

## 7 ADJUSTMENT

### 1. ADJUSTMENT CONDITIONS

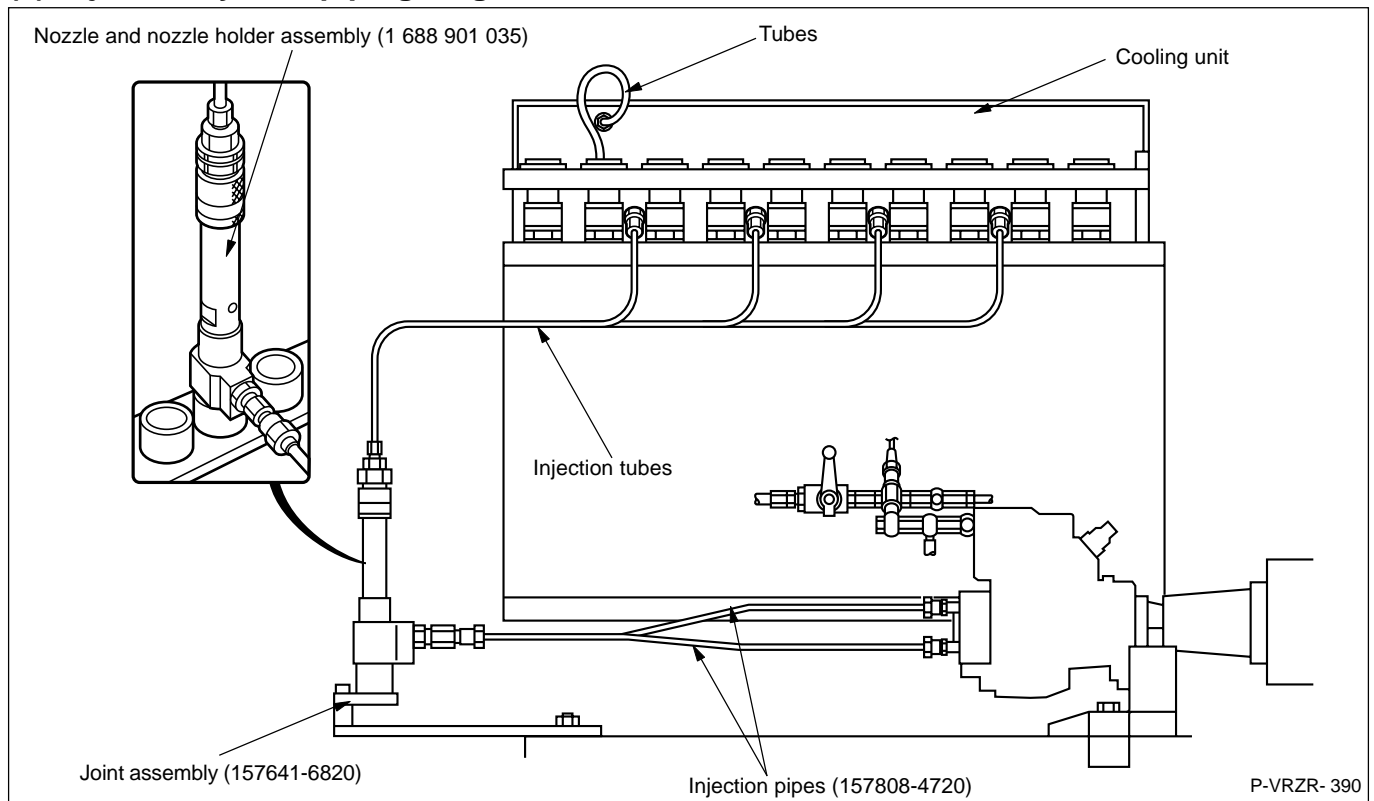
#### [1] Test equipment

- (1) Pump test bench EPS815
- (2) KMA802
- (3) Oil cooler (1 687 010 130)
- (4) Adjustment software operating environment

Windows OS	Windows 2000 PRO (at least Service Pack 2.0) English language version
Clock speed	Personal computer equipped with Pentium CPU (clock speed at least 333 MHz)
Memory	At least 128 MB usable memory
Hard disk	At least 20 MB space
Display	Resolution: at least 1027 x 768, number of display colors: high color minimum (16 bit)
Drive devices	CD-ROM drive, floppy disk drive
Additional devices	At least 2 communication ports (2 necessary for controller assembly) Mouse, keyboard

#### [2] Fuel piping

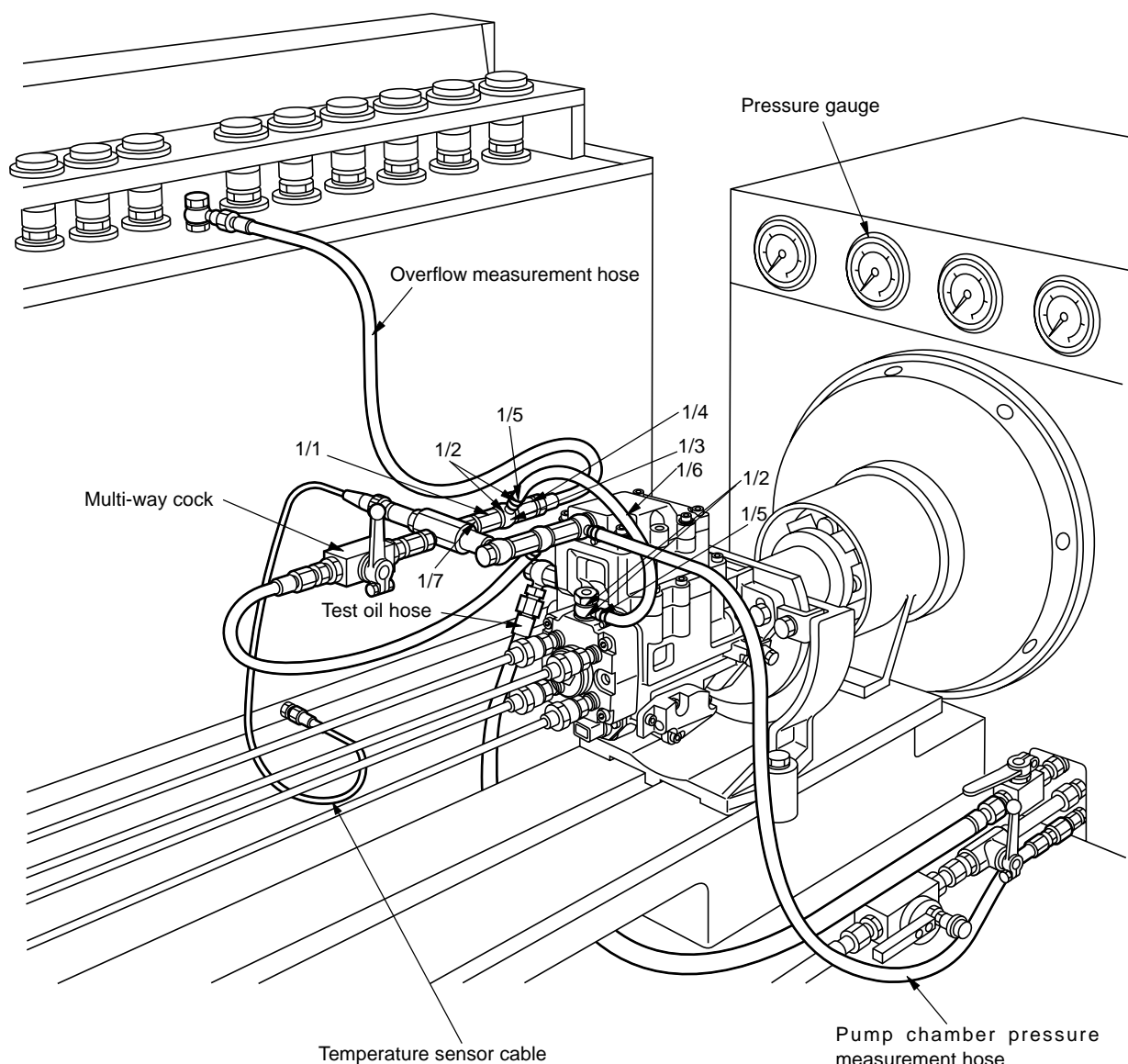
##### (1) Injection system piping diagram



## (2) Fuel piping

Key no	RBAJ part no	Bosch part no	Part name	Qty	Remarks
1	157971-1020	9 443 613 442	Piping assembly	-	For VRZ overflow fuel piping
1/1	157971-1100	9 443 613 443	Bolt	1	For distributor head overflow
1/2	026512-1640	9 421 617 041	Gasket	6	For distributor head overflow
1/3	029711-2180	9 442 610 444	Eye	2	For distributor head overflow
1/4	157971-1000	9 443 613 444	Adapter	1	For distributor head overflow
1/5	017211-2010	9 442 611 983	Hose clip	2	For distributor head overflow
1/6	157986-8100	9 443 613 445	Hose	1	For distributor head overflow
1/7	026510-1340	9 442 610 043	Gasket	1	For distributor head overflow

### Piping outline

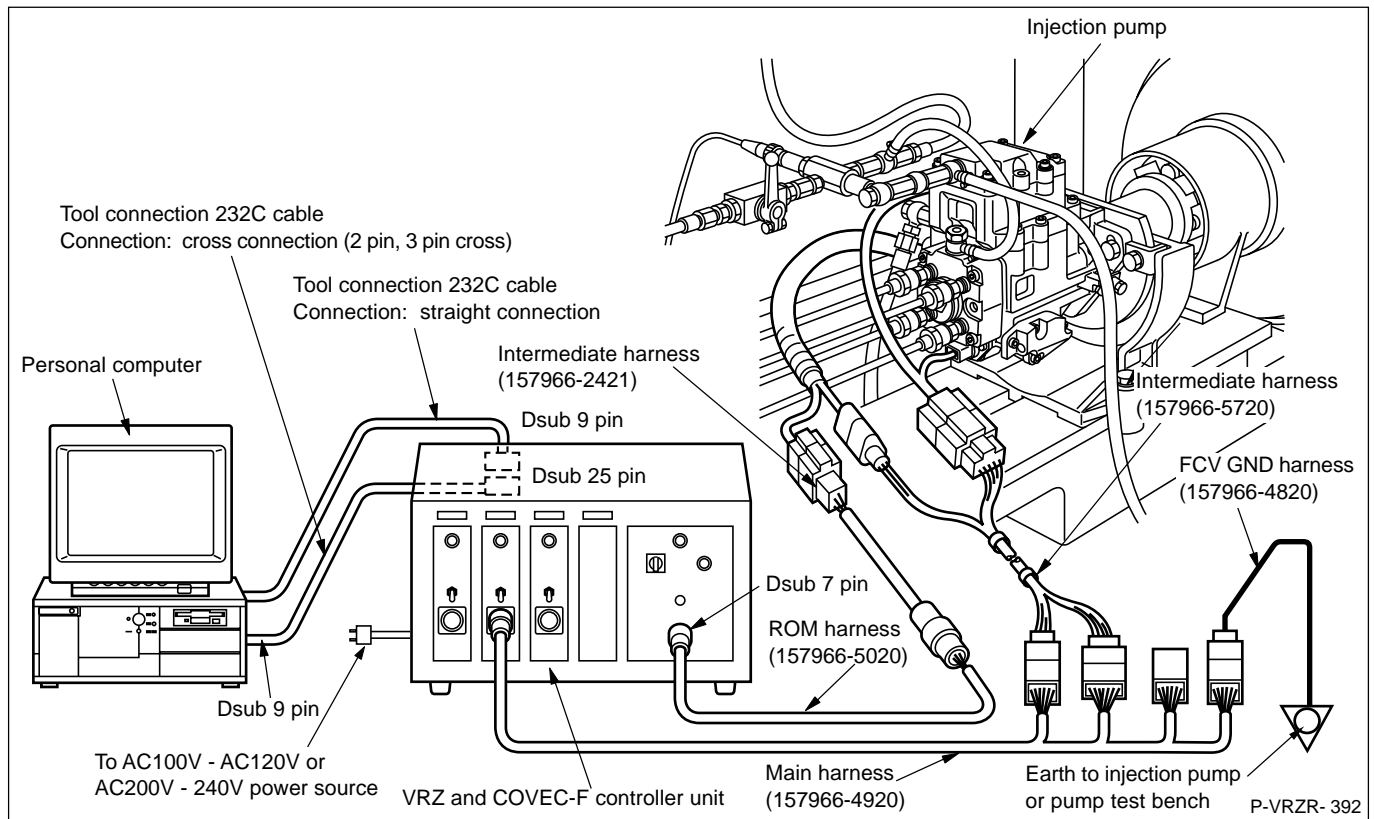


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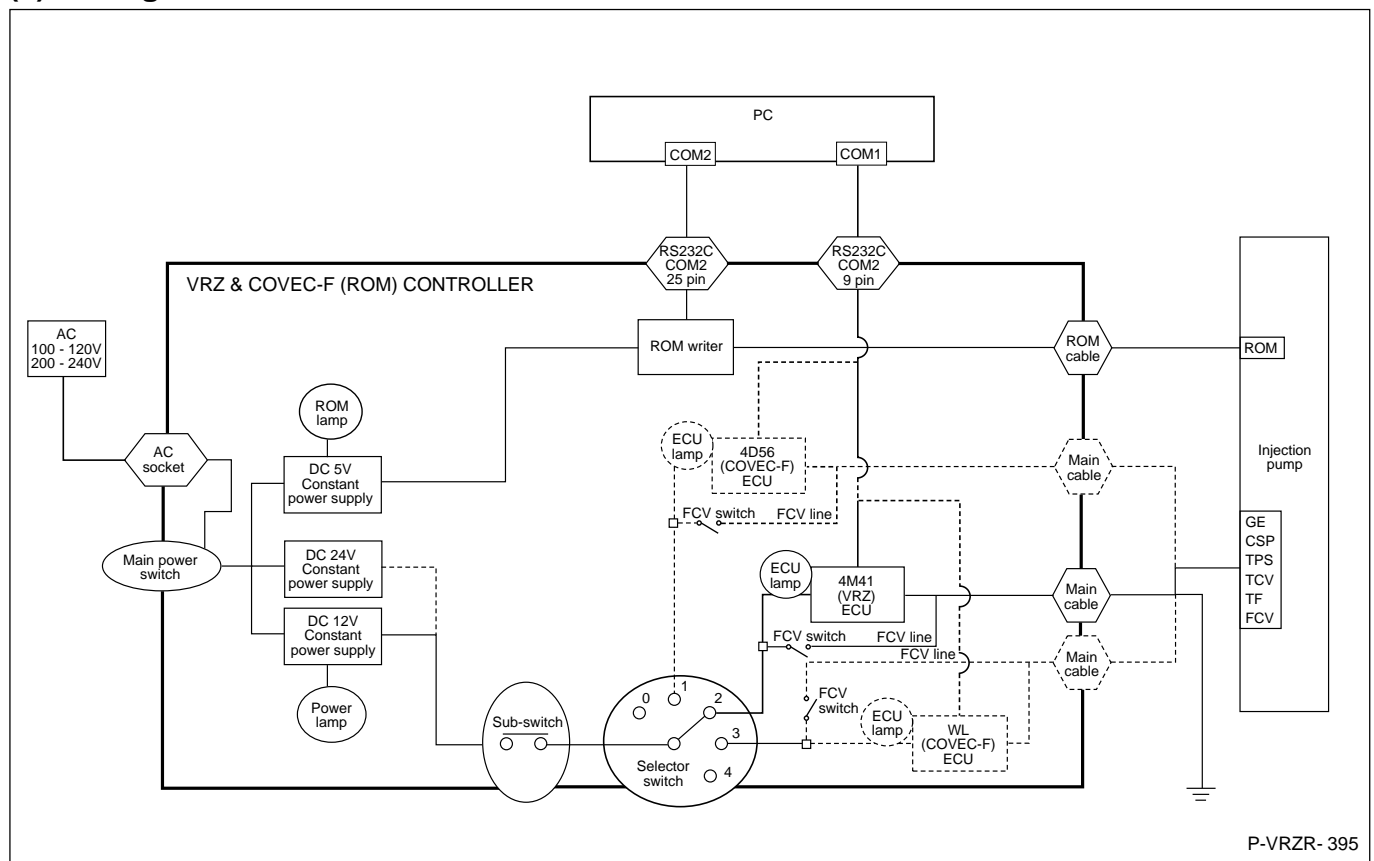
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### [3] Wiring outline

#### (1) Controller assembly wiring



#### (2) Wiring connections inside controller unit



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**[4] Related materials**

No.	Publication No.	Remarks
1	ED14E-11020	When installing the ECU assembly for the controller unit, refer to the installation instructions included with the controller unit.
2	ED14E-11010	When installing the adjustment software, refer to the installation manual included with the CD-ROM.

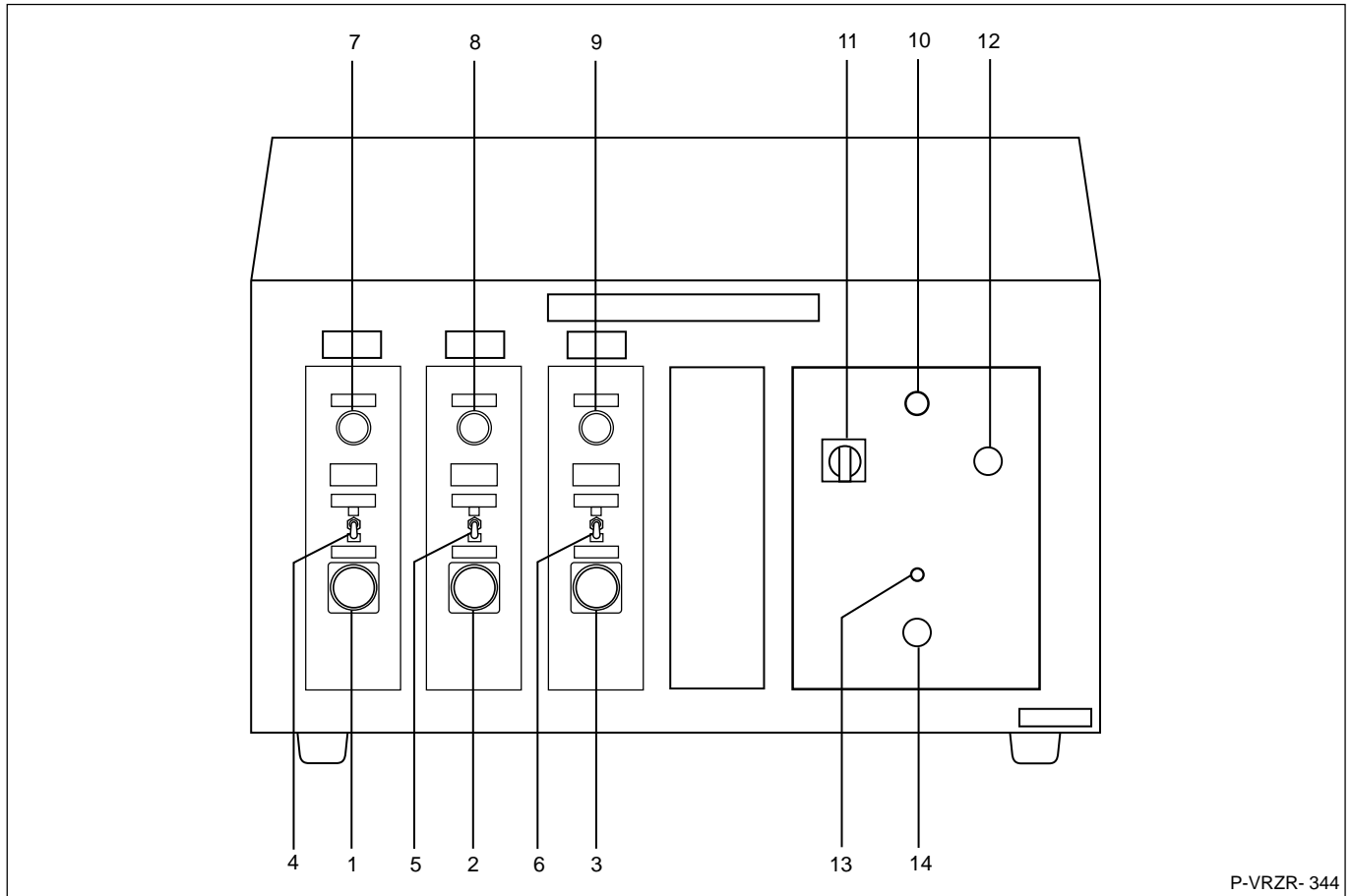
**Note:**

Where updating of adjustment data and inspection data is indicated, copy the data from the ESPI (ZW)'s CD-ROM.

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### 2. CONTROLLER UNIT CONTROLS

#### [1] Front panel



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Key no	Name	Use and purpose
1	Pump side wire harness connection	For connecting harness for injection pump's harness connectors and GE controller.
2	Pump side wire harness connection	For connecting harness for injection pump's harness connectors and GE controller.
3	Pump side wire harness connection	For connecting harness for injection pump's harness connectors and GE controller.
4	FCV (magnet valve) ON / OFF switch	Turns the FCV (magnet valve) ON and OFF. Turned ON when in use (positioned up). Usually turned OFF (positioned down).
5	FCV (magnet valve) ON / OFF switch	Turns the FCV (magnet valve) ON and OFF. Turned ON when in use (positioned up). Usually turned OFF (positioned down).
6	FCV (magnet valve) ON / OFF switch	Turns the FCV (magnet valve) ON and OFF. Turned ON when in use (positioned up). Usually turned OFF (positioned down).
7	4D56 ECU pilot lamp	Orange lamp lights when 4D56 ECU in use.
8	4M41 ECU pilot lamp	Orange lamp lights when 4M41 ECU in use.
9	WL ECU pilot lamp	Orange lamp lights when WL ECU in use.
10	Power pilot lamp	Orange lamp lights when ECU in use (when breaker is turned ON).

