HELSINKI, FINLAND, 2015

COMMON RAIL INJECTORS TESTER

STARDEX® 0402

Safety rules for working with STARDEX 0402 device.

Before using the device STARDEX 0402 (further “the device”) read this manual carefully.

The device should be plugged only in a circuit of alternative current mentioned in the passport of the device. In order to power up the device, use only supply cable from the delivery kit.

Getting the electrical charges on device body is strongly prohibited!

Ingress of moisture inside the device is strictly unacceptable!

Device body is constructed to protect its components from mechanical impact, while operating. Avoid body damage, do not drop the device and do not put any heavy objects on its cover.

At any sign of device defect as smoke, sparking or specific smell, unplug the device immediately and contact the nearest STARDEX service center.

All cables connected to the device must be supplied with standard plugs without mechanical damage.

There are no self-repairable parts inside of the device. It is strongly prohibited to open the device.

Store and use away from children and pets.

The device is designed to work with common rail system. The device user must understand the structure and principle of operation of injection systems.

Incorrect use of the device can lead to breakage of the equipment or user’s injury.

Specifications and operation directions

Dimensions	370x300x130 mm
AC power supply	220V 50Hz or 110V 60Hz
Power consumption in stand-by mode	40W
Power consumption in load mode	400W
Operating temperature	From -10^0C to + 50^0C
Relative air humidity	not more than 90% at 25^0C

Purpose and range of application.

- STARDEX 0402 is a highly professional universal device for testing pumps and injectors of Common Rail system.

- The device is designed to work with Common Rail systems by **Bosch, Delphi, Denso, Siemens, Caterpillar**, **Cummins** and is also able to test all mechanical injectors as well as nozzles of the unit-injectors.

- The device is specified to test one injector simultaneously with a hand pump or a test bench.

- It works both with electromagnetic and piezoelectric Common Rail injectors.

- It enables to test current characteristics of an injector, displaying a high-precision current graph on the screen.

- Device management is performed through the user interface, installed on the notebook supplied.

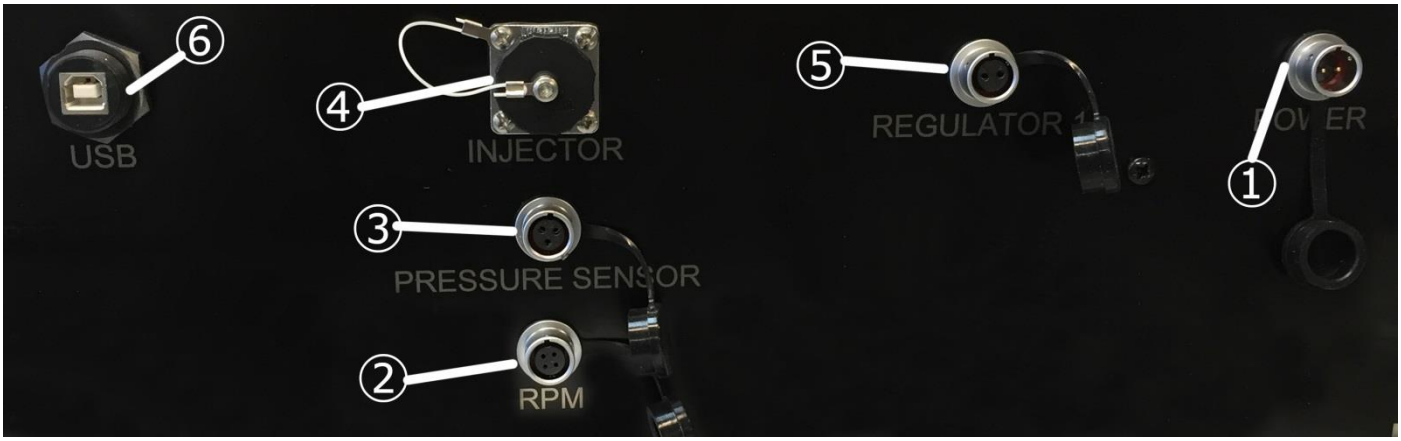
- STARDEX 0402 combined with a hand pump, enables to make an express test of Common Rail injectors on the following parameters: efficiency, leakage, quality of injection, pressure at the beginning of the injection, state of electromagnetic coil (solenoid) or piezo element of injector.

- **The memory of the device contains approximately 1500 test-plans for checking pumps and Common Rail injectors, such as Bosch, Delphi, Denso, Siemens, Caterpillar, Cummins and over 10000 test-plans for checking mechanical injectors of different manufactures.**

- **The device STARDEX 0402, combined with the bench, is a full-fledged highly professional solution, which enables completed test and setting of Common Rail system pumps and injectors according to all necessary parameters in semi-automatic mode, while following step-by-step instructions contained in the device in the form of test-plans.**

- **The device is suitable for fitting out any high-pressure pump test bench, including test benches without measuring unit.**

Connectors and control buttons.



① Power cable connector.

② RPM sensor connector.

③ Pressure sensor connector.

④ Injector cable connector.

⑤ Regulator connector.

⑥ USB port.

① Front panel light diode

Has two states:

- No light – the device isde-energized.
- Green light – the device is on.

② On/off button.

Switching on/off the device.

Connect the device to the AC power, using the AC adapter supplied.

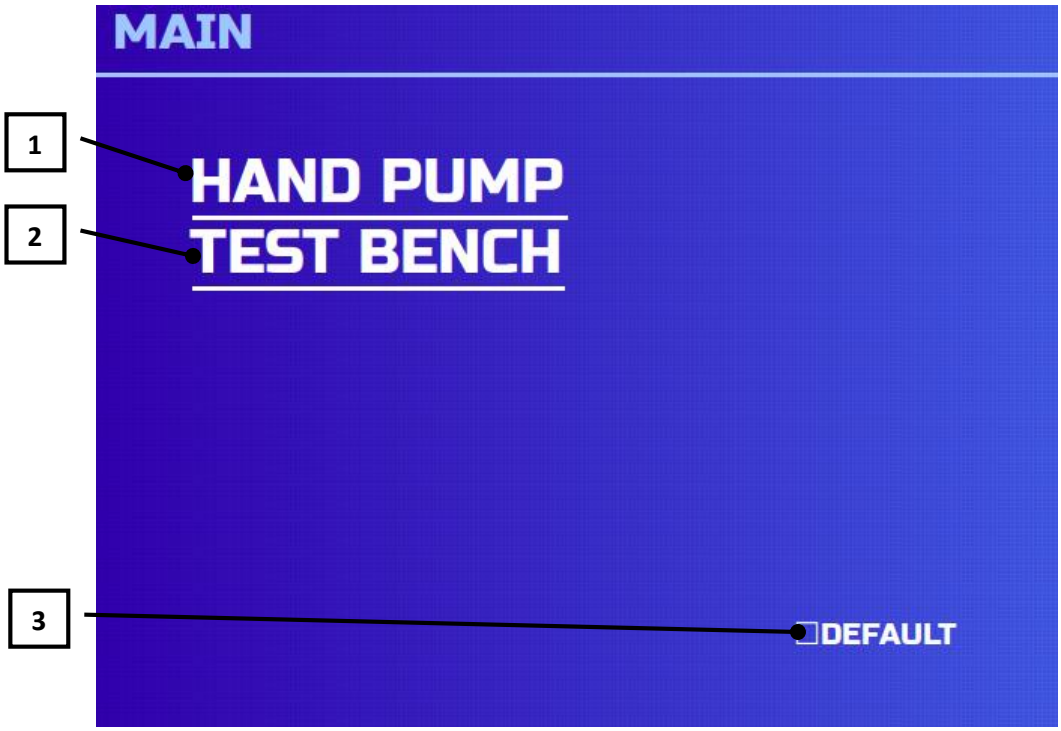
Insert the supplied notebook and connect it to the appropriate USB cable from the device.

Connect to notebook peripherals (keyboard, mouse, printer). Turn on the device corresponding key on the front panel.

To switch off the device, press the on/off button on the front panel of the device.

Main menu.

After switching on and loading the device, the main menu will be shown on the display, where a user can chose the mode of the device.



