Operating Instructions
Read and observe this Operating Instructions!

# Vacuum pump system with wireless remote control

# SC920


CE

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KNF 121308-121311 11/12
Translation of original Operating Instructions, english

**Items including delivery:**

- Vacuum pump system including hand terminal (batteries included)
- Coated collection flasks (2 x)
- Flask clamps (2 x)
- Mains cable
- USB cable for connecting vacuum pump system to PC
- Power supply for hand terminal
- Operating Instructions
- CD with digital Operating Instructions and software for operating the vacuum pump system with a PC
- Allen key for transport fastener

**Transport fastener**

The hand terminal is fastened in place at the factory, to prevent damage during transport.

To remove the hand terminal, it is first necessary to release the transport fastener. For further details, see chapter *6. Installation and connection*.

**Content** Page

# 1. About this document

## 1.1. Using the Operating Instructions

The Operating Instructions are part of the vacuum pump system.

➔ Carefully study the Operating Instructions before using a vacuum pump system.

➔ Always keep the Operating Instructions handy in the work area.

➔ Pass on the Operating Instructions to the next owner.

Project systems

Customer-specific project systems (systems which begin with “PJ” or “PM”) may differ from the Operating Instructions.

➔ For project systems, also observe the agreed upon specifications.

**i** Compliance with the Operating Instructions is essential for the safe and reliable operation of the vacuum pump system. Failure to do so may result in damage or injury.

## 1.2. Symbols and Markings

**Warning**

**WARNING**

A danger warning is located here.

Possible consequences of a failure to observe the warning are specified here. The signal word, e.g. Warning, indicates the danger level.

➔ Measures for avoiding the danger and its consequences are specified here.

**Danger levels**

| Signal word | Meaning | Consequences if not observed |
|---|---|---|
| **DANGER** | warns of immediate danger | Death or serious injuries and/or serious damage are the consequence. |
| **WARNING** | warns of possible danger | Death or serious injuries and/or serious damage are possible. |
| **CAUTION** | warns of a possibly dangerous situation | Minor injuries or damage are possible. |

*Tab. 1*

**Other information and symbols**

➔ An activity to be carried out (a step) is specified here.

1. The first step of an activity to be carried out is specified here. Additional, consecutively numbered steps follow.

**i** This symbol refers to important information.

# 2. Use

## 2.1. Proper Use

The SC 920 vacuum pump system is designed for use in chemical, pharmaceutical, and biological laboratories. The vacuum pump system is exclusively intended for transferring gases and vapors.

Make sure that the installation location is dry and the pump/system is protected against rain, splash, hose and drip water.

Vacuum pump system is solely for use in indoor areas.

**Owner's responsibility**

Operating parameters and conditions

Only install and operate the vacuum pump system under the operating parameters and conditions described in chapter 4, Technical data.

Protect vacuum pump system against humidity.

Requirements for transferred medium

Before using a medium, check the compatibility of the materials of the pump head, diaphragm, stabilization diaphragm, valves, sealings and tubing with the medium.

Before using a medium, check whether the medium can be transferred danger-free in the specific application case.

Only transfer gases which remain stable under the pressures and temperatures occurring in the pump.

High performance condenser

The high performance condenser must be installed on the outlet side of the pump; if it is installed on the inlet side there is a danger of implosion.

Observe the correct usage of the gas- and cooling liquid-connections on the high performance condenser. Inlet and outlet connections for the gas are not interchangeable.

Accessories

Laboratory equipment or additional components connected to a vacuum pump system have to be suitable for use with the pneumatic capabilities of the vacuum pump system (see chapter 4, page 8).

## 2.2. Improper Use

The vacuum pump system may not be operated in an explosive atmosphere.

The vacuum pump system is not suitable for transferring dusts.

The vacuum pump system is not suitable for transferring liquids.

The vacuum pump system must not be used if the entry of air or gas into the vacuum pump system during venting (vent valve) could result in the creation of reactive, explosive or otherwise hazardous mixtures (e.g. with the medium).

The vacuum pump system must not be used to create vacuum and overpressure simultaneously.

An overpressure must not be applied to the suction side of the vacuum pump system.

# 3. Safety

The vacuum pump system is built according to the generally recognized rules of technology and in accordance with the occupational safety and accident prevention regulations. Nevertheless, dangers can result during their use which lead to injuries to the user or others, or to damage to the vacuum pump system or other property.

Only use the vacuum pump system when it is in a good technical and proper working order, in accordance with its intended use, observing the safety advice within the operating instructions, at all times.

Personnel

Make sure that only trained and instructed personnel or specially trained personnel work on the vacuum pump system. This especially applies to assembly, connection and servicing work.

Make sure that the personnel has read and understood the operating instructions, and in particular the "Safety" chapter.

Working in a safety-conscious manner

Observe the accident prevention and safety regulations when performing any work on the vacuum pump system and during operation.

Do not expose any part of your body to the vacuum.

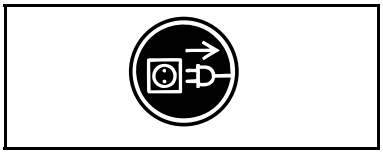


*Fig. 1: Notice sticker*

Open housing parts with notice sticker (see fig. 1) only after separating mains plug from power source.

Correct match between hand terminal and vacuum pump system

Ensure that the employees check that the hand terminal is the right one for this particular system before using a SC 920 vacuum pump system. Vacuum pump systems are equipped with a paging system for this purpose (see Actuating the vacuum pump system, page 28).

Handling dangerous media

When transferring dangerous media, observe the safety regulations when handling these media.

Handling flammable media

Be aware that the vacuum pump system is not designed to be explosion-proof.

Make sure the temperature of the medium is always sufficiently below the ignition temperature of the medium, to avoid ignition or explosion. This also applies for unusual operational situations.

Note that the temperature of the medium increases when the pump compresses the medium.

Hence, make sure the temperature of the medium is sufficiently below the ignition temperature of the medium, even when it is compressed to the maximum permissible operating pressure of the vacuum pump system. The maximum permissible operating pressure of the vacuum pump system is stated in the technical specifications (see chapter 4, page 8).

If necessary, consider any external sources of energy, such as radiation, that may add heat to the medium.

In case of doubt, consult the KNF customer service.

**Ventilating the vacuum pump system**

When ventilating the vacuum pump system with air or inert gas, be sure to prevent formation of reactive or explosive media. The maximum permissible operating pressure at the ventilation connection (Fig 2/**5**, page 11) is 0.1 bar g.

**Environmental protection**

Store all replacement parts in a protected manner and dispose of them properly in accordance with the applicable environmental protection regulations. Observe the respective national and international regulations. This especially applies to parts contaminated with toxic substances.

**Standards**

The vacuum pump system SC920 conforms to the Directive 2011/65/EU (RoHS2).

The vacuum pump system SC920 conforms to the safety regulations of the EC Directive 2004/108/EC concerning Electromagnetic Compatibility and the EC Directive 2006/42/EC concerning Machinery. The requirements of the following harmonised standards are fulfilled:

- DIN EN 61010-1
- DIN EN 55011 – class A
- DIN EN 61326-1
- DIN EN 61000-3-2/3

The pumps correspond to IEC 664:

- the overvoltage category II
- the pollution degree 2

**Customer service and repairs**

Only have repairs to the vacuum pump system carried out by the KNF Customer Service responsible.

Only authorized personnel should open those parts of the housing that contain live electrical parts.

Use only genuine parts from KNF for servicing work.

# 4. Technical Data

## 4.1. Vacuum pump system

| | |
|---|---|
| *Materials for parts contacting the medium** | |
| Pump head | PPS |
| Diaphragms | PTFE-coated |
| Stabilization diaphragm | FPM |
| Valves | FFPM |
| Sealings | FPM |
| Hose connectors | PVDF |
| Tubing | Norprene® |
| Pressure sensor | Ceramics |
| Venting valve | FFPM |
| Valve block | PP |
| *Pneumatic performance* | |
| Max. permissible operating pressure [bar g] | 0 |
| Ultimate vacuum [mbar abs.] | 2.0 |
| Delivery rate at atm. pressure [l/min]** | 0-20 (controllable) |
| Max. permissible pressure at inert gas connection [bar g] | 0.1 |
| *Ambient and media temperature* | |
| Permissible ambient temperature | + 10 °C to + 40 °C |
| Permissible media temperature | + 10 °C to + 40 °C |
| *Other parameters* | |
| Vacuum connection and gas outlet | For tube ID 10 mm |
| Ventilation connection | For tube ID 6 mm |
| Weight of vacuum pump system, including hand terminal [kg] | 15.2 |
| Dimensions: width x height x length [mm] | 366 x 423 x 294 |
| Maximum permissible ambient relative humidity | 80 % for temperatures up to 31°C, decreasing linearly to 50 % at 40°C |
| Maximum altitude of site [m above sea level] | 2000 |
| *Operating parameters of coolant (high performance condenser)* | |
| Max. permissible pressure [bar g] | 3 |
| Permissible temperature | - 15 °C to + 20 °C |
| Coolant connections on high-peformance condenser | For tube ID 8 mm |
| Coolant-wetted surface [$cm^2$] | Min. 460 |

**according to DIN ISO 1629 and 1043.1*

**Liters in standard state (1,013 mbar at 0 °C)

*Tab. 2 (part 1*)

| *Electrical data vacuum pump system* | |
|---|---|
| Voltage*** [V] | 100-240 V +/- 10 % |
| Frequency [Hz] | 50-60 Hz |
| Max. current consumption at 100 V / 115 V / 240 V [A] | 1.7 / 1.5 / 0.8 |
| Max. watt consumption [W] | 135 |
| Protection class | IP20 |
| Fuse vacuum pump system [A] | 2 x T2.5 |
| Drive motor fusing | Electronic overcurrent protection |

*Tab. 2 (part 2)* **** Automatic voltage selection*

The pump is equipped with a diaphragm stabilization system for high suction speed in vacuum.

## 4.2. Vacuum pump system's hand terminal

| | |
|---|---|
| Dimensions:<br>width x height x length [mm] | 90 x 205 x 55 |
| Weight [kg] | 0.51 |
| Operating voltage | 12 V DC |
| Current consumption | 1.25 A |
| Wireless connection's frequency band | 2.4 GHz |
| Wireless range | About 50 m without obstacles, about 10 m through walls |
| Power supply | Through integrated batteries or power supply (in delivery included) |
| DC charging socket |  <br>External diameter: 6.3 mm<br>Inside diameter: 2 mm |
| Chargeable batteries | 4 x round AA 1.2 V 2500 mAh, fast-charging; see spare parts list in chapter 11 |
| Battery service life* | Up to 12 hours, depending on number of entries and data transmission |
| Charging time* | about 7 h |

*Tab. 3* ** Applies to standard included batteries*

Several different vacuum pump systems may be operated simultaneously with their respective hand terminals within the wireless connection range.

The wireless connection between hand terminal and vacuum pump system is robustly resistant to operation of mobile telephones and Bluetooth devices in the immediate area.

## 4.3. Software

System requirements for operating the vacuum pump system via PC software:

- Windows 98 SE, Windows ME, Windows NT, Windows 2000, Windows XP
- 200 MHz processor
- Available memory of at least 64 MB

The USB connection between the PC and vacuum pump system is operated as an RS-232 interface. Accordingly, in the operating system it is managed as an additional COM connection and can be addressed with conventional terminal software. The interface protocol contains all necessary information. See chapter 13, page 50.

