

FUEL SYSTEM

NOTE: For troubleshooting procedures, refer to DIESEL ENGINE DIAGNOSIS (EM Section).

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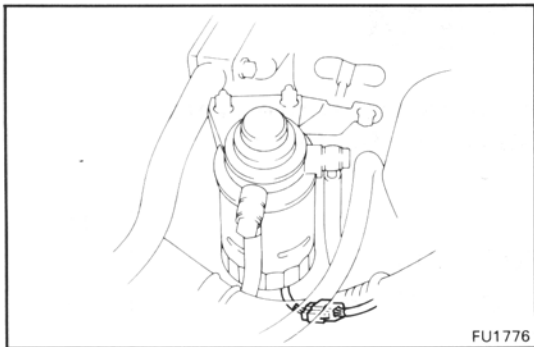
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REPLACEMENT OF FUEL FILTER

1. DISCONNECT FUEL FILTER WARNING SWITCH CONNECTOR

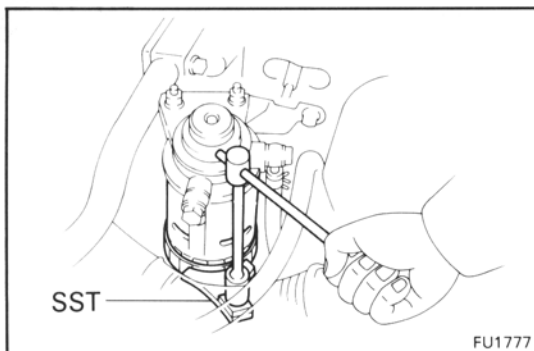
2. DRAIN FUEL FROM FUEL FILTER

NOTE: Put a suitable container or shop towel under the fuel filter.



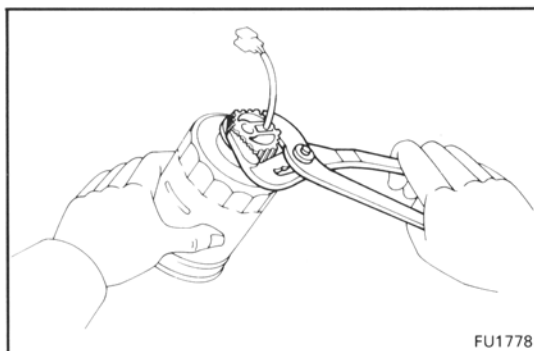
3. REMOVE FUEL FILTER

(a) Using SST, remove the fuel filter with the gasket.
SST 09228-64010



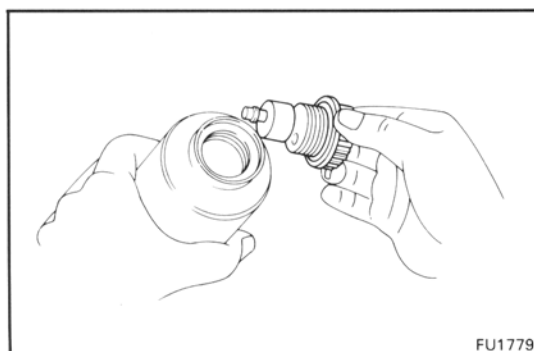
(b) Using pliers, remove the fuel filter warning switch with the O-ring.

CAUTION: Be careful not to damage the warning switch.

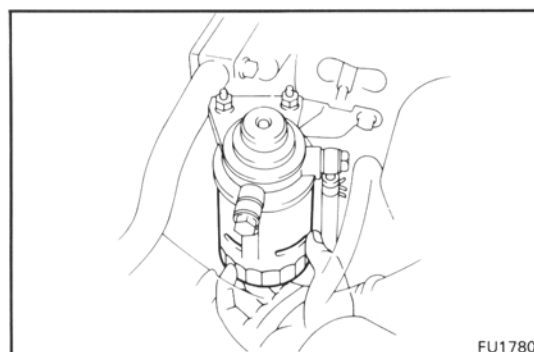


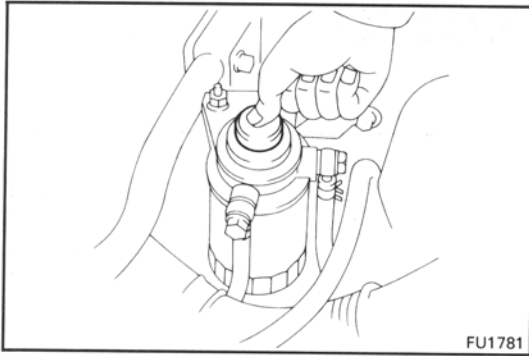
4. INSTALL NEW FUEL FILTER

(a) Install a new O-ring to the fuel filter warning switch.
(b) Apply fuel to the O-ring of the fuel filter warning switch.
(c) Install the fuel filter warning switch to the fuel filter by hand.



(d) Apply fuel to the gasket of the new fuel filter.
(e) Install the fuel filter to the fuel filter bracket by hand.





5. CONNECT FUEL FILTER WARNING SWITCH CONNECTOR

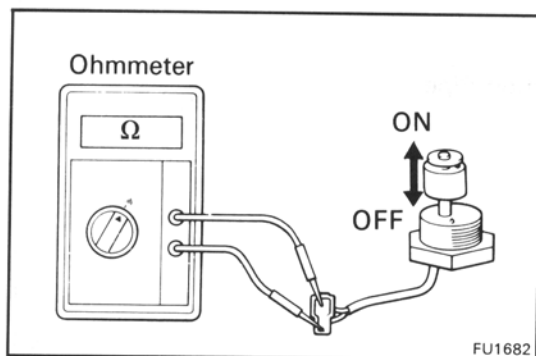
6. CHECK FOR FUEL LEAKS

Using a priming pump, fill with fuel and check for leaks.

FUEL FILTER WARNING SWITCH

INSPECTION OF FUEL FILTER WARNING SWITCH

1. REMOVE FUEL FILTER WARNING SWITCH
(See page FU-2)



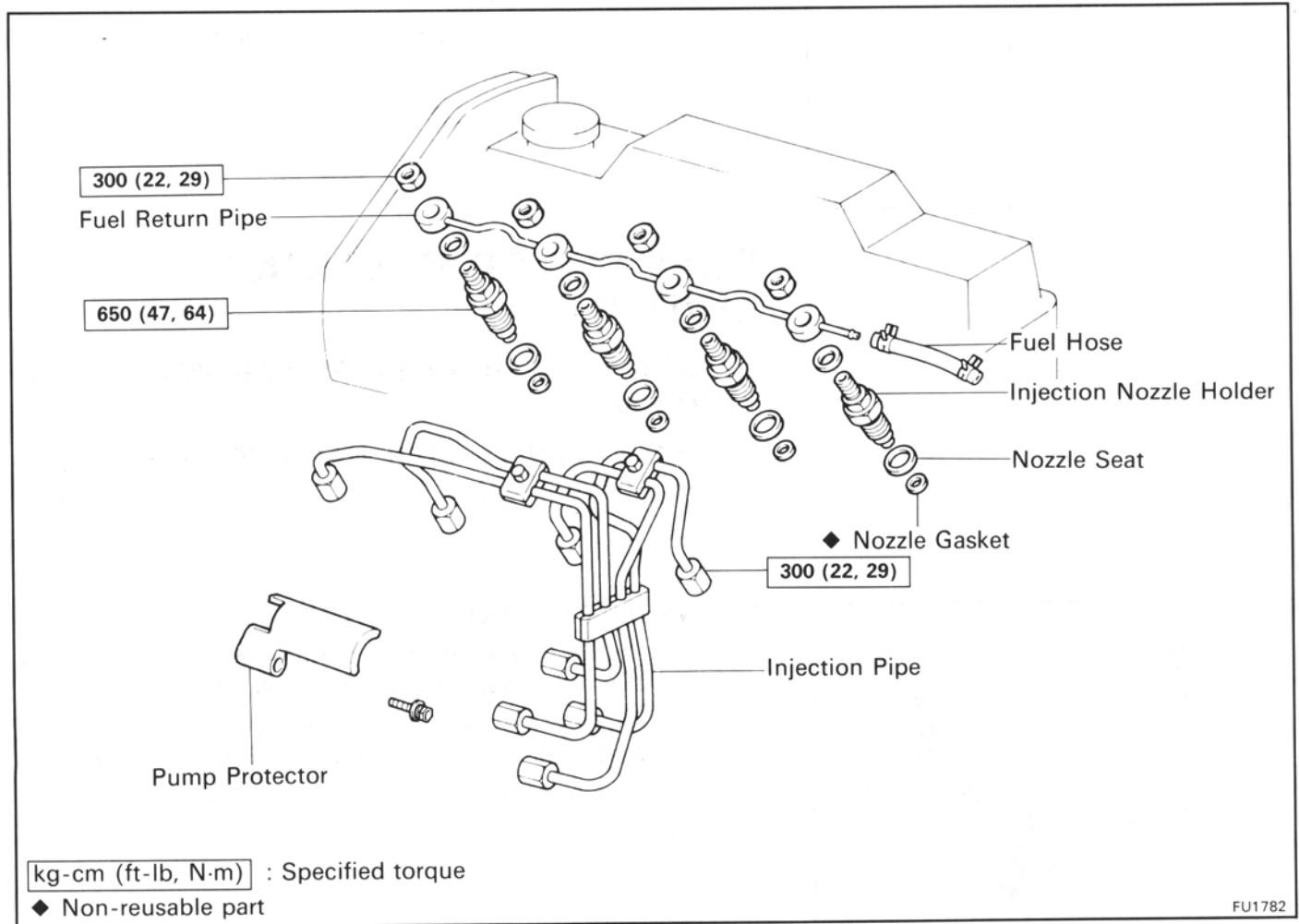
2. INSPECT WARNING SWITCH

- (a) Check that there is continuity between terminals when the warning switch is ON (float up).
- (b) Check that there is no continuity between terminals when the warning switch is OFF (float down).

If operation is not as specified, replace the warning switch.

3. INSTALL FUEL FILTER WARNING SWITCH
(See page FU-2)

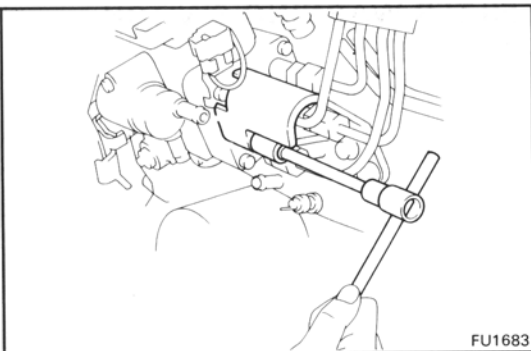
INJECTION NOZZLE COMPONENTS



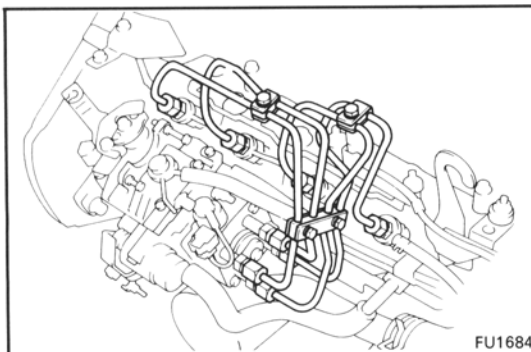
REMOVAL OF INJECTION NOZZLE HOLDERS

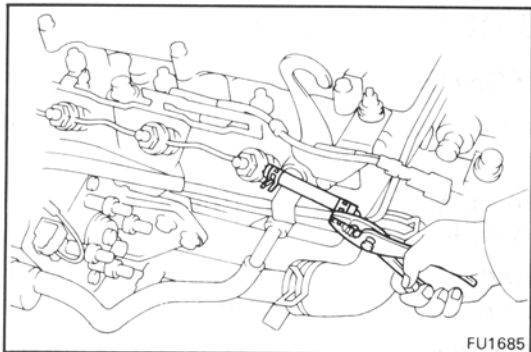
1. REMOVE INJECTION PIPES

(a) Remove the bolt and injection pump protector.



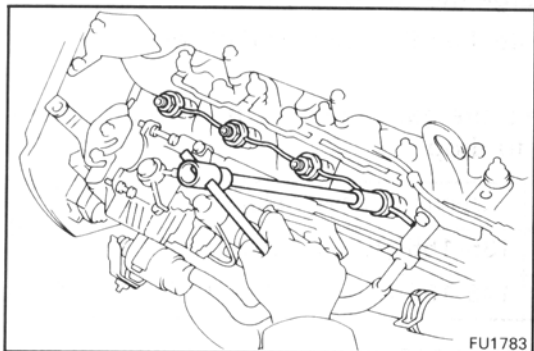
(b) Disconnect both ends of the injection pipes from the injection pump and injection holders.



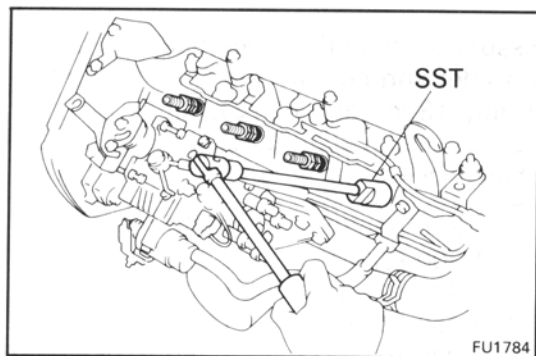


2. REMOVE FUEL RETURN PIPE

(a) Disconnect the fuel hose from the return pipe.



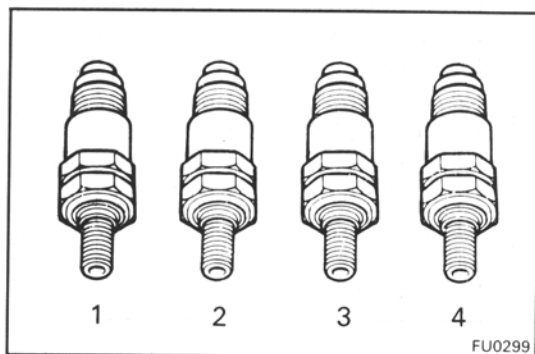
(b) Remove the four lock nuts and return pipe with the four gaskets.



3. REMOVE INJECTION NOZZLE HOLDERS

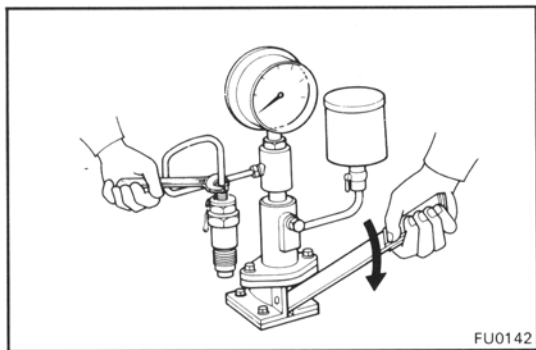
(a) Using SST, remove the four injection nozzle holders.

SST 09268-64010

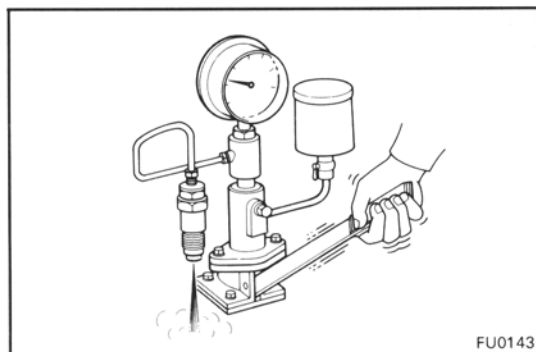


(b) Arrange the injection nozzle holders in order.

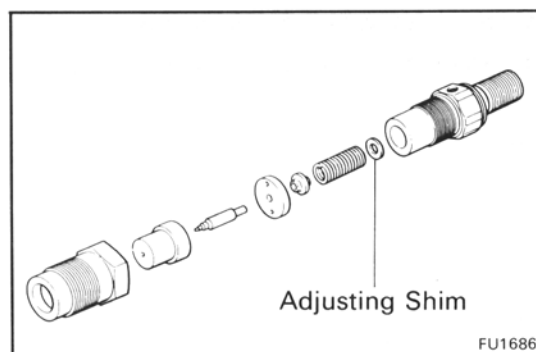
(c) Remove the nozzle seats and nozzle gaskets.



FU0142



FU0143



FU1686

TEST OF INJECTION NOZZLE HOLDERS

1. INJECTION PRESSURE TEST

- (a) Pump the handle several times to flush out nozzle fittings, then tighten the fittings.

WARNING: Do not place your finger over the nozzle injection hole.

- (b) Install the nozzle holder to the injection nozzle hand tester and bleed air from the union nut.
- (c) Pump the tester handle a few times as fast as possible to discharge the carbon from the injection hole.
- (d) Pump the tester handle slowly and observe the pressure gauge.
- (e) Read the pressure gauge just as the injection pressure begins to drop.

	Opening pressure kg/cm ² (psi, kPa)
Reused nozzle	135-155 (1,920-2,205, 13,239-15,200)
New nozzle	145-155 (2,062-2,205, 14,220-15,200)

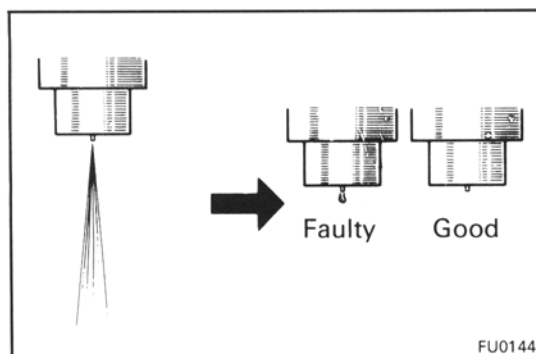
NOTE: Proper nozzle operation can be determined by a swishing sound.

If the opening pressure is not within specification, disassemble the nozzle holder and change the shim in the top of the pressure spring. (See page FU-8).

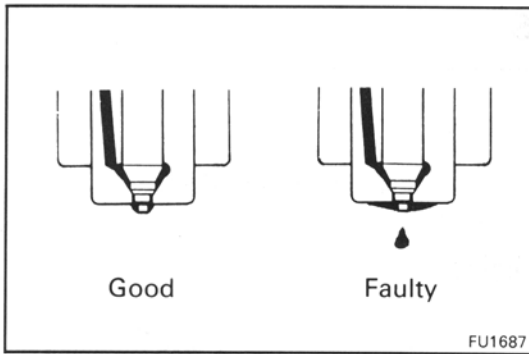
Adjusting shim thickness		mm (in.)
0.900 (0.0354)	1.275 (0.0502)	1.650 (0.0650)
0.925 (0.0364)	1.300 (0.0512)	1.675 (0.0659)
0.950 (0.0374)	1.325 (0.0522)	1.700 (0.0669)
0.975 (0.0384)	1.350 (0.0531)	1.725 (0.0679)
1.000 (0.0394)	1.375 (0.0541)	1.750 (0.0689)
1.025 (0.0404)	1.400 (0.0551)	1.775 (0.0699)
1.050 (0.0413)	1.425 (0.0561)	1.800 (0.0709)
1.075 (0.0423)	1.450 (0.0571)	1.825 (0.0719)
1.100 (0.0433)	1.475 (0.0581)	1.850 (0.0728)
1.125 (0.0443)	1.500 (0.0591)	1.875 (0.0738)
1.150 (0.0453)	1.525 (0.0600)	1.900 (0.0748)
1.175 (0.0463)	1.550 (0.0610)	1.925 (0.0758)
1.200 (0.0472)	1.575 (0.0620)	1.950 (0.0768)
1.225 (0.0482)	1.600 (0.0630)	
1.250 (0.0492)	1.625 (0.0640)	

NOTE:

- Varying the adjusting shim thickness by 0.025 mm (0.0010 in.) changes the injection pressure by about 3.5 kg/cm² (50 psi, 343 kPa).
 - Only one adjusting shim should be used.
 - If adjusting the opening pressure, use the specification for a new nozzle.
- (f) There should be no dripping after injection.



FU0144



2. LEAKAGE TEST

While maintaining pressure at about 10 – 20 kg / cm² (142 – 284 psi, 981 – 1,961 kPa) below opening pressure (adjust by tester handle), check that there is no dripping for 10 seconds from the injection hole or around the retaining nut.

