GROUP 11C

ENGINE MECHANICAL <4G6>

CONTENTS

GENERAL INFORMATION

M1111000100408

Item		4G6
Total displacement mL		1,997
Bore × Stroke mm		85 × 88
Compression ratio		10.0
Compression chamber		Pentroof
Camshaft arrangement		DOHC
Number of valve	Intake	8
	Exhaust	8
Valve timing	Intake opening	BTDC 9°
	Intake closing	ABDC 59°
	Exhaust opening	BBDC 63°
	Exhaust closing	ATDC 21°
Fuel system		Electronically controlled multipoint fuel injection
Rocker arm		Roller type
Auto-lash adjuster		Equipped

SERVICE SPECIFICATIONS

M1112000300267

Item		Standard value	Limit
Drive belt tension	Vibration frequency Hz	110 – 144	–
	Tension N	245 – 412	–
Basic ignition timing		5° BTDC ±3°	–
Ignition timing		Approximately 5° BTDC	–
Idle speed r/min		750 ±100	–
CO contents %		0.6 or less	–
HC contents ppm		100 or less	–
Compression pressure (at engine speed of 250 – 400 r/min) kPa		1,370	Minimum 980
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	–

Item		Standard value	Limit
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	–

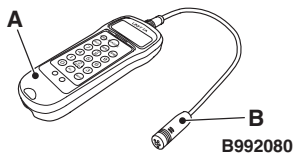
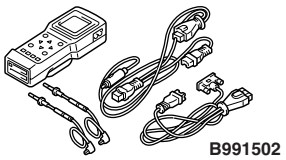
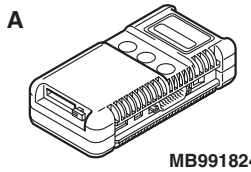
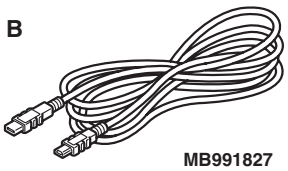
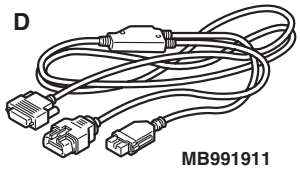
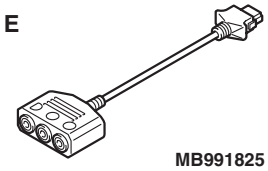
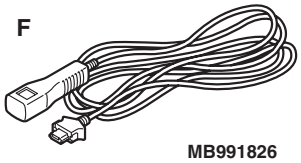
SEALANTS

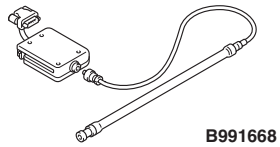
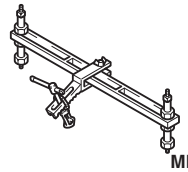
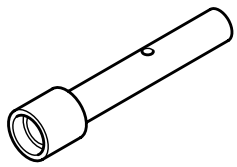
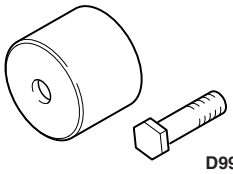
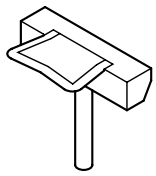
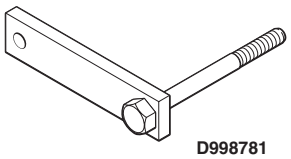
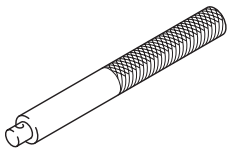
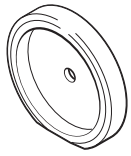
M1112000500272

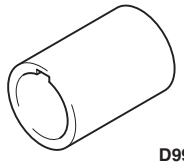
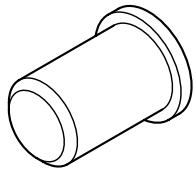
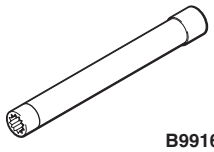
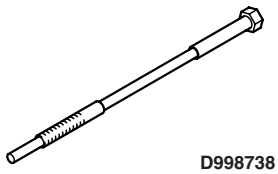
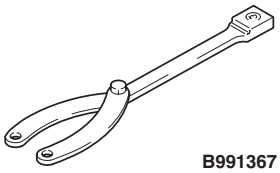
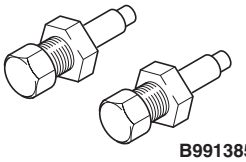
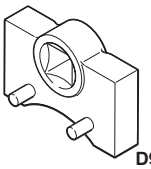
Item	Specified Sealant	Remark
Engine cylinder head	MITSUBISHI GENUINE PART MD970389 or equivalent	Semi-drying sealant
Camshaft position sensor support		
Rocker cover assembly		
Cylinder head camshaft end seal	3M ATD Part No.8660 or equivalent	
Rocker cover gasket	MITSUBISHI GENUINE PART MD970389 or equivalent	
Engine oil pan		

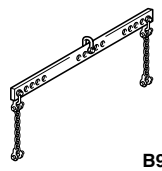
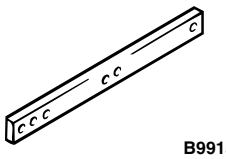
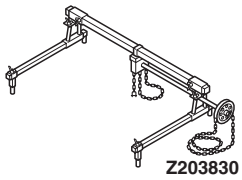
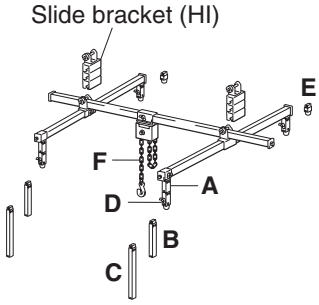
SPECIAL TOOLS

M1112000601056

Tool	Number	Name	Use
	MB992080 A: MB992081 B: MB992082	Belt tension meter set A: Belt tension meter B: Microphone assembly	Drive belt tension check
	MB991502	M.U.T.-II sub assembly	• Drive belt tension check • Checking the ignition timing • Checking the idle speed
      MB991955	MB991955 A: MB991824 B: MB991827 C: MB991910 D: MB991911 E: MB991825 F: MB991826	M.U.T.-III sub assembly A: Vehicle communication interface (V.C.I.) B: M.U.T.-III USB cable C: M.U.T.-III main harness A (Vehicles with CAN communication system) D: M.U.T.-III main harness B (Vehicles without CAN communication system) E: M.U.T.-III adapter harness F: M.U.T.-III trigger harness	**⚠ CAUTION** **If you connect M.U.T.-III main harness A to a vehicle without CAN communication system to use the M.U.T.-III, a pulse signal may interfere with the simulated vehicle speed lines, thus causing the M.U.T.-III inoperative. Therefore, use the M.U.T.-III main harness B (MB991911) instead.** • Drive belt tension check • Checking the ignition timing • Checking the idle speed

Tool	Number	Name	Use
 B991668	MB991668	Belt tension meter set	Drive belt tension check (used together with M.U.T.-II/III)
 MD998772	MD998772	Valve spring compressor	Compressing valve spring
	MD998737	Valve stem seal installer	Valve stem seal installation
 D998713	MD998713	Camshaft oil seal installer	Camshaft oil seal installation
 D998727	MD998727	Oil pan remover	Engine oil pan removal
 D998781	MD998781	Flywheel stopper	Supporting the flywheel assembly <M/T> or A/T drive plate <A/T>
	MB990938	Installer bar	Crankshaft rear oil seal installation
 D998776	MD998776	Crankshaft rear oil seal installer	

Tool	Number	Name	Use
 D998285	MD998285	Crankshaft front oil seal guide	Crankshaft front oil seal installation
	MD998375	Crankshaft front oil seal installer	
 B991654	MB991654	Cylinder head bolt wrench (12)	Removal and installation of cylinder head bolt
 D998738	MD998738	Adjusting bolt	Supporting the timing belt tensioner arm and timing belt tensioner adjuster
 B991367	MB991367	Special spanner	Holding the crankshaft camshaft drive sprocket
 B991385	MB991385	Pin	
 D998767	MD998767	Tensioner wrench	Valve timing belt tension adjustment

Tool	Number	Name	Use
 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	

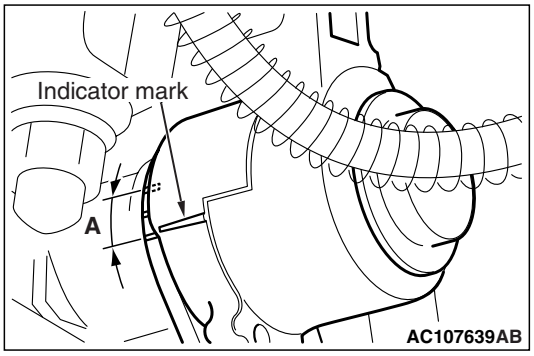
ON-VEHICLE SERVICE

DRIVE BELT TENSION CHECK

M1111003100441

⚠ 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.11C-16.)

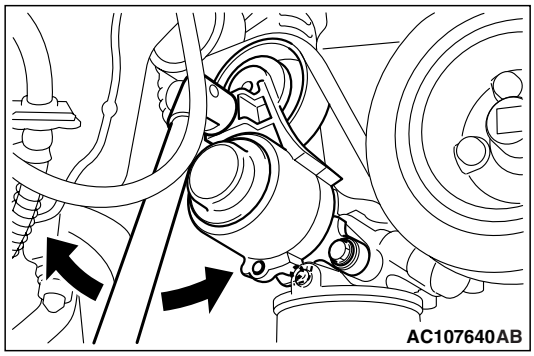
   NOTE: The drive belt tension check is not necessary as alternator drive belt auto tensioner is adopted.

ALTERNATOR DRIVE BELT AUTO TENSIONER CHECK

M1111003000712

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 alternator drive belt auto tensioner.
2. Remove the drive belt (Refer to P.11C-16).


AC107640AB

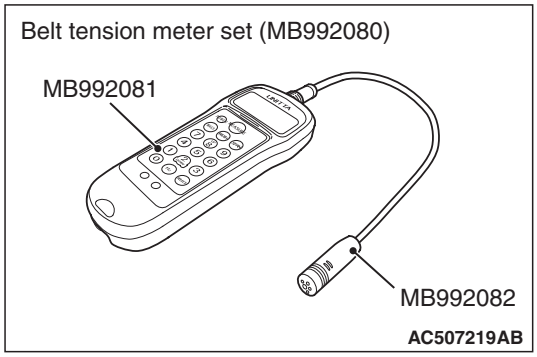
3. Securely insert the spindle handle or ratchet handle with a 12.7 mm insertion angle into the jig hole of the alternator drive belt auto tensioner. Turn the alternator drive belt auto tensioner to the left and right to check and see that there is no threading.
4. If there are any problems in the procedure 1 or 3, replace the alternator drive belt auto tensioner (Refer to P.11C-35).
5. Install the drive belt (Refer to P.11C-16).

FUNCTION CHECK

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

When the vibration frequency is measured (M.U.T.-II or V.C.I. is not used): Recommendation

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



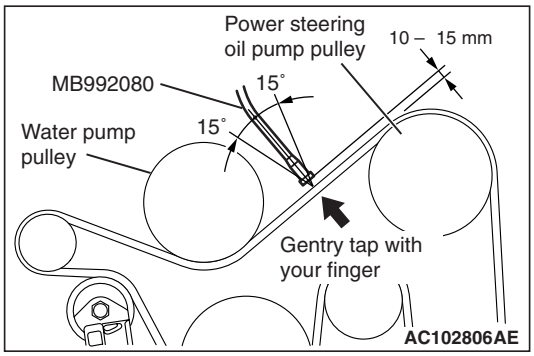
(1) Connect special tool microphone assembly (MB992082) to special tool belt tension meter (MB992081) of special tool belt tension meter set (MB992080).
(2) Press the "POWER" button to turn on the power supply.
(3) Press the numeral key of "1" and check that "No. 1" appears on the upper left of the display.

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

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

⚠ CAUTION

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



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

Standard value: 110 – 144 Hz

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

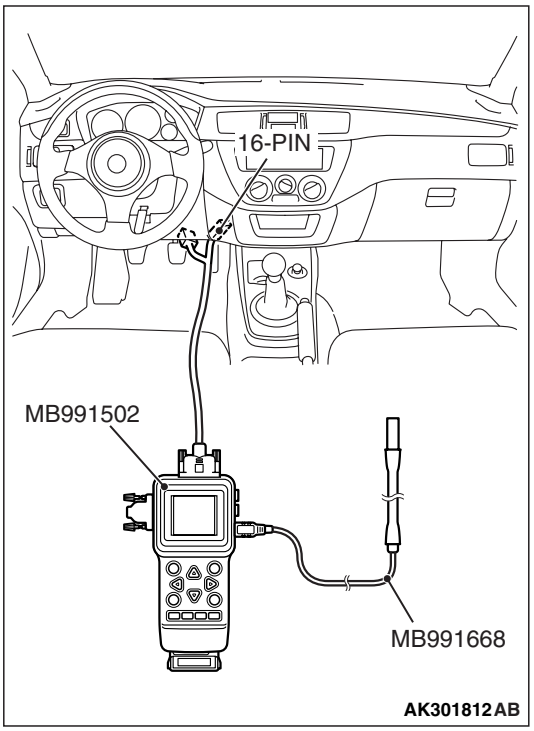
(8) Press and hold the "POWER" button to turn off the power supply.

3. If not within the standard value, replace the alternator drive belt auto tensioner (Refer to P.11C-35).

When the vibration frequency is measured (M.U.T.-II is used): Recommendation

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

⚠ CAUTION

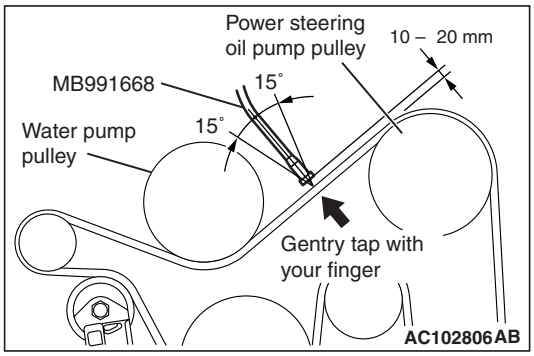


To prevent damage to M.U.T.-II, always turn the ignition switch to the "LOCK" (OFF) position before connecting or disconnecting M.U.T.-II.

(1) Connect special tool belt tension meter set (MB991668) to the M.U.T.-II.
(2) Connect the M.U.T.-II to the diagnosis connector.
(3) Turn the ignition switch to "ON" position, and select "BELT TENSION" on the menu screen.

⚠ CAUTION

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



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

Standard value: 110 – 144 Hz

3. If not within the standard value, replace the alternator drive belt auto tensioner (Refer to P.11C-35).

When the vibration frequency is measured (V.C.I. is used): Recommendation

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

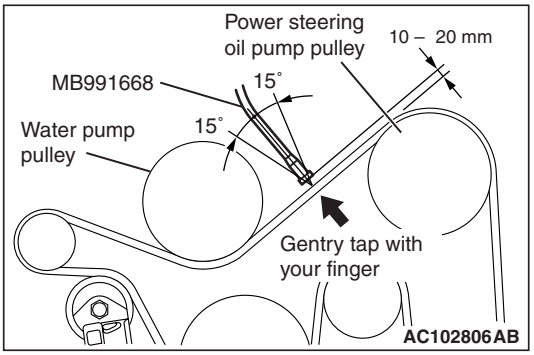
⚠ CAUTION

To prevent damage to the special tool V.C.I. (MB991824), always turn the ignition switch to the "LOCK" (OFF) position before connecting or disconnecting the 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 V.C.I. (MB991824) to the diagnosis connector.
(3) Turn the ignition switch to "ON" position, and select "BELT TENSION" on the menu screen.

⚠ CAUTION

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



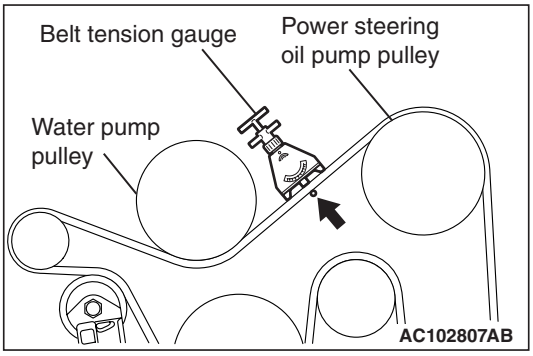
(4) Hold special tool belt tension meter set (MB991668) to the middle of the drive belt between the pulleys (at the place indicated by arrow), approximately 10 – 20 mm away from the rear surface of the belt so that it is perpendicular to the belt (within an angle of ± 15 degree).
(5) Gently tap the middle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

Standard value: 110 – 144 Hz

3. If not within the standard value, replace the alternator drive belt auto tensioner (Refer to P.11C-35).

When the tension is measured

1. Check the drive belt tension (Refer to P.11C-7).



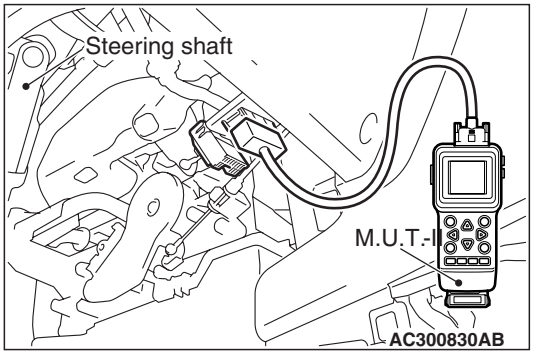
2. Use a belt tension gauge in the middle of the belt between the pulleys (at the place indicated by the arrow) to measure that the belt tension is within the standard value.

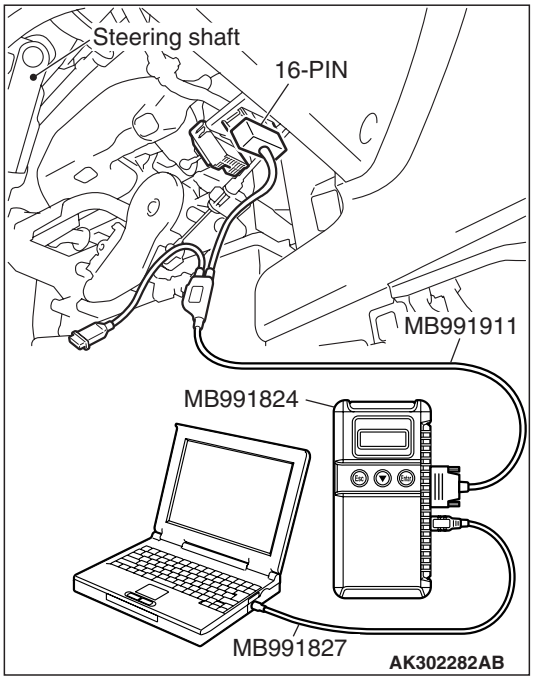
Standard value: 245 – 412 N

3. If not within the standard value, replace the alternator drive belt auto tensioner (Refer to P.11C-35).

IGNITION TIMING CHECK

M1111001700555





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.-II/III to the diagnosis connector.
3. Connect a timing lamp.
4. Start the engine and let it run at idle.
5. Use the M.U.T.-II/III to measure engine idle speed and check that it is within the standard value.

   Standard value: 750 ±100 r/min
6. Select No. 17 of the M.U.T.-II/III Actuator test.
7. Check that basic ignition timing is within the standard value.

   Standard value: 5° BTDC ±3°
8. If the basic ignition timing is outside the standard value, inspect the MPI system (Refer to GROUP 13B – Troubleshooting – Inspection chart for diagnosis code P.13B-15).

⚠ CAUTION

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

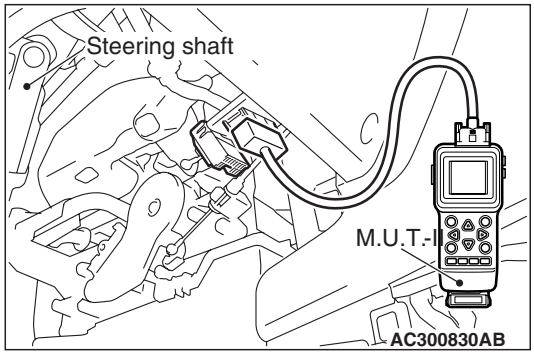
9. Press the M.U.T.-II/III clear key (Select a forced driving cancel mode) to release the Actuator test.
10. Check that ignition timing is at the standard value.

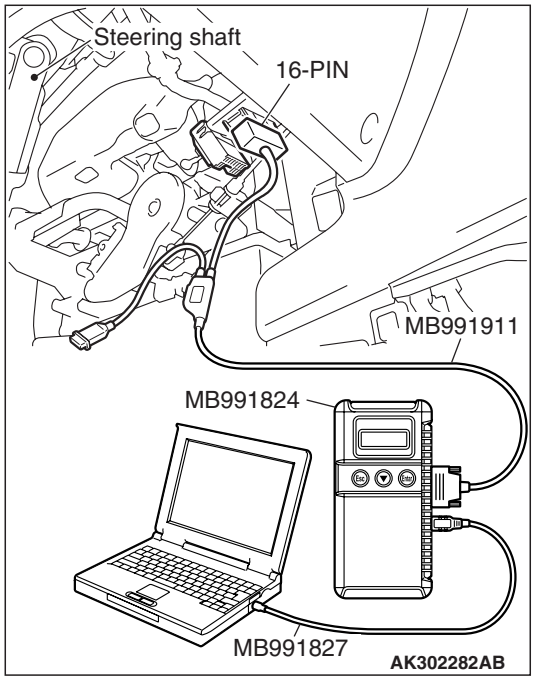
    Standard value: approximately 5° BTDC

    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 lamp.
12. Turn off the ignition switch and then remove the M.U.T.-II/III.

