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Servicing shop test bench EL.1105.000-03

Operating Manual

AUTOMOTIVE AC PARTS

TOOLS

TRAINING

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INTRODUCTION

This Operating Manual is a document confirming the technical characteristics of the auto servicing shop test bench EL.1105.000-03 for 14TC-mini, BINAR-5S, and PLANAR-2/44/8/9 products. The document will familiarize you with the bench's characteristics and operating rules.

For bench study and operation, the following documents should be used as guidance:

- EL.1105.000-03 PS datasheet.
- Ammeter M42300 – 20A, class 1.5 or equivalent (datasheet);
- Technical specifications TU4591-008-40991176-2005 for air heaters;
- Technical specifications TU4591-012-40991176-2009 for hydronic heaters;
- Technical specifications TU 4591-004-40991176-2003 for diesel engine pre-heaters;

Operation manuals:

- PLANAR – 2/44/8/9 12 V and 24 V air heaters;
- BINAR-5S 12 V and 24 V hydronic pre-heaters;
- 14TC-Mini 12 V/24 V diesel engine pre-heaters;
- PU-27 control panel.

1 PURPOSE

The bench is designed for testing of air heaters, hydronic pre-heaters and their components.

The bench is used for testing of the following air heater models:

- PLANAR-2D-12/24;
- PLANAR-44D-12/24;
- PLANAR-8DM-12/24;
- PLANAR-9D-12/24.

Hydronic pre-heater models:

- BINAR-5S (12B);
- BINAR-5S (diesel);
- BINAR-5S.24 (diesel).

- 14TC-Mini-24.

Components of the items:

- air pump;
- temperature sensor;
- flame detector;
- glow plug.

The bench is used for fault diagnostics, measurement of supply voltage and testing of item operation in various modes.

Testing of modified models delivered with components differing from the basic components is permitted.

2 TECHNICAL CHARACTERISTICS

Characteristic	Parameter
Maximum power drawn (W)	480, depends on the item power
Bench rated supply voltage (V)	12/24
Fuel type	diesel according to GOST 305; petrol according to GOST R 51105
Maximum monitored exhaust gas temperature (°C)	500
Monitored current consumption (A)	0 to 20
Monitored supply voltage (V)	10 to 30
Monitored power consumption (W)	0 to 480
Coolant	distilled water
Liquid tank volume (L)	17
Coolant filling volume (L)	12.5
Quantity of items tested simultaneously (pcs)	1
Maximum bench weight (kg)	42
Bench dimensions HxWxD (mm)	560x400x780
The bench is designed for operation under the following conditions:	
Ambient temperature (°C)	(25±15);
Relative humidity (%)	30 to 80
Atmospheric pressure (mmHg)	(760 ± 25)

3 SAFETY MEASURES

- 31** The bench should only be operated by persons who have studied this operating manual and passed occupational safety training.
- 32** All wires and connections should be insulated.
- 33** Use of open flame near the bench is prohibited.
- 34** Exhaust gases should be removed by exhaust pipe or exhaust ventilation.
- 35** Do not remove the item during a test.
- 36** Dismantling, installation and repair of bench units should be performed with the supply voltage disconnected.
- 37** During operation, avoid contact of exposed body parts with heated bench elements (coolant, liquid tank, exhaust pipes).
- 38** While testing glow plugs, do not touch the heated parts of the plug. Avoid the presence of foreign flammable liquids near the plug until the plug cools.

4 BENCH COMPOSITION AND DESIGN

- The **control panel** PU-27 (Fig. 1, pos. 7) is used to control the items during testing.
- **Terminals** (Fig. 1, pos. 14) are used to connect the bench to an external power supply.
- **Mounts 1 and 2** (Fig. 1, pos. 1 and 2): the ends of steel water and gas lines in which **thermocouple** sensors are installed to measure exhaust temperature.
- The **ammeter** is used to measure the current consumed by the item (Fig. 1, pos. 8).
- **Bench assembly** (Fig. 1, pos. 8) is designed for testing of the item components.
- The fuel system includes petrol and diesel **fuel tanks** and Thomas Magnete P326 (6.8 ml capacity) and P327 (4.0 ml capacity) **fuel pumps**.
- The hydraulic loop comprises a 17 L **tank** and **pumps** (Fig. 1, pos. 11 and 12) providing fluid circulation.
- The exhaust pipes are used for exhaust gas removal.
- **Fuse box Bpr-3** with rated current up to 25 A is installed on the bench for protection against short circuits and to prevent increased current consumption.

