

# COBRA PLUS

Dry Screw Vacuum Pumps  
NX 0950 A PLUS

## Instruction Manual



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# 1 Safety

Prior to handling the machine, this instruction manual should be read and understood. If anything needs to be clarified, please contact your Busch representative.

Read this manual carefully before use and keep for future reference.

This instruction manual remains valid as long as the customer does not change anything on the product.

The machine is intended for industrial use. It must be handled only by technically trained personnel.

Always wear appropriate personal protective equipment in accordance with the local regulations.

The machine has been designed and manufactured according to state-of-the-art methods. Nevertheless, residual risks may remain, as described in the following chapters and in accordance with the chapter *Intended Use* [→ 8]. This instruction manual highlights potential hazards where appropriate. Safety notes and warning messages are tagged with one of the keywords DANGER, WARNING, CAUTION, NOTICE and NOTE as follows:



## DANGER

... indicates an imminent dangerous situation that will result in death or serious injuries if not prevented.



## WARNING

... indicates a potentially dangerous situation that could result in death or serious injuries.



## CAUTION

... indicates a potentially dangerous situation that could result in minor injuries.



## NOTICE

... indicates a potentially dangerous situation that could result in damage to property.

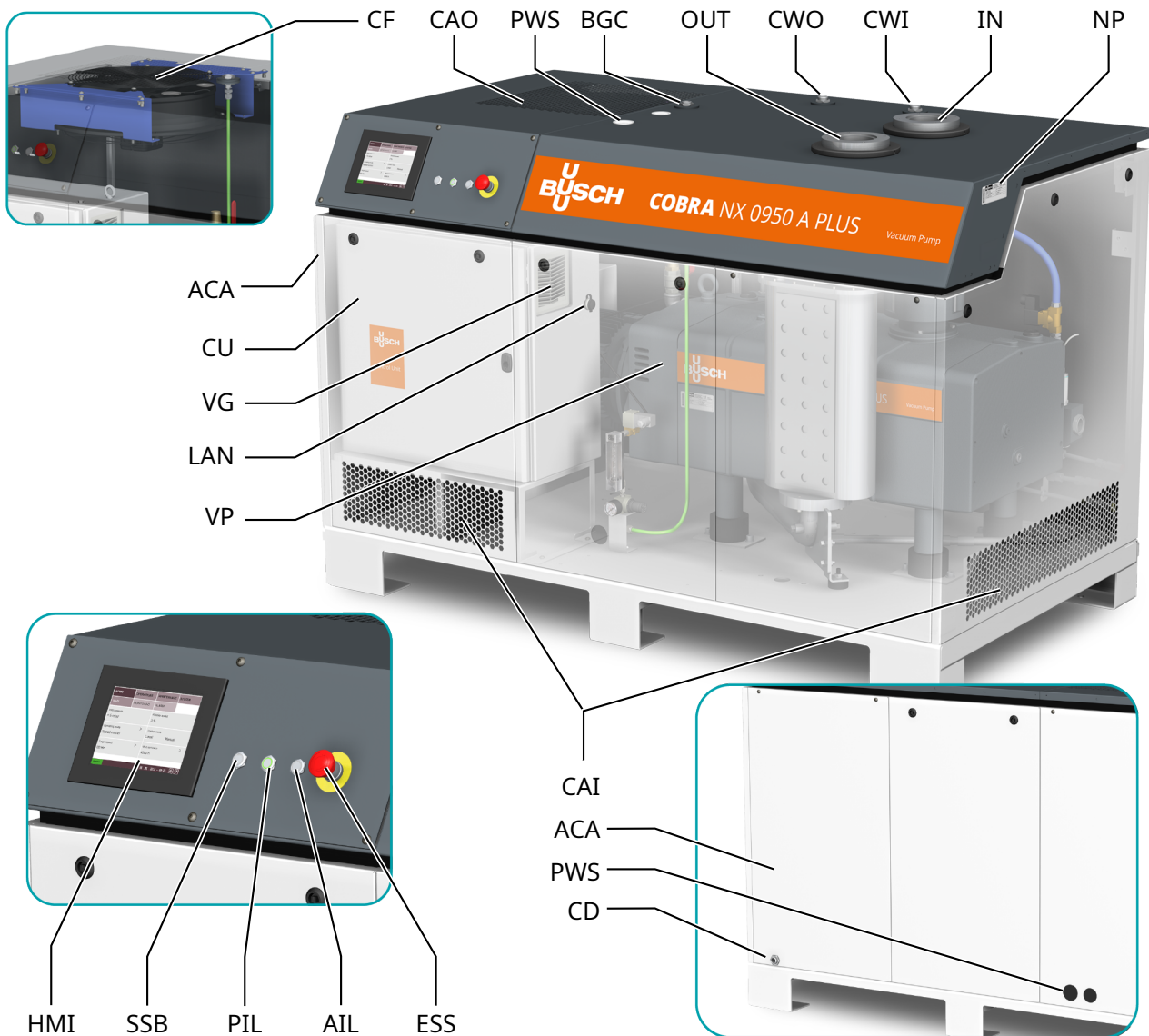


## NOTE

... indicates helpful tips and recommendations, as well as information for efficient and trouble-free operation.

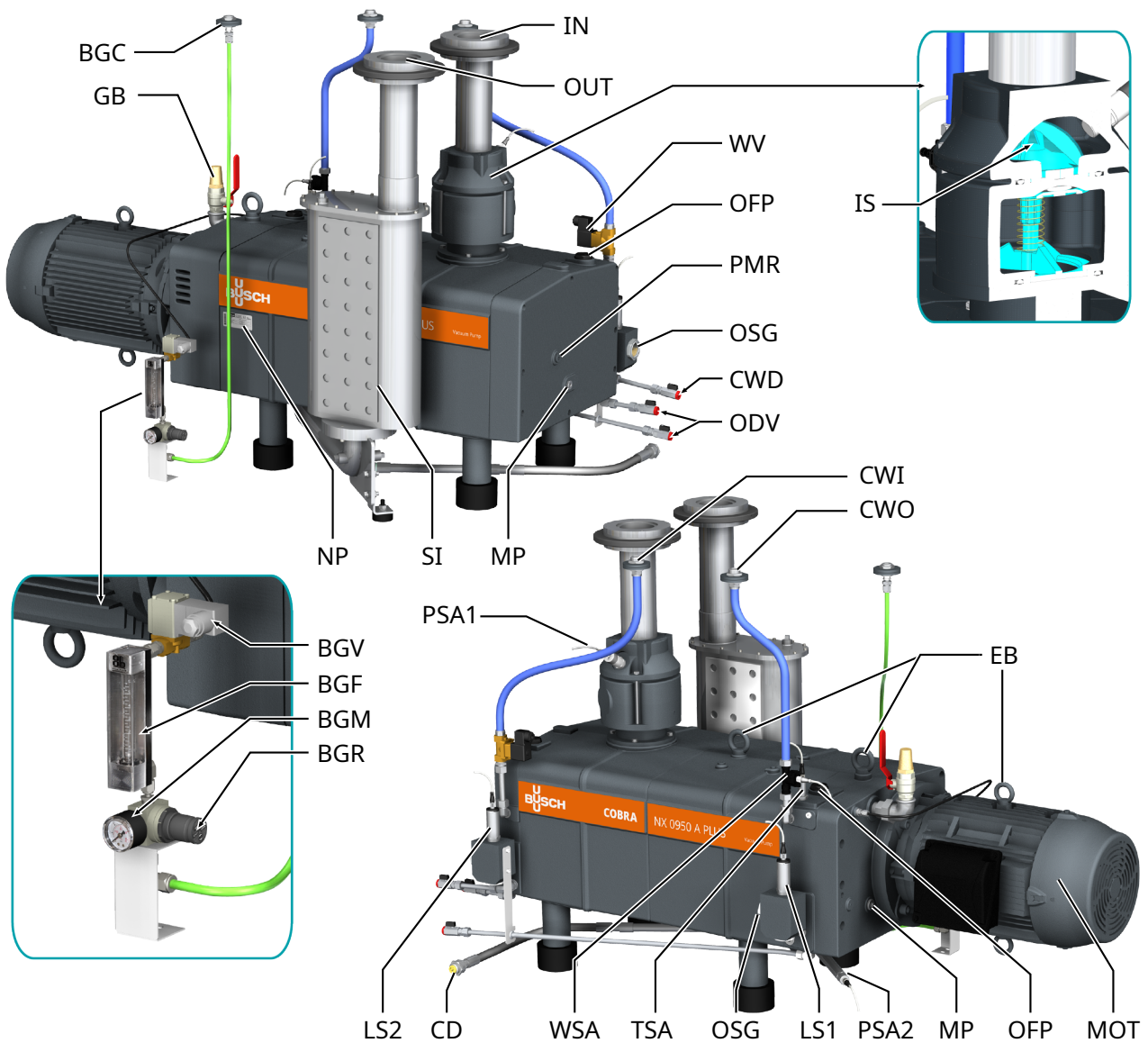


## 2 Product Description



Description			
IN	Suction connection (Inlet)	OUT	Discharge connection (Outlet)
ACA	Acoustic cabinet	AIL	Alarm indicator light
BGC	Barrier gas connection	CAI	Cooling air inlet
CAO	Cooling air outlet	CD	Condensate drain
CF	Cooling fan	CU	Control unit
CWI	Cooling water inlet	CWO	Cooling water outlet
ESS	Emergency stop switch	HMI	User interface (Human-Machine)
LAN	Communication port (Modbus TCP/IP)	NP	Nameplate
PIL	Power indicator light	PWS	Power supply (Cable gland)
SSB	Start/Stop button	VG	Ventilation grid
VP	Vacuum pump		

### Vacuum pump (VP)



Description			
IN	Suction connection (Inlet)	OUT	Discharge connection (Outlet)
BGC	Barrier gas connection	BGF	Barrier gas flow meter
BGM	Barrier gas manometer	BGR	Barrier gas pressure regulator
BGV	Solenoid valve (Barrier gas)	CD	Condensate drain
CWD	Cooling water drain plug	CWI	Cooling water inlet
CWO	Cooling water outlet	EB	Eye bolt
GB	Gas ballast valve	IS	Inlet screen
LS1	Level switch (Oil level motor side)	LS2	Level switch (Oil level inlet side)
MOT	Motor (Pump drive)	MP	Magnetic plug
NP	Nameplate	ODV	Oil drain valve
OFF	Oil fill plug	OSG	Oil sight glass
PMR	Plug for manual rotation of rotors	PSA1	Pressure transmitter (Inlet gas pressure)
PSA2	Pressure transmitter (Exhaust gas pressure before silencer)	SI	Silencer

Description			
TSA	Resistance thermometer (Pump temperature)	WSA	Waterflow sensor (Cooling liquid)
WV	Solenoid valve (Cooling water)		

## NOTE

**Technical term.**

In this instruction manual, we consider that the term 'machine' refers to the 'vacuum pump'.

## NOTE

**Illustrations**

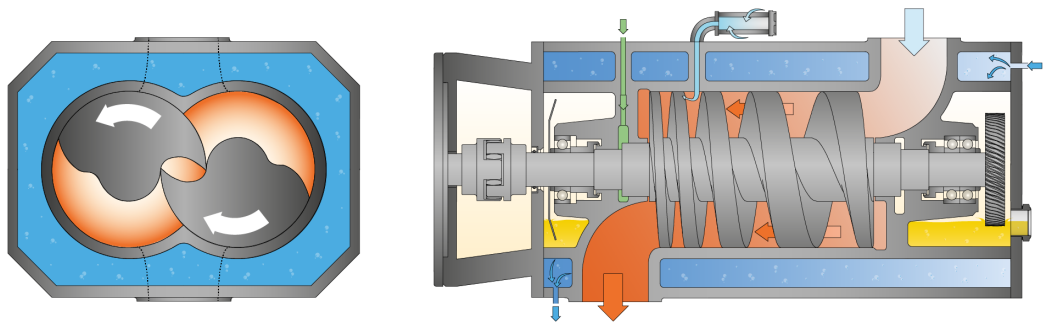
In this instruction manual, the illustrations may differ from the machine appearance.

## NOTE

**Illustrations and displays of the Human-Machine Interface (HMI).**

Some of the HMI illustrations which are shown in this manual are taken from the HMI display of the "R5 RA 0840 A PLUS" vacuum pump. Although they may differ slightly for the "COBRA NX 0950 A PLUS" vacuum pump, the principles of using of the interface however are similar.

## 2.1 Operating Principle



The machine works on the one-stage, twin-screw pump principle.

Two screw rotors rotate inside the cylinder. The pumped medium is trapped between the cylinder and screw chambers, compressed, and transported to the gas outlet. During the compression process, the two screw rotors do not come into contact with each other or with the cylinder. There is no need for a lubrication or an operating fluid in the compression chamber.

## 2.2 Intended Use



### WARNING

**In case of foreseeable misuse outside the intended use of the machine.**

**Risk of injuries!**

**Risk of damage to the machine!**

**Risk of damage to the environment!**

- Make sure to follow all instructions described in this manual.

The machine is intended for the suction of air and other dry, non-aggressive, non-toxic and non-explosive gases.

Conveying of other media leads to an increased thermal and/or mechanical load on the machine and is permissible only after a consultation with Busch.

The machine is intended for indoor placement in a non-potentially explosive environment.

The machine is capable of maintaining ultimate pressure, see Technical Data.

The machine is suitable for continuous operation.

Permitted environmental conditions, see Technical Data.



### NOTICE

**Chemical compatibility of the process gases with the machine component materials.**

**Risk of corrosion inside the compression chamber which can reduce performance and its lifetime!**

- Check if the process gases are compatible with those following materials:
  - Cast iron
  - Steel
  - Stainless Steel
  - Aluminum
  - Fluor elastomer (FKM/FPM)
- In doubt, please contact your Busch representative.

## 2.3 Standard Features

### 2.3.1 User Interface

A user interface, also termed human-machine interface (HMI), allows the control, monitoring and configuration of the machine via a 7.5" touchscreen.

Further information in the chapter *Description of User Interface Functions* [→ 11].

### 2.3.2 Acoustic Cabinet

Stylish and functional, the acoustic cabinet (ACA) significantly reduces the sound emitted by the vacuum pump.

### 2.3.3 Control Unit

The control unit is an electrical cabinet where a variable speed drive, a PLC and other electrical components are integrated.

It also supplies the active cooling air with electrical current.

The power supply must be connected to it, see Electrical Connection.

### 2.3.4 Monitoring Devices

The machine is equipped with several monitoring devices to visualise the operating values, machine conditions and to protect the machine from any severe damage.

The pump temperature, cooling water flow, oil level, inlet gas pressure and counter pressure at the discharge can be displayed when the machine is running, see *Monitoring* [→ 52]

Two signal levels are transmitted, a warning and an alarm/trip, see *Dysfunction* [→ 57].

### 2.3.5 I/O and Communication Port

The control unit (CU) is equipped with a RJ45 (Modbus) communication port that can allow remote control and monitoring of the machine.

- Refer to the specific document “Pump Control Instructions, art. no.: 0870213261” for more details or contact your Busch representative.

### 2.3.6 Gas Ballast Valve

The gas ballast valve mixes the process gas with a limited quantity of ambient air to counteract the condensation of vapor inside the machine.

The gas ballast valve has an influence on the ultimate pressure of the machine, see Technical Data.

### 2.3.7 Inlet Check Valve

In order to avoid reverse rotation after switching off, the machine is equipped with an inlet check valve.

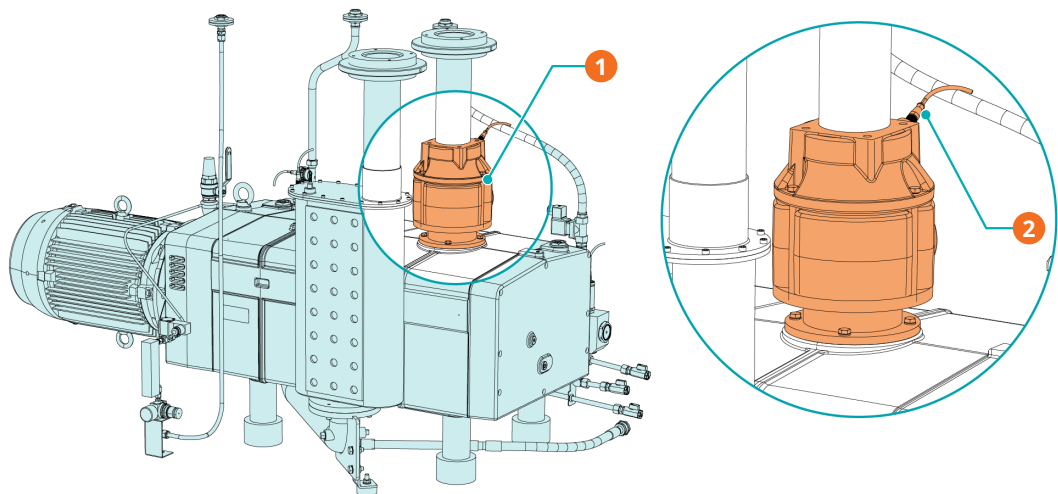
The inlet check valve also prevents fast venting of the connected vacuum system.

The inlet check valve is also equipped with a pressure sensor.

**Pressure sensor range and accuracy**

Range: 0-1600 mbar

Accuracy: +/- 9.6 mbar



**Description**

1	Inlet Check Valve	2	Pressure sensor
---	-------------------	---	-----------------

### 2.3.8 Water Cooling

The machine is cooled by a cooling water circuit in the cylinder cover and cylinder.

### 2.3.9 Sealing Systems

The machine is equipped with labyrinth seals on the motor side and suction side.

Sealing systems prevent the process gas going to the bearings chambers.

Depending on the application, the sealing systems efficiency can be improved with a barrier gas system, see *Barrier Gas System* [→ 10].

### 2.3.10 Silencer

The silencer reduces the exhaust gas noise at the machine discharge (OUT).

### 2.3.11 Barrier Gas System

The barrier gas system allows the supply of compressed air or nitrogen into the motor side shaft seals to improve the sealing efficiency.

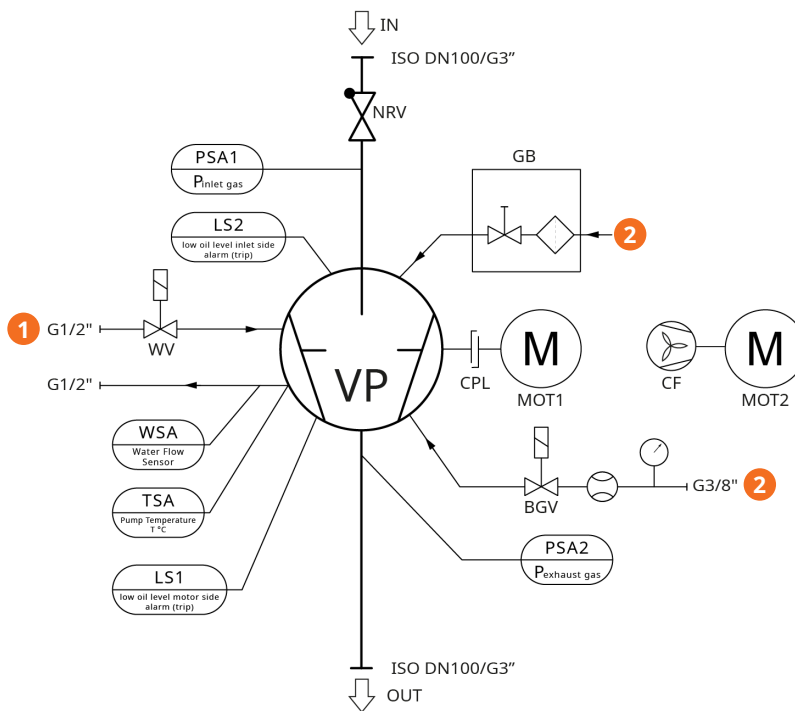
### 2.3.12 Oil Level Switches

The machine is equipped with two oil level switches to monitor the oil levels at the motor and suction sides.

### 2.3.13 Exhaust Pressure Sensor

The machine is equipped with an exhaust pressure sensor to monitor the back pressure at the discharge.

## 2.4 P&ID "Piping and Instrumentation Diagram"



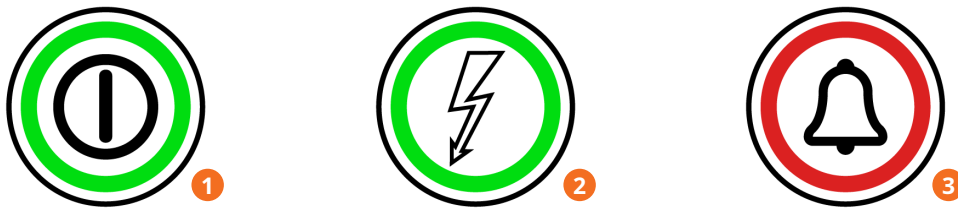
Description			
1	Cooling Water	2	Air

Description			
IN	Suction connection (Inlet)	OUT	Discharge connection (Outlet)
BGV	Barrier gas solenoid valve	CF	Cooling Fan
CPL	Coupling	GB	Gas ballast
LS1	Level switch "alarm/trip" (Oil level motor side)	LS2	Level switch "alarm/trip" (Oil level inlet side)
MOT1	Motor (Pump drive)	MOT2	Motor (Active system cooling)

Description			
NRV	Non-return valve (Not used as an isolation valve)	PSA1	Pressure transmitter (Inlet gas pressure)
PSA2	Pressure transmitter (Exhaust gas pressure before silencer)	TSA	Resistance thermometer (Pump safety temperature)
VP	Vacuum pump	WSA	Water flow sensor (Cooling liquid)
WV	Solenoid valve (Cooling water)		

## 2.5 LED Indicators

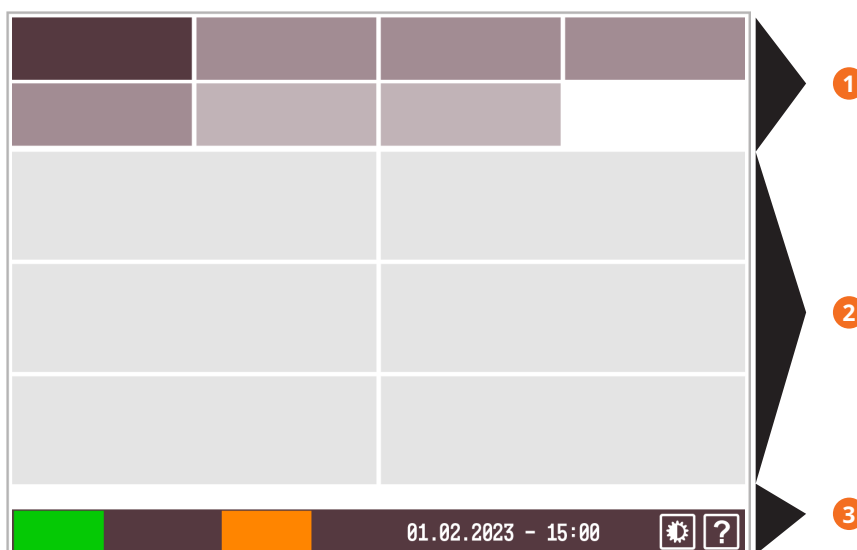
Next to the user interface, there are three LEDs giving a visual indication of the state of machine.



Description			
1	Start/stop button (SSB): The LED is green when the machine is running.	2	Power indicator light (PIL): The LED is green when the machine is powered.
3	Alarm indicator light (AIL): The LED flashes in red when a warning occurred. The LED is continuously red when an alarm occurred.		

