

COBRA

Dry Screw Vacuum Pumps
DS 3181 C

Instruction Manual



Table of Contents

1	Preface	4
1.1	Congratulations on your purchase	4
2	Product Description	5
2.1	COBRA DS 3181 C	5
2.2	Use	8
2.3	Operating Principle	9
2.3.1	COMBI	9
2.3.2	Gas Flow Checks	10
2.4	Oil Circuit	10
2.5	Cooling	10
2.6	Nitrogen System	10
2.7	Optional Functions/ Use of Available Accessories	11
2.8	On/ Off Switch	11
2.9	Versions	11
3	Safety	12
3.1	Intended Use	12
3.2	Safety Information	12
3.3	Safety Stickers	13
3.4	Noise Emission	14
3.5	Safety Area	14
3.6	Electrical Safety	14
3.6.1	Types of Electrical Work	14
3.6.2	Lock Out/ Tag Out Procedure (Type 1 of Electrical Work)	15
3.6.3	Emergency Off Circuit Description	15
3.6.4	Safety Lockout Procedure	15
3.6.5	Lock Out/ Tag Out for Hydraulics and Pneumatics	15
3.6.6	Lock Out/ Tag Out Procedure (Type 1 of Electrical Work)	15
3.7	Seismic Zone Installation	16
3.8	Information over the Lubricants	17
3.8.1	Oil	17
3.8.2	Cooling Liquid	17
3.9	Decommissioning Procedure	17
4	Transport	18
4.1	Transport in Packed State	18
4.2	Transport in Unpacked State	18
5	Storage	20
5.1	Temporary Storage	20
5.2	Removal of the Vacuum Pump	20
5.3	Preservation	20
5.3.1	Start-up of the Vacuum Pump after Storage	20
6	Installation and Commissioning	21
6.1	Installation Prerequisites	21
6.1.1	Local Installation	21
6.1.2	Dimensional Drawing	23
6.1.3	Inlet Connection	23
6.1.4	Discharge Connection	24
6.1.5	Cooling Water Connection	25
6.1.6	Nitrogen Connection	25

6.1.7	Electrical Connection/ Checks	25
6.2	Installation	25
6.2.1	Mounting	25
6.2.2	Electrical Connection.....	26
6.2.3	Equipment Connections (with Options).....	30
6.2.4	Connection of Lines/ Pipes.....	31
6.2.5	Oil Filling	31
6.2.6	Cooling Liquid Filling.....	36
6.2.7	Direct Cooling Checking	38
6.2.8	Nitrogen Supply Checking.....	38
6.2.9	Operating Parameters Saving	38
6.3	Recommendations on Operation.....	38
6.3.1	Application.....	38
6.3.2	Switching the Vacuum Pump On/ Off	40
6.4	Load Lock Operation Mode.....	41
7	Standard Operational Time Chart	43
7.1	Signal Control Mode (Select LL Mode = EXTERN)	43
7.2	Current Control Mode (Select LL Mode = AUTO).....	44
8	Maintenance	45
8.1	Maintenance Schedule	46
8.1.1	Lock Out/ Tag Out Procedure	48
8.1.2	Safety Lockout Procedure	48
8.2	Oil Checking	48
8.2.1	Oil Level Checking	48
8.2.2	Oil Refilling	49
8.2.3	Oil Color Inspection.....	50
8.2.4	Oil Change	50
8.3	Cooling Liquid Checking.....	53
8.3.1	Cooling Liquid Level Checking	53
8.3.2	Cooling Liquid Refilling	53
8.3.3	Cooling Liquid Draining.....	54
8.3.4	New Cooling Liquid Filling	54
8.4	Additional Checking	55
9	Overhaul	56
10	Removal from Service	57
10.1	Temporary Removal from Service.....	57
10.2	Recommissioning.....	57
10.3	Dismantling and Disposal	58
11	Spare Parts	59
12	Troubleshooting	60
13	Oil Type/ Quantity	62
13.1	Oil Type.....	62
13.2	Oil Quantity	62
14	Cooling Liquid Type/ Quantity	63
14.1	Cooling Liquid Type	63
14.2	Cooling Liquid Quantity.....	63
15	Technical Data	64
16	EU Declaration of Conformity	65
17	UK Declaration of Conformity.....	66

1 Preface

1.1 Congratulations on your purchase

Congratulations on your purchase of the Busch vacuum pump. With watchful observation of the field's requirements, innovation and steady development Busch delivers modern vacuum and pressure solutions worldwide.

These operating instructions contain information for

- product description,
- safety,
- transport,
- storage,
- installation and commissioning
- maintenance,
- overhaul and
- troubleshooting

of the vacuum pump.

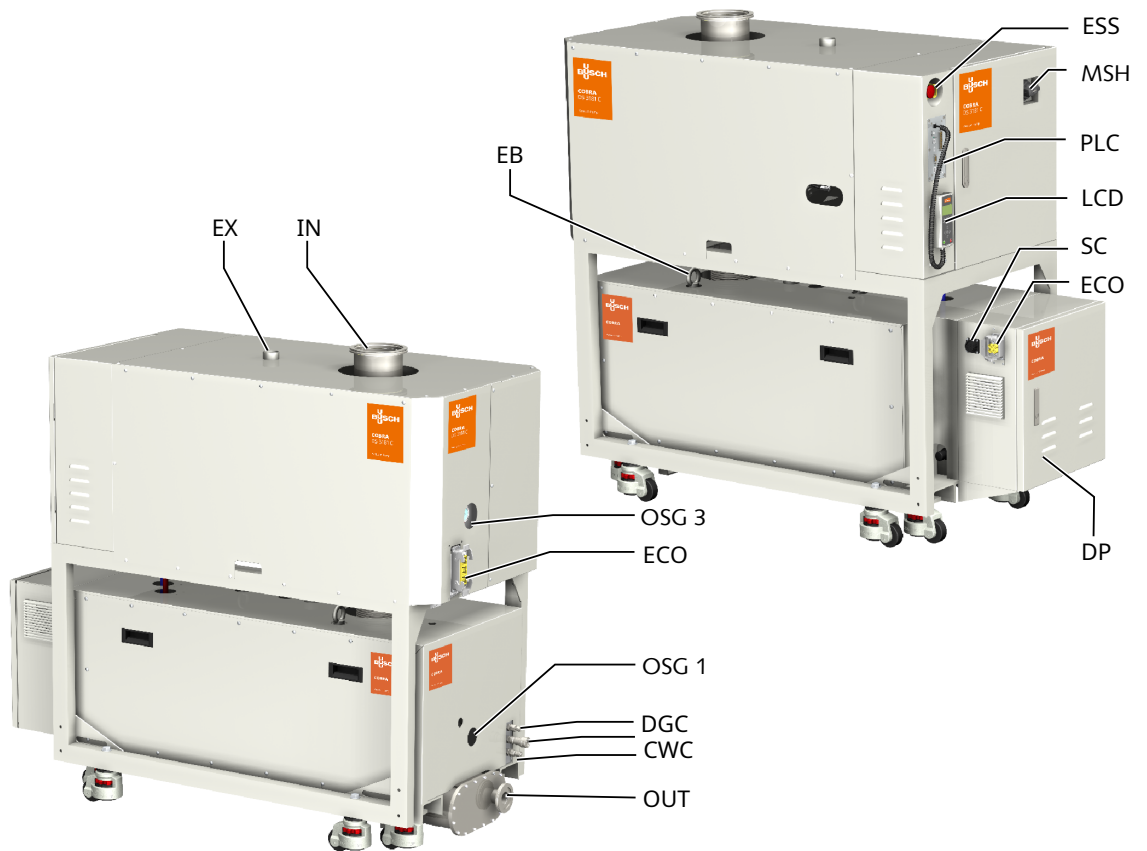
For the purpose of these instructions, "handling" the vacuum pump means the transport, storage, installation, commissioning, influence on operating conditions, maintenance, troubleshooting and overhaul of the vacuum pump.

Prior to handling the vacuum pump these operating instructions shall be read and understood. If anything remains to be clarified, please contact your Busch representative.

Keep these operating instructions and, if applicable, other pertinent operating instructions available on site.

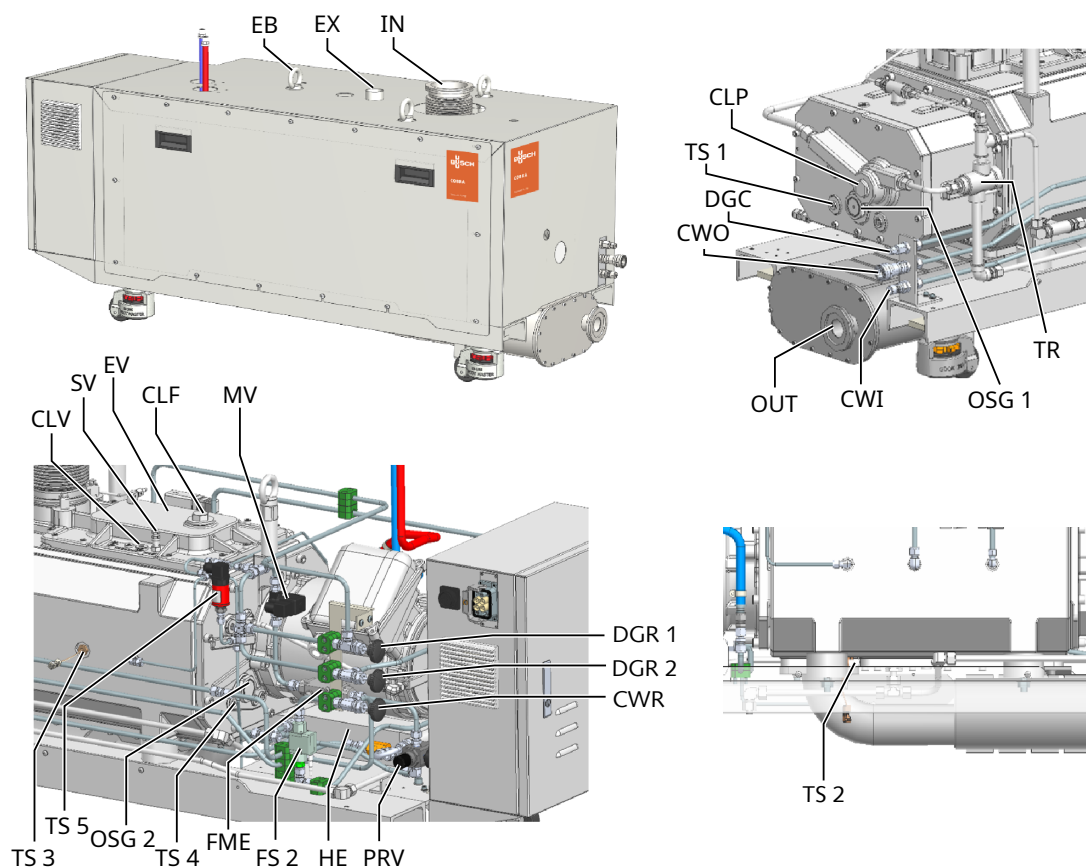
2 Product Description

2.1 COBRA DS 3181 C



Description			
IN	Suction connection	OUT	Discharge connection
CWC	Cooling water connections	DGC	Nitrogen connections
DP	Backing vacuum pump DP 0800 A	EB	Lifting eyebolt for DP 0800 A
ESS	Emergency stop button	ECO	Electrical connections
EX	Extracting ventilator	LCD	Handpad
MSH	Main switch	OSG 1	Oil sight glass
OSG 3	Oil sight glass	PLC	Busch PLC
SC	Sensor connection		

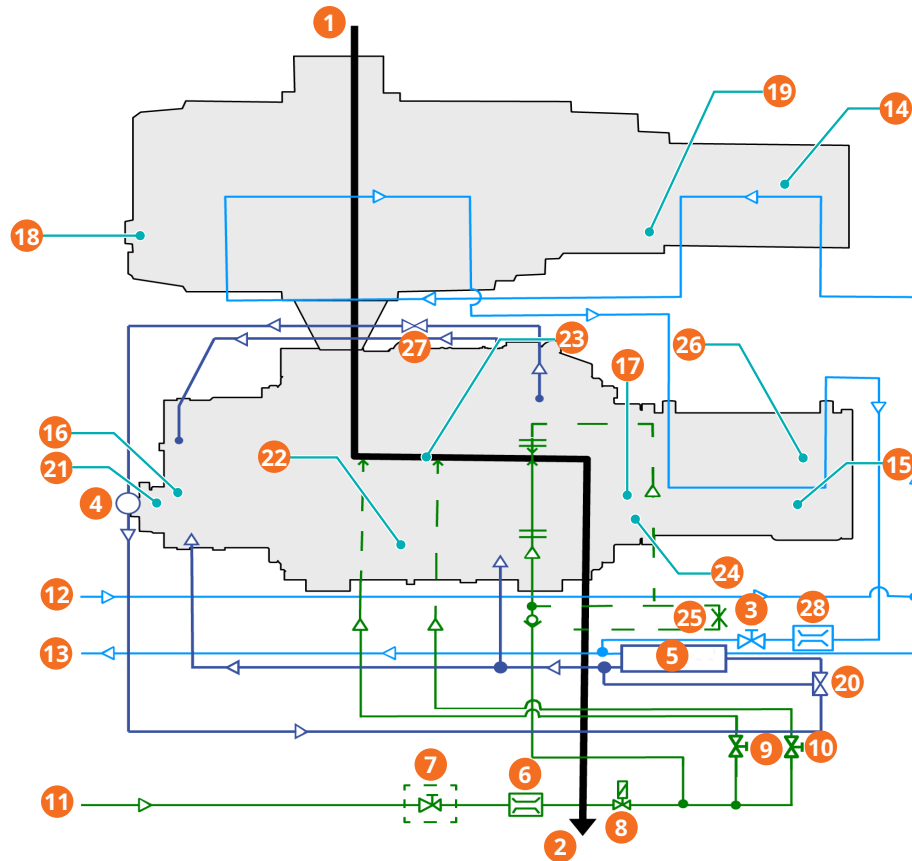
COBRA DP 0800 A



Description

CLP	Glycol circulating pump	CWI	Cooling water inlet connection
CWO	Cooling water outlet connection	CWR	Regulating valve, cooling water
DGC	Nitrogen connection	DGR 1	Regulating valve, dilution gas (middle of cylinder)
DGR 2	Regulating valve, dilution gas (end of cylinder)	ECO	Power connection
FME	Nitrogen flowmeter	FS 1	Flow switch, cooling liquid
FS 2	Flow switch, cooling water	HE	Heat exchanger
MV	Regulating with solenoid valve, dilution gas	OSG 1	Oil sight glass
OSG 2	Oil sight glass	OUT	Discharge
PRV	Regulating valve, Nitrogen	SV	Safety valve
TR	Temperature regulator, 55°C	TS 1	Temperature switch, oil temperature 120°C
TS 2	Temperature switch, cooling liquid temperature 100°C	TS 3	Temperature sensor PT100
TS 4	Temperature switch, oil temperature 140°C	TS 5	Overpressure sensor

