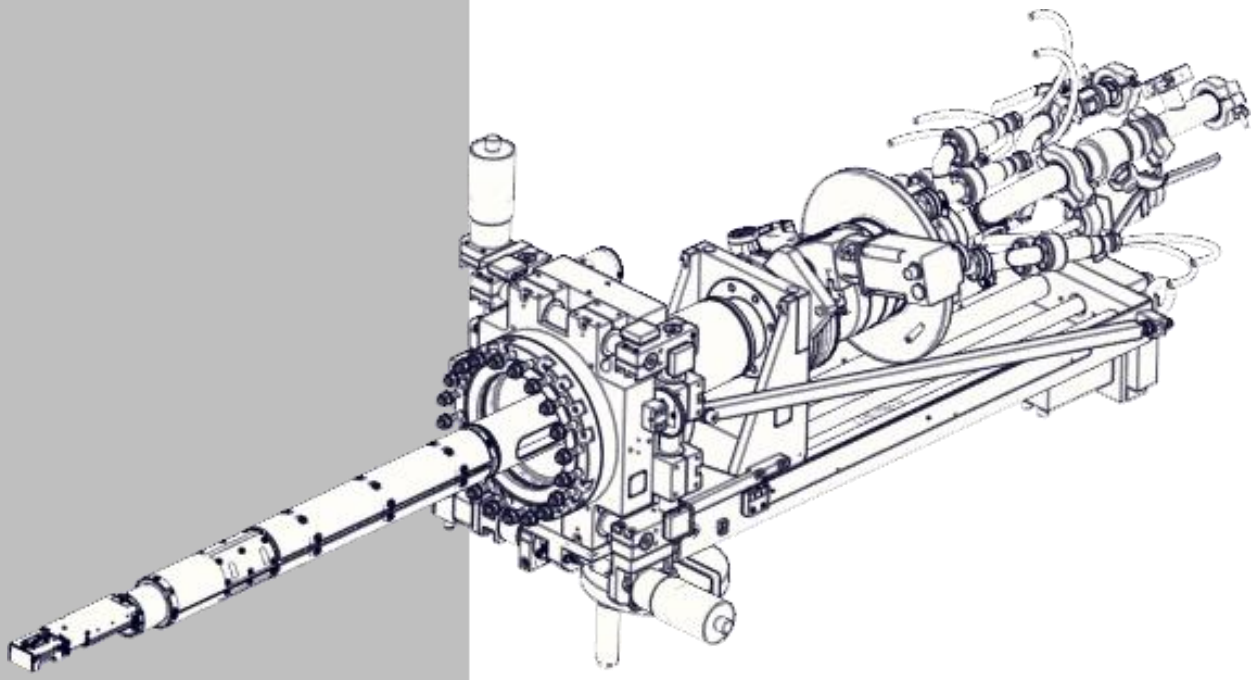
USER MANUAL



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Manipulator

PREVAC

Operating manual

English translation

Document no. 1064792

Version 01

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1. Introduction

This manual is an integral part of the machine and is intended mainly for the machine operator. It should always be kept with the machine to use it during operation and maintenance, and in the event of sale it should be handed over to the new owner.

Read the manual carefully to ensure the optimum working conditions and safety of the user. The manual contains important information concerning the functionality, installation, commissioning and operation of the machine. Moreover, it contains information necessary to ensure safe and reliable operation of a new machine!

The document is only a part of the technical documentation of the device. Other documents necessary for the user are listed in chapter "6". The document must be read.

The contents of the manual have been developed on the basis of the guidelines of the Directive 2006/42/EC of the European Parliament and of the Council of 17 May 2006, the harmonised standards specified therein, and the risk analysis carried out for the purposes of a given project.

In case of loss of the manual an additional copy can be ordered with PREVAC sp. z o.o.

All the dimensions and weights are given in the metric system (in [mm] and [kg]).

Legal note

Issuer:

PREVAC sp. z o.o.

PL-44362 Rogow, ul. Raciborska 61

We reserve the right to make design and technical changes.

1.1. Intended use

1.1.1. Purpose of use

The manipulator is designed to operate carriers in the Flag Style standard in the conditions of ultra-high vacuum. The device enables:

- changing of the position of a holder in relation to a fixed mounting flange;
- cooperation with a transferring system;
- heating of the surface of a sample mounted on the holder;
- cooling of the surface of a sample mounted on the holder;
- measurement of the pace of evaporation with a quartz balance.

Operating the machine incompatibly with the intended use may cause threat to health or life. Strictly adhere to the intended use and acceptable operating methods.

Examples of possible unacceptable use and operating methods:

- employing untrained or insufficiently trained personnel, e.g. operators do not have access to the operating manual;
- bypassing safety switch (if installed);
- bypassing or disassembly of safety devices, e.g. no fixed shield (casing) after a finished repair;
- using the device in other operating conditions other than vacuum, e.g. operating at internal pressures higher than the atmospheric one;

1.1.2. Principles of responsibility

To avoid hazards to persons or the environment and ensure effective operation of the machine, the user and operating personnel are obliged to observe the following duties.

Scope of user's responsibility

Through appropriate manuals and regular inspection the user must ensure that:

- improper use of the machine is excluded i.e. the machine is always operated according to the recommendations specified in chapter "Intended use";
- general health and safety regulations issued by a competent supervising authority (e.g. professional association) are observed;
- before starting the machine, the operating personnel have read and understood instructions/operating manual;
- the manual of the machine is always at hand near the machine and in the event of selling the machine it is handed over to the new owner;
- the personnel always use required personal protective equipment (working clothes, protective goggles, shoes, working gloves, etc.);
- the machine is operated only in perfect technical condition and breakdowns are immediately repaired;
- all the information on the machine and in the operating manual are always clear and complete;
- working environment is tidy and clean;
- all the personnel is adequately trained on specific hazards on the basis of this manual and the participation in the training is confirmed with signatures;
- consumables and used up machine parts are appropriately disposed of;
- all the works connected with the machine are performed only by qualified specialists;
- responsibilities are clearly established.

Scope of personnel's responsibility

The personnel is obliged to:

- stop the machine immediately in case of a hazard, irregularities, abnormal noises and visible defects; such incidents must be reported to the supervisor and recorded. Then the incident must be inspected, and its cause removed (by qualified personnel or the service of PREVAC sp. z o.o.);

Transport of the machine

It must be carried out by a specialist transport firm. The instructions in chapter "3" must be followed!

Connecting the machine to electrical installation

It must be carried out by a qualified electrician. The instructions in chapter "3" must followed!

Starting the machine

It can be carried out only by the service of PREVAC sp. z o.o. a service authorised by PREVAC sp. z o.o. The instructions of this manual must be followed!

Operating the machine

The machine can be operated only by a specialist properly trained in this respect. The instructions of this manual must be followed!

A person with specialist knowledge acquired through professional education and experience in operating such types of machinery is considered to be the specialist. The specialists must be able to assess the work ordered to them, recognise possible hazards and prevent them.

1.2. Abbreviations

PTS	PREVAC's Transferring System
FV	Forevacuum (>1x10E-3 mbar)
HV	High Vacuum (1x10E-6 ÷ 1x10E-8 mbar)
UHV	Ultra-High Vacuum (< 1x10E-9 mbar)
MN	Manipulator
RGA	Residual Gas Analyser
TMP	Turbo-Molecular Pump
LN2	Liquid nitrogen
LHe	Liquid helium
X, Y, Z, R1, R2, R3, R4	Manipulator axis movement

Tab.1 Abbreviations

1.3. General information

The “4ss” manipulator, “device”, is a high-precision device of high rigidity, modular construction, suitable for ultra-high vacuum conditions, and enabling movement in the X, Y, Z, R1 axes.

A modular construction means that the device can be expanded by replacing, modifying or adding new modules. A manipulator module means:

- XY module;
- Z module;
- R1 module;
- Receiving station of flag style sample holders;

1.3.1. MN manipulators

A manipulator is a single module or system of modules (manipulators) connected to one another and ended with an effector.

The effector according to PREVAC sp. z o.o. manipulators is an regulating unit of a manipulator, which can be a shaft or receiving station for samples or sample adapters. The

manipulator transfers torque or other operations are carried out through torque (e.g. opening the manipulator door with a wobblestick).

In the 2ss XY manipulators one of the mounting flanges is an effector.

The manipulator modules are also called manipulators.

The manipulator can realise up to 6 degrees of freedom of the effector depending on the construction and application.

If a holder or adapter is mounted on the effector, the surface of the sample mounted on it usually moves in the chamber/tank along the axis of the mounting flanges.

The manipulator is mounted on the flange of the device chamber.

Information

More details on the manipulators can be found in a separate operating manual specified in the list of manuals.

1.3.1.1. Degreed of freedom for effector

The picture below shows an example manipulator built of modules (manipulators) with indicated and named possible directions of possible movements.

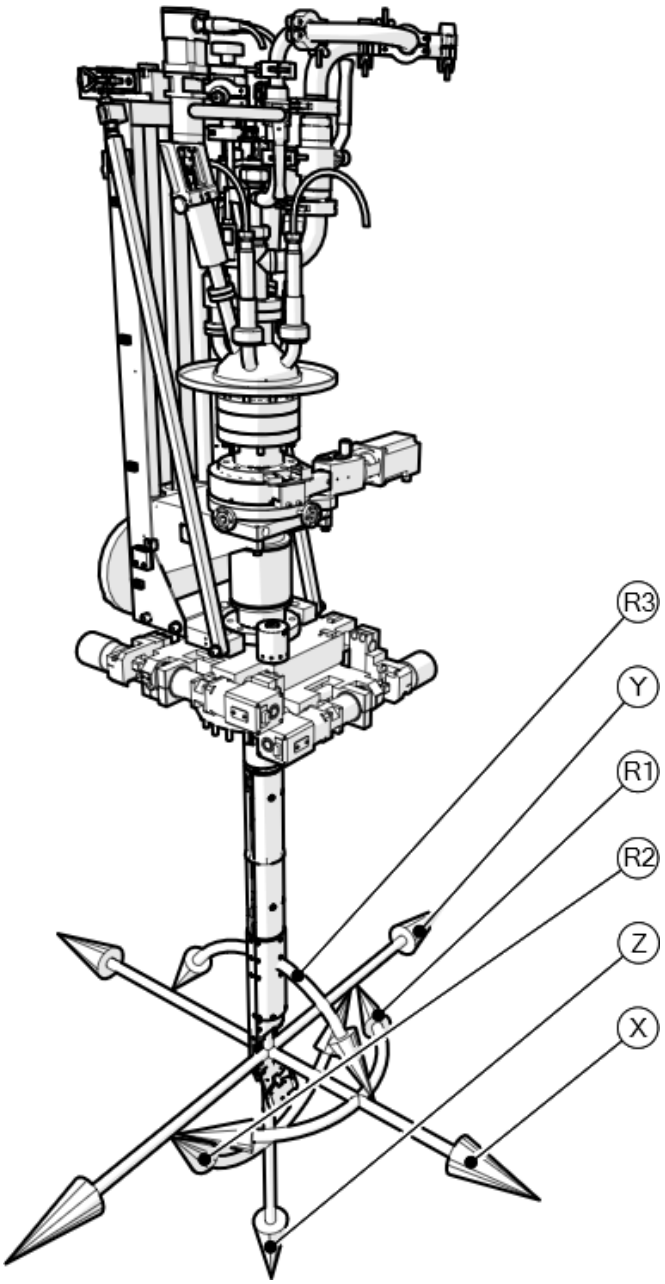


Fig.1. Relative system of axes for manipulators

	Axis	**Name**	**Name**	**Name**
Z rotations	R1	Primary	Polar	Theta
Y rotations	R2	Azimuthal	Phi	Alpha
X rotations	R3	Tilt	Flip	Beta
X rotations	R4	Tilt	Flip	Beta

Tab.2 Alternative description of rotational axes of the effector

1.3.1.2. Resolution

Resolution is an ability to present clearly small details; also: value describing this ability.