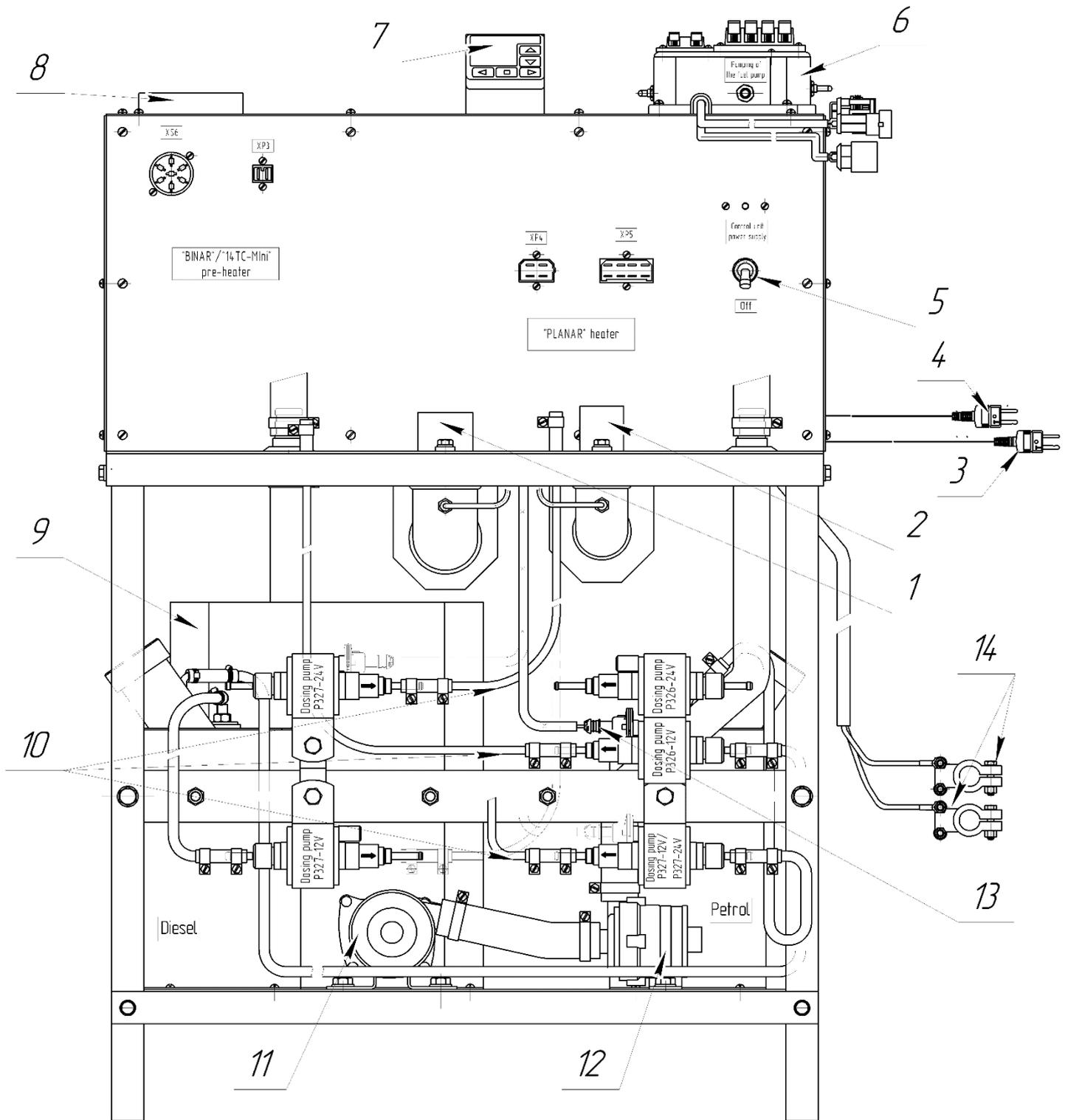


Figure 1. General view of the bench. 1) Mount 1; 2) Mount 2; 3) TR-1; 4) TR-2; 5) Bench assembly switch; 6) Bench assembly; 7) Control panel; 8) Ammeter; 9) Hydraulic loop tank; 10) Fuel lines; 11) P6 24 V pump; 12) 12 V Bosch pump; 13) Fuel pump harness; 14) Terminals

