

PISTON INJECTOR

USER MANUAL

214.4.464.020UM

Edition 14.07.2024

Instructions marked with this box must be followed to prevent personal injury or equipment damage.

In the same way, information that you should pay special attention to is highlighted.



This symbol warns of the danger of burns.



The instructions highlighted with this symbol must be followed to avoid electric shock.

Table of contents

1 Description and operation 5

1.1 Basic data 5

1.2 Purpose 5

1.3 Specifications and delivery set 5

1.4 Design and operation 6

2 Intended use 8

2.1 Safety provisions 8

2.2 Preparation for operation and operation order 8

3 Maintenance 13

3.1 Current maintenance 14

3.1.1 Inspection of injector condition 14
3.1.2 Evaluation of detector signal level 14
3.1.3 Evaluation of pneumatic actuator operation 16
3.1.4 Visual inspection of seals condition in sample lines 17

3.2 Periodic maintenance 18

3.2.1 Replacing the piston rod seal in the injector 18
3.2.2 Maintenance of the pneumatic actuator 22
3.2.3 Flushing the injector. General recommendations 23

4 Transportation and storage 24

5 Claims 24

1 Description and operation

1.1 Basic data

This manual contains information on the operation of the Piston injector (hereinafter referred to as the Injector). The Injector is manufactured by JSC SDO Chromatec.

Инжектор выпускается в исполнениях:

- 214.4.464.020-04.00 – sample volume 0.25 µL;
- 214.4.464.020-04.01 – sample volume 0.5 µL;
- 214.4.464.020-04.02 – sample volume 1.2 µL;
- 214.4.464.020-04.03 – sample volume 2.0 µL;
- 214.4.464.020-05.00 – sample volume 0.25 µL. Inert treatment Incomsteel®100;
- 214.4.464.020-05.01 – sample volume 0.5 µL. Inert treatment Incomsteel®100;
- 214.4.464.020-05.02 – sample volume 1.2 µL. Inert treatment Incomsteel®100;
- 214.4.464.020-05.03 – sample volume 2.0 µL. Inert treatment Incomsteel®100.

Sample volume is determined by the size of the groove on the rod of the piston.

In versions 214.4.464.020-05.00 (.01; .02; .03), the injector stainless steel parts in contact with the analyzed sample are protected with a sulfinert coating Incomsteel®100, trademark of REC Incomsystem.

Materials in contact with the sample: stainless steel, PTFE (fluoroplastic), PEEK (polyetheretherketone).

The injector may contain parts that are not fundamentally modernized, in accordance with new developments. Or may be subject to minor, unprincipled modifications that do not affect the technical characteristics and safety requirements, not reflected in this document.

1.2 Purpose

The Piston injector is designed to automatically introduce a constant amount of a liquid sample (sample) into the separation column of a gas chromatograph (hereinafter, the GC)) with its preliminary evaporation in a heated chamber.

Before use, you should carefully read this manual and the operating instructions for the chromatograph.

1.3 Specifications and delivery set

Specifications and delivery set are specified in the passport for the Injector 214.4.464.020-04PS or 214.4.464.020-05PS.

1.4 Design and operation

The overview of the injector is shown in Figure 1.

The injector contains: a pneumatic actuator (1), a sampling line (2), a carrier gas supply line (3), an evaporation chamber (4), a cooling line for the sampling area (5).

