Diesel Tech CRU.2

Owner's Manual

007935095200

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Warranty

2 –YEAR CRU.2 LIMITED WARRANTY

"Magneti Marelli" company manufactures its equipment from new parts and components that are in accordance with industry-standard practices. Magneti Marelli warrants that the equipment it manufactures will be free of defects in materials and workmanship.
The warranty terms are 2 years, beginning on the date of the Magneti Marelli invoice in accordance with the following described:

This warranty does not cover damage due to external causes, including accident, abuse, misuse, scratches on external components or surfaces, problems with electrical power supply, servicing not authorized by Magneti Marelli, usage not in accordance with machine's operating manual, failure to perform required preventative maintenance, failure to change the testing calibration oil fluid (and

cleaning detergent) when indicated by machine, failure to change the testing (and cleaning) fluid filter when indicated by machine, to permit machines fluid pump to sit or operate without fluid in it, usage of improper testing or cleaning fluid in the machine, usage of improper ultrasonic cleaning fluid in the ultrasonic bath, usage of ultrasonic fluid instead of testing fluid or the opposite, usage of cleaning solvents and chemicals not provided or indicated/approved by Magneti Marelli, use of parts and components not supplied or approved by Magneti Marelli.
Note: Failure to clean injectors with Magneti Marelli's ultrasonic device (provided) before any test is performed on the CRU.2 test bench will void the warranty of the machine. *If the iVM sensor reading is out of specification or accuracy due to dirt (verified), the machine's warranty will be voided*.

Magneti Marelli will repair or replace parts and components returned to manufacturer's facility. To request warranty service, contact Magneti Marelli within the warranty period. If warranty service is required, you must ship the defective part or component in their original or equivalent packaging, prepay shipping charges, and insure, or accept the risk of loss or damage during shipment. Magneti Marelli will return the repaired or replacement part or component freight prepaid. If Magneti Marelli repairs or replaces a part or component, its warranty term is Not Extended.

Magneti Marelli does not accept liability beyond the remedies set forth in this warranty statement or liability for incidental or consequential damages.

Chapter 1
“Introduction”

Through the years, there has been an excess demand in Pollution Reduction, Fuel Economy and Enhanced Performance for Consumer Engines. Engine Manufacturers have gone a long way, since conventional Diesel systems, to reach today at the revolutionary approach of Electronically Controlled Injection systems, thereafter called Common-Rail (CRDI). With this approach they have successfully reduced emissions and gained fuel economy and performance through accurate injection of fuel.

The Electronically Controlled Diesel Fuel Injectors, although accurate, produce chronicle defects. Through time numerous faults may occur, such as fuel residue built-up at nozzle and back-leak valve (pressure-relief valve), electrical coil or Piezo crystal failure and injector pathway blockage. These faults in turn, produce an undesired effect which causes increase in emissions and fuel consumption, unstable engine operation and loss of engine performance.

Magneti Marelli, a leading manufacturer in Automotive Injection Service Solutions, offers the CRU.2 Unit for the treatment of all Common-Rail Injectors presently used, and provides upgradeability of the machine for Future Injectors.

Equipment checklist

Carefully unpack the machine and its components. Save the box and packaging materials for future use.

Check if you have all the following items:

- CRU.2 Series Common-Rail Testing and Servicing Unit
- Injector Ultrasonic Device [100/240 VAC] with:
    - Operating Manual
    - AC Power Cord[100/240 VAC]
    - Injector Holder
- AC [100/240 VAC] Power Cord, for CRU.2 Series Unit
- Calibrating Oil (Shell V-OEL 1404), prefilled ½ tank start-up consumable for Testing injectors
- 4 liter Ultrasonic Cleaning Solvent, start-up consumable for Ultrasonic Cleaning injectors
- 2 liter Cleaning Detergent, start-up consumable for MACC Cleaning of injectors [CRU.2-XXX1 only]
- Calibration Oil/Fluid Funnel – Large
- Cleaning detergent Funnel (MACC) - Small with extension for quick coupler [C] [CRU.2-XXX1 only]
- Adapters and Accessories Kit for Testing Injectors [look at Appendix B]
- Adapters and Accessories Kit for Cleaning Injectors [look at Appendix B] [CRU.2-XXX1 only]
- Piezo Injector Back-Leak Regulator Kit [Optional]
- Operating Manual and Quality Control Certificate

Options

There are a number of options to make the CRU.2 unit even more powerful and universal in diagnosing and servicing the Diesel Injectors. The following options are available:

Code	Description	Hardware Needed	Models
IRTS	Injection Response sensor	YES	CRU.2-XXXX
CIM	Coil Injector Inductance Test	NO	CRU.2-XX**0**X
MI	Multiple Injections Activation	NO	CRU.2-XXXX
IDB	Injector Database	NO	CRU.2-XXXX
ICD	Injector Coding	NO	CRU.2-XXXX
MACC	Upgrade Kit	YES	CRU.2-XXX**0**
CRIN ADAPTS	Industrial Common-Rail Injector Adapters *(Request availability list from your local dealer)*	YES	CRU.2-XXXX
PS80	Portable stand CRU.2	YES	CRU.2-XXXX
PRN	Hewlett Packard Printer Model (DeskJet USB)	YES	CRU.2-XXXX
PIR	Piezo Injector Back-Leak Regulator Kit	YES	CRU.2-XXXX

Chapter 2
“Product Tour”

This chapter provides an overview of the CRU.2 exterior views and connections. It covers the following topics:

- Front View
- Side View
- Rear View
- Rear View Symbols
- Serial Tag

A new user should be familiar with all the views and connections in this chapter.

Front View

a. Injector Clamp
b. Injector Spray Chamber fumes extractor
c. Injector Spray Chamber
d. Unit adjustable support pads
e. LCD/Touch Screen
f. Screen Cover
g. PC connections
h. EMERGENCY STOP power switch
i. Front Connections
    a. [sh] Sensor Harness connector (for future use)
    b. [ih] injector Harness connector
    c. iVM
        i. [D] iVM Testing Discharge Connector
        ii. [R] Testing Return Connector
    d. MACC
        i. [C] Cleaning MACC Discharge and Return Port
j. HP-T clear protective cover opening switch
k. Clear Protective cover

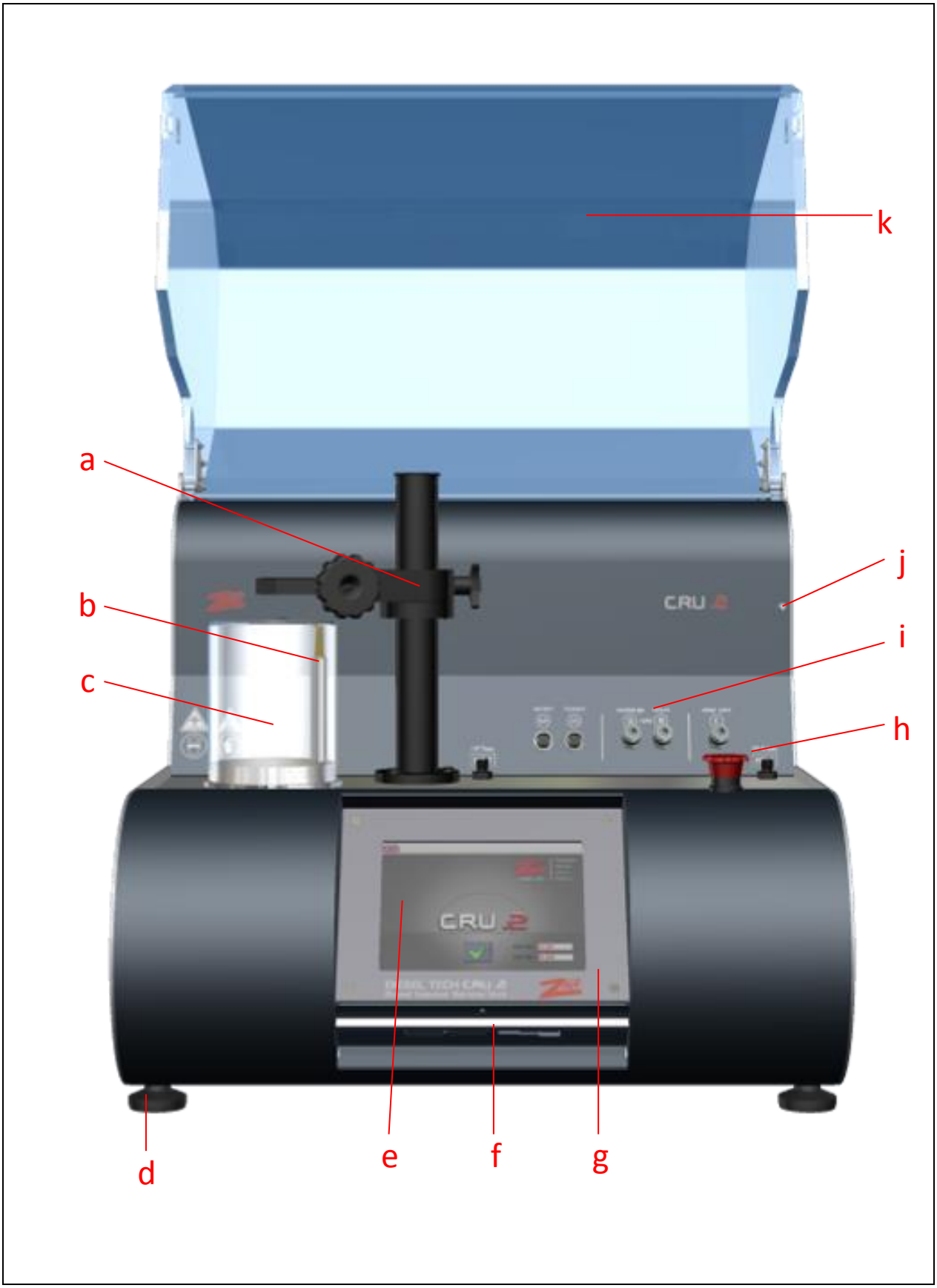


Figure 2-i

Side View

a. Left, Top Side Panel
b. Left, Bottom Side Panel
c. Testing Calibration OIL level indicator
d. Side air vents
e. Right, Top Side Panel
f. Right, Bottom Side Panel
g. Cleaning (MACC) detergent level indicator

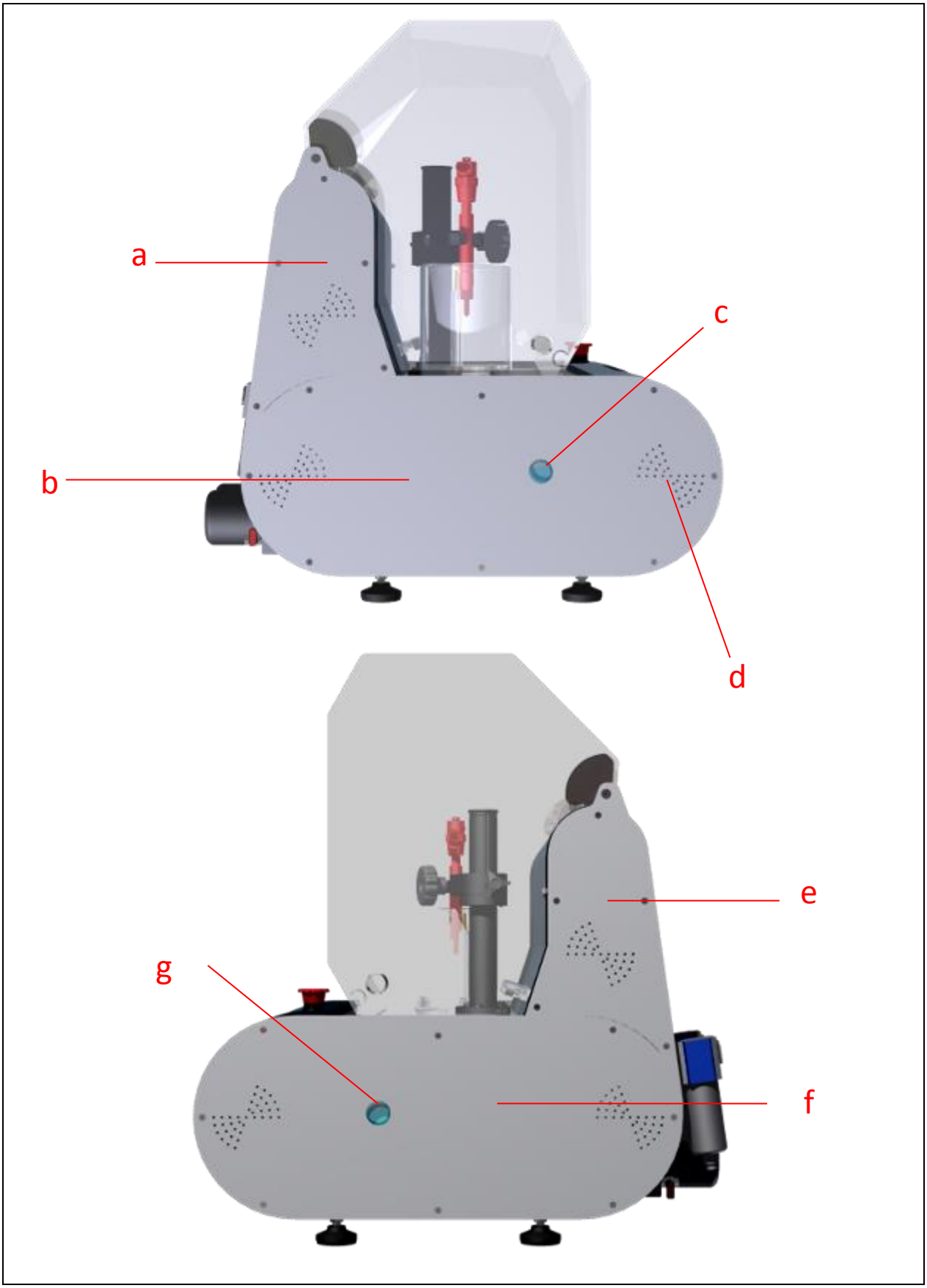


Figure 2-ii

Rear View

a. Rear Air vents
b. Rear, Top Panel
c. Spray Chamber fumes extractor output
d. Regulated and filtered compressed air input
e. HP Pump air exhaust ports
f. Cleaning (MACC) drain valve
g. Cleaning (MACC) Filter
h. Testing Calibration OIL Filter
i. Testing Calibration OIL drain valve
j. Rear, Bottom Panel
k. Mains, Rear ON/OFF switch
m. Rear Panel symbols (connections)
n. Serial Tag

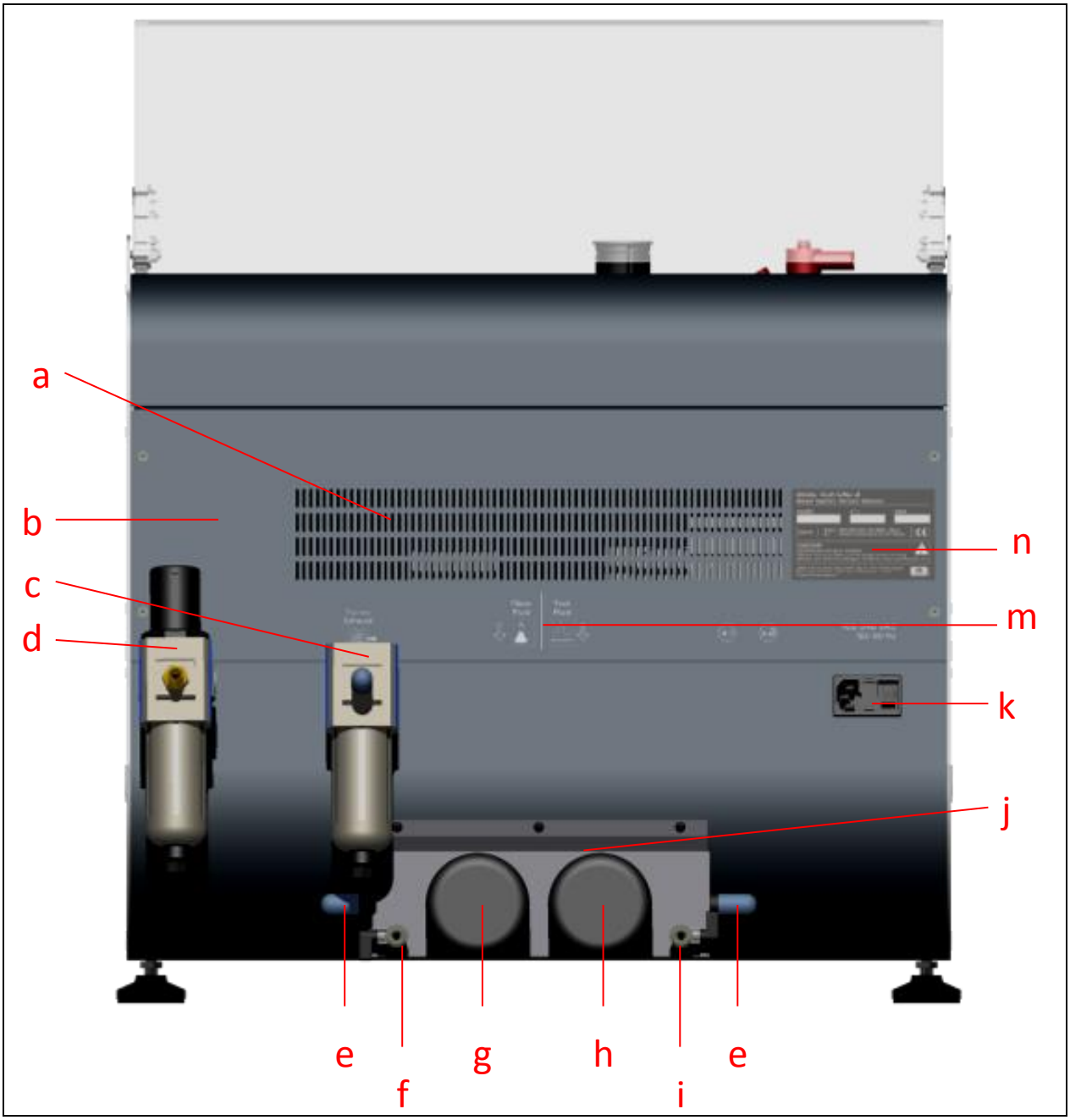
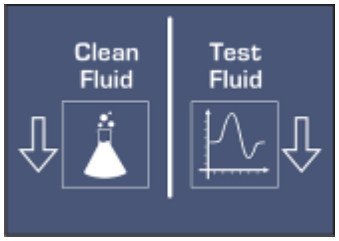


Figure 2-iii

Rear Panel symbols

: This symbol is used to denote the Air Input connection. Please consult Appendix A for specifications. Beneath it is a Water Trap/Filter/Regulator (Figure 2-iii-[d]).

: This symbol is used to denote the Fumes Output (Spray Chamber Extractor) Connection. DO NOT connect the compressed air line here. Beneath it is a Fumes, liquid Trap/collector / Separator (Figure 2-iii-[c]).

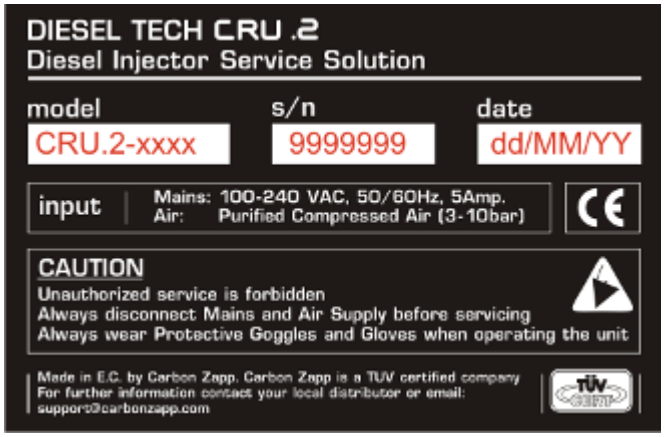


: This symbol denotes that in the left part of the machine the hydraulics are used for the Cleaning (MACC) and in the right part of the machine the hydraulics are used for Testing (Calibration Oil). The **level indicators**, **filters** and **drain valves** are considered hydraulics in this case.

: These symbols, x.1 and x.2, provide relative positions for further connectors.

: This symbol denotes the Mains Power Supply of the unit. Beneath it are the: ON/OFF switch, Fuse Holder and Mains Power Connector (Figure 2-iii-[k]). For further specifications, please consult Appendix A.

Serial Tag



: The Serial Tag of the machine provides information on the Machine Model, Serial Number, Date of Manufacturing and also basic specifications.

Chapter 3
“Getting Started”

This chapter provides basic information to start using the CRU.2 unit and covers the following topics:

[**info**]

All users should be familiar with diesel systems and should always wear protective goggles and gloves.

- Unpacking and setting up
- Connecting the AC power
- Connecting the Pneumatics
- Starting up for the first time
- Powering down the system

A new user should follow the steps in each section of this chapter in order to operate the machine.

Unpacking and setting up

- Verify that all the items in the equipment check list in Chapter 1 are present
- Place the CRU.2 Unit, Ultrasonic Device and Printer [optional] in a clean and well ventilated space
- Use a leveled, steady bench that can support the weight and vibrations of the machine, or use the PS80 Portable Stand [optional]. When using the PS80, the adjustable support pads of the CRU.2 unit should be removed (Figure 3-i).

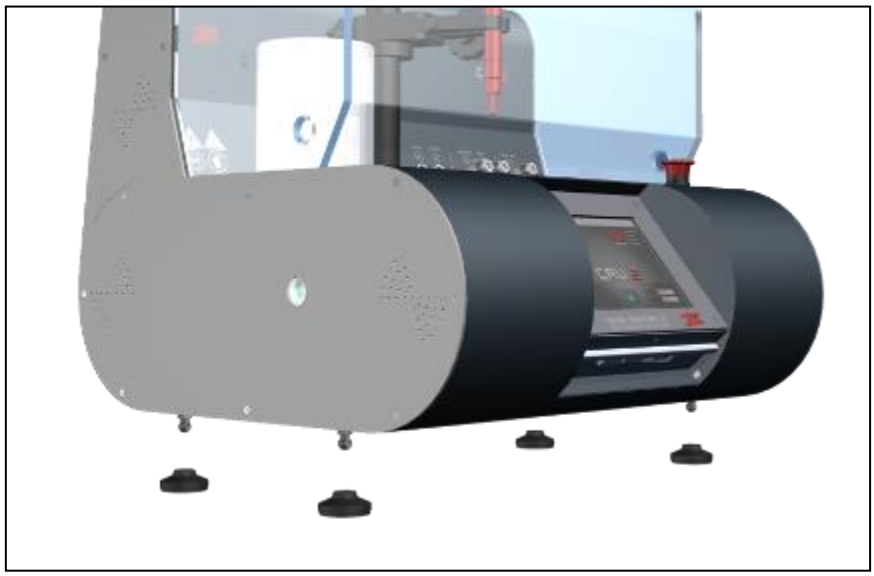


Figure 3-i

Connecting the AC power

CRU.2 Unit

Verify that the rear ON/OFF Power Switch and the front Emergency Stop Switch are in the OFF position.

1. Connect one end of the AC power cord [a] to the rear power socket of the machine [b] (Figure 3-ii)
2. Connect the other end of the AC Power cord to any grounded 100/240 VAC, 50/60 Hz power source (live wall outlet)

Figure 3-ii

Injector Ultrasonic Device

1. Connect one end of the AC power cord to the rear power socket of the device
2. Connect the other end of the AC Power cord to any grounded 100/240 VAC, 50/60 Hz power source (live wall outlet), depending on the Ultrasonic device specifications.

[**info**]

Please consult the accompanying Ultrasonic device Operating Manual.

Connecting the Pneumatics

[**info**]

- Always use a Water Trap/Filter/Regulator to connect the Air Supply to the machine, even if the Shop Air Compressor has a dehumidifier installed.
- Always use the nearest route to the Shop Air Compressor and avoid Air Hose bottlenecks, in order to achieve maximum Air Pressure and Air Flow. Follow the specifications in Appendix A.

1. Use a hose fitting [b] (not provided) to connect the Water Trap / Regulator to the hose that leads to the Shop Air Compressor (Figure 3-iii)

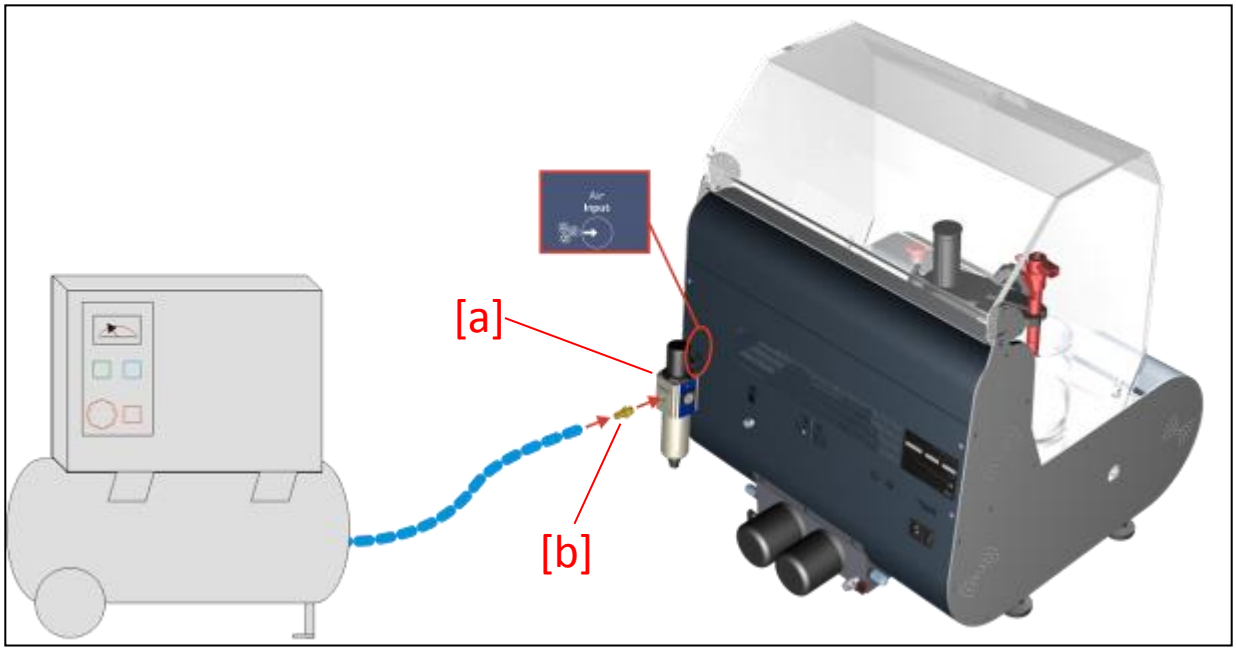


Figure 3-iii

2. [Optional] Disconnect the Fumes Extractor Exhaust Port muffler/filter [c] (Figure 3-iv) and connect a large diameter hose in order to reduce fumes and noise.

[**info**]

- Vacuum performance issues may occur by installing a hose instead of the muffler.

