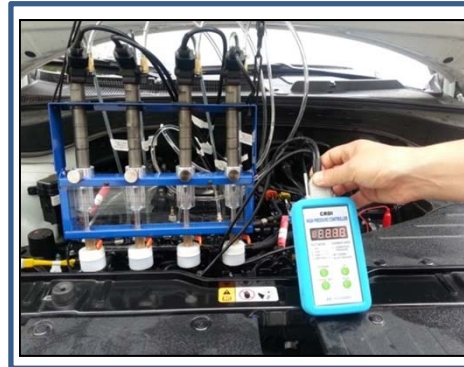


HYUNDAI CIT-3500

Common Rail Injector Tester

User's Manual



A, U, D, J, S, R Engine & U-II, A-II



Digital Controller

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- 1) Diagnostic & Repair procedure of CRDi system
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- 2) Measurement Test of injected-fuel-quantity
- 3) PIEZO Injector Low Fuel Test

1. CIT-3500 Composition

1. 	2. 	3. 	4. 	5. 	6. 	7. 	8. 	9. 
Tool Case	CRDI HIGH PRESSURE CONTROLLER	INJECTOR MESS CYLINDER	TYPE-A PIPE(M12*M12)	TYPE-B PIPE (M12*M14)	TYPE-C PIPE (M14*M14)	TYPE-D PIPE (M14*M14)	BOSCH/DELPHI DUMMY INJECTOR	NEW DELPHI DUMMY INJECTOR
10. 	11. 	12. 	13. 	14. 	15. 	16. 	17. 	18. 
"L" DUMMY INJECTOR & ADAPTER	Engine Compression Gauge	LOW PRESSURE GAUGE	VACUUM GAUGE	BOSCH CONNECTOR	PIEZO CONNECTOR	NEW DELPHI CONNECTOR	RPS BOSCH DUMMY CONNECTOR	RPS NEW DELPHI DUMMY CONNECTOR
19. 	20. 	21. 	22. 	23. 	24. 	25. 	26. 	27. 
DUMMY REGISTER (PRV)	DUMMY REGISTER (HP SENSOR)	BACK LEAK CONNECTOR & ADAPTER	PIEZO RETURN LINE CONNECTOR & ADAPTER	Back Leak Test bottle	LOW PRESSURE GAUGE CONNECTION TUBE	CONNECTION ADAPTER	FUEL FILTER PLUG (For DELPHI)	Connection ADAPTER WITH HOSE
28. 	29. 	30. 	31. 	32. 	33. 			
COMMONRAIL PLUG (FOR BOSCH / M12)	COMMONRAIL PLUG (FOR DELPHI / M14)	DUMMY INJECTOR ADAPTER	Injector Return Line Block Hose	Dust Cap	SPARE PART Kit	User's Manual		

This new Injector Tester has developed in order to improve diagnostic efficiency and accuracy for Common Rail System in the vehicle.

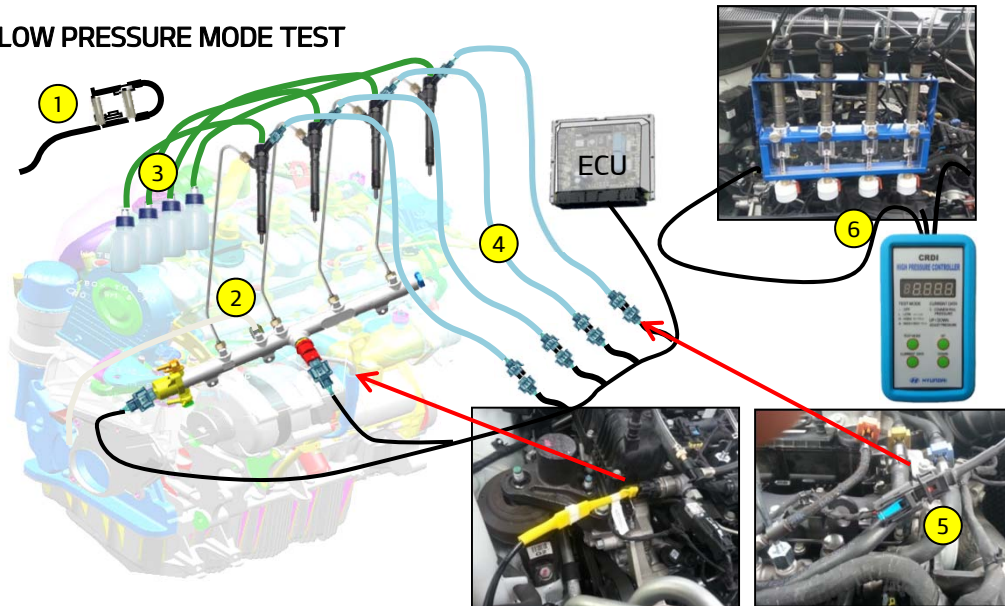
Enables Injection Amount Comparison Test under Low and High fuel pressure conditions that was not possible with GDS/G-Scan .

Also Cylinder compression and Rail pressure regulator test are additionally available.



2-1 INJECTION COMPARISON TEST (LOW PRESSURE MODE)

1) LOW PRESSURE MODE TEST

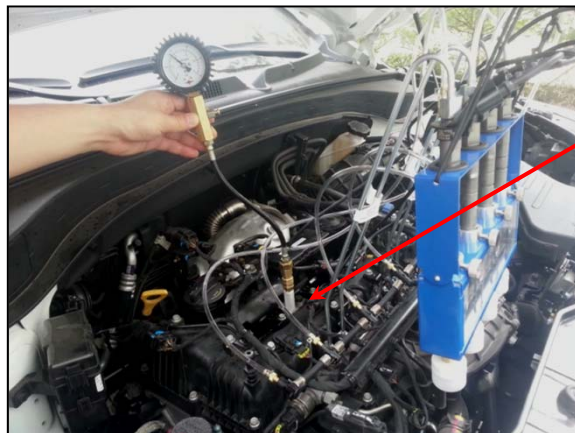


LOW PRESSURE MODE TEST

1. Remove the injectors from the engine
2. ① Block the return line of injectors
3. ② Install the test pipes in the rail (4ea) and Install Test Body in injectors.
4. Install the Back Leak ③ bottle in the Injectors
5. ④ Connect the injector control wire and holding the housing with o-ring.⑤
6. Crank the engine until the injection amount up to the target level.⑥

NOTE :

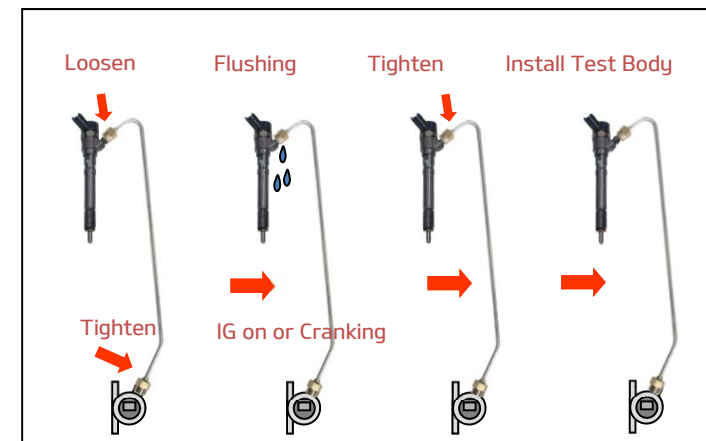
Rail pressure will be maintained 250~350bar automatically by vehicle's ECU. Thus, you don't need to use HP controller during the test.



Remove injectors and install the dummy injectors on the Injector hole. Block the fuel return line of injectors to prevent fuel leaking.



