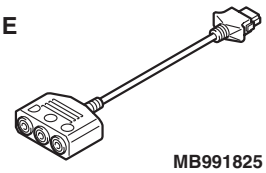
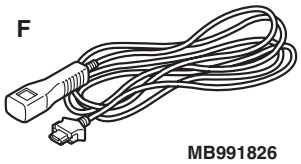
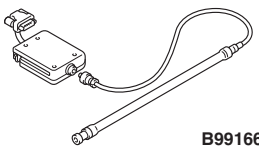
SEALANTS

M1112000500335

Item	Specified sealant	Remark
Camshaft position sensor support	MITSUBISHI GENUINE PART MD970389 or equivalent	Semi-drying sealant
Engine upper oil pan		
Engine lower oil pan		
Taper plug	LOCTITE203MP	Anaerobic sealant

SPECIAL TOOLS

M1112000600815

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 measurement adapter F: M.U.T.-III trigger harness	• Drive belt tension check • Checking the ignition timing • Checking the idle speed • Erasing the diagnosis code **⚠ 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.**
 B991668	MB991668	Belt tension meter set	Drive belt tension check (used together with M.U.T.-III)

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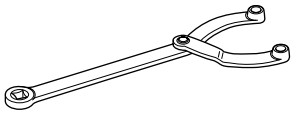
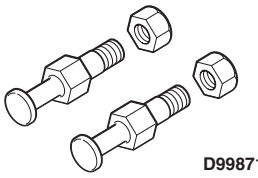
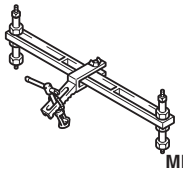
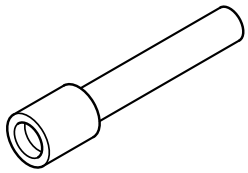
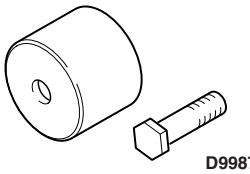
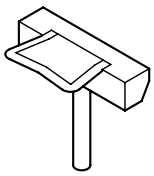
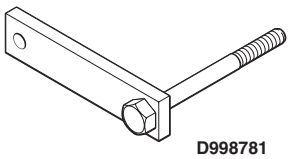
Tool	Number	Name	Use
 B990767	MB990767	Front hub and flange yoke holder	Holding the camshaft sprocket
 D998719	MD998719	Pin	
 MD998772	MD998772	Valve spring compressor	Compressing valve spring
	MB991999	Valve stem seal installer	Valve stem seal installation
 D998713	MD998713	Camshaft oil seal installer	Camshaft oil seal installation
 D998727	MD998727	Oil pan FIPG cutter	Oil pan removal
 D998781	MD998781	Flywheel stopper	• Supporting the flywheel assembly <M/T> • Supporting the A/T drive plate <A/T>

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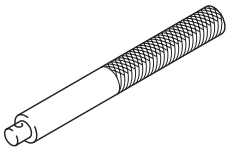
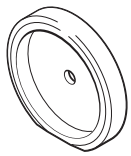
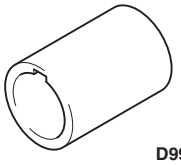
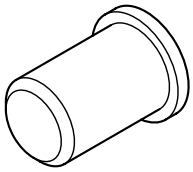
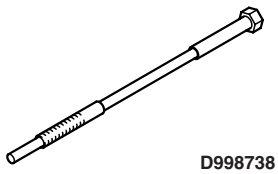
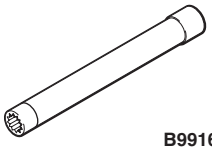
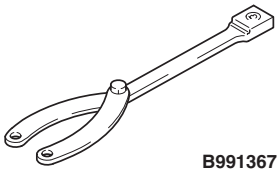
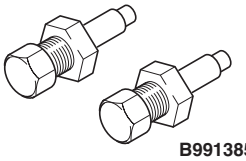
Tool	Number	Name	Use
	MB990938	Installer bar	Crankshaft rear oil seal installation
 D998776	MD998776	Crankshaft rear oil seal installer	
 D998285	MD998285	Crankshaft front oil seal guide	Crankshaft front oil seal installation
	MD998375	Crankshaft front oil seal installer	
 D998738	MD998738	Adjusting bolt	Supporting the timing belt tensioner arm and timing belt tensioner adjuster
 B991654	MB991654	Cylinder head bolt wrench (12)	Removal and installation of cylinder head bolt
 B991367	MB991367	Special spanner	Holding the crankshaft camshaft drive sprocket
 B991385	MB991385	Pin	

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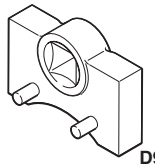
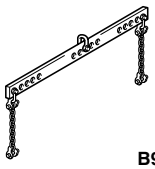
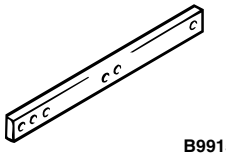
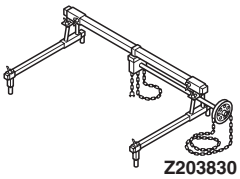
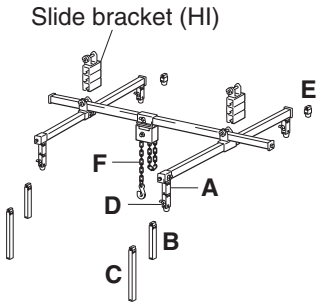
Tool	Number	Name	Use
 D998767	MD998767	Tensioner wrench	Valve timing belt tension adjustment
 B991454	MB991454	Engine hanger balancer	When the engine hanger is used: Supporting the engine assembly during removal and installation of the transmission assembly *NOTE: Special tool MB991454 is a part of engine hanger attachment set MB991453.*
 B991527	MB991527	Hanger	
 Z203830	MB991895	Engine hanger	
 B991928	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	

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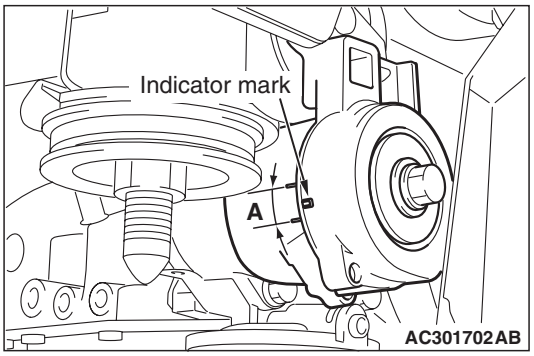
ON-VEHICLE SERVICE

DRIVE BELT TENSION CHECK

M1111003100623

⚠ CAUTION

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



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

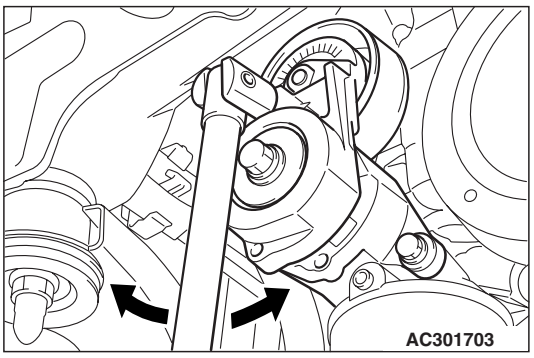
   NOTE: The drive belt tension check is not necessary as auto-tensioner is adopted.

AUTO-TENSIONER CHECK

M1111003000507

OPERATION CHECK

1. Turn OFF the engine from the idle state then check to see that the drive belt is not protruding from the pulley width of the auto-tensioner.
2. Remove the drive belt. (Refer to P.11A-16).



3. Securely insert the spindle handle or ratchet handle with a 12.7 mm insertion angle into the jig hole of the auto tensioner. Turn the auto-tensioner to the left and right to check and see that there is no threading.
4. If there are any problems in the procedure 1 or 3, replace the auto-tensioner. (Refer to P.11A-36).
5. Install the drive belt. (Refer to P.11A-16).

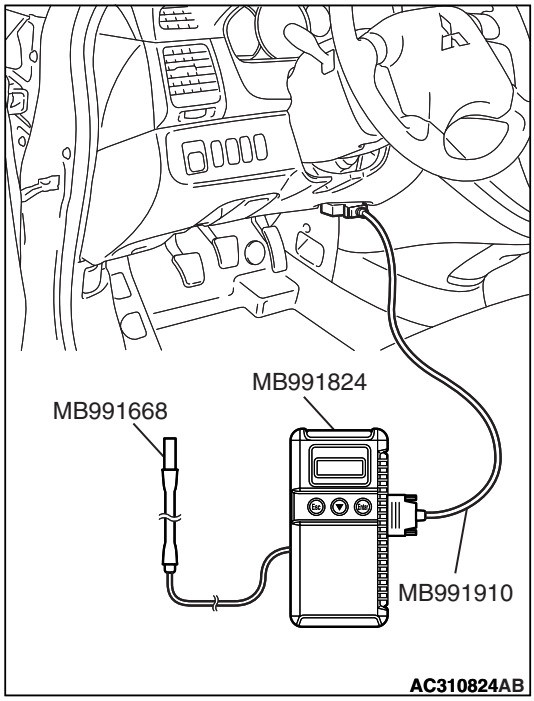
FUNCTION CHECK

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

When using V.C.I.

1. Check the drive belt tension. (Refer to P.11A-8).
2. Measure the drive belt tension vibration frequency by the following procedures:

⚠ CAUTION



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

(1) Connect special tool belt tension meter set (MB991668) to special tool V.C.I. (MB991824).
(2) Connect special tool M.U.T.-III main harness A (MB991910) to special tool V.C.I. (MB991824).
(3) Connect special tool M.U.T.-III main harness A (MB991910) to the diagnosis connector.
(4) Turn the ignition switch to "ON" position, and select "Belt Tension" on the menu screen.

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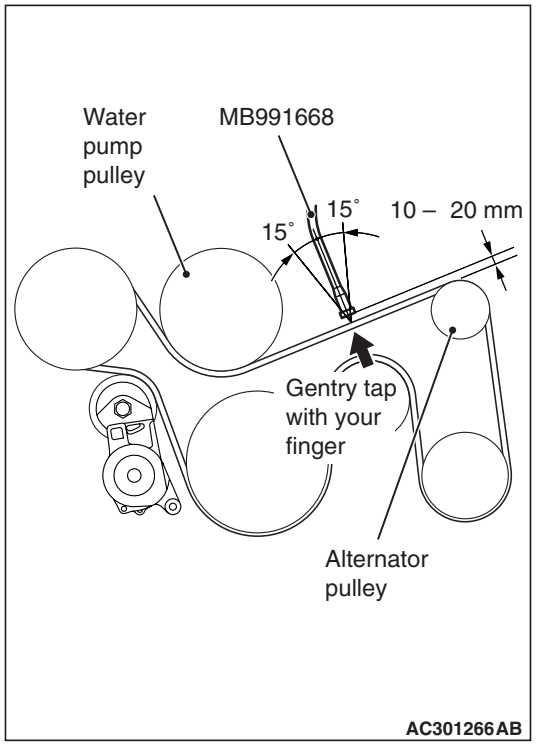
⚠ CAUTION

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



(5) Hold special tool belt tension meter set (MB991668) to the middle of the drive belt between the pulleys (at the place indicated by arrow), approximately 10 – 20 mm away from the rear surface of the belt so that it is perpendicular to the belt (within an angle of ± 15 degree).

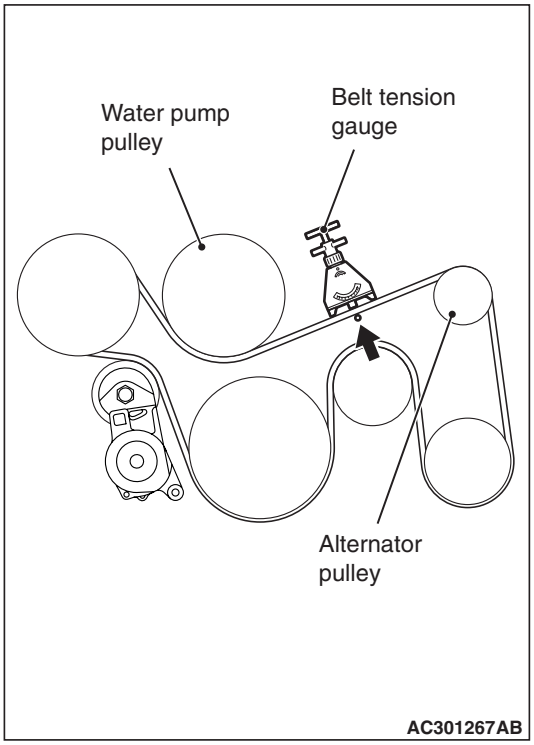
(6) Gently tap the middle of the belt between the pulleys (the place indicated by the arrow) with your finger as shown in the illustration, and measure that the vibration frequency of the belt is within the standard value.

Standard value:
<Except vehicles for Hong Kong, Singapore, Australia and New Zealand> 109 – 145 Hz
<Vehicles for Hong Kong, Singapore, Australia and New Zealand> 113 – 145 Hz

3. If not within the standard value, replace the alternator drive belt auto tensioner. (Refer to P.11A-36).

When using a tension gauge

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



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

Standard value:
<Except vehicles for Hong Kong, Singapore, Australia and New Zealand> 331 – 577 N
<Vehicles for Hong Kong, Singapore, Australia and New Zealand> 340 – 555 N

3. If not within the standard value, replace the auto-tensioner. (Refer to P.11A-36).

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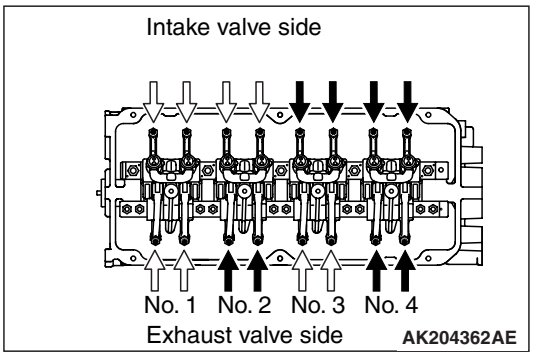
VALVE CLEARANCE CHECK AND ADJUSTMENT

M1111001500164

1. Before inspection, set the vehicle to the pre-inspection condition.
2. Turn the ignition switch to the "LOCK" (OFF) position.
3. Remove all ignition coils.
4. Remove the rocker cover.
5. Turn the crankshaft clockwise until the notch on the pulley is lined up with the "T" mark on the timing indicator.
6. Move the rocker arms on the No.1 and No.4 cylinders up and down by hand to determine which cylinder has its piston at the top dead centre on the compression stroke. If both intake and exhaust valve rocker arms have a valve lash, the piston in the cylinder corresponding to these rocker arms is at the top dead centre on the compression stroke.



7. Valve clearance inspection and adjustment can be performed on rocker arms indicated by white arrow mark when the No.1 cylinder piston is at the top dead centre on the compression stroke, and on rocker arms indicated by black arrow mark when the No.4 cylinder piston is at the top dead centre on the compression stroke.
8. Measure the valve clearance.

   If the valve clearance is not as specified, loosen the rocker arm lock nut and adjust the clearance using a thickness gauge while turning the adjusting screw.

   Standard value (hot engine):
   Intake valve: 0.20 mm
   Exhaust valve: 0.30 mm

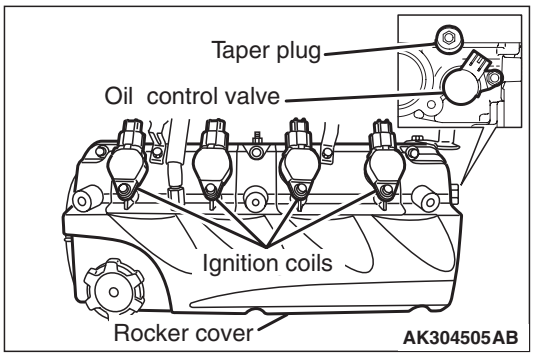
9. While holding the adjusting screw with a screwdriver to prevent it from turning, tighten the lock nut to the specified torque.

   Tightening torque: 9 ±1 N· m

10. Turn the crankshaft through 360 degree angle to line up the notch on the crankshaft pulley with the "T" mark on the timing indicator.
11. Repeat steps (9) and (10) on other valves for clearance adjustment.
12. Install the rocker cover.
13. Install the ignition coils.

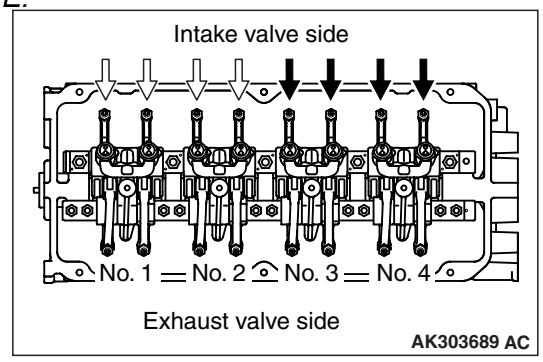
ROCKER ARM PISTON OPERATION CHECK

M1111051000034

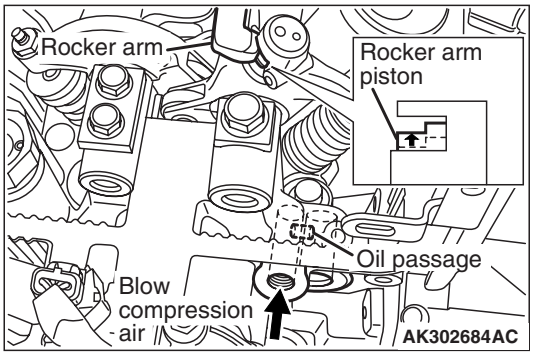


1. Remove all of the ignition coils.
2. Remove the rocker cover.
3. Remove the oil control valve.
4. Remove the taper plug.
5. Turn the crankshaft clockwise until the notch on the crankshaft pulley is lined up with "T" mark on the lower cover of timing belt.
6. Move the rocker arms on the No.1 and No.4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

NOTE:



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



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

NOTE: To fully confirm the check, prevent the compression air from leaking as much as possible by installing the O-ring to the end of air blowgun.

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

    Specified sealant: LOCTITE203MP or equivalent

⚠ CAUTION

Do not start the engine within one hour after the engine taper plug has been installed.

12. Install the taper plug and tighten to the specified torque.

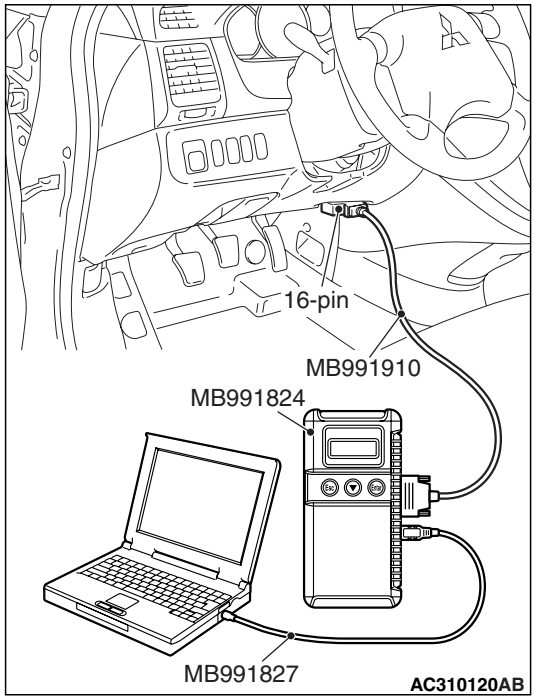
    Tightening torque: 10 ±2 N· m

13. Install the oil control valve. (Refer to Camshaft and Valve Stem Seal –Removal and Installation P.11A-17.)
14. Install the rocker cover.
15. Install all of the ignition coils.

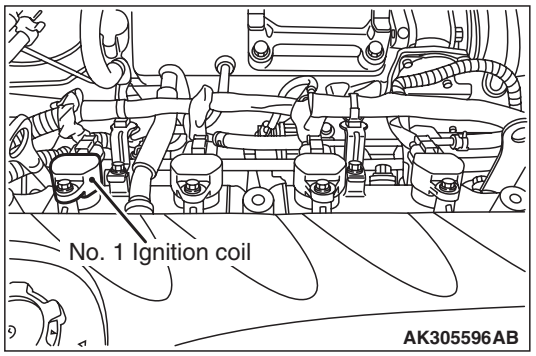
IGNITION TIMING CHECK

M1111001701321

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.1) of the ignition coil No.1.

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

4. Start the engine and let it run at idle.
5. Use the M.U.T.-III to measure engine idle speed and check that it is within the standard value.

   Standard value: 700 ±100 r/min

6. Select No. 17 of the M.U.T.-III Actuator test.
7. Check that basic ignition timing is within the standard value.

   Standard value: 5° BTDC ±3°

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8. If the basic ignition timing is outside the standard value, inspect the MPI system (Refer to GROUP 13A –Troubleshooting –Inspection Chart for Diagnosis Code <Except for Hong Kong, Singapore, Australia and New Zealand>P.13A-14 or GROUP 13B –Troubleshooting –Inspection Chart for Diagnosis Code <Vehicles for Hong Kong and Singapore>P.13B-15 or GROUP 13C –Troubleshooting –Inspection Chart for Diagnosis Code <Vehicles for Australia and New Zealand>P.13C-21).

⚠ CAUTION

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

9. Press the M.U.T.-III clear key (Select a forced driving cancel mode) to release the Actuator test.
10. Check that ignition timing is at the standard value.

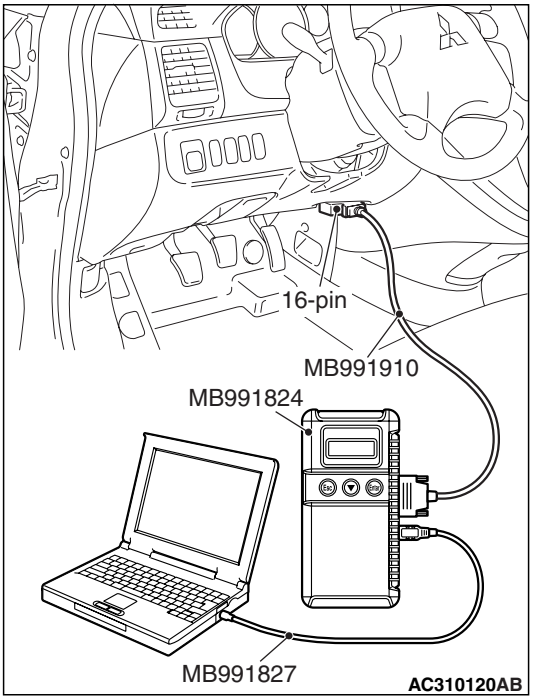
    Standard value: approximately 10° BTDC

    NOTE:
    - *The ignition timing may fluctuate within ±7° BTDC. This is normal.*
    - *In higher altitude, the ignition timing is more advanced than the standard value by approximately 5°.*
11. Remove the timing light.
12. Turn the ignition switch to the "LOCK" (OFF) position and then remove the M.U.T.-III.