# 5. Design and Function

## 5.1. Vacuum pump system overwiew

**1** Carrying handle
**2** Hand terminal (removable; signals transmitted wirelessly)
**3** Set screw of transport fastener
**4** High-performance condenser
**5** Ventilation connection
**6** Vacuum chamber connection (gas inlet)
**7** Hexagonal gland
**8** Pump
**9** Base
**10** Flask clamp for **11**
**11** Suction-side condensation collection flask (coated)
**12** Mains switch
**13** Hand terminal dock
**14** Pressure-side condensation collection flask (coated)
**15** Flask clamp for **14**
**16** Gas outlet
**17** Pin of transport fastener
**18** Coolant connection on high-performance condenser (feed)
**19** Coolant connection on high-performance condenser (return)

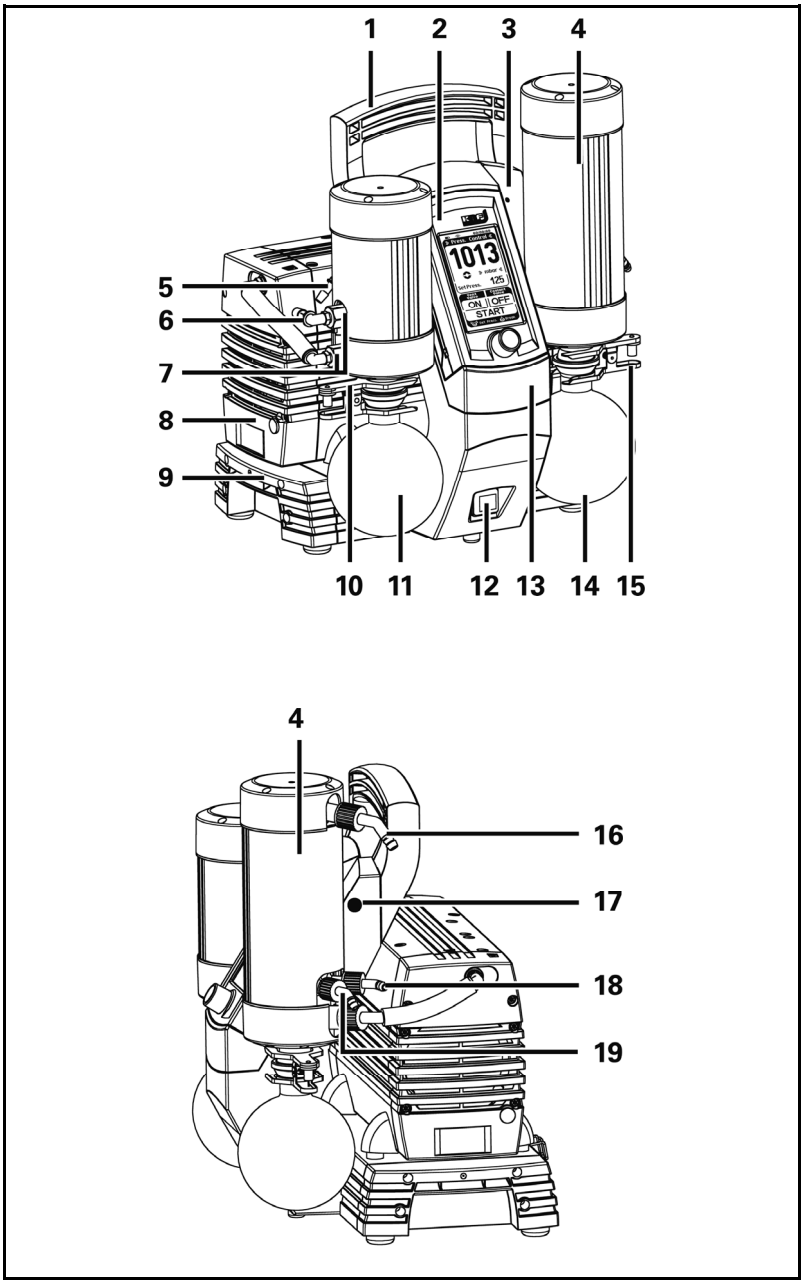



*Fig. 2: Vacuum pump system SC 920*

**1** USB port for connecting vacuum pump system to PC
**2** Coolant valve connection
**3** Mains plug connection
**4** Fuse drawer

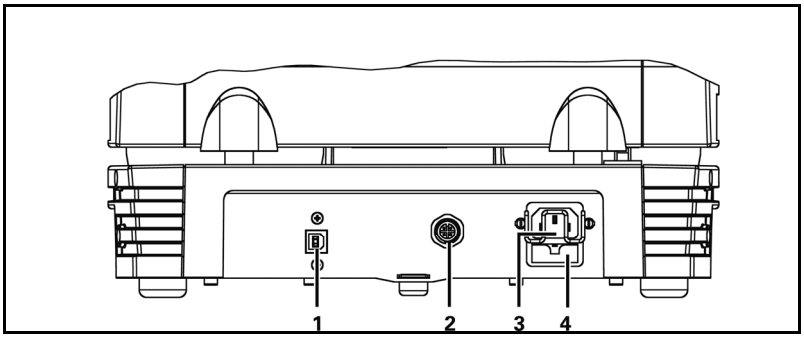



*Fig. 3: Plug strip on rear of base (Fig. 2/**9**)*

The vacuum pump system generates a vacuum that can be controlled either through the hand terminal (see chapter 5.3, page 14) or a PC.

Collection flask (Fig. 2/**11**) collects on the suction side of the pump particles and drops that were, contrary to the requirements of the pump, suctioned from the vacuum chamber. The collection flask is coated (implosion protection) and fastened to the vacuum pump system via a flask clip.

The high-performance condenser at the pump outlet once again recollects solvents from the pumped gas instead of allowing it exit into the environment or fume hood. The high-performance condenser is surrounded by a shell for temperature insulation and explosion protection.

Solvents deposited in the high-performance condenser are collected in the coated (for explosion protection) collection flask (Fig. 2/**14**). A flask clip secures the glass flask to the condenser flange. A recirculating cooler or continuously flowing cold water cools the high-performance condenser to the condensation temperature.

## 5.2. Vacuum pump system functions

The vacuum pump system can be operated in four different modes:

- **Evacuate**
  The vacuum pump system evacuates a vacuum chamber with adjustable pump capacity.
- **Pressure control**
  The vacuum pump system controls system pressure to the set-point pressure value (constant pressure).
- **Automatic**
  The vacuum pump system independently finds the sample's vapor pressure and adjusts process pressure accordingly.
- **Function**
  The vacuum pump system controls pressure according to the entered pressure curve. The following process parameters can be entered:
  - Setpoint pressure at various time points after starting the process
  - Coolant valve (accessory) ON and OFF with time point after start of process

At any time during an active process, you can switch to **manual process control**. Functions for Evacuate and Pressure control will be available simultaneously. When activating manual process control, the current actual pressure will be adopted as the first setpoint pressure. In other words, process pressure will be initially "frozen" at the current value.

The operating modes can be **combined in any way** for the purposes of intelligent process control. For example, after successful boiling point detection in the automatic mode, the following operating modes are available for specific distilling off of the solvent recovered:

- Evacuation
  (constant vaporization rate for optimum condenser capacity utilization)
- Function
  (Following a preset pressure ramp provided in order to attain a separation from components with higher boiling points)
- Manual process control
  (active control of the distillation using the setpoint pressure)

In order to change to another operating mode, the process is first stopped and then restarted in the new operating mode.

## 5.3. Hand terminal

**Basic elements**

**1** Upper grip
**2** Touchscreen
**3** I/O switch
**4** DC input 12 V
**5** Rotating knob for
- adjusting pump speed and setpoint pressure
- switching to manual operation

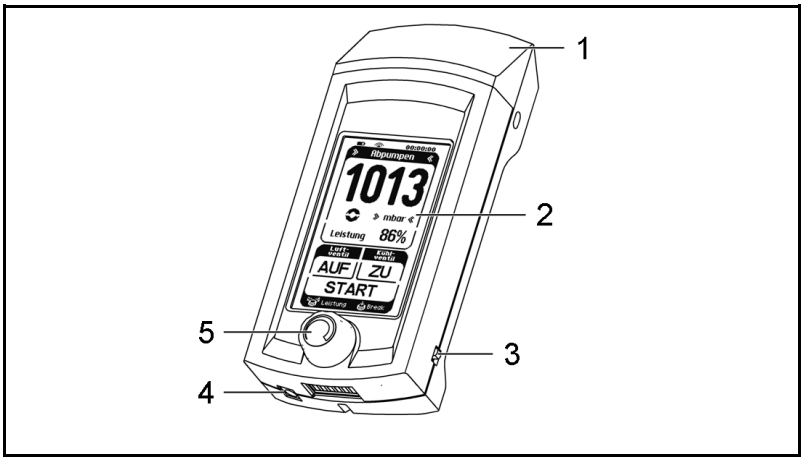



*Fig. 4: Hand terminal*

**Function**

The hand terminal is used to set process parameters with which the vacuum pump system will control pressure.

Settings can be made on the hand terminal's touchscreen (**2**) and with the rotating knob (**5**).

To operate the vacuum pump system remotely, remove the hand terminal from the holder (see chapter 8.1.1, page 23) on the vacuum pump system. This provides a convenient way to operate the vacuum pump system when it is in a cabinet or under a closed fume hood.

Whenever the hand terminal is located in the holder while the vacuum pump system is turned on, the batteries in the hand terminal will charge automatically. This happens even when hand terminal is switched off. Alternatively, the batteries can be charged through the hand terminal's power supply (see DC input (**4**)). As a result, it is not necessary to place the vacuum pump system where it is easily accessible for the user.

The power supply also makes it possible to supply the hand terminal with electrical power directly from a mains connection.

An acoustic alarm sounds on the hand terminal when the battery charge levels are low.

## 5.4. Pump

### Design

**1** Outlet valve
**2** Inlet valve
**3** Transfer chamber
**4** Diaphragm
**5** Eccentric
**6** Connecting rod
**7** Pump drive

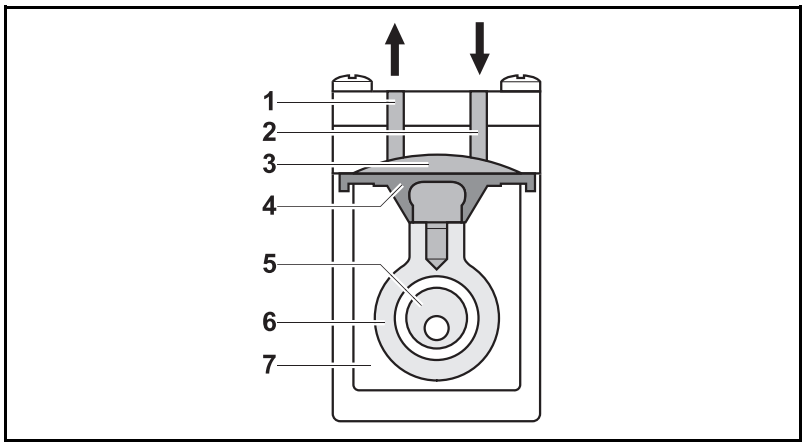



*Fig. 5: Pump design*

### Function Diaphragm pump

Diaphragm pumps transfer, compress (depending on pump version) and evacuate gases and vapors.

The elastic diaphragm (**4**) is moved up and down by the eccentric (**5**) and the connecting rod (**6**). In the downward stroke it aspirates the gas to be transferred via the inlet valve (**2**). In the upward stroke, the diaphragm presses the medium out of the pump head via the outlet valve (**1**). The transfer chamber (**3**) is hermetically separated from the pump drive (**7**) by the diaphragm.

