



VACUUM SOLUTIONS

Part of the **BUSCH** GROUP

COBRA

Dry Screw Vacuum Pumps
DS 9161 B

Instruction Manual

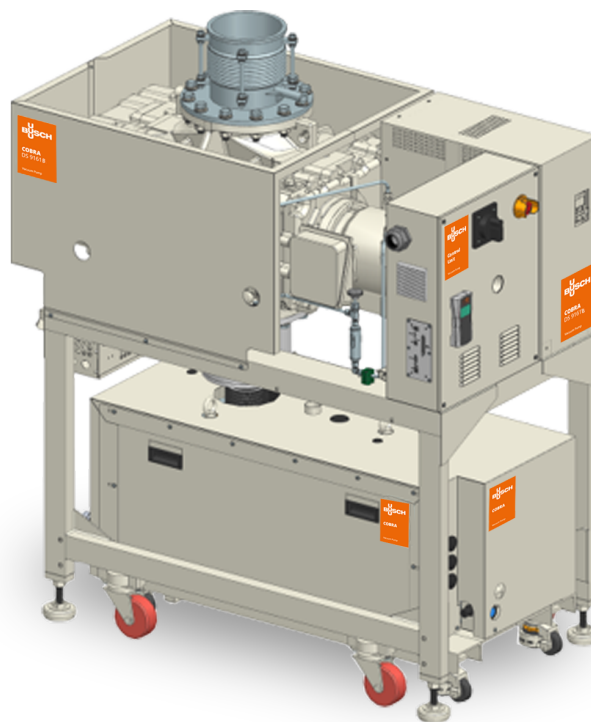


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1 Preface

1.1 Congratulations on your purchase

Congratulations on your purchase of COBRA DS 9161 B vacuum pump. With watchful observation of the field's requirements, innovation and steady development, we deliver 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.

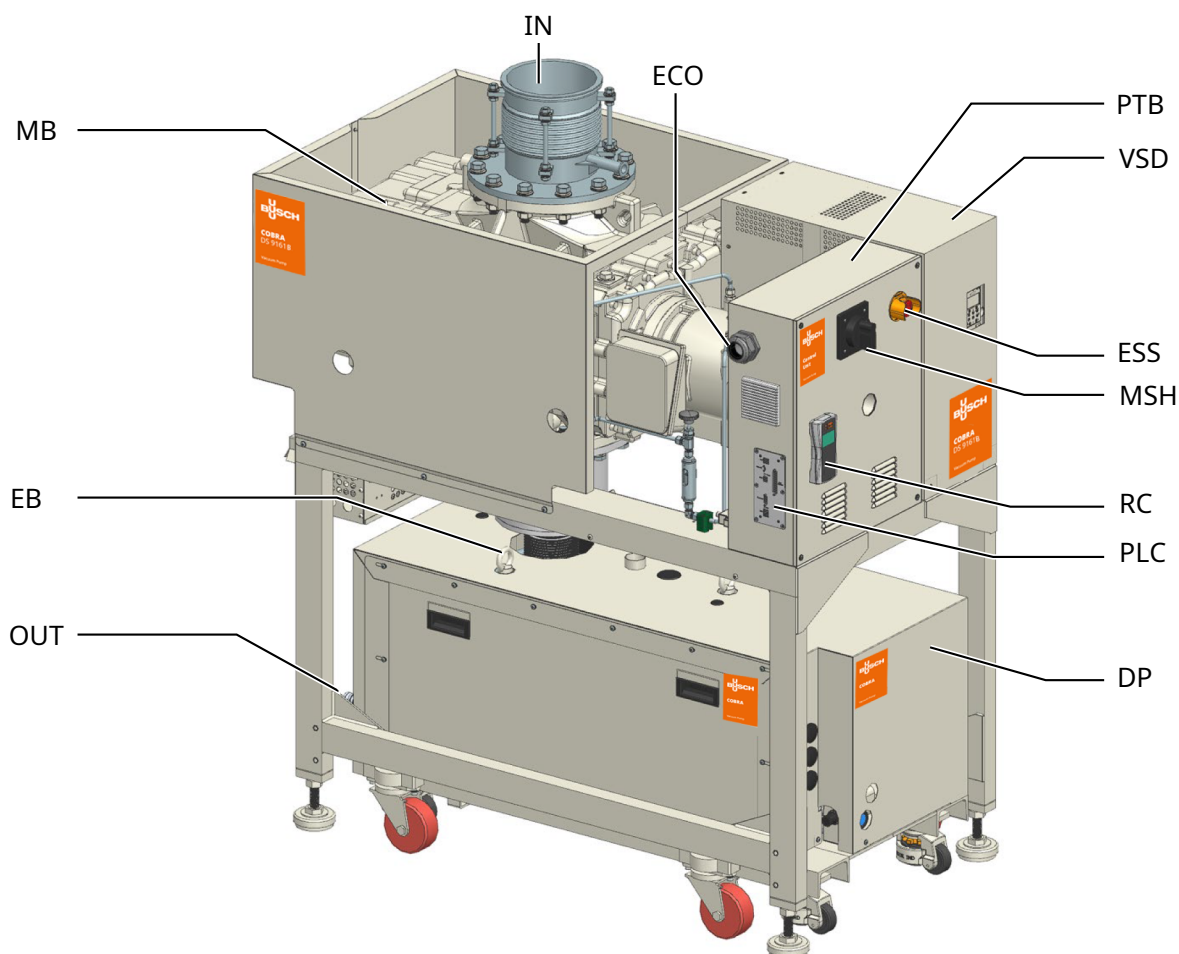
For the purpose of these instructions, "handling" the vacuum pump means the transport, storage, installation, commissioning, influence on operating conditions, maintenance, troubleshooting and overhaul of the vacuum pump.

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

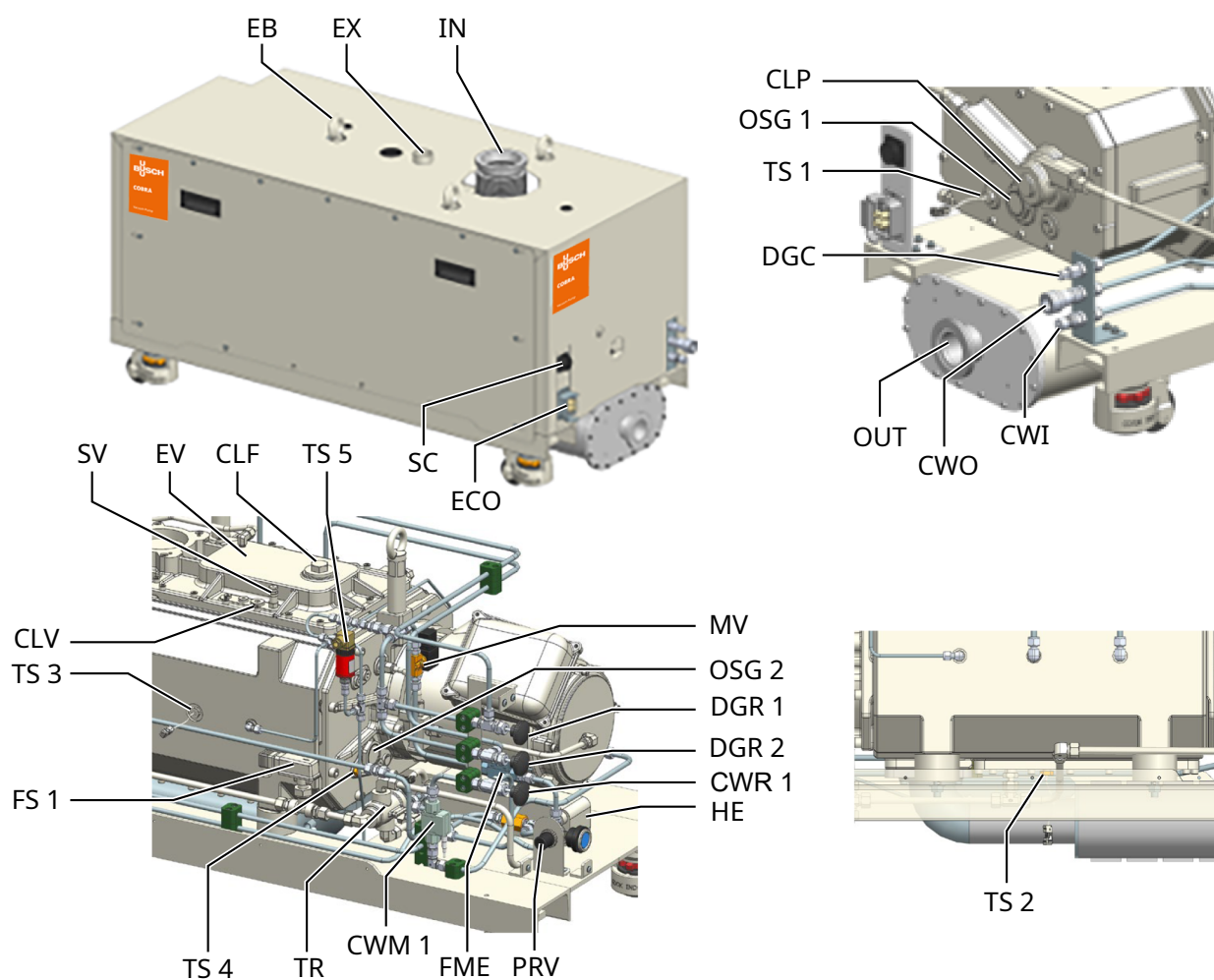
Keep these operating instructions and, if applicable, other pertinent operating instructions available on site.

