ENGINE
<4G9-MPI>

Click on the applicable bookmark to selected the required model year

ENGINE
<4G9-MPI>

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GENERAL

OUTLINE OF CHANGE

The following contents have been established to correspond to the addition of vehicles with 4G9-MPI engine.

GENERAL INFORMATION

Items			Specification
Total displacement mL			1,834
Bore × Stroke mm			81.0 × 89.0
Compression ratio			10.0
Combustion chamber			Pentroof type
Camshaft arrangement			SOHC
Number of valve	Intake		8
	Exhaust		8
Valve timing	Intake	Opening	BTDC 14°
		Closing	ABDC 50°
	Exhaust	Opening	BBDC 58°
		Closing	ATDC 10°
Fuel system			Electronically controlled multipoint fuel injection
Rocker arm			Roller type
Auto-lash adjuster			Equipped

SERVICE SPECIFICATIONS

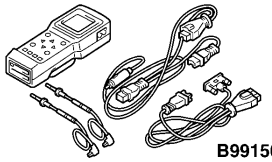
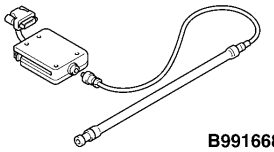
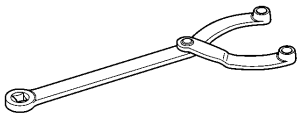
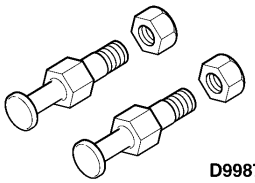
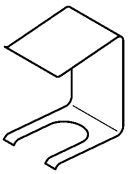
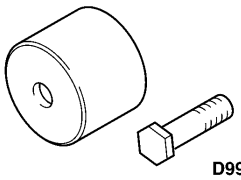
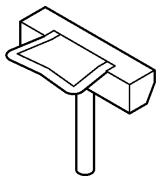
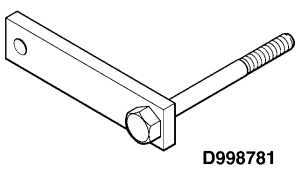
Items		Standard value	Limit
Alternator drive belt tension (When checked)	Vibration frequency Hz	143 – 185	–
	Tension N	294 – 490	–
	Deflection (Reference) mm	9.7 – 12.9	–
Alternator drive belt tension (When adjusted)	Vibration frequency Hz	155 – 175	–
	Tension N	343 – 441	–
	Deflection (Reference) mm	10.5 – 12.0	–
Alternator drive belt tension (When replaced)	Vibration frequency Hz	203 – 234	–
	Tension N	588 – 784	–
	Deflection (Reference) mm	6.7 – 8.5	–

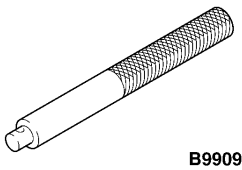
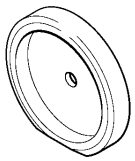
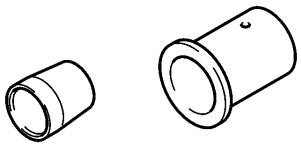
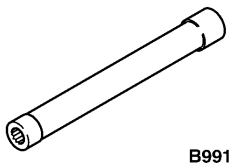
Items		Standard value	Limit
Power steering oil pump drive belt tension <Vehicles without A/C>, power steering oil pump and A/C compressor drive belt tension <Vehicles with A/C> (When checked)	Vibration frequency Hz	114 – 139	–
	Tension N	392 – 588	–
	Deflection (Reference) mm	10.0 – 12.0	–
Power steering oil pump drive belt tension <Vehicles without A/C>, power steering oil pump and A/C compressor drive belt tension <Vehicles with A/C> (When adjusted)	Vibration frequency Hz	121 – 133	–
	Tension N	441 – 539	–
	Deflection (Reference) mm	10.0 – 11.0	–
Power steering oil pump drive belt tension <Vehicles without A/C>, power steering oil pump and A/C compressor drive belt tension <Vehicles with A/C> (When replaced)	Vibration frequency Hz	145 – 166	–
	Tension N	637 – 833	–
	Deflection (Reference) mm	7.0 – 9.0	–
Basic ignition timing		5°BTDC ± 3°	–
Ignition timing		approx. 5°BTDC	–
Idle speed r/min		700 ± 100	–
CO contents %		0.1 or less	–
HC contents ppm		100 or less	–
Compression pressure (250 r/min) kPa		1370	Min. 1039
Compression pressure difference of all cylinder kPa		–	Max. 100
Intake manifold vacuum kPa		–	Min. 60
Cylinder head bolt shank length mm		–	96.4

SEALANTS

Items	Specified Sealants	Remarks
Camshaft position sensor support	MITSUBISHI GENUINE PART MD970389 or equivalent	Semi-drying sealant
Oil pan		
Flywheel bolt <M/T>	3M Stud Locking 4170 or equivalent	–
Drive plate bolt <A/T>		

SPECIAL TOOLS

Tool	Number	Name	Use
 B991502	MB991502	MUT-II sub assembly	• Engine idle speed check • Basic ignition timing check • Drive belt tension measurement
 B991668	MB991668	Belt tension meter set	Drive belt tension measurement (used together with MUT-II)
 B990767	MB990767	Front hub and flange yoke holder	• Holding the crankshaft sprocket • Holding the camshaft sprocket
 D998719	MD998719	Pin	
 D998443	MD998443	Auto lash adjuster holder	Holding the lash adjuster
 D998713	MD998713	Camshaft oil seal installer	Press-in of the camshaft oil seal
 D998727	MD998727	Oil pan cutter	Removal of oil pan
 D998781	MD998781	Flywheel stopper	Securing the flywheel <M/T> or drive plate <A/T>

Tool	Number	Name	Use
 B990938	MB990938	Installer bar	Press-in of the crankshaft rear oil seal
 D998776	MD998776	Crankshaft rear oil seal installer	
 D998717	MD998717	Crankshaft front oil seal installer	Press-in of the crankshaft front oil seal
 B991653	MB991653	Cylinder head bolt wrench	Cylinder head bolt removal and installation

ON-VEHICLE SERVICE

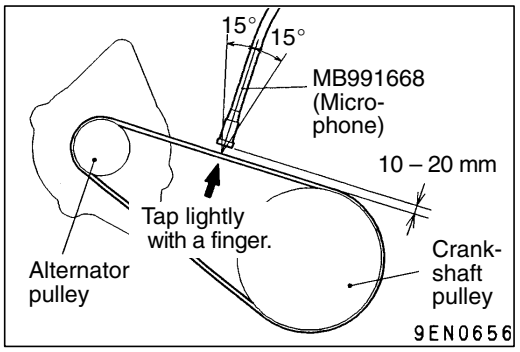
DRIVE BELT TENSION CHECK AND ADJUSTMENT

ALTERNATOR DRIVE BELT TENSION CHECK

Check the drive belt tension by the following procedure.

Standard value:

Vibration frequency Hz	143 – 185
Tension N	294 – 490
Deflection (Reference) mm	9.7 – 12.9

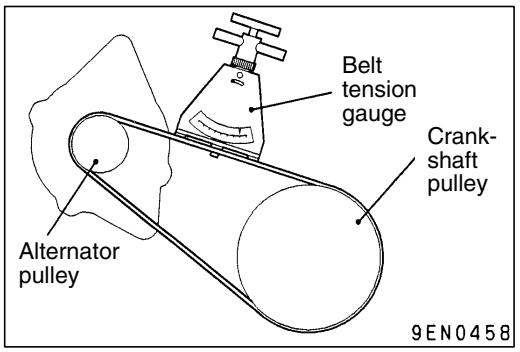


<When using the MUT-II>

1. Connect the special tool (MB991668) to the MUT-II.
2. Connect the MUT-II to the diagnosis connector.
3. Turn the ignition switch to ON and select "Belt Tension Measurement" from the menu screen.
4. Hold the microphone to the middle of the drive belt between the pulleys (at the place indicated by the arrow), about 10 – 20 mm away from the rear surface of the belt and so that it is perpendicular to the belt (within an angle of ± 15°).
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 check that the vibration frequency of the belt is within the standard value.

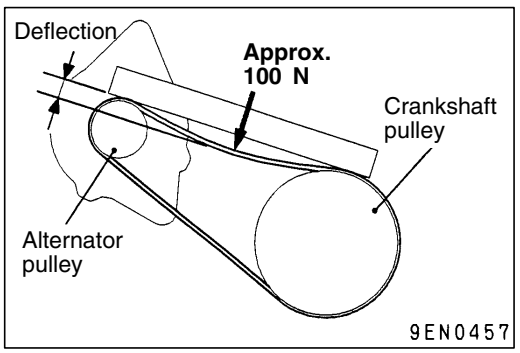
Caution

(1) The temperature of the surface of the belt should be as close as possible to normal temperature.
(2) Do not let any contaminants such as water or oil get onto the microphone.
(3) 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.
(4) 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.
(5) Do not take the measurement while the vehicle's engine is running.



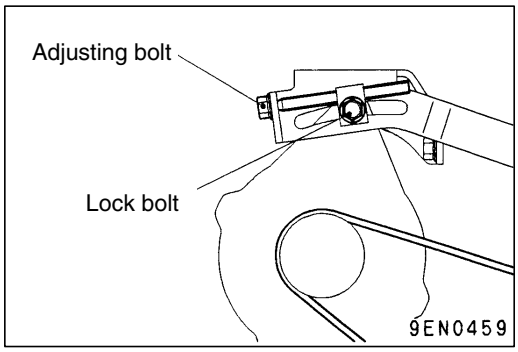
<When using a tension gauge>

Use a belt tension gauge to check that the belt tension is within the standard value.



<Belt deflection check>

Apply approx. 100 N of force to the middle of the drive belt between the pulleys (at the place indicated by the arrow) and check that the amount of deflection is within the standard value.



ALTERNATOR DRIVE BELT TENSION ADJUSTMENT

1. Loosen the nut of the alternator pivot bolt.
2. Loosen the lock bolt.
3. Use the adjusting bolt to adjust the belt tension and belt deflection to the standard values.

Standard value:

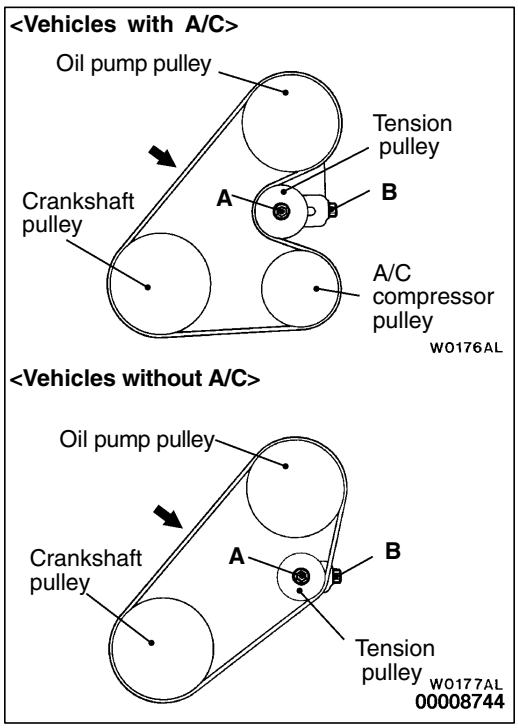
Items	When adjusted	When replaced
Vibration frequency Hz	155 – 175	203 – 234
Tension N	343 – 441	588 – 784
Deflection (Reference) mm	10.5 – 12.0	6.7 – 8.5

4. Tighten the nut of the alternator pivot bolt.

   Tightening torque: 44 ± 10 N·m
5. Tighten the lock bolt.

   Tightening torque: 23 ± 2 N·m
6. Tighten the adjusting bolt.

   Tightening torque: 5.0 ± 1.0 N·m



POWER STEERING OIL PUMP DRIVE BELT <Vehicles without A/C>, POWER STEERING OIL PUMP AND A/C COMPRESSOR DRIVE BELT <Vehicles with A/C> TENSION CHECK AND ADJUSTMENT

1. Check if the belt tension is within the standard value using one of the methods below.

Standard value:

Items	When checked	When adjusted	When replaced
Vibration frequency Hz	114 – 139	121 – 133	145 – 166
Tension N	392 – 588	441 – 539	637 – 833
Deflection (Reference) mm	10.0 – 12.0	10.0 – 11.0	7.0 – 9.0

<When measuring the vibration frequency>

With your finger tip lightly tap the centre of the belt between the pulleys in the location shown by the arrow in the illustration and then measure the belt vibration frequency.

NOTE
Refer to P.11B-6 for information regarding the vibration frequency measurement method using MUT-II.

<When measuring the tension>

Use a belt tension gauge to measure the belt tension.

