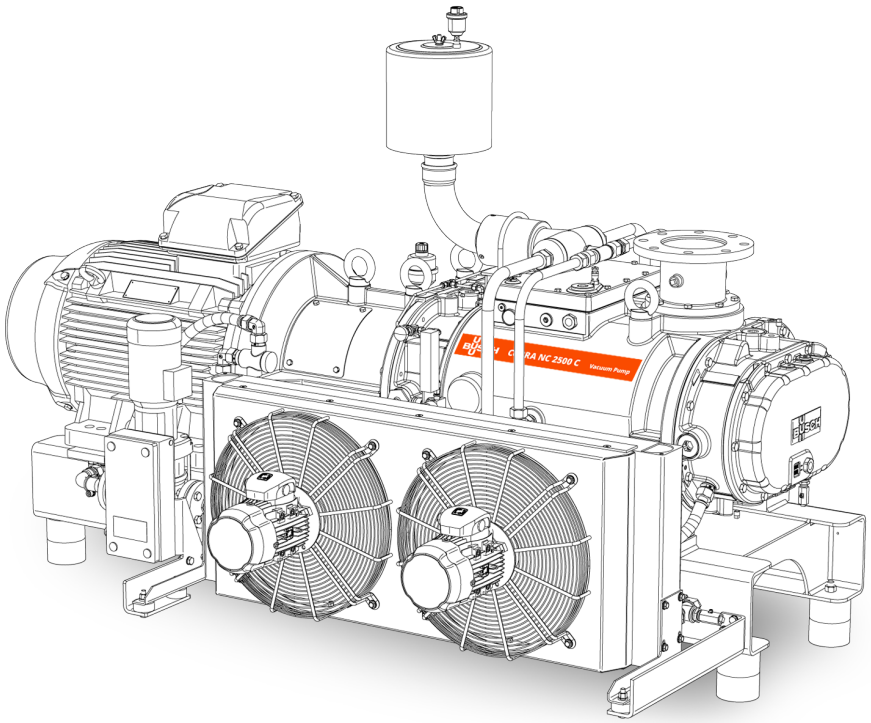
VACUUM SOLUTIONS

Part of the BUSCH GROUP

COBRA

Dry Screw Vacuum Pumps
NC 2500 C Air-Cooled Version (ACV)

Instruction Manual



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2025/04/24

Table of Contents

1 Safety

Prior to handling the machine, this instruction manual should be read and understood. If anything needs to be clarified, please contact your manufacturer 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 in accordance with the state-of-the-art methods. Nevertheless, residual risks may remain, as described in the following chapters and in accordance with the chapter *Intended Use* [➔ 7].

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.

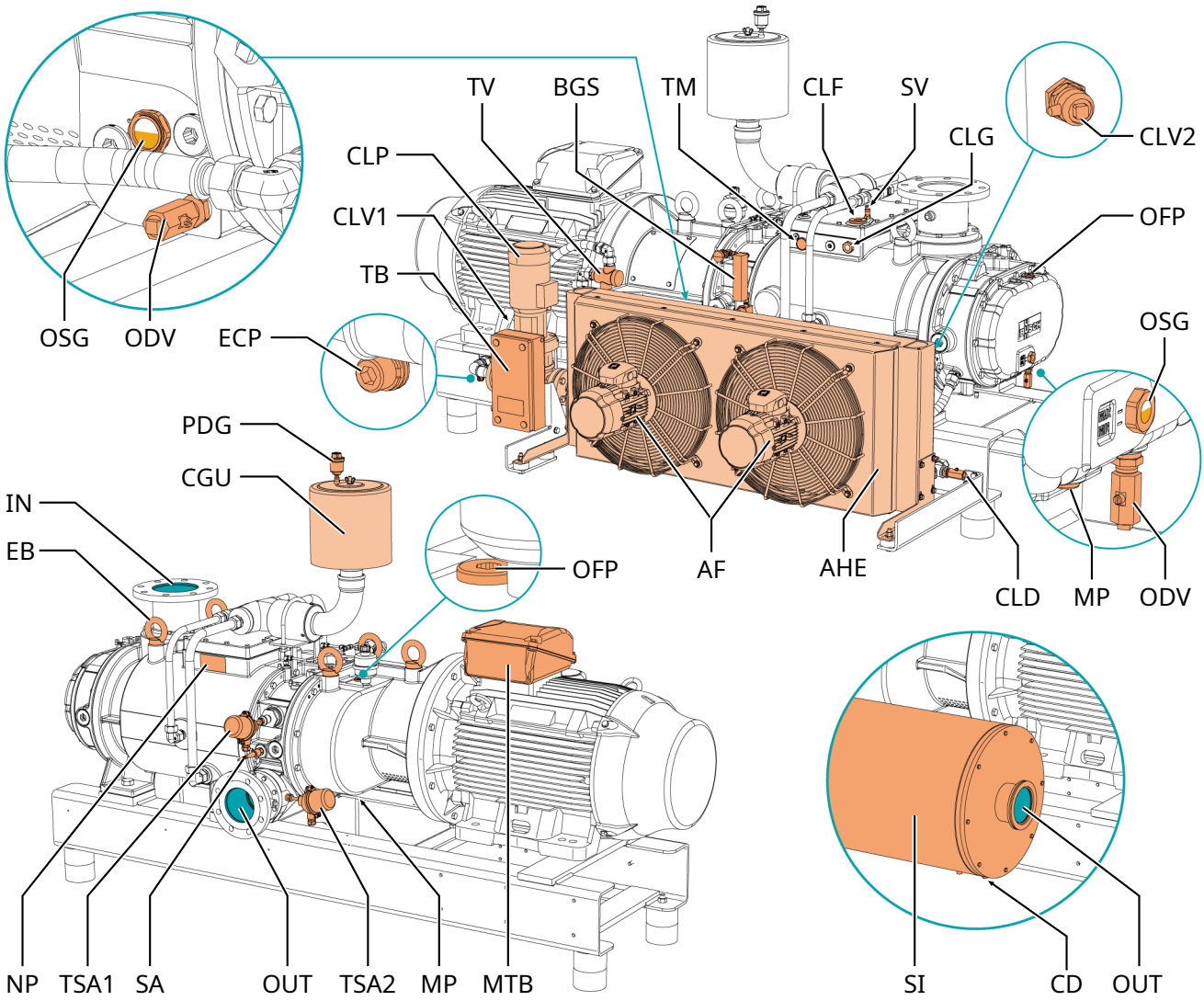
NOTICE

... 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	Inlet connection with mesh screen	OUT	Exhaust connection (Outlet)
AHE	Air-water heat exchanger	AF	Axial fan (x2)
BGS	Barrier gas system	CD	Condensate drain
CGU	Cooling gas unit (Air filter included)	CLD	Cooling liquid drain valve*
CLF	Cooling liquid fill plug	CLG	Cooling liquid sight glass
CLP	Cooling liquid pump	CLV1	Cooling liquid vent plug (Cooling liquid pump)
CLV2	Cooling liquid vent valve (Heat exchanger)	EB	Eye bolt
ECP	Earth connection	MP	Magnetic plug
MTB	Motor terminal box	NP	Nameplate
ODV	Oil drain valve	OFP	Oil fill plug
OSG	Oil sight glass	PDG	Pressure differential gauge (Delivered loose)
SA	Vibration transmitter (Option)	SI	Silencer (Option)
SV	Safety valve	TB	Cooling system terminal box
TM	Thermometer	TSA1	Resistance thermometer (Cooling liquid temperature)

Description			
TSA2	Resistance thermometer (Exhaust gas temperature)	TV	Thermostatic valve

* For additional cooling liquid drain points, see *Cooling Liquid Change* [➔ 39].

NOTE

Technical term.

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

NOTE

Illustrations.

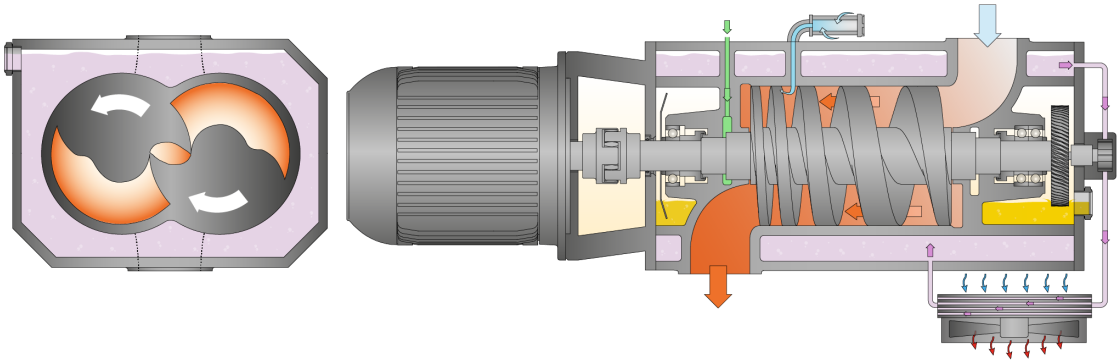
In this instruction manual, the illustrations may differ from the appearance of the machine.

NOTE

Illustrations.

In this instruction manual, some illustrations may be those of the water-cooled version of the machine. Although not shown in the air-cooled version configuration, the principles 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, non-ignitable 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 the manufacturer.

The machine is intended for 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.

2.3 Start Controls

The machine comes without start controls. The control of the machine is to be provided in the course of installation.

The machine must be equipped with a variable speed drive (not included in the scope of supply).

2.4 Standard Features

2.4.1 Air Cooling

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

The cooling liquid pump (CLP) allows a recirculating flow in the cooling liquid chamber.

The motor of the cooling liquid pump must be electrically connected, see *Electrical Connection of the Cooling Liquid Pump* [➔ 25]

The cooling liquid is cooled by an air-water heat exchanger (AHE).

Two motor driven fans, integrated to the heat exchanger, allows the cooling air to be drawn through the heat exchanger.

For more information, see Electrical Connection of the Cooling System.

2.4.2 Cooling Gas Unit

The purpose of the cooling gas unit (CGU), including an air filter is to cool the compression chamber and reduce the amount of heat generated by the compression of the process gases.

At inlet pressure < 300 mbar, cooling air is automatically drawn through an air filter.

2.4.3 Resistance Thermometer (Cooling Liquid)

The resistance thermometer monitors the cooling liquid temperature of the machine.

Warning and trip signals must be set, see *Wiring Diagram Resistance Thermometer* [➔ 28].

2.4.4 Resistance Thermometer (Exhaust Gas)

The resistance thermometer monitors the exhaust gas temperature at the machine exhaust connection.

Warning and trip signals must be set, see *Wiring Diagram Resistance Thermometer* [➔ 28].

2.4.5 Thermometer

The thermometer allows a visual display of the cooling liquid temperature.

2.4.6 Sealing Systems

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

Other sealing systems are optionally available, see *Mechanical Seals* [➔ 8].

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

The sealing systems include a barrier gas system, see *Barrier Gas System Connection* [➔ 16].

2.5 Optional Accessories

2.5.1 Silencer

A silencer at the exhaust connection (OUT) can be installed to reduce the exhaust gas noise.

2.5.2 Vibration Diagnostic Unit

The vibration diagnostic unit monitors the correct mechanical operation of the machine.

This unit is composed of a vibration sensor (SA) and a diagnostic electronics VSE100 (delivered loose).

The machine must be stopped when the vibration limit value (preset at the factory) is reached.

For more information, see *Wiring Diagram Vibration Diagnostic Unit (Option)* [➔ 29].

2.5.3 Mechanical Seals

The sealing systems can be equipped with mechanical seals. The following variants are possible:

- Oil lubricated single mechanical seals on the motor side and labyrinth seals on the inlet side.
- Oil lubricated single mechanical seals on the motor side and inlet side.

3 Transport

WARNING

Suspended load.

Risk of severe injury!

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

WARNING

Lifting the machine using the motor eye bolt.

Risk of severe injury!

- Do not lift the machine using the eye bolt fitted to the motor. Only lift the machine as shown.

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.

