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### **Attention! Compressed air!**

The more the gas volume and pressure, the more its stored potential energy, which—in case of an emergency or wrong actions of the operator—may be released with a blast-wave rate, carrying parts, debris, etc.

This Manual aims to ensure safety and efficient operation of the device. Keep this Manual together with the device. Before beginning any operations, the user must read and understand the Manual and the operating principles of the device. The foundation of safe work is to comply with the requirements of the Manual as well as of general safety rules, local regulations, etc.

## **1 Purpose**

1.1 An electro-pneumatic pressure booster K-450 (hereinafter — booster) is intended to increase the pressure of dry purified air and nitrogen for the laboratory and scientific purpose.

1.2 The booster shall be used strictly as intended, without any deviations from the requirements of the User's Manual.

1.3 The booster is designed for operation in laboratory conditions at the ambient air temperature of 10 to 30°C and maximum relative humidity of 80% or lower.

## **2 Technical Characteristics**

Maximum inlet pressure .....	0,7 MPa
Maximum operating outlet pressure .....	45 MPa
Working fluid <sup>1</sup> .....	nitrogen, air
Supply mains voltage .....	220 V ±10%
Supply mains frequency .....	50 Hz
Power consumption .....	800 W
Duty cycle .....	50%
Maximum capacity	
no-boost .....	3,9 L/min
of the booster, output (at 45 MPa).....	8,6 cm <sup>3</sup> /min

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<sup>1</sup> The gas supplied shall be dried and purified. The maximum particle size in the incoming gas shall not exceed 5 µm. The solid particle concentration shall not exceed 5 mg/m<sup>3</sup>. The water content shall be no higher than 5 g/m<sup>3</sup>.

Overall dimensions (LxWxH), no more than ..... 1200×360×480 mm  
 Booster weight, no more than ..... 110 kg

### 3 Scope of Supply, pcs

Booster's power unit .....	1
Control panel .....	1
Connecting cable for the control panel .....	1
Network cable .....	1

#### Optionally

- Inlet filter<sup>2</sup>
- Outlet filter<sup>2</sup>
- Compressor K-9, with a connecting tube
- High-pressure outlet tube, connectors

### 4 Instrument Design and Principle of Operation

4.1 The booster's appearance is shown in Fig. 1.

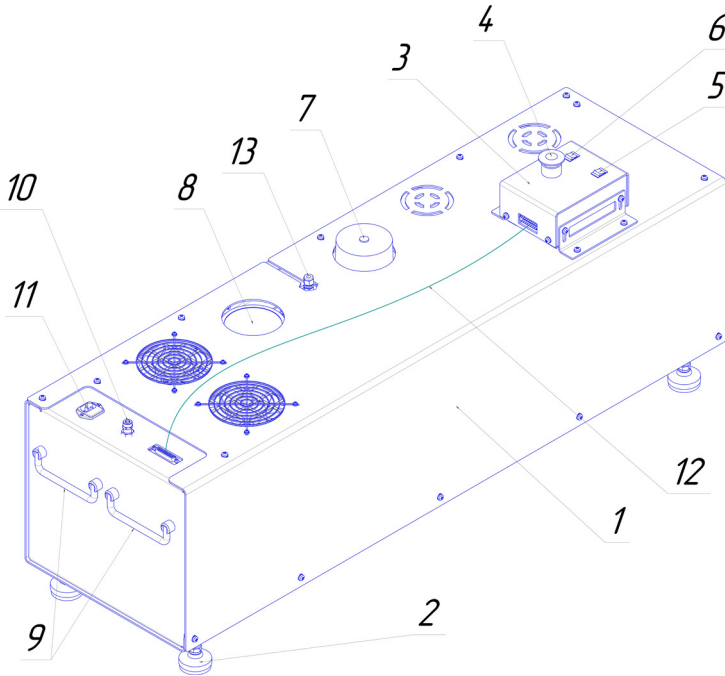


Fig. 1.

