
SECTION 1B3

DIESEL ENGINE MECHANICAL

CAUTION: *Disconnect the negative battery cable before removing or installing any electrical unit or when a tool or equipment could easily come in contact with exposed electrical terminals. Disconnecting this cable will help prevent personal injury and damage to the vehicle. The ignition must also be in LOCK unless otherwise noted.*

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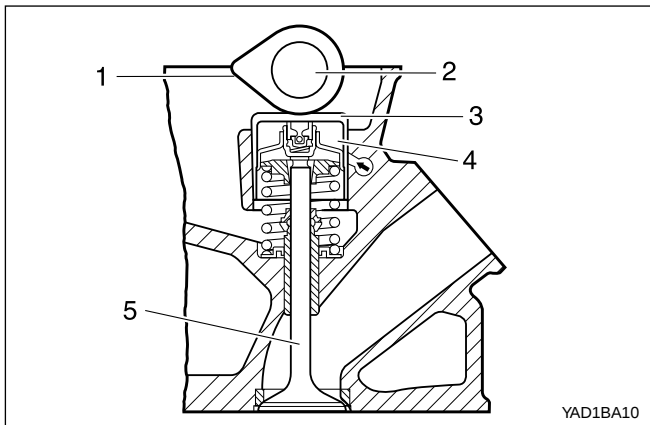
DESCRIPTION AND OPERATION

VALVE DEVICE

Operation

The diesel engines have valves with bucket tappets and automatic valve clearance adjustment. This eliminates the need to re-set the valve clearance.

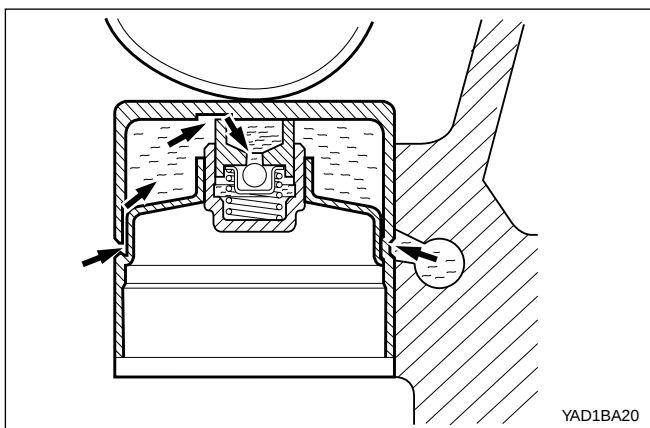
The compact design of the valve timing gear from the cam through the bucket tappet to the valve contributes to weight savings, to low drag power and also to increased rigidity. Oil is supplied to the bucket tappets through oil bores in the cylinder head.



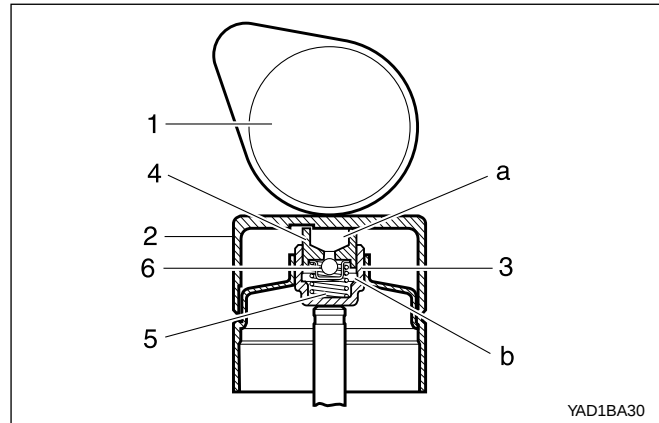
- | | |
|------------|---------|
| 1 Cam | 4 Oil |
| 2 Camshaft | 5 Valve |
| 3 Tappet | |

The maintenance-free hydraulic valve clearance adjusting elements automatically compensates the valve clearance resulting from thermal expansion and wear.

This produces a quiet-running valve train.



Function



- | | |
|----------------|-------------------|
| 1 Cam | 5 Pressure Spring |
| 2 Tappet | 6 Ball Valve |
| 3 Guide Sleeve | a Supply Chamber |
| 4 Thrust Piece | b Working Chamber |

The hydraulic valve clearance adjusting elements are installed in the bucket tappets and operate the valves directly through the thrust pins and guide sleeves.

When the engine is running and a load is applied on the element by cam tip, the element cam go down fully. The oil displaced from the working chamber flows via the annular gap (clearance between guide sleeve and thrust pin) to the supply chamber.

As soon as the cam lobe rotates upwards from the tappet (2), the load on the guide sleeve (3) is relieved. The spring (5) pushes the thrust pin (4) up until the tappet is resting against the cam (1). The vacuum produced in the working chamber (b) as a result of the upward movement of the guide sleeve opens the ball valve (6) and oil flows out of the supply chamber (a) into the working chamber (b).

The ball valve closes when the cam presses against the tappet and thus applies pressure on the thrust pin.

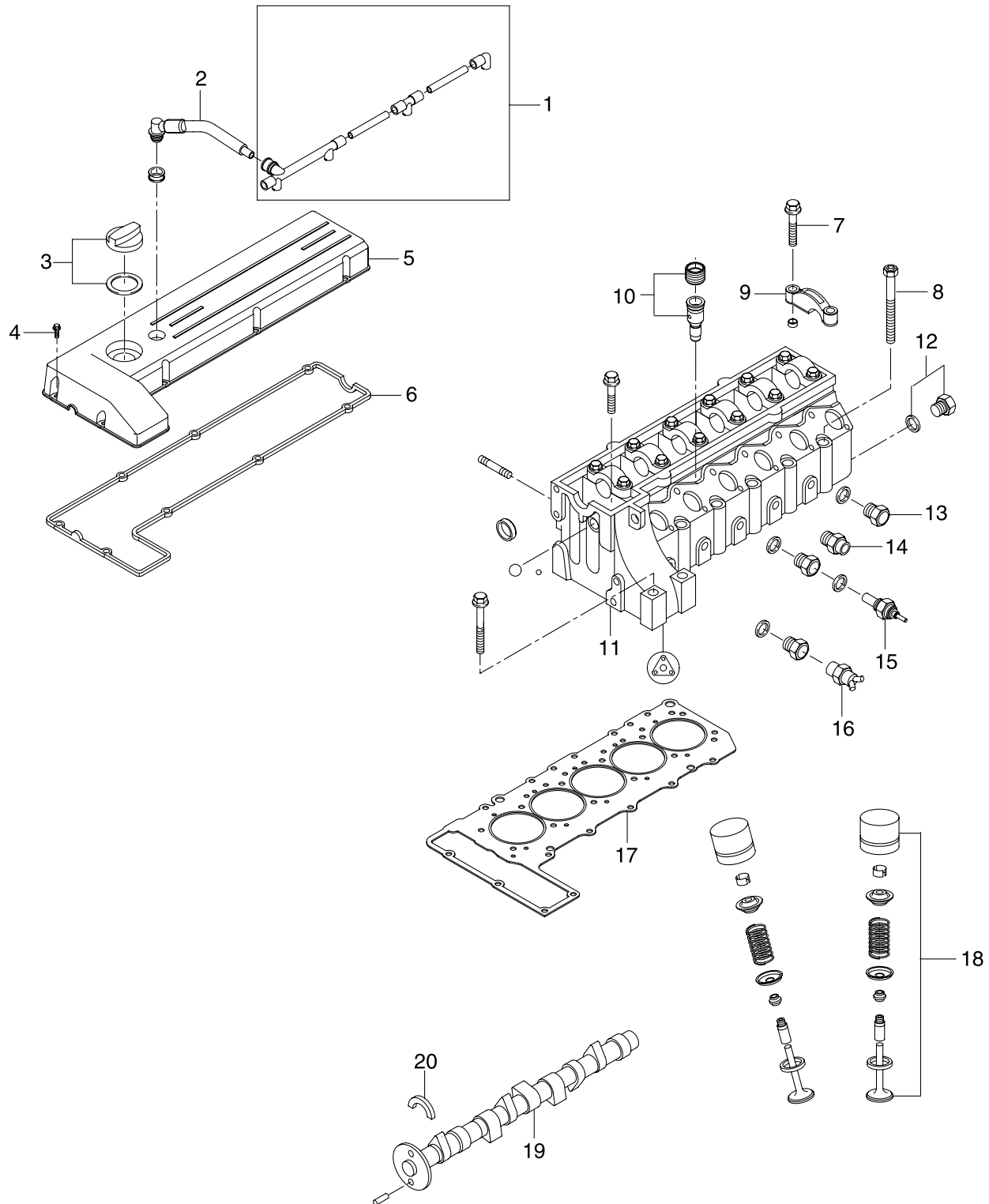
The oil in the working chamber acts as a "hydraulic rigid connection" when the engine is running and the relevant valve is opened. The oil required for this purpose is supplied to the elements along a longitudinal passage in the cylinder head. From here, the oil flows through a bore to the relevant adjustment element.

The oil to the supply chamber flows via the groove provided in the base of the tappet.

BLANK

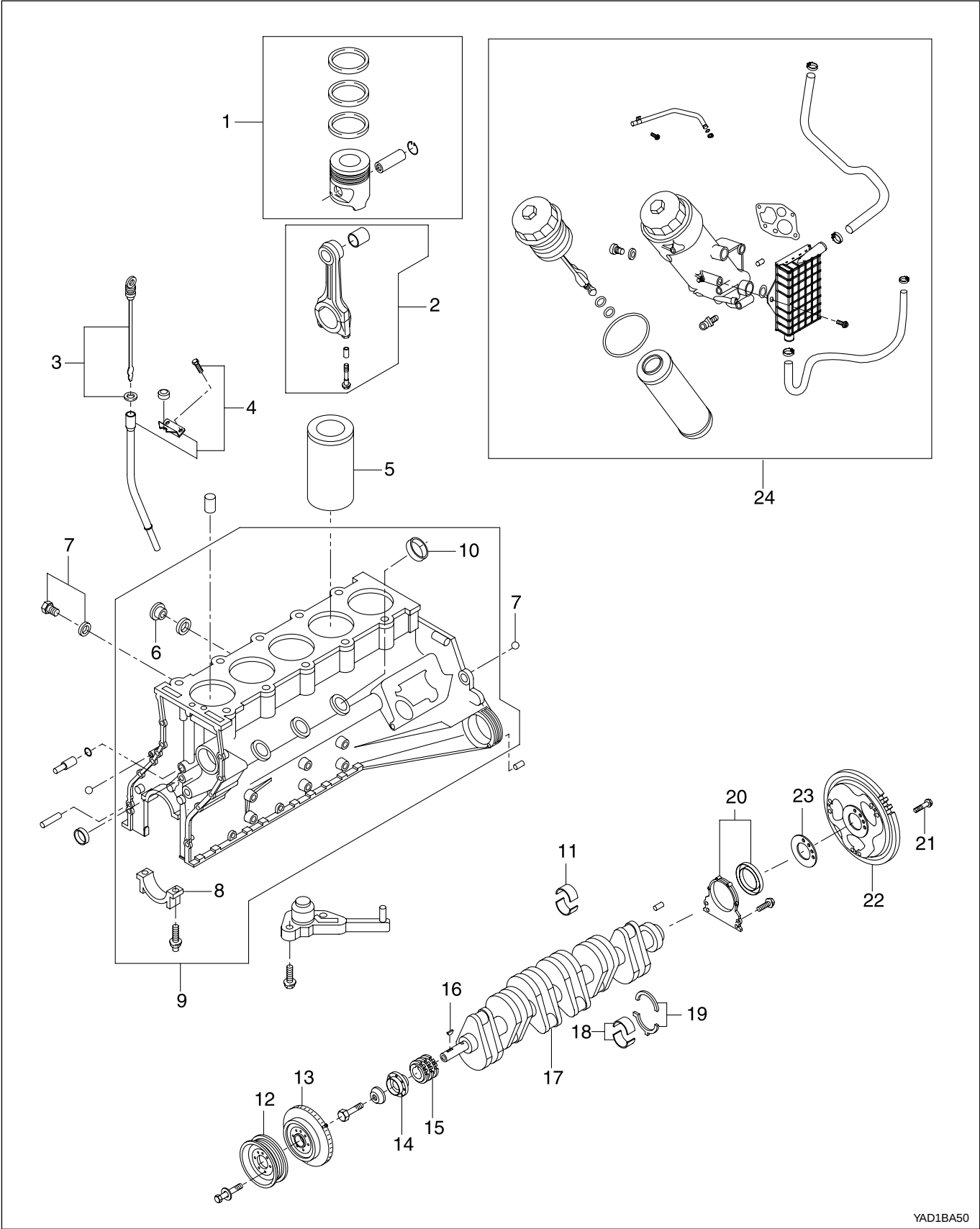
COMPONENT LOCATOR

CYLINDER HEAD



- | | | | |
|----|----------------------------|----|-----------------------------------|
| 1 | Blow By Gas Return Hose | 11 | Cylinder Head |
| 2 | Blow By Gas Return Pipe | 12 | Plug |
| 3 | Oil Filler Cap | 13 | Plug |
| 4 | Bolt | 14 | Connector |
| 5 | Cylinder Head Cover | 15 | Engine Coolant Temperature Sensor |
| 6 | Cylinder Head Cover Gasket | 16 | Thermo Valve |
| 7 | Camshaft Cap Bolt | 17 | Cylinder Head Gasket |
| 8 | Cylinder Head Bolt | 18 | Valve Assembly |
| 9 | Camshaft Bearing Cap | 19 | Camshaft |
| 10 | Pre Chamber Assembly | 20 | Camshaft Adjust Key |
-

