

HEADSPACE SAMPLER

MODEL DRP-4

USER MANUAL
214.4.464.022-04UM

PRODUCTS P/N: 400-2111, 400-2112

Rev. 26.12.2023

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1 Overview

1.1 Application

The headspace sampler, model DRP-4 (hereinafter – the DRP-4), serves to inject volatile samples into chromatograph using static headspace analysis method. The DRP-4 is used together with the following gas chromatographs (GC): Crystal 2000M, Chromatec-Crystal 5000 and Chromatec-Crystal 9000. Though, it can also be used with chromatographs produced by third party manufacturers.

The DRP-4 is available in two versions: 214.4.464.022-04.00 comes with 1 ml syringe unit 214.4.464.099 and 214.4.464.022-04.01 with 2.5 ml syringe unit 214.4.464.109.

Operation of the DRP-4 is carried out in closed laboratory premises if combustible gases and highly inflammable liquids may be present in volume insufficient for creation of explosive– or fire-hazardous mix. Environmental conditions:

- air temperature from 10 to 35 °C;
- relative humidity not more than 80 %;
- Atmospheric pressure from 84 to 107 kPa (from 630 to 800 mm Hg);
- Impurity content in premises air shall be normal, regulated by GOST 12.1.005.

As for climate performance, the DRP-4 is referred to cold-temperate category 4.2 according to GOST 15150-69.

The DRP-4 should be connected to 220^{+22}_{-33} VAC, 50 ± 1 Hz power mains.

Instructions marked by this box are necessary for carrying out in order to avoid injuries sustaining at working with DRP-4and to avoid DRP-4damage.

1.2 Technical specifications and delivery set

Technical specifications and delivery set as per DRP-4 Passport 214.4.464.022-04PS.

1.3 DRP-4 design

The DRP-4 consists of the following main functional units:

- Syringe unit with purging tube and syringe;
- Thermostat for syringe;
- Syringe purging valve;
- Vial oven with orbital shaker;
- DRP-4 control unit.

DRP-4 overview (Figure 1.1):

Syringe unit 1 is used to select and inject required sample volume with pre-set temperature. The syringe unit is housed in the thermostat (2) and should only be taken out for a short time (max. 20 secs) to draw the sample from the vial and inject it into the GC inlet.

Keyboard and 4-4-line LCD will display the status and configuration parameters of the DRP-4.

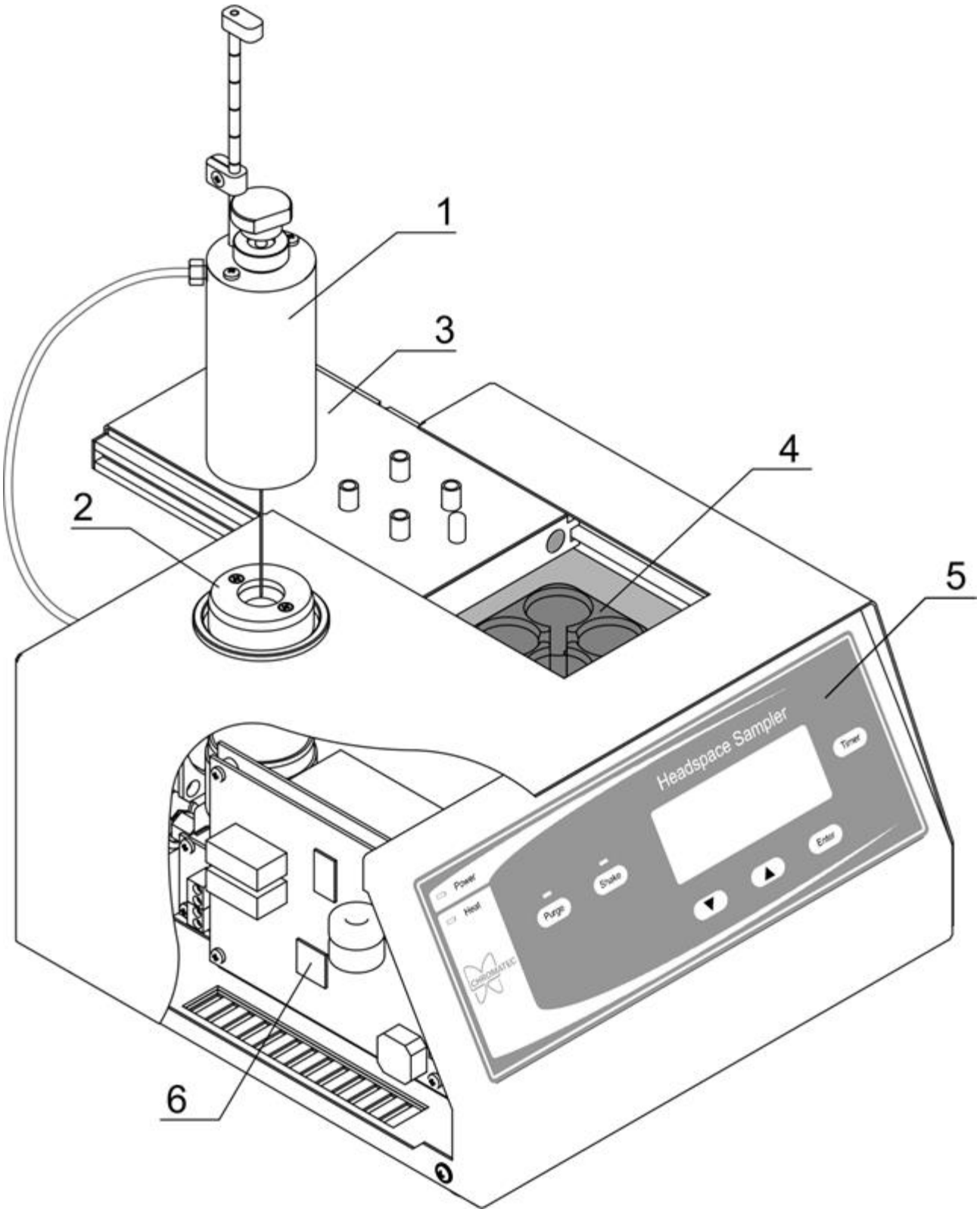
The control unit (6) is used to manage the DRP-4 operation. It includes the power unit and controller board.

Syringe thermostat (2) maintains the syringe unit (1) at the pre-set temperature.

Vial oven (4) enables the incubation of the sample vials to the pre-set temperature. The thermostat also features an orbital shaking function.

Slide back the oven cover (3) to install the vials into the oven (4) or to remove them (Figure 1.1). Keep the cover closed while incubating samples and drawing sample with the syringe.

Up to 4 vials can be placed into the oven (4).



1 – Syringe unit; 2 – Syringe thermostat; 3 – Cover; 4 – Vial oven; 5 – Keyboard and display; 6 – Control unit.