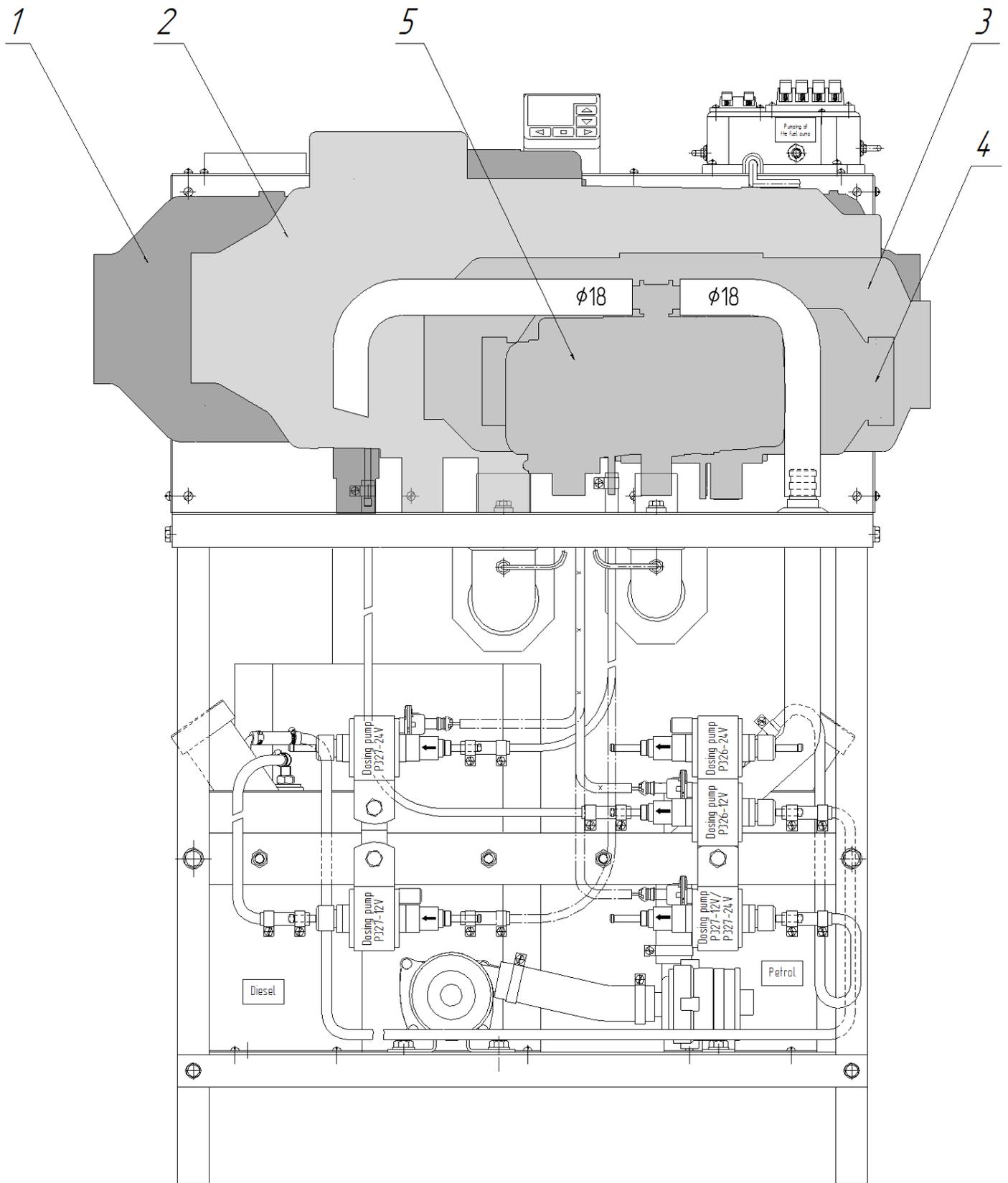


Figure 2. General view with test items mounted. 1) PLANAR-9D-12/24; 2) PLANAR-8DM-12/24; 3) PLANAR-44D-12/24; 4) PLANAR-2D-12/24; 5) BINAR-5S/(12B)BINAR-5S (diesel)/BINAR-5S.24 (diesel)

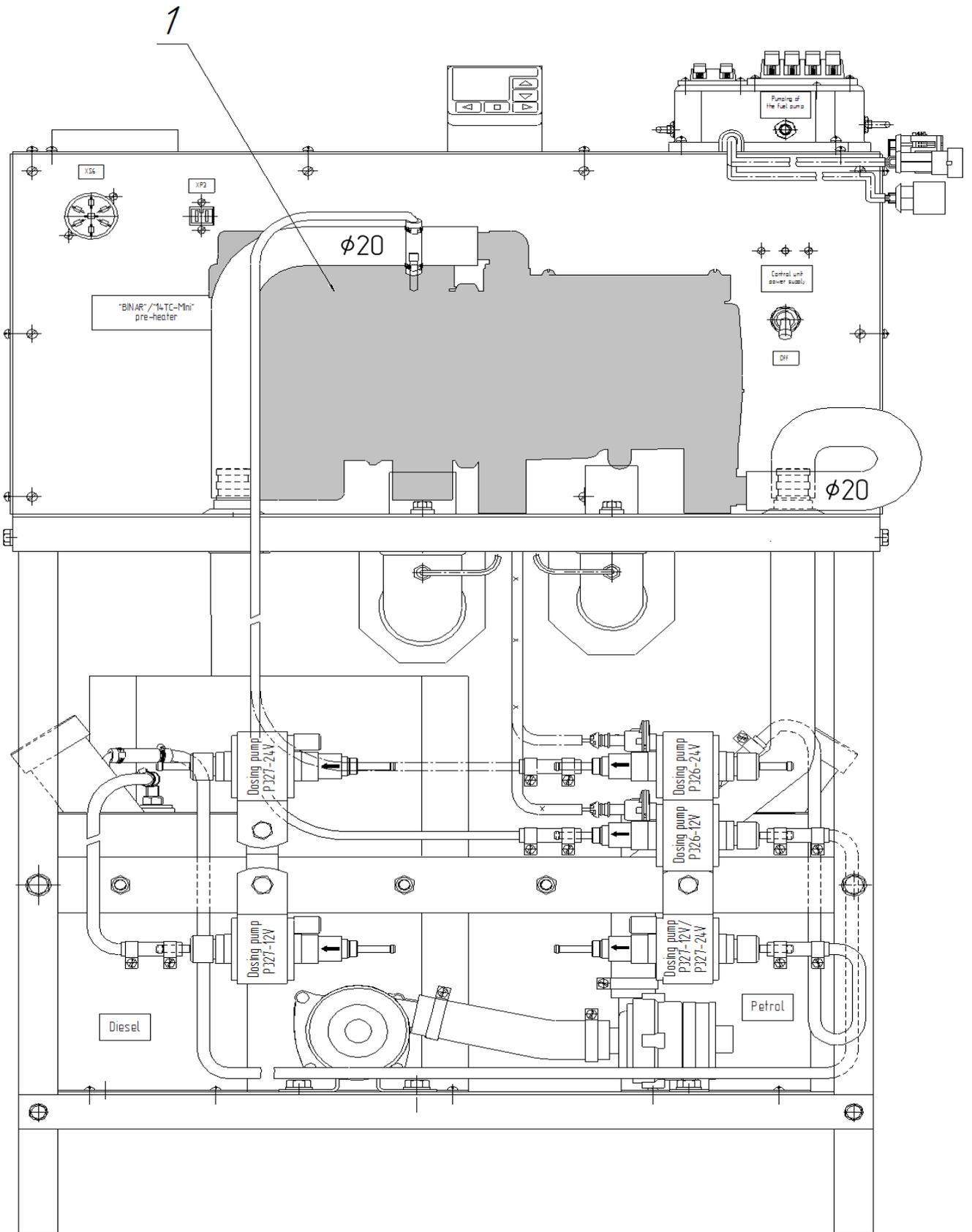


Figure 3. General view with 14TC-mini mounted. 1) 14TC-mini

The bench assembly (Fig. 4) is installed with the **fuel pump priming actuation button** (Fig. 4, pos. 4), the **switch** (Fig. 4, pos. 3) for glow plug test voltage selection, **terminals for connection of air pump** (Fig. 4, pos. 6) and **thermocouple sensors** (Fig. 4, pos. 2).