2 Product Description

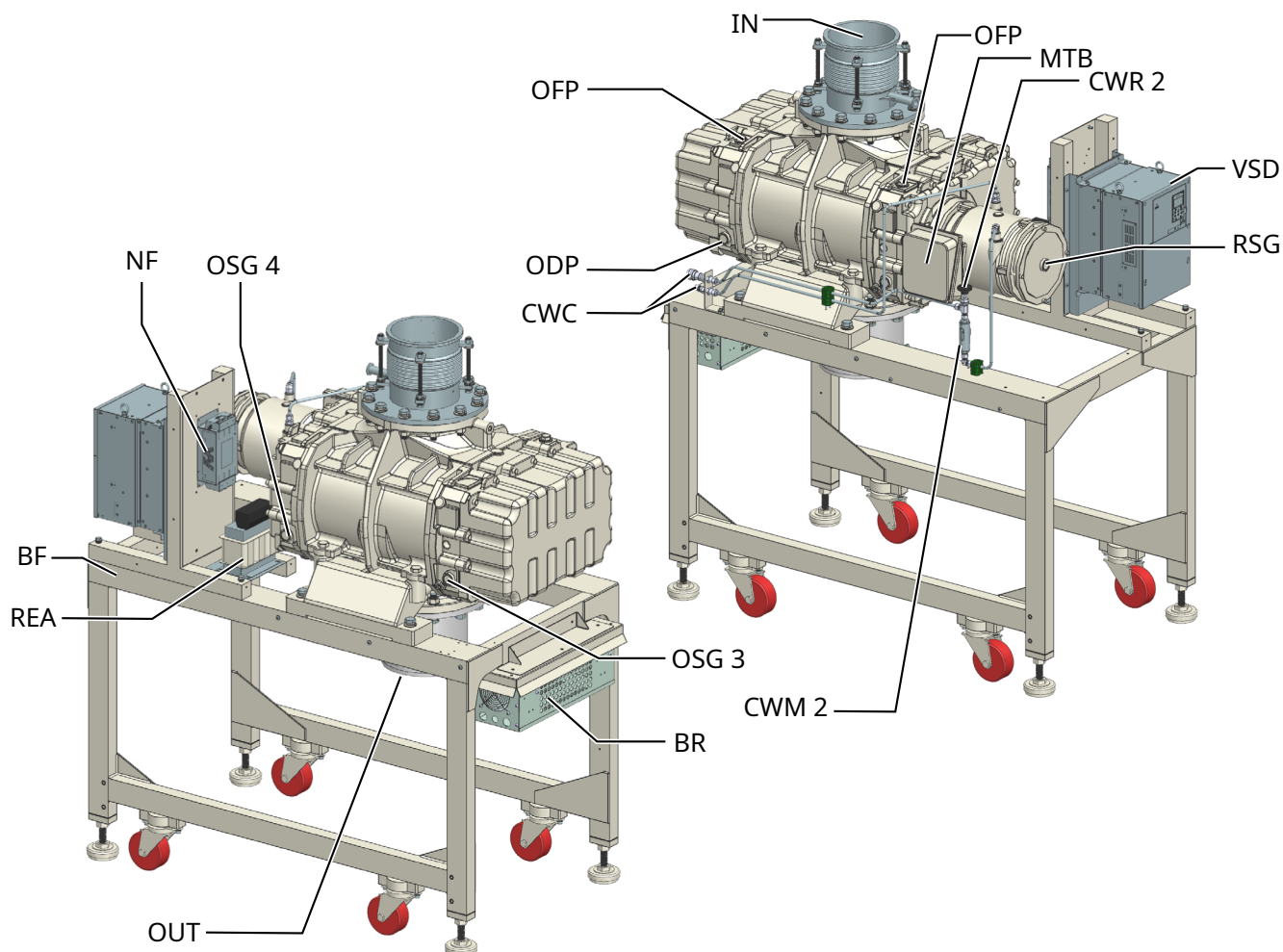
COBRA DS 9161 B



Description			
IN	Inlet connection (Inlet)	OUT	Exhaust connection (Outlet)
DP	Backing vacuum pump DP 0600 C	EB	Lifting eyebolt
ECO	Electrical connection	ESS	Emergency stop button
MB	Booster WY 075	MSH	Main power switch
PLC	Busch PLC	PTB	Pump control box
RC	Remote control, LCD	VSD	Variable speed drive

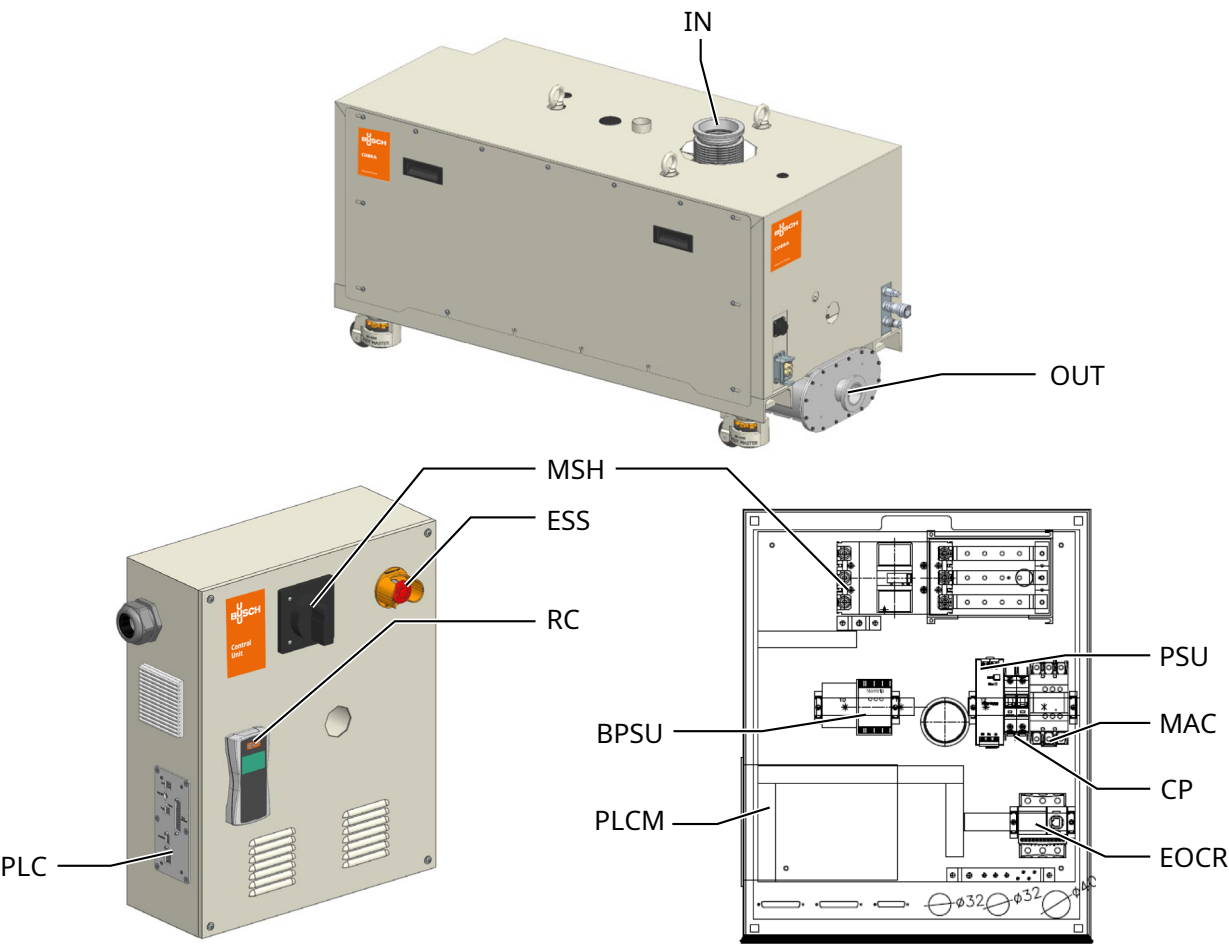
COBRA DP 0600 C**Description**

IN	Inlet connection (Inlet)	OUT	Exhaust connection (Outlet)
CLF	Cooling liquid filler plug	CLP	Cooling liquid pump
CLV	Cooling liquid purge plug	CWI	Cooling water inlet connection
CWM 1	Flowmeter, cooling water	CWO	Cooling water outlet connection
CWR 1	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)
EB	Lifting eyebolt	ECO	Electrical connection
EV	Expansion vessel	EX	Ventilating duct
FME	Nitrogen flowmeter	FS 1	Flow switch, cooling liquid
HE	Heat exchanger	MV	Regulating with solenoid valve, dilution gas
OSG 1	Oil sight glass	OSG 2	Oil sight glass
PRV	Regulating valve, Nitrogen	SC	Signal connection
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		

Booster WY 075**Description**

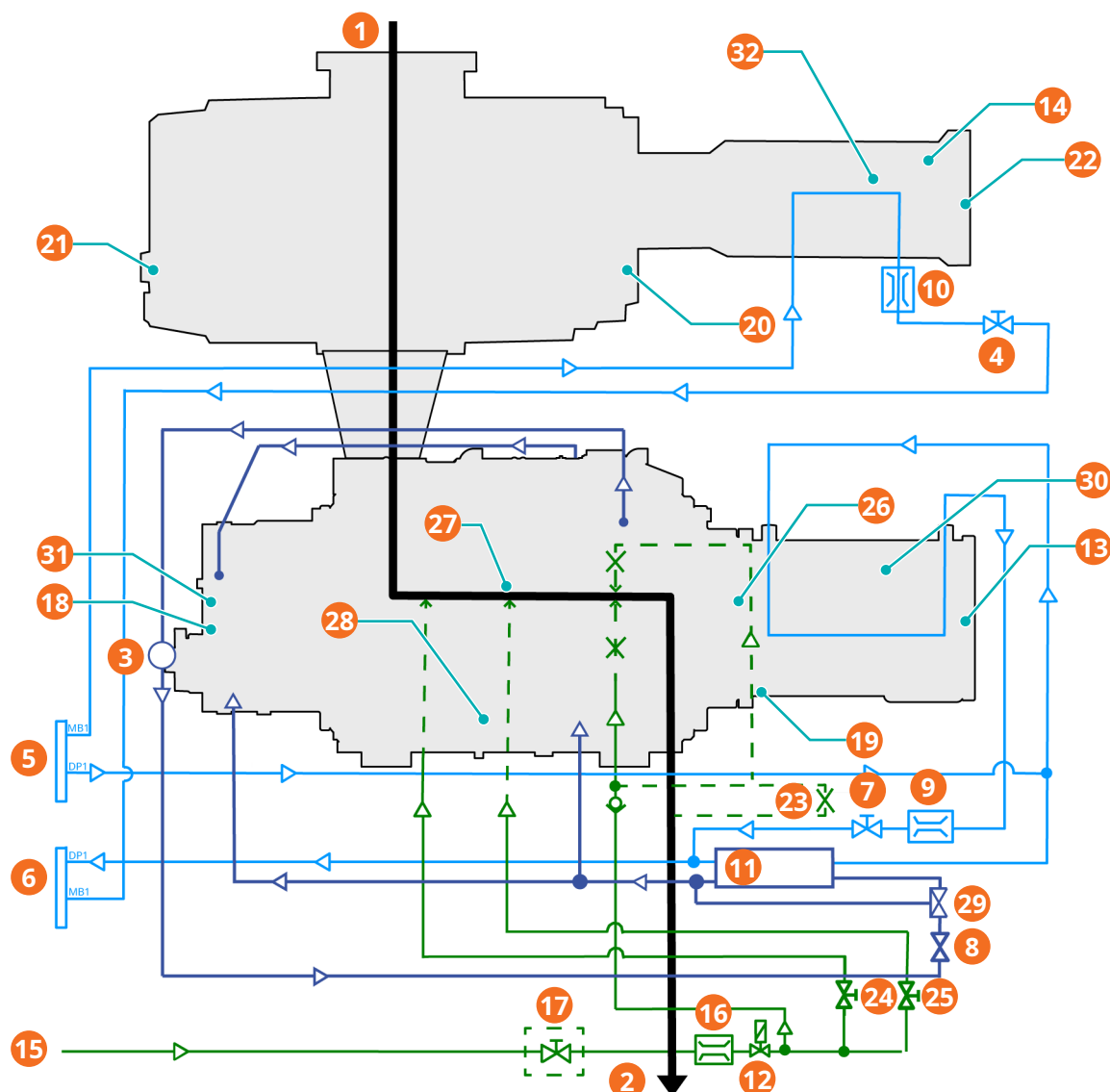
IN	Inlet connection (Inlet)	OUT	Exhaust connection (Outlet)
BR	Braking resistance	BF	Base frame
CWC	Cooling water connection	CWM 2	Flow meter, cooling water
CWR 2	Cooling water regulating valve	MTB	Motor terminal box
NF	Noise filter	ODP	Oil drain plug
OFP	Oil fill plug	OSG 3	Oil sight glass
OSG 4	Oil sight glass	REA	Reactor
RSG	Rotation sight glass	VSD	Variable speed drive