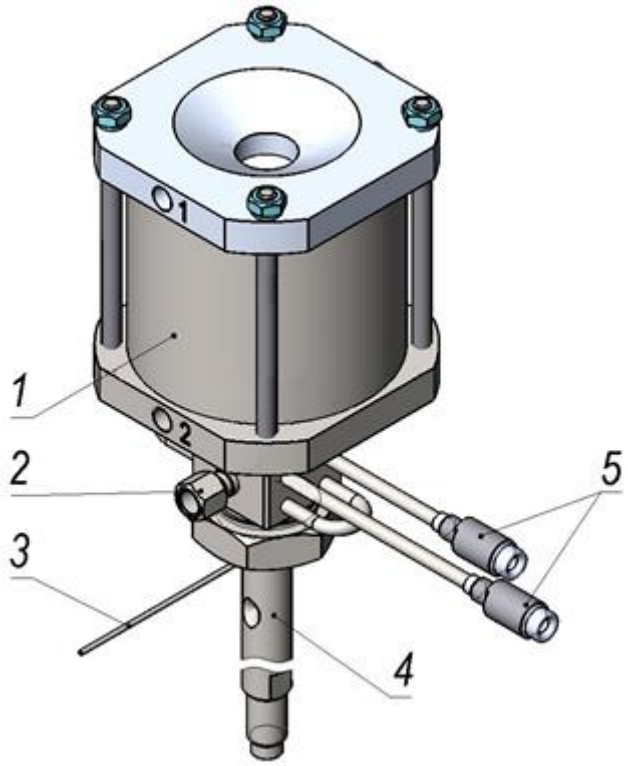
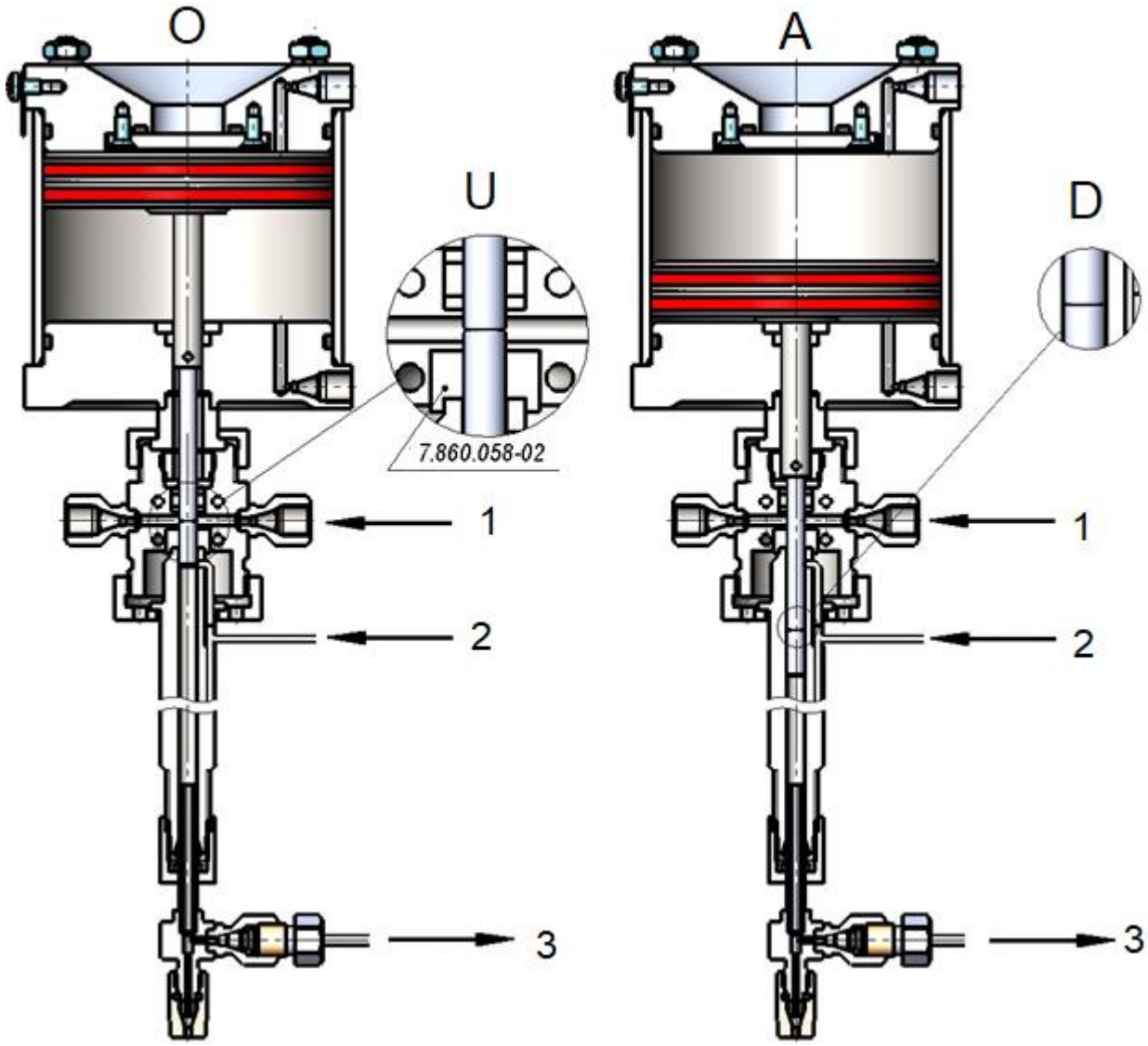


Figure 1 – Piston injector. Overview

The injector design is shown in Figure 2.



1 – sample; 2 – carrier gas; 3 – Split vent (sample split flow).

O – position of the injector “sampling” (“O” – for Russian made version), A – position of the injector “Analysis”; U – piston rod in the upper position, D – rod in the lower position; 7.860.058-02 – sleeve sealing the rod.

Figure 2 – Design of the injector

The injector works as follows.

In the sampling position “O”, the sample volume is filled with sample. The sampling area is constantly cooled to prevent degassing of the sample. The sample volume is structurally made in the form of a groove on the rod. The rod moves up and down using a pneumatic actuator drive. A pneumatic actuator moves the sample groove down into the evaporation chamber, where the sample is evaporated and transferred by the carrier gas to the chromatographic column.

When working with split flow (injection into capillary column), the flow rate corresponding to the required split flow rate is set through the “Split vent” line. When operating without split of the flow, the “Split vent” line should be plugged.

2 Intended use

2.1 Safety provisions

Sources of danger in the injector are:

- high pressure of the injected sample;
- gas pressure to control the pneumatic actuator;
- heated parts of the injector.

Follow the instructions in Section 2 of this manual to keep safely operating the injector and prevent injury during operation.



Parts of the injector design may be at high temperatures.



Do not operate the chromatograph with the top cover open as this may result in burns or electric shock.

При монтаже, установке, проверке и обслуживании инжектора должны соблюдаться действующие “Rules of electrical equipment design” (PUE), “Rules of operation of electrical equipment” (PTEEP), "Inter-industry rules on labor protection (safety rules) during the operation of electrical equipment", "Rules for the design and safe operation of pressure vessels".

Only persons who have studied this manual and passed a workplace skills test are allowed to work with the injector.

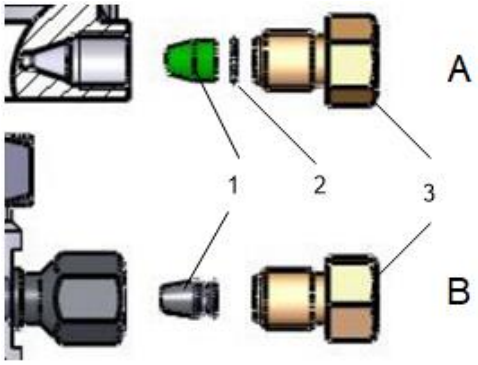
When working with flammable, harmful and aggressive substances, fire safety measures must be observed in accordance with GOST 12.1.004-91, as well as the measures provided for in special instructions developed by the customer (in accordance with the specifics of the substances in use) based on GOST 12.1.007-76.