## 2.6 Description of User Interface Functions

The display is divided into three distinct parts.



Description			
1	Menu tabs and sub-tabs	2	Information panel
3	Bottom bar		

## 2.6.1 Menu Overview

The menu consists of four main tabs with their own sub-tabs:

- The "HOME" tab is the main display and is mainly useful for live monitoring.

HOME	OPERATIONS	MAINTENANCE	SYSTEM
MAIN	MONITORING	ALARM	

- The "OPERATIONS" tab displays the operating parameters/modes and allows the control of the machine.

HOME	OPERATIONS	MAINTENANCE	SYSTEM
MODE	PARAMETERS	WEEK PLANNER	

- The "MAINTENANCE" tab displays the history of malfunctions, maintenance intervals and operating curves.

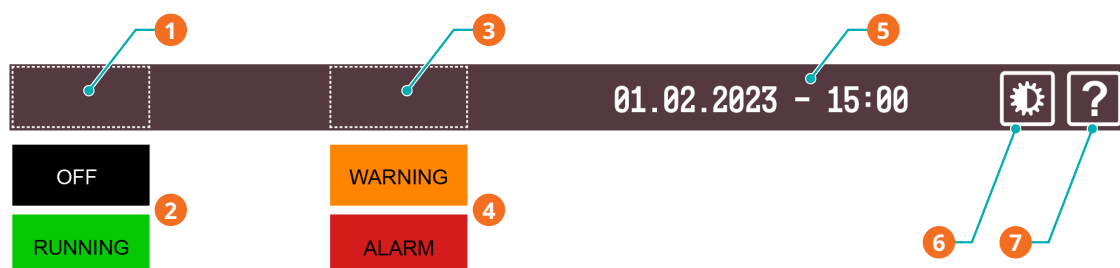
HOME	OPERATIONS	MAINTENANCE	SYSTEM
HISTORY	SERVICE	TREND	

- The "SYSTEM" tab allows to set or change settings and provides information about the product and its distributor.

HOME	OPERATIONS	MAINTENANCE	SYSTEM
SETTING	CONTACT	MODEL	ETHERNET

## 2.6.2 Bottom Bar

The bottom bar provides different pieces of information, in particular the machine state and warning/alarm status.



Description			
1	Machine state	2	Machine state: "OFF" or "RUNNING"
3	Warnings and alarms status	4	Status: "WARNING" or "ALARM"
5	Date and hour	6	Screen brightness
7	Help		



## 2.6.3 Navigation

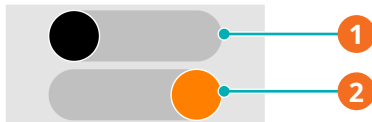
When several screens/pages are available in the information panel, dots representing the different screens/pages and "PREVIOUS/NEXT" buttons are displayed above the bottom bar.

- Press either on a dot or "PREVIOUS/NEXT" button to pass from a screen/page to another.



The switch button is black when deactivated and orange when activated.

- Press on the switch button to change its state.



### Description

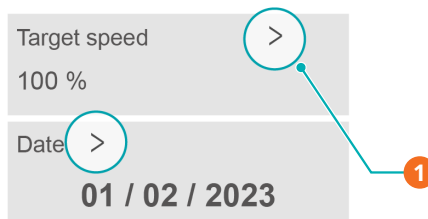
1	Deactivated (Off)	2	Activated (On)
---	-------------------	---	----------------

If a password is required:

- Enter the password, see the chapter *Roles and Users* [→ 13].

When the character ">" is displayed in a cell of the information panel, that means a step further is available. For example: a redirect link to another view or to open a specific editing view.

- Press in the cell to open the next dialog windows.



### Description

1	Step further available, press to access the next dialog window.		
---	---	--	--

If a password is required:

- Enter the password, see the chapter *Roles and Users* [→ 13].

## 2.6.4 Roles and Users

Three roles of user rights are predefined in the system.

### Role 1 ► Operator

This role is intended for machine operators to control the machine (limited rights) or monitor operating values. It does not require any password.

### Role 2 ► Installation/Maintenance technician

This role is intended for installation/maintenance technicians to configure the machine according to the application. The password for this role can be found in the separate sheet attached to this instruction manual and allows an access to the following features:

- change operating mode,
- reset hours before the next service,
- set the remote control and monitoring parameters, refer to the specific document "Pump Control Instructions, art. no.: 0870213261".

### Role 3 ► Busch Service

Only authorized personnel from Busch Service have this level of access rights.



## NOTE

**In case of any questions related to the machine settings:**

- Please contact Busch Service.



When a password is required, the display shows the following screen:



- Press on the three stars.
- Enter the correct password in the number pad according to your access right.
- Press "Save".
- From now on, the specific rights are open for a limited period ► delay of 5 minutes.

## 2.6.5 System Settings

- To edit the system settings such as date, time, language, and units:
  - Go to "SYSTEM" > "SETTINGS".
  - Press on the value to change the selected data.

HOME	OPERATIONS	MAINTENANCE	SYSTEM
SETTING	CONTACT	MODEL	ETHERNET
Date 05 / 10 / 2022	>	Language English	>
Time 16 : 59	>	Units mbar / mbar g	°C
Warnings and alarms thresholds >		Advanced settings >	
Off 05.10.2022 - 16:59  			



### NOTE

#### Warnings and alarms thresholds

Thresholds can only be changed by Busch Service "Role 3", see the predefined factory settings in the chapter *Warnings and Alarms Thresholds* [→ 57].



### NOTE

#### Advanced settings

Advanced settings can only be changed by Busch Service "Role 3", refer to the specific document "Pump Control Instructions, art. no.: 0870213261".

## 2.6.6 Machine and Software Identification

To display the machine and software identification:

- Go to "SYSTEM" > "MODEL".

HOME	OPERATIONS	MAINTENANCE	SYSTEM
SETTING	CONTACT	MODEL	ETHERNET
Vacuum pump type <b>COBRA PLUS</b>		Vacuum pump model <b>NX 0950 A PLUS</b>	
Software HMI <b>3.4</b>		Software PLC <b>3.4</b>	
Serial number <b>CHM112345678</b>			
Off		07.10.2022 - 14:12	

## 2.6.7 Ethernet Settings

- To configure the ethernet settings according to your network:
  - Go to "SYSTEM" > "ETHERNET".
  - Make sure that the Ethernet port (COM) on the right side of the control unit (CU) of the machine is connected to a computer or to the company network.
  - Change the values on the right side of the screen (Change settings), password required ▶ Role 2, see *Roles and Users* [→ 13].
  - Press on the switch button to save the new settings.

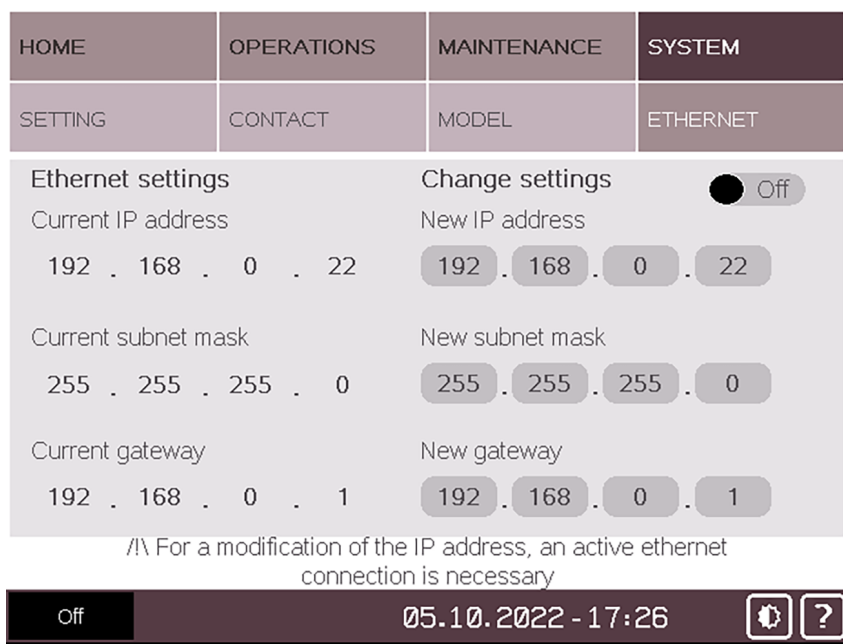


### NOTE

The current Ethernet values are displayed in the left side of the screen (Ethernet settings).

To change these values, it is necessary to fill in all the fields in the right side of the screen (Change settings) before applying the changes by pressing on the switch button:

- New IP address
  - New subnet mask
  - New gateway
- To change the Ethernet settings, it is recommended to connect the vacuum pump with the desired equipment beforehand via the Ethernet port available on the right side of the control cabinet (LAN - see illustration in the chapter "Product Description" of the instruction manual of the vacuum pump).



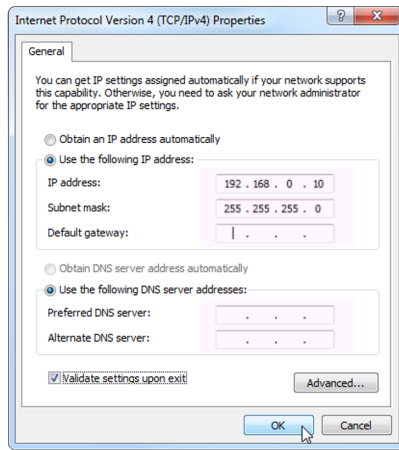
Description	Default value
IP address	192.168.0.22
Subnet mask	255.255.255.0
Gateway	192.168.0.1
PLC port (0-65535)	502 (cannot be changed)
PLC Slave no.	247 (F7) (cannot be changed)

## 2.7 Web Visualization

Each machine has a built-in Web visualization interface, which allows remote monitoring of the main operating parameters from a computer (via a LAN connection or via an optional WIFI connection), a tablet or a smartphone (via an optional WIFI connection).

### To use the Web visualization interface via a LAN connection:

- Connect an Ethernet cable to the Ethernet port (COM) on the right side of the control unit (CU) of the machine.
- Connect the Ethernet cable to the company network or to the computer. To connect the Ethernet cable to the computer, use a USB/LAN adapter or connect it directly to the Ethernet port of the computer and use the internal network card (administrator access required).
- Check the ethernet settings of the machine in the “Ethernet Settings” menu of the User Interface Display (HMI), see *Ethernet Settings* [→ 16]. By default, the ethernet settings are:
  - IP address: 192.168.0.22
  - Subnet mask: 255.255.255.0
  - Gateway: 192.168.0.1
- Check the ethernet settings of the computer network (Internet Protocol Version 4 (TCP/IPv4) Properties). The Subnet mask and the first 3 bytes of the IP address must be the same as on the PLUS machine.



- Open your web browser (full screen window) and type the IP address of the machine to monitor in the address bar, followed by: `:8080/smartpump.htm`. By default, the whole address to be typed in the web browser is: `192.168.0.22:8080/smartpump.htm`
- When the Web visualization interface opens, select "Computer" as monitoring device.

## NOTE

The following illustrations are taken from the web visualization of the "R5 RA 0840 A PLUS" vacuum pump.

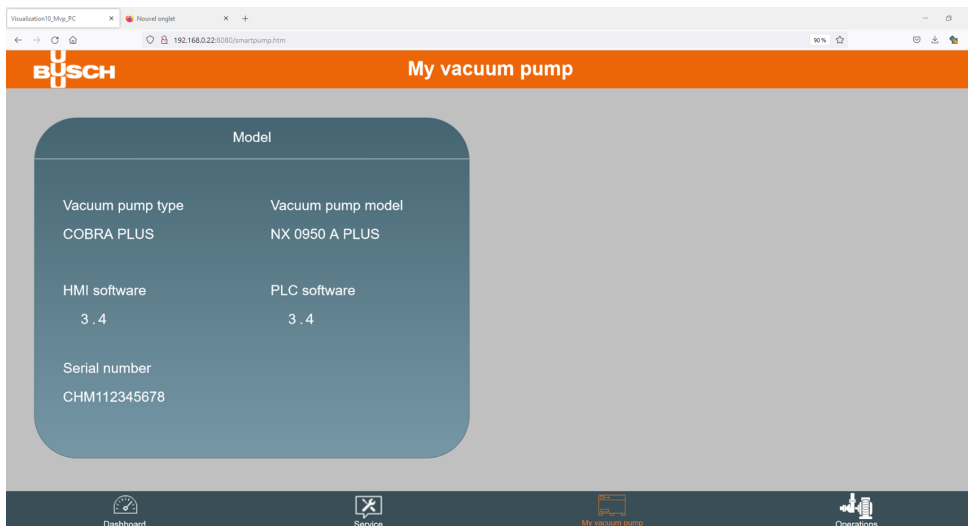
- The main screen, "**Dashboard**", shows the main operating parameters and settings of the machine (machine status, operating mode, running hours, inlet pressure...).



- Use the icons in the bottom bar to navigate in the Web visualization interface.
- The second page "**Service**" shows the service table of the machine and Busch service contact information.



- The third page “My vacuum pump” gives general information about the machine.



- The fourth page "Operations" gives remote access to the basic settings of the vacuum pump: Control mode, Operating mode, Ecomode, Week planner, Warm-up and Cool-down, Inlet valve control, Vacuum booster control.



For more information about these settings, see chapter *In Operation* [→ 40].



## NOTE

### **Remote start/stop.**

**Remote start/stop of the vacuum pump is not possible via the Web Visualization interface.**

---



## NOTE

- Contact Busch:
    - If the Ethernet port of the machine (COM) is already used for remote control / monitoring purpose.  
OR
    - In order to use the Web visualization function via a WIFI connection (requires an optional WIFI module).
  - The Web visualization interface is optimized for Google Chrome.
  - To change the IP address of the machine (in the event it is already used by another machine for instance), go to the "Ethernet Settings" menu of the User Interface Display (HMI) on the machine, see *Ethernet Settings* [→ 16].
-



## 3 Transport



### WARNING

**Suspended load.**

**Risk of severe injury!**

- Do not walk, stand or work under suspended loads.



### WARNING

**Transport and lifting.**

**Risk of severe injury!**

- Lift the machine from underneath with care to prevent the load from tipping over.
- Do not use straps, ropes or other lifting means.

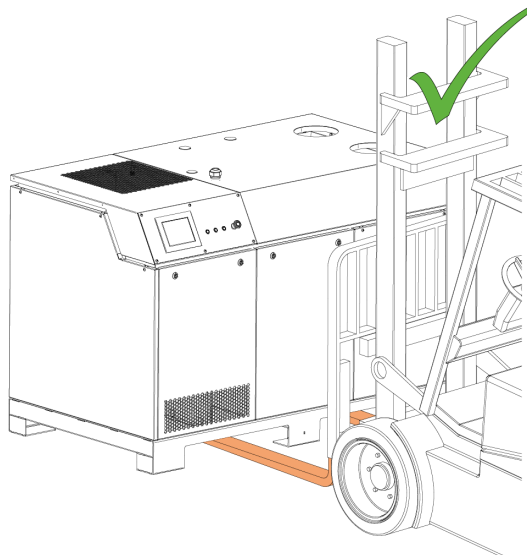


### NOTICE

**In case the machine is already filled with oil.**

**Tilting a machine that is already filled with oil can cause large quantities of oil to ingress into the cylinder.**

- Drain the oil prior to every transport or always horizontally transport the machine.
- To find out the weight of the machine, refer to the chapter Technical Data or the nameplate (NP).



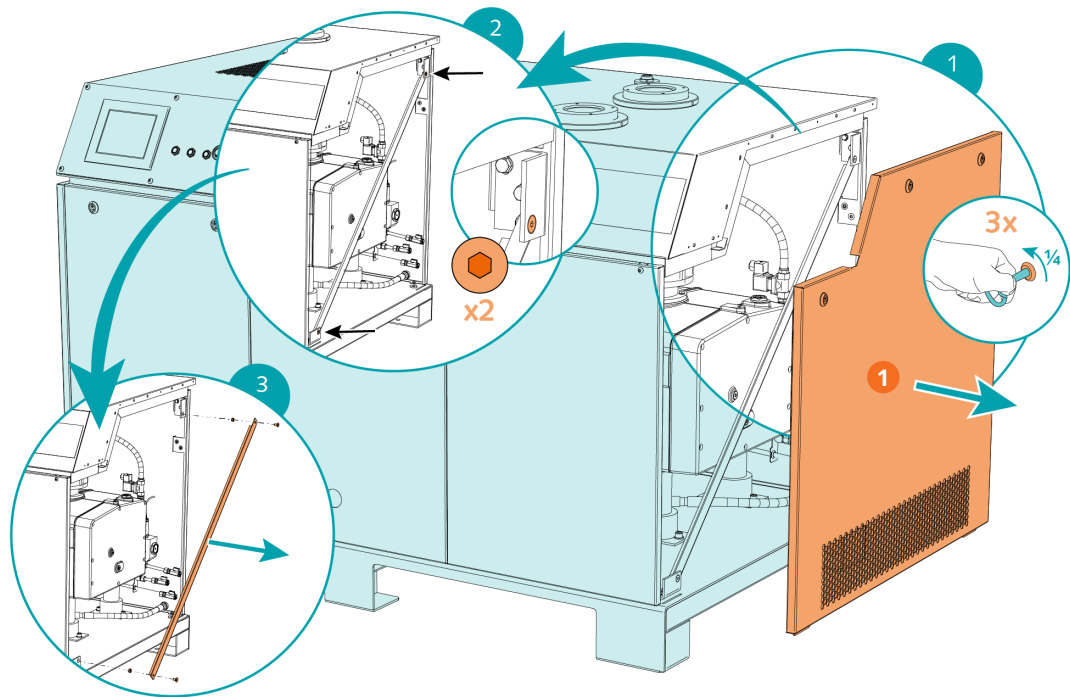
- Check the machine for transport damage.

If the machine is secured to a base plate:

- Remove the machine from the base plate.

As soon as the machine is placed at its final location:

- Remove the reinforcement bar as it can hinder a technician when performing maintenance tasks.
- Conserve and remount it for future machine transport.



#### Description

1	Remove side cover (Quarter turn key delivered loose)		
---	--	--	--

- Replace the side cover.

## 4 Storage

- Seal all apertures with adhesive tape or reuse provided caps.



### NOTICE

**Long storage time.**

**Risk of damage to the machine!**

- Due to a long storage time the capacitors of the variable speed drive can lose efficiency because of electrochemical processes. In the worst case, it can lead to a short-circuit and therefore to a damage to the variable speed drive of the machine.
- Connect the machine every 18 months for 60 minutes to the mains.

If the machine is to be stored for more than 3 months:

- Wrap the machine in a corrosion inhibiting film.
- Store the machine indoors, dry, dust free and if possible in original packaging preferably at temperatures between 0 ... 30 °C.

# 5 Installation

## 5.1 Installation Conditions

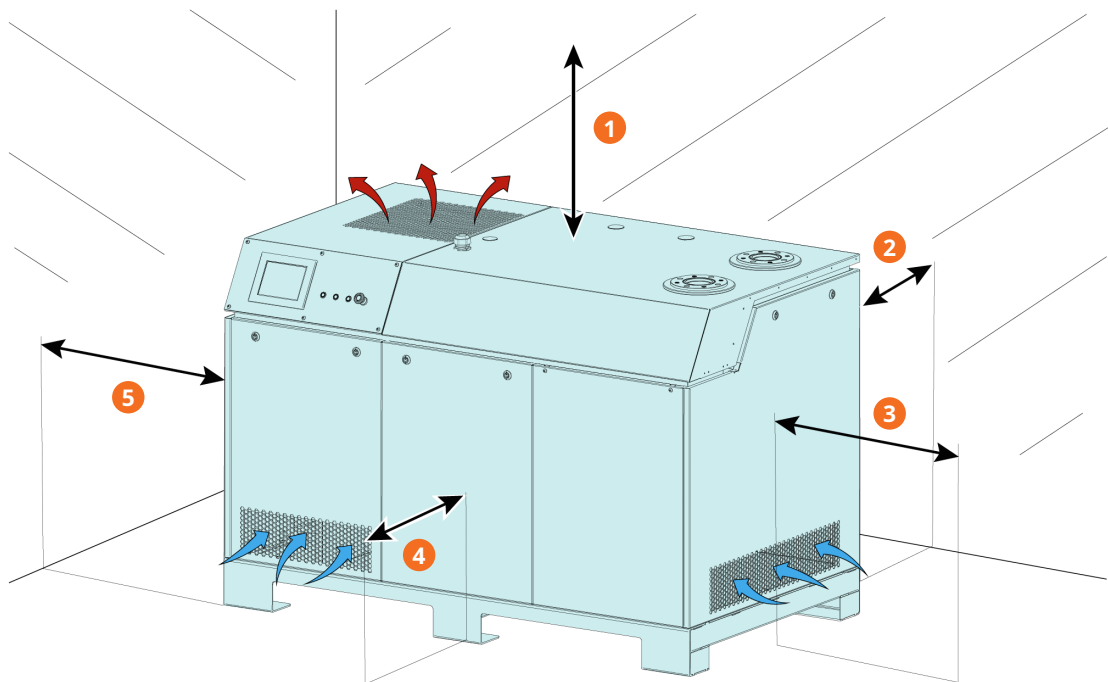
**! NOTICE**

**Use of the machine outside of the permitted installation conditions.**

**Risk of premature failure!**

**Loss of efficiency!**

- Take care that the installation conditions are fully complied with.



Description			
1	~50 cm	2	~100 cm
3	~100 cm	4	~100 cm
5	~5 cm		

- Make sure that the environment of the machine is not potentially explosive.
- Make sure that the ambient conditions comply with the Technical Data.
- Make sure that the environmental conditions comply with the protection class IP54.
- Make sure that the installation space or location is vented such that sufficient cooling of the machine is provided.
- Make sure that cooling air inlets and outlets are not covered or obstructed and that the cooling air flow is not affected adversely in any other way.
- Make sure that enough space remains for maintenance work.
- Make sure that the machine is placed or mounted horizontally, a maximum deviation of 1° in any direction is acceptable.
- Check the oil level, see Oil Level Inspection.

- Make sure that all provided covers, guards, hoods, etc. are mounted.
- Make sure that the cooling water complies with the requirements, see *Cooling Water Connection* [→ 27].

If the machine is installed at an altitude greater than 1000 meters above sea level:

- Contact your Busch representative, the ambient temperature should be limited.

## 5.2 Connecting Lines / Pipes

- Remove all protective covers before installation.
- Make sure that the connection lines cause no stress on the connection of the machine; if necessary use flexible joints.
- Make sure that the line size of the connection lines over the entire length is at least as large as the connections of the machine.

In case of long connection lines, it is advisable to use larger line sizes in order to avoid a loss of efficiency. Seek advice from your Busch representative.

- Make sure that the connection flanges are fitted with the appropriate gaskets.
- Make sure that the maximum load on the connection flanges (IN/OUT) does not exceed 50 kg.

### 5.2.1 Suction Connection



#### WARNING

**Unprotected suction connection.**

**Risk of severe injury!**

- Do not put hand or fingers in the suction connection.



#### NOTICE

**Ingress of foreign objects or liquids.**

**Risk of damage to the machine!**

If the inlet gas contains dust or other foreign solid particles:

- Install a suitable filter (5 micron or less) upstream from the machine.

Connection size(s):

- G3
- ISO DN100, DIN 28404

## 5.2.2 Discharge Connection



### NOTICE

**Discharge gas flow obstructed.**

**Risk of damage to the machine!**

- Make sure that the discharged gas will flow without obstruction. Do not shut off or throttle the discharge line or use it as a pressurized air source.

