CHECKING AND ADJUSTING START OF DELIVERY

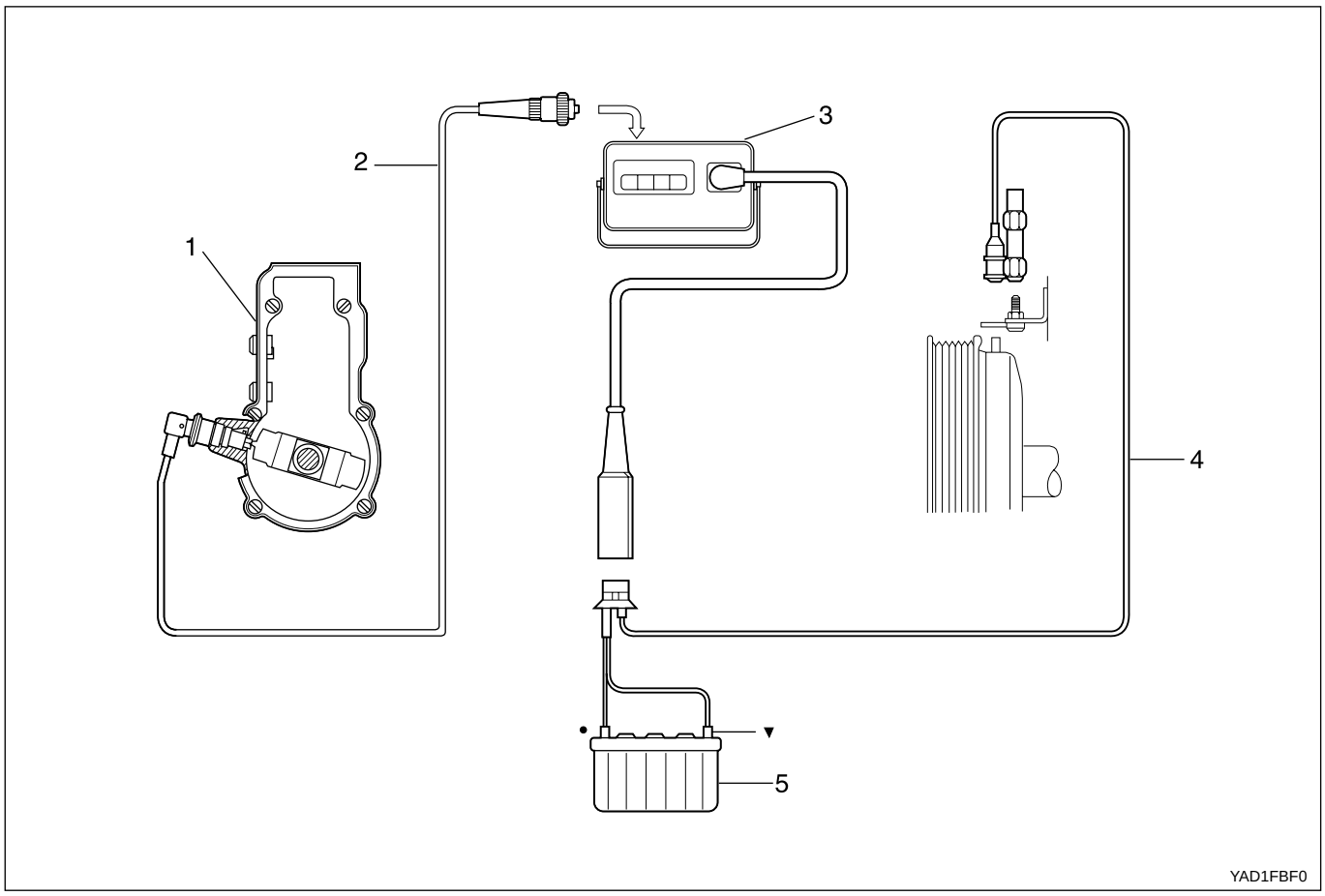
Governor Impulse Method (RIV)

In order to be able to register the relationship of the injection pump relative to the engine two signals are required.

- TDC impulse from the crankshaft.
- Governor impulse from the injection pump.

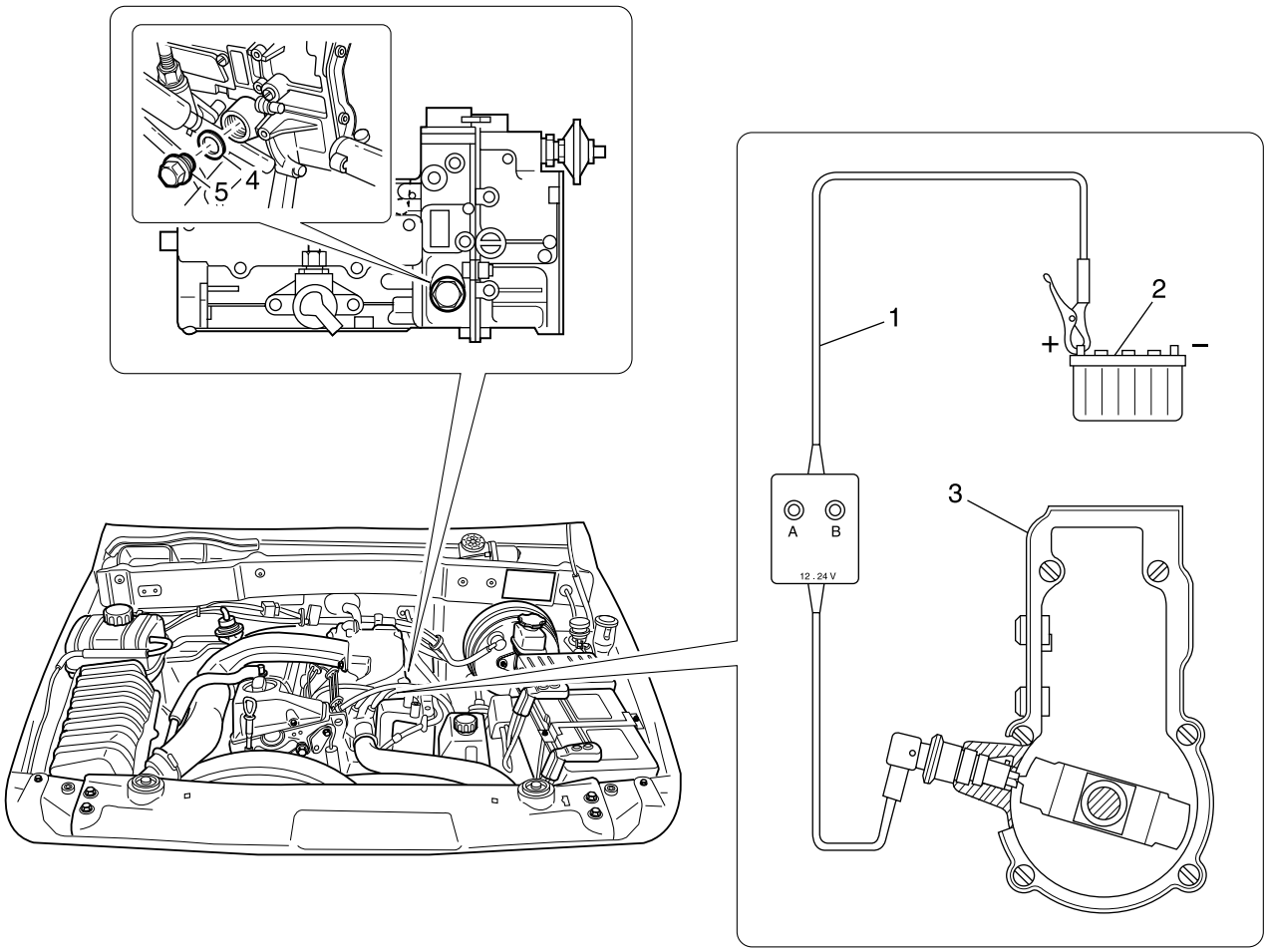
Both impulses are supplied by pulse generators.

In order to obtain a measuring signal the sensor pins must be moved past the pulse generators with a minimum speed (idle speed). A measuring instrument measures the time interval of the two impulses, converting the result into an angular value which is then indicated.



1 Fuel Injection Pump
2 RI Sensor
3 Digital Testor
4 TDC Pluse Sender Unit
5 Battery

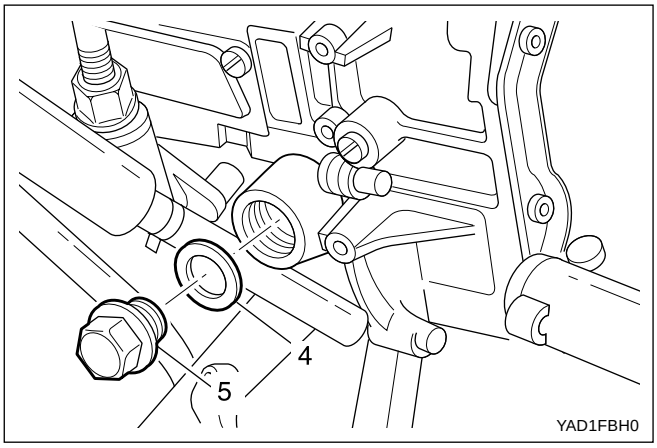
Position Sensor, RIV Method



1 Position Sensor
2 Battery
3 Fuel Injection Pump
4 Seal ..... Replace
5 Screw Plug ..... 30 N•m (22 lb-ft)

Service Data

Start of Delivery (RIV)	ATDC 14° - 16°



Tools Required

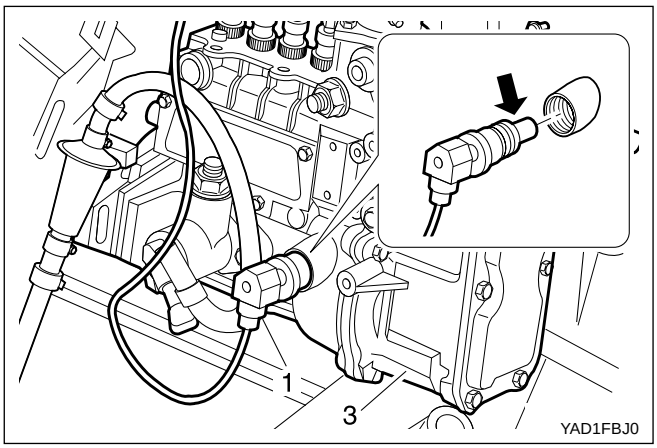
617 589 08 21 00 Position Sensor

Test Procedure

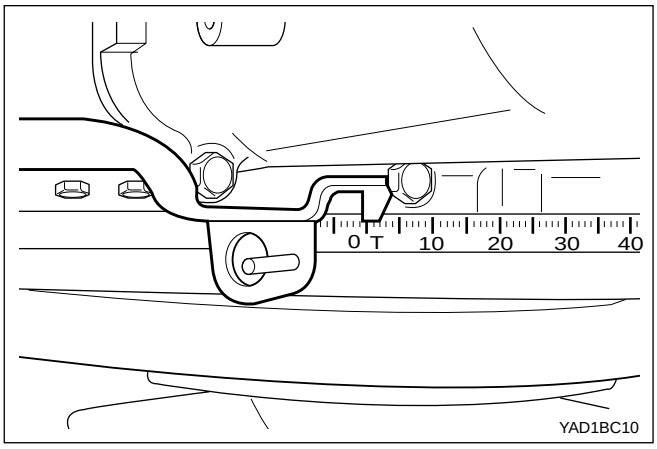
1. Remove the screw plug (5) and seal (4) and collect oil in a suitable vessel.

   Installation Notice

Tightening Torque	30 N•m (22 lb-ft)



2. Install the position sensor 617 589 08 21 00 (1) into the governor housing of the injection pump to be the guide pin of the position sensor facing up.
3. Connect the battery terminal of position sensor 617 589 08 21 00 (1) to positive terminal (+) of battery.

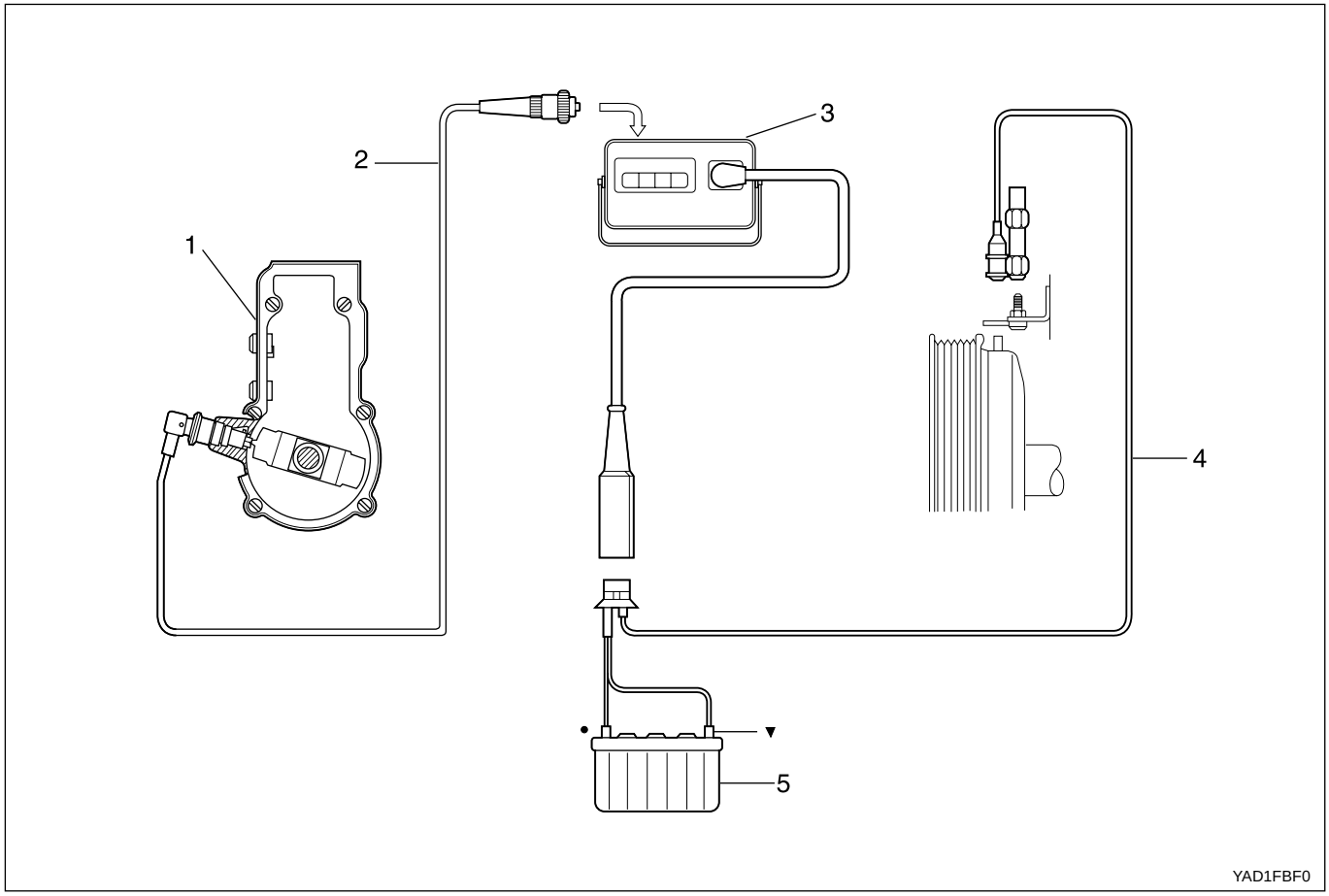


4. Rotate the crankshaft by hand (in direction of engine rotation) until the lamp ‘B’ lights up. Rotate the crankshaft carefully further until both lamps ‘A and B’ come on. In this position, check the Rl value on the crankshaft vibration damper.