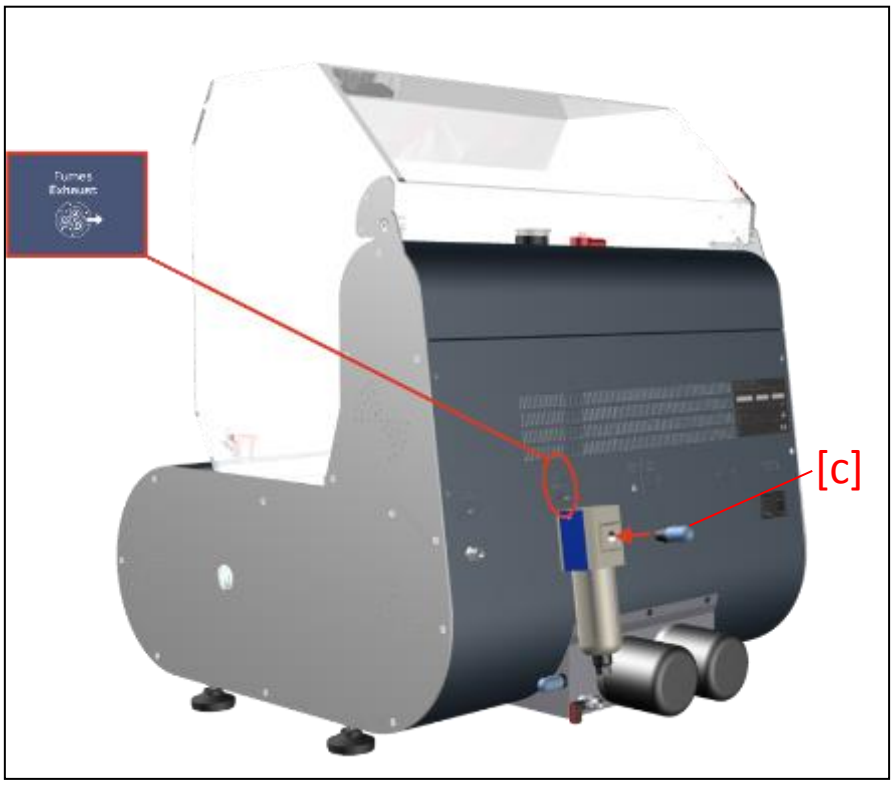


Figure 3-iv

[**important**]

- A periodic emptying of the vacuum collector is needed (Figure 3-v).

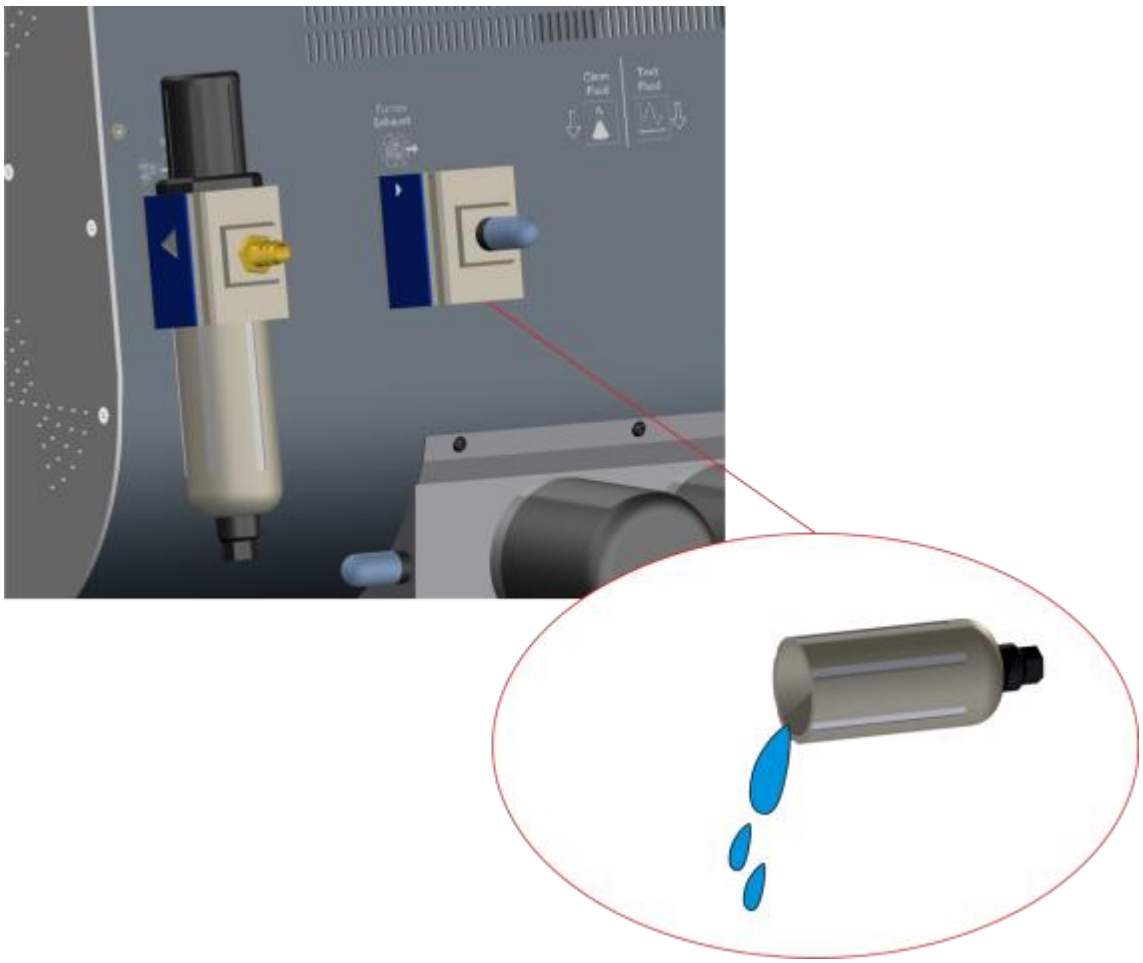


Figure 3-v

Starting up for the first time

1. Switch to the ON position the rear power Switch [a] (Figure 3-vi).
   0: OFF / **I**:ON

Figure 3-vi

2. Switch to the ON position (Counter-Clockwise) the front Emergency Stop Switch (Figure 3-vii)

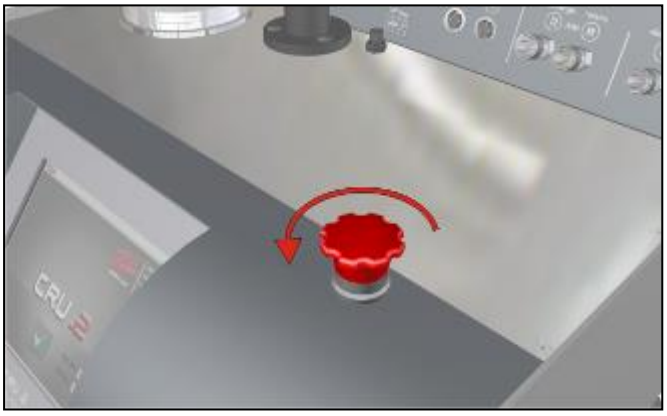


Figure 3-vii

3. Wait a few minutes until the CRU.2 Software Boots up. If more than 15 minutes pass and the Software has not loaded, look at Chapter 8 “Troubleshooting”
4. Once the Software loads, the initial Screen will show the S/W and H/W version of the machine

Figure 3-viii

5. By Pressing the ACCEPT button the HOME screen will pop-up
6. Look in Chapter 4 “HMI Menu Tour” for further information on software navigation.

[**important**]

- Always wait at least 45 seconds when switching on the unit again (after a power down)

[**info**]

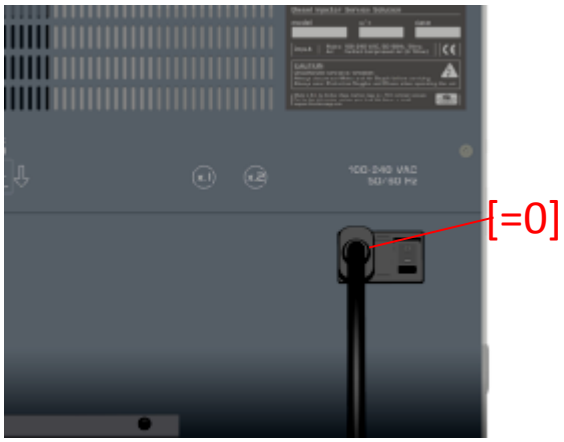
- If the Touch Screen is not operable or if the software does not load, look at Chapter 8 “Troubleshooting”
- A keyboard and mouse are not needed. In case of Touch Screen failure or for ease of use, a USB Mouse is recommended

Powering down the system

1. Navigate to the HOME Screen:

Figure 3-ix

2. Press the POWER-OFF button (Figure 3-ix-[a]) to Power down the system
3. Wait at least 30 seconds until the CRU.2 Software Boots down
4. Once this operation is complete, you can switch off the machine using rear ON/OFF Power Switch and/or the EMERGENCY STOP switch (Figure 3-x).



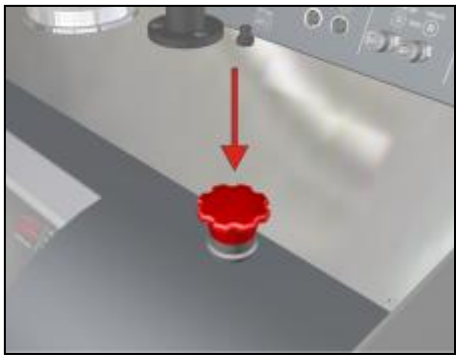


Figure 3-x

[**info**]

- It is advised not to power down the system by use of the EMERGENCY STOP or ON/OFF Power Switch, before powering down the CRU.2 software. Doing so, it may result in file corruption and/or slow future boot up times

Chapter 4
“HMI Menu Tour”

This chapter provides useful information on the CRU.2 HMI (Human Machine Interface or LCD touch menu). It covers the following topics:

- General PC knowledge
- Common Buttons and Features
- Basic Screens
    - Start-up Screen
    - Home Screen
    - Injector Settings
    - Saved Reports
    - Settings Menu and Options
    - Manual Tests
    - MACC Cleaning
    - AUTO Testing

A new user should preview all the screens in this chapter prior to operating the CRU.2 unit.

General PC Knowledge

The CRU.2 HMI is based on a LINUX Operating System. Its sole purpose is to provide an easy way for the operator to control the CRU.2 unit with different commands, as well as view previously saved data, e.g. injector test reports.

Although the HMI is an advanced system on its own, patience may be required sometimes. Bear in mind that there are many calculations being made on every press of a button, such as searching through a large injector database or analyzing the injector condition and state, therefore slow reaction may be expected at normal operation.

The software is designed to provide visual feedback to the user on every step, such as the booting up screen or a press of a button. Only if the software is inoperable for a very long time (more than 15 minutes) should the operator terminate/restart the CRU.2 HMI by use of the ON/OFF switch or the EMERGENCY STOP switch.

[**important**]

- In the rare case that smoke comes out of the machine or the injector under test, or there is a high risk of personal injury, Only then should the operator use the EMERGENCY STOP switch. The CRU.2 HMI has a fail-safe mechanism (Back-Up/Restore) in order to restore the HMI to its original state, if something results in the system being inoperable.

Common Buttons and Features

In this section the most commonly used buttons and features are previewed and explained. The HMI is designed with simple images in order for the operator to be able to use the unit without reading each button or info.

 **ACCEPT Button:**

With this button, the HMI operator confirms the changes made or accepts the message or procedure that will follow.

 **CANCEL Button:**

With this button, the HMI operator cancels any changes made or declines the message or procedure that will follow.

 **RETURN Button:**

With this button, the HMI operator can return to the previous screen, exit a current screen or just acknowledge the message provided.

 **HOME Button:**

With this button, the HMI operator can return to the Home Screen.

 **FUNCTIONS Button:**

This button is shown in the Manual Test and will open the Functions screen from which the operator can turn ON/OFF the LED and the VACUUM.

 **Pass/Fail Symbols:**

These are the symbols for the Pass/Fail. They are shown every time a Test is completed, either in Auto or in Manual Mode. Pass denotes the current test is within specifications, whereas Fail denotes the opposite.

HP.T Module:

This is the High Pressure – Testing Module, and consists of 3 features, the Pressure Module Lock, the Pressure Indicator and the Pressure ON/OFF button.

-  **HP-T module lock:**

  When the LED is RED on this button, it means that the HP-T module is locked and the operator cannot change its state. By pressing on the button once, the lock LED toggle to GREY (unlocked) and the operator can then change the pressure or switch the pressure On/Off.

- 

Pressure Indicator:

  This is the HP-T indicator and, when it is available on the screen, it indicates the current pressure of the system. When the HP-T module is unlocked, the operator can press it and add the desired value of pressure, through the Numeric Keypad that pops-up. If the Pressure ON/OFF button is in the ON position, the system pressure will slowly adjust to the desired value. If the Pressure ON/OFF button is in the OFF position the system pressure will not change.

- 

HP-T ON/OFF button:

This button is both a button and an indicator, meaning that when the operator presses this button, it will toggle values (above images). Left image: the system HP-T pressure is OFF. When pressed, it will switch ON the pressure. Right image: the system HP-T pressure is ON. When pressed, it will switch OFF the pressure.


START button:

This button Starts the current test.


STOP button:

This button Stops / Terminates the current test.


PAUSE button:

This button will only be shown in some test after the Start button has been pressed. It gives the operator the opportunity to pause the current test, instead of stopping the current test and restarting from the beginning.

Injector Preview/Selection Module:

This module provides information such as which injector database is currently used: The Default DB  or User DB  . The Default DB is the database that comes with the machine, whereas the User DB is the database created by the user. Further, in the center of the module, the indicator/button shows the currently selected injector, Make, Type, Code and Actuation. When this indicator/button is pressed, the injector selection screen pops up, providing the operator the capability to select a different injector or database.

Injector Selection Screen:

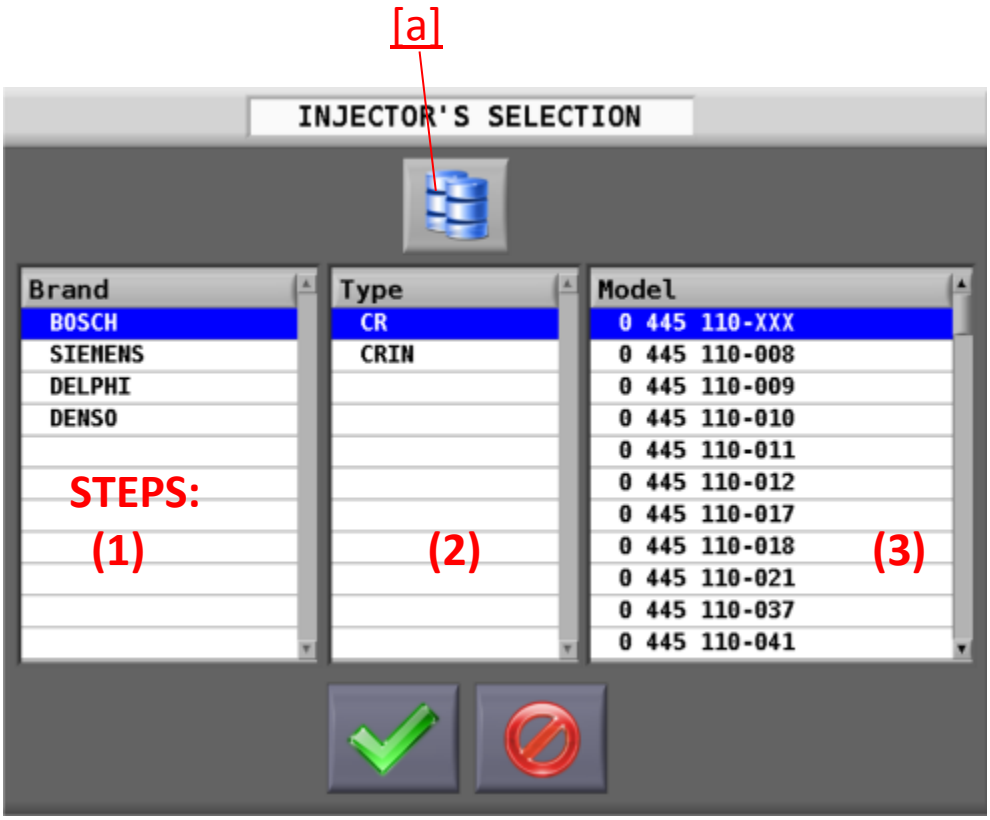


Figure 4-i

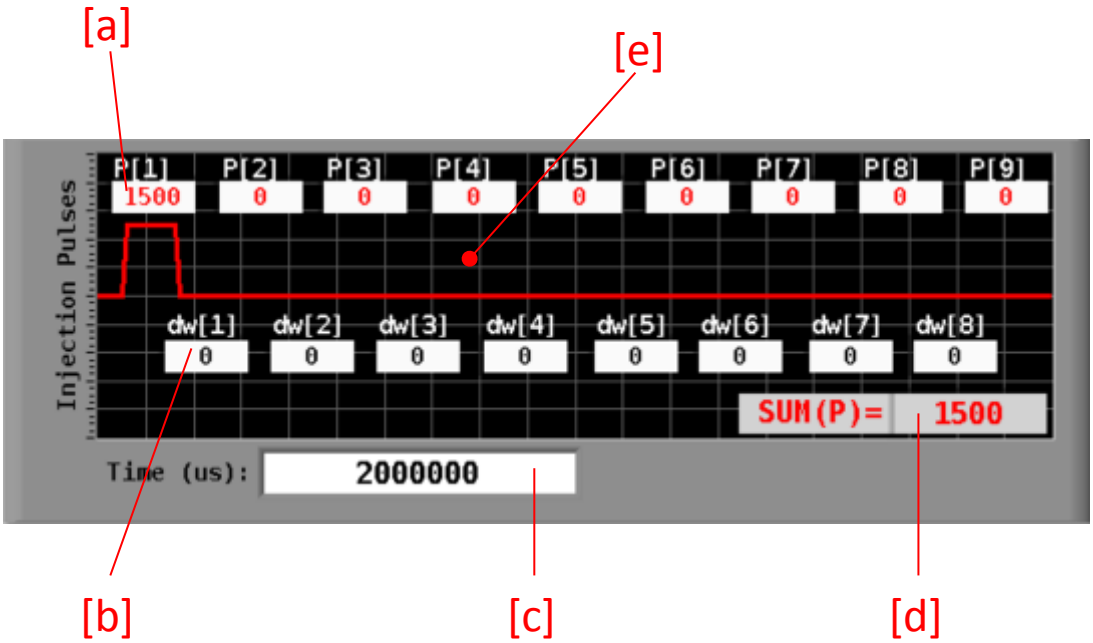
Through this screen the operator can:

1. Select the desired Database by pressing the [a] button/indicator. Once pressed the value will toggle between the Default and the User DBs. The [a] button/indicator will always show the active DB.
2. Select the desired injector by following the 3 steps listed above: select the Brand, Type and then the Model of the injector.

If a specific injector model is not listed here, you can request it from your local distributor or contact support@carbonzapp.com. When an injector model has unrecognized characters, e.g. “0 445 110-XXX(1)” this means that this is a generic injector profile

and can be used for all similar injectors; for instance the example model “0 445 110-XXX(1)” is a generic profile for all Bosch 110 type injectors where “XXX” is anything, e.g. “008” and the (1) denotes 1 generation injectors, in particular (CRI.1).

Injector Pulses Module (Single Injection):



Whenever this module is displayed, the operator has the capability to preview the Injection pulses used in the current Test Plan and sometimes to edit these values.

[a]: the P[n] indicator/button displays the n-th pulse in microseconds (μs / us). For example, in the above injection pulses module, the 1st pulse P[1] is 1500 microseconds. Because the P[2] is equal to zero (and also the dw[1]) the specific Test Plan has 1 pulse per Stroke and it is equal to 1500 us.

[b]: the dw[n] indicator/button displays the n-th dwell time between the pulse n and n+1, in microseconds (μs / us). For example, in the above injection pulses module, the 1st dwell time dw[1] is 0 microseconds. This means that there is zero time between the 1st and the 2nd pulse. If the value of the dw[n] is zero then the next pulses will all be zero until that specific dw[n] is something other than zero.

[c]: the total time between Strokes. In the above example the time in microseconds is 2000000, approximately 2 seconds,

meaning that every 2 seconds a pulse of 1500 microseconds (0.0015 seconds) is being performed. This feature is useful when creating a custom test plan and the total time is needed to help is the specific selection of P and dw values. The sum of all P and dw values cannot exceed the total time [c].

[d]: the SUM of Pulses in the current test plan. Basically if there are more than 1 pulse in the test plan (Multiple injection feature), that the sum of all the P[n]'s will be shown here. This is a useful feature, because it displays the total time of Pulses between the Stokes (without the dwell time) and can therefore be compared to a single injection pulse of the same time.

[e]: the Injection pulse diagram shows the number of pulses, and therefore the operator can easily understand the injection profile.

In order to create a multi injection profile a ZIG-ZAG procedure (Figure 4-ii) is needed, first selecting the desired 1st P[1] pulse, then the desired dwell time between the 1st and 2nd pulse dw[1], then the desired P[2] pulse and so on. If a total of 3 multiple injection profile is needed, then the above procedure should stop at the P[3] value, and the dw[3] value should be equal to 0 (zero).

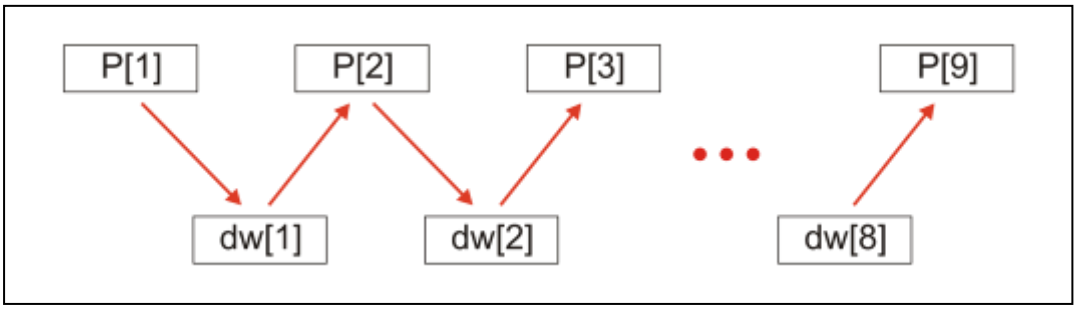


Figure 4-ii

An example of 3 multiple injection profile is shown in (Figure 4-iii)

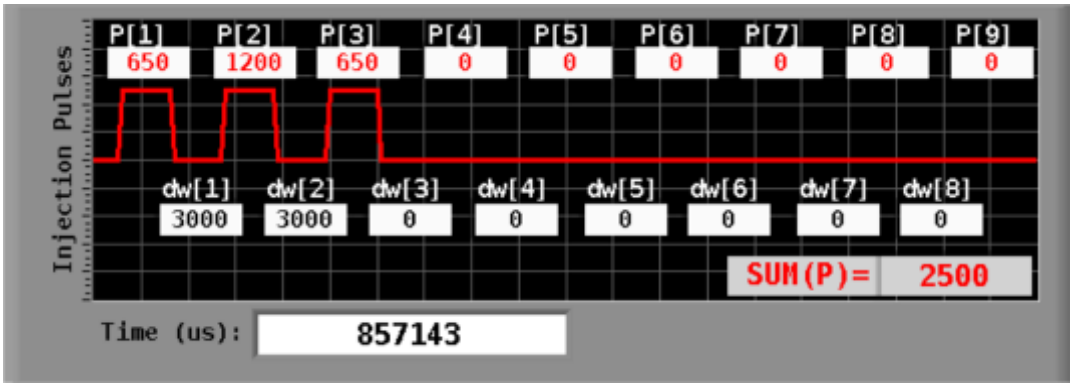


Figure 4-iii

Numeric Keyboard:

Once a numeric indicator/button is pressed, this Numeric Keyboard is displayed, providing the opportunity for the operator to enter the desired numeric value, e.g to set the HP-T Pressure.

Alphanumeric Keyboard:

Once an alphanumeric indicator/button is pressed, this Keyboard is displayed, providing the opportunity for the operator to enter the desired value, e.g. a specific Code or Name.

Startup Screen

This screen is shown once the CRU.2 software loads. Information such as Software (S/W) and Hardware (H/W) versions are shown here. The CRU.2 is now ready for operation. Press the ACCEPT button to continue.

[**info**]

- If the Startup Screen loads and after 2 minutes there is no H/W or S/W version displayed, then consult Chapter 8 “Troubleshooting”.

Figure 4-iv

Home Screen

This is the main screen (Figure 4-v) of the CRU.2 software. From here you can do:

a. Language selection / preview (future update)
b. Injector Testing (AUTO MODE)
    i. AUTO mode with PREVIEW [ON/OFF]
    ii. AUTO mode with SPRAY TEST [ON/OFF]
c. Injector Testing (MANUAL MODE)
d. Injector Cleaning (MACC “Molecular Activation Chemical Cleaning”) [CRU.2-XXX1 only]
e. Setup an Injector or create your own injector
f. Browse the Reports
g. Further Customize the software to your needs (Settings)
h. INFO: View information on this screen. (future update)
j. Power Down the system

[**info**]

- Notice the difference between [b-i] button and [b-ii]. The [b-i] button / feature is switched to the ON position by default, whereas the [b-ii] button / feature is switched to the OFF position by default.

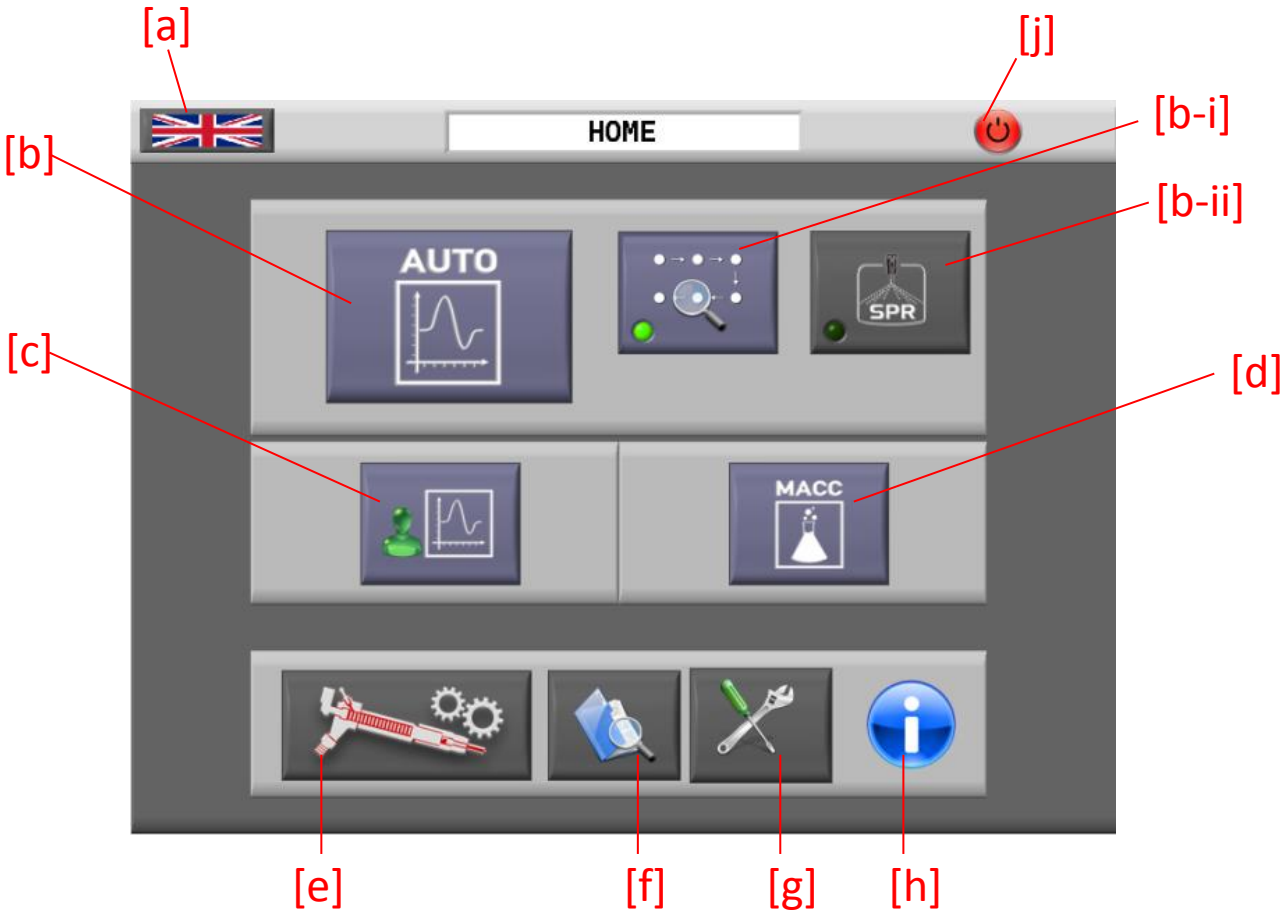


Figure 4-v

Injector Settings

Here you can further customize an existing injector, or create a new injector. Each button / indicator is explained below:

a. Injector preview / selection bar: This bar provides information on the selected injector. If pressed, the injector DB menu will appear (Figure 4-i) providing the user with the capability to select a different DB or Injector.

b. Database (DB) type selected, Default DB  or User DB  . Default DB is the database that comes with the machine, whereas the User DB is the database created by the user.

c. SAVE: Saves the current changes done on the injector (no confirmation provided). If the Injector MODEL field is changed, then this button will automatically save the injector to the User DB.

d. SAVE AS: Saves the current injector to the User DB (no confirmation provided) with the specified MODEL name.

e. DELETE: Deletes the current injector. This option is only available when using the User DB.

f. CANCEL: Discards any changes made to the current injector.

g. RETURN: Exits the Injectors screen

h. iVM UTP 1-3: Opens the User Test Plans screen for the iVM test for this injector (Figure 7-iv).

j. iVM DTP 1-4: Opens the Default Test Plans screen for the iVM test for the injector (Figure 7-iv). This option in only available when using Default DB.
k. Injector Properties (1-4), pages 2-4 are only available when using User DB:
    1: Provides information of the injector:
        i. Brand: Manufacturer
        ii. Type: CR, CRIN, EUI etc.
        iii. Model: The manufacturer model No
        iv. Actuation: Coil, Piezo etc.
    2: Reserved for later use
    3: Provides information on NOP,LKT and eRLC tests
    4: Provides information Volt and Amperes parameters.