## 5.5. Diaphragm stabilization system

### Design

**1** Balancing connection for vacuum chamber
**2** Vacuum chamber
**3** Stabilization diaphragm

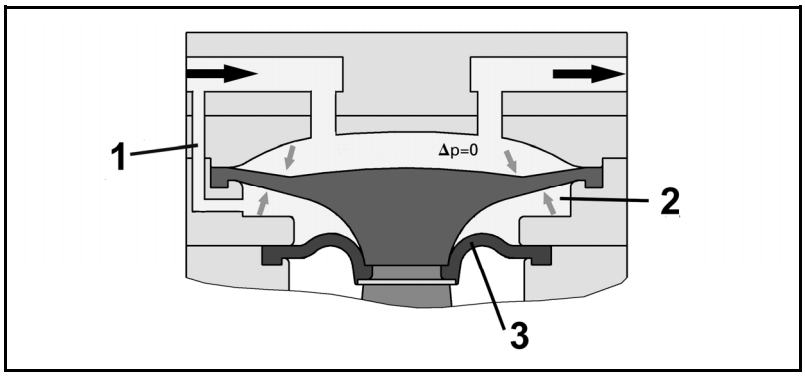



*Fig. 6: Function of diaphragm stabilization system*

### Function

Diaphragm pumps are characterized by high suction speed, however, the speed decreases as working pressure goes down. The reason for this is the difference between the pump's working pressure and the ambient pressure. The greater the pressure difference is, the more the elastic diaphragm will bulge inward and reduce the pump's effective input volume. KNF's patented diaphragm stabilization system helps alleviate this situation.

An additional diaphragm, the so-called stabilization diaphragm, separates the underside of the diaphragm from the “crank” space of the pump. The space between the two diaphragms (called a vacuum chamber) is connected with the suction side of the pump via an balancing connection. This way, the vacuum chamber has approximately the same pressure as the working space of the diaphragm pump. The pressure difference between the upper and underside of the diaphragm approaches zero. The diaphragm remains stable, independent of the inlet pressure of the pump. This improves the suction speed of the pump significantly, over its entire working range.

# 6. Installation and connection

➔ Only install the vacuum pump system under the operating parameters and conditions described in chapter 4, Technical data, page 8).

➔ Observe the safety precautions (see chapter 3, page 6).

## 6.1. Installation

➔ Before installation, store the vacuum pump system at the installation location to bring it up to room temperature.

Cooling air supply

➔ Install the vacuum pump system so that the motor fan of the pump can intake sufficient cooling air.

Installation location

➔ Make sure that the installation location is dry and the vacuum pump system is protected against rain, splash, hose and drip water.

➔ Choose a safe location (flat surface) for the vacuum pump system.

➔ Protect the vacuum pump system from dust.

➔ Protect the vacuum pump system from vibrations and jolts.

Connected components

➔ Only connect components to the vacuum pump system which are designed for the pneumatic data of the vacuum pump system (see chapter 4, page 8).

Coolant for high-performance condenser

A recirculating cooler or flowing cold water is needed to cool the high-performance condenser to the condensation temperature.

Removing the transport fastener

➔ The hand terminal is fastened in place at the factory, to prevent damage during transport. To remove the hand terminal, it is first necessary to release the transport fastener.

1. Loosen the set screw (Fig. 2/**3**, p. 11).
2. Pull out the pin of the transport fastener (Fig. 2/**17**, p. 11) as far as the limit stop.
3. Tighten the set screw again.

**i** The transport fastener can be reattached for any future transport operations.

## 6.2. Connection

1. Connect the vacuum chamber to the gas inlet's hose connector (Fig. 2/**6**, page 11, for hose inside diameter of 10 mm). For this, vacuum tubing must be used.
2. Connect hose to high-performance condenser in order to discharge gas exhaust (Fig. 2/**16**, page 11, for hose inside diameter of 10 mm).

**CAUTION**

Danger of high performance condenser bursting. The high-performance condenser is not pressure-proof.

➔ Do not reduce or regulate the quantity of gas at the gas outlet, and do not install any components that hinder the gas flow.

- Safely discharge gas exhaust so that no gas can escape into the ambient air.
- Make sure that the high-performance condenser's gas outlet is not blocked (high-performance condenser is not pressure-proof).

3. Attach coolant feed and return to high-performance condenser (Fig. 2/**18** and **19**, page 11, for hose inside diameter of 8 mm).
4. If necessary: Connect inert gas supply to ventilation connection (Fig. 2/**5**, page 11). Observe the safety instructions in chapter 3.
5. Insert the power cable plug into a properly installed shockproof socket.

# 7. Operation

## 7.1. Start up

Before switching on the vacuum pump system, observe the following points:

| Operational requirements |
|---|
| ▪ All hoses attached properly |
| ▪ Fan openings not blocked |
| ▪ Specifications of the power supply correspond with the data on the vacuum pump system's type plate. |
| ▪ Recirculating cooler or cold water connection ready on high-performance condenser. |
| ▪ The high-performance condenser's gas outlet is not blocked (high-performance condenser is not pressure-proof). |
| ▪ Vacuum pump system is at room temperature. |
| ▪ Vacuum pump system and hand terminal belong together. |
| ▪ No reactive, explosive or otherwise hazardous mixtures may be produced when ventilating the vacuum system through the air inlet (Fig. 2/**5**, page 11) (if necessary, use an inert gas) |

*Tab. 4*

➔ Only operate the vacuum pump system under the operating parameters and conditions described in chapter 4, Technical data (page 8).

➔ Make sure the vacuum pump system is used properly (see chapter 2.1, page 5).

➔ Make sure the vacuum pump system is not used improperly (see chapter 2.2, page 5).

➔ Observe the safety precautions (see chapter 3, page 6).

**DANGER**

Uncontrolled operation may result in personal injury and damage to the vacuum pump system.

When using several vacuum pump systems, there is the danger of confusing them, which can result in undesired interference into other processes: The transmission of commands from the wrong hand terminal for the vacuum pump system may trigger an uncontrolled response in the vacuum pump system that the terminal controls.

- ➔ Every time a vacuum pump system is used with a hand terminal, it is essential to ensure a correct match between the two components. Use the paging function for this purpose (see Actuating the vaccum pump system, page 28).
- ➔ Additionally it is possible to use color stickers to indicate which hand terminal belongs to which vacuum pump system (see chapter *11. Ordering information*).

**WARNING**

Uncontrolled operation may result in personal injury and damage to the vacuum pump system.

If the wireless connection between the hand terminal and vacuum pump system is broken, the vacuum pump system will continue to operate with the current settings.

- ➔ Immediately determine and remove the cause of the interruption between the hand terminal and vacuum pump system (chapter 10, page 43).
- ➔ If you are not able to reestablish wireless contact, replace the hand terminal back to the vacuum pump system (chapter 8.1.1, page 23). The vacuum pump system can also be operated directly and the ventilation valve and coolant valve can be opened and closed directly (chapter 8.2, page 30).

**WARNING**

Personal injury caused by poisoning or explosion and damage to the vacuum pump system.

- ➔ Make sure that no reactive or explosive mixtures will be produced when ventilating the vacuum pump system through the air inlet.

**WARNING**

Hazard of the vacuum pump system bursting due to excessive pressure increase

➔ Do not exceed max. permissible operating pressure (0 bar).

➔ Monitor pressure during operation.

➔ If the pressure exceeds the maximum permissible operating pressure, immediately shut down vacuum pump system and eliminate fault (see chapter 10, page 43).

**WARNING**

Personal injury caused by poisoning or explosion and damage to the pump.

➔ Make sure that no reactive or explosive mixtures will be produced when ventilating the vacuum system through the air inlet.

➔ Make sure that the media are compatible with each other (when running two different processes simultaneously).

**CAUTION**

Danger of high performance condenser bursting. The high-performance condenser is not pressure-proof.

➔ Make sure that the high performance condenser's gas outlet is not blocked.

i In order for the high-performance condenser to recover solvent from the delivered gas, it must be cooled by means of a cold water supply or recirculating cooler.

When using a coolant valve:

**WARNING**

Danger of the high performance condenser bursting

➔ Make sure that the coolant valve is mounted between the coolant supply and the coolant inlet port of high performance condenser.

Pump standstill

With the pump at a standstill, open pressure and suction lines to normal atmospheric pressure

Inspect and empty collection flasks

At appropriate intervals, inspect the fill level in the condensation collection flasks located on the suction and pressure sides of the vacuum pump system (Fig. 2/**11** and **14**, page 11). When needed, empty the collection flasks; properly dispose contents.

**Switching vacuum pump system on**

i The vacuum pump system may not start up against overpressure during switch-on. During operation as well, there may be no overpressure in the pneumatic lines. If a pump starts against pressure, it may block. This activates the thermal switch, and the pump switches off.

➔ Switch on vacuum pump system at mains switch (Fig. 2/**12**, page 11).

➔ Switch on hand terminal at its I/O switch (see Fig. 4/**3**, page 14).

Refer to chapter 8, page 23, for information on operating the vacuum pump system.

## 7.2. Taking system out of operation

➔ Stop the ongoing process.

➔ When transferring aggressive media, flush the vacuum pump system prior to switch-off to increase the service life of the diaphragms (see chapter 9.2.1, page 37).

➔ Switch off vacuum pump system with mains switch (see fig. Fig. 2/**12,** page 11).

➔ Switch off hand terminal at its I/O switch (see Fig. 4/**3**, page 14).

**WARNING**

Uncontrolled operation may result in personal injury and damage to the vacuum pump system.

If the hand terminal is switched off while the vacuum pump system remains switched on, the vacuum pump system will continue to operate with the current settings.

➔ Always switch the vacuum pump system off when done working.

# 8. Operating vacuum pump system

## 8.1. Hand terminal

### 8.1.1. General functions and displays

**1** Upper grip
**2** Touchscreen
**3** I/O switch
**4** DC input 12 V
**5** Rotating knob for
- adjusting pump speed and setpoint pressure
- switching to manual operation

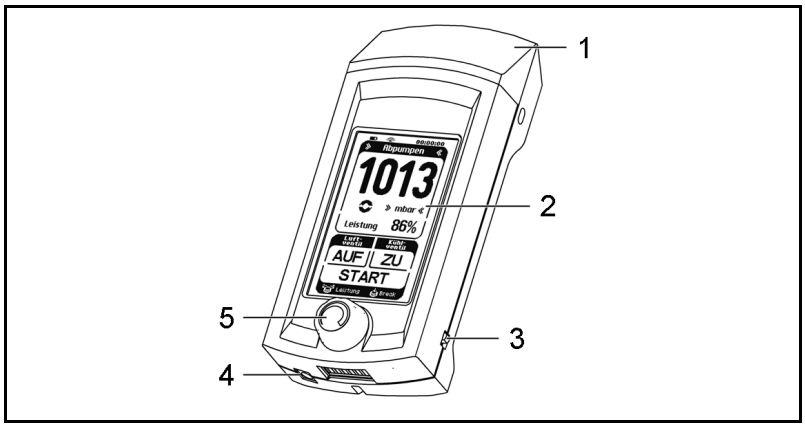



*Fig. 7: Hand terminal*

The vacuum pump system is operated via the hand terminal with the aid of:

- a rotating knob
- a touchscreen.

The **rotating knob** has the following functions:

- Rotate: Changes pump capacity or the selected pressure setting (depending on selected operating mode).
- Press: Interrupts the active process and switches into manual process control (pressing effects an evacuation in this case).

**Touchscreen** contents:

- Display of the most important process variables (Fig. 8, page 24).
- Menu for selecting operating mode and units for pressure display (Fig. 9, page 24).
- Operating buttons (Fig. 9, page 24) with the following functions:
  - Start and stop the process;
  - open and close the ventilation valve;
  - open and close the high-performance condenser's coolant valve (accessory).

**Removing and replacing the hand terminal**

To remove the hand terminal from the vacuum pump system: grasp the upper grip of the hand terminal (Fig. 7/**1**) and pull until it releases, and then remove it.

Replacing the hand terminal:
Insert the bottom of the terminal into the holder provided in the vacuum pump system (Fig. 2/**13**, page 11); then push firmly on the upper grip of the terminal (Fig. 7/**1**) until it clicks into place.