IDLE SPEED CHECK

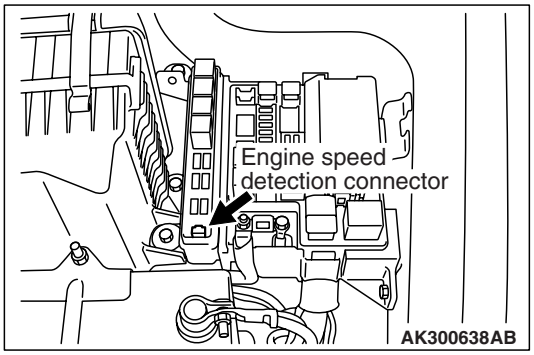
M1111003500609





1. Before inspection, set the vehicle to the pre-inspection condition.

2. Turn the ignition switch to "LOCK" (OFF) position.
3. Connect the M.U.T.-II/III to the diagnosis connector or connect a tachometer to the engine speed detection connector.
4. Connect a timing lamp.



5. Start the engine and let it run at idle.
6. Check that ignition timing is at the standard value.

   Standard value: approximately 5° BTDC

7. Check the idle speed.

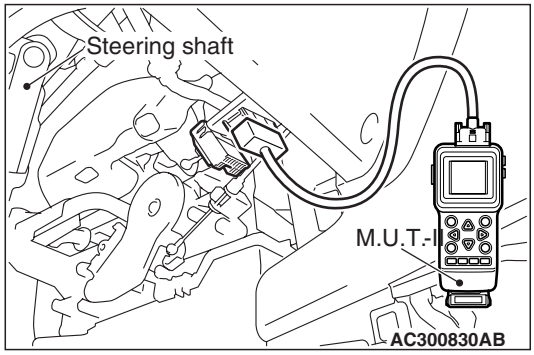
   Standard value: 750 ±100 r/min

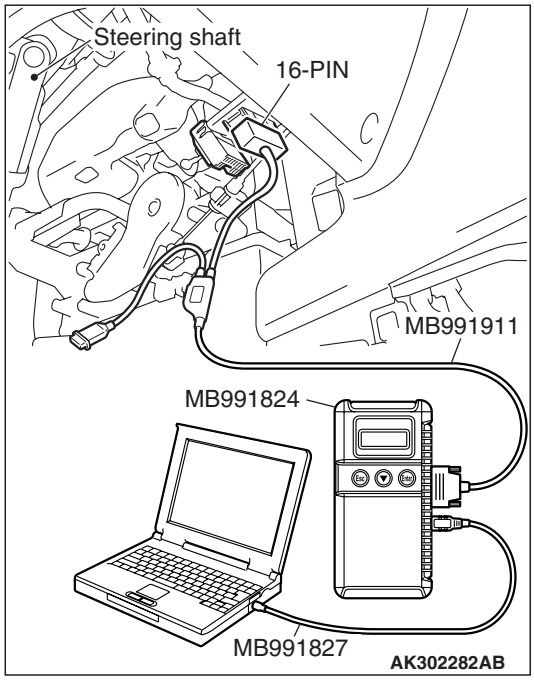
   NOTE:
   - *The idle speed is controlled automatically by the idle speed control system.*
   - *When using the M.U.T.-II/III, select item No. 22 and take a reading of the idle speed.*

8. If the idle speed is outside the standard value, inspect the MPI system (Refer to GROUP 13B – Troubleshooting –Inspection chart for diagnosis code P.13B-15).

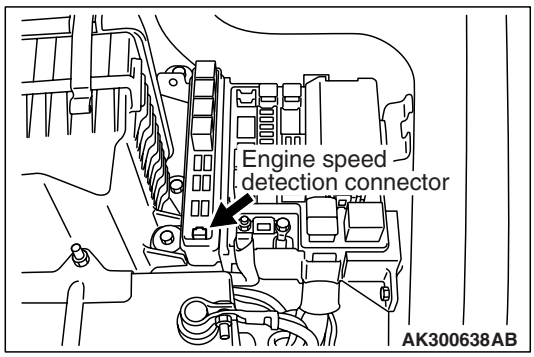
IDLE MIXTURE CHECK

M1111002100374





1. Before inspection, set the vehicle to the pre-inspection condition.
2. Turn the ignition switch to "LOCK" (OFF) position.
3. Connect the M.U.T.-II/III to the diagnosis connector or connect a tachometer to the engine speed detection connector.
4. Connect a timing lamp.



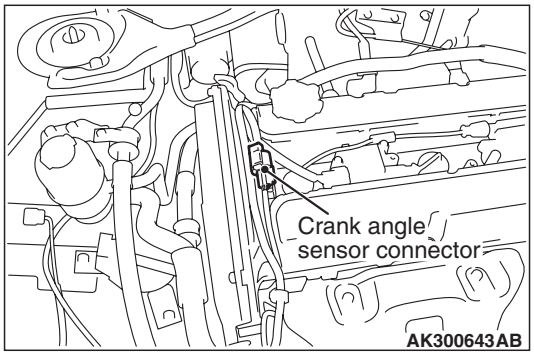
5. Start the engine and let it run at idle.

6. Check that ignition timing is at the standard value.
   Standard value: approximately 5° BTDC
7. Run the engine at 2,500 r/min for 2 minutes.
8. Set the CO, HC tester.
9. Check the CO contents and the HC contents at idle.
   Standard value
   CO contents: 0.6 % or less
   HC contents: 100 ppm or less
10. If there is a deviation from the standard value, check the following items:
- Diagnosis output
- Fuel pressure
- Injector
- Ignition coil, spark plug cable, spark plug
- EGR control system
- Evaporative emission control system
- Compression pressure

NOTE: Replace the three way catalyst when the CO and HC contents are not within the standard value, even though the result of the inspection is normal on all items.

COMPRESSION PRESSURE CHECK

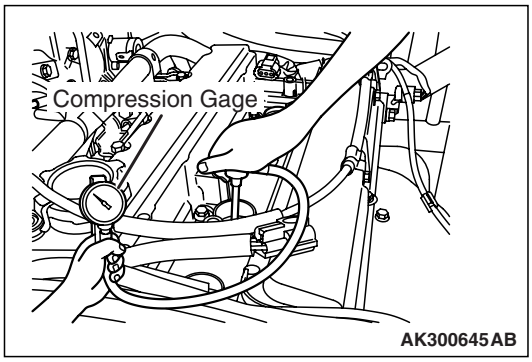
M1111002600562



1. Before inspection, set the vehicle to the pre-inspection condition.
2. Disconnect the spark plug cables.
3. Remove all of the spark plugs.
4. Disconnect the crank angle sensor connector.
   NOTE: Doing this will prevent the engine-A/T-ECU from carrying out ignition and fuel injection.

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

5. 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.



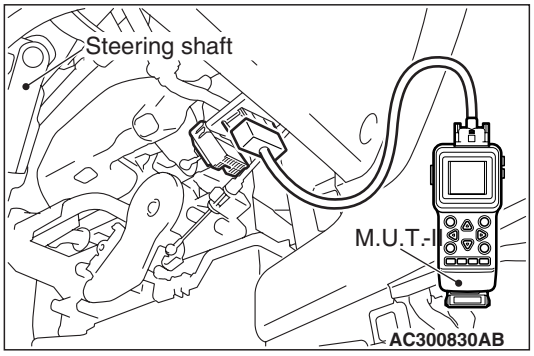
6. Set compression gauge to one of the spark plug holes.
7. Crank the engine with the throttle valve fully open and measure the compression pressure.
   Standard value (at engine speed of 250 – 400 r/min):
   1,370 kPa
   Limit (at engine speed of 250 – 400 r/min):
   Minimum 980 kPa
8. Measure the compression pressure for all the cylinders, and check that the pressure differences of the cylinders are below the limit.
   Limit: Maximum 98 kPa
9. If there is a cylinder with compression or a compression difference that is outside the limit, pour a small amount of engine oil through the spark plug hole, and repeat the operations in steps from (6) to (8).
   (1) If the compression increases after oil is added, the cause of the malfunction is a worn or damaged piston ring and/or cylinder inner surface.
   (2) If the compression does not rise after oil is added, the cause is a burnt or defective valve seat, or pressure is leaking from the gasket.
10. Connect the crank angle sensor connector.
11. Install the spark plugs and spark plug cables.

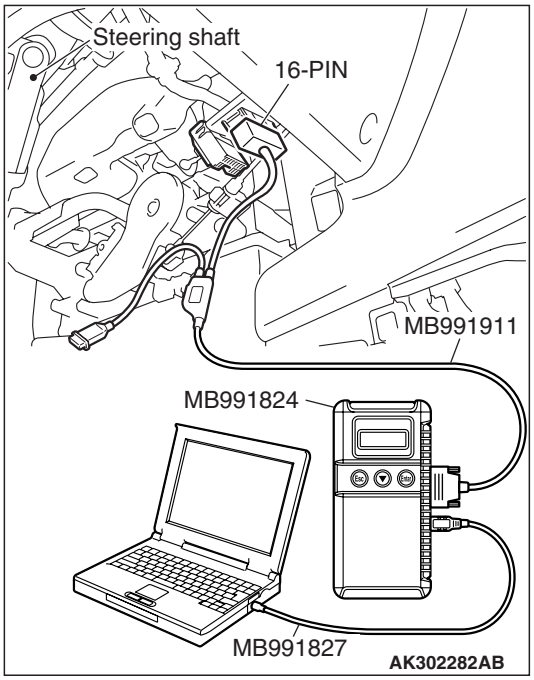
12.Use the M.U.T.-II/III to erase the diagnosis codes.

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

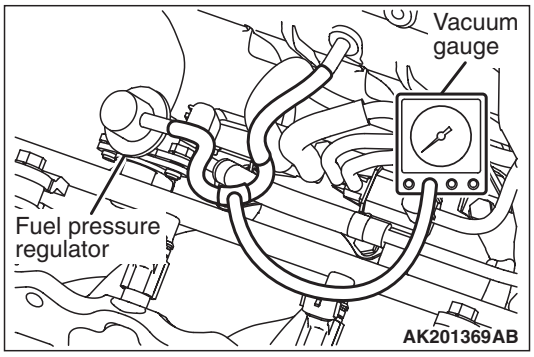
MANIFOLD VACUUM CHECK

M1111002700514





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



4. Attach a three-way joint to the vacuum hose between the fuel pressure regurator and the air intake plenum, and connect a vacuum gauge.
5. Start the engine and check that idle speed is within the standard valve.

   Standard value: 750 ±100 r/min
6. Check the intake manifold vacuum.

   Limit: Minimum 60 kPa
7. Turn off the ignition switch.
8. Remove the vacuum gauge and the three-way joint, and then connect the vacuum hose.
9. Remove the engine tachometer or the M.U.T.-II/III.

LASH ADJUSTER CHECK

M1111002900433

If an abnormal noise (knocking) that seems to be coming from the lash adjuster is heard after starting the engine and does not stop, carry out the following check.

NOTE:

- *The abnormal noise which is caused by a problem with the lash adjusters is generated after the engine is started, and will vary according to the engine speed. However, this noise is not related to the actual engine load.*

  Because of this, if the noise does not occur immediately after the engine is started, if it does not change in accordance with the engine speed, or if it changes in accordance with the engine load, the source of the noise is not the lash adjusters.
- *If there is a problem with the lash adjusters, the noise will almost never disappear, even if the engine has been run at idle to let it warm up. The only case where the noise might disappear is if the oil in the engine has not been looked after properly and oil sludge has caused the lash adjusters to stick.*

1. Start the engine.

2. Check that the noise occurs immediately after the engine is started, and that the noise changes in accordance with changes in the engine speed.

   If the noise does not occur immediately after the engine is started, or if it does not change in accordance with the engine speed, the problem is not being caused by the lash adjusters, so check for some other cause of the problem. Moreover, if the noise does not change in accordance with the engine speed, the cause of the problem is probably not with the engine (In these cases, the lash adjusters are normal).
3. While the engine is idling, check that the noise level does not change when the engine load is varied (for example, by shifting from N to D).

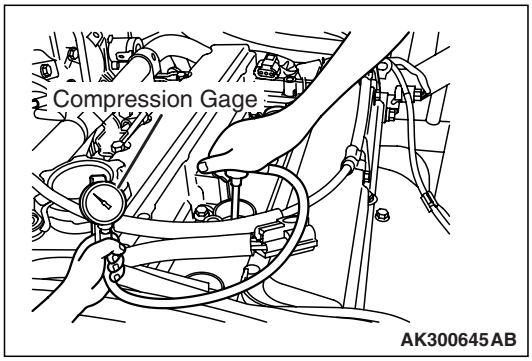
   If the noise level changes, the cause of the noise is probably parts striking because of worn crankshaft bearings or connecting rod bearings (In such cases, the lash adjusters are normal).
4. After the engine has warmed up, run it at idle and check if any noise can be heard.

   If the noise has become smaller or disappeared, oil sludge could make the lash adjusters stick. Clean the lash adjusters (Refer to GROUP 11D – Rocker Arms and Camshaft –Rocker Arms and Camshaft Inspection P.11D-31). If not improved, go to step 5.
5. Bleed air from the lash adjusters (Refer to P.11C-15).
6. If the noise has not disappeared even after the air bleeding, clean the lash adjusters (Refer to GROUP 11D –Rocker Arms and Camshaft – Rocker Arms and Camshaft Inspection P.11D-31).

<LASH ADJUSTER AIR BLEEDING>

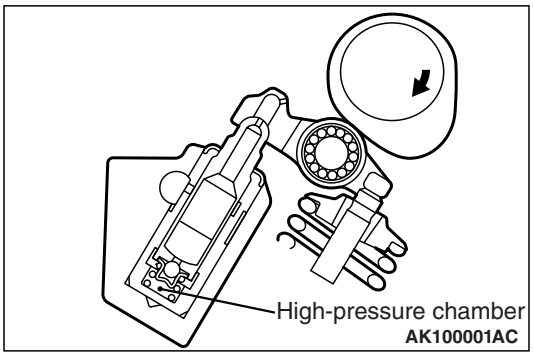
NOTE:

- *If the vehicle is parked on a slope fir a long period of time, the amount of oil inside the lash adjuster will decrease, and air may get into the high pressure chamber when starting the engine.*
- *After parking the vehicle for long periods, the oil drains out of the oil passage, and it takes time for the oil to be supplied to the lash adjuster, so air can get into the high-pressure chamber.*
- *If either of the above situations occur, the abnormal noise can be eliminated by bleeding the air from inside the lash adjusters.*

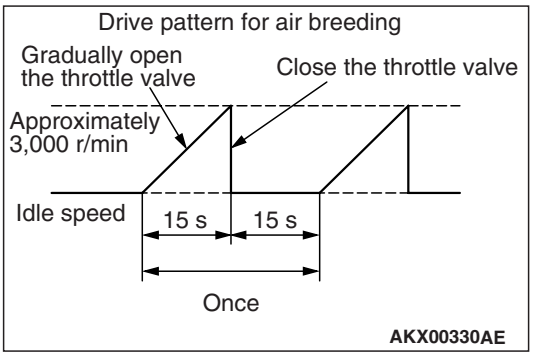


1. Check the engine oil and replenish or replace the oil if necessary.

   NOTE:
   - *If there is an only small amount of oil, air will be drawn in through the oil screen and will get into the oil passage.*
   - *If the amount of oil is greater than normal, then the oil will being mixed by the crankshaft and a large amount of air may get mixed into the oil.*
   - *If the oil is degenerated, air and oil will not separate easily in oil, and the amount of air mixed into the oil will increase.*



   - *If the air which has been mixed in with the oil due to any of the above reasons gets into the high pressure chamber of the lash adjuster, the air inside the high pressure chamber will be compressed when the valve is open and the lash adjuster will over-compress, resulting in abnormal noise when the valve close. This is the same effect as if the valve clearance is adjusted to be too large by mistake. If the air inside the lash adjusters is then released, the operation of the lash adjusters will return to normal.*



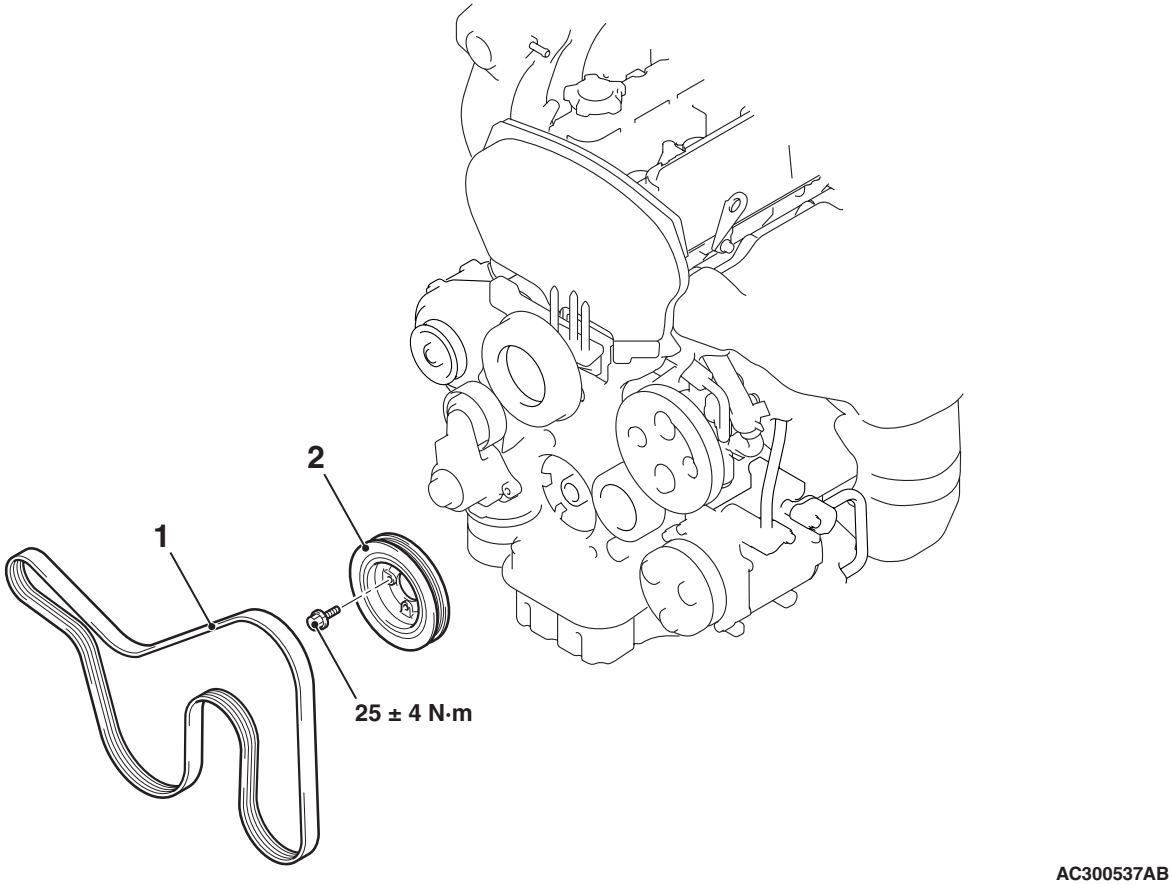
2. Run the engine at idle for 1 –3 minutes to let it warm up.
3. With no load on the engine, repeat the drive pattern shown in the illustration above and check if the abnormal noise disappears (The noise should normally disappear after 10 – 30 repetitions, but if there is no change in the noise level after 30 repetitions or more, the problem is probably not due to air inside the lash adjusters).
4. After the noise has disappeared, repeat the drive pattern shown in the illustration above a further 5 times.
5. Run the engine at idle for 1 – 3 minutes and check that the noise has disappeared.

CRANKSHAFT PULLEY

REMOVAL AND INSTALLATION

M1112001600443

Pre-removal Operation	Post-installation Operation
• Under Cover Removal	• Drive Belt Tension Check (Refer to P.11C-7). • Under Cover Installation



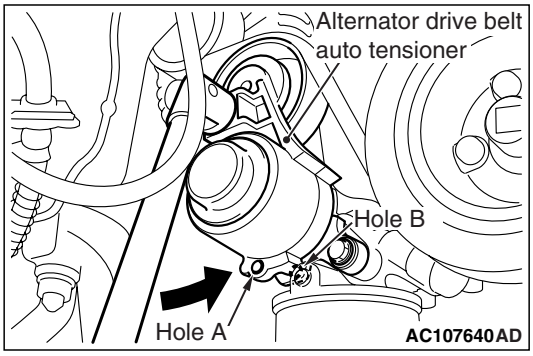
Removal steps

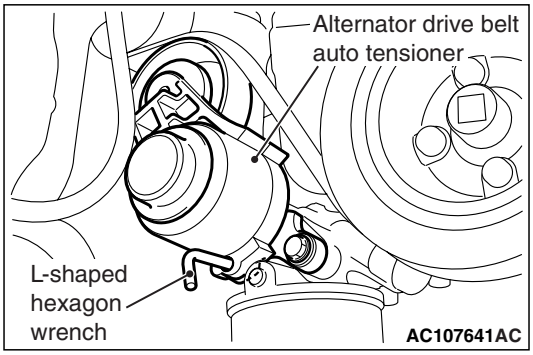
<<A>> 1. Alternator drive belt
2. Crankshaft pulley

REMOVAL SERVICE POINT

<<A>> ALTERNATOR DRIVE BELT REMOVAL

The following operations will be needed due to the serpentine drive system with the alternator 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 alternator drive belt auto tensioner, and turn the alternator drive belt auto tensioner anti-clockwise until it hits the stopper.