<sup>2</sup>To ensure the required purity of the outlet compressed air, the booster can be supplied with an extra filter

In terms of the design, the device is made as finished unit 1, in a metal housing. Adjustable antivibration supports 2, an internal vibration dampening system, and a high-precision drive allow achieving comfortable operation of the booster. This distinguishes the device from other various booster brands, making it unique in its own way. The booster is controlled remotely with wired panel 3, which makes it easy to install in users' systems. The panel can be secured on the booster housing. Those two units are connected one to another with a cable item 12. To transfer the booster and to make installation works easier, swing-aside handles 9 are installed on both sides of the booster. To connect the inlet pressure, there is fitting 10, with connection via a plastic tube  $\varnothing 8/6$  mm. Compressed air exits through fitting 13, with connection via a stainless steel tube  $6 \times 1.5$  mm. There is connector 11 for connection to the 220 volt, 50 Hz mains. A 250 V, 8 A fuse is installed in that connector for electrical safety.

4.2 Booster controls are as follows:

1. STOP button 4. It is intended for emergency shutdown of the drive in emergency situations. It does not release the pressure in the system, so the system remains pressurized.
2. Power-on button 5. It is intended to prepare the booster for operation. When it is activated, the power is supplied to the booster control system and to the drive.
3. Start/Stop button 6. It is intended to start and stop the booster running as the user chooses.
4. Electric-contact manometer 7, on the booster unit. It is intended for monitoring and setting of the outlet pressure. Also, the second manometer 8 is installed for additional visual pressure monitoring.

4.3 An internal mechanism is a two-stage compression system (Fig. 2).

Each stage operates mechanically separately, while being controlled by a common work algorithm. Each of them is a piston-type compressor driven by ball-and-screw unit 1 with direct drive 2 from high-precision electric motor 3. The direct drive together with the use of high-technology screws of all-and-screw units with increased efficiency make the booster an economical device. And the absence of additional auxiliary pneumatic supply of the booster makes its installation and operation easier.

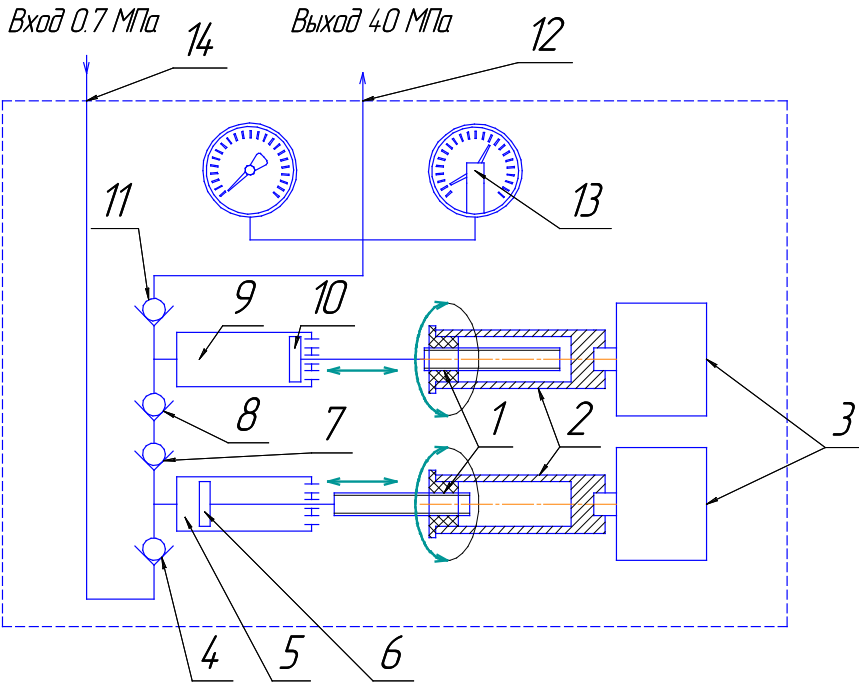


Fig. 2.