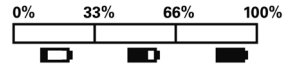
Whenever the hand terminal is located in the holder while the vacuum pump system is turned on, the batteries in the hand terminal will charge automatically. This happens irrespective of whether the hand terminal is switched on or off.

Every time you use a hand terminal, check to ensure a correct match between the terminal and the vacuum pump system. Use the paging system for this purpose (see Actuating the vacuum pump system, page 28).

**Displays**

**1** Battery:
- Charging

- Charging status




**2** Connection to vacuum pump system
- Direct connection
- Wireless connection

**3** Process time

**4** Actual pressure in selected pressure unit (or „No connection“, if no wireless connection to vacuum pump system)

**5** Process active

**6** Capacity in percent or setpoint pressure in selected pressure unit (depending on operating mode)

**7** Explanation of rotating knob functions
(Rotate: change capacity; Press: interrupt operating mode and switch to manual process control)

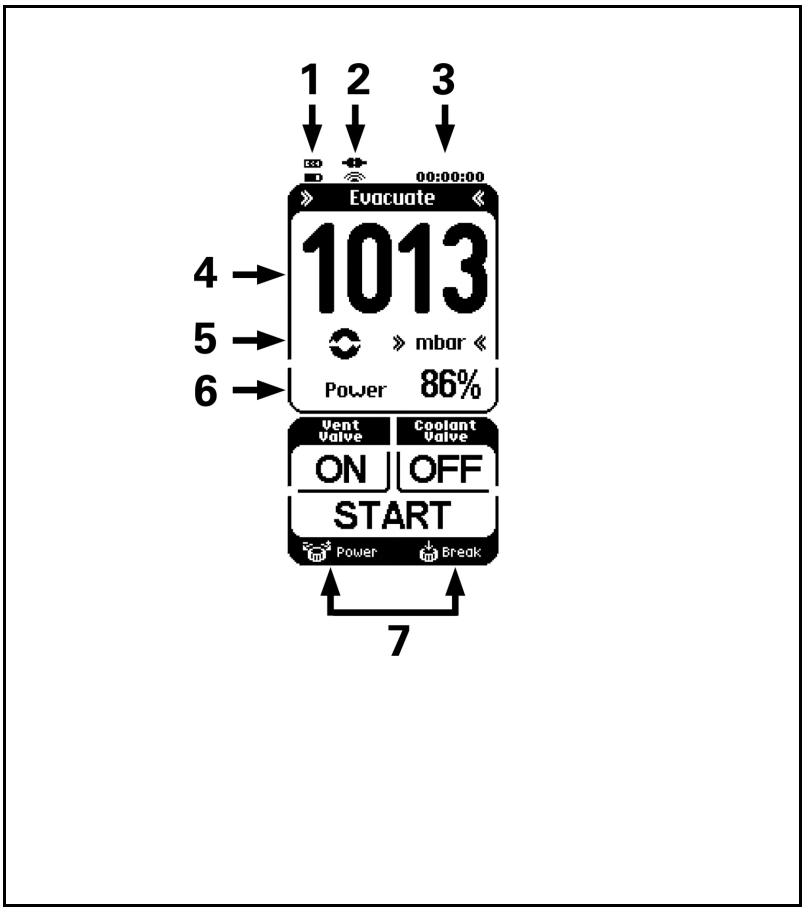



*Fig. 8: Display on the touchscreen*

**Menus and buttons**

**1** Operating mode menu

**2** Pressure units menu

**3** Button Actuating the vacuum pump system (Paging)

**4** Button for ventilation valve:
ON = To open
CLOSE = To close

**5** Button for coolant valve (accessory) at high-performance condenser:
ON = To open
CLOSE = To close

**6** Button for the process:
START = To start
STOP = To stop

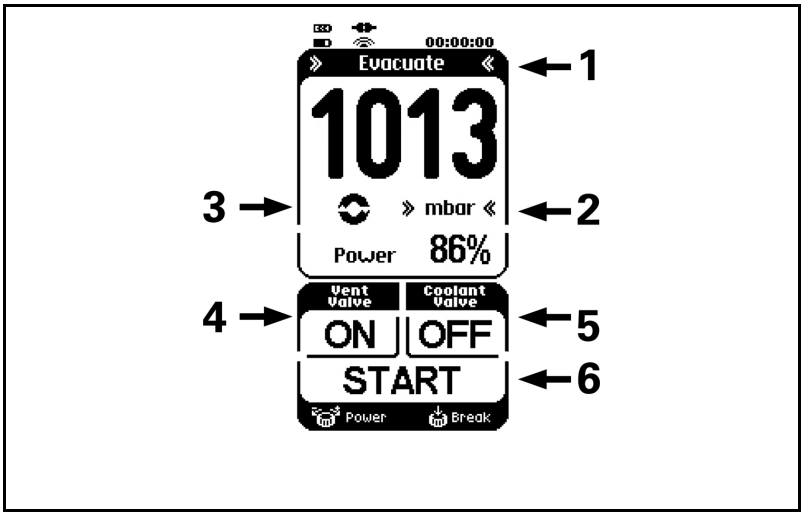



*Fig. 9: Menus and buttons on the touchscreen*

### 8.1.2. Operation

**Menu language**

When the start page appears after switching the hand terminal on, choose between the following languages: English, German, French, Italian, Spanish and Chinese. The selection can be made only immediately after switching on.

**Pressure unit**

Process pressure can be displayed on the hand terminal in mbar, bar, hPa, or Torr.

Use the Pressure units menu to select the pressure units (button on touchscreen; see Fig. 10).

Pressure units can be changed only when no process is active.

In order to change the unit of pressure, it is necessary to temporarily switch to another operating mode.

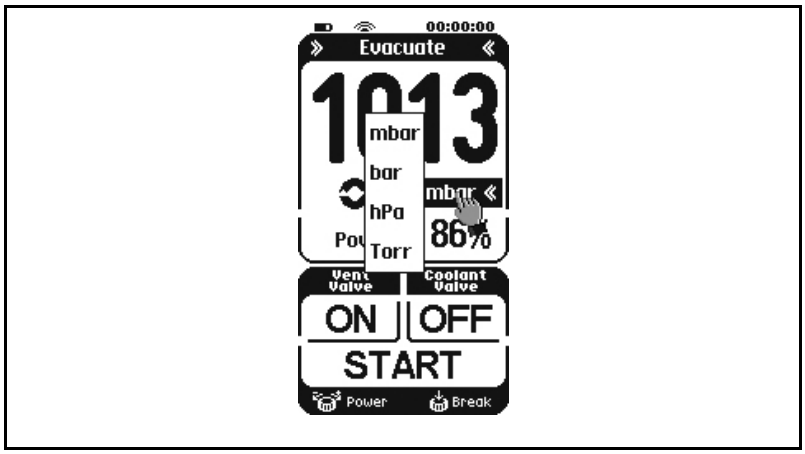



*Fig. 10: Pressure units menu*

**Operating modes**

The current operating mode is displayed at the top of the hand terminal's touchscreen. Press on this line of the touchscreen to open the menu for changing operating mode (see Fig. 11, at the top).

Operating mode can be changed only when no process is active.

**Switching to manual process control (Break)**

- Press briefly on the rotating knob:
  Manual process control; actual pressure will be adopted as the setpoint pressure and actively controlled.

**Within the manual process control**

- Press on the rotating knob:
  Vacuum pump system will evacuate.
- Let go:
  Actual pressure will be adopted as setpoint pressure.

- Rotate:
  Changes setpoint pressure.

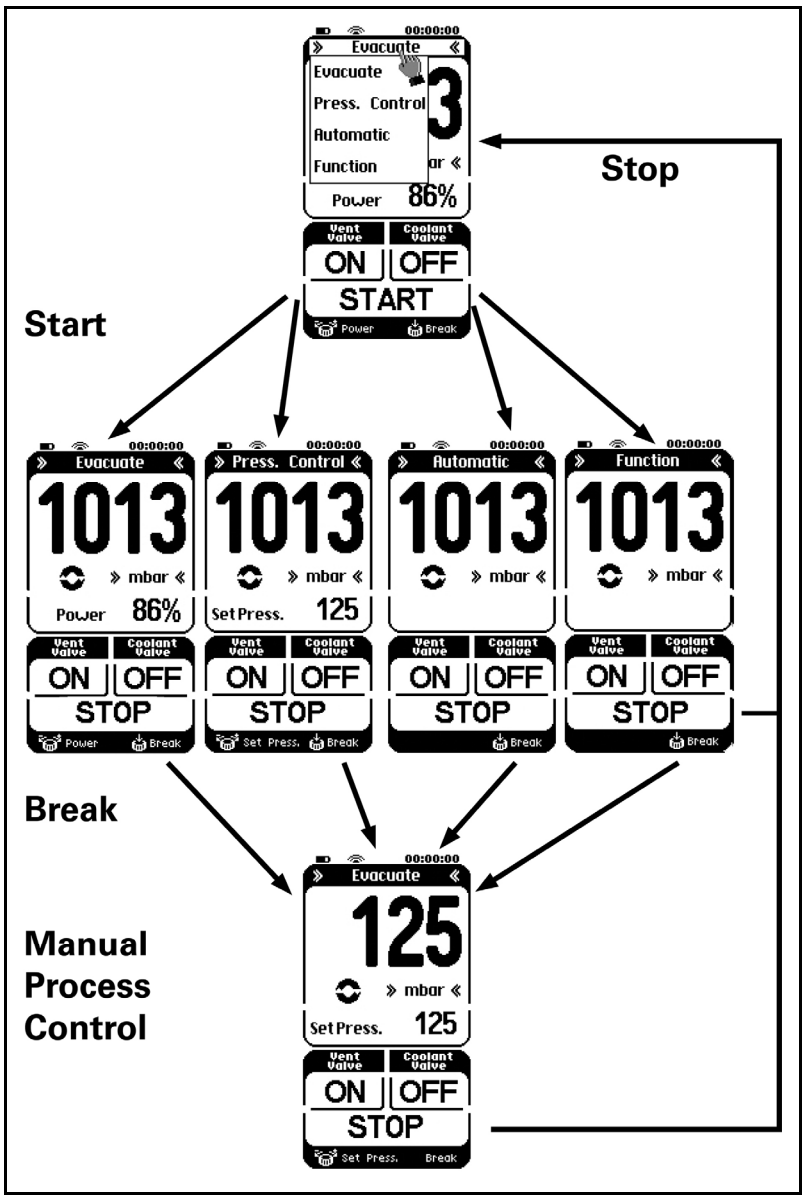



*Fig. 11: Operating mode menu*

**Starting and stopping the process**

Pressing the START button starts a process.

Pressing the STOP button stops a process.

**Open and close the ventilation valve**

**WARNING**

Personal injury caused by poisoning or explosion and damage to the vacuum pump system

➔ Ensure that the creation of reactive, explosive or otherwise hazardous mixtures during the supply of air is prevented.

Pressing the ON button for ventilation valve (left button below) opens the ventilation valve.

Pressing the OFF button for the ventilation valve closes the ventilation valve.

**Opening and closing coolant valve (accessory)**

Pressing the ON button for coolant valve (right button below) opens the coolant valve on the high-performance condenser.

Pressing the OFF button for the coolant valve closes the coolant valve on the high-performance condenser.

**Entering value in Evacuate operating mode**

Use the rotating knob to set pump capacity.

**Entering value in Pressure control operating mode**

Use rotating knob to set desired pressure.

**Entering value in Automatic operating mode**

Not necessary to enter value.

**Entering value in Function operating mode**

The desired pressure curve is entered via data points that connect the vacuum pump system to pressure ramps.