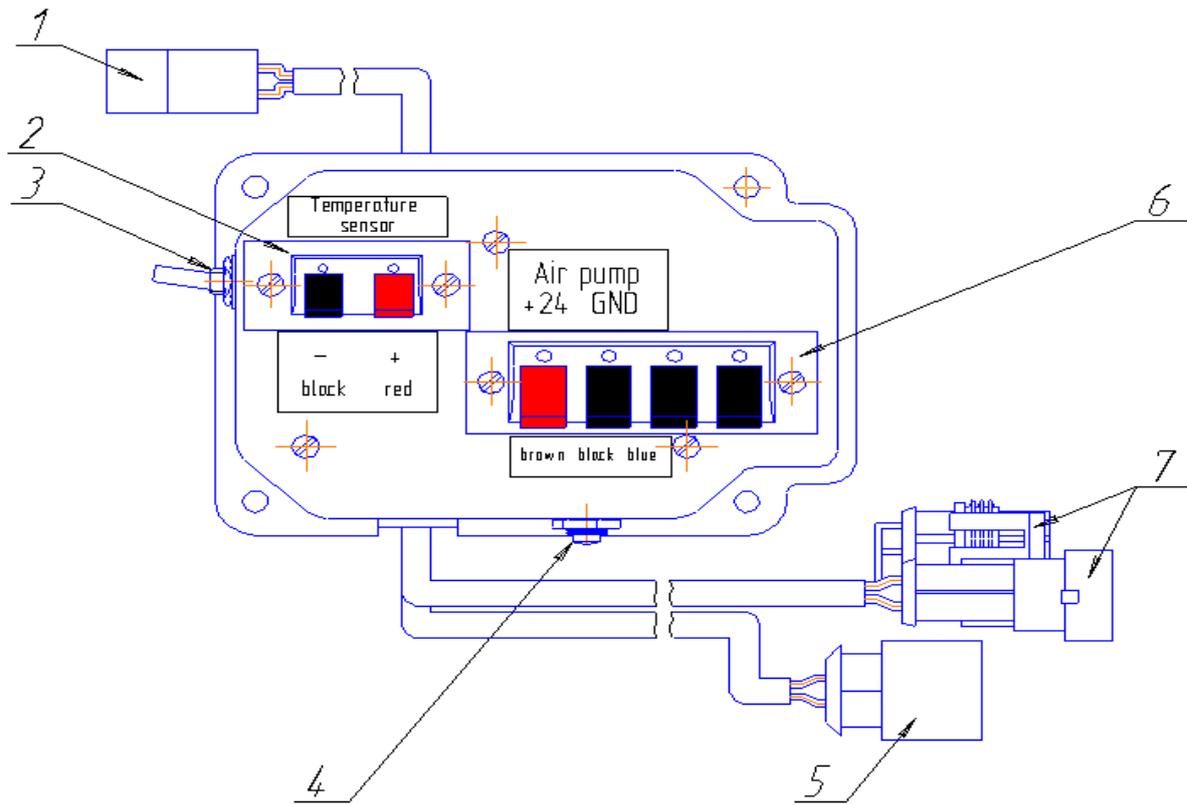


Fig. 4: Bench general view. 1 – power supply harness; 2 – terminals for thermocouple sensor connection; 3 – glow plug voltage selection switch; 4 – fuel pump priming actuation button; 5 – fuel pump connector; 6 – terminals for air pump connection; 7 – glow plug connectors.

5 OPERATING PRINCIPLE

The bench is used to test the functioning of hydronic pre-heaters, air heaters and components of these under operating conditions. Data on item operation is displayed on instruments installed on the bench.

Under operating conditions, the items are operating separately from the vehicle engine, being connected to the battery and fuel system. On the bench, the item is powered by connection to an external power supply; the fuel is supplied from the tanks using fuel pumps; operation of 12 V and 24 V pumps provides coolant circulation.

The bench serves to test items running on diesel and petrol, and it uses Thomas Magnete 12 V and 24 V fuel pumps.

The operation of the items is controlled using the control panel or software using a USB-adaptor and PC. Software for device diagnostics is available at the autoterm.ru website in the “Service and documentation” section, “Diagnostic software” subsection.

The control panel is connected to the control unit included in the basic set of the item and performing item-assembly diagnostics during startup and operation. The control unit performs an automatic shutdown in case of fault detection in any of the circuits monitored, or in case of temperature or voltage parameters exceeding allowable limits.

If no faults were detected, the item starts in the set mode.

Data on automatic diagnostics of the item are displayed on the control panel display, which is used to monitor the temperature change and switch the item to different operating modes.

The bench unit (Fig. 4) is used to test the item components.

6 PREPARATION FOR OPERATION

Before starting the item test, the operating principle of the bench described in this manual must be studied.

6.1. Fill the coolant tank (Fig. 1, pos. 9).

Before testing hydronic heaters, make sure the level of coolant is sufficient. The tank must be filled 2/3 full (≈ 12 liters).

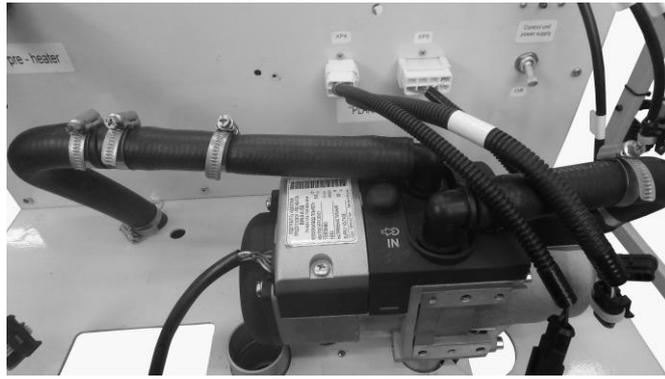
6.2. Fill the fuel tanks.

To test items running on petrol or diesel, fill the tanks and connect fuel lines to them (Fig. 1, pos. 10).



6.3. Place the test item on the bench in keeping with Figures 1, 2, and 3 and Table 1 (page 20). Connect fuel lines to the test item. If testing Binar-5S, connect hydraulic-loop connection pipes 18 mm in diameter, and connect the 24 V (Fig. 1, pos. 11) or 12 V (Fig. 1, pos. 12) pump.