Connection size(s):

- G3
- ISO DN100, DIN 28404

Unless the aspirated air is discharged to the environment right at the machine:

- Make sure that the discharge line either slopes away from the machine or provide a liquid separator or a siphon with a drain cock, so that no liquids can flow back into the machine.
- Make sure that the counter pressure (also termed back pressure) at the discharge connection (OUT) does not exceed the maximum allowable discharge pressure, see Technical Data.

## 5.2.3 External Inlet Pressure Sensor

An external inlet pressure sensor can be connected to the Control Unit. To control the machine with an external sensor:

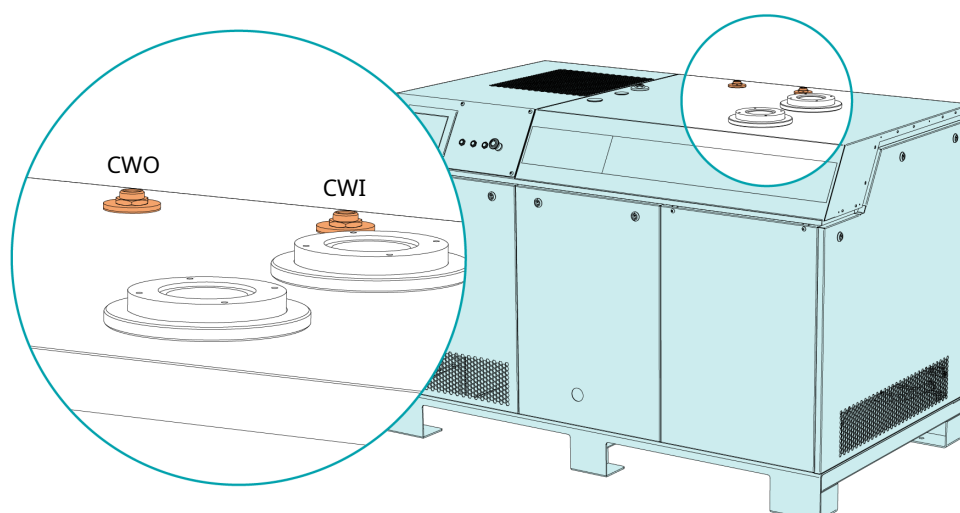
- Mechanically fit the pressure sensor at the desired location upstream of the vacuum pump inlet (on a vacuum vessel or in the vacuum chamber for instance).
- Electrically connect the external pressure sensor to the control unit (CU): See wiring diagram in the control unit cabinet.
- Set the sensor parameters and enable the External inlet pressure sensor control in the “Advanced settings” menu of the User Interface, refer to the specific document “Pump Control Instructions, art. no.: 0870213261”. This parameter is only available for “Role 3” users, see *Roles and Users* [→ 13].



### NOTE

- Use an ECM cable gland and a shielded cable.
- Connect the cable shielding according to the state of the art (refer to the instructions of the cable gland manufacturer).

## 5.2.4 Cooling Water Connection



### Description

CWI	Cooling water inlet	CWO	Cooling water outlet
-----	---------------------	-----	----------------------

- Connect the cooling water connections (CWI / CWO) to the water supply.

Connection size:

- G1/2, ISO 228-1 (CWI / CWO)

- Make sure that the cooling water complies with the following requirements:

Supply capacity	l/min	8 ... 16
Water pressure	bar	1.5 ... 6
Supply temperature	°C	+10 ... +30
Required pressure differential across supply and return	bar	≥ 1.5

- To reduce the maintenance effort and ensure a long product lifetime we recommend the following cooling water quality:

Hardness	mg/l (ppm)	< 90
Properties	Clean & clear	
PH value		7 ... 8
Particle size	µm	< 200
Chloride	mg/l	< 100
Electrical conductivity	µS/cm	≤ 100
Free chloride	mg/l	< 0.3
Materials in contact with the cooling water	Stainless steel and cast iron	

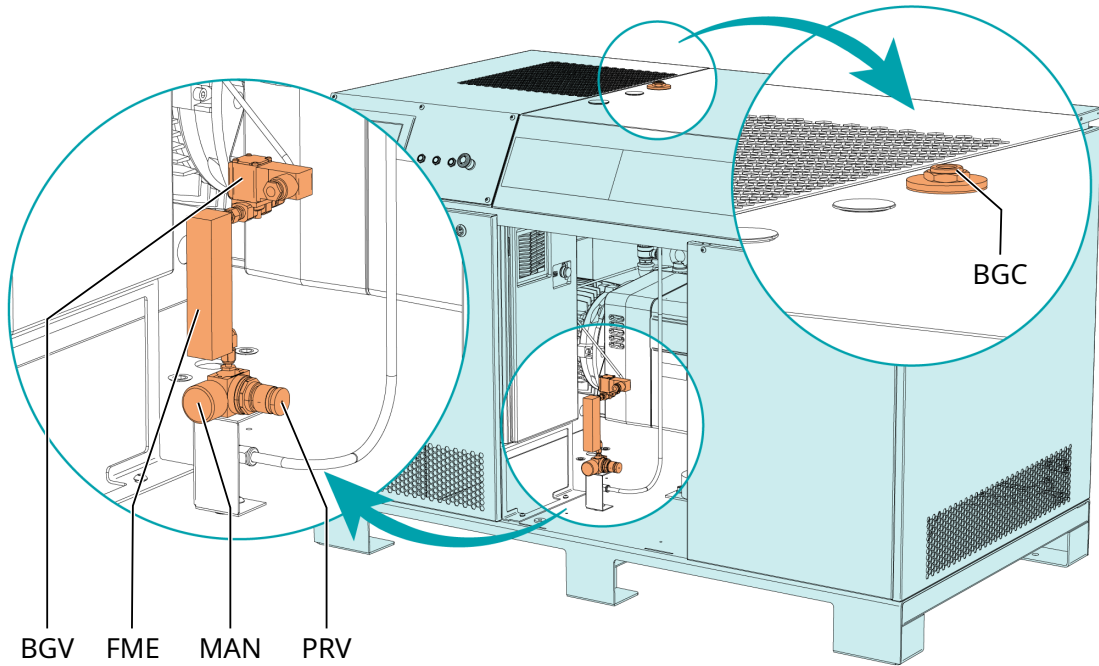


### NOTE

**Water hardness unit conversion.**

**1 mg/l (ppm) = 0.056 °dh (german degree) = 0.07 °e (english degree) = 0.1 °fH (french degree)**

## 5.2.5 Barrier Gas System Connection



Description			
BGC	Barrier gas connection	BGV	Barrier gas solenoid valve
FME	Flow meter (BGF)	MAN	Manometer (BGM)
PRV	Pressure regulating valve (BGR)		

- Connect the barrier gas connection (BGC) to the gas supply.

Connection size:

- G3/8, ISO 228-1

- Make sure that the gas complies with the following requirements:

Gas type	Dry nitrogen or air	
Gas temperature	°C	0 ... 60
Maximum gas pressure	bar	13
Recommended pressure setting at the pressure regulating valve (PRV)	bar(a)	3
Filtration	µm	5
Recommended flow rate	SLM (standard liter per minute)	15 ... 20
Air quality (only for air)	Acc. to ISO 8573-1	Class 5.4.4.



## 5.3 Filling Oil

### NOTICE

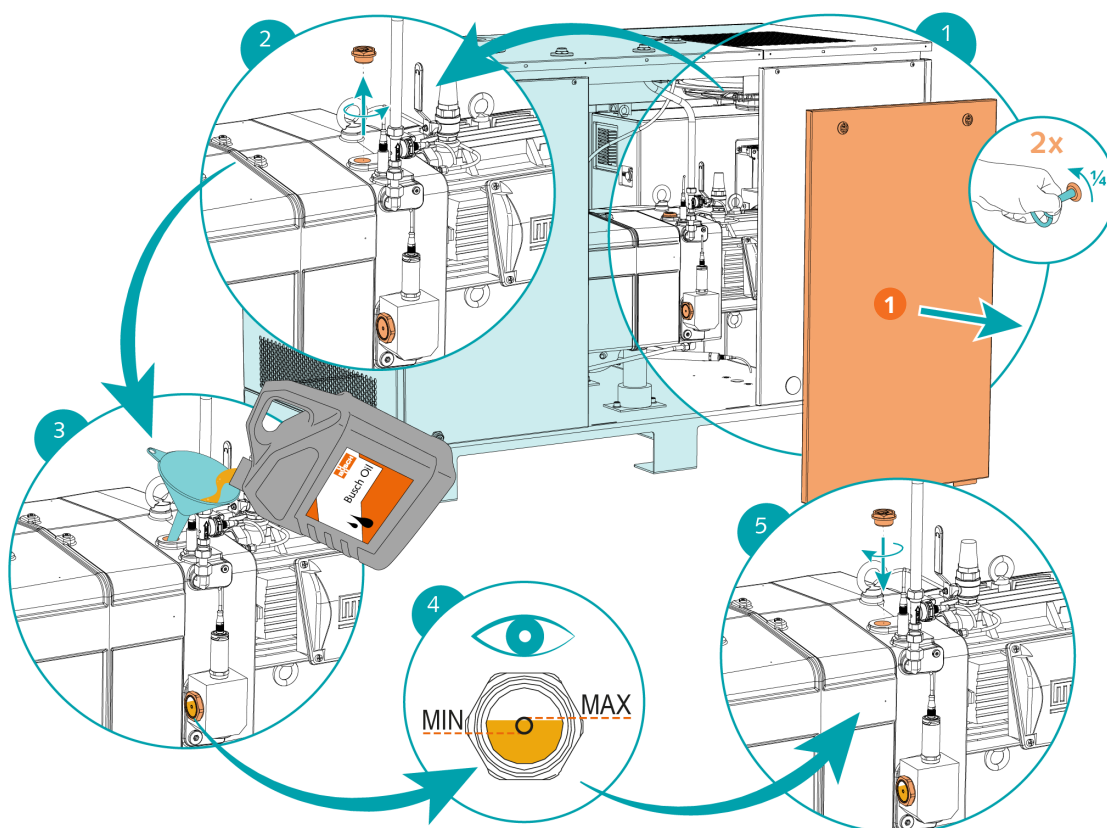
**Use of an inappropriate oil.**

**Risk of premature failure!**

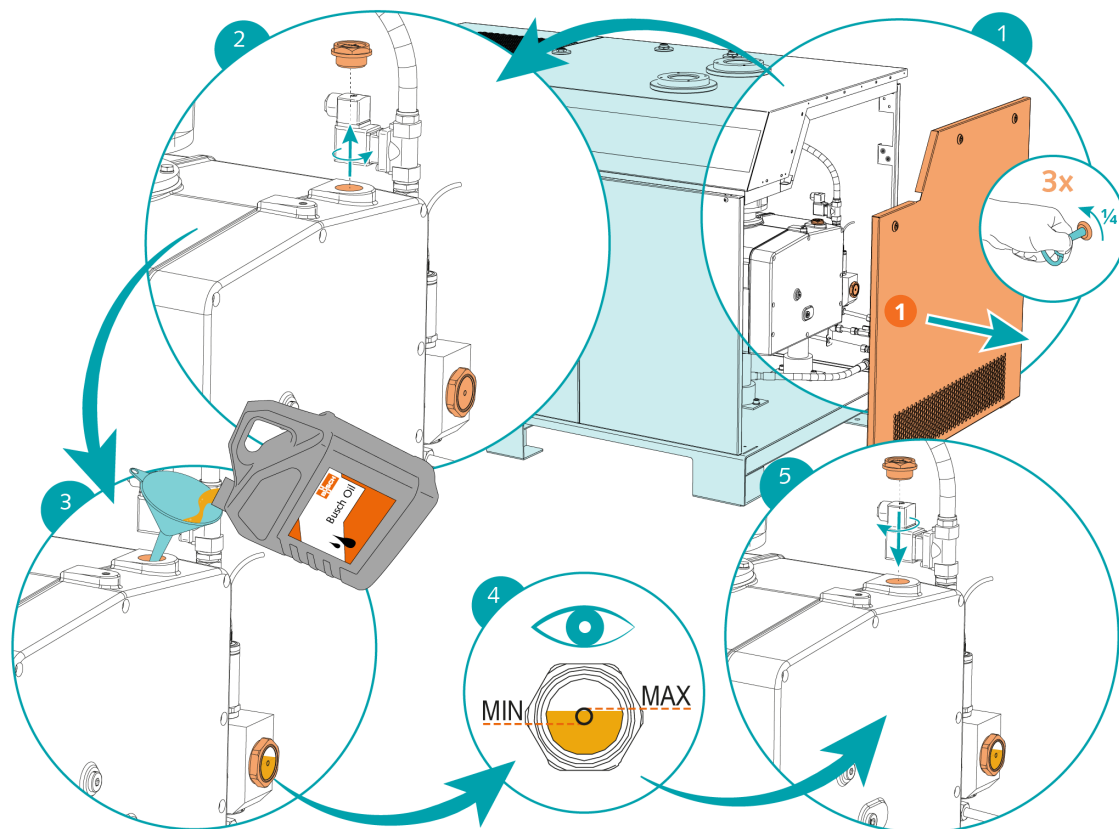
**Loss of efficiency!**

- Only use an oil type which has previously been approved and recommended by Busch.

For oil type and oil capacity see Technical Data and *Oil* [→ 82].



Description	
1	Remove central back cover (Quarter turn key delivered loose)

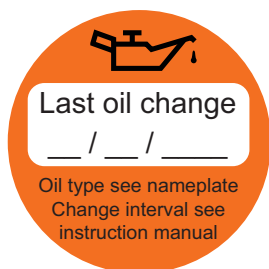


### Description

1	Remove side cover (Quarter turn key delivered loose)
---	--

When the oil filling is achieved:

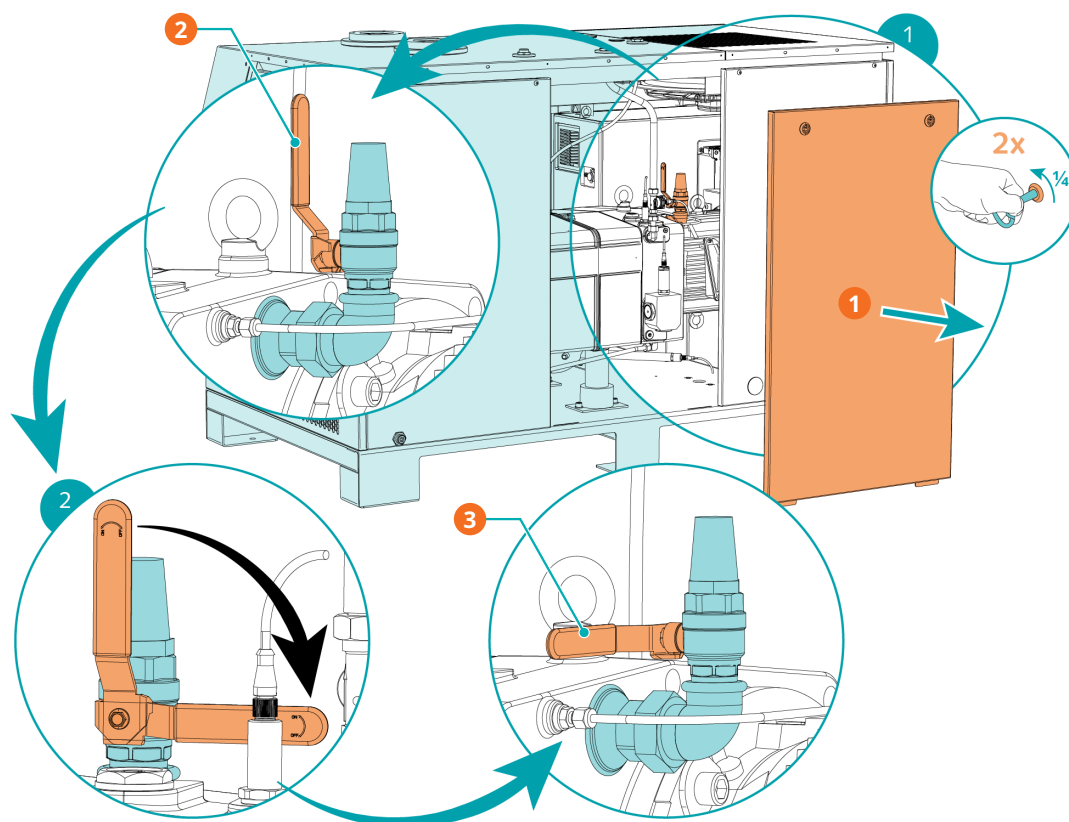
- Write down the oil change date on the sticker.



If there is no sticker (part no. 0565 568 959) on the machine:

- Order it from your Busch representative.

## 5.4 Gas Ballast Opening and Closing



Description			
1	Remove central back cover (Quarter turn key delivered loose)	2	Open position
3	Closed position		

## 6 Electrical Connection



### DANGER

**Live wires.**

**Risk of electrical shock.**

- Electrical installation work must only be executed by qualified personnel.

#### CURRENT PROTECTION OF THE CUSTOMER INSTALLATION:



### DANGER

**Missing current protection.**

**Risk of electrical shock.**

- Current protection in accordance with EN 60204-1 must be provided by the customers on their installation(s).
- The electrical installation must comply with the applicable national and international standards.



### NOTICE

**Electromagnetic compatibility.**

- Make sure that the motor of the machine will not be affected by electric or electromagnetic disturbance from the mains, if necessary seek advice from Busch.
- Make sure that the EMC of the machine is compliant with the requirements of your supply network system, if necessary provide further interference suppression (EMC of the machine, see *EU Declaration of Conformity* [→ 83] or *UK Declaration of Conformity* [→ 84]).

### 6.1 PLUS Machine



### DANGER

**Live wires. Carry out any work on the variable speed drive and motor.**

**Risk of electrical shock!**

- Electrical installation work must only be executed by qualified personnel.



### DANGER

**Maintenance work without switching-off the power supply to the control unit.**

**Risk of electrical shock.**

- Switch-off the power supply to the control unit with a lockable disconnect switch before attempting any work on it. High voltages are present at the terminals and within the variable speed drive for up to 10 minutes after disconnection of the electrical supply.
- Always ensure by using a suitable multimeter that no voltage is present on any drive power terminals prior to commencing any work.

- Make sure that the power supply is compatible with the data on the nameplate of the control unit.
- If the machine is equipped with a power connector, install a residual current protective device to protect persons in case of a defective insulation.
  - Busch recommends installing a type B residual protective device suitable for the electrical installation.
- If the control unit is not equipped with a lockable disconnect switch, provide it on the power line so that the machine is completely secured during maintenance tasks.
- Provide an overload protection according to EN 60204-1.
  - Busch recommends installing a C-curve circuit breaker.
- Connect the protective earth conductor.
- Electrically connect the control unit (CU), see *Wiring Diagram Control Unit* [→ 34].

## ! NOTICE

**The admissible motor speed exceeds the recommendation.**

**Risk of damage to the machine!**

- Check the admissible motor speed range, see Technical Data.

## ! NOTICE

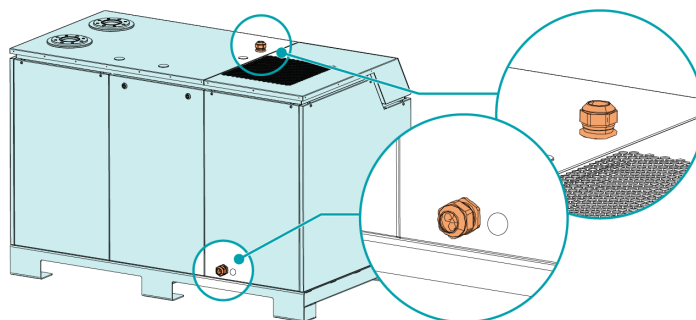
**Incorrect connection.**

**Risk of damage to the control unit!**

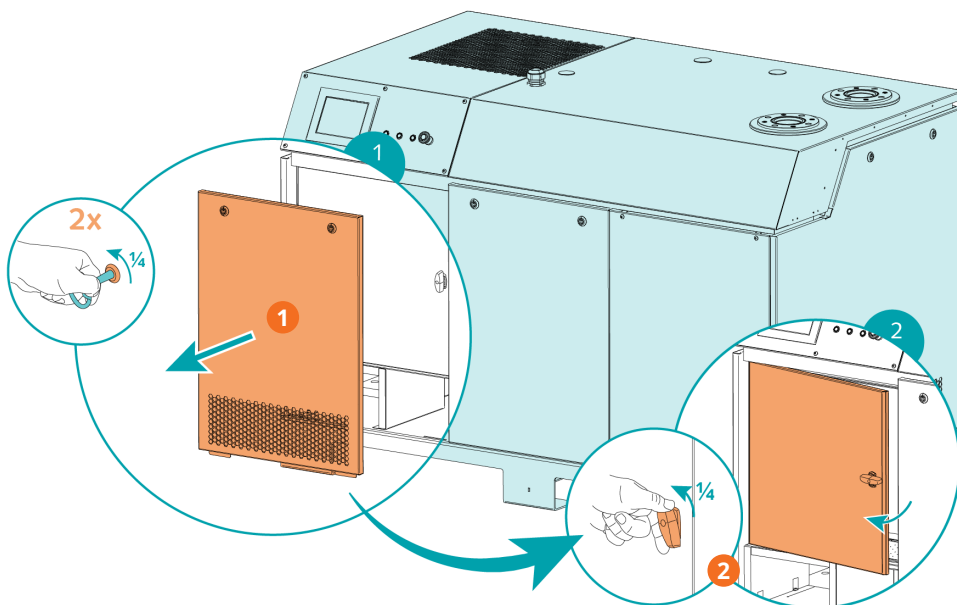
- The wiring diagrams given below are typical. Check the inside of the control unit for connection instructions/diagrams.

In case of PLUS pumps equipped with a sound reduction enclosure:

- Make sure that the cable is isolated from the acoustic cabinet via the provided cable gland. The temperature inside the cabinet may reach 60°C.
- Define the location of the power supply cable gland (PWS), choose between two possibilities illustrated below:



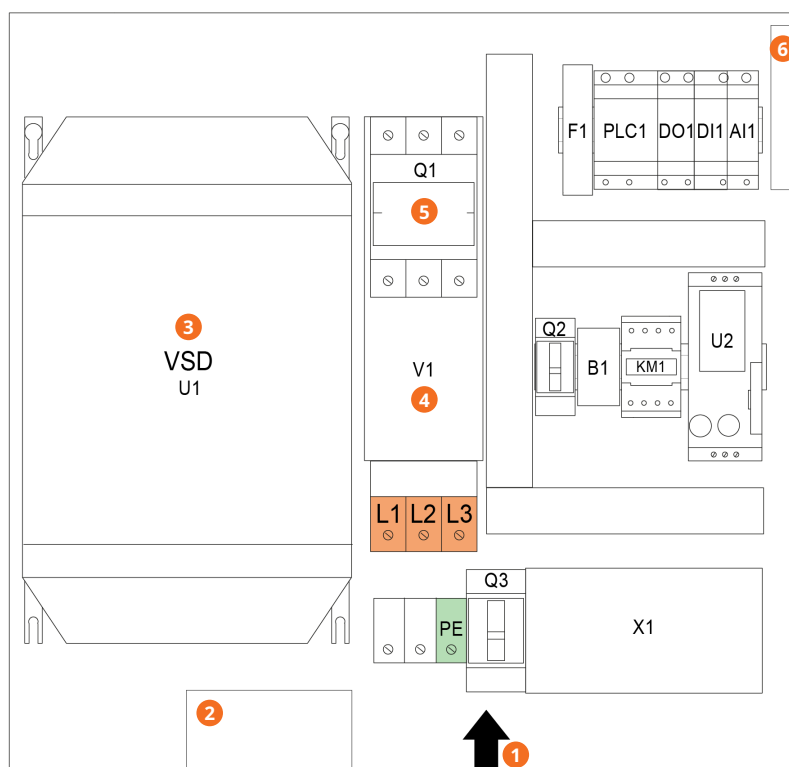
- Electrically connect the control unit to the power supply and connect the protective earth connection according to the electrical scheme, see *Wiring Diagram Control Unit* [→ 34].