⚠ CAUTION

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

2. Align hole A with hole B, insert an L-shaped hexagon wrench, etc. to fix and then remove the alternator drive belt.

CAMSHAFT AND VALVE STEM SEAL

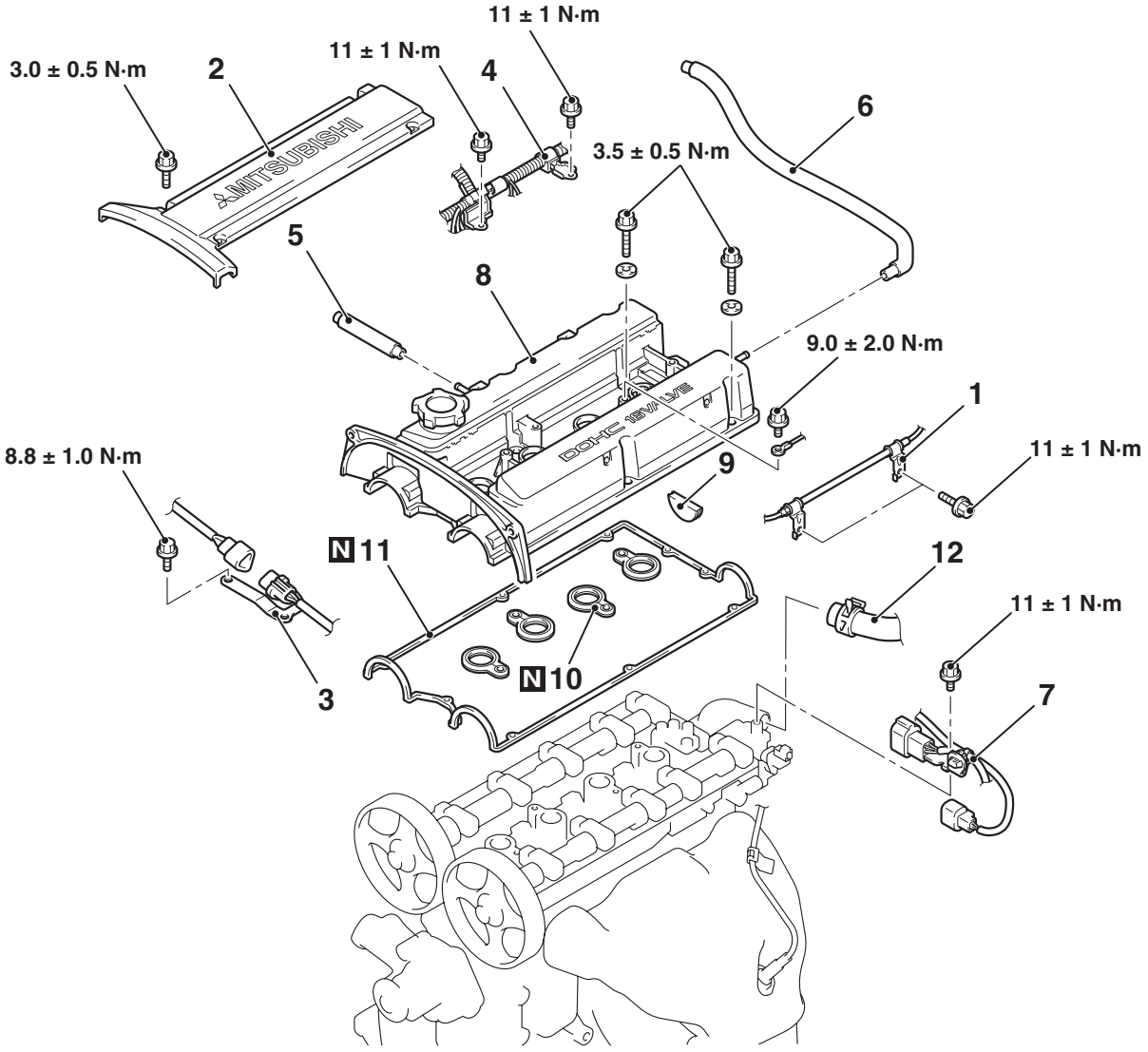
REMOVAL AND INSTALLATION

M1112006600255

⚠ CAUTION

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

Pre-removal Operation	Post-installation Operation
• Engine Coolant Draining (Refer to GROUP 14 - On-vehicle Service P.14-21). • Air Cleaner Assembly Removal (Refer to GROUP 15 P.15-3). • Battery and Battery Tray Removal • Valve Timing Belt Removal (Refer to P.11C-35).	• Valve Timing Belt Installation (Refer to P.11C-35). • Battery and Battery Tray Installation • Air Cleaner Assembly Installation (Refer to GROUP 15 P.15-3). • Engine Coolant Refilling (Refer to GROUP 14 - On-vehicle Service P.14-21). • Drive Belt Tension Check (Refer to P.11C-7).



AC300538AB

Removal steps

1. Accelerator cable connection <L.H. drive vehicles>
2. Rocker cover centre cover
3. Engine crank angle sensor connector
4. Control wiring harness connection

Removal steps (Continued)

- Spark plug cables and ignition coils (Refer to GROUP 16 P.16-37).

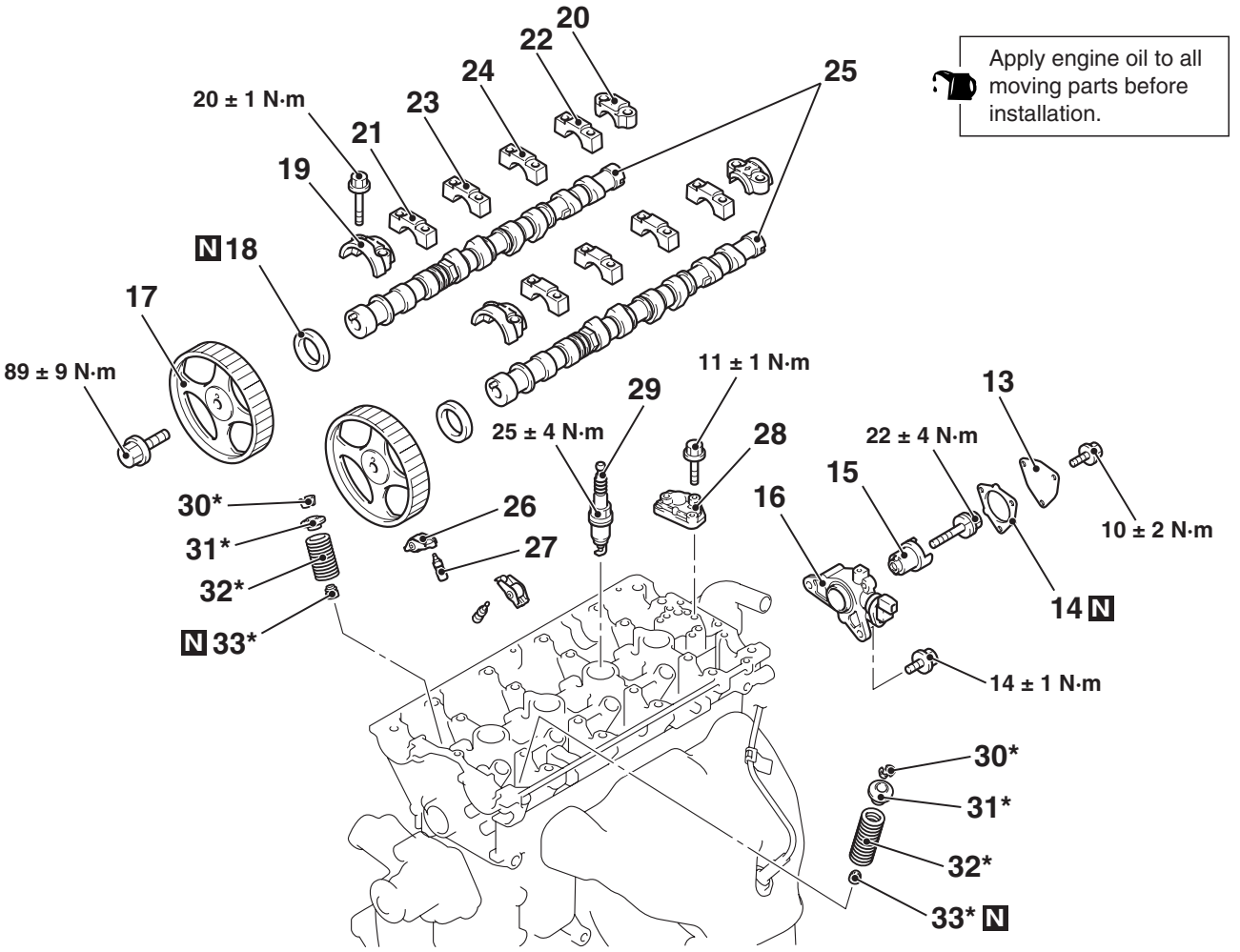
5. Rocker cover PCV hose
6. Rocker cover breather hose
7. Control wiring harness connection

>>N<< 8. Rocker cover assembly

>>M<< 9. Cylinder head camshaft end seal

Removal steps (Continued)

10. Rocker cover spark plug hole gaskets
>>L<< 11. Rocker cover gasket
<<A>> >>K<< 12. Radiator upper hose connection



AC300539AC

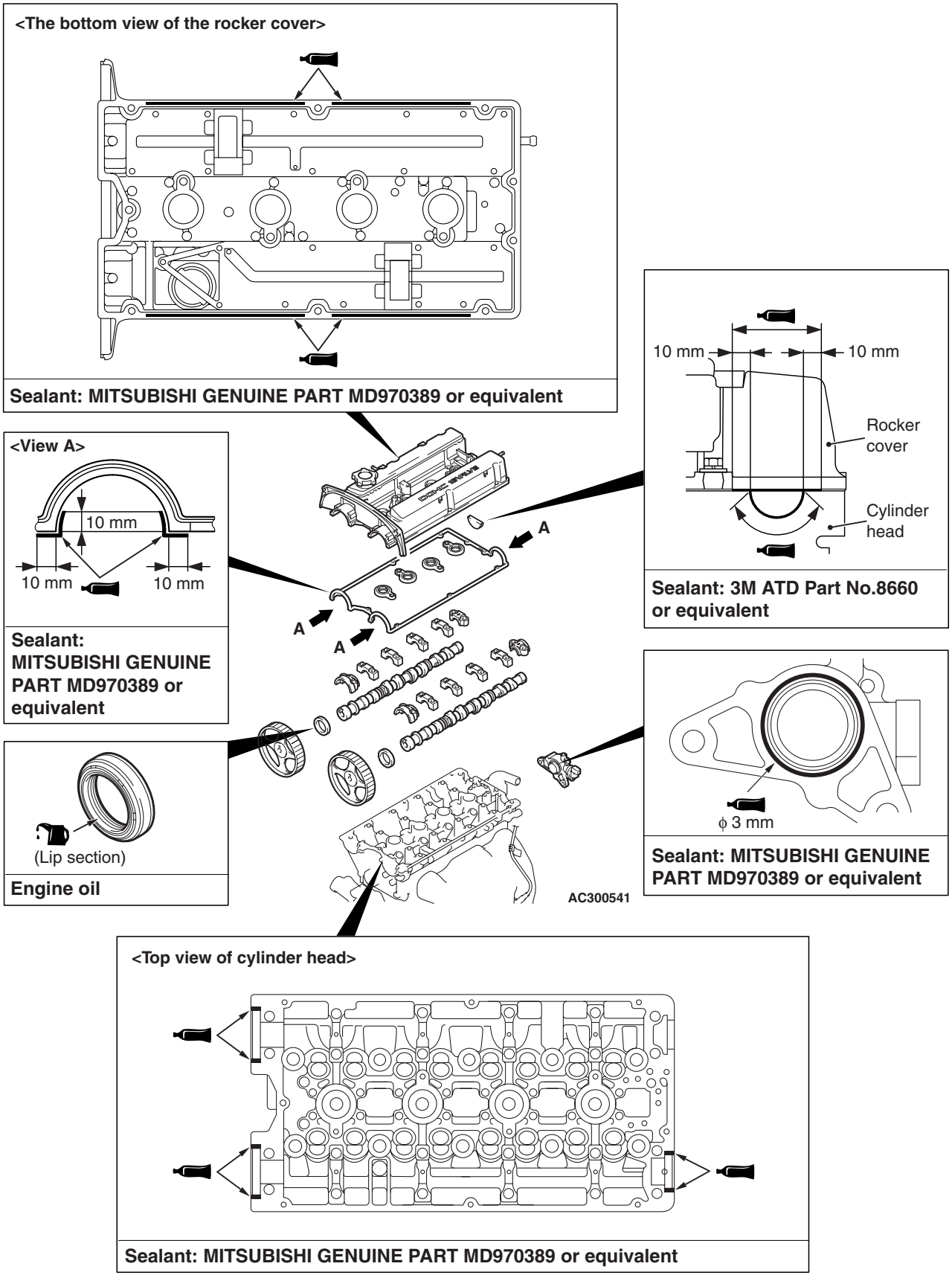
Removal steps

13. Camshaft position sensor support cover
14. Camshaft position sensor support cover gasket
>>J<< 15. Camshaft position sensing cylinder
>>I<< 16. Camshaft position sensor support and camshaft position sensor assembly
<<B>> >>H<< 17. Camshaft sprocket
>>G<< 18. Camshaft oil seal
>>F<< 19. Camshaft bearing cap, front
>>F<< 20. Camshaft bearing cap, rear
>>F<< 21. Camshaft bearing cap, No.2
>>F<< 22. Camshaft bearing cap, No.5

Removal steps (Continued)

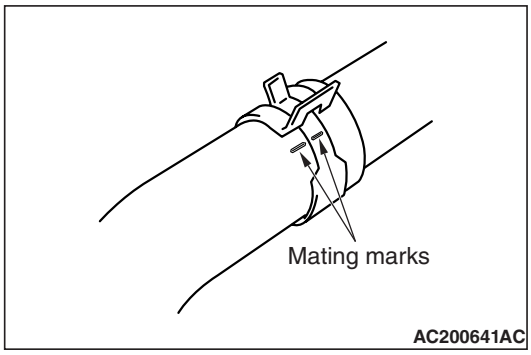
>>F<< 23. Camshaft bearing cap, No.3
>>F<< 24. Camshaft bearing cap, No.4
>>E<< 25. Camshaft
26. Rocker arm
>>D<< 27. Rocker arm lash adjuster
28. Lash adjuster oil delivery body
29. Spark plug
<<C>> >>C<< 30. Valve spring retainer lock
31. Valve spring retainer
>>B<< 32. Valve spring
>>A<< 33. Valve stem seal

LUBRICATION AND SEALING POINTS



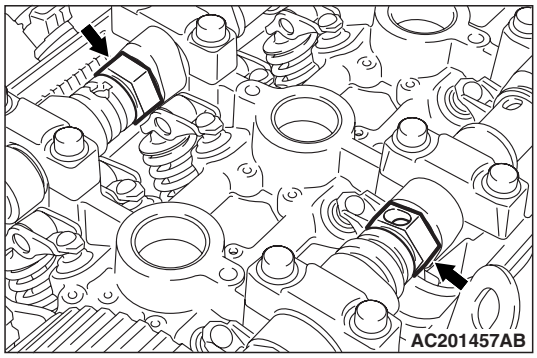
REMOVAL SERVICE POINTS

<<A>> RADIATOR UPPER HOSE DISCONNECTION



Make mating marks on the radiator upper hose and the radiator piping clip. Disconnect the radiator upper hose.

<<B>> CAMSHAFT SPROCKET REMOVAL

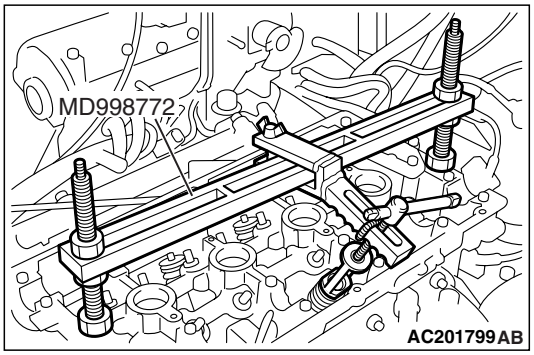


1. Hold the hexagon part of the camshaft with a wrench.
2. Loosen the camshaft sprocket mounting bolt and remove the camshaft sprocket.

<<C>> VALVE SPRING RETAINER LOCK REMOVAL

⚠ CAUTION

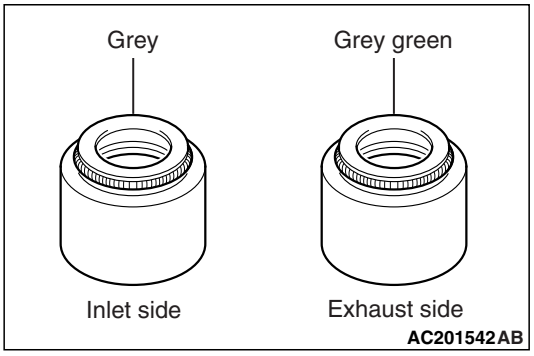
When removing valve spring retainer lock, leave the piston of each cylinder in the TDC (Top Dead Centre) position. The valve may fall into the cylinder if the piston is not properly in the TDC position.



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

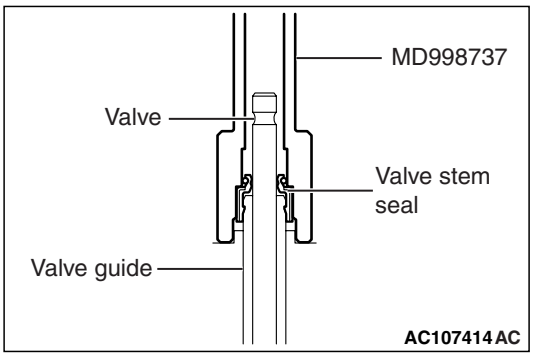
INSTALLATION SERVICE POINTS

>>A<< VALVE STEM SEAL INSTALLATION



1. Check the valve stem seal colour to identify the inlet side or exhaust side.
2. Apply a small amount of engine oil to the valve stem seal.

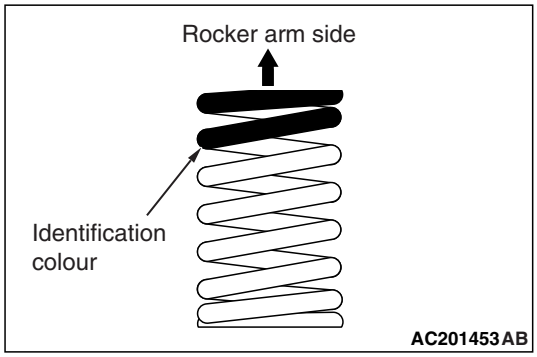
⚠ CAUTION



- **Valve stem seal cannot be reused.**
- **The special tool valve stem seal installer (MD998737) must be used to install the valve stem seal. Improper installation could result in oil leaking past the valve guide.**

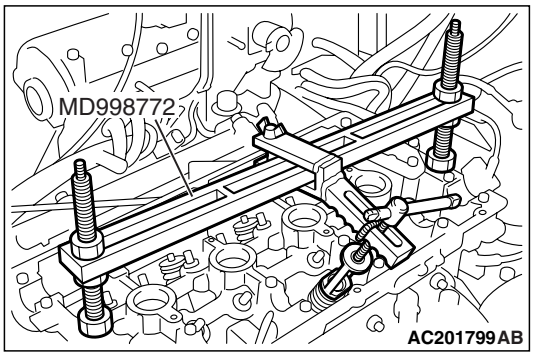
3. Use special tool to fill a new valve stem seal in the valve guide using the valve stem area as a guide.

>>B<< VALVE SPRING INSTALLATION



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

>>C<< VALVE SPRING RETAINER LOCK INSTALLATION



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

>>D<< ROCKER ARM LASH ADJUSTER INSTALLATION

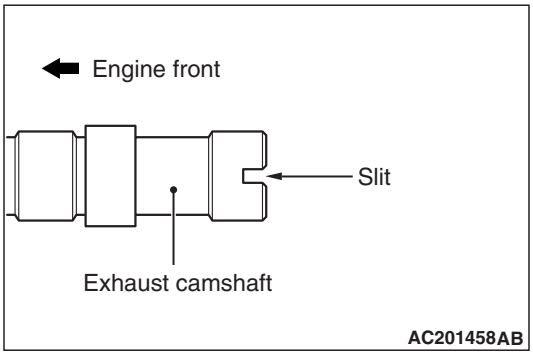
⚠ CAUTION

If the rocker arm lash adjuster is reused, always clean and check it before installation. (Refer to GROUP 11B, Rocker Arms and Camshaft).

