

COBRA

Dry Screw Vacuum Pumps
NC 0100 B, NC 0200 B, NC 0300 B
Water-Cooled Version (WCV)

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* [→ 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

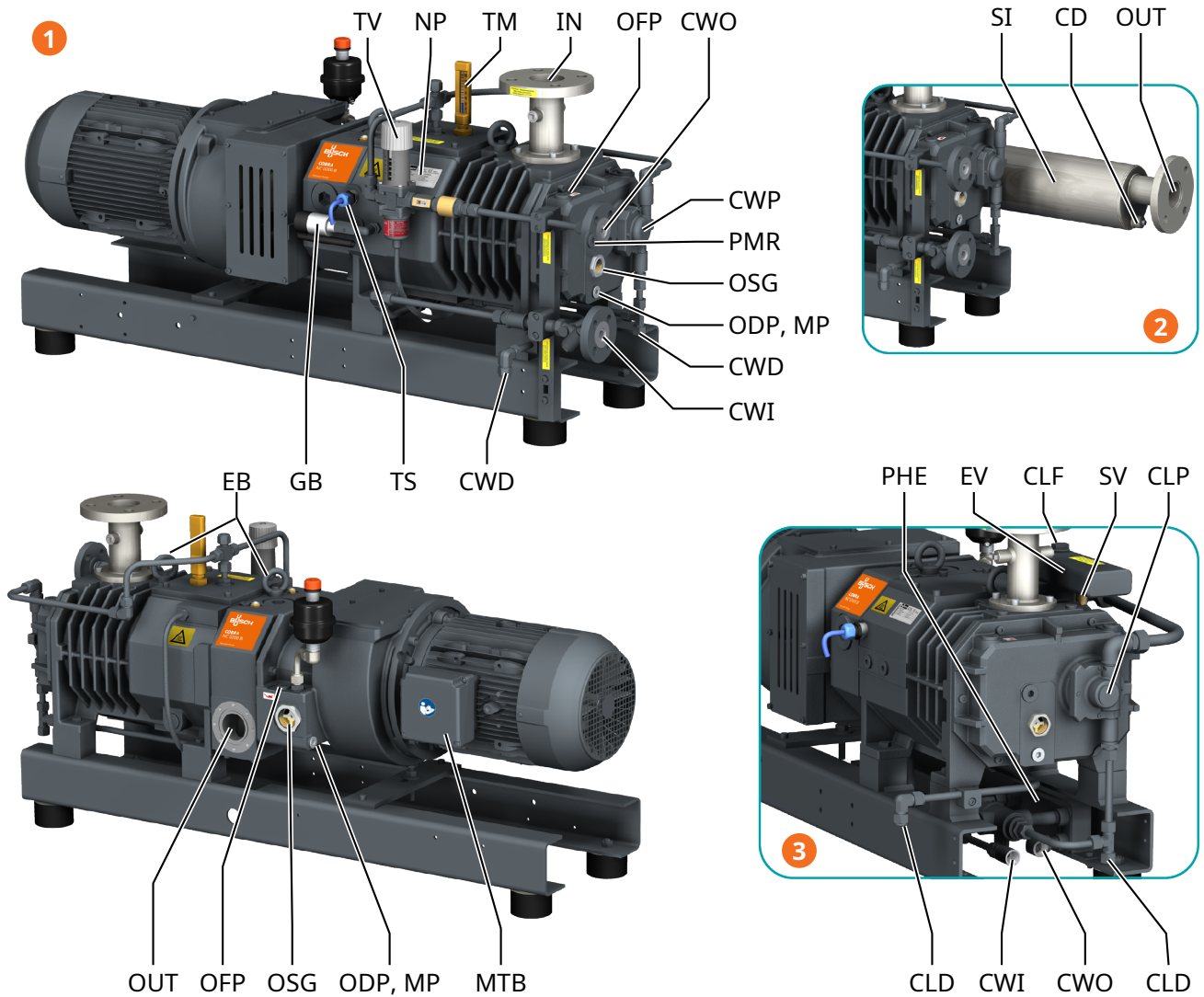
... indicates a potentially dangerous situation that could result in damage to property.



NOTE

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

2 Product Description



Description			
1	NC 0200 B with direct cooling	2	NC 0200 B with silencer
3	NC 0100 B with plate heat exchanger		

Description			
IN	Suction connection (Inlet)	OUT	Discharge connection (Outlet)
CD	Condensate drain	CLD	Cooling liquid drain plug
CLF	Cooling liquid fill plug	CLP	Cooling liquid pump
CWD	Cooling water drain plug	CWI	Cooling water inlet
CWO	Cooling water outlet	CWP	Cooling water pump
EB	Eye bolt	EV	Expansion vessel
GB	Gas ballast valve	MP	Magnetic plug
MTB	Motor terminal box	NP	Nameplate
ODP	Oil drain plug	OFF	Oil fill plug
OSG	Oil sight glass	PHE	Plate heat exchanger
PMR	Plug for manual rotation of rotors	SI	Silencer
SV	Safety valve	TM	Thermometer
TS	Temperature switch	TV	Thermostatic valve

NOTE

Technical term.

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

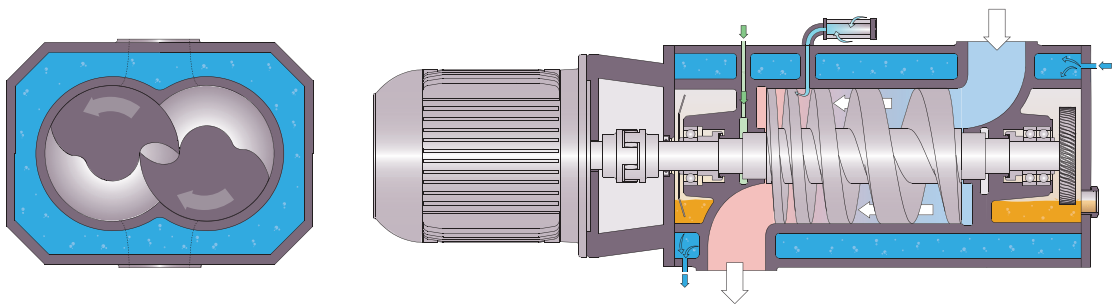
NOTE

Illustrations

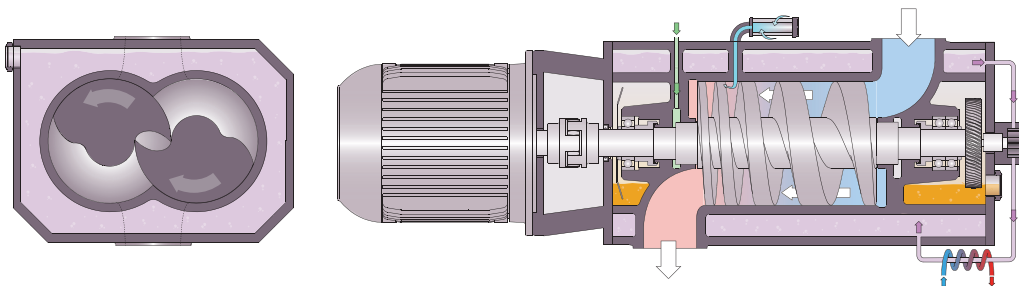
In this instruction manual the illustrations may differ from the machine appearance.

2.1 Operating Principle

Water-cooled version with direct cooling



Water-cooled version with plate heat exchanger (optional)



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 damages to the machine!

Risk of damages 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 the 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 can be equipped with a variable speed drive (option).

2.4 Water Cooling Variants

2.4.1 Direct Cooling

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

The cooling water pump (CWP) allows a recirculating flow in the cooling water chamber.

The thermostatic valve (TV) allows a temperature regulation of the machine by regulating the cooling water flow.

The adjustment of thermostatic valve from position 1 (cool position) to the position 5 (hot position) alters the cooling water temperature and must correspond to the application requirements.



NOTE

Busch recommendations for the thermostatic valve adjustment:

- The position 1 (cold position) is mainly intended for applications with a risk of polymerization.
- The position 5 (hot position) is mainly intended for applications with a risk of condensation .

2.4.2 Plate Heat Exchanger (Optional)

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

The cooling liquid is cooled by a plate heat exchanger (PHE) which must be connected to the water main.

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

2.5 Standard Features

2.5.1 Temperature Switch

The temperature switch monitors the operating temperature of the machine.

The machine must be stopped when the temperature switch trips (106 °C).

2.5.2 Thermometer

The thermometer allows a visual display of the cooling water temperature in the cooling water chamber.

2.5.3 Sealing Systems

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

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

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* [→ 8].

2.6 Optional Accessories

2.6.1 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.

2.6.2 Silencer

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

A non-return flap can be optionally added to the silencer.

2.6.3 Barrier Gas System

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

2.6.4 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 suction side.
- Oil lubricated single mechanical seals on the motor side and suction side.
- Gas lubricated double mechanical seals on the motor side and oil lubricated single mechanical seals on suction side.

2.6.5 Nitrogen Panel

The nitrogen panel fitted to the base frame allows the supply of nitrogen to a number of different points on the machine.

Each device consists of a pressure regulator and a flow meter to adjust pressure and volume flow separately.

The following devices are available:

- The barrier gas system for sealing systems on motor side. This device is equipped with a flow switch integrated to the flow meter to switch off the machine if the nitrogen volume flow drops below the minimum set flow value.
- The dilution gas ballast prevents the formation of condensates or dilutes them, depending on the application. The nitrogen is fed into the cylinder.
- The purge gas system fitted at the inlet flange allows to flush the machine after use or during operation. The nitrogen is fed into the inlet flange.

2.6.6 Pressure Switch (Barrier Gas)

The pressure switch monitors the barrier gas pressure. It is only available if the machine has been equipped with gas lubricated double mechanical seals.

The machine must be stopped if the barrier gas pressure is below 2.5 bar, see *Wiring Diagram Pressure Switch (Optional)* [→ 28].

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.

