**WARNINGS**

The following definitions and warning signs are used in this service manual. These are extremely important to safe operation. Important points are described to prevent bodily injury and property damage. They must be fully understood before beginning COVEC-F maintenance.

![CAUTION](image)

Improper maintenance can result in injury and property damage.

**MEANINGS OF MARKS**

The following marks are used in this service manual to facilitate correct COVEC-F maintenance.

**Advice**

Procedures that must be performed to enable the best possible COVEC-F maintenance.

**Note**

Information assisting in the best possible COVEC-F maintenance.
FOREWORD

This service manual describes service precautions and the adjustment and inspection of COVEC-F (Computed VE pump Control system-Full). Refer to the separate service manuals listed below to facilitate COVEC-F maintenance. This manual is intended for use by vehicle maintenance technicians or persons with an adequate knowledge of injection pumps.

The contents of the manual, including illustrations, drawings and specifications were the latest available at the time of printing. The right is reserved to make changes in specifications and procedures at any time without notice.

BOSCH K.K.
Sales Automotive Aftermarket Division

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<th>Publication number</th>
</tr>
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<td>ED14E-11010</td>
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<td>ECU ASSEMBLY, ADJUSTMENT AND INSPECTION DATA, Installation</td>
<td>ED14E-11020</td>
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<td>50</td>
</tr>
<tr>
<td>NUMBER</td>
<td></td>
</tr>
<tr>
<td>2. BOSCH TYPE NUMBER</td>
<td>50</td>
</tr>
</tbody>
</table>
[1] Carrying the injection pump
- Never knock or drop the injection pump when carrying it.
- When carrying the injection pump, hold the pump by the bottom of the pump body.

⚠️ CAUTION
Never hold the pump by the GE actuator or the harnesses.
Holding the pump by these components may result in damage or injury.

[2] Disassembly and reassembly
- Only the mechanical components of the injection pump body can be disassembled and reassembled.

Advice
Do not disassemble the GE actuator other than directed in this manual.
- The GE actuator consists of electrical components. Do not damage them.
- When cleaning the injection pump, do not clean the GE actuator, the harnesses, or the harness connectors using fuel oil. Use only clean waste cloth.
Q ADJUSTMENT ROM

[1] Purpose
The purpose of improving the Q adjustment ROM was to compensate for variations in injection quantities between individual injection pumps.

[2] Comparison of Q adjustment ROM features
The system includes a ROM (ie, the Q adjustment ROM) onto which injection quantity adjustment data (ie, Q adjustment data) for individual pumps has been written.

<table>
<thead>
<tr>
<th>Current Q adjustment compensation system</th>
<th>Improved Q adjustment compensation system</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Compensation limited to full Q adjustment compensation</td>
<td>• Multiple point compensation possible using a single component</td>
</tr>
<tr>
<td>• A single device is necessary for compensation only at a single point.</td>
<td></td>
</tr>
</tbody>
</table>

[3] Compensation example
With the Q adjustment ROM, multiple point compensation is possible for a single component. As shown in the figure below, 3 speed patterns x 3 partial load patterns give 9 compensation locations:
### [1] Adjustment tools

#### (1) Bosch Automotive System specifications

<table>
<thead>
<tr>
<th>Key no</th>
<th>RBAJ part no</th>
<th>Bosch part no</th>
<th>Part name</th>
<th>Qty</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>105796-0000</td>
<td>1 688 010 129</td>
<td>Fixing stand</td>
<td>1</td>
<td>For driving pump; center height: 125 mm</td>
</tr>
<tr>
<td>2</td>
<td>157811-0521</td>
<td>9 681 610 291</td>
<td>Flange</td>
<td>1</td>
<td>For fixing pump</td>
</tr>
<tr>
<td>3</td>
<td>105780-8190</td>
<td>9 430 610 134</td>
<td>Nozzle, nozzle holder assembly</td>
<td>4</td>
<td>New injection system (nozzle holder part no: 105780-2150, nozzle part no: 105780-0060)</td>
</tr>
<tr>
<td>4</td>
<td>157805-7320</td>
<td>9 681 611 029</td>
<td>Injection pipe</td>
<td>4</td>
<td>Inner dia φ2 x outer dia φ6 - length 450mm</td>
</tr>
<tr>
<td>5</td>
<td>157641-4720</td>
<td>9 443 612 897</td>
<td>Joint assembly</td>
<td>1</td>
<td>For fixing key no 3</td>
</tr>
<tr>
<td>6</td>
<td>157641-7020</td>
<td>9 443 612 976</td>
<td>Tube assembly</td>
<td>4</td>
<td>Used together with key no 5</td>
</tr>
<tr>
<td>7</td>
<td>157842-4522</td>
<td>9 681 610 326</td>
<td>Coupling</td>
<td>1</td>
<td>For driving pump (shaft dia φ20)</td>
</tr>
<tr>
<td>8</td>
<td>105782-8260</td>
<td>9 680 610 061</td>
<td>Measuring device</td>
<td>1</td>
<td>For measuring timer stroke (high pressure)</td>
</tr>
<tr>
<td>9</td>
<td>105782-8160</td>
<td>9 680 610 016</td>
<td>Measuring device</td>
<td>1</td>
<td>For measuring pre-stroke</td>
</tr>
<tr>
<td>10</td>
<td>157954-4100</td>
<td>9 681 610 942</td>
<td>Dial gauge</td>
<td>1</td>
<td>Used together with key no 9</td>
</tr>
<tr>
<td>11</td>
<td>157829-0820</td>
<td>9 681 610 336</td>
<td>Adjusting device</td>
<td>1</td>
<td>For adjusting regulating valve pressure</td>
</tr>
<tr>
<td>12</td>
<td>157928-2920</td>
<td>9 443 613 009</td>
<td>Pliers</td>
<td>1</td>
<td>For disassembling regulating valve</td>
</tr>
<tr>
<td>13</td>
<td>157829-5220</td>
<td>9 681 610 184</td>
<td>Inserter</td>
<td>1</td>
<td>For assembling regulating valve</td>
</tr>
<tr>
<td>14</td>
<td>157971-1020</td>
<td>9 443 613 442</td>
<td>Piping assembly</td>
<td>1</td>
<td>For test oil overflow piping</td>
</tr>
<tr>
<td>15</td>
<td>157641-6920</td>
<td>9 443 612 975</td>
<td>Socket assembly</td>
<td>10</td>
<td>Used together with key no 6</td>
</tr>
</tbody>
</table>