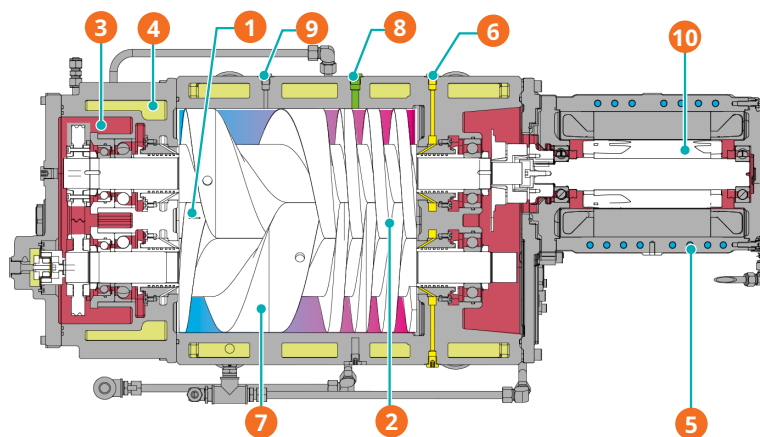
Process Gas Diagram



Description

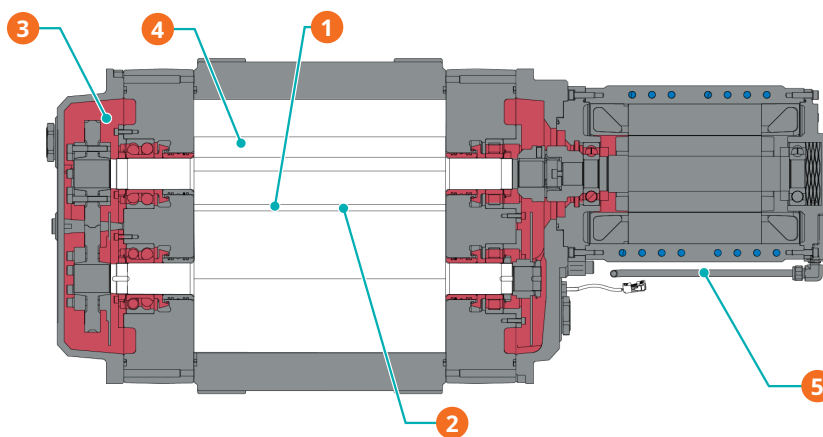
1	Process gas inlet (PGI)	2	Process gas outlet (PGO)
3	Cooling water regulating valve (CWR)	4	Cooling liquid pump (CLP)
5	Heat exchanger (HE)	6	Nitrogen flow meter, dilution gas (FME)
7	Nitrogen pressure reducer (PRV)	8	Magnetic valve (MV), regulating valve with solenoid valve, dilution gas
9	Regulating valve, dilution gas DP (DGR1)	10	Regulating valve, dilution gas at exhaust (DGR2)
11	Nitrogen supply (NC)	12	Cooling water inlet (CWI)
13	Cooling water outlet (CWO)	14	Motor MB (MOT2)
15	Motor DP (MOT1)	16	Oil sight glass DP (OSG1)
17	Oil sight glass DP (OSG2)	18	Oil sight glass MB (OSG3)
19	Oil sight glass MB (OSG4)	20	Temperature regulator, 55°C (TR)
21	Temperature switch, oil temperature 120°C (TS1)	22	Temperature switch, cooling liquid temperature 100°C (TS2)
23	Temperature sensor PT100 (TS3)	24	Temperature switch 140°C (TS4)
25	Overpressure sensor (TS5)	26	Temperature switch 155°C (TS6)
27	Flow switch, cooling liquid (FS 1)	28	Flow switch, cooling water (FS 2)

COBRA NS 0800 A



Description			
1	Inlet	2	Outlet
3	Oil	4	Cooling liquid
5	Cooling water	6	Barrier gas
7	Screw rotors	8	Dilution gas (dil 2)
9	Dilution gas (dil 1)	10	Motor klixon

PUMA WY 3600 A



Description			
1	Inlet	2	Outlet
3	Oil	4	Booster lobe
5	Cooling water		

2.2 Use

The COBRA DS vacuum pumps are designed for use in the field of microelectronics and similar industries.

They can be used to suck gases and gas mixtures.



WARNING

When using toxic, inflammable and/or explosive gases, make sure that the system corresponds in design to applicable local and national safety regulations and that all applicable safety measures are followed.

All product-specific safety regulations must be observed.

Solid particles must not get into the vacuum pump. Procedural errors can result in the vacuum pump sucking in a certain quantity of liquid. If the pump has sucked in liquid, a short drying time is necessary at the end of the procedure.

The allowed maximum inlet gas temperature depends on the inlet pressure and the type of gas: the lower the inlet pressure (Pa), the higher the drawn gas temperature (TGas) can be.

The following indicative values for air can be considered:

- Pa > 50 mbar, TGas < 80°C
- Pa < 50 mbar, TGas < 200°C

The vacuum pump is intended for use in a potentially non-explosive environment.

- Make sure that the maximum permissible number of starts does not exceed 2 starts per hour. Those starts should be spread within the hour.

The vacuum pump is thermally suitable for continuous operation at any pressure between atmospheric pressure and ultimate pressure.

The vacuum pump is tight down to ultimate pressure.

2.3 Operating Principle

2.3.1 COMBI

The COBRA DS 3181 C vacuum pumps are a combination of a screw vacuum pump NS 0800 A (DP) and a Booster vacuum pump WY 3600 A (MB). The COMBI vacuum pumps are streamlined.

The COBRA DS vacuum pumps are COBRA NS screw vacuum pumps with cooling water and nitrogen circuits.

The COBRA NS screw vacuum pumps are driven by water-cooled motors.

2.3.1.1 Principle of DP Vacuum Pumps

The COBRA NS screw vacuum pumps work by the principle of spiral pumps. Two parallel screws (8) rotate in opposite directions in the pump body. Entering gases are trapped between the flights of the screws and the pump body. The gases are conveyed by the rotation of the screws to the exhaust, where they are discharged.

2.3.1.2 Principle of MB Vacuum Pumps

The Booster vacuum pumps operate according to the approved principle of the Booster type machine. Operation is both simple and effective. Two lobes (9) with identical profiles rotate in opposite directions within a casing. As they rotate, gas is drawn into the space between each lobe and the casing where it is trapped and by the rotation pushed out into the discharge. This action is repeated twice for each revolution of each lobe and therefore four times for each revolution of the drive shaft. There is no mechanical contact between lobes and cylinder. So no oil lubrication is required.

The drive motor of Booster vacuum pump is a water-cooled canned motor.

The WY 3600 A rotary lobes vacuum pumps are equipped with an automatic by-pass valve that limits the differential pressure between inlet and outlet.

2.3.2 Gas Flow Checks

A pressure sensor TS5 at the discharge monitors the discharge pressure. If the pressure reaches more than the limit value (alarm, preset at the factory: 0.2 bar), the purge cycle starts.

2.4 Oil Circuit

Since the complete operating principle works without contact, no oil circuit is needed in the work area.

2.5 Cooling

The vacuum pump is cooled by:

- The filling of cooling liquid (mix of water and glycol) inside the water chambers (6) of cylinder and end plate of cylinder B-side. An indirect circuit is made with a water pump mounted at the end-plate of cylinder B-side. The flow of the cooling liquid is controlled by a flow switch FS 1. If the flow is under 1 l/min during a minimum time of 30 seconds, then the vacuum pump stops. The temperature switch TS2 will give an emergency signal if the temperature of the cooling liquid is above 100°C. The pump will stop immediately after the emergency alarm ring.
- A direct cooling water circuit in the motors in the cylinder covers A and B side of WY rotary lobes vacuum pump and COBRA NS vacuum pump. The cooling water flow is preset at 10 l/min at the factory and can be adjusted with regulating valve CWR. The flow is controlled by flow switch FS 2. The cooling water circuit stabilizes the temperature of cooling liquid. When flow is too low a warning then an alarm signal is generated by flowmeter CWM to the PLC. Status of the pump depends on the alarm function set by user (factory setting: ESS, pump stops after alarm condition).
- a direct cooling water circuit in the rear bearing (for exceptionally cool running in option).



NOTE

The COBRA DS vacuum pumps are principally dispatched with oil and cooling liquid already in the vacuum pump but, without cooling water. Before vacuum pump first startup, control the oil level and the cooling liquid level. In the event of absence of one or the other of these lubricants, please carry out the filling (please refer to the various chapters of filling). Do not forget to connect the cooling water supply before the first startup. Operation without these coolants can result in damage to the vacuum pump.

2.6 Nitrogen System

The nitrogen system can be used in a number of different ways:

- Nitrogen is used as dilution gas. It is injected inside the cylinder on two different places. Nitrogen flow FME injected in the middle hole is preset at 20 NI/min and can be adjusted with valve DGR1, depending on the application. Nitrogen flow injected in the hole on cylinder end-plate side is preset at 40 NI/min and can be adjusted with valve DGR2, depending on the application. When flow is too low a warning then an alarm signal is generated by flowmeter FME to the PLC. Status of the pump depends on the alarm function set by user (factory setting: None, pump continues running with an alarm). Dilution improves the screws functioning, especially when sucking corrosive gases.
- Nitrogen is used as sealing gas. The nitrogen is injected between the transmission and the process gas to achieve good closeness.

2.7 Optional Functions/ Use of Available Accessories

The relief valve (SV) prevents excessively high pressure in the expansion tank (EV), relief pressure: 6 bar.

A pressure switch (optional) with normally closed contact mounted in the expansion tank monitors the pressure of the cooling liquid. It must be connected in such a way that actuation causes the vacuum pump to be switched off when the pressure exceeds a value of 3 bar.

A pressure sensor (TS5) mounted at the exhaust, controls the overpressure at the exhaust. If overpressure is above 0,2 bar, pressure sensor gives a warning then an alarm signal. Status of the pump depends on the alarm function set by user (factory setting: None, vacuum pump continues running with an alarm).

A temperature sensor PT100 (TS3) mounted on the cylinder, measures the temperature inside the cylinder (DP).

A silencer or sound absorber (accessory) at the exhaust reduces the noise of the vacuum pump and collects any condensate.

A leak-protection non-return valve (optional) at the exhaust traps the condensate in the vacuum pump when the vacuum pump is switched off.

The nitrogen can also be used as flushing gas. Depending on the application, flushing is recommended after every use to ensure trouble-free operation of the vacuum pump. The nitrogen is injected directly into the intake port. In the absence of nitrogen flushing can also be performed with the help of air.

The LCD controller processes the data of the sensors as follows:

- TS1: exhaust pressure
- TSA: temperature inside the cylinder DP
- MOT1 and MOT2: DP and MB current and speed
- FME: nitrogen flow rate, dilution
- CWM: cooling water flow rate in motors/ transmission / variable speed drives

See "Installation and Maintenance Instructions, Busch PLC and Busch LCD (No. 0870758077)".

2.8 On/ Off Switch

The vacuum pump is delivered with a circuit breaker. The function start/ stop can be done in Local by using the LCD controller or in Remote by the production machine.

2.9 Versions

Further vacuum pump descriptions state the nominal displacement and the design level.

Example: DS 3181 C

DS = standard version

3181 = 3500 m³/h

C = Design

3 Safety

3.1 Intended Use

DEFINITION: To rule out any misunderstanding, the term “handling” of the vacuum pump covers transport, storage, installation, and operation of the pump as well as effects on operating states and troubleshooting on the vacuum pump.

The vacuum pump is intended for industrial use. It may only be operated by qualified personnel.

The different application possibilities and limit values for operation described in “Product description” and “Installation requirements” must be observed by the manufacturer of the system into which the vacuum pump is to be integrated and by users.

The need for personal safety regulations depends in principle on the type of use. The operator must provide the users with the necessary means and must inform his personnel about the dangers emanating from the processed product.

The operator of the vacuum pump must observe the safety regulations and must train and instruct his personnel accordingly.

Local regulations regarding the motors and electric control elements must be observed when installing the pump in potentially explosive environments.

The maintenance instructions must be followed and observed.

These installation and maintenance instructions must be read and understood before the vacuum pump is used. If you have any doubts, contact your Busch representative.

3.2 Safety Information

The vacuum pump is designed and manufactured in compliance with the latest technical standards and safety regulations. Nevertheless, an element of residual risk remains.

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.

i NOTE

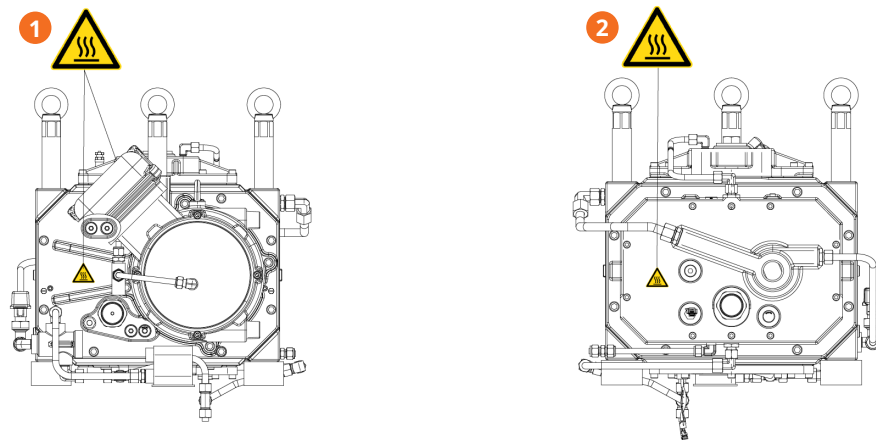
... indicates helpful tips and recommendations, as well as information for efficient and trouble-free operation.

! CAUTION

The COBRA DS system includes provision for the secondary containment of liquids leaks such as water and oil.

3.3 Safety Stickers

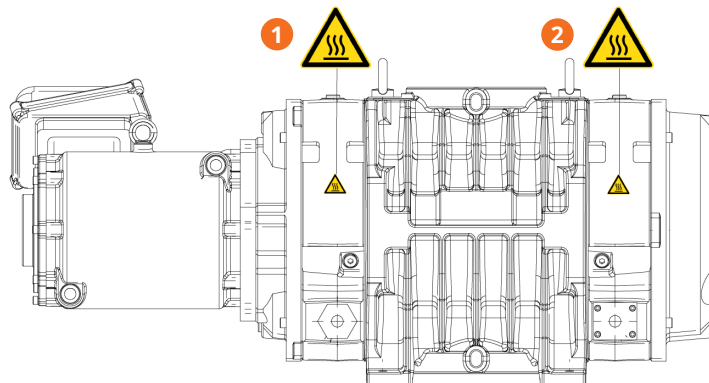
COBRA NS 0800 A



Description

1	Warning! Hot surface! Do not touch!	2	Warning! Hot surface! Do not touch!
---	-------------------------------------	---	-------------------------------------

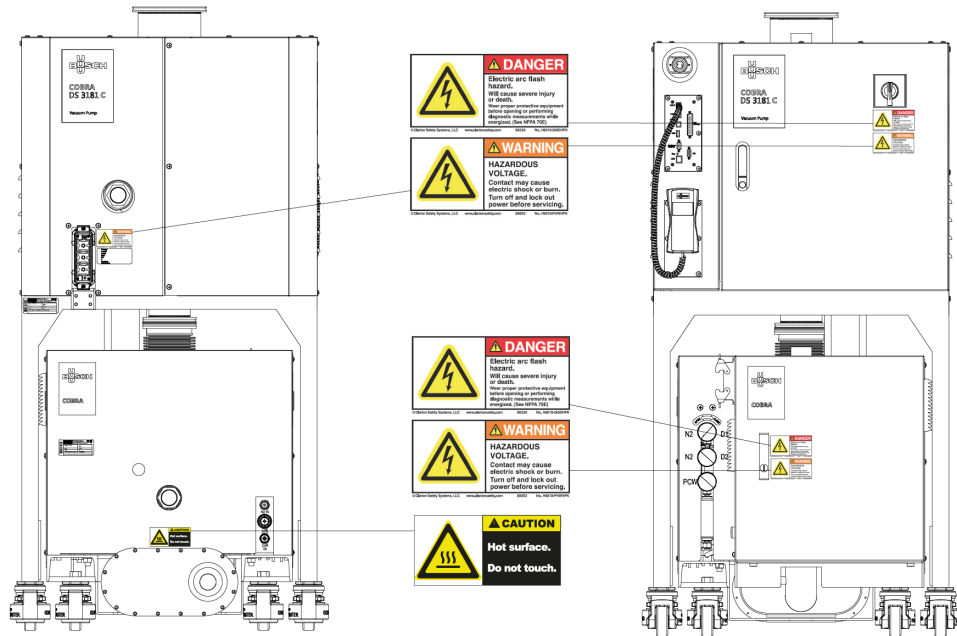
PUMA WY 3600 A



Description


1	Warning! Hot surface! Do not touch!	2	Warning! Hot surface! Do not touch!
---	-------------------------------------	---	-------------------------------------

COBRA DS 3181 C




3.4 Noise Emission

Refer to the table “Technical data” for the permissible noise levelling free field conditions according to EN ISO 2151.