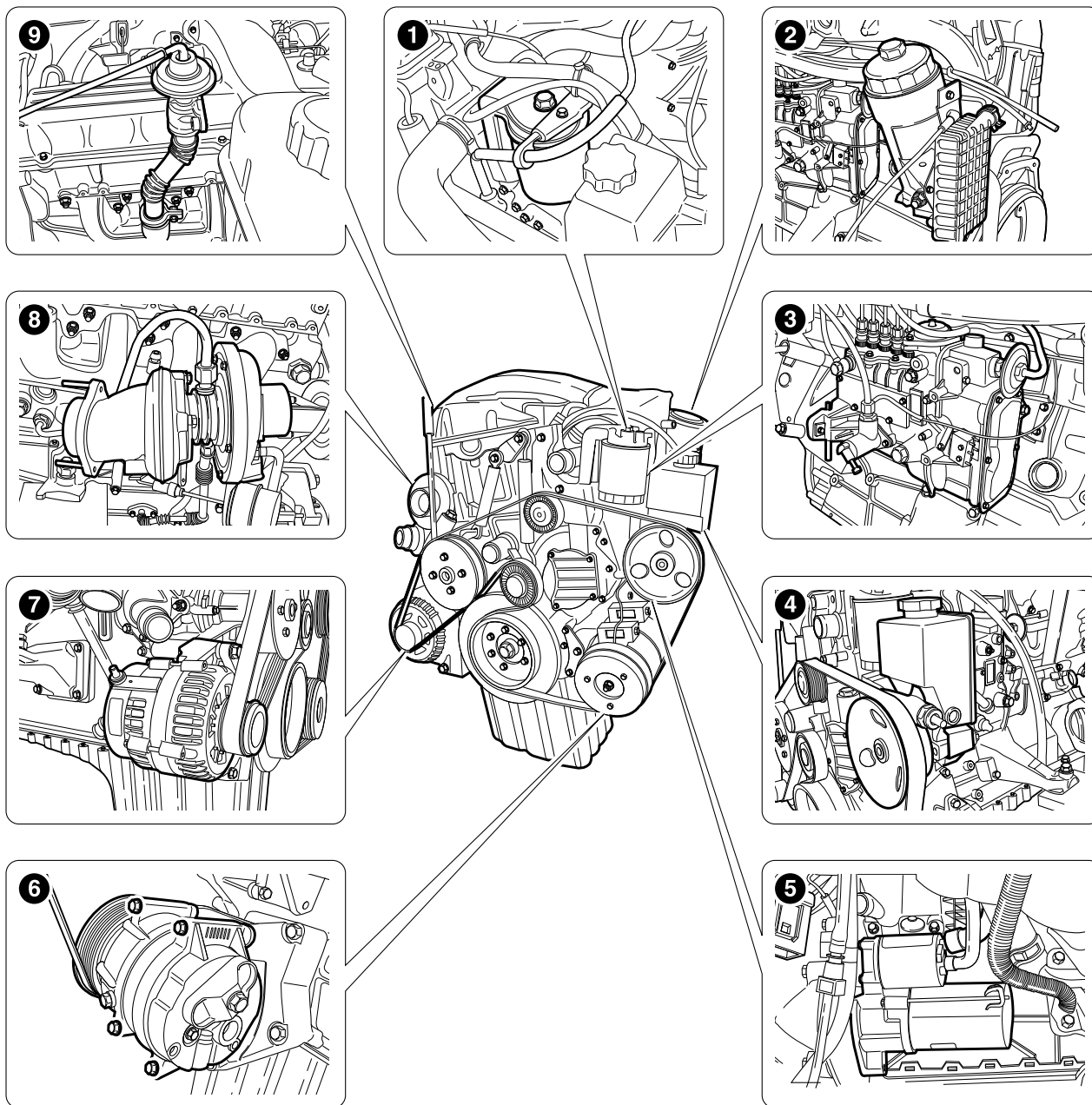
CYLINDER BLOCK



YAD1BA50

1	Piston & Piston Ring Assembly	13	Vibration Damper
2	Connection Rod Assembly	14	Hub
3	Oil Dipstick Gauge	15	Crankshaft Sprocket
4	Oil Dipstick Gauge Bracket	16	Key
5	Cylinder Liner	17	Crankshaft
6	Plug	18	Crankshaft Journal Bearing
7	Screw & Seal Ring	19	Crankshaft Thrust Bearing
8	Crankshaft Bearing Cap	20	Crankshaft Sealing Cover
9	Cylinder Block	21	Bolt
10	Plug	22	Flywheel
11	Crankshaft Journal Bearing	23	Plate
12	Crankshaft Pulley	24	Oil Pump Assembly

ENGINE COMPONENT



YAD1BA60

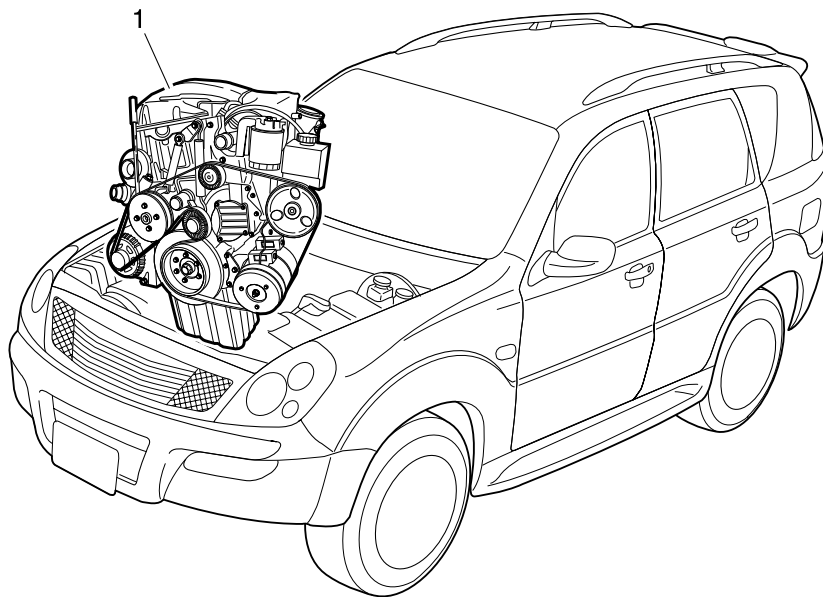
- 1 Fuel Filter Assembly
- 2 Oil Filter Assembly
- 3 Injection Pump Assembly
- 4 Power Steering Pump Assembly
- 5 Starter Assembly

- 6 A/C Compressor Assembly
 - 7 Generator Assembly
 - 8 Turbo Charger Assembly
 - 9 EGR Valve Assembly
-

REPAIR INSTRUCTIONS

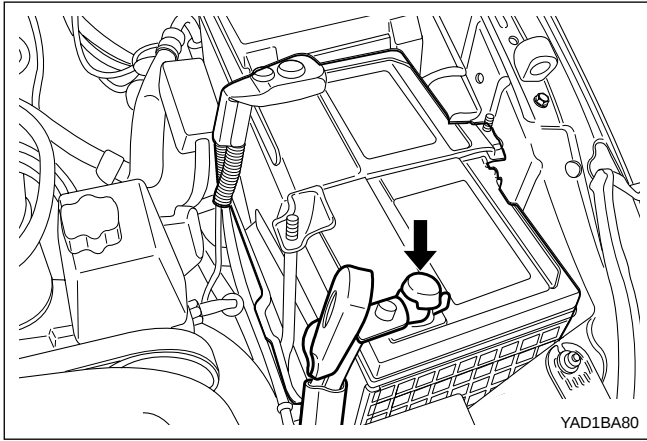
ON-VEHICLE SERVICE

ENGINE ASSEMBLY



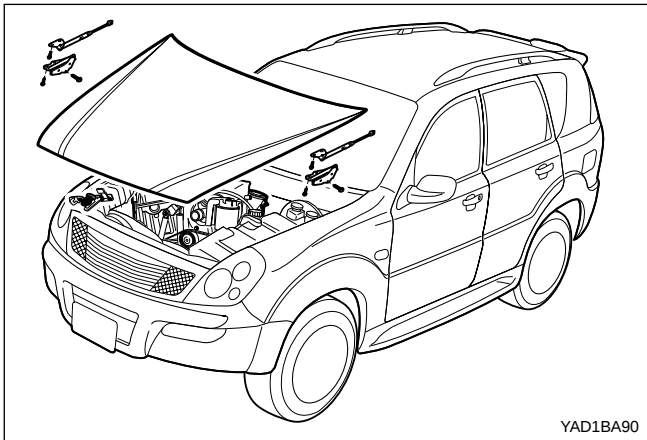
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1. Engine Assembly

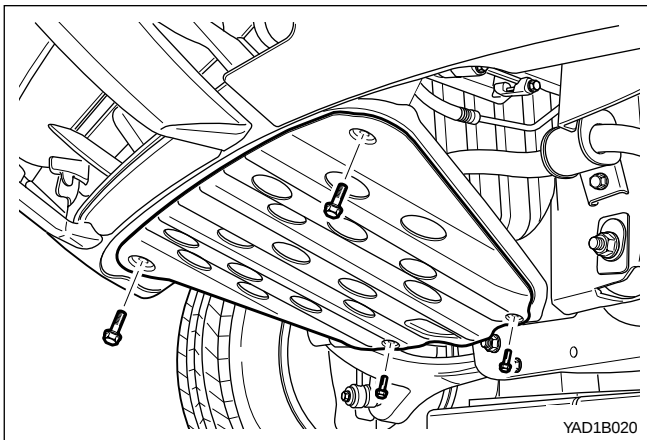


Removal Procedure

1. Disconnect the negative battery cable.



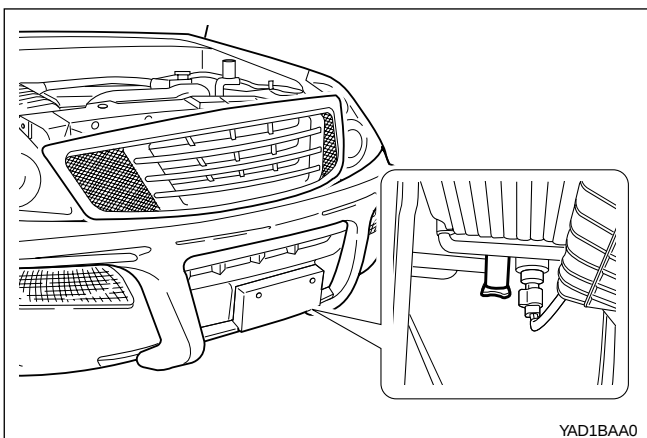
2. Remove the hood.



3. Remove the skid plate.

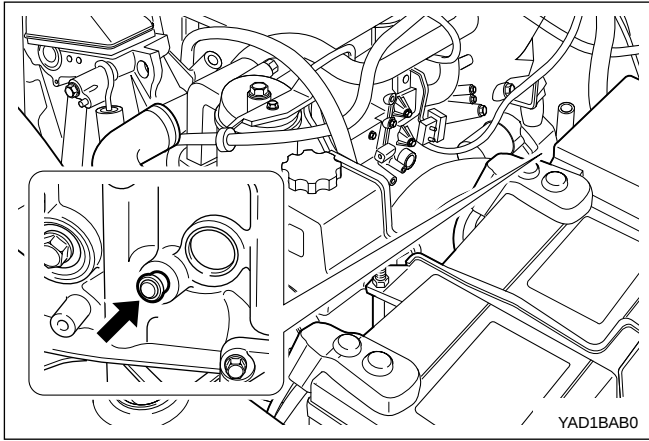
Installation Notice

Tightening Torque	28 - 47 N•m (21 - 35 lb-ft)
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4. Remove the radiator drain cock and drain the coolant.

Notice: Open the coolant reservoir tank cap.

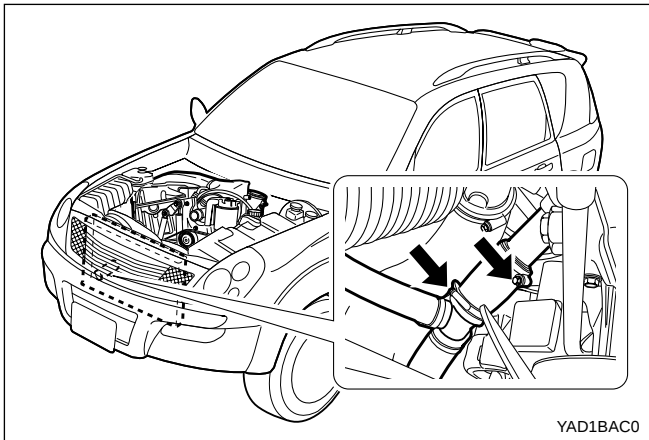


- Remove the drain plug and seal from the cylinder block and drain the coolant completely.

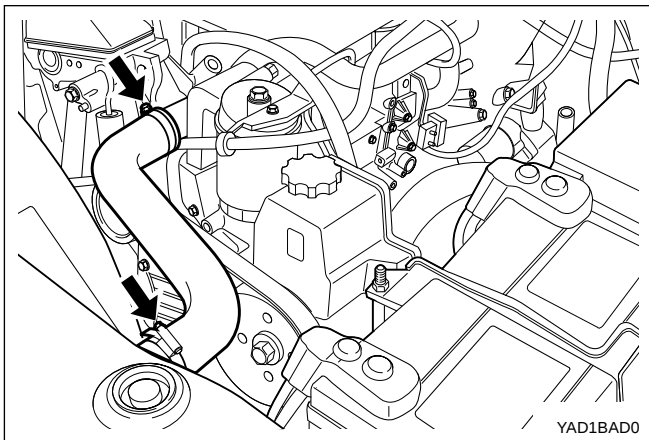
Installation Notice

Tightening Torque	30 N•m (22 lb-ft)
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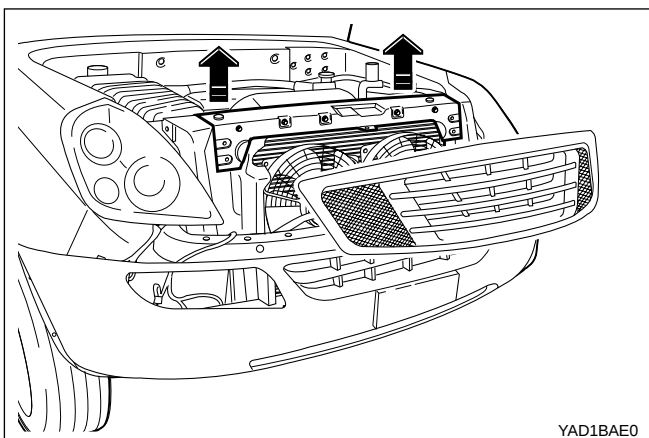
After draining, replace the seal and reinstall the drain plug.



- Disconnect the lower coolant hose from the radiator.



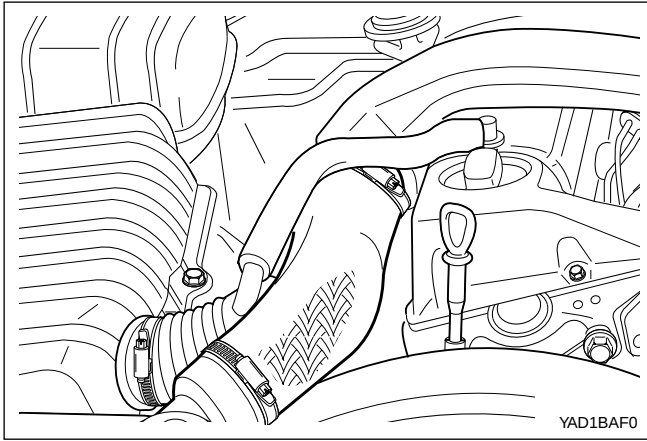
- Disconnect the upper coolant hose from the radiator.