>>E<< CAMSHAFT INSTALLATION

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

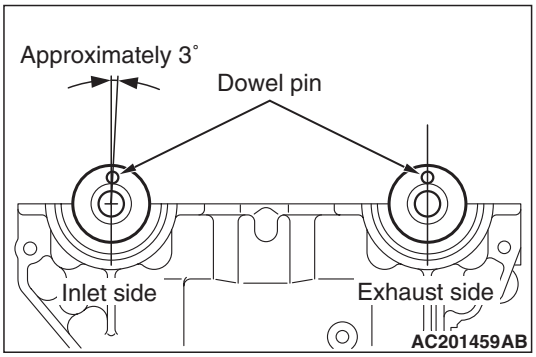
⚠ CAUTION



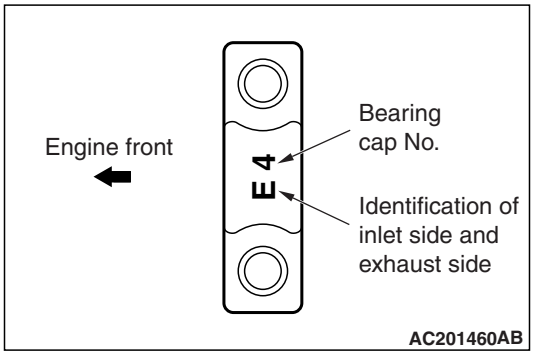
Do not install wrong camshaft at the side of inlet or exhaust. The exhaust camshaft has a slit at the rear surface.

3. Install the camshaft to the engine cylinder head.

>>F<< CAMSHAFT BEARING CAP, NO. 4/CAMSHAFT BEARING CAP, NO. 3/CAMSHAFT BEARING CAP, NO. 5/CAMSHAFT BEARING CAP, NO. 2/CAMSHAFT BEARING CAP, REAR/CAMSHAFT BEARING CAP, FRONT INSTALLATION

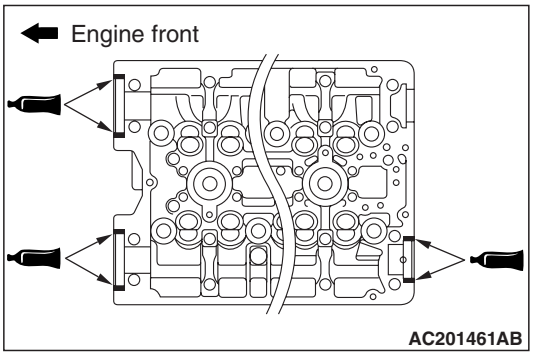


1. Set the dowel pin of the camshaft to the position as shown in the illustration.



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

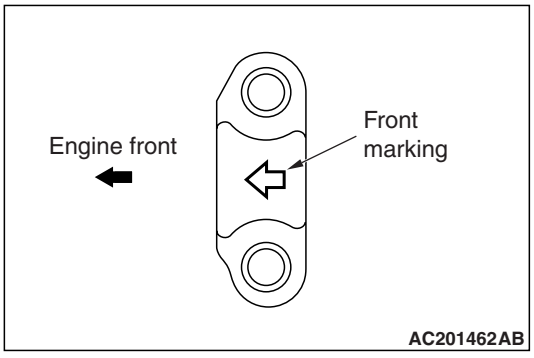
   Identification mark (engraved on the front and bearing caps No.2 – 5)
   I: Inlet side
   E: Exhaust side



3. Apply sealant to the positions (6 areas) of the upper side of the cylinder head as shown in the illustration.

   Specified sealant: MITSUBISHI GENUINE PART MD970389 or equivalent

   NOTE: Install the camshaft bearing cap, rear and camshaft bearing cap, front within 15 minutes after applying liquid gasket.



4. Position the camshaft bearing cap, rear in the direction as shown in the illustration for installation.
5. Check the identification marks on the camshaft bearing cap, front so that inlet side and exhaust side cannot be mistaken in the same way as that of bearing caps No.2 – 5.

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

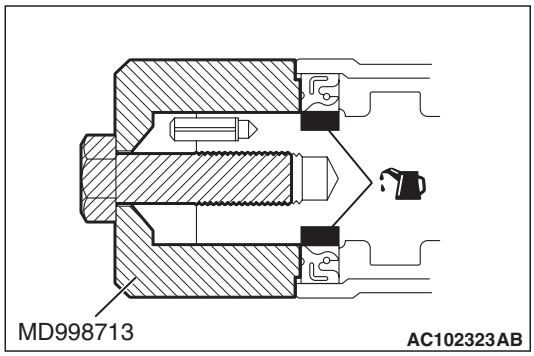
6. Tighten the bearing cap mounting bolts increasing the pressure in 2 to 3 times and finally tighten to the specified torque.

   Tightening torque: 20 ±1 N· m

7. Ensure that the rocker arms are installed properly.

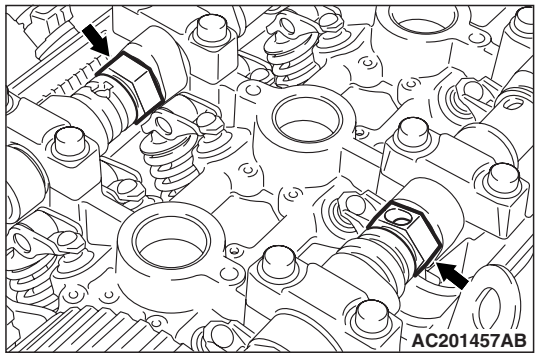
   NOTE: Remove an excess of sealant completely.

>>G<< CAMSHAFT OIL SEAL INSTALLATION



1. Apply new 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.

>>H<< CAMSHAFT SPROCKET INSTALLATION

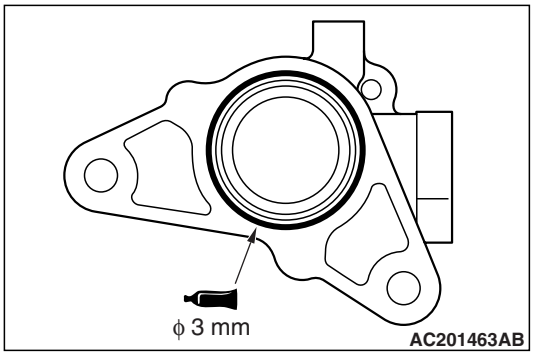


1. Hold the hexagon part of the camshaft with a wrench in the same manner as removal.
2. Tighten the camshaft sprocket mounting bolt to the specified torque.

   Tightening torque: 89 ±9 N· m

>>I<< CAMSHAFT POSITION SENSOR SUPPORT AND CAMSHAFT POSITION SENSOR ASSEMBLY INSTALLATION

1. Remove sealant from the camshaft position sensor support and engine 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 liquid gasket.

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

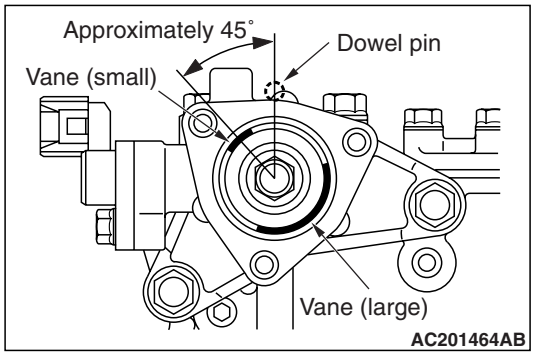
⚠ CAUTION

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

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

   Tightening torque: 14 ±1 N· m

>>J<< CAMSHAFT POSITION SENSING CYLINDER INSTALLATION



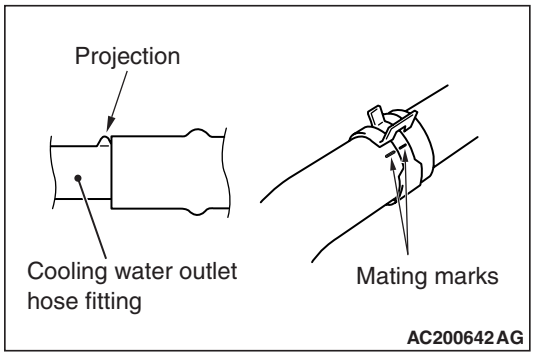
1. Set the dowel pin of the exhaust camshaft to the position (No.1 cylinder at compression TDC) as shown in the illustration.

   NOTE: Use the force of the exhaust valve spring to rotate anti-clockwise.

2. Install the vane (small) of the camshaft position sensing cylinder at an angle of approximately 45 degrees to the position of the dowel pin of the exhaust camshaft.
3. Tighten the camshaft position sensing cylinder mounting bolt to the specified torque.

   Tightening torque: 22 ±4 N· m

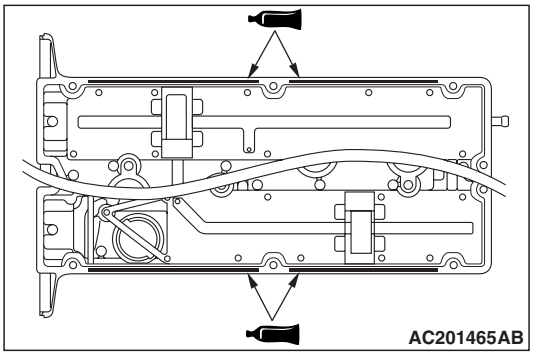
>>K<< RADIATOR UPPER HOSE CONNECTION



1. Insert radiator upper hose as far as the projection of the cooling water outlet hose fitting.
2. Align the mating marks on the radiator upper hose and radiator piping clip, and then connect the radiator upper hose.

>>L<< ROCKER COVER GASKET INSTALLATION

1. Remove sealant remained on the rocker cover assembly.



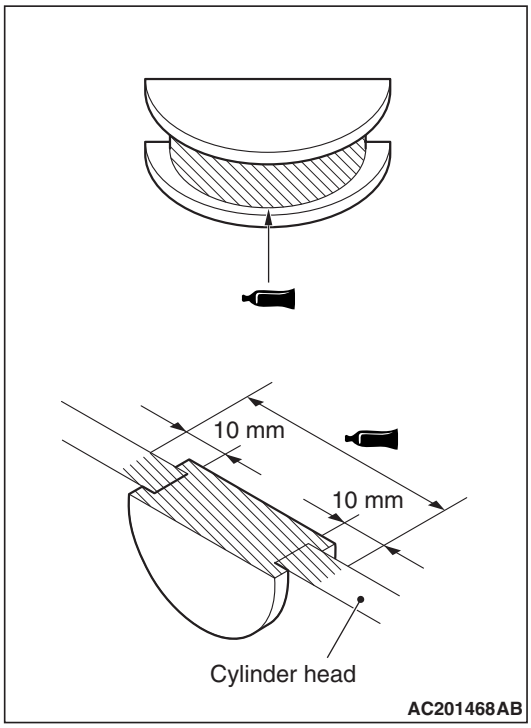
2. Apply sealant to the positions (4 areas) of the lower side of the rocker cover as shown in the illustration.

   Specified sealant: MITSUBISHI GENUINE PART MD970389 or equivalent

   NOTE: Install the rocker cover gasket within 15 minutes after applying liquid gasket.

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

>>M<< CYLINDER HEAD CAMSHAFT END SEAL INSTALLATION

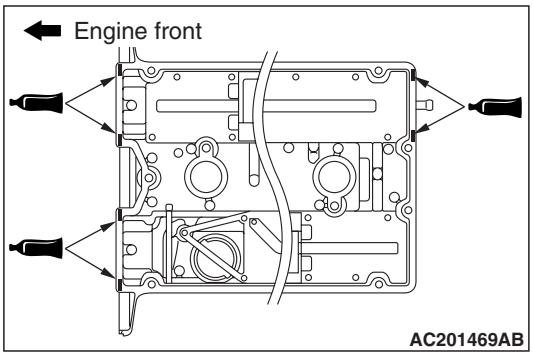


Apply sealant to the positions of the cylinder head camshaft end seal as shown in the illustration and install to the engine cylinder head.

Specified sealant: 3M ATD Part No.8660 or equivalent

NOTE: Install the cylinder head camshaft end seal within 15 minutes after applying liquid gasket.

>>N<< ROCKER COVER ASSEMBLY INSTALLATION



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

   Specified sealant: MITSUBISHI GENUINE PART MD970389 or equivalent

   NOTE: Install the rocker cover assembly within 15 minutes after applying liquid gasket.
2. Install the rocker cover assembly to the engine cylinder head.

⚠ CAUTION

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

3. Tighten the rocker cover mounting bolts to the specified torque.

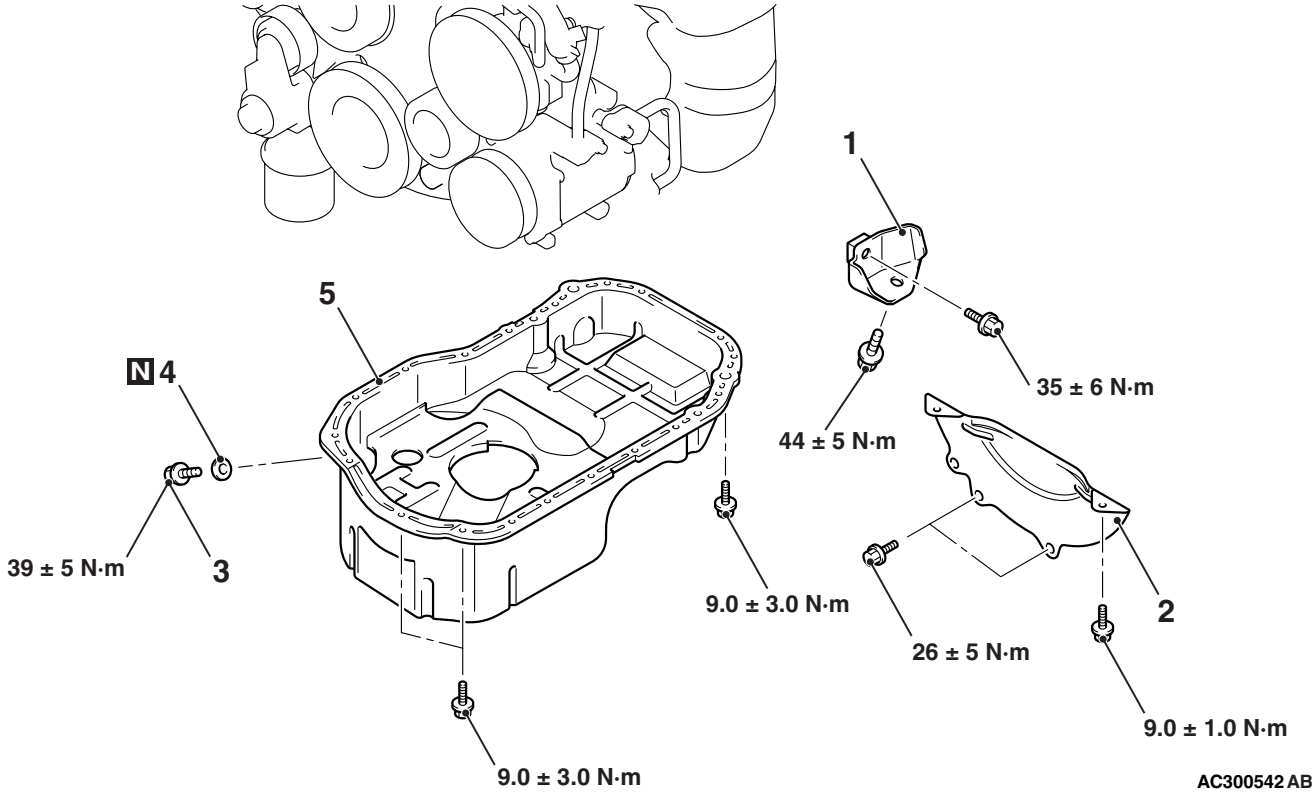
   Tightening torque: 3.5 ±0.5 N· m

OIL PAN

REMOVAL AND INSTALLATION

M1112002800666

Pre-removal Operation	Post-installation Operation
• Under Cover Removal • Engine Oil Draining (Refer to GROUP 12 - On-vehicle Service P.12-4). • Front Exhaust Pipe Removal (Refer to GROUP 15 P.15-11).	• Front Exhaust Pipe Installation (Refer to GROUP 15 P.15-11). • Engine Oil Refilling (Refer to GROUP 12 - On-vehicle Service P.12-4). • Under Cover Installation



Removal steps

1. Exhaust manifold bracket
2. Flywheel housing front lower cover
3. Engine oil pan drain plug

>>B<< 4. Engine oil pan drain plug gasket

<<A>> >>A<< 5. Engine oil pan

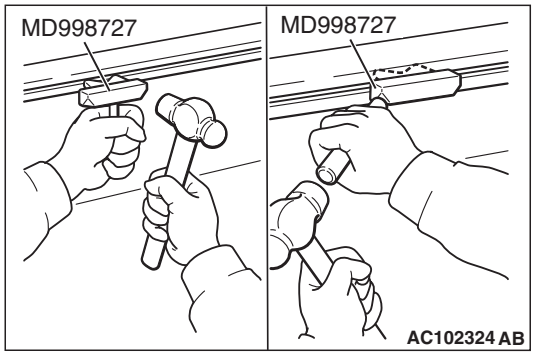
REMOVAL SERVICE POINT

<<A>> ENGINE OIL PAN REMOVAL

1. Remove the engine oil pan mounting bolts.

⚠ CAUTION

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

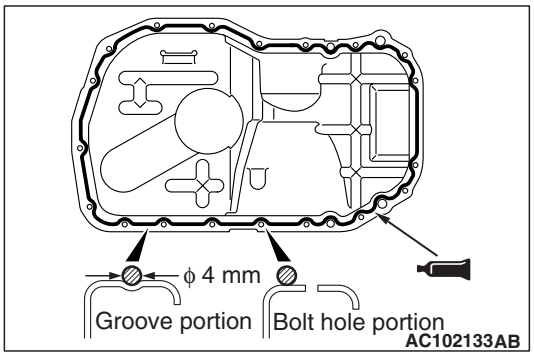


2. Remove the engine oil pan using special tool oil pan remover (MD998727).

INSTALLATION SERVICE POINTS

>>A<< ENGINE OIL PAN INSTALLATION

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



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

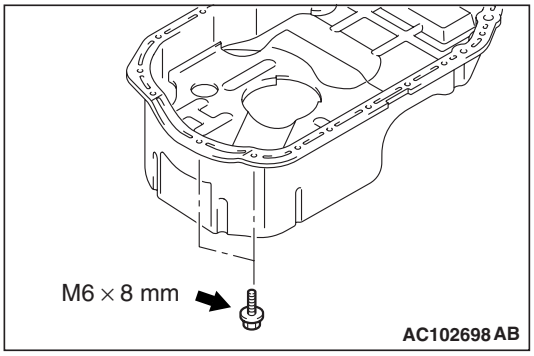
   Specified sealant: MITSUBISHI GENUINE PART MD970389 or equivalent

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

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

⚠ CAUTION

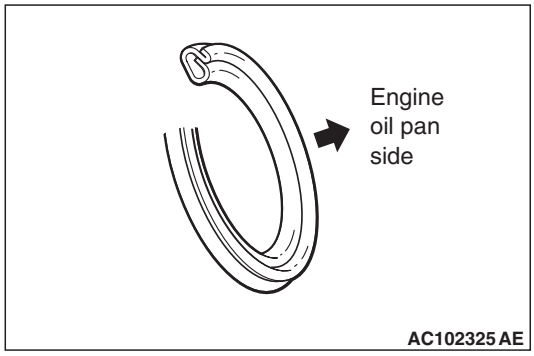
Then wait at least one hour. Never start the engine or let engine oil or coolant touch the sealant surface during that time.



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

   Tightening torque: 9.0 ±3.0 N· m

>>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.

