ENGINE

CONTENTS

ENGINE

CONTENTS

GENERAL INFORMATION

Items			4G63
Total displacement mL			1,997
Bore × Stroke mm			85.0 × 88.0
Compression ratio			8.8
Combustion chamber			Pentroof type
Camshaft arrangement			DOHC
Number of valve	Intake		8
	Exhaust		8
Valve timing	Intake	Opening	BTDC 21°
		Closing	ABDC 59°
	Exhaust	Opening	BBDC 58°
		Closing	ATDC 18°
Fuel system			Electronically controlled multipoint fuel injection
Rocker arm			Roller type
Auto-lash adjuster			Equipped

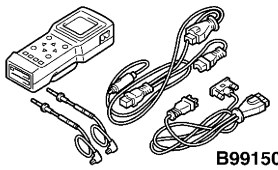
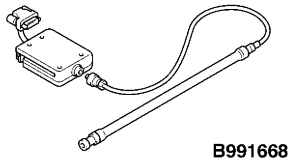
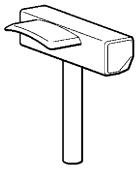
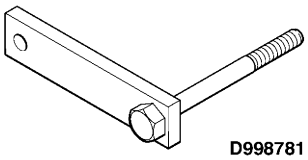
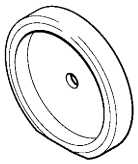
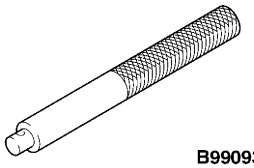
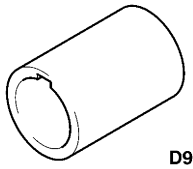
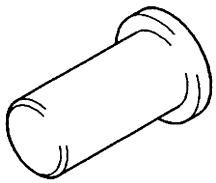
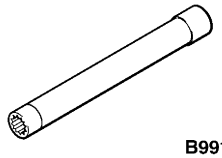
SERVICE SPECIFICATIONS

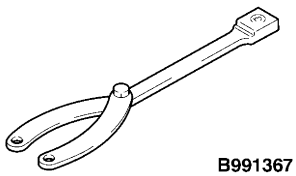
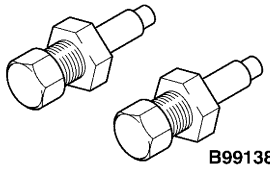
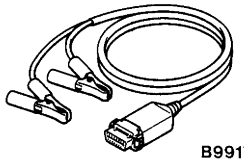
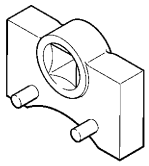
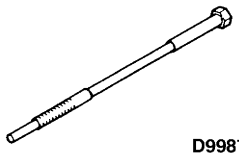
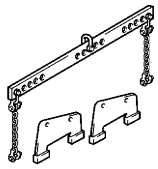
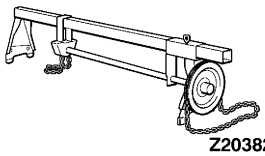
Items		Standard value	Limit
Drive belt tension	Vibration frequency Hz (Reference)	110 - 144	-
	Tension N (Reference)	245 - 412	-
Basic ignition timing		5°BTDC ± 3°	-
Ignition timing		Approximetely 5°BTDC	-
Idle speed r/min		850 ± 100	-
CO contents %		0.1 or less	-
HC contents ppm		100 or less	-
Compression pressure (250 - 400 r/min) kPa		1,128	951
Compression pressure difference of all cylinder kPa		-	Max. 98
Intake manifold vacuum kPa		-	Min. 60
Cylinder head bolt shank length mm		-	99.4
Timing belt B tension (When checked)	Vibration frequency Hz	52 - 92	-
	Deflection mm (Reference)	5 - 10	-
Timing belt B tension (When adjusted)	Vibration frequency Hz	76 - 92	-
	Deflection mm (Reference)	5 - 7	-
Timing belt B tension (When replaced)	Vibration frequency Hz	76 - 92	-
	Deflection mm (Reference)	5 - 7	-
Auto-tensioner rod protrusion amount mm		3.8 - 4.5	-
Auto-tensioner rod sink in amount mm		Within 1	-

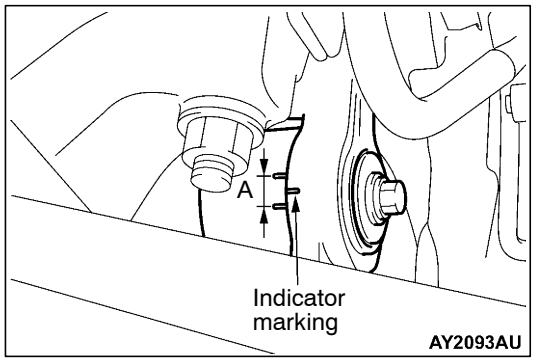
SEALANTS

Items	Specified Sealants	Remarks
Rocker cover	MITSUBISHI GENUINE PART MD970389 or equivalent	Semi-drying sealant
Rocker cover gasket		
Cylinder head		
Camshaft position sensor support		
Oil pan		
Camshaft end seal	3M ATD Part No. 8660 or equivalent	

SPECIAL TOOLS

Tool	Number	Name	Use
 B991502	MB991502	MUT-II sub assembly	• Measuring the drive belt tension • Checking the ignition timing • Checking the idle speed • Erasing diagnosis code • Measuring the timing belt B tension
 B991668	MB991668	Belt tension meter set	• Measuring the drive belt tension (used together with MUT-II) • Measuring the timing belt B tension (used together with MUT-II)
 D998727	MD998727	Oil pan remover	For removing the oil pan
 D998781	MD998781	Flywheel stopper	For fixing the flywheel
 D998776	MD998776	Crankshaft rear oil seal installer	For pressfitting the crankshaft rear oil seal
 B990938	MB990938	Installer bar	
 D998285	MD998285	Crankshaft front oil seal guide	For pressfitting the crankshaft front oil seal
	MD998382	Crankshaft front oil seal installer	
 B991654	MB991654	Cylinder head bolt wrench	For removal and installation of cylinder head bolts

Tool	Number	Name	Use
 B991367	MB991367	Special spanner	For retaining the crankshaft sprocket
 B991385	MB991385	Pin	
 B991704	MB991704	Battery harness	Measuring the timing belt B tension (used together with MUT-II)
 D998767	MD998767	Tensioner pulley socket wrench	For adjusting timing belt tension
 D998738	MD998738	Adjusting bolt	For retaining the tensioner arm and the auto-tensioner
 B991453	MB991453	Engine hanger attachment set	Supporting the engine assembly during removal and installation of the transmission
 Z203827	GENERAL SERVICE TOOL MZ203827	Engine lifter	



ON-VEHICLE SERVICE

DRIVE BELT TENSION CHECK

1. Check that the indicator marking of the auto-tensioner is within the range as shown in the illustration A of the tensioner bracket.

   Caution
   Inspection must be carried out after turning the crankshaft clockwise for more than once.

2. If the marking is outside the range as shown in the illustration A, replace the drive belt.

   NOTE
   Due to the adoption of the auto-tensioner, no adjustment for belt tension is required.

AUTO-TENSIONER CHECK

1. Check that the driver belt stays within the width of the pulley of the auto-tensioner after turning off the engine at idle.
2. Remove the drive belt.(Refer to P.11C-15.)
3. Use the 12.7sq. spinner handle and etc. to check that the auto-tensioner is not stuck by turning it in both directions.
4. If there is any abnormality in the above-mentioned 1 or 3, replace the auto-tensioner.
5. Install the drive belt.(Refer to P.11C-15.)

<Reference>

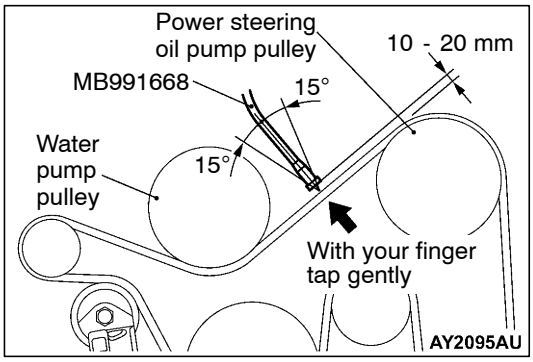
To determine whether the auto-tensioner is acceptable can be done by checking the drive belt tension.

1. Use the following procedure to check the drive belt tension.

   <When using MUT-II>
   (1) Connect the special tool (MB991668) to the MUT-II.
   (2) Connect the MUT-II to the diagnosis connector.

   Caution
   Connection and disconnection of the MUT-II must be carried out after turning the ignition switch to the "LOCK" (OFF) position.

   (3) Turn the ignition switch to the "ON" position and select "Belt Tension Measurement" from the menu screen.



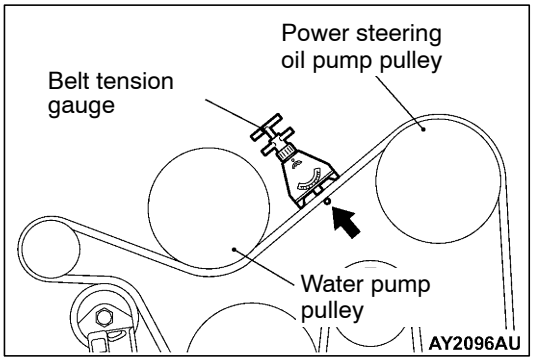
(4) Hold the special tool (MB991668) to the middle of the belt between the pulleys (at the place indicated by the arrow) about 10 - 20 mm away from the rear surface and so that it is perpendicular to the belt (within an angle of ± 15°).

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

Standard value: 110 - 144 Hz

Caution

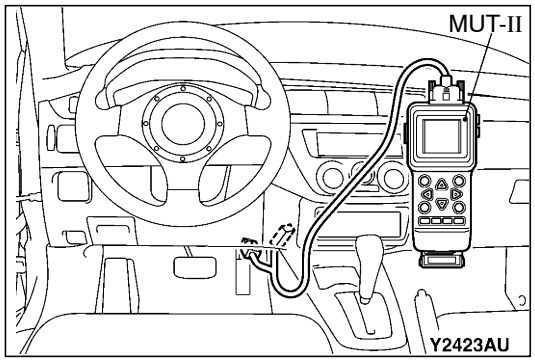
1) Check the vibration frequency of the belt when the temperature of the surface of the belt is as close as possible to normal temperature.
2) Do not let any contaminants such as water or oil get onto the microphone.
3) If strong gusts of wind blow against the microphone or if there are any loud sources 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 belt tension gauge>
Use the belt tension gauge and check that the belt tension of the middle of the belt between pulleys (at the place indicated by arrow) is within the standard value.

Standard value: 245 - 412 N

2. If the value is outside the standard value, replace the drive belt.



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: 850 ± 100 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°

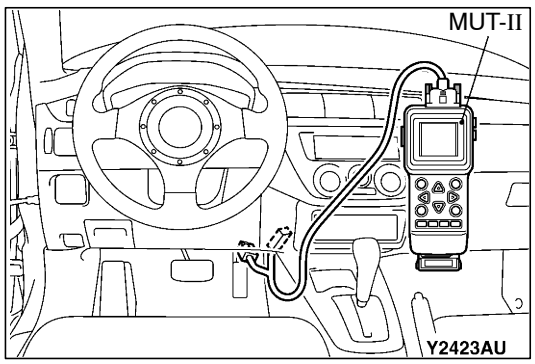
8. If the basic ignition timing is outside the standard value, inspect the MPI system while referring to GROUP 13A - Troubleshooting.
9. Press the MUT-II clear key (Select a forced driving cancel mode) to release the Actuator test.

   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: approximately 5°BTDC

    NOTE
    (1) Ignition timing is variable within about ± 7, even under normal operating.
    (2) And it is automatically further advanced by approximately 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

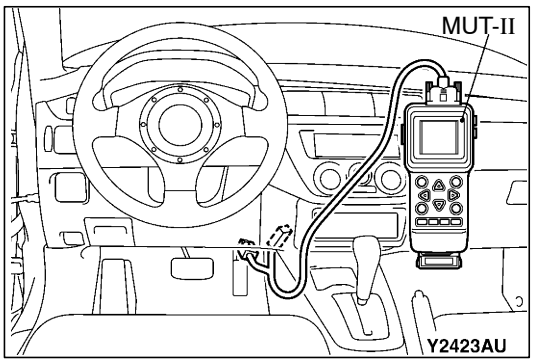
1. Before inspection, set the vehicle to the pre-inspection condition.
2. Turn the ignition switch to “LOCK” (OFF) position, and then connect the MUT-II to the diagnosis connector.
3. Set the timing light.
4. Check that the basic ignition timing is within the standard value.

Standard value: 5° BTDC ± 3°

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: 850 ± 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 13A - 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 the "LOCK" (OFF) position, and then connect the MUT-II to the diagnosis connector.
3. Set the timing light.
4. Check that the basic ignition timing is within the standard value.

   Standard value: 5° BTDC ± 3°
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

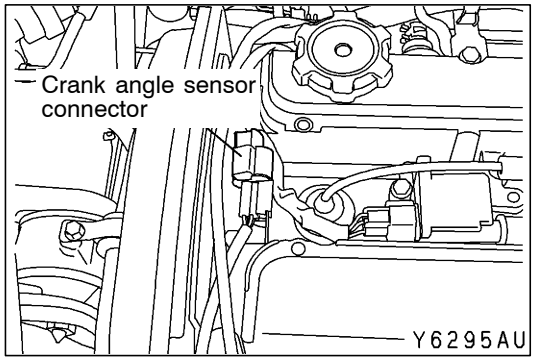
   NOTE
   Replace the three way catalyst when the CO and HC contents are not within the standard value, even though the result of the inspection is normal on all items.
9. Remove the timing light.

10. Turn the ignition switch to the “LOCK” (OFF) position and then remove the MUT-II.

COMPRESSION PRESSURE CHECK

1. Before inspection, check that the engine oil, starter and battery are normal. In addition, set the vehicle to the pre-inspection condition.
2. Remove the ignition coils 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.

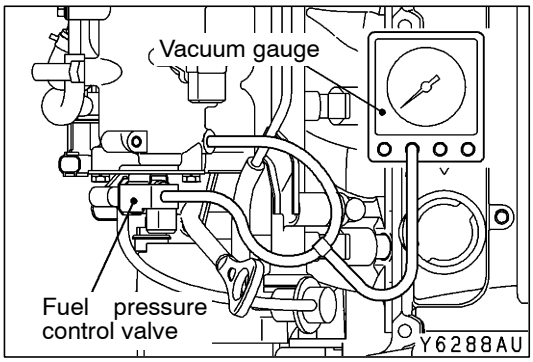
   Standard value (at engine speed of 250 r/min):
   1,128 kPa

   Limit (at engine speed of 250 r/min):
   Min. 951 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. 98 kPa
9. If there is a cylinder with compression or a compression difference that is outside the limit, pour a small amount of engine oil through the spark plug hole, and repeat the operations in steps 7 and 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 plugs.
13. Use the MUT-II to erase the self-diagnosis codes or disconnect the battery cable from the battery (-) terminal for 10 seconds or more and then reconnect the cable.

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



MANIFOLD VACUUM CHECK

1. Set the vehicle to the pre-inspection condition.
2. Turn the ignition switch to the “LOCK” (OFF) position.
3. Set the engine tachometer or connect the MUT-II.
4. Check that the idle speed is within the standard value.

NOTE
When using the MUT-II, select the code No.22.

5. Connect the three-way union joint to the vacuum hose between the fuel pressure control valve and the air intake plenum, and connect a vacuum gauge.
6. Check the manifold vacuum at idle.

Limit: 58 kPa

7. Turn the ignition switch to the “LOCK” (OFF) position.
8. Remove the vacuum gauge and install the vacuum hose in its original location.
9. Remove the engine tachometer or the MUT-II.

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.

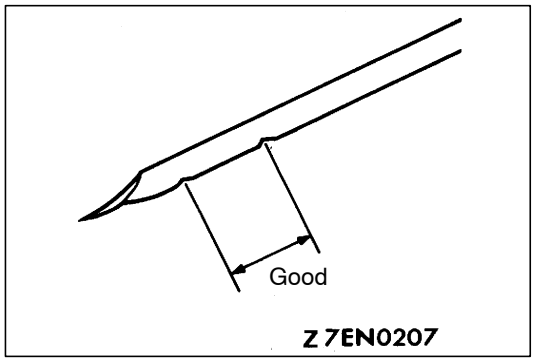
NOTE
(1) The abnormal noise which is caused by a problem with the lash adjusters is generated after the engine is started, and will vary according to the engine speed. However, this noise is not related to the actual engine load.
Because of this, if the noise does not occur immediately after the engine 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.

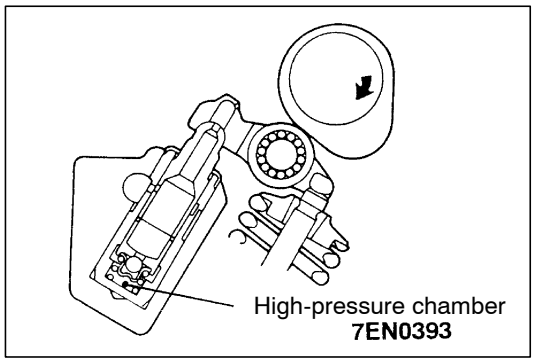
(2) If there is a problem with the lash adjusters, the noise will almost never disappear, even if the engine has been run at idle to let it warm up.
The only case where the noise might disappear is if the oil in the engine has not been looked after properly and oil sludge has caused the lash adjusters to stick.

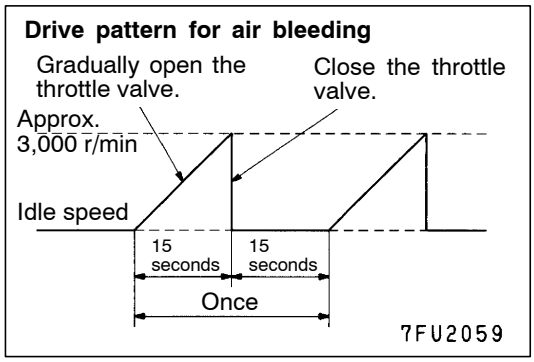
1. Start the engine.
2. Check that the noise occurs immediately after the engine is started, and that the noise changes in accordance with changes in the engine speed.
If the noise does not occur immediately after the engine is started, or if it does not change in accordance with the engine speed, the 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.
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 GROUP 11B - Rocker Arms and Camshaft.)

<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.

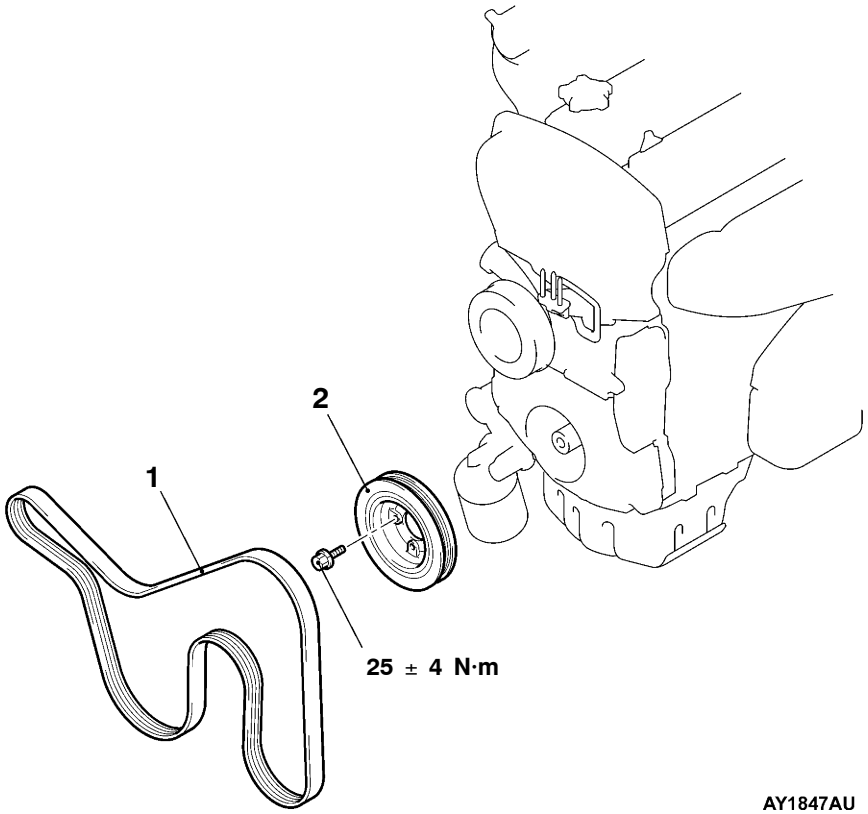
CRANKSHAFT PULLEY

REMOVAL AND INSTALLATION

Caution

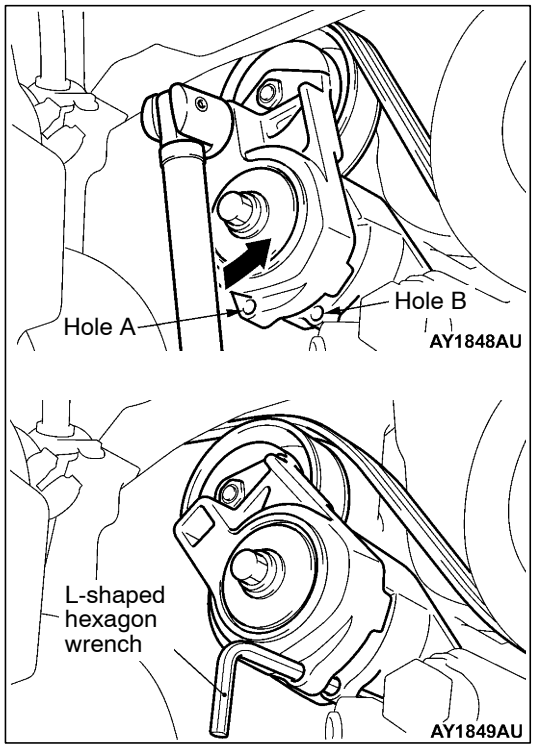
If the vehicle is equipped with the Brembo disc brake, during maintenance, take care not to contact the parts or tools to the caliper because the paint of caliper will be scratched.

Pre-removal and Post-installation Operation
- Under Cover Removal and Installation (Refer to GROUP 51 - Front Bumper.)
- Side Cover Removal and Installation
- Drive Belt Tension Check (Refer to P.11A-7.) <After installation only>



Removal steps

◀A▶ 1. Drive belt
2. Crankshaft pulley



REMOVAL SERVICE POINT

◀A▶ DRIVE BELT REMOVAL

Due to the adoption of the Serpentine drive system with the auto-tensioner, the following operation is required:

1. Insert the 12.7sq. spinner handle and etc. into the tool hole of the auto-tensioner and rotate it counterclockwise until the auto-tensioner gets to the stopper.
2. Align hole A with hole B for fixing by inserting the L-shaped hexagon wrench, then remove the drive belt.

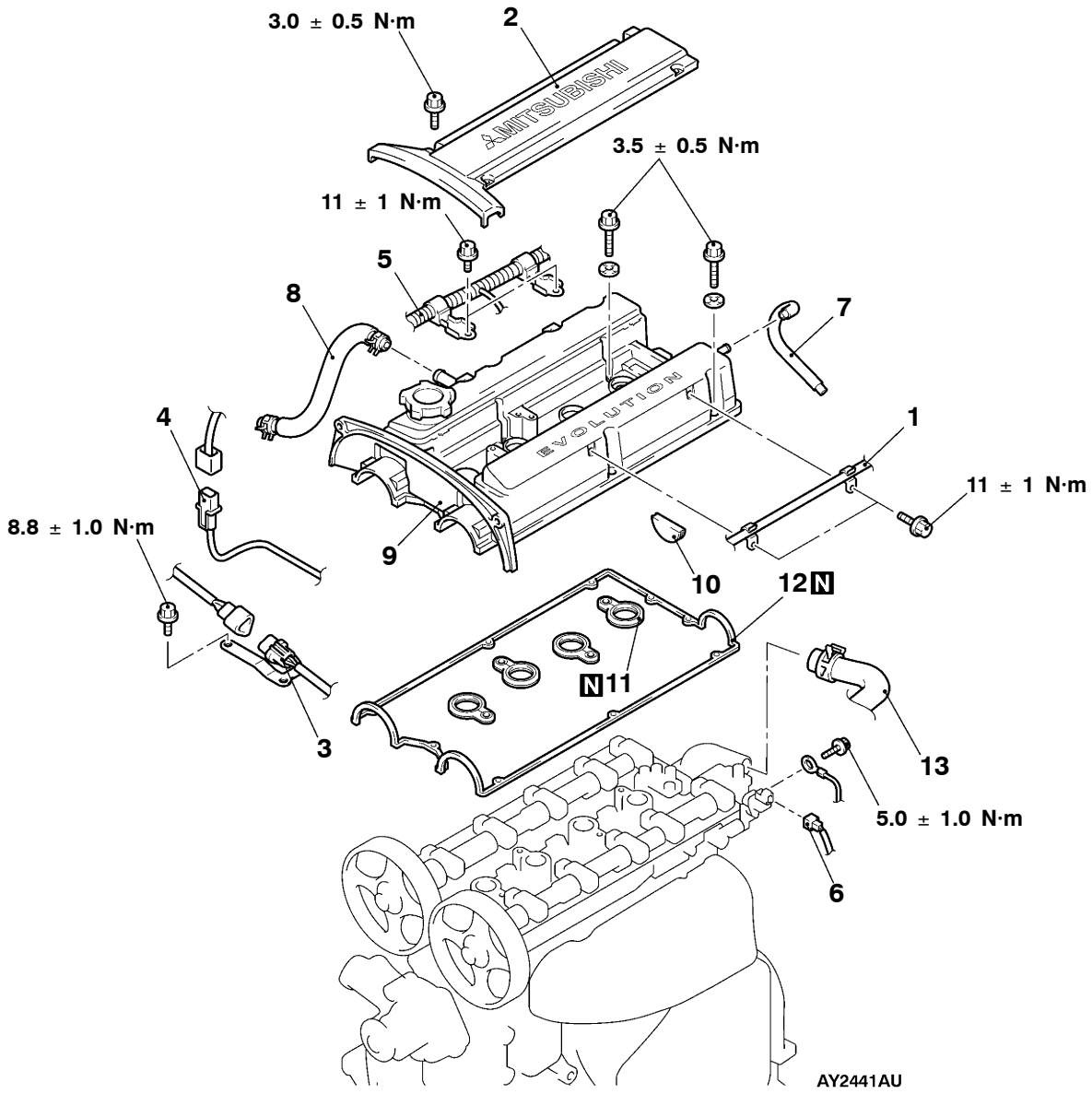
Caution
When the drive belt is reused, use a chalk to indicate an arrow of rotation direction on the back of the belt so that it can be re-assembled in the same direction as before.

CAMSHAFT AND CAMSHAFT OIL SEAL

REMOVAL AND INSTALLATION

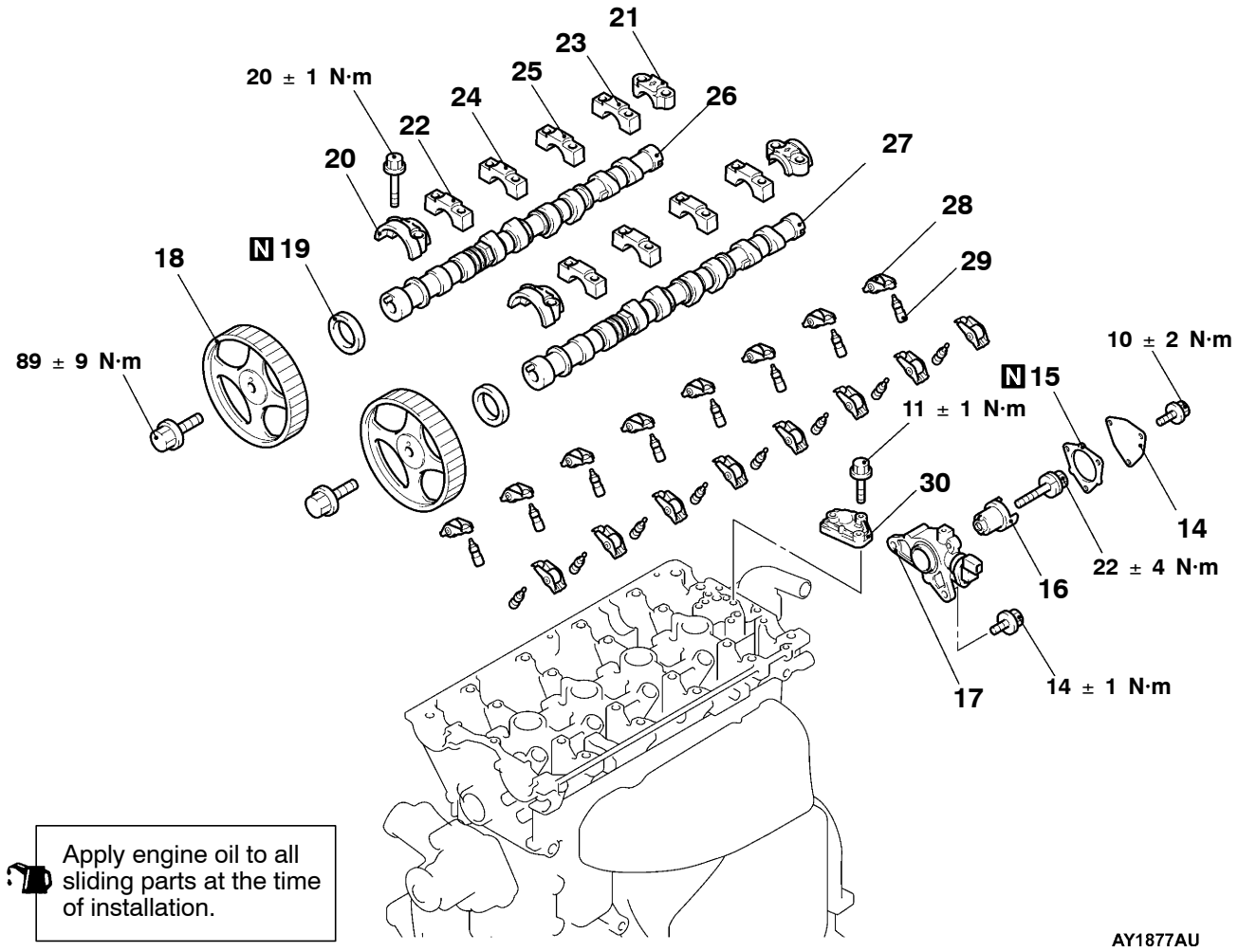
Caution
If the vehicle is equipped with the Brembo disc brake, during maintenance, take care not to contact the parts or tools to the caliper because the paint of caliper will be scratched.

Pre-removal and Post-installation Operation
- Under Cover Removal and Installation (Refer to GROUP 51 - Front Bumper.)
- Drive Belt Tension Check (Refer to P.11A-7.) <After installation only>
- Drainage and Refilling of Engine Coolant (Refer to GROUP 14 - On-vehicle Service.)
- Air Duct Removal and Installation (Refer to Group 15 - Air Cleaner.)
- Air Pipe C Removal and Installation (Refer to GROUP 15 - Intercooler.)
- Secondary Air Pipe Assembly Removal and Installation (Refer to GROUP 15 - Secondary Air Supply System.)
- Timing belt Removal and Installation (Refer to P.11A-34.)



Removal steps

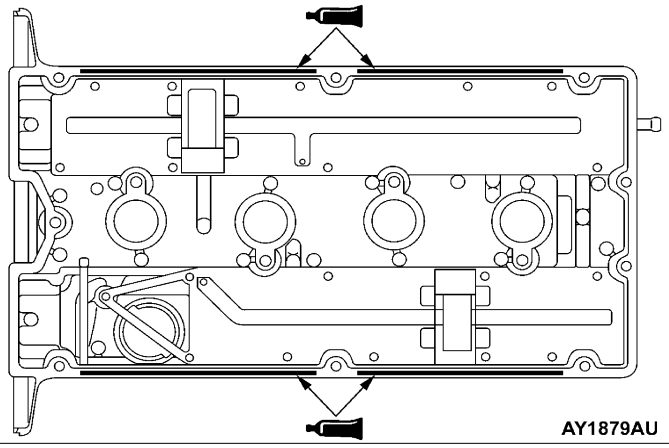
1. Accelerator cable connection <L.H. drive vehicles>
2. Center cover
- Ignition coil (Refer to Group 16 - Ignition System.)
3. Crank angle sensor connector
4. Oxygen sensor connector
5. Control wiring harness connection
6. Camshaft position sensor connector
7. Breather hose
8. PCV hose
▶K◀ 9. Rocker cover
▶J◀ 10. Camshaft end seal
11. Spark plug hole gasket
▶I◀ 12. Rocker cover gasket
◀A▶ ▶H◀ 13. Radiator upper hose connection



14. Camshaft position sensor support cover
15. Camshaft position sensor support cover gasket
▶G◀ 16. Camshaft position sensing cylinder
▶F◀ 17. Camshaft position sensor support
◀B▶ ▶E◀ 18. Camshaft sprocket
▶D◀ 19. Camshaft oil seal
▶C◀ 20. Camshaft bearing cap front
▶C◀ 21. Camshaft bearing cap rear
▶C◀ 22. Camshaft bearing cap No. 2
▶C◀ 23. Camshaft bearing cap No. 5
▶C◀ 24. Camshaft bearing cap No. 3
▶C◀ 25. Camshaft bearing cap No. 4
▶B◀ 26. Intake camshaft
▶B◀ 27. Exhaust camshaft
28. Rocker arm
▶A◀ 29. Lash adjuster
30. Oil delivery body

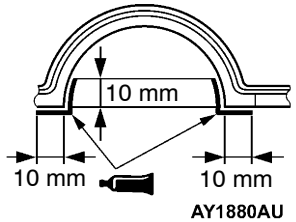
LUBRICATION AND SEALING POINTS

<The bottom view of the rocker cover>

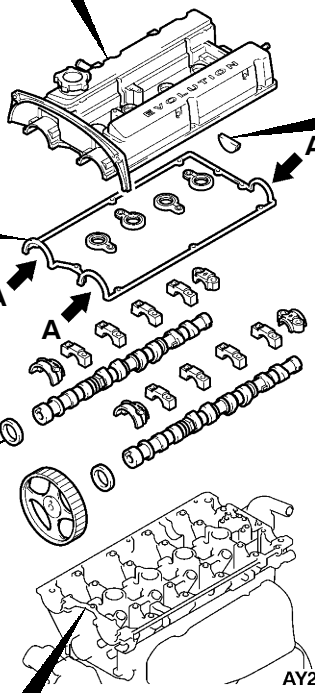


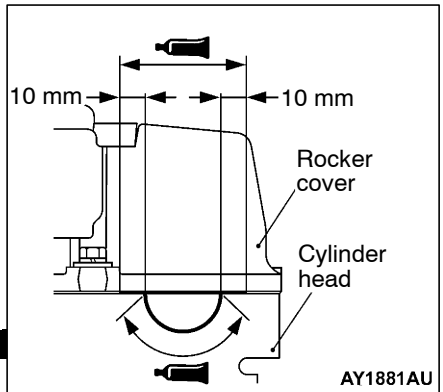
Sealant: MITSUBISHI GENUINE PART MD970389 or equivalent

<View A>

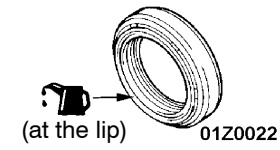


Sealant: MITSUBISHI GENUINE PART MD970389 or equivalent

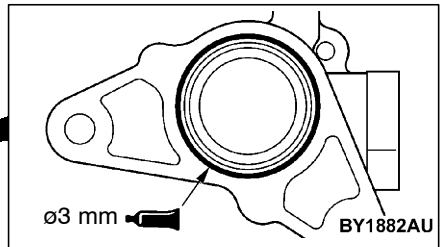




Sealant: 3M ATD Part No.8660 or equivalent

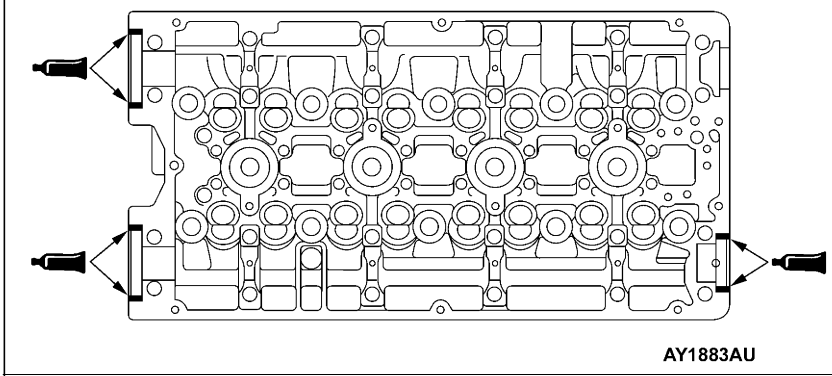


Engine oil



Sealant: MITSUBISHI GENUINE PART MD970389 or equivalent

<Top View of cylinder head>

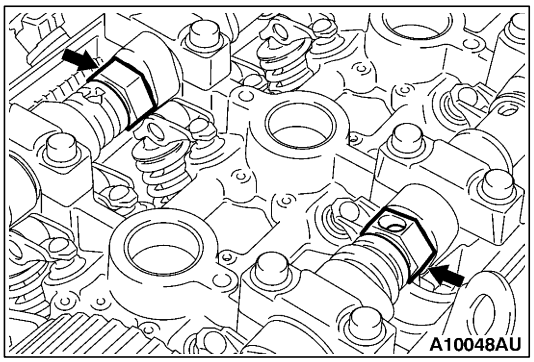


Sealant: MITSUBISHI GENUINE PART MD970389 or equivalent

REMOVAL SERVICE POINTS

◀A▶ RADIATOR UPPER HOSE DISCONNECTION

Indicate the mating marks on the radiator upper hose and the hose clamp for release.



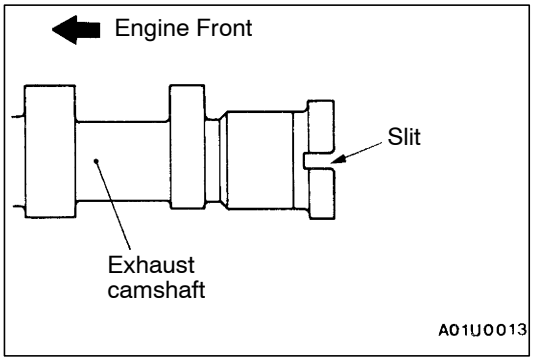
◀B▶ CAMSHAFT SPROCKET REMOVAL

Hold the hexagon part of the camshaft with a wrench and loosen the mounting bolt, then remove the camshaft sprocket.

INSTALLATION SERVICE POINTS

▶A◀ LASH ADJUSTER INSTALLATION

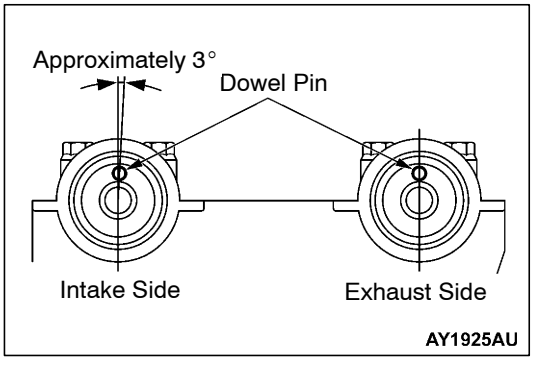
Caution
When the lash adjuster is reused, always install it after cleaning and inspecting.
(Refer to GROUP 11B - Rocker Arms and Camshaft.)



▶B◀ EXHAUST CAMSHAFT/INTAKE CAMSHAFT INSTALLATION

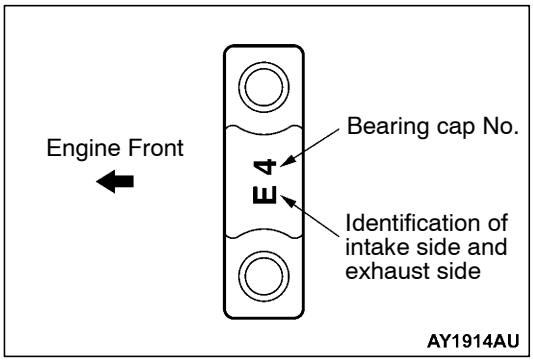
1. Remove sealant remained on the cylinder head.
2. Apply engine oil to the cam and the journal of the camshaft.
3. Install the camshaft to the cylinder head.

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



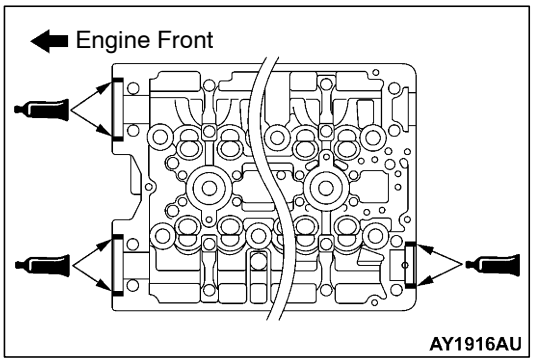
▶C◀ CAMSHAFT BEARING CAP NO.4/CAMSHAFT BEARING CAP NO.3/CAMSHAFT BEARING CAP NO.5/CAMSHAFT BEARING CAP NO.2/ CAMSHAFT BEARING CAP REAR/CAMSHAFT BEARING CAP FRONT INSTALLATION

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



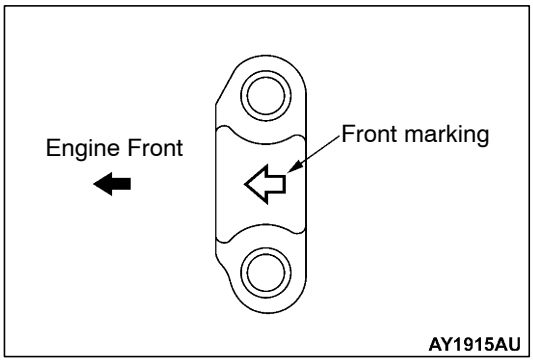
2. Since the shape of camshaft bearing caps No.2 - 5 is identical, check the identification marks so that the bearing cap No., intake side, or exhaust side cannot be mistaken to install to the direction as shown in the illustration.

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



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

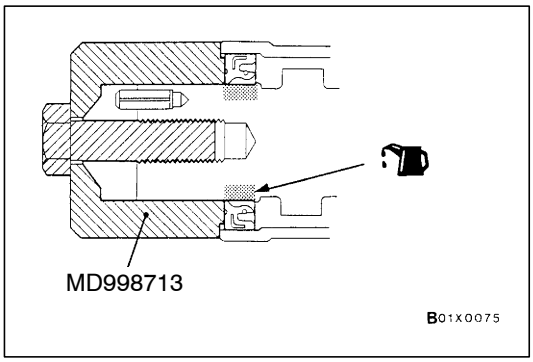
   Specified sealant:
   MITSUBISHI GENUINE PART MD970389 or equivalent



4. Position the camshaft bearing cap rear in the direction as shown in the illustration for installation.
5. Check the identification marks on the camshaft bearing cap front so that intake side and exhaust side cannot be mistaken in the same way as that of bearing caps No.2 - 5.
6. Tighten the bearing cap mounting bolt increasing the pressure in 2 to 3 times and finally tighten to the specified torque.

   Tightening Torque: 20 ± 1 N·m

7. Ensure that the rocker arm is installed properly.
   NOTE
   Remove an excess of sealant completely.



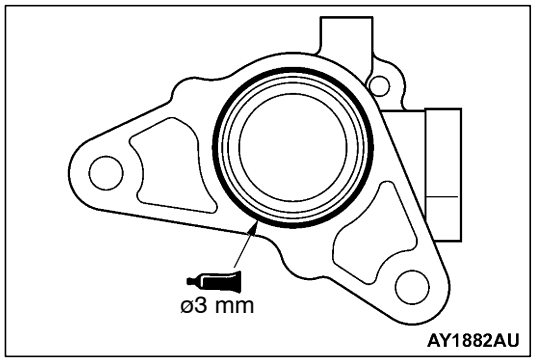
▶D◀ CAMSHAFT OIL SEAL INSTALLATION

1. Apply engine oil on the circumference of oil seal lip.
2. Use the special tool as shown in the illustration to pressfit the oil seal.

▶E◀ CAMSHAFT SPROCKET INSTALLATION

Hold the hexagon part of the camshaft with a wrench and tighten the mounting bolt to the specified torque in the same way as that for removal.