### (2) Bosch specifications

<table>
<thead>
<tr>
<th>Key no</th>
<th>Bosch part no</th>
<th>Part name</th>
<th>Qty</th>
<th>Remarks</th>
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<tbody>
<tr>
<td>1</td>
<td>1 687 010 126</td>
<td>VE pump overflow accessory set</td>
<td>1</td>
<td>Three-way valve (multiway cock)</td>
</tr>
</tbody>
</table>

Note:
Center height is the height from the center of the pump test bench’s flywheel to the drive stand.
1. 105796-0000 (1 688 010 129) Fixing stand

2. 157811-0521 (9 681 610 291) Flange

3. 105780-8190 (9 430 610 134) Nozzle, nozzle holder assembly

4. 157805-7320 (9 681 611 029) Injection pipe

5. 157641-4720 (9 443 612 897) Joint assembly

6. 157641-7020 (9 443 612 976) Tube assembly

7. 157842-4522 (9 681 610 326) Coupling

8. 105782-8260 (9 680 610 061) Measuring device

9. 105782-8160 (9 680 610 016) Measuring device
10. 157954-4100
   (9 681 610 942)
   Dial gauge

11. 157829-0820
    (9 681 610 336)
    Adjusting device

12. 157928-2920
    (9 443 613 009)
    Pliers

13. 157829-5220
    (9 681 610 184)
    Inserter

14. 157971-1020
    (9 443 613 442)
    Piping assembly

15. 157641-6920
    (9 443 612 975)
    Socket assembly
Adjustment controller assembly construction:

Key number 1 (RBAJ part no. 105782-8360, Bosch part no. 9 680 610 209) is used with both VRZ and COVEC-F pumps. With the COVEC-F pump, key numbers 1-1 (RBAJ part no. 157966-4020, Bosch part no. 9 443 613 446), 1-2 (RBAJ part no. 157966-3720, Bosch part no. 9 443 613 456) and 1-4 (RBAJ part no. 157966-3920, Bosch part no. 9 443 613 458) are used.

### Adjustment controller assembly table (for COVEC-F)

#### Key no. 1: 105782-8360 (9 680 610 209)

<table>
<thead>
<tr>
<th>Key no</th>
<th>RBAJ part no</th>
<th>Bosch part no</th>
<th>Part name</th>
<th>Qty</th>
<th>Remarks</th>
</tr>
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<tbody>
<tr>
<td>1-1</td>
<td>157966-4020</td>
<td>9 443 613 446</td>
<td>CONTROLLER ASSY</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>1-1-1</td>
<td>157966-4120</td>
<td>9 443 613 447</td>
<td>Controller unit</td>
<td>1</td>
<td>Checker assy</td>
</tr>
<tr>
<td>1-1-2</td>
<td>157966-4420</td>
<td>9 443 613 448</td>
<td>Wire harness</td>
<td>1</td>
<td>Power supply (Japan, USA)</td>
</tr>
<tr>
<td>1-1-3</td>
<td>157966-4520</td>
<td>9 443 613 449</td>
<td>Wire harness</td>
<td>1</td>
<td>Power supply (EC)</td>
</tr>
<tr>
<td>1-1-4</td>
<td>157966-4620</td>
<td>9 443 613 450</td>
<td>Wire harness</td>
<td>1</td>
<td>PC: COM1 ~ MC-02</td>
</tr>
<tr>
<td>1-1-5</td>
<td>157966-4720</td>
<td>9 443 613 451</td>
<td>Wire harness</td>
<td>1</td>
<td>PC: COM2 ~ MC-02</td>
</tr>
<tr>
<td>1-1-6</td>
<td>157966-4820</td>
<td>9 443 613 452</td>
<td>Wire harness</td>
<td>1</td>
<td>FCV GND harness</td>
</tr>
<tr>
<td>1-1-7</td>
<td>157966-4920</td>
<td>9 443 613 453</td>
<td>Main harness</td>
<td>1</td>
<td>Controller-Pump GE</td>
</tr>
<tr>
<td>1-1-8</td>
<td>157966-5020</td>
<td>9 443 613 454</td>
<td>Main harness</td>
<td>1</td>
<td>Controller-Pump ROM</td>
</tr>
<tr>
<td>1-1-9</td>
<td>157966-5100</td>
<td>9 443 613 455</td>
<td>CD-ROM</td>
<td>1</td>
<td>Software (Overseas Ver.) &amp; (Calibration data) &amp; Manual</td>
</tr>
<tr>
<td>1-2</td>
<td>157966-3720</td>
<td>9 443 613 456</td>
<td>ECU assembly (4D56)</td>
<td>1</td>
<td>4D56 throttle</td>
</tr>
<tr>
<td>1-4</td>
<td>157966-3920</td>
<td>9 443 613 458</td>
<td>ECU assembly (WL)</td>
<td>1</td>
<td>WL throttle</td>
</tr>
<tr>
<td>Code</td>
<td>Description</td>
<td>Code</td>
<td>Description</td>
<td>Code</td>
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<td>------------------------------</td>
<td>--------</td>
<td>------------------------------</td>
<td>--------</td>
<td>------------------------------</td>
</tr>
<tr>
<td>1-1</td>
<td>157966-4020 (9 443 613 446)</td>
<td>1-1-1</td>
<td>157966-4120 (9 443 613 447)</td>
<td>1-1-3</td>
<td>157966-4520 (9 443 613 449)</td>
</tr>
<tr>
<td></td>
<td>CONTROLLER ASSY</td>
<td></td>
<td>Controller unit</td>
<td></td>
<td>Wire harness</td>
</tr>
<tr>
<td>1-1-2</td>
<td>157966-4420 (9 443 613 448)</td>
<td></td>
<td>Wire harness</td>
<td>1-1-5</td>
<td>157966-4720 (9 443 613 451)</td>
</tr>
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<td></td>
<td>Wire harness</td>
<td></td>
<td>Wire harness</td>
<td></td>
<td>Wire harness</td>
</tr>
<tr>
<td>1-1-4</td>
<td>157966-4620 (9 443 613 450)</td>
<td></td>
<td>Wire harness</td>
<td>1-1-6</td>
<td>157966-4820 (9 443 613 452)</td>
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<td>Wire harness</td>
<td></td>
<td>Wire harness</td>
<td></td>
<td>Wire harness</td>
</tr>
<tr>
<td>1-1-7</td>
<td>157966-4920 (9 443 613 453)</td>
<td></td>
<td>Main harness</td>
<td>1-1-8</td>
<td>157966-5020 (9 443 613 454)</td>
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<td></td>
<td>Main harness</td>
<td></td>
<td>Main harness</td>
<td></td>
<td>Main harness</td>
</tr>
<tr>
<td>1-1-9</td>
<td>157966-5100 (9 443 613 455)</td>
<td></td>
<td>CD-ROM</td>
<td></td>
<td>CD-ROM</td>
</tr>
</tbody>
</table>
**3 SPECIAL TOOLS**