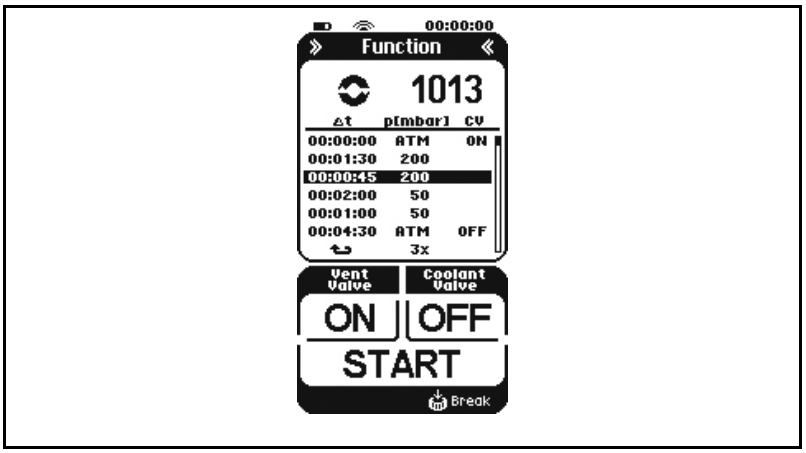



*Fig. 12: Menu for Function operating mode*

Entering data points (up to 12):

1. Time interval since the last data point: Δ t
2. Setpoint pressure: p (mbar) / p (bar) / p (hPa) / p (Torr)
3. Command for coolant valve (accessory):
   CV ON: to open valve; CV OFF: to close valve

Line selection (see Fig. 12):

- To change the line:
  Turn the rotating knob.
- To select a line for editing:
  Press the rotating knob.

To edit a selected line:

- To change columns:
  (e.g. from ∆ t to p (mbar):
  Press the rotating knob.
- To change an entry:
  Turn the rotating knob.

After the last column (CV), the display automatically returns to line selection and jumps to the next line.

If you are in input mode and have not entered any data within 3 seconds, the display automatically returns to line selection.

The function values of the data point table are stored in the internal memory of the vacuum pump system when the process starts, and are available again when there is a restart.

Changes to the function values (sampling point table) are carried over directly from the PC software, which may be used simultaneously.

Repeating/deleting sampling points:

The following symbols may be set in the column for the time intervals under the value 00:00:00:

- ↺ = Repetition. The desired number of repetitions can now be specified in the field for the setpoint pressure.
- **…** = Deletion of the data point.

In both cases, all subsequent sampling points are automatically deleted.

**Actuating the vacuum pump system (Paging)**

When you press the circle symbol for the active process (Fig. 8/**5**, page 24) in the hand terminal display, the LED next to the page button (Fig. 14, page 30) on the vacuum pump system will blink.

The other way around, the hand terminal will answer with a signal tone if you press the paging button of the vacuum pump system (see chapter 8.2, page 30).

**No wireless connection**

If there is no wireless connection between the hand terminal and the related vacuum pump system (for example if the vacuum pump system is not switched on or the wireless connection is being established or is interrupted):

- The message "No connection" will blink in the hand terminal's display (see figure 13);
- An audible warning will be emitted if a button on the touch-screen is pressed.

Refer to chapter 10, table 9 for tips on resolving this problem.

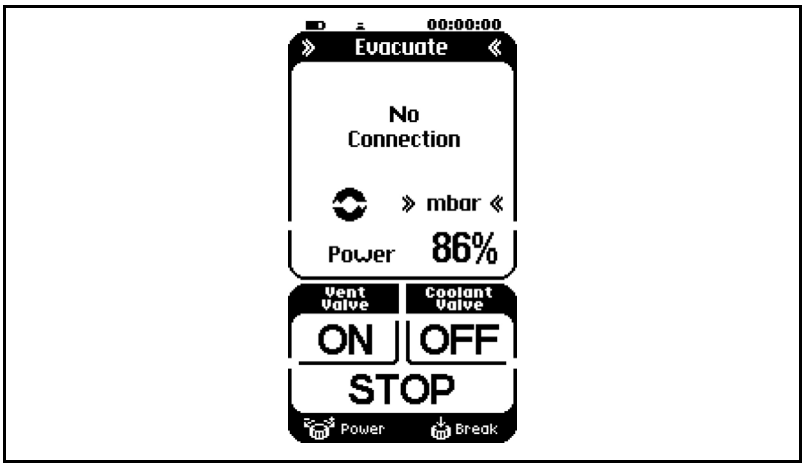



*Fig. 13: Display „No connection“*

### 8.1.3. Changing batteries on the hand terminal

1. Loosen the four screws on the underside of the hand terminal.
2. Remove the rear cover plate.
3. Replace the batteries.

Refer to chapter 4.2, page 9, for required battery specifications.

Never use new and used batteries together. Batteries must always be replaced all at the same time.

4. Re-install cover plate.
5. Dispose of batteries according to regulations.

## 8.2. Operation without hand terminal

The following actions can be taken directly on the vacuum pump system when the hand terminal is removed (Fig. 14):

- Stop the process;
- Open and close the ventilation valve;
- Open and close the high-performance condenser's coolant valve (accessory).
- Call the hand terminal (paging); the hand terminal will answer with a signal tone.

**1** Stop process button
**2** To open/to close ventilation valve button
**3** Call the hand terminal button (paging)
**4** Button to open/to close coolant valve (accessory) on the high-performance condenser

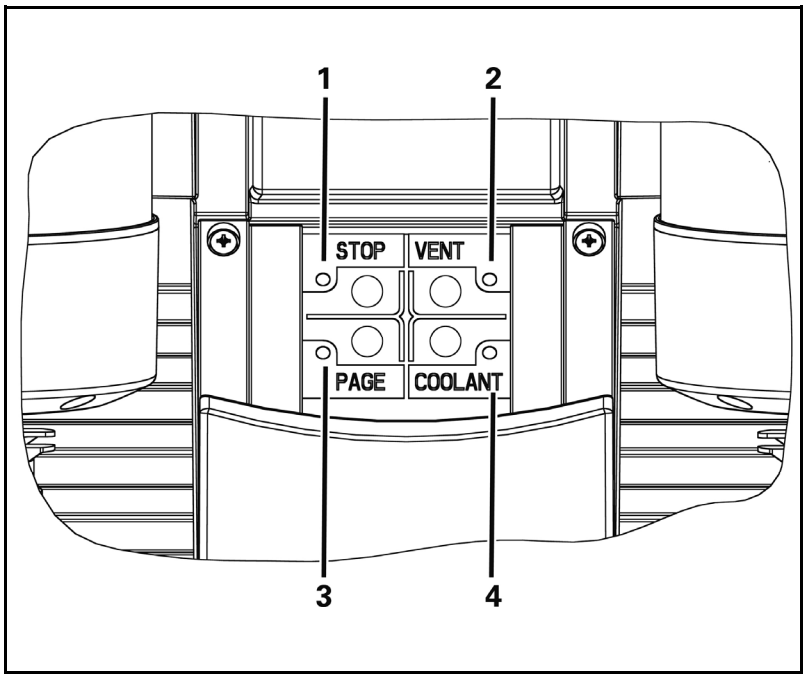



*Fig. 14: Buttons on vacuum pump system*

## 8.3. Software

### 8.3.1. General functions and displays

The software included with the delivery enables you to control the vacuum pump system from a PC.

Fig. 15 displays an example of the software interface.

**Menus and buttons**

**1** Menu bar
**2** Administers user-defined functions
**3** Print chart
**4** Buttons to export data as Excel file or text file
**5** Establish/break connection to vacuum pump system
**6** Start/Stop button
**7** Actual pressure display
**8** Pressure units menu
**9** Operating mode display
**10** Operating mode menu
**11** Ventilation valve button
**12** Coolant valve (accessory) button
**13** Setpoint pressure display[1]
**14** Buttons to increase/reduce setpoint pressure[1]
**15** Pump capacity slide control[2]
**16** Display of pump capacity in percent[2]
**17** Buttons to increase/reduce pump capacity[2]
**18** Chart for actual and setpoint pressure
**19** Break button for switching to manual process control

[1] not in *Function* operating mode

[2] only in *Evacuate* operating mode

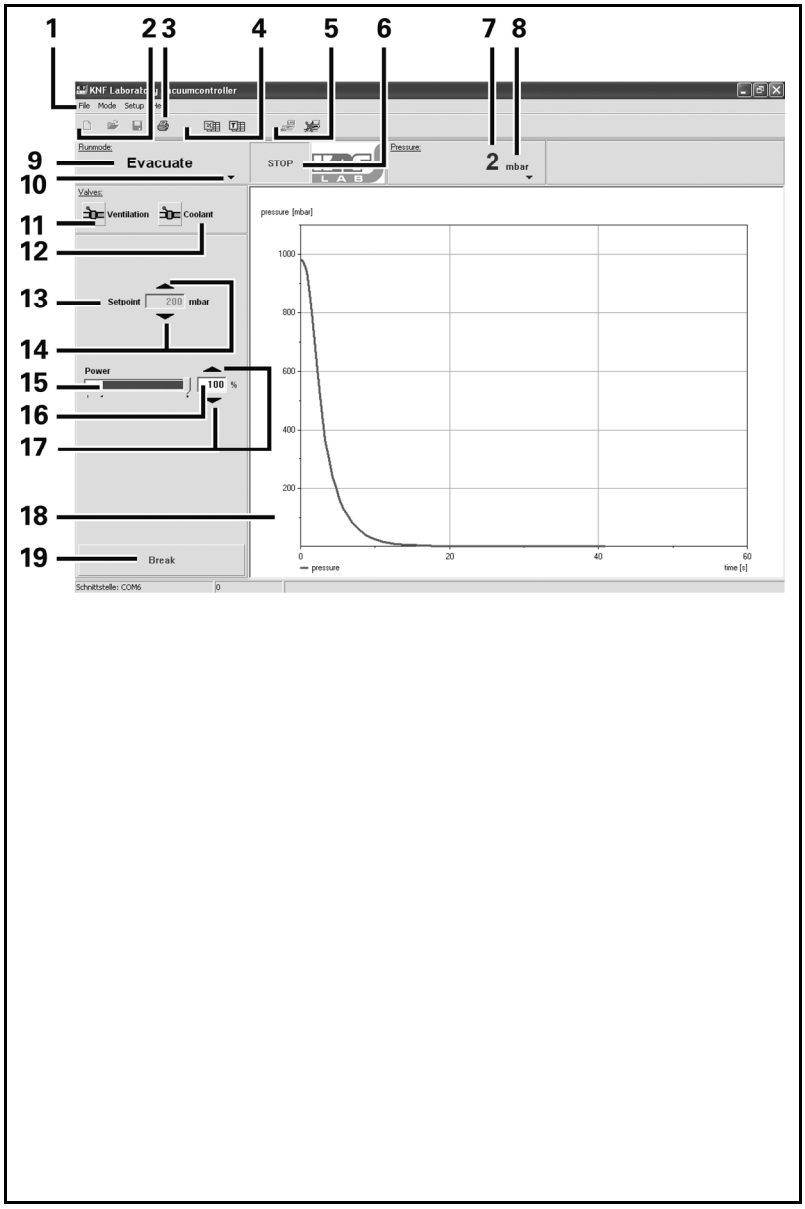



*Fig. 15: Example of software interface showing Evacuate operation mode*

In addition to the hand terminal options, the software contains the following options:

- Display pressure curves as chart (setpoint and actual pressure)
- Export pressure curves in Excel or text files (setpoint and actual pressure)
- Save and open entered setpoint pressure functions.