Tightening Torque: 89 ± 9 N·m

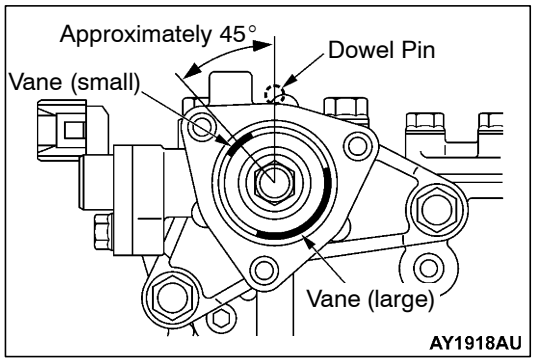


▶F◀ CAMSHAFT POSITION SENSOR SUPPORT INSTALLATION

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



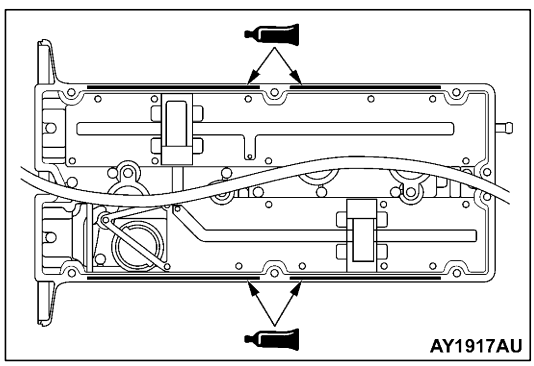
▶G◀ CAMSHAFT POSITION SENSING CYLINDER INSTALLATION

1. Set the dowel pin of the exhaust camshaft to the position (No.1cylinder at compression TDC) as shown in the illustration.
   NOTE
   Use the force of the exhaust valve spring to rotate counterclockwise.
2. Install the vane (small) of the camshaft position sensing cylinder at an angle of approximately 45 degrees to the position of the dowel pin of the exhaust camshaft.
3. Tighten the camshaft position sensing cylinder mounting bolt to the specified torque.

   Tightening Torque: 22 ± 4 N·m

▶H◀ RADIATOR UPPER HOSE CONNECTION

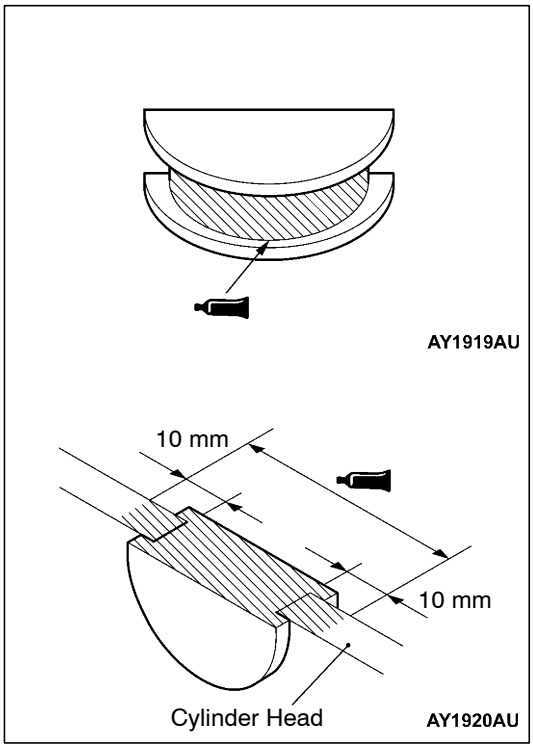
1. Insert the radiator upper hose to the convex part of the water outlet fitting.
2. Make the mating marks on the upper hose and the hose clamp for installation.



▶I◀ ROCKER COVER GASKET INSTALLATION

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

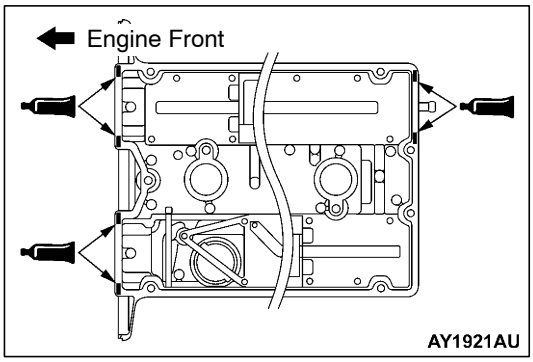
   Specified sealant:
   MITSUBISHI GENUINE PART MD970389 or equivalent
3. Install the rocker cover gasket to the rocker cover.



▶J◀ CAMSHAFT END SEAL INSTALLATION

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

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



▶K◀ ROCKER COVER INSTALLATION

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

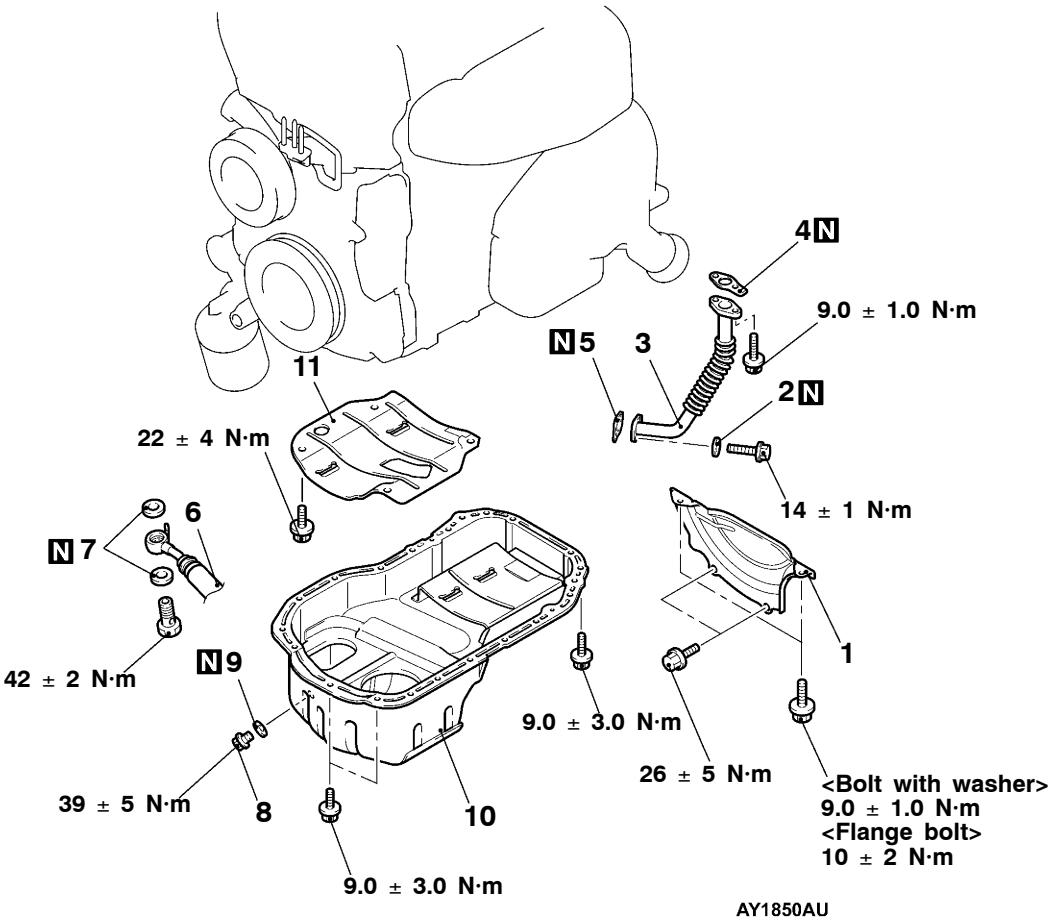
   Specified sealant:
   MITSUBISHI GENUINE PART MD970389 or equivalent

2. Install the rocker cover to the cylinder head.

OIL PAN

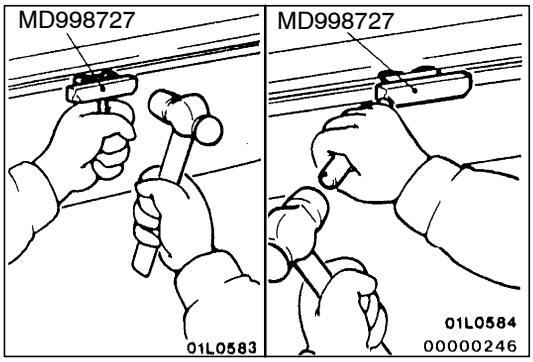
REMOVAL AND INSTALLATION

Pre-removal and Post-installation Operation
- Under Cover Removal and Installation (Refer to GROUP 51 - Front Bumper.)
- Drainage and Refilling of Engine Oil (Refer to GROUP 12 - On-vehicle Service.)
- Crossmember Bar Removal and Installation (Refer to GROUP 32 - Engine Roll Stopper, Centermember.)
- Front Exhaust Pipe Removal and Installation (Refer to GROUP 15.)
- Starter Removal and Installation (Refer to GROUP 16.)



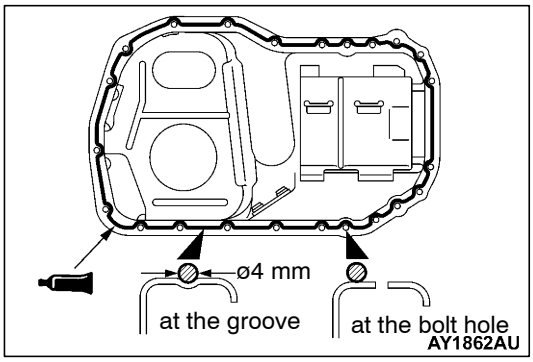
Removal steps

1. Bell housing cover
2. Oil return pipe gasket
3. Oil return pipe
4. Oil return pipe gasket
▶C◀ 5. Oil return pipe gasket
6. Engine oil cooler return hose
7. Engine oil cooler tube gasket
8. Drain plug
▶B◀ 9. Drain plug gasket
◀A▶ ▶A◀ 10. Oil pan
11. Baffle plate



REMOVAL SERVICE POINT

◀A▶ OIL PAN REMOVAL

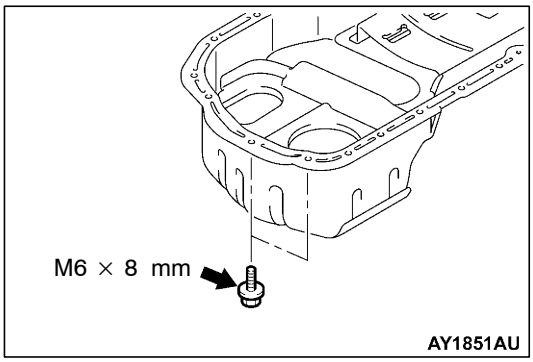


INSTALLATION SERVICE POINTS

▶A◀ OIL PAN INSTALLATION

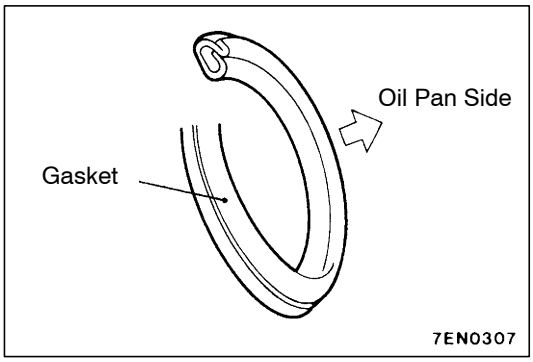
1. Remove sealant remained on the oil pan and the cylinder block.
2. Apply sealant on the mounting surface of oil pan without any gap as indicated in the figure, and install oil pan on cylinder block.

   Specified sealant:
   MITSUBISHI GENUINE PART MD970389 or equivalent



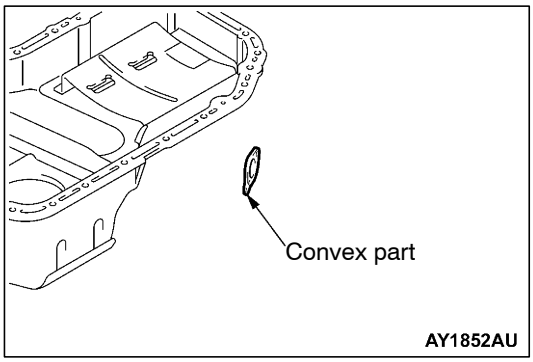
3. Tighten the mounting bolt of oil pan to the specified torque. Be careful not to use a wrong bolt when tightening the bolt as shown in the illustration.

   Tightening Torque: 9.0 ± 3.0 N·m



▶B◀ DRAIN PLUG GASKET INSTALLATION

Gasket should be replaced with a new one, and install it in the direction specified in the figure.



▶C◀ OIL RETURN PIPE GASKET INSTALLATION

Gasket should be replaced with a new one, and set the convex part to the position as shown in the illustration for installation.

NOTE
There is no specific direction indicated for installing the turbocharger side of the oil return pipe gasket.

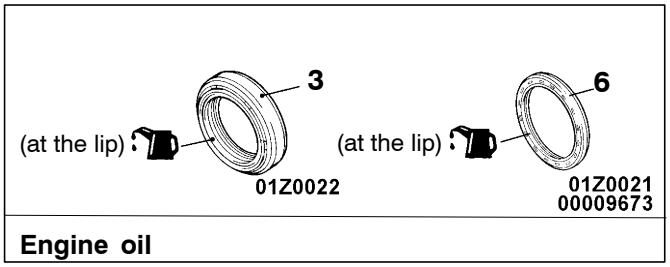
INSPECTION

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

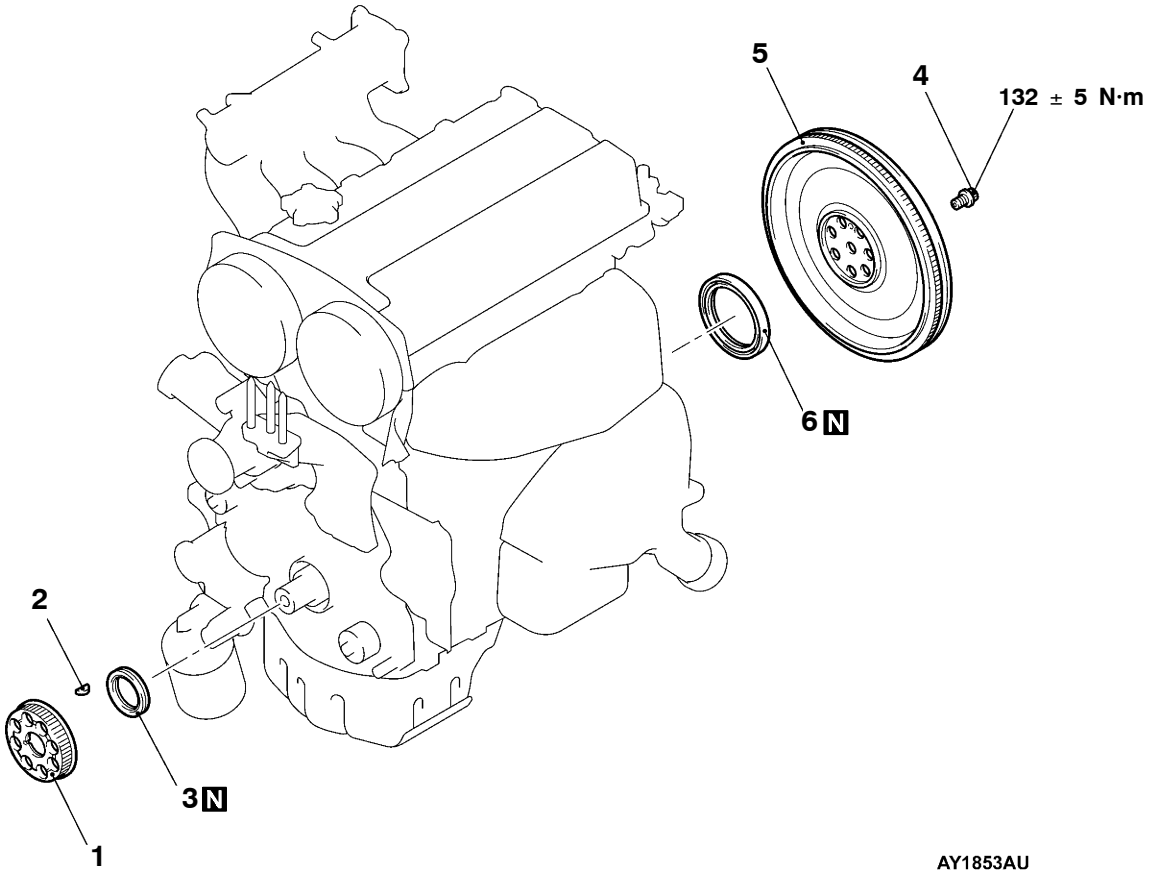
CRANKSHAFT OIL SEAL

REMOVAL AND INSTALLATION

Caution
If the vehicle is equipped with the Brembo disc brake, during maintenance, take care not to contact the parts or tools to the caliper because the paint of caliper will be scratched.



Engine oil



Crankshaft Front Oil Seal Removal Steps

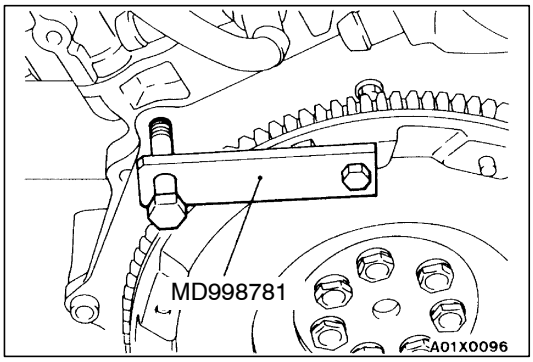
- Timing belt and timing belt B (Refer to P.11A-34.)

▶D◀ 1. Crankshaft sprocket B
2. Key
▶C◀ 3. Crankshaft front oil seal

Crankshaft Rear Oil Seal Removal Steps

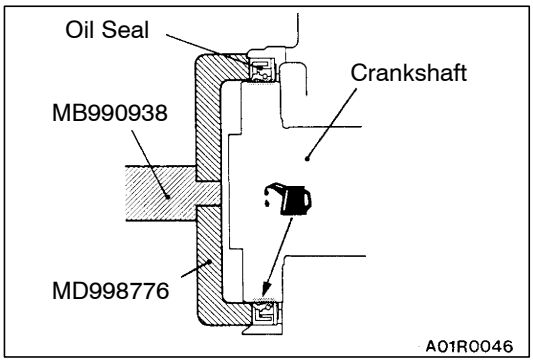
- Transfer assembly (Refer to GROUP 22A.)
- Transmission assembly (Refer to GROUP 22A.)
- Clutch cover, disc

◀A▶ ▶B◀ 4. Flywheel bolt
5. Flywheel
▶A◀ 6. Crankshaft rear oil seal



REMOVAL SERVICE POINT

◀A▶ FLYWHEEL BOLT REMOVAL



INSTALLATION SERVICE POINTS

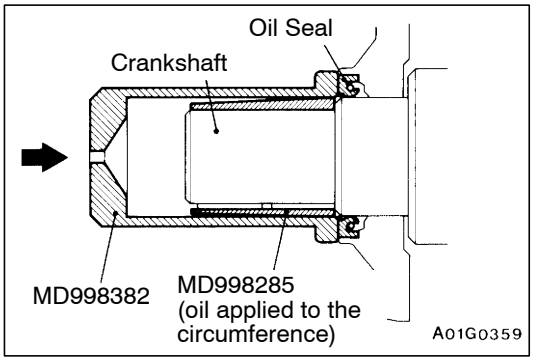
▶A◀ CRANKSHAFT REAR OIL SEAL INSTALLATION

1. Apply small quantity of engine oil on the circumference of oil seal lip.
2. Use special tool to press in oil seal up to the chamfered surface of oil seal case.

▶B◀ FLYWHEEL BOLT INSTALLATION

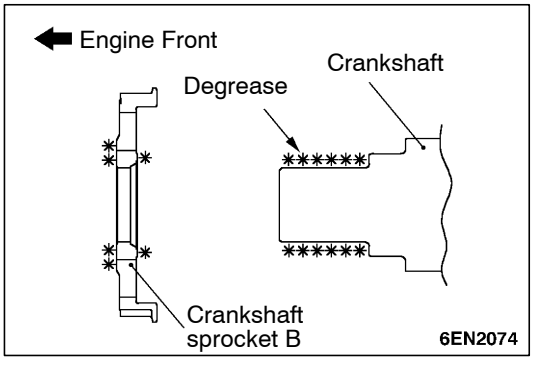
Use the special tool to fix the flywheel and tighten the bolt to the specified torque in the same way as that for removal.

Tightening Torque: 132 ± 5 N·m



▶C◀ CRANKSHAFT FRONT OIL SEAL INSTALLATION

1. Apply small quantity of engine oil on the circumference of oil seal lip.
2. Use special tool to press in oil seal up to the chamfered surface of oil seal case.



▶D◀ CRANKSHAFT SPROCKET B INSTALLATION

1. Clean and degrease crankshaft sprocket B and crankshaft sprocket B mounting surface of crankshaft.

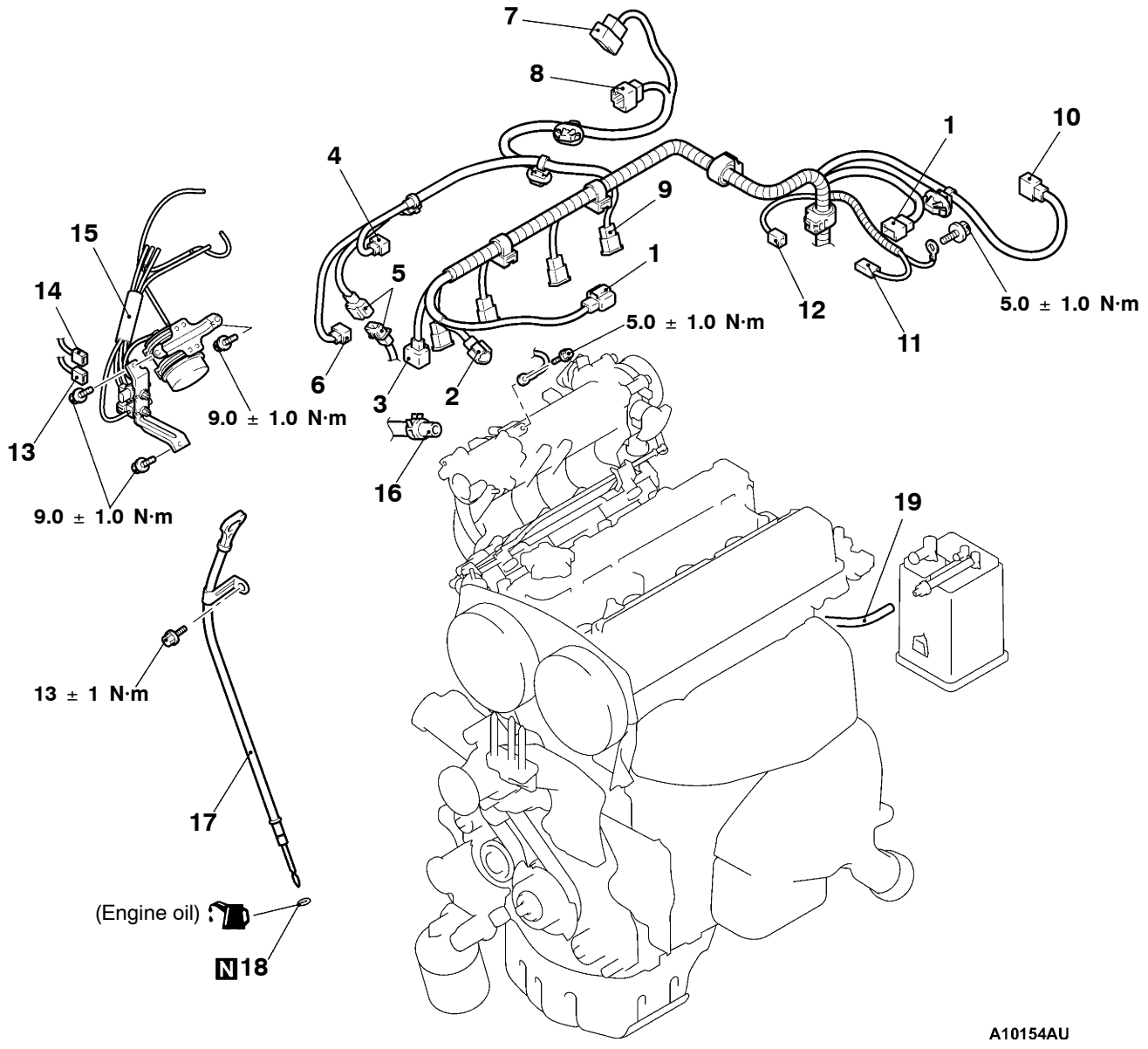
   NOTE
   Degrease to prevent the friction coefficient of pressed surface from dropping by stuck oil.
2. Position crankshaft sprocket B to the direction as shown in the illustration.

CYLINDER HEAD GASKET

REMOVAL AND INSTALLATION

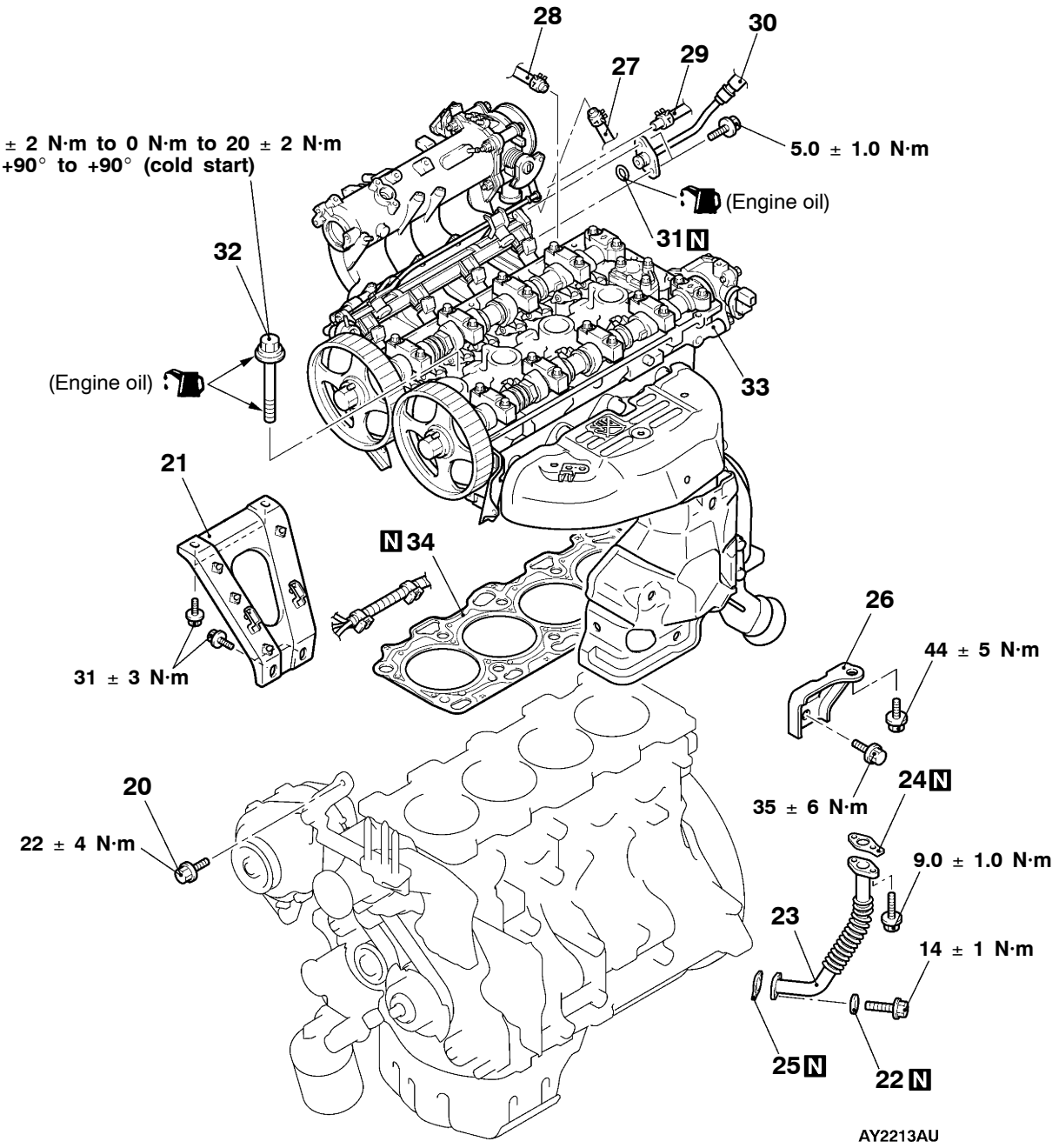
Caution
If the vehicle is equipped with the Brembo disc brake, during maintenance, take care not to contact the parts or tools to the caliper because the paint of caliper will be scratched.

Pre-removal and Post-installation Operation
- Fuel Outflow Preventive Operation (Refer to GROUP 13A - On-vehicle Service.) <Before removal only>
- Fuel Leak Check <After installation only>
- Strut Tower Bar Removal and Installation (Refer to GROUP 42.)
- Under Cover Removal and Installation (Refer to GROUP 51 - Front Bumper.)
- Drive Belt Tension Check (Refer to P.11A-7.) <After installation only>
- Accelerator Cable Adjustment (Refer to GROUP 17 - On-vehicle Service.) <After installation only>
- Drainage and Refilling Engine Oil (Refer to GROUP 12 - On-vehicle Service.)
- Drainage and Refilling of Engine Coolant (Refer to GROUP 14 - On-vehicle Service.)
- Air Cleaner Assembly Removal and Installation (Refer to GROUP 15.)
- Air Hose E, Air Pipe C, Air hose D Removal and Installation (Refer to GROUP 15 - Intercooler.)
- Battery Removal and Installation
- Center Cover Removal and Installation (Refer to P.11A-17.)
- Accelerator Cable Removal and Installation (Refer to GROUP 17.)
- Radiator Removal and Installation (Refer to GROUP 14.)
- Secondary Air Control Valve Bracket Removal and Installation (Refer to GROUP 15 - Secondary Air Supply System.)
- Crossmember Bar Removal and Installation (Refer to GROUP32 - Engine Roll Stopper, Centermember.)
- Front Exhaust Pipe Removal and Installation (Refer to GROUP 15.)
- Starter Removal and Installation (Refer to GROUP 16.)
- Timing Belt Removal and Installation (Refer to P.11A-34.)

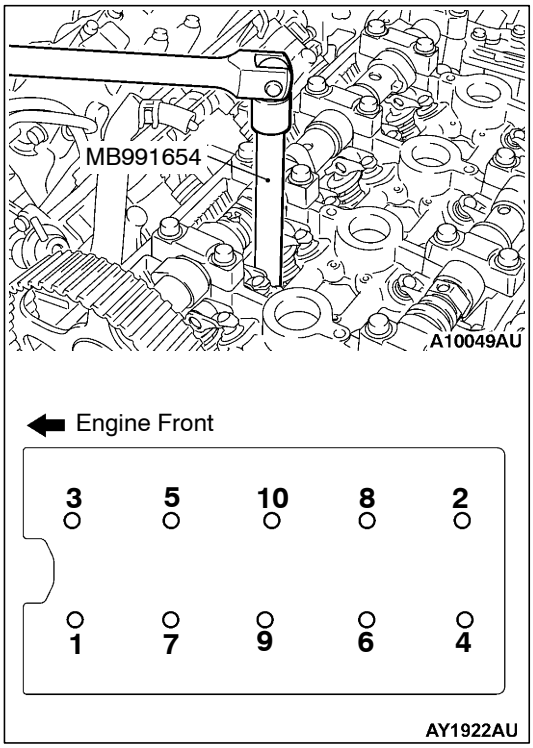


Removal steps

1. Ignition coil connector
2. Crank angle sensor connector
3. Oxygen sensor connector
4. Fuel pressure solenoid valve connector
5. Detonation sensor connector
6. Purge control solenoid valve connector
7. Throttle position sensor connector
8. Idle speed control servo connector
9. Injector connector
10. Camshaft position sensor connector
11. Engine coolant temperature gauge unit connector
12. Engine coolant temperature sensor connector
    - Rocker cover (Refer to P.11A-17.)
13. EGR solenoid valve connector
14. Secondary air control solenoid valve connector
15. Vacuum tank, solenoid valve, vacuum pipe and hose assembly
16. Brake booster vacuum hose connection
17. Oil level gauge and guide assembly
18. O-ring
19. Purge hose connection



20. Alternator brace connection
21. Intake manifold stay
22. Oil return pipe gasket
23. Oil return pipe
24. Oil return pipe gasket
▶D◀ 25. Oil return pipe gasket
26. Exhaust fitting bracket
    - Water outlet fitting and thermostat case assembly (Refer to Group 15 - Water Hose and Pipe.)
27. Water hose connection
28. Heater hose connection
29. Fuel return hose connection
▶C◀ 30. Fuel high pressure hose connection
▶C◀ 31. O-ring
◀A▶ ▶B◀ 32. Cylinder head bolt
33. Cylinder head assembly
▶A◀ 34. Cylinder head gasket



REMOVAL SERVICE POINT

◀A▶ CYLINDER HEAD BOLTS REMOVAL

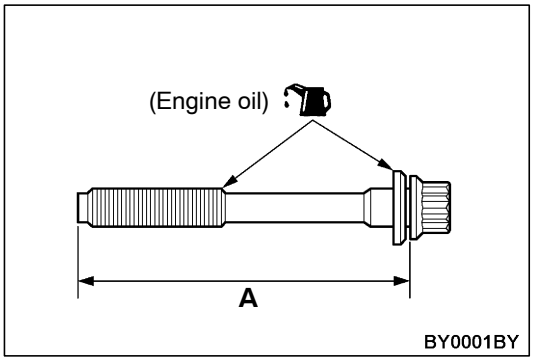
Use the special tool to loosen the bolt in 2 to 3 times in the order of the numbers shown in the illustration for removal.

INSTALLATION SERVICE POINTS

▶A◀ CYLINDER HEAD GASKET INSTALLATION

1. Remove residual gasket attached on the mounting surface of the gasket.

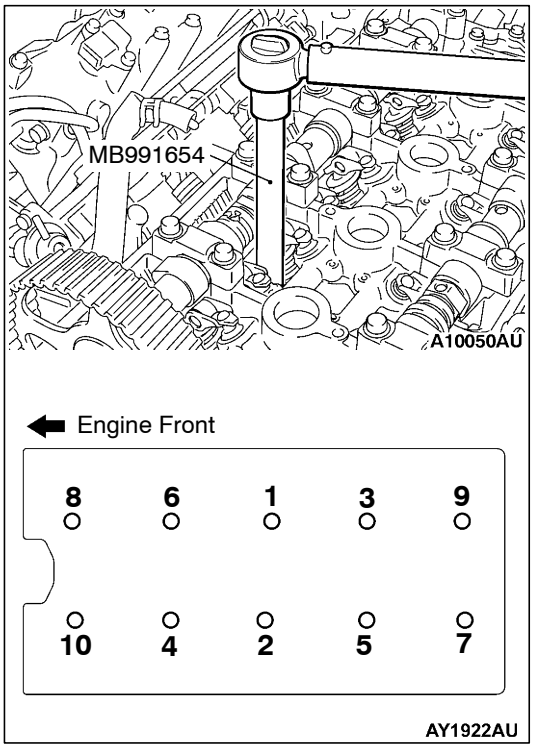
   Caution
   Do not let contaminants get into engine coolant, oil passage or cylinder.
2. With individual holes of cylinder head aligned on individual holes of cylinder head gasket, install cylinder head gasket on cylinder head.



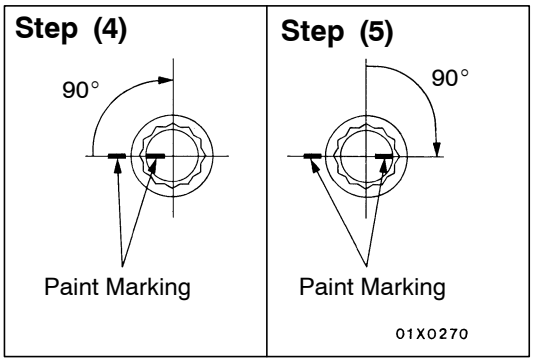
▶B◀ CYLINDER HEAD BOLTS INSTALLATION

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): 99.4 mm
2. Apply small quantity of engine oil at the threads of cylinder head bolts and the washers.



3. Use special tool to tighten bolts according to the following procedure (tightening for plastic zone)
   (1) According to the sequence specified in the figure, tighten the bolt to the specified torque 78 ± 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 degree in the sequence specified in the figure.
   (5) When bolts are tightened at the angle of 90 degree 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◀ O-RING/FUEL HIGH PRESSURE HOSE INSTALLATION

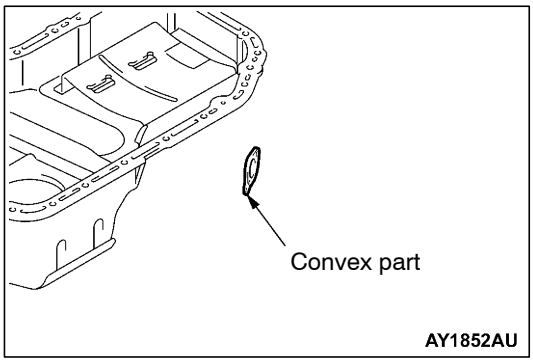
1. Apply small quantity of new engine oil on O-ring.

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

2. Install the fuel high pressure pipe to the delivery pipe rotating in both directions without damaging the O-ring and check that it rotates smoothly.

3. In case of not rotating smoothly, remove the fuel high pressure hose and insert it to the delivery pipe again after checking damage of the O-ring since there is a possibility of O-ring engagement.
4. Tighten fuel high pressure hose mounting bolts to the specified torque.

   Tightening Torque: 5.0 ± 1.0 N·m



▶D◀ OIL RETURN PIPE GASKET INSTALLATION

Gasket should be replaced with a new one, and set the convex part to the position as shown in the illustration for installation.

NOTE
There is no specific direction indicated for installing the turbocharger side of the oil return pipe gasket.

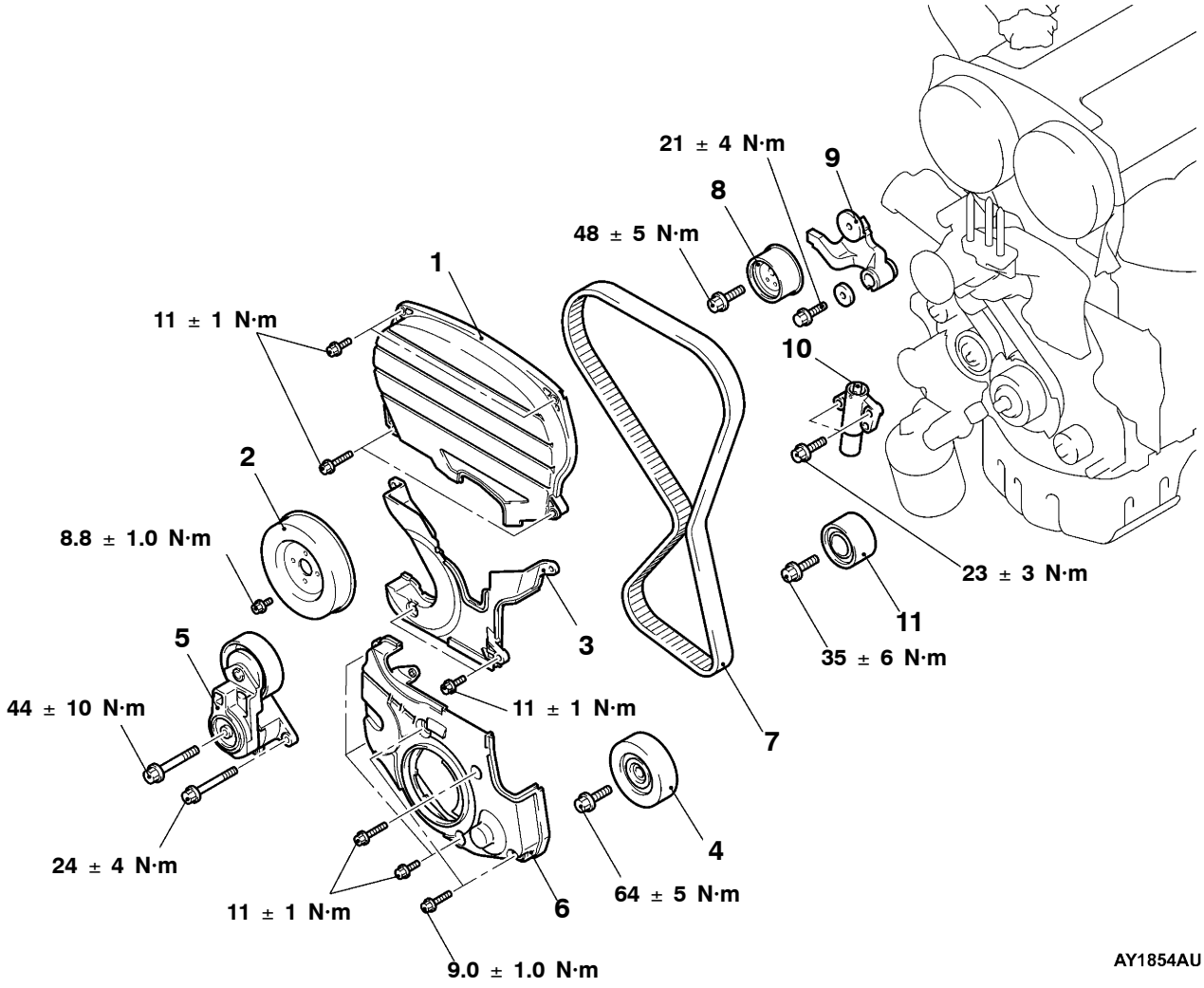
TIMING BELT AND TIMING BELT B

REMOVAL AND INSTALLATION

Caution

If the vehicle is equipped with the Brembo disc brake, during maintenance, take care not to contact the parts or tools to the caliper because the paint of caliper will be scratched.

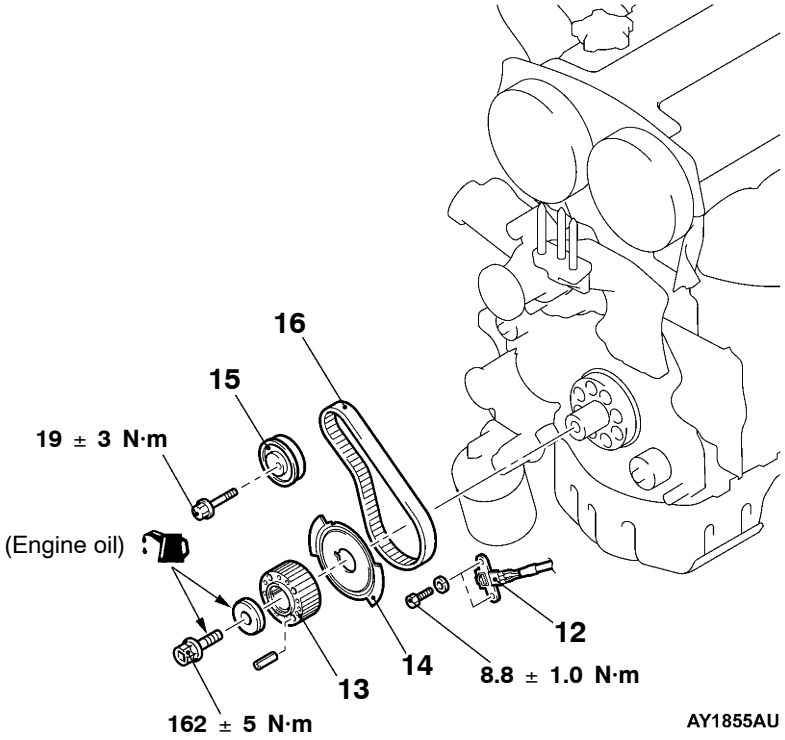
Pre-removal and Post-installation Operation
- Under Cover Removal and Installation (Refer to GROUP 51 - Front Bumper.)
- Side Cover Removal and Installation
- Drive Belt Tension Check (Refer to P.11A-7.) <After installation only>
- Crankshaft Pulley Removal and Installation (Refer to P.11A-15.)
- Crossmember Bar Removal and Installation (Refer to GROUP 32 - Engine Roll Stopper, Centermember.)
- Front Exhaust Pipe Removal and Installation (Refer to GROUP 15.)
- Engine Mounting Removal and Installation (Refer to GROUP 32.)



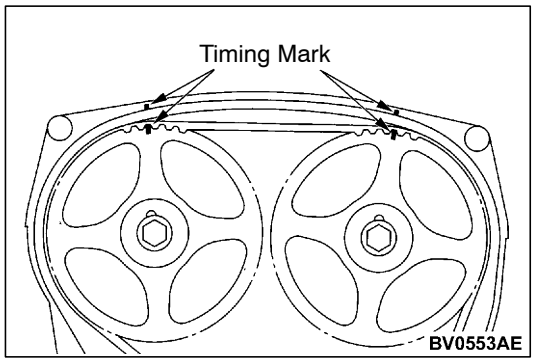
Removal steps

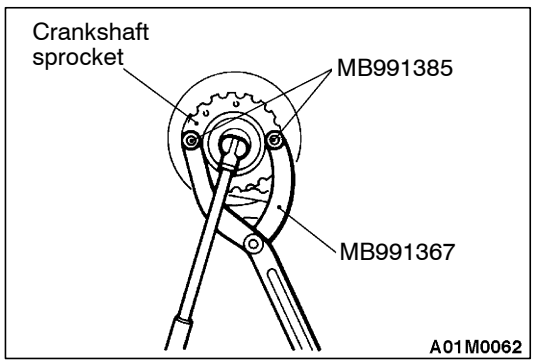
1. Timing belt front upper cover
2. Water pump pulley
3. Timing belt front center cover
4. Idler pulley
5. Drive belt auto-tensioner
6. Timing belt front lower cover

◀A▶ ▶G◀ ● Timing belt tension adjustment
▶F◀ 7. Timing belt
▶E◀ 8. Tensioner pulley
9. Tensioner arm
▶D◀ 10. Auto-tensioner
11. Idler pulley



◀B▶ ▶C◀ 12. Crank angle sensor
◀B▶ ▶C◀ 13. Crankshaft sprocket
▶C◀ 14. Crankshaft sensing blade
▶B◀ • Timing belt B tension adjustment
▶A◀ 15. Timing belt B tensioner
◀C▶ ▶A◀ 16. Timing belt B





REMOVAL SERVICE POINTS

◀A▶ TIMING BELT REMOVAL

1. Rotate the crankshaft clockwise and mate timing marks with each other to position No.1 cylinder at compression TDC.

   Caution
   Ensure that the crankshaft always rotates clockwise.