1-2 157966-3720  (9 443 613 456)  
ECU assembly (4D56)

1-4 157966-3920  (9 443 613 458)  
ECU assembly (WL)

---

**[3] Intermediate harnesses**

<table>
<thead>
<tr>
<th>Key no</th>
<th>RBAJ part no</th>
<th>Bosch part no</th>
<th>Part name</th>
<th>Qty</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>157966-5620</td>
<td>9 443 613 459</td>
<td>Intermediate harness</td>
<td>1</td>
<td>4M56 Covec-F GE</td>
</tr>
<tr>
<td>2</td>
<td>157966-5820</td>
<td>9 443 613 461</td>
<td>Intermediate harness</td>
<td>1</td>
<td>WL Covec-F GE</td>
</tr>
<tr>
<td>3</td>
<td>157966-2421</td>
<td>9 443 613 462</td>
<td>Intermediate harness</td>
<td>1</td>
<td>For 4M41, 4D56 ROM</td>
</tr>
</tbody>
</table>

---

1. 157966-5620  
(9 443 613 459)  
Intermediate harness  
(4D56)

2. 157966-5820  
(9 443 613 461)  
Intermediate harness  
(WL)

3. 157966-2421  
(9 443 613 462)  
Intermediate harness  
(4M41, 4D56 ROM)
1. ADJUSTMENT CONDITIONS

[1] Test equipment
(1) Pump test bench EPS815
(2) KMA802
(3) Adjustment software operating environment

<p>| | |</p>
<table>
<thead>
<tr>
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<tbody>
<tr>
<td>Windows OS</td>
<td>Windows 2000 PRO (at least Service Pack 2.0) English language version</td>
</tr>
<tr>
<td>Clock speed</td>
<td>Personal computer equipped with Pentium CPU (clock speed at least 333 MHz)</td>
</tr>
<tr>
<td>Memory</td>
<td>At least 128 MB usable memory</td>
</tr>
<tr>
<td>Hard disk</td>
<td>At least 20 MB space</td>
</tr>
<tr>
<td>Display</td>
<td>Resolution: at least 1024 x 768, number of display colors: high color minimum (16 bit)</td>
</tr>
<tr>
<td>Drive devices</td>
<td>CD-ROM drive, floppy disk drive</td>
</tr>
<tr>
<td>Additional devices</td>
<td>At least 2 communication ports (2 necessary for controller assembly)</td>
</tr>
<tr>
<td></td>
<td>Mouse, keyboard</td>
</tr>
</tbody>
</table>

(1) Injection system piping diagram

![Injection system piping diagram](image-url)
## (2) Fuel piping

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

### Piping outline

[Image of fuel piping diagram]

- **Overflow measurement hose**
- **Temperature sensor cable**
- **Test oil hose**
- **Piping assembly**
- **Multi-way cock**
- **Pressure gauge**
- **Pump chamber pressure measurement hose**
(1) Controller assembly wiring
MAZDA WL ENGINES

COVEC-F type injection pump for WL model engines

Intermediate harness
(157966-5820)

Earth to injection pump or pump test bench

To AC100V - AC120V or AC200V - 240V power source

ROM harness
(157966-5020)

Main harness
(157966-4920)

To AC100V - AC120V or AC200V - 240V power source

Dsub 9 pin

Dsub 25 pin

Dsub 7 pin

Dsub 9 pin

To AC100V - AC120V or AC200V - 240V power source

VRZ and COVEC-F controller unit

MITSUBISHI 4D56 ENGINES

To AC100V - AC120V or AC200V - 240V power source

Dsub 9 pin

Dsub 25 pin

Dsub 7 pin

Dsub 9 pin

To AC100V - AC120V or AC200V - 240V power source

VRZ and COVEC-F controller unit

Intermediate harness
(157966-5620)

Injection pump

Intermediate harness
(157966-2421)

FCV GND harness
(157966-4820)

Earth to injection pump or pump test bench

To AC100V - AC120V or AC200V - 240V power source

Personal computer

Tool connection 232C cable
Connection: cross connection (2 pin, 3 pin cross)

Tool connection 232C cable
Connection: straight connection

Connection: cross connection (2 pin, 3 pin cross)
(2) Wiring connections inside controller unit

Note:
The above figure shows the wiring connections for the controller unit when used for the Mazda WL engine.