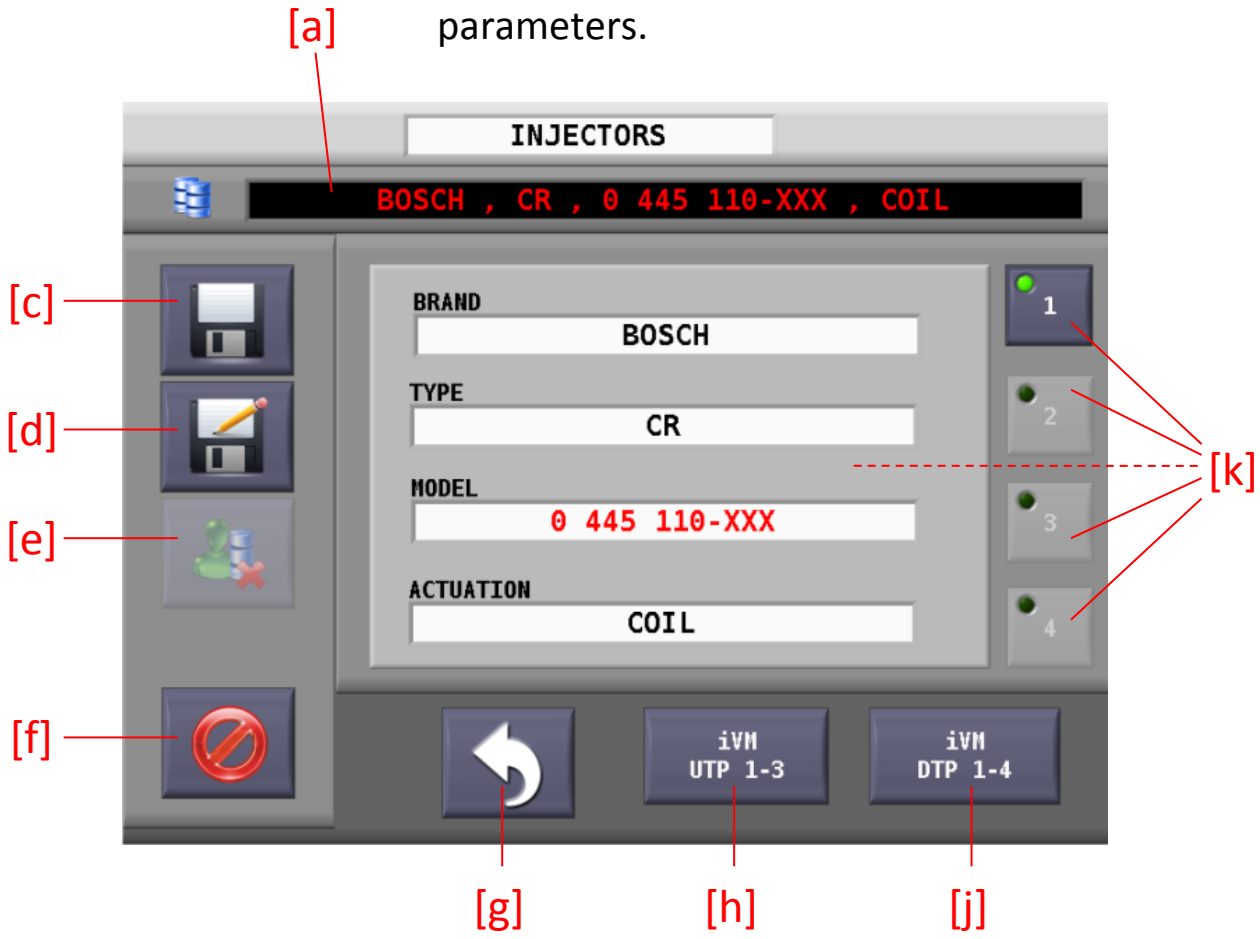


Figure 4-vi

Further information on injector DBs can be found in Chapter 7.

Saved Reports

In the saved reports screen (Figure 4-vii) there are options to view, print, save-to-usb or delete a pre-generated report.

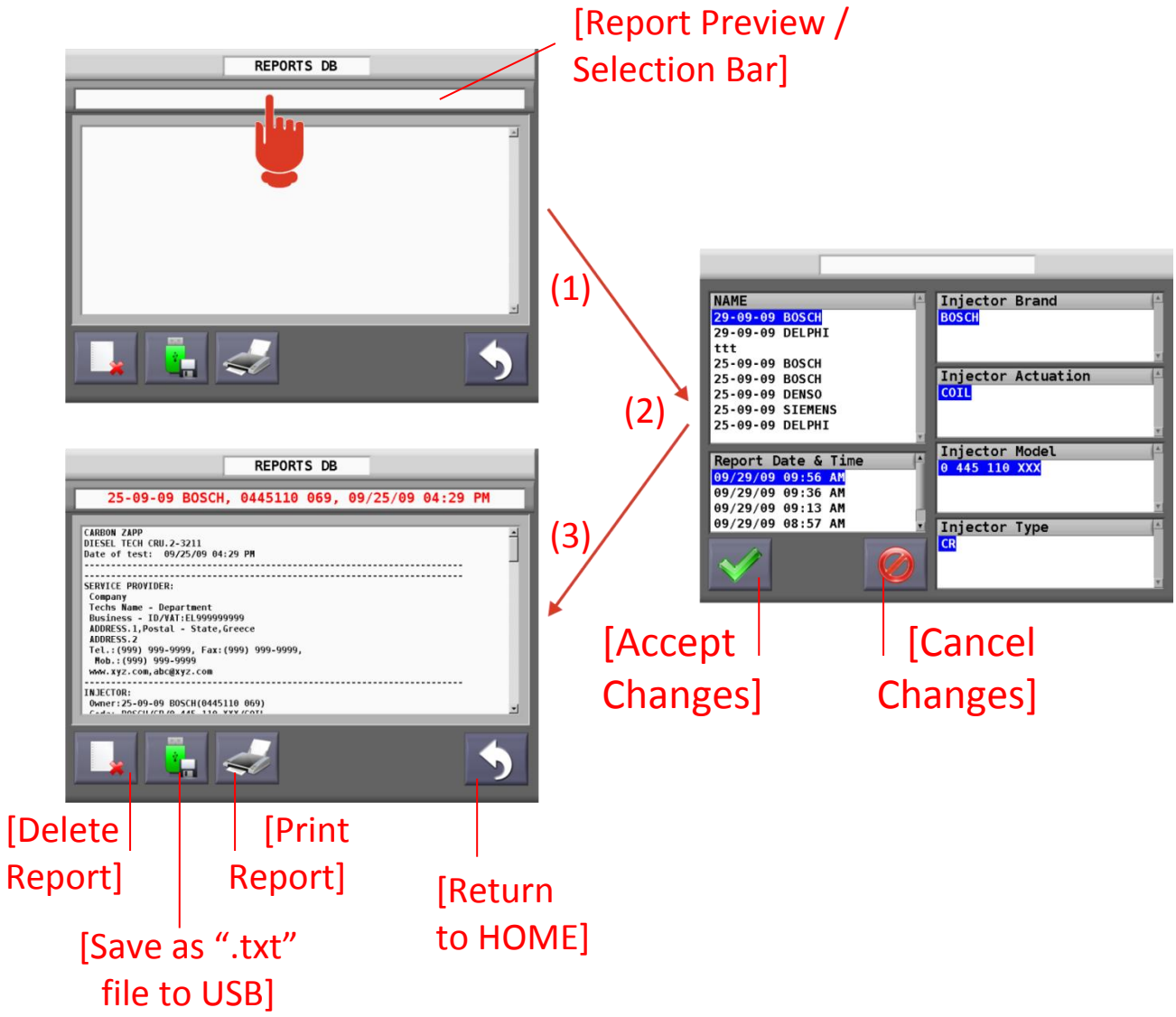


Figure 4-vii

Press on the Report Bar in order to browse/select the desired report. The reports are categorized/grouped with:

- Customer Name
- Injector Brand
- Injector Actuation
- Injector Model
- Injector Type
- Report Generation Date

Press the ACCEPT button to view the selected report, or the CANCEL button to cancel this selection.

Once a report in selected and viewed, the following options are available:

- DELETE: completely deletes this report from memory (no confirmation is provided).
- SAVE-TO-USB: saves the report in the **first** available USB pen drive attached to the CRU.2 USB ports. The report is saved in a .txt (simple text) format, and it can be transferred and/or viewed in any computer using a word editor program like WORDPAD, MSOFFICE WORD etc.
- PRINT: prints the report to the pre-installed HP USB printer attached to the CRU.2. For further information on Printer and installation, please consult Chapter 5 (page 5-9).
- RETURN: closes the report generation, and returns to the Home Screen.

Settings Menu and Options

There are several options in the settings menu that can further customize, update or backup the CRU.2 software. Click on one of the following buttons in the setting menu:

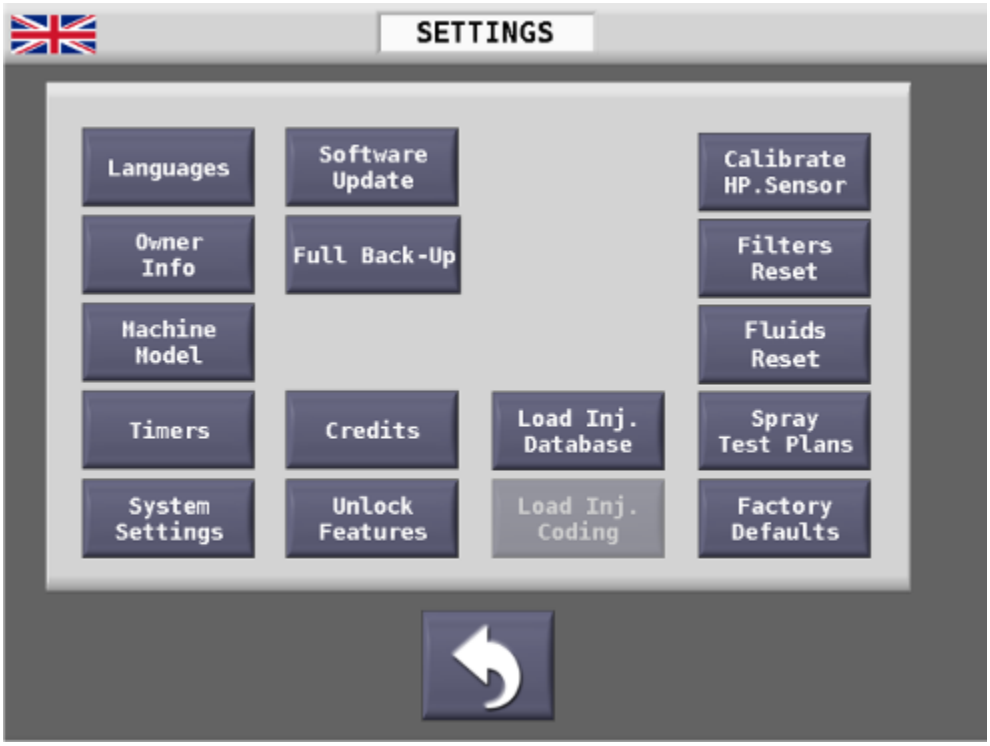


Figure 4-viii

- **Languages**: Select the preferred language of the system. Some languages may not be available yet.
- **Owner Info**: Change the information of the owner of the CRU.2 unit. This information is used on each Generated Report.
- **Machine Model**: Preview the model type of the CRU.2 unit.
- **Timers**: View or change the time for the:
    - AUTO CHECKLIST: the time in seconds that the Checklist in the Auto Mode is previewed in-between test screens

    - MACC TIMER [CRU.2-XXX1 only]: the predefined time in minutes that the MACC program will run.
- **System Settings**: Install a new HP (Hewlett Packard) Printer, configure/activate the Internet Port for the software, or just set the Time and Date. Further information on these settings can be found in Chapter 5 (page 5-8).
- **Software Update**: Once a new update for the CRU.2 software is available, save the update file in a USB pen drive, insert the drive in the first available CRU.2 USB ports and press the Software Update button. If the file is found on the drive and it is the correct type, the software will automatically update, asking from the operator to Press the RESTART APPLICATION button. If not you will get an error message. Please consult Chapter 8 “Troubleshooting” for further information.
- **Full Back-Up**: This option will completely backup the software and all the changes/settings that have been made up to that moment. If for any reason the CRU.2 software is inoperable, there is an option in the boot-up sequence to restore the back-up settings. For further information, please consult the Chapter 8 “Troubleshooting”.
- **Unlock Features**: This option is available for entering the passkey given when purchasing an additional feature.
- **Load Injector Database**: This option will update the current Manufacture DB in the CRU.2 with newer records found in the specific file in the attached USB pen drive. Like in the Unlock Features option, a passkey is required here as well.
- **Load Injector Coding**: This option will update the current Manufacture DB Coding in the CRU.2 with newer records found in the specific file in the attached USB pen drive. Like in the Unlock Features option, a passkey is required here as well.
- **Calibrate HP Sensor**: In order to check if the sensor is correctly calibrated, connect a 0-2500 bar analog or digital Calibration Gauge to the [HP.T] hose, press on the Black ACTUAL VALUE bar and enter a value, then press the HP.T ON/OFF button to start the pressure. Compare the value of

the gauge to the value shown in the ACTUAL VALUE indicator on the screen; if the values are the same, the sensor is calibrated. If for any reason the High Pressure sensor is not calibrated correctly, the operator can recalibrate it following these simple steps:

i. The HP sensor has to points of calibration, the ZERO point and the Maximum point. In order to set the Zero point, the [HP.T] hose needs to be disconnected from any injector or gauge.
ii. Press the SET button on the SET VALUE control (while the SET VALUE=0) in order to set the ZERO VALUE point.
iii. Connect a 0-2500 bar analog or digital gauge, to the [HP.T] hose, and securely tighten.
iv. Press on the Black ACTUAL VALUE bar in order to enter the preferred pressure. Start with lower values e.g. 200-500 bar and then go to 1800 bar, to avoid any possible leaks in the connections.
v. Press the HP.T ON/OFF button in order to start or stop the pressure. Once the HP is on, the CRU.2 will constantly try to calibrate the pressure to the desired value.
vi. Once the pressure is stabilized, type the value of the attached gauge in the SET VALUE indicator, and press the SET button.
vii. The HP sensor is now calibrated.
viii. If for any reason the calibration was unsuccessful, by pressing the Default Values button the Calibration will revert to its original state.

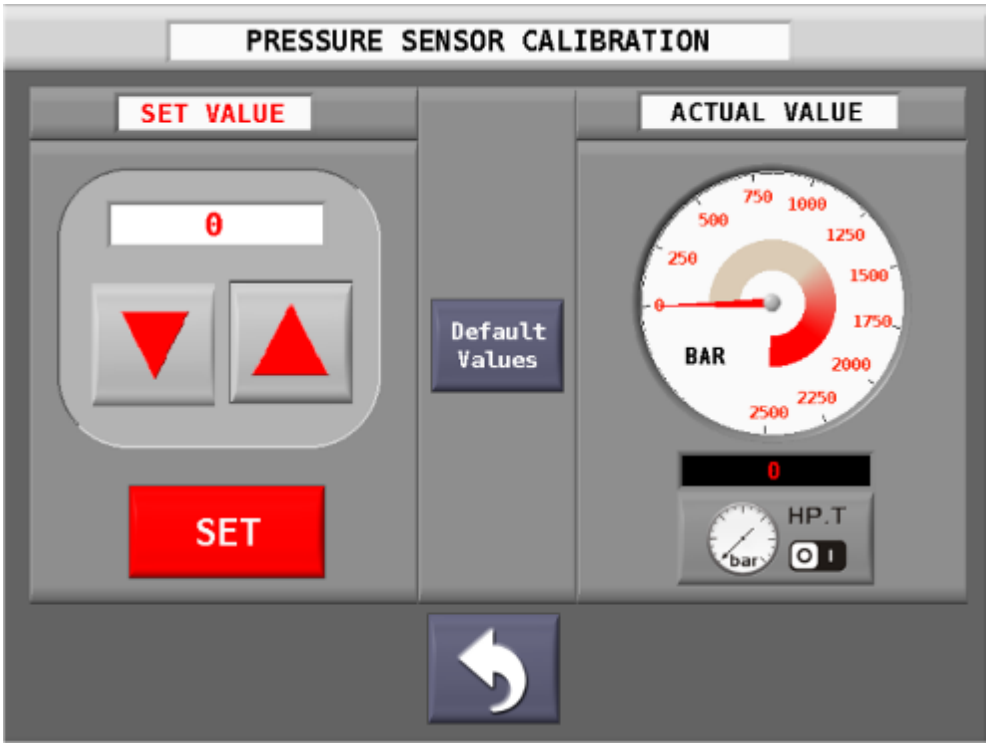


Figure 4-ix

- **Filters/Fluids Reset**: In these options the Filter and Fluid life span can be viewed (in hours) for both Testing and Cleaning (MACC). When the Life of the filter/fluid is over (equals to zero) a pop-up message will appear every time in the Home Screen informing of the filter/fluid needing to be changed. The RESET TIME button below each filter/fluid will reset the value to the original. This should only be done when the filter/fluid is changes in order to increase the effectiveness of the fluids/filters and to avoid warranty issues. More information regarding fluid and filter specification can be found Appendix A.

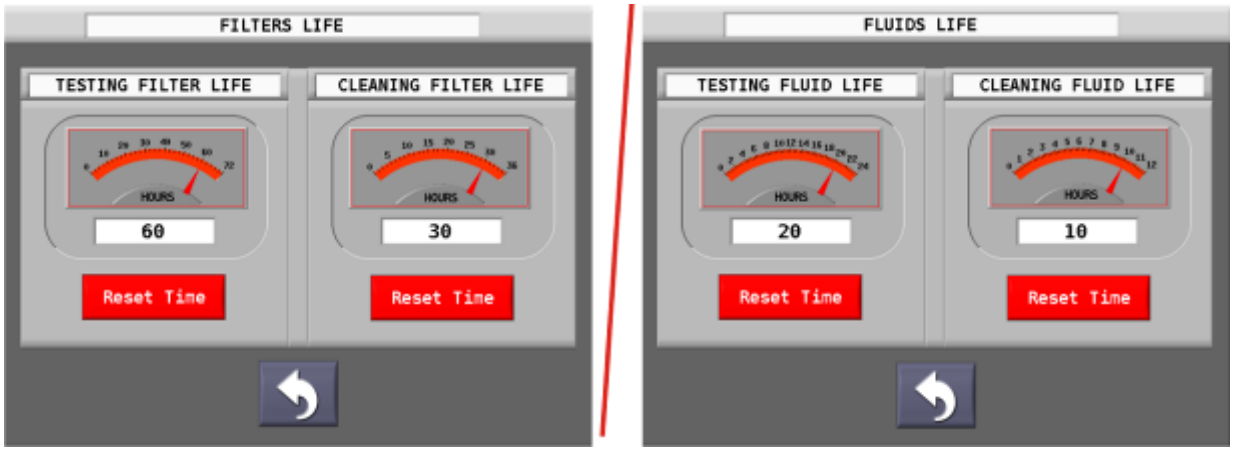


Figure 4-x

- **Spray Test Plans**: Here, the three Default Spray Test Plans SPR.1/SPR.2/SPR.3, used in the Spray Test, can be changed to preferred values.

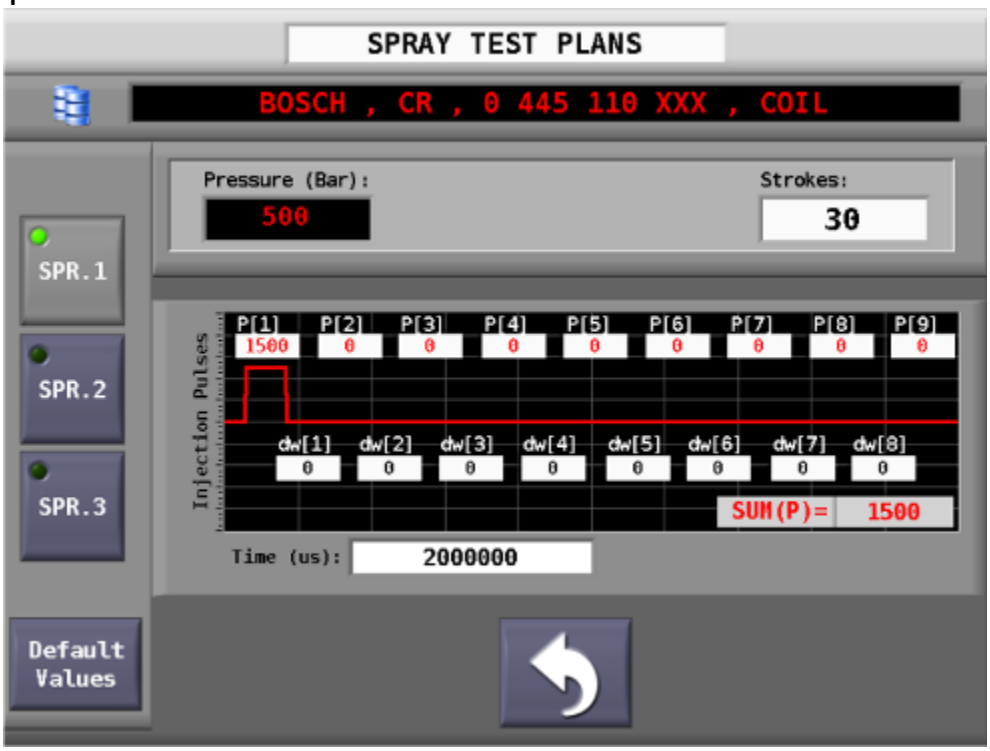
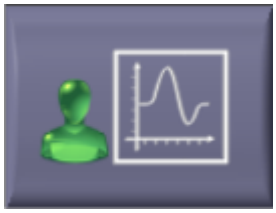


Figure 4-xi

- **Factory Defaults**: This option resets the following options to their original values:
  i. Default Spray Test Plans (SPR.1/SPR.2/SPR.3)
  ii. User Single Spray Test Plan
  iii. User Multi Spray Test Plan
  iv. Filter & Fluid Timers



Manual Tests

Through this test, the operator can perform each test manually, one by one. This procedure is for advanced users and, thus, it is further explained in detail in Chapter 7 “Advanced Users”.

MACC Cleaning [CRU.2-XXX1 only]

a. **Time Remaining**: Once the Start button is pressed, the timer starts to countdown. The MACC will operate in different frequencies during this time and will automatically stop when finished
b. **Start/Pause button**: Initiates or pauses the MACC process
c. **Stop button**: Stops the MACC process
d. **Fluid Life**: indicates time remaining on the Cleaning Fluid, until it needs to be replaced
e. **Filter Life**: Indicates time remaining on the Cleaning Filter, until it needs to be replaced

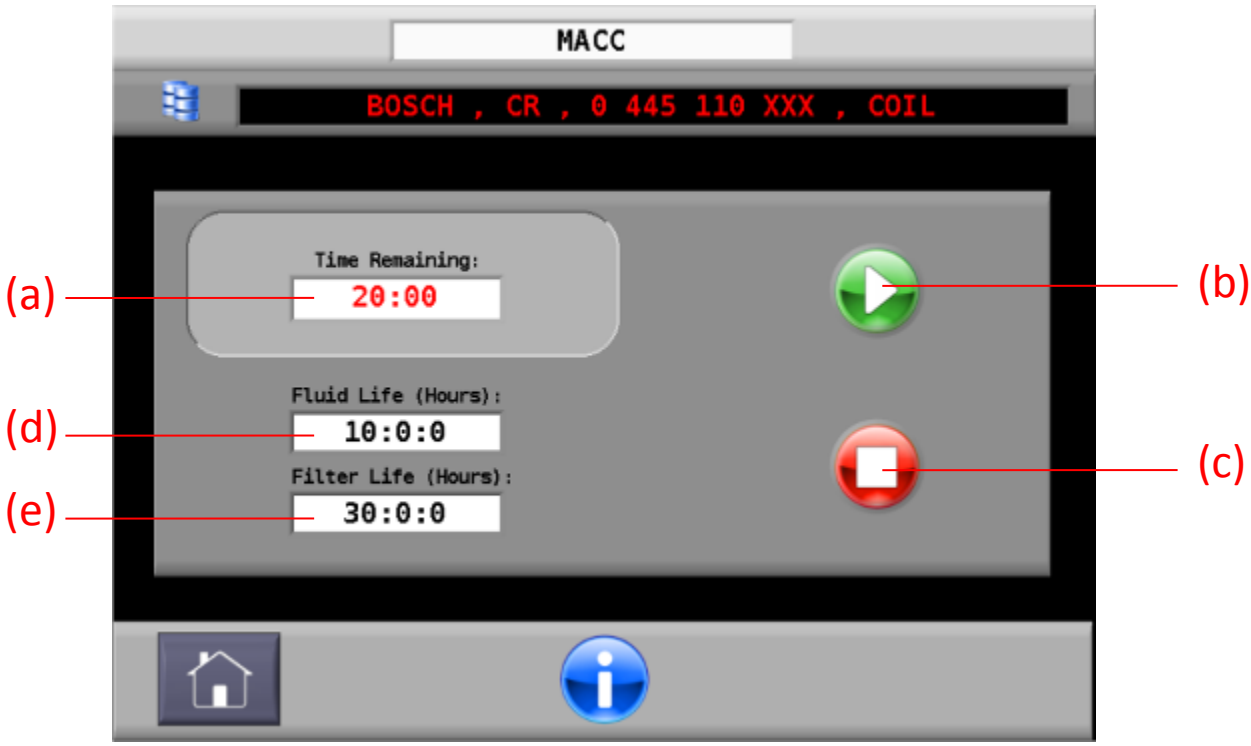


Figure 4-xii

AUTO Testing

a. **Spray Test**: If the Spray Test was active before beginning the AUTO procedure, it will be performed here. Figure 4-xiii (a.1) indicator displays the status of this test.
b. **eRLC Test**: The AUTO procedure will perform a Resistance/Inductance test if a coil injector is selected, otherwise a Capacitance test will be performed for Piezo injectors. Figure 4-xiii (b.1) indicator displays the status of this test.
c. **Leak Test**: The AUTO procedure will perform a Leak test (for Coil Injector only), in order to check the injectors return valve. Figure 4-xiii (c.1) indicator displays the status of this test.
d. **NOP Test**: The AUTO procedure will perform a Nozzle Opening Pressure, in order to find the minimum pressure the Common-Rail injector needs for operation. Figure 4-xiii (d.1) indicator displays the status of this test.
e. **iVM Test**: The AUTO procedure will perform the iVM measuring test, for the preselected Test Plans in the injector's database; if no changes have been made to the injector database, the AUTO procedure will perform DTPs.1-4 . Figure 4-xiii (e.1) indicator displays the status of this test.
f. **Return button**: This button will become available as soon as the AUTO procedure has completed. Pressing it will redirect to the REPORT generation screen.
g. **TERMINATE button**: This button is for software emergency use only. If the AUTO procedure has halted or for any other

reason, by pressing this button, it will restart the software application; ALL PREVIOUS DATA WILL BE LOST.