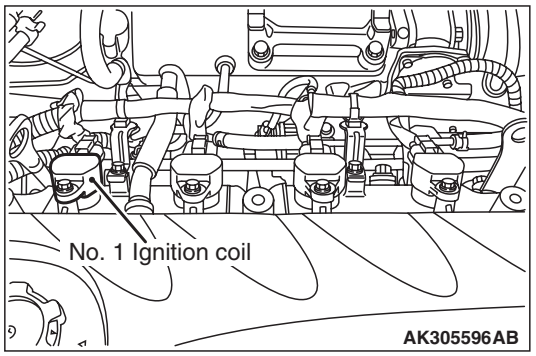
IDLE SPEED CHECK

M1111003501204

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.1) of the ignition coil No.1.

   NOTE: The power supply line is looped and also longer than the other ones.
4. Start the engine and let it run at idle.
5. Check that ignition timing is at the standard value.

   Standard value: approximately 10° BTDC
6. Check the idle speed.

   Standard value: 700 ±100 r/min

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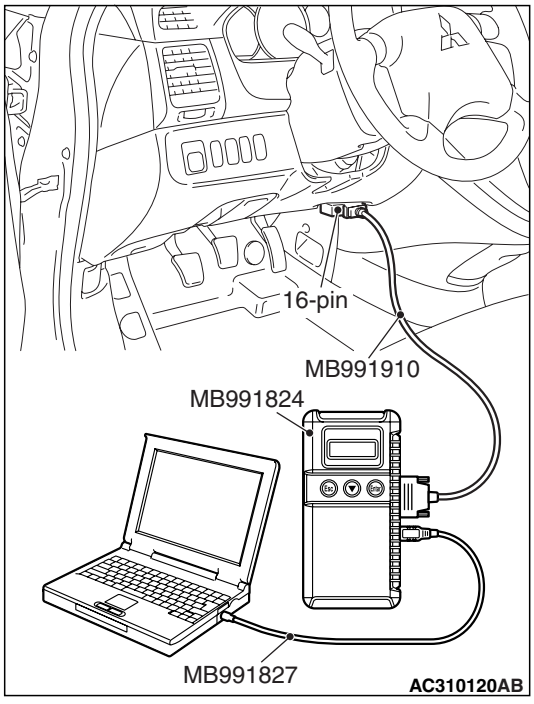
NOTE:
- *The idle speed is controlled automatically by the idle speed control system.*
- *When using the M.U.T.-III, select item No. 22 and take a reading of the idle speed.*

7. If the idle speed is outside the standard value, inspect the MPI system (Refer to GROUP 13A – Troubleshooting –Inspection Chart for Diagnosis Code <Except for Hong Kong, Singapore, Australia and New Zealand>P.13A-14 or GROUP 13B –Troubleshooting –Inspection Chart for Diagnosis Code <Vehicles for Hong Kong and Singapore>P.13B-15 or GROUP 13C – Troubleshooting –Inspection Chart for Diagnosis Code <Vehicles for Australia and New Zealand>P.13C-21).
8. Turn the ignition switch to the "LOCK" (OFF) position and then remove the M.U.T.-III.

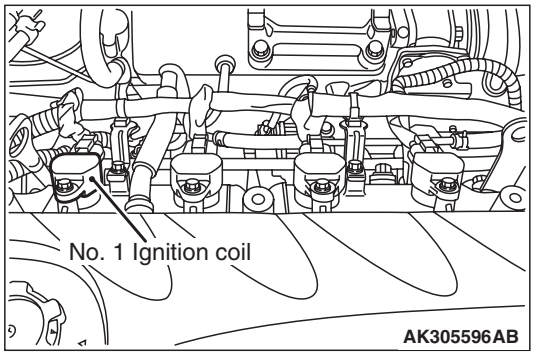
IDLE MIXTURE CHECK

M1111002100910

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.1) of the ignition coil No.1.

   NOTE: The power supply line is looped and also longer than the other ones.
4. Start the engine and let it run at idle.
5. Check that ignition timing is at the standard value.

   Standard value: approximately 10° BTDC
6. Run the engine at 2,500 r/min for 2 minutes.
7. Set the CO, HC tester.
8. Check the CO contents and the HC contents at idle.

   Standard value
   CO contents: 0.5% or less
   HC contents: 100 ppm or less
9. If there is a deviation from the standard value, inspect the MPI system (Refer to GROUP 13A – Troubleshooting –Inspection Chart for Diagnosis Code <Except for Hong Kong, Singapore, Australia and New Zealand>P.13A-14 or GROUP 13B –Troubleshooting –Inspection Chart for Diagnosis Code <Vehicles for Hong Kong and Singapore>P.13B-15 or GROUP 13C – Troubleshooting –Inspection Chart for Diagnosis Code <Vehicles for Australia and New Zealand>P.13C-21).
10. Turn the ignition switch to the "LOCK" (OFF) position and then remove the M.U.T.-III.

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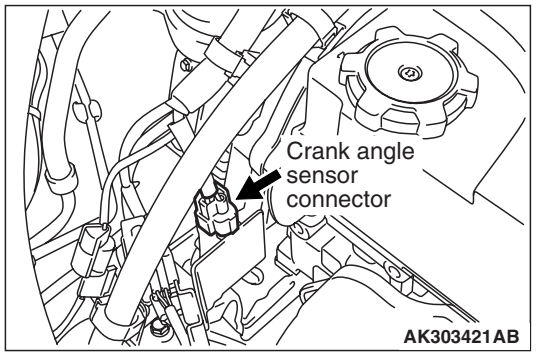
COMPRESSION PRESSURE CHECK

M1111002600722

1. Before inspection, set the vehicle to the pre-inspection condition.
2. Remove all of the ignition coils and spark plugs.



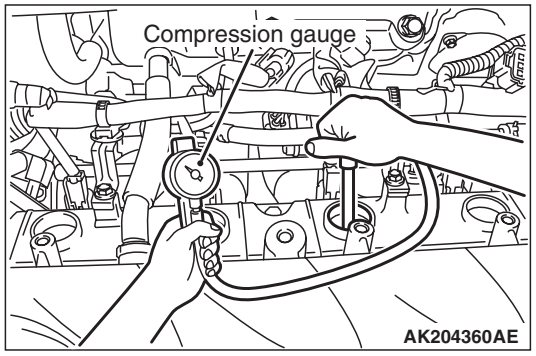
3. Disconnect the crank angle sensor connector.

   NOTE: Doing this will prevent the engine-ECU<M/T> or engine-A/T-ECU<A/T> from carrying out ignition and fuel injection.

⚠ WARNING

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.

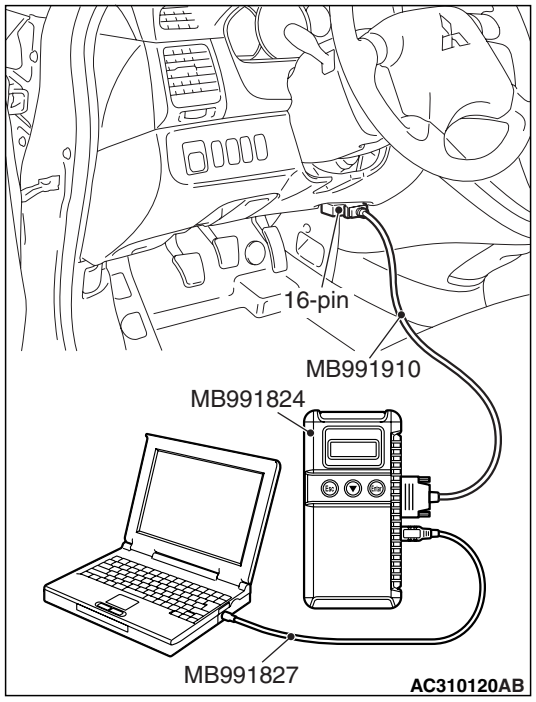
   Standard value (at engine speed of 200 r/min):
   1,560 kPa

   Limit (at engine speed of 200 r/min):
   Minimum 1130 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 dose 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 crank angle sensor connector.
10. Install the spark plugs and ignition coils.



11. Use the M.U.T.-III to erase the diagnosis codes.

    NOTE: This will erase the diagnosis code resulting from the crank angle sensor connector being disconnected.

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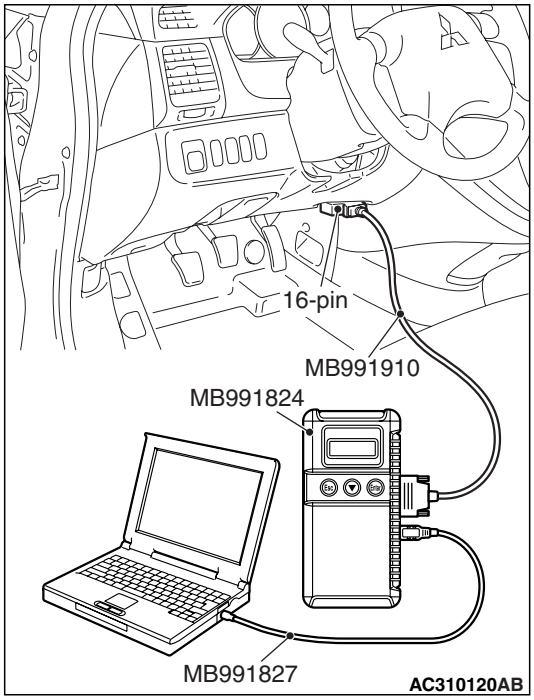
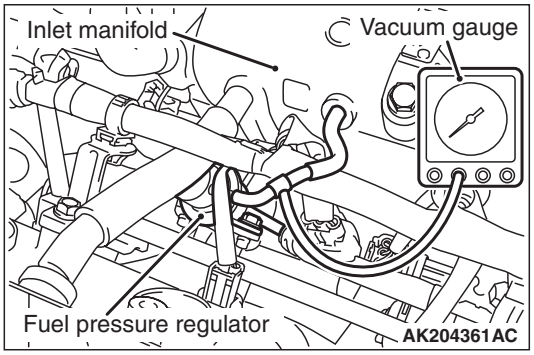
MANIFOLD VACUUM CHECK

M1111002700644

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. Attach a three-way joint to the vacuum hose between the fuel pressure regulator and the inlet manifold, and connect a vacuum gauge.
4. Start the engine and check that idle speed is within the standard valve.

   Standard value: 700 ±100 r/min

5. Check the inlet manifold vacuum.

   Limit: Minimum 60 kPa

6. Turn off the ignition switch.
7. Remove the vacuum gauge and the three-way joint, and then connect the vacuum hose.
8. Remove the engine tachometer or the M.U.T.-III.

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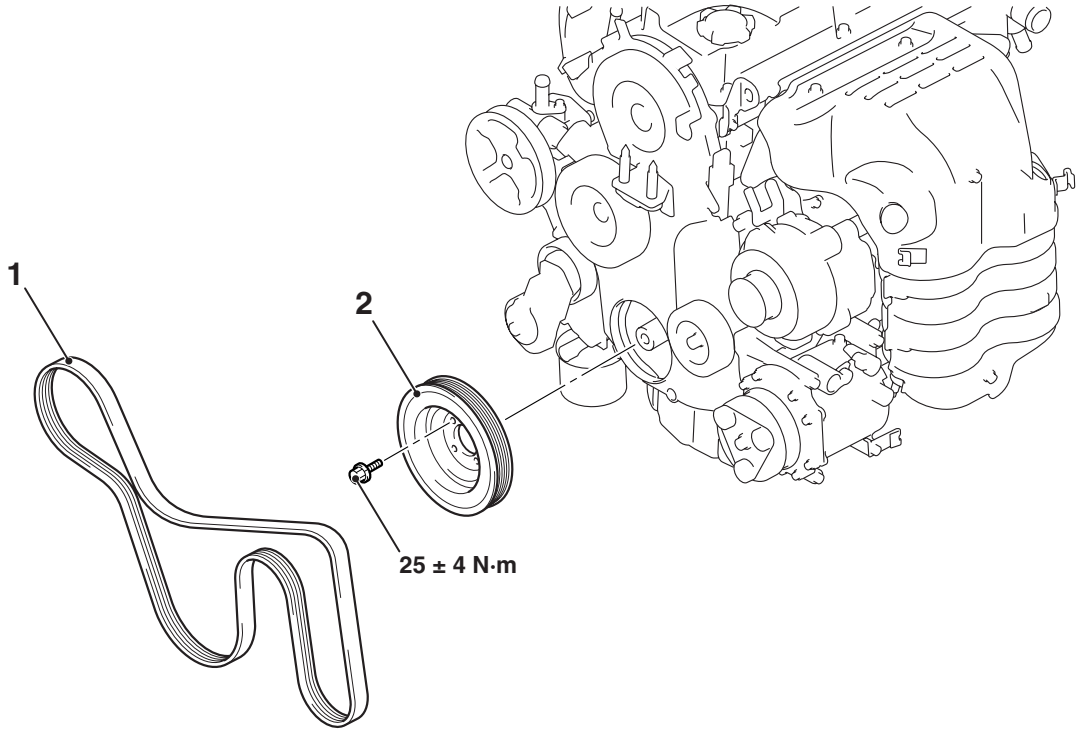
CRANKSHAFT PULLEY

REMOVAL AND INSTALLATION

M1112001600614

Pre-removal Operation	Post-installation Operation
• Engine Room Side Cover Removal.	• Drive Belt Tension Check (Refer to P.11A-8). • Engine Room Side Cover Installation.



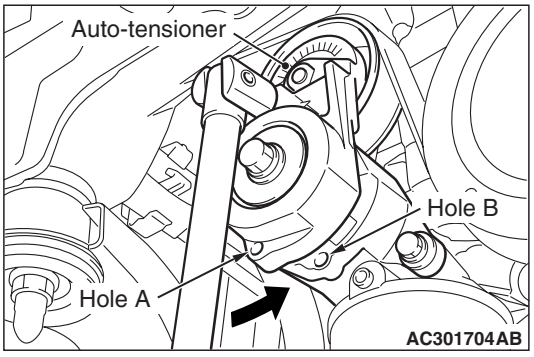
Removal steps

<<A>> 1. Drive belt
2. Crank shaft damper pulley

REMOVAL SERVICE POINT

<<A>> DRIVE BELT REMOVAL

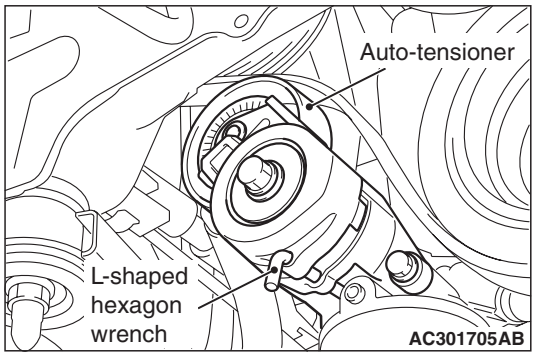
The following operations will be needed due to the introduction of the serpentine drive system with the drive belt auto-tensioner.



1. Securely insert the spindle handle or ratchet handle with a 12.7 mm insertion angle into the jig hole of the auto-tensioner.
2. Rotate the auto-tensioner anti-clockwise and align hole A with hole B.

⚠ CAUTION

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



3. Insert an L-shaped hexagon wrench, etc. into the hole to fix and then remove the drive belt.

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CAMSHAFT AND VALVE STEM SEAL

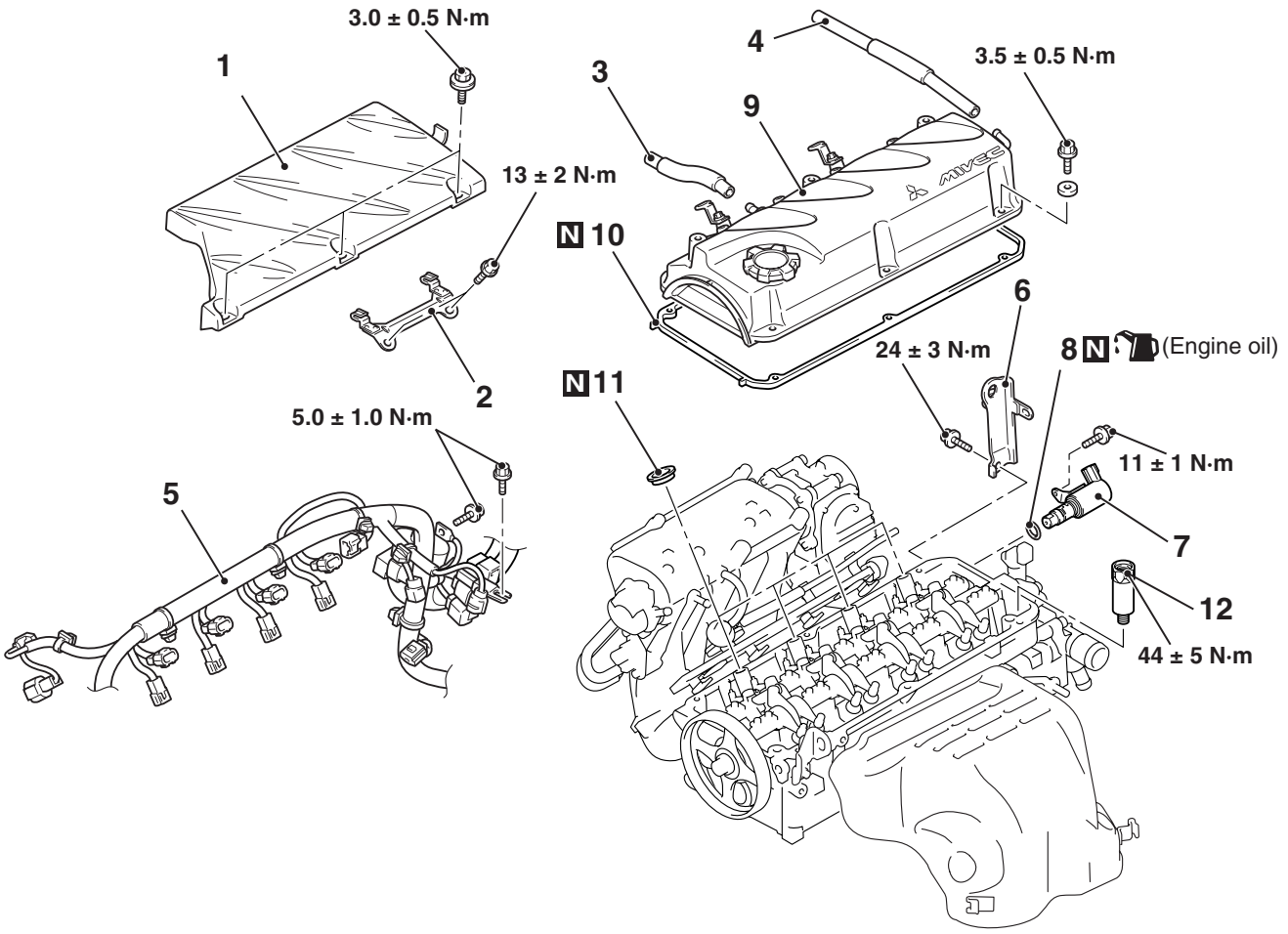
REMOVAL AND INSTALLATION

M1112006600910

⚠ CAUTION

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

Post-installation Operation
- Drive Belt Tension Check (Refer to P.11A-8).
- Valve Clearance Check and Adjustment (Refer to P.11A-10).



AC501695AB

Camshaft removal steps

- Timing belt upper cover (Refer to P.11A-36)

>>K<< 1. Engine cover
2. Engine cover bracket
3. Rocker cover PCV hose connection
4. Rocker cover breather hose connection
- Air cleaner (Refer to GROUP 15, Air cleaner P.15-3)
- Ignition coils (Refer to GROUP 16, Ignition System –Ignition Coil P.16-31)

Camshaft removal steps

5. Control wiring harness connection
6. Engine hanger

>>J<< 7. Oil control valve

>>J<< 8. O-ring

9. Rocker cover assembly
10. Rocker cover gasket
11. Spark plug guide oil seals
12. Accumulator assembly
- Valve timing belt (Refer to P.11A-36).

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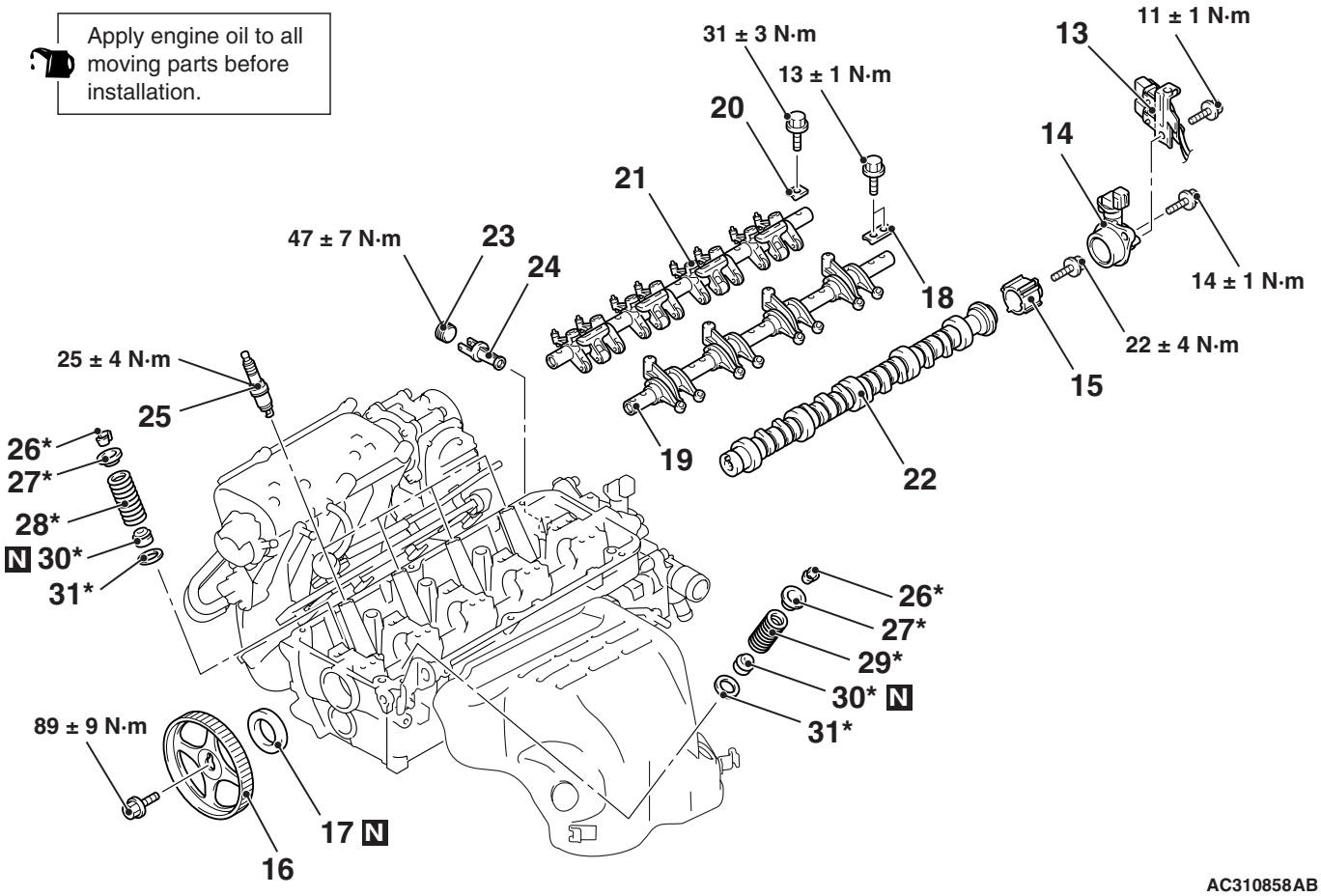

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Camshaft removal steps

13. Connector bracket
>>I<< 14. Camshaft position sensor support
15. Camshaft position sensing cylinder
<<A>> >>H<< 16. Camshaft sprocket
>>G<< 17. Camshaft oil seal
>>F<< 18. Exhaust rocker arm shaft caps
<<B>> >>F<< 19. Exhaust rocker arm and shaft assembly
>>E<< 20. Inlet rocker arm shaft caps
<<B>> >>E<< 21. Inlet rocker arm and shaft assembly
>>D<< 22. Camshaft
- Water inlet fitting and thermostat case assembly (Refer to GROUP 14, Water Hose and Water Pipe P.14-24).