[4] Related materials

<table>
<thead>
<tr>
<th>No.</th>
<th>Publication No.</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>ED14E-11020</td>
<td>When installing the ECU assembly for the controller unit, refer to the installation instructions included with the controller unit.</td>
</tr>
<tr>
<td>2</td>
<td>ED14E-11010</td>
<td>When installing the adjustment software, refer to the installation manual included with the CD-ROM.</td>
</tr>
</tbody>
</table>

Note:
Where updating of adjustment data and inspection data is indicated, copy the data from the ESPI (ZW)’s CD-ROM.
## 2. CONTROLLER UNIT CONTROLS

### [1] Front panel

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

![Diagram of controller unit controls]
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.
[2] Rear panel

**CAUTION**

- 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.

---

<table>
<thead>
<tr>
<th>Key no</th>
<th>Name</th>
<th>Use and purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>AC100V - 120V power or AC 200V - 240V power terminal</td>
<td>Connect to AC100V - 120V, 50Hz/60Hz power or AC 200V - 240V, 50Hz/60Hz power source.</td>
</tr>
<tr>
<td>2</td>
<td>Main switch (breaker)</td>
<td>Controller assembly power switch. Turn ON when in use (position at 'T'). Position at 'O' to turn OFF.</td>
</tr>
<tr>
<td>3</td>
<td>D-sub 9 pin cable connection (COM1)</td>
<td>Connects RS232C cable to personal computer (for GE).</td>
</tr>
<tr>
<td>4</td>
<td>D-sub 25 pin cable connection (COM2)</td>
<td>Connects RS232C cable to personal computer (for Q-ROM).</td>
</tr>
</tbody>
</table>

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.
3. PUMP ADJUSTMENT TOOL FLOW CHART

1. Password input
   - Agreement
   - Disagreement

2. ECU selection
   [1] 4D56
   [2] 4M41
   [3] WL
   [5] Workshop name registration
   [6] Exit


   Part no. input
   [1] Adjustment
   [2] Inspection

   Pre-check 1.

   Adjustment
   Step 1-XX Adjustment
   StepXX + 1 ROM compensation
   StepXX + 2 ROM writing

   Inspection
   Step 1-XX Inspection

   Repeat measurement
   Adjustment result

   OK
   Repeat measurement
   Inspection result

   Print result
   Cancel
   OK
   Final confirmation

   OK
   Cancel
   Print result
   Cancel
   Final confirmation

   Push [MENU] button
   (= Registration change completed)
   Confirmation
   OK

   Program completed

   Select "Registration" button

   Workshop name registration

   Input item
   [1] Workshop name
   [2] Address
   [3] Telephone
   [4] Fax
   [5] Operator's name
   [6] Password

   Confirmation
   OK

   Push [MENU] button
   (= Item is not changed)

   Exit

   Workshop name registration

   Confirmation

   Program completed
## 4. PUMP ADJUSTMENT TOOL MONITOR SCREEN

![Diagram of pump adjustment tool monitor screen]

<table>
<thead>
<tr>
<th>No.</th>
<th>Name</th>
<th>Use and purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>4D56 model engine's COVEC-F type injection pump inspection / adjustment key</td>
<td>Select for inspection / adjustment of COVEC-F injection pump for Mitsubishi 4D56 model engine</td>
</tr>
<tr>
<td>2</td>
<td>4M41 model engine's VRZ type injection pump inspection / adjustment key</td>
<td>Select for inspection / adjustment of VRZ injection pump for Mitsubishi 4M41 model engine</td>
</tr>
<tr>
<td>3</td>
<td>WL model engine's COVEC-F type injection pump inspection / adjustment key</td>
<td>Select for inspection / adjustment of COVEC-F injection pump for Mazda WL model engine</td>
</tr>
<tr>
<td>4</td>
<td>Pre-stroke adjustment key</td>
<td>For adjusting injection pump's pre-stroke</td>
</tr>
<tr>
<td>5</td>
<td>Workshop registration key</td>
<td>For workshop registration</td>
</tr>
<tr>
<td>6</td>
<td>Exit key</td>
<td>To exit adjustment software</td>
</tr>
</tbody>
</table>
5. PUMP ADJUSTMENT TOOL MONITOR SCREEN OUTLINE
Inspection and adjustment step screen

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

**Pre-stroke adjustment (manual operation)**

Pump adjustment tools for service

**Pre-stroke adjustment (manual operation)**

![Image of Manual Operation Table]

- Values must be input for GE soll, TCV Duty and TCV Frequency.
- Np values do not appear at VRZ pump adjustment.

<table>
<thead>
<tr>
<th>No.</th>
<th>Name</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Control sleeve position actual voltage display</td>
<td>Displays actual control sleeve position voltage.</td>
</tr>
<tr>
<td>2</td>
<td>Control sleeve position target voltage input</td>
<td>By operating the input keys, the control sleeve position can be set for the engine specified in No. 5.</td>
</tr>
<tr>
<td>3</td>
<td>Initialize ECU</td>
<td>Clears display values.</td>
</tr>
<tr>
<td>4</td>
<td>MENU</td>
<td>Displays MENU screen.</td>
</tr>
<tr>
<td>5</td>
<td>Select ECU</td>
<td>Select the ECU for the engine.</td>
</tr>
</tbody>
</table>

7. WORKSHOP DISPLAY

**Second timing adjustment (manual operation)**

Pump adjustment tools for service

**Workshop name registration**

![Image of Workshop Name Registration Table]

<table>
<thead>
<tr>
<th>No.</th>
<th>Name</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Workshop name</td>
<td>Workshop name registration</td>
</tr>
<tr>
<td>2</td>
<td>Address</td>
<td>JAPAN</td>
</tr>
<tr>
<td>3</td>
<td>Telephone</td>
<td>000-000-0000</td>
</tr>
<tr>
<td>4</td>
<td>Fax</td>
<td>111-111-1111</td>
</tr>
<tr>
<td>5</td>
<td>Operator’s name</td>
<td>Sse</td>
</tr>
<tr>
<td>6</td>
<td>Password</td>
<td>****</td>
</tr>
<tr>
<td>7</td>
<td>Menu</td>
<td>Menu selection</td>
</tr>
<tr>
<td>8</td>
<td>Registration</td>
<td>Registration button.</td>
</tr>
</tbody>
</table>
### WORKSHOP REGISTRATION

(1) Select ‘Workshop name registration.’