Test Indicator Status:

- BLANK: Test has not been performed yet
- SKIP/ -: Test was skipped
- PASSED: Test performed and injector was successful
- FAIL: Test performed but injector has failed to meet specifications
- ERROR_05: Test Performed but was incomplete. Please consult Chapter 8 “Troubleshooting” for Error code description.
- BLINKING RED: (only in AUTO without preview mode) this test is currently performed

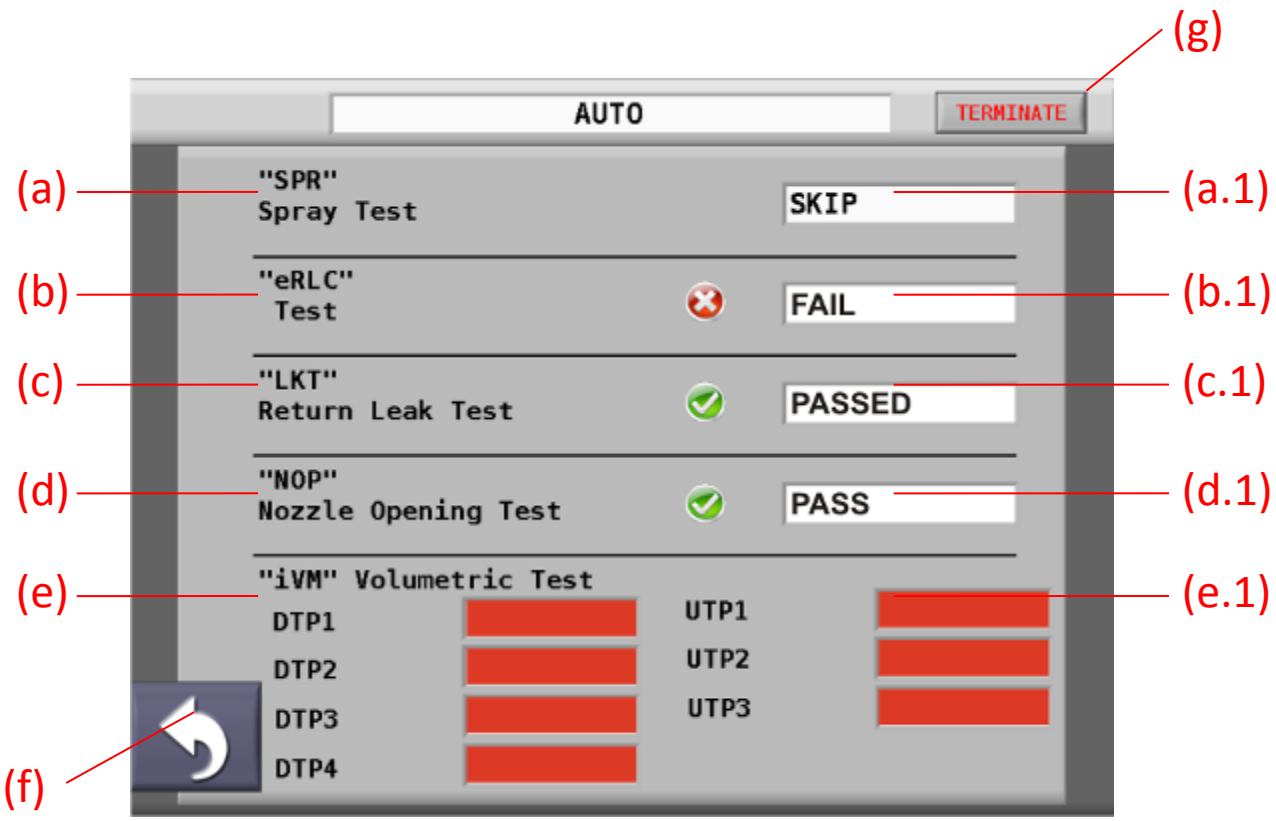


Figure 4-xiii

Chapter 5
“Prepare the CRU.2”

This chapter provides useful information on preparing the CRU.2 unit for the initial operation. It covers the following topics:

- Fluids and Filters
    - Testing Fluid & Filter
    - Cleaning Fluid & Filter
- Owner Information
- System Settings
    - Installing a new Printer
    - Configuring/Activating the Internet Port
    - Setting the Correct Time & Date

Fluids and Filters

The CRU.2 comes with half a tank of Testing fluid (Diesel Calibration oil) and an empty tank of Cleaning fluid. The machine tank indicators, filters and drain valves are divided into two parts, left/right and are shown on the rear panel of the machine (Figure 5-i).

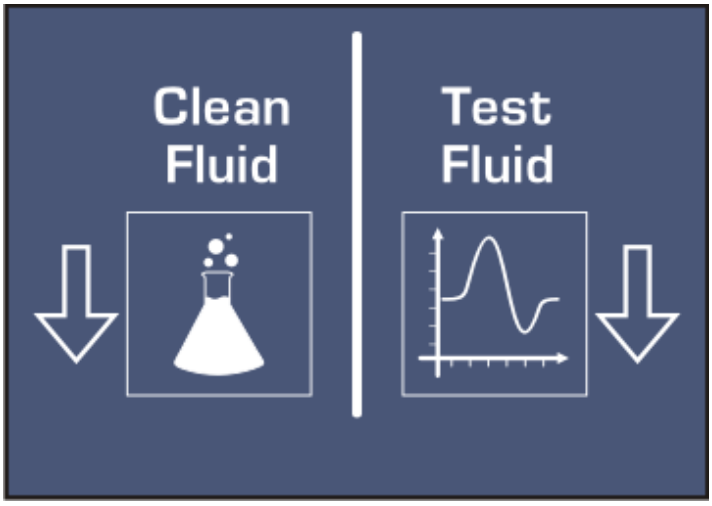


Figure 5-i

[**info**]

- Always check if you have acceptable levels of fluids.

Testing Fluid & Filter

- In order to fill the Testing tank up to acceptable level, you must use the accompanied funnel and pour liquid through the Large Spray Chamber (Figure 5-ii).
- In order to change the filter, you must first empty the tank completely, using the drain valve next to the filter and then use a Filter tool to unscrew it (Counterclockwise).
- In order to install a new filter, after taking out the old one, close the drain valve and screw the new one in (Clockwise) using the Filter tool. After that you can fill again the tank.
- In order to fill with Testing fluid, use the accompanied funnel through the large Spray Chamber (Figure 5-ii). The fluid will drain directly into the testing tank.

[**important**]

- When completely replacing the testing fluid/filter, air elimination process should be followed, after filling the tank:
    - Disconnect the air input
    - Place the HP.T hose directly into the large Spray Chamber, without connecting anything to the hose end
    - Enter a pressure of 500 bar and press the HP ON/OFF button, from the HP Module, and turn on the pressure
    - Some fluid will drip through the hose at low flow
    - After a period of 20 seconds, press the HP ON/OFF button, and turn off the pressure
    - Connect the air input to the machine, and press the HP ON/OFF button to turn on the pressure once more, now with more flow
    - After a period of 20 seconds, press the HP ON/OFF button to turn OFF the pressure
    - Now the CRU.2 Testing Tank, Filter and Lines are free of air.

[**info**]

- Fluid level is acceptable when it is visible through the level indicator
- Always check fluid level when the CRU.2 is idle
- Never let the fluid level fall below the lowest visible point in the tank level indicator
- Always consult Appendix A for Tank and Filter capacity and specifications
- Excess Fluid can always be drained using the specified drain valve
- The CRU.2 Software will provide a visual prompt on when to change the Fluid and/or Filter.

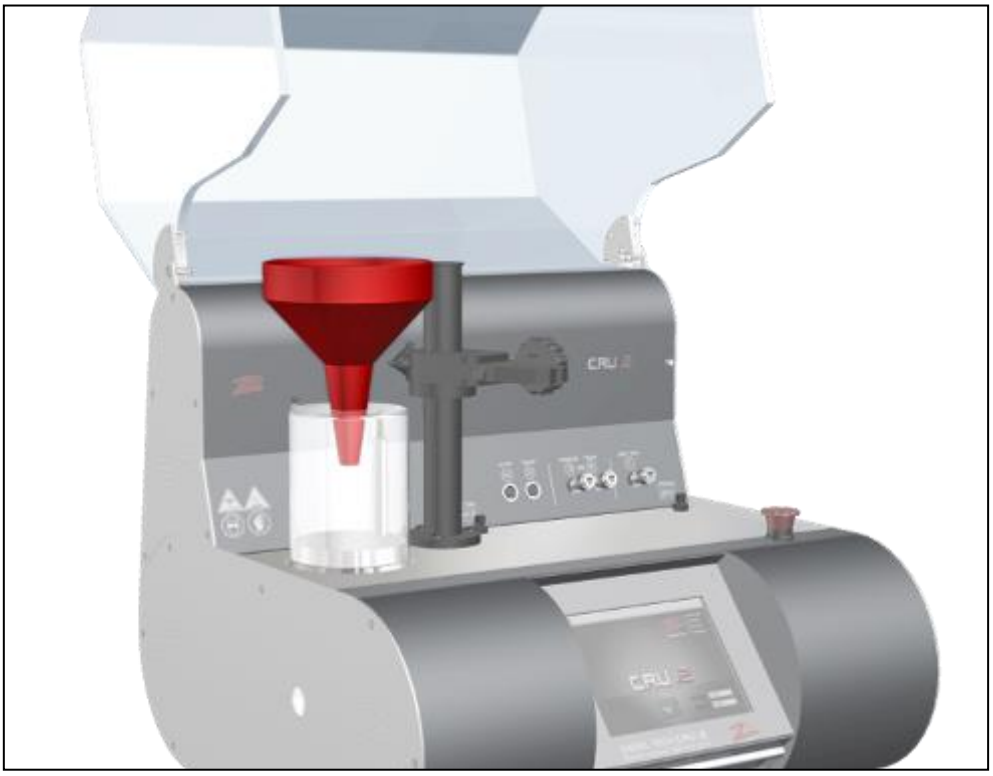


Figure 5-ii

Cleaning Fluid & Filter [CRU.2-XXX1 only]

- In order to fill the Cleaning tank up to acceptable level, you must use the accompanied funnel and pour liquid through the [C] Cleaning port (Figure 5-iii).
- In order to change the filter, you must first empty the tank completely, using the drain valve next to the filter and then use a Filter tool to unscrew it (Counterclockwise).
- In order to install a new filter, after taking out the old one, close the drain valve and screw the new one in (Clockwise) using the Filter tool. After that you can fill again the tank.

[**info**]

- Fluid level is acceptable when it is visible through the level indicator
- Always check fluid level when the CRU.2 is idle
- Never let the fluid level fall below the lowest visible point in the tank level indicator
- Always consult Appendix A for Tank and Filter capacity and specifications
- Excess Fluid can always be drained using the specified drain valve
- The CRU.2 Software will provide a visual prompt on when to change the Fluid and/or Filter.

Figure 5-iii

Owner Information

The CRU.2 software provides a screen in the Settings Menu in order to fill in all the owner information. This information is shown on every report.

Navigate to the HOME->SETTINGS-> OWNER INFO screen, and enter the data. Press the RETURN button to exit and save the changes (Figure 5-iv).

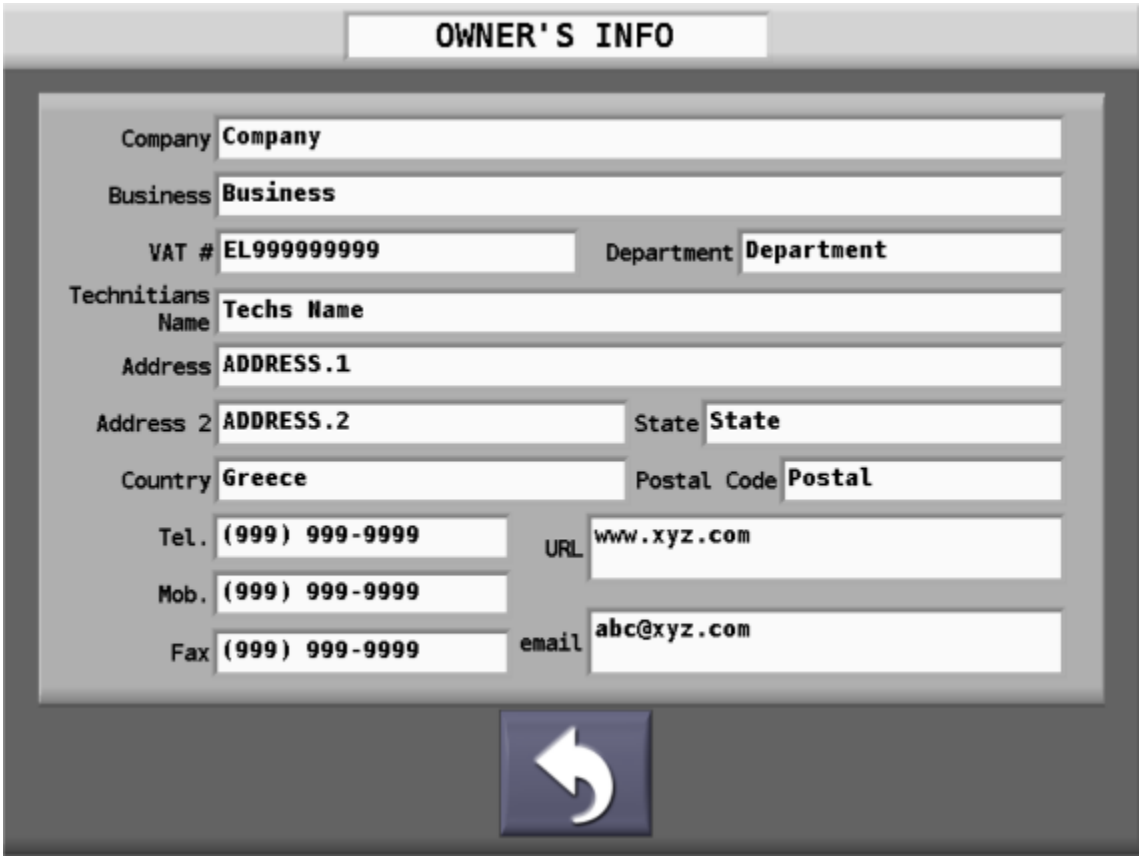


Figure 5-iv

System Settings

Here you can install a new HP (Hewlett Packard) Printer, configure/activate the Internet Port for the software, or just set the Time and Date.

Navigate to the HOME->SETTINGS-> SYSTEM SETTINGS screen (Figure 5-v).

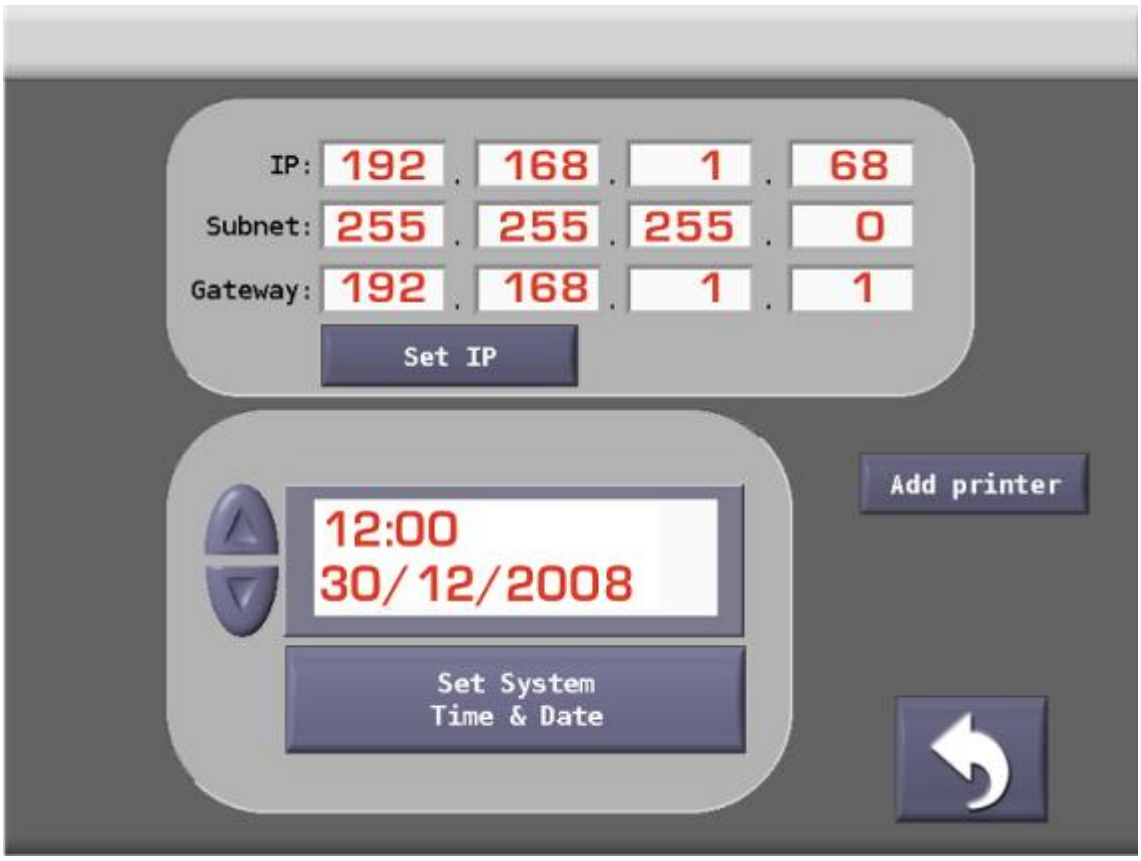


Figure 5-v

Installing a new Printer

1. Connect the USB cable to the printer and machine (Figure 5-vi)
2. Connect the Power cable to the printer and wall outlet, and power ON the printer.
3. Click on the ADD PRINTER button, and a Test Page will shortly be printed. (if no test page is printed, look in Chapter 8 “Troubleshooting”)

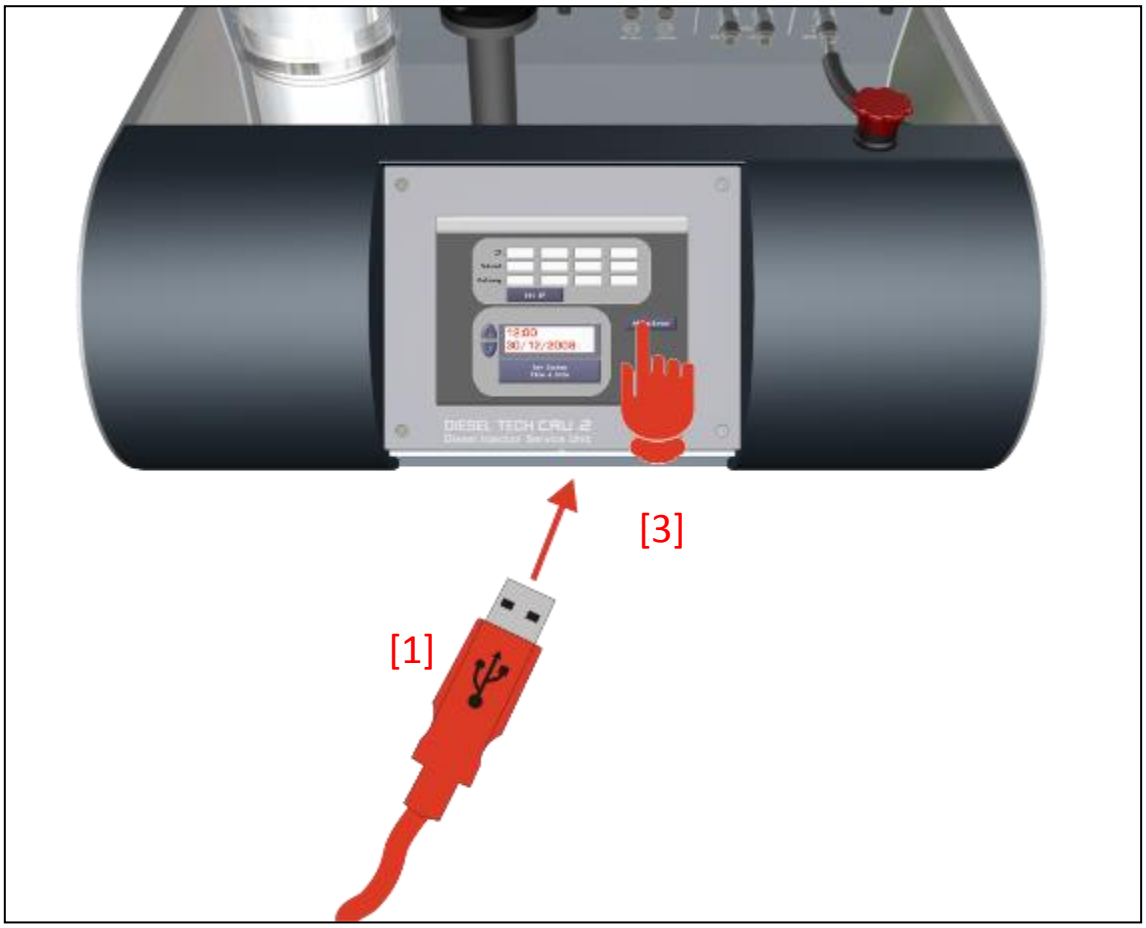


Figure 5-vi

[**info**]

- For HP USB model compatibility, visit: http://hplipopensource.com/hplip-web/supported_devices/index.html *(HPLIP ver: 3.9.8 is used in the CRU.2 unit)*

Configuring/Activating the Internet Port

1. Connect a CAT.5/6 UTP (Ethernet Cable) from your Internet Router to the Ethernet port on the machine (Figure 5-vii).
2. Enter the IP, SUBNET & DEFAULT GATEWAY, in the available boxes (Please consult you network administrator for further details).
3. Press the SET IP button.
4. The Internet Port must be configured every time, before use.

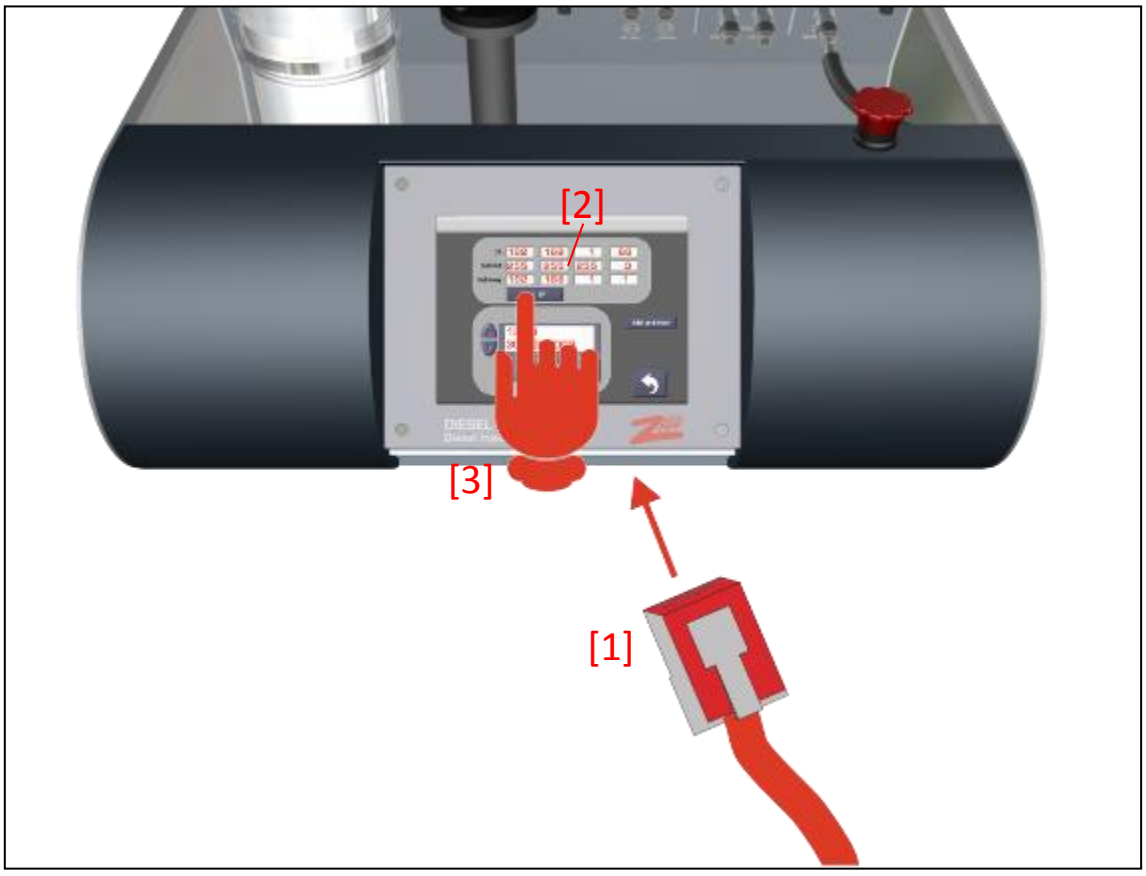


Figure 5-vii

[**info**]

- For further assistance consult you network administrator
- Port **22** should be forwarded in the router for this IP address

Setting the correct Time & Date

1. Click on the available fields and use the UP/DOWN arrow button, in order to set the desired time and date (Figure 5-viii).
2. Press the SET SYSTEM TIME & DATE, in order to save the new system time and date.