Accessories



Description			
IN	Inlet connection (Inlet)	OUT	Exhaust connection (Outlet)
BPSU	Back up power supply	CP	Circuit protect
EOCR	Electronic Over Current Relay	ESS	Emergency switch button
MAC	Magnetic contactor	MSH	Main switch
PLC	Busch PLC	PLCM	PLC module
PSU	DC Power supply unit	RC	Remote control, LCD

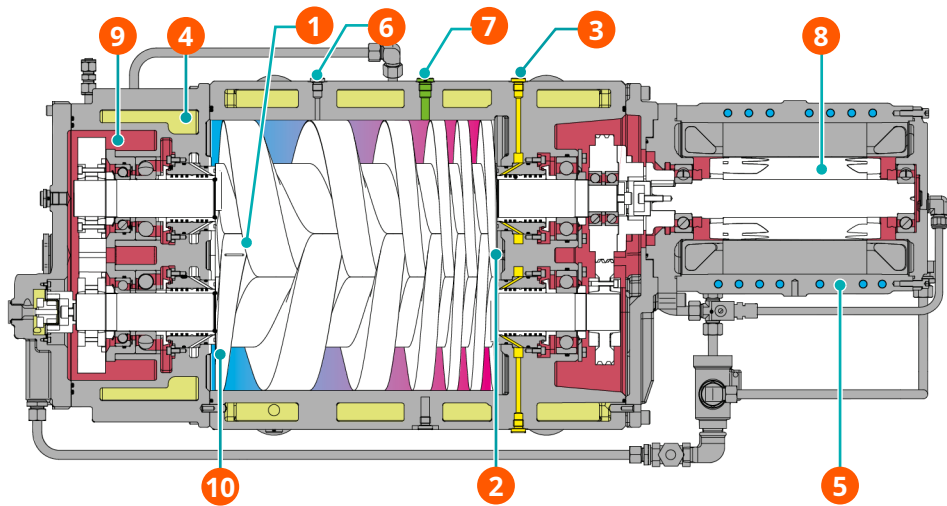
Process Gas Diagram



Description			
1	Process gas inlet (PGI)	2	Process gas outlet (PGO)
3	Cooling liquid pump (CLP)	4	Cooling water regulating valve (CWR 2)
5	Cooling water inlet (CWI)	6	Cooling water outlet (CWO)
7	Cooling water regulating valve (CWR 1)	8	Flow switch, cooling liquid (FS 1)
9	Flow meter, cooling water (CWM 1)	10	Flowmeter, cooling water (CWM 2)
11	Heat exchanger (HE)	12	Magnetic valve (MV), regulating valve with solenoid valve, dilution gas
13	Motor DP (MOT1)	14	Motor MB (MOT 2)
15	Nitrogen supply (NC)	16	Nitrogen flow meter, dilution gas (FME)
17	Nitrogen pressure reducer (PRV)	18	Oil sight glass DP (OSG 1)
19	Oil sight glass DP (OSG 2)	20	Oil sight glass MB (OSG 3)
21	Oil sight glass MB (OSG 4)	22	Oil sight glass MB (motor) (OSG 5)
23	Overpressure sensor (TS 5)	24	Regulating valve, dilution gas DP (middle of cylinder) (DGR 1)
25	Regulating valve, dilution gas DP (at exhaust) (DGR 2)	26	Temperature switch 140°C (TS 4)

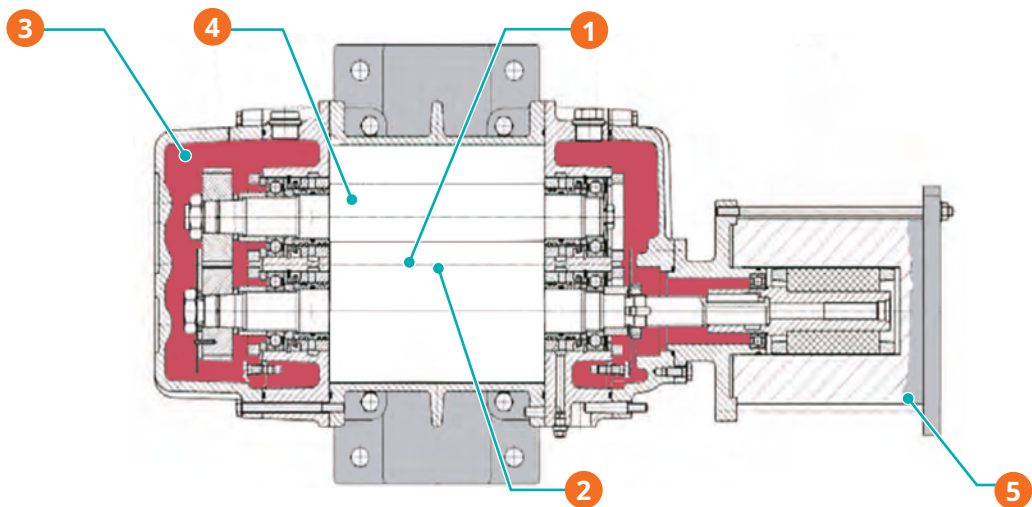
Description			
27	Temperature sensor PT100 (TS 3)	28	Temperature switch, cooling liquid temperature 100°C (TS 2)
29	Temperature regulator, 55°C (TR)	30	Temperature switch 155°C (TS 6)
31	Temperature switch, oil temperature 120°C (TS 1)	32	Temperature switch (TS 7)

COBRA NS 0600 C



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

Booster WY 075



Description			
1	Inlet	2	Outlet

Description			
3	Oil	4	Booster lobe
5	Cooling water		

2.1 Use

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

They can be used to draw 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 system. Procedural errors can result in the vacuum system drawing in a certain quantity of liquid. If the vacuum system has drawn 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 system 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 system is thermally suitable for continuous operation.

2.2 Operating Principle

2.2.1 COMBI

The COBRA DS 9161 B vacuum pumps are a combination of a screw vacuum pump NS 0600 C (DP) and a Booster vacuum pump WY 075 (MB). The COMBI vacuum pumps are streamlined.

The vacuum systems COBRA DS standard version is a combination of one or more COBRA NS (DP 600) vacuum pumps with cooling water and nitrogen circuits and one or more WY (MB) rotary lobes boosters with a variable speed drive.

The gas conveying is done on two levels: one by the Booster WY 075 and the other by one or two COBRA NS 600 C vacuum pumps working in parallel. The pressured gas is conveyed to the respective silencers.

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.

2.2.1.1 Principle of DP Vacuum Pumps

The COBRA NS screw vacuum pumps work by the principle of spiral pumps. Two parallel screws 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.

2.2.1.2 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 with identical profiles rotate in opposition 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 to the exhaust. 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.

2.2.1.3 Principle of COBRA DS vacuum system

- Start DP: During start-up, the COBRA NS (DP 600) starts first. If there are several pumps' NS, DP1 starts first and then DP2 starts after the delay of the timer "DP2 ON DELAY" is done (timer settable in the settings, normally at 1s).
- Start MB: The WY Booster pump will start after the DP1 when the delay of the timer "MB ON DELAY" is done (timer settable in the settings, normally at 30s). If there are several WY Boosters, they start together.
- Cold start timer: After the start-up, the WY Booster runs at low speed for heating-up. It runs normally when the delay of the timer "COLD START" is done (timer settable in the settings, normally at 1200s). The timer can be bypassed by pressing the "Start" button 5 seconds.
- Ready for work: When the COBRA NS pump and the WY Booster pump are hot, the pump can normally work for the customer process.
- Purge time: When the "Stop" button is pressed only one time, the "PURGE TIMER" starts. When the timer is done (timer settable in the settings, normally at 1800s), the pump switches off normally. This timer can be deactivated by the parameter "PURGE CYCLE = OFF" in the settings. The timer can be bypassed by pressing the "Stop" button 10 seconds.
- Stop sequence: All the WY Booster pumps are firstly stopped and then all the COBRA NS vacuum pumps stop 60 seconds after. The timer cannot be modified.

2.2.2 Gas Flow Checks

A pressure sensor TS 5 at the exhaust 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.