Key no	Name	Use and purpose
11	ECU changeover switch	Turn to align with ECU in use. 0: All OFF 1: No. 1 ECU 2: No. 2 ECU 3: No. 3 ECU 4: Spare ECU
12	Sub-switch	Power sub-switch for controller unit for VRZ adjustment. Press once to turn ON. When turned ON for use, orange lamp lights. Press once again to turn OFF.
13	ROM pilot lamp	Green lamp lights when ROM in use.
14	ROM wire harness connecting terminal	For connecting injection pump's ROM harness connector to ROM controller using wire harness.

### CAUTION

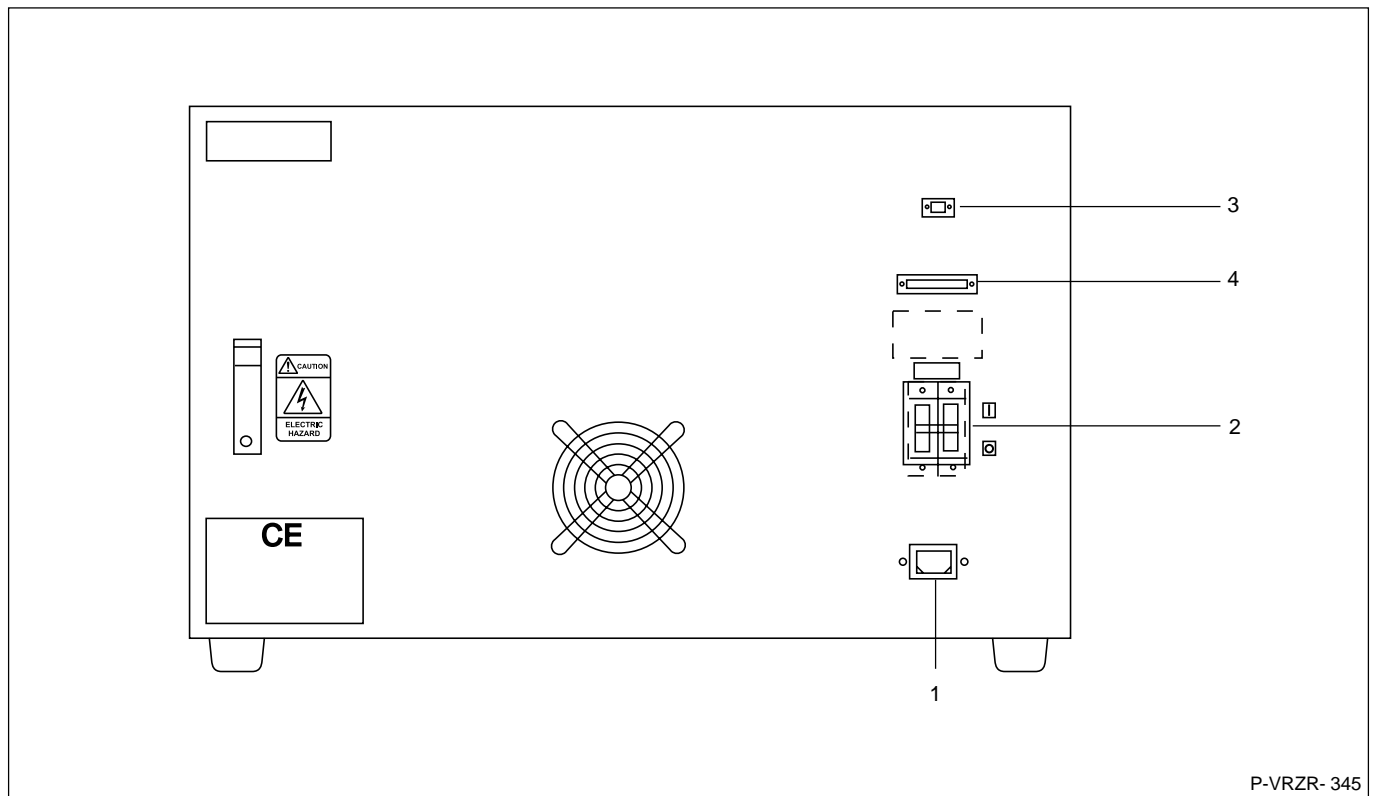
**If you smell any unusual smell or see smoke or sparks when using the controller unit, turn the power switch OFF immediately and stop using the controller unit.  
Fire may result if you continue to use the controller unit.**

#### Advice

- **Do not use the controller unit with oily hands. The oil may stick to the dials and cause improper resistor contact inside the controller unit, preventing proper operation.**
- **Before turning the power switch ON, confirm that the wire harnesses are properly connected.**

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### [2] Rear panel



Key no	Name	Use and purpose
1	AC100V - 120V power or AC 200V - 240V power terminal	Connect to AC100V - 120V, 50/60Hz power source or AC 200V - 240V power source, 50/60Hz.
2	Main switch (breaker)	Controller unit power switch. Turn ON when in use (position at 'I'). Position at 'O' to turn OFF.
3	D-sub 9 pin cable connection (COM1)	Connects RS232C cable to personal computer (for GE).
4	D-sub 25 pin cable connection (COM2)	Connects RS232C cable to personal computer (for Q-ROM)

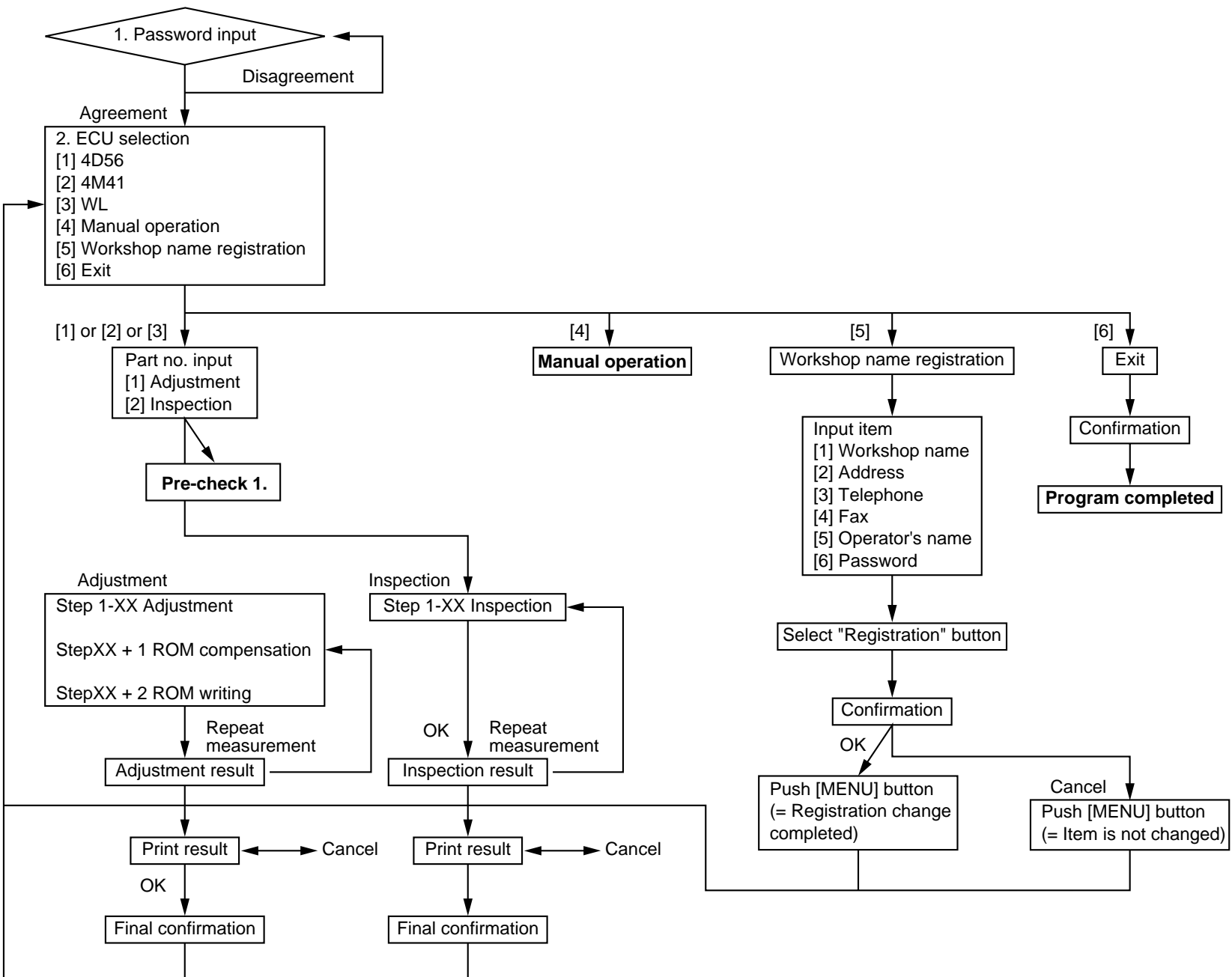
### CAUTION

If you smell any unusual smell or see smoke or sparks when using the controller unit, turn the power OFF immediately and stop using the controller unit.  
Fire may result if you continue to use the controller unit.

#### Advice

- Do not use the controller unit with oily hands. The oil may stick to the dials and cause improper resistor contact inside the controller unit, preventing proper operation.
- Before turning the power switch ON, confirm that the wire harnesses are properly connected.

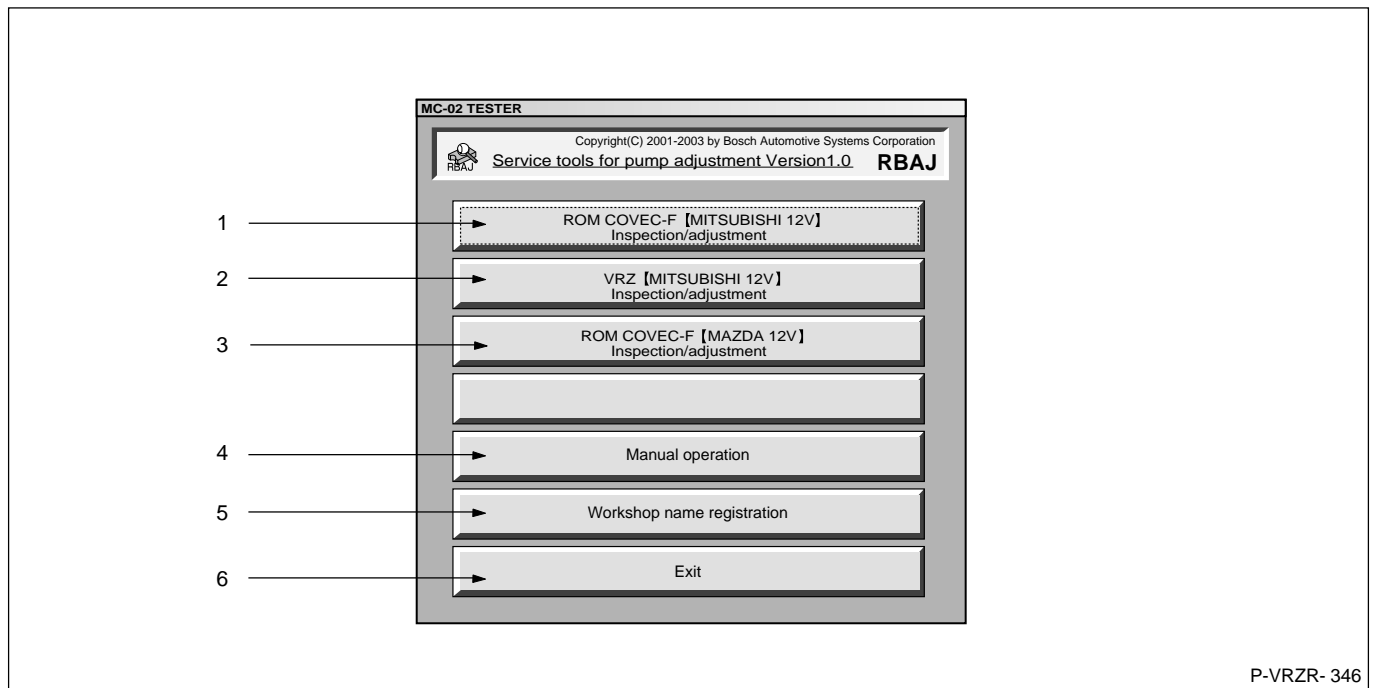
## 3. PUMP ADJUSTMENT TOOL FLOW CHART





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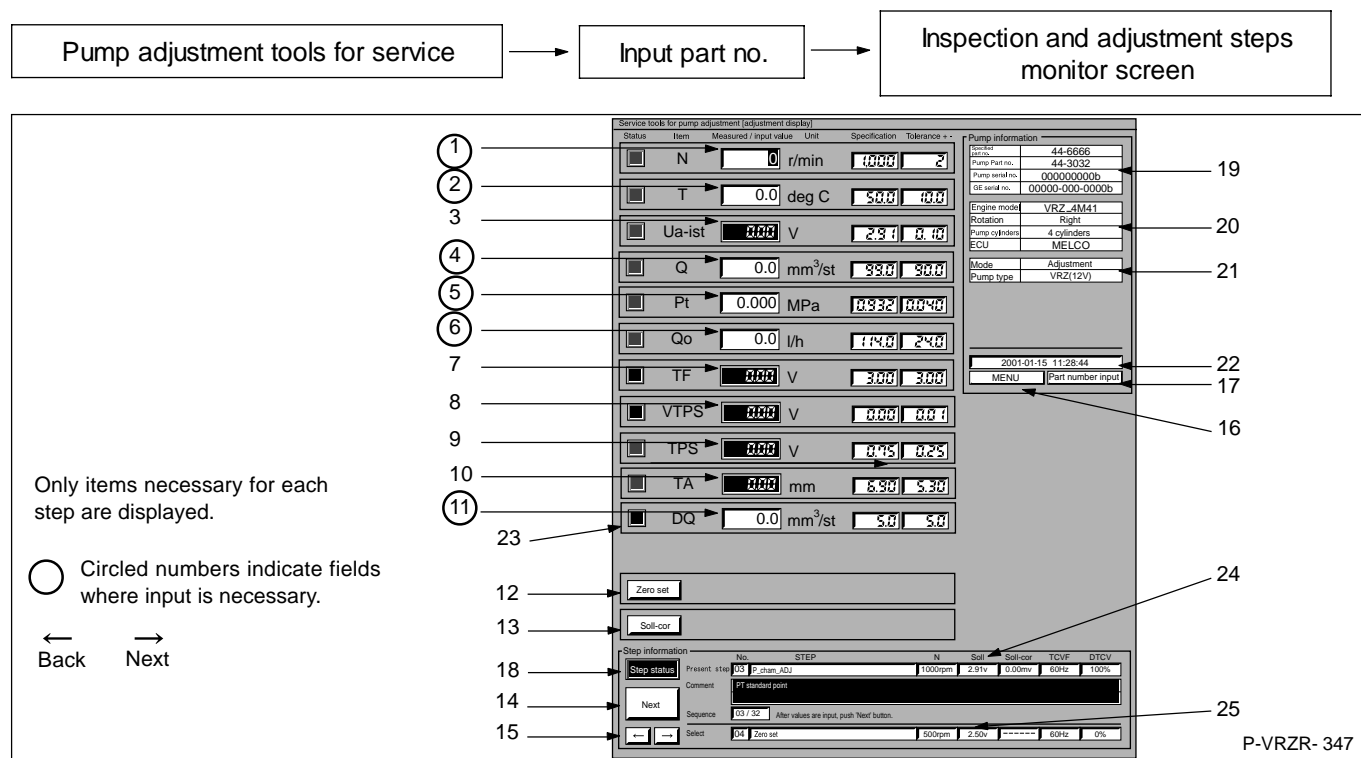
### 4. PUMP ADJUSTMENT TOOL MONITOR SCREEN



No.	Name	Use and purpose
1	4D56 model engine's COVEC-F type injection pump inspection / adjustment key	Select for inspection / adjustment of COVEC-F injection pump for Mitsubishi 4D56 model engine
2	4M41 model engine's VRZ type injection pump inspection / adjustment key	Select for inspection / adjustment of VRZ injection pump for Mitsubishi 4M41 model engine
3	WL model engine's COVEC-F type injection pump inspection / adjustment key	Select for inspection / adjustment of COVEC-F injection pump for Mazda WL model engine
4	Manual operation key	For adjusting injection pump and engine's installation timing
5	Workshop registration key	For workshop registration
6	Exit key	To exit adjustment software

## 5. PUMP ADJUSTMENT TOOL MONITOR SCREEN OUTLINE

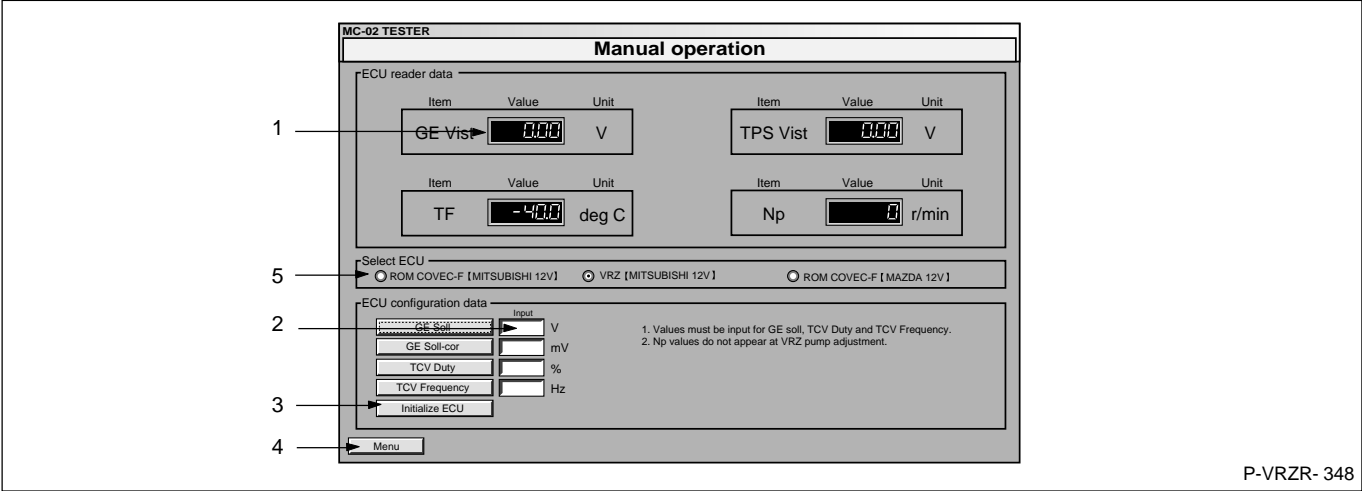
### Inspection and adjustment step screen



No.	Name	Use and purpose
1	Pump speed input	N: pump speed Input the pump's speed.
2	Test oil temperature input	T: test oil temperature Input the test oil temperature.
3	Actual control sleeve position voltage display	Ua-soll: actual control sleeve position voltage Displays actual control sleeve position voltage.
4	Pump injection quantity input	Q: pump injection quantity Input pump's injection quantity.
5	Pump chamber pressure input	Pt: pump chamber pressure Input pump's chamber pressure.
6	Pump overflow quantity input	Qo: pump overflow quantity Input pump's overflow quantity.
7	TF output display	TF: fuel temperature Displays fuel temperature output voltage.
8	VTPS output display	VTPS: voltage at 0 mm timer stroke Displays VTPS output voltage (voltage at 0 mm timer stroke).
9	TPS output display	TPS: timer piston sensor output voltage Displays TPS (timer piston sensor) output voltage.
10	TA output display	TA: timer stroke Displays TA (timer stroke) output.
11	Variation between cylinders display	DQ: variation between cylinders Input pump's variation between injection quantities.
12	Zero setting key	TPS output voltage at TA = 0 mm can be set at 0 V.
13	Target control sleeve position compensation voltage key	Any control sleeve position can be set by setting the compensation voltage.
14	NEXT key	To set at next step.
15	Keys for moving to next or previous step	To set at any step ( ← BACK, → NEXT).
16	Menu key	To set at MENU display.
17	Part number input key	To set at part number input display.
18	Step status display	Displays step status. Changes from red to green when all items are within specifications.
19	Part number, serial number display	Displays pump information part number (specification, pump) and serial number (pump, GE).
20	Specification display	Displays pump information specifications.
21	Measurement mode display	Displays pump information measurement mode (inspection, adjustment).
22	Measurement date display	Displays date and time of measurements.
23	Status display	Displays step status. Green: within specifications; red: outside of specifications.
24	Current step display	Displays current step items.
25	Next step display	Displays next step's items.

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**6. MANUAL OPERATION DISPLAY**  
**Second timing adjustment (manual operation)**



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No.	Name	Remarks
1	Control sleeve position actual voltage display	Displays actual control sleeve position voltage.
2	Control sleeve position target voltage display	By operating the input keys, the control sleeve position can be set for the engine specified in No. 5.
3	Initialize ECU	Clear display values
4	MENU	Displays MENU screen.
5	Select ECU	Select the ECU for the engine.

