

GROUP 11C

ENGINE

MECHANICAL

<3.5L ENGINE>

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GENERAL DESCRIPTION

M1111000100033

The 6G74 (3.5 L) engine is a six-cylinder engine. The cylinder numbers are assigned as 1-3-5 for the right bank and 2-4-6 for the left bank from the front of the engine (timing belt side). This engine is fired in the order of 1-2-3-4-5-6 cylinders.

ITEMS			SPECIFICATIONS
Type			V type, overhead camshaft
Number of cylinders			6
Bore mm (in)			93.0 (3.66)
Stroke mm (in)			85.8 (3.38)
Piston displacement cm ³ (cu. in)			3,497 (213.4)
Compression ratio			9.0
Firing order			1-2-3-4-5-6
Valve timing	Intake valve	Opens (BTDC)	13°
		Closes (ABDC)	55°
	Exhaust valve	Opens (BBDC)	51°
		Closes (ATDC)	17°

DIAGNOSIS

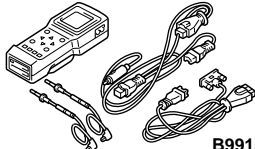
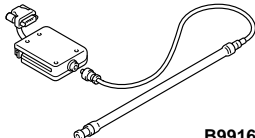
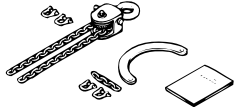
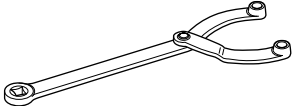
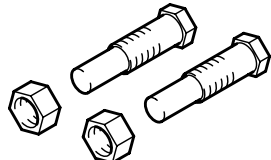
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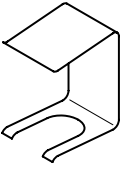
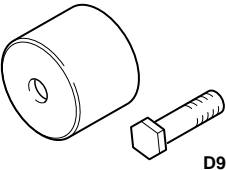

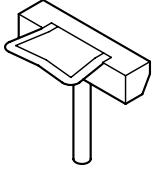
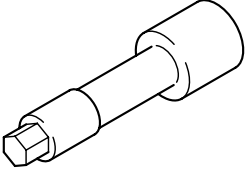
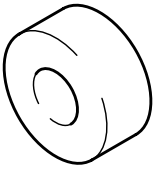
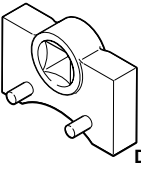
TROUBLE SYMPTOM	PROBABLE CAUSE	REMEDY
Compression is too low	Blown cylinder head gasket	Replace the gasket.
	Worn or damaged piston rings	Replace the rings.
	Worn piston or cylinder	Repair or replace the piston and/or the cylinder block.
	Worn or damaged valve seat	Repair or replace the valve and/or the seat ring.
Drop in oil pressure	Engine oil level is too low	Check the engine oil level.
	Malfunction of oil pressure switch	Replace the oil pressure switch.
	Clogged oil filter	Install a new filter.
	Worn oil pump gears or cover	Replace the gears and/or the cover.
	Thin or diluted engine oil	Change the engine oil to the correct viscosity.
	Stuck (opened) oil relief valve	Repair the relief valve.
	Excessive bearing clearance	Replace the bearings.
Oil pressure too high	Stuck (closed) oil relief valve	Repair the relief valve.

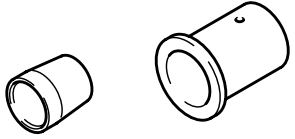
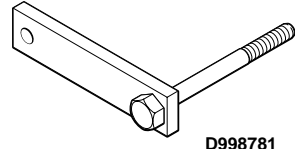
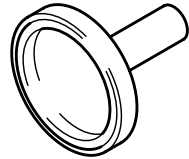
TROUBLE SYMPTOM	PROBABLE CAUSE	REMEDY
Noisy valves	Malfunction of lash adjuster (including entry of air into high pressure chamber)	Check the lash adjuster.
	Thin or diluted engine oil (low oil pressure)	Change the engine oil.
	Worn or damaged valve stem or valve guide	Replace the valve and/or the guide.
Connecting rod noise/main bearing noise	Insufficient oil supply	Check the engine oil level.
	Thin or diluted engine oil	Change the engine oil.
	Excessive bearing clearance	Replace the bearings.

SPECIAL TOOLS

M1112000600202

TOOL	TOOL NUMBER AND NAME	SUPERSESSION	APPLICATION
 B991502	MB991502 Scan tool (MUT-II)	MB991496-OD	<ul style="list-style-type: none"> • Drive belt tension check • Ignition timing check • Idle speed check • Idle mixture check • Balancer timing belt tension check and adjustment
 B991668	MB991668 Belt tension meter set	Tool not available	Drive belt tension check (used together with scan tool)
 B991683	MB991683 Sling chain set	—	Removal and installation of engine assembly
 B990767	MB990767 End yoke holder	MB990767-01	Holding the camshaft sprocket
	MD998715 Crankshaft pulley holder pin	MIT308239	Holding the camshaft sprocket

TOOL	TOOL NUMBER AND NAME	SUPERSESSION	APPLICATION
 D998443	MD998443 Auto-lash adjuster holder	MD998443-01	Holding the auto-lash adjuster
 D998713	MD998713 Camshaft oil seal installer	MD998713-01	Press-in of the camshaft oil seal
 B991559	MB991559 Camshaft oil seal adapter installer	—	Press-fitting the camshaft oil seal (left bank side)
 D998727	MD998727 Oil pan remover	MD998727-01	Oil pan removal
	MD998051 Cylinder head bolt wrench	MD998051-01 or General service tool	Cylinder head bolt removal and installation
	MD998769 Crankshaft pulley spacer	General service tool	Rotating the crankshaft when installing the timing belt
 D998767	MD998767 Tension pulley socket wrench	MD998752-01	Timing belt tension adjustment

TOOL	TOOL NUMBER AND NAME	SUPERSESSON	APPLICATION
	MD998717 Crankshaft front oil seal installer	MD998717-01	Press-in of the crankshaft front oil seal
 D998781	MD998781 Flywheel stopper	General service tool	Securing the drive plate
	MD998718 Crankshaft rear oil seal installer	MD998718-01	Press-fitting the crankshaft rear oil seal

ON VEHICLE SERVICE

DRIVE BELT TENSION CHECK AND ADJUSTMENT

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Refer to GROUP 00, Maintenance Service – Drive Belts
(Check Condition) [P.00-43](#).

POWER STEERING OIL PUMP DRIVE BELT TENSION CHECK AND ADJUSTMENT

M1111001100092

Refer to GROUP 00, Maintenance Service – Drive Belts
(Check Condition) [P.00-43](#).

A/C COMPRESSOR DRIVE BELT TENSION CHECK AND ADJUSTMENT

M1111001000095

Refer to GROUP 00, Maintenance Service – Drive Belts
(Check Condition) [P.00-43](#).

IGNITION TIMING CHECK

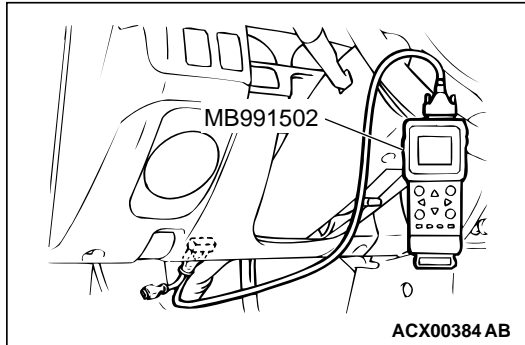
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Required Special Tool:

MB991502: Scan Tool (MUT-II)

1. Before inspection, set vehicles in the following condition:

- Engine coolant temperature: 80 – 95°C (176 – 203°F)
- Lights and all accessories: OFF
- Transmission: P range

**⚠ CAUTION**

To prevent damage to scan tool MB991502, always turn the ignition switch to "LOCK" (OFF) position before connecting or disconnecting scan tool MB991502.

2. Connect scan tool MB991502 to the data link connector.
3. Set up a timing light.
4. Start the engine and run it at idle.
5. Check that the idle speed is approximately 700 r/min.
6. Select scan tool MB991502 actuator test "item number 17".
7. Check that basic ignition timing is within the standard value.

Standard value: 5° BTDC ± 3°

8. If the basic ignition timing is not within the standard value, check the following items:
 - Diagnosis output
 - Timing belt cover and crankshaft position sensor installation conditions
 - Crankshaft sensing blade condition

⚠ CAUTION

If the actuator test is not canceled, the forced drive will continue for 27 minutes. Driving in this state could lead to engine failure.

9. Press the clear key on scan tool MB991502 (select forced drive stop mode), and cancel the actuator test.
10. Check that the actual ignition timing is at the standard value.

Standard value: Approximately 10° BTDC

NOTE: Ignition timing fluctuates about ± 7° Before Top Dead Center, even under normal operating condition.

NOTE: It is automatically further advanced by about 5° to 15° Before Top Dead Center at higher altitudes.

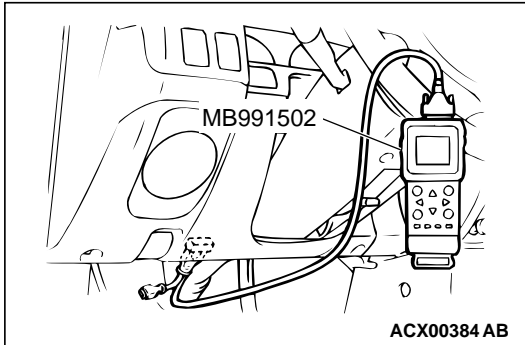
CURB IDLE SPEED CHECK

M1111003500405

Required Special Tool:

MB991502: Scan Tool (MUT-II)

1. Before inspection and adjustment set vehicles in the following condition.
 - Engine coolant temperature: 80 – 95°C (176 – 203°F)
 - Lights, and all accessories: OFF
 - Transmission: P range



CAUTION

To prevent damage to scan tool MB991502, always turn the ignition switch to "LOCK" (OFF) position before connecting or disconnecting scan tool MB991502.

2. Connect scan tool MB991502 to the data link connector.
3. Check the basic ignition timing.

Standard value: 5° BTDC \pm 3°

4. Start the engine.
5. Run the engine at idle for 2 minutes.
6. Check the idle speed. Select item number 22 and take a reading of the idle speed.

Curb idle speed: 700 \pm 100 r/min

NOTE: The idle speed is controlled automatically by the idle air control system.

7. If the idle speed is outside the standard value, refer to GROUP 13CB, Multiport Fuel Injection (MFI) Diagnosis – Symptom Chart [P.13Ab-25](#).

IDLE MIXTURE CHECK

M1111002100084

Required Special Tool:

MB991502: Scan Tool (MUT-II)

1. Before inspection, set vehicles in the following condition:
 - Engine coolant temperature: 80 – 95°C (176 – 203°F)
 - Lights, and all accessories: OFF
 - Transmission: P range

CAUTION

To prevent damage to scan tool MB991502, always turn the ignition switch to "LOCK" (OFF) position before connecting or disconnecting scan tool MB991502.

2. Connect scan tool MB991502 to the data link connector.
3. Check that the basic ignition timing is within the standard value.

Standard value: 5° BTDC \pm 3°

4. Start the engine and increase the engine speed to 2,500 r/min for 2 minutes.
5. Set the CO, HC tester.
6. Check the CO contents and the HC contents at idle.

Standard value:

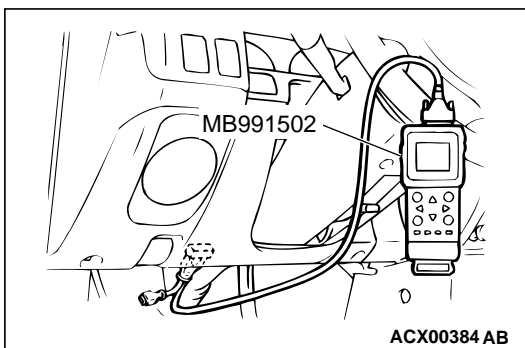
CO contents: 0.5% or less

HC contents: 100 ppm or less

7. If the CO and HC contents do not remain inside the standard value, check the following items:

NOTE: Replace the catalytic converter when the CO and HC contents do not remain inside the standard value, even though the result of the inspection is normal for all items.

- Diagnosis output



- Closed-loop control (When the closed-loop control is carried out normally, the output signal of the heated oxygen sensor changes between 0 – 400 mV and 600 – 1,000 mV at idle.)
- Fuel pressures
- Injector
- Ignition coil, spark plug cable, spark plug
- EGR system and EGR valve leak
- Evaporative emission control system
- Compression pressure

COMPRESSION PRESSURE CHECK

M1111002600324

1. Before inspection, check that the engine oil, starter and battery are normal. Also, set the vehicle in the following condition:
 - Engine coolant temperature: 80 – 95°C (176 – 203°F)
 - Lights, and all accessories: OFF
 - Transmission: P range
2. Disconnect the spark plug cables.
3. Remove all of the spark plugs.
4. Disconnect the crankshaft position sensor connector.