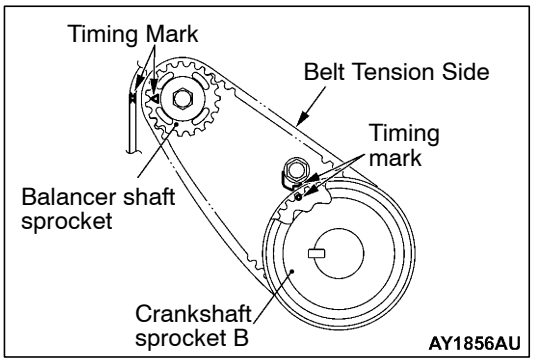
2. Loosen the mounting bolt of the tensioner pulley and remove the timing belt.

   Caution
   When the timing belt is reused, use a chalk to indicate an arrow of rotation direction on the back of the belt so that it can be re-assembled in the same direction as before.

◀B▶ CRANKSHAFT SPROCKET REMOVAL

◀C▶ TIMING BELT B REMOVAL

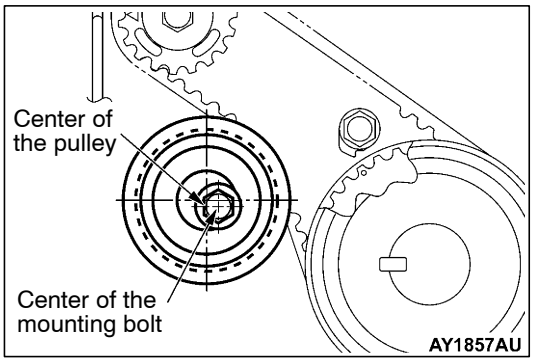
Caution
When the timing belt B is reused, use a chalk to indicate an arrow of rotation direction on the back of the belt so that it can be re-assembled in the same direction as before.



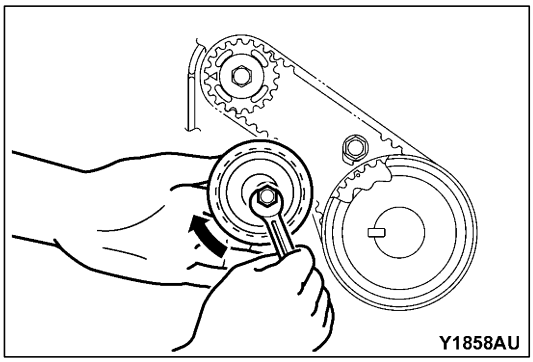
INSTALLATION SERVICE POINTS

▶A◀ TIMING BELT B/TIMING BELT B TENSIONER INSTALLATION

1. Check that timing marks of crankshaft sprocket B and balancer shaft sprocket are aligned with each other.
2. Install timing belt B to crankshaft sprocket B and balancer shaft sprocket. Prevent the tension side of the belt from sagging.



3. Position the center of the timing belt tensioner B at the center or upper left of the mounting bolt and flange pulley at the engine front to assemble and fix them temporarily.
4. Adjust the tension of timing belt B.



▶B◀ TIMING BELT B TENSION ADJUSTMENT

1. Apply force to the timing belt B tensioner in the direction indicated by the arrow to give tension torque (3.0 ± 0.4 N·m) to the timing belt B so that the tension side of the timing belt B can become tense. Maintaining the condition, tighten the mounting bolt to the specified torque for fixing.

   Tightening Torque: 19 ± 3 N·m

   Caution
   Be careful not to let the tensioner rotate together when tightening the mounting bolt. If the tensioner rotates together, belt tension becomes too much.

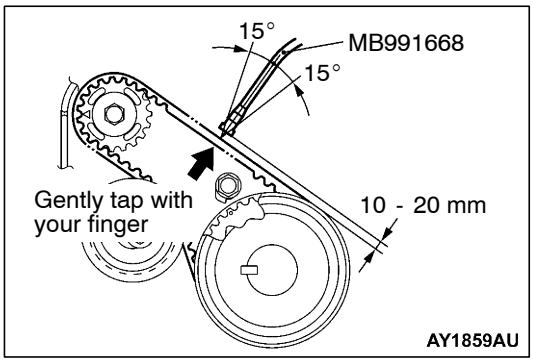
2. Measure the tension of timing belt B by following procedures.

   Standard value:

Item	When adjusted	When replaced
Vibration frequency Hz	76 - 92	76 -92
Deflection mm (Reference)	5 - 7	5 - 7

<When using MUT-II>

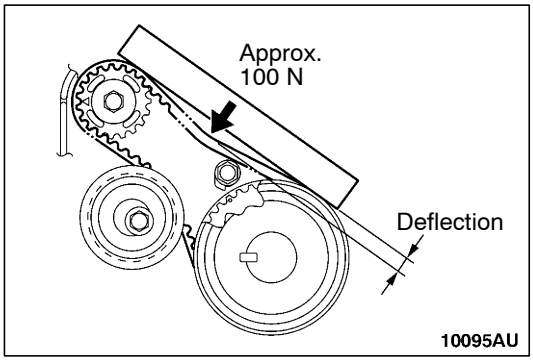
(1) Connect the special tool (MB991668) to the MUT-II.
(2) Connect the special tool (MB991704) to the MUT-II and the battery.
(3) Rotate the crankshaft clockwise for two rounds to position No.1 cylinder at compression TDC and check that timing marks of each sprocket are aligned with each other.
(4) Select "Belt Tension Measurement" from the menu screen of the MUT-II.



(5) Hold the special tool (MB991668) to the middle of the belt between sprockets (at the place indicated by the arrow) as shown in the illustration 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°).
(6) Gently tap the middle of the belt between sprockets (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

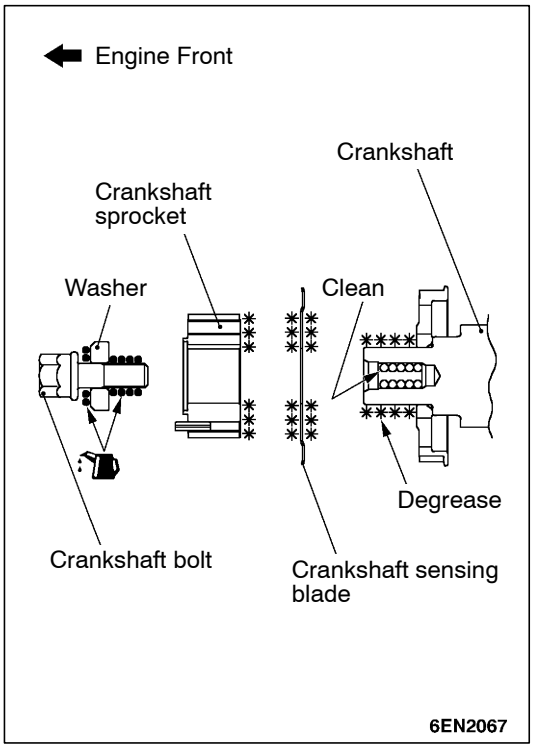
1) If strong gusts of wind blow against the microphone or if there are any loud sources of noise nearby, the values measured by the microphone may not correspond to actual values.
2) If the microphone is touching the belt while the measurement is being made, the values measured by the microphone may not correspond to actual values.



<When checking the deflection>

Apply a force of approx.100N to the middle (arrow part) of pulley shown in the figure, and check that the deflection is within the standard value.

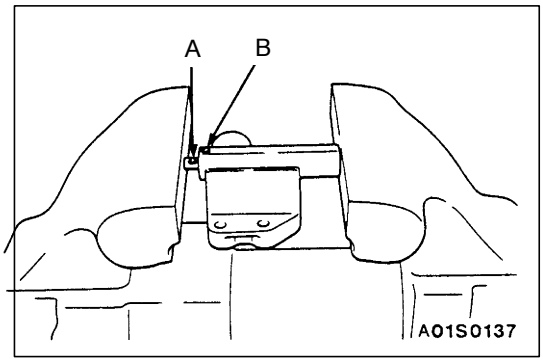
3. If it is outside the standard value, re-adjust belt tension.



▶C◀ CRANKSHAFT SENSING BLADE/CRANKSHAFT SPROCKET INSTALLATION

1. Clean and degrease the crankshaft sensing blade and the crankshaft sprocket mounting surfaces of the crankshaft sprocket and the crankshaft.
2. Install the crankshaft sensing blade and crankshaft sprocket to the direction as shown in the illustration.
3. Clean the tapped hole of the crankshaft.
4. Position the chamfered side of the washer to the direction as shown in the illustration and install to the crankshaft bolt.
5. Apply a small quantity of engine oil to the contact surface and the threads of crankshaft bolts.
6. Use the special tool to hold the crankshaft sprocket and tighten the the crankshaft bolt to the specified torque in the same way as that for removal.

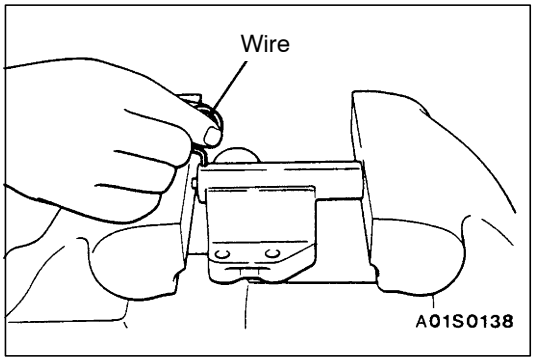
Tightening Torque: 162 ± 5 N·m



▶D◀ AUTO-TENSIONER INSTALLATION

1. If the auto-tensioner rod is being extended, set according to the following procedure.
   (1) Use a press or a vise to compress the rod of the auto-tensioner slowly and align the mounting hole A of the rod with the mounting hole B of the tensioner cylinder.

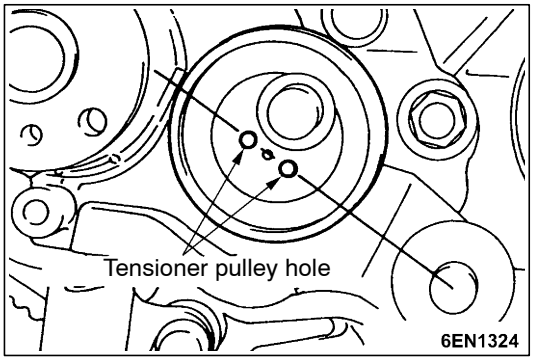
   Caution
   Ensure that the operation should be done slowly because quick compression could damage a rod.



   (2) Insert a wire or etc. into the mated mounting hole.

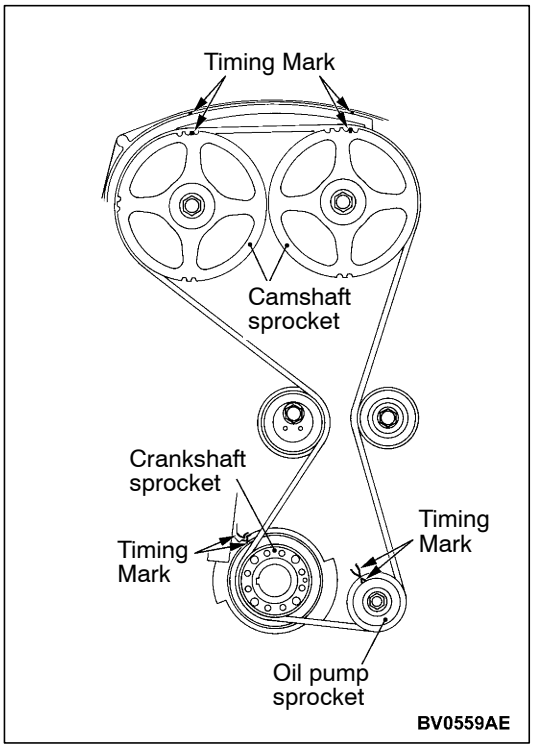
   NOTE
   If the automatic tensioner is replaced with a new one, the automatic tensioner comes with a new pin.
2. Install the auto-tensioner to the engine and tighten the mounting bolt to the specified torque. Do not remove a wire or a pin before completing timing belt tension adjustment.

Tightening Torque: 23 ± 3 N·m



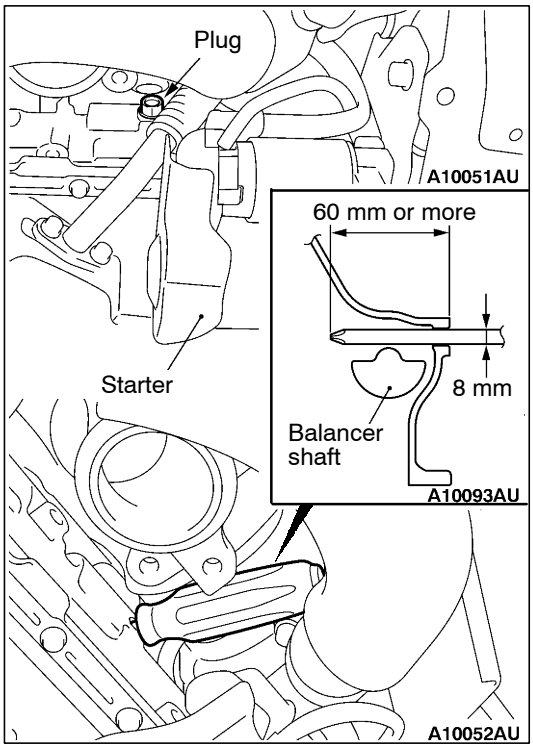
▶E◀ TENSIONER PULLEY INSTALLATION

Secure the tensioner pulley temporarily as shown in the illustration.

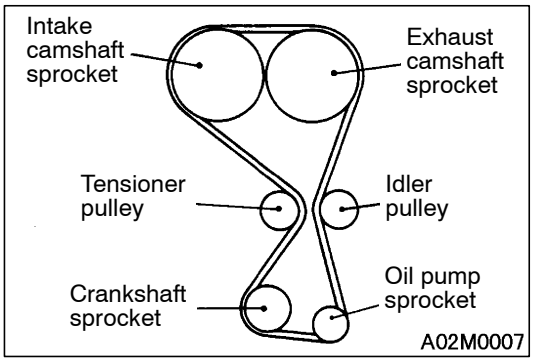


▶F◀ TIMING BELT INSTALLATION

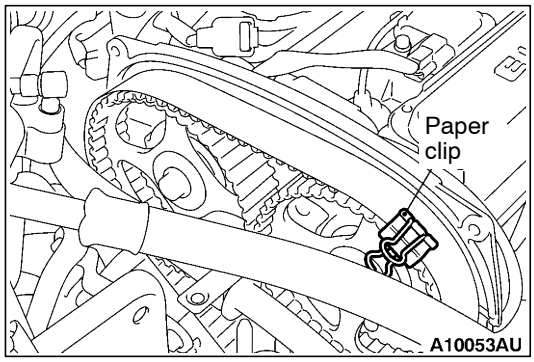
1. Check that timing marks of camshaft sprocket, crankshaft sprocket, and oil pump sprocket are aligned with each other.



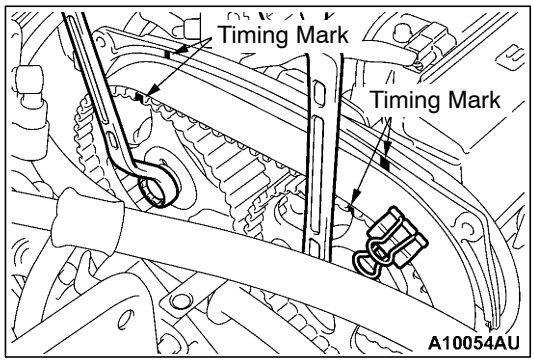
2. After aligning the timing marks of the oil pump sprocket, remove the cylinder block plug and insert a Phillips screw driver with a shaft diameter of 8 mm through the plug hole to check that the shaft of the screw driver can be inserted for 60 mm or more. If the screw driver makes contact with the balancer shaft and can be inserted for only 20 - 25 mm, turn the sprocket for one round and align timing marks again to check that screw driver can be inserted for 60 mm or more. Do not take the screw driver out before completing installation of the timing belt.



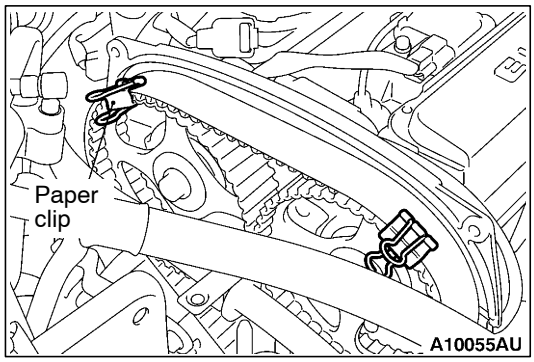
3. Position the timing belt without having any slack at the tension side of the belt.
   (1) Hook the timing belt to the crankshaft sprocket, the oil pump sprocket, and the idler pulley in the sequence.



(2) Hook the timing belt with exhaust side of the camshaft sprocket and retain the specified position indicated in the figure with paper clips.

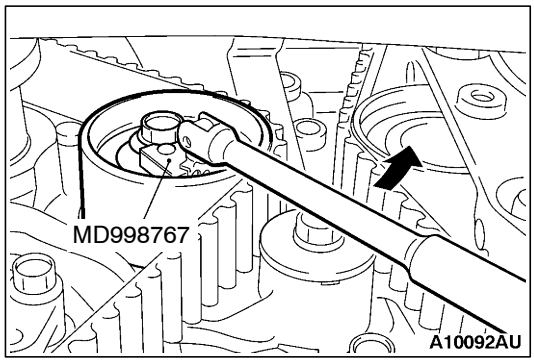


(3) Use two wrenches to hook the timing belt to the intake side of the camshaft sprocket while aligning the timing marks on the rocker cover and camshaft sprocket.

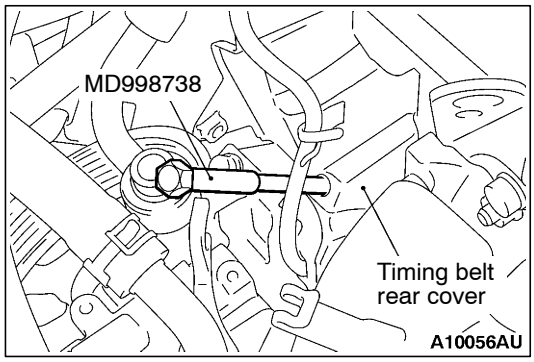


(4) Retain timing belt at the specified positions with paper clips according to the figure.
(5) Hook the timing bolt to the tensioner pulley.
(6) Remove two paper clips.

Caution
After hooking the timing belt, apply force to the camshaft sprocket counterclockwise(in left turn) and reconfirm that each timing mark is in the proper position while the belt is being stretched.



4. Use the special tool to rotate the tensioner pulley in the direction indicated in the figure, tighten the timing belt, and temporarily tighten the mounting bolt of the tensioner pulley for fixing.
5. Check that each timing mark is properly aligned.
6. Remove the screw driver and install a plug.
7. Adjust timing belt tension.

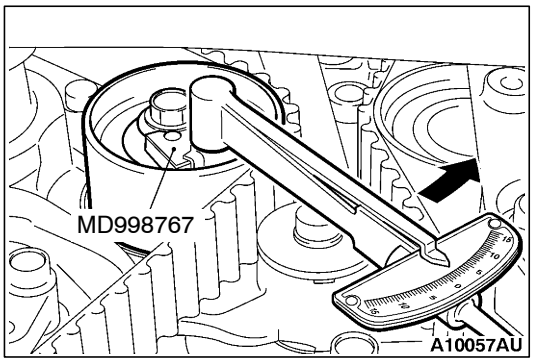


▶G◀TIMING BELT TENSION ADJUSTMENT

1. After removal of the rubber plug of the timing belt rear cover, prepare the special tool to insert the special tool into the position where a wire or a pin inserted during installation of automatic tensioner can be moved easily.

Caution
Be sure to pressfit the special tool with a hand because pressfitting the special tool with tools, such as spanner, and etc. could damage a wire or a pin inserted into the automatic tensioner.

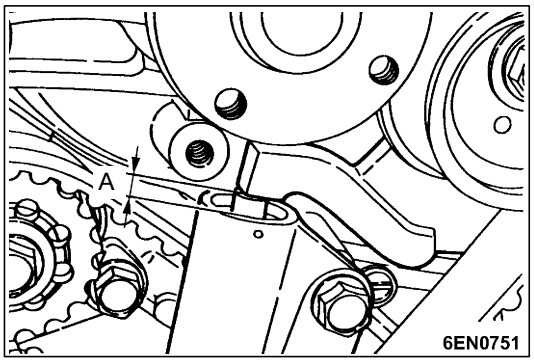
2. Rotate the crankshaft counterclockwise for 1/4 round.
3. Rotate the crankshaft clockwise and mate timing marks with each other to position No.1 cylinder at compression TDC.
4. Loosen the temporarily tightened tensioner pulley mounting bolt.



5. Use the special tool and torque wrench to apply tension torque (3.5 N m) to the timing belt in the direction indicated in the figure and tighten the tensioner pulley mounting bolt to the specified torque.

   Tightening Torque: 48 ± 5 N·m

   Caution
   Be careful not to let the tensioner pulley rotate together when tightening the mounting bolt. If the tensioner rotates together, belt tension becomes too loose.



6. Remove a wire or a pin inserted during installation of the automatic tensioner.
7. Remove the special tool installed in the above-mentioned 1 with a hand.
8. Rotate the crankshaft clockwise for two rounds and leave it alone for approximately 15 minutes.
9. Insert the removed wire or pin in the above-mentioned 6 again to check that it can be removed easily.
   If either wire or pin can be removed easily, the timing belt tension is correct and remove a wire or a pin. Then, check that projection of the automatic tensioner rod is within the standard value.

   Standard value (A): 3.8 - 4.5 mm

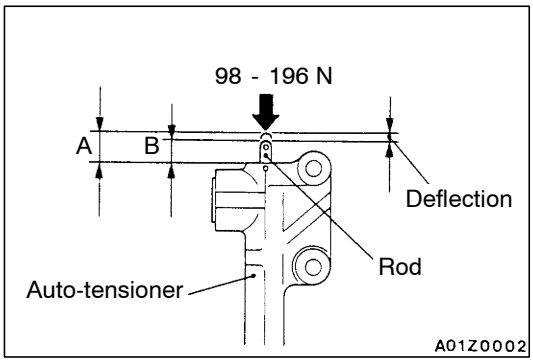
10. If a wire or a pin cannot be easily removed, repeat the above-mentioned operations 1 - 8 to obtain the correct timing belt tension.
11. Check that timing marks of each sprocket are aligned with each other.

    Caution
    After turning the crankshaft bolt counterclockwise, always check the tightening torque of the crankshaft bolt and tighten it again if it becomes loose.

INSPECTION

AUTO-TENSIONER CHECK

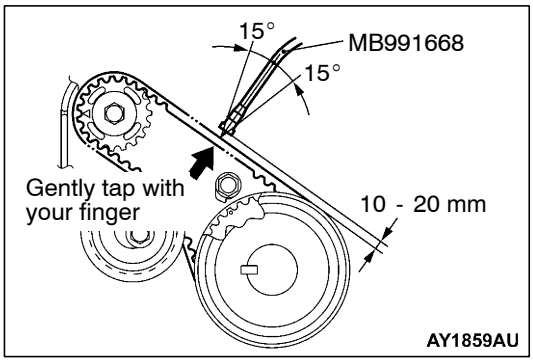
1. Check the sealant for oil leakage and replace if necessary.
2. Check the rod end for wear or damage and replace if necessary.



3. Measure the deflection of the rod end pressed against the metal (cylinder block, etc) with the force of 98 - 196 N while holding the auto-tensioner with a hand.

   Standard value: Within 1 mm
   A: Length in the released state
   B: Length in the pressed state
   A - B: Deflection

4. If the value is outside the standard value, replace the auto-tensioner.

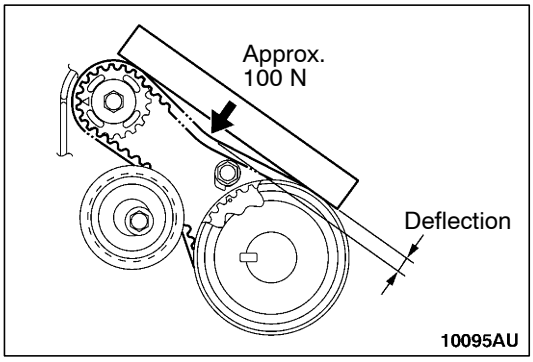


TIMING BELT B TENSION CHECK

1. Measure the tension of timing belt B by following procedures.

   Standard value:

Item	When checked
Vibration frequency Hz	52 - 92
Deflection mm (Reference)	5 - 10



<When using MUT-II>
Tap the center of the belt between the pulleys (arrow), and check that the belt vibration frequency is within the standard values.

NOTE
For the vibration frequency measurement using the MUT-II, refer to P11A-37.

<When checking the deflection>
Apply a force of approx.100N to the middle (arrow part) of pulley shown in the figure, and check that the deflection is within the standard value.

2. If it is outside the standard value, re-adjust belt tension. (Refer to P.11A-36.)

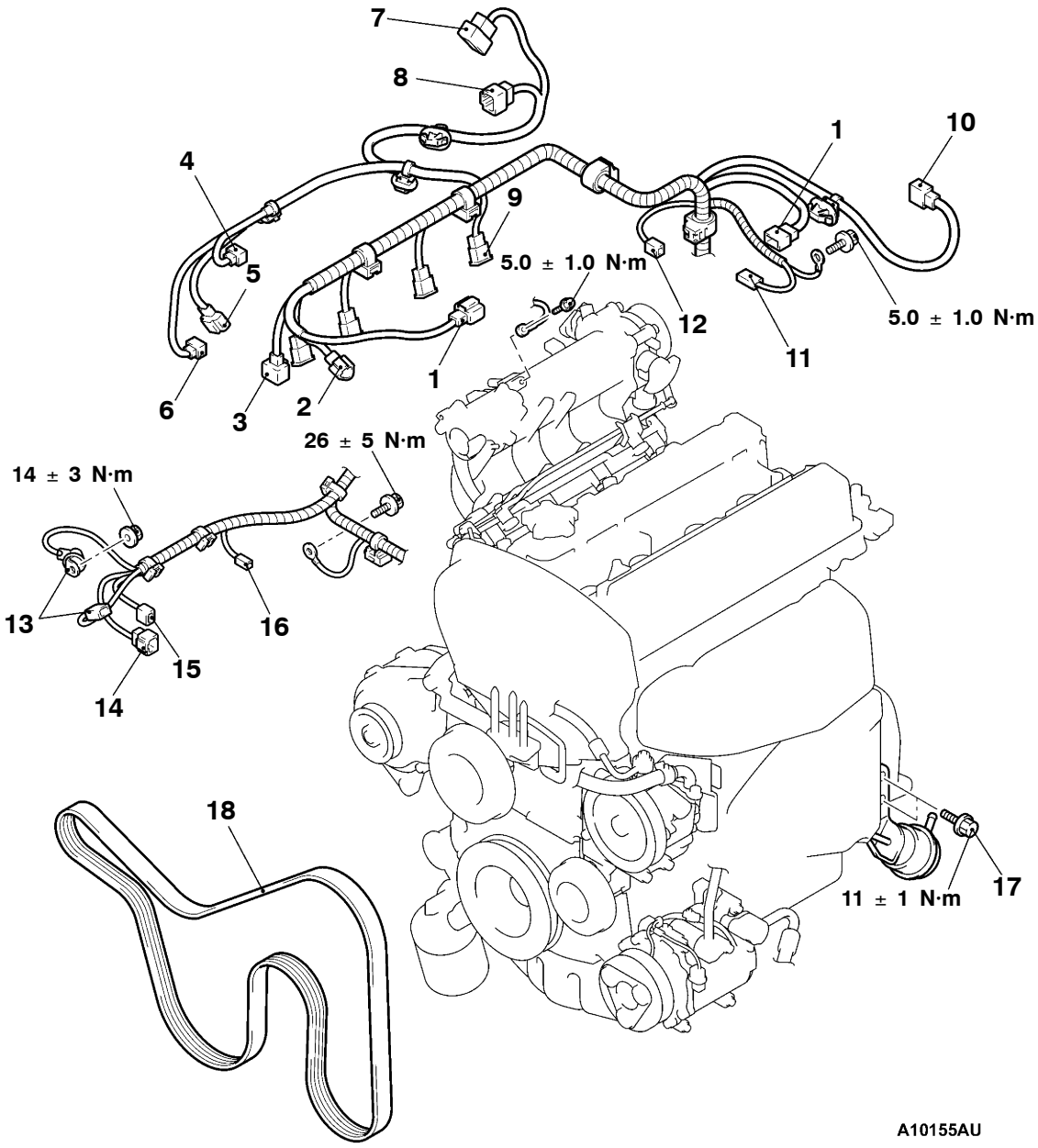
ENGINE ASSEMBLY

REMOVAL AND INSTALLATION

Caution

1. **If the vehicle is equipped with the Brembo disc brake, during maintenance, take care not to contact the parts or tools to the caliper because the paint of caliper will be scratched.**
2. **Tightening sections indicated in the mark (*) should be finally tightened with engine weight applied on the body after lightly tightening.**

Pre-removal and Post-installation Operation
- Fuel Outflow Preventive Operation (Refer to GROUP 13A - On-vehicle Service.) <Before removal only>
- Fuel Leak Check <After installation only>
- Removal and Installation of Hood (Refer to GROUP 42.)
- Removal and Installation of Strut Tower Bar (Refer to GROUP 42.)
- Removal and Installation of Under Cover (Refer to GROUP 51 - Front Bumper.)
- Removal and Installation of Side Cover.
- Drive Belt Tension Check (Refer to P.11A-7.) <After installation only>
- Accelerator Cable Adjustment (Refer to GROUP 17 - On-vehicle Service.) <After installation only>
- Drainage and Refilling Engine Oil(Refer to GROUP 12 - On-vehicle Service.)
- Drainage and Refilling of Engine Coolant (Refer to GROUP 14 - On-vehicle Service.)
- Air Cleaner Removal and Installation (Refer to GROUP 15)
- Removal and Installation of Air Pipe C, Air Pipe B and Air Hose A (Refer to GROUP 15 - Intercooler.)
- Battery and Battery Tray Removal and Installation
- Removal and Installation of Center Cover (Refer to P.11A-17.)
- Removal and Installation of Accelerator Cable (Refer to GROUP 17.)
- Removal and Installation of Radiator (Refer to GROUP 14.)
- Removal and Installation of Crossmember Bar (Refer to GROUP 32 - Engine Roll Stopper, Centermember.)
- Removal and Installation of Front Exhaust Pipe (Refer to GROUP 15.)
- Removal and Installation of Air Outlet Fitting (Refer to GROUP 15 - Exhaust manifold.)

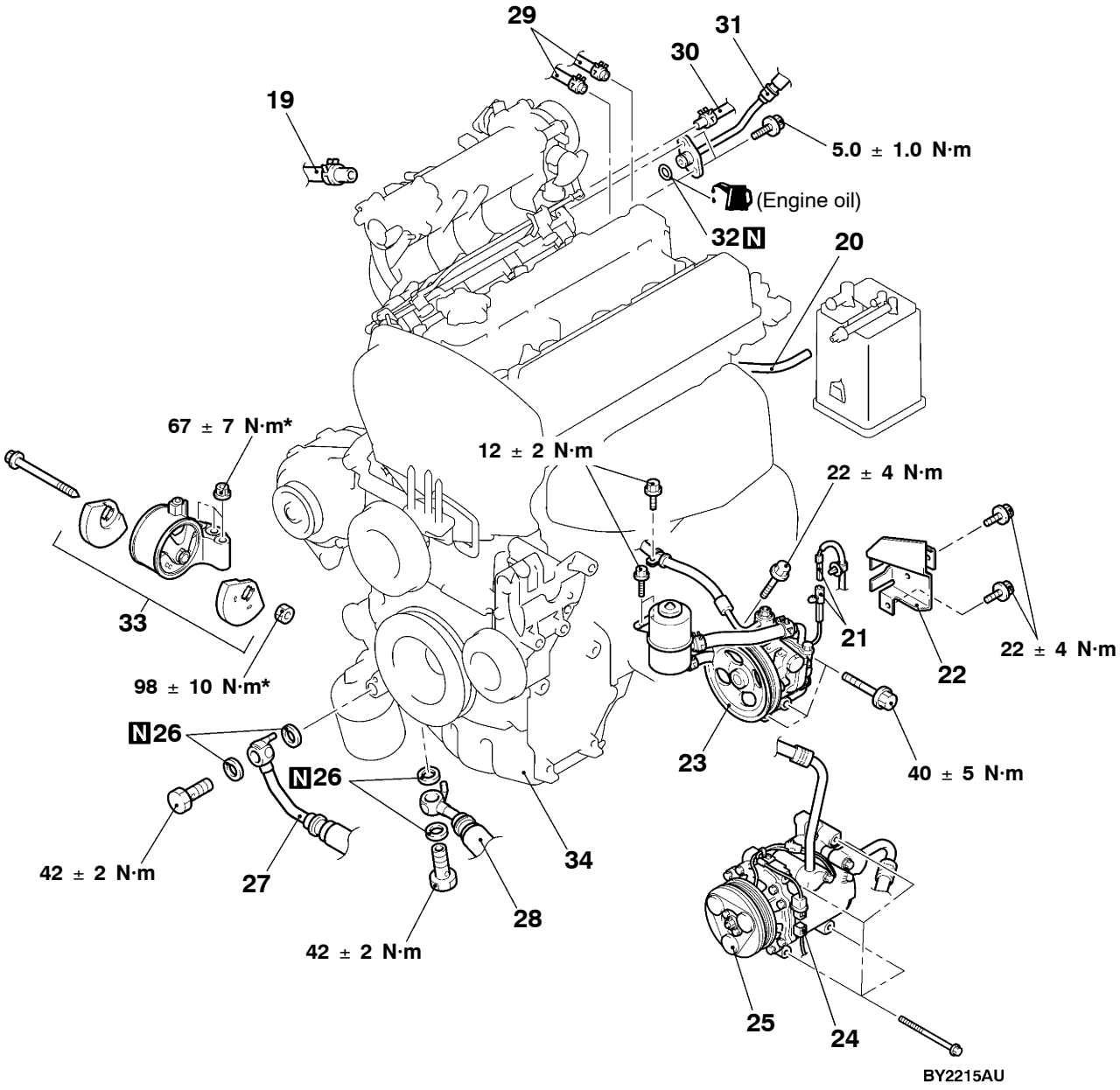


Removal steps

1. Ignition coil connector
2. Crank angle sensor connector
3. Oxygen sensor connector
4. Fuel pressure solenoid valve connector
5. Detonation sensor connector
6. Purge control solenoid valve connector
7. Throttle position sensor connector
8. Idle speed control servo connector
9. Injector connector
10. Camshaft position sensor connector

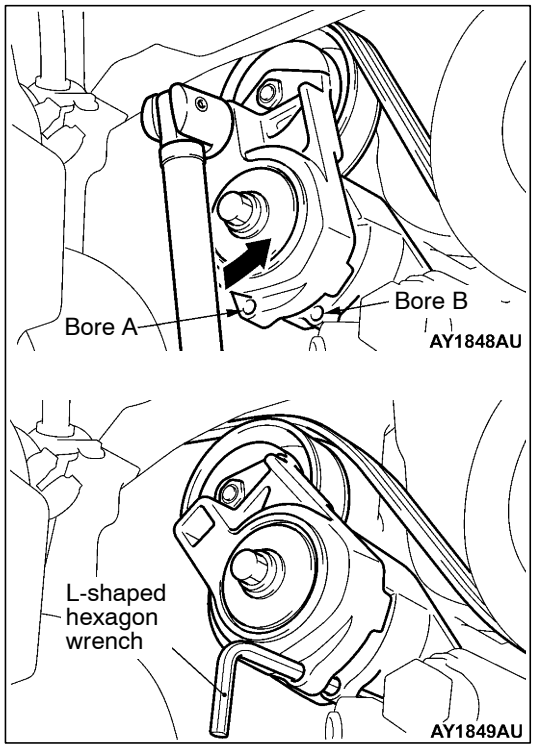
◀A▶

11. Engine coolant temperature gauge unit connector
12. Engine coolant temperature sensor connector
13. Alternator connector
14. EGR solenoid valve connector
15. Secondary air control solenoid valve connector
16. Engine oil pressure switch connector
17. Waste gate actuator mounting bolt
18. Drive belt



19. Brake booster vacuum hose connection
20. Purge hose connection
21. Power steering oil pressure switch connector
22. Heat protector
◀B▶ 23. Power steering oil pump, bracket and oil reservoir assembly
24. A/C compressor connector <Vehicle with A/C>
◀B▶ 25. A/C compressor <Vehicle with A/C>
26. Engine oil cooler tube gasket
27. Engine oil cooler feed hose connection
28. Engine oil cooler return hose connection
29. Heater hose connection
30. Fuel return hose connection
▶C◀ 31. Fuel high pressure hose connection
▶C◀ 32. O-ring
- Transfer assembly (Refer to Group 22.)
- Transmission assembly (Refer to Group 22.)

◀C▶ ▶B◀ 33. Engine mounting bracket and stopper assembly
◀D▶ ▶A◀ 34. Engine assembly



REMOVAL SERVICE POINTS

◀A▶ DRIVE BELT REMOVAL

Due to the adoption of the Serpentine drive system with the auto-tensioner, the following operation is required:

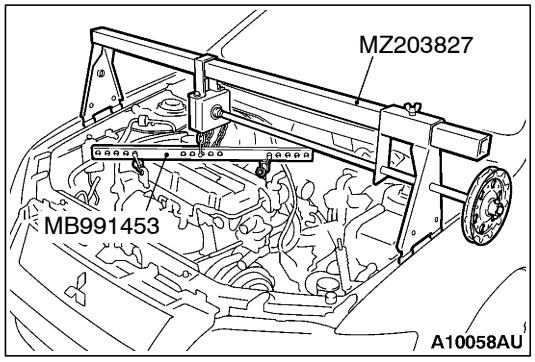
1. Insert the 12.7sq. spinner handle into the tool hole of the auto-tensioner and rotate it counterclockwise until the auto-tensioner reaches to the stopper.
2. Align hole A with hole B for fixing by inserting the L shaped-hexagon wrench, then remove the drive belt.

Caution
When the drive belt is reused, use a chalk to indicate an arrow of rotation direction on the back of the belt so that it can be re-assembled in the same direction as before.

◀B▶ POWER STEERING OIL PUMP, BRACKET AND OIL RESERVOIR ASSEMBLY / A/C COMPRESSOR REMOVAL

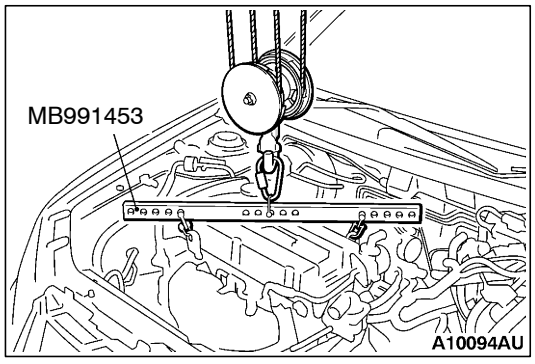
Remove the power steering oil pump, bracket, oil reservoir and A/C compressor with the hose attached from the bracket.

NOTE
Tie the removed oil pump and A/C compressor with a rope and set aside where they cannot hinder the removal of the engine assembly.



◀C▶ ENGINE MOUNTING BRACKET AND STOPPER ASSEMBLY REMOVAL

1. Support the engine with a garage jack.
2. Remove special tool (MZ203827).
   (Tool used for removal of transmission assembly)



3. Hold the engine assembly with a chain block.
4. Support the engine oil pan with a garage jack via a block of wood cut without applying the weight of the engine and remove the engine mounting bracket and stopper assembly.

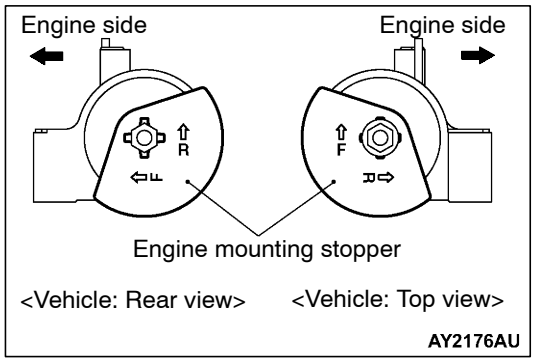
◀D▶ ENGINE ASSEMBLY REMOVAL

After checking that all the cables, hoses, and harness connectors have been disconnected, lift the engine with a chain block slowly and remove the engine assembly located at the upper engine room.

INSTALLATION SERVICE POINTS

▶A◀ ENGINE ASSEMBLY INSTALLATION

Install the engine assembly while checking that none of cables, hoses, or harness connectors, etc. has been engaged.



▶B◀ ENGINE MOUNTING BRACKET AND STOPPER ASSEMBLY INSTALLATION

1. Support the engine oil pan with a garage jack via a block of wood cut adjusting the engine position and install the engine mounting bracket and stopper assembly. Position the engine mounting stopper so that a mark indicated by an arrow can face the direction shown in the illustration.
2. Support engine with garage jack.
3. Remove the chain block and hold the engine assembly with the special tool.(Tool used for removal of transmission assembly)

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

1. Apply small quantity of new engine oil on O-ring.

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

2. Install the fuel high pressure pipe to the delivery pipe rotating in both directions without damaging the O-ring and check that it rotates smoothly.
3. In case of not rotating smoothly, remove the fuel high pressure hose and insert it to the delivery pipe again after checking damage of the O-ring since there is a possibility of O-ring engagement.
4. Tighten fuel high pressure hose mounting bolt to the specified torque.