## 7. WORKSHOP DISPLAY

### Second timing adjustment (manual operation)

Pump adjustment tools for service

Workshop name registration

1 Workshop name RBAJ

2 Address JAPAN

3 Telephone 000-000-0000

4 Fax 111-111-1111

5 Operator's name sse

6 Password \*\*\*\*

7 Menu

8 Registration

Input items and select 'Registration' button.

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No.	Name	Remarks
1	Workshop name	Input comany name.
2	Address	Input company address.
3	Telephone	Input telephone number.
4	Fax	Input fax number.
5	Operator's name	Input operator's name.
6	Password	Input password and change password.
7	MENU	Can be used to set MENU display.
8	Registration	For keeping registered items.

(1) Workshop name registration

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### WORKSHOP REGISTRATION

(1) Select 'Workshop name registration.'

(2) Workshop name RBAJ

(3) Address JAPAN

(4) Telephone 000-000-0000

(5) Fax 111-111-1111

(6) Operator's name sse

(7) Password \*\*\*\*

Registration

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(2) Input the company name, etc, in the fields on the screen.

(3) Click the 'Registration' button.

Note:

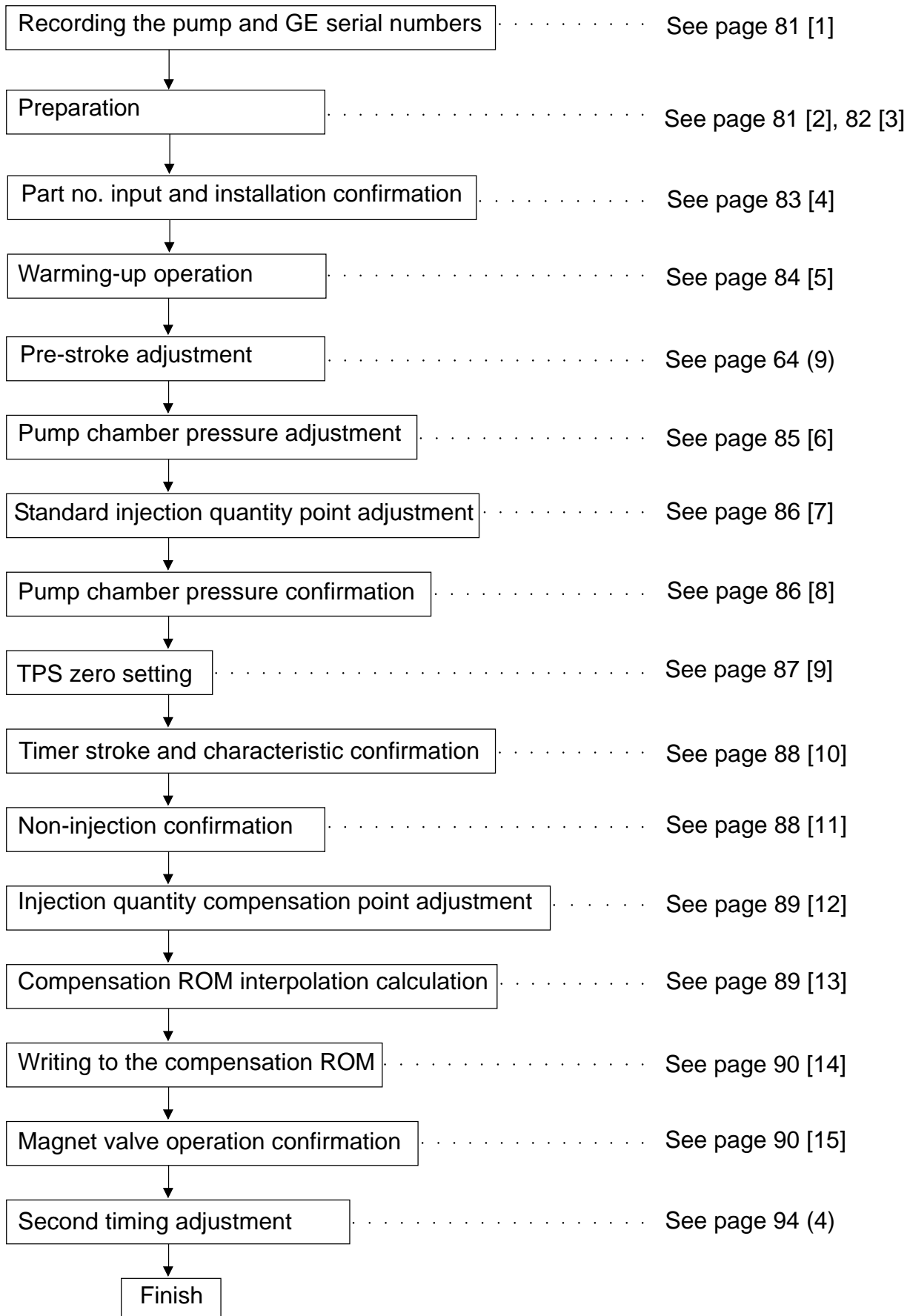
The default password at setup is 'RBAJ'. Input a new password if desired. (The only limit to the number of figures and letters in the password is the size of the input field.)

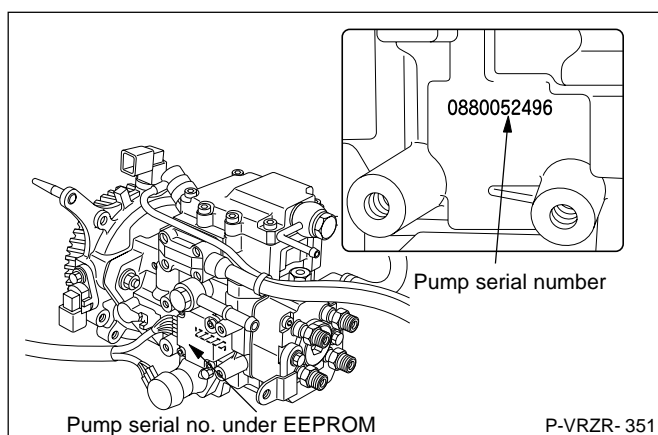
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### 8. ADJUSTMENT

#### Adjustment sequence





## [1] Recording the pump and GE serial numbers

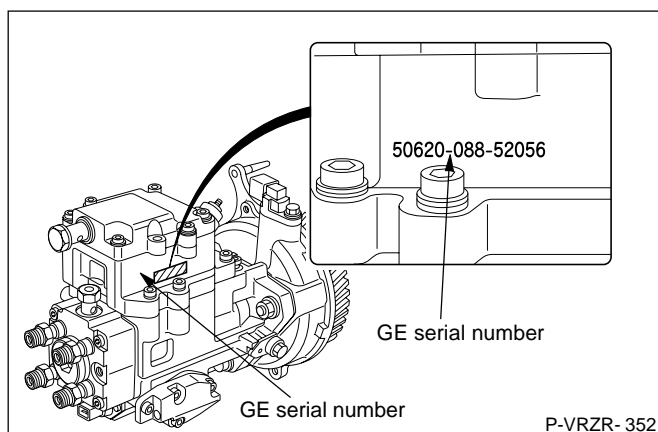
- (1) Read and record the 10 digit pump serial number.

### Advice

**It is easier to read the pump's serial number before beginning 'Preparation.'**

Note:

Serial number input is used during adjustment mode and inspection mode.



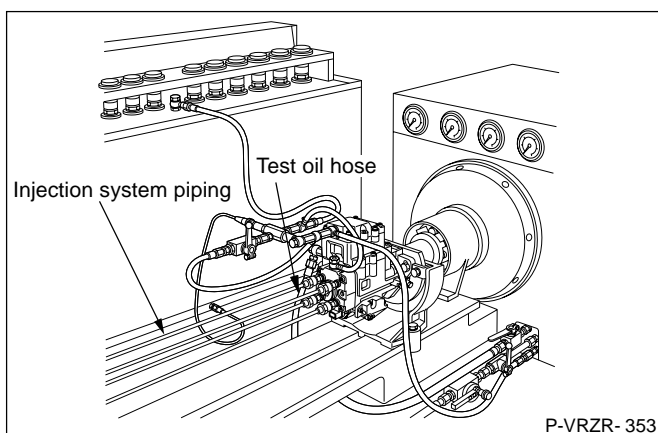
- (2) Read and record the 13 digit GE actuator's serial number.

### Advice

**It is easier to read the GE actuator's serial number before beginning 'Preparation.'**

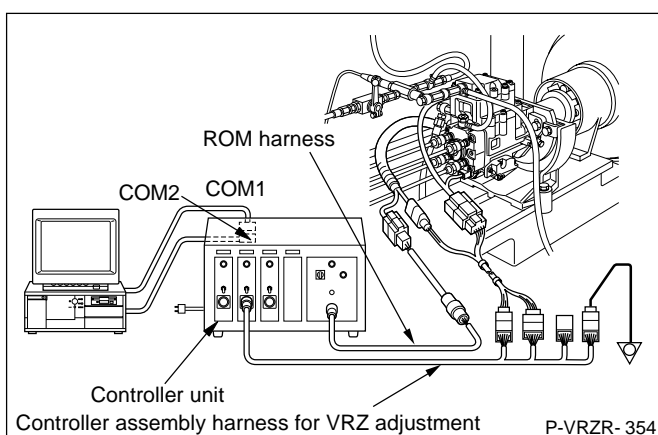
Note:

Serial number input is used during adjustment mode and inspection mode.

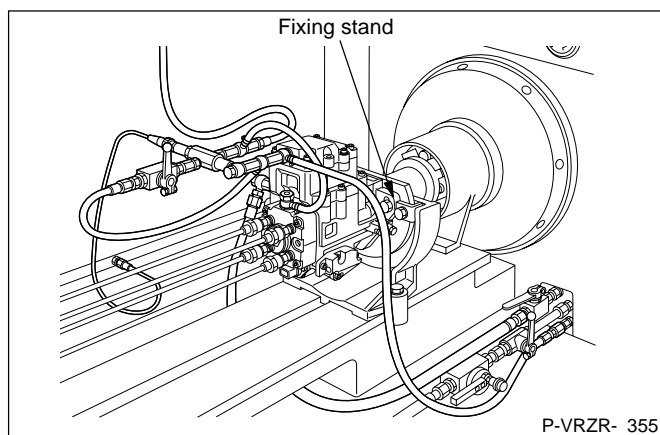


## [2] Preparation

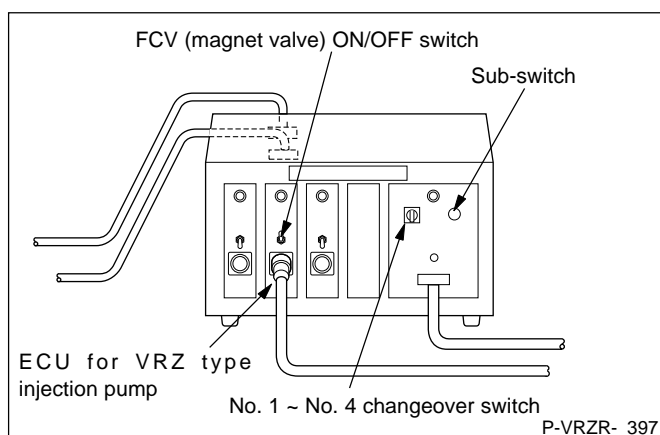
- (1) Connect the test oil hose to the injection pump. (Refer to page 69 for the fuel piping.)
- (2) Connect the injection system piping to the injection pump. (Refer to page 68 for the injection system piping.)
- (3) Connect the controller assembly's wire harness and intermediate harness to the injection pump's connectors. (Refer to page 70 for the controller assembly's wiring.)
- (4) Connect the ROM controller's wire harness and intermediate harness to the injection pump's VRZ EEPROM connector.
- (5) Connect the FCV GND harness to the controller assembly's wire harness and to earth.
- (6) Connect the D-Sub 9 pin cable connector (COM 1) on the rear of the controller unit to the personal computer using the wire harness.
- (7) Connect the D-Sub 25 pin cable connector (COM 2) on the rear of the controller unit to the personal computer using the wire harness.



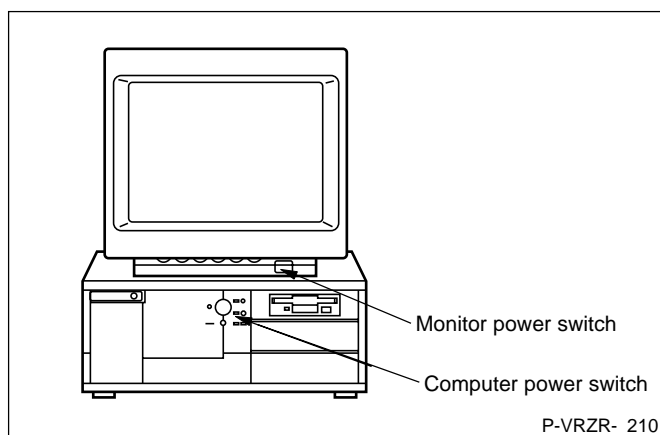
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- (8) Reconfirm that the coupling and the fixing stand bolts and nuts are securely tightened.
- (9) Set the 20NP pump test bench's test oil outlet temperature at 45°C.
- (10) Set the cooling unit oil delivery pressure lever at '80 kPa {0.8 kgf/cm<sup>2</sup>}' or less.

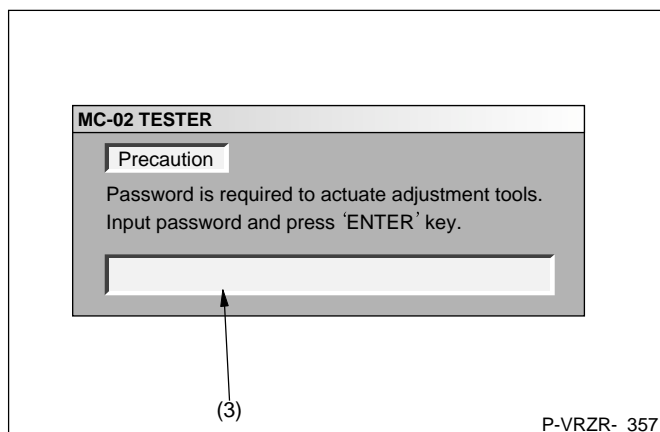


- (11) Connect the wire harness to the controller unit's No 2 ECU connector.
- (12) Turn the main switch on the rear of the controller unit ON.
- (13) Set the No 1 ~ No 4 changeover switch at No 2.
- (14) Turn the FCV (magnet valve) ON/OFF switch ON to energize the magnet valve.
- (15) Turn the sub switch on the front of the controller unit ON.



### [3] Adjustment software set up: preparation

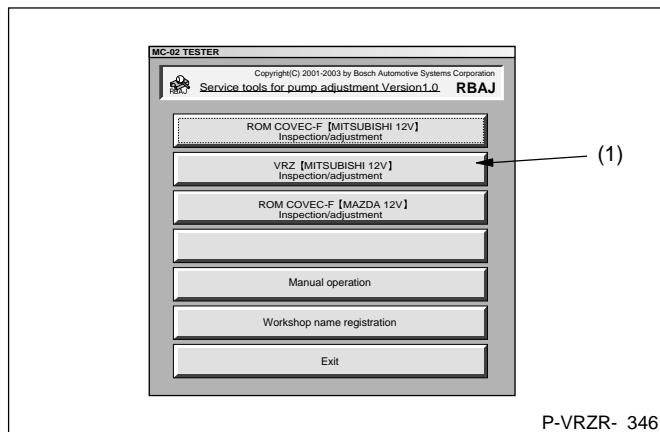
- (1) Turn the computer and the monitor power switches ON.



- (2) Start the 'Service tools for pump adjustment' software.
- (3) Input the password and press the 'Enter' key.

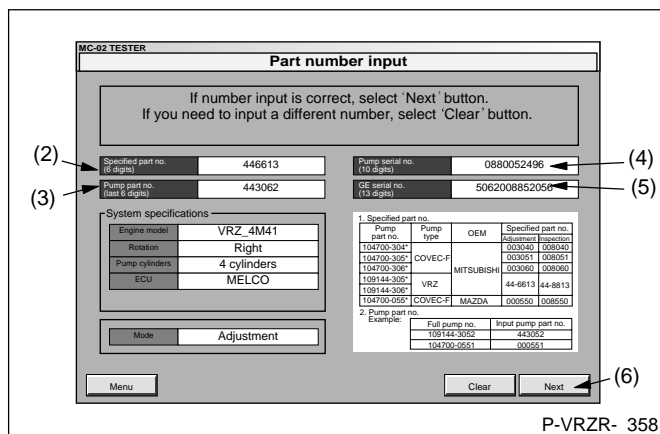
#### **Advice**

**Input the initial default password 'RBAJ' or your own password.**



## [4] Part number input and confirmation

(1) Select the 'VRZ [Mitsubishi 12V] Inspection/adjustment' button.



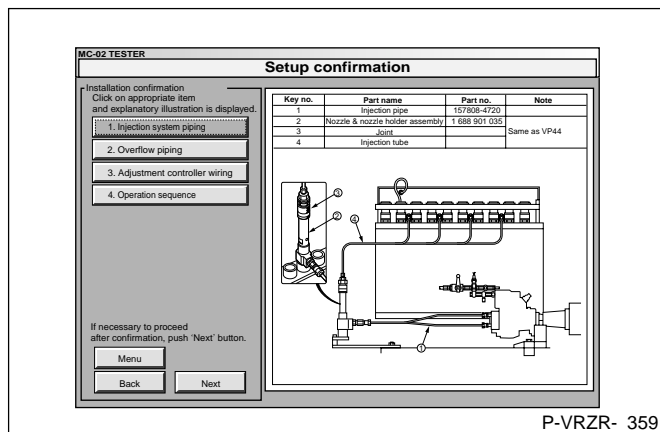
(2) When the dialog shown at left appears, input the specified part number (6 digits).

(3) Input the pump part number (last 6 digits).

(4) Input the pump serial number (10 digits).

(5) Input the GE's serial number (13 digits).

(6) Press the 'Next' key.



(7) Confirm that the screen changes to the injection system piping display.

Note:

Clicking the different buttons (1. Injection system piping, 2. Overflow piping, 3. Adjustment controller wiring, and 4. Operation sequence) displays different Setup confirmation screens.



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(4) N 0 r/min 300 2

(5) T 0.0 deg C 500 250

(6) Ua-ist 0.00 V 280 0.10

(2) Q 0.0 mm³/st 990 900

Step information

No.	Step name	N	Soil	Soil-con	Frequency	Duty
01	Warm-up	300r/min	2.80v	0.00mv	60Hz	100%

Present step: 01/31

Comment: Check for fuel leaks.

Sequence: 01/31 After values are input, push 'Next' button.

Select: 02 Warm-up 1000r/min 2.91v 0.00mv 60Hz 100%

Pump information

Specified part no.	44-6613
Pump part no.	44-3062
Pump serial no.	0880052496
GE serial no.	50620-088-52056
Engine model	VRZ_4M41
Rotation	Right
Pump cylinders	4 cylinders
ECU	MELCO
Mode	Adjustment
Pump type	VRZ (12V)

05/04/03 13:20:52

Menu Part number input

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### [5] Warming-up operation

- (1) Set the pump test bench delivery pressure at the specified 40 kPa {0.4 kgf/cm²}.
- (2) Confirm that the sequence is 01/31.
- (3) Run the injection pump at the specified speed N (see figure at left).
- (4) Measure N, T and Q on the pump test bench and input the values.

Note:

U α ist is displayed automatically.

- (5) Confirm that the Step status field is green.

- (6) Proceed to the next step.

#### Advice

If U α ist values are not as specified, press the 'Next' button several times. Then, return to Step 01/31 using the back arrow.

Repeat the Step 01/31 and confirm that U α ist values are as specified.

Note:

If not as specified after confirming U α ist several times, the GE may be faulty.

(9) N 1000 r/min 1000 2

(13) T 0.0 deg C 500 50

(14) Ua-ist 0.00 V 291 0.10

(7) Q 9.25 mm³/st 500

Step information

No.	Step name	N	Soil	Soil-con	Frequency	Duty
02	Warm-up	1000r/min	2.91v	0.00mv	60Hz	100%

Present step: 02/31

Comment: Warm-up

Sequence: 02/31 After values are input, push 'Next' button.

Select: 03 Warm-up 1000r/min 2.91v 0.00mv 60Hz 100%

Pump information

Specified part no.	44-6613
Pump part no.	44-3062
Pump serial no.	0880052496
GE serial no.	50620-088-52056
Engine model	VRZ_4M41
Rotation	Right
Pump cylinders	4 cylinders
ECU	MELCO
Mode	Adjustment
Pump type	VRZ (12V)

05/04/03 13:21:45

Menu Part number input

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- (7) Confirm that the sequence is 02/31.
- (8) Run the injection pump at the specified speed N (see figure at left).
- (9) Measure N, T and Q on the pump test bench and input the values.

Note:

U α ist is displayed automatically.

- (10) Confirm injection.

- (11) Confirm that no fuel leaks from the injection pump fuel piping connections.