Figure 1.1 – DRP-4 Overview

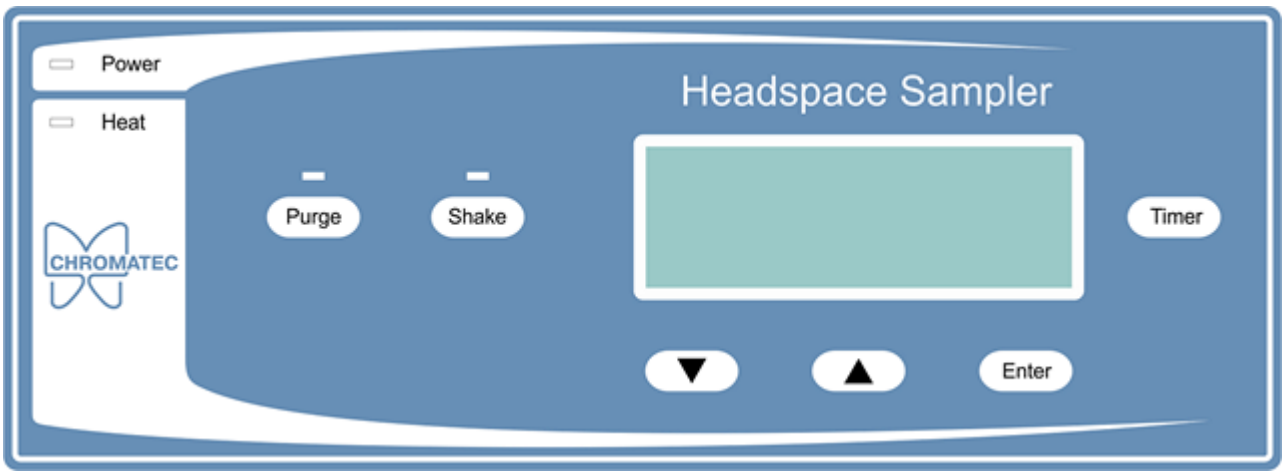


Figure 1.2 – Keyboard and display

When using 10 or 15 ml vials, inserts are needed in the oven (4) vial positions, 8.220.308 (for 15 ml vial) or 8.220.308-01 (for 10 ml vial).

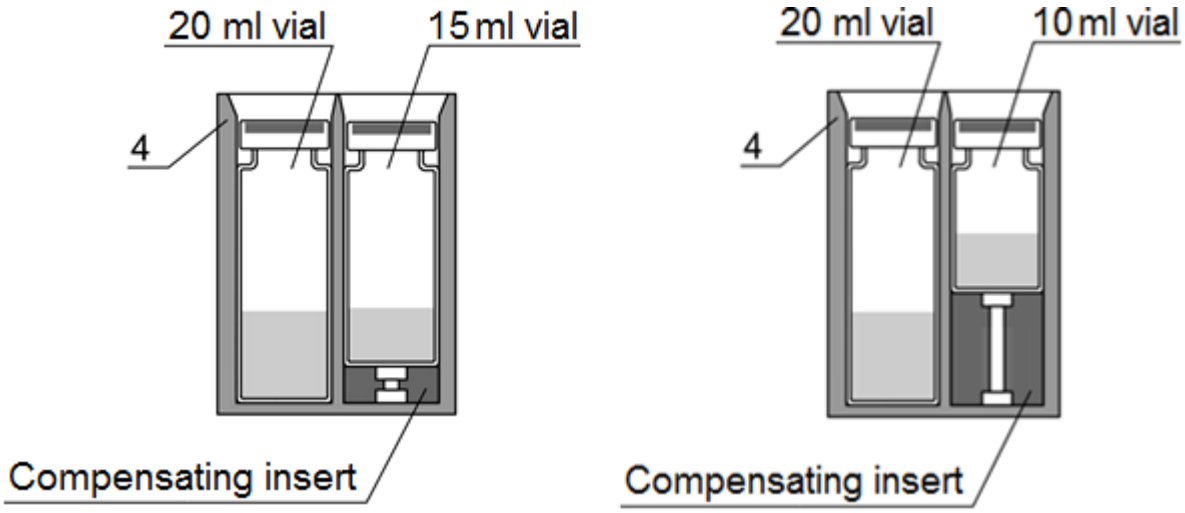


Figure 1.2 – Vial seating in the vial oven

Syringe unit 1 (Figure 1.1) is used to draw sample from the vial and inject it into the GC inlet. The main component of the unit (4.464.099) is the gas-tight syringe, SGE-1.0 ml (P/N 008131), with an adapter for purging the syringe and needle of sample residue.

The syringe unit 4.464.109 has a similar design to syringe unit 4.464.099 but is equipped with a larger volume syringe – SGE-2.5 ml (P/N 008631).

The syringe plunger has three possible fixed positions:

- Lower, when the plunger is completely pushed into the syringe;
- Intermediate, to select the required sample volume up to the adjustable stop;
- Upper, by a slightly rotating along its axis, to purge the syringe. (Figure 1.3).