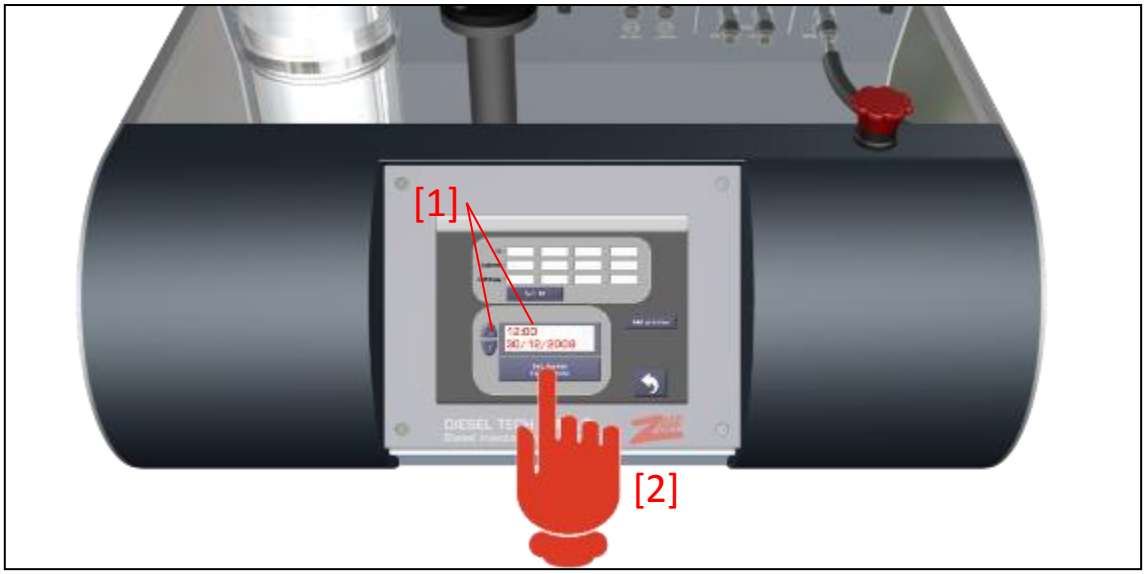


Figure 5-viii

Chapter 6
“Operation Basics”

In this chapter instructions with figures will be shown on how to perform a basic operation with the CRU.2 unit. The following topics are covered:

- Cleaning Injectors with ultrasonic device
- Injector Mounting
- Injector Clamp
- Injector Spray Chamber Clamping Position and connections
- Injector iVM Clamping Position and connections
- Sample Procedure on testing injectors in AUTO mode
    - Select the injector
    - Spray Test
    - eRLC Test
    - LKT Test
    - NOP test
    - iVM test
    - AUTO Checklist
    - STOP button in each test screen
    - Report Generation
- Injector MACC Clamping Position and connections
- Sample Procedure on MACC cleaning injectors
- Saved Reports

A new user should fully understand this chapter prior to operating the CRU.2 unit.

Injector Ultrasonic Cleaner

Before mounting any injector on the CRU.2, it is obligatory to clean the Injectors (Nozzles) (Figure 6-i) in the ultrasonic device (Figure 6-ii).

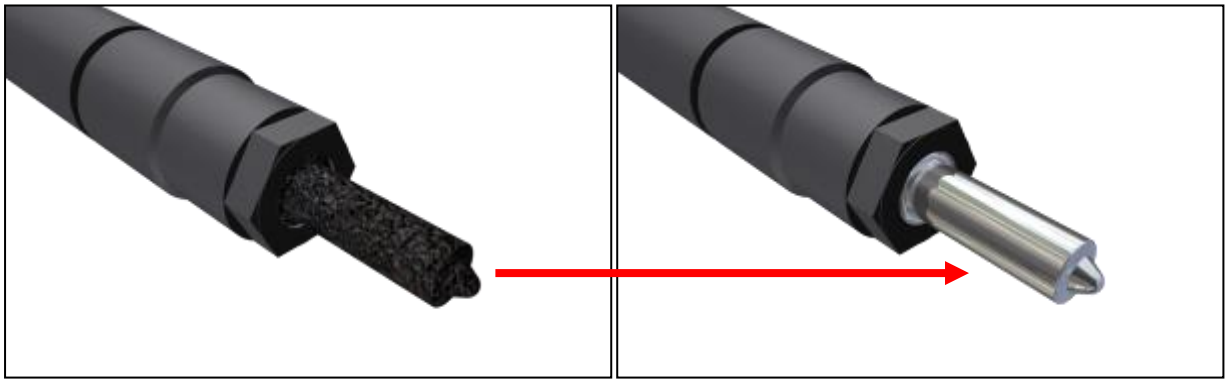


Figure 6-i

Injector Ultrasonic Cleaning is Mandatory

Failure to clean injectors with the use of Magneti Marelli's ultrasonic device (provided) before any test is completed on the test bench will void the warranty of the machine. If the sensor reading is out of specification or accuracy due to dirt (verified), the machine's warranty will be voided.

This step is needed, first to clean the (micro meter) nozzle openings as part of servicing the injector, and second to avoid any dirt particles to enter the CRU.2 sensors and hydraulics of the system.

The Ultrasonic Cleaning operation should be performed for **at least 15 minutes**, although 30 minutes is recommended.

Figure 6-ii

Injector Mounting

All the Common-Rail injectors can be mounted on the CRU.2, using the Injector clamp (Figure 6-iii). Some injectors e.g. Side Feed Injectors (e.g.: BOSCH INDUSTRIAL CRIN) may need additional adapters. For further specifications on Clamping diameters, please consult the Appendix A. For further guidance in Side Feed Injector (CRIN) adapter mounting, please consult Appendix C.

Injector Clamp

The injector Clamp has two horizontal and many vertical positions.

- Using the (a) side handle you can securely clamp the injector, or loosen to free the injector (Figure 6-iii).
- Using the (b) rear handle you can adjust the height (vertical position) of the clamp (Figure 6-iv).
- Using just force Figure 6-iv-(c), the clamp rotates horizontally between two preset positions:
    - Left Position: Spray Chamber
    - Right Position: iVM (Volume metering) & MACC

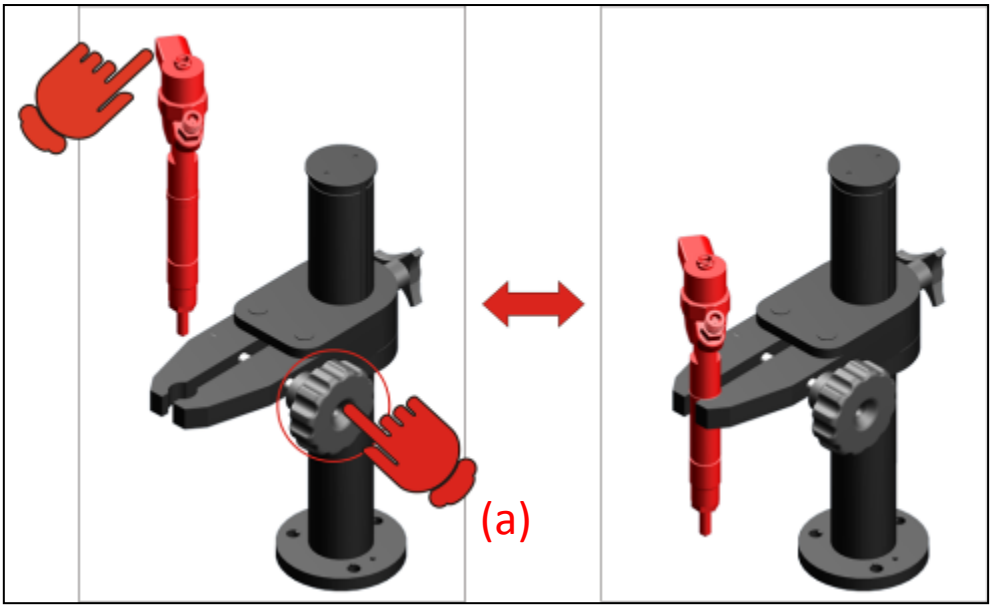


Figure 6-iii

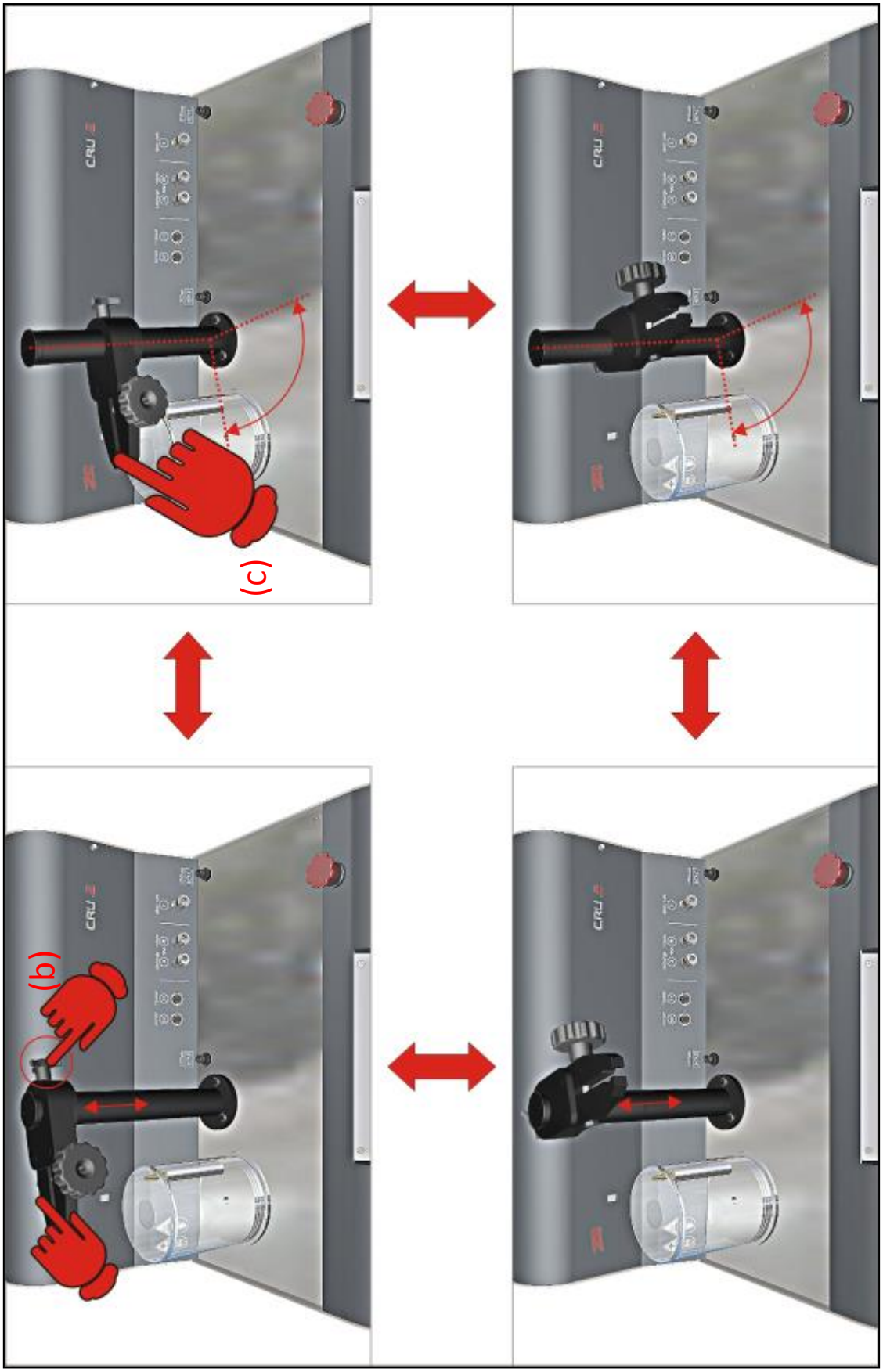


Figure 6-iv

Injector Spray Chamber Clamping Position and connections

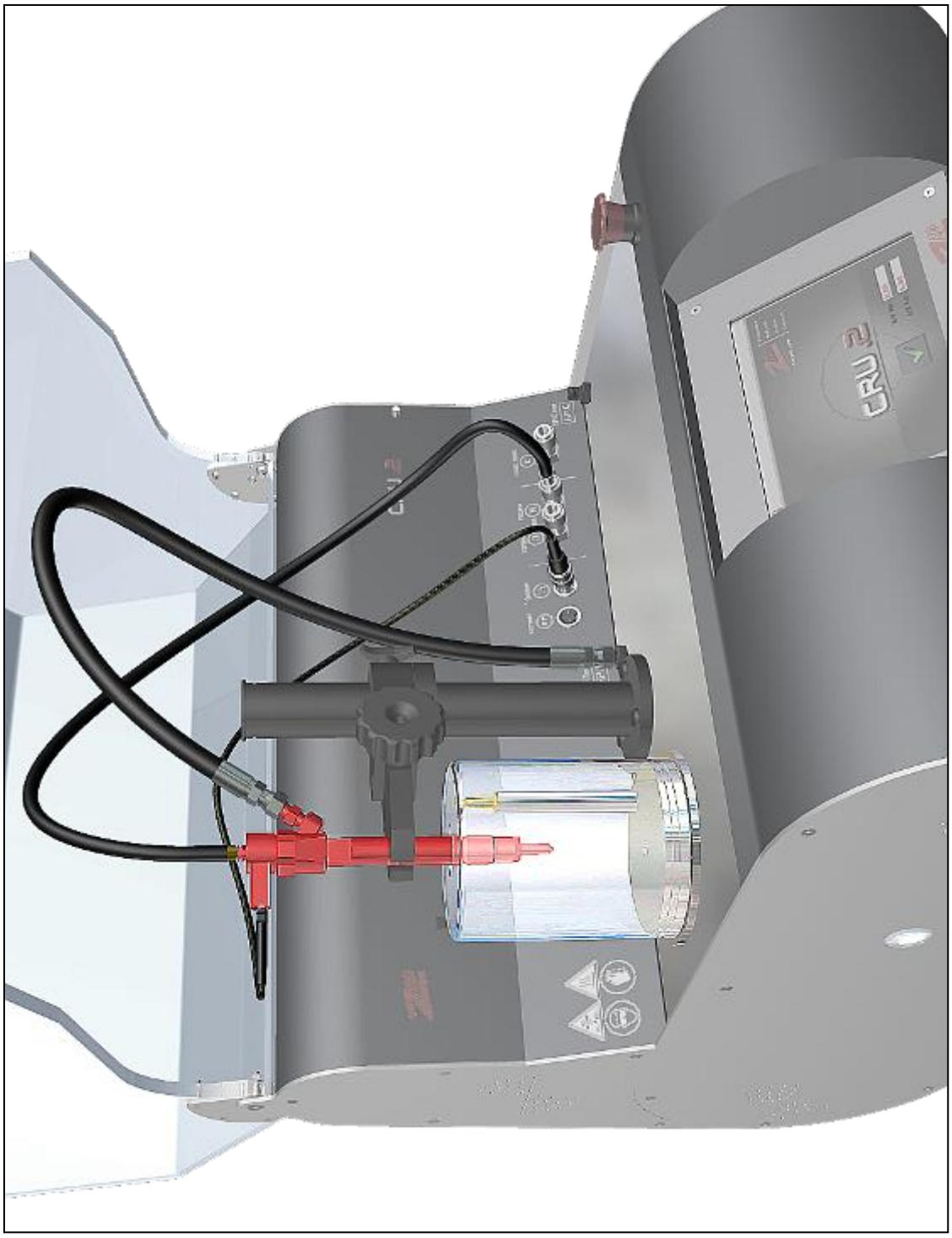


Figure 6-v

Injector iVM Clamping Position and connections

Figure 6-vi

Sample Procedure on Testing Injectors in AUTO Mode

The CRU.2 software provides an easy and hands-off way to test Diesel Injectors. The steps preformed in order to do a complete test are listed below. In addition, there are a few combinations to perform the Automatic Test:

PRV: When this option is enabled, the AUTO program provides a preview screen of the tests performed. When not enabled, the AUTO CHECKLIST screen presents only the tests being performed in a list along with their results.

SPR: When this option is enabled, the AUTO program will first execute a Spray test for the injector (User needs to switch between Spray Chamber Clamping Position and iVM clamping position) and then complete all the other tests in the iVM clamping position. When not checked, the AUTO program will skip the Spray test and proceed to the rest of the tests, in the iVM clamping position.

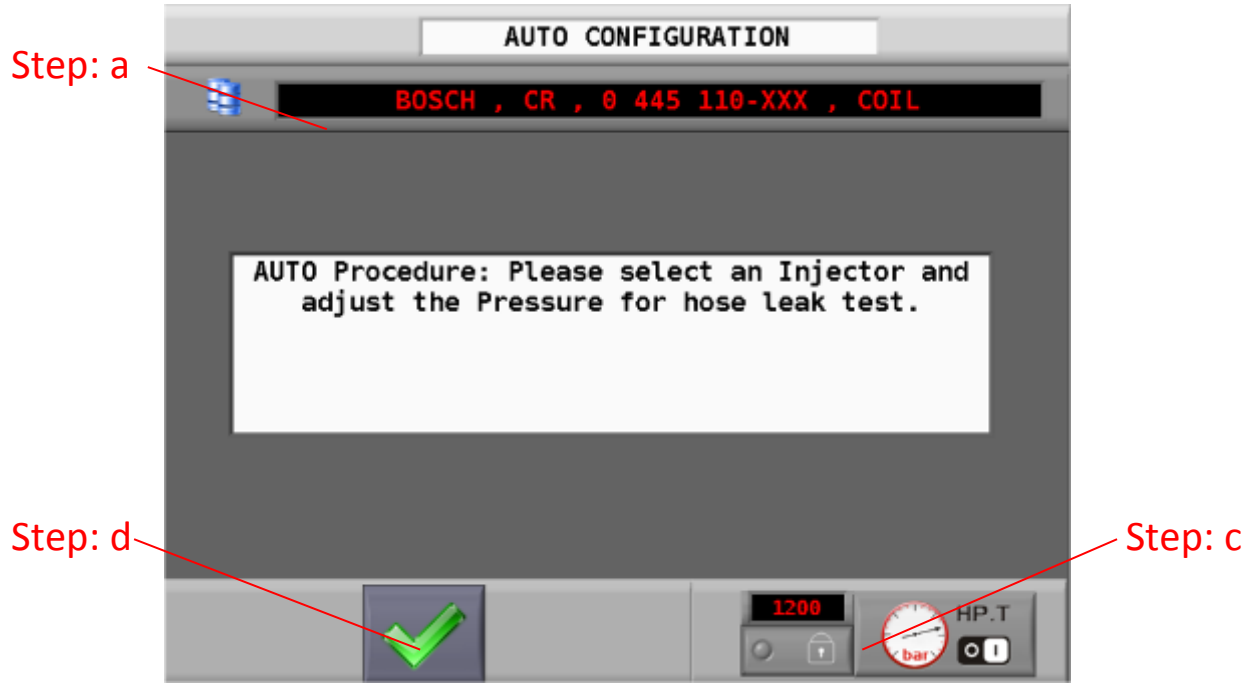
Steps Performed in AUTO Mode Testing:

During the initial setting up of the AUTO Procedure, some helpful messages will pop-up instructing the operator on how to continue. Please provide the time to carefully read all messages for the correct operation. In addition, during these messages the CRU.2 software is preparing the Test Plans and profiles for the injector to be tested.

[**info**]

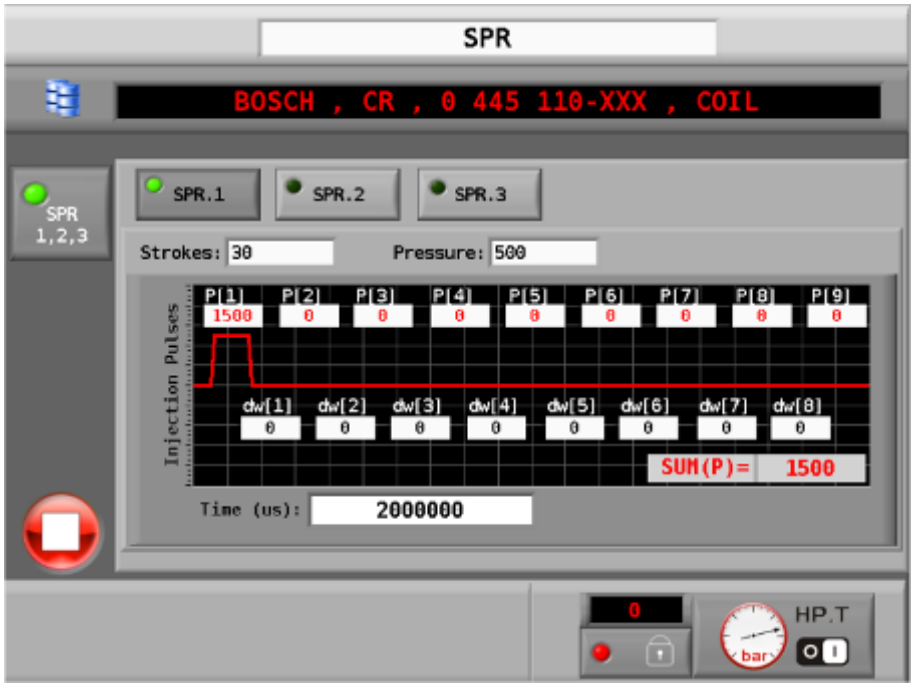
- If the Test is performed for a Piezo injector, please consult the Appendix C for PIR (Piezo Injector Return adapter) connectivity instructions and procedure.
- If all the tests complete and only a few are marked as FAIL, it is advised to rerun the test for a more coherent result
- When a test is marked FAIL, the operator should first repair the problem at the top of the list, and then rerun the test. Most likely if the following tests are marked as FAIL, the cause is the first test on the list.

1: Select the injector



a. Press on the Injector bar and select an injector from the CRU.2 Database list.
b. Mount the injector on the CRU.2 and connect the [ih] injector harness, [R] Return hose/adapter, [D] Discharge hose/adapter and [HP.T] High Pressure hose for Testing. Some hoses/connectors may need additional adapters to connect to the injector, please consult Appendix B.
c. Apply some pressure, to ensure there are no leaks.
d. **IMPORTANT**: Turn OFF the HP.T Pressure before continuing.
e. Press the ACCEPT button when ready.

2: Spray Test (only if activated)



f. The Injector should be in the Spray Chamber clamping position.
g. The test will automatically start, and 3 programs will be preformed, SPR.1 / SPR.2 / SPR.3. The time and programs can be altered from the SETTINGS menu.
h. Once all 3 tests have finished, the program will wait for an evaluation response (Score= 0 to 4). Because the machine cannot evaluate the spray condition of the injector, the CRU.2 operator must visually check the spray condition of the injector and provide the evaluation.

3: eRLC Test (Electrical condition of the injector)

a. The injector must be in the iVM clamping position for this and the remaining tests, because the AUTO program will not stop.
b. Depending on the Actuation type of the injector, COIL or PIEZO, a different test will be preformed:

i. COIL: 

1. Resistance Test (OHM [Ω])
2. Inductance Test (micro Henry [µH]) *[Only when feature is activated]*

ii. PIEZO: 

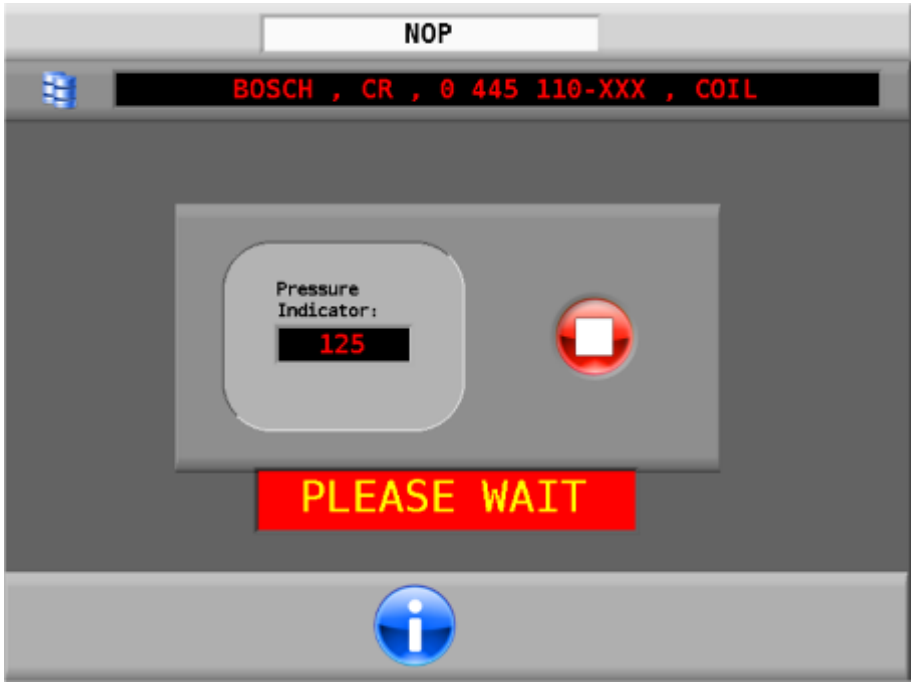
1. Capacitance Test (micro Farad [µF])

c. If an ERROR code is printed in the Report, please consult Chapter 8 “Troubleshooting”.

4: LKT Test (Leak Test / Injector Return valve Condition)

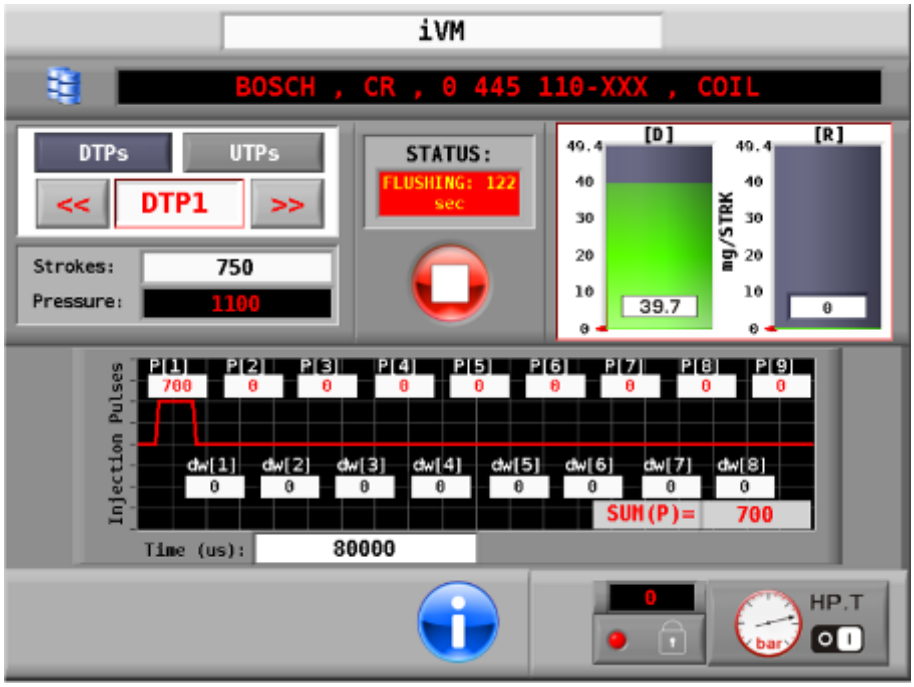
a. This test is not available on PIEZO actuated injectors.
b. The test will apply a predefined pressure to the injector, without activating the injector actuator (Solenoid/ Piezo stack).
c. The return valve of the injector is checked against the rate at which the pressure is dropping compared to the specified time
d. If an ERROR code is printed in the Report, please consult Chapter 8 “Troubleshooting”.

5: NOP test (Nozzle Opening Pressure)

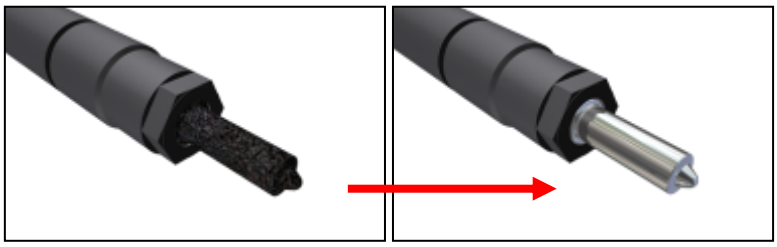


a. The program determines at what pressure the injector is begins to operate.
b. If an ERROR code is printed in the Report, please consult Chapter 8 “Troubleshooting”.