(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.)

---

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

---

![Diagram](P-COVR-282)

![Diagram](P-COVR-214)
8. **ADJUSTMENT**  
**Adjustment sequence**

Note: The following describes adjustment of the COVEC-F pump for Mazda WL engines. For Mitsubishi 4D56 engines, the adjustment sequence, the wiring harnesses and connections, and the ECU assembly used differ from those of Mazda engines. The details of the adjustment procedures, however, are the same. Refer to page 11 for the wiring outline for Mitsubishi 4D56 engines.

<table>
<thead>
<tr>
<th>Step</th>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Recording the pump and GE serial numbers</td>
<td>See page 23 [1]</td>
</tr>
<tr>
<td>2</td>
<td>Pre-stroke adjustment: preparation</td>
<td>See page 23 [2]</td>
</tr>
<tr>
<td>3</td>
<td>Adjustment software set up</td>
<td>See page 25 [3]</td>
</tr>
<tr>
<td>4</td>
<td>Pre-stroke adjustment</td>
<td>See page 26 [4]</td>
</tr>
<tr>
<td>5</td>
<td>Adjustment mode preparation</td>
<td>See page 28 [5]</td>
</tr>
<tr>
<td>6</td>
<td>Part no. input and installation confirmation</td>
<td>See page 29 [6]</td>
</tr>
<tr>
<td>7</td>
<td>Warming-up operation</td>
<td>See page 30 [7]</td>
</tr>
<tr>
<td>8</td>
<td>Pump chamber pressure adjustment</td>
<td>See page 31 [8]</td>
</tr>
<tr>
<td>9</td>
<td>TPS zero setting</td>
<td>See page 33 [9]</td>
</tr>
<tr>
<td>10</td>
<td>Timer stroke adjustment and characteristic confirmation</td>
<td>See page 34 [10]</td>
</tr>
<tr>
<td>11</td>
<td>Measuring the overflow quantity</td>
<td>See page 34 [11]</td>
</tr>
<tr>
<td>12</td>
<td>Standard injection quantity point adjustment</td>
<td>See page 35 [12]</td>
</tr>
<tr>
<td>13</td>
<td>Injection quantity compensation pre-confirmation</td>
<td>See page 35 [13]</td>
</tr>
<tr>
<td>14</td>
<td>Magnet valve operation confirmation</td>
<td>See page 36 [14]</td>
</tr>
</tbody>
</table>

Continued on next page
4 ADJUSTMENT

- Timer stroke confirmation
  - TPS confirmation
    - Injection quantity confirmation point adjustment
      - Compensation ROM interpolation calculation
        - Writing to the compensation ROM
          - Printing the adjustment result and saving the data
            - Finish

See page 36 [15]
See page 37 [16]
See page 38 [17]
See page 38 [18]
See page 39 [19]
See page 39 [20]
[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.


(1) Temporarily attach the fixing stand to the pump test bench and attach the injection pump to the fixing stand.

<table>
<thead>
<tr>
<th>Tool name</th>
<th>Part no.</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fixing stand</td>
<td>105796-0000</td>
<td></td>
</tr>
</tbody>
</table>

(2) Attach the plug to where the overflow valve was removed.

(3) Assemble the key to the drive shaft.

(4) Align the coupling with the key, assemble it to the shaft and fix it using the nut.

<table>
<thead>
<tr>
<th>Tool name</th>
<th>Part no.</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coupling</td>
<td>105842-4522</td>
<td></td>
</tr>
</tbody>
</table>
(5) Move the fixing stand and assemble the coupling teeth to the pump test bench drive coupling. Ensure approximately 1 mm clearance between the coupling and the drive coupling.

**Advice**
The clearance between the coupling and the drive coupling must not exceed 1 mm.

(6) Rotate the pump test bench flywheel using the lever and confirm that the injection pump rotates smoothly.

(7) Securely tighten the fixing stand installation bolts and nuts and the drive coupling socket head bolt to fix the injection pump to the pump test bench.

(8) Attach the dial gauge to the measuring device.

<table>
<thead>
<tr>
<th>Tool name</th>
<th>Part no.</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dial gauge</td>
<td>157954-4100</td>
<td></td>
</tr>
<tr>
<td>Measuring device</td>
<td>105782-8160</td>
<td></td>
</tr>
</tbody>
</table>

**Advice**
Confirm that the gauge needle moves smoothly.

(9) Remove the air bleeder bolt.

(10) Install the measuring device to where the air bleeder bolt was installed.
(11) Connect the test oil hose to the injection pump’s fuel inlet.

Advice
Do not connect the pump chamber pressure measurement hose, the overflow measurement hose, the temperature sensor cable or the multiway cock.

(12) Connect the controller assembly’s wire harness and intermediate harness to the injection pump’s connectors. (Refer to page 11 for the controller assembly’s wiring. The following describes Mazda wiring.)

(13) Connect the wire harness to the controller unit’s ECU assembly connector (Mazda: No. 3; Mitsubishi: No. 1).

(14) Connect the ROM controller’s wire harness to the intermediate harness.

(15) Connect the FCV GND harness to the controller assembly’s wire harness and to earth.

(16) 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.

(17) 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.

[3] Adjustment software set up
(1) Turn the computer and the monitor power switches ON.
Precaution
Password is required to actuate adjustment tools. Input password and press ‘ENTER’ key.

Advice
Input the initial default password (‘RBAJ’) or your own password.

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

Turn the main switch on the rear of the controller unit ON.
(5) Set the No 1 ~ No 4 changeover switch at the relevant setting (Mazda: No. 3; Mitsubishi: No. 1).
(6) Turn the FCV (magnet valve) ON/OFF switch ON to energize the magnet valve.
(7) Turn the sub-switch on the front of the controller unit ON.