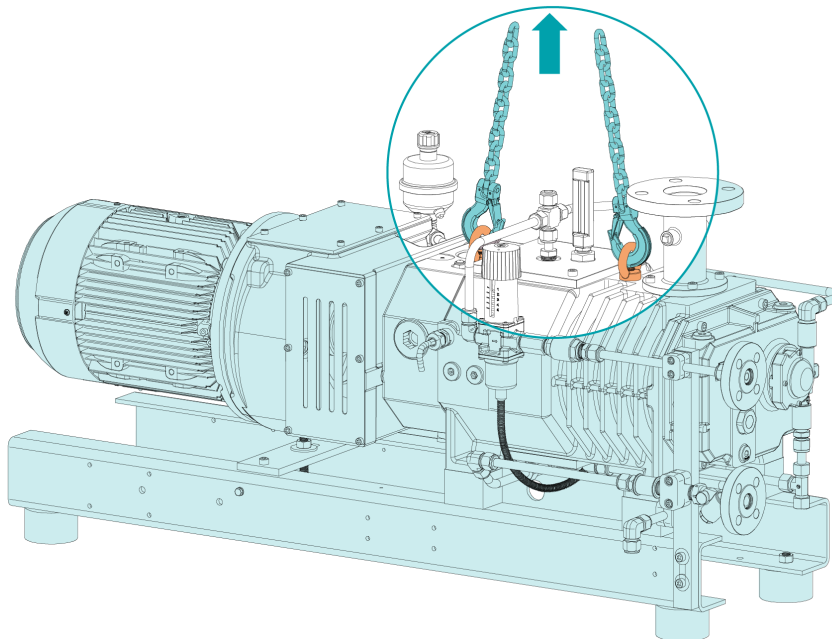


NOTICE

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.
- 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.



- Check the machine for transport damage.

If the machine is secured to a base plate:

- Remove the machine from the base plate.

4 Storage

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

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 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* [→ 34]. This protects the mechanical seals during a long storage. Use the standard pump oil, see chapter *Oil* [→ 45].
- Before restarting the machine, drain the oil to the normal oil level, see "Oil draining" in chapter *Oil Change* [→ 34].

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!

- Take care that the installation conditions are fully complied with.
- 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* [→ 33].

If the machine is equipped with a plate heat exchanger (PHE):

- Check the cooling liquid level, see *Cooling Liquid Level Inspection* [→ 33].
- Make sure that the cooling water complies with the requirements, see *Cooling Water Connection* [→ 14].

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

- Contact your Busch representative, the motor should be derated or the ambient temperature 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.

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):

- DN40 PN16, EN 1092-1 for NC 0100 B
- DN50 PN16, EN 1092-1 for NC 0200 B and NC 0300 B

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

- Busch recommends the installation of an isolation valve in order to prevent the machine from turning backwards.

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):

At the machine discharge connection:

- Ø85 / 8 x M8

At the extra flange discharge connection (Optional):

- DN40 PN16, EN 1092-1 for NC 0100 B
- DN50 PN16, EN 1092-1 for NC 0200 B and NC 0300 B

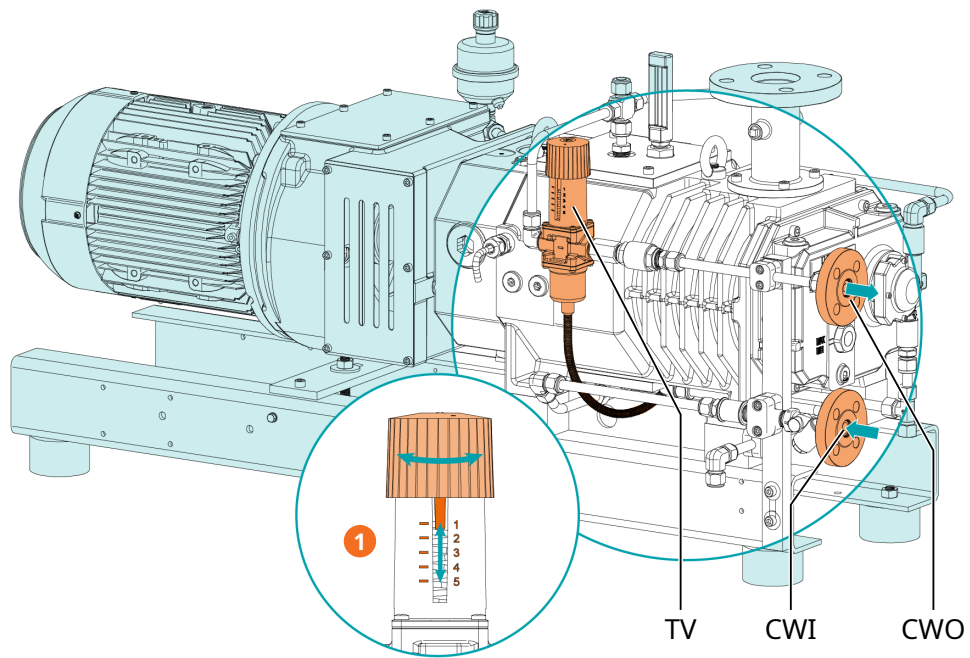
At the silencer (SI) discharge connection (Optional):

- DN40 PN16, EN 1092-1 for NC 0100 B
- DN50 PN16, EN 1092-1 for NC 0200 B and NC 0300 B

- 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 Cooling Water Connection

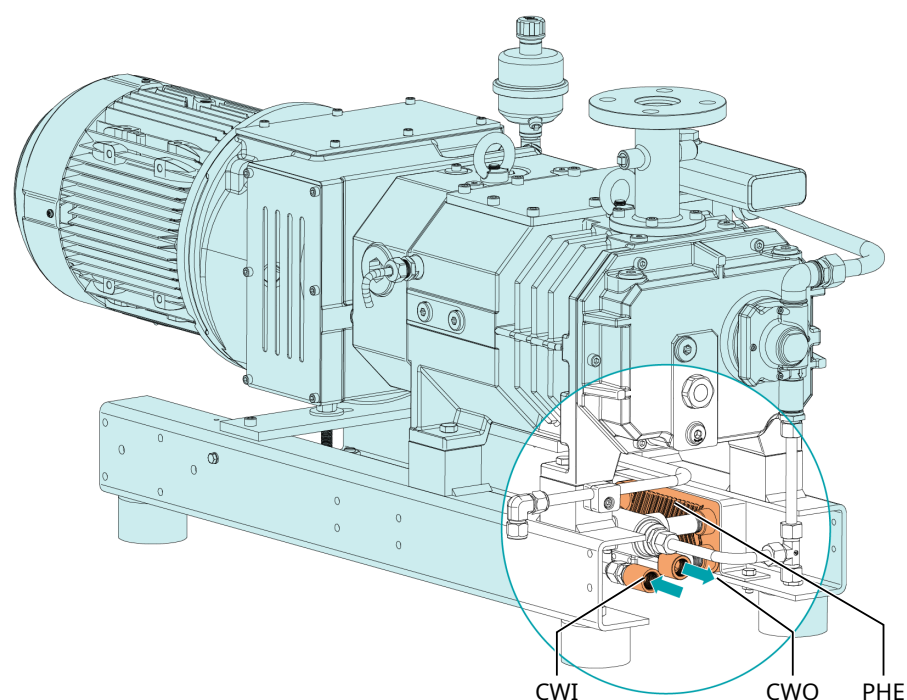
Water-cooled version with direct cooling



Description			
1	Thermostatic valve adjustment		

Description			
CWI	Cooling water inlet	CWO	Cooling water outlet
TV	Thermostatic valve		

Water-cooled version with plate heat exchanger (optional)



Description

CWI	Cooling water inlet	CWO	Cooling water outlet
PHE	Plate heat exchanger		

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

Connection size:

- DN15 PN10, DIN 2566 (CWI / CWO) with direct cooling
- G1/2, ISO 228-1 (CWI / CWO) with plate heat exchanger

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

Supply capacity	l/min	2 ... 4
Water pressure	bar	3 ... 6 (direct cooling) / 1 ... 6 (plate heat exchanger)
Supply temperature	°C	+10 ... +25
Required pressure differential across supply and return	bar	≥ 3 (direct cooling) / > 0.5 (plate heat exchanger)

- 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, copper and cast iron	

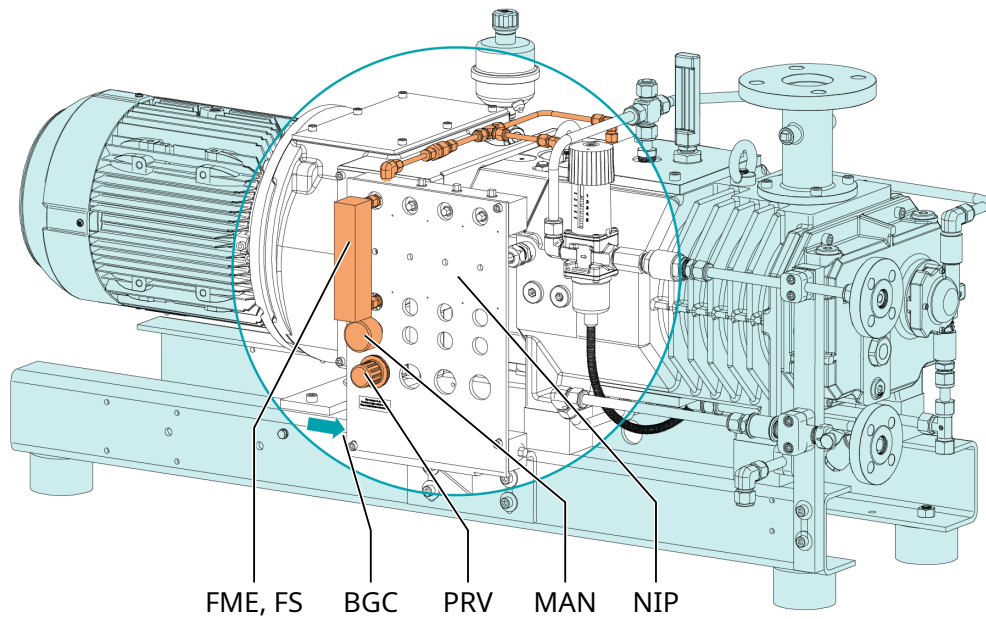
i NOTE

Water hardness unit conversion.