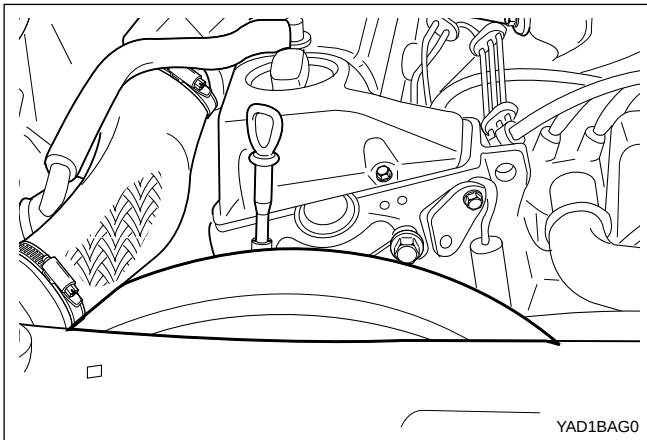
- Remove the radiator grille mounting screws and radiator grille.
- Remove the front end upper member mounting bolts and front end upper.

Installation Notice

Tightening Torque	30 - 40 N•m (22 - 30 lb-ft)
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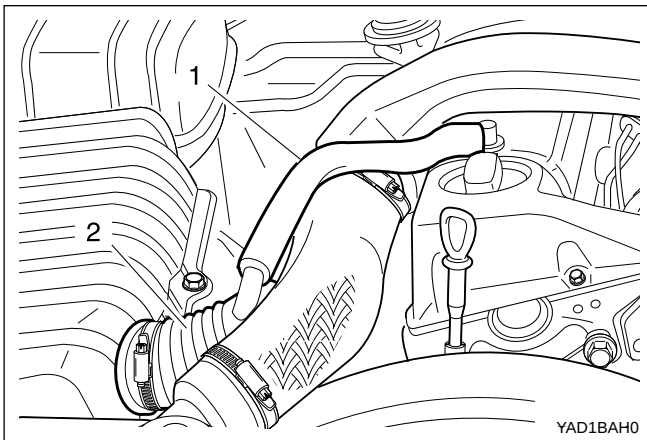
10. Remove the hoses (air intake to intercooler, intercooler to intake duct).



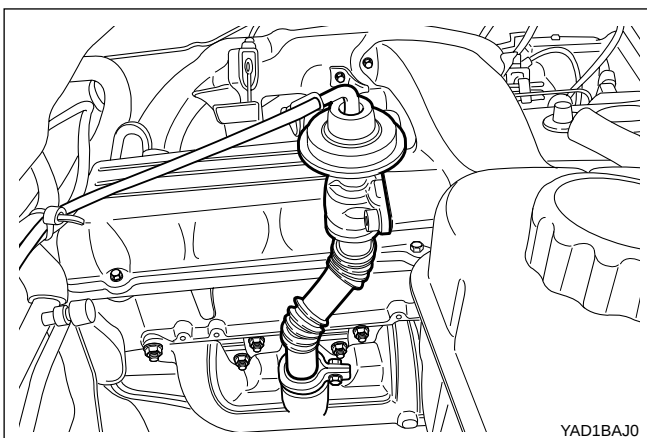
11. Loosen the cooling fan shroud bolts and remove the cooling fan shroud.

Installation Notice

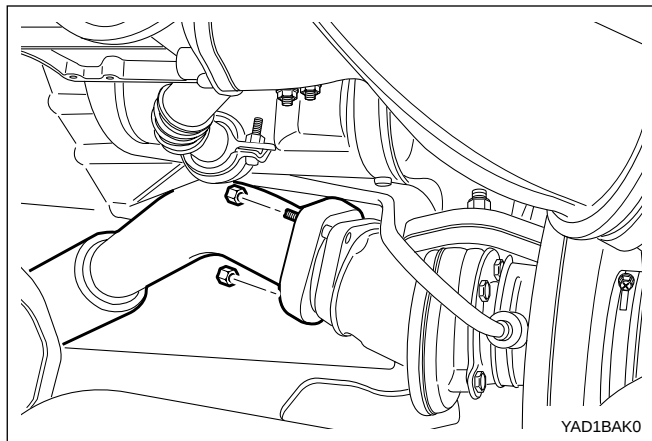
Tightening Torque	3 - 7 N•m (27 - 62 lb-in)
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12. Remove the air cleaner to turbo charger hose(2) with blow by hose(1).



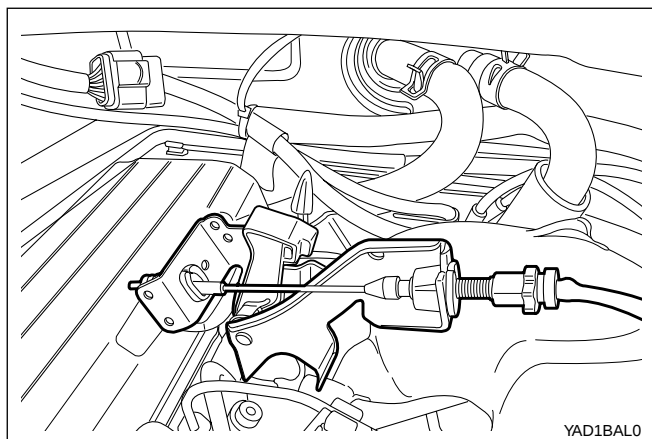
13. Disconnect the exhaust gas recirculation (EGR) valve hose and necessary hoses and pipes.



14. Remove the turbo charge to exhaust pipe bolts and separate the exhaust pipe flange from the turbo charger.

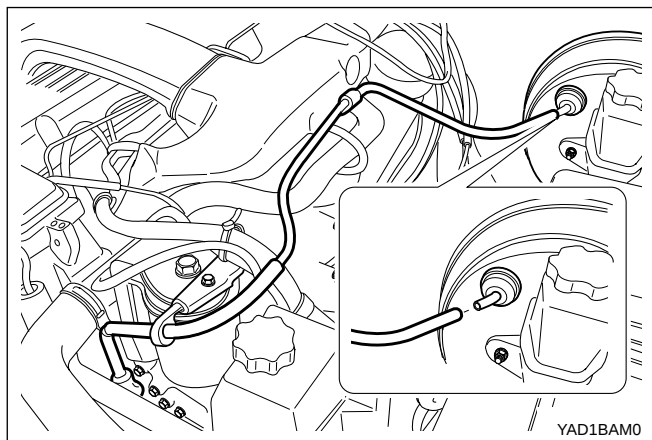
Installation Notice

Tightening Torque	30 N•m (22 lb-ft)
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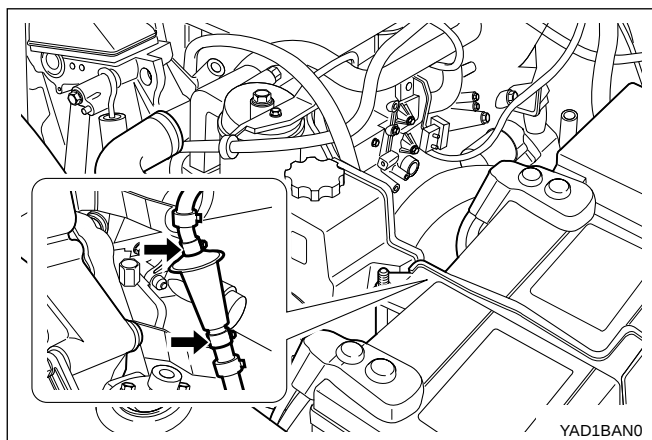


15. Disconnect the accelerator cable from the control linkage.

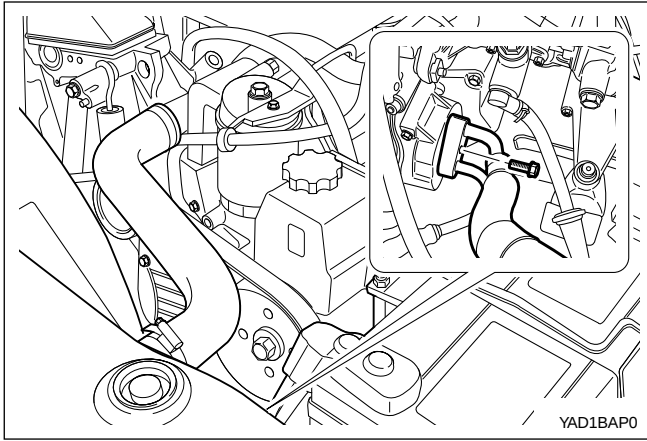
Notice: After installation of accelerator cable, check the engine idling and operation condition.



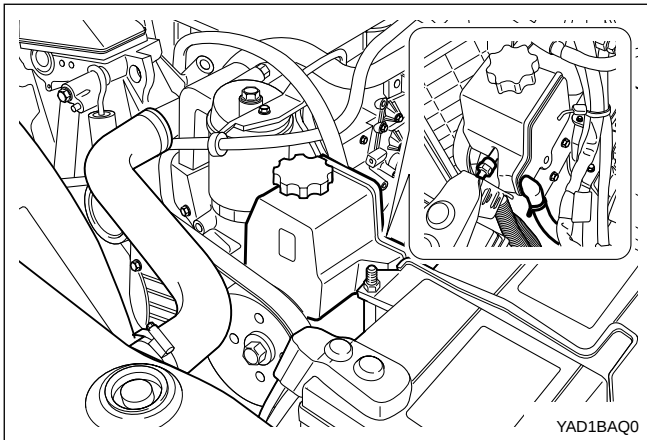
16. Disconnect the brake booster hose from vacuum pump.



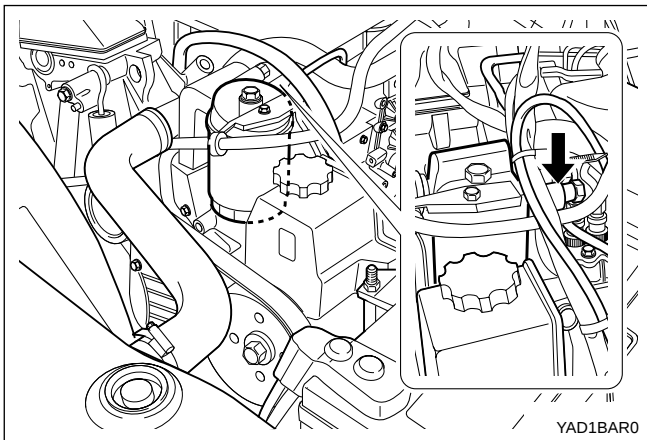
17. Disconnect the fuel feed line with prefilter from the feed pump on injection pump.



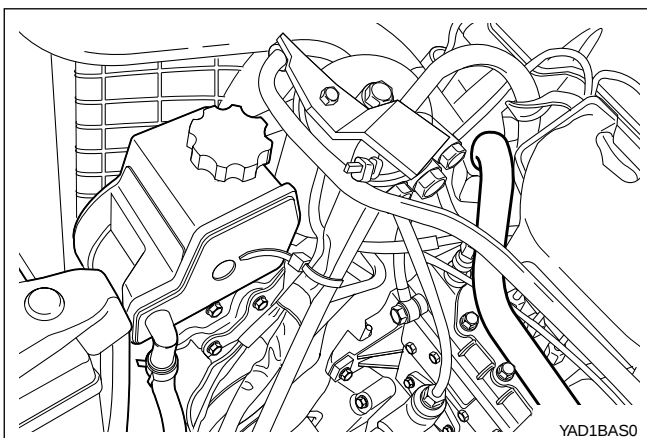
18. Remove the A/C compressor IN/OUT pipes.
Notice: Evacuate the refrigerant before removal.



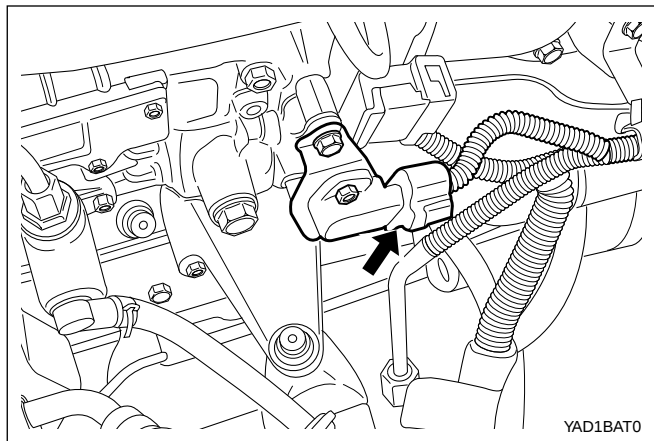
19. Remove the power steering pump lines.
Notice: Completely drain the fluid.



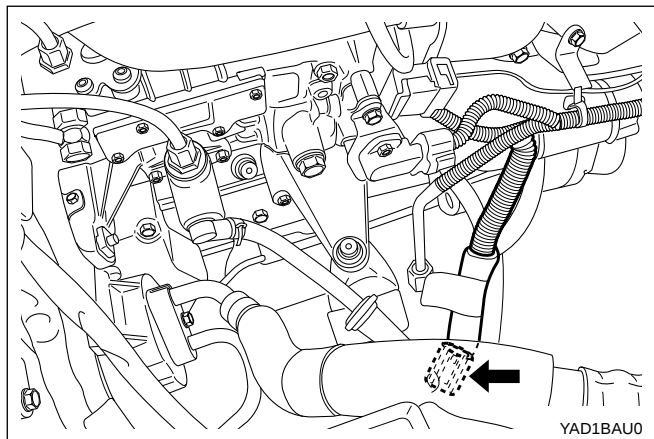
20. Remove the fuel lines from the fuel filter and cover the filter with plug.



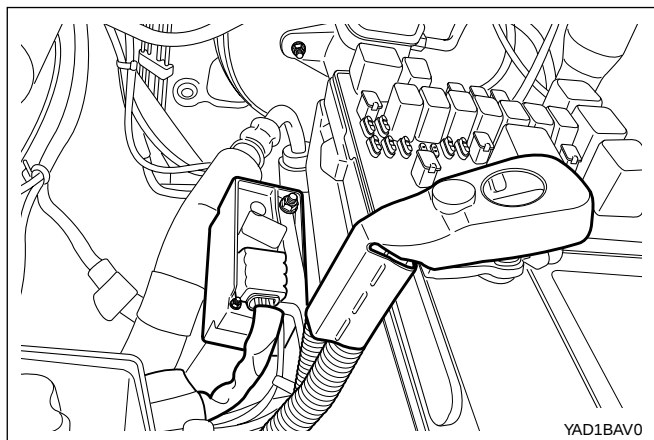
21. Disconnect the coolant hose from the water inlet.



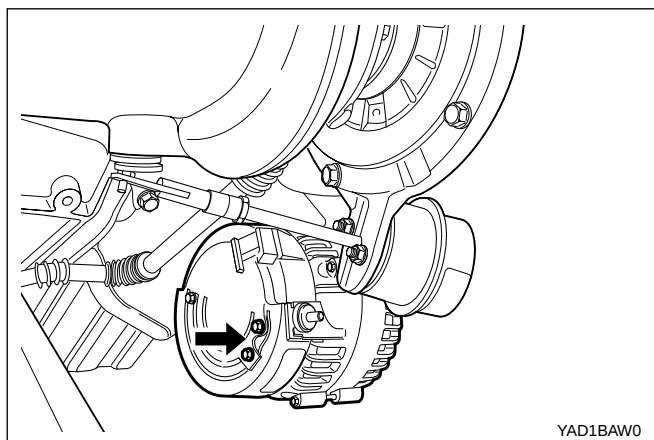
22. Disconnect the injection timing relay connector from injection pump.