NOTE: Doing this will prevent the powertrain control module from carrying out ignition and fuel injection.

⚠ WARNING

Keep your distance from the spark plug hole when cranking. Oil, fuel, etc., may spray out from the spark plug hole and may cause serious injury.

5. Cover the spark plug hole with a shop towel etc., during cranking. After the engine has been cranked, check for foreign material adhering to the shop towel.
6. Set compression gauge to one of the spark plug holes.
7. Crank the engine with the throttle valve fully open and measure the compression pressure.

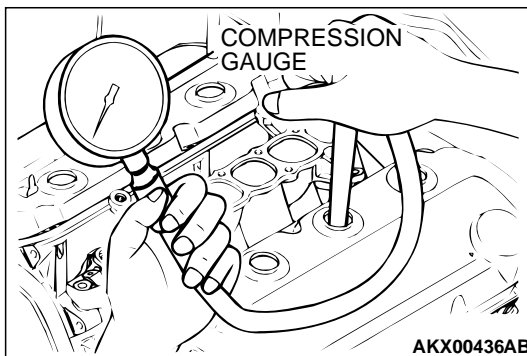
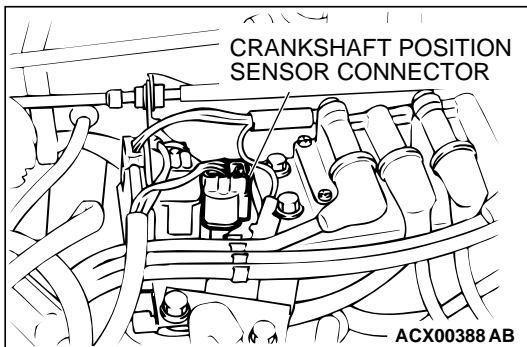
**Standard value (at engine speed of 250 – 400 r/min):
1,200 kPa (171 psi)**

**Minimum limit (at engine speed of 250 – 400 r/min):
890 kPa (127 psi)**

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

Limit: 98 kPa (14 psi)

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 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 crankshaft position sensor connector.
11. Install the spark plugs and spark plug cables.
12. Use the scan tool to erase the diagnostic trouble codes.

NOTE: This will erase the diagnostic trouble code resulting from the crankshaft position sensor connector being disconnected.

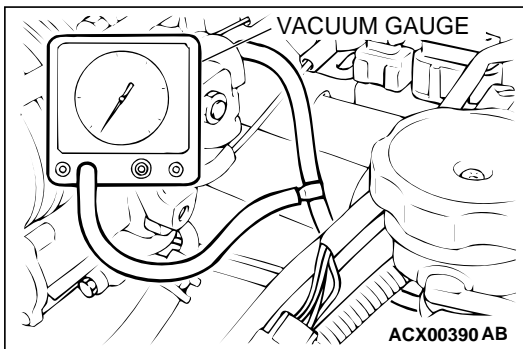
MANIFOLD VACUUM CHECK

M1111002700086

1. Before inspection, set vehicles in the following condition:
 - Engine coolant temperature: 80 – 95°C (176 – 203°F)
 - Lights and all accessories: OFF
 - Transmission: P range
2. Connect a tachometer.
3. Attach a Tee-fitting union to the vacuum hose between the fuel pressure regulator and the intake manifold plenum, and connect a vacuum gauge.
4. Start the engine and check that idle speed is within specification. Then check the vacuum gauge reading.

Idle speed: 700 ± 100 r/min

Minimum limit: 60 kPa (18 in Hg)



LASH ADJUSTER CHECK

M1111002900091

If an abnormal noise (chattering noise) suspected to be caused by malfunction of the lash adjuster is produced immediately after starting the engine and does not disappear, perform the following check.

NOTE: An abnormal noise due to malfunction of the lash adjuster is produced immediately after starting the engine and changes with the engine speed, irrespective of the engine load. If, the abnormal noise is not produced immediately after starting the engine or does not change with the engine speed, or it changes with the engine load, the lash adjuster is not the cause for the abnormal noise.

NOTE: When the lash adjuster is malfunctioning, the abnormal noise is rarely eliminated by continuing the warming-up of the engine at idle speed.

However, the abnormal noise may disappear only when seizure is caused by oil sludge in the engine whose oil is not maintained properly.

1. Start the engine.
2. Check if the abnormal noise produced immediately after starting the engine, changes with the change in the engine speed.

If the abnormal noise is not produced immediately after starting the engine or it does not change with the engine speed, the lash adjuster is not the cause for the noise. Therefore, investigate other causes. The abnormal noise is probably caused by some other parts than the engine proper if it does not change with the engine speed. (In this case, the lash adjuster is in good condition.)

3. With the engine idling, change the engine load (shift from N to D range, for example) to make sure that there is no change in the level of abnormal noise.

If there is a change in the level of abnormal noise, suspect a tapping noise due to worn crankshaft bearing or connecting rod bearing (In this case, the lash adjuster is in good condition.).

4. After completion of warm-up, run the engine at idle to check for abnormal noise.

If the noise is reduced or disappears, clean the lash adjuster (Refer to GROUP 11D, Rocker Arms and Camshaft – Inspection P.11D-23.). As it is suspected that the noise is due to seizure of the lash adjuster. If there is no change in the level of the abnormal noise, proceed to step 5.

5. Run the engine to bleed the lash adjuster system (Refer to P.11C-10.).
6. If the abnormal noise does not disappear after air bleeding operation, clean the lash adjuster (Refer to GROUP 11D, Rocker Arms and Camshaft – Inspection P.11B-23.).

Bleeding lash adjuster system

NOTE: Parking the vehicle on a grade for a long time may decrease oil in the lash adjuster, causing air to enter the high pressure chamber when starting the engine.

NOTE: After parking for many hours, oil may run out from the oil passage and take time before oil is supplied to the lash adjuster, causing air to enter the high pressure chamber.

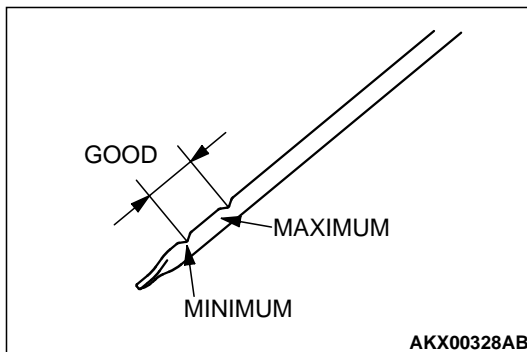
NOTE: In the above cases, abnormal noise can be eliminated by bleeding the lash adjuster system.

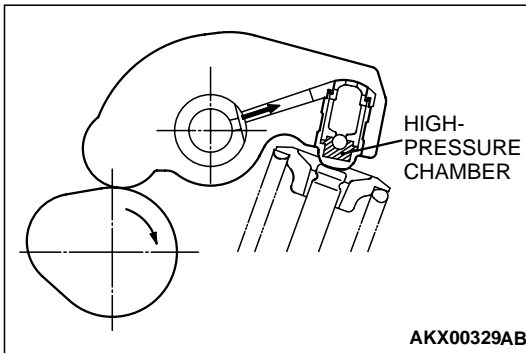
1. Check engine oil and add or change oil if required.

NOTE: If the engine oil level is low, air is sucked from the oil screen, causing air to enter the oil passage.

NOTE: If the engine oil level is higher than specification, oil may be stirred by the crankshaft, causing oil to be mixed with a large quantity of air.

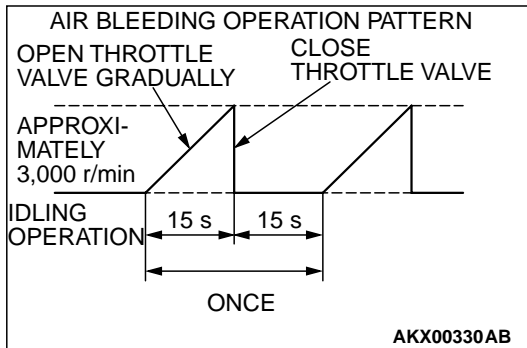
NOTE: If oil is deteriorated, air is not easily separated from oil, increasing the quantity of air contained in oil.





NOTE: If air mixed with oil enters the high pressure chamber inside the lash adjuster from the above causes, air in the high pressure chamber is compressed excessively while the valve is opened, resulting in an abnormal noise when the valve closes. This is the same phenomenon as that observed when the valve clearance has become excessive. The lash adjuster can resume normal function when air entered the lash adjuster is removed.

2. Idle the engine for one to three minutes to warm it up.



3. Repeat the operation pattern, shown in left figure, at no load to check for abnormal noise. (Usually the abnormal noise is eliminated after repetition of the operation 10 to 30 times. If, however, no change is observed in the level of abnormal noise after repeating the operation more than 30 times, suspect that the abnormal noise is due to some other factors.)

4. After elimination of abnormal noise, repeat the operation shown in left figure five more times.

5. Run the engine at idle for one to three minutes to make sure that the abnormal noise has been eliminated.

ENGINE ASSEMBLY

REMOVAL AND INSTALLATION

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CAUTION

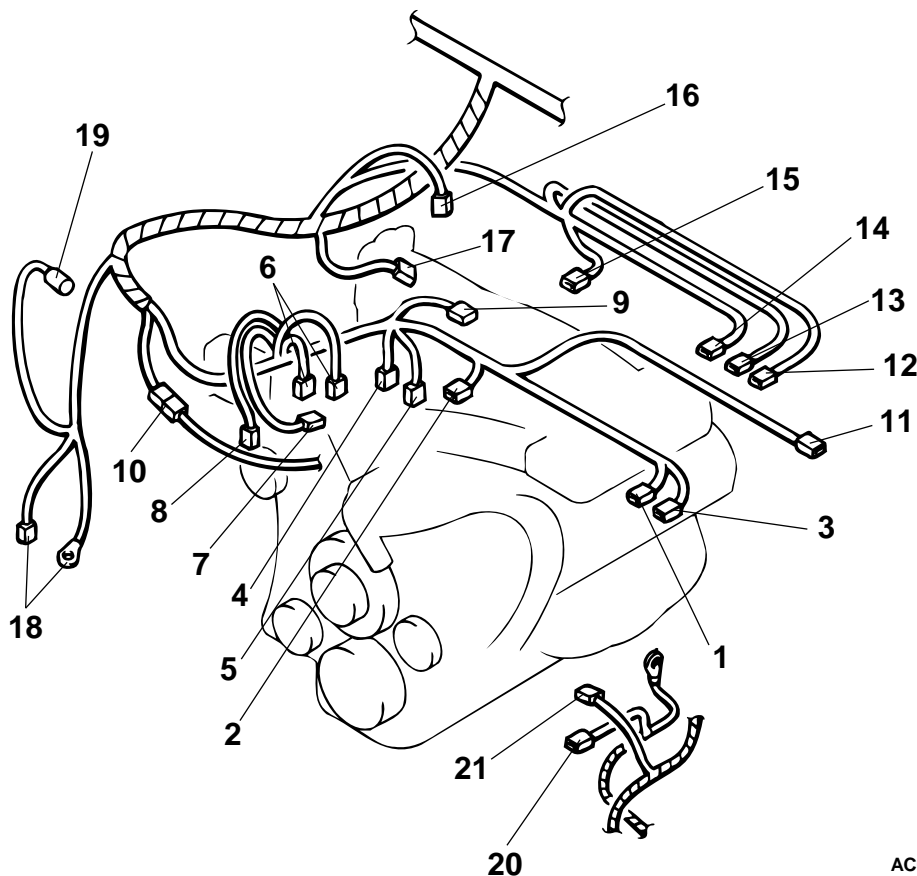
*: Indicates parts which should be initially tightened, and then fully tightened after placing the vehicle horizontal and loading the full weight of the engine on the vehicle body.