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

5.2.4 Barrier Gas System Connection (Optional)

With nitrogen panel



Description			
BGC	Barrier gas connection	FME	Flow meter
FS	Flow switch	MAN	Manometer
NIP	Nitrogen panel	PRV	Pressure regulating valve

- Connect the barrier gas connection (BGC) to the gas supply.
Connection size:
 - G1/4, ISO 228-1
- Electrically connect the flow switch (FS) of the flow meter, see *Wiring Diagram Flow Switch* [→ 28].

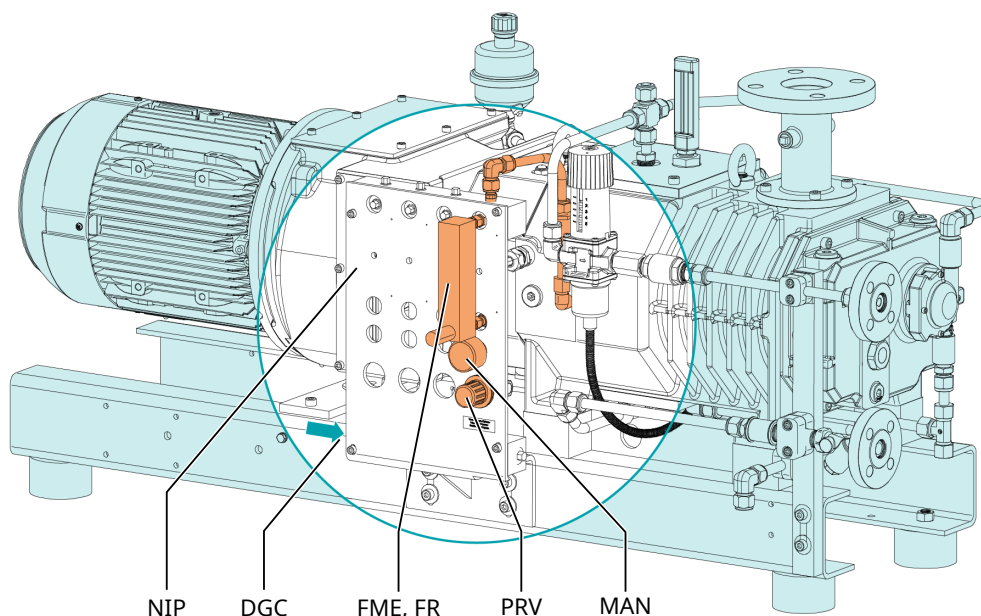
If a pressure switch is installed:

- Electrically connect the pressure switch, see *Wiring Diagram Pressure Switch (Optional)* [→ 28].
- 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 for labyrinth seals, oil lubricated single mechanical seals and PTFE shaft seals	SLM (standard liter per minute)	2.5 ... 3

Recommended flow rate for gas lubricated double mechanical seals	SLM (standard liter per minute)	≤1
Air quality (only for air)	Acc. to ISO 8573-1	Class 5.4.4.

5.2.5 Dilution Gas System Connection (Optional)



Description			
DGC	Dilution gas connection	FME	Flow meter
FR	Flow regulator	MAN	Manometer
NIP	Nitrogen panel	PRV	Pressure regulating valve

- Connect the dilution gas connection (DGC) to the gas supply.

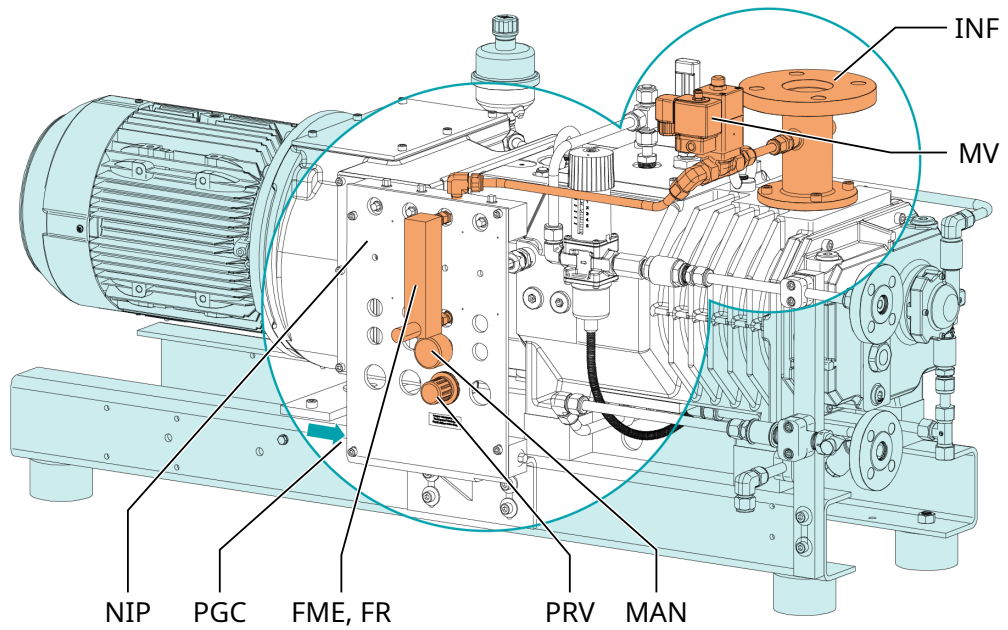
Connection size:

- G1/4, ISO 228-1

- Electrically connect the solenoid valve (MV), see *Wiring Diagram Solenoid Valve* [→ 27].
- Make sure that the gas complies with the following requirements:

Gas type	Dry nitrogen	
Gas temperature	°C	0 ... 60
Maximum gas pressure	bar	13
Recommended pressure setting at the pressure regulating valve (PRV)	bar	0.5
Filtration	µm	5
Recommended flow rate	SLM (standard liter per minute)	20

5.2.6 Purge Gas System Connection (Optional)



Description			
PGC	Purge gas connection	FME	Flow meter
FR	Flow regulator	INF	Inlet flange
MAN	Manometer	MV	Solenoid valve
NIP	Nitrogen panel	PRV	Pressure regulating valve

- Connect the purge gas connection to the gas supply.

Connection size:

- G1/4, ISO 228-1

- Electrically connect the solenoid valve (MV), see *Wiring Diagram Solenoid Valve* [→ 27].
- Make sure that the gas complies with the following requirements:

Gas type	Dry nitrogen	
Gas temperature	°C	0 ... 60
Maximum gas pressure	bar	13
Recommended pressure setting at the pressure regulating valve (PRV)	bar	0.5
Filtration	µm	5
Recommended flow rate	SLM (standard liter per minute)	≥ 40 for NC 0100-0200 B ≥ 50 for NC 0300 B

5.3 Filling Oil

! NOTICE

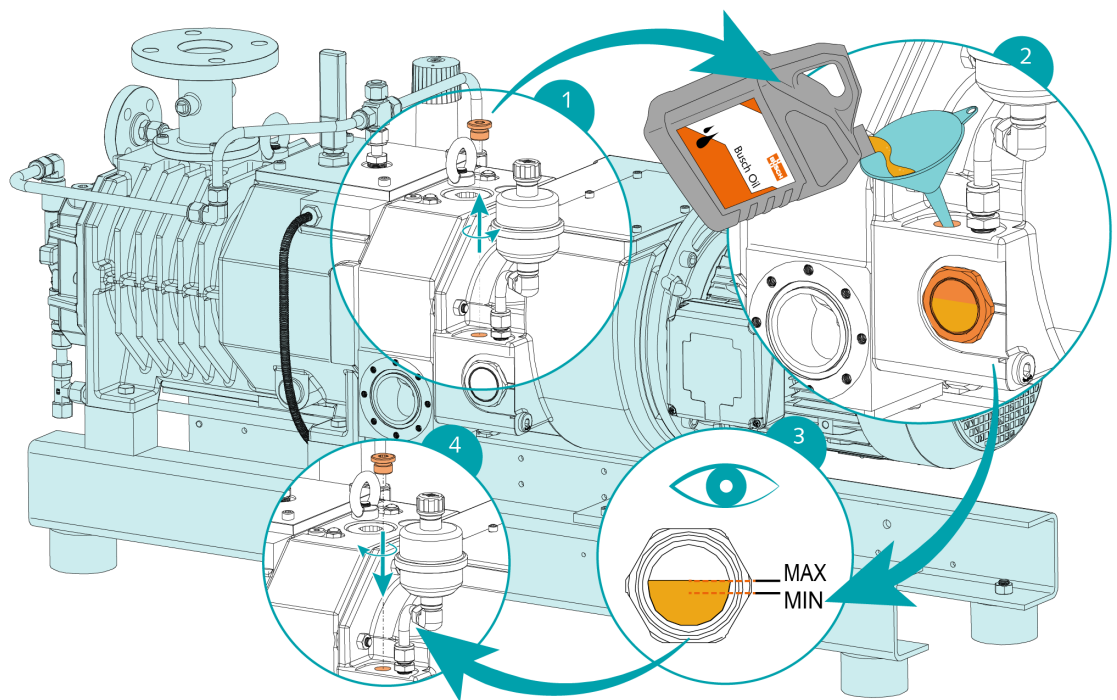
Use of an inappropriate oil.