2.2 Preparation for operation and operation order

The injector is inserted into the heating panel 214.5.863.198, pre-installed on the GC platform and connected to the heating control and temperature control circuits of the GC.

The pneumatic actuator of the injector is controlled, setting and maintaining the required temperature is carried out by the chromatograph control module.

Tubing connections to the sample line and pneumatic actuator are shown in Figure 3.



A – connecting gas to pneumatic actuator, B – connecting sample line

1 – ferrule, 2 – washer, 3 – nut

Figure 3 – Tubing connection

The sampling line tubes must be connected with metal ferrules. Pneumatic actuator gas tubes must be connected with rubber ferrules.

Connection of gas line to control pneumatic actuator (Figure 3A).

For connecting gas line to the pneumatic actuator use rubber ferrule 1 (214.8.658.053), washer 2 (A 2.32.L63 GOST 10450-78) and brass nut 3 (214.8.930.161).

The nuts with rubber ferrules are tightened with force “by hand”, with further wrench turned at 60 degrees. Insert the ends of the tubes up to the stop and hold this position while tightening.

Connection of sampling line (Figure 3B).

For sampling line, use stainless steel ferrule 1 (214.8.658.039-01) and brass nut 3 (214.8.930.161).

Tightening the nuts for metal ferrules is done by hand, with further 3/4 turn (270 degrees) with a wrench. Insert the ends of the tubes up to the stop and hold this position while tightening.

Requirements for gas lines and tubing connections are described in more details in the User Manual. Chromatograph. Installation.

The sample outlet line from the injector must be led into a disposal container or under an exhaust hood.

Connection of cooling water.

Adapter 214.6.115.277 for connection to the injector cooling line is shown in Figure 4.

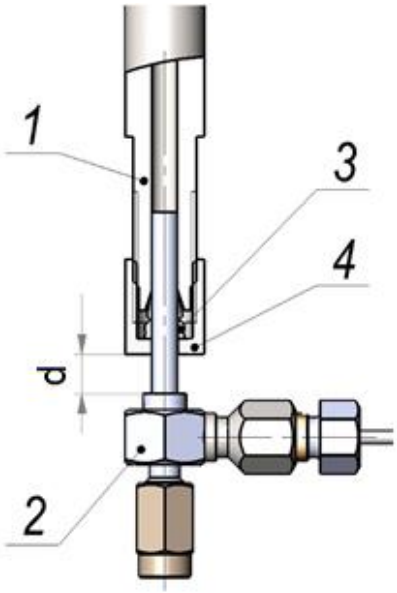
Water is supplied to the injector cooling line and water is drained through a PVC tube with an internal diameter of 8 mm connected to the adapter.



Figure 4 – Installed adapter 6.115.277 for connecting cooling tubes

Connection of split tee in GC oven.

Once the injector into the heating panel of the GC, you should connect a tee for further connection the capillary column and split vent line (Figure 5). The tee and connection elements are included in the injector shipping kit (when the injector is supplied with the GC, the tee is pre-installed in the GC oven at the manufacturer).



1 – evaporation chamber; 2 – tee 6.453.131-01 (-05); 3 – ferrule 8.658.038-03; 4 – nut 8.930.284; d = 5 mm

Figure 5 – Tee installation

When the injector is supplied as part of the GC, installation of the injector on the GC and connection of electrical, gas and hydraulic lines to it are carried out at the manufacturer. The supply of water (or refrigerant when using a minichiller) to the chromatograph for cooling the injector is provided by the customer.

If the customer has specialists who have been duly trained at Chromatec, installation and connection of the injector can be carried out on site.

After connecting the gas and hydraulic lines, check the connections for leaks according to the instructions given in the User manual for the chromatograph.

When connecting the injector to the sample source, it is important to minimize total volume of the sampling line and avoid the appearance of dead volumes in the connectors.

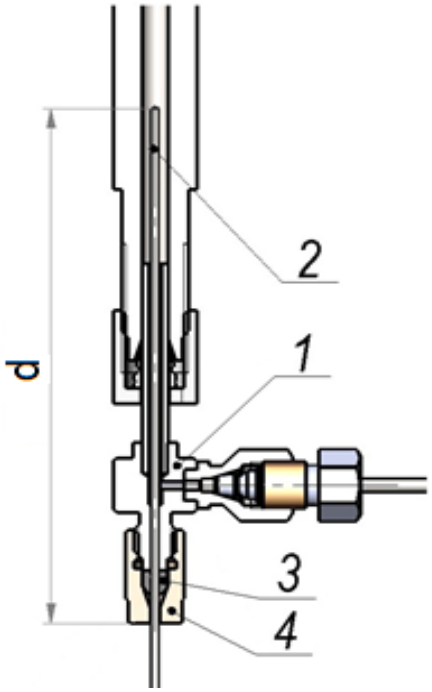
If there is no water in the cooling line of the sampling zone, do not allow exceeding 200 °C in the injector.

The programmable operating parameters for the injector are:

- Number of injections;
- Temperature of injector;
- Sampling time.

If the piston rod (with a sample volume) in the injector doesn't work properly or damaged, it can be replaced with a serviceable piston rod (with the same sample volume) (from the shipping kit) or a piston rod with other volume size (ordered and supplied separately). The replacement procedure can be performed by a representative of the manufacturer or a customer specialist trained at Chromatec.