Pre-removal Operation

- Hood Removal (Refer to GROUP 42, Hood [P.42-7.](#))
- Fuel Line Pressure Reduction (Refer to GROUP 13A, On-vehicle Service [P.13Aa-15.](#))
- Air Cleaner and Air Intake Hose Removal (Refer to GROUP 15, Air Cleaner [P.15-4.](#))
- Battery Removal
- Radiator Removal (Refer to GROUP 14, Radiator [P.14-8.](#))
- Front Exhaust Pipe Removal (Refer to GROUP 15, Exhaust Pipe and Main Muffler [P.15-14.](#))
- Transmission Assembly Removal (Refer to GROUP 23A, Transmission Assembly [P.23Aa-38.](#))

Post-installation Operation

- Transmission Assembly Installation (Refer to GROUP 23A, Transmission Assembly [P.23Aa-38.](#))
- Front Exhaust Pipe Installation (Refer to GROUP 15, Exhaust Pipe and Main Muffler [P.15-14.](#))
- Radiator Installation (Refer to GROUP 14, Radiator [P.14-8.](#))
- Battery Installation
- Air Cleaner and Air Intake Hose Installation (Refer to GROUP 15, Air Cleaner [P.15-4.](#))
- Hood Installation (Refer to GROUP 42, Hood [P.42-7.](#))
- Drive Belt Tension Adjustment (Refer to [P.11C-5.](#))
- Accelerator Cable Adjustment (Refer to GROUP 17, On-vehicle Service [P.17-4.](#))



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REMOVAL STEPS

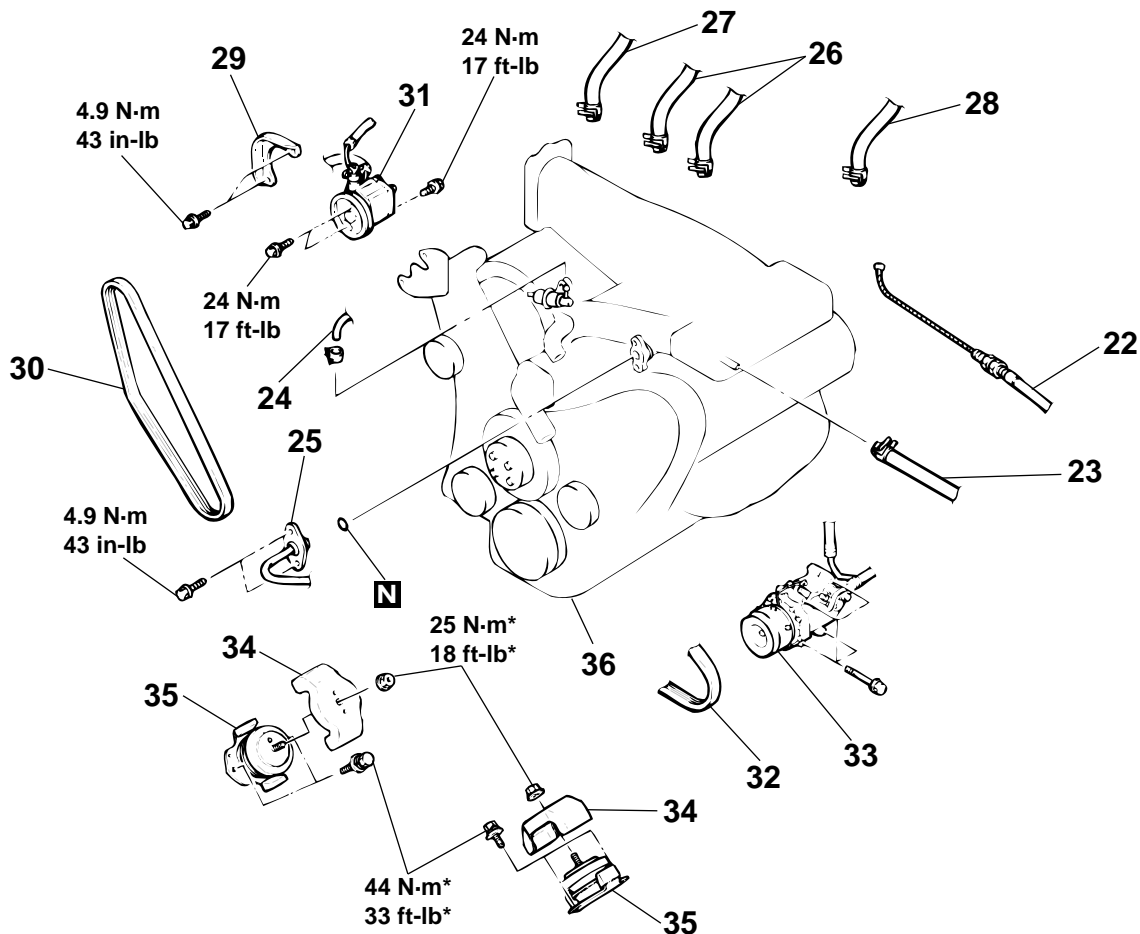
1. IGNITION COIL 1 CONNECTOR
2. IGNITION COIL 2 CONNECTOR
3. IGNITION COIL 3 CONNECTOR
4. CAMSHAFT POSITION SENSOR CONNECTOR

REMOVAL STEPS (Continued)

5. CAMSHAFT POSITION SENSOR CONNECTOR
6. IGNITION POWER TRANSISTOR CONNECTOR
7. CAPACITOR CONNECTOR

REMOVAL STEPS (Continued)

8. ENGINE COOLANT
TEMPERATURE SENSOR
CONNECTOR
9. ENGINE COOLANT
TEMPERATURE GAUGE UNIT
CONNECTOR
10. FRONT WIRING HARNESS AND
INJECTION WIRING HARNESS
COMBINATION CONNECTOR
11. MANIFOLD DIFFERENTIAL
PRESSURE SENSOR
12. EGR SOLENOID CONNECTOR
13. EVAPORATIVE EMISSION
PURGE SOLENOID CONNECTOR
14. LEFT BANK HEATED OXYGEN
SENSOR CONNECTOR (FRONT)
15. RIGHT BANK HEATED OXYGEN
SENSOR CONNECTOR (FRONT)
16. THROTTLE POSITION SENSOR
CONNECTOR
17. IDLE AIR CONTROL MOTOR
CONNECTOR
18. GENERATOR CONNECTOR
19. POWER STEERING PRESSURE
SWITCH CONNECTOR
20. MAGNETIC CLUTCH AND
REFRIGERANT TEMPERATURE
SWITCH CONNECTOR
21. OIL PRESSURE SWITCH
CONNECTOR



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- | | | |
|--|-------------|-------------------------------------|
| 22. THROTTLE CABLE CONNECTION | | 30. DRIVE BELT (FOR POWER STEERING) |
| 23. VACUUM HOSE CONNECTION | <<A>> | 31. POWER STEERING PUMP ASSEMBLY |
| 24. FUEL RETURN HOSE CONNECTION | | 32. DRIVE BELT (FOR A/C) |
| 25. HIGH-PRESSURE FUEL HOSE CONNECTION | <<A>> | 33. A/C COMPRESSOR ASSEMBLY |
| 26. HEATER HOSE CONNECTION | | 34. FRONT INSULATOR STOPPER |
| 27. HEATER HOSE CONNECTION <VEHICLES WITH REAR HEATER> | <> >>A<< | 35. ENGINE MOUNT INSULATOR |
| 28. VACUUM HOSE CONNECTION | | 36. ENGINE ASSEMBLY |
| 29. POWER STEERING DRIVE BELT COVER | | |

Required Special Tool:
MB991683: Sling Chain Set

REMOVAL SERVICE POINTS

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

1. Remove the oil pump and A/C compressor (with the hose attached).

2. Suspend the removed oil pump (by using wire or similar material) at a place where no damage will be caused during removal/installation of the engine assembly.

<> ENGINE ASSEMBLY REMOVAL

1. Check that all cables, hoses, harness connectors, etc. are disconnected from the engine.
2. Use special tool MB991683 and chain block to lift the engine assembly slowly and remove it.

INSTALLATION SERVICE POINT

>>A<< ENGINE ASSEMBLY INSTALLATION

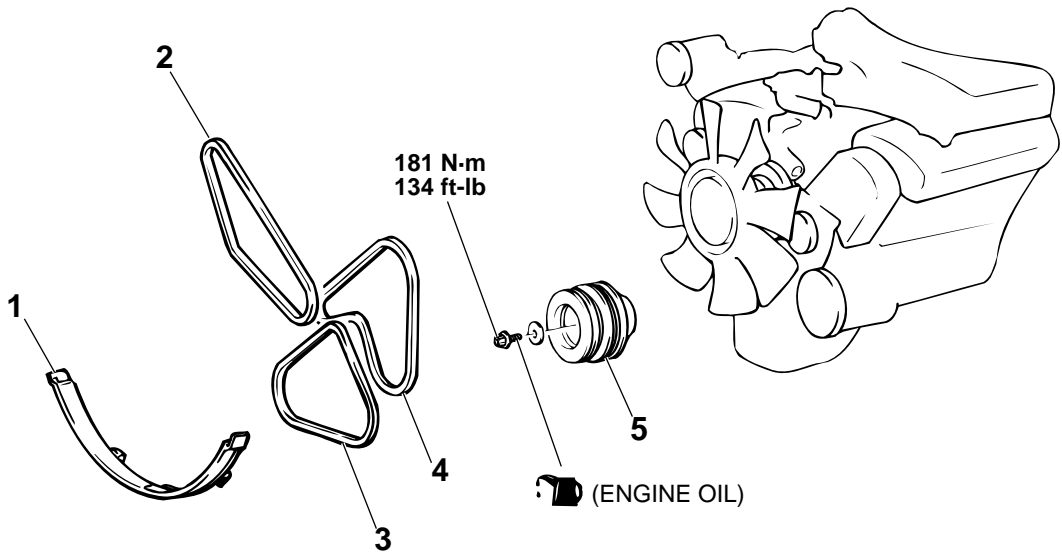
Install the engine assembly. When doing so, check carefully that all pipes and hoses are connected, and that none are twisted, damaged, etc.

CRANKSHAFT PULLEY

REMOVAL AND INSTALLATION

M1112001600238

Pre-removal Operation <ul style="list-style-type: none">• Skid Plate and Under Cover Removal	Post-installation Operation <ul style="list-style-type: none">• Drive Belt Tension Adjustment (Refer to P.11C-5.)• Skid Plate and Under Cover Installation
---	--



ACX00324 AB

REMOVAL STEPS

1. RADIATOR SHROUD COVER
2. DRIVE BELT (FOR POWER STEERING OIL PUMP)
3. DRIVE BELT (FOR GENERATOR)
4. DRIVE BELT (FOR A/C)
5. CRANKSHAFT PULLEY

Required Special Tools:

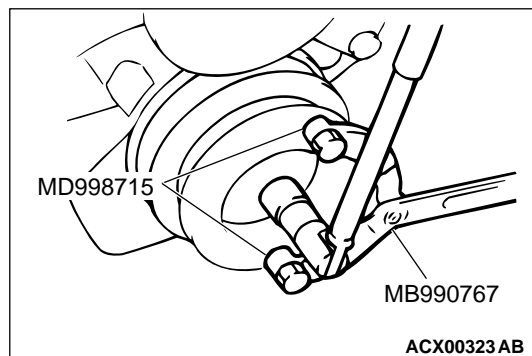
- MB990767: End Yoke Holder
- MD998715: Crankshaft Pulley Holder Pin

<<A>> >>A<<

REMOVAL SERVICE POINT

<<A>> CRANKSHAFT PULLEY REMOVAL

Use special tools MD998715 and MB990767 to remove the crankshaft pulley from the crankshaft.



INSTALLATION SERVICE POINT

>>A<< CRANKSHAFT PULLEY INSTALLATION

Use special tools MD998715 and MB990767 in the same way as during removal to install the crankshaft pulley.