4.4 There is no output receiver in the booster, for the safety reasons. Due to the booster's ability to run with frequent alternate automatic turn-on and off, the outlet-gas pressure fluctuations will be as low as possible.

4.5 When the gas inlet pressure (0 to 0.7 MPa) is supplied to fitting 14, a portion of this pressure is immediately transferred to the outlet, passing through both stages of the booster, regardless of whether the device is on or off. Due to this, the operator must be particularly careful when supplying the pressure to the booster.

4.6 When starting the booster, pistons of both stages get set in motion, and incoming pre-compressed gas first passes through inlet valve 4 into first-stage cylinder 5. Then the gas is compressed by piston 6 and pushed out through first-stage outlet valve 7 and then through second-stage inlet valve 8 into second-stage cylinder 9. Further, the gas is compressed by second-stage piston 10 and pushed out through second-stage outlet valve 11 to pass to system outlet fitting 12.

4.7 The maximum pressure in the booster's outlet portion is monitored with built-in electric-contact manometer 13. When the user-set pressure

is reached, the booster switches off and is waiting for pressure decrease in the user's system. As soon as the manometer detects a decrease in pressure, the booster automatically proceeds with the operation.

## 5 Safety Precautions

### Attention

This Section contains general information on major safety aspects, safe operation methods, personnel health protection, and property safeguarding, including this instrument. A number of guidelines are described in more detail in other sections hereof.

### 5.1 Intended use

The electro-pneumatic pressure booster K-450 is designed to create a pneumatic pressure in the user's receiving device. The booster serves to compress dry purified air or nitrogen. The booster must be used strictly as intended. Otherwise, it is considered that the device is used not as intended. This can result in injuries, maims, and other severe consequences.

### 5.2 Permissible gases to be compressed by the booster are

- Dried purified air.
- Nitrogen

### 5.3 Potential risks when using the booster as intended

Even the intended use of the booster has risks caused by the human factor and force-majeure circumstances that the pressure specified in the User's Manual would be exceeded.

### 5.4 Noise hazard

The noise level at air/gas release/expansion can exceed permissible standards, depending on the booster usage method. Use the personal protective equipment. Being near the running device shall be strictly as necessary and with the permission of a local supervisor.

### 5.5 Danger of pressurized gases

One shall remember that pressurized gas has certain potential energy. Uncontrolled release of this energy may have severe consequences. Improper handling of the pneumatic system may result in gas release from it, which might lead to severe injuries. Compression of large gas amounts is extremely dangerous! Creating compressed gas in volume over 200 normal litres is extremely not advisable ("normal litres" means

the volume of compressed gas in equivalent to the atmospheric pressure, i.e. the gas volume of 2 litres at a pressure of 100 atm corresponds to 200 normal litres). When creating large volumes of compressed gas, the operator shall be properly qualified and have a permit to work. The Federal Regulations for Industrial Safety “Rules for Industrial Safety of Hazardous Production Facilities That Use Equipment Operating under Excessive Pressure” and others shall be met as well.

*5.6 When mounting or dismantling any assemblies and parts of the device as well as when performing maintenance or any off-standard works, always release the pressure in the system. Should any defective parts or faults be identified, the device must not be operated until the parts are replaced and the faults are eliminated. Works shall be carried out only by qualified personnel authorized to access the respective equipment.*

### **5.7 Danger of low and high temperatures**

The components of the pneumatic system that interact with the expanding gas can become covered with ice and have low temperatures. Expanding, the gas performs the work and loses potential energy, which decreases its temperature. Further interaction of the cooled-down gas with the system’s components decreases the temperature of the components. Operations with them may be performed only after they are heated to the ambient temperature.

When such components as silencers or outlet holes are iced, care should be taken. Ice can come off and, being caught up by the gas stream, fly around, causing injuries. Freeze burns are possible as well. Use the personal protective equipment.

Components and surfaces that interact with the gas being compressed can get heated and have a high temperature. While being compressed, the energy is transferred to the gas, which results in its heating. To perform any works with components prone to heating, make sure that they cooled down. Use the personal protective equipment.