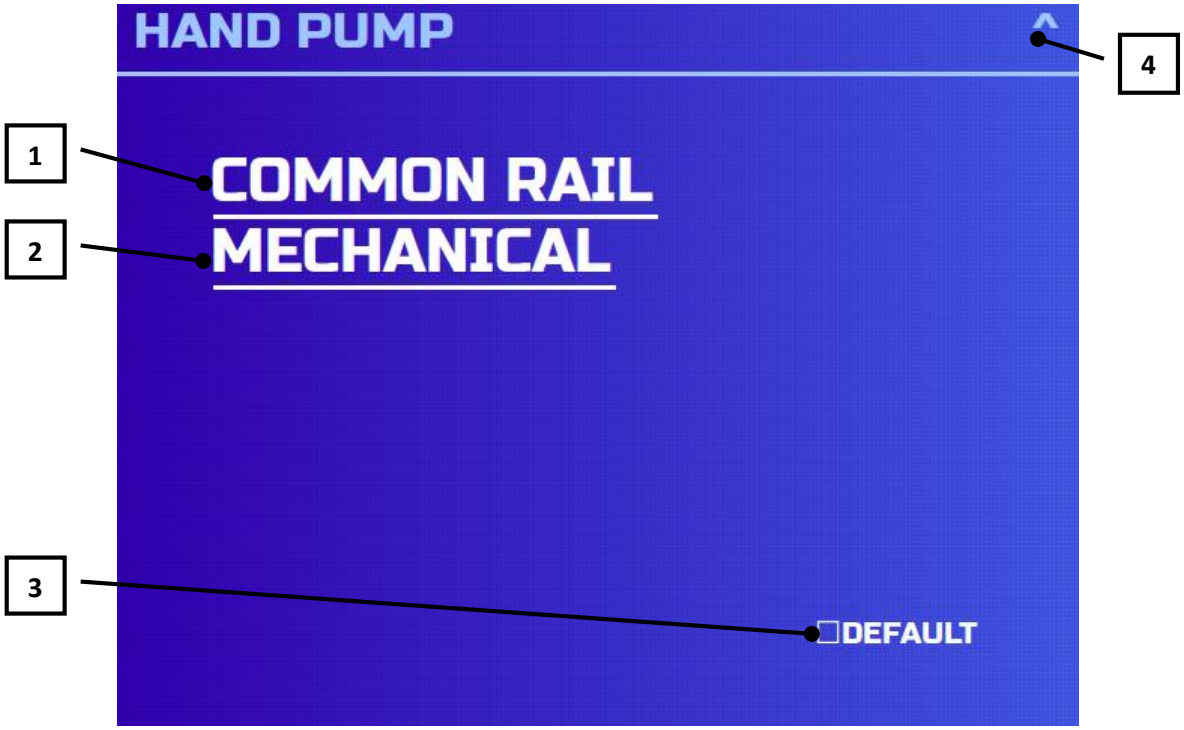
① **HAND PUMP** is a mode for testing mechanical and common rail injectors with the hand pump.

② **TEST BENCH** is a mode for testing injectors and common rail pumps on the high-pressure pump bench.

③ **DEFAULT** if the field is ticked, the next chosen mode will be loaded by default during the following launch.

HAND PUMP (MAIN > HAND PUMP)

After going to HAND PUMP mode, the hand pump mode menu will be displayed.



① **COMMON RAIL** – testing of Common Rail injectors on the hand pump (express test).

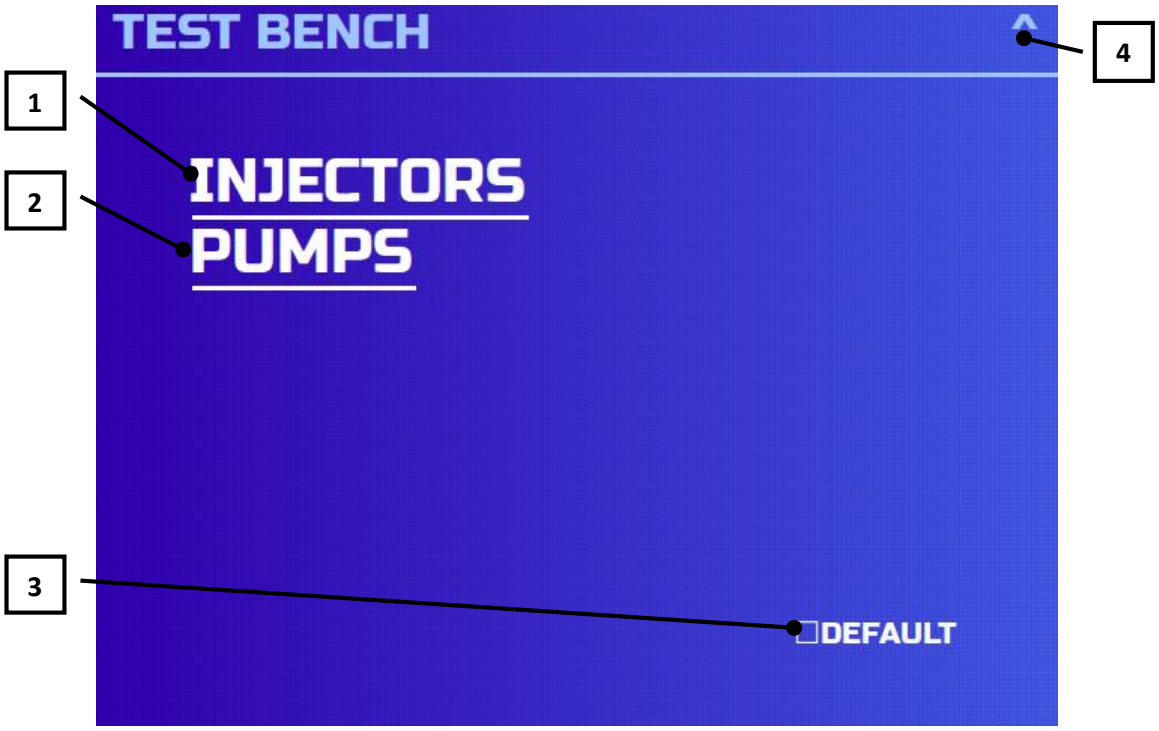
② **MECHANICAL** – testing of usual mechanical injectors on the hand pump.

③ **DEFAULT** – if the field is ticked, the next chosen mode will be loaded by default during the following launch.

④ **Quit to main menu (MAIN).**

High pressure pump bench (MAIN > TEST BENCH)

After going to **TEST BENCH,** the high-pressure pump bench menu will be shown on the display.



① **INJECTORS** – testing of common rail injectors on the high-pressure pump bench in hand or semi-automatic mode.

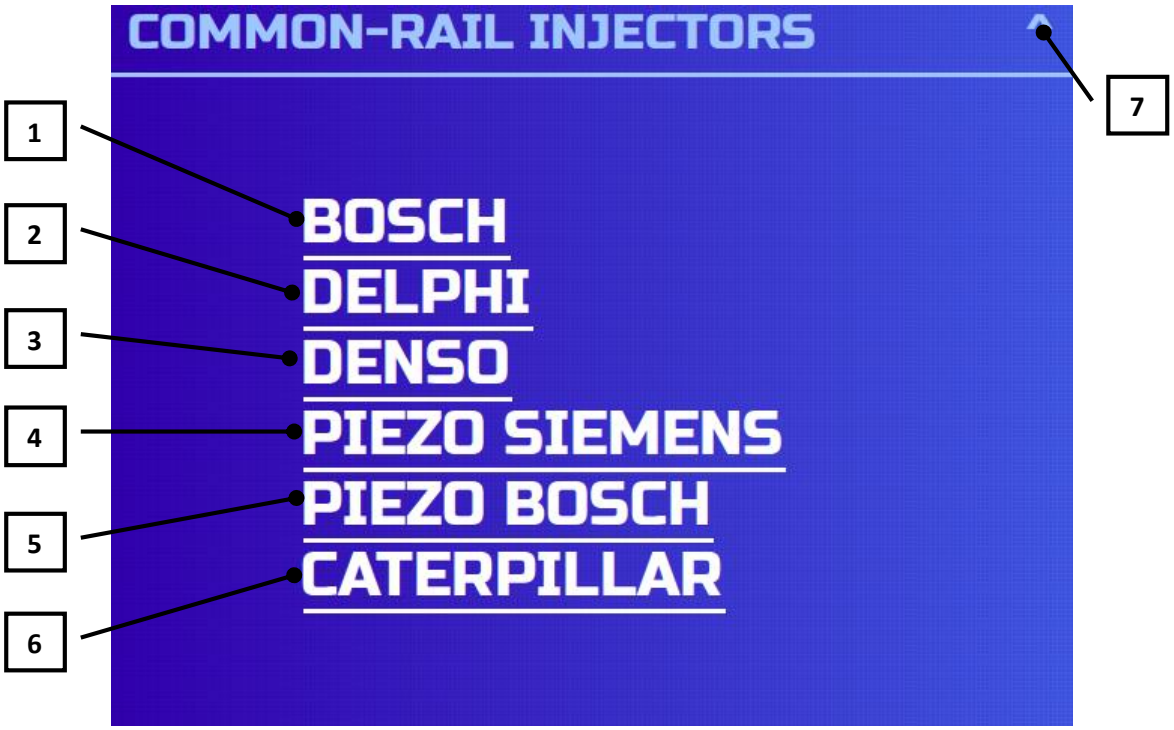
② **PUMPS** – testing of common rail pumps on the high-pressure pump bench in hand or semi-automatic mode.

③ **DEFAULT** - if the field is ticked, the next chosen mode will be loaded by default during the following launch.

④ **Quit to main menu (MAIN).**

Testing of common rail injectors on the hand pump (MAIN > HAND PUMP > COMMON RAIL)

After going to the common rail injector test mode on the hand mode, the selection of injector types will be displayed.



① **BOSCH** – electromagnetic injectors Bosch.

② **DELPHI** – electromagnetic injectors Delphi.

③ **DENSO** – electromagnetic injectors Denso.

④ **SIEMENS** – piezoelectric injectors Siemens.

⑤ **PIEZO BOSCH** – piezoelectric injectors Bosch.

⑥ **CATERPILLAR** – electromagnetic injectors Caterpillar.

⑦ **Quit to main menu (MAIN).**

All Common Rail injectors have different current-voltage characteristics, so, it is extremely important to select the type of the tested injector correctly. Incorrect choice may cause injector's or device's damage!