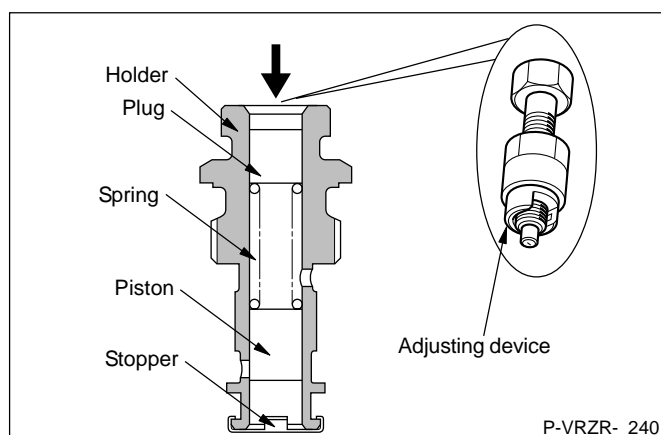
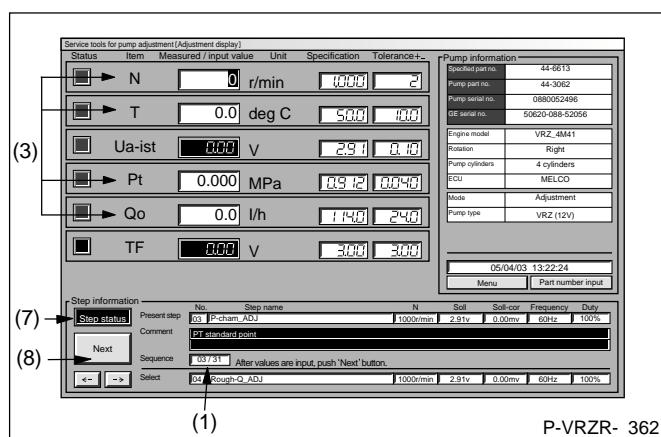
### ⚠ CAUTION

If there are any fuel leaks, if there is no injection or if any unusual noises occur during operation, stop test bench operation immediately and inspect the pump.

- (12) Confirm that the injection pump is operating normally.
- (13) Confirm that the Step status field is green.
- (14) Proceed to the next step.

#### Advice

Because the test oil temperature takes longer to increase in cold weather, turn the pump test bench on earlier.



## [6] Pump chamber pressure adjustment

- (1) Confirm that the sequence is 03/31.
- (2) Run the injection pump at the specified speed N (see figure at left).
- (3) Measure N, T, Pt and Qo on the pump test bench and input the values.

Note:

U  $\propto$  ist and Tf are displayed automatically.

- (4) If Pt is as specified, perform steps (7) and (8). If Pt is not as specified, adjust as described below.

When the pump chamber pressure exceeds the specifications

- Replace the regulating valve assembly and adjust the pump chamber pressure to the specified pressure.

When the pump chamber pressure is less than the specifications

- Attach the adjusting device to the regulating valve.
- Gradually press the regulating valve plug into the regulating valve assembly using the adjusting device to adjust the pump chamber pressure.

### Advice

Do not press the plug in too far.

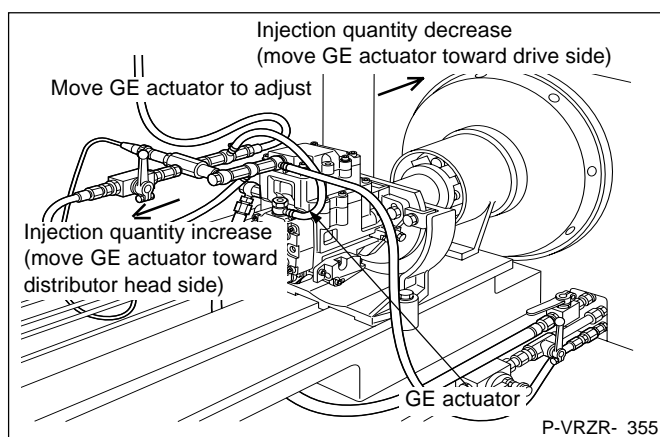
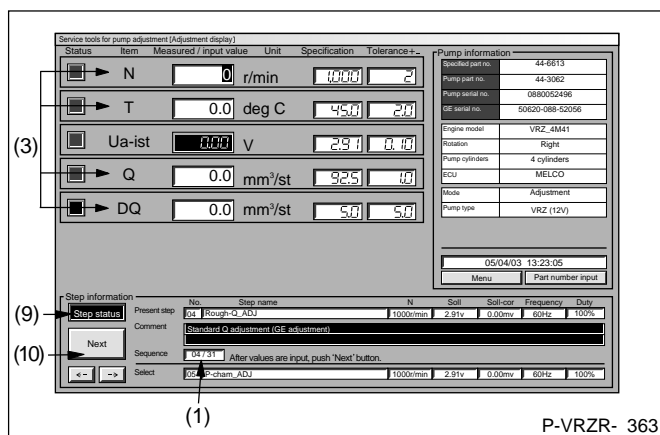
Tool name	Part no	Remarks
Adjusting device	157829-0820	

- (5) Measure N, T, Pt and Qo again on the pump test bench and input the values.
- (6) Confirm that the injection pump is operating normally.
- (7) Confirm that the Step status field is green.
- (8) Proceed to the next step.

### Advice

If the overflow quantity is not as specified after confirming pump chamber pressure, check the overflow valve.

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### [7] Standard injection quantity point adjustment

- (1) Confirm that the sequence is 04/31.
- (2) Run the injection pump at the specified speed N (see figure at left).
- (3) Measure N, T, Q and DQ on the pump test bench and input the values.

Note:

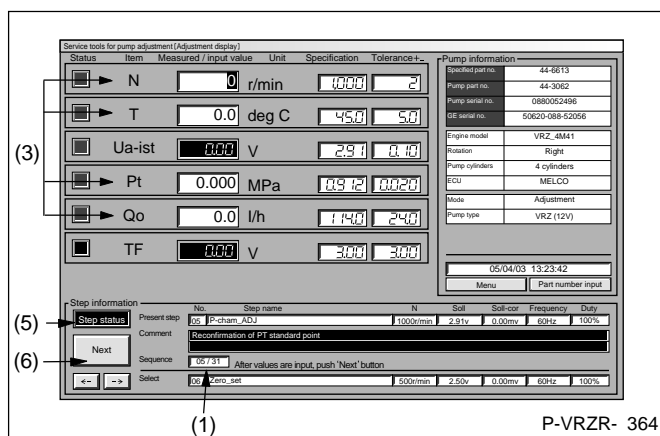
U  $\alpha$  ist is displayed automatically.

- (4) If Q is as specified, perform steps (9) and (10). If Q is not as specified, adjust as described below.

- (5) To adjust the fuel injection quantity, loosen the torx bolts so that the GE actuator can move a little.
- (6) Move the GE actuator in the drive shaft's axial direction to adjust the full load injection quantity. (To increase the injection quantity, move the GE actuator toward the distributor head. To decrease the injection quantity, move the GE actuator toward the drive side.) Record the measured injection quantity and the position of the GE actuator to facilitate adjustment.
- (7) Following adjustment, tighten the torx bolts to the specified torque.

**Specified torque: 7 ~ 10 N.m  
{0.7 ~ 1.0 kgf.m}**

- (8) Measure N, T, Q and DQ again on the pump test bench and input the values.
- (9) Confirm that the Step status field is green.
- (10) Proceed to the next step.



### [8] Pump chamber pressure confirmation

- (1) Confirm that the sequence is 05/31.
- (2) Run the injection pump at the specified speed N (see figure at left).
- (3) Measure N, T, Pt and Qo on the pump test bench and input the values.

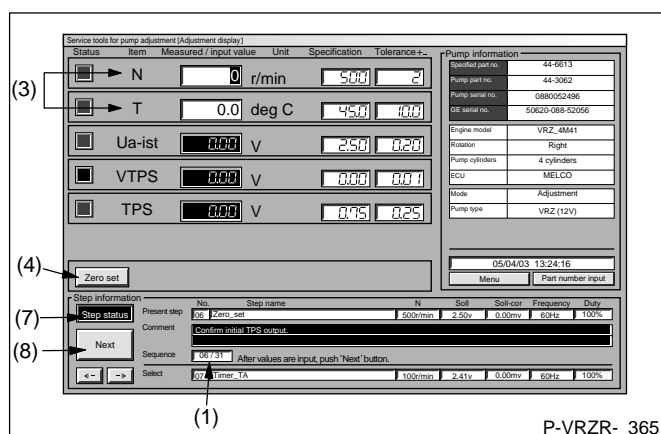
Note:

U  $\alpha$  ist and TF are displayed automatically.

- (4) Confirm the pump chamber pressure.
- (5) Confirm that the Step status field is green.
- (6) Proceed to the next step.

**Advice**

**Recheck the feed pump.**



## [9] TPS zero setting

- (1) Confirm that the sequence is 06/31.
- (2) Run the injection pump at the specified speed N (see figure at left).
- (3) Measure N and T on the pump test bench and input the values.

Note:

U α ist, VTPS and TPS are displayed automatically.

- (4) Press the 'Zero set' key and confirm that the VTPS value is within the specifications.

Note:

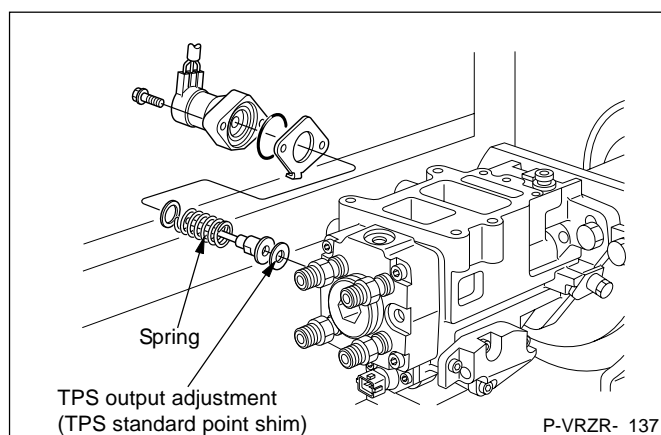
VTPS is the voltage value for when the timer piston is 0 mm.

- (5) If the TPS is as specified, perform steps (7) and (8). If the TPS is not as specified, replace the TPS standard point shim to adjust the TPS initial output.

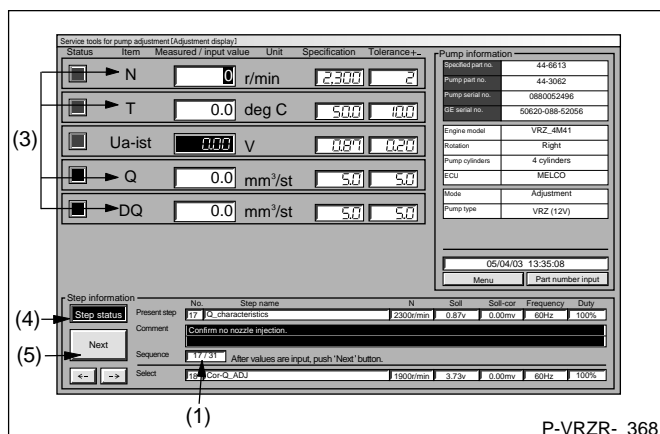
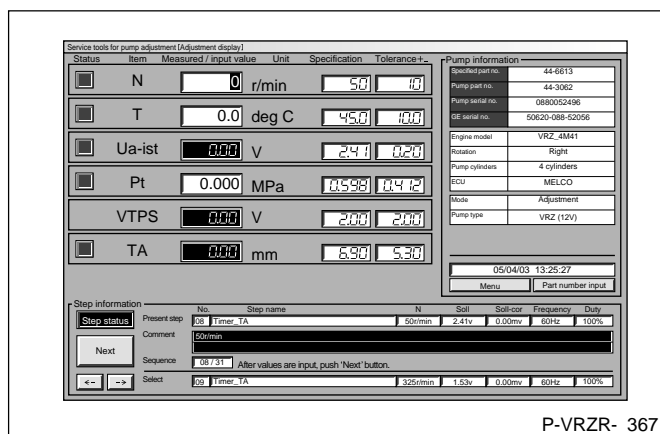
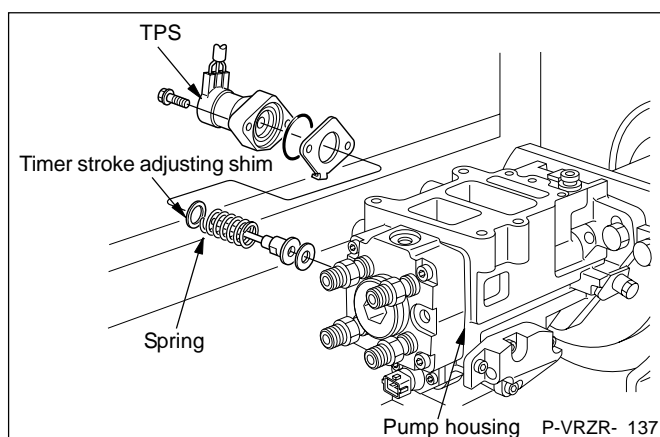
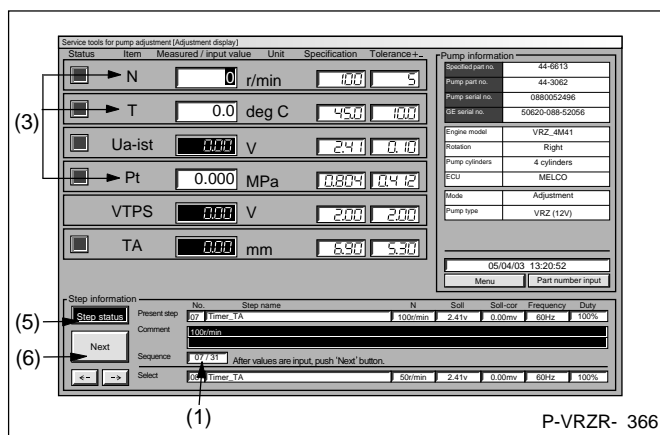
## TPS standard point shims

Shim part no	Th/ness (mm)	Shim part no	Th/ness (mm)
149653-0200 (9 443 613 473)	0.2	149653-0500 (9 443 613 475)	2.1
149653-0300 (9 443 612 841)	0.6	149653-0600 (9 443 612 842)	2.5
149653-0400 (9 443 613 474)	1.0	149653-0700 (9 443 613 476)	2.9

- (6) Measure N and T again on the pump test bench and input the values.
- (7) Confirm that the Step status field is green.
- (8) Proceed to the next step.



## 7 ADJUSTMENT



### [10] Timer stroke and characteristic confirmation

- (1) Confirm that the sequence is 07/31.
- (2) Run the injection pump at the specified speed N (see figure at left).
- (3) Measure N, T and Pt on the pump test bench and input the values.

Note:

$U \propto ist$ , VTPS and TA are displayed automatically.

- (4) Confirm that the timer stroke is within the specifications.
- (5) Confirm that the Step status field is green.
- (6) Proceed to the next step.

Note:

Because the TPS standard point shim was adjusted in Step 06/31, it cannot be changed.

Confirm 50 revolutions (Step 08/31) ~ 1,900 revolutions (Step 16/31) using the same procedure used for 100 revolutions (Step 7/31) above.

### Advice

Repeat Step 06/31 if the timer stroke is not as specified.

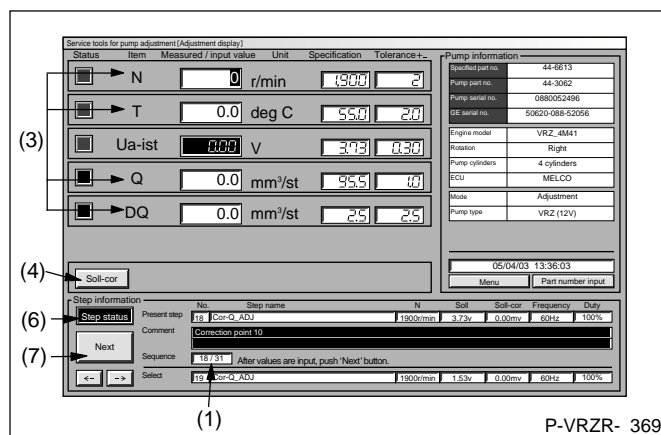
### [11] Non-injection confirmation

- (1) Confirm that the sequence is 17/31.
- (2) Run the injection pump at the specified speed N (see figure at left).
- (3) Measure N, T, Q and DQ on the pump test bench and input the values.

Note:

$U \propto ist$  is displayed automatically.

- (4) Confirm that the Step status field is green.
- (5) Proceed to the next step.



## [12] Injection quantity compensation point adjustment

- (1) Confirm that the sequence is 18/31.
- (2) Run the injection pump at the specified speed N (see figure at left).
- (3) Measure N, T, Q and DQ on the pump test bench and input the values.

Note:

U  $\alpha$  ist is displayed automatically.

- (4) If the injection quantity is not as specified, press the 'Soll-cor' setting, input the soll compensation voltage and adjust the injection quantity to the specification.
- (5) Measure the injection quantity and confirm that it is as specified.

### Advice

With the Soll-cor setting, the compensation voltage range differs with the service data or the calculation file. If the compensation voltage range is exceeded, a 'Reset' message is displayed.

### When the injection quantity is greater than the specification

Input a minus to the compensation voltage and input the value

### When the injection quantity is less than the specification

Input the value only to the compensation voltage

- (6) Confirm that the Step status field is green.
- (7) Proceed to the next step.

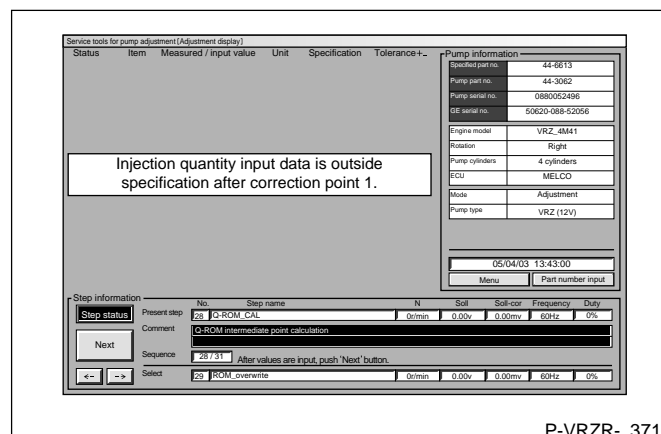
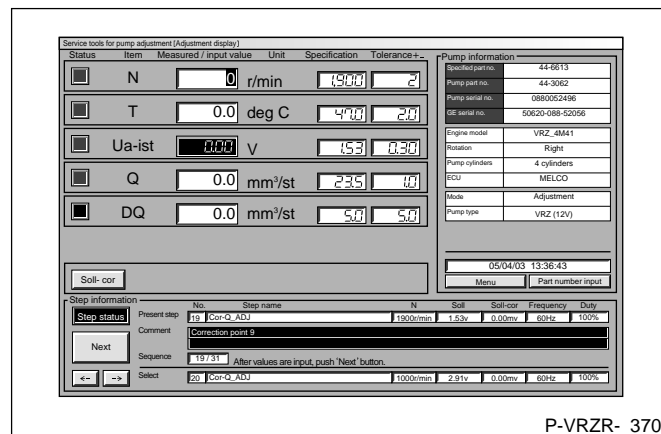
Confirm compensation point 9 (Step 19/31) ~ compensation point 1 (Step 27/31) using the same procedure used for compensation point 10 (Step 18/31) above.

After adjusting the compensation point 1, press the 'Next' button to automatically proceed to Step 28/31.

## [13] Compensation ROM interpolation calculation

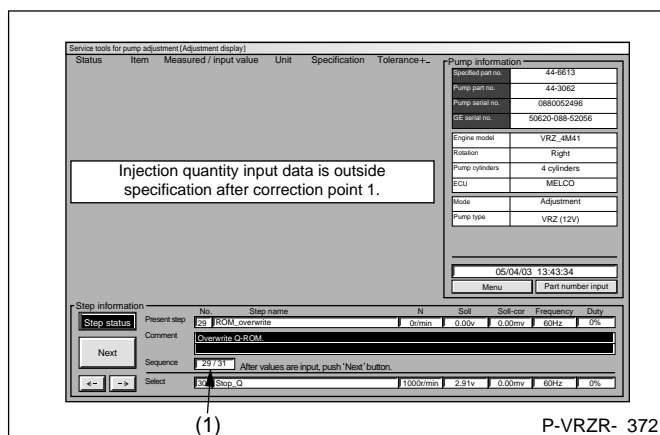
Note:

- In Step 28/31 the adjustment software automatically performs the calculations.
- If the compensation voltage Soll values are not correct, compensation calculations are not performed and an error is displayed. If an error is displayed, repeat Step 18/31.





## 7 ADJUSTMENT

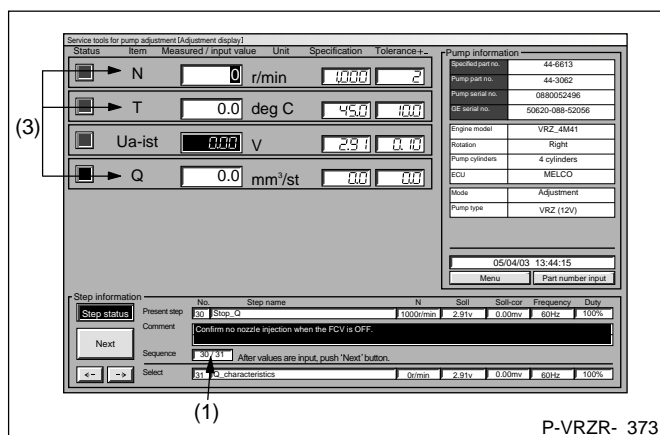


### [14] Writing to the compensation ROM

- (1) Press Step 28/31 to automatically display the step.
- (2) The adjustment software automatically writes the compensation Q data to the injection pump's Q adjustment ROM.