### **5.8 Electric shock hazard**

Do not forget that the booster is supplied from the 220 volt, 50 Hz mains. A plug and a power cord shall be in the fault-free condition at all times. The booster shall be connected only to a mains that has the third, earthing contact. Connect the booster via a residual current device (RCD) designed for the operating current of 16 A and the breaking current of 10 or 30 mA. This increases protection against electric shock. Electric systems of the device shall be repaired only by qualified personnel.

Improper handling of electric and electronic assemblies of the booster creates a risk of electric shock.

### **5.9 Fire/explosion hazard**

The booster is not designed for operation in explosion-hazard areas. Fire safety rules must be strictly followed.

### **5.10 Danger from working fluids (gas being compressed)**

Remember that, unlike the air, when entering indoors, the gas being compressed can cause toxic poisoning, asphyxia, and even death. For instance, when discharge valves are opened in an uncontrolled manner and the gas fills the room. Gas can force out oxygen, which is necessary for breathing, or change the air composition, which would result in loss of consciousness and death. The working area shall be fitted with exhaust ventilation equipment, for a case of gas penetration indoors. In case of dizziness or suspected intoxication, the work must be stopped immediately, and victims must be provided with medical assistance.

### **5.11 Responsibility of the operating organization**

5.11.1 The operating organization is a person that uses this device or provides it for the use to third parties and that has legal responsibility during the operation for protection of the user, personnel, or third parties.

5.11.2 Since the booster is intended, among other things, for the use as a part of other devices/equipment, the organization that operates boosters must ensure safety of works according to the legislation.

5.11.3 Along with safety guidelines contained herein, the applicable safety regulations, labour safety regulations, and environmental protection regulations shall be followed.

5.11.4 The operating organization shall collect information on the applicable labour safety regulations and additionally identify potential hazards that occur at the place where boosters are used due to specific working conditions. Based on that, it shall develop guidelines for booster operation. The guidelines developed shall comply with regulatory documents throughout the service life of the device.

5.11.5 The operating organization shall regulate and define responsibilities for installation, operation, troubleshooting, and maintenance.

5.11.6 The operating organization shall take care that all operation-related works are performed exclusively by personnel that is properly qualified and authorized to carry out these works. All the persons that



work with boosters must read and understand this Manual. Besides, the personnel shall be trained and informed on hazards on a regular basis.

5.11.7 The operating organization shall provide the personnel with necessary personal protective equipment and oblige them to use it.

5.11.8 The operating organization shall keep booster in the technically good order. The presence and legibility of nameplates and texts on the booster shall be checked. Every commissioning shall include maintenance. The emergency and automatic shutdown system of the booster shall be checked on a periodic basis. Free access to the emergency shutdown button shall be ensured at all times.

5.11.9 The operating organization shall make sure that boosters are used for compression of permitted working fluids only. Also, working compressed air and working gases shall be properly pre-connected and properly stored.

5.11.10 The operating organization shall make sure that all elements to be connected to the booster are designed and selected according to the booster's characteristics.

#### 5.12 Personnel requirements

Engage only properly qualified personnel for performance of any works. Do not allow unqualified personnel in a hazardous area.

The operating organization shall brief the personnel on a regular basis. In order to make the control possible, briefing records shall be kept.

## 6 Preparation for Operation

6.1 Unpacking and visual inspection of the booster.

6.2 Unpack the equipment and wipe it with clean cloth.

6.3 Install the system at the workstation. Connect the booster unit with the control panel using a cable included. Connect the power cable.

6.4 The pneumatic connection (Fig. 3) shall be made only using compressor 1 with a constant outlet pressure of 0.7 MPa or lower.

6.5 It is preferable to connect extra dehydrating filter 2, pressure safety valve 3, and shut-off valve 4. In addition, gas cylinder 5 can be connected to the booster via reduction gearbox 6 with a pre-set pressure of 0.7 MPa or lower.