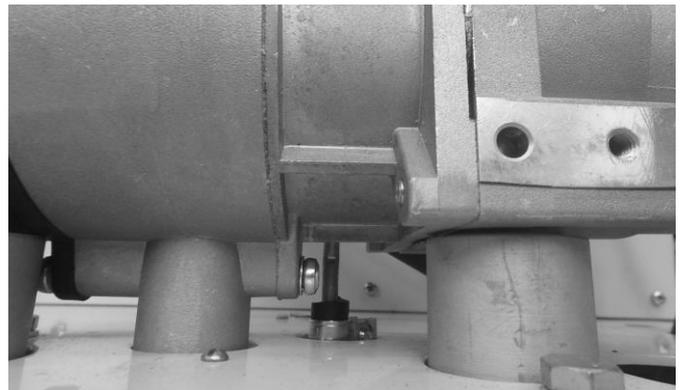
In the case of 14-TC-mini, connect connection pipes 20 mm in diameter.



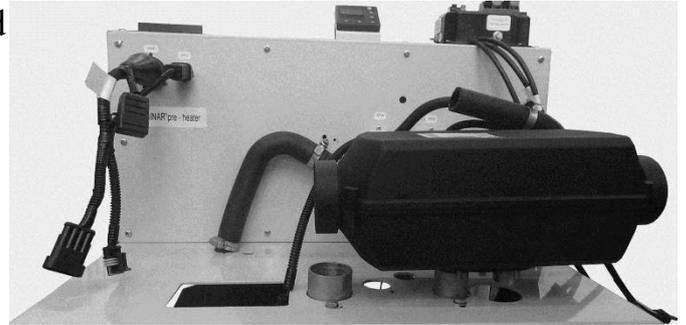
Binar-5S pre-heaters must be placed on mount 2 (Fig. 1, pos. 2) and connected to the hydraulic loop with connection pipes 18 mm in diameter.

14TC-mini pre-heaters must be placed on mount 1 and connected to the hydraulic loop with connection pipes 20 mm in diameter.

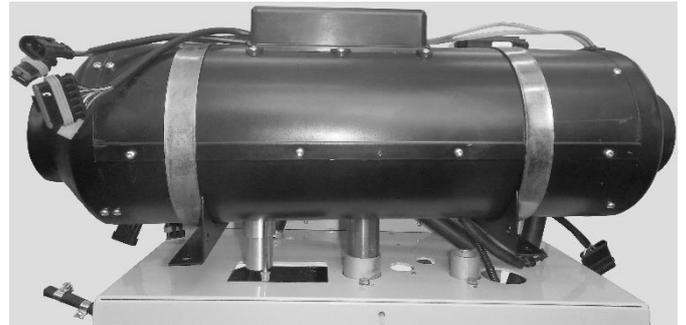
To connect the connection pipes to the test item, undo the fasteners of the item's nozzles then turn and fix them in position so that the inlet and outlet connection pipes can be connected. Use clamps to fasten the connection pipes on the nozzles.



Planar-2/44 heaters are also installed on mount 2.



Planar-8\9 heaters are installed on mount 1 (Fig. 1, pos. 1).



6.4 Connect the item electrical connectors to the bench using adapter harnesses.

Binar-5S pre-heaters are connected to XS6 and XP3 terminals via the “adapter no. 4” harness.

14TC-mini pre-heaters are connected to the XP3 terminal directly and via the “adapter no. 6” harness to the XS6 terminal.

Planar heaters are connected to the XP4 terminal via the “adapter no. 2” harness and to XP5 via the “adapter no. 1” harness.

6.5 Connect the bench terminals (Fig. 1, pos. 14) to the battery or power supply with the required output voltage.

6.6 Connect the fuel lines to the fuel pump lines (Fig. 1, pos. 10). Prime fuel to the fuel pump used using the bench assembly (Fig. 4).

6.7 To test liquid pre-heaters, connect the pump to the appropriate voltage.

For the fuel pumps to be used and fuel types to test a specific item, see Table 1 (page 20).

	14TC-mini pre-heaters are connected to the fuel pump via the “adapter no. 5” harness. Other test items are connected to the fuel pump with the fuel pump harness (Fig. 1, pos. 13).
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To prime the pump, connect the fuel lines to the fuel lines of the fuel pump to be used: the line from the fuel tank to the item. Secure the lines using clamps.

Connect the adapter harness “adapter no. 5” to the “to fuel pump” bench assembly harness and connect it to the fuel pump.

Switch on the power supply.

Using the switch (Fig. 1, pos. 10), energize the bench assembly.

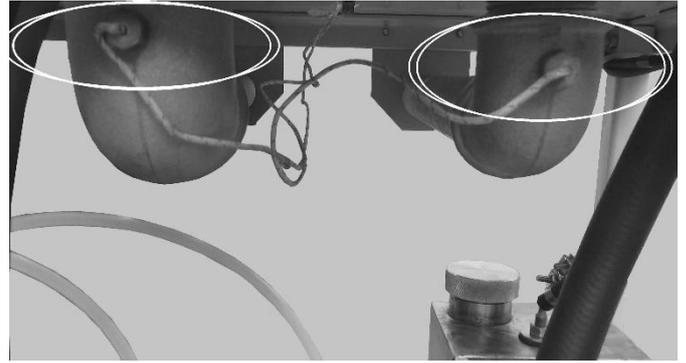
Press the “pumping of the fuel pump” button (Fig. 4, pos. 4) on the bench assembly.

Continue priming until the fuel line running to the item is full, then disconnect the adapter harness.

When testing Binar-5S and Planar-2, use the P327 fuel pump with a capacity of 4.0 ml. Which pump voltage to select depends on the pre-heater’s rated voltage.

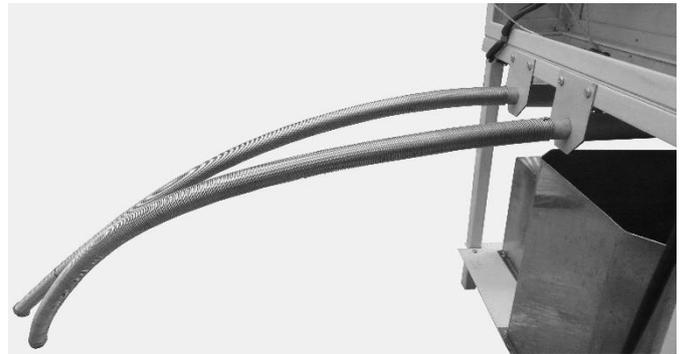
When testing Planar-44/8/9, use the P326 fuel pump with a capacity of 6.8 ml.