Specification	ATDC 14° - 16°

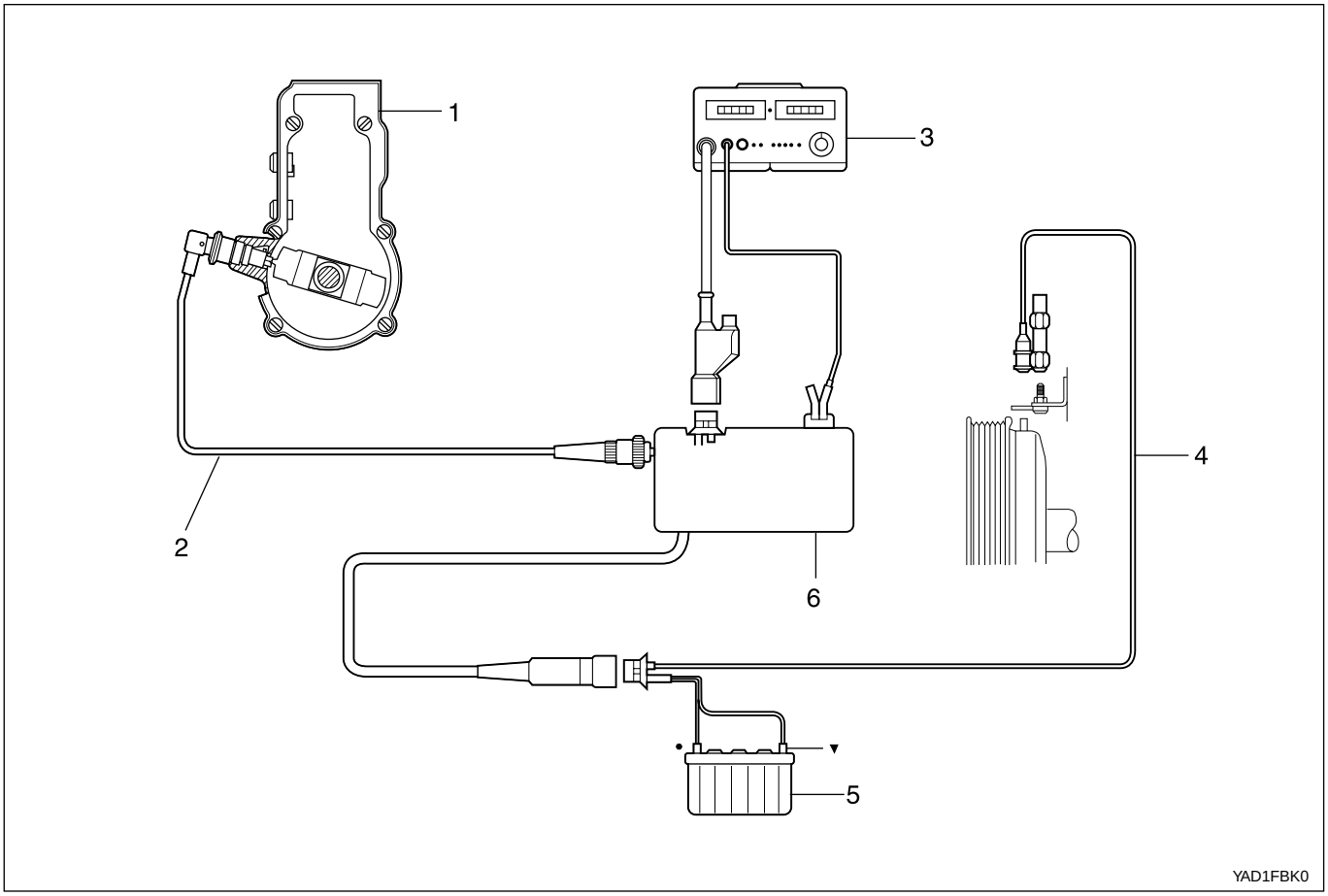
Notice: If only lamp ‘A’ lights up, repeat the test and if out of specification, adjust start of delivery.

Digital Tester, RIV Method
(Connection Diagram for Testers Without Adapter)



1 Fuel Injection Pump
2 Rl Sensor
3 Digital Tester
4 TDC Pulse Generator
5 Battery

(Connection Diagram for Testers With Adapter)



1 Fuel Injection Pump
2 RI Sensor
3 Digital Tester
4 TDC Pulse Sender Unit
5 Battery
6 RI Pulse Generator

Service Data

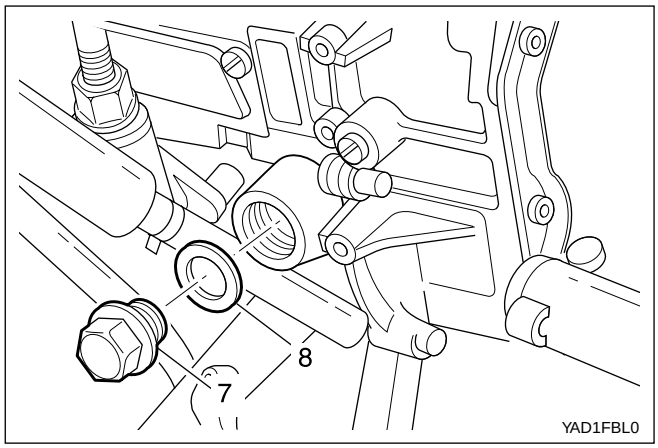
Start of Delivery (RIV)	ATDC 14° - 16°
Idle Speed	720 - 820 rpm

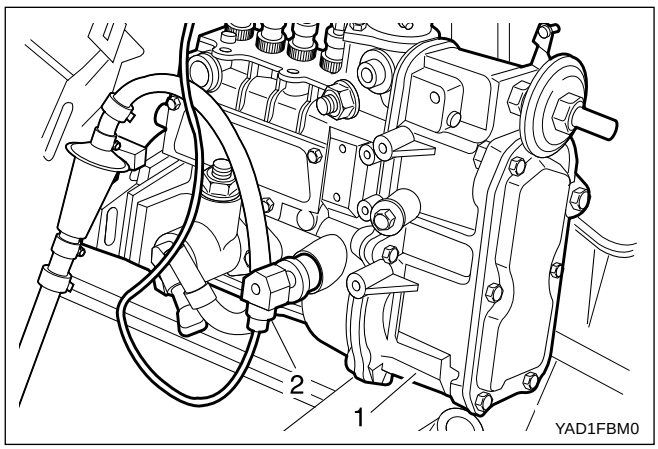
Tools Required

617 589 09 21 00 RI Adapter
617 589 10 21 00 RI Sensor
667 589 00 21 00 TDC Pulse Generator

Commercial Tools

Item		Tools
Digital Tester	With Pluse Generator	Bosch, MOT 001.03
		Hartmann & Braun. EOMT3
	Without Pulse Generator	Bosch, ETD 019.00
		Sun, DIT 9000
		ALV, Diesel - Tester 875





Test Procedure

1. Remove the screw plug (7) and seal (8) collect oil in a suitable vessel.
2. Install the RI sensor 617 589 10 21 00 into the governor housing of injection pump (1).
3. Connect the digital tester and TDC pulse generator 667 589 00 21 00 according to connection diagram.
4. Run the engine at idle speed and check the RI value on the digital tester

RI valve	ATDC 14° - 16°

Notice: If out of standard, adjust the start of delivery.

5. Stop the engine.
6. Remove the RI sensor, digital tester and TDC pulse generator.
7. Replace the seal and tighten the plug.

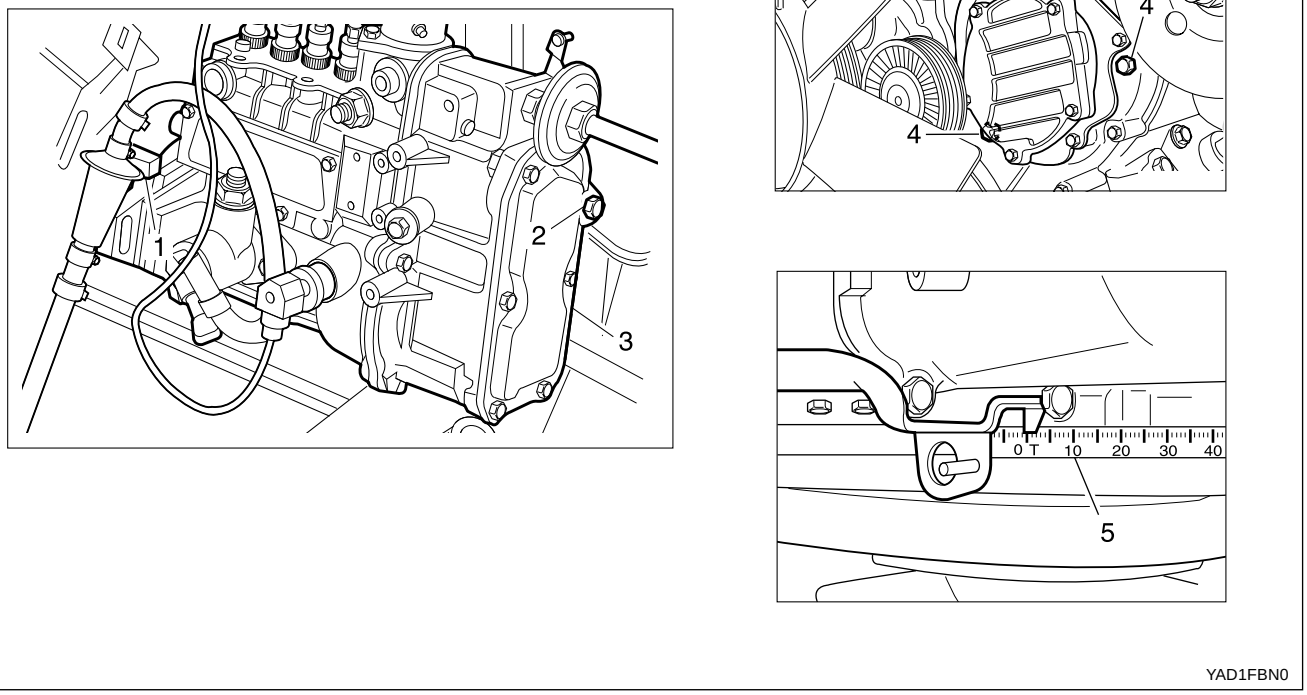
Installation Notice

Tightening Torque	30 N•m (22 lb-ft)

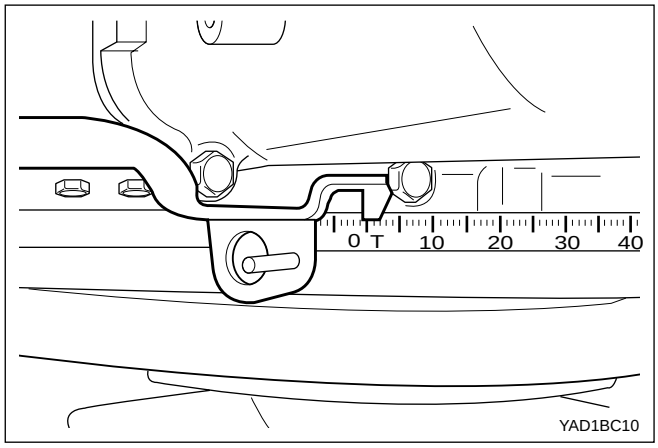
8. Check engine oil level and adjust if necessary.

After Testing - Position Sensor (RIV Method)

Preceding Work: Start of delivery test



1 Adjusting Screw
2 Bolt ..... 23 N•m (17 lb-ft)
3 Fuel Injection Pump
4 Bolt ..... 23 N•m (17 lb-ft)
5 Scale ..... RI start of delivery = 14° - 16° ATDC



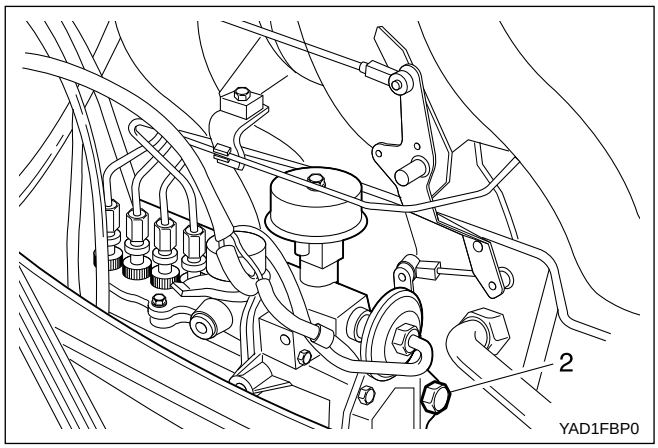
Tools Required

617 589 08 21 00 Position Sensor

Adjustment Procedure

1. Position the No. 1 cylinder at ATDC 15°

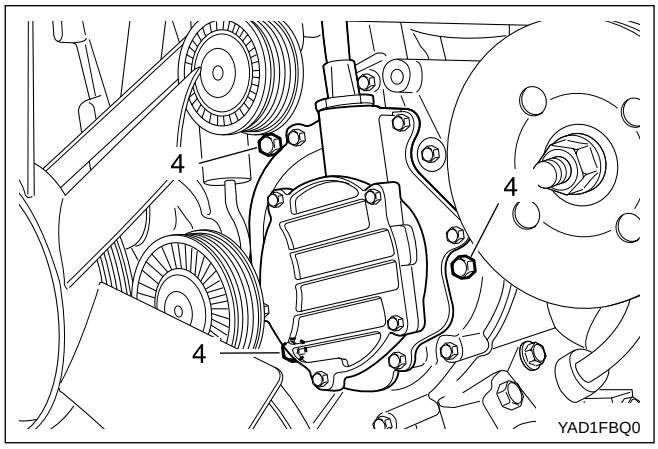
   Notice: Do not rotate the engine in opposite direction of engine rotation.



2. Remove the bolt (2) at the supporting bracket.

   Installation Notice

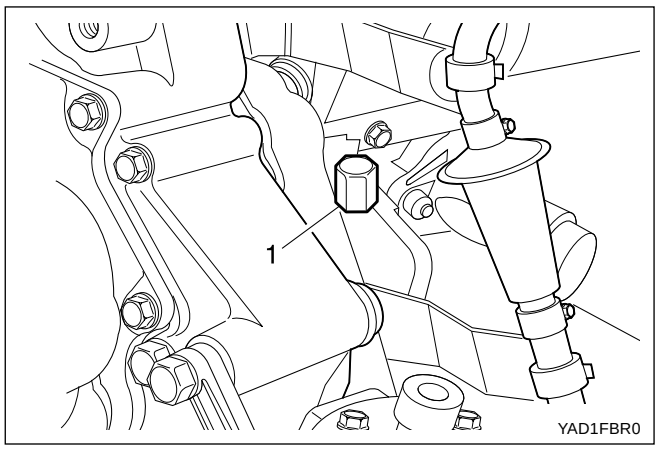
Tightening Torque	23 N•m (17 lb-ft)



3. Remove the bolt (4) at the timing case cover.

   Installation Notice

Tightening Torque	23 N•m (17 lb-ft)



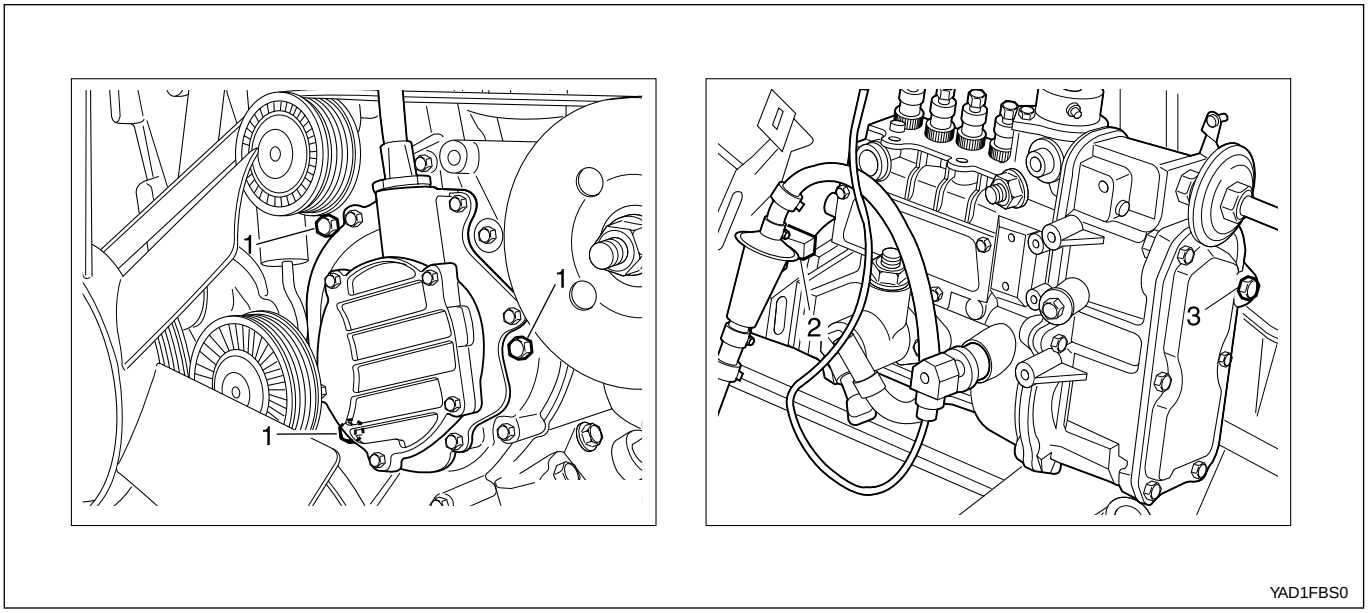
4. Turn the adjusting screw (1) until both lamps ‘A’, ‘B’ on the position sensor 617 589 08 21 00 light up.

To the right	Start of Delievery Retarded
To the left	Star of Delivery Advanced

   Notice: If the adjustment range is not adequate, remove the injection pump and reinstall.