After selecting the type of the injector, the express test window will open.

① **Type of the tested injector.**

② **Pre-installed pulse mode** – beforehand installed pulse characteristics for an injector (width, frequency).

- **Minimal** – 500 microseconds 20Hz.
- **Low** – 800 microseconds 20 Hz.
- **Medium** – 1200 microseconds 15 Hz.
- **High** – 1500 microseconds 10 Hz.

③ **Pulse width** is the exact period of time, when the injector is operating, which is called pulse width of injection or duration of injection and is measured in microseconds.

④ **Pulse frequency** – the number of complete injections per 1 sec measured in Hz.

⑤ **START/STOP button** switches on and off pulse to the injector with the determined width and frequency.

⑥ **Leakage** is a digital speed indication of pressure, falling in the injector, which is expressed by the time needed for pressure to fall from 350 bar to 200 bar in the tested injector on the hand pump.

⑦ **Leakage scale** is a graphical display of leakage on the screen. The fixed white stripe stands for 0. Movable stripe that changes its color, identifies the current value of leakage.

⑧ **Pressure scale** is a graphical display of pressure on the screen. The movable white stripe shows the value of pressure in the rail at the moment. The movable red stripe shows maximal fixed pressure in the fuel rail.

⑨ **Current pressure** is real pressure in the fuel rail, fixed by the pressure sensor.

⑩ **Maximal pressure** is maximal pressure, fixed in the fuel rail. The value of maximal pressure is instantly updated, when press on it.

⑪ **Quit to main menu (MAIN).**

Install Common Rail injector on the hand pump and make sure all connections are sealed. Connect the injector to **injector cable connector,** using universal cable with an appropriate cap. Connect the fuel rail pressure sensor for testing one injector, installed on the hand pump to the **pressure sensor connector**. Switch on STARDEX 0402 and follow **MAIN > HAND PUMP > COMMON RAIL.** Select the type of the injector tested. Select pulse width and frequency. Press **START/STOP** button to start injector's work. Create pressure in the fuel line, using the hand pump handle. Measure pressure at the beginning of an injection. Press **START/STOP** button to stop injector's work and create pressure in the fuel rail higher than 370 bar, using the hand pump handle. With the falling of pressure in the fuel rail, starting with 350 bar, counting of injector leakage will automatically start and will stop when it is 200 bar. Pressure at the beginning of injection and leakage of the injector are the most important parameters in the express diagnostics of Common Rail injectors.

Reference data on leakage of Common Rail injectors.

Bosch and **Denso** Common Rail injectors have the following gradation of leakage:

- **From -5 to -2** — **critically bad**
- **From -2 to -1** — **relatively bad**
- **From -1 to 0** — **relatively operational**
- **From 0 to 1** — **good**
- **From 1 and higher** — **very good**

Delphi, Piezo Bosch, Siemens Common Rail injectors have the following gradation of leakage:

- **From -5 to -1** **critically bad**
- **From -1 to 0** **relatively bad**
- **From 0 to 1** **relatively operational**
- **From 1 to 3** **good**
- **From 3 and higher** **very good**

Reference data at the beginning of injection on MEDIUM pulse.

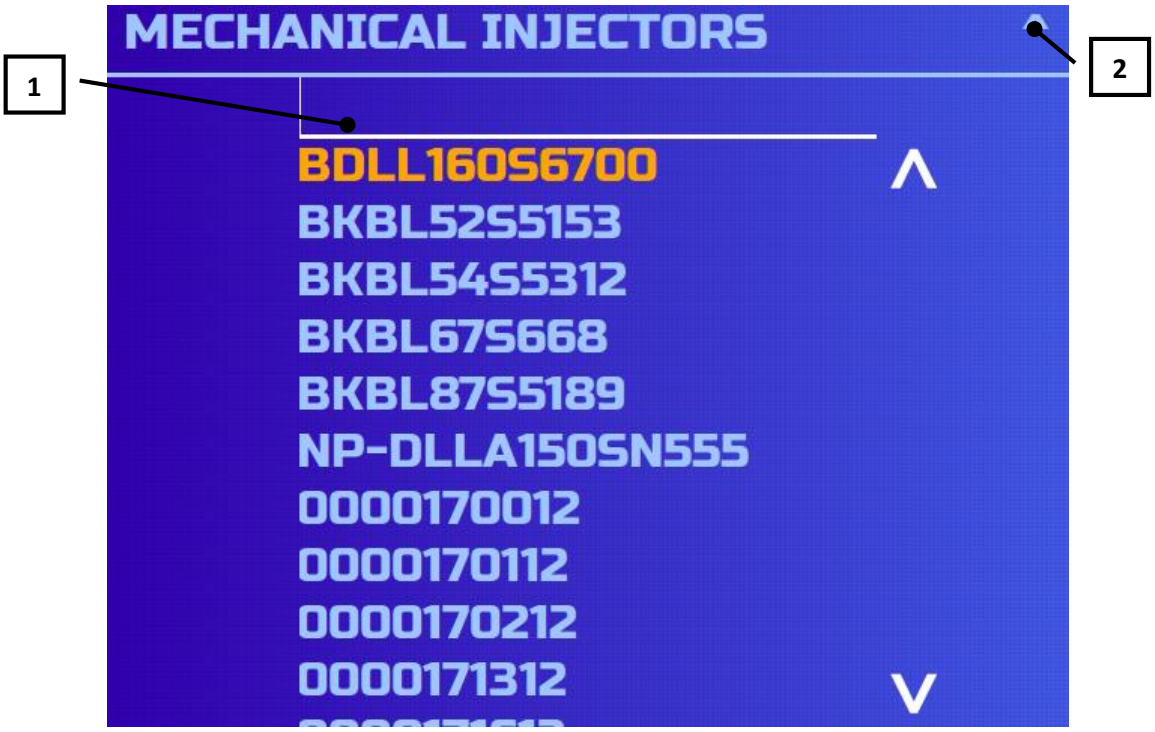
- **Bosch cars** **190 bar ± 25 bar**
- **Bosch trucks** **200 bar ± 30 bar**
- **Denso cars, trucks** **190 bar ± 40 bar**
- **Delphi cars** **175bar ± 30 bar**
- **Delphi trucks** **200 bar ± 30 bar**
- **Siemens and Piezo Bosch** **170bar ± 25 bar**

These reference materials are generalized and accurate for most of Common Rail injectors!

When conduct express diagnostics it is important to note that all tested Common Rail system injectors, that are taken from one engine, have the same pressure at the beginning of the injection, otherwise adjustment on the high-pressure pump bench is required.

Testing of mechanical injectors on the hand pump (MAIN > HAND PUMP > MECHANICAL)

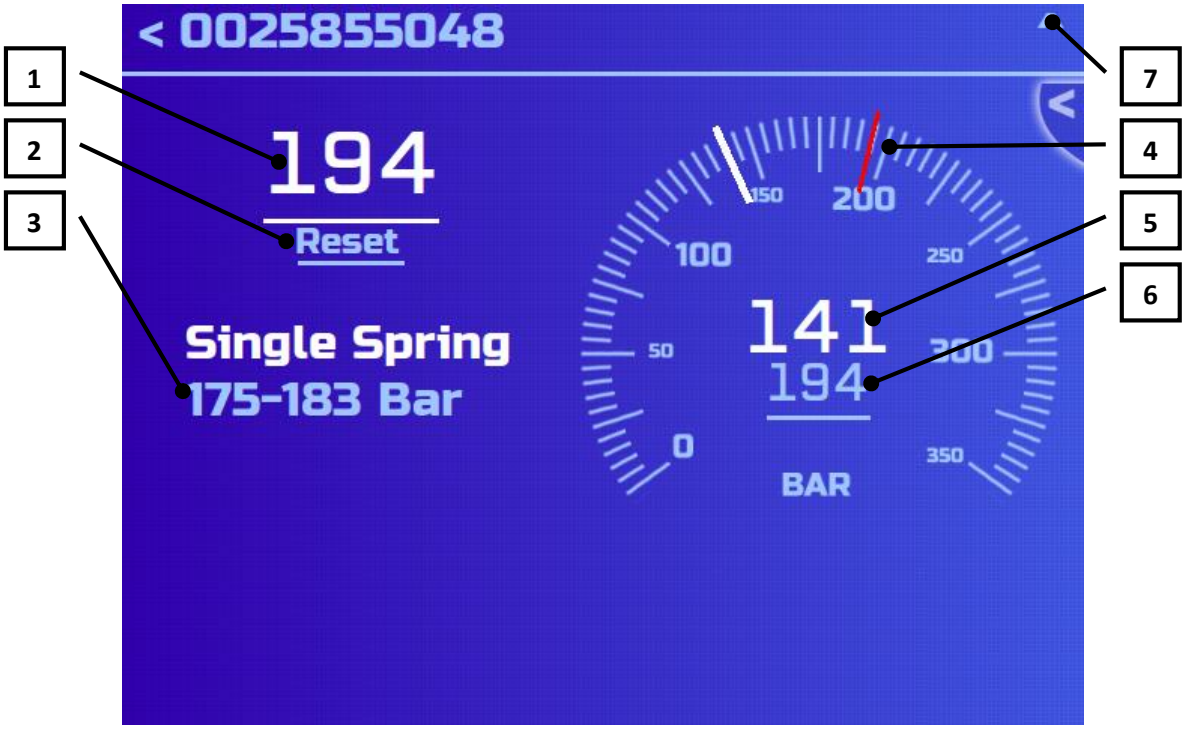
After going to **MECHANICAL,** the window for selecting a serial number will open.



