COMMON RAIL
(Delphi)

Chonan Technical Service Training Center
Fuel System
Common Rail System
Common Rail System
Common Rail System

- Brake switch
- Accelerator pedal sensor
- Clutch switch
- Air cleaner
- Mass air flow sensor and air temp. sensor
- Air intercooler
- Vacuum pump
- EGR proportional valve
- EGR valve
- LP pump
- Injector
- Linear rail
- Cam sensor
- Turbo charger
- Water temp. sensor
- Engine speed sensor
- Electronic control unit

- Fuel tank
- Fuel filter
- Check engine lamp
- Pre-post heat lamp
- Anti-theft lamp

- Main supply relay
- AC comp. relay
- AC fan relay
- Heater fan relays
- Air heater relays
- Water heater relays
- Auto gearbox ECU
- Anti-theft (Smartra)
- Vehicle speed sensor

Diesel injection main Components
High Pressure Pump

Transfer pressure regulation valve
LP supply
Venturi
Pressure limiter

Diesel oil temperature sensor
IMV
HP outlet (to the rail)
### High Pressure Pump

<table>
<thead>
<tr>
<th>Number</th>
<th>Component</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Inlet Metering Valve(IMV)</td>
</tr>
<tr>
<td>2</td>
<td>Hydraulic Head</td>
</tr>
<tr>
<td>3</td>
<td>Plunger</td>
</tr>
<tr>
<td>4</td>
<td>Drive Shaft + Cam Ring</td>
</tr>
<tr>
<td>5</td>
<td>Housing</td>
</tr>
<tr>
<td>6</td>
<td>Roller + Shoe</td>
</tr>
<tr>
<td>7</td>
<td>Transfer Pressure Pump</td>
</tr>
<tr>
<td>8</td>
<td>Temperature Sensor</td>
</tr>
<tr>
<td>9</td>
<td>Venting</td>
</tr>
<tr>
<td>10</td>
<td>Outlet High Pressure Flange</td>
</tr>
<tr>
<td>11</td>
<td>Transfer Pressure Regulator</td>
</tr>
</tbody>
</table>
High Pressure Pump
High Pressure Pump

Diagram showing the flow of fluids through a high pressure pump system, with labels indicating different pressure states and components such as lift pump, high pressure pump, venturi, and back leaks to the tank.
High Pressure Pump
Low Pressure (Feed) Pump of High Pressure Pump
Common Rail (Linear Rail)
Common Rail (Linear Rail)
Common Rail (Linear Rail)
High Pressure Pipes

1. 4 HP pipes rail / injector

2. 1 HP pipe pump / rail

If the Injector or main rail feed pipes are removed they MUST BE REPLACED WITH NEW
Injector
Injector Operation (Phase 1)

Valve Closed (Phase 1)

- Force = Pressure x Surface
- Closed

- NO INJECTION
- phase 1
- phase 2
- phase 3
- phase 4
Injector Operation (Phase 2)

FUEL DISCHARGE

Phase 1

Phase 2

Phase 3

Phase 4

Valve Open

Nozzle Closed

Force $= \text{Pressure} \times \text{Surface}$

When

Opening

HYUNDAI Service Training
Injector Operation (Phase 3)

Fuel Discharge

\[
\text{Force} = \text{pressure} \times \text{SURFACE}
\]

\[
\text{Force} = \text{PRESSURE} \times \text{SURFACE}
\]

Phase 1  Phase 2  Phase 3  Phase 4
Injector Operation (Phase 4)

END OF INJECTION

Force = PRESSURE x SURFACE

HOW CAN THE NOZZLE BE CLOSED?
Calibration Individual Injector

CII for A/S

CII for production
1.9. INDIVIDUAL INJECTOR CORRECTION

INJECTOR WRITE MODE
* CONDITION: IG . ON
* METHOD
1. BARCODE 1ST
   1 => INJ1, 2 => INJ2, 3 => INJ3,
   4 => INJ4

Selection of Injector to change CII

To display Current CII

To erase Current CII

INJ1  INJ2  INJ3  INJ4  INFO  CLR

* CII : Calibration Individual Injector
1.9. INDIVIDUAL INJECTOR CORRECTION

| INJECTOR 1 | A8 39 D3 DA B5 AD 6E AC |
| INJECTOR 2 | 4C 3E 24 60 3E 09 F1 8E |
| INJECTOR 3 | 84 39 DD 60 41 D2 30 30 |
| INJECTOR 4 | 7C 3D A3 DF BE 25 D2 0E |
Cleared(Default Value)

1.9. INDIVIDUAL INJECTOR CORRECTION

| INJECTOR 1 | 30 42 04 20 42 02 10 10 |
| INJECTOR 2 | 30 42 04 20 42 02 10 10 |
| INJECTOR 3 | 30 42 04 20 42 02 10 10 |
| INJECTOR 4 | 30 42 04 20 42 02 10 10 |