Description			
1	Remove left front cover (Quarter turn key delivered loose)	2	Open control unit (CU)

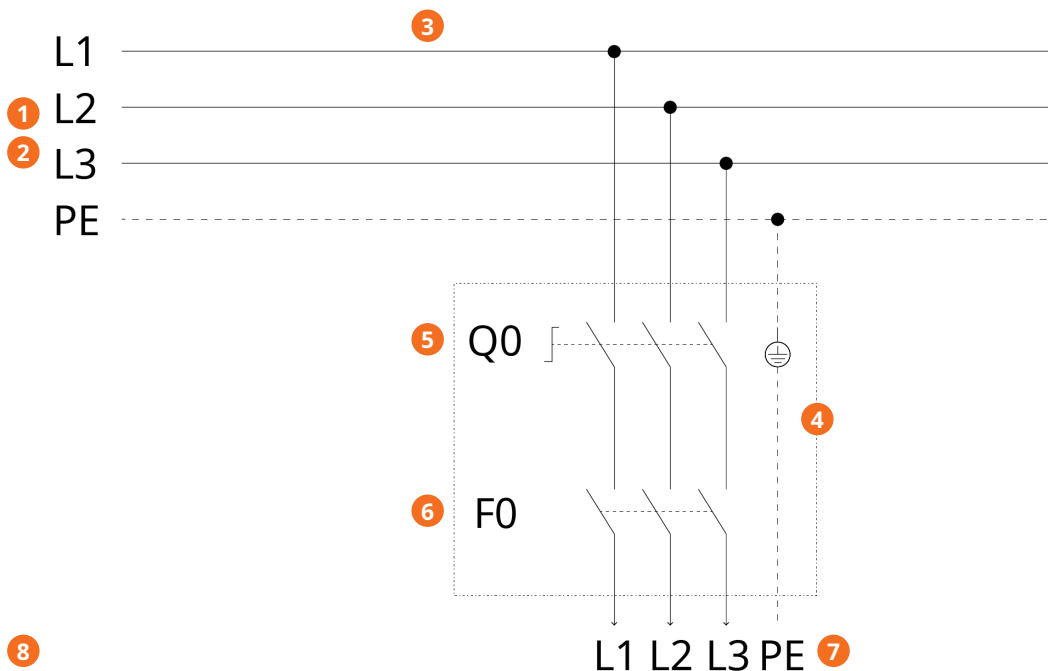
## 6.2 Wiring Diagram Control Unit

### Internal view of the control unit



Description			
1	Power input	2	Box fan
3	VSD: Variable Speed Drive	4	Filter
5	on EMC filter	6	Box filter

### Customer power supply

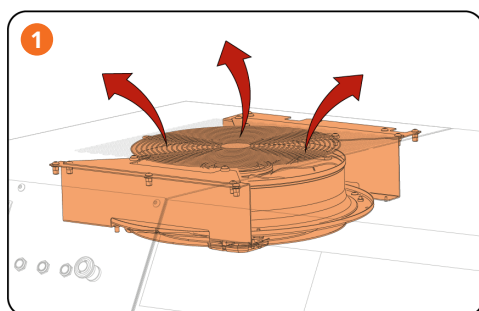


Description			
1	Power supply Standard Control Unit: 3L+PE 380-440V +/-10% (50/60Hz)	2	Power supply Optional Control Unit: 3L+PE 380-460V +/-10% (50/60Hz)
3	Wire gauge according to EN 60204-1	4	Must be provided by the customer
5	Lockable disconnect switch	6	Overload protection: C-curve - 80A without DCR / C-curve - 50A with DCR
7	Vacuum pump terminal board (L1, L2, L3, PE to the control unit)	8	The complete wiring diagram of the control unit is placed inside the electrical cabinet.

Cable gland size of the power input:

- M40 x 1.5 (cable  $\varnothing$  ► 20 ... 33 mm)

- Make sure that the air flow blows in the right direction according to the following illustration.



Description			
1	Air flow (blowing)		

If the rotation must be changed:

- Switch any two of the phase wires.

# 7 Commissioning

## 7.1 Prerequisites Before Use



### NOTICE

**The machine can be shipped without oil.**

**Operation without oil will ruin the machine in short time!**

- Prior to commissioning, the machine must be filled with oil, see *Filling Oil* [→ 29].

- Make sure that the *Installation Conditions* [→ 24] are met.
- Power the machine, the power indicator light (PIL) must be lit in green.
- Fill in the system settings (such as date/time, language and units), see chapter *System Settings* [→ 15].
- After installation, it is recommended to leave the electrical cabinet switched on for 60 minutes before the first start-up of the vacuum pump, especially if the pump has been stored for a long period.
- Make sure all covers are in place and properly installed.
- Turn on the water supply.
- After a power shutdown, a message will appear, requiring a correct water flow rate to start.
  - Select “Open water valve”.
  - As soon as the water flow sensor detects a flow over 8l/min, the message “Pump ready to use” will appear. Simply press on it to validate.



### NOTE

- **At the first start-up (pump without water inside), the correct water flow rate will take some time to be reached. This is due to the complete filling of the pump (>50l.) as the water flow is on the water back circuit.**

- **It is possible to skip temporarily the water flow check message to change some parameters or modify the configuration. The message will then appear again after a period of 2 minutes or when pushing the start button.**

Once these steps are completed, the machine is ready to start with default settings:

- Speed control mode at 100 %

If the barrier gas system is intended to be used:

- Turn on the barrier gas supply.
- Adjust the barrier gas pressure.

(See *Barrier Gas System Connection* [→ 28], recommended pressure setting at the pressure regulating valve)



### NOTE

**Adjusting the barrier gas pressure is only possible when the machine is running, so that the solenoid valve is opened.**



For all other operating settings:

- Consult the chapter *Configuration* [→ 37].
- After a few minutes of operation, perform an Oil Level Inspection.

## 7.2 Configuration



### NOTICE

**Configuration.**

**Incorrect configuration can lead to malfunctions!**

- The configuration must only be performed by authorized personnel.

The configuration of the machine has to be according to the process type and only performed by "Role 2" users, see *Roles and Users* [→ 13].

Different machine parameters can be configured, such as:

- *Control Mode* [→ 40] ▶ Local/Manual (default), Local/Auto (week planner) or Remote/Auto,
- *Operating Mode* [→ 43] ▶ Speed control (default) or Pressure control,
- *Ecomode* [→ 45],
- *Warm-up / Cool-down Modes* [→ 46],
- *Inlet Valve Control* [→ 48],
- *Vacuum Booster Control* [→ 50].

Do not hesitate to contact Busch to get any further information about the configuration of your machine.

- Click on the "Help" icon in the bottom bar to get the contact information of your Busch representative, see *Bottom Bar* [→ 12].

## 7.3 Start Up

### NOTICE

**The machine can be shipped without oil.**

**Operation without oil will ruin the machine in short time!**

- Prior to commissioning, the machine must be filled with oil, see *Filling Oil* [→ 29].

### NOTICE

**Lubricating a dry running machine (compression chamber).**

**Risk of damage to the machine!**

- Do not lubricate the compression chamber of the machine with oil or grease.



### CAUTION

**During operation the surface of the suction and exhaust connections may reach temperatures of more than 70°C.**

**Risk of burns!**

- Avoid contact with these surfaces during and directly after operation.



### CAUTION

**Remove covers during operation.**

**Risk of burns!**

- If a cover is removed when the machine is operating, avoid contact with surfaces inside the acoustic cabinet.

### CAUTION



**Noise of running machine.**

**Risk of damage to hearing!**

If people are present in the vicinity of a machine that is not insulated from noise for extended periods of time:

- Make sure to wear hearing protection.

To start the machine:

- Press and hold the start/stop button (SSB) for at least 3 seconds.
- Monitor the operating values (*Monitoring* [→ 52]) and make sure that they always comply with the operating conditions, see Technical Data.

As soon as a warning/alarm signal occurred:

- Investigate the cause of the signal, see *Dysfunction* [→ 57].



## NOTE

**Activated oil level signal.**

**The machine is generally shipped without oil, therefore an alarm signal occurs during the first start-up.**

- As soon as the machine has been filled with oil, acknowledge the alarm signal by following the *Warning/Alarm Acknowledgment Procedure* [→ 59].



## NOTE

**Control mode "Remote/Auto".**

**The machine cannot be started manually if the control mode is set to "Remote/Auto".**

# 8 In Operation



## CAUTION

During operation the surface of the suction and exhaust connections may reach temperatures of more than 70°C.

**Risk of burns!**

- Avoid contact with these surfaces during and directly after operation.



## CAUTION

Remove covers during operation.

**Risk of burns!**

- If a cover is removed when the machine is operating, avoid contact with surfaces inside the acoustic cabinet.



## CAUTION



Noise of running machine.

**Risk of damage to hearing!**

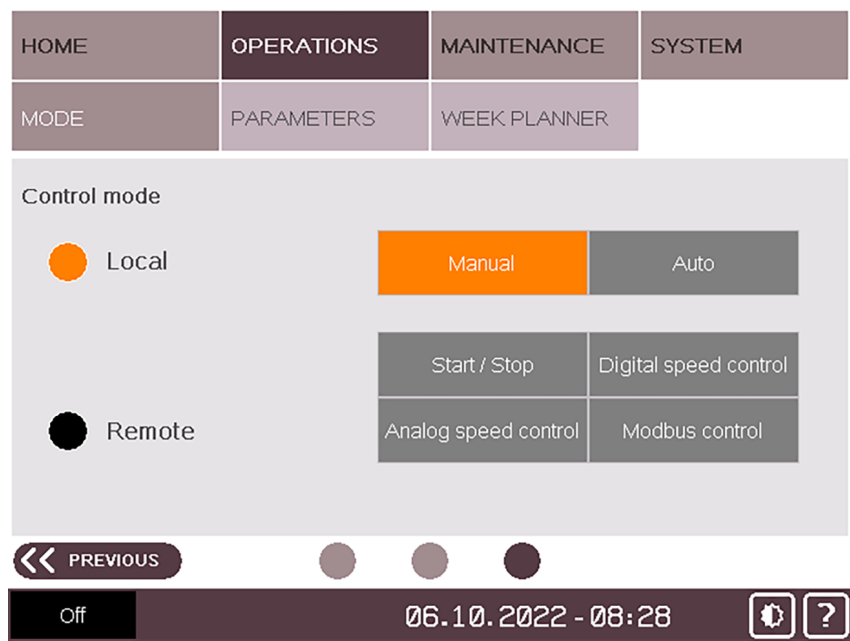
If people are present in the vicinity of a machine that is not insulated from noise for extended periods of time:

- Make sure to wear hearing protection.

## 8.1 Control Mode

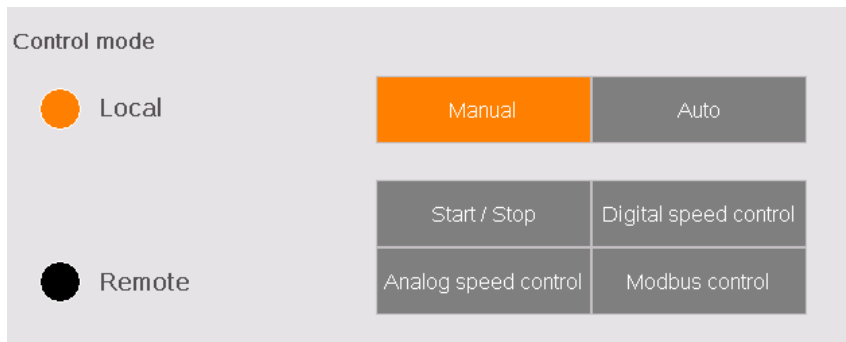
To access the control mode menu:

- Go to "OPERATIONS" > "MODE".
- Go to the third screen/page.



### 8.1.1 Local/Manual

Configured by default, this mode allows to control manually the machine directly from the user interface (HMI).

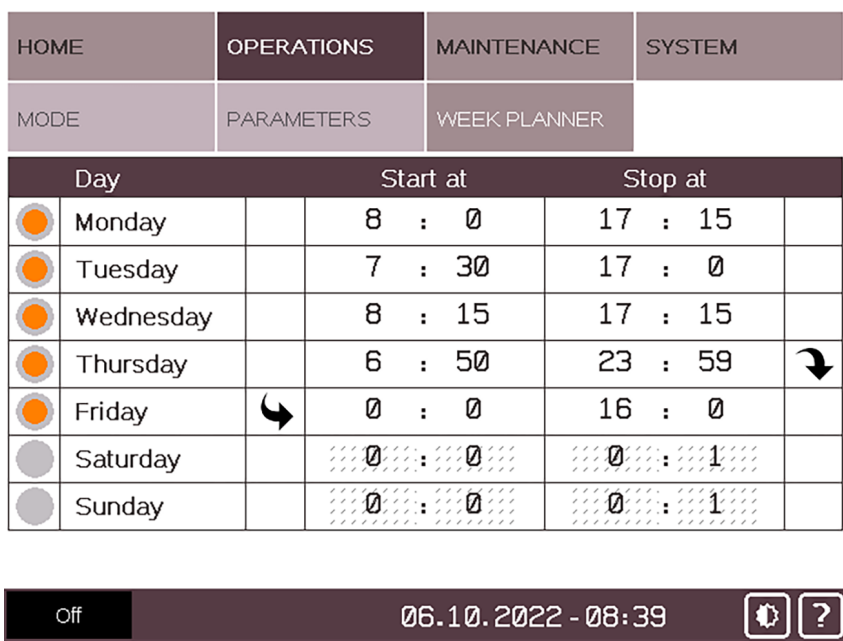


### 8.1.2 Local/Auto "Week Planner"

The "week planner" function allows definition of a weekly schedule for starting or stopping the machine automatically using the current local settings. A single start and stop a day is possible.

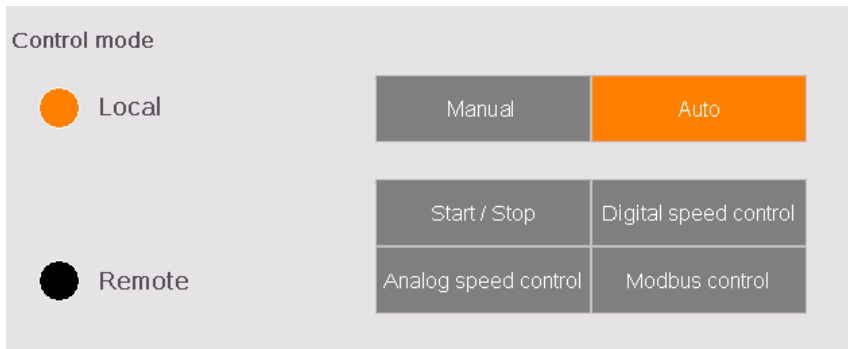
To configure the weekly schedule:

- Go to "OPERATIONS" > "WEEK PLANNER".
- Press on the days when automatic start and stop are required.
- Set up the start and stop times.



As soon as the schedule is filled in, the control mode "Local/Auto" has to be activated (by "Role 2" users only, see *Roles and Users* [→ 13]):

- Go to the control mode menu, see *Control Mode* [→ 40].
- Select the mode "AUTO" in the "LOCAL" field (password required).




 **WARNING**

**The machine may start without notice.**


**Risk of severe injury!**

As soon as the mode “Local/Auto” is activated:

- Make sure the machine is fully operational when the programmed schedule begins.

 **NOTE**

To allow the machine to operate non-stop from one day to the next one, select 23:59 as the stop time on the first day and 00:00 as the start time on the second day. Arrows appear in the weekly schedule table to show that the machine will continuously run between the two days.

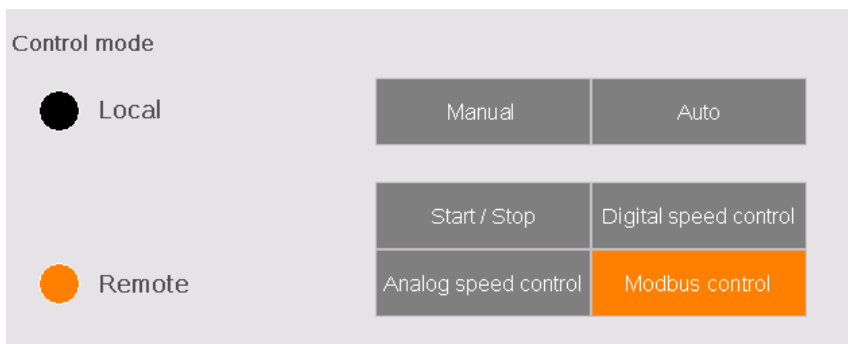
 **NOTE**

**Manual starts and stops.**

**The week planner still allows manual starts and stops.**

### 8.1.3 Remote/Auto

The remote control mode is only available for “Role 2” users, this mode allows remote control of the machine via an analog, digital or Modbus input.



- Refer to the specific document “Pump Control Instructions, art. no.: 0870213261” for more details or contact your Busch representative.



## WARNING

**The machine may start without notice.**

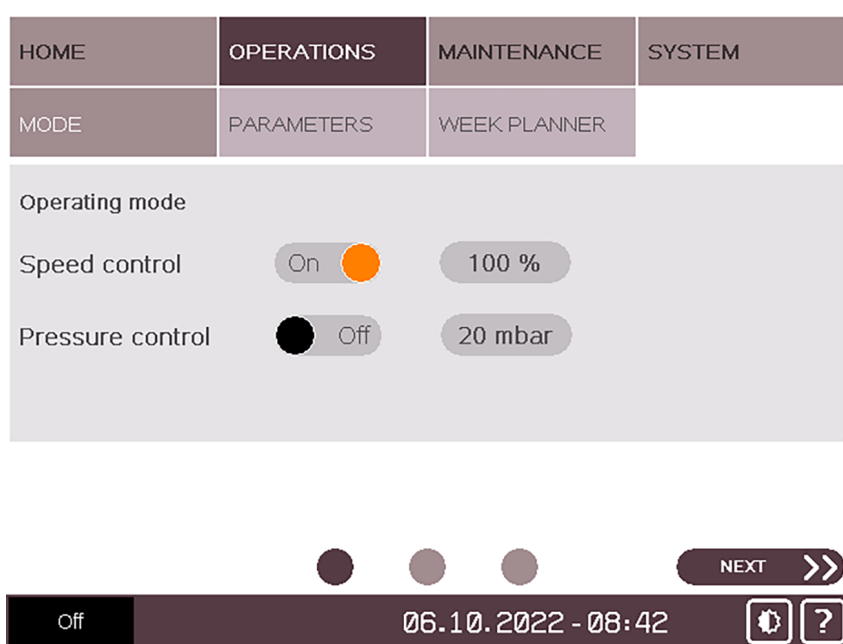
**Risk of severe injury!**

As soon as the “Remote” mode is activated:

- Make sure the machine is fully operational.

## 8.2 Operating Mode

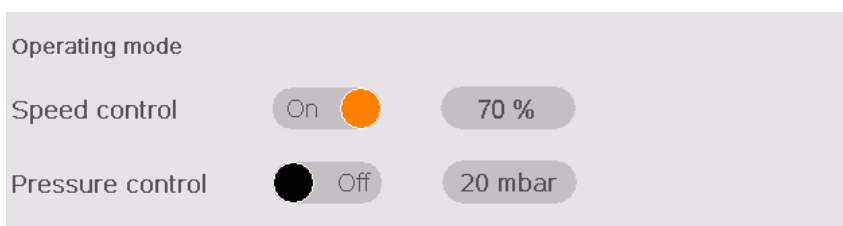
- To access the operating mode menu:
  - Go to “OPERATIONS” > “MODE” and stay on the first screen/page.



### 8.2.1 Speed Control

Configured by default with a vacuum pump speed of 100 %, the speed control mode allows the variation of the motor frequency. This mode is only available for “Role 2” users, see *Roles and Users* [→ 13].

- To change the vacuum pump speed:
  - Press on the speed percentage (password required, see *Roles and Users* [→ 13]).
  - Assign the desired frequency on the keypad and press “Enter”.



Parameter	Default value	Adjustment range*
Speed control (target speed)	100 %	1 ... 100 %

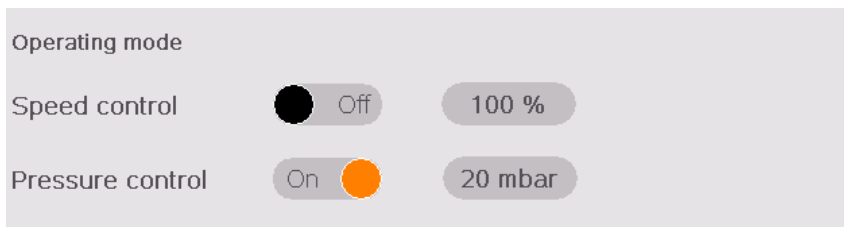
\* In percentage of the operating speed range

- For more information on "pumping speed" versus "% speed", refer to the vacuum pump performance curves.

## 8.2.2 Pressure Control

The pressure control mode allows to maintain a constant pressure level (target pressure) by automatically adapting the motor frequency. This mode is only available for "Role 2" users, see *Roles and Users* [→ 13].

- To switch from speed control to pressure control:
  - Press on the target pressure value (password required, see *Roles and Users* [→ 13]).
  - Assign the target pressure on the keypad and press "Enter".
  - Press on the switch button.



Parameter	Default value	Adjustment range
Pressure control (target pressure)	20	<5 ... 400 mbar

- For smooth process pressure control, it is required to adjust the PID parameters.
- Refer to the specific document "Pump Control Instructions, art. no.: 0870213261" for more details or contact your Busch representative.



### NOTE

**Display of the ultimate pressure.**

**Due to sensor accuracy, the minimum displayed value of the ultimate pressure is 5 mbar preceded by the symbol "<", which means that the actual value is lower than displayed. The ultimate pressure of the machine is indicated on the nameplate (NP).**

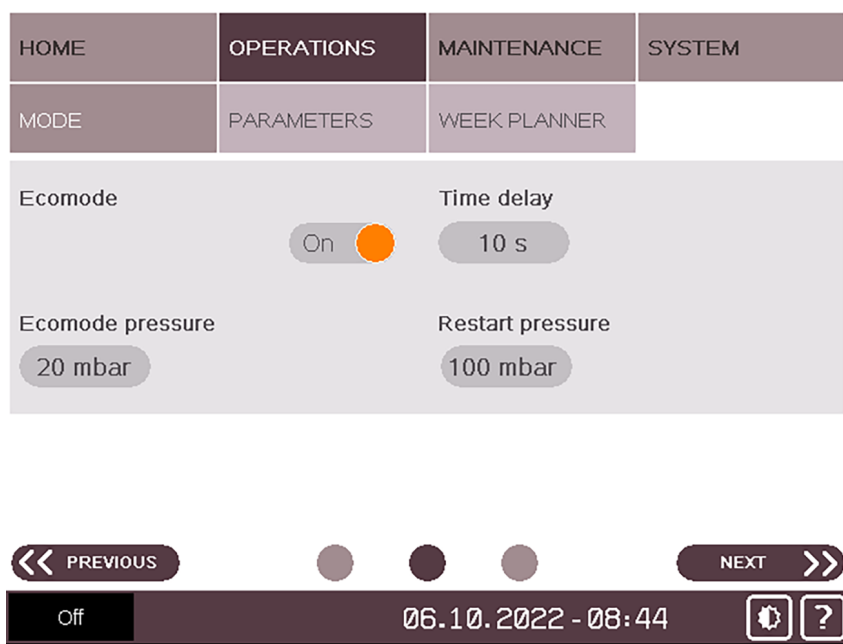


## 8.3 Ecomode

The Ecomode stops the machine when the inlet pressure has reached the preset "ecomode pressure" within a defined time delay and will restart once the inlet pressure exceeds the "restart pressure".