The capillary column (metal capillary) is sealed in the tee being connected to the injector in the GC oven. The installation depth of the column (the distance from the end of the column to the nut) into the evaporation chamber should be 65 – 70 mm (see Figure 6), it is important that the end of the column does not touch the walls of the evaporation chamber.



1 – Tee 6.453.131-01 (-05); 2 – capillary column; 3 – graphite ferrule (Ferrule 0,8 mm ID Graphite); 4 – nut 8.930.339; d = 65-70 mm

Figure 6 – Installation of capillary column

Procedure: capillary column installation to the injector

- Put on the nut 8.930.339 and the ferrule (e.g. #072626 SGE, with its cone into nut) on the end of column to be installed into evaporation chamber of the injector;
- Cut column end at (5–20 mm) to avoid graphite ingress into column. The cut should be flat without chips and scratches.
- Wipe cut end of the column with lint-free tissue wetted in alcohol in order to remove dust and other contaminants;
- Locate nut and ferrule at required distance (d) from the column end (Figure 6). For convenience, use column measuring tool 6.236.249 from shipping kit. Install column end into measuring tool and pre-swage the nut in the tool fingertight. Align column end at required distance (d). Then holding column position, screw nut by wrenches at about 60 – 90 degrees so that column is fixed tightly by ferrule. Use wrenches of 7 and 8 size for swaging in tool.
- Then release nut.

Analyzes should be carried out in accordance with the measurement procedure (MVI) and operational documentation for the chromatograph

3 Maintenance

There are two types of maintenance for the injector:

- Current maintenance. Carried out based on the results of monitoring the condition of the injector, if a malfunction is suspected, by the operator and personnel who have studied this operating manual and are working with the injector;
- Periodic maintenance. Conducted according to regulations. Performed by a representative of the manufacturer or User's specialist trained at Chromatec.

The requirement for periodic maintenance by a qualified service engineer applies exclusively to work carried out during the warranty period.

Maintenance work carried out after the expiration of the warranty period completely becomes the responsibility of the User, unless otherwise specified in the maintenance contract.

Maintenance intervals may vary depending on:

- on the intensity of the chromatograph running;
- type of samples to be injected.

For more intensive work, the time between periodic maintenance activities must be shortened accordingly.

Except eliminating possible leaks of carrier gas or sample, and flushing the injector channels, the User should not independently eliminate possible malfunctions. If detected, their elimination should be carried out by a representative of the manufacturer or a User's specialist trained at Chromatec.

During any maintenance work on the injector, it is necessary to ensure that the chromatograph is turned off, the sample supply lines and pneumatic drive control gas lines are closed, and the residual sample pressure in the injector is released. The sample outlet line from the injector must be led into a disposal container or under an exhaust hood.

3.1 Current maintenance

When operating the injector, it is necessary to monitor:

- Condition of the injector;
- Signal level of the detector;
- Pneumatic actuator proper operation;
- Seals in sample lines.

The recommended maintenance frequency is based on 8 test runs per work shift (work shift duration is eight hours).

3.1.1 Inspection of injector condition

Table 3.1 – Procedures of inspection of injector condition

Procedures	**Periodicity**
Evaluation of detector signal level	Daily
Evaluation of pneumatic actuator operation	Daily
Visual check of seals condition in sample lines	Daily

3.1.2 Evaluation of detector signal level

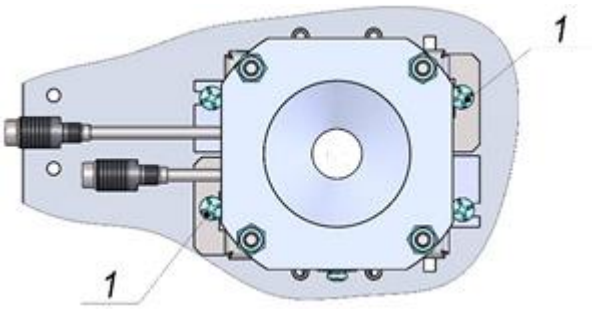
The criterion for a malfunction is that FID baseline level exceeds 1000 mV (for the TCD detector – when it goes off scale).

The maximum operating pressure of the sample in the injector sampling line can reach 10.1 MPa (100 Bar), and the pressure of the carrier gas is significantly lower. Due to such difference of pressure rate, a significant increase in detector signal indicates the presence of a leak of the analyzed sample into the gas lines of the GC. In this case, to prevent failure of the GC, it is necessary to immediately relieve the pressure in the injector sample input lines.

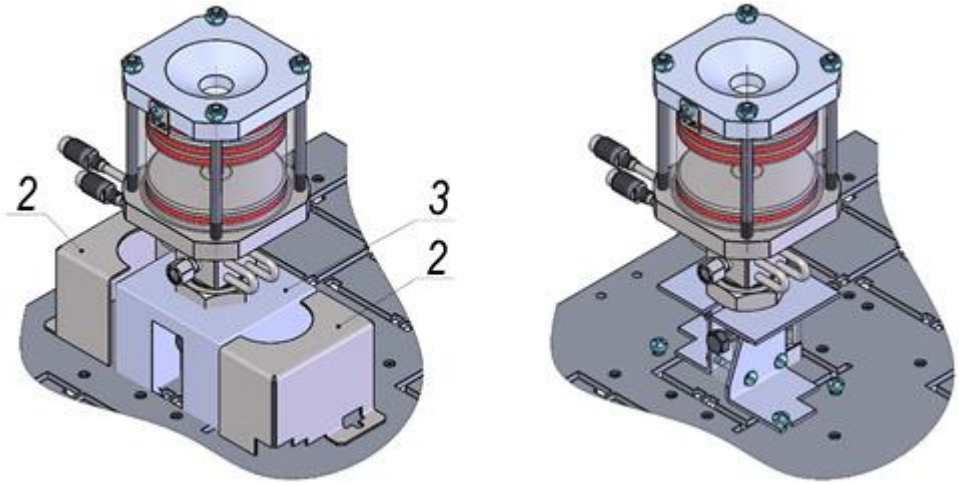
Procedures:

Based on the results of assessing the signal level of the detector, carry out routine maintenance. For this it is necessary:

- remove the injector casing 2 and insulation 3, having first loosened the screws 1 securing the casing (Figures 7a, 7b);



a)

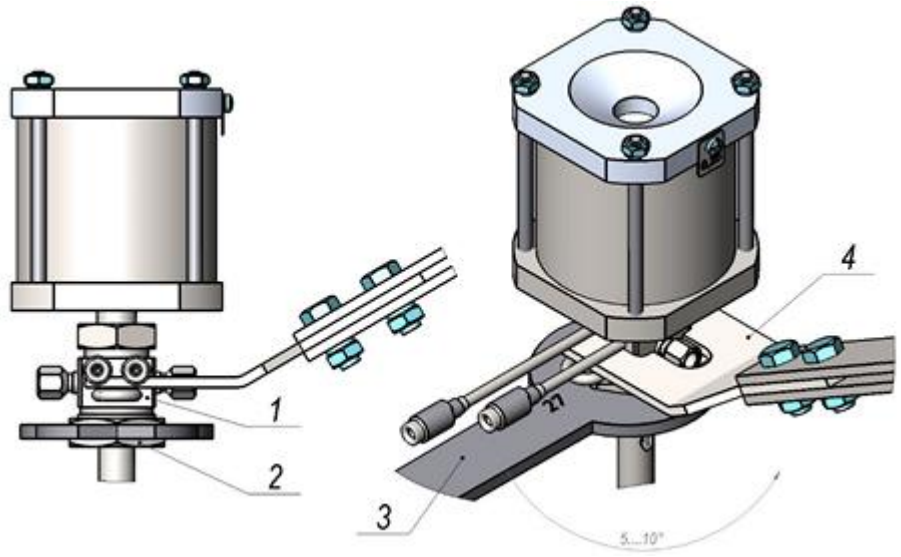


b)

1 – screws fixing the casing; 2 – casing 8.634.692; 3 – insulation.

Figure 7 – Casing removal

- then, holding the injector body with a special wrench, tighten clockwise the lower nut with a 27 wrench (both wrenches are from the shipping kit) by 5 – 10 degrees (figure 8);



1 – injector body; 2 – lower nut; 3 – wrench 22x27; 4 – wrench 6.395.008

Figure 8 – Tightening lower nut of the injector

- turn on the GC and repeat the signal assessment. If the result is positive – the signal level decreases, install the casing and insulation in place and continue working;
- if the result is unsatisfactory, repeat the steps to tighten the nut.

If tightening the seal twice does not reduce the signal of the detector, then it is necessary to replace this seal with a new one from the shipping kit (see periodic maintenance section).

3.1.3 Evaluation of pneumatic actuator operation

The failure criteria for pneumatic actuator operation are:

- there are no peaks in the chromatogram when starting the analysis (no sample injected);
- there is no piston movement when switching between “sampling and analysis” positions.

Procedures:

If incorrect operation of the pneumatic actuator is detected, you should:

- check the tightness of all lines from the control gas source to the pneumatic drive ports, if necessary, tighten or replace the seals;
- check the operation of the control valve (according to the gas diagram);
- increase the output pressure at the control gas source up to the maximum permissible values (0.7 MPa).

Usually, these procedures are enough to eliminate malfunctions of the pneumatic actuator.

Maintenance of the injector and pneumatic actuator is described in more detail in the periodic maintenance section.

3.1.4 Visual inspection of seals condition in sample lines

If leaks are detected in the sample input lines, close the valve on the sample vessel and relieve pressure in the sample input lines.

Procedures:

Based on the results of a visual inspection of the seals condition in the sample input lines, tighten the seals of the gas lines until the leak is eliminated. If it is impossible to eliminate the leak, replace the sealing sleeve following the instructions in the relevant sections of the User manual.

3.2 Periodic maintenance

Periodic maintenance includes the operations listed in Table 3.2.

Table 3.2 – Injector periodic maintenance procedures

Procedures	Periodicity
Replacing injector rod seals	Based on the results of assessing the signal level of the detector. Recommended replacement interval 3000 tests.
Pneumatic actuator maintenance	Annually
Injector flushing	Annually