5. After adjusting, retighten all the bolt to the specified torque.

After Testing - Digital Tester (RIV Method)



1 Bolt..... 23 N•m (17 lb-ft)
2 Adjusting
Screw .... To the right : start of delivery retarded
To the left : start of delivery advanced
3 Bolt..... 23 N•m (17 lb-ft)

Service Data

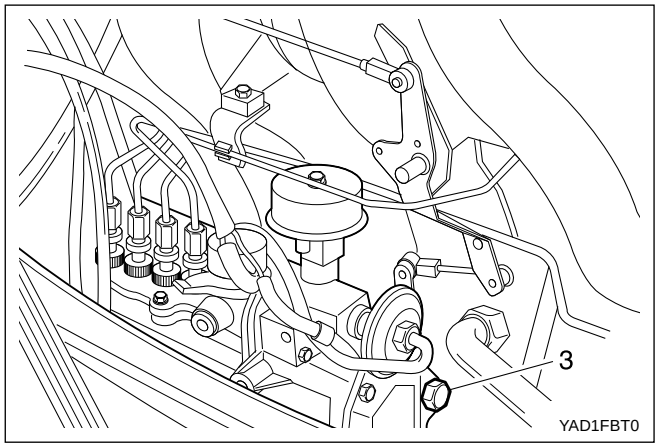
Start of Delivery (RIV)	ATDC 14° - 16°
Ldling Speed	720 - 820 rpm

Tools Required

617 589 09 21 00 RI Adaptor
617 589 10 21 00 RI Sensor
667 589 00 21 00 TDC Pulse Generator

Commercial Tools

Item		Tools
Digital Tester	With Pulse Generator	Bosch, MOT 001.03
		Hartmann & Braun, EOMT3
	Without Pulse Generator	Bosch, ETD 019.00
		Sun, DIT 9000
		ALV, Diesel - Tester 875

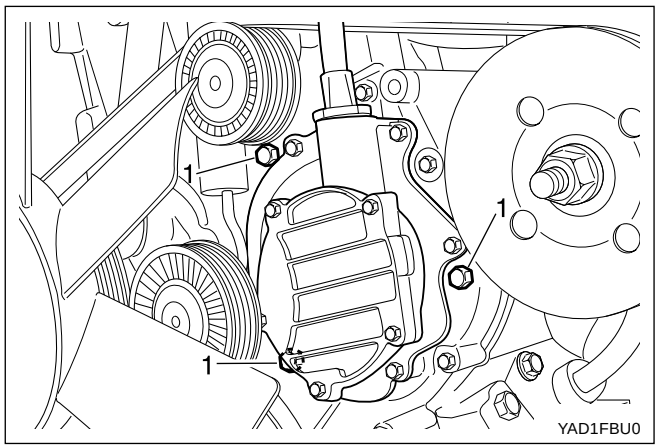


Adjustment Procedure

1. Remove the bolt (3) at the supporting bracket.

Installation Notice

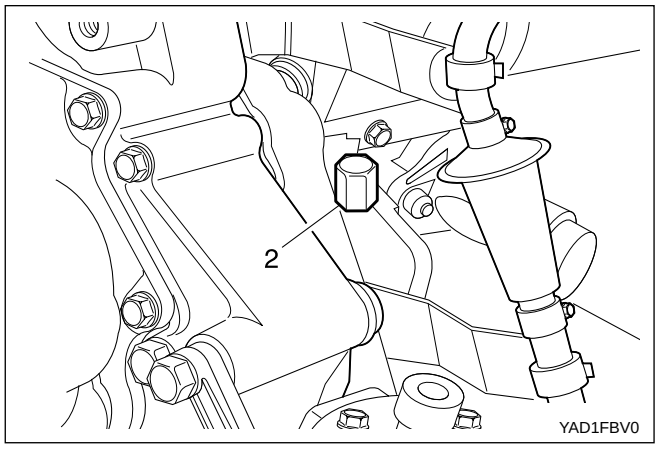
Tightening Torque	23 N•m (17 lb-ft)



2. remove the bolts (1) at the timing case cover.

Installation Notice

Tightening Torque	23 N•m (17 lb-ft)



3. Run the engine at idle speed.
4. Turn the adjusting screw (2) until the specification (15° ± 1° ATDC) is indicated on the digital tester.

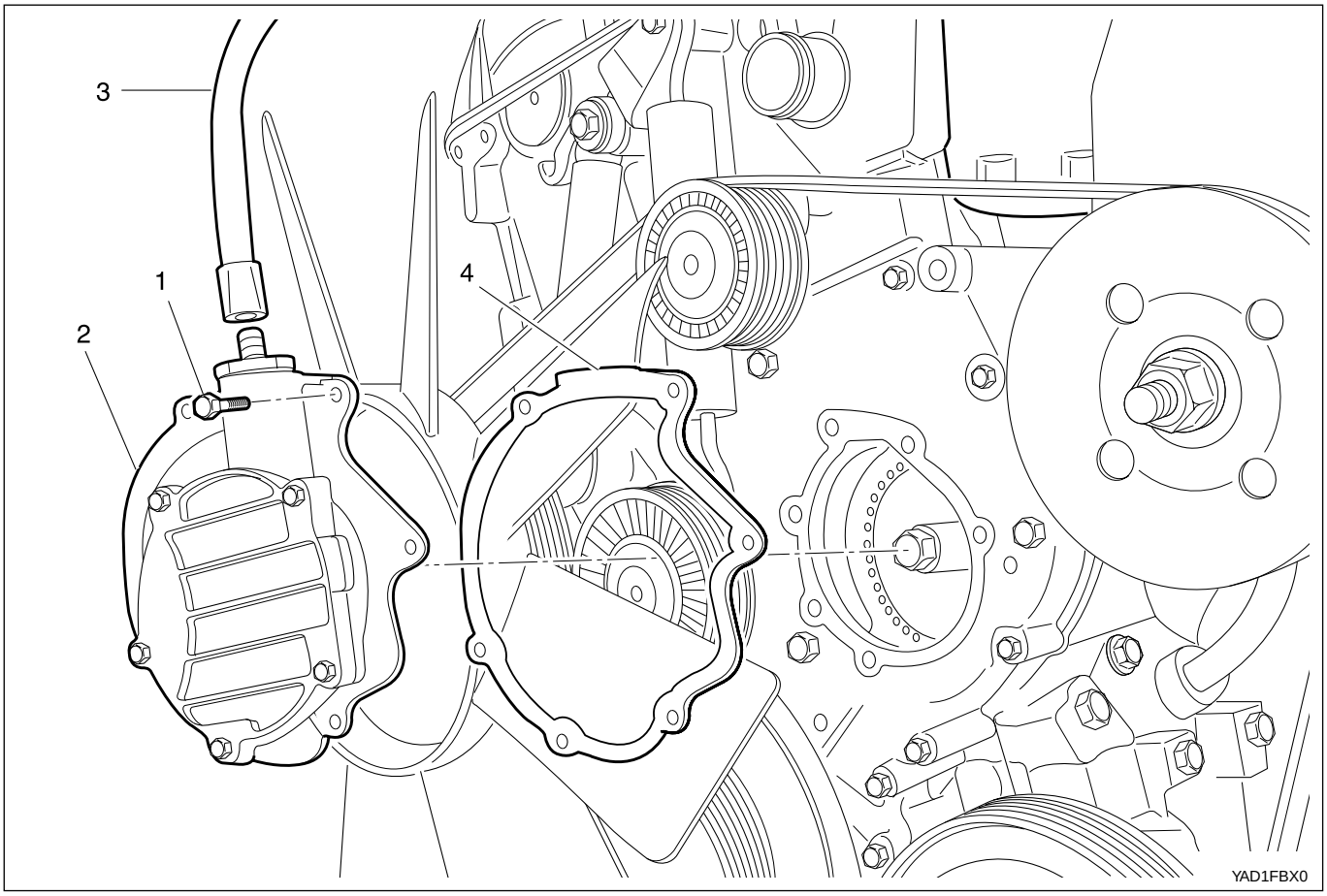
To the Right	Start of Delivery Retarded
To the Left	Start Delivery Advanced

REPAIR INSTRUCTIONS

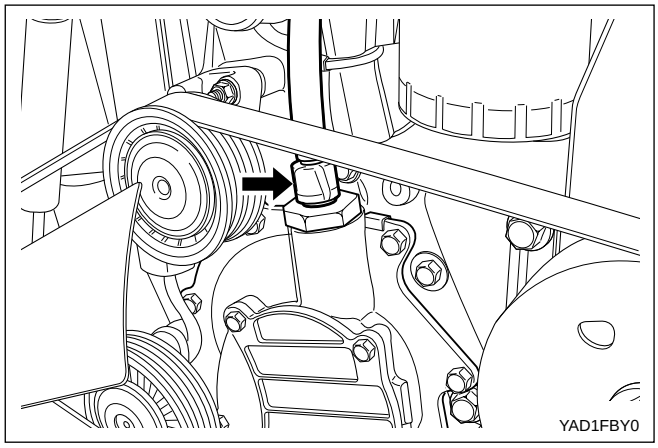
ON-VEHICLE SERVICE

VACUUM PUMP

Preceding Work: Removal the poly V-belt

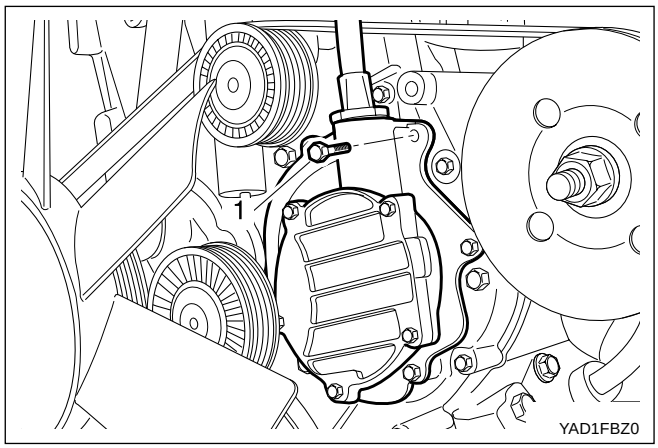


1 Bolt ..... 10 N•m (89 lb-in)
2 Vacuum Pump
3 Vacuum Line
4 Gasket ..... Replace



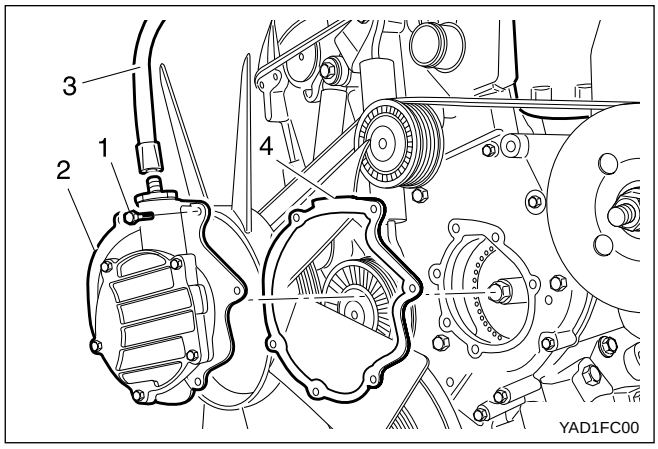
Removal & Installation Procedure

1. Remove the vacuum line.



2. Remove the bolts (1) evenly.

   Notice: If necessary, rotate the engine until the pressure on the tappet of the vacuum pump is released.



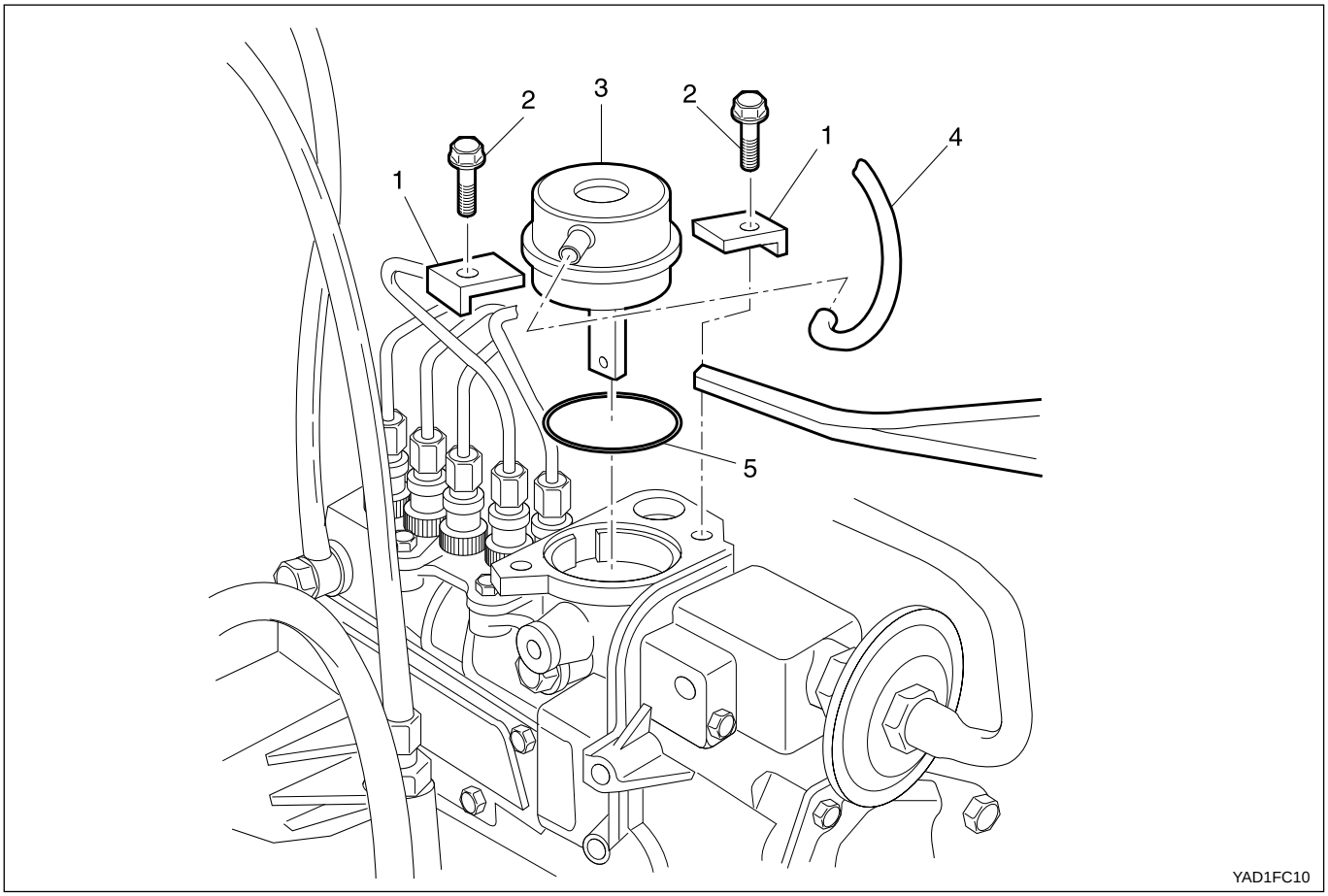
3. Remove the vacuum pump (2).
4. Install the vacuum pump (2).

   Installation Notice

Tightening Torque	10 N•m (89 lb-in)

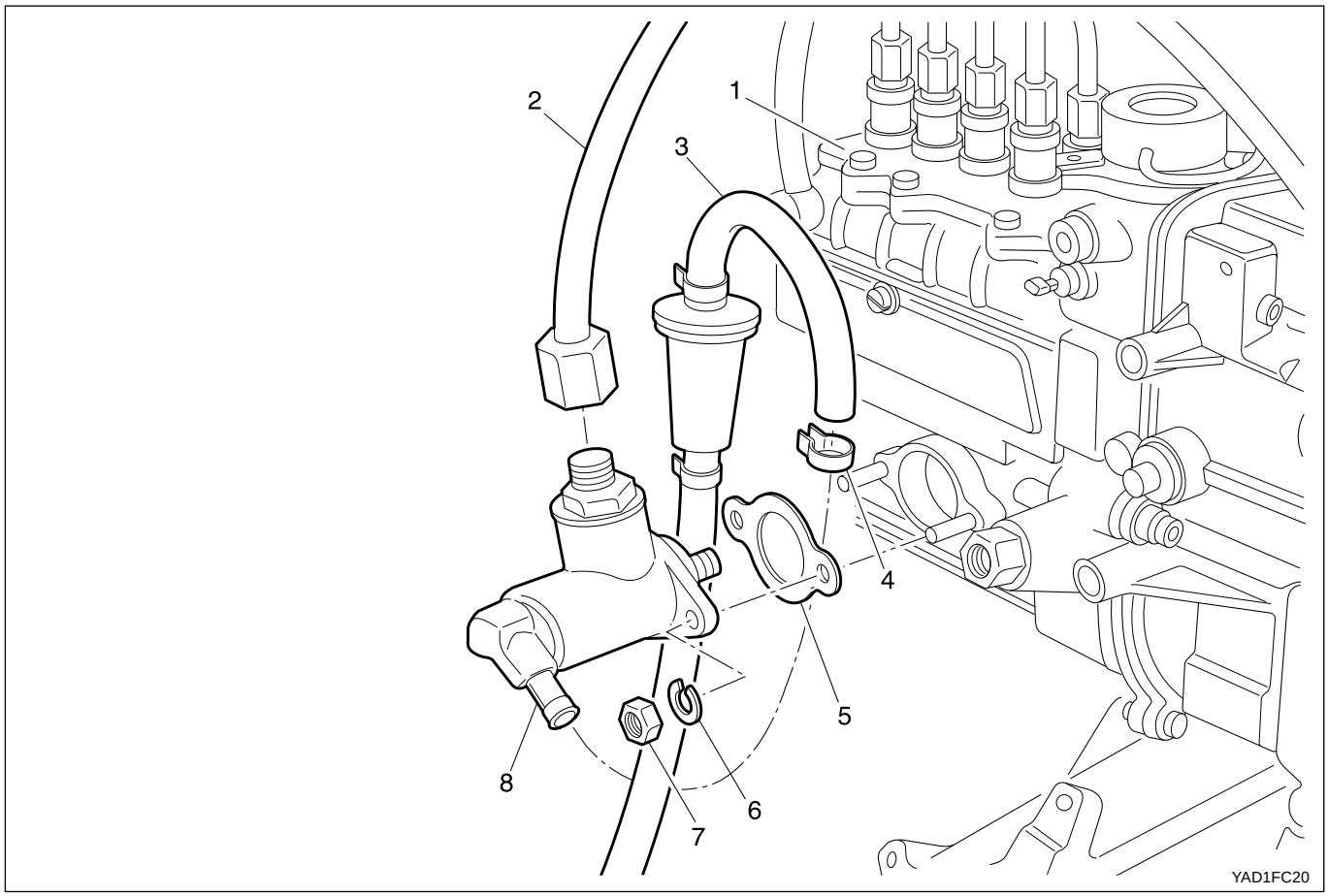
   Clean the gasket residues of sealing surface of vacuum pump and replace the gasket (5).
5. Connect the vacuum line.