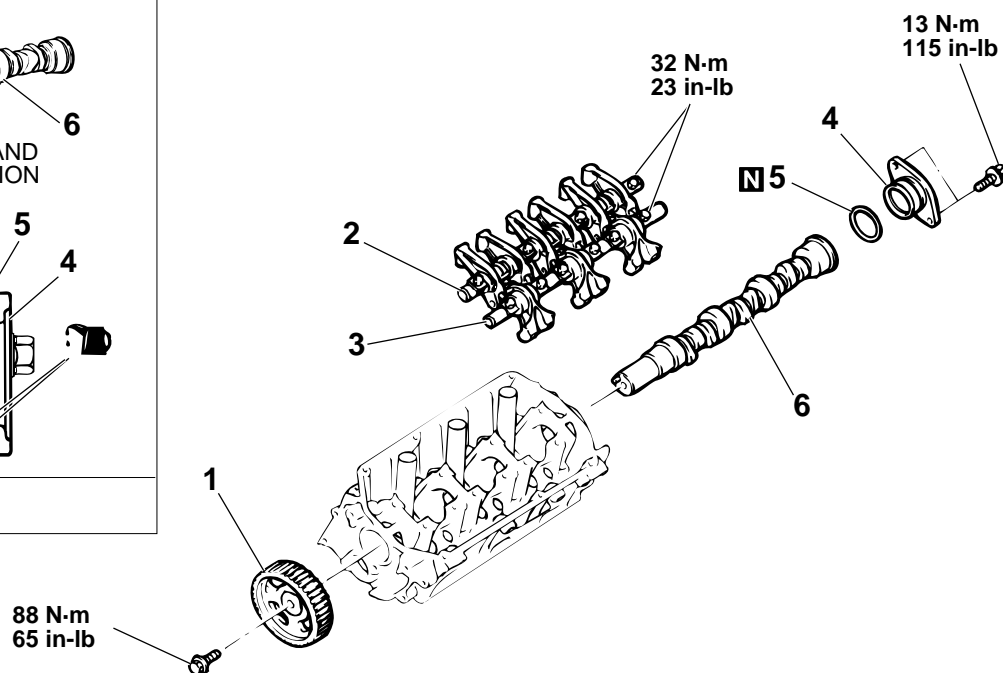
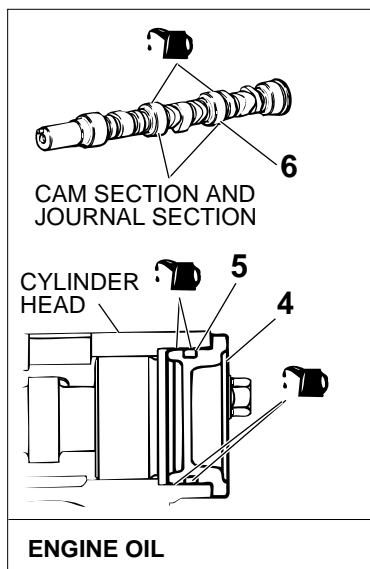
CAMSHAFT

REMOVAL AND INSTALLATION

M1112023100082

Pre-removal and Post-installation Operation

- Cylinder Head Assembly Removal and Installation (Refer to P.11C-27.)



ACX00382AB

- | | | | |
|-------|-------|----|---|
| <<A>> | >>B<< | 1. | CAMSHAFT SPROCKET |
| <> | >>A<< | 2. | ROCKER ARM AND SHAFT ASSEMBLY(INTAKE SIDE) |
| <> | >>A<< | 3. | ROCKER ARM AND SHAFT ASSEMBLY(EXHAUST SIDE) |
| | | 4. | THRUST CASE |

REMOVAL STEPS (Continued)

5. O-RING
6. CAMSHAFT

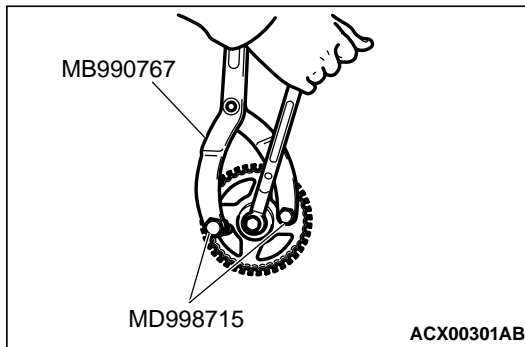
Required Special Tools:

- MB990767: End Yoke Holder
- MD998443: Auto-lash Adjuster Holder
- MD998715: Crankshaft Pulley Holder Pin

REMOVAL SERVICE POINTS

<<A>> CAMSHAFT SPROCKET REMOVAL

Use special tools MD998715 and MB990767 to remove the camshaft sprocket.



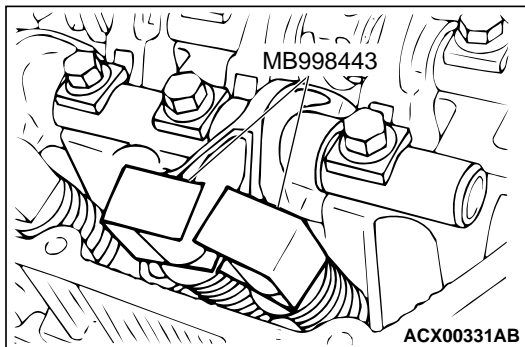
<> ROCKER ARM AND SHAFT ASSEMBLY REMOVAL

1. Install special tool MD998443 as shown in the illustration so that the lash adjusters will not fall out.

CAUTION

Never disassemble the rocker arm and shaft assembly.

2. Loosen the rocker arm and shaft assembly mounting bolt, and then remove the rocker arm and shaft assembly with the bolt still attached.



INSTALLATION SERVICE POINTS

>>A<< ROCKER ARM AND SHAFT ASSEMBLY INSTALLATION

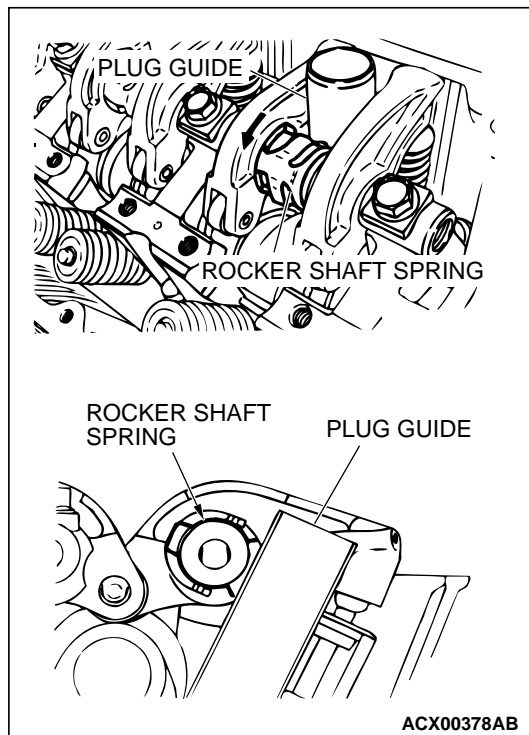
1. Temporarily tighten the rocker shaft with the bolt so that all rocker arms on the inlet valve side do not push the valves.
2. Fit the rocker shaft spring from the above and position it so that it is right angles to the plug guide.

NOTE: Install the rocker shaft spring before installing the rocker arm and rocker arm shaft on the exhaust side.

3. Tighten the rocker arm and shaft assembly mounting bolt to the specified.

Tightening torque: 32 N·m (23 ft-lb)

4. Remove the special tool for fixing the lash adjuster.



>>B<< CAMSHAFT SPROCKET INSTALLATION

Use special tools MD998715 and MB9980767 in the same way as during removal to install the camshaft sprocket.

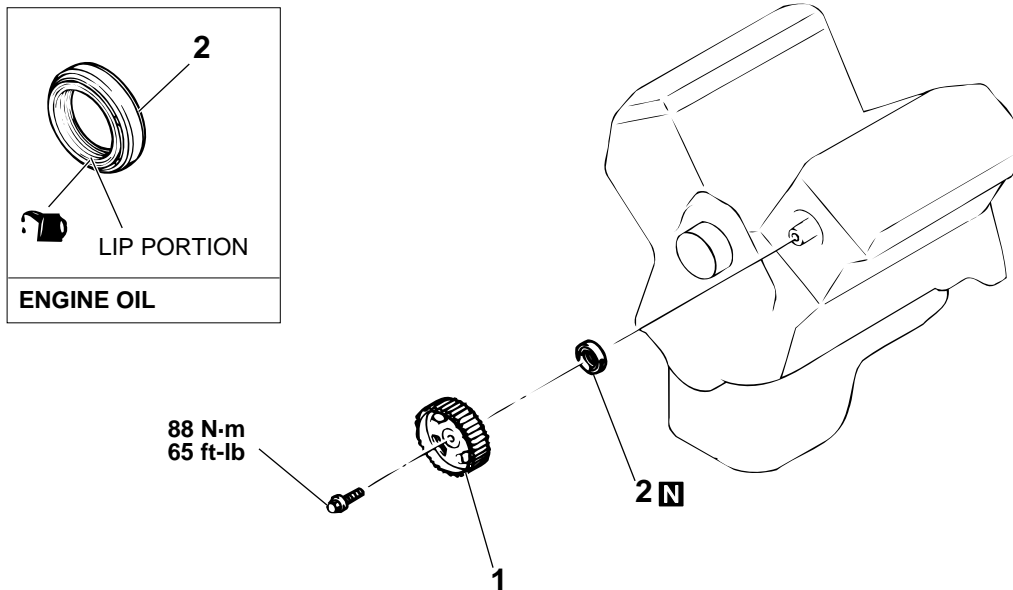
CAMSHAFT OIL SEAL

REMOVAL AND INSTALLATION

M1112002200136

Pre-removal and Post-installation Operation

- Timing Belt Removal and Installation (Refer to [P.11C-30.](#))



ACX00375 AB

- <<A>> >>B<< 1. CAMSHAFT SPROCKET
<> >>A<< 2. CAMSHAFT OIL SEAL

REMOVAL STEPS

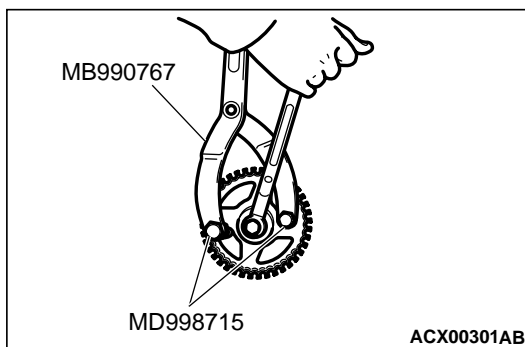
Required Special Tools:

- MB990767: End Yoke Holder
- MB991559: Camshaft Oil Seal Adapter
- MD998713: Camshaft Oil Seal Installer
- MD998715: Crankshaft Pulley Holder Pin

REMOVAL SERVICE POINTS

<<A>> CAMSHAFT SPROCKET REMOVAL

Use special tools MD998715 and MB990767 to remove the camshaft sprocket.



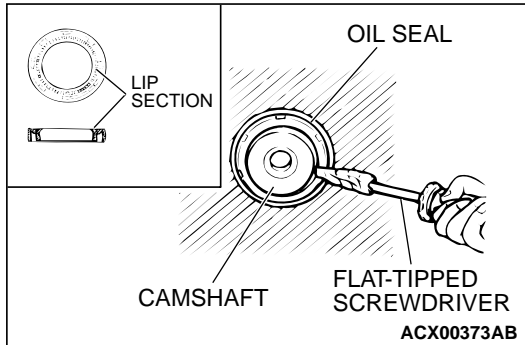
<> CAMSHAFT OIL SEAL REMOVAL

1. Make a notch in the oil seal lip section with a knife, etc.

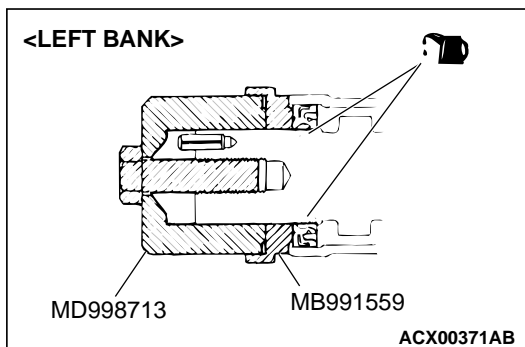
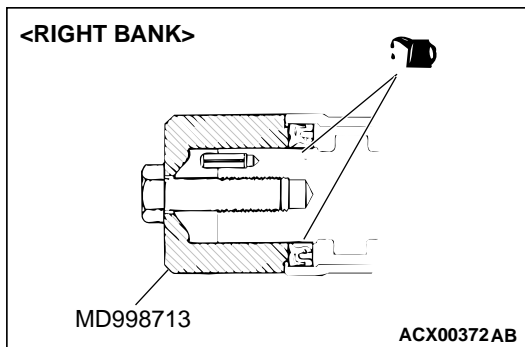
⚠ CAUTION

Be careful not to damage the camshaft and the cylinder head.

2. Cover the end of a flat-tipped screwdriver with a shop towel and insert into the notched section of the oil seal, and pry out the oil seal to remove it.

**INSTALLATION SERVICE POINTS****>>A<< CAMSHAFT OIL SEAL INSTALLATION**

1. Apply engine oil to the camshaft oil seal lip.
2. Use special tools MD998713 and MB991559 to press-fit the camshaft oil seal.

**>>B<< CAMSHAFT SPROCKET INSTALLATION**

Use special tools MD998715 and MB990767 in the same way as during removal to install the camshaft sprocket.