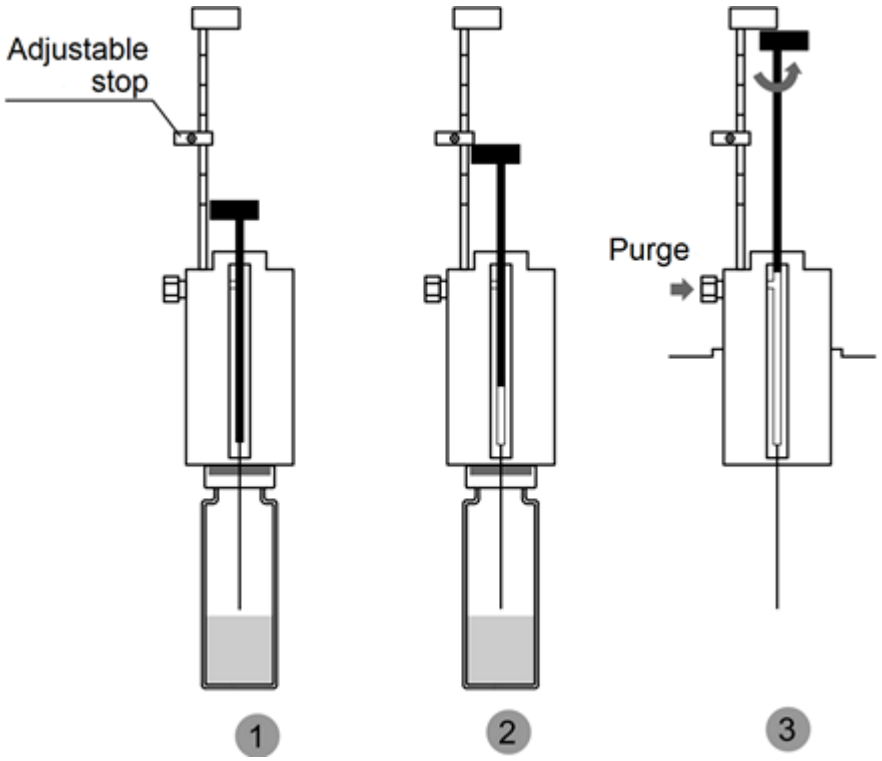
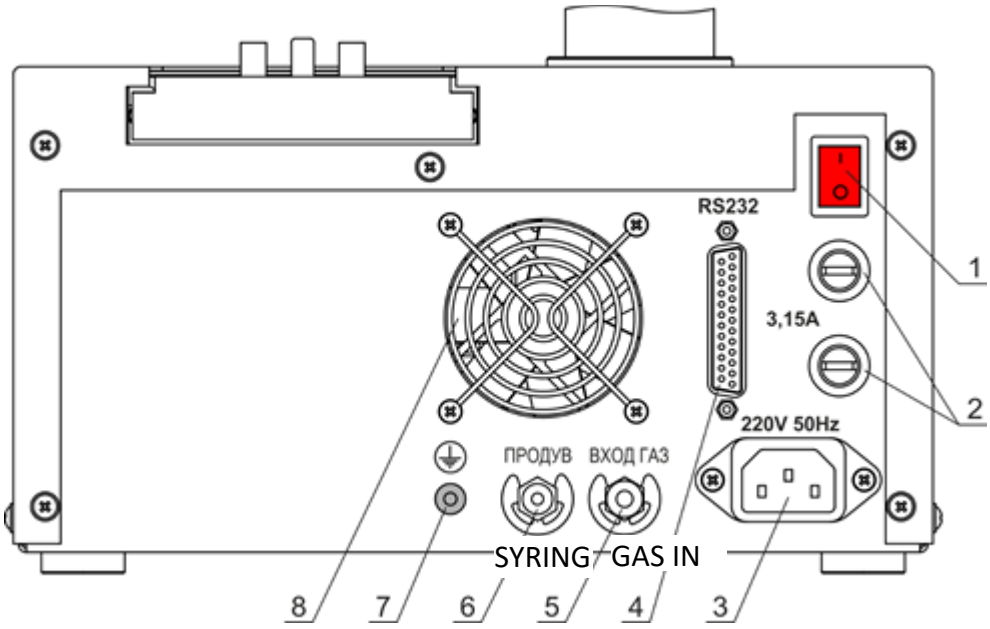


Figure 1.3 – syringe plunger positions

Handle the syringe needle with care when moving the syringe unit.

The manufacturer is not responsible for any damage to the syringe or plunger caused by the operator.

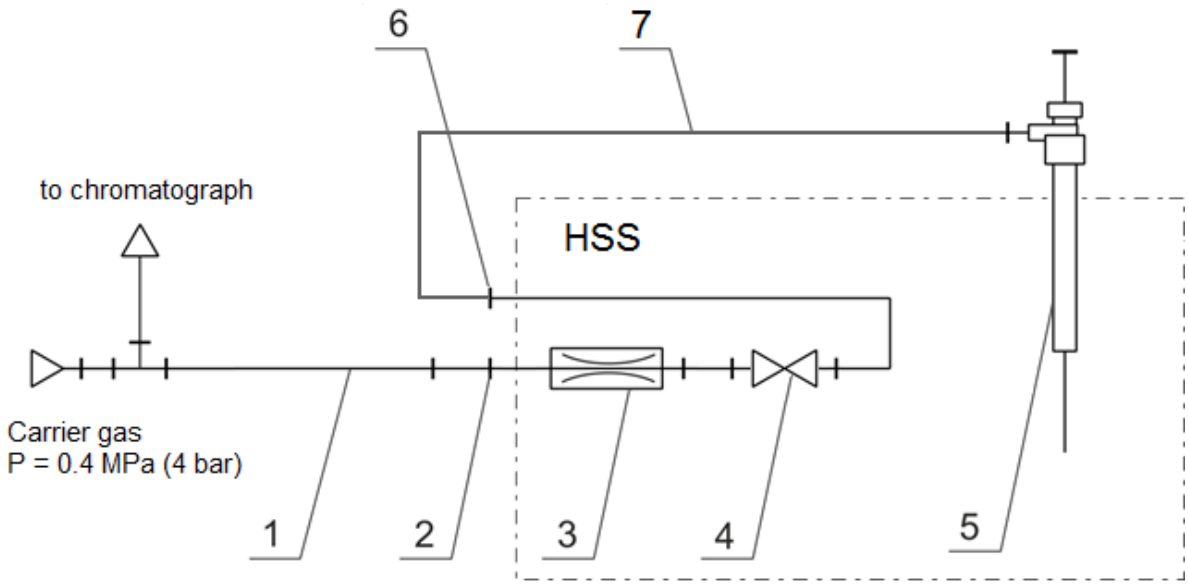


1 – Power switch; 2 – fuses; 3 – power input, 220 V, 50 Hz;4 – RS232 port; 5 –"GAS IN" fitting; 6 – "SYRINGE" fitting; 7 – grounding terminal; 8 – fan.

Figure 1.4–DRP-4 Rear view

RS232 slot (4) on the rear cover of the DRP-4 (Figure 1.4) is for updating the DRP-4's firmware via a Chromatec Crystal GC or a PC. Appropriate software is required when updating via a PC.

Gas connections (5) & (6) are the inlet and return for the high-purity purging gas:



1 – Tube (6.457.237); 2 – Fitting "GAS IN"; 3 – Restrictor; 4 – Solenoid valve; 5 – Syringe unit; 6 – Fitting "SYRINGE"; 7 – Tube (6.457.224)

Figure 1.5 – Diagram of DRP-4 connection to the gas source

Attention! Set the carrier gas pressure connected to "GAS IN" at 0.4–0.44 MPa. At this pressure level, the restrictor restricts the purge gas flow to 20 ml/min (nitrogen or air).

2 Usage

2.1 Safety precautions

Avoid touching the hot area of DRP-4 when the power is on!

Make sure the DRP-4 is switched off before starting any maintenance.

AVOID operating the DRP-4 with its covers removed**!**

DRP-4 should only be operated by persons familiar with this User Manual and following any in-house training procedures.

DRP-4 must be grounded. This is usually via the power plug but an additionally grounding terminal is located at the rear of DRP-4. The cable (6.644.056) from the shipping kit is for this purpose.

When using flammable, hazardous or aggressive substances be sure to follow the fire safety regulations specified in GOST 12.1.004-91 as well as the regulations prescribed in any special user instructions (specific to the substance) based on GOST 12.1.007-76.

When the DRP-4 is not being used then un-plug it and shut off the gas lines.

2.2 Preparation for operation

Be sure to switch off the DRP-4 and chromatograph power supply before starting any preparations. The gas lines must be shut off.

2.2.1 Syringe unit assembly

Syringe unit is supplied disassembled (see Table (1),
Table (2). Before starting operation, you need to assemble it. Follow instructions below.