INSPECTION

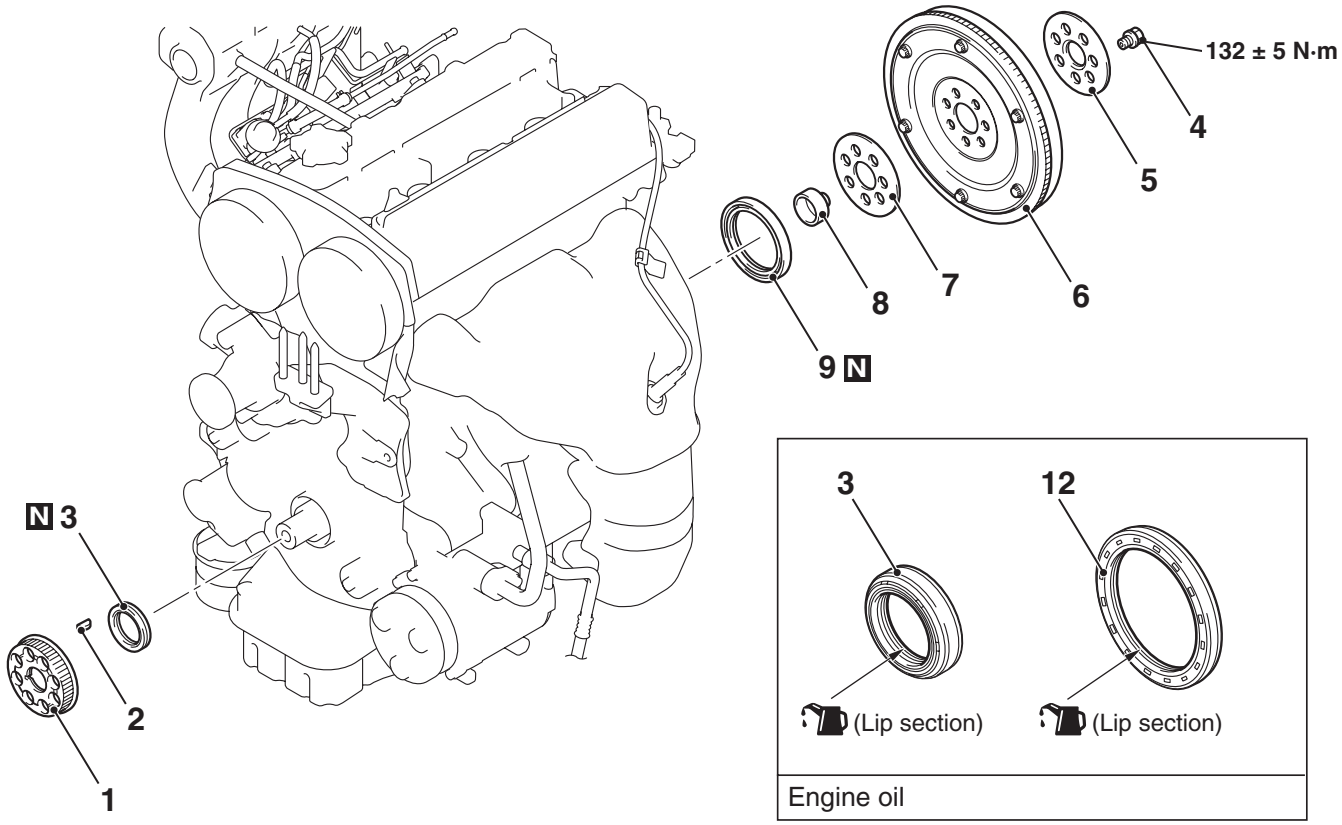
M1112002900243

- 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

M1112003101317



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Crankshaft front oil seal removal steps

- Valve timing belt, balancer timing belt (Refer to P.11C-35).

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

Crankshaft rear oil seal removal steps

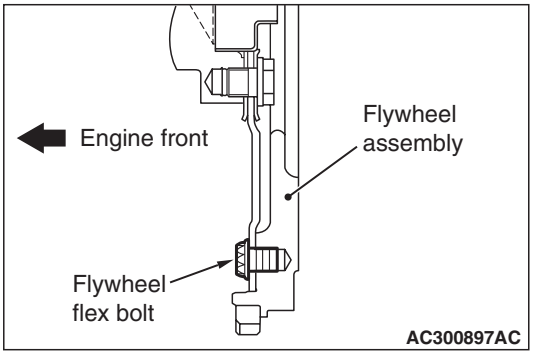
<<A>>
- Transmission assembly

<<B>> >>B<< 4. Flywheel bolt <M/T>
5. Flywheel adapter plate <M/T>
6. Flywheel assembly <M/T>
7. Flywheel adapter plate <M/T>
8. Crankshaft bushing <M/T>
<<B>> >>B<< 9. A/T drive plate bolt <A/T>
10. A/T drive plate adapter plate <A/T>
11. A/T drive plate <A/T>
>>A<< 12. Crankshaft rear oil seal

REMOVAL SERVICE POINTS

<<A>> TRANSMISSION ASSEMBLY REMOVAL

⚠ CAUTION



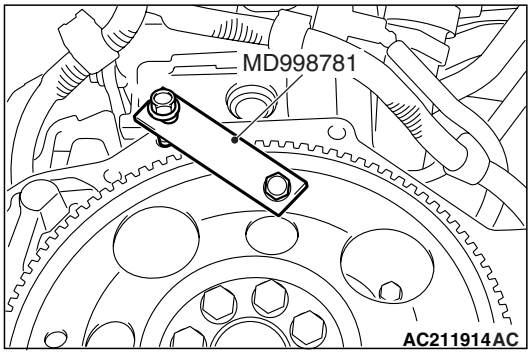
AC300897AC

For vehicles with M/T, do not remove the flywheel flex bolt shown by the arrow. If this bolt is removed, the flywheel assembly will become out of balance and damaged.

Refer to GROUP 22A - Transmission Assembly P.22A-18. <M/T>

Refer to GROUP 23A - Transmission Assembly P.23A-151. <A/T>

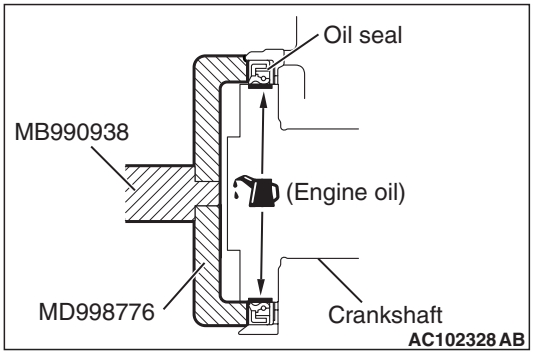
<<B>> FLYWHEEL BOLT <M/T>/A/T DRIVE PLATE BOLTS <A/T> REMOVAL



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

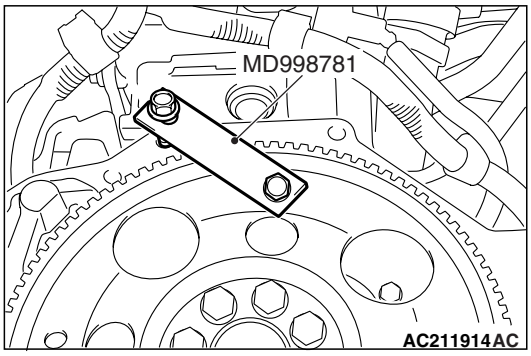
INSTALLATION SERVICE POINTS

>>A<< CRANKSHAFT REAR OIL SEAL INSTALLATION



1. Apply a small amount of new 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)

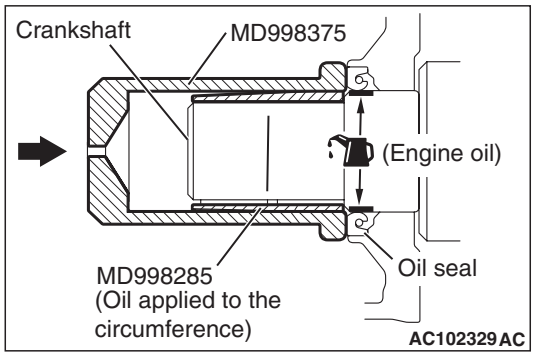
>>B<< A/T DRIVE PLATE BOLT <A/T>/FLYWHEEL BOLT <M/T> INSTALLATION



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

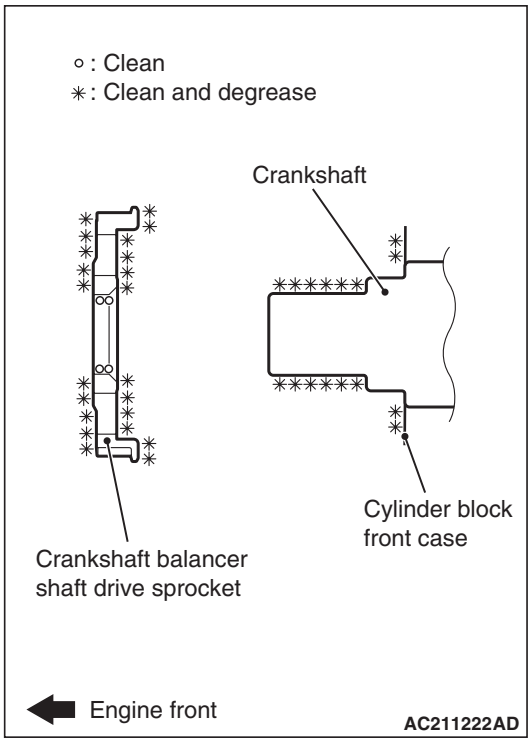
Tightening torque: 132 ±5 N·m

>>C<< CRANKSHAFT FRONT OIL SEAL INSTALLATION



1. Apply a small amount of new engine oil to the entire inner diameter of the oil seal lip.
2. Apply a small amount of engine oil to the outer diameter of special tool crankshaft front oil seal guide (MD998285) and install it to the crankshaft.
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 cylinder block front case, the crankshaft and the crankshaft balancer shaft drive sprocket as shown.

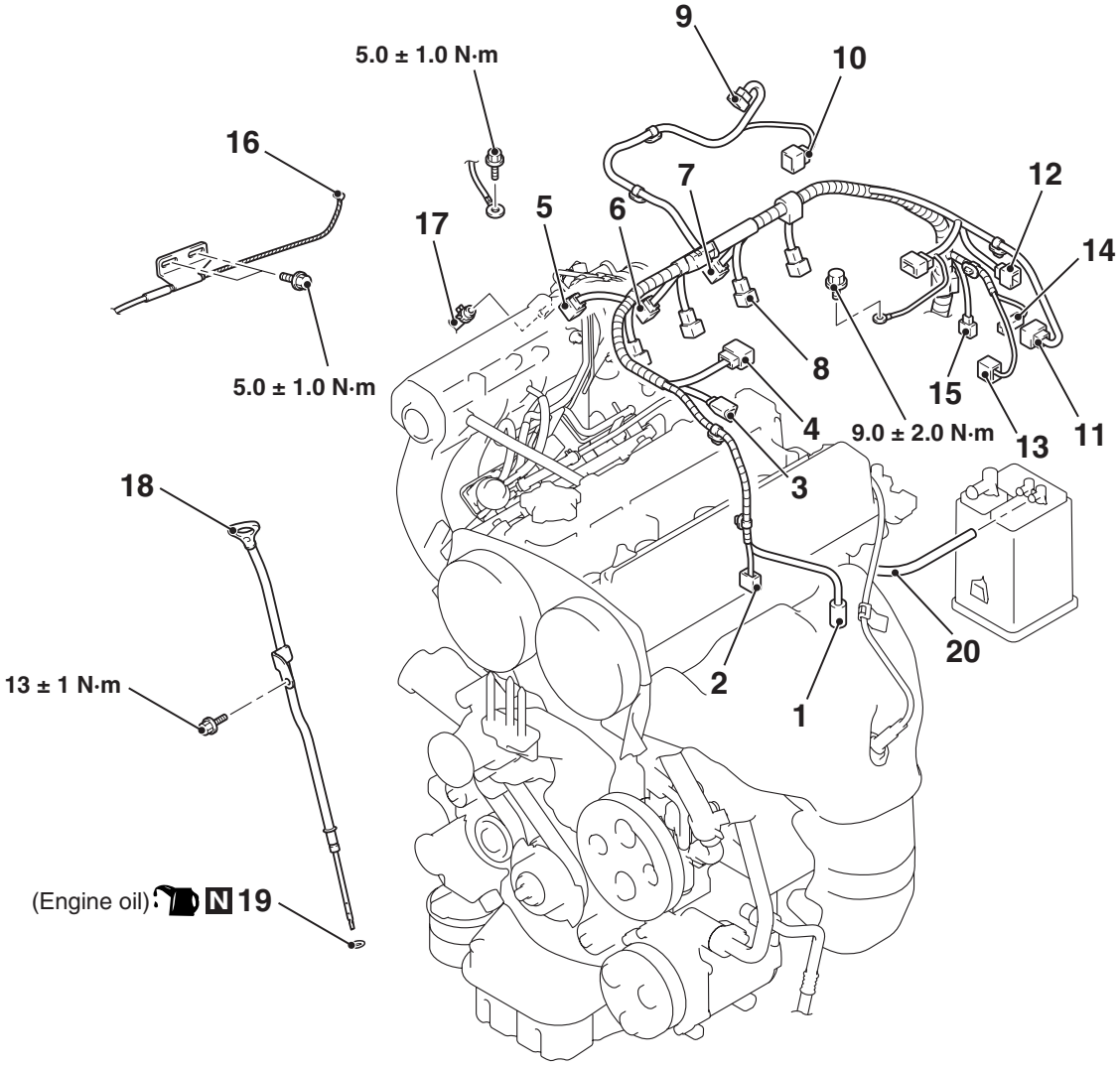
   NOTE: Also clean the degreased surfaces.
2. Install the crankshaft balancer shaft drive sprocket in the direction shown in the illustration.

CYLINDER HEAD GASKET

REMOVAL AND INSTALLATION

M1112004001896

Pre-removal Operation	Post-installation Operation
• Fuel Line Pressure Reduction (Refer to GROUP 13B - On-vehicle Service P.13B-327). • Under Cover Removal • Engine Oil Draining (Refer to GROUP 12 - On-vehicle Service P.12-4). • Engine Coolant Draining (Refer to GROUP 14 - On-vehicle Service P.14-21). • Air Cleaner Assembly Removal (Refer to GROUP 15 P.15-3). • Battery Removal • Strut Tower Bar Removal (Refer to GROUP 42 P.42-9). • Rocker Cover Centre Cover Removal (Refer to P.11C-18). • Valve Timing Belt Removal (Refer to P.11C-35).	• Valve Timing Belt Installation (Refer to P.11C-35). • Rocker Cover Centre Cover Installation (Refer to P.11C-18). • Strut Tower Bar Installation (Refer to GROUP 42 P.42-9). • Battery Installation • Air Cleaner Assembly Installation (Refer to GROUP 15 P.15-3). • Engine Coolant Refilling (Refer to GROUP 14 - On-vehicle Service P.14-21). • Engine Oil Refilling (Refer to GROUP 12 - On-vehicle Service P.12-4). • Accelerator Cable Adjustment (Refer to GROUP 17 - On-vehicle Service P.17-2). • Drive Belt Tension Check (Refer to P.11C-7). • Under Cover Installation • Fuel Leak Check



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Removal steps

1. A/C compressor connector
2. Power steering fluid pressure switch connector

Removal steps (Continued)

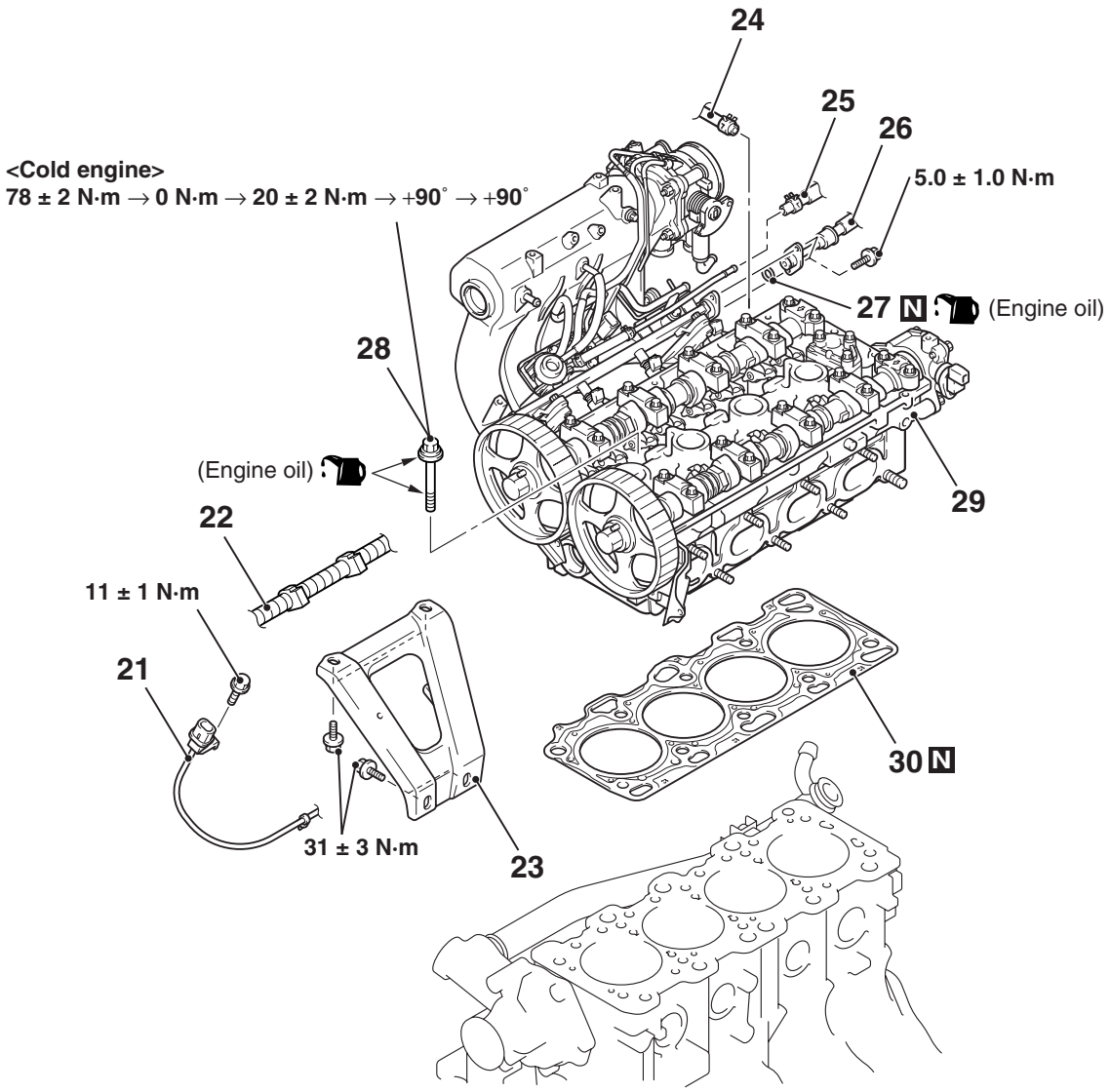
3. Engine crank angle sensor connector
4. Ignition coil connector

Removal steps (Continued)

5. Engine control detonation sensor connector
6. Emission solenoid valve (purge control system) connector
7. Emission solenoid valve (EGR system) connector
8. Fuel injector connector
9. Throttle body throttle sensor connector
10. Throttle body idle speed control servo connector
11. Camshaft position sensor connector
12. Engine control oxygen sensor (front) connector

Removal steps (Continued)

13. Water temperature sensor unit connector
14. Water temperature gauge unit connector
15. Capacitor connector
16. Accelerator cable connection
17. Brake booster vacuum hose connection
18. Engine oil level gauge and guide assembly
19. Engine oil filler O-ring
20. Emission vacuum hose (fuel vapour canister side) connection



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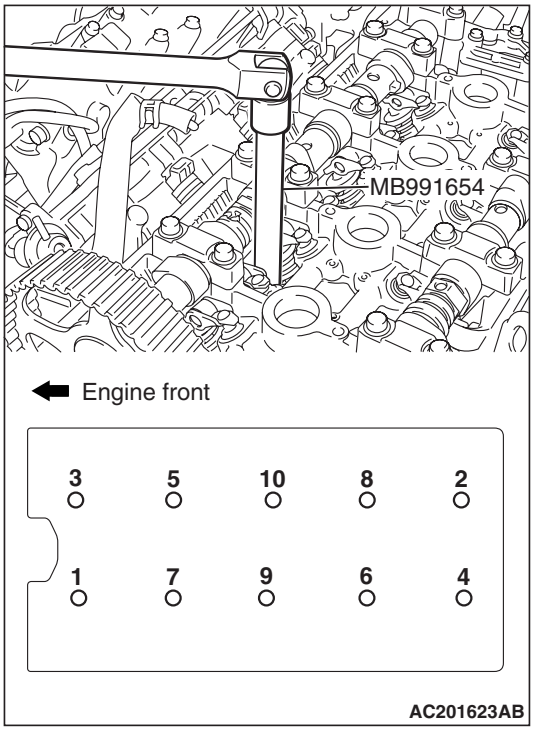
Removal steps

21. Engine control detonation sensor connector
22. Battery wiring harness connection
23. Inlet manifold stay
- Exhaust manifold (Refer to GROUP 15 P.15-10).
- Cooling water outlet hose fitting and thermostat case assembly (Refer to GROUP 14 - Water Hose and Water Pipe P.14-31).
- Rocker cover assembly (Refer to P.11C-18).

24. Heater water hose connection
25. Fuel return line hose connection
>>C<< 26. Fuel high-pressure hose connection
>>C<< 27. Fuel line O-ring
<<A>> >>B<< 28. Cylinder head bolt
29. Engine cylinder head assembly
>>A<< 30. Cylinder head gasket

REMOVAL SERVICE POINT
<<A>> CYLINDER HEAD BOLT REMOVAL



Using special tool cylinder head bolt wrench (MB991654), loosen the cylinder head bolts in two or three steps in the order of the numbers shown in the illustration.

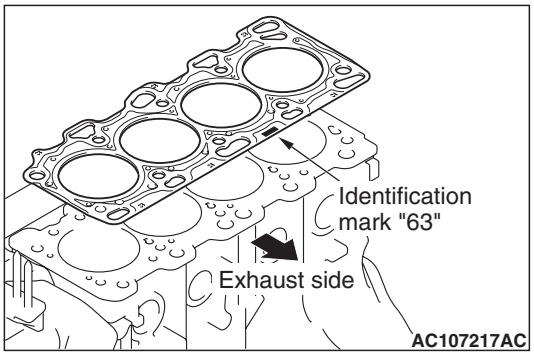
NOTE: If the cylinder head bolts cannot be pulled out due to the washer being trapped in the valve spring, raise the bolt slightly, then remove it while holding it by using a magnet.