<When measuring the deflection>

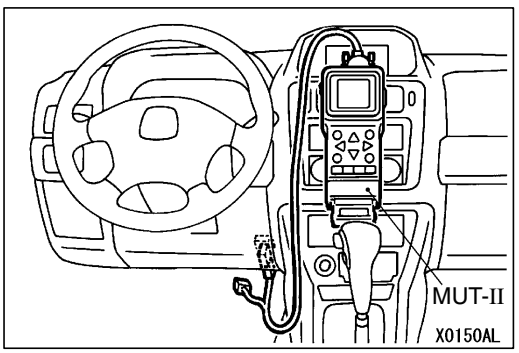
Apply approx. 100 N of pressure against the location between the pulleys shown by the arrow in the illustration and then measure the deflection.

2. If the tension or deflection is outside the standard value, adjust by the following procedure.
   (1) Loosen tensioner pulley fixing nut A.
   (2) Adjust the amount of belt deflection using adjusting bolt B.
   (3) Tighten fixing nut A.

   Tightening torque: 26 ± 4 N·m

   (4) Check the belt deflection amount and tension, and readjust if necessary.

   Caution
   Check after turning the crankshaft once or more clockwise (right turn).



IGNITION TIMING CHECK

1. Before inspection, set the vehicle to the pre-inspection condition.
2. Turn the ignition switch to LOCK (OFF) position, and then connect the MUT-II to the diagnosis connector.
3. Set up a timing light.
4. Start the engine and run at idle.
5. Check that engine idle speed is within the standard value.

   Standard value: approx. 700 r/min

6. Select No.17 of the MUT-II 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 while referring to GROUP 13C – Troubleshooting.
9. Press the MUT-II clear key (Select a forced driving cancel mode) to release the Actuator test.

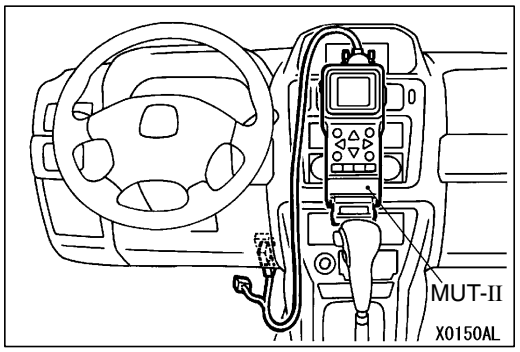
   Caution
   If the test is not cancelled, a forced driving will continue for 27 minutes. Driving under this condition may damage the engine.

10. Check that ignition timing is at the standard value.

    Standard value: approx. 10°BTDC

    NOTE
    (1) Ignition timing is variable within about ± 7°, even under normal operating.
    (2) And it is automatically further advanced by about 5° from standard value at higher altitudes.

11. Remove the timing light.
12. Turn the ignition switch to LOCK (OFF) position, and then remove the MUT-II.



IDLE SPEED CHECK

1. Before inspection, set the vehicle to the pre-inspection condition.
2. Turn the ignition switch to LOCK (OFF) position, and then connect the MUT-II to the diagnosis connector.
3. Set up the timing light.
4. Check the ignition timing is within the standard value.

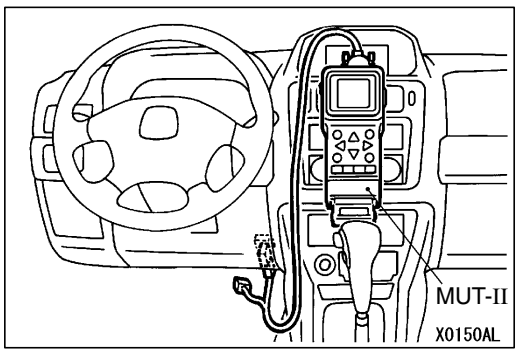
   Standard value: approx. 5° BTDC

5. Run the engine at idle for 2 minutes.
6. Check the idle speed. Select item No. 22 and take a reading of the idle speed.

   Curb idle speed: 700 ± 100 r/min

   NOTE
   The idle speed is controlled automatically by the idle speed control (ISC) system.

7. If the idle speed is outside the standard value, check the MPI components by referring to GROUP 13C – Troubleshooting.
8. Remove the timing light.
9. Turn the ignition switch to the LOCK (OFF) position, and then remove the MUT-II.



IDLE MIXTURE CHECK

1. Before inspection, set the vehicle to the pre-inspection condition.
2. Turn the ignition switch to LOCK (OFF) position, and then connect the MUT-II to the diagnosis connector.
3. Set up the timing light.
4. Check that the ignition timing is within the standard value.

   Standard value: approx. 5° BTDC

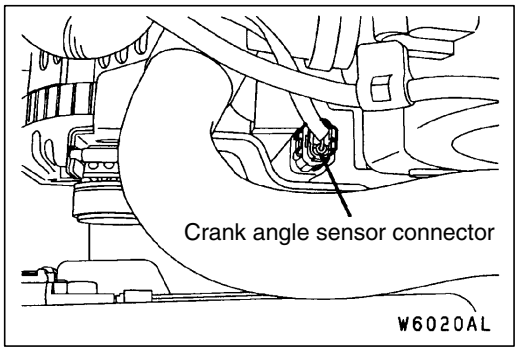
5. Run the engine at 2,500 r/min for 2 minutes.
6. Set the CO, HC tester.
7. Check the CO contents and the HC contents at idle.

   Standard value
   CO contents: 0.1 % or less
   HC contents: 100 ppm or less

8. If there is a deviation from the standard value, check the following items:
   - Diagnosis output
   - Closed-loop control (When the closed-loop control is normal, the output signal of the oxygen sensor changes between 0 – 400 mV and 600 – 1,000 mV at idle.)
   - Fuel pressure
   - Injector
   - Ignition coil, spark plug cable, spark plug
   - Evaporative emission control system
   - Compression pressure

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

9. Remove the timing light.
10. Turn the ignition switch to the LOCK (OFF) position, and then remove the MUT-II.



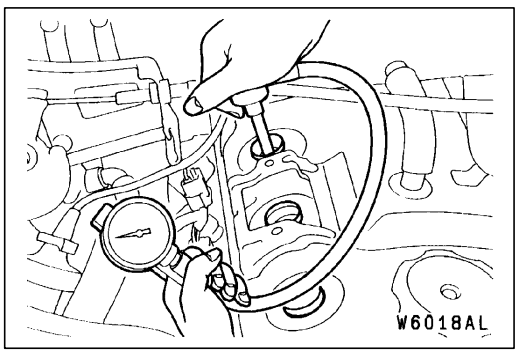
COMPRESSION PRESSURE CHECK

1. Before inspection, set the vehicle to the pre-inspection condition.
2. Disconnect the ignition coil and spark plug cables.
3. Remove all of the spark plugs.
4. Disconnect the crank angle sensor connector.

   NOTE
   Doing this will prevent the engine-ECU from carrying out ignition and fuel injection.

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.

   Caution
   (1) Keep away from the spark plug hole when cranking.
   (2) 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.



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): 1370 kPa

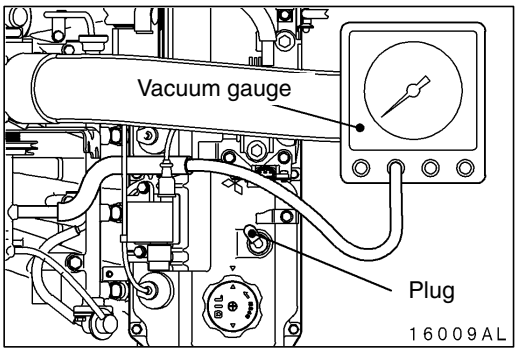
   Limit (at engine speed of 250 r/min): min. 1039 kPa

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

   Limit: max. 100 kPa

9. If there is a cylinder with compression or a compression difference that is outside the limit, pour a small amount of engine oil through the spark plug hole, and repeat the operations in steps from (6) to (8).
   (1) If the compression increases after oil is added, the cause of the malfunction is a worn or damaged piston ring and/or cylinder inner surface.
   (2) If the compression does not rise after oil is added, the cause is a burnt or defective valve seat, or pressure is leaking from the gasket.
10. Connect the crank angle sensor connector.
11. Install the spark plugs.
12. Install the ignition coils and spark plug cables.
13. Use the MUT-II to erase the diagnosis codes.

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

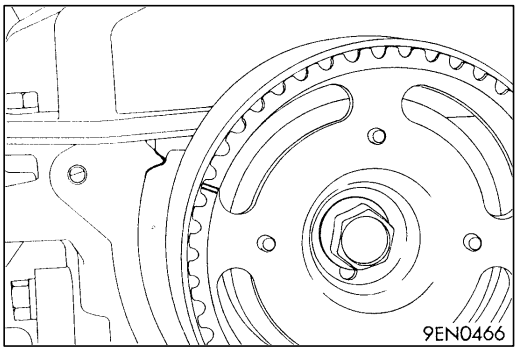


MANIFOLD VACUUM CHECK

1. Before inspection, set the vehicle to the pre-inspection condition.
2. Turn the ignition switch to LOCK (OFF) position.
3. Connect the engine tachometer or connect the MUT-II to the diagnosis connector.
4. Disconnect the ventilation hose from the positive crankcase ventilation (PCV) valve, and then connect a vacuum gauge to the ventilation hose. Plug the positive crankcase ventilation (PCV) valve.
5. Check the intake manifold vacuum while the engine is idling.

   Limit: Min. 60 kPa

6. Turn the ignition switch to LOCK (OFF) position.
7. Remove the vacuum gauge, and then connect the ventilation hose to the positive crankcase ventilation (PCV) valve.
8. Remove the engine tachometer or the MUT-II.



TIMING BELT TENSION ADJUSTMENT

1. Remove the timing belt upper cover.
2. Turn the crankshaft clockwise to set the No. 1 cylinder to top dead compression centre.

   Caution
   As the purpose of this procedure is to apply the proper amount of tension to the timing belt by means of the cam drive torque, be sure not to rotate the crankshaft in the opposite direction.

3. Remove the access cover.
4. Loosen the timing belt tensioner fixing bolt to apply tension to the belt by means of the force of the tensioner spring.

   Caution
   The bolt can be loosened 90° – 180°.
   If the belt is loosened more than necessary, the bolt may fall inside the cover.

5. Tighten the timing belt tensioner fixing bolt.
6. Install the access cover.
7. Install the timing belt upper cover.

LASH ADJUSTER CHECK

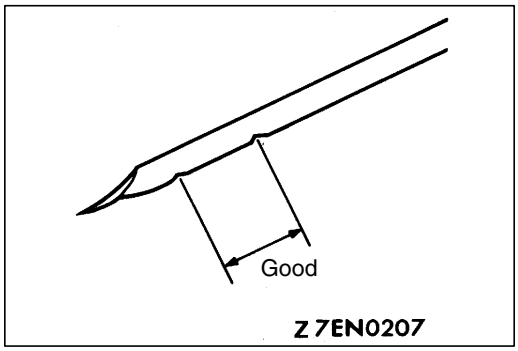
If an abnormal noise (knocking) that seems to be coming from the lash adjuster is heard after starting the engine and does not stop, carry out the following check.

NOTE
(1) 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.
(2) 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 → 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 the Engine Workshop Manual.) If not improved, go to step 5.
5. Bleed air from the lash adjusters.
6. If the noise has not disappeared even after the air bleeding, clean the lash adjusters. (Refer to the Engine Workshop Manual.)

<LASH ADJUSTER AIR BLEEDING>

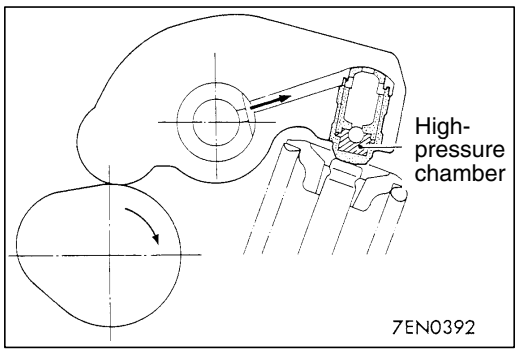
NOTE
(1) If the vehicle is parked on a slope for a long period of time, the amount of oil inside the lash adjuster will decrease, and air may get into the high pressure chamber when starting the engine.
(2) After parking the vehicle for long periods, the oil drains out of the oil passage, and it takes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



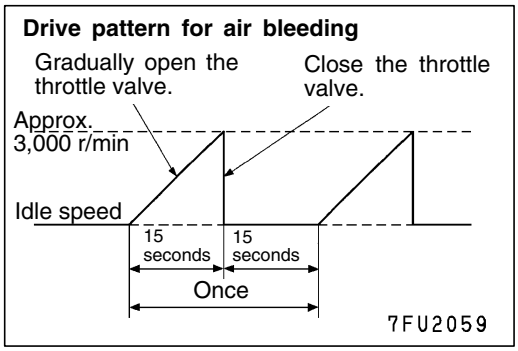
1. Check the engine oil and replenish or replace the oil if necessary.