6.6 All connections shall be made only by qualified personnel.

6.7 The outlet line shall be connected with a stainless steel tube  $\varnothing 6 \times 1.5$  mm designed for the operating pressure no lower than the

booster outlet pressure. Also, if it is necessary to obtain purer media, the manufacturer can supply optionally extra filter 7, with a filtering element made of pressed ultrafine perchlorvinyl fibres (the filtering element is up to 6 mm thick). The air (gas) flow rate might decrease due to the use of filters.

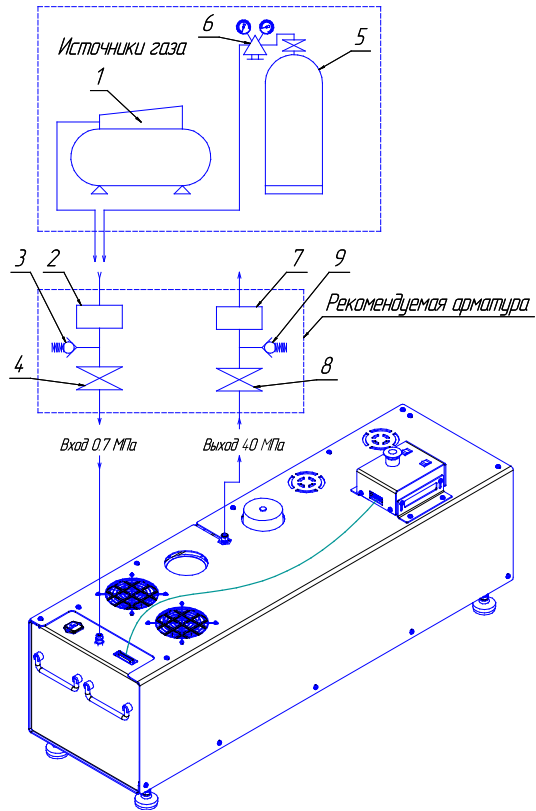


Рис. 3.

## **Attention**

All the instruments, devices, etc. to be connected shall meet the safety requirements, have documentation, be designed for the pressure generated by the booster, and be allowed for operation by the operating organization.

To avoid backstreaming of high-pressure gas through the booster to the inlet line during booster downtimes, isolation valves 8 and pressure safety valve 9 shall be installed in the outlet line. Gas backstreaming might result in a failure of the device!

In order to prevent the booster from overheating and a failure, do not cover vent holes on the housing.

## **7 Operation Procedure**

7.1 Make necessary mechanical connections and prepare the equipment being connected for operation. Check the system, considering the safety requirements.

1. Remove the personnel without permits to work from the hazardous area.
  2. Connect the booster to the mains.
  3. Power the booster on.
  4. Set the required pressure, on the basis of the electric-contact manometer, for the system being connected.
  5. Supply the gas pressure to the booster (at this, a portion of the inlet pressure passes through the booster into the system being connected).
  6. Press the Start/Stop button (the booster begins running).
  7. Once the required pressure is reached, the booster will maintain it (without exceeding the gas consumption).
- 7.2 Upon completion of the works,
1. Stop the booster (Start/Stop button).
  2. Close the gas supply to the booster.
  3. Release the gas pressure from the system connected and the booster.
  4. Power the booster off.
  5. Disconnect the booster from the supply mains.

## 8 Maintenance

8.1 In order to keep the booster in the good working order, daily and routine maintenance is required.

8.2 Daily maintenance shall include visual inspection and removal of dirt and dust with dry clean cloth.

8.3 Routine maintenance shall include works on lubrication of the booster assemblies and wear inspection of the device parts. Check that air filters of fans are clean; if not – clean or replace them with new ones.

8.3.1 To perform routine maintenance, remove the device cover (all works shall be carried out with the booster disconnected from the electric and pneumatic networks, with no pressure in the system).

