
GROUP 11A

ENGINE

MECHANICAL

<4G64>

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GENERAL INFORMATION

M1111000100884

| Item | | Specification |
|-----------------------|-----------------|---|
| Total displacement mL | | 2,351 |
| Bore × Stroke mm | | 86.5 × 100 |
| Compression ratio | | 9.0 |
| Compression chamber | | Pentroof |
| Camshaft arrangement | | SOHC |
| Number of valve | Intake | 8 |
| | Exhaust | 8 |
| Valve timing | Intake opening | BTDC 16° |
| | Intake closing | ABDC 53° |
| | Exhaust opening | BBDC 50° |
| | Exhaust closing | ATDC 16° |
| Fuel system | | Electronically controlled multipoint fuel injection |
| Rocker arm | | Roller type |
| Auto-lash adjuster | | Equipped |

SERVICE SPECIFICATIONS

M1112000300580

| Item | | Standard value | Limit |
|---|------------------------------------|------------------------|------------|
| Drive belt tension | Vibration frequency Hz (Reference) | 110 – 144 | – |
| | Tension N (Reference) | 245 – 412 | – |
| Basic ignition timing | | 5° BTDC ± 3° | – |
| Ignition timing | | Approximately 10° BTDC | – |
| Idle speed r/min | | 750 ± 100 | – |
| CO contents % | | 1.5 ± 0.5 | – |
| Compression pressure kPa-r/min | | 1,270 – 250 | 880 – 250 |
| Compression pressure difference of all cylinders kPa | | – | Maximum 98 |
| Intake manifold vacuum kPa | | – | Minimum 60 |
| Cylinder head bolt nominal length mm | | – | 99.4 |
| Balancer timing belt tension (When adjusted) | Deflection mm | 5 – 7 | – |
| Balancer timing belt tension (When replaced) | Deflection mm | 5 – 7 | – |
| Balancer timing belt tension (When checked) | Deflection mm | 5 – 10 | – |
| Timing belt tensioner adjuster rod protrusion amount mm | | 3.8 – 4.5 | – |
| Timing belt tensioner adjuster rod movement mm | | Within 1 | – |

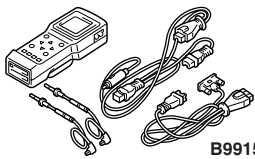
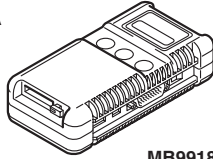
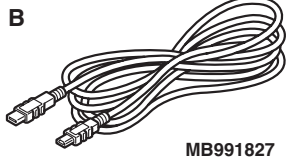

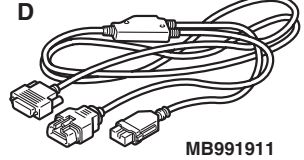
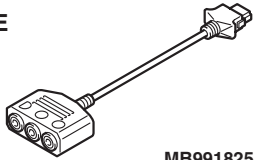
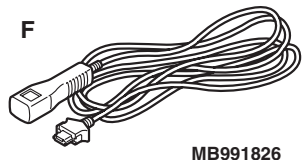
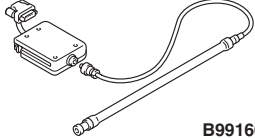
SEALANTS

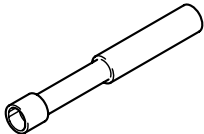
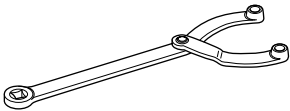
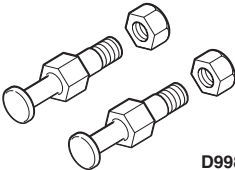
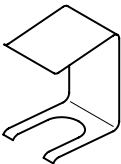
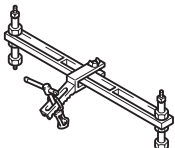
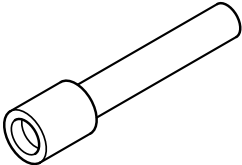
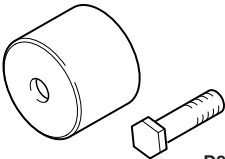
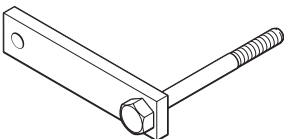
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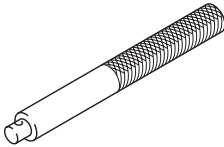

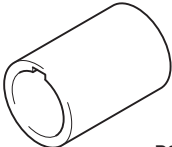
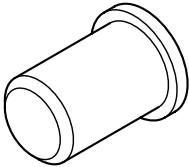
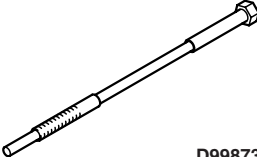
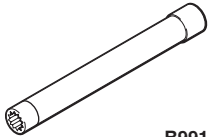
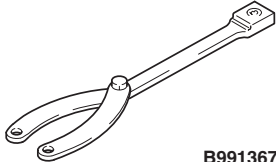
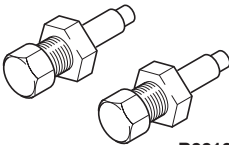
| Item | Specified Sealant | Remark |
|----------------------------------|--|---------------------|
| Camshaft position sensor support | MITSUBISHI GENUINE PART MD970389 or equivalent | Semi-drying sealant |
| Engine upper oil pan | | |
| Engine lower oil pan | | |

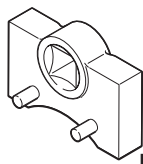
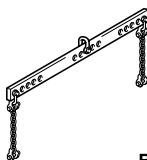
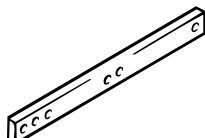
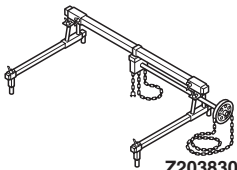
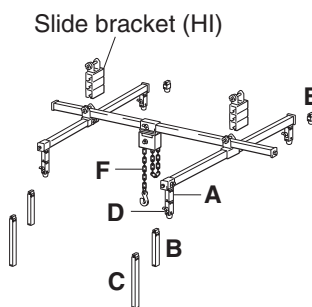
SPECIAL TOOLS

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| Tool | Number | Name | Use |
|--|--|--|--|
|  B991502 | MB991502 | M.U.T.-II sub assembly | <ul style="list-style-type: none"> • Drive belt tension check • Checking the ignition timing • Checking the idle speed |
| <p>A</p>  MB991824 <p>B</p>  MB991827 <p>C</p>  MB991910 <p>D</p>  MB991911 <p>E</p>  MB991825 <p>F</p>  MB991826 MB991955 | MB991955 A: MB991824 B: MB991827 C: MB991910 D: MB991911 E: MB991825 F: MB991826 | M.U.T.-III sub assembly A: Vehicle communication interface (V.C.I.) B: M.U.T.-III USB cable C: M.U.T.-III main harness A (Vehicles with CAN communication system) D: M.U.T.-III main harness B (Vehicles without CAN communication system) E: M.U.T.-III measurement adapter F: M.U.T.-III trigger harness | <ul style="list-style-type: none"> • Drive belt tension check • Checking the ignition timing • Checking the idle speed <div style="border: 1px solid black; padding: 2px; margin: 5px 0;"> CAUTION </div> <p>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.</p> |
|  B991668 | MB991668 | Belt tension meter set | Drive belt tension check (used together with M.U.T.-II or M.U.T.-III) |

| Tool | Number | Name | Use |
|---|----------|----------------------------------|--|
|  MD998299 | MD998299 | MAS screwdriver | Idle speed and mixture check and adjustment <Vehicles without catalytic converter> |
|  B990767 | MB990767 | Front hub and flange yoke holder | Holding the camshaft sprocket |
|  D998719 | MD998719 | Pin | |
|  D998443 | MD998443 | Lash adjuster holder | Supporting the lash adjuster |
|  MD998772 | MD998772 | Valve spring compressor | Compressing valve spring |
|  | MB991999 | Valve stem seal installer | Valve stem seal installation |
|  D998713 | MD998713 | Camshaft oil seal installer | Camshaft oil seal installation |
|  D998781 | MD998781 | Flywheel stopper | Supporting the A/T drive plate |

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

| Tool | Number | Name | Use |
|---|--|--|--|
|  D998767 | MD998767 | Tensioner wrench | Valve timing belt tension adjustment |
|  B991454 | MB991454 | Engine hanger balancer | When the engine hanger is used: Supporting the engine assembly during removal and installation of the transmission assembly <i>NOTE: Special tool MB991454 is a part of engine hanger attachment set MB991453.</i> |
|  B991527 | MB991527 | Hanger | |
|  Z203830 | MB991895 | Engine hanger | |
|  Slide bracket (HI) A: MB991929 B: MB991930 C: MB991931 D: MB991932 E: MB991933 F: MB991934 | 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 | |

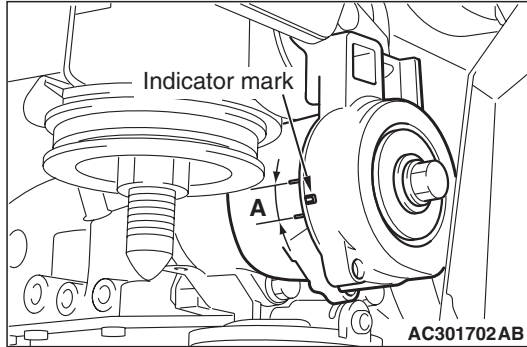
ON-VEHICLE SERVICE

DRIVE BELT TENSION CHECK

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CAUTION

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



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

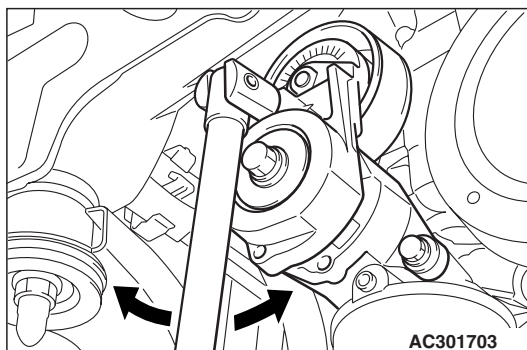
NOTE: The drive belt tension check is not necessary as auto-tensioner is adopted.

AUTO-TENSIONER CHECK

M1111003000392

OPERATION CHECK

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



3. Securely insert the spindle handle or ratchet handle with a 12.7 mm insertion angle into the jig hole of the auto tensioner. Turn the auto-tensioner to the left and right to check and see that there is no threading.

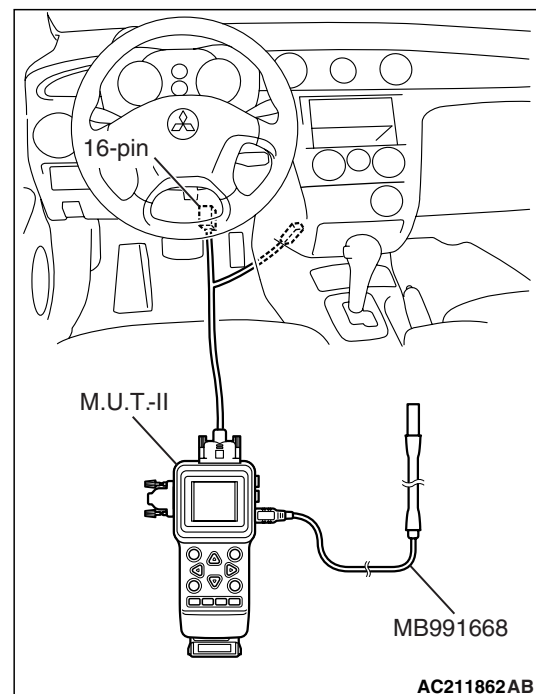
4. If there are any problems in the procedure 1 or 3, replace the auto-tensioner. (Refer to [P.11A-36](#)).
5. Install the drive belt. (Refer to [P.11A-16](#)).

FUNCTION CHECK

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

When using M.U.T.-II

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

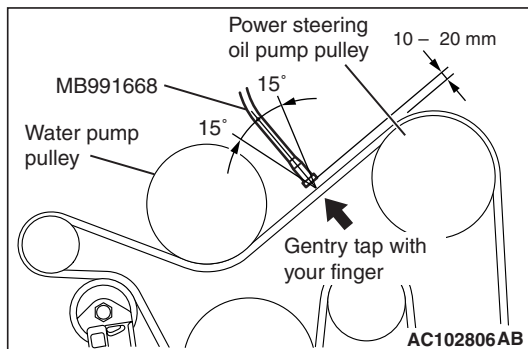
CAUTION

To prevent damage to 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.

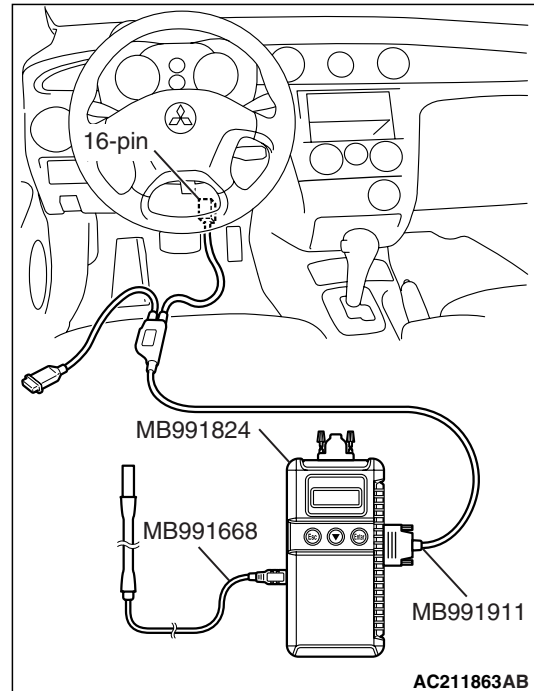
Standard value (Reference): 110 – 144 Hz

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

When using V.C.I.

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

CAUTION



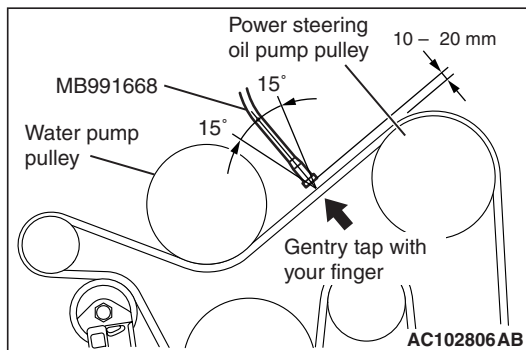
To prevent damage to special tool V.C.I. (MB991824), always turn the ignition switch to the "LOCK" (OFF) position before connecting or disconnecting special tool V.C.I. (MB991824).

- (1) Connect special tool belt tension meter set (MB991668) to special tool V.C.I. (MB991824).
- (2) Connect special tool M.U.T.-III main harness B (MB991911) to special tool V.C.I. (MB991824).
- (3) Connect special tool M.U.T.-III main harness B (MB991911) to the diagnosis connector.

- (4) 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.



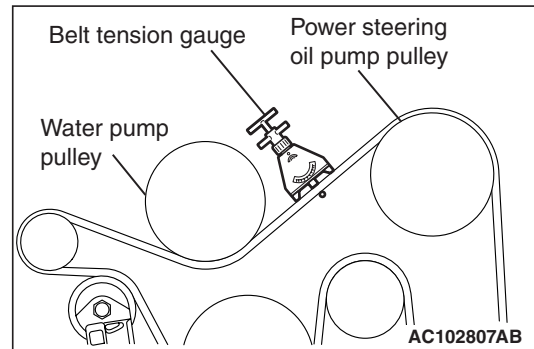
- (5) Hold special tool belt tension meter set (MB991668) to the middle of the drive belt between the pulleys (at the place indicated by arrow), approximately 10 – 20 mm away from the rear surface of the belt so that it is perpendicular to the belt (within an angle of ± 15 degree).
- (6) Gently tap the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

Standard value (Reference): 110 – 144 Hz

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

When using a tension gauge

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



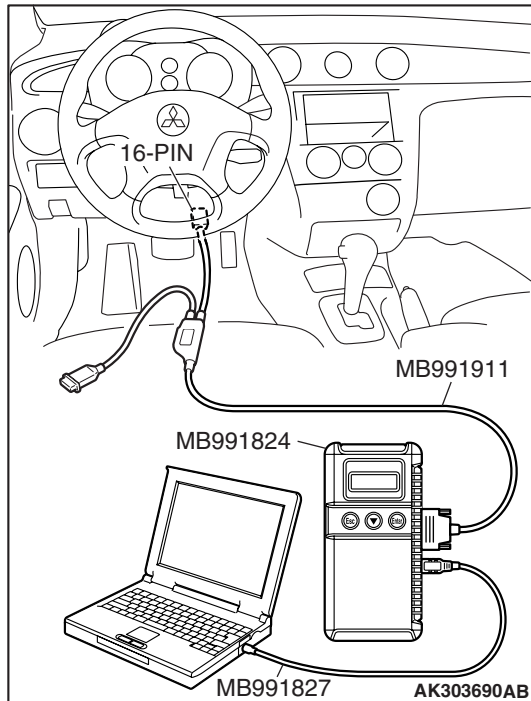
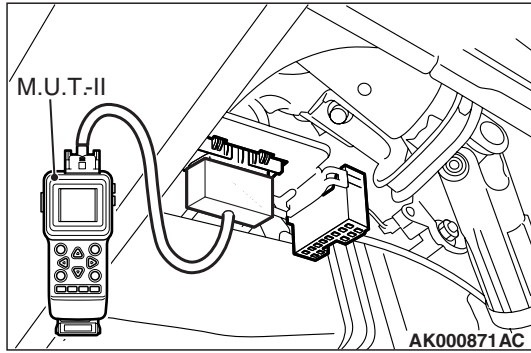
2. Use a belt tension gauge in the middle of the belt between the pulleys (at the place indicated by the arrow) to measure that the belt tension is within the standard value.

Standard value (Reference): 245 – 412 N

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

IGNITION TIMING CHECK

M1111001701309



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 light.
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 13A – Troubleshooting – Inspection chart for diagnosis code [P.13A-11](#)).

CAUTION

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

9. Select a forced driving cancel mode to release the Actuator test.
10. Check that ignition timing is at the standard value.

Standard value: approximately 10° BTDC

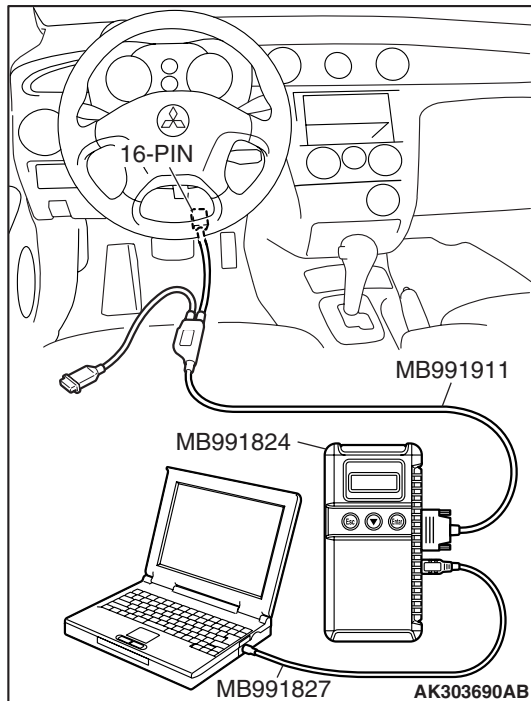
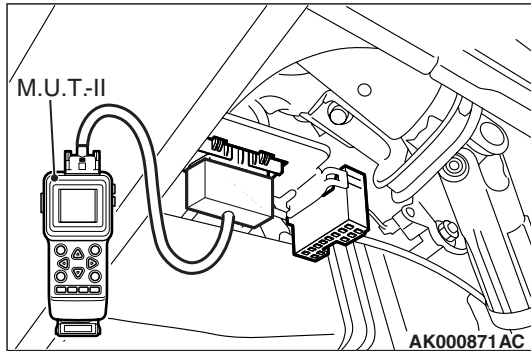
NOTE:

- The ignition timing may fluctuate within $\pm 7^\circ$ BTDC. This is normal.
- In higher altitude, the ignition timing is more advanced than the standard value by approximately 5° .