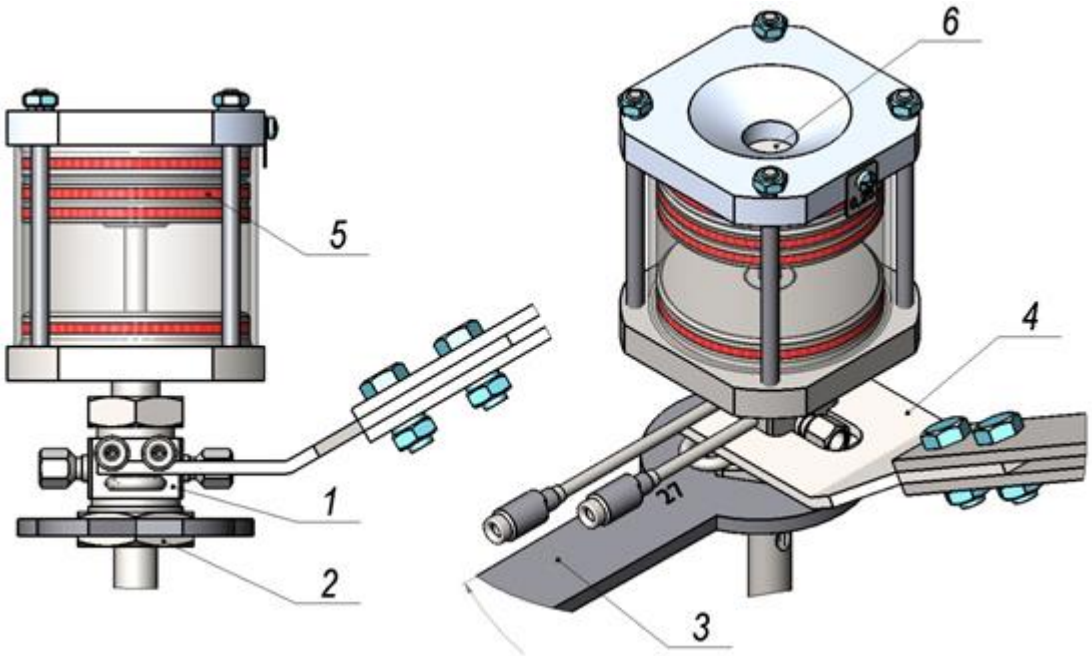
During any maintenance work on the injector, it is necessary to ensure that the GC is turned off, the sample supply lines and pneumatic actuator control gas lines are closed, and the residual sample pressure in the injector is released. The sample outlet line from the injector must be led into a disposal container or under an exhaust hood.

3.2.1 Replacing the piston rod seal in the injector

If during current maintenance it was not possible to restore the tightness of the injector by simply tightening the seal nut, then it is necessary to replace the rod sealing elements (sleeve 7.860.058-02) from the shipping kit with new ones.

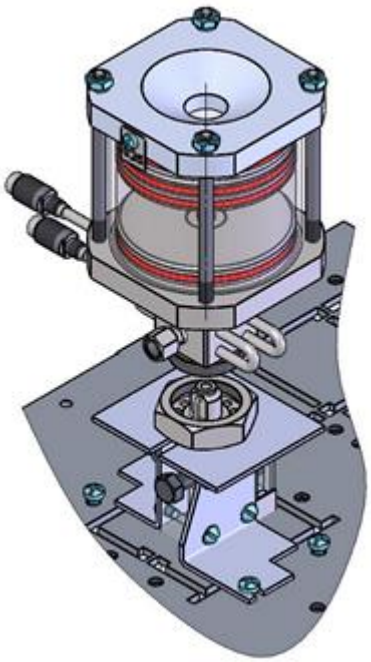
Procedure:

- move the injector piston to the “Sampling” position (O). Check using the inspection window of the top cover of the pneumatic actuator (Figure 9a);
- remove the injector casing, having first loosened the screws securing the casings (Figures 7a, 7b);
- disconnect the pneumatic actuator control tubes, cooling lines and sample lines from the injector;
- holding the injector body with a special wrench, loosen and then completely unscrew the lower nut of the injector using a 27 wrench (Figure 9a);
- remove the upper part of the injector (pneumatic actuator with sampling unit) (Figure 9b). When removing, be careful not to damage the injector piston rod;



a)

a)



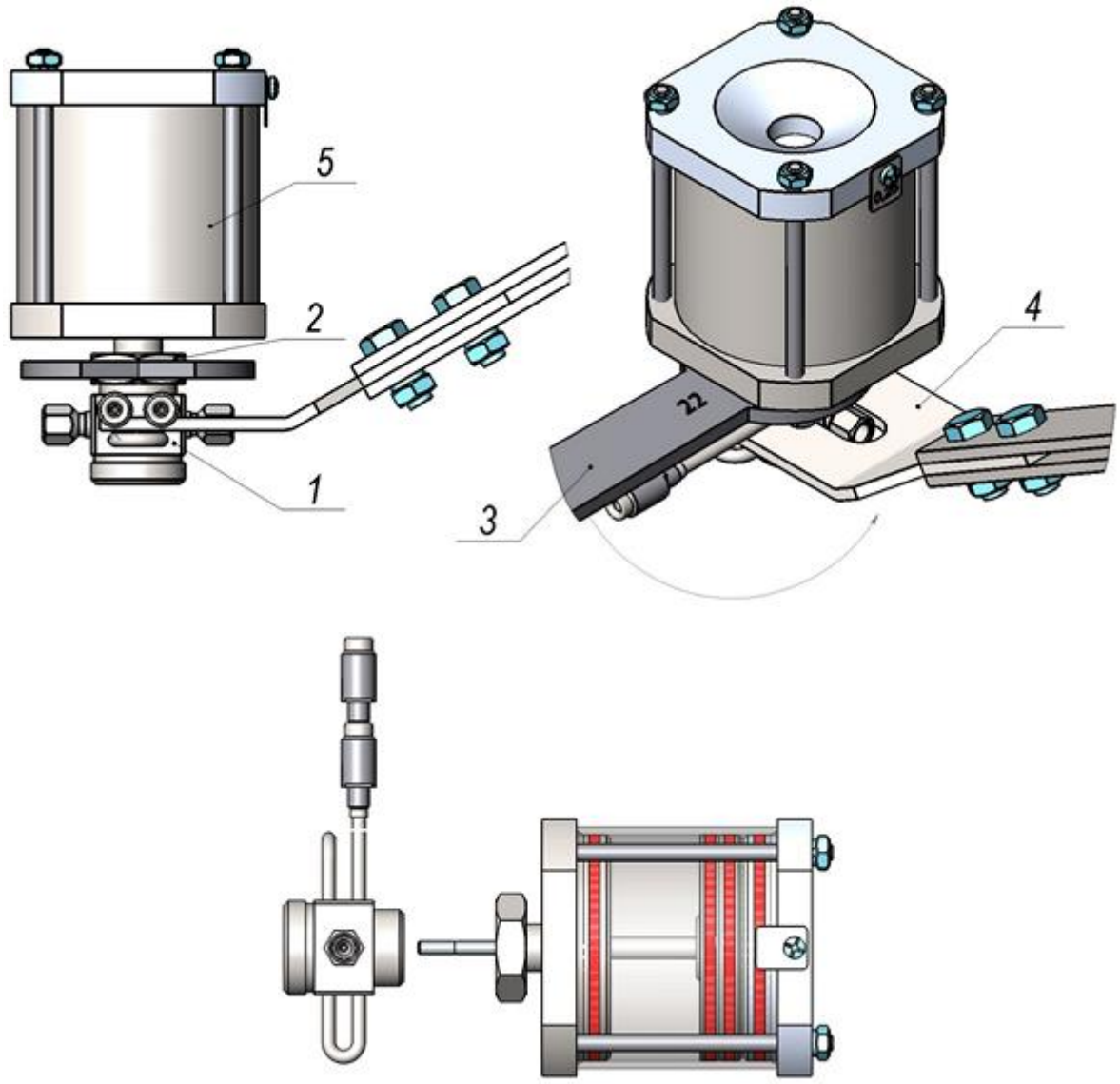
b)