VACUUM UNIT REPLACEMENT

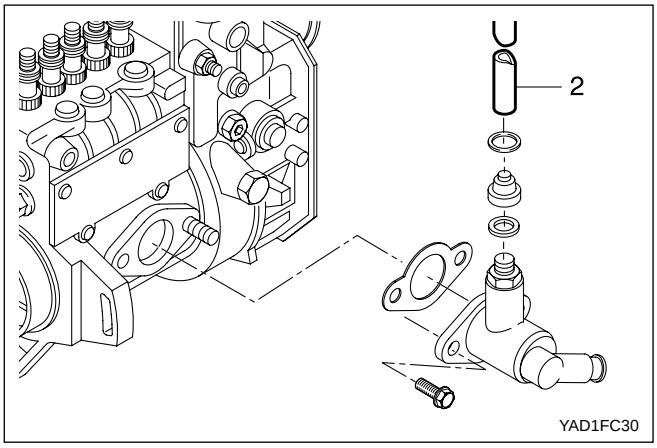


1 Bracket
2 Bolt
3 Vacuum Unit
4 Vacuum Line
5 Seal ..... Replace

FUEL PUMP



1 Fuel Injection Pump
2 Pressure Line ..... 13 N•m (10 lb-ft)
3 Suction Line
4 Hose Clip ..... Replace
5 Gasket ..... Replace
6 Spring Lock Washer
7 Hexagon Nuts ..... 18 N•m (13 lb-ft)
8 Fuel Pump

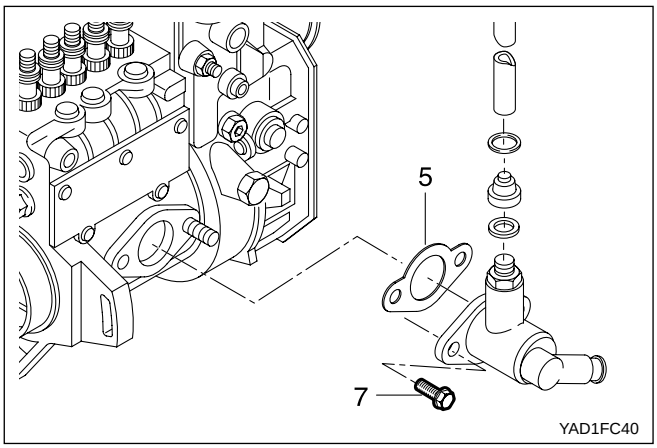


Removal & Installation procedure

1. Disconnect the fuel pressure and suction line.

   Installation Notice

Tightening Torque	13 N•m (10 lb-ft)

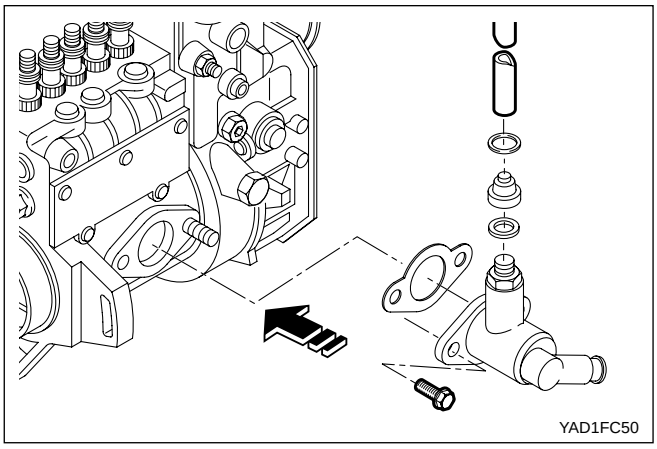


2. Remove the fuel pump mounting bolts.

   Installation Notice

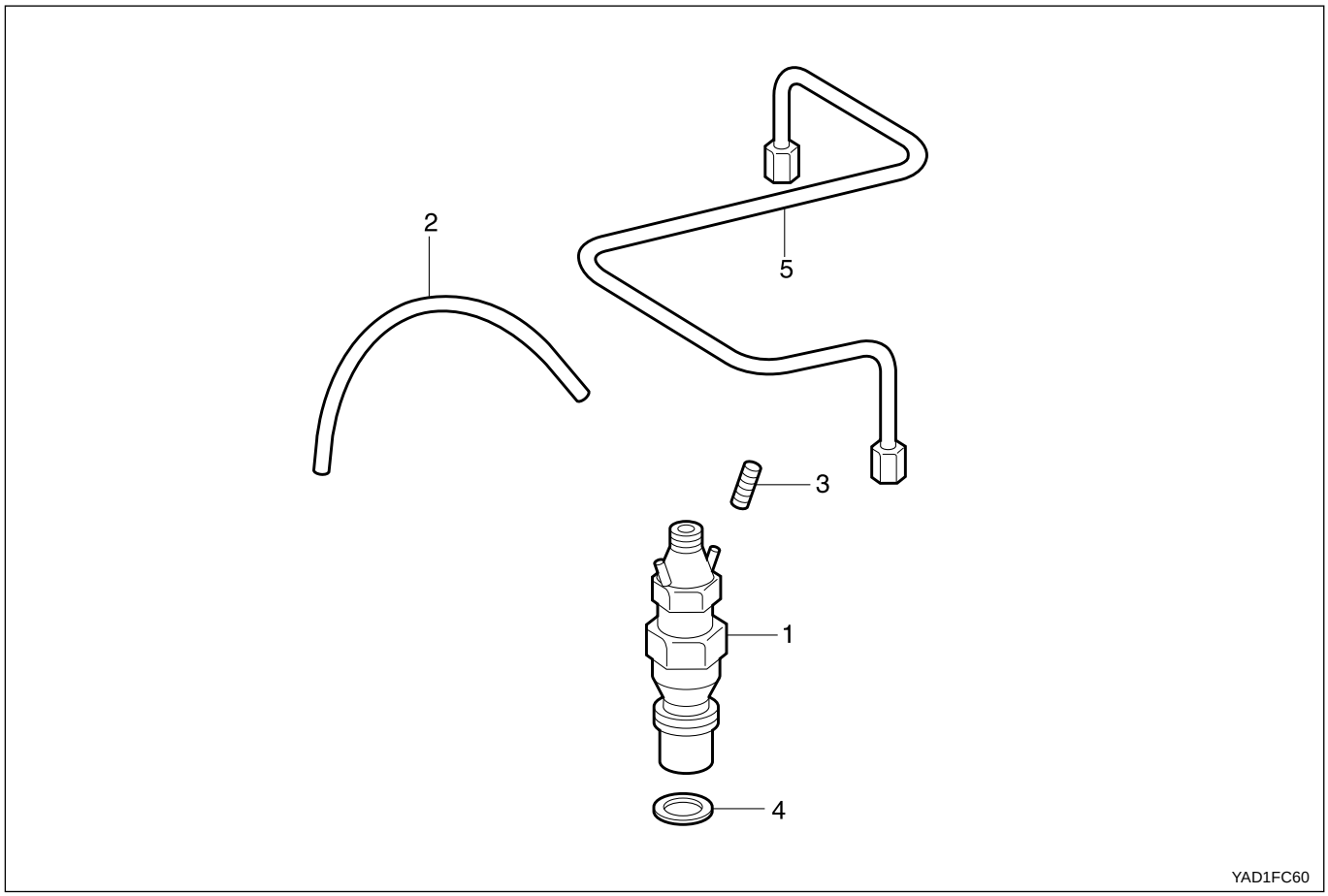
Tightening Torque	17 N•m (10 lb-ft)

3. Remove the fuel pump and gasket.

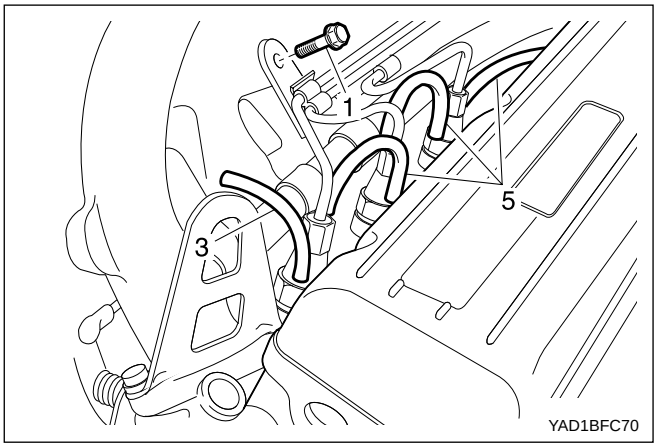


4. Installation should follow the removal procedure in the reverse order.

INJECTION NOZZLES



1 Fuel Injection Nozzle . 35 - 40N•m (26 - 30 lb-ft)
2 Fuel Return Hose
3 Plug
4 Nozzle Washer ..... Replace
5 Fuel Injection Pipe ..... 18 N•m (13 lb-ft)

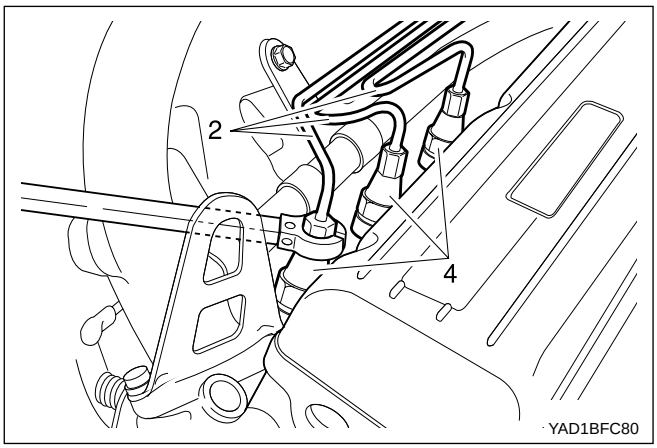


Tools Required

001 589 65 09 00 Serration Wrench

Removal & Installation Procedure

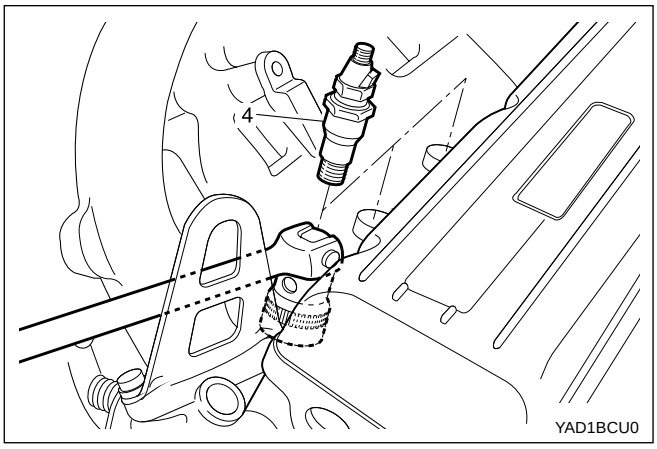
1. Remove the plastic clip from the injection pipe
2. Remove the fuel return hose (5).
3. Remove the plug(3).



4. Disconnect the injection pipes from the injection nozzles and push them to the side.

Installation Notice

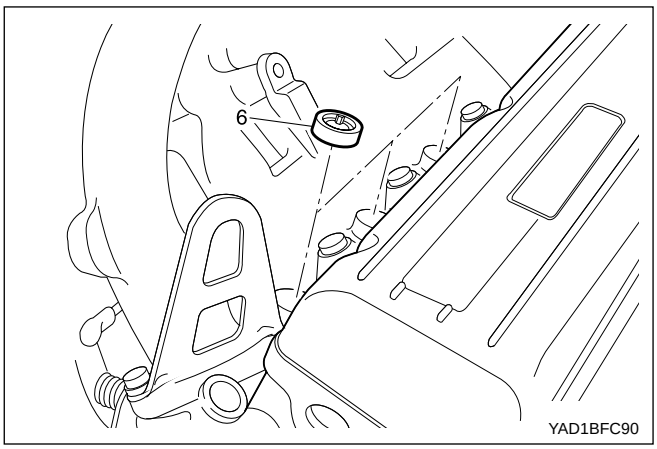
Tightening Torque	18 N•m (13 lb-ft)



5. Remove the fuel injection nozzle (4) with serration wrench 001 589 65 09 00.

Installation Notice

Tightening Torque	35 - 40 N•m (26 - 30 lb-ft)

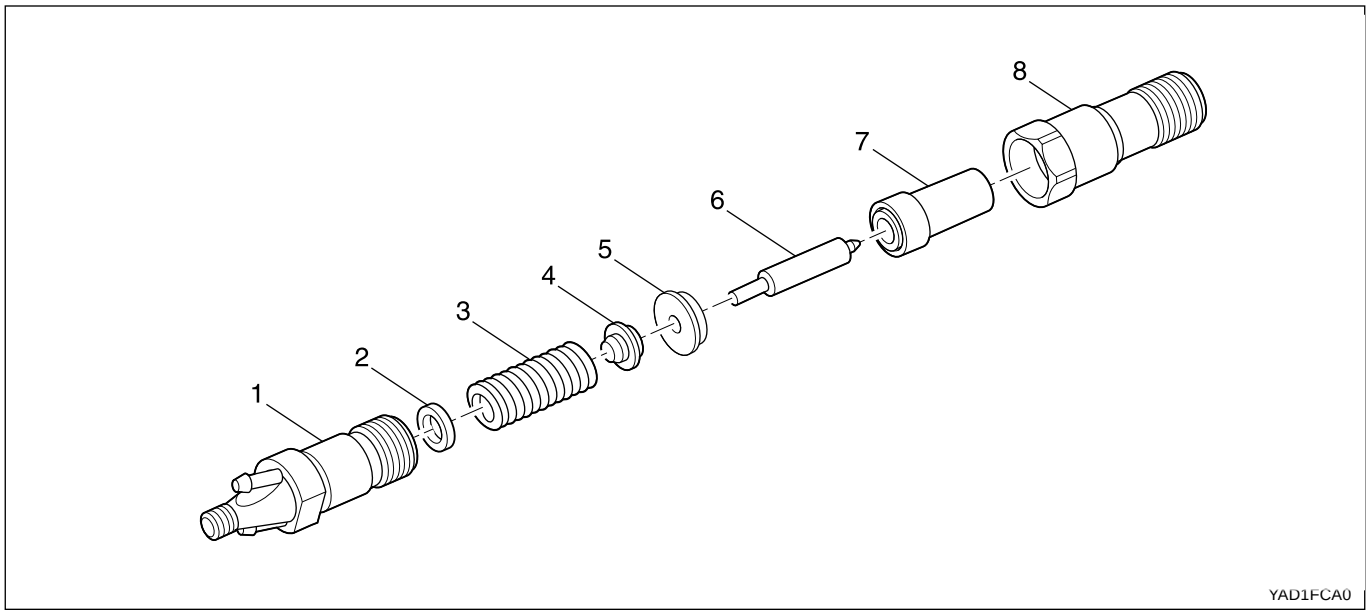


6. Replace the washers (6).
7. Installation should follow the removal procedure in the reverse order.

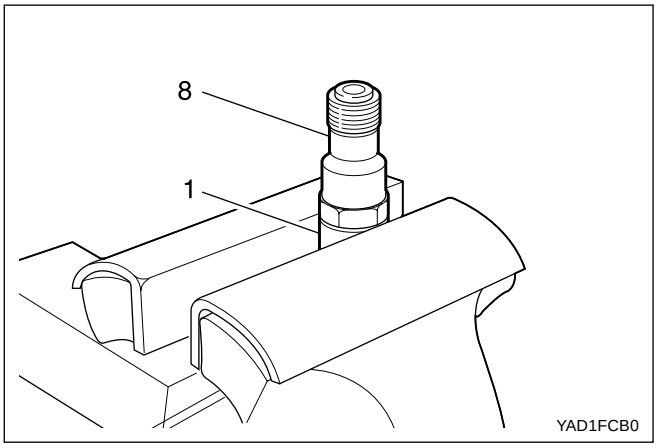
Notice: Pay attention to the installation position of new nozzle washer and tightening torque.

