



CR Injector Test and Repair

Manual

Ver. 1.21

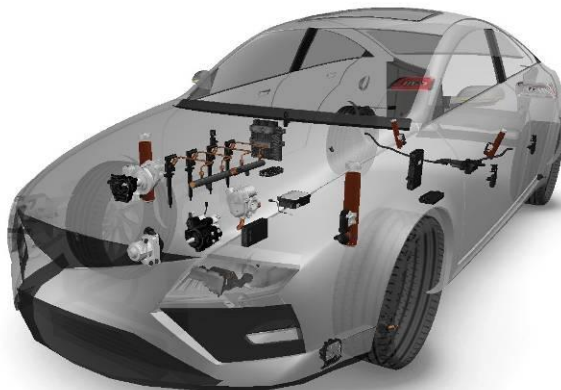
Our innovation. Your advantage

The worldwide first high-pressure diesel injection system with piezo injectors was the forerunner of the current Continental Common Rail Diesel System. Common Rail Diesel Injection Systems consist of the following main components: a high-pressure pump, piezo injectors, rail, lines and engine control unit. The high-pressure pump continually delivers diesel fuel into the rail under pressure; the rail supplies fuel to the piezo injectors through the lines. The engine unit controls the piezo injectors to ensure that the right amount of diesel fuel is injected into the cylinders at the right point in time.

The piezo actuator allows extremely short switching times for precise control and stability of smallest injection quantities possible. This means that the injector provides multiple injections with an outstanding repeatability.

The main components of the injector are:

- The nozzle
- The injector body with control module and throttles
- Servo valve with direct valve drive
- Piezo actuator



The brands of "VDO CR Injectors" mentioned in this manual could be Siemens, Siemens VDO or Continental. This due to historical reasons.

Version History

Document version	Previous version	Change description
1.21	1.20	Injector packaging number has changed
1.20	1.11	K9K EU4 repair information added: <ul style="list-style-type: none">- 3.1. Repair kit order number added- 6.2. Pressure transfer adapter assigned- 6.3. Tools spare parts for K9K EU4 added- 6.4. Detailed data regarding the tightness of the high pressure connection added- 6.5. Torque values for K9K EU4 added
1.11	1.10	Piezo stack capacitance check added
1.10	1.09	- 6.3. Tools – spare parts added - 12. Height adjustment moved up to chapter 6
1.09	1.08	3.2.2. changed – detailed specified

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1. Components

There are two different types of VDO CR Injectors covered in this manual. The first generation equipped with a long nozzle nut which covers the whole CR Injector body (Illustration 2.1) and the second generation (Illustration 2.2) which is equipped with a much shorter nozzle nut.



Illustration 2.1 First generation of VDO CR injector



Illustration 2.2 Second generation of VDO CR injector

CR Injector – main components

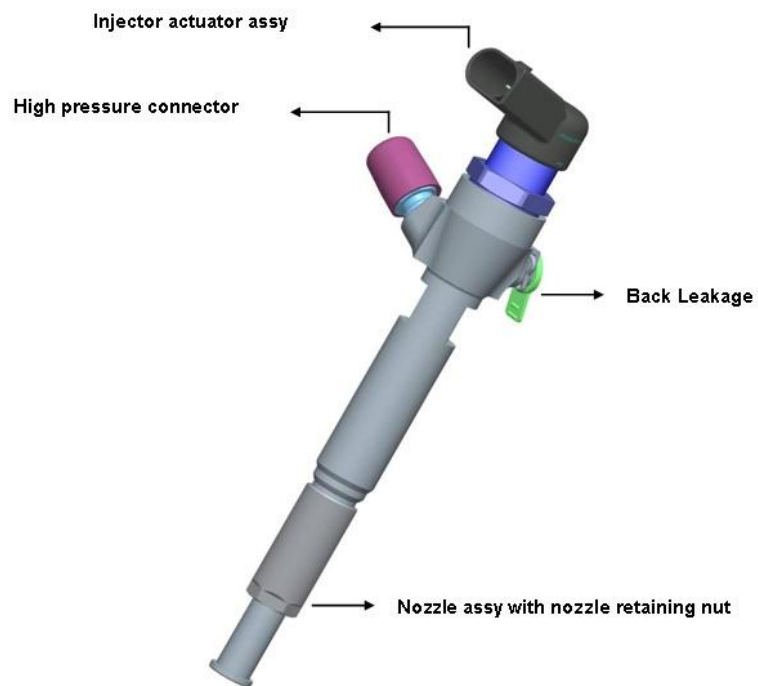


Illustration 2.3 The main components of a Common Rail Injector

2. Visual check – before start

The first step of the process is the visual check. This step makes sure that only CR injectors which are not physically damaged will remain in the process.

The injector is a very sensitive part and therefore must be handled with care!
Inappropriate storage can lead to irreparable damages



CR Injectors with broken connector housings cannot be repaired and must be thrown out.



Dirty injector bodies (rusty or carbonized) must be cleaned before testing.



CR Injectors which show signs of being overheated or burned on the surface cannot be tested as inner parts have been damaged.



If just the nozzle has been damaged the test & repair process should solve the problem.



Always check the angular between high pressure connection and piezo actuator.
(example DV4 Euro 4)



The CR Injector which indicates any other damages of injector body, mustn't be reworked
(for example deformed back leak connection).



3. Visual check

3.1. Identifying the injector

Before starting any operations the CR Injector type has to be identified. Please see table below for reference.

For further information please check the Diesel Handout which is available on the Extranet.

Category	DV4 EU4	DV4 EU3	DW10TD	DW10BTED
Injector	5WS40149-Z replaced by A2C59511612	5WS40148-Z	5WS40000-Z not available anymore	5WS40156-4Z – Class 4 5WS40156-Z – Class 5 A2C59511601 – Class 6 A2C59513552 – Class 7 A2C59511603 – DW10B MFMA
Rep. Kit	A2C59513998	A2C59513997	Not available	A2C59514909 – DW10B all classes A2C59514910 – DW10U

Category	DV6C TED4	K9K Euro 4	K9K Euro 5	Lynx
Injector	A2C59513556	A2C59511606	A2C59513484	A2C59511610 A2C59511611 - V227
Rep. Kit	Not available	A2C59506606	Not available	A2C59514911 – Lynx A2C59514912 – Lynx V227

Category	VW Common Rail	Lion V6	Lion V6 Upgrade	Lion V8
Injector	A2C59513554	A2C59511315 - JAGUAR EURO 3 A2C59511316 - DT17 EURO 4 A2C59511316 - LAND ROVER	A2C59513553	A2C59513597 - Red Clip A2C59513596 - White Clip
Rep. Kit	Not available	Not available	Not available	Not available

3.2. Initial electric test

Before the electrical test, make sure that the injector was stored at least for 3 hours at ambient temperature.

First inspection of the injector checks the circuit between the actuator and the body of the injector. For this test you can use both High voltage insulation tester or Digital multimeter/multitester.

3.2.1. High voltage insulation tester

This can be measured using insulation resistance tester. In order to check for an open or short circuit:

- 1) Connect plug supplying high voltage (approx. 300 V) to both actor pins.
- 2) Connect the ground pole to the injector body.
- 3) Measure the insulation resistance for at least 4 seconds. The measured value must be greater than 100 MΩ.

The insulation resistance should be tested under “Clean Room” conditions thus temperature and moisture have very strong influence on the measured value.

3.2.2. Piezo stack – resistance check

The piezo resistance can be measured using a multimeter / multitester. In order to check for open or short circuit:

- 1) Keep the temperature of the injector between 0 – 80°C
- 2) Set the multimeter to measure resistance (Ω Ohms).
- 3) Place the probes, one to the left pin and the other to the right pin of the connector in turn.
- 4) Wait for at least 5 seconds for the measurement to stabilize before reading. The resistance value must be between 160 kΩ – 220 kΩ

Please bear in mind that the used multimeter must fulfill following requirements:

- 1) Voltage 0 – 10V ± 0,1V
- 2) Current 0 – 400µA ± 0,4%

In case the injector fails one of the above mentioned tests, the injector's actuator is faulty and the injector cannot be reworked.

3.2.3. Piezo stack – capacitance check

The piezo capacitance can be measured using a handheld LCR meter (e.g. Agilent U1730C Series). In order to perform the test, please keep following requirements:

- 1) Temperature of the injector 0 – 25°C
- 2) Voltage 1V and Frequency 1kHz
- 3) Stabilization time 15s

Below you will find a table within the capacitance values for different injector types. The capacitance value mustn't be lower than specified.

Injector type	The measured capacitance value mustn't be lower than
DV4 EU3	2,8μF
DV4 EU4	Still under development
DW10B	2,8μF
DW10U	2,8μF
Lynx	2,8μF
Lynx V227	2,8μF
K9K EU4	2,8μF
IESA NGD 3.0	2,8μF
Lion V6 Base	2,8μF
Lion V6 Upgrade	2,8μF
Lion V8	2,8μF
K9K EU5	Still under development
VW CR	Still under development
Puma	Still under development
DV6C	Still under development

4. Injector cleaning

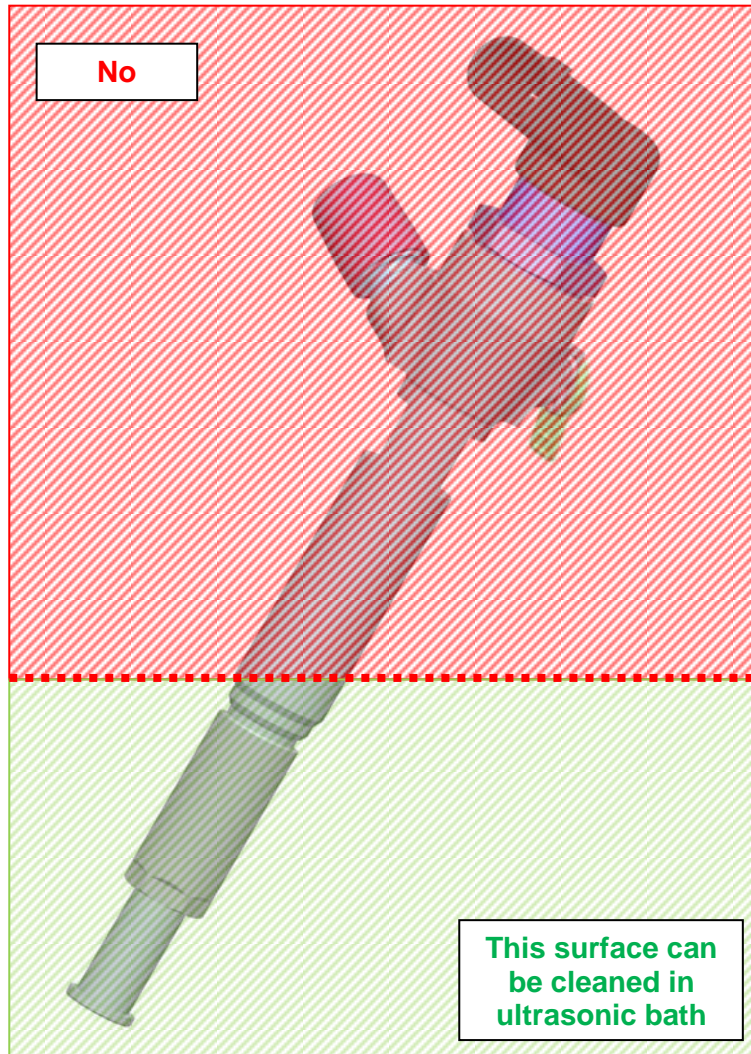
After the visual check has been passed the Clean and Purge step can be started which is a part of the analysis preparing the CR Injectors for further tests.

In order to clean the CR injector please use an ultrasonic cleaner (for example Hartridge HM1003).

Recommend:

- 1) **Cleaning fluid TICKOPUR TR 13**
- 2) **Temperature of 80°C**
- 3) **Duration of 30 minutes**

Please note that the CR injector must not be placed under water or any other fluid. Only clean the injector's body and nozzle (shown on the illustration below).



The Actor connector needs to be sealed with "Sealing clip X39-800-100-040" (see below) to avoid any fluid getting into the contact housing.
For high pressure connection and back leakage connection, use usual commercial caps.



5. Spray pattern test and injector purge

The spray pattern test gives initial information about the injector itself. This simple test determines if the nozzle is still delivering fuel through all holes or if the spray pattern is OK and purges the injector. To perform this test a CR Injector nozzle test bench is required (e.g. IFR-50 or IFT-70 from Hartridge).

Injector type	Number of spray holes
DV4 EU3	6
DV4 EU4	6
DW10B	6
DW10U	6
Lynx	7
Lynx V227	7
K9K EU4	6
K9K EU5	7
DV6C	7
DW10TD	5
VW CR	7
Lion V6 Base	6
Lion V6 Upgrade	7
Lion V8	7

6. Nozzle change – CR injector repair

6.1. Tools – installation and adjustment

Please check whether all components have been delivered and then put the toggle press tool in a dry and secure place to avoid damage.