Table 5 lists menu bar options.

| *Menu option* | *Contained functions* | *Meaning* |
|---|---|---|
| File | New* | Create new file for user-defined functions |
| | Open* | Open an existing file for user-defined functions |
| | Save* | Save current file |
| | Save as…* | Create a copy of a file for user-defined functions or save the file to a new location |
| | Page view | Page view |
| | Print | Print chart |
| | Export … | Export data |
| | Stop | Close software |
| Mode | Evacuate | Select Evacuate operating mode |
| | Pressure control | Select Pressure control operating mode |
| | Automatic | Select Automatic operating mode |
| | Function | Select Function operating mode |
| Settings | Language | Select menu language |
| | Unit of measurement | Select pressure unit |
| | Interface | Establish or interrupt PC connection |
| Help | Help | Help for operating the vacuum pump system |
| | About… | Information about the attached vacuum pump system |

*Tab. 5: Menu bar options* ** only in Function operating mode*

### 8.3.2. Operation

**Install software**

Refer to chapter 4.3, page 10 for system requirements for operating the vacuum pump system from a PC.

Please read the license agreement (on CD: license_agreement.pdf) for the software carefully. By using all or any portion of the software you accept all terms and conditions of the agreement. If you do not agree, do not use the software.

1. Insert CD into PC.
2. Open CD.
3. Copy "KNFLab" folder to any location on the PC's hard drive.
4. Switch on the vacuum pump system.
5. Use the included USB cable to connect the vacuum pump system to the PC's interface.

The USB port is located on the rear of the vacuum pump system's base (see Fig. 3, page 11).
Windows will announce the presence of a new device and start the installation wizard.

➔ Use the CD-ROM drive as the source for the driver.

The installation wizard will automatically install the driver.

6. Remove the CD from the PC and store it in a safe place.
7. Start the software by double-clicking on the file "KNFLab.exe"; this file is located on the hard drive in the new folder "KNFLab". You may wish to place a shortcut to the file on your desktop.

Software functions are described under the *Help* menu entry.

**Establishing and separating a connection from the PC to the vacuum pump system**

The connection to the vacuum pump system is established and separated by pressing the corresponding button (see figure 15/**5**, page 31). If several vacuum pump systems are connected to the PC, select the desired vacuum pump system from the list.

The connection to the vacuum pump system can also be established through the toolbar "Settings → Interface → Connect". In the dialog that appears you can directly select the communication connection (if known) or click on the button "Test" to search with the software. If several vacuum pump systems are connected, select the desired vacuum pump system from the list.

**Menu language**

In the menu bar, choose between the following languages: English, German, French, Italian, Spanish and Chinese.

Settings → Language

**Pressure units**

Process pressure can be displayed in mbar, bar, hPa, or Torr.

The pressure units can be changed as follows:

- through the menu bar:
  Settings →Measurement units
- through the program:
  Pressure units menu (Fig. 15/**8**, page 31)

Pressure units can be changed only when no process is active.

**Operating modes**

The operating mode can be changed in two different ways:

- Menu bar: Operating mode
- Diagram: Operating mode menu (Fig. 15/**10**, page 31)

Operating mode can be changed only when no process is active.

**Starting and stopping the process**

➔ Press START/STOP button (Fig. 15/**6**, page 31).

**Open and close the ventilation valve**

**WARNING**

Personal injury caused by poisoning or explosion and damage to the vacuum pump system.

➔ Make sure that no reactive or explosive mixtures will be produced when ventilating the vacuum pump system through the air inlet.

➔ Press Ventilation valve button (Fig. 15/**11**, page 31).

**Open and close the coolant valve (accessory)**

➔ Press Coolant valve button (Fig. 15/**12**, page 31).

**Entering value in Evacuate operating mode**

➔ Adjust pump capacity by moving slide control (Fig. 15/**15**, page 31), button (**17**) or display (**16**).

**Entering value in Pressure control operating mode**

➔ Set setpoint pressure with the Increase/decrease setpoint pressure button (Fig. 15/**14**, page 31) or enter data into display (**13**) via keybord.

**i** Setpoint pressure can be changed only when no process is active.

**Entering value in Automatic operating mode**

Not necessary to enter value.

**Function operating mode**

The desired pressure curve is entered via data points that connect the vacuum pump system to pressure ramps.

The following entries must be made for each data point (up to 12):

- Time interval since the last data point
- Setpoint pressure
- Coolant valve (accessory):
  - No action
  - Open (W)
  - Close (~~W~~).

The values can be entered either through the table or through the chart (Fig. 16, page 35).

Entry through the diagram:

- Insert data point:
  Right-click on the function curve and select the desired action from the menu that appears.
- Shifting data point:
  Left-click on the data point and move it as desired.

- Delete data point / specify action for coolant valve (accessory): Right-click on the point and select the desired action from the menu that appears.

The action of the coolant valve is set by double-clicking in the corresponding field of the “Cooling” column. A menu opens containing the selectable actions ON (open valve) and OFF (close valve).

Repetitions of the function are set in the first empty line below the sampling points entered. Double-clicking in the field in the “Cooling” column opens a menu containing the REPEAT option. If this is activated, the desired number of repetitions can then be entered in the field of the “p [...]” column.

In order to delete a data point, remove the corresponding entry in the dt column. The subsequent sampling points are automatically moved up in the column.

Start the user-defined function by clicking on the START button. The process will stop automatically after reaching the end of the setpoint pressure curve.

Changes to the function values (sampling point table) are adopted directly from the hand terminal.

**1** Table
**2** Curve
**3** Break button for switching to manual process control

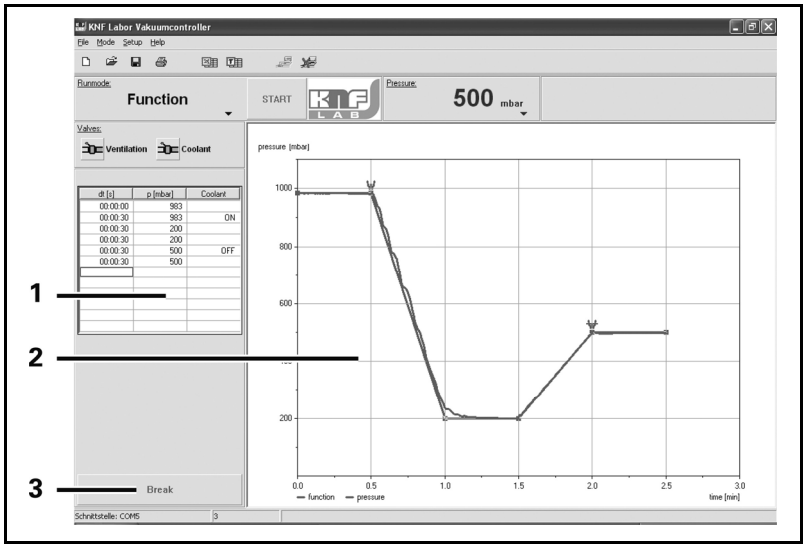



*Fig. 16: Function mode*

**Switching to manual process control**

From any operating mode, briefly press the Break button (Fig. 16/**3**) to switch to manual process control. The actual pressure will be adopted as the setpoint pressure.

You can switch to manual process control only during an active process.

**Operation in manual process control**

- Change setpoint pressure:
  Press Increase/reduce setpoint pressure button (Fig. 15/**14**, page 31) or enter data via keybord into display (**13**).

- Evacuation:
  Press the break button (Fig. 15/**19**, page 31). When the button is released, the actual pressure will in turn be adopted as the setpoint pressure for the pressure regulation.
- Changing to an operating mode:

1. Press STOP button.
2. Select operating mode through the menu bar or chart (Operating mode menu (Fig. 15/**10**, page 31)).

You can switch to an operating mode only when no process is active.

# 9. Servicing

## 9.1. Servicing Schedule

| Component | Servicing interval |
|---|---|
| Vacuum pump system | Regular inspection for external damage or leaks |
| Diaphragms and valve plates | Replace at the latest, when pump output decreases |

*Tab. 6*

## 9.2. Cleaning

When cleaning, make sure that no liquids enter the inside of the housing.

### 9.2.1. Flushing Vacuum pump system

Before switching off the vacuum pump system, separate it from the vacuum chamber and flush it with air (if necessary for safety reasons: with an inert gas) under atmospheric conditions (ambient pressure) for about five minutes.

If inert gas is used: connect the inert gas feed to the gas inlet (Fig. 2/**6**, page 11) of the vacuum pump system. Observe the safety instructions in chapter 3.

### 9.2.2. Cleaning Vacuum pump system

➔ Only clean vacuum pump system with a damp cloth and non-flammable cleaning agents.

### 9.2.3. Emptying collection flask on the suction and pressure sides

**Suction side**

1. Grasp the collection flask (Fig. 2/**11**, page 11) and simultaneously remove attachment clamp **10**; pull out collection flask.
2. Dispose of contents in collection flask according to local regulations. Then rinse out collection flask.
3. Reattach collection flask.

**Pressure side**

1. Grasp the collection flask (Fig. 2/**14**, page 11) and simultaneously remove attachment clamp **15**; pull out collection flask.
2. Dispose of contents in collection flask according to local regulations. Then rinse out collection flask.
3. Reattach collection flask.

## 9.3. Changing Diaphragms and Valve Plates

Conditions

- Vacuum pump system is switched off and mains plug is removed from the socket
- Vacuum pump system is clean and free of hazardous materials

Tools and material

| Qty | Material |
|---|---|
| 1 | Phillips-head screwdriver No. 2 |
| 1 | 4-mm hexagon screwdriver |
| 1 | Service Set (see chapter 11, page 48) |
| 1 | Felt-tip pen |
| 1 | Stabilization diaphragm (if required) |

*Tab. 7*

Information on procedure

➔ Always replace diaphragms and valve plates together to maintain the pump performance.

**WARNING**

Health hazard due to dangerous substances in the vacuum pump system and pump!

Depending on the substance transferred, caustic burns or poisoning are possible.

➔ Wear protective clothing if necessary, e.g. protective gloves.

➔ Flush vacuum pump system before replacing the diaphragms and valve plates (see chapter 9.2.1, page 37).

**Remove pump head**

1. Remove tubing from the inlet and outlet connectors of the pump.
2. Undo the two screws (**1**) and nine screws (**2**) of the head cover (**3**).
3. Undo two screws (**6**) each, and remove both covers (**5**) at head cover (**4**).
4. Lift the head cover (**3**) off the pump housing (**19**).
5. Lift off head plate (**9**) with intermediate plates (**11**), (**14**) and (**15**).