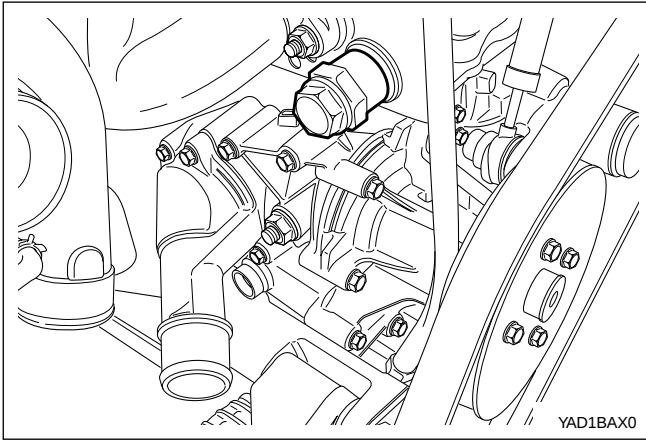
23. Disconnect the starter motor wires and necessary connectors.



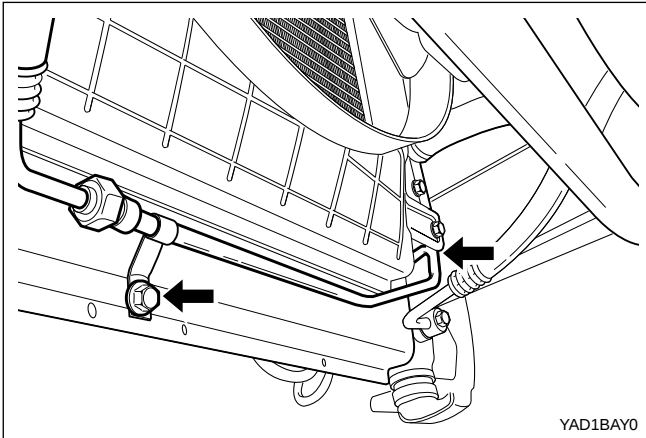
24. Disconnect the preheating time relay cable and glow plug cable.



25. Disconnect the ground cable.
26. Disconnect the generator wires.



27. Disconnect the engine coolant temperature sensor connector.

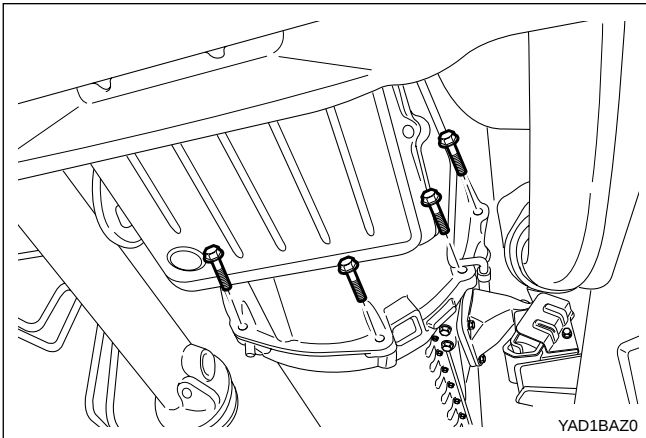


28. Remove the automatic transmission oil cooler lines.

Installation Notice

Tightening Torque	25 - 35 N•m (18 - 26 lb-ft)
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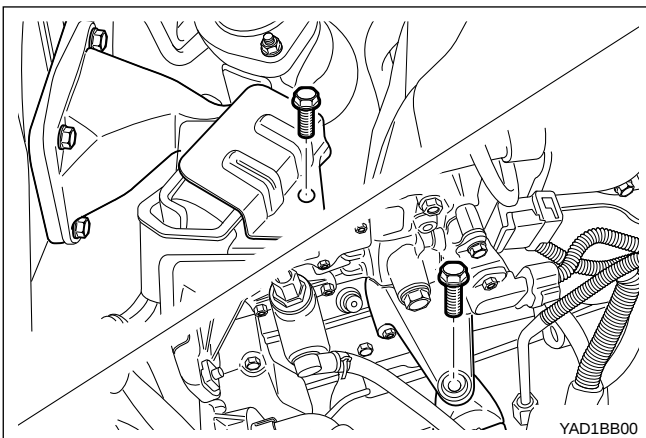
Use the new washer before installation of oil cooler lines.



29. Remove the transmission mounting bolts and separate the transmission from the engine.

Installation Notice

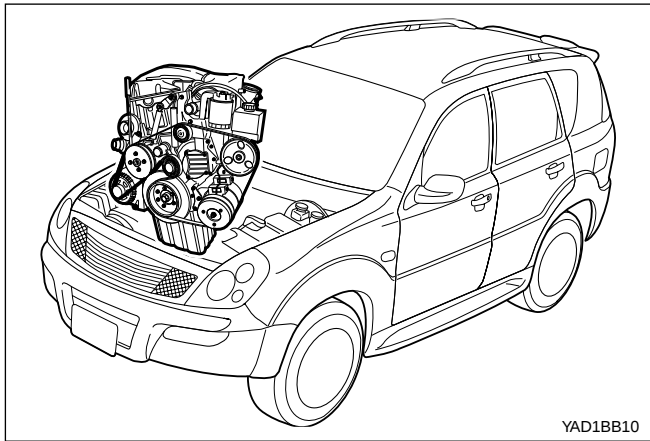
Tightening Torque	54 - 68 N•m (40 - 50 lb-ft)
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30. Remove the engine mounting bracket bolts.

Installation Notice

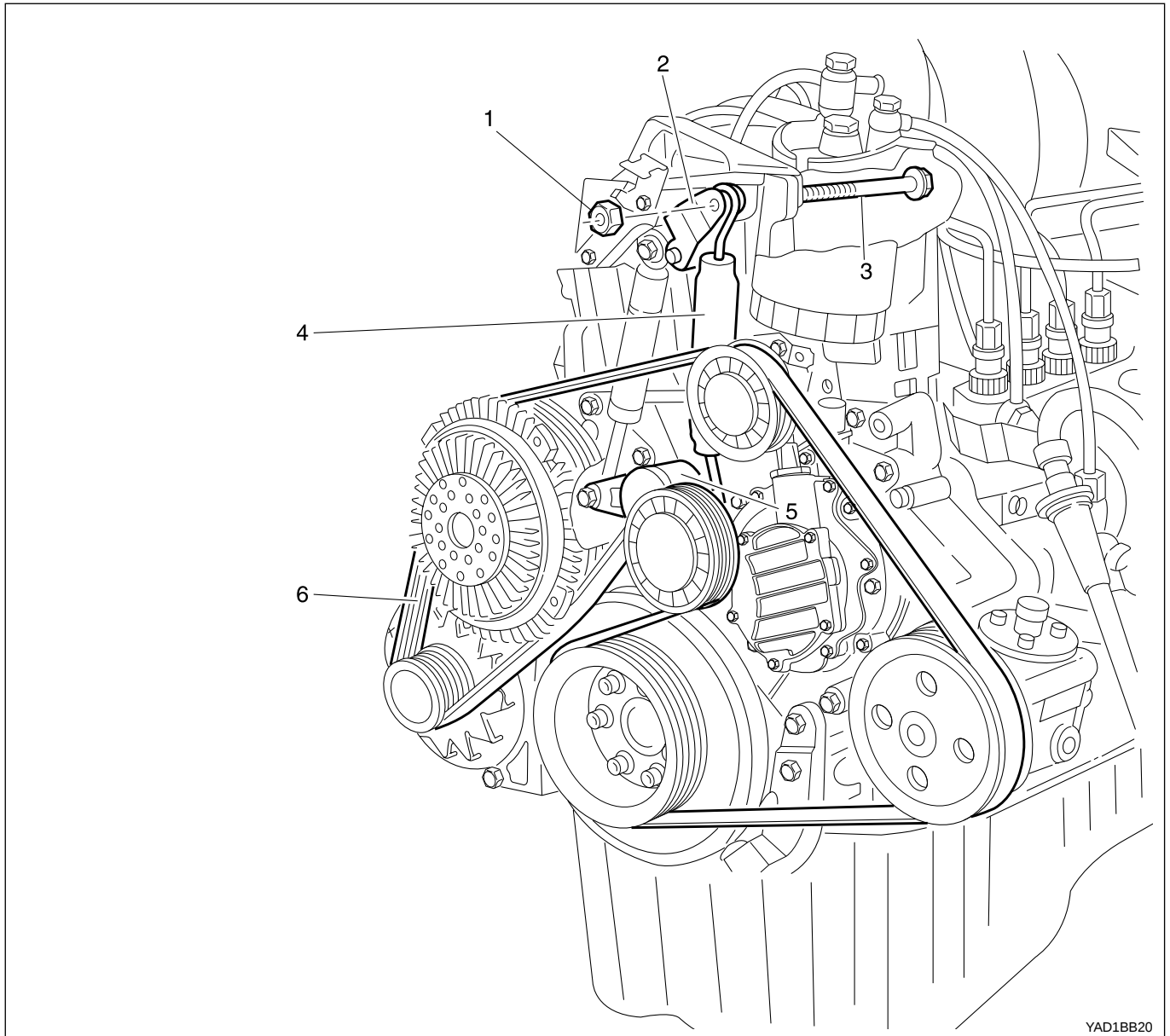
Tightening Torque	50 - 75 N•m (37 - 55 lb-ft)
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31. Remove the engine assembly from the vehicle by using a hoistor crane.
32. Installation should follow the removal procedure in the reverse order.

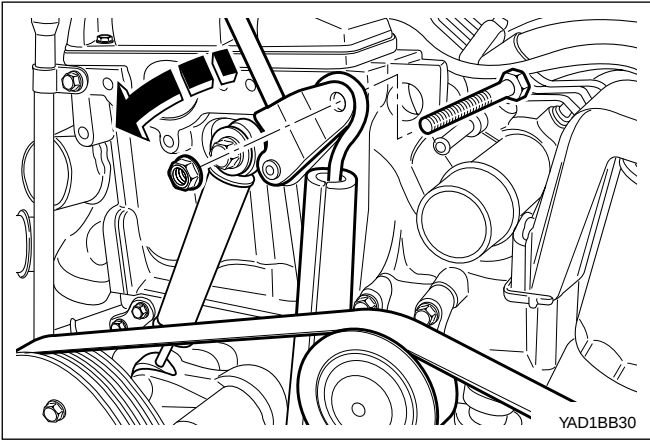
POLY V-BELT AND TENSIONING DEVICE

POLY V-BELT



YAD1BB20

- | | |
|-------------------------------|--------------------|
| 1 Nut 21 N•m (15 lb-ft) | 4 Spring |
| 2 Tensioning Lever | 5 Tensioning Lever |
| 3 Bolt | 6 Poly V-Belt |



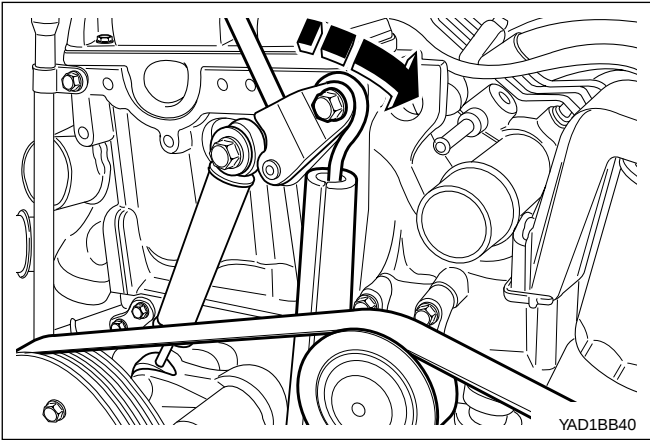
Removal & Installation Procedure

1. Remove the tensioning lever nut (1).

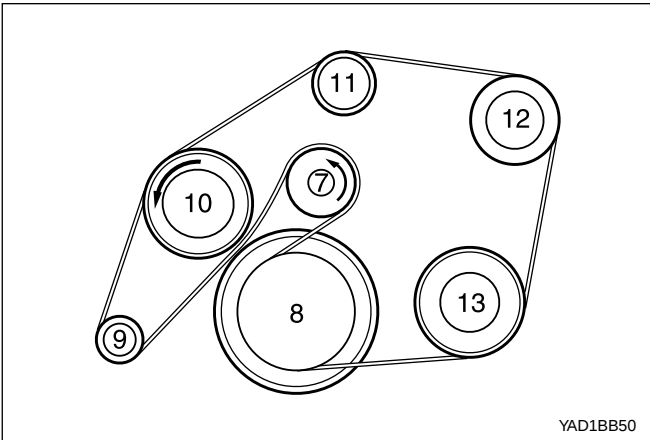
Installation Notice

Tightening Torque	21 N•m (15 lb-ft)
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2. Push the tensioning lever in direction of arrow with a rod (ϕ 12, 180 mm) and pull out the bolt to the rear.