The resolution in a manipulator is the smallest measuring unit by which an effector can be moved. For manipulators a linear and angular resolution is defined.

The value of the resolution is given in [mm] or [°], less often in inches.

1.3.1.3. Repeatability

Repeatability is a degree of conformity of successive results of measurements of the same measurand carried out in the same measuring conditions.

The repeatability of the manipulator's movement is connected with its resolution. It is an ability to reach the same working position in its successive movements.

The value of the resolution is given in [mm] or [°], less often in inches.

1.3.1.4. Pitch, range

A pitch or range is a linear or angular measure describing the movement range of an effector in relation to the point of reference, which usually is the manipulator mounting flange.

The kinematic range of rectilinear operation is measured from the end of the effector or the main axis of the holder or adapter (if mounted on the effector), to the mounting flange.

The kinematic range of rotational operation is measured for the main axis of the effector or to the main axis of the holder or adapter (if mounted on the effector), in relation to the mounting flange.

1.3.1.5. Cooling modules and heating

Cooling modules support cooling of sample holders. They can be used for cooling shields, receiving stations and other.

The manipulator can cool down and heat up samples mounted of sample holders. Cooling is realised by means of liquid nitrogen or helium as a coolant.

The manipulator may enable heating of samples.

Available temperatures of cooling and heating of samples depend on the sample holder used and the manipulator type (and at the same time method of cooling).

1.3.1.6. Cryostats

A cryostat is a device (manipulator module) used for generating and maintaining very low temperatures, i.e. as low as the temperatures of liquid nitrogen or helium.

1.4. Information on health and safety

1.4.1. Qualifications of personnel

All work described in this document may only be carried out by persons who have suitable technical training and the necessary experience or who have been instructed by the final user of the device.

The owner of the device must ensure that all the users have been informed about the safety requirements contained in this manual. In the event of sale or transfer of the device to another owner this manual should be attached.

1.4.2. Illustration of types of dangers

This operating manual illustrates safety notes concerning dangers as follows:

	
Information on potential serious accident or personal injury.	
	
Information on possible damage to the device.	
	
Information on correct handling or use. Disregarding safety notes can lead to malfunctions or device damage.	
Information	Indicates particularly important, but not safety-relevant information.

Tab.3 Types of dangers - illustrations

1.4.3. General information

During all the operations carried out in connection with the use of the device described in this manual, observe the applicable safety regulations. Observe all the safety notes given in this document and forward the information to all other users of the device. Pay particular attention to the following safety notes.

Improper use can damage the device.

Use the device only as intended by the manufacturer.

Improper installation and operation parameters may damage the device.

Strictly adhere to the stipulated installation and operation instructions.

This device must be installed by qualified personnel.

Improper installation and operation parameters may damage the manipulator.

Strictly adhere to the stipulated installation and operation instructions.

The equipment described in this manual must be installed by qualified personnel.

It is the responsibility of the user to consider the safety requirements of hazardous materials, e.g. poisonous, explosive and harmful to health gases used with this device and the consequence of their leakage.

Any equipment returned to the service for repair must have the correct Declaration of Contamination of Vacuum Equipment attached to the product. If the declaration is filled improperly and some information on the contamination of the surfaces of vacuum details with hazardous or poisonous substances is missing, the User may be held liable for causing threat to the health or injury of the personnel carrying out maintenance work. The declaration must be securely attached to the outside of the packaging. The product servicing will not be started until it is delivered. "Declaration of Contamination of Vacuum Equipment" can be download from PREVAC sp. z o.o. website: www.prevac.eu on page “download”.

Grease used in the product may cause skin irritation. Wear protective clothing.

The information about the weight of the device and its serial number are given on the data plate.

1.4.4. Operating manual

The owner of the device must ensure that all the users are aware of the Health and Safety information contained in this manual.

Information

If the product is sold or passed to another owner, the complete manual must be included with the product as an integral part.

A complete list of all the operating manuals can be found in "6.1“.

1.4.5. Safety devices

The product is equipped with safety devices preventing exceeding the admissible operating parameters.

1.4.5.1. Earthing

The product must be fully earthed to prevent dangerous electrostatic charge build-up.

1.4.5.2. Overpressure

Information

The product cannot be used with positive internal pressure above the specified maximum.

The maximum internal pressure (inside chambers) must be smaller than P < 1.2 [bar] of the absolute pressure.

1.4.6. Hot surfaces

Some components may develop extreme hot or cold surfaces. Wear protective clothing.

Hot surfaces are labelled (according to the PN-EN ISO 13732 standard) with a warning sign.

1.4.7. Cryogenic liquids

When using cryogenic liquids, the user is responsible for ensuring appropriate precautions during using and storing those liquids.

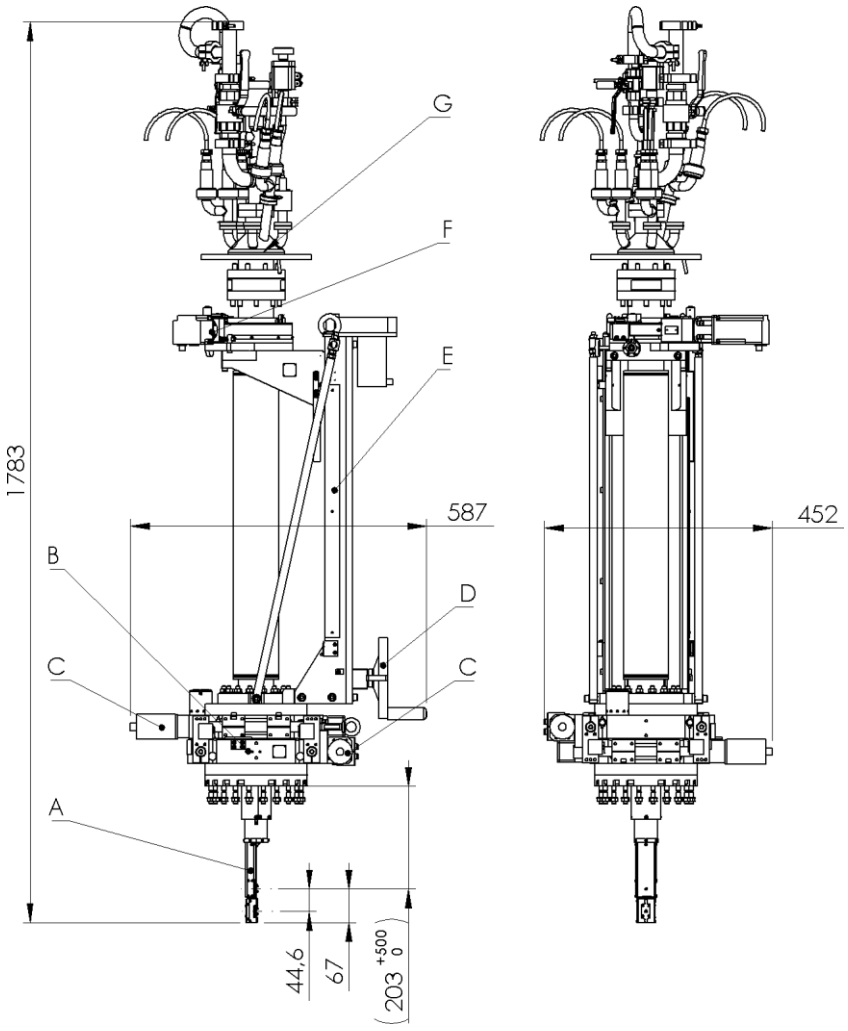
1.4.8. Bakeout

Note:

The maximum bakeout temperature is 150^{o}C.

2. Technical data

2.1. Mechanical data (manipulator)



A - receiving station; B - XY manipulator; C - XY manipulator drive; D - Z manipulator drive crank handle; E - Z manipulator; F - R1 axis drive; G - cryostat module with receiving stations

Fig.2. Manipulator dimensions

Width	According to fig. “Device dimensions”
Height	According to fig. “Device dimensions”
Depth	According to fig. “Device dimensions”
Mounting flange	DN 160CF
Operating position	Horizontal
Weight	See: data plate
Maximum value of sound intensity	<50 dB(A)

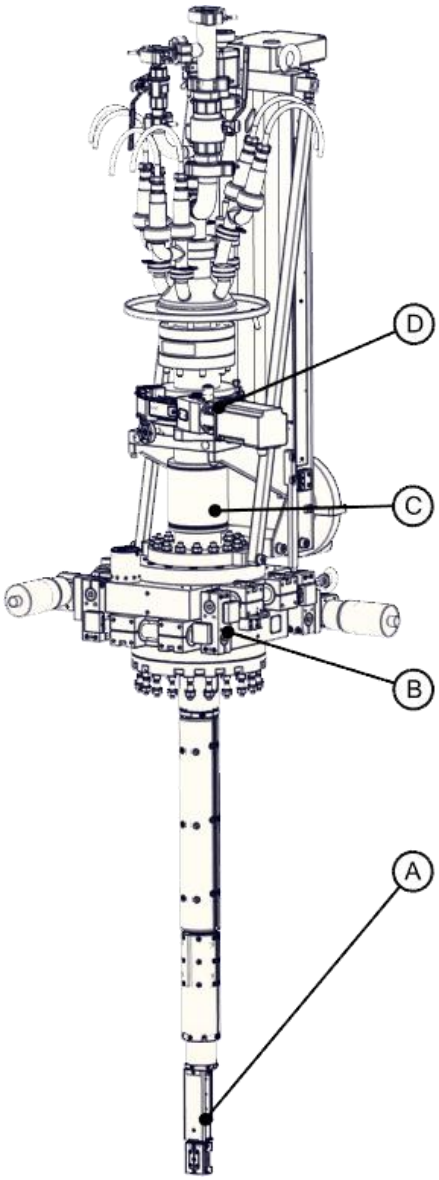
Non-ionising radiation	none

Tab.4 Manipulator - mechanical data

2.2. Kinematic data (manipulator)

Axis	Drive type	Range of movement	Resolution
X	Motorised	+/- 25 [mm] (+/- 17.5 [mm] along square lines)	1 [µm]
Y	Motorised	+/- 25 [mm] (+/- 17.5 [mm] along square lines)	1 [µm]
Z	Motorised	0 ÷ 500 [mm]	1 [µm]
R1	Motorised	max. +/- 175 [°]	0.1 [°]

Tab.5 Manipulator - kinematic data



A - receiving station; B - XY manipulator; C - Z manipulator; D - R1 manipulator

Fig.3. Modules manipulator

2.3. Operating conditions

Storing temperature	-40[°C] ÷ +70[°C]
Working temperature	+5[°C] ÷ +40[°C]
Relative humidity	max. max. 60 % (do +31[°C]), falls down to max. 50% (at 40[°C])
Use	Only in closed rooms
Bakeout temperature	Max. 150[°C]

Tab.6 Operating conditions

2.4. Required connections (manipulator)

Required connections:

- Lhe coolant;
- electrical cables for:

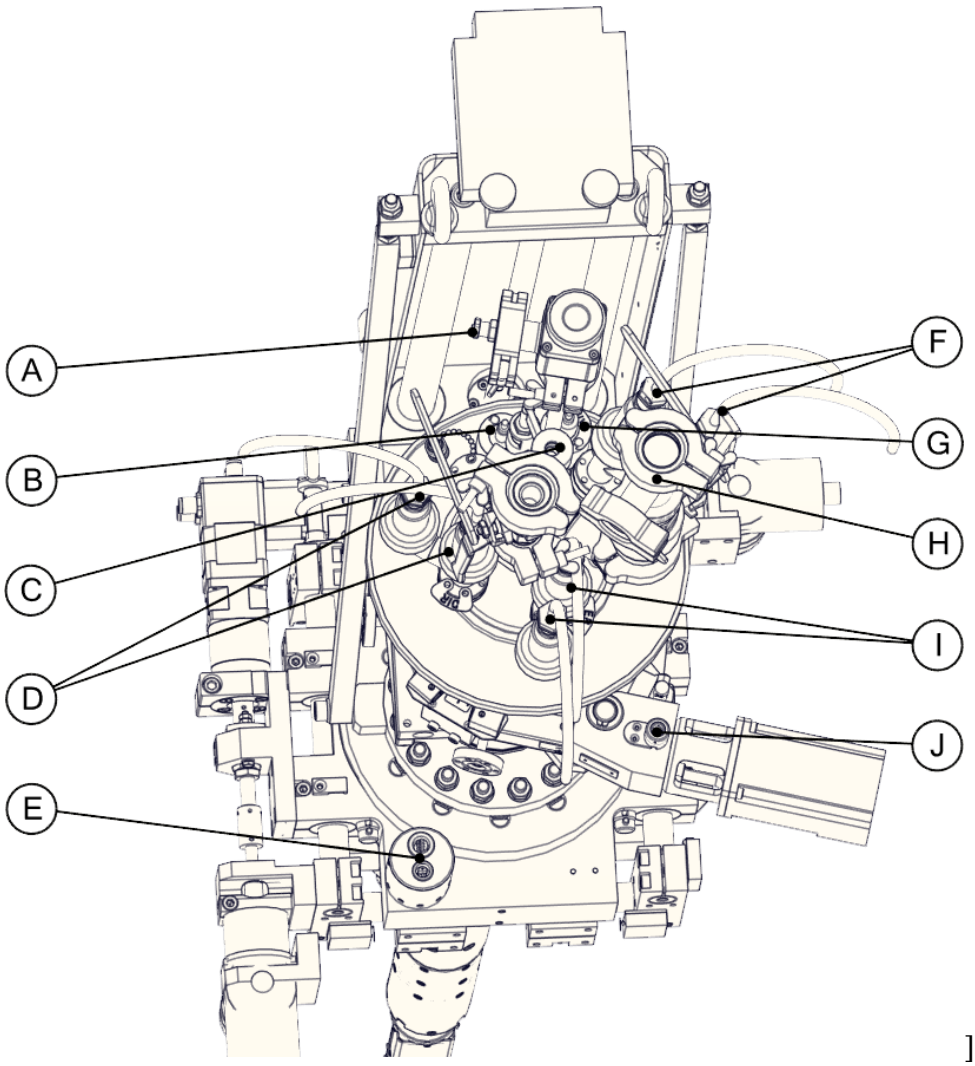
  - heating;

  - temperature measurements;

  - limit switches;

  - supply of motors;

  - reading of motor encoders;



]

A - inlet of dry nitrogen; B - electrical socket of thermocouple K; C - installation place of helium siphon; D - DIR heating electrical sockets; E - electrical sockets of limit switches for XYZ MN; F - electrical sockets for temperature stabilisation by Thermocoax; G - electrical socket of diodes for temperature measurement; H - outlet of helium vapours; I - EG heating electrical sockets; J - electrical socket of limit switches of MN R1

Fig.4. Device connections:

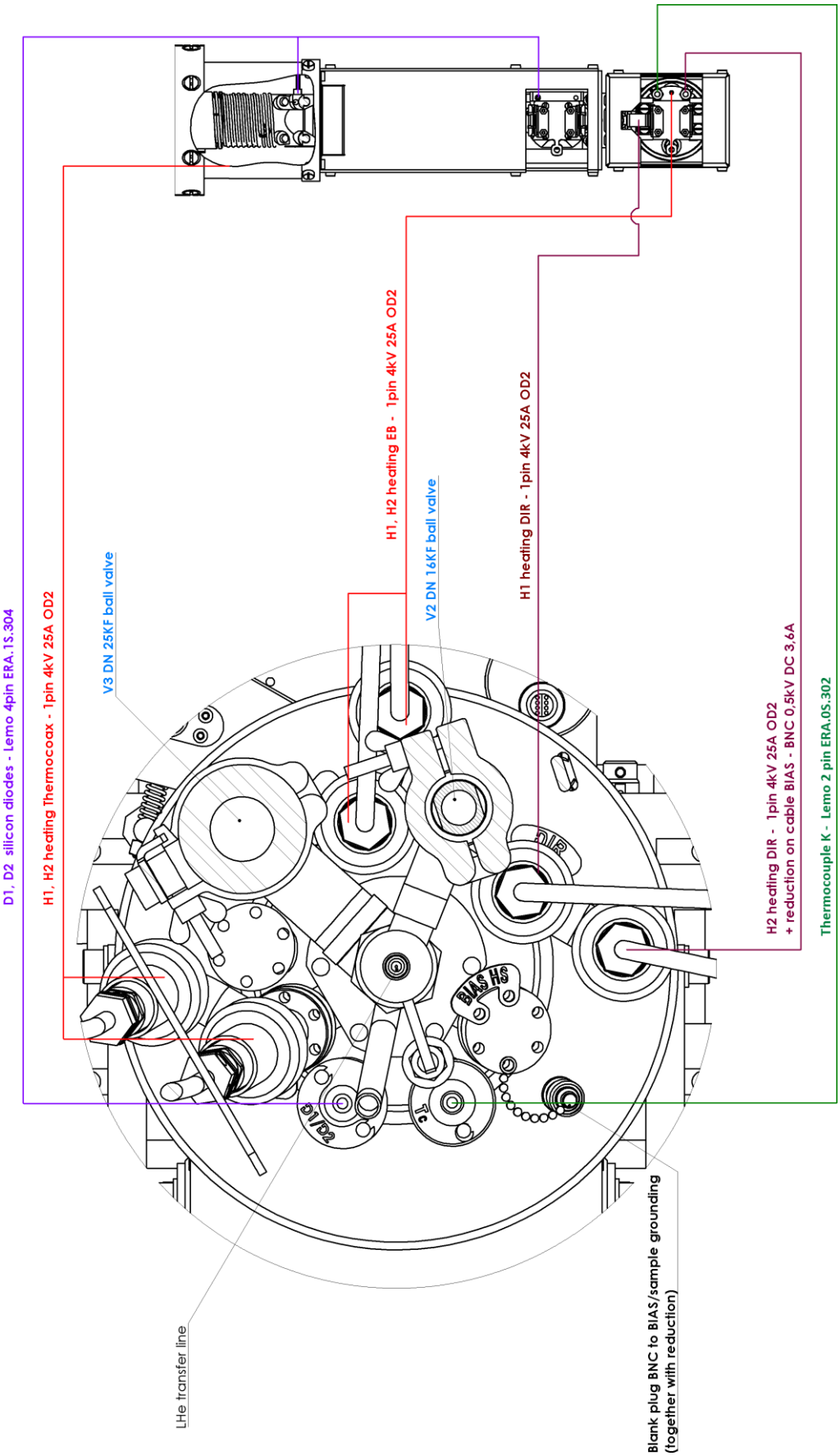


Fig.5. Electrical feedthrough of manipulator - connection diagram

2.5. Operation

- automatic by using stepper motors, which are operated through the software installed;
- manual with knobs;
- manual with control buttons or touch screen on the front panel;

2.6. Materials used for construction

Most of the materials used for construction is made of stainless steel, aluminium alloys, copper and titanium. The vacuum flanges are fitted with the use of copper and viton seals. All the bearings used in the vacuum part have ceramic balls, and the bearing races can be made from ceramic, stainless steel or bronze. The device may have details made of polymers (PTFE). The bearings on the atmospheric side are lubricated using high-temperature grease. The micrometre screws are adapted for bakeout up to 150[°C].

The threads of the mounting bolts (used on the atmospheric side) are covered with silver coating preventing seizure of separable threaded connections.

3. Installation

3.1. Important information – read before unpacking

Carefully inspect the product for visual signs of damage. The packaging is designed to withstand shock and vibration but some of the fixing screws may become loose. All the parts should be secured and they should not be in motion. All the screws should be securely tightened.

3.2. Packing and transport

Note

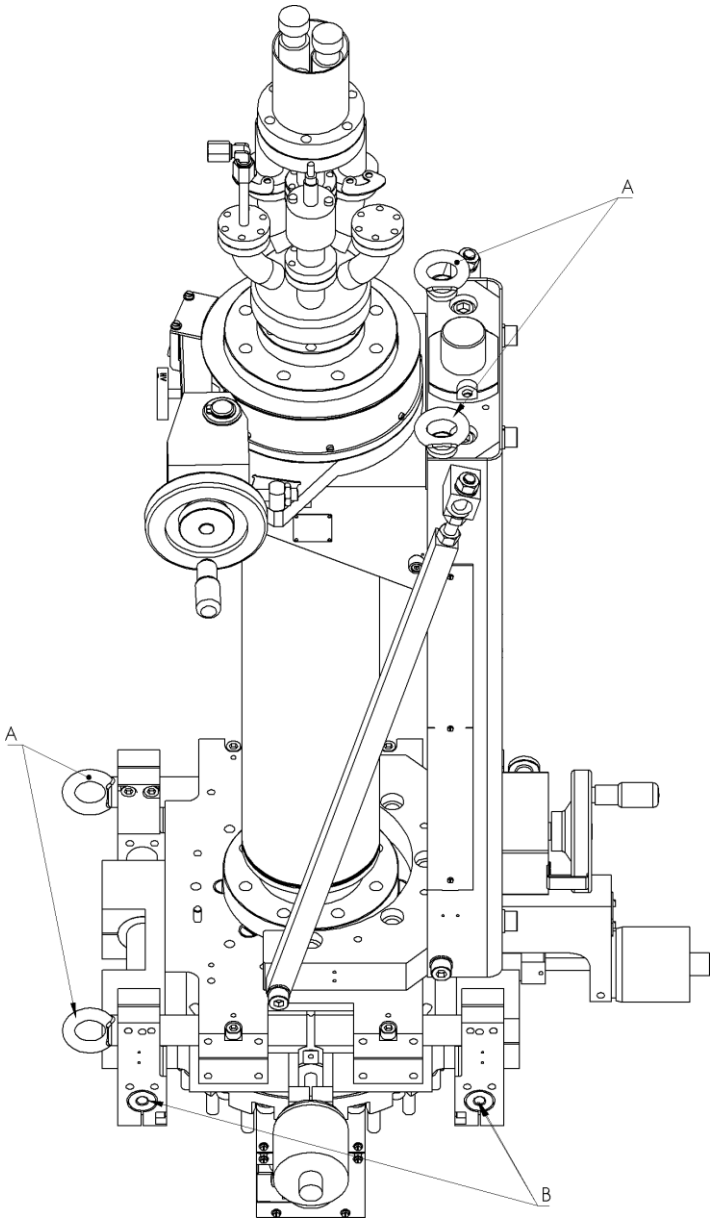
It is recommended to retain the transport packaging wherever possible. The packing may be used for warranty return transport if required. Any damage in transit should be reported to the carrier and to PREVAC sp. z o.o., or your local agent, within three days.

Boxes, containers, stands and cartons must be stored in dry and clean room or storehouse. It is recommended to store the equipment close to the destination place (laboratory) if possible.

When lifting the product take care that the weight and position do not exceed admissible lifting limits for machine and human abilities. When installing the device make sure that it is adequately supported at all times.

It is recommended to use a crane, forklift or dedicated equipment for lifting heavy objects.