CAUTION



The sound level of the vacuum pump within a certain perimeter of the vacuum pump is high. Risk of hearing damage.

Users who are spending a longer period in the vicinity of a non-insulated vacuum pump must wear suitable ear protection.

3.5 Safety Area

Before any maintenance action, ensure a safety perimeter of a least 610 [mm] around the vacuum pump. Before any maintenance action, ensure a safety perimeter of a least 610 [mm] around the vacuum pump.

3.6 Electrical Safety

3.6.1 Types of Electrical Work

The following are the four types of electrical work defined by the SEMI S2, latest version, guideline:

Type 1

Equipment is fully deenergized.

Type 2

Equipment is energized. Energized circuits are covered or insulated.

NOTE: Type 2 work includes tasks where the energized circuits are or can be measured by placing probes through suitable openings in the covers or insulators.

Type 3

Equipment is energized. Energized circuits are exposed and inadvertent contact with uninsulated energized parts is possible. Potential exposures are no greater than 30 volts rms, 42.4 volts peak, 60 volts dc or 240 volt-amp in dry locations.

Type 4

Equipment is energized. Energized circuits are exposed and inadvertent contact with uninsulated energized parts is possible. Potential exposures are greater than 30 volts rms, 42.4 volts peak, 60 volts dc, or 240 volt-amp in dry locations. Potential exposures to radio-frequency currents, whether induced or via contact, exceed the limits in Table A5-1 of Appendix 5 (SEMI S2 guideline).

3.6.2 Lock Out/ Tag Out Procedure (Type 1 of Electrical Work)

- Stop the pump with the LCD controller (press on STOP button during 10s).
- Press on emergency stop button.
- Switch off the main circuit breaker.
- Switch off the customer's power supply.
- Switch off the water and nitrogen quick connections (inlet first, then outlet).
- Put the label or warning board "Maintenance processing" on or next to the vacuum pump.

3.6.3 Emergency Off Circuit Description

- The Emergency off circuit may be opened by pressing on emergency stop button. If this element occurs, then the DP and MB vacuum pumps will immediately stop. The PLC will remain energized to save the pump status.
- If the emergency stop button was pressed, check the startup of the pump then release this button to restart the pump. Press on Start button on the LCD controller, the pump will restart.

3.6.4 Safety Lockout Procedure

- Take off the label or warning board "Maintenance processing".
- Check the cooling liquid and oil levels according to the chapters "Checking the oil level" and "Checking the cooling liquid level".
- Open the power box cover and check that the FDP1 thermal relay is on manual reset position.
- Close the cover.
- Switch on the main disconnect switch.
- Release the emergency stop button.
- Switch on the water (outlet first, then inlet) and nitrogen quick connections.
- Start the pump with the remote control (press on START button).

3.6.5 Lock Out/ Tag Out for Hydraulics and Pneumatics

- Hydraulics: cooling water.
- Pneumatics: nitrogen.

3.6.6 Lock Out/ Tag Out Procedure (Type 1 of Electrical Work)

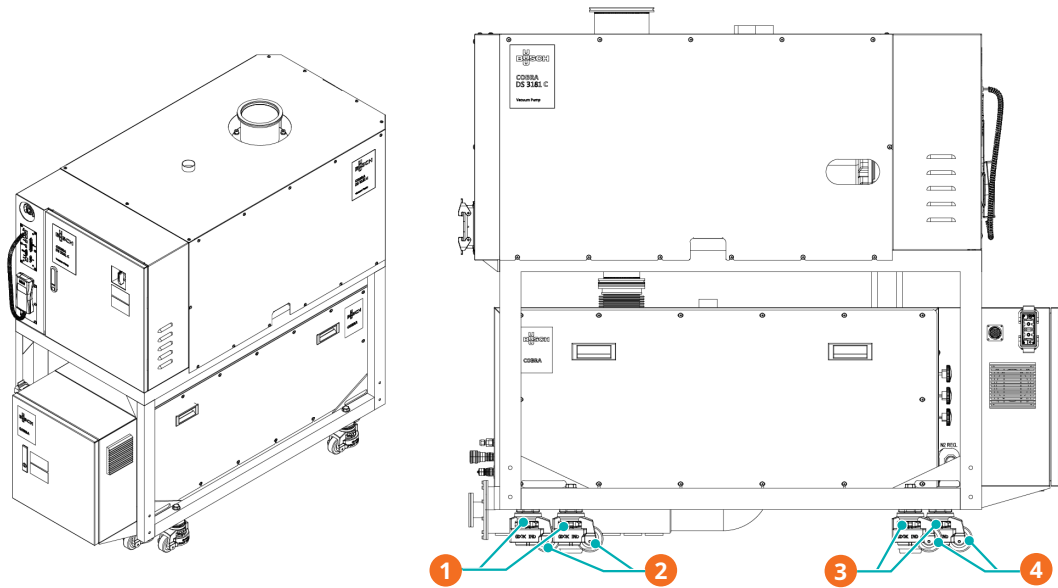
- Stop the pump with the remote control (press on STOP button during 10s).
- Press on emergency stop button.
- Switch off the main disconnect switch.
- Switch off the customer's power supply.
- Switch off the water (inlet first, then outlet) and nitrogen quick connections.
- Put the label or warning board "Maintenance processing" on or next to the pump.

The end user is responsible for providing energy isolation capabilities on the water and nitrogen.

3.7 Seismic Zone Installation

Upon receipt, the vacuum pump is fixed on the transport pallet with two brackets.

- Convey the vacuum pump to its final location with a pallet truck before removing it from its support.
- Unscrew the fixing screws of the vacuum pump on the transport pallet and remove the machine from its support with an appropriate lifting system by using the lifting brackets made for this purpose.



Description			
1	Adjusting nut	2	Wheel
3	Adjusting nut	4	Wheel

- The vacuum pump must not lay only on the brackets. Unscrew the four adjusting nuts until the machine legs touch the ground.
- Check that the wheels no longer touch the ground.

 **CAUTION**

The vacuum pump is fixed to the ground with four M10 screws, two screws per bracket. The fixing screw must stand a 1200 N tensible force (per bracket).

The final user must adapt the type of screws depending on the ground material.

3.8 Information over the Lubricants

3.8.1 Oil

Oil filling	NS 0800 A	WY 3600 A
Oil quantity (Liter)	1.6	3.5
Oil type	Busch YLC 250 B, Art. No. 0831 131 400 (0,5 l ≈ 1 kg)	

- Replacement: After 5000 h (see "Maintenance Schedule [→ 46]").

3.8.2 Cooling Liquid

Cooling liquid filling	NS 0800 A
Cooling liquid quantity (Liter)	approx. 26 liters
Cooling liquid type	Glycol (Ethylene), Art. No. 0831 563 469, Zitrec M-25 (already mixed ready-to-use)

- Replacement: After 5000 h (see "Maintenance [→ 45]").

3.9 Decommissioning Procedure

When the product arrives at the end of the lifetime, it is necessary to proceed to the decontamination of the vacuum pump.



CAUTION

Only authorized personnel may carry out any dismantling on the vacuum pump. Before work begins, the operator of the vacuum pump must fill in a form or a "Declaration Regarding Contamination of Vacuum Equipment and Components" that provides information on possible dangers and appropriate measures.

If this form has not been filled in completely and signed by a responsible person, the vacuum pump may not be dismantled.

- Proceed to disassembly of the vacuum pump. Please make sure to wear a personal protective equipment (PPE) prior to any intervention on the vacuum pump. Some residues may remain inside.
- Proceed to decommissioning of the different parts according to the current local and national laws.

4 Transport

The COBRA DS vacuum pumps are tested and checked in our factory before careful packing. Check the packaging for transport damage when the goods arrive. The vacuum pump can withstand temperatures between -25°C and +55°C during transport.

4.1 Transport in Packed State

Packed on a pallet, the vacuum pump can be moved with a hand forklift truck.

4.2 Transport in Unpacked State

The vacuum pump is fastened to the pallet with fixing pins:

- Unscrew the fastening nuts underneath the pallet.



CAUTION

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



CAUTION

Please check out the weight of the vacuum pump before lifting it up (see "Technical Data"). Use adequate lifting gear for this.



NOTE

The eyebolts are fitted more or less at equal distance from the center of gravity of the vacuum pump incl. drive motor. If any accessories that could upset the balance of the vacuum pump, are installed, or if the vacuum pump is delivered without drive motor, it is necessary to add a belt or rope at a suitable point when lifting the vacuum pump.

- Attach lifting gear securely to the eyebolt or eyebolts.
- Use lifting gear with a crane hook equipped with safety latch.
- Lift the vacuum pump.

Lifting for DP 0800 A



In case the vacuum pump was bolted to a pallet with fixing bolts:

- Unscrew the fixing bolts in the base frame.



CAUTION

In case of a vacuum pump filled with oil, make sure that by lifting the inclination angle of the vacuum pump do not exceed 5° from the horizontal. In case of too high inclination (>5°), risk of oil leak within the work area.

- Make sure before every transport using the appropriate lifting mean that the inclination of the vacuum pump is less than 5°.

The packaging material must be disposed of in accordance with local and national regulations.

This handbook is contained in the delivery package.

For future transportation:

- Seal all open connections with protective caps (to prevent penetration of dirt and water).
- Secure loose cables.
- Protect from shock.
- Drain all process and operating media.
- Secure vacuum system firmly before transporting (e.g. bolt to several pallets).
- Use a lift truck to move and set the vacuum system down.

5 Storage

5.1 Temporary Storage

- Make sure that the intake and exhaust flanges are closed (put on the protective caps included in the delivery package of the vacuum pump)
- Store the vacuum pump:
 - if possible, the vacuum pump should be stored in its original packaging,
 - indoors,
 - dry,
 - in a dust-free and vibration-free room.

5.2 Removal of the Vacuum Pump

Before starting a vacuum pump that has been stored outside the building for a while, the vacuum pump must be moved to a room with ambient temperature, where it should rest for a day.

5.3 Preservation

If the vacuum pump will be exposed to unfavorable ambient conditions (for example, aggressive environment, frequent temperature changes), begin immediately with preservation work on the vacuum pump.

In the case of favorable ambient conditions, perform preservation work on the vacuum pump if a storage period of more than three months is planned.

- Make sure that all openings are hermetically sealed; use adhesive tape to fasten loose parts (seal rings, flat seals, etc.).



NOTE

VCI is the abbreviation for “volatile corrosion inhibitor”. The VCI molecule is an organic corrosion inhibitor in the vapor phase. Integrated in various carriers such as film, cardboard, paper, foam, liquid and powder, it protects the parts against corrosion because of its action in the vapor phase. However, VCI packaging can attack synthetic surfaces and surfaces of other elastomers. If in doubt, please contact your nearest distributor. VCI packaging provides several years of protection against corrosion, even under the harshest of conditions: overseas shipment, extended storage before use.

- Wrap the vacuum pump in a VCI film.
- Store the vacuum pump:
 - if possible, the vacuum pump should be stored in its original packaging,
 - indoors,
 - dry,
 - in a dust-free and
 - vibration-free room.

5.3.1 Start-up of the Vacuum Pump after Storage

- Make sure that all protective elements, stoppers, or adhesive tapes attached before preservation have been removed.
- Switch on the vacuum pump in the sequence described in “*Installation and Commissioning* [→ 21]”.

6 Installation and Commissioning

6.1 Installation Prerequisites

CAUTION

In case of non-compliance with the installation prerequisites, particularly in case of insufficient cooling:

Risk of damage or destruction of the vacuum pump and its components!

Risk of personal injury!

The installation prerequisites must be complied with.

- Please ensure that the integration of the vacuum pump is compliant with the safety requirements of the Machine Directive 2006/42/EC (concerning the responsibility of the system’s manufacturer into which the vacuum pump is to be incorporated, please also refer to the note in the EU-Declaration of Conformity).



WARNING

Local regulations regarding the motors and electric control elements must be observed when installing the vacuum pump in potentially explosive environments.

Make sure before start-up that all safety measures have been followed.

6.1.1 Local Installation

- Make sure that the environment of the vacuum pump is not potentially explosive.
- Make sure that the following ambient conditions are fulfilled:

Ambient conditions	Requirements
Ambient temperature	0 ... 40 °C (32 ... 104 °F).
Ambient pressure	Atmosphere
Humidity range	20 to 95%
Altitude	Up to 1000 m

- Make sure that the cooling water fulfills the following requirements:

Hardness	dGH	< 5 °
Temperature	°C	10 - 25
Overpressure	bar (relative)	2 - 5
Approximate flow rate for the standard version	l/ min	min. 10
Approximate flow rate for other applications	l/ min	min. 12
Properties	Clean & clear	
Particle size	µm	< 200
Chloride	mg/l	< 100
Electrical conductivity	µS/cm	≤ 100
Free chloride	mg/l	< 0.3

**NOTE**

1° (german degree = 1° dGH) = 1,78° (french degree) = 1,25 e (english degree) = 17,9 mg/kg Ca-CO₃ (american hardness).

- Make sure that the cooling water is neutral and clean.
- Make sure that the cooling water outlet is unpressurised.
- Make sure that the nitrogen fulfills the following requirements:
- Make sure that the ambient conditions correspond to the protection class of the motor (according to nameplate).
- Make sure that the vacuum pump is placed on or fastened to a horizontal surface.
- Make sure that the vacuum pump is level.
- Make sure that the vacuum pump is at least 1 m away from any wall to ensure good cooling.
- Make sure that the vacuum pump is easily accessible and that the selected installation site fulfills the requirements for assembly/dismantling.
- Make sure that no temperature-sensitive parts (for example, of plastic, wood, cardboard, paper, electronic parts) come into contact with the hot surfaces of the vacuum pump.
- Make sure that the installation site or assembly area is ventilated in such a way that adequate cooling of the vacuum pump is ensured.

**CAUTION**

The surface temperature of the vacuum pump can exceed 50°C when the vacuum pump is in operation.