This mode is only available for "Role 2" users, see *Roles and Users* [→ 13].

- To activate and set the Ecomode:
  - Go to "OPERATIONS" > "MODE".
  - Go to the second screen/page.
  - Press on the Ecomode switch button (password required, see *Roles and Users* [→ 13]).



- Press a value to change it.

Parameter	Default value	Adjustment range
Ecomode pressure	20 mbar	5 ... 400 mbar
Restart pressure	100 mbar	5 ... 1000 mbar
Time delay	10 s	1 ... 999 s



### NOTE

The control unit of the vacuum pump may send a signal to pilot an isolation valve (see *Inlet Valve Control* [→ 48]) or to control a vacuum booster (see *Vacuum Booster Control* [→ 50]).

## 8.4 Warm-up / Cool-down Modes

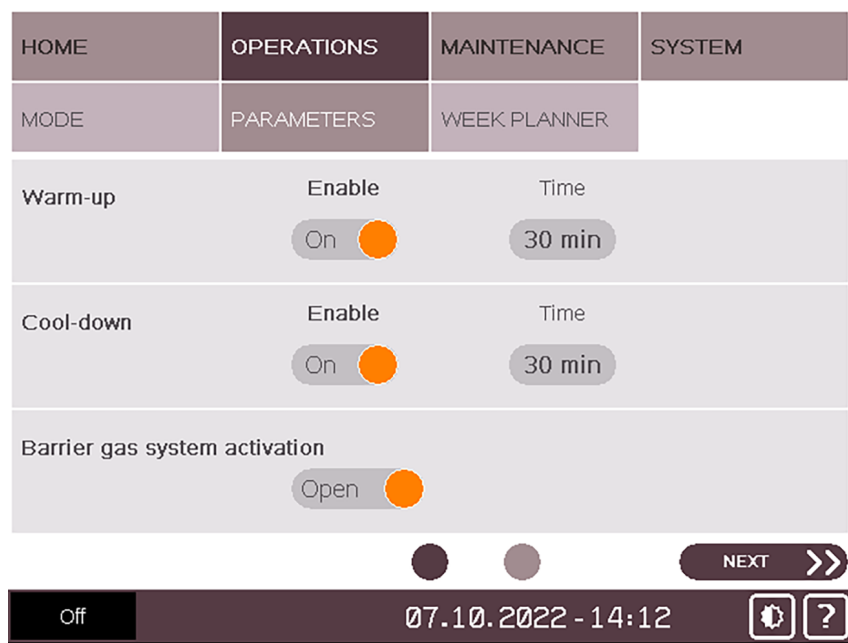
The warm-up mode allows the machine to obtain a suitable operating temperature for the process. The cool-down mode allows the evacuation of any condensable vapors, refer to chapter Conveying Condensable Vapours for conditions to be met.

During these phases, the machine operates at maximum speed, recommended with the gas ballast valve open to warm up and evacuate a maximum of humidity.

The warm-up mode and the cool-down mode can both be set with a target time (default value = 30 minutes).

They are only available for "Role 2" users, see *Roles and Users* [→ 13].

- To activate these two modes:
  - Go to "OPERATIONS" > "PARAMETERS".
  - Press on warm-up and/or cool-down switch button (password required, see *Roles and Users* [→ 13]).



- Press a value to change it.

Parameter	Default value
Warm-up time	30 min
Cool-down time	30 min

### NOTE

**When the warm-up and cool-down modes are activated, the isolation valve must be closed to allow the vacuum pump to operate at ultimate vacuum.**

**The isolation valve can be automatically controlled by the pump during the warm-up and cool-down phases, see *Inlet Valve Control* [→ 48].**

**In this case, the valve will open and close according to the diagram available in the chapter Conveying Condensable Vapours.**

## 8.4.1 Conveying Condensable Vapors

Observe the following when conveying condensable vapors, e.g. water vapors:

### START

- Close the isolation valve\*
- Start the machine
- Warm up the machine for 30 minutes (WARM-UP MODE)
- Open the isolation valve\* and perform the process
- Close the isolation valve\*
- Dry the machine (SHUT-DOWN MODE)
- Wait 30 minutes
- Stop the machine

### END

\* Not included in the scope of delivery

#### – Limit the flow rate with cold cooling water (<20°C):

- 8 ... 12 l/min
- Ensure that the barrier gas system (dry compressed air) is connected. Check the volume flow on the barrier gas flow meter (BGF), see *Barrier Gas System Connection* [→ 28].
- Make sure that the air gas ballast (GB) is mounted and open. If the gas ballast filter is dirty, it must be cleaned periodically (unscrew and wash out).
- Make sure that the condensate drain (CD) is open.
- Water vapor within the gas flow is tolerated within certain limits. The conveyance of other vapors shall be agreed upon with Busch.

## 8.5 Inlet Valve Control

This menu allows the control and setting of the opening parameters of an inlet valve installed at the suction side of the vacuum pump (not included in the scope of delivery of the vacuum pump).

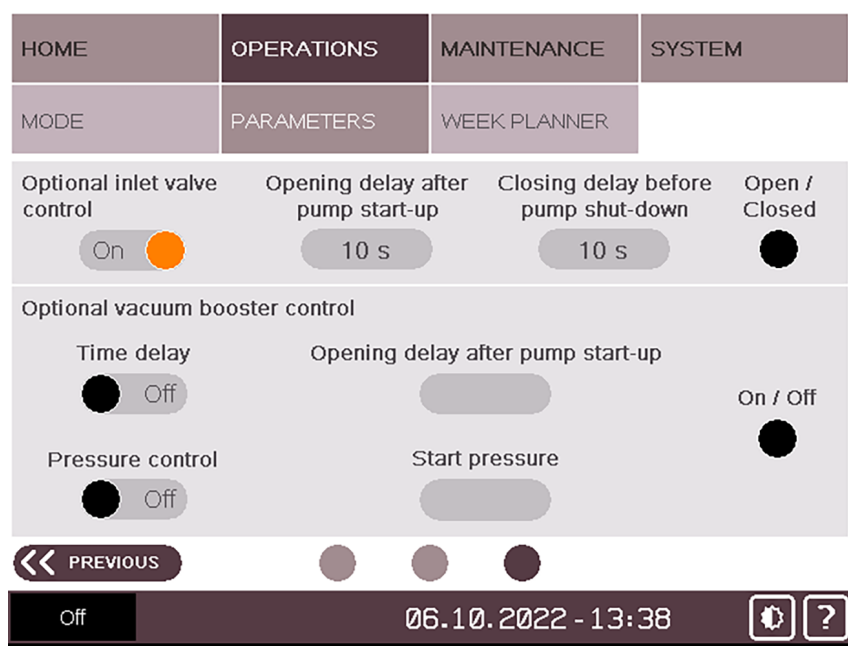
This parameter is only available for "Role 2" users, see *Roles and Users* [→ 13].

- To activate the optional inlet valve control:
  - Go to "OPERATIONS" > "PARAMETERS".
  - Go to the second screen/page.
  - Switch the optional inlet valve control on (password required, see *Roles and Users* [→ 13]).

The Opening delay after pump start-up default value is 10 seconds.

- Press to change it.

Once the inlet valve control is enabled, the Open/Closed indicator light switches from black to orange.



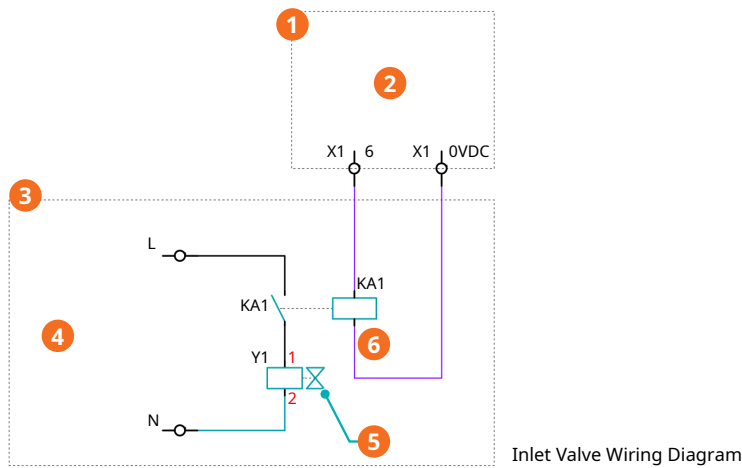
The system allows a time delay between the opening of the valve and the start-up of the vacuum pump (Default value 10s).

### START

- Wait 10 seconds
- Open the inlet valve\* and perform the process

\* Not included in the scope of delivery

The isolation valve control signal must be physically connected to the vacuum pump's control cabinet for the control to operate (See pump wiring diagram in the control unit cabinet).



Description			
1	PLUS Pump control unit	2	Inlet Valve command line (24VDC from PLUS Pump - Max 1A)
3	Customer side	4	Power line from customer with appropriate protection
5	Customer Inlet valve	6	Customer relay



## NOTE

The installation of an isolation valve at the vacuum pump inlet also requires the installation of an external pressure sensor to control the vacuum pump, see *External Inlet Pressure Sensor* [→ 26].

## 8.6 Vacuum Booster Control

This menu allows the control and setting of the start-up parameters of a vacuum booster installed at the suction side of the vacuum pump (not included in the scope of delivery of the vacuum pump).

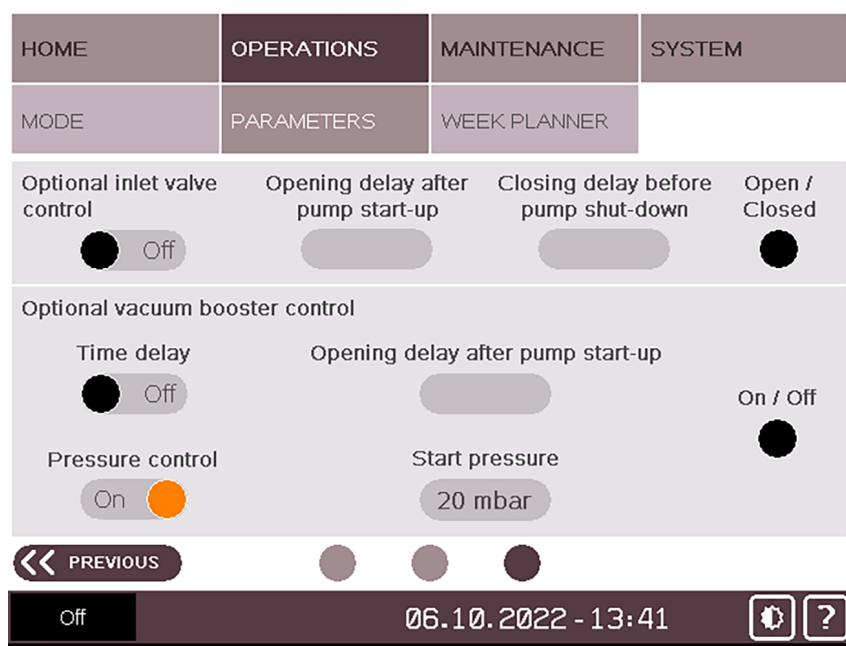
This parameter is only available for "Role 2" users, see *Roles and Users* [→ 13].

- To activate the optional vacuum booster control:
  - Go to "OPERATIONS" > "PARAMETERS".
  - Go to the second screen/page.
  - Switch the optional vacuum booster control on (password required, see *Roles and Users* [→ 13]).

The Start pressure default value is 20 mbar.

- Press to change it.

Once the vacuum booster control is enabled, the On/Off indicator light switches from black to orange.



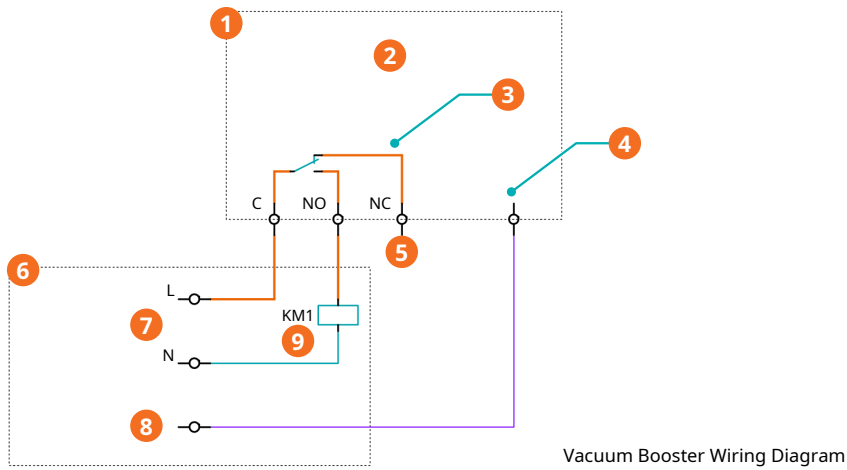
The booster start signal is given by the PLUS pump when the pressure reaches a set value (Default value 20 mbar).

### START

- The pressure reaches the set value
- Start vacuum booster\*

\* Not included in the scope of delivery

The vacuum booster control signal must be physically connected to the vacuum pump's control cabinet for the control to operate (See pump wiring diagram in the control unit cabinet).



Vacuum Booster Wiring Diagram

Description			
1	PLUS Pump control unit	2	Vacuum Booster start
3	Dry contact Max 250VAC 6A	4	Dry contact status 24VDC Max 1A
5	Not used	6	Customer side
7	Customer Booster command	8	Vacuum Booster PLC
9	Customer motor start		



## NOTE

For detailed information, see wiring diagram in the control unit cabinet.



## NOTICE

**Vacuum booster compatibility.**



**Risk of damage to the machine!**

- Contact Busch to check the compatibility of the vacuum booster with the vacuum pump and the recommended starting pressure.

## 8.7 Monitoring

### 8.7.1 Operating Information

This display "HOME" > "MAIN" corresponds to the principal menu and is automatically loaded when the machine is started. It displays the principal operating information.

HOME	OPERATIONS	MAINTENANCE	SYSTEM
MAIN	MONITORING	ALARM	
Inlet pressure < 5 mbar		Actual speed 0 %	
Operating mode > Speed control		Control mode > Local                      Manual	
Target speed > 100 %		Next service in > 4000 h	
Off		06.10.2022 - 13:48  	

**Inlet pressure:** Indicates the operating pressure at the suction connection (IN) according to the selected unit. To change the unit, see *System Settings* [→ 15].

#### NOTE

**Display of the ultimate pressure.**

**Due to sensor accuracy, the minimum displayed value of the ultimate pressure is 5 mbar preceded by the symbol "<", which means that the actual value is lower than displayed. The ultimate pressure of the machine is indicated on the nameplate (NP).**

**Actual speed:** Indicates the operating speed of the machine in percentage based on the variable speed drive speed range (1% -> minimum speed ; 100% -> maximum speed).

- For more information on "pumping speed" versus "% speed", refer to the vacuum pump performance curves.

**Operating mode:** Indicates which operating mode is selected, either "Speed control" or "Pressure control", see *Operating Mode* [→ 43].

**Control mode:** Indicates which control mode is selected, "Local/Manual", "Local/Auto" or "Remote/Auto", see *Control Mode* [→ 40].

**Target speed or target pressure:** Depending on the selected operating mode it indicates the target speed (in percentage of the operating speed range) or the target pressure, see *Operating Mode* [→ 43].




**Next service in:** Indicates the number of operating hours remaining before the next maintenance, see *Maintenance Schedule*.



## 8.7.2 Operating Data

This display "HOME" > "MONITORING" displays operating values, it is divided into three different screens/pages.

### Screen/Page 1

HOME	OPERATIONS	MAINTENANCE	SYSTEM
MAIN	MONITORING	ALARM	
Barrier gas solenoid valve Open		>	Exhaust pressure 15 mbar g
Instant absorbed power 7.8 kW			Mean absorbed power 2 kW
Running hours since last maintenance 3 h			Running hours total 5465 h
			
Off		NEXT >>	
07.10.2022 - 14:15			
 			

**Barrier gas solenoid valve:** Indicates the state of the barrier gas solenoid valve ► "Open" or "Closed".

**Exhaust pressure:** Indicates the counter pressure value at the exhaust of the machine according to the selected unit. To change the unit, see *System Settings* [→ 15].

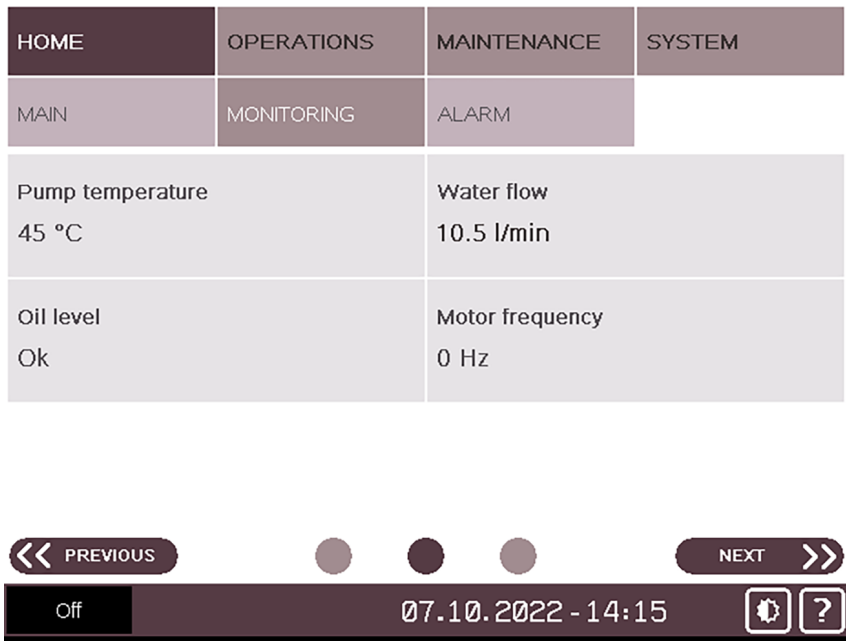
**Instant absorbed power:** Indicates the absorbed power (in kW) in real time.

**Mean absorbed power:** Indicates the average of the absorbed power (in kW) since the last reset.

**Running hours since last maintenance:** Indicates the number of operating hours of the machine since the last maintenance.

**Running hours total:** Indicates the total number of operating hours since the first machine commissioning.

### Screen/Page 2



**Pump temperature:** Indicates the pump coolant temperature, in case of a too high temperature a warning or an alarm occurs, see *Dysfunction* [→ 57].

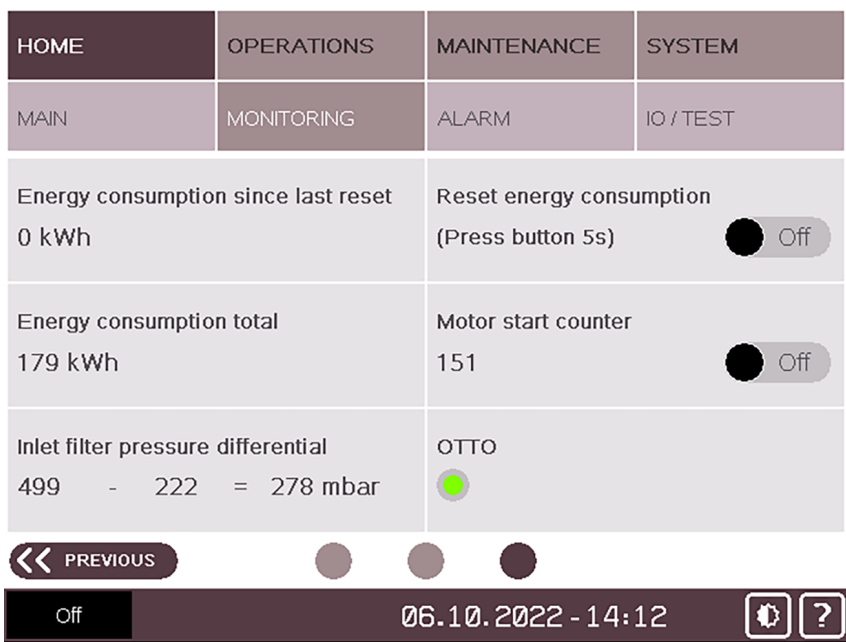
**Water flow:** Indicates the cooling liquid water flow in the cooling liquid circuit in l/min.

**Oil level:** Indicates the oil level state on the A side (motor side) and on the B side (suction side) ▶ “Ok” or “Not Ok”.

If “Not Ok”: Level A “Not Ok” or Level B “Not Ok” or Levels A & B “Not Ok”.  
In case of a low oil level an alarm occurs, see *Dysfunction* [→ 57].

**Motor Frequency:** Indicates the current drive frequency (in Hz).

### Screen/Page 3



**Energy consumption since last reset:** Indicates the energy consumption in kWh since the last re-set.

**Reset energy consumption:** Allows the resetting of the energy consumption reading by pressing the switch button for 5 seconds.

**Energy consumption total:** Indicates the total energy consumption in kWh since the first machine commissioning.

**Motor start counter:** Indicates the number of starts since the first machine commissioning.

**Inlet filter pressure differential:** Indicates the pressure differential in the inlet filter cartridge (only if the inlet filter condition monitoring kit is installed).

**OTTO:** Indicates that OTTO (optional) is enabled and connected to the cloud (data transfer).

## 8.7.3 History

This display "MAINTENANCE" > "HISTORY" shows the history of:

- Events ► Parameter changes, function activation, etc....
- Alarms ► Alarm signals from sensors
- Warnings ► Warning signals from sensors
- Service ► Service tasks completed

It is possible to filter the type of message by selecting a specific tab.