6.8 Connect the multimeter for exhaust gas temperature measurement. The multimeter should be connected to thermocouple connector 1 (Fig. 1, pos. 3) or 2 (Fig. 1, pos. 4) depending on the location of the mount the item is installed on.



6.9 Ensure exhaust gas removal from the room during operation.

Corrugated flexible tubing must be connected tightly to the bench's exhaust pipes, which are structurally connected to the mounts.



Exhaust pipes get hot during operation.

6.10 The bench is ready for operation.

7 OPERATING PROCEDURE

7.1. Prepare the bench for operation according to subparagraphs 6.1 - 6.9.

When voltage is applied to the bench, the control panel establishes a connection with the item. The control panel version number is displayed on the display.

After the connection is established, the operation is started by pressing the control panel middle button.



In case of failure to establish connection, the “No connection” message will appear on the display. In this case, test for correct connections.

After the item starts, the control panel performs an automatic test. In case of fault detection, the fault code will be displayed on the display.

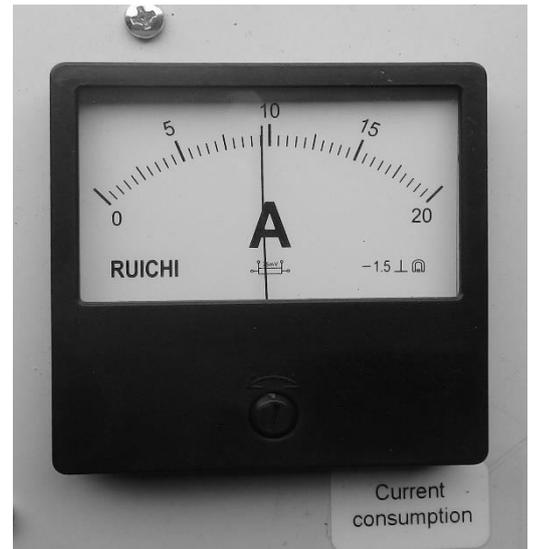
For fault code descriptions, see Attachment 1.



After successful diagnostics, the pump begins to supply fuel, the air pump is started and ignition is performed. At this stage, slight smoking is allowed. If ignition is successful, the item is switched to operation in the selected mode. Information on the operating mode is displayed on the control panel display.

During testing of heaters, the control panel display shows data on the ambient temperature and the item outlet fluid temperature. For the control panel operating procedure, see the control panel operating manual.

7.2. Use the multimeter to monitor the current drawn during the test.



7.3. During item operation, the exhaust gas temperature is monitored using a multimeter connected to the thermocouple connectors.

7.4. Power drawn is calculated using the formula $P = I \times U$ W, where I – consumed current in amperes (monitored with an ammeter); U – bench supply voltage in volts.

For the characteristics of the items in specific operating modes, see the operating manuals for the items.

7.5. During the test, the tested item's vibration should be assessed, with visual monitoring of coolant leaks and exhaust gas smoke performed. The item's operation should not be accompanied by abnormal noises.

7.6. To stop operation of the item, press the control panel middle button again.

7.7. After test completion, with the power supply switched off, remove the item from the bench, disconnecting harnesses and lines connected to the item. Install the new item and repeat the procedure as described in paragraphs 7.1 - 7.7.

7.8. When work is finished, switch off the bench power supply.

Table 1. Fuel pumps connected to the item and fuel used.

Test item	Fuel pump	Fuel	Mount	Terminals
Planar-2 (12 V)	P327 4,0 ml - 12 V	Diesel		XP4 + adapter no. 2 XP5 + adapter no. 1
Planar-2 (24 V)	P327 4,0 ml - 24 V			
Planar-44 (12 V)	P			
Planar-44 (24 V)	P			
Planar-8 (12 V)	P			
Planar-8 (24 V)	P			
Planar-9 (12 V)	P			
Planar-9 (24 V)	P			
BINAR-5s (12 V)	P 4			
BINAR -5s (diesel, 12 V)		Diesel		
BINAR-5s.24(diesel,24 V)				
14TC-mini (24 V)	P326 6,8 ml - 24 V + adapter no. 5			X XS3

	Ø	
B		B
B		B
B		
14TC-mini (24 B)		V

Test of item main components.

Temperature sensor test.

- 1) Connect the temperature sensor to be tested to the “Temperature sensor” terminals (Fig. 4, pos. 2) on the bench assembly (Fig. 1, pos. 8; Fig. 4) according to the marking (red wire to red terminal, black wire to black terminal).
- 2) Using the switch (Fig. 1, pos. 10), energize the bench assembly.
- 3) Connect the multimeter wires to the terminals in dc voltage measurement mode with a 20 V limit.
- 4) Using the voltage measured by the multimeter, the temperature can be determined using the formula:

$$T_{\text{sensor}} = T_{\text{ambient}} = (U_{\text{meas.}} - 2.73) 100 \text{ }^{\circ}\text{C}$$

A temperature of 0 °C corresponds to sensor output voltage of 2.73 V. One degree corresponds to 10 mV voltage.

Air pump test.

- 1) Connect the air pump to be tested to the “Air pump” terminals (Fig. 4, pos. 6) according to the colors of the wires (see marking on terminals sticker).
- 2) Using the switch (Fig. 1, pos. 8), energize the bench assembly. The air pump should operate without abnormal noises. The power drawn should not exceed the allowable value and is calculated using the formula $P=I \times U$.

Glow plug test.

- 1) Set the switch on the bench assembly (Fig. 4, pos. 3) in the 9/18 V or 12 V position according to the voltage of the glow plug to be tested. When the switch is switched to a certain position, make sure the correct voltage is set on the bench power supply: 12 V for 9 and 12V glow plugs and 24 V for 18 V glow plugs.
- 2) Connect the glow plug to the connector on the bench assembly (Fig. 4, pos. 7).
- 3) Using the switch (Fig. 1, pos. 10), energize the bench assembly.