1 – injector body; 2 – lower nut; 3 – wrench 22x27; 4 – wrench 6.395.008;

5 – injector piston rod (Sampling position); 6 – inspection window.

Figure 9 – Injector disassembling

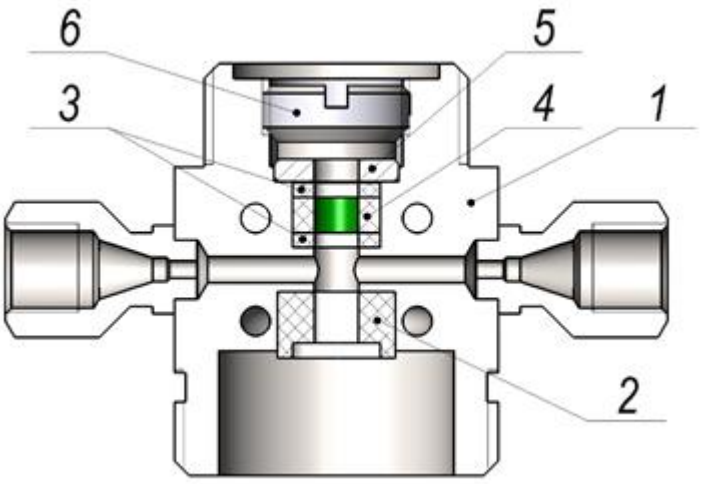
- holding the injector body with a special wrench, loosen and then completely unscrew the top nut using a 22mm wrench (included in the shipping kit) (Figure 10);
- carefully disconnect the sampling unit and the pneumatic actuator with the piston (Figure 10);



1 – injector body (sampling unit); 2 – top nut; 3 – wrench 22x27; 4 – wrench 6.395.008; 5 – pneumatic actuator with piston.

Figure 10 – Injector disassembling (continuation)

- remove the worn sealing sleeve 2 from the lower part of the sampling unit housing and replace it with a new one from the shipping kit, having previously inspected the housing for dirt and damage (Figure 11). Contaminations must be removed and there should be no damage;
- if you suspect leaks through the upper seal, disassemble it and carry out an inspection. To do this, unscrew screw 6, remove washer 5 and sealing O-rings pos. 3 and 4. There should be no cracks, tears or other defects on the surface of the O-rings. If necessary, replace defective O-rings with new ones from the shipping kit. Reassemble the seal (Figure 11);



1 – housing 6.113.187; 2 – sleeve 7.860.058-02; 3 – O-ring 8.683.080 (2 pcs); 4 – O-ring 8.685.085-01 (003-006-19); 5 – washer 8.940.022; 6 – screw 8.914.038

Figure 11 – Sampling unit

- inspect the rod with the sampling groove; they should not have visible damage (scratches) or traces of contamination. If necessary, it is recommended to wipe the rod with a soft, lint-free cloth with a solvent similar to the sample being analyzed;
- carefully assemble the housing of the sampling unit with a pneumatic actuator, and tighten the nut to 22 using the necessary wrenches;
- check the upper part of the injector evaporation chamber for dirt and damage. If necessary, remove contamination; there should be no damage;
- install the assembled sampling unit with a pneumatic actuator onto the evaporation chamber, and screw the lower nut until it stops with hand force, then using a special wrench and a 27 key, tighten the sealing nut at another 30 degrees;
- connect the pneumatic actuator control tubes, cooling lines, and sample lines according to the flow diagram;
- install protective covers and insulation.