INJECTION NOZZLE REPAIR

Preceding Work: Removal of fuel injection nozzle



1 Nozzle Holder
2 Steel Washer
3 Compression Spring
4 Thrust Pin
5 Intermediate Disc
6 Nozzle Needle
7 Nozzle Body
8 Nozzle Tensioning Nut ..... 80 N•m (59 lb-ft)



Tools Required

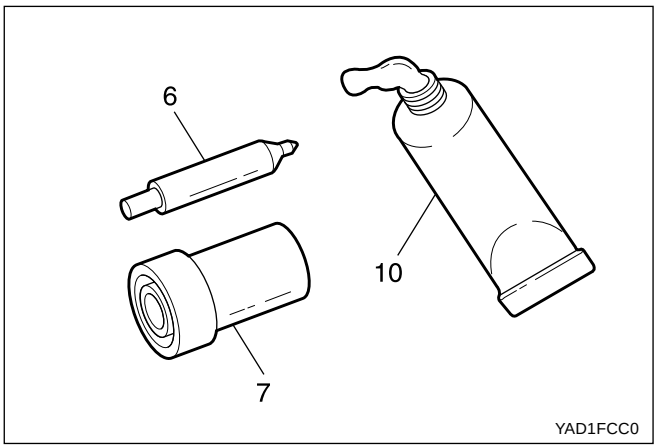
000 589 00 68 00 Cleaning Set

Repair Procedure

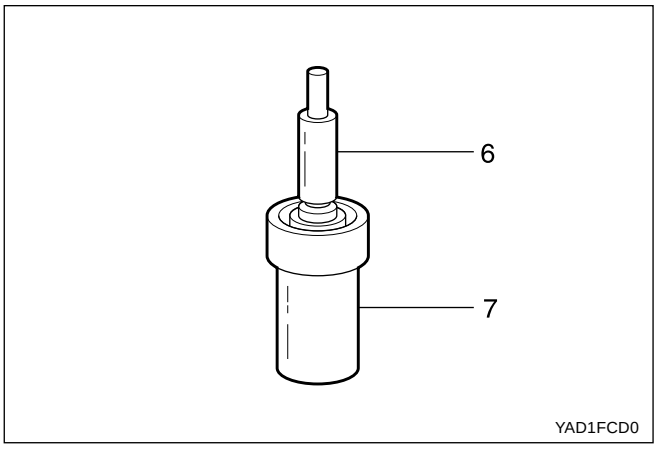
1. Clamp the nozzle holder (1) in a vice and remove the nozzle tensioning nut (8).

   Notice: Use protective jaws for clamping.

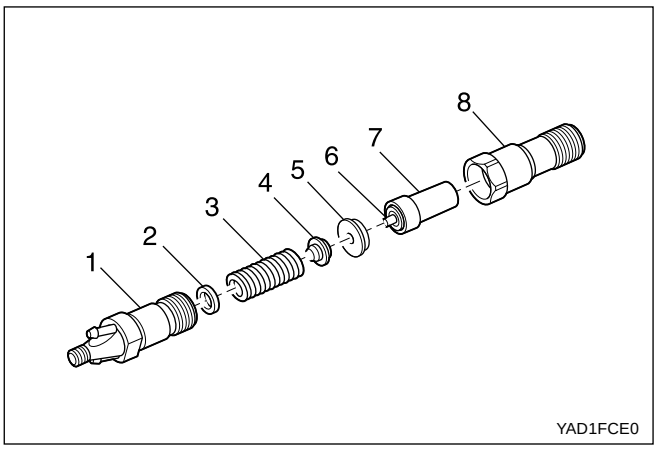
2. Disassemble the fuel injection nozzle.



3. Clean the nozzle needle (6) and nozzle body (7) with an abradant.
4. Clean the nozzle seat with cleaning cutter.



5. Immerse nozzle needle (6) and nozzle body (7) in filtered diesel fuel. When the nozzle body is held vertical, the weight of the nozzle needle must cause it to slide down toward the nozzle needle seat.



6. Assemble the injection nozzle so that the tip of the thrust (4) pin is facing toward the nozzle holder.

   Installation Notice

Tightening Torque	80 N•m (59 lb-ft)

   Nozzle needle (6) and nozzle body (7) should always be replaced as a pair.

7. Check the fuel injection nozzle and adjust opening pressure if necessary.

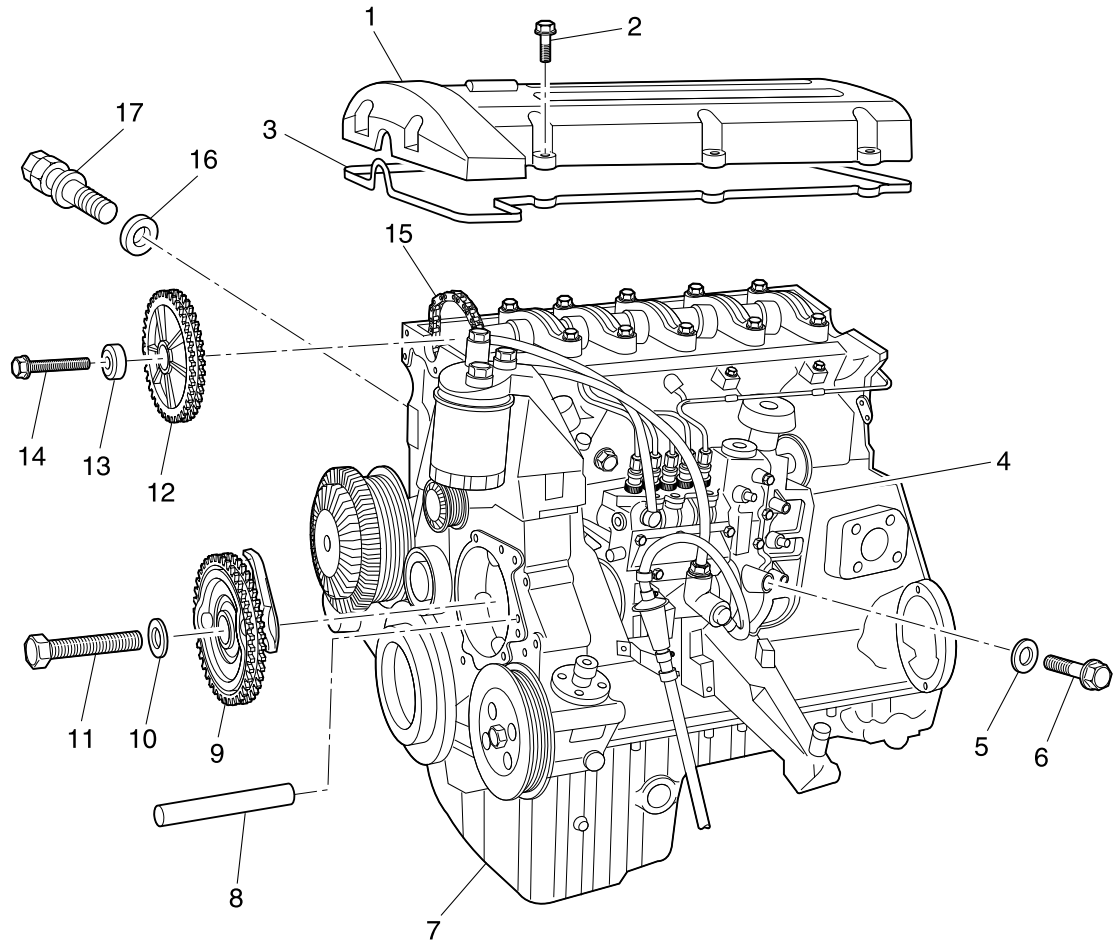
   Opening pressure adjustment

   Disassemble the fuel injection nozzle and replace the steel washer (2).

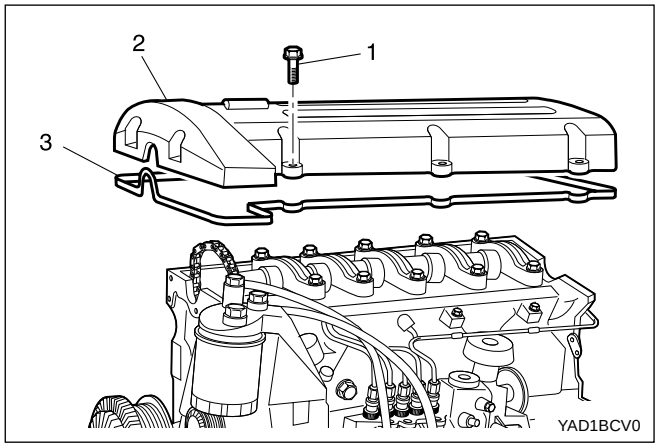
   Notice: Each 0.05 mm thickness of the washer results in a pressure difference of approx. 3 bar.

INJECTION TIMING DEVICE ASSEMBLY

Preceding Work : Removal of vacuum pump



1 Cylinder Head Cover
2 Bolt ..... 10 N•m (89 lb-in)
3 Gasket ..... Replace
4 Fuel Injection Pump
5 Seal ..... Replace
6 Screw Plug ..... 30 N•m (22 lb-ft)
7 Oil Pan
8 Locking Pin
9 Injection Timing Device
10 Washer
11 Bolt (Left-Hand Thread) ..... 46 N•m (34 lb-ft)
12 Camshaft Sprocket
13 Washer
14 12-Sided Stretch Bolt ..... Check, 25 N•m (18 lb-ft)+ 90°
15 Timing Chain
16 Seal
17 Chain Tensioner ..... 80 N•m (59 lb-ft)



Tools Required

116 589 02 34 00 Threaded Bolt
116 589 20 33 00 Sliding Hammer
601 589 00 08 00 Flange
601 589 05 21 00 Locking Screw
667 589 04 63 00 Retaining Plate

Removal & Installation Procedure

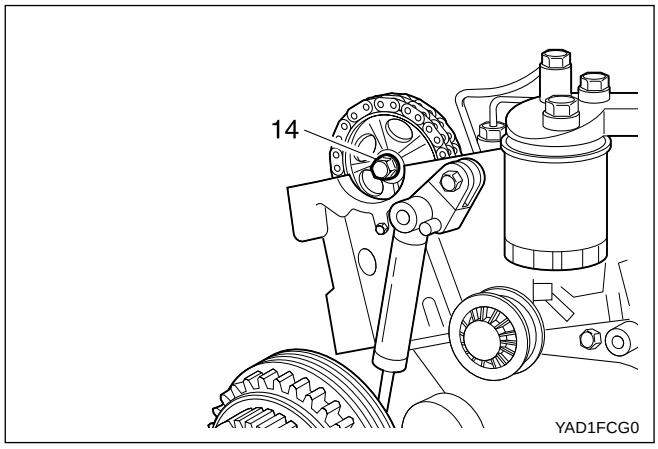
1. Remove the bolts (2) and then remove the cylinder head cover (1) and gasket (3).

   Installation Notice

Tightening Torque	10 N•m (89 lb-in)

   Replace the gasket.

   Rotate the engine 1 revolution by hand and check TDC marking of the crankshaft and camshaft.



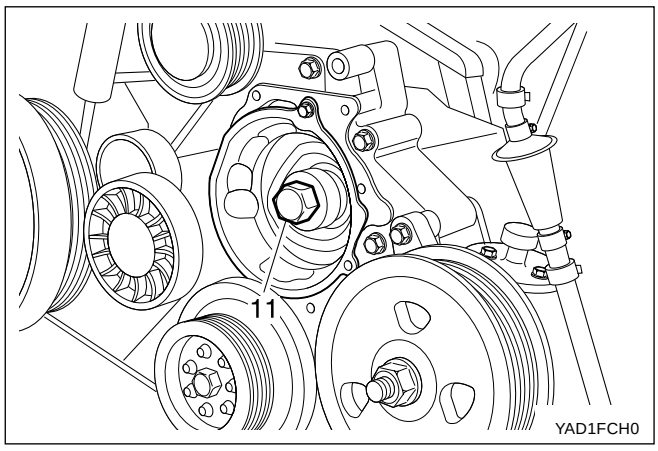
2. Loosen the camshaft sprocket bolt (14).

   Installation Notice

Tightening Torque	25 N•m (18 lb-ft)+ 90°

   Do not remove the bolt.

   If max. length of bolt exceeds 53.6 mm, replace it.

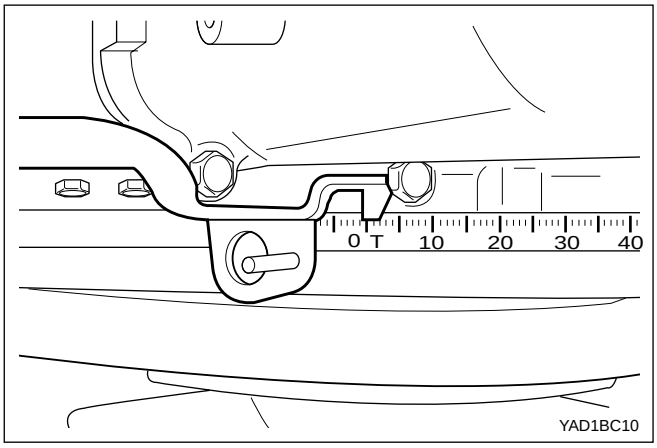


3. Loosen the bolt (11) (left-hand thread).

   Installation Notice

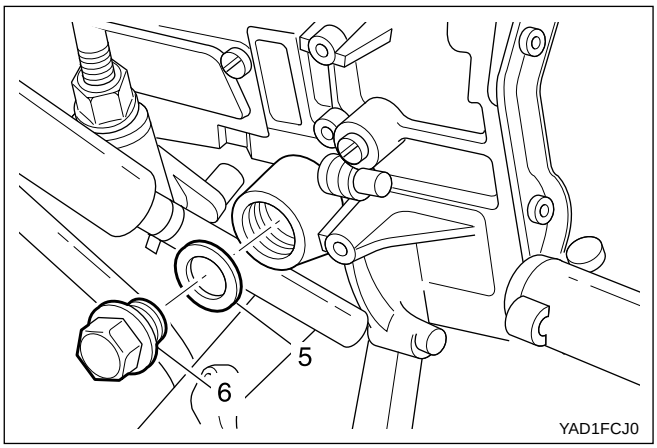
Tightening Torque	46 N•m (34 lb-ft)

   Do not remove the bolt.



4. Position the no.1 cylinder at ATDC 15°.

   Notice: Do not rotate the engine with camshaft sprocket bolt or opposite direction of the engine rotation.

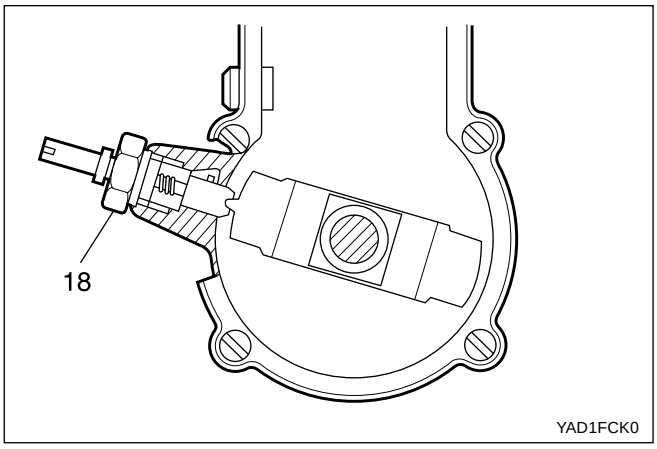


5. Remove the plug (6) and seal (5) from the fuel injection pump and collect oil in a suitable vessel.

   Installation Notice

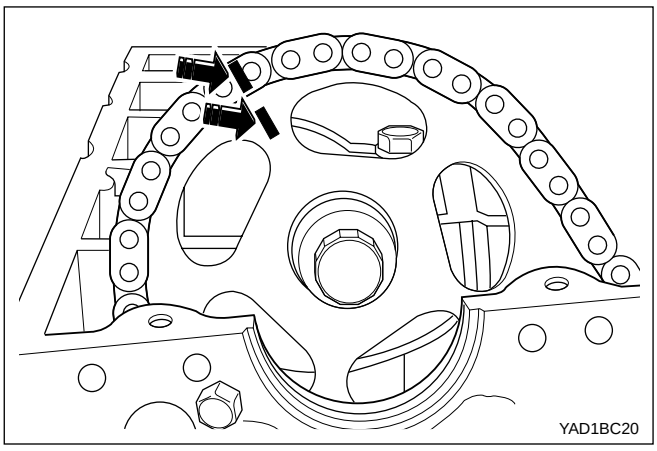
Tightening Torque	30 N•m (22 lb-ft)

   Replace the seal.

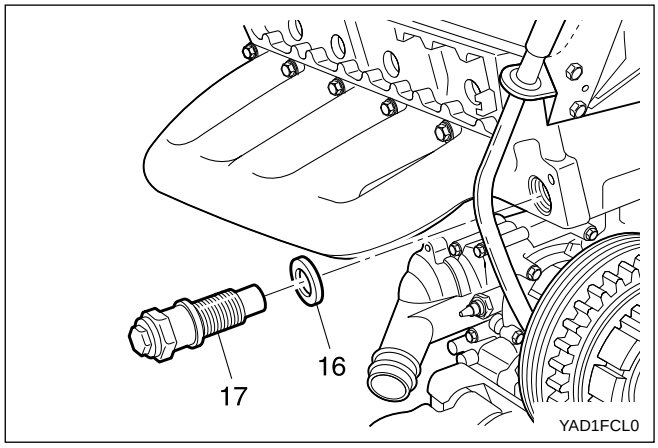


6. Install the locking screw 601 589 05 21 00 (18) into the injection pump.

   Notice: Before tightening the bolts for the injection timing device and the camshaft sprocket, always remove the locking screw 601 589 05 21 00 from the injection pump and reinstall the plug.