23. Cylinder head plug
24. Oil control valve filter

Valve stem seal removal steps

- Timing belt upper cover (Refer to P.11A-36)

1. Engine cover
2. Engine cover bracket
3. Rocker cover PCV hose connection
4. Rocker cover breather hose connection
- Air cleaner (Refer to GROUP 15, Air cleaner P.15-3)
- Ignition coils (Refer to GROUP 16, Ignition System –Ignition Coil P.16-31)

5. Control wiring harness connection
6. Engine hanger
9. Rocker cover assembly
10. Rocker cover gasket
11. Spark plug guide oil seals
>>F<< 18. Exhaust rocker arm shaft caps
<<B>> >>F<< 19. Exhaust rocker arm and shaft assembly
>>E<< 20. Inlet rocker arm shaft caps
<<B>> >>E<< 21. Inlet rocker arm and shaft assembly
25. Spark plugs
<<C>> >>C<< 26. Valve spring retainer locks
27. Valve spring retainer
>>B<< 28. Inlet valve spring
>>B<< 29. Exhaust valve spring
>>A<< 30. Valve stem seals
31. Valve spring seats

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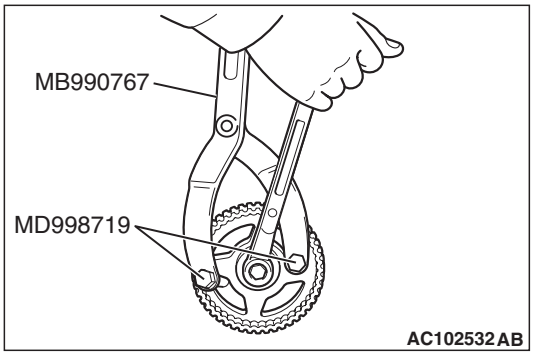
REMOVAL SERVICE POINTS

<<A>> CAMSHAFT SPROCKET REMOVAL



1. Use the following special tools to hold the camshaft sprocket.
   - Front hub and flange yoke holder (MB990767)
   - Pin (MD998719)
2. Loosen the camshaft sprocket mounting bolt and remove the camshaft sprocket.

<<B>> EXHAUST ROCKER ARM AND SHAFT ASSEMBLY/INLET ROCKER ARM AND SHAFT ASSEMBLY REMOVAL

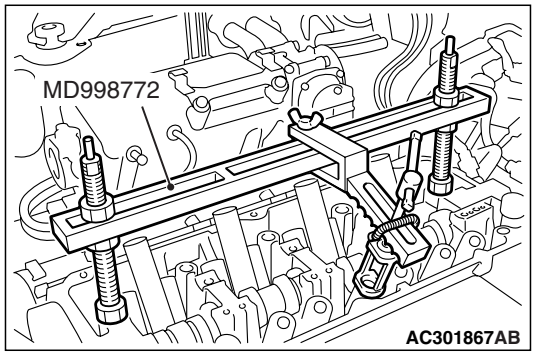
⚠ CAUTION

Never disassemble the exhaust rocker arm and shaft assembly, and inlet rocker arm and shaft assembly.

<<C>> VALVE SPRING RETAINER LOCKS REMOVAL

⚠ CAUTION

When removing valve spring retainer locks, leave the piston of each 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.



Use special tool valve spring compressor (MD998772) to compress the valve spring and then remove the valve spring retainer lock.

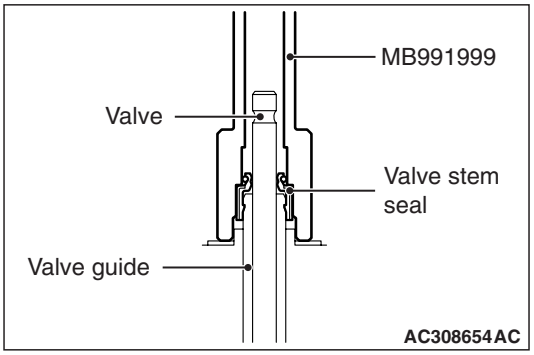
INSTALLATION SERVICE POINTS

>>A<< VALVE STEM SEALS INSTALLATION

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

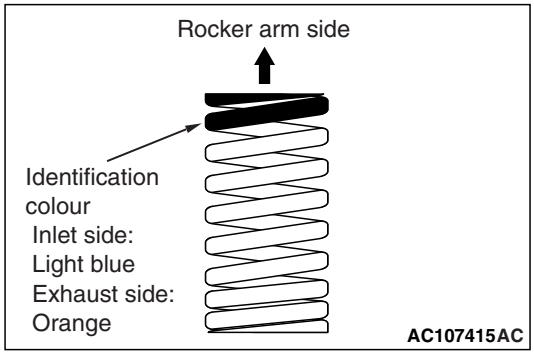
⚠ CAUTION

- **Do not re-use the valve stem seal.**
- **Special tool valve stem seal installer (MB991999) must be used to install the valve stem seal. Improper installation could result in oil leaking past the valve guide.**



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

>>B<< EXHAUST VALVE SPRINGS/INLET VALVE SPRINGS INSTALLATION



Install the valve springs with its identification colour painted end facing the locker arm.

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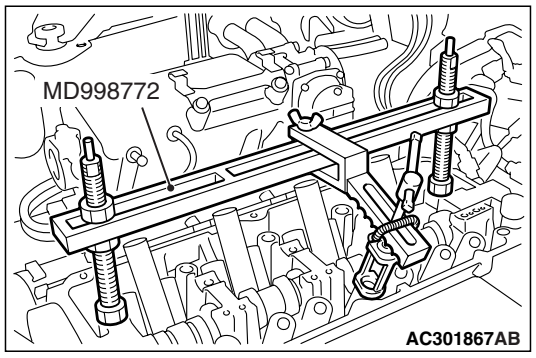
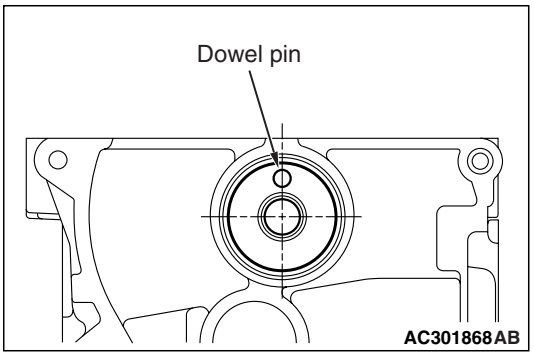
>>C<< VALVE SPRING RETAINER LOCKS INSTALLATION



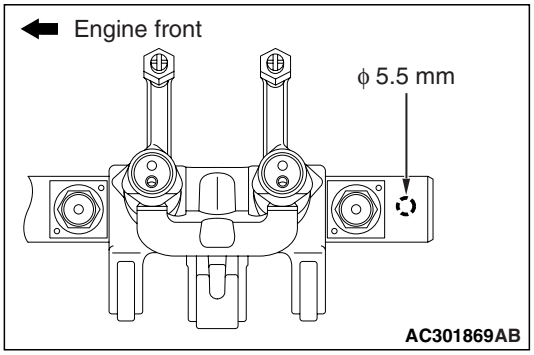
Use special tool valve spring compressor (MD998772) to compress the valve spring and then install the valve spring retainer lock in the same manner as removal.

>>D<< CAMSHAFT INSTALLATION



Set the dowel pin of the camshaft in the position shown in the figure.

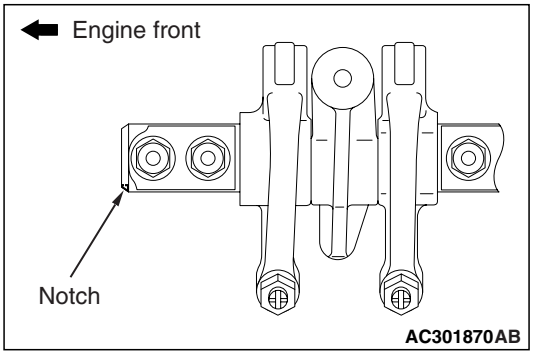
>>E<< INLET ROCKER ARM AND SHAFT ASSEMBLY/INLET ROCKER ARM SHAFT CAPS INSTALLATION



1. Place the inlet rocker shaft so that its 5.5 mm hole faces toward the cylinder head.
2. Install the inlet rocker arm shaft caps.
3. Tighten the inlet rocker shaft mounting bolts to the specified torque.

Tightening torque: 31 ±3 N· m

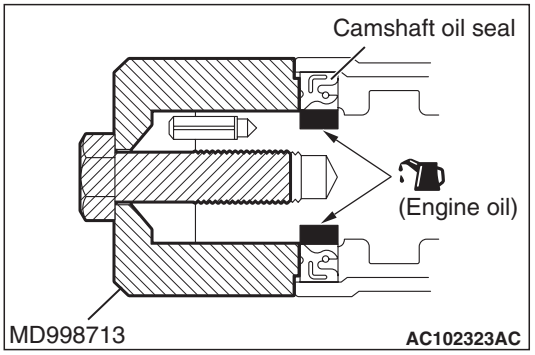
>>F<< EXHAUST ROCKER ARM AND SHAFT ASSEMBLY/EXHAUST ROCKER ARM SHAFT CAPS INSTALLATION



1. Install the exhaust rocker shaft so that its notch is positioned as shown.
2. Install the exhaust rocker arm shaft caps.
3. Tighten the exhaust rocker shaft mounting bolts to the specified torque.

Tightening torque: 13 ±1 N· m

>>G<< CAMSHAFT OIL SEAL INSTALLATION



1. Apply engine oil to the entire inner diameter of the oil seal lip.
2. Use special tool camshaft oil seal installer (MD998713) to press-fit the oil seal as shown.

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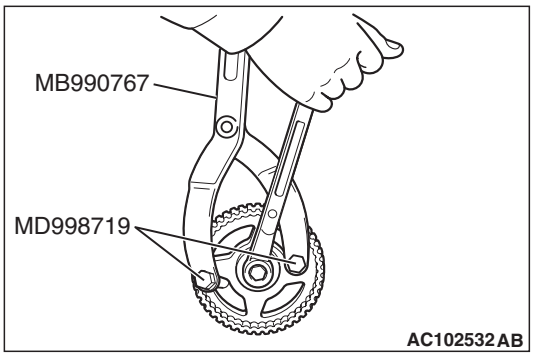
Group TOC

>>H<< CAMSHAFT SPROCKET INSTALLATION

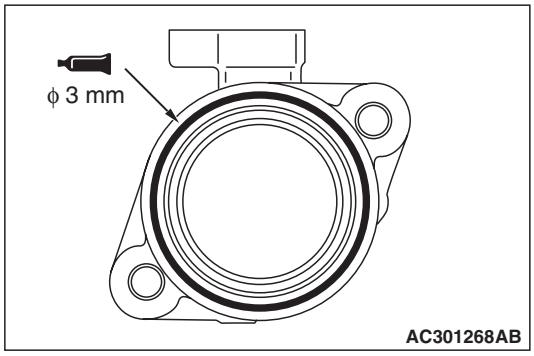


1. Use the following special tool as during removal to hold the camshaft sprocket.
   - Front hub and flange yoke holder (MB990767)
   - Pin (MD998719)
2. Tighten the camshaft sprocket mounting bolt to the specified torque.

   Tightening torque: 89 ±9 N· m

>>I<< CAMSHAFT POSITION SENSOR SUPPORT INSTALLATION

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



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

   Specified sealant: MITSUBISHI GENUINE PART MD970389 or equivalent

   NOTE: Install the camshaft position sensor support within 15 minutes after applying the sealant.
3. Install the camshaft position sensor support to the cylinder head.

⚠ CAUTION

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

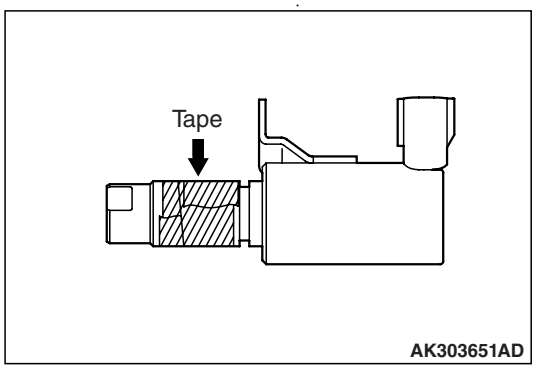
4. Tighten the camshaft position sensor support mounting bolts to the specified torque.

   Tightening torque: 14 ±1 N· m

>>J<< O-RING/OIL CONTROL VALVE INSTALLATION

⚠ CAUTION

- **Never re-use the O-ring.**

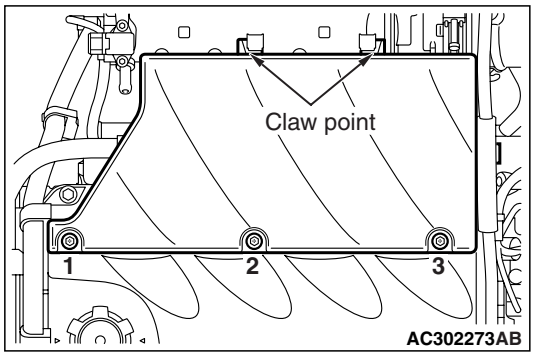


Before installing O-ring, wind the tape with the soft adhesion (sealing tape) around the oil passages cut-out area of engine oil control valve to prevent the damage. If the O-ring is damaged, it can be the cause of oil leak.

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

   Tightening torque: 11 ±1 N· m

>>K<< ENGINE COVER INSTALLATION



1. Engage the engine cover claws in the engine cover bracket.
2. Finger-tighten the engine cover mounting bolts in the order shown in the figure so that the engine cover can be moved by hand.
3. Tighten the engine cover mounting bolts to the specified torque in the order shown.

   Tightening torque: 3.0 ±0.5 N· m

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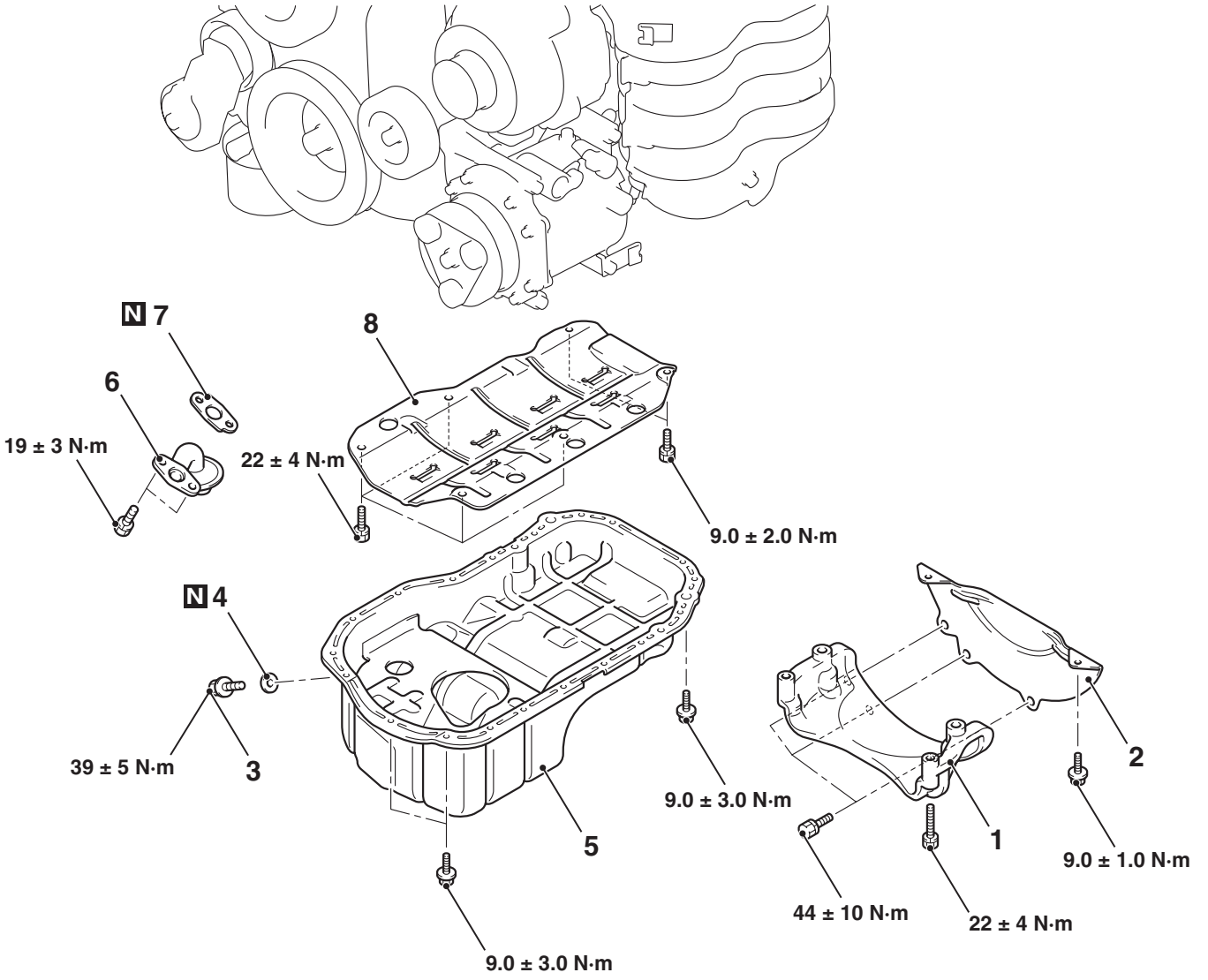
OIL PAN

REMOVAL AND INSTALLATION

M1112002801313

Pre-removal Operation	Post-installation Operation
• Engine Oil Draining (Refer to GROUP 12, On-vehicle Service –Engine Oil Replacement P.12-4). • Front Exhaust Pipe Removal (Refer to GROUP 15, Exhaust Pipe and Main Muffler P.15-9). • Exhaust Pre-muffler Removal (Refer to GROUP 15, Exhaust Pipe and Main Muffler P.15-9) <Except vehicles for Hong Kong, Singapore, Brazil, Australia and New Zealand>. • Catalytic Converter Removal (Refer to GROUP 15, Exhaust Pipe and Main Muffler P.15-9) <Vehicles for Hong Kong, Singapore, Brazil, Australia and New Zealand>.	• Catalytic Converter Installation (Refer to GROUP 15, Exhaust Pipe and Main Muffler P.15-9) <Vehicles for Hong Kong, Singapore, Brazil, Australia and New Zealand>. • Exhaust Pre-muffler Installation (Refer to GROUP 15, Exhaust Pipe and Main Muffler P.15-9) <Except vehicles for Hong Kong, Singapore, Brazil Australia and New Zealand>. • Front Exhaust Pipe Installation (Refer to GROUP 15, Exhaust Pipe and Main Muffler P.15-9). • Engine Oil Refilling (Refer to GROUP 12, On-vehicle Service –Engine Oil Replacement P.12-4).



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Removal steps

>>C<< 1. Transmission housing front lower cover stay
2. Flywheel housing front lower cover <M/T> or torque converter housing front lower cover <A/T>
3. Engine oil pan drain plug

Removal steps (Continued)

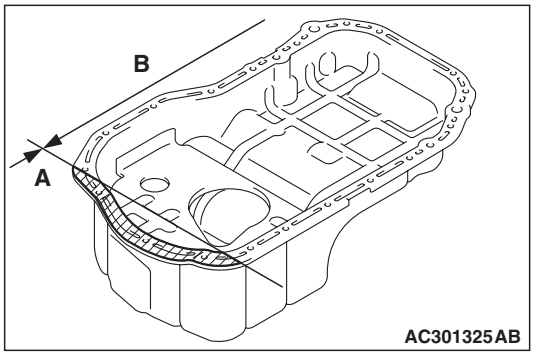
>>B<< 4. Engine oil pan drain plug gasket
<<A>> >>A<< 5. Engine oil pan
6. Engine oil pan strainer
7. Engine oil pan strainer gasket
8. Baffle plate

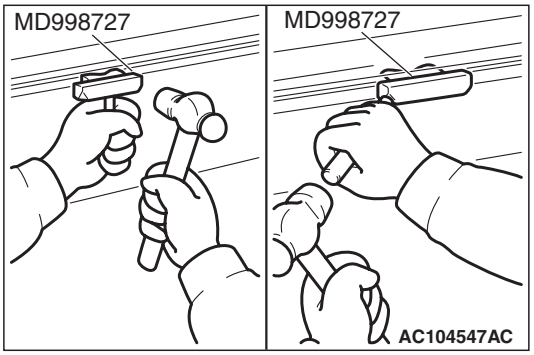
REMOVAL SERVICE POINT

<<A>> ENGINE OIL PAN REMOVAL

1. Remove the engine oil pan mounting bolts.

⚠ CAUTION





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

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

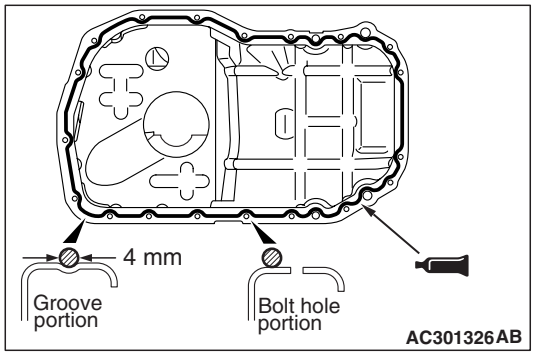
   NOTE: If any sounding parts interfere with the removal, there is no need to use special tool MD998727.