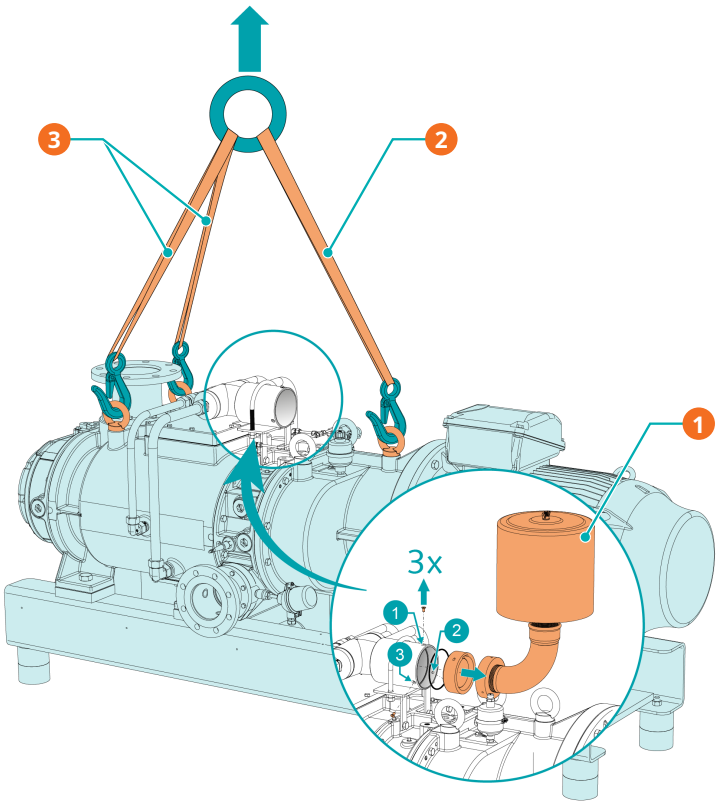
NOTE

Transport, commissioning and maintenance illustrations.

Some of the illustrations may be those of the water-cooled version of the machine. Although not shown in the air-cooled version configuration, the principles are similar.

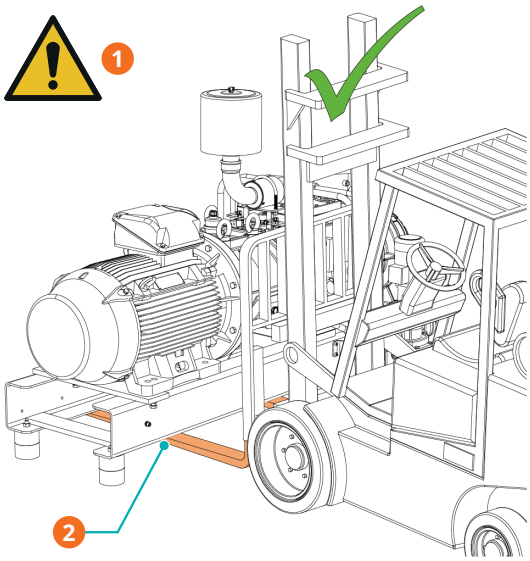
- To find out the weight of the machine, refer to the chapter Technical Data or the nameplate (NP).
- Make sure that the eye bolt(s) (EB) is/are in faultless condition, fully screwed in and tightened by hand.

Transport with a lifting hook



Description			
1	The air filter must be removed before lifting the machine!	2	l1 = ~430 mm
3	l2 & l3 = ~650 mm		

Transport with a forklift



Description			
1	Pay attention to the machine's center of gravity. Always handle the machine horizontally without tilting it.	2	Handling must be from the underside of the frame

- Check that the machine has not been damaged during transport.

If the machine is secured to a base plate:

- Remove the machine from the base plate.

4 Storage

- Seal hermetically all apertures with the caps provided with the machine, or with adhesive tape if the caps are no longer available.
- Store the machine indoors, in a dry place, away from dust and vibrations and if possible, in original packaging, preferably at temperatures between 5 ... 55 °C.

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

- Seal hermetically all apertures with the caps provided with the machine, or with adhesive tape if the caps are no longer available.
- Wrap the machine in a corrosion inhibitor film.
- Store the machine indoors, in a dry place, away from dust and vibrations and if possible, in original packaging, preferably at temperatures between 5 ... 55 °C.

NOTICE

Long storage time.

Risk of damage to the machine!

- If the machine is equipped with oil lubricated mechanical seals, we recommend to completely fill the oil chamber before a long storage, see “Oil filling” in chapter *Oil Change* [➔ 36]. This protects the mechanical seals during a long storage. Use the standard pump oil, see chapter *Oil* [➔ 52].
- Before restarting the machine, drain the oil to the normal oil level, see “Oil draining” in chapter *Oil Change* [➔ 36].

5 Installation

5.1 Installation Conditions

WARNING

If the machine is installed in a potentially explosive environment or if the machine is used to draw toxic, inflammable or non-inert gases:

Risk of injuries!

Risk of death!

- Ensure that the machine complies with all local, national rules and safety regulations.

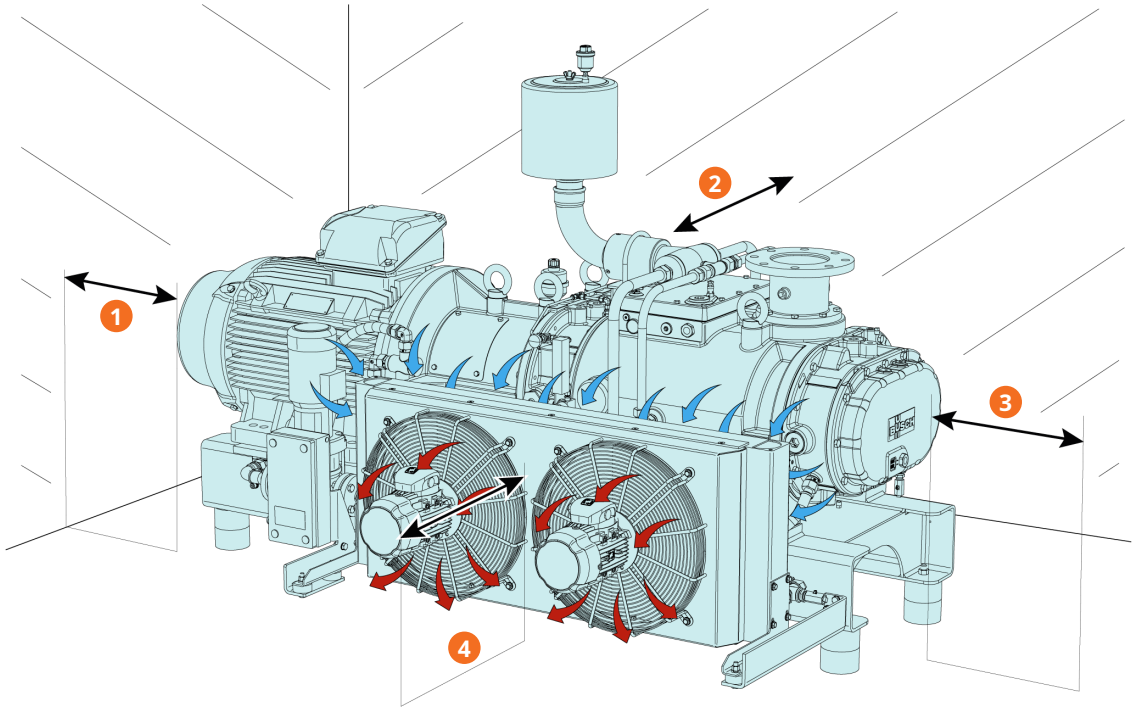
NOTICE

Use of the machine outside of the permitted installation conditions.

Risk of premature failure!

Loss of efficiency!

- Make sure that the installation conditions are fully respected.



Description			
1	~50 cm	2	~50 cm
3	~50 cm	4	~150 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 of the motor and the electrical elements.

- 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 of the motor fan are not covered or obstructed and that the cooling air flow is not affected adversely in any other way.
- Make sure that the oil sight glass (OSG) remains easily visible.
- 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* [➔ 35].
- Check the cooling liquid level, see *Cooling Liquid Level Inspection* [➔ 35].

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

- Contact your manufacturer representative, the motor must be derated or the ambient temperature limited.

5.2 Connecting Lines / Pipes

WARNING

Rotating Parts.

Risk of severe injury!

- Do not operate the machine without inlet and exhaust connections installed.

- Remove all protective covers before installation.
- Make sure that the connection lines cause no stress on the connections of the machine. Therefore, we recommend installing flexible lines at the inlet and exhaust connections.
- Make sure that the diameter 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:

- Use larger diameters to avoid a loss of efficiency.
- Contact your manufacturer representative for more information.

5.2.1 Inlet Connection

WARNING

Unprotected inlet connection.

Risk of severe injury!

- Do not put hand or fingers in the inlet 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 (25 micron or less) at the inlet of the machine.

Connection size(s):

– DN160 ISO-F

– DN150 PN16, EN 1092-1 (Optional)

– ANSI 150, 6” (Optional)

If the machine is used as part of a vacuum system:

- Busch recommends the installation and use of an isolation valve to prevent the machine from running backwards.
- Busch also recommends not opening the isolation valve until at least the minimum machine speed has been reached.

- Make sure that the connection lines cause no stress on the connections of the machine. Therefore, we recommend installing flexible lines at the inlet and exhaust connections.

5.2.2 Exhaust Connection

NOTICE

Exhaust gas flow obstructed.

Risk of damage to the machine!

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

Connection size(s):

At the machine exhaust connection:

– DN100 ISO-F

– DN100 PN16, EN 1092-1 (Optional)

– ANSI 150, 4” (Optional)

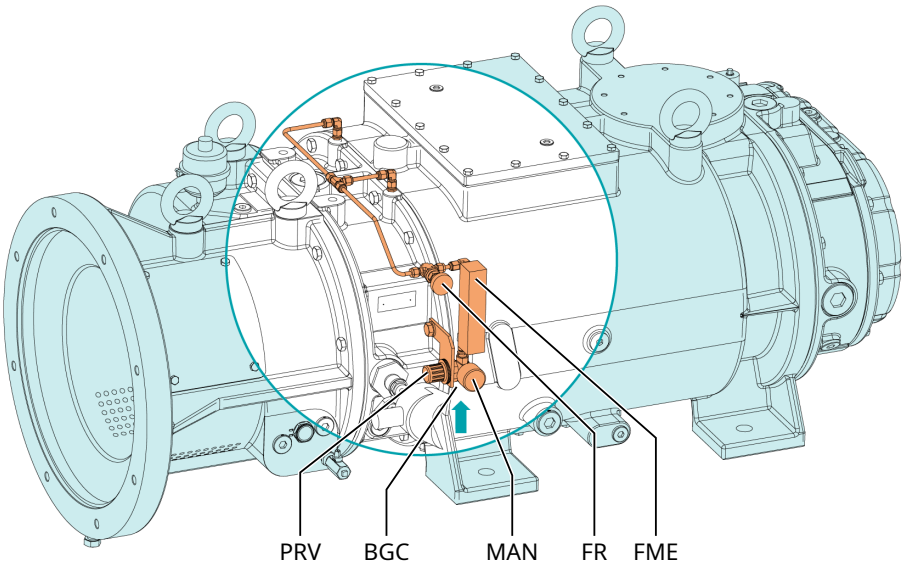
At the silencer (SI) exhaust connection:

– DN100 ISO-K, DIN 28404

- Make sure that the connection lines cause no stress on the connections of the machine. Therefore, we recommend installing flexible lines at the inlet and exhaust connections.
- Make sure that the counter pressure (also called “back pressure”) at the exhaust connection (OUT) does not exceed the maximum allowable exhaust pressure, see Technical Data.

5.2.3 Barrier Gas System Connection

Without nitrogen panel



Description			
BGC	Barrier gas connection	FME	Flow meter
FR	Flow regulator	MAN	Manometer
PRV	Pressure regulating valve		

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

Connection size:

– G1/4”, 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 (g)	13
Recommended pressure setting at the pressure regulating valve (PRV)	bar (g)	3
Filtration	µm	5
Recommended flow rate	SLM (standard liter per minute)	30
Air quality (only for air)	Acc. to ISO 8573-1	Class 5.4.4.

5.3 Filling Oil

NOTICE

Use of inappropriate oil.

Risk of premature failure!

Loss of efficiency!

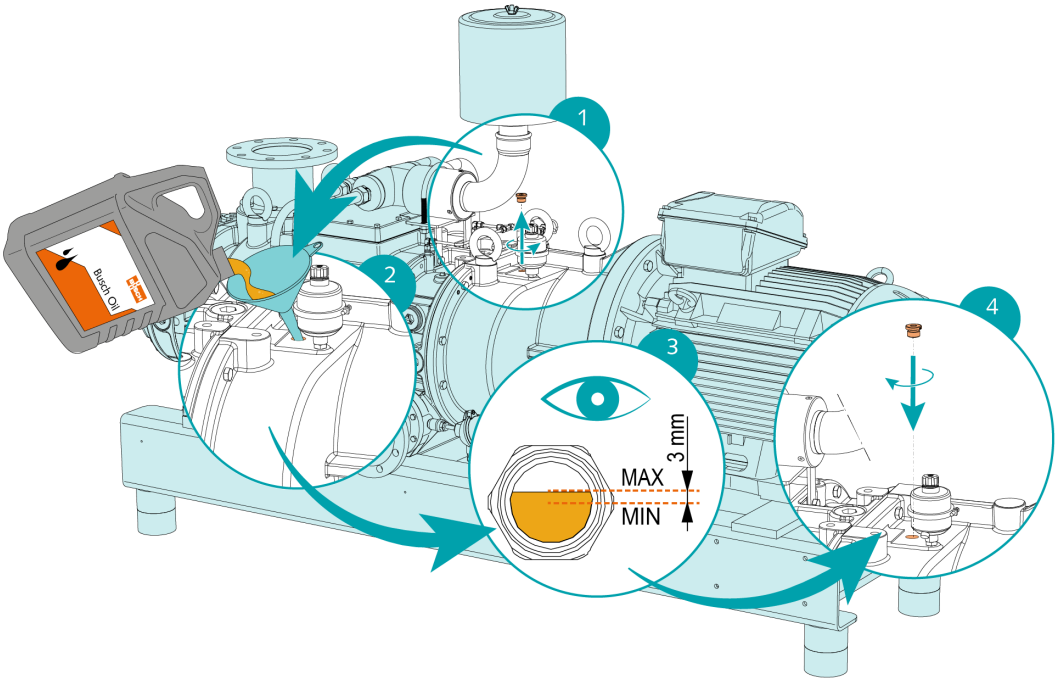
- Use only a type of oil previously approved and recommended by the manufacturer.