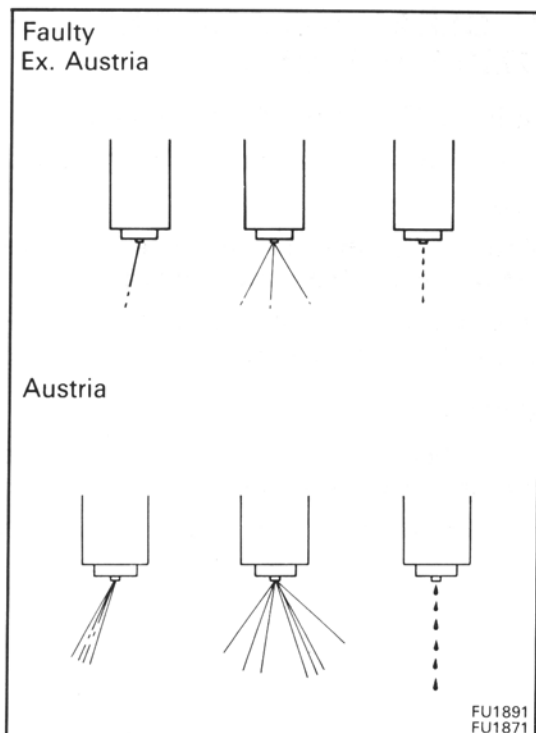
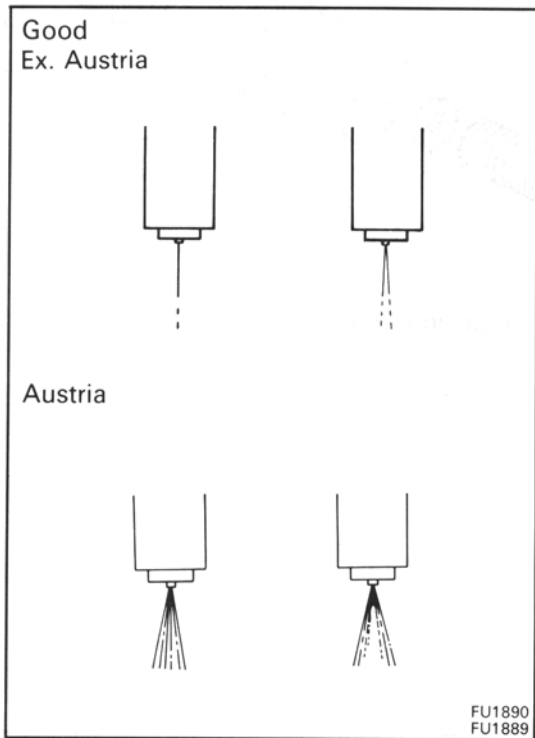
If the nozzle drips within 10 seconds, replace or clean and overhaul the nozzle assembly.

3. SPRAY PATTERN TEST

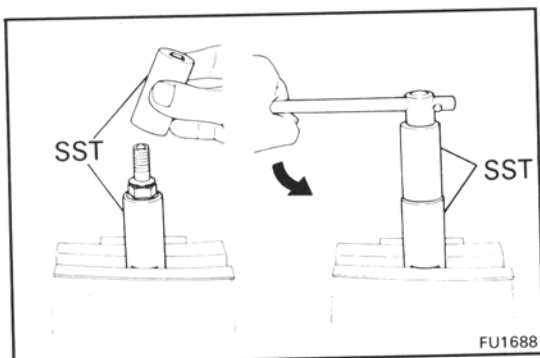
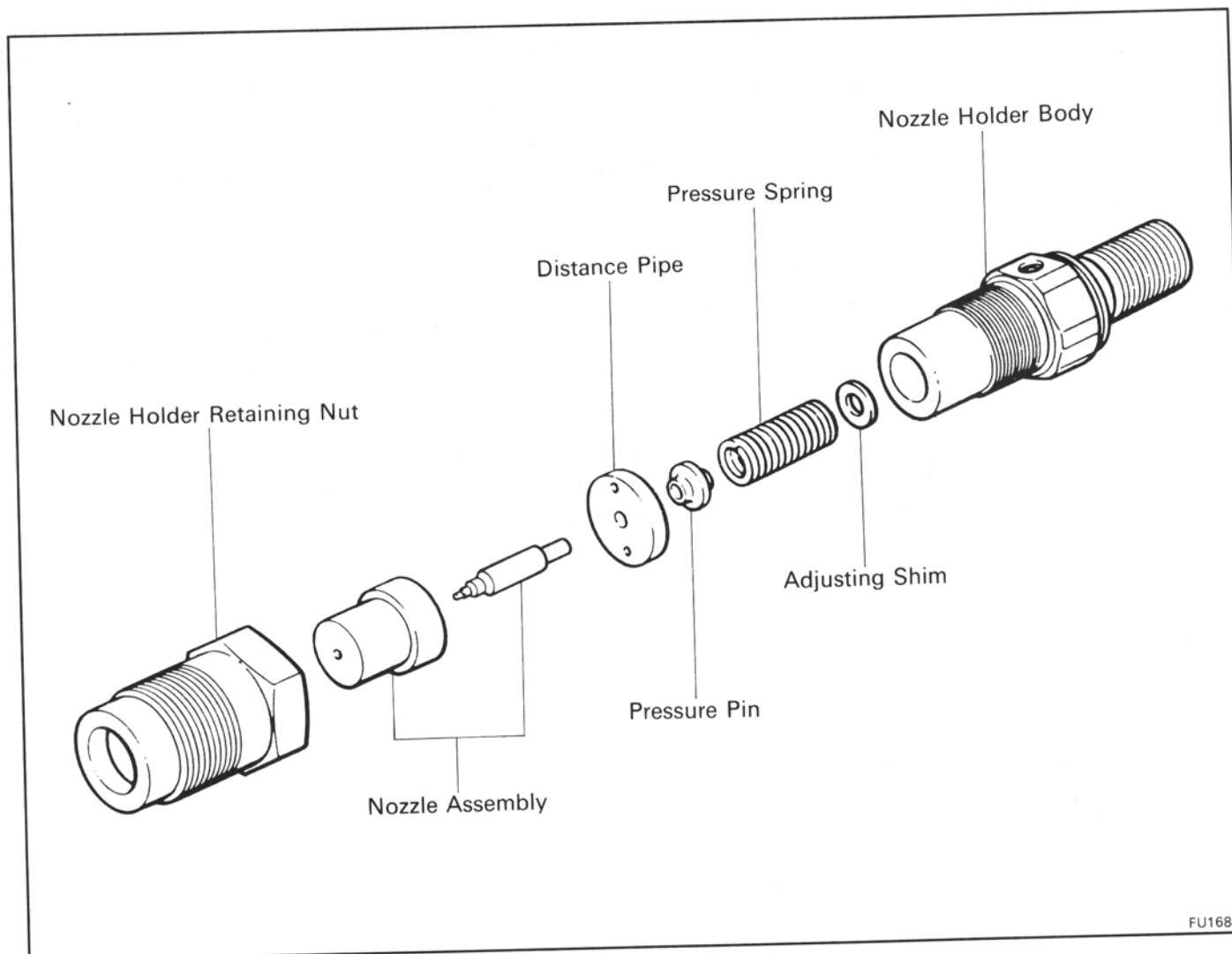
(a) The injection nozzle should shudder at a certain pumping speed between 15 – 60 times (old nozzle) or 30 – 60 times (new nozzle) per minute.

(b) Check the spray pattern during shuddering.

If the spray pattern is not correct during shuddering, the nozzle must be replaced or cleaned.



COMPONENTS



DISASSEMBLY, CLEANING AND TEST OF INJECTION NOZZLE HOLDER

1. DISASSEMBLE INJECTION NOZZLE HOLDER

- (a) Using SST, unscrew the nozzle holder retaining nut. SST 09268-64010

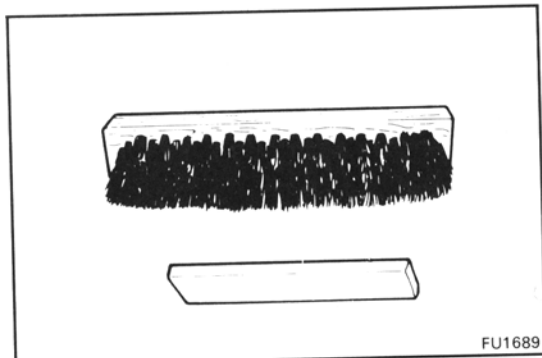
CAUTION: When disassembling the nozzle holder, be careful not to drop the inner parts.

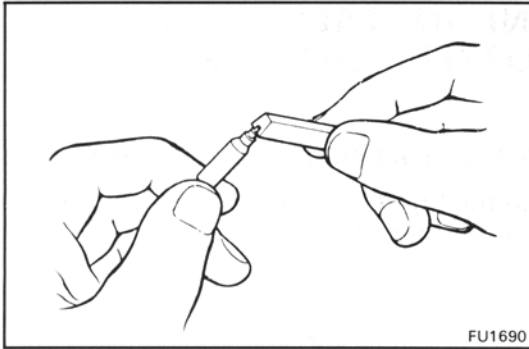
- (b) Remove the pressure spring, shim, pressure pin, distance piece and nozzle assembly.

2. NOZZLE CLEANING

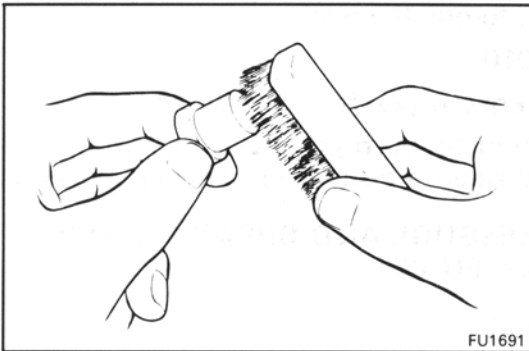
- (a) Use a wooden stick and brass brush to wash the nozzles. Wash in clean diesel fuel.

NOTE: Do not touch the nozzle mating surfaces with your fingers.

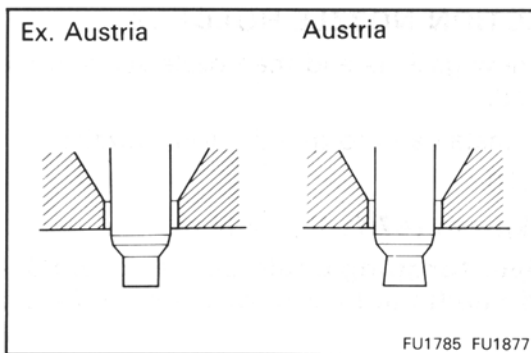




- (b) Use a wooden stick to remove any carbon adhering to the nozzle needle tip.



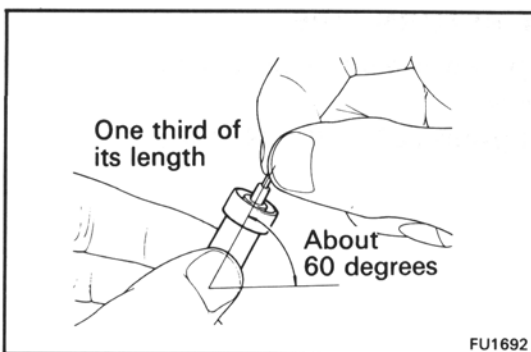
- (c) Remove the carbon from the exterior of the nozzle body (except lapped surface) with a brass brush.



- (d) Inspect the seat of the nozzle body for burns or corrosion.

- (e) Inspect the nozzle needle tip for damage or corrosion.

If any of these conditions are present, replace the nozzle assembly.

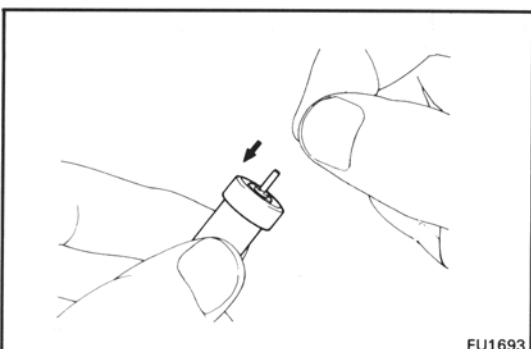


3. SINKING TEST

- (a) Wash the nozzle in clean diesel fuel.

NOTE: Do not touch the nozzle mating surfaces with your fingers.

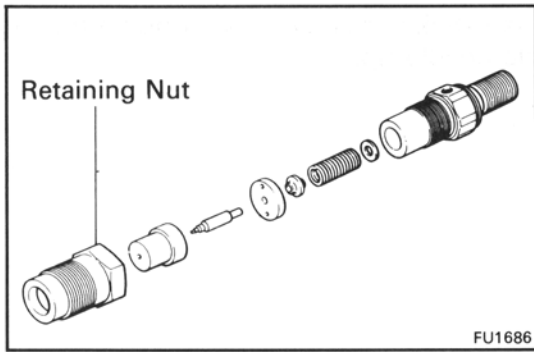
- (b) Tilt the nozzle body about 60 degrees and pull the needle out about one third of its length.



- (c) When released, the needle should sink down into the body vent smoothly by its own weight.

- (d) Repeat this test, rotating the needle slightly each time.

If the needle does not sink freely, replace the nozzle assembly.



ASSEMBLY AND INSTALLATION OF INJECTION NOZZLE HOLDERS

(See page FU-8)

1. ASSEMBLY INJECTION NOZZLE HOLDERS

- (a) As shown in the figure, assemble the injection nozzle and finger tighten the retaining nut.

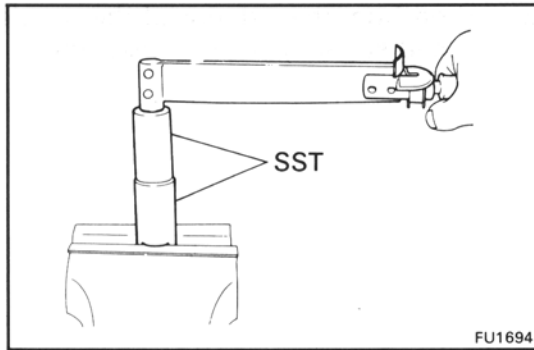
- (b) Using SST, torque the retaining nut.

SST 09268-64010

Torque: 375 kg-cm (27 ft-lb, 37 N·m)

CAUTION: Over torquing could cause nozzle deformation and needle adhesion or other defects.

2. PERFORM PRESSURE AND SPRAY PATTERN TEST (See page FU-6)



3. INSTALL INJECTION NOZZLE HOLDERS

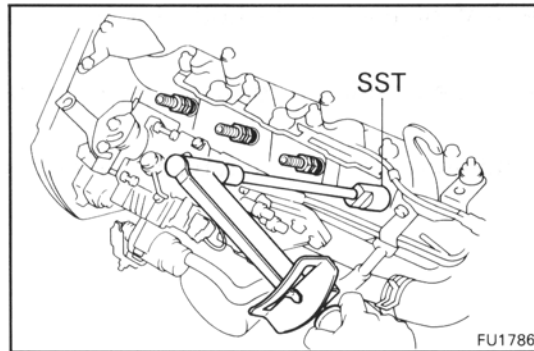
- (a) Place four new gaskets and the nozzle seats in the cylinder head.

- (b) Using SST, install and torque the four nozzles.

SST 09268-64010

Torque: 650 kg-cm (47 ft-lb, 64 N·m)

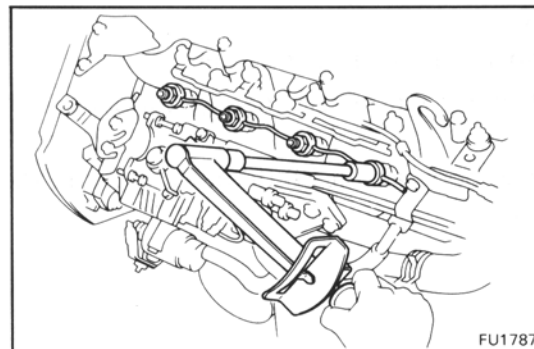
CAUTION: Over torquing could cause nozzle deformation and needle adhesion or other defects.



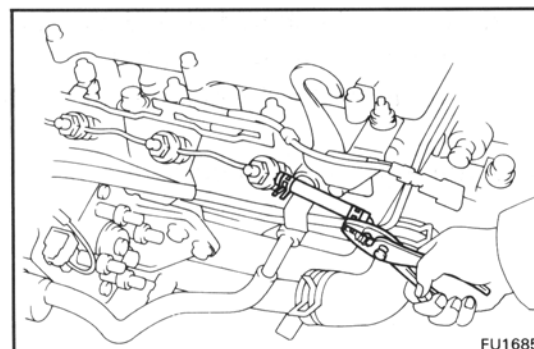
4. INSTALL FUEL RETURN PIPE

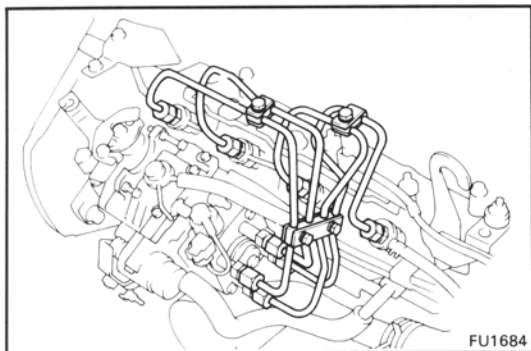
- (a) Install four new gaskets and the return pipe with the four lock nuts.

Torque: 300 kg-cm (22 ft-lb, 29 N·m)



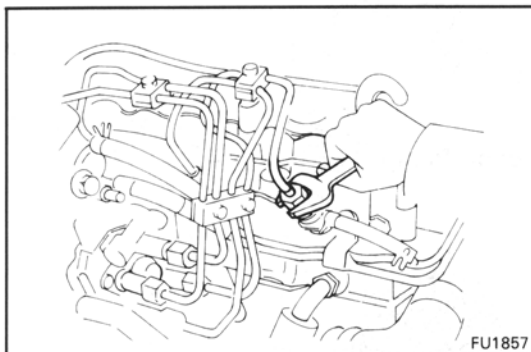
- (b) Connect the fuel hose to the return pipe.





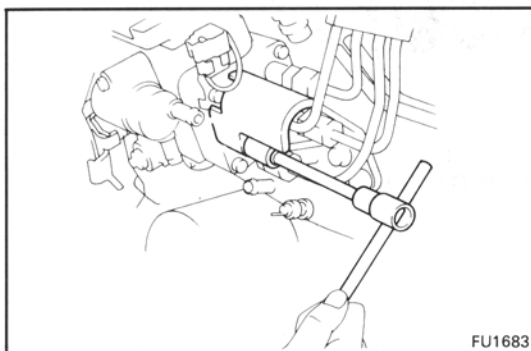
5. INSTALL INJECTION PIPES

- (a) Connect both ends of the injection pipes to the injection pump and nozzle holder.

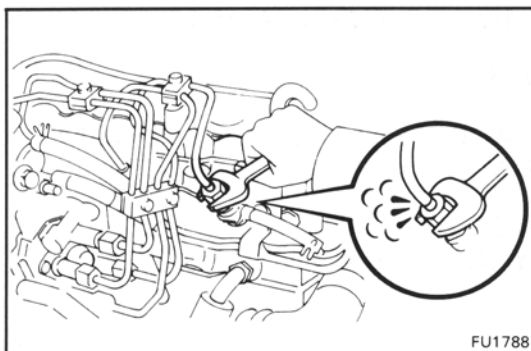


- (b) Torque the injection pipe union nuts.

Torque: 300 kg-cm (22 ft-lb, 29 N·m)



- (c) Install the injection pump protector with the bolt.



6. BLEED INJECTION NOZZLES

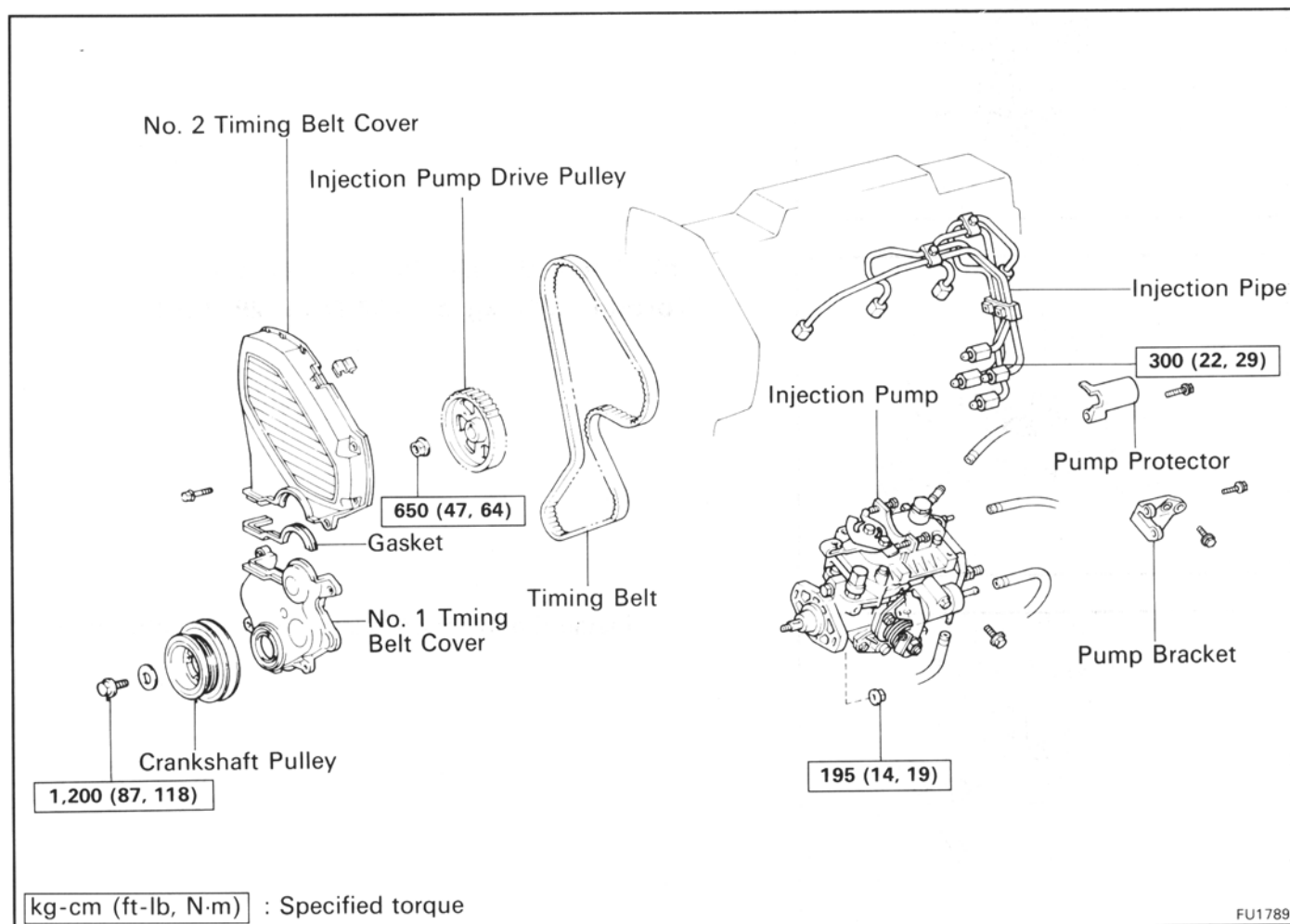
- (a) Loosen all union nuts of the injection pipe on the nozzle holder side.
- (b) Crank the engine to bleed the air and force out the fuel from the injection pipe.
- (c) Tighten the injection pipe union nuts.