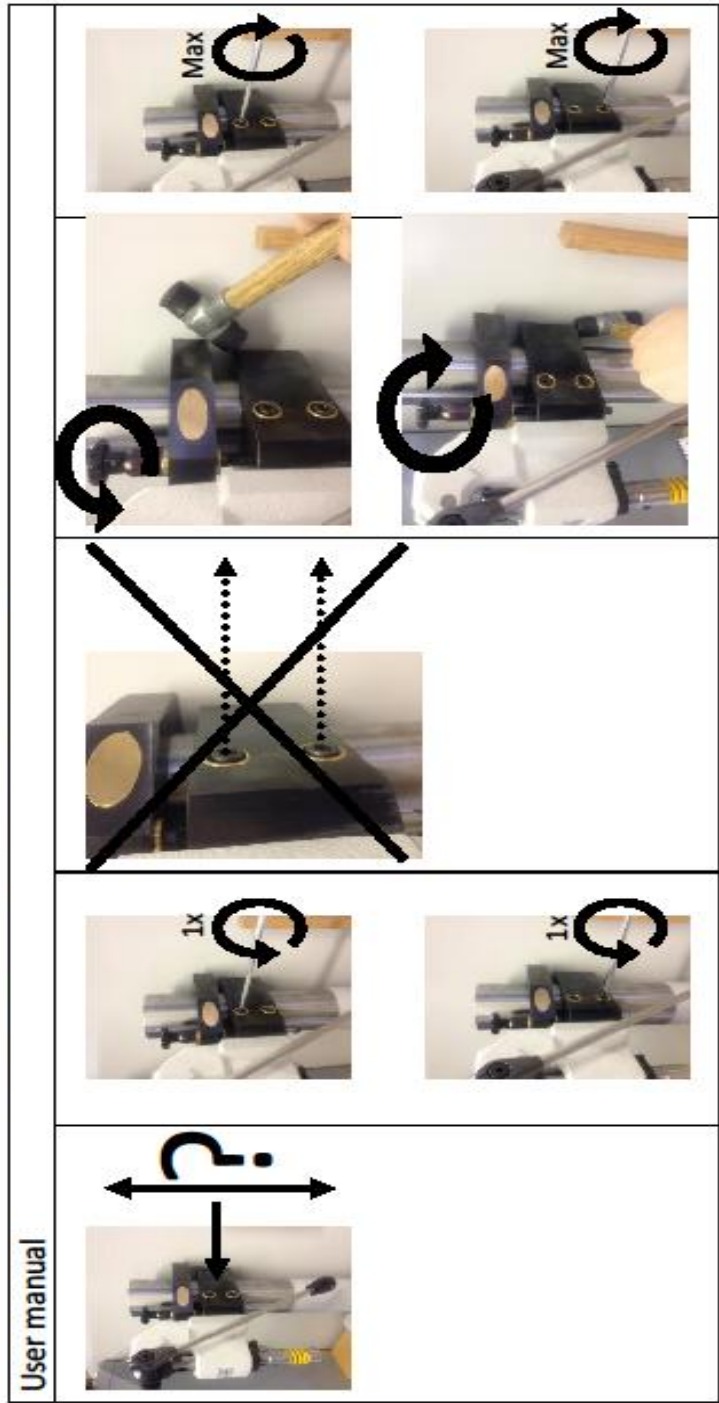
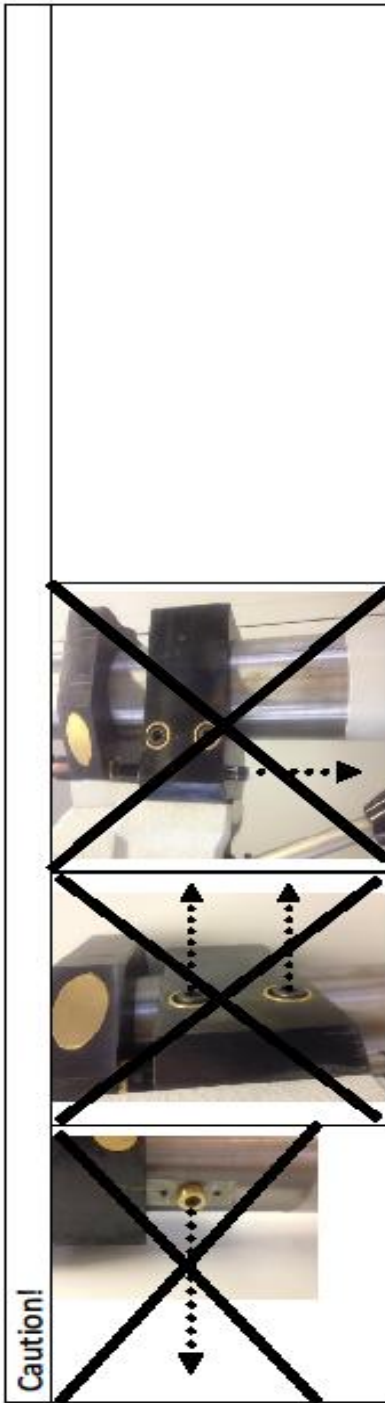
Please bear in mind that the toggle press has been covered with anti-corrosive coating to avoid any transportation damage.

The toggle press tool must not be cleaned with any aggressive cleaning agents.

Every quarter year, all unprotected parts of the toggle press tool need to be lubricated in order to maintain optimal functionality and longevity. In case any small rust stains appear on any of the parts, please use fine sandpaper (grit: 100-120 according to CAMI or P100, P120 according to ISO/FEPA) to remove them and afterwards please lubricate the parts accordingly.


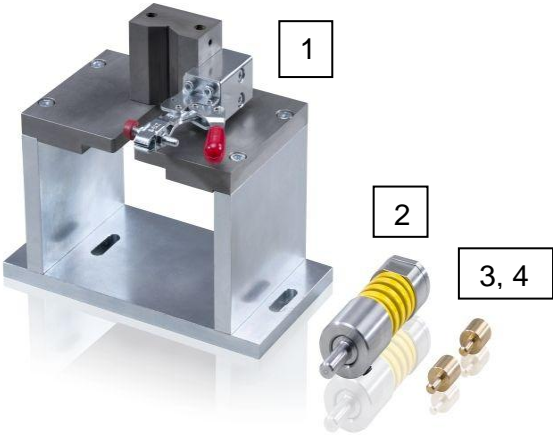
6.1.1. Height adjustment

Due to a number of different injector variants, the height of the toggle press needs to be adjusted. Please see the instruction below.



6.2. Tools – overview

To change the CR Injector's nozzle specific tools are required to perform repairs:

<p>Toggle Press</p> <p>Order number: A2C59514000</p>	
<p>CR Injector Repair Tool Kit "version A"</p> <p>Order number: A2C59514886</p> <p>Package contents:</p> <ol style="list-style-type: none">1) Injector holder2) Pre-load device3) Pressure transfer adapter DV4 EU3, marked with the letter "E"4) Pressure transfer adapter DV4 EU4, marked with the letter "D"	

CR Injector Repair Tool Kit "version B"

Order number:

A2C59514001

Scope of delivery:

- 1) Injector holder
- 2) Injector holder pad



System	Injector holder	Pressure transfer adapter
DV4 EU3	A2C59514886	Letter E
DV4 EU4	A2C59514886	Letter D
DW10B all classes	A2C59514001	Letter E
DW10U	A2C59514001	Letter E
Lynx	A2C59514886	Letter D
Lynx V227	A2C59514886	Letter D
K9K EU4	A2C59514886	Letter F

6.3. Tools – spare parts

The pressure transfer adapter is available as spare part (always a kit of 2 pieces) and must be replaced once a quarter.



Pressure transfer adapter	Part number
Letter D	A2C59513999
Letter E	A2C59514913
Letter F	A2C59506472

6.4. High pressure connection – tightness check

Under no circumstances loose the high pressure connection during the disassembling of the injector from the car!

If the high pressure connection, during the disassembly of the injector (high pressure pipe from the injector) loosens, please tighten it back with appropriate torque.
Under no circumstances exchange the high pressure connection.



Below, values for assembly of the **non-lubricated** high pressure connection.

System	Initial torque (Nm)	Rotation angle Starting at initial torque (deg)	Final torque value (Nm)
DV4 (EU3 and EU4)	-	-	35±5
DW10BTED (DW10U)	10	70±20	55±15
Lynx	10	104±5	60±20
Lynx V227	10	104±5	60±20
K9K Euro 4	10	70 -35/+20	55±15

6.5. Repair process

See below detailed instructions how to dismantle and re-assemble the injector with the tools mentioned in previous section.

Please note: always use the appropriate Personnel Protection Equipment (PPE)!

Step 1

Check the CR Injector condition according to section 3, Page 9.

If the CR Injector passed all tests and was cleaned accordingly so that there are no particles or dirt on the surface, identify the correct "Repair Kit" (see page 9).





Step 2

Mount the appropriate CR Injector holder, the Preload Device and select the suitable Pressure Transfer Adapter.

Put the CR Injector into the holder and secure it with the clamp.

Put the torque wrench on the nozzle retaining nut ($\varnothing 15$) and close the toggle press clamp.

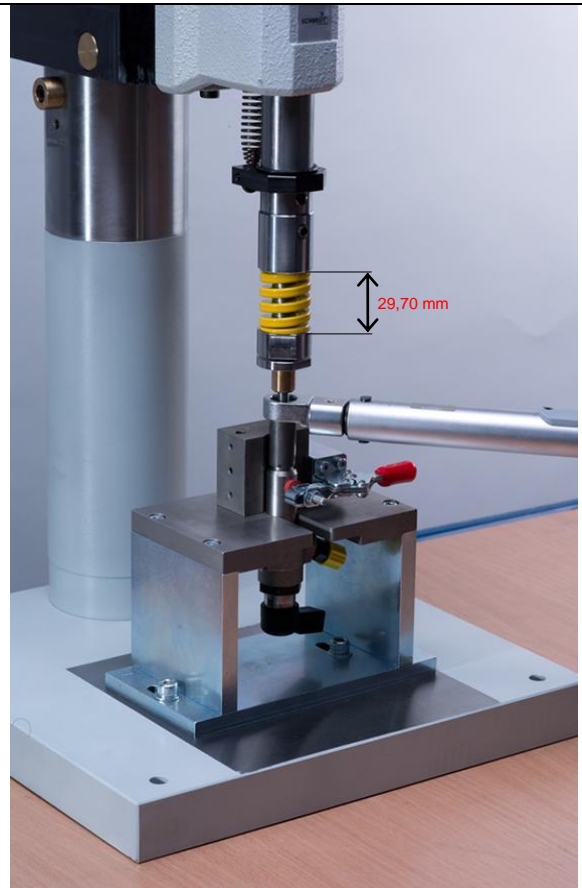
Attention!

Please note: the spring length in a closed position, should measure 29,70 mm.

Once closed, the nozzle retaining nut, can be released.

Attention!

Please use appropriate Pressure Transfer Adapter for each injector type!



Step 3

After the nozzle retaining nut has been released the CR Injector can be taken out of the holder and opened carefully.



Step 4

Carefully dismantle the nozzle from the injector. The injector's stop disk must not be disassembled, therefore, please hold it firmly with your thumb to prevent it from falling apart.

Attention!

Do NOT touch the nozzle's head!

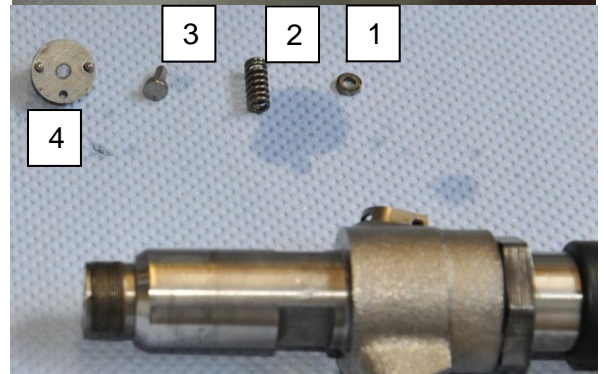


Step 5

Clean the repair parts (nozzle and nozzle retaining nut) in the brake-cleaning fluid. Use compressed air or a suction system to remove excess brake-cleaning fluid.

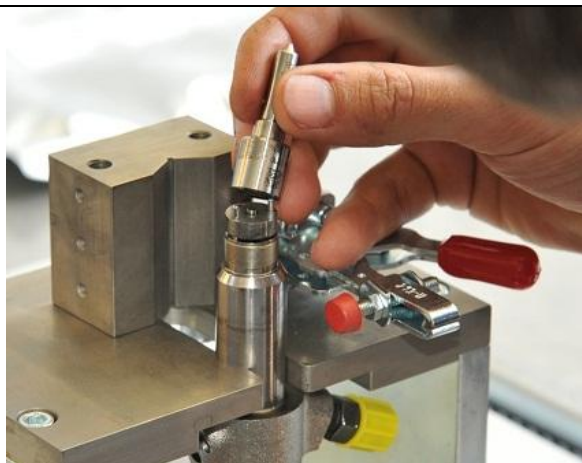
Should parts like the spacer bolt (3), spiral spring (2), spacer washer (1) or stop disk with parallel pins (4), fallen out of the injector, please proceed with the brake-cleaning fluid and compressed air or suction.