3. Push back the tensioning lever (arrow direction) to release the spring tension and remove the belt.

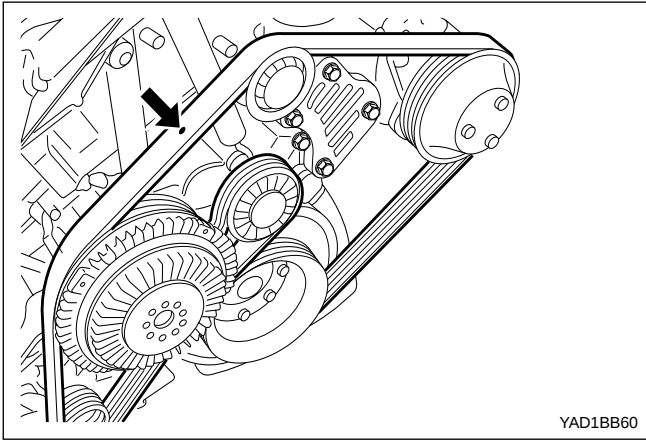


4. Install the poly V-belt beginning at the tensioning pulley (7).

- 7 Tensioning Pulley
- 8 Crankshaft
- 9 Generator
- 10 Water Pump
- 11 Guide Pulley
- 12 Power Steering Pump
- 13 A/C Compressor

Length of Belt

Length (L)	With Air Conditioner	2,100 mm
	Without Air Conditioner	2,040 mm

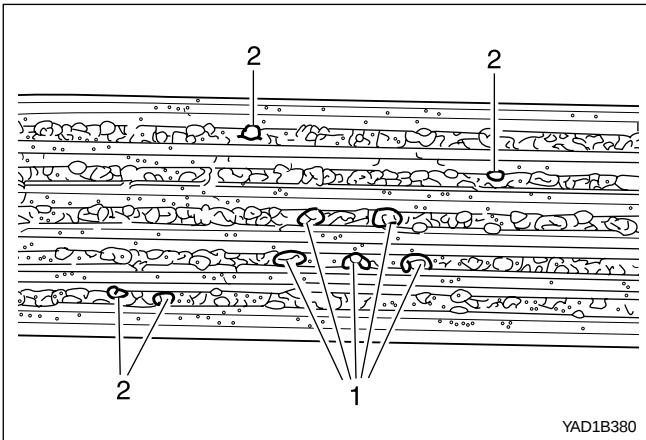


Poly V-Belt Inspection

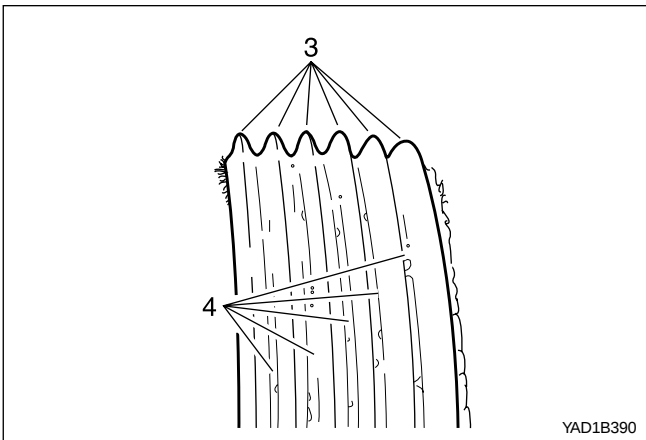
Inspection Procedure

- Mark poly V-belt at a clearly visible point with chalk.
- Rotate the engine and check the belt.

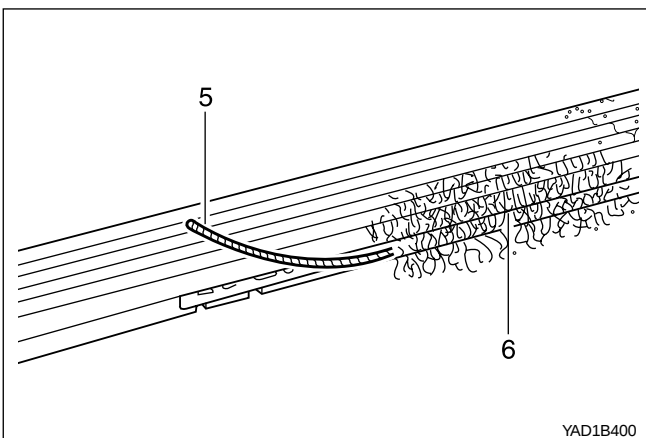
Notice: If one of the following types of damage is found, replace the belt.



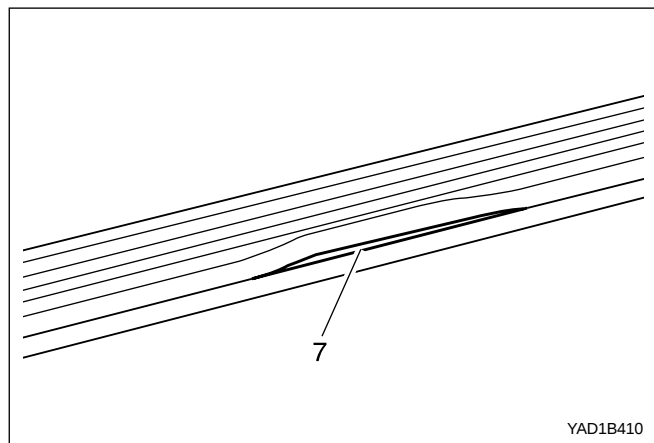
1. Rubber lumps in the base of rips.
2. Dirt or grit ingrained.



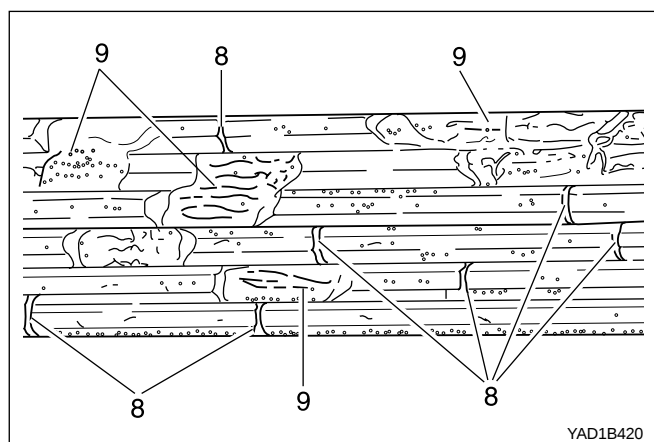
3. Pointed rips.
4. Belt cord visible in the base of rips.



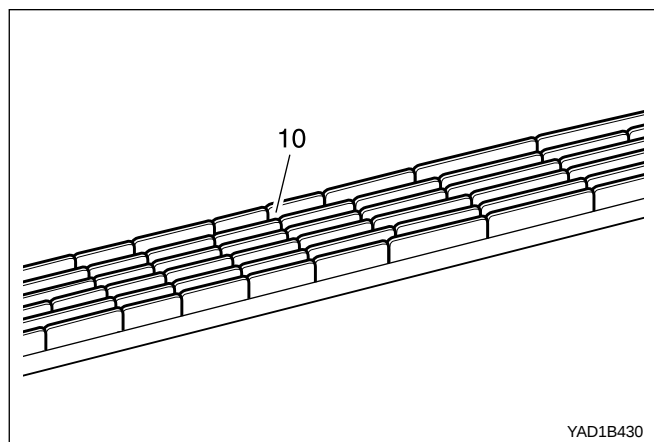
5. Cord torn out at the side.
6. Outer cords frayed.



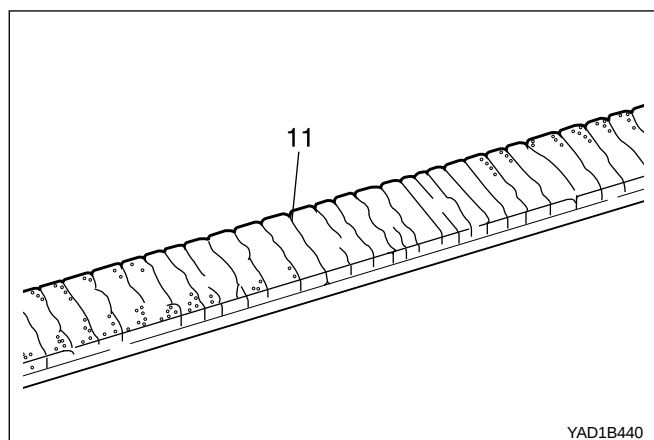
7. Belt detached from the base of rip.



8. Splits across the rips.
9. Sections of rip torn out.



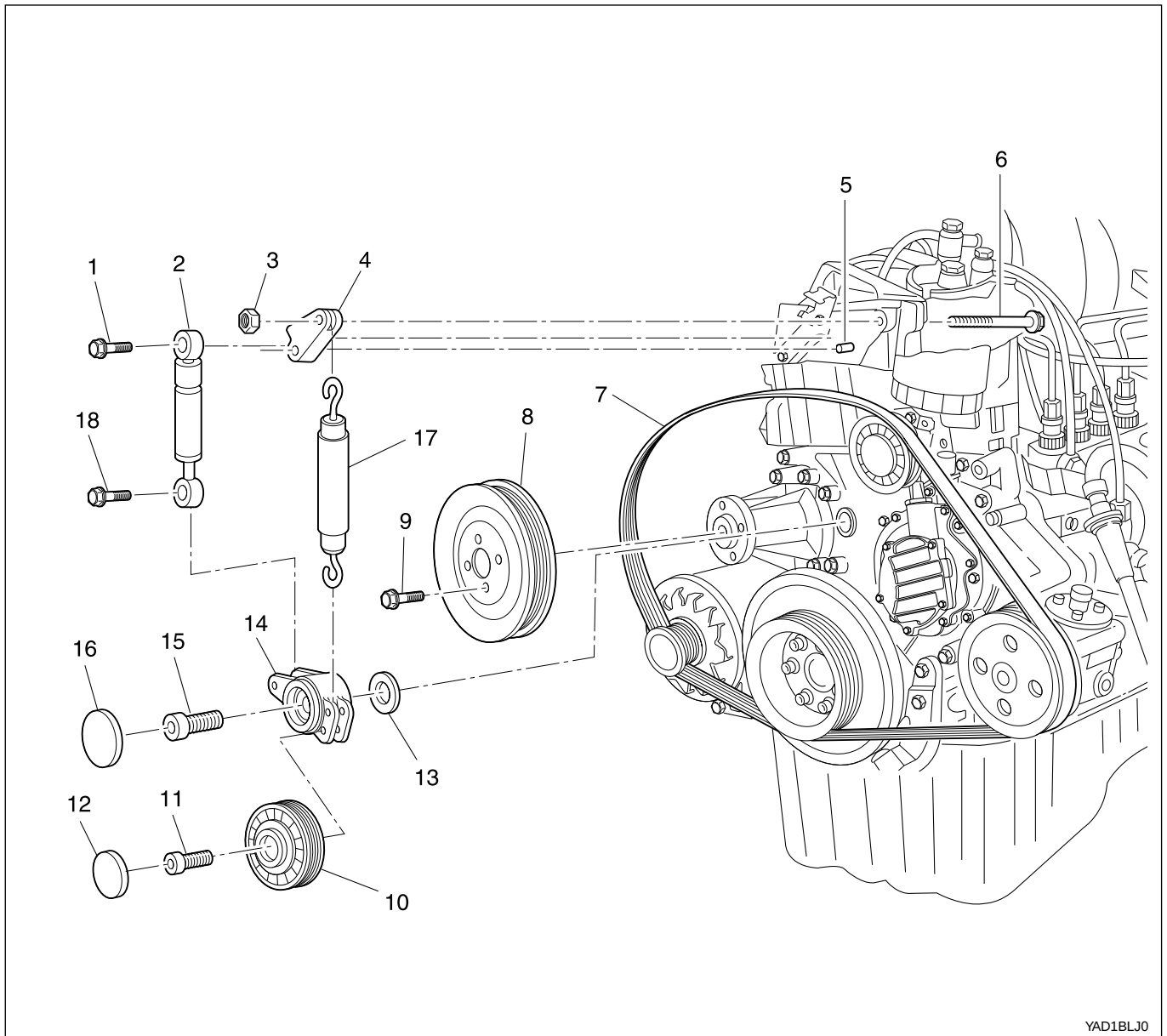
10. Splits across several rips.



11. Splits across the back.

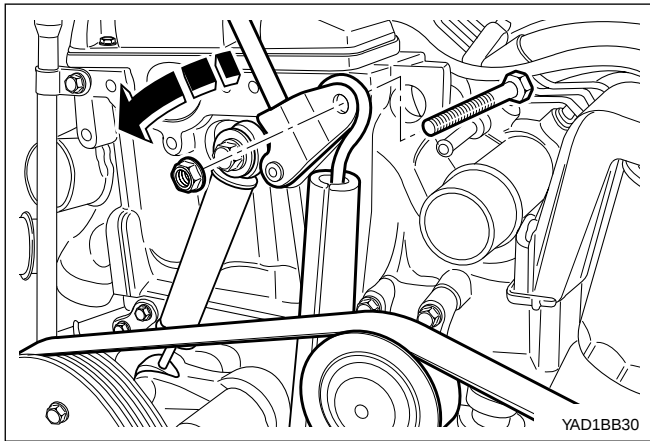
TENSIONING DEVICE

Preceding Work: Removal of cooling fan



YAD1BLJ0

- | | | | |
|--------------------|-------------------|----------------------|--------------------|
| 1 Bolt..... | 21 N•m (15 lb-ft) | 10 Tensioning Pulley | |
| 2 Damper | | 11 Socket Bolt | 29 N•m (21 lb-ft) |
| 3 Nut | 21 N•m (15 lb-ft) | 12 Closing Cover | |
| 4 Tensioning Lever | | 13 Washer | |
| 5 Guide Rail Pin | | 14 Tensioning Lever | |
| 6 Bolt | | 15 Fit Bolt..... | 100 N•m (74 lb-ft) |
| 7 Poly V-Belt | | 16 Closing Cover | |
| 8 Belt Pulley | | 17 Spring | |
| 9 Bolt..... | 10 N•m (89 lb-in) | 18 Bolt..... | 20 N•m (15 lb-ft) |



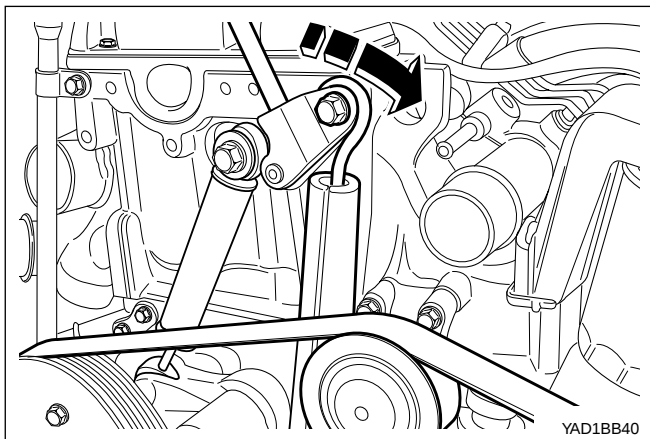
Removal & Installation Procedure

1. Remove the tensioning lever nut.

Installation Notice

Tightening Torque	21 N•m (15 lb-ft)
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2. Push the tensioning lever in direction of arrow with a rod ($\phi 12$, 180 mm) and push out the bolt to the rear.