NOTE
(1) If there is a only small amount of oil, air will be drawn in through the oil screen and will get into the oil passage.
(2) If the amount of oil is greater than normal, then the oil will being mixed by the crankshaft and a large amount of air may get mixed into the oil.

(3) 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.



(4) 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 closes. 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.

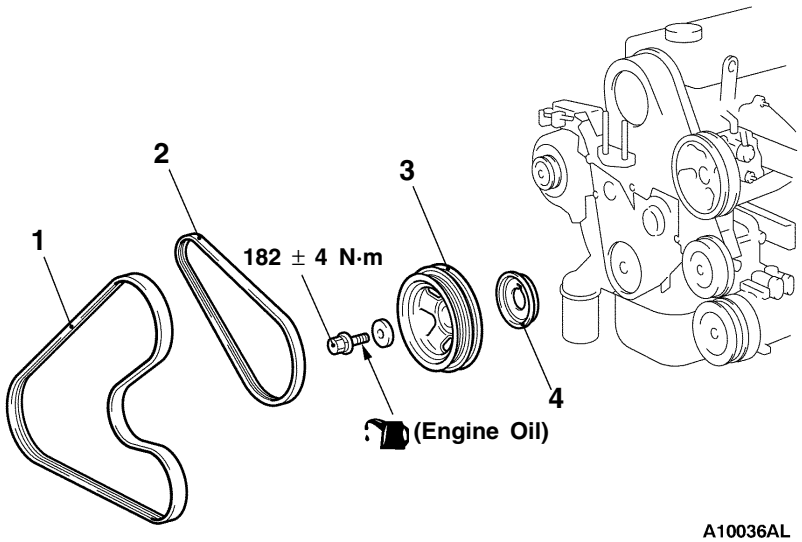


2. Run the engine at idle for 1 – 3 minutes to let it warm up.
3. With no load on the engine, repeat the drive pattern shown in the illustration at left and check if the abnormal noise disappears. (The noise should normally disappear after 10 – 30 repetitions, but if there is no change in the noise level 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

Pre-removal and Post-installation Operation
- Under Cover Removal and Installation
- Drive Belt Tension Adjustment (Refer to P.11B-5.) <only after installation>

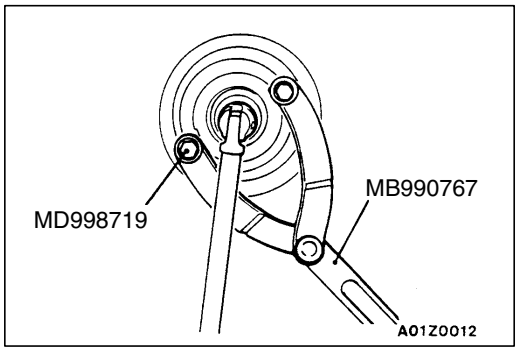


Removal steps

1. Power steering oil pump drive belt <Vehicles without A/C>, Power steering oil pump and A/C compressor drive belt <Vehicles with A/C>

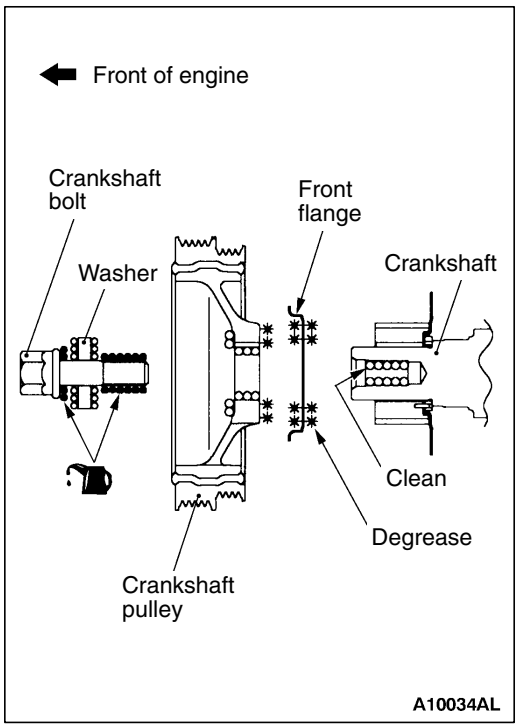
◀A▶ ▶A◀ ▶A◀

2. Alternator drive belt
3. Crankshaft pulley
4. Front flange



REMOVAL SERVICE POINT

◀A▶ CRANKSHAFT PULLEY REMOVAL



INSTALLATION SERVICE POINT

▶A◀ FRONT FLANGE/CRANKSHAFT PULLEY INSTALLATION

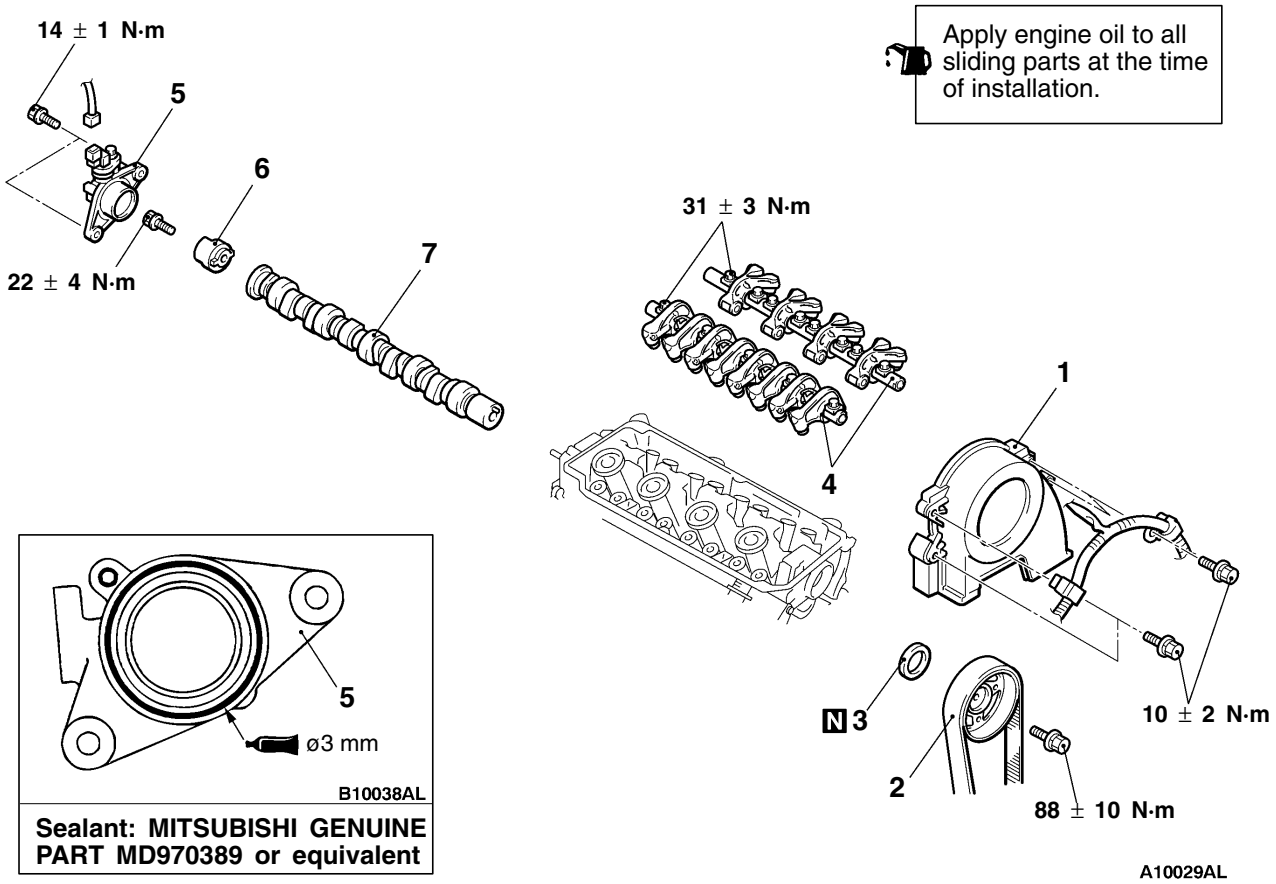
1. Clean and then degrease the front flange contacting surface of the crankshaft pulley.

   NOTE
   Degreasing is necessary to prevent decrease in the friction between contacting surfaces.
2. Clean the bolt hole in the crankshaft, the crankshaft contacting surface and washer contacting surface of the crankshaft pulley, and the washer.
3. Apply an appropriately small amount of oil to the threads and seating surface of the crankshaft bolt.
4. Use the special tools to stop the crankshaft pulley from turning in the same way as was done during removal, and then tighten the crankshaft bolt to the specified torque.

   Tightening torque: 182 ± 4 N·m

CAMSHAFT AND CAMSHAFT OIL SEAL

REMOVAL AND INSTALLATION



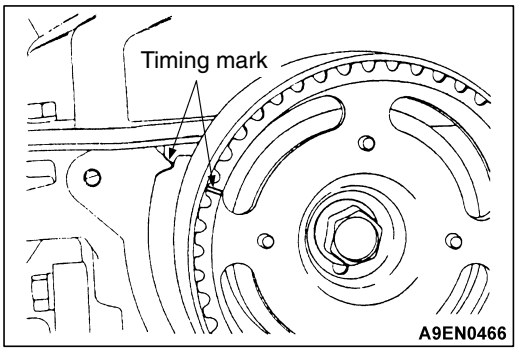
Camshaft oil seal removal steps

◀A▶ ▶D◀ 1. Timing belt upper cover
2. Camshaft sprocket and timing belt assembly
▶C◀ 3. Camshaft oil seal

Camshaft removal steps

- Cylinder head assembly (Refer to P.11B-25.)

◀B▶ ▶B◀ 4. Lash adjuster, rocker arm and shaft assembly
▶A◀ 5. Camshaft position sensor support
6. Camshaft position sensing cylinder
7. Camshaft

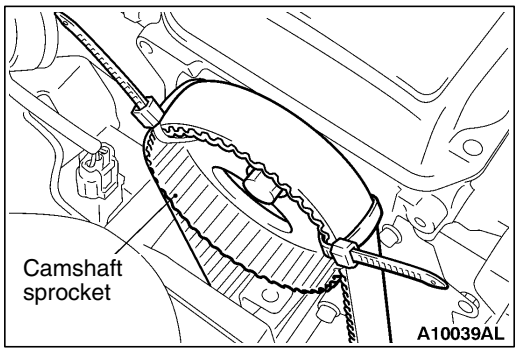


REMOVAL SERVICE POINTS

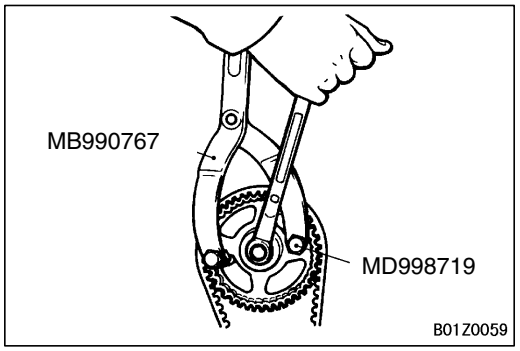
◀A▶ CAMSHAFT SPROCKET AND TIMING BELT ASSEMBLY REMOVAL

1. Turn the crankshaft clockwise (right turn) to align the timing mark and to set the No.1 cylinder at compression top dead center

Caution
The crankshaft should always be turned only clockwise.

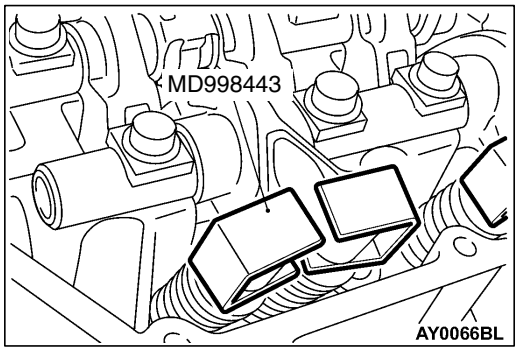


2. Tie the camshaft sprocket and timing belt with a band cable so that the position of the camshaft sprocket will not move with respect to the timing belt.



3. Use the special tools to remove the camshaft sprocket with the timing belt attached.

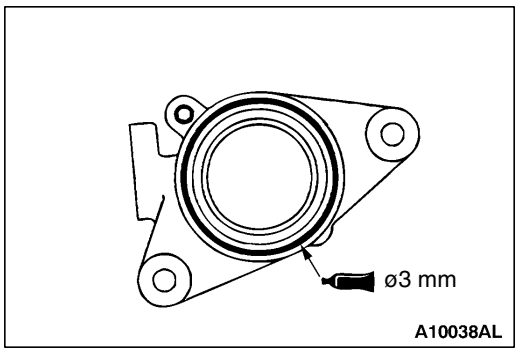
Caution
After removing the camshaft sprocket, be sure not to rotate the crankshaft.