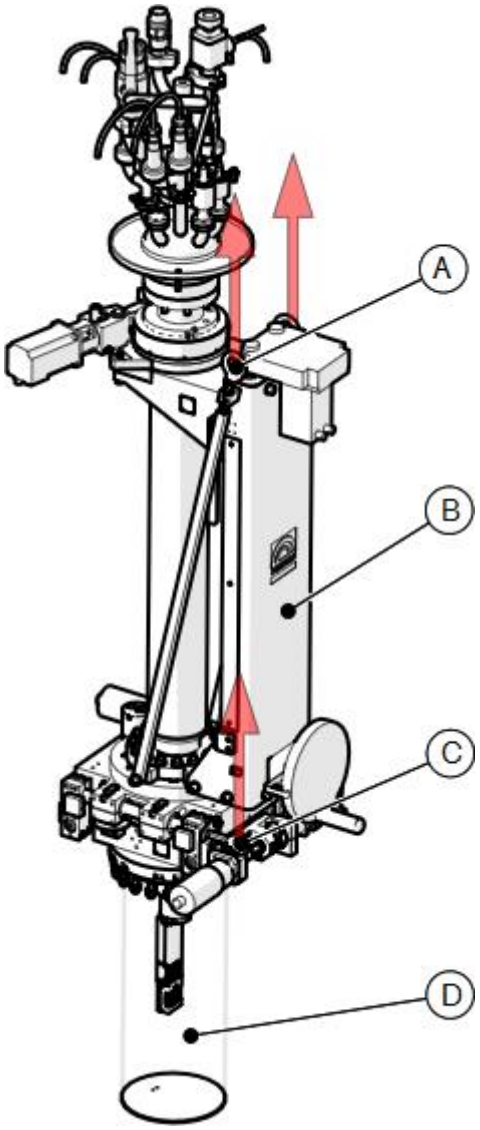
The manipulator must be lifted using at least two eye bolts.



A - eye bolts for attaching crane hooks; B - holes for screwing in eye bolts

Fig.6. Lifting of manipulator with lifting equipment

PREVAC sp. z o.o. bears no liability for personal injuries or detriment to health caused by lifting heavy objects without appropriate equipment. Objects whose weight exceeds lifting capacity limits of human, governed by the applicable health and safety regulations, are equipped with eye bolts or other elements facilitating the use of dedicated lifting equipment.



A - eye bolts for attaching crane hooks; B - manipulator; C -eye bolts for attaching crane hooks; D - transport shield

Fig.7. View of example manipulator with transport shield (for transport in upright position)

3.2.1. Preparing manipulator for transport

Procedure of preparing manipulator for transport:

CAUTION

- put the XY table in the centre position (micrometre screws must indicate middle value at the scale);

- put the Z axis manipulator trolley in the position enabling installation of a transport shield;
- lock the rotary feedthroughs and Z module by tightening their locking screws;
- mount and tighten the shielding cap;
- mount the manipulator on the transport base or box
- the XY table should be secured against movement with locking screws
- put the manipulator in a transport box (if supplied);
- it is recommended to secure the manipulator with protective foil.

3.3. Installation guidelines

Before installation prepare the destination room in which the equipment will be located according to the list supplied earlier.

The destination room must be equipped with appropriate electrical connectors and other required.

The flanges of the device should be bolted using bolts and gaskets of appropriate sizes.

Connect water hoses and all electrical cables before starting the device.

3.4. Installation of manipulator on chamber

- Connect the manipulator to the target port of the chamber;
- Connect heating cables and thermocouple cables from HEAT3;
- Connect all electrical feedthroughs;
- Connect electrical sockets for the drives:
- Pump out the chamber with the manipulator;
- Test the chamber and manipulator for tightness.

3.5. Sample holder

A sample holder - a component enabling transport and testing of a material sample, which is placed on it.

The manipulator accepts flag style holders.

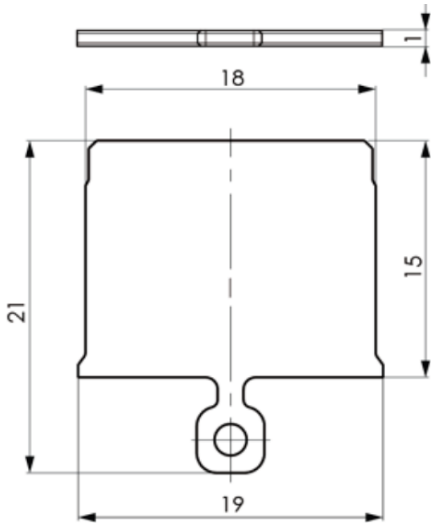


Fig.8. Flag Style sample holder (example)

4. Correct use

The device is ready for operation after the installation. All the connections such as: supply of electricity and compressed air should be made according to safety standards.

Always check electrical connections before using the equipment.

Before use of the product check electronic settings.

4.1. Operating position

The operating position has not been clearly defined. Operating the device requires taking many positions by the user.

4.2. Operation

- The device must be correctly installed;
- The information in this manual must be followed carefully;
- Keep the moving parts of the mechanisms clean;
- If any movement becomes tight or loose the device will require maintenance. Report any noticed irregularities immediately;
- The whole device requires regular maintenance at least once a year, however, individual components should be maintained according to the requirements contained in respective manuals;

4.3. HV and UHV vacuum joints - operation

In vacuum technology many types of joints (flanged) are used, e.g. CF, KF, ISO, ASA, JIS, Wire-Seal and other.

The operating principle of such joints is based on using soft sealing materials placed between harder surfaces of flanges to make vacuum seal.

Some of the joint types require using polymer elastomers as sealing material of other metals (usually non-ferrous). Joints with elastomer seals usually limits vacuum to 10E-7 mbar, and their use limits the working temperature in the range of -10[°C] ÷ 150[°C].

Other types of seals (soft metal gaskets) are used for pressures as low as 10E-9 mbar and often work in temperatures between -196[°C] and 450[°C].

Each system has its advantages and disadvantages in certain applications, but for UHV and HV Usually CF and KF joints are used, which offer easy maintenance and financial benefits.

The choice of a certain type of joints in vacuum chambers and pumping systems depends on:

- required vacuum conditions;

- required working conditions (temperature);
- no influence on materials, products and processes carried out;
- most economical solution;
- extension possibilities;
- most comfortable and available solution.

It is not recommended to mix seal types using distributors or reducers. Such practice may limit pumping speed. However, using different types of flanges for the element mounted on the chamber and for those mounted on the pumping line is a common practice.

PREVAC sp. z o.o. definitely recommends that every new user of vacuum equipment tries to understand the basic features of each type of flanges. Such practice can contribute to correct evaluation and operation of flanged joints.

4.3.1. HV joints (ISO-KF)

The ISO-KF flange system utilises a single clamp system. This is an economical and reusable solution for quick and frequent assembly and disassembly. The ISO-KF flanges can operate in high partial vacuum environments to pressures in the range from 1E-8mbar.

ISO-KF flanges comply with all ISO specifications (DIN 28 404 and ISO 1609) for mounting parts for vacuum equipment.

- flanges for all common sizes are used;
- flanges used are compatible with the standards of all other manufactures of WN components;
- vacuum of 1E-8[mbar];
- bakeout temperature up to 200[°C] (150[°C] continuous);
- air tight to 1E-10 [mbar*x*/s].

Centering Viton O-rings

Used to make proper vacuum seal. The O-ring (Viton® or Nitrile) is held in place between flanges by means of a metal ring. The design of the ring means that it is impossible to over tighten the O-ring.

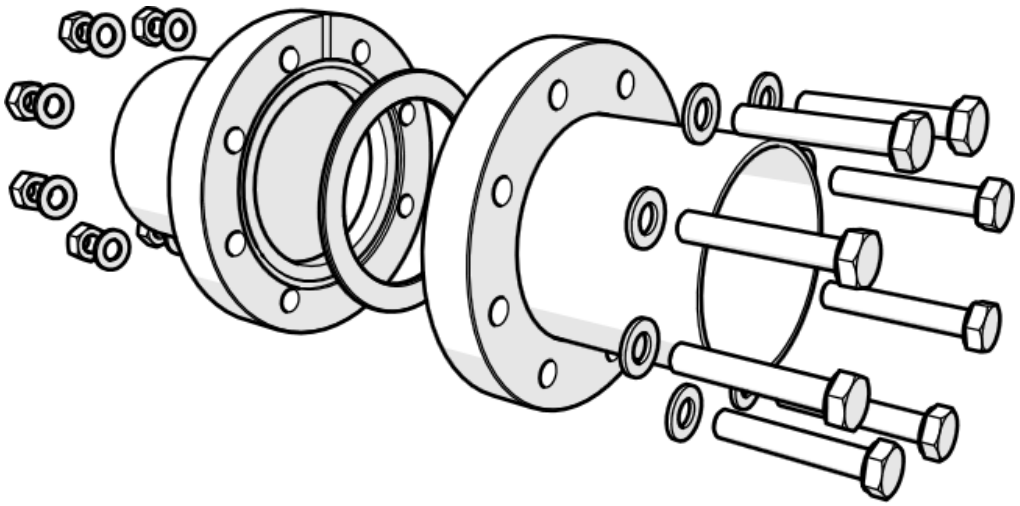
Viton O-rings - centering adapter

Centering adapters are similar to the centering O-rings. They are shaped to allow flanges of different internal bore sizes (with the same OD) to be joined together. Viton® material is characterised by good bakeable resistance, even up to +150°C.

Flange clamps

Used to make tight connection. The clamp is placed around the outside of the two mating flanges (of the same type and size) and tightened by a screwed joint with the use of a wing nut.

4.3.2. UHF joints (CF - Conflat®)



Introduction to ConFlat® Flanges

- wide range of Imperial and Metric standard sizes;
- all flanges manufactured on computer controlled CNC machines for shape accuracy and repeatability;
- made of 304L or 316LN stainless steel;
- low outgassing rates, <1x10E-13 mbar*l*sE-1cmE-2;
- available with optional through or tapped holes for mounting screws.

Introduction

ConFlat® flanges were invented to overcome the problems associated with enclosing a UHV environment, i.e. a vacuum chamber.

PREVAC's range of flanges is world renowned both for its quality and the range of sizes and materials. The complete range of flanges are fully compatible with the international ISO/TS 3669-2 standards. The exception is for flanges with a diameter greater than 300[mm] - no such standards exist at present. All flange dimensions are nominal.

Method of sealing

The UHV seal is made by trapping a copper gasket between two flanges that have a sharp knife-edge profiled onto their operating face. When joined together with a set of connecting bolts, the knife-edges cut into the surface of the copper gasket. When exposed to bakeout temperatures the shape of the knife-edge ensures that the seal remains air-tight and resistant to any differential movements between the copper gasket and the stainless steel flange parts.

Fixed and rotatable Flanges

To facilitate the construction of UHV chambers and components, PREVAC sp. z o.o. flanges are available in both fixed and rotatable configurations. Fixed flanges are welded as single onto a chamber or other parts of the fittings. Rotatable flanges are manufactured in two parts and then welded to the chamber or other parts of the fittings.

Note

It is not advisable to have two rotatable flanges at the same joint.