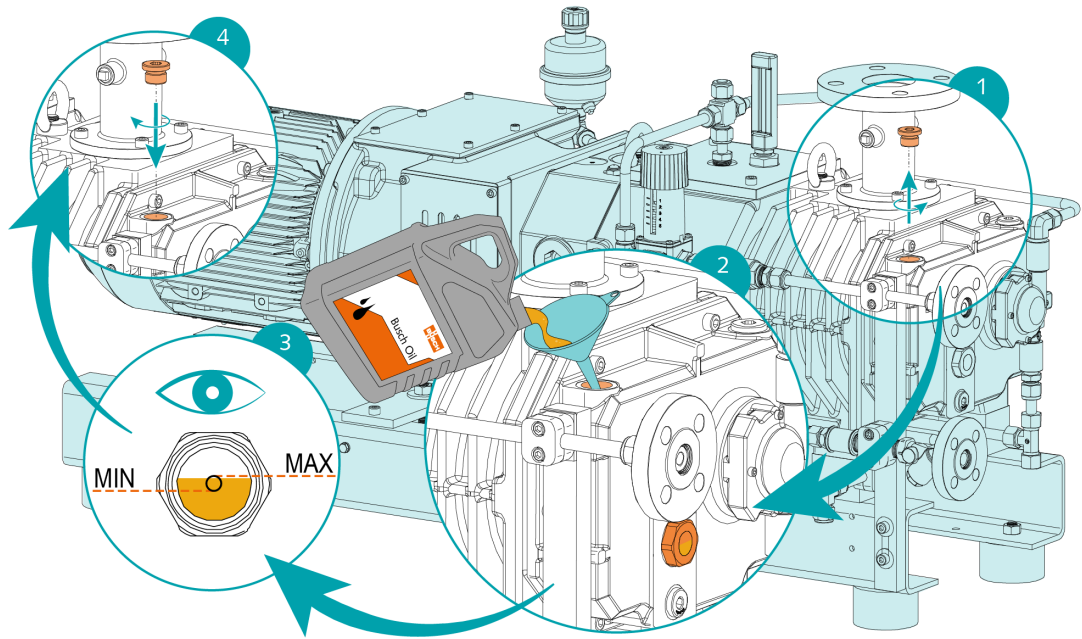
Risk of premature failure!

Loss of efficiency!

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

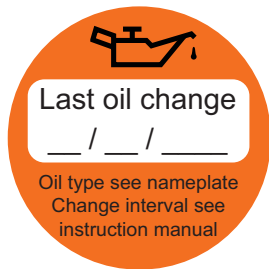
For oil type and oil capacity see Technical Data and *Oil* [→ 45].





When the oil filling is achieved:

- Write down the oil change date on the sticker.

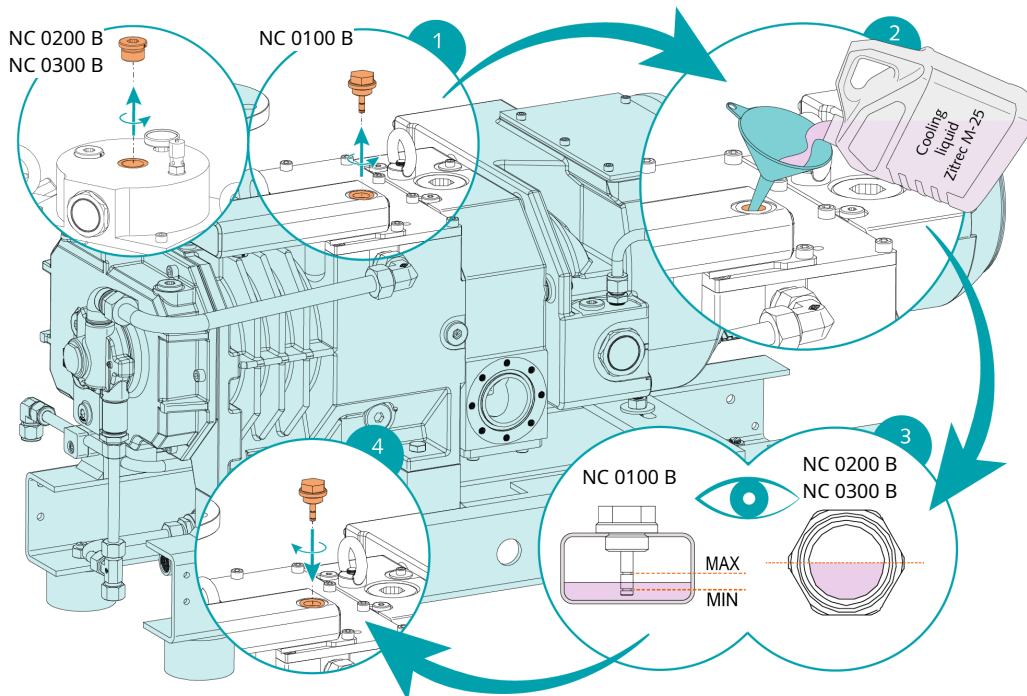


If there is no sticker (part no. 0565 568 959) on the machine:

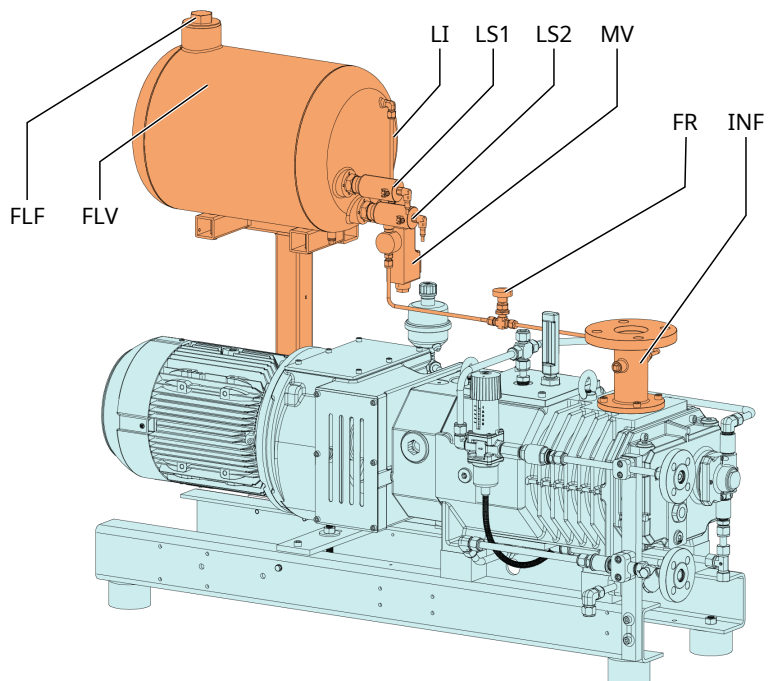
- Order it from your Busch representative.

5.4 Filling Cooling Liquid

This step has to be carried out only if the machine is equipped with a plate heat exchanger. For cooling liquid type and cooling liquid capacity see Technical Data and *Cooling Liquid* [→ 44].



5.5 Liquid Flushing Device Installation (Optional)



Description			
FLF	Flushing liquid fill plug	FLV	Flushing liquid vessel
FR	Flow regulator	INF	Inlet flange
LI	Level indicator	LS	Level switch
MV	Solenoid valve		

- Electrically connect the solenoid valve (MV), see *Wiring Diagram Solenoid Valve* [→ 27].
- Electrically connect the two level switches (LS), see *Wiring Diagram Level Switch* [→ 28].
- Fill the flushing liquid vessel (FLV) with a process compatible flushing liquid.

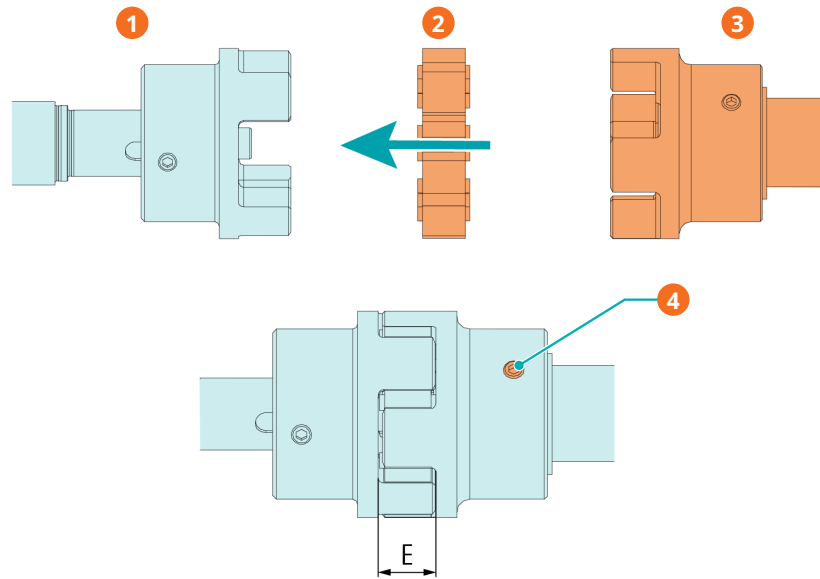
5.6 Fitting the Coupling



NOTE

Radial screw.

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



Description			
1	Coupling hub (machine side)	2	Coupling spider
3	Coupling hub (motor side)	4	Radial screw / max. admissible torque: 10Nm

Machine type	Coupling size	Value "E" (mm)
NC 0100 B	ROTEX® 38	24
NC 0200 B		
NC 0300 B		
NC 0300 B	ROTEX® 42	26

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.
- Mount the motor on the machine by including the coupling spider.

For further coupling information, go to www.ktr.com and download the instruction manual of the ROTEX® coupling.

English	German	French
		
<i>Instruction Manual - English</i>	<i>Instruction Manual - German</i>	<i>Instruction Manual - French</i>

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 according to EN 60204-1 must be insured by the customer on its installation.
- 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 electro-magnetic 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* [→ 46] or *UK Declaration of Conformity* [→ 47]).

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).

Seek advice from your Busch representative.

- 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 isolation default.

- 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 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.
- Consult the Technical Data to get more information.

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 Machine delivered with a Variable Speed Drive (Option)



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 disconnecting the variable speed drive.

Risk of electrical shock.

- Disconnect and isolate the variable speed drive 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 for the drive is compatible with the data on the nameplate of the variable speed drive.
- If the machine is equipped with a power connector, install a residual current protective device to protect persons in case of isolation default.
 - Busch recommends installing a type B residual protective device suitable for the electrical installation.
- If the variable speed drive 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 Variable Speed Drive (VSD).