HOME		OPERATIONS		MAINTENANCE		SYSTEM			
HISTORY		SERVICE		TREND					
All		Event		Alarm		Warning		Service	
No.	Date	Time	Message						
1	07/10/2022	14:11	Warm-up ON						
2	07/10/2022	14:11	Ecomode ON						
3	07/10/2022	14:11	Cool-down ON						
4	07/10/2022	14:11	Stop on control cabinet temp. alarm: ON						
5	07/10/2022	14:11	Stop on oil temperature sensor disc. alarm: ON						
6	07/10/2022	14:11	Stop on oil temperature alarm: ON						
7	07/10/2022	14:11	Stop on inlet pressure sensor disc. alarm: ON						
8	07/10/2022	14:11	Stop on inlet pressure alarm: ON						
9	07/10/2022	14:11	Stop on exhaust pressure sensor disc. alarm: ON						
10	07/10/2022	14:11	Stop on exhaust pressure alarm: ON						
11	07/10/2022	14:11	Stop on analog input disc. alarm: ON						
12	07/10/2022	14:11	Stop on water flow low: ON						
13	07/10/2022	14:11	Stop on water flow sensor disconnected alarm: ON						
14	07/10/2022	14:11	Stop on oil level alarm: ON						
15	07/10/2022	14:11	Stop on Modbus Ethernet port 1 disc. alarm: ON						
16	07/10/2022	14:11	Stop on exhaust gas temperature alarm: ON						
17	07/10/2022	14:11	Stop on external inlet P sensor disc. alarm: ON						
18	07/10/2022	14:11	Vacuum pump OFF						

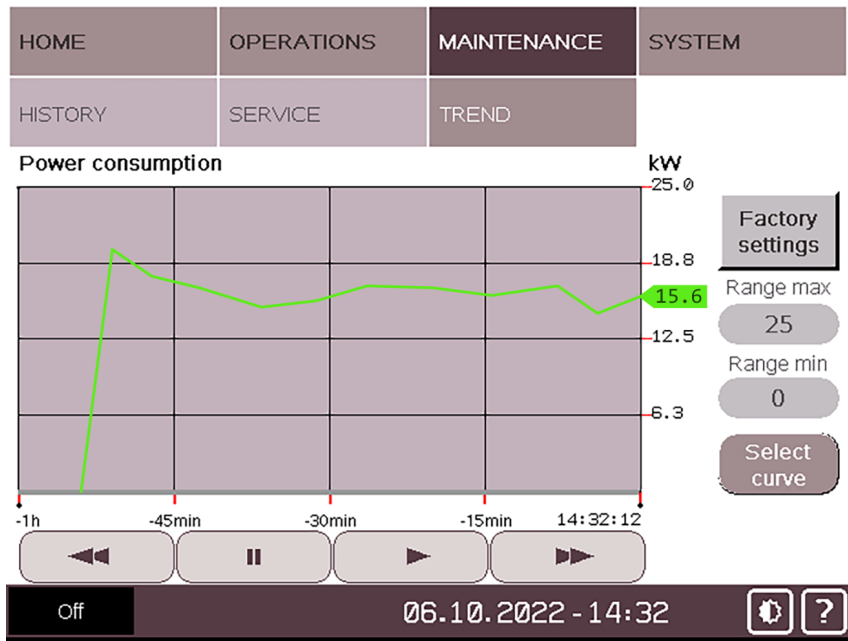
Off

07.10.2022 - 14:18



### 8.7.4 Operating Curves

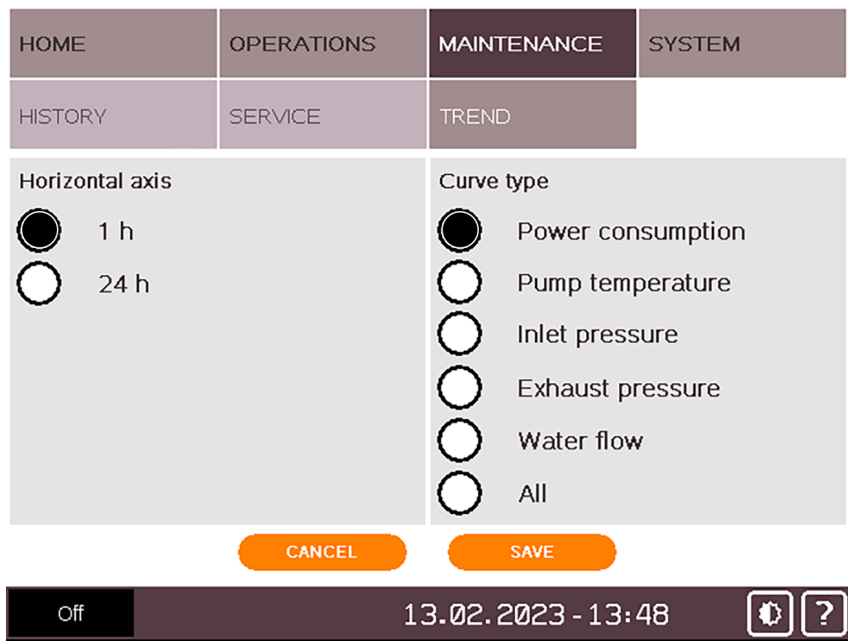
The "MAINTENANCE" > "TREND" display shows the trend curve of one or more operating values.



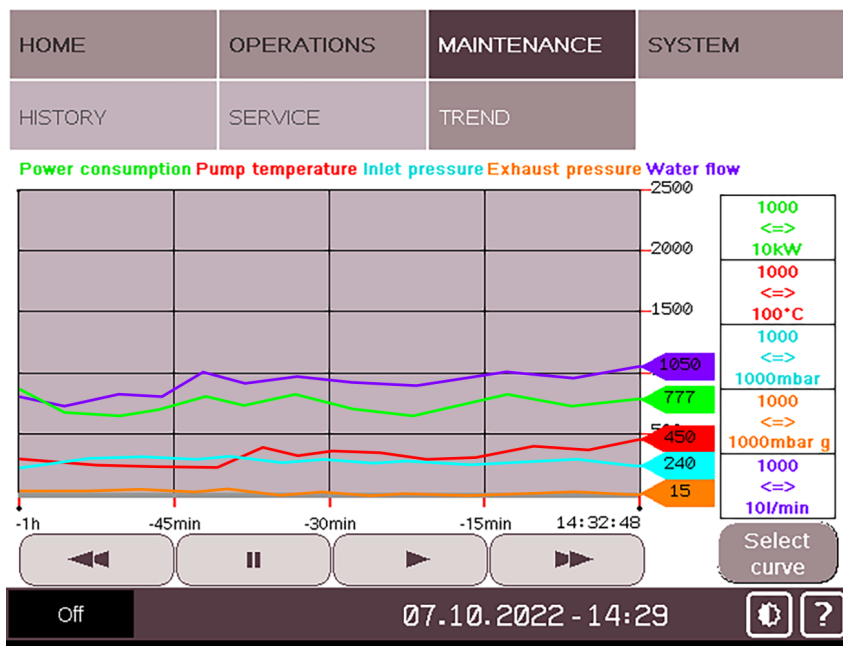
It offers the possibility to change the time lapse and the curve of 5 different operating values or all at the same time.

To change the curve type:

- Press on "Select curve"



- Select the desired time lapse (Horizontal axis) and the curve type of the operating value.
- Once the choice is made, press on "SAVE" button.



## 8.8 Dysfunction

### 8.8.1 Warnings and Alarms Thresholds

When the machine has reached the limit threshold of an operating value, which is predefined in the system, a signal is sent and visible in the bottom bar.

There are two signal levels:

- Level 1, an orange signal "WARNING" appears, it informs that a value has reached a certain limit. The machine is still working, in the meantime, investigate the source of the dysfunction before the machine reaches the level 2.



- Level 2, a red signal "ALARM" appears, it informs that a value has reached the maximum permitted limit. The machine must stop immediately, investigate the source of the dysfunction.



#### NOTE

By default, the machine stops when an alarm signal is sent. However, it may be possible that the settings have been voluntarily changed to leave the machine running even after an alarm signal.

In any case, you must investigate the source of the dysfunction.

#### NOTE

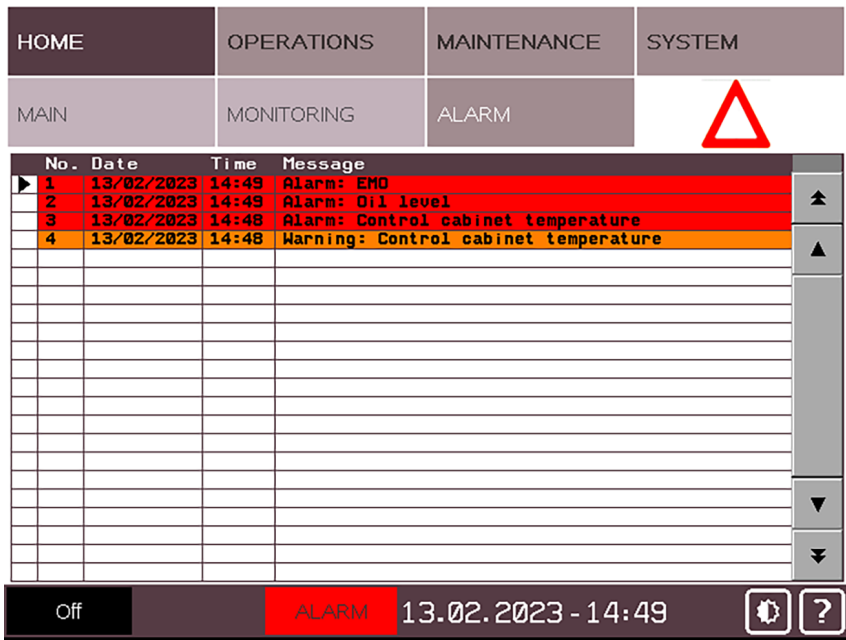
**Bottom bar Warning & Alarm signals.**

Warning and Alarm signals in the bottom bar are provided with a direct link to the Alarm display.

- Press on the signal to directly access the Alarm display or proceed as follows.

As soon as a signal is sent, the system collects all active dysfunctions in a list:

- Go to "HOME" > "WARNING/ALARM".
- Consult the list of dysfunctions to identify the problem.



- Investigate why this signal occurred using the Troubleshooting tables.
- Follow the *Warning/Alarm Acknowledgment Procedure* [→ 59] when the problem has been rectified.

Below, the default warnings and alarms thresholds:

Signal type	Warning (level 1)	Alarm (level 2)
Water flow	< 8l/min for 15 seconds	< 8l/min for 30 seconds
Inlet pressure	>800 hPa (mbar) for 15 minutes	>800 hPa (mbar) for 30 minutes
Pump temperature	>65°C	>70°C
Exhaust pressure	>150 hPa g (mbar g) rel.	>200 hPa g (mbar g) rel.
Electrical cabinet temperature	>50°C for 30 seconds	>50°C for 60 seconds

**i NOTE**

Threshold values are preset with the factory settings. However, depending on the application, it is possible to adjust the threshold values only after Busch approval. Threshold changes are only available for "Role 3" users.



## 8.9 Stop the Machine

To stop the machine:

- Press and hold the start/stop button (SSB) for at least 3 seconds.

In case of emergency stop:

- Push the emergency stop switch (ESS).

As long as the power indicator light (PIL) is green, the machine is still powered.



### NOTE

**Control mode "Remote/Auto".**

**The machine cannot be stopped with the start/stop button (SSB) when the machine is remotely controlled.**

---



## 9 Maintenance



### DANGER

**Live wires.**

**Risk of electrical shock.**

- Electrical installation work must only be executed by qualified personnel.



### WARNING

**The machine may start without notice.**

**Risk of severe injury!**

If the machine is remotely controlled or using auto mode (week planner):

- Make sure that the lockable disconnect switch is activated and protects the machine against inadvertent start up.
- The power indicator light (PIL) must be turned off.



### WARNING



**Machines contaminated with hazardous material.**

**Risk of poisoning!**

**Risk of infection!**

If the machine is contaminated with hazardous material:

- Wear appropriate personal protective equipment.



### CAUTION

**Hot surface.**

**Risk of burns!**

- Prior to any action requiring touching the machine, let the machine cool down first.



### CAUTION

**Failing to properly maintain the machine.**

**Risk of injuries!**

**Risk of premature failure and loss of efficiency!**

- Maintenance work must only be executed by qualified personnel.
- Respect the maintenance intervals or ask your Busch representative for service.



## NOTICE

### Using inappropriate cleaners.

#### Risk of removing safety stickers and protective paint!

- Do not use incompatible solvents to clean the machine.

- Turn off the water supply.

If the machine is equipped with a barrier gas system:

- Close the barrier gas supply.
- Vent the connected lines to atmospheric pressure.

If necessary:

- Drain the cooling water from the water drain valve (CWD).
- Disconnect all connections.

## 9.1 Maintenance Schedule

The maintenance intervals depend very much on the individual operating conditions. The intervals given below are considered as starting values which should be shortened or extended as appropriate. Particularly harsh applications or heavy duty operation, such as high dust loads in the environment or in the process gas, other contamination or ingress of process material, can make it necessary to shorten the maintenance intervals significantly.

Interval	Maintenance work
Monthly	<ul style="list-style-type: none"> <li>• Check the machine for oil leaks - in case of leaks have the machine repaired (contact Busch).</li> </ul>
Every 6 months	<ul style="list-style-type: none"> <li>• Clean the machine from dust and dirt, especially the cooling air inlet and outlet (CAI/CAO), see <i>Machine Cleaning</i> [→ 73].</li> <li>• Check the electrical cabinet fan and filter. Clean if necessary.</li> <li>• Check and clean the filters of the inlet/outlet ventilation grids (VG) of the Control Unit (CU) cabinet, see <i>Troubleshooting</i> [→ 77]. Change them if necessary.</li> </ul>
Yearly	<ul style="list-style-type: none"> <li>• Carry out a visual inspection and clean the machine from dust and dirt.</li> <li>• Check the electrical connections and the monitoring devices.</li> <li>• Clean the inlet screen, see <i>Cleaning the Inlet Screen</i> [→ 65].</li> <li>• Check the filter of the gas ballast valve (GB) and clean it if necessary, see <i>Cleaning the Gas Ballast Filter</i> [→ 66].</li> <li>• Check the silencer (SI) and clean it if necessary, see <i>Cleaning the Silencer</i> [→ 67].</li> <li>• Check and clean the inlet check valve.</li> </ul>
Yearly If these accessories are installed	<ul style="list-style-type: none"> <li>• Check the inlet filter, replace the filter cartridge if necessary.</li> </ul>

Interval	Maintenance work
Every 8500 hours or after 1 year	<ul style="list-style-type: none"> <li>• Change the oil of the gear and bearing housings (both sides), see <i>Oil Change</i> [→ 70].</li> <li>• Check and clean the water flow sensor (WSA), the inlet pressure sensor (PSA 1), the exhaust pressure sensor (PSA 2) and the safety pump temperature sensor (TSA).</li> <li>• Clean the magnetic plugs (MP).</li> </ul>
Every 25000 hours or after 4 years	<ul style="list-style-type: none"> <li>• Have a major overhaul on the machine (contact Busch).</li> </ul>

To visualize information about remaining hours:

- Go to "MAINTENANCE" > "SERVICE".
- Check when the maintenance tasks must be performed and how long the machine has operated since the first commissioning or last maintenance task.

HOME	OPERATIONS	MAINTENANCE	SYSTEM
HISTORY	SERVICE	TREND	
Next oil service 3997 h Last service: 14-09-2022		Oil service interval 4000 h 5111Running hours	
Next overhaul 60 month(s) Last service: 14-09-2022		Overhaul interval 60 month(s)	
Reset		Set	
Reset		Set	
Off		07.10.2022 - 14:33	



## NOTE

**RESET can only be done by "Role 2" users.**

**A reset must be done after the completion of the following task:**  
**- *Oil Change* [→ 70]**

## 9.2 Oil Level Inspection

If the oil level is too low, an alarm signal will be sent by the monitoring system.

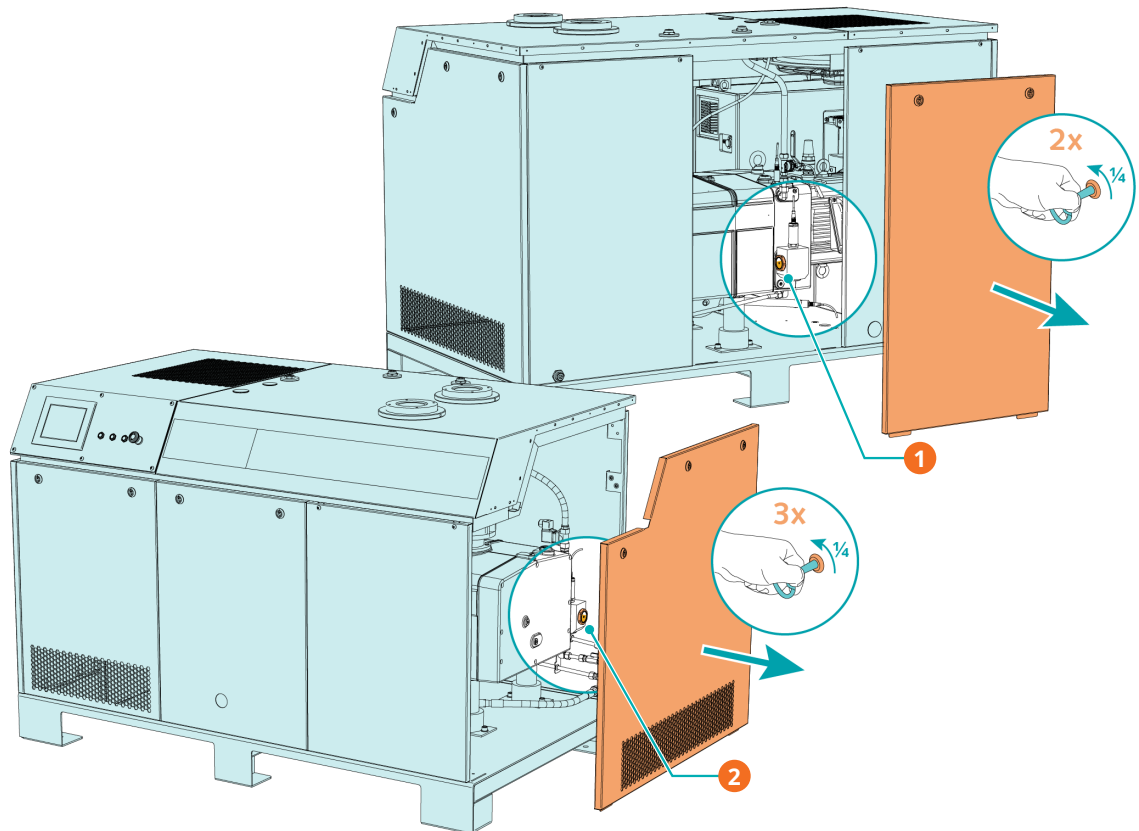
To check the oil level status:

- Go to "HOME" > "MONITORING".
- In the cell "Oil level", "OK" must always be written.

To perform a visual control of the oil level:

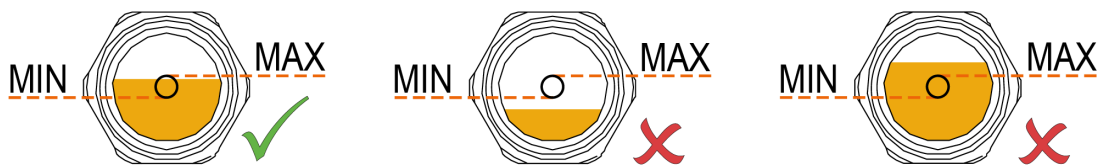
- Check the oil sight glass (OSG).

(See *Operating Data* [→ 53], Oil level monitoring, screen/page 2 display).



Description			
1	At the motor side: Remove central back cover (Quarter turn key delivered loose)	2	At the suction side: Remove side cover (Quarter turn key delivered loose)

- Shut down the machine.
- When the machine is stopped, wait 1 minute before checking the oil level.



- Fill up if necessary, see *Oil Filling* [→ 29].

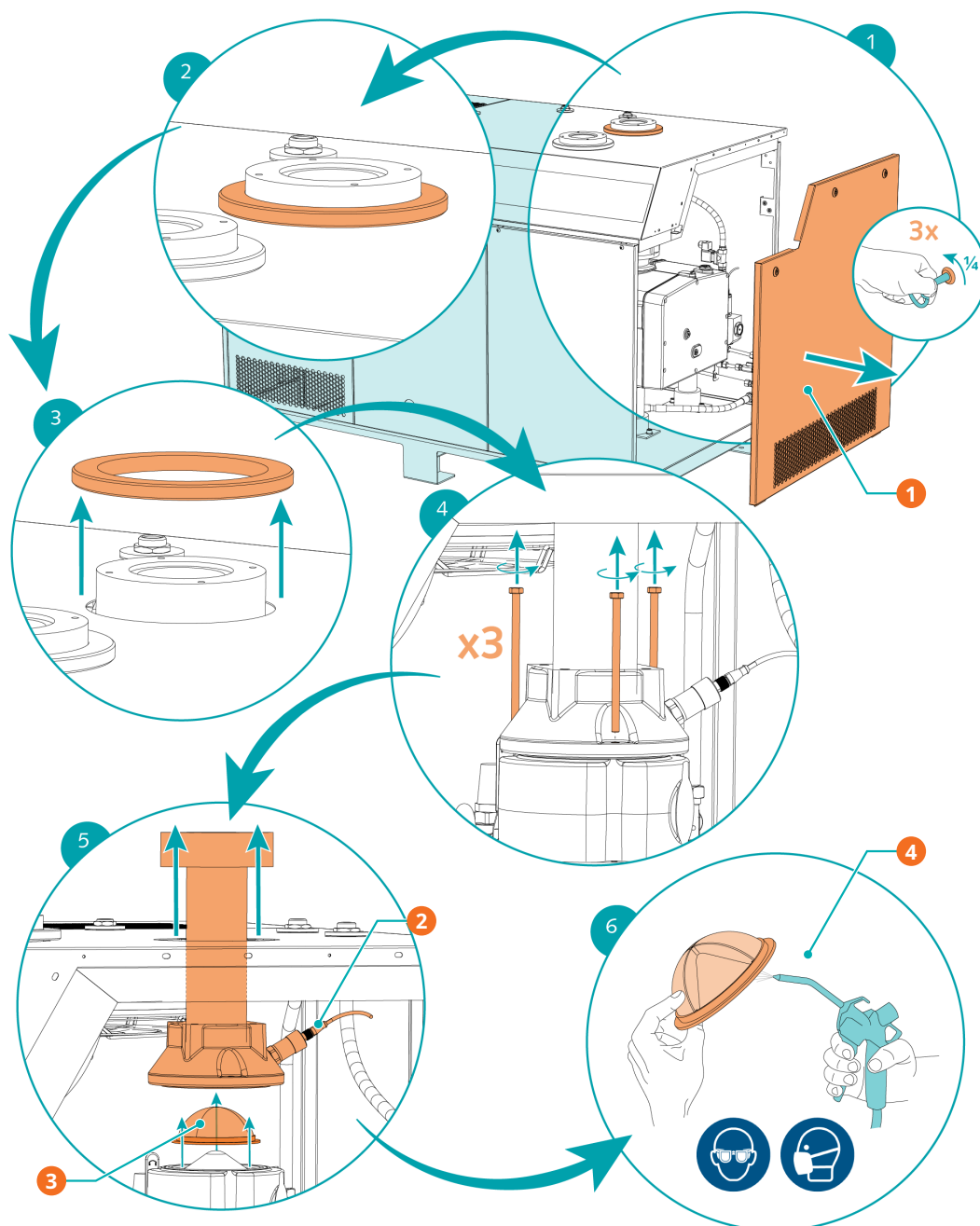
## NOTE

**Oil level and Oil level alarm.**

**Risk of machine shutdown!**

- When the oil level is in the lower half of the target of the oil sight glass, the machine may stop because of the oil level alarm. Fill up as required.