Note

To make an air-tight UHV seal between two ConFlat® flanges, a gasket is required. OFHC (oxygen free high conductivity) copper is normally used as this sealing material as it is very clean, can easily be formed to shape, has a wide temperature range, and has a low outgassing rate. PREVAC's gaskets are manufactured from precision sheet material (to guarantee a consistent gasket thickness) and then inspected, cleaned and packed

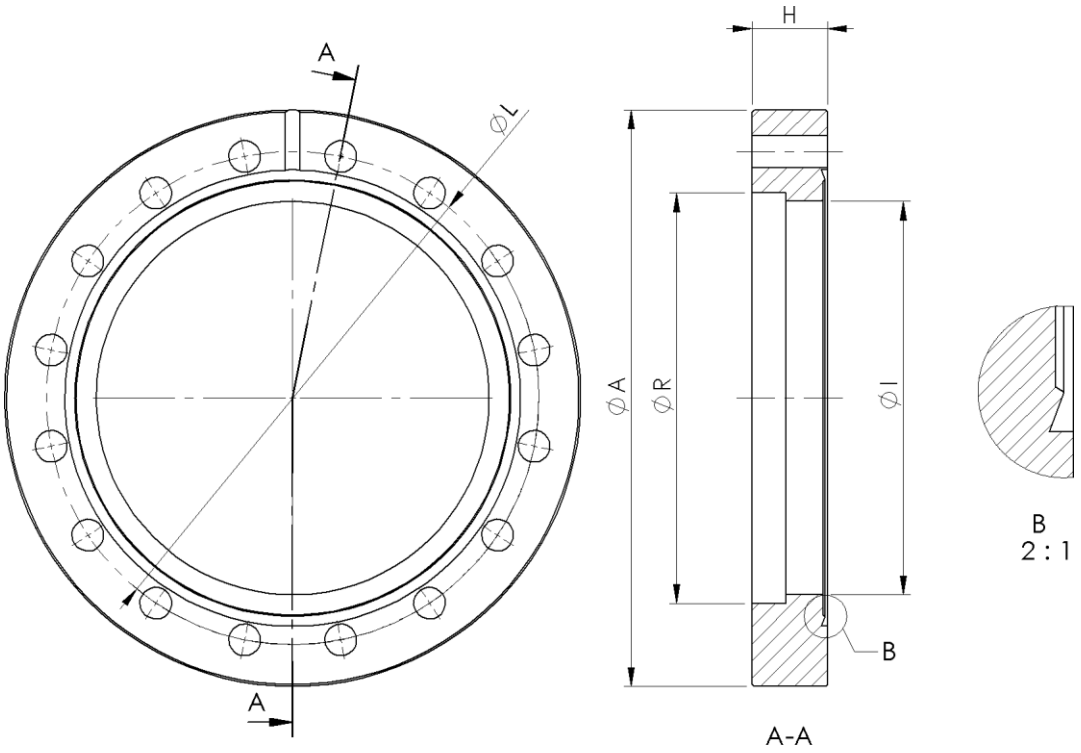
As OFHC copper gaskets are not always needed for all applications, a wide range of several different types of sealing materials. Some of these gaskets are used in special operating conditions, whereas others can be used for most general UHV applications.

The device is made of high quality steel.

All components contain vacuum suitable welds that have been created from the inside of the components connected. If the geometry is too complex to achieve a suitable internal weld, the flange is welded from the outside to avoid leaks.

Note

The minimum inside diameter of a vacuum joint depends on the combination of flange, pipe and gasket. In addition, welds and manufacturing variances from the nominal size can locally reduce the inside diameter.



Nominal diameter	16CF 1 1/3"	40CF 2 3/4"	63CF 4 1/2"	100CF 6"	160CF 8"	200CF 10"	250CF 12"
Outside diameter A [mm]	33.8	69.9	114.3	152.4	203.2	254	304.8
Height H [mm]	7	12.5	17	19.5	21	24	24
Typical size of pipe RxD [mm] I=R-2xD	18x1	42.4x1.6	70x2	108x2	159x3	206x3	256x3
Pitch diameter of holes L [mm]	27	58.7	92.2	130.3	181	231.8	284
Diameters of holes G [mm]	4.4	6.6	8.4	8.4	8.4	8.4	8.4
Bolts	6x M4	6x M6	8x M8	16x M8	20x M8	24x M8	32x M8
Torque [Nm]	4	10	20	20	20	20	20

Tab.7 Sizes of CF flanges according to ISO/TS 3669-2 standard

4.3.2.1. Installation of CF flanges

CF flanges are connected with bolted joints. Fasten the screws on a CF connection opposite each other. After the first one, fasten the screw spaced by 180°, the next one will be a screw spaced by 90°. The fourth one is spaced by 180° from the third etc. This will prevent any unnecessary tension.

If it is possible, try to set together the channels incised on flat surfaces while connecting flanges. These channels are used during pumping down the product to find possible leaks by supplying helium gas into them.

Note

Based on years of experience PREVAC Sp. z o.o. recommends to mount CF vacuum flanges in a slightly different manner than described in the literature:

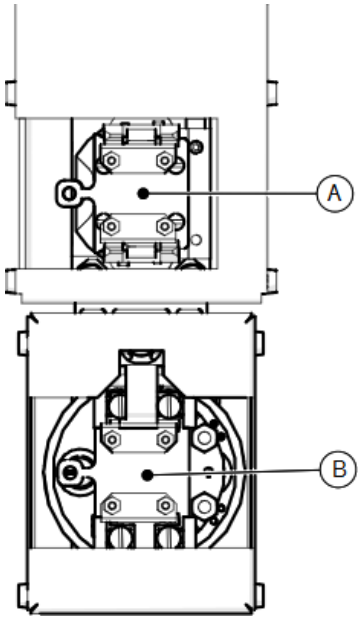
- use latex gloves when mounting flanges;
- prepare wrenches, gasket and necessary bolts, nuts and washers. Cover bolt threads with high-temperature lubricant (to avoid hedge of threads, possible after the bakeout);
- place the gasket in the groove of the flange;

- put flanges together by aligning holes and cylindrical surfaces. If it is possible, try to put together the channels incised on the flat surfaces;
- place in the mounting holes all bolts, nuts and washers. Tighten them by hand;
- make a quarter turn for each nut (or bolt). Repeat sequence several times until obtaining proper sealing.

4.4. Receiving station of flag style sample holders - operation

The manipulator can heat up and cool down holders mounted in the receiving station of the manipulator. Heating is carried out in the following stations:

- front - resistive heating by a heater wire (RES + EB) and directly (DIR);
- rear - LHe cooling with temperature stabilisation to 100°C;



A - rear station (cooling); B - front station (heating)

Fig.9. Receiving station

CAUTION

Always use talk-free latex gloves not to soil holders.

WARNING

Due to a very delicate construction of some of the parts of a holder take special care when using a sample holder so that it is not damaged.

WARNING

If the manipulator works in conditions in which layers are put on the station and holder by means of material evaporation, it is necessary to plug the unused station with an empty sample holder (flag-style). An empty sample holder is used to protect the assembly table against evaporation.

WARNING

To secure holders against falling out during R1 rotations or to improve low temperatures on the station with cooling, it is required to clamp grips installed on the station. To tighten the screws on the rear of the station use a dedicated wobblestick with a hex key.

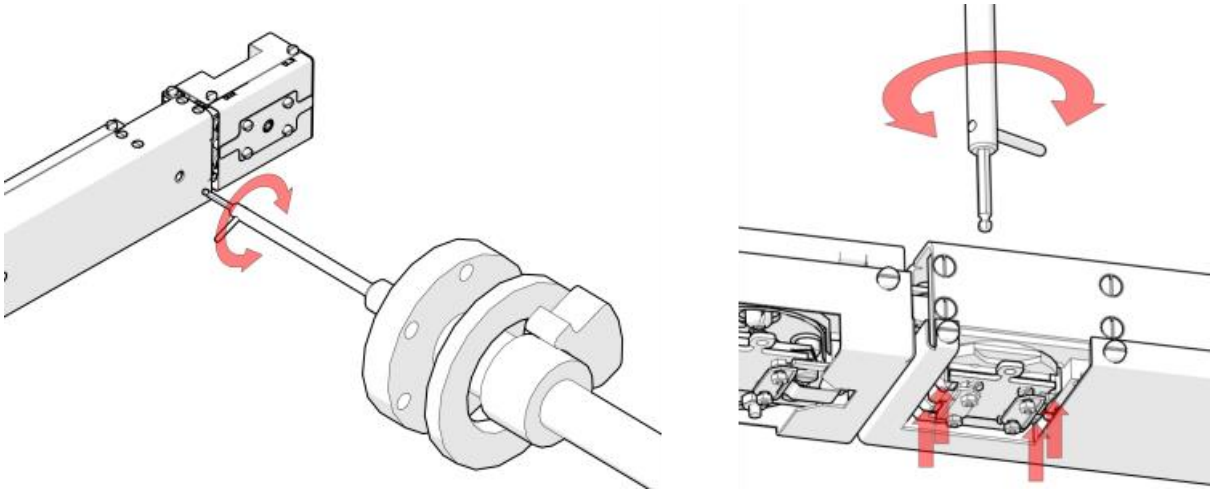
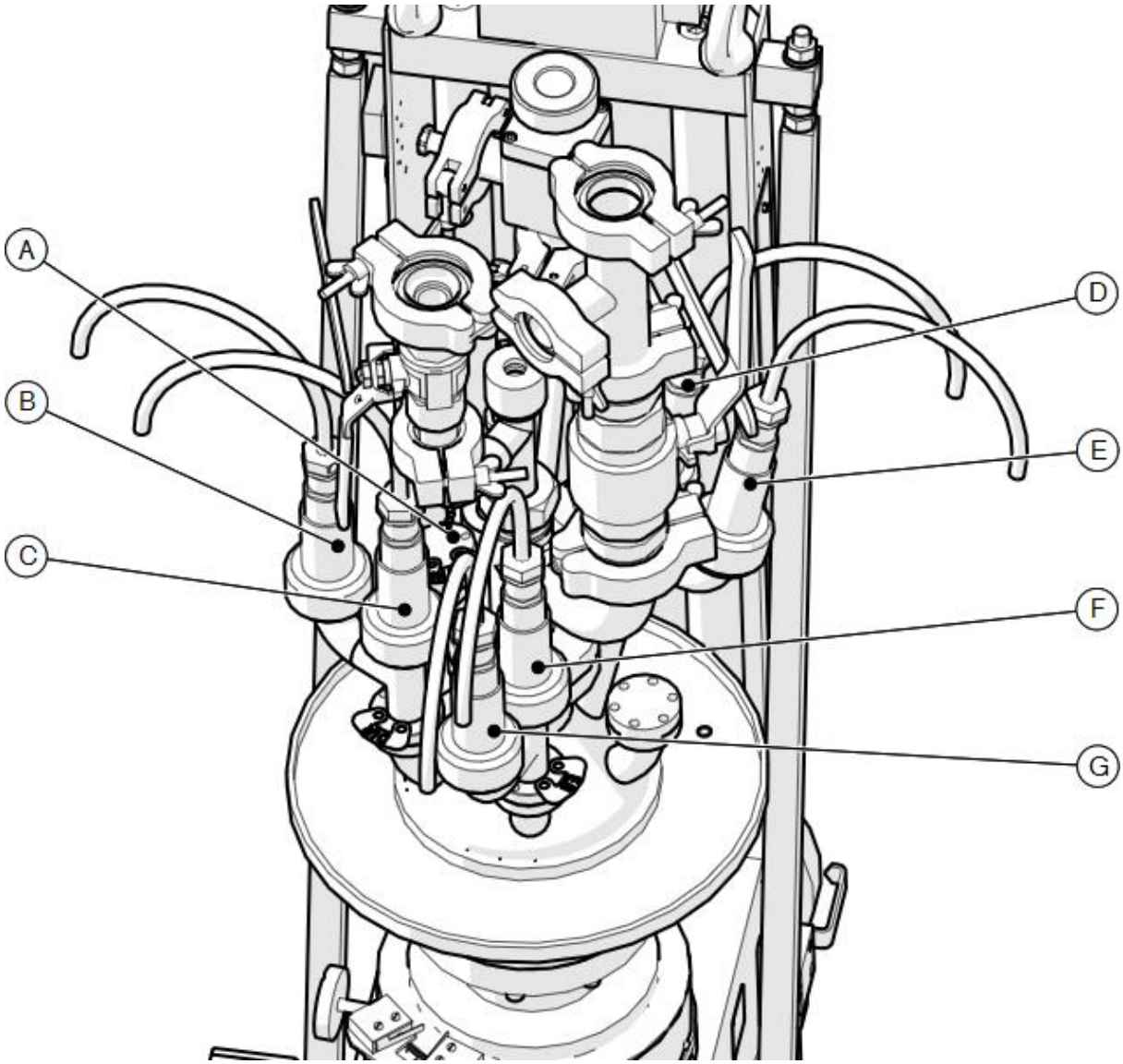


Fig.10. Tightening of clamps with wobblestick

4.4.1. Heating of holders

To start heating depending on the selected method connect properly only two cables from PS-HEAT to the manipulator to appropriate sockets depending on the type of heating. Feed-throughs



A - earthing nut; B - connection for DIR heating/earthing of table; C - connection for heating; D - connection for Thermocoax heating (temperature stabilisation); E - connection for Thermocoax heating (temperature stabilisation); F - connection for EB/RES heating; G - connection for EB/RES heating;

Fig.11. Electrical connections for heating

CAUTION

During EB heating the earthing nut (A in Fig.11) must be installed on connector B. During RES heating the table should not be earthed.