6: iVM (Injector Volume Metering)



a. **Important: Please clean injectors in the ultrasonic device, for at least 15 minutes, prior to mounting on the CRU.2 unit. Injector Ultrasonic Cleaning is Mandatory** (Please review the Warranty)**.**
Failure to clean injectors with the use of Magneti Marelli's ultrasonic device (provided) before any test is completed on the test bench will void the warranty of the machine. If the sensor reading is out of specification or accuracy due to dirt (verified), the machine's warranty will be voided.



b. When this test first begins, it activates the injector with a high volume / high pressure program, in order to flush

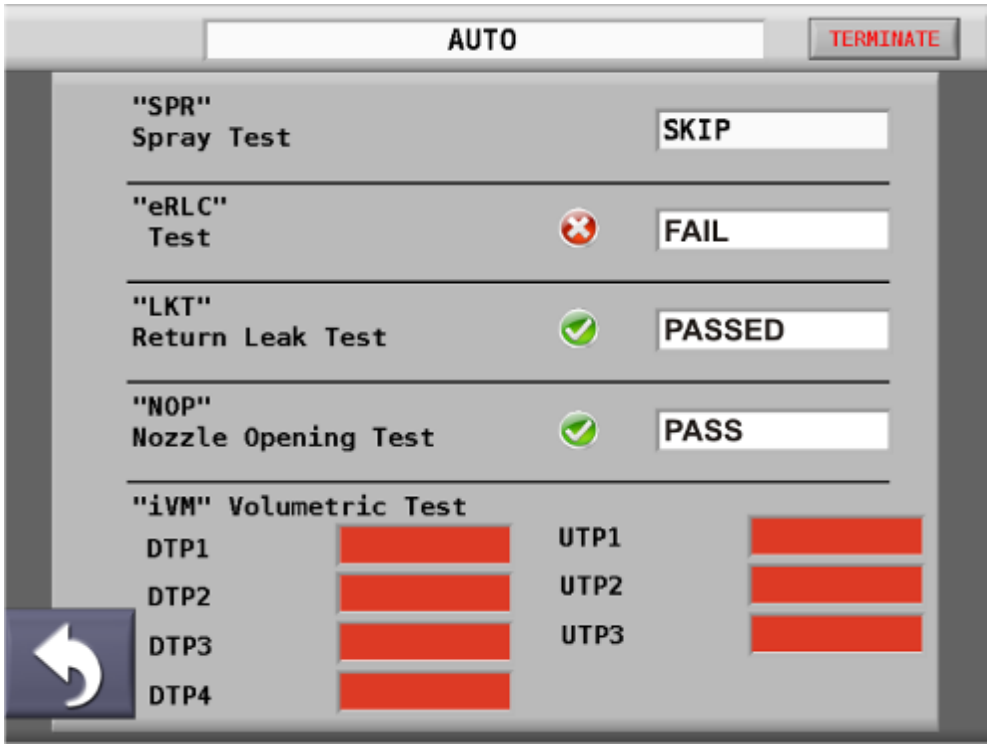
the [D] & [R] lines, thus eliminating any possible air pockets.

c. Depending on the Database (DB) being used, the test will perform the activated Test Plans (TP) for this injector. For further information on the DB type or TP options, please consult the Chapter 4 and Chapter 7:
   iii. Default Data Base:
      1. DTP.1 to DTP.4
      2. UTP.1 to UTP.3
   iv. User Data Base
      1. UTP.1 to UTP.3

d. Each Test Plan will perform for a predefined time, measuring both [D]ischarge and [R]eturn mass per Stroke of injection (mg/STRK). An automatic conversion to volume (ml/min) is made and shown in the final Report of the test.

e. If an ERROR code is printed in the Report, please consult Chapter 8 “Troubleshooting”.

7: AUTO Checklist



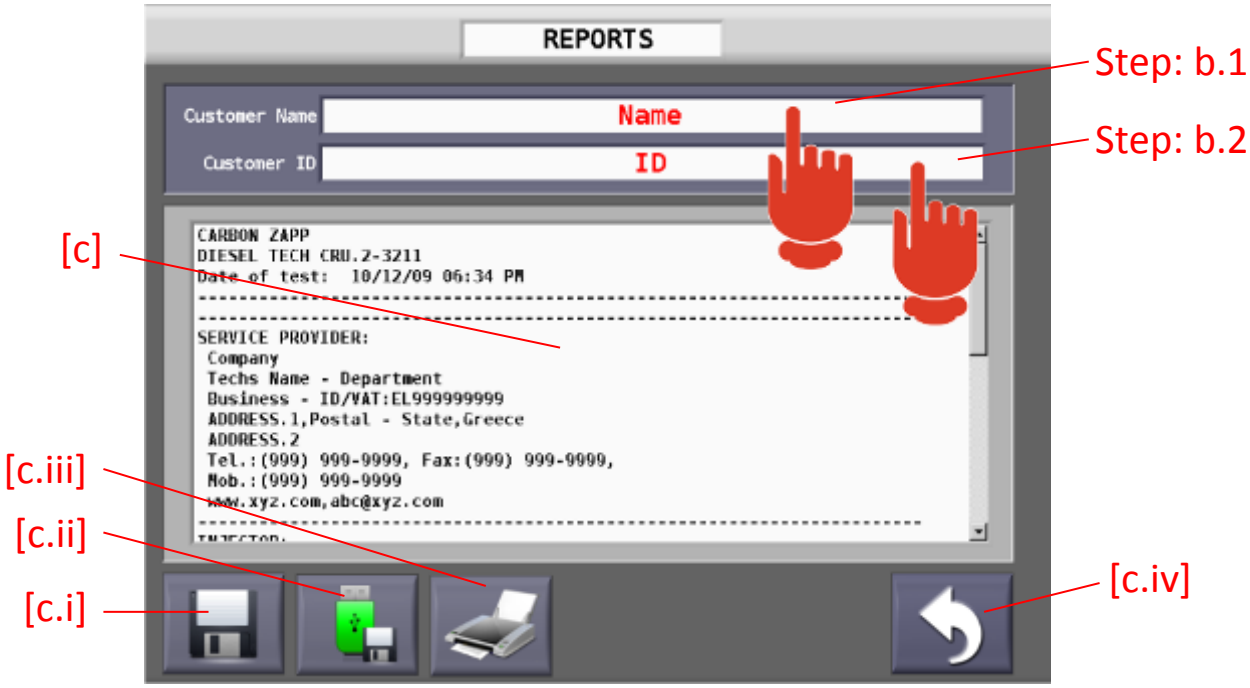
a. This screen is shown in the AUTO mode, either constantly (Test Screen Preview not selected), or in-between the different tests.
b. When no preview is selected the test current test status indicator will blink RED.
c. Once all tests have been performed, a RETURN button will appear, giving the opportunity to exit the AUTO mode and proceed to the REPORT of the test.
d. Although it is not recommended, a TERMINATE button is available on the Top Right corner of the screen. This button will terminate the current process and restart the application. All the current data will be lost.

8: STOP button in each test screen

a. Only when performing the AUTO program with preview enabled, an option to press the STOP button in each test screen is available, and provides the following options:

i. SKIP: skips the current test
ii. REPEAT: repeats from the beginning the current test. If performing the iVM test, all data from each Test Plan will be lost and the iVM test will begin again.
iii. HOME: cancels the AUTO program and returns to the Home Screen, losing all the results from the tests performed.

9: Report Generation



a. Once the AUTO program has performed all the tests, a RETURN button will appear. When the RETURN button is pressed, the Report Generation screen will appear.
b. In order to generate the report for the current test, a Full Customer Name and optionally a Customer ID must be entered in the TOP of the screen.
c. Once the report is generated, the following options are available:
    i. SAVE: saves the report in the CRU.2 report database
    ii. SAVE-TO-USB: saves the report in the first available USB pen drive attached to the CRU.2 USB ports.

The report is saved in a .txt (simple text) format, and it can be transferred and/or viewed in any computer using a word editor program like WORDPAD, MSOFFICE WORD etc.

iii. PRINT: prints the report to the pre-installed HP USB printer attached to the CRU.2. For further information on Printer and installation, please consult Chapter 5 (page 5-9).

iv. RETURN: closes the report generation, and returns to the Home Screen.

v. For further information on Reports, please consult Chapter 4 (page 4-20).

Injector MACC Clamping Position and connections

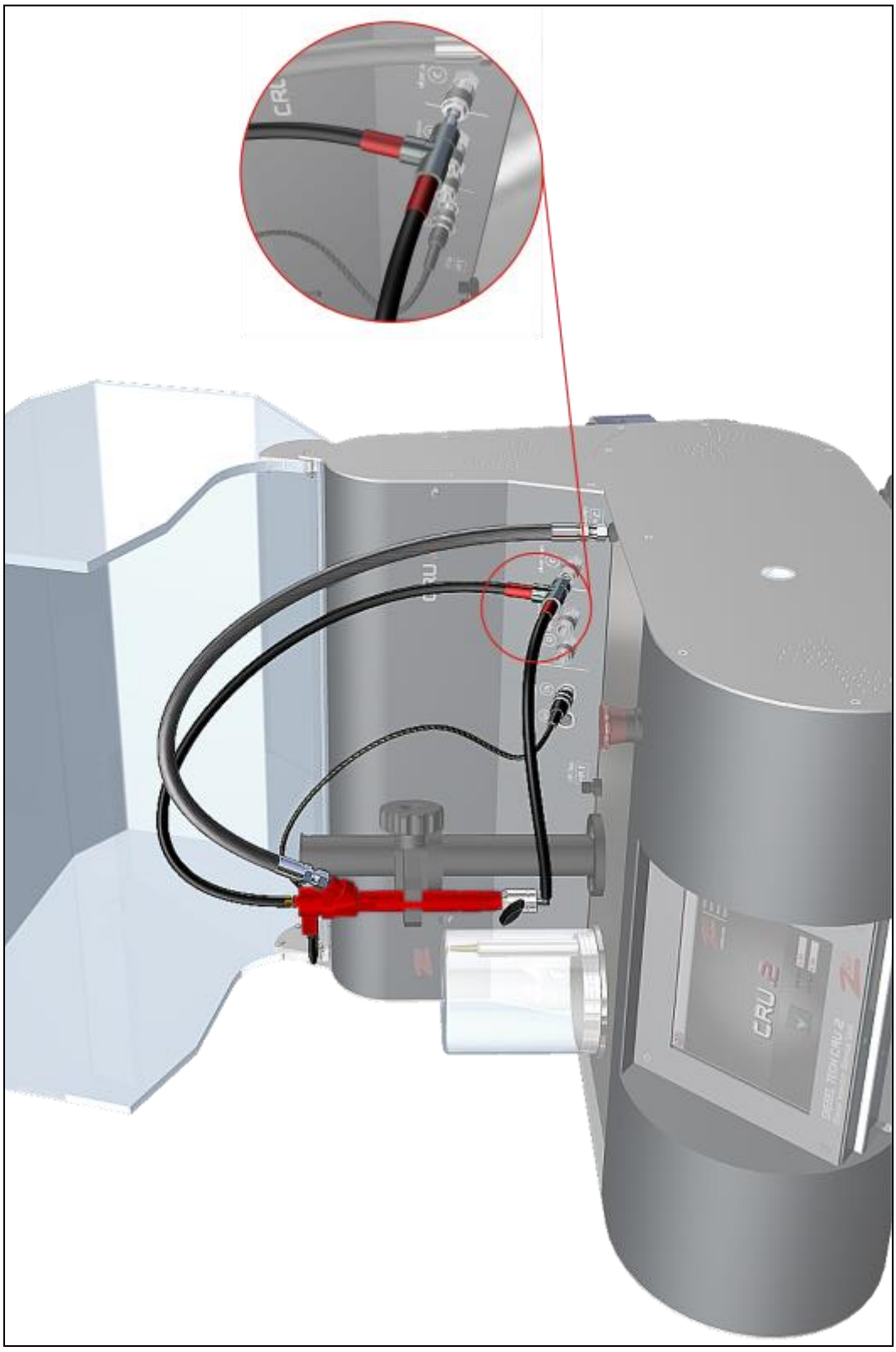


Figure 6-vii

MACC (Cleaning Injectors internally)

[CRU.2-XXX1 only]

The CRU.2 provides a separate function for cleaning injectors with the MACC (Molecule Activated Chemical Cleaning) method. Navigate to the Home Screen and press the MACC button. The MACC Screen will appear (Figure 6-viii). Follow the steps below to effectively service the injectors:

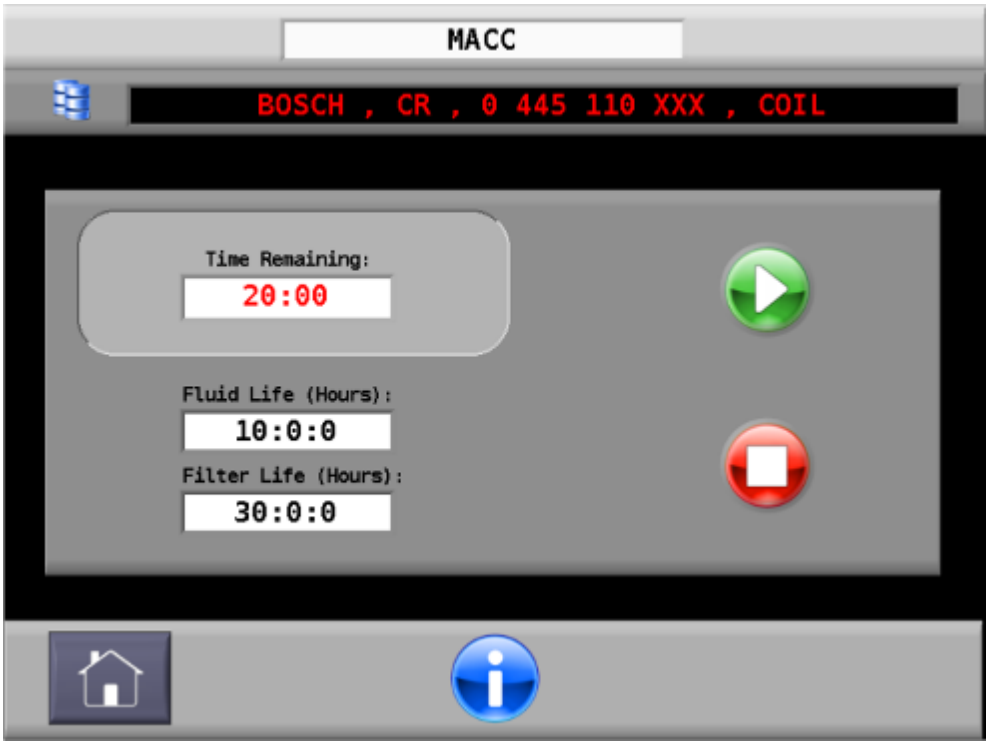


Figure 6-viii

1. Click the Injector Bar and select the injector from the Database.
2. Mount the injector on the CRU.2 in the MACC clamping position.
3. Use the [HP-C] hose, C-adapt and [ih] electrical harness, and connect the injector with the CRU.2 (Figure 6-vii)
4. Press the START button and the MACC process will begin.

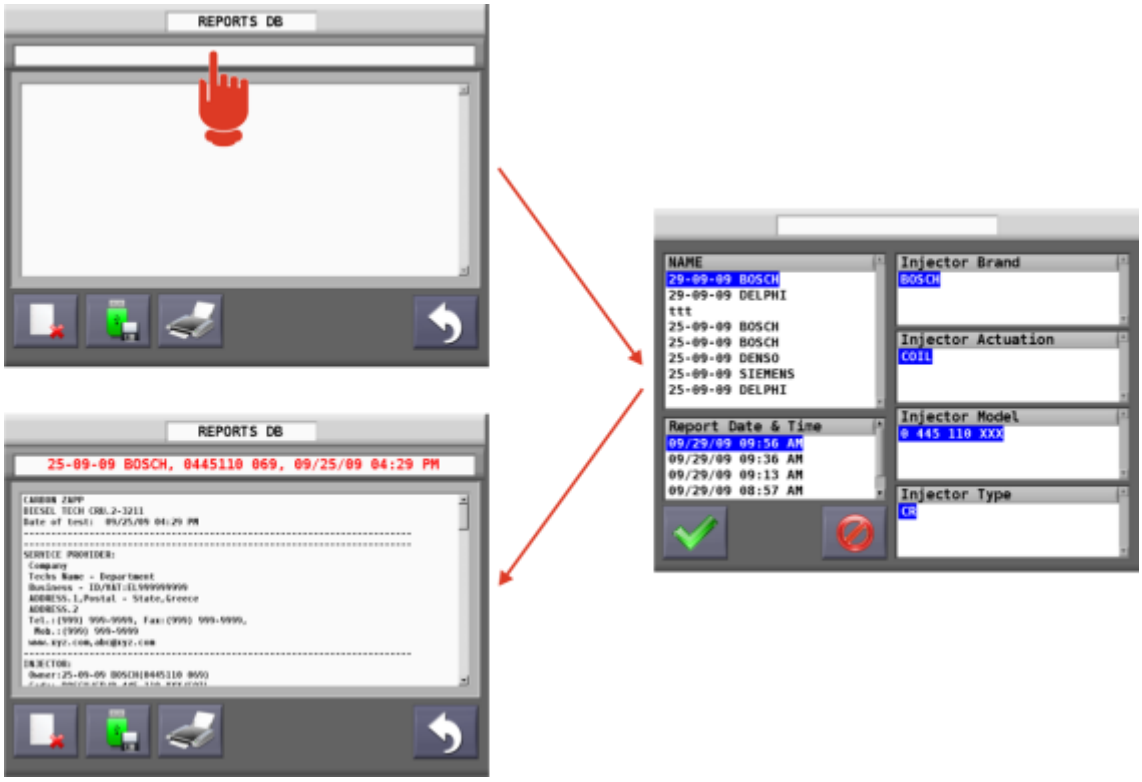
5. Four predefined test plans will activate the injector in different frequencies for the full period of the time for more effective servicing.
6. As soon as this process has terminated, the program will remain in idle mode, and the operator can either repeat the process or Return to the Home Screen.
7. Information regarding the Filter and Fluid life span are shown in hours.

[**IMPORTANT**]

- The MACC High pressure system can provide up to 600 bar of pressure. The Protective Clear Cover will only protect from possible squirts of fluid/spray, and will not zero the High Pressure when in the Open Position, as in the Testing procedure.
- When Disconnecting the HP-C Hose from the injector, please where goggles and gloves, because there will be some pressure left in the system. Unbolting the hose connector slowly is a good practice to slowly drop the pressure to zero and therefore minimize fluid squirting with high pressure.
- The MACC hydraulic system is completely separated from the Testing system, please use all adapters, hoses and connector marked with a “C”.

Saved Reports

In the Home Screen there is an option to view, print, save-to-usb and delete a pre-generated report.



Navigate to the Home Screen and press the REPORTS button. Once the Report Screen appears, press on the Report Bar in order to browse/select the desired report. The reports are categorized/grouped with:

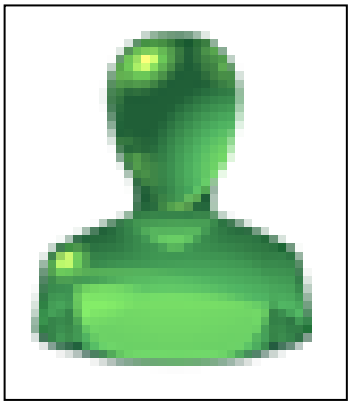
- Customer Name
- Report Generation Date
- Injector Brand
- Injector Actuation
- Injector Model
- Injector Type

Press the ACCEPT button to view the selected report, or the CANCEL button to cancel this selection.

Once a report in selected and viewed, the following options are available:

- DELETE: completely deletes this report from memory (no confirmation is provided).
- SAVE-TO-USB: saves the report in the first available USB pen drive attached to the CRU.2 USB ports. The report is saved in a .txt (simple text) format, and it can be transferred and/or viewed in any computer using a word editor program like WORDPAD, MSOFFICE WORD etc.
- PRINT: prints the report to the pre-installed HP USB printer attached to the CRU.2. For further information on Printer and installation, please consult Chapter 5 (page 5-9).
- RETURN: closes the report generation, and returns to the Home Screen.

Chapter 7
“Advanced Users”



This Chapter is intended for advanced users with knowledge on diesel systems. The following topics are covered:

- Manual Tests
  - SPR Test
  - eRCL Test
  - LKT Test
  - NOP Test
  - iVM Test
  - RSP Test
- User Injector Database
  - Procedure in editing/creating the user database

Manual Tests

Instead of testing each injector in AUTO mode, there is an option to perform each test separately, in order to do a specific, customized test, or just save time when repairing a specific part on the injector.

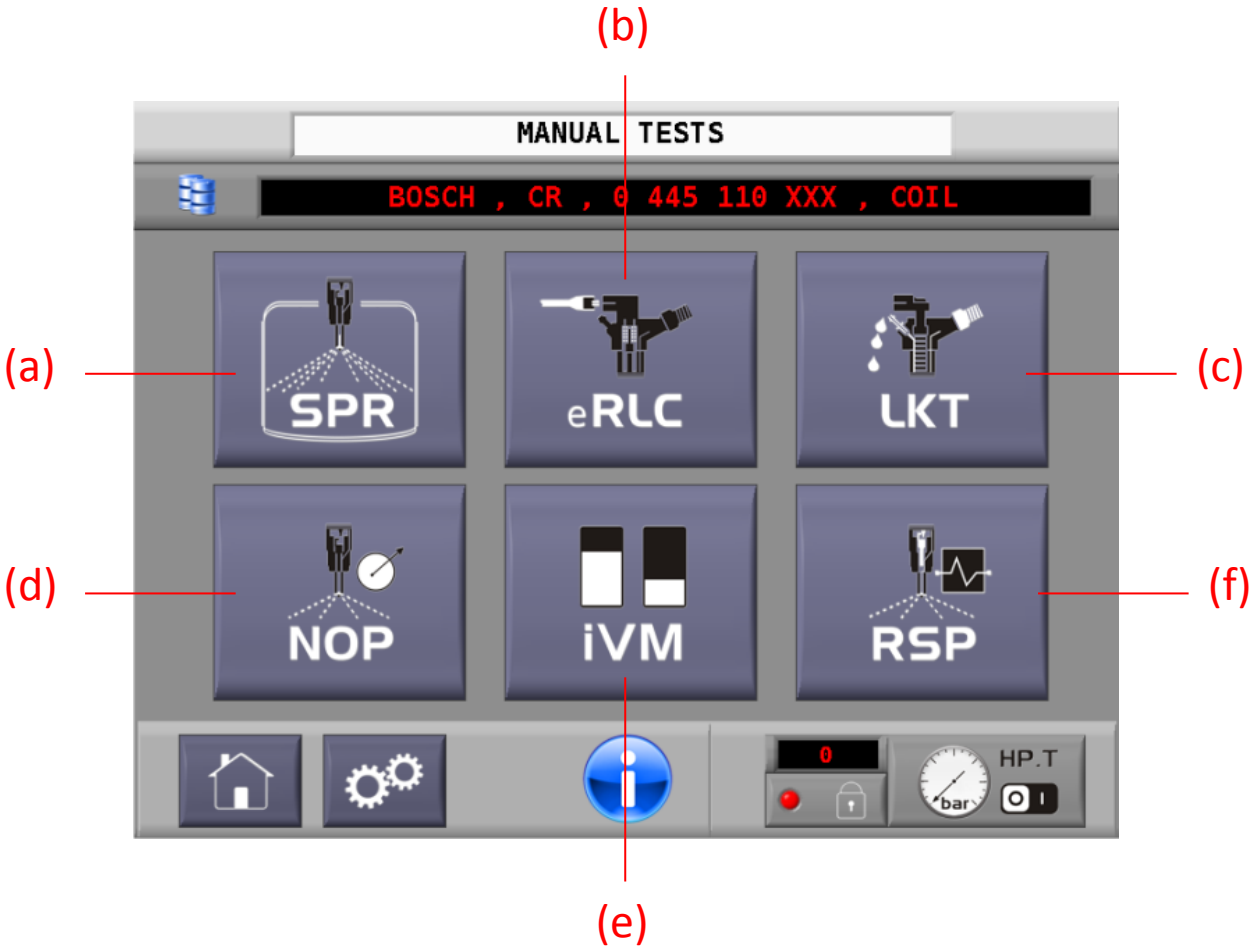
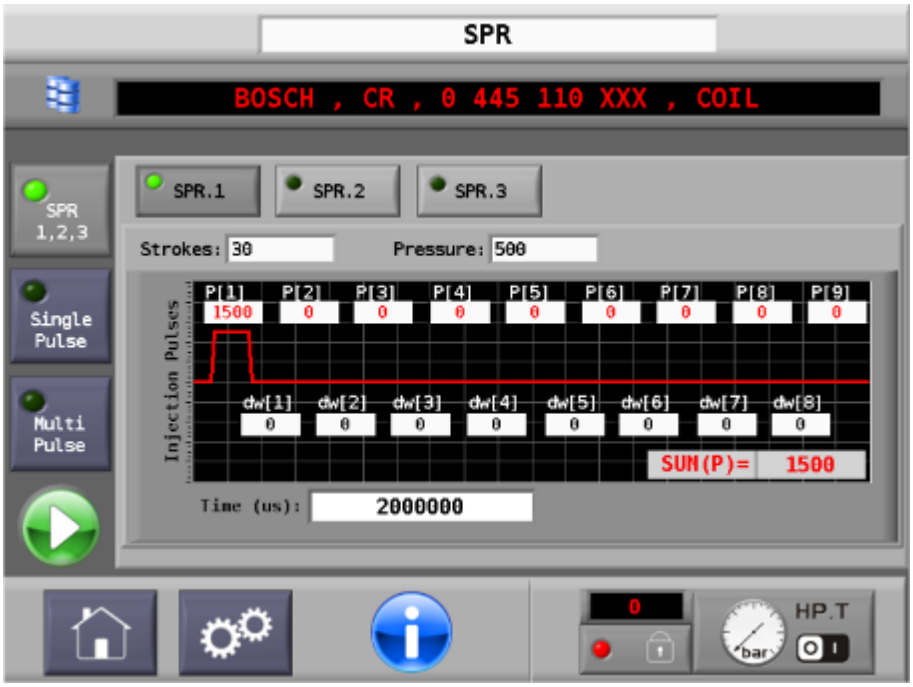


Figure 7-i

a. **SPR**: The Operator inspects and values the Spray condition and the nozzle of the injector in different simulation test plans. The time that the test will perform is entirely up to the operator, since the injection start performing when the START button is pressed and stop performing when the STOP button is pressed. The operator can switch between different simulation programs without stopping and restarting the test. ***Important Note: some time is needed until all test plan parameters are loaded on the injector, therefore the operator should wait at least 30 seconds before switching to another test plan.*** The LED lighting and Injector Spray Chamber Fumes Extractor are automatically activated in this test and are also switched off when exiting. The injector must be in the Spray Chamber Clamping position. Three different types of procedures are available for this test:

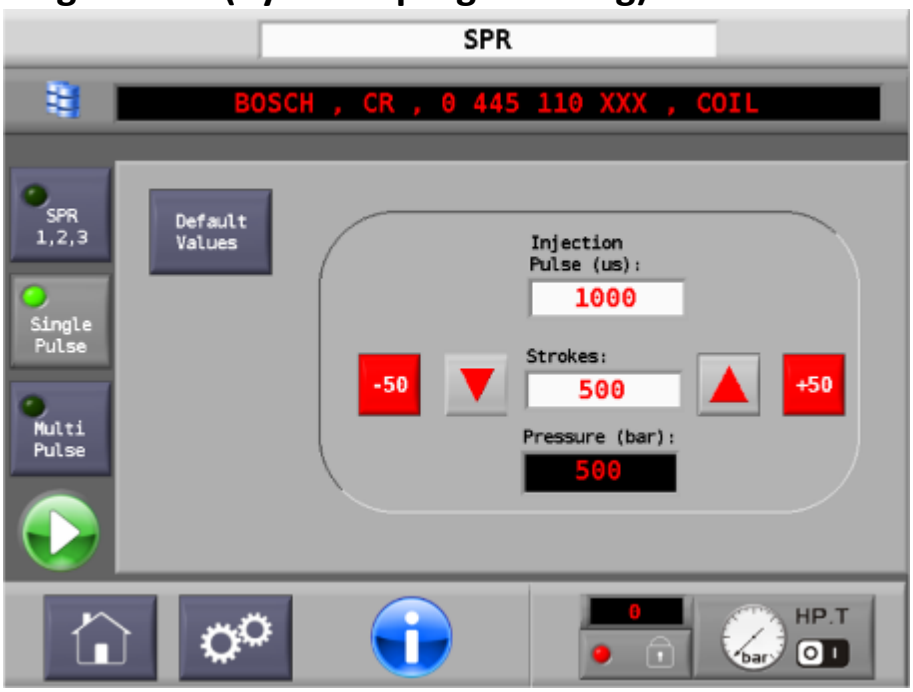
- **Default**:



The predefined Spray Test Plans (SPR.1, SPR.2, SPR.3) from the system settings menu can be used here. These test plans are predefined and are injector independent. The SPR.1,2,3 test plans can be altered

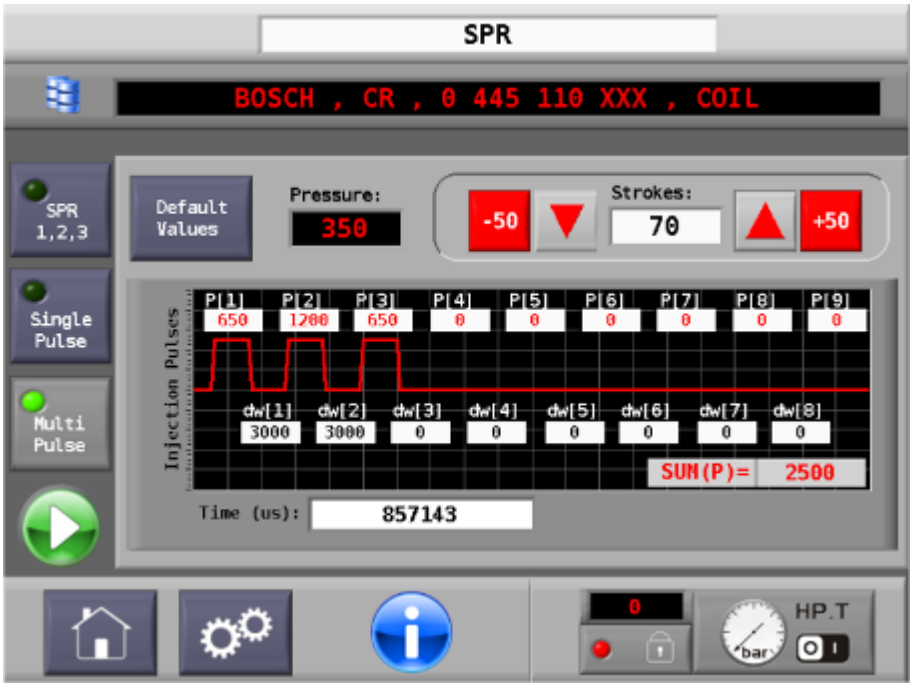
only by entering the system setting menu, were a save option is available.