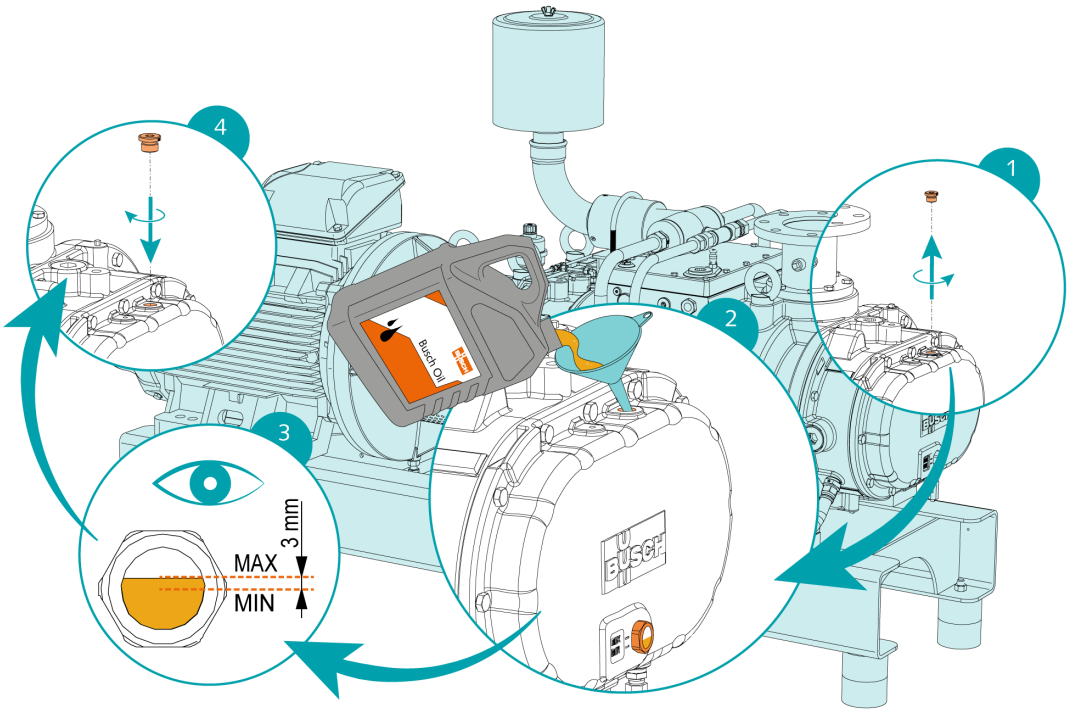
NOTE

Transport, commissioning and maintenance illustrations.

Some of the illustrations may be those of the water-cooled version of the machine. Although not shown in the air-cooled version configuration, the principles are similar.

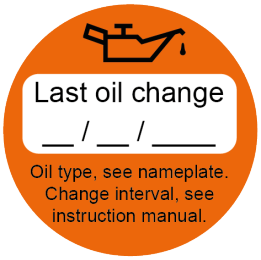
For oil type and oil capacity see Technical Data and *Oil* [➔ 52] chapters.





When the oil filling is achieved:

- Write down the oil change date on the sticker.

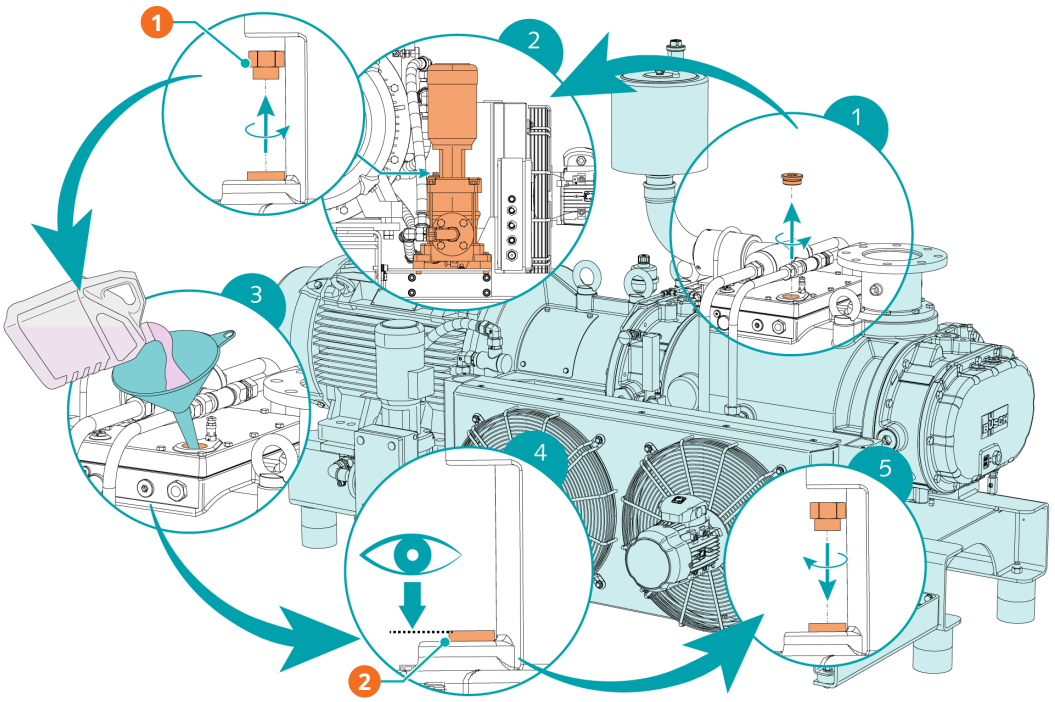


If there is no sticker (part no. 0565 568 959) on the machine:

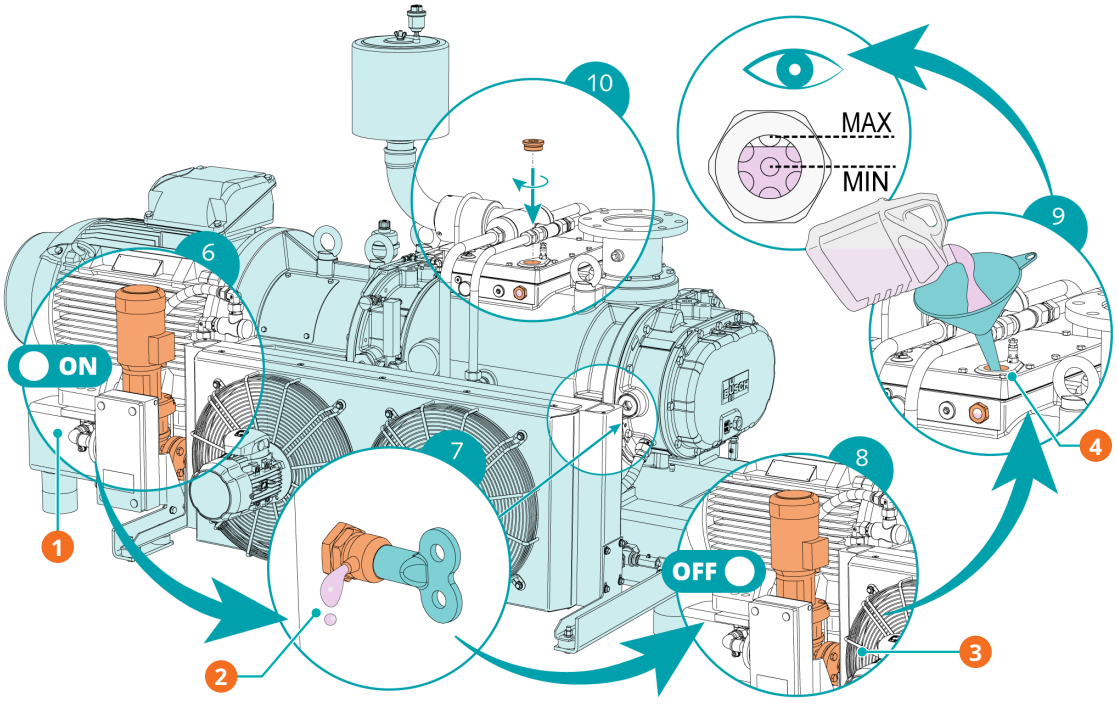
- Order it from your Busch representative.

5.4 Filling Cooling Liquid

For cooling liquid type and cooling liquid capacity see Technical Data and *Cooling Liquid* [➔ 51].



Description			
1	Cooling liquid vent plug (CLV1)	2	Fill up to the top of the vent orifice (CLV1)



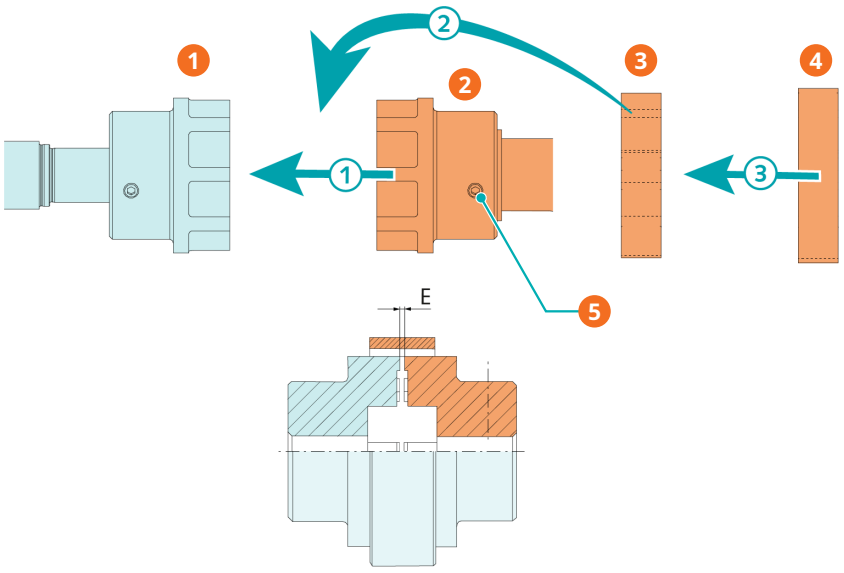
Description			
1	Start the cooling liquid pump (CLP)	2	Open the cooling liquid vent valve of the heat exchanger (CLV2) to vent air from the cooling sytsem. Close the valve when the cooling liquid flows continously.
3	Stop the cooling liquid pump (CLP)	4	Resume cooling liquid filling

5.5 Fitting the Coupling

NOTE

Radial screw.

For trouble-free operation, use thread locking glue to secure the radial screw.