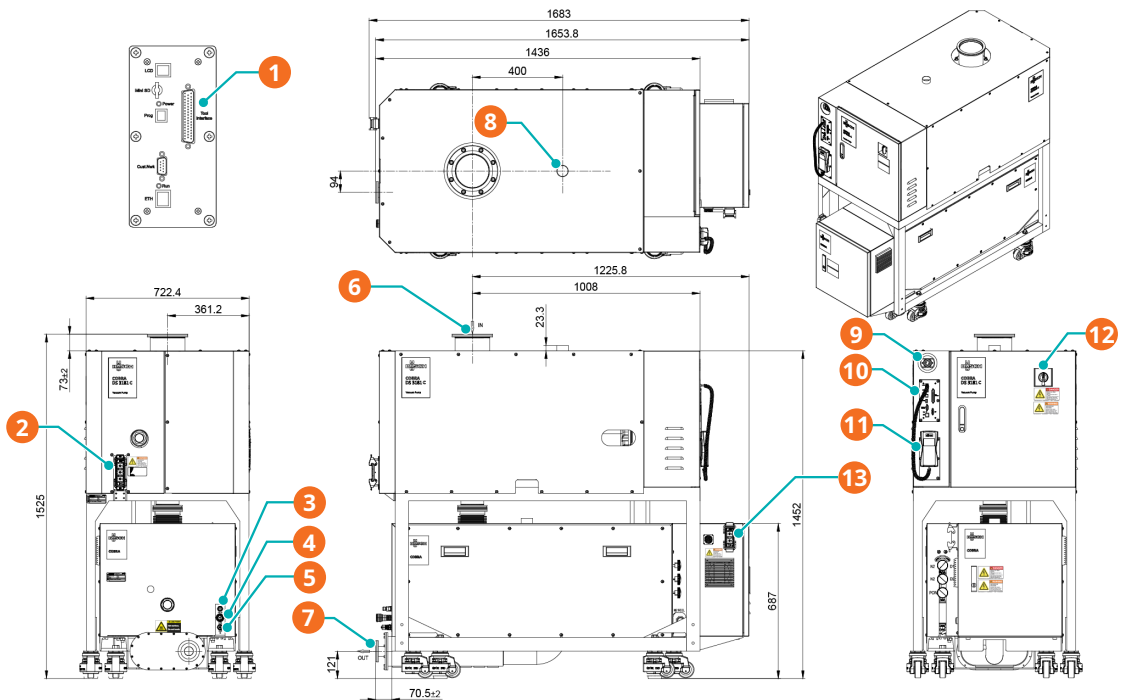
Danger of burns!

- Make sure that no-one can touch the vacuum pump accidentally. If necessary, attach safeguard.
- Make sure that the oil sight glasses (OSG1,2,3,4) are easily accessible.

If oil changes are to be made on site:

- Make sure that the oil drain and oil filler are easily accessible.

6.1.2 Dimensional Drawing



Description			
1	PLC control panel layout	2	Main power connector
3	Nitrogen inlet 1/4"	4	Cooling water inlet 3/8"
5	Cooling water outlet 3/8"	6	Inlet DN 160 ISO-K
7	Outlet DN 63 ISO-KF	8	Ventilating duct, diameter 50.8
9	Emergency stop	10	Busch PLC
11	Remote Control (Moveable)	12	Main switch
13	DP power connector		

- Make sure that the vacuum pump is at least 1 meter away from any wall to ensure good cooling.
- Before any maintenance action, ensure a safety perimeter of at least 610 [mm] around the vacuum pump.

6.1.3 Inlet Connection

- Make sure that the protection that was attached to prevent penetration of particles during transport has been removed before the vacuum pump is connected to the vacuum line

 **CAUTION**

Do not put hands into the inlet aperture!
Risk of body damage!

 **CAUTION**

The intake of liquids or solid particles can lead to the destruction of the vacuum pump.

If the sucked gas contains dusts or solid foreign bodies:

- Make sure that a filter or protective grating is installed at the extraction point.
- Make sure that the nominal diameter of the intake line is at least equal to the diameter of the intake flange of the vacuum pump to prevent a drop in the performance of the vacuum pump in the case of a smaller cross-section
- Make sure that the vacuum pump is connected with leakproof lines.



CAUTION

When the intake lines have been connected, make sure that the system does not leak.

Leakages of dangerous substances must be prevented!

- Make sure that the intake lines are equipped with a shut-off device upstream of the intake flange so that the flow of sucked gas can be stopped.
- Make sure that the intake lines do not exercise any force on the intake flange. Mount bellows if necessary.
- The inlet flange has the following dimension:
 - DN 160 ISO-K

In the case of long intake lines, the line cross-section should be larger than the intake flange to prevent a drop in the performance of the vacuum pump. If you have any doubts, contact your Busch representative.

6.1.4 Discharge Connection

- Make sure that the protection that was attached to prevent penetration of particles during transport has been removed before the vacuum pump is connected to the vacuum line



CAUTION

Do not put hands into the outlet aperture!

Risk of body damage!

The following instructions for connection to the discharge only apply if the sucked gas is discharged by the vacuum pump into a suitable environment.

- Make sure that the nominal diameter of the exhaust line is at least equal to the diameter of the exhaust flange of the vacuum pump to prevent a drop in the performance of the vacuum pump in the case of a smaller cross-section
- Make sure that the vacuum pump is connected with leakproof lines.



CAUTION

When the discharge lines have been connected, make sure that the system does not leak.

Leakages of dangerous substances must be prevented!

- Make sure that the discharge line is mounted in such a way that condensate cannot penetrate into the vacuum pump (siphon trap, gradient).
- Make sure that no shut-off devices are mounted in the discharge line.

- Make sure that the discharge lines do not exercise any force on the discharge flange. Mount bellows if necessary.
- The discharge flange has the following dimension:
 - DN 63 ISO-K

In the case of long discharge lines, the line cross-section should be larger than the discharge flange to prevent a drop in the performance of the vacuum pump. If you have any doubts, contact your Busch representative.

6.1.5 Cooling Water Connection

The cooling water is generally connected with a hose.
The cooling water outlet must be unpressurised.

Connection diameter	3/8 NPT
---------------------	----------------

6.1.6 Nitrogen Connection

The nitrogen is connected with a pipe (leakproof against oxygen).

Connection diameter	1/4 NPT
---------------------	----------------

6.1.7 Electrical Connection/ Checks

- Make sure that the regulations of the Electromagnetic Compatibility Directive 2014/30/EU as well as standard EN norms, safety directives and especially local and national regulations are observed, (this is the responsibility of the manufacturer of the system into which the vacuum pump is integrated according to the EU-Declaration of Conformity).
- Make sure that the main power supply corresponds to the data on the nameplate of the motor.
- Make sure that an overload cut-out according to EN 60204-1 is provided for the motor.
- Make sure that the drive of the vacuum pump is not disturbed by any electric or electromagnetic interferences. If you have any doubts, contact your Busch representative.

6.2 Installation

6.2.1 Mounting

- Make sure that the "Necessary installation instructions" are followed.
- Fasten or install the pump at its final installation site.

6.2.2 Electrical Connection



WARNING

Risk of electrocution, risk of damage.

Electrical installation must be performed by a suitably qualified electrician who knows and follows the following regulations:

- IEC 364 or CENELEC HD 384 or DIN VDE 0100,
- IEC Report 664 or DIN VDE 0110,
- VBG 4 or corresponding national regulations on accident prevention.



CAUTION

The circuit diagrams described below conform to the standard. Other circuit diagrams might be used. This depends on the particular order and the market.

Risk of damage to the motors!

Check the connection of the motors inside the terminal box according to the circuit diagram.

Motor of screw pump DS is connected at factory.

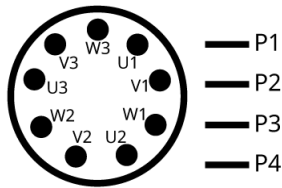


CAUTION

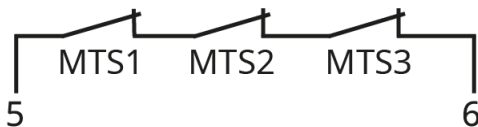
When connecting up the wires into the terminal box: please make sure the tightening torque of 2 Nm is adhered to and check with a calibrated torque wrench (Nuts M6).

DP Motor Connection

Motor connectors:



Connection of motor temperature switches (recommended):

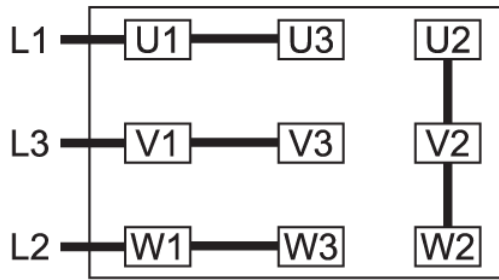


Control voltage: ≤ 250 V

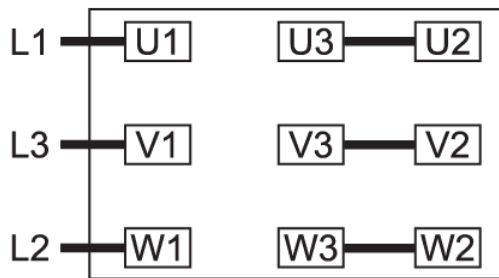
Max current: 1.6 A

MTS = Motor temperature switch (in motor coil)

Double star connection (low voltage):

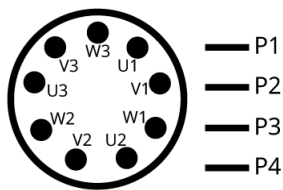


Star connection (high voltage):

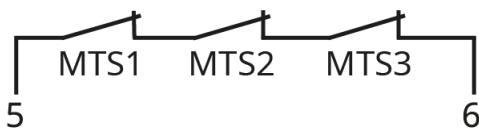


MB Motor Connection

Motor connectors:



Connection of motor temperature switches (recommended):

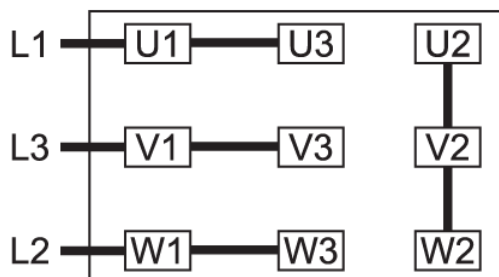


Control voltage: $\leq 250\text{ V}$

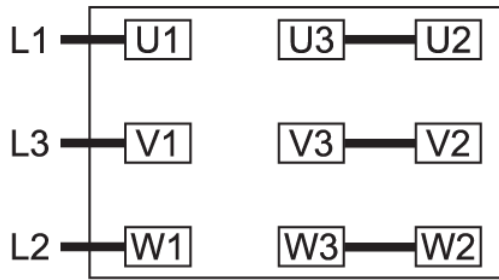
Max current: 1.6 A

MTS = Motor temperature switch (in motor coil)

Double star connection (low voltage):



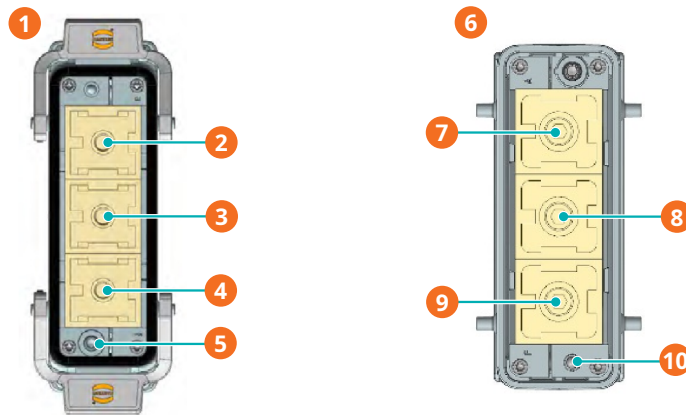
Star connection (high voltage):



6.2.2.1 Power Wiring Connection

Power wiring 4 poles	
1	Phase L1
2	Phase L2
3	Phase L3
4	Ground

6.2.2.2 Power Connector on Rear Side Power Connector (208V)



Description			
1	Pump side	2	Phase L1 (Pump side)
3	Phase L2 (Pump side)	4	Phase L3 (Pump side)
5	Ground (Pump side)	6	Mating connectors
7	Phase 1 (Mating connectors)	8	Phase 2 (Mating connectors)
9	Phase 3 (Mating connectors)	10	Ground (Mating connectors)

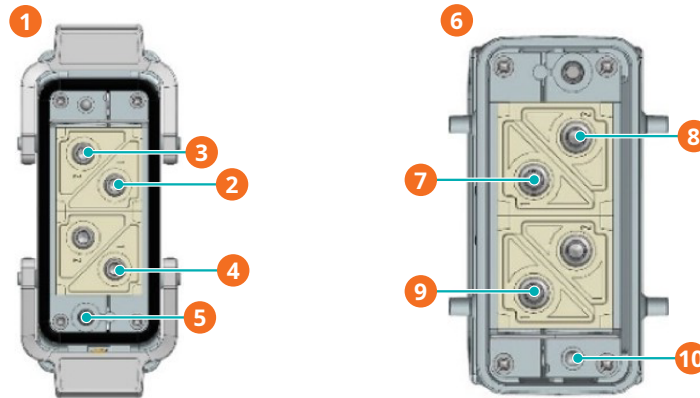
Pump side

Supplier	Part description	Part number
HARTING	Housing 24B, 2 Lever	0680800042
HARTING	Frame 24B, Marking a...f	0680800043
HARTING	Insert 200A, 25~40SQ, Male	0676800015
HARTING	PE Extension 16SQ	0680800098

Mating connectors

Supplier	Part description	Part number
HARTING	Housing 6B, Top entry, M32, 1 Lever	0680800049
HARTING	Frame 6B, Marking A...F	0680800041
HARTING	Insert 200A, 25~40SQ, Female	0676800016
HARTING	PE Extension 16SQ	0680800098

Power Connector (400V)



Description			
1	Pump side	2	Phase L1 (Pump side)
3	Phase L2 (Pump side)	4	Phase L3 (Pump side)
5	Ground (Pump side)	6	Mating connectors
7	Phase 1 (Mating connectors)	8	Phase 2 (Mating connectors)
9	Phase 3 (Mating connectors)	10	Ground (Mating connectors)

Pump side

Supplier	Part description	Part number
HARTING	Housing 16B, 2 Lever	0680700059
HARTING	Frame 16B, Marking a...f	0680700066
HARTING	Insert 100A, 16~35SQ, Male	0676700029
HARTING	PE Extension 16SQ	0680800098

Mating connectors

Supplier	Part description	Part number
HARTING	Housing 16B, 2 Lever	0680800050
HARTING	Frame 16B, Marking a...f	0680700065
HARTING	Insert 100A, 16~35SQ, Female	0676700028
HARTING	PE Extension 16SQ	0680800098

- Protect the vacuum pump with the electrical device according to the rated current of the vacuum pump.

CAUTION

If the vacuum pump is operated with a motor that turns in the wrong direction, it can be destroyed, even if this is the case for only a short moment.

- Make sure that the vacuum pump is connected correctly before switching it on.

- Determine rotation sense of the motor by using a phase rotation tester.
- Press on the start button.
- Make sure that the vacuum pump draws in.
- If not, push the Emergency stop button.

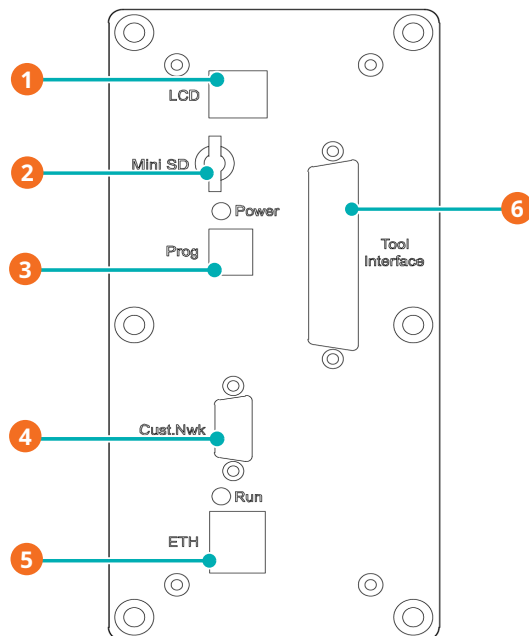
If the direction of rotation must be changed:

- Exchange two of the three feeder leads.