The numbers shown on the Illustration show you the proper sequence for assembly.



Step 6

Carefully put the nozzle on the stop disk.



Step 7

Clean the injector's thread with brake-cleaning fluid.



Step 8

Use compressed air to remove residual dust and brake-cleaning fluid.



Step 9

Slightly lubricate both the nozzle nut thread and the contact surface between the nozzle and the nozzle nut before re-fitting and tightening of the nozzle nut.

Attention!

Do NOT use LUBRICATING GREASE instead of OIL!

TIP!

You can use oil with parameters like Molykote L-1346FG



Step 10

Carefully put the nozzle nut on the nozzle.

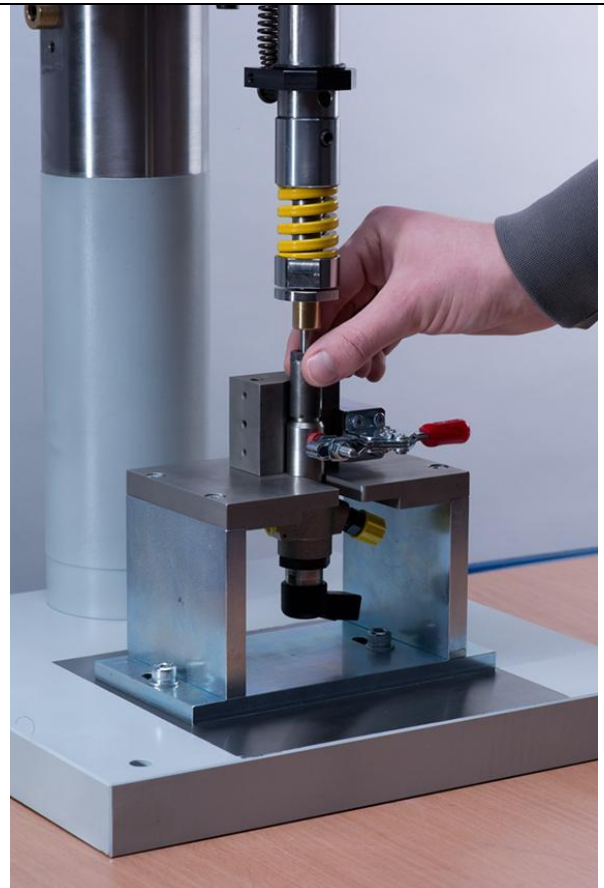
Put the CR injector into the holder and secure it with the clamp.

Slowly tighten the nozzle's nut by hand.

Attention!

Do not rotate the injector's nozzle!

Never touch the nozzle's head while assembling the injector!



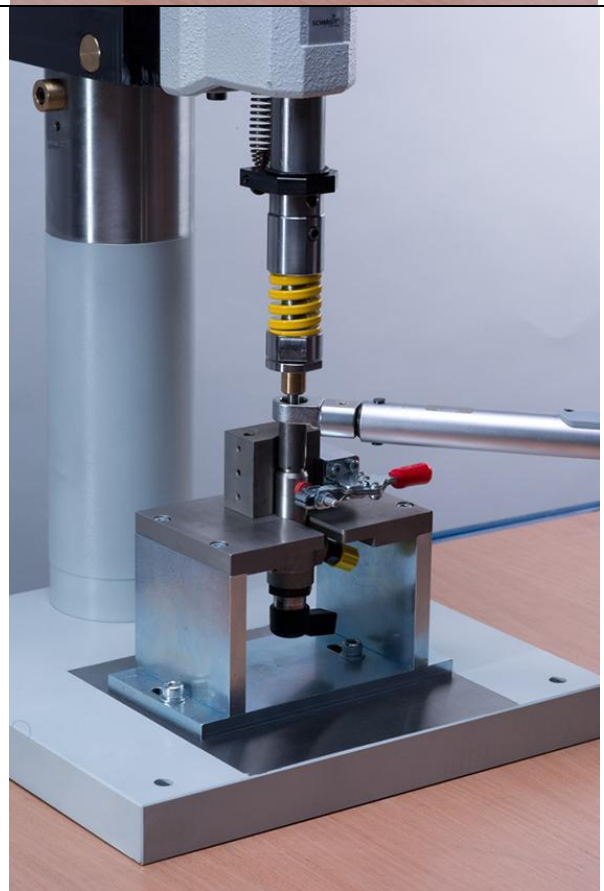
Step 11

Place the torque wrench on the nozzle retaining nut and close the toggle press clamp.

Tighten the nut according to the specification shown below (see page 24).

Attention!

Start measuring the rotation angle at 10Nm of initial torque.

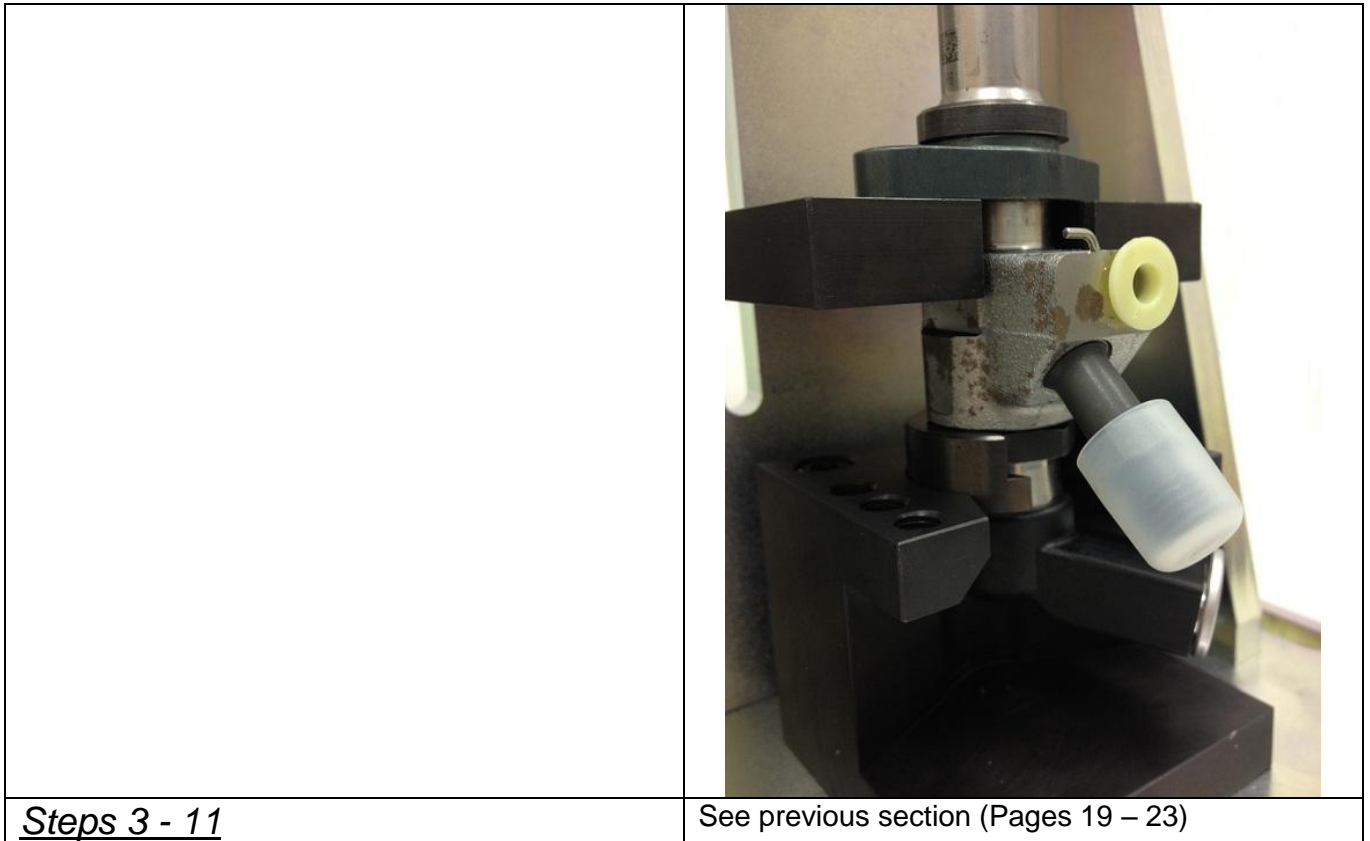


6.5.1. Repair process – CR Injector Repair Tool Kit “version B”

See below detailed instructions how to dismantle and re-assemble the injector with the CR Injector Repair Tool Kit “version B”.

Please note: always use appropriate Personnel Protection Equipment (PPE)!

<p><u>Step 1</u></p>	<p>See previous section (page 17)</p>
<p><u>Step 2</u></p> <p>Mount the appropriate CR Injector holder, the Preload Device and select the suitable Pressure Transfer Adapter.</p> <p>Put the CR Injector into the holder using the injector holder pad.</p> <p>Put the torque wrench on the nozzle retaining nut (Ø15) and close the toggle press clamp.</p> <p>Attention!</p> <p>Please note: the spring length in a closed position, should measure 29,70 mm.</p> <p>Once closed the nozzle retaining nut can be released.</p> <p>Attention!</p> <p>Please use appropriate Pressure Transfer Adapter for each injector type!</p>	



System	Initial torque (Nm)	Rotation angle (deg)	Max torque value (Nm)
DV4 (EU3 and EU4)	10	104±5	60±20
DW10BTED (DW10U)	10	104±5	60±20
DV6C TED4	10	104±5	60±20
K9K Euro 4	10	104±5	65±20
K9K Euro 5	10	104±5	60±20
Lynx	10	104±5	60±20
Lynx V227	10	104±5	60±20
VW Common Rail	10	104±5	60±20

7. Test on bench – Continental specific software for CRi-PC

To test VDO CR Injectors on the Hartridge CRi-PC test bench, customized software is required. Once the injectors have been tested and passed every single step of the test plan, then the injector is ready to use.

Please note: the software has been exclusively developed to run on the Hartridge CRi-PC. It requires the generic Hartridge "All Makes Application" to run.

Below, please find details regarding software version 1.00b12 and the test procedure.

7.1. Important notices

Before testing on the test bench, make sure that the injector has been stored at least for 3 hours at room temperature.

Due to some technical issues it may happen that the injector won't pass the CP2 test step. In this case we advise you to repeat the test procedure. If the injectors fail twice at the same test step, they are no longer repairable.

Before testing on the bench, make sure that all copper rings are in good condition; exchange if necessary.

Please test always pairs of injectors placed on the lines 1 and 2 or 3 and 4 to avoid any cross talk between the test lines. If you should test only one injector please use a dummy injector placed next to the one tested.

7.2. Software purchase

The VDO specific Hartridge CRi-PC software will be provided, authorized and handled between you and Hartridge directly.

The order form will also be provided by Hartridge.

7.3. Software updates

Software updates as well as new test plans will be provided exclusively by Hartridge.

7.4. Overall information about the software



Illustration 4 Start of the software

The CRi-PC will always start with the „Allmakes“ software. In order to open up the VDO application, please close the „Allmakes“ solution and double click on the CRi-PC VDO icon that is to find on the desktop.



Illustration 5 Error message while attempt to start any other related application

If one of the applications is already running („All Makes“ or VDO), an error message will appear.