INSTALLATION SERVICE POINTS
>>A<< CYLINDER HEAD GASKET INSTALLATION

⚠ CAUTION

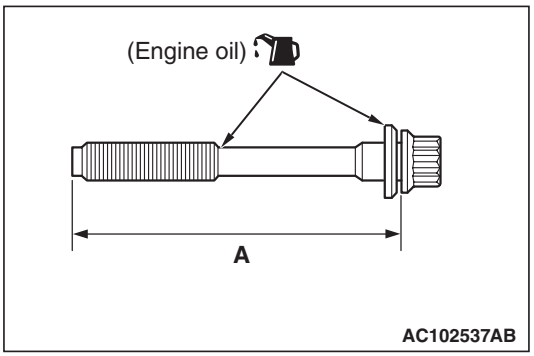
Do not allow any foreign materials to get into the coolant passages, oil passages and cylinder.

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



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

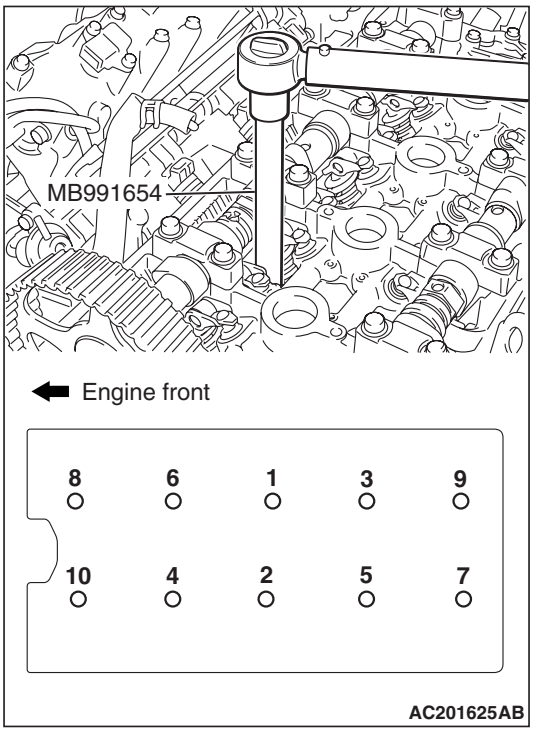
>>B<< CYLINDER HEAD BOLT INSTALLATION



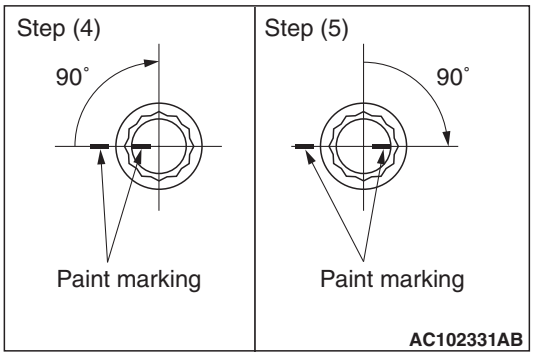
1. Check that the nominal length of each cylinder head bolt meets the limit. If it exceeds the limit, replace the cylinder head bolt with a new one.

   Limit (A): 99.4 mm

2. Apply a small amount of new 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 as follows:
   (1) Tighten the cylinder head bolts to 78 ±2 N· m in the order shown.
   (2) Loosen the cylinder head bolts fully in the reverse order of that shown.
   (3) Tighten the cylinder head bolts to 20 ±2 N· m in the order shown.



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

⚠ CAUTION
The bolt is not tightened sufficiently if the bolt is tightened less than 90 degree angle.

   (5) Tighten the bolt an additional 90 degree angle as shown. Then check to see that the paint mark on the head of the cylinder head bolts and the paint mark on the engine cylinder head are aligned.
   (6) If tightening the bolt 90 degree angle results in moving the paint mark on the bolt past the paint mark on the engine cylinder head, remove the cylinder head bolts and start over from step 1.

>>C<< FUEL LINE O-RING/FUEL HIGH-PRESSURE HOSE INSTALLATION

⚠ CAUTION
Do not let any engine oil get into the fuel delivery pipe.

1. Apply a small amount of new engine oil to the fuel line O-ring.
2. Turning the fuel high-pressure hose to the right and left, install it to the fuel delivery pipe, while being careful not to damage the fuel line O-ring. After installing, check that the hose turns smoothly.
3. If the hose does not turn smoothly, the fuel line O-ring is probably being clamped. Disconnect the fuel high-pressure hose and check the fuel line O-ring for damage. After this, re-insert it to the fuel delivery pipe and check that the hose turns smoothly.
4. Tighten the fuel high-pressure hose mounting bolts to the specified torque.

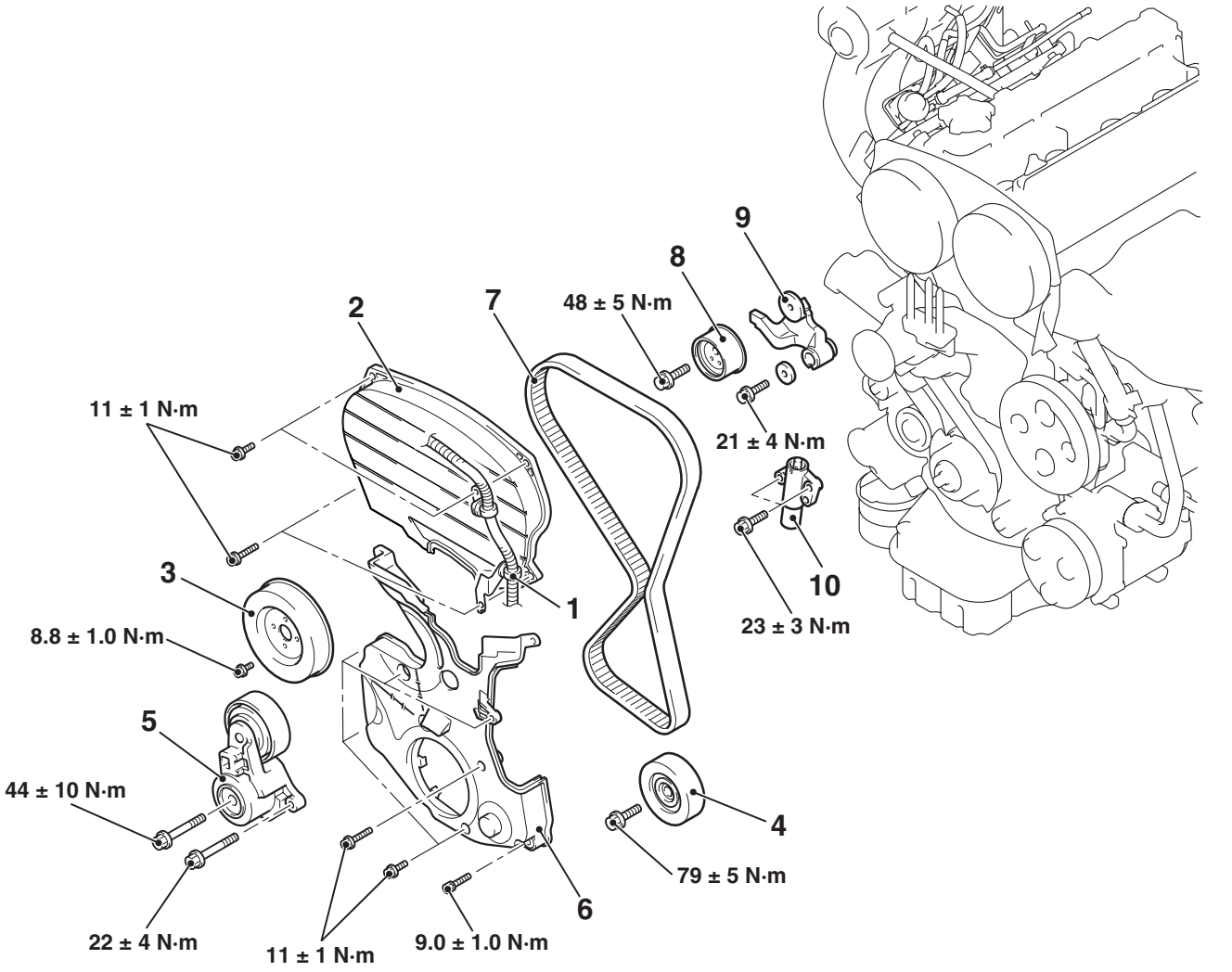
   Tightening torque: 5.0 ±1.0 N· m

TIMING BELT

REMOVAL AND INSTALLATION

M1112004300719

Pre-removal Operation	Post-installation Operation
• Under Cover Removal • Crankshaft Pulley Removal (Refer to P.11C-16).	• Crankshaft Pulley Installation (Refer to P.11C-16). • Drive Belt Tension Check (Refer to P.11C-7). • Under Cover Installation



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Removal steps

1. Control wiring harness connection
2. Timing belt upper cover
3. Water pump pulley
4. Power steering oil pump idler pulley
5. Alternator drive belt auto tensioner
6. Timing belt lower cover
- Engine mounting insulator (Refer to GROUP 32 P.32-4).

Removal steps (Continued)

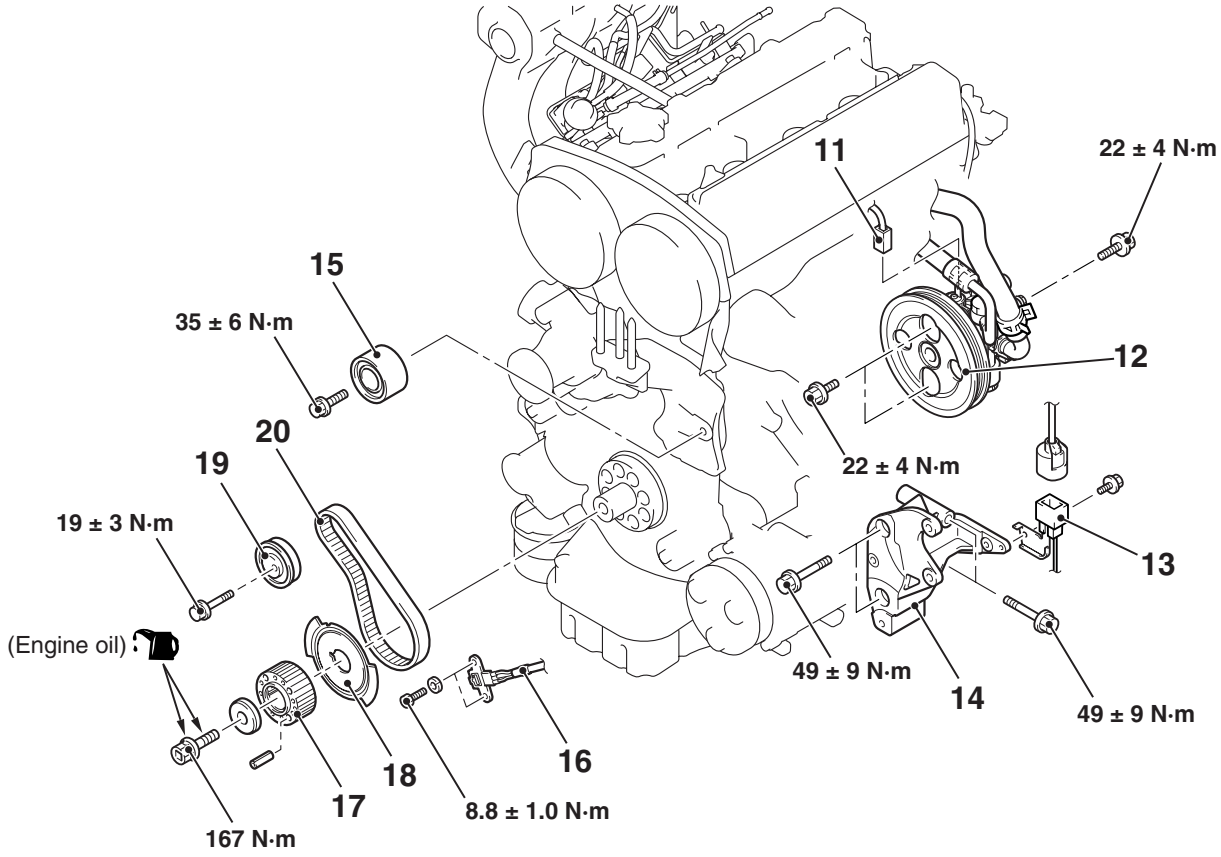
>>G<<
- Valve timing belt tension adjustment

<<A>> >>F<< 7. Valve timing belt

>>E<< 8. Timing belt tensioner pulley

9. Timing belt tensioner arm

>>D<< 10. Timing belt tensioner adjuster



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Removal steps

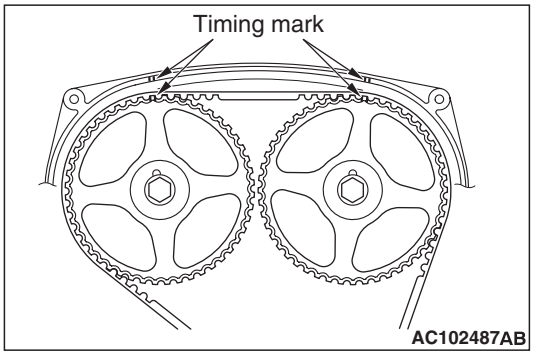
11. Power steering fluid pressure switch connector
<<B>> 12. Power steering oil pump assembly
13. A/C compressor connector
14. Power steering oil pump bracket
15. Timing belt idler pulley
16. Engine crank angle sensor
<<C>> >>C<< 17. Crankshaft camshaft drive sprocket
>>C<< 18. Crankshaft angle sensing blade
>>B<< • Balancer timing belt tension adjustment
>>A<< 19. Balancer timing belt tensioner
<<D>> >>A<< 20. Balancer timing belt

REMOVAL SERVICE POINTS

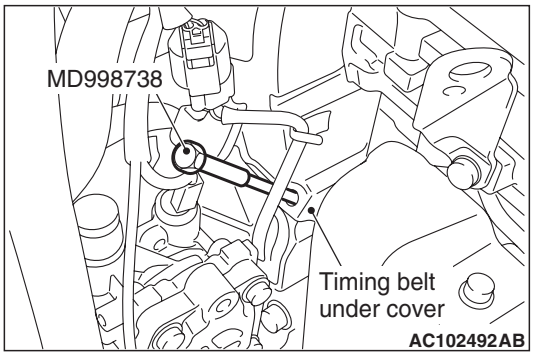
<<A>> VALVE TIMING BELT REMOVAL

⚠ CAUTION

Never turn the crankshaft anti-clockwise.



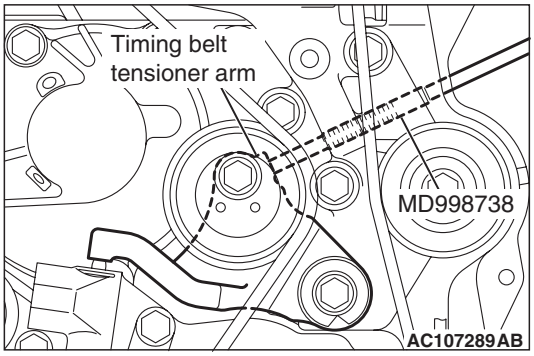
1. Turn the crankshaft clockwise, align each timing mark to set No.1 cylinder to TDC of its compression stroke.



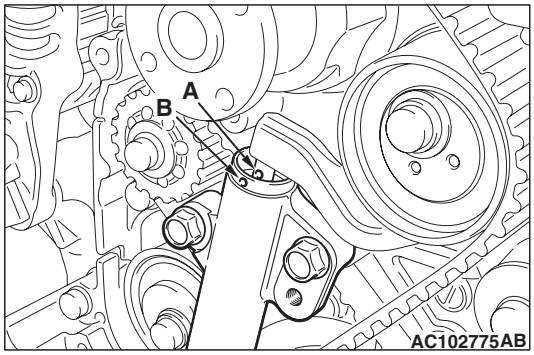
2. Remove the timing belt under cover rubber plug and then set the special tool adjusting bolt (MD998738).

⚠ CAUTION

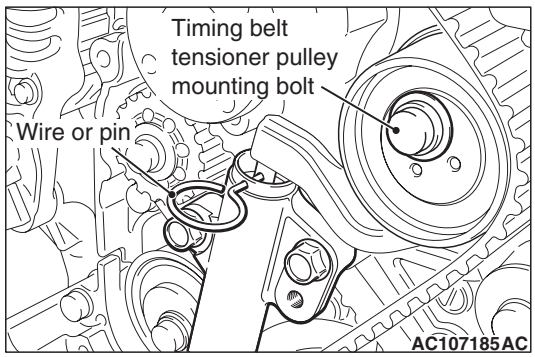
The special tool can be gradually installed at a rate of a 30 degree turn per second. If it is screwed in all at once, the timing belt tensioner adjuster rod will not easily retract and the special tool may bend.



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



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



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

⚠ CAUTION

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

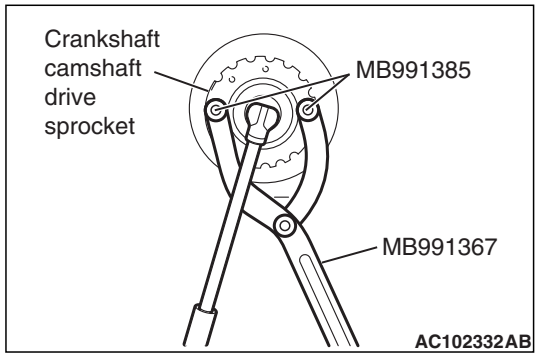
6. After removal of adjusting bolt special tool, loosen the timing belt tensioner pulley mounting bolt and remove the valve timing belt.

<<B>> POWER STEERING OIL PUMP ASSEMBLY REMOVAL

With the hose installed, remove the power steering oil pump assembly from the bracket.

NOTE: Secure the removed power steering oil pump assembly with cord or rope at a position where they will not interfere with the removal of the balancer timing belt.

<<C>> CRANKSHAFT CAMSHAFT DRIVE SPROCKET REMOVAL



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

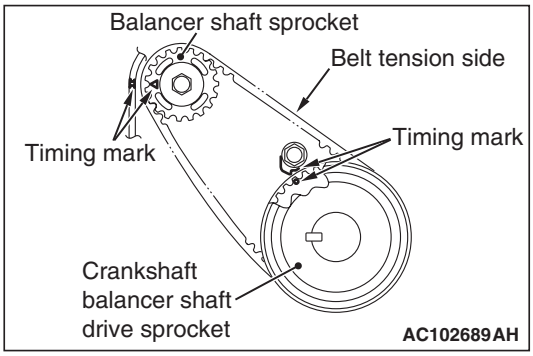
<<D>> BALANCER TIMING BELT REMOVAL

⚠ CAUTION

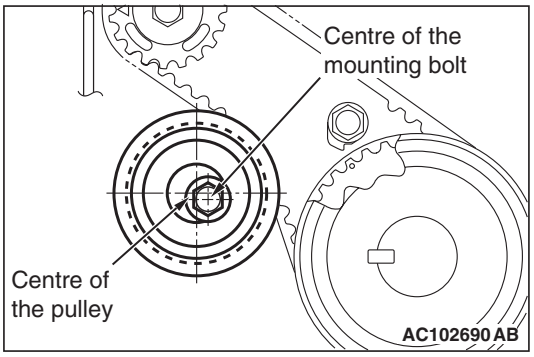
To reuse the balancer timing belt, draw an arrow indicating the rotating direction (clockwise) on the back of the belt using chalk.

INSTALLATION SERVICE POINTS

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



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

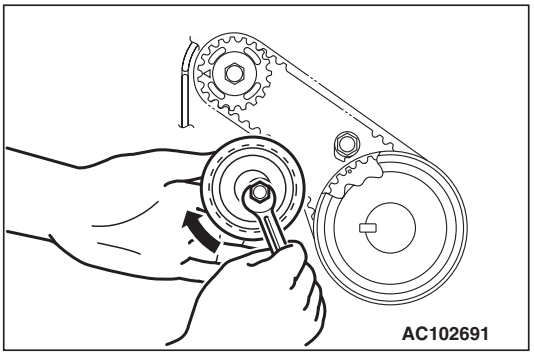


3. Assemble and temporarily fix the centre of the pulley of the balancer timing belt tensioner so that it is at the top left from the centre of the mounting bolt, and the pulley flange is at the front-side of the engine.
4. Adjust the balancer timing belt tension.