Electrical data

Frequency	I Rate		I Max		Icu	
	200-240V	380-480V	200-240V	380-480V	200-240V	380-480V
50 Hz/ 60 Hz	130A	69.5A	160A	100A	85kA	50kA

6.2.3 Equipment Connections (with Options)



Description	
1	LCD serial wiring (RJ12), LCD
2	Micro SD slot
3	PC serial wiring (only for Busch engineers)
4	Customer Network, Communication modbus RTU RS 232/ RS 485

Description			
5	Ethernet network connection (Busch Monitoring System - Option)	6	Interface connection (50 poles) / PID Interface

The information concerning the use of the Busch PLC and the Busch LCD can be found in the Operation and Maintenance manual (Art. No. 0870758077).

6.2.4 Connection of Lines/ Pipes

- Connect the intake lines.
- Connect the discharge lines.
- Make sure that all caps, safeguards, and similar covers are mounted.
- Make sure that the inlet and outlet for the cooling air are not covered or closed and that the flow of cooling air is not impaired in any way.

6.2.5 Oil Filling

NOTE

The COBRA DS vacuum pumps are generally dispatched with oil already in the vacuum pump. Before vacuum pump first startup, control the oil level.

In the event of absence of one or the other of these lubricants, please carry out the filling (see "Oil Type/ Quantity [→ 62]" for information on the recommended oils).

- Prepare the quantity of oil specified in the table "Oil Quantity [→ 62]".

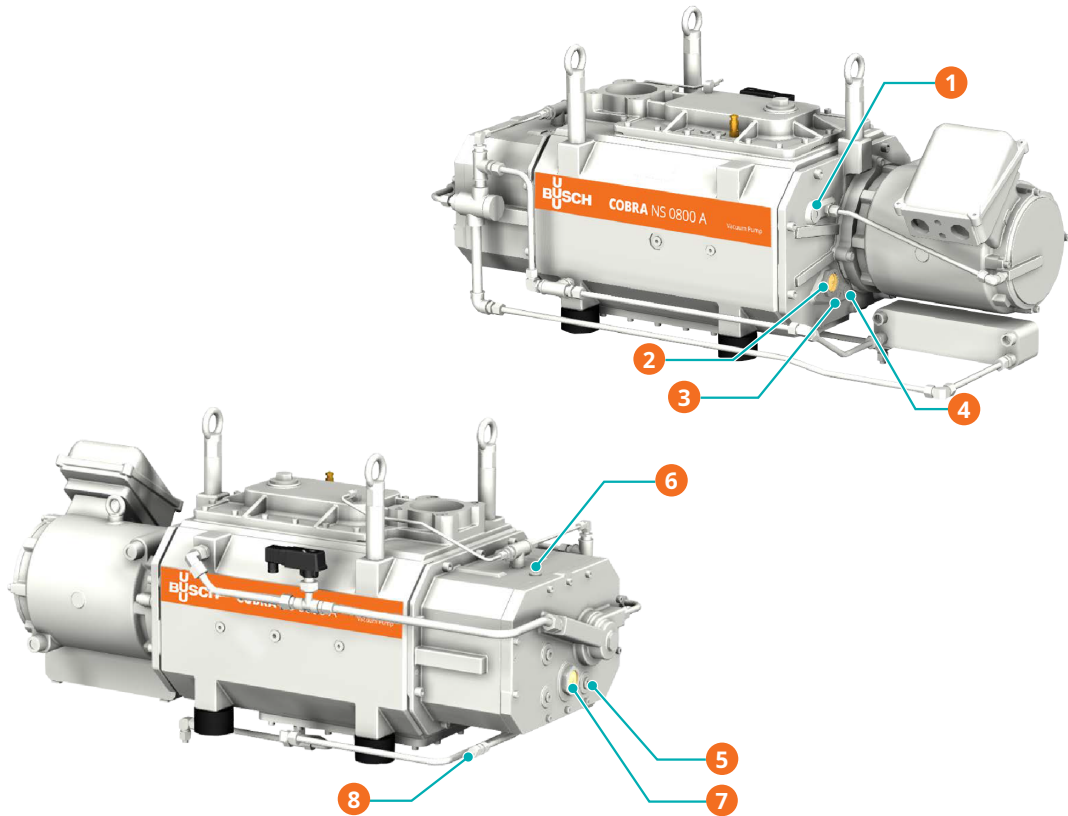
Oil filling	NS 0800 A	WY 3600 A
Oil quantity (Liter)	1.6	3.5
Oil type	Busch YLC 250 B, Art. No. 0831 131 400 (0,5 l ≈ 1 kg)	

6.2.5.1 COBRA NS 0800 A Oil Filling

- Prepare the quantity of oil specified in the table "Oil Quantity".

NOTE

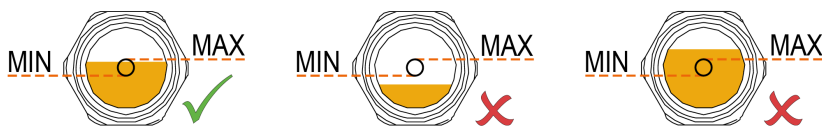
The quantity of oil specified in the installation handbook is of informative nature only. Check the oil level with the help of the various oil sight glasses (OSG1,2,3,4) on the vacuum pump.



Description			
1	Oil fill plug (OFP)	2	Oil sight glass (OSG)
3	Oil drain plug (ODP)	4	Oil drain plug, magnetic plug (ODP, MP)
5	Oil drain plug, magnetic plug (ODP, MP)	6	Oil fill plug (OFP)
7	Oil sight glass (OSG)	8	Oil drain plug (ODP)

- Unscrew the oil filler plugs (OFP).
- Fill up to the upper level of the target circle of the oil sight glasses (OSG). Make sure that the filling level is in the target circle of the oil sight glasses (OSG).

Oil level, pump not operating



- Make sure that the seal ring in the oil filler plugs is not damaged, replace plugs if necessary.
- Fit the oil filler plugs and tighten up.

NOTE

It is easier to switch on the vacuum pump with cold oil when the intake line is not closed or when the intake flange is not covered by a rubber plate.

- Start the vacuum pump.

If the intake line is equipped with a shut-off device:

- Close the shut-off device.

If the intake line is not equipped with a shut-off device:

- Place a rubber plate on the intake flange.
- Let the vacuum pump run for a few minutes.
- Stop the vacuum pump and wait for a few minutes.
- Make sure that the oil level still lies in the target circle of the oil sight glasses.

If the oil level is below the target circle:

- Fill in more oil.

If the intake line is equipped with a shut-off device:

- Open the shut-off device.

If the intake line is not equipped with a shut-off device:

- Remove the rubber plate from the intake flange and connect the intake line to the intake flange.



CAUTION

In case of a vacuum pump filled with oil, make sure that by lifting the inclination angle of the vacuum pump do not exceed 5° from the horizontal.

In case of too high inclination (>5°), risk of oil leak within the work area.

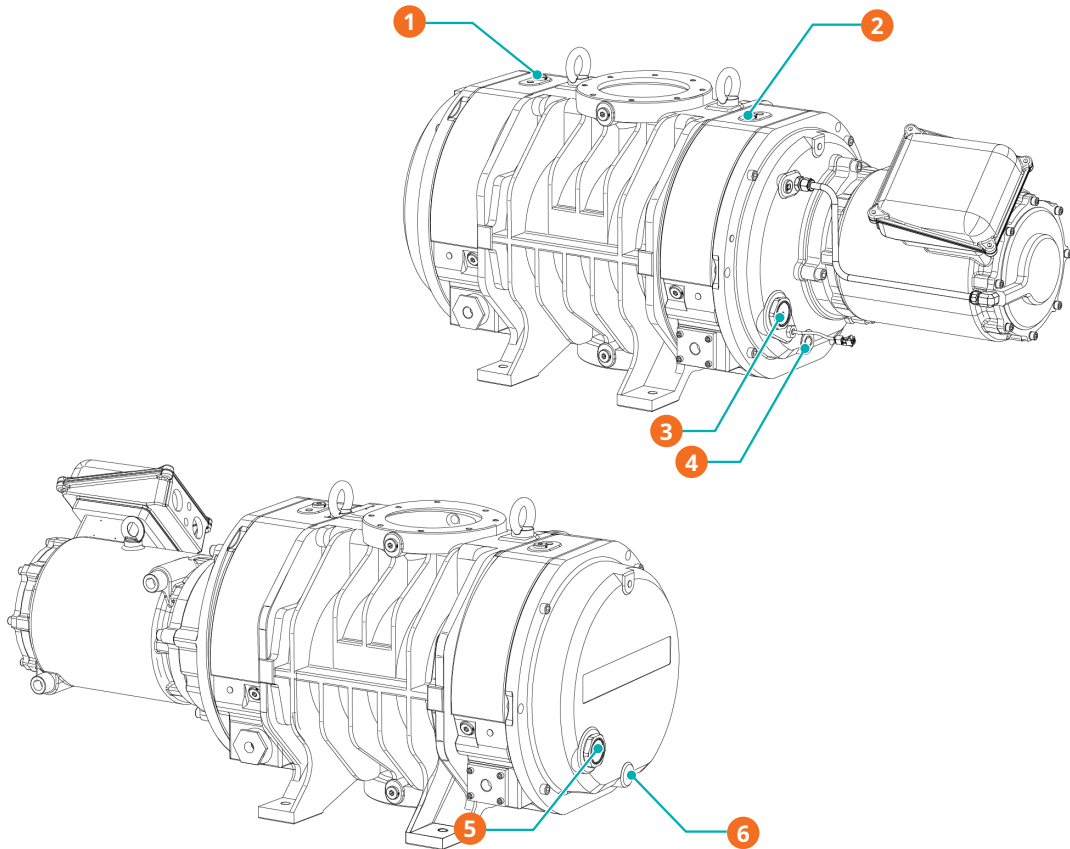
- Make sure before every transport using the appropriate lifting mean that the inclination of the vacuum pump is less than 5°.



CAUTION

The vacuum pump must remain in a horizontal position when it has been filled with oil.

6.2.5.2 PUMA WY 3600 A Oil Filling



Description			
1	Oil fill plug (OFP)	2	Oil fill plug (OFP)
3	Oil sight glass (OSG)	4	Oil drain plug (ODP)
5	Oil sight glass (OSG)	6	Oil drain plug (ODP)

i NOTE

The quantity of oil specified in the installation handbook is of informative nature only. Check the oil level with the help of the various oil sight glasses (OSG1,2,3,4) on the vacuum pump.

! CAUTION

Before you change the type of oil, make sure that the new type is compatible with the old type. If necessary, flush the vacuum pump.

- Unscrew the oil filler cap (OFP).
- Fill in oil.
- Make sure that the oil level lies in the target circle of the oil sight glasses.
- Make sure that the seals of the oil filler cap are not damaged. Replace them if necessary
- Screw on the oil filler cap hermetically tight.

**NOTE**

It is easier to switch on the vacuum pump with cold oil when the intake line is not closed or when the intake flange is not covered by a rubber plate.

DS vacuum pump:

- Start the vacuum pump.

If the intake line is equipped with a shut-off device:

- Close the shut-off device.

If the intake line is not equipped with a shut-off device:

- Place a rubber plate on the intake flange.
- Let the vacuum pump run for a few minutes.
- Stop the vacuum pump and wait a few minutes.

COBRA NS (DP) vacuum pump:

- Start the vacuum pump.

If the intake line is equipped with a shut-off device:

- Close the shut-off device.

If the intake line is not equipped with a shut-off device:

- Place a rubber plate on the intake flange.
- Let the vacuum pump run for a few minutes.

Booster (MB):

- Make sure that the oil level still lies in the target circle of the oil sight glasses.

If the oil level is below the target circle:

- Fill in more oil.

If the intake line is equipped with a shut-off device:

- Open the shut-off device.

If the intake line is not equipped with a shut-off device:

- Remove the rubber plate from the intake flange and connect the intake line to the intake flange.

**CAUTION**

In case of a vacuum pump filled with oil, make sure that by lifting the inclination angle of the vacuum pump do not exceed 5° from the horizontal.

In case of too high inclination (>5°), risk of oil leak within the work area.

- Make sure before every transport using the appropriate lifting mean that the inclination of the vacuum pump is less than 5°.

**CAUTION**

The vacuum pump must remain in a horizontal position when it has been filled with oil.

6.2.6 Cooling Liquid Filling



NOTE

The COBRA DS vacuum pumps are generally dispatched with cooling liquid already in the vacuum pump. Before vacuum pump first startup, control the cooling liquid level. In the event of absence of one or the other of these lubricants, please carry out the filling (see “*Cooling Liquid Type/ Quantity* [→ 63]” for information on the recommended cooling liquids).

- Prepare the quantity of cooling liquid specified in the table “*Cooling Liquid Quantity* [→ 63]”.

Cooling liquid filling	NS 0800 A
Cooling liquid quantity (Liter)	approx. 26 liters
Cooling liquid type	Glycol (Ethylene), Art. No. 0831 563 469, Zitrec M-25 (already mixed ready-to-use)

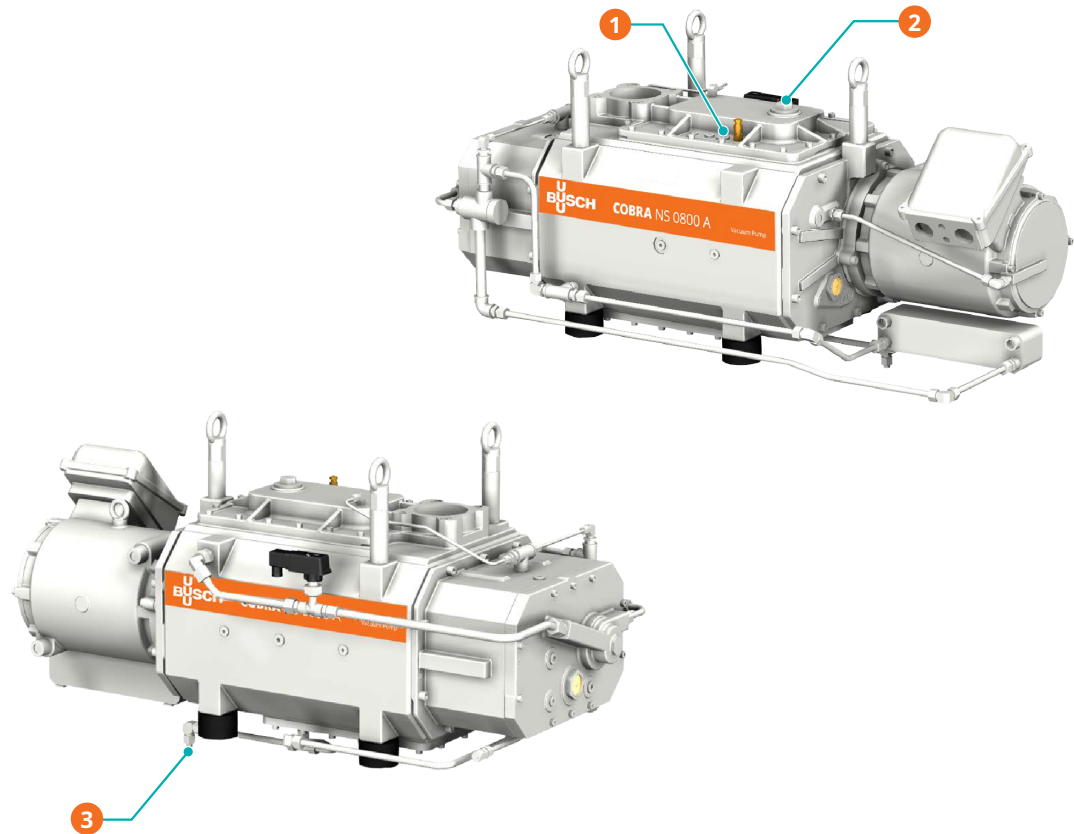
6.2.6.1 COBRA NS 0800 A Cooling Liquid Filling



NOTE

Cooling liquid does not normally have to be refilled outside the recommended change intervals. A drop in the level of the liquid indicates a fault (see “*Troubleshooting* [→ 60]”).