Description			
1	Coupling hub (machine side)	2	Coupling hub (motor side)
3	Elastic insert	4	Ring
5	Radial screw / Tightening torque: 10Nm		

Machine type	Coupling size	Value “E” (mm)
NC 2500 C	Samiflex® A45	3,5 (0/+1)

In case of a machine delivery without motor:

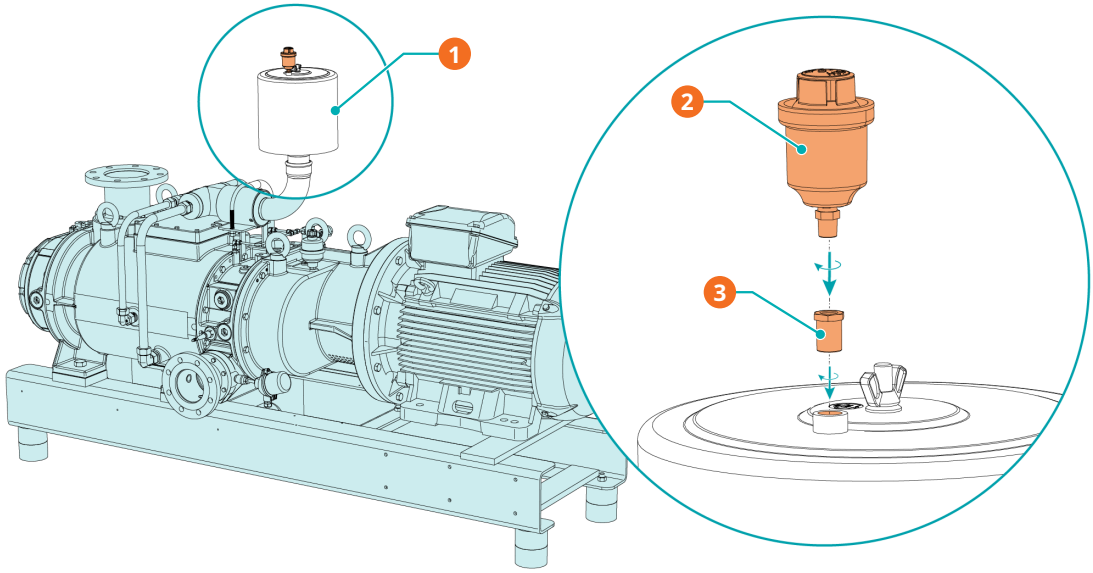
- Fit the second coupling hub on the motor shaft (separately delivered).
- Axially adjust the hub in such a way until value "E" is reached.
- When the coupling adjustment is done, lock the coupling hub by tightening the radial screw.

For further coupling information, go to *www.samiflex.se* and download the instruction manual of the Samiflex® coupling.

5.6 Fitting the Cooling Gas Filter Pressure Differential Gauge

The pressure differential gauge (PDG) is delivered loose with the machine.

- Install the gauge on the cooling gas unit (CGU) as follows:



Description			
1	Cooling gas unit	2	Pressure differential gauge (Delivered loose)
3	Reduction (1/4" - 1/8")		

6 Electrical Connection

DANGER

Live wires.

Risk of electrical shock!

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

INSTALLATION(S) CURRENT PROTECTION:

DANGER

Missing current protection.

Risk of electrical shock!

- Provide current protection in accordance with EN 60204-1 on your 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, contact your Busch representative for more information.
- 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* [➔ 53] or *UK Declaration of Conformity* [➔ 54]).

NOTE

- Make sure that the machine is started by a variable speed drive!

6.1 Machine delivered without Variable Speed Drive

DANGER

Live wires.

Risk of electrical shock!

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

NOTE

The operation with variable speed, i.e. with a variable speed drive, is allowed as long as the motor is capable and the permitted motor speed range is respected (see Technical Data).

Contact your Busch representative for further advice and information.

- Make sure that the power supply for the motor is compatible with the data on the nameplate of the motor.
- 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.
- Provide a lockable disconnect switch or an emergency stop switch on the power line so that the machine is completely secured in case of an emergency situation.
- Provide a lockable disconnect switch on the power line so that the machine is completely secured during maintenance tasks.
- Provide an overload protection according to EN 60204-1 for the motor.
- Connect the protective earth conductor.
- Electrically connect the motor.

NOTICE

The motor frequency is below 20 Hz.

Risk of damage to the machine!

- The motor nominal speed must always be higher than 1200 min^{-1} (20 Hz).

NOTICE

The admissible motor nominal speed exceeds the recommendation.

Risk of damage to the machine!

- Check the admissible motor nominal speed (n_{max}) on the nameplate of the machine (NP).
- Make sure to comply with it.
- For more information, consult the chapter Technical Data.

NOTICE

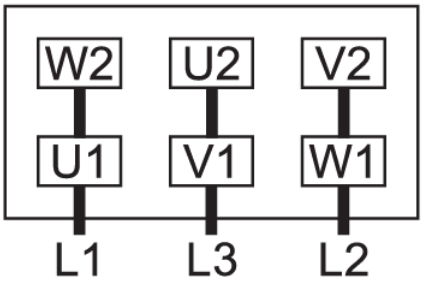
Incorrect connection.

Risk of damage to the motor!

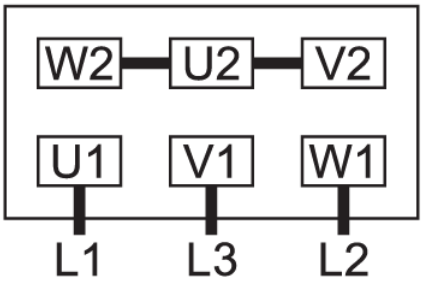
- The wiring diagrams given below are typical. Check the inside of the terminal box for motor connection instructions/diagrams.

6.2 Wiring Diagram Three-Phase Motor (Pump Drive)

Delta connection (low voltage):



Star connection (high voltage):



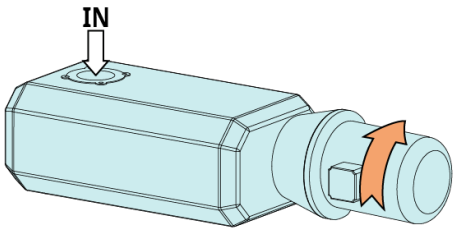
NOTICE

Incorrect direction of rotation.

Risk of damage to the machine!

- Operation in the wrong direction of rotation can destroy the machine in a short time! Prior to start-up, ensure that the machine is operated in the right direction.

The intended rotation direction of the motor is defined by the illustration below:



- Jog the motor briefly.
- Watch the fan wheel of the motor and determine the direction of rotation just before the fan wheel stops.

If the rotation of the motor must be changed:

- Switch any two of the motor phase wires.

6.3 Electrical Connection of the Cooling Liquid Pump

DANGER

Live wires.

Risk of electrical shock!

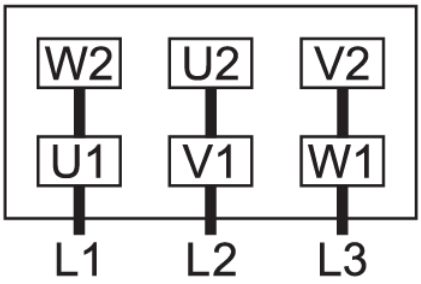
- Electrical installation work must only be executed by qualified personnel.

- Provide overload protection for the cooling liquid pump in accordance with EN 60204-1.
- Connect the cooling liquid pump electrically.
- Make sure that the cooling liquid pump is connected in such a way as to operate when the machine is started.

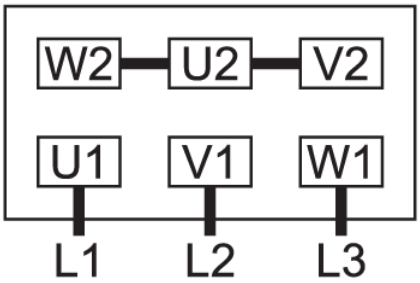
6.3.1 Wiring Diagram Cooling Liquid Pump

230/400 VAC cooling liquid pump version

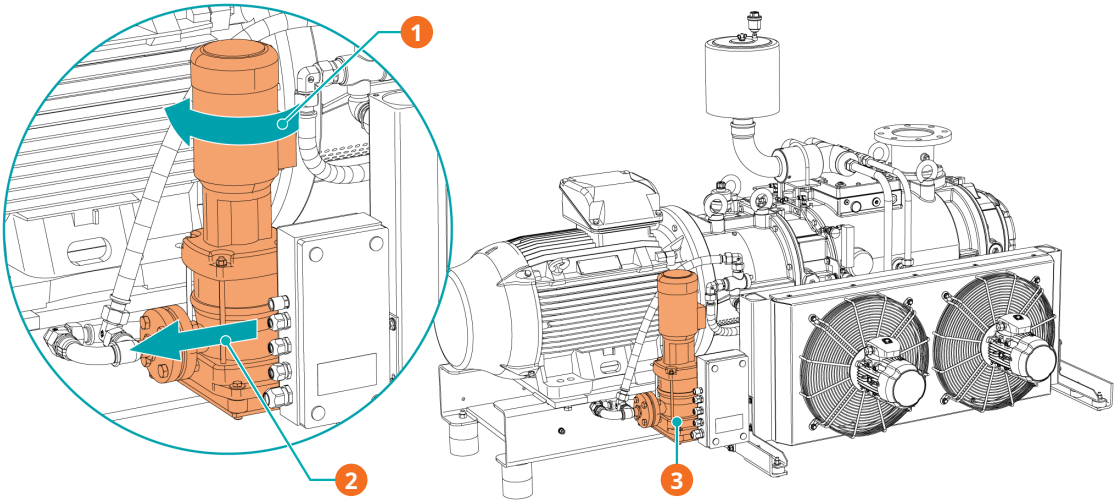
Delta connection (low voltage):



Star connection (high voltage):



- Make sure that the cooling liquid flows in the right direction according to the following illustration.



Description			
1	Rotation direction of the motor	2	Cooling liquid flow direction
3	Cooling liquid pump (CLP)		

If the rotation of the motor must be changed:

- Switch any two of the motor phase wires.

6.4 Electrical Connection of the Axial Fans

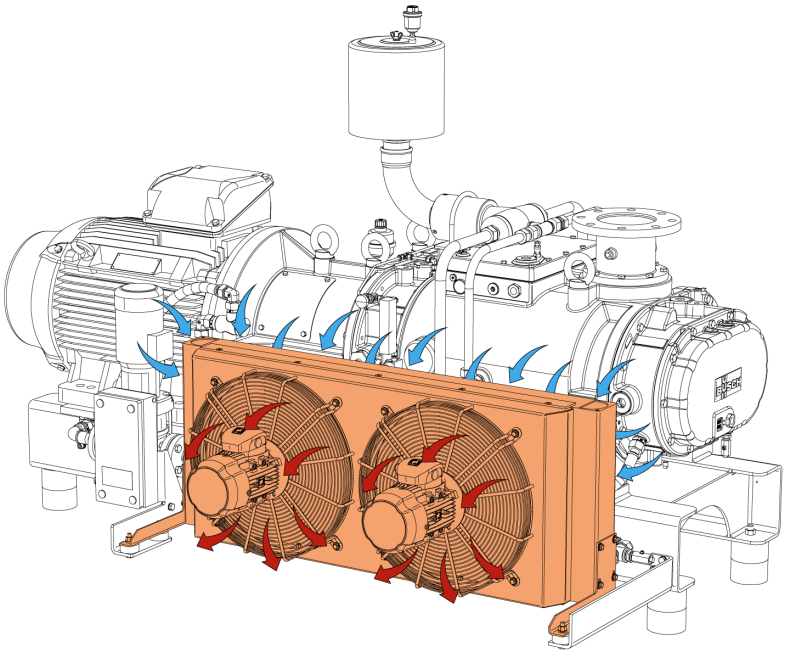
DANGER

Live wires.

Risk of electrical shock!

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

- Make sure that the power supply for the motor is compatible with the data on the nameplate of the motor.
- Provide overload protection for the fan motor(s) in accordance with EN 60204-1.
- Connect the cooling system electrically, see *Wiring Diagram Cooling System* [➔ 27].
- Make sure that the cooling system is operating when the machine is started.
- Make sure that the air flow blows in the right direction according to the following illustration.



If the rotation of the motor must be changed:

- Switch any two wires of the cooling system power supply.

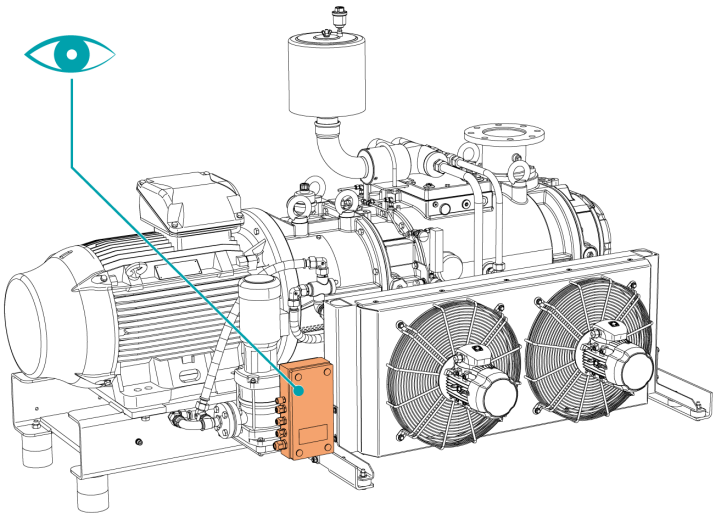
6.4.1 Wiring Diagram Cooling System

Cooling system = Cooling liquid pump (CLP) + Axial fans (AF)

NOTE

The wiring diagram of the cooling system might be specific to the order.

- Please refer to the specific wiring diagram supplied inside the terminal box (TB).



6.5 Electrical Connection of the Monitoring Devices

WARNING

If monitoring sensors are not used.

Risk of explosion!

- Always use the mandatory monitoring sensors.

WARNING

Other sensor types.

Risk of severe injury!

Risk of explosion!