7. Place alignment marks (arrow) on the timing chain (12) and camshaft sprocket (15).

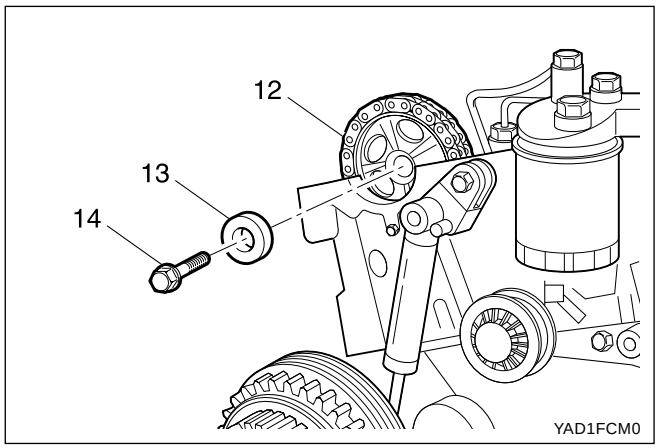


8. Remove the chain tensioner (17).

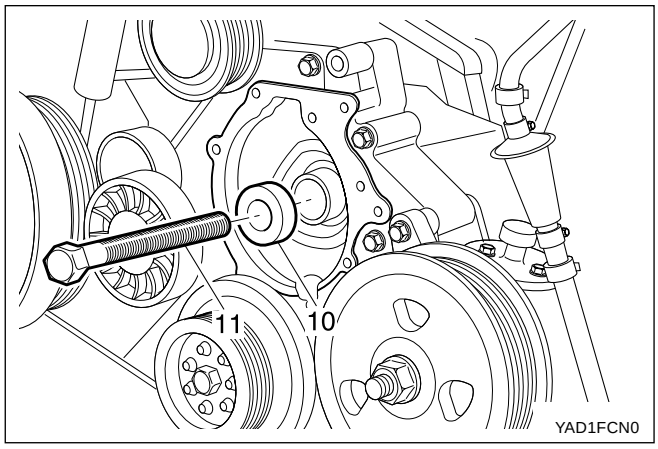
Installation Notice

Tightening Torque	80 N•m (59 lb-ft)

Replace the seal (16).

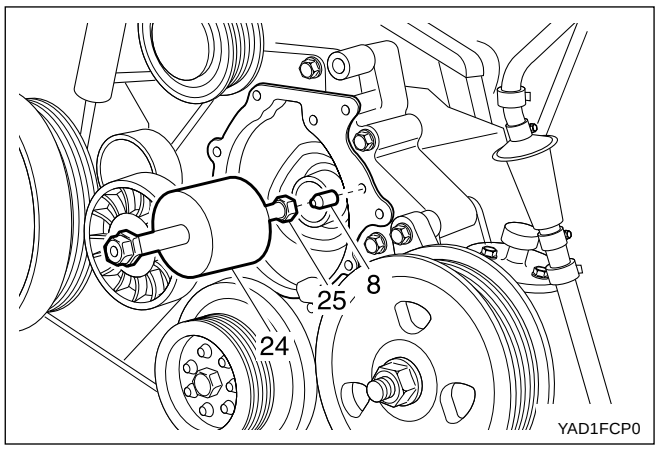


9. Pull out the 12-sided stretch bolt (14) and washer and remove the camshaft sprocket (12).

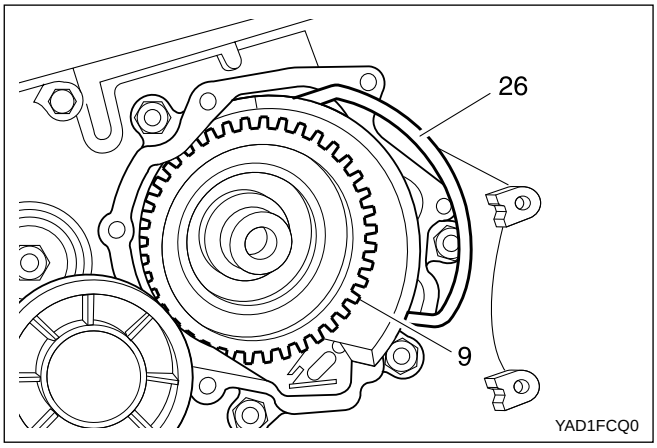


10. Pull out the bolt (11) and washer (10).

Notice: Be careful that the bolt is left-hand thread.



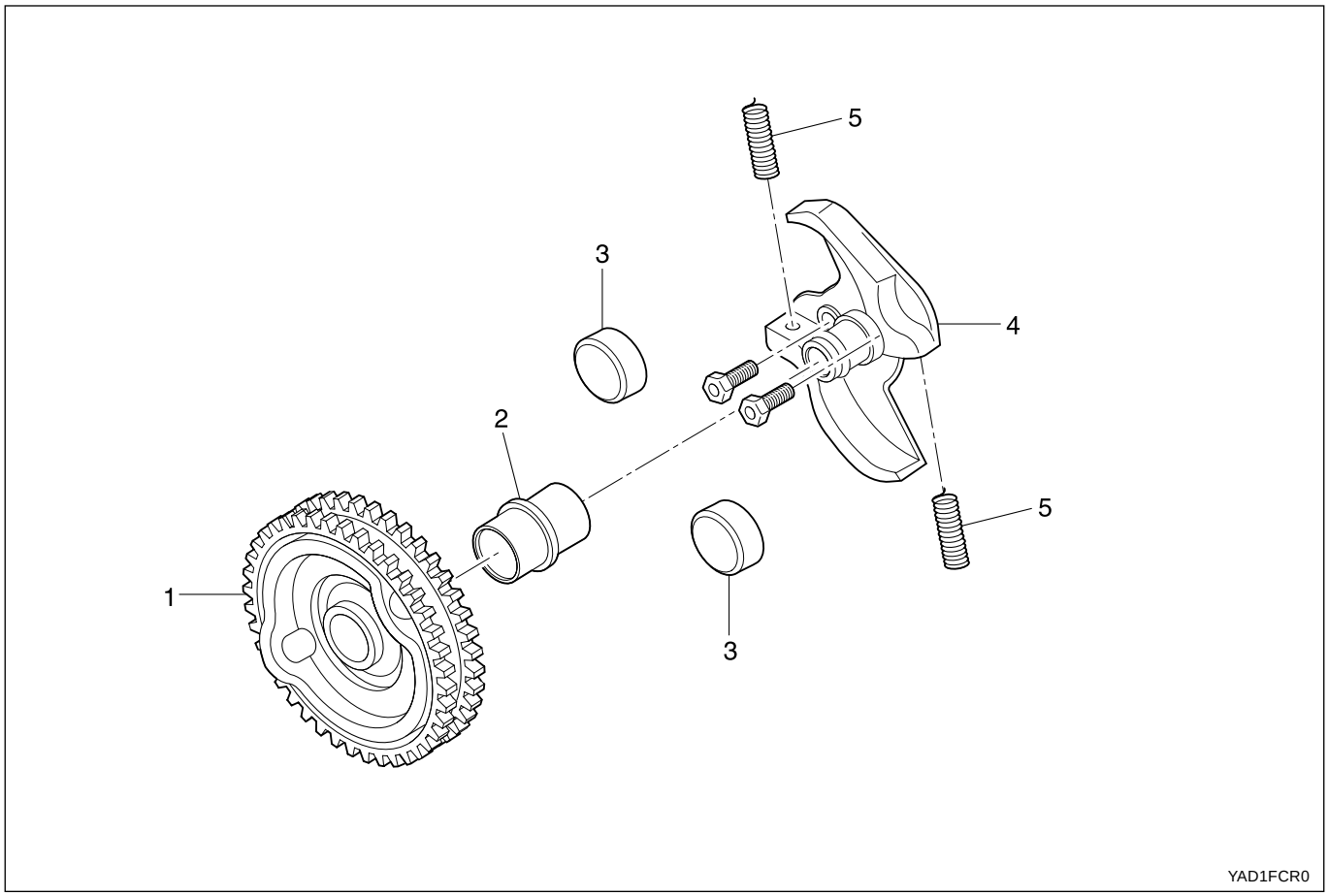
11. Using special tool (Sliding Hammer 116 589 20 33 00 - 24,Threaded bolt 116 589 02 34 00 - 25), remove the locking pin (8).



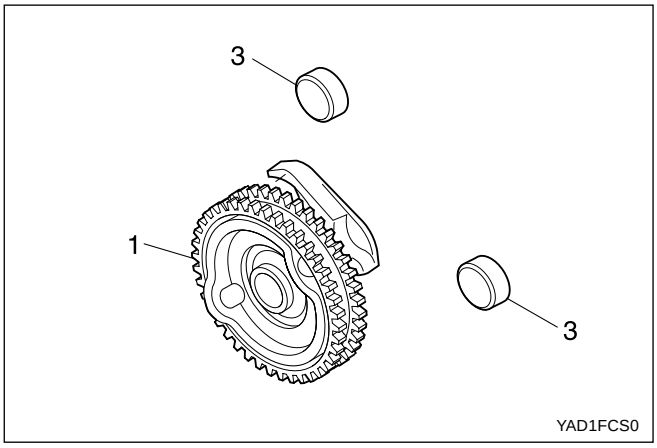
12. Push back the timing chain with retaining plate 667 589 04 63 00 (26) and remove the injection timing device (9).
13. Installation should follow the removal procedure in the reverse order.
14. After assembling the engine, check start of delivery and adjust if necessary.

INJECTION TIMING DEVICE

Preceding Work: Removal of injection timing device assembly

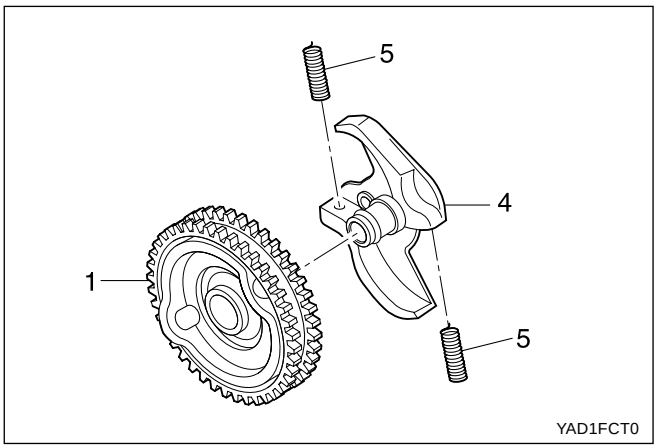


1 Cam Sprocket ..... Check
2 Bushing ..... Check
3 Governor Weights
4 Segment Flange and Drive Hub
5 Compression Springs

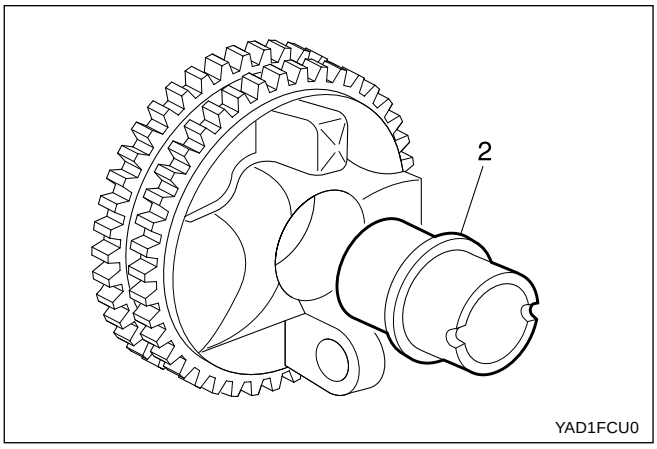


Removal & Installation Procedure

1. Remove the governor weights (3).



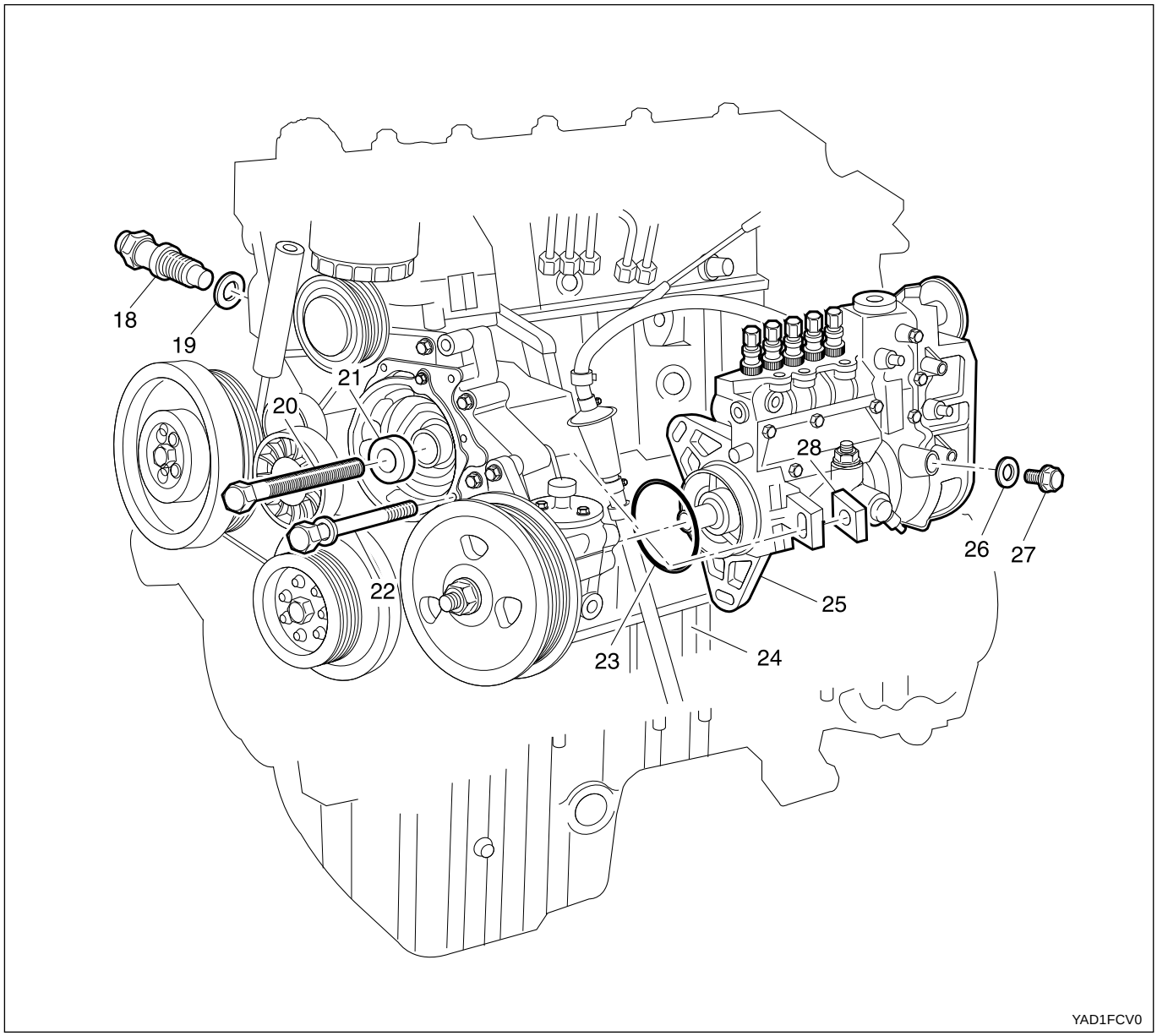
2. Pull out the compression springs (5) and cam sprocket (1) from the segment flange (4).



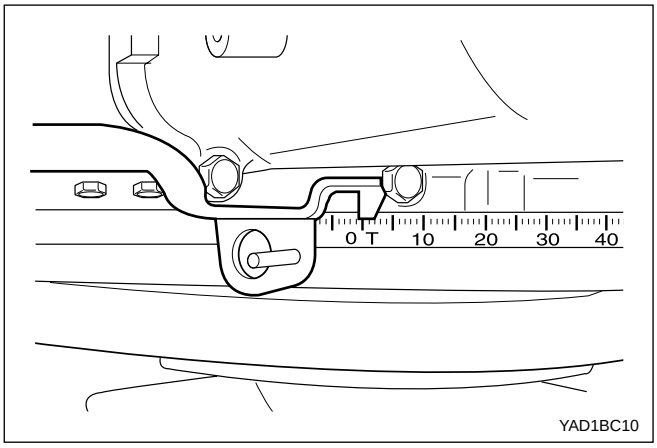
3. Knock out the bushing (2) with a proper drift.
4. Installation should follow the removal procedure in the reverse order.