① **Filter** is a line for inputting a part of a serial number to simplify search in the database. Data base records, which do not contain the inserted part of the number, will be automatically removed from the screen.

② **Quit to menu HAND PUMP.**

After selecting the type of tested injectors, the test window will open.



① **Opening injector pressure** – fixed pressure of the injector opening.

② **Reset button** cleans a value of opening injector pressure before next testing.

③ **Reference data** is a list of the reference data about opened injector or nozzle (data span of opening pressure in bar).

④ **Pressure scale** is a graphical display of pressure on the screen. The movable white stripe shows the value of pressure in the rail at the moment. The movable red stripe shows maximal fixed pressure in the fuel rail.

⑤ **Current pressure** is real pressure in the fuel rail, fixed by the pressure sensor.

⑥ **Maximal pressure** is maximal pressure, fixed in the fuel line. The value of maximal pressure is instantly updated, when press on it.

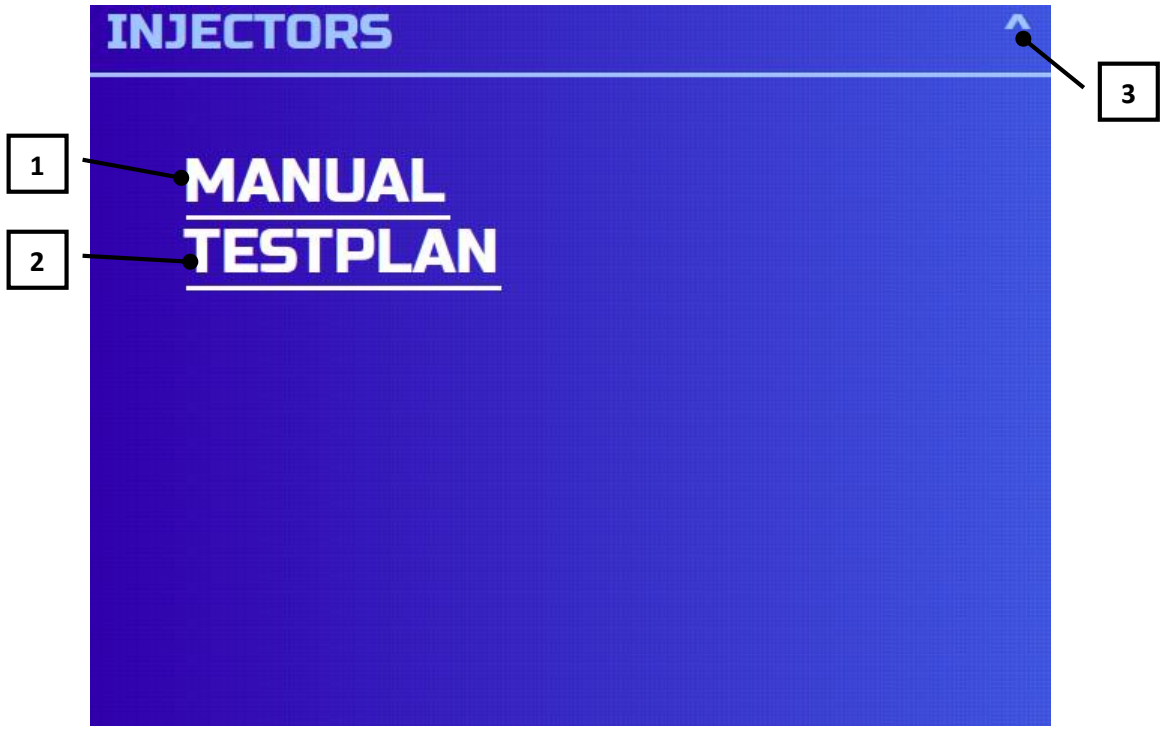
⑦ **Quit to menu HAND PUMP.**

Install a mechanical injector on the hand pump and make sure all connections are sealed. Connect the fuel rail pressure sensor for testing one injector, installed on the hand pump to the **pressure sensor connector** by the cable from the kit. Switch on STARDEX 0304 and follow to **MAIN > HAND PUMP > MECHANICAL**. Choose the serial number of the injector or of the nozzle. Create pressure in the fuel rail, which is enough for the injector to be activated by the hand pump. Pressure of the injector tested is shown by big numerals in the left top corner of the screen and by the red stripe on **the pressure scale.**

To get accurate value of opening injector pressure the handle of the hand pump must be moved several times!

Testing of Common Rail injectors on the high pressure pump bench (MAIN > TEST BENCH > INJECTORS)

After following to **INJECTORS,** the window for selecting the test mode will open.

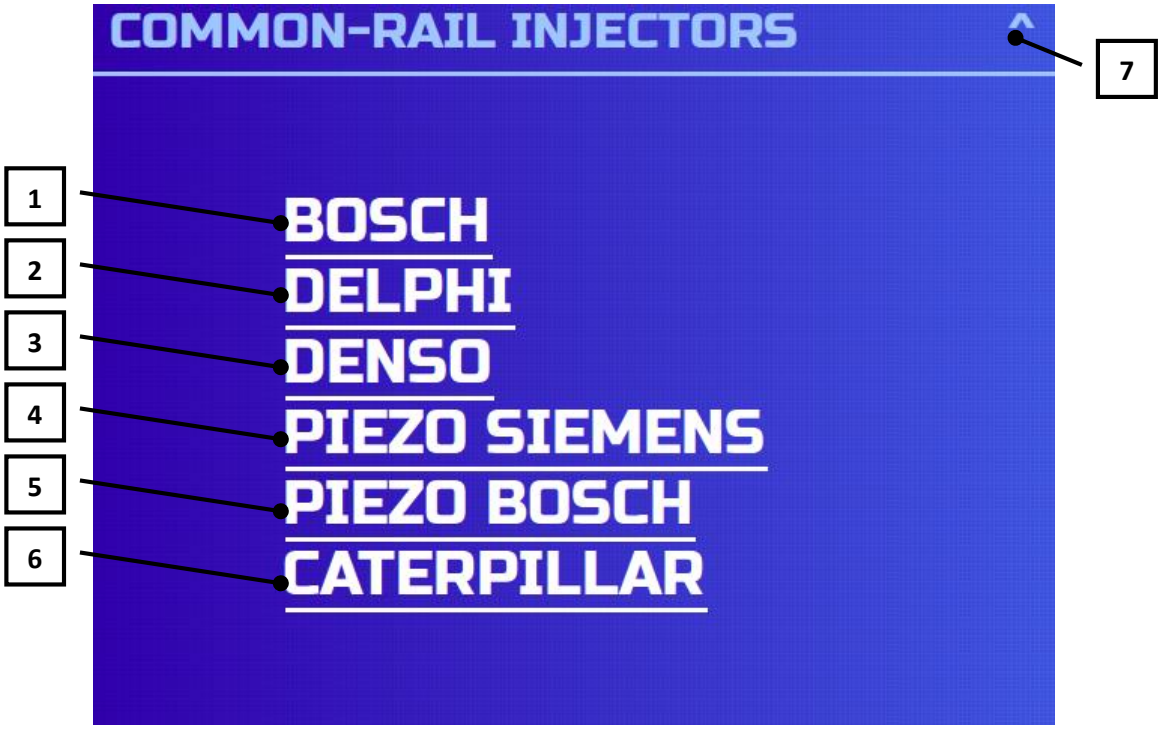


① **Manual** is a manual mode for testing on the high-pressure pump bench.

② **Testplan** is a semi-automatic mode for testing injectors according to test plan.

③ **Quit to menu TEST BENCH**

After following to **TESTPLAN,** the window for selecting the type of common rail injectors will open.



① **BOSCH** – electromagnetic injectors Bosch.

② **DELPHI** – electromagnetic injectors Delphi.

③ **DENSO** – electromagnetic injectors Denso.

④ **SIEMENS** – piezoelectric injectors Siemens.