2.3 Structure

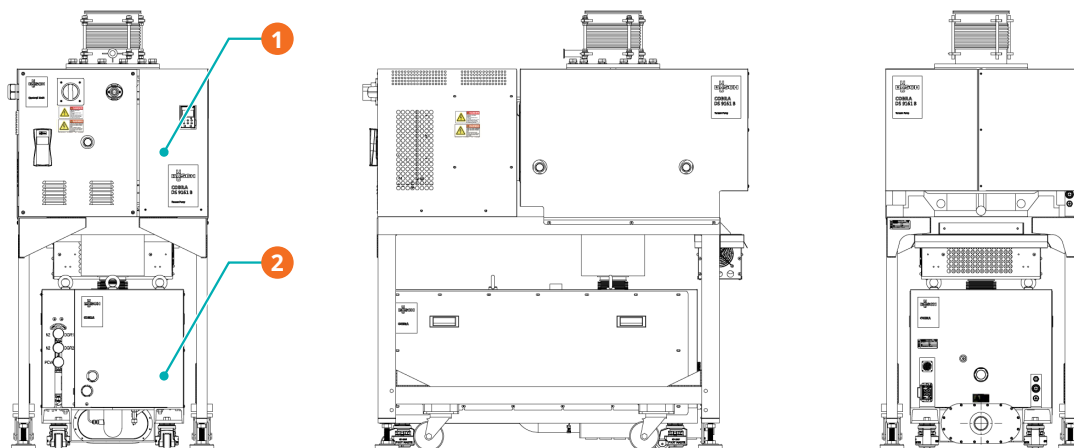
The vacuum system COBRA DS is made of the following elements:

- Horizontal silencer mounted on each vacuum pump (standard).
- Vertical silencer installed behind each vacuum pump to collect condensates in an external tank. This silencer is water cooled (min.14 l/min).
- Connection kit MB to DP. The kit contains different parts (solid pipes with bellows and O-rings hold by claws and screws). Each kit depends on the pump configuration. If there are only one DP 600 and one WY Booster (DS 8161 for example), the connection is directly made from the MB Booster to the DP 600.
- One or more WY 075 Boosters (MB1, MB2...) rotary lobes vacuum pumps with sensors and variable speed drive.
- An electrical box mounted on the right or rear side of the MB Booster with combined cables (powers and sensors) for each pump.
- An LCD controller.
- Other special parts if the vacuum system is especially large extra (extra inlet or exhaust piping, special power cables rack).

All parts of the installation are mounted on a stable frame and are completely equipped with their pipes.

The electrical components are wired with a connection box.

COMBI DS 9161 B: one Booster WY 075 with one COBRA DP 600 C vacuum pump:



Description

1	Booster WY 075	2	COBRA DP 0600 C
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2.4 Oil Circuit

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

2.5 Cooling



CAUTION

The cooling liquid system is active only when the DP vacuum pumps are in function. The cooling liquid circuit works on the axe of the motor.



CAUTION

The cooling water system is always active. The cooling water flows continuously from the water distributor.

The vacuum system COBRA DS is cooled by:

- The circuit of cooling liquid (mix of water and glycol) inside the water chambers (6) of cylinder and endplate of cylinder B-side. An indirect circuit is made with a water pump mounted at the endplate of cylinder B-side. The flow of the cooling water 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 pump stops. The temperature switch TS 2 will give an emergency signal if the temperature of the cooling liquid is above 100°C.
- A direct cooling water circuit in the motors of COBRA NS vacuum pump. The cooling water flow is preset at 13 l/min at the factory and can be adjusted with valve CWR 1. The flow is monitored by flow meter FME 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 flow meter CWM 1 to the PLC. Status of the pump depends on the alarm function set by user (factory setting: EMO, pump stops after alarm condition).
- A direct cooling water circuit in the motors of WY rotary lobes vacuum pump. The cooling water flow is preset at 13 l/min at the factory and can be adjusted with valve CWR 2. The flow is controlled by flow meter CWM 2. The cooling water circuit stabilizes the temperature of cool-

ing liquid. When flow is too low a warning then an alarm signal is generated by flow meter CWM 2 to the PLC. Status of the pump depends on the alarm function set by user (factory setting: EMO, pump stops after alarm condition).



NOTE

The COBRA DS vacuum pumps are principally dispatched with oil (injected according to customer's order) 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.

The CWM 1 and CWM 2 captors are serial connected. One alarm signal is generated for the both.

2.6 Nitrogen System



CAUTION

The nitrogen system is active only when the DP vacuum pumps are in function. The electro valve is controlled by KDP.

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 injected in the middle hole is preset at 10 NI/min and can be adjusted with valve DGR 1, depending on the application. Nitrogen flow injected in the hole on cylinder end-plate side is preset at 20 NI/min and can be adjusted with valve DGR 2, 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 drawing corrosive gases.
- Nitrogen is used as sealing gas. The nitrogen is injected into the intermediate chamber in the cover of the cylinder of the NS pump to achieve good closeness.
- 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 system. The nitrogen is injected directly into the intake port. In the absence of nitrogen flushing can also be performed with the help of air.

2.7 Optional Functions/ Use of Available Accessories

A horizontal silencer under the pump or a vertical silencer (option) at the exhaust reduces the noise of the vacuum system and collects any condensate.

The data process with the C.M.S. (Central Monitoring System) (accessory) has the same function as the LCD controller (see Operating Instructions of Central Monitoring System).

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

A temperature sensor PT100 (TS 3) 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.

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

- TS 5: exhaust pressure
- TS 3: temperature inside the cylinder DP
- MOT 1 and MOT 2: DP and MB current
- FME: nitrogen flow rate, dilution
- CWM: cooling water flow rate in pump
- TS 1 + TS 4: oil temperature
- FS 1: cooling liquid flow control
- TS 2: cooling liquid temperature

See "Installation and Maintenance Instructions, PLC and LCD (No. 0870758077 / -0002)".

2.8 On/ Off Switch

The vacuum system 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 system descriptions state the nominal displacement and the design level.

Example: DS 9161 B

DS = standard version

9161 = 6220 m³/h

B = 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 manufacturer 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.



NOTE

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



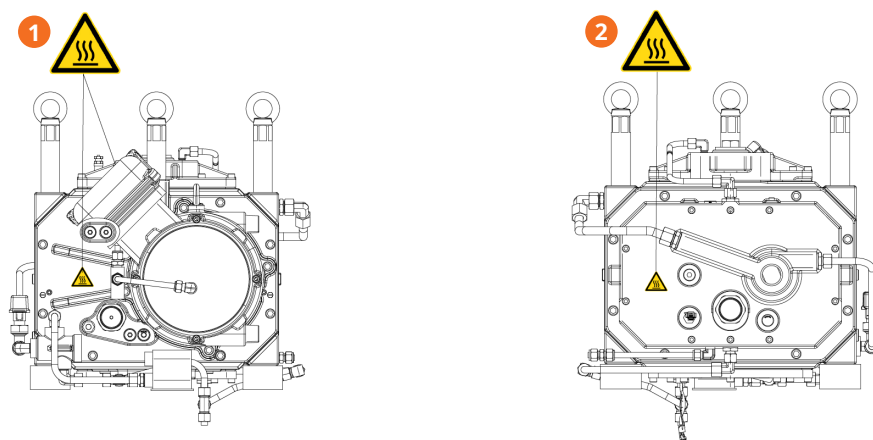
CAUTION

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

3.3

Safety Stickers

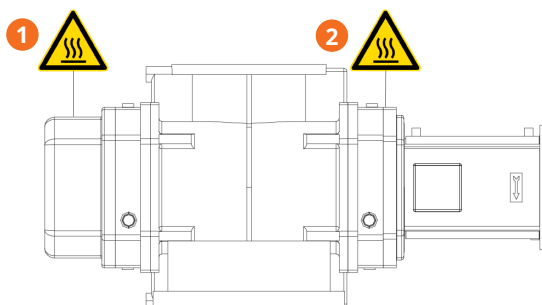
COBRA NS 0600 C



Description

1	Warning! Hot surface! Do not touch!	2	Warning! Hot surface! Do not touch!
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Booster WY 075



Description

1	Warning! Hot surface! Do not touch!	2	Warning! Hot surface! Do not touch!
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3.4

Sound Pressure Emission

Refer to the table "Technical data" for the permissible sound levelling free field conditions according to EN ISO 2151.



CAUTION



The sound level of the vacuum system within a certain perimeter of the vacuum system is high.

Risk of hearing damage.

Users who are spending a longer period in the vicinity of a non-insulated vacuum system 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.

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.

- If the FDP1 or FDP2, FDP3, FDP4 thermal protection is on, press on emergency stop button, switch off and padlock the main dis-connect switch, switch off the customer's power supply (type 1 of electrical work). Open the power box cover and check the value on the FDP1 or FDP2, FDP3, FDP4 thermal relay(s) according to the settings indicated in the electrical schematics.
- If ok, check the wiring system from the terminal box motor to the KDP1 contactor. If ok, call the BUSCH Semicon service team in charge of the maintenance of the pumps.
- Before restarting the vacuum system, reactivate the FDP1 thermal relay by pressing on Reset. If this does not work, wait 60 seconds, and start the operation again.
- Close the cover again. Switch on the main disconnect switch, then release the emergency stop button. Restart the vacuum system by pressing on Start button on the remote control.
- If the vacuum system does not start, press on emergency stop button, switch off and padlock the main disconnect switch, switch off the customer's power supply and put the label "maintenance processing". Call the BUSCH Semicon service team in charge of the maintenance of the pumps.
- If the external thermal protection B11 is engaged, check that the water flow shows min.14 l/min on the flowmeter. If not, set the water flow at 13 l/min according to the instruction (see chapter "Checking the cooling liquid flow"). Check the wiring system of the thermal protection by opening the side face (Type 3 of electrical work). Wait a few minutes for the cooling of the protection, then press on Start button to restart the vacuum system.