   Tightening Torque: 5.0 ± 1.0 N·m

NOTES

ENGINE OVERHAUL

CONTENTS

GENERAL DESCRIPTION

LIST OF MODELS

Vehicle name	Vehicle model	Engine model	Displacement mL	Specifications
LANCER Evolution VII	CT9A	4G63-7	2000	DOHC 16 valve T/C

SPECIFICATIONS

Items		Specifications
Bore × stroke mm		85 × 88
Total displacement mL		1,997
Combustion chamber shape		Pentroof type
Number of cylinders		4
Valve mechanism	Type	DOHC
	Intake valve	2
	Exhaust valve	2
	Lash adjuster	Hydraulic type
	Rocker arm	Roller follower type
Compression ratio		8.8
Fuel injection device		Electronic control MPI
Ignition device type		Electronic control type 2-coil
Alternator type		Alternating current type (IC regulator built in)
Starter motor type		Deceleration drive

SPECIFICATIONS

SERVICE SPECIFICATIONS

Unit: mm

Items	Standard value	Limited value
Timing belt		
Timing belt B		
Vibration frequency Hz (during inspection)	56 - 92	
Vibration frequency Hz (when re-tensing working belt)	76 - 92	
Vibration frequency Hz (when mounting new belt)	76 - 92	
Deflection amount <reference value> (during inspection)	5 - 10	
Deflection amount <reference value> (when re-tensing working belt)	5 - 7	
Deflection amount <reference value> (when mounting new belt)	5 - 7	
Auto-tensioner		
Rod protrusion length (free length)	12.0	-
Rod protrusion length (when mounting timing belt)	3.8 - 4.5	-
Rod recess amount (when pressed at 98 to 196 N•m)	Within 1	-
Rocker arm, camshaft		
Camshaft		
Cam height		
Intake	35.79	35.29
Exhaust	35.49	34.99
Cylinder head, valve		
Cylinder head		
Lower surface strain	0.05	0.2
Lower surface grinding limit (in combination with combined cylinder block)	-	0.2
Total height	131.9 - 132.1	-
Valve		
Margin		
Intake	1.0	0.5
Exhaust	1.5	1.0
Total length		
Intake	109.50	109.00
Exhaust	109.70	109.20
Valve spring		
Free height	48.3	47.3
Squareness	1.5° or less	4°
Valve guide		
Clearance between valve guide and valve stem		
Intake	0.02 - 0.05	0.10
Exhaust	0.05 - 0.09	0.15
Total length		
Intake	45.5	-
Exhaust	50.5	-
Protrusion amount	19.2 - 19.8	-
Valve seat		
Contact width	0.9 - 1.3	-
Valve protrusion amount from spring seat surface		
Intake	49.20	49.70
Exhaust	48.40	48.90

Unit: mm

Items	Standard value	Limited value
Oil pump, oil pan		
Oil pump		
Side clearance		
Drive gear	0.08 - 0.14	-
Driven gear	0.06 - 0.12	-
Piston, connecting rod		
Piston		
Press-in load N	7,355 - 17,162	-
Piston ring		
Clearance between ring and ring groove		
No. 1 ring	0.03 - 0.07	0.1
No. 2 ring	0.02 - 0.06	0.1
Closed gap		
No. 1 ring	0.20 - 0.30	0.8
No. 2 ring	0.35 - 0.50	0.8
Oil	0.10 - 0.40	1.0
Connecting rod		
Large end thrust clearance	0.10 - 0.25	0.4
Crankshaft		
Pin section oil clearance	0.03 - 0.05	0.1
Crankshaft, cylinder block		
Crankshaft		
End play	0.05 - 0.25	0.4
Journal section oil clearance	0.03 - 0.04	0.1
Cylinder block		
Upper surface strain	0.05	0.1
Upper surface grinding limit (in combination with combined cylinder head)	-	0.2
Cylinder bore	85.0	-
Cylindricity	0.01 or less	-
Clearance between piston and cylinder	0.02 - 0.04	-
Turbocharger		
Waste gate actuator operation pressure	100 kPa	-
Alternator		
Alternator		
Rotor coil resistance Ω	3 - 5	-
Brush protrusion length	-	2
Starter motor		
Starter motor		
Deviation on commutator periphery	0.05	0.1
Commutator outer diameter	29.4	28.8
Undercut depth	0.5	0.2

MACHINING STANDARDS

Unit: mm

Items	Standard value	Limited value
Cylinder head, valve		
Cylinder head		
Oversize valve guide hole diameter		
0.05 O.S.	12.05 - 12.07	-
0.25 O.S.	12.25 - 12.27	-
0.50 O.S.	12.50 - 12.52	-
Oversize valve seat hole diameter		
Intake		
0.3 O.S.	35.30 - 35.33	-
0.6 O.S.	35.60 - 35.63	-
Exhaust		
0.3 O.S.	33.30 - 33.33	-
0.6 O.S.	33.60 - 33.63	-

TIGHTENING TORQUE

Items	Tightening torque N·m
Alternator, ignition system	
Oil level gauge guide bolt	13 ± 1
Water pump pulley bolt	8.8 ± 1.0
Alternator brace bolt (flange)	23 ± 3
Alternator brace bolt (washer)	22 ± 4
Alternator nut	44 ± 10
Crankshaft pulley bolt	25 ± 4
Center cover bolt	3 ± 0.5
Ignition coil bolt	10 ± 2
Spark plug	25 ± 5
Connector bracket bolt	8.8 ± 1.0
Timing belt	
Timing belt cover bolt (flange)	11 ± 1
Timing belt cover bolt (washer)	9 ± 1
Power steering pump bracket bolt	49 ± 9
Tensioner pulley bolt	49 ± 6
Tensioner arm bolt	21 ± 4
Auto tensioner bolt	23 ± 3
Idler pulley bolt	35 ± 6
Crank angle sensor bolt	8.8 ± 1.0
Oil pump sprocket nut	54 ± 5
Crankshaft bolt	162 ± 5
Tensioner B bolt	19 ±3
Counter balance shaft sprocket bolt	46 ± 3
Rocker cover bolt	3.5 ± 0.5
Engine support bracket bolt	49 ± 5

Items	Tightening torque N·m
Camshaft sprocket bolt	88 ± 10
Fuel system	
Throttle body bolt	19 ± 3
EGR valve bolt	20 ± 2
Fuel pressure regulator bolt	8.8 ± 2.0
Delivery pipe and injector bolt	11 ± 1
Vacuum hose and pipe bolt	11 ± 1
Solenoid assembly bolt	9 ± 1
Vacuum tank bracket bolt	9 ± 1
Secondary air system, intake manifold	
Exhaust manifold heat protector bolt	14 ± 1
Vacuum hose and pipe bolt	11 ± 1
Air pipe assembly bolt (eye bolt)	49 ± 5
Air pipe assembly bolt (M6 flange)	11 ± 1
Air pipe assembly bolt (M8 flange)	24 ± 3
Air pipe assembly bolt (M8 washer)	14 ± 1
Air control valve assembly bolt	22 ± 4
Air control valve bracket bolt	22 ± 4
MDP sensor bolt	5 ± 1
Intake manifold stay bolt	31 ± 3
Intake manifold bolt (M8)	20 ± 2
Intake manifold bolt nut (M8)	36 ± 6
Exhaust manifold	
Engine hanger bolt	19 ± 3
Turbocharger heat protector bolt	14 ± 1
O_2 sensor	44 ± 5
Exhaust fitting bracket bolt	47 ± 6
Exhaust fitting bolt nut	59 ± 5
Air outlet fitting bolt	19 ± 1
Oil return pipe bolt (flange)	14 ± 1
Oil return pipe bolt (washer)	9 ± 1
Turbocharger assembly and pipe bolt, nut	59 ± 5
Oil pipe bolt (M10 eye bolt)	17 ± 2
Oil pipe bolt (M12 eye bolt)	31 ± 2
Oil pipe bolt (M12 flange)	11 ± 1
Water pipe bolt (flange)	10 ± 1
Water pipe bolt (eye bolt)	42 ± 7
Exhaust manifold nut (M8)	33 ± 6
Exhaust manifold nut (M10)	55 ± 10
Water pump, water hose	
Engine coolant temperature sensor	29 ± 10
Engine coolant temperature gauge unit	10.8 ± 1.0

Items	Tightening torque N·m
Water outlet fitting bolt	10 ± 1
Thermostat housing bolt	23 ± 4
Water inlet pipe bolt (M6)	10 ± 1
Water inlet pipe bolt (M8)	13 ± 2
Water pump bolt	14 ± 1
Knock sensor	23 ± 2
Rocker arm, camshaft	
Cam position sensor bolt	8.8 ± 1.0
Cover bolt	10 ± 2
Cam position sensing cylinder bolt	22 ± 4
Cam position sensor support bolt	14 ± 1
Bearing cap bolt	20 ± 1
Oil delivery body bolt	11 ± 1
Cylinder head, valve	
Cylinder head bolt	78 ± 2 → Completely loosen → 20 ± 2 → 90° + 90°
Oil pump, oil pan	
Drain plug	39 ± 5
Oil pan bolt	9 ± 3
Oil screen bolt	19 ± 3
Baffle plate bolt	22 ± 4
Oil pressure switch	19 ± 3
Oil cooler bypass valve	54 ± 5
Relief plug	44 ± 5
Oil filter bracket bolt	19 ± 3
Plug cap	23 ± 3
Flange bolt	36 ± 3
Oil pump case bolt	23 ± 3
Oil pump cover bolt	17 ± 1
Oil pump cover screw	10 ± 2
Piston, connecting rod	
Connecting rod cap nut	20 ± 2 + 90° - 94°
Crankshaft, cylinder block	
Flywheel bolt	132 ± 5
Rear plate bolt	11 ± 1
Bell housing cover bolt	9 ± 1
Rear oil seal case bolt	11 ± 1
Beam bearing cap bolt	25 ± 2 + 90° - 100°
Check valve	32 ± 2
Throttle body	
Throttle position sensor bolt	2.0 ± 0.5
Turbocharger	
Waste gate actuator bolt	11.3 ± 1.5

SEALANTS

Item	Specified sealant	Quantity
Engine support bracket bolt	3M™ AAD Part No. 8672 or equivalent	As required
Semi-circular packing	3M™ AAD Part No. 8672 or equivalent	As required
Rocker cover	3M™ AAD Part No. 8672 or equivalent	As required
Water outlet fitting	Mitsubishi Genuine Part No. MD970389 or equivalent	As required
Engine coolant temperature gauge unit	3M™ AAD Part No. 8672 or equivalent	As required
Engine coolant temperature sensor	3M™ AAD Part No. 8672 or equivalent	As required
Cylinder head (camshaft bearing cap mounting section)	3M™ AAD Part No. 8672 or equivalent	As required
Cam position sensor support	Mitsubishi Genuine Part No. MD970389 or equivalent	As required
Oil pressure switch	3M™ AAD Part No. 8672 or equivalent	As required
Oil pan	Mitsubishi Genuine Part No. MD970389 or equivalent	As required
Oil seal case	Mitsubishi Genuine Part No. MD970389 or equivalent	As required

FORM-IN-PLACE-GASKET

FIPG is used for several members of this engine. With this gasket, caution is required to the application amount, application procedure and state of the application surface so that the performance is sufficiently attained.
If sufficient gasket is not applied, leaks could occur, and if too much is applied, the gasket could protrude and plug or restrict the oil and water flow passage. Thus, to prevent leaks from the joined sections, it is absolutely necessary to evenly apply the correct amount.
The FIPG used for the engine parts reacts with moisture in the air and hardens so use it for the normal metal flange parts.

DISASSEMBLY

The parts assembled with FIPG can be easily disassembled without special means. However, in some cases, the sealant on the seams must be broken by lightly tapping with a wood hammer or similar tool. A smooth and thin gasket scraper can be lightly tapped into the seams but in this case, take care not to damage the seams.
The special tool oil pan remover (MD998727) is set for this purpose.

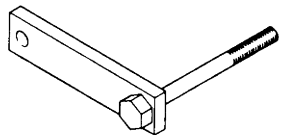
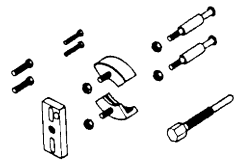
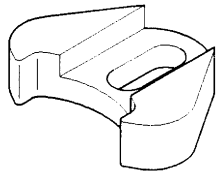
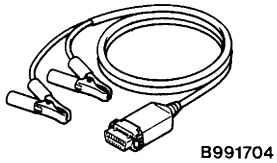
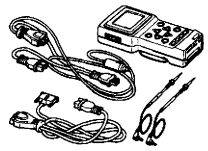
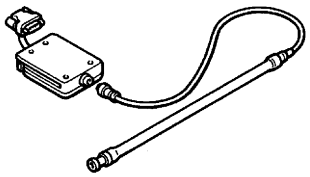
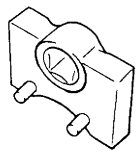
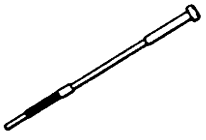
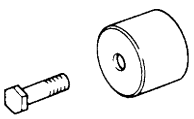
WASHING THE GASKET SURFACE

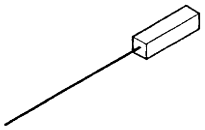
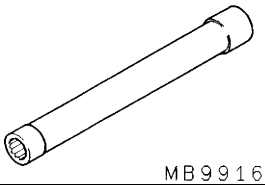
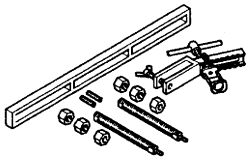
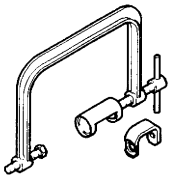
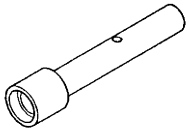
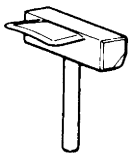
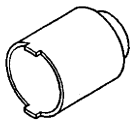
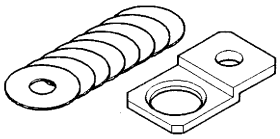
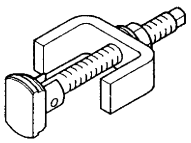
Completely remove all matters adhered on the gasket surfaces with a gasket scraper or wire brush. Confirm that the FIPG application surface is smooth. There must be no grease or foreign matter on the gasket surface.
Always remove the old FIPG that has entered the mounting holes and screw holes.

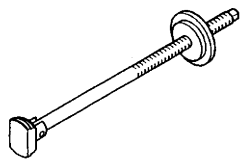
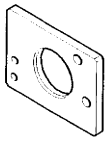
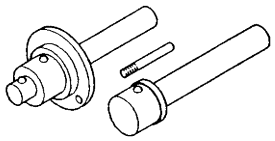
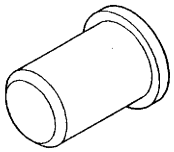
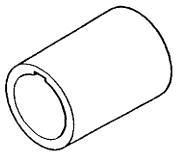
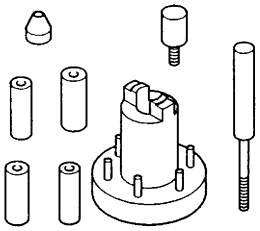
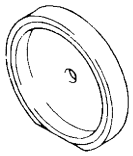
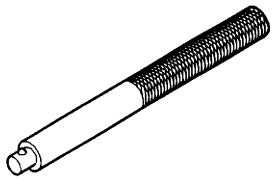
APPLICATION PROCEDURES

Apply an even coat of FIPG within the predetermined radius. Completely cover the areas around the mounting holes. The FIPG can be wiped off if it has not hardened. Install at the set position while the FIPG is still wet (within 15 minutes). When installing, maker sure that the FIPG does not get on areas other than the required areas. After installing, do not subject the application areas to oil or water or start the engine until the FIPG has sufficiently hardened (approx. one hour). The FIPG application procedures differ according to the member, so follow the procedures given in this manual and apply the FIPG.

SPECIAL TOOLS

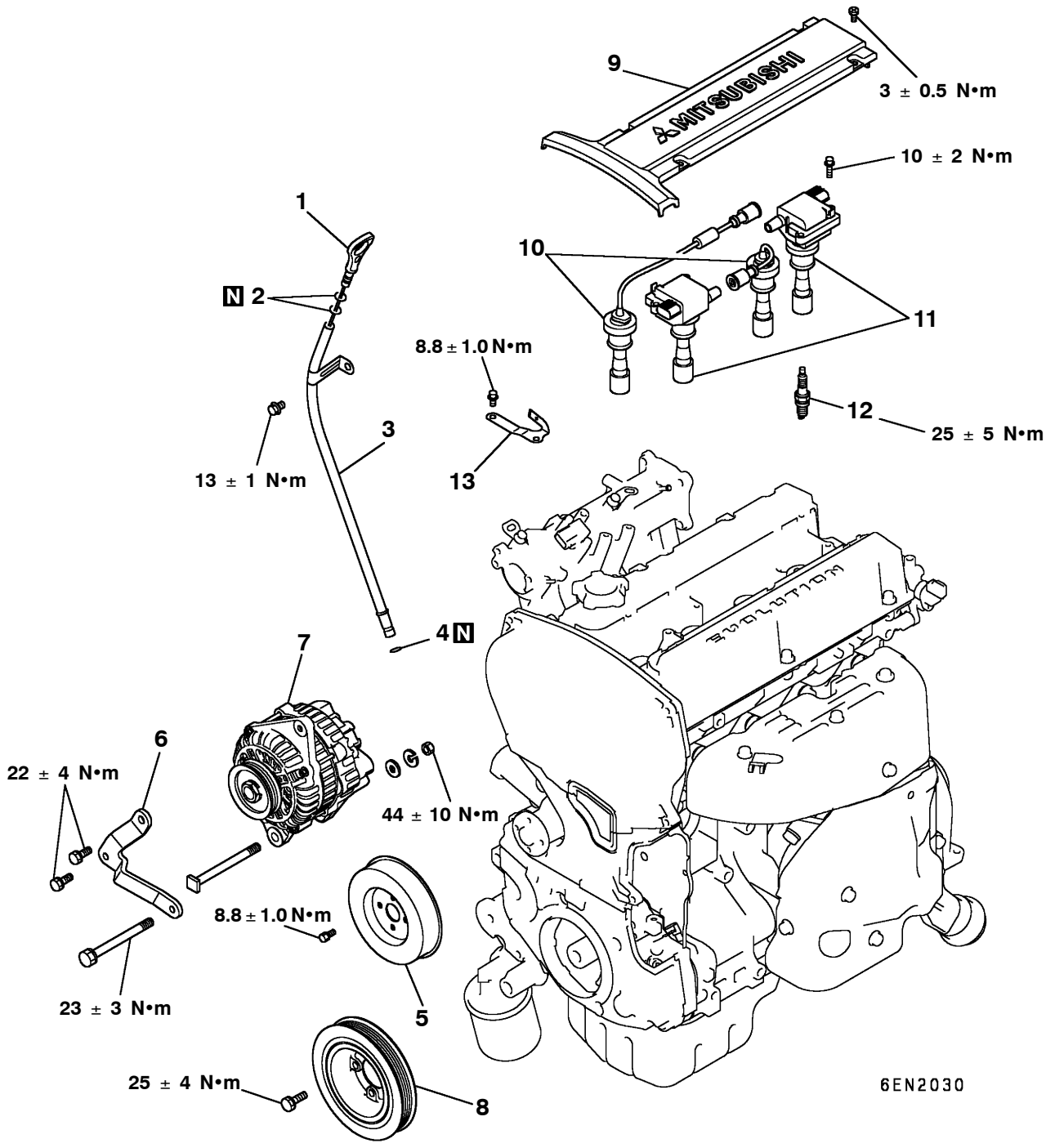
Tool	Number	Name	Use
	MD998781	Flywheel stopper	Fixing of flywheel
	MD998778	Crankshaft sprocket	Removal of crankshaft sprocket and crankshaft sprocket B
	MB998785	Sprocket stopper	Holding of counter balance shaft sprocket
 B991704	MB991704	Battery harness	Measurement of timing belt B tension (Use together with MUT-II.)
	MB991502	MUT-II sub assembly	Measurement of timing belt B tension (Use together with MB991704 and MB991668.)
	MB991668	Belt tension meter set	Measurement of timing belt B tension (Use together with MUT-II.)
	MD998767	Tension pulley socket wrench	Operation of tensioner pulley during adjustment of timing belt tension
	MD998738	Set screw	Holding of tensioner arm and auto tensioner during installation of timing belt
	MD998713	Camshaft oil seal installer	Installation of camshaft oil seal

Tool	Number	Name	Use
	MD998442	Air bleed wire	Bleeding of lash adjuster
 MB991654	MB991654	Cylinder head bolt wrench	Loosening/tightening of cylinder head bolt
	MD998772	Valve spring compressor	Compression of valve spring
	MD998735	Valve spring compressor	Compression of valve spring
	MD998737	Valve stem seal installer	Installation of valve stem seal
	MD998727	Oil pan remover	Removal of oil pan
	MD998162	Plug wrench	Removal and installation of front case plug cap (Use together with MD998783.)
	MD998783	Plug wrench retainer	Removal and installation of front case plug cap (Use together with MD998162.)
	MD998371	Silent shaft bearing puller	Removal of counter balance shaft front bearing

Tool	Number	Name	Use
	MD998372	Silent shaft bearing puller	Removal of counter balance shaft rear bearing
	MB991603	Silent shaft bearing installer stopper	Guide stopper when removing/pressing in counter balance shaft rear bearing
	MD998705	Silent shaft bearing installer	Press in of counter balance shaft front and rear bearings
	MD998375	Crankshaft front oil seal installer	Installation of crankshaft front oil seal
	MD998285	Crankshaft front oil seal guide	Guide for installation of crankshaft front oil seal
	MD998780	Piston pin setting tool	Removal/press in of piston pin
	MD998776	Crankshaft rear oil seal installer	Installation of crankshaft rear oil seal
	MD990938	Handle	Installation of crankshaft rear oil seal (Use together with MD998776.)

ALTERNATOR AND IGNITION SYSTEM

REMOVAL AND INSTALLATION

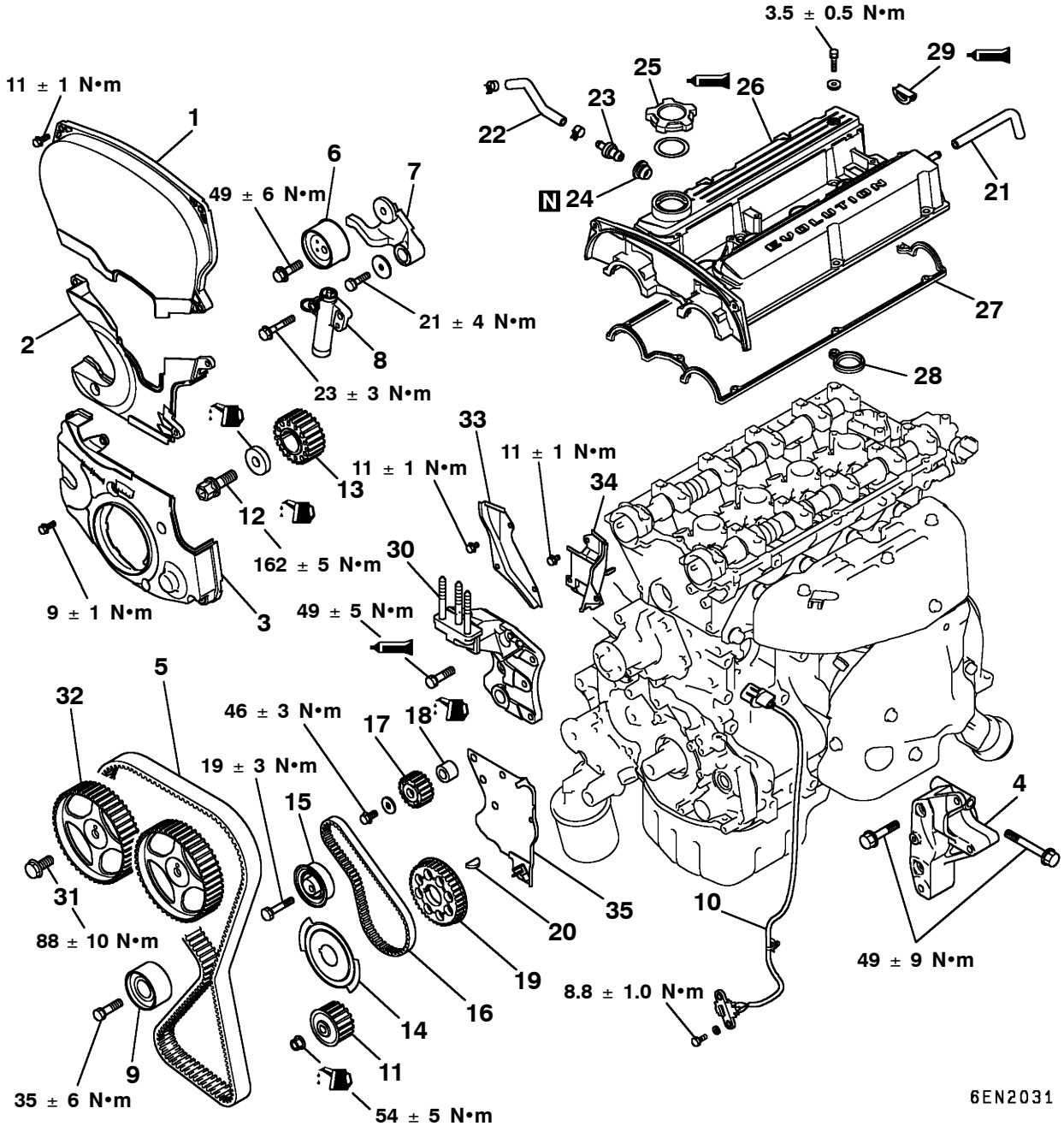


Removal steps

1. Oil level gauge
2. O-ring
3. Oil level gauge guide
4. O-ring
5. Water pump pulley
6. Alternator brace
7. Alternator
8. Crankshaft pulley
9. Center cover
10. Spark plug cable
11. Ignition coil
12. Spark plug
13. Connector bracket

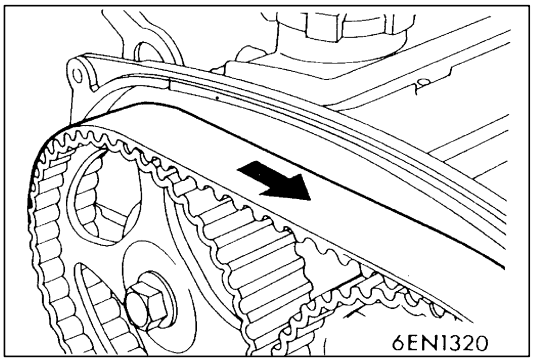
TIMING BELT

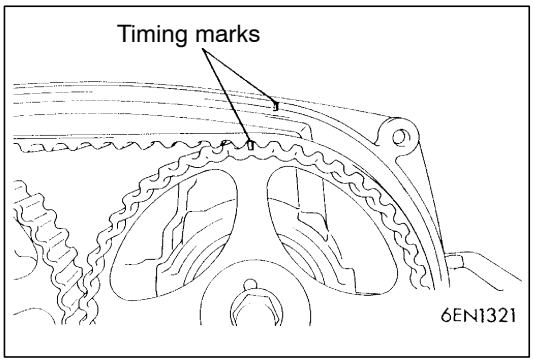
REMOVAL AND INSTALLATION



Removal steps

1. Timing belt front upper cover
2. Timing belt front center cover
3. Timing belt front lower cover
4. Power steering pump bracket
- ◀A▶ ▶M◀ ▶L◀ 5. Timing belt
- ▶L◀ 6. Tensioner pulley
7. Tensioner arm
- ▶K◀ 8. Auto tensioner
9. Idler pulley
10. Crank angle sensor
- ◀B▶ ▶J◀ 11. Oil pump sprocket
- ◀C▶ ▶I◀ 12. Crankshaft bolt
- ◀D▶ ▶I◀ 13. Crankshaft sprocket
- ▶I◀ 14. Crankshaft sensing blade
15. Tensioner B
- ◀E▶ ▶H◀ 16. Timing belt B
- ◀F▶ ▶G◀ 17. Counter balance shaft sprocket
- ▶F◀ 18. Spacer
- ◀G▶ ▶E◀ 19. Crankshaft sprocket B
20. Crankshaft key
21. Breather hose
22. PCV hose
23. PCV valve
24. PCV valve gasket
25. Oil filler cap
- ▶D◀ 26. Rocker cover
- ▶D◀ 27. Rocker cover gasket A
28. Rocker cover gasket B
- ▶C◀ 29. Semi-circular packing
- ▶B◀ 30. Engine support bracket
- ◀H▶ ▶A◀ 31. Camshaft sprocket bolt
32. Camshaft sprocket
33. Timing belt rear right cover
34. Timing belt rear left upper cover
35. Timing belt rear left lower cover



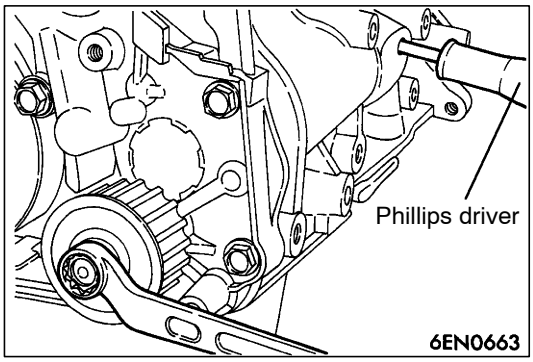


REMOVAL SERVICE POINTS

◀A▶ TIMING BELT REMOVAL

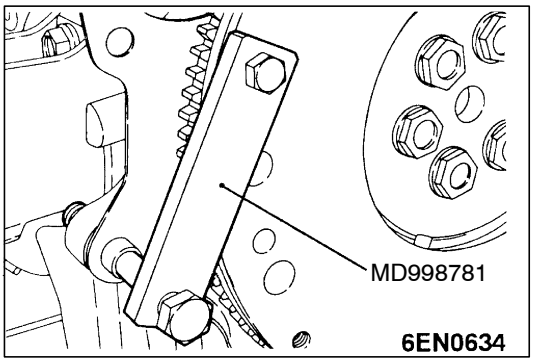
1. To ensure that the timing belt is assembled in the same direction when reused, using chalk, etc., make an arrow showing the rotation direction on the back surface of the timing belt.
2. Position the exhaust camshaft sprocket's timing mark by approx. one tooth before the No. 1 cylinder compression top dead centre.

   Caution
   When removed at the compression top dead centre, since the exhaust camshaft is at the position pressing down on the valve, the sprocket could rotate in reverse due to the force of the valve spring creating a hazardous situation.
3. Loosen the lock nut for the tensioner pulley, and remove the timing belt.



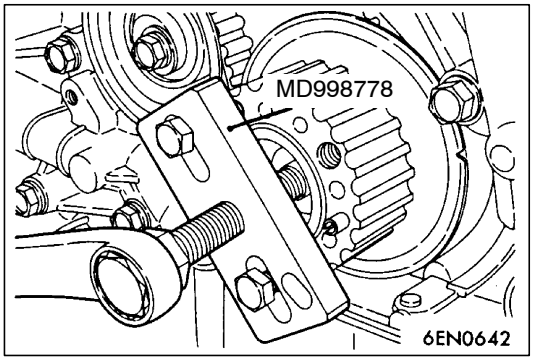
◀B▶ OIL PUMP SPROCKET REMOVAL

1. Remove the plug on the left side of the cylinder block.
2. Insert a Phillips driver (shaft diameter 8 mm) to stop the counter balance shaft left from rotating.
3. Loosen the flange bolt.
4. Remove the oil pump sprocket.



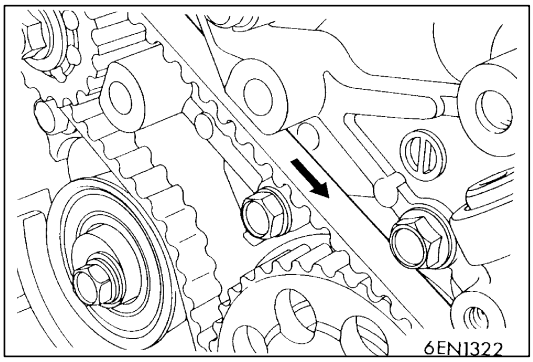
◀C▶ CRANKSHAFT BOLT REMOVAL

1. Fix the flywheel with the special tool.
2. Remove the crankshaft bolt.



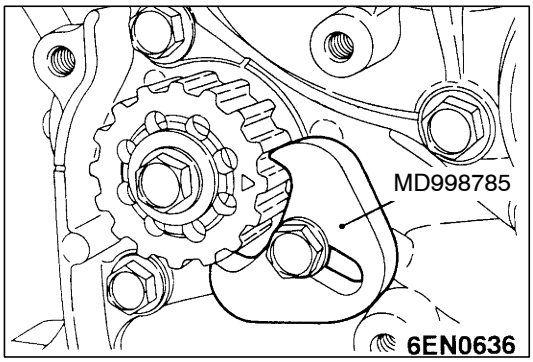
◀D▶ CRANKSHAFT SPROCKET REMOVAL

Use the special tool to remove the sprocket if it is stuck and hard to remove.



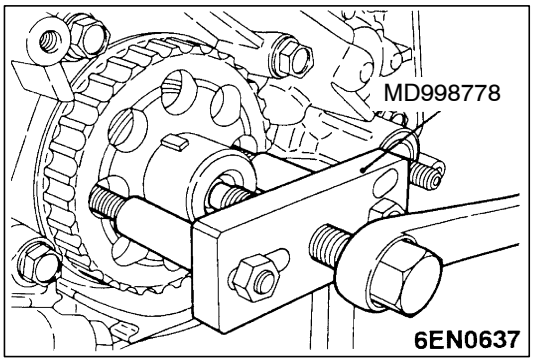
◀E▶ TIMING BELT B REMOVAL

To ensure that the timing belt is assembled in the same direction when reused, using chalk, etc., make an arrow showing the rotation direction on the back surface of the timing belt.



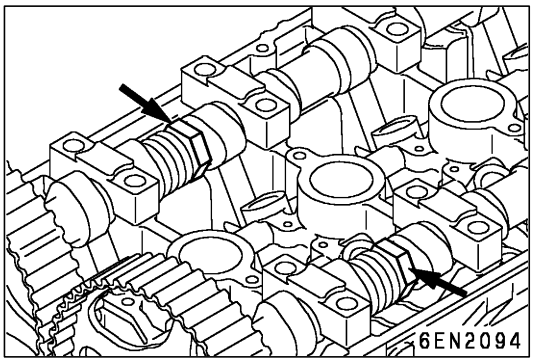
◀F▶ COUNTER BALANCE SHAFT SPROCKET REMOVAL

1. Fix the counter balance shaft sprocket with the special tool.
2. Remove the installation bolt of the counter balance shaft.



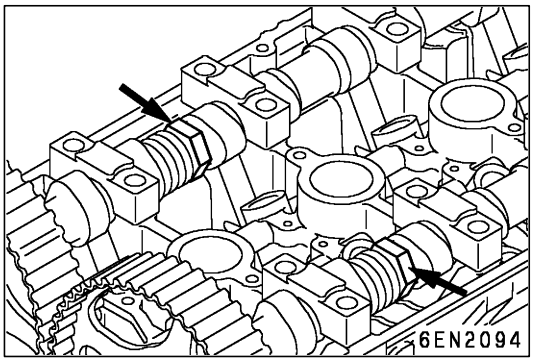
◀G▶ CRANKSHAFT SPROCKET B REMOVAL

Use the special tool to remove the sprocket if it is stuck and hard to remove.



◀H▶ CAMSHAFT SPROCKET BOLT REMOVAL

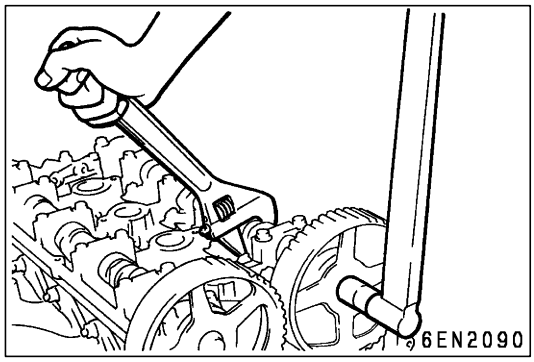
Hold the hexagon part of the camshaft with a wrench, and remove the camshaft sprocket bolt.

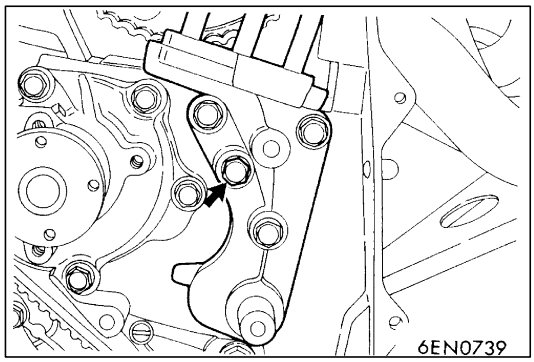


INSTALLATION SERVICE POINTS

▶A◀ CAMSHAFT SPROCKET BOLT INSTALLATION

Hold the hexagon part of the camshaft with a wrench, and tighten the camshaft sprocket bolt at the specified torque 88 ± 10 N•m.





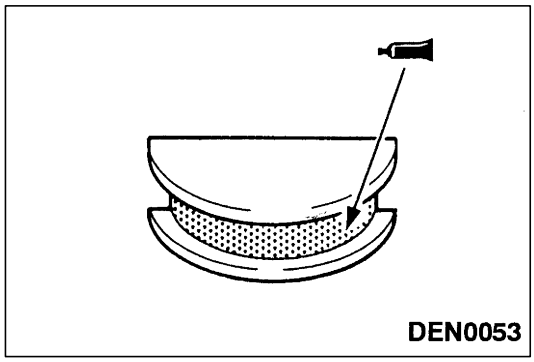
▶B◀ ENGINE SUPPORT BRACKET INSTALLATION

Before tightening, apply sealant on the bolt at the position shown in the illustration.

Sealant

Specified sealant:

3M™ AAD Part No. 8672 or equivalent



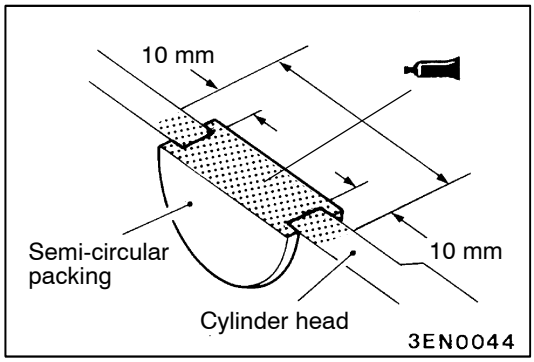
▶C◀ SEMI-CIRCULAR PACKING INSTALLATION

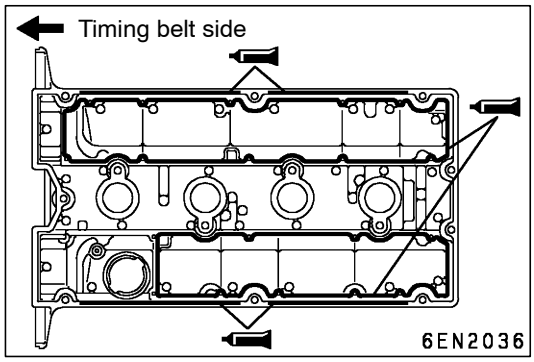
Apply sealant at the position shown in the illustration.

Sealant

Specified sealant:

3M™ AAD Part No. 8672 or equivalent





▶D◀ ROCKER COVER/ROCKER COVER GASKET A INSTALLATION

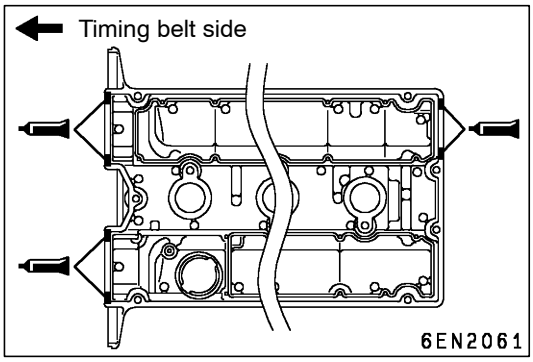
1. Apply form-in-place gasket on the rocker cover at the position shown in the illustration.

   Sealant

   Specified sealant:

   3M™ AAD Part No. 8672 or equivalent

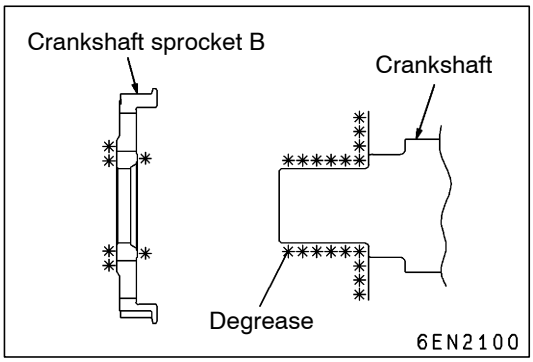
2. Install the rocker cover gasket A onto the rocker cover before the form-in-place gasket hardens.



3. Apply form-in-place gasket on the rocker cover at the position shown in the illustration.

Sealant
Specified sealant:
3M™ AAD Part No. 8672 or equivalent

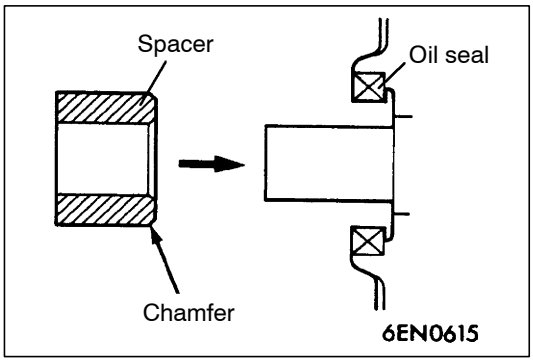
4. Install the rocker cover onto the cylinder head before the form-in-place gasket hardens.



▶E◀ CRANKSHAFT SPROCKET B INSTALLATION

Clean the crankshaft sprocket B installation surface before degreasing the crankshaft sprocket B.

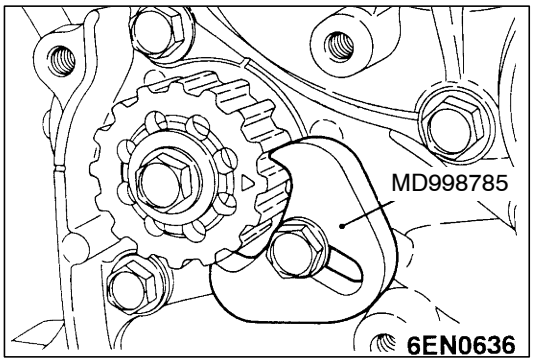
NOTE
Always degrease the surface to prevent a drop in the frictional coefficient at the pressing section caused by the adherence of oil.



▶F◀ SPACER INSTALLATION

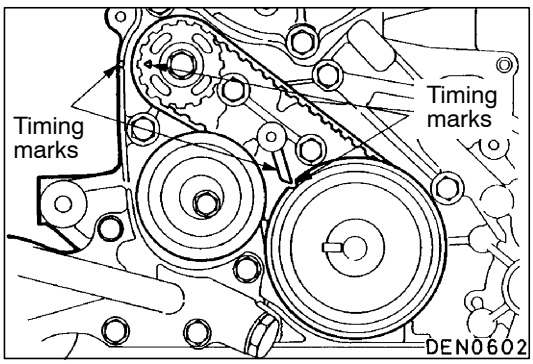
1. Apply a slight amount of oil on the outer periphery of the spacer (oil seal contact section).
2. Insert the spacer from the chamfered side as shown in the illustration.

Caution
Reversed insertion of the spacer can cause damage to the oil seal lip.



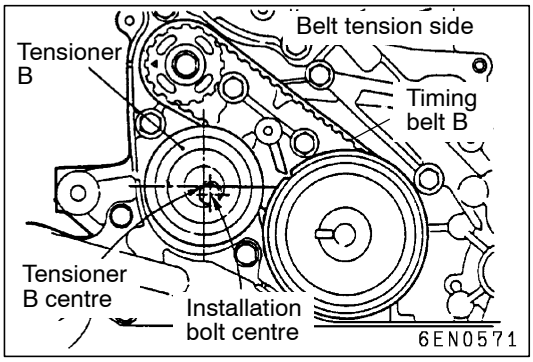
▶G◀ COUNTER BALANCE SHAFT SPROCKET INSTALLATION

1. Fix the counter balance shaft sprocket with the special tool.
2. Tighten the counter balance shaft sprocket installation bolt at the specified torque 46 ± 3 N•m.

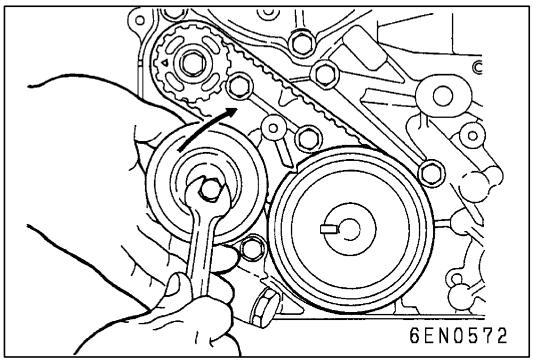


▶H◀ TIMING BELT B INSTALLATION

1. Align the crankshaft sprocket B and counter balance shaft sprocket timing marks with the timing mark on the oil pump case.
2. Attach the timing belt B to the crankshaft sprocket B and counter balance shaft sprocket.
   Do not loosen the belt tension too much at this time.



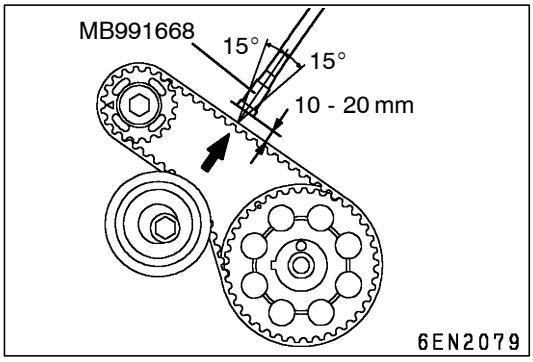
3. Confirm that the tensioner B centre and bolt centre are positioned as shown in the illustration.



4. Apply tension on the timing belt by lifting tensioner B in the direction of the arrow with a finger, and tension the tension side until it is “tight”. Fix tensioner B in this state by tightening the bolt.

   NOTE
   Make sure that the tensioner B shaft does not rotate when tightening the bolt. If the shaft rotates, the timing belt becomes too tense.

5. Connect the special tool (MB991704) to MUT-II and the battery.
6. Connect the special tool (MB991668) to MUT-II.
7. Rotate the crankshaft clockwise two turns, and align each timing mark.
8. Select “Belt Tension Measurement” from the MUT-II menu screen.



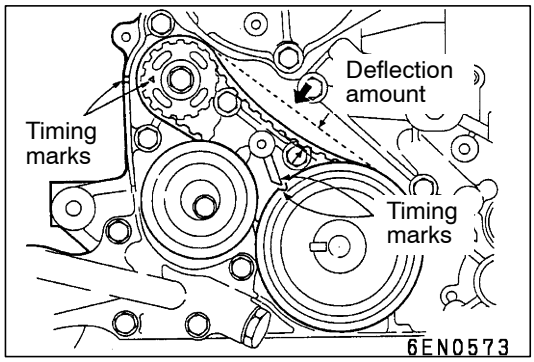
9. Separate the special tool (MB991668) 10 to 20 mm from the centre back between the sprockets (shown with an arrow), and hold so that it is vertical (inclination within ±15°) in respect to the belt.
10. Lightly tap the section shown with an arrow with fingers, and measure the belt vibration frequency. If the results are deviated from the standard value, loosen the bolt, tension the belt again, and then measure the vibration frequency again. Repeat this step until the standard value is attained. Tighten the bolt when the standard value is attained.