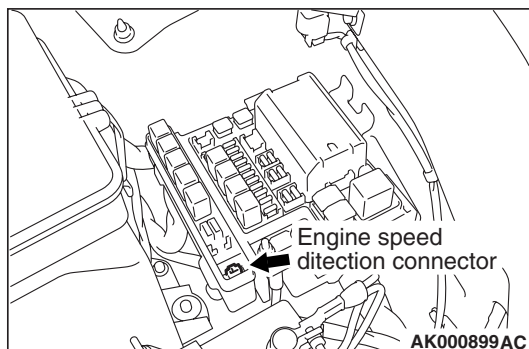
11. Remove the timing light.
12. Turn off the ignition switch and then remove the M.U.T.-II/III.

IDLE SPEED AND MIXTURE CHECK AND ADJUSTMENT

M1111002200177



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 light.



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

Standard value: approximately 10° BTDC

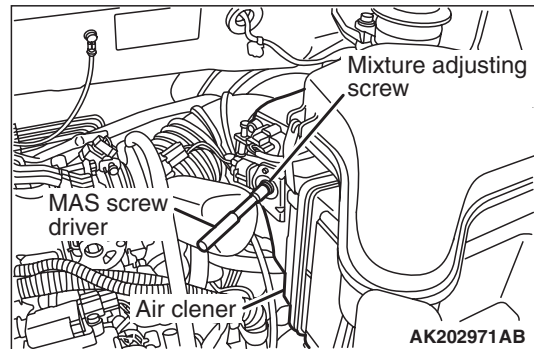
7. Check the idle speed.

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 13A – Troubleshooting – Inspection chart for diagnosis code [P.13A-11](#)).
 9. Set the CO tester.
 10. Check the CO contents at idle.

Standard value: 1.5 ± 0.5%

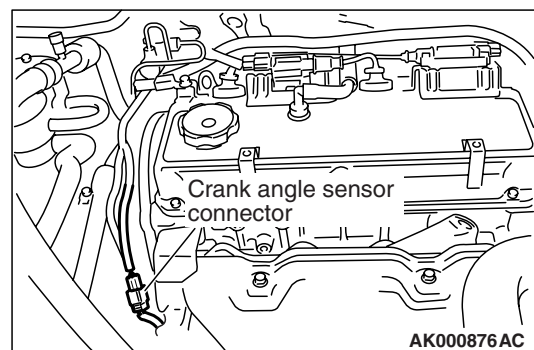


11. If there is deviation from the standard value, set the idle mixture to the specified value by adjusting the mixture adjusting screw (variable resistor).

Use the special tool MAS screwdriver (MD998299) to turn the mixture adjusting screw.

COMPRESSION PRESSURE CHECK

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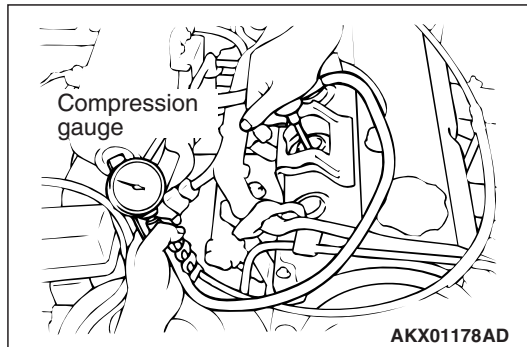
1. Before inspection, set the vehicle to the pre-inspection condition.
2. Disconnect the spark plug cables.
3. Remove all of the spark plugs.

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 r/min): 1,270kPa

Limit (at engine speed of 250 r/min): Minimum 880

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 dose 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.

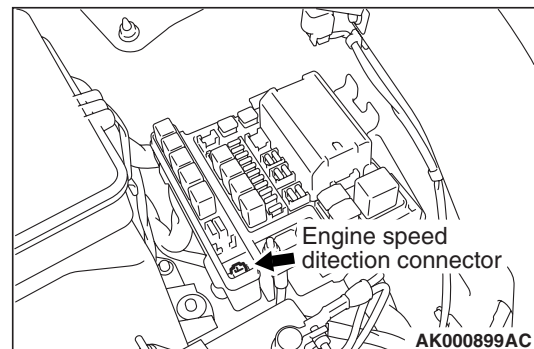
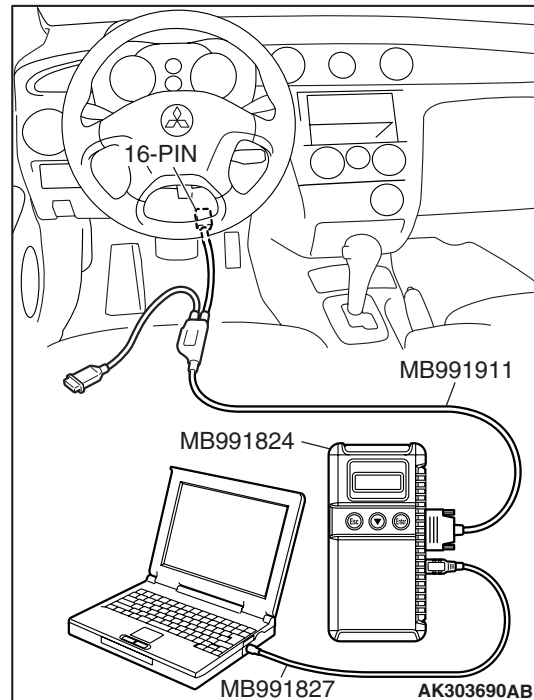
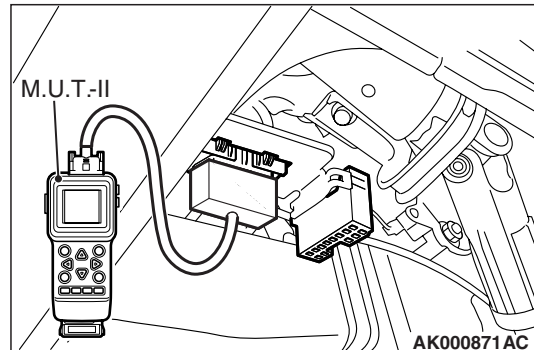
11. Install the spark plugs and spark plug cables.

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.

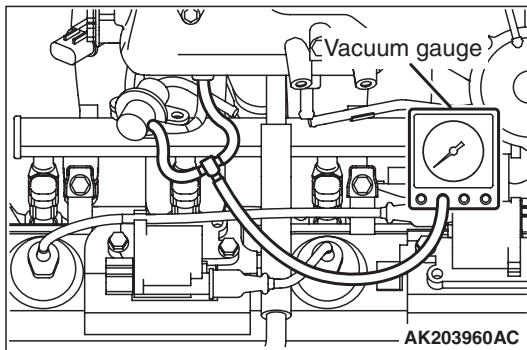
MANIFOLD VACUUM CHECK

M1111002701012



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 regulator and the air intake plenum, and connect a vacuum gauge.
5. Start the engine and check that idle speed is within the standard value.
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

M1111002900325

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.

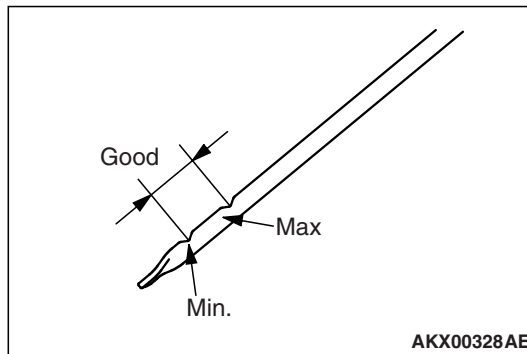
If the noise has become smaller or disappeared, oil sludge could make the lash adjusters stick. Clean the lash adjusters (Refer to GROUP 11B – Rocker Arms and Camshaft – Rocker Arms and Camshaft Inspection P.11B-31). If not improved, go to step 5.

5. Bleed air from the lash adjusters (Refer to P.11A-14).
6. If the noise has not disappeared even after the air bleeding, clean the lash adjusters (Refer to, GROUP 11B – Rocker Arms and Camshaft – Rocker Arms and Camshaft Inspection P.11B-31).

<LASH ADJUSTER AIR BLEEDING>

NOTE:

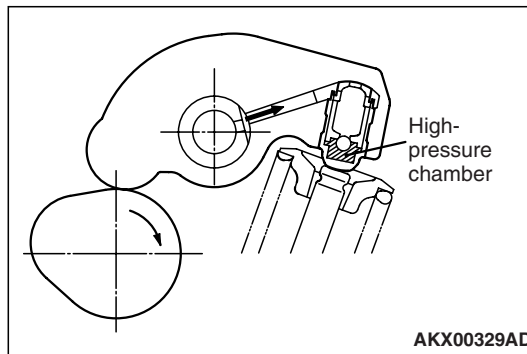
- If the vehicle is parked on a slope for a long period of time, the amount of oil inside the lash adjuster will decrease, and air may get into the high pressure chamber when starting the engine.
- After parking the vehicle for long periods, the oil drains out of the oil passage, and it takes time for 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.

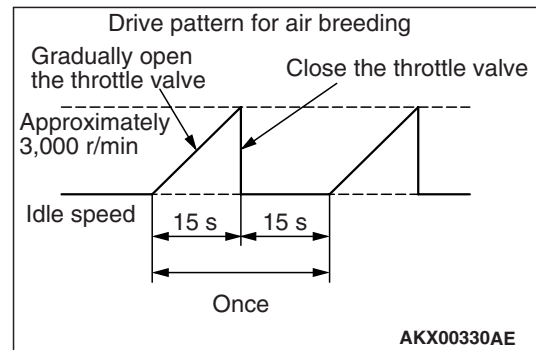
NOTE:

- 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 be 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 at left 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 at left 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

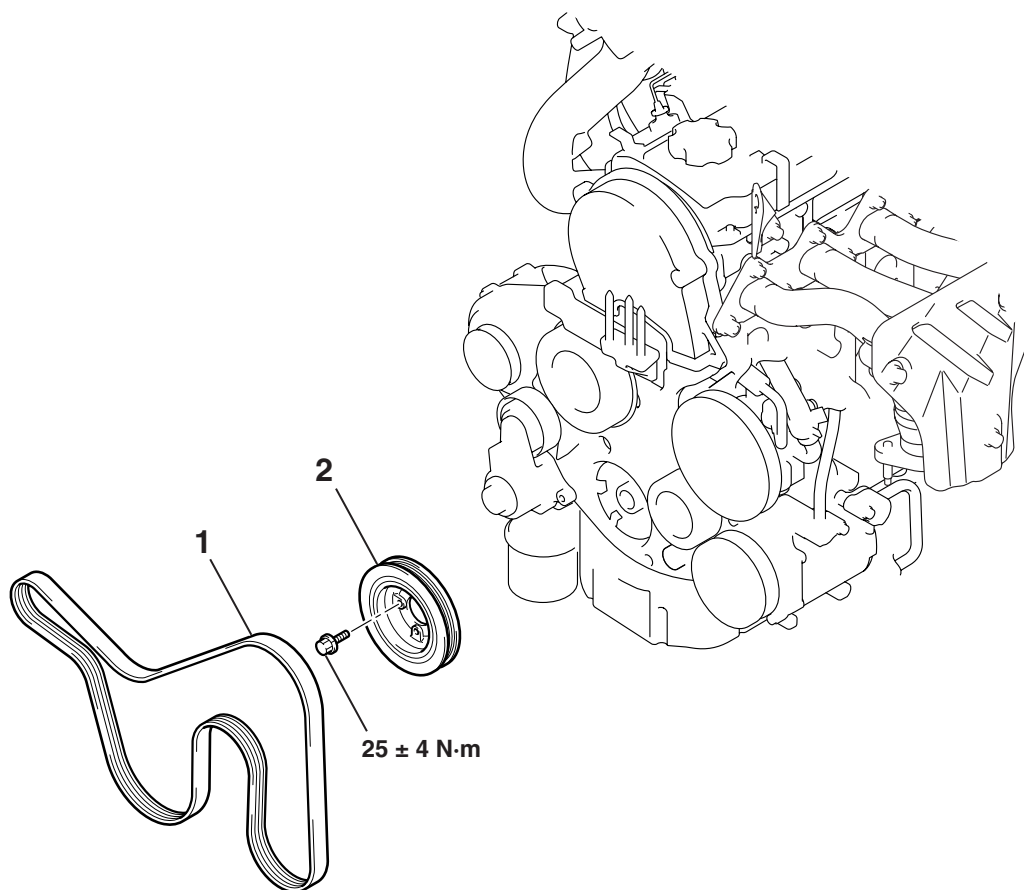
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Pre-removal Operation

- Under Cover Removal (Refer to GROUP 51, Under Cover [P.51-29](#)).

Post-installation Operation

- Drive Belt Tension Check (Refer to [P.11A-8](#)).
- Under Cover Installation (Refer to GROUP 51, Under Cover [P.51-29](#)).



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<<A>>

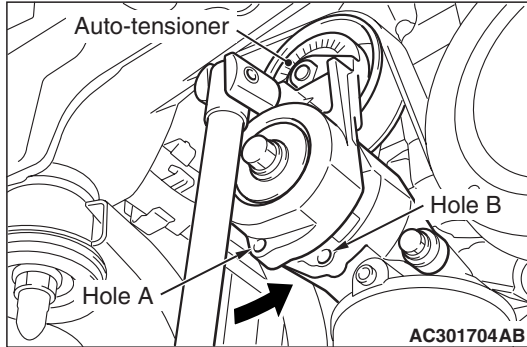
Removal steps

1. Drive belt
2. Crank shaft damper pulley

REMOVAL SERVICE POINT

<<A>> DRIVE BELT REMOVAL

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

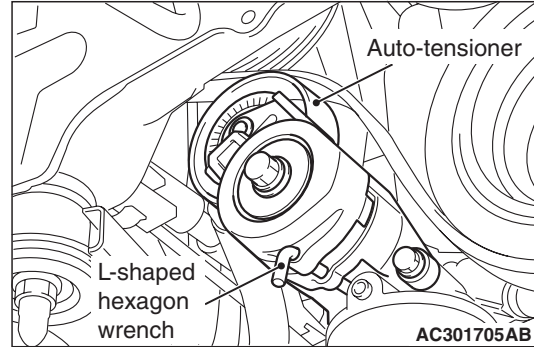


1. Securely insert the spindle handle or ratchet handle with a 12.7 mm insertion angle into the jig hole of the auto-tensioner.

2. Rotate the auto-tensioner anti-clockwise and align hole A with hole B.

CAUTION

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



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

CAMSHAFT AND VALVE STEM SEAL

REMOVAL AND INSTALLATION

M1112006601009

CAUTION

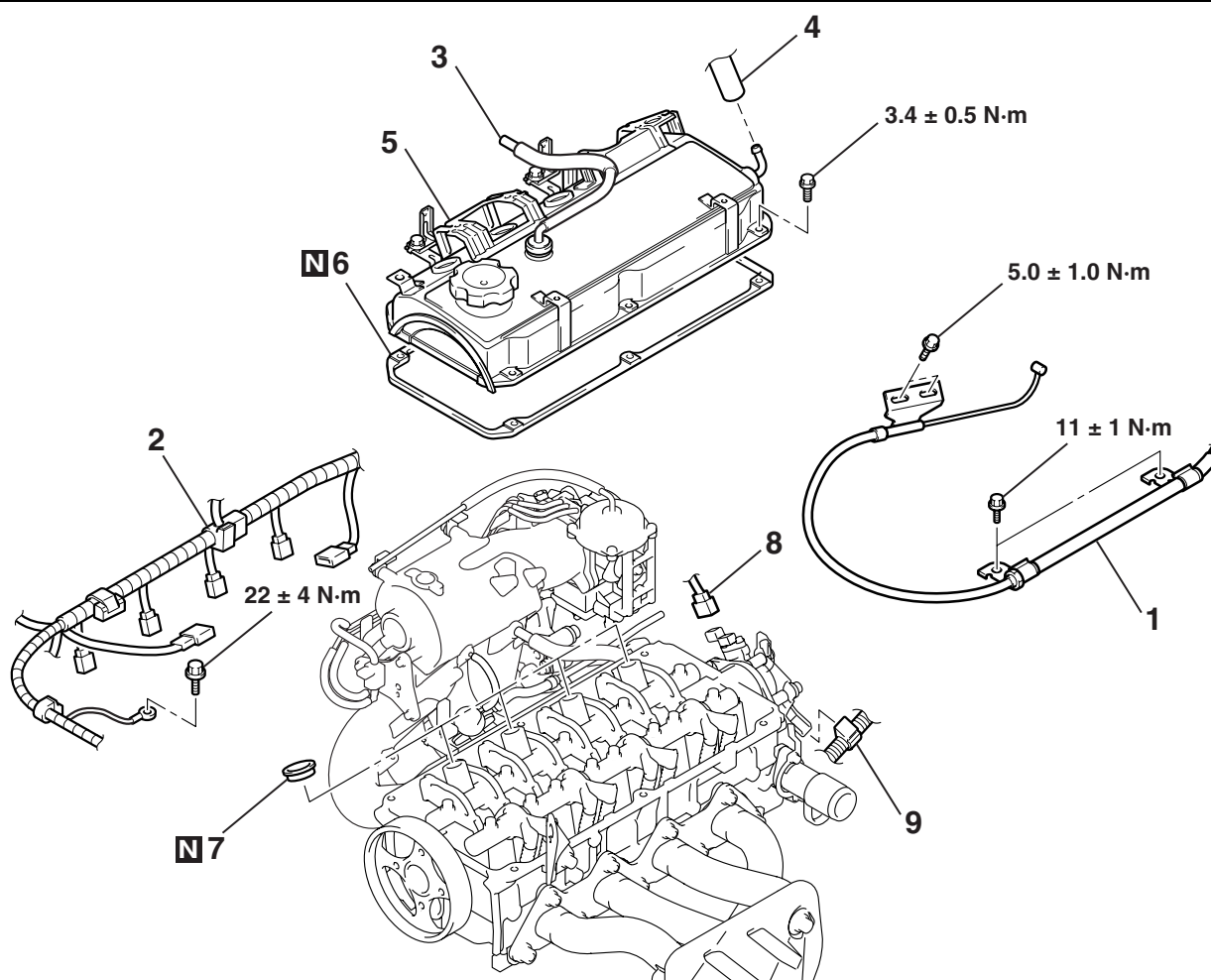
*Remove and assemble the marked parts in each cylinder unit.

Pre-removal Operation

- Air Cleaner and Air Cleaner Bracket Removal (Refer to GROUP 15, Air Cleaner [P.15-3](#)).
- Battery and Battery Tray Removal
- Spark Plug Cables and Ignition Coils Removal (Refer to GROUP 16, Ignition Coil [P.16-42](#)).

Post-installation Operation

- Spark Plug Cables and Ignition Coils Installation (Refer to GROUP 16, Ignition Coil [P.16-42](#)).
- Battery and Battery Tray Installation
- Air Cleaner and Air Cleaner Bracket installation (Refer to GROUP 15, Air Cleaner [P.15-3](#)).
- Accelerator Cable Adjustment (Refer to GROUP 17, On-vehicle Service – Accelerator Cable Check and Adjustment [P.17-7](#) <L.H. drive vehicles>).
- Drive Belt Tension Check (Refer to [P.11A-8](#)).