4.4.1.1. Heating - factory tests

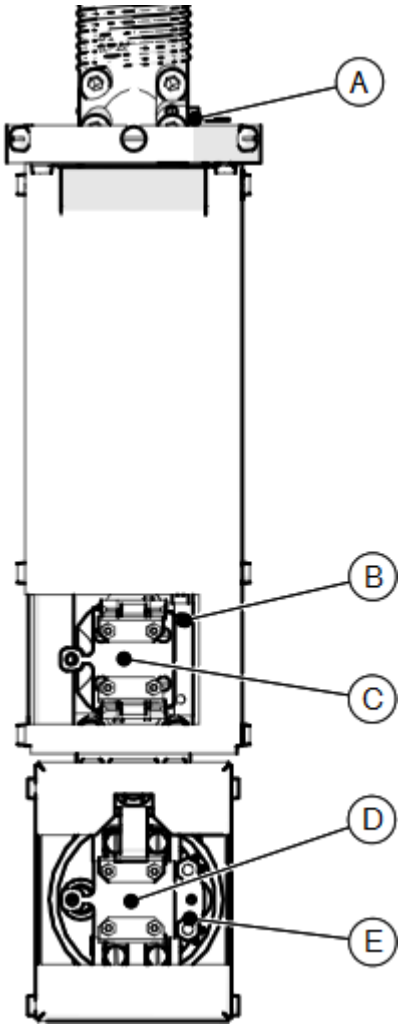


Fig.12. Installation places of thermocouples/diodes to determine reference

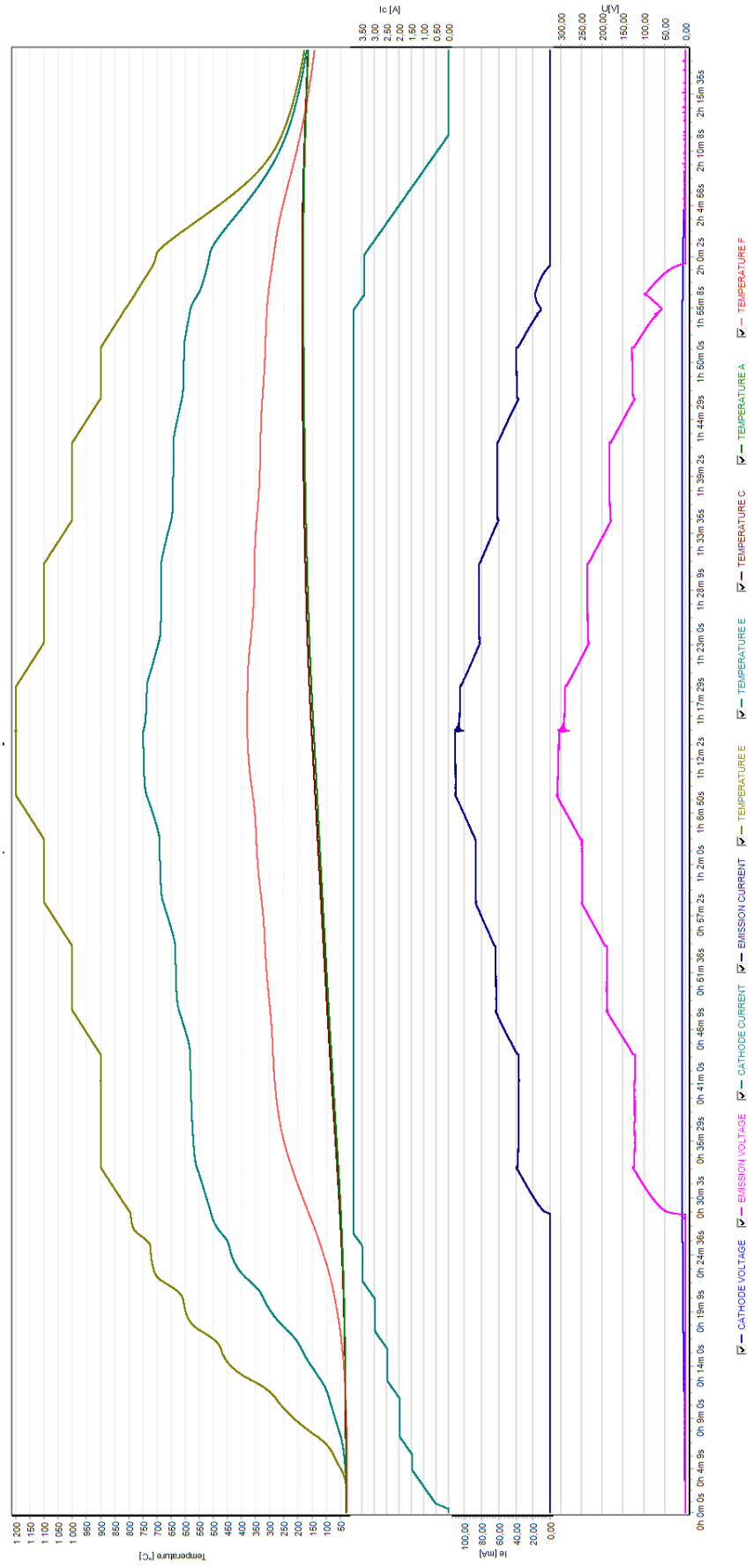


Fig.13. EB heating

Maximum temperature for EB heating is 1200^{0}C (on the sample holder!). With cooling required!

During long-lasting heating <8h of a sample holder in the manipulator on the front station above 600°C on sample holder (~350°C on the station), the station should be cooled with nitrogen or helium vapour, through the siphon. Up to that temperature cooling is not required but recommended.

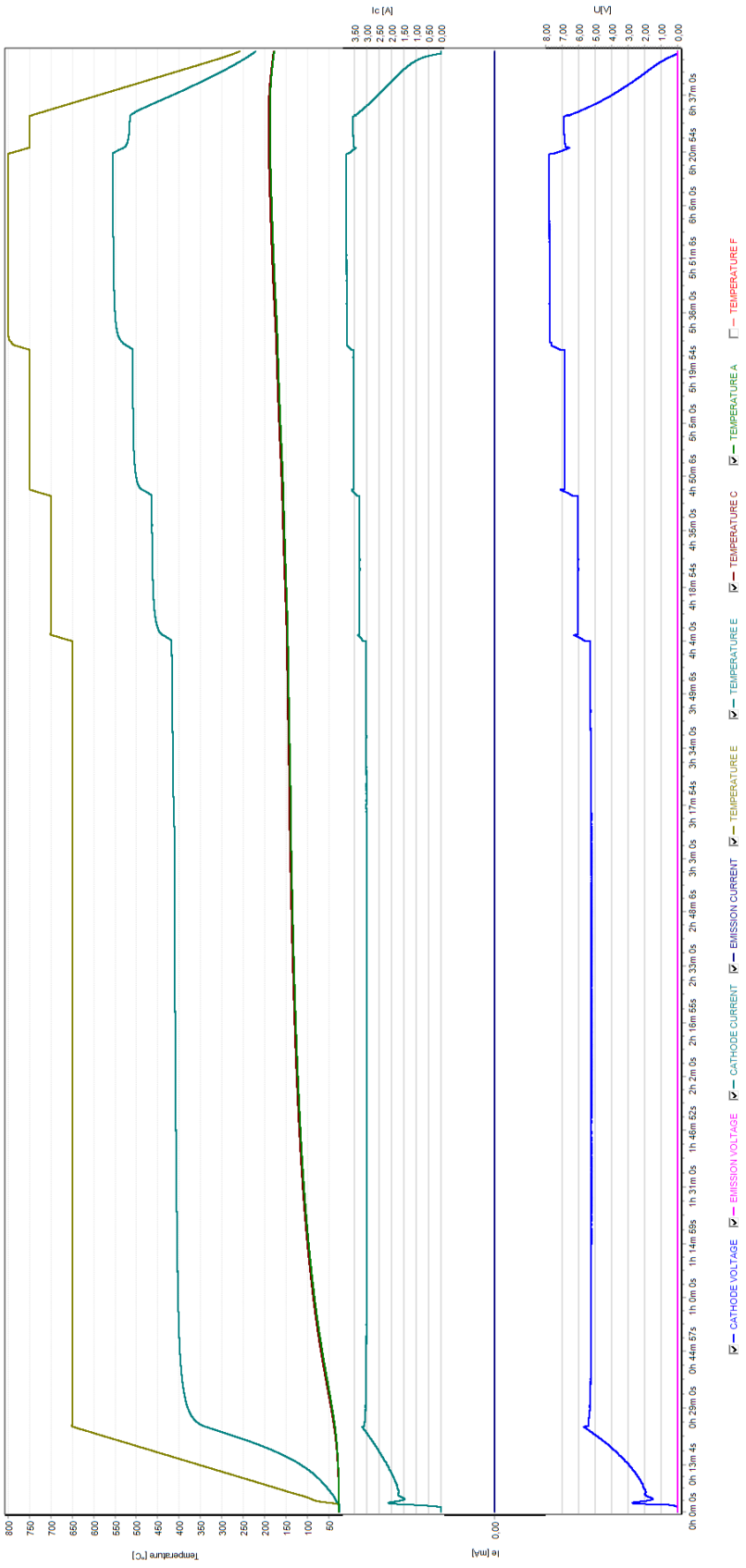


Fig.14. RES heating

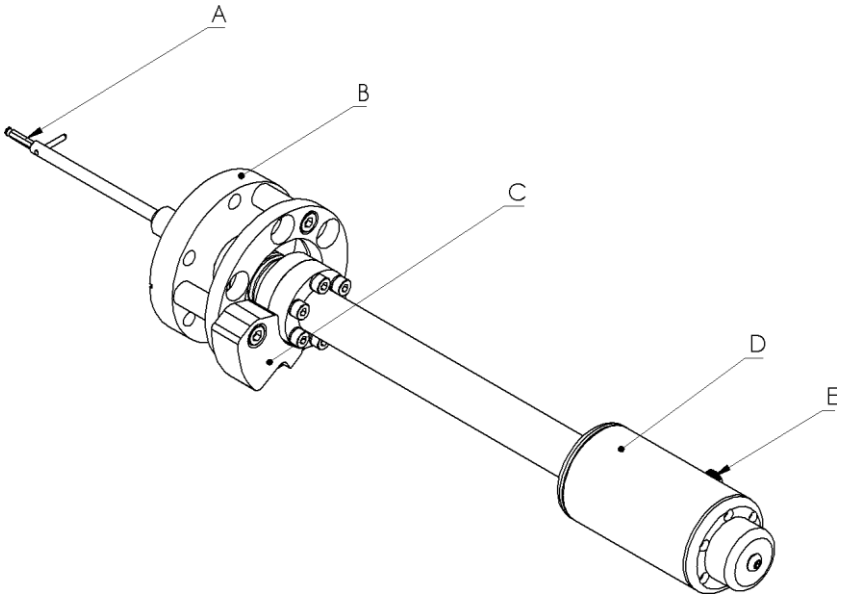
Maximum temperature for RES heating is 800^{0}C (on the sample holder!). With cooling required!