※ All the pipes must be cleaned before installed .
(Clean it with an Air gun)



Flushing : Crank the engine and find the fuel leaks from the fitting area for flushing purpose.

2-2 INJECTION COMPARISON TEST (LOW & HIGH PRESSURE MODE)

1) LOW & HIGH PRESSURE MODE TEST

LOW PRESSURE MODE TEST

- 1) Disconnect the PRV's & rail pressure sensor's connector from the rail
- 2) Install ① Dummy Resistor and ② Rail Pressure Sensor Dummy in each wiring connectors.
- 3) Connect HP controller's wire to the ③PRV & ④ rail pressure sensor.
- 5) Connect HP controller's ⑤ power cable to battery.
- 4) Crank the engine until the injection amount level of 1 or 2 test body are close to target level. (5 scale in LOW, 8 scale in HIGH)

NOTE: Battery must be fully charged before test

NOTE :

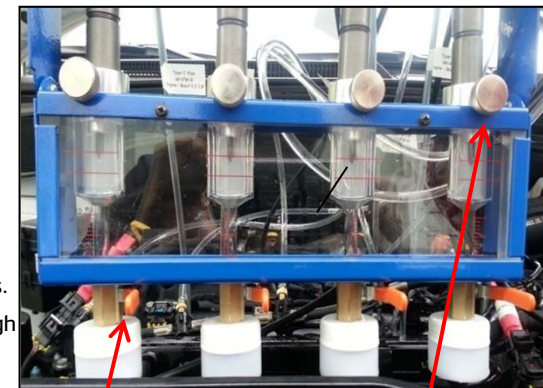
- Rail pressure can be adjusted from 100 to 1000bar by pressure adjust knob.
- In the old model, you must use rail pressure sensor dummy, otherwise injector will not work while cranking.



TEST PROCEDURE

- 1) Select MAX HIGH mode and crank engine for 2-3seconds.
- 2) Crank engine and adjust the rail pressure in Low and High mode while engine cranking.
 - LOW = 250 ~ 350 bar
 - HIGH = 800 ~ 1000 bar

※ Select injection pressure using the up & down button
- 3) Drain the fuel from the test body.
- 4) Perform test for each mode: LOW & HIGH.



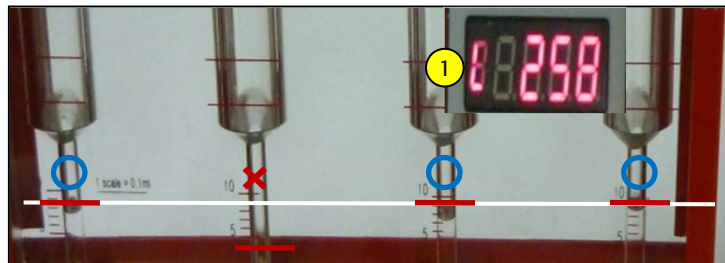
Drain Valve

Injectors Holding screw

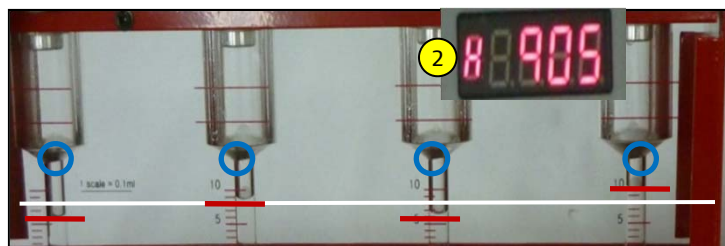
NOTE : Perform the test more than 2 ~ 4 times to get accurate data.

2-3 Test & Diagnostic

LOW PRESSURE MODE JUDGMENT



HIGH PRESSURE MODE JUDGEMENT



Test & Judgment

Crank the engine until the highest level of one or more test tubes are close to targeted level. (① LOW : 5th / ② HIGH : 8th scale)

Judgment will automatically be made once you fill out measured values CRDI diagnosis check sheet in GDS (Global Diagnosis System)

For user who has no GDS

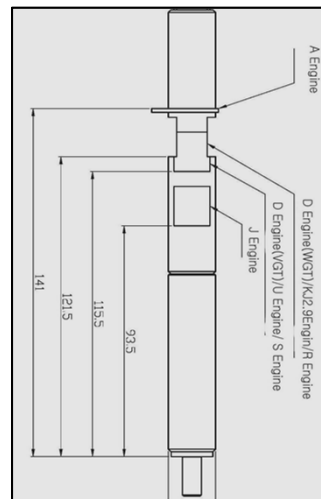
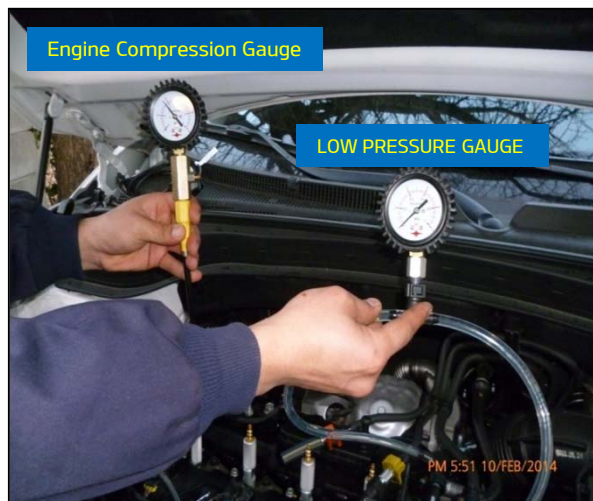
Crank the engine until the injection amount of 2nd largest fuel amount injector is close to target level. (5 scale when low pressure mode, 8 scale when high pressure mode)

Measure the other injector's injection amount and judge as below.

LOW PRESSURE MODE : 0.15 ml (1.5 scale) or higher is normal

HIGH PRESSURE MODE : 0.5 ml (5 scale) or higher is normal

Compression Test



Select the correct groove according to engine type when you install dummy injectors.

Quick coupling on dummy injector will help you to perform cylinder compression test easily and quickly.

Judgments

- Please note that the engine compression standard is showed on the shop manual.

Adapter for New (A-ENG) Injectors



2-4 HOW TO USE CRDI HP DIGITAL CONTROLLER.

◎ USE METHOD

1. Connect the Controller Data link cable(DLC) to the Rail Pressure Sensor(RPS), Pressure Regulator Valve(PRV)
2. Connect the Battery Power on the Controller.
3. Select Mode then, Crank In.

※ **Warning : Electrode should be connected correctly. Reverse connection can cause electric trouble.**

◎ MODE USAGE

1. Selection : Press the TEST MODE Key.
(OFF → LOW → HIGH → MAX-HIGH → HIGH → LOW → OFF)

2. Explanation

- 1) OFF : Controller Run status after Power On.
 - Power off status in the Pressure Regulating Valve.
- 2) LOW : Set the pressure by 250 ~ 350bar.
- 3) HIGH : Set the pressure by 800~1000bar.
- 4) MAX-HIGH : Set the pressure over 1000bar.
 - Particulars adjustment : Press the UP/DOWN button by click.
 - Fast Adjustment : Press the UP/DOWN button continuously.

3. CURRENT DATA

- Monitoring Crank-In pressure by the power on status of Pressure Regulating Valve.
- CURRENT DATA (Use only for the high pressure pump test)
- Run the current data mode without press any other key when start the high pressure pump test.