Table (1) – 4.464.099 Syringe unit set at delivery

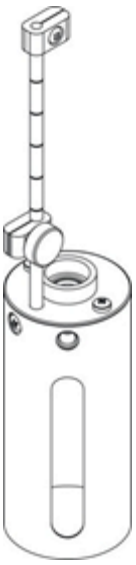
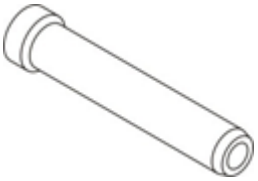
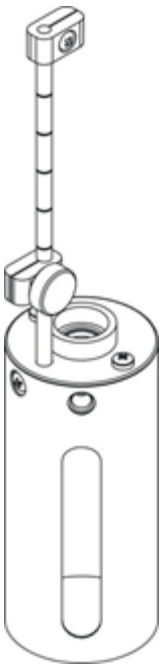
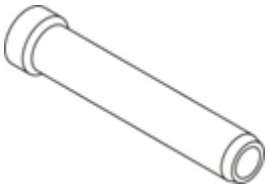
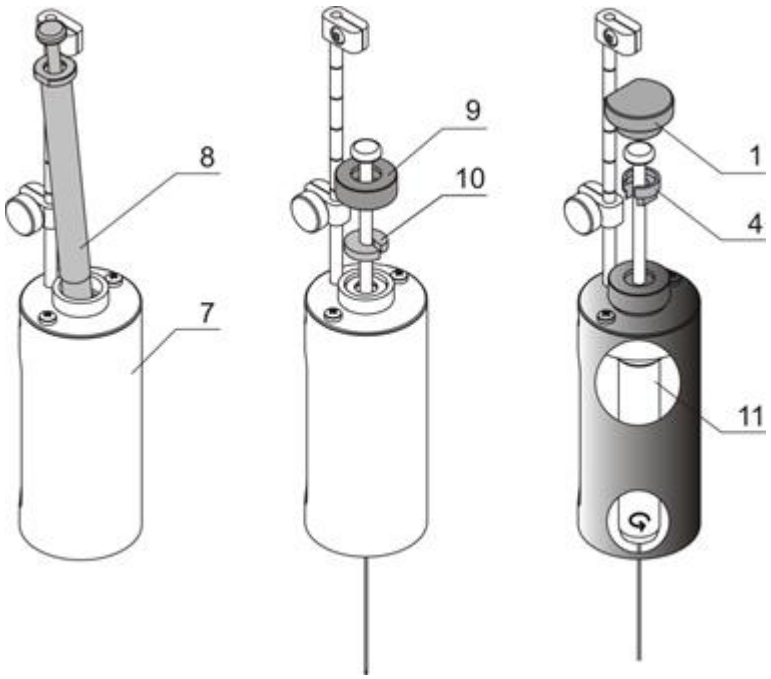
Cross ID	Description	Qty	Figure	Note
4.464.117	Syringe 1 ml	1		
6.113.289	Shell	1		
6.451.028	Cap	1		
8.236.559	Tube	1		
8.362.054	Clamp	1		
8.936.101	Nut	1		
8.947.127	Washer	1		Split washer (PTFE)

Table (2) – 4.464.109 Syringe unit set at delivery

Cross ID	Description	Qty	Figure	Note
4.464.118	Syringe 2.5 ml	1		
6.113.290	Shell	1		
6.451.028	Cap	1		
8.236.574	Tube	1		
8.362.054	Clamp	1		
8.936.101	Nut	1		
8.947.127	Washer	1		Split washer (PTFE)

Syringe unit assembly procedure:

- Insert syringe (8) into shell (7) (Figure 2.1)
- Attach split washer (10) on the syringe plunger, then put and tighten nut (9) by fingers.
- Attach the cap (1) on the plunger, and then fix it with a clamp (4).
- Fit a tube (11) on the syringe barrel turning clockwise.



1 – Cap (6.451.028); 4 – Clamp (8.362.054); 7 – Shell (6.113.289) or (6.113.290); 8 – Syringe (4.464.117) or (4.464.118); 9 – Nut (8.936.101); 10 – Washer (8.947.127); 11 – Tube (8.236.574)

Figure 2.1 – Syringe installation in the shell

Do not over tighten the nut (9) and tube (11). This will not affect the air-tightness of purging path but may hinder the future disassembly of the syringe unit.

Disassemble the syringe unit in reverse order.

2.2.2 GC inlet preparation

GC inlet preparation procedures (O-ring and liner replacement, septum replacement, leak check) are described in detail in the relevant GC User Manual.

Replacement of the liner is not obligatory but recommended to reduce peaks broadening of headspace sample in the inlet:

- Remove adapter of the inlet and take out the liner;
- Fit O-ring (8.683.032) on the liner (7.352.066) (in the shipping kit of the DRP-4). Install the liner into the inlet.
- Assemble the inlet.

Inlet septum and nut replacement:

- Remove the nut and the septa from chromatograph inlet;
- Replace with the nut (6.482.013-02) (with wider cone and hole diameter 0.8 mm) and a new septum (214.7.010.019-01) (or similar) on the GC inlet.

Screw the nut (6.482.013-02) with a new septum (214.7.010.019-01) on the GC inlet in the following sequence:

- Screw the nut until it holds down on the septa;
- Further tighten the nut by turning it clockwise (60 ... 90 degrees) to form a slight deformation of the septa.

After completing this inlet procedure check the GC inlet for leaks observing difference between the input carrier and vent gas flow rate values. Refer to the Chromatograph Operation Manual, Part 2, Section 1.6.1.

2.2.3 Vial preparation

Crimp-top headspace 20 ml vials, 10 ml or 15 ml vials of appropriate size are used to operate the DRP-4. The calibration procedure for 15ml vials are described below.

Before starting operation, the vials must be carefully washed and dried.

Aluminium caps and 20mm silicone septa with inert PTFE film are used for sealing.

The re-using of septa may lead to ghost peaks and poor analytical results.

A crimper for sealing and a de-capper for removing caps (20 mm size) are to be used for any operations with vials. Crimpers and de-cappers are available by order.

2.2.4 Vial calibration

The 15 ml vials must be selected by volume before usage. The difference in volume should not exceed 1.5 %.

Vial calibration is carried out by weight as follows:

- Weigh the empty vials to a precision of 0.01 g (m_1).
- Fill in the vials with water at room temperature (if water forms a convex meniscus, remove it with blotting paper) and weigh again (m_2).
- Calculate the weight difference of the full and empty vial ($m_2 – m_1$); this is equivalent to the vial volume.
- For measurement select the set of vials with the volume difference ±1.5 % from the average vial volume.

2.2.5 DRP-4 installation

- Place DRP-4 on the table close to chromatograph inlet;
- Insert the syringe unit into the syringe thermostat;
- Connect the syringe unit side fitting to the "SYRINGE" fitting using PTFE tube 6.457.224 (see shipping kit);

- Connect the carrier gas line to the "GAS IN" fitting;
- Connect DRP-4 to power supply using the mains cable;
- Purge the syringe. Apply the pressure 0.4–0.44 MPa to the "GAS IN" fitting. Switch on DRP-4. Move the syringe plunger in the upper position (Figure 1.3), position 3). Immerse the syringe needle into the water. Open the purging valve by pressing the "Purge" button. With the valve open the gas shall bubble through the needle;
- Pierce the septa with a needle (6.054.005) (from chromatograph shipping kit) one time;
- Make sure the syringe needle goes through the inlet nut and septa. To do so take the syringe unit and carefully puncture the septum with the needle until syringe barrel touches the nut.