- Make sure that the vacuum pump has been switched off and that it cannot be switched on again accidentally.



Description

1	Cooling liquid vent plug (CLV)	2	Cooling liquid fill plug (CLF)
3	Cooling liquid drain plug (CLD)		

- Unscrew the filler cap (CLF) for the cooling liquid.
- Open purge cap (CLV) on cylinder upper plate and purge cap on cylinder endplate B-side.
- Fill in by filler hole until cooling liquid flows by purge cap on cylinder endplate B-side.
- Stop fill in.
- Close the purge cap on cylinder endplate B-side.
- Fill in again by filler hole until cooling liquid flows by purge cap of cylinder upper plate.
- Close the purge cap of cylinder upper plate.
- Stop fill in.
- Screw on the cooling liquid filler cap again.
- If liquid has run on to the outside surfaces of the vacuum pump, wipe it off.
- Start the vacuum pump
- If the intake line is equipped with a shut-off device:
 - Close the shut-off device.
- If the intake line is not equipped with a shut-off device:
 - Place a rubber plate on the intake flange.
 - Let the vacuum pump run for a few minutes
 - Stop the vacuum pump and wait a few minutes.

- Unscrew purge cap on cylinder upper plate.
- Control that cooling liquid level is just under cylinder upper plate.
- In case cooling liquid level is below required level:
 - Fill in more cooling liquid.
- If the intake line is equipped with a shut-off device:
 - Open the shut-off device.
- If the intake line is not equipped with a shut-off device:
 - Remove the rubber plate from the intake flange and connect the intake line to the intake flange.

6.2.7 Direct Cooling Checking

The flow of the cooling water is checked by the flow switch FS2. The flowmeter must be connected in such a way that switching-on leads to an alarm and stopping of the vacuum pump, when the flow drops below 9 l/min.

6.2.8 Nitrogen Supply Checking

The flow of the nitrogen is checked by the flowmeter FME. The flowmeter must be connected in such a way that switching-on leads to an alarm. The alarm limit can be adjusted depending the type of process.

6.2.9 Operating Parameters Saving

As soon as the vacuum pump is working under normal conditions after being switched on:

- Measure the working current of the motor and save it as reference value for all future maintenance and repair work.

6.3 Recommendations on Operation

6.3.1 Application



WARNING

The vacuum pump is designed for use under the conditions specified here.

If these conditions are not met, there is a risk of damage to or total destruction of the vacuum pump and its components!

The vacuum pump may only be switched on under the specified conditions.

The COBRA DS vacuum pumps are designed for use in the field of microelectronics and similar industries.

They can be used to suck gases and gas mixtures.



WARNING

When using toxic, inflammable and/or explosive gases, make sure that the system corresponds in design to applicable local and national safety regulations and that all applicable safety measures are followed.

All product-specific safety regulations must be observed.

Solid particles must not get into the vacuum pump. Procedural errors can result in the pump sucking in a certain quantity of liquid. If the pump has sucked in liquid, a short drying time is necessary at the end of the procedure.

The allowed maximum inlet gas temperature depends on the inlet pressure and the type of gas: the lower the inlet pressure (Pa), the higher the drawn gas temperature (T_{Gas}) can be.

The following indicative values for air can be considered:

Pa > 50 mbar	T _{Gas} < 80°C
Pa < 50 mbar	T _{Gas} < 200°C

The vacuum pump is intended for use in a potentially non-explosive environment.

- Make sure that the maximum permissible number of starts does not exceed 2 starts per hour. Those starts should be spread within the hour.

As far as temperature is concerned, the pump is suitable for continuous duty at any pressure between atmosphere and ultimate pressure.

The vacuum pump is tight down to ultimate pressure.



CAUTION

The surface temperature of the vacuum pump can exceed 50 °C when the vacuum pump is in operation.

Danger of burns!

The vacuum pump may not be touched when it is in operation. If touching the pump is unavoidable, wait until the surface temperature has cooled down or wear protective gloves.



CAUTION



The sound level of the vacuum pump within a certain perimeter of the vacuum pump is high. Risk of hearing damage.

Users who are spending a longer period in the vicinity of a non-insulated vacuum pump must wear suitable ear protection.



CAUTION

The COBRA DS vacuum pumps could be delivered without oil, without cooling water and without cooling liquid.

Operation without oil will result in damage to the vacuum pump!

The vacuum pump must remain in a horizontal position when it has been filled with oil.



CAUTION

The COBRA DS vacuum pumps are always delivered without oil, without cooling water and without cooling liquid.

Operation without coolants will result in damage to the vacuum pump!



CAUTION

The cooling water flow, which is checked by the flow switch FS2, must be at least 10 l/min.

- Make sure that all caps, safeguards, and similar covers are mounted.
- Make sure that the safeguards are switched on.
- Make sure that the inlet and outlet for the cooling air are not covered or closed and that the flow of cooling air is not impaired in any way.
- Make sure that the system does not leak. Leakages of dangerous substances must be prevented.
- Make sure that the “Necessary installation instructions” are followed and especially that adequate cooling is ensured.

The following must be noted when the vacuum pump is shut down for a longer period of time:



CAUTION

If there is a risk of frost, all the cooling water must be drained out of the vacuum pump if the pump is shut down for a longer period of time!

- Drain the cooling liquid.
 - Unscrew the filler cap for the cooling liquid.
 - Drain the cooling liquid completely.
 - Screw on the filler cap for the cooling liquid again.
 - Collect the cooling liquid and recycle it or dispose of it according to local or national regulations.
- Drain the cooling water
 - Pull off the connections for the inlet and outlet of the cooling water.
 - Drain the cooling water completely.
 - If necessary, drain the cooling water with the help of compressed air to prevent any risk of frost or corrosion.



NOTE

When the vacuum pump has not been in operation for a few days or when a sticky substance has been sucked, it is possible that the two scroll rotors of the NS (DP) vacuum pump will stick to each other. Screw opens the access cover to the scroll rotors. Loosen the rotors from each other with the help of an Allan key by turning them in clockwise direction by hand.

6.3.2 Switching the Vacuum Pump On/ Off

6.3.2.1 First Start-up of the System

- Make sure that the “Necessary installation instructions” are followed.

If the system is equipped with a solenoid gate valve in the cooling water circuit:

- Open the solenoid gate valve.
- Make sure that the cooling water flow is set correctly:

- The cooling water flow is factory set on 10 l/min and can be adjusted at the regulating valve CWR. This water circuit is used to cool the motor of the NS pump. It cools also the cylinder and cylinder endplate B-side when temperature of cooling liquid is above 50°C.
- Make sure that the nitrogen flow is set correctly:
- Nitrogen is used as dilution gas. It is injected inside the cylinder on two different places. Nitrogen flow FME injected in the middle hole is preset at 20 NI/min and can be adjusted with valve DGR1, depending on the application. Nitrogen flow injected in the hole on cylinder end-plate side is preset at 40 NI/min and can be adjusted with valve DGR2.
- Switch on the vacuum pump.
 - Make sure that the system does not leak.

If the system is equipped with a solenoid gate valve at the intake:

- Open the solenoid gate valve.

6.3.2.2 Switching the System Off

If the system is equipped with a solenoid gate valve at the intake:

- Close the solenoid gate valve.
- Switch off the vacuum pump.
- Shut off the nitrogen supply.
- Shut off the cooling water supply.

If the system is equipped with a solenoid gate valve in the cooling water circuit:

- Close the solenoid gate valve.
- Make sure that the system is current less.

6.4 Load Lock Operation Mode

LL Mode = Off

- The mode « Load Lock » is de-activated, the module DP and the module MB, when present, operate constantly at their maximum frequency of rotation.



NOTE

The parameters « DP (or MB) Current Level », « Time Before » and « DP Idle » are idle.



CAUTION

LL Mode = Off is not recommended for Load Lock cyclic pumping due to the current load and the mechanical stress with full speed.

LL Mode = Auto

- The mode Load Lock is activated and de-activated according to the current load taken in by the module DP (or MB). The current threshold is adjustable using the parameters « DP/MB Current Level ». When the current level exceeds the threshold, the modules DP and MB accelerate to their maximum frequency of rotation. When the current level drops below the threshold, a

time delay which is adjustable in its duration using the parameter « Time Before », will start. As soon as the time delay's duration has elapsed, the modules DP and MB slow down to their minimum frequency of rotation.



NOTE

- If the parameter « DP Idle » is configured to « Disable », the module DP runs constantly at maximum frequency of rotation.
- If the module is not controlled by a frequency inverter, module MB is started if the current level exceeds the threshold and is stopped if the current level drops below the threshold and if the time delay's duration has elapsed.

LL Mode = External

- The Load Lock mode is activated and de-activated depending on the digital input status « Remote Process On » which is available on the tool interface. When the input changes to status 1, the modules DP and MB accelerate to their maximum frequency of rotation. When the input changes to status 0, the modules DP and MB slow down to their minimum frequency of rotation.



NOTE

When the parameter « DP Idle » is configured to « Disable », the module DP runs constantly at the maximum frequency of rotation.

The parameters « DP (or MB) Current Level » and « Time Before » are idle.

Refer to chapter « Description of MENU 08 TOOL INTERFACE » for the configuration of the input « Remote Process On ».

If the module MB is not controlled by a frequency inverter, module MB is started if the input changes to status 1 and is stopped if the input changes to status 0.



CAUTION

The mode « Load Lock » will not work when:

The warming up cycle has not finished.

The mode maintenance is activated.



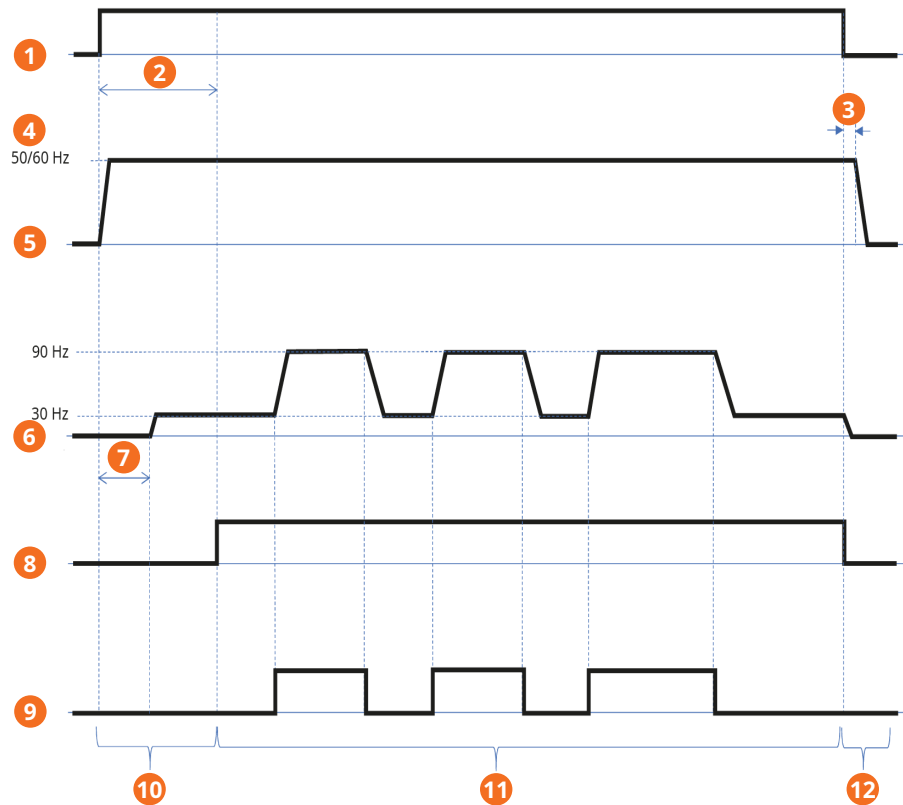
CAUTION

Be careful to set « Current level » and « Time Before » parameters regarding process cycle time and chamber size to be sure module MB is stopped or running idle speed before opening inlet valve.

Be careful to change input status to 0 before opening inlet valve.

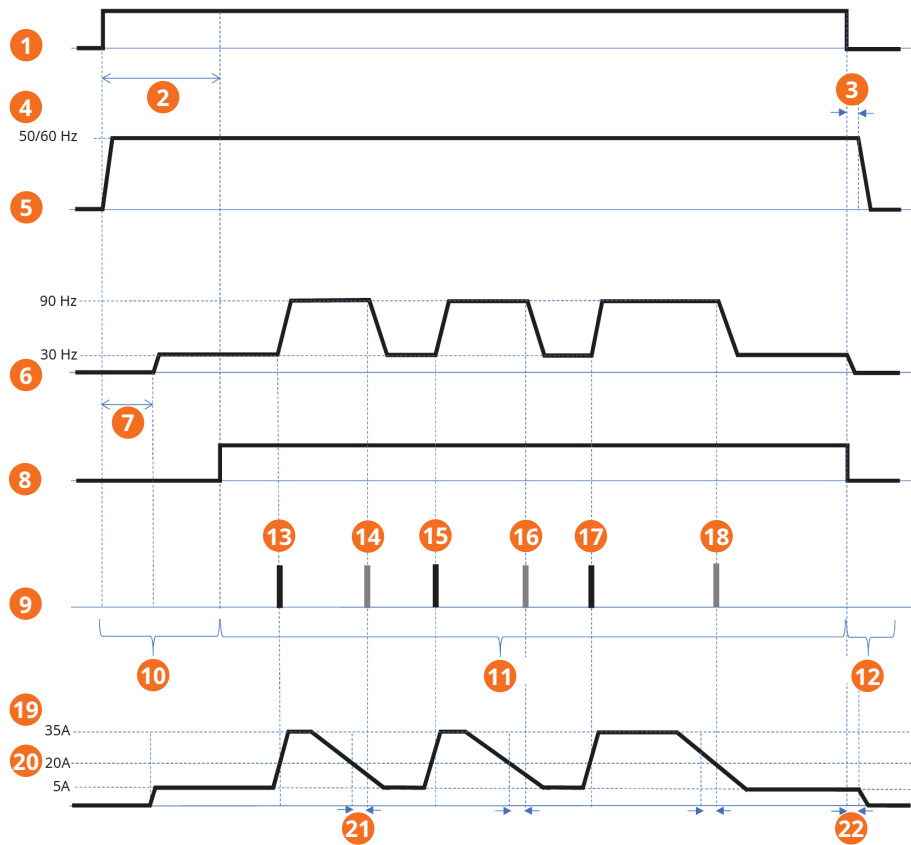
7 Standard Operational Time Chart

7.1 Signal Control Mode (Select LL Mode = EXTERN)



Description			
1	LCD start or Remote start (tool to pump)	2	1) Cold start
3	Delay (5 sec)	4	Pump speed
5	Dry pump	6	Booster
7	2/ MB on delay	8	Pump ready (pump to tool)
9	Process on (tool to pump)	10	Pump start-up
11	Processing	12	Pump stop

7.2 Current Control Mode (Select LL Mode = AUTO)



Description			
1	LCD start or Remote start (tool to pump)	2	1) Cold start
3	Delay (5 sec)	4	Pump speed
5	Dry pump	6	Booster
7	2/ MB on delay	8	Pump ready (pump to tool)
9	Chamber open/ close (gate valve on/ off)	10	Pump start-up
11	Processing	12	Pump stop
13	Open (on)	14	Close (off)
15	Open (on)	16	Close (off)
17	Open (on)	18	Close (off)
19	DP current	20	DP current level
21	Time before (40 sec)	22	Delay (5 sec)

Standard DP current level	DP current level	40A (200V)	20A (400V)
	Time before	40 seconds	
** it depends on the process time, chamber capacity and end vacuum level			
Standard setting (time)	• Cold start	900 seconds	
	• MB on delay	30 seconds	

8 Maintenance



DANGER

Live wires.