※**Note : Do not press CURRENT DATA key during the Injection test, It prevented the operation during the test mode.**

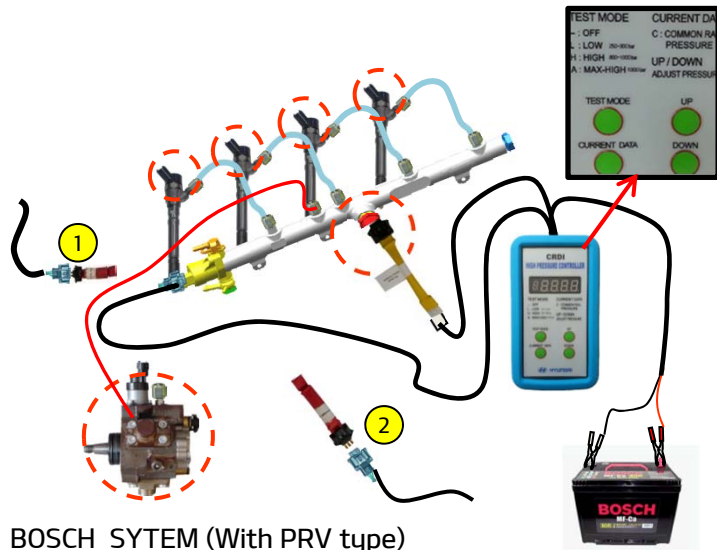
- DATA HOLD FUNCTION : Press the "UP" button in the CURRENT DATA Mode.
(Release : Press any other button in the Data Hold status)

※ **Do not use more 5 minute in the Current mode, otherwise PRV can be damaged by high temperature.**



3-1 HIGH PRESSURE TEST for each system

High pressure test with Injectors (Step 2-1)



BOSCH SYTEM (With PRV type)

Purpose of this test is to check the High pressure pump's and the rail pressure sensor's performance.

TEST PROCEDURE

- Remove the wiring connectors from all injectors.
- Install the HP controller and set the mode switch to **current mode**.
- Install ① PRV Dummy Resistor and ② Rail Pressure Sensor Dummy in each wiring connectors.
- Crank the engine and measure the rail pressure and injector back leak amount.

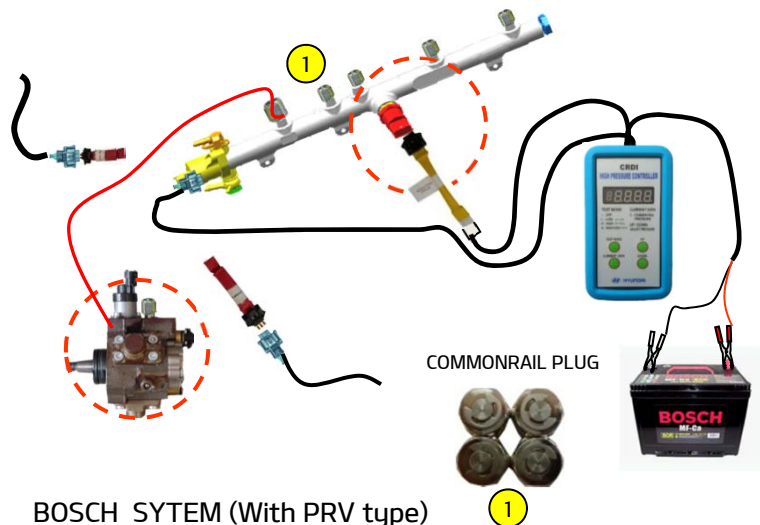
SERVICE SPEC

High pressure : Above 700 bar (with normal Back Leak)
Back Leak : Less than 3 times than minimum amount injector

CHECK POINT (If test is failed)

- Fuel Leak (rail plug or pipes connection)
- PRV (leakage or damaged) & Fuel line
- HP pump (leakage or damaged)

High pressure test without Injectors (Step 2-2)



BOSCH SYTEM (With PRV type)

The Purpose of this test is to confirm the High pressure pump performance or to reconfirm high pressure pump performance when measured value of pressure was lower than 700bar during Step 2-1.

Avoid injector back leak completely by blocking rail outlet.

Test Procedure

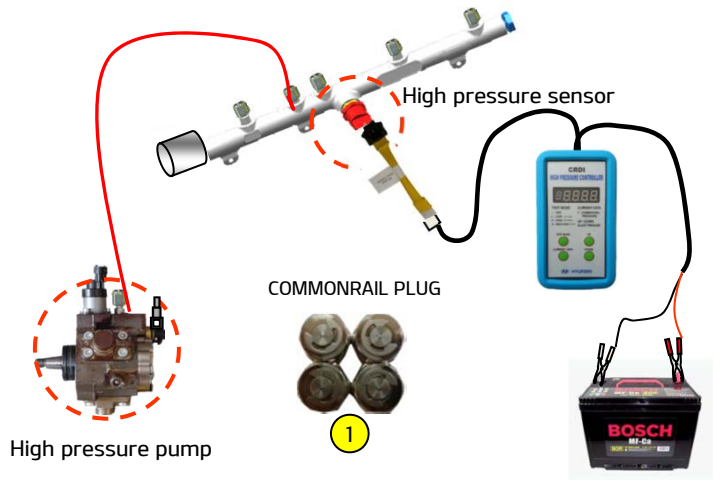
- Remove the Injector pipes from the rail.
- ① Block the rail outlet using rail plug.
- Install the HP controller and set the mode switch to **current mode**.
- Crank the engine and measure the rail pressure.

SERVICE SPEC : Above 700 bar

If measured pressure from Step2-1 was below 700bar and measured pressure from Step2-2 was over 1000bar, the high pressure pump is in good condition. The low pressure (below 700bar) might be read due to too much injector back leak.

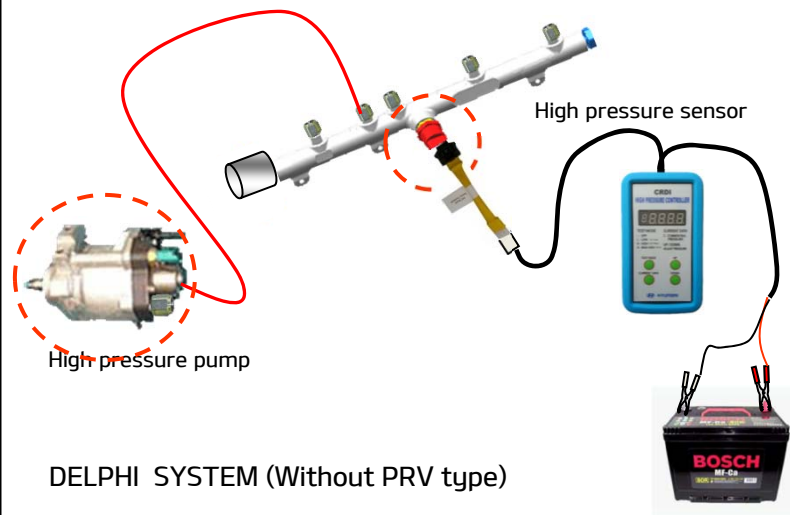
3-2 HIGH PRESSURE TEST for each system

High pressure test without Injectors (Step 2-3)



BOSCH SYTEM (Without PRV type)

High pressure test without Injectors (Step 2-4)



DELPHI SYSTEM (Without PRV type)

Test Procedure

- Remove the injector pipes from the rail
- ① Block the rail outlet using rail plug.
- Install the HP controller and set mode switch to **current mode**.
- Crank the engine and measure rail pressure.

※Refer to the 2-4 page.