4.4.2. LHe cooling

During the preparation of a helium line, installation of a siphon and cooling - the safety valve on the tank must be open!

Slight opening / closing of the valve - slight opening / closing means very delicate using of the handwheel to change the flow of agent as minimally as possible.

The lowest temperature on a holder may be reached only by tightening the clamps of the station with a wobblestick. It ensures good thermal contact between the station plate and holder



A - tip (hex key); B - DN63CF mounting flange; C - support; D - handle; E - locking screw

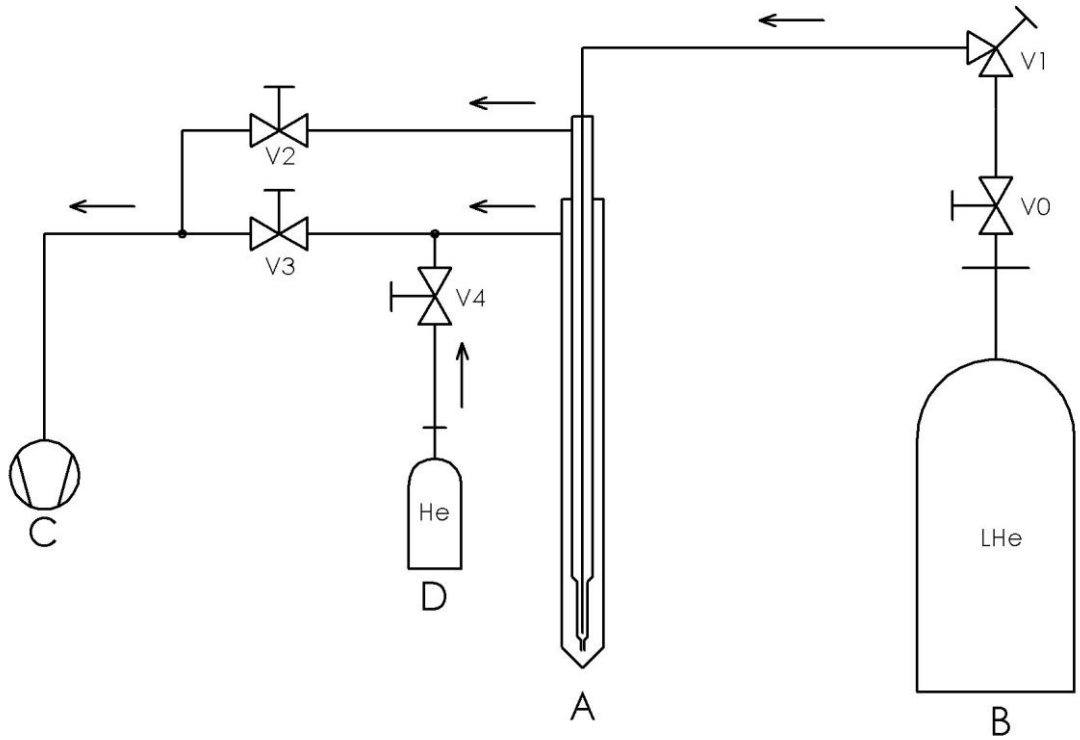
Fig.15. Wobblestick with hex key

Procedure of Sample Holder cooling with liquid nitrogen

4.4.2.1. Preparing of cooling system

1. mount the siphon of the cryostat and seal it with nuts with o-rings (installed on the cryostat => picture below).
2. plug the end of the siphon (equipped with a filter) with a silicon hose. (pull the hose over the filter)
3. two ball valves are installed on the cryostat. The first DN 16KF valve and the other DN 25KF, to which a forevacuum pump is connected.
4. immerse several coils of the pumping hose in the tank with water. Water is used to heat up the helium pumped out of the system preventing damage to the forevacuum pump.

A T-connection is installed between the DN 25KF valve and the cryostat. A valve cutting off the line with gas helium is connected to the T-connection. Gas helium under pressure of ~ 0,5bar is used to clean and valve the cryostat and the helium siphon.

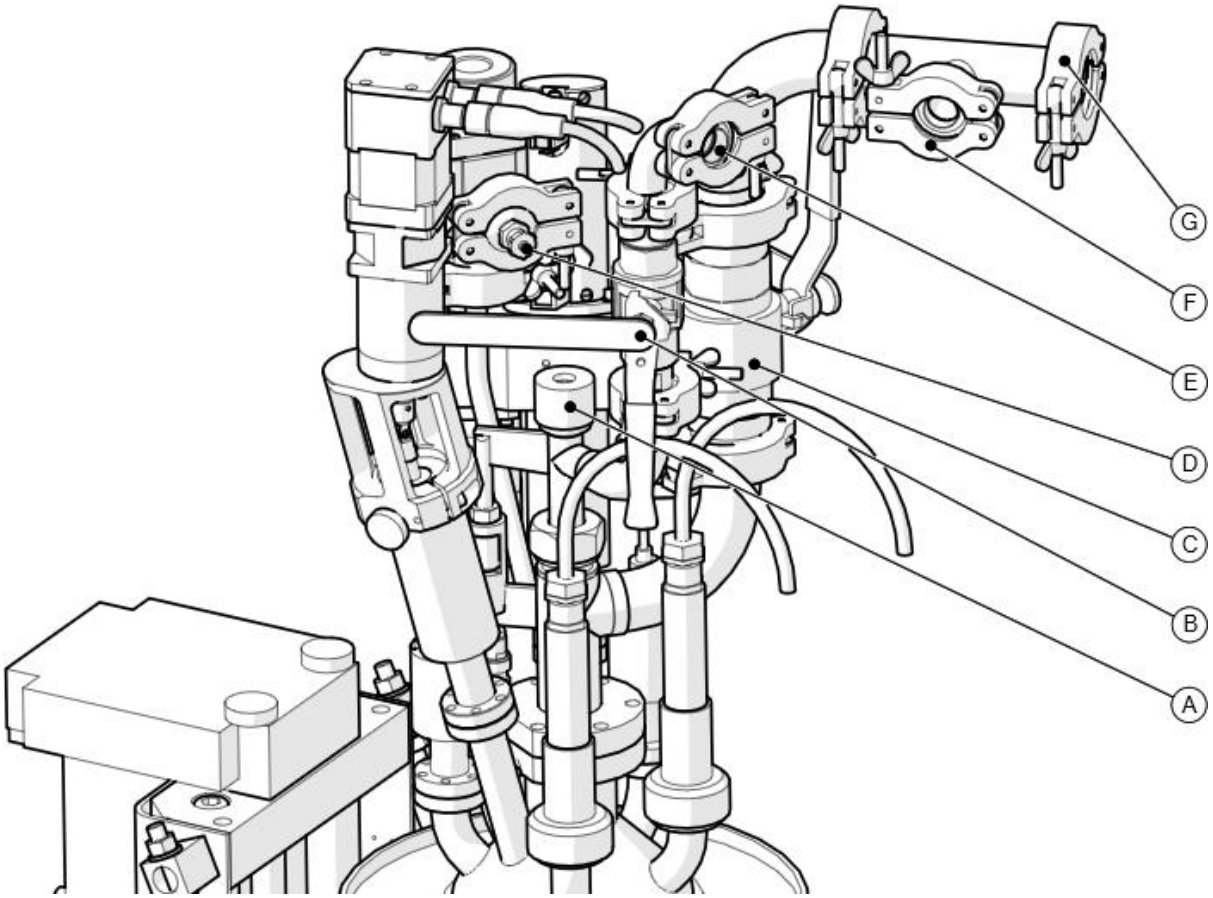


A - helium cryostat; B - tank with liquid helium (Dewar); C - forevacuum pump;
D - tank with gas helium; V0 - cut-off valve; V1 - angle control valve
V2 - DN 16KF ball valve; V3 - DN 25KF ball valve; V4 - gas helium dosing valve

Fig.16. Cooling with liquid helium - diagram

4.4.2.2. Helium manipulator - connections

The picture below shows example geometry of the helium manipulator with valves and connections according to the diagram above.



A - helium siphon installation port; B - “V2” manual valve; C - “V3” manual valve; D - “V4” connection with valve; E, F - ports joined with hose (not shown in picture); G - exhaust;

Fig.17. Helium manipulator - connections

4.4.2.3. Drying of helium siphon (of moisture)

Note

The helium siphon should be dried before inserting it into the tank with liquid helium.

1. before starting cleaning procedure open the V1 valve completely on the helium siphon and two ball valves V2 and V3.
2. leave closed the V4 valve cutting off gas helium.
3. switch on the forevacuum pump and pump the helium siphon with cryostat for at least 3 min.
4. close both V2 and V3 ball valves.
5. open the V4 vent valve and feed gas helium from the cylinder to the system.
6. after about 3 minutes close the V4 vent valve and open the V2 and V3 ball valves.
7. repeat the procedure at least 3 times.

Note

After finishing the cleaning procedure do not turn on the forevacuum pump.

4.4.2.4. Installation of siphon on dewar

1. After finishing the cleaning procedure close the V2 and V3 pumping valves and open the V4 vent valve to reach overpressure in the dewar (about 0.5 bar).
2. meanwhile, open the V0 main valve on the dewar, letting out excess gas helium to equalise pressure in the dewar. The operation allows to get rid of gas cushion in the dewar chamber.
3. remove the plug from the dewar end.
4. loosen the sealing nut on the cryostat.

Note

When loosening the sealing nut hold the helium siphon so that it will not fall out of the cryostat (it will be pushed by overpressure).

5. pull the siphon out of the cryostat to the height allowing for inserting the end to the dewar.
6. carefully insert the end to the dewar inserting at the same time the siphon to the cryostat.
7. tighten the nuts sealing the helium line on the dewar and cryostat

8. having inserted the siphon end to the dewar close the V4 vent supplying gas helium and open the V2 and V3 ball valves.

9. if the nut on the dewar is very frosted, it should be heated (e.g. with a heat gun). It will prevent damage to the o-ring during tightening of the nut (at low temperatures rubber becomes hard and brittle).

Note

Take particular care during the installation of the siphon. Wear protective clothing, thermal gloves and protective goggles.

4.4.2.5. Cooling

1. Having installed the siphon (see chapter above) the V4 valve supplying gas helium is closed and the V2 and V3 pumping valves open.

Note

The V1 valve on the siphon must be maximally open.

2. When the upper part of the cryostat starts to frost, turn off the V2 ball valve (DN 16KF) by 80% (it should be slightly open). The V2 ball valve (DN 16KF) should be closed before it starts to frost.

3. The V3 ball valve (DN 25KF) stays open during the entire cooling process.

4. At that moment the cryostat end is cooled and the station, shield and sample holder are cooled by means of litz wires.

5. On reaching the required temperature close completely the V1 valve on the siphon, and then turn it on by 1 turn.

4.4.2.6. Optimisation of helium consumption during cooling

To minimise helium consumption carry out the following operations:

1. When the temperature on the cryostat end has stabilised, turn off the valve slightly on the V1 siphon, monitoring at the same time the temperature on the monitor.

2. The temperature will slightly rise and then fall down and stabilise.

3. Repeat the operation until the temperature drop becomes unnoticeable (temperature may only rise).
4. Return to the last settings of the V1 valve described in points 1 - 2 ensures minimum helium consumption for a given operating temperature.

4.4.2.7. Stopping of cooling

To stop cooling close the valve on the siphon. Close both ball valves and turn on pumping.