[4] Pre-stroke adjustment
(1) Select the ‘Manual operation’ button.
(2) Select the ECU.
(3) Click the ‘GE soll’ key and input the specified GE soll voltage value 2.8 V.
(4) Confirm that the GE Vist value is displayed.

Note:
The GE Vist values vary.
(5) Supply test oil to the injection pump at the specified supply pressure (20 kPa (0.2 kgf/cm²)).

(6) Rotate the pump test bench’s flywheel 1 ~ 2 turns in the specified direction of rotation using the lever and confirm from the dial gauge that the plunger lifts smoothly.

Advice
Test oil will flow from the measuring device’s spill pipe. Prepare a container.

(7) Rotate the pump test bench’s flywheel in the specified direction to position the plunger in the bottom dead center position.

Note:
The plunger’s bottom dead center position is the smallest reading indicated by the dial gauge needle.

(8) Zero the dial gauge.

Advice
Test oil will flow from the measuring device’s spill pipe. Prepare a container.

(9) Slowly rotate the pump test bench’s flywheel in the specified direction of rotation using the lever. Read the dial gauge indication (i.e., the pre-stroke) when test oil stops flowing from the measuring device’s spill pipe.

**CAUTION**

Remove the lever after operating the flywheel.
Operating the pump test bench with the lever in place can result in bodily injury or pump test bench damage.

(10) If pre-stroke is not as specified, replace the shim to adjust the ‘K’ dimension. (Refer to the COVEC-F Service Manual, Publication No. EE14E-11102, pages 40 to 42 for ‘K’ dimension measurement.)

1. Remove the dial gauge and the measuring device.
2. Remove the plug.

3. Connect the pump chamber pressure measurement hose, the overflow measurement hose, the temperature sensor cable, and the multiway cock to the injection pump. (Refer to page 10 for the fuel piping.)
4. Connect the injection system piping to the injection pump. (Refer to page 9 for the injection system piping.)

5. Reconfirm that the coupling and the fixing stand bolts and nuts are securely tightened.
6. Attach the measuring device to the injection pump. (The measuring device cannot be seen in the figure at left.)

<table>
<thead>
<tr>
<th>Tool name</th>
<th>Part no.</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Measuring device</td>
<td>105782-8260</td>
<td></td>
</tr>
</tbody>
</table>

7. Set the 20NP pump test bench test oil overflow temperature at 45°C.
[6] Part number input and installation confirmation

(1) Select the Inspection/adjustment button (Mazda: ‘ROM COVEC-F [MAZDA 12V] Inspection/adjustment’; Mitsubishi: ‘ROM COVEC-F [MITSUBISHI 12V] Inspection/adjustment’).

(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) Select ‘1. Injection system piping.’

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.
[7] Warming-up operation

(1) Set the pump test bench delivery pressure at the specified 20 kPa (0.2 kgf/cm²).
(2) Confirm that the sequence is 01/28.
(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:
Uα ist is displayed automatically.
(5) Confirm that the Step status field is green.
(6) Proceed to the next step.

Advice
• If Uα ist values are not as specified, press the ‘Next’ button several times. Then, return to Step 01/28 using the back arrow. Repeat the Step 01/28 and confirm that Uα ist values are as specified.

Note:
If not as specified after confirming Uα ist several times, the GE may be faulty.

(7) Confirm that the sequence is 02/28.
(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:
Uα 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.
[8] **Pump chamber pressure adjustment**

1. Confirm that the sequence is 03/28.
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 α i st and T f are displayed automatically.
   - If Pt is as specified, perform steps (8) and (9) below. If Pt is not as specified, adjust as described below.

When the pump chamber pressure exceeds the specifications

- Stop the pump test bench and remove the regulating valve.
- Remove the spring ring using the pliers, then remove the piston and spring.

<table>
<thead>
<tr>
<th>Tool name</th>
<th>Part no.</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pliers</td>
<td>157829-2920</td>
<td></td>
</tr>
</tbody>
</table>

- Push the plug out to the end of the regulating valve using the pushrod.

<table>
<thead>
<tr>
<th>Tool name</th>
<th>Part no.</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pushrod</td>
<td>157829-5300</td>
<td></td>
</tr>
</tbody>
</table>

**Note:**
- The pushrod (157829-5300) is part of the inserter (157829-5220).
- Insert the spring and piston into the regulating valve.
- Press fit a new spring ring into the regulating valve using the holder and a hammer.

<table>
<thead>
<tr>
<th>Part name</th>
<th>Part no.</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spring ring</td>
<td>146114-0000 (9 461 610 094)</td>
<td></td>
</tr>
</tbody>
</table>

**Note:**
- The holder (157829-5200) is part of the inserter (157829-5220).
• Screw the regulating valve into the pump housing and tighten it to the specified torque using the socket wrench.

**Specified torque:** 11.0 ~ 13.0 N.m

{1.1 ~ 1.3 kgf.m}

<table>
<thead>
<tr>
<th>Tool name</th>
<th>Part no.</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Socket wrench</td>
<td>157913-7000</td>
<td></td>
</tr>
</tbody>
</table>

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.**

(5) While reading the pump chamber pressure, adjust to within specifications using the adjusting device.

<table>
<thead>
<tr>
<th>Tool name</th>
<th>Part no.</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adjusting device</td>
<td>157829-0820</td>
<td></td>
</tr>
</tbody>
</table>

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

**Advice**
**If the overflow quantity is not as specified after confirming pump chamber pressure, check the overflow valve.**
[9] TPS zero setting

(1) Confirm that the sequence is 04/28.
(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:
Uα 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) below. If the TPS is not as specified, replace the TPS standard point shim to adjust the TPS initial output.

Note:
• For pumps for Mazda WL engines, a TPS standard point shim with a thickness of 0.6 mm is assembled as standard.

<table>
<thead>
<tr>
<th>Shim part no.</th>
<th>Thickness</th>
<th>Outer dia, inner dia</th>
</tr>
</thead>
<tbody>
<tr>
<td>146603-0700</td>
<td>0.6</td>
<td>17.5, 7.5</td>
</tr>
</tbody>
</table>

• For pumps for Mitsubishi 4D56 engines, select shims from the table below.