3. Remove the engine oil pan.

INSTALLATION SERVICE POINTS

>>A<< ENGINE OIL PAN INSTALLATION

1. Remove sealant from the engine oil pan, front case and cylinder block surfaces.



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

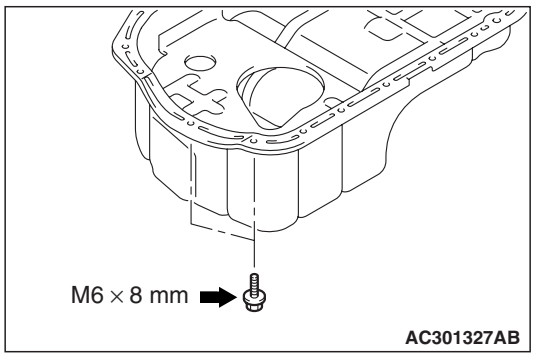
   Specified sealant: MITSUBISHI GENUINE PART MD970389 or equivalent

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

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

⚠ CAUTION

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



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

   Tightening torque: 9.0 ±3.0 N· m

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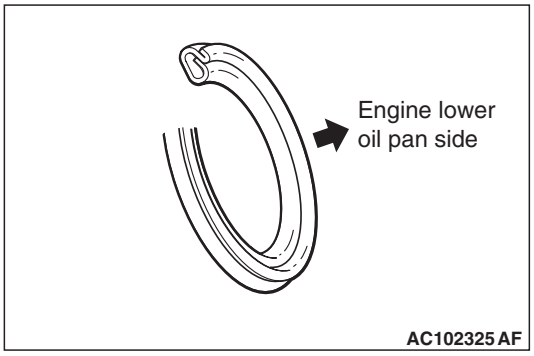
>>B<< ENGINE OIL PAN DRAIN PLUG GASKET INSTALLATION



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

>>C<< TRANSMISSION HOUSING FRONT LOWER COVER STAY INSTALLATION

Install the transmission housing front lower cover stay as follows.

1. Tighten four mounting bolts of the engine side by hand.
2. Tighten three mounting bolts of the transmission side to the specified torque.

   Tightening: 44 ±10 N· m
3. Tighten four mounting bolts of the engine side to the specified torque.

   Tightening: 22 ±4 N· m

INSPECTION

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

CRANKSHAFT OIL SEAL

REMOVAL AND INSTALLATION

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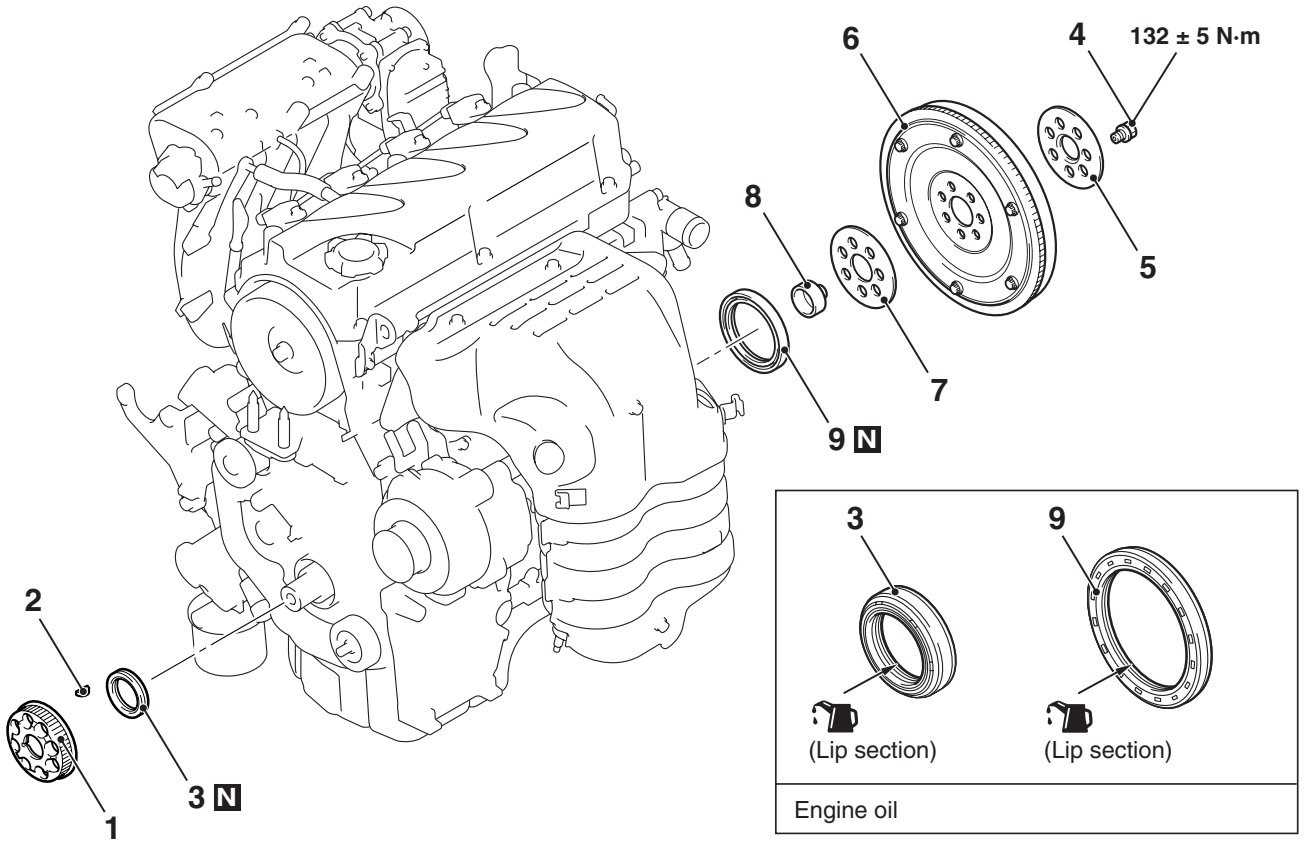
<M/T>



Crankshaft front oil seal removal steps

- Valve timing belt, balancer timing belt (Refer to P.11A-36).

>>D<< 1. Crankshaft balancer shaft drive sprocket
2. Crankshaft key
>>C<< 3. Crankshaft front oil seal

<<A>>

<<B>>

Crankshaft rear oil seal removal steps

- Transmission assembly
- Clutch cover and clutch disc (Refer to GROUP 21B, Clutch P.21B-3).

>>B<< 4. Flywheel bolts
5. Flywheel adapter plate
6. Flywheel assembly
7. Flywheel adapter plate
8. Crankshaft bush
>>A<< 9. Crankshaft rear oil seal

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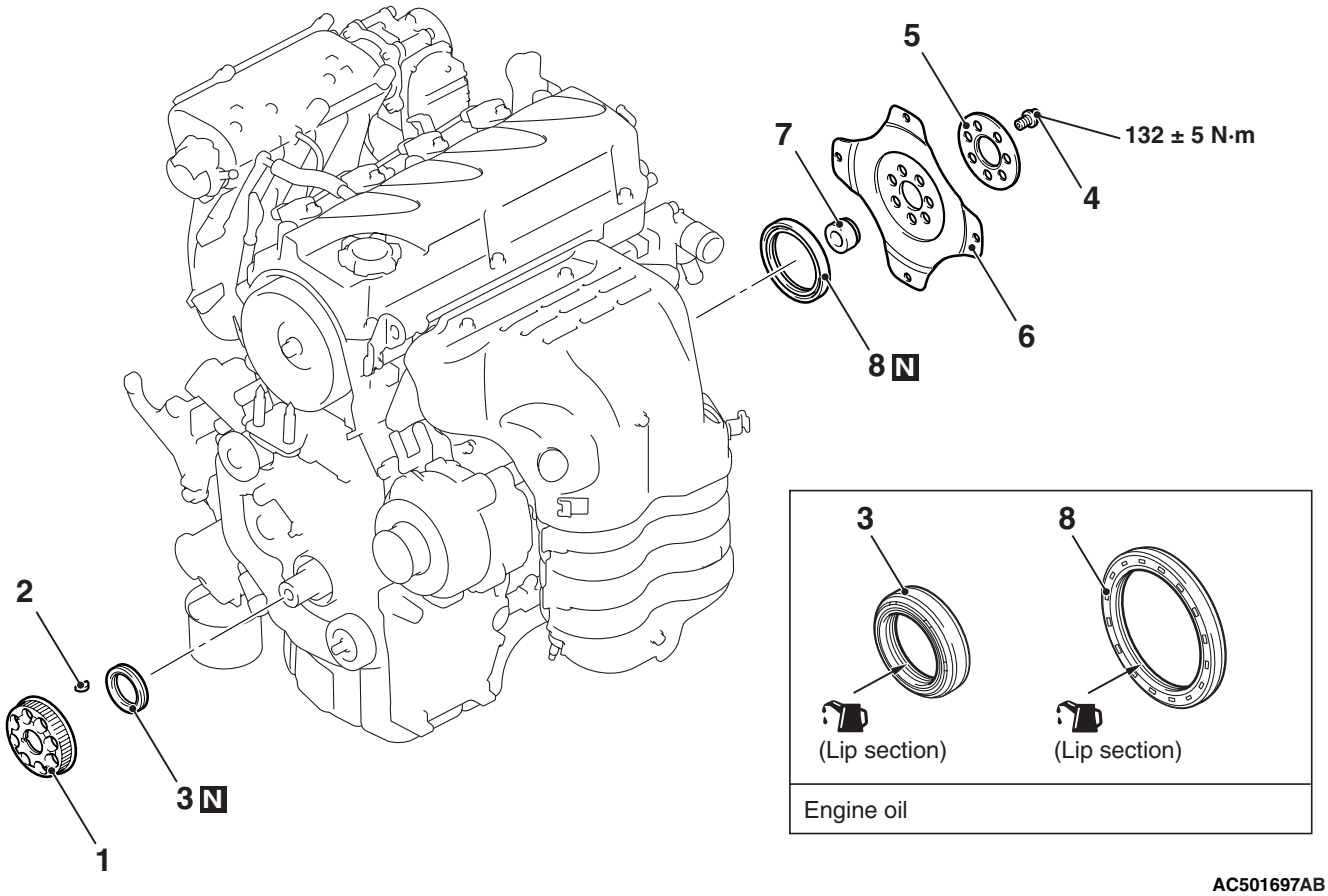
<A/T>



Crankshaft front oil seal removal steps

- Valve timing belt, balancer timing belt (Refer to P.11A-36).

>>D<< 1. Crankshaft balancer shaft drive sprocket
2. Crankshaft key
>>C<< 3. Crankshaft front oil seal

Crankshaft rear oil seal removal steps

- Transmission assembly (Refer to GROUP 23A, Transmission Assembly P.23A-165).

<<B>> >>B<< 4. A/T drive plate bolts
5. A/T drive plate adapter plate
6. A/T drive plate
7. Crankshaft bush
>>A<< 8. Crankshaft rear oil seal

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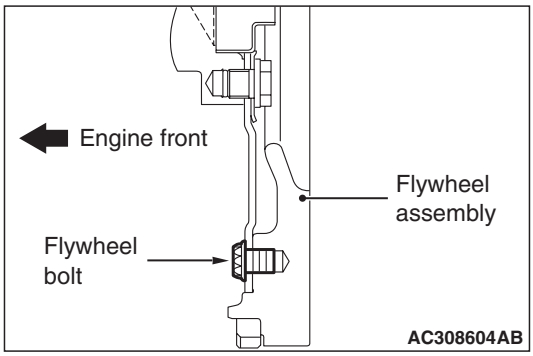
REMOVAL SERVICE POINTS

<<A>> TRANSMISSION ASSEMBLY REMOVAL

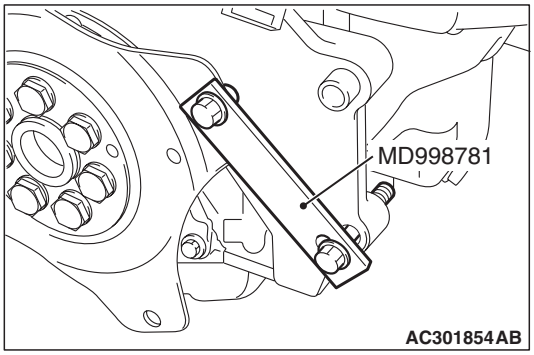
⚠ CAUTION



Do not remove the flywheel bolt. If this bolt is removed, the flywheel assembly will become out of balance and damaged.

Refer to GROUP 22A, Transmission Assembly P.22A-11.

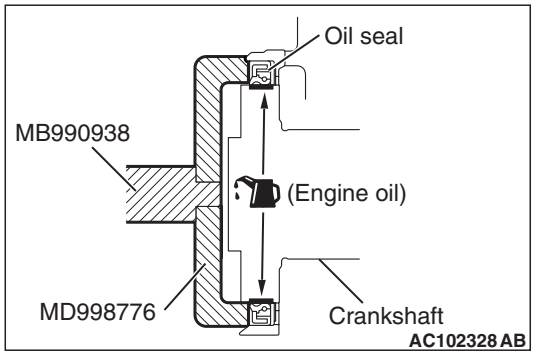
<<B>> FLYWHEEL BOLTS/A/T DRIVE PLATE BOLTS REMOVAL



1. Use special tool flywheel stopper (MD998781) to secure the flywheel assembly or A/T drive plate.
2. Remove the flywheel bolts or A/T drive plate bolts.

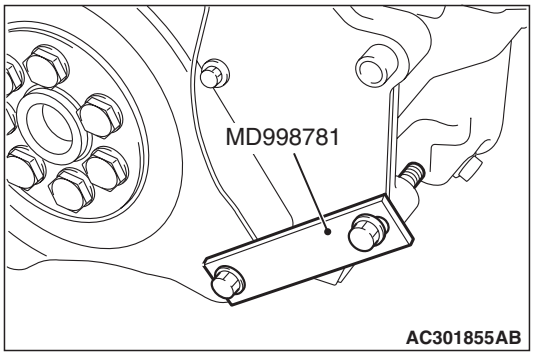
INSTALLATION SERVICE POINTS

>>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. Use the following special tools to press-fit the oil seal.
   - Installer bar (MB990938)
   - Crankshaft rear oil seal installer (MD998776)

>>B<< FLYWHEEL BOLTS/A/T DRIVE PLATE BOLTS INSTALLATION



1. Use special tool flywheel stopper (MD998781) to secure the flywheel assembly or A/T drive plate in the same manner as removal.
2. Tighten the flywheel bolts or A/T drive plate bolts to the specified torque.

Tightening torque: 132 ±5 N·m

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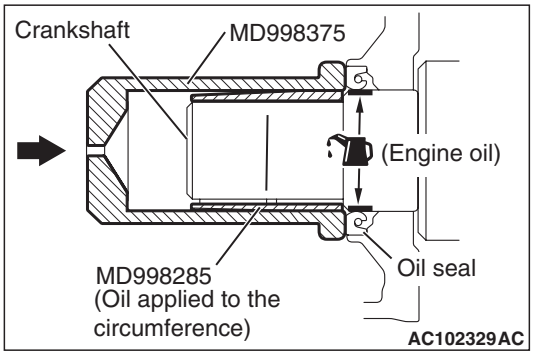
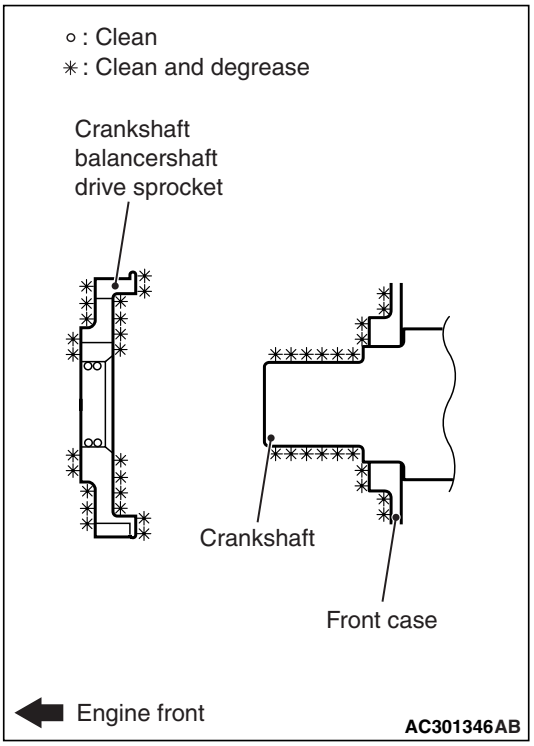
>>C<< CRANKSHAFT FRONT OIL SEAL INSTALLATION



1. Apply a small amount of engine oil to the outer diameter of special tool crankshaft front oil seal guide (MD998285) and install it to the crankshaft.
2. Apply a small amount of engine oil to the entire inner diameter of the oil seal lip.
3. Use special tool crankshaft front oil seal installer (MD998375) to press-fit the oil seal.

>>D<< CRANKSHAFT BALANCER SHAFT DRIVE SPROCKET INSTALLATION



1. Clean or degrease the front case, the crankshaft and the crankshaft balancer shaft drive sprocket as shown.

   NOTE: Also clean the degreased surfaces.
2. Install the crankshaft balancer shaft drive sprocket in the direction shown in the illustration.

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Group TOC

CYLINDER HEAD GASKET

REMOVAL AND INSTALLATION

M1112004001647

Pre-removal Operation	Post-installation Operation
• Fuel Line Pressure Reduction [Refer to GROUP 13A, On-vehicle Service –Fuel Pump Connector Disconnection (How to Reduce Pressurized Fuel Lines) <Except Vehicles for Hong Kong, Singapore, Australia and New Zealand>P.13A-310]. • Fuel Line Pressure Reduction [Refer to GROUP 13B, On-vehicle Service –Fuel Pump Connector Disconnection (How to Reduce Pressurized Fuel Lines) <Vehicles for Hong Kong and Singapore>P.13B-284]. • Fuel Line Pressure Reduction [Refer to GROUP 13C, On-vehicle Service –Fuel Pump Connector Disconnection (How to Reduce Pressurized Fuel Lines) <Vehicles for Australia and New Zealand>P.13C-337]. • Engine Coolant Draining (Refer to GROUP 14, On-vehicle Service –Engine Coolant Replacement P.14-18). • Cowl Top Panel Removal (Refer to GROUP 42, Loose Panel P.42-80). • Engine Cover Removal (Refer to P.11A-17). • Air Cleaner Removal (Refer to GROUP 15, Air Cleaner P.15-3).	• Air Cleaner Installation (Refer to GROUP 15, Air Cleaner P.15-3). • Engine Cover Installation (Refer to P.11A-17). • Cowl Top Panel Installation (Refer to GROUP 42, Loose Panel P.42-80). • Engine Coolant Refilling (Refer to GROUP 14, On-vehicle Service –Engine Coolant Replacement P.14-18). • Fuel Leak Check

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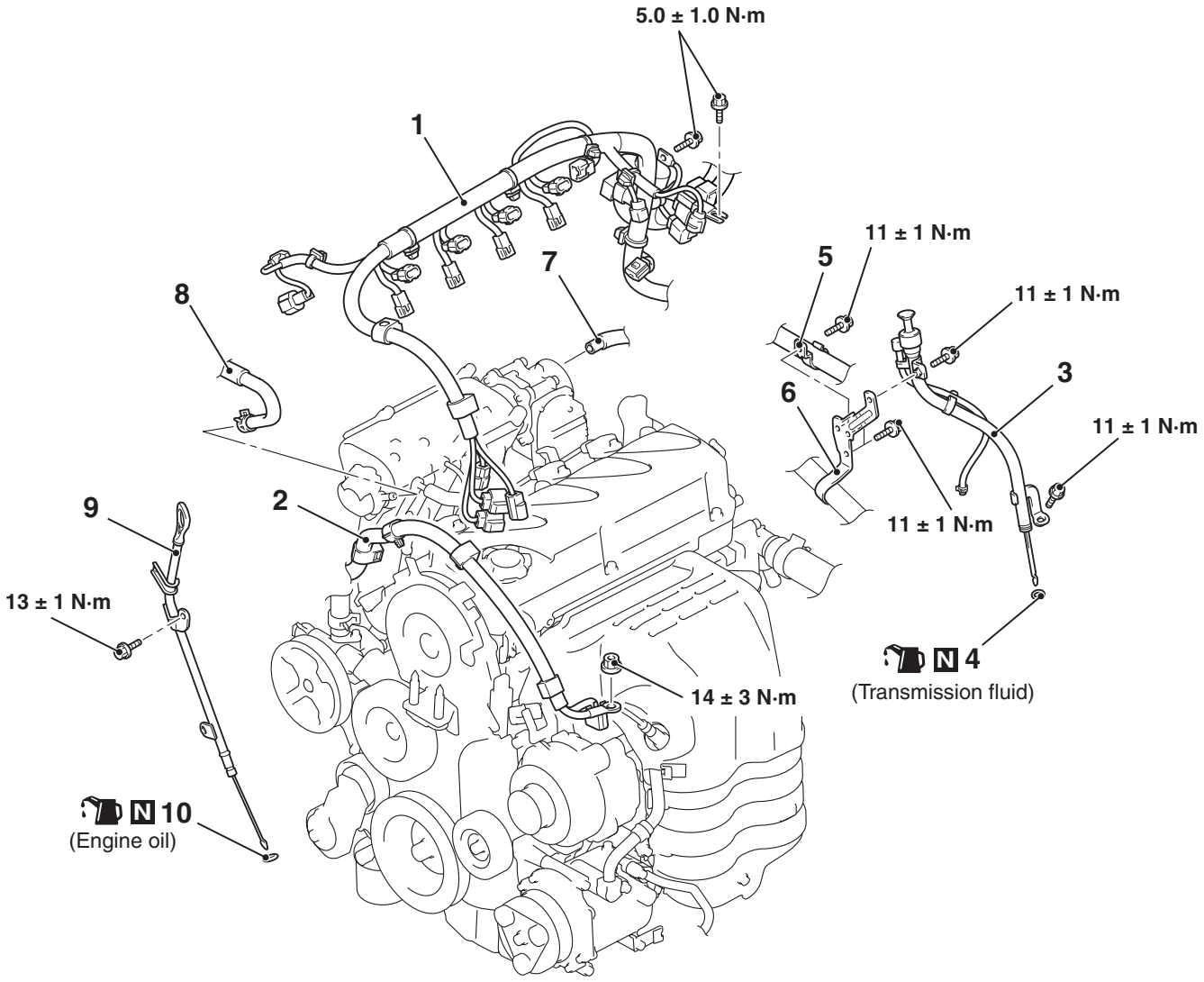