The needle should easily pierce the septa without leak through the septa.

2.2.6 Setting the sampling volume

To set the required sampling volume:

- Remove the heat insulating tube (1) and loosen the stop (2).

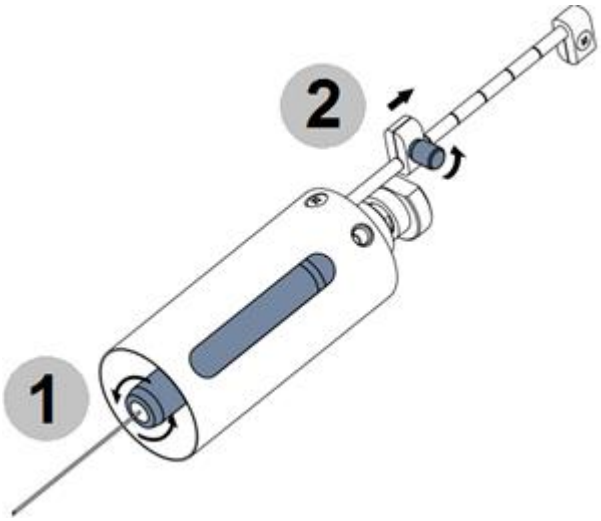


Figure 2.2 – Removal of tube

- Set the required sampling volume referring to the syringe scale through the side slot (3).
- Install and fix the stop in respect with the required plunger level (4).
- Visually check the sampling accuracy by moving the plunger all the way back and forth several times.

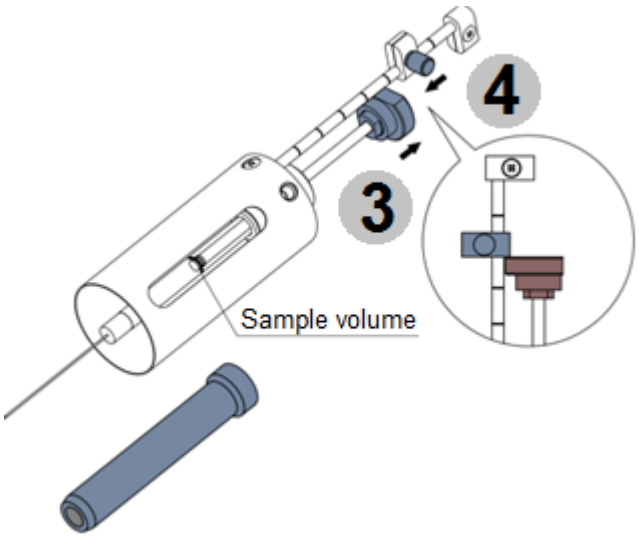


Figure 2.3 – Setting the volume and fixing the stop

- Fit back the heat insulating tube (5).

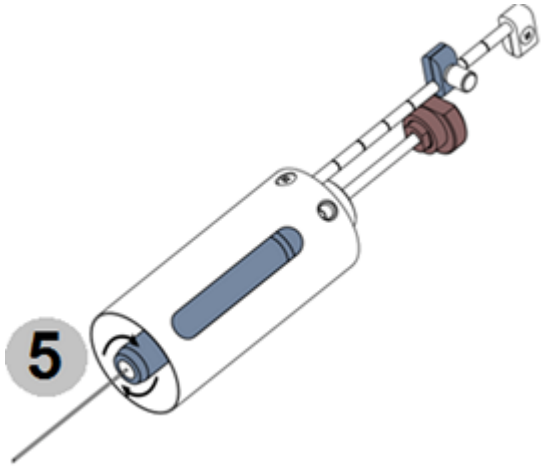


Figure 2.4– Fitting the tube

To make the volume setting easier always fit the syringe into the unit with its scale towards the sight glass.

2.3 Operation

2.3.1 DRP-4 operating mode setting

DRP-4 keeps the sample oven and the syringe thermostat at a constant temperature.

Operating and configuration parameters can be set through the DRP-4 menu. It also allows for adjusting the shaker functions and purging the syringe.

Table 2.3 – DRP-4 configuration parameters

Parameter	**Description, recommended values**
Calibration of the vial thermostat	Ensures the fine adjustment of pre-set vial thermostat temperature with increment 0.1 °C. Maintains the constant thermostat temperature (for example, 80 °C) in case of significant deviation from the pre-set value. The temperature is measured by an external thermometer with an appropriate certificate of calibration.
Calibration of the syringe thermostat	Ensures the fine adjustment of pre-set syringe thermostat temperature with increment 0.1 °C. Maintains the constant thermostat temperature (for example, 85 °C) in case of significant deviation from the pre-set value. The temperature is measured by an external thermometer with an appropriate certificate of calibration.
Sampling interval	This parameter is the cycle time of the GC temperature program and ensures the next vial will be ready.
Incubation time	This parameter is the time required for each sample vial to spend being incubated in the vial oven.
Purging time	Time for the purging valve to open after sampling. Recommended value: 2 to 5 minutes.
Shaker on/off/with timer	Shaker activation/deactivation. Recommended value –"with timer". In this case, the shaker turns on only for the period of vial incubation. Using shaker reduces the required equilibrium time and is highly recommended for viscous and solid samples.
Speed high/low	Shaker speed selection.
Shaker switch-on time	This parameter is the shaker operation time in seconds. The recommended value is 2.
Shaker switch-off time	This parameter is the shaker non-operation time set in seconds. The recommended value is 0.
Pause	This parameter is the shaker deactivation time during sampling or vials loading/unloading in seconds. The recommended value is 40.
2 inlets	This parameter enables parallel incubation of the two vials with slight shift in loading time. For a twin inlet GC or using 2 GC's. This is seldom used. The recommended value is "off".
Shift time (for the second inlet)	Sets the shift time for the second vial loading. The recommended value is 1–2 minutes.

Save	Saves the pre-set parameters in DRP-4 memory. Recommended to use after changing the configuration parameters or mode.
Back	Return to the main menu.

Table 2.4 – DRP-4 operating parameters

Parameter	**Description, recommended values**
Syringe temperature	Temperature of the syringe thermostat in °C. The recommended operating temperature range is 50–150 °C. The syringe temperature depends on the boiling point temperatures of sample components. The optimum syringe temperature is equal to that of the sample or 5 °C higher.
Sample temperature	Depends on the method used. The recommended operating temperature range for the sample oven is 50–150 °C. Recommended max temperature for water-based samples is 80 °C.
Configuration	Switch to configuration menu.
Timer	Switch to timer menu.
Version	DRP-4 firmware version.