FUEL INJECTION PUMP

Preceding Work: Removal of vacuum pump
Removal of air cleaner housing
Removal of intake manifold



18 Chain Tensioner ..... 80 N•m (59 lb-ft)
19 Seal ..... Replace
20 Bolt(Left-Hand Thread) ..... 46 N•m (34 lb-ft)
21 Washer
22 Bolt ..... 23 N•m (17 lb-ft)
23 Seal ..... Replace
24 Oil Pan
25 Fuel Injection Pump
26 Seal ..... Replace
27 Screw Plug ..... 30 N•m (22 lb-ft)
28 Square Nut



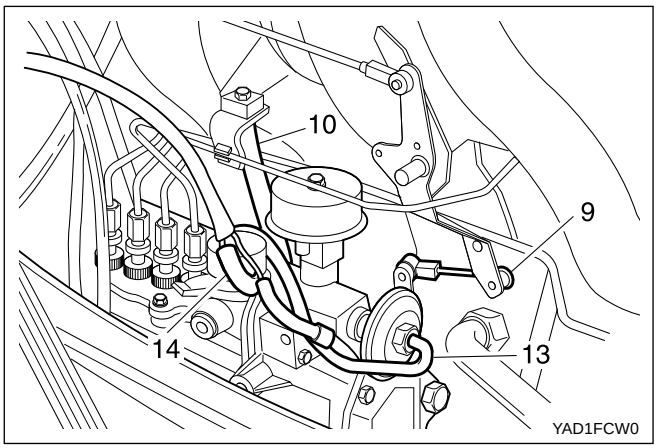
Tools Required

000 589 77 03 00	Box Wrench Insert
601 589 00 08 00	Flange
601 589 05 21 00	Locking Screw
601 589 05 14 00	Assembly Cage

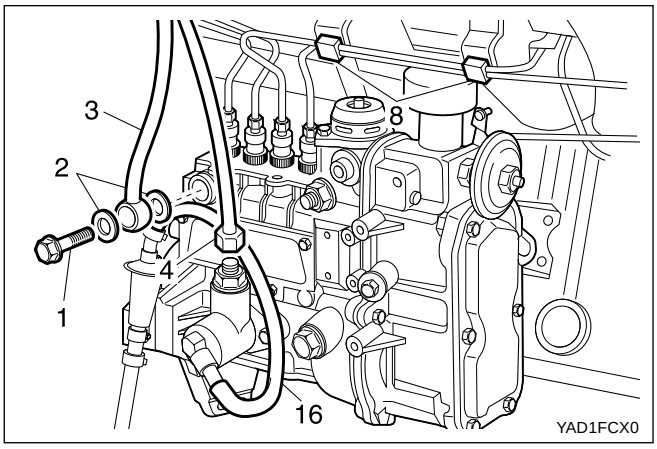
Removal Procedure

1. Position the no.1 cylinder at 15° ATDC.

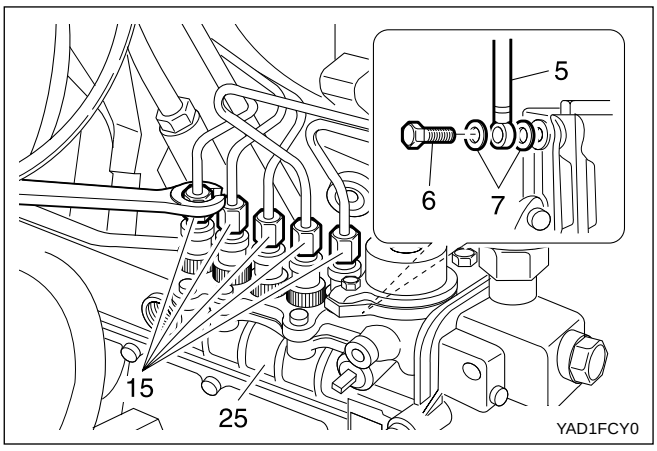
   Notice: Do not rotate the engine in opposition direction of engine rotation.



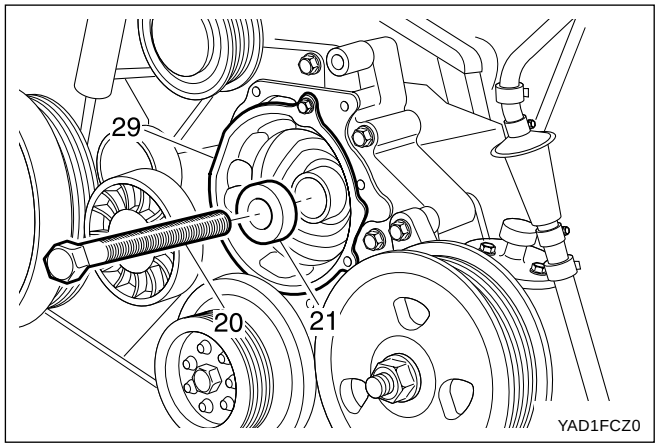
2. Remove the connecting rod (9).
3. Disconnect the vacuum lines (13, 14).
4. Remove the accelerator control damper (10).
   (Manual transmission vehicle)



5. Remove the suction line (16) and pressure line (4).
6. Remove the banjo bolt (1) and then remove the seal (2) and fuel line (3).
7. Remove the plastic clip (8) on the injection line.

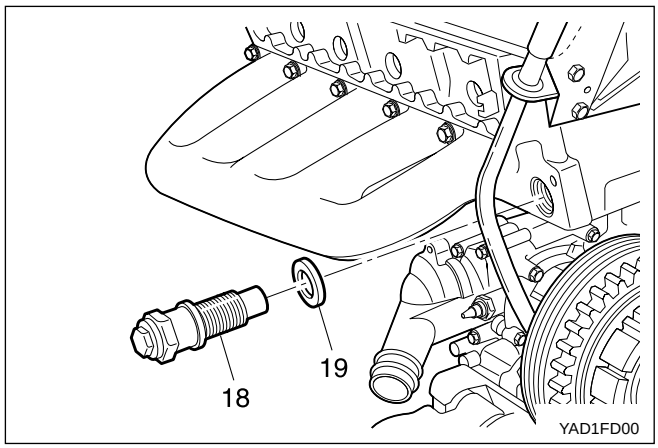


8. Disconnect the injection lines (15) from the injection pump (25).
9. Remove the banjo bolt (6) and then remove the seal (7) and return line (5).

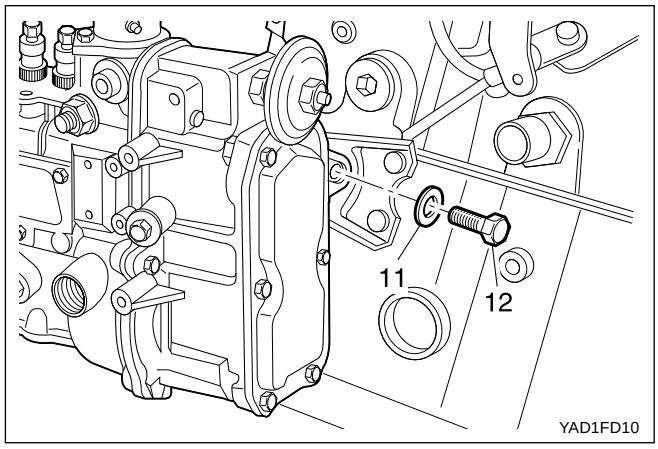


10. Install the assembly cage 601 589 05 14 00 (29) and remove the bolt (20) and pull off the washer (21).

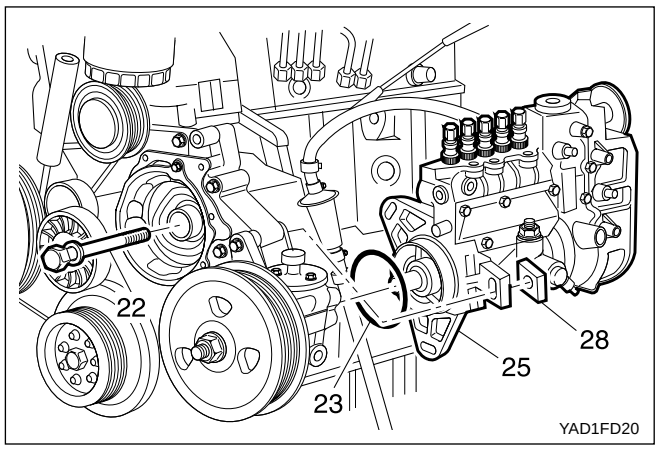
    Notice: Be careful that the bolt (20) is left hand thread.



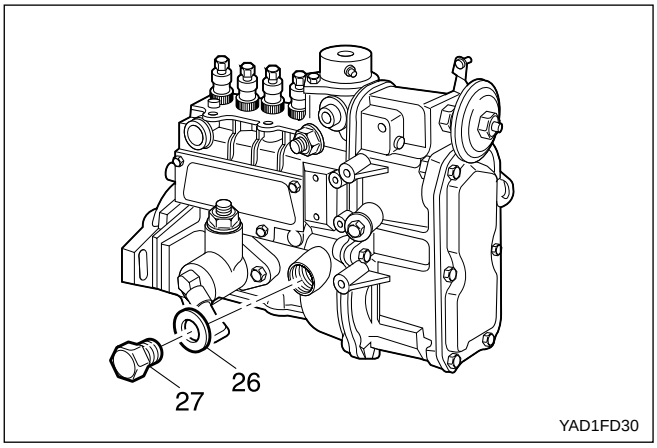
11. Remove the chain tensioner (18) and seal (19).



12. Remove the bolt (12) and pull off the washer (11).

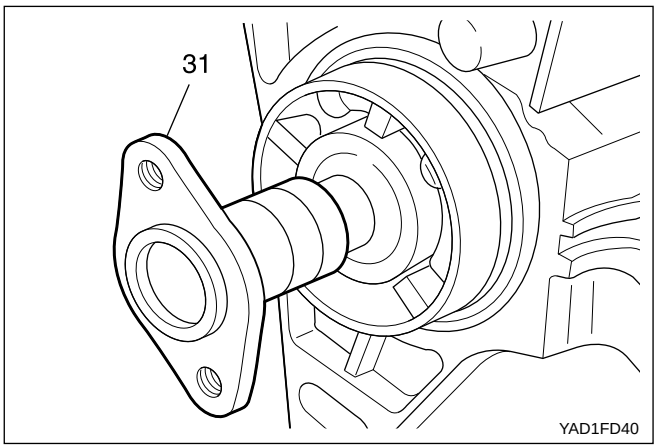


13. Remove the bolt (22) and pull off the square nut (28).
14. Pull out the fuel injection pump (25) and seal (23).

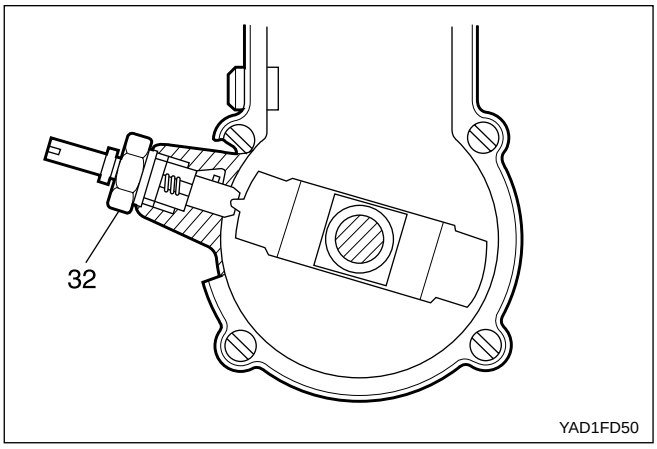


Installation Procedure

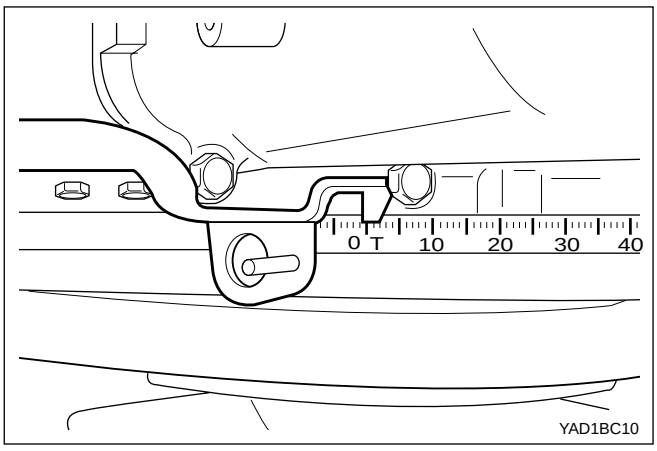
1. Remove the screw plug (27) and seal (26) and collect oil in a vessel.



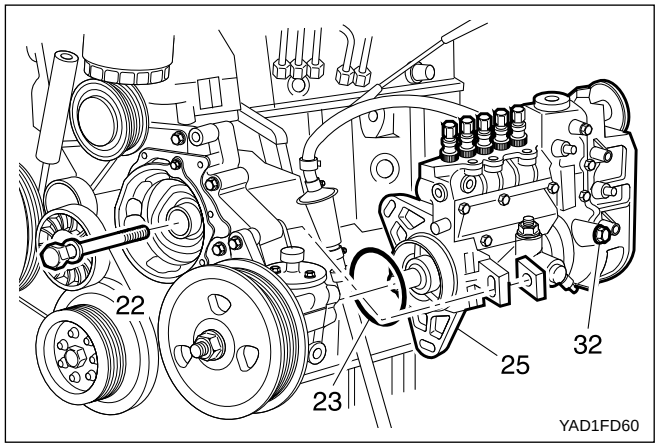
2. Insert flange 601 589 00 08 00 (31) onto the injection pump camshaft and turn until the cam of the governor is visible in the hole.



3. Tighten the locking screw 601 589 05 21 00.



4. Ensure that the no.1 cylinder is positioned at ATDC 15°.

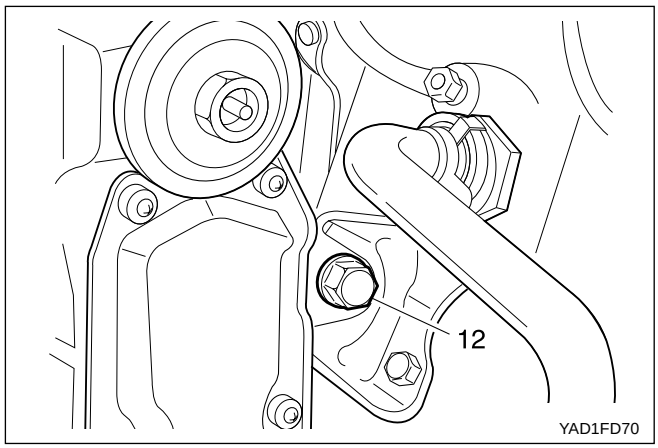


5. Coat the new seal (23) with engine oil and install it.
6. Insert the fuel injection pump (25) and tighten the bolts (22).

Installation Notice

Tightening Torque	23 N•m (17 lb-ft)

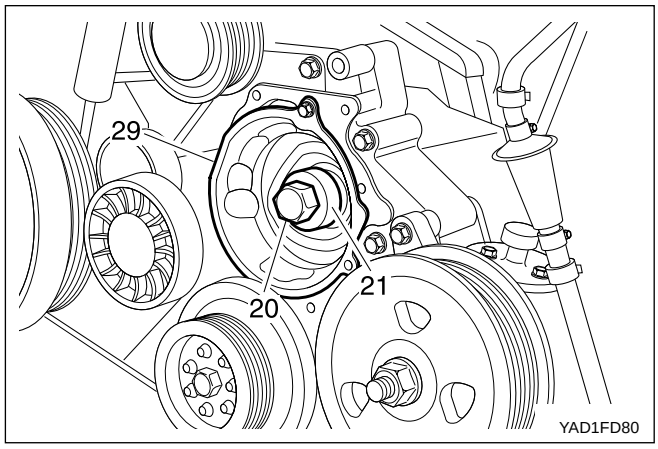
7. Remove the locking screw (32).