    Standard value:

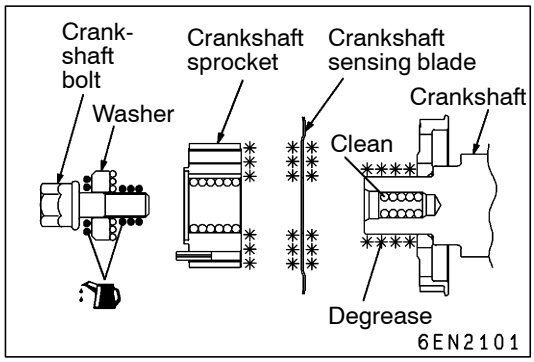
Item	When check	When adjusted	When replaced
Vibration frequency Hz	52 - 92	76 - 92	76 - 92
Deflection (Reference value) mm	5 - 10	5 - 7	5 - 7

Caution
(1) Measure when the belt's surface temperature is close to room temperature.
(2) Make sure that water or oil, etc., do not get on the mike.
(3) If strong winds contact the mike or if noise is generated in the area while measuring, a value that differs from the actual value may be indicated.
(4) If the measurement is carried out with the mike contacted against the belt, a value that differs from the actual value may be indicated.
(5) Do not measure while the engine is running.

11. Disconnect MUT-II.

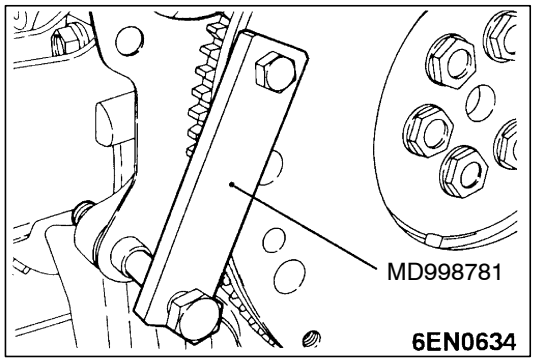


12. When measuring with the deflection amount, press the centre of the tensed side of timing belt B with your index finger in the arrow direction, and confirm that the deflection is between 5 and 7 mm.

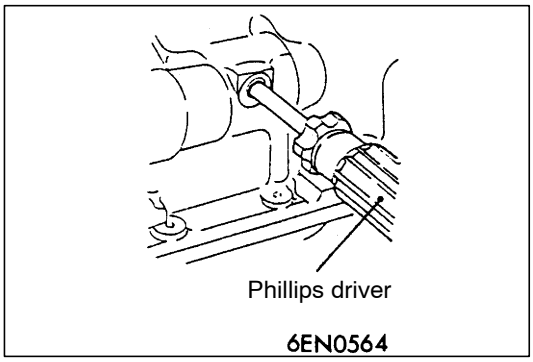


▶I◀ CRANKSHAFT BOLT/CRANKSHAFT SPROCKET/CRANKSHAFT SENSING BLADE INSTALLATION

1. Clean and degrease the crankshaft sprocket, crankshaft sprocket installation surface of crankshaft and crankshaft sensing blade, and then install the crankshaft sprocket and crankshaft sensing blade.
2. Clean the crankshaft bolt hole section.
3. Apply the minimum required amount of engine oil on the crankshaft bolt section and upper surface of the washer.

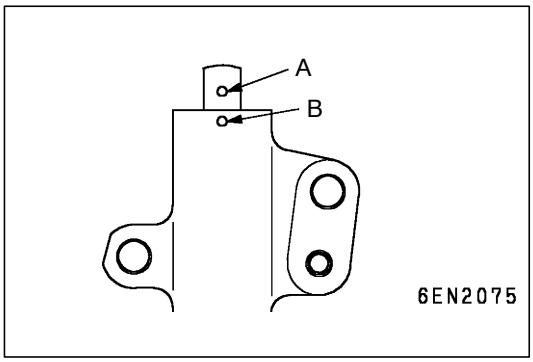


4. Fix the flywheel with the special tool.
5. Tighten the crankshaft bolt at the specified torque 162 ± 5 N•m.



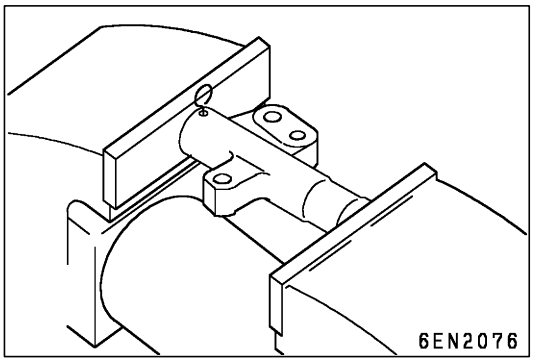
▶J◀ OIL PUMP SPROCKET INSTALLATION

1. Stop the rotation of the counter balance shaft in the same manner as for removal.
2. Install the oil pump sprocket.
3. Apply the minimum required amount of engine oil on the flange nut seat surface.
4. Tighten the flange nut at the specified torque 54 ± 5 N•m.

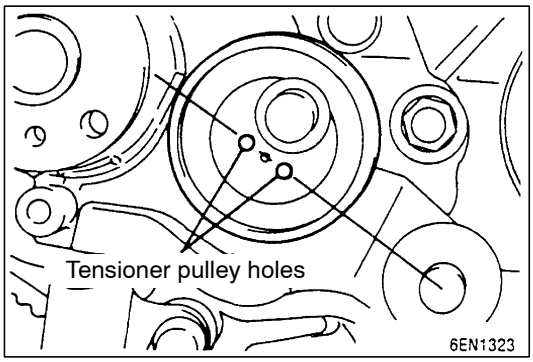


▶K◀ AUTO TENSIONER INSTALLATION

1. If the auto tensioner rod is in the extended state, set it with the following steps.
   (1) Set the rod of the auto tensioner into a vice so that it is straight and not inclined.
   (2) Press in the rod gradually with the vice, and align the rod's set hole A with the cylinder's set hole B.

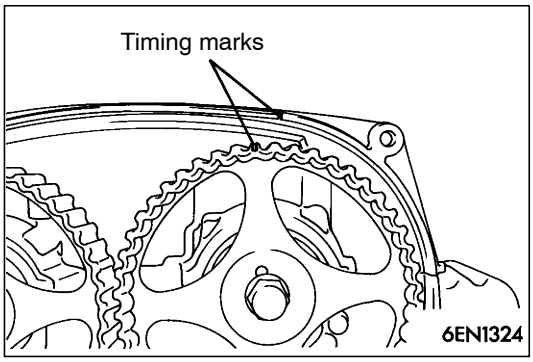


   (3) Insert a wire (diameter 1.4 mm) into the set holes.
   (4) Remove the auto tensioner from the vice.
2. Install the auto tensioner.
   Do not remove the wire until the timing belt has been installed.



▶L◀ TENSIONER PULLEY INSTALLATION

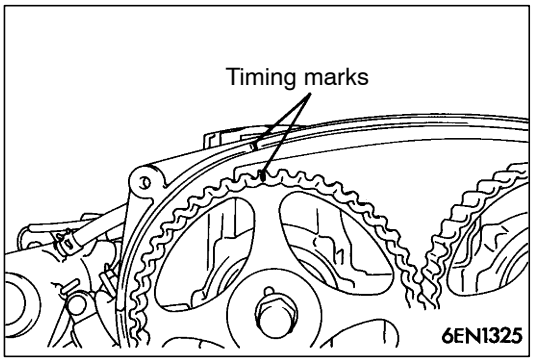
Set the tensioner pulley as shown in the illustration.



▶M◀TIMING BELT INSTALLATION

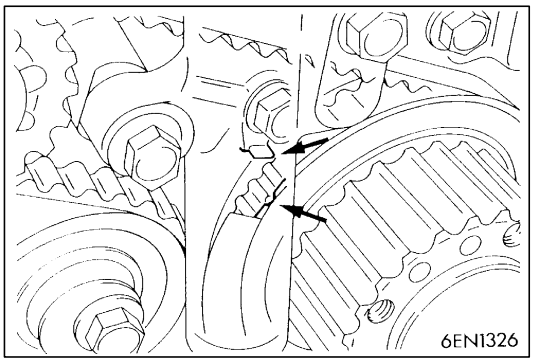
1. Set the timing mark on the exhaust side camshaft sprocket so that it is deviated by one tooth in the counterclockwise direction from the timing mark on the rocker cover.

   NOTE
   Even if the sprocket and rocker cover timing marks are aligned, the exhaust camshaft will return in the counterclockwise direction by the force of the valve spring and will stabilize at a position deviated by one tooth.

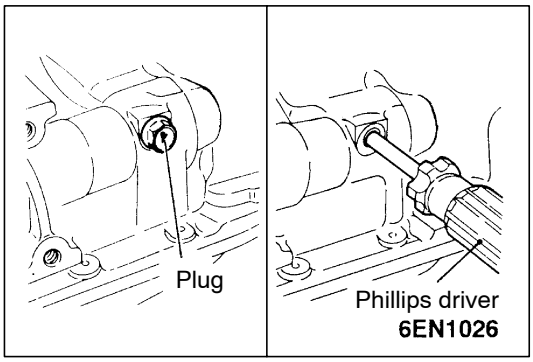


2. Align the timing mark of the intake side camshaft sprocket to the timing mark on the rocker cover.

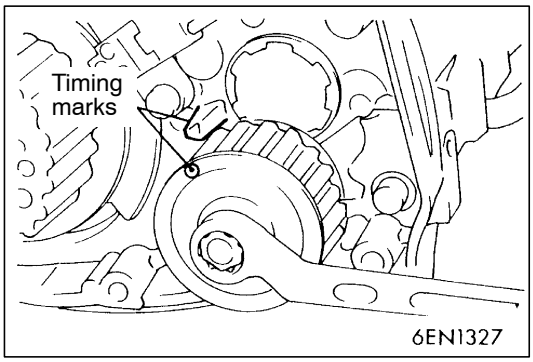
   NOTE
   Even when the sprocket and rocker cover timing marks are aligned, the intake camshaft will rotate slightly in the clockwise direction by the force of the valve spring and will stabilize.



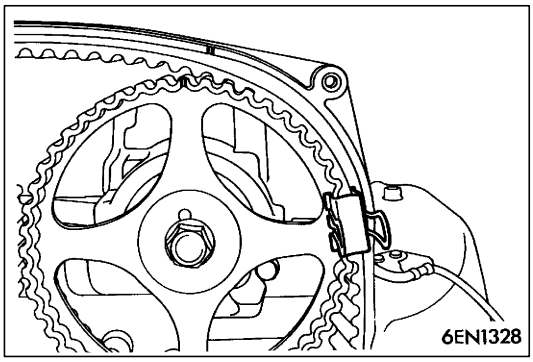
3. Shift and set the crankshaft sprocket timing mark by one tooth in the counterclockwise direction in the same manner as the exhaust side camshaft sprocket.



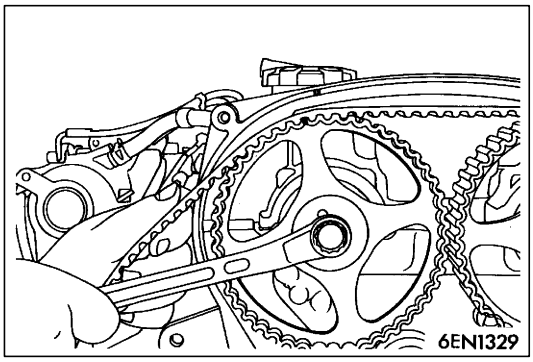
4. Align the oil pump sprocket timing marks.
5. When aligning the oil pump sprocket timing marks, remove the cylinder block plug, and insert an 8 mm shaft diameter Phillips driver into the plug hole, and confirm that the driver shaft can be inserted by 60 mm or more. Do not remove the Phillips driver until the timing belt has been attached. If the driver shaft contacts the silent shaft and only enters 20 to 25 mm, rotate the sprocket once, align the timing marks again, and then confirm that the Phillips driver can be inserted by 60 mm or more.



6. Remove the Phillips driver, and set the oil pump sprocket at a position returned by one tooth in the counterclockwise direction.

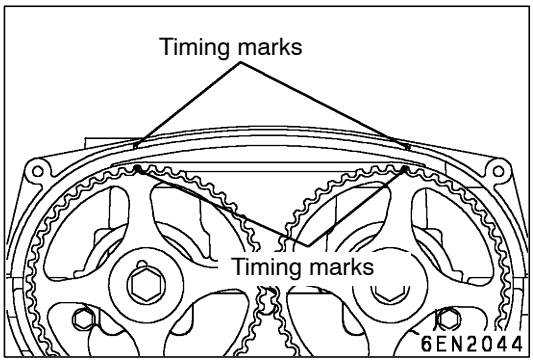


7. Attach the timing belt to the exhaust side camshaft sprocket, and fix with a paper clip at the position shown in the illustration.

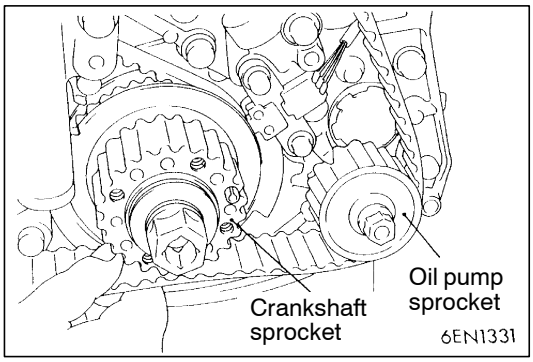


8. Rotate the intake side camshaft sprocket in the counterclockwise direction. Attach the belt at a position where the timing mark is deviated by one tooth in the counterclockwise direction, and then fix with a paper clip.

   NOTE
   Even if the belt is attached at a position deviated by one tooth, the intake camshaft will rotate slightly in the clockwise direction by the force of the valve spring and will stabilize.

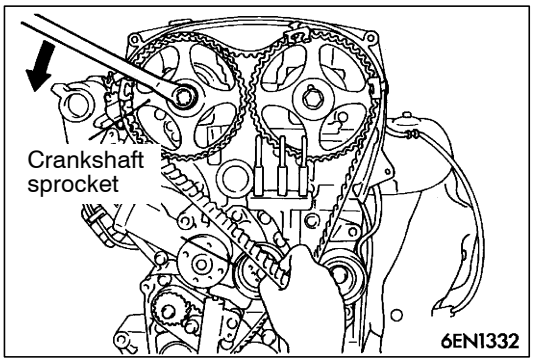


9. Rotate the exhaust side camshaft sprocket in the clockwise direction, and confirm that the intake side camshaft sprocket's timing marks are aligned when the timing marks are aligned.



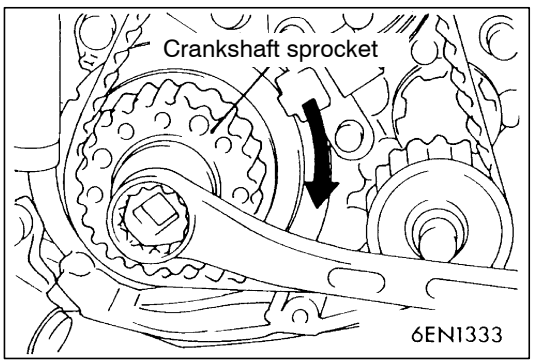
10. Attach the timing belt in the order of the idler pulley, oil pump sprocket and crankshaft sprocket.

    NOTE
    Attach the timing belt so that it is not deflected.

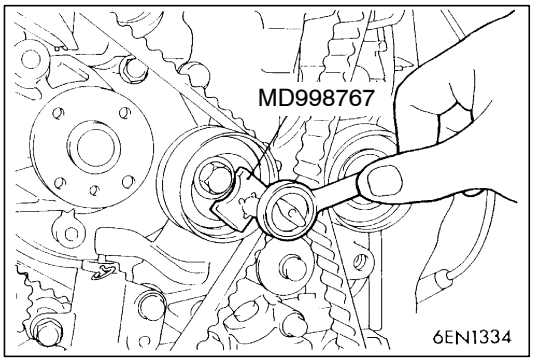


11. Attach the timing belt to the tensioner pulley.

    NOTE
    The timing belt can be attached easily to the tensioner pulley by rotating the intake side camshaft sprocket slightly in the counterclockwise direction.



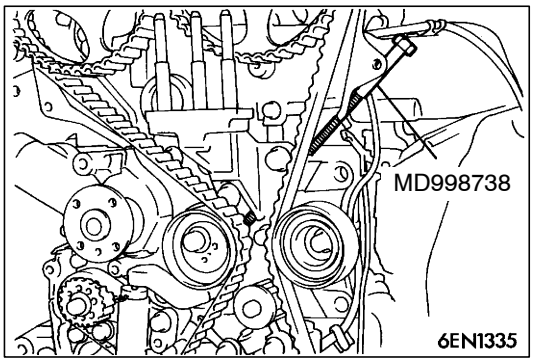
12. Rotate the crankshaft sprocket slightly in the clockwise direction, and remove the timing belt deflection on the idler pulley side.
13. Confirm that the timing marks on the crankshaft, oil pump and exhaust camshaft are each deviated by one tooth in the counterclockwise direction.



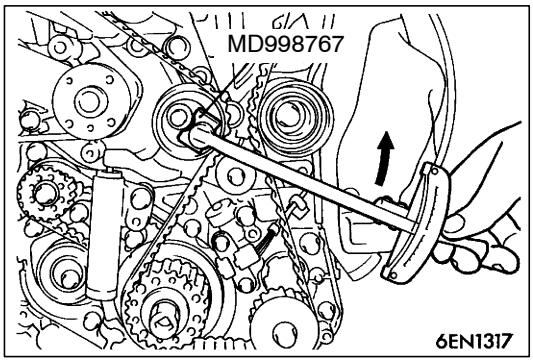
14. Using the special tool, rotate the tensioner pulley in the counterclockwise direction to tense the timing belt, and then fix by temporarily tightening the tensioner fixing bolt.

    NOTE
    Remove the deflection of the timing belt between the intake side and exhaust side camshafts.

15. Rotate the crankshaft in the clockwise direction, and set the timing mark at the No. 1 cylinder compression top dead centre.



16. Set the special tool, and screw it in until the wire inserted when the auto tensioner was installed slightly moves.

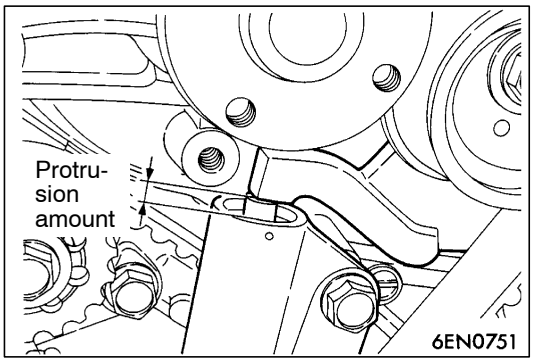


17. Loosen the tensioner pulley fixing bolt.

    Caution
    The timing belt will loosen at this time due to the rotation of the intake and exhaust camshafts, so make sure that the timing belt does not deviate.

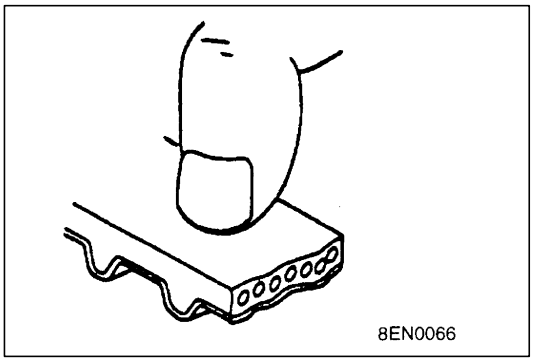
18. Rotate the special tool and torque wrench in the counterclockwise direction to remove the timing belt deflection.
19. From that state, return to the position where the torque wrench scale reads 3.5 N•m, and then tighten the fixing bolt.
20. Remove the special tool installed in step 16.
21. Rotate the crankshaft two rotations in the clockwise direction, and let stand for approx. 15 minutes.
22. Confirm whether the wire inserted when the auto tensioner was installed can be pulled out easily. If it can be removed easily, the belt tension is appropriate, so remove the wire. If the auto tensioner rod's protrusion amount is at the standard value, the tension is appropriate.

    Standard value: 3.8 - 4.5 mm



23. If the wire cannot be pulled out easily, repeat steps 16 to 21, and tense the belt to the appropriate tension.

    Caution
    When the crankshaft bolt has been rotated in the counterclockwise direction, always check the crankshaft bolt's tightening torque. If loosen, re-tighten.

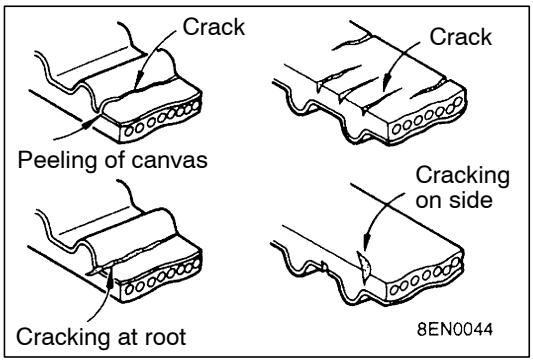


INSPECTION

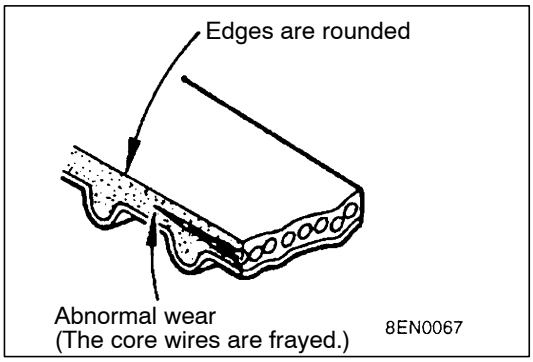
1. TIMING BELT

Inspect each section of the belt in detail, and if any of the following type of damage is found, replace the belt with a new part.

(1) Hardening of backface rubber.
The backface is glossy, marks are not made even when a fingernail is run cross it, and there is no elasticity.

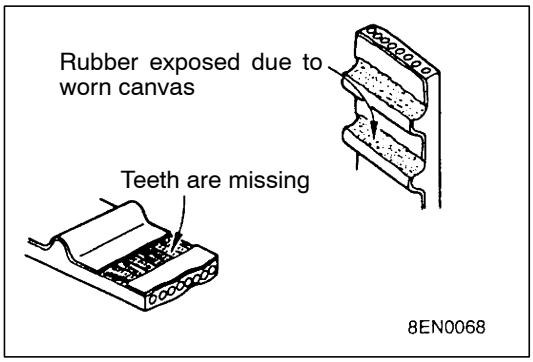


(2) Cracking of backface rubber.
(3) Cracking of canvas.
(4) Cracking at root.
(5) Cracking on side of belt.

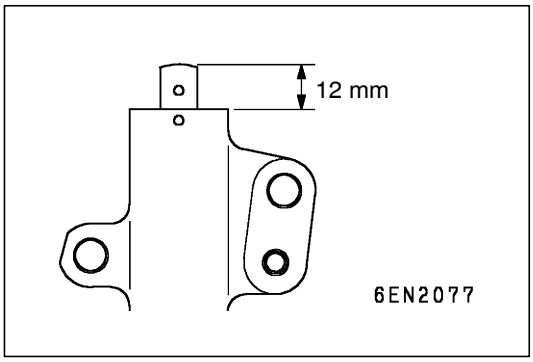


(6) Abnormal wear on side of belt.

NOTE
The state is normal if the cutting surface is neat as if cut with a sharp knife.



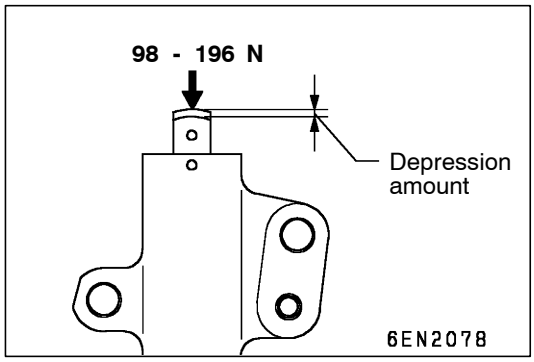
(7) Abnormal wear of teeth.
First stages: Canvas is worn (canvas fibres are raised, rubber is removed and whitish, and canvas seams are unclear).
Latter stages: Canvas is worn off, and rubber is exposed (face width is narrow).
(8) Teeth are missing.



2. AUTO TENSIONER

(1) Check for oil leaks. If any leaks are found, replace.
(2) Check whether the rod end is worn or damaged, and replace if necessary.
(3) Measure the rod protrusion length. If not at the standard value, replace the auto tensioner.

Standard value: 12 mm

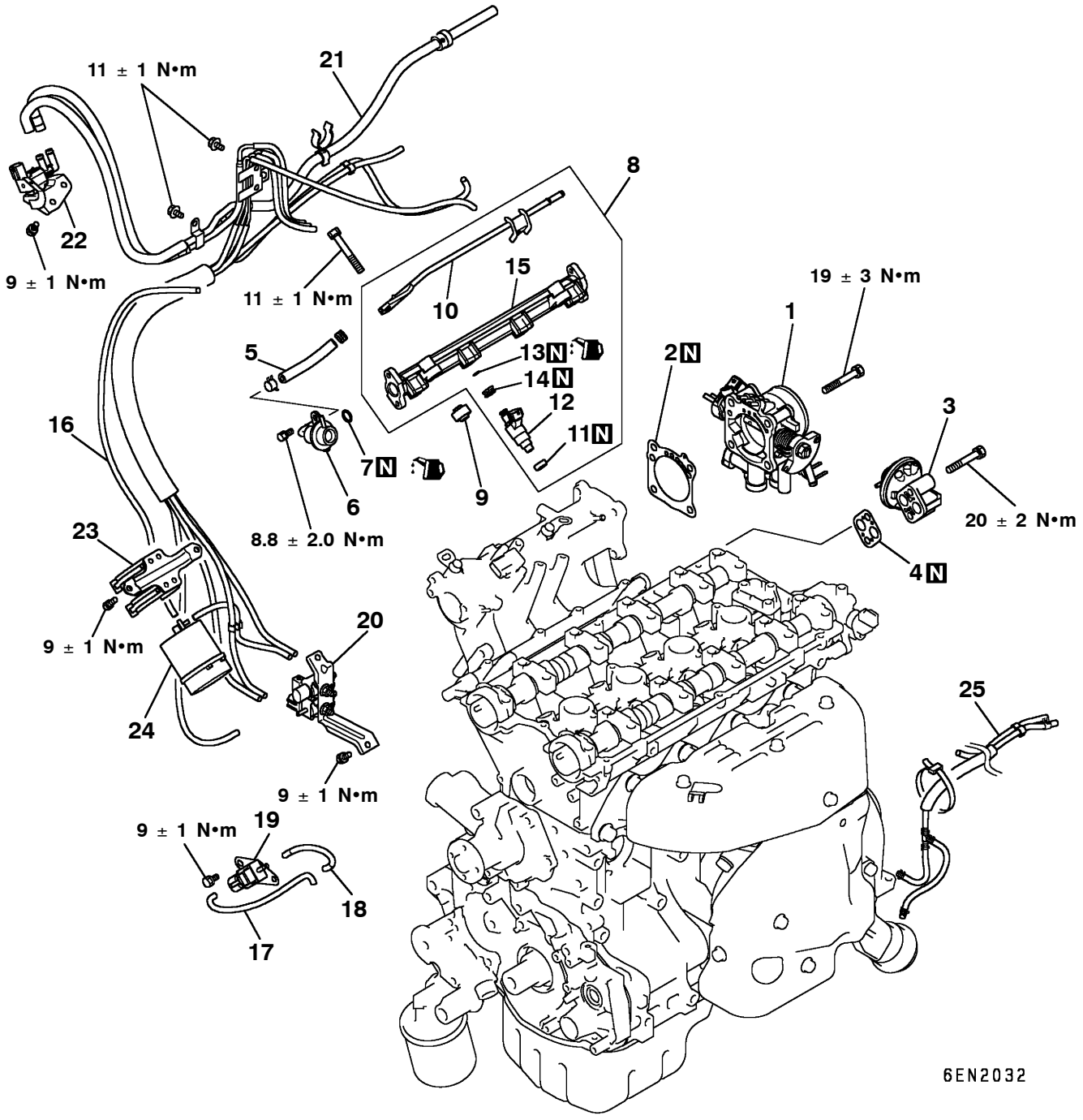


(4) Measure the depression amount when the rod is pressed with a force of 98 to 196 N. If not at the standard value, replace the auto tensioner.

Standard value: 1 mm or less

FUEL SYSTEM

REMOVAL AND INSTALLATION



Removal steps

1. Throttle body assembly
▶C◀ 2. Throttle body gasket
3. EGR valve
4. EGR gasket
5. Fuel hose
▶B◀ 6. Fuel pressure regulator
7. O-ring
8. Delivery pipe and injector
9. Insulator
10. Fuel return pipe
11. Insulator
▶A◀ 12. Injector
13. O-ring
14. Grommet
15. Delivery pipe
16. Vacuum hose
17. Vacuum hose
18. Vacuum hose
19. Solenoid valve assembly
20. Solenoid valve assembly
21. Vacuum hose and pipe
22. Solenoid valve assembly
23. Vacuum tank bracket
24. Vacuum tank
25. Vacuum tank hose assembly

INSTALLATION SERVICE POINTS

▶A◀ INJECTOR INSTALLATION

1. Apply a small amount of new engine oil on the O-ring.
2. While rotating the injector to the left and right, insert the O-ring into the delivery pipe while taking care not to damage it.

Caution
Make sure that the engine oil does not enter the delivery pipe.

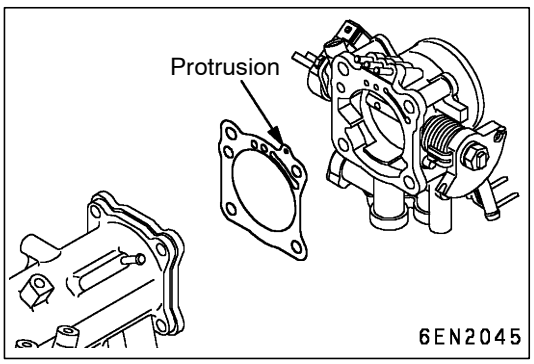
3. Confirm that the injector rotates smoothly. If it does not rotate smoothly, the O-ring may be biting in. Remove the injector, check the O-ring for damage, and then insert it into the delivery pipe. Check the rotation again.

▶B◀ FUEL PRESSURE REGULATOR INSTALLATION

1. Apply a small amount of new engine oil on the O-ring.
2. While rotating the fuel pressure regulator to the left and right, insert the O-ring into the delivery pipe while taking care not to damage it.

Caution
Make sure that the engine oil does not enter the delivery pipe.

3. Confirm that the fuel pressure regulator rotates smoothly. If it does not rotate smoothly, the O-ring may be biting in. Remove the fuel pressure regulator, check the O-ring for damage, and then insert it into the delivery pipe. Check the rotation again.

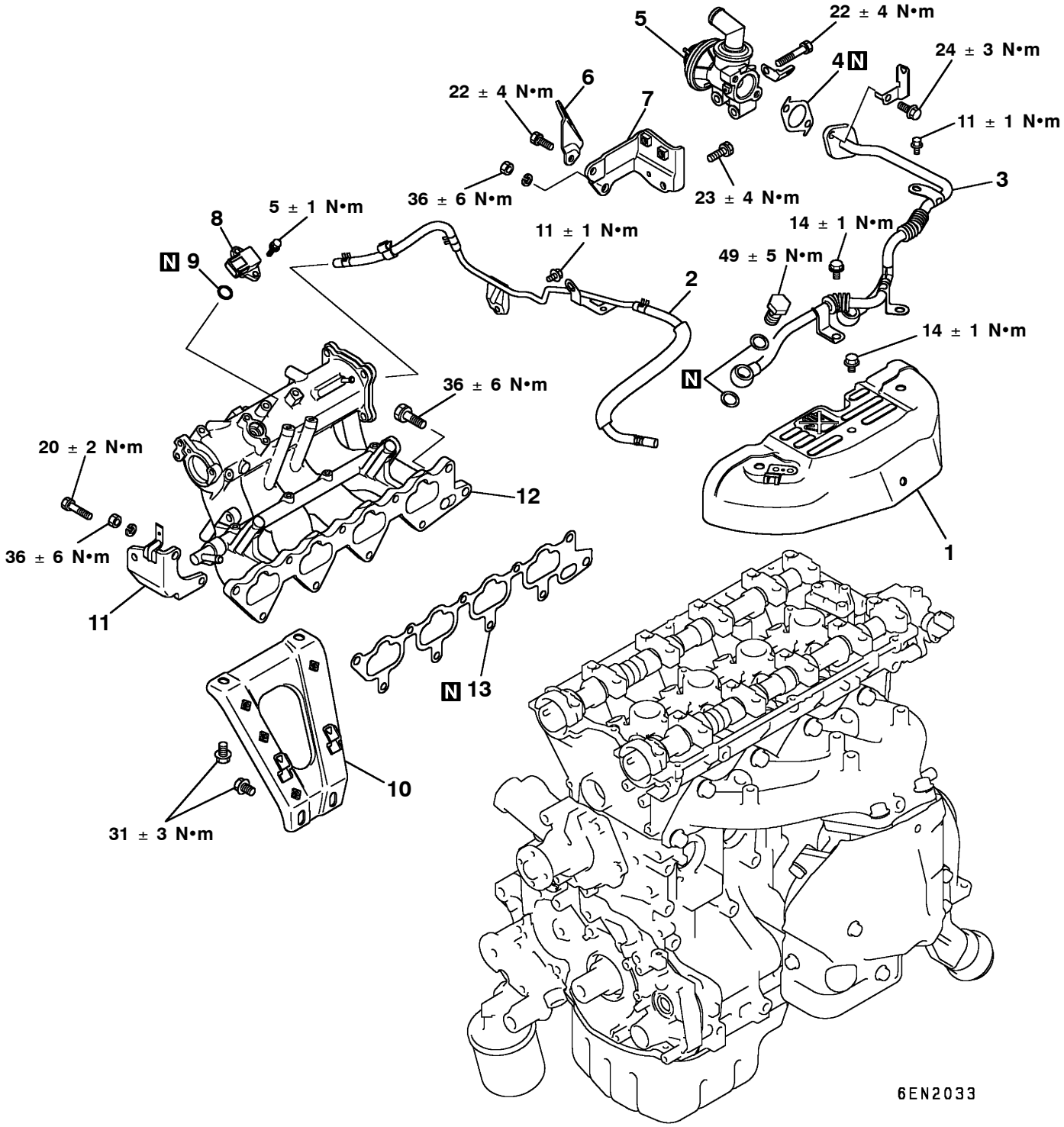


▶C◀ THROTTLE BODY GASKET INSTALLATION

Assembly so that the protrusion on the throttle body gasket is at the position shown in the illustration.

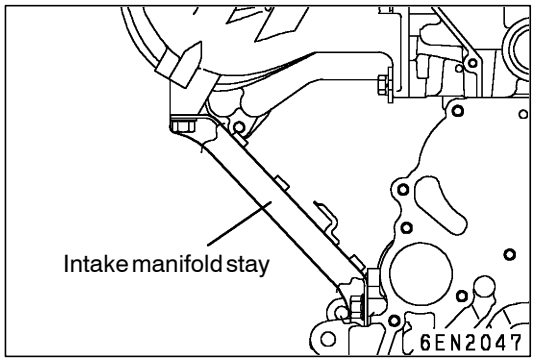
SECONDARY AIR SYSTEM AND INTAKE MANIFOLD

REMOVAL AND INSTALLATION



Removal steps

1. Exhaust manifold heat protector
2. Vacuum hose and pipe
- ▶D◀ 3. Air pipe assembly
4. Air control valve gasket
5. Air control valve assembly
6. Engine hanger
- ▶C◀ 7. Air control valve bracket
- ▶B◀ 8. Manifold differential pressure (MDP) sensor
9. O-ring
- ▶A◀ 10. Intake manifold stay
11. Alternator brace stay
12. Intake manifold
13. Intake manifold gasket



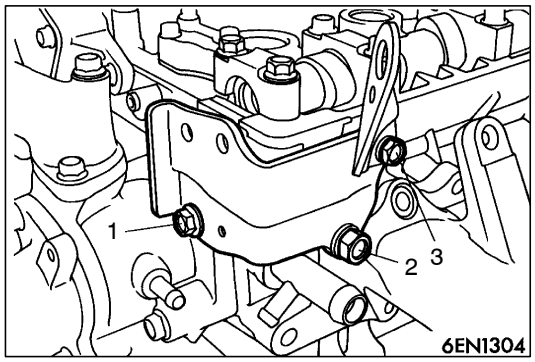
INSTALLATION SERVICE POINTS

▶A◀ INTAKE MANIFOLD STAY INSTALLATION

Check that the intake manifold stay is seated against the intake manifold and cylinder block boss, and then tighten at the specified torque 31 ± 3 N•m.

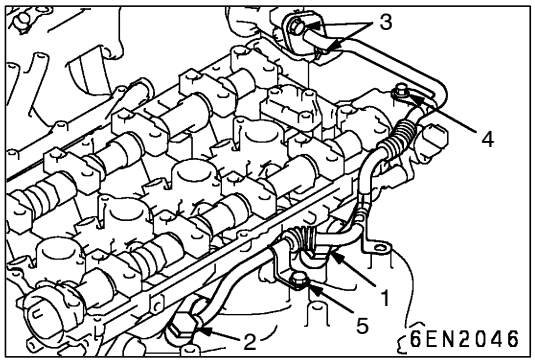
▶B◀ MANIFOLD DIFFERENTIAL PRESSURE (MDP) SENSOR INSTALLATION

Caution
Make sure not to apply impact against the sensor when installing.
Do not use a sensor that has been dropped.



▶C◀ AIR CONTROL VALVE BRACKET INSTALLATION

1. Temporarily tighten the air control valve bracket and engine hanger with the bolt for tightening with the intake manifold.
2. Tighten the bolt 1 shown in the illustration at the specified torque 23 ± 4 N•m.
3. Tighten the bolt 2 shown in the illustration at the specified torque 36 ± 6 N•m.
4. Tighten the bolt 3 shown in the illustration with the engine hanger at the specified torque 22 ± 4 N•m.

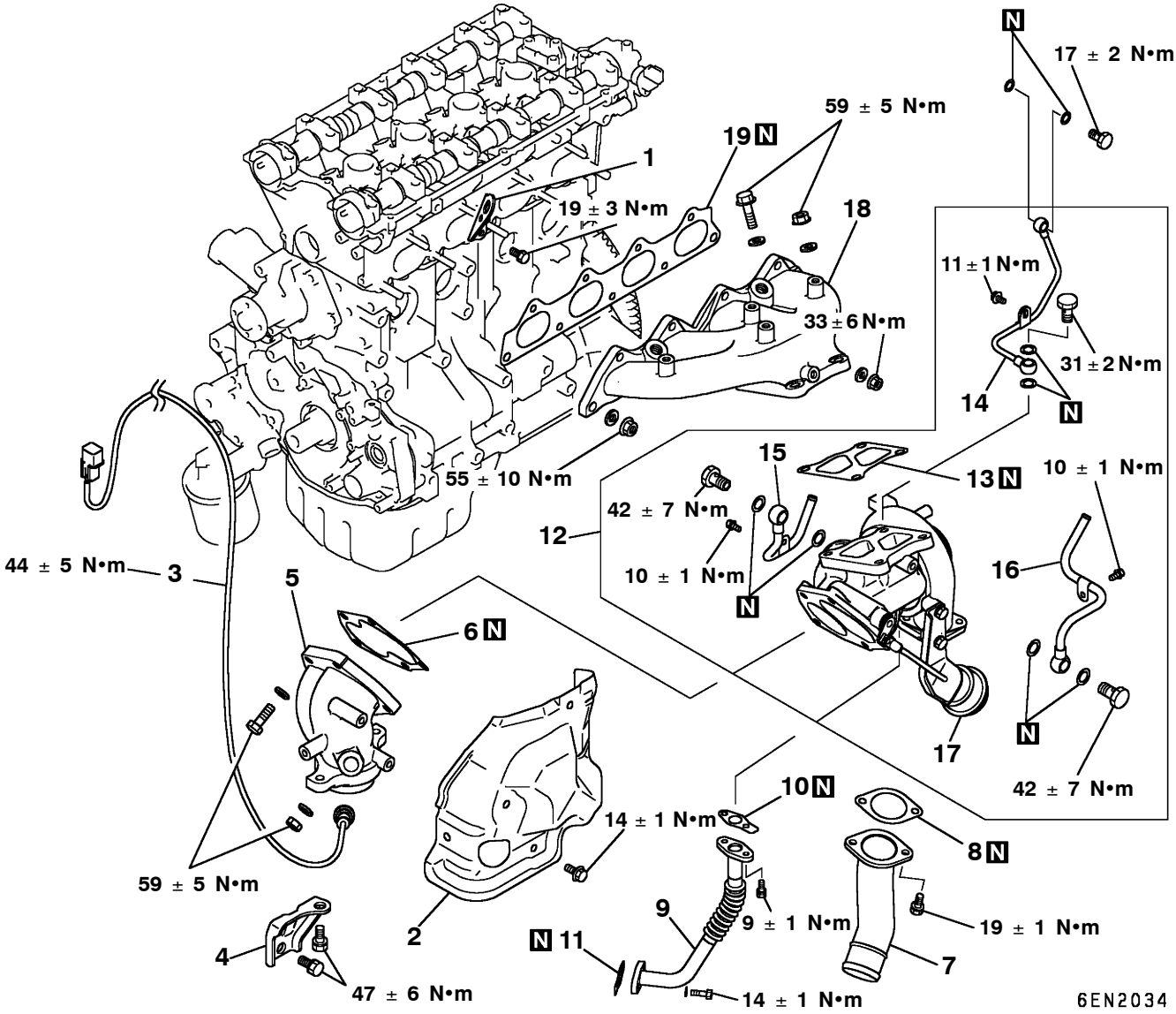


▶D◀ AIR PIPE ASSEMBLY INSTALLATION

1. Temporarily tighten air pipe assembly onto the air control valve.
2. Tighten the bolts 1 and 2 shown in the illustration to the exhaust manifold at the specified torque 49 ± 5 N•m.
3. Tighten the bolt 3 shown in the illustration to the air control valve at the specified torque 24 ± 3 N•m.
4. Tighten the bolt 4 shown in the illustration to the cam position sensor support at the specified toque 11 ± 1 N•m.
5. Tighten the bolt 5 shown in the illustration to the exhaust manifold at the specified torque 14 ± 1 N•m.

EXHAUST MANIFOLD

REMOVAL AND INSTALLATION



Removal steps

1. Engine hanger
2. Turbocharger heat protector
3. Oxygen sensor
4. Exhaust fitting bracket
5. Exhaust fitting
6. Exhaust fitting gasket
7. Air outlet fitting

▶C◀ 8. Air outlet fitting gasket

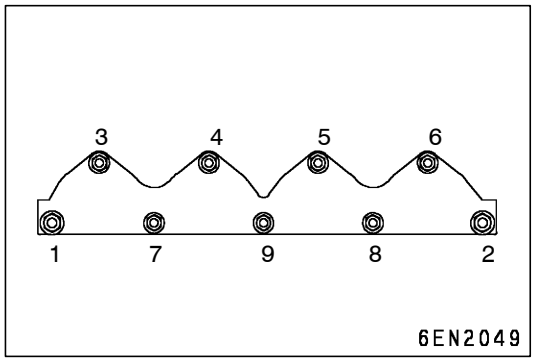
9. Oil return pipe
10. Oil return pipe gasket

▶B◀ 11. Oil return pipe gasket

12. Turbocharger assembly and pipe assembly
13. Turbocharger gasket
14. Oil pipe
15. Water pipe B
16. Water pipe A
17. Turbocharger assembly

▶A◀ 18. Exhaust manifold

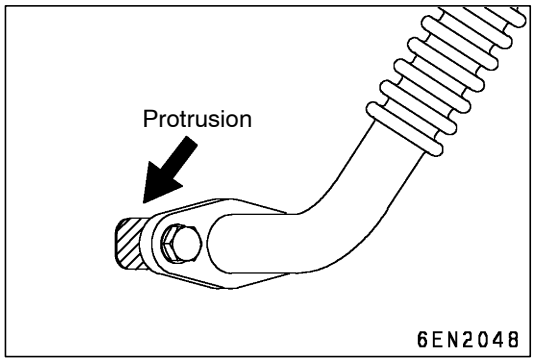
19. Exhaust manifold gasket



INSTALLATION SERVICE POINTS

▶A◀ EXHAUST MANIFOLD INSTALLATION

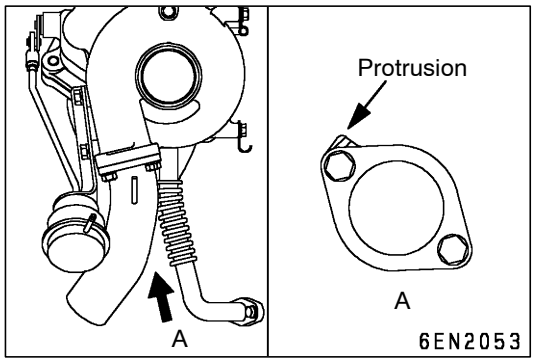
1. Lightly tighten the installation nut for the exhaust manifold.
2. Following the tightening order shown in the illustration, tighten the M8 nuts at the tightening torque 29 N•m.
3. Following the tightening order shown in the illustration, tighten the M10 nuts at the tightening torque 49 N•m.
4. Following the tightening order shown in the illustration, tighten the M8 nuts again at the tightening torque 29 N•m.
5. Finally, following the tightening order shown in the illustration, tighten the M10 nuts at the tightening torque 55 ± 10 N•m, and tighten the M8 nuts at the tightening torque 33 ± 6 N•m.