- Only the following sensor types have been approved by Busch and may not be replaced by others without authorization of the Busch representative.

NOTE

To prevent potential nuisance alarms, Busch recommends that the control system is configured with a time delay of at least 20 seconds.

6.5.1 Wiring Diagram Resistance Thermometer

Part no.: PT100: 0651 550 436 / Transmitter: 0643 536 800

U_i = 30 VDC; I_i = 100 mA; P_i = 750 mW; L_i = 0 µH; C_i = 0 pF

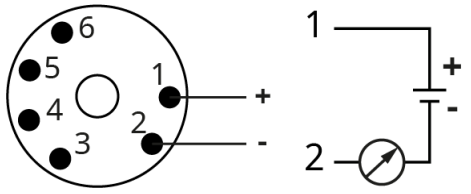
4 ... 20 mA ▶ 0 ... 300 °C

Maintenance procedure: *Resistance Thermometer Calibration* [➔ 43]

Trip signal (Cooling liquid / TSA1): T_{trip}: 70 °C

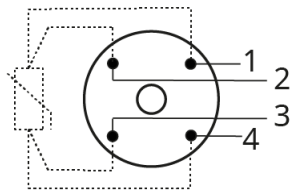
Trip signal (Exhaust gas / TSA2): T_{trip}: 245 °C

Wiring with transmitter:



1 = Brown; 2 = Blue

Wiring without transmitter:



1 and 2 = Red; 3 and 4 = White

6.5.2 Wiring Diagram Vibration Diagnostic Unit (Option)

NOTE

The wiring diagram is supplied separately (Specific sheet) with the machine.

Part no.: Vibration sensor: 0658 569 597 / Diagnostic electronics: 0646 564 555

Supplier references: Vibration sensor: CTC AC915

Diagnostic electronics: IFM VSE100

Maintenance procedure: *Vibration Sensor Calibration* [➔ 43].

P&ID position: SA+/0701

Electrical data: U = 24 VDC; I = 200 mA

	Normal operation	Warning signal	Trip signal
Digital output I/O 1	24 V (100 mA)	0 V	0 V
Output 2	24 V (100 mA)	24 V (100 mA)	0 V
Output 1 analog signal 4-20 mA	4 to 15 mA	>15 to 18 mA	>18 mA

7 Commissioning

CAUTION

During operation the surface of the machine can reach temperatures over 70°C.

Risk of burns!

- Avoid contact with the machine during and directly after operation.

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.

NOTICE

The machine is normally 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* [➔ 17].

NOTICE

The machine can be shipped without cooling liquid.

Operation without cooling liquid will ruin the machine in short time!

- Prior to commissioning, the machine must be filled with cooling liquid, see *Filling Cooling Liquid* [➔ 18].

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.

NOTICE

Running without air-cooled system.

Risk of damage to the machine!

- Make sure the fan motors of the heat exchanger (AHE) and the cooling liquid pump (CLP) are running when the machine is in operation.

- Make sure that the *Installation Conditions* [➔ 13] are met.

If the machine is equipped with a barrier gas system:

- Turn on the barrier gas supply.
- Adjust the barrier gas pressure and volume flow.

- Start the cooling liquid pump (CLP) and the radiator fan motors.
- Start the machine.
- Make sure that the maximum permissible number of starts does not exceed 6 starts per hour. Those starts should be spread within the hour.
- Make sure that the operating conditions comply with the Technical Data.
- After a few minutes of operation, perform an *Oil Level Inspection* [➔ 35].
- After a few minutes of operation, perform a *Cooling Liquid Level Inspection* [➔ 35].

As soon as the machine is used under normal operating conditions:

- Measure the motor current and record it as reference for future maintenance and trouble-shooting work.

- Two to four weeks after commissioning, check the inlet mesh screen:
  - Remove it if you consider that the vacuum system is clean and free of solid particles. If not, leave the inlet mesh screen in place and check it periodically (See *Maintenance Schedule* [➔ 34]).

7.1 Recommendations on Operation

7.1.1 Operating Frequency

- Operate the machine continuously at 35 ... 60 Hz (2100 ... 3600 min^{-1}).
- For continuous operation at 20 ... 35 Hz (e.g. for stand-by purposes), a 3-minute acceleration ramp for 0 ... 60 Hz must be used (acceleration of 20 Hz per minute), or the inlet pressure must be kept at >100 mbar for cooling purposes.
  - The G ½" connection at the machine inlet spool piece can be used to inject ambient cooling air.
- Operation below 20 Hz is not recommended.
- Maximum allowed operation frequency is 60 Hz (3600 min^{-1}).

7.1.2 Stop & Start

Frequent stop-start operation to be avoided.

- For standard start, use a ≥ 3-minute acceleration ramp for 0 ... 60 Hz.
- Or, for fast start (30 seconds for 0 ... 60 Hz), wait more than 60 minutes between stop and start.

7.1.3 Use with Argon

Pumping of high Argon concentrations (up to 50-80% of Argon) requires additional limits of operation:

- Rotational speed: max 50 Hz = 3000 min^{-1}.
- Gas inlet temperature: max. 80 °C.
- Cooling gas: air or nitrogen.
- Temperature monitoring: standard setting.

7.2 Conveying Condensable Vapors

CAUTION

Venting the machine.

The discharged gases and/or liquids may reach temperatures above 70°C!

Risk of burns!

- Avoid direct contact with the flow of gases and/or liquids.

The machine is suitable for conveying condensable vapors in the gas stream.

If condensable vapors are to be conveyed:

START

- Start the machine and warm it up for 30 minutes.
- Open the inlet valve.
- Perform the process.
- Close the inlet valve.

END

- Continuously drain condensate from the condensate drain plug (CD) of the silencer (SI) (Optional).

8 Maintenance

DANGER

Live wires.

Risk of electrical shock!

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

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.

WARNING

The machine is 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!

- Before doing anything that requires touching the machine, let it cool down first.

CAUTION

Hot liquids.

Risk of burns!

- Before draining liquids, 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.

- Stop the machine and lock it to prevent accidental start-up.

If the machine is equipped with a barrier gas system:

- Close the barrier gas supply.

- Vent the connected lines to atmospheric pressure.

If necessary:

- Disconnect all connections.

8.1 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 individually 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

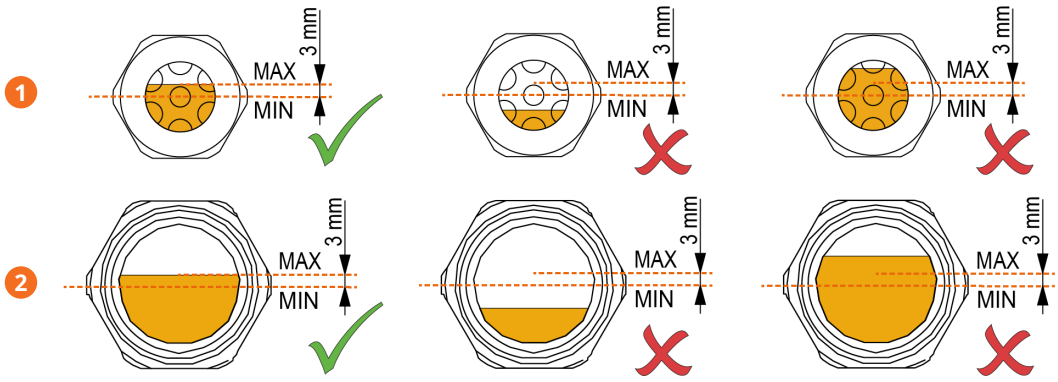
Monthly	• Check the oil level and oil condition, see *Oil Level Inspection* [➔ 35]. If the oil is contaminated or discolored, change the oil.
	• Check the cooling liquid level, see *Cooling Liquid Level Inspection* [➔ 35].
	• Visually inspect the air-water heat exchanger and remove any dust and dirt.
	• Check the machine for oil leaks. In case of leaks, have the machine repaired (contact Busch).
	• Check the cooling gas filter pressure differential gauge:
	  • If the yellow pressure drop indicator reached the red zone, the cooling gas filter must be replaced **immediately**.
	  • Reset the pressure gauge by pressing the pushbutton on the top of the gauge.

Yearly	• Carry out a visual inspection and clean the machine from dust and dirt. • Check the electrical connections and the monitoring devices.

Interval	Maintenance work
Every 5000 hours or after 1 year	• Change the oil of the gear and bearing housings (both sides), see *Oil Change* [➔ 36]. • Change the cooling liquid, see *Cooling Liquid Change* [➔ 39]. • Check the air filter in the Cooling Gas Unit (CGU). If necessary, clean or replace the air filter. • If the inlet is equipped with a mesh screen, check the condition of the mesh screen: • Clean or replace if any damage is observed. • Clean the magnetic plugs (MP).
Every 16000 hours or after 4 years	• Carry out a major overhaul on the machine (Contact Busch).
Refer to motor nameplate for interval and grease type	• Regrease motor bearings.

8.2 Oil Level Inspection

- Stop the machine.
- Wait 1 minute.
- Check the oil level.

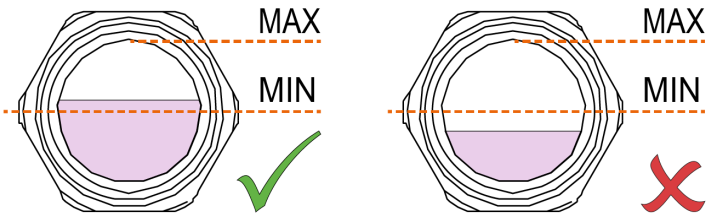


Description			
1	Oil sight glass on inlet side	2	Oil sight glass on motor side

- Make sure that the oil level is between the middle of the oil sight glass and 3mm above it.
- Fill up if necessary, see *Filling Oil* [➔ 17].

8.3 Cooling Liquid Level Inspection

- Stop the machine.



- Fill up if necessary, see *Filling Cooling Liquid* [➔ 18].

8.4 Oil Change

NOTICE

Use of inappropriate oil.

Risk of premature failure!

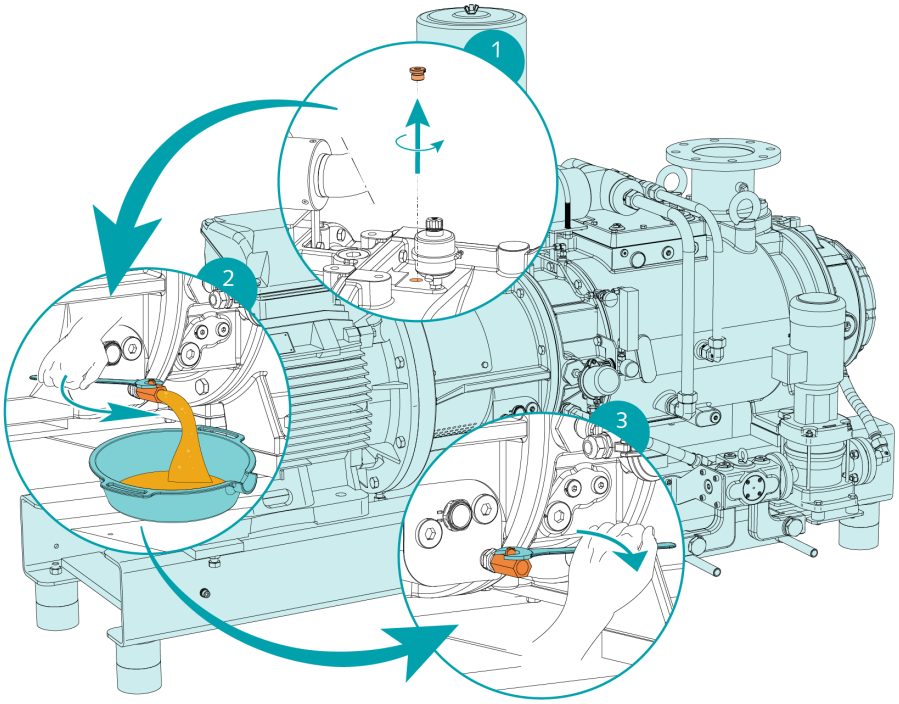
Loss of efficiency!