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Removal steps

1. Control wiring harness connection
2. Battery wiring harness connection
3. Breather hose, transmission fluid level gauge and guide assembly
4. O-ring
5. Radiator lower hose clamp
6. Transmission fluid level gauge bracket

Removal steps (Continued)

>>F<<
7. Canister vacuum hose connection
8. Brake booster vacuum hose connection
9. Engine oil level gauge and guide assembly
10. O-ring

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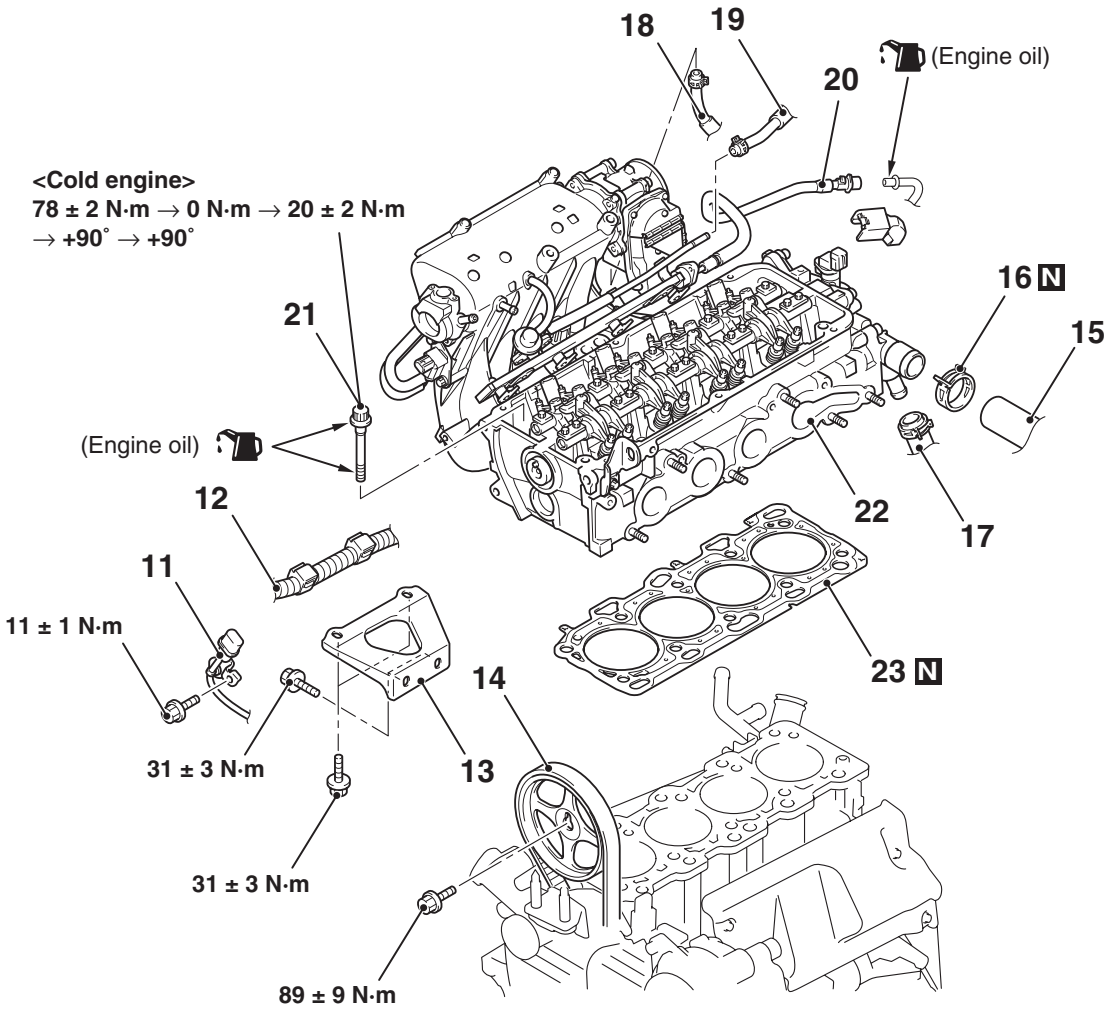

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Removal steps

11. Detonation sensor connection
12. Battery wiring harness connection
13. Inlet manifold stay
- Exhaust manifold (Refer to GROUP 15, Exhaust Manifold P.15-7).
- Timing belt upper cover (Refer to P.11A-36).

<<A>> >>E<< 14. Camshaft sprocket
<<B>> >>D<< 15. Radiator upper hose connection
<<B>> >>D<< 16. Hose clip
17. Water hose connection <Vehicles for Hong kong>
18. Water hose connection

Removal steps (Continued)

- Water inlet fitting and thermostat case assembly (Refer to GROUP 14, Water Hose and Water Pipe P.14-24).

19. Fuel return hose connection
<<C>> >>C<< 20. Fuel high-pressure hose connection
- Rocker cover assembly (Refer to P.11A-17).

<<D>> >>B<< 21. Cylinder head bolts
22. Cylinder head assembly
>>A<< 23. Cylinder head gasket

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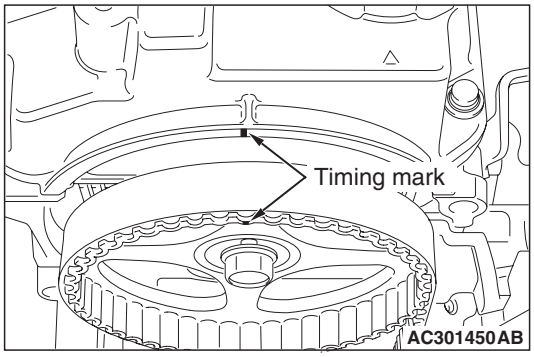
REMOVAL SERVICE POINTS

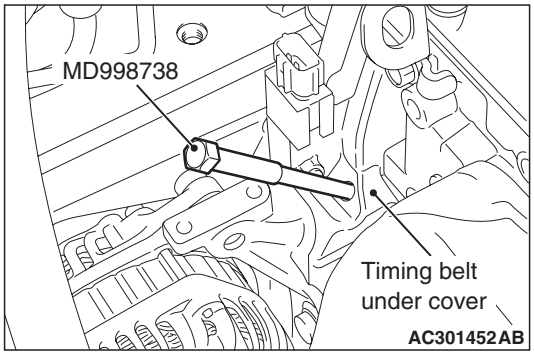
<<A>> CAMSHAFT SPROCKET REMOVAL

⚠ CAUTION

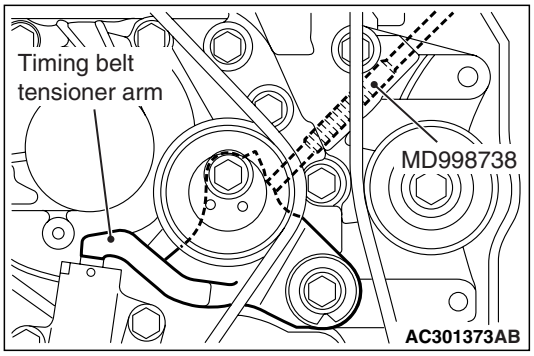
Never turn the crankshaft anti-clockwise.



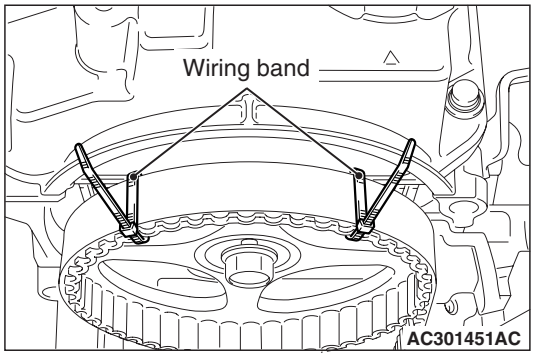
1. Turn the crankshaft clockwise, align the timing marks on the camshaft sprocket to set No.1 cylinder to TDC of its compression stroke.



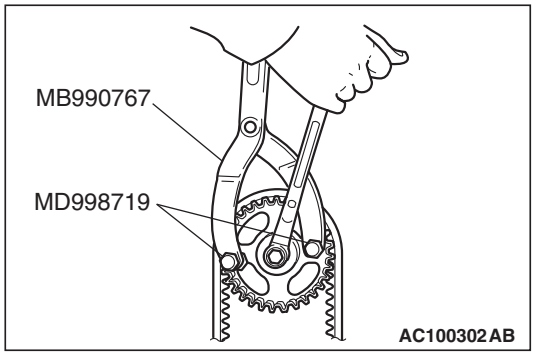
2. Remove the timing belt under cover rubber plug and then set special tool adjusting bolt (MD998738).



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



4. Secure the camshaft sprocket and valve timing belt with wiring bands and so on to prevent slippage between the camshaft sprocket and valve timing belt.



5. Use the following special tools to hold the camshaft sprocket.
   - Front hub and flange yoke holder (MB990767)
   - Pin (MD998719)

⚠ CAUTION

Do not rotate the crankshaft after camshaft sprocket removal.

6. Remove the camshaft sprocket with the valve timing belt and place it on the timing belt lower cover.

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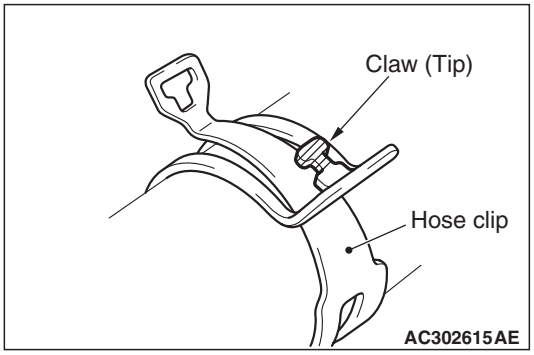
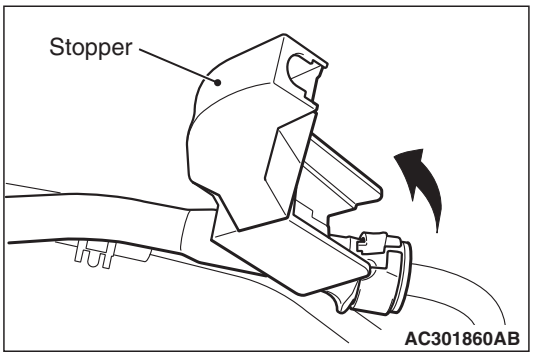
<<B>> RADIATOR UPPER HOSE/HOSE CLIP DISCONNECTION



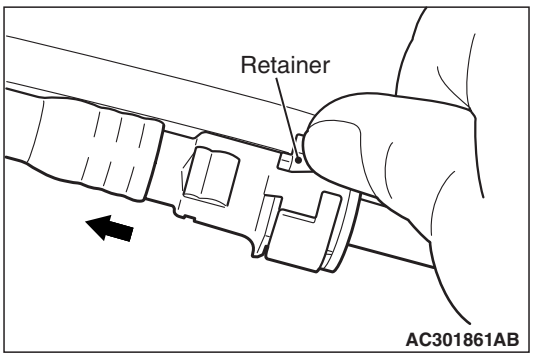
Break off the tip of hose clip claw and spread out the hose clip, then disconnect the radiator upper hose.

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

<<C>> FUEL HIGH-PRESSURE HOSE REMOVAL



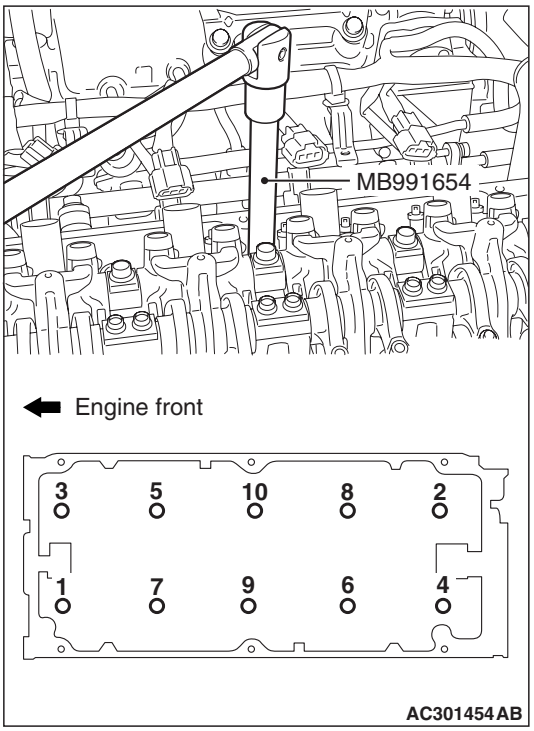
1. Remove the fuel high-pressure hose stopper.



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

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

<<D>> CYLINDER HEAD BOLTS REMOVAL



Use special tool cylinder head bolt wrench (MB991654) to loosen the cylinder head bolts in two or three steps in the order of the numbers shown in the illustration. If the cylinder head bolts cannot be pulled out due to the washer being trapped in the valve spring, raise the bolt slightly, then remove it while holding it by using a magnet.

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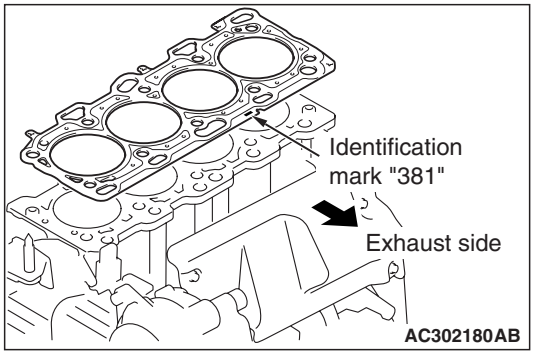
INSTALLATION SERVICE POINTS

>>A<< CYLINDER HEAD GASKET INSTALLATION

⚠ CAUTION

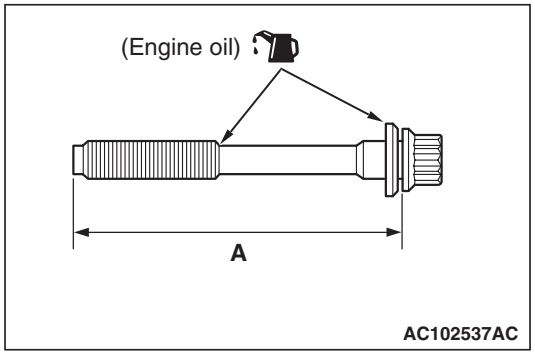
Do not allow any foreign materials get into the coolant passages, oil passages and cylinder.

1. Degrease the cylinder head gasket mounting surface.



2. Assemble to the cylinder block so the cylinder head gasket identification mark of "381" is at the top surface and on the exhaust side.

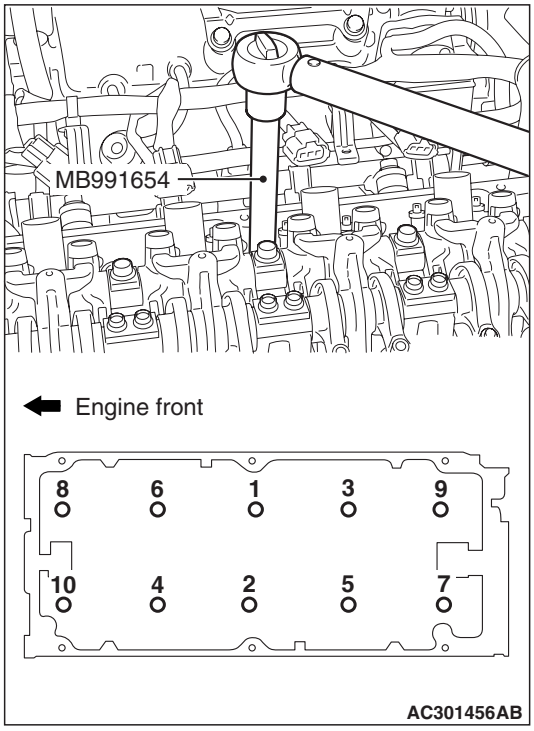
>>B<< CYLINDER HEAD BOLTS INSTALLATION



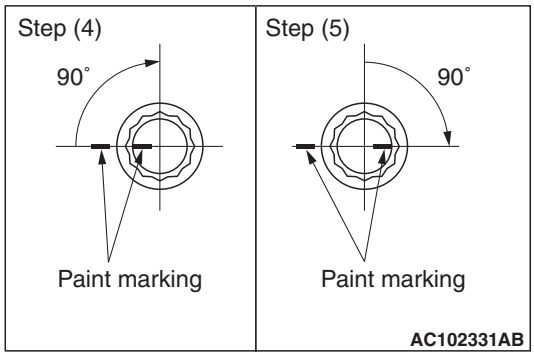
1. Check that the nominal length of each cylinder head bolt meets the limit. If it exceeds the limit, replace the bolts with a new one.

   Limit (A): 99.4 mm

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



3. Use special tool cylinder head bolt wrench (MB991654) to tighten the cylinder head bolts in the following procedures.
   (1) Tighten the bolts to 78 ±2 N· m in the order shown.
   (2) Loosen the bolts fully in the reverse sequence to that shown.
   (3) Tighten the bolts to 20 ±2 N· m in the order shown.



   (4) Apply a paint mark to the heads of the cylinder head bolts and cylinder head, then tighten 90 degree angle as shown.

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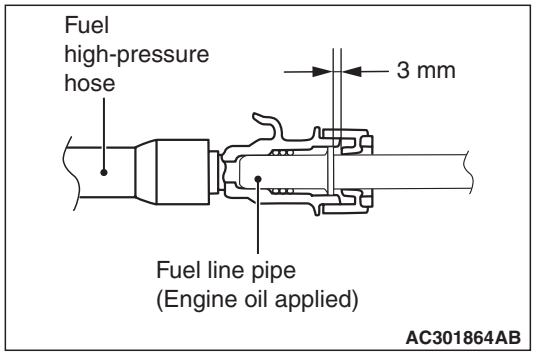
⚠ CAUTION

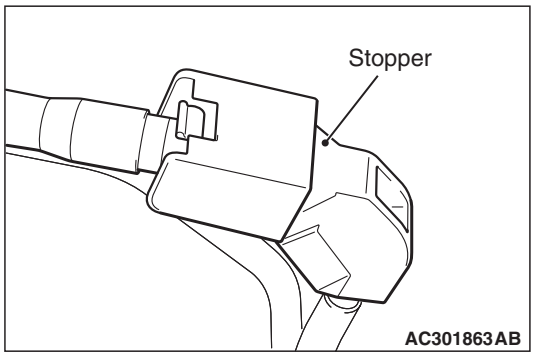
- **The bolt is not tightening sufficiently if the tightening angle is less than a 90 degree angle.**
- **If the tightening angle exceeds the standard specification, remove the bolt and start over from step 1.**

(5) Tighten in a 90 degree angle as shown in the instructions of the figure, then check to see that the paint mark on the head of the cylinder head bolts and the paint mark on the cylinder head is on a linear line.

>>C<< FUEL HIGH-PRESSURE HOSE INSTALLATION

⚠ CAUTION





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

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

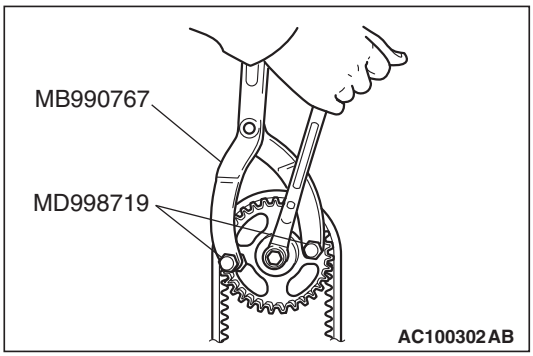
>>D<< RADIATOR UPPER HOSE/HOSE CLIP CONNECTION

⚠ CAUTION

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

1. insert a new hose clip into the radiator upper hose.
2. Insert the radiator upper hose until the protrusion of water outlet fitting.
3. Remove the hose clip claw and shorten the hose clip, then secure the radiator upper hose.

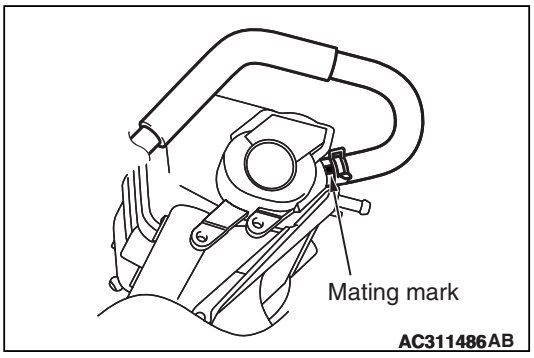
>>E<< CAMSHAFT SPROCKET INSTALLATION



1. Use the following special tool as during removal to hold the camshaft sprocket.
   - Front hub and flange yoke holder (MB990767)
   - Pin (MD998719)
2. Tighten the camshaft sprocket mounting bolt to the specified torque.

   Tightening torque: 89 ±9 N· m

>>F<< BRAKE BOOSTER VACUUM HOSE INSTALLATION



1. Insert the brake booster vacuum hose thoroughly until it contacts the inlet manifold so that its mating mark faces towards the direction shown.
2. Secure the brake booster vacuum hose with hose clip.