▶B◀ OIL RETURN PIPE GASKET INSTALLATION

Assembly so that the protrusion of the oil return pipe gasket on the oil pan side is at the position shown in the illustration.

NOTE
There is no designated assembly direction for the gasket on the turbocharger side.

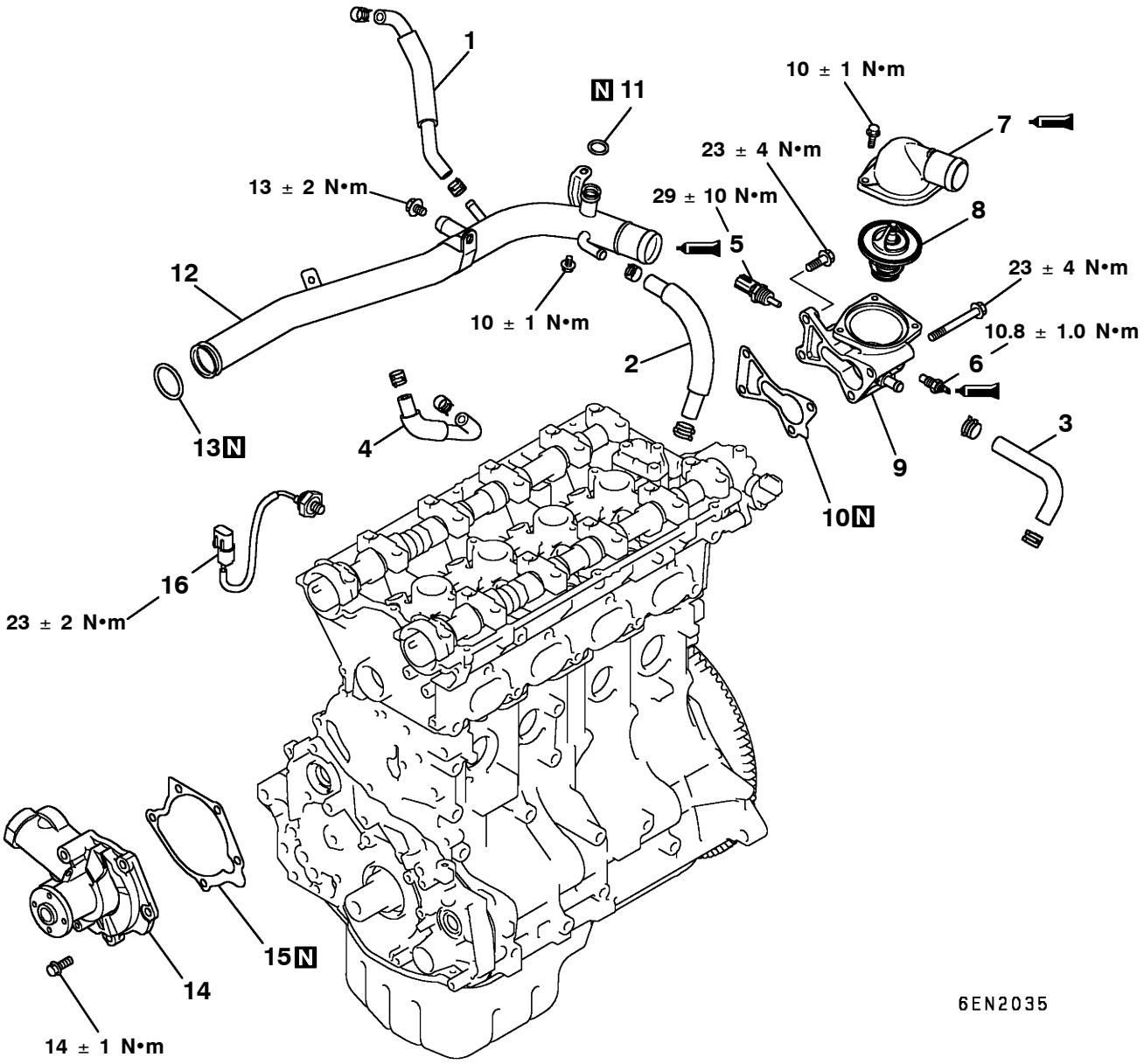


▶C◀ AIR OUTLET FITTING GASKET

Assembly so that the protrusion of the air outlet fitting gasket is at the position shown in the illustration.

WATER PUMP AND WATER HOSE

REMOVAL AND INSTALLATION



Removal steps

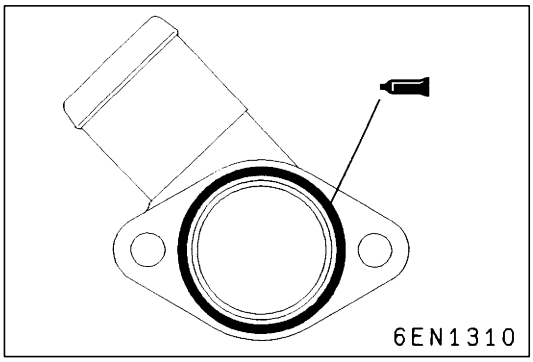
1. Water hose
2. Water hose
3. Water hose
4. Water hose
- ▶D◀ 5. Engine coolant temperature sensor
- ▶C◀ 6. Engine coolant temperature gauge unit
- ▶B◀ 7. Water outlet fitting
8. Thermostat
9. Thermostat housing
10. Gasket
- ▶A◀ 11. O-ring
- ▶A◀ 12. Water inlet pipe
- ▶A◀ 13. O-ring
14. Water pump
15. Water pump gasket
16. Knock sensor

INSTALLATION SERVICE POINTS

▶A◀ O-RING/WATER INLET PIPE INSTALLATION

Replace the O-ring for the water inlet pipe with a new part, and apply water on the periphery of the O-ring so that it can be inserted easily into the water pump and thermostat housing.

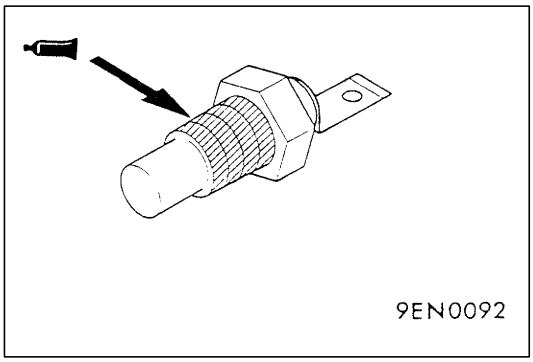
Caution
(1) Never apply grease or oil, such as engine oil, on the O-ring.
(2) Install the water inlet pipe onto the thermostat housing, and then fix.



▶B◀ WATER OUTLET FITTING INSTALLATION

Squeeze out form-in-place gasket at a 3 mm width, and apply at the position shown in the illustration.

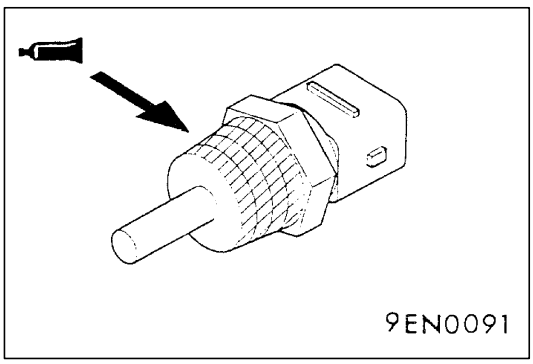
Form-in-place gasket
Specified gasket:
Mitsubishi Genuine Part No. MD970389 or equivalent



▶C◀ ENGINE COOLANT TEMPERATURE GAUGE UNIT INSTALLATION

When reusing the bolts, apply the specified sealant on the threads.

Sealant
Specified sealant:
3M™ AAD Part No. 8672 or equivalent



▶D◀ ENGINE COOLANT TEMPERATURE SENSOR INSTALLATION

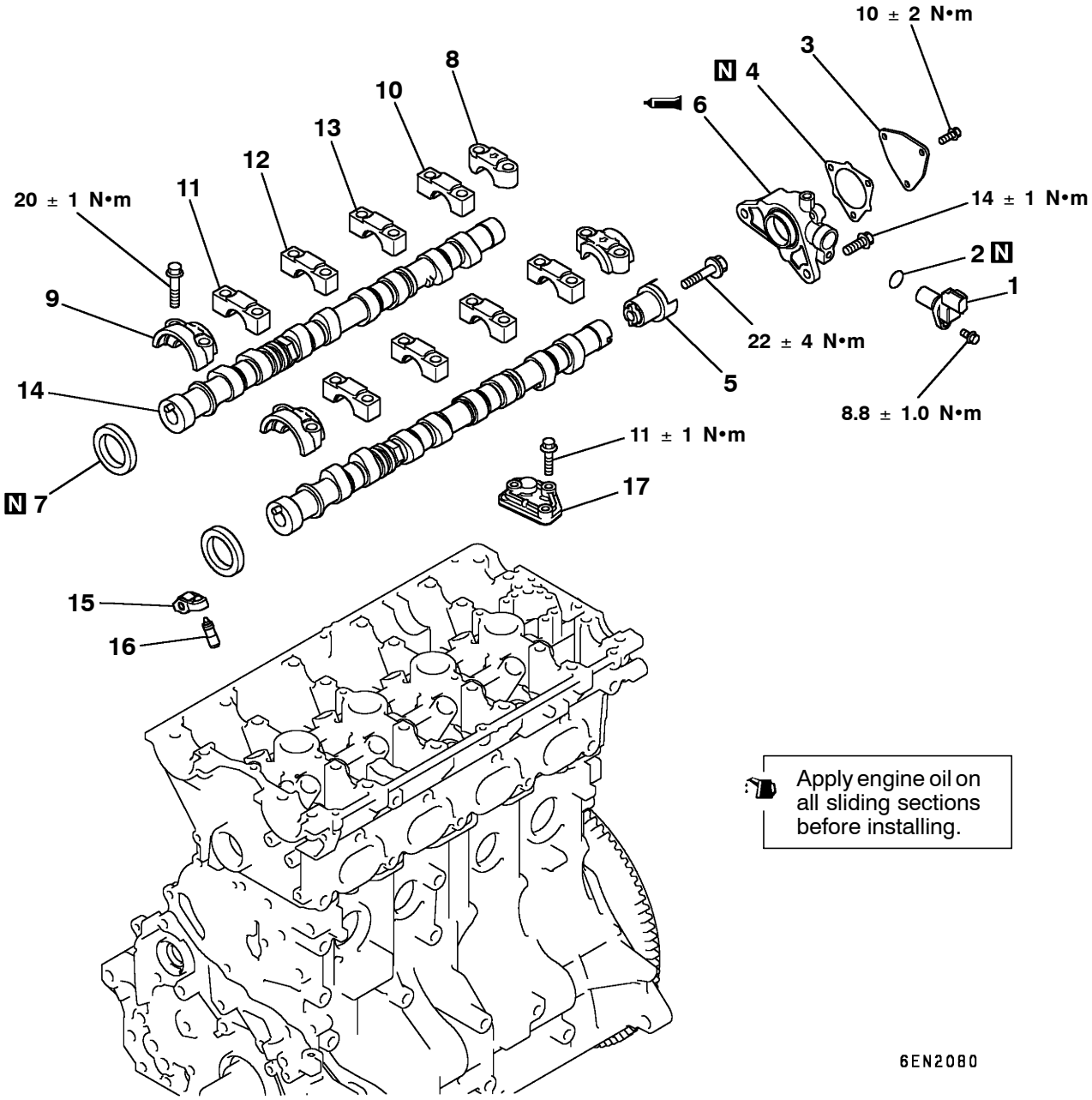
Apply the specified sealant onto the threads.

Sealant
Specified sealant:
3M™ AAD Part No. 8731 or equivalent

Caution
Make sure that the tool does not contact the connector section (resin section).

ROCKER ARM AND CAMSHAFT

REMOVAL AND INSTALLATION



Removal steps

1. Cam position sensor
2. O-ring
3. Cover
4. Gasket
- ▶F◀ 5. Cam position sensing cylinder
- ▶E◀ 6. Cam position sensor support
- ▶D◀ 7. Camshaft oil seal
- ▶C◀ 8. Bearing cap, rear
- ▶C◀ 9. Bearing cap, front
- ▶C◀ 10. Bearing cap No. 5
- ▶C◀ 11. Bearing cap No. 2
- ▶C◀ 12. Bearing cap No. 3
- ▶C◀ 13. Bearing cap No. 4
- ▶B◀ 14. Camshaft
15. Rocker arm
- ◀A▶ ▶A◀ 16. Lash adjuster
17. Oil delivery body

REMOVAL SERVICE POINT

◀A▶ LASH ADJUSTER REMOVAL

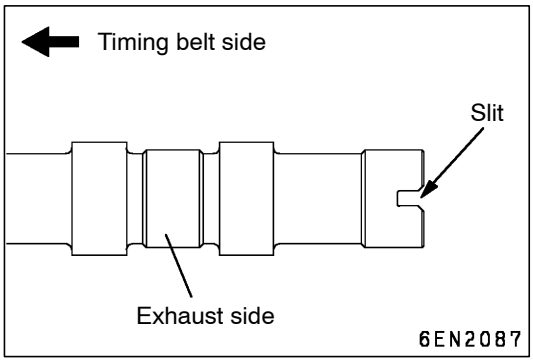
Caution
When reusing the lash adjuster, always clean and inspect it before installing. (Refer to the section on checking the lash adjuster.)

INSTALLATION SERVICE POINTS

▶A◀ LASH ADJUSTER INSTALLATION

Caution
When reusing the lash adjuster, always clean and inspect it before installing. (Refer to the section on checking the lash adjuster.)

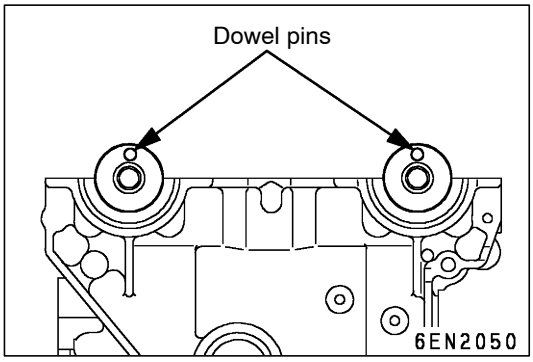
Assembly the lash adjuster onto the rocker arm while taking care not to spill out diesel oil in it.



▶B◀ CAMSHAFT INSTALLATION

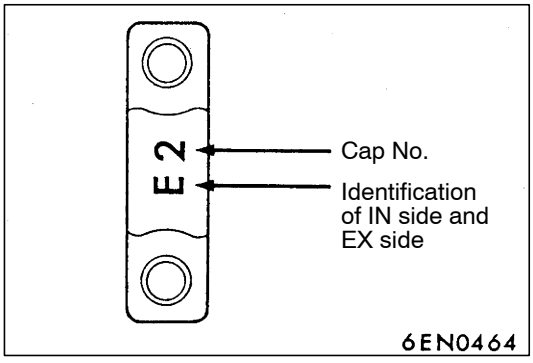
1. Apply engine oil on the camshaft journal and cam.
2. Install the camshaft onto the cylinder head.

Caution
Do not mistake the intake and exhaust camshafts. There is a 4 mm width slit on the back end of the exhaust side camshaft.



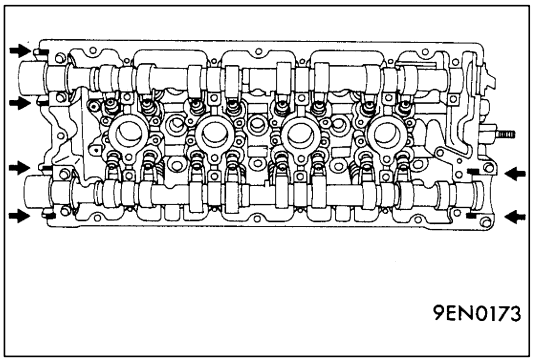
▶C◀ BEARING CAP INSTALLATION

1. Set the camshaft's dowel pin to the approximate top.



2. The bearing caps No. 2 to 5 have the same shape. Check the identification symbol before installing to prevent mistaking the cap No., intake side and exhaust side.

Identification symbol
(Stamped on front and on No. 2 to 5 bearing caps)
I : Intake side
E : Exhaust side

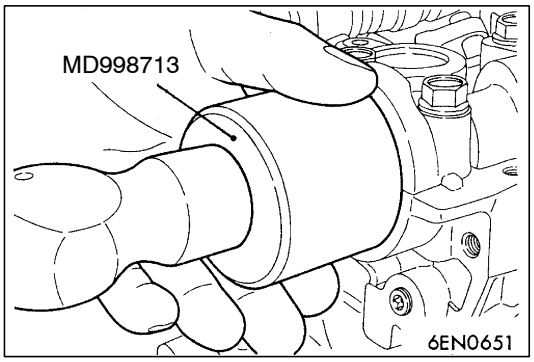


3. Apply sealant on the contact surfaces with the head shown in the illustration.

Sealant
Specified sealant:
3M™ AAD Part No. 8672 or equivalent

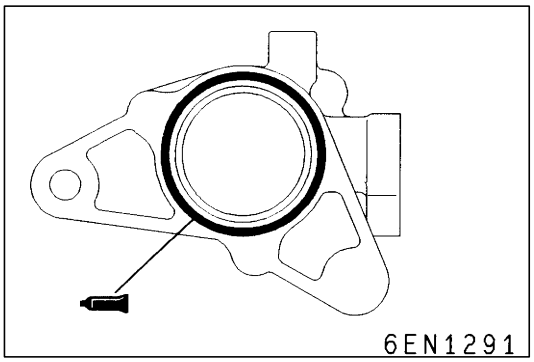
4. Install the bearing caps onto the cylinder head, and in two to three steps tighten strongly.
5. Finally, tighten at the specified torque 20 ± 1 N•m.
6. Confirm that the rocker arm is correctly installed.

NOTE
Wipe off all excessive sealant.



▶D◀ CAMSHAFT OIL SEAL INSTALLATION

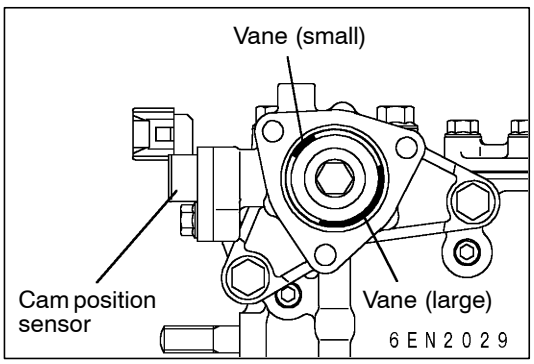
Install the oil seal using the special tool.



▶E◀ CAM POSITION SENSOR SUPPORT INSTALLATION

Apply a 3 mm width of form-in-place gasket at the position shown in the illustration.

Form-in-place gasket
Specified gasket:
Mitsubishi Genuine Part No. MD970389 or equivalent

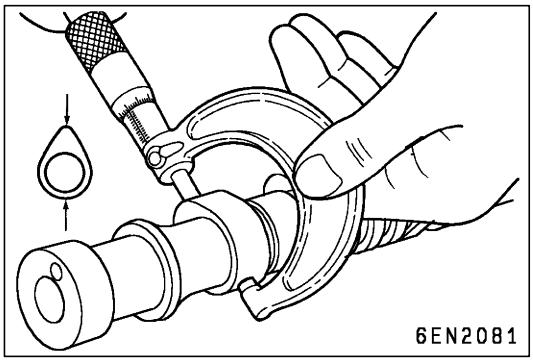


▶F◀ CAM POSITION SENSING CYLINDER INSTALLATION

1. Set the exhaust camshaft at the No. 1 compression top dead centre.

NOTE
The shaft will rotate slightly in the counterclockwise direction by the force of the exhaust valve spring.

2. Install the cam position sensing cylinder's vane (small) and vane (large) at the positions shown in the illustration.



INSPECTION

1. CAMSHAFT

Measure the cam height (length). Replace if it exceeds the limit value.

Standard value:

Intake	**35.79 mm**
Exhaust	**35.49 mm**

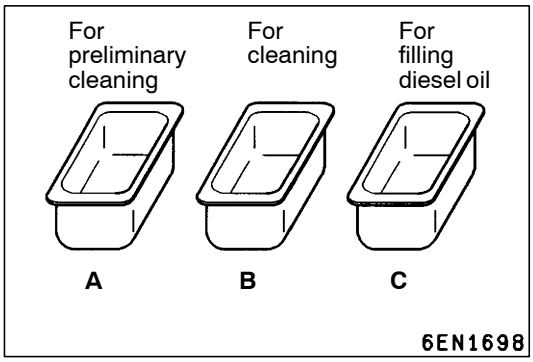
Limit value:

Intake	**35.29 mm**
Exhaust	**34.99 mm**

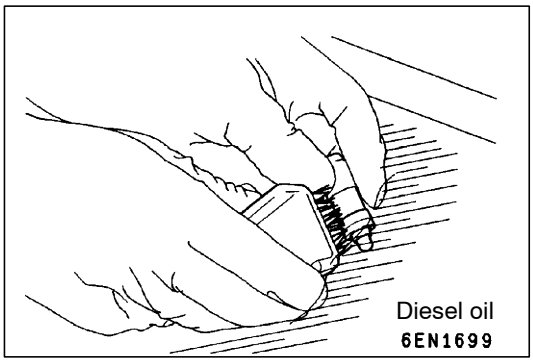
2. LASH ADJUSTER

Caution

(1) The lash adjuster is a sophisticated part, so make sure that foreign matter, such as dirt, does not enter it.
(2) Do not disassemble the lash adjuster.
(3) When cleaning the lash adjuster, use clean diesel oil.

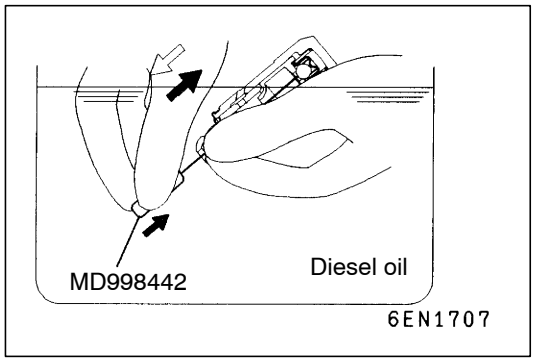


(1) Prepare three vats and approx. five litres of diesel oil.
Fill the vats with diesel oil so that the lash adjuster will be submerged when placed standing in the vat.



(2) Submerge the lash adjuster in vat A, and clean the outside.

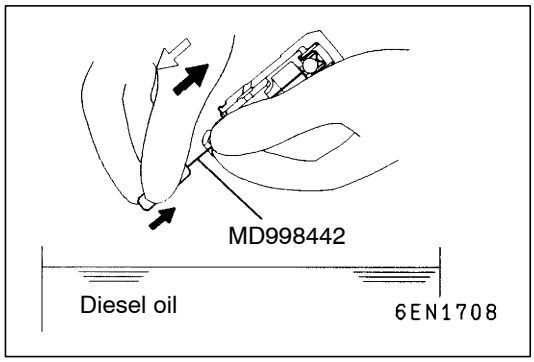
NOTE
Use a nylon brush if the lash adjuster is heavily contaminated.



(3) Lightly press down on the steel ball inside using the special tool MD998442. Remove all matter and deteriorated oil adhered on the plunger by pressing the tool back and forth five to ten times until the plunger moves smoothly.

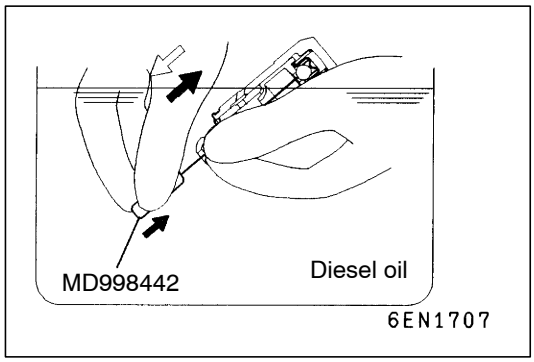
Caution
The steel ball spring's load is extremely weak, so if the special tool is pressed in with force, the functions of the lash adjuster could be damaged.

NOTE
The plunger movement must not snag at this time. If the movement is abnormal, replace the lash adjuster.



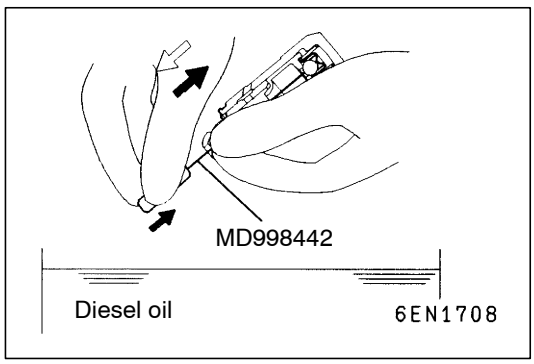
(4) Remove the lash adjuster from the vat, and while lightly pressing down on the steel ball, press the plunger and removal all diesel oil, etc., inside the pressure chamber.

Caution
Always face the oil hole on the side of the lash adjuster toward vat A. Never face the oil hole toward people.



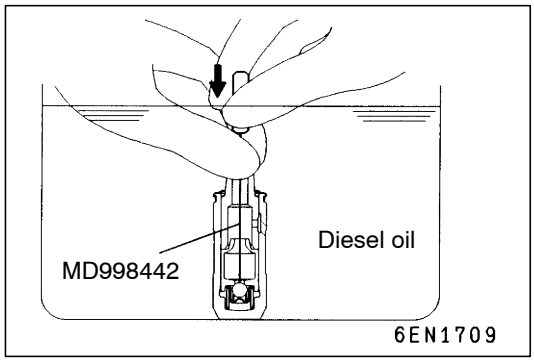
(5) Submerge the lash adjuster in vat B. Lightly press down on the steel ball inside using the special tool MD998442. Clean the inside of the lash adjuster pressure chamber by pressing the tool back and forth five to ten times until the plunger moves smoothly.

Caution
The steel ball spring's load is extremely weak, so if the special tool is pressed in with force, the functions of the lash adjuster could be damaged.



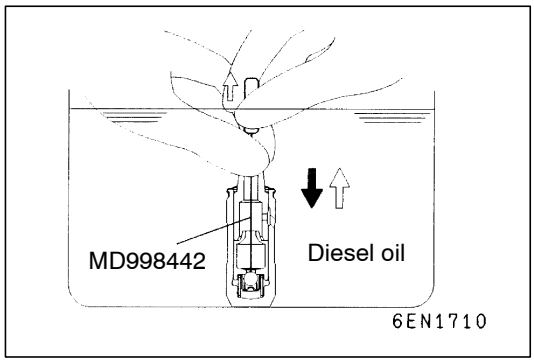
(6) Remove the lash adjuster from the vat, and while lightly pressing down on the steel ball, press the plunger and removal all diesel oil, etc., inside the pressure chamber.

Caution
Always face the oil hole on the side of the lash adjuster toward vat A. Never face the oil hole toward people.

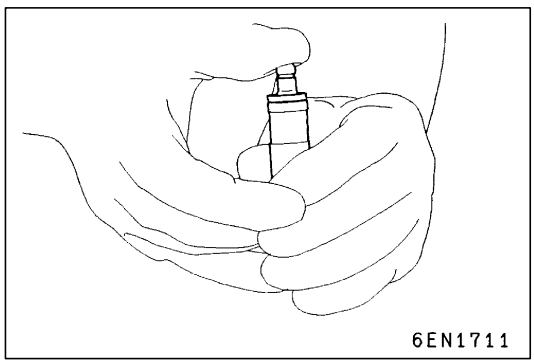


(7) Submerge the lash adjuster in vat C, and lightly press down on the steel ball inside using the special tool MD998442.

Caution
Do not use vat C for cleaning. If vat C is used for cleaning, foreign matter, etc., could enter the pressure chamber when filling it with diesel oil.



(8) Stand the lash adjuster with the plunger at the top position. Press down on the plunger with force, and after it has reached the maximum stroke, gradually return it. Then, release the steel ball to fill the pressure chamber with diesel oil.



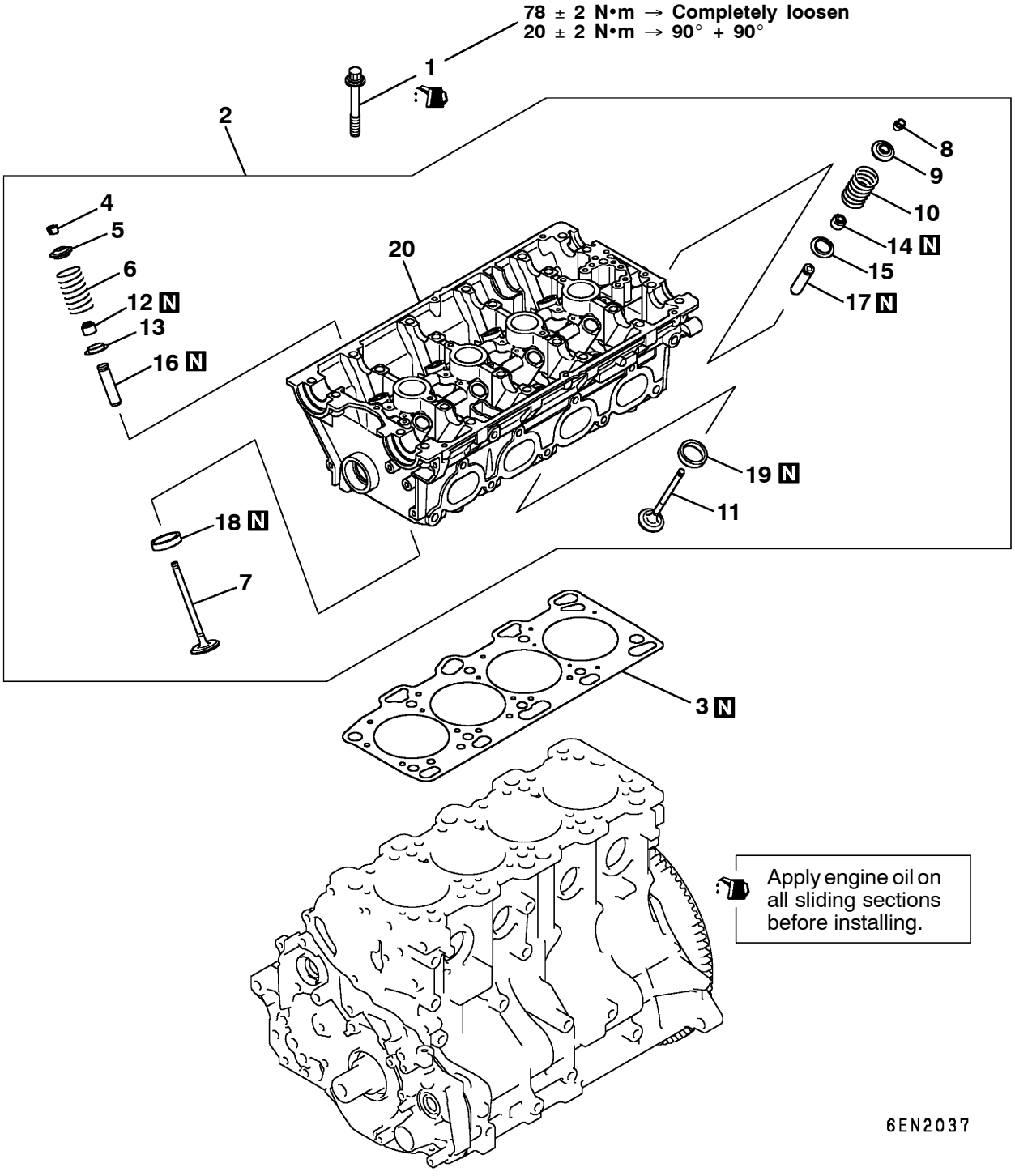
(9) Remove the lash adjuster from the vat, and stand the lash adjuster with the plunger at the top position. The plunger should not move when pressed down with force.

NOTE
If the lash adjuster compresses, repeat steps (7) to (9). Replace the lash adjuster if the same phenomenon occurs even after diesel oil has been filled in the pressure chamber (after the air has been bled).

(10) Store the lash adjuster in the vertical state so that the internal diesel oil will not spill out, and so that foreign matter, such as dirt, will not adhere. Install it onto the engine as soon as possible.

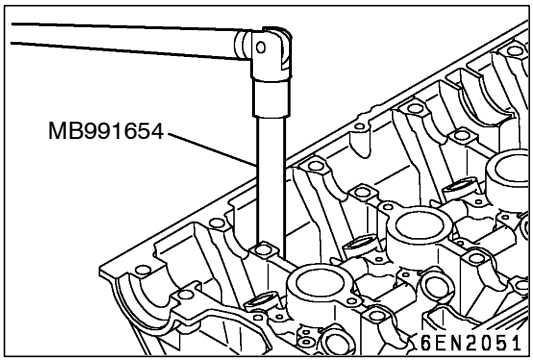
CYLINDER HEAD AND VALVE

REMOVAL AND INSTALLATION



Removal steps

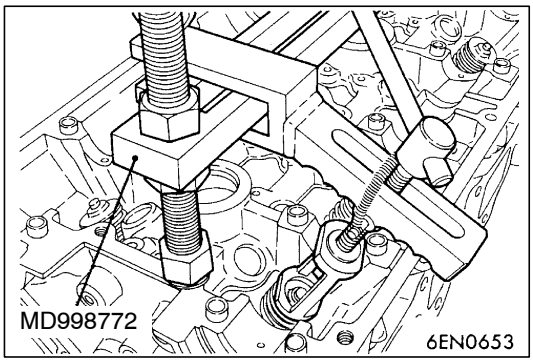
◀A▶ ▶D◀ 1. Cylinder head bolt
2. Cylinder head assembly
3. Cylinder head gasket
◀B▶ ▶C◀ 4. Retainer lock
5. Valve spring retainer
▶B◀ 6. Valve spring
7. Intake valve
◀B▶ ▶C◀ 8. Retainer lock
9. Valve spring retainer
▶B◀ 10. Valve spring
11. Exhaust valve
◀C▶ ▶A◀ 12. Valve stem seal
13. Valve spring seat
◀C▶ ▶A◀ 14. Valve stem seal
15. Valve spring seat
16. Intake valve guide
17. Exhaust valve guide
18. Intake valve seat
19. Exhaust valve seat
20. Cylinder head



REMOVAL SERVICE POINTS

◀A▶ CYLINDER HEAD BOLT REMOVAL

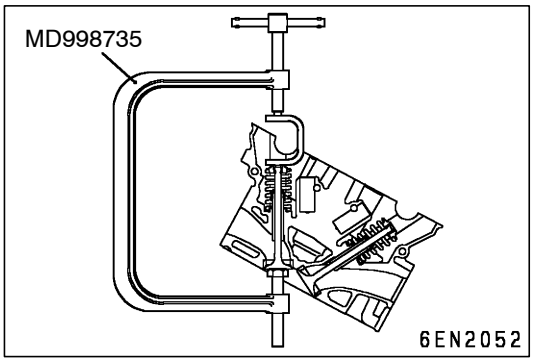
Remove the cylinder head bolt using the special tool.

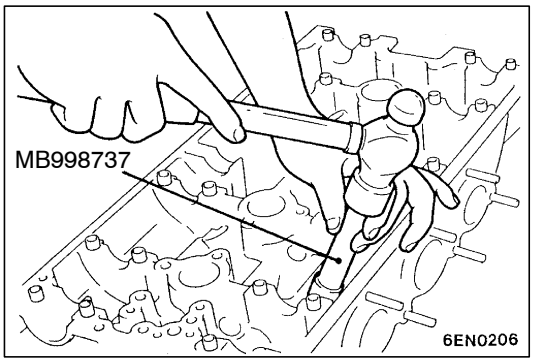


◀B▶ RETAINER LOCK REMOVAL

Compress the valve spring using the special tool, and remove the retainer lock.

NOTE
Attach a tag indicating the cylinder No. and installation position onto the parts including the removed valve and springs so that they can be reassembled later.





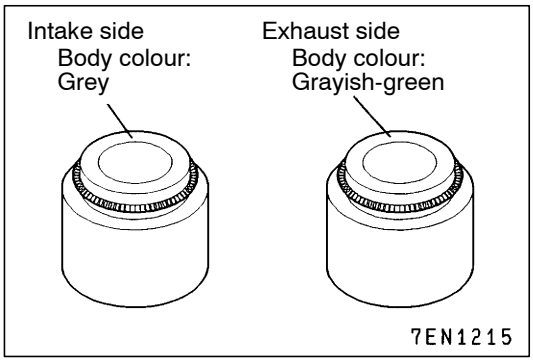
INSTALLATION SERVICE POINTS

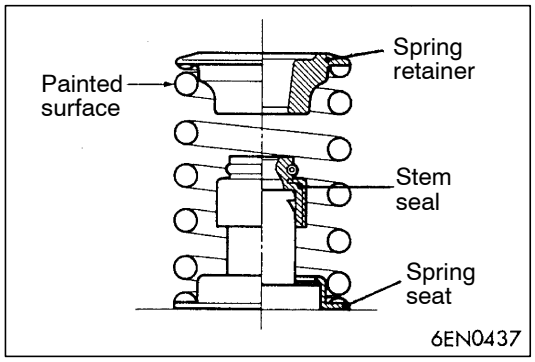
▶A◀ VALVE STEM SEAL INSTALLATION

1. Install the valve spring seat.
2. Install the valve.
3. Apply a small amount of engine oil on the valve stem seal.
4. Using the valve stem as a guide, press in the valve guide using the special tool.

Caution
Improper installation of the valve stem seal can lead to oil reduction, so always install using the special tool.

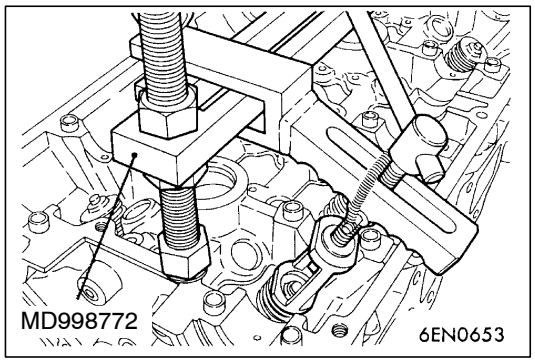
NOTE
Note that the valve stem seals for the intake side and exhaust side are different.





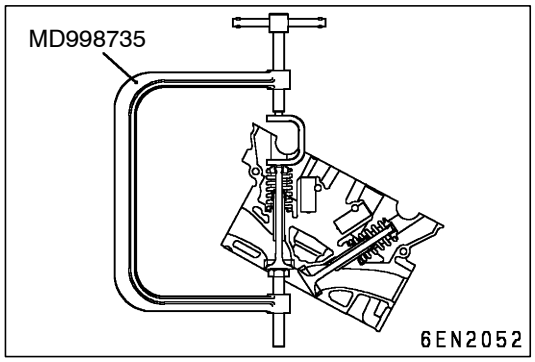
▶B◀ VALVE SPRING INSTALLATION

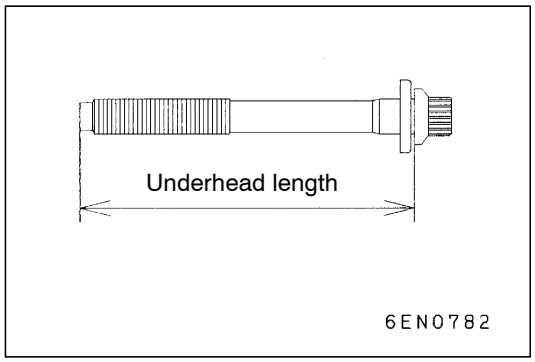
Install the valve spring so that the painted surface faces the rocker arm.



▶C◀ RETAINER LOCK INSTALLATION

Compress the valve spring using the special tool, and install the retainer lock.



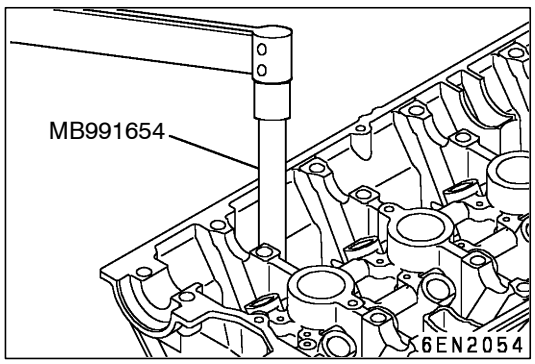


▶D◀ CYLINDER HEAD BOLT INSTALLATION

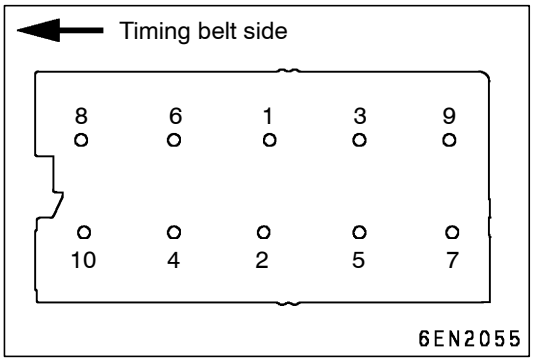
1. Before reusing the cylinder head bolt, confirm that the bolt's underhead length is less than the limit value. Replace the bolt if it exceeds the limit value.

   Limit value: 99.4 mm

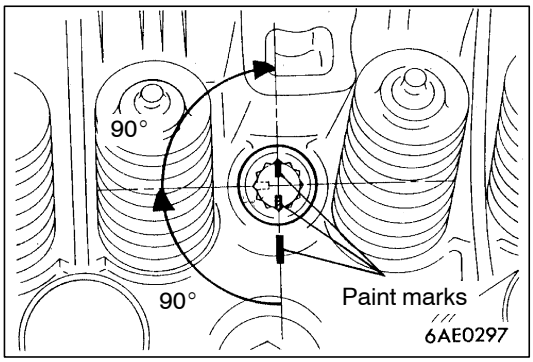
2. Apply engine oil on the bolt threads and washer.



NOTE
Use the special tool to tighten the cylinder head bolt.

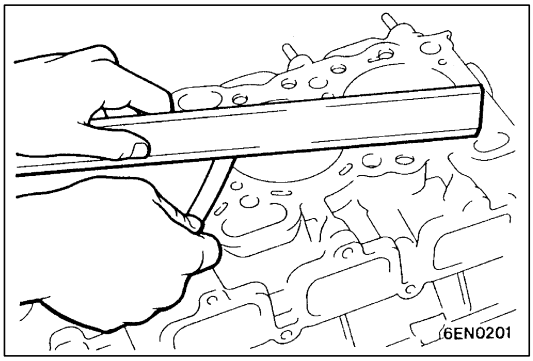


3. Following the tightening order, tighten at 78 ± 2 N•m.
4. Completely loosen the bolts.
5. Next, following the tightening order, tighten the loosened bolts at the torque 20 ± 2 N•m again.



6. Make paint marks on the cylinder head bolt's head and cylinder head.
7. Following the tightening order, tighten the cylinder head by 90°.
8. Tighten by another 90°, and confirm that the paint mark made on the cylinder head bolt's head and the paint mark on the cylinder head are positioned on the same line.

Caution
(1) If the tightening angle is less than 90°, the connection performance may not be attained, so take special care to the tightening angle when tightening.
(2) If the tightening angle is larger than the specified value, completely loosen the bolt and start again from step 1.



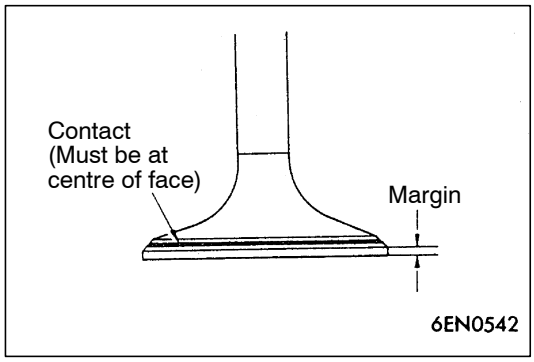
INSPECTION

1. CYLINDER HEAD

(1) Before cleaning the cylinder head, check it for water leaks, gas leaks, damage or cracks.
(2) Completely remove the oil, water deposits, sealant and carbon, etc. After cleaning the oil path, blow air and confirm that there is not clogging.
(3) Using a straight edge and thickness gauge, inspect the flatness of the bottom of the cylinder head for strain.
If the strain exceeds the limit value, grind the end and correct the flatness.