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Camshaft removal steps

- Valve timing belt (Refer to [P.11A-36](#)).
1. Accelerator cable connection <L.H. drive vehicles>
 2. Control wiring harness connection
 3. Rocker cover PCV hose connection

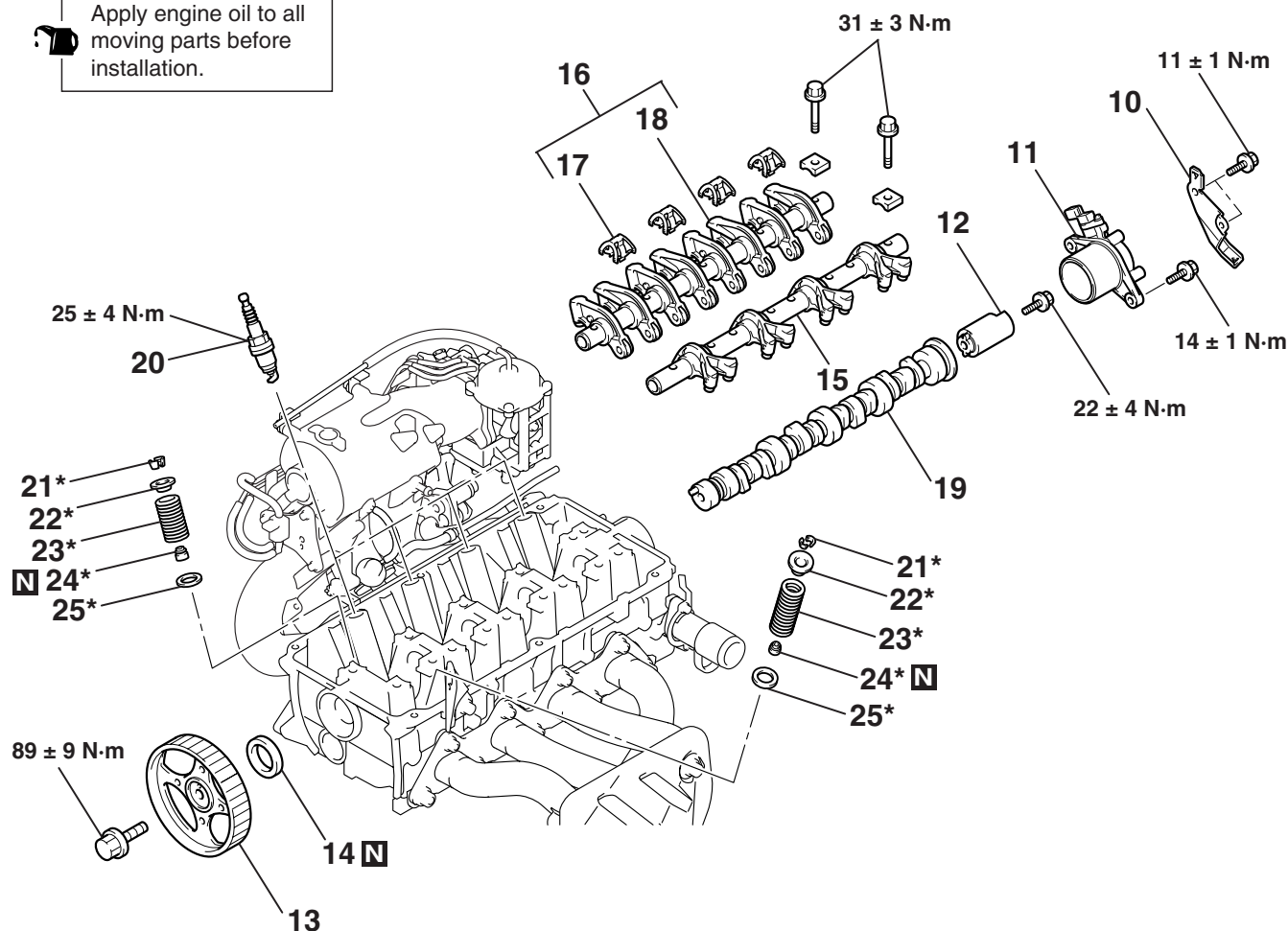
Camshaft removal steps

4. Rocker cover breather hose connection
5. Rocker cover
6. Rocker cover gasket
7. Cylinder head spark plug guide seals

Camshaft removal steps

8. Camshaft position sensor connector
9. Battery wiring harness connection

Apply engine oil to all moving parts before installation.



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Camshaft removal steps

- | | |
|-------|--|
| | 10. Engine wiring bracket |
| >>H<< | 11. Camshaft position sensor support |
| | 12. Camshaft position sensing cylinder |
| <<A>> | >>G<< 13. Camshaft sprocket |
| | >>F<< 14. Camshaft oil seal |
| <> | >>E<< 15. Rocker arm, shaft and lash adjuster assembly |
| <<C>> | >>D<< 16. Rocker arm, shaft, lash adjuster and spring assembly |
| | >>D<< 17. Rocker shaft springs |
| <<C>> | >>D<< 18. Rocker arm, shaft and lash adjuster assembly |
| | 19. Camshaft |

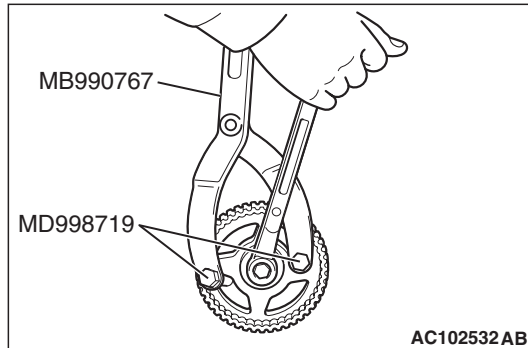
Valve stem seal removal steps

- Timing belt upper cover (Refer to P.11A-36).
1. Accelerator cable connection <LH drive vehicles>
 2. Control wiring harness connection

Valve stem seal removal steps

- | | |
|-------|--|
| | 3. Rocker cover PCV hose connection |
| | 4. Rocker cover breather hose connection |
| | 5. Rocker cover |
| | 6. Rocker cover gasket |
| | 7. Cylinder head spark plug guide seals |
| <> | >>E<< 15. Rocker arm, shaft and lash adjuster assembly |
| <<C>> | >>D<< 16. Rocker arm, shaft, lash adjuster and spring assembly |
| | >>D<< 17. Rocker shaft springs |
| <<C>> | >>D<< 18. Rocker arm, shaft and lash adjuster assembly |
| | 20. Spark plugs |
| <<D>> | >>C<< 21. Valve spring retainer locks |
| | >>B<< 22. Valve spring retainers |
| | >>A<< 23. Valve springs |
| | 24. Valve stem seals |
| | 25. Valve spring seats |

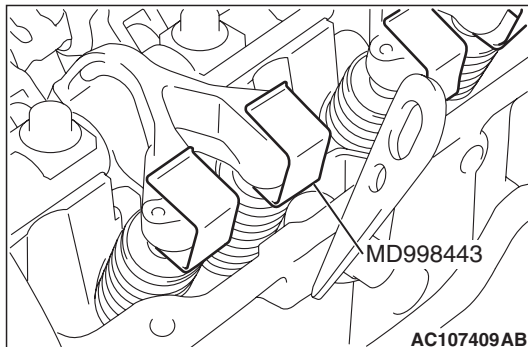
REMOVAL SERVICE POINTS

<<A>> CAMSHAFT SPROCKET
REMOVAL

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

<> ROCKER ARM, SHAFT AND LASH
ADJUSTER ASSEMBLY REMOVAL**CAUTION**

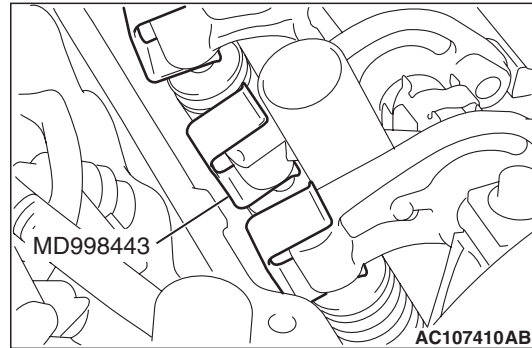
Never disassemble the rocker arm, shaft and lash adjuster assembly.



Before rocker arm, shaft and lash adjuster assembly removal, install special tool lash adjuster holder (MD998443) as shown in the illustration so that the lash adjusters will not fall out.

<<C>> ROCKER ARM, SHAFT, LASH
ADJUSTER AND SPRING
ASSEMBLY/ROCKER ARM, SHAFT AND
LASH ADJUSTER ASSEMBLY REMOVAL**CAUTION**

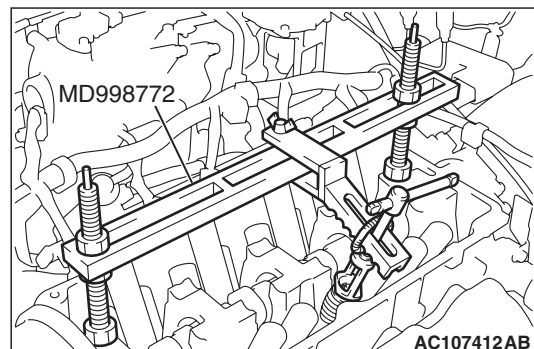
Never disassemble the rocker arm, shaft and lash adjuster assembly.



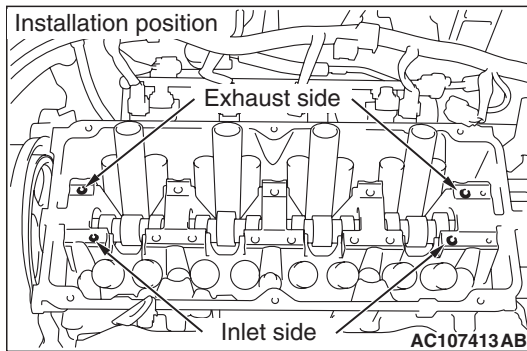
Before rocker arm, shaft, lash adjuster and spring assembly removal, install special tool lash adjuster holder (MD998443) as shown in the illustration so that the lash adjusters will not fall out.

<<D>> VALVE SPRING RETAINER LOCKS
REMOVAL**CAUTION**

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



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



NOTE: Installation position of special tool is different between exhaust side and inlet side.

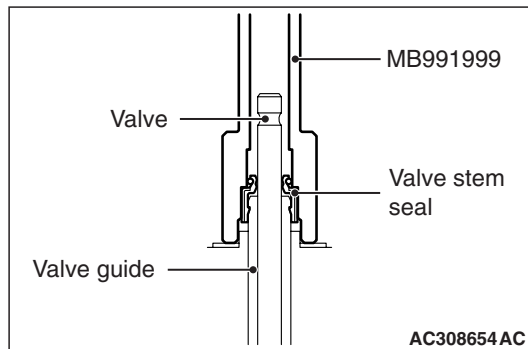
INSTALLATION SERVICE POINTS

>>A<< VALVE STEM SEALS INSTALLATION

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

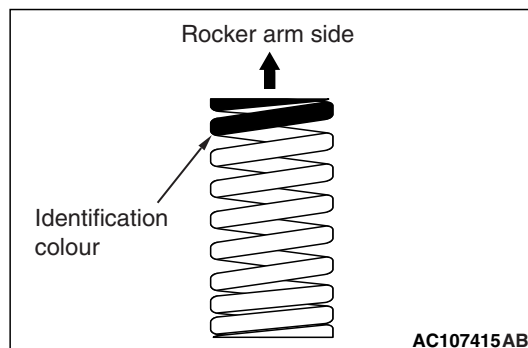
CAUTION

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



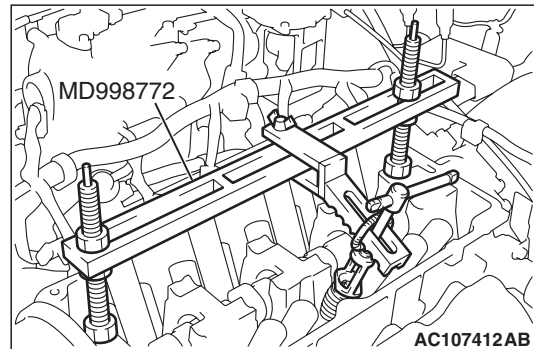
2. Use special tool to fill a new valve stem seal in the valve guide using the valve stem area as a guide.

>>B<< VALVE SPRINGS INSTALLATION



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

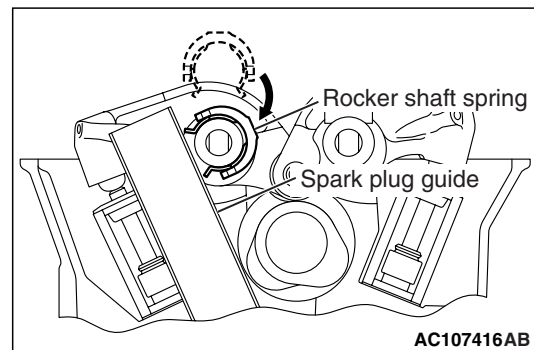
>>C<< VALVE SPRING RETAINER LOCKS INSTALLATION



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

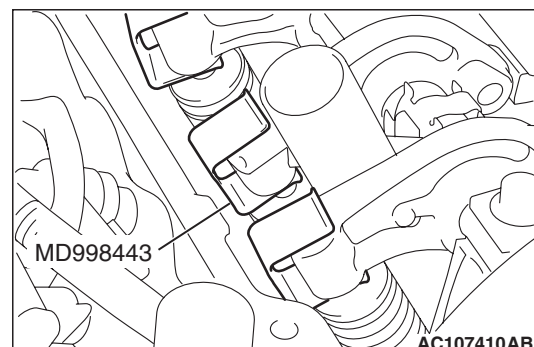
>>D<< ROCKER ARM, SHAFT AND LASH ADJUSTER ASSEMBLY/ROCKER SHAFT SPRINGS/ROCKER ARM, SHAFT, LASH ADJUSTER AND SPRING ASSEMBLY INSTALLATION

1. Ensure that all rocker arms do not press against the valve, then pre-tighten the rocker arm, shaft and lash adjuster assembly with the assembling bolt.



2. Install the rocker shaft spring so that it is at a right angle against the spark plug guide.
3. Tighten the mounting bolts to the specified torque.

Tightening torque: 31 ± 3 N·m

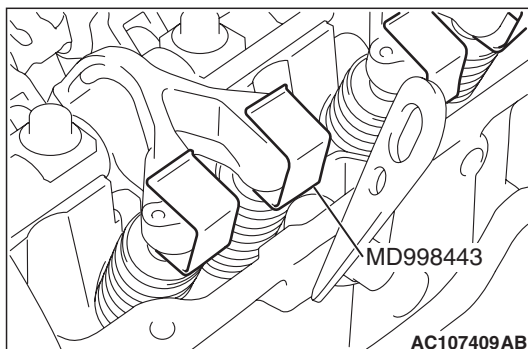


4. Remove special tool lash adjuster holder (MD998443).

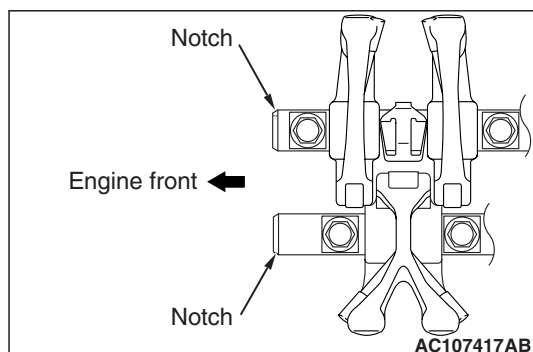
>>E<< ROCKER ARM, SHAFT AND LASH ADJUSTER ASSEMBLY INSTALLATION

1. Install the rocker arm, shaft and lash adjuster assembly.
2. Tighten the mounting bolts to the specified torque.

Tightening torque: 31 ± 3 N·m

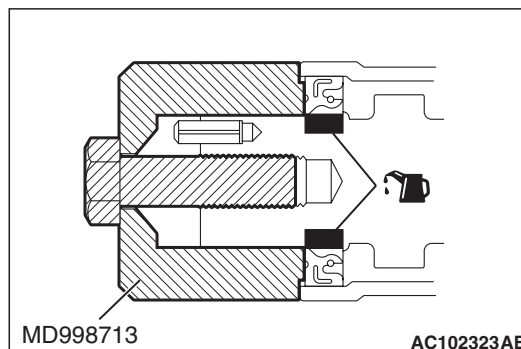


3. Remove special tool lash adjuster holder (MD998443).



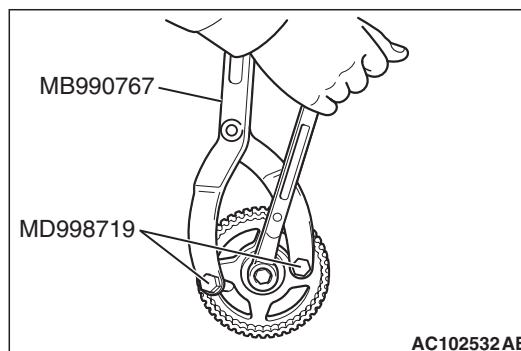
4. Check that notches in the each rocker shaft are facing the direction shown in the illustration.

>>F<< CAMSHAFT OIL SEAL INSTALLATION



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

>>G<< CAMSHAFT SPROCKET INSTALLATION

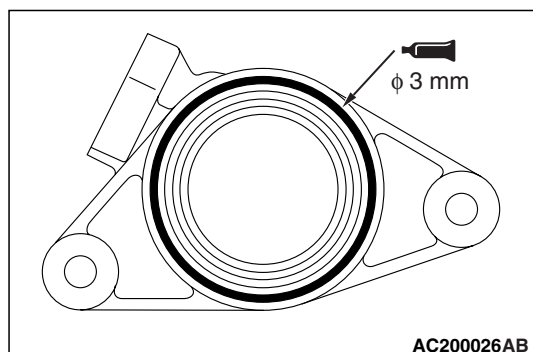


1. Use the following special tool as during removal to support the camshaft sprocket.
 - Front hub and flange yoke holder (MB990767)
 - Pin (MD998719)
2. Tighten the camshaft sprocket mounting bolt to the specified torque.

Tightening torque: 89 ± 9 N·m

>>H<< CAMSHAFT POSITION SENSOR SUPPORT INSTALLATION

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



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

**Specified sealant: MITSUBISHI GENUINE
PART MD970389 or equivalent**

NOTE: . Install the camshaft position sensor support within 15 minutes after applying liquid gasket.