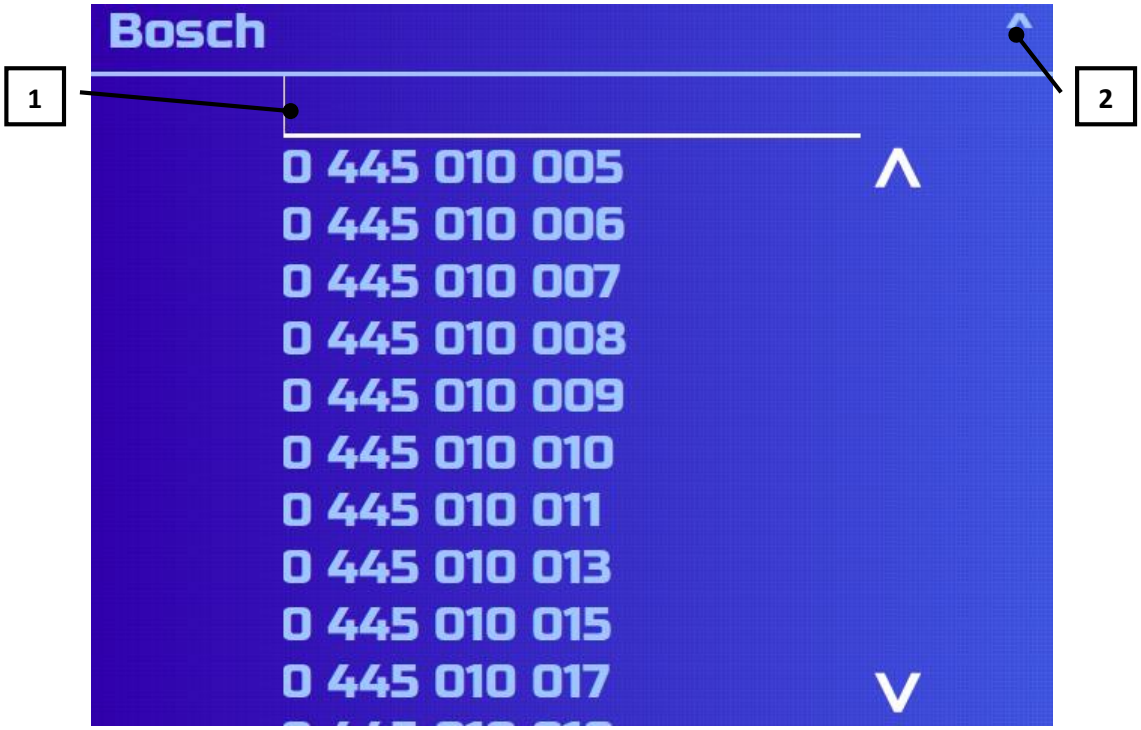
⑤ **PIEZO BOSCH** – piezoelectric injectors Bosch.

⑥ **CATERPILLAR** – electromagnetic injectors Caterpillar.

⑦ **Quit to menu TEST BENCH.**

All Common Rail injectors have different current-voltage characteristics, so, it is extremely important to select the type of the tested injector correctly. Incorrect choice may cause injector or device damage!

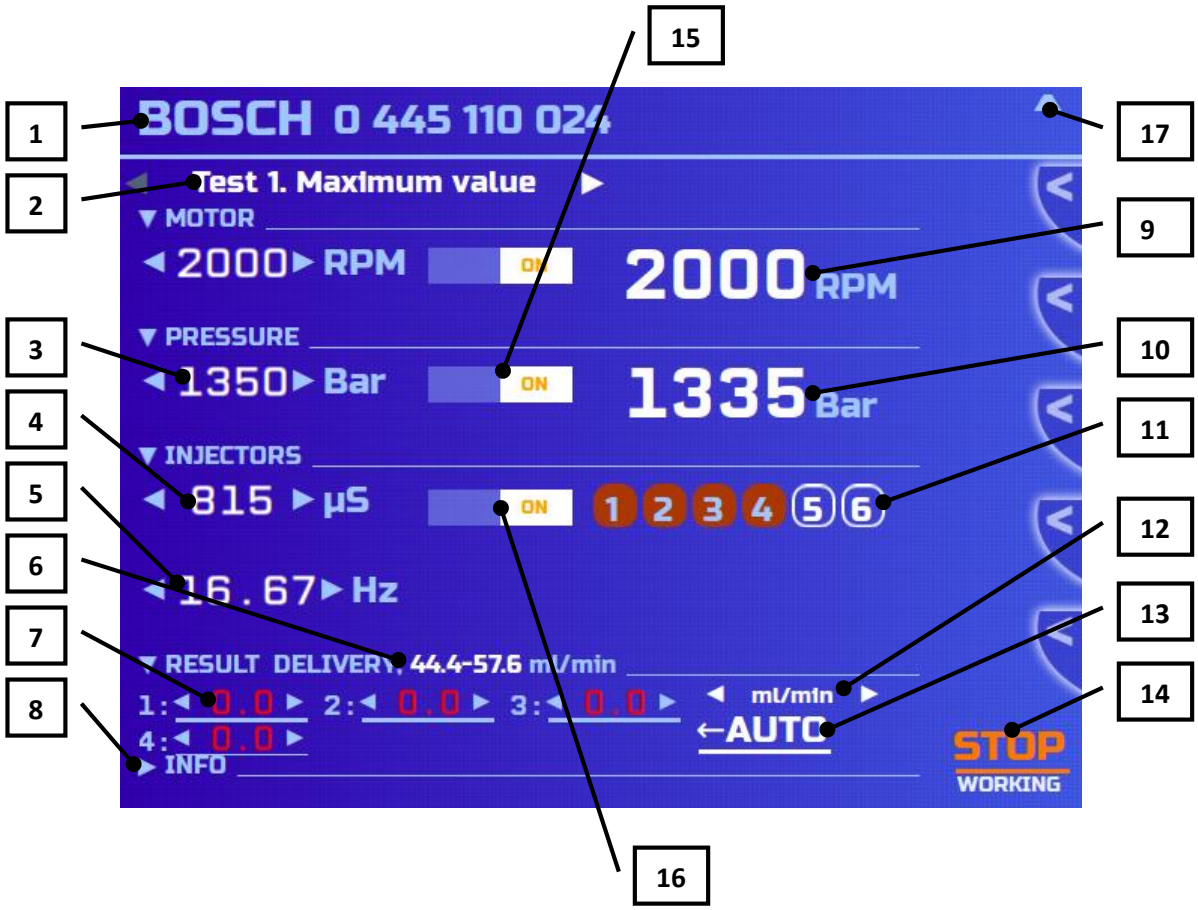
After choosing the manufacturer, the window for selecting injector's serial number will open.



① **Filter** is a line for inputting a part of a serial number to simplify search in the database. Data base records, which do not contain the inserted part of the number, will be automatically removed from the screen.

② **Quit to menu TEST BENCH.**

After selecting injector serial number, the window for testing Common Rail injectors on the high-pressure pump bench will open.



① **Information line** is a line where manufacturer and serial number of tested injectors are shown.

② **Test step** shows the name of the current testing mode, horizontal arrows change modes.

③ **Target pressure** is the pressure, which will be set in the fuel rail if you activate control of the reducing valve by **ON/OFF** switch in the section **PRESSURE** or by the button **START/STOP.**

If the Common Rail bench pump has lower productivity, than required for testing this type of injectors or back flow of injector is too high, real pressure in the rail can be fixed considerably lower than target. In such case Common Rail, bench pump should be replaced by more productive one or number of injectors tested simultaneously should be lessened.

④ **Pulse width** is the exact period of time, when the injector is operating, which is called pulse width of injection or duration of injection, it is measured in microseconds.

⑤ **Pulse frequency** is the number of complete injections per 1 sec measured in Hz.

⑥ **Result delivery/ back flow** – references values of measurements of injector delivery or back flow for this test step.

⑦ **Result field** serves for inserting the value of delivery or back leak of injectors into report. Numeral on the left of the field corresponds to the number of the injector tested.

⑧ **Information area** is an opening section where the mode of the current test step is described.

⑨ **RPM** – real revolutions of the pump measured by RPM sensor (optionally included in STARDEX 0304 delivery kit). A user sets the value of revolutions by himself, according to the conditions of the test specified in **the information area.**

⑩ **Real pressure** is indication of the pressure sensor in the fuel rail.

⑪ **Select buttons** are used for choosing the number of injectors tested. Each numeral corresponds to numerated wire connected to injector.

Selection buttons have 3 states:

- **Lights red –** injector is selected
- **Winks red –** injector is pulsed
- **Does not light –** injector is not selected

⑫ **Units of measurement** switches units of measurement of **result delivery/ back flow** as well as units of the **result field.**

Units of measurement have 2 states:

- **ml/200str** – milliliter per 200 cycles.
- **ml/min** – milliliter per minute.

⑬ **AUTO** automatically inputs measurements, taken from digital flow meter STARDEX 0104 into **the result field**. The button is only active if STARDEX 0304 is connected to STARDEX 0104 by USB interface, otherwise the button is not active and delivery or back flow measurement results should be manually input by a user.

⑭ **START/STOP** switches on/off **pressure control** and **injector pulse.**

⑮ **Pressure control** switches on and off control of pressure in the fuel rail. After switching on, control of the reducing valve in the fuel pump starts so, that the **real pressure** in the rail is kept on the level of **target pressure**. After switching off, control of the reducing valve in the fuel rail is stopped.

Pressure control has two states:

- **ON** – control is on.
- **OFF** – control is off.

⑯ **Injector pulse** switches on and off pulse to active injectors with set width and frequency.