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) or with the Start / Stop 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 or with the Start / Stop button (press it during 2s).
- 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 Safety Interlock Table

Interlock event	Sensor	Response	
Cooling liquid over-temperature	Temperature switch TS 2	Contactors open and remove power to motors.	S
DP, MB motors over-current	Thermal overload relays EOCR (MB) Thermal overload relays EOCR (DP 1 & 2).	Contactors open and remove power to motors. For DP, the security circuit is shut down then reload the thermal relay. For MB, the MB circuit is shut down then reload the thermal relay.	S
DP Motor overtemperature (t° > 150°C)	Temperature switch TS 6	Contactors open and remove power to motors. EMO: security circuit.	S
MB Motor overtemperature (t° > 150°C)	Temperature switch TS 7	MB vacuum pump stops.	S
Exhaust overpressure (option)	Overpressure sensor TS 5	Depends on alarm function set in the PLC for overpressure Set at factory: None ie. the vacuum pump continues running with alarm.	S
DP, MB motors over-current	Current gauge EOCR	Depends on alarm function set in the PLC for overcurrent. Set at factory: General Stop ie. the contactors open and remove power to motors. For DP overcurrent: EMO urgent switch off. For MB overcurrent: all MB pumps stop.	S
Cylinder overtemperature	Temperature switch TS 3	Depends on alarm function set in the PLC for cylinder temperature. Set at factory: General Stop ie. the contactors open and remove power to motors.	S
Cooling water flow too low	Water flow meter CWM 1 & CWM 2	Depends on alarm function set in the PLC for water flow. Set at factory: General Stop ie. the contactors open and remove power to motors.	S
Nitrogen flow too low	Nitrogen flowmeter FME	Depends on alarm function set in the PLC for nitrogen flow. Set at factory: General Stop ie. the vacuum system continues running with the alarm.	S
Cooling liquid flow too low	Flow switch FS 1	The contactors open and cut the engine supply after 30 seconds	S
Excessive oil temperature (t° > 105°C)	Temperature switch TS 1	The contactors open and cut the engine supply after 120 seconds (changeable duration).	S

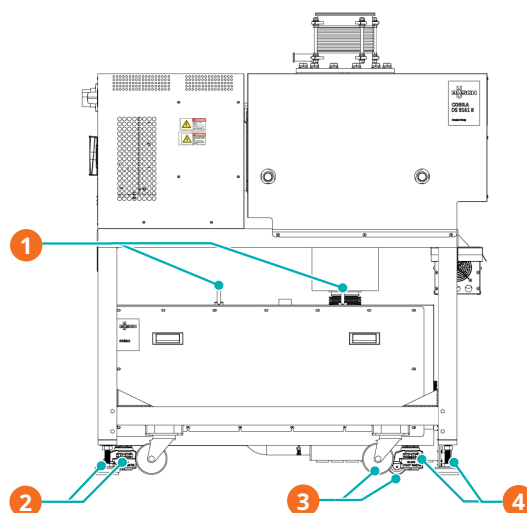
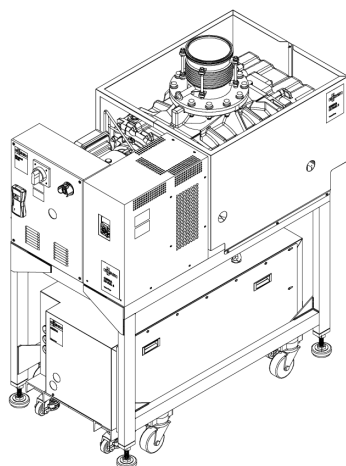
H= Hardware, S= Software

"X" is the number of the DP or MB vacuum pump

3.8 Seismic Zone Installation

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

- Convey the vacuum system to its final location with a pallet truck before removing it from its support.
- Unscrew the fixing screws of the vacuum system 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	Lifting eyebolt	2	Adjusting nut
3	Wheel	4	Adjusting nut

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

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

3.9 Information over Lubricants

3.9.1 Oil

Oil filling	NS 0600 C	WY 075
Oil quantity (Liter)	1.6	12.5
Oil type	YLC 250 B, Art. No. 0831 131 400 (0,5 l ≈ 1 kg)	

- Replacement: After 5000 h (see "*Maintenance Schedule* [→ 52]").

3.9.2 Cooling Liquid

Cooling liquid filling	NS 0600 C
Cooling liquid quantity (Liter)	approx. 26 liters
Cooling liquid type	Glycol (Ethylene), Art. No. 2000 241 757, CLA 25 (already mixed ready-to-use)

- Replacement: After 5000 h (see "*Maintenance* [→ 50]").

3.10 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 Handling

For handling of individual components look up the relevant Operating Instructions in the Appendix.

The vacuum system is supplied in wooden crates.

The ring bolts on the components are not designed to take the full weight of the vacuum system.

Depending on the dead weight and size of the vacuum system, use a forklift to move it on several pallets.

Or lift the vacuum system using slings and the appropriate lifting gear to move the vacuum system or remove the pallets.

Be sure to avoid strain on pipework or vacuum pumps when placing the slings.

4.2 Transport in Packed State

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

4.3 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 0600 C



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 Vacuum Pump Removal

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* [→ 26]”.

6 Installation and Commissioning

6.1 Installation Prerequisites

It is important for operating safety to observe the instructions when installing the vacuum system. Installation must be carried out by qualified technicians.



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 vacuum system and its components!

Risk of personal injury!

The installation prerequisites must be complied with.

- 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 system 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. 14
Approximate flow rate for other applications	l/ min	min. 16
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:

Nitrogen overpressure	bar	1.5
Standard flow rate Dilution 1	l/min	10 NI/min
Standard flow rate Dilution 2	l/min	20 NI/min
Nitrogen consumption max.	l/min	200 NI/min

- Make sure that the ambient conditions correspond to the protection class of the motor (according to nameplate).
- Make sure that the vacuum system is placed on or fastened to a horizontal surface.
- Make sure that the vacuum system is level.



NOTE

The pump levelling is facilitated by the adjustment stroke (~30 mm) of the four machine foots.

- Make sure that the four rollers do not touch the ground.



NOTE

In order to ensure the pump fixation to the ground, it is possible to use again the four yellow brackets that were removed at the machine reception.

- Make sure that the vacuum system is at least 1 m away from any wall to ensure good cooling.
- Make sure that the vacuum system 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 system.
- Make sure that the installation site or assembly area is ventilated in such a way that adequate cooling of the vacuum system is ensured.



CAUTION

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

Danger of burns!

- Make sure that no-one can touch the vacuum system accidentally. If necessary, attach safeguard.
- Make sure that the oil sight glasses (OSG) 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 Unpacking



DANGER

Danger of vacuum system falling or tipping over!

The weight of the vacuum system can kill a person or cause severe crushing.

The ring bolts on the components are not designed to take the full weight of the vacuum system. Depending on the dead weight and size of the vacuum system, use a forklift to move it on several pallets.

Or lift the vacuum system using slings and the appropriate lifting gear to move the vacuum system or remove the pallets.

Be sure to avoid strain on pipework or vacuum pumps when placing the slings.

Unpacking of vacuum system:

- Unpack the vacuum system as near the installation site as possible.
- Check scope of delivery for completeness.
- Check the vacuum system for damage.
- Only remove the vacuum system from pallets at the installation site. Observe the above safety precautions when doing so.
- Dispose of packing material as required by current regulations.

6.1.3 Mounting



WARNING

The vacuum system can be damaged by foreign matter in the pipelines!

Remove all foreign matter (welding beads, swarf etc.) from the pipelines!

This may be done by flushing or blowing through pipelines.

The installer must ensure that the pipework at the inlet is clean.

- Set the vacuum system on as level, horizontal surface.
- Leave enough space (min. 1,5 m) around the vacuum system for maintenance work.

If necessary, anchor the vacuum system base frame to the floor.

- Reception and unpacking of the crates.
- Oil filling in the Booster MB vacuum pumps.
- Oil filling in the DP vacuum pumps.
- Glycol filling in the DP vacuum pumps.
- Set, fix and connect the Booster MB assembly (connection with the inlet of the DS vacuum pump).
- Install the piping bows on the DP/ MB vacuum pumps and the troughs on the MB vacuum pump.

- Install the sensor wires and place the cables in the trough (power, N2 solenoid valve, sensors) (connection with power supply).
- Set and fix the H2O and N2 distributor (connection with the H2O and N2 supply).
- Cable and connect the MB Booster (power, sensors, H2O and N2).
- Set and fix the DP pumps and connect the flexible piping to the Booster MB (connection with the DS group).
- Connect the DP pumps (power, N2 solenoid valve, sensors)
- Connect the LCD control and switch the main contactor.
- Flow and H2O alarm adjustment, Danfoss.
- Start-up of the vacuum system (Start).
- Flow and N2 alarm adjustment and final adjustment.



WARNING

The vacuum system can be damaged by tensile or compressive stresses on pipe connections!

- If stresses could occur, use compensators to connect pipes!



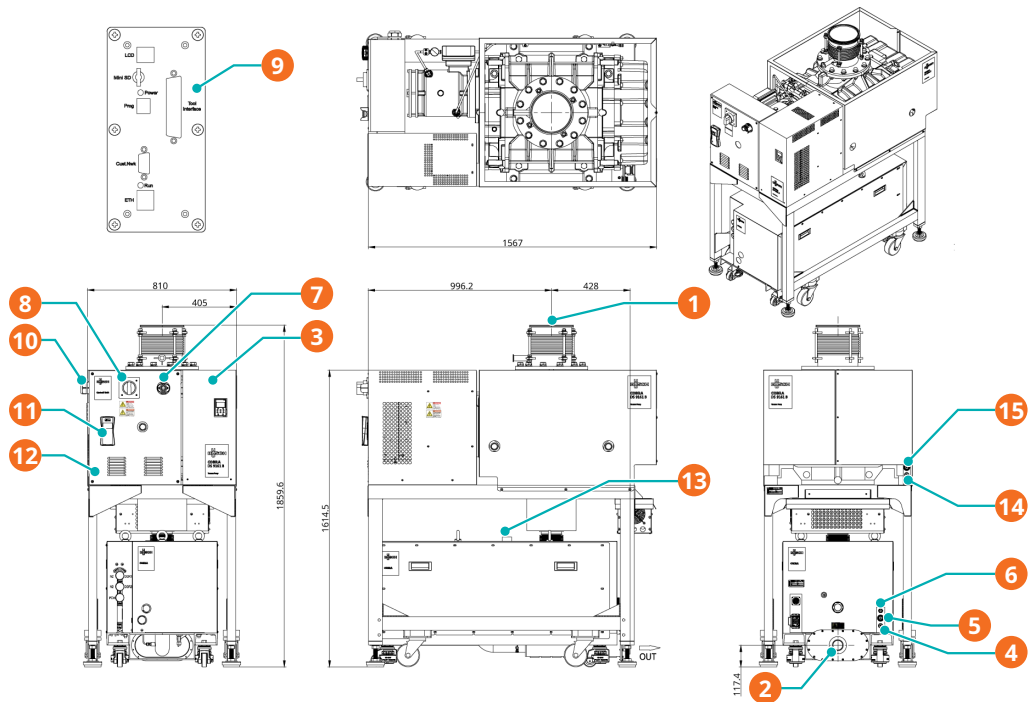
WARNING

The vacuum system can be damaged by condensate!