Risk of electrical shock.

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



DANGER



In case the vacuum pump has conveyed gases that have been contaminated with foreign materials that are dangerous to health, the oil and condensates will also be contaminated.

These foreign materials can infiltrate the pores, recesses, and other internal spaces of the vacuum pump.

Danger to health when the vacuum pump is dismantled.

Danger to the environment.

Always wear protective clothing when carrying out maintenance work.

Before any maintenance work, the inlet and outlet piping as well as the vacuum pump itself must be flushed with nitrogen.



CAUTION

Only authorized personnel may carry out dismantling work on the vacuum pump. Before work begins, the operator of the vacuum pump must fill in a form or a "Declaration of Contamination of Vacuum Equipment and Components" that provides information on possible dangers and appropriate measures.

If this form has not been filled in completely and signed, the vacuum pump may not be dismantled.



CAUTION

Before maintenance work is started, a safety area of at least 610 [mm] around the machine must be set up.



CAUTION

The surface temperature of the vacuum pump can exceed 50 °C when the vacuum pump is in operation.

Danger of burns!

The vacuum pump may not be touched when it is in operation. If touching the pump is unavoidable, wait until the surface temperature has cooled down or wear protective gloves.

Before starting maintenance work, make sure that the vacuum pump has been switched off and that it cannot be switched on again accidentally. Follow the shutdown procedure in the section "Lock Out/ Tag Out Procedure [→ 48]":

- Stop the pump with the LCD control (press on STOP button during 10s).
- Press on emergency stop button.
- Switch off the main circuit breaker.
- Switch off the customer's power supply.
- Switch off the water and nitrogen quick connections (inlet first, then outlet).
- Put the label or warning board "Maintenance processing" on or next to the vacuum pump.



CAUTION

The oil temperature can reach a value of 100°C!

The cooling liquid temperature can reach a value of 100°C!

Danger of burns!

- Make sure that the oil circuit and the coolant circuit have been emptied before moving the vacuum pump.
- Make sure that there are no cleaning tools in the pump anymore according to local and national regulations.

Before pulling off the different connections, make sure that the intake and exhaust lines of the vacuum pump correspond to atmospheric pressure

When the maintenance work has been finished, follow the procedure "Safety Lockout Procedure [→ 48]":

- Take off the label or warning board "Maintenance Processing".
- Check the cooling liquid and oil levels according to the chapters "Oil Level Checking [→ 48]" and "Cooling liquid Level Checking [→ 53]".
- Switch on the main circuit breaker.
- Release the emergency stop button.
- Switch on the water and nitrogen quick connections (outlet first, then inlet).
- Make sure that the "Necessary Installation Instructions" are followed.
- Start the pump with the LCD control (press on START button).

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
Weekly	<ul style="list-style-type: none"> ● Check the oil level, see “<i>Oil Level Checking</i> [→ 48]”. ● Check the cooling liquid, see “<i>Cooling Liquid Level Checking</i> [→ 53]”. ● Check the cooling water flow, see “<i>Cooling Water</i>” in “<i>Additional Checking</i> [→ 55]”. ● Check the nitrogen flow, see “<i>Nitrogen</i>” in “<i>Additional Checking</i> [→ 55]”. ● Check the vacuum pump for oil leaks - in case of leaks have the vacuum pump repaired (contact Busch). ● Check the vacuum pump for cooling liquid leaks - in case of leaks have the vacuum pump repaired (contact Busch). ● Check the vacuum pump for cooling water leaks - in case of leaks have the vacuum pump repaired (contact Busch).
Monthly	<ul style="list-style-type: none"> ● In the case of operation in a dusty environment: <ul style="list-style-type: none"> ● Make sure that the operating room is clean and free of dust; clean if necessary. ● Make sure that the vacuum pump has been switched off and that it cannot be switched on again accidentally. ● Check the electrical connections. ● Carry out a visual inspection of the vacuum pump.
Yearly	<ul style="list-style-type: none"> ● Make sure that the vacuum pump has been switched off and that it cannot be switched on again accidentally. ● Carry out a visual inspection and clean the machine from dust and dirt ● Check the electrical connections and the monitoring devices. ● Check the seals and replace if necessary. ● Check the intake and discharge lines and clean or replace if necessary.
Yearly If one or more of these accessories are installed.	<ul style="list-style-type: none"> ● If the intake is equipped with a sieve: <ul style="list-style-type: none"> ● Check the sieve at the intake and clean if necessary. ● Check the measuring and safety equipment for working order. ● If the discharge is equipped with a silencer (SI): <ul style="list-style-type: none"> ● Bleed the condensation of the silencer (SI) through the purge system ● If the discharge is equipped with a leak-protection non-return valve: <ul style="list-style-type: none"> ● Clean the leak-protection non-return valve. ● Drain the cooling liquid (see “<i>Cooling Liquid Draining</i> [→ 54]”). ● Check the ventilator filter (RF), clean if necessary. ● If the cooling water line is equipped with a filter: <ul style="list-style-type: none"> ● Check the filter and clean or replace if necessary.
Every 5000 hours or after 1 year	<ul style="list-style-type: none"> ● Change the cooling liquid, see “<i>Cooling Liquid Draining</i> [→ 54]”. ● Clean the magnetic plugs (MP).

Interval	Maintenance work
Every 16000 hours or after 4 years	<ul style="list-style-type: none"> Change the oil of the gear and bearing housings (both sides), see "Oil Change [→ 50]". Have a major overhaul on the vacuum pump (contact Busch).

8.1.1 Lock Out/ Tag Out Procedure

- Stop the pump with the LCD control (press on STOP button during 10s).
- Press on emergency stop button.
- Switch off the main circuit breaker.
- Switch off the customer's power supply.
- Switch off the water and nitrogen quick connections (inlet first, then outlet).
- Put the label or warning board "Maintenance Processing" on or next to the vacuum pump.

8.1.2 Safety Lockout Procedure

- Take off the label or warning board "Maintenance Processing".
- Check the cooling liquid and oil levels according to the chapters "Oil Level Checking [→ 48]" and "Cooling Liquid Level Checking [→ 53]".
- Open the power box cover and check that the FDP1 thermal relay is on manual reset position.
- Close the cover.
- Switch on the main circuit breaker.
- Release the emergency stop button.
- Switch on the water and nitrogen quick connections (outlet first, then inlet).
- Make sure that the "Necessary Installation Instructions" are followed.
- Start the pump with the LCD control (press on START button).

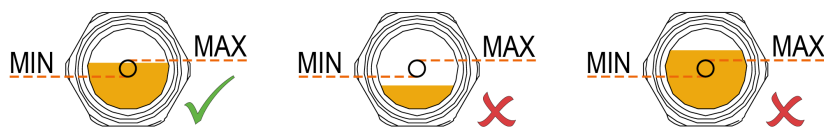
8.2 Oil Checking

8.2.1 Oil Level Checking

Make sure that the vacuum pump has been switched off and that it cannot be switched on again accidentally.

Indication of the oil level on the various oil sight glasses (OSG 1,2,3,4).

Oil level, pump not operating



COBRA NS (DP) vacuum pump:

If the oil level lies below the target circle:

- Top up with oil (see "Refilling oil")

If the oil level exceeds the target circle:

- Check the condensate drain
- Drain the oil (see "Draining the oil")

Booster (MB):

If the oil level lies below the target circle:

- Top up with oil (see "Refilling oil")

If the oil level exceeds the target circle:

- Check the condensate drain
- Drain the oil (see "Draining the oil")

8.2.2 Oil Refilling



NOTE

Oil does not normally have to be refilled outside the recommended oil change intervals. A drop in the oil level indicates a fault (see "Alarms and warnings -> Busch PLC and Busch LCD").



CAUTION

Only fill in oil through the oil filler opening.



CAUTION

Danger of burns when the oil filler cap is open.

Danger of injuries when the oil filler cap is not screwed on properly.

Only unscrew the oil filler cap when the vacuum pump has been switched off.

The vacuum pump may only be switched on when the oil filler cap is properly closed and tight.

We recommend submitting the pump to a leakage rate test in order to ensure the pump is leak tight.

- Make sure that the vacuum pump has been switched off and that it cannot be switched on again accidentally.
- Unscrew the oil filler caps (OFP) of the DP and MB vacuum pumps (if necessary).

COBRA NS (DP) vacuum pump:

- Fill in oil up to the top of the target circle of the oil sight glasses.
- Make sure that the oil level is in the top of target circle of the oil sight glasses.
- Make sure that the seals of the filler cap are not damaged and that they sit properly. Replace them if necessary.
- Screw on the filler cap again.

Booster (MB):

- Fill in oil up to the top of the target circle of the oil sight glasses.
- Make sure that the oil level is in the top of target circle of the oil sight glasses.
- Make sure that the seals of the filler cap are not damaged and that they sit properly. Replace them if necessary.
- Screw on the filler cap again.
- Fill up to the upper level of the target circle of the oil sight glasses (OSG) or middle of the oil sight glass (Booster).

- Make sure that the oil level still lies in the target circle or between the MIN and MAX markings (Booster) on the oil sight glasses.
- Make sure that the seals of the filler cap are not damaged and that they sit properly. Replace them if necessary. Screw on the filler cap again.

8.2.3 Oil Color Inspection



WARNING

Oil "YLC 250 B" contaminated chemically or by foreign bodies.

Risk of explosion!

If the oil becomes dark:

- Contact your Busch representative without delay.

- Make sure that the oil is either light or transparent.

If the oil becomes dark or looks different from the initial color:

- Change the oil immediately, see Oil Change.



You can consult your Busch representative in order to find out why this color change has occurred.

8.2.4 Oil Change



DANGER

If the vacuum pump has pumped gases that were contaminated with foreign bodies that are hazardous to health, the oil is also contaminated with these foreign bodies.

There is a health hazard when changing contaminated oil. There is also a danger to the environment.

Wear protective clothing when replacing contaminated oil.

Contaminated oil must be treated specially and must be disposed of according to applicable regulations.

8.2.4.1 Used Oil Draining

NOTE

After switching off the vacuum pump at normal operating temperature wait no more than 20 minutes before the oil is drained.

- Make sure that the vacuum pump is switched off and cannot accidentally be switched on again.
- Make sure that the vacuum pump is vented to atmospheric pressure.

COBRA NS (DP) vacuum pump:

- Put a drain tray underneath the oil drain plugs (ODP).
- Remove the oil drain plugs (ODP).
- Carefully remove the drain plugs.
- Drain the oil.
- Because of wear and tear on the seals replace the current drain plugs with new ones.

When the oil flow has stopped:

- Close the oil drain plugs (ODP).
- Switch on the vacuum pump for a few seconds.
- Make sure that the vacuum pump is switched off and cannot accidentally be switched on again.
- Remove the oil drain plugs again and drain any remaining oil.
- Check that no metal swarf sticks to the magnet of the drain plug, clean if necessary.
- Refit the oil drain plugs and tighten up.
- Dispose of the used oil in compliance with applicable regulations.

**CAUTION**

Because the ends of the drain plugs are magnetic, metal swarf can stick to them. Always clean away this swarf when removing the drain plugs.

Because of wear and tear of the seals, it is recommended to replace the drain plugs whenever the oil is changed.

Booster (MB):

- Put a drain tray underneath the oil drain plugs (ODP).
- Unscrew the oil drain plugs (ODP).
- Drain the oil.

When the oil flow has stopped:

- Refit the oil drain plugs (ODP) again.
- Switch on the vacuum pump for a brief moment and let it run for a few seconds.
- Make sure that the vacuum pump is switched off and cannot accidentally be switched on again.
- Carefully remove the oil drain plugs again and drain any remaining oil.
- Make sure that the seals of the drain plugs are not damaged and that they sit properly. Replace them if necessary.
- Refit the oil drain plugs and tighten them up.
- Dispose of the used oil in compliance with applicable regulations.

8.2.4.2**New Oil Filling****COBRA NS (DP) vacuum pump:**

- Prepare the quantity of oil needed (see "Oil Type/ Quantity [→ 62]").

**CAUTION**

The use of chemically contaminated or polluted oil can lead to hazardous pump conditions which could cause personal injury.

**NOTE**

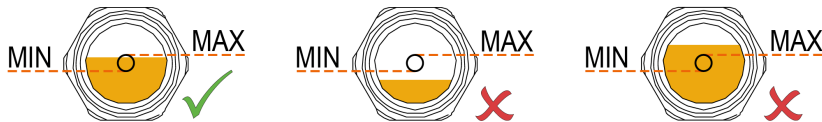
The quantity of oil specified in the Instruction Manual is of informative nature only. Check the oil level with the help of the various oil sight glasses on the vacuum pump.

- Make sure that the drain plugs have been fitted properly and that they do not leak.

**CAUTION**

Only fill in oil through the oil filler opening.

- Make sure that the vacuum pump has been switched off and that it cannot be switched on again accidentally.
- Unscrew the oil filler cap (OFP)

Oil level, pump not operating

- Fill up to the upper level of the target circle of the oil sight glasses (OSG).
- Make sure that the oil level still lies in the target circle of the oil sight glasses.
- Make sure that the seals of the filler cap are not damaged and that they sit properly. Replace them if necessary.
- Screw on the filler cap again.

Booster (MB):

- Prepare the quantity of oil needed (see "Oil Type/ Quantity [→ 62]").

**CAUTION**

The use of chemically contaminated or polluted oil can lead to hazardous pump conditions which could cause personal injury.

**NOTE**

The quantity of oil specified in the Instruction Manual is of informative nature only. Check the oil level with the help of the various oil sight glasses on the vacuum pump.

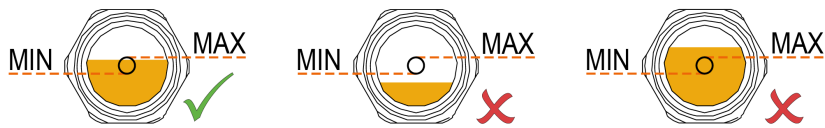
- Make sure that the drain plugs have been fitted properly and that they do not leak.

**CAUTION**

Only fill in oil through the oil filler opening.

- Make sure that the vacuum pump has been switched off and that it cannot be switched on again accidentally.
- Unscrew the oil filler cap (OFF)

Oil level, pump not operating



- Fill up to the upper level of the target circle of the oil sight glasses (OSG).
- Make sure that the oil level still lies in the target circle of the oil sight glasses.
- Make sure that the seals of the filler cap are not damaged and that they sit properly. Replace them if necessary.
- Screw on the filler cap again.
- Fill up to the upper level of the target circle of the oil sight glasses (OSG) or middle of the oil sight glass (Booster).
- Make sure that the oil level still lies in the target circle or between the MIN and MAX markings (Booster) on the oil sight glasses.
- Make sure that the seals of the filler cap are not damaged and that they sit properly. Replace them if necessary. Screw on the filler cap again.