◀B▶ LASH ADJUSTER, ROCKER ARM AND SHAFT ASSEMBLY REMOVAL

1. Before removing the lash adjuster, rocker arm and shaft assembly, install the special tools as shown in the illustration so that the lash adjusters will not fall out.
2. Loosen the lash adjuster, rocker arm and shaft assembly mounting bolt, and then remove the lash adjuster, rocker arm and shaft assembly with the bolt still attached.

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



INSTALLATION SERVICE POINTS

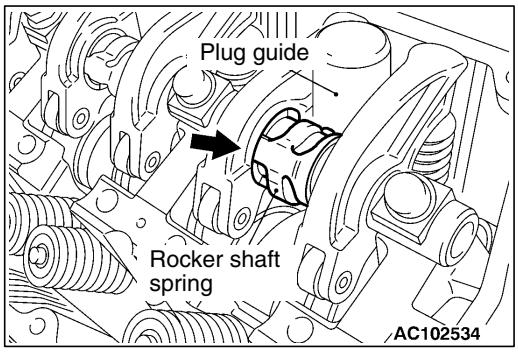
▶A◀ CAMSHAFT POSITION SENSOR SUPPORT INSTALLATION

1. Remove sealant remained on the camshaft position sensor support.
2. Apply sealant to the flange of the camshaft position sensor support and install to the cylinder head.

Specified sealant:
MITSUBISHI GENUINE PART MD970389 or equivalent

3. Tighten the camshaft position sensor support mounting bolt to the specified torque.

Tightening torque: 14 ± 1 N·m

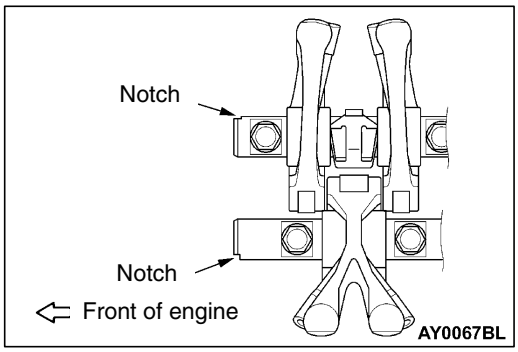


▶B◀ LASH ADJUSTER, ROCKER ARM AND SHAFT ASSEMBLY INSTALLATION

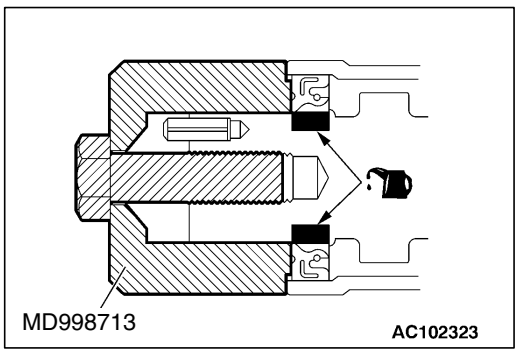
1. Remove the rocker shaft spring.
2. Tighten the lash adjuster, rocker arm and shaft assembly temporarily with mounting bolts so that all the rocker arms on the intake side will not push the valves.
3. Install the rocker shaft spring and plug guide so that they can meet at right angle to each other.
4. Tighten the lash adjuster, rocker arm and shaft assembly mounting bolt to the specified torque.

   Tightening torque: 31 ± 3 N·m
5. Install the the lash adjuster, rocker arm and shaft assembly on the exhaust side, and then tighten the bolt to the specified torque.

   Tightening torque: 31 ± 3 N·m
6. Remove the special tool used for retaining the lash adjuster.



7. Ensure that the notch at the rocker shaft points towards the direction as shown in the illustration.



▶C◀ CAMSHAFT OIL SEAL INSTALLATION

1. Apply engine oil to the camshaft oil seal lip.
2. Use the special tool to press-fit the camshaft oil seal.

▶D◀ CAMSHAFT SPROCKET AND TIMING BELT ASSEMBLY INSTALLATION

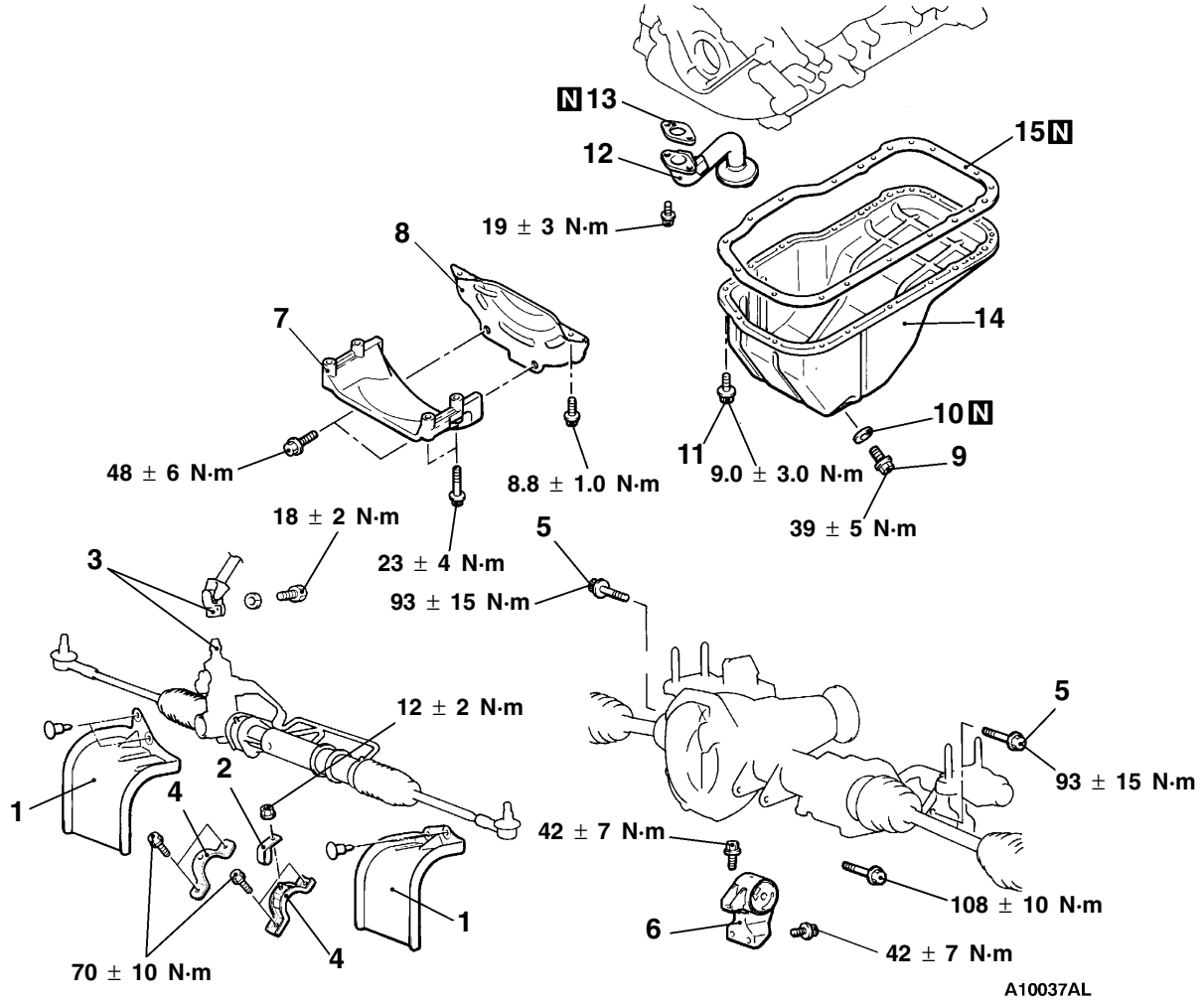
1. Use the special tools to stop the camshaft sprocket from turning in the same way as was done during removal, and then tighten the camshaft sprocket securing bolt to the specified torque.

   Tightening torque: 88 ± 10 N·m
2. Remove the band cable which binds the camshaft sprocket and timing belt.

OIL PAN

REMOVAL AND INSTALLATION

Pre-removal and Post-installation Operation
- Under Cover Removal and Installation
- Engine Oil Draining and Supplying
- Oil Level Gauge Removal and Installation



Removal steps

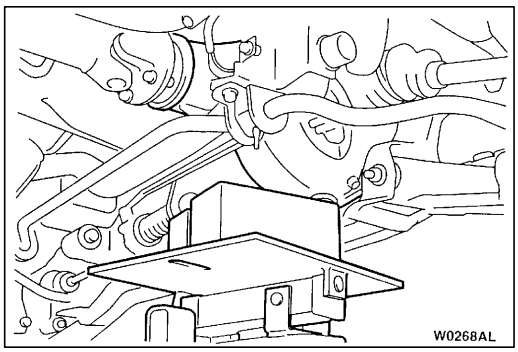
1. Splash shield
2. Power steering pressure hose clamp <R.H. drive vehicles>
3. Steering gear box and shaft connection
4. ◀A▶ Steering gear box installation bolts
5. ◀B▶ Front differential mount center bolt
6. ◀B▶ Front differential mount
7. Transmission stay
8. Bell housing cover
9. Drain plug
10. ▶B◀ Drain plug gasket
11. ◀C▶ ▶A◀ Oil pan installation bolts
12. ◀C▶ ▶A◀ Oil screen
13. ◀C▶ ▶A◀ Oil screen gasket
14. ◀C▶ ▶A◀ Oil pan
15. ▶A◀ Oil pan gasket

NOTE
Liquid-type gasket is used as the oil pan gasket for the vehicle shipped from the factory or the engine to be overhauled. If liquid gasket is used during the replacement of the oil pan gasket in the on-vehicle service, the sealing surfaces affect other parts, thereby resulting in oil leaks. So, be sure to use an oil pan gasket supplied as a spare part.

REMOVAL SERVICE POINTS

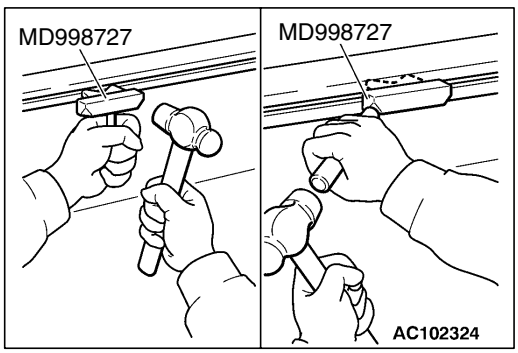
◀A▶ STEERING GEAR BOX INSTALLATION BOLT REMOVAL

Remove the steering gear box installation bolts and lower the steering gear box.



◀B▶ FRONT DIFFERENTIAL MOUNT CENTER BOLT/ FRONT DIFFERENTIAL MOUNT REMOVAL

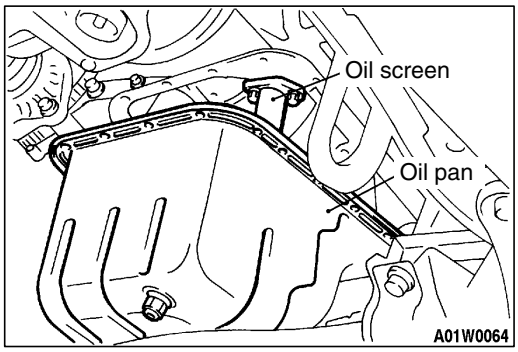
1. Support the front differential by a jack, and remove the front differential mount center bolts and the front differential mount.
2. Remove the jack and lower the front differential.



◀C▶ OIL PAN INSTALLATION BOLT/OIL SCREEN/OIL SCREEN GASKET/OIL PAN REMOVAL

1. After removing the oil pan installation bolts, use a special tool to remove the oil pan from the engine.

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

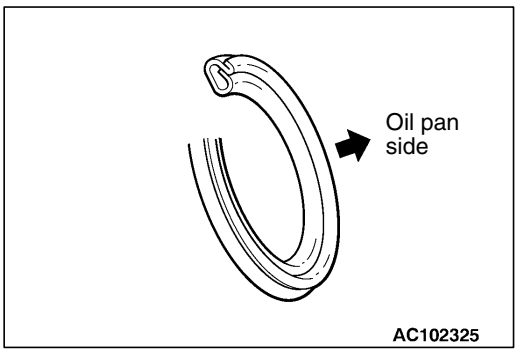


2. With the oil pan removed from the cylinder block, remove the oil screen installation bolts.
3. Remove the oil pan and the oil screen as a set.

INSTALLATION SERVICE POINTS

▶A◀ OIL PAN GASKET/OIL PAN/OIL SCREEN GASKET/OIL SCREEN/OIL PAN INSTALLATION BOLT INSTALLATION

1. Put the oil screen in the oil pan. With the oil pan gasket in position, place the oil pan between the cylinder block and front differential.
2. Install the oil screen gasket and oil screen to the cylinder block.
3. Install the oil pan to the cylinder block.