#### Advice

**Never touch the computer, the injection pump or the connecting wire harnesses while writing to the ROM.**

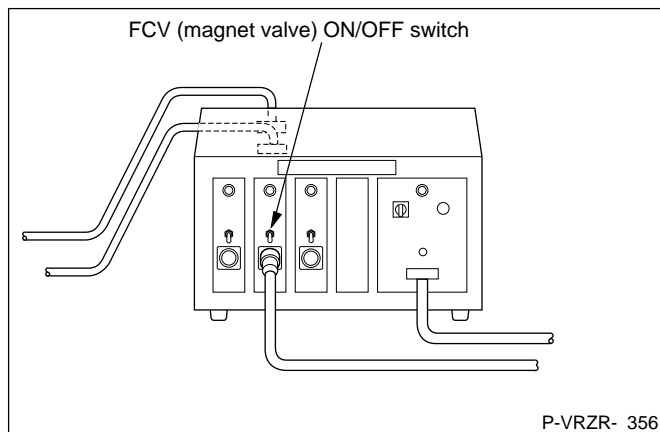


### [15] Magnet valve operation confirmation

- (1) Confirm that the sequence is 30/31.
- (2) Run the injection pump at the specified speed N (see figure at left).
- (3) Measure N, T and Q on the pump test bench and input the values.

#### Note:

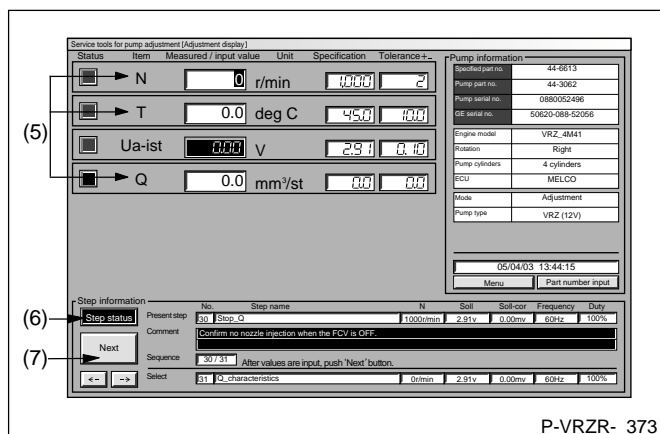
U α ist is displayed automatically.



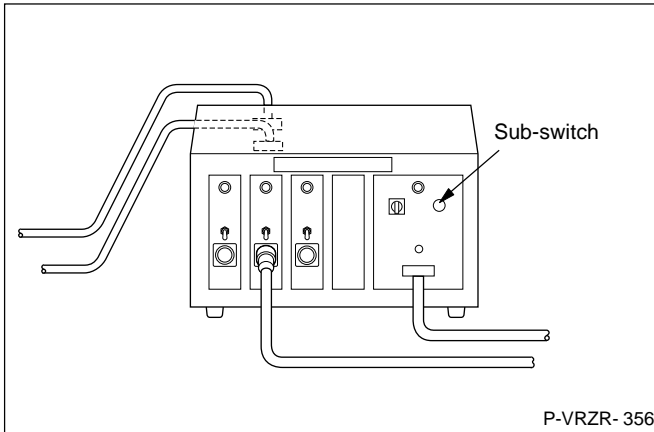
- (4) Turn the FCV (magnet valve) ON/OFF switch OFF and confirm that non-injection results.

#### Advice

**To confirm non-injection from the nozzle, look at the monitor screen and confirm that non-injection occurs within a short time (6 ~ 7 seconds).**



- (5) Measure N, T and Q again on the pump test bench and input the values.
- (6) Confirm that the Step status field is green.
- (7) Proceed to the next step.



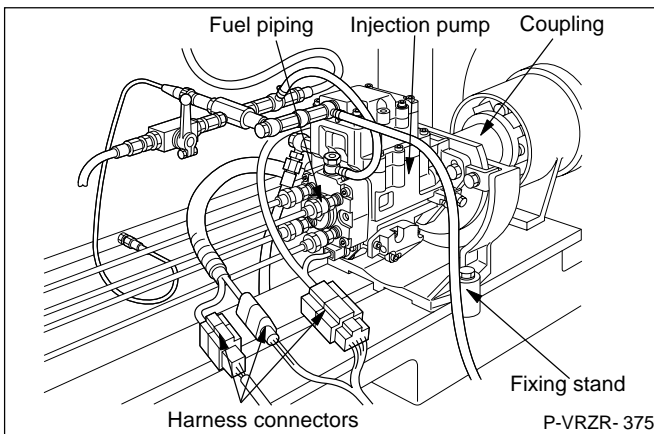
### [16] Second timing adjustment

Note:

The following describes the preparation for and performance of automatic adjustment of second timing.

#### (1) Injection pump disassembly

(1) Turn the sub-switch OFF.



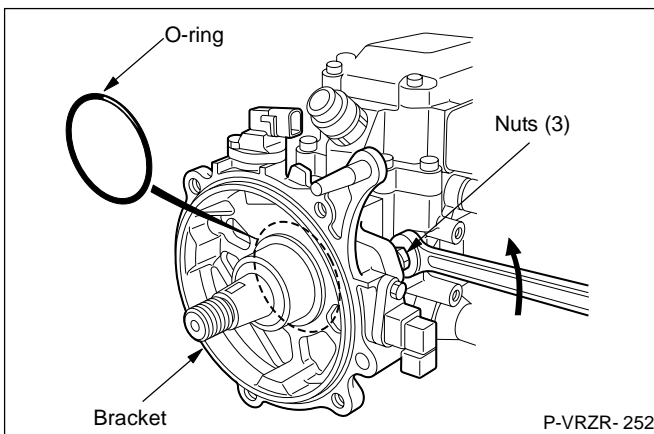
(2) Disconnect the intermediate harness connectors.

(3) Disconnect the fuel piping.

(4) Remove the coupling.

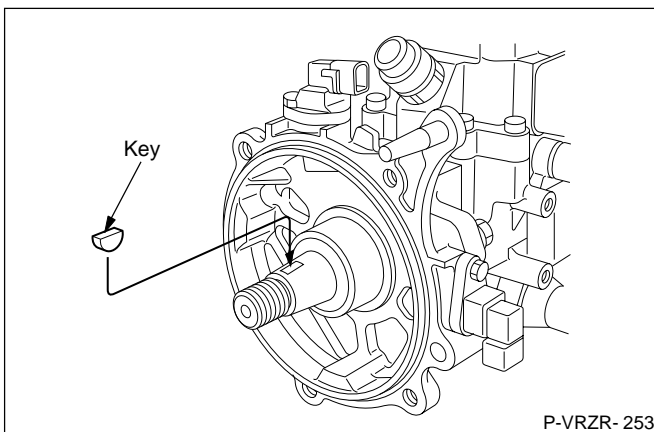
(5) Remove the pump from the fixing stand.

(6) Remove the fixing stand.



#### (2) Drive gear installation

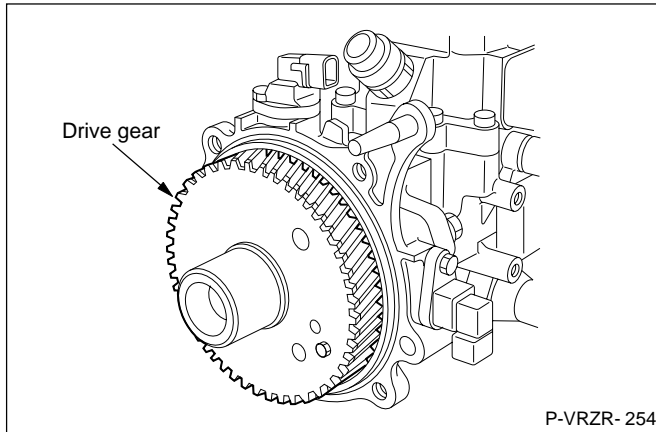
(1) Temporarily assemble the O-ring and bracket to the pump housing.



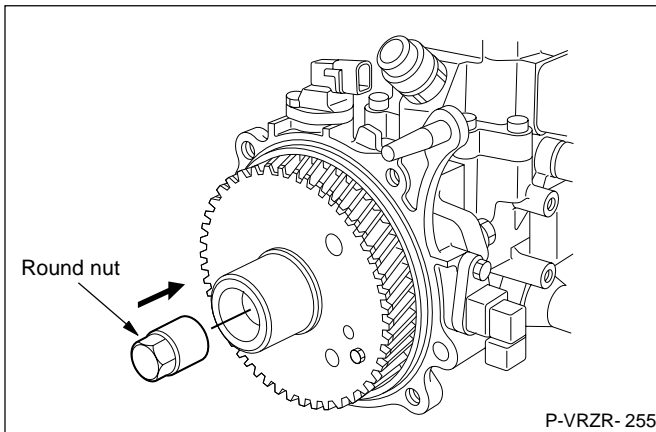
(2) Assemble the drive shaft key in the drive shaft's key groove.



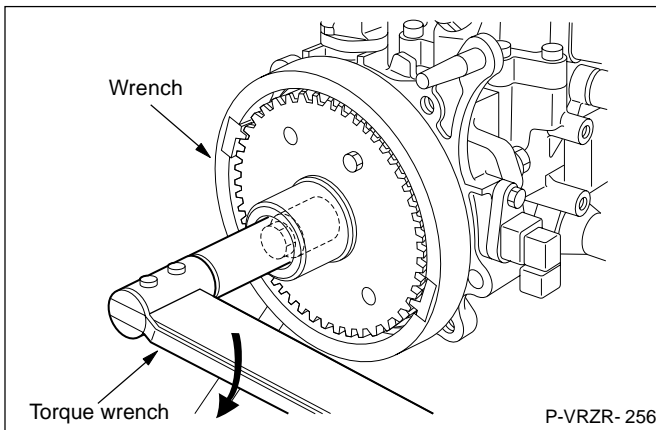
## 7 ADJUSTMENT



(3) Assemble the drive gear to the drive shaft.



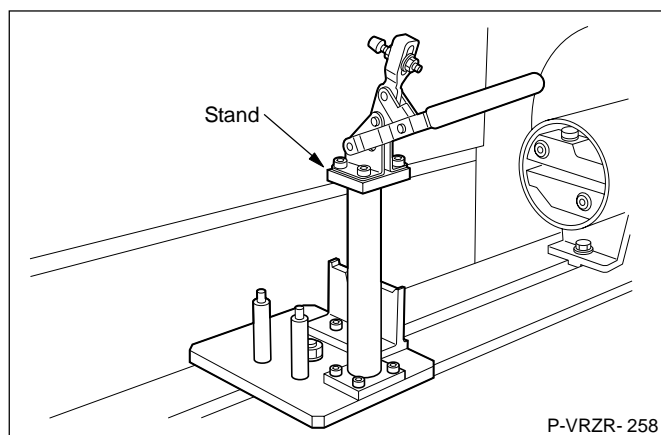
(4) Assemble the drive gear fixing round nut to the drive shaft and tighten it lightly.



(5) Assemble the wrench to the drive gear and tighten the round nut (SW21) to the specified torque using a torque wrench.

**Specified torque: 167 ~ 185 N·m**  
**{17 ~ 18.7 kgf·m}**

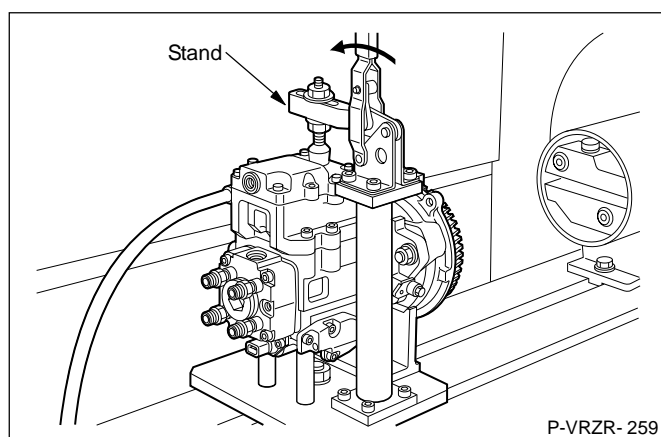
Tool name	Part no	Remarks
Wrench	157917-4620	



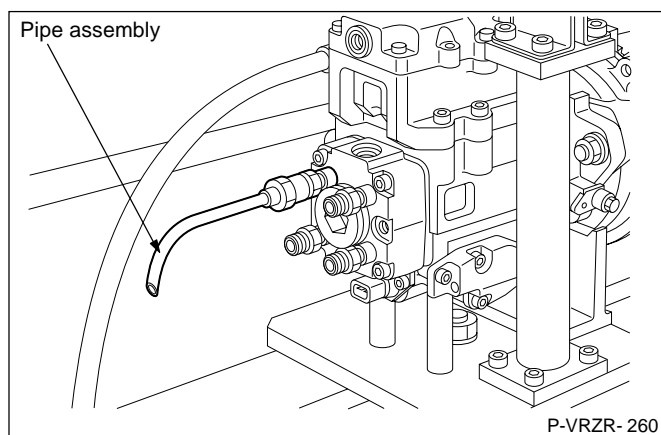
### (3) Injection pump installation

- (1) Attach the stand to the pump test bench.

Tool name	Part no	Remarks
Stand	105781-0890	

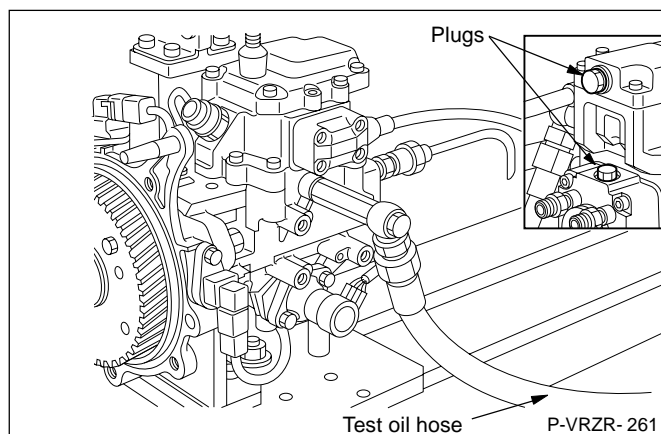


- (2) Attach the injection pump to the stand.  
 (3) Pull the stand's handle as shown in the figure to fix the injection pump.



- (4) Remove the CPV from cylinder B and attach the pipe assembly and the gasket.

Tool name	Part no	Remarks
Pipe assembly	157845-9520	

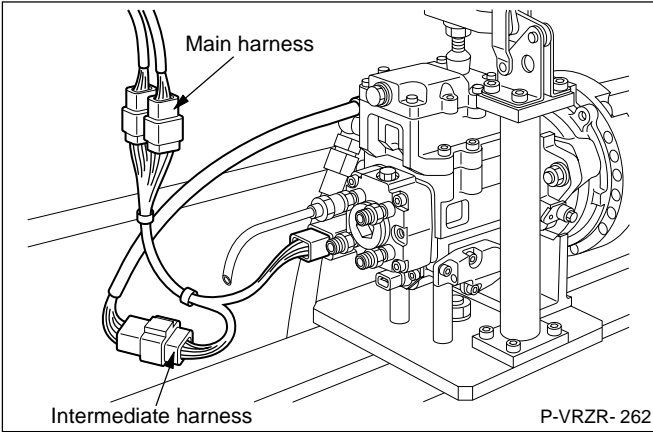


- (5) Connect the test oil hose to the injection pump.  
 (6) Attach the plugs to where the GE and the distributor head overflow valves were removed.

#### Advice

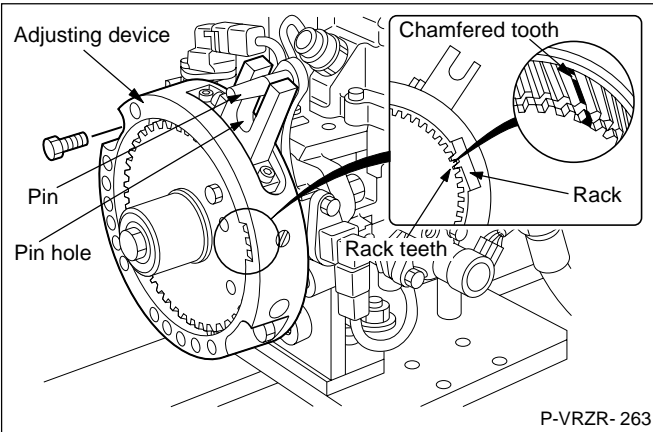
**Install any suitable plugs to maintain pump chamber air tightness.**

## 7 ADJUSTMENT



- (7) Connect the controller assembly's main harness and intermediate harness to the injection pump's GE connector.

Tool name	Part no	Remarks
Main harness	157966-4920	
Intermediate harness	157966-5720	



- (8) Align the adjusting device's pin hole with the injection pump bracket's pin. In this position, attach the adjusting device to the injection pump's bracket and fix using the bolts.

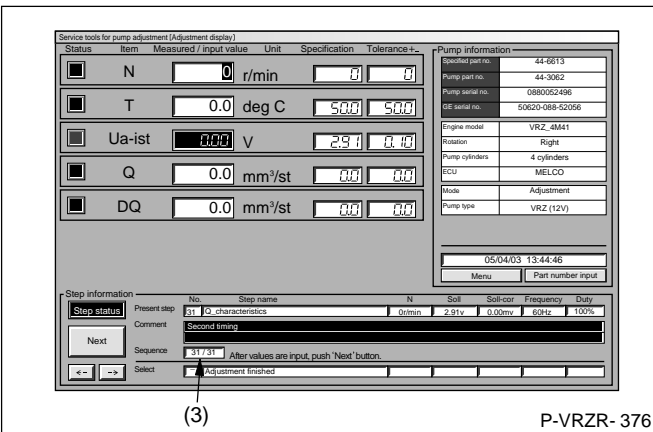
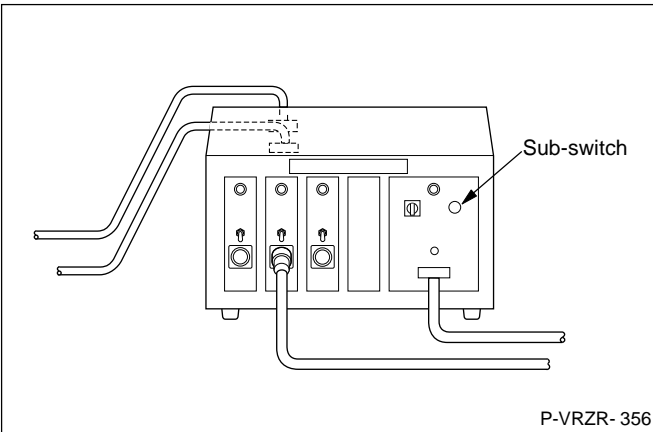
Tool name	Part no	Remarks
Adjusting device	105793-0020	

### Advice

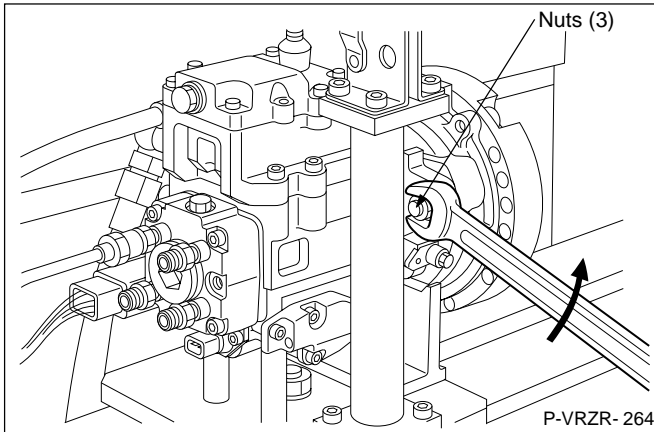
When aligning the adjusting device's pin hole with the bracket's pin, position the adjusting device's rack teeth on either side of the drive gear's chamfered tooth.

### (4) Second timing adjustment

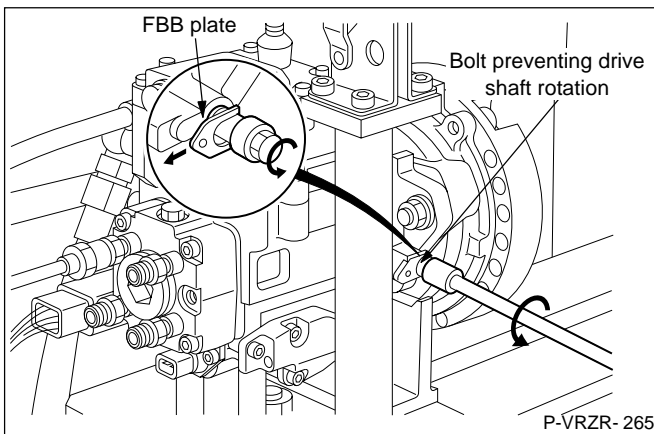
- Turn the controller unit's sub-switch ON.
- Supply test oil to the injection pump at the specified pressure of 20 kPa {0.2 kgf/cm<sup>2</sup>}.



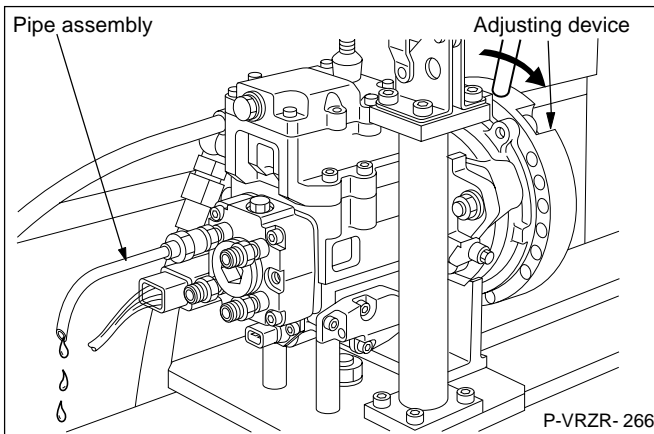
- (3) Confirm that the sequence is Step 31/31 (Q characteristics).