Torque: 300 kg-cm (22 ft-lb, 29 N·m)

7. START ENGINE AND CHECK FOR FUEL LEAKS

8. CHECK ENGINE IDLE SPEED AND MAXIMUM SPEED (See page EM-22)

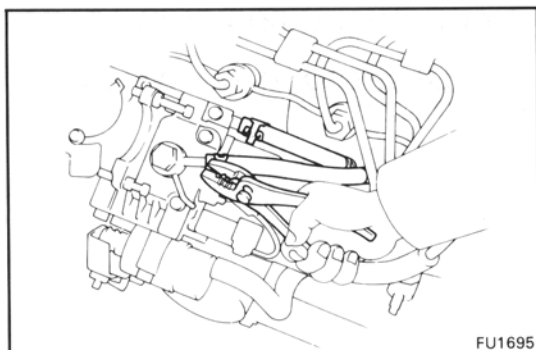
INJECTION PUMP COMPONENTS



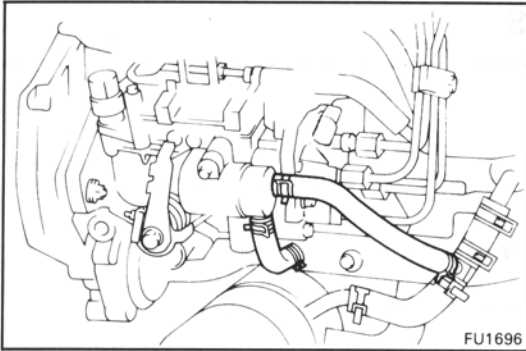
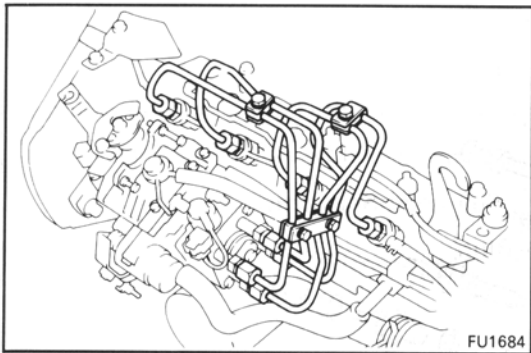
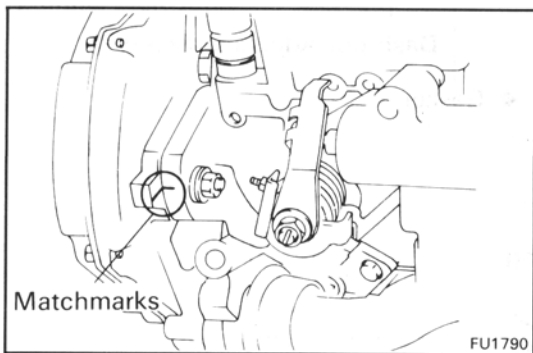
FU1789

REMOVAL OF INJECTION PUMP

1. DRAIN COOLANT
2. DISCONNECT ACCELERATOR CABLE FROM INJECTION PUMP
3. REMOVE TIMING BELT AND INJECTION PUMP DRIVE PULLEY (See pages EM-25 to 28)
4. DISCONNECT FUEL CUT SOLENOID CONNECTOR
5. DISCONNECT FUEL INLET AND OUTLET HOSES



FU1695

**6. DISCONNECT WATER BY-PASS HOSES****7. REMOVE FOUR INJECTION PIPES**
(See step 1 on page FU-4)**8. REMOVE INJECTION PUMP**

(a) Before removing the injection pump, check if the matchmarks are aligned.

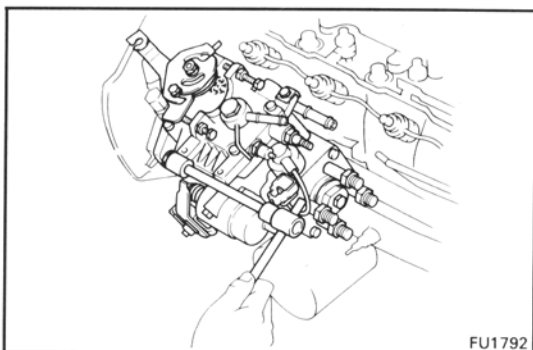
If not, place new matchmarks for reinstallation.

(b) Remove the four bolts and bracket.

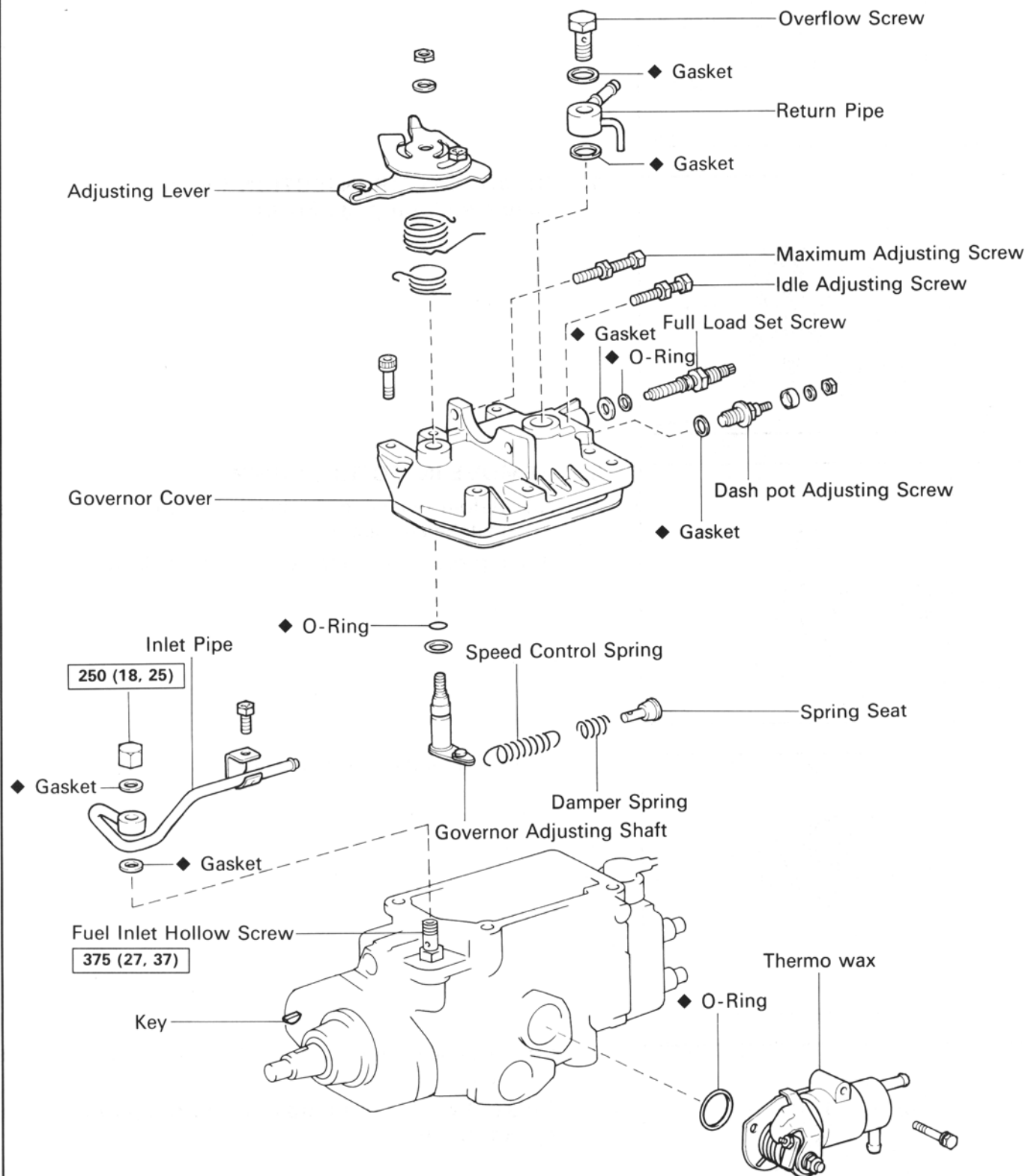


(c) Remove the two nuts and then remove the injection pump.

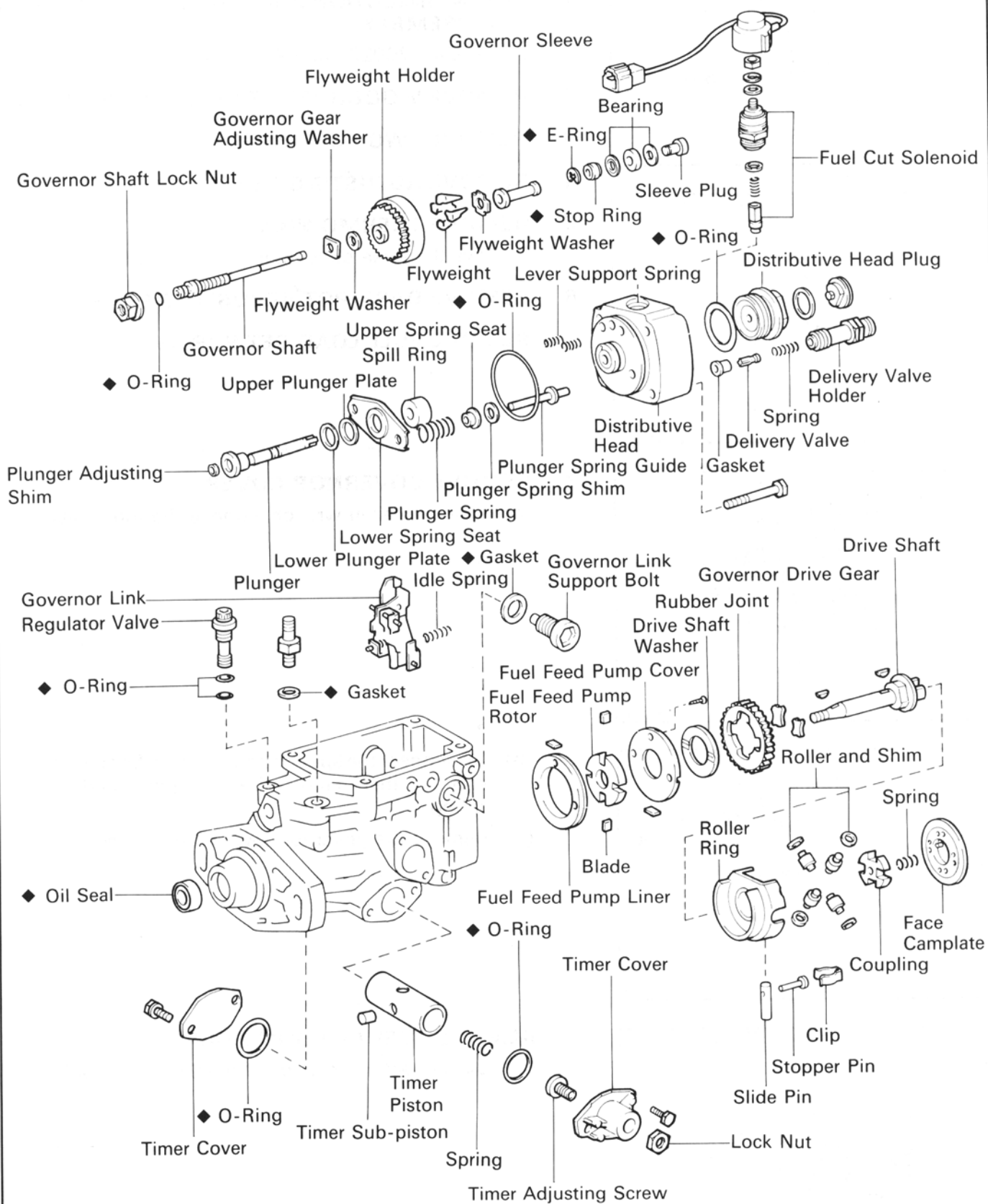
CAUTION: Do not hold or carry the pump by the adjusting lever.



COMPONENTS

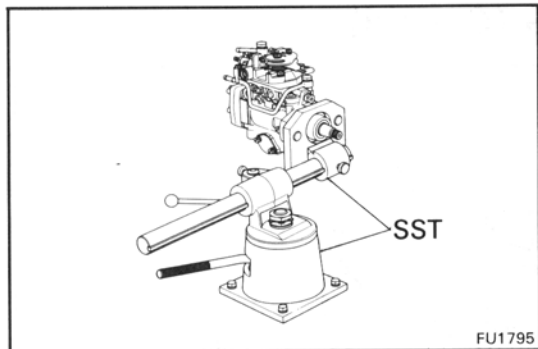


COMPONENTS (Cont'd)



◆ Non-reusable part

FU1794



DISASSEMBLY OF INJECTION PUMP

(See pages FU-14 and 15)

1. **MOUNT INJECTION PUMP TO STAND (SST) FOR DISASSEMBLY**

SST 09241-76022 and 09245-54010

2. **REMOVE WOODRUFF KEY FROM DRIVE SHAFT**

3. **REMOVE TWO FUEL PIPES**

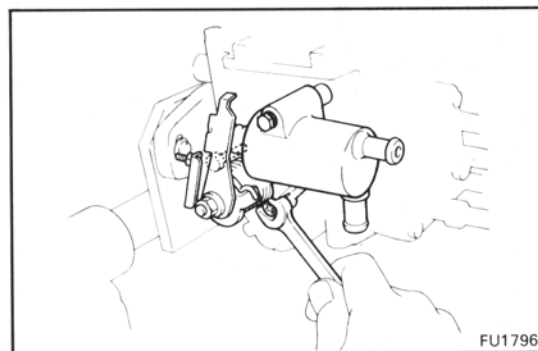
4. **REMOVE ADJUSTING LEVER**

5. **REMOVE THERMO WAX**

Remove the three bolts, thermo wax and O-ring.

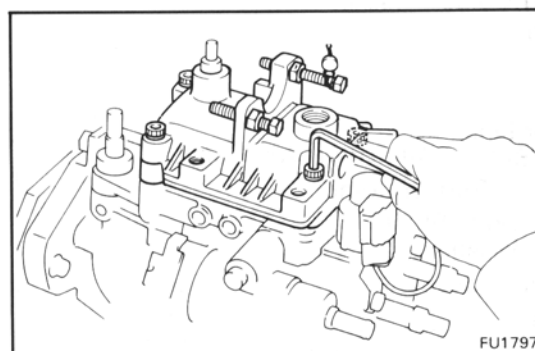
6. **REMOVE DASH POT ADJUSTING SCREW**

7. **REMOVE FULL LOAD SET SCREW**



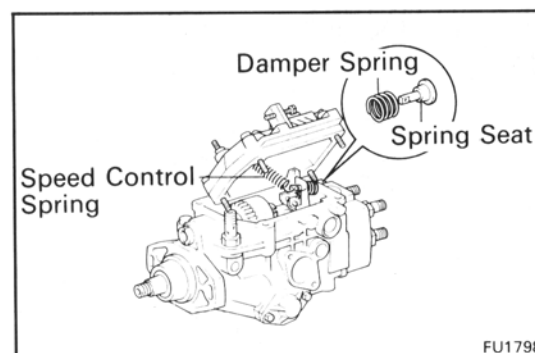
8. **REMOVE GOVERNOR COVER**

(a) Using an allen wrench, remove the four bolts.



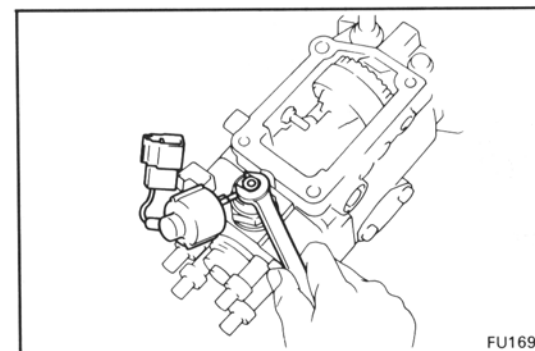
(b) Disconnect the speed control spring from the spring seat and then remove the spring seat and damper spring.

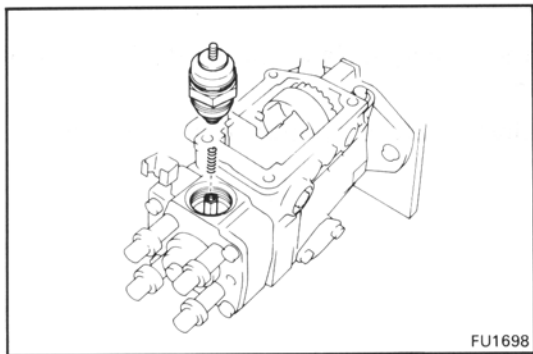
(c) Remove the governor cover with the gasket.



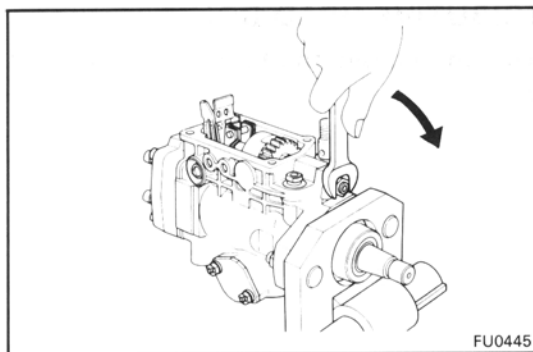
9. **REMOVE FUEL CUT SOLENOID**

(a) Disconnect the lead wire from the fuel cut solenoid.



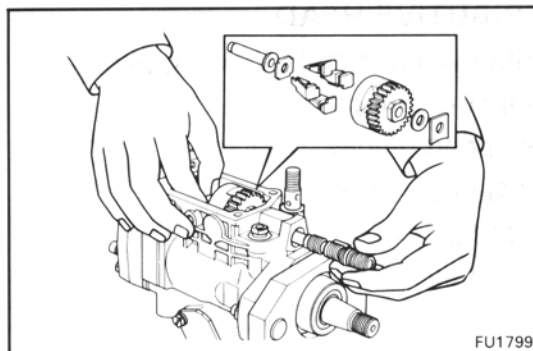


- (b) Remove the fuel cut solenoid, spring and valve.



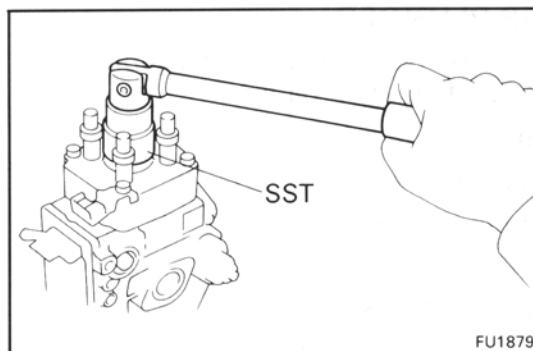
10. REMOVE GOVERNOR SHAFT AND FLYWEIGHT HOLDER

- (a) Remove the governor shaft lock nut by turning it clockwise.



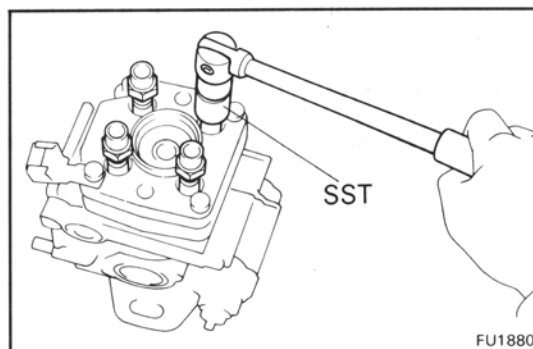
- (b) Using an allen wrench, remove the governor shaft.
 (c) Hold the flyweight holder subassembly and screw out the governor shaft clockwise.

NOTE: Be careful not to drop the two washers into the pump housing.