Standard value for lower surface strain: 0.05 mm
Limit value for lower surface strain: 0.2 mm
Grinding limit value: 0.2 mm
Cylinder head height (standard value for new part): 131.9 - 132.1 mm

Caution
The grinding limit is within 0.2 mm together with the combined cylinder block.



2. VALVE

(1) If there is a faulty contact, one-sided contact or improper seating with the valve seat, correct the valve seat.

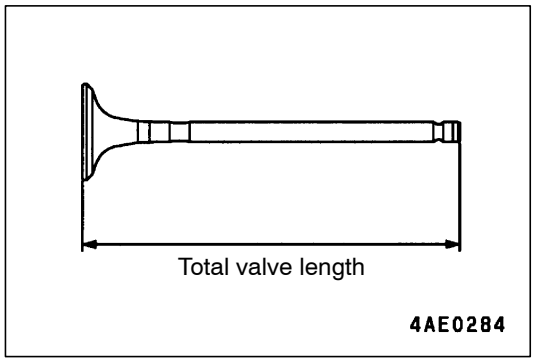
(2) Replace the valve if the margin exceeds the limit value.

Standard value:

Intake	**1.0 mm**
Exhaust	**1.5 mm**

Limit value:

Intake	**0.5 mm**
Exhaust	**1.0 mm**



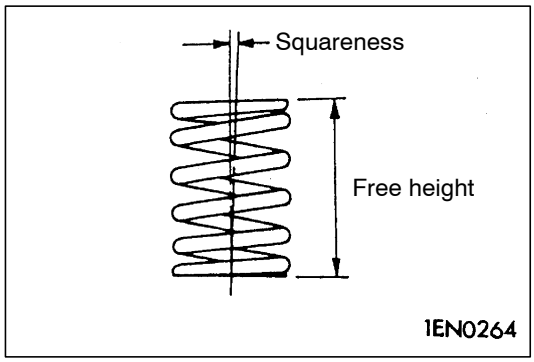
(3) Measure the total length of the valve, and replace the valve if the length exceeds the limit value.

Standard value:

Intake	**109.50 mm**
Exhaust	**109.70 mm**

Limit value:

Intake	**109.00 mm**
Exhaust	**109.20 mm**



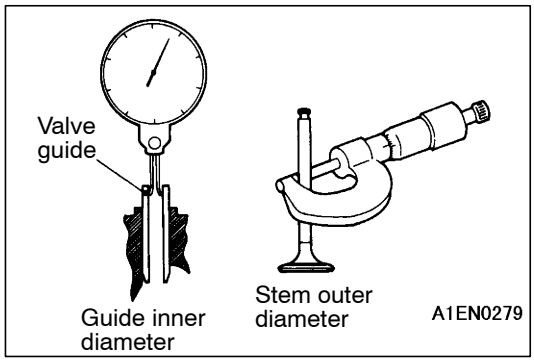
3. VALVE SPRING

(1) Measure the free height of the spring, and replace the valve spring if the height exceeds the limit value.

Standard value: 48.3 mm
Limit value: 47.3 mm

(2) Measure the spring squareness, and replace the valve spring if the inclination exceeds the limit value.

Standard value: 1.5° or less
Limit value: 4°



4. VALVE GUIDE

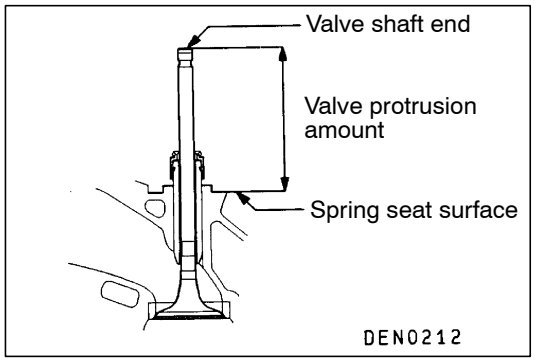
Measure the clearance between the valve guide and valve stem. If the clearance exceeds the limit value, replace the valve guide, valve or both parts.

Standard value:

Intake	**0.02 - 0.05 mm**
Exhaust	**0.05 - 0.09 mm**

Limit value:

Intake	**0.10 mm**
Exhaust	**0.15 mm**



5. VALVE SEAT

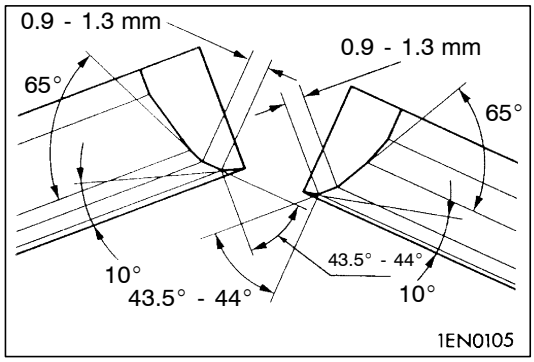
Assemble the valve, and measure the amount that the valve protrudes from the valve shaft end between the spring seat surfaces when the valve is pressed against the valve seat. Replace the valve seat if the protrusion amount exceeds the limit value.

Standard value:

Intake	**49.20 mm**
Exhaust	**48.40 mm**

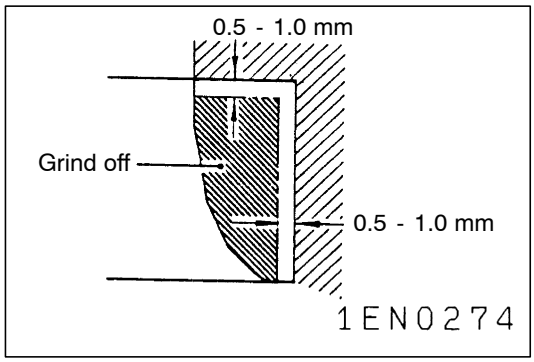
Limit value:

Intake	**49.70 mm**
Exhaust	**48.90 mm**



Valve Seat Correction

1. Before correcting the valve seat, inspect the clearance between the valve guide and valve, and replace the valve guide if necessary.
2. Correct so that the seat width and seat angle are at the specified shape.
3. After correcting, apply wrapping compound, and fit the valve and valve seat together.



Valve Seat Replacement

1. Grind off the valve seat to be replaced from the inside to reduce the thickness and then remove the valve seat.
2. Machine the valve seat hole on the cylinder head to match the diameter of the oversized valve seat into which it is to be pressed in.

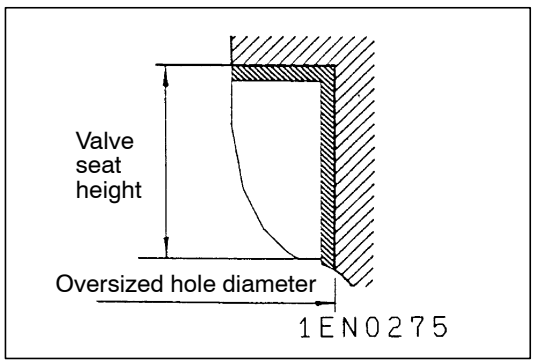
Intake valve seat hole diameter:

0.3 O.S.	**35.30 - 35.33 mm**
0.6 O.S.	**35.60 - 35.63 mm**

Exhaust valve seat hole diameter:

0.3 O.S.	**33.30 - 33.33 mm**
0.6 O.S.	**33.60 - 33.63 mm**

3. When pressing in the valve seat, cool the valve seat with liquid nitrogen, and make sure that the inner diameter of the cylinder head is not galled.
4. Refer to the “Valve Seat Correction” procedures, and machine the valve seat.

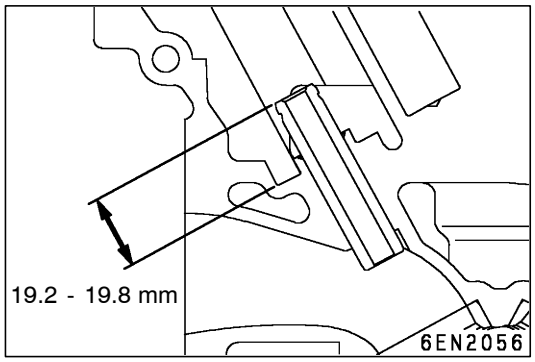


Valve Guide Replacement

1. Using a press, push the valve guide to the cylinder block side.
2. Machine the valve guide hole on the cylinder head to match the oversized valve guide into which it is to be pressed in.

   Caution
   Do not use a valve guide having the same size as the removed valve guide.

   Valve guide hole diameter:
   0.05 O.S. 12.05 - 12.07 mm
   0.25 O.S. 12.25 - 12.27 mm
   0.50 O.S. 12.50 - 12.52 mm



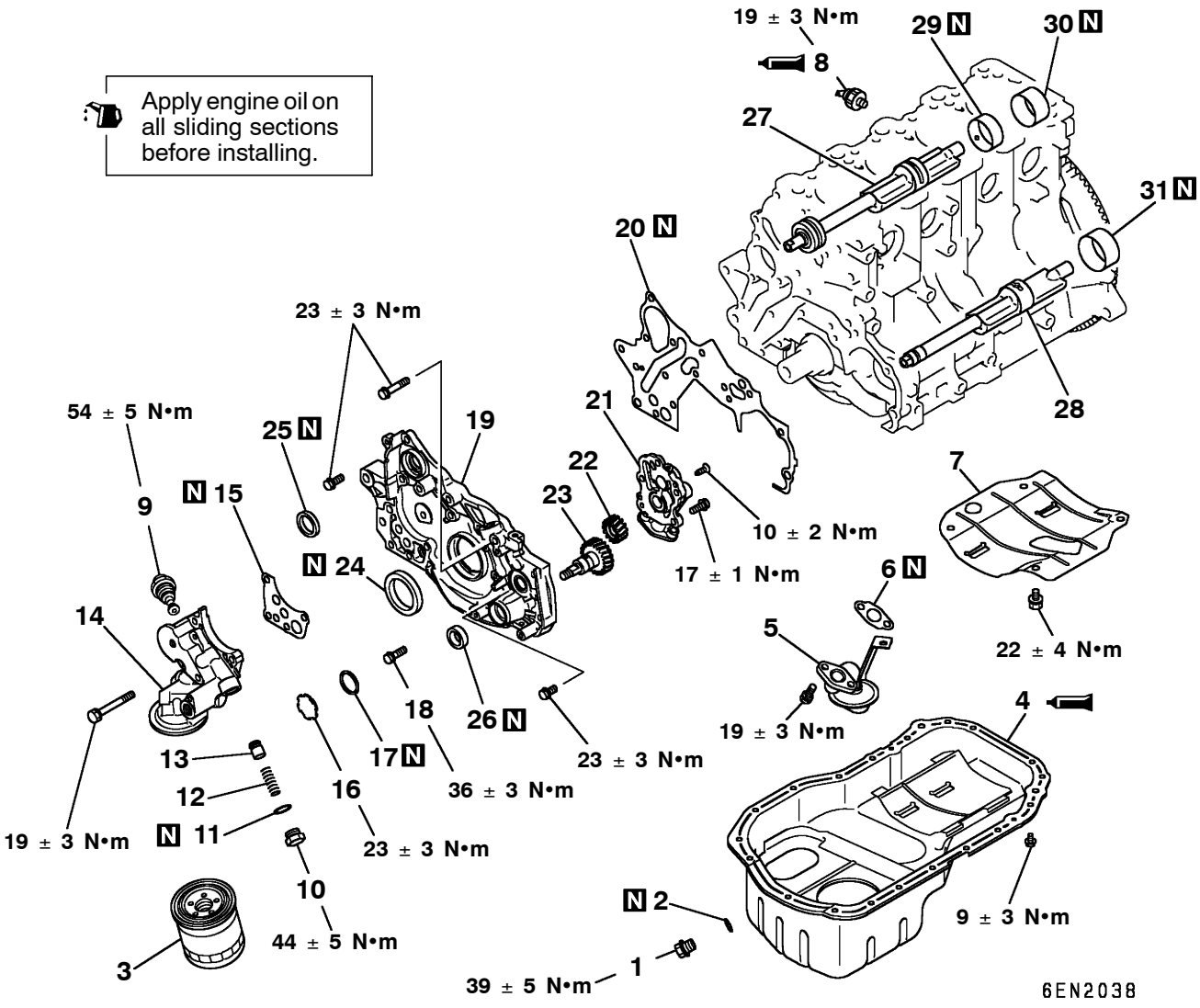
3. Press in the valve guide to the dimensions shown in the illustration.

   NOTE
   (1) Press in the valve guide from the top of the cylinder head.
   (2) Note that the length of the valve guides differs.
   Intake 45.5 mm
   Exhaust 50.5 mm

4. After pressing in the valve guide, insert a new valve, and confirm the sliding state.

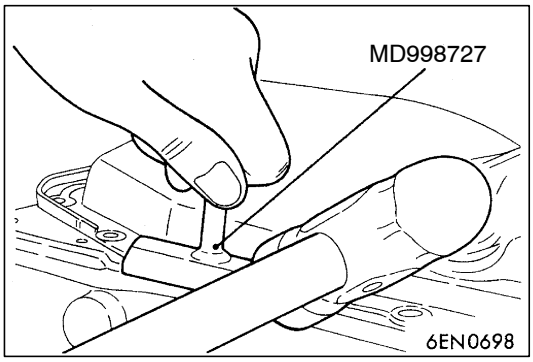
OIL PUMP AND OIL PAN

REMOVAL AND INSTALLATION



Removal steps

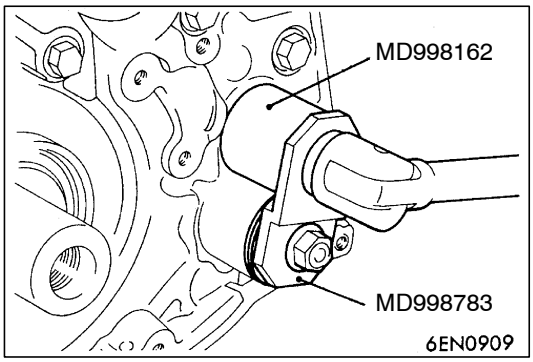
1. Drain plug
▶N◀ 2. Drain plug gasket
▶M◀ 3. Oil filter
◀A▶ ▶L◀ 4. Oil pan
5. Oil screen
6. Oil screen gasket
7. Baffle plate
▶K◀ 8. Oil pressure switch
9. Oil cooler bypass valve
10. Relief plug
11. Gasket
12. Relief spring
13. Relief plunger
14. Oil filter bracket
15. Oil filter bracket gasket
◀B▶ ▶J◀ 16. Plug cap
17. O-ring
◀C▶ ▶I◀ 18. Flange bolt
▶H◀ 19. Oil pump case
20. Oil pump case gasket
21. Oil pump cover
▶G◀ 22. Oil pump driven gear
▶G◀ 23. Oil pump drive gear
▶F◀ 24. Crankshaft front oil seal
▶E◀ 25. Counter balance shaft oil seal
▶D◀ 26. Oil pump oil seal
27. Counter balance shaft, right
28. Counter balance shaft, left
◀D▶ ▶C◀ 29. Counter balance shaft front bearing
◀E▶ ▶B◀ 30. Counter balance shaft rear bearing, right
◀E▶ ▶A◀ 31. Counter balance shaft rear bearing, left



REMOVAL SERVICE POINTS

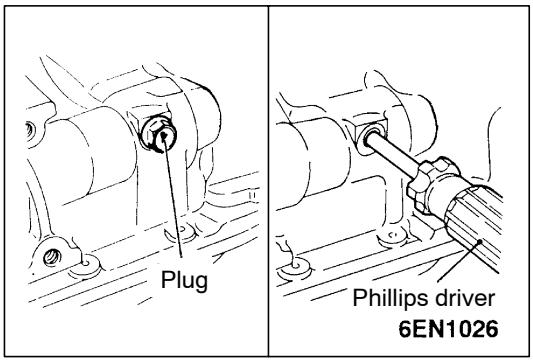
◀A▶ OIL PAN REMOVAL

1. Remove the oil pan tightening bolts.
2. Tap the special tool between the oil pan and cylinder block.
3. Tap on the edge of the special tool, slide the tool and remove the oil pan.



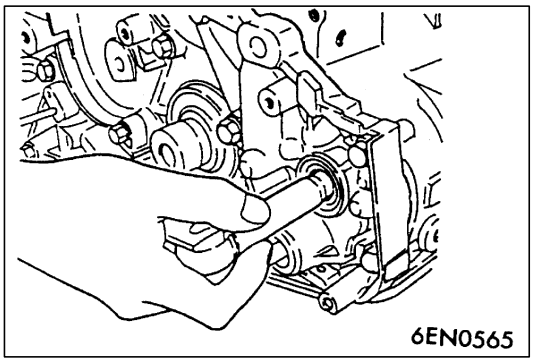
◀B▶ PLUG CAP REMOVAL

Fit the special tool (MD998162) into the notch on the plug cap as shown in the illustration. Loosen the plug cap while supporting with the special tool (MD998783).

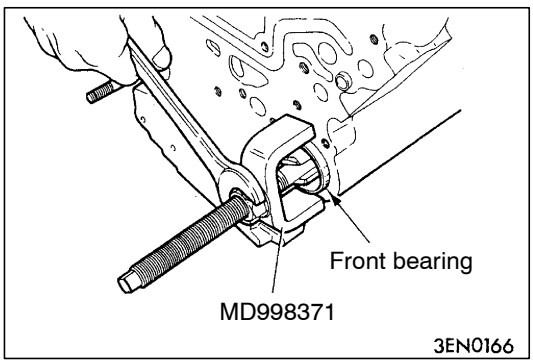


◀C▶ FLANGE BOLT REMOVAL

1. Remove the plug on the left side of the cylinder block, and insert a Phillips driver (shaft diameter 8 mm) by 60 mm or more to stop the rotation of the counter balance shaft left.



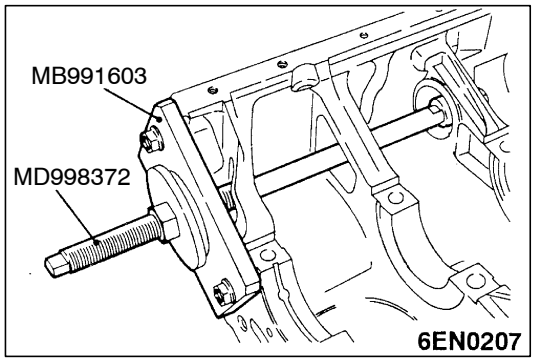
2. Loosen the flange bolt.



◀D▶ COUNTER BALANCE SHAFT FRONT BEARING REMOVAL

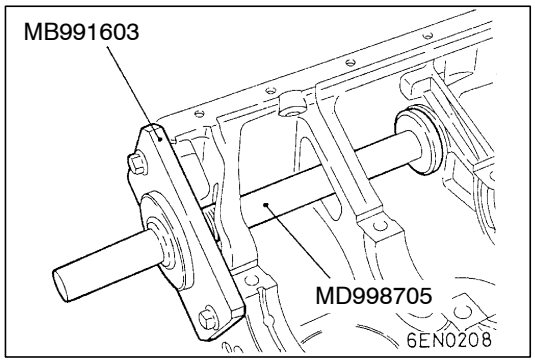
Pull out the counter balance shaft front bearing from the cylinder block using the special tool.

Caution
Always remove the counter balance shaft front bearing first. Otherwise, the counter balance shaft rear bearing cannot be removed.



◀E▶ COUNTER BALANCE SHAFT REAR BEARING REMOVAL

1. Pull out the counter balance shaft rear bearing right from the cylinder block using the special tool (MD998372).
2. When removing the counter balance shaft rear bearing left, install the special tool (MB991603) onto the front of the cylinder block, and then remove the bearing using the special tool (MD998372).



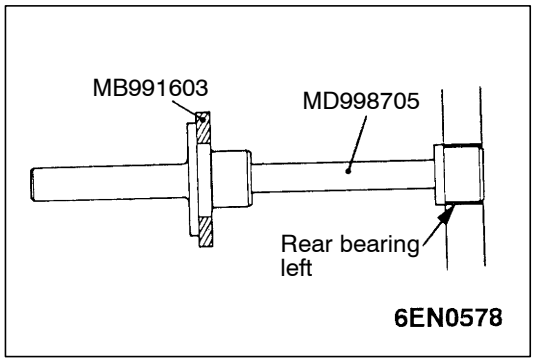
INSTALLATION SERVICE POINTS

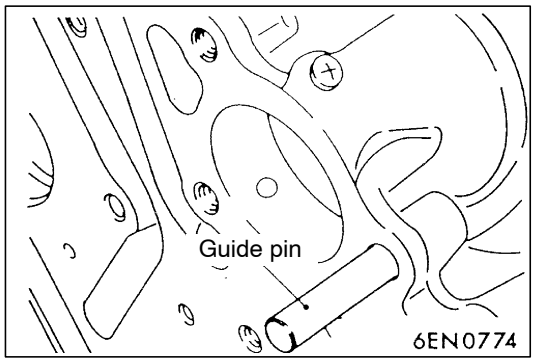
▶A◀ COUNTER BALANCE SHAFT REAR BEARING LEFT INSTALLATION

1. Install the special tool (MB991603) onto the cylinder block.
2. Set the counter balance shaft rear bearing left into the special tool (MD998705).

   NOTE
   There is no oil hole on the counter balance shaft rear bearing left.

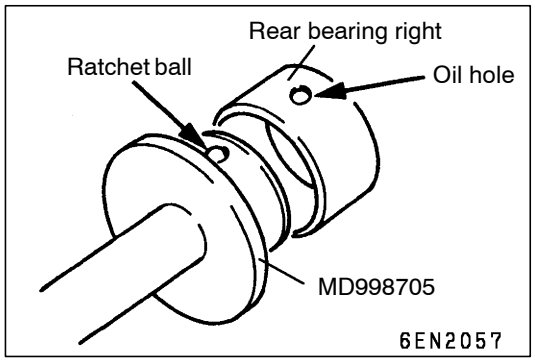
3. Tap in the counter balance shaft rear bearing left.



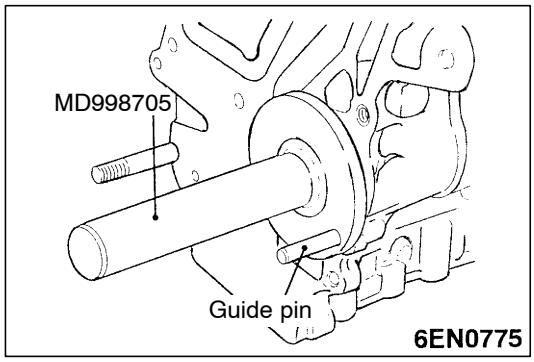


▶B◀ COUNTER BALANCE SHAFT REAR BEARING RIGHT INSTALLATION

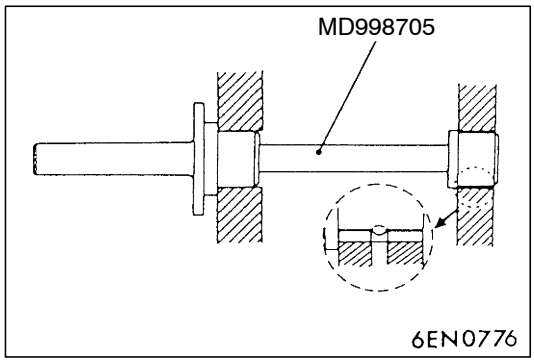
1. Install the guide pin onto the cylinder block.

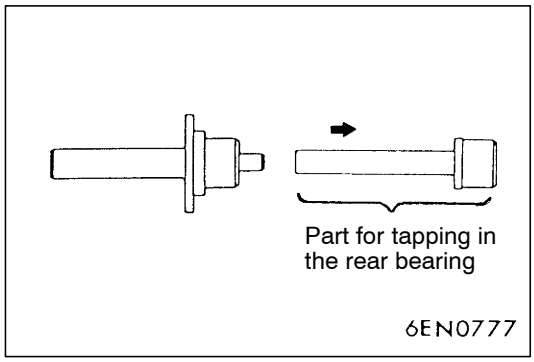


2. Align the ratchet ball of the special tool with the oil hole, and set the counter balance shaft rear bearing right.



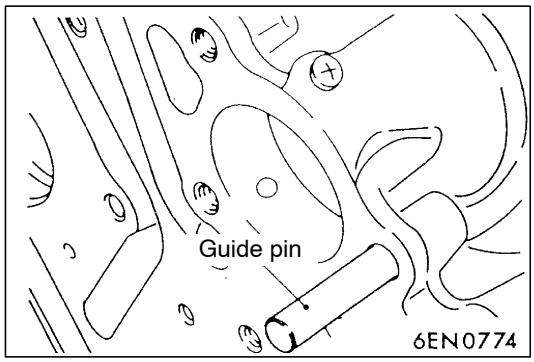
3. Align and insert the special tool into the guide pin, and tap in the counter balance shaft rear bearing right.



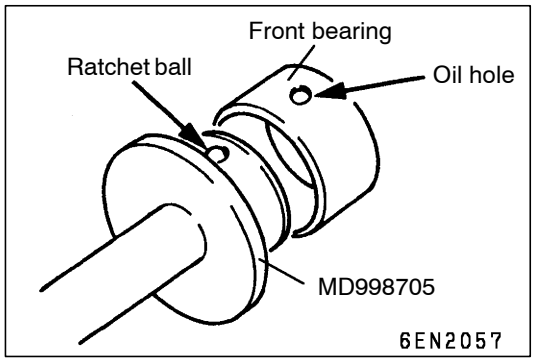


▶C◀ COUNTER BALANCE SHAFT FRONT BEARING INSTALLATION

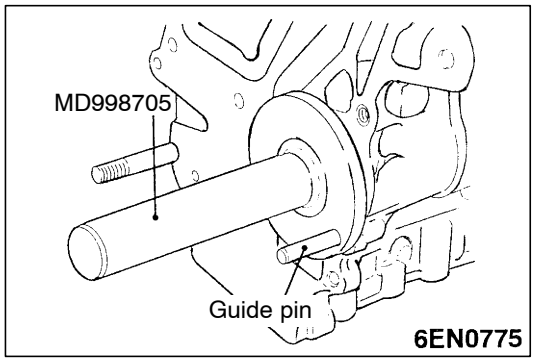
1. Remove the part for tapping in the rear bearing from the special tool.



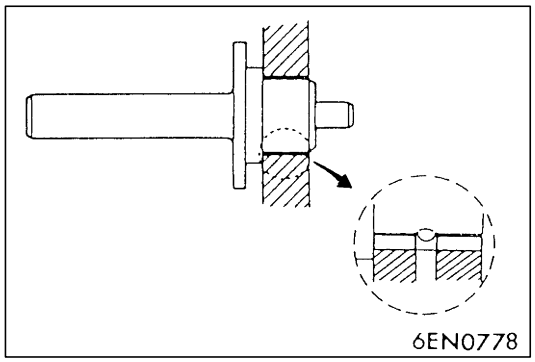
2. Install the guide pin onto the cylinder block.

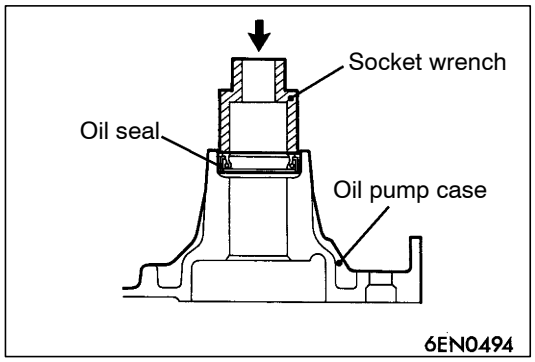


3. Align the ratchet ball of the special tool with the oil hole, and set the counter balance shaft front bearing.



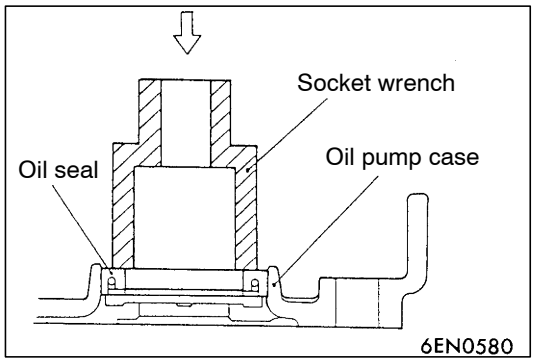
4. Align and insert the special tool into the guide pin, and tap in the counter balance shaft front bearing.





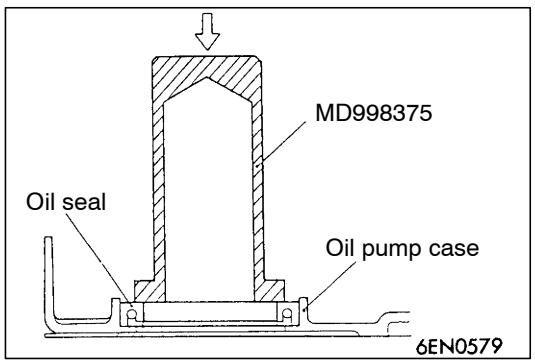
▶D◀ OIL PUMP OIL SEAL INSTALLATION

Install the oil pump oil seal using an appropriate socket wrench.



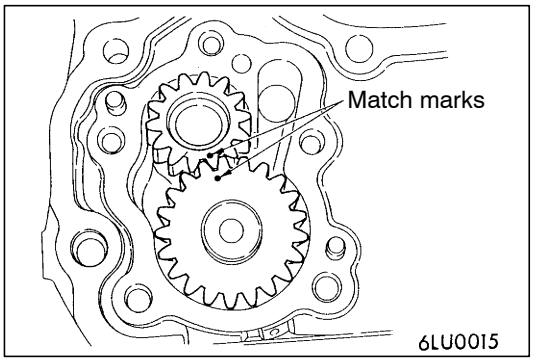
▶E◀ COUNTER BALANCE SHAFT OIL SEAL INSTALLATION

Install the counter balance shaft oil seal using an appropriate socket wrench.



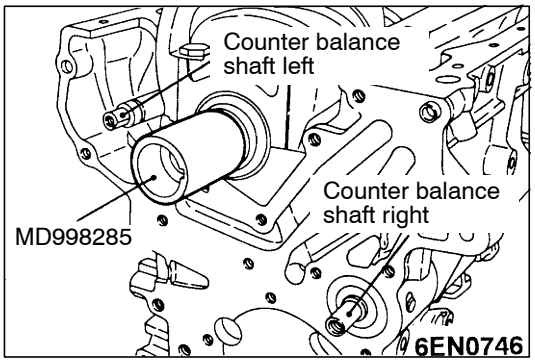
▶F◀ CRANKSHAFT FRONT OIL SEAL INSTALLATION

Install the crankshaft front oil seal using the special tool.



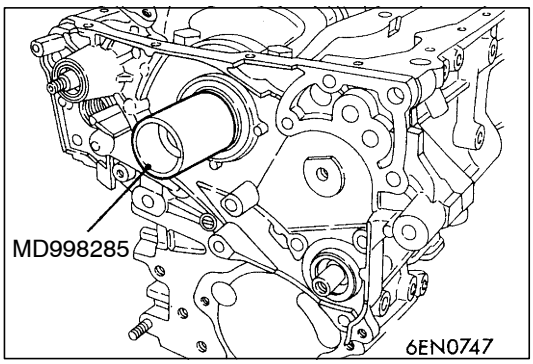
▶G◀OIL PUMP DRIVE GEAR/OIL PUMP DRIVEN GEAR INSTALLATION

Apply sufficient engine oil onto the gears, align the match marks, and assemble.

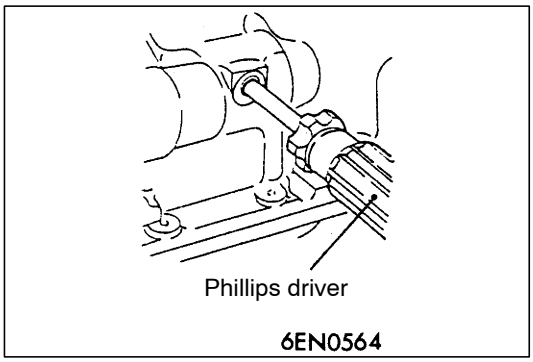


▶H◀OIL PUMP CASE INSTALLATION

1. Install the special tool onto the front end of the crankshaft, and apply a light coat of engine oil onto the periphery of the guide. If an oil seal is installed on the oil pump case, always use a guide.

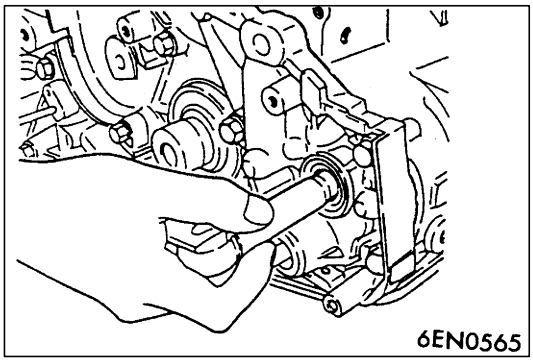


2. Install the oil pump case through the new oil pump case gasket, and temporarily tighten the bolts other than the oil filter bracket tightening bolt.
3. Install the oil filter bracket through the oil filter bracket gasket, and temporarily tighten with the bolt.
4. Tighten the oil pump case at the specified torque 23 ± 3 N•m, and the oil filter bracket at the specified torque 19 ± 3 N•m.

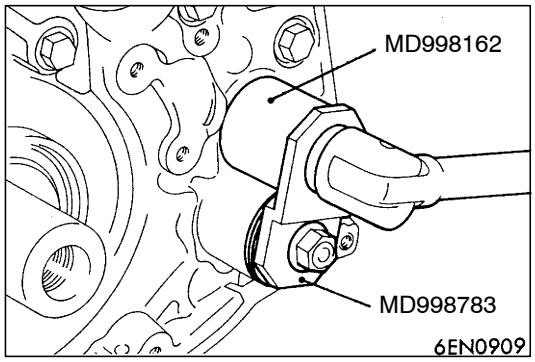


▶I◀ FLANGE BOLT INSTALLATION

1. Insert a Phillips driver (shaft diameter 8 mm) by 60 mm or more into the hole on the left side of the cylinder block to stop the rotation of the counter balance shaft left.

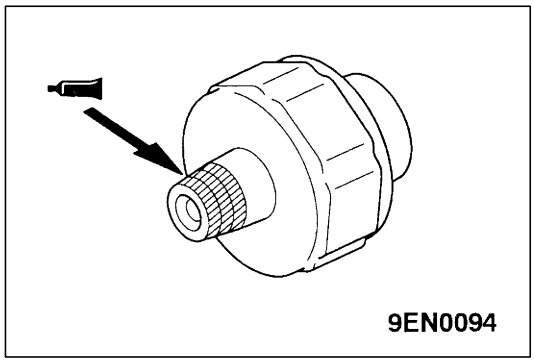


2. Tighten the flange bolt at the specified torque 36 ± 3 N•m.



▶J◀ PLUG CAP INSTALLATION

1. Install a new O-ring onto the oil pump case.
2. Lightly tighten the plug cap by hand.
3. As shown in the illustration, fit the special tool (MD998162) into the notch on the plug cap, and while supporting with the special tool (MD998783), tighten the plug cap at the specified torque 23 ± 3 N•m.



▶K◀ OIL PRESSURE SWITCH INSTALLATION

Sealant

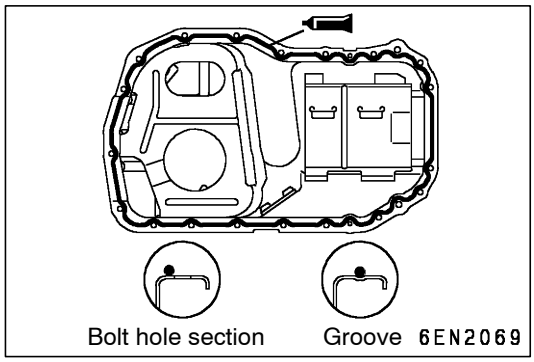
Specified sealant:

3M™ AAD Part No. 8672 or equivalent

Caution

(1) Make sure that the sealant does not protrude to the end of the threads.

(2) Do not tighten too far.



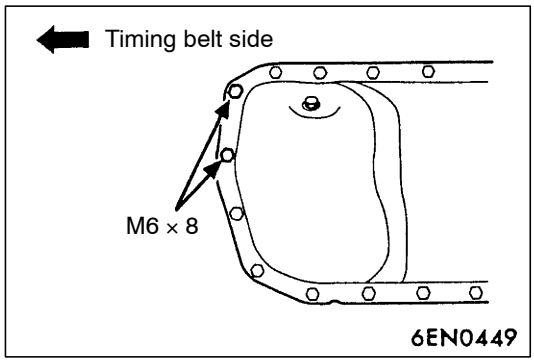
▶L◀ OIL PAN INSTALLATION

1. Clean the surface of the cylinder block and oil pan onto which gasket is to be applied.
2. Squeeze out form-in-place gasket at a 4 mm width, and apply onto the entire periphery of the oil pan flange.

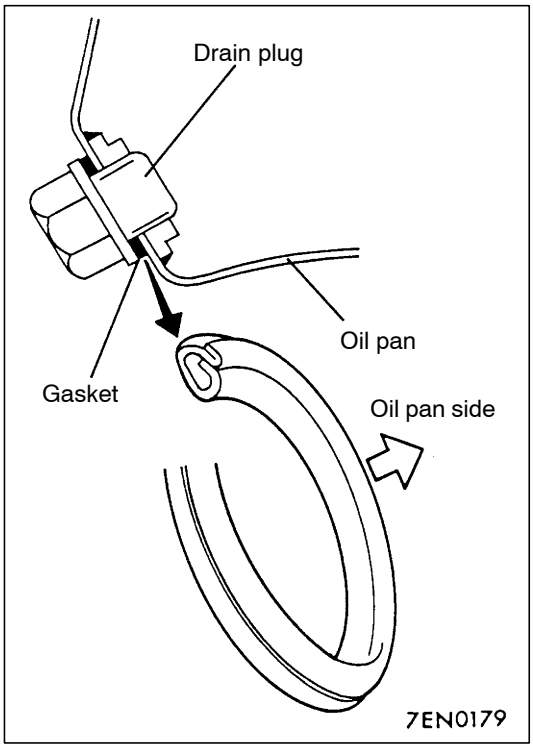
Form-in-place gasket

Specified gasket:

Mitsubishi Genuine Part No. MD970389 or equivalent



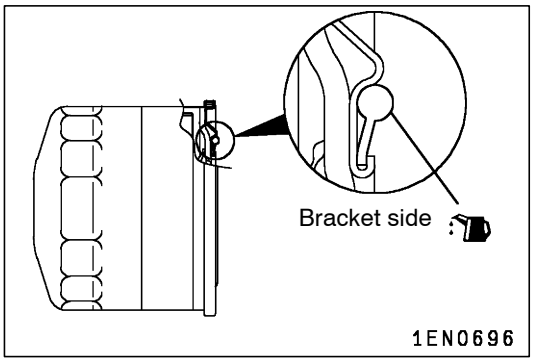
3. Note that the lengths of the bolts shown in the illustration differ, so take care when installing.



▶M◀DRAIN PLUG GASKET INSTALLATION

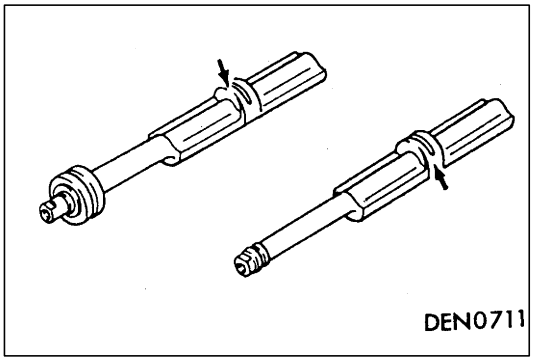
Replace the gasket with a new part, and install at the direction shown in the illustration.

Caution
Incorrect installation direction will lead to oil leaks.



▶N◀OIL FILTER INSTALLATION

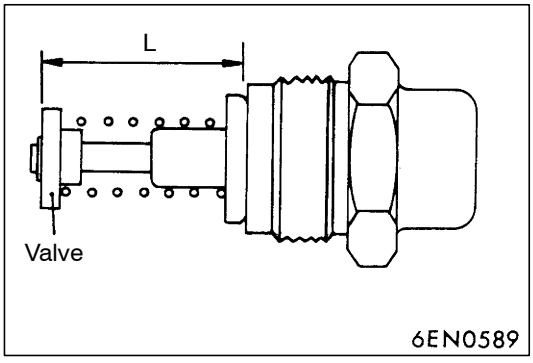
1. Clean the installation surface on the cylinder block side.
2. Apply engine oil on the O-ring for the oil filter.
3. Screw in the oil filter, and tighten approx. 3/4 of a rotation (approx. 14 ± 2 N•m) from where the O-ring contacts the installation surface.



INSPECTION

1. COUNTER BALANCE SHAFT

(1) Make sure that the oil hole is not clogged.
(2) Check the journal (bearing section) for seizure or damage, and check the state of contact with the bearings. If any faults are found, replace the counter balance shaft, bearing or oil pump case assembly.



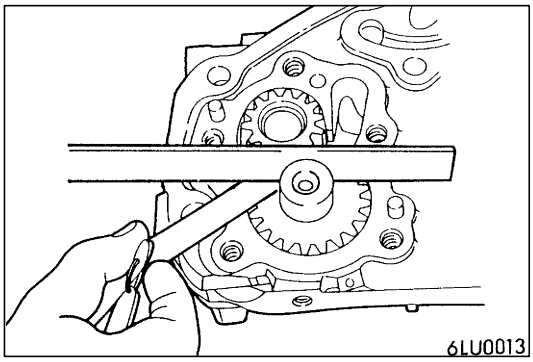
2. OIL COOLER BYPASS VALVE

(1) The valve must move smoothly.
(2) The L dimension must be at the standard value at a constant temperature, constant humidity state.

Standard value: 34.5 mm

(3) The protruded dimensions must be at the standard value after submerging into 100°C oil.

Standard value: 40 mm



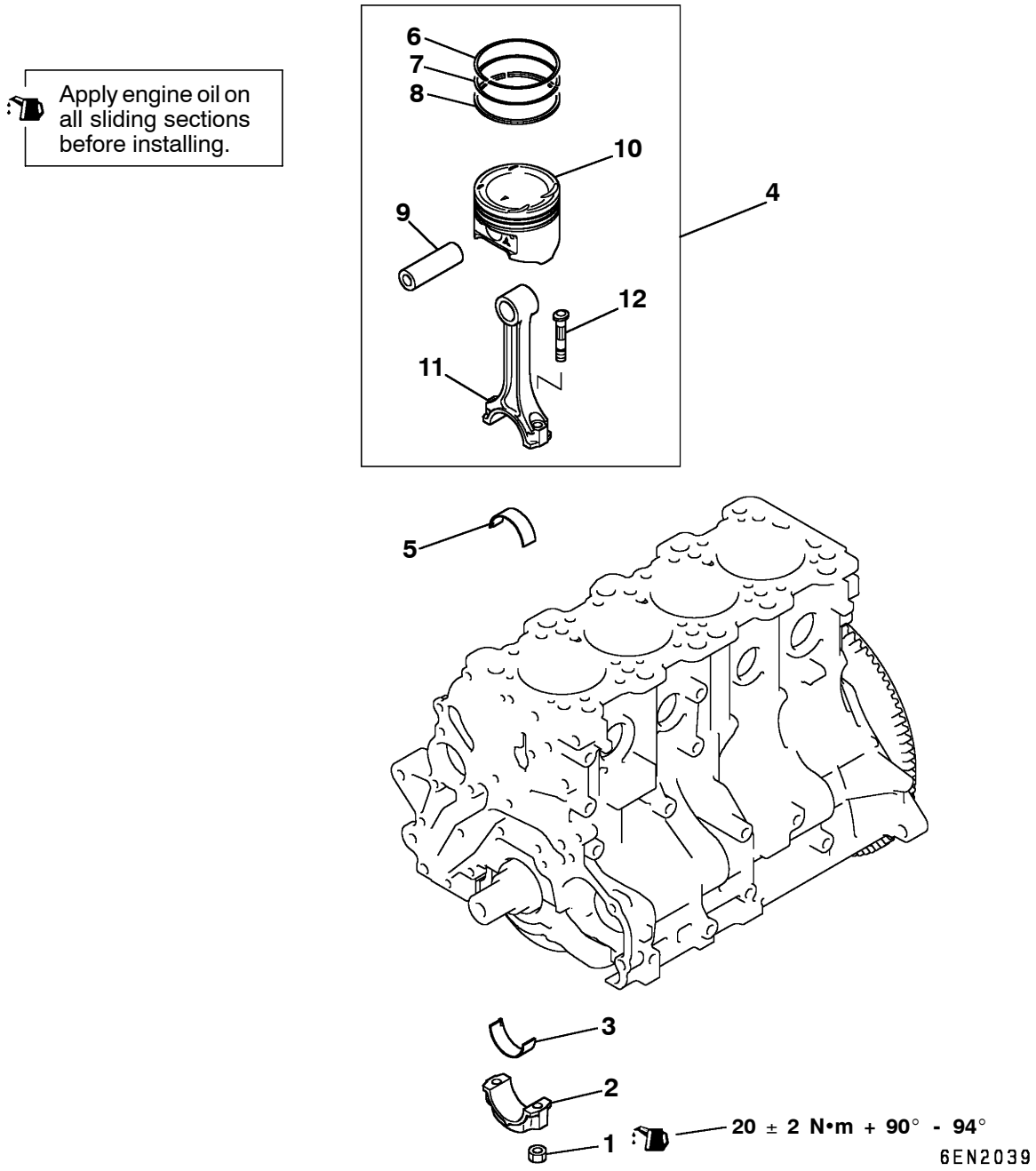
3. OIL PUMP

(1) Assemble the drive gear and driven gear into the oil pump case.
(2) Inspect the side clearance with a thickness gauge.