### 9.3 Cleaning the Inlet Screen

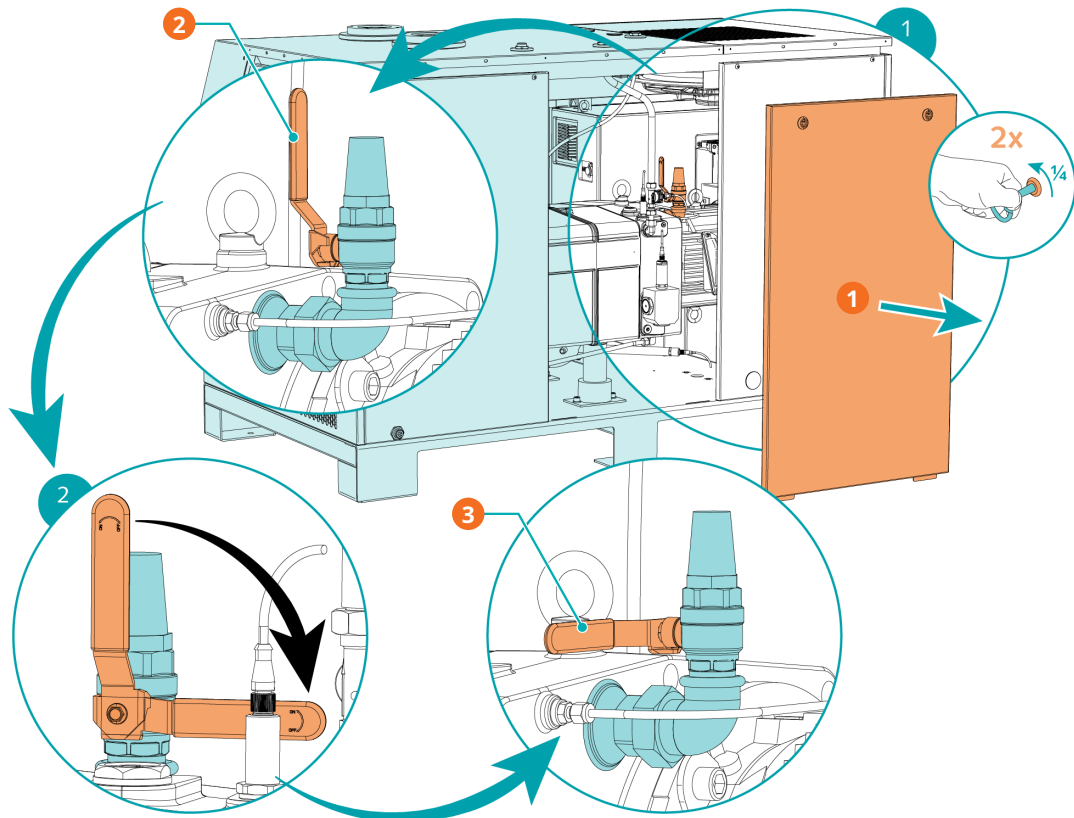


Description			
1	Remove side cover (Quarter turn key delivered loose)	2	Pressure sensor
3	Inlet screen	4	Use compressed air and wear protective eyewear and mask

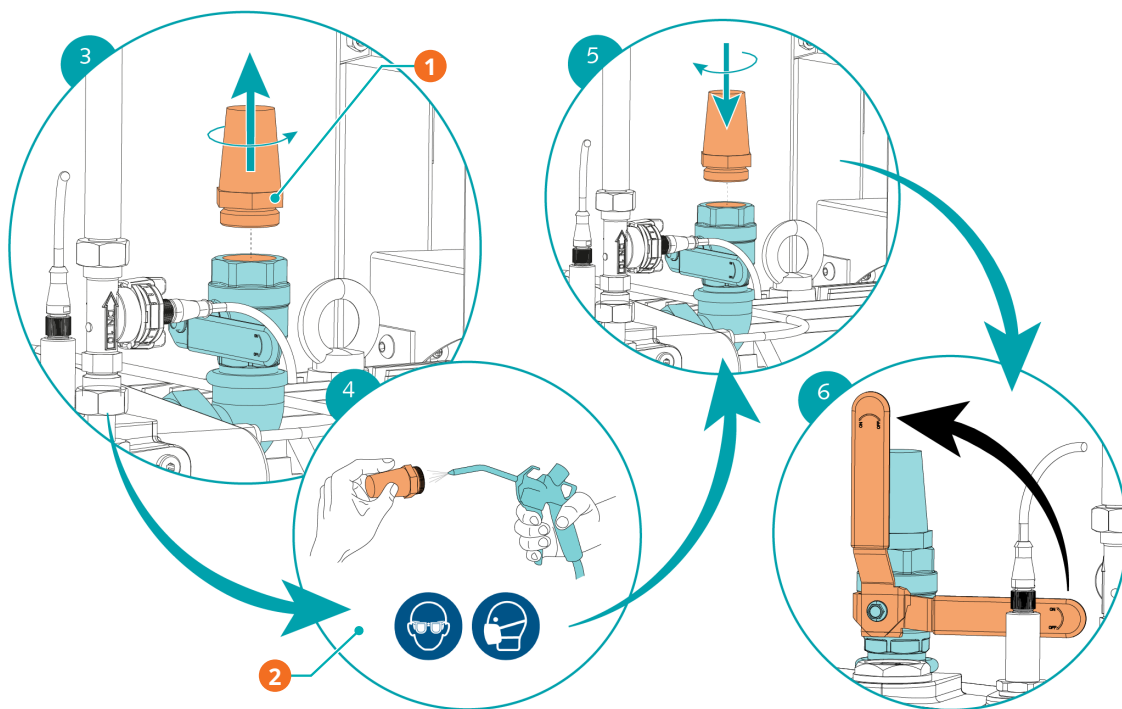
- Prior to instruction 5, disconnect the pressure sensor.
- Once the inlet screen has been cleaned, put it back in place and reassemble the elements in reverse order from 5 to 1.

## 9.4 Cleaning the Gas Ballast Filter

- Close the gas ballast valve.



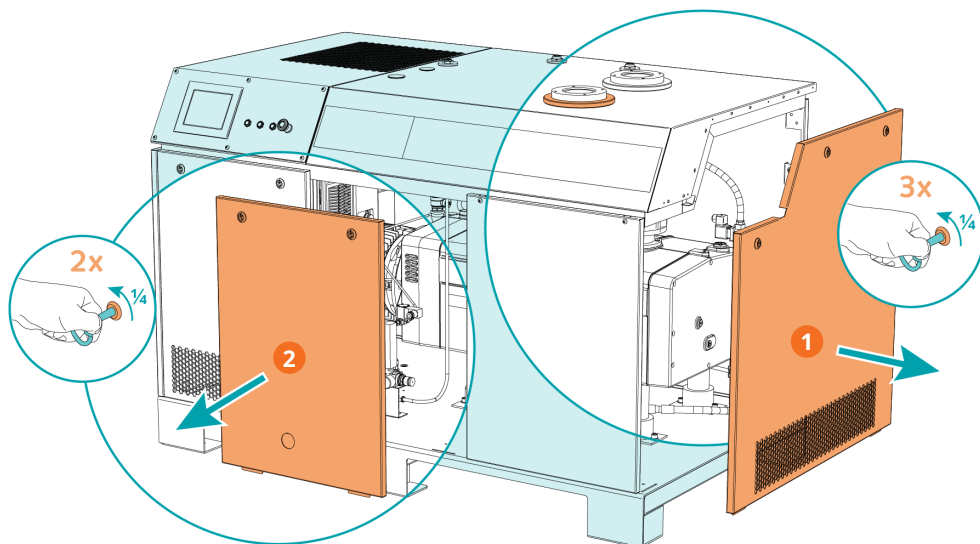
Description	
1	Remove central back cover (Quarter turn key delivered loose)
2	Open position
3	Closed position



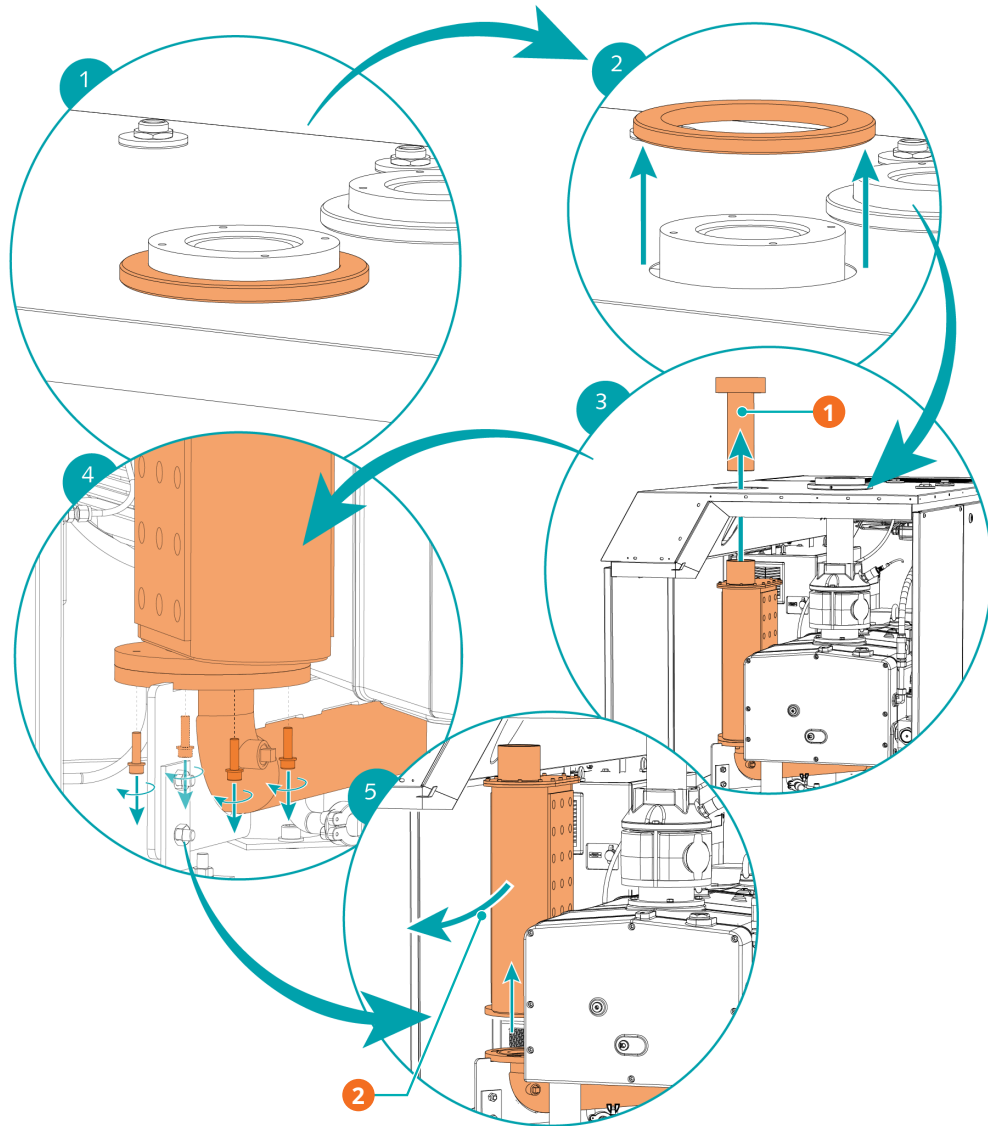
Description			
1	Remove the gas ballast filter with a 36 mm wrench	2	Use compressed air and wear protective eyewear and mask

- Once the cleaning is completed, reassemble the gas ballast filter, and open the gas ballast valve.

## 9.5 Cleaning the Silencer



Description			
1	Remove side cover (Quarter turn key delivered loose)	2	Remove central front cover (Quarter turn key delivered loose)



Description			
1	Remove the exhaust flange of the silencer* through the hole in the cabinet cover	2	Tilt the silencer before removing it through the side of the cabinet



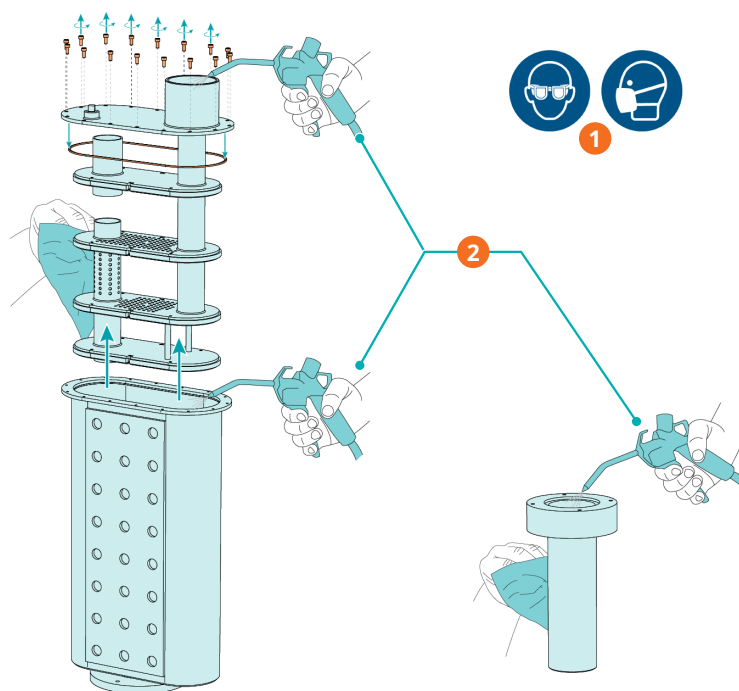
**NOTE**

**\*Removal of the exhaust flange.**

**When removing the exhaust flange, the Teflon sealing tape will be deteriorated and no longer usable!**

- Make sure to apply a new Teflon sealing tape before reassembling the flange.





Description			
1	Wear protective eyewear and mask	2	Use compressed air and cleaning clothes to clean the inside and outside of the silencer

- Once the inner parts of the silencer have been cleaned, reassemble them.
- Put the silencer back in place and reassemble the elements in reverse order from 5 to 1. Make sure to apply a new Teflon sealing tape before reassembling the exhaust flange.
- Replace the cabinet covers.

## 9.6 Oil Change

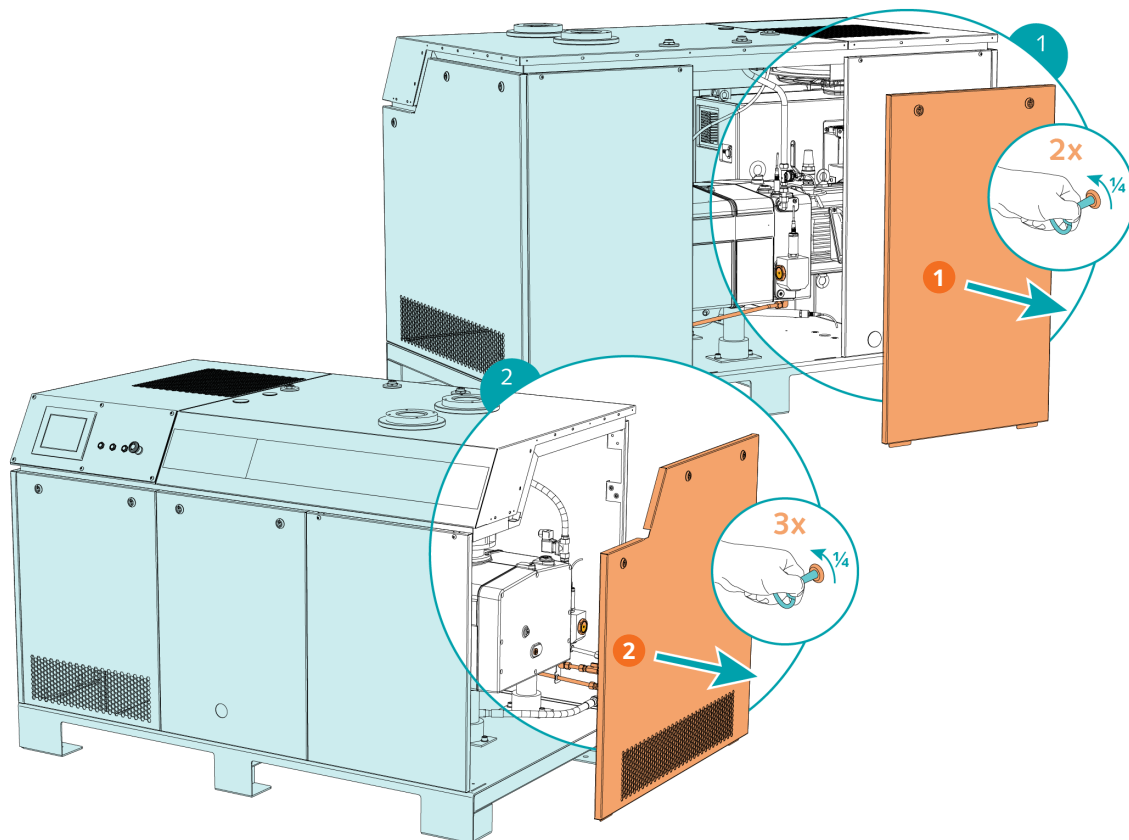
### ! NOTICE

**Use of an inappropriate oil.**

**Risk of premature failure!**

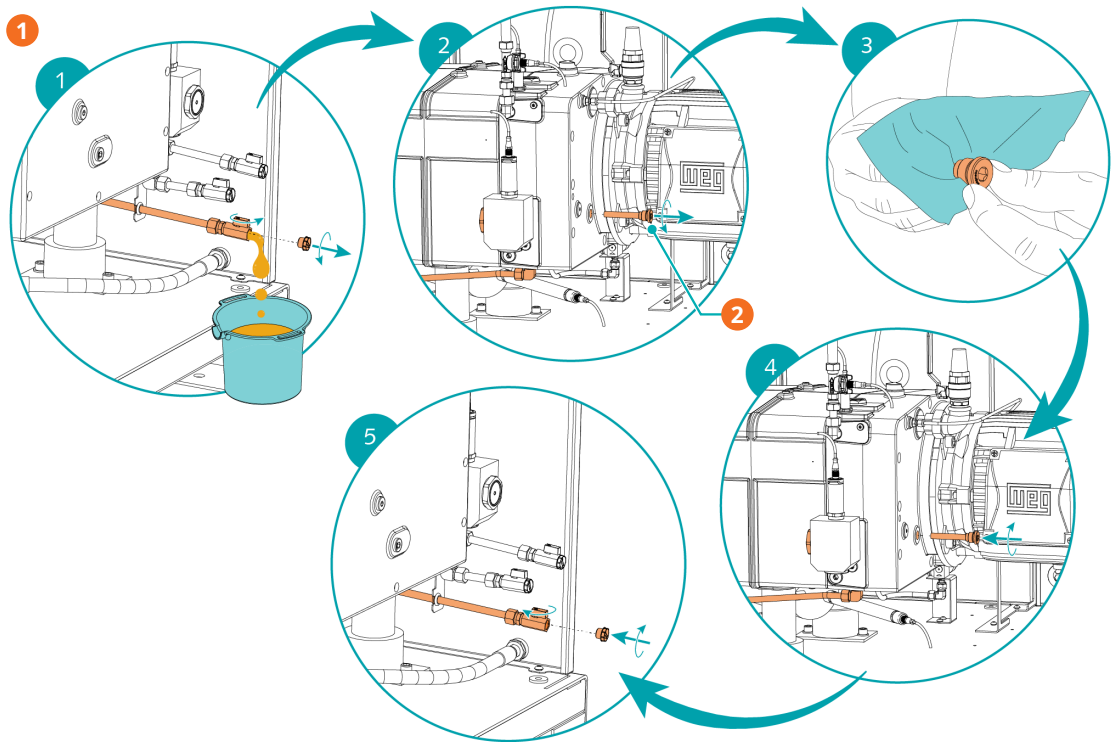
**Loss of efficiency!**

- Only use an oil type which has previously been approved and recommended by Busch.

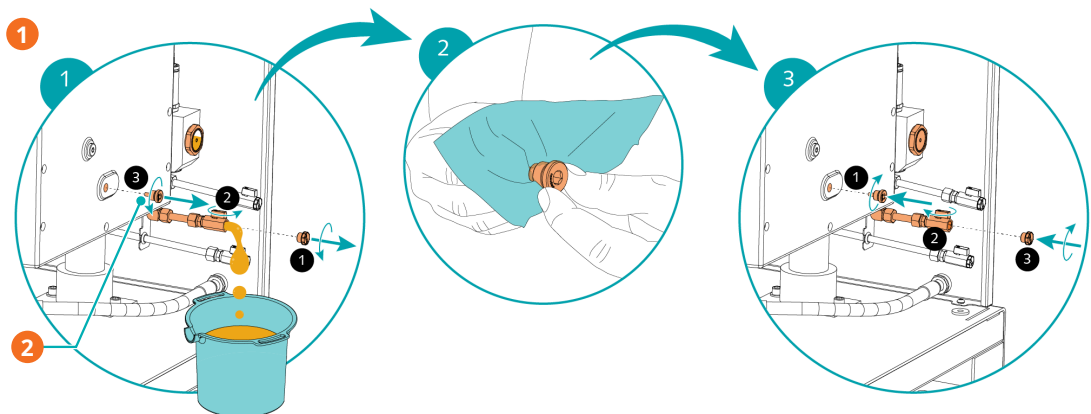


#### Description

1	At the motor side: Remove central back cover (Quarter turn key delivered loose)	2	At the suction side: Remove side cover (Quarter turn key delivered loose)
---	---	---	---

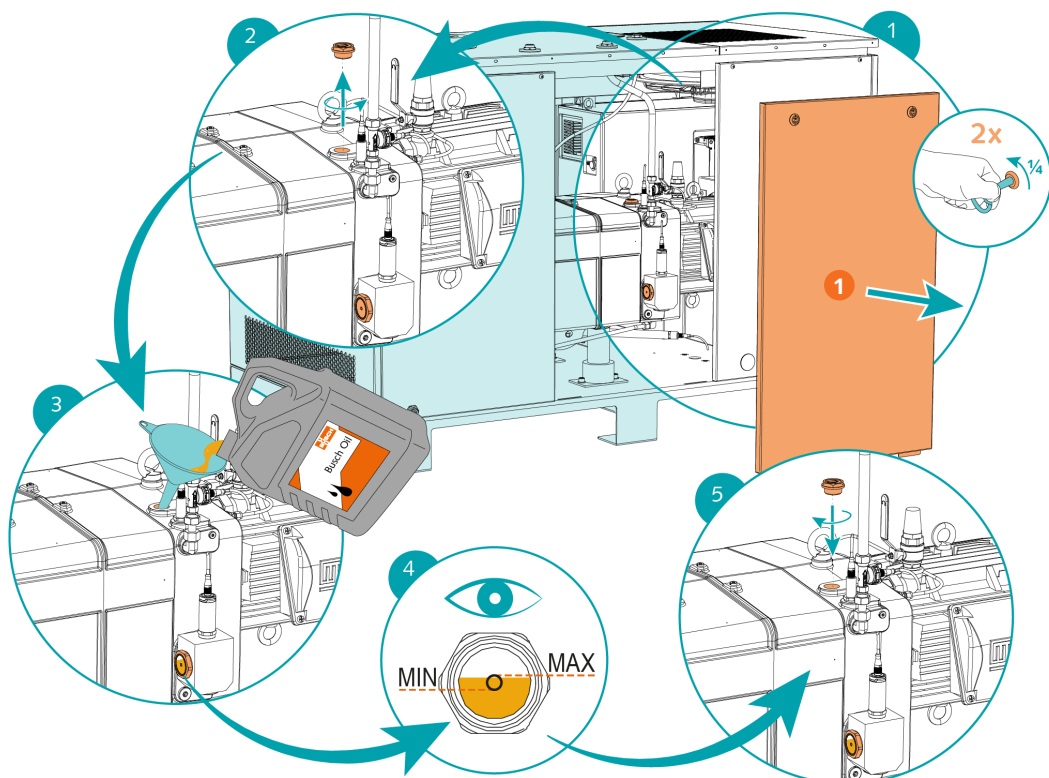


Description	
1	Oil draining at the motor side
2	Magnetic plug



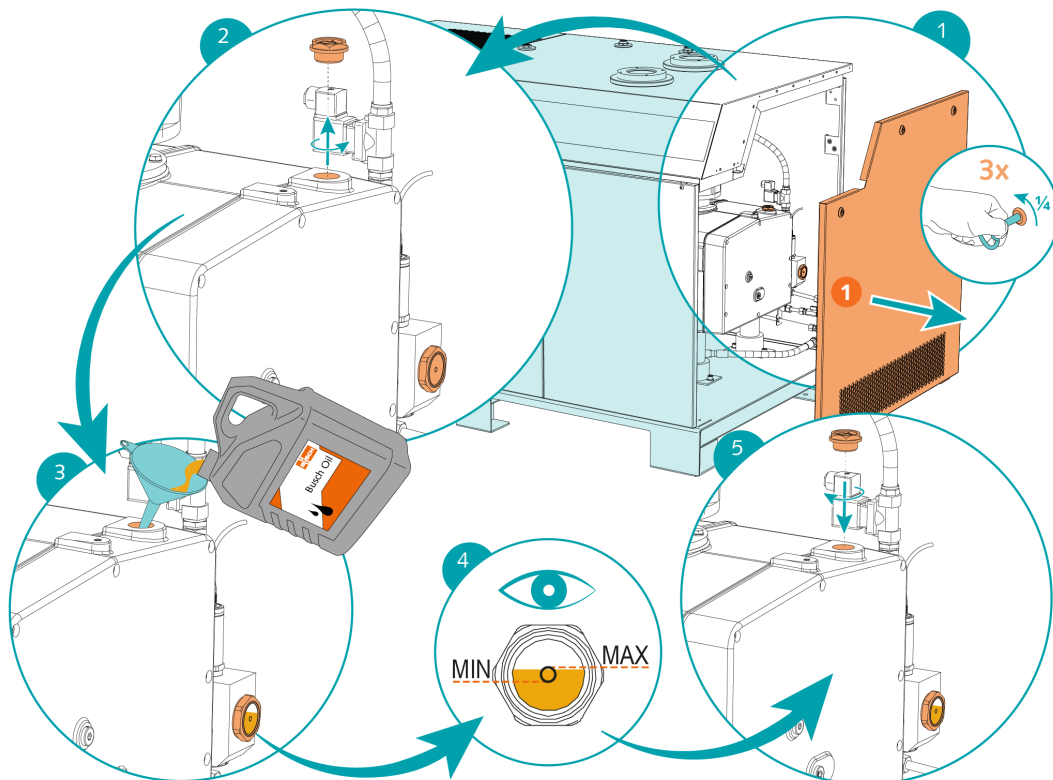
Description	
1	Oil draining at the suction side
2	Magnetic plug

For oil type and oil capacity see Technical Data and *Oil* [→ 82].