SERVICE SPEC

BOSCH : Above 700 bar (With PRV Type)

Above 1000 bar (Without PRV Type)

DELPHI : Above 1000 bar

NOTE :

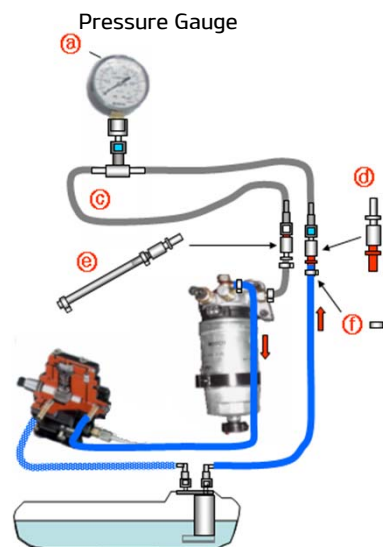
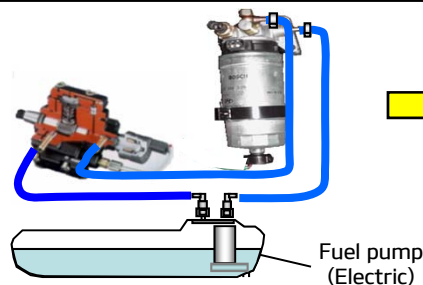
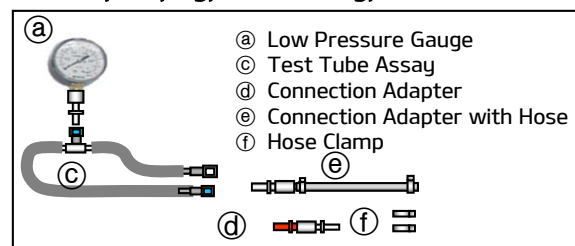
If measured rail pressure value was out of specification check following items.

- Low pressure pump (or suction pump) and its strainer (Including fuel tank)
- High pressure pump and IMV (Inlet Metering Valve)

If the vehicle problem is still persisted while rail pressure value is in specification check whether the fuel pump was contaminated or damaged.

3-3 HIGH PRESSURE TEST for each system

Electric pump type (Bosch Type)



Electric pump type (BOSCH Type)

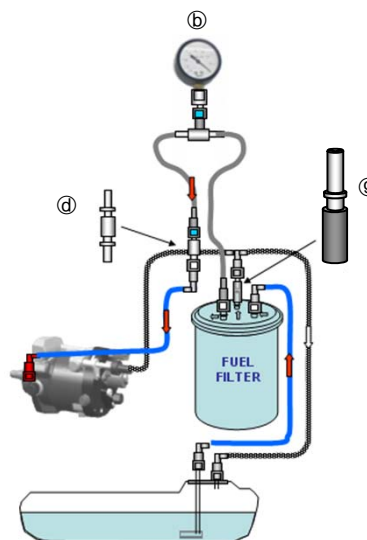
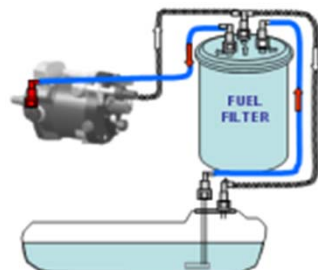
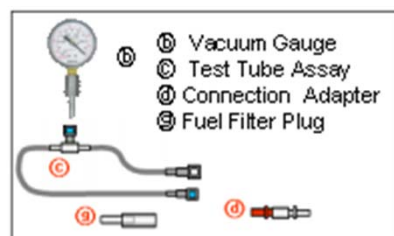
EURO-III model

CASE	PRESSURE (bar)	JUDGMENT
1	1.5~3.5 kg/cm ²	System normal
2	0 ~1.5 kg/cm ²	Fuel Filter (or fuel line / strainer or etc) clogging
3	no pressure	Abnormal function of fuel pump

EURO-IV model

CASE	PRESSURE (bar)	JUDGMENT
1	2.5 ~ 5 kg/cm ²	System normal
2	0.5~2.0 kg/cm ²	Filter or fuel line clogging (pump in good condition)
3	no pressure	Abnormal function of fuel pump

Internal suction pump type (Delphi)



Internal suction pump type (DELPHI Type)

CASE	VACUUM	JUDGMENT
1	10~20 cmHg	System normal (good condition)
2	20~60 cmHg	Filter or fuel line clogging (pump in good condition)
3	0~10 cmHg	Air leak in to the system or Suction pump damage

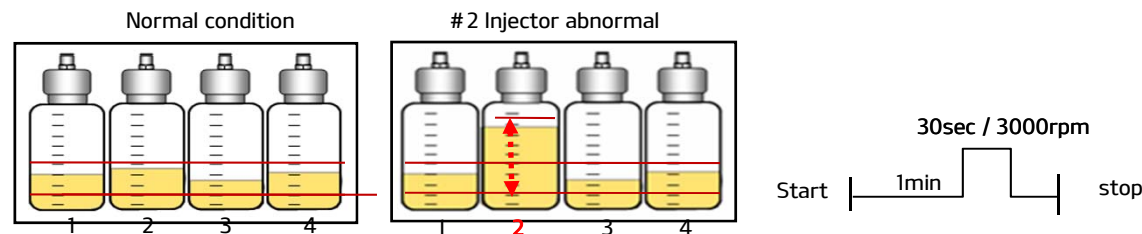
3-4 INJECTOR BACK LEAK TEST(DYNAMIC)

INJECTOR BACK LEAK TEST (DYNAMIC)

- 1) Remove the return hose from each injector and install injector return hose adapter visible tubes, flasks and injector return hose plug referring to Injector back leak test (STATIC) in previous page.
- 2) Conduct the high pressure leak test referring to following explanation.
BOSCH Type I,II,III : D3EA(1.5D-ENG), D4EA(2.0D-ENG), D4FA(U-ENG), D4CB(2.5A-ENG)
- 3) Start engine → 3 minutes at idle → accelerate engine up to 2500 rpm and keep the 2500rpm for 2 minutes → Stop Engine after 2 minutes
- 4) When the test is completed, measure the amount of fuel in each flask
- 5) Judgments

BOSCH Type

Replace the injector which is shown more 3 times than the minimum value.

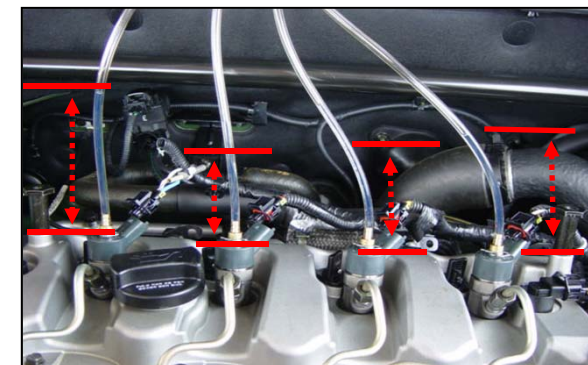
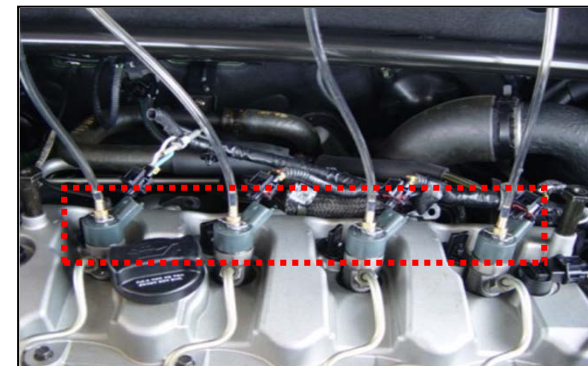
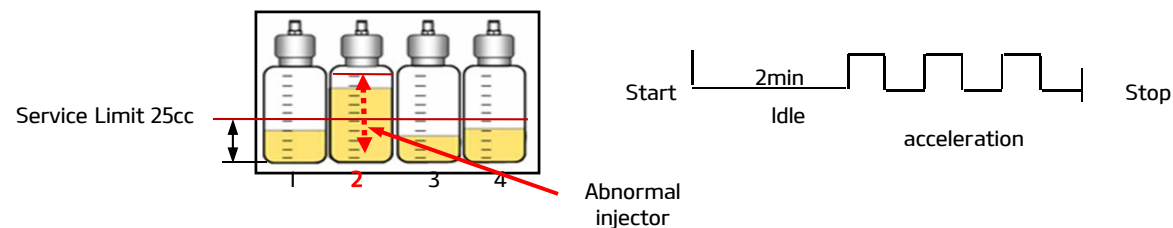


DELPHI Type

- 3) Connect the Hi-Scan and select the 'High Pressure Leak Test' mode.
- 4) Conduct the 'High Pressure Leak Test' until the Hi-Scan finish the test automatically.
or manually : Start engine → 2minutes at idle → 3 times acceleration → Stop Engine
- 5) For the accuracy of the test, perform the test more than twice and select the largest amount as a measured value.
※ The flasks should be empty before the 2nd test started.
- 6) Judgments

DELPHI Type

Replace the injector which indicates exceeds 25cc.