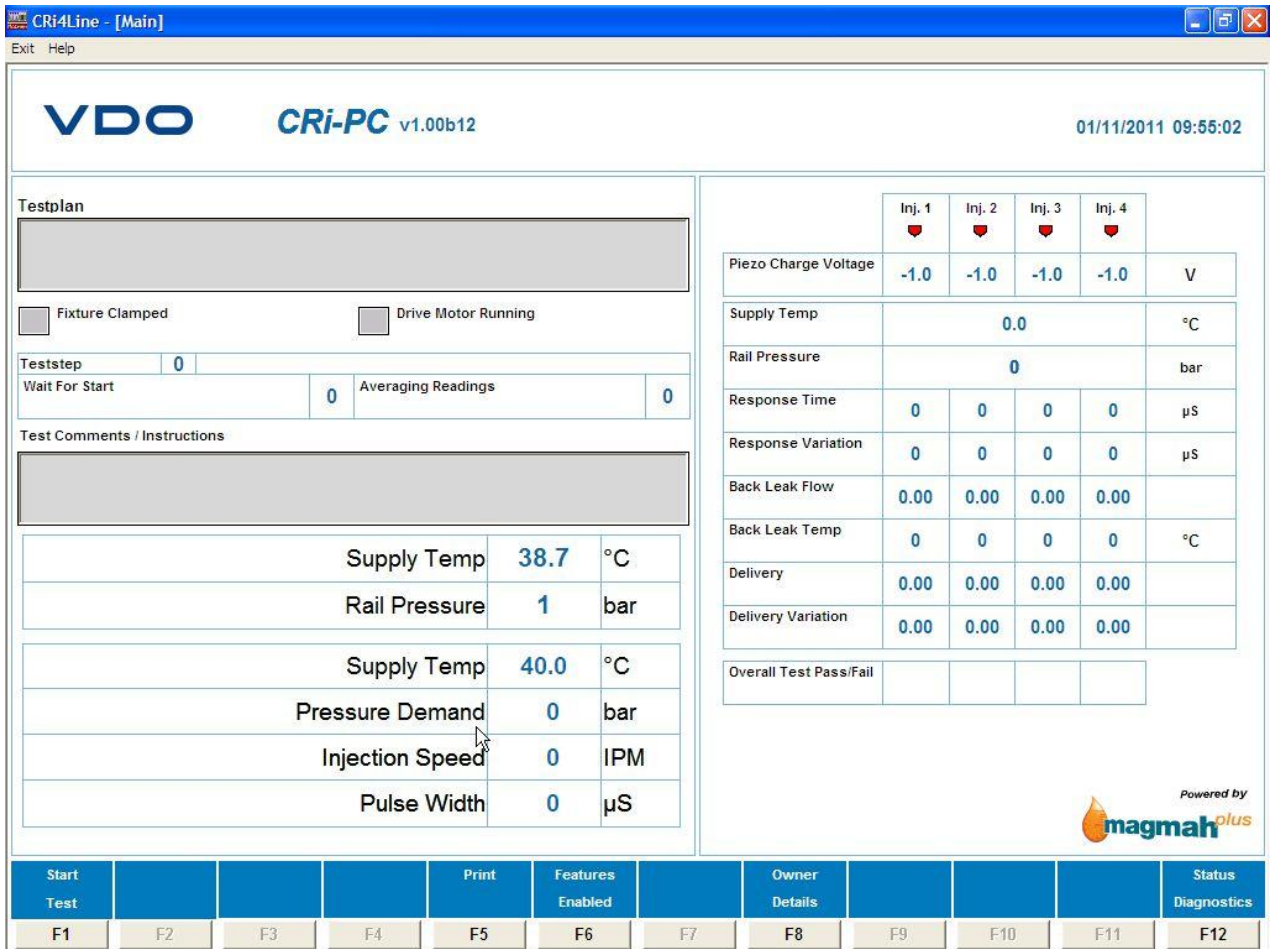
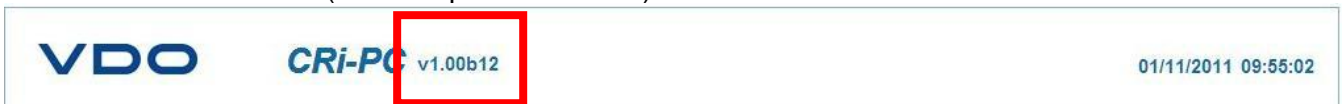


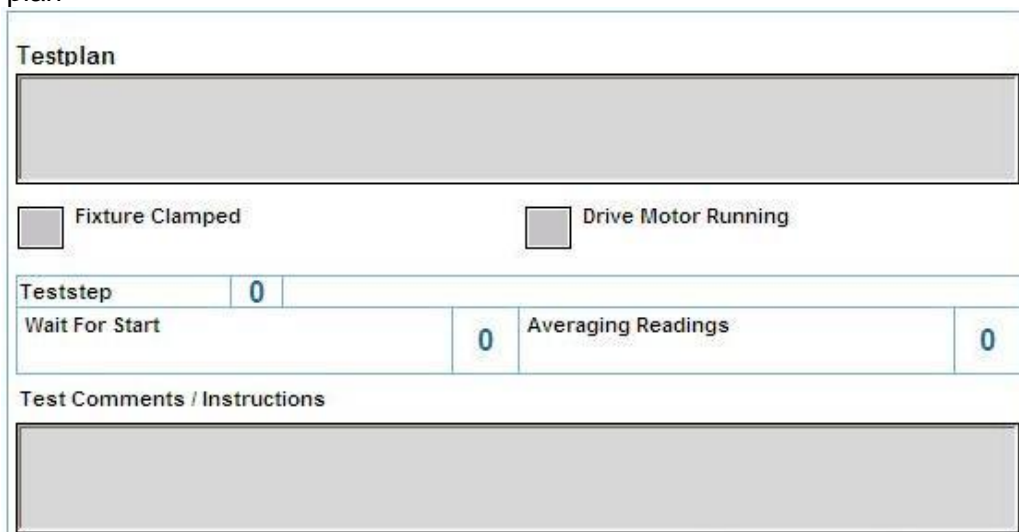
Illustration 6 Main screen

The main screen of the VDO Software contains the information about:

- Software version (on the top of the screen)



- Test plan



- Overall parameters defined in the test plan

Supply Temp	38.7	°C
Rail Pressure	1	bar
Supply Temp	40.0	°C
Pressure Demand	0	bar
Injection Speed	0	IPM
Pulse Width	0	µS

- Test data of the injectors

	Inj. 1	Inj. 2	Inj. 3	Inj. 4	
Piezo Charge Voltage	-1.0	-1.0	-1.0	-1.0	V
Supply Temp	0.0				°C
Rail Pressure	0				bar
Response Time	0	0	0	0	µS
Response Variation	0	0	0	0	µS
Back Leak Flow	0.00	0.00	0.00	0.00	
Back Leak Temp	0	0	0	0	°C
Delivery	0.00	0.00	0.00	0.00	
Delivery Variation	0.00	0.00	0.00	0.00	
Overall Test Pass/Fail					

- Additional buttons

Start Test				Print	Features Enabled		Owner Details				Status Diagnostics
F1	F2	F3	F4	F5	F6	F7	F8	F9	F10	F11	F12

The buttons allows you to control the machine:

- ✓ F1 – starts the test procedure (it opens the mask, where the general information can be defined incl. choice which line should be activated) – see Illustration 13
- ✓ F5 – allows you to open and print out the reports from particular tests – see Illustrations 11 and 12
- ✓ F6 – allows you to check the detailed information about the license – see Illustration 10
- ✓ F8 – allows you to enter and save the owner’s data – see Illustration 7
- ✓ F12 -allows you to switch to diagnostic menu – see Illustration 8

- F1 – allows you to check whether there are any problems with Back Leak – see Illustration 9
- F11 – reboots the software without rebooting of the machine
- F12 – switch to the main view

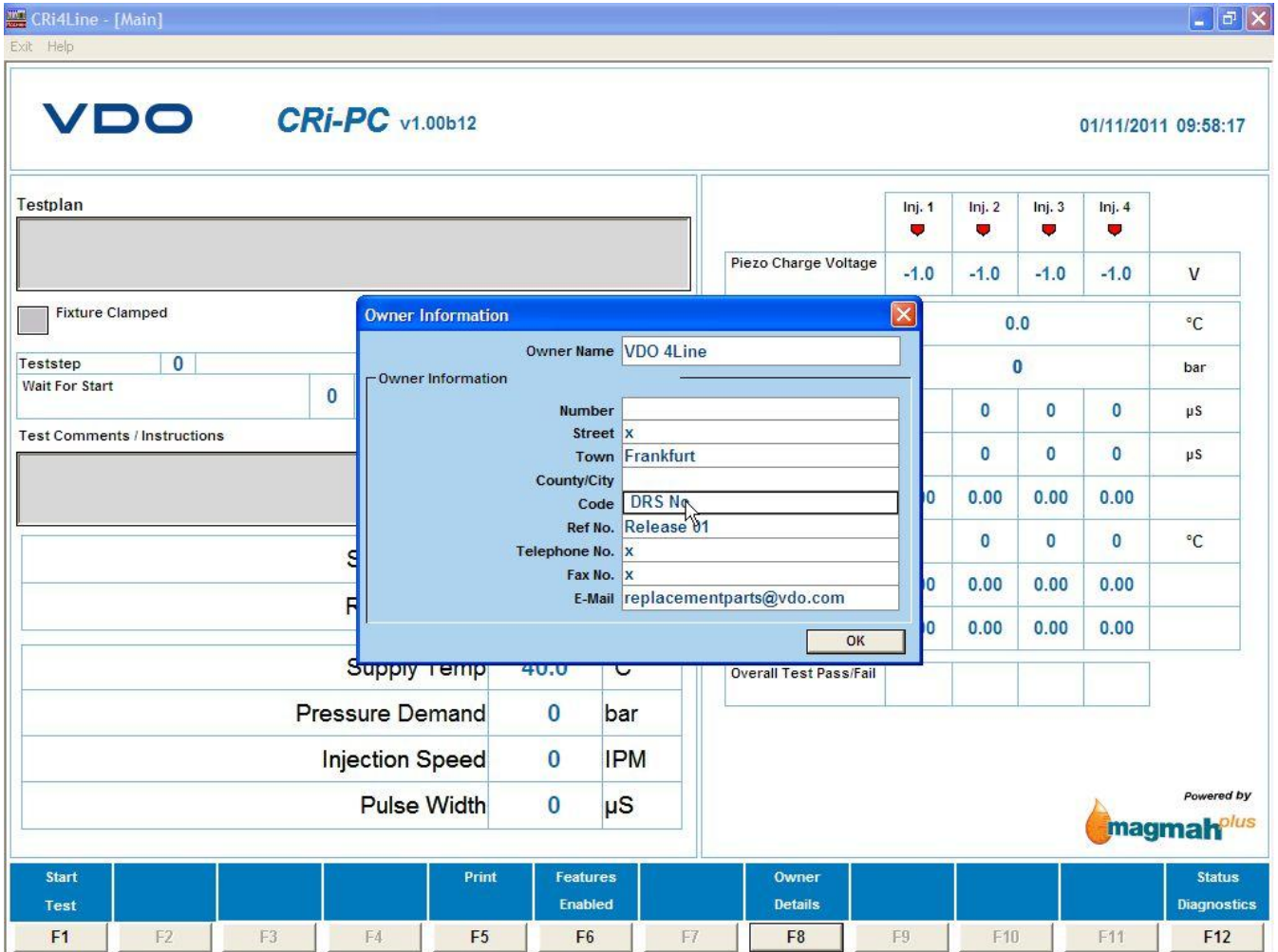


Illustration 7 Owner Details mask

The personal information of the company can be defined here

VDO CRI-PC v1.00b12 01/11/2011 09:58:49


Pump Control PCB Pump S/W Version: 2 <input type="checkbox"/> Pump PCB Trip Reset	Metering PCB MCB4 S/W Version: 9.05 Metering Unit Temp: 15.3 °C MCB4 Speed: 100 IPM	Machine Status Machine Use Hours: 57.7 Pump Use Hours: 21.3 Reset Fuel Filter Hours: 55.3 Reset
Injector PCB Injector S/W Version: 9 <input type="checkbox"/> Injector PCB Trip Reset <input type="checkbox"/> Volts Low <input type="checkbox"/> Pulse Too Great <input checked="" type="checkbox"/> Default Injector Setting	Interlocks <input type="checkbox"/> Emergency Stop Active <input type="checkbox"/> Main Tank Level Low <input type="checkbox"/> Main Tank Thermostat <input type="checkbox"/> Air Pressure Low <input type="checkbox"/> Clean Tank Level Low <input type="checkbox"/> Motor Circuit Breaker <input type="checkbox"/> Main Guard Open <input type="checkbox"/> Disable Interlock Messages	<input type="checkbox"/> Fixture Clamped <input type="checkbox"/> Clamp Button Pressed <input type="checkbox"/> Unclamp Button Pressed <input type="checkbox"/> Drive Motor Running <input type="checkbox"/> Cooler Circulation On <input type="checkbox"/> Heater On <input type="checkbox"/> Log Temperature Control <input type="checkbox"/> Lamp ON
PIB3: Control PCB Injector Cable: 4.658 V 16 ID 1 2 3 4 Current Gain: 0.990 0.985 0.970 1.010 <input type="checkbox"/> No Errors A204A902 - 1.00b17	Supply Temp: 40.5 °C Rail Pressure: 1 bar	
Backleak Unit Status <input type="checkbox"/> Back Leak Pressure Applied Leak Rate: 0 Back Leak Pressure: 0 mbar		
Backleak Errors F1 F2 F3 F4 F5 F6 F7 F8 F9 F10 F11 F12	<input type="button" value="Reset"/> <input type="button" value="Return"/>	

Illustration 8 Status and Diagnostics window

Under Status and Diagnostics all the information about the present status of the machine can be found. From this mask it is possible to reset the counter of the fuel filter hours, in case it should have been changed due to the regular maintenance (please see the CRI-PC Manual delivered from Hartridge).