Injector pulse has two states:

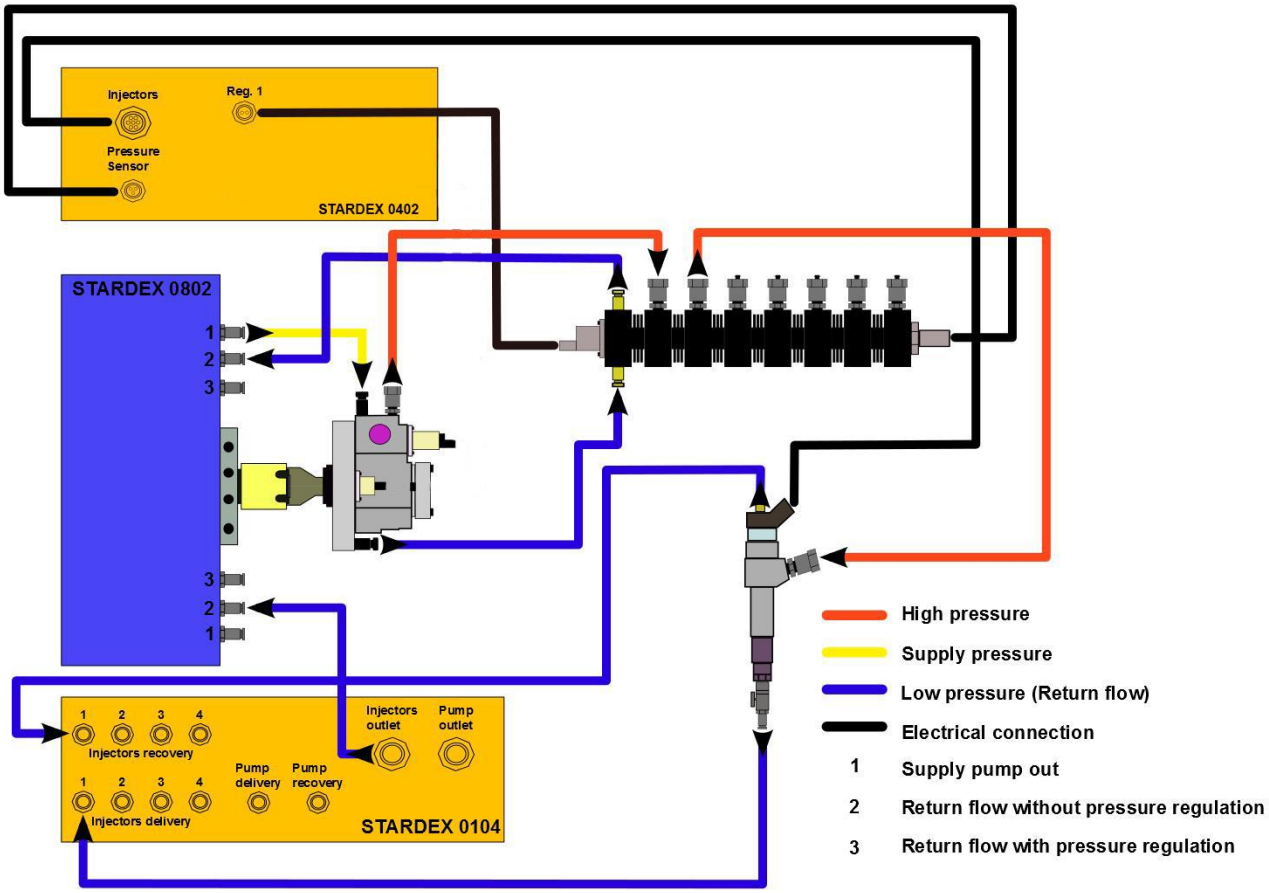
- **ON** – injector pulse is on.
- **OFF** – injector pulse is off.

⑰ **Quit to menu TEST BENCH.**

Install Common Rail system pump on the bench. Connect the fuel supply from the bench to the pump inlet. Attach six-injector fuel rail to the bench and connect it with the high-pressure fuel pipe to the high-pressure pump outlet. Connect back flow of the pump and fuel rail to the test oil tank. Connect Common Rail injector with high-pressure pipes to the fuel rail. Connect supply and return flow to the measuring unit (e.g. measuring unit of the test bench or STARDEX 0104). Connect the fuel rail pressure sensor to the appropriate channel of STARDEX 0402 and connect the fuel rail pressure regulator to **PRESSURE REGULATOR** connector, using wires from the kit. Connect injector to **INJECTOR** connector, using appropriate cable with corresponding cap from the kit. Switch on STARDEX 0402. Follow **MAIN > TEST BENCH > INJECTORS** in STARDEX 0402. Select manufacturer and serial number of tested injectors. Activate first injector channel, using **buttons for injector selection.** Follow step-by-step instructions in the **information field.**

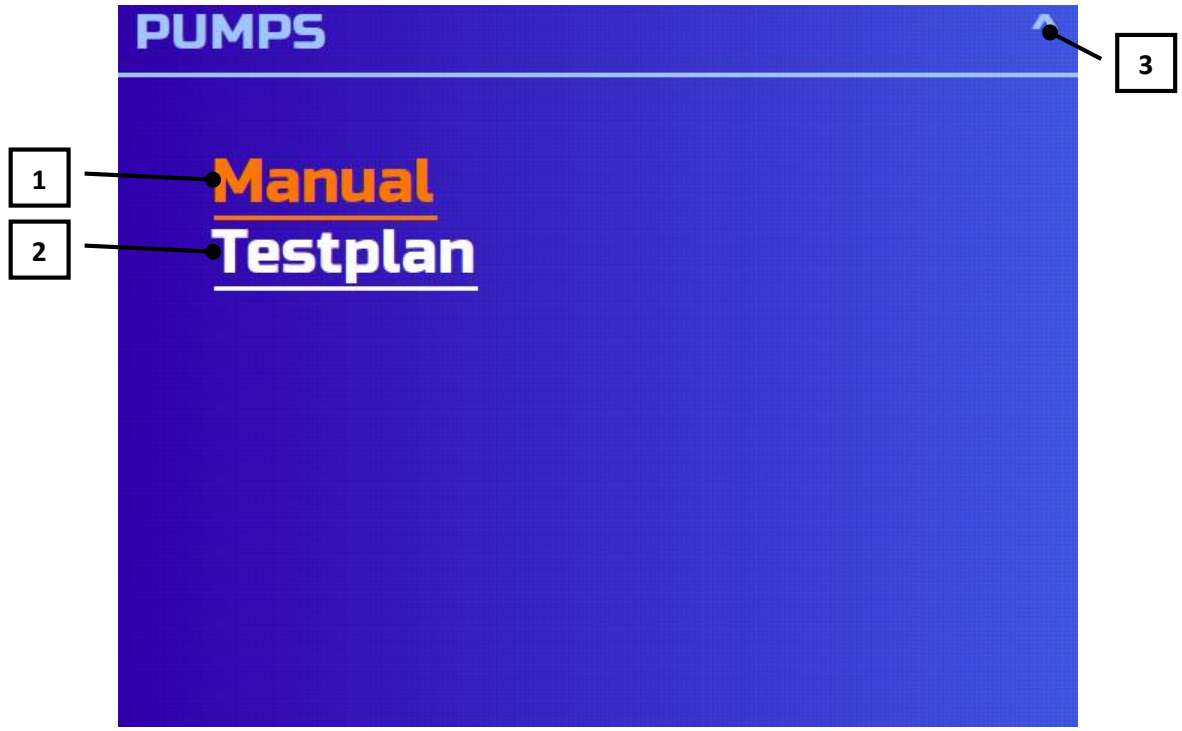
Working with the high-pressure bench, a protective shroud should be used to avoid injury of the user in case of emergency!

Typical connection diagram.



Testing of Common Rail pump on the high pressure pump bench (MAIN > TEST BENCH > PUMPS)

After going to **PUMPS,** the window for the test mode selection will open.

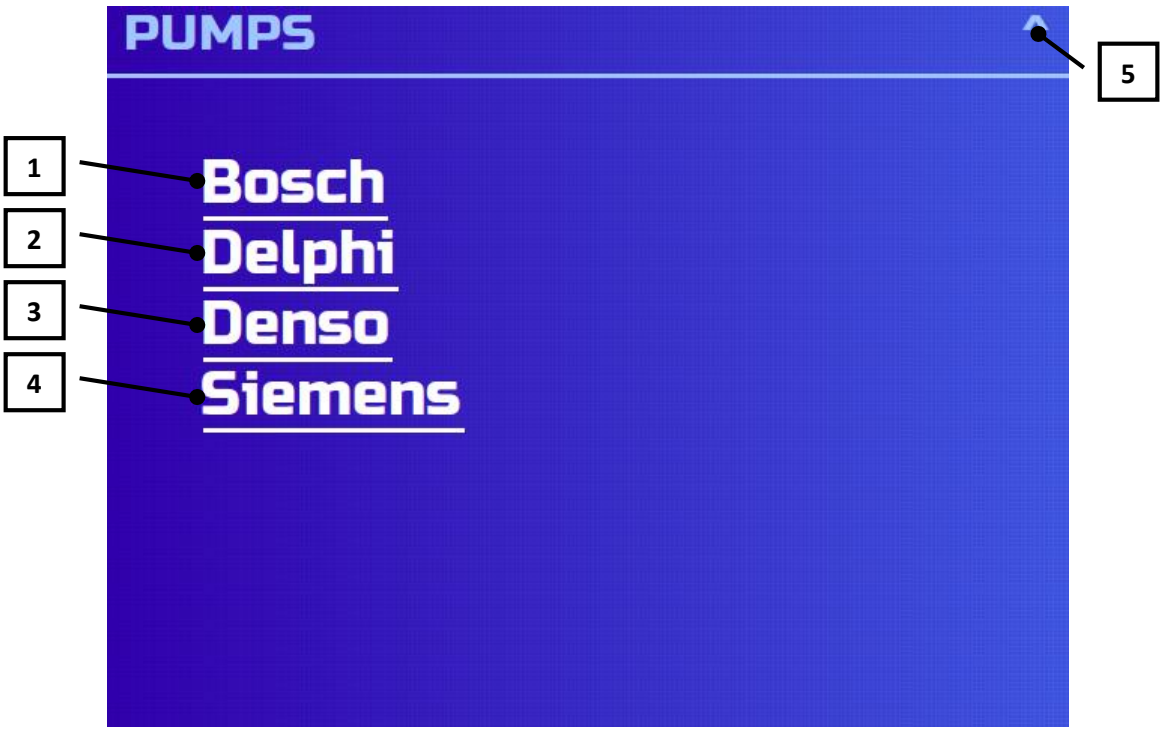


① **Manual** is a manual mode for testing the pump on the high-pressure pump bench.