4-1. Diagnostic & Repair procedure of CRDi system

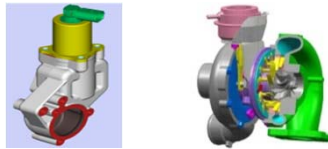
Classify the symptoms

Injector/EGR/TC problem

- Engine Vibration
- Hesitation / jerking
- Smoke emitting



Check the function of
EGR & VGT / WGT system



NG



Repair or
Replace

OK
↓

Test



Cleaning



Test



OK
→

Finish



NG
→

Replace Injector

Fuel line or pump problem

- Engine stall
- Hard start
- Impossible to start
- Fuel pump noise
- DTC set
(related with pressure line)



Check the CRDI line function



Diagnosis by CRT-3500 UP

NG
→



Repair or replace the part
related to problem.

OK
→

Finish



Enter



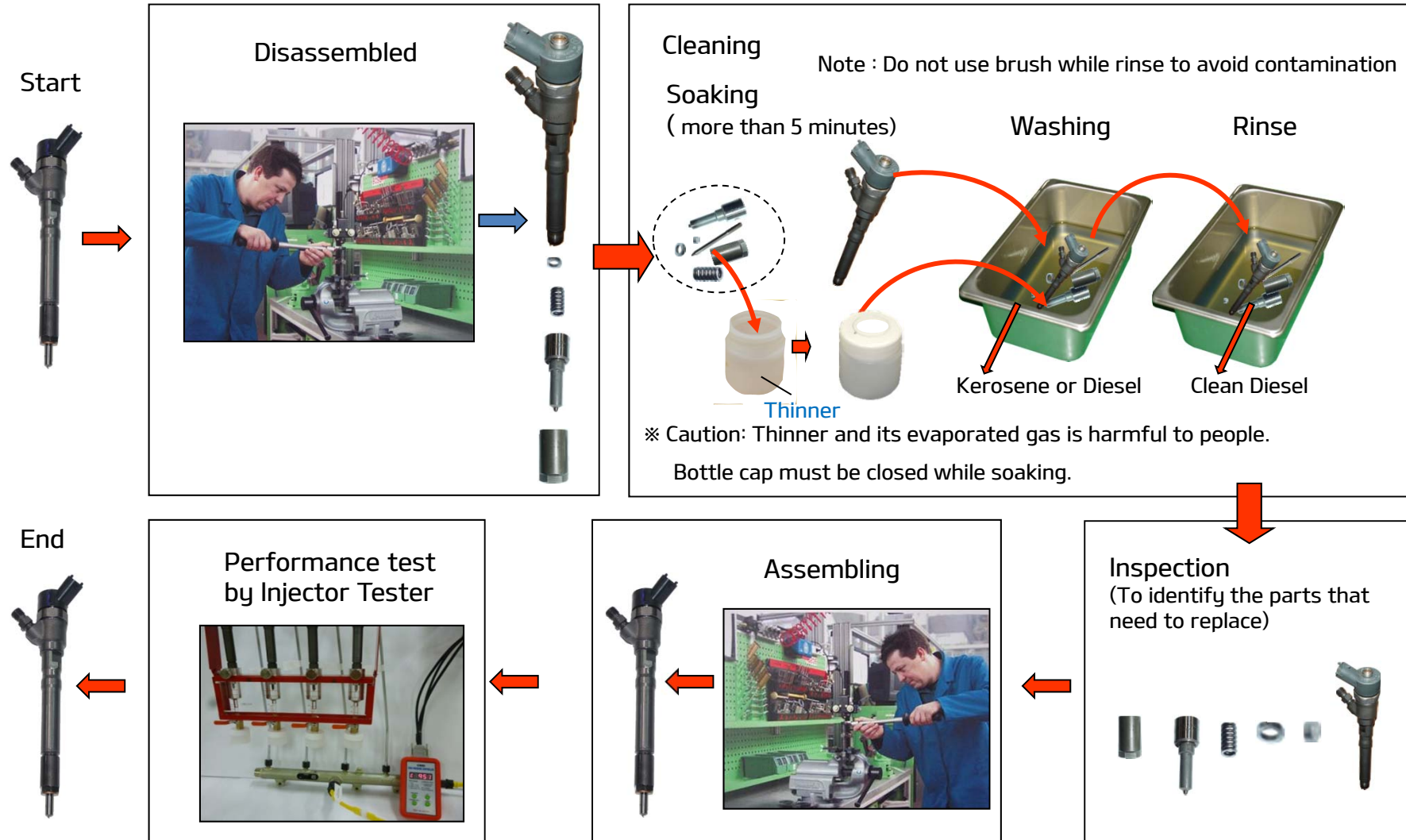
* Injector repairs : Repair injector (replacing internal parts) if it is not recovered after cleaning.

* Replace injector assembly when the internal parts are not available.

4-2. Cleaning procedure of injector

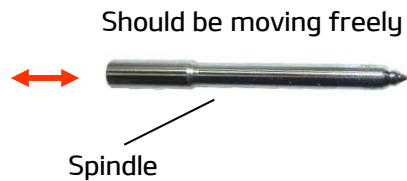
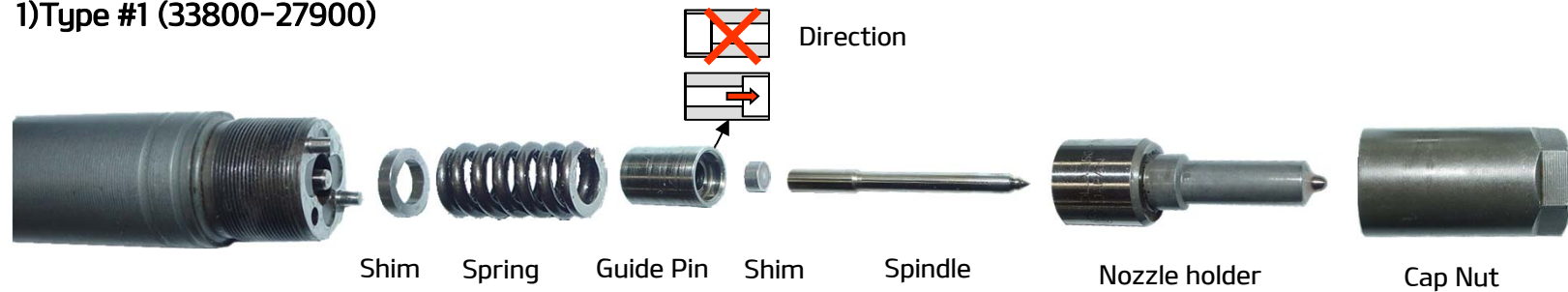
Repairing injector must be done in a clean and dust free environment to prevent injector contamination.