NOTICE

The admissible motor speed exceeds the recommendation.

Risk of damage to the machine!

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

NOTICE

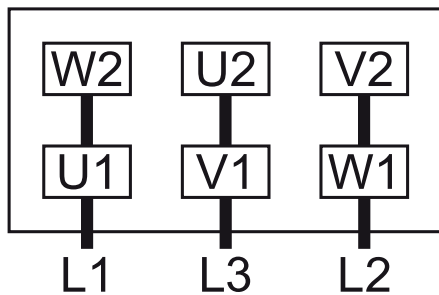
Incorrect connection.

Risk of damage to the variable speed drive!

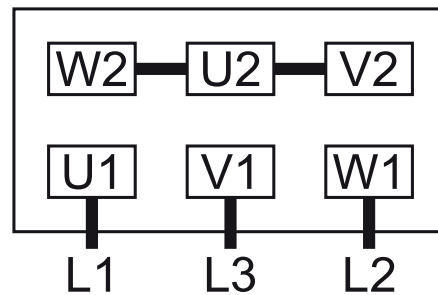
- The wiring diagrams given below are typical. Check the connection instructions/diagrams.

6.3 Wiring Diagram Three-Phase Motor (Pump Drive)

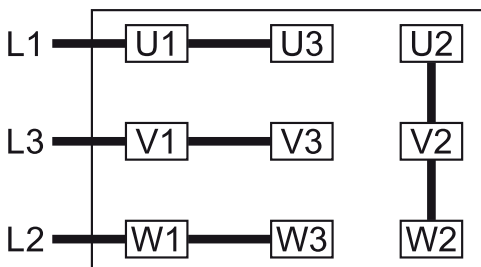
Delta connection (low voltage):



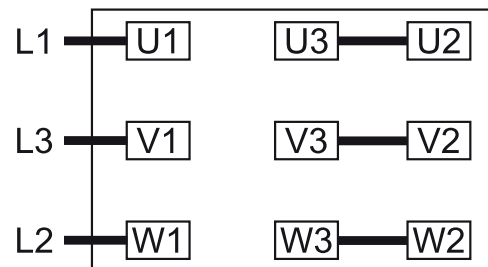
Star connection (high voltage):



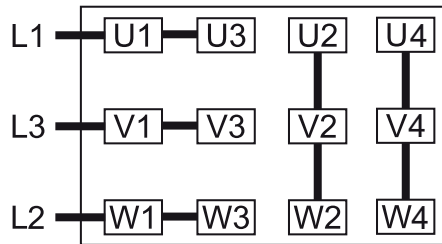
Double star connection, multi-voltage motor with 9 pins (low voltage):



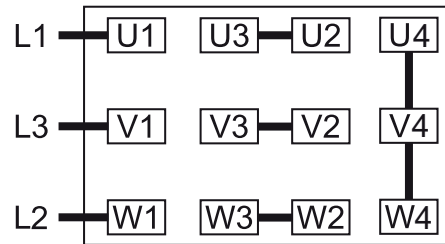
Star connection, multi-voltage motor with 9 pins (high voltage):



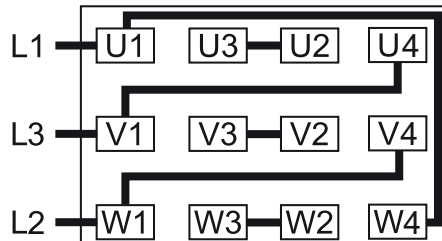
Double star connection, multi-voltage motor with 12 pins (low voltage):



Star connection, multi-voltage motor with 12 pins (high voltage):



Delta connection, multi-voltage motor with 12 pins (middle voltage):



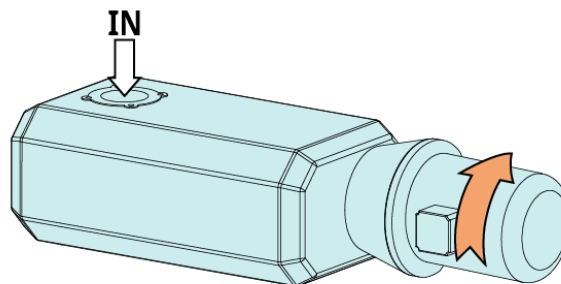
! NOTICE

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:

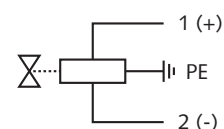
- Switch any two of the motor phase wires.

6.4 Wiring Diagram Solenoid Valve (Optional)

Part no. : 0654 000 092

$U = 24 \text{ VDC}$; $P_{\text{max}} = 8 \text{ W}$

Contact: Normally closed



6.5 Electrical Connection of the Monitoring Devices

NOTE

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

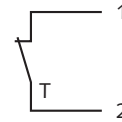
6.5.1 Wiring Diagram Temperature Switch

Part no.: 0651 555 985

U = 6 ... 30 VDC ; I = 10 ... 100 mA

Contact : Normally closed

Switch point: $T_{trip} = 106\text{ °C}$



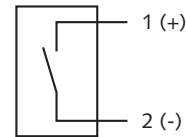
1 = White ; 2 = Brown

6.5.2 Wiring Diagram Flow Switch (Optional)

Part no.: RC15-14-N3 (ref. Pepperl+Fuchs)

U = 5 ... 25 V ; I = 1 ... 3 mA

Switching element function:
NAMUR, bistable



1 = Brown ; 2 = Blue

For labyrinth seals, oil lubricated single mechanical seals and PTFE shaft seals:

Contact:
Normally open

Switch point:
1.5 SLM ▶ min. volume flow

Contact:
Normally closed

Switch point:
1 SLM ▶ max. volume flow

6.5.3 Wiring Diagram Pressure Switch (Optional)

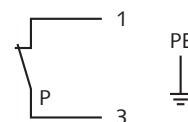
Part no.: 0653 518 304

Contact: Normally closed

U = 250 VAC ; I = 6 A

U = 12 ... 220 VDC ; I = 6 ... 0.25 A

Switch point: $P_{trip} = 2.5\text{ bar (relative)}$ ▶ min. admissible pressure



6.5.4 Wiring Diagram Level Switch (Optional)

Part no.: 0652 556 531

Connector: M12x1, 4-pin

< 6 mW at I < 1 mA;

< 38 mW at I = 3.5 mA

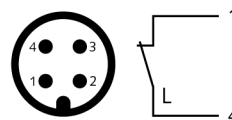
Switching element function:
NAMUR

Contact: Normally closed

Switch point:

$L_{warning} = LS1$ ▶ pin 1 + 4 ▶ low level "warning"

$L_{trip} = LS2$ ▶ pin 1 + 4 ▶ low level "stop flushing"



1 = Brown ; 4 = Black

7 Commissioning



CAUTION

During operation the surface of the machine may reach temperatures of more than 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 persons are present in the vicinity of a non noise insulated machine over extended periods:

- Make sure that ear protection is being used.



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* [→ 19].



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.

- Make sure that the installation conditions (see *Installation Conditions* [→ 12]) are met.
- Turn on the water supply.
- Adjust the thermostatic valve position according to the process requirements.

If the machine is equipped with a barrier gas system:

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

If the machine is equipped with a plate heat exchanger (PHE):

- After a few minutes of operation, perform a *Cooling Liquid Level Inspection* [→ 33].
- After a few minutes of operation, perform an *Oil Level Inspection* [→ 33].

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

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

7.1 Conveying Condensable Vapors

The machine, equipped either with a gas ballast valve or a dilution gas system, is suitable for the conveyance of condensable vapors within the gas flow.

If condensable vapors are to be conveyed:

START

- Open the gas ballast valve* or the dilution gas system* (solenoid valve)
- Warm up the machine
- Wait 30 minutes
- Open the inlet valve
- Perform the process
- Close the inlet valve
- Wait 30 minutes
- Close the gas ballast valve* or the dilution gas system* (solenoid valve)

END

* *optional accessories*

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

7.2 Liquid Flushing Procedure

Liquid flushing of the machine is recommended only if the machine is equipped with oil lubricated mechanical seals on both sides.

If after the application process a liquid flushing is required:

START

- Reduce the motor speed to 10 Hz (minimum admissible frequency) with the inlet valve closed
- Open the liquid flushing device (solenoid valve)
- Adapt the flushing liquid flow according to the application requirements
 - The flushing duration depends on the application
- Close the liquid flushing device

END

7.3 Gas Purging Procedure

The machine can be optionally equipped with a purge gas system.

If after the application process a gas purge is required, i.e. after a liquid flushing sequence or to render the compression chamber inert:

START

- Close the inlet valve
- Open the purge gas (solenoid valve)
 - The flushing duration depends on the application (minimum 200 seconds to render the machine inert)
- Close the purge gas

END

8 Maintenance



DANGER

Live wires.

Risk of electrical shock.

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



DANGER

Maintenance work without disconnecting the variable speed drive.

Risk of electrical shock.

- Disconnect and isolate the variable speed drive 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.



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



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.

- Shut down the machine and lock against inadvertent start up.
- 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:

- Disconnect all connections.