The syringe temperature is selected depending on the analysis method. Normally, it is equal to the vial temperature or slightly higher. The syringe subjected to high temperatures is not always as leak-free as at low temperatures. Therefore, be sure the operating temperature does not exceed the maximum permitted syringe temperature.

2.3.2 DRP-4 control

The keyboard on the front panel of the DRP-4 features 6 buttons (Figure).

With the DRP-4 on, **the MODE menu** with pre-set and measured parameters is displayed on the screen.

Buttons "▼" and "▲"

By pressing the "▼" and "▲" buttons you can select any line in "mode" or "configuration" menus. These buttons are also used to set the numeric values.

"Enter" button

Selects between parameters or switches to the respective menu. This button is also used to confirm the selected parameter value.

"Purge" button

Activates the purging valve. This button starts the purging time countdown specified in DRP-4 configuration. The LED above the button lights while purging is going on.

"Timer" button

This button starts the Incubation time countdown specified in DRP-4 configuration. When the DRP-4 configuration indicates "shaker – with timer", the shaker starts together with the timer.

"Shaker" button

When the "Shaker" button is pressed, the shaker stops for a period specified in DRP-4 configuration (pause). Once shaker is off, the LED above the button will go out.

2.3.3 Parameter setting using keyboard

- Select the parameter using buttons "▼"and "▲".
- Press the "Enter" button to set the value.
- Press buttons "▼" and "▲" to select the required value.
- Press the "Enter" button to confirm the specified value.

2.3.4 Configuration setting

Set the configuration:

- Turn on DRP-4.
- Select the "configuration" line using buttons "▼" and "▲".
- Press the "Enter" button and go to configuration menu.

Set the parameters:

- Adjustment of sample oven sensor (when required)
- Adjustment of syringe thermostat sensor (when required)
- Sampling interval
- Incubation time
- Purging time
- Shaker on/off/with timer
- Speed high/low
- Shaker switch-on time
- Shaker switch-off time
- Shaker pause
- 2 inlets
- Shift time

The recommended parameter values are given in Table 3.

Adjustment of thermostat (oven) sensors

In case of discrepancies between an external thermostat temperature and the pre-set one the sensor can be adjusted within ±15 °C. (The thermostat is fitted with a thermometer for this purpose.) The temperature offset should be adjusted according to the measured temperature.

- **Example 1**. Pre-set temperature is 80 °C. External thermometer shows 77.0 °C. Therefore, the sensor offset temperature should be adjusted by +3.0 °C.
- **Example 2.** Pre-set temperature is 80 °C. External thermometer shows 81.5 °C. Therefore, the sensor offset temperature should be adjusted by -1.5 °C.

Sampling interval. This is a timer parameter that should be specified in configuration. The interval between sample injections into chromatograph depends on run time and chromatograph preparation for the next run, and generally represents the sum of all these stages (slightly longer). Also known as the GC cycle time.

Calculation of sampling interval time (Cycle time):

Sampling interval > GC run time + GC preparation time for the next run

Incubation time This is a timer parameter that should be specified in configuration. Incubation time depends on the analysis method.

Purging time The time required to purge the syringe after sampling.

Shaker Features the on/off/speed/operating time/pause settings. Three options are possible: On – operates continuously; Off – not used; With timer –turns on together with timer (shaker turns on only for the period of timer countdown).

Speed Shaker has two speed options – high or low.

Shaker on/off intervals This parameter allows for interrupted or continuous vial shaking.

Shaker pause Stops the shaker for sampling and vial loading/unloading into the thermostat.

2.3.5 Operation order

Before starting a measurement verify the chromatograph and DRP-4 mode.

To start the measurements the chromatograph needs to display the "Ready" status, while syringe and sample temperatures must reach the pre-set values.

The timer allows for regulating each individual Incubation time of each separate vial. This improves repeatability in sequence of repeat analyses. To use the timer, set vial Incubation time and sampling interval value in the DRP-4 configuration menu.

Using the shaker option permits a lower equilibrium time and is highly recommended for use with viscous and solid samples.

To improve sample repeatability, the syringe plunger should be held in the upper position for several seconds when sampling from the vial. This allows the pressure in the syringe to be equalized due to the small hole diameter of the needle.

The timer setting procedure:

- Set the "Incubation time" and "Sampling interval" in the DRP-4 configuration menu and save the changes.

- Set the chromatograph and DRP-4 operating mode.
- Wait until chromatograph and DRP-4 are ready for operation.
- Load the vial with sample into the thermostat vial position 1 and press the "Timer" button. Pressing this button starts the incubation countdown of the first vial.
- Do not load the second vial right after the start of first vial incubation ("V2 waiting") – follow the pre-set sampling interval.
- When the first vial incubation is over the message "V1 sampling" will display on the screen followed by a sound signal.
- Stop the shaker by pressing the "Shaker" button. The LED over the button shall go off.
- Bring the syringe plunger to the lower position and rotate the plunger cap until the stop (position 1, Figure 1.3).
- Inject the syringe needle into the respective vial through the opening in the cover.
- Draw the sample by moving the plunger up and down several times then stopping at the point limited by the lower stop (position 2, Figure 1.3).
- Remove the needle from the vial and bring the syringe unit to the GC inlet. Insert the syringe needle into GC inlet. Inject the headspace by smoothly bringing the plunger down and then press the "Start" button on GC.
- Remove the syringe unit from the GC inlet and set it into its thermostat. Bring the syringe plunger up (position 3, Figure 1.3).
- Press the "Purge" button.
- Wait until the message "V1 remove" with a sound signal appears in the "Vial" line. Remove the vial from the thermostat using the hook (6.461.000) from the shipping kit.

When running a sequence of analyses from several vials, load the vials into the thermostat in ascending order starting from the first thermostat position. Then load the positions specified in timer menu.

Overlapping

Before sampling, each vial requires a certain amount of time in incubation. When running a sequence of analyses, this "non-productive" time for the second and subsequent vials can be compensated by starting the incubation in advance of the previous analysis ending. The DRP-4 configuration menu features the "Sampling interval" parameter for this purpose. This interval should be longer than the total time spent by the GC for analysis and preparation for the following analysis.

Sampling interval > GC run time + GC preparation time for the next run

The vials are loaded into the thermostat corresponding to this pre-set sampling interval.

The vial incubation starts together with the sampling interval countdown for the next vial. The next vial can be loaded into the thermostat only when this time is out. During the sampling interval countdown, the message "V# waiting" displays in the "vial" line and "V# loading" – will display after the time is out.

However, it is not critical if the vial is not loaded immediately after the message "V# loading" appears, since incubation runs separately for each vial and starts by pressing the button "Timer".

he message "V# loading" will display until the "Timer" button is pressed.

Sequence of analyses

When carrying out a batch of analyses with the timer, the operation procedure is the same as described above. The loading of the second and subsequent vials is carried out with the DRP-4 command.

- The message "V# loading" displays the vial number.
- Load the vial with sample into the cell specified in the message and press the "Timer" button to start incubation of the loaded vial.

It is much easier to follow the time for incubation with the timer. Particularly, when the time for incubation increases the time required for chromatographic analysis.