Do not interchange internal parts of injectors as it will influence on its calibration. Use only original parts to maintain the proper performance.



4-3. Injector assembly (Nozzle area)

1) Type #1 (33800-27900)



2) Type #2 (33800-27000)

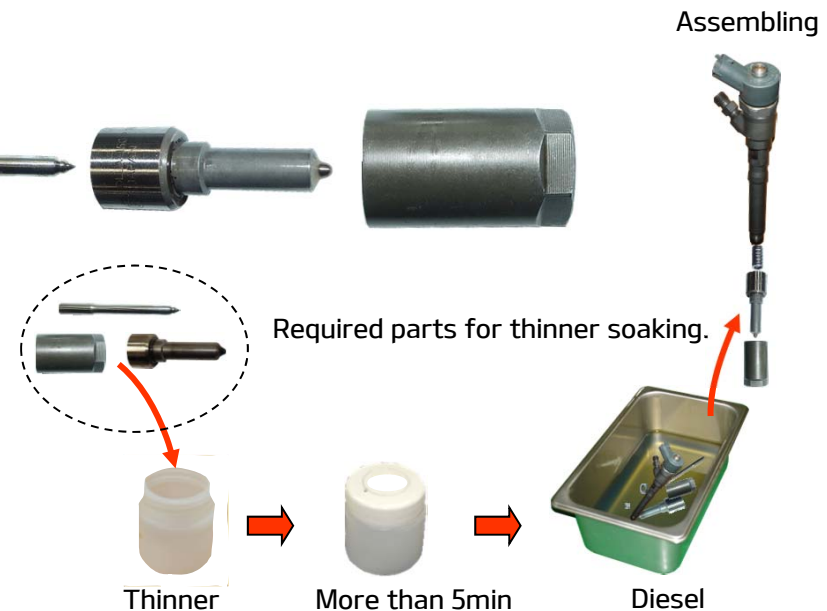


NOTE :

Cap nut must be tighten by Torque wrench.
Over torque will cause to have lack of injection amount while insufficient torque will cause to have fuel leaking or abnormal function.

Tightening Torque : 45N-m

Repairing injector must be done in a clean and dust free environment to prevent injector contamination.



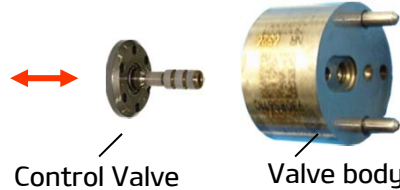
4-4. Injector assembly (Nozzle area)

3) Type #3 (DELPHI)

Repairing injector must be done in a clean and dust free environment to prevent injector contamination.

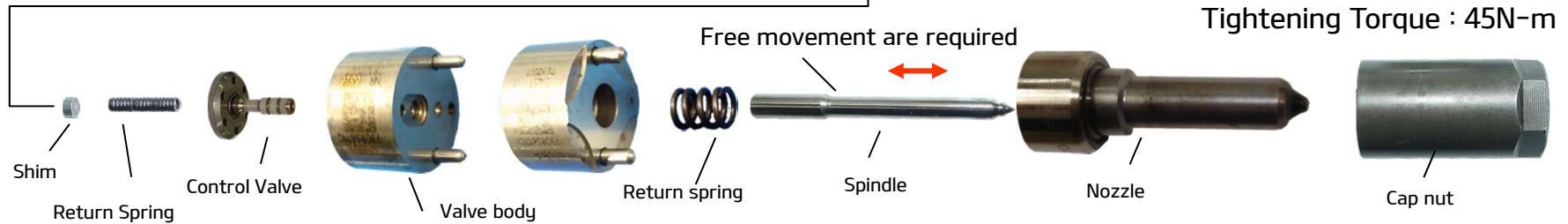


Should be moving freely

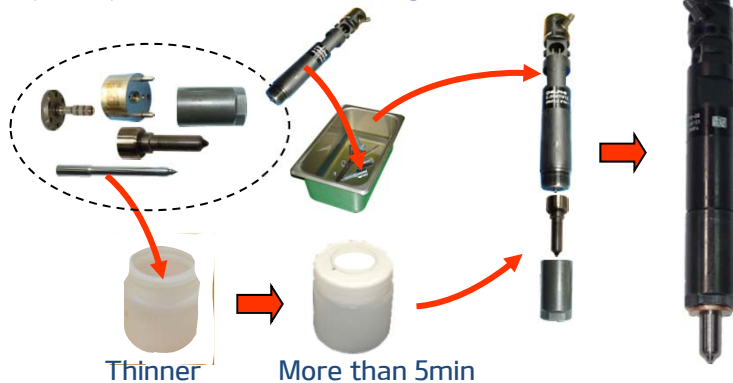


Control valve should be inserted into valve body freely (without any resistance).

The purpose of the control valve on the Delphi injector is to control injection amount. It might cause incorrect injection amount and excessive back leak if the valve has stuck.



Required parts for thinner soaking



NOTE

When you test injector after cleaning operate injector more than 3~4 times in high pressure mode of HP controller for bed-in and flushing.

4-5. Tips for Injector assembly (Nozzle area)

Cleaning procedure of nozzle

1. Remove the spindle from the nozzle holder



2. Change the direction of spindle

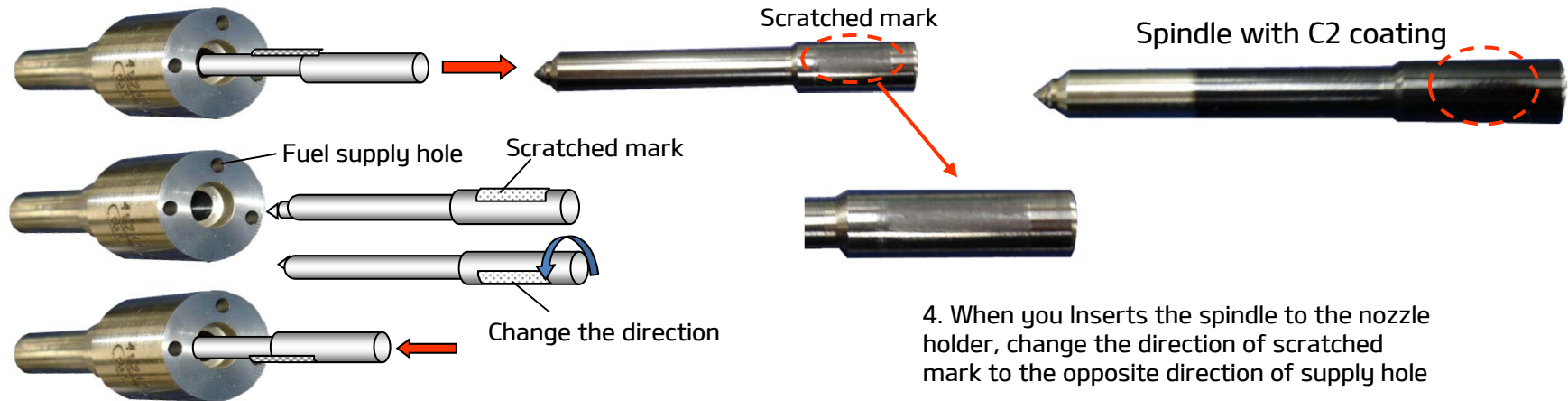


Free movements are required

3. While cleaning the injector in cleaning fluid it must be checked for free movement of the spindle in nozzle holder. It must be gently moved until there is no resistance to movement.



Try to in and out the spindle for the cleaning



Most scratched marks on spindle of nozzle are due to wearing.

The damaged spindle causes friction increase and produce low or over injection

Normally , you must replace the damaged nozzle assembly or change to new injector.