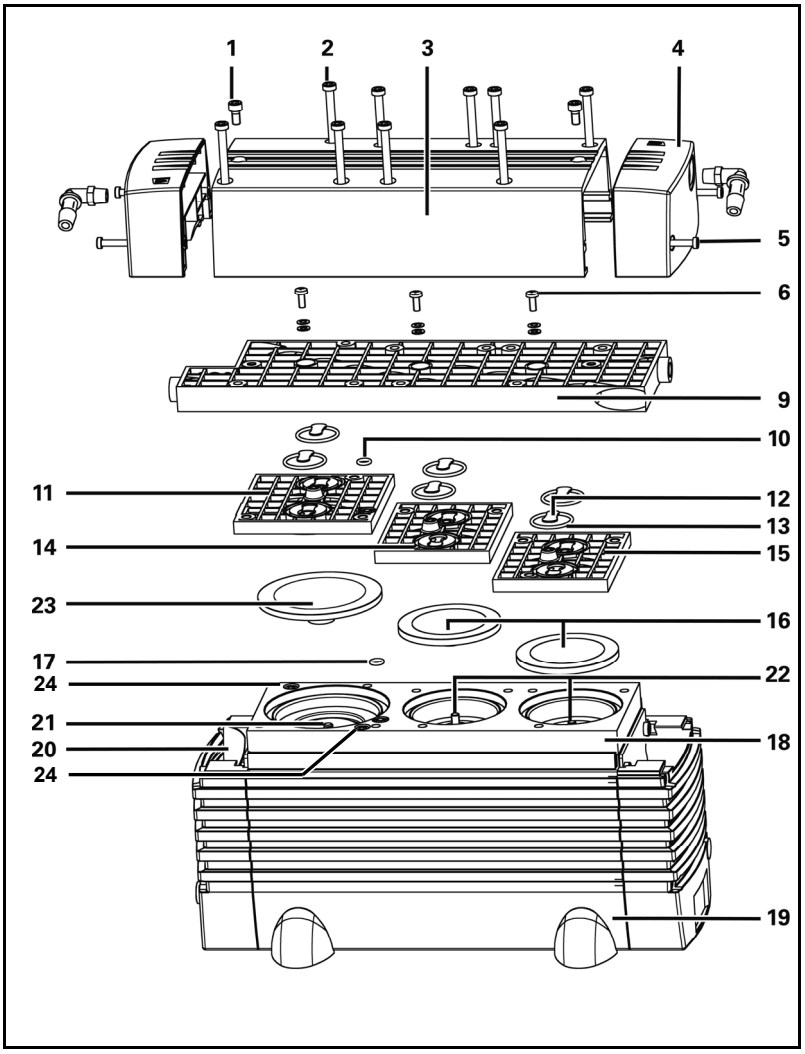



*Fig. 17: Pump (exploded drawing, symbolic)*

**Change diaphragms**

1. Turn the diaphragms (**16**) (2 pieces) and (**23**) (1 piece) outwards with your hands, counterclockwise. For this, turn the fan (**20**) such that you can easily grip each diaphragm with your hands.

For diaphragms (**16**):
Make sure the diaphragm spacers being between diaphragm and connecting rod (**22**) do not fall into the pump housing.

If diaphragm spacers should adhere to the diaphragms, take them off and put them on the thread of the corresponding connecting rod.

In order to ensure the pneumatic output of the pump, it is essential that the diaphragm washers are subsequently remounted in the same quantity in each case.

Carry out steps 2 to 8 only if the stabilization diaphragm also shall be changed.

2. Loosen the two screws (**24**) and remove the adapter (**18**) from the pump housing (**19**).
   The stabilization diaphragm (**21**) is now visible.
3. Remove the existing diaphragm spacers from the stabilization diaphragm (**21**).

i It is important to later re-install the same quantity of diaphragm spacers in order to ensure the pump's pneumatic performance.

4. Use the assembly key to loosen the stabilization diaphragm (**21**) and then manually screw it out (in the counterclockwise direction).
5. Screw in the new stabilization diaphragm (**21**) and tighten it hand-tight with the assembly key.
6. Put spacer(s) onto the thread of the new stabilization diaphragm (**21**) (same number).
7. Place the adapter (**18**) onto the pump housing (**19**).

i The adapter must be aligned flush with the pump housing (**19**). This is important for later installation of the diaphragm (**23**).

8. Tighten the two screws (**24**) to hand-tightness.

i Begin with the outermost screw and make sure that the adapter (**18**) does not move while you are tightening the screws.

9. Screw the new diaphragm (**23**) into the thread of the stabilization diaphragm (**21**) and tighten it by hand.

i To ensure proper pump performance, it is important to maintain a uniform distance everywhere between the outer edge of the diaphragm (**23**) and the adapter (**18**). If the distance is not uniform, you must re-loosen the screws (**24**) and re-align the adapter so the distance is the same everywhere.

10. Screw the new diaphragms (**16**) onto the connecting rods (**22**) and tighten it by hand.

i Before you finally tighten the diaphragm, you are recommended to move the diaphragm to the upper dead center by rotating the fan (**20**).

11. Exchange the O-ring (**17**) for a new one in adapter (**18**).
12. Put head plate (**9**) with intermediate plates (**11**), (**14**) and (**15**) on adapter (**18**).

**Change valve plates**

1. Mark the position of head plate (**9**) and intermediate plate (**11**) relative to each other by a drawing line with a felt-tip pen. This helps avoid incorrect assembly later.
2. Mark the position of head plate (**9**) and intermediate plate (**14**) relative to each other by two drawing lines with a felt-tip pen.

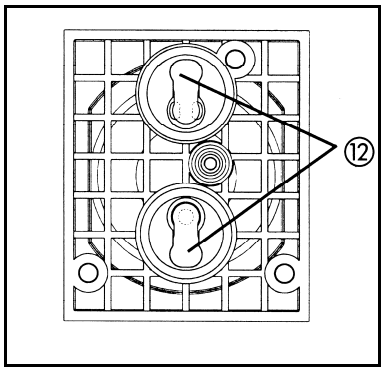



*Fig. 18: Position of valve plates (**12**)*

3. Mark the position of head plate (**9**) and intermediate plate (**15**) relative to each other by three drawing lines with a felt-tip pen.
4. Undo the three screws (**6**) in head plate (**9**) and remove head plate from intermediate plates (**11**), (**14**) and (**15**).
5. Remove valve plates (**12**) and O-rings (**13**) from intermediate plates (**11**), (**14**) and (**15**).

**i** Instead of lying on intermediate plate, O-rings could stick to head plate (**9**).

6. Remove O-ring (**10**) from intermediate plate (**11**) and exchange it for a new one.
7. Lay the new valve plates (**12**) and the new O-rings (**13**) on the intermediate plates (**11**), (**14**) and (**15**).

**i** Upper and lower sides of the valve plates are identical. For correct position see fig. 18.

8. Dispose of the old diaphragms and valve plates/sealings properly.

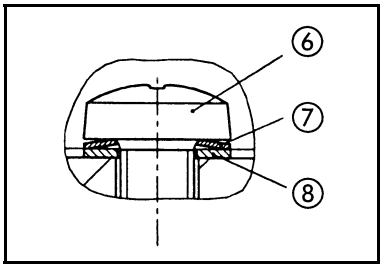



*Fig. 19: Position and orientation of disk spring (**7**) and washer (**8**) at screw (**6**)*

**Mount pump head**

1. Place head plate (**9**) on intermediate plates (**11**), (**14**) and (**15**) in the position indicated by the drawing lines.

➔ At the front edge the three intermediate plates must lie in a line on which head plate is placed flushly.

2. Tighten the three screws (**6**) of head plate (**9**) carefully slightly hand-tight (tightening torque: 0.6 Nm).

➔ For position and orientation of disk spring (**7**) and washer (**8**) of screw (**6**) see fig. 19.

3. Place head cover (**3**) on pump housing (**19**).
4. Tighten the nine screws (**2**) of head cover (**3**) slightly in the first instance. Start with the screws of medium pump stage, then tighten the screws on the right, and finally on the left.
5. Now, tighten the screws (**2**) firmly (tightening torque: 6 Nm); tighten the center screws first, then continue outward.

**i** If the screws are stiff to turn, the intermediate plates do not lie in a line at front edge, or intermediate plates and head plate are not placed flushly (see step 1).

6. Remount the covers (**4**).
7. Tighten the two screws (**1**) on the head cover (tightening torque: 5 Nm).

**Final steps**

1. Reconnect vacuum pump system tubing.
2. Reconnect vacuum pump system to the electricity supply.

## 9.4. Replace overpressure valve on high performance condenser

Conditions

- Vacuum pump system is switched off and mains plug is removed from the socket
- Vacuum pump system is clean and free of hazardous materials

Information on procedure

**WARNING**

Health hazard due to dangerous substances in the vacuum pump system and pump!

Depending on the substance transferred, caustic burns or poisoning are possible.

➔ Wear protective clothing if necessary, e.g. protective gloves.

➔ Flush vacuum pump system before replacing overpressure valve (see chapter 9.2.1, page 37).

1. Unscrew and remove hose nozzle which connects the high performance condenser with the pressure side of the pump from high performance condenser.
2. Detach the old overpressure valve from screw socket of high performance condenser.
3. Slide on the new overpressure valve. Be aware that the overpressure port is completely covered.
4. Reconnect high performance condenser with pump.

# 10. Troubleshooting

**DANGER**

Extreme danger from electrical shock!

➔ Disconnect the pump power supply before working on the pump.

➔ Make sure the pump is de-energized and secure.

- Vacuum pump system as a whole: see table 8.
- Hand terminal: see table 9.
- Software operation: see table 10.

| **Vacuum pump system as a whole** | | |
|---|---|---|
| **Problem** | **Cause** | **Solution** |
| Vacuum pump system is switched on, but the mains switch does not light up. | Mains cable not plugged in. | ➔ Plug the mains cable for the vacuum pump system into a properly grounded power socket. |
| | No current in electricity network. | ➔ Check the electricity supply. |
| | Vacuum pump system fuses blown. | 1. Find and eliminate the cause of the overload.<br>2. Replace the mains fuse(s) of the vacuum pump system:<br>▪ Push the locking clip on the fuse drawer down (Fig. 3/**4**, p. 11) and pull the drawer out.<br>▪ Replace the defective fuse(s) (for fuse specifications see chapter 4.1, page 8; for fuse order numbers see chapter 11, p. 48).<br>▪ Push the fuse drawer back in until it clicks into position. |
| Required vacuum not generated even though pump is running. | Leaks in vacuum chamber. | 1. Run a test by closing the gas inlet (Fig. 2/**6**,p. 11). If the pump reaches the required vacuum, this confirms the presence of leaks in the vacuum chamber.<br>2. Eliminate leaks in the vacuum chamber. |
| | O-ring is not sitting correctly in the slot on the suction side of the collection flask. | ➔ Adjust O-ring.<br>➔ Replace if defective (for order number for O-ring, see chapter 11, p. 48). |
| | Leaks in hose connection. | ➔ Check hoses are sitting correctly on hose nipples.<br>➔ Replace any leaky hoses.<br>➔ Replace any damaged hose nipples.<br>➔ For ordering numbers see chapter 11, page 48. |
| | Hexagonal gland (Fig. 2/**6**, p. 11) loose. | ➔ Carefully tighten hexagonal gland with wrench. |

| **Vacuum pump system as a whole** | | |
|---|---|---|
| **Problem** | **Cause** | **Solution** |
| | Leaks in venting valve. | ➔ Temporarily close the ventilation connection (Fig. 2/**5**, p. 11). If this stops the leak, leaks are present in the venting valve. In this case:<br>➔ Flush the venting valve:<br>1. Close the gas inlet (Fig. 2/**6**).<br>2. If necessary for safety reasons: Connect inert gas to ventilation connection. Observe the safety instructions in chapter 3.<br>3. Run the vacuum pump system at 100% pump capacity in *evacuation* mode.<br>4. Re-open the gas inlet.<br>➔ If problem persists, contact KNF Service. |
| | Condensation in pump head. | ➔ Dry system with fresh air or, if necessary for safety reasons, with an inert gas:<br>1. Using inert gas: Connect inert gas source with gas inlet (Fig. 2/**6**, p. 11) and start system up in *evacuation* mode (100% capacity). Observe the safety instructions in chapter 3.<br>2. Using air: Open gas line (Fig. 2/**6**, p. 11) to the surrounding environment and start system up in *evacuation* mode (100% capacity).<br>3. Close the gas inlet after 30 seconds, and leave the vacuum pump system running for 30 seconds under vacuum.<br>4. Repeat this process 3–5 times.<br>➔ If this problem occurs frequently, place the vacuum pump system at a higher level than the vacuum chamber. |
| | Gas outlet blocked on high-performance condenser. | Risk of bursting of high-performance condenser!<br>➔ Eliminate blocking of gas outlet. |
| | Worn diaphragms or valve plates. | ➔ Replace diaphragms and valve plates (chapter 9.3). |
| | Replaced diaphragms and valve plates. | ➔ Check that the correct diaphragm spacers are placed under the diaphragms.<br>➔ If necessary, carefully tighten the pump head fixing screws (Fig. 17/**2**, p. 39) in diagonally opposite sequence. |
| Pump not activated on process start-up, in spite of pressure decrease command. | Hand terminal or software not connected to vacuum pump system. | ➔ Make connection. |

| **Vacuum pump system as a whole** | | |
|---|---|---|
| **Problem** | **Cause** | **Solution** |
| | Overcurrent protection of vacuum pump system has been activated. | ➔ Reset by switching the vacuum pump system off and back on.<br>➔ Check that there is no object blocking the pump fan (Fig. 17/**20**, p. 39) and make sure that adequate supply and removal of cool air is provided.<br>➔ Find and eliminate any other cause of pump overload. |
| Noisy pump. | Leaking hose connection. | ➔ Check that hoses are sitting correctly on hose nipples.<br>➔ Replace any leaking hoses.<br>➔ Replace any damaged hose nipples. |
| | Leaks at hose nipple on high-performance condenser. | ➔ Tighten hose nipple at gas outlet (Fig. 2/**16**, p. 11). |
| | Leaks in overpressure valve on high-performance condenser. | ➔ Check overpressure valve is sitting correctly; replace if necessary. For ordering number see chapter 11, page 48. |