**Description**

- |   |  |  |  |
|---|--|--|--|
| 1 | Remove central back cover (Quarter turn key delivered loose) |  |  |
|---|--|--|--|

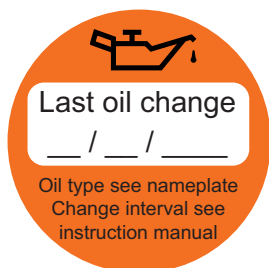


**Description**

- |   |  |  |  |
|---|--|--|--|
| 1 | Remove side cover (Quarter turn key delivered loose) |  |  |
|---|--|--|--|

When the oil filling is achieved:

- Write down the oil change date on the sticker.

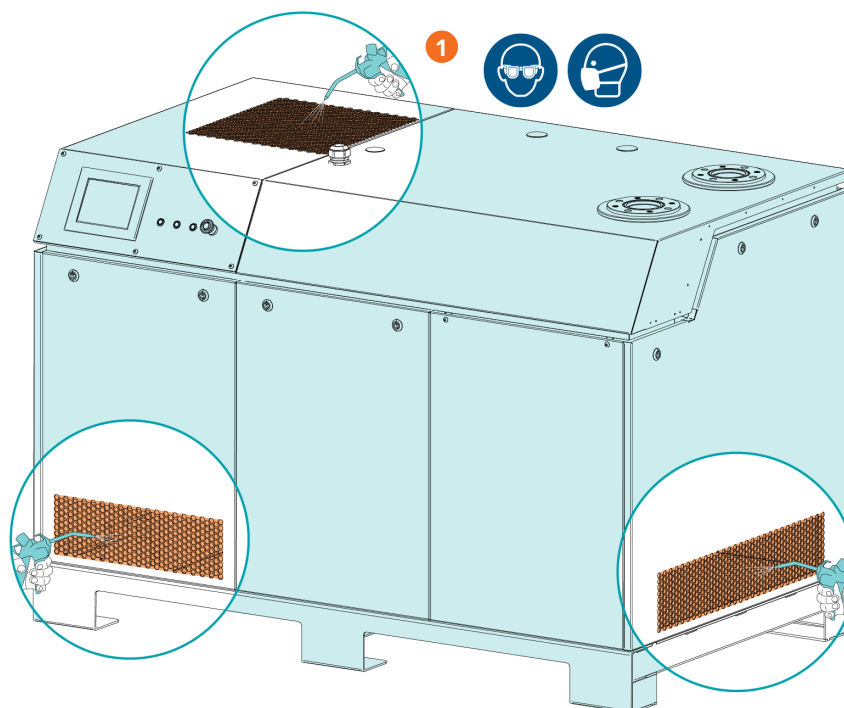


If there is no sticker (part no. 0565 568 959) on the machine:

- Order it from your Busch representative.

## 9.7 Machine Cleaning

- Clean the cooling air inlet and outlet (CAI/CAO) with pressurized air, especially when the machine is in a dusty environment.
- Remove covers if necessary.



Description		
1	Use compressed air and wear protective eyewear and mask	

# 10 Overhaul



## WARNING



**Machines contaminated with hazardous material.**

**Risk of poisoning!**

**Risk of infection!**

If the machine is contaminated with hazardous material:

- Wear appropriate personal protective equipment.



## NOTICE

**Improper assembly.**

**Risk of premature failure!**

**Loss of efficiency!**

- Any dismantling of the machine that goes beyond anything that is described in this manual should be done by Busch authorized technicians.

In case of the machine having conveyed gas that was contaminated with foreign materials which are dangerous to health:

- Decontaminate the machine as much as possible and state the contamination status in a 'Declaration of Contamination'.

Busch will only accept machines that come with a completely filled in and legally binding signed 'Declaration of Contamination' (form downloadable from [www.buschvacuum.com](http://www.buschvacuum.com)).

# 11 Decommissioning



## DANGER

**Live wires.**

**Risk of electrical shock.**

- Electrical installation work must only be executed by qualified personnel.



## CAUTION

**Hot surface.**

**Risk of burns!**

- Prior to any action requiring touching the machine, let the machine cool down first.

- Shut down the machine and lock against inadvertent start up.
- Disconnect the power supply.
- Turn off the water supply.

If the machine is equipped with a barrier gas system:

- Close the barrier gas supply.
- Vent the connected lines to atmospheric pressure.
- Drain the cooling water from the water drain valve (CWD).
- Disconnect all connections.

If the machine is going to be stored:

- See *Storage* [→ 23].

## 11.1 Dismantling and Disposal

- Drain and collect the oil.
- Make sure that no oil drips onto the floor.
- Separate special waste from the machine.
- Dispose of special waste in compliance with applicable regulations.
- Dispose of the machine as scrap metal.

# 12 Spare Parts



## NOTICE

**Use of non-Busch genuine spare parts.**

**Risk of premature failure!**

**Loss of efficiency!**

- The exclusive use of Busch genuine spare parts and consumables is recommended for the correct functioning of the machine and to validate the warranty.

Spare parts available:

Quantity	Description	Part no.
1	Overhaul kit	0993 233 559
3	Oil, VSC100, 1 L can	0831 122 573
1	Dilution gas ballast filter	0562 564 818
1	Barrier gas flowmeter	0657 562 359
1	Barrier gas nozzle (orifice 0,8mm)	0322 566 498
1	Temperature sensor cooling water outlet, PT100, 4-20mA	0651 563 753
1	Inlet mesh screen	0534 000 094
1	Motor 18,5kW, WEG, CE, UL	0633 219 575
1	Main fan for canopy	0524 221 302
1	Cooling water flowmeter 4-20mA	0657 232 643
1	Cooling water solenoid valve DN13, 24VDC	0654 559 332
1	Coupling gear rim Rotex 42	0512 566 954
1	Inlet pressure transmitter, 4-20mA	0653 233 987
2	Oil level switch A+B (motor + suction) side	0652 569 236
1	Discharge pressure transmitter, 4-20mA	0653 224 363
1	SD memory card for PLC	0683 214 521
1	Battery for PLC clock	Type BR 2032

Spare parts kit	Description	Part no.
Service kit for PLUS Control Unit	Includes the filters for the ventilation grids of the PLUS Control Unit.	0992 241 181



# 13 Troubleshooting



## DANGER

Carry out any work on the control unit and motor.

**Risk of electrical shock!**

- Electrical installation work must only be executed by qualified personnel.



## CAUTION

**Hot surface.**

**Risk of burns!**

- Prior to any action requiring touching the machine, let the machine cool down first.



## NOTICE

**Variable speed drive maintenance.**

**Risk of damage to the variable speed drive!**

- Maintenance and adjustment must only be executed by qualified personnel.

The first troubleshooting table describes general problems while the second table describes the meaning of occurrences visible from the user interface in the menu "HOME" > "WARNINGS/ALARMS".

Table 1		
Problem	Possible Cause	Remedy
The machine does not start.	The power indicator light (PIL) is not activated. No power signal.	<ul style="list-style-type: none"> <li>• Check the power supply connection.</li> </ul>
	The machine is not supplied with the correct voltage.	
	The machine is powered on but the touchscreen or the PLC does not run.	<ul style="list-style-type: none"> <li>• Check the 24 V power supply.</li> </ul>
	The machine has reached a limit operating value.	<ul style="list-style-type: none"> <li>• Identify and solve the problem listed in the menu "HOME" &gt; "WARNING/ALARM", see <i>Warnings and Alarms Thresholds</i> [→ 57].</li> <li>• Look up the related problem in the troubleshooting table 2.</li> </ul>
	The motor is defective.	<ul style="list-style-type: none"> <li>• Replace the motor.</li> </ul>
	The coupling (CPL) is defective.	<ul style="list-style-type: none"> <li>• Replace the coupling (CPL).</li> </ul>

<b>Table 1</b>		
<b>Problem</b>	<b>Possible Cause</b>	<b>Remedy</b>
	The rotors are jammed or seized.	<ul style="list-style-type: none"> <li>Rotors inspection or repair the machine (contact Busch).</li> </ul>
	Solid foreign matter has entered the machine.	<ul style="list-style-type: none"> <li>Remove the solid foreign matter or repair the machine (contact Busch).</li> <li>Check the inlet screen (IS) at the suction connection.</li> </ul>
The machine does not reach the usual pressure on the suction connection.	Suction or discharge lines too long or section diameter too small.	<ul style="list-style-type: none"> <li>Use larger diameter or shorter lines.</li> <li>Seek advice from your local Busch representative.</li> </ul>
	The inlet screen (IS) is partially clogged.	<ul style="list-style-type: none"> <li>Clean the inlet screen (IS), see <i>Cleaning the Inlet Screen</i> [→ 65].</li> </ul>
	Internal parts are worn or damaged.	<ul style="list-style-type: none"> <li>Repair the machine (contact Busch).</li> </ul>
The machine runs very noisily.	Wrong oil quantity or unsuitable oil type.	<ul style="list-style-type: none"> <li>Use one of the recommended oils in the correct quantity, see <i>Oil</i> [→ 82].</li> </ul>
	Defective gears, bearings or coupling element.	<ul style="list-style-type: none"> <li>Repair machine (contact Busch).</li> </ul>
The machine runs too hot.	Insufficient cooling.	<ul style="list-style-type: none"> <li>Make sure to comply with the cooling water requirements, see <i>Cooling Water Connection</i> [→ 27].</li> <li>Remove dust and dirt from the machine, see <i>Machine Cleaning</i> [→ 73].</li> </ul>
	Ambient temperature too high.	<ul style="list-style-type: none"> <li>Observe the permitted ambient temperature, see <i>Technical Data</i>.</li> </ul>
	Temperature of the process gases at the inlet too high.	<ul style="list-style-type: none"> <li>Observe the permitted gas inlet temperature, see <i>Technical Data</i>.</li> </ul>
The oil is black.	Oil change intervals are too long.	<ul style="list-style-type: none"> <li>Drain the oil and fill in new oil, see <i>Oil Change</i> [→ 70].</li> </ul>
	The machine runs too hot.	<ul style="list-style-type: none"> <li>See problem "The machine runs too hot".</li> </ul>
The machine does not reach the target pressure (pressure control mode only).	<p>The machine is over or under-sized for the application.</p> <p>Leaks or pressure drops in the pipework upstream the suction connection.</p>	<ul style="list-style-type: none"> <li>Check the system pipework.</li> <li>Ask Busch for advice.</li> </ul>

<b>Table 1</b>		
<b>Problem</b>	<b>Possible Cause</b>	<b>Remedy</b>
Communication problems when the machine is remotely controlled.	A wire is broken or not connected. The connection is not properly made. Wrong settings between the machine and network.	<ul style="list-style-type: none"> <li>• Check the wiring between the machine and the network.</li> <li>• Check remote control parameters, refer to the specific document "Pump Control Instructions, art. no.: 0870213261".</li> </ul>
The machine cannot be controlled via the User Interface.	The machine is in Automatic or in Remote control mode.	<ul style="list-style-type: none"> <li>• Switch the control to Local / Manual mode.</li> </ul>

<b>Table 2</b>		
<b>Message</b>	<b>Possible Cause</b>	<b>Remedy</b>
Oil level motor side (alarm)	Oil level too low.	<ul style="list-style-type: none"> <li>• Top up oil at motor side, see <i>Filling Oil</i> [→ 29].</li> </ul>
Oil level suction side (alarm)	Oil level too low.	<ul style="list-style-type: none"> <li>• Top up oil at suction side, see <i>Filling Oil</i> [→ 29].</li> </ul>
Pump temperature (warning + alarm)	Pump temperature too high.	<ul style="list-style-type: none"> <li>• See problem "The machine runs too hot".</li> </ul>
Exhaust gas pressure (warning + alarm)	Counter pressure too high.	<ul style="list-style-type: none"> <li>• Clean the silencer.</li> <li>• Check the discharge piping.</li> </ul>
Inlet pressure (warning + alarm)	Inlet pressure too high. The machine has operated for too long at a high inlet pressure.	<ul style="list-style-type: none"> <li>• Reduce the the inlet pressure.</li> <li>• Limit the operating time at a high inlet pressure.</li> </ul>
Water flow (alarm)	Water flow insufficient (risk of pump too hot).	<ul style="list-style-type: none"> <li>• Check the valves on the cooling liquid circuit.</li> <li>• Check the water solenoid valve.</li> <li>• Check the flowmeter.</li> </ul>
Electrical cabinet temperature (alarm)	Temperature in the control unit too high. Insufficient cooling. Ambient temperature too high.	<ul style="list-style-type: none"> <li>• Check and clean the filters of the inlet/outlet ventilation grids (VG) of the Control Unit (CU) cabinet. Change them if necessary.</li> <li>• Check the cooling fan (CF).</li> <li>• Observe the permitted ambient temperature.</li> </ul>
Sensor disconnected (alarm)	At least one of the analog sensors has been disconnected.	<ul style="list-style-type: none"> <li>• Check the electrical connection of the sensors.</li> </ul>
Inverter (VSD) (alarm)	Variable Speed Drive (VSD) default.	<ul style="list-style-type: none"> <li>• Have the variable speed drive checked by an electrician.</li> <li>• Repair the variable speed drive (contact Busch).</li> </ul>

<b>Table 2</b>		
<b>Message</b>	<b>Possible Cause</b>	<b>Remedy</b>
EMO	The emergency stop has been actuated.	<ul style="list-style-type: none"> <li>• Clarify the reason of the emergency.</li> <li>• Solve the problem and follow the <i>Warning/Alarm Acknowledgment Procedure</i> [→ 59].</li> </ul>
Low battery (alarm)	The PLC battery is low.	<ul style="list-style-type: none"> <li>• Replace the PLC battery (see <i>Spare Parts</i> [→ 76]).</li> </ul>
Fan breaker (warning)	The circuit breaker of the cooling fan has tripped.	<ul style="list-style-type: none"> <li>• Refer to schematic and reset the breaker.</li> </ul>
VSD breaker (alarm)	The circuit breaker of the variable speed drive has tripped.	<ul style="list-style-type: none"> <li>• Refer to schematic and reset the breaker.</li> </ul>
Analog input module disconnected	The analog input module is not connected or has been disconnected.	<ul style="list-style-type: none"> <li>• Refer to schematic and reconnect the analog input module.</li> </ul>

For resolution of problems not listed in the troubleshooting table, please contact your Busch representative.

# 14 Technical Data

NX 0950 A PLUS				
Pumping speed		m <sup>3</sup> /h	900	
Ultimate pressure (without gas ballast)		hPa (mbar) abs.	≤0.01	
Ultimate pressure (with gas ballast)		hPa (mbar) abs.	≤0.05	
Nominal motor rating (72Hz)		kW	18.5	
Permitted motor speed range (20Hz ... 72Hz)		min <sup>-1</sup>	1200 ... 4320 (factory setting ► speed control mode at 72Hz)	
Power supply frequency		Hz	50 / 60	
Power supply voltage (50/60 Hz)		V	3L+PE 380-440V +/-10% <sup>(1)</sup>	3L+PE 380-460V +/-10% <sup>(2)</sup>
Circuit breaker (MCCB)	With DC Reactor	A	50 (SCCR 20 kA)	50 (SCCR 20 kA)
	Without DC Reactor	A	80 (SCCR 20 kA)	n/a
Noise level (ISO 2151)		dB(A)	≤63	
Ambient temperature range		°C	5 ... 46	
Max. allowable counter pressure at the discharge		hPa (mbar) rel.	200	
Max. allowable gas inlet temperature according to the inlet pressure		°C	Inlet pressure ≤50 hPa (mbar) abs. ► 200	
			Inlet pressure >50 hPa (mbar) abs. ► 70	
Relative humidity		at 30 °C	90%	
Cooling water requirements		See <i>Cooling Water Connection</i> [→ 27]		
Oil capacity - motor side		l	~1.3	
Oil capacity - suction side		l	1	
Weight approx.		kg	1250	

<sup>(1)</sup> Standard Control Unit

<sup>(2)</sup> 3~ 460V Control Unit with lockable main switch

# 15 Oil

VSC 100	
ISO-VG	100
Oil type	Synthetic
Part number 1 L packaging	0831 168 356
Part number 5 L packaging	0831 168 357
Part number 10 L packaging	0831 210 162
Part number 20 L packaging	0831 168 359

## Oil suitability

- **Oil VSC 100:** Suitable for harsh applications.

# 16 EU Declaration of Conformity

This Declaration of Conformity and the CE-markings affixed to the nameplate are valid for the machine within the Busch scope of delivery. This Declaration of Conformity is issued under the sole responsibility of the manufacturer.

When this machine is integrated into a superordinate machinery the manufacturer of the superordinate machinery (this can be the operating company, too) must conduct the conformity assessment process for the superordinate machine or plant, issue the Declaration of Conformity for it and affix the CE-marking.

The manufacturer

**Ateliers Busch S.A.  
Zone Industrielle  
CH-2906 Chevenez**

declares that the machine: COBRA NC 0950 A PLUS; COBRA NX 0950 A PLUS

fulfill(s) all the relevant provisions from EU directives:

- 'Machinery' 2006/42/EC
- 'Electromagnetic Compatibility' (EMC) 2014/30/EU
- 'RoHS' 2011/65/EU Restriction of the use of certain hazardous substances in electrical and electronic equipment (incl. all related applicable amendments)

and comply(-ies) with the following harmonized standards that have been used to fulfill those provisions:

Standards	Title of the Standard
EN ISO 12100 : 2010	Safety of machinery - Basic concepts, general principles of design
EN ISO 13857 : 2019	Safety of machinery - Safety distances to prevent hazard zones being reached by the upper and lower limbs
EN 1012-2 : 1996 + A1 : 2009	Vacuum pumps - Safety requirements - Part 2
EN ISO 2151 : 2008	Acoustics - Noise test code for compressors and vacuum pumps - Engineering method (grade 2)
EN 60204-1 : 2018	Safety of machinery - Electrical equipment of machines - Part 1: General requirements
EN IEC 61000-6-2 : 2019	Electromagnetic compatibility (EMC) - Generic standards. Immunity for industrial environments
EN IEC 61000-6-4 : 2019	Electromagnetic compatibility (EMC) - Generic standards. Emission standard for industrial environments

Legal person authorized to compile the technical file and authorized representative in the EU (if the manufacturer is not located in the EU):

Busch Dienste GmbH  
Schauinslandstr. 1  
DE-79689 Maulburg

Chevenez, 01.03.2023



**Christian Hoffmann, General Manager**

# 17 UK Declaration of Conformity

This Declaration of Conformity and the UKCA-markings affixed to the nameplate are valid for the machine within the Busch scope of delivery. This Declaration of Conformity is issued under the sole responsibility of the manufacturer.

When this machine is integrated into a superordinate machinery the manufacturer of the superordinate machinery (this can be the operating company, too) must conduct the conformity assessment process for the superordinate machine or plant, issue the Declaration of Conformity for it and affix the UKCA-marking.

The manufacturer

**Ateliers Busch S.A.  
Zone Industrielle  
CH-2906 Chevenez**

declares that the machine: COBRA NC 0950 A PLUS; COBRA NX 0950 A PLUS

fulfill(s) all the relevant provisions from UK legislations:

- Supply of Machinery (Safety) Regulations 2008
- Electromagnetic Compatibility Regulations 2016
- Restriction of the use of certain hazardous substances in Electrical and Electronic Equipment Regulations 2021

and comply(-ies) with the following designated standards that have been used to fulfill those provisions:

Standards	Title of the Standard
EN ISO 12100 : 2010	Safety of machinery - Basic concepts, general principles of design
EN ISO 13857 : 2019	Safety of machinery - Safety distances to prevent hazard zones being reached by the upper and lower limbs
EN 1012-2 : 1996 + A1 : 2009	Vacuum pumps - Safety requirements - Part 2
EN ISO 2151 : 2008	Acoustics - Noise test code for compressors and vacuum pumps - Engineering method (grade 2)
EN 60204-1 : 2018	Safety of machinery - Electrical equipment of machines - Part 1: General requirements
EN IEC 61000-6-2 : 2019	Electromagnetic compatibility (EMC) - Generic standards. Immunity for industrial environments
EN IEC 61000-6-4 : 2019	Electromagnetic compatibility (EMC) - Generic standards. Emission standard for industrial environments

Legal person authorized to compile the technical file and importer in the UK (if the manufacturer is not located in the UK):

Busch (UK) Ltd  
30 Hortonwood  
Telford - UK

Chevenez, 01.03.2023



**Christian Hoffmann, General Manager**



# Notes

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# Busch

## Vacuum Solutions

With a network of over 60 companies in more than 40 countries and agencies worldwide, Busch has a global presence. In every country, highly competent local personnel delivers custom-tailored support backed by a global network of expertise. Wherever you are. Whatever your business. We are there for you.



● Busch companies and Busch employees   ● Local representatives and distributors   ● Busch production site

[www.buschvacuum.com](http://www.buschvacuum.com)