3. Install the camshaft position sensor support to the 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.

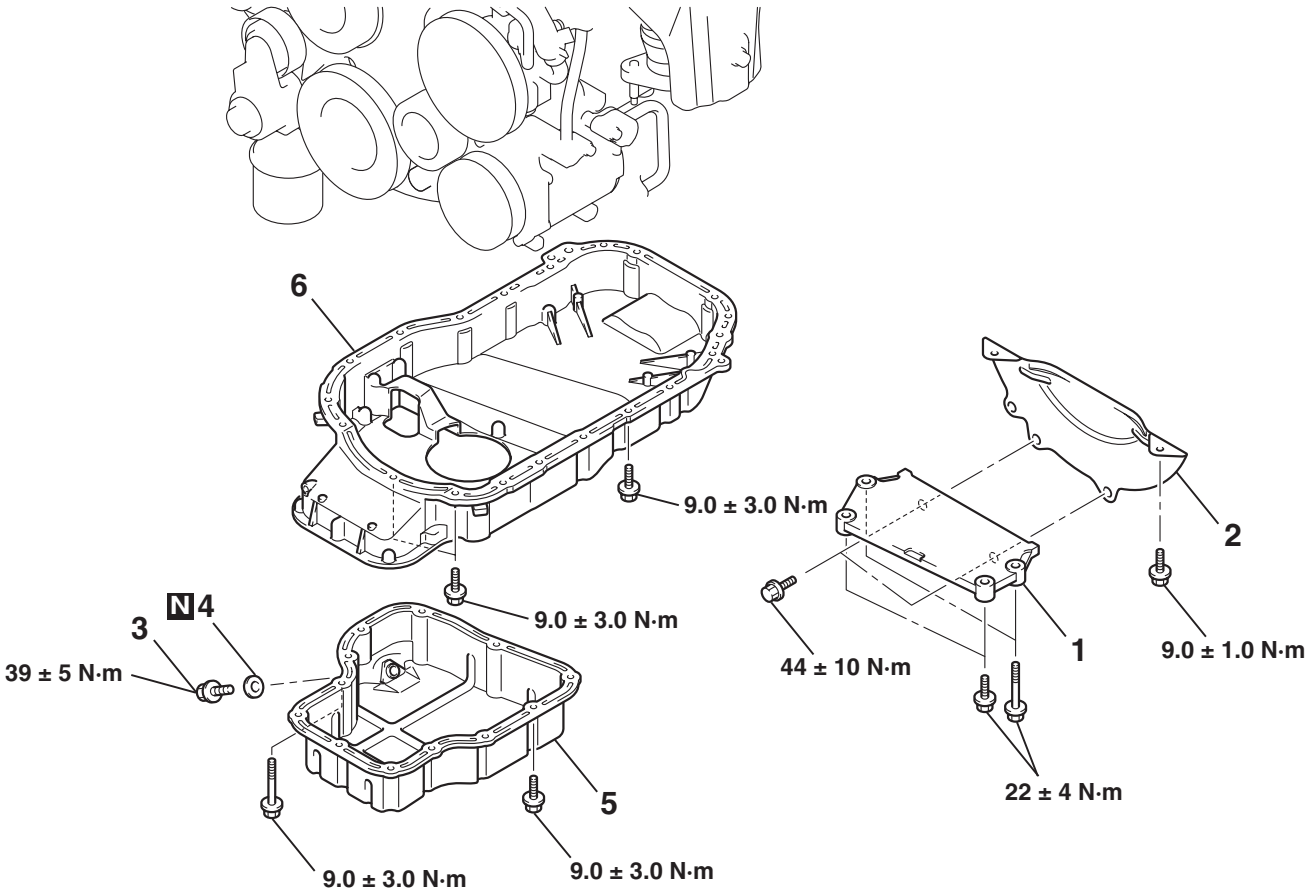
Tightening torque: $14 \pm 1 \text{ N}\cdot\text{m}$

OIL PAN

REMOVAL AND INSTALLATION

M1112002801379

| | |
|---|---|
| Pre-removal Operation <ul style="list-style-type: none">Under Cover Removal (Refer to GROUP 51, Under Cover P.51-29).Engine Oil Draining (Refer to GROUP 12, On-vehicle Service – Engine Oil Replacement P.12-4).Front Exhaust Pipe Removal (Refer to GROUP 15, Exhaust Pipe and Main Muffler P.15-13).Centre Member Removal (Refer to GROUP 32, Engine Roll Stopper and Centre Member P.32-7). | Post-installation Operation <ul style="list-style-type: none">Centre Member Installation (Refer to GROUP 32, Engine Roll Stopper and Centre Member P.32-7).Front Exhaust Pipe Installation (Refer to GROUP 15, Exhaust Pipe and Main Muffler P.15-13).Engine Oil Refilling (Refer to GROUP 12, On-vehicle Service – Engine Oil Replacement P.12-4).Under Cover Installation (Refer to GROUP 51, Under Cover P.51-29). |
|---|---|



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| | |
|--|---|
| Removal steps | Removal steps (Continued) |
| >>D<< 1. Transmission housing front lower cover stay | >>C<< 3. Engine oil pan drain plug |
| 2. Torque converter housing front lower cover | >>B<< 4. Engine oil pan drain plug gasket |
| <<A>> | 5. Engine lower oil pan |
| <> | >>A<< 6. Engine upper oil pan |

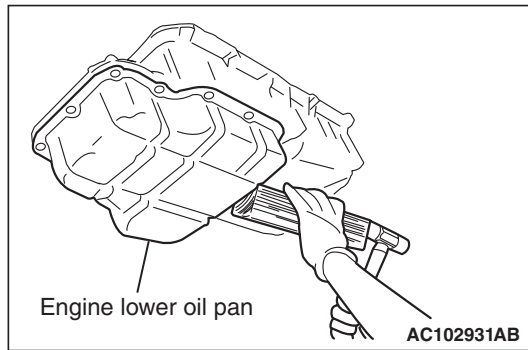
REMOVAL SERVICE POINTS

<<A>> ENGINE LOWER OIL PAN REMOVAL

1. Remove the engine lower oil pan mounting bolts.

CAUTION

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



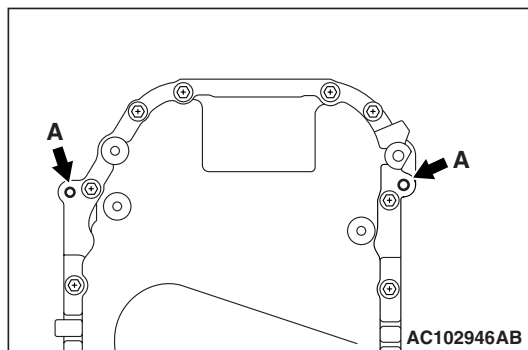
2. Apply a piece of wood to the lower oil pan and strike it with a hammer to remove the engine lower oil pan.

<> ENGINE UPPER OIL PAN REMOVAL

1. Remove the engine upper oil pan mounting bolts.

CAUTION

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

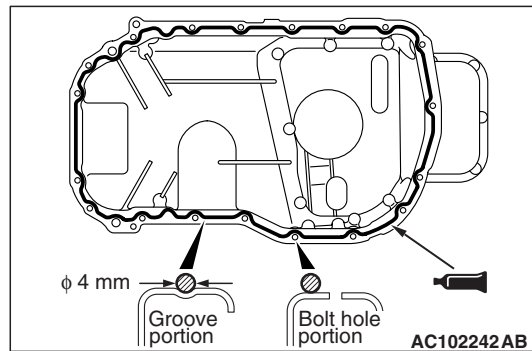


2. Screw in the bolt into bolt hole A in the location shown. Then lift the upper oil pan and remove it.

INSTALLATION SERVICE POINTS

>>A<< ENGINE UPPER OIL PAN INSTAL- LATION

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



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

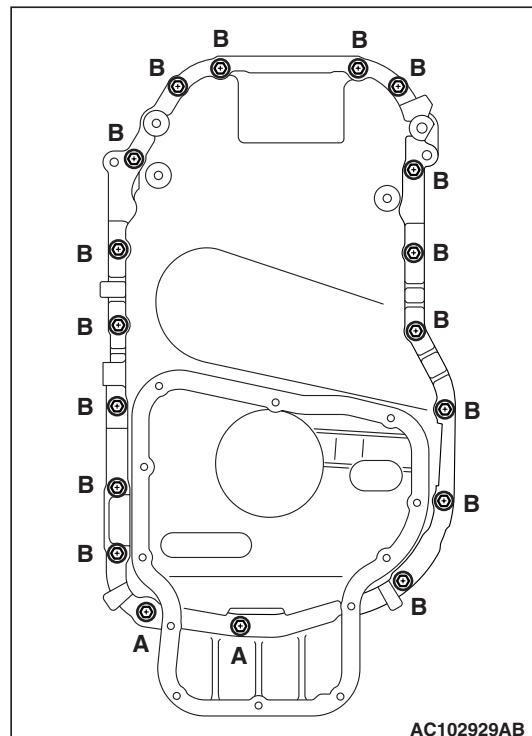
Specified sealant: MITSUBISHI GENUINE PART MD970389 or equivalent

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

3. Assemble the engine upper 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. Insert the bolts to the engine upper oil pan as shown, and tighten them to the specified torque.

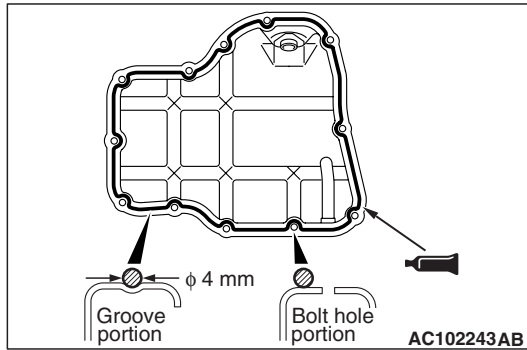
| Name | Symbol | Quantity | Size mm (D × L) |
|-------------|--------|----------|-----------------|
| Flange bolt | A | 2 | M6 × 16 |
| | B | 16 | M6 × 18 |

NOTE: D: Nominal diameter, L: Nominal length

Tightening torque: $9.0 \pm 3.0 \text{ N}\cdot\text{m}$

>>B<< ENGINE LOWER OIL PAN INSTALLATION

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



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

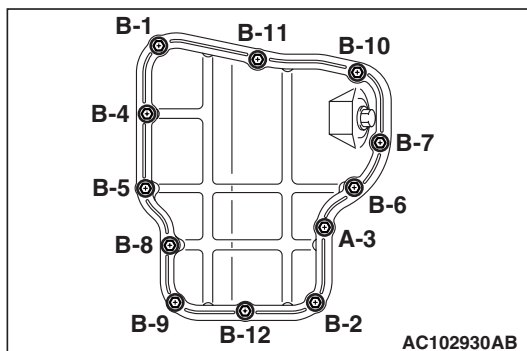
**Specified sealant: MITSUBISHI GENUINE
PART MD970389 or equivalent**

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

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

⚠ CAUTION

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



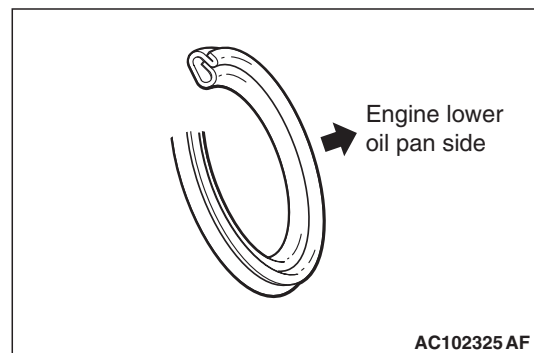
4. Insert the bolts to the engine lower oil pan as shown, and tighten them to the specified torque in the order shown.

| Name | Symbol | Quantity | Size mm (D × L) |
|-------------|--------|----------|-----------------|
| Flange bolt | A | 1 | M6 × 75 |
| | B | 11 | M6 × 10 |

NOTE: D: Nominal diameter, L: Nominal length

Tightening torque: $9.0 \pm 3.0 \text{ N}\cdot\text{m}$

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



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

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

Install the transmission housing front lower cover stay in the following order.

1. Tighten the engine side four mounting bolts to the specified torque.

Tightening torque: $22 \pm 4 \text{ N}\cdot\text{m}$

2. Tighten the transmission side two mounting bolts to the specified torque.

Tightening torque: $44 \pm 10 \text{ N}\cdot\text{m}$

INSPECTION

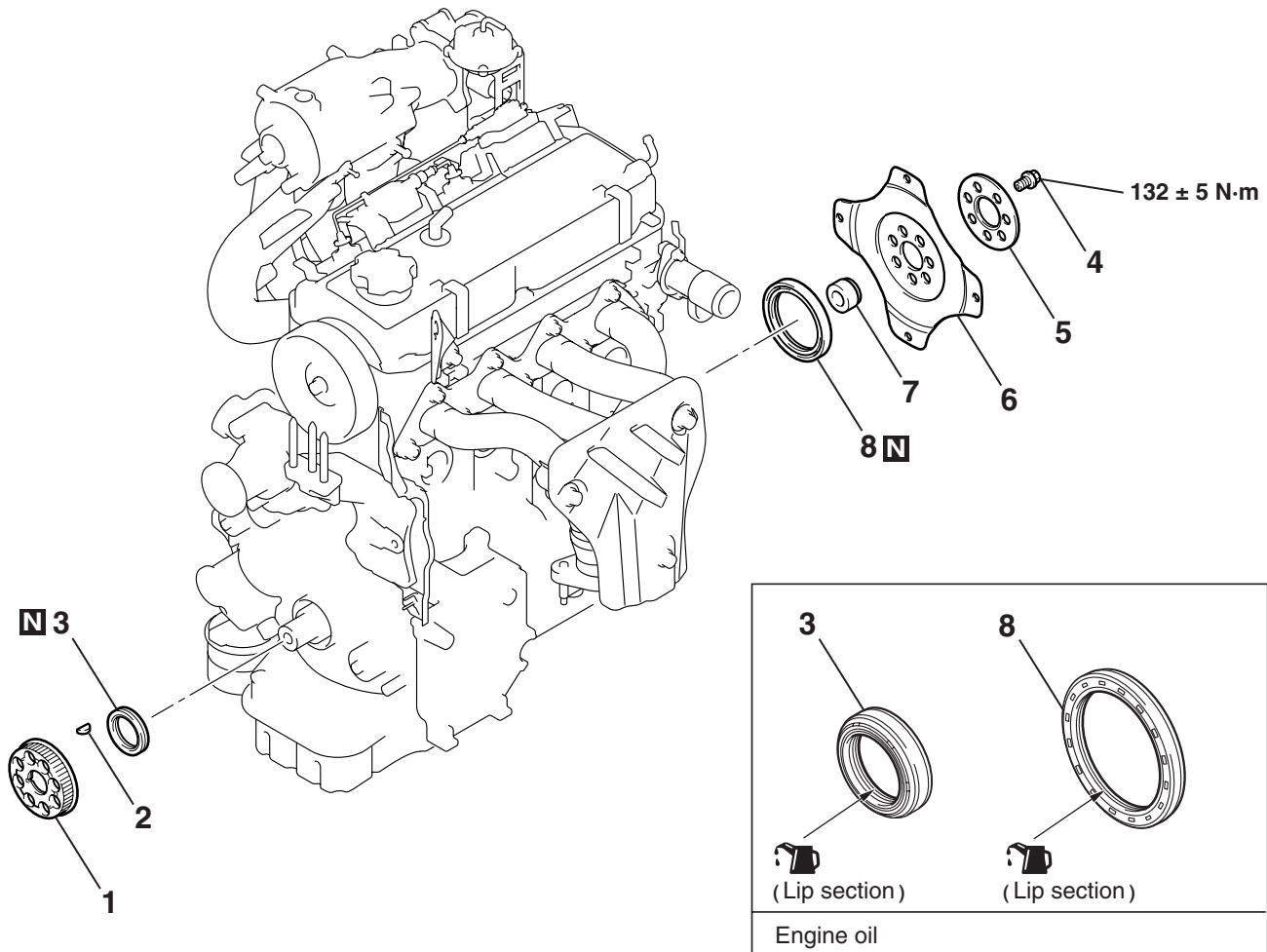
- Check the oil pan for cracks.
- Check the oil pan sealant-coated surface for damage and deformation.

M1112002900191

CRANKSHAFT OIL SEAL

REMOVAL AND INSTALLATION

M1112003101113



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Crankshaft front oil seal removal steps

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

>>D<< 1. Crankshaft balancer shaft drive sprocket

2. Crankshaft key

>>C<< 3. Crankshaft front oil seal

Crankshaft rear oil seal removal steps

- Transmission assembly (Refer to GROUP 23A, Transmission Assembly P.23A-139).

<<A>> >>B<< 4. A/T drive plate bolts

5. A/T drive plate adapter plate

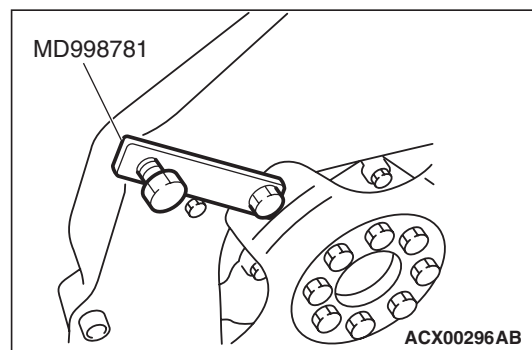
6. A/T drive plate

7. Crankshaft bush

>>A<< 8. Crankshaft rear oil seal

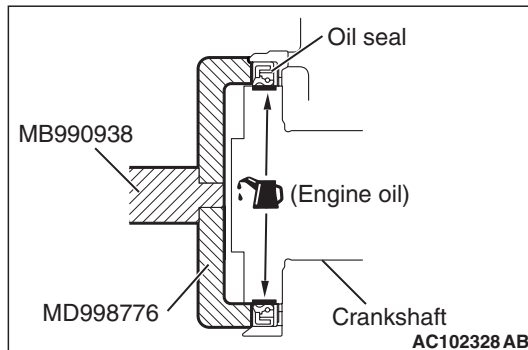
REMOVAL SERVICE POINT

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

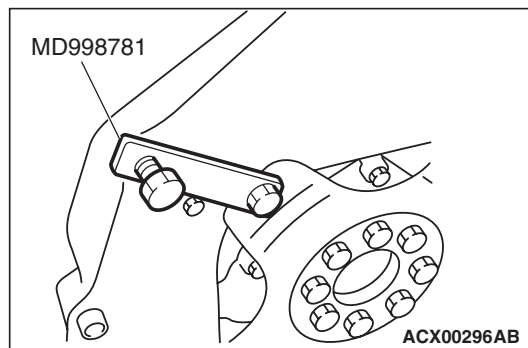


1. Use special tool flywheel stopper (MD998781) to secure the A/T drive plate.
2. Remove the A/T drive plate bolts.

INSTALLATION SERVICE POINTS

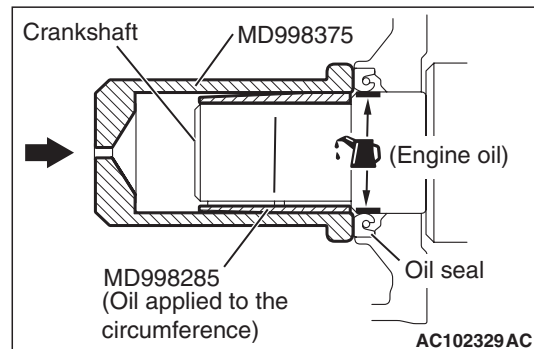
>>A<< CRANKSHAFT REAR OIL SEAL
INSTALLATION

1. Apply a small amount of engine oil to the entire inner diameter of the oil seal lip.
2. Use the following special tools to press-fit the oil seal.
 - Installer bar (MB990938)
 - Crankshaft rear oil seal installer (MD998776)

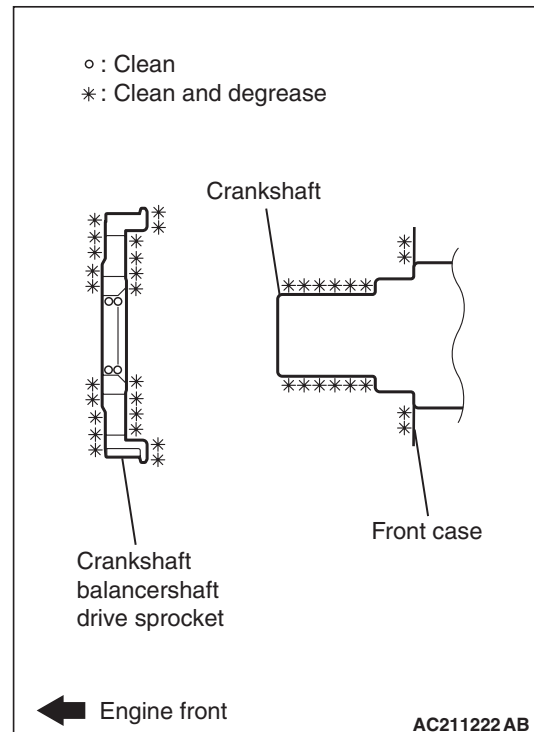
>>B<<A/T DRIVE PLATE BOLTS
INSTALLATION

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

Tightening torque: 132 ± 5 N·m

>>C<< CRANKSHAFT FRONT OIL SEAL
INSTALLATION

1. Apply a small amount of 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 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