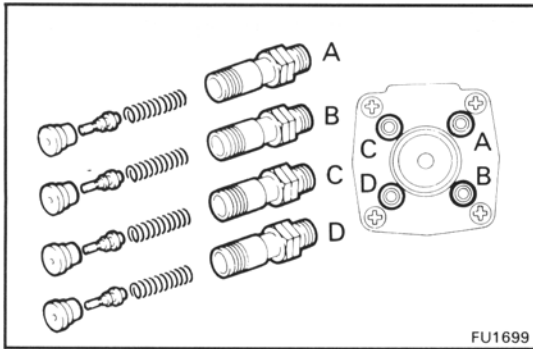
11. REMOVE DISTRIBUTIVE HEAD PLUG

Using SST, remove the distributive head plug.
 SST 09260-54012 (09262-54010)

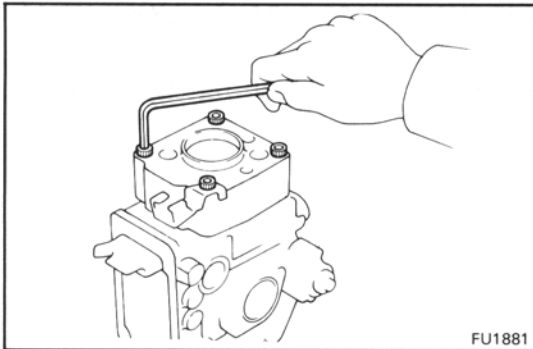


12. REMOVE FOUR DELIVERY VALVE HOLDERS

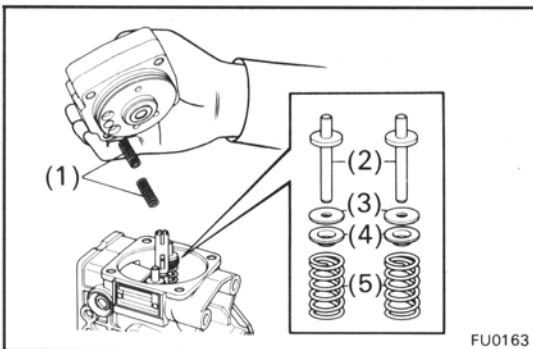
- (a) Using SST, remove the four delivery valve holders, springs and spring seats.
 SST 09260-54012 (09269-54020)
 (b) Remove four delivery valves and gaskets.

**NOTE:**

- Do not touch the sliding surfaces of the delivery valve with your hand.
- Arrange the delivery valves, springs and holders in order.

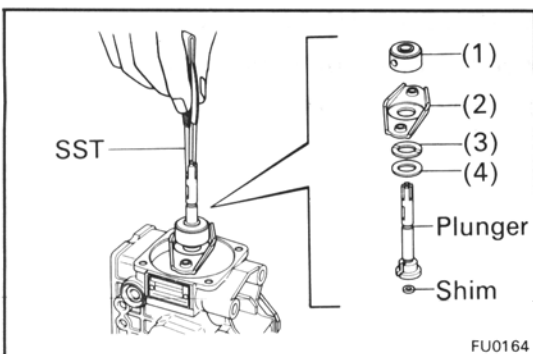
**13. REMOVE DISTRIBUTIVE HEAD BOLTS**

Using an allen wrench, remove the four head bolts and connector clamp.

**14. REMOVE DISTRIBUTIVE HEAD**

Remove the distributive head and following parts:

- (1) Lever support springs
- (2) Plunger spring guides
- (3) Plunger spring shims
- (4) Upper spring seats
- (5) Plunger springs

**15. REMOVE PUMP PLUNGER**

Using SST, remove the pump plunger and plunger adjusting shim with the following parts:

- (1) Spill ring
- (2) Lower spring seat
- (3) Upper plunger plate
- (4) Lower plunger plate
- (5) Plunger adjusting shim

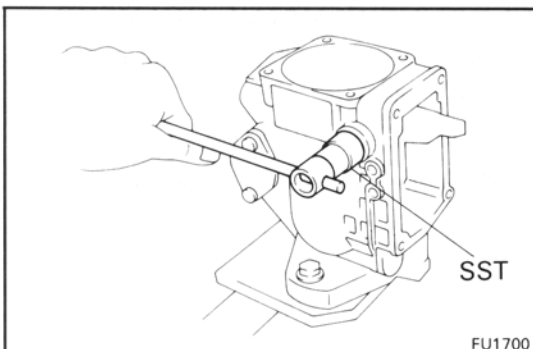
SST 09260-54012 (09269-54030)

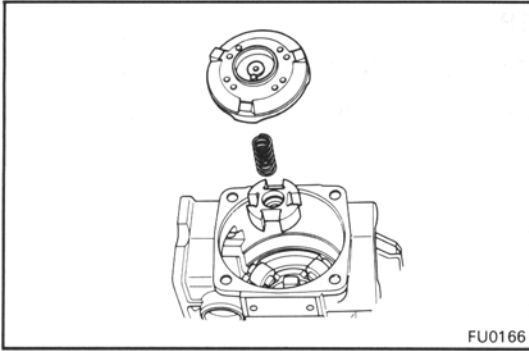
NOTE: Do not touch the sliding surfaces of the pump plunger with your hand.

16. REMOVE GOVERNOR LINK

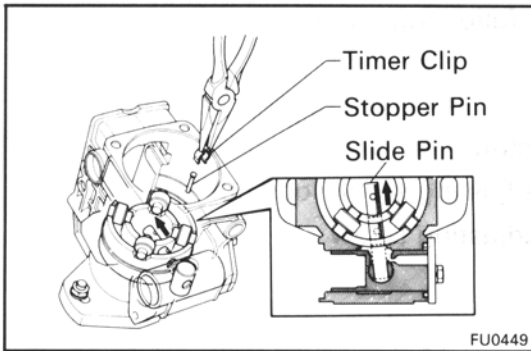
Using SST, remove the two support bolts and governor link.

SST 09260-54012 (09269-54040)



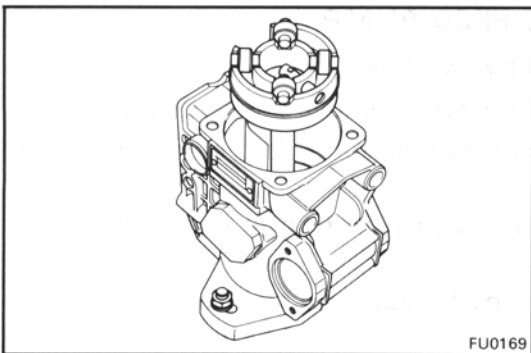
**17. REMOVE FACE CAMPLATE AND COUPLING**

Remove the face camplate, spring and coupling.

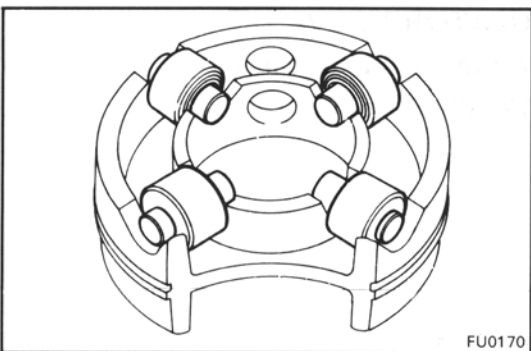
**18. REMOVE ROLLER RING AND DRIVE SHAFT**

(a) Remove the timer clip and stopper pin.

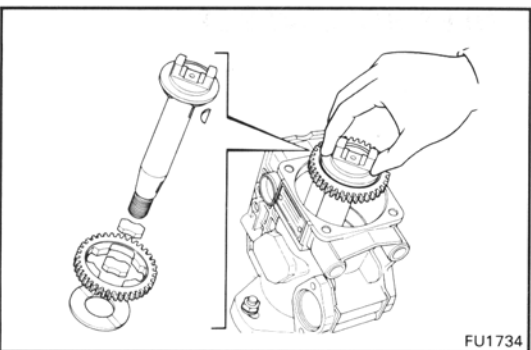
(b) Push on the slide pin as shown.



(c) Push the drive shaft and remove the roller ring.

**NOTE:**

- Be careful not to drop the rollers.
- Do not alter the position or assembly of the rollers.

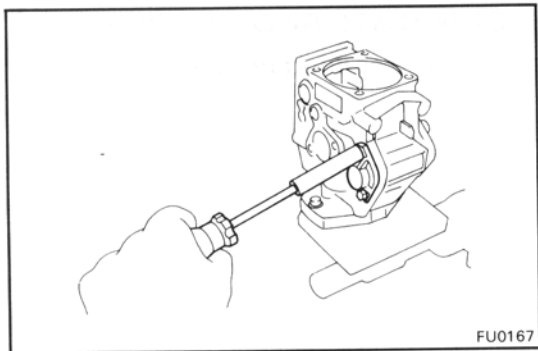


(d) Remove the drive shaft with the governor drive gear.

(e) Remove the drive shaft washer.

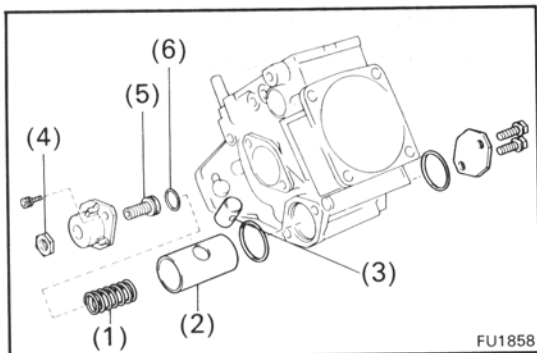
19. REMOVE TIMER

- (a) Loosen the timer adjusting screw lock nut.
- (b) Remove the two timer covers and O-rings.



- (c) Remove the following parts:

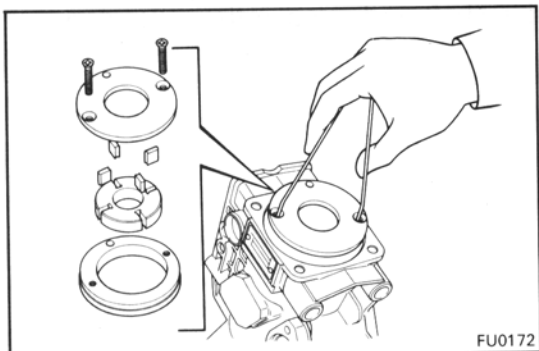
- (1) Spring
- (2) Piston
- (3) Sub-piston
- (4) Timer adjusting screw lock nut
- (5) Timer adjusting screw
- (6) O-ring

**20. REMOVE FUEL FEED PUMP**

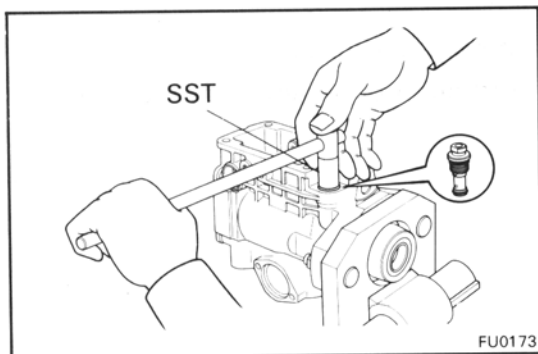
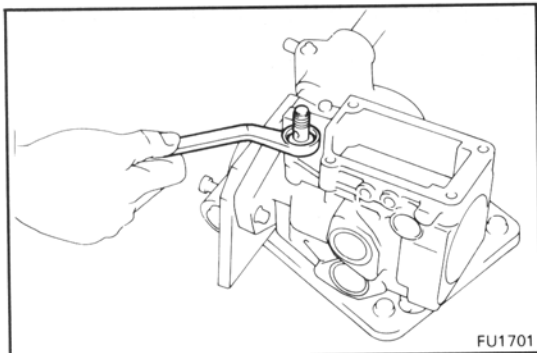
- (a) Remove the two screws.
- (b) Using a piece of wire, remove the feed pump cover.
- (c) Remove the feed pump rotor, four blades and liner.

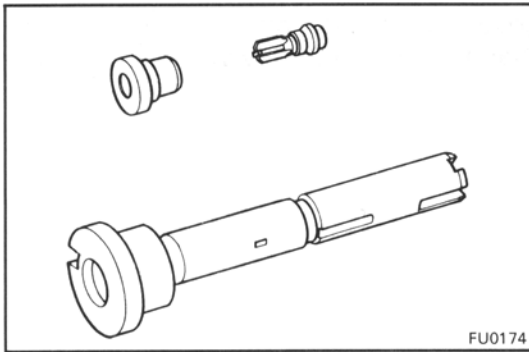
CAUTION:

- Be careful not to interchange the blade positions.
- Be careful not to damage to the pump body.

**21. REMOVE REGULATOR VALVE**

Using SST, remove the regulator valve.
SST 09260-54012 (09262-54020)

**22. REMOVE FUEL INLET HOLLOW SCREW**



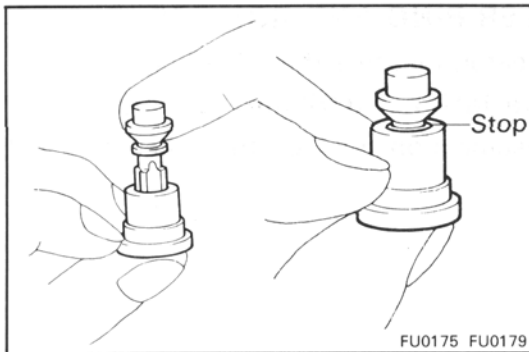
INSPECTION OF INJECTION PUMP COMPONENTS

NOTE: Do not touch the sliding surfaces of the pump plunger and delivery valves.

1. INSPECT DELIVERY VALVES

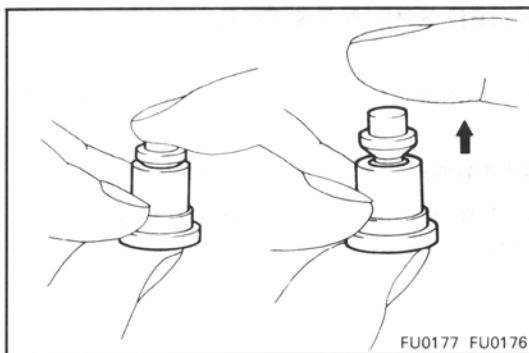
- (a) Pull up the valve and close the hole at the valve seat bottom end with your thumb. When the valve is released, it should sink down quickly and stop at the position where the relief ring closes the valve seat hole.

If defective, replace the valve as a set.



- (b) Close the hole at the valve seat bottom end with your thumb. Insert the valve into the valve seat and press down with your finger. When your finger is released, the valve should rise back to its original position.

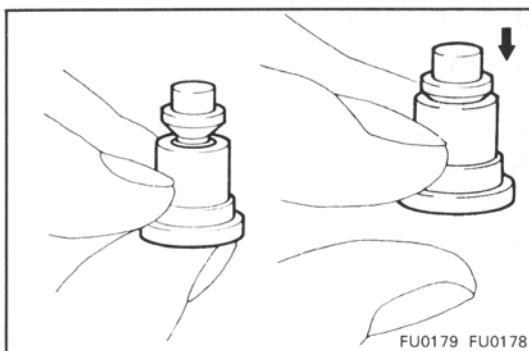
Replace if defective.



- (c) Remove your thumb from the valve seat hole. The valve should close completely by its own weight.

Replace if defective.

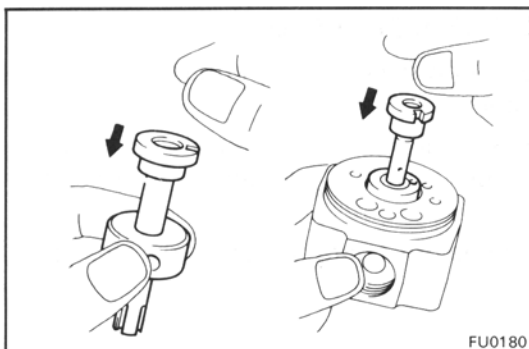
NOTE: Before using a new valve set, wash off the rust prevention compound with light oil or gasoline. Then re-wash with diesel fuel and perform the above tests.

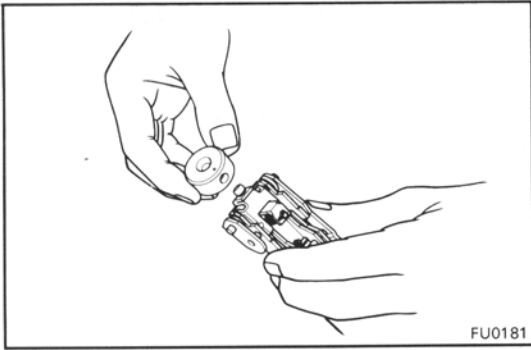


2. INSPECT PUMP PLUNGER, SPILL RING AND DISTRIBUTIVE HEAD

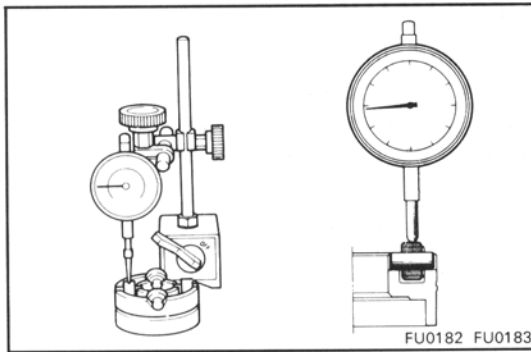
- (a) Tilt the spill ring (distributive head) slightly and pull out the plunger.
- (b) When released, the plunger should sink down smoothly into the spill ring (distributive head) by its own weight.
- (c) Rotate the plunger and repeat the test at various positions.

If the plunger sticks at any position, replace the parts as a set.





- (d) Insert the governor link ball pin into the spill ring and check that it moves smoothly without any play.

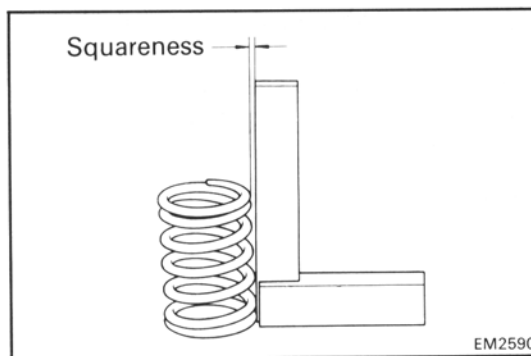


3. INSPECT ROLLER RING AND ROLLERS

Using a dial indicator, measure the roller height.

Roller height variation: 0.02 mm (0.0008 in.)

If not within specification, replace the roller ring and roller as a set.

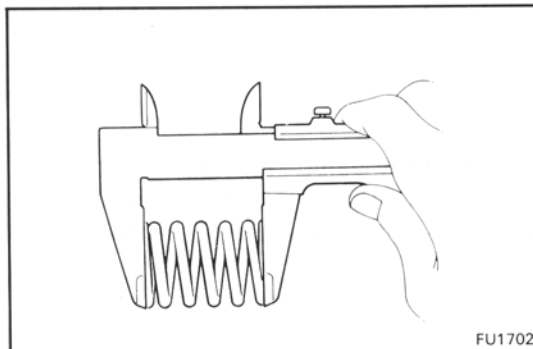


4. INSPECT PLUNGER SPRINGS FOR SQUARENESS

Using a steel square, check the squareness of the plunger springs.

Maximum squareness: 2.0 mm (0.079 in.)

If one spring is out of square more than the maximum, replace both springs.



5. INSPECT SPRING LENGTH

Using calipers, measure the free length of each spring.

Spring length mm (in.)

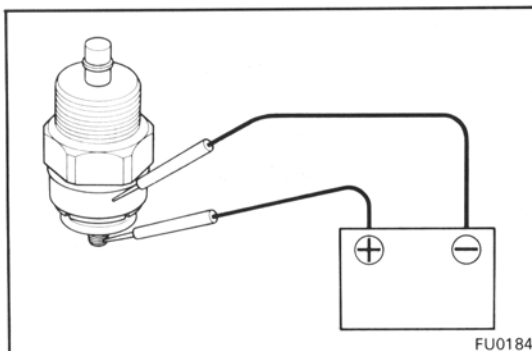
	Delivery valve spring	Plunger spring
Standard	24.4 (0.961)	30.0 (1.181)
Minimum	23.5 (0.925)	29.5 (1.161)

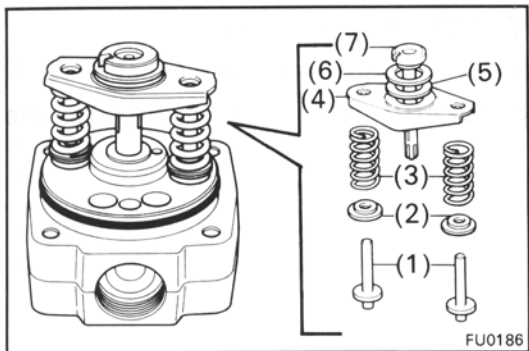
If the length is less than minimum, replace the spring.

6. INSPECT FUEL CUT SOLENOID

- Connect the solenoid valve body and terminal to the battery terminals.
- You should feel the click from the solenoid valve when the battery power is connected and disconnected.

If the solenoid valve is not operating properly, replace it.



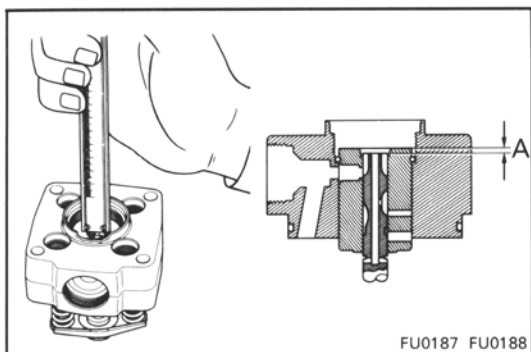


7. ADJUST PLUNGER SPRING SHIM

(a) Install the following parts to the distributive head.

- (1) Two plunger spring guides
- (2) Two upper spring seats
- (3) Two plunger springs
- (4) Lower spring seat
- (5) Upper plunger plate
- (6) Lower plunger plate
- (7) Pump plunger

NOTE: Do not assemble the plunger spring shims at this time.



(b) Using calipers, measure clearance A indicated in the figure.

(c) Determine the shim size by using the following formula and chart.

$$\text{New shim thickness} = 5.8 - A$$

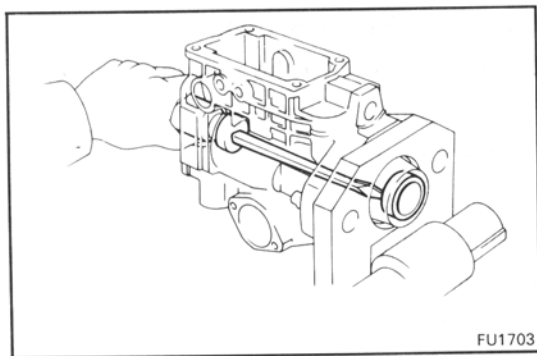
A Plunger position measured

Shim selection chart mm (in.)