CRi4Line - [Status]
Exit Help

VDO **CRi-PC** v1.00b12 01/11/2011 10:04:42

Pump Control PCB Pump S/W Version: 2 <input type="checkbox"/> Pump PCB Trip Reset	Metering PCB MCB4 S/W Version: 9.05 Metering Unit Temp: 16.2 °C MCB4 Speed: 100 IPM	Machine Status Machine Use Hours: 57.8 Pump Use Hours: 21.3 Reset Fuel Filter Hours: 55.4 Reset
Injector PCB Injector S/W Version: 9 <input type="checkbox"/> Injector PCB Trip Reset <input type="checkbox"/> Volts Low <input type="checkbox"/> Pulse Too Great <input checked="" type="checkbox"/> Default Injector Setting	Interlocks <input type="checkbox"/> Fixture Clamped <input type="checkbox"/> Lamp Button Pressed <input type="checkbox"/> Clamp Button Pressed <input type="checkbox"/> Drive Motor Running <input type="checkbox"/> Cooler Circulation On <input type="checkbox"/> Heater On	
PIB3: Control PCB Injector Cable: 4.653 V 16 ID Current Gain: 1: 0.990, 2: 0.985, 3: 0.970, 4: 1.010 <input type="checkbox"/> No Errors A204A902 - 1.00b17	<input type="checkbox"/> Motor Circuit Breaker <input type="checkbox"/> Main Guard Open <input type="checkbox"/> Disable Interlock Messages	<input type="checkbox"/> Log Temperature Control <input type="checkbox"/> Lamp ON
Backleak Unit Status <input type="checkbox"/> Back Leak Pressure Applied Leak Rate: 0 Back Leak Pressure: 0 mbar	Supply Temp: 39.8 °C Rail Pressure: 1 bar	

Back Leak Unit Errors

- Injector Line 1: OK
- Injector Line 2: OK
- Injector Line 3: OK
- Injector Line 4: OK

OK

Backleak Errors											Reset	Return
F1	F2	F3	F4	F5	F6	F7	F8	F9	F10	F11	F12	

Illustration 9 Status and Diagnostics – Back Leak Errors mask

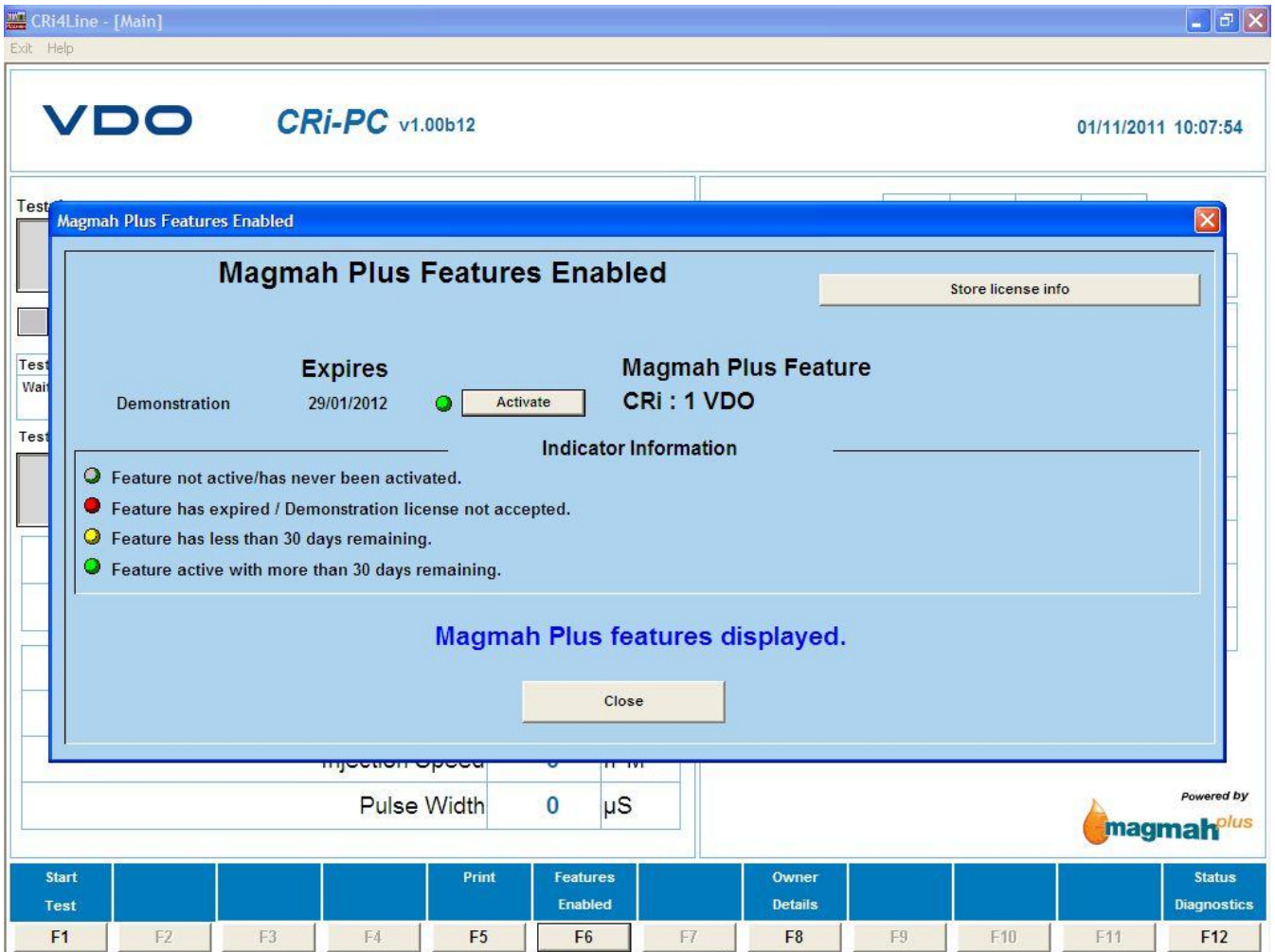


Illustration 10 Enabled features' window

License details for the VDO software can be found in window shown on Illustration 10.

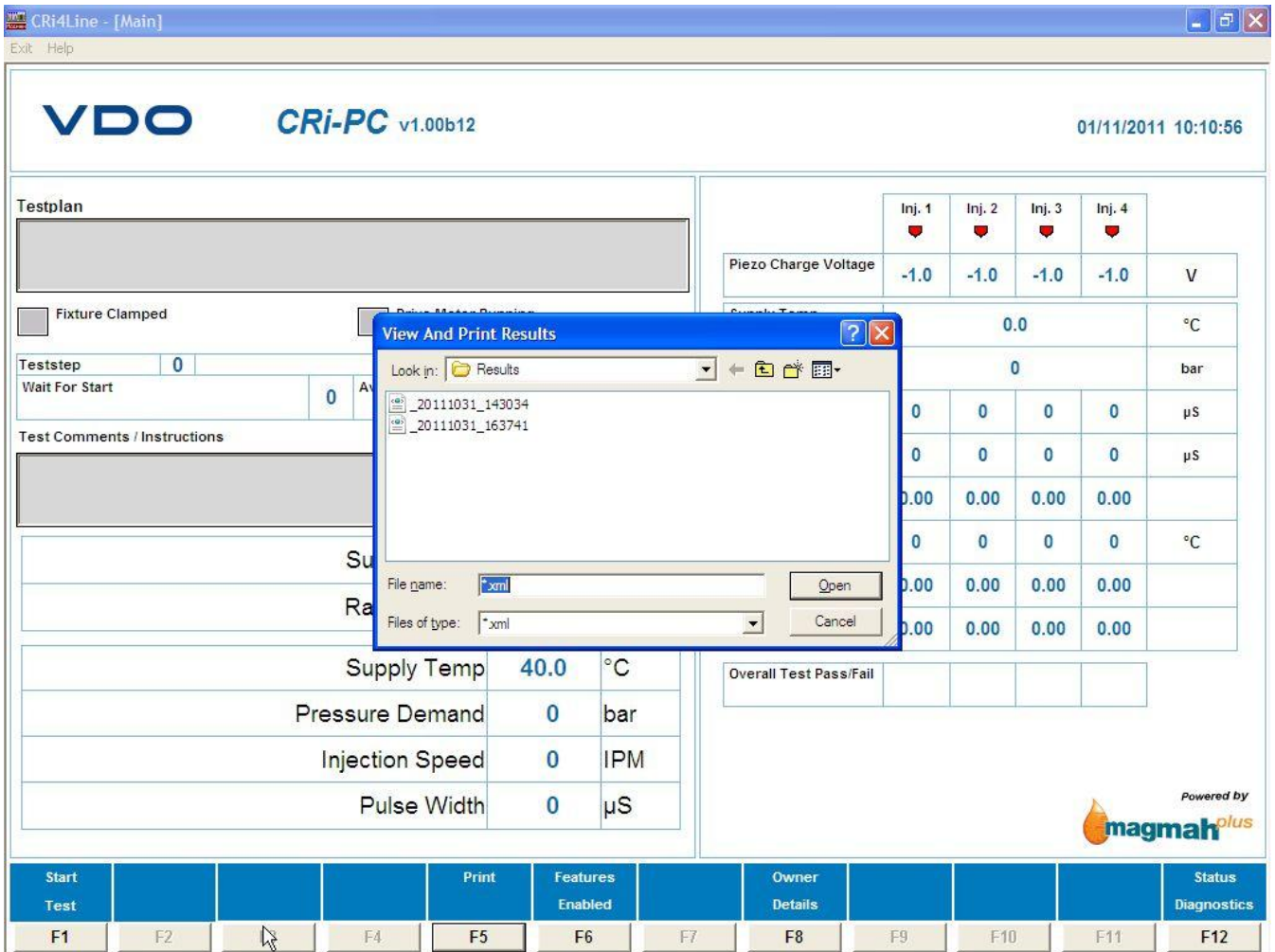


Illustration 11 Open Dialog Box for printing of the reports



Injector Test Results

Date:	01/11/2011
Time:	11:20:01
Ref:	VDO 4Line 2nd run
Part No:	DV4_EU4

	1	2	3	4
Serial Number	17-24	19-24	18-24	20-24
Overall Status	✓	✓	✓	✓
CP5	✓	✓	✓	✓
CP4	✓	✓	✓	✓
CP3	✓	✓	✓	✓
CP2	✓	✓	✓	✓
CP1	✓	✓	✓	✓
CP1_2	✓	✓	✓	✓
Service Dealer		Operator: MP		
Name: VDO 4Line		Signature:		
Address: x Frankfurt		Date:		
DRS No				
Telephone No.x Fax No.x E-Mail.replacementparts@vdo.com				

Illustration 12 Printout of the report opened in Internet Explorer



7.5. Injector testing

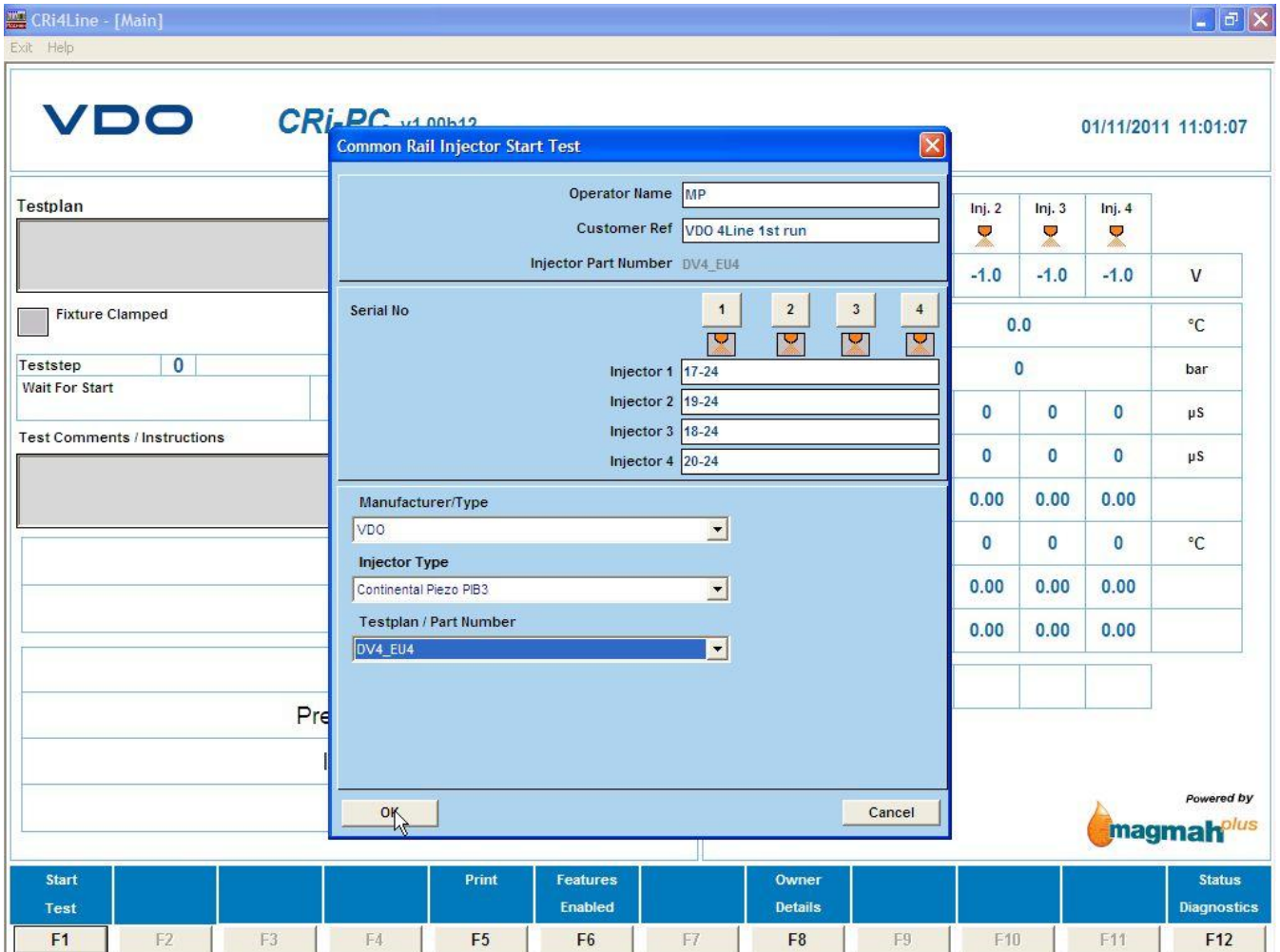


Illustration 13 Test start – definition of the initial data

To start testing procedure, Push F1 button, Input the operator's name and Customers Reference (for example the number of the Invoice) choose which line is to be operated (only for 4 line machine) type the serial numbers of the injectors. Choose the test plan for the identified injectors and push the "OK" button. The test will start automatically.