8.3.2 Remove old grease from ball-and-screw units 1 (Fig. 4) and piston rods 2 with clean, soft cloth.

8.3.3 Apply new grease Shell Gadus s2 v220ac 2 on screws (to use LITHOL grease is allowed – 24 GOST 21150-87).

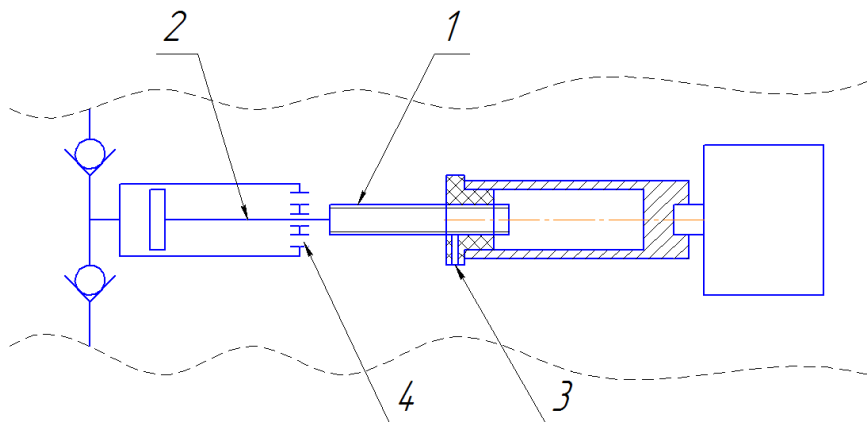


Рис. 4.

8.3.4 Use a suitable gun to inject the grease into holes 3 of the ball-and-screw unit's nuts.

8.3.5 Apply the grease on piston rods. Use a suitable gun to inject the grease into holes 4 intended for connecting the under-piston spaces of cylinders with the atmosphere. It is necessary to ensure that grease penetrates inside cylinders and the rod guides are lubricated.

8.3.6 Check the tightening of fastening elements.

8.4 Routine maintenance shall be performed as required, but no less than once every 3 months.

## 9 Storage

9.1 In laboratory conditions: clean the booster with clean cloth and cover it with a polyethylene cap.

9.2 In a storage room: before putting the booster into storage, wipe it with clean cloth, perform routine maintenance, and pack it in the original package (or a similar one). The booster shall be stored in a dry heated room at an air temperature no lower than +5 °C and relative humidity no higher than 80 %.

## 10 Troubleshooting

<b>Malfunction</b>	<b>Cause of the malfunction</b>	<b>Repair method</b>
The booster won't switch on	Mains voltage failure	Check the voltage
	A failure of electric equipment	Contact a specialist
	A fuse is blown	Replace the fuse
The system is leaky	Leak-tightness of connections is lost	Identify the place of leakage with soapy water and eliminate the leak
		Contact a specialist

## 11 Warranty Obligations

11.1 The Manufacturer guarantees booster operation, provided that the operating, storage, and transportation conditions are met.

11.2 The warranty service life is 18 months.

11.3 The warranty storage life is 6 months.

11.4 The average service life is at least 8 years.

## 12 Claim Details

In case of a failure, prepare a certificate of required repair and submit it to the following address: "Alfapascal" LLC, 36, 2nd Paveletskaya, Chelyabinsk, 454047, Russia, phone: +7 (351) 725-74-50, e-mail: q@alfapascal.ru

### 13 Acceptance Certificate

The electro-pneumatic pressure booster K-450 Serial Number \_\_\_\_\_  
complies with engineering documentation KD AP.055.000.000 and is  
deemed to be suitable for operation.

Date of issue \_\_\_\_\_

Responsible person \_\_\_\_\_  
Signature Surname

LS

### 14 Packing Certificate

The electro-pneumatic pressure booster K-450 Serial Number \_\_\_\_\_  
was packed by “Alfapascal” LLC in compliance with engineering  
documentation KD AP.055.000.000.

Date of packing \_\_\_\_\_

Responsible person \_\_\_\_\_  
Signature Surname

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#### Note

The Manufacturer reserves the right to make changes to the  
booster design without prior notice.