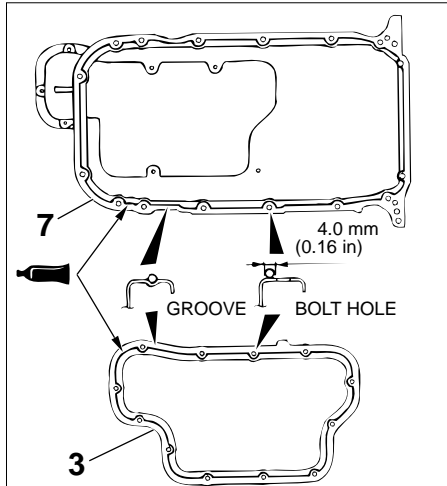
OIL PAN AND OIL SCREEN

REMOVAL AND INSTALLATION

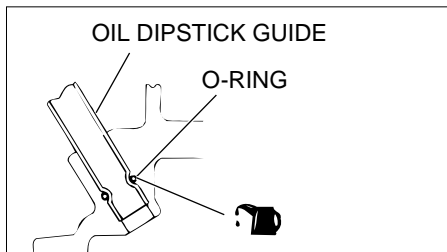
M1112002500159

Pre-removal and Post-installation Operation

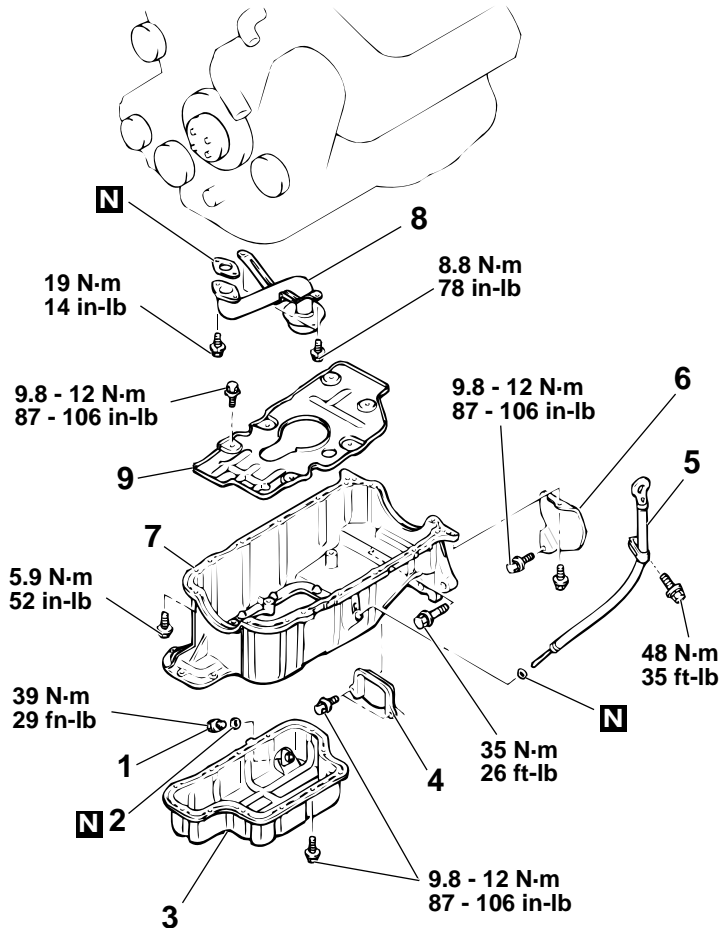
- Skid Plate and Under Cover Removal and Installation
- Engine Oil Draining and Refilling (Refer to GROUP 12, On-vehicle Service [P.12-3.](#))
- Generator Removal and Installation (Refer to GROUP 16, Generator [P.16-13.](#))
- Stabilizer Bar Removal and Installation (Refer to GROUP 33A, Stabilizer Bar [P.33A-15.](#))
- Front Exhaust Pipe Removal and Installation (Refer to GROUP 15, Exhaust Pipe and Main Muffler [P.15-14.](#))
- Front Differential Carrier Removal and Installation (Refer to GROUP 26, Front Differential Carrier [P.26-36.](#)) <4WD>



**SPECIFIED SEALANT: MITSUBISHI
GENUINE PART NO. MD970389 OR
EQUIVALENT**



ENGINE OIL



ACX00370 AB

REMOVAL STEPS

- <<A>> >>B<< 1. DRAIN PLUG
>>A<< 2. DRAIN PLUG GASKET
>>A<< 3. OIL PAN, LOWER
4. COVER
5. OIL DIPSTICK ASSEMBLY
6. COVER
>>A<< 7. OIL PAN, UPPER

REMOVAL STEPS (Continued)

8. OIL SCREEN
9. BAFFLE PLATE

Required Special Tool:

MD998727: Oil Pan Remover

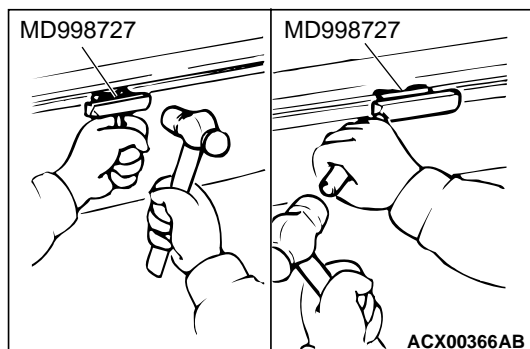
REMOVAL SERVICE POINT

<<A>> OIL PAN LOWER REMOVAL



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

After removing the oil pan mounting bolts, remove the oil pan with special tool MD998727 and brass bar.



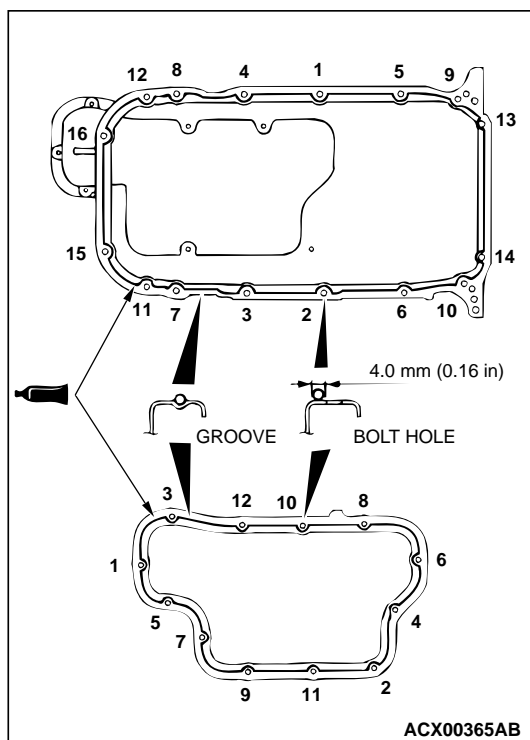
INSTALLATION SERVICE POINTS

>>A<< OIL PAN UPPER/OIL PAN LOWER INSTALLATION

1. Remove sealant from the oil pan and cylinder block mating surfaces.
2. Degrease the sealant-coated surface and the engine mating surface.
3. Apply MITSUBISHI genuine part number MD970389 or equivalent around the gasket surface of oil pan as specified in the illustration.

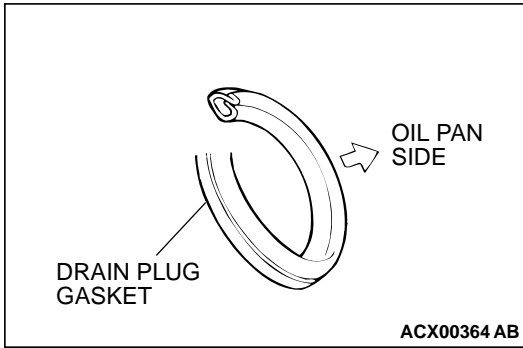
NOTE: The sealant should be applied in a continuous bead approximately 4.0 mm (0.16 inch) in diameter.

4. Assemble the oil pan to the cylinder block within 30 minutes after applying the sealant.
5. Tighten the bolts in order of the numbers shown in the illustration.



>>B<< DRAIN PLUG GASKET INSTALLATION

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



INSPECTION

M1112002600093

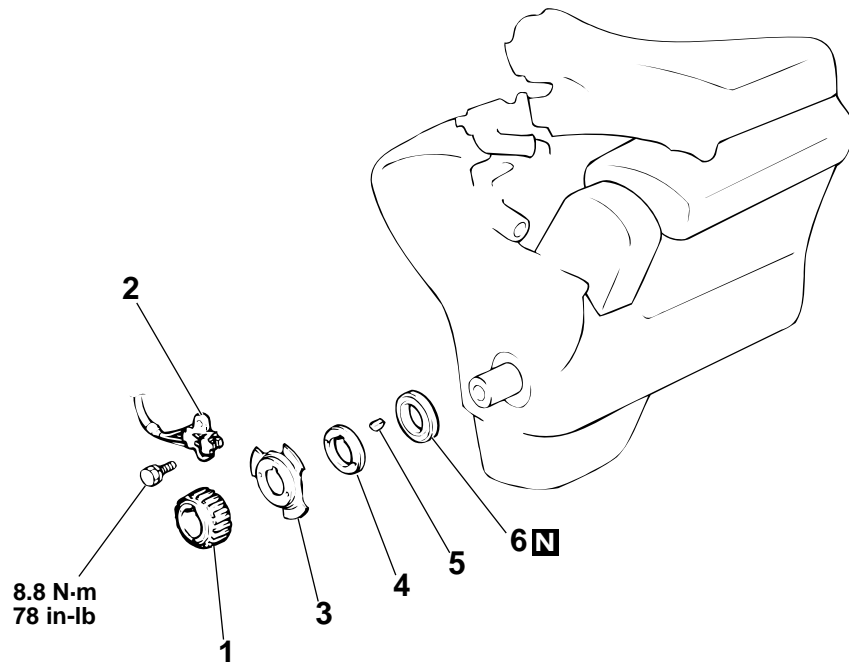
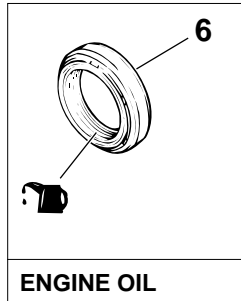
- Check the oil pan for cracks.
- Check the oil pan sealant-coated surface for damage and deformation.
- Check the oil screen for cracked, clogged or damaged wire net and pipe.

CRANKSHAFT FRONT OIL SEAL**REMOVAL AND INSTALLATION**

M1112003400348

Pre-removal and Post-installation Operation

- Timing Belt Removal and Installation (Refer to [P.11C-30.](#))



ACX00362AB

REMOVAL STEPS

- >>B<< 1. CRANKSHAFT SPROCKET
 >>B<< 2. CRANKSHAFT POSITION
 SENSOR
 >>B<< 3. CRANKSHAFT SENSING BLADE
 >>B<< 4. CRANKSHAFT SPACER

REMOVAL STEPS (Continued)

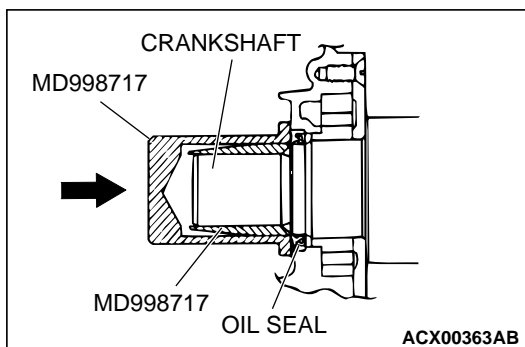
5. KEY
 >>A<< 6. CRANKSHAFT FRONT OIL SEAL

Required Special Tool:

MD998717: Crankshaft Front Oil Seal Installer

INSTALLATION SERVICE POINTS**>>A<< CRANKSHAFT FRONT OIL SEAL INSTALLATION**

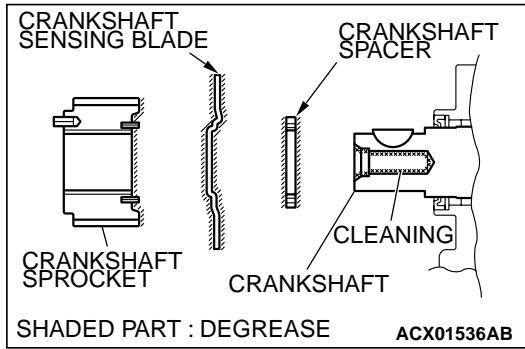
1. Apply a small amount of engine oil to the oil seal lip and then insert.
2. Using special tool MD998717, tap the oil seal into the front case.



ACX00363AB

>>B<< CRANKSHAFT SPACER/CRANKSHAFT SENSING BLADE/CRANKSHAFT SPROCKET INSTALLATION

To prevent the crankshaft pulley mounting bolt from loosening, degrease or clean the crankshaft, the crankshaft spacer, the crankshaft sensing blade and the crankshaft at the shown positions.