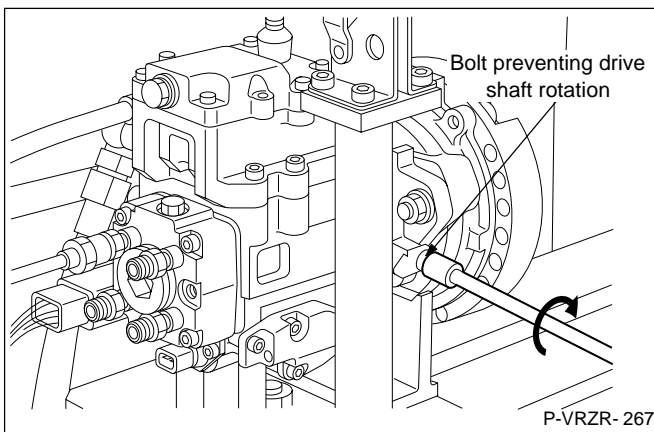
- (4) Loosen the injection pump bracket installation nuts.



- (5) Loosen the bolt preventing drive shaft rotation and remove the FBB plate.



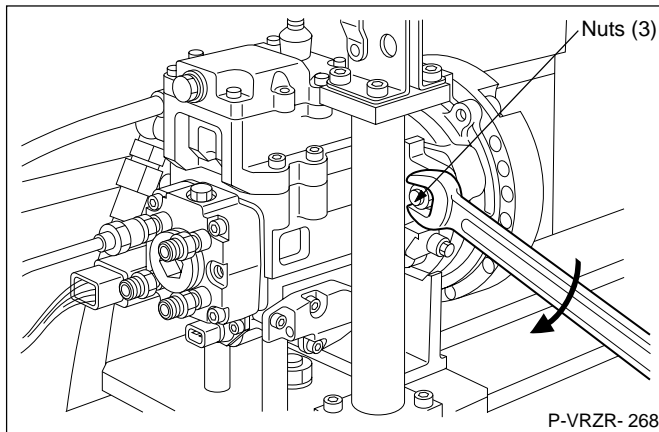
- (6) Insert the lever into the adjusting device and turn the lever once in the reverse rotation direction, then turn the lever in the direction of rotation.  
 (7) Adjust so that test oil flows from cylinder B's pipe assembly at a rate of 1 drop / 3 seconds.



- (8) Tighten the bolt preventing drive shaft rotation to fix the drive shaft.

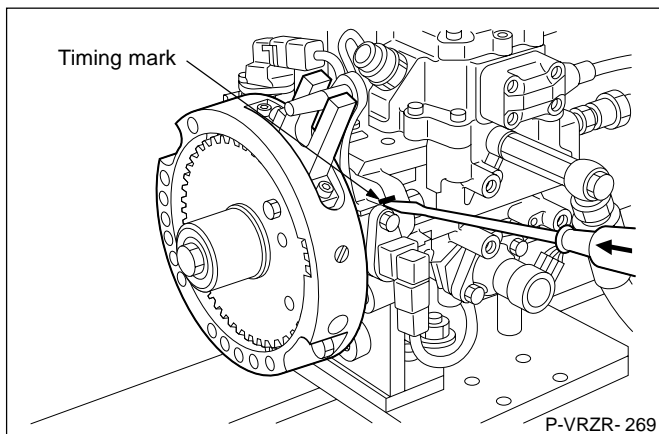
**Specified torque: 27 ~ 35 N·m**  
**{2.8 ~ 3.6 kgf·m}**

## 7 ADJUSTMENT



(9) Tighten the bracket nuts.

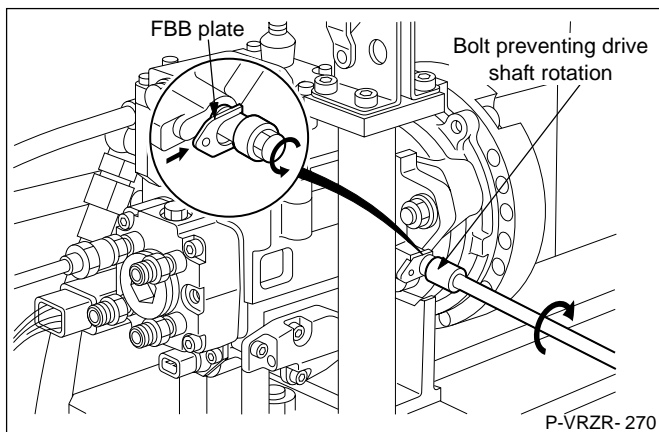
**Specified torque:** 34 ~ 39 N·m  
{3.5 ~ 4.0 kgf·m}



(10) Mark the timing mark on the injection pump and the bracket.

**Advice**

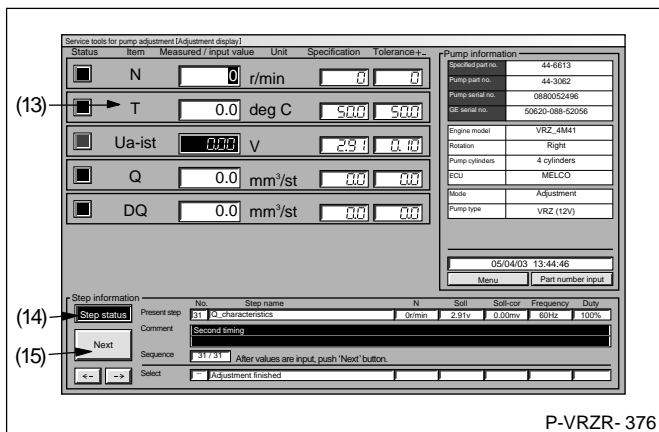
**Erase the previous mark.**



(11) Loosen the bolt preventing drive shaft rotation, install the FBB plate and fix the FBB plate by tightening the bolt preventing drive shaft rotation.

**Specified torque:** 10 ~ 15 N·m  
{1.0 ~ 1.5 kgf·m}

(12) Turn the test oil switch OFF.



(13) Measure T on the pump test bench and input the value.

**Note:**

U α ist is displayed automatically.

(14) Confirm that the Step status field is green.

(15) Proceed to the next step.



### (5) Printing the adjustment results and saving the test record

- (1) Click the 'Next' key.
- (2) 'Do you want to print and save test record' is displayed.
- (3) Click 'OK.'

Note:

If you select 'Cancel,' you cannot continue to the next step.

## Advice

- **The printed test record can be given to the customer.**
  - **The saved test record is a record of all the data and must be handled carefully.**
- (4) Turn the controller unit's sub-switch OFF.
- (5) Turn the controller unit's main switch OFF.

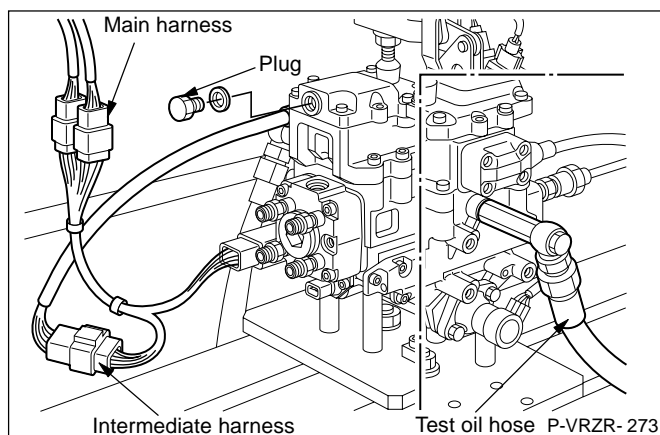


## (6) Injection pump removal

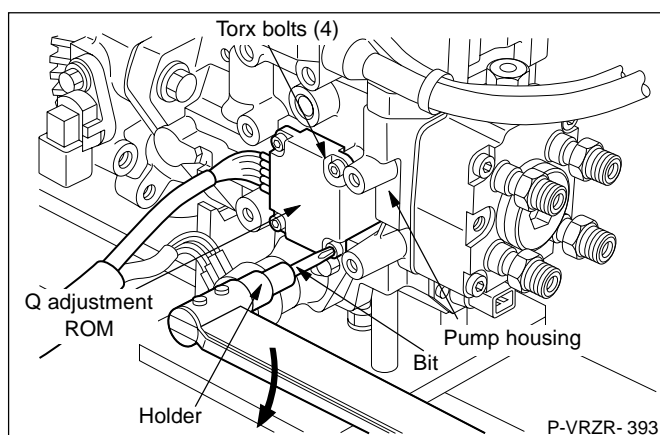
- (1) Remove the adjusting device from the injection pump's drive gear.

- 
- (2) Replace cylinder B's pipe assembly with the CPV. At this time, replace the gasket with a new one.

## 7 ADJUSTMENT



- (3) Disconnect the main harness and the intermediate harness from the injection pump.
- (4) Remove the test oil hose and the overflow valve plugs from the injection pump.



- (5) Install the Q adjustment ROM to the pump housing.

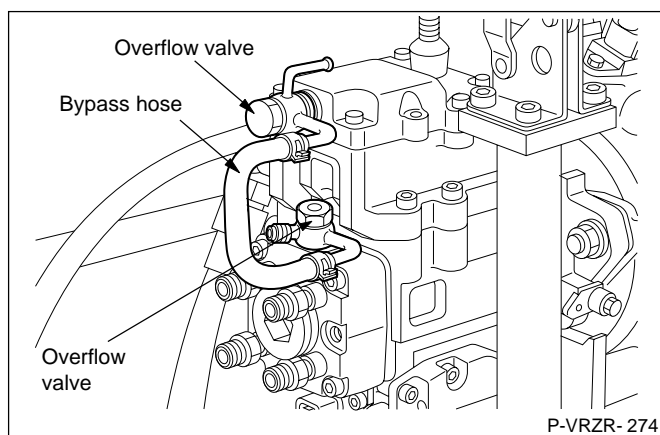
Note:

Removing the inlet adapter facilitates installation.

- (6) Tighten the Q adjustment ROM's torx bolts.

**Specified torque: 2 ~ 3 N·m**  
**{0.2 ~ 0.3 kgf·m}**

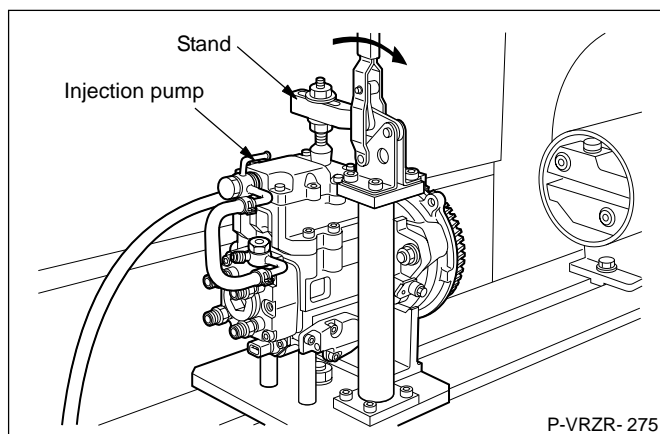
Tool name	Part no	Remarks
Holder	157915-9820	
Bit	157915-9301	T20



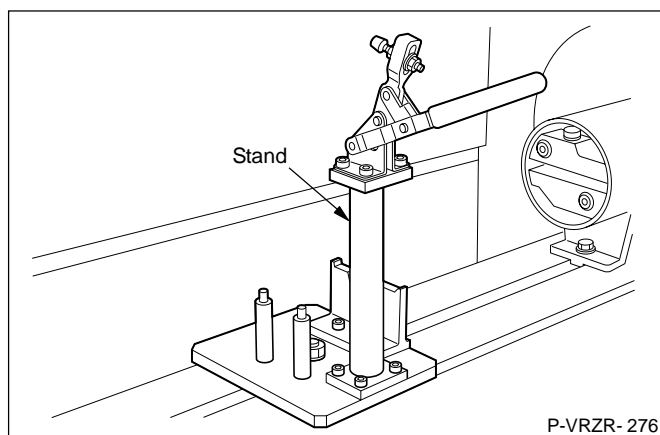
- (7) Connect the overflow valve's bypass hose to the injection pump.

- (8) Tighten the overflow valves using a torque wrench.

**Specified torque: 20 ~ 29 N·m**  
**{2 ~ 3 kgf·m}**



- (9) Remove the injection pump from the test bench.



- (10) Remove the stand from the pump test bench.

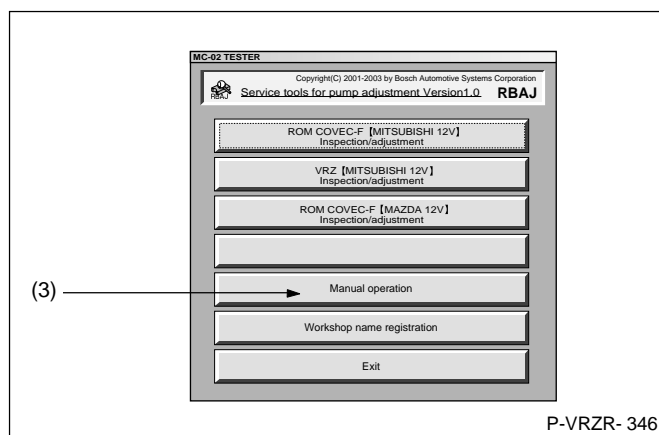
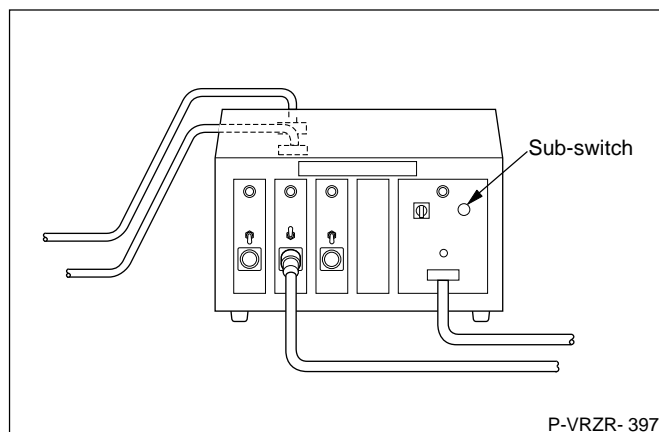
## 9. MANUAL OPERATION (SECOND TIMING ADJUSTMENT)

Note:

Preparation (Injection pump disassembly, Drive gear installation and Injection pump installation) is the same as that described on pages 93 to 96 for automatic adjustment of second timing.

### [1] Second timing adjustment

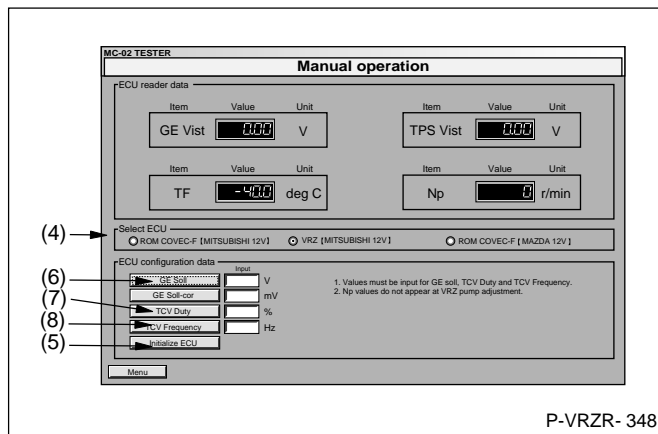
- (1) Turn the controller unit's sub-switch ON.
- (2) Supply test oil to the injection pump at the specified pressure of 20 kPa {0.2 kgf/cm<sup>2</sup>}.



- (3) Select 'Manual operation' on the menu display.



## 7 ADJUSTMENT

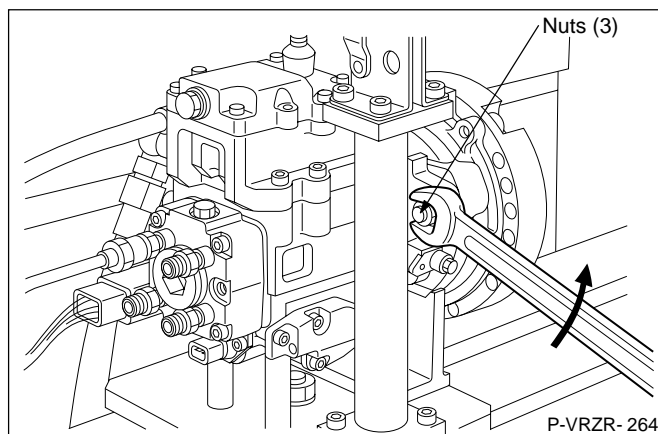


- (4) Select the ECU (a black point appears when the ECU is selected).
- (5) Press 'Initialize ECU' after selecting the ECU.
- (6) Press the 'GE soll' button and input '2.91' into the field. Press the keyboard's 'Enter' key.
- (7) Press the 'TCV Duty' button and input '100' into the field. Press the keyboard's 'Enter' key.
- (8) Press the 'TCV Frequency' button and input '60' into the field. Press the keyboard's 'Enter' key.

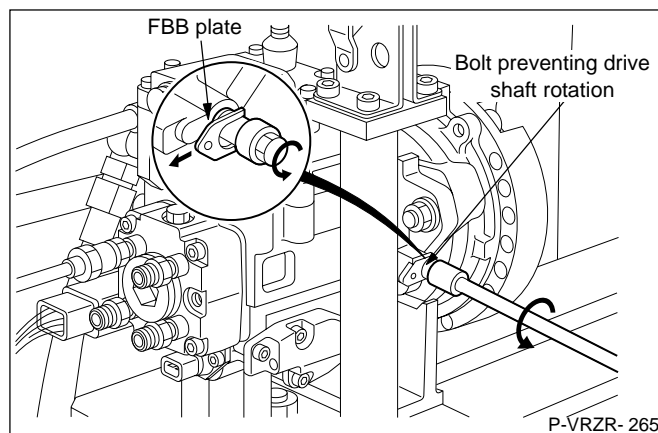
### Advice

**Values must be input for GE soll, TCV Duty and TCV Frequency.**

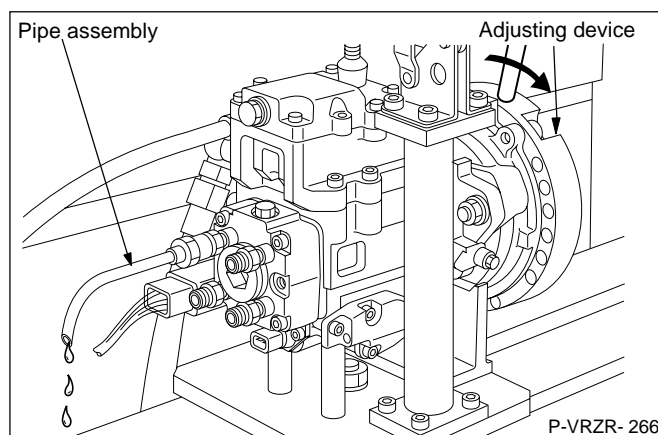
- (9) Loosen the injection pump bracket installation nuts.

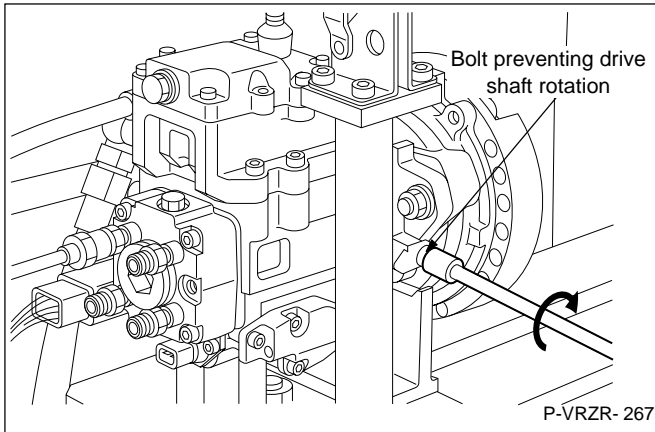


- (10) Loosen the bolt preventing drive shaft rotation and remove the FBB plate.



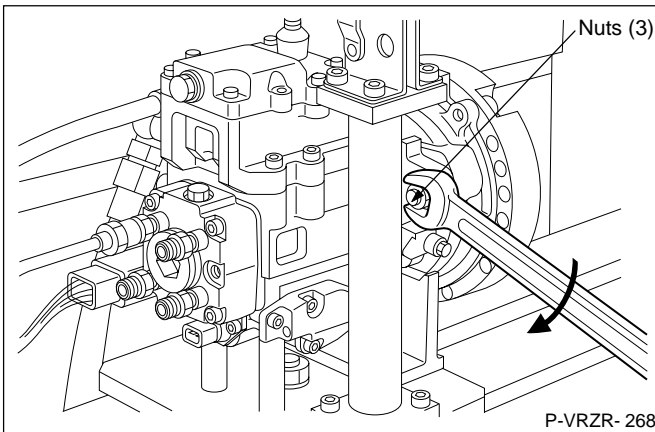
- (11) Insert the lever into the adjusting device and turn the lever once in the reverse rotation direction, then turn the lever in the direction of rotation.
- (12) Adjust so that test oil flows from cylinder B's pipe assembly at a rate of 1 drop /3 seconds.