- **Single Pulse (dynamic programming):**



By activating the Single Pulse option from the SPR test screen, the operator can perform a single pulse per stroke test and can dynamically alter the Injection Pulse width (microseconds: us/µs), the Strokes and the Pressure in Bar. ***CAUTION is advised when selecting high values. If the operator is unfamiliar with injection test plan parameters, it is advised not to perform this procedure.*** By pressing the Default Values button, the original values for this test will be loaded.

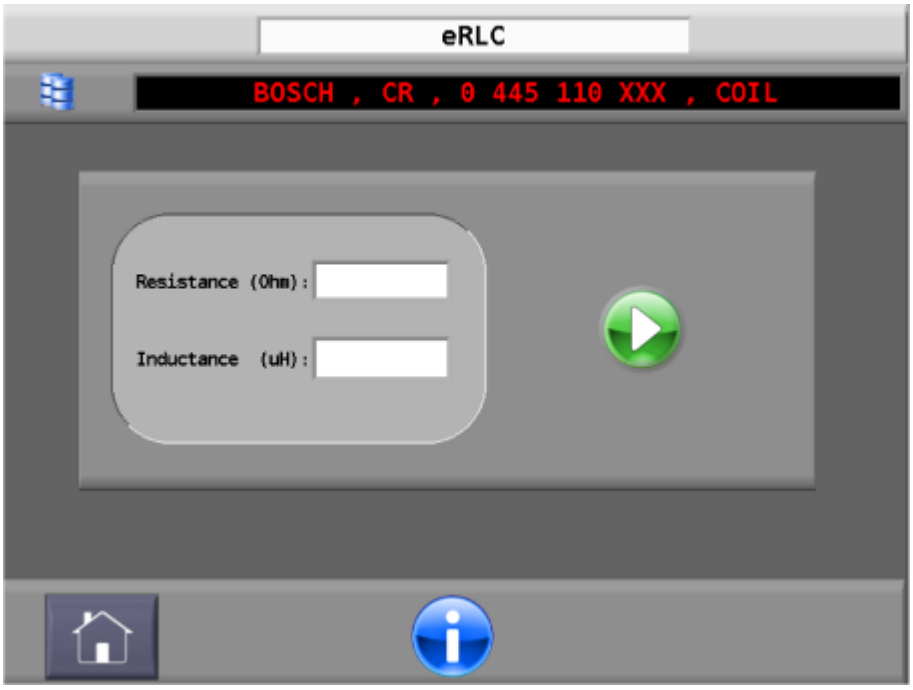
- **Multi Pulse (dynamic programming):**



By activating the Multi Pulse option from the SPR test screen, the operator can perform a multi pulse per stroke test and can dynamically alter the Injection Pulse width and dwell time (microseconds: us/µs), the Strokes and the Pressure in Bar. ***CAUTION is advised when selecting high values. If the operator is unfamiliar with injection test plan parameters, it is advised not to perform this procedure.*** By pressing the Default Values button, the original values for this test will be loaded.

b. **eRLC**: Inspect the electrical condition of the injector. Depending on the injector selected (COIL/PIEZO actuation), a different test will be performed. By pressing the START button the test will perform automatically and as soon as the values are displayed it will terminate automatically. ***Important Note: some time is needed until the test is performed, therefore the operator should wait at least 30 seconds before repeating the test or exiting the test.***

- **Coil Injectors:**



1. Resistance Test (OHM)
2. Inductance Test (µH)

- **Piezo Injectors:**

1. Capacitance Test (µF)

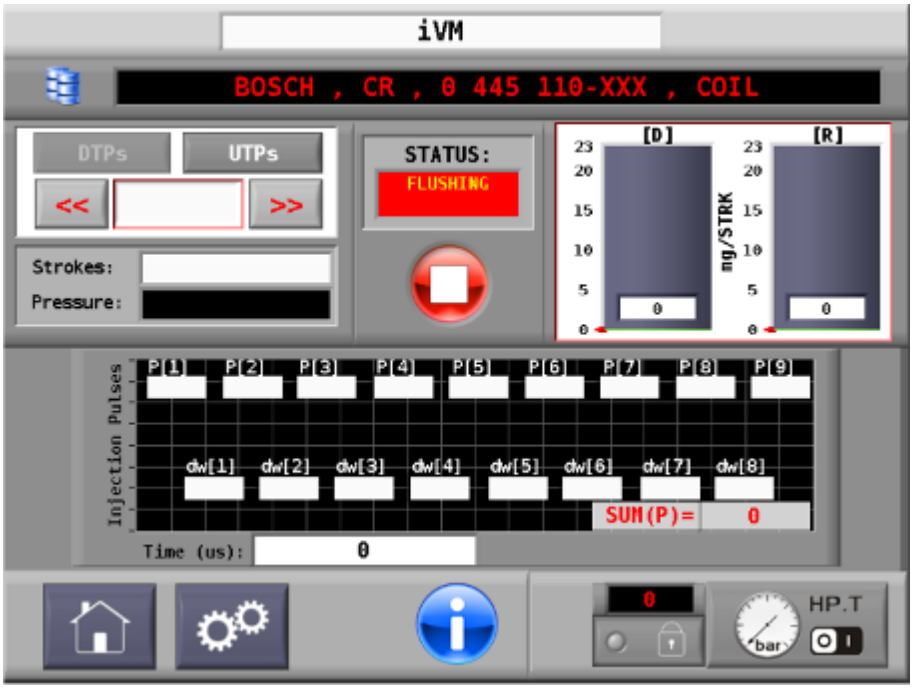
c. **LKT**: Inspect the return valve condition of the injector. This test is not available for Piezo injectors. By pressing the START button, the operator initiates the test procedure. The software will automatically raise the high pressure and

will automatically drop the pressure within a certain time to evaluate the leakage condition of the tested injector; in the meantime a “Please Wait” pop-up will appear informing the operator to wait for the procedure. If an error message appears, please consult Chapter 8 “Troubleshooting”. ***Important Note: some time is needed until the test is performed, therefore the operator should wait at least 30 seconds before repeating the test or exiting the test.***

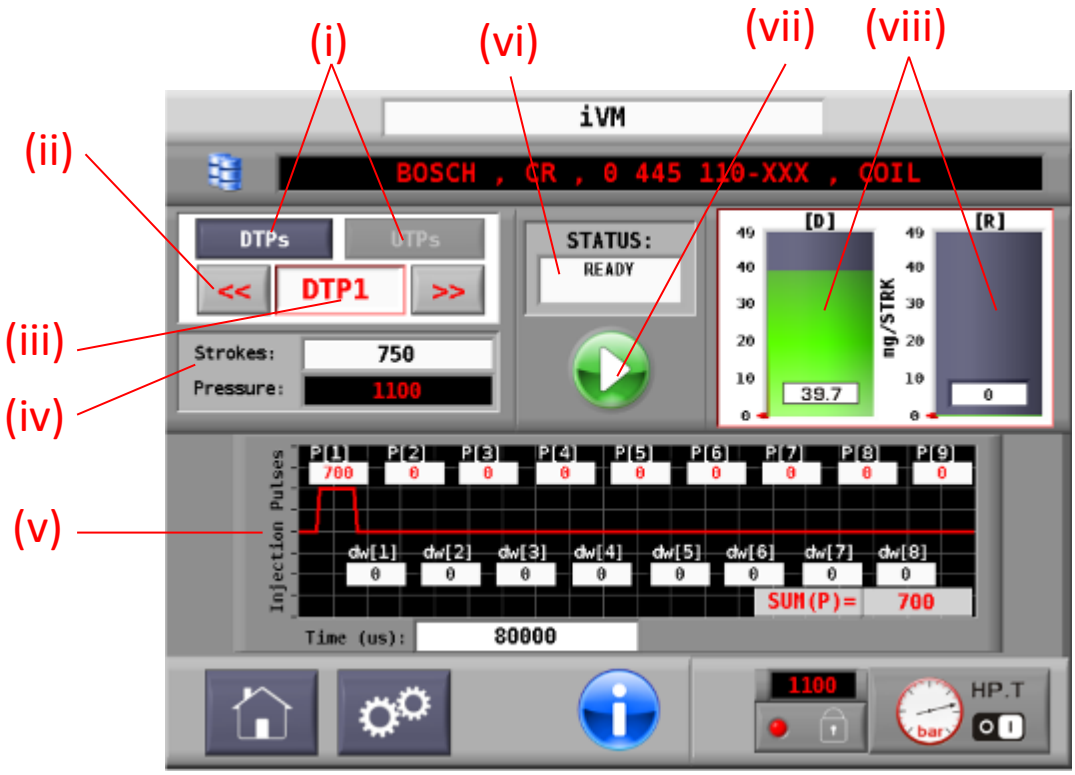
d. **NOP**: Derives the Nozzle Opening Pressure of the Injector (the minimum pressure Common-Rail Injectors need for operation). By pressing the START button, the operator initiates the test procedure. The software will automatically raise the high pressure in increments, activating the injector in-between pressures and deriving thus the NOP value; in the meantime a “Please Wait” popup will appear informing the operator to wait for the procedure. If an error message appears, please consult Chapter 8 “Troubleshooting”. ***Important Note: some time is needed until the test is performed, therefore the operator should wait at least 30 seconds before repeating***

the test or exiting the test. The injector must be in the iVM Clamping position.

e. **iVM**: Measures the injector Discharge and Return values in milligrams per Stroke (mg/STRK), performing different simulation test plans, Default and User Customizable. The injector must be in the iVM Clamping position. Once the Test screen initiates, an initial Flushing program will be performed eliminating thus the possibility of air particles in the hose lines. Performing this test for similar injector codes without exiting and re-entering the test screen will result in inconsistent results. In addition, the Injector Selection Module is de-activated and thus no other injector can be selected.



Once the FLUSHING procedure is performed the first active iVM Test Plan for the current injector will be loaded. ***Important Note: some time is needed until each procedure/test is performed, therefore the operator should wait at least 30 seconds before repeating/ switching the test or exiting.*** Each injector is loaded with its own test plans, 4 Default test plans (DTPs) and 3 User test plans (UTPs) which are fully customizable.



i. Select/Toggle between DTP and UTP test plans. In case the injector selected is from the User Database, the DTP feature is not available. Further, if the injector property has all UTP test plans turned OFF, the UTP feature is not available. Every time the DTP or UTP button is pressed, the 1st available (active) test plan is loaded on to the injector.

ii. Scroll left and right between the available (active) test plans in the selected DTP or UTP profile.

iii. Indicates the currently loaded test plan.

iv. Strokes and Pressure Indicators for the specific test plan. If a UTP profile is selected by pressing on these values, the operator can dynamically input the desired strokes or pressure for this test; the changes are not saved in the profile nor are they displayed in the reports.

v. Injection Pulses Module indicates the injection profile of the current test plan. If a UTP profile is selected by

pressing on these values, the operator can dynamically input the desired Pulse and dwell timings for this test; the changes are not saved in the profile nor are they displayed in the reports.

vi. The Status indicator provides the current state of operation, e.g. READY, FLUSHING, ERROR, D: 99 seconds etc.

vii. Once the desired test plan is selected and loaded, the operator can initiate or terminate the iVM test by pressing the START/STOP button.

viii. The [D]isharge and [R]eturn indicators provide the measurement in mass per stroke (mg/STRK). When a UTP profile is selected upper and lower tolerance values will also be displayed on the indicators, providing the capability to the operator to visual check the passing state of the injector.

f. **RSP**: *Future Update Option*.

User Injector Database

The CRU.2 HMI software is equipped with 2 individual databases, the default database and the user database. The default database is the database that comes preloaded in the CRU.2 and can be updated, whereas the user database is an empty database an advanced user can create. The default database provides 4 Default Test Plans (DTP.1-4) that the operator can activate or deactivate for the iVM test, as well as 3 User Test Plans (UTP.1-3) which the user can customize, activate or deactivate. The user database is only equipped with UTPs that the user can customize and activate or deactivate.

1: Procedure in creating/editing the user database

1. Select an injector with the closest specifications, e.g. Brand, actuation etc.
2. Press on the SAVE AS button in order to save that injector to the user database (Figure 7-ii).
3. Once saved to the user database, the injector can be edited then or at a later time. The Default Test Plans (DTPs) in the injector are now all inactive and cannot be used, only the User Test Plans (UTPs) are available here.
4. An advanced user can:
   a. Rename the Injector Model (Figure 7-ii)
   b. Edit specific UTP parameters (Figure 7-iv). Here the Discharge and Return values can be set (mg/strk) along with the percent of tolerance. For example a [D] value of 30 with a tolerance of 15% gives an outcome of (25.5-34.5 mg/strk), and similarly for the [R] value.

5. Change the values for the (Figure 7-v):
    a. NOP (provide the NOP value and % of tolerance)
    b. LKT (provide the LKT High pressure, Low pressure and time of test in seconds)
    c. eRLC (provide the resistance, inductance or capacitance and their tolerances)
    d. Volts
    e. Amperes
6. Any Changes made can be saved by pressing the SAVE button.
7. In addition, the User Database injectors can be deleted (Figure 7-iii-[e])

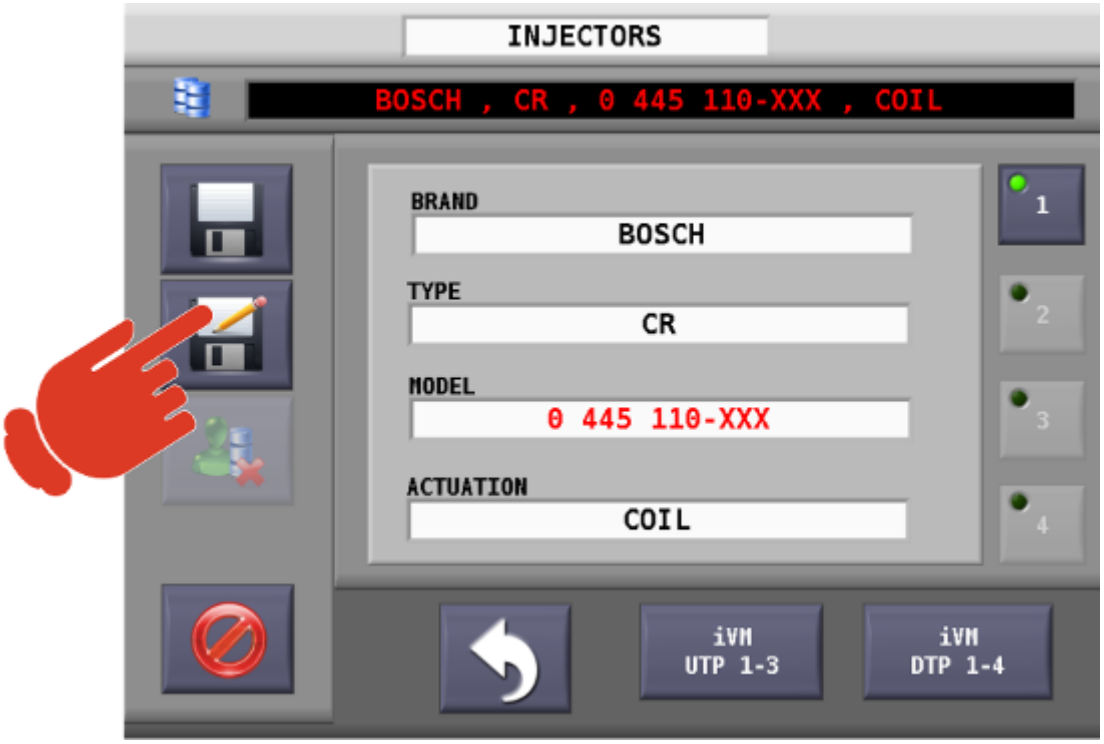


Figure 7-ii

a. Injector preview / selection bar: This bar provides information on the selected injector. If pressed, the injector DB menu will appear (Figure 4-i) providing the user with the capability to select a different DB or Injector.

b. Database (DB) type selected, Default DB  or User DB  . Default DB is the database that comes with the machine, whereas the User DB is the database created by the user.

c. SAVE: Saves the current changes done on the injector (no confirmation provided). If the Injector MODEL field is changed, then this button will automatically save the injector to the User DB.

d. SAVE AS: Saves the current injector to the User DB (no confirmation provided) with the specified MODEL name.

e. DELETE: Deletes the current injector. This option is only available when using the User DB.

f. CANCEL: Discards any changes made to the current injector.

g. RETURN: Exits this Injectors screen

h. iVM UTP 1-3: Opens the User Test Plans screen for the iVM test for this injector (Figure 7-iv).

l. iVM DTP 1-4: Opens the Default Test Plans screen for the iVM test for this injector (Figure 7-iv). This option in only available when using Default DB.

m. Injector Properties (1-4), pages 2-4 are only available when using User DB:

    1: Provides information of the injector:

        i. Brand: Manufacturer

        ii. Type: CR, CRIN, EUI etc.

        iii. Model: The manufacturer model No

        iv. Actuation: Coil, Piezo etc.

2: Reserved for later use

3: Provides information on NOP,LKT and eRLC tests

4: Provides information Volt and Amperes parameters.

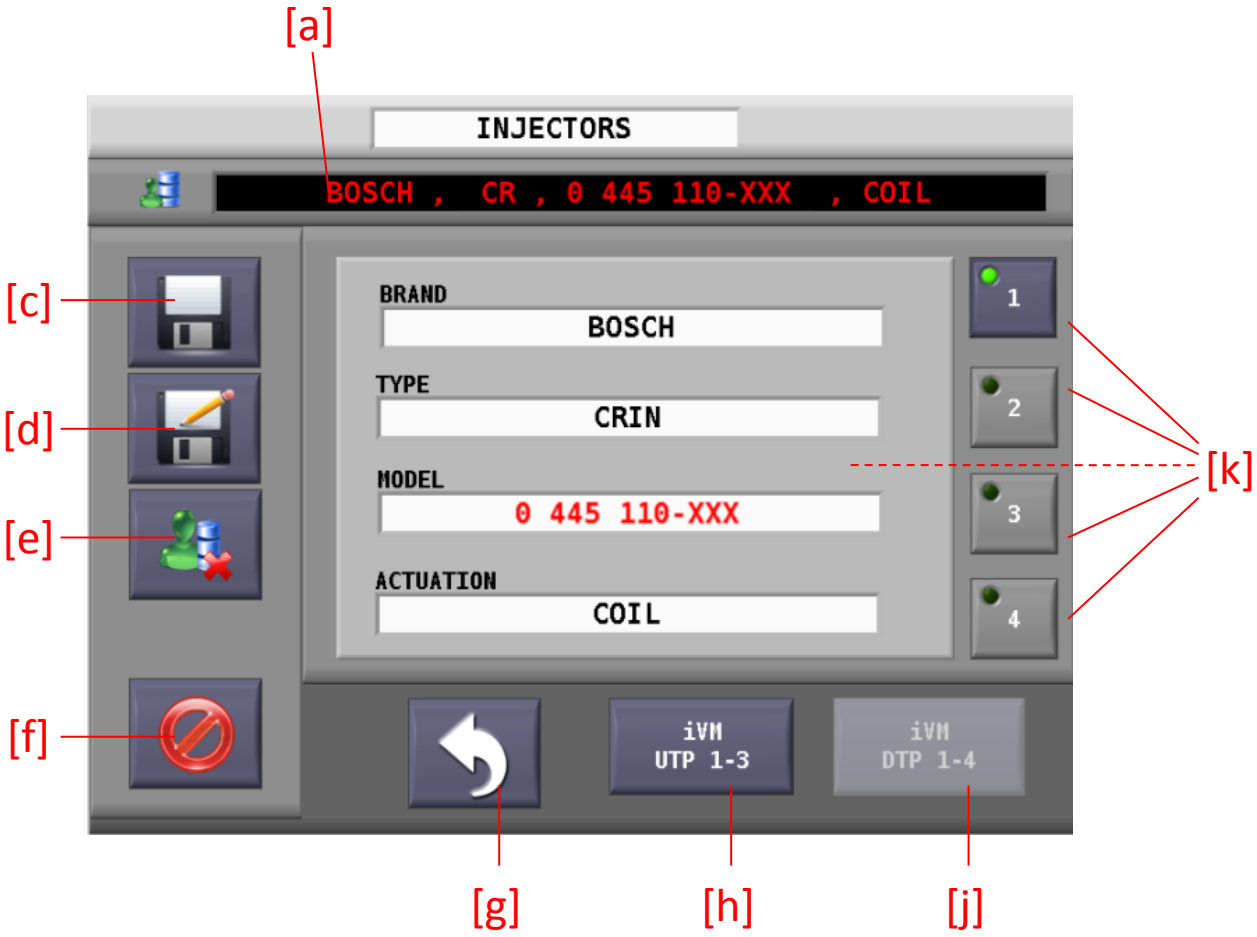
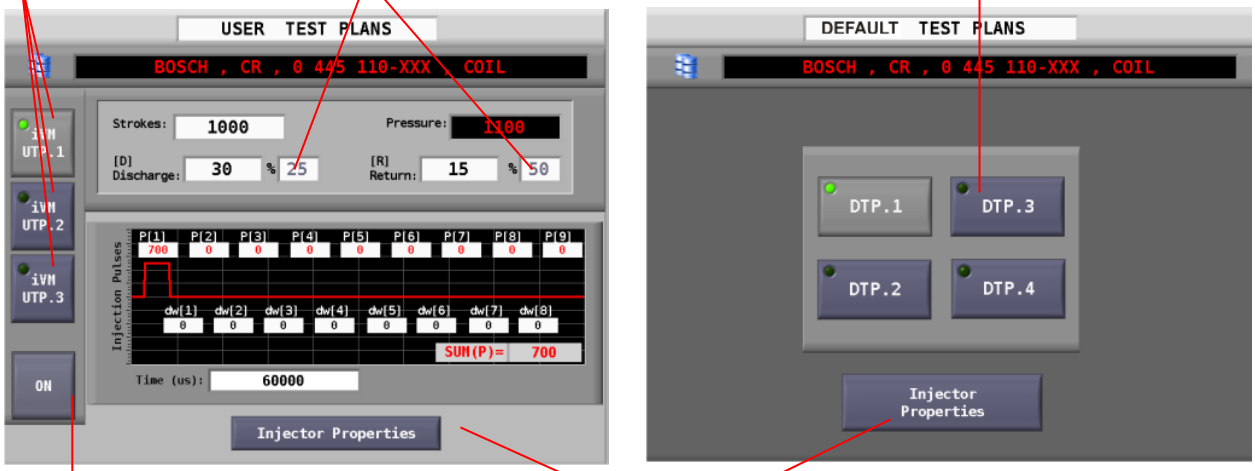


Figure 7-iii

[Select User TP]

iVM [D] & [R] values and (+/-) % tolerance

[Activate/ Deactivate Default TP 2-4



[Activate/ Deactivate the Selected TP]

[Return to Injector Properties]

Figure 7-iv

(*): Default Field Values

Figure 7-v

Chapter 8
“Troubleshooting”

Magneti Marelli designed the CRU.2 unit for durability. However, should problems occur, following the procedures in this chapter can help to determine the cause.

All CRU.2 operators should become familiar with this chapter. Knowing what might go wrong can help prevent problems from occurring.