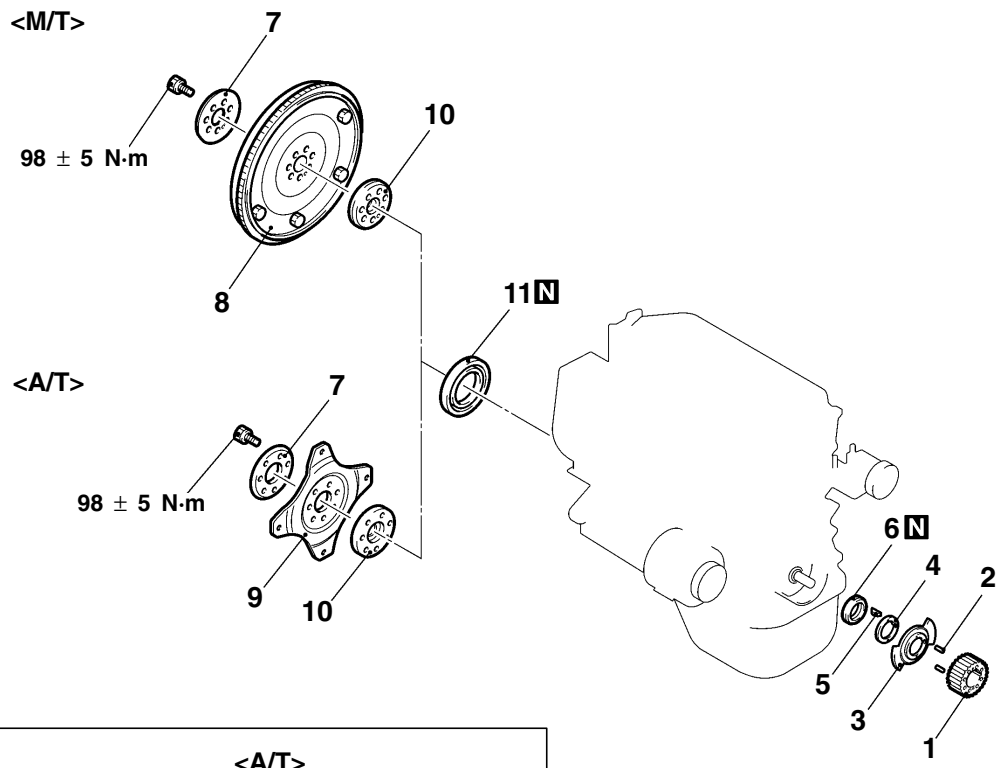


▶B◀ DRAIN PLUG GASKET INSTALLATION

Install the drain plug gasket in the direction so that it faces as shown in the illustration.

CRANKSHAFT OIL SEAL

REMOVAL AND INSTALLATION



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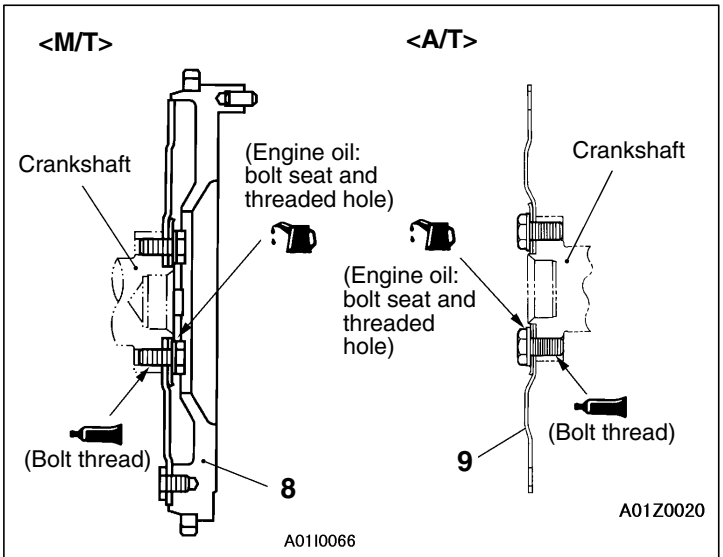
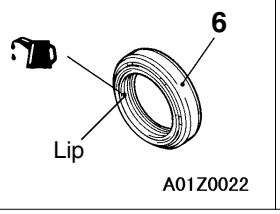
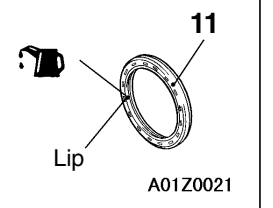


Sealant: 3M Stud Locking 4170 or equivalent





Engine oil

Crankshaft front oil seal removal steps

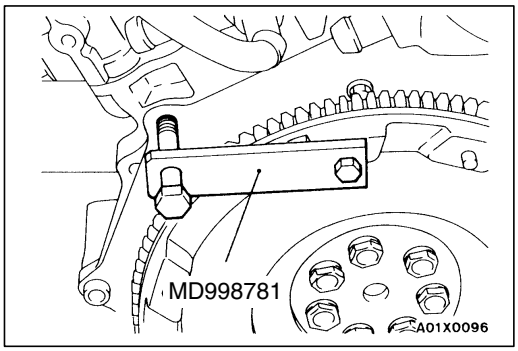
- Timing belt (Refer to P.11B-30.)
- Crank angle sensor (Refer to GROUP 16 – Ignition System.)

▶D◀ 1. Crankshaft sprocket
▶D◀ 2. Spring pin
▶D◀ 3. Crankshaft sensing blade
▶D◀ 4. Crankshaft spacer
5. Crankshaft key
▶C◀ 6. Crankshaft front oil seal

Crankshaft rear oil seal removal steps

- Transmission assembly
- Clutch cover and disc <M/T>

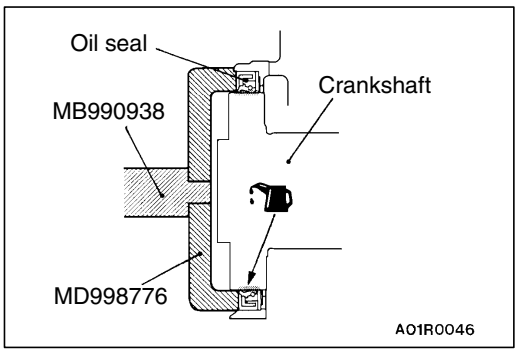
◀A▶ ▶B◀ 7. Adapter plate
◀A▶ ▶B◀ 8. Flywheel <M/T>
◀A▶ ▶B◀ 9. Drive plate <A/T>
◀A▶ ▶B◀ 10. Crankshaft adapter
▶A◀ 11. Crankshaft rear oil seal



REMOVAL SERVICE POINT

◀A▶ ADAPTER PLATE/FLYWHEEL <M/T>/DRIVE PLATE <A/T>/CRANKSHAFT ADAPTER REMOVAL

Use the special tool to secure the flywheel or drive plate, and remove the bolts.



INSTALLATION SERVICE POINTS

▶A◀ CRANKSHAFT REAR OIL SEAL INSTALLATION

1. Apply a small mount of engine oil to the entire circumference of the oil seal lip.
2. Install the oil seal by tapping it as far as the chamfered position of the oil seal case as shown in the illustration.

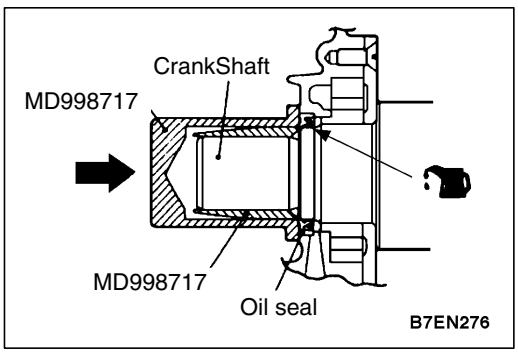
▶B◀ CRANKSHAFT ADAPTER /DRIVE PLATE <A/T>/ FLYWHEEL <M/T>/ADAPTER PLATE INSTALLATION

1. Clean off all sealant, oil and other substances which are adhering to the threaded bolts, crankshaft thread holes and the drive plate or flywheel.
2. Apply oil to the bearing surface of the drive plate bolts or flywheel bolts.
3. Apply oil to the crankshaft thread holes.
4. Apply sealant to the threaded mounting holes.

   Specified sealant: 3M Stud locking 4170 or equivalent

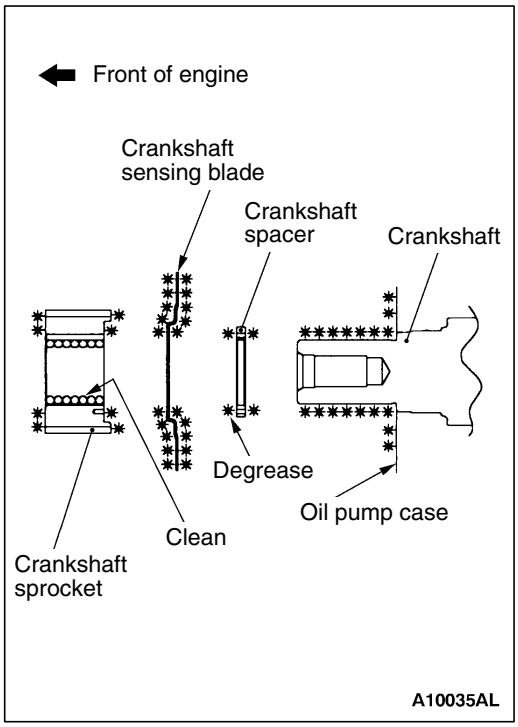
5. Use the same special tool as in the removal procedure to retain drive plate or flywheel, and tighten drive plate bolts or flywheel bolts to the specified torque.

   Tightening torque: 98 ± 5 N·m



▶C◀ CRANKSHAFT FRONT OIL SEAL INSTALLATION

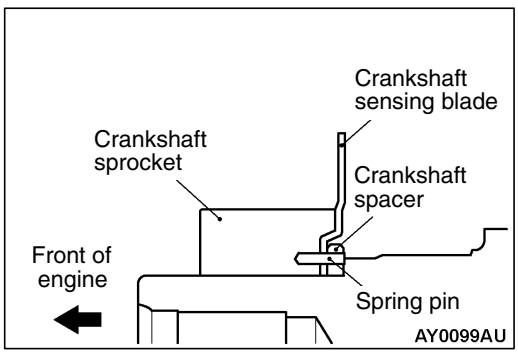
1. Apply a small amount of engine oil to the entire circumference of the oil seal lip.
2. Tap the oil seal unit it is flush with the oil seal case.



▶D◀ CRANKSHAFT SPACER/CRANKSHAFT SENSING BLADE/SPRING PIN/CRANKSHAFT SPROCKET INSTALLATION

1. Clean and then degrease the following surfaces and parts: front surface of oil pump case, sprocket mounting surface of crankshaft, crankshaft spacer, crankshaft sensing blade, and crankshaft sprocket.

   NOTE
   Degreasing is necessary to prevent decrease in the friction between contacting surfaces.
2. Clean the crankshaft contacting surface of crankshaft sprocket.