Measured clearance	Shim thickness	Measured clearance	Shim thickness
More than 5.3 (0.209)	0.5 (0.020)	4.3 – 4.5 (0.169 – 0.177)	1.5 (0.059)
5.0 – 5.2 (0.196 – 0.205)	0.8 (0.031)	4.0 – 4.2 (0.157 – 0.165)	1.8 (0.071)
4.8 – 4.9 (0.189 – 0.193)	1.0 (0.039)	Less than 3.9 (0.154)	2.0 (0.079)
4.6 – 4.7 (0.181 – 0.185)	1.2 (0.047)	—	—

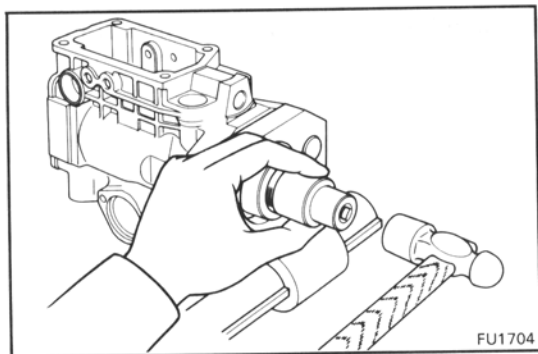
NOTE:

- For a measurement between listed sizes, use the next larger size. Ex. If thickness is 1.1 mm (0.043 in.) by calculation, use a 1.2 mm (0.047 in.) shim.
- Select two shims which have the same thickness.

**8. IF NECESSARY, REPLACE OIL SEAL**

- (a) Using a screwdriver, push out the oil seal.

CAUTION: Be careful not to damage to the pump body.



- (b) Apply MP grease to the lip of a new oil seal.
- (c) Using a socket wrench, drive in the oil seal until its surface is flush with the pump housing.

ASSEMBLY OF INJECTION PUMP

(See page FU-14 and 15)

1. INSTALL FUEL INLET HOLLOW SCREW

Torque: 375 kg-cm (27 ft-lb, 37 N·m)

2. INSTALL REGULATOR VALVE

Using SST, install and torque the regulator valve.

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Torque: 90 kg-cm (78 in.-lb, 8.8 N·m)

3. INSTALL FUEL FEED PUMP

- (a) Install the liner, rotor and four blades.
- (b) Check that the liner and blades are facing in the correct direction, as shown.
- (c) Check that the blades move smoothly.

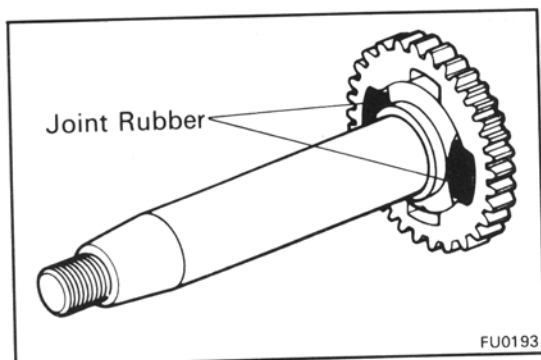
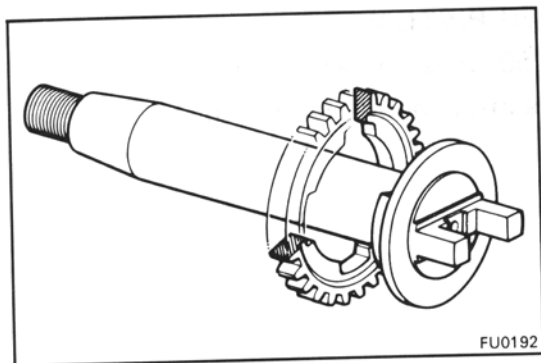
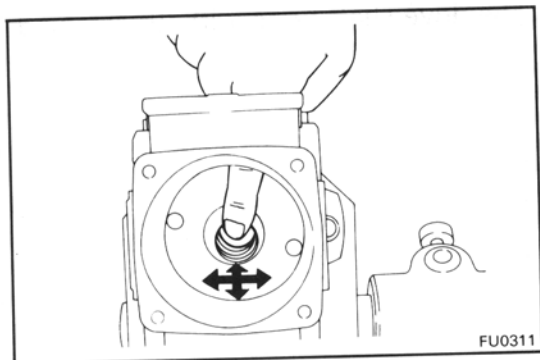
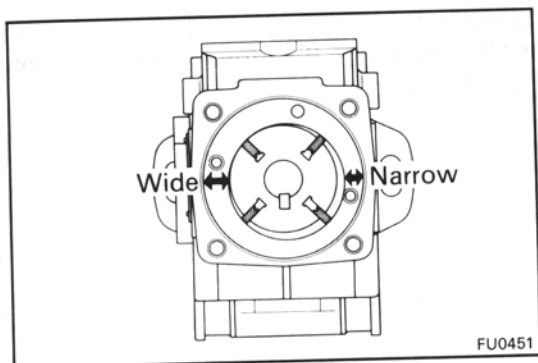
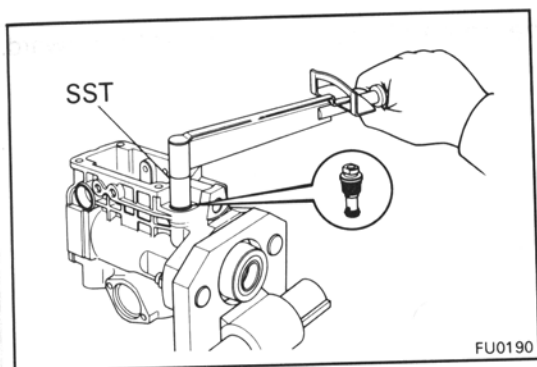
- (d) Install the pump cover with the two screws and check that the rotor moves smoothly.

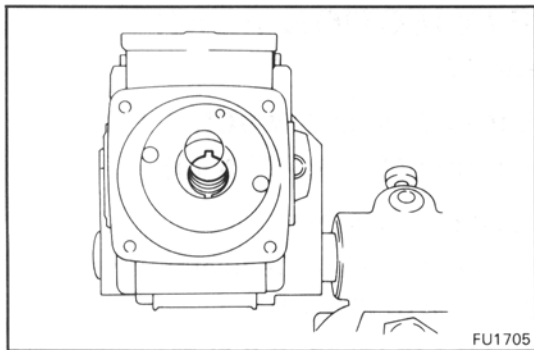
NOTE: Check that the fuel outlet hole of the cover is aligned with the liner.

4. INSTALL DRIVE SHAFT

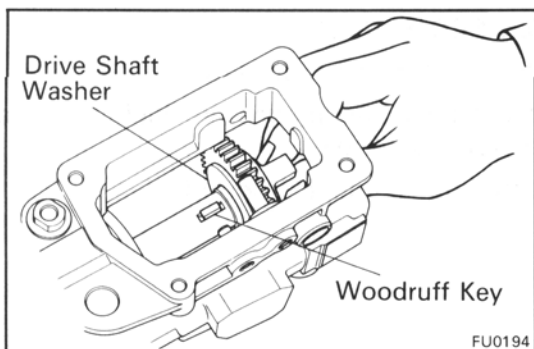
- (a) Install the drive gear on the drive shaft as shown.

- (b) Install new two joint rubbers into the drive gear.
- NOTE: Replace the joint rubber when overhauling.

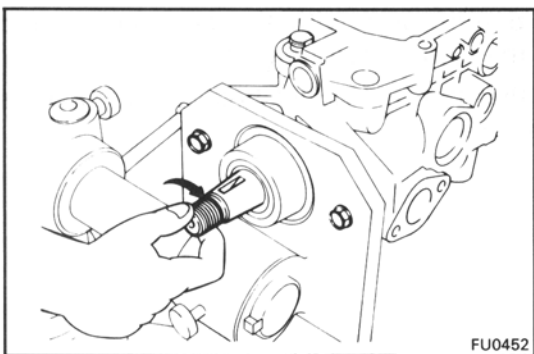




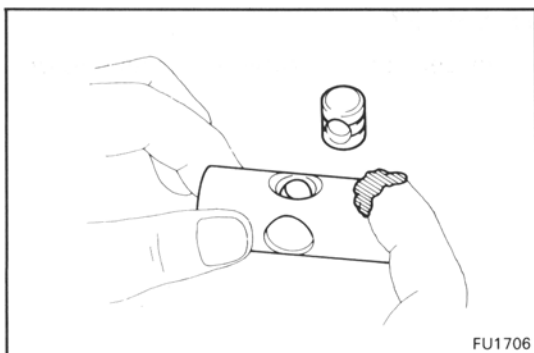
(c) Position the notch of the feed pump rotor upward.



(d) Install the woodruff key and drive shaft washer on the drive shaft and insert the drive shaft assembly into the pump housing.

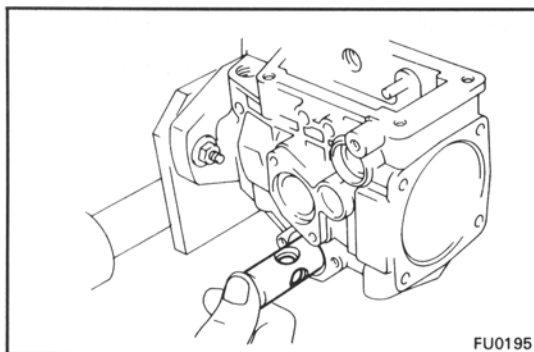


(e) Check that the drive shaft turns without catching.

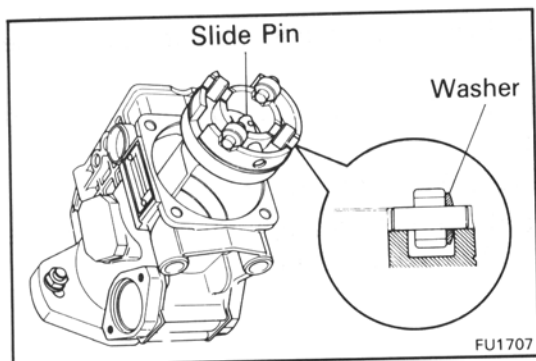


5. INSTALL TIMER PISTON

- (a) Apply No. 50 Denso grease to the timer piston.
- (b) Install the sub-piston in the timer piston.



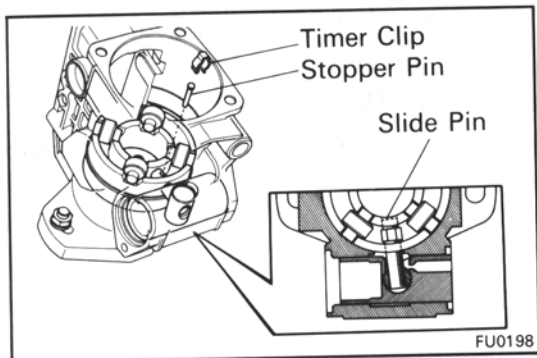
(c) Insert the timer piston into the pump housing.



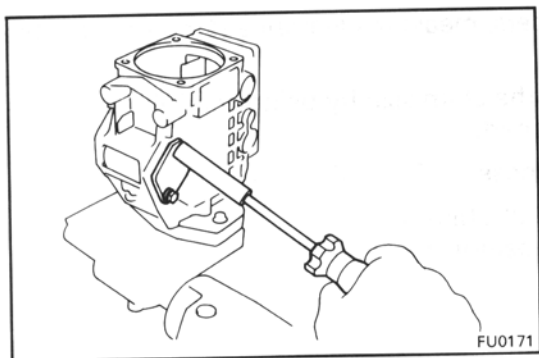
6. INSTALL ROLLER RING

- (a) Install the slide pin, four rollers and washers on the roller ring.
- (b) Check that the roller is facing the flat surface of the washer.
- (c) Install the roller ring in the pump housing.

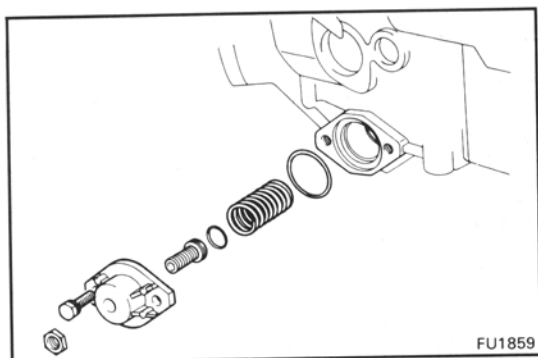
- (d) Carefully push down the slide pin and install the stopper pin and clip.



- (e) Install a new O-ring and the flat timer cover with the two bolts.

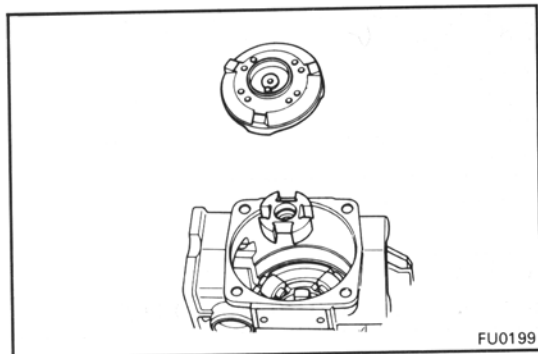


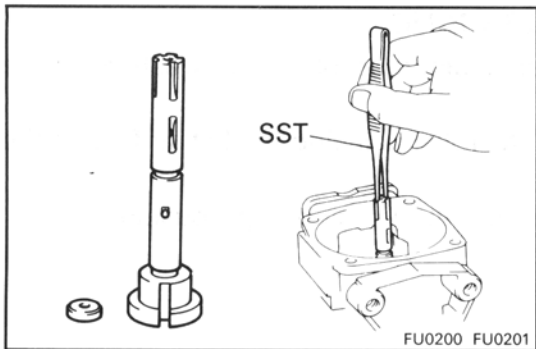
- (f) Install a new O-ring and the timer adjusting screw.
- (g) Install a new O-ring, the spring and other timer cover, two bolts and adjusting screw lock nut.



7. ADJUST PLUNGER ADJUSTING SHIM

- (a) Install the coupling and camplate.
- NOTE: Do not assemble the coupling spring.

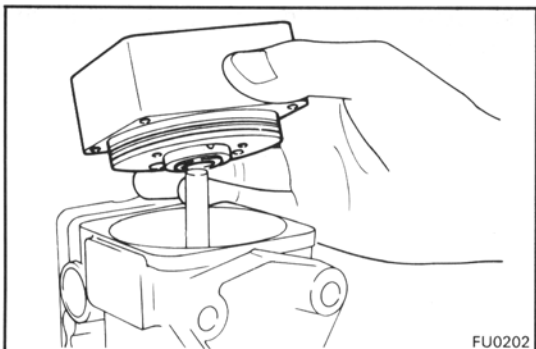




- (b) Clean the adjusting shim and contacting surface area.
- (c) Using SST, install the used adjusting shim and pump plunger.

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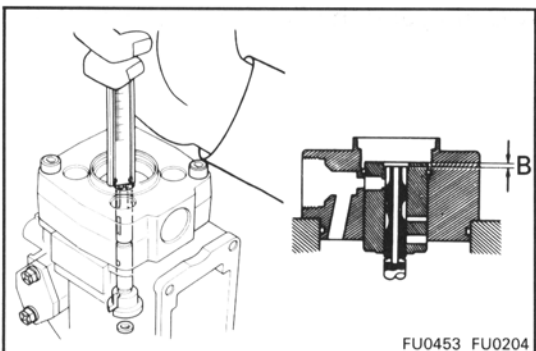
- (d) Check that the notch on the pump plunger is aligned with the camplate pin.



- (e) Install the distributive head with the four bolts. Torque the bolts.

Torque: 120 kg-cm (9 ft-lb, 12 N·m)

CAUTION: Be careful not to damage the pump plunger.



- (f) Using calipers, measure clearance B indicated in the figure.

- (g) Determine the shim size by using the following formula and chart.

$$\text{New shim thickness} = T + (B - 3.3)$$

T . . . Thickness of shim used

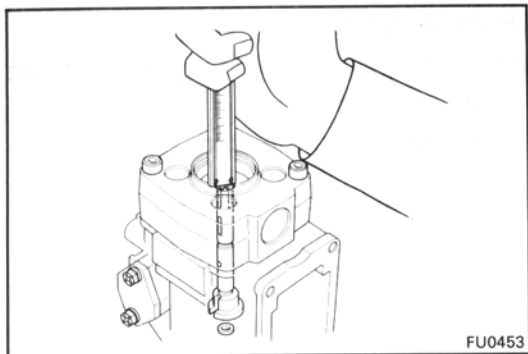
B . . . Plunger position measured

Shim selection chart

		Measured clearance (mm)																			
		2.3	2.4	2.5	2.6	2.7	2.8	2.9	3.0	3.1	3.2 – 3.4	3.5	3.6	3.7	3.8	3.9	4.0	4.1	4.2	4.3	4.4
	1.9	–	–	–	–	–	–	–	–	–	–	2.1	2.2	2.3	2.4	2.5	2.6	2.7	2.8	2.9	2.9
	2.0	–	–	–	–	–	–	–	–	1.9	–	2.2	2.3	2.4	2.5	2.6	2.7	2.8	2.9	2.9	–
	2.1	–	–	–	–	–	–	–	1.9	1.9	–	2.3	2.4	2.5	2.6	2.7	2.8	2.9	2.9	–	–
	2.2	–	–	–	–	–	–	1.9	1.9	2.0	–	2.4	2.5	2.6	2.7	2.8	2.9	2.9	–	–	–
	2.3	–	–	–	–	–	1.9	1.9	2.0	2.1	–	2.5	2.6	2.7	2.8	2.9	2.9	–	–	–	–
	2.4	–	–	–	–	1.9	1.9	2.0	2.1	2.2	–	2.6	2.7	2.8	2.9	2.9	–	–	–	–	–
	2.5	–	–	–	1.9	1.9	2.0	2.1	2.2	2.3	–	2.7	2.8	2.9	2.9	–	–	–	–	–	–
	2.6	–	–	1.9	1.9	2.0	2.1	2.2	2.3	2.4	–	2.8	2.9	2.9	–	–	–	–	–	–	–
	2.7	–	1.9	1.9	2.0	2.1	2.2	2.3	2.4	2.5	–	2.9	2.9	–	–	–	–	–	–	–	–
	2.8	1.9	1.9	2.0	2.1	2.2	2.3	2.4	2.5	2.6	–	2.9	–	–	–	–	–	–	–	–	–
2.9	1.9	2.0	2.1	2.2	2.3	2.4	2.5	2.6	2.7	–	–	–	–	–	–	–	–	–	–	–	

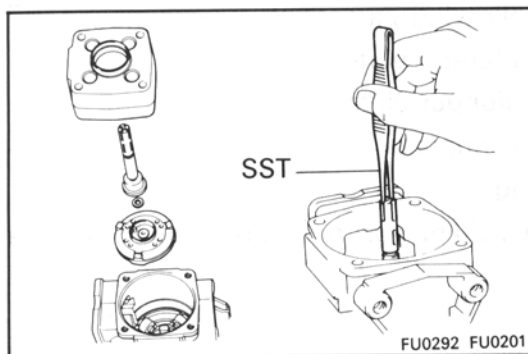
Example: 2.5 mm (0.098 in.) shim installed. Measured clearance is 3.0 mm (0.118 in.).
Replace with 2.2 mm (0.087 in.) shim.

Plunger adjusting shim thickness mm (in.)	1.9 (0.075)	2.0 (0.079)	2.1 (0.083)	2.2 (0.087)	2.3 (0.091)	2.4 (0.094)	2.5 (0.098)	2.6 (0.102)	2.7 (0.106)	2.8 (0.110)	2.9 (0.114)
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(h) Install a new shim and recheck clearance B.

B: $3.3 \pm 1 \text{ mm}$ ($0.130 \pm 0.039 \text{ in.}$)



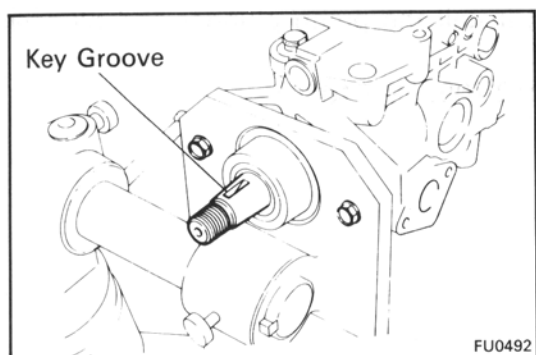
(i) Remove the distributive head and the following parts with SST:

- (1) Pump plunger
- (2) Plunger adjusting shim
- (3) Camplate

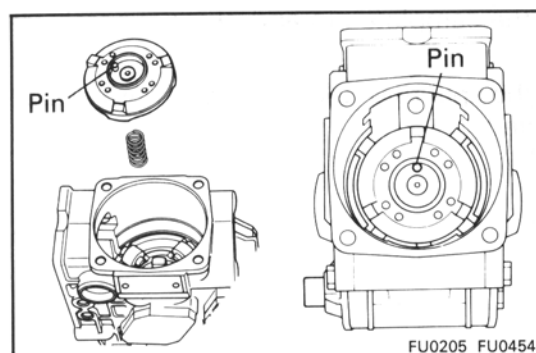
SST 09260-54012 (09269-54030)

8. INSTALL CAMPLATE

(a) Face the key groove of the drive shaft upward.