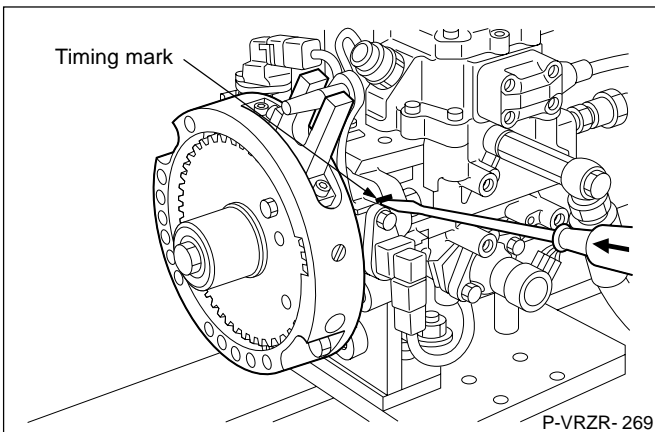
(13) Tighten the bolt preventing drive shaft rotation to fix the drive shaft.

**Specified torque: 27 ~ 35 N·m**  
**{2.8 ~ 3.6 kgf·m}**



(14) Tighten the bracket nuts.

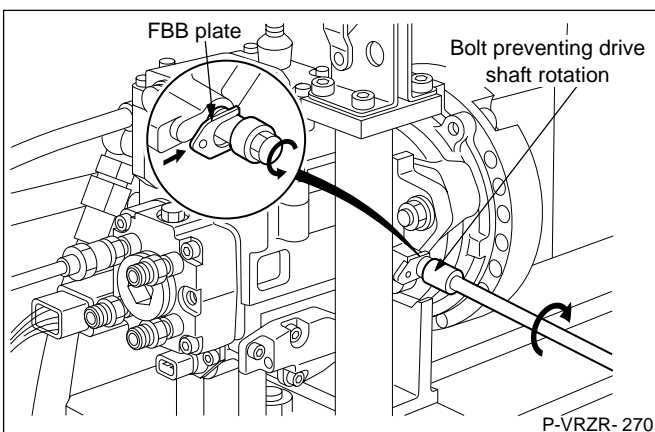
**Specified torque: 34 ~ 39 N·m**  
**{3.5 ~ 4.0 kgf·m}**



(15) Mark the timing mark on the injection pump and the bracket.

**Advice**

**Erase the previous mark.**



(16) Loosen the bolt preventing drive shaft rotation, install the FBB plate and fix the FBB plate by tightening the bolt preventing drive shaft rotation.

**Specified torque: 10 ~ 15 N·m**  
**{1.0 ~ 1.5 kgf·m}**

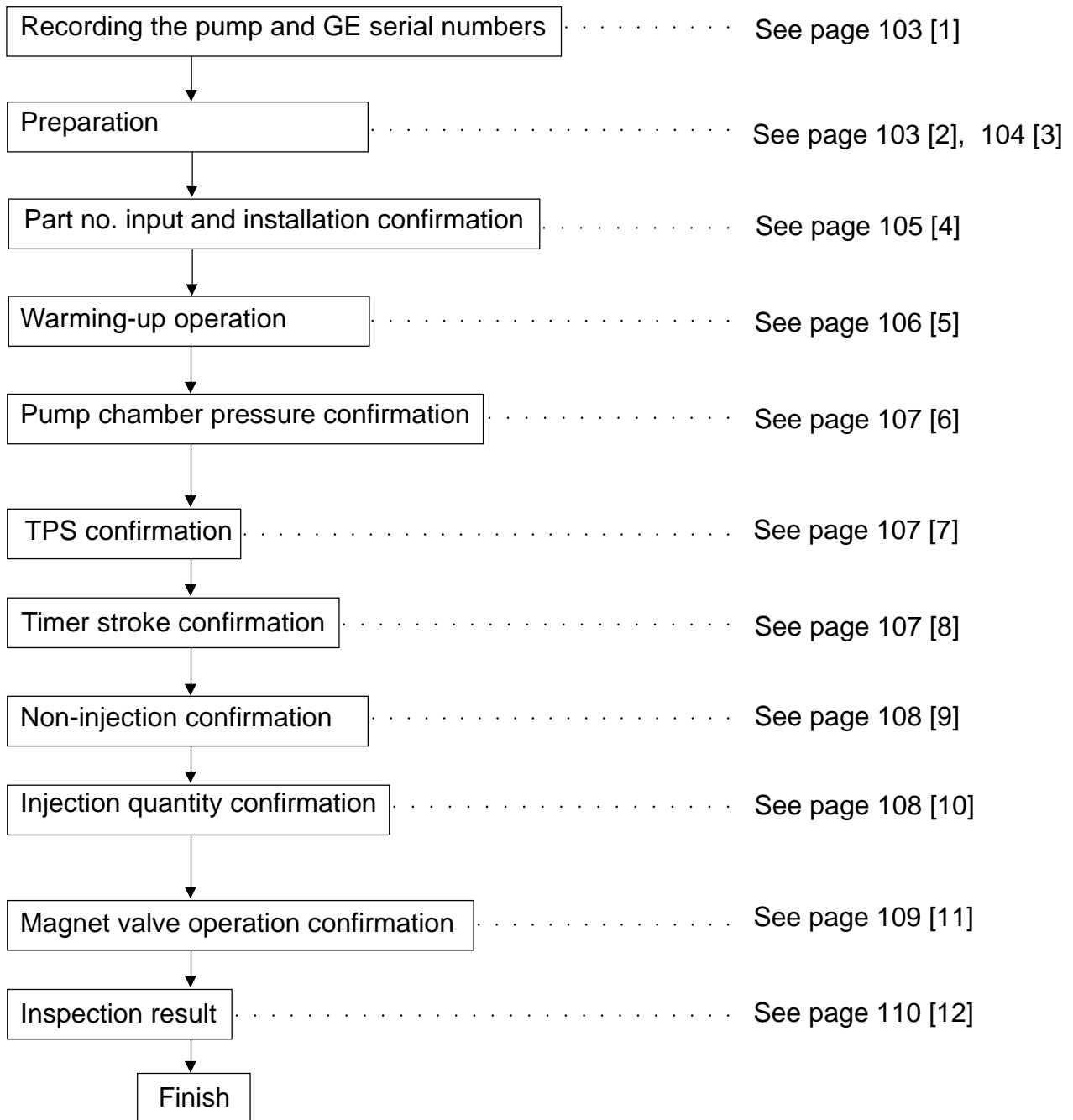
(17) Turn the test oil switch OFF.

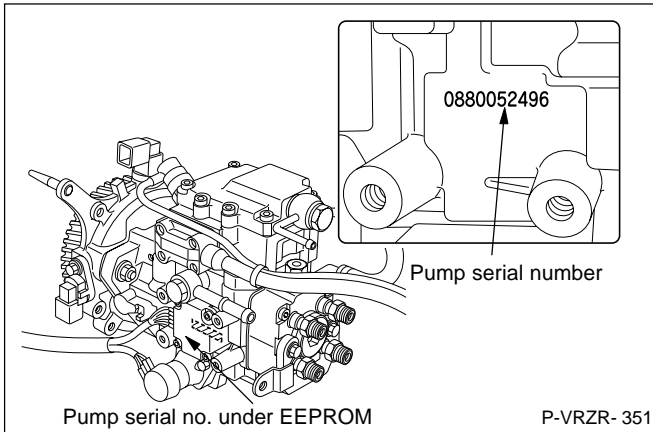
(18) Remove the injection pump as described in (6) Injection pump removal [steps (1) to (10)] on pages 97 to 99.

## 8 INSPECTION

### INSPECTION

#### Inspection sequence





### [1] Recording the pump and GE serial numbers

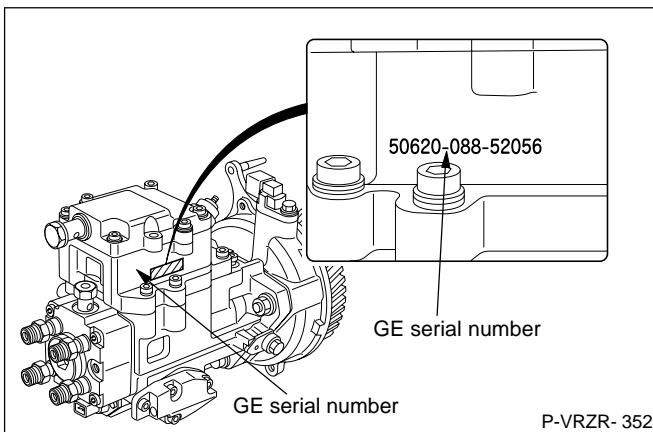
- (1) Read and record the 10 digit pump serial number.

#### **Advice**

**It is easier to read the pump's serial number before beginning 'Preparation.'**

Note:

Serial number input is used during adjustment mode and inspection mode.



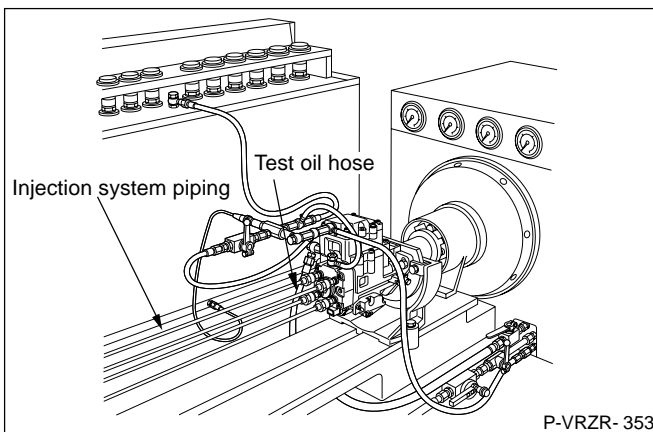
- (2) Read and record the 13 digit GE actuator serial number.

#### **Advice**

**It is easier to read the GE actuator's serial number before beginning 'Preparation.'**

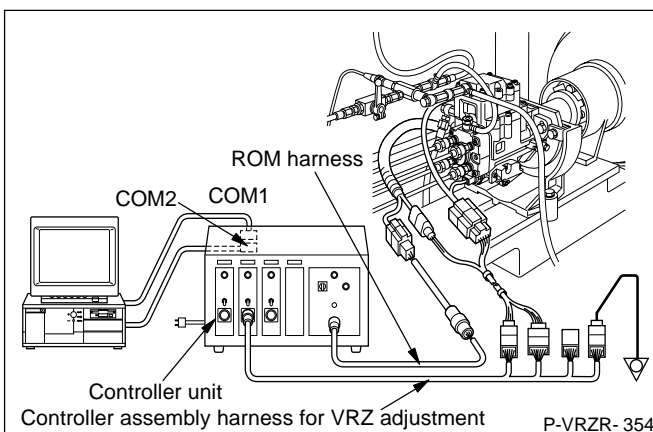
Note:

Serial number input is used during adjustment mode and inspection mode.

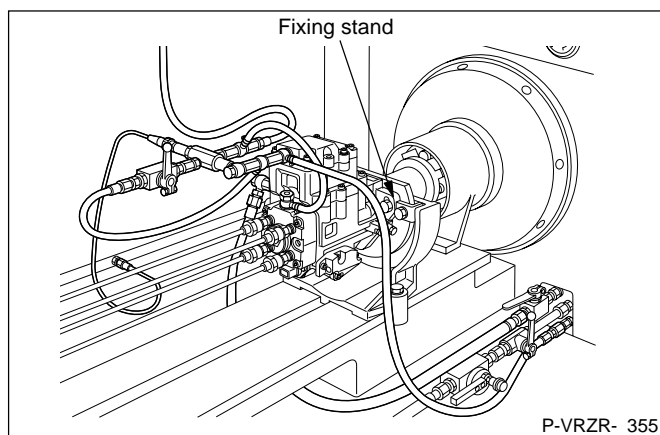


### [2] Preparation

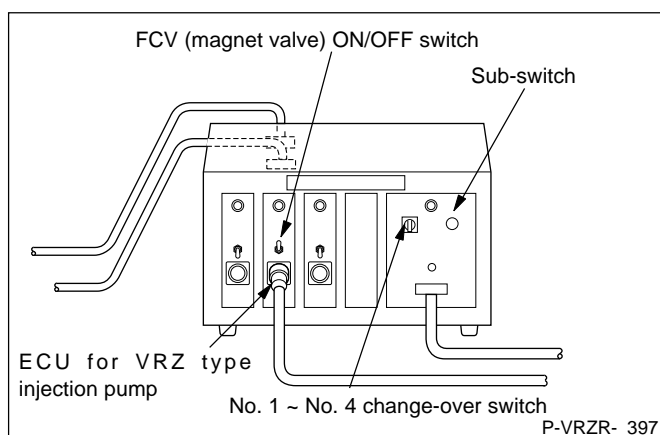
- (1) Connect the test oil hose to the injection pump. (Refer to page 69 for the fuel piping.)
- (2) Connect the injection system piping to the injection pump. (Refer to page 68 for the injection system piping.)
- (3) Connect the controller assembly's wire harness and intermediate harness to the injection pump's connectors. (Refer to page 70 for the controller assembly's wiring.)
- (4) Connect the ROM controller's wire harness and intermediate harness to the injection pump's VRZ EEPROM connector.
- (5) Connect the FCV GND harness to the controller assembly's wire harness and to earth.
- (6) Connect the D-Sub 9 pin cable connector (COM 1) on the rear of the controller unit to the personal computer using the wire harness.
- (7) Connect the D-Sub 25 pin cable connector (COM 2) on the rear of the controller unit to the personal computer using the wire harness.



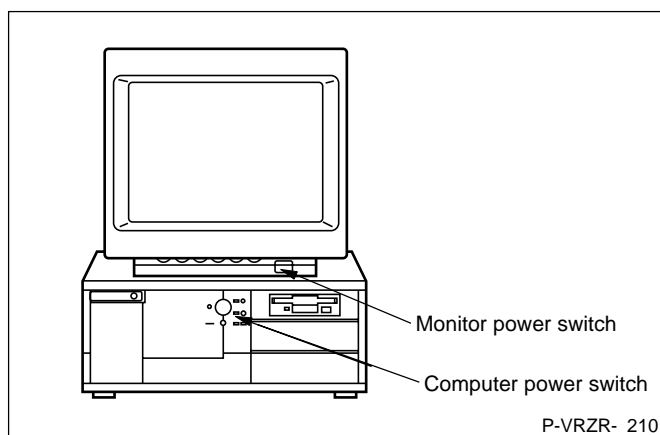
## 8 INSPECTION



- (8) Reconfirm that the coupling and the fixing stand bolts and nuts are securely tightened.
- (9) Set the 20NP pump tester's test oil outlet temperature at 45°C.
- (10) Set the cooling unit oil delivery pressure lever at '80 kPa {0.8 kgf/cm<sup>2</sup>}' or less.

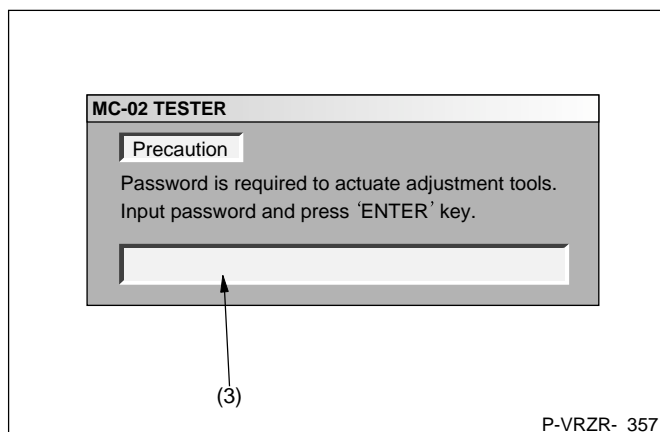


- (11) Connect the wire harness to the controller unit's No 2 ECU connector.
- (12) Turn the main switch on the rear of the controller unit ON.
- (13) Set the No 1 ~ No 4 changeover switch at No 2.
- (14) Turn the FCV (magnet valve) ON/OFF switch ON to energize the magnet valve.
- (15) Turn the sub switch on the front of the controller unit ON.

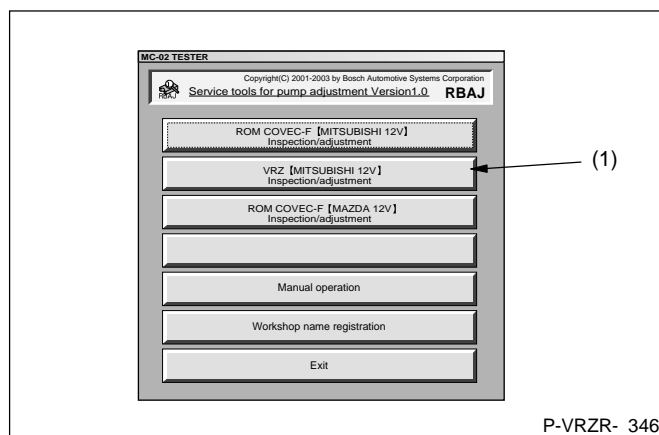


### [3] Inspection software set up: preparation

- (1) Turn the computer and the monitor power switches ON.

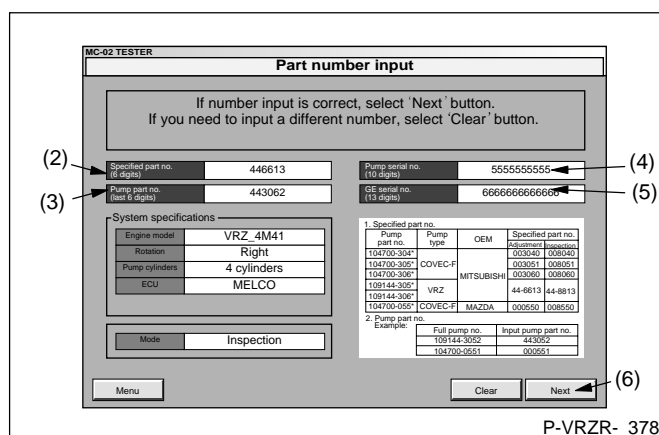


- (2) Start the 'Service tools for pump adjustment' software.
  - (3) Input the password and press the 'Enter' key.
- Advice**  
Input the initial default password 'RBAJ' or your own password.



## [4] Part number input and confirmation

(1) Select the 'VRZ [Mitsubishi 12V] Inspection/adjustment' button.



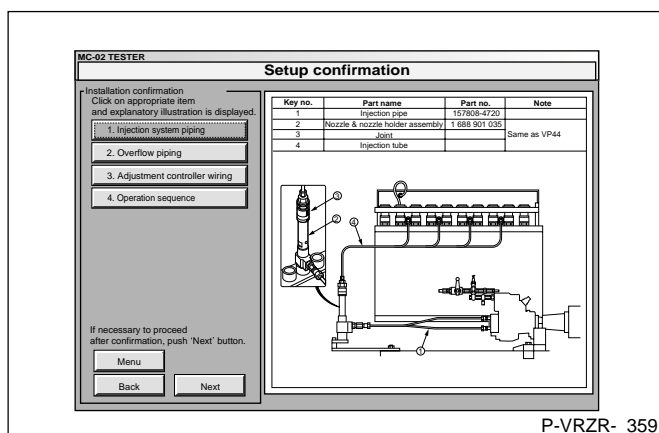
(2) When the dialog shown at left appears, input the specified part number (6 digits).

(3) Input the pump part number (last 6 digits).

(4) Input the pump serial number (10 digits).

(5) Input the GE's serial number (13 digits).

(6) Press the 'Next' key.



(7) Confirm that the screen changes to the injection system piping display.

## 8 INSPECTION

(4) (5) (6) (2)

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### [5] Warming-up operation

- (1) Set the pump test bench delivery pressure at the specified 40 kPa {0.4 kgf/cm<sup>2</sup>}.
- (2) Confirm that the sequence is Step 01/26.
- (3) Run the injection pump at the specified speed N (see figure at left).
- (4) Measure N, T and Q on the pump test bench and input the values.

Note:

U  $\alpha$  ist is displayed automatically.

(5) Confirm that the Step status field is green.

(6) Proceed to the next step.

#### Advice

If U  $\alpha$  ist values are not as specified, press the 'Next' button several times. Then, return to Step 01/26 using the back arrow.

Repeat the Step 01/26 and confirm that U  $\alpha$  ist values are as specified.

Note:

If not as specified after confirming U  $\alpha$  ist several times, the GE may be faulty.

(9) (13) (14) (7)

P-VRZR- 380

- (7) Confirm that the sequence is Step 02/26.
- (8) Run the injection pump at the specified speed N (see figure at left).
- (9) Measure N, T and Q on the pump test bench and input the values.

Note:

U  $\alpha$  ist is displayed automatically.

(10) Confirm injection.

(11) Confirm that no fuel leaks from the injection pump fuel piping connections.

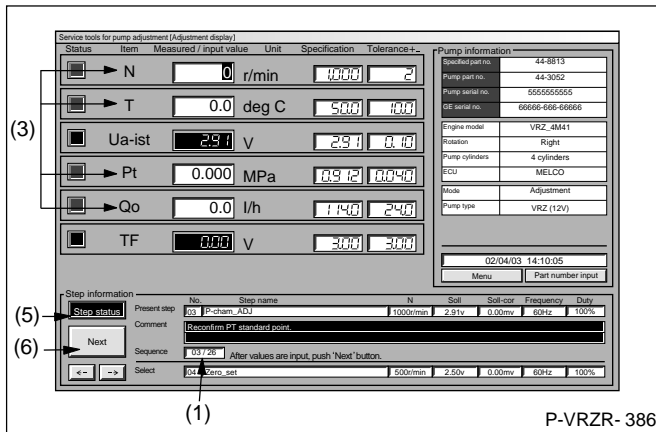
### ⚠ CAUTION

If there are any fuel leaks, if there is no injection or if any unusual noises occur during operation, stop test bench operation immediately and inspect the pump.