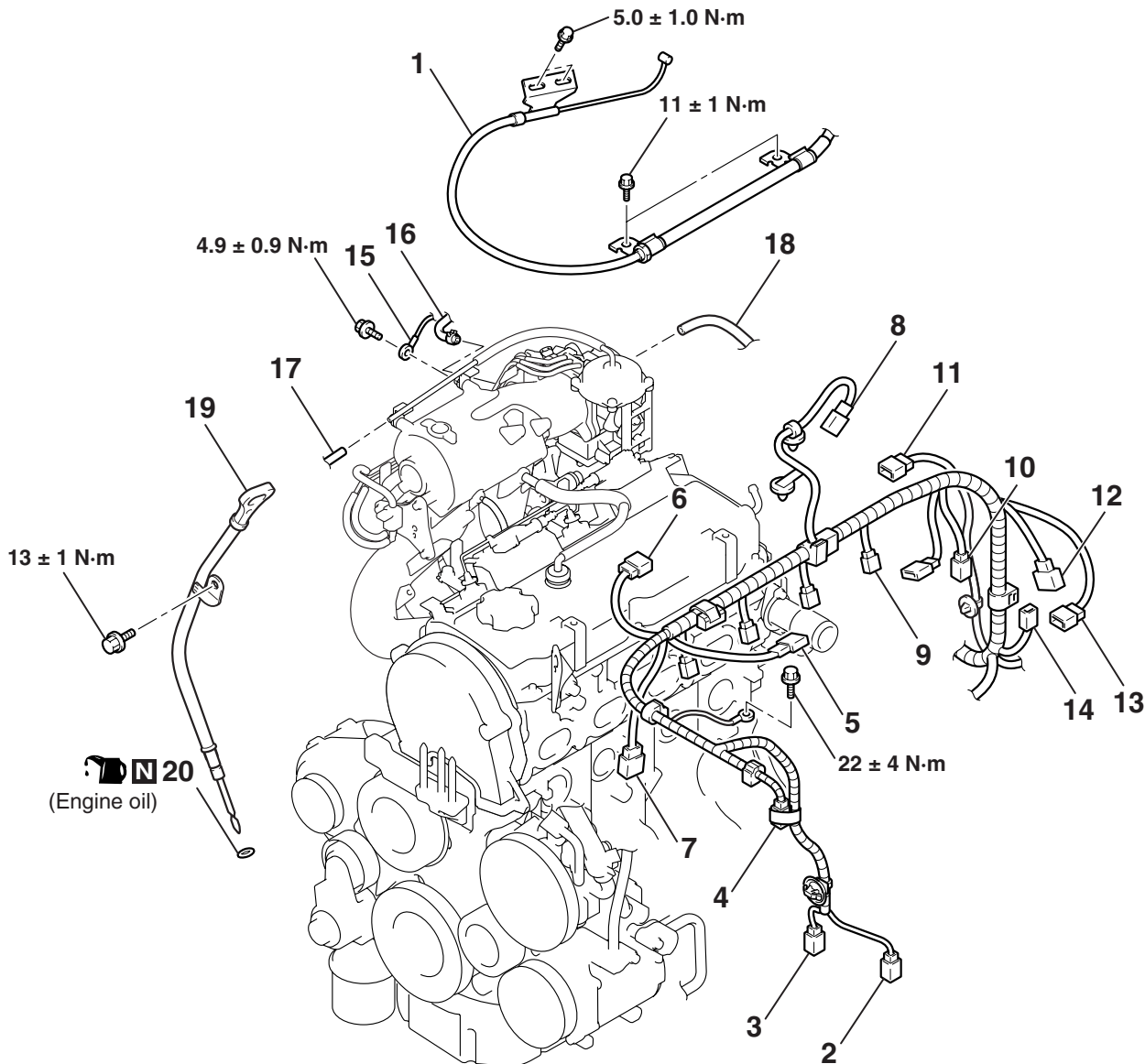
M1112004001711

Pre-removal Operation

- Fuel Line Pressure Reduction [Refer to GROUP 13A, On-vehicle Service – Fuel Pump Connector Disconnection (How to Reduce Pressurized Fuel Lines) [P.13A-283](#).]
- Engine Oil Draining (Refer to GROUP 12, On-vehicle Service – Engine Oil Replacement [P.12-4](#)).
- Engine Coolant Draining (Refer to GROUP 14, On-vehicle Service – Engine Coolant Replacement [P.14-10](#)).
- Air Cleaner and Air Cleaner Bracket Removal (Refer to GROUP 15, Air Cleaner [P.15-3](#)).
- Exhaust Manifold Removal (Refer to GROUP 15, Exhaust Manifold [P.15-10](#)).
- Spark Plug Cables and Ignition Coils Removal (Refer to GROUP 16, Ignition Coil [P.16-42](#)).

Post-installation Operation

- Spark Plug Cables and Ignition Coils Installation (Refer to GROUP 16, Ignition Coil [P.16-42](#)).
- Exhaust Manifold Installation (Refer to GROUP 15, Exhaust Manifold [P.15-10](#)).
- Air Cleaner and Air Cleaner Bracket installation (Refer to GROUP 15, Air Cleaner [P.15-3](#)).
- Engine Coolant Refilling (Refer to GROUP 14, On-vehicle Service – Engine Coolant Replacement [P.14-10](#)).
- Engine Oil Refilling (Refer to GROUP 12, On-vehicle Service – Engine Oil Replacement [P.12-4](#)).
- Accelerator Cable Adjustment (Refer to GROUP 17, On-vehicle Service – Accelerator Cable Check and Adjustment [P.17-7](#)).
- Fuel Leak Check



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Removal steps

1. Accelerator cable connection
2. A/C compressor connector

Removal steps (Continued)

3. Power steering oil pressure switch connector

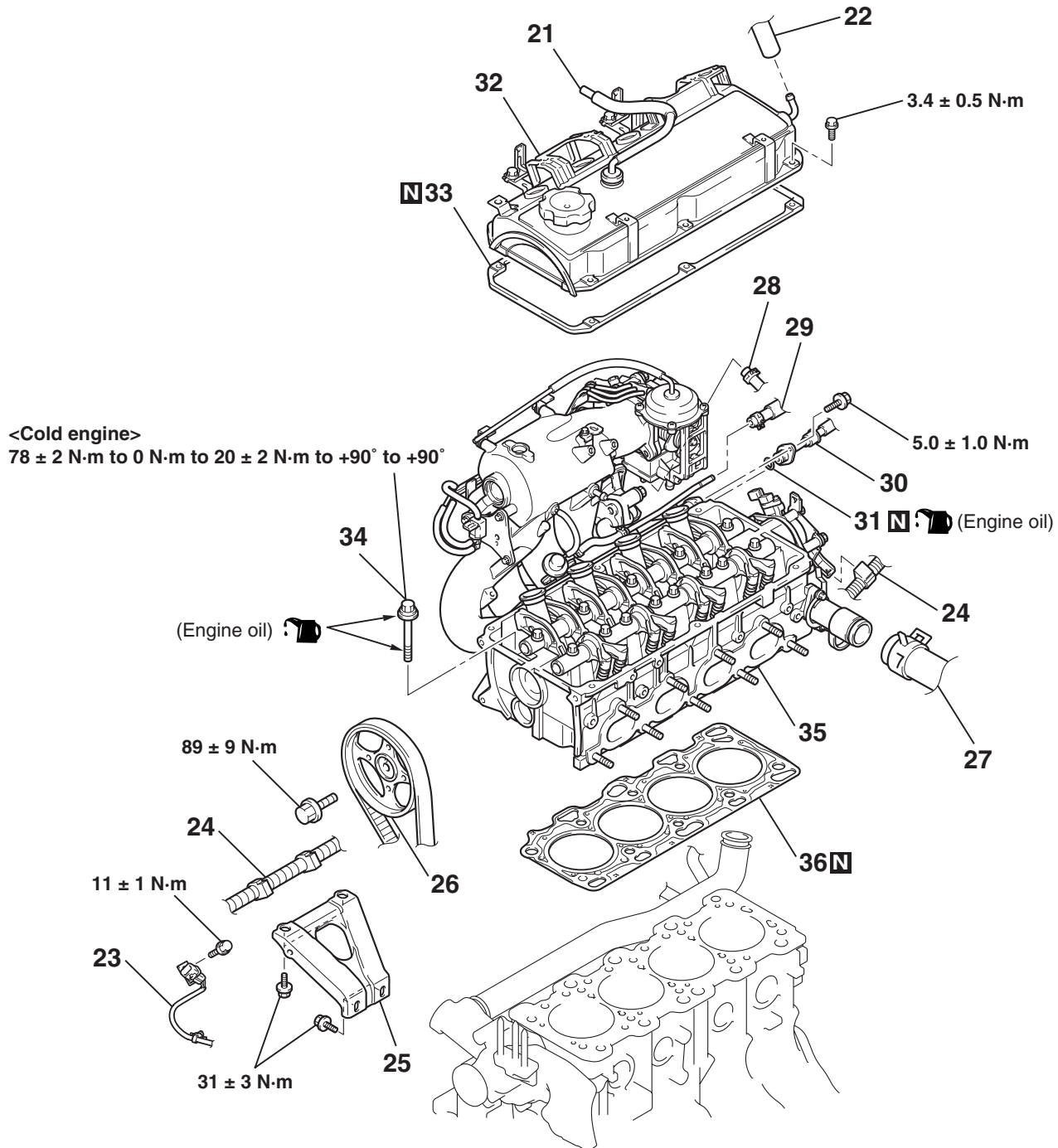
<<A>>

Removal steps (Continued)

4. Crank angle sensor connector
5. Ignition coil connectors
6. EGR control solenoid valve connector
7. Detonation sensor connector
8. Throttle position sensor connector
9. Injector connectors
10. Engine coolant temperature gauge unit connector
11. Idle speed control servo connector
12. Camshaft position sensor connector
13. Engine coolant temperature sensor connector

Removal steps (Continued)

14. Capacitor connector
15. Earth cable connection
16. Brake booster vacuum hose connection
17. Auto-cruise control vacuum hose connection <Vehicles with auto-cruise control>
18. Canister vacuum hose connection
19. Engine oil level gauge and guide assembly
20. O-ring



AC401533AB

Removal steps

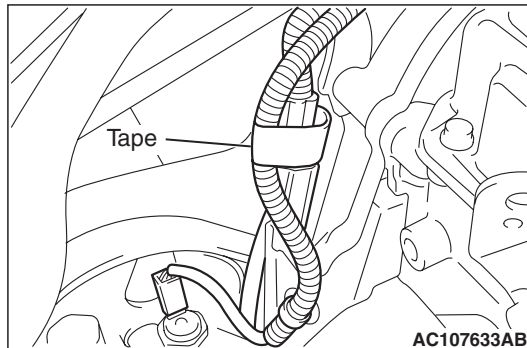
- 21. Rocker cover PCV hose connection
- 22. Rocker cover breather hose connection
- 23. Detonation sensor connector
- 24. Battery wiring harness connection
- 25. Inlet manifold stay
- Timing belt upper cover (Refer to P.11A-36).
- 26. Camshaft sprocket
- 27. Radiator upper hose connection
- 28. Water hose connection

Removal steps (Continued)

- Water inlet fitting and thermostat case assembly (Refer to GROUP 14, Water Hose and Water Pipe P.14-18).
- 29. Fuel return line hose connection
- 30. Fuel high-pressure hose connection
- 31. O-ring
- 32. Rocker cover
- 33. Rocker cover gasket
- 34. Cylinder head bolts
- 35. Cylinder head assembly
- 36. Cylinder head gasket

REMOVAL SERVICE POINTS

<<A>> CRANK ANGLE SENSOR CONNECTOR REMOVAL

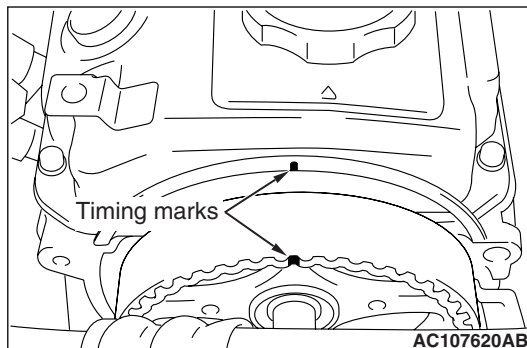
CAUTION

Do not remove the tape securing the crank angle sensor connector and control wiring harness, since the control wiring harness may contact the power steering oil pump pulley.

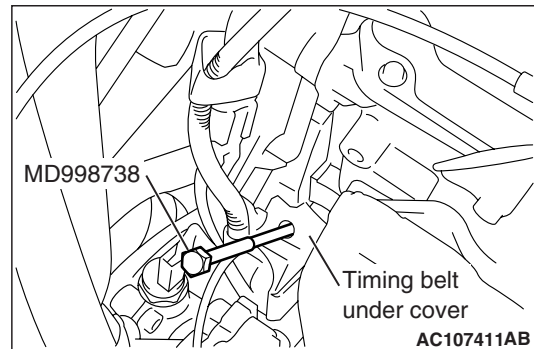
<> CAMSHAFT SPROCKET REMOVAL

CAUTION

Never turn the crankshaft anti-clockwise.



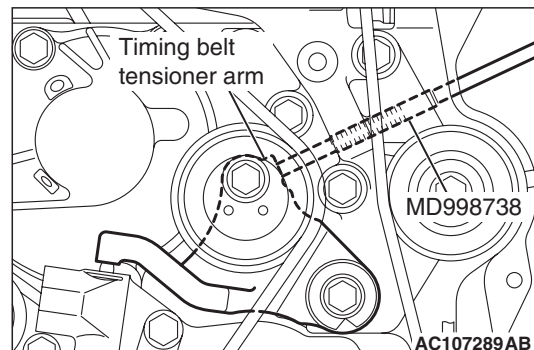
1. Turn the crankshaft clockwise, align the timing marks on the camshaft sprocket to set No.1 cylinder to TDC of its compression stroke.



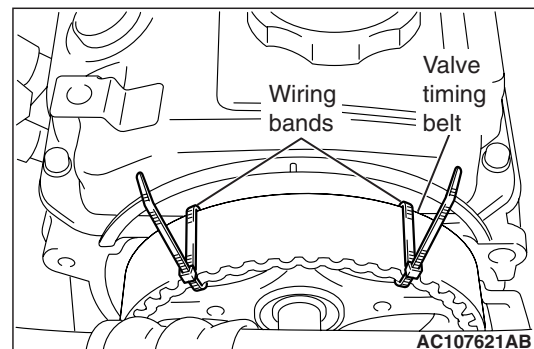
2. Remove the timing belt under cover rubber plug and then set the special tool adjusting bolt (MD998738).

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.



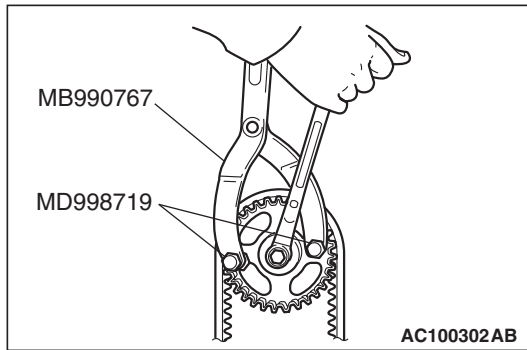
3. Screw in the special tool until it comes in contact with the timing belt tensioner arm.



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

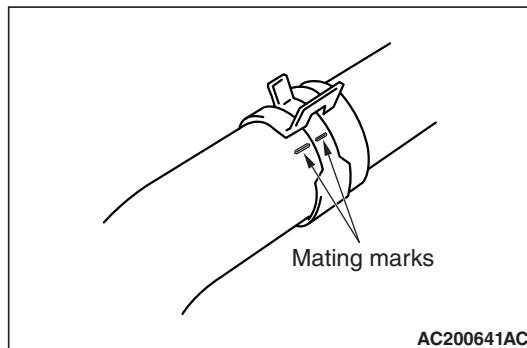
CAUTION

Do not rotate the crankshaft after camshaft sprocket removal.



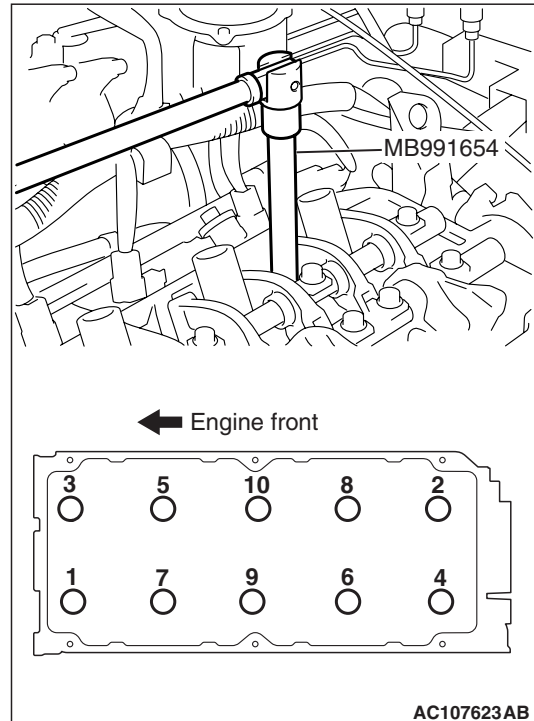
5. Use the special tool below to remove the camshaft sprocket and the valve timing belt as an assembly.
 - Front hub and flange yoke holder (MB990767)
 - Pin (MD998719)
6. Place the camshaft sprocket above the timing belt lower cover.

<<C>> RADIATOR UPPER HOSE DISCONNECTION



Make mating marks on the radiator hose and the hose clamp. Disconnect the radiator hose.

<<D>> CYLINDER HEAD BOLTS REMOVAL



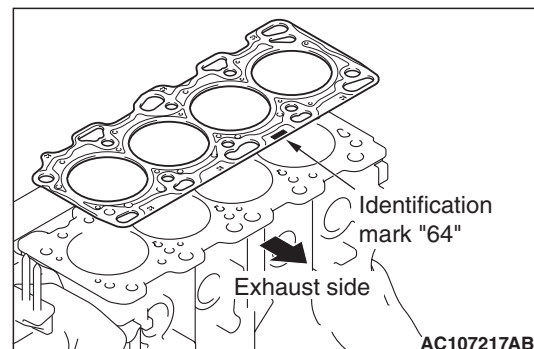
Using special tool cylinder head bolt wrench (MB991654), loosen the cylinder head bolts in two or three steps in the order of the numbers shown in the illustration.

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

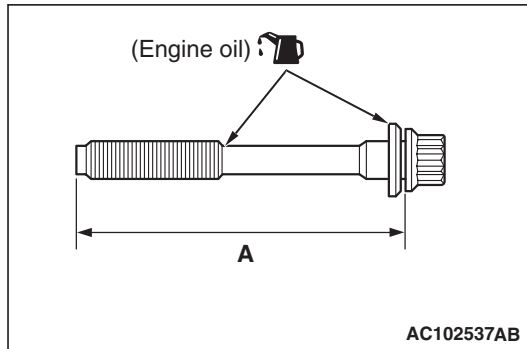
CAUTION

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

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



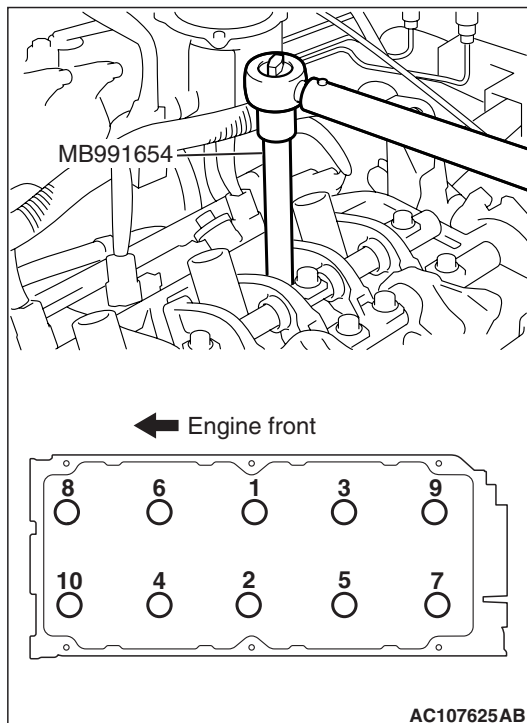
2. Assemble to the cylinder block so the cylinder head gasket identification mark "64" is at the top surface and on the exhaust side.