3.2.2 Maintenance of the pneumatic actuator

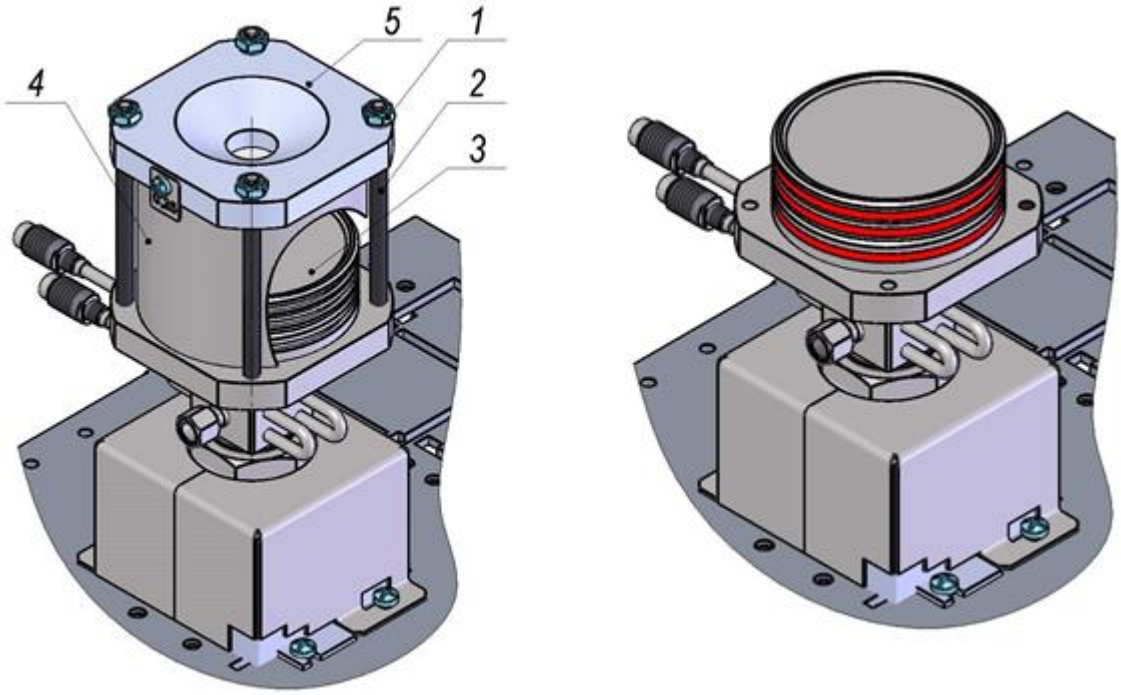
Maintenance of a pneumatic actuator involves mainly of lubricating the moving parts of the actuator.

Before servicing the pneumatic actuator, move the injector piston rod to the analysis position.

When servicing the pneumatic drive, neo need to remove the upper part of the injector.

Procedures (refer to Figure 12):

- unscrew nuts pos.1, securing the top cover of the pneumatic actuator;
- for convenience, unscrew mounting pins pos.2;
- remove cylinder 4 together with the top cover 5;
- lubricate the inner surface of the cylinder, the outer surface of the piston rings, and place a small amount of CIATIM-221 lubricant into the groove between the sealing rings;
- assemble the pneumatic actuator in reverse order.



1 – nut M4 (4 pcs.); 2 – pin 8.927.032-01 (4 pcs.); 3 – piston rod ("Analysis" position);

4 – cylinder 8.626.938; 5 – cover 6.172.042.

Figure 12 – Disassembling a pneumatic actuator

3.2.3 Flushing the injector. General recommendations

It is recommended to flush the injector channels, tubes and sampling groove in the following cases:

- in case of contamination by components of the analyzed sample;
- when the analyzed sample enters the gas channels of the injector;
- if it is impossible to get rid of residual ghost peaks of components (carryover effect);
- when preserving the injector

Before washing the channels, you should make sure that ghost peaks are the result of contamination of the device channels and are not present in the other GC channels or in the analyzed sample.

When washing, consider the following recommendations:

- it is recommended to flush only those sections of the gas lines where sample components may enter;
- Gas line assemblies should not be flushed. Before flushing, it is necessary to completely disassemble the gas lines and wash each section (pipeline, tap channel, etc.) separately;
- choose the right solvent, guided by the following requirements. The solvent should dissolve the expected contaminant components well, be inert to the material of the flushed channels, and be easily removed and purged with a carrier gas. Preferred solvents are ethanol, acetone, hexane;
- after washing, thoroughly blow out and dry the channels with carrier gas.

4 Transportation and storage

At transportation the package shall by protected from precipitations.

Transportation and storage under conditions 5 according to GOST 15150-69:

- Ambient temperature from minus 50 to plus 50 °C;
- Relative humidity up to 98 % at 35 °C;
- Air shall be free of dust and any aggressive admixtures.

Maintain the packaging with the product for at least 4 hours under operating conditions after transportation or storage at subzero temperatures.

5 Claims

In case of detector failure within warranty period it is necessary to:

- draw up a technically reasoned act of defects concerning its incompliance with technical specifications indicated in Passport;
- make abstracts from section "Acceptance certificate";
- indicate the date, organization or person who carried out the commissioning;
- specify provided maintenance procedures.

It’s allowable sending copies of sections "Acceptance certificate" and "Maintenance registration" witnessed by head of customer’s organization.

The claim should be sent to the address of manufacturer:
Address: 94 Stroiteley Str., Yoshkar-Ola, Russian Federation 424000

or 424000, Yoshkar-Ola, Main Post Office, PO Box 84.

Or at the fax of the service department: +7(8362) 68-59-19, 68-59-87.

E-mail: 19@chromatec.ru, service@chromatec.ru, 32@chromatec.ru