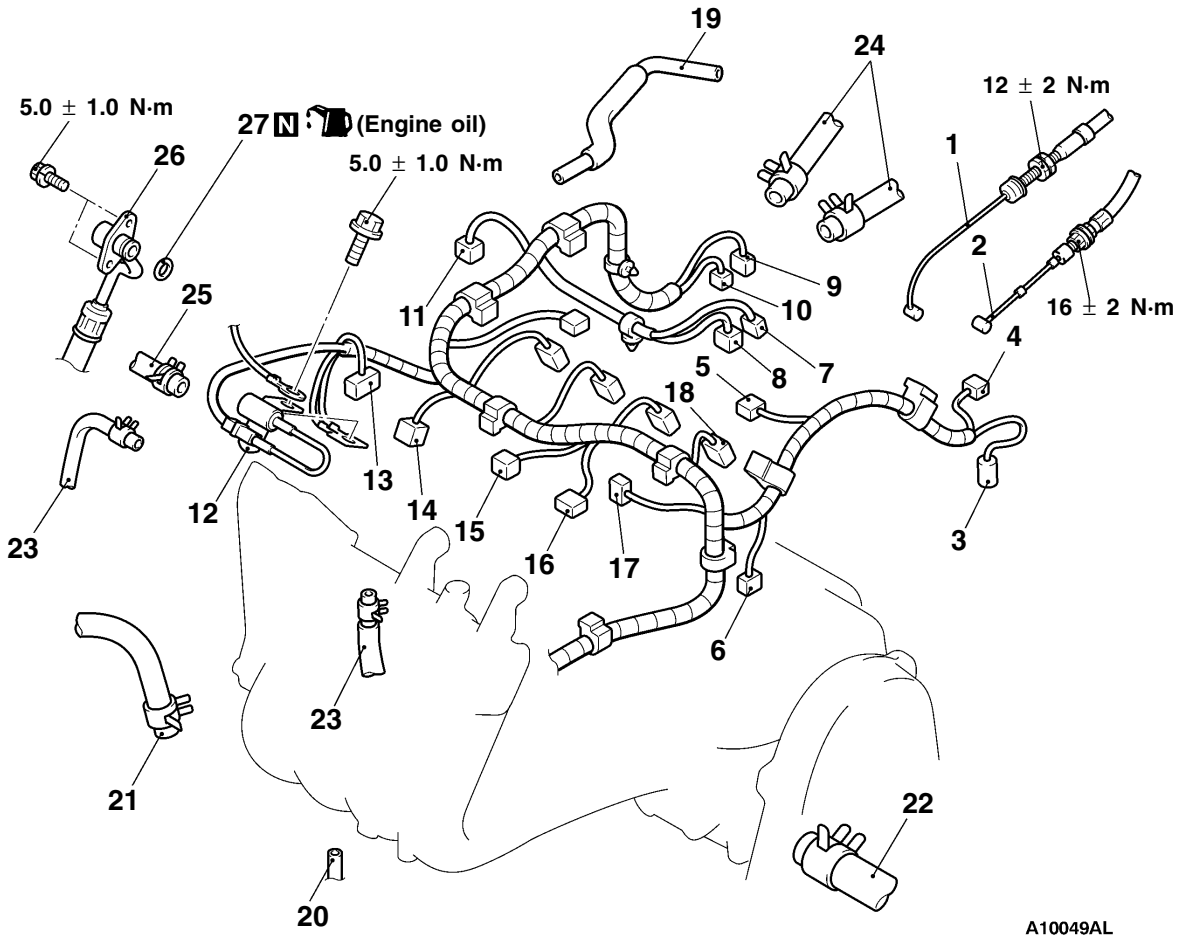


3. With spring pin, crankshaft sensing blade and crankshaft spacer assembled, install crankshaft sprocket on crankshaft.

CYLINDER HEAD GASKET

REMOVAL AND INSTALLATION

Pre-removal and Post-installation Operation
- Fuel Discharge Prevention (Refer to GROUP 13C – On-vehicle Service.) <Pre-removal only>
- Kickdown Cable Adjustment <A/T> (Refer to GROUP 23 – On-vehicle Service.) <Post-installation only>
- Accelerator Cable Adjustment (Refer to GROUP 17 – On-vehicle Service.) <Post-installation only>
- Engine Coolant Draining and Supplying
- Engine Oil Draining and Supplying
- Exhaust Manifold Removal and Installation (Refer to GROUP 15.)
- Thermostat Case Assembly Removal and Installation (Refer to GROUP 14 – Water Hose and Pipe.)
- Water By-pass Fitting Removal and Installation (Refer to GROUP 14 – Water Hose and Pipe.)



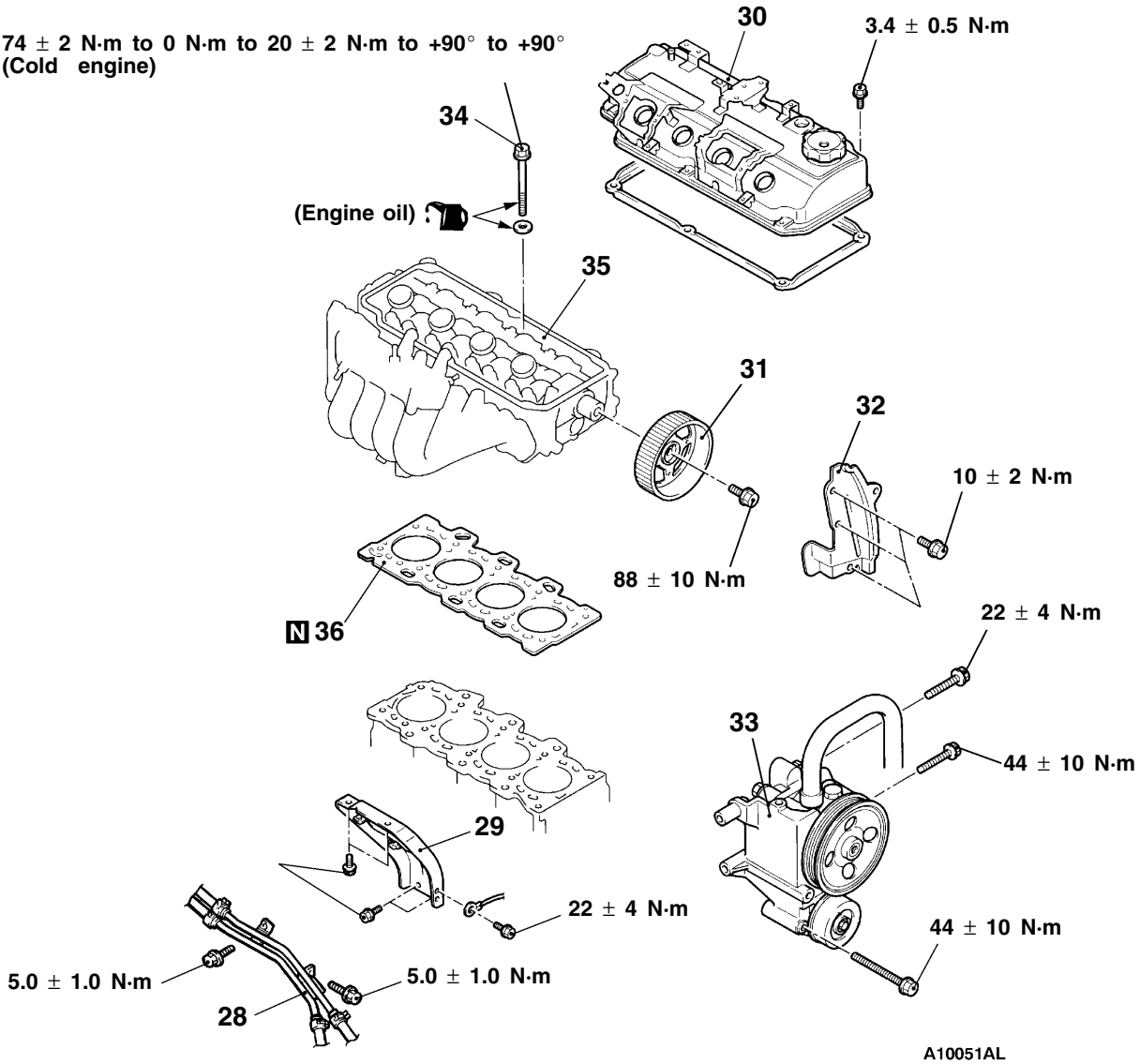
Removal steps
1. Accelerator cable connection
2. Kickdown cable connection <A/T>
3. Power steering oil pressure switch connector
4. A/C compressor magnetic clutch connector
5. Ignition coil connector
6. Crank angle sensor connector
7. Oxygen sensor connector
8. Ignition failure sensor connector
9. Engine coolant temperature sensor connector
10. Engine coolant temperature gauge unit connector
11. Camshaft position sensor connector
12. Capacitor
13. Throttle position sensor connector
14. Idle speed control servo connector
15. Purge control solenoid valve connector
16. EGR solenoid valve connector
17. Detonation sensor connector
18. Injector connector
19. PCV hose
20. Vacuum hoses connection
21. Brake booster vacuum hose connection

◀A▶ ▶E◀ 22. Radiator upper hose connection

23. Water hose connection
24. Heater hose connection
25. Fuel return hose connection

▶D◀ 26. Fuel high-pressure hose connection

▶D◀ 27. O-ring



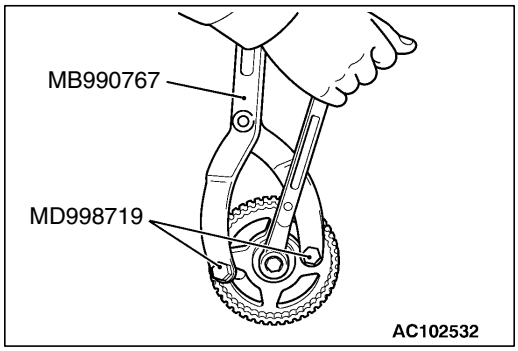
28. Oil cooler pipe connection <A/T>
29. Intake manifold stay
    - Ignition failure sensor (Refer to GROUP 16 – Ignition System.)
    - Ignition coil (Refer to GROUP 16 – Ignition System.)
    - Timing belt (Refer to P.11B-30.)
30. Rocker cover

◀B▶ ▶C◀ 31. Camshaft sprocket
32. Timing belt under upper cover
◀C▶ 33. Power steering oil pump and bracket assembly
◀D▶ ▶B◀ 34. Cylinder head bolt
35. Cylinder head assembly
▶A◀ 36. Cylinder head gasket

REMOVAL SERVICE POINTS

◀A▶ RADIATOR UPPER HOSE REMOVAL

After alignment marks are indicated on radiator upper hose and hose clamps, remove the hose.

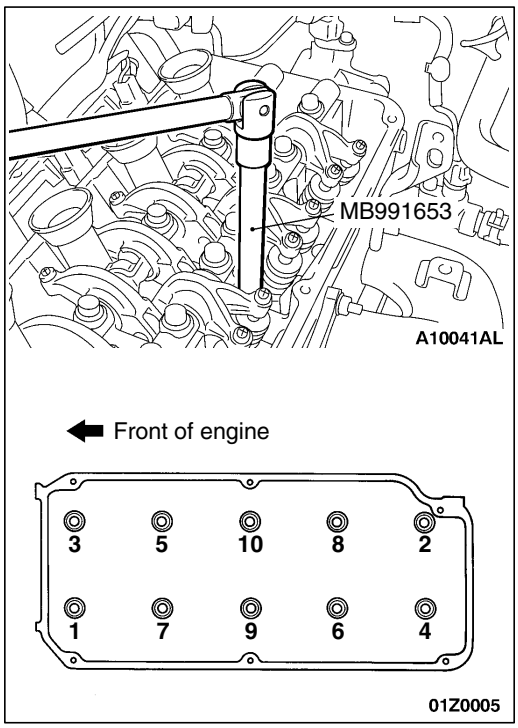


◀B▶ CAMSHAFT SPROCKET REMOVAL

◀C▶ POWER STEERING OIL PUMP AND BRACKET ASSEMBLY REMOVAL

Remove the power steering oil pump and bracket assembly from the engine with the hose attached.

NOTE
Place the removed power steering oil pump and bracket assembly in a place where it will not be a hindrance when removing and installing the cylinder head assembly, and tie it with a cord.



◀D▶ CYLINDER HEAD BOLT REMOVAL

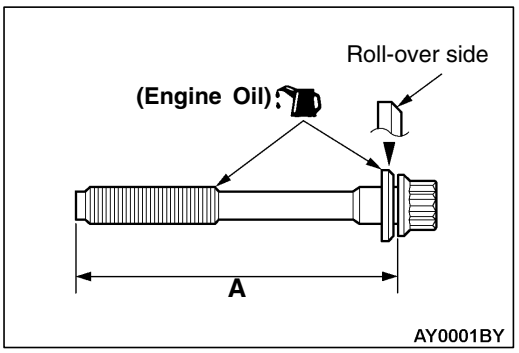
Use the special tool to loosen the bolts in two or three steps in the order of the numbers shown in the illustration, and then remove the bolts.
If the washer is caught on valve spring and the bolt is not removed, pull up the bolt slightly and remove the bolt while tilting the washer by using a magnet, etc.

INSTALLATION SERVICE POINTS

▶A◀ CYLINDER HEAD GASKET INSTALLATION

1. Wipe off all oil and grease from the gasket mounting surface.

   Caution
   Do not insert foreign objects into coolant, oil passage and cylinders.
2. Install so that the shapes of the respective cylinder head gasket holes match the shapes of the cylinder block holes.