*Tab. 8*

| **Hand terminal** | | |
|---|---|---|
| **Problem** | **Cause** | **Solution** |
| Hand terminal cannot be removed from vacuum pump system. | Transport fastener has not been removed. | ➔ Remove transport fastener (see chapter 6, p. 17). |
| Hand terminal display fails to light up. | Hand terminal not switched on. | ➔ Switch hand terminal on. |
| | Batteries of hand terminal have run down. | ➔ Charge batteries by placing the terminal in the holder provided on the vacuum pump system, with the system switched on.<br>➔ Alternatively, operate the terminal via the power supply. |
| The hand terminal display keeps showing "No connection"; if a button of the touchscreen is actuated a signal tone sounds. | Vacuum pump system is switched off. | ➔ Switch the vacuum pump system on at the mains switch. The mains switch should light up. |
| | The hand terminal is designed for use with a different SC 920 vacuum pump system. | ➔ Use the page function (see Actuating the vaccum pump system, p. 28) to check whether the right hand terminal is being used. |

| **Hand terminal** | | |
|---|---|---|
| **Problem** | **Cause** | **Solution** |
| | Problem with wireless connection. | ➔ Check whether the hand terminal is being operated outside the wireless connection range.<br>➔ Check that the wireless connection is not obstructed by any electrical devices or metal objects.<br>➔ Otherwise, to confirm that the problem lies in the wireless connection, place the hand terminal in the holder provided on the vacuum pump system. |
| | Defective wireless module. | ➔ Contact KNF Service. |
| Vacuum pump system does not respond to commands input at the hand terminal after removal from the system, even though the "No connection " is no longer lit up and a pressure is displayed. | The hand terminal is designed for use with a different SC 920 system, which is currently in operation. | ➔ Use the page function (see Actuating the vaccum pump system, p. 28) to check whether the right hand terminal is being used. |
| Acoustic alarm sounds on hand terminal. | Batteries low. | ➔ Charge batteries by placing the terminal in the holder provided on the vacuum pump system, with the system switched on.<br>➔ Alternatively, operate the terminal via the power supply. |
| Marked decrease in operating time for the hand terminal in wireless mode. | Batteries have reached limit of their useful life. | ➔ Change batteries (see chapter 8.1.3, p. 29). |
| Vacuum pump system cannot be activated, even with the hand terminal placed in the holder provided. | Soiled contacts on the bottom of the hand terminal or in the holder for the terminal on the vacuum pump system. | ➔ Clean contacts. |
| Pressure display shows implausible values. | Unit of pressure for display has been changed. | ➔ Set desired unit of pressure. |
| | Leaks in system. | ➔ See Tab. 8, "Required vacuum not generated even though pump is running”. |
| | Recalibration of pressure sensor required. | ➔ Contact KNF Service. |

*Tab. 9*

| Software operation | | |
|---|---|---|
| **Problem** | **Cause** | **Solution** |
| PC software unable to connect to vacuum pump system. | Vacuum pump system not switched on. | ➔ Switch vacuum pump system on. |
| | USB connection between system and PC is not operating correctly. | ➔ Check correct connection of USB cable. If necessary, pull out the USB cable and reinsert (USB interface reset). |
| Pressure display shows implausible values. | Unit of pressure for display has been changed. | ➔ Set desired unit of pressure. |
| | Leaks in system. | ➔ See Tab. 8, "Required vacuum not generated even though pump is running”. |
| | Recalibration of pressure sensor required. | ➔ Contact KNF Service. |

*Tab. 10*

**Fault cannot be rectified**

If you are unable to determine any of the specified causes, send the vacuum pump system to KNF Customer Service (see last page for the address).

1. Flush the vacuum pump system to free the pump head, tubing and glas vessels of dangerous or aggressive gases (see chapter 9.2.1, page 37).
2. Clean the vacuum pump system (see chapter 9.2.2, page 37).
3. Send the pump to KNF with a filled out decontamination declaration (see chapter 12, page 49) and specification of the medium transferred.

# 11. Ordering Information

**Spare parts Pump**

| Spare part | Order-No. |
|---|---|
| A spare parts kit:<br>3 diaphragms, 6 valve plates, 6 O-rings (24 x 2) and 2 O-rings (5.5 x 2) | 111905 |
| Stabilization diaphragm | 059619 |

*Tab. 11*

**Other spare parts**

| Spare part | Order-No. |
|---|---|
| Overpressure valve for high-performance condenser | 047807 |
| Battery set for hand terminal<br>(see chapter 8.1.3, page 29) | 117427 |
| Power supply for hand terminal | 125524 |
| USB cable | 117428 |
| Mains cable D | 026363 |
| Mains cable CH | 027523 |
| Mains cable GB | 029866 |
| Mains cable USA/JP | 027524 |
| Tubes (yard ware)* | 028187 |
| Hose nipple gas inlet and pump connections (ID 10) | 112005 |
| Hose nipple ventilating (ID 6) | 055958 |
| Hose nipple for high performance condenser: gas connection (ID 10) | 026237 |
| Hose nipple for high performance condenser: coolant connection (ID 8) | 025981 |
| O-ring adapter on collection flask | 047744 |
| Collection flask 500 ml (coated) | 047729 |
| Flask clamp | 025968 |
| Fuse T 2.5 | 027575 |
| Allen key 2.0 for transport fastener | 117432 |

*Tab. 12* ** Please specify the required length (in whole meters)*

**Accessories**

| Accessory | Order-No. |
|---|---|
| Coolant valve | 117121 |
| Color sticker for indicating correct match between hand terminal and vacuum pump system* | 117433 |
| Chemical-resistant protective film for hand terminal display | 117407 |
| Assembly key for stabilization diaphragm | 116885 |

** For situations in which several SC 920 vacuum pump systems are operated within the wireless connection range.*

*Tab. 13*

# 12. Decontamination Declaration

The condition for the repair of a the vacuum pump system by KNF is the certification of the customer on the transferred media and on the cleaning of the vacuum pump system (decontamination declaration).

➔ Copy this page.

➔ Enter the vacuum pump system model, the Serial No. and the transferred media in the form below and sent the signed form together with the flushed and cleaned vacuum pump system to KNF Customer Service (see last page for the address).

## Customer decontamination declaration for repair order

We herewith confirm that the following media have been pumped with the vacuum pump system listed below, and that the vacuum pump system has been flushed and cleaned.

| | |
|---|---|
| Vacuum pump system model | |
| Serial No. | |
| Fed media | |
| | |
| | |
| | |
| | |

The vacuum pump system contains neither aggressive, biological, radioactive, poisonous nor other dangerous media.

Company Date/Signature

# 13. Annex: Interface protocol

The USB connection between the PC and vacuum pump system is operated as an RS-232 interface. Accordingly, in the operating system it is managed as an additional COM connection and can be addressed with conventional terminal software. Special configuration of baud rate, etc. is not required.

Tables 13 to 16 contain the necessary command sets, shown as ASCII characters. When transmitting, the commands must be followed by ASCII character <CR> (carriage return, decimal value 013). The underlined expressions are not characters, but symbols as explained in table 16. Spaces are ignored by the controller.

| Parameter | Command | Function | Reply |
|---|---|---|---|
| Ventilation valve | dV 1 | open | S ; E |
| | dV 0 | closed | S ; E |
| Coolant valve | dW 1 | open | S ; E |
| | dW 0 | closed | S ; E |
| Process | dB | Start | S ; E |
| | dE | Stop | S ; E |
| Setpoint pressure | cC ps | Set value [*] | ps ; E |
| Capacity | cS P | Set value [%] | P ; E |
| Operating mode | cM n | Evacuate | M ; E |
| | cM r | Pressure control | M ; E |
| | cM a | Automatic | M ; E |
| | cM f | Function | M ; E |
| Pressure units | cUp 0 | mbar | U ; E |
| | cUp 1 | bar | U ; E |
| | cUp 2 | hPa | U ; E |
| | cUp 3 | Torr | U ; E |
| Data point of function table | cFd i | Delete | i ; E |
| | cFc i | Delete from here | i ; E |
| | cFs i ; Δt ; ps ; K | Set values [ - ; s ; * ; - ] | i ; E |

*Tab. 14: Control commands* ** currently selected pressure unit*

| Parameter | Command | Reply |
|---|---|---|
| Ventilation valve | gV | V |
| Coolant valve | gW | W |
| Process [ s ; * ; * ; % ] | pP | t ; pi ; ps ; P; S |
| Operating mode | gM | M ; E |
| Pressure unit | gUp | U ; 0 ; 0 |
| Data point | gFv i | i ; Δt ; ps ; K; E |

*Tab. 15: Read commands* ** currently selected pressure unit*

An active process is identified by Process time ≠ 0.

| Symbol | Interpretation | Meaning |
|---|---|---|
| V | Ventilation valve | 0 closed |
| | | 1 open |
| W | Coolant valve | 0 closed |
| | | 1 open |
| ps | Setpoint pressure | Value [*] |
| pi | Actual pressure | Value [*] |
| P | Pump capacity | Value [%] |
| t | Process time | Value [s] |
| M | Operating mode | 0 pump out |
| | | 1 pressure control |
| | | 2 automatic |
| | | 3 function |
| U | Pressure units | 0 mbar |
| | | 1 bar |
| | | 2 hPa |
| | | 3 Torr |
| E | Announcement of completion | 0 command cannot be completed |
| | | 1 command completed |
| | | ? command unclear |
| i | Line index | 0…11 |
| Δt | Length of time from previous data point | Value [s] |
| K | Acting cooling | 1 OPEN |
| | | 2 CLOSED |
| | | 10 REPEAT |
| | | Other value = none |
| S | Status message | For service only |

*Tab. 16:Symbols* ** currently selected pressure unit*

The symbols represent the ASCII codes of sequences of digits any length. The floating decimal point is shown as a period. The controller rounds input values where applicable.

| Parameter | Set | Read |
|---|---|---|
| Ventilation valve [0/1] | dV _ | gV |
| Coolant valve [0/1] | dW _ | gW |
| Process time [s] | dB / dE | pP (1.Wert) |
| Actual pressure [*] | - | pP (2.Wert) |
| Setpoint pressure [*] | cC _____ | pP (3.Wert) |
| Capacity [%] | cS _____ | pP (4.Wert) |
| Operating mode [n/r/a/f] | cM _ | gM |
| Pressure units [0/1/2/3] | cUp _ | gUp |
| Data point | cFs i ; Δt ; ps ; K | gFv i |

*Tab. 17: Overview* ** currently selected pressure unit*

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