When using the timer, the DRP-4 will display all the actions required to run the sequence of analyses.

Analysis without using the timer

The time for vial incubation can be regulated in any convenient way without using timer.

Timer sequence interruption

To interrupt the sequence press and hold the "Timer" button for 5 seconds. This will reset the timer.

When starting the timer any new sequence of analyses will begin from the 1st vial.

If you selected the function "shaker – with timer" in the DRP-4 configuration menu the shaker will start only with the timer.

To use the shaker without timer select the respective item in DRP-4 configuration menu. By doing this the shaker will be on all the time possibly reducing the DRP-4’s service life.

2.4 Troubleshooting

DRP-4 user level problems, their causes and remedy actions are given in the table below. In case of any other failures please contact the DRP-4 manufacturer or your local agent.

Table 23– Possible failures and recommended remedy actions

Type of failure	Possible cause	Remedy action
The repeatability within sequence of analyses goes beyond the acceptable relative RSD value, as to peak heights and/or areas	GC inlet is not leak-free.	Check the air-tightness of GC inlet septa (214.7.010.019-01 or similar) and gas line connections. Tighten or replace the septa if necessary.
	The following operating modes are not optimized: sample injection speed; Incubation time; vial temperature.	Optimize the DRP-4 operating mode.
	Liquid sample ingress into DRP-4 syringe from vial.	Fit the syringe into DRP-4. Dry it with carrier gas in purging mode.
	Syringe plunger wear.	Replace the syringe unit.
Carryover	No purging or insufficient purge time of the syringe or its needle due to short purging time or low temperature.	Increase the syringe temperature and purging time.
	Liquid sample ingress into DRP-4 syringe from vial.	Fit the syringe into DRP-4. Dry it with carrier gas in purging mode.

To prevent liquid sample ingress in the syringe, make sure that there are no sample drops under the vial cover before fitting it into the DRP-4 thermostat.

These drops can form with excessive shaking of the vial. The ingress of liquid into the syringe lead to poor analyses repeatability, false peaks (from previous samples) leading to the need to purge and blow the syringe.

To improve sample repeatability, the syringe plunger should be held in the upper position for several seconds when sampling from the vial. This allows the pressure in the syringe to be equalized due to the small hole diameter of the needle.

3 Maintenance

Basic maintenance procedures to observe when using the DRP-4:

- Check inlet septum of the GC is free of leaks. Change GC septa if necessary. Follow the GC User Manual. For Chromatec-Crystal GC refer to Part 2, section 1.6.1, 1.6.2.
- Keep the syringe internal channels and needle clean.
- Check that plunger tip is free of leaks in syringe barrel.
- If necessary follow the syringe or plunger replacement procedure.

3.1 Check the syringe is clean

Follow this procedure if you have poor sensitivity, no peaks on the chromatogram or carryover. Possible contamination (rubber particles, liquid sample drops) in the needle may cause carryover or even block the needle.

Carry out a visual check to ensure that the syringe barrel and needle are clean. Manually aspirate air into syringe then dip needle tip into clean water and flush air observing the bubbles that go out from the needle. If bubble flow is low or no bubbles are observed then check the needle hole carefully. Wipe needle tip with Lindt cloth and dry internal channels in inert gas flow as soon as procedure completed.

To recover normal sampler operation, replace the syringe unit with new one and proceed with maintenance of removed unit.

3.2 Check for leaks between plunger and syringe barrel

Before starting this procedure make sure that GC inlet is free of leaks.

Keep the GC in READY state while performing this test.

The PTFE tip of plunger in gas tight syringes tends to leak after a while (typically more than half year). Leaks past the plunger in the syringe can be observed in this case.

Leaks past the plunger may result in poor repeatability and/or decreasing sensitivity due to a loss in sample through the plunger.

To check if there is a leak between the plunger tip and syringe barrel follow the procedure below. The problem occurs when the syringe needle has penetrated through the GC inlet septum and gas from the inlet overpressures the syringe through the needle. The difference between input gas flow and vent gas flow can be observed in the GC Control Panel software.

- Take the syringe unit out from the DRP-4;
- Move plunger into middle (position 2, Figure 1.3) (to provide leak check at maximum volume of injection);

- Record difference between input gas flow and vent gas flow values in control panel SW. Typically, if the column is connected into front inlet, it is a difference between Gas-1 and Gas-2. For the back inlet, it is a difference between Gas-3 and Gas-4 flow rates.
- Inject needle from the syringe into inlet;
- Keeping plunger in the same position 1 min after penetration (observe the change as above), record the difference between the input gas flow and vent gas flow. If there is no difference, the syringe is leak free. If the difference is more than 0.2-0.5 ml/min then there is a leak between the plunger tip and glass barrel.

If there is a leak in the plunger the plunger or entire syringe should be replaced. If leakage is detected, it is necessary to replace the syringe or temporarily restore syringe tightness. To do this, unscrew nut 9 (Figure 2.1), remove cut fluoroplastic washer 10 and cap 1 from the plunger and place it in boiling water for 5-10 minutes. In case of significant wear replace the plunger or syringe with a new one.

3.3 Syringe / Plunger replacement

- Remove the pin (1) by loosening the screw (2) (opening in syringe unit case 4) with the screwdriver (3) from GC shipping kit;
- Unscrew the nut (5) that fixes the syringe in the unit.

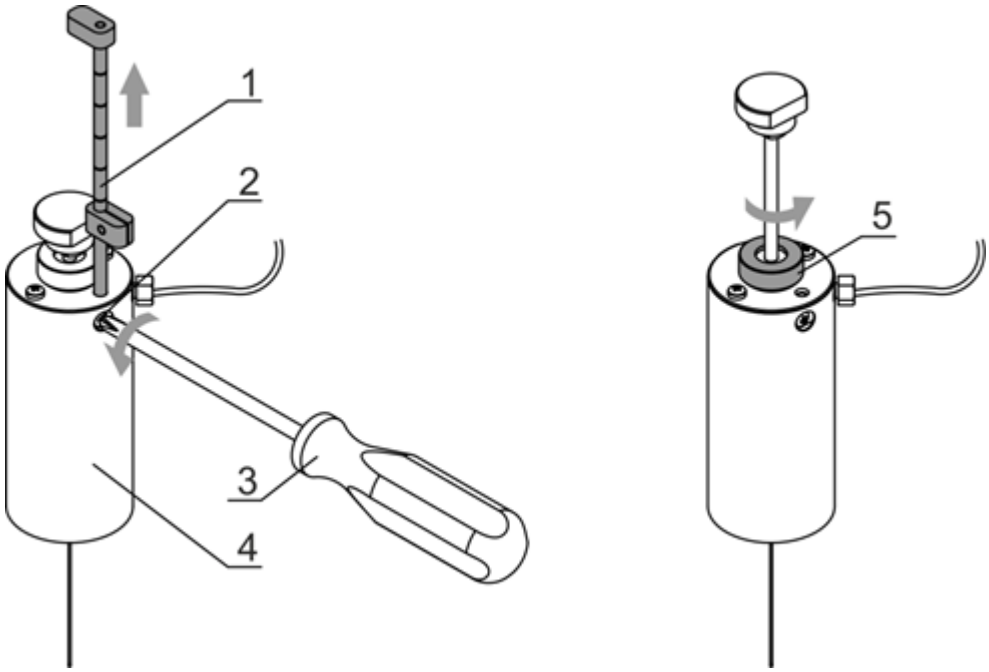


Figure (3.1) – Removal of pin and fixing nut

- Remove the tube (7) and carefully (thrusting against the glass case) pull out the syringe (6). Since the syringe has two rubber sealing rings, it requires some effort to pull out.