CRi4Line - [Main]
Exit Help

VDO **CRi-PC** v1.00b12 01/11/2011 11:01:18

Testplan DV4_EU4

K0614V2

Fixture Clamped Drive Motor Running

Teststep 1 CP5

Wait For Start 0 Averaging Readings 0

Test Comments / Instructions

Max power

	Inj. 1	Inj. 2	Inj. 3	Inj. 4	
Piezo Charge Voltage	-1.0	-1.0	-1.0	-1.0	V
Supply Temp	0.0				°C
Rail Pressure	0				bar
Response Time	0	0	0	0	µS
	0	0	0	0	µS
	0.00	0.00	0.00	0.00	mm3/st
	0	0	0	0	°C
Delivery	0.00	0.00	0.00	0.00	mm3/st
Delivery Variation	0.00	0.00	0.00	0.00	mm3/st
Overall Test Pass/Fail					

Supply Temp	38.8	°C
Rail Pressure	0	bar
Supply Temp	40.0	°C
Pressure Demand	1500	bar
Injection Speed	1000	IPM
Pulse Width	830	µS

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Stop Test				Print	Features Enabled		Owner Details				Status Diagnostics
F1	F2	F3	F4	F5	F6	F7	F8	F9	F10	F11	F12

Illustration 14 Test start – installing of injectors in clamping and starting of the motor

If the injectors are not correctly installed or the motor is not running, a message in the centre of the screen will appear. Please check and correct and push the “OK” button.

CRi4Line - [Main] Exit Help

VDO **CRi-PC** v1.00b12 01/11/2011 11:02:03

Testplan DV4_EU4

K0614V2

Fixture Clamped
 Drive Motor Running

Teststep 1 CP5

Wait For Start 0 Averaging Readings 0

Test Comments / Instructions

Max power

Supply Temp	40.3	°C
Rail Pressure	75	bar
Supply Temp	40.0	°C
Pressure Demand	1500	bar
Injection Speed	1000	IPM
Pulse Width	830	µS

	Inj. 1	Inj. 2	Inj. 3	Inj. 4	
Piezo Charge Voltage	-1.0	-1.0	-1.0	-1.0	V
Supply Temp	0.0				°C
Rail Pressure	0				bar
Response Time	0	0	0	0	µS
Response Variation	0	0	0	0	µS
Back Leak Flow	0.00	0.00	0.00	0.00	mm3/st
Back Leak Temp	0	0	0	0	°C
Delivery	0.00	0.00	0.00	0.00	mm3/st
Delivery Variation	0.00	0.00	0.00	0.00	mm3/st
Overall Test Pass/Fail					

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magma^{plus}

Stop Test				Print	Features Enabled		Owner Details				Status Diagnostics
F1	F2	F3	F4	F5	F6	F7	F8	F9	F10	F11	F12

Illustration 15 Test start - successful installation of the injectors and operation of the drive motor

Once the injectors are installed in clamping fixture and the motor is running, two green ticks/check marks (see Illustration 15) will be visible and test procedure will start (see Illustration 16 and 17).

During the first two test steps (“Low Pressure Leakage Test” and “High Pressure Leakage Test”) please check whether there are any leakages.

CRi4Line - [Main] Exit Help

VDO **CRi-PC** v1.00b12 01/11/2011 11:04:26

Testplan DV4_EU4

K0614V2

Fixture Clamped Drive Motor Running

Teststep 1 CP5

Wait For Start 9 Averaging Readings 1

Test Comments / Instructions

Max power

Supply Temp	39.5	°C
Rail Pressure	1501	bar
Supply Temp	40.0	°C
Pressure Demand	1500	bar
Injection Speed	1000	IPM
Pulse Width	830	µS

	Inj. 1	Inj. 2	Inj. 3	Inj. 4	
Piezo Charge Voltage	106.1	110.0	106.1	113.9	V
Supply Temp	39.5				°C
Rail Pressure	1501				bar
Response Time	427	435	446	389	µS
Response Variation	0	0	0	0	µS
Back Leak Flow	43.38	47.04	44.22	44.16	mm3/st
Back Leak Temp	54	57	58	51	°C
Delivery	31.85	31.61	30.87	31.73	mm3/st
Delivery Variation	0.00	0.00	0.00	0.00	mm3/st
Overall Test Pass/Fail					

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magma^{plus}

Stop Test				Print	Features Enabled		Owner Details				Status Diagnostics
F1	F2	F3	F4	F5	F6	F7	F8	F9	F10	F11	F12

Illustration 16 System adjusted to the demands

The software shows details of each test step (incl. the number of the test step, short description, “wait to start” time before measurement, average readings and the requirements of the system).

CRi4Line - [Main] Exit Help

VDO **CRi-PC** v1.00b12 01/11/2011 11:02:37

Testplan DV4_EU4

K0614V2

Fixture Clamped Drive Motor Running

Teststep 1 CP5

Wait For Start 119 Averaging Readings 1

Test Comments / Instructions

Max power

	Inj. 1	Inj. 2	Inj. 3	Inj. 4	
Piezo Charge Voltage	112.9	115.8	108.0	117.8	V
Supply Temp	39.2				°C
Rail Pressure	1497				bar
Response Time	382	416	451	458	µs
	0	0	0	0	µs
	16	32.10	31.80		mm3/st
Injection Temp	30	31	32	26	°C
Delivery	32.47	31.53	5.19	32.98	mm3/st
Delivery Variation	0.00	0.00	0.00	0.00	mm3/st
Overall Test Pass/Fail					

Supply Temp	39.2	°C
Rail Pressure	1497	bar
Supply Temp	40.0	°C
Pressure Demand	1500	bar
Injection Speed	1000	IPM
Pulse Width	830	µs

I

Learning

Learning Firing Sequence

X

Stop Test	F2	F3	F4	F5	F6	F7	F8	F9	F10	F11	Status Diagnostics
F1											

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Illustration 17 Testing - Learning of the firing sequence

CRi4Line - [Main] Exit Help

VDO **CRi-PC** v1.00b12 01/11/2011 11:04:39

Testplan DV4_EU4

K0614V2

Fixture Clamped Drive Motor Running

Teststep: 1 CP5

Wait For Start: 0 Averaging Readings: 0

Test Comments / Instructions

Max power

Supply Temp	39.5	°C
Rail Pressure	1499	bar
Supply Temp	40.0	°C
Pressure Demand	1500	bar
Injection Speed	1000	IPM
Pulse Width	830	µS

	Inj. 1	Inj. 2	Inj. 3	Inj. 4	
Piezo Charge Voltage	105.6	111.4	106.1	115.3	V
Supply Temp	39.5				°C
Rail Pressure	1499				bar
Response Time	447	436	446	395	µS
Response Variation	0	0	0	0	µS
Back Leak Flow	45.24	46.38	43.68	45.78	mm3/st
Back Leak Temp	57	59	61	54	°C
Delivery	31.65	31.36	30.83	31.75	mm3/st
Delivery Variation	0.00	0.00	0.00	0.00	mm3/st
Overall Test Pass/Fail	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	

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Stop Test				Print	Features Enabled		Owner Details				Status Diagnostics
F1	F2	F3	F4	F5	F6	F7	F8	F9	F10	F11	F12

Illustration 18 The first test step (CP5) completed

CRi4Line - [Main] Exit Help

VDO **CRi-PC** v1.00b12 01/11/2011 11:05:42

Testplan DV4_EU4

K0614V2

Fixture Clamped Drive Motor Running

Teststep **2** CP4

Wait For Start Averaging Readings

Test Comments / Instructions

Max torque

Supply Temp	39.5	°C
Rail Pressure	1152	bar
Supply Temp	40.0	°C
Pressure Demand	1150	bar
Injection Speed	1000	IPM
Pulse Width	1162	µS

	Inj. 1	Inj. 2	Inj. 3	Inj. 4	
Piezo Charge Voltage	105.6	106.1	106.5	114.4	V
Supply Temp	39.5				°C
Rail Pressure	1152				bar
Response Time	386	413	404	384	µS
Response Variation	0	0	0	0	µS
Back Leak Flow	37.56	41.94	40.74	38.82	mm3/st
Back Leak Temp	60	64	65	55	°C
Delivery	37.25	36.39	36.54	37.03	mm3/st
Delivery Variation	0.00	0.00	0.00	0.00	mm3/st
Overall Test Pass/Fail	✓	✓	✓	✓	

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Stop Test				Print	Features Enabled		Owner Details				Status Diagnostics
F1	F2	F3	F4	F5	F6	F7	F8	F9	F10	F11	F12

Illustration 19 The completion of the second test step

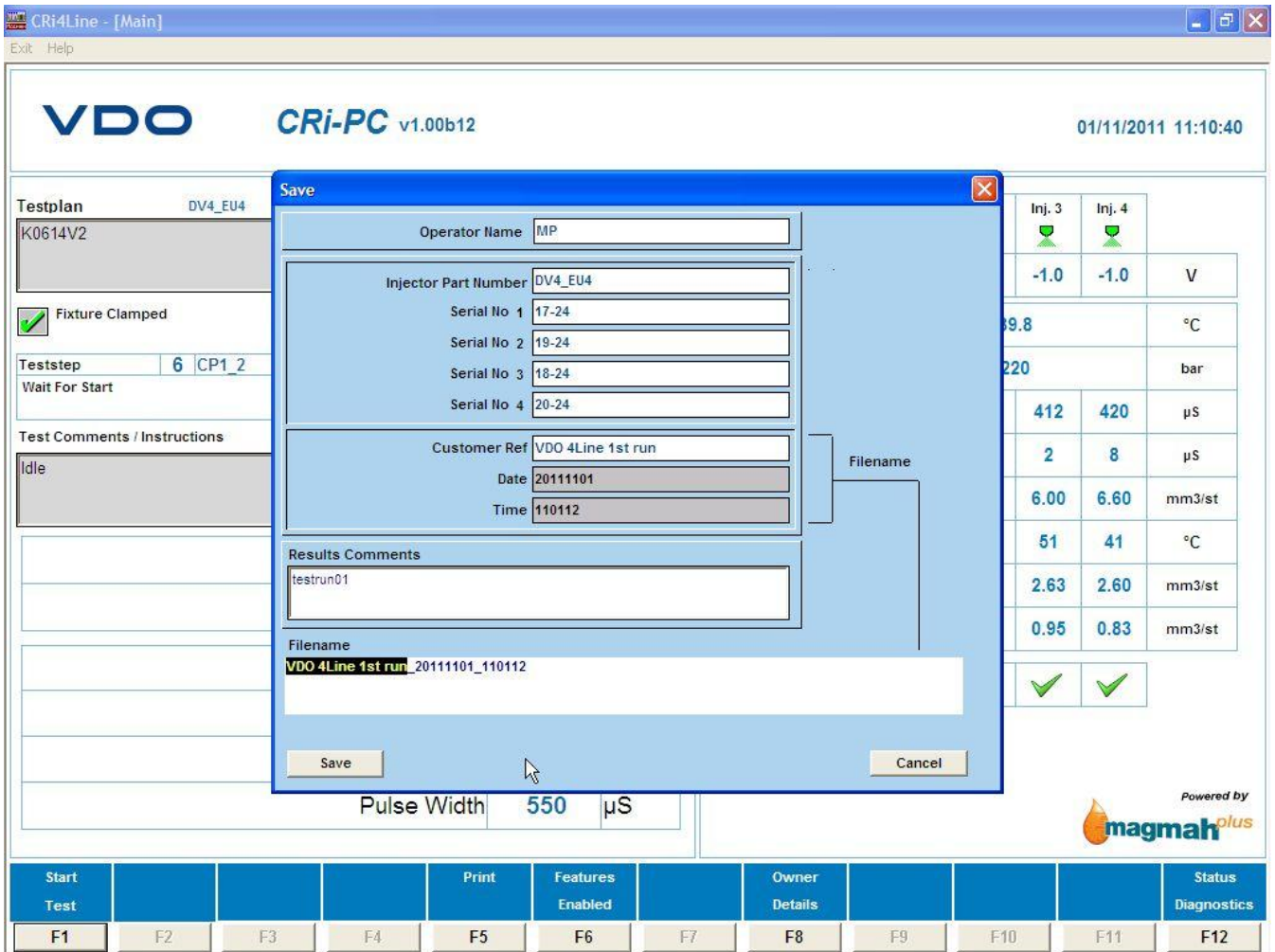


Illustration 20 The end of the 6th test step - Saving the results

After the final test step is finished the software will open a dialogue window for saving the report file, which can be later opened and printed out. It is possible to add some comments to the report file or re-enter the values from the fields coloured white.