4.4.2.8. Cooling - factory tests

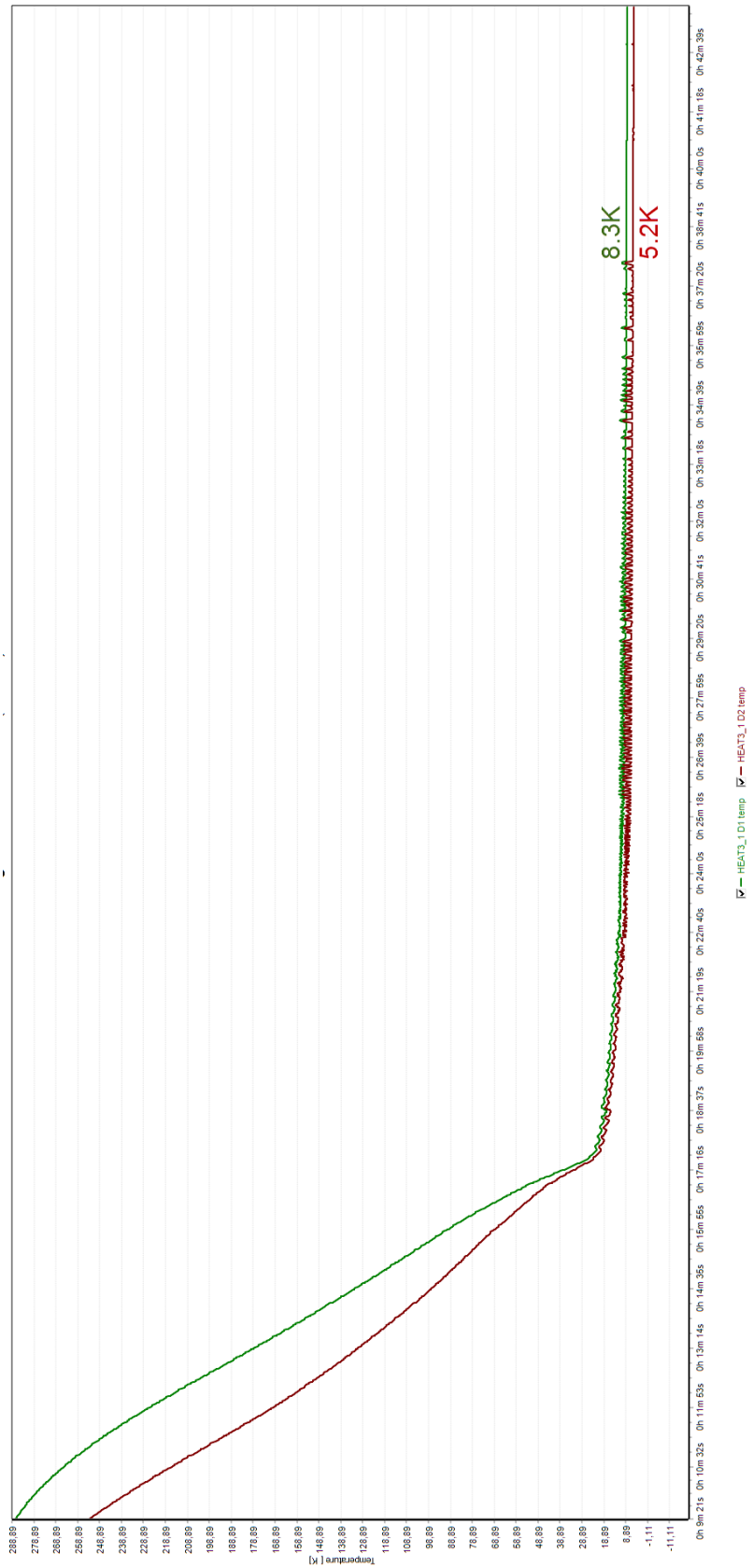


Fig.18. Cooling diagram

4.5. Disassembly of motors

All the motors of the drives of any axis of the manipulator must be disassembled before bakeout and transport.

4.5.1.1. R1 axis motor (feedthrough pumped differentially)

The surface of the motor can be very hot in extreme cases. Check the temperature of the motor to avoid burns.

To disassemble the motor from the drive of a given axis carry out the following procedure:

1. turn off the controllers before disconnecting supply cables;
2. unscrew the mounting screw.
3. remove the motor module by sliding it out along the guide. It is forbidden to tilt or turn the motor.

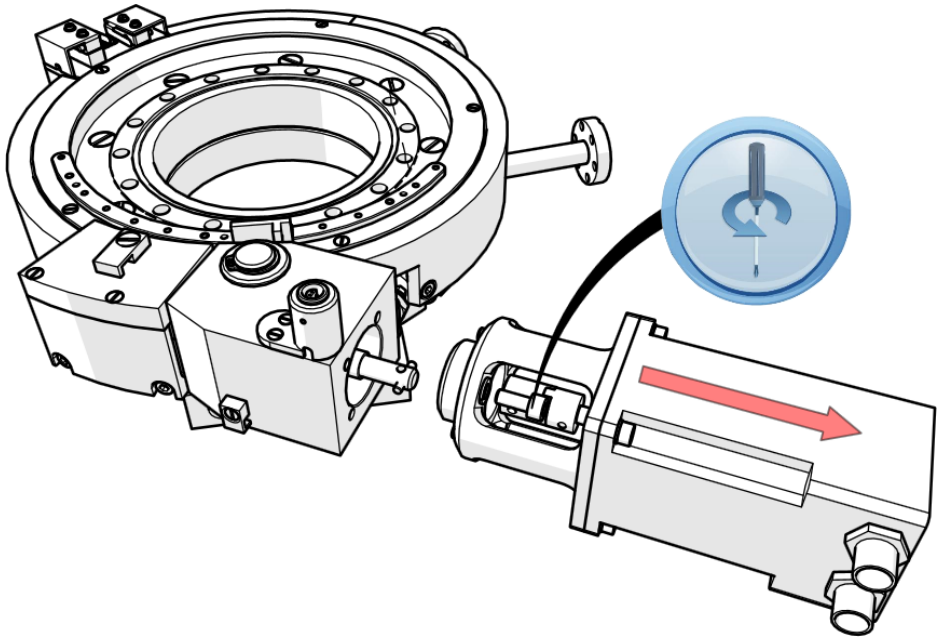


Fig.19. Removing of R1 axis motor 01-3021-3108-31001

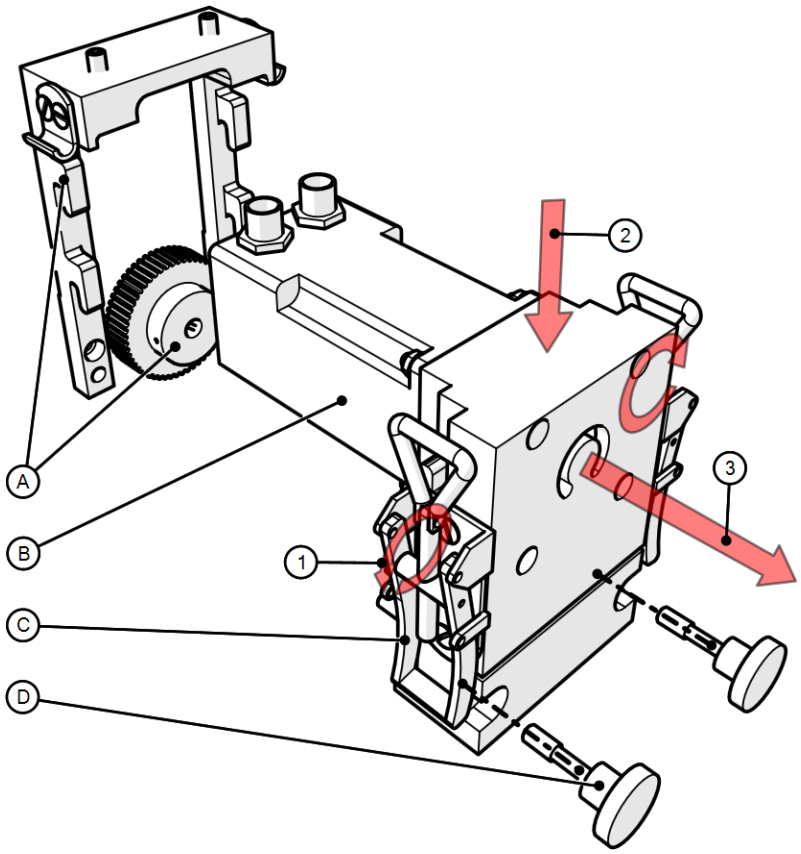
4.5.2. Z manipulator motor

The surface of the motor can be very hot in extreme cases. Check the temperature of the motor to avoid burns.

To disassemble the motor from the drive of a given axis carry out the following procedure:

1. turn off the controllers before disconnecting supply cables;
2. release the clamps;
3. unscrew mounting screws
4. remove the motor with all the removable parts;

To assemble the motor after bakeout/transport reverse the instructions.



A- non-removable parts (mounted on Z module); B - motor;
C - locking clamps; D - mounting screws;

1 - release of clamps; 2 - direction of removing motor; 3 - direction of removing motor;

Fig.20. Disassembly of Z manipulator motor

4.5.3. XY manipulator motor

Note

All the motors of the drives of any axis of the manipulator must be disassembled before bakeout and transport.

The surface of the motor can be very hot in extreme cases. Check the temperature of the motor to avoid burns.

To disassemble the motor from the drive of a given axis carry out the following procedure:

1. turn off the controllers before disconnecting supply cables.
2. unscrew mounting screws.
3. remove the motor module by sliding it out along the guide. It is forbidden to tilt or turn the motor.

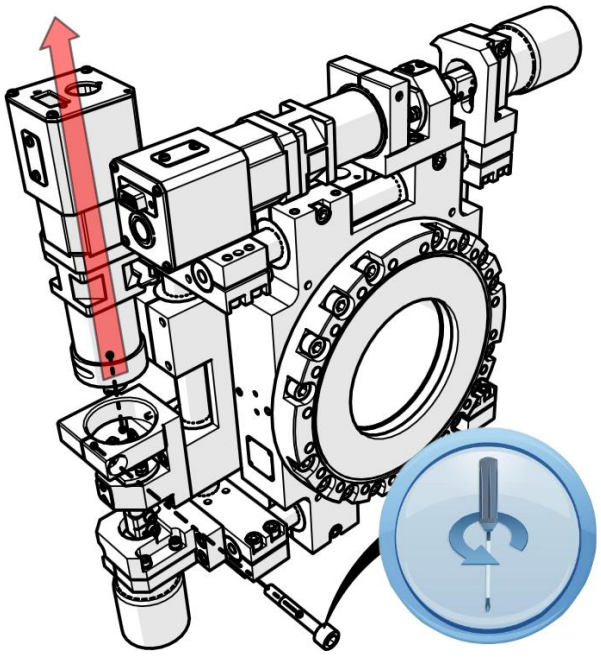


Fig.21. Disassembly of an example motor from XY manipulator 01-3022-3109-30008

5. Technical recommendations

1. Bakeout cannot last longer than 72 hours.
2. Supply of all the devices, which are not used, should be disconnected.
3. Do not replace any parts which are still under warranty before contacting PREVAC sp. z o.o.
4. Before any service visit from PREVAC sp. z o.o. the user must send a list with all of the current problems. During the service intervention will only those problems be solved which have been earlier described and sent to PREVAC sp. z o.o.

5. Before using sample holders read the "Heat3-PS" operating manual.
6. Use the Eurotherm PID controllers in the "ramp mode" <30[°C/min] mode.

7. Check the settings of the electronics before every start-up.
8. Before bakeout check whether all the non-bakeable components are removed from the bakeout areas.
9. Read all the operating manuals!

6. Appendix

6.1. List of operating manual

	Component to which manual applies	No. Doc. PL	No. Doc. EN
1.	HEAT 3	1035725	1035724

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