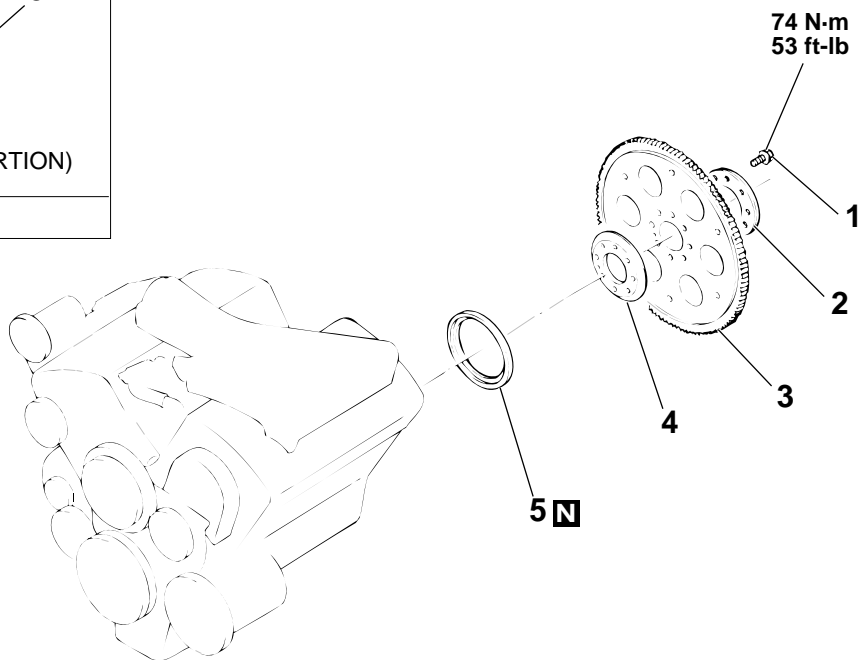
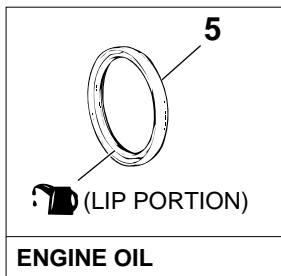
CRANKSHAFT REAR OIL SEAL

REMOVAL AND INSTALLATION

M1112003700349

Pre-removal and Post-installation Operation

- Transmission and Transfer Assembly Removal and Installation (Refer to GROUP 23A, Transmission Assembly P.23Aa-38.)



ACX00359 AD

<<A>> >>B<<

REMOVAL STEPS

1. DRIVE PLATE BOLT
2. ADAPTOR PLATE
3. DRIVE PLATE
4. CRANKSHAFT ADAPTOR
5. CRANKSHAFT REAR OIL SEAL

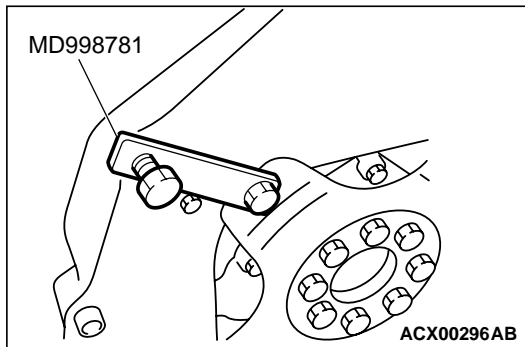
>>A<<

Required Special Tools:

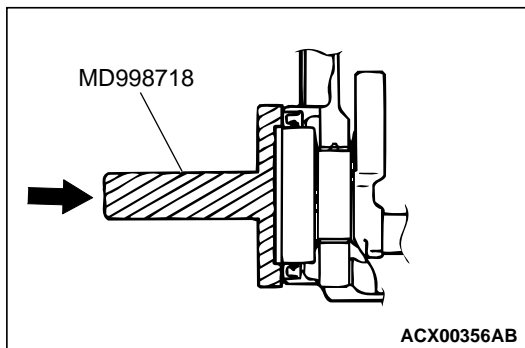
- MD998718: Crankshaft Rear Oil Seal Installer
- MD998781: Flywheel Stopper

REMOVAL SERVICE POINT**<<A>> CRANKSHAFT REAR OIL SEAL INSTALLATION**

Use special tool MD998781 to secure the drive plate and remove the drive plate bolt.

**INSTALLATION SERVICE POINTS****>>A<< CRANKSHAFT REAR OIL SEAL INSTALLATION**

1. Apply a small amount of engine oil to the entire circumference of the oil seal lip.
2. Use special tool MD998718 to tap in the oil seal as shown in the illustration.

**>>B<< DRIVE PLATE BOLT INSTALLATION**

Use special tool MD998781 in the same way as during removal to install the drive plate bolt.

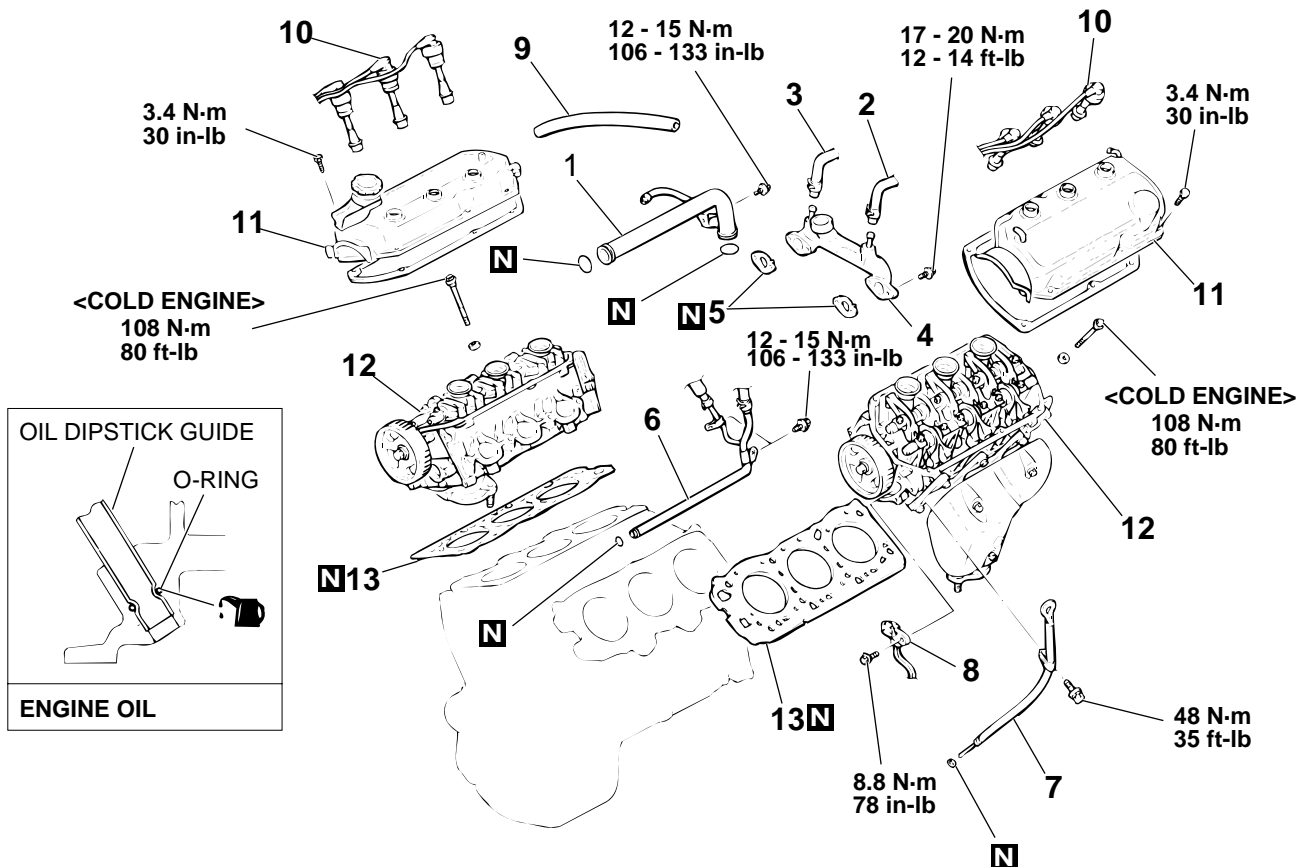
CYLINDER HEAD GASKET

REMOVAL AND INSTALLATION

M1112004000462

Pre-removal and Post-installation Operation

- Intake Manifold Removal and Installation (Refer to GROUP 15, Intake Manifold P.15-9.)
- Timing Belt Removal and Installation (Refer to P.11C-30.)
- Front Exhaust Pipe Removal and Installation (Refer to GROUP 15, Exhaust Pipe and Main Muffler P.15-14.)



ACX00355 AB

REMOVAL STEPS

1. WATER OUTLET PIPE ASSEMBLY
2. HEATER HOSE CONNECTION
3. HEATER HOSE CONNECTION <VEHICLES WITH REAR HEATER>
4. WATER PASSAGE ASSEMBLY
5. GASKET
6. WATER PIPE AND HOSE ASSEMBLY
7. OIL DIPSTICK ASSEMBLY <WHEN REMOVING LEFT BANK ONLY>

REMOVAL STEPS (Continued)

8. CAMSHAFT POSITION SENSOR <WHEN REMOVING LEFT BANK ONLY>
9. BREATHER HOSE
10. SPARK PLUG CABLE
11. ROCKER COVER
12. CYLINDER HEAD ASSEMBLY
13. CYLINDER HEAD GASKET

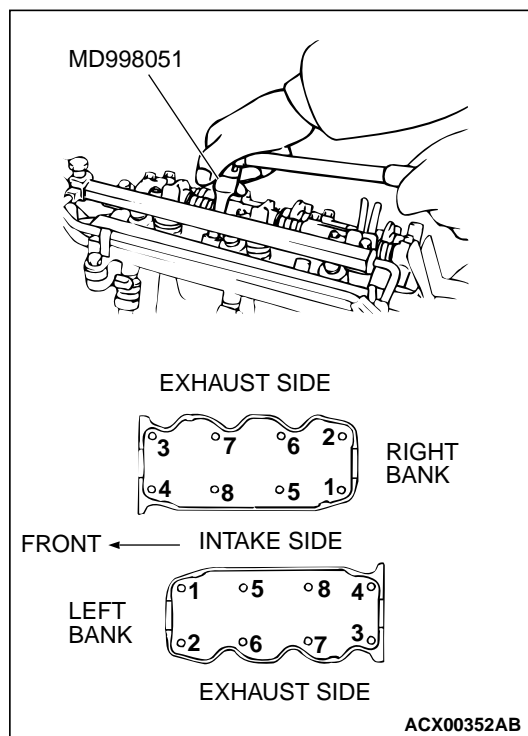
Required Special Tool:

MD998051: Cylinder Head Bolt Wrench

REMOVAL SERVICE POINT

<<A>> CYLINDER HEAD ASSEMBLY REMOVAL

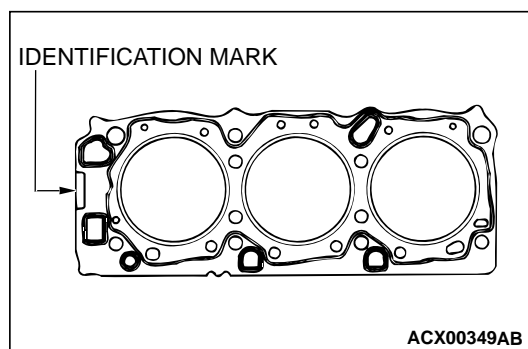
Use special tool MD998051 to tighten each bolt two or three steps in the order shown in the illustration.



INSTALLATION SERVICE POINTS

>>A<< CYLINDER HEAD GASKET INSTALLATION

1. Degrease the cylinder head and cylinder block gasket mounting surfaces.
2. Make sure that the gasket has the proper identification mark for the engine.
3. Lay the cylinder head gasket on the cylinder block with the identification mark at the front top.



>>B<< CYLINDER HEAD ASSEMBLY INSTALLATION

⚠ CAUTION

Be careful that no foreign material gets into the cylinder, coolant passages or oil passages. Engine damage may result.