<table>
<thead>
<tr>
<th>Shim part no</th>
<th>Thickness (mm)</th>
<th>Shim part no</th>
<th>Thickness (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>146603-0700 (9 461 610 447)</td>
<td>0.6</td>
<td>146603-1000 (9 461 610 450)</td>
<td>1.0</td>
</tr>
<tr>
<td>146603-0800 (9 461 610 448)</td>
<td>0.7</td>
<td>146603-1100 (9 461 610 451)</td>
<td>1.2</td>
</tr>
<tr>
<td>146603-0900 (9 461 610 449)</td>
<td>0.9</td>
<td>146603-3600 (9 461 610 452)</td>
<td>2.4</td>
</tr>
</tbody>
</table>

(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.
[10] **Timer stroke adjustment and characteristic confirmation**

1. Confirm that the sequence is 05/28.
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.
4. Measure TA from the measuring device and input the value.

**Note:**

U_α_ist and VTPS are displayed automatically.

5. If the timer stroke TA is not as specified, replace the timer stroke adjusting shim until the timer stroke is as specified.
6. Measure N, T and Pt on the pump test bench and input the values.
7. Measure TA from the measuring device and input the value.
8. Confirm that the timer stroke is as specified.
9. Confirm that the pump chamber pressure is as specified.
10. Confirm that the Step status field is green.
11. Proceed to the next step.

---

<table>
<thead>
<tr>
<th>Shim part no</th>
<th>Thness (mm)</th>
<th>Shim part no</th>
<th>Thness (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>146603-0700</td>
<td>0.6</td>
<td>146603-1000</td>
<td>1.0</td>
</tr>
<tr>
<td>(9 461 610 447)</td>
<td></td>
<td>(9 461 610 450)</td>
<td></td>
</tr>
<tr>
<td>146603-0800</td>
<td>0.7</td>
<td>146603-1100</td>
<td>1.2</td>
</tr>
<tr>
<td>(9 461 610 448)</td>
<td></td>
<td>(9 461 610 451)</td>
<td></td>
</tr>
<tr>
<td>146603-0900</td>
<td>0.9</td>
<td>146603-3600</td>
<td>2.4</td>
</tr>
<tr>
<td>(9 461 610 449)</td>
<td></td>
<td>(9 461 610 452)</td>
<td></td>
</tr>
</tbody>
</table>

(6) Measure N, T and Pt on the pump test bench and input the values.
(7) Measure TA from the measuring device and input the value.
(8) Confirm that the timer stroke is as specified.
(9) Confirm that the pump chamber pressure is as specified.
(10) Confirm that the Step status field is green.
(11) Proceed to the next step.

---


1. Confirm that the sequence is 06/28.
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_α_ist and TF are displayed automatically.

4. Confirm the overflow quantity.
5. Confirm that the Step status field is green.
6. Proceed to the next step.
[12] **Standard injection quantity point adjustment**

1. Confirm that the sequence is 07/28.
2. Run the injection pump at the specified speed N (see figure at left).
3. Measure N, T, Q and DQ (ΔQ) on the pump test bench and input the values.

Note:
U α ist is displayed automatically.

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

5. To adjust the fuel injection quantity, loosen the torx screws 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 screws to the specified torque.

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

8. Measure N, T, Q and DQ (ΔQ) 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.

[13] **Injection quantity compensation pre-confirmation**

1. Confirm that the sequence is 08/28.
2. Run the injection pump at the specified speed N (see figure at left).
3. Measure N, T, Q and DQ (ΔQ) on the pump test bench and input the values.

Note:
U α ist is displayed automatically.

4. Confirm that the Step status field is green.

5. Proceed to the next step.
[14] Magnet valve operation confirmation
(1) Confirm that the sequence is 10/28.
(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: $U_{\alpha \text{ ist}}$ 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.

[15] Timer stroke confirmation
(1) Confirm that the sequence is 12/28.
(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.
(4) Measure TA from the measuring device and input the value.
Note: $U_{\alpha \text{ ist}}$ and VTPS are displayed automatically.
(5) Confirm that the timer stroke is as specified.
(6) Confirm that the Step status field is green.
(7) Proceed to the next step.
Confirm 350 revolutions (Step 13/28) ~ 2,200 revolutions (Step 15/28) using the same procedure used for 100 revolutions (Step 12/28) above.

Advice
Repeat Step 04/28 if the timer stroke is not as specified.

[16] TPS confirmation
(1) Confirm that the sequence is 16/28.
(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) Confirm that the TPS value is within the specified range.
Note:
VTPS is the voltage value for when the timer piston is in the full stroke position.
(5) Confirm that the Step status field is green.
(6) Proceed to the next step.
[17] Injection quantity compensation point adjustment

1. Confirm that the sequence is 17/28.
2. Run the injection pump at the specified speed N (see figure at left).
3. Measure N, T, Q and DQ (ΔQ) on the pump test bench and input the values.

Note:

U α 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 (a plus is not necessary).

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

Adjust compensation point 2 (Step 18/28) ~ compensation point 10 (Step 26/28) using the same procedure used for compensation point 1 (Step 17/28) above.

1. After adjusting the compensation point 1, press the ‘Next’ button to automatically proceed to Step 27/28.

[18] Compensation ROM interpolation calculation

Note:
In Step 27/28 the adjustment software automatically performs the calculations.

Advice
If the compensation voltage Soll values are not correct, compensation calculations are not performed and an error message is displayed. If an error message is displayed, repeat Step 17/28.
[19] Writing to the compensation ROM
(1) Press Step 27/28 to automatically display the step 28/28.
(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.

[20] Printing the adjustment result and saving the data
(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.
The following describes inspection of the COVEC-F pump for Mazda WL engines. For Mitsubishi 4D56 engines, the inspection sequence, the wiring harnesses and connections, and the ECU assembly used differ from those of Mazda engines. The details of the inspection procedures, however, are the same. Refer to page 11 for the wiring outline for Mitsubishi 4D56 engines.