- Fit traps to inlet and exhaust sided pipes to prevent condensate getting into vacuum pumps!

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

6.1.4 Dimensional Drawing



Description			
1	Inlet DN 200 ISO-K (Booster WY 075)	2	Outlet DN 63 ISO-K
3	Variable speed drive (VSD)	4	DP Cooling water inlet 3/8" (CWI)
5	DP Cooling water outlet 3/8" (CWO)	6	DP Nitrogen inlet 1/4" (DGC)
7	Emergency stop (ESS)	8	Main power switch (MSH)
9	PLC Control panel layout	10	Main power inlet (ECO)
11	Remote control, LCD (RC)	12	Pump control box (PTB)
13	Ventilating duct, diameter 50.8 (EX)	14	MB Cooling water inlet 3/8" (CWI)
15	MB Cooling water outlet 3/8" (CWO)		

- Make sure that the vacuum system 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 system.

6.1.5 Inlet Connection

- Make sure that the protection that was attached to prevent penetration of particles during transport has been removed before the vacuum system 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 system.

If the drawn 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 system 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 drawn 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 200 ISO-K for the Booster WY 075 inlet
 - DN 100 ISO-K for the COBRA DP 600 C inlet (inlet backing vacuum pump)

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 manufacturer representative.

6.1.6 Exhaust Connection

- Make sure that the protection that was attached to prevent penetration of particles during transport has been removed before the vacuum system 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 exhaust only apply if the drawn gas is discharged by the vacuum pump into a suitable environment.

- Make sure that the protection that was attached to prevent penetration of particles during transport has been removed before the vacuum system is connected to the vacuum line.
- 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 system is connected with leakproof lines.



CAUTION

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

Leakages of dangerous substances must be prevented!

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

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

6.1.7 Cooling Water Connection

The cooling water is generally connected with a hose (leakproof against oxygen). The cooling water outlet must be unpressurised.

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

- Reach 3-5 bar.
- Connect the cooling water hose to the vacuum system distributor.
- Connect the distributor to the cooling water supply.
- Set the waterflow at min.14 l/min (CWR 1 & 2).

6.1.8 Nitrogen Connection

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

- Connect the nitrogen pipe to the vacuum system distributor.
- Connect the distributor to the nitrogen supply.

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

- Reach 1.5 bar (≈3 bar).

6.1.9 Electrical Connection/ Checks



WARNING

Danger from electric shock! Electric shock can cause death and may damage the vacuum system.

- 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 manufacturer representative.



CAUTION

Overvoltage damages the vacuum system!

- Check permissible primary voltage next to the power connection!
- Connect the supply voltage leads on the main contactor.



CAUTION

Incorrect rotation of drive motors can seriously damage vacuum pumps!



CAUTION

The COBRA NS 0600 C gear ratio varies based on the used power specifications of 50 Hz or 60 Hz.

Check the module specifications before connecting the machine.

6.2 Installation

6.2.1 Mounting

- Make sure that the “Necessary installation instructions” are followed.
- Fasten or install the vacuum system 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.

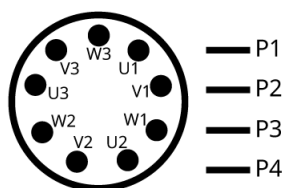


CAUTION

When connecting up the wires into the terminal box: please make sure the tightening torque of 3 Nm is adhered to and check with a calibrated torque wrench (Nuts M6).

DP Motor Connection

Motor connectors:



Connection of motor temperature switches (recommended):

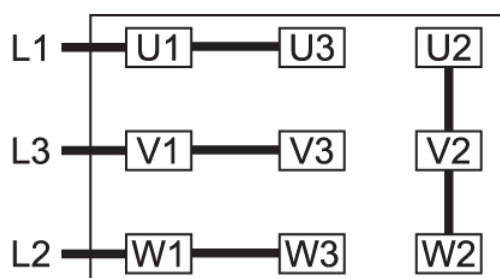


Control voltage: $\leq 250\text{ V}$

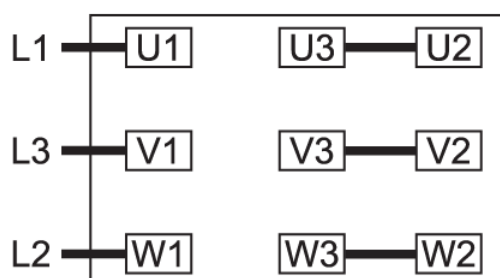
Max current: 1.6 A

MTS = Motor temperature switch (in motor coil)

Double star connection (low voltage):

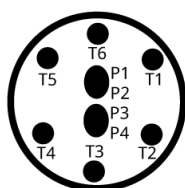


Star connection (high voltage):



MB Motor Connection

Motor connectors:



Connection of motor temperature switches (recommended):

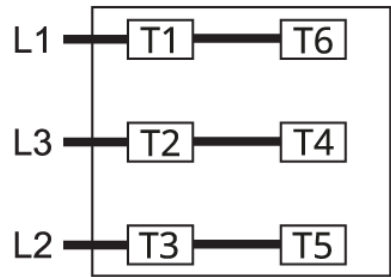


Control voltage: $\leq 250\text{ V}$

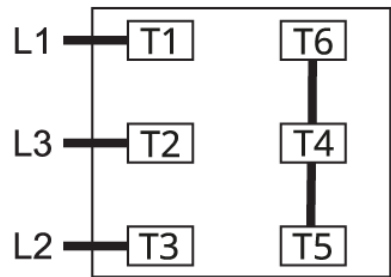
Max current: 1.6 A

MTS = Motor temperature switch (in motor coil)

Double star connection (low voltage):

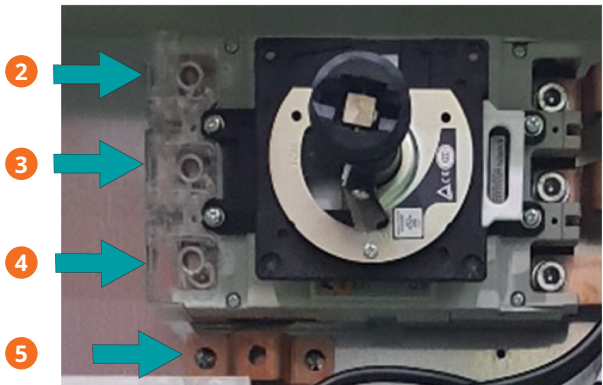
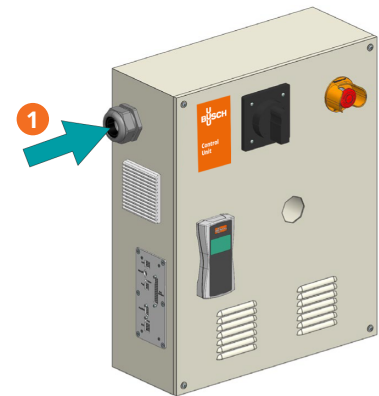


Star connection (high voltage):



6.2.2.1 Connect the Inline Power Cable

- Pass the cable through the inline power stuffing box.
- Unscrew completely the ground phases screws.
- Connect the ground wire to ground phase.
- Unscrew completely the first connector on the main contactor.



Description			
1	Cable	2	Phase

Description			
3	Phase	4	Phase
5	Ground phase		

- Place the first phase wire and screw it completely, tight at **15 Nm**.
- Repeat for the other two phases.



CAUTION

If the vacuum system 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 system is connected correctly before switching it on.

- If message "rotation sense false" appears, exchange two phases.
- Switch on the vacuum system for a short period of time.
- Make sure that the vacuum system draws in.



CAUTION

There are two pump versions with different mechanical gears depending on the operating / present electrical frequency (50 or 60 Hz). The pump speed (rpm) depends on the frequency.

Take care to choose the right pump version (regarding voltage and frequency).

It depends usually on operating site (example: Europe = 400V/50Hz).

Usual worldwide Voltages and Frequencies in SEMICON INDUSTRIES:

Country	Voltages and Frequencies
Europe	400 V @ 50 Hz
China	400 V @ 50 Hz
Taiwan	208 V @ 60 Hz
Korea	208 V @ 60 Hz
USA	208 V or 460 V @ 60 Hz

6.2.2.2

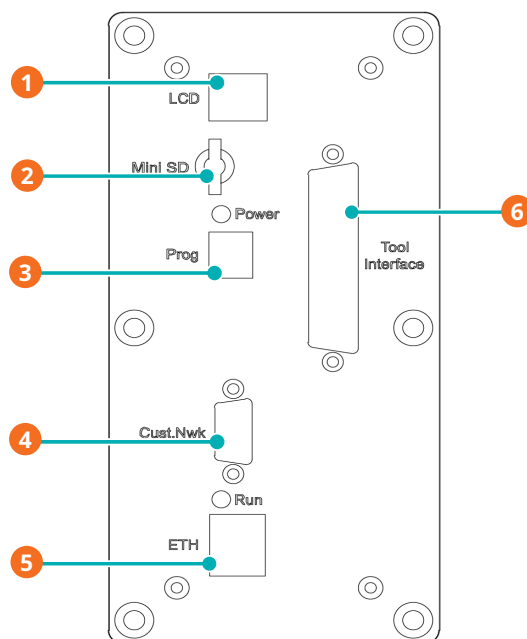
Controls/ Function

Once start-up is complete the vacuum system need only to be switched on, in order to perform its work. No further control is necessary during normal operation. The unit is designed for continuous operation.

The vacuum system is controlled according to the program flow chart.

Operators must be familiar with the controls. This will ensure smooth operation.

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

The information concerning the use of the manufacturer PLC and LCD (RC) can be found in the Operation and Maintenance manual (Art. No. 0870758077 / -0002).

6.2.4 Connection of Lines/ Pipes

- Connect the intake lines.
- Connect the exhaust 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 [→ 68]" for information on the recommended oils).

- Prepare the quantity of oil specified in the table "Oil Quantity [→ 68]".