8.3 Cooling Liquid Checking

8.3.1 Cooling Liquid Level Checking

- Make sure that the vacuum pump has been switched off and that it cannot be switched on again accidentally.
- Let the vacuum pump cool down.
- Check the level of the cooling liquid.
- Unscrew purge cap (CLV) on cylinder upper plate.
- Cooling liquid level should be just under the plate.

If the level is below:

- Top up with cooling liquid (see "Cooling Liquid Refilling").

8.3.2 Cooling Liquid Refilling

i NOTE

Cooling liquid does not normally have to be refilled outside the recommended change intervals. A drop in the level of the liquid indicates a fault (see "Troubleshooting [→ 60]").

- Make sure that the vacuum pump has been switched off and that it cannot be switched on again accidentally.
- Unscrew the filler cap (CLF) for the cooling liquid.
- Open purge cap (CLV) on cylinder upper plate and purge cap on cylinder endplate B-side.
- Fill in by filler hole until cooling liquid flows by purge cap on cylinder endplate B-side.
- Stop fill in.
- Close the purge cap on cylinder endplate B-side.

- Fill in again by filler hole until cooling liquid flows by purge cap of cylinder upper plate.
- Close the purge cap of cylinder upper plate.
- Stop fill in.
- Screw on the cooling liquid filler cap again.
- Open the plug on cylinder upper plate.
- Fill in cooling liquid by filler hole until the cooling liquid flows of the plug on cylinder upper plate.
- Stop the filling.
- Close the cooling liquid filler plug (CLF) on the expansion vessel.
- Fit the plug on cylinder upper plate.
- Make sure that the seal rings of the cooling liquid filler plug (CLF) and cooling liquid drain plug (CLD) are not damaged, replace plugs if necessary.
- If liquid has run on to the outside surfaces of the vacuum pump, wipe it off.

8.3.3 Cooling Liquid Draining

- Make sure that the vacuum pump has been switched off and that it cannot be switched on again accidentally.
- Make sure that the vacuum pump has adjusted to atmospheric pressure.
- Place a container under the drain plug (CLD) for the cooling liquid.
- Unscrew purge cap on cylinder upper plate.
- Unscrew purge cap on cylinder endplate B-side.
- Unscrew drain plug of cooling liquid.
- Drain the cooling liquid.

When cooling liquid stops running out:

- Close the drain plug for the cooling liquid.
- Screw purge caps.
- Screw the drain plug.
- Switch on the vacuum pump and let it run for a few seconds.
- Make sure that the vacuum pump has been switched off and that it cannot be switched on again accidentally.
- Unscrew again purge cap (CLV) on cylinder upper plate.
- Unscrew again purge cap (CLV) on cylinder endplate B-side.
- Unscrew the drain plug for the cooling liquid again and drain the remaining liquid.
- Make sure that the seal of the drain plug is not damaged and that it sits properly. Replace it if necessary.
- Screw purge caps.
- Screw on the drain plug again.
- Dispose of the used cooling liquid according to applicable environmental protection regulations.

8.3.4 New Cooling Liquid Filling

- Prepare the quantity of cooling liquid needed (see "*Cooling Liquid Type/ Quantity* [→ 63]").



NOTE

The quantity of cooling liquid specified is of informative nature only. Respect the procedure of filling the cooling liquid.

- Make sure that the drain plug sits properly and does not leak.
- Unscrew purge cap on cylinder upper plate.
- Unscrew purge cap on cylinder endplate B-side.
- Unscrew the filler cap for the cooling liquid.
- Fill in by filler hole until cooling liquid flows by purge cap of cylinder endplate B-side.
- Stop fill in.
- Close the purge cap on cylinder endplate B-side.
- Fill in again by filler hole until cooling liquid flows by purge cap of cylinder upper plate.
- Close the purge cap on cylinder upper plate.
- Make sure that the seal of the filler cap are not damaged and that they sit properly. Replace them if necessary.
- Wipe cooling liquid that may have run on outside surfaces of vacuum pump.
- Start the vacuum pump.

8.4 Additional Checking

Subject	Checking
Cooling Water	<ul style="list-style-type: none"> • Check the cooling water flow. If the flow drops, check for leaks: <ul style="list-style-type: none"> • Make sure that the cooling water specifications are followed.
Nitrogen	<ul style="list-style-type: none"> • Check the nitrogen flow. If the flow drops, check for leaks: <ul style="list-style-type: none"> • Make sure that the nitrogen specifications are followed.
Current Consumption	<ul style="list-style-type: none"> • Check the current intensity of the motor. An increased intensity is an indication for a fault (see " <i>Troubleshooting</i> [→ 60]").
Silencer (Accessory)	<ul style="list-style-type: none"> • Make sure that the condensate does not collect at the exhaust of the vacuum pump. • Drain the condensate at the drain opening and collect it in a container. • Dispose of the condensate according to applicable environmental protection regulations. • Check the silencer regularly and clean it if necessary.
Leak-protection Non-return Valve (Accessory)	<ul style="list-style-type: none"> • Check the leak-protection non-return valve regularly and clean it if necessary.



Wear protective clothing when carrying out maintenance work on the silencer and leak-protection non-return valve.

There could still be residues of contamination.

9 Overhaul

CAUTION

Inappropriate maintenance work on the vacuum pump can damage the vacuum pump.

Danger of explosion!

- If requirements are not met, the vacuum pump may not be switched on!
- Should work exceed the dismantling work described in this handbook, it may only be carried out by authorized persons.



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

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

10 Removal from Service



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.

10.1 Temporary Removal from Service

Before disconnecting the intake and exhaust lines and switching off the cooling water and nitrogen lines, make sure that the lines have adjusted to atmospheric pressure.

10.2 Recommissioning



CAUTION

After a long period of inactivity, it is possible that the rotor screws of the COBRA NS vacuum pump are stuck.

Turn the rotor screws manually.

- Make sure that the various protective elements, stoppers, or adhesive tapes have been removed.
- Switch on the vacuum pump by following the procedure described in "Installation and Commissioning [→ 63]".

10.3 Dismantling and Disposal



DANGER



In case the vacuum pump has conveyed gases that have been contaminated with harmful foreign material which are harmful to health, the oil and the condensates will also be contaminated with harmful foreign material.

These foreign materials can infiltrate the pores, recesses, and other internal spaces of the vacuum pump.

Danger to health during dismantling of the vacuum pump.

Danger to the environment.

During dismantling of the vacuum pump protective equipment and clothing must be worn.

Prior to shipping, the vacuum pump must imperatively be decontaminated, and the degree of contamination must be documented in a declaration of decontamination ("Declaration of Decontamination"), which can be downloaded from www.buschvacuum.com.

Used oil and condensates must be disposed of separately in compliance with applicable environmental regulations.

When the product has reached the end of its lifetime:

- decontaminate the vacuum pump.



CAUTION

Only authorized personnel may carry out dismantling work on the vacuum pump. Before work begins, the operator of the vacuum pump must fill in a form or a "Declaration of Decontamination" that provides information on possible dangers and appropriate measures.

If this form has not been filled in completely and signed, the vacuum pump may not be dismantled.

- drain the oil.
- dispose of the oil according to local environmental protection regulations.
- drain the cooling liquid.
- dispose of the cooling liquid according to local environmental protection regulations.
- begin dismantling the vacuum pump.



CAUTION



During dismantling of the vacuum pump protective equipment and clothing must be worn.

- dispose of the vacuum pump as scrap metal.
- dispose of the individual parts of the machine according to local regulations.

A lithium battery is present inside the PLC:

- eliminate the lithium battery according to local and national regulations in place, relating to environment.

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!

- Before doing anything that requires touching the machine, let it 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 Conveying Condensable Vapours.
	The motor is defective.	<ul style="list-style-type: none"> • Replace the motor.

Problem	Possible Cause	Remedy
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.
	If an inlet screen or an inlet filter is installed, it can be partially clogged.	<ul style="list-style-type: none"> • Clean the inlet screen or replace the inlet filter cartridge.
	The machine runs in the wrong direction.	<ul style="list-style-type: none"> • Check the direction of rotation, see Wiring Diagram Three-Phase Motor (Pump Drive).
	Internal parts are worn or damaged.	<ul style="list-style-type: none"> • Repair the machine (contact Busch).
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 Oil.
	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 Cooling Water Connection.
	Ambient temperature too high.	<ul style="list-style-type: none"> • Observe the permitted ambient temperature, see Technical Data.
	Temperature of the process gases at the inlet too high.	<ul style="list-style-type: none"> • Observe the permitted gas inlet temperature, see Technical Data.
	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 Oil Change.
	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 Oil Type/ Quantity

13.1 Oil Type

Make sure that the oil type corresponds to specifications:

YLC 250 B	
ISO-VG	250
Oil Type	Synthetic
Part number 0.5 L packaging	0831 131 400
Part number 1 L packaging	0831 108 878
Part number 5 L packaging	0831 108 879



CAUTION

The use of chemically contaminated or polluted oil can lead to hazardous pump conditions which could cause personal injury.

13.2 Oil Quantity

The quantity of oil specified in the following table is of informative nature only. Check the oil level with the help of the various oil sight glasses on the vacuum pump.

Quantity (l)	Motor side (A)	Inlet side (B)
NS 0800 A	0,8	0,8
Quantity (l)	Motor side (A)	Gear side (B)
WY 3600 A	1,3	2,2

14 Cooling Liquid Type/ Quantity

14.1 Cooling Liquid Type

Make sure that the Cooling Liquid type corresponds to specifications:

Zitrec M-25 (ready-to-use)	
Part number 25 L packaging	0831 563 468
Part number 5 L packaging	0831 563 469

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.

14.2 Cooling Liquid Quantity

The quantity of cooling liquid specified in this Instruction Manual is of informative nature only. Respect the procedure of filling the cooling liquid.

Cooling liquid filling	NS 0800 A
Cooling liquid quantity (Liter)	approx. 26 liters
Cooling liquid type	Glycol (Ethylene), Art. No. 0831 563 469, Zitrec M-25 (already mixed ready-to-use)



CAUTION

The proportion of pure glycol and water for the cooling liquid corresponds to a percentage of 40% pure glycol and 60% water. It is therefore not necessary to prepare the mix before use. But when using pure glycol, it is imperative to prepare the mix prior to filling the vacuum pump and to respect this proportion.

15 Technical Data

DS 3181 C		
Nominal pumping speed	m ³ /h	3500
	ACFM (60 Hz)	2059.8
Ultimate pressure	TORR	0.00075
	hPa (mbar)	0.001
Nominal motor rating backing pump	kW (60 Hz)	18.5
Nominal motor rating vacuum booster	kW (90 Hz)	15.0
Power consumption at ultimate pressure	kW MB: (90 Hz)	12.4
Power consumption at ultimate pressure / idle mode	kW MB: (30 Hz)	10.3
Maximal intensity Δ	A	35
Nominal motor speed backing pump	min ⁻¹ (60 Hz)	4320
Nominal motor speed vacuum booster	min ⁻¹ (90 Hz)	5400
Noise level (ISO 2151) *	dB(A) (50 / 60 Hz)	< 75
Ambient temperature range	°C	0 - 40
	°F	32 - 104
Maximum allowable counter pressure at discharge	hPa (mbar)	200
Water consumption	l/min	min. 10
Cooling water temperature	°C	10 - 25
Cooling water pressure	bar / ΔP	2 - 5
Nitrogen consumption	l/min	0 - 200
Nitrogen overpressure	bar	1.5
Weight approx.	kg	1500

* with silencer at exhaust

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

Busch Manufacturing Korea, Ltd.
189-51, Soicheon-ro, Majang-myun
Icheon-si, Gyunggi-do, 467-813
Republic of Korea

declares that the machine: COBRA DS 3181 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:

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

Icheon-si, 29.06.2023



Seung-hwa Yoo

General Manager

Busch Manufacturing Korea, Ltd

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

Busch Manufacturing Korea, Ltd.
189-51, Soicheon-ro, Majang-myun
Icheon-si, Gyunggi-do, 467-813
Republic of Korea

declares that the machine: COBRA DS 3181 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 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

Icheon-si, 29.06.2023



Seung-hwa Yoo

General Manager

Busch Manufacturing Korea, Ltd

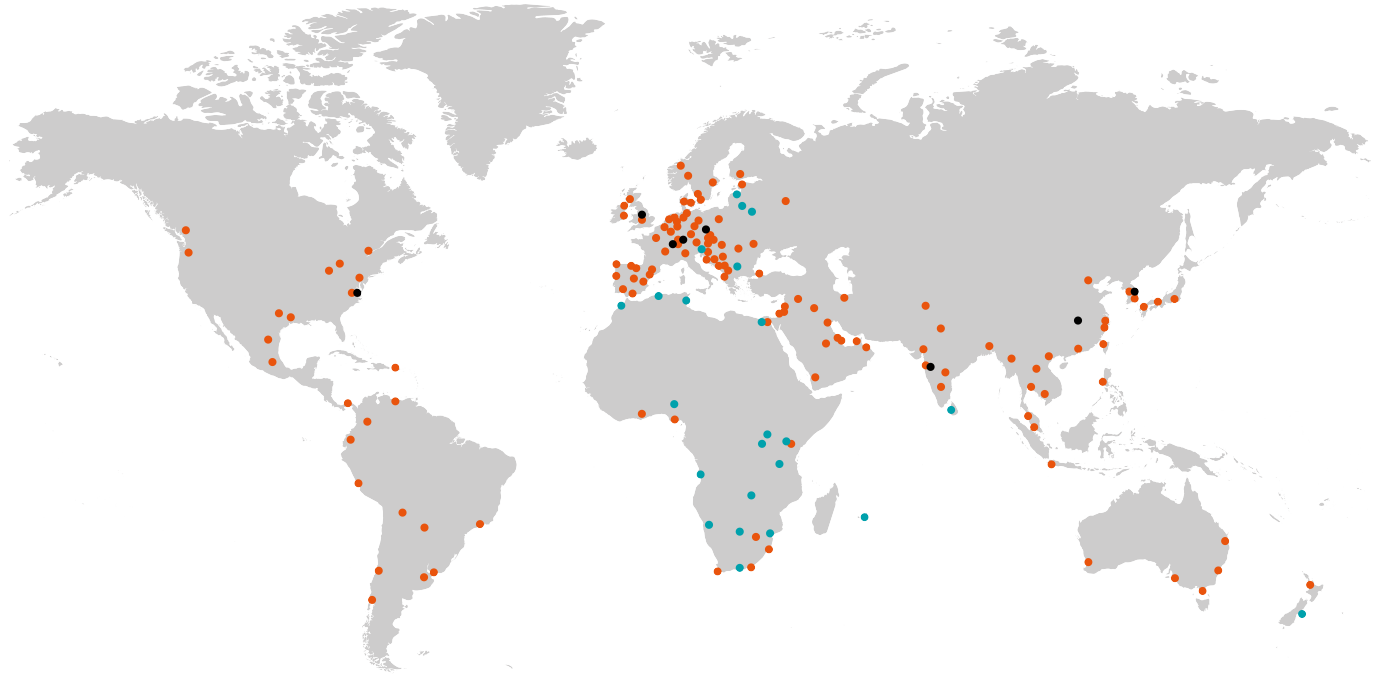
Notes

A large grid of small dots for taking notes, consisting of approximately 30 columns and 40 rows.

Busch

Vacuum Solutions

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



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

www.buschvacuum.com