8.1 Maintenance Schedule

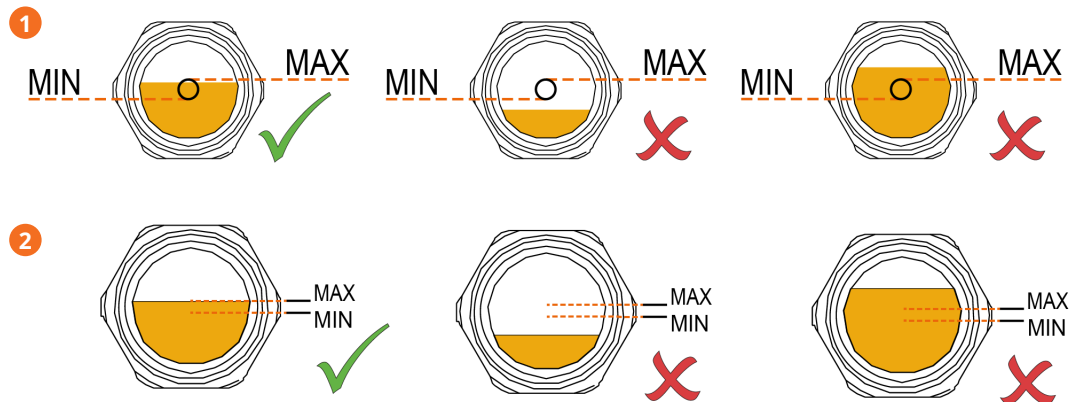
The maintenance intervals depend very much on the individual operating conditions. The intervals given below are considered as starting values which should be shortened or extended as appropriate. Particularly harsh applications or heavy duty operation, such as high dust loads in the environment or in 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"> • Check the oil level, see <i>Oil Level Inspection</i> [→ 33]. <p>If the machine is equipped with a plate heat exchanger (PHE):</p> <ul style="list-style-type: none"> • Check the cooling liquid level, see <i>Cooling Liquid Level Inspection</i> [→ 33]. • Check the machine for oil leaks - in case of leaks have the machine repaired (contact Busch).
Yearly	<ul style="list-style-type: none"> • Carry out a visual inspection and clean the machine from dust and dirt. • Check the electrical connections and the monitoring devices.
Yearly In case of those accessories being installed.	<ul style="list-style-type: none"> • Check the filter of the gas ballast valve (GB), clean it if necessary. • Check the silence (SI) and clean it if necessary.
Every 5000 hours or after 1 year	<ul style="list-style-type: none"> • Change the oil of the gear and bearing housings (both sides), see <i>Oil Change</i> [→ 34]. • Clean the magnetic plugs (MP).

Interval	Maintenance work
Every 16000 hours or after 4 years	<ul style="list-style-type: none"> Have a major overhaul on the machine (contact Busch).

8.2 Oil Level Inspection

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



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

- Fill up if necessary, see *Oil Filling* [→ 19].

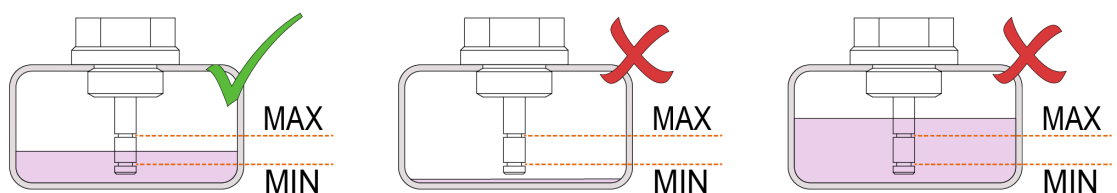
8.3 Cooling Liquid Level Inspection

This step has to be carried out only if the machine is equipped with a plate heat exchanger.

- Shut down the machine.

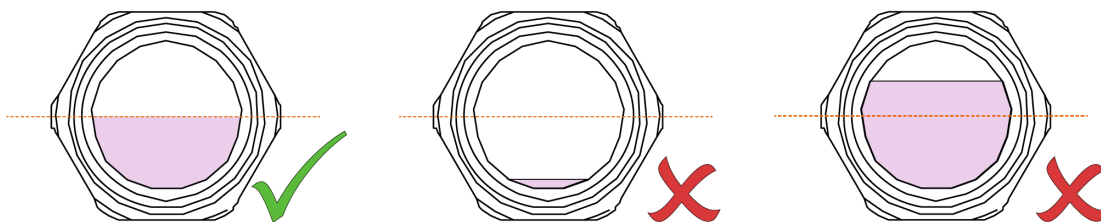
For NC 0100 B

- Let the machine cool down.
- Remove the cooling liquid fill plug (CLF).
- Check the cooling liquid level.



For NC 0200 – 0300 B

- Check the cooling liquid level.



- Fill up if necessary, see *Filling Cooling Liquid* [→ 21].

8.4 Oil Change

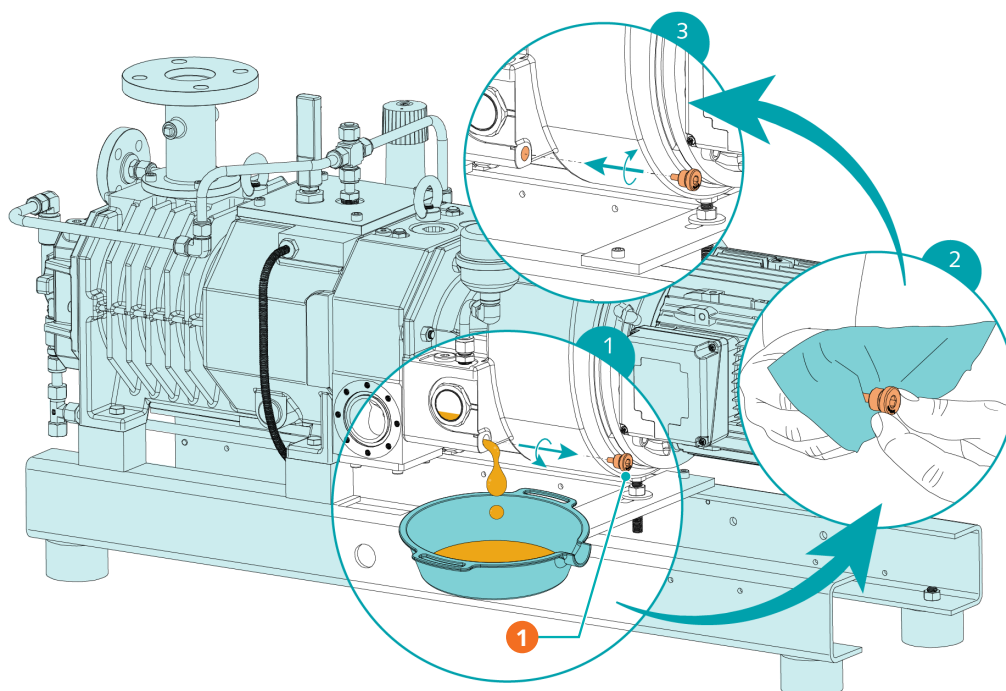
! NOTICE

Use of an inappropriate oil.

Risk of premature failure!

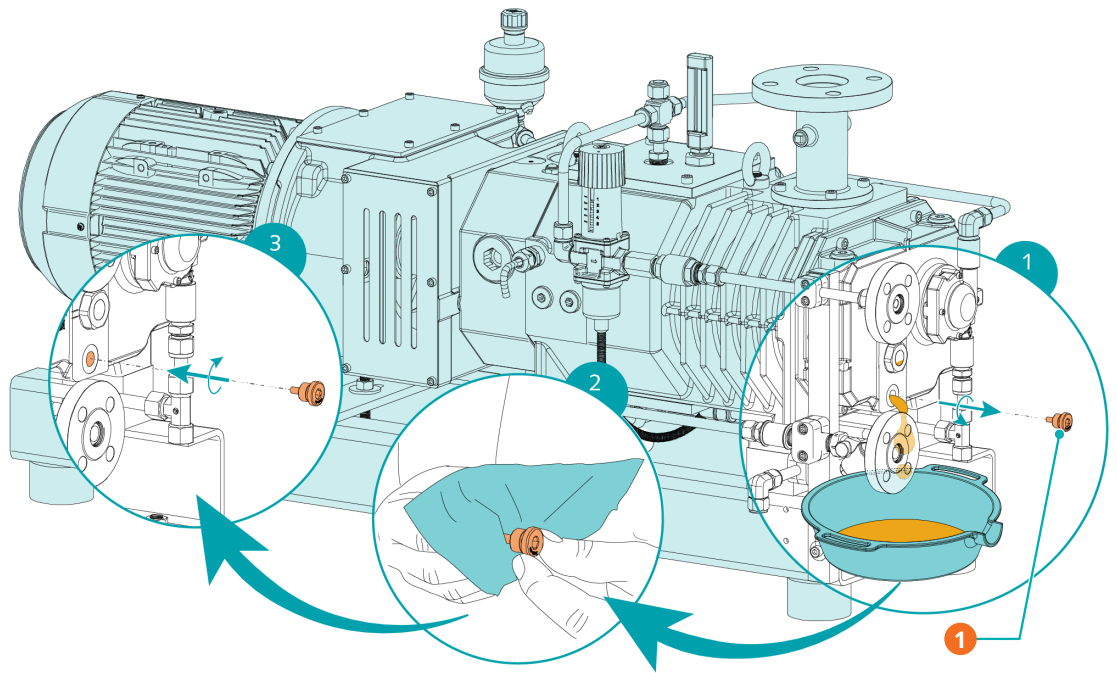
Loss of efficiency!