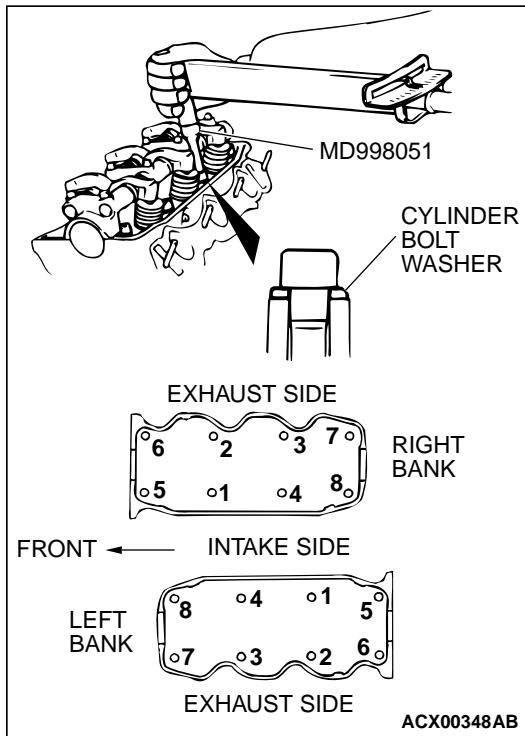
1. Use a scraper to clean the gasket surface of the cylinder head assembly.

⚠ CAUTION

Install the head bolt washers with the beveled side facing upwards as shown in the illustration.

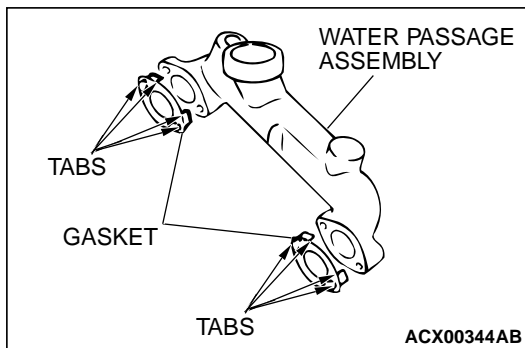
- Using special tool MD998051 and a torque wrench, tighten the bolts to the specified torque in the order shown in the illustration. (in two or three cycles)

Tightening torque: 108 N·m (80 ft-lb)



>>C<< GASKET/WATER PASSAGE ASSEMBLY INSTALLATION

Bend the tabs onto the water passage assembly. Then install the water passage assembly to the cylinder head so that the gasket doesn't slip.



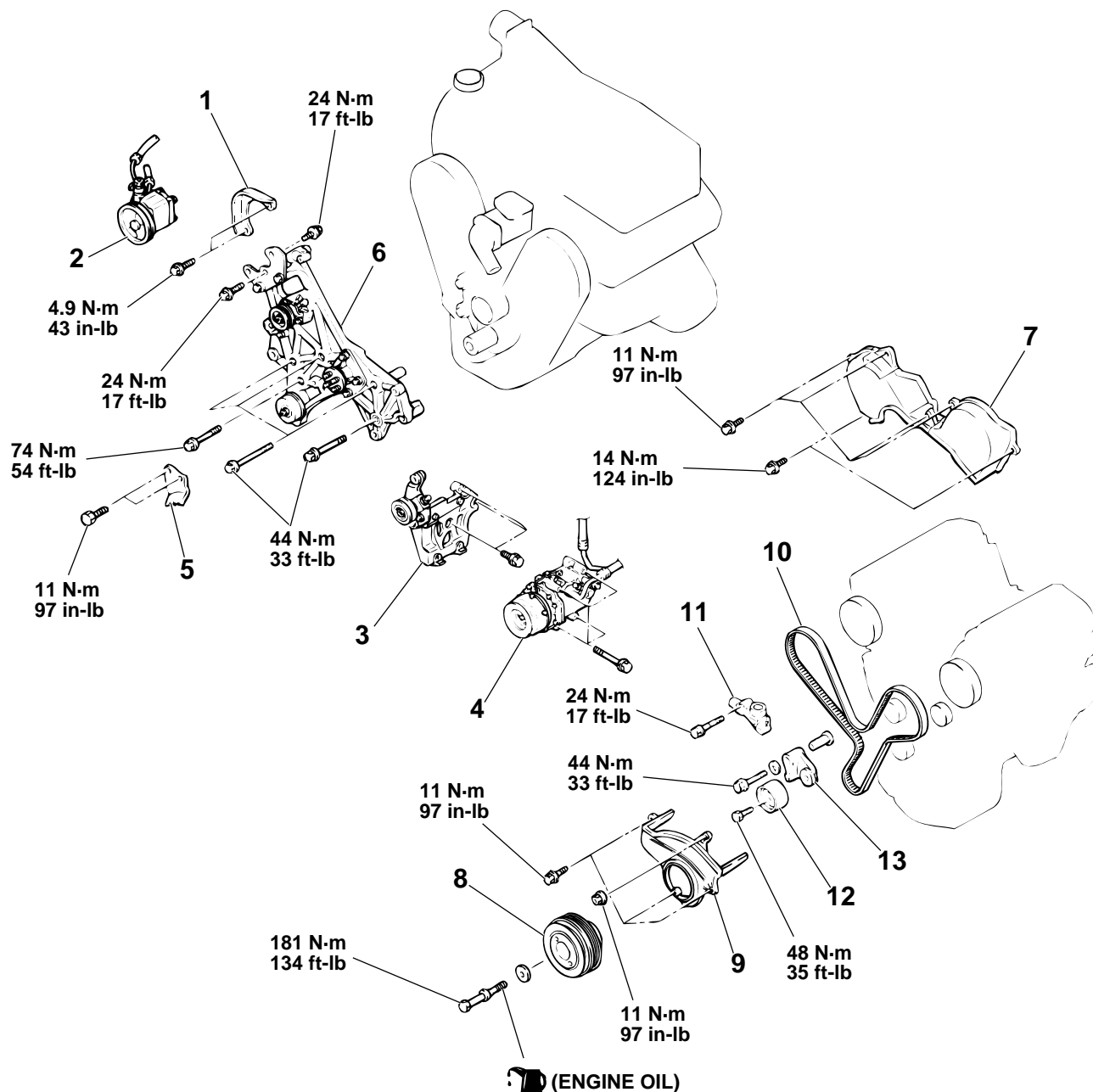
TIMING BELT

REMOVAL AND INSTALLATION

M1112004300463

Pre-removal and Post-installation Operation

- Engine Coolant Draining and Refilling (Refer to GROUP 14, On-vehicle Service [P.14-5.](#))
- Cooling Fan Removal and Installation (Refer to GROUP 14, Cooling Fan [P.14-10.](#))
- Generator Removal and Installation (Refer to GROUP 16, Generator [P.16-13.](#))



ACX00343 AB

REMOVAL STEPS

- | | | |
|-------|----|----------------------------------|
| | 1. | POWER STEERING DRIVE COVER |
| <<A>> | 2. | POWER STEERING OIL PUMP ASSEMBLY |
| <<A>> | 3. | A/C COMPRESSOR ASSEMBLY |
| | 4. | COMPRESSOR BRACKET |
| | 5. | TIMING INDICATOR BRACKET |

REMOVAL STEPS (Continued)

- | | | |
|-------|-------|-------------------------------------|
| | 6. | ACCESSORY MOUNT ASSEMBLY |
| | 7. | TIMING BELT UPPER COVER
ASSEMBLY |
| <> | >>C<< | 8. CRANKSHAFT PULLEY |
| | 9. | TIMING BELT LOWER COVER
ASSEMBLY |
| <<C>> | >>B<< | 10. TIMING BELT |

TSB Revision

- >>A<<**
- REMOVAL STEPS (Continued)**
11. AUTO-TENSIONER
 12. TENSION PULLEY
 13. TENSIONER ARM ASSEMBLY

Required Special Tools:

- MB990767: End Yoke Holder
- MD998715: Crankshaft Pulley Holder Pin
- MD998767: Tension Pulley Socket Wrench
- MD998769: Crankshaft Pulley Spacer

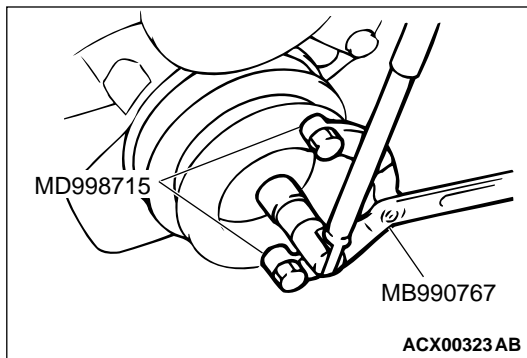
REMOVAL SERVICE POINTS

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

1. Do not disconnect the hoses to remove the pump and compressor.
2. Support the removed pump and compressor with a wire, etc. so that they will not get in the way while working.

<> CRANKSHAFT PULLEY REMOVAL

Use special tools MD998715 and MB990767 to remove the crankshaft pulley from the crankshaft.

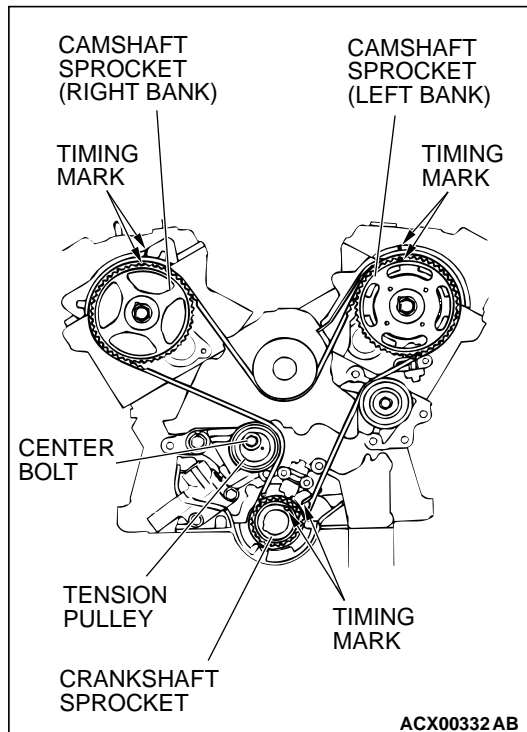


<<C>> TIMING BELT REMOVAL

⚠ CAUTION

Never turn the crankshaft counterclockwise.

1. Turn the crankshaft clockwise to align each timing mark and to set the number 1 cylinder to compression top dead center.
2. If the timing belt is to be reused, chalk mark the flat side of the belt with an arrow indicating the clockwise direction.
3. Loosen the center bolt of the tension pulley, and then remove the timing belt.



INSTALLATION SERVICE POINTS

>>A<< AUTO-TENSIONER INSTALLATION

1. While holding the auto-tensioner by hand, press the end of the pushrod against a metal surface (such as the cylinder block) with a force of 98 – 196 N·m (72 – 145 ft-lb) and measure how far the pushrod is pushed in.

Standard value: Within 1 mm (0.04 inch)

A: Length when no force is applied

B: Length when force is applied

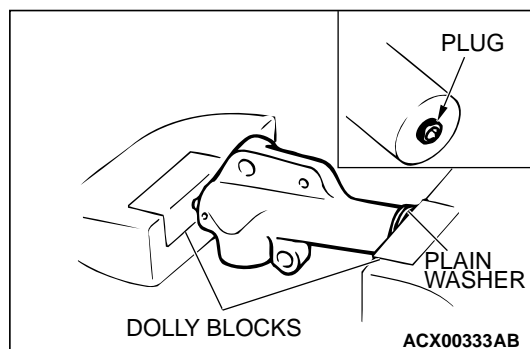
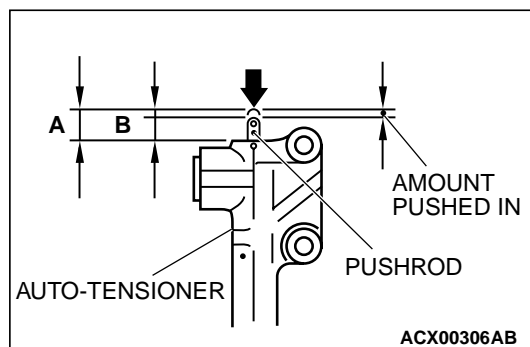
A – B: Amount pushed in

2. If it is not within the standard value, replace the auto-tensioner.

⚠ CAUTION

- Place the auto-tensioner perpendicular to the jaws of the vice.
- If there is a plug at the base of the auto-tensioner, insert a plain washer onto the end of the auto-tensioner to protect the plug.

3. Place two dolly blocks in a vice as shown in the illustration, and then place the auto-tensioner in the vice.



⚠ CAUTION

Never compress the pushrod too fast, or the pushrod may be damaged.