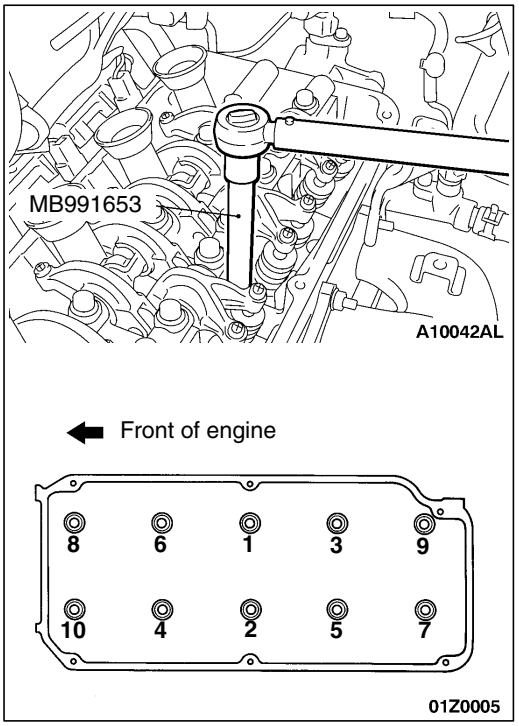


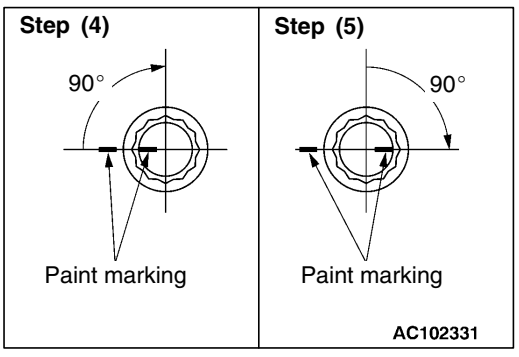
▶B◀ CYLINDER HEAD BOLT INSTALLATION

1. Ensure that the length under head of cylinder head bolts is under the limit value. When the measured value exceeds the limit value, replace the bolt with new one.

   Limit (A): 96.4 mm
2. With roll-over side of punched cylinder head bolt washer moved in the direction specified in the figure, install it on cylinder head bolt.
3. Apply small quantity of engine oil at the threads of cylinder head bolts and the washers.
4. Use special tool to tighten bolts according to the following procedure (tightening for plastic zone).
   (1) According to the sequence in the figure, tighten bolts to the specified torque 74 ± 2 N·m.
   (2) In the reverse sequence of the figure, fully loosen bolts.
   (3) According to the sequence specified in the figure, tighten bolts to the specified torque 20 ± 2 N·m.
   (4) Indicate paint markings on the heads of cylinder head bolts and cylinder head, and tighten bolts at the angle of 90 degrees in the sequence specified in the figure.
   (5) When bolts are tightened at the angle of 90 degrees according to the figure, ensure that the paint markings on the heads of cylinder head bolts and cylinder head are standing in line.

   Caution
   1) When the tightening angle is under 90 degree, the bolt is not sufficiently tightened.
   2) When the tightening angle exceeds the specified value, remove the bolt and repeat the same procedure beginning with Step 1.





▶C◀ CAMSHAFT SPROCKET INSTALLATION

Use the special tool to stop the the camshaft sprocket from turning in the same way as was done during removal, and then tighten the bolts to the specified torque.

Tightening torque: 88 ± 10 N·m

▶D◀ O-RING/FUEL HIGH-PRESSURE HOSE INSTALLATION

1. Apply a small amount of new engine oil to the O-ring.

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

2. While turning the fuel high-pressure hose to the right and left, install 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 the delivery pipe and check that the hose turns smoothly.
4. Tighten the fuel high-pressure hose mounting bolt to the specified torque.

   Tightening torque: 5.0 ± 1.0 N·m

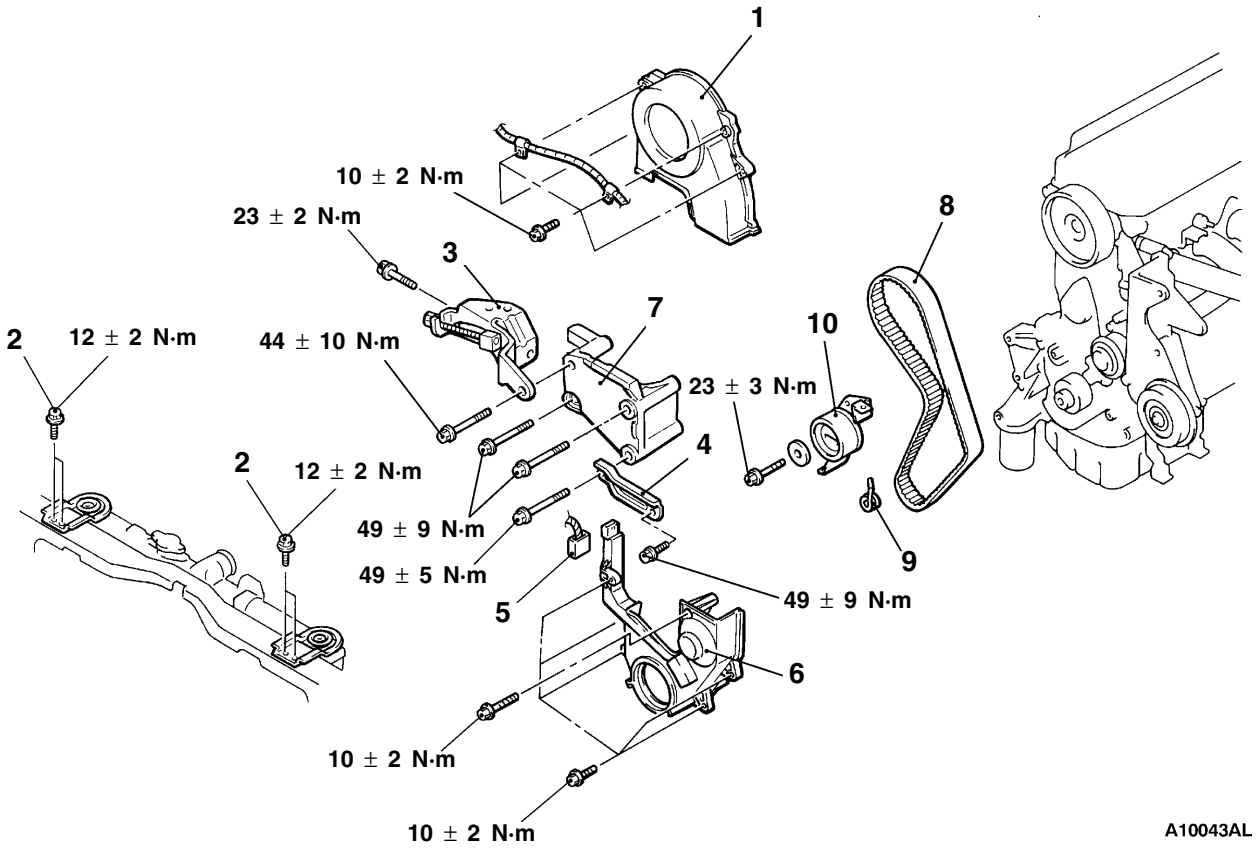
▶E◀ RADIATOR UPPER HOSE INSTALLATION

1. Insert the radiator upper hose to the protruded parts of the water outlet fitting.
2. Align the marks on the radiator upper hose and hose clamp drawn during removal when installing.

TIMING BELT

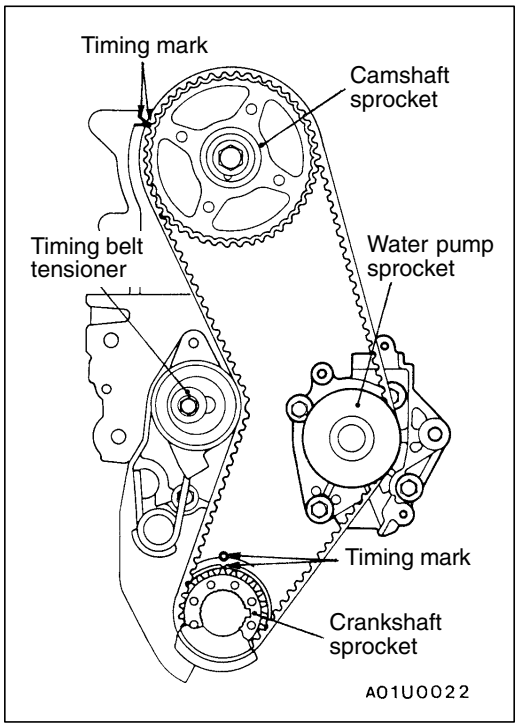
REMOVAL AND INSTALLATION

Pre-removal and Post-installation Operation
- Under Cover Removal and Installation
- Air Intake Pipe Removal and Installation (Refer to GROUP 15 – Air Cleaner.)
- Crankshaft Pulley Removal and Installation (Refer to P.11B-13.)



Removal steps

1. Timing belt front upper cover
2. Radiator upper installation bolts
3. Alternator brace
4. Power steering oil pump bracket stay
5. Crank angle sensor connector
- ▶C◀ 6. Timing belt front lower cover
7. Accessory mount
- ▶B◀ ● Timing belt tension adjustment
- ◀A▶ ▶A◀ 8. Timing belt
9. Tensioner spring
10. Timing belt tensioner

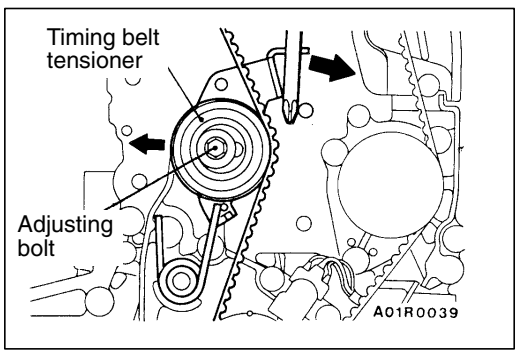


REMOVAL SERVICE POINT

◀A▶ TIMING BELT REMOVAL

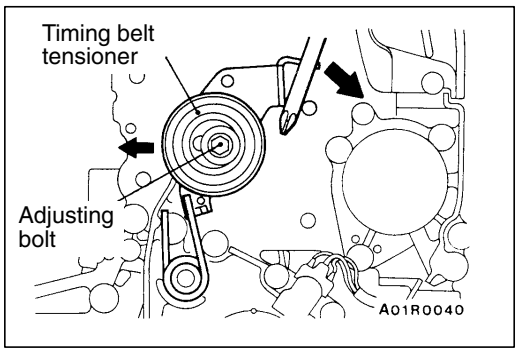
1. Turn the crankshaft clockwise (right turn) to align each timing mark and to set the No. 1 cylinder at compression top dead centre.

Caution
The crankshaft should always be turned only clockwise.



2. Loosen the adjusting bolt.
3. Set a screwdriver to the timing belt tensioner and press it fully back in the direction of the arrow.
4. Provisionally tighten the adjusting bolt.
5. Remove the timing belt.

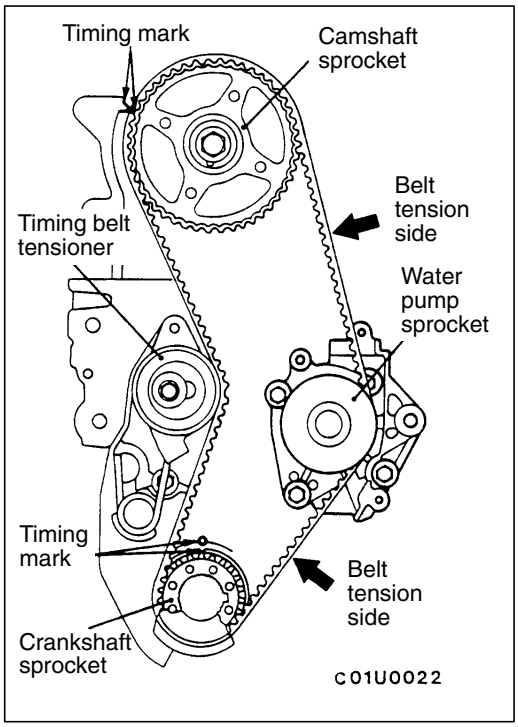
Caution
If the timing belt is to be re-used, use chalk to mark the flat side of the belt with an arrow indicating the direction of rotation (right turn).



INSTALLATION SERVICE POINTS

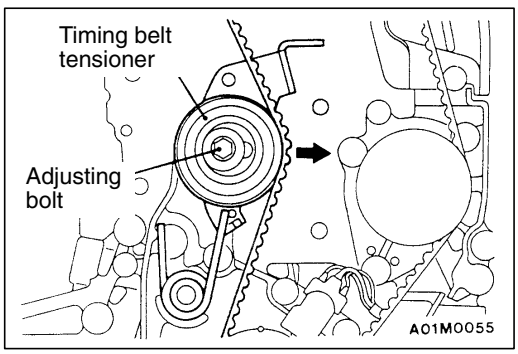
▶A◀ TIMING BELT INSTALLATION

1. Set a screwdriver to the timing belt tensioner and press it fully back in the direction of the arrow.
2. Provisionally tighten the adjusting bolt.



3. Align each of the camshaft sprocket and the crankshaft sprocket timing marks.
4. Install the timing belt in the following order, while making sure that the tension side of the belt is not slackened.
   (1) Crankshaft sprocket
   (2) Water pump sprocket
   (3) Camshaft sprocket
   (4) Tensioner pulley

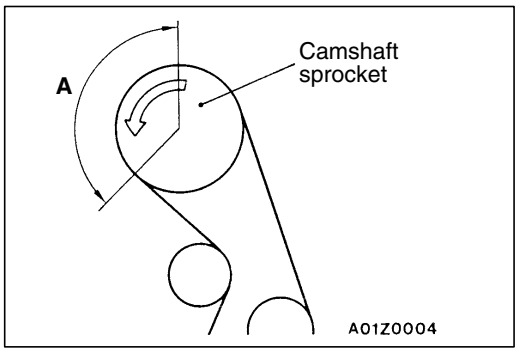
Caution
After installing the timing belt, apply force to turn the camshaft sprocket in the reverse direction, and recheck to be sure that the belt is fully tensioned and that each timing mark is in the proper position.