Oil filling	NS 0600 C	WY 075
Oil quantity (Liter)	1.6	12.5
Oil type	YLC 250 B, Art. No. 0831 131 400 (0,5 l ≈ 1 kg)	

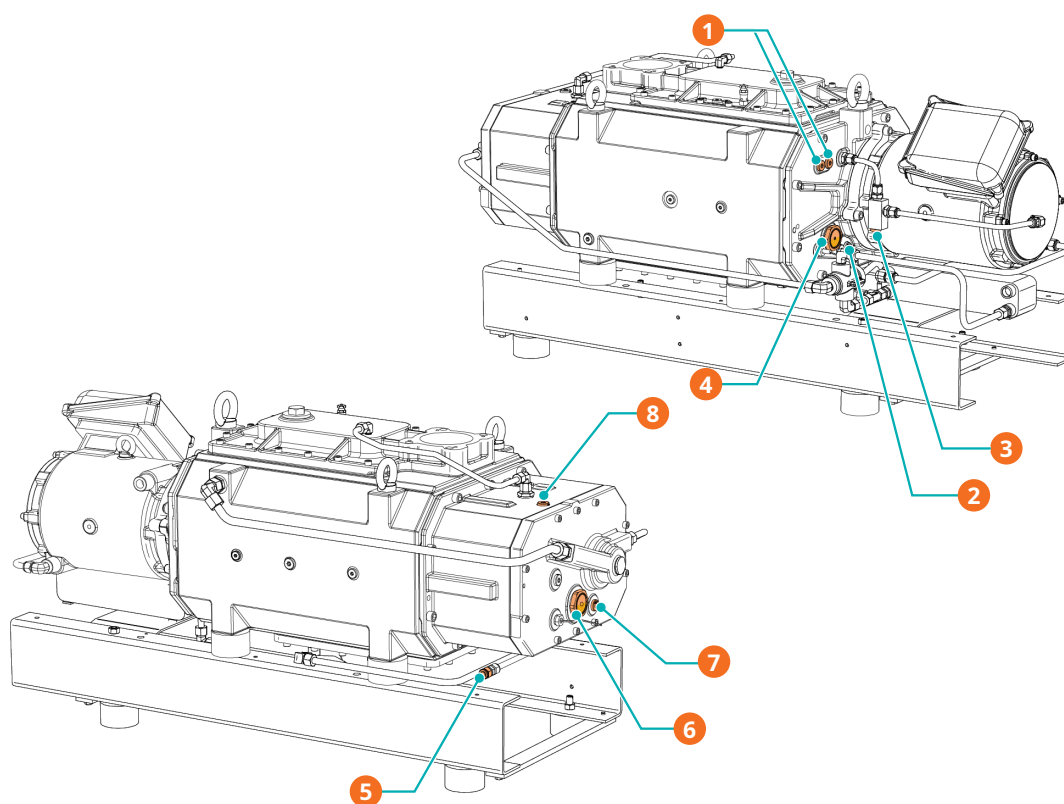
6.2.5.1 COBRA NS 0600 C Oil Filling

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



NOTE

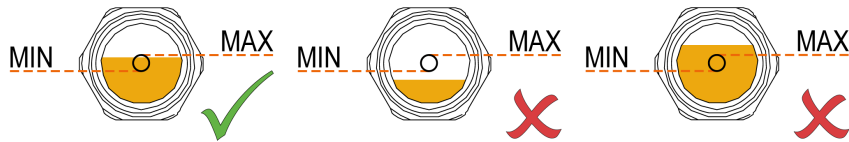
The quantity of oil specified in the installation handbook is of informative nature only. Check the oil level with the help of the various oil sight glasses (OSG 1,2,3,4) on the vacuum pump.



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

- 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 075 Oil Filling

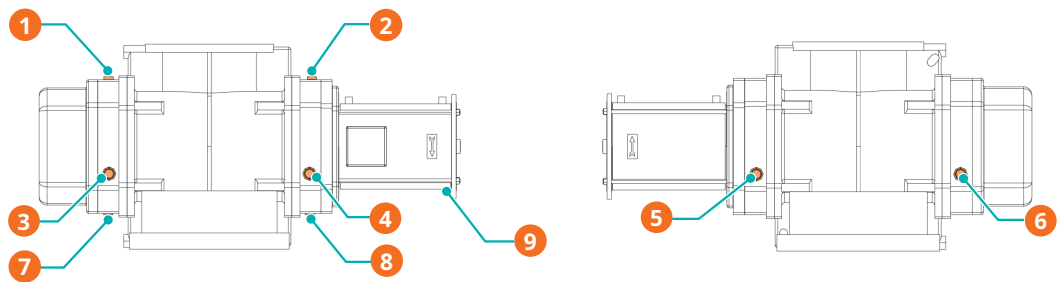
- Prepare the quantity of oil specified in the table "Oil quantity".

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 (OSG 1,2,3,4) on the vacuum pump.

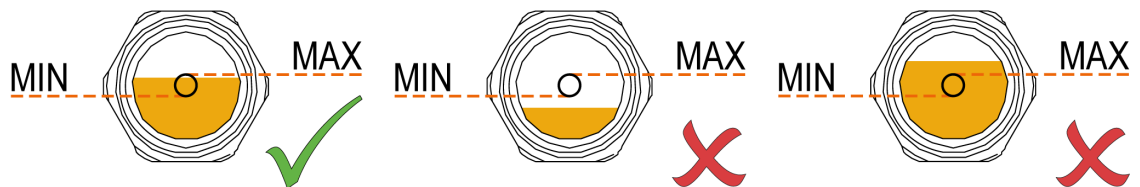
CAUTION

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.



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

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



- 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 system :

- 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



CAUTION

Do not run the vacuum system without cooling liquid!



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* [→ 69]” for information on the recommended cooling liquids).

- Prepare the quantity of cooling liquid specified in the table “*Cooling Liquid Quantity* [→ 69]”.

Cooling liquid filling		NS 0600 C
Cooling liquid quantity (Liter)		approx. 26 liters
Cooling liquid type		Glycol (Ethylene), Art. No. 2000 241 757, CLA 25 (already mixed ready-to-use)

6.2.6.1 COBRA NS 0600 C Cooling Liquid Filling



NOTE

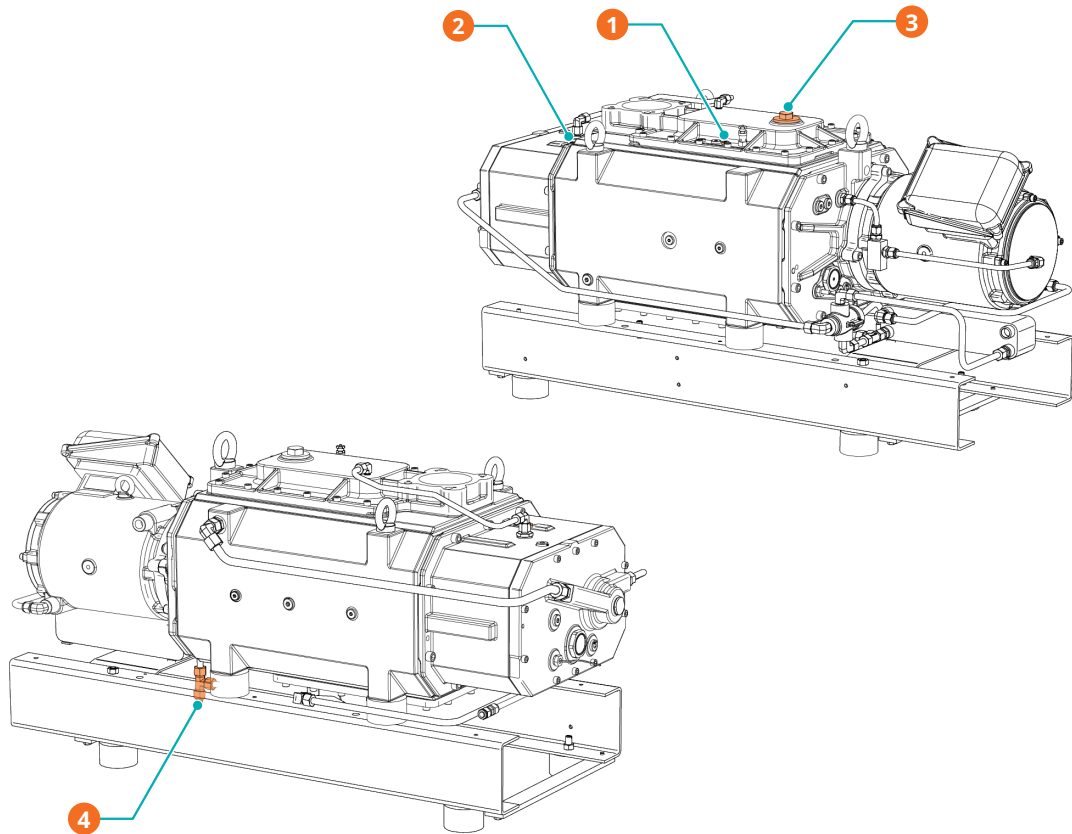
The quantity of cooling liquid specified is of informative nature only. Respect the procedure of filling the cooling liquid.



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* [→ 66]”).

- 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 1)	2	Cooling liquid vent plug (CLV 2)
3	Cooling liquid fill plug (CLF)	4	Cooling liquid drain plug (CLD)

- 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 meter CWM 1. 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 4 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 on 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 system 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 system and its components!

The vacuum system 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 draw in 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 system. Procedural errors can result in the pump drawing in a certain quantity of liquid. If the vacuum system has drawn 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 system 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 vacuum system is suitable for continuous duty at any pressure between atmosphere and ultimate pressure.

The vacuum system is tight down to ultimate pressure.



CAUTION

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

Danger of burns!

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



CAUTION



The sound level of the vacuum system within a certain perimeter of the vacuum system is high.

Risk of hearing damage.

Users who are spending a longer period in the vicinity of a non-insulated vacuum system 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 system!



CAUTION

The cooling water flow, which is checked by the flow meter CWM 1, must be at least 13 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 vacuum 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 system 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 system if the pump is shut down for a longer period of time!

- Drain the cooling liquid.
 - Open the drain plug (CLD) under the vacuum pump
- Open the purge cap (CLV 1) on the top of the vacuum pump DP near the expansion vessel and also the purge cap (CLV 2) on the B-side (gearings).
 - Unscrew the filler cap (CLF) for the cooling liquid.
 - Drain the cooling liquid completely.
 - Screw on the drain plug (CLD) under the vacuum pump for the cooling liquid.
 - Collect the cooling liquid and recycle it or dispose of it according to local or national regulations.
- Drain the cooling water
- Open the cooling water regulating valve (CWR) and the thermostatic valve (TV)
- Open the cooling water regulating valves (CWR 1 & 2).
 - 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 system has not been in operation for a few days or when a sticky substance has been drawn, 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 Vacuum System Start-up



WARNING

The vacuum system may be destroyed if low on operating material!