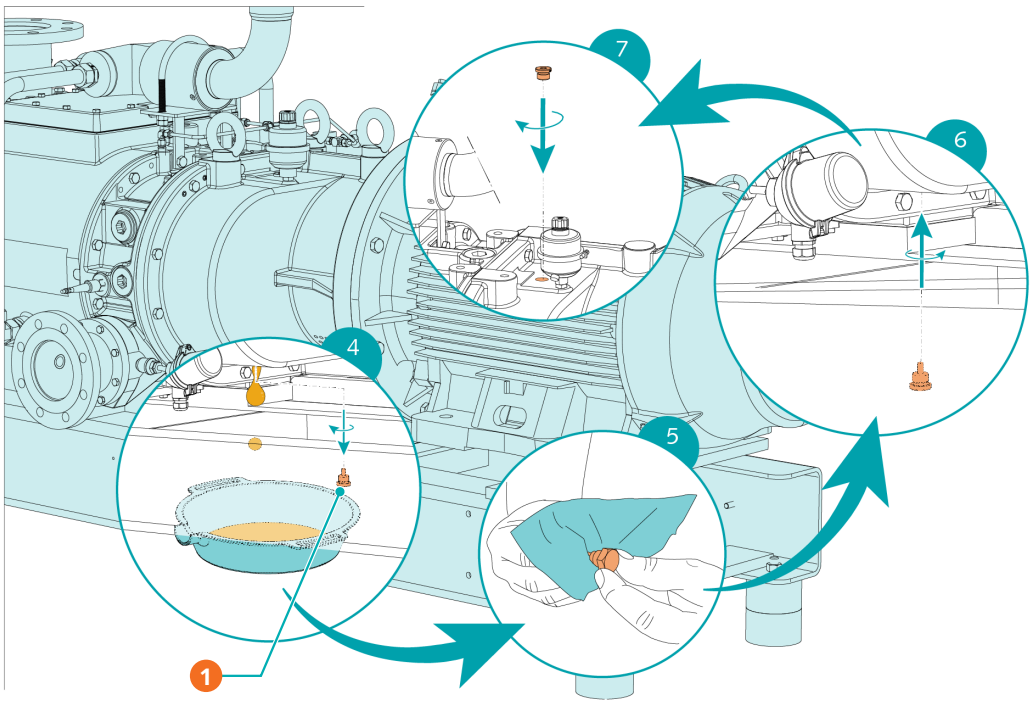
- Use only a type of oil previously approved and recommended by the manufacturer.

NOTE

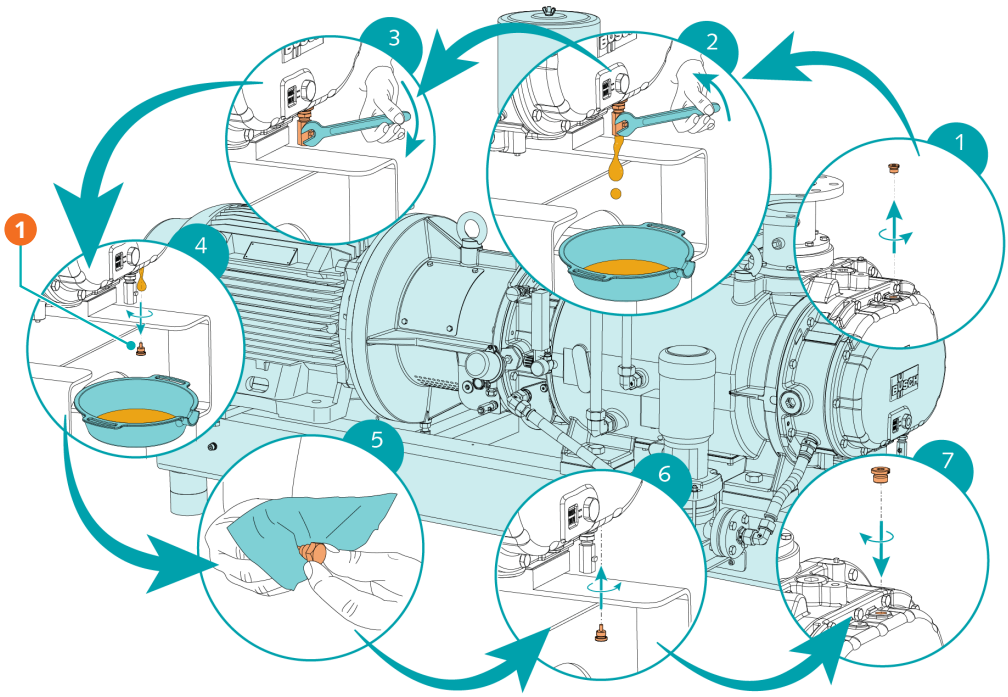
Transport, commissioning and maintenance illustrations.

Some of the illustrations may be those of the water-cooled version of the machine. Although not shown in the air-cooled version configuration, the principles are similar.





Description			
1	Magnetic plug		



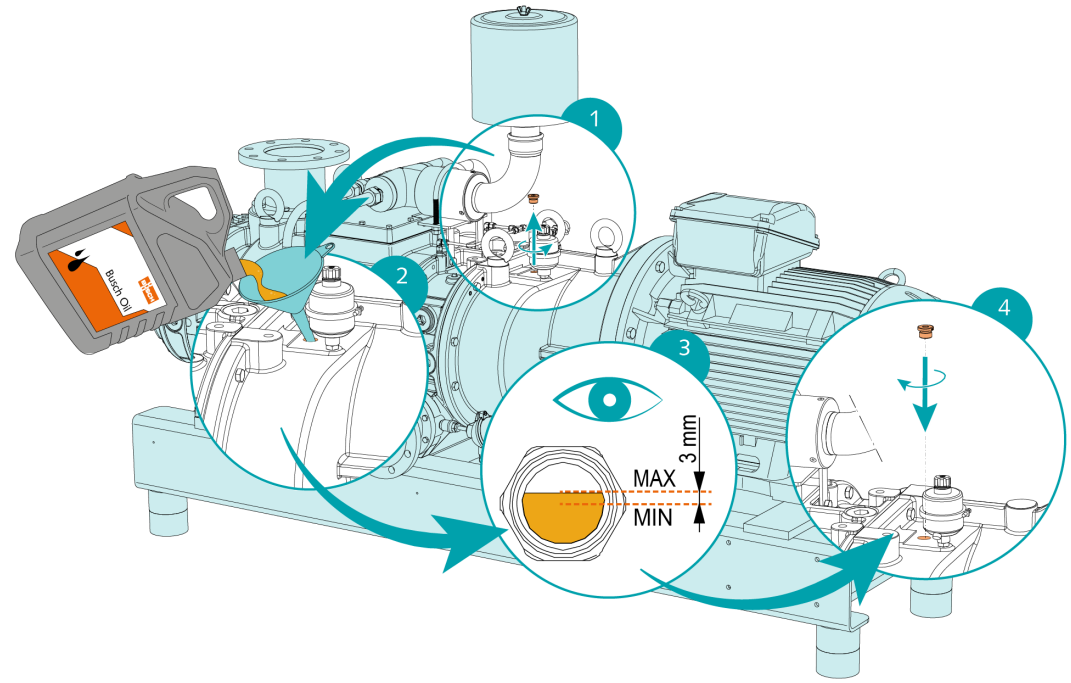
Description			
1	Magnetic plug		

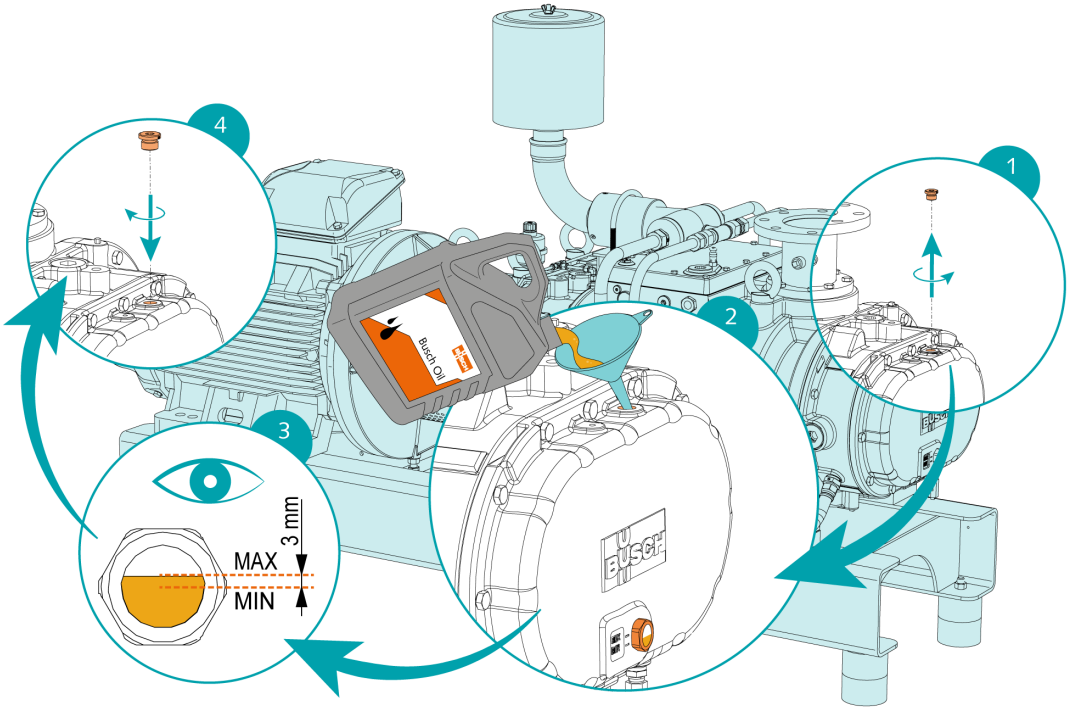
NOTE

Transport, commissioning and maintenance illustrations.

Some of the illustrations may be those of the water-cooled version of the machine. Although not shown in the air-cooled version configuration, the principles are similar.

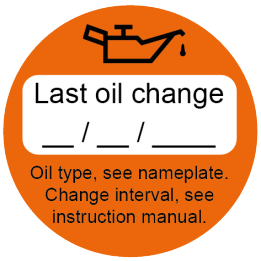
For oil type and oil capacity see Technical Data and *Oil* [➔ 52] chapters.





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.

8.5 Cooling Liquid Change

NOTICE

Cooling liquid draining.

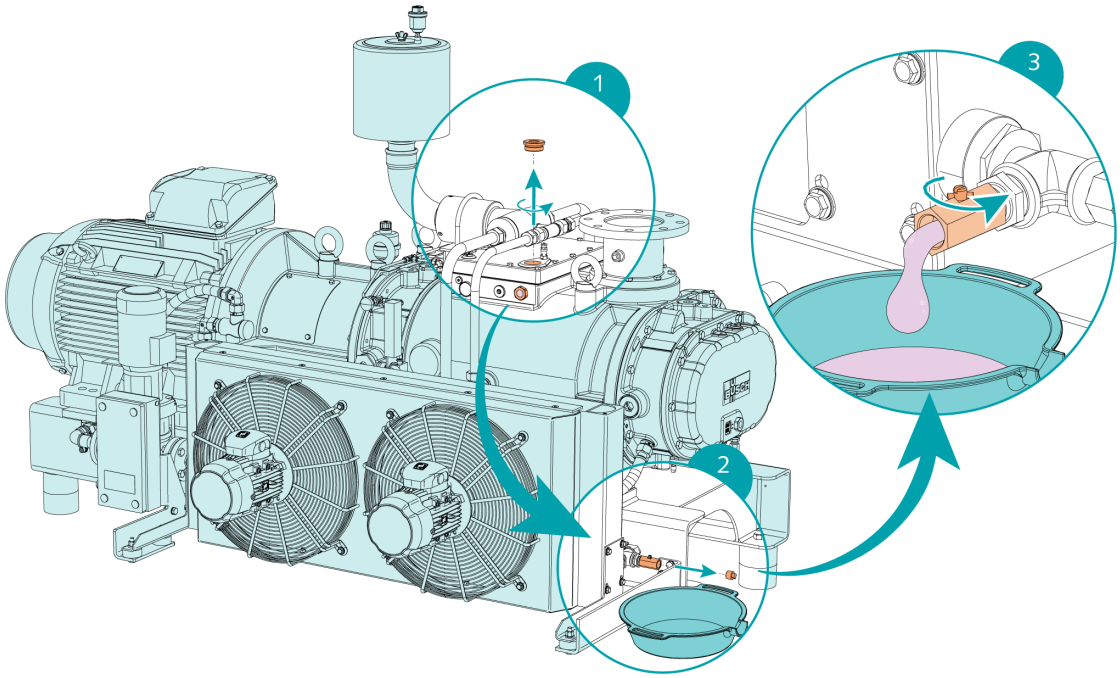
Risk of substantial cooling liquid flow!