If all the data is correct, don't forget to save or the data will be lost!

CRi4Line - [Main] Exit Help

VDO **CRi-PC** v1.00b12 01/11/2011 11:10:56

Testplan DV4_EU4

K0614V2

Fixture Clamped Drive Motor Running

Teststep: 6 CP1_2

Wait For Start: 0 Averaging Readings: 0

Test Comments / Instructions

Idle

Supply Temp	39.2	°C
Rail Pressure	66	bar
Supply Temp	40.0	°C
Pressure Demand	220	bar
Injection Speed	1000	IPM
Pulse Width	550	µS

	Inj. 1	Inj. 2	Inj. 3	Inj. 4	
Piezo Charge Voltage	-1.0	-1.0	-1.0	-1.0	V
Supply Temp	39.8				°C
Rail Pressure	220				bar
Response Time	421	403	412	420	µS
Response Variation	5	5	2	8	µS
Back Leak Flow	6.48	5.76	6.00	6.60	mm3/st
Back Leak Temp	46	47	51	41	°C
Delivery	2.07	3.21	2.63	2.60	mm3/st
Delivery Variation	0.63	0.88	0.95	0.83	mm3/st
Overall Test Pass/Fail	✓	✓	✓	✓	

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Start Test

Print

Features Enabled

Owner Details

Status Diagnostics

F1

F2

F3

F4

F5

F6

F7

F8

F9

F10

F11

F12

Illustration 21 The end of the test procedure - results report and file saved

Once the report is saved or cancelled, software will show a summary window.

CRI4Line - [Main] Exit Help

VDO **CRI-PC** v1.00b12 01/11/2011 11:11:11

Testplan DV4_EU4

K0614V2

Fixture Clamped

Teststep 6 CP1_2

Wait For Start 0

Test Comments / Instructions

Idle

	Inj. 1	Inj. 2	Inj. 3	Inj. 4	
Piezo Charge Voltage	-1.0	-1.0	-1.0	-1.0	V
	39.8				°C
	220				bar
	421	403	412	420	µS
	5	5	2	8	µS
	5.48	5.76	6.00	6.60	mm3/st
	46	47	51	41	°C
	2.07	3.21	2.63	2.60	mm3/st
	0.63	0.88	0.95	0.83	mm3/st

Overall Test Pass/Fail	✓	✓	✓	✓
------------------------	---	---	---	---

Supply Temp	40.0	°C
Pressure Demand	220	bar
Injection Speed	1000	IPM
Pulse Width	550	µS

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Start Test				Print	Features Enabled		Owner Details				Status Diagnostics
F1	F2	F3	F4	F5	F6	F7	F8	F9	F10	F11	F12

Illustration 22 Opening of the result report



Injector Test Results

Date:	01/11/2011
Time:	11:20:01
Ref:	VDO 4Line 2nd run
Part No:	DV4_EU4

	1	2	3	4
Serial Number	17-24	19-24	18-24	20-24
Overall Status	✓	✓	✓	✓
CP5	✓	✓	✓	✓
CP4	✓	✓	✓	✓
CP3	✓	✓	✓	✓
CP2	✓	✓	✓	✓
CP1	✓	✓	✓	✓
CP1_2	✓	✓	✓	✓
Service Dealer		Operator: MP		
Name: VDO 4Line		Signature:		
Address: x Frankfurt		Date:		
DRS No				
Telephone No.x Fax No.x E-Mail.replacementparts@vdo.com				

Illustration 23 Report of the measured results



7.6. Language support



Illustration 24 Changing the language

In order to change the language please click on “Change Language” under menu entry “Help”. After that the language will be switched automatically to the language of your choice (Illustrations 24 and 25).

Important notice: the software supports only 2 languages installed on the machine at the same time. Report will be also saved in the desired language. Please note that once you have saved a report file in one language, for example English, it will always be opened in that language!

CRi4Line - [Main] Verlassen ?

VDO **CRi-PC** v1.00b12 01/11/2011 11:35:23

Prüfplan DV4_EU4

K0614V2

Aufspannelement festgeklemmt Antriebsmotor läuft

Prüfschritt 1 CP5

Warten auf Start 0 Messwerte mitteln 1

Prüfungskommentare / Anweisungen

Max power

Eingangstemp.	39.8	°C
Schienendruck	2	bar
Eingangstemp.	40.0	°C
Druckbedarf	1500	bar
Einspritzgeschwindigkeit	1000	IPM
Impulsbreite	830	µs

	Inj. 1	Inj. 2	Inj. 3	Inj. 4	
Piezo-Ladespannung	-1.0	-1.0	-1.0	-1.0	V
Eingangstemp.	40.1				°C
Schienendruck	1497				bar
Antwortzeit	451	462	435	451	µs
Antwortabweichung	0	0	0	0	µs
Rückflussrate	0.00	0.00	0.00	0.00	mm3/st
Rückflusstemp	70	70	73	64	°C
Abgabe	0.00	32.02	32.31	31.33	mm3/st
Abgabeabweichung	0.00	0.00	0.00	0.00	mm3/st
Gesamtprüfung					
Erfolg/Fehler					

Powered by
magma^{plus}

Start				Drucken	Funktionen		Eigentümer				Status
Prüfung					Aktiviert		Details				Diagnose
F1	F2	F3	F4	F5	F6	F7	F8	F9	F10	F11	F12

Illustration 25 Language changed

7.7. Tips

7.7.1. Cable check

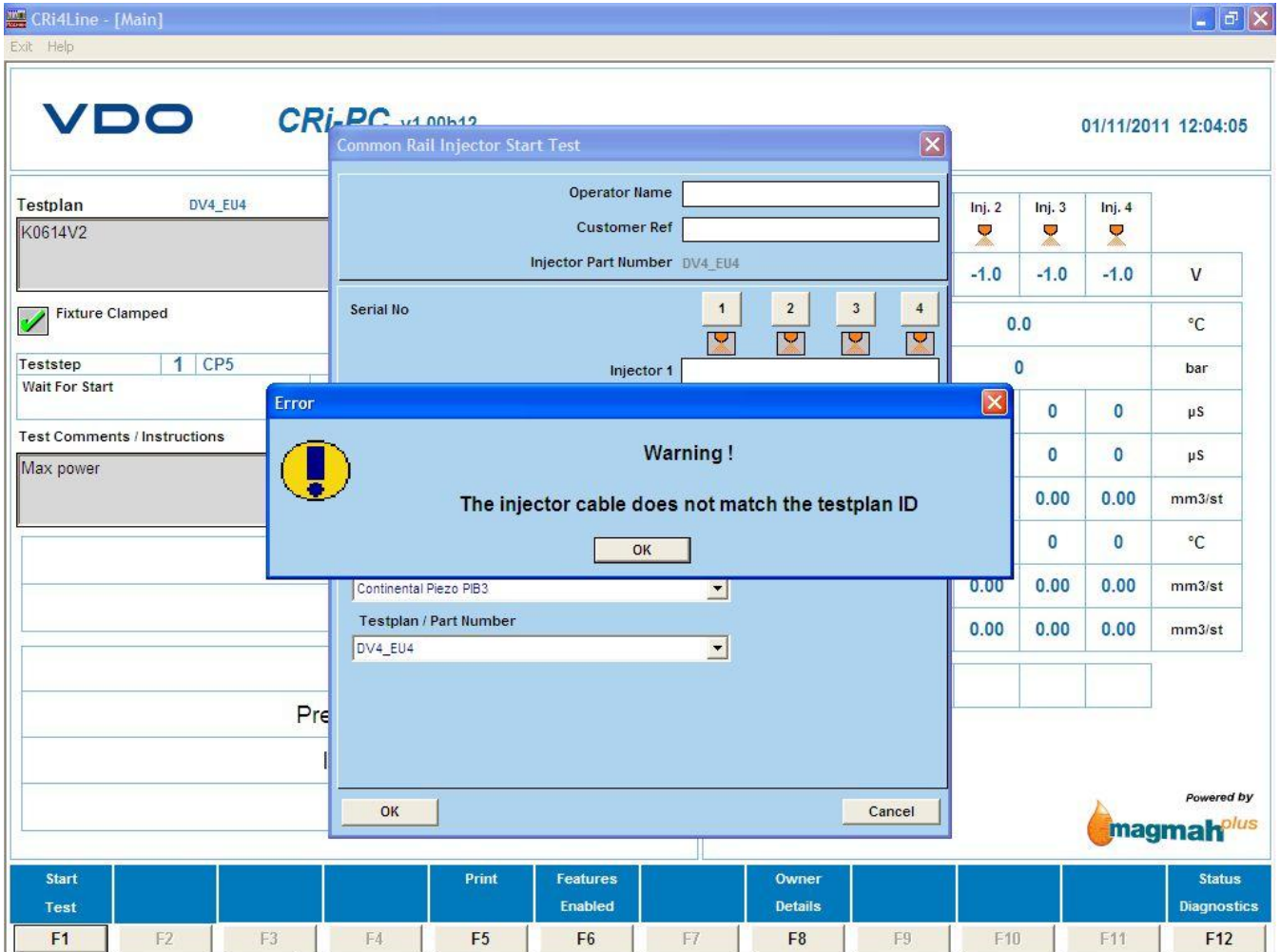


Illustration 26 Cable check

The VDO software checks automatically that the correct cable is connected, otherwise an error message will appear.

7.7.2. Injector not connected or broken actuator

The screenshot displays the VDO CRI-PC v1.00b12 software interface. The main window shows test parameters for a test plan 'K0614V2' under 'DV4_EU4'. The test step is '4 CP2' with 'Wait For Start' set to 59 and 'Averaging Readings' set to 1. A 'Learning' dialog box is open, titled 'Learning Firing Sequence', which is a blue box with a yellow and black warning icon. The dialog box is positioned over the 'Test Comments / Instructions' section, which contains the text 'Min injection quantity'. The main interface shows various test parameters in a table format:

	Inj. 1	Inj. 2	Inj. 3	Inj. 4	
Piezo Charge Voltage	110.0	109.0	-1.0	155.9	V
Supply Temp	39.4				°C
Rail Pressure	938				bar
Response Time	394	402	-1	999	µs
Min injection quantity	0	0	0	0	µs
Delivery	0.00	0.00	0.00	0.00	mm3/st
Delivery Variation	0.00	0.00	0.00	0.00	mm3/st
Overall Test Pass/Fail	✓	✓		✗	

Below the main table, there are several rows of parameters:

Supply Temp	39.4	°C
Rail Pressure	938	bar
Supply Temp	40.0	°C
Pressure Demand	850	bar
Injection Speed	1000	IPM
Pulse Width	154	µs

The bottom of the interface features a navigation bar with buttons for 'Stop Test', 'Print', 'Features Enabled', 'Owner Details', and 'Status Diagnostics'. The 'Status Diagnostics' button is highlighted in blue. The bottom right corner of the interface includes the 'magmah plus' logo and the text 'Powered by'.

Illustration 27 Broken piezo actuator or no plug connected

If the connection to the injector cannot be established the software will still keep showing the dialogue box "Learning Firing Sequence". The Response Time will be at the level of 999µs and the injector will fail every step of the test.

7.7.3. False test plan selected

The screenshot shows the VDO CRI-PC v1.00b12 software interface. The window title is "CRI4Line - [Main]". The date and time are 01/11/2011 14:47:02. The test plan is "K0614V1" under "DV4_EU3". The test step is "5 CP1" with "Wait For Start" set to 59 and "Averaging Readings" set to 1. The test comments are "Idle".