Symptom / Problem	Detailed Description	Solution / Repair
PC BASED PROBLEMS	Long Delay in Boot or No Boot	• CRU.2 was not shutdown properly • File System is corrupt • Perform a Full System Restore: • or contact support@carbonzapp.com
	LCD /Touch screen	• Touch Screen was scratched / vandalized • Contact: support@carbonzapp.com
	HMI: HW and/or SW not showing on boot up, injector properties/data not showing, Pop-up messages not showing	• No Hardware Connection • CRU.2 was not shutdown properly • File System is corrupt • Open Left Side Panel and check wiring. • Perform a Full System Restore • or contact: support@carbonzapp.com
	System Restore Procedure	• Switch Off the CRU.2 Unit • Connect a USB Keyboard • Switch On the CRU.2 Unit • Press the “Esc” key many times on the keyboard until a hidden menu appears • Select the “Full System Restore” option, using the keyboard Up/Down arrows

		• Press the “Enter” key on the keyboard to initiate the process • Please Wait while the system is Restored, this can take several minutes • The system will be rebooted automatically into the CRU.2 HMI software
	Software Update Failure	• Update file missing from USB Drive or USB drive did not have time to be read by the system • Updating version is earlier than current version.
	PC locks-up, while in HMI	• Wait, up to 5 minutes, if no hazardous condition exist • If problem does not repair automatically, switch OFF the CRU.2 unit using the ON/OFF switch on the Rear of the machine, wait at least 1 minute and then switch ON the machine again.
	INJECTOR DRIVER PCB board issues	• Good Injector not working correctly (Spray, Ohm, Inductance, Capacitance): Injector Driver PCB is defective, contact: support@carbonzapp.com
MACHINE LEAKS FLUIDS INTERNALLY WHILE OPERATING	Possible LOW PRESSURE Leaks from: 1. Low Pressure Pump	• Open both side panels of machine • Operate unit in Manual mode at both spray test and iVM test • Visually inspect for leaks while operating unit • When leak is located, focus on the

	2. Low Pressure Supply Hoses to low pressure pump, filtering systems and HP pumps 3. [D] and [R] hoses internally connecting to iVM sensor 4. iVM sensor hoses connecting to machine tank 5. iVM electro hydraulic control valves 6. Cleaning [C] hose connecting to machine Cleaning tank [CRU.2-XXX1 only] 7. Spray Chamber drain Hose 8. Fumes Extractor fluid hose from Spray Chamber to rear side of machine 9. Testing tank gaskets or level	origin of the problem. • If a hose clamp is loose, tighten it to solve the problem • If there is a damaged or worn hose or part, replace with equivalent from the local market or contact your closest Magneti Marelli dealer for spare part • Re-test unit after repairing to verify the problem is solved

	indicator Cleaning tank gaskets or level indicator [CRU.2-XXX1 only]	
	Possible HIGH PRESSURE Leaks Inside the machine:	• Open both side panels of machine • Operate unit in Manual mode at spray test and adjust pressure at 200Bar • Visually inspect for leaks while operating unit. If there is no visual leak, then increase gradually the operating pressure in increments of 50Bar until leak is visible • When leak is located, focus on the origin of the problem. • If there is a damaged, loose or worn HP hose or connector/part, ONLY replace with new from your closest Magneti Marelli dealer • Re-test unit after repairing to verify the problem is solved
MACHINE LEAKS FLUIDS EXTERNALLY WHILE OPERATING	HP hose [D] squirting fluid from the connectors or the hose itself	• Replace complete HP hose with new one supplied from your closest Magneti Marelli dealer
	BACK-LEAK [R] hose leaking fluid from the	• Replace complete Back-Leak hose with new one supplied from your

	connectors or the hose itself	closest Magneti Marelli dealer
	[D] or [R] QUICK CONNECT COUPLER AT FRONT PANEL OF MACHINE Is leaking while operating ([D]or[R] hose connected	• Replace Quick connect coupler with New one supplied from your closest Magneti Marelli dealer
	EXHAUST(S) in back-side of machine are spraying water mist along with air instead of dry air (Soaking wet behind the machine)	• Check Air supply circuit and water trap (dehumidifier) of the shop for water and dirt. • Empty the water trap which is located at the rear side of the machine • After this has been done, operate again the machine for at least 5 minutes for the system to free the water from within • If the system is still releasing a lot of water, you need to contact your hydraulic/air network provider to check your system for humidity and dehumidifier for possible problem
	EXHAUST(S) in back-side of machine after long operation and humid environment are	• This is Normal operation of the machine and pump(s) and does not present a problem.

	spraying a small amount of water mist along with air instead of dry air (NOT soaking wet behind the machine)	
	EXHAUST(S) in back-side of machine are spraying calibration oil mist along with air instead of dry air	• One or both pumps will need to be replaced or serviced from authorized personnel only. Please contact you nearest Magneti Marelli dealer to report the problem or email to support@carbonzapp.com to be send the service guide for replacing or repairing the pump(s)
MACHINE LEAKS FLUIDS AT STAND-BY	Possible Leaks from: 1. Testing tank gaskets or level indicator 2. Cleaning tank gaskets or level indicator [CRU.2-XXX1 only] 3. Low Pressure Supply Hoses to low pressure pump, filtering system and HP	• Open both side panels of machine • Visually inspect for leaks around the body of the unit • When leak is located, focus on the origin of the problem. • If a hose clamp is loose, tighten it to solve the problem • If there is a damaged or worn hose or part, replace with equivalent from the local market or contact your closest Magneti Marelli dealer for spare part

	pump	
GLASS SPRAY CHAMBER	Cracked or broken Glass tube	• Replace with new one. Contact your closest Magneti Marelli dealer for spare part
	Leaky Glass tube	• Remove Glass Tube by turning counterclockwise and applying an upward force • Replace both Viton o-rings at the base with equivalent from the local market or contact your closest Magneti Marelli dealer for spare part • Replace the Glass tube in its position and test
FLUID PRESSURE ISSUES	ERROR 5 (Screen message)	• Run test once more to verify that the message shows again and eliminate the possibility to be an intermediate problem • Injector to be tested has a very high back-leak value and injector cannot built the required pressure to operate • Check Air Supply and verify that the input specifications are according to the ones listed in Appendix A “Specifications”. • If message shows only at tests performed at high pressures (more than 1250 Bars), then the Air

		Supply is not according to specifications
	NO or LOW Pressure built-up	• Check Air Supply and verify that the input specifications are according to the ones listed at Appendix A “Specifications”.
	Pump is continuously pumping but NO Pressure is built in the system	• **Clear Protection cover Switch has failed.** Use contact spray at the switch (Figure 2-i-[j]) to solve the problem. If problem is not solved this way, replace switch with new one. Contact your closest Magneti Marelli dealer for spare part and instructions • **Pressure Regulator** located inside the machine at the center bottom compartment has been disconnected from the control wire. Re-connect wire to pressure regulator to solve the problem. If this does not solve the problem, then replace the regulator with a new one. Contact you closest Magneti Marelli dealer for spare part and instructions
	Inaccurate pressure Indication	• Calibrate Pressure Sensor by entering the menu and follow the instructions as explained at page 4-22 (Figure 4-ix)

INJECTOR DRIVING PROBLEMS	Coil Injector ONLY Not operating	• Verify that injector is good and operating • Test with a good known injector • Check if eRLC test gives valid numbers and not values out of specification • If the ERLC test passes than the driver circuit on the pcb board has failed • Contact you closest Magneti Marelli dealer for spare part and instructions
	Piezo injector ONLY Not operating	• Verify that injector is good and operating • Test with a good known injector • If Piezo does not work, test the machine with a coil injector and verify normal operation • If test fails, then the high voltage circuit on the PCB board has failed • Contact you closest Magneti Marelli dealer for spare part and instructions
	No injector operation	• Verify that injector is good and operating • Test with a good known injector • Check if ERLC test gives valid numbers and not values out of specification

		• If the ERLC test passes than the driver circuit on the pcb board has failed • Contact you closest Magneti Marelli dealer for spare part and instructions
	ERLC test results are inaccurate	• Verify that injector is good and operating • Test with a good known injector • Check if ERLC test gives valid numbers and not values out of specification (verify with a calibrated multimeter) • If the ERLC test passes than the low power resistance metering circuit on the pcb board has failed • Contact you closest Magneti Marelli dealer for spare part and instructions
CLEAR PROTECTION COVER CRACKED OR BROKEN		• Replace the clear protection cover with a new one • Contact you closest Magneti Marelli dealer for spare part and instructions
EXHAUST VACUUM AND FUMES EXTRACTOR/ SEPERATOR ISSUES	NOT WORKING	• Verify that there is air input at the machine of at least 4 Bars • Inside the menu manually activate the vacuum (refer to Common Buttons and Features, page 4-3)

		and check if vacuum is operating • If not, replacement of the vacuum electrical valve controller is needed to be replaced. Contact you closest Magneti Marelli dealer for spare part and instructions
	LEAKING AT BACK-SIDE OF MACHINE	• Remove the glass bottom of the device and empty the fluid • Visually check o-ring seal at upper position of glass bottle and replace if needed • Replace into original position
	POOR SPRAY CHAMBER CLEARING EFFICIENCY	• Remove the silencer/filter (Figure 2-iii-[c]) from the exhaust of extractor/collector at rear-side of machine and verify the problem still exists or not • If it still exists, then remove the glass bottom of the device and empty the fluid • Replace into original position
IVM OPERATION	INACCURATE OR INCONSISTENT iVM Sensor indication light blinks or constantly lights Red *(remove Rear panel to observe)*	<u>NOTE:</u> Failure to clean injectors with the use of Magneti Marelli's ultrasonic device (provided) before any test is completed on the test bench will void the warranty of the machine. If the sensor reading is out of specification or accuracy due to dirt

(verified), the machine's warranty will be voided.

- The iVM sensor will need to be serviced, calibrated or replaced from authorized personnel only. Please contact you nearest Magneti Marelli dealer to report the problem or email to support@carbonzapp.com to be send the service guide for diagnosing, repairing or replacing the iVM sensor

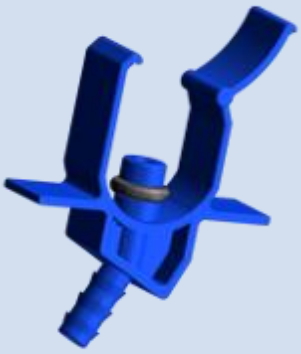
Appendix A
“Specifications”

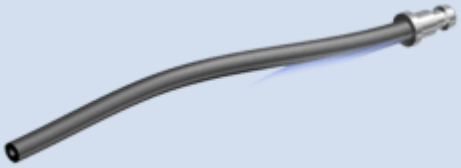
Mains Voltage	Vac	100-250 V
Mains Frequency	Hz	50 / 60
Mains Fuse	Ampere	5.0 A
Mains Power Cord (CE Approved) Voltage/Amperage/Length	V / A / mm	250 / 10 / 200
Power Consumption at Idle Operation	Watt	35.0
Power Consumption at Average Operation	Watt	160.0
Power Consumption at Max	Watt	370.0
Outer dimensions W / D / H	mm	605 / 702 / 730
Outer Max dimensions W / D / H (Clear Protection Cover Open)	mm	605 / 702 / 925
Weight of CRU.2-XXX0 (Testing Unit only)	Kg / Lbs	58.0 / 128
Weight of CRU.2-XXX1 (Testing & Cleaning Unit)	Kg / Lbs	64.0 / 141
Weight of CRU.2-XXX0 [Complete in Box]	Kg / Lbs	76.0 / 168
Weight of CRU.2-XXX1 [Complete in Box]	Kg / Lbs	84.0 / 185
Max. Filling Volume for Testing/Calibration Oil Tank	lt. / gal.	2.92 / 0.771
Filtering for Testing/Calibration Oil (MANN 5-WK712/2 or Equivalent)	µm	2.0
Testing Filter Life	Hours	60
Testing Fluid Life	Hours	20
Max. Filling Volume for Cleaning Detergent Tank	lt. / gal.	2.30 / 0.607
Filtering for Cleaning Detergent (FLEETGUARD 7-FF-5074 or	µm	10.0

Equivalent)		
Cleaning Filter Life	Hours	30
Cleaning Fluid Life	Hours	10
Input System Pressure	Bar / Psi	03-10 / 45-145
Recommended Min. Operating Pressure (for iVM)	Bar / Psi	08 / 115
Min. Inner Diameter of Input Supply Hose	mm	1
Min. Exhaust Hose if used to replace the Exhaust muffler as shown in (Figure 3-iv**)**	mm	14
Max. System Build-Up Pressure	Bar / Psi	1850 / 26,830
Injector Clamping diameters	mm	9-35

Appendix B
“Adapters and Connectors”

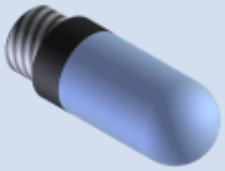
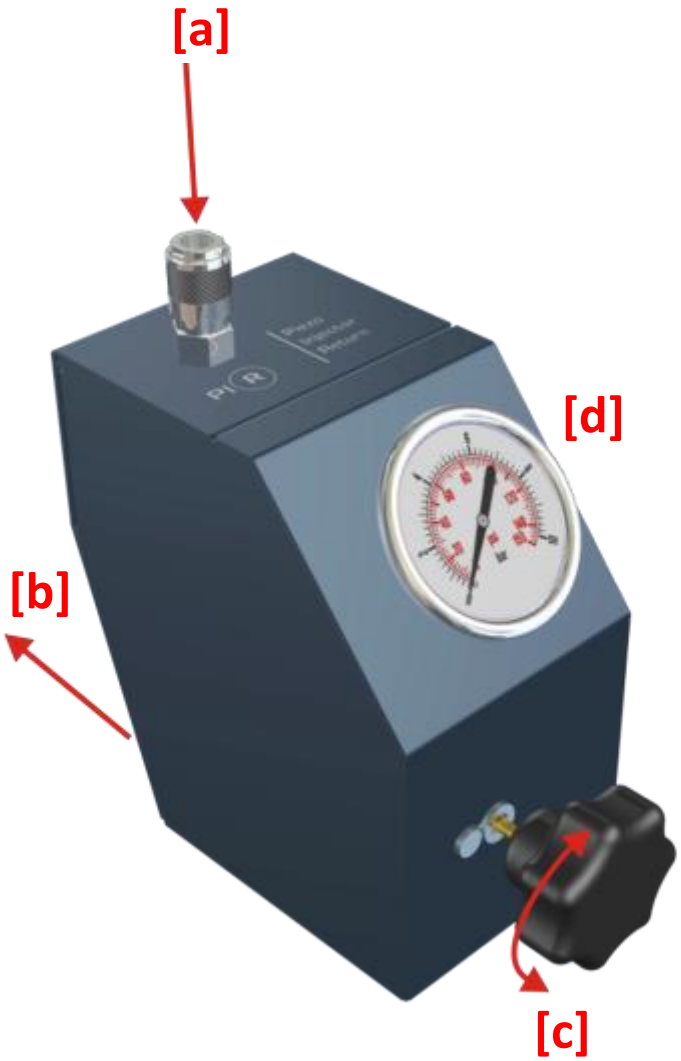
CODE	DESCRIPTION	Qty	IMAGE
IH.1	Generic_1 Electrical connector for connector [ih]	**1**	
IH.2	Generic_2 Electrical connector for connector [ih]	**1**	
IH.3	Delphi Electrical connector for connector [ih]	**1**	
HPT.14	High Pressure Hose Extension converter from M12 to M14 HP-T Connection	**1**	

RA.1	Bosch, Siemens etc. R-Adapt for Returned Testing Calibration Oil	**1**	
RA.2	Denso, CRIN etc. R-adapt for Returned Testing Calibration Oil	**1**	
RA.3	Delphi R-Adapt for Returned Testing Calibration Oil	**1**	
OR1	Spare o-ring for RA.1 Adapter	**2**	
OR2	Spare o-ring for D-ADAPT.7 (DA.7) Adapter	**2**	

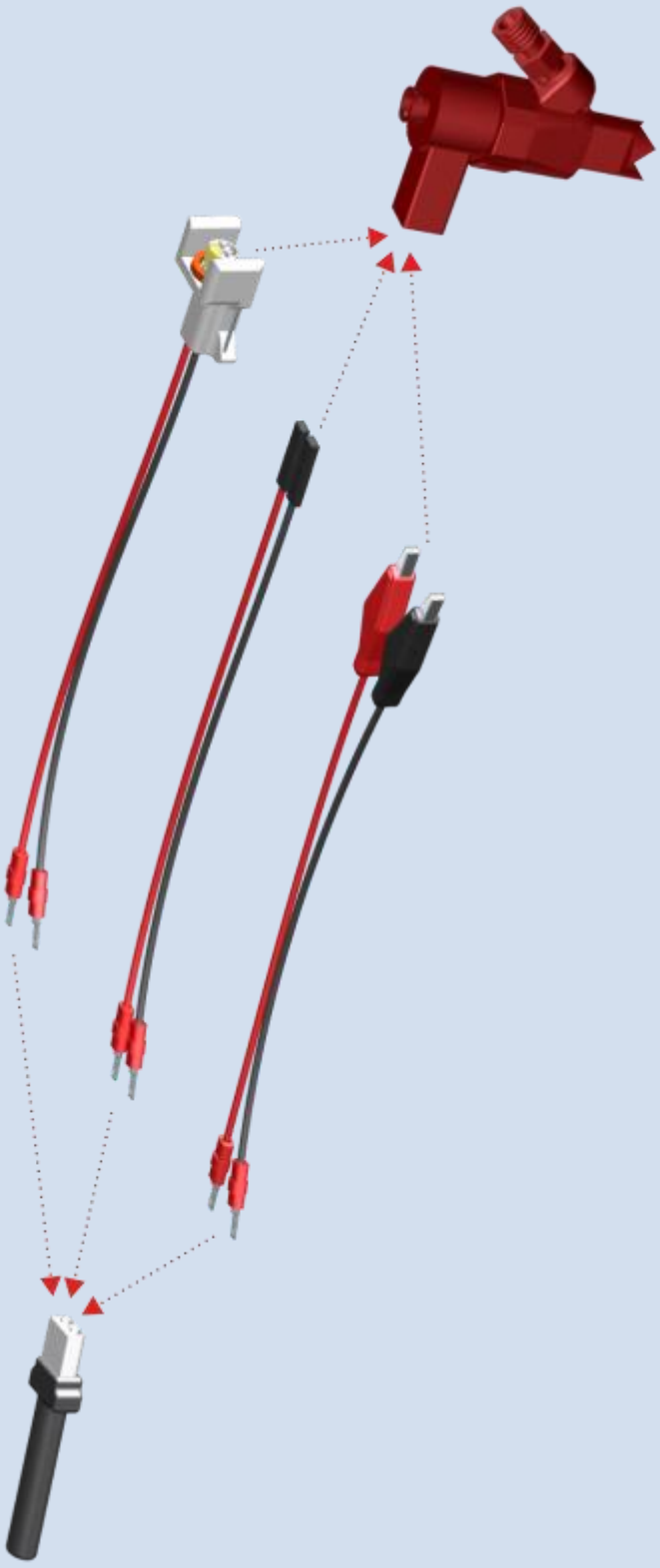
OR3	Spare o-rings for D-ADAPT.7 (DA.7) Adapter	**2**	
R-ADAPT.H	R-Adapt Hose for Returned Testing Calibration Oil for quick coupler [R]	**1**	
R-ADAPT.BP	Bosch Piezo R-Adapt for Returned Testing Calibration Oil for quick coupler [R]	**1**	
D-ADAPT.7	7mm D-Adapt for Discharged Testing Calibration Oil for quick coupler [D]	**1**	
D-ADAPT.9	9mm D-Adapt for Discharged Testing Calibration Oil for quick coupler [D]	**1**	

T-FUN	Calibration Oil/Fluid Funnel – Large	**1**	
DA.7	7mm Discharge Adapter for Cleaning MACC for quick coupler [C] **[CRU.2-XXX1 only]**	**1**	
DA.9	9mm Discharge Adapter for Cleaning MACC (C-Adapt) **[CRU.2-XXX1 only]**	**1**	
RA.BP	Bosch Piezo Return Adapter for Returned Cleaning MACC C-Adapt **[CRU.2-XXX1 only]**	**1**	

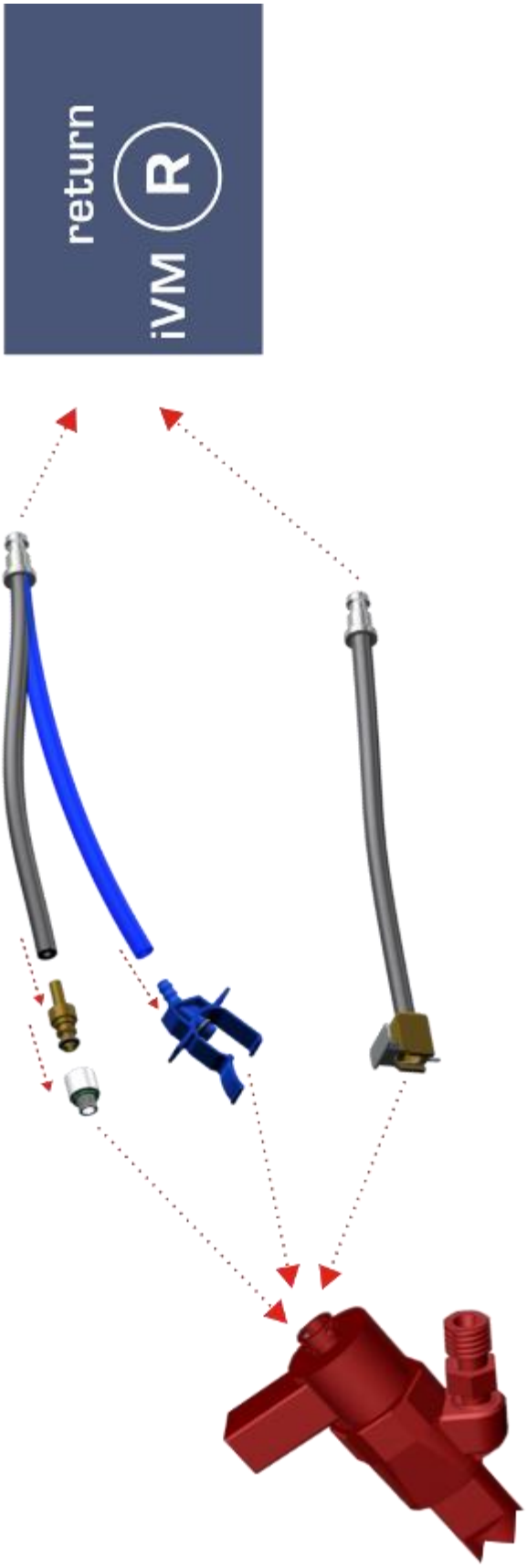
C-ADAPT	T-Piece C-Adapt Hose for quick coupler [C] **[CRU.2-XXX1 only]**	**1**	
C-FUN	Cleaning detergent Funnel (MACC) - Small with extension for quick coupler [C] **[CRU.2-XXX1 only]**	**1**	
PWC	100/240 VAC Mains Power Cable	**1**	
HC	Hose Clamp **[CRU.2-XXX1] (+1 QTY)**	**1**	

VMF	Vacuum Muffler for connecting to the rear Spray Chamber fumes extractor (Figure 2-iii-[c])	**1**	
PIR	**Piezo Injector Back-Leak Regulator Kit** **[a]:** (Input) Piezo Injector Return (from injector) **[b]:** (Output) (to [R] conn. on CRU.2) **[c]:** (Regulator) Increase Pressure Clockwise **[d]:** (Gauge) Piezo Return Indicator	**[Optional]**	 **Important:** To be used ONLY in **Testing Mode**

Appendix C
“Connectivity Illustrations”

Description	Illustration
Electrical Wire Connection [ih] -> Injector	

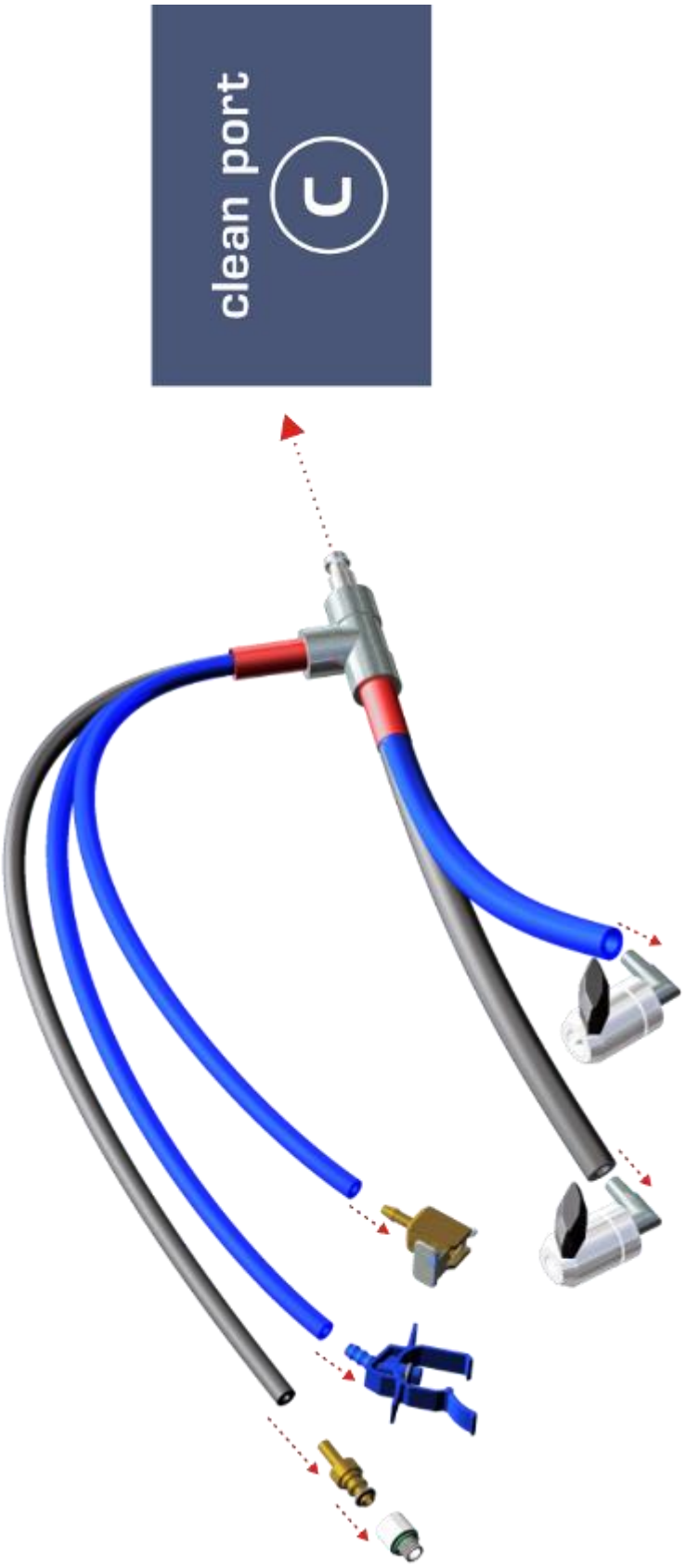
Return Adapter (R-Adapt) Connection for Testing Calibration Oil [R] iVM



Discharge Adapter (D-Adapt) Connection for Testing Calibration Oil [D] iVM

Discharge and Return T-Piece Adapter (C-Adapt) Connections for Cleaning MACC [C]

[CRU.2-XXX1 only]



“PIR”
Piezo Injector
Back-Leak Pressure
Regulator

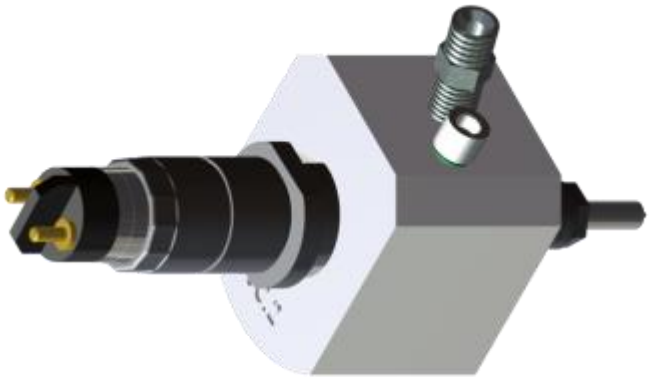
Piezo Injector Back-Leak
Pressure Regulation/Operation Instructions:

For correct operation of the Piezo injectors (Testing Mode ONLY), use the optional Magneti Marelli Piezo Back-leak Pressure Controller (PIR). Connect using the proper back-leak adapter from the injector to the PIR and then connect the PIR to the CRU.2 unit at the front side at connector [R] as shown in above figure. Unwind completely the pressure regulator knob to drop pressure. Close clear protection cover, Choose Piezo injector type and select [Spray Test] from Manual Tests at the menu to start. Let injector operate for at least 30sec at 1000STRK, 700us and at least 750bar HP-T pressure, and read the pressure indicated on the PIR gauge. To reach the correct PIR operating pressure, press the Stop button, open clear protection cover and turn the pressure regulator clock-wise to built pressure. Close the cover again and re-activate the test pressing the Start button, to see the pressure indicated. Continue this process until desired pressure is reached. Pressure should be adjusted at the following values:

- **Bosch Piezo: 8 bars**
- **Siemens Piezo: 1.5 bars**

Note: All injectors to be tested should be tested at the exact same Back-Leak pressure.

CRIN / Side Feed Injector Adapter connection



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