**Inspection sequence**

1. **Recording the pump and GE serial numbers**  
   See page 41 [1]
2. **Preparation (including inspection software)**  
   See page 41 [2], 42 [3]
3. **Part no. input and installation confirmation**  
   See page 43 [4]
4. **Warming-up operation**  
   See page 44 [5]
5. **TPS confirmation**  
   See page 45 [6]
6. **Pump chamber pressure confirmation**  
   See page 45 [7]
7. **Overflow operation confirmation**  
   See page 45 [8]
8. **Magnet valve operation confirmation**  
   See page 46 [9]
9. **Timer stroke confirmation**  
   See page 46 [10]
10. **TPS confirmation**  
    See page 47 [11]
11. **Injection quantity confirmation**  
    See page 47 [12]
12. **Inspection result**  
    See page 48 [13]
13. **Finish**
[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 10 for the fuel piping.)

2. Connect the injection system piping to the injection pump. (Refer to page 9 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 11 for the controller assembly’s wiring. The following describes Mazda wiring.)

4. Connect the wire harness to the controller unit’s ECU assembly connector (Mazda: No. 3; Mitsubishi: No. 1).

5. Connect the ROM controller’s wire harness to the intermediate harness.

6. Connect the FCV GND harness to the controller assembly’s wire harness and to earth.

7. 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.

8. 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.
(9) Reconfirm that the coupling and the fixing stand bolts and nuts are securely tightened.

(10) Attach the measuring device to the injection pump.

(11) Set the 20NP pump tester’s test oil outlet temperature at 45°C.

(12) Turn the main switch on the rear of the controller unit ON.

(13) Set the No 1 ~ No 4 changeover switch at the relevant setting (Mazda: No. 3; Mitsubishi: No. 1).

(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

(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 installation confirmation

(1) Select the Inspection/adjustment button (Mazda: ‘ROM COVEC-F [MAZDA 12V] Inspection/adjustment’; Mitsubishi: ‘ROM COVEC-F [MITSUBISHI 12V] Inspection/adjustment’).

(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) Select ‘1. Injection system piping.’

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.
[5] Warming-up operation

(1) Set the pump test bench delivery pressure at the specified 20 kPa (0.2 kgf/cm²).

(2) Confirm that the sequence is 01/25.

(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 01/25 using the back arrow.
Repeat the Step 01/25 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.

(7) Confirm that the sequence is 02/25.

(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] **TPS confirmation**

1. Confirm that the sequence is 03/25.
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:**
- Uα ist, VTPS and TPS are displayed automatically.

4. Push the ‘Zero set’ key and confirm that the VTPS value is within the specified range.
5. Confirm that the Step status field is green.
6. Proceed to the next step.

[7] **Pump chamber pressure confirmation**

1. Confirm that the sequence is Step 04/25.
2. Run the injection pump at the specified speed N (see figure at left).
3. Measure N, T, Pt and TA on the pump test bench and input the values.

**Note:**
- Uα ist and VTPS are displayed automatically.

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

[8] **Overflow operation confirmation**

1. Confirm that the sequence is 05/25.
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:**
- Uα 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.
[9] Magnet valve operation confirmation

1. Confirm that the sequence is 06/25.
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: \( U_\alpha \text{ist} \) 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.

[10] Timer stroke confirmation

1. Confirm that the sequence is Step 07/25.
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. Measure TA from the measuring device and input the value.
   Note: \( U_\alpha \text{ist} \) and VTPS 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.
Confirm 350 revolutions (Step 08/25) ~ 2,200 revolutions (Step 14/25) using the same procedure used for 100 revolutions (Step 07/25) above.

(1) Confirm that the sequence is Step 15/25.
(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.
(5) Confirm that the Step status field is green.
(6) Proceed to the next step.

[12] Injection quantity confirmation
(1) Confirm that the sequence is Step 16/25.
(2) Run the injection pump at the specified speed N (see figure at left).
(3) Measure N, T, Q and DQ (ΔQ) on the pump test bench and input the values.

Note:
U α ist is displayed automatically.
Advice
Do not perform injection quantity adjustment.
(4) Confirm that the Step status field is green.
(5) Proceed to the next step.

Confirm compensation point 2 (Step 17/25) ~ compensation point 10 (Step 25/25) using the same procedure used for compensation point 1 (Step 16/25) above.
[13] 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.
TIGHTENING TORQUES

Units: N·m (kgf·m)

- SW14
  T = 44 ~ 54 (4.5 ~ 5.5)

- SW10
  T = 6 ~ 9 (0.6 ~ 0.9)

- SW21
  T = 20 ~ 25 (2.0 ~ 2.5)

- SW17
  T = 20 ~ 29 (2.0 ~ 3.0)

- SW12
  T = 6 ~ 9 (0.6 ~ 0.9)

- WL:
  T = 14 ~ 20 (1.4 ~ 2.0)

- 4D56:
  T = 20 ~ 26 (2.0 ~ 2.7)

P-COVR-279
### 1. INJECTION PUMP ASSEMBLY NUMBER

<p>| | | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0</td>
<td>4</td>
<td>7</td>
<td></td>
</tr>
</tbody>
</table>

(1): VE type injection pump  
(2): Number of cylinders  
0 → 4 cylinders  
1 → 6 cylinders  
(3): Number of plungers - diameter  
8 → φ8  
9 → φ9  
0 → φ10  
5 → φ11  
(4): Proper number  
(5): Suffix

### 2. BOSCH TYPE NUMBER

<p>| | | | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>NP</td>
<td>VE</td>
<td></td>
<td></td>
<td></td>
<td>R</td>
</tr>
</tbody>
</table>

(1): Manufactured by Bosch Automotive Systems Corporation  
(2): VE type injection pump  
(3): Number of cylinders  
(4): Plunger diameter  
(5): E Electronic governor  
F Mechanical 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