(b) Install the coupling spring and camplate with the camplate pin facing toward the governor cover side.



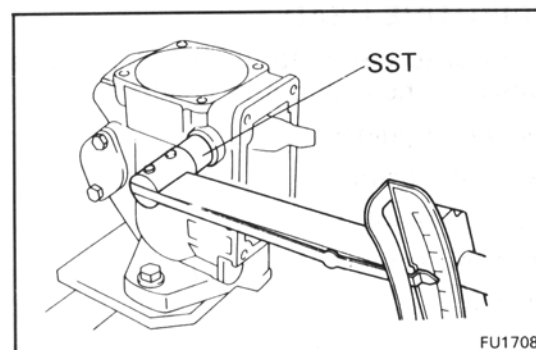
9. INSTALL GOVERNOR LINK

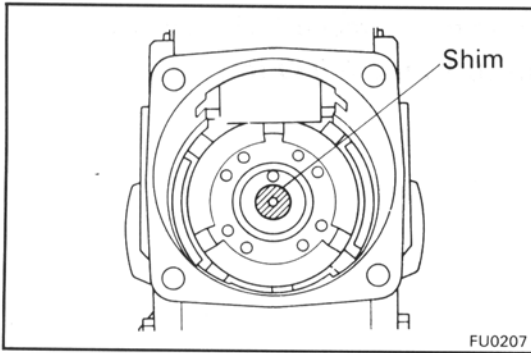
(a) Using SST, install the governor link with the two support bolts and gaskets. Torque the bolts.

Torque: 115 kg-cm (8 ft-lb , $11 \text{ N}\cdot\text{m}$)

SST 09260-54012 (09269-54040)

(b) Check that the governor link moves smoothly after assembly.

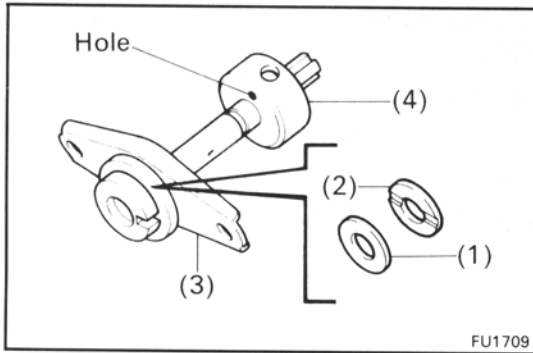




10. INSTALL PUMP PLUNGER

- (a) Place the selected plunger adjusting shim on the center of the camplate.

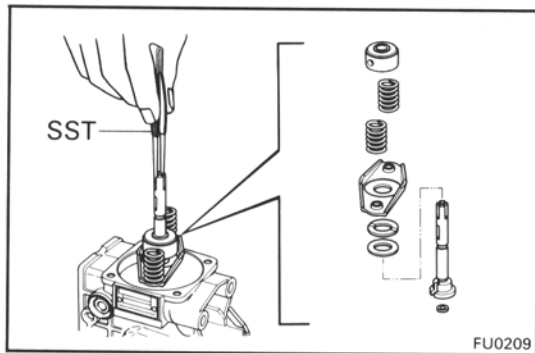
NOTE: Do not apply grease to the shim.



- (b) Install the following parts to the pump plunger:

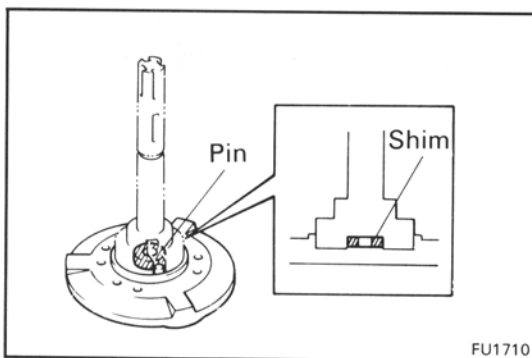
- (1) Lower plunger plate
- (2) Upper plunger plate
- (3) Lower spring seat
- (4) Spill ring

NOTE: Face the spill ring with the hole side toward the lower seat.



- (c) Using SST, install the pump plunger and plunger springs.

SST 09260-54012 (09269-54030)



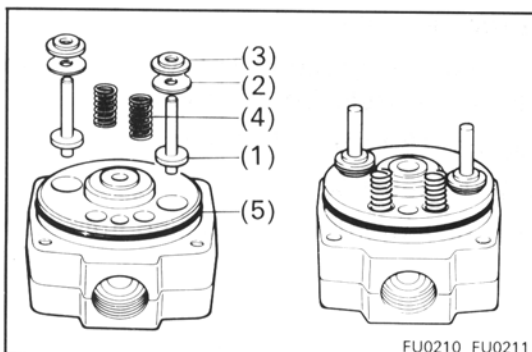
- (d) Check that the camplate pin and plunger notch are aligned.

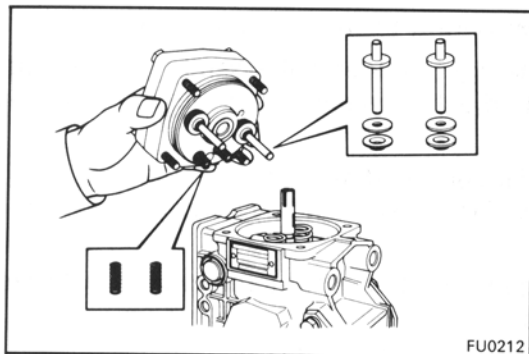
- (e) Check that the spill ring hole and governor link ball pin are aligned.

11. INSTALL DISTRIBUTIVE HEAD

- (a) Apply No. 50 Denso grease to the following parts and install them to the distributive head:

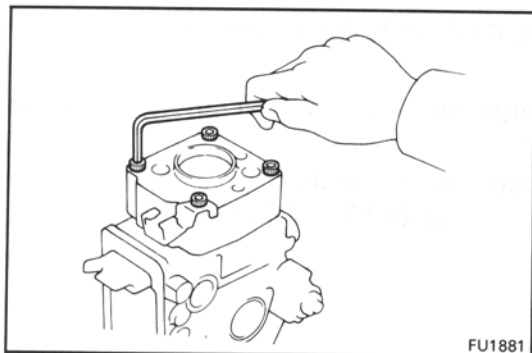
- (1) Plunger spring guides
- (2) Plunger spring shims
- (3) Upper spring seats
- (4) Lever support springs
- (5) New O-ring





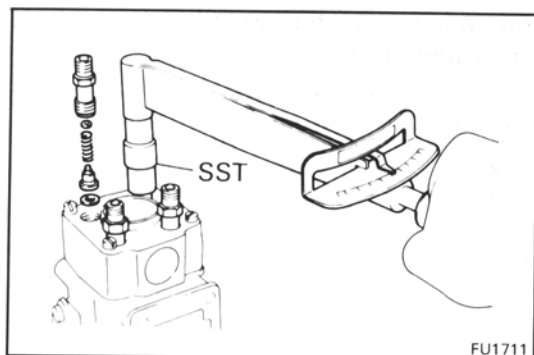
(b) Install the distributive head.

CAUTION: Be careful not to damage the pump plunger.



(c) Install and torque the four bolts and wire connector bracket.

Torque: 120 kg-cm (9 ft-lb, 12 N·m)



12. INSTALL FOUR DELIVERY VALVE HOLDERS

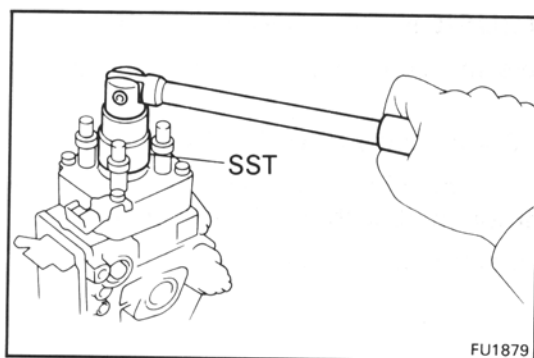
(a) Install four new gaskets and the valves into the distributive head.

(b) Install the spring seats and springs into the delivery valve holders.

(c) Using SST, install and torque the delivery valve holders.

SST 09260-54012 (09269-54020)

Torque: 500 kg-cm (36 ft-lb, 49 N·m)



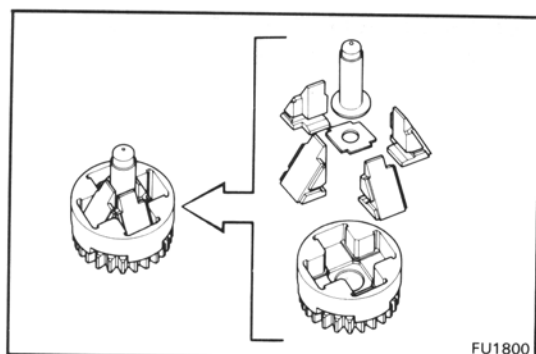
13. INSTALL DISTRIBUTIVE HEAD PLUG

(a) Install a new O-ring on the head plug.

(b) Using SST, install and torque the head plug.

SST 09260-54012 (09262-54010)

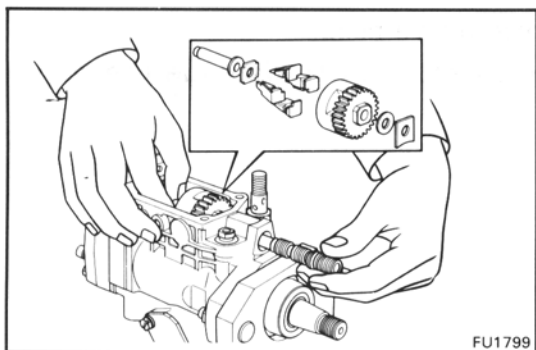
Torque: 700 kg-cm (51 ft-lb, 69 N·m)



14. INSTALL GOVERNOR SHAFT AND FLYWEIGHT HOLDER ASSEMBLY

(a) Install the four flyweights, washer and governor sleeve on the flyweight holder.

NOTE: Replace the four flyweights as a set.



FU1799

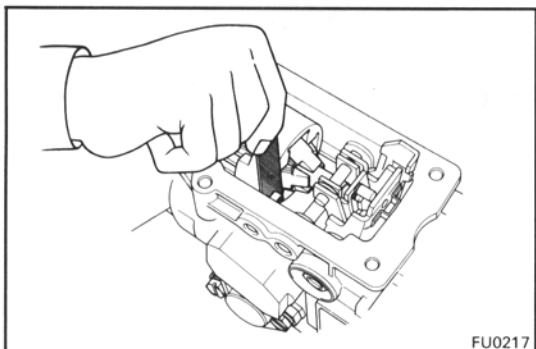
- (b) Install a new O-ring to the governor shaft.
- (c) Put the flyweight holder subassembly, flyweight washer and adjusting washer into the pump housing.
- (d) Install the governor shaft through the adjusting washer, flyweight washer and flyweight holder sub-assembly.
- (e) Turn the governor shaft counterclockwise with an allen wrench.

NOTE: The governor shaft has LH threads.

15. CHECK FLYWEIGHT HOLDER THRUST CLEARANCE

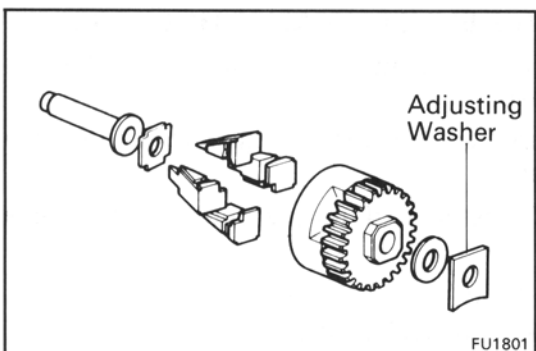
Using a feeler gauge, measure the flyweight holder thrust clearance.

**Thrust clearance: 0.15 – 0.35 mm
(0.0059 – 0.0138 in.)**



FU0217

If the thrust clearance is not within specification, adjust with a governor gear adjusting washer.



FU1801

Governor gear adjusting washer thickness mm (in.)	
1.05 (0.0413)	1.65 (0.0650)
1.25 (0.0492)	1.85 (0.0728)
1.45 (0.0571)	

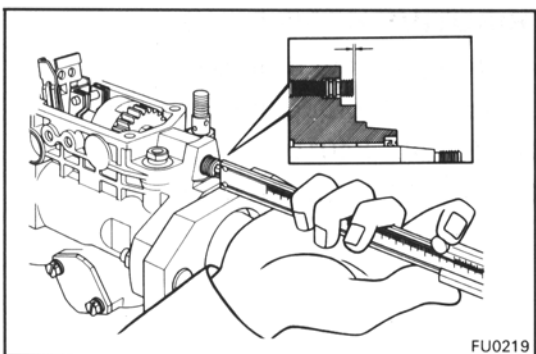
16. ADJUST PROTRUSION OF GOVERNOR SHAFT

- (a) Using calipers, measure the protrusion of the governor shaft.

Protrusion: 2.0 – 2.5 mm (0.079 – 0.098 in.)

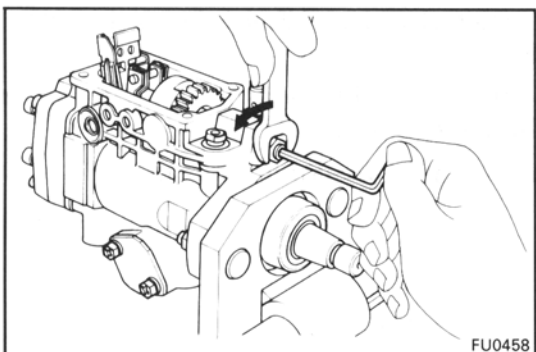
If the protrusion is not within specification, adjust by turning the governor shaft with an allen wrench.

NOTE: The governor shaft has LH threads.

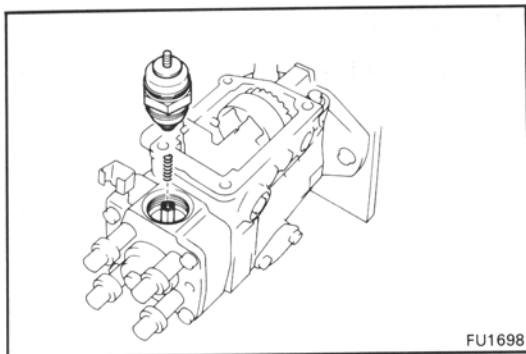


FU0219

- (b) Install and torque the lock nut while holding the governor shaft with an allen wrench.

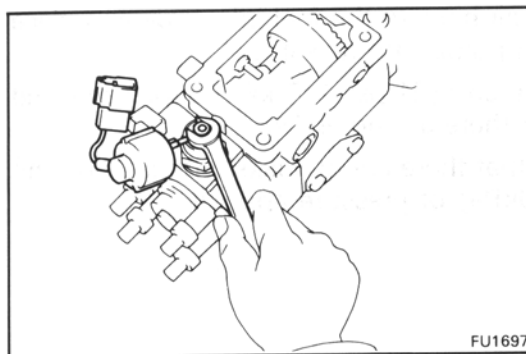


FU0458

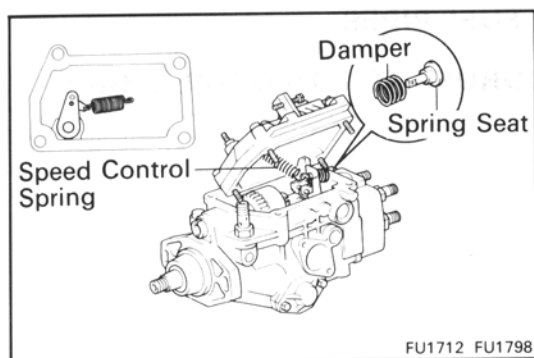
**17. INSTALL FUEL CUT SOLENOID**

- (a) Install a new O-ring on the fuel cut solenoid.
- (b) Install the valve and spring.
- (c) Install and torque the fuel cut solenoid.

Torque: 225 kg-cm (16 ft-lb, 22 N·m)



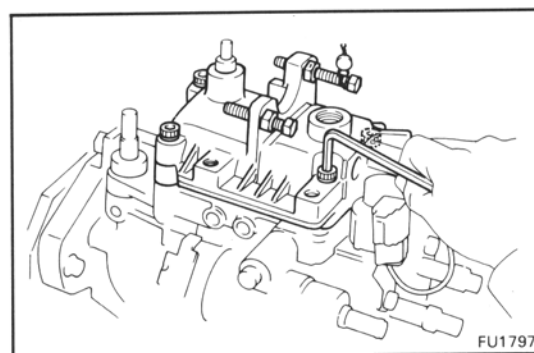
- (d) Connect the lead wire to the fuel cut solenoid.
- (e) Install the lead wire connector to bracket.

**18. INSTALL GOVERNOR COVER**

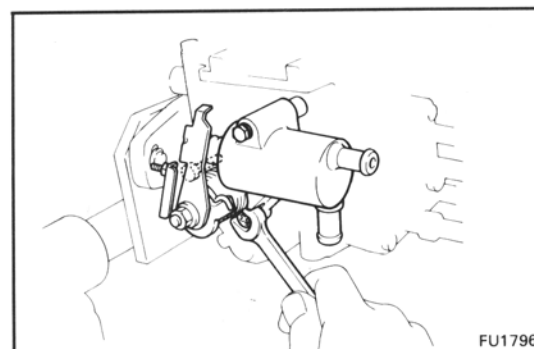
- (a) Install a new gasket into the groove of the governor cover.
- (b) Install the damper spring and spring seat, and connect them with the control spring.

NOTE: Install the damper spring as shown.

CAUTION: Never install the governor cover without removing the full load set screw and dash pot adjusting screw.

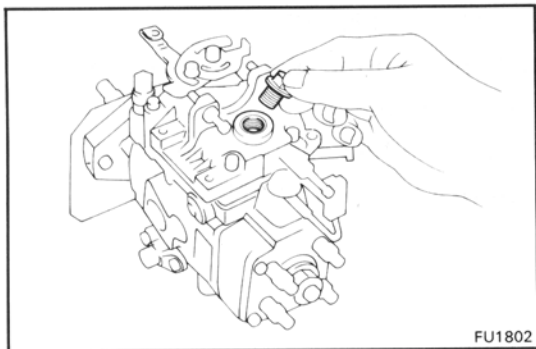


- (c) Using an allen wrench, install the four bolts.

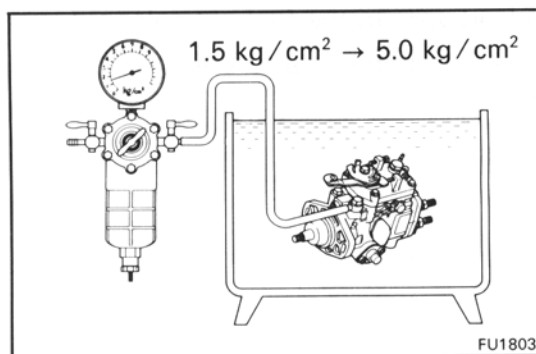
19. INSTALL FULL LOAD SET SCREW**20. INSTALL DASH POT ADJUSTING SCREW****21. INSTALL THERMO WAX**

Install a new O-ring and thermo wax with two bolts.

22. INSTALL ADJUSTING LEVER

**23. PERFORM AIR TIGHT TEST**

(a) Install a bolt to the overflow port.

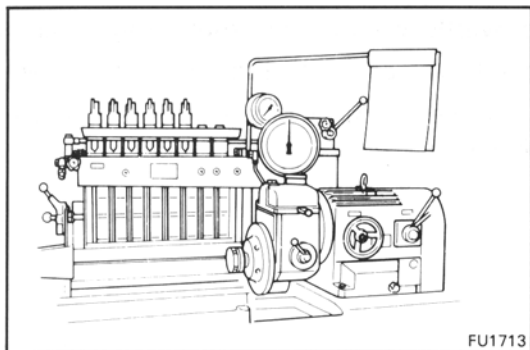


(b) Connect an air hose to the fuel inlet pipe and place the injection pump into diesel fuel.

(c) Apply 1.5 kg/cm² (21 psi, 147 kPa) of pressure and confirm that there are no leaks.

(d) Next check that there are no leaks with 5.0 kg/cm² (71 psi, 490kPa) of pressure applied.

24. INSTALL TWO FUEL PIPES**25. INSTALL WOODRUFF KEY ON DRIVE SHAFT**



ADJUSTMENT OF INJECTION PUMP

1. PRE-TEST CHECK AND PREPARATION

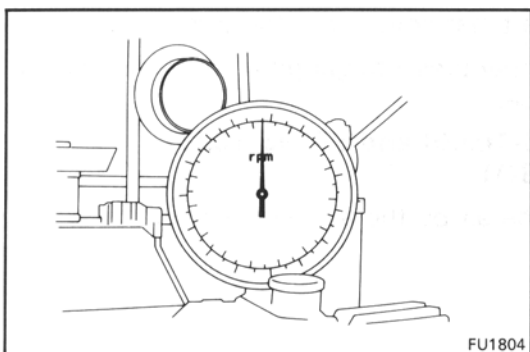
- (a) The specifications for test nozzle and nozzle holders are as follows.

Test nozzle: DN 12 SD 12 (NIPPONDENSO)

Test nozzle holder valve opening pressure:

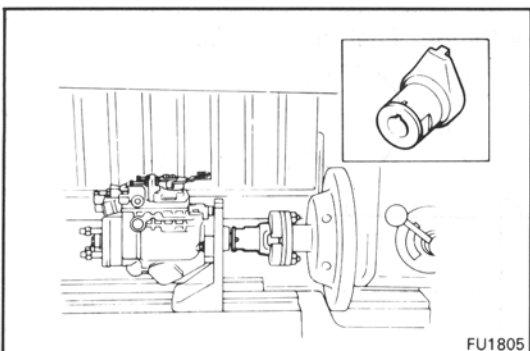
145 – 155 kg-cm²

(2,062 – 2,205 psi, 14,220 – 15,200 kPa)



- (b) Check the accuracy of the tachometer.