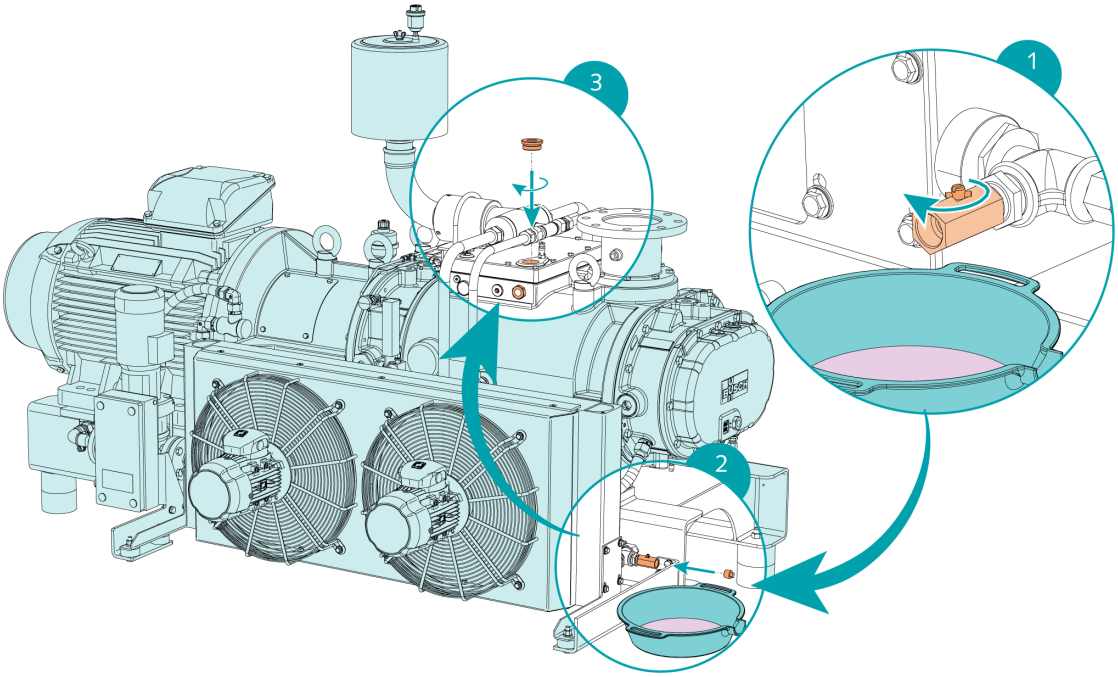
- Make sure to place sufficiently large drain pans under the machine before removing the cooling liquid drain plugs.

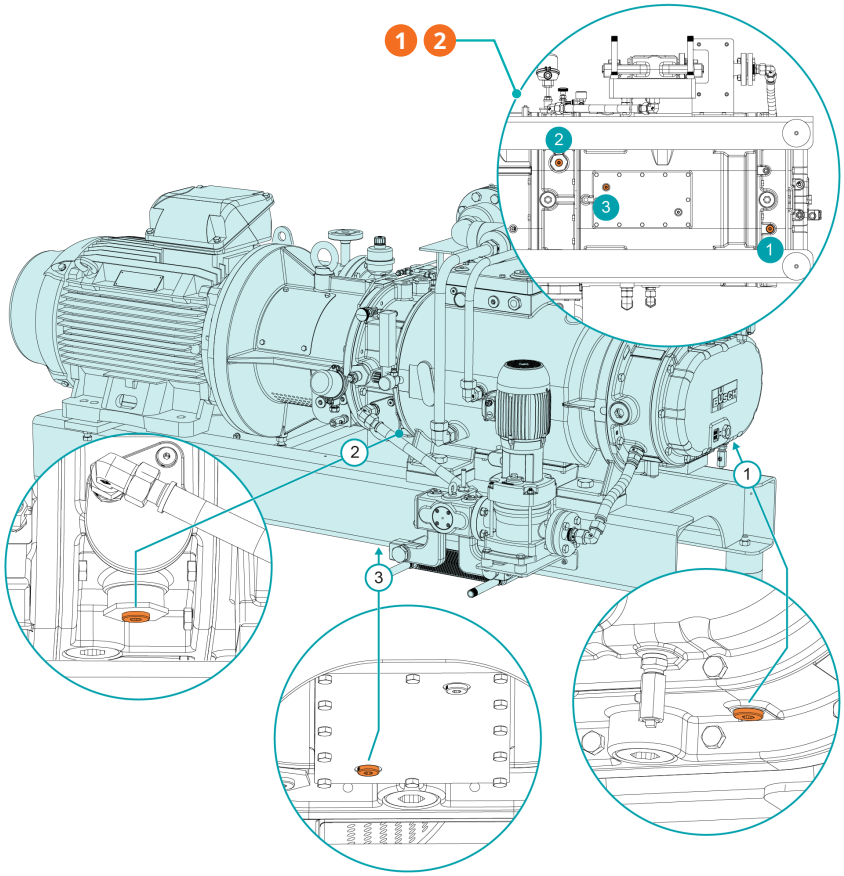
NOTE

Transport, commissioning and maintenance illustrations.

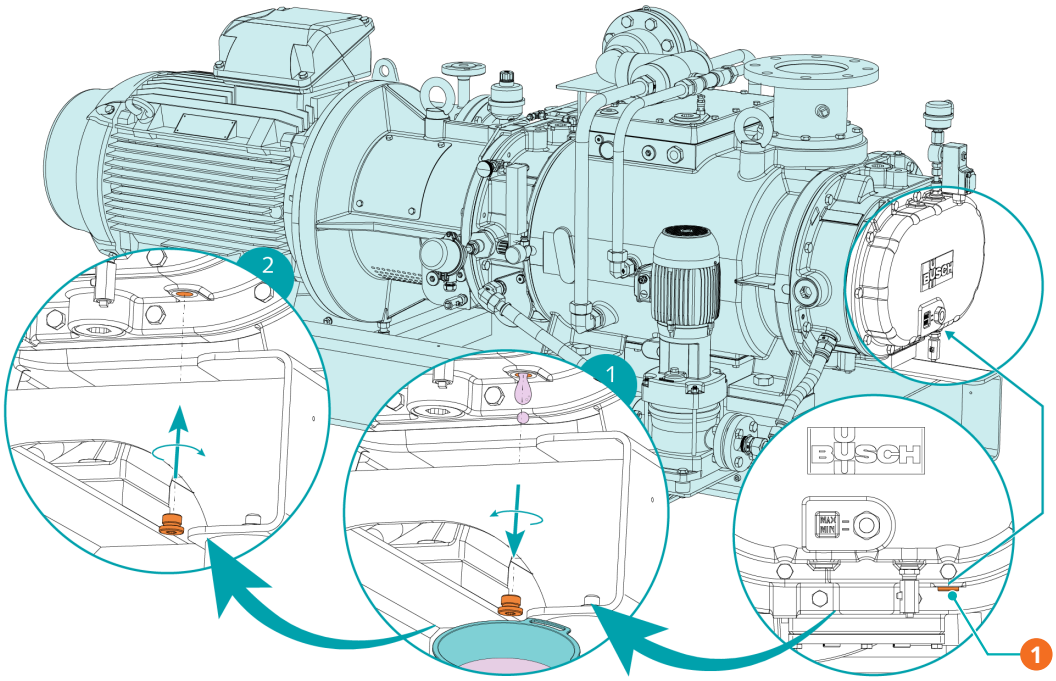
Some of the illustrations may be those of the water-cooled version of the machine. Although not shown in the air-cooled version configuration, the principles are similar.



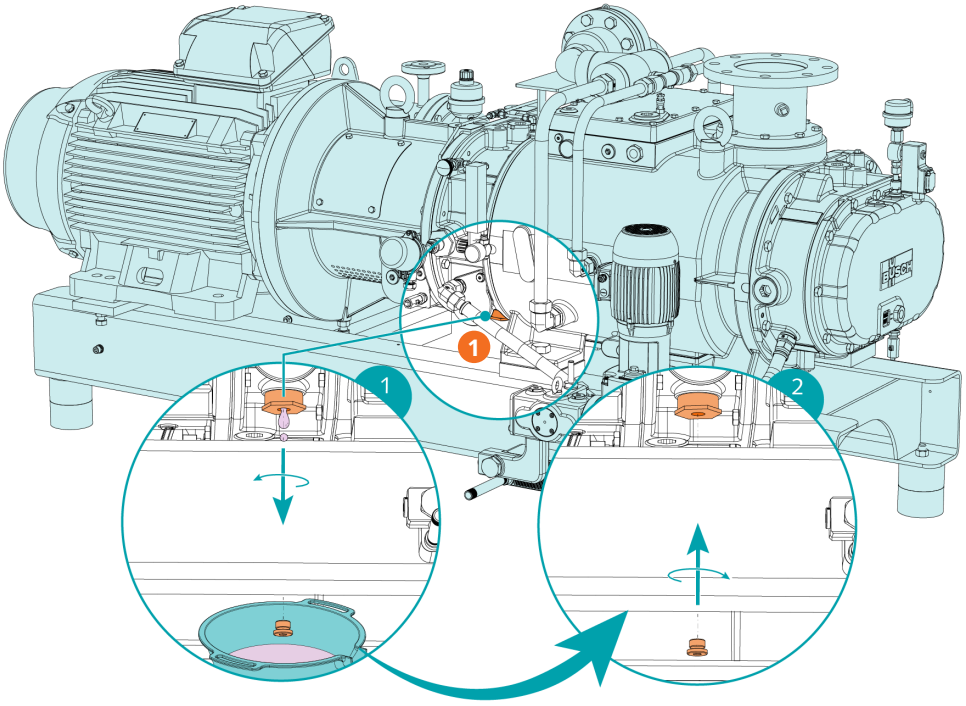




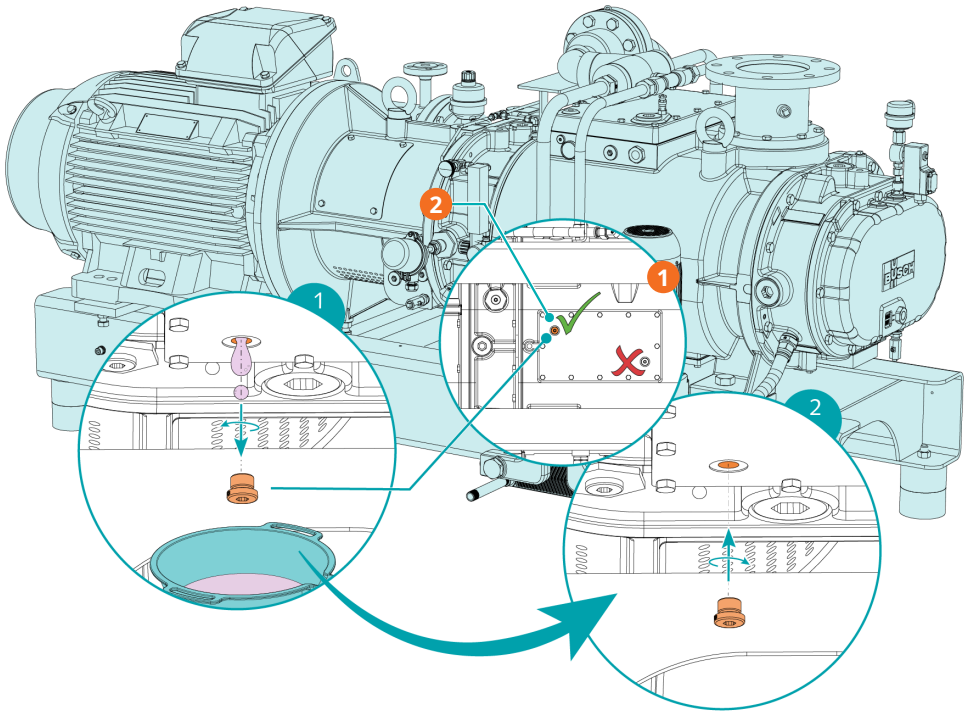
Description			
1	Additional cooling liquid draining points (x3)	2	Bottom view of the machine