The summary table shows the following parameters:

	Inj. 1	Inj. 2	Inj. 3	Inj. 4	
Piezo Charge Voltage	107.5	106.5	109.5	108.0	V
Supply Temp	40.1				°C
Rail Pressure	585				bar
Response Time	999	999	999	999	µs
Response Variation	0	0	0	0	µs
Back Leak Flow	0.00	0.00	0.00	0.00	mm3/st
Back Leak Temp	62	64	66	57	°C
Delivery	0.00	0.00	0.00	0.00	mm3/st
Delivery Variation	0.00	0.00	0.00	0.00	mm3/st
Overall Test Pass/Fail	✗	✗	✗	✗	

The interface also shows a "magmah plus" logo and a bottom menu with buttons for "Stop Test", "Print", "Features Enabled", "Owner Details", and "Status Diagnostics".

Illustration 28 Test plan for EU3 injectors – 5th test step

If the wrong test plan was selected at beginning of the test procedure, the injector will fail the test.

7.7.4. Connection of the plugs to different measuring units

7.7.4.1. Two plugs wrongly connected

VDO CRI-PC v1.00b12 01/11/2011 16:54:08

Testplan: DV4_EU4
K0614V2

Fixture Clamped Drive Motor Running

Teststep: 6 CP1_2
Wait For Start: 0 Averaging Readings: 2

Test Comments / Instructions: Idle

Supply Temp	39.6	°C
Rail Pressure	221	bar
Supply Temp	40.0	°C
Pressure Demand	220	bar
Injection Speed	1000	IPM
Pulse Width	550	μS

	Inj. 1	Inj. 2	Inj. 3	Inj. 4	
Piezo Charge Voltage	106.1	107.0	108.0	106.5	V
Supply Temp	39.6				°C
Rail Pressure	221				bar
Response Time	424	999	999	429	μs
Response Variation	0	0	0	0	μs
Back Leak Flow	6.42	7.56	7.20	6.00	mm3/st
Back Leak Temp	63	64	67	58	°C
Delivery	1.91	3.37	2.11	3.39	mm3/st
Delivery Variation	0.00	0.00	0.00	0.00	mm3/st
Overall Test Pass/Fail	✓	✓	✓	✓	

Powered by **magma^{plus}**

Stop Test: F1, F2, F3, F4, F5, F6, F7, F8, F9, F10, F11, F12

Illustration 29 The 2nd and 3rd plug are switched

If the plugs are connected to the wrong injectors, this will result in slow response time. If the value reaches the level of 999μs check that the cables are connected to the correct injector position— see Illustration 29 and 30.

7.7.4.2. Four plugs wrongly connected

VDO CRI-PC v1.00b12 01/11/2011 16:43:30

Testplan: DV4_EU4
K0614V2

Fixture Clamped Drive Motor Running

Teststep: 6 CP1_2
Wait For Start: 0 Averaging Readings: 4

Test Comments / Instructions: Idle

Supply Temp	39.3	°C
Rail Pressure	222	bar
Supply Temp	40.0	°C
Pressure Demand	220	bar
Injection Speed	1000	IPM
Pulse Width	550	µS

	Inj. 1	Inj. 2	Inj. 3	Inj. 4	
Piezo Charge Voltage	107.0	107.5	108.5	107.0	V
Supply Temp	39.3				°C
Rail Pressure	222				bar
Response Time	999	999	999	999	µS
Response Variation	0	0	0	0	µS
Back Leak Flow	0.00	0.00	0.00	0.00	mm3/st
Back Leak Temp	62	62	67	56	°C
Delivery	2.67	3.38	1.87	1.77	mm3/st
Delivery Variation	0.00	0.00	0.00	0.00	mm3/st
Overall Test Pass/Fail	✓	✓	✓	✓	

Powered by **magma^{plus}**

Stop Test: F1 | F2 | F3 | F4 | F5 | F6 | F7 | F8 | F9 | F10 | F11 | F12 | Print | Features Enabled | Owner Details | Status Diagnostics

Illustration 30 The plugs are switched (1st with 4th and 2nd with 3rd)

7.7.4.3. Two plugs wrongly connected and line deactivated

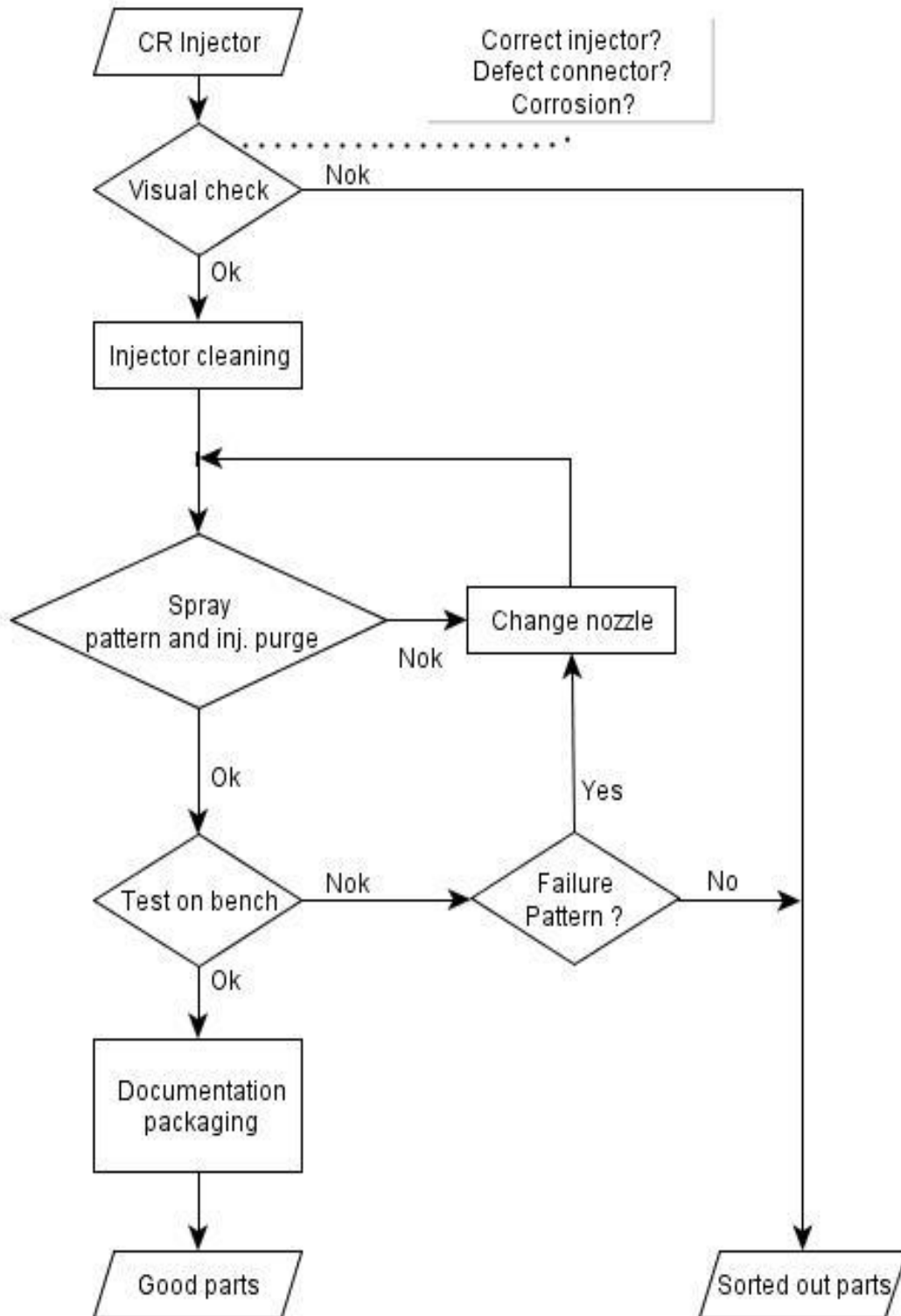
The screenshot displays the CRI4Line software interface. The main window shows the test plan 'K0614V2' and various test parameters. The results table indicates that Inj. 2 and Inj. 3 have failed, while Inj. 1 and Inj. 4 passed.

	Inj. 1	Inj. 2	Inj. 3	Inj. 4	
Piezo Charge Voltage	105.6	106.1	-1.0	106.1	V
Supply Temp	39.8				°C
Rail Pressure	220				bar
Response Time	418	999	-1	425	µs
Response Variation	0	0	0	0	µs
Back Leak Flow	0.00	0.00	0.00	0.00	mm3/st
Back Leak Temp	66	67	71	61	°C
Delivery	2.28	0.00	0.00	2.70	mm3/st
Delivery Variation	0.00	0.00	0.00	0.00	mm3/st
Overall Test Pass/Fail	✓	✗		✓	

Illustration 31 The plugs for line 2 and 3 are switched and the line 3 is deactivated

In this scenario the plugs from line 2 and 3 were switched and the line 3 was deactivated. It means that injector 2 is operated by line 3 cable and this particular line is inactive. The software tries to measure the delivery from the 2nd injector and once again the response time stays constantly at the level of 999µs.

8. Workflow



9. Injector storage

If the repaired injectors are to be stored for a long period of time, it is recommend that they are stored in special VCI bags with water vapour permeability $\leq 0,01 \text{ g/m}^2\cdot\text{d}$ (measured at 23°C / 85% ambient air humidity according to DIN 53122).

Injectors stored in vacuum-sealed bags have a maximum storage period of one year. After this time we recommend retest and repackage as necessary.

Order number X11-800-100-101

9.1. Injector packaging

As and when required, VDO original packaging can be used. In this case the repaired injector must be sealed in an appropriate coated bag (for details see section 9 on this page), then packed in VDO Original Box (Order Number A2C59507770) and marked with a VDO Label, designed especially for the repaired injectors. Illustration below reflects the VDO label design:

A2C59511601	
Injector repaired according to the VDO requirements	
CR System Type : DW10B	DRS Partner : Schmitz & Krieger
Class or Code : Class 6	DRS Number : D 001/08
Refurbished : 28.07.2012	
Use Before: 27.07.2013	VDO original repair parts used



The QR-Code includes following data:

[Part Number]
[Refurbished][Date of Repair]
[UseBefore][Use Before Date]
[DRS Number]

For example:

A2C59511601
Refurbished28.07.2012
UseBefore27.07.2012
DRS 001/08

10. Test on bench – monthly feedback

In order to meet the quality level and to continuously improve the service we need your feedback. We kindly ask you to provide a monthly feedback by sending the data files created by your Hartridge CRi-PC which includes data about the tests which have been run on the bench. The result files can be found on your CRi-PC under **C:\VDO\Cri\Results**

Please forward us the data to the following email address:

07DEFMDieselIAM@continental-corporation.com

11. Engine test – test drive

In order to finish the repair procedure the repaired injector/injectors need to be tested in a car. If possible mount the CR Injectors exactly in the same position (cylinder) as before, and start the engine. If the engine jerks in idle or during the test drive isn't functioning smoothly the CR Injector have to be replaced.

11.1. Injector copper ring

The injector Copper Ring must always be replaced.

Order numbers for the different systems, can be found in the latest Diesel Handout catalogue on the VDO Extranet site.

12. FAQs listed by problems

Where do I get software to test VDO CR Injectors on a Hartridge test bench?

The VDO CR Injector test software for the Hartridge CRi-PC can only be sourced by authorised DRS partners.

Software installation problems. What I am doing wrong?

If there are any further questions/problems, please contact your local Hartridge distributor/Hartridge support.

Software license, where do I get it from and how long is it valid?

The software license is valid for 1 year from the day of the activation on CRi-PC. After the expiration date, the software will no longer function. To extend it, please contact your local Hartridge dealer.

Problems with the CRi-PC

In case of any problems with CRi-PC, please contact your local Hartridge representative, who provide appropriate support.

What if a CR Injector fails the tests after being repaired?

In case a repaired CR Injector does not work properly, please replace the nozzle and nozzle retaining nut again and run the test on the bench. If this does not help, this particular CR Injector cannot be repaired and needs to be replaced.

Dealer's stamp

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The information provided in this brochure contains only general descriptions or performance characteristics, which do not always apply as described in case of actual use or which may change as a result of further development of the products. This information is merely a technical description of the product. This information is not meant or intended to be a special guarantee for a particular quality or a particular durability. An obligation to provide the respective characteristics shall only exist if expressly agreed in the terms of contract. We reserve the right to make changes in availability as well as technical changes without prior notice.

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Please note:

Application – The products described in this catalogue are designed for use in land vehicles, engines and equipment.
Disclaimer – The data in this replacement parts catalogue has been compiled and processed for the purpose of presenting our replacement parts range and is correct to the best of our knowledge. Subject to technical alterations, errors and omissions. Availability is not guaranteed. We cannot be held liable with regard to any information contained in the Continental Trading replacement parts catalogue except in case of intent, gross negligence or where mandatory liability is borne in accordance with German product liability law.

VDO