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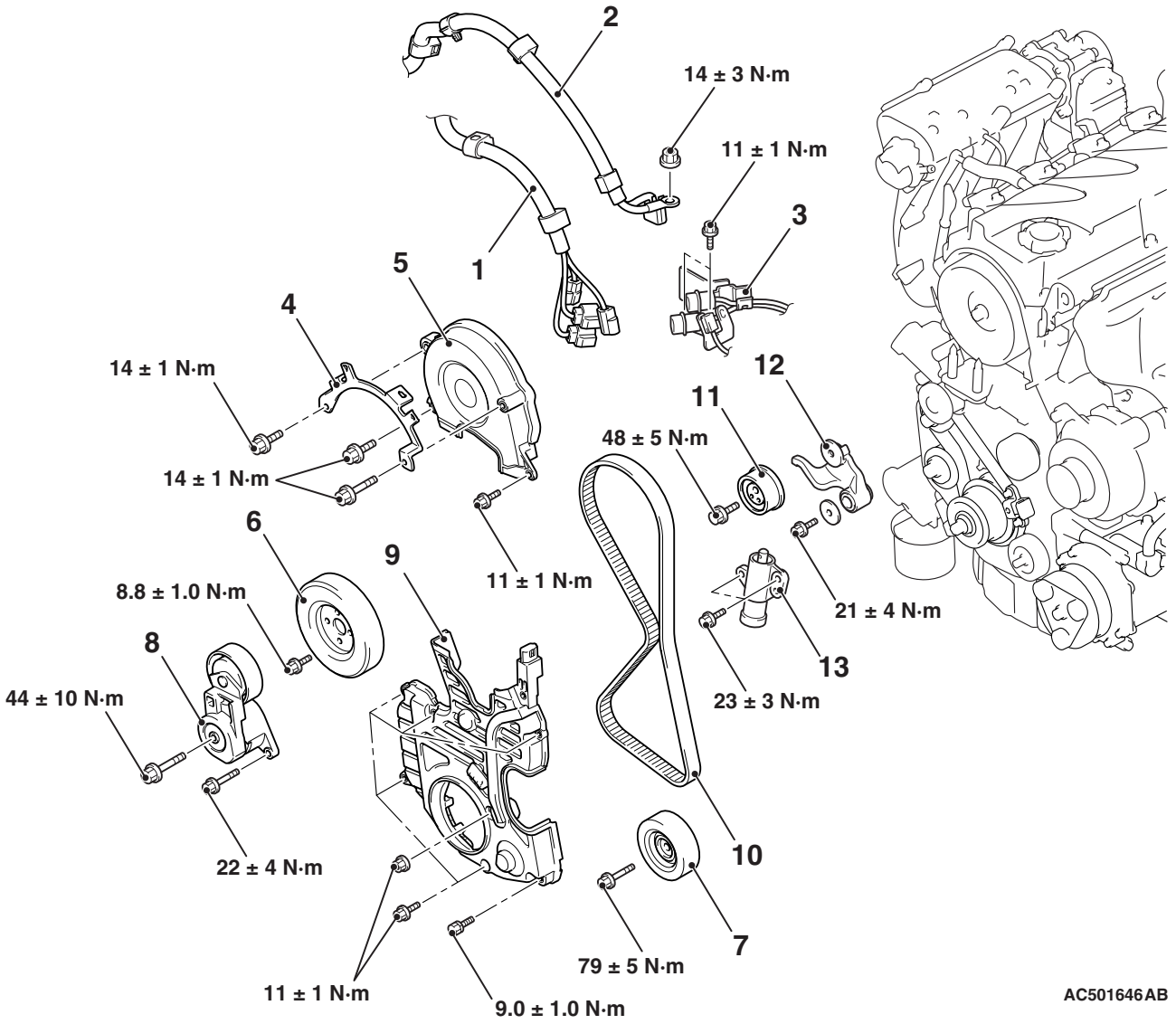
TIMING BELT

REMOVAL AND INSTALLATION

M1112004301303

Pre-removal Operation	Post-installation Operation
• Engine room side cover (RH) Removal. • Crankshaft Shaft Damper Pulley Removal (Refer to P.11A-16).	• Crankshaft Shaft Damper Pulley Installation (Refer to P.11A-16). • Drive Belt Tension Check (Refer to P.11A-8). • Engine room side cover (RH) Installation.



Removal steps

1. Control wiring harness connection <<A>>
2. Battery wiring harness connection
3. Connector bracket
4. Harness bracket >>G<<
5. Timing belt upper cover
6. Water pump pulley <<B>> >>F<<
7. Idler pulley >>E<<
8. Auto-tensioner
9. Timing belt lower cover >>D<<

Removal steps (Continued)

- Brake fluid reservoir assembly
- Engine mounting insulator (Refer to GROUP 32, Engine Mount P.32-3).
- Valve timing belt tension adjustment (Installation only)

10. Valve timing belt
11. Timing belt tensioner pulley
12. Timing belt tensioner arm
13. Timing belt tensioner adjuster

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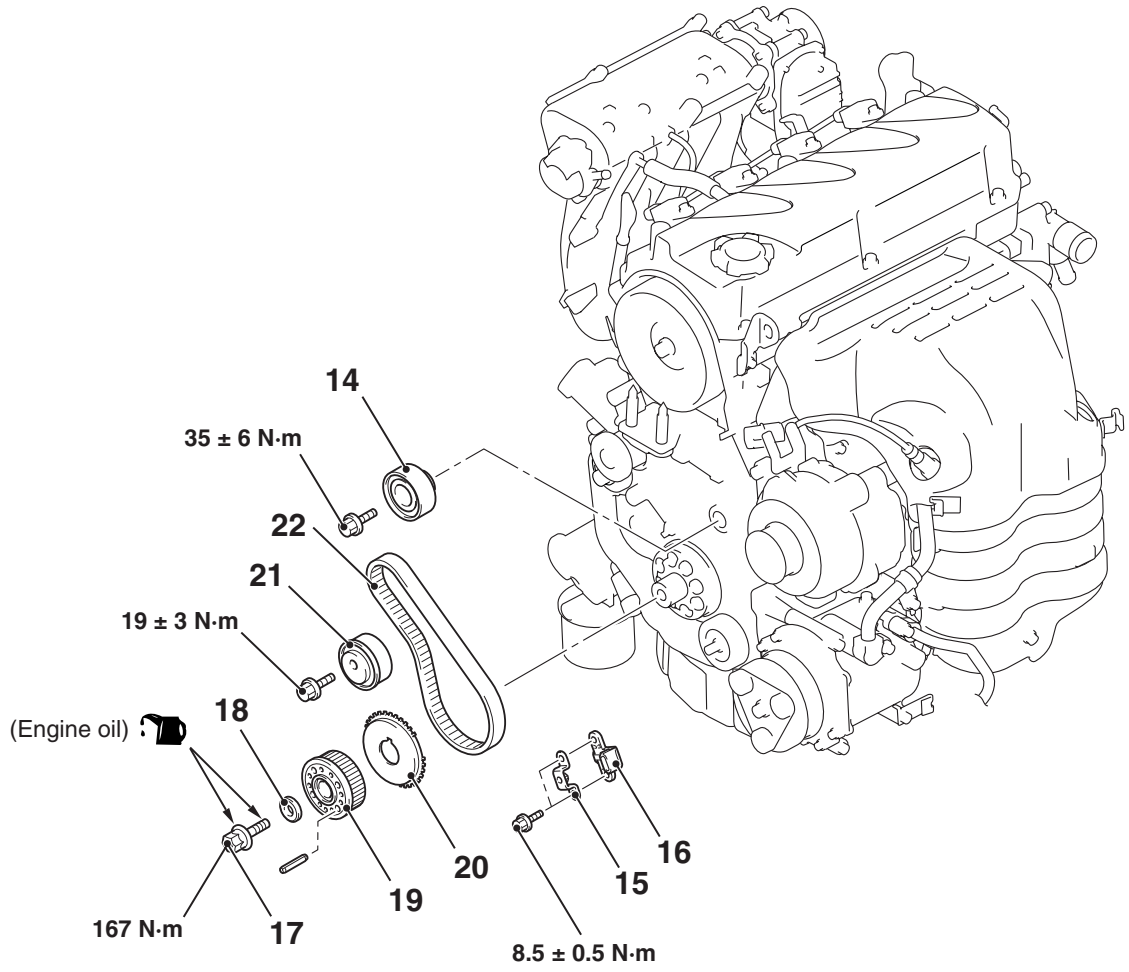

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Removal steps

14. Timing belt Idler pulley
15. Timing belt lower cover bracket
16. Crank angle sensor

<<C>> >>C<< 17. Crankshaft pulley centre bolt

<<C>> >>C<< 18. Crankshaft pulley washer

<<C>> >>C<< 19. Crankshaft camshaft drive sprocket

Removal steps (Continued)

>>C<< 20. Crankshaft angle sensing blade

>>B<< • Balancer timing belt tension adjustment (Installation only)

>>A<< 21. Balancer timing belt tensioner

<<D>> >>A<< 22. Balancer timing belt

REMOVAL SERVICE POINTS

<<A>> BRAKE FLUID RESERVOIR ASSEMBLY REMOVAL

1. With the hose installed, remove the brake fluid reservoir assembly from the vehicle. (Refer to GROUP 35A, Master Cylinder Assembly and Brake Booster P.35A-15).
2. Tie the removed brake fluid reservoir assembly with a string at a position where it will not interfere with the removal and installation of timing belt.

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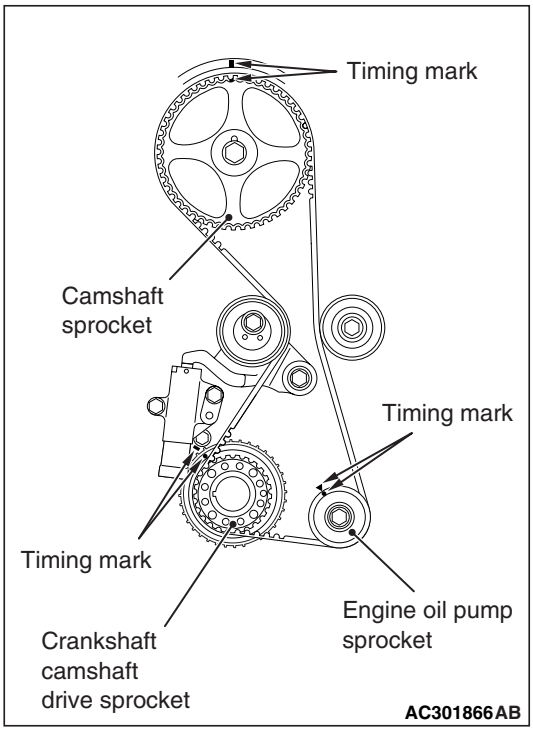
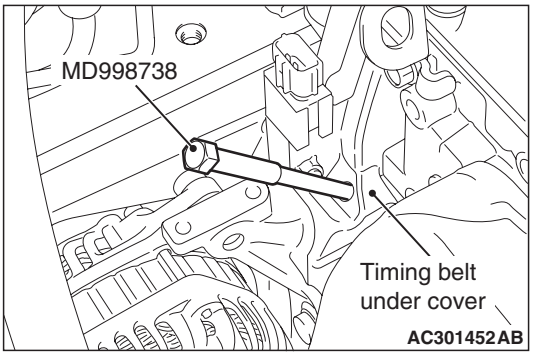
<<B>> VALVE TIMING BELT REMOVAL

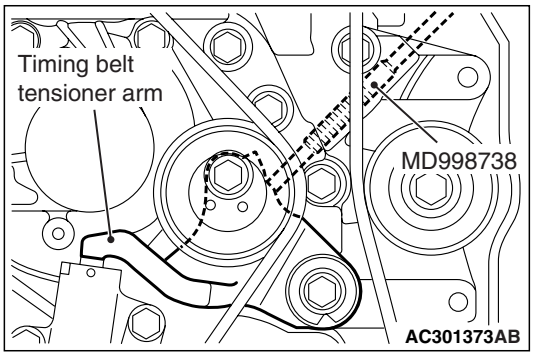
⚠ CAUTION
Never turn the crankshaft anti-clockwise.



1. Turn the crankshaft clockwise, align each timing mark to set No.1 cylinder to TDC of its compression stroke.

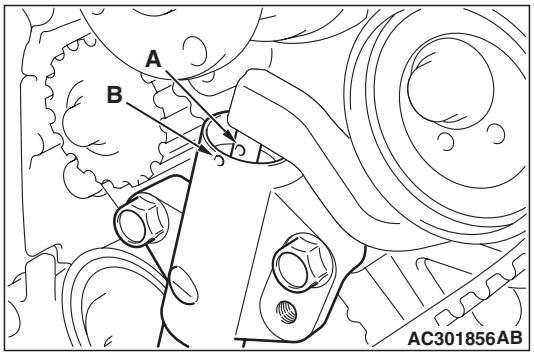


2. Remove the timing belt under cover rubber plug and then set special tool adjusting bolt (MD998738).

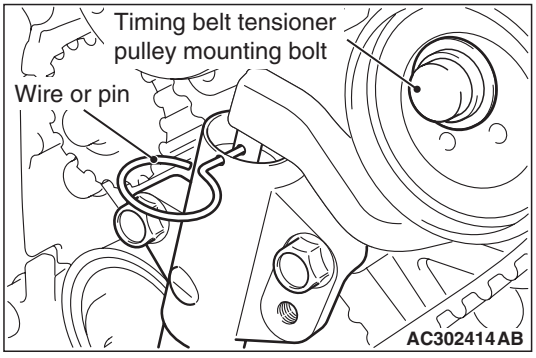


3. Screw in the special tool with hands until it contacts the timing belt tensioner arm.

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



4. Gradually screw in the special tool and then align the timing belt tensioner adjuster rod set hole A with the timing belt tensioner adjuster cylinder set hole B.



5. Insert a wire or pin in the set hole aligned.

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

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

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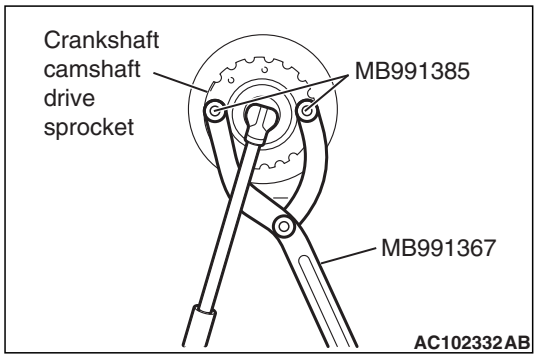
<<C>> CRANKSHAFT PULLEY CENTRE BOLT/CRANKSHAFT PULLEY WASHER/CRANKSHAFT CAMSHAFT DRIVE SPROCKET REMOVAL



1. Use the following special tools to hold the crankshaft camshaft drive sprocket.
   - Special spanner (MB991367)
   - Pin (MB991385)
2. Loosen the crankshaft pulley centre bolt and remove the crankshaft pulley washer and crankshaft camshaft drive sprocket.

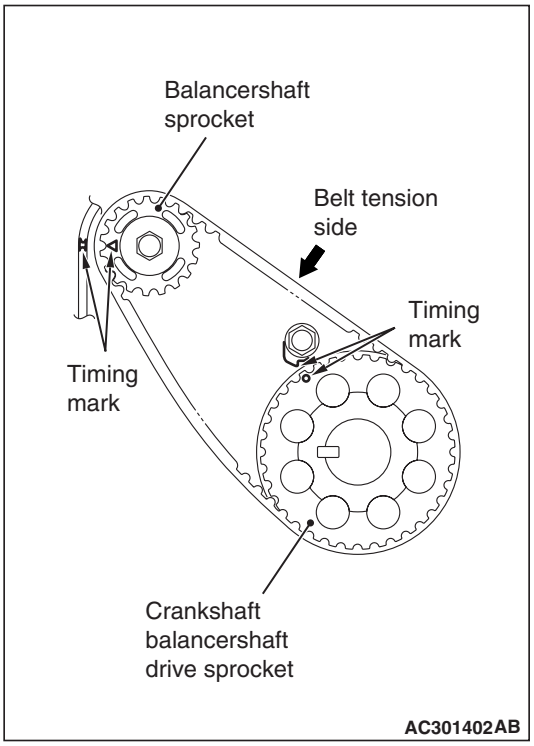
<<D>> BALANCER TIMING BELT REMOVAL

⚠ CAUTION

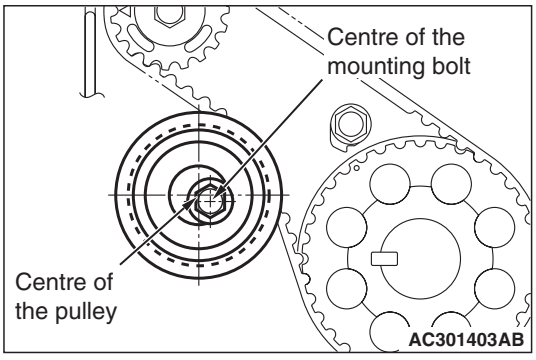
To reuse the balancer timing belt, draw an arrow indicating the rotating direction on the back of the belt using chalk, etc.

INSTALLATION SERVICE POINTS

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



1. Ensure that the crankshaft balancer shaft drive sprocket timing marks and balancer shaft sprocket timing marks are aligned.
2. Install the balancer timing belt on the crankshaft balancer shaft drive sprocket and balancer shaft sprocket. There should be no slack on the tension side.



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

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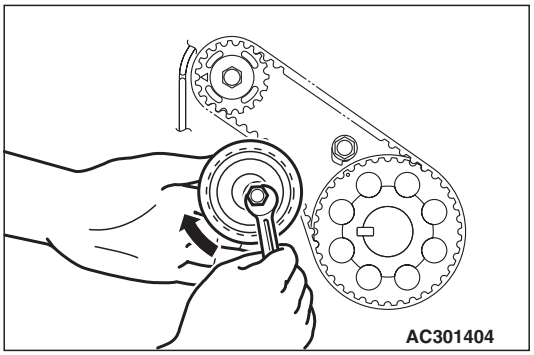
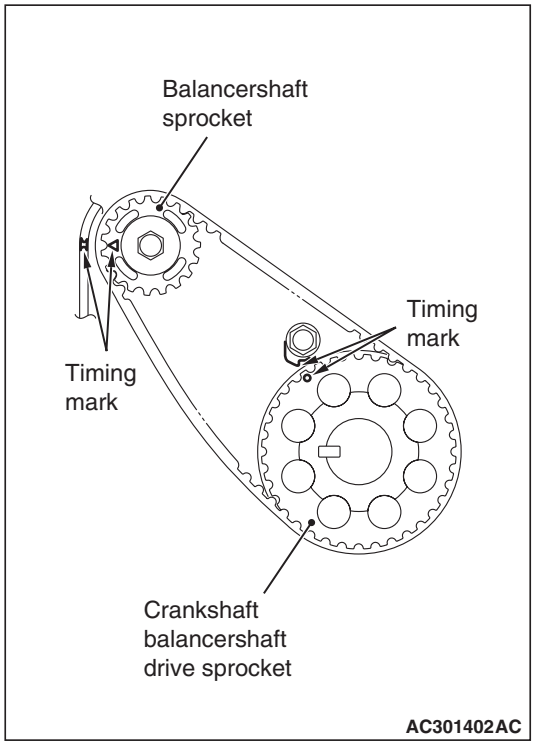
>>B<< BALANCER TIMING BELT TENSION ADJUSTMENT

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

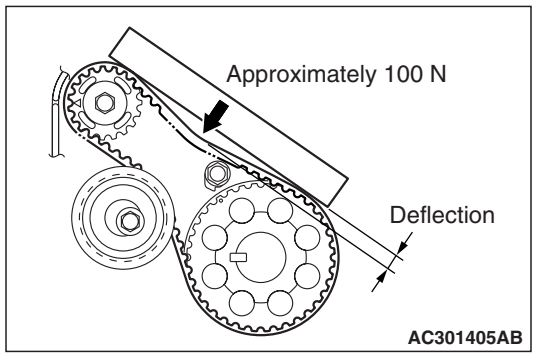


1. Lift with your fingers the balancer timing belt tensioner in the direction of the arrow. Apply a tensile torque of 3.0 ±0.4 N· m to the balancer timing belt so the belt is tense without any looseness. Tighten the assembling bolt to the specified torque in this state. Then, fix the balancer timing belt tensioner.

   Tightening torque: 19 ±3 N· m



2. Turn the crankshaft clockwise two turns to set No.1 cylinder to TDC of its compression stroke and check that sprocket timing marks are aligned.

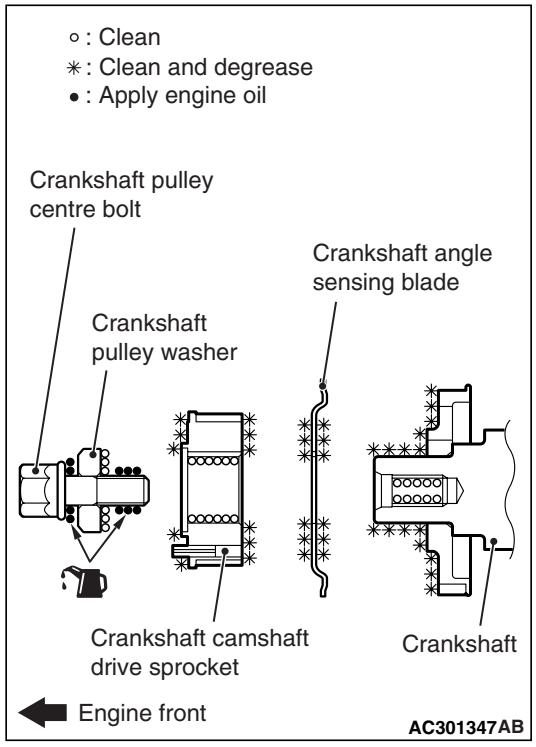


3. Apply a pressure of approximately 100 N at the centre (arrow area) between the sprocket as shown in the figure, then inspect whether the belt deflection is within the standard value.

   Standard value:
   <When adjusting> 5 – 7 mm
   <When replacing> 5 – 7 mm

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

>>C<< CRANKSHAFT ANGLE SENSING BLADE/CRANKSHAFT CAMSHAFT DRIVE SPROCKET/CRANKSHAFT PULLEY WASHER/CRANKSHAFT PULLEY CENTRE BOLT INSTALLATION



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

   NOTE: Also clean the degreased surfaces.

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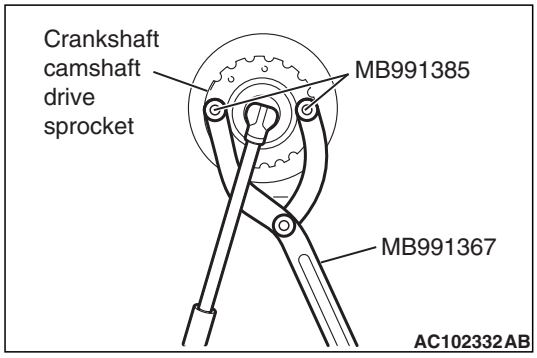
2. Install the crankshaft angle sensing blade and crankshaft camshaft drive sprocket in the direction shown.
3. Place the larger chamfer side of the crankshaft pulley washer in the direction shown in the Figure and then assemble on the crankshaft pulley centre bolt.
4. Apply a small of engine oil to the crankshaft pulley centre bolt bearing surface and screw.



5. Use the following special tool as during removal to hold the crankshaft camshaft drive sprocket.
   - Special spanner (MB991367)
   - Pin (MB991385)
6. Tighten the crankshaft pulley centre bolt to the specified torque.