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



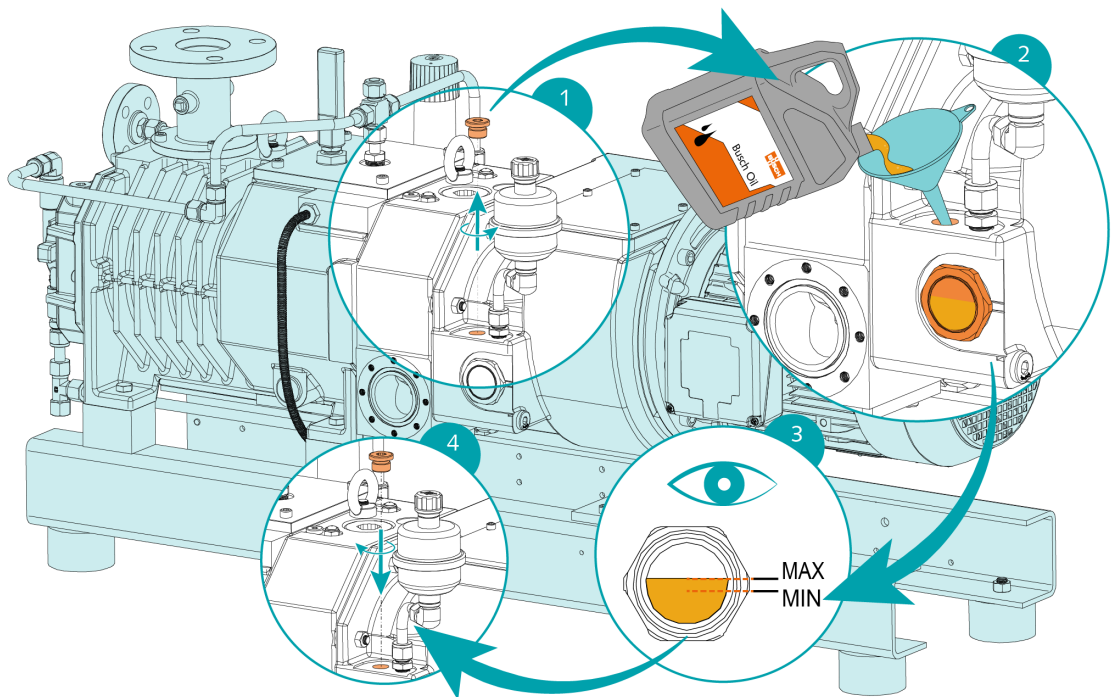
Description

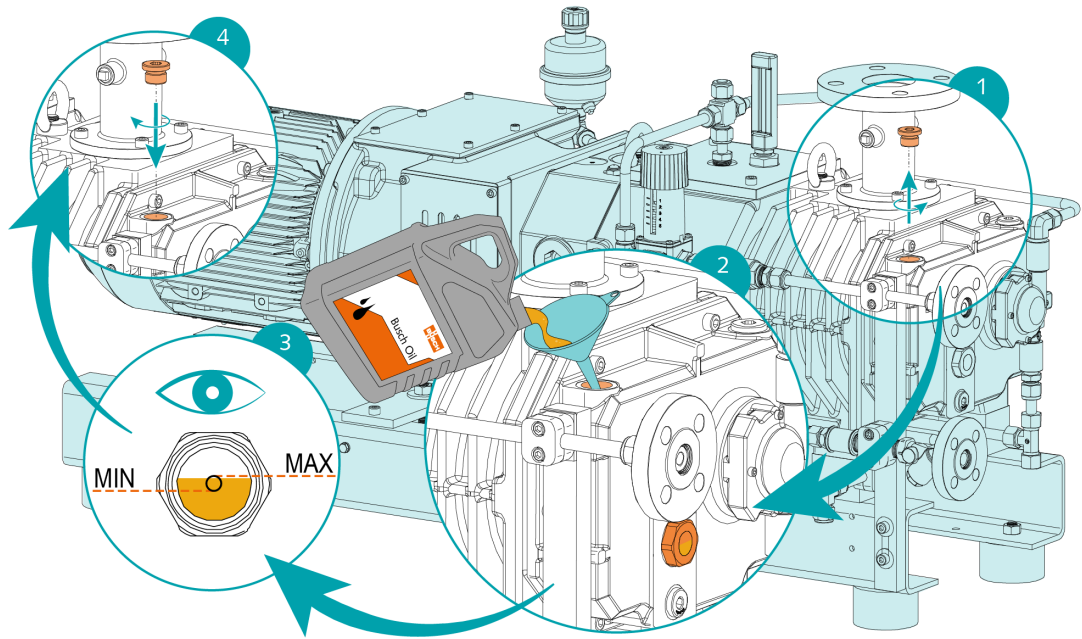
1	Magnetic plug
---	---------------



Description	
1	Magnetic plug

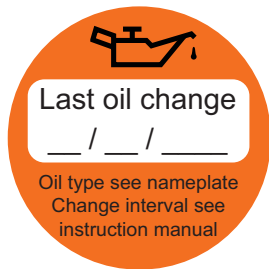
For oil type and oil capacity see Technical Data and Oil [→ 45].





When the oil filling is achieved:

- Write down the oil change date on the sticker.

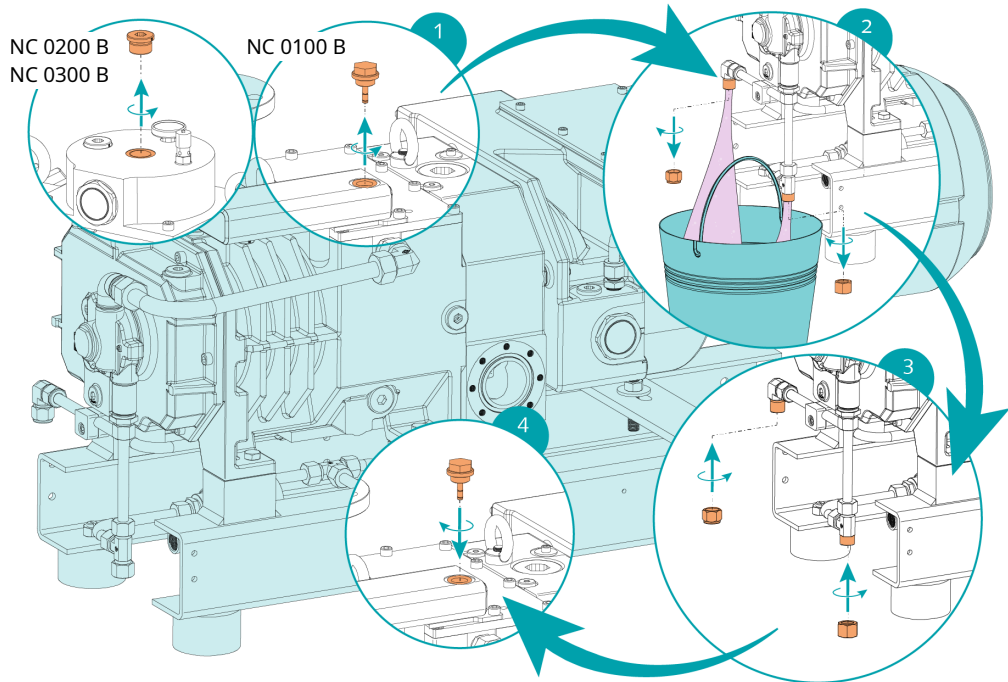


If there is no sticker (part no. 0565 568 959) on the machine:

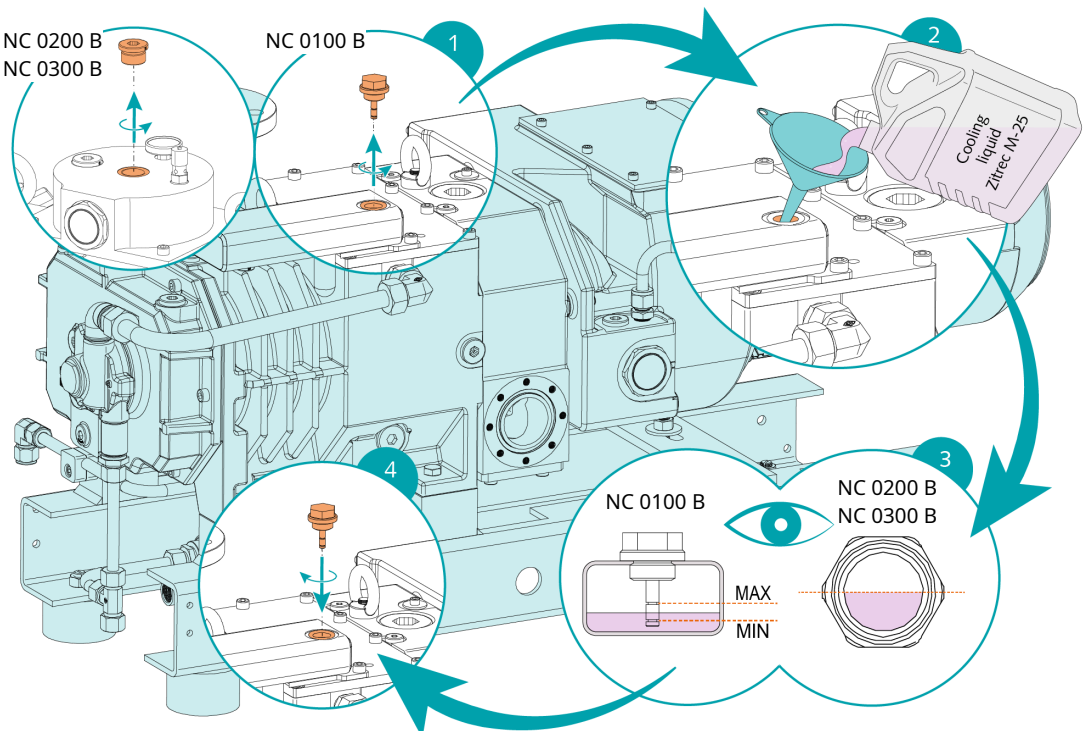
- Order it from your Busch representative.

8.5 Cooling Liquid Change

This step has to be carried out only if the machine is equipped with a plate heat exchanger.



For cooling liquid type and cooling liquid capacity see Technical Data and *Cooling Liquid* [→ 44].



9 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).

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!

- 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 two cooling water drain plugs (CWD).
- Disconnect all connections.

If the machine is going to be stored:

- See *Storage* [→ 11].

10.1 Dismantling and Disposal

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

If the machine is equipped with a plate heat exchanger (PHE):

- 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!

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

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

If you require Busch genuine 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!