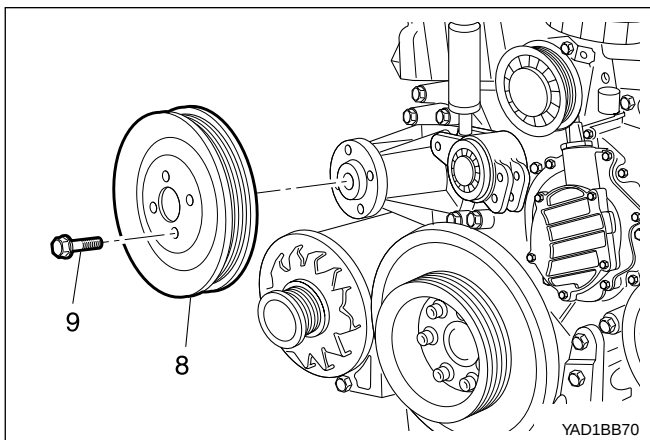


3. Push back the tensioning lever to release the spring tension and remove the belt.

4. Remove the bolt (9) and then remove the belt pulley (8).

Installation Notice

Tightening Torque	10 N•m (89 lb-in)
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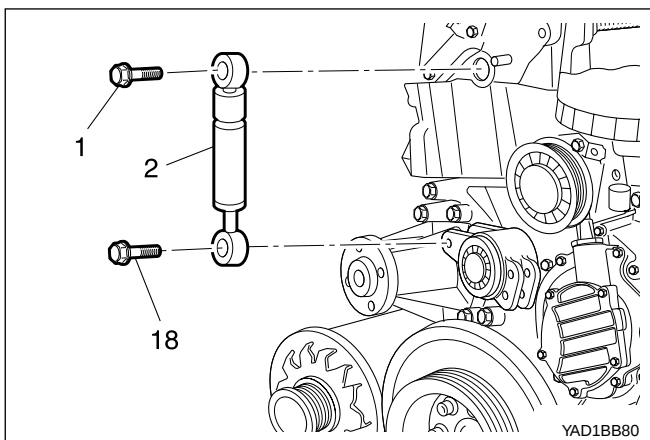


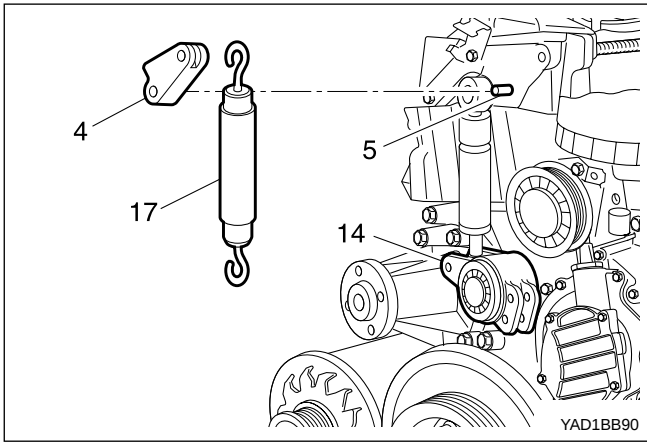
5. Remove the bolt (1, 18) and take off the damper (2).

Installation Notice

Tightening Torque	bolt (1) : 21 N•m (15 lb-ft)
	bolt (18): 20 N•m (15 lb-ft)

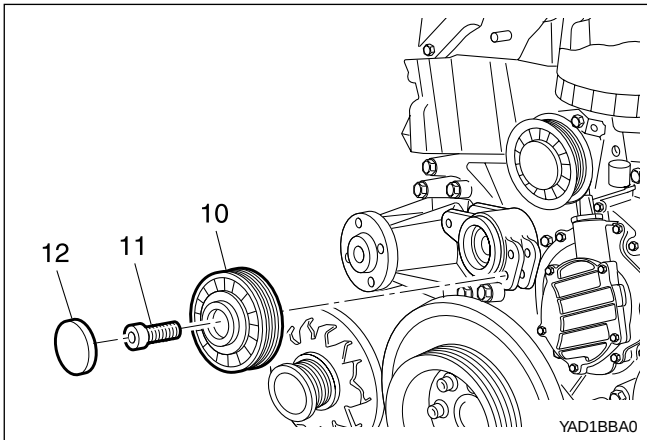
Pay attention to installation position of the damper.





6. Pull off the tensioning lever (4) from guide rail pin.
7. Remove the spring (17).

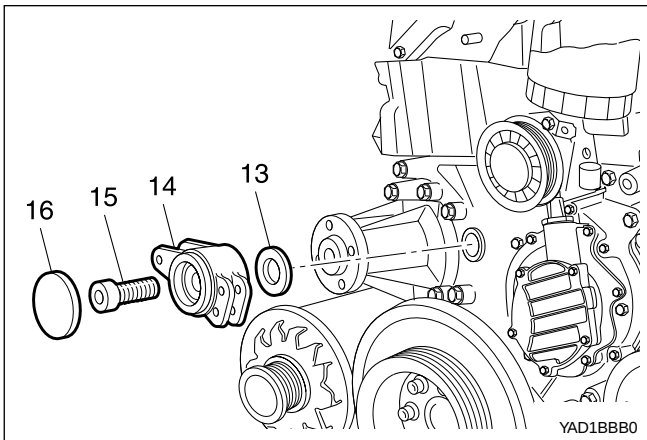
Notice: Insert spring (17) with color coding (blue/violet) facing up.



8. Pry off the closing cover (12) and remove the socket bolt (11) and then remove the tensioning pulley (10).

Installation Notice

Tightening Torque	29 N•m (21 lb-ft)
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9. Pry off the closing cover (16) and remove the fit bolt (15).

Installation Notice

Tightening Torque	100 N•m (74 lb-ft)
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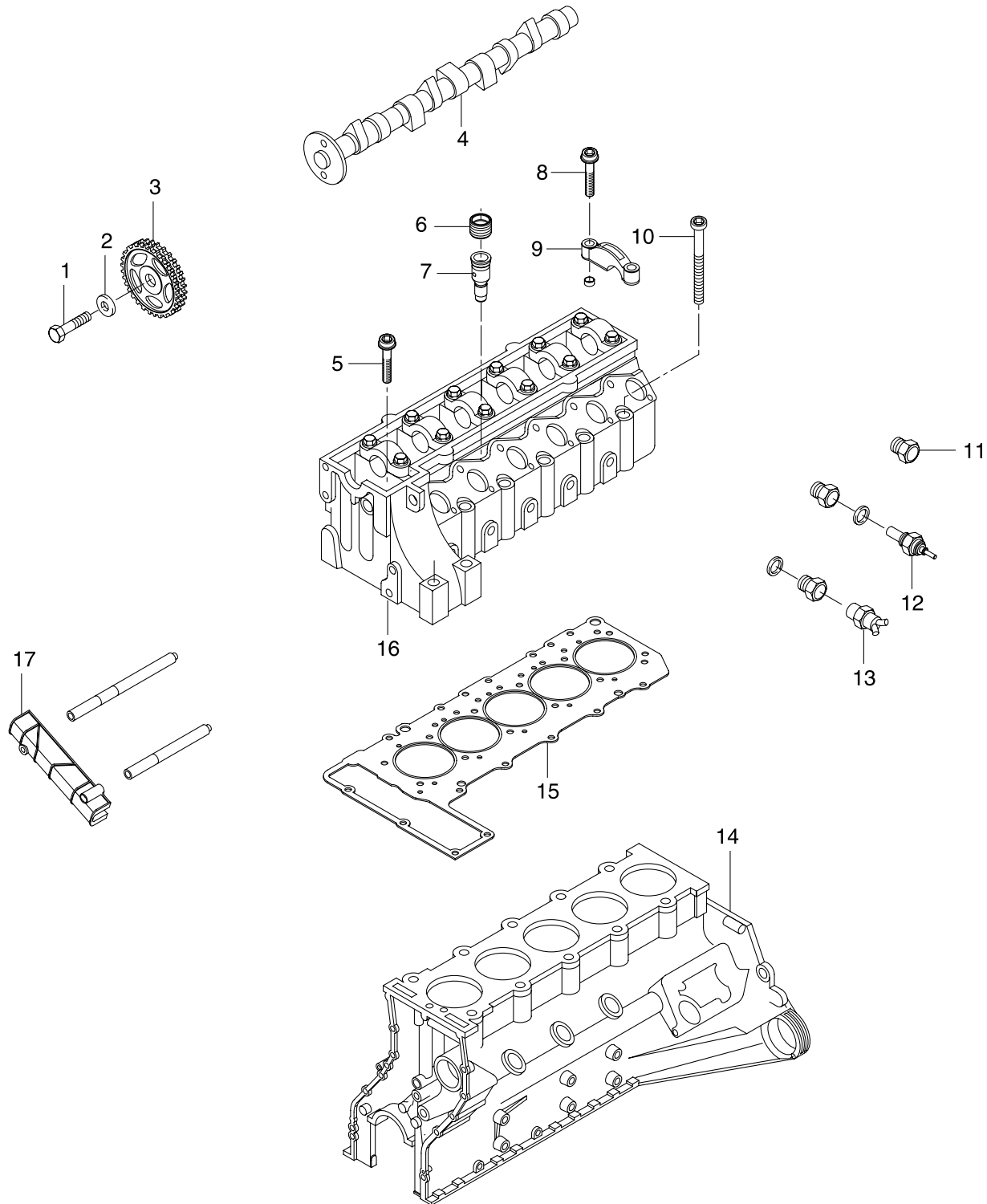
Apply loctite on thread of fit bolt.

10. Remove the tensioning lever (14) and washer (13).
11. Clean thread in the timing case cover and fit bolt.

12. Installation should follow the removal procedure in the reverse order.

CRANKCASE AND CYLINDER HEAD

CYLINDER HEAD

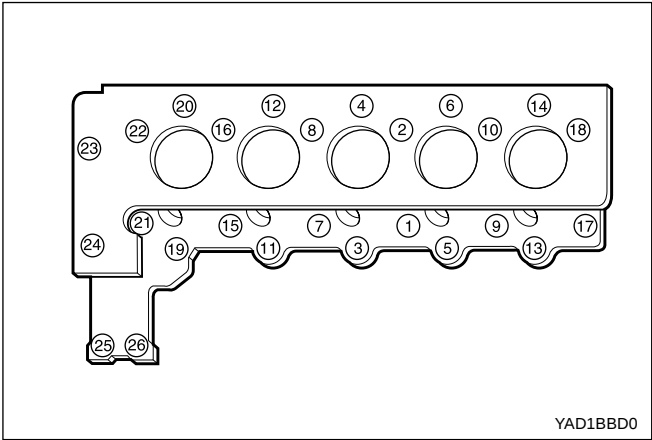


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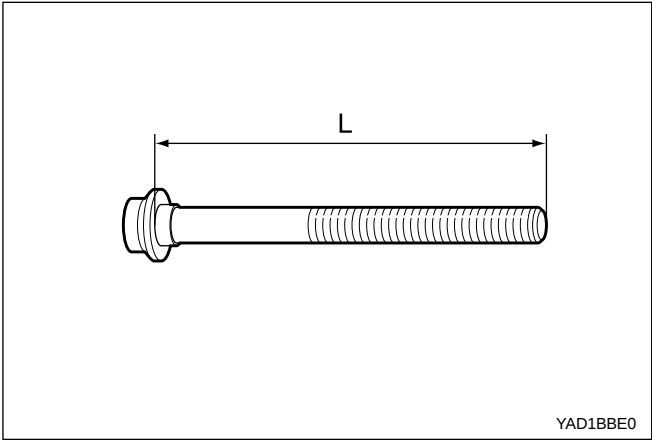
1 Bolt.....	25 N•m (18 lb-ft)+90°	10 Cylinder Head Bolt	See Table
2 Washer		11 Plug	
3 Camshaft Drive Sproket	Relace	12 Engine Coolant Temperature	
4 Camshaft		13 Thermo Valve Sensor	
5 Bolt.....	10 N•m (89 lb-in)	14 Cylinder Block	
6 Threaded Ring	130 N•m (96 lb-ft)	15 Gasket.....	Replace
7 Prechamber		16 Cylinder Head	
8 Bolt.....	25 N•m (18 lb-ft)	17 Sliding Rail	
9 Camshaft Bearing Cap			

Cylinder Head Bolt Tightening Torque

Cylinder Head Bolts (12-sided socket head) (Engine cold)	1st Step	10 N•m (89 lb-in)
	2nd Step	35 N•m (26 lb-ft)
	3rd Step	180°
M8 Cylinder Head Bolts		25 N•m (18 lb-ft)



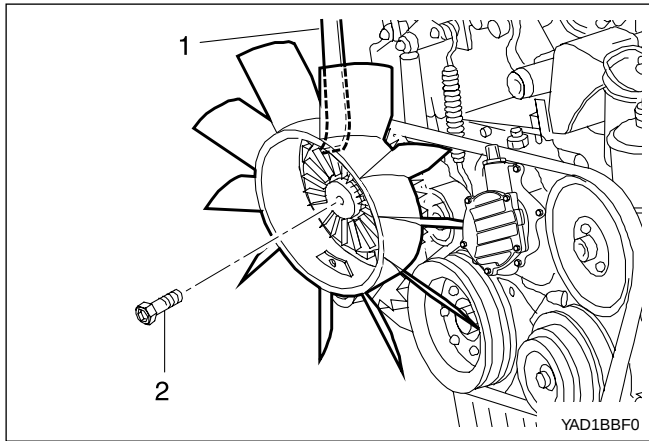
Tightening Sequence for Cylinder Head Bolts



Notice: The cylinder head may only be removed when the engine has cooled down. The cylinder head is removed together with the exhaust manifold. As the cylinder head bolts undergo a permanent tightening. They require to be replaced if they exceed the maximum lengthes indicated in the table.

Thread Dia.	Length(L) When New	Max. Length(L)
M10	80 mm	82 mm
M10	102 mm	104 mm
M10	115 mm	117 mm

The twelve-sided socket head bolts are tightened with each stages of torque and torque angle.
It is not necessary to retighten the cylinder head bolts at the 1000~1500 km inspection or after 1000~1500 km of repairs.