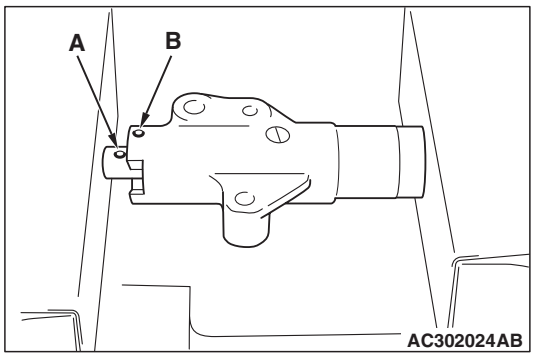
   Tightening torque: 167 N· m

>>D<< TIMING BELT TENSIONER ADJUSTER INSTALLATION

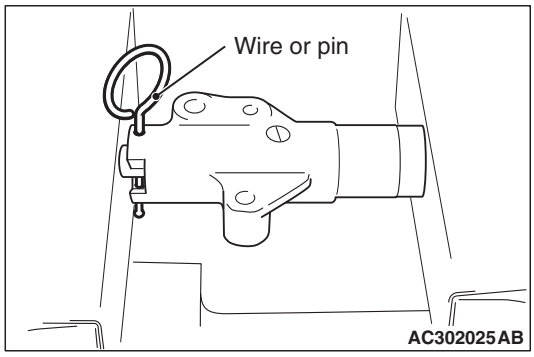
1. Set according to the following procedures when the timing belt tensioner adjuster rod is fully extended.

⚠ CAUTION

If the compression is too fast the procedure may damage the rod. Make a point to slowly and thoroughly compress.



(1) Slowly compress the timing belt tensioner adjuster rod using a press or vice, then align the set hole A of the rod with set hole B of the timing belt tensioner adjuster cylinder.



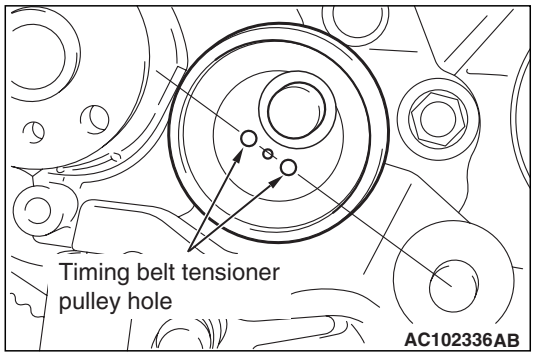
(2) Insert a wire or pin in the set hole aligned.

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

2. Install the timing belt tensioner adjuster to the engine and then tighten the mounting bolt to the specified torque. Do not remove the wire or pin until the tension of the valve timing belt is adjusted.

   Tightening torque: 23 ±3 N· m

>>E<< TIMING BELT TENSIONER PULLEY INSTALLATION



Temporarily tighten the timing belt tensioner pulley as shown.

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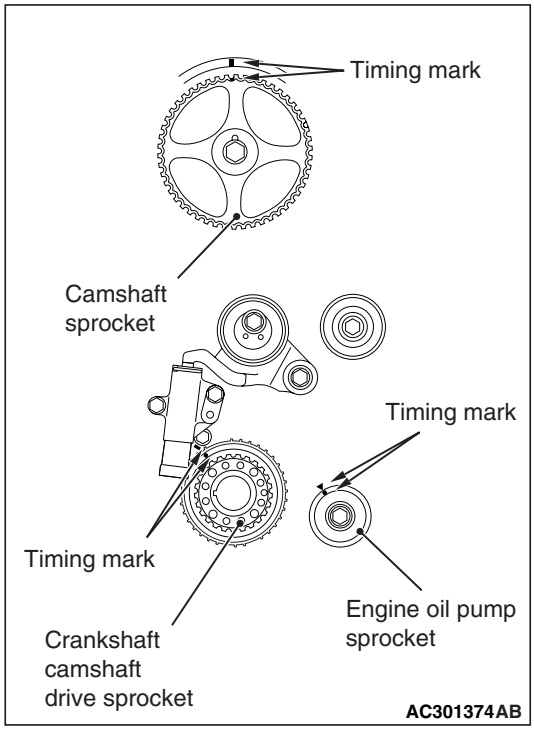
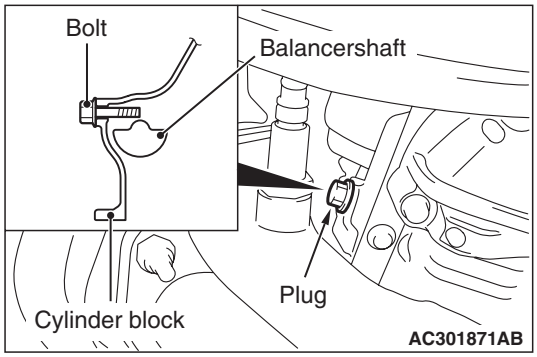
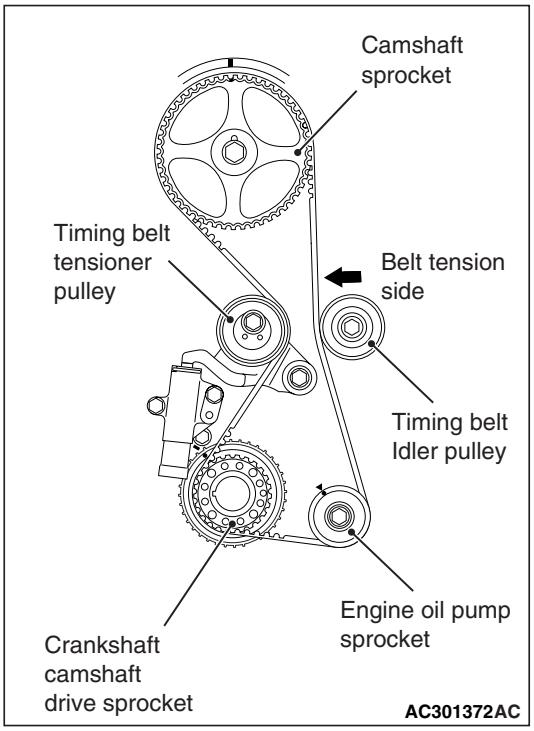
>>F<< VALVE TIMING BELT INSTALLATION



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



2. Adjust the timing mark of the engine oil pump sprocket. Unplug the cylinder block plug. Insert a bolt (M6, section width 10 mm, nominal length 45 mm) from the plug hole. If the bolt comes in contact with the balancer shaft, turn the engine oil sprocket one rotation. Re-adjust the timing mark and then check to see that the bolt fits. Do not remove the bolt until the valve timing belt is assembled.

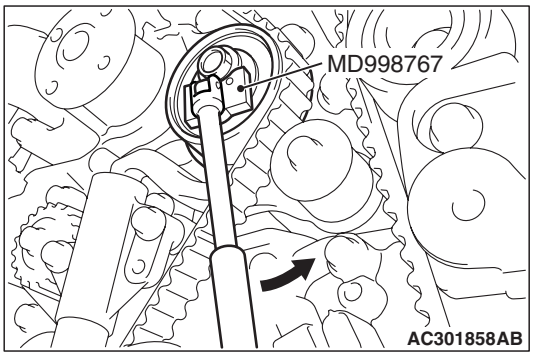


3. Incorporate the valve timing belt in the following manner so that the tensile force of the belt is not lax.
   (1) Place the valve timing belt on the timing belt tensioner pulley and crankshaft camshaft driver sprocket and then support it with your left hand so it does not slide.
   (2) Place the valve timing belt on the engine oil pump sprocket while pulling it with the right hand.
   (3) Place the valve timing belt on the timing belt idler pulley.

⚠ CAUTION

Incorporate the valve timing belt. Then apply reverse rotation (anti-clockwise rotation) pressure to the camshaft sprocket. Re-check to see that each timing mark is aligned while the tension side of the belt is right.

   (4) Place the valve timing belt on the camshaft sprocket.



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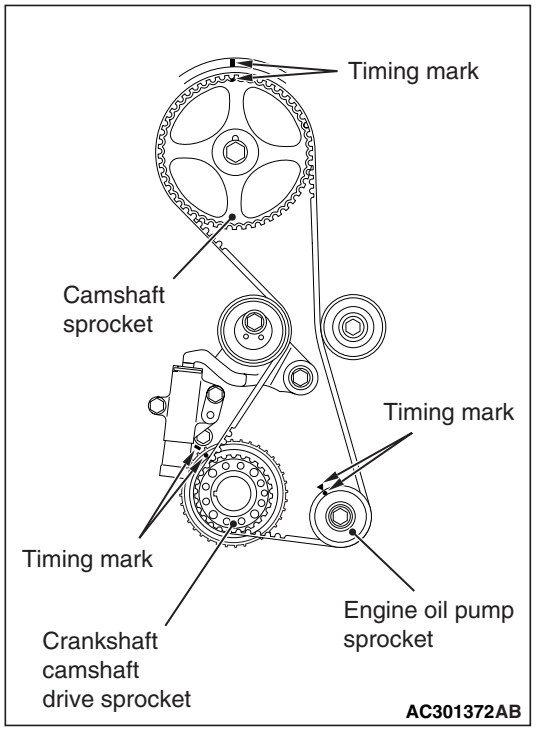
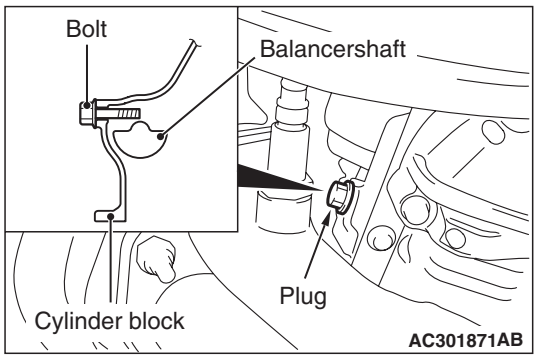
4. Turn the timing belt tensioner pulley in the direction shown in the figure using special tool tensioner wrench (MD998767) to apply tension to the valve timing belt. Then temporarily tighten and fix the timing belt tensioner pulley mounting bolt.



5. Check that the timing marks are aligned.

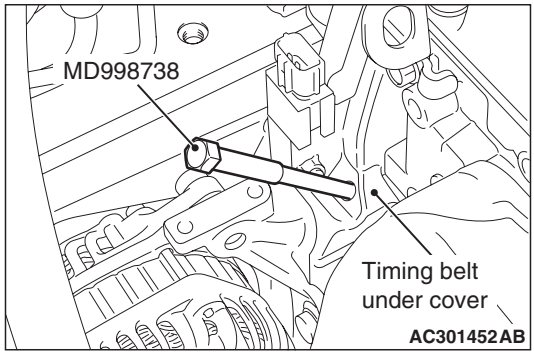


6. Remove the bolt inserted in Step 2 above, then assemble the cylinder block plug.
7. Tighten the cylinder block plug to the specified torque.

   Tightening torque: 30 ±3 N· m

8. Adjust the valve timing belt tension.

>>G<< VALVE TIMING BELT TENSION ADJUSTMENT

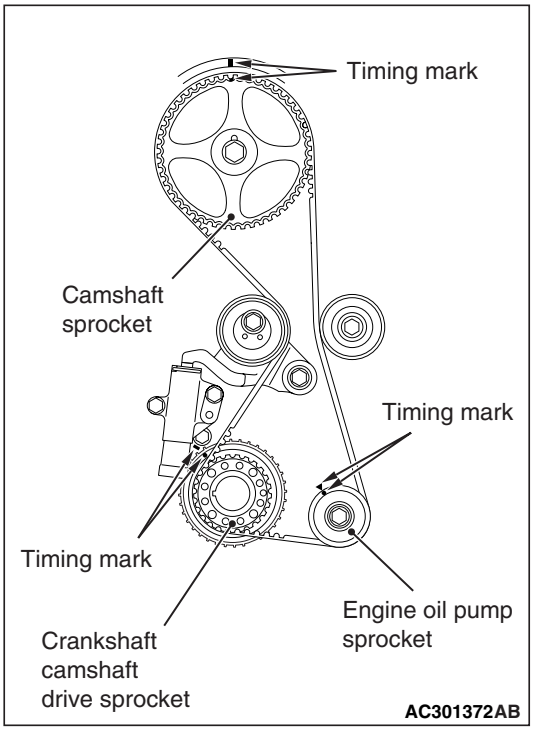


1. Set special tool adjusting bolt (MD998738) used when removing the valve timing belt.

⚠ CAUTION

Always screw in the special tool in with your hands, since use of a spanner or other tools may damage the wire or pin inserted in the timing belt tensioner adjuster.

2. Gradually screw in the special tool to a position in which the wire or pin inserted in the timing belt tensioner adjuster lightly moves.
3. Turn the crankshaft 1/4 of a revolution in the anti-clockwise direction.



4. Turn the crankshaft in the clockwise direction, align each timing mark to set No.1 cylinder to TDC of its compression stroke.

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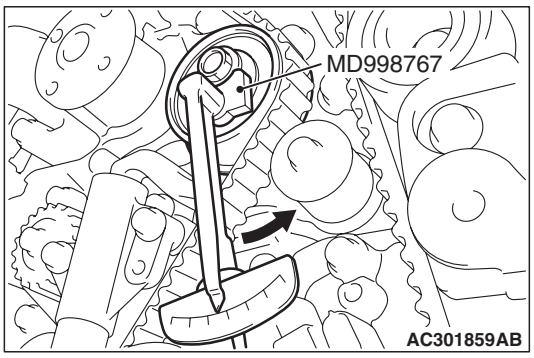
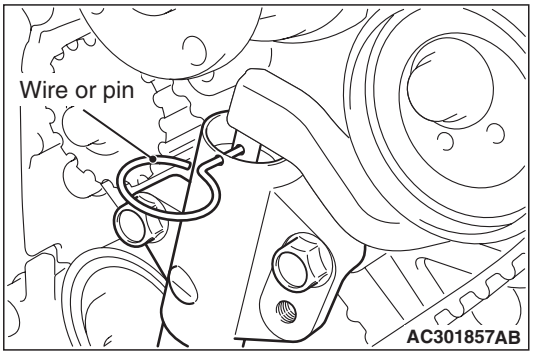
5. Loosen the timing belt tensioner pulley mounting bolt.

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

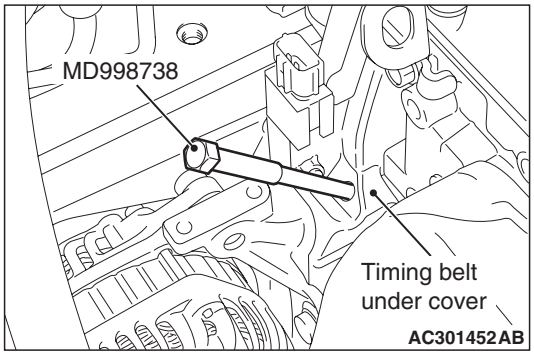


6. With special tool tensioner wrench (MD998767) and torque wrench, apply tension torque 3.5 N· m to the valve timing belt, and tighten the timing belt tensioner pulley mounting bolt to the specified torque.

Tightening torque: 48 ±5 N· m

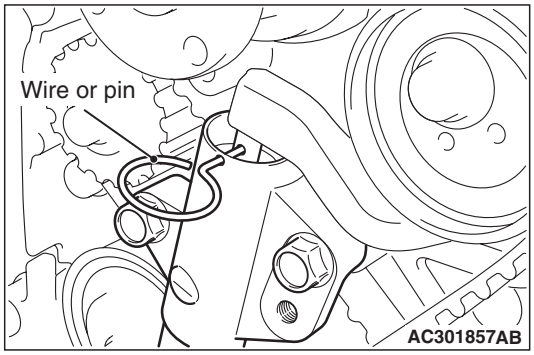


7. Remove wire or pin inserted to timing belt tensioner adjuster.

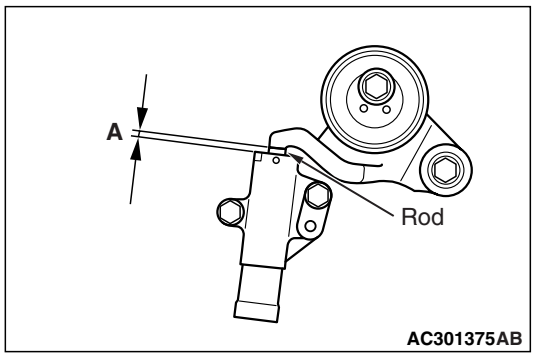


8. Remove special tool adjusting bolt (MD998738), and install the rubber plug to the timing belt under cover.

9. Rotate crankshaft clockwise two turns, and leave it for about 15 minutes.



10. Insert wire or pin removed in Step 7 again, and ensure that it can be pulled out with a light load. When wire or pin can be lightly removed, appropriate tension is applied on timing belt. In this case, remove wire or pin.



Also the projection of timing belt tensioner adjuster rod (A) is within the standard value, appropriate tension is applied.

Standard value (A): 3.8 – 4.5 mm

11. If wire or pin cannot be easily pulled out, repeat Step 1 through Step 9 to reach proper valve timing belt tension.

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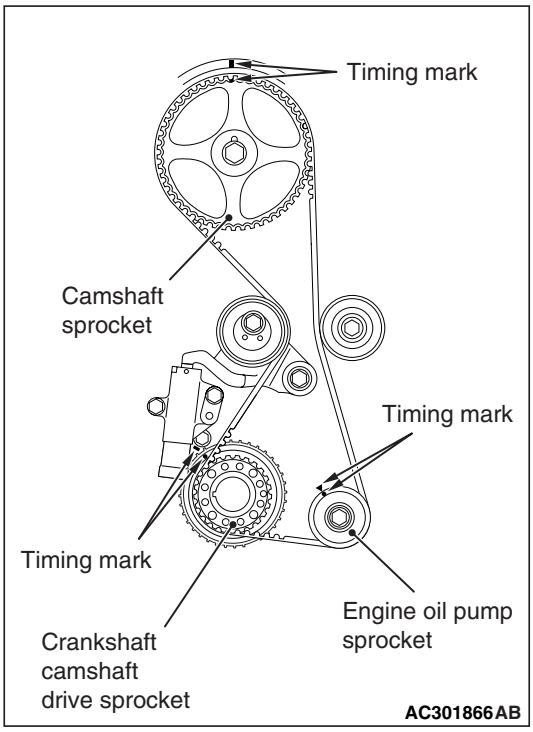
⚠ CAUTION
Always check the tightening torque of the crankshaft pulley centre bolt when turning the crankshaft pulley centre bolt anti-clockwise.
Re-tighten if it is loose.



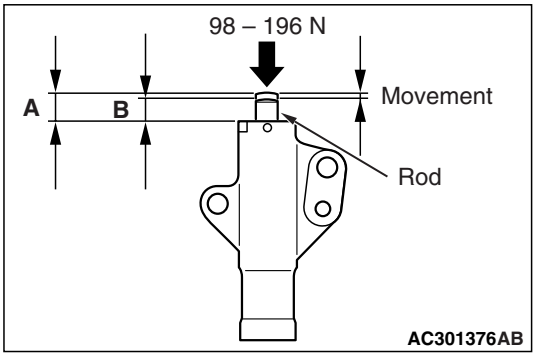
12.Check again that the timing marks on sprockets are aligned.

INSPECTION

M1112004400512

TIMING BELT TENSIONER ADJUSTER CHECK

1. Check for oil leak from seal, and replace it if leak is detected.
2. Check for wear or damage at the top of the rod. Replace it, if required.



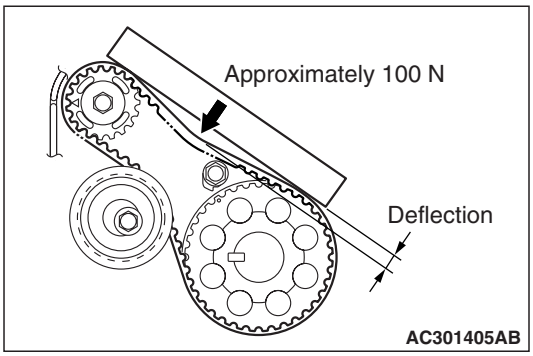
3. Hold the timing belt tensioner adjuster by hand, and press top end of the rod onto the metal (e.g. cylinder block) under a pressure of 98 –196 N to measure the movement of the rod.

   Standard value: Within 1 mm
   A: Length when it is free (not pressed)
   B: Length when it is pressed
   A – B: Movement

4. If the measured value is out of the standard value, replace the timing belt tensioner adjuster.

BALANCER TIMING BELT TENSION CHECK

Check the balancer timing belt tension in the following procedures.



1. Apply a pressure of approximately 100 N at the centre (arrow area) between the sprocket as shown in the figure, then inspect whether the flexure is within the standard value.

   Standard value: 5 –10 mm

2. If not within the standard value, adjust the belt tension. (Refer to P.11A-36).

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ENGINE ASSEMBLY

REMOVAL AND INSTALLATION

M1112001002113

⚠ CAUTION

- **When the engine assembly replacement is performed, use the M.U.T.-III to initialize the learning value (Refer to GROUP 00, Precautions Before Service –Initialization Procedure for Learning Value in MPI Engine P.00-24).**
- ***: indicates parts which should be temporarily tightened, and then fully tightened with the engine weight applied on the vehicle body.**

Pre-removal Operation	Post-installation Operation
• Fuel Line Pressure Reduction [Refer to GROUP 13A, On-vehicle Service –Fuel Pump Connector Disconnection (How to Reduce Pressurized Fuel Lines) <Except Vehicles for Hong Kong, Singapore, Australia and New Zealand>P.13A-310]. • Fuel Line Pressure Reduction [Refer to GROUP 13B, On-vehicle Service –Fuel Pump Connector Disconnection (How to Reduce Pressurized Fuel Lines) <Vehicles for Hong Kong and Singapore>P.13B-284]. • Fuel Line Pressure Reduction [Refer to GROUP 13C, On-vehicle Service –Fuel Pump Connector Disconnection (How to Reduce Pressurized Fuel Lines) <Vehicles for Australia and New Zealand>P.13C-337]. • Engine side cover Removal. • Engine Oil Draining (Refer to GROUP 12, On-vehicle Service –Engine Oil Replacement P.12-4). • Engine Coolant Draining (Refer to GROUP 14, On-vehicle Service –Engine Coolant Replacement P.14-18). • Transmission Oil Draining (Refer to GROUP 22A, On-vehicle Service –Transmission Oil Replacement P.22A-7). • Exhaust Pre-muffler Removal (Refer to GROUP 15, Exhaust Pipe and Main Muffler P.15-9) <Except vehicles for Hong Kong, Singapore, Brazil, Australia and New Zealand>. • Catalytic Converter Removal (Refer to GROUP 15, Exhaust Pipe and Main Muffler P.15-9) <Vehicles for Hong Kong, Singapore, Brazil, Australia and New Zealand>. • Front Exhaust Pipe Removal (Refer to GROUP 15, Exhaust Pipe and Main Muffler P.15-9). • Hood Removal (Refer to GROUP 42, Hood <Except for Hong Kong and Singapore>P.42-6). • Hood Removal (Refer to GROUP 42, Hood <Vehicles for Hong Kong and Singapore>P.42-7). • Engine Cover Removal (Refer to P.11A-17). • Air Cleaner Removal (Refer to GROUP 15, Air Cleaner P.15-3). • Battery and Battery Tray Removal.	• Battery and Battery Tray Installation • Air Cleaner Installation (Refer to GROUP 15, Air Cleaner P.15-3). • Engine Cover Installation (Refer to P.11A-17). • Hood Installation (Refer to GROUP 42, Hood <Except for Hong Kong and Singapore>P.42-6). • Hood Installation (Refer to GROUP 42, Hood <Vehicles for Hong Kong and Singapore>P.42-7). • Front Exhaust Pipe Installation (Refer to GROUP 15, Exhaust Pipe and Main Muffler P.15-9). • Catalytic Converter Installation (Refer to GROUP 15, Exhaust Pipe and Main Muffler P.15-9) <Vehicles for Hong Kong, Singapore, Brazil, Australia and New Zealand>. • Exhaust Pre-muffler Installation (Refer to GROUP 15, Exhaust Pipe and Main Muffler P.15-9) <Except vehicles for Hong Kong, Singapore, Brazil, Australia and New Zealand>. • Transmission Oil Refilling (Refer to GROUP 22A, On-vehicle Service –Transmission Oil Replacement P.22A-7). • Engine Coolant Refilling (Refer to GROUP 14, On-vehicle Service –Engine Coolant Replacement P.14-18). • Engine Oil Refilling (Refer to GROUP 12, On-vehicle Service –Engine Oil Replacement P.12-4). • Fuel Leak Check • Drive Belt Tension Check (Refer to P.11A-8). • Engine side cover Installation.