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

Problem	Possible Cause	Remedy
The machine does not start.	The motor is not supplied with the correct voltage.	<ul style="list-style-type: none"> • Check the power supply.
	The rotors are jammed or seized.	<ul style="list-style-type: none"> • Turn the screw rotors manually from the rotor access plug (PMR). • Repair the machine (contact Busch).
	Solid foreign matter has entered the machine.	<ul style="list-style-type: none"> • Remove the solid foreign matter or repair the machine (contact Busch). • Install an inlet filter if necessary.
	A temperature sensor has reached the switch point.	<ul style="list-style-type: none"> • Let the machine cool down. • See problem "The machine runs too hot".
	Corrosion in the machine from remaining condensate.	<ul style="list-style-type: none"> • Repair the machine. • Check the process and follow the recommendation in case of <i>Conveying Condensable Vapors</i> [→ 30].
	The motor is defective.	<ul style="list-style-type: none"> • Replace the motor.
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"> • Use larger diameter or shorter lines. • Seek advice from your local Busch representative.
	Process deposits on the pumping components	<ul style="list-style-type: none"> • Flush the machine.
	The machine runs in the wrong direction.	<ul style="list-style-type: none"> • Check the direction of rotation, see Wiring Diagram Three-Phase Motor.
	Internal parts are worn or damaged.	<ul style="list-style-type: none"> • Repair the machine (contact Busch).

Problem	Possible Cause	Remedy
The machine runs very noisily.	Wrong oil quantity or unsuitable oil type.	<ul style="list-style-type: none"> Use one of the recommended oils in the correct quantity, see <i>Oil</i> [→ 45].
	Defective gears, bearings or coupling element.	<ul style="list-style-type: none"> Repair machine (contact Busch).
The machine runs too hot.	Insufficient cooling.	<ul style="list-style-type: none"> Make sure to comply with the cooling water requirements, see <i>Cooling Water Connection</i> [→ 14].
	Ambient temperature too high.	<ul style="list-style-type: none"> Observe the permitted ambient temperature, see <i>Technical Data</i>.
	Temperature of the process gases at the inlet too high.	<ul style="list-style-type: none"> Observe the permitted gas inlet temperature, see <i>Technical Data</i>.
	The cooling water pump is defective.	<ul style="list-style-type: none"> Repair the machine.
	Oil level too low.	<ul style="list-style-type: none"> Top up oil.
The oil is black.	Oil change intervals are too long.	<ul style="list-style-type: none"> Drain the oil and fill in new oil, see <i>Oil Change</i> [→ 34].
	The machine runs too hot.	<ul style="list-style-type: none"> See problem "The machine runs too hot".

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

13 Technical Data

		NC 0100 B	NC 0200 B	NC 0300 B
Pumping speed (50Hz / 60Hz)	m ³ /h	110 / 130	220 / 265	320 / 385
	ACFM	76.5	155	225
Ultimate pressure (50Hz / 60Hz) (with "NC" standard coating)	hPa (mbar) abs.	≤0.05 / ≤0.01		
	TORR	≤0.0075		
Ultimate pressure (50Hz / 60Hz) (with "NT" special coating)	hPa (mbar) abs.	≤0.5 / ≤0.1		
	TORR	≤0.075		
Nominal motor rating (50Hz / 60Hz)	kW	3.5 / 4.8	6.0 / 7.6	7.5 / 9.5
	HP	5	10	15
Nominal motor speed (50Hz / 60Hz)	min ⁻¹	3000 / 3600		
	RPM	3600		
Noise level (ISO 2151) (50Hz / 60Hz)	dB(A)	≤70 / ≤74	≤71 / ≤76	≤72 / ≤77
	dB(A)	≤74	≤76	≤77
Ambient temperature range	°C	5 ... 50		
	°F	41 ... 122		
Max. allowable counter pressure at the discharge	hPa (mbar) rel.	200		
	TORR	150		
Max. allowable gas inlet tempera- ture	°C	≤50 hPa (mbar) abs. ► 200		
		>50 hPa (mbar) abs. ► 70		
	°F	≤37.5 TORR ► 392		
		>37.5 TORR ► 158		
Relative humidity	at 30 °C	90%		
	at 86 °F			
Ambient pressure	Atmospheric pressure			
Cooling water requirements	See <i>Cooling Water Connection</i> [→ 14]			
Oil capacity - motor side	L	1.1		
	qts.	1.16		
Oil capacity - suction side	L	0.45		
	qts.	0.48		
Cooling liquid capacity approx. (with plate heat exchanger only)	L	4	5.5	6.5
	qts.	4.23	5.81	6.87
Weight approx.	kg	300	350	400
	Lbs.	662	772	882

14 Cooling Liquid

Zitrec M-25 (ready-to-use)	
Part number 5 L packaging	0831 563 469
Part number 20 L packaging	0831 238 761

The cooling liquid Zitrec M-25 is ready-to-use and does not require additional water.

For further information, consult the website www.arteco-coolants.com.

15 Oil

VSC 100	
ISO-VG	100
Part number 1 L packaging	0831 168 356
Part number 5 L packaging	0831 168 357

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 is determined by the serial number:

Serial number starts with **CHM1...**

Ateliers Busch S.A.
Zone industrielle
2906 Chevenez
Switzerland

Serial number starts with **USM1...**

Busch Manufacturing LLC
516 Viking Drive
Virginia Beach, VA 23452
USA

declares that the machine: COBRA NC 0100 B; COBRA NT 0100 B; COBRA NX 0100 B; COBRA NC 0200 B; COBRA NX 0200 B; COBRA NC 0300 B; COBRA NT 0300 B; COBRA NX 0300 B

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

- 'Machinery' 2006/42/EC
- 'Electromagnetic Compatibility' (EMS) 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 designated standards that have been used to fulfill those provisions:

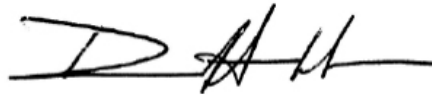
Standards	Title of the Standard
EN ISO 12100 : 2010	Safety of machinery - Basic concepts, general principles of design
EN ISO 13857 : 2019	Safety of machinery - Safety distances to prevent hazard zones being reached by the upper and lower limbs
EN 1012-2 : 1996 + A1 : 2009	Vacuum pumps - Safety requirements - 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 authorized representative in the EU (if the manufacturer is not located in the EU):

Busch Dienste GmbH
 Schauinslandstr. 1
 DE-79689 Maulburg

Chevenez, 2.01.2021

Virginia Beach, 2.01.2021

Christian Hoffmann
General Manager
Ateliers Busch S.A.

David Gulick
General Manager
Busch Manufacturing LLC

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 is determined by the serial number:

Serial number starts with **CHM1...**

Ateliers Busch S.A.
Zone industrielle
2906 Chevezey
Switzerland

Serial number starts with **USM1...**

Busch Manufacturing LLC
516 Viking Drive
Virginia Beach, VA 23452
USA

declares that the machine: COBRA NC 0100 B; COBRA NT 0100 B; COBRA NX 0100 B; COBRA NC 0200 B; COBRA NX 0200 B; COBRA NC 0300 B; COBRA NT 0300 B; COBRA NX 0300 B

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):

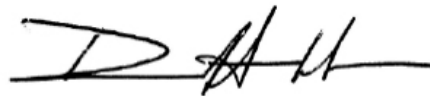
Busch (UK) Ltd
 30 Hortonwood
 Telford - UK

Chevezey, 2.01.2021

Virginia Beach, 2.01.2021



Christian Hoffmann
General Manager
Ateliers Busch S.A.

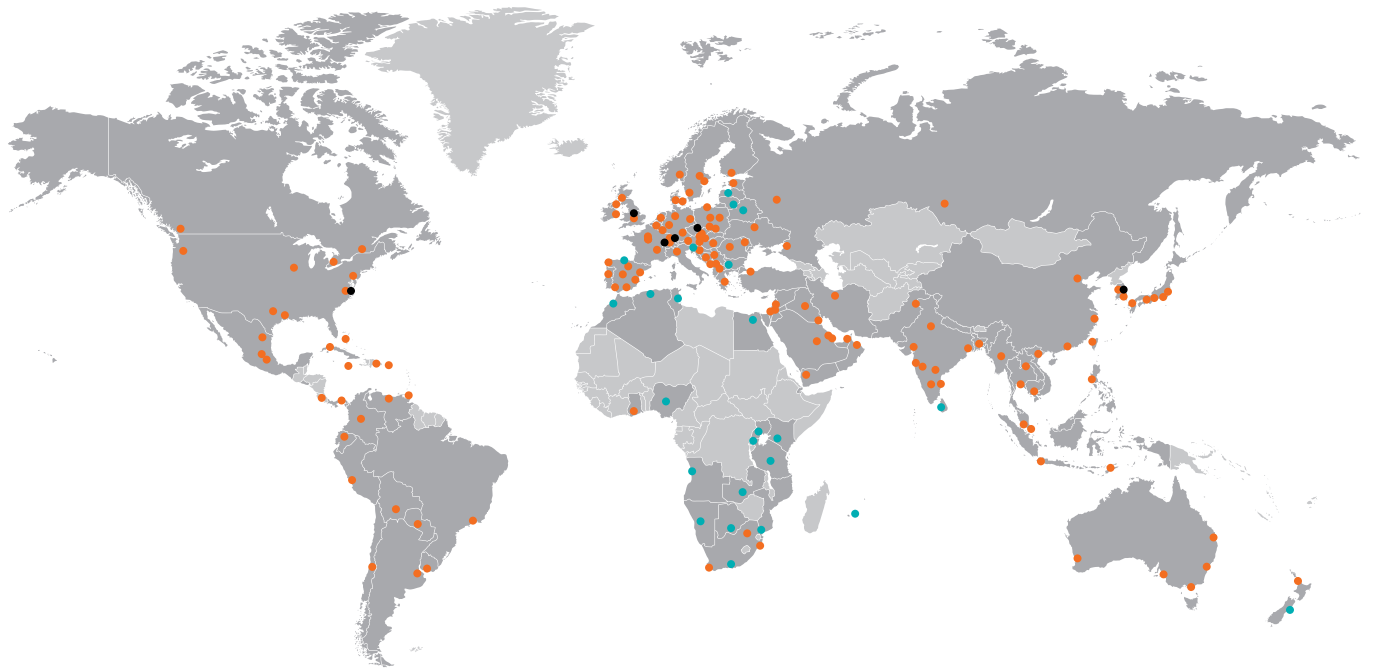


David Gulick
General Manager
Busch Manufacturing LLC

Busch

Vacuum Solutions

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