>>B<< CYLINDER HEAD BOLTS
INSTALLATION

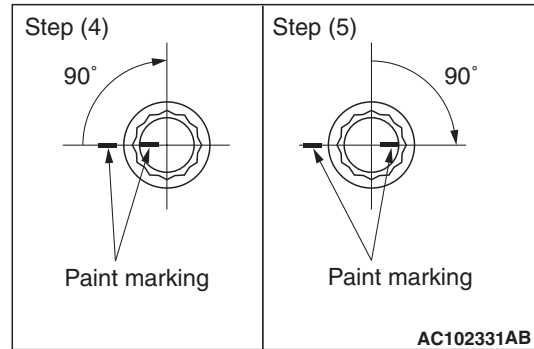
1. Check that the nominal length of each cylinder head bolt meets the limit. If it exceeds the limit, replace the bolt with a new one.

Limit (A): 99.4 mm

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



3. Use special tool cylinder head bolt wrench (MB991654) to tighten the cylinder head bolts as follows:
 - (1) Tighten the cylinder head bolts to 78 ± 2 N·m in the order shown.
 - (2) Loosen the 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 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 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 cylinder head, remove the bolt and start over from step 1.

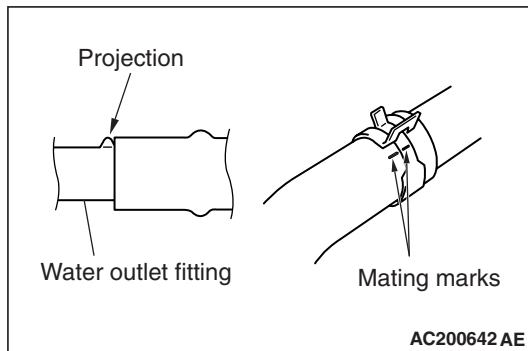
>>C<< O-RING/FUEL HIGH-PRESSURE
HOSE INSTALLATION**CAUTION**

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

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

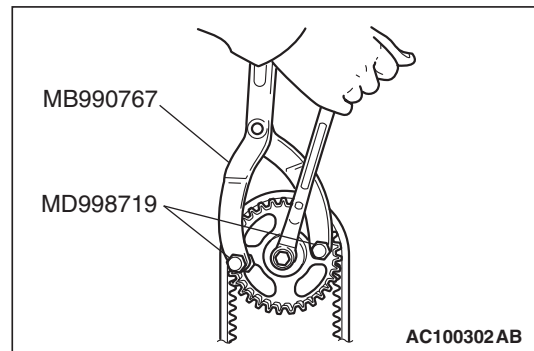
Tightening torque: 5.0 ± 1.0 N·m

>>D<< RADIATOR UPPER HOSE CONNECTION



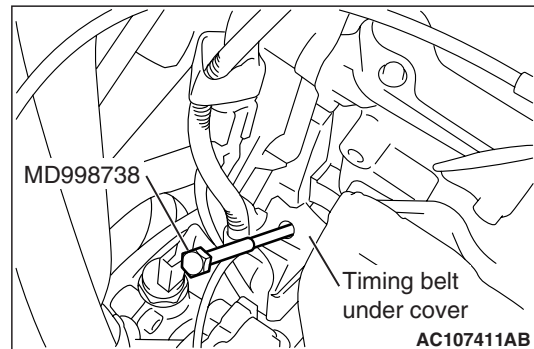
1. Insert each hose as far as the projection of the water outlet fitting.
2. Align the mating marks on the radiator hose and hose clamp, and then connect the radiator hose.

>>E<< CAMSHAFT SPROCKET INSTALLATION



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

Tightening torque: 89 ± 9 N·m



3. Remove special tool adjusting bolt (MD998738), then assemble the timing belt under cover rubber plug.

TIMING BELT

REMOVAL AND INSTALLATION

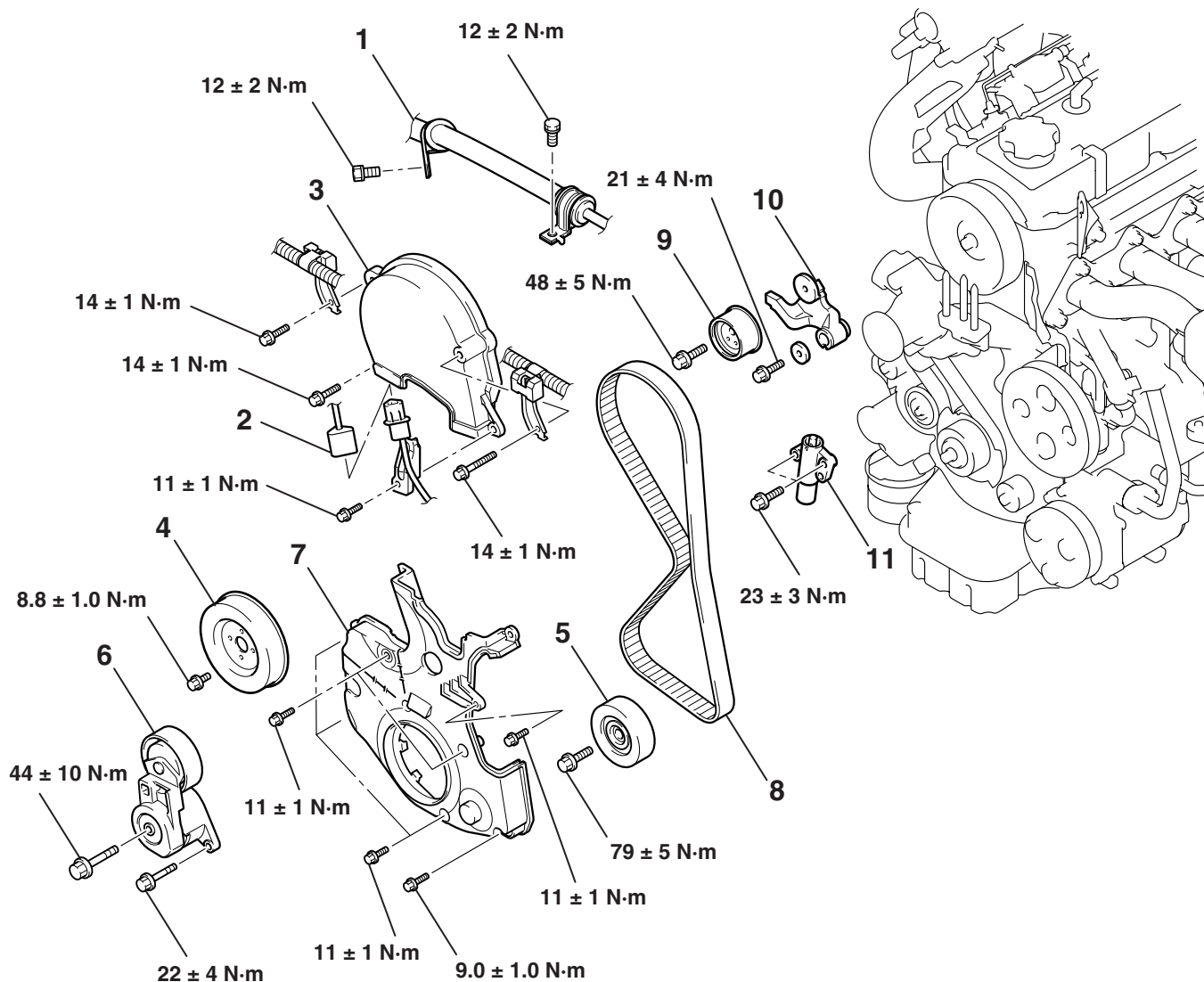
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Pre-removal Operation

- Under Cover Removal (Refer to GROUP 51, Under Cover [P.51-29](#)).
- Crankshaft Shaft Damper Pulley Removal (Refer to [P.11A-16](#)).

Post-installation Operation

- Crankshaft Shaft Damper Pulley Installation (Refer to [P.11A-16](#)).
- Drive Belt Tension Check (Refer to [P.11A-8](#)).
- Under Cover Installation (Refer to GROUP 51, Under Cover [P.51-29](#)).



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Removal steps

1. Power steering oil pressure hose
2. Crank angle sensor connector
3. Timing belt upper cover
4. Water pump pulley
5. Idler pulley
6. Auto-tensioner
7. Timing belt lower cover

Removal steps (Continued)

- Engine mounting insulator (Refer to GROUP 32, Engine mount [P.32-4](#)).
 - Valve timing belt tension adjustment
8. Valve timing belt
 9. Timing belt tensioner pulley
 10. Timing belt tensioner arm
 11. Timing belt tensioner adjuster

<<A>>

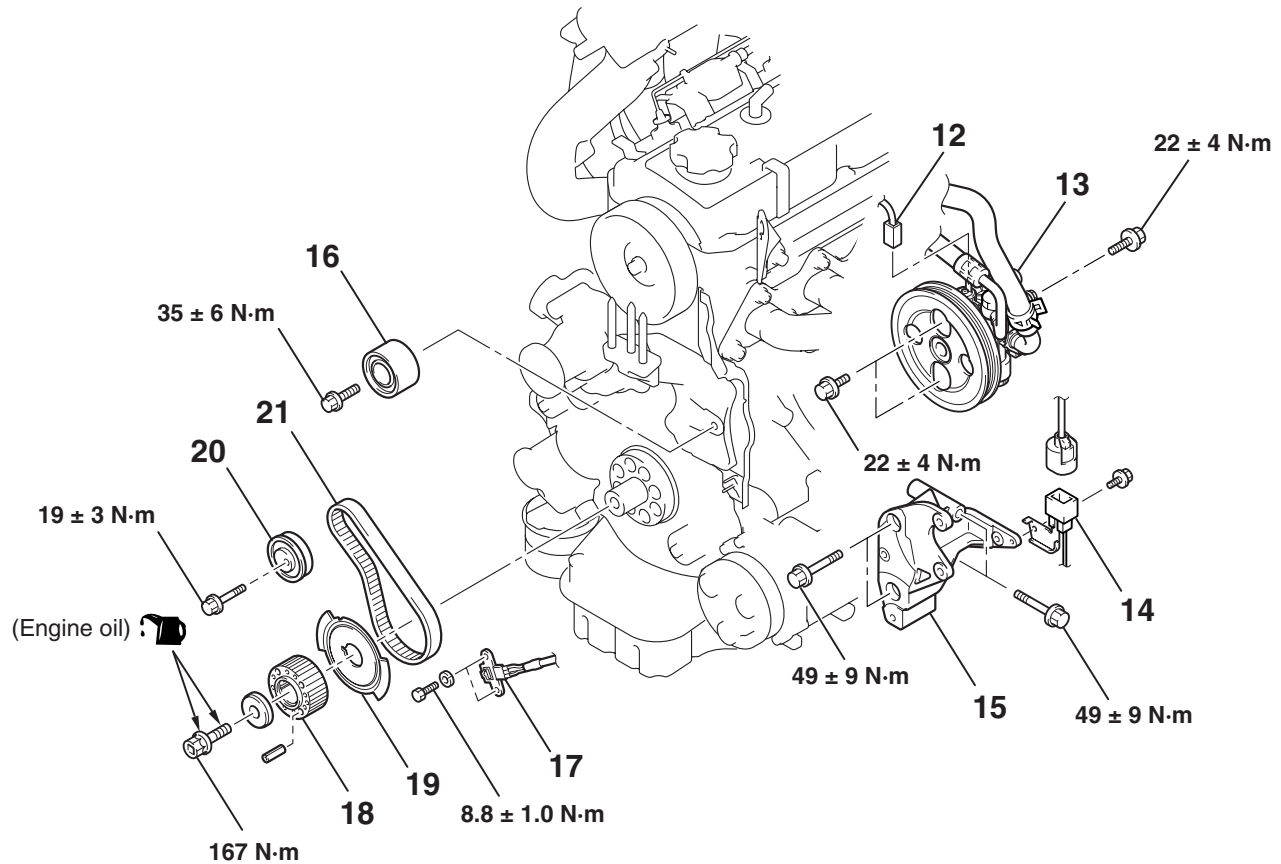
>>G<<

<>

>>F<<

>>E<<

>>D<<



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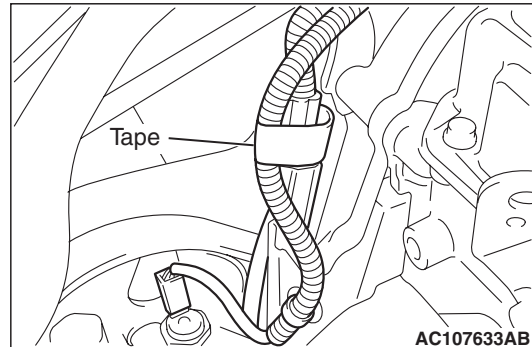
Removal steps

- <<C>> 12. Power steering oil pressure switch connector
- <<D>> >>C<< 13. Power steering oil pump assembly
- >>C<< 14. A/C compressor connector
- >>B<< 15. Power steering oil pump bracket
- >>A<< 16. Timing belt Idler pulley
- <<E>> >>A<< 17. Crank angle sensor
- >>C<< 18. Crankshaft camshaft drive sprocket
- >>B<< 19. Crankshaft angle sensing blade
- >>A<< 20. Balancer timing belt tensioner
- >>A<< 21. Balancer timing belt

REMOVAL SERVICE POINTS

<<A>>CRANK ANGLE SENSOR CONNECTOR REMOVAL

CAUTION

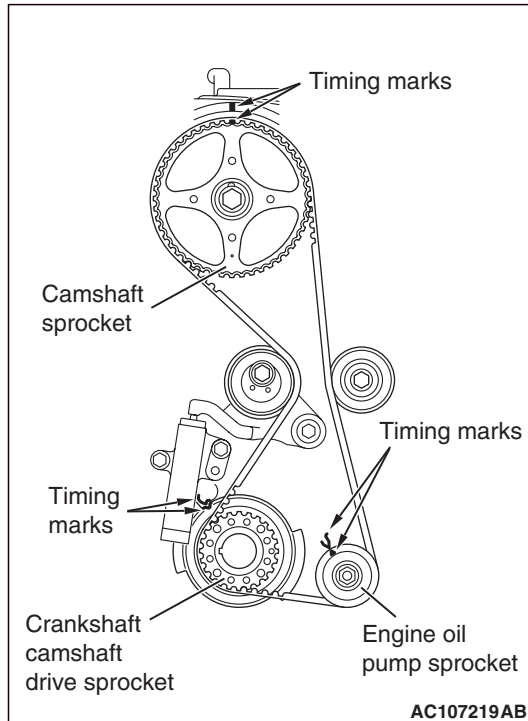


Do not remove the tape securing the crank angle sensor connector and control wiring harness, since the control wiring harness may contact the power steering oil pump pulley.

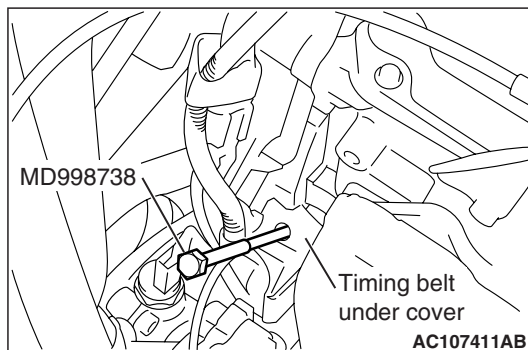
<> VALVE TIMING BELT REMOVAL

CAUTION

Never turn the crankshaft anti-clockwise.



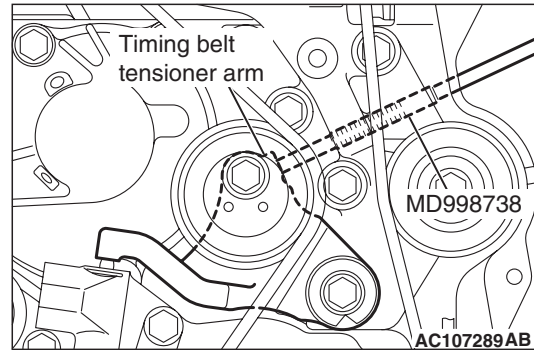
1. Turn the crankshaft clockwise, align each timing mark to set No.1 cylinder to TDC of its compression stroke.



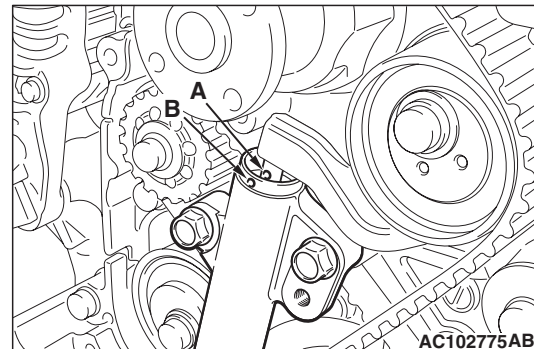
2. Remove the timing belt under cover rubber plug and then set the special tool adjusting bolt (MD998738).

CAUTION

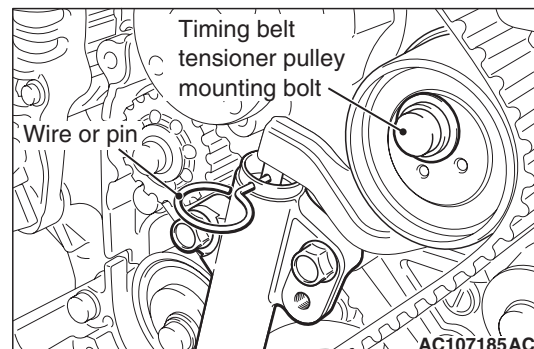
The special tool can be gradually installed at a rate of a 30 degree turn per second. If it is screwed in all at once, the timing belt tensioner adjuster rod will not easily retract and the special tool may bend.



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 adjuster 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.

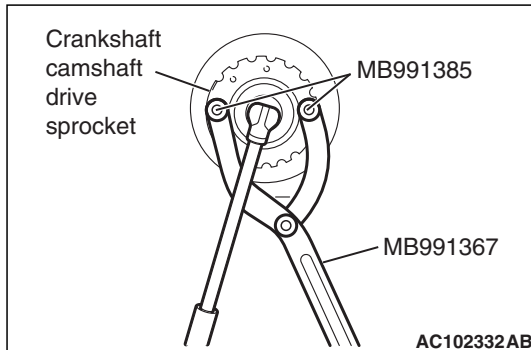
6. After removal of adjusting bolt special tool, loosen the timing belt tensioner pulley mounting bolt and remove the valve timing belt.

<<C>> 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.

<<D>> 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.

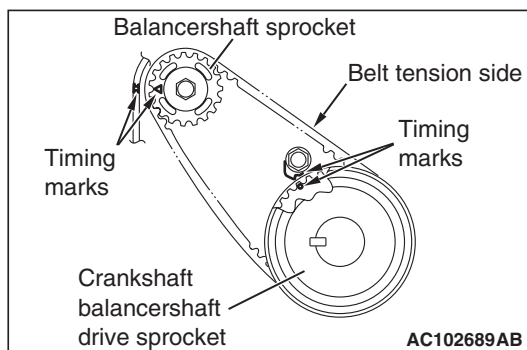
<<E>> BALANCER TIMING BELT REMOVAL

⚠ CAUTION

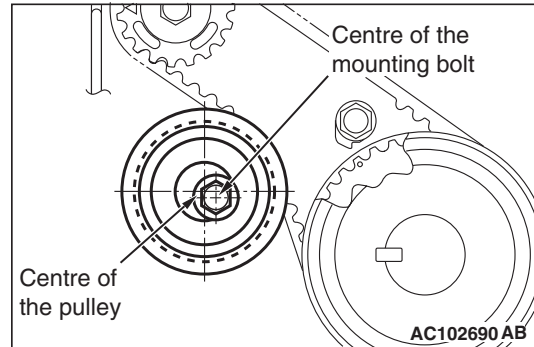
To reuse the balancer timing belt, draw an arrow indicating the rotating direction (clockwise) on the back of the belt using chalk.