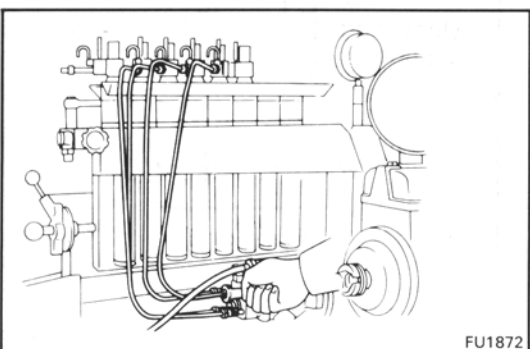
Allowable error: ± 40 rpm



- (c) Install the angle gauge stand.

- (d) Mount the injection pump body on the pump tester.

NOTE: Place a mark on the key groove portion of the coupling.



- (e) Install an injection pipe with the following specifications.

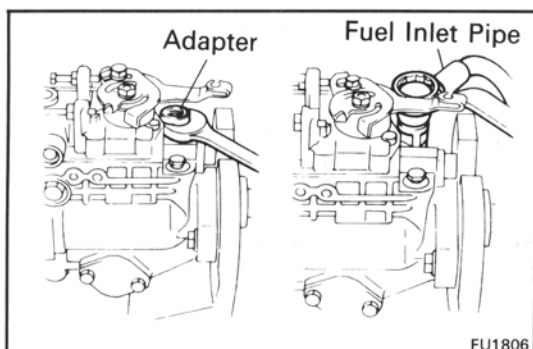
Outer diameter: 6.0 mm (0.236 in.)

Inner diameter: 2.0 mm (0.079 in.)

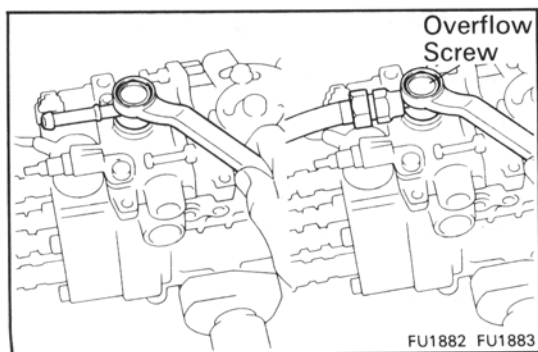
Length: 840 mm (33.07 in.)

Minimum bending radius:

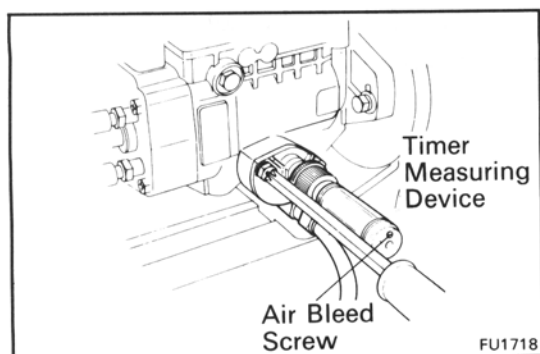
More than 25 mm (0.98 in.)



- (f) Connect the fuel inlet pipe with an adapter.



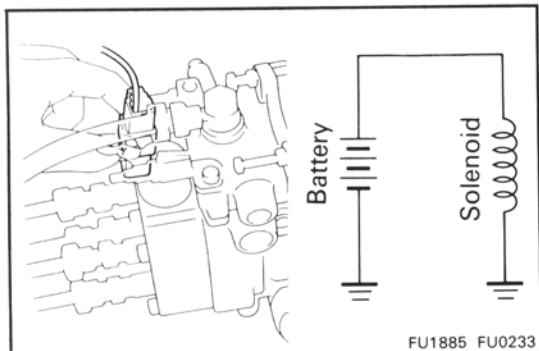
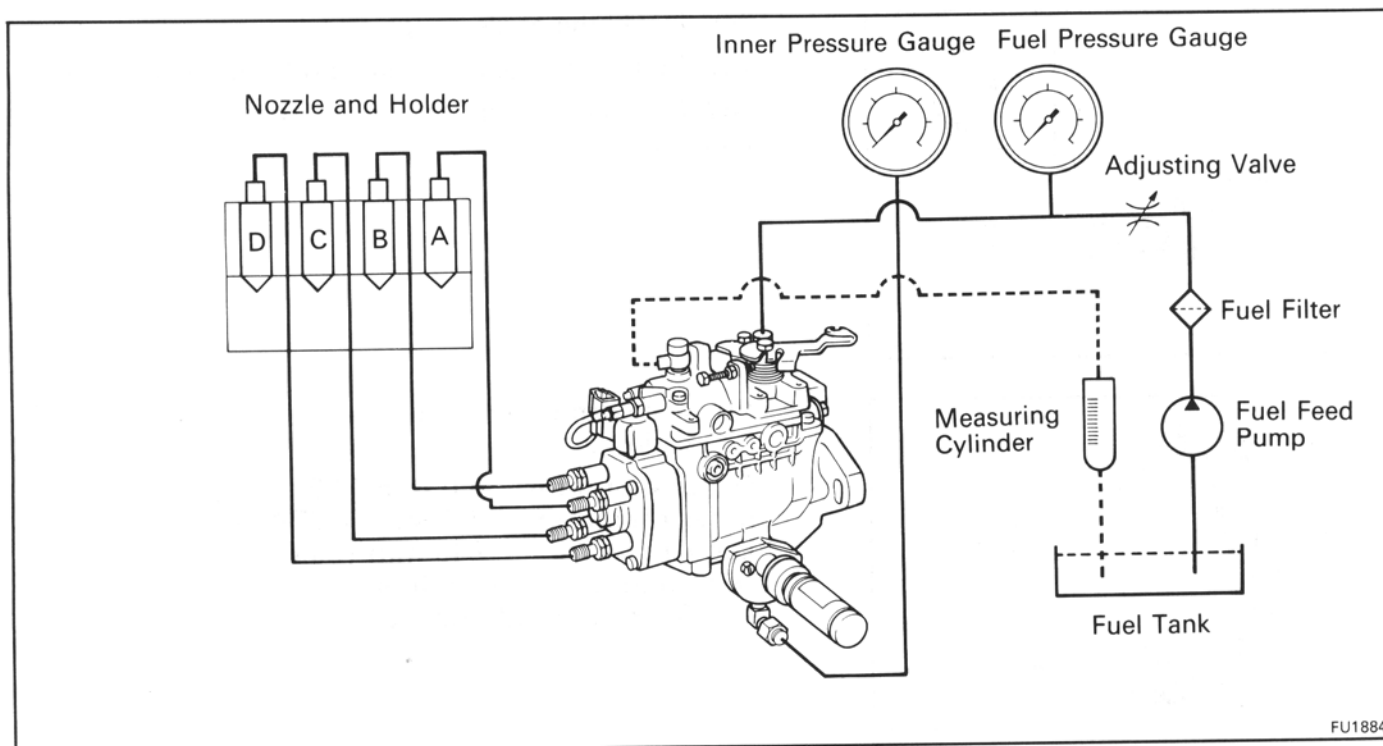
- (g) Remove the overflow screw and fuel return pipe.
 (h) Install the overflow hose with the overflow screw.
NOTE: Always use the overflow screw installed on the pump to be adjusted.



- (i) Remove the timer cover with the two screws.
 (j) Install the inner pressure gauge with the timer measuring device.

**Part No. 95095-10220 and 95095-10231
 (NIPPONDENSO)**

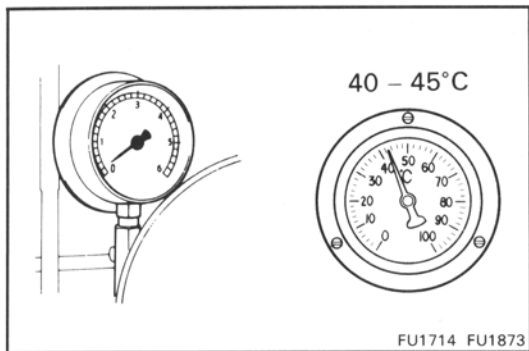
NOTE: Bleed the air by the air bleed screw.



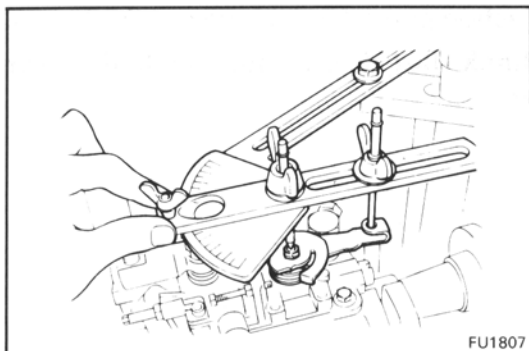
- (k) Apply about 12 volts of DC power to the fuel cut solenoid.

CAUTION:

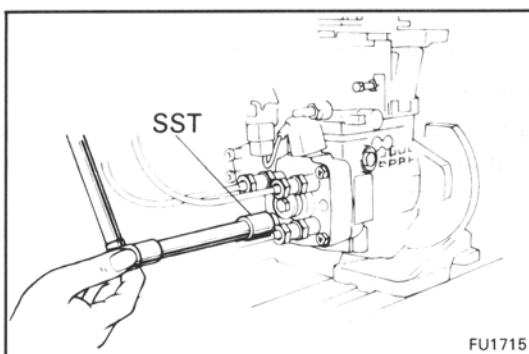
1. When applying voltage to the solenoid, position the battery as far away from the solenoid as possible so that a spark does not occur.
2. When connecting the battery cable, connect the solenoid side first.



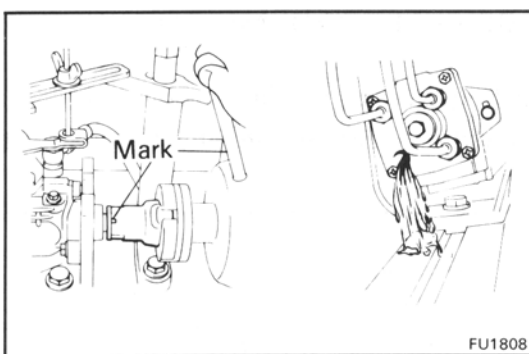
- (l) The pressure for feeding fuel to the injection pump should be 0.2 kg/cm^2 (2.8 psi, 20 kPa). The fuel temperature for pump testing should be $40 - 45^\circ\text{C}$ ($104 - 113^\circ\text{F}$).



- (m) Install an angle gauge to the stand and set it to the adjusting lever.
- (n) Secure the adjusting lever fully on the maximum speed side.

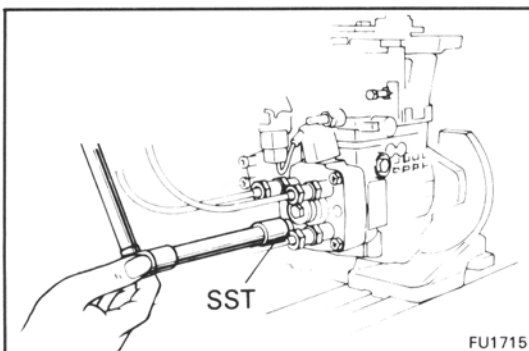


- (o) Check the installation direction of the camplate.
- (1) Disconnect the injection pipe from the position marked "C" on the distributive head.
 - (2) Using SST, remove the delivery valve holder.
- SST 09260-54012 (09269-54020)

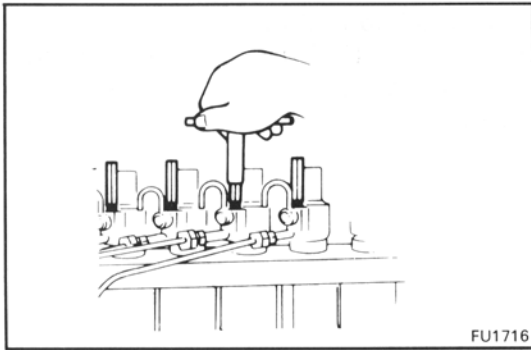


- (3) Check that fuel is flowing out when the mark is in the position shown in the figure. If not, it is improperly assembled.
- (4) Disassemble and change the camplate position 180° in the opposite direction.

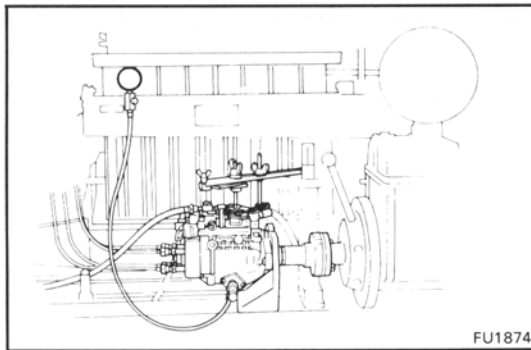
NOTE: At this time, disconnect the fuel cut solenoid wire harness.



- (5) Using SST, install the delivery valve holder.
 - (6) Connect the injection pipe.
- SST 09260-54012 (09269-54020)

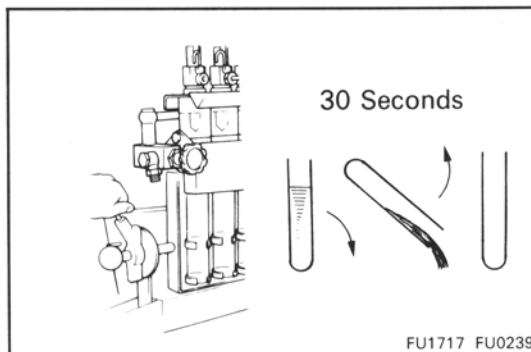


(p) Bleed the air from the injection pipes.



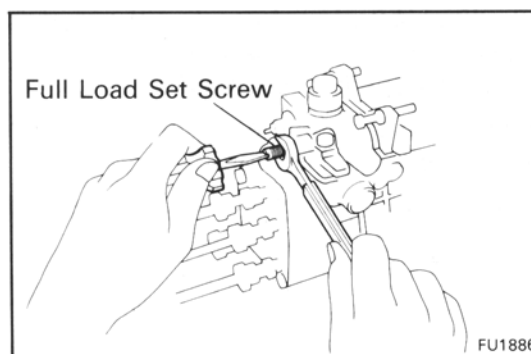
(q) Race the injection pump for 5 minutes at 2,000 rpm.

CAUTION: Check that there is no fuel leakage or abnormal noise.



NOTE:

- Measure the volume of each injection cylinder with a measuring cylinder.
- Before measuring the injection volume first hold the cylinder tilted for at least 30 seconds to discard all the fuel.

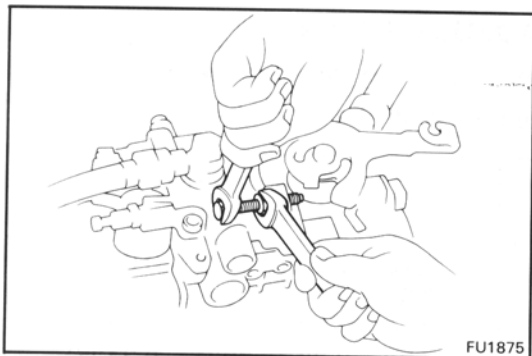


2. PRE-SETTING OF FULL LOAD INJECTION VOLUME

- Set the adjusting lever to maximum position.
- Adjust the injection volume with the full load set screw.

Pump revolution (rpm)	No. of measuring strokes	Injection volume cc (cu in.)
1,300	200	6.2 – 6.6 (0.38 – 0.40)

NOTE: The injection volume will increase about 3 cc (0.18 cu in.) with each 1/2 turn of the screw.

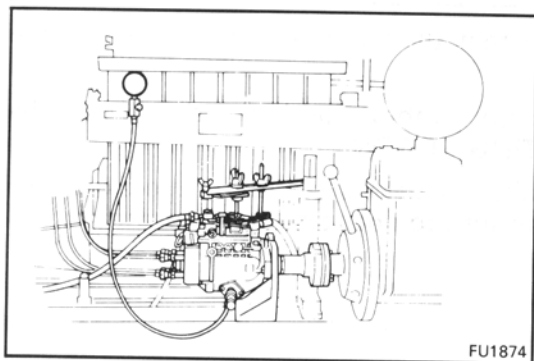


FU1875

3. PRE-SETTING OF MAXIMUM SPEED

- Set the adjusting lever to maximum position.
- Adjust the injection volume with the maximum adjusting screw.

Pump revolution (rpm)	No. of measuring strokes	Injection volume cc (cu in.)
2,900	200	1.6 – 2.8 (0.10 – 0.17)



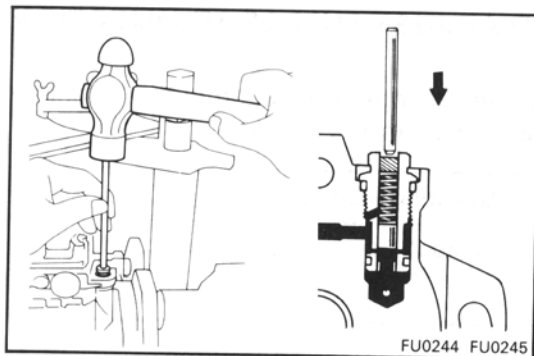
FU1874

4. MEASURE PUMP INNER PRESSURE

Measure the pump inner pressure at the below-listed rpm.

Pump revolution (rpm)	Inner pressure kg/cm ² (psi, kPa)
500	2.4 – 3.0 (34 – 43, 235 – 294)
2,900	7.6 – 8.2 (108 – 117, 745 – 804)

- If the pressure is low, adjust by lightly tapping the regulator valve piston while watching the pressure gauge.
- If the pressure is too high or if the regulator valve was tapped in too far, the regulator valve must be replaced.



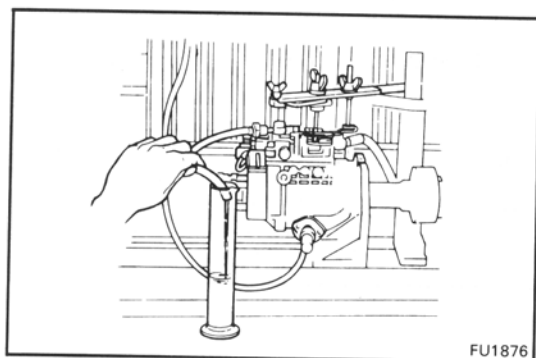
FU0244 FU0245

5. MEASURE OVERFLOW VOLUME

Measure the overflow volume at the below listed rpm.

Pump revolution (rpm)	Overflow volume cc/min. (cu in./min.)
2,900	392 – 845 (23.9 – 51.6)

NOTE: Always use the overflow screw installed on the pump to be adjusted.

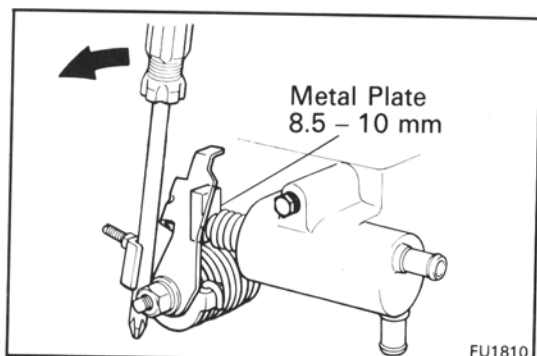


FU1876

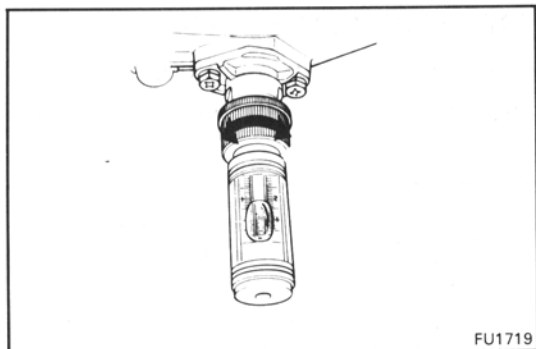
6. RELEASE COLD STARTING SYSTEM FOR NEXT INSPECTIONS

Using a screwdriver, turn the cold start lever counter-clockwise and put a metal plate of 8.5 – 10 mm (0.33 – 0.39 in.) in thickness between the lever and thermo wax.

NOTE: Keep the cold starting system released until all measurements and adjustments are finished.



FU1810



7. CHECK AND ADJUST TIMER

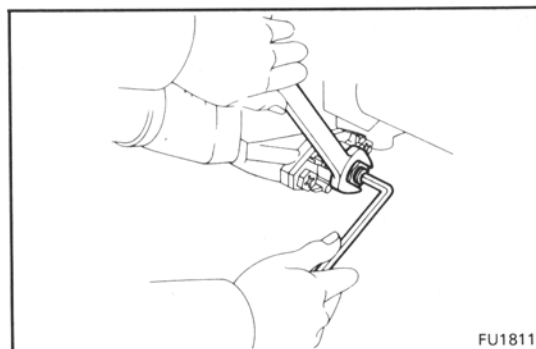
- Set the timer measuring device at zero.
- Measure the piston stroke at the below listed rpms.

Pump revolution (rpm)	Piston strokes mm (in.)
700	0.20 – 1.20 (0.0079 – 0.0472)
1,300	2.37 – 3.37 (0.0931 – 0.1327)
2,300	6.06 – 7.06 (0.2386 – 0.2780)
2,900	7.70 – 8.70 (0.3031 – 0.3425)

NOTE: Confirm that the hysteresis is within 0.3 mm (0.012 in.)