>>B<< BALANCER TIMING BELT TENSION ADJUSTMENT

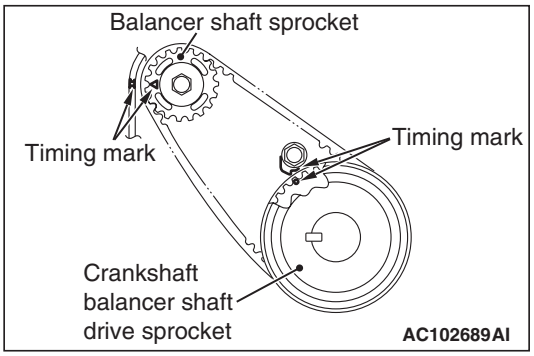
⚠ CAUTION

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

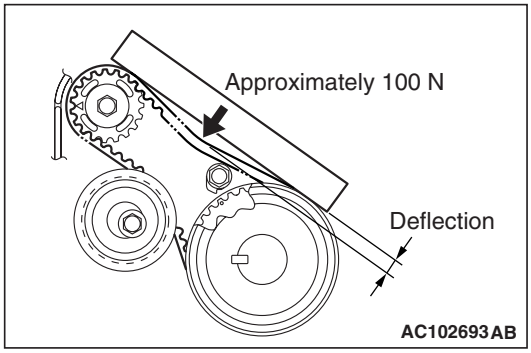


1. With your fingers, lift the balancer timing belt tensioner in the direction of the arrow. Apply pressure of 3.0 ±0.4 N· m to the balancer timing belt. Tighten the assembling bolt to the specified torque. Then, fix the balancer timing belt tensioner.

   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 the sprocket timing marks are aligned.

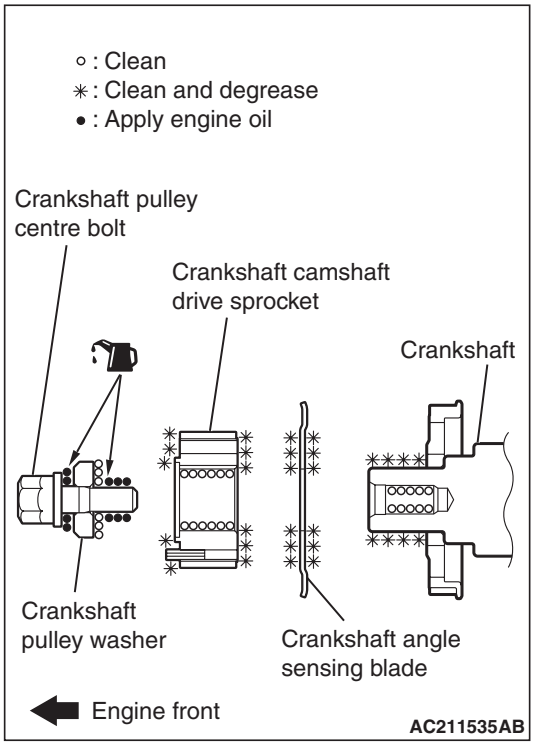


3. Apply a pressure of approximately 100N at the centre (arrow area) between the sprocket as shown, then inspect whether the belt deflection is within the standard value.

   Standard value:
   At adjustment: 5 – 7 mm
   At replacement: 5 – 7 mm

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

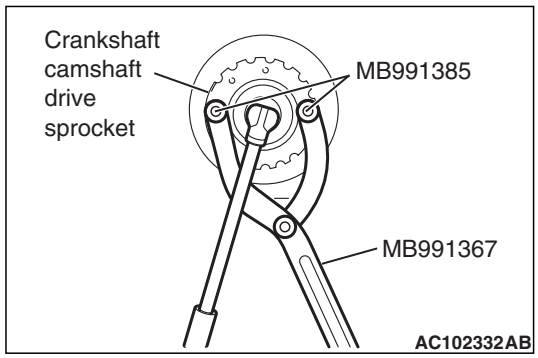
>>C<< CRANKSHAFT ANGLE SENSING BLADE/CRANKSHAFT CAMSHAFT DRIVE SPROCKET INSTALLATION



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

   NOTE: Also clean the degreased surfaces.

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



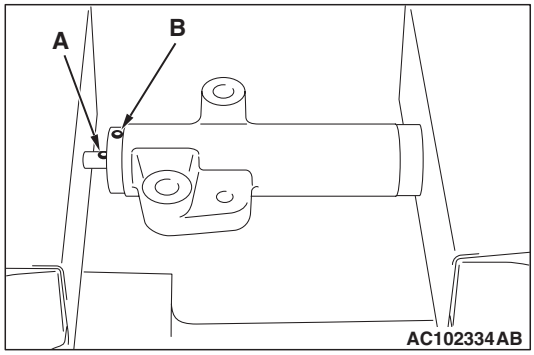
5. Use the following special tool as during removal to support the crankshaft camshaft drive sprocket.
   - Special spanner (MB991367)
   - Pin (MB991385)
6. Tighten the crankshaft pulley centre bolts to the specified torque.

   Tightening torque: 167 N· m

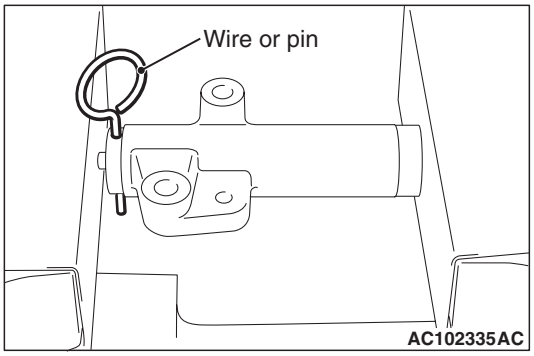
>>D<< TIMING BELT TENSIONER ADJUSTER INSTALLATION

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

⚠ CAUTION
If the compression is too fast, the procedure may damage the rod.



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



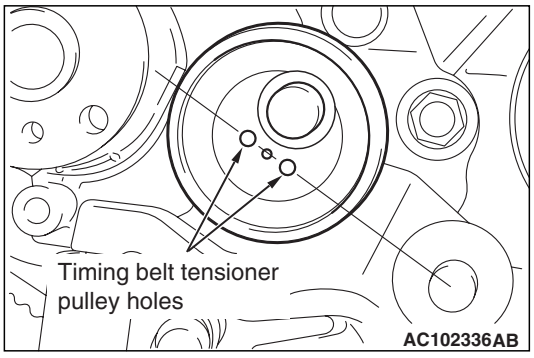
(2) Insert a wire or pin into the aligned set hole.

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

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

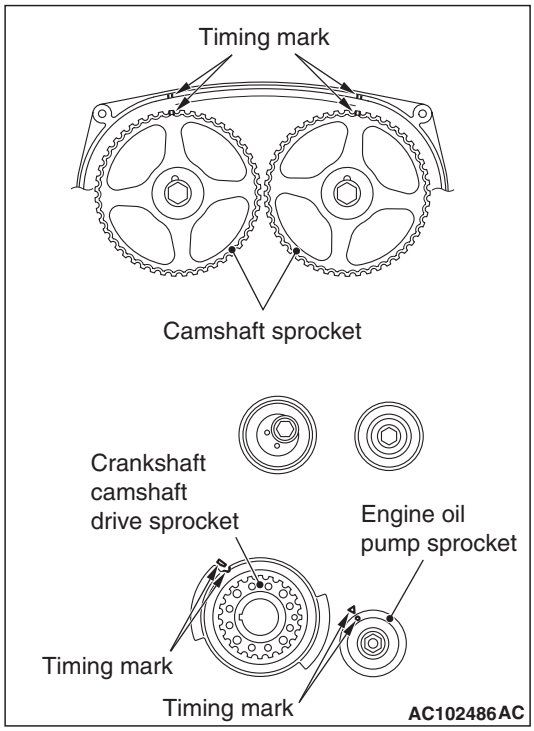
Tightening torque: 23 ±3 N· m

>>E<< TIMING BELT TENSIONER PULLEY INSTALLATION

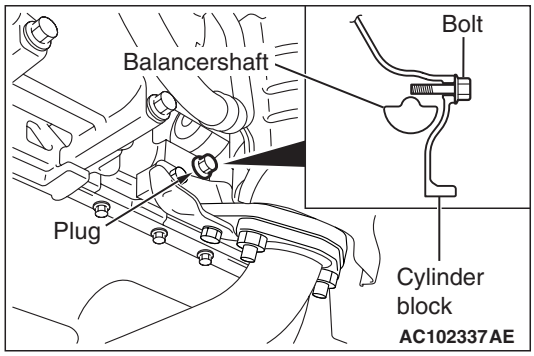


Temporarily tighten the timing belt tensioner pulley as shown.

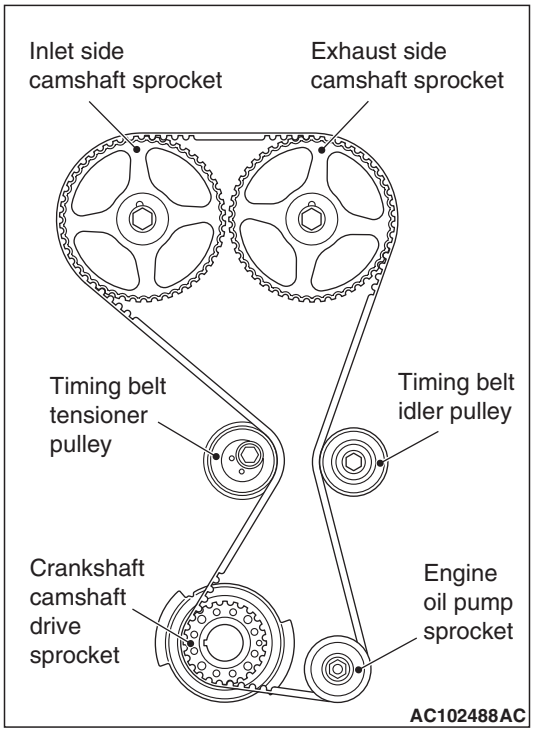
>>F<< VALVE TIMING BELT INSTALLATION



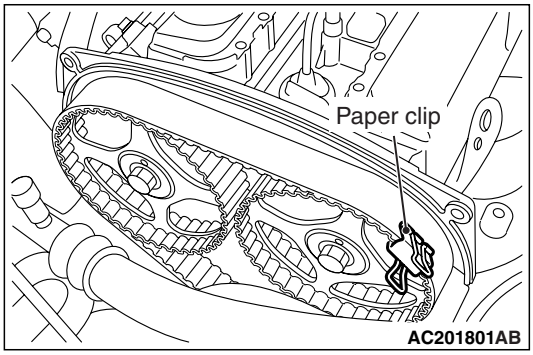
1. Align the timing marks on the camshaft sprocket, crankshaft camshaft drive sprocket and engine oil pump sprocket.



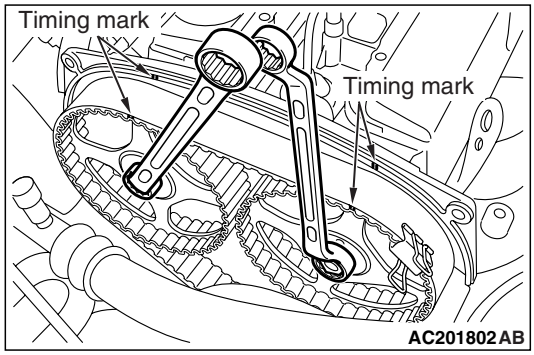
2. Adjust the timing mark of the engine oil pump sprocket. Unplug the cylinder block plug. Insert a bolt (M6 sectional width 10 mm, minor diameter 45 mm) from the plug hole and then check. If the bolt comes in contact with the balancer shaft turn the sprocket one rotation. Re-adjust the timing mark and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



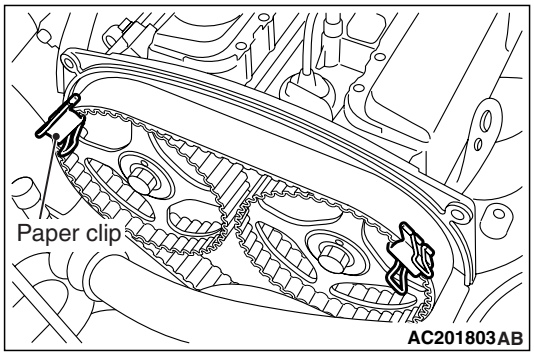
(1) Pass the valve timing belt around the crankshaft camshaft drive sprocket, the engine oil pump sprocket and the timing belt idler pulley in that order.



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



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



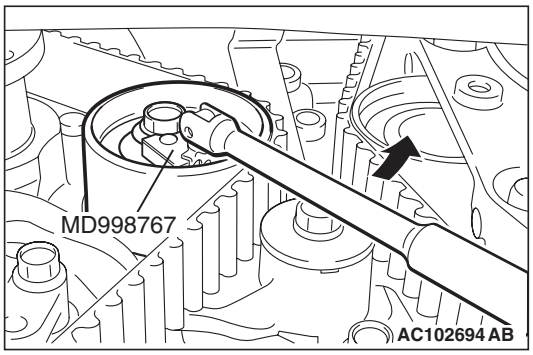
(4) Hold the valve timing belt with paper clips.

(5) Pass the valve timing belt around the timing belt tensioner pulley.

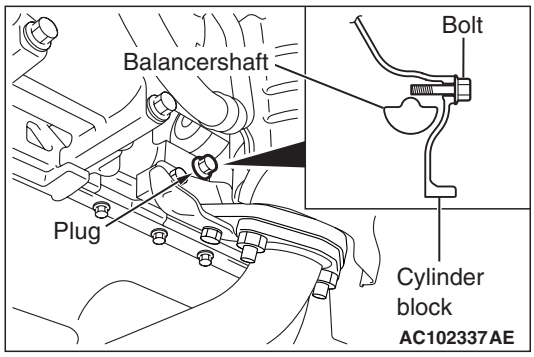
⚠ CAUTION

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

(6) Remove the two paper clips.



4. Turn the timing belt tensioner in the direction shown using special tool tensioner wrench (MD998767) to apply tension to the valve timing belt. Then pre-tighten the timing belt tensioner pulley.
5. Check that the timing marks are aligned.



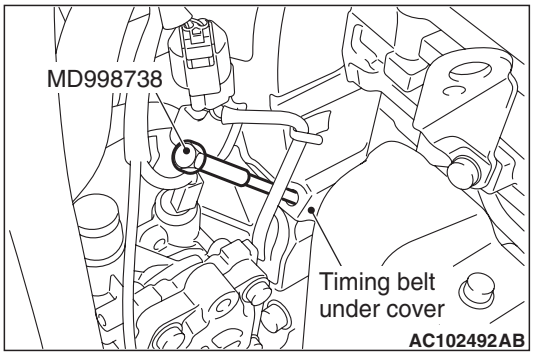
6. Remove the bolt inserted in Step 2 above, then assemble the cylinder block plug.

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

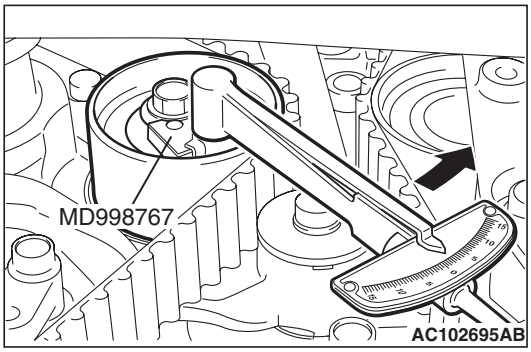


1. Set special tool adjusting bolt (MD998738) when removing the valve timing belt.

⚠ CAUTION
Always screw in special tool by hand, since use of a spanner or other tools may damage the wire or pin inserted in the timing belt tensioner adjuster.

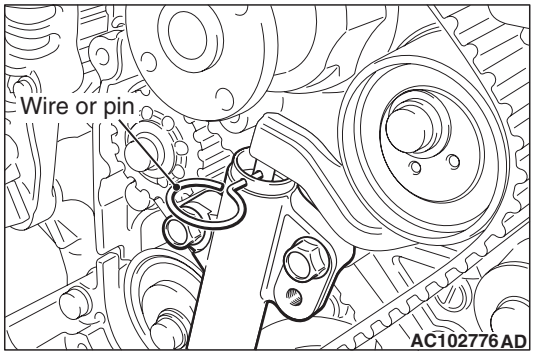
2. Gradually screw in special tool until the wire or pin inserted in the timing belt tensioner adjuster lightly moves.
3. Turn the crankshaft 1/4 turn anti-clockwise.
4. Turn the crankshaft in the clockwise direction until you align each timing mark to set No.1 cylinder to TDC of its compression stroke.
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.

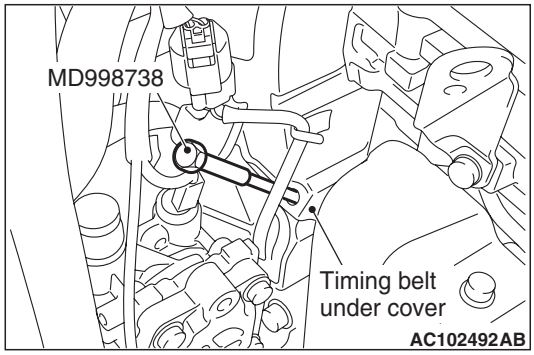


6. With special tool tensioner wrench (MD998767) and torque wrench, apply tension torque 3.5 N· m, and tighten the timing belt tensioner pulley mounting bolt to the specified torque.

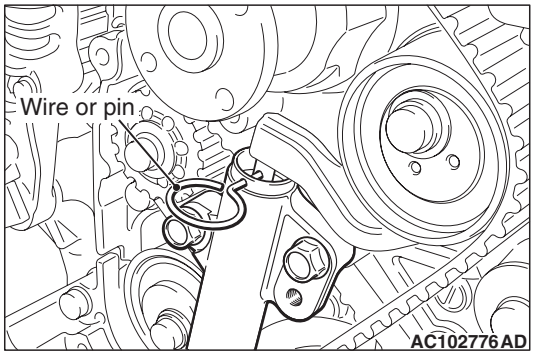
Tightening torque: 48 ±5 N· m



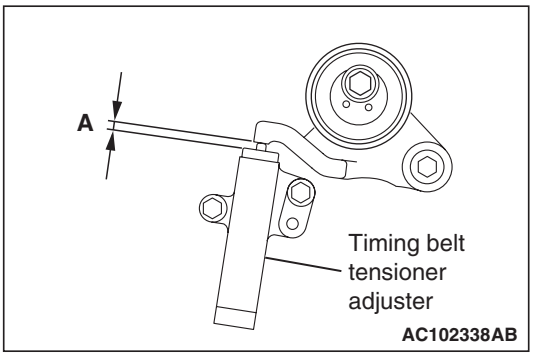
7. Remove wire or pin inserted to timing belt tensioner.



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



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



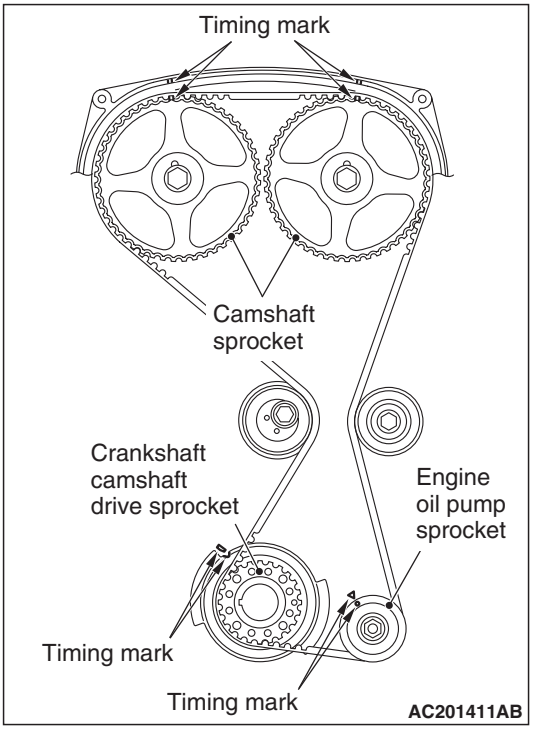
If the projection of timing belt tensioner adjuster rod is within the standard value, appropriate tension is applied.

Standard value (A): 3.8 – 4.5 mm

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

⚠ CAUTION

Always check the tightening torque of the crank shaft pulley centre bolt when turning the crack shaft pulley centre bolt anti-clockwise. Re-tighten if it is loose.



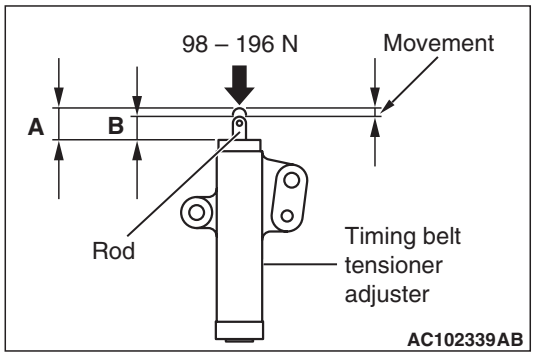
12. Check again that the timing marks on sprockets are aligned.

INSPECTION

M1112004400396

TIMING BELT TENSIONER ADJUSTER CHECK

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



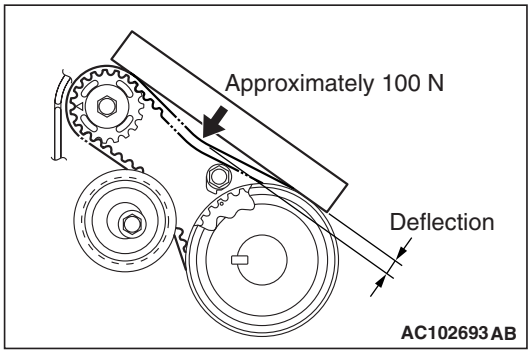
3. Hold the timing belt tensioner adjuster by hand, and press the top end of the rod onto the metal (e.g. cylinder block) under a pressure of 98 –196 N to measure the movement of the rod.