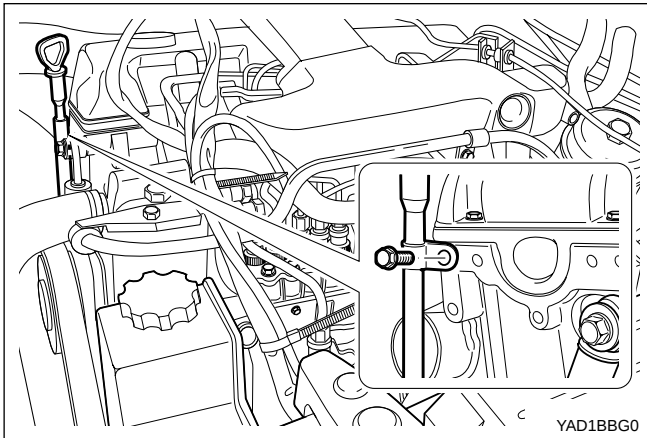


Tools Required

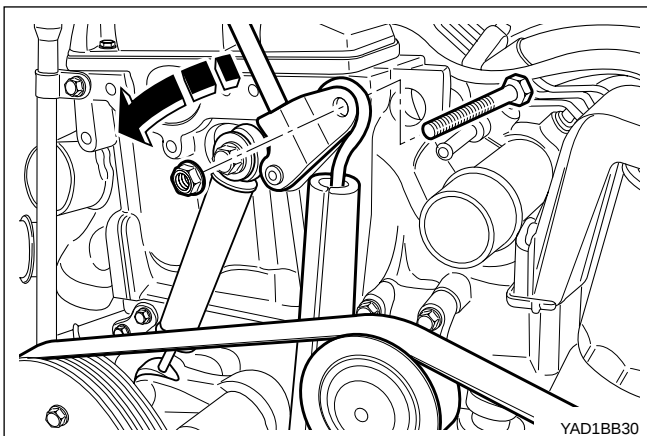
- 116 589 02 34 00 Threaded Pin
- 116 589 03 07 00 T Type Socket Wrench
- 116 589 20 33 00 Sliding Hammer
- 602 589 00 40 00 Engine Lock
- 603 589 00 40 00 Counter Holder

Removal Procedure

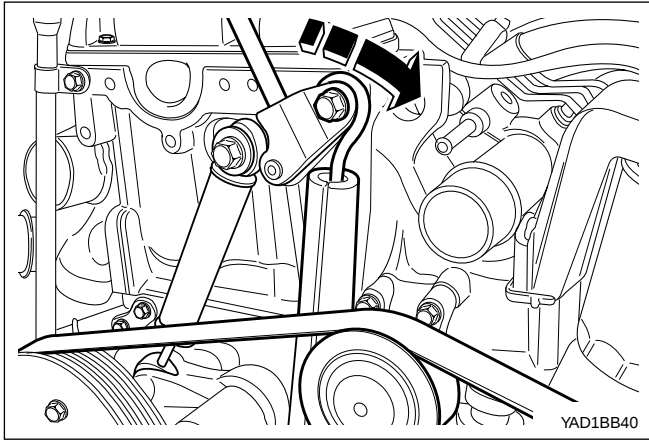
1. Completely drain the coolant from the radiator and cylinder block.
2. Remove the cooling fan shroud.
3. Hold the fan with counter holder 603 589 00 40 00 and remove the bolt and then remove the cooling fan.



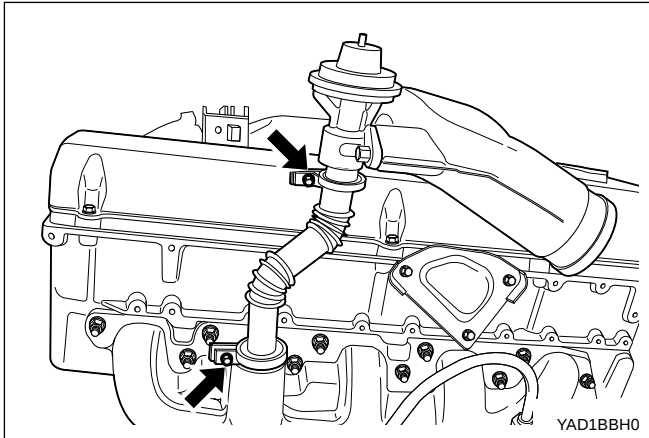
4. Remove the bracket oil dipstick tube.



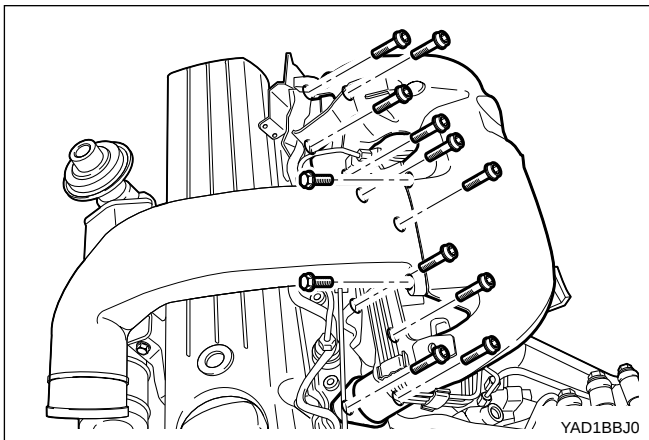
5. Remove the tensioning lever nut.
6. Remove the nut on the tensioning lever and insert the rod(ϕ 18, 180 mm). By pushing the rod to the arrow direction, pull back the bolt.



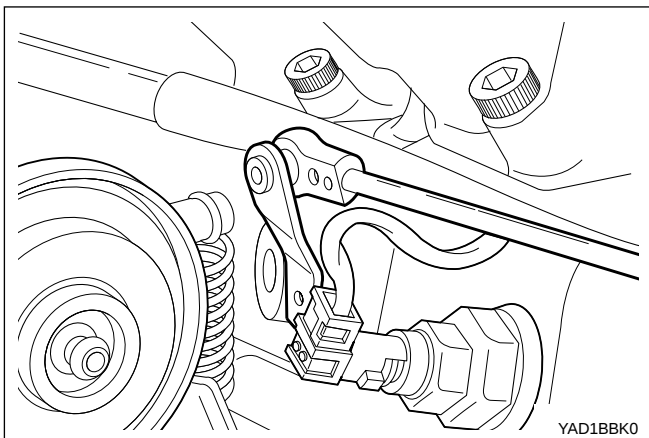
7. Push the tensioning lever to the opposite direction to release the spring tension and remove the poly V-belt.



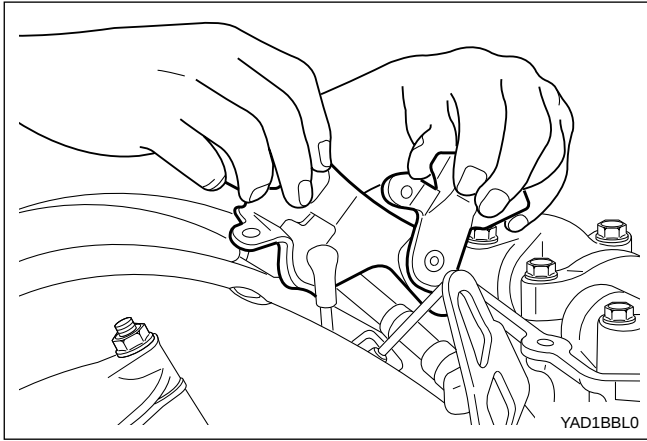
8. Unscrew the EGR pipe mounting bolts onto the exhaust manifold.
9. Remove the duct bracket from the cylinder head.



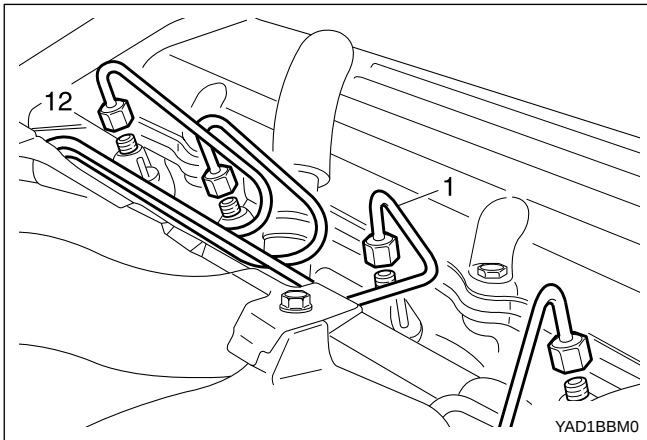
10. Unscrew the intake duct mounting bolts onto the intake manifold.



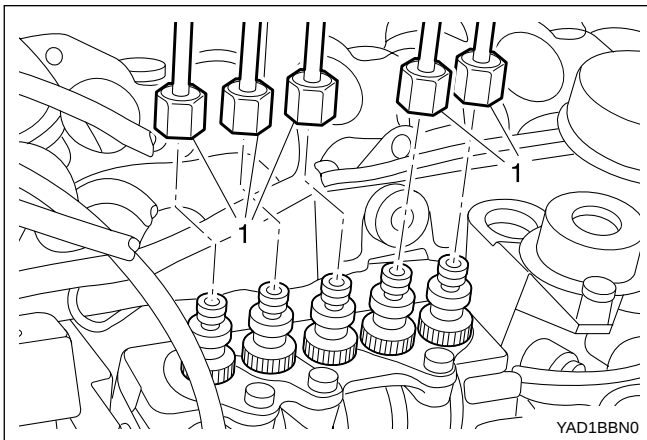
11. Separate the connecting rod from the control lever.



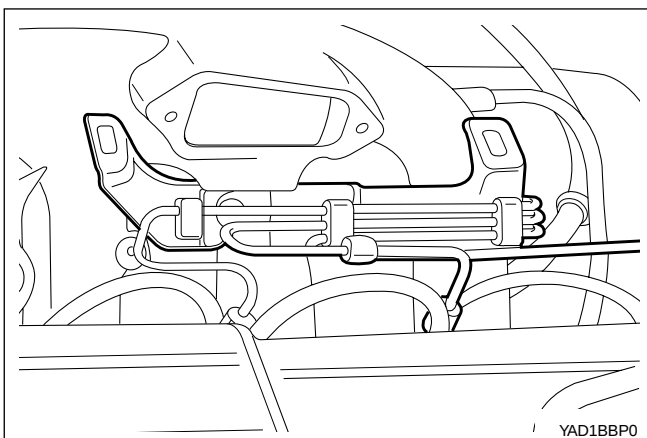
12. Pull out the accelerator control linkage.



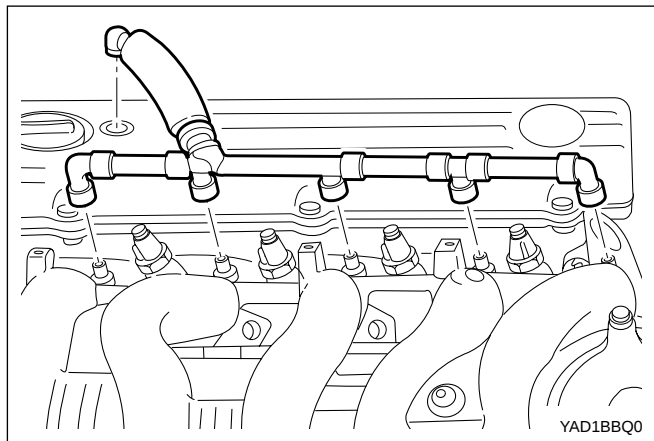
13. Remove the fuel injection line (1) from the fuel injection nozzle (12).



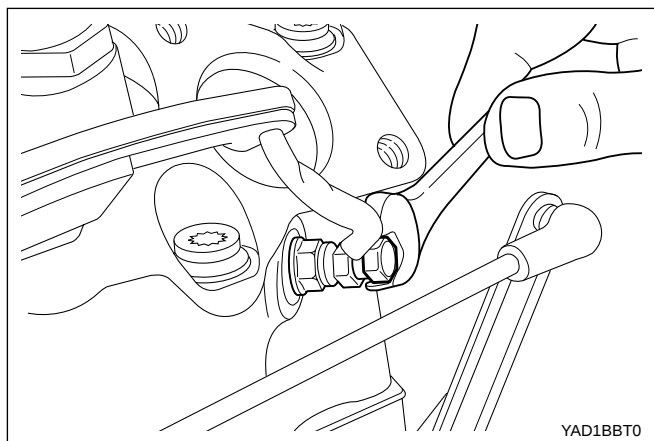
14. Remove the fuel injection line from the fuel injection pump.



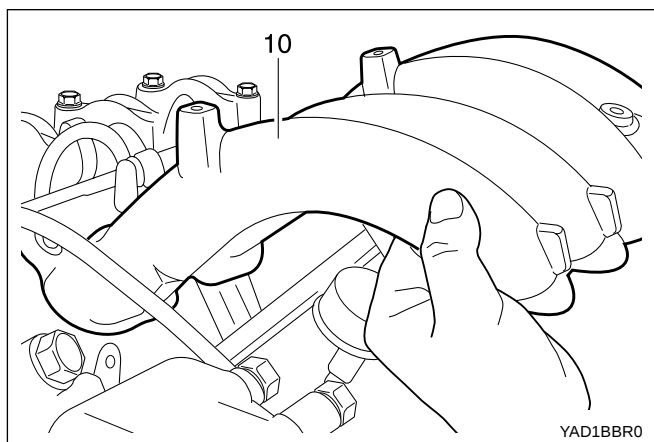
15. Remove the bracket mounting bolts and then remove the fuel injection line (1).



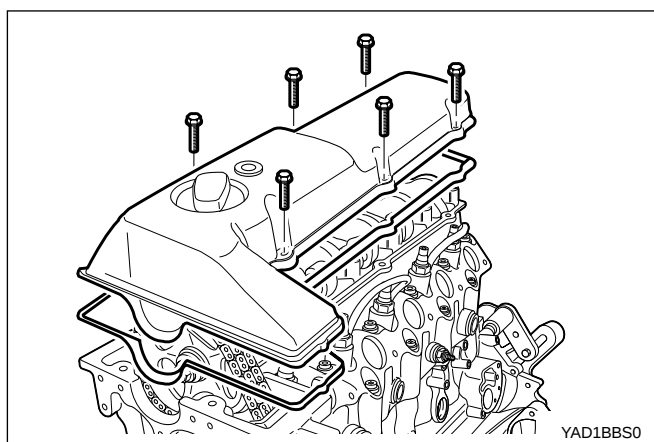
16. Disconnect the blow by hose from the cylinder head cover.



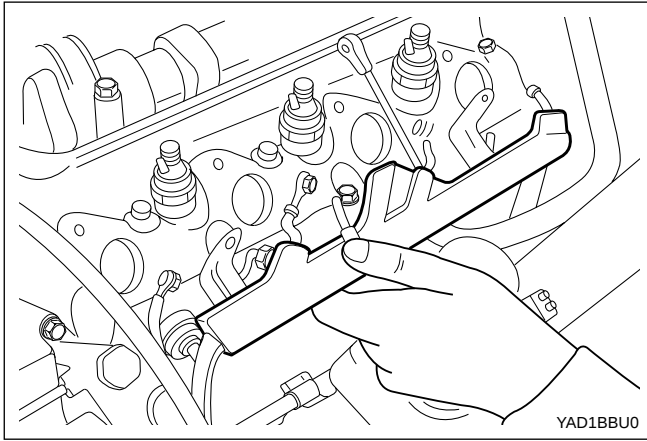
17. Disconnect the glow plug cables.



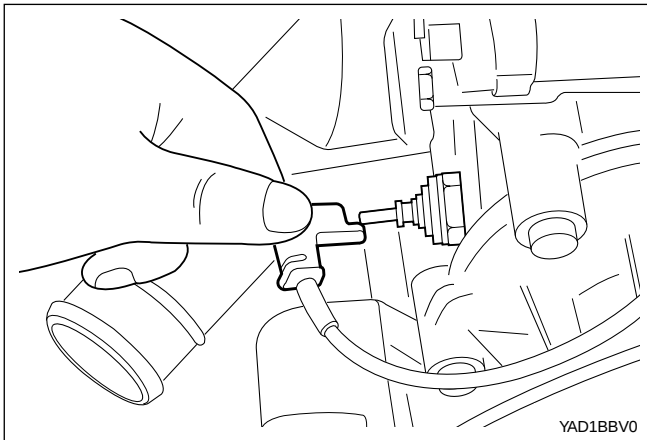
18. Remove the intake manifold (10) and gasket.