Table 2. Correspondence of voltage on glow plug label, switch position and power supply (battery) voltage.

Voltage on glow plug label (V)	“Glow plug selection” switch position	Power supply (battery) voltage (V)
9 V	9/18 V	12 V
12 V	12 V	12 V
18 V	9/18 V	24 V

The length of glow plug “incandescence” should be in the 10 to 18 mm range. The measurement should be made with a metal ruler.

During the testing, the safety precautions should be strictly observed.

Flame detector test.

The multimeter is used to test the flame detector electrical circuit integrity. The resistance between the display terminals at room temperature should not exceed 10 Ω .

8 MALFUNCTIONS

Item malfunctions are diagnosed when work starts using the item control unit. In case of fault detection, the fault code will be displayed on the control panel display. For code descriptions, see Attachment 1.

Faults during testing of items:

Symptoms:

The item fails to switch on. No indication on the control panel. No communication with the item or the item component when connected to bench assembly. The bench assembly display not lit, no readings on the ammeter

Possible causes of faults:

Power loss. Short circuit in the power supply. Fault in item.

Troubleshooting measures:

Test fuses. If fuses are blown, switch off the power and test the bench and the item for short circuit. Replace fuses. Check the voltage at the item connector. Test the item and control panel connection harnesses and power supply terminals.

9 MAINTENANCE

Maintenance must be performed to keep the bench in operating condition during its entire service life.

Maintenance types:

Daily maintenance. Performed by the bench operator to ensure the bench is serviceable. This includes the removal of dust and debris from the bench surface - to be performed daily, before the work day begins.

Routine maintenance. Performed to prevent the premature failure and for replacement of bench components with service life expired and operation of which may cause the bench parameters to decline. This includes:

- fuel tank cleaning - every 14 days of operation;
- coolant tank cleaning - every 14 days of operation;
- fuel line replacement - every 14 days of operation;

Repair should be performed as necessary in case of malfunctions.

Attachment 1. PU-27 fault codes.

Table 1. PLANAR malfunctions.

Code	Malfunction description	Comments. Troubleshooting method
1	Heat exchanger overheating	Test the heater inlet and outlet line for free inflow and outflow of heated air.
2	Overheating in the control unit area. Overheating via flame detector	Test the heater inlet and outlet line for free inflow and outflow of heated air. Test the combustion air supply system and the gas exhaust pipe. Repeat the starting procedure for heater cooling.
	Failure of integrated temperature sensor	Replace the control unit.
	Failure of flame indicator	Check the indicator circuit for disconnection: inter-contact resistance should not exceed 10 Ω . Replace the indicator if faulty.
	Flame interrupted while heater is operating	Check air quantity and supply. Check the combustion air supply system and gas exhaust piping. If the heater starts up, check the fuel pump and replace if necessary.
	Faulty glow plug	Check the plug and replace if necessary.
	Air blower motor not attaining necessary speed	Check the motor wiring and replace the air blower if necessary.
12	Shutdown due to overvoltage	Test the battery, the voltage regulator and power supply wiring. Voltage between contacts 1 and 2 of power supply connector should not be higher than 30 V (not higher than 16 V for the 12 V item).
13	All attempts to start failed	Test the fuel supply (inspect the fuel line). Test the combustion air supply system and the gas exhaust pipe.
15	Shutdown due to undervoltage	Test the battery, the voltage regulator and power supply wiring. Voltage between contacts 1 and 2 of power supply connector should not be lower than 20 V (not lower than 10 V for the 12 V item).
16	Ventilation time exceeded	Test the air intake and the exhaust pipe. In case of clogging, all foreign particles should be removed.
	Failure of fuel pump	Check the pump electric drive circuit for short circuit and disconnection and replace if necessary.
20	No communication between control panel and control unit	Test connecting wires, connectors. Control panel fails to receive data from the control unit.
	Failure of fan motor. Motor not rotating	Check terminals and harnesses going to the motor board and the control unit. Correct any faults detected, if possible. Replace the air blower if necessary.
	Failure of fan motor. Motor keeps operating	Check the fan motor's wiring for conductivity and replace the fan motor if necessary.
	Too many flameouts during operation	Test the fuel supply (inspect the fuel line). Test the combustion air supply system and the gas exhaust pipe.
30	Flame blowoff in the combustion	Test the battery and wiring. (Voltage drop can be caused

	chamber due to a voltage drop	by long operation of the electric starter).
	Overheating inside the heater in the area of heated outlet air temperature sensor	Test the heater inlet and outlet line for free inflow and outflow of heated air.
	Temperature sensor fault	Test connecting wires. The output signal and voltage depend linearly on the temperature (0 °C corresponds with 2.73 V; every 1 °C of temperature increase corresponds with 10 mV). Check the sensor. Replace if necessary.
	Heater is locked**	To unlock the heater, contact a service center.
	Flameout in combustion chamber due to a voltage drop	Test the battery and wiring. (Voltage drop may be caused by long operation of the electric starter).
	Flameout during operation.	<i>Information for the user.</i> Test the tightening of the fuel line clamps, tightness of fuel line and fuel pump line

** If the “Overheating” error appears three times in a row during heater startup or operation, it will be locked. The locking is activated based on the fact of overheating, regardless of the sensors that detected the errors. In case of lock, fault code 33 will be displayed on the control panel.

Table 2. BINAR-5S malfunctions.