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 as follows:



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

Standard value: 5 – 10 mm

2. If not within the standard value, adjust the belt tension. (Refer to P.11C-35).

ENGINE ASSEMBLY

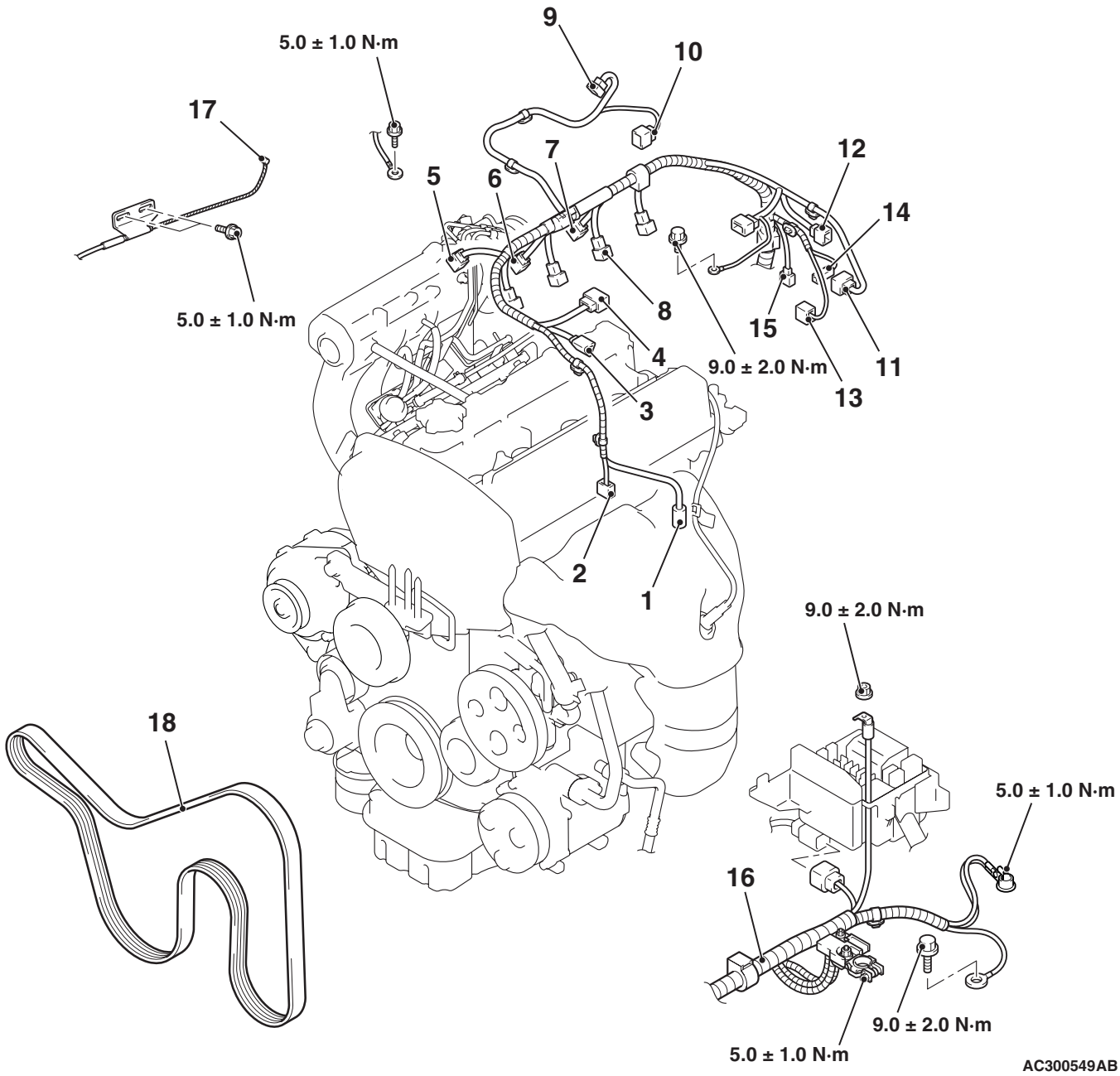
REMOVAL AND INSTALLATION

M1112001002599

⚠ CAUTION

- **When the engine assembly replacement is performed, use the M.U.T.-II/III to initialise the learning value (Refer to GROUP 00, Precautions Before Service –Initialisation Procedure for Learning Value in MPI Engine P.00-19).**
- ***: 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 13B - On-vehicle Service P.13B-327). • Hood Removal (Refer to GROUP 42 P.42-4). • Strut Tower Bar Removal (Refer to GROUP 42 P.42-9). • Under Cover Removal • Engine Oil Draining (Refer to GROUP 12 - On-vehicle Service P.12-4). • Engine Coolant Draining (Refer to GROUP 14 - On-vehicle Service P.14-21). • Air Cleaner Assembly Removal (Refer to GROUP 15 P.15-3). • Battery and Battery Tray Removal • Rocker Cover Centre Cover Removal (Refer to P.11C-18). • Radiator Assembly Removal (Refer to GROUP 14 P.14-35). • Front Exhaust Pipe Removal (Refer to GROUP 15 P.15-11). • Starter Assembly Removal (Refer to GROUP 16 P.16-20).	• Starter Assembly Installation (Refer to GROUP 16 P.16-20). • Front Exhaust Pipe Installation (Refer to GROUP 15 P.15-11). • Radiator Assembly Installation (Refer to GROUP 14 P.14-35). • Rocker Cover Centre Cover Installation (Refer to P.11C-18). • Battery and Battery Tray Installation • Air Cleaner Assembly Installation (Refer to GROUP 15 P.15-3). • Engine Coolant Refilling (Refer to GROUP 14 - On-vehicle Service P.14-21). • Engine Oil Refilling (Refer to GROUP 12 - On-vehicle Service P.12-4). • Accelerator Cable Adjustment (Refer to GROUP 17 - On-vehicle Service P.17-2). • Drive Belt Tension Check (Refer to P.11C-7). • Under Cover Installation • Strut Tower Bar Installation (Refer to GROUP 42 P.42-9). • Hood Installation (Refer to GROUP 42 P.42-4). • Fuel Leak Check



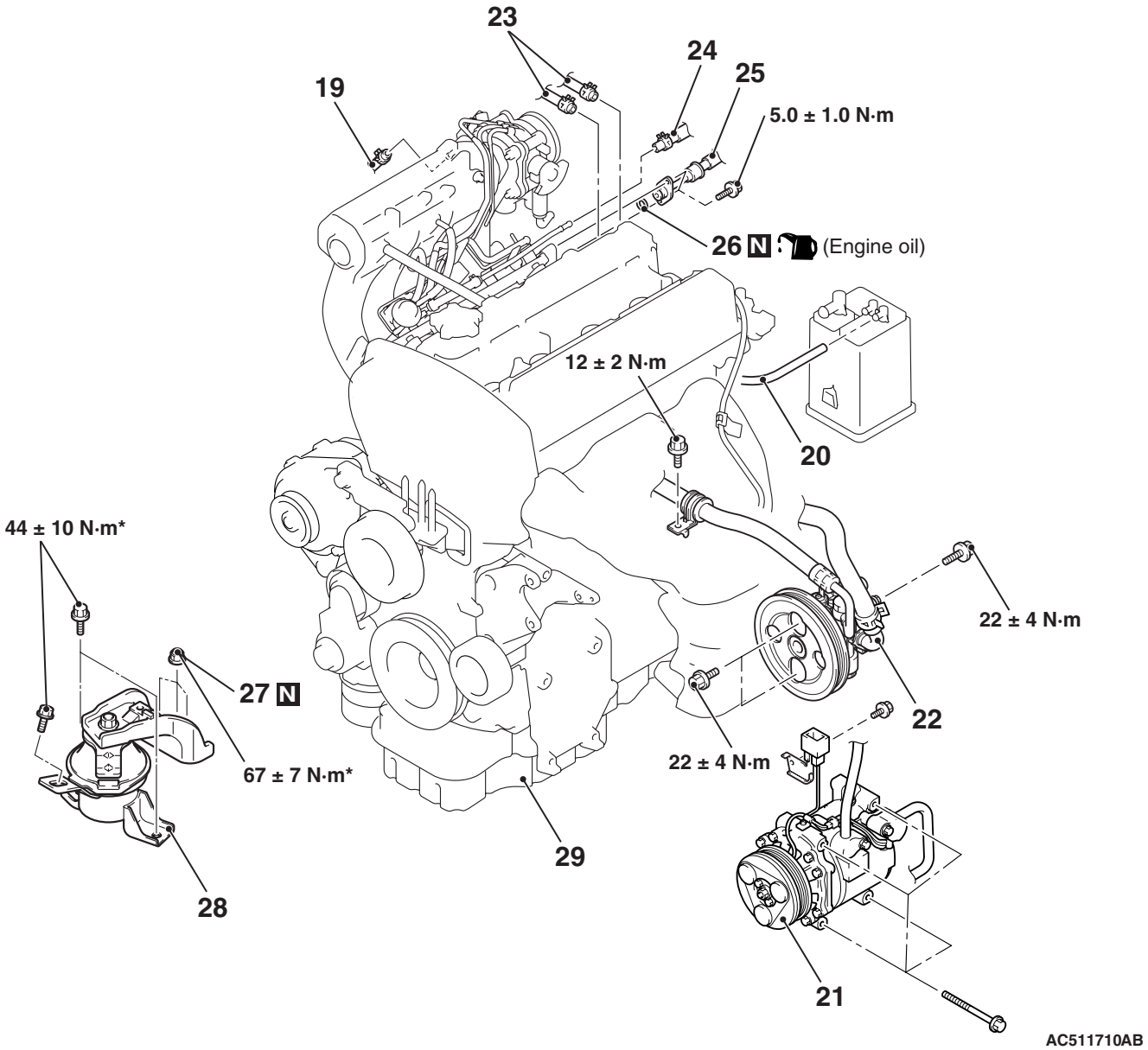
Removal steps

1. A/C compressor connector
2. Power steering fluid pressure switch connector
3. Engine crank angle sensor connector
4. Ignition coil connector
5. Engine control detonation sensor connector
6. Emission solenoid valve (purge control system) connector
7. Emission solenoid valve (EGR system) connector
8. Fuel injector connector
9. Throttle body throttle sensor connector

<<A>>

Removal steps (Continued)

10. Throttle body idle speed control servo connector
11. Camshaft position sensor connector
12. Engine control oxygen sensor (front) connector
13. Water temperature sensor unit connector
14. Water temperature gauge unit connector
15. Capacitor connector
16. Battery wiring harness connection
17. Accelerator cable connection
18. Alternator drive belt



Removal steps

19. Brake booster vacuum hose connection
20. Emission vacuum hose (fuel vapour canister side) connection

<<B>> 21. A/C compressor and clutch assembly

<<B>> 22. Power steering oil pump assembly

23. Heater water hoses connection
24. Fuel return line hose connection

>>E<< 25. Fuel high-pressure hose connection

>>E<< 26. Fuel line O-ring

Removal steps (Continued)

<<C>> >>D<< • Transmission assembly

>>C<< 27. Self-locking nut

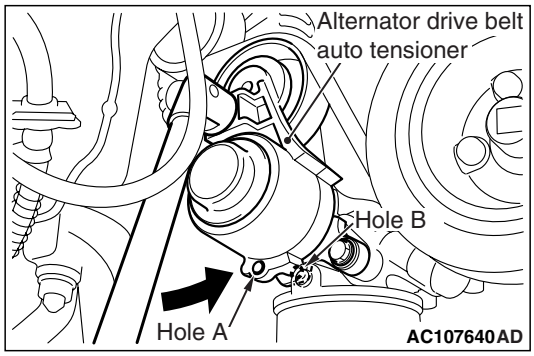
<<D>> >>B<< 28. Engine mounting insulator

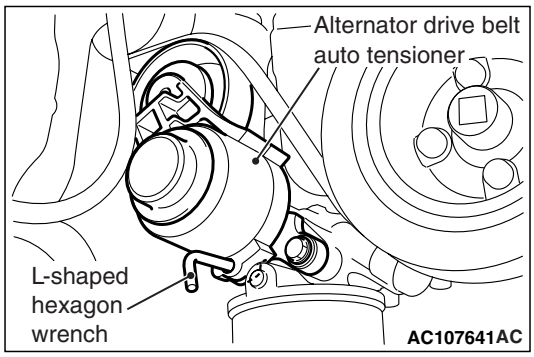
<<E>> >>A<< 29. Engine assembly

REMOVAL SERVICE POINTS

<<A>> ALTERNATOR DRIVE BELT REMOVAL

The following operations will be needed due to the serpentine drive system with the alternator 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 alternator drive belt auto tensioner, and turn the alternator drive belt auto tensioner anti-clockwise until it hits the stopper.

⚠ CAUTION

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

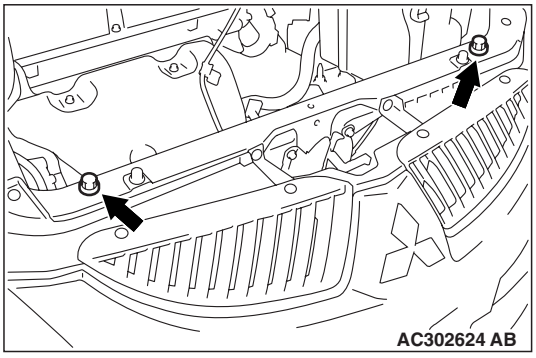
2. Align hole A with hole B, insert an L-shaped hexagon wrench, etc. to fix and then remove the alternator drive belt.

<<B>> A/C COMPRESSOR AND CLUTCH ASSEMBLY/POWER STEERING OIL PUMP ASSEMBLY REMOVAL

With the hose installed, remove the A/C compressor and clutch assembly, and power steering oil pump assembly from the bracket.

NOTE: Secure the removed A/C compressor and clutch assembly, and power steering oil pump assembly with cord or rope at a position where they will not interfere with the removal of the engine assembly.

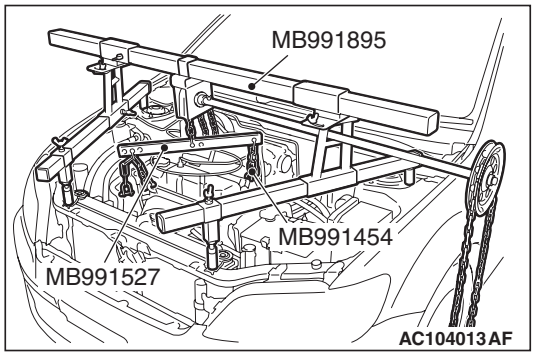
<<C>> TRANSMISSION ASSEMBLY REMOVAL



1. Pre-tighten the 2 bolts on the vehicle to assemble the radiator support upper insulator to set the special tools engine hanger MB991895 or engine hanger MB991928.
2. Remove the transmission assembly (Refer to GROUP 22A P.22A-18) <M/T>, (Refer to GROUP 23A P.23A-151) <A/T>.

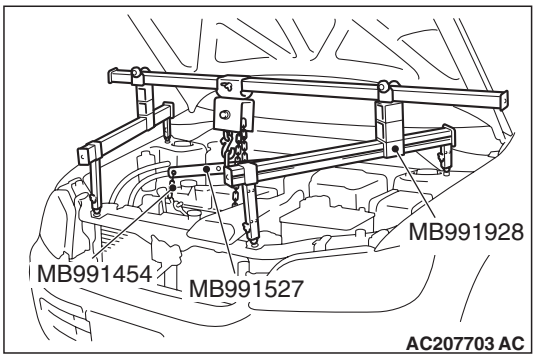
<<D>> ENGINE MOUNTING INSULATOR REMOVAL

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



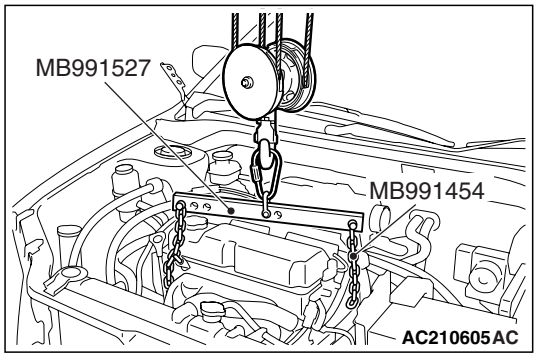
(1) <Special tool engine hanger (MB991895) is used>

Remove special tool MB991895.



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

Remove special tool MB991928.



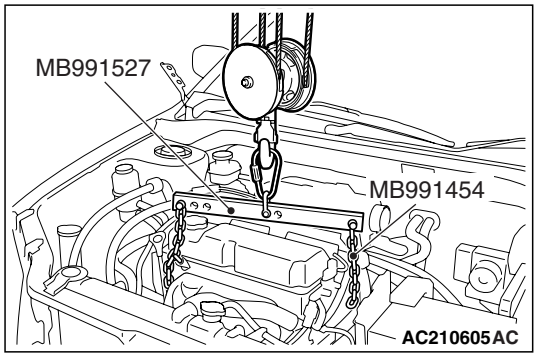
3. Hold the engine assembly with a chain block or similar tool.
4. Place a garage jack against the engine oil pan with a piece of wood in between, jack up the engine so that the weight of the engine is no longer being applied to the engine mounting insulator.
5. Loosen the engine mounting insulator mounting nuts and bolt, and remove the engine mounting insulator.

<<E>> ENGINE ASSEMBLY REMOVAL

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

INSTALLATION SERVICE POINTS

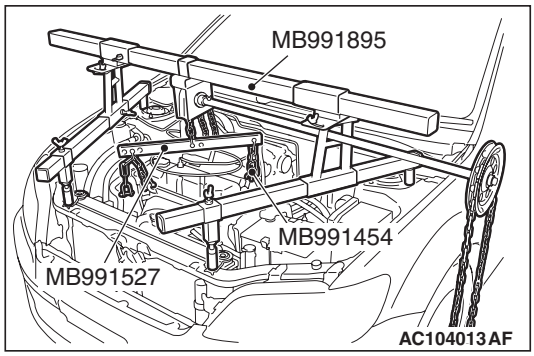
>>A<< ENGINE ASSEMBLY INSTALLATION



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

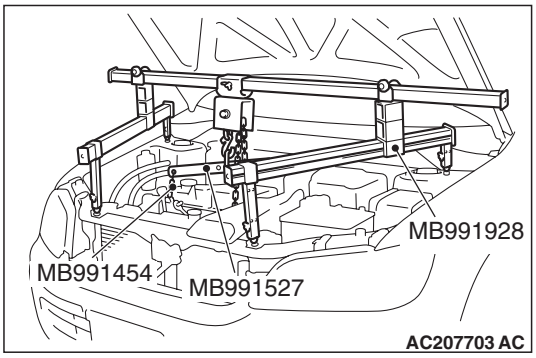
>>B<< ENGINE MOUNTING INSULATOR INSTALLATION

1. 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.
2. Support the engine assembly with a garage jack.
3. Remove the chain block.
4. Use the following special tool as during removal to support the engine.



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

Set special tool MB991895 (Refer to GROUP 22A - Transmission Assembly P.22A-18) <M/T>, (Refer to GROUP 23A - Transmission Assembly P.23A-151) <A/T>.



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

Set special tool MB991928 (Refer to GROUP 22A - Transmission Assembly P.22A-18) <M/T>, (Refer to GROUP 23A - Transmission Assembly P.23A-151) <A/T>.

>>C<< SELF-LOCKING NUT INSTALLATION

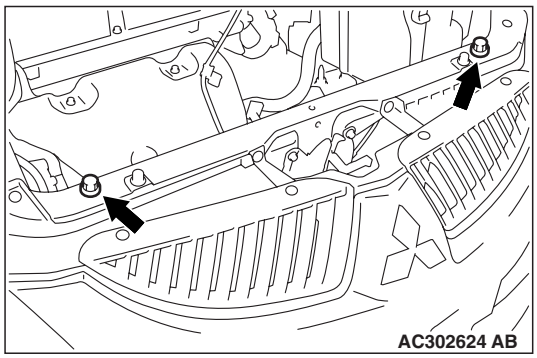
⚠ CAUTION
Do not tighten the self-locking nuts while the engine is hot.

Tighten the self-locking nuts to the specified torque while the engine is cold.

Tightening torque: 45 ±5 N· m

>>D<< TRANSMISSION ASSEMBLY INSTALLATION

1. Install the transmission assembly (Refer to GROUP 22A P.22A-18) <M/T>, (Refer to GROUP 23A P.23A-151) <A/T>.



2. Remove from the vehicle the 2 bolts, to assemble the radiator support upper insulator.

>>E<< FUEL LINE O-RING/FUEL HIGH-PRESSURE HOSE INSTALLATION

⚠ CAUTION
Do not let any engine oil get into the fuel delivery pipe.

1. Apply a small amount of new engine oil to the fuel line O-ring.
2. While turning the fuel high-pressure hose to the right and left, install the fuel delivery pipe, while being careful not to damage the fuel O-ring. After installing, check that the hose turns smoothly.
3. If the hose does not turn smoothly, the fuel line O-ring is probably being clamped. Disconnect the fuel high-pressure hose and check the fuel line O-ring for damage. After this, re-insert the fuel delivery pipe and check that the hose turns smoothly.
4. Tighten to the specified torque.

Tightening torque: 5.0 ±1.0 N· m

NOTES