- (12) Confirm that the injection pump is operating normally.
- (13) Confirm that the Step status field is green.
- (14) Proceed to the next step.

#### Advice

Because the test oil temperature takes longer to increase in cold weather, turn the pump test bench on earlier.



## [6] Pump chamber pressure confirmation

- (1) Confirm that the sequence is Step 03/26.
- (2) Run the injection pump at the specified speed N (see figure at left).
- (3) Measure N, T, Pt and Qo on the pump test bench and input the values.

Note:

U  $\alpha$  ist and Tf are displayed automatically.

- (4) Confirm the pump chamber pressure.
- (5) Confirm that the Step status field is green.
- (6) Proceed to the next step.

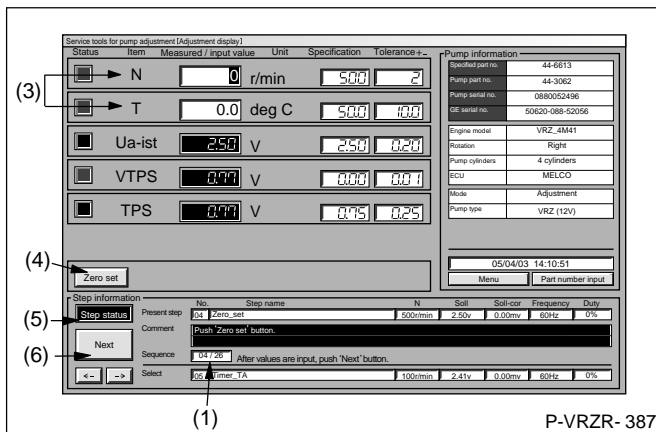
## [7] TPS confirmation

- (1) Confirm that the sequence is Step 04/26.
- (2) Run the injection pump at the specified speed N (see figure at left).
- (3) Measure N and T on the pump test bench and input the values.

Note:

U  $\alpha$  ist, VTPS and TPS are displayed automatically.

- (4) Press the 'Zero set' key and confirm that the VTPS value is within the specifications.
- (5) Confirm that the Step status field is green.
- (6) Proceed to the next step.



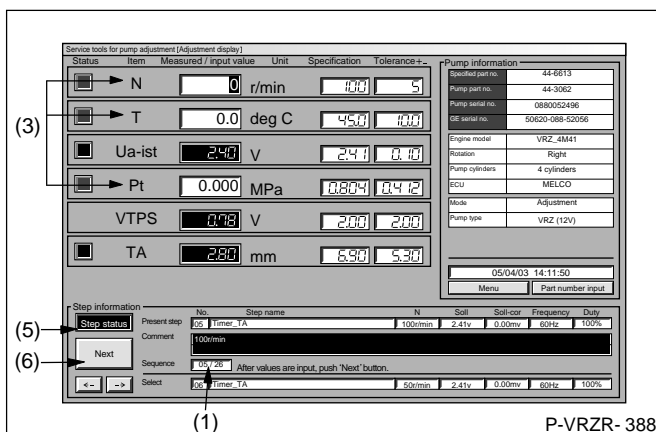
## [8] Timer stroke confirmation

- (1) Confirm that the sequence is Step 05/26.
- (2) Run the injection pump at the specified speed N (see figure at left).
- (3) Measure N, T and Pt on the pump test bench and input the values.

Note:

U  $\alpha$  ist, VTPS and TA are displayed automatically.

- (4) Confirm that the timer stroke TA is within the specifications.
- (5) Confirm that the Step status field is green.
- (6) Proceed to the next step.





## 8 INSPECTION

Service tools for pump adjustment (Adjustment display)

Status	Item	Measured / input value	Unit	Specification	Tolerance
N	0	r/min	100	5	
T	0.0	deg C	45.0	10.0	
Ua-ist	2.40	V	2.41	0.10	
Pt	0.000	MPa	0.004	0.412	
VTPS	0.75	V	2.00	2.00	
TA	280	mm	6.90	5.30	

Step information

No.	Step name	N	Soil	Soil-cor	Frequency	Duty
05	Timer TA	100/min	2.41V	0.00mm	60Hz	100%

Next

Sequence: 05/26 After values are input, push 'Next' button.

Select: 05 Timer TA

Pump information

Specified part no.	44-6613
Pump part no.	44-3062
Pump serial no.	0880052486
OE serial no.	50620-088-52056
Engine model	VR2_4M41
Rotation	Right
Pump cylinders	4 cylinders
ECU	MELCO
Mode	Adjustment
Pump type	VRZ (12V)

05/04/03 14:11:50

Menu Part number input

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Confirm 50 revolutions (Step 06/26) ~ 1,900 revolutions (Step 14/26) using the same procedure used for 100 revolutions (Step 5/26) above.

Service tools for pump adjustment (Adjustment display)

Status	Item	Measured / input value	Unit	Specification	Tolerance
N	0	r/min	2300	2	
T	0.0	deg C	50.0	10.0	
Ua-ist	0.87	V	0.87	0.20	
Q	0.0	mm³/st	5.0	5.0	
DQ	0.0	mm³/st	5.0	5.0	

Step information

No.	Step name	N	Soil	Soil-cor	Frequency	Duty
15	Q characteristics	2300/min	0.87V	0.00mm	60Hz	100%

Next

Sequence: 15/26 After values are input, push 'Next' button.

Select: 15 Cor-Q INSP

Pump information

Specified part no.	44-8813
Pump part no.	44-3052
Pump serial no.	5555555555
OE serial no.	66666-666-66666
Engine model	VR2_4M41
Rotation	Right
Pump cylinders	4 cylinders
ECU	MELCO
Mode	Adjustment
Pump type	VRZ (12V)

02/04/03 14:13:11

Menu Part number input

P-VRZR- 382

### [9] Non-injection confirmation

- Confirm that the sequence is Step 15/26.
- Run the injection pump at the specified speed N (see figure at left).
- Measure N, T, Q and DQ on the pump test bench and input the values.

Note:

U α ist is displayed automatically.

- Confirm that the Step status field is green.
- Proceed to the next step.

Service tools for pump adjustment (Adjustment display)

Status	Item	Measured / input value	Unit	Specification	Tolerance
N	0	r/min	1000	2	
T	0.0	deg C	45.0	2.0	
Ua-ist	2.87	V	2.91	0.30	
Q	0.0	mm³/st	9.25	1.5	
DQ	0.0	mm³/st	2.5	2.5	

Step information

No.	Step name	N	Soil	Soil-cor	Frequency	Duty
16	Cor-Q INSP	1000/min	2.87V	-34.18mm	60Hz	100%

Next

Sequence: 16/26 After values are input, push 'Next' button.

Select: 16 Cor-Q INSP

Pump information

Specified part no.	44-8813
Pump part no.	44-3052
Pump serial no.	5555555555
OE serial no.	66666-666-66666
Engine model	VR2_4M41
Rotation	Right
Pump cylinders	4 cylinders
ECU	MELCO
Mode	Adjustment
Pump type	VRZ (12V)

02/04/03 14:13:47

Menu Part number input

P-VRZR- 383

### [10] Injection quantity confirmation

- Confirm that the sequence is Step 16/26.
- Run the injection pump at the specified speed N (see figure at left).
- Measure N, T, Q and DQ on the pump test bench and input the values.

Note:

U α ist is displayed automatically.

Advice

**Do not perform injection quantity adjustment.**

- Confirm that the Step status field is green.
- Proceed to the next step.

Service tools for pump adjustment (Adjustment display)

Status	Item	Measured / input value	Unit	Specification	Tolerance
N	0	r/min	1800	2	
T	0.0	deg C	45.0	2.0	
Ua-ist	2.87	V	2.91	0.30	
Q	0.0	mm³/st	9.25	1.5	
DQ	0.0	mm³/st	2.5	2.5	

Step information

No.	Step name	N	Soil	Soil-cor	Frequency	Duty
17	Cor-Q INSP	1800/min	2.87V	-34.18mm	60Hz	100%

Next

Sequence: 17/26 After values are input, push 'Next' button.

Select: 17 Cor-Q INSP

Pump information

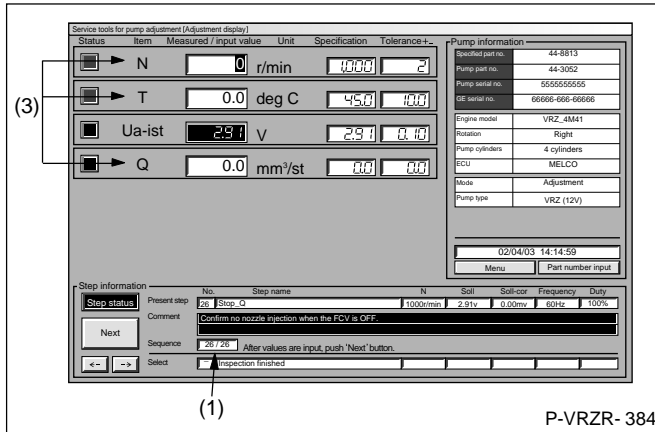
Specified part no.	44-8813
Pump part no.	44-3052
Pump serial no.	5555555555
OE serial no.	66666-666-66666
Engine model	VR2_4M41
Rotation	Right
Pump cylinders	4 cylinders
ECU	MELCO
Mode	Adjustment
Pump type	VRZ (12V)

02/04/03 14:13:47

Menu Part number input

P-VRZR- 383

Confirm compensation point 11 (Step 17/26) ~ compensation point 1 (Step 25/26) using the same procedure used for compensation point 10 (Step 16/26) above.

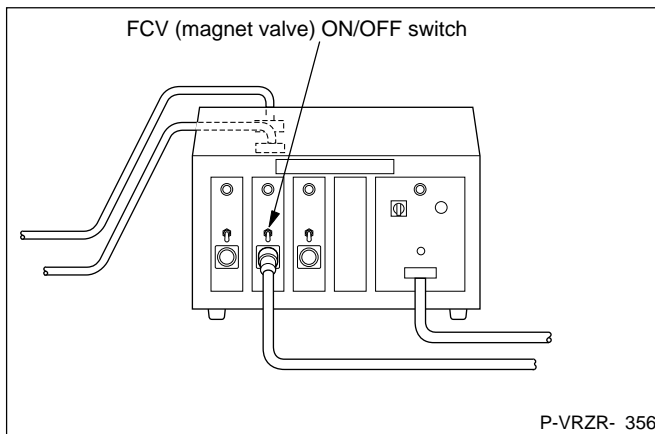


## [11] Magnet valve operation confirmation

- (1) Confirm that the sequence is Step 26/26.
- (2) Run the injection pump at the specified speed N (see figure at left).
- (3) Measure N, T and Q on the pump test bench and input the values.

Note:

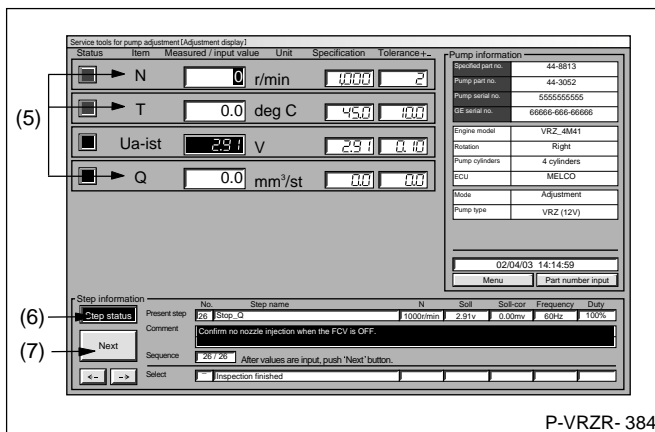
$U \propto ist$  is displayed automatically.



- (4) Turn the FCV (magnet valve) ON/OFF switch OFF and confirm that non-injection results.

### Advice

To confirm non-injection from the nozzle, look at the monitor screen and confirm that non-injection occurs within a short time (6 ~ 7 seconds).



- (5) Measure N, T and Q on the pump test bench and input the values.
- (6) Confirm that the Step status field is green.
- (7) Proceed to the next step.

## 8 INSPECTION

**MC-02 TESTER**

**Inspection result**

Specified part no. 44-8813 Pump serial no. 5555555555 Test complete Adjustment necessary  
 Pump part no. 44-3052 Unit serial no. 66666-666-66666

No.	Result	Step name	ECU values										Measured values									
			A	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	
1	X	Warm-up	200	2.50	0.00	0.00	100	0	0.0	2.50	0.0											
2	X	Warm-up	200	2.50	0.00	0.00	100	0	0.0	2.50	0.0											
3	X	P-Check ASD	200	2.50	0.00	0.00	100	0	0.0	2.50	0.0											
4	X	Idle	100	2.41	0.00	0.00	100	0	0.0	2.41	0.0											
5	X	Idle	100	2.41	0.00	0.00	100	0	0.0	2.41	0.0											
6	X	Idle	100	2.41	0.00	0.00	100	0	0.0	2.41	0.0											
7	X	Idle	100	2.41	0.00	0.00	100	0	0.0	2.41	0.0											
8	X	Idle	100	2.41	0.00	0.00	100	0	0.0	2.41	0.0											
9	X	Idle	100	2.41	0.00	0.00	100	0	0.0	2.41	0.0											
10	X	Idle	100	2.41	0.00	0.00	100	0	0.0	2.41	0.0											
11	X	Idle	100	2.41	0.00	0.00	100	0	0.0	2.41	0.0											
12	X	Idle	100	2.41	0.00	0.00	100	0	0.0	2.41	0.0											
13	X	Idle	100	2.41	0.00	0.00	100	0	0.0	2.41	0.0											
14	X	Idle	100	2.41	0.00	0.00	100	0	0.0	2.41	0.0											
15	X	Idle	100	2.41	0.00	0.00	100	0	0.0	2.41	0.0											
16	X	Idle	100	2.41	0.00	0.00	100	0	0.0	2.41	0.0											
17	X	Idle	100	2.41	0.00	0.00	100	0	0.0	2.41	0.0											
18	X	Idle	100	2.41	0.00	0.00	100	0	0.0	2.41	0.0											
19	X	Idle	100	2.41	0.00	0.00	100	0	0.0	2.41	0.0											
20	X	Idle	100	2.41	0.00	0.00	100	0	0.0	2.41	0.0											
21	X	Idle	100	2.41	0.00	0.00	100	0	0.0	2.41	0.0											
22	X	Idle	100	2.41	0.00	0.00	100	0	0.0	2.41	0.0											
23	X	Idle	100	2.41	0.00	0.00	100	0	0.0	2.41	0.0											
24	X	Idle	100	2.41	0.00	0.00	100	0	0.0	2.41	0.0											
25	X	Idle	100	2.41	0.00	0.00	100	0	0.0	2.41	0.0											
26	X	Idle	100	2.41	0.00	0.00	100	0	0.0	2.41	0.0											
27	X	Idle	100	2.41	0.00	0.00	100	0	0.0	2.41	0.0											
28	X	Idle	100	2.41	0.00	0.00	100	0	0.0	2.41	0.0											

If no further measurements are required, select 'Next' button.  
 To repeat a measurement, select 'Repeat' button and input step number.

Step number  Repeat

(1) P-VRZR- 385

## [12] Inspection result

- (1) Click the 'Next' key.
- (2) The message 'Do you want to print and save test record' appears.
- (3) Click 'OK.'

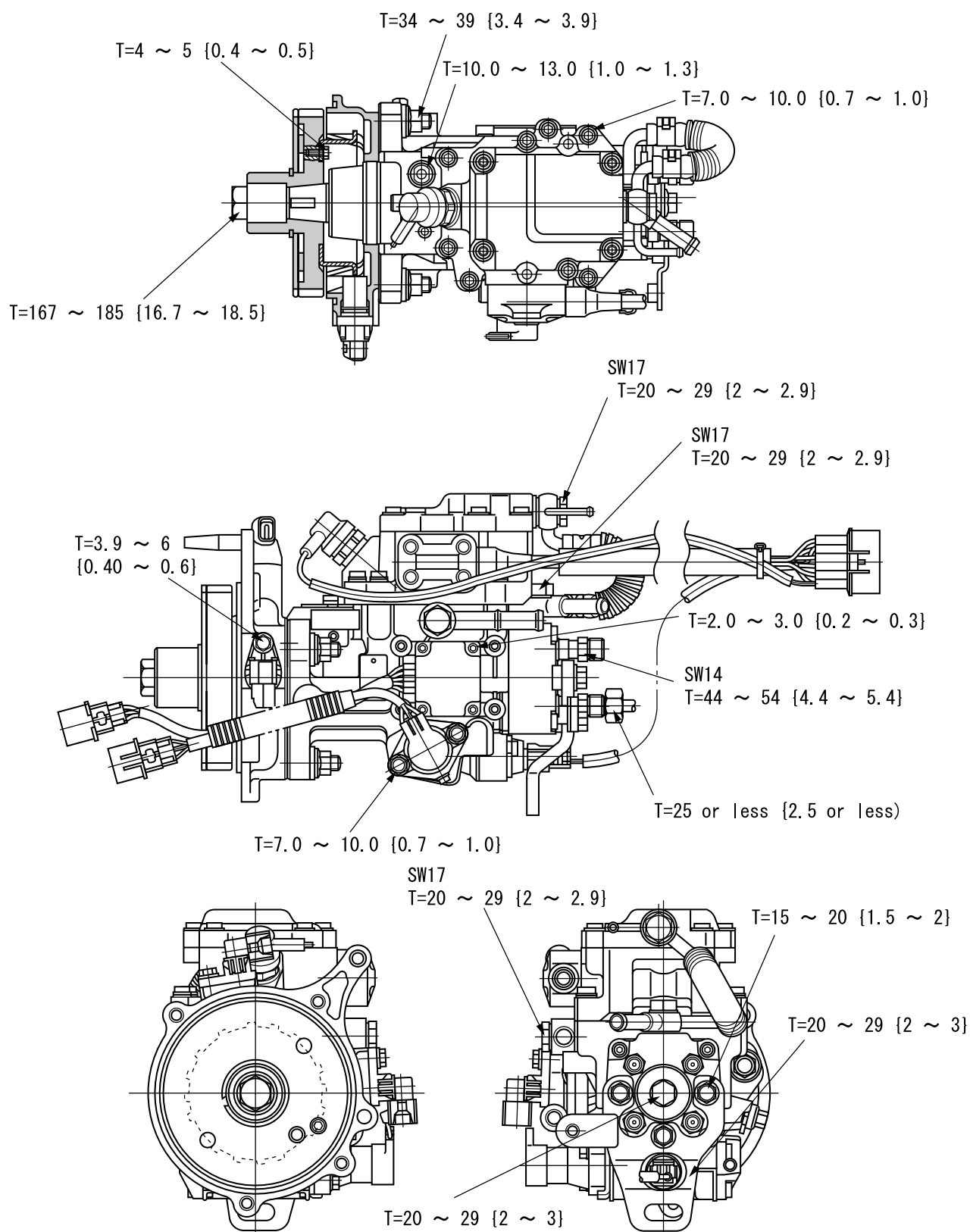
Note:

If you select 'Cancel,' you cannot continue to the next step.

### Advice

- The printed test record can be given to the customer.
  - The saved test record is a record of all the data and must be handled carefully.
- (4) Turn the controller unit's sub-switch OFF.
  - (5) Turn the controller unit's main switch OFF.

## 9 TIGHTENING TORQUES



Units: N·m {kgf·m}

P-VRZR-389

## 10 PART NUMBER EXPLANATION

### 1. INJECTION PUMP ASSEMBLY NUMBER

1 0 9 1 \* \* - \* \* \* \*

(1) (2) (3) (4) (5) (6)

(1): VRZ type injection pump

(2): Number of cylinders

0 → spare	1 → spare	2 → spare
3 → 3 cylinders	4 → 4 cylinders	5 → 5 cylinders
6 → 6 cylinders	7 → spare	8 → spare
9 → master pump		

(3): Number of plungers - diameter

0 → 2 - $\phi$ 6.5	1 → 2 - $\phi$ 7	2 → 2 - $\phi$ 7.5
3 → 2 - $\phi$ 8	4 → 2 - $\phi$ 8.5	5 → 2 - $\phi$ 9
6 → spare	7 → spare	8 → spare
9 → spare		

(4): Engine manufacturer

0 → Mazda	1 → Isuzu	2 → Nissan (Motor)
3 → Mitsubishi (Motors)	4 → Nissan (Diesel), Komatsu, others	5 → spare
6 → spare	7 → spare	8 → spare
9 → spare		

(5): Proper number

Design sequence starting from '00' with each change in the first seven digits.

(6): Suffix

### 2. BOSCH TYPE NUMBER

NP - VRZ - \* / \*\* E \*\*\*\* R NP\*\*\*\*

(1) (2) (3) (4) (5) (6) (7) (8)

(1): Manufactured by Bosch Automotive Systems Corporation

(2): VRZ type injection pump

(3): Number of cylinders

(4): Plunger diameter

(5): Electronic governor

(6): Maximum controlled governor speed (r/min)

(7): Direction of pump rotation

R: clockwise viewed from drive side

L: counter clockwise viewed from drive side

(8): Proper number

Pub. No: EE14E-11161

FUEL INJECTION PUMP MODEL VRZ

Service Manual

Repair Service & Maintenance

Printing: July 2003

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