If CII is cleared from ECM
- DTC(P1300 INJECTOR CORRECTION DATA) is set
- Failsafe mode and fixed 1250rpm
- No acceleration
- Check engine lamp “on”
1.9. INDIVIDUAL INJECTOR CORRECTION

INJECTOR 1

READ ECU DATA

<<<< A8 39 D3 DA B5 AD 6E AC >>>>

2. BARCODE DATA 2ND ~ 17TH INPUT

, AND [ENTER] KEY
1.9. INDIVIDUAL INJECTOR CORRECTION

INJECTOR 2

READ ECU DATA
<<<< 4C 3E 24 60 3E 09 F1 8E >>>>

2. BARCODE DATA 2ND ~ 17TH INPUT
   , AND [ENTER] KEY
1.9. INDIVIDUAL INJECTOR CORRECTION

INJECTOR 3

READ ECU DATA

<<<< 84 39 DD 60 41 D2 30 30 >>>>

2. BARCODE DATA 2ND ~ 17TH INPUT
   , AND [ENTER] KEY
1.9. INDIVIDUAL INJECTOR CORRECTION

INJECTOR 4

READ ECU DATA
<<<<< 7C 3D A3 DF BE 25 D2 0E >>>>

2. BARCODE DATA 2ND ~ 17TH INPUT
, AND [ENTER] KEY
1.9. INDIVIDUAL INJECTOR CORRECTION

INJECTOR 4

READ ECU DATA
<<<< 30 42 04 20 42 02 10 10 >>>>

2. BARCODE DATA 2ND ~ 17TH INPUT
, AND [ENTER] KEY

7C3DA3DFBE

Ignition ON, Engine Stop
The correction is impossible on Engine Running Condition
ECM

Connection
Input / Output

AFS
Accelerator pedal sensor
CMP sensor
CKP sensor
Rail Pressure sensor
Knock sensor (Accelerometer)
Fuel Temperature sensor
ECT sensor
IAT sensor
Vehicle Speed sensor
Brake switch
Clutch switch (M/T)
A/C switch
A/C Pressure sensor

ECM

Main Relay
Injector
Cooling Fan control
Air Heater
EGR Valve
MIL lamp
Inlet Metering Valve
IMV (Inlet Metering Valve)
IMV (Inlet Metering Valve)
Fuel Temperature Sensor
Venturi
Auxiliary
Air Intake Heater

- Air Intake heater
- Air Intake manifold
Air Intake Heater

Heater element
Air Intake Heater

Battery voltage
Coolant temperature
Flow requested
Engine speed
Atmospheric pressure

ECM

Preheating warning light
Preheating resistors
AH control relay

+Bat
+AC
Air Intake Heater

Pre-heating

**Variable preheating**

<table>
<thead>
<tr>
<th>Engine coolant temperature (°C)</th>
<th>-30</th>
<th>-25</th>
<th>-20</th>
<th>-15</th>
<th>-10</th>
<th>-5</th>
<th>0</th>
<th>20</th>
</tr>
</thead>
<tbody>
<tr>
<td>Illumination (s)</td>
<td>28</td>
<td>25</td>
<td>15</td>
<td>10</td>
<td>5</td>
<td>3</td>
<td>2</td>
<td>0</td>
</tr>
</tbody>
</table>

**Fixed preheating**

This begins when the preheating warning light extinguishes. During this second phase, the preheating resistors remain supplied for 5 seconds.

Post-heating

<table>
<thead>
<tr>
<th>Coolant temperature (°C)</th>
<th>-20</th>
<th>-10</th>
<th>0</th>
<th>20</th>
<th>80</th>
</tr>
</thead>
<tbody>
<tr>
<td>Duration of post-heating (s)</td>
<td>100</td>
<td>50</td>
<td>25</td>
<td>10</td>
<td>10</td>
</tr>
</tbody>
</table>
Exhaust Gas Return (EGR)

- EGR Valve
- Solenoid Valve
EGR Cooler (Heat Exchanger)
Mass Air Flow Sensor

Direct installation at the air cleaner housing
without additional intake duct

* Space saving installation
* Little sensitivity to disturbed flow by using a combined flow straightener
* High precision (plug-in module is trimmed in the metering tube)
* Cost optimized design (minimum number of parts)
Mass Air Flow Sensor

- Hybrid cover
- Metering duct
- Hybrid SHF
- Sensor Chip CMF
- Sheet metal
- Plug-in sensor
- O-Ring
- Temperature sensor
Fuel Heater

- Priming pump
- Fuel heater
- Fuel filter

Outlet
Inlet
Priming Pump

From fuel tank
To fuel filter
From fuel tank
Accelerator Pedal Position Sensor
Fuel Filter

Fuel Input (from the fuel tank)

Fuel Input (back leakage from the pump and injector)

Fuel Output (to the HP pump)

BACKLEAK (to the fuel tank)

DRAIN screw
Fuel Filter (Recirculation)
Fuel Filter

- Bi-metal strip
- Steel ball
Handling
Safety Instructions

It is strictly prohibited to smoke or to eat while working on the Common Rail injection system.