INSTALLATION SERVICE POINTS

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



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

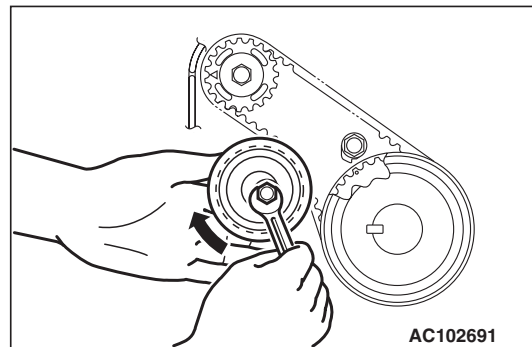


3. Assemble and temporarily fix the centre of the pulley of the balancer timing belt tensioner so that it is at the top left from the centre of the mounting bolt, and the pulley flange is at the front-side of the engine.
4. Adjust the balancer timing belt tension.

>>B<< BALANCER TIMING BELT TENSION ADJUSTMENT

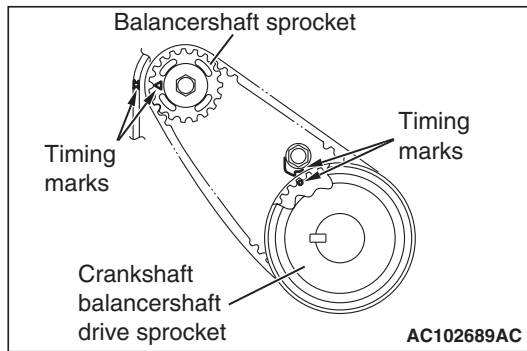
⚠ CAUTION

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.

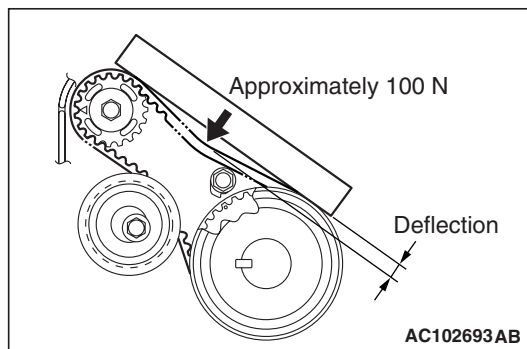


1. With your fingers, lift the balancer timing belt tensioner in the direction of the arrow. Apply pressure of $3.0 \pm 0.4 \text{ N}\cdot\text{m}$ to the balancer timing belt. Tighten the assembling bolt to the specified torque. Then, fix the balancer timing belt tensioner.

Tightening torque: $19 \pm 3 \text{ N}\cdot\text{m}$



- 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.



- 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.

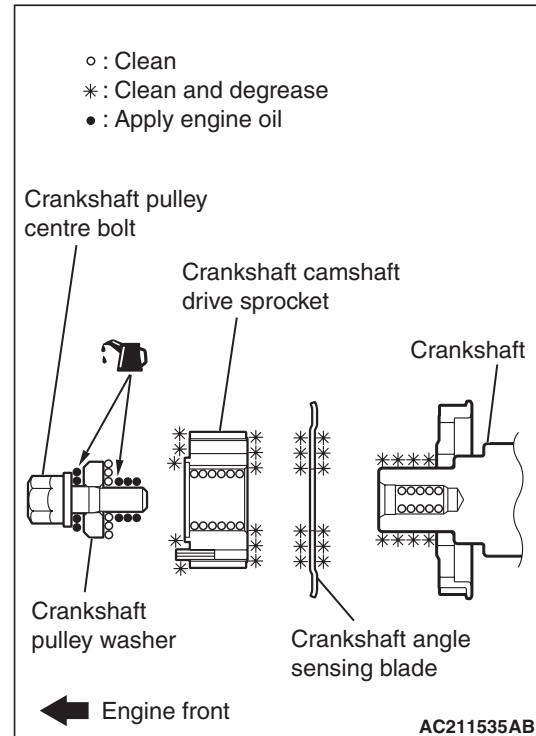
Standard value:

At adjustment: 5 – 7 mm

At replacement: 5 – 7 mm

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

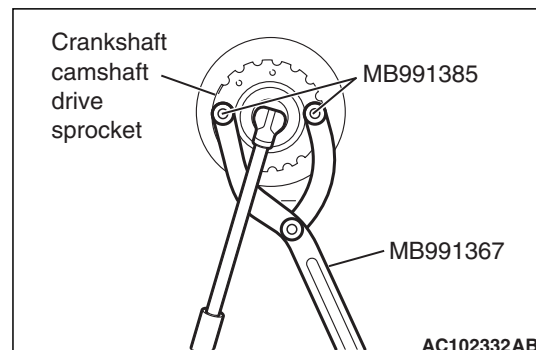
>>C<< CRANKSHAFT ANGLE SENSING BLADE/CRANKSHAFT CAMSHAFT DRIVE SPROCKET INSTALLATION



- 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.

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



- 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.

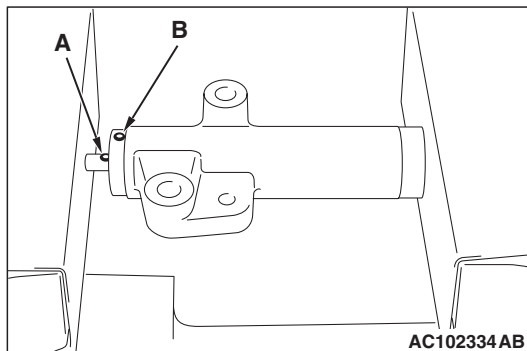
Tightening torque: 167 N·m

>>D<< TIMING BELT TENSIONER ADJUSTER INSTALLATION

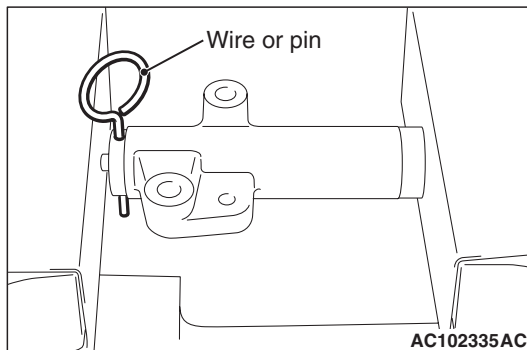
1. Install according to the following procedures when the timing belt tensioner adjuster rod is fully extended.

⚠ 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.



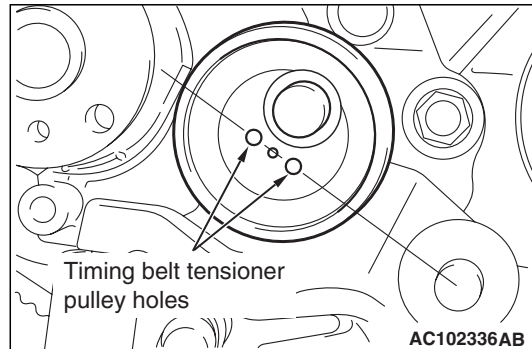
- (2) Insert a wire or pin into the aligned set hole.

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.

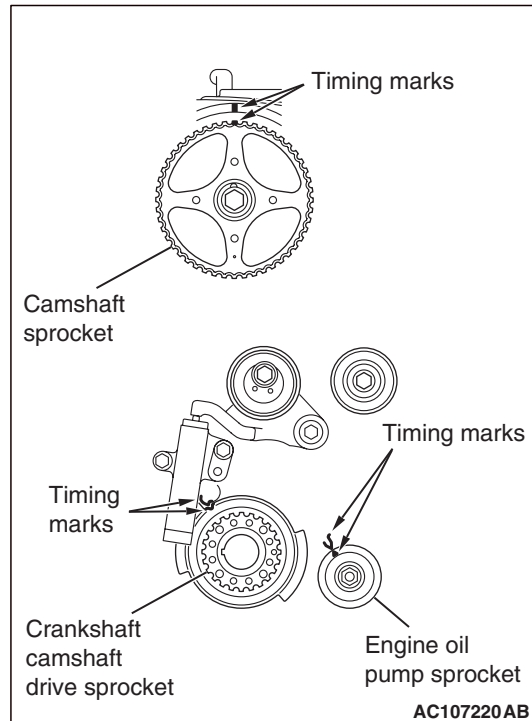
Tightening torque: 23 ± 3 N·m

>>E<< TIMING BELT TENSIONER PULLEY INSTALLATION

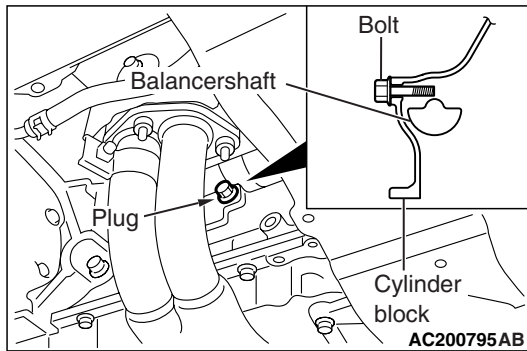


Temporarily tighten the timing belt tensioner pulley as shown.

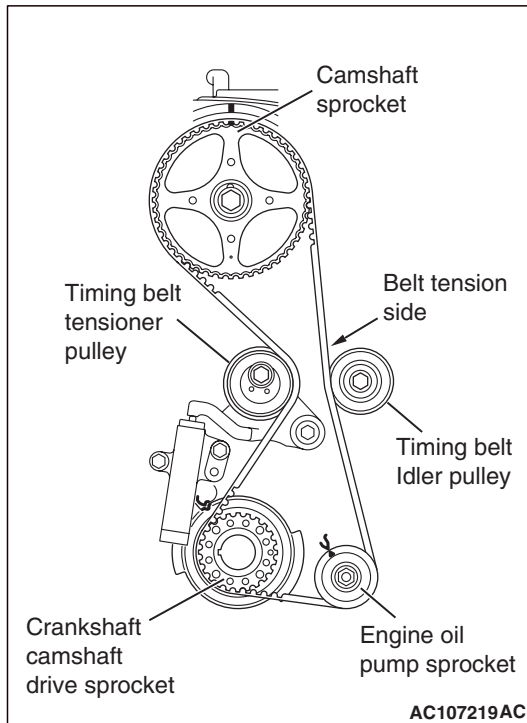
>>F<< VALVE TIMING BELT INSTALLATION



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, section width 10 mm, nominal length 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:



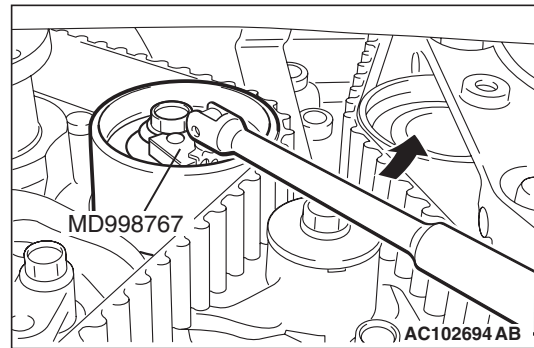
- (1) Place the valve timing belt on the timing belt tensioner pulley and crankshaft cam shaft driver sprocket. Support it with your hand so it does not slide.

- (2) Place the valve timing belt on the engine oil pump sprocket while pulling it with your other hand.
- (3) Place the valve timing belt on the timing belt idler pulley.

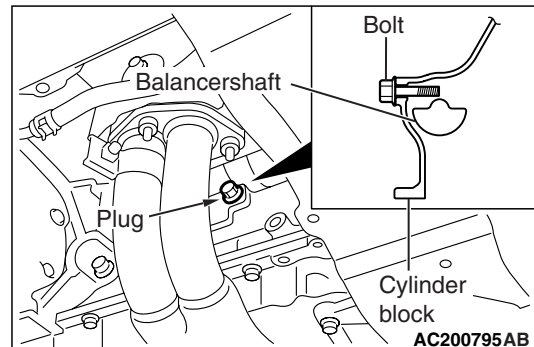
CAUTION

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

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



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.

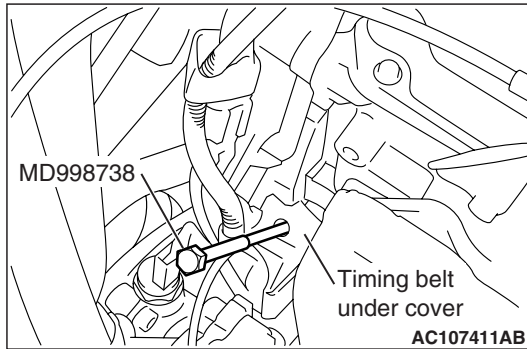


6. Remove the bolt inserted in Step 2 above, then assemble the cylinder block plug.
7. Tighten the cylinder block plug to the specified torque.

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.

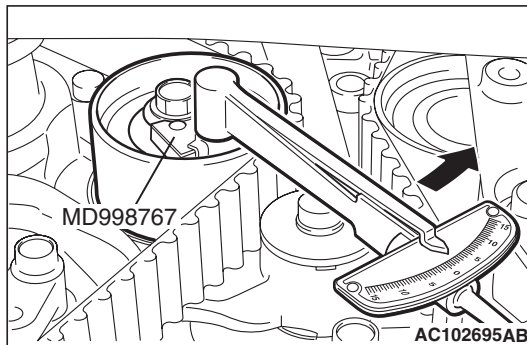
CAUTION

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.

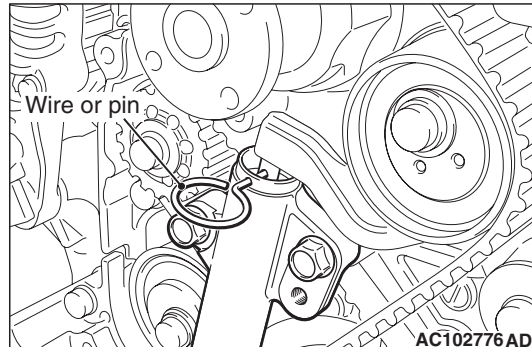
CAUTION

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.

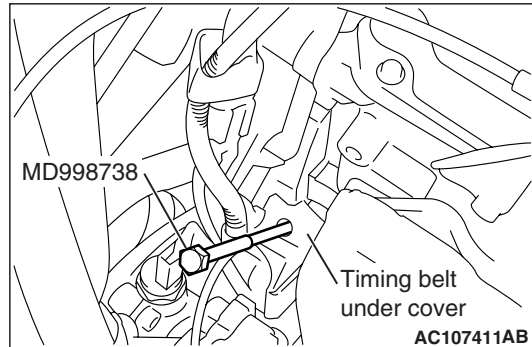


6. With special tool tensioner wrench (MD998767) and torque wrench, apply tension torque 3.5 N·m, and tighten the timing belt tensioner pulley mounting bolt to the specified torque.

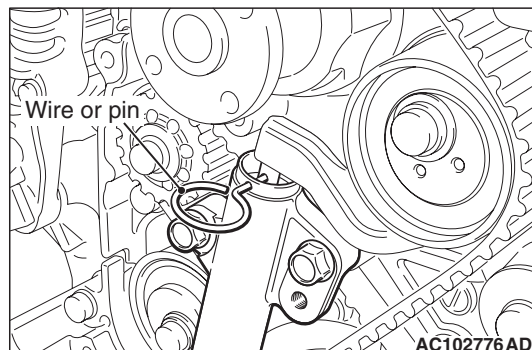
Tightening torque: 48 ± 5 N·m



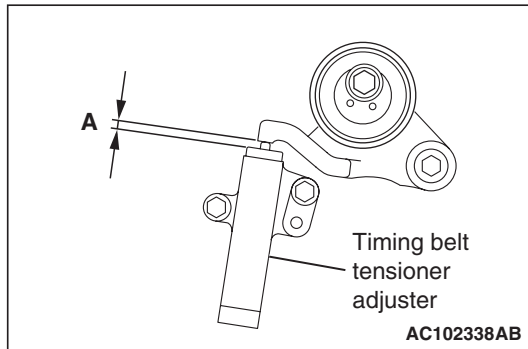
7. Remove wire or pin inserted to timing belt tensioner.



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.



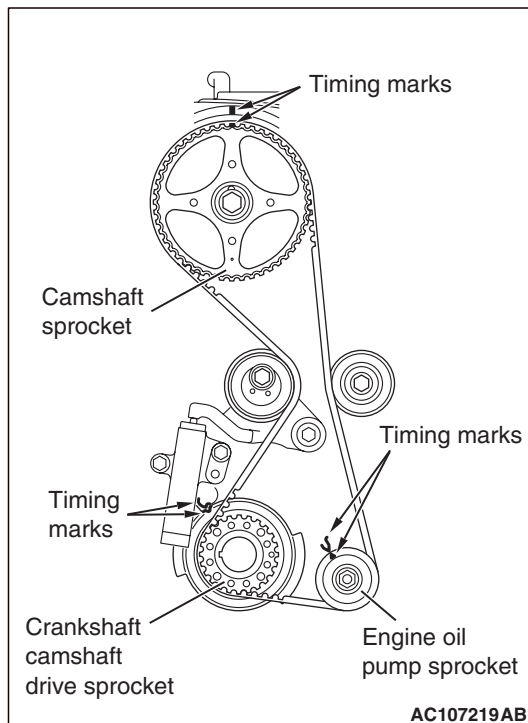
If the projection of timing belt tensioner adjuster rod is within the standard value, appropriate tension is applied.

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 crank shaft pulley centre bolt anti-clockwise. Re-tighten if it is loose.



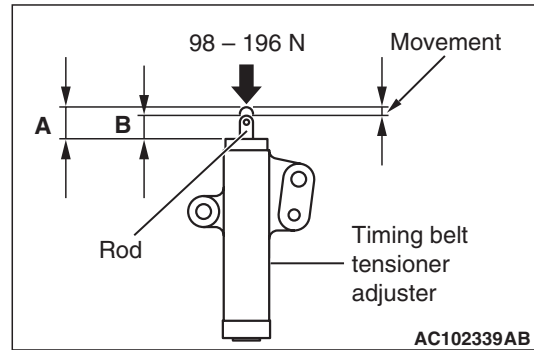
12. Check again that the timing marks on sprockets are aligned.

INSPECTION

M1112004400318

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)

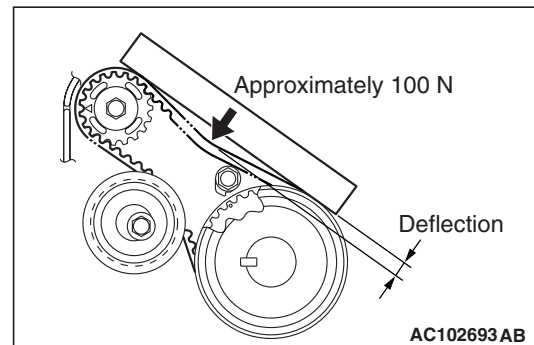
B: Length when it is pressed

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.11A-36](#)).