② **Testplan** is a semi-automatic pump testing mode on the test plan.

③ **Quit to menu TEST BENCH.**

After going to **TESTPLAN,** the window for selecting manufacturer will open.



① **BOSCH** – **Bosch** pumps.

② **DELPHI** – **Delphi** pumps.

③ **DENSO** – **Denso** pumps.

④ **SIEMENS** – **Siemens** pumps.

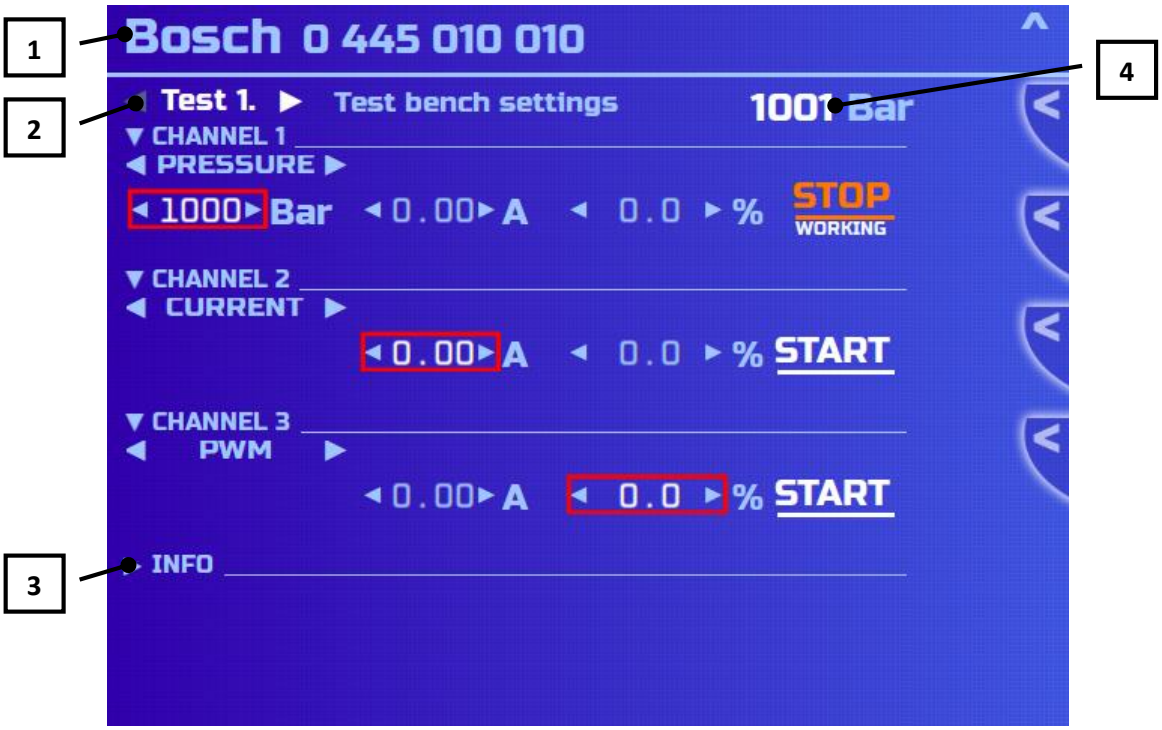
⑤ **Quit to menu TEST BENCH.**

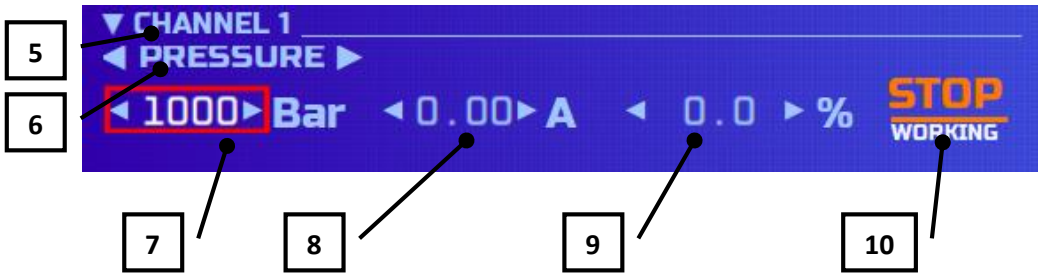
After choosing manufacturer, the window for selecting serial number will open.

① **Filter** is a line for inputting a part of a serial number to simplify search in the database. Data base records, which do not contain the inserted part of the number, will be automatically removed from the screen.

② **Quit to menu TEST BENCH.**

After choosing serial number, the window for pump test will open.





① **Information line** is a line, where manufacturer and serial number of tested injectors are shown.

② **Test step** shows the name of the current testing mode, horizontal arrows change modes.

③ **Field of information** is an opening list, where the mode of the current test step is described.

④ **Real pressure** is an indication of the pressure sensor in the fuel rail.

⑤ **Channel** identifies the number of channel, which is being regulated.

⑥ **Channel control mode** shows control mode on the channel, horizontal arrows change modes.

Channel control mode has three states:

- **PRESSURE** – target pressure control mode**.**
- **CURRENT** – current control mode.
- **PWM** – duty cycle control mode

⑦ **Target pressure** is the pressure, which will be set in the fuel rail after pressing **START/STOP** button (only for the first channel in the target pressure control mode).

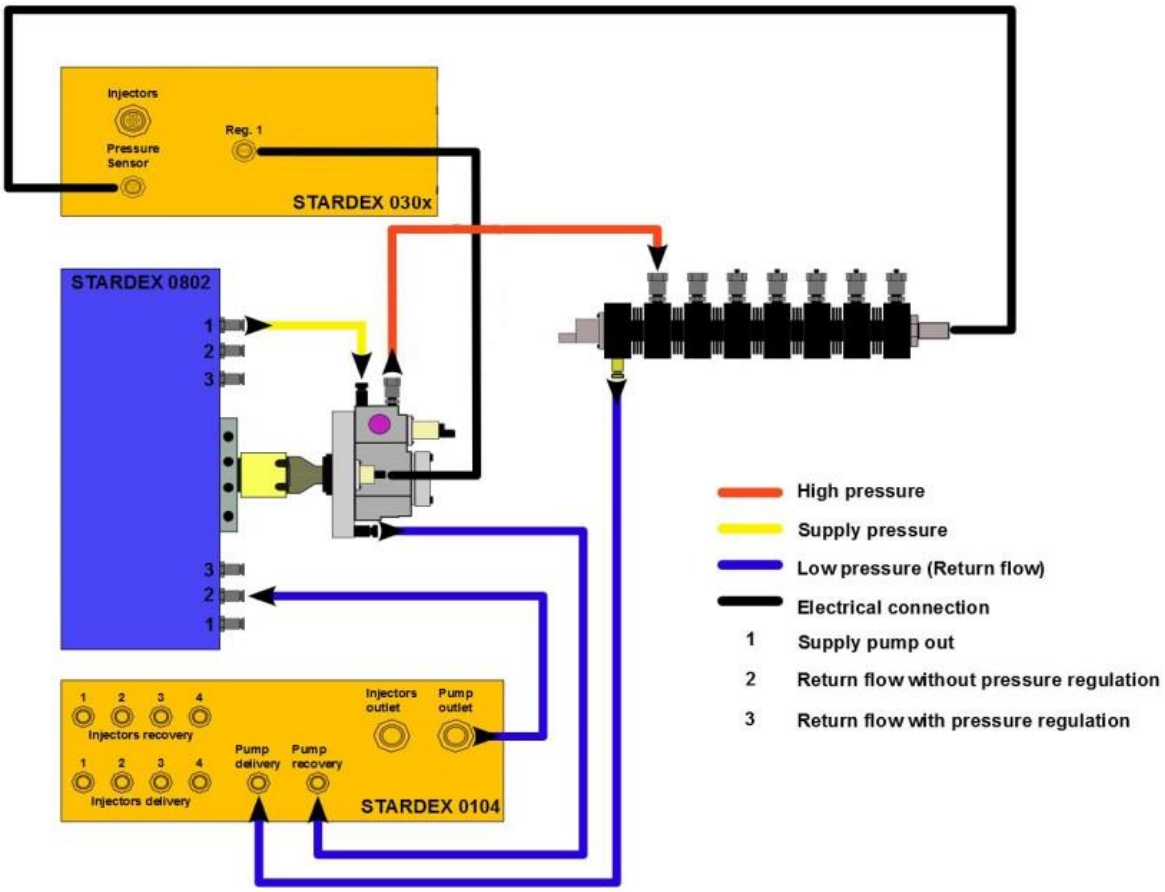
⑧ **Current** is a value of current in this channel.