But it is possible to fix the injector without replacing the parts by using the above method.

Usually(100%) scratch marks match with the fuel supply hole, therefore if you change the direction of scratched area, you may save the parts without technical problem.

By using the CIT- 3000 or CRT-3500UP, you can get the right results.

5. Technical Information

Compensation of injected-fuel-quantity

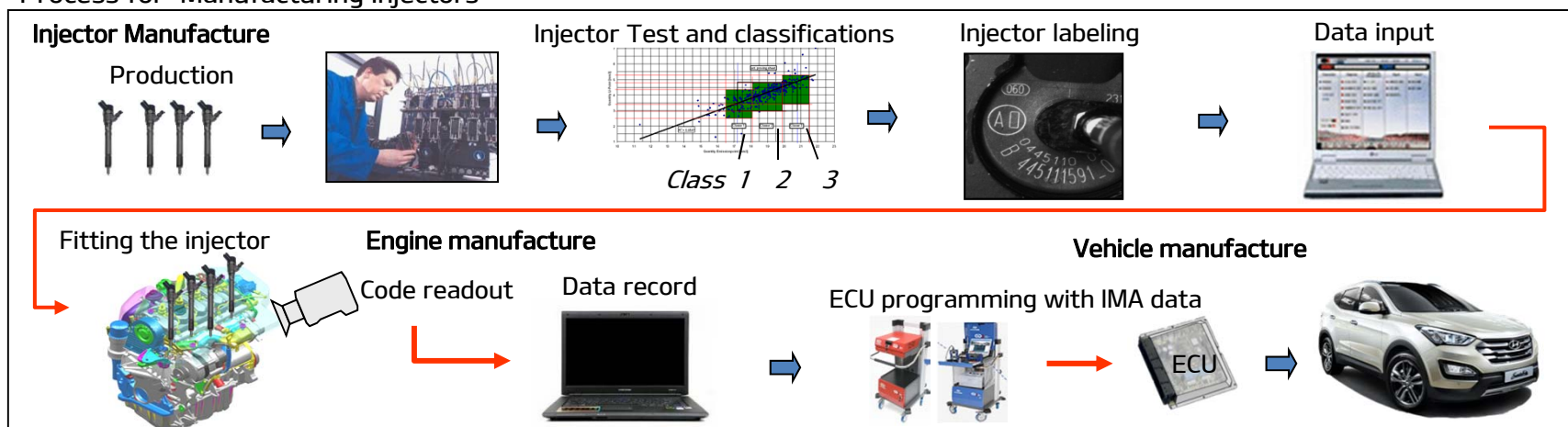
New functions are added to common-rail systems to enhance the high precision of the fuel-injection system further, and ensure them for the service life of the vehicle. With injector delivery compensation (IMA), a mass of measuring data is detected for each injector during the injector manufacturing process. The data is then affixed to the injector in the form of a data-matrix code. This data is transferred to the ECU during vehicle production. While the engine is running, these values are used to compensate for deviation in metering and switching response.

But In case of re-manufactured injectors(for in-use car service), it is almost impossible to classify control and label due to technical limitation as remarked as below.

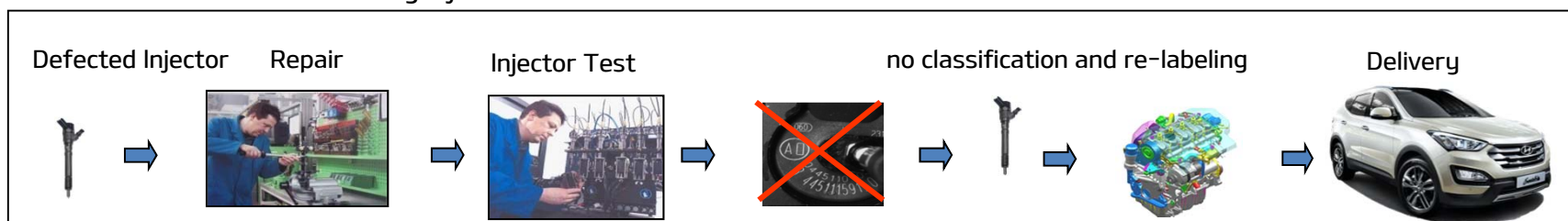
- Mechanical wearing and increasing tolerance (even rest of all injectors)
- Different regulation between new car and in-use car (no required)
- According to mileage of vehicle tolerance of all injectors are increased simultaneously (most of them out of control range).
- There is no space for re-labeling on injector head
- Cost saving

The Injector Delivery Compensation system offers solutions to above situation. Thus using an unclassified repaired injector will not influence engine performance or emission level in significant ways .

Process for Manufacturing Injectors

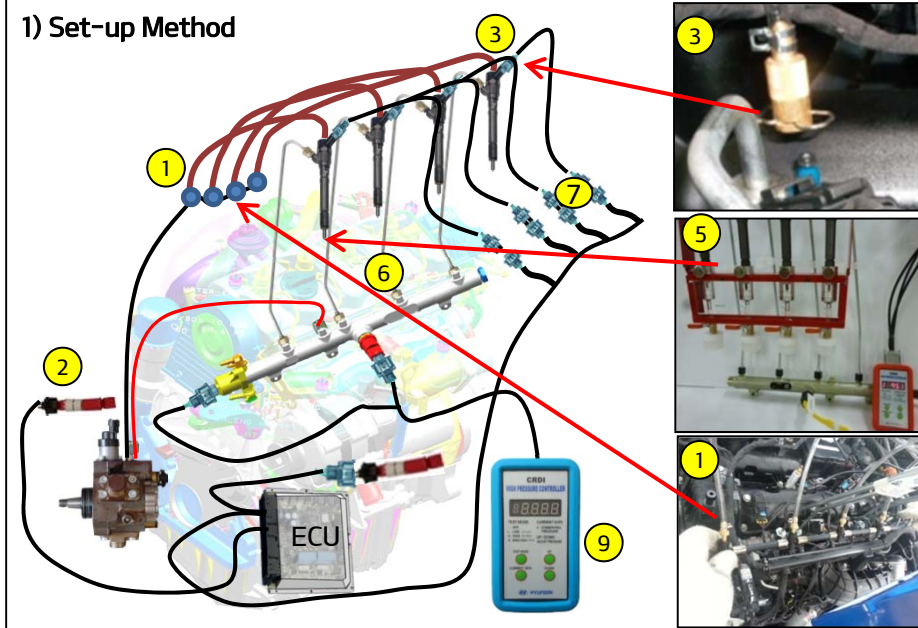


Process for Re-manufacturing Injectors



6-1 PIEZO Injector Test

1) Set-up Method



- ※ Piezo Injector is not an previous Solenoid Type. Piezo injector making satisfy method of the high exhaust, power and precision.
- ※ Previous Solenoid Valve needs an oil pressure coupler to help limited movement of Piezo injector and there is a system to maintain the oil pressure coupler for the safety maintain of it.
- Piezo injector is high reply and power, it is also less exhaust.

■ Set-up

1. Detached Injector ① return Line and attached as left picture by Tube.
2. ② Set-up the dummy resistor
- ※ Why? If control valve of Rail is detached, ECU order to stop the fuel pump by disconnect the line.
3. ③ Set-up the injector return line connector. (Install #22 PIEZO RETURN LINE CONNECTOR & ADAPTER)
- ※ Why? To avoid PIEZO type injector damage.
4. Detached the injectors form engine and ④ set up the dummy injectors.
5. ⑤ Cleaning the nozzle at end of Injector by sinner
6. ⑥ Attached the test pipe and injector on the rail.
7. ⑦ Connecting the injector wire line.
8. ⑧ Tighten pipe connection to stand up test body.
9. ⑨ Check all connection are right to connect including HP controller

■ Test

1. Keep ignition (engine) on until injected fuel.
2. If not to injected fuel, please check the leaking fuel in any parts.