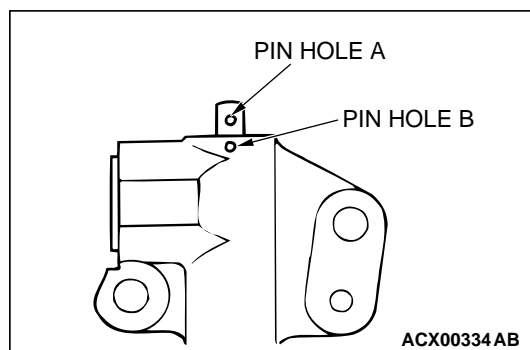
4. Slowly compress the pushrod of the auto-tensioner until pin hole A in the pushrod is aligned with pin hole B in the cylinder.
5. Insert the setting pin into the pin holes once they are aligned.

NOTE: If replacing the auto-tensioner, the pin will already be inserted into the pin holes of the new part.

⚠ CAUTION

Do not remove the setting pin from the auto-tensioner.

6. Install the auto-tensioner to the engine.



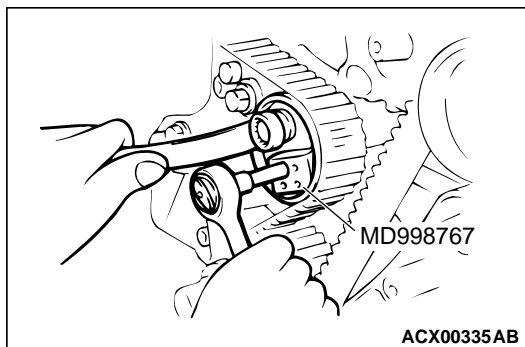
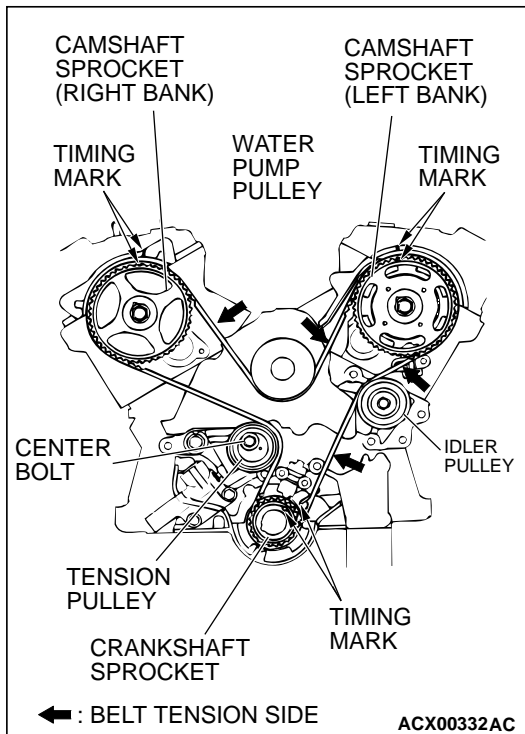
>>B<< TIMING BELT INSTALLATION

1. Align the timing marks of the camshaft sprocket with those of crankshaft sprocket.

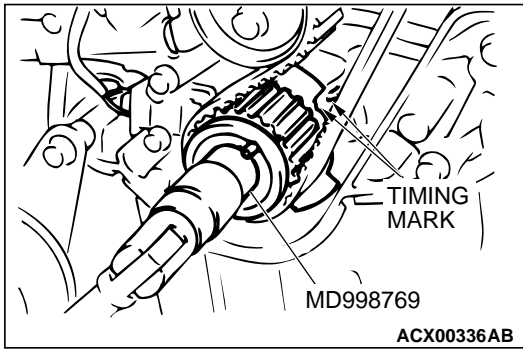
⚠ CAUTION

The camshaft sprocket (right side) can turn easily due to the spring force applied, so be careful not to get your fingers caught.

2. Install the timing belt by the following procedure so that there is no deflection in the timing belt between each sprocket and pulley.
 - (1) Crankshaft sprocket
 - (2) Idler pulley
 - (3) Camshaft sprocket (Left side)
 - (4) Water pump pulley
 - (5) Camshaft sprocket (Right side)
 - (6) Tension pulley
3. Turn the camshaft sprocket counterclockwise until the tension side of the timing belt is firmly stretched. Check all timing marks again.



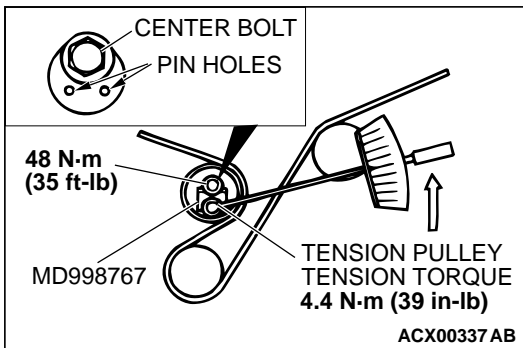
4. Use special tool MD998767 to push the tensioner pulley into the timing belt, and then temporarily tighten the center bolt.



5. Use special tool MD998769 to turn the crankshaft 1/4 turn counterclockwise and then turn it again clockwise until the timing marks are aligned.

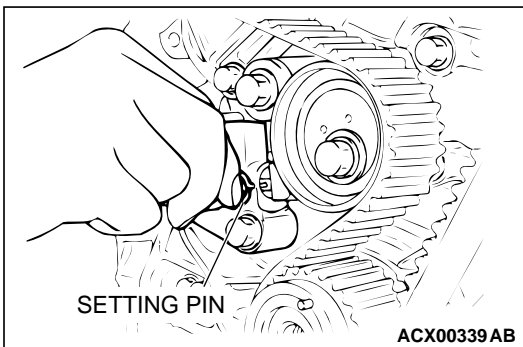
⚠ CAUTION

When tightening the center bolt, be careful that the tensioner pulley does not turn with the bolt.

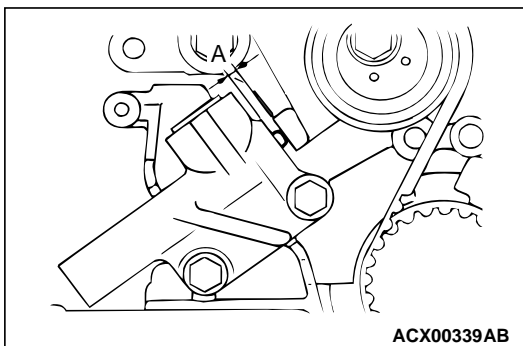


6. Loosen the center bolt of the tensioner pulley. Use special tool MD998767 and a torque wrench to apply the standard torque to the timing belt as shown in the illustration. Then tighten the center bolt to the specified torque.

- **Standard value: 4.4 N·m (39 in-lb) <Timing belt tension torque>**
- **Tightening torque: 48 N·m (35 ft-lb)**



7. Remove the setting pin that has been inserted into the auto-tensioner.
8. Turn the crankshaft two turns clockwise to align the timing marks.



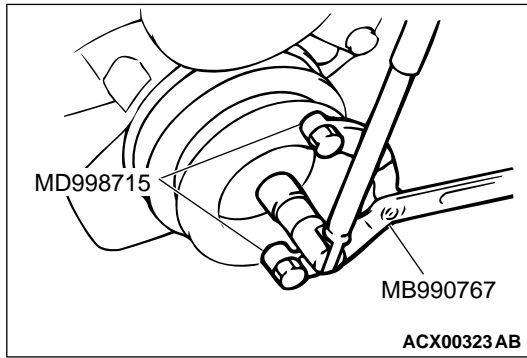
9. Wait for at least five minutes, and then check that the auto-tensioner pushrod extends within the standard value.

Standard value (A): 3.8 – 5.0 mm (0.15 – 0.20 inch)

10. If no, repeat the operation in steps (5) to (9) above.
11. Check again that the timing marks of each sprocket are aligned.

>>C<< CRANKSHAFT PULLEY INSTALLATION

Use special tools MD998715 and MB990767 to install the crankshaft pulley.

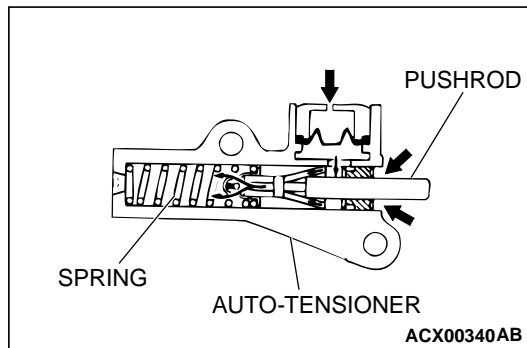


INSPECTION

M1112004400222

AUTO-TENSIONER

- Check the auto-tensioner for possible leaks.
- Check the pushrod for cracks.



SPECIFICATIONS

FASTENER TIGHTENING SPECIFICATIONS

M1111003800235

ITEM	SPECIFICATION
Accessory mount assembly mounting bolt	44 N·m (33 ft-lb)
Accessory mount assembly mounting bolt (12 × 100)	74 N·m (54 ft-lb)
A/T oil dipstick assembly attaching bolt	48 N·m (35 ft-lb)
Baffle plate attaching bolt	9.8 – 12 N·m (87 – 106 in-lb)
Camshaft position sensor	8.8 N·m (78 in-lb)
Camshaft sprocket attaching bolt	88 N·m (65 ft-lb)
Camshaft thrust case attaching bolt	13 N·m (115 in-lb)
Cover bolt	9.8 – 12 N·m (87 – 106 in-lb)
Crankshaft position sensor attaching bolt	8.8 N·m (78 in-lb)
Crankshaft pulley attaching bolt	181 N·m (134 ft-lb)
Cylinder head bolt <cold engine>	108 N·m (80 ft-lb)
Drive plate bolt	74 N·m (54 ft-lb)
Engine mount insulator attaching bolt	44 N·m (33 ft-lb)
Engine mount insulator attaching nut	25 N·m (18 ft-lb)
Generator drive belt tension pulley fixing nut	49 N·m (36 ft-lb)
High-pressure fuel hose	4.9 N·m (43 in-lb)
Oil dipstick assembly attaching bolt	48 N·m (35 ft-lb)
Oil pan attaching bolt (upper)	5.9 N·m (52 in-lb)
Oil pan attaching bolt (lower)	9.8 – 12 N·m (87 – 106 in-lb)
Oil pan drain plug	39 N·m (29 ft-lb)
Oil screen attaching bolt (8 × 20)	19 N·m (14 ft-lb)
Oil screen attaching bolt	8.8 N·m (78 in-lb)
Power steering oil pump drive belt cover attaching bolt	4.9 N·m (43 in-lb)
Power steering oil pump mounting bolt	24 N·m (17 ft-lb)
Rocker arm and shaft assembly mounting bolt	32 N·m (23 ft-lb)
Rocker cover attaching bolt	3.4 N·m (30 in-lb)
Timing belt auto-tensioner	24 N·m (17 ft-lb)
Timing belt lower cover attaching bolt	11 N·m (97 in-lb)
Timing belt lower cover attaching nut	4.9 N·m (43 in-lb)
Timing belt tension arm assembly attaching bolt	44 N·m (33 ft-lb)
Timing belt tension pulley attaching bolt	48 N·m (35 ft-lb)
Timing belt upper cover attaching bolt (6 × 18)	11 N·m (97 in-lb)
Timing belt upper cover attaching bolt	14 N·m (124 in-lb)
Timing indicator bracket attaching bolt	11 N·m (97 in-lb)
Transmission mounting bolt	35 N·m (26 ft-lb)
Water outlet pipe attaching bolt	12 – 15 N·m (106 – 133 in-lb)
Water passage assembly attaching bolt	17 – 20 N·m (12 – 14 ft-lb)
Water pipe and hose assembly attaching bolt	12 – 15 N·m (106 – 133 in-lb)

SERVICE SPECIFICATIONS

M1112000300171

ITEM	STANDARD VALUE	LIMIT
Basic ignition timing at idle	5° BTDC ± 3°	–
Actual ignition timing at curb idle	Approximately 10° BTDC	–
CO contents %	0.5 or less	–
HC contents ppm	100 or less	–
Curb idle speed r/min	700 ± 100	–
Compression pressure (250 – 400 r/min) kPa (psi)	1200 (171)	Minimum 890 (127)
Compression pressure difference of all cylinder kPa (psi)	–	98 (14)
Intake manifold vacuum at curb idle kPa (in Hg)	–	Minimum 60 (18)
Timing belt tensioner torque N·m (in-lb)	4.4 (39)	
Timing belt tensioner adjuster rod protrusion amount mm (in)	3.8 – 5.0 (0.15 – 0.20)	–
Timing belt tensioner adjuster rod movement mm (in)	Within 1 (0.04)	–

SEALANT

M1111000500291

ITEM	SPECIFIED SEALANT
Oil pan	MITSUBISHI GENUINE Part No. MD970389 or equivalent

NOTES