Description			
1	Additional cooling liquid draining point 1		

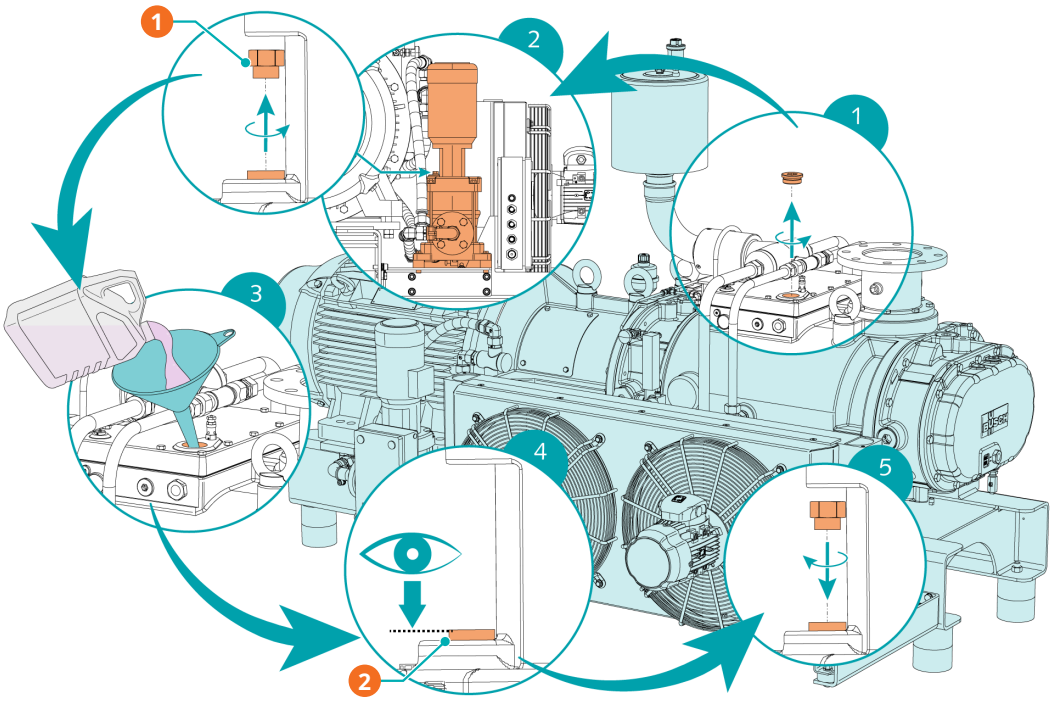


Description			
1	Additional cooling liquid draining point 2		

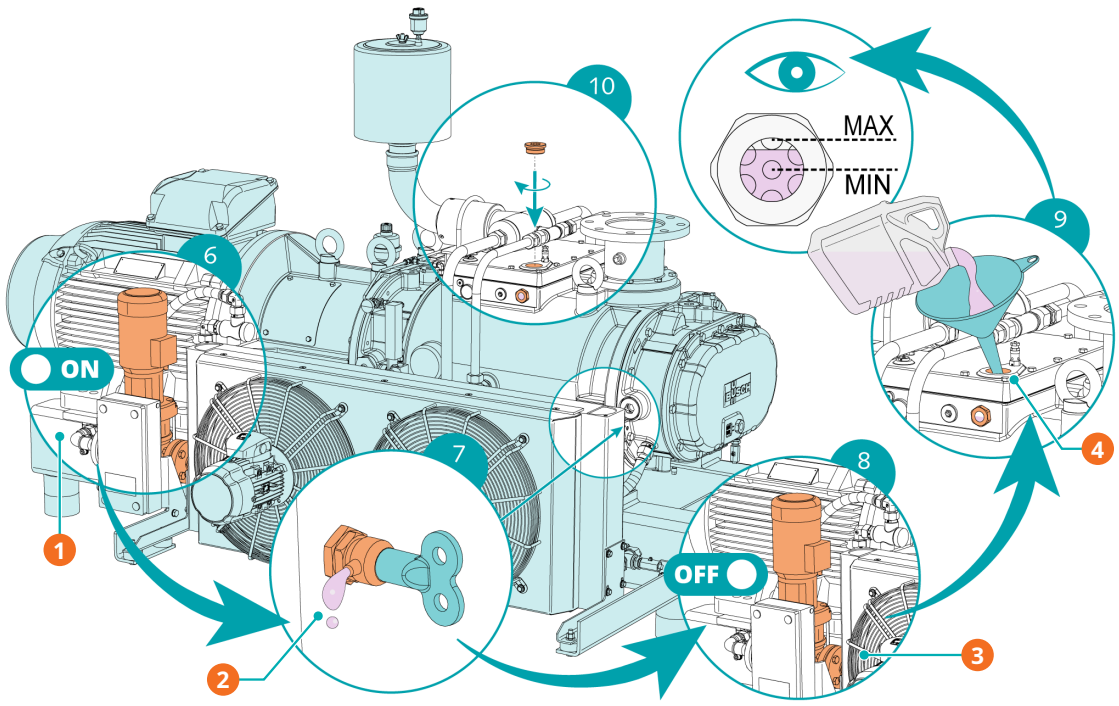


Description			
1	Bottom view of the machine	2	Additional cooling liquid draining point 3

For cooling liquid type and cooling liquid capacity see Technical Data and *Cooling Liquid* [➔ 51].



Description			
1	Cooling liquid vent plug (CLV1)	2	Fill up to the top of the vent orifice (CLV1)



Description			
1	Start the cooling liquid pump (CLP)	2	Open the cooling liquid vent valve of the heat exchanger (CLV2) to vent air from the cooling sytsem. Close the valve when the cooling liquid flows continously.
3	Stop the cooling liquid pump (CLP)	4	Resume cooling liquid filling

8.6 Calibration Procedure of the Electrical Devices

8.6.1 Resistance Thermometer Calibration

- Remove the resistance thermometer from the machine.
- Check it with a calibrated oven or send it to an approved laboratory for inspection.
- Reassemble the resistance thermometer on the machine.

8.6.2 Vibration Sensor Calibration

- Remove the vibration sensor from the machine.
- Control it with a calibration system or send it to:
  - Ateliers Busch S.A.
    Zone Industrielle
    CH-2906 Chevenez – Switzerland
    info@busch.ch
- Reassemble the vibration sensor on the machine (8Nm).
- Perform a test of the control loop by disconnecting output 1 and 2.

9 Overhaul

WARNING

The machine is contaminated with hazardous material.

Risk of poisoning!

Risk of infection!

If the machine is contaminated with hazardous material:

- Wear appropriate personal protective equipment.

NOTICE

Incorrect assembly.

Risk of premature failure!

Loss of efficiency!

- Any disassembly of the machine beyond that described in this manual must be carried out by technicians approved by Busch.

If the machine has conveyed gas contaminated with foreign materials which are hazardous to health:

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

The manufacturer will only accept machine accompanied by a signed, fully completed and legally binding "declaration of contamination", downloadable from the following link: *buschvacuum.com/declaration-of-contamination*.

10 Decommissioning

DANGER

Live wires.

Risk of electrical shock!

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

CAUTION

Hot surface.

Risk of burns!

- Before doing anything that requires touching the machine, let it cool down first.

CAUTION

Hot liquids.

Risk of burns!

- Before draining liquids, let the machine cool down first.

- Stop the machine and lock it to prevent accidental start-up.
- Disconnect the power supply.

If the machine is equipped with a barrier gas system:

- Close the barrier gas supply.

- Vent the connected lines to atmospheric pressure.
- Disconnect all connections.

If the machine is to be stored:

- See *Storage* [➔ 12].

10.1 Dismantling and Disposal

- Drain and collect the oil.
- Make sure that no oil drips onto the floor.
- Drain and collect the cooling liquid.
- Make sure that no cooling liquid 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.

11 Spare Parts

NOTICE

Use of non-Busch genuine spare parts.

Risk of premature failure!

Loss of efficiency!

- Use only Busch genuine spare parts, consumables and supplies to ensure correct operation of the machine and to validate the warranty.

There are no standard spare parts kits available for this product.

For Busch genuine spare parts:

- Contact your Busch representative.

12 Troubleshooting

DANGER

Live wires.

Risk of electrical shock!

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

CAUTION

Hot surface.

Risk of burns!

- Before doing anything that requires touching the machine, let it cool down first.

CAUTION

Hot liquids.

Risk of burns!

- Before draining liquids, let the machine cool down first.

Problem	Possible Cause	Remedy
The machine does not start.	The motor is not supplied with the correct voltage.	• Check the power supply.
	The rotors are jammed or seized.	• Turn the screw rotors manually from the rotor access plug (PMR). • Repair the machine (contact Busch).
	Solid foreign matter has entered the machine.	• Remove the solid foreign matter or repair the machine (contact Busch). • Install an inlet filter if necessary.
	The resistance thermometer (TSA) reached the switch point.	• Let the machine cool down. • See problem “The machine runs too hot”.
	Corrosion in the machine from remaining condensate.	• Repair the machine. • Check the process and follow the recommendation in case of Conveying Condensable Vapours.
	The motor is defective.	• Replace the motor.

Problem	Possible Cause	Remedy
The machine does not reach the usual pressure at the inlet connection.	Suction or exhaust lines too long or section diameter too small.	• Use larger diameter or shorter lines. • Seek advice from your local Busch representative.
	Process deposits on the pumping components	• Flush the machine.
	If an inlet screen or an inlet filter is installed, it can be partially clogged.	• Clean the inlet screen or replace the inlet filter cartridge.
	The machine runs in the wrong direction.	• Check the direction of rotation, see *Wiring Diagram Three-Phase Motor (Pump Drive)* [➔ 24].
	Internal parts are worn or damaged.	• Repair the machine (contact Busch).
The machine runs very noisily.	Wrong oil quantity or unsuitable oil type.	• Use one of the recommended oils in the correct quantity, see *Oil* [➔ 52].
	Defective gears, bearings or coupling element.	• Repair machine (contact Busch).
The machine runs too hot.	Ambient temperature too high.	• Observe the permitted ambient temperature, see Technical Data.
	Insufficient cooling.	• Make sure the air-water heat exchanger is clean. • Make sure the radiator fan(s) are operating in the correct direction of rotation. • Make sure the cooling liquid pump has been vented correctly, see *Filling Cooling Liquid* [➔ 18]. • Make sure the cooling liquid level is correct, see *Cooling Liquid Level Inspection* [➔ 35].
	The heat exchanger (AHE) is dirty or obstructed.	• Clean it and make sure that the air flow path is clear of all obstacles.
	Temperature of the process gases at the inlet too high.	• Observe the permitted gas inlet temperature, see Technical Data.
	The cooling liquid pump is defective.	• Repair the machine.
	Oil level too low.	• Top up oil.
	Cooling liquid level too low.	• Top up cooling liquid.
The oil is black.	Oil change intervals are too long.	• Drain the oil and fill in new oil, see *Oil Change* [➔ 36].
	The machine runs too hot.	• See problem "The machine runs too hot".

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

13 Technical Data

		NC 2500 C
Pumping speed (50 / 60 Hz)	m^3/h	2000 / 2500
Ultimate pressure (50 / 60 Hz)	hPa (mbar) abs.	≤ 1.0
Nominal motor rating (50 / 60 Hz)	kW	55.0 / 63.0
Nominal motor speed (50 / 60 Hz)	min^{-1}	3000 / 3600
Sound pressure level (ISO 2151) KpA = 3 dB (50 / 60 Hz)	dB(A)	≤ 80 / ≤ 82
Ambient temperature range	°C	-20 ... 45
Maximum allowable counter pressure at exhaust connection	hPa (mbar) rel.	200
Maximum allowable gas inlet temperature according to the inlet pressure	°C	≤ 50 hPa (mbar) abs. : 200
		> 50 hPa (mbar) abs. : 70
Relative humidity	at 30°C	90 %
Ambient pressure		Atmospheric pressure
Oil capacity - Motor side	l	3.5
Oil capacity - Inlet side	l	1.0
Cooling liquid capacity approx.	l	55
Weight approx.	kg	2500
Water pump power (50 / 60 Hz)	kW	0.37 / 0.37
Fan motor power (50 / 60 Hz)	kW	0.75 / 0.90 (2x)

14 Cooling Liquid

	CLA 25 (Ready-to-use)
Part number 5 L packaging	2000 241 757
Part number 20 L packaging	2000 241 738

CLA 25 cooling liquid is ready-to-use and requires no additional water.

For more information, contact your Busch representative.

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

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 2500 C

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:

Standard	Title of the Standard
EN ISO 12100 : 2010	Safety of machinery - Basic concepts, general principles of design
EN 1012-2 : 1996 + A1 : 2009	Vacuum pumps - Safety requirements - Part 2
EN 60204-1 : 2018	Safety of machinery - Electrical equipment of machines - Part 1: General requirements
EN ISO 13857 : 2019	Safety of machinery - Safety distances to prevent hazard zones being reached by the upper and lower limbs
EN ISO 2151 : 2008	Acoustics - Noise test code for compressors and vacuum pumps - Engineering method (grade 2)
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 2500 C

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 2012

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

Standard	Title of the Standard
EN ISO 12100 : 2010	Safety of machinery - Basic concepts, general principles of design
EN 1012-2 : 1996 + A1 : 2009	Vacuum pumps - Safety requirements - Part 2
EN 60204-1 : 2018	Safety of machinery - Electrical equipment of machines - Part 1: General requirements
EN ISO 13857 : 2019	Safety of machinery - Safety distances to prevent hazard zones being reached by the upper and lower limbs
EN ISO 2151 : 2008	Acoustics - Noise test code for compressors and vacuum pumps - Engineering method (grade 2)
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

BUSCH GROUP

The Busch Group is one of the world's largest manufacturers of vacuum pumps, vacuum systems, blowers, compressors and gas abatement systems. Under its umbrella, the group houses two well-known brands: Busch Vacuum Solutions and Pfeiffer Vacuum+Fab Solutions. Together, they offer solutions to a wide range of industries. A global network of highly competent local teams in 44 countries ensures that expert, tailor-made support is always available near you. Wherever you are. Whatever your business.

- Busch Group companies
- Busch Group production sites
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www.buschvacuum.com

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