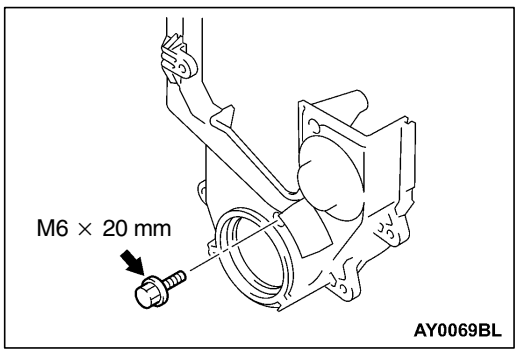
▶B◀ TIMING BELT TENSION ADJUSTMENT

1. Loosen the adjusting bolt of the temporarily secured timing belt tensioner by 1/4 – 1/2 turn, and use the force of the tensioner spring to apply tension to the belt.
2. Turn the crankshaft in the proper rotation direction (right turn) for two rotations, and recheck to be sure that the timing marks on each sprocket are aligned.

Caution
As the purpose of this procedure is to apply the proper amount of tension to the tension side of the timing belt by using the cam driving torque, turn the crankshaft only by the amount given above. Be sure not to turn the crankshaft in the opposite direction (left turn).



3. After checking to be sure that no belt teeth in the section marked with A are lifted up and that the teeth in each sprocket are engaged, secure the tensioner pulley.



▶C◀ TIMING BELT FRONT LOWER COVER INSTALLATION

1. Mount the bolt shown in the illustration first.
2. Mount the other bolts, and tighten them to the specified torque.

Tightening torque: 10 ± 2 N·m

ENGINE ASSEMBLY

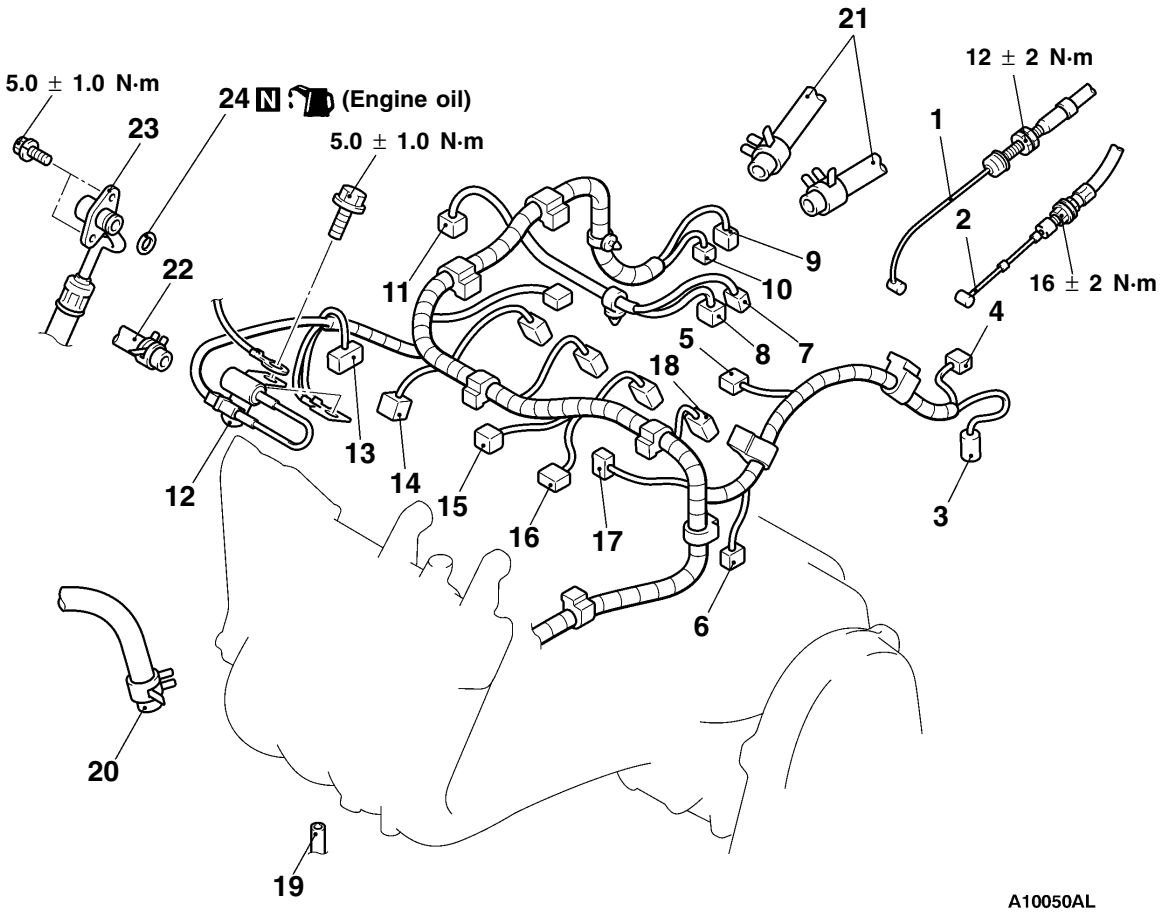
REMOVAL AND INSTALLATION

Caution

***: Indicates parts which should be temporarily tightened, and then fully tightened with the vehicle on the ground in the unladen condition.**

Pre-removal and Post-installation Operation

- Fuel Discharge Prevention (Refer to GROUP 13C – On-vehicle Service.) <Pre-removal only>
- Kickdown Cable Adjustment <A/T> (Refer to GROUP 23 – On-vehicle Service.) <Post-installation only>
- Accelerator Cable Adjustment (Refer to GROUP 17 – On-vehicle Service.) <Post-installation only>
- Drive Belt Tension Check and Adjustment <Post-installation only> (Refer to P.11B-5.)
- Hood Removal and Installation
- Radiator Assembly Removal and Installation (Refer to GROUP 14.)
- Under Cover Removal and Installation
- Air Cleaner and Air Intake Pipe Removal and Installation (Refer to GROUP 15.)
- Front Exhaust Pipe Removal and Installation (Refer to GROUP 15.)

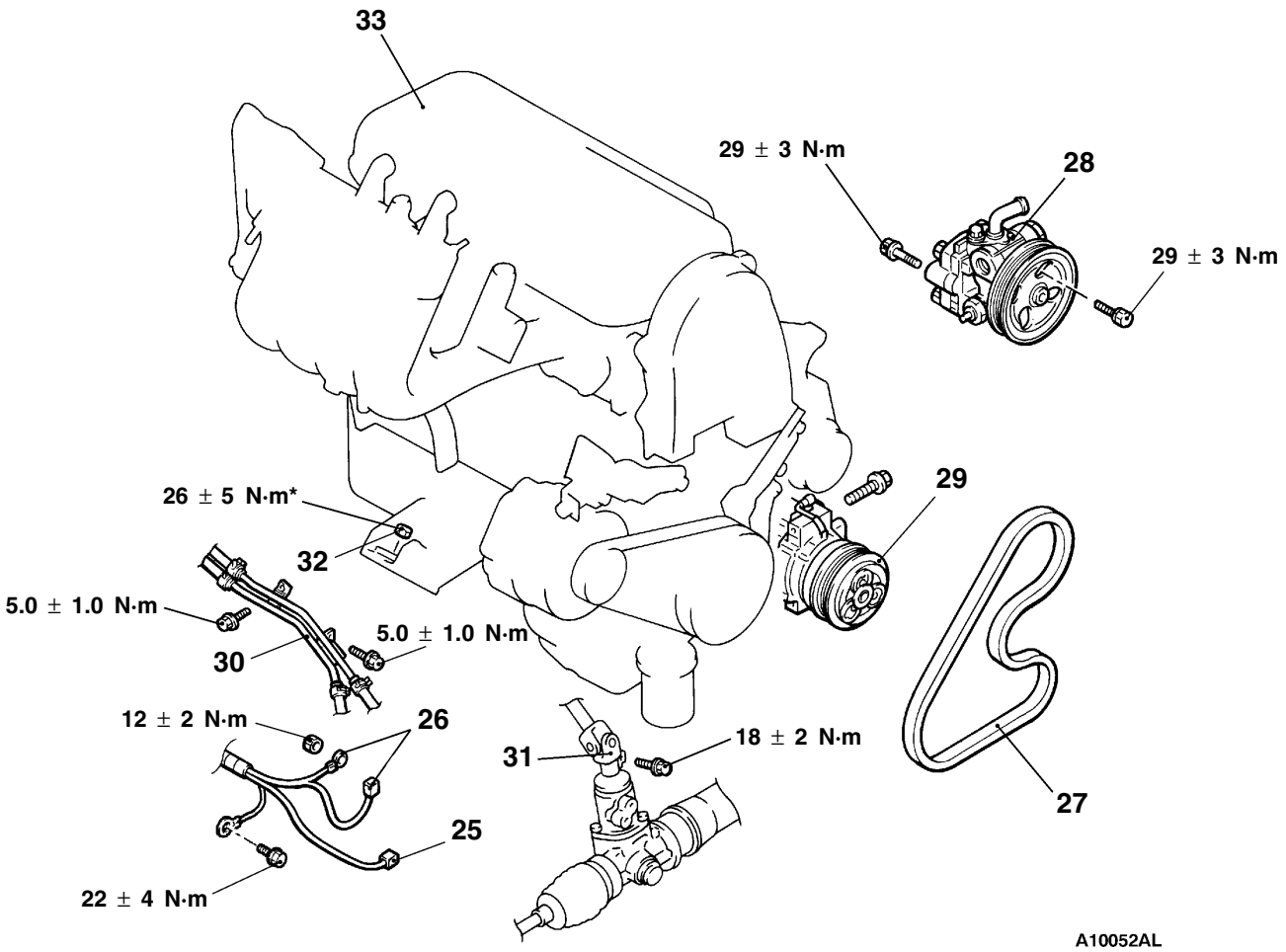


Removal steps

1. Accelerator cable connection
2. Kickdown cable connection <A/T>
3. Power steering oil pressure switch connector
4. A/C compressor magnetic clutch connector
5. Ignition coil connector
6. Crank angle sensor connector
7. Oxygen sensor connector
8. Ignition failure sensor connector
9. Engine coolant temperature sensor connector
10. Engine coolant temperature gauge unit connector
11. Camshaft position sensor connector
12. Capacitor
13. Throttle position sensor connector
14. Idle speed control servo connector
15. Purge control solenoid valve connector
16. EGR solenoid valve connector
17. Detonation sensor connector
18. Injector connector
19. Vacuum hoses connection
20. Brake booster vacuum hose connection
21. Heater hose connection
22. Fuel return hose connection

▶B◀ 23. Fuel high-pressure hose connection

▶B◀ 24. O-ring



25. Oil pressure switch connector
26. Alternator connector and terminal
27. Power steering oil pump drive belt <Vehicles without A/C>, Power steering oil pump and A/C compressor drive belt <Vehicles with A/C>

◀A▶ 28. Power steering oil pump

◀B▶ 29. A/C compressor
30. Oil cooler pipe connection <A/T>
- Transmission assembly

31. Steering gear box and shaft connection
32. Engine mount installation nut

◀C▶ ▶A◀ 33. Engine assembly

REMOVAL SERVICE POINTS

◀A▶ POWER STEERING OIL PUMP REMOVAL

Remove the power steering oil pump with the hose attached from the engine.

NOTE
Place the removed power steering oil pump where it will not be a hindrance when removing and installing the engine assembly, and tie it with a cord.

◀B▶ A/C COMPRESSOR REMOVAL

Disconnect the A/C compressor connector and remove the compressor from the compressor bracket with the hose still attached.

NOTE
Place the removed A/C compressor where it will not be a hindrance when removing and installing the engine assembly, and tie it with a cord.

◀C▶ ENGINE ASSEMBLY REMOVAL

1. Check that all cables, hoses and harness connectors, etc. are disconnected from the engine.
2. 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, checking that the cables, hoses, and harness connectors are not clamped.

▶B◀ O-RING/FUEL HIGH-PRESSURE HOSE INSTALLATION

1. Apply a small amount of new engine oil to the O-ring.

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

2. While turning the fuel high-pressure hose to the right and left, install 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 the delivery pipe and check that the hose turns smoothly.
4. Tighten the fuel high-pressure hose mounting bolt to the specified torque.

   Tightening torque: 5.0 ± 1.0 N·m

NOTES