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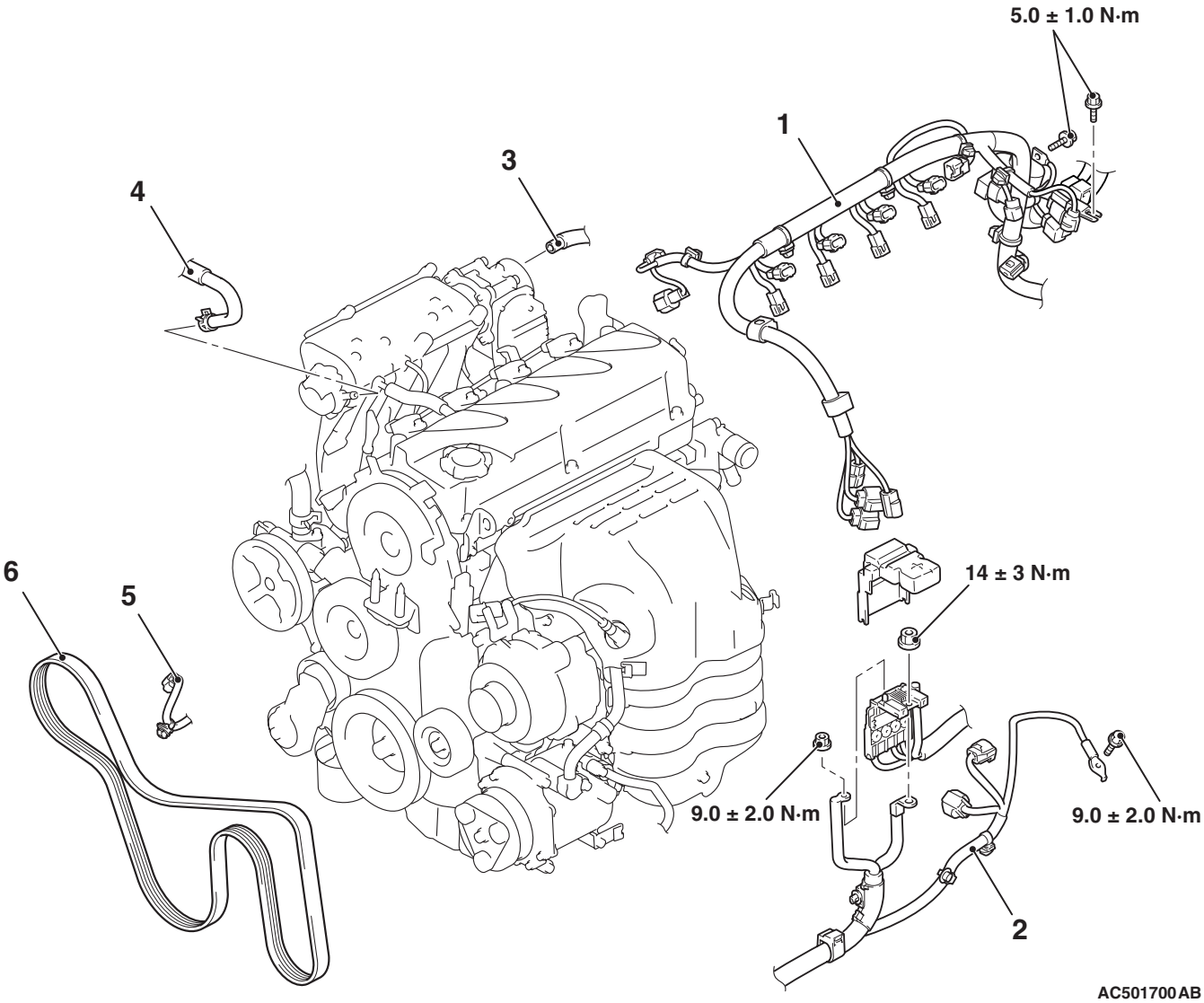

Removal steps

1. Control wiring harness connection
2. Battery wiring harness connection
3. Canister vacuum hose connection

>>F<< 4. Brake booster vacuum hose connection

<<A>>

Removal steps (Continued)

5. Power steering oil pressure sensor connector
6. Drive belt

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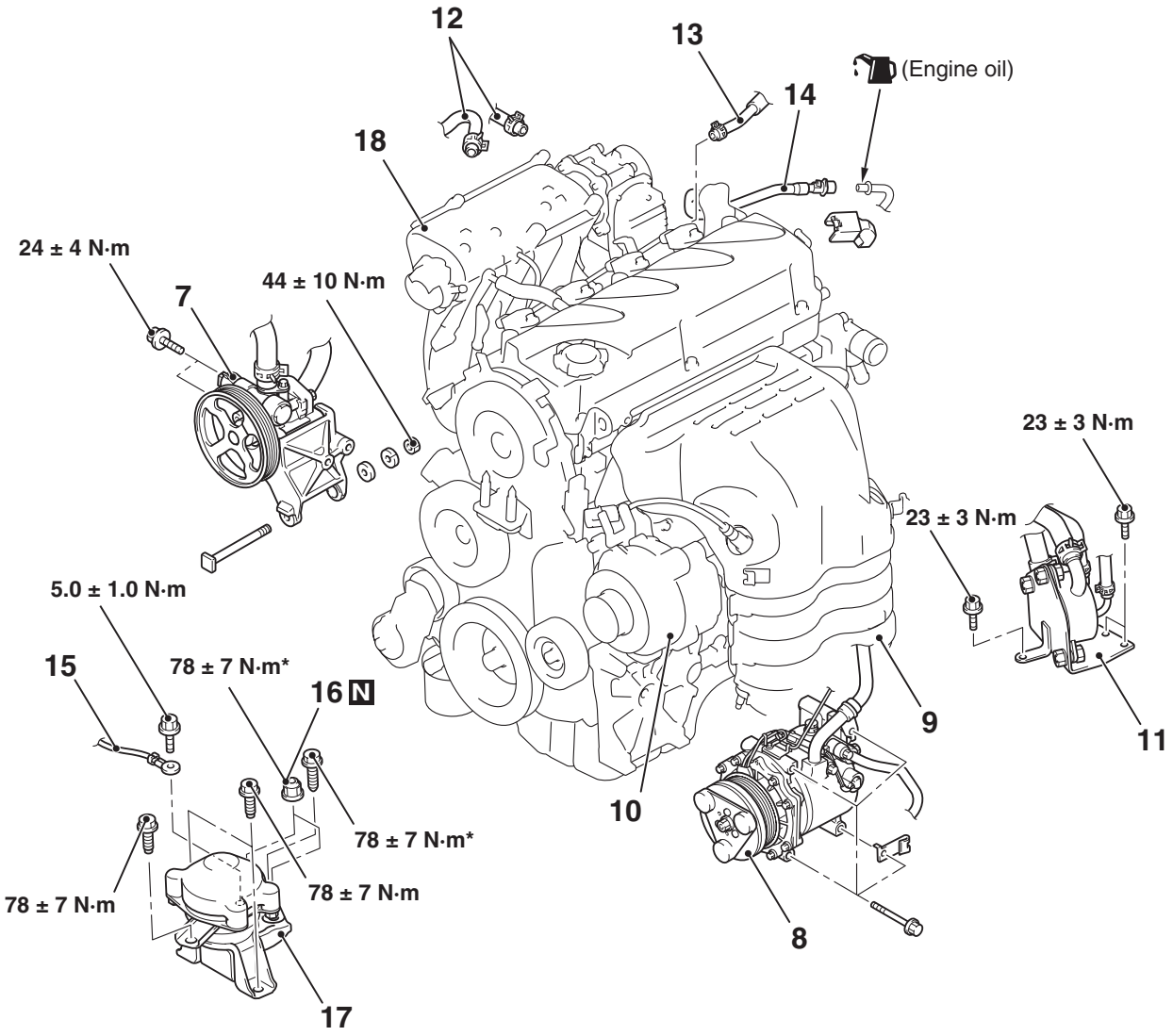

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Removal steps

<<B>> 7. Power steering oil pump and bracket assembly

<<C>> 8. A/C compressor and clutch assembly

9. Exhaust manifold (Refer to GROUP 15, Exhaust Manifold P.15-7)

10. Alternator assembly (Refer to GROUP 16, Charging System, Alternator Assembly P.16-12)

<<D>> 11. ATF warmer (A/T oil cooler) and bracket assembly <Vehicles with ATF warmer (A/T oil cooler) >

Removal steps (Continued)

12. Heater water hoses connection

13. Fuel return line hose connection

<<D>> >>E<< 14. Fuel high-pressure hose connection

<<E>> >>D<< • Transmission assembly

<<F>> >>C<< • Radiator assembly

15. Earth cable connection

16. Self-locking nuts

<<G>> >>B<< 17. Engine mounting insulator

<<H>> >>A<< 18. Engine assembly

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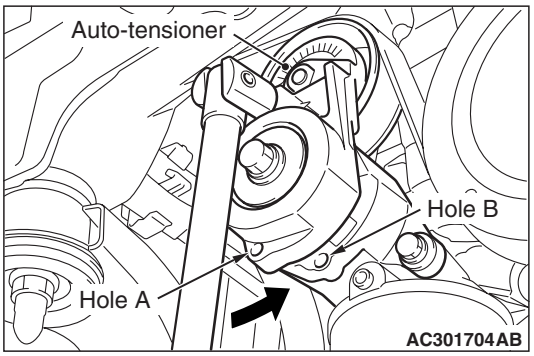
REMOVAL SERVICE POINTS

<<A>> DRIVE BELT REMOVAL

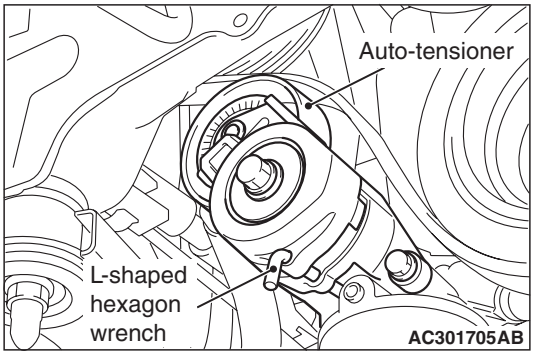
The following operations will be needed due to the introduction of the serpentine drive system with the drive belt auto-tensioner.



1. Securely insert the spindle handle or ratchet handle with a 12.7 mm insertion angle into the jig hole of the auto-tensioner.
2. Rotate the auto-tensioner anti-clockwise and align hole A with hole B.

⚠ CAUTION

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



3. Insert an L-shaped hexagon wrench, etc. into the hole to fix and then remove the drive belt.

<<B>> POWER STEERING OIL PUMP AND BRACKET ASSEMBLY REMOVAL

1. With the hose installed, remove the power steering oil pump and bracket assembly from the engine assembly.
2. After removing the power steering oil pump and bracket assembly, secure it with a cord in the location where the removal and installation of the engine assembly cannot be hindered.

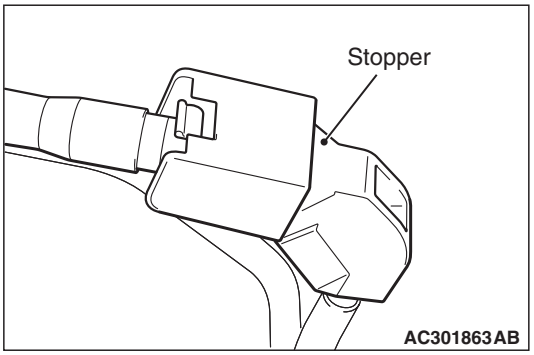
<<C>> A/C COMPRESSOR AND CLUTCH ASSEMBLY REMOVAL

1. With the hose installed, remove the A/C compressor and clutch assembly from the bracket.
2. After removing the A/C compressor and clutch assembly, secure it with a cord in the location where the removal and installation of the engine assembly cannot be hindered.

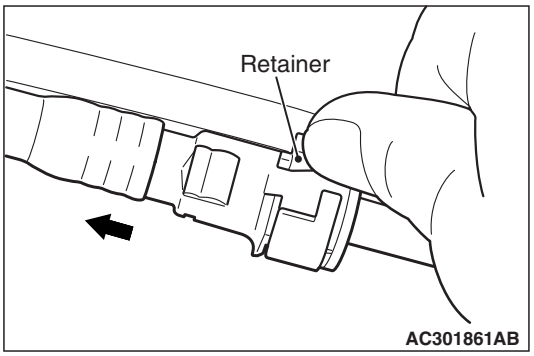
<<D>> ATF WARMER (A/T OIL COOLER) AND BRACKET ASSEMBLY REMOVAL < VEHICLES WITH ATF WARMER (A/T OIL COOLER) >

With the hose installed, remove the ATF warmer and bracket assembly from the transmission case front roll stopper bracket.

<<D>> FUEL HIGH-PRESSURE HOSE REMOVAL



1. Remove the fuel high-pressure hose stopper.



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

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

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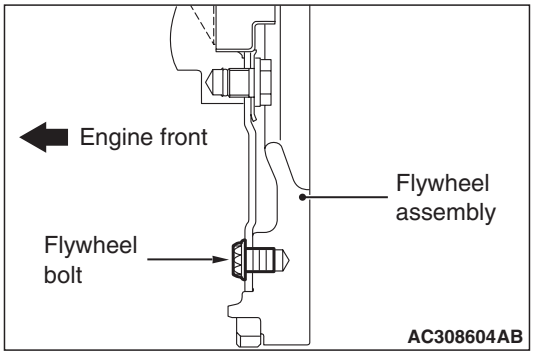
<<E>> TRANSMISSION ASSEMBLY REMOVAL

⚠ CAUTION

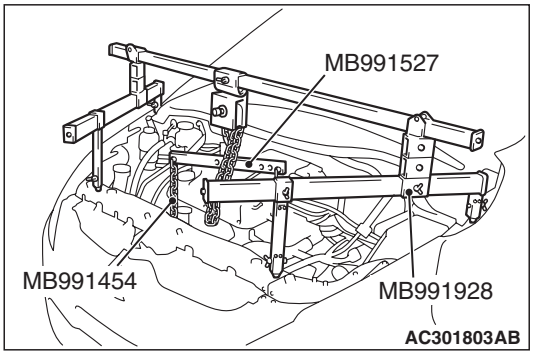


M/T: Do not remove the flywheel bolt. If this bolt is removed, the flywheel assembly will become out of balance and damaged.

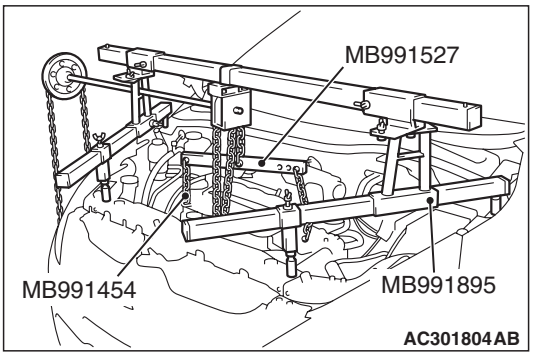
Remove the transmission assembly (M/T: Refer to GROUP 22A, Transmission Assembly P.22A-11, A/T: Refer to GROUP 23A, Transmission Assembly P.23A-165).

<<F>> RADIATOR ASSEMBLY REMOVAL

1. Place a garage jack against the engine oil pan with a piece of wood in between and support the engine assembly.
2. Remove the following special tool.
   (1) <Special tool engine hanger (MB991928) is used>

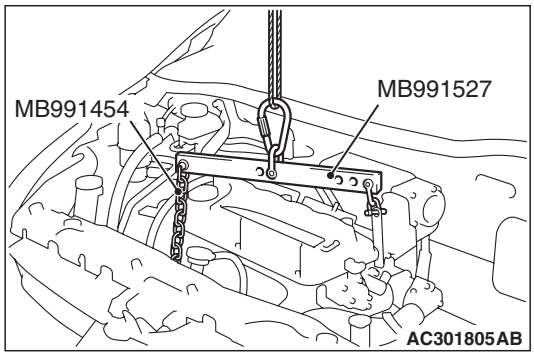


Remove special tool MB991928.



(2) <Special tool engine hanger (MB991895) is used>

Remove special tool MB991895.



3. Hold the engine assembly with a chain block, etc.
4. Remove the radiator. (Refer to GROUP 14, Radiator P.14-27)

<<G>> ENGINE MOUNTING INSULATOR REMOVAL

Place a garage jack against the engine oil pan with a piece of wood in between so that the weight of the engine is not applied to the engine mounting insulator and remove the engine mounting insulator.

<<H>> ENGINE ASSEMBLY REMOVAL

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

INSTALLATION SERVICE POINTS

>>A<< ENGINE ASSEMBLY INSTALLATION

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

>>B<< ENGINE MOUNTING INSULATOR INSTALLATION

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

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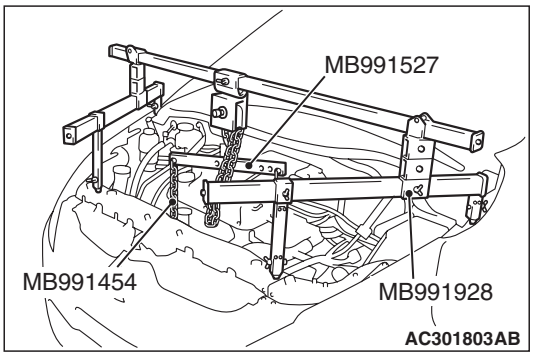
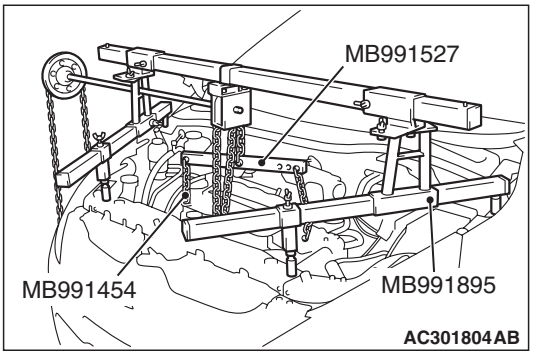
>>C<< RADIATOR ASSEMBLY INSTALLATION

1. Install the radiator assembly. (Refer to GROUP 14, Radiator P.14-27)
2. Place a garage jack against the engine oil pan with a piece of wood in between and support the engine assembly.
3. Remove the chain block.
4. Use the following special tool as during removal to support the engine assembly.



(1) <Special tool engine hanger (MB991928) is used>

Set special tool MB991928. (M/T: Refer to GROUP 22A, Transmission Assembly P.22A-11, A/T: Refer to GROUP 23A, Transmission Assembly P.23A-165).



(2) <Special tool engine hanger (MB991895) is used>

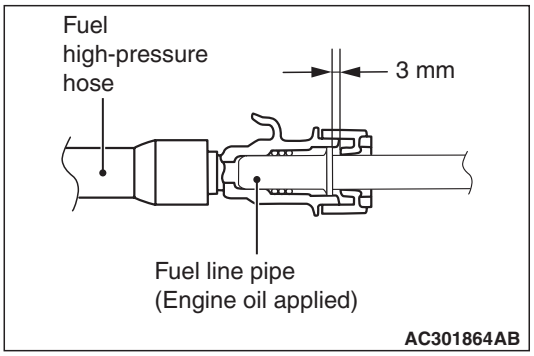
Set special tool MB991895 (M/T: Refer to GROUP 22A, Transmission Assembly P.22A-11, A/T: Refer to GROUP 23A, Transmission Assembly P.23A-165).

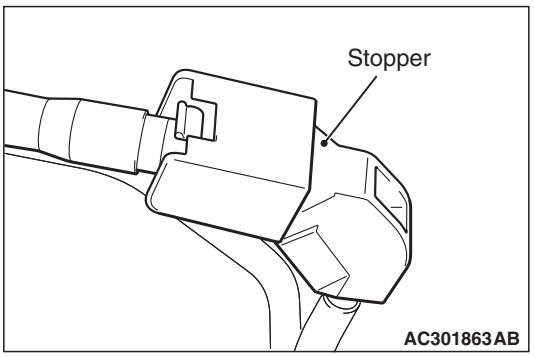
>>D<< TRANSMISSION ASSEMBLY INSTALLATION

Install the transmission assembly (M/T: Refer to GROUP 22A, Transmission Assembly P.22A-11, A/T: Refer to GROUP 23A, Transmission Assembly P.23A-165).

>>E<< FUEL HIGH-PRESSURE HOSE INSTALLATION

⚠ CAUTION

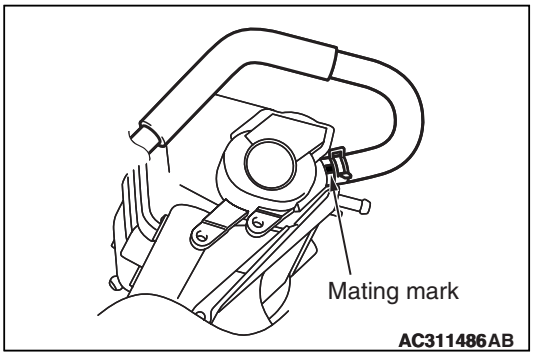




After connecting the fuel high-pressure hose, slightly pull it to ensure that it is installed securely. Also confirm that there is a play approximately 3 mm. Then install the stopper securely.

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

>>F<< BRAKE BOOSTER VACUUM HOSE INSTALLATION



1. Insert the brake booster vacuum hose thoroughly until it contacts the inlet manifold so that its mating mark faces towards the direction shown.
2. Secure the brake booster vacuum hose with hose clip.