⑨ **Duty cycle** is a value of duty cycle in this channel.

⑩ **START/STOP** switches on and off control signal on this channel. A user sets control signal characteristics by control mode and value of target pressure, current or duty cycle.

Install Common Rail pump on the bench. Connect test fuel supply from the bench to the pump inlet. Install six-injector fuel rail on the test bench and connect it to the high-pressure pump outlet using a high-pressure pipe. Close the rest fuel rail outlets by special plugs. Connect return flow of the pump and fuel rail to the measuring unit (e.g. measuring unit of the test bench, STARDEX 0103 or STARDEX 0104). Connect the fuel rail pressure sensor to the **pressure sensor connector** and the fuel rail pressure regulator to the **regulator connector 1,** using appropriate wires from the kit. Turn on STARDEX 0402 and follow **MAIN > TEST BENCH > PUMPS.** Select manufacturer and serial number of the tested pump. Follow step-by-step instructions in **the information field**.

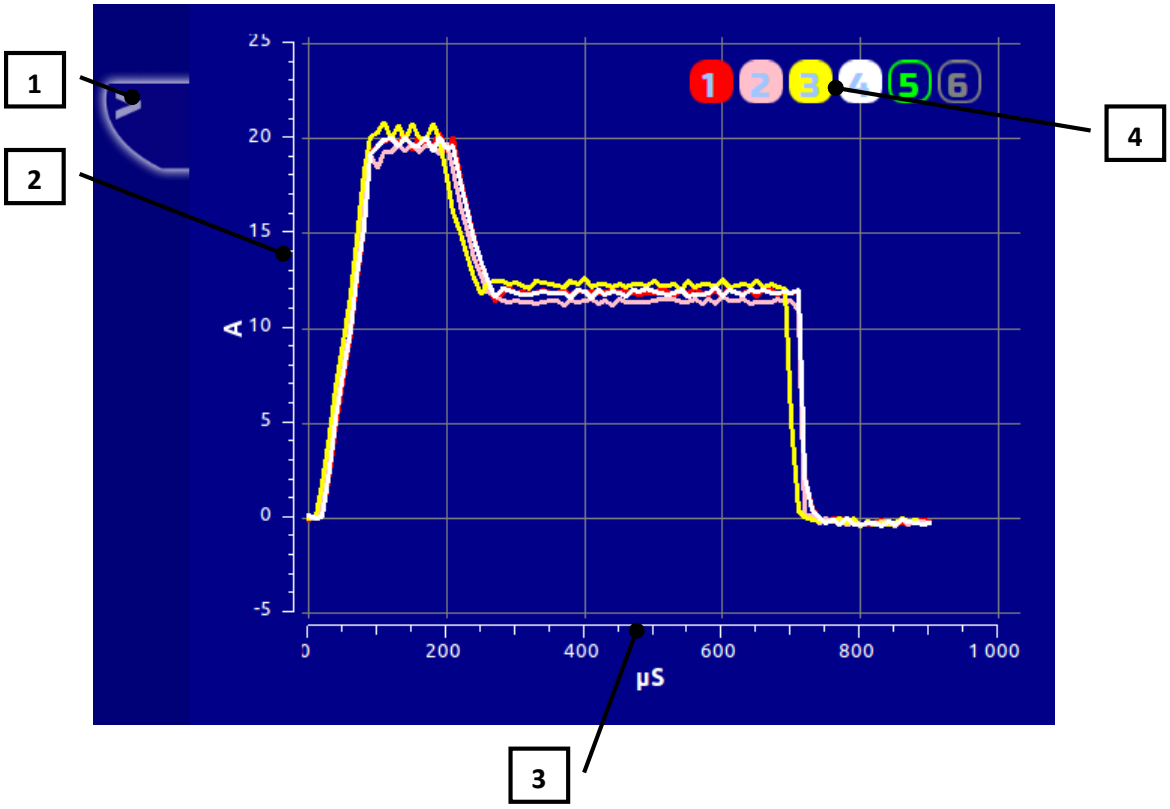
Typical connection diagram.



Additional menu.

There are additional menus in the right part of the screen. Additional menus can vary, depending on the test mode or other connected STARDEX devices.

Current graph.



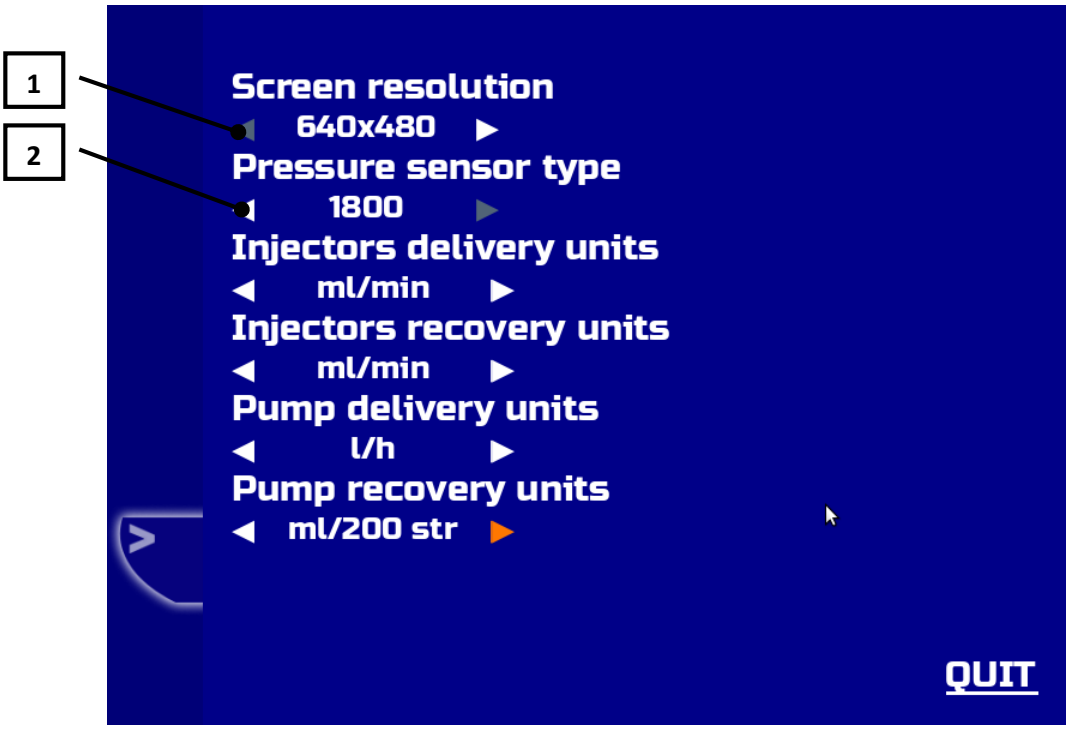
① **Return** – go back to the previous window.

② **Current scale** – intensity of current in the injector circuit, measured in Ampere.

③ **Time scale** – time measured in microseconds.

④ **Select buttons** – activate/deactivate display of the current graph for selected injector. Color of graphs corresponds to color of buttons; numbers of buttons correspond to numerated wire of injectors.

Settings.



① **Display resolution** sets resolution of an external monitor.

② **Pressure sensor type** is set according to the type of the pressure sensor, connected to the device.

It has two values:

- 1500 bar
- 1800 bar

Quit – quit to the operation system.

Supply kit.

Basic	
Device STARDEX 0402	1 piece
Notebook with preinstalled STARDEX software	1 piece
Power supply unit with cable and connector	1 piece
USB cable	1 piece
Main cable for connecting injectors	1 piece
Adapter for main cable to test Bosch injectors	1 piece
Adapter for main cable to test Delphi injectors	1 piece
Adapter for main cable to test Denso injectors	1 piece
Adapter for main cable to test piezoelectric Siemens injectors	1 piece
Adapter for main cable to test piezoelectric Bosch injectors	1 piece
Adapter for main cable multisystem 1	1 piece
Adapter for main cable multisystem 2	1 piece
Cable for connecting Bosch pressure sensor (old style)	1 piece
Cable for connecting Bosch pressure sensor (new style)	1 piece
Cable for connecting Bosch pressure regulator	1 piece
Cable for connecting Bosch Mercedes pressure regulator	1 piece
Cable for connecting Delphi/Siemens pressure regulator	1 piece
Cable for connecting Denso pressure regulator	1 piece
RPM sensor with cable and connector	1 piece
Technical description	1 piece

Additional (supplied separately)
Hand Pump
Fuel Aspirator
Fuel rail for testing one injector
Pressure sensor Bosch

Warranty and technical support.

The equipment has 1-year warranty. The manufacturer is not responsible for the damage, due to violation of the operation terms, misuse, including unskillful or mistaken personnel actions and if there are traces of mechanical impact. Post-warranty service of device is performed at cost components and the work. The manufacturer reserves the right to design modifications and equipment without an advance notice.

Shipping details.

The device is packed into a bubble wrap and a carton box.

Weight 12 kg.

Length 560 mm.

Width 460 mm.

Height 330 mm.

MANUFACTURED BY:

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