- Detached injectors and set up the dummy injectors.
- Set up the tube and plastic holder on the injector return hole.



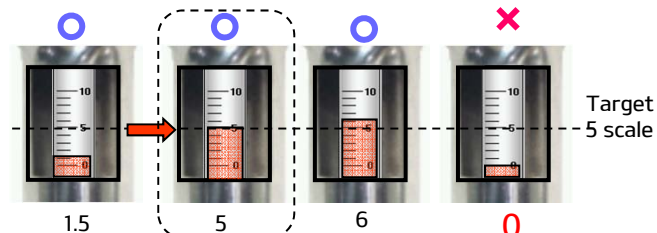
Tightening Torque

Test Body Set Up Procedure.

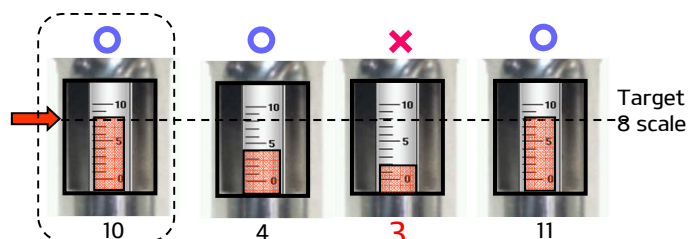
1. Test Pipes installed with Injectors first then, tighten the test body's holding screw with injectors. Fix the test pipes with Injectors & CRDI Rail side.
2. Tie the Test body holding roof on the bonnet hook then, connect the Return house & Wire.
3. Install the HP controller and dummy register.
4. Compare the injection amount of each by the level of test bodies scale.

6-2 Diagnosis Method of injected-fuel-quantity Measurement

Test judgment of Low pressure mode (250~350 bar)



Test judgment of high pressure mode (800~1000 bar)



Test and Judgment :

Low Mode (250~350bar), the result of test & high pressure mode (800~1000bar)

Test and Judgment

At the engine on , if 2nd injector reached target quantity out of 4 injectors, stop the E/G
If the injector is a brand new injector or a standard injector, it should be a standard.

Target injection scale : Low mode = 5 scales, High mode = 8 scales

Judgment and service limitation

Low pressure test : above 1.5 scales is normal condition

(In case of standard injector is on 5 scales)

Low pressure test : above 4 scales is normal condition

(In case of standard injector is on 8 scales)

Warning :

- The injected-fuel-quantity is very important, because a injector has a good condition as closed to injected-fuel-quantity of standard injector.
- It can be possible to estimate life time of the injector with the injected-fuel-quantity. It doesn't matter with service limitation . Strong standard measurement is good to judgment, but it will be increased cost. Recommending to consider the vehicle's condition and model year.
- If injected-fuel-quantity is over 30% compare with the normal condition and new injector, is a faulty injector. (Over injected-fuel-quantity)

Cylinder Pressure Test Method



PIEZO & BOSCH Injector Adapter



1. Need to use dummy injector to prevent oil leaking at the compression and pressure test.
2. Before attach the dummy, need to check injector combined space.
3. Standard pressure is 17~30kg/cm²
(Possible to have a difference, according to the performance of Diesel Vehicle or old vehicle)

Standard : 1,600cc (200rpm) 22.0 kg/cm²

Minimum : 17.0 kg/cm²

Standard : 2,000cc (260rpm) 26.0 kg/cm²

Minimum : 20.0 kg/cm²

Standard : 2,200cc (200rpm) 21.0 kg/cm²

Minimum : 18.0 kg/cm²

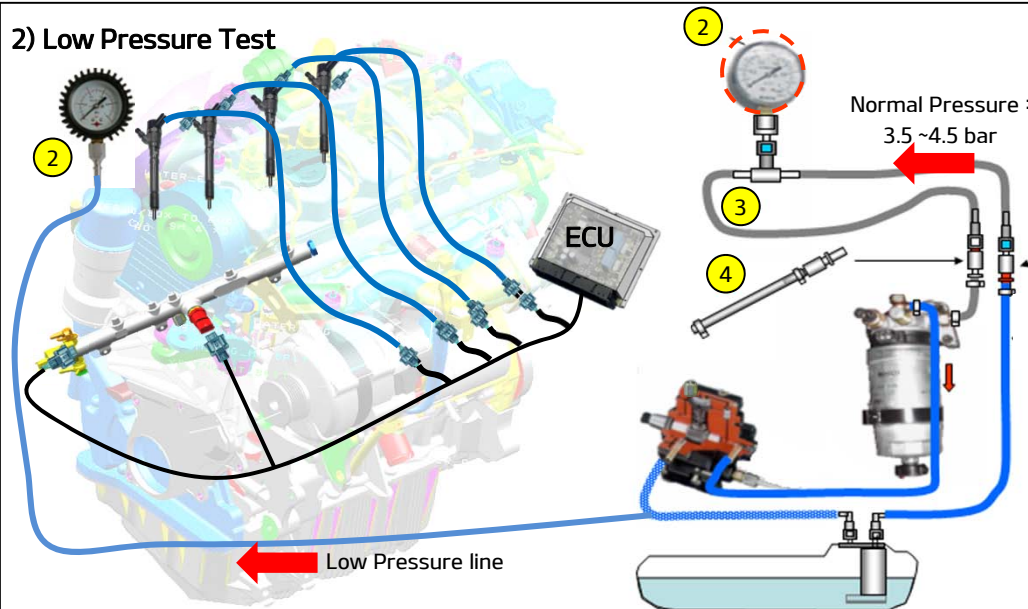
Standard : 3,000cc (350rpm) 30.0 kg/cm²

Minimum : 25.0 kg/cm²

Note : Please refer to the workshop manual.

6-3 PIEZO Injector Low Fuel Test

2) Low Pressure Test



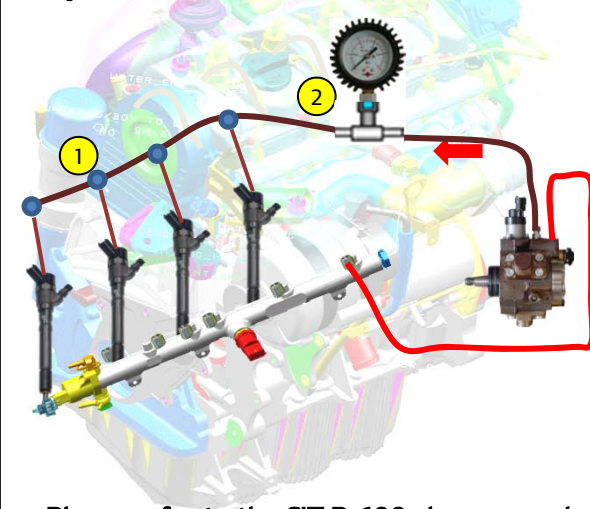
■ Set up

1. ① Before the Fuel filter, please fuel hose detached and connect ② low pressure gauge as left picture.
2. To connect ③ hose to use fuel line.
※ For the low pressure fuel type, the fuel pressure gauge should be connect before the fuel filter.
(Install : #24 LOW PRESSURE GAUGE CONNECTION TUBE)
3. ④ Connect the connection adapter with hose.(Install : #27)
4. Engine on (ignition on).
※ Check any fuel leaking.
4. Read the low pressure gauge. .

■ Judgment

1. E/G Idle RPM should be maintain at normal condition.
2. Check any fuel leaking again and again
3. Based on the below table, to judge the low pressure line.

3) Injector Return Measurement



Low Pressure return line



Engine Idle Test



Fuel line measurement