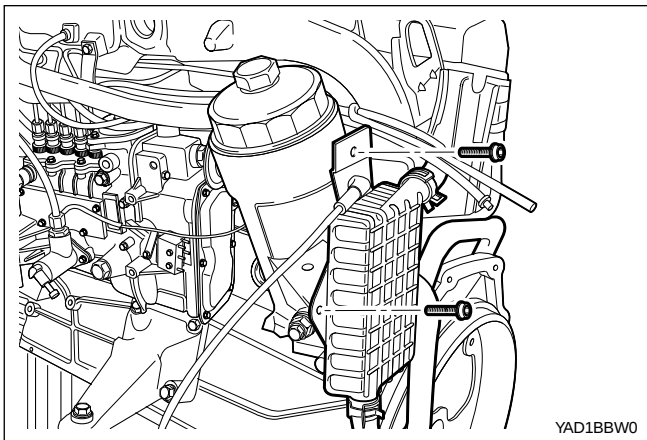
19. Remove the cylinder head cover and gasket.



20. Remove the cable channel.

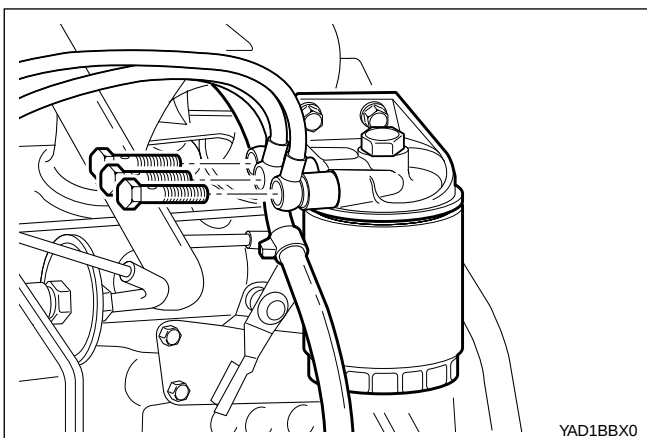


21. Disconnect the cables from the glow plug sensor and engine coolant temperature sensor.

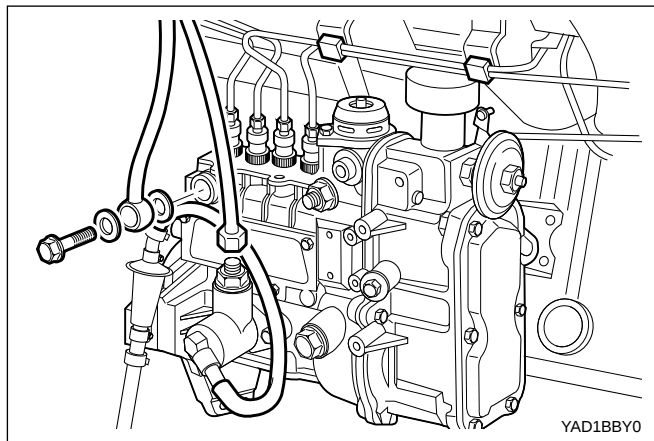


22. Remove the heater pipe bracket from the oil filter.

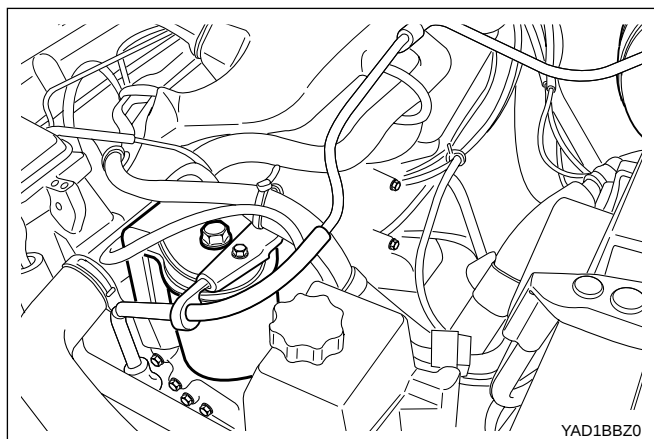
23. Pry off the clamp and push the heater feed pipe forward and then pull out the pipe.



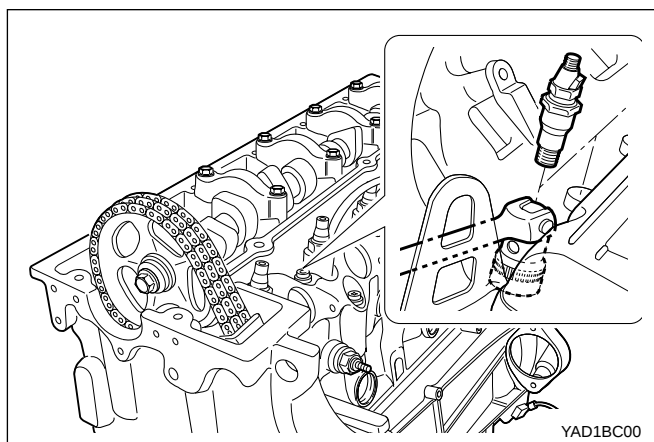
24. Disconnect the fuel lines from the fuel filter.



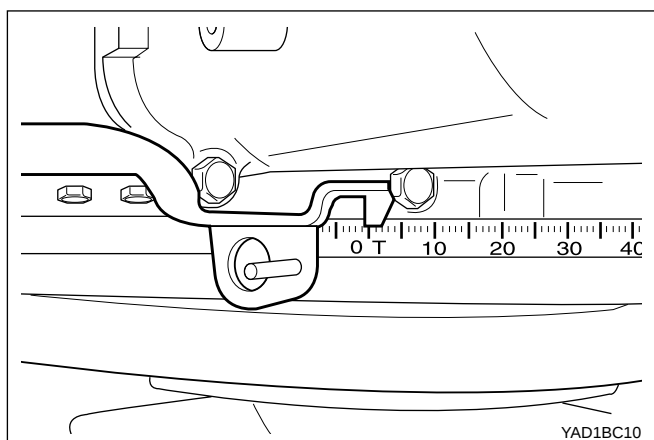
25. Disconnect the fuel lines from the injection pump.



26. Remove the fuel filter.

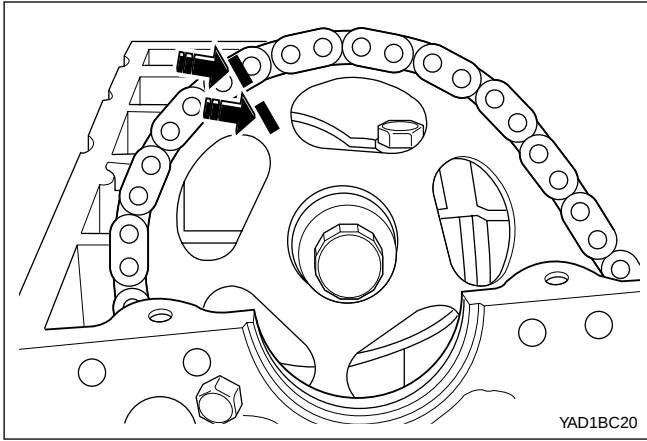


27. Remove the fuel injection nozzle and nozzle washer.

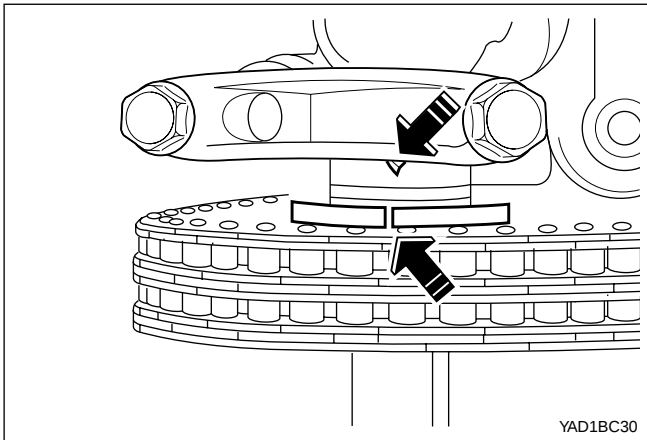


28. Rotate the crankshaft and set the no.1 cylinder at TDC.

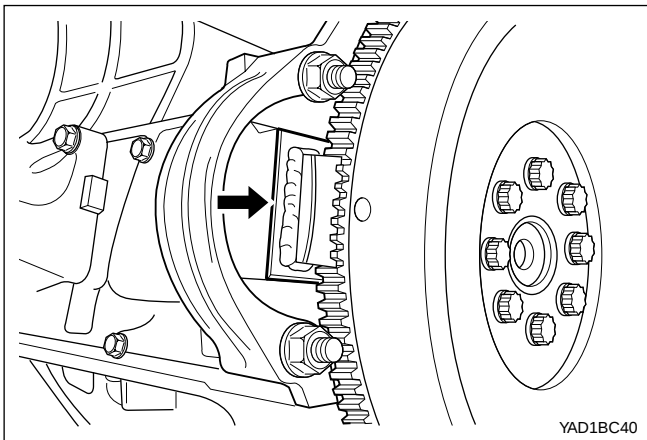
Notice: Do not rotate the crankshaft to the opposite direction of engine revolution.



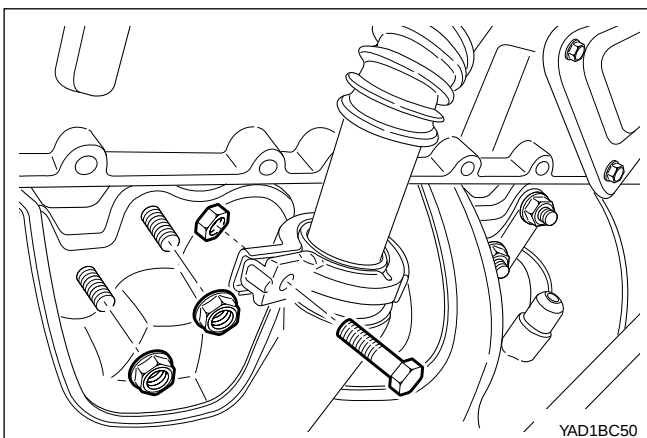
29. Place alignment marks on the camshaft gear and timing chain.



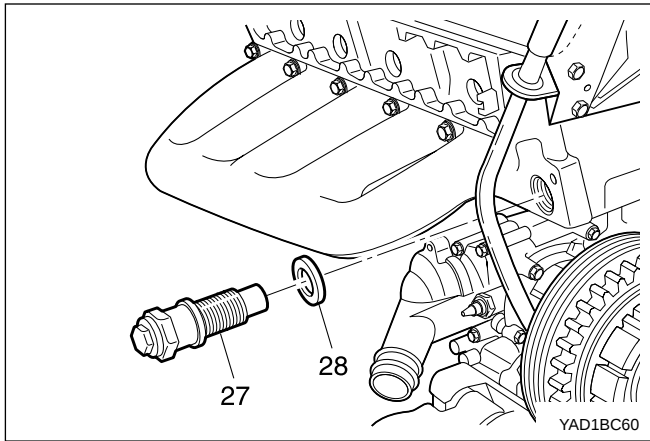
30. Ensure that the camshaft and the bearing cap marking are aligned.



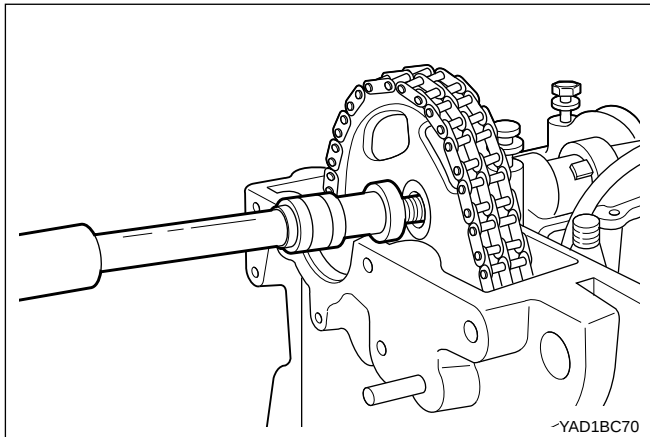
31. Remove the starter motor and install the engine lock 602 589 00 40 00 onto the flywheel ring gear.



32. Remove the exhaust manifold and exhaust pipe.



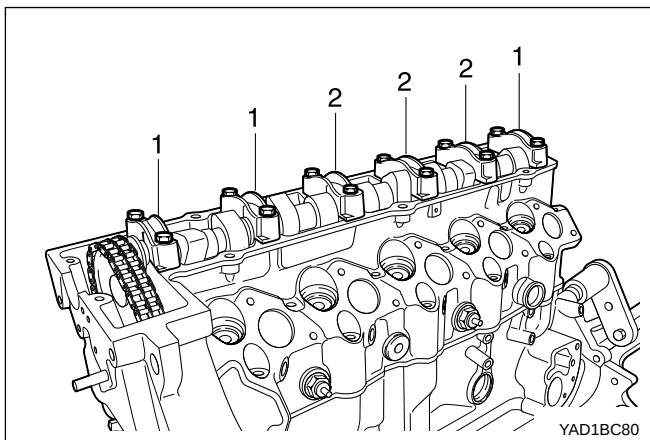
33. Remove the chain tensioner and seal.



34. Remove the bolt and separate the drive sprocket.

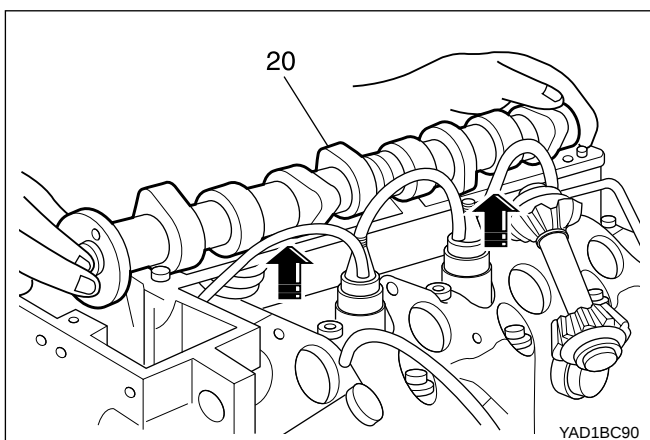
Notice: During removal, be careful not to drop the sprocket and chain into the timing case.

Carefully pull off the chain and then pull out the sprocket.



35. Remove the camshaft bearing cap bolts according to the numerical sequence.

Notice: Remove the No.1 bolts first and then remove the No. 2 bolts. Do not remove the bolts at a time completely but remove them step by step evenly or camshaft can be seriously damaged.



36. Remove the bearing caps and then pull out the camshaft(20) upward.

Notice: Be careful not to miss the locking washer.

37. Remove the locking washer.

Notice: Check the locking washer and replace if necessary.