If any stroke is not within standard, adjust with the **TIMER ADJUSTING SCREW**.

NOTE: The stroke will decrease with turn to clockwise and increase with turn to counterclockwise.



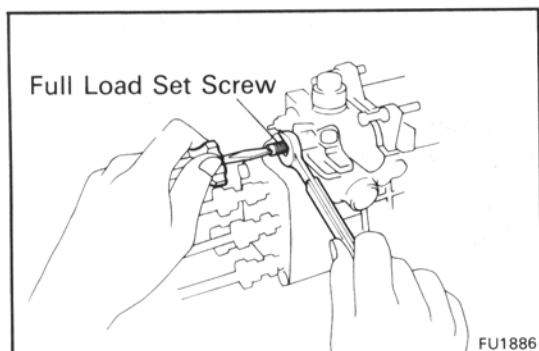
8. MEASURE AND ADJUST FULL LOAD INJECTION VOLUME

- The adjusting lever angle for the adjustment below should be as shown in the figure.

Adjusting lever angle	
A (Maximum speed side)	B (Idle speed side)
plus 42 – 52 °	Minus 5 – Plus 5°

- Measure the full load injection volume.

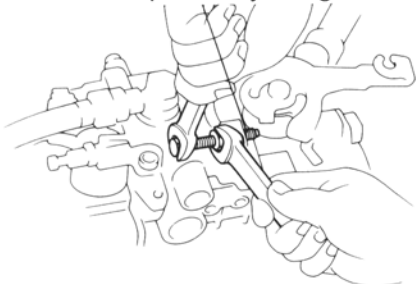
Adjusting lever angle	Pump revolution (rpm)	No. of measuring strokes	Injection volume cc (cu in)	Remarks
Plus 42 – 52°	1,300	200	6.2 – 6.6 (0.38 – 0.40)	Adjust
	500		5.1 – 5.8 (0.31 – 0.35)	—
	2,600		6.1 – 6.8 (0.37 – 0.41)	



If any injection volume is not at standard value, adjust with the **FULL LOAD SET SCREW**.

NOTE: The injection volume will increase about 3 cc (0.18 cu in.) with each 1/2 turn of the screw.

Maximum Speed Adjusting Screw



FU1875

9. ADJUST MAXIMUM SPEED

Adjust to the standard value with the MAXIMUM SPEED ADJUSTING SCREW.

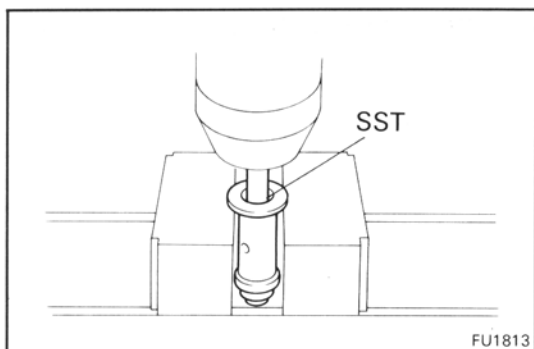
Adjusting lever angle	Pump revolution (rpm)	No. of measuring strokes	Injection volume cc (cu in.)	Remarks
Plus 42 – 52°	2,900	200	1.6 – 2.8 (0.10 – 0.17)	Adjust
	2,800		4.2 – 5.8 (0.26 – 0.35)	—
	3,100		Less than 1.5 (0.09)	

10. INSPECT INJECTION VOLUME

Measure the injection volume for each pump rpm.

Adjusting lever angle	Pump revolution (rpm)	No. of measuring strokes	Injection volume cc (cu. in.)	Variation limit cc (cu. in.)	Remarks
Plus 42 – 52°	1,300	200	6.2 – 6.6 (0.38 – 0.40)	0.4 (0.02)	Basic full-load injection volume
	100		6.6 – 11.4 (0.40 – 0.70)	1.2 (0.07)	Volume during starting
	500		5.1 – 5.8 (0.31 – 0.35)	0.5 (0.03)	—
	2,600		6.1 – 6.9 (0.37 – 0.42)		—

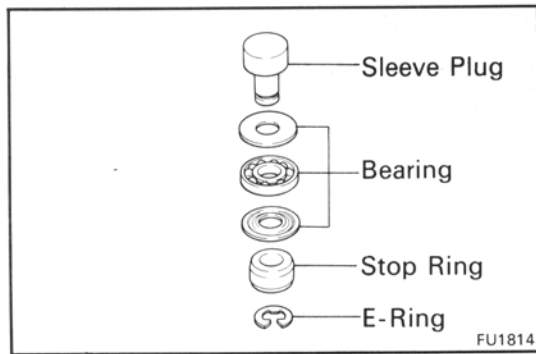
If the injection volume at 100 rpm is not within specification, replace the governor sleeve plug.



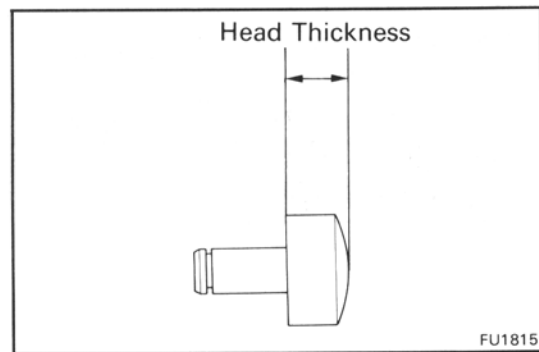
FU1813

- (1) Using SST and press, remove the sleeve plug subassembly.

SST 09236-00101 (09237-00070)



- (2) Remove the E-ring, stop ring, bearing and sleeve plug.

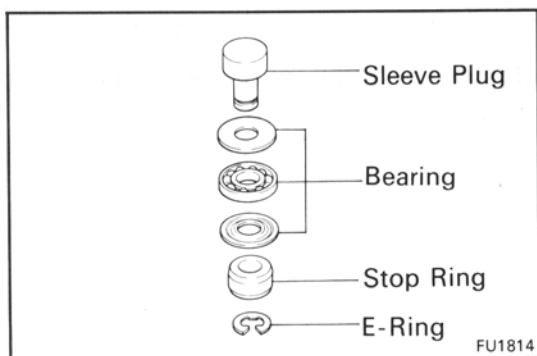


- (3) Select the head thickness of the sleeve plug.

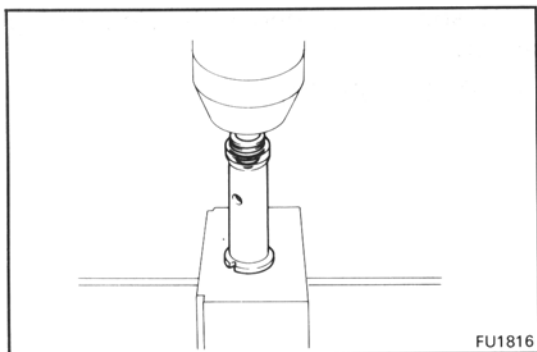
Governor sleeve plug head thickness		mm (in.)
3.0 (0.118)		3.7 (0.146)
3.1 (0.122)		3.8 (0.150)
3.2 (0.126)		3.9 (0.154)
3.3 (0.130)		4.0 (0.157)
3.4 (0.134)		4.1 (0.161)
3.5 (0.138)		4.2 (0.165)
3.6 (0.142)		

NOTE: Lengthening the plug 0.1 mm (0.004 in.) will increase injection volume by 0.6 cc (0.04 cu in.).

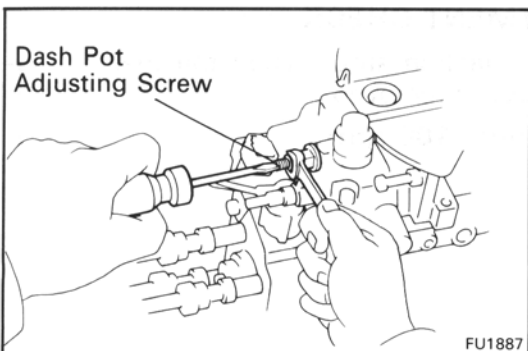
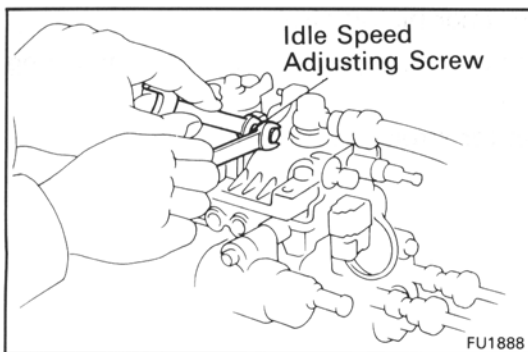
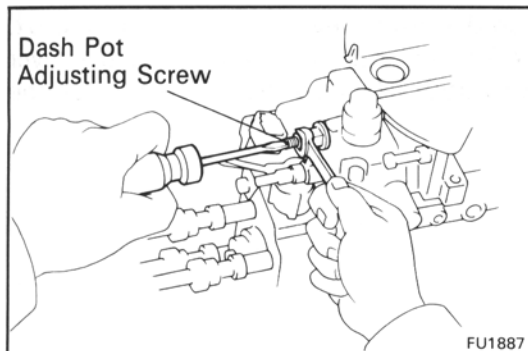
If the variation limit exceeds specification, replace the delivery valve.



- (4) Install the sleeve plug, bearing, a new stop ring and a new E-ring.



- (5) Using a hand press, install the sleeve plug sub-assembly.



11. ADJUST IDLE SPEED

- (a) Loosen the dash pot adjusting screw fully.

- (b) Adjust the injection volume with the IDLE SPEED ADJUSTING SCREW.

Pump revolution (rpm)	No. of measuring strokes	Injection volume cc (cu in.)	Remarks
500	1,000	$q = 0.5 - 1.5$ (0.03 - 0.09)	Adjust
350		$q \text{ plus } 5 - 9$ (0.31 - 0.55)	—

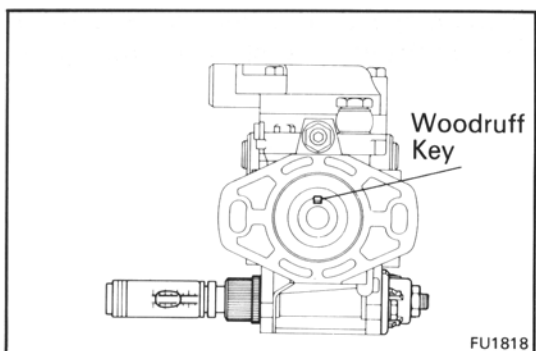
- (c) Adjust the injection volume with the DASH POT ADJUSTING SCREW.

NOTE: The stroke will decrease with turn to clockwise and increase with turn to counterclockwise.

Pump revolution (rpm)	No. of Measuring strokes	Injection volume cc (cu in.)
500	1,000	$q \text{ plus } 0.7 - 1.2$ (0.04 - 0.07)

- (d) Adjust the injection volume with the IDLE SPEED ADJUSTING SCREW.

Adjusting lever angle	Pump revolution (rpm)	No. of measuring strokes	Injection volume cc (cu in.)	Remarks
Minus 5° – Plus 5°	350	1,000	8.75 – 12.25 (0.53 – 0.75)	Adjust

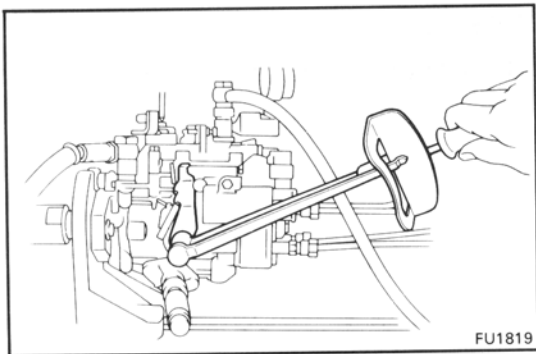


12. ADJUST COLD STARTING SYSTEM

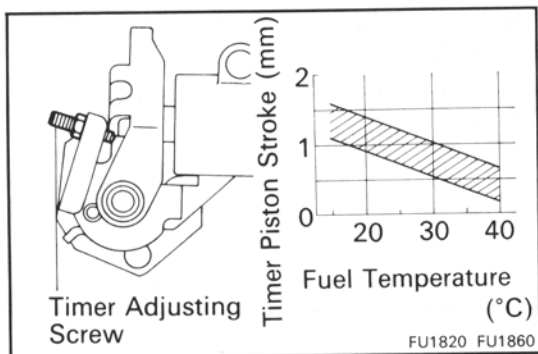
- (a) Remove the overflow screw and check the fuel temperature in the fuel pump.

Fuel temperature: 15 – 35°C (59 – 95 °F)

- (b) Set the woodruff key on the pump drive shaft in a vertical or horizontal position.
- (c) Set the scale of the timer measuring device to zero.
- (d) Check the adjusting lever opening angle and consider this angle as zero.
- (e) Remove the metal plate put between the cold starting lever and thermo wax.



- (f) Torque the cold starting lever clockwise to approx. 50 kg-cm (43 in.-lb, 4.9 N·m) and keep the lever tightened for about 10 seconds. Then release the torque.



- (g) Measure the timer piston stroke.

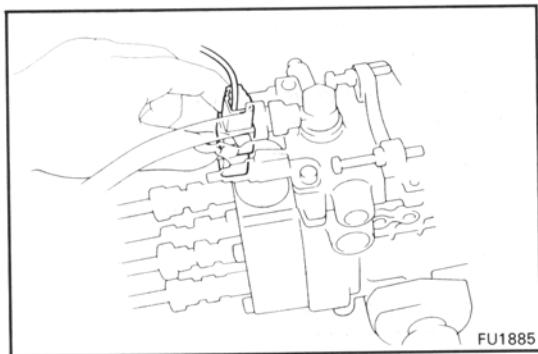
If not within specification, adjust with the timer adjusting screw.

NOTE: Screw in for stroke decrease.

13. POST ADJUSTMENT CHECK

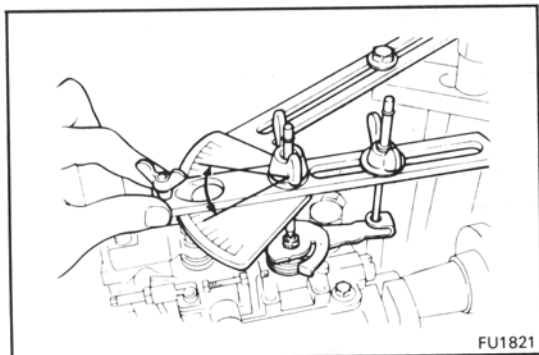
- (a) Check that injection stops when the fuel cut solenoid harness is removed.

Pump revolution: 100 rpm

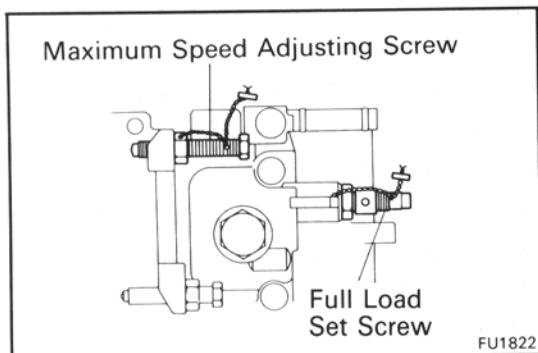


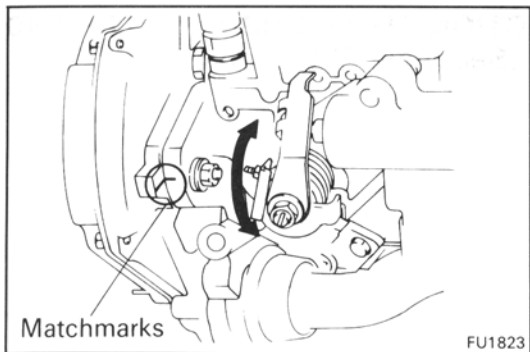
- (b) Check the adjusting lever movement.

Adjust lever angle: 42° – 52°



- (c) Lock the maximum speed adjusting screw and full load set screw with the wires as shown in the figure.





INSTALLATION OF INJECTION PUMP

(See page FU-12)

1. INSTALL INJECTION PUMP

- (a) Align the matchmarks on the injection pump and water pump.
- (b) Temporarily install the mount nuts.

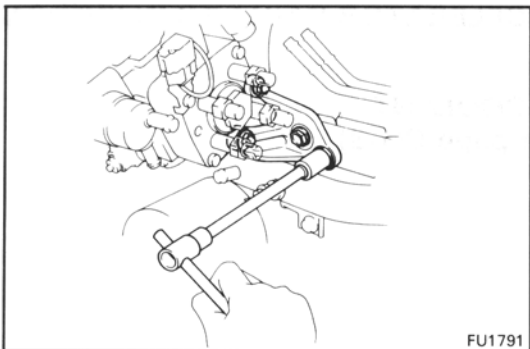
NOTE: Torque the mount bolt and nut to specification after adjusting the injection timing.

- (c) Install the bracket with the four bolts.

Torque: 195 kg-cm (14 ft-lb, 19 N·m)

2. INSPECT AND ADJUST INJECTION TIMING

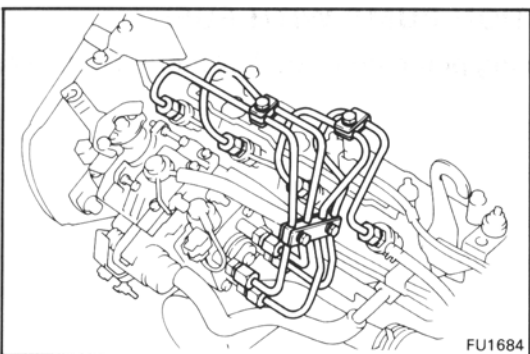
(See page EM-20)



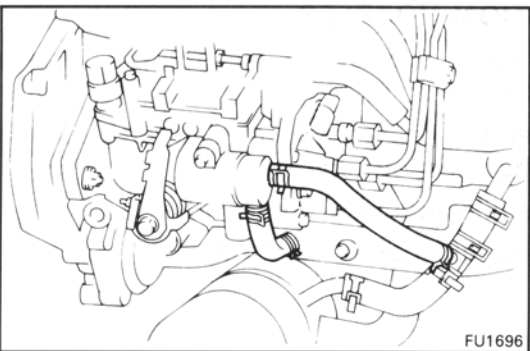
3. INSTALL FOUR INJECTION PIPES

(See steps 5 on pages FU-11)

Torque: 300 kg-cm (22 ft-lb, 29 N·m)

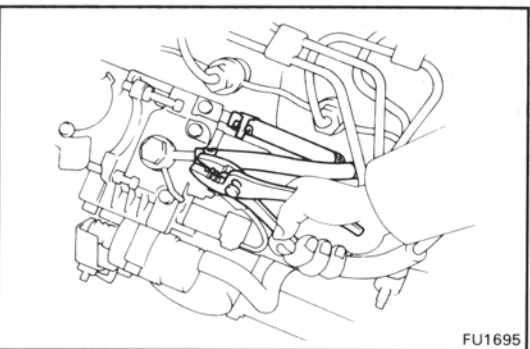


4. CONNECT WATER BY-PASS HOSES



5. CONNECT FUEL INLET AND OUTLET HOSES

6. CONNECT FUEL CUT SOLENOID CONNECTOR



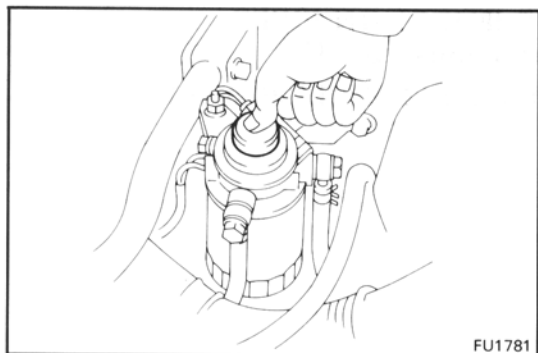
7. INSTALL INJECTION PUMP DRIVE PULLEY AND TIMING BELT (See page EM-31 to 36)

8. CONNECT ACCELERATOR CABLE TO INJECTION PUMP

9. REFILL WITH COOLANT
(See step 3 on page CO-3)

10. REFILL INJECTION PUMP WITH FUEL

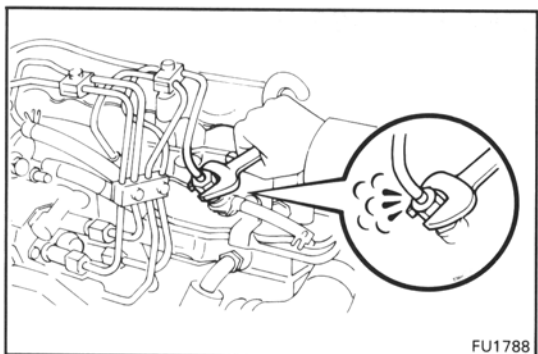
Operate the priming pump until you feel more resistance.



11. BLEED INJECTION NOZZLES

- (a) Loosen all union nuts of the injection pipe on the nozzle holder side.
- (b) Crank the engine to bleed the air and force out the fuel from the injection pipe.
- (c) Tighten the injection pipe union nuts.

Torque: 300 kg-cm (22 ft-lb, 29 N·m)



12. START ENGINE AND CHECK FOR FUEL LEAKS

13. CHECK ENGINE IDLE SPEED AND MAXIMUM SPEED (See page EM-22)

14. RECHECK COOLANT LEVEL