ENGINE ASSEMBLY

REMOVAL AND INSTALLATION

M1112001002254

CAUTION

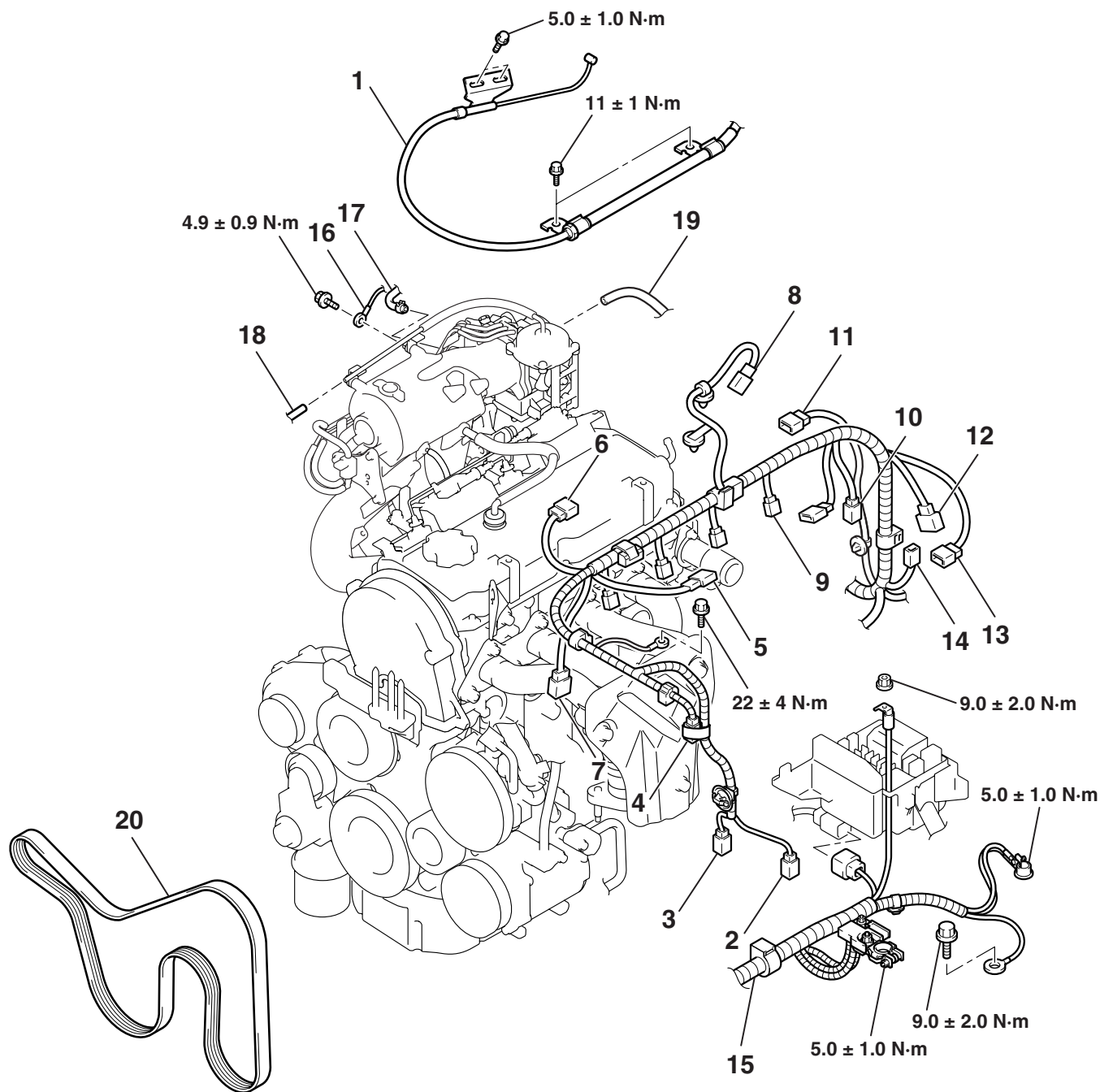
- When the engine assembly replacement is performed, use the M.U.T.-II/III to initialise the learning value (Refer to GROUP 00, Precautions Before Service – Initialisation Procedure for Learning Value in MPI Engine [P.00-25](#)).
- *: indicates parts which should be temporarily tightened, and then fully tightened with the engine weight applied on the vehicle body.

Pre-removal Operation

- Fuel Line Pressure Reduction [Refer to GROUP 13A, On-vehicle Service – Fuel Pump Connector Disconnection (How to Reduce Pressurized Fuel Lines) [P.13A-283](#).]
- Hood Removal (Refer to GROUP 42, Hood [P.42-4](#)).
- Under Cover Removal (Refer to GROUP 51, Under Cover [P.51-29](#)).
- Engine Oil Draining (Refer to GROUP 12, On-vehicle Service – Engine Oil Replacement [P.12-4](#)).
- Engine Coolant Draining (Refer to GROUP 14, On-vehicle Service – Engine Coolant Replacement [P.14-10](#)).
- Air Cleaner Removal (Refer to GROUP 15, Air Cleaner [P.15-3](#)).
- Battery and Battery Tray Removal
- Radiator Assembly Removal (Refer to GROUP 14, Radiator [P.14-22](#)).
- Front Exhaust Pipe Removal (Refer to GROUP 15, Exhaust Pipe and Main Muffler [P.15-13](#)).
- Starter Assembly Removal (Refer to GROUP 16, Starter Motor Assembly [P.16-21](#)).

Post-installation Operation

- Starter Assembly Installation (Refer to GROUP 16, Starter Motor Assembly [P.16-21](#)).
- Front Exhaust Pipe Installation (Refer to GROUP 15, Exhaust Pipe and Main Muffler [P.15-13](#)).
- Radiator Assembly Installation (Refer to GROUP 14, Radiator [P.14-22](#)).
- Battery and Battery Tray Installation
- Air Cleaner Installation (Refer to GROUP 15, Air Cleaner [P.15-3](#)).
- Engine Coolant Refilling (Refer to GROUP 14, On-vehicle Service – Engine Coolant Replacement [P.14-10](#)).
- Engine Oil Refilling (Refer to GROUP 12, On-vehicle Service – Engine Oil Replacement [P.12-4](#)).
- Accelerator Cable Adjustment (Refer to GROUP 17, On-vehicle Service – Accelerator Cable Check and Adjustment [P.17-7](#)).
- Drive Belt Tension Check (Refer to [P.11A-8](#)).
- Under Cover Installation (Refer to GROUP 51, Under Cover [P.51-29](#)).
- Hood Installation (Refer to GROUP 42, Hood [P.42-4](#)).
- Fuel Leak Check



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Removal steps

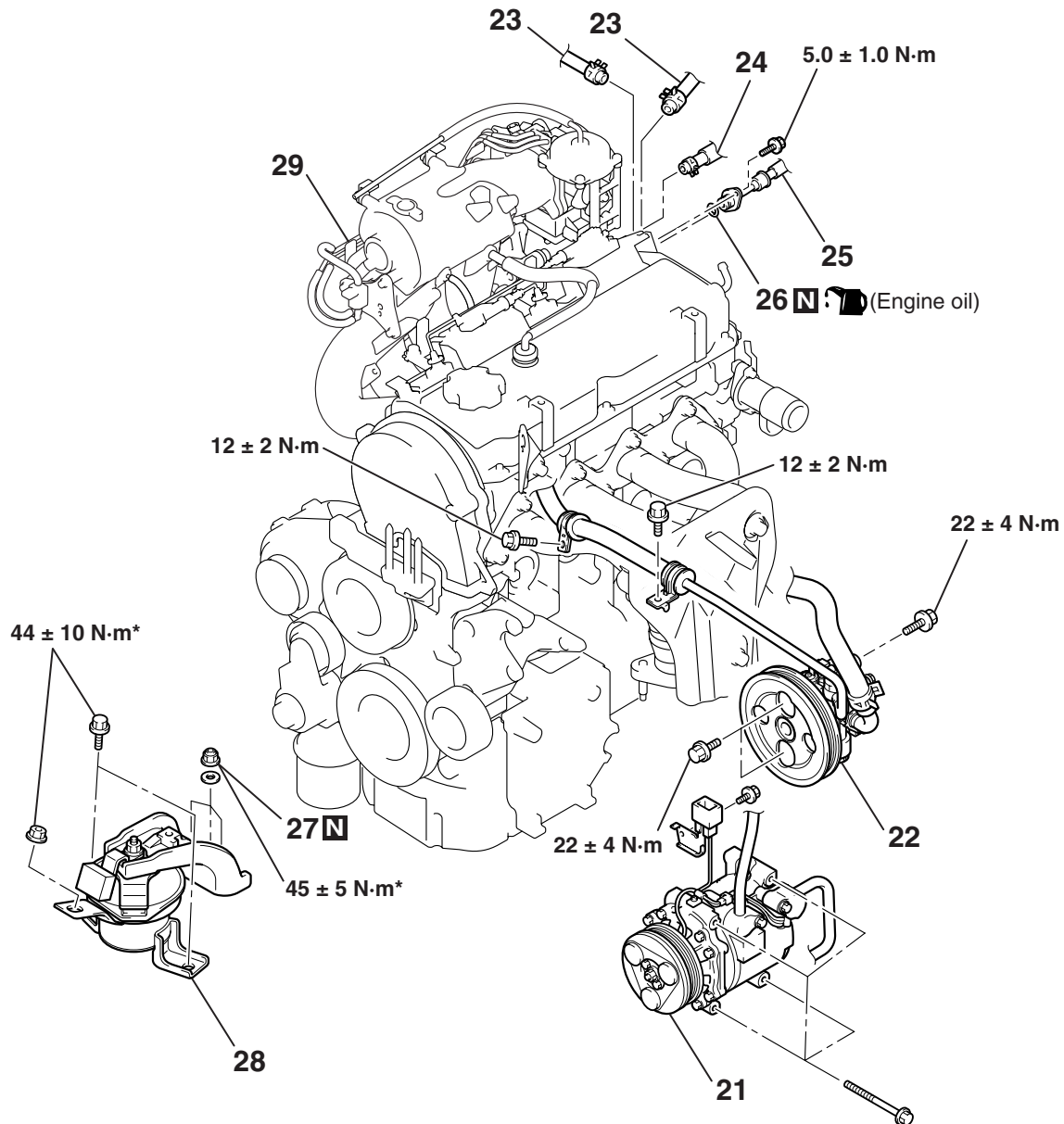
1. Accelerator cable connection
2. A/C compressor connector
3. Power steering oil pressure switch connector
4. Crank angle sensor connector
5. Ignition coil connectors
6. EGR control solenoid valve connector
7. Detonation sensor connector
8. Throttle position sensor connector
9. Injector connectors
10. Engine coolant temperature gauge unit connector
11. Idle speed control servo connector

Removal steps (Continued)

12. Camshaft position sensor connector
13. Engine coolant temperature sensor connector
14. Capacitor connector
15. Battery wiring harness connection
16. Earth cable connection
17. Brake booster vacuum hose connection
18. Auto-cruise control vacuum hose connection <Vehicles with auto-cruise control>
19. Canister vacuum hose connection
20. Drive belt

<<A>>

<>



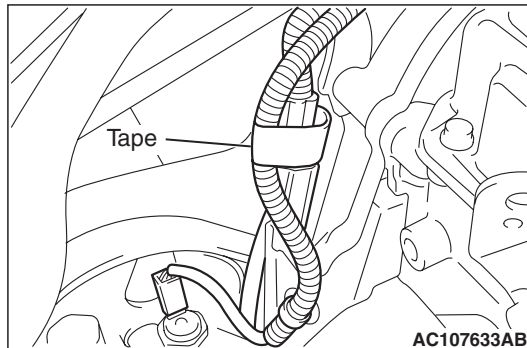
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(Continued)

- | | | | |
|-------|--|-------|-------------------------------------|
| <<C>> | 21. A/C compressor and clutch assembly | >>E<< | 26. O-ring |
| <<C>> | 22. Power steering oil pump assembly | <<D>> | >>D<< • Transmission assembly |
| <<C>> | 23. Heater water hoses connection | >>C<< | 27. Self-locking nuts |
| >>E<< | 24. Fuel return line hose connection | <<E>> | >>B<< 28. Engine mounting insulator |
| | 25. Fuel high-pressure hose connection | <<F>> | >>A<< 29. Engine assembly |

REMOVAL SERVICE POINTS

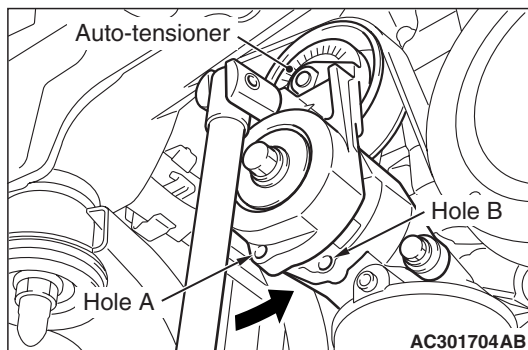
<<A>> CRANK ANGLE SENSOR CONNECTOR REMOVAL

CAUTION

Do not remove the tape securing the crank angle sensor connector and control wiring harness, since the control wiring harness may contact the power steering oil pump pulley.

<> DRIVE BELT REMOVAL

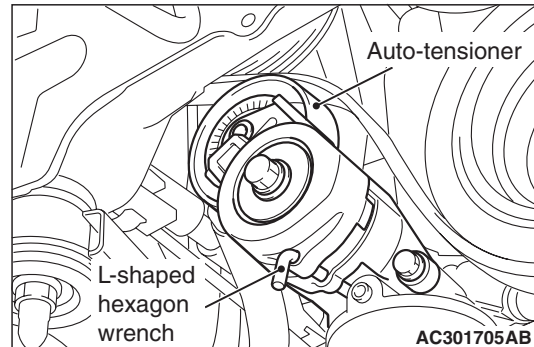
The following operations will be needed due to the introduction of the serpentine drive system with the drive belt auto-tensioner.



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

CAUTION

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

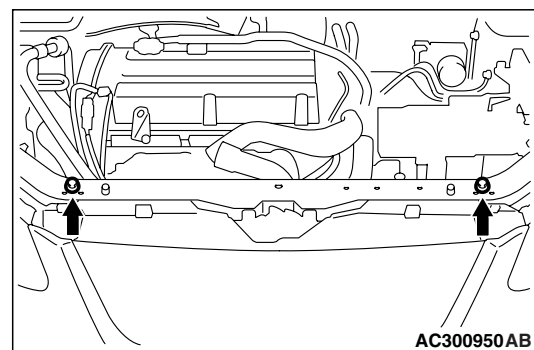


3. Insert an L-shaped hexagon wrench, etc. into the hole to fix and then remove the drive belt.

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

1. With the hose installed, remove the A/C compressor and clutch assembly, and power steering oil pump assembly from the bracket.
2. 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.

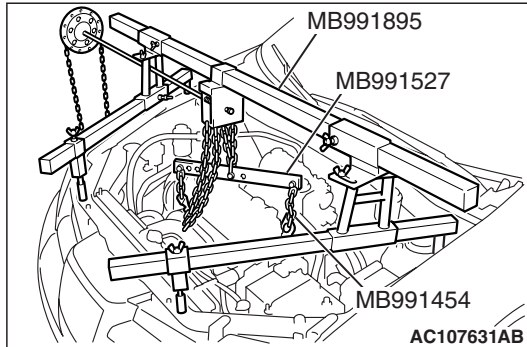
<<D>> TRANSMISSION ASSEMBLY REMOVAL



1. Pre-tighten the 2 bolts on the car 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 23A, Transmission Assembly [P.23A-139](#)).

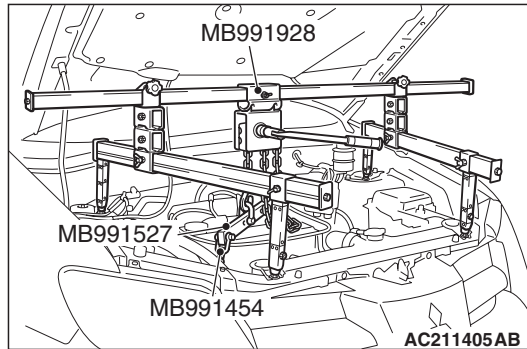
<<E>> ENGINE MOUNTING INSULATOR REMOVAL

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



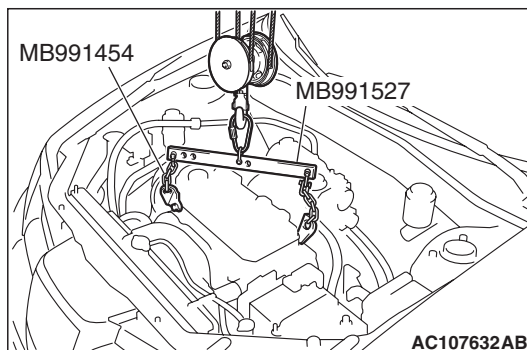
- (1) <Special tool engine hanger (MB991895) is used>

Remove special tool MB991895.



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

Remove special tool MB991928.



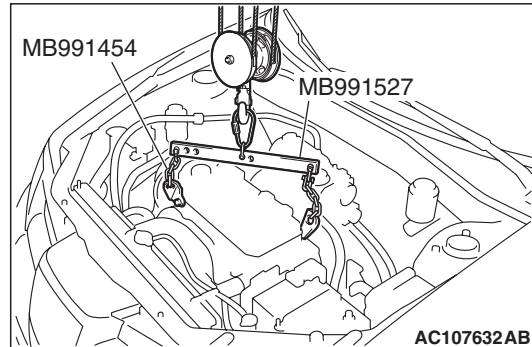
3. Hold the engine assembly with a chain block, etc.
4. Place a garage jack against the engine oil pan with a piece of wood in between so that the weight of the engine assembly is no longer being applied to the engine mounting insulator.
5. Loosen the engine mounting insulator mounting nuts and bolt,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

<<F>> 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

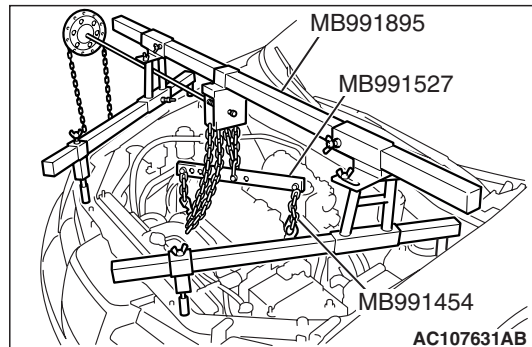
>>A<< ENGINE ASSEMBLY INSTALLATION



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

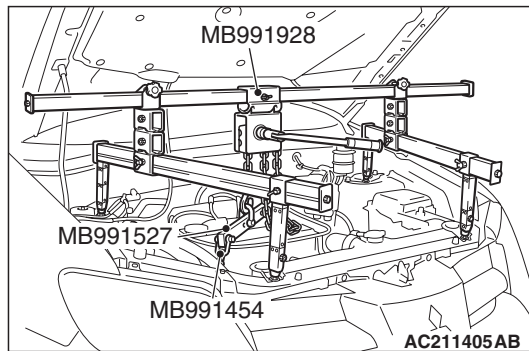
>>B<< ENGINE MOUNTING INSULATOR INSTALLATION

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 23A, Transmission Assembly P.23A-139).



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

Set special tool MB991928. (Refer to GROUP 23A, Transmission Assembly P.23A-139).

>>C<< SELF-LOCKING NUTS INSTALLATION

⚠ CAUTION

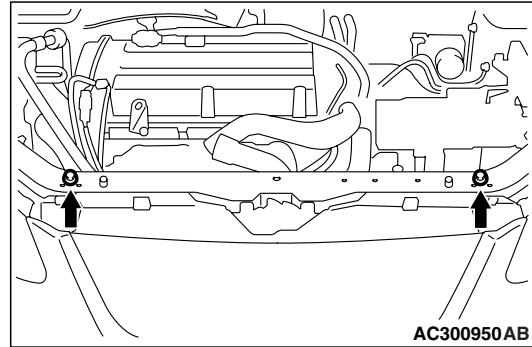
Do not tighten the self-locking nuts while the engine is hot.

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 23A, Transmission Assembly P.23A-139).



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

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

⚠ CAUTION

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

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