8. Tighten the bolt (12).

Installation Notice

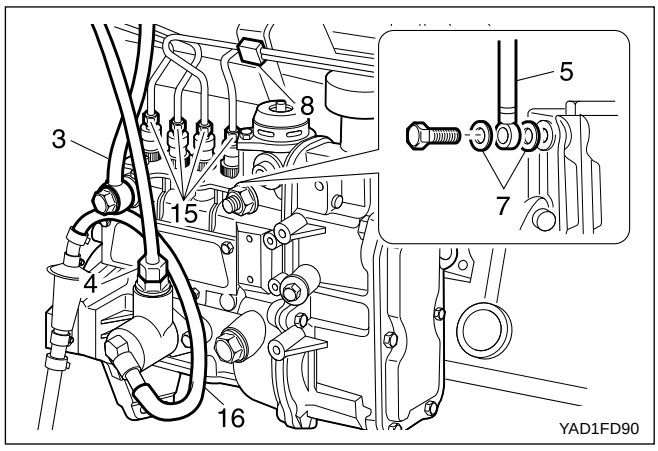
Tightening Torque	23 N•m (17 lb-ft)



9. Insert the washer (21) and tighten the bolts (20) and then remove the assembly cage 601 589 05 14 00 (29).

Installation Notice

Tightening Torque	46 N•m (34 lb-ft)



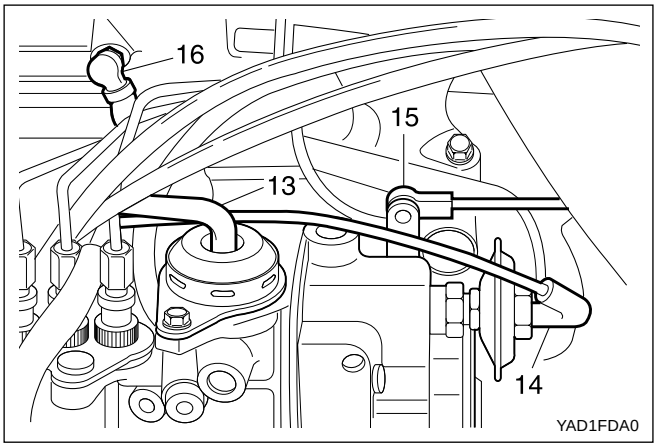
10. Connect the fuel pipes

Installation Notice

Return Line (5)	13 N•m (10 lb-ft)
Fuel Injection Line (15)	18 N•m (13 lb-ft)
Fuel feed Line (3)	13 N•m (10 lb-ft)
Suction and Pressure Line (4)	13 N•m (10 lb-ft)

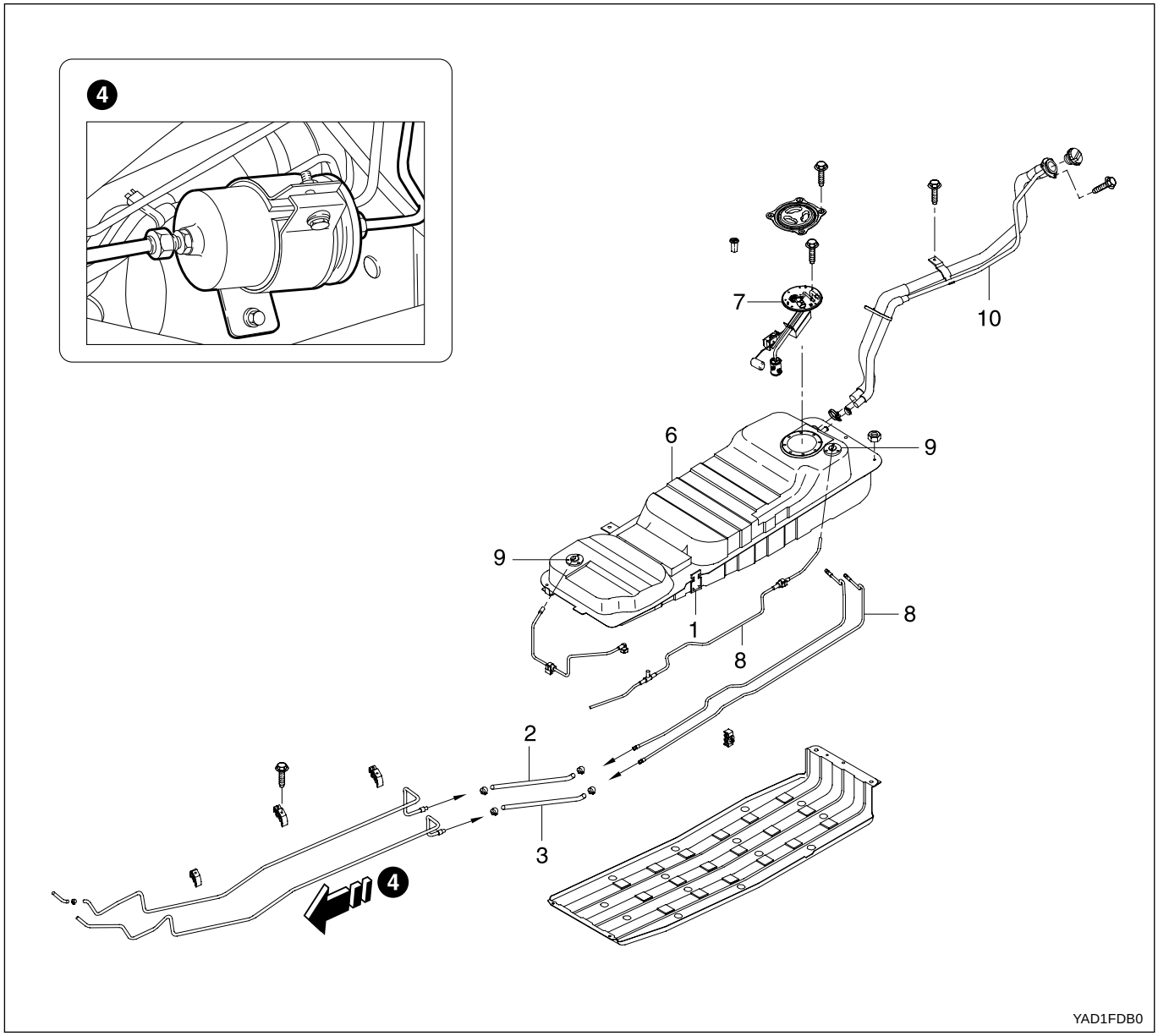
Replace the seal.

11. Assemble the plastic clip (8).

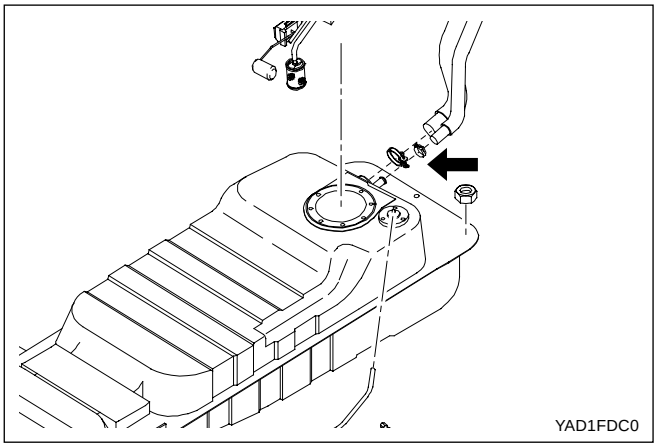


12. Connect the vacuum line (13, 14).
13. Connect the connecting rod (15).
14. connect the accelerator control damper (16). (Manual transmission vehicle)
15. Install the chain tensioner.
16. Install the vacuum pump.
17. Check the start of delivery.
18. Adjust the idle speed.

FUEL TANK



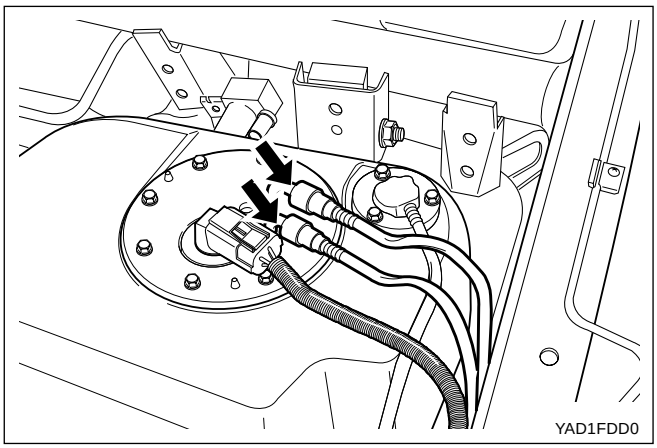
1 Fuel Tank Mounting Bracket
2 Fuel Return Line
3 Fuel Supply Line
4 Fuel Filter
6 Fuel Tank
7 Fuel Pump
8 Fuel Tank Rear Pipe
9 Fuel Tank Air Cap
10 Fuel Filler Assembly



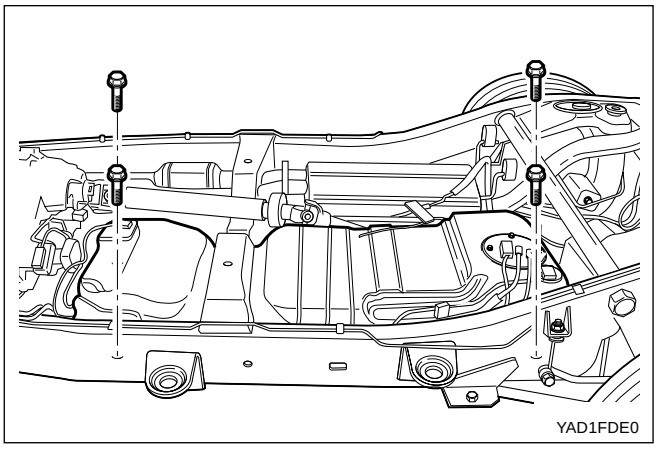
Removal & Installation Procedure

Caution: The fuel system is under pressure. To avoid fuel spillage and the risk of personal injury or fire, it is necessary to relieve the fuel system pressure before disconnecting the fuel lines.

1. Disconnect the negative battery cable.
2. Disconnect the fuel filler hoses.



3. Put aside the floor carpet to remove the fuel pump access cover.
4. Remove the fuel pump access cover.
5. Disconect the fuel return and supply line.
6. Disconnect the fuel pump wiring connector.



7. Remove the fuel pump moumting bolts and bracket.
8. Carefully lower the fuel tank.
9. Installation should follow the removal precedure in the reverse order.

SPECIFICATIONS

GENERAL SPECIFICATIONS

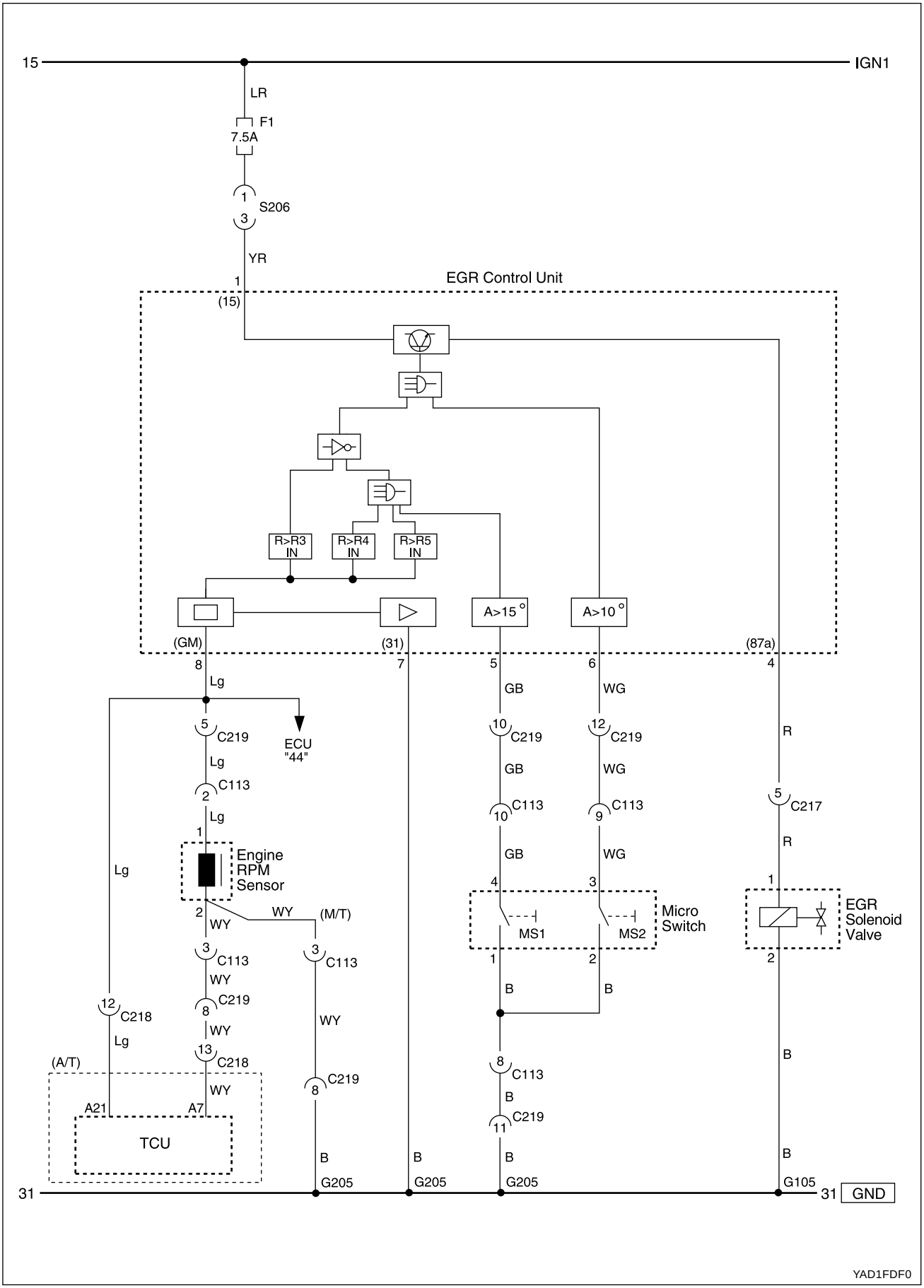
Fuel Distribution Type	Individual Injection Type (Same Number of Cylinder and Plunger)
Number of Cylinders	5 Cylinder
Mounting Type	End Flange Mounting
Drive Type	Inside Chain Connected with Camshaft
Flange Stroke	7 mm
Flange Outside Diameter	5.5 mm
Rack Movement	21 mm
Max. Speed	2,500 rpm
Injected Fuel Quantity / Stroke	35 mm^3 / Stroke
Lubrication Type	Sump Lubrication Type (Connected with Engine Oil Passage)

FASTENER TIGHTENING SPECIFICATIONS

Application	N•m	Lb - Ft	Lb - In
Camshaft Sprocket Bolt	25 + 90°	18 + 90°	-
Chain Tensioner	80	59	-
Cylinder Head Cover Bolt	10	-	89
Fuel Feed Line (at Fuel Injection Pump)	13	10	-
Fuel Injection Nozzle	35 - 40	26 - 30	-
Fuel Injection Pipe	18	13	-
Fuel Injection Pump Mounting Bolt (at the Timing Cast Cover)	23	17	-
Fuel Injection Pump Supporting Bracket Bolt	23	17	-
Fuel Line Bolt (at Fuel Filter)	13	10	-
Fuel Pressure Line (at Fuel Pump)	13	10	-
Fuel Return Line (at Fuel Injection Pump)	13	10	-
Injection Timing Device Bolt	46	34	-
Nozzle Tensioning Nut	80	59	-
Screw Plug	30	22	-
Vacuum Pump Mounting Bolt	10	-	89

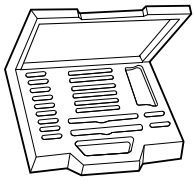
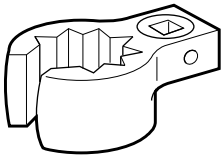
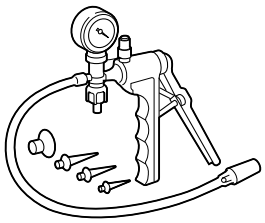
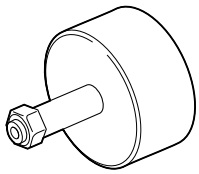
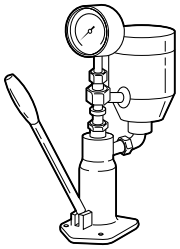
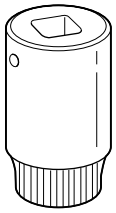
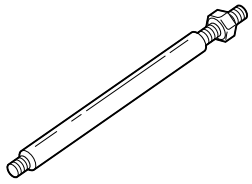
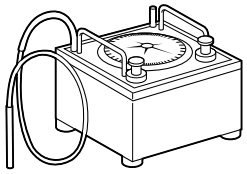
SCHEMATIC AND ROUTING DIAGRAMS

EGR SYSTEM

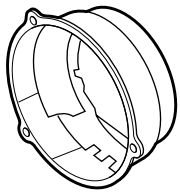
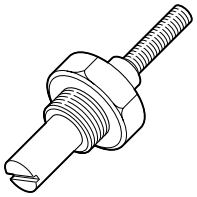
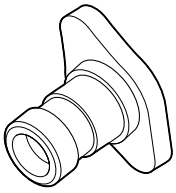
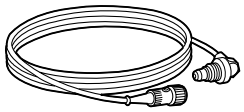
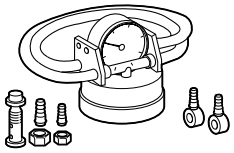
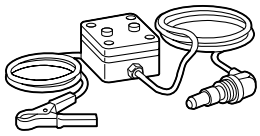
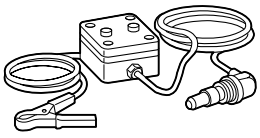
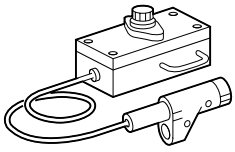


SPECIAL TOOLS AND EQUIPMENT

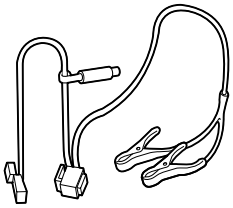
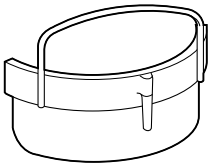
SPECIAL TOOLS TABLE

 YAD1FDU0	**000 589 00 68 00** **Cleaning Set**
 YAD1FDT0	**000 589 77 03 00** **Box Wrench Insert**
 YAD1A190	**001 589 73 21 00** **Vacuum Pump**
 YAD1B580	**116 589 20 33 00** **Sliding Hammer**
 YAD1FDK0	**000 589 14 27 00** **Fuel Injection Nozzle Tester**
 YAD1BKB0	**001 589 65 09 00** **Serration Wrench**
 YAD1BLH0	**116 589 02 34 00** **Threaded Bolt**
 YAD1FDG0	**201 589 13 21 00** **Vacuum Tester**

SPECIAL TOOLS TABLE (Cont'd)

 YAD1FDS0	**601 589 05 14 00** **Assembly Cage**	 YAD1FDQ0	**601 589 05 21 00** **Locking Sensor**
 YAD1FDP0	**610 589 00 08 00** **Flange**	 YAD1FDN0	**617 589 00 21 00** **Ri Sensor**
 YAD1FDJ0	**617 589 04 21 00** **Tester**		**617 589 08 21 01** **Micro Switch Setting Device**
 YAD1FDL0	**617 589 08 21 00** **Position Sensor**	 YAD1FDM0	**617 589 09 21 00** **Ri Adapter**

SPECIAL TOOLS TABLE (Cont'd)

 YAD1FDH0	**667 589 00 21 00** **TDC Pulse Generator**
 YAD1FDR0	**667 589 04 63 00** **Retaining Plate**