It is essential to disconnect the battery before any work is done on the Common Rail injection system.

**It is strictly forbidden to work on the Common Rail injection system with the engine running.**

It is necessary to read the value of the rail pressure and of the diesel oil temperature with the engine running.

It is necessary to read the value of the rail pressure and of the diesel oil temperature with the aid of the diagnostic tool before any work is done on the fuel circuit. The opening of the circuit can only begin if the diesel oil temperature is less than 50°C (122 °F) and the rail pressure is close to 0 bar. If it is not possible to communicate with the computer, wait for 5 minutes after the engine has stopped before starting any work on the fuel circuit.
Safety Instructions

It is strictly prohibited to supply an actuator directly off an external power supply.

The injector must not be dismantled.

The HP sensor must not be removed from the rail. If the HP sensor fails, it is essential to replace the complete rail.

The IMV, the diesel temperature sensor and the venturi must not be removed from the pump. If one of these components is faulty, the whole pump must be replaced.

The HP pipes are not reusable: a removed pipe must be replaced.

Decarbonizing the injector in an ultrasonic bath is strictly prohibited. The computer’s metal casing must never be used as an earth.

The packaging of the spare parts should be opened just before they are used. Moreover, the sealing plugs must not be removed until the final connection is made. The plugs and the sealed pouches must be discarded after use.
Removal a rail/injector pipe(rail/HP pump)

1. Clean the nuts of the HP unions with a solvent (CARCLEAN type) applied with a clean brush.

2. Vacuum the particles with the aid of a ‘BLOVAC BV11’ type suction device(Figure4).
Removal a rail/injector pipe(rail/HP pump)

3. Disconnect the injector with the aid of pliers, applying pressure to the locking clips on the side of the connector.
4. Slacken the nut screwed onto the injector using a 17 mm (0.67 in) open wrench (Figure 4).

5. Slacken the nut screwed onto the rail using a 17 mm (0.67 in) open wrench (Figure 5).

* Notice
It is important to position the wrench level with the solid end of the nut, in order to apply the stresses to the strongest part of the nut. If the torque is applied to the open end of the nut, there is a risk of distortion of the nut when it is tightened. Or use a pipe-wrench with cloth.
6. Move the nut along the pipe, keeping the olive in contact with the injector cone (Figure 6) and vacuum the particles in the contact area between the olive and the cone, using a pneumatic suction device.

7. Carry out the same operation on the rail side.

8. Remove the pipe and vacuum the particles inside the injector cone with the aid of the pneumatic suction device (Figure 7).
Removal a rail/injector pipe (rail/HP pump)

9. Carry out the same operation on the rail side.

10. Immediately seal the HP outlets with the aid of the recommended plugs (Figure 8).
Assembly a rail/injector pipe (rail/HP pump)

1. Take the new pipe out of its packing just before fitting it.

* WARNING
IT IS FORBIDDEN TO RE-USE AN OLD PIPE.

2. Remove the plug inserted at each end of pipe.

3. Lubricate the threads of the nuts with the lubricant supplied in the kit before fitting the pip (Figure 9).

4. Remove the protective plugs from the HP outlets of the rail and the injector.

* WARNING
THE PLUGS MUST BE DISCARDED AFTER USE

5. Fit the pipe olive into the injector cone and the rail cone. Tighten the nut by hand (Figure 10).
Assembly a rail/injector pipe (rail/HP pump)

6. Fit the pipe olive into the rail cone and tighten the nut by hand.

7. Tighten the nut on the injector side to 40 Nm (29.5 lb-ft), applying reverse torque with the support tool for the injector holder (Figure 12).
Assembly a rail/injector pipe (rail/HP pump)

* Notice
When tightening the nut, ensure that the connector remains aligned with the injector row axis (Figure 13).

7. Tighten the nut on the rail side to a torque of 40 Nm(29.5 lb-ft)

ESSNTIAL
To validate the repair, start the engine and check the tightness of the HP connection.
Injector holder-removal

1. Remove the HP pipe of the injector being removed (following the method indicated in refer to page).

2. Disconnect the injector connector

3. Disconnect the injector leakage return hose(Figure2).

4. Slacken off the flange of the injector holder(Figure3).

5. Remove the injector with the flange and its bolts.
   Use a special tool if the injector is stuck.
Assembly of injector holder

1. Clean the socket of the injector holder and vacuum the particles using the pneumatic suction device (Figure 5).

2. Clean the flange of the injector holder with solvent (CARCLEAN type) using a clean brush.

3. Place a new heat protection washer on the seat of the injector holder.
   * WARNING
   IT IS PROHIBITED TO RE-USE AN OLD HEAT PROTECTION WASHER!

4. Fit the injector holder with its flange.

5. Tighten the injector holder flange bolt to a torque of 19 Nm (14.01 lb-ft) (Figure 6).

6. Reconnect the return hose of the injector holder. Reconnect the injector connector.

7. Reassembly the HP pipe, referring to the method described in page.
Delphi Common Rail Cap Kit
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