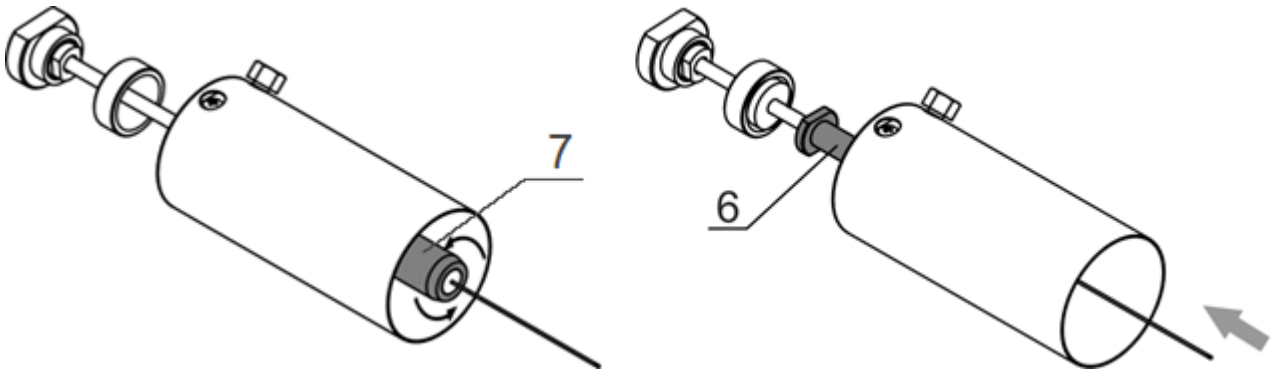


Figure (3.2) – Removal of tube, syringe pull-out

- Remove the fluoroplastic slot washer (9) and the nut (5).

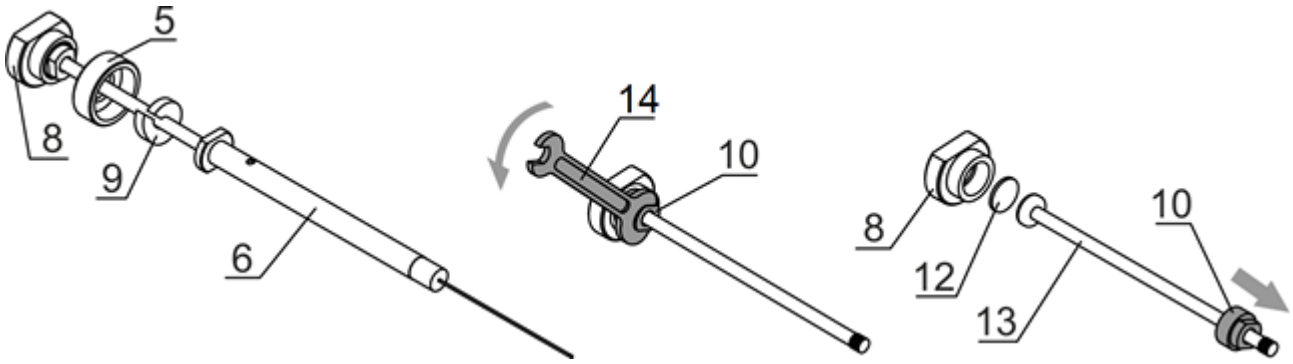


Figure (3.3) – Plunger cap removal

Having removed the plunger from the syringe place it on a clean dry surface.

- Using spanner (14) (from chromatograph shipping kit) unscrew the retainer (10).
- Remove the cap (8) and the rubber gasket (12) from the plunger (13). Then remove the retainer (10).

Another syringe should be fitted in the reversed sequence.

Do not over tighten the nut (5) and tube (7). This does not affect the air tightness of purging path but may hinder the future disassembly of the syringe unit.

4 Shipping and storage

When placed into original package the DRP-4 can be shipped over any distance by any mode of transportation (except for non-pressurized aircraft cargo compartments and open decks of water transport). Shipping container should be protected against precipitations.

Shipping conditions:

- Ambient temperatures between -50 and 50 °C;
- Relative humidity up to 98 % at 35 °C;
- Dust in the air or vapour aggressive impurities are unacceptable.

To avoid damage during transit the DRP-4 should be removed and placed into a suitable shipping container.

Containers should be placed in such a way as to prevent them from moving. During the handling operations, containers must be protected from overturning, impacts or precipitations.

DRP-4 in a package must be stored indoors meeting storage conditions (2), as specified in GOST 15150-69:

- Ambient air temperature between 30 and 40 °C;
- Relative humidity up to 98 % at 25 °C.

Dusty air, acid/alkali fumes or other aggressive substances should be avoided.

When stacking containers, there should be no more than three layers.

After unpacking the DRP-4 in winter time, leave it in normal ambient conditions for at least 4 hours.

5 Manufacturer warranty

The manufacturer guarantees that the DRP-4 will meet the specifications stated, provided that the user complies with the shipping, storage, installation and operation requirements. Failure to achieve these conditions as well as misuse of the DRP-4 (operations not specified in the section 3 herein) will cancel the warranty.

The equipment may feature slight design deviations that are not reflected in this User Manual.

Warranty period covers 12 months since putting into operation, but no more than 18 months since acceptance.

6 Claims

In case of any failures the DRP-4 has during the warranty period, proceed as follows:

- Prepare a claim report with details of any non-compliance with the specifications given in subsection 1.2;
- Provide extracts from "Acceptance certificate" section;
- Specify the commissioning date, company and person responsible for commissioning;
- Specify the maintenance operations carried out.

  Forward copies of "Acceptance certificate" and "Maintenance records" approved by a director of the company operating the DRP-4.

The claim should be sent to the following address:

Special Design Office "Chromatec", 94 Stroiteley Str., Yoshkar-Ola, Russian Federation 424000; or to the correspondence address: Central post office, P.O. box 84, Yoshkar-Ola, Mari-El Republic, Russian Federation 424000.

Fax: +7.8362.685916, E-mail: mail@chromatec.ru

Service support department Tel. +7.8362.685919, +78362.685932, Fax. +7.8362.685987,

E-mail: service@chromatec.ru

Sales department Tel. +7.8362.685968, +78362.685969, Fax. +78362.685970,

E-mail: sales@chromatec.ru