Code	Malfunction description	Comments. Troubleshooting method
01	Overheating. Temperature exceeds 120 °C.	1. Perform complete test of the fluid loop. 2. Test the pump; replace if necessary. 3. Test the overheating sensor and the temperature sensor; replace if necessary. 4. Test the antifreeze for suitability at current ambient temperatures.
03	Temperature sensor fault No. 1.	Replace the sensor assembly.
04	Temperature sensor fault No. 2.	
05	Flame detector fault.	Test connecting wires. Test ohmic resistance between display leads; it must not exceed 10 Ω. Replace the faulty flame indicator.
06	Control unit temperature sensor fault	Replace the control unit of the heater.
09	Glow plug fault.	Test glow plug. Replace if necessary.
10	Air pump fault. Speed lower than rated.	Test electric motor wiring. Correct the fault; replace the air pump if necessary.
12	Shutdown due to voltage over 16 V (30.8 V).	This defect is possible if the pre-heater starts when the vehicle engine is running. This may be caused by vehicle voltage regulator fault.
13*	All attempts to start failed.	In case all start attempts were used - test the amount and flow of fuel supplied. Test the air intake, the filter, and the gas exhaust pipe. Test the glow plug.
14	Pump fault.	Test short circuit and discontinuity of circulation pump wiring; test the pump; replace if necessary.
15	Shutdown due to voltage below 10 (20) V.	Test voltage at connector XS2 on the heater. Test the battery, the vehicle voltage regulator, and power supply wiring.
16	Ventilation time exceeded.	The flame detector is not cooled down enough by purging. Test the air intake, the filter, and the gas exhaust pipe. Test the flame detector; replace if necessary.
17	Fuel pump fault.	Test the fuel pump power wiring for short circuit, replace if necessary.
20	No communication between the control unit and the control panel.	Test connecting wires, connectors. Control panel fails to receive data from the control unit.
22	Fuel pump fault.	Test the fuel pump power wiring for breaks, replace if necessary.
24	Rapid temperature change indicated by one of the sensors.	Possible overheating near one of the temperature sensors due to poor coolant circulation.

25	The coolant heats up too quickly.	Perform complete test of the fluid loop. The pre-heater goes into the cooling down mode three times in one cycle in less than 6 minutes.
26	Air pump overload	Test the air pump. Air pump vane wheel jamming in the heater housing due to bracing misalignment is possible
27	Air pump fault. The motor does not rotate.	
28	Air pump fault. The engine rotates uncontrollably.	Test wiring, the air pump, and the control unit; replace if necessary.
29	All ignition attempts failed with the pre-heater in operation.	Test the fuel system. Test the tightness of the fuel line clamps, the seal of the fuel line and the fuel pump line, and the fuel pump output.
30	No communication between the control unit and the control panel.	Test connecting wires and connectors. Control unit fails to receive data from the control panel.
37*	Pre-heater is locked	To unlock the pre-heater, contact a service center.
50	No communication between the control panel and the modem.	Test connecting wires, connectors.
78	Flameout during operation.	Shown to inform the user. Check the tightness of the fuel line clamps, and integrity of fuel line and fuel pump fitting.

* If error 13 appears three times in a row during pre-heater start, it will be locked. This lock is to prevent excess fuel supply to the combustion chamber. In case of lock, the fault code 37 will be displayed on the control panel.

Table 3. 14TC-Mini malfunctions

Codes	Fault	Notes / Troubleshooting
	Overheating	1. Check thoroughly the liquid circuit
	The risk of overheating. Temperature difference between the readings of the overheating sensor and heat sensor is too big	2. Check circulation pump, replace if necessary 3. Check temperature sensor and overheating sensor ,replace if necessary 4. Check the quality of antifreeze to be applied depending on the ambient temperature.
	Faults overheating sensor	Check connecting wires. The output signal and voltage are in linear dependence on temperature (0 °C correspond 2,73 V and at increase in temperature at 1 °C, respectively, the output signal increases by 10 mV). Check the overheating sensor and replace it, if necessary
	Faults heat sensor	Check connecting wires. The output signal and voltage are in linear dependence on temperature (0 °C correspond 2,73 V and at increase in temperature at 1 °C, respectively, the output signal increases by 10 mV). Check the heat sensor and replace it, if necessary
	Faulty flame indicator	Check connecting leads. Check ohmic resistance between indicator contacts, it must be not more 10 Ohm. Replace the indicator if necessary
	Faulty temperature sensor on the control unit	Replace control unite of the pre-heater
	Glow plug malfunction	Check the glow plug, replace if necessary
	Air pump motor malfunction	Check the electric wiring of the air pump motor, replace the air pump, if necessary.
	Shutdown, voltage boost 30V (16V) more	This malfunction is possible if the pre-heater is switched on when vehicle engine is running. The possible reason of the trouble is vehicle voltage regulator failure. Check voltage on XS1 connector of the pre-heater
	No more tries to start the preheater are left	In case there are no more tries to start the pre-heater left check fuel supply and amount of fuel supplied. Check the air supply system to the combustion and exhaust gas-escape channel, check ignition plug. Check a lining and a hole of Ø 1,5 mm in the glow plug union of the combustion chamber on a dirt and a deposit. Clean a hole of Ø 1,5 mm, replace a lining, if necessary.
	Pump malfunction	Check circulation pump wiring for short-circuit fault or disconnection fault. Replace the pump if necessary
	Shutdown, low voltage less then 20V (10,5V).	Check voltage on XS1 connector of the pre-heater. Check the battery, regulator and power supply wiring

	Excessive ventilation time	The pre-heater is not cooled enough during purging. Check the air duct and exhaust gas-escape channel. Check the combustion detector and replace, if necessary
	Fuel pump malfunction	Check the electric wiring of the fuel pump for the short circuit check the pumping capacity and replace the fuel pump if necessary
	No connection between Control panel and the heater	Check wiring, connectors
	Air pump failure. Motor won't rotate	Check the wiring of the air pump, control unit, replace if necessary.
	Air pump failure. The motor rotates without control	
	The admissible number of breakdowns of a flame in operating time is exceeded	Check the fuel level and fuel supply system. Check combustion air system and the exhaust pipe line. If the heater can be started, check fuel pump and replace if necessary.
	Fixed the flame failure when the time of pre-heater work	Check fuel supply and amount of fuel supplied. Check the air supply system to the combustion and exhaust gas-escape channel. If the pre-heater starts, check the combustion detector and replace, if necessary. Check the fine fuel filter for clogging up.