Standard value:
Drive gear 0.08 - 0.14 mm
Driven gear 0.06 - 0.12 mm

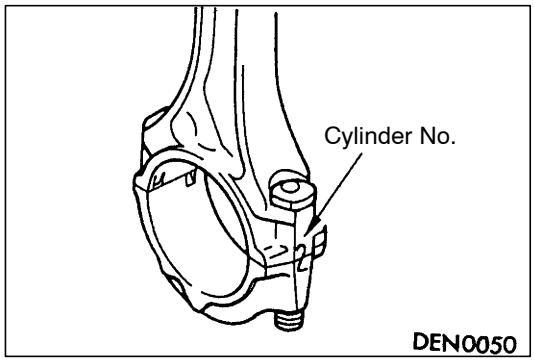
PISTON AND CONNECTING ROD

REMOVAL AND INSTALLATION



Removal steps

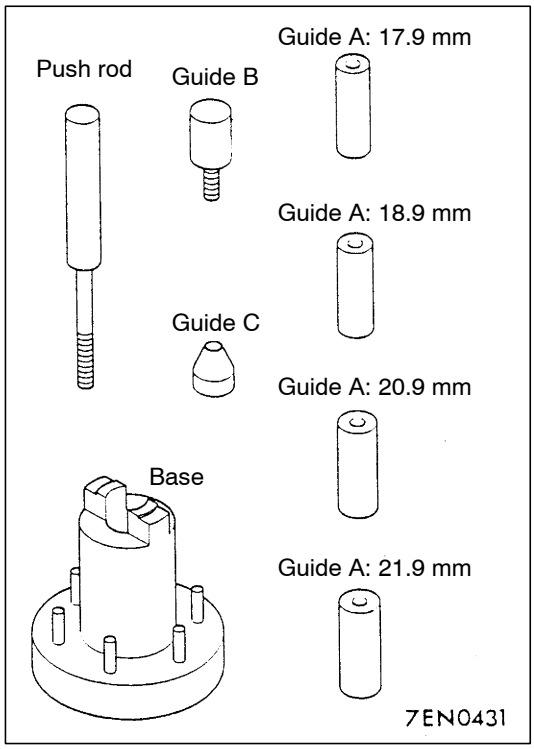
◀A▶ ▶G◀ 1. Connecting rod cap nut
◀A▶ ▶F◀ 2. Connecting rod cap
◀A▶ ▶E◀ 3. Connecting rod bearing
▶D◀ 4. Piston connecting rod
5. Connecting rod bearing
▶C◀ 6. Piston ring No. 1
▶C◀ 7. Piston ring No. 2
▶B◀ 8. Oil ring
◀B▶ ▶A◀ 9. Piston pin
10. Piston
11. Connecting rod
12. Bolt



REMOVAL SERVICE POINTS

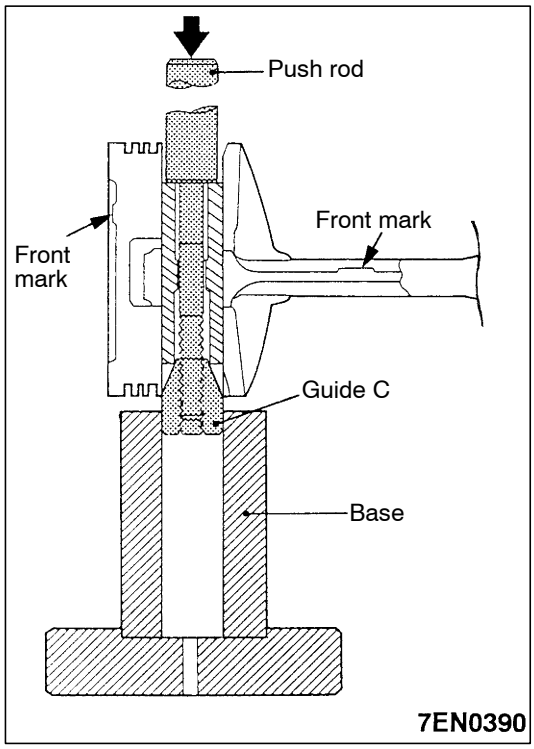
◀A▶ CONNECTING ROD CAP REMOVAL

Note the cylinder No. on the side of the connecting rod's large end for identification during reassembly.



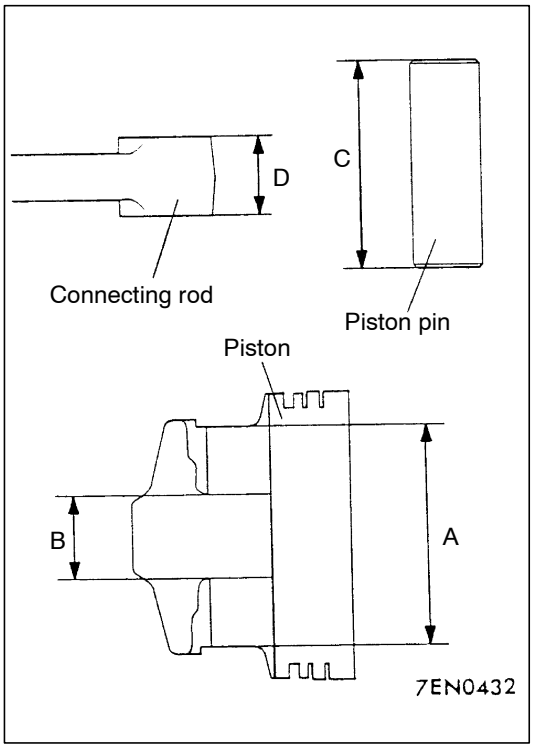
◀B▶ PISTON PIN REMOVAL

The special tool's piston pin setting tool (MD998780) is configured of the parts shown in the left illustration.



1. Insert the special tool's push rod in from the front mark (arrow) side of the piston's front face, and install guide C.
2. Set the piston and connecting rod assembly onto the special tool's piston pin setting base so that the front mark faces upward.
3. Push out the piston pin using a press.

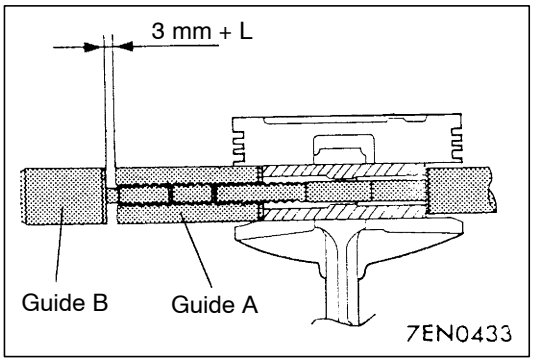
   NOTE
   After removing the piston pin, group the piston, piston pin and connecting rod for each cylinder No.

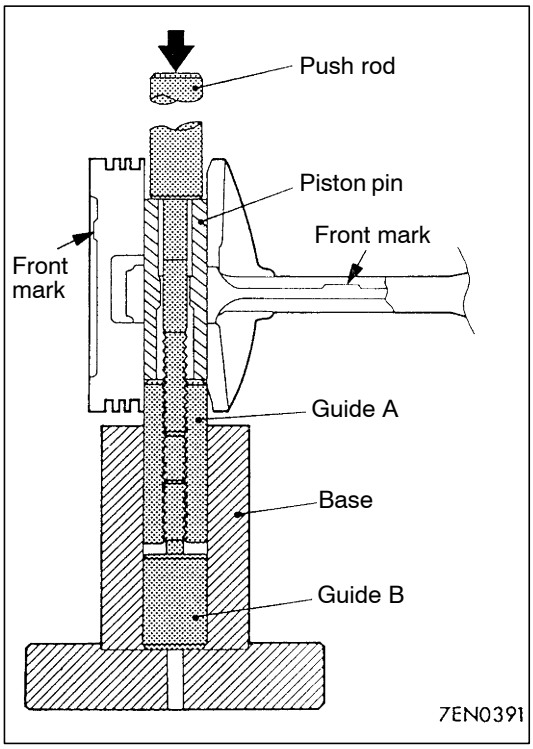


INSTALLATION SERVICE POINTS

▶A◀ PISTON PIN INSTALLATION

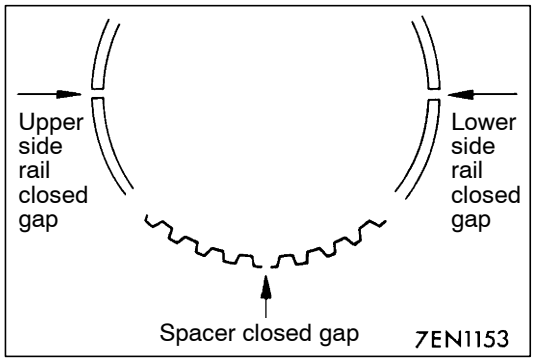
1. Measure the length of the following parts.
   A : Piston pin installation section
   B : Between piston boss
   C : Piston pin
   D : Connecting rod
2. Calculate using the following expression.
   L = ((A - C) - (B - D)) ÷ 2
3. Insert the special tool's push rod into the piston pin, and remove guide A.
4. Align the piston and connecting rod front marks, and assemble.
5. Apply engine oil on the periphery of the piston pin.
6. Insert the guide A side of the piston pin assembled in step 3 into the pin hole from the front mark side of the piston.
7. Screw guide B into guide A, and assemble so that the clearance is the value 3 mm more than the value (L) obtained in step 2.





8. Set onto the special tool's piston setting base so that the front mark faces upward.
9. Press in the piston pin using a press. If the press in load is less than the standard value, replace the piston pin (piston assembly), connecting rod or both parts.

   Standard value: 7,355 - 17,162 N

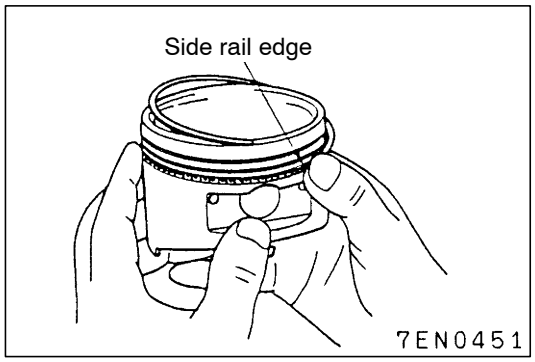


▶B◀ OIL RING INSTALLATION

1. Assemble the oil ring's spacer into the piston ring groove. Next, assemble the upper side rail, and then assemble the lower side rail.

   NOTE
   (1) Install so that the side rail and spacer closed gaps are at the position shown in the illustration.
   (2) The following identification colours are applied on the spacer and side rail (new parts) according to the size.

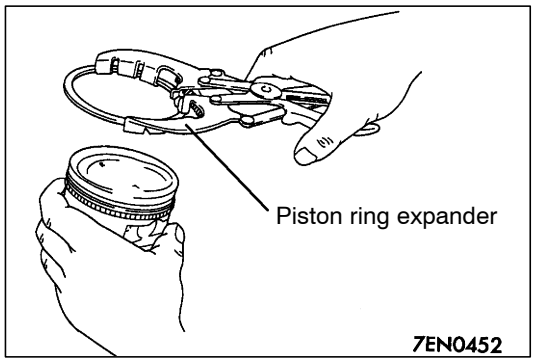
Size	Identification colour
S.T.D.	None
0.50 mm O.S.	Blue
1.00 mm O.S.	Yellow



2. The side rail can be assembled easily by fitting one end of the side rail into the piston groove and then pressing on it with fingers as shown in the illustration.

   Caution
   The side rail's closed gap could break if it is spread open with a ring expander in the same manner as the other piston rings.

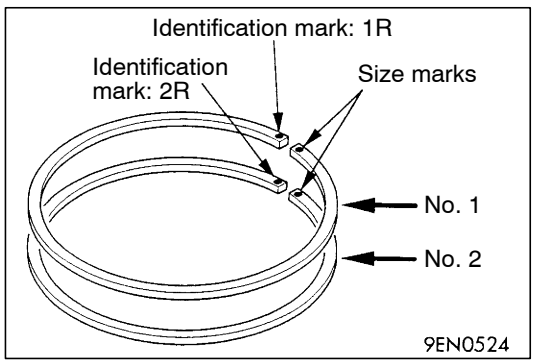
3. After assembling into the piston, check that the side rail rotates smoothly in either direction.



▶C◀ PISTON RING NO. 2/PISTON RING NO. 1 INSTALLATION

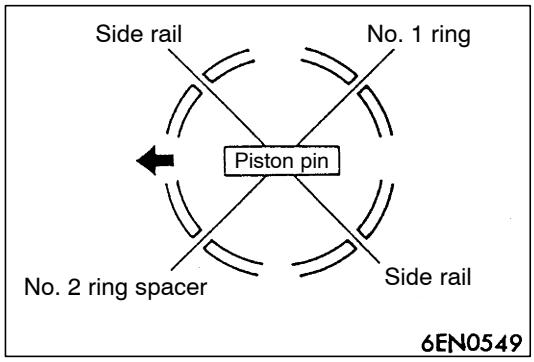
Using a piston ring expander, assemble the ring with the identification mark facing upward.

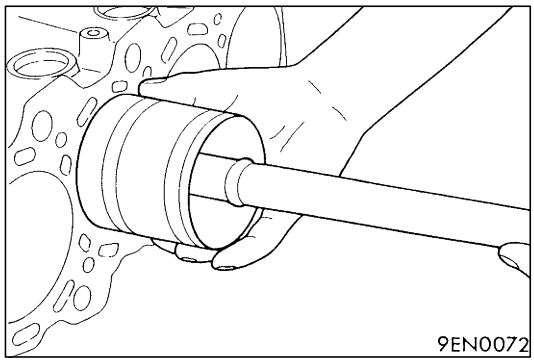
Identification mark
No. 1 ring 1R
No. 2 ring 2R



NOTE
The following size marks are stamped on the piston ring according to the size.

Size	Size mark
S.T.D.	(None)
0.50 mm O.S.	50
1.00 mm O.S.	100

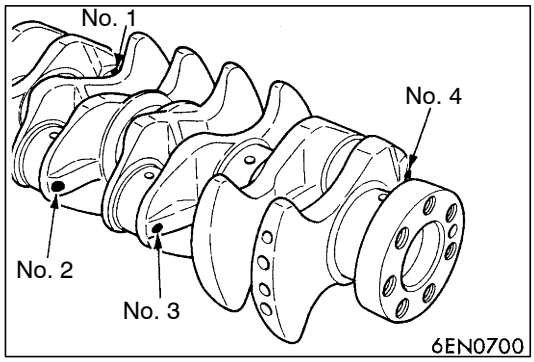




▶D◀ PISTON AND CONNECTING ROD ASSEMBLY INSTALLATION

1. Apply sufficient engine oil on the piston ring's periphery, piston ring and oil ring.
2. Align the piston ring and oil ring (side rail, spacer) closed gap positions as shown in the illustration.
3. Insert the piston and connecting rod assembly from the top of the cylinder so that the front mark (arrow) on the piston's front face faces the camshaft sprocket side.
4. Securely hold the piston ring with a ring band, and insert the piston and connecting rod assembly.

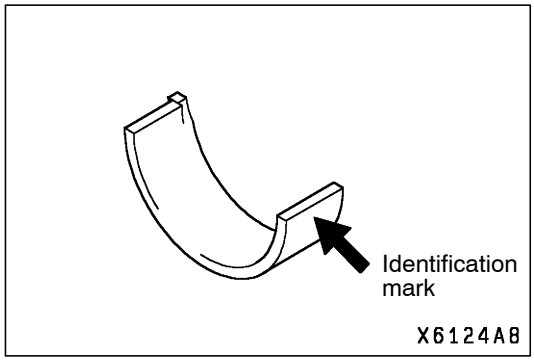
Caution
(1) The piston ring could break if tapped in with force.
(2) Make sure not to contact the oil jet when tapping in.



▶E◀ CONNECTING ROD BEARING INSTALLATION

When replacing the bearing, use the following procedure to select and assemble the bearing.

1. Measure the diameter of the crankshaft pin, and confirm the class shown below.
   When using a spare part, each identification colour is painted at the position shown in the illustration.



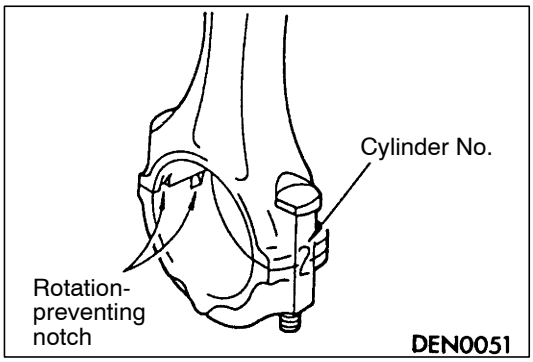
2. The identification marks of the connecting rod bearings are attached at the position shown in the illustration.

Crankshaft pin section				Connecting rod bearing
Class	Product identification colour	Spare part identification colour	Diameter mm	Identification mark
1	None	Yellow	44.995 - 45.000	0
2	None	None	44.985 - 44.995	1
3	None	White	44.980 - 44.985	2

3. Select the bearing from the above table according to the identification confirmed in steps 1 and 2.

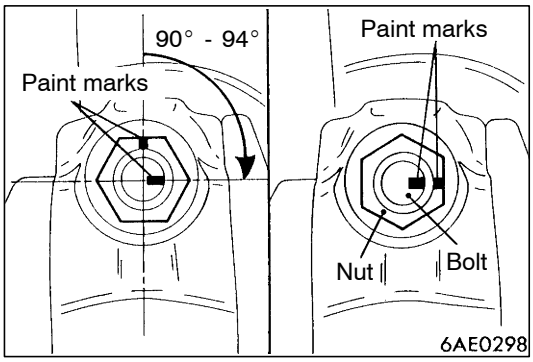
   Example of selecting bearing
   If the measured outer diameter of the crankshaft pin is 44.996 mm, Class 1 applies, and the spare part identification colour is yellow. Thus, select a bearing with identification mark 0.

4. If there is no identification, measure the oil clearance and select.



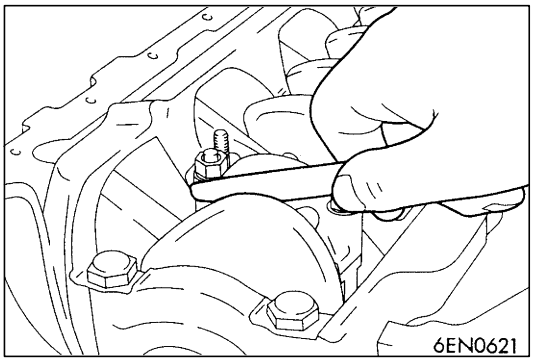
▶F◀ CONNECTING ROD CAP INSTALLATION

1. Align the marks made during disassembly, and install the bearing cap onto the connecting rod. When using a new connecting rod that has no match marks, assemble so that the bearing rotation-preventing notch comes to the same side as shown in the illustration.



2. The plasticity range tightening method is adopted for the connecting rod bolt and nut, so elongate and inspect the bolt before reusing it.
   Inspect that the bolt is elongated to the extent that the nut can be screwed onto the last thread when screwed by hand. If the nut cannot be screwed on smoothly to the end, the bolt threads are elongated and the bolt must be replaced.
3. Apply engine oil on the nut's threads and seat surface before installing the nut.
4. After installing each nut onto the bolt with fingers, alternately tighten the nuts to assemble the cap correctly.
5. Tighten the nut at a 20 N•m torque.
6. Make a paint mark on the head of the nut.
7. Using the position of the mark painted on the nut as reference, make paint marks on the bolt at the 90° to 94° positions in the nut tightening direction.
8. Tighten the nut between 90° and 94°, and confirm that the paint marks on the nut and bolt match.

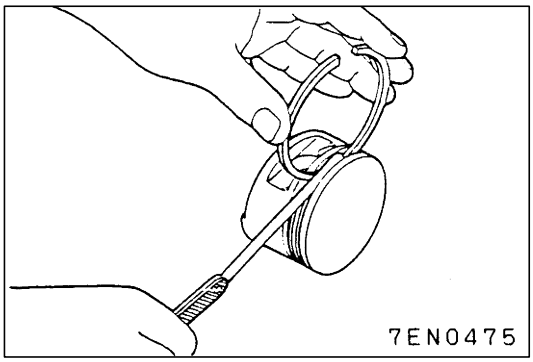
Caution
If the tightening angle is less than 90°, the connection performance may not be attained, so take special care to the tightening angle when tightening.
If the tightening angle is larger than 94°, completely loosen the nut and start again from step 1.



9. Check that the thrust clearance at the large end of the connecting rod is correct.

   Standard value: 0.10 - 0.25 mm

   Limit value: 0.4 mm



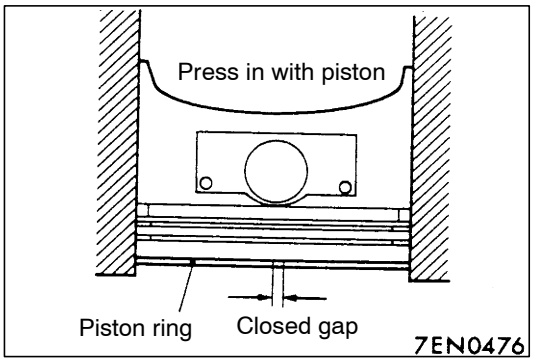
INSPECTION

1. PISTON RING

(1) Inspect the clearance between the piston ring and ring groove. If the limit value is exceeded, replace the piston ring or the piston ring and piston.

Standard value:
No. 1 0.03 - 0.07 mm
No. 2 0.02 - 0.06 mm

Limit value: 0.1 mm

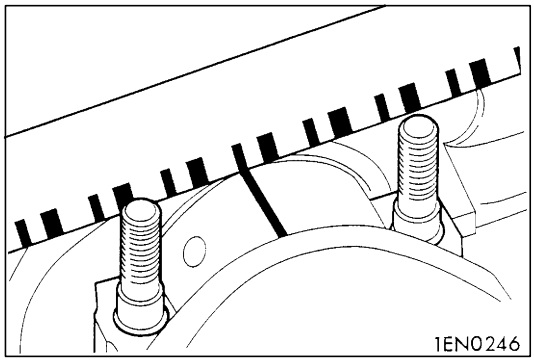


(2) Place the piston ring and oil ring side rail into the cylinder bore, and contact the piston front face side, and press in. After attaining a right angle, measure the closed gap with a thickness gauge.

NOTE
Press in the closed gap of the piston ring and oil ring's side rail at the position of the piston shown in the illustration, and measure the closed gap.

Standard value:
No. 1 0.20 - 0.30 mm
No. 2 0.35 - 0.50 mm
Oil ring 0.10 - 0.40 mm

Standard value:
No. 1 0.8 mm
No. 2 0.8 mm
Oil ring 1.0 mm



2. CRANKSHAFT PIN OIL CLEARANCE (PLASTIC GAUGE METHOD)

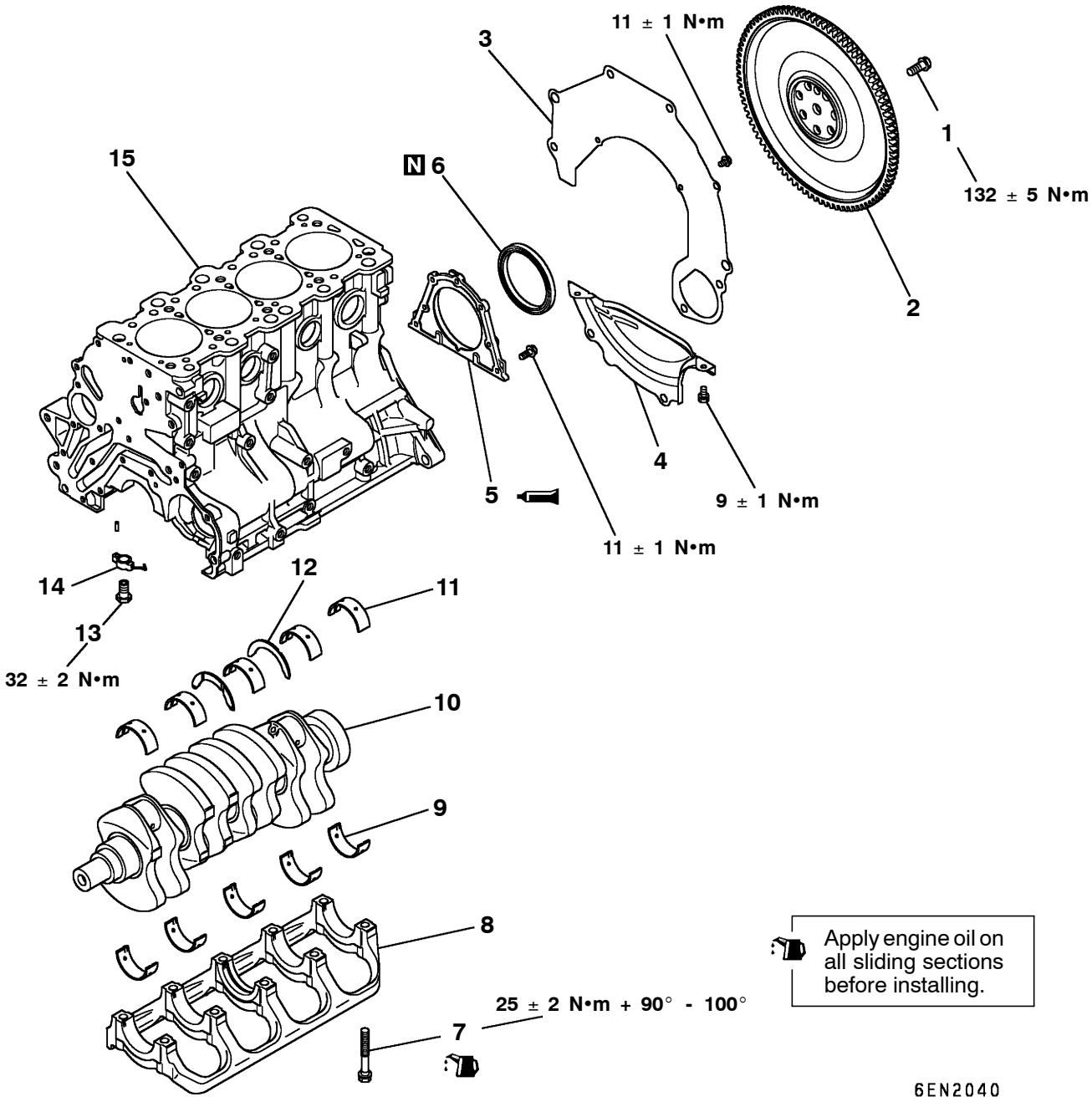
(1) Wipe off the oil from the crankshaft pin and connecting rod bearing.
(2) Set a plastic gauge as long as the bearing width on the pin shaft so that straightly aligned with the shaft centre.
(3) Carefully set the connecting rod cap, and tighten the nut at the specified torque 20 ± 2 N•m + 90° to 94°
(4) Remove the nut, and carefully remove the connecting rod cap.
(5) Measure the width of the crushed plastic gauge (at the section crushed the most) with the scale printed on the plastic gauge bag.

Standard value: 0.03 - 0.05 mm

Limit value: 0.1 mm

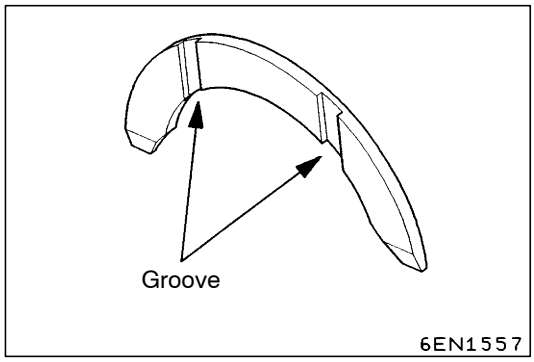
CRANKSHAFT AND CYLINDER BLOCK

REMOVAL AND INSTALLATION



Removal steps

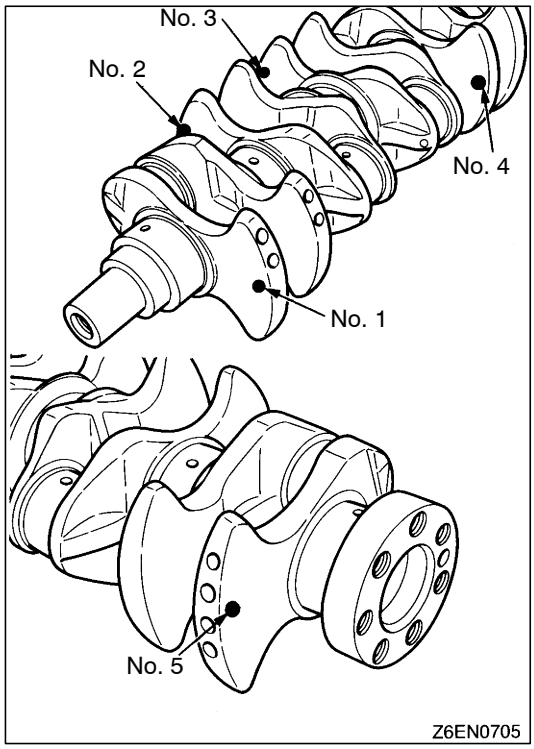
1. Flywheel bolt
2. Flywheel
3. Rear plate
4. Bell housing cover
- ▶E◀ 5. Rear oil seal case
- ▶D◀ 6. Rear oil seal
- ▶C◀ 7. Bearing cap bolt
- ▶C◀ 8. Beam bearing cap
- ▶B◀ 9. Crankshaft bearing lower
10. Crankshaft
- ▶B◀ 11. Crankshaft bearing upper
- ▶A◀ 12. Thrust bearing
13. Check valve
14. Oil jet
15. Cylinder block



INSTALLATION SERVICE POINTS

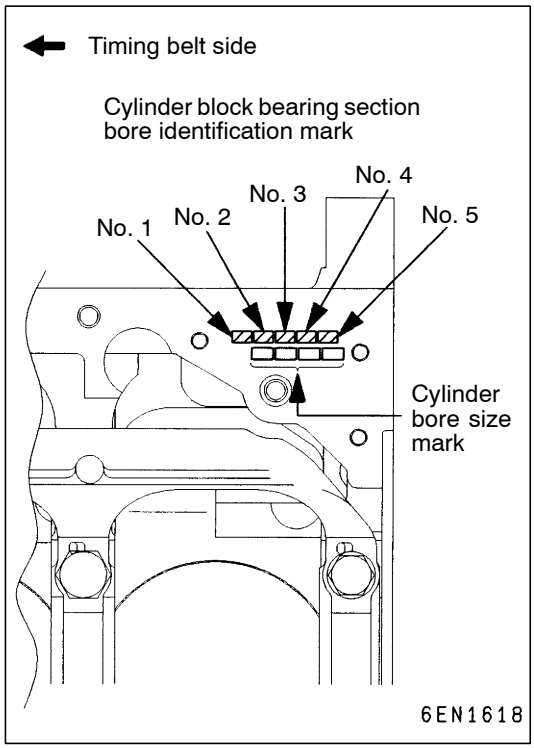
▶A◀ THRUST BEARING INSTALLATION

1. Install the thrust bearing onto the cylinder block side of the No. 3 bearing section. The bearing can be installed easily by applying engine oil.
2. Install the thrust bearing so that the side with the groove faces the crankshaft weight side.



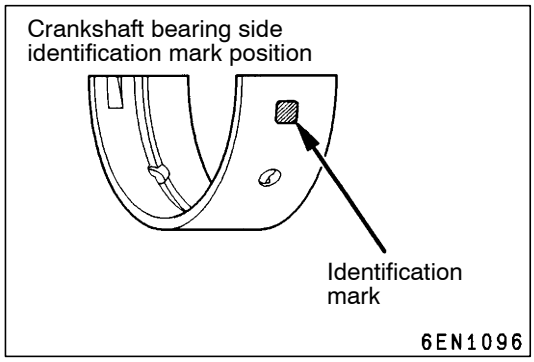
▶B◀ CRANKSHAFT BEARING INSTALLATION

1. Measure the diameter of the crankshaft journal, and confirm the class shown below. When using a spare part, each identification colour is painted at the position shown in the illustration.



2. The cylinder block bearing section bore identification mark is stamped at the position shown in the illustration.

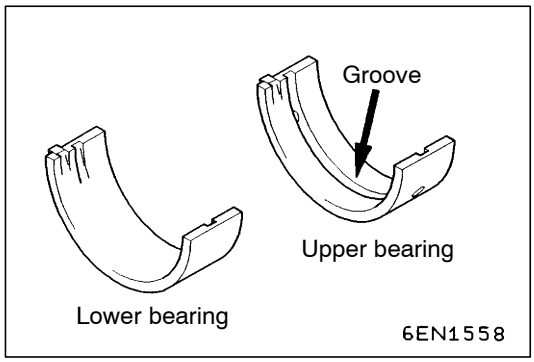
Crankshaft journal				Cylinder block bearing section bore identification mark	Spare bearing identification mark
Class	Product identification colour	Spare part identification colour	Journal diameter mm		
1	None	Yellow	56.994 - 57.000	0	0
				1	1
				2	2
2	None	None	56.988 - 56.994	0	1
				1	2
				2	3
3	None	White	56.982 - 56.988	0	2
				1	3
				2	4



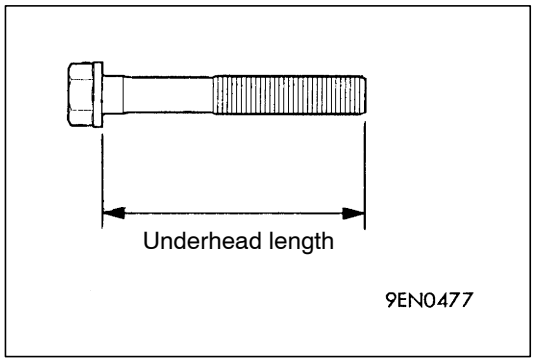
3. Select the bearing from the above table according to the identification confirmed in steps 1 and 2.

[Example of selecting bearing]

(1) If the measured outer diameter of the crankshaft journal is 57.000 mm, Class 1 applies, and the identification colour is yellow.
(2) If the cylinder block bearing bore identification mark is 0, select identification mark 0 in consideration of step (1).



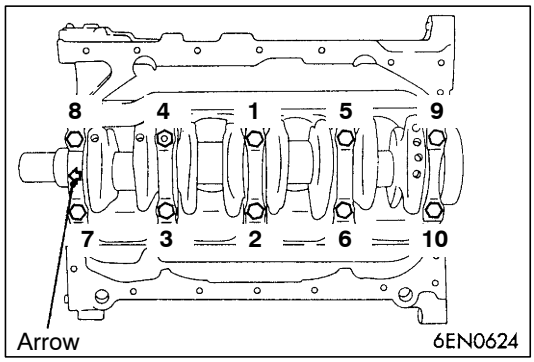
4. Install the grooved bearing on the cylinder block side.
5. Install the bearing with no oil groove onto the beam bearing cap side.



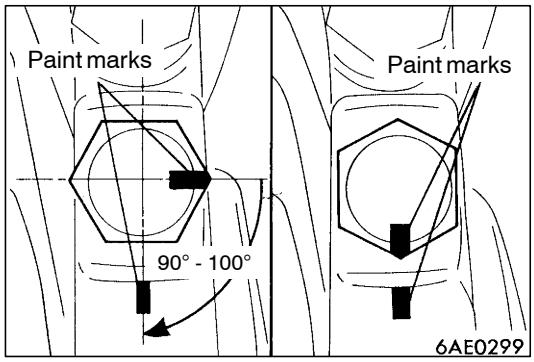
▶C◀ BEAM BEARING CAP/BEARING CAP BOLT INSTALLATION

1. Install the beam bearing cap with the arrow facing the timing belt side.
2. Before installing the bearing cap bolt, confirm that the bolt's underhead length is less than the limit value. Replace the bolt if it exceeds the limit value.

Limit value: 71.1 mm



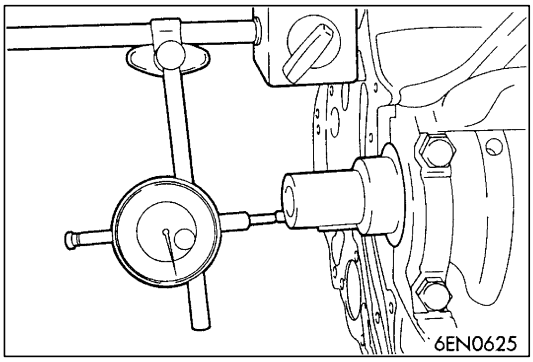
3. Apply engine oil on the bolt threads and bolt surface.
4. Following the tightening order, tighten the bearing cap bolt at 25 ± 2 N•m.
5. Make paint marks on the bolt head.
6. Using the position of the mark painted on the bolt head as reference, make paint marks on the seat surface at the 90° to 100° positions in the tightening direction.



7. Following the tightening order, tighten the bolt by 90° to 100°, and confirm that the paint marks made on the bolt and seat surface match.

Caution

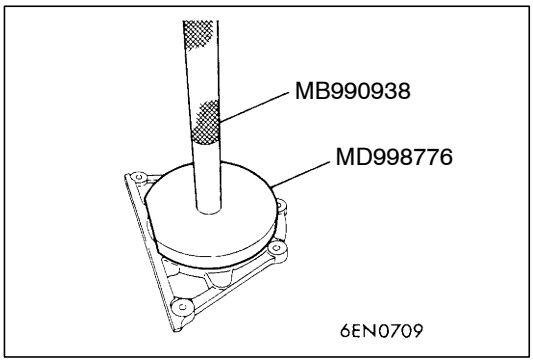
(1) If the tightening angle is less than 90°, the connection performance may not be attained, so take special care when tightening.
(2) If the tightening angle exceeds 100°, completely loosen the nut, and start again from step 1.



8. After installing the beam bearing cap, inspect the end play of the crankshaft. If the end play exceeds the limit value, replace the crankshaft bearing.

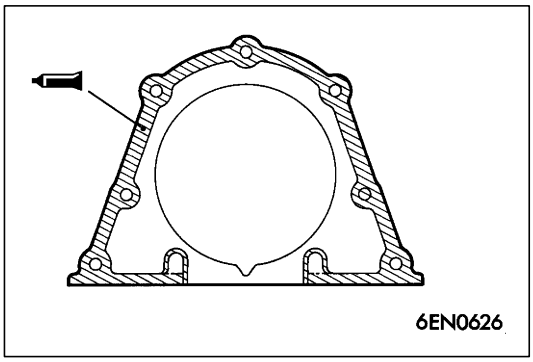
   Standard value: 0.05 - 0.25 mm

   Limit value: 0.4 mm



▶D◀ REAR OIL SEAL INSTALLATION

Press in the rear oil seal using the special tool.



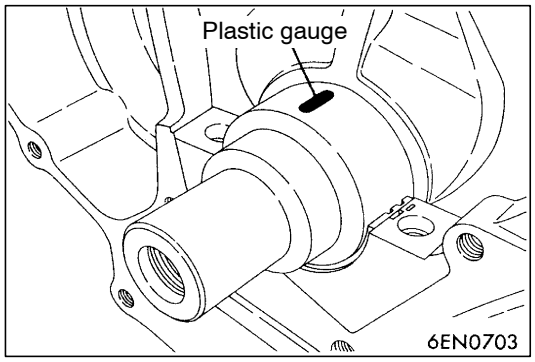
▶E◀ REAR OIL SEAL CASE INSTALLATION

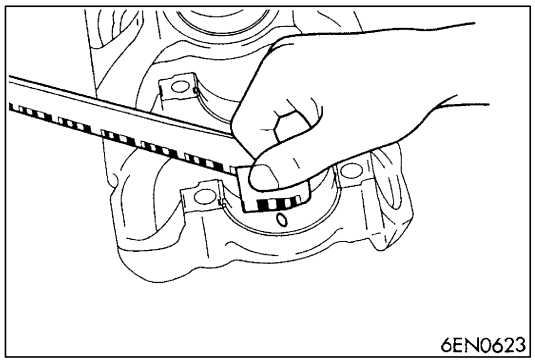
1. Apply form-in-place gasket onto the rear oil seal case at the position shown in the illustration.

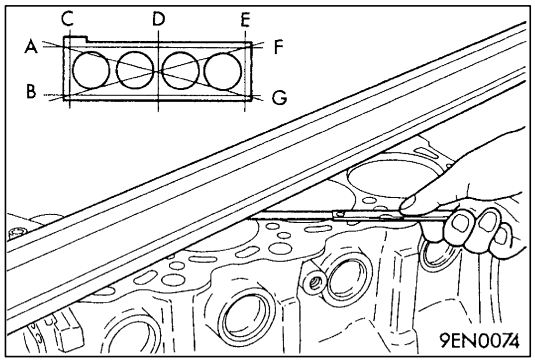
   Form-in-place gasket
   Specified gasket:
   Mitsubishi Genuine Part No. MD970389 or equivalent

   Caution
   Evenly squeeze out the form-in-place gasket so that it is not insufficient or excessive.

2. Apply an appropriate amount of engine oil on the entire periphery of the oil seal lip, and install on the cylinder block.







INSPECTION

1. CRANKSHAFT OIL CLEARANCE (PLASTIC GAUGE METHOD)

The oil clearance can be measured easily by using the “plastic gauge”.
Use the following steps to use the “plastic gauge”.

(1) Wipe off all oil from the crankshaft’s outer diameter and bearing’s inner diameter.
(2) Assemble the crankshaft.
(3) Set a plastic gauge as long as the bearing width on the journal shaft so that straightly aligned with the shaft centre.
(4) Carefully install the beam bearing cap, and tighten the bolt at the specified torque 25 ± 2 N•m + 90° to 100°.
(5) Remove the bolt, and carefully remove the beam bearing cap.
(6) Measure the width of the crushed plastic gauge (at the section crushed the most) with the scale printed on the plastic gauge bag.

Standard value: 0.03 - 0.04 mm

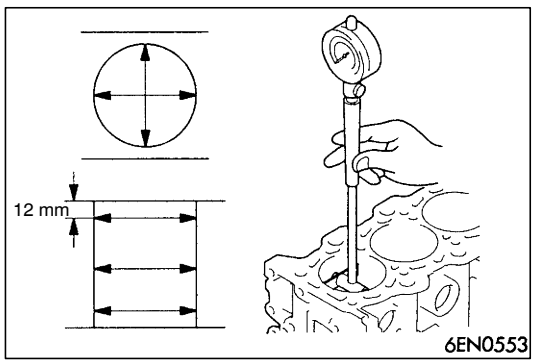
Limit value: 0.1 mm

2. CYLINDER BLOCK

(1) Visually check for the presence of scratches, rusting, or corrosion, and using flaw detection agent, etc., check for cracks. If any faults are found, repair or replace the part.
(2) Using a straight edge and thickness gauge, measure the flatness of the cylinder block’s upper surface. Make sure that no gasket pieces, etc., are adhered to the upper surface of the cylinder block when measuring.

Standard value: 0.05 mm

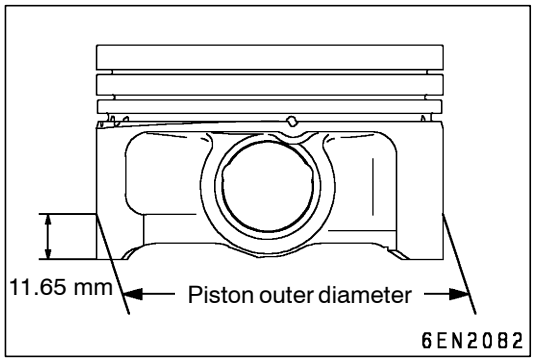
Limit value: 0.1 mm



(3) Check for the presence of scratches or seizure on the cylinder wall. If any faults are found, repair (over size) or replace the part.
(4) Using a cylinder gauge, measure the inner diameter and cylindricity of the cylinder. If greatly worn, repair the cylinder to the over size, and replace the piston ring.

Standard value: 85.0 mm

Cylindricity: 0.01 mm



3. CYLINDER BORING

(1) Select the oversized piston to be used using the maximum inner diameter cylinder as a reference.
(2) There are two types of oversized pistons (0.50 mm, 1.00 mm), so bore so that the clearance is at the specified value that matches the piston's outer diameter. The reference points for measuring the piston's outer diameter are shown in the illustration.
(3) Calculate the boring finish dimensions based on the piston outer diameter measurement value.
Boring finish dimension = Piston outer diameter + 0.02 to 0.04 mm (clearance with cylinder) - 0.02 mm (honing margin)
(4) Bore each cylinder to the boring finish dimensions calculated above.

Caution
To prevent strain caused by a temperature rise during boring, bore in the order of the No. 2 → No. 4 → No. 1 → No. 3 cylinders.

(5) Hone to the final finish dimension (piston outer diameter + clearance with cylinder).
(6) Confirm the clearance between the piston and cylinder.

Standard value: 0.02 - 0.04 mm

NOTES