Check the gear oil level on the vacuum pumps (oil sight glass), see also relevant operating instructions!

- Fill or top up with gear oil as necessary.
- Inlet and delivery side of vacuum system are correctly piped.
- Inlet and delivery water of vacuum system are correctly piped.
- Compressed air is available for the valve controls.
- Supply voltage is switched on.
- The vacuum system is switched on by the LCD or interface box.

6.3.3 Monitoring Equipment

The vacuum system drive motors are safeguarded by a motor protection circuit. If an overload occurs the vacuum system is shut down.

For DP vacuum pumps: the manually set thermal relays shut down the circuit when alarm occurs. It needs to be reloaded in the electrical box for restart. The current sensor and the temperature motor sensor shut down the power supply of the pumping group when alarm occurs.

For MB vacuum pumps: the manually set thermal relays shut down all the MB vacuum pumps when alarm occurs. It needs to be reloaded in the electrical box for restart. The current sensor, the temperature sensor and the variable speed drive (VSD) shut down all the MB vacuum pumps when alarm occurs.



WARNING

Risk of vacuum system deterioration by excessive temperature!

6.3.4 Switching the Vacuum Pump On/ Off

6.3.4.1 First Start-up of the System

- In REMOTE mode, the start/ stop drive of the vacuum system passes through the main machine interface of the vacuum system (the one connected to TOOL).
- In LOCAL mode, the start/ stop drive of the COMBI COBRA DS is done independently.
- Make sure that the "Necessary installation instructions" are followed.

If the vacuum 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 13 l/min and can be adjusted at the regulating valves CWR 1 & 2. This water circuit is used to cool the motor of the DP and MB vacuum pumps and the cylinder covers A- and B-side of the MB vacuum pump. It cools also the cylinder and cylinder end-plate 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 injected in the middle hole is preset at 10 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 20 NI/min and can be adjusted with valve DGR2.
- Switch on the vacuum system.
 - Make sure that the vacuum system does not leak.

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

- Open the solenoid gate valve.

6.3.4.2 Switching the System Off

- In REMOTE mode, the start/ stop drive of the vacuum system passes through the main machine interface of the vacuum system (the one connected to TOOL).
- In LOCAL mode, the start/ stop drive of the COMBI COBRA DS is done independently.

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

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

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

- Close the solenoid gate valve.
- Make sure that the vacuum system is currentless.

7 Maintenance



DANGER

Live wires.

Risk of electrical shock!

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



DANGER



In case the vacuum system 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 system .

Danger to health when the vacuum system 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 system itself must be flushed with nitrogen.



CAUTION

Only authorized personnel may carry out dismantling work on the vacuum system. Before work begins, the operator of the vacuum system 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 system may not be dismantled.



CAUTION

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



CAUTION

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

Danger of burns!

The vacuum system may not be touched when it is in operation. If touching the vacuum system 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 [→ 53]" depending on the needs of maintenance:

- In REMOTE mode, the start/ stop drive of the vacuum system passes through the main machine interface of the vacuum system (the one connected to TOOL) and the COMBI COBRA DS starts simultaneously.
- In LOCAL mode, the start/ stop drive of the COMBI COBRA DS is done independently. For safety reasons, execute the start of the COMBI COBRA DS simultaneously.
 - Stop the pump with the Remote control (RC) (press on STOP button during 10s).
 - Press on emergency stop button.
 - Switch off the main circuit breaker.
 - Open the power box and switch off the circuit breakers.
 - Switch off the customer's power supply.
 - Switch off the water (inlet first, the outlet) and nitrogen quick connections.(pumps cooling is quickly done by not switching off the water connections) .
 - Depending on the maintenance type, let the vacuum system cool in order to avoid burn (rapid cooling of the vacuum pump wished or not).
 - 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 system.
- Make sure that there are no cleaning tools in the vacuum system anymore according to local and national regulations.

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

When the maintenance work has been finished, follow the procedure "*Safety Lockout Procedure* [→ 53]":

- Take off the label or warning board "Maintenance Processing".
- Check the cooling liquid and oil levels according to the chapters "*Oil Level Checking* [→ 54]" and "*Cooling liquid Level Checking* [→ 59]".
- Open the power box cover and check that the thermal relays are on position "ON". Then close the power box cover.
- Release the emergency stop button and the lock.
- 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 vacuum system with the Remote control (RC) (press on START button or with START / STOP button).

7.1 Maintenance Schedule

The maintenance intervals depend very much on the individual operating conditions. The intervals given below are considered as starting values which should be individually shortened or extended as appropriate.

Particularly harsh applications or heavy duty operation, such as high dust loads in the environment or in the process gas, other contamination or ingress of process material, can make it necessary to shorten the maintenance intervals significantly.

Interval	Maintenance work
Weekly	<ul style="list-style-type: none"> • Check the oil level, see "<i>Oil Level Checking</i> [→ 54]". • Check the cooling liquid, see "<i>Cooling Liquid Level Checking</i> [→ 59]". • Check the cooling water flow, see "<i>Cooling Water</i>" in "<i>Additional Checking</i> [→ 61]". • Check the nitrogen flow, see "<i>Nitrogen</i>" in "<i>Additional Checking</i> [→ 61]". • Check the vacuum pump for oil leaks - in case of leaks have the vacuum pump repaired (contact the manufacturer). • Check the vacuum pump for cooling liquid leaks - in case of leaks have the vacuum pump repaired (contact the manufacturer). • Check the vacuum pump for cooling water leaks - in case of leaks have the vacuum pump repaired (contact the manufacturer).
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 system 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 system .
Yearly	<ul style="list-style-type: none"> • Make sure that the vacuum system has been switched off and that it cannot be switched on again accidentally. • Carry out a visual inspection and clean the vacuum system from dust and dirt • Check the electrical connections and the monitoring devices. • Check the seals and replace if necessary. • Check the intake and exhaust lines and clean or replace if necessary.

Interval	Maintenance work
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 exhaust 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 exhaust 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> [→ 60]"). • 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> [→ 60]". • Clean the magnetic plugs (MP).
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 "<i>Oil Change</i> [→ 56]". • Have a major overhaul on the vacuum system (contact the manufacturer).

7.1.1 Lock Out/ Tag Out Procedure

- Stop the vacuum system with the remote control (RC) (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 system .

7.1.2 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* [→ 54]" and "*Cooling Liquid Level Checking* [→ 59]".
- 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 vacuum system with the remote control (RC) (press on START button).

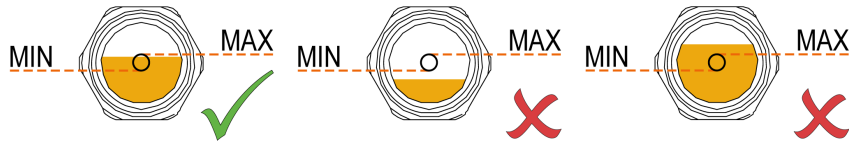
7.2 Oil Checking

7.2.1 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")

7.2.2 Oil Refilling

- Prepare the needed oil quantity, see *Oil Type/ Quantity* [→ 68].



WARNING

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



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 -> Manufacturer PLC and LCD").



CAUTION

Only fill in oil through the oil filler opening.



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.



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.

7.2.3

Oil Color Inspection



WARNING

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

Risk of explosion!

If the oil becomes dark:

- Contact your manufacturer 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.



- Contact your manufacturer representative to find out why the oil color has changed.

7.2.4 Oil Change



DANGER



If the vacuum system 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.

7.2.4.1 Used Oil Draining



NOTE

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

- Make sure that the vacuum system is switched off and cannot accidentally be switched on again.
- Make sure that the vacuum system 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 system for a few seconds.
- Make sure that the vacuum system 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.
- Make sure that the seals of the magnetic plug is undamaged and correctly positioned, replace 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 system for a brief moment and let it run for a few seconds.
- Make sure that the vacuum system is switched off and cannot accidentally be switched on again.
- Carefully remove the oil drain plugs (ODP) 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 (ODP) and tighten them up.
- Dispose of the used oil in compliance with applicable regulations.

7.2.4.2

New Oil Filling

COBRA NS (DP) vacuum pump:

- Prepare the quantity of oil needed (see "Oil Type/ Quantity [→ 68]").



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.

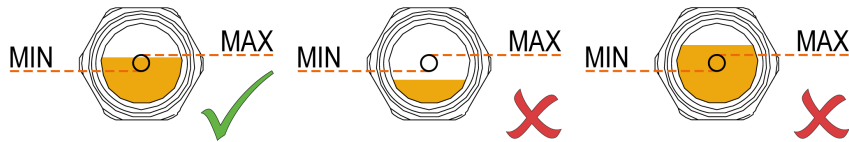


CAUTION

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 [→ 68]").



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.

7.3 Cooling Liquid Checking

7.3.1 Cooling Liquid Level Checking

- Make sure that the vacuum system 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 1) on cylinder upper plate.
- Cooling liquid level should be just at the level of purge cap (space in the expansion vessel).
- Check the level of the cooling liquid in the cylinder endplate B-side (opposite side of the motor).
- Unscrew, but do not remove completely the purge cap (CLV 2).
- The level is OK only if the cooling liquid try to flow out.



WARNING

Be carefull, the cooling liquid quantity which could flow, could be important.

If the level is below:

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

7.3.2 Cooling Liquid Refilling



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 [→ 66]").

- Make sure that the vacuum system 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 1) on cylinder upper plate.
- Check the level of the cooling liquid: if the cooling liquid level is at the purge cap on cylinder upper plate, do not unscrew the purge cap on cylinder endplate B-side as the cooling liquid will flow outside, otherwise follow the procedure.
- Unscrew purge cap (CLV 2) on cylinder endplate B-side.
- Unscrew the filler cap (CLF) for the cooling liquid.
- Fill in by filler hole until cooling liquid flows by purge cap (CLV 2) on cylinder endplate B-side.
- Stop fill in.
- Close the purge cap (CLV 2) 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 (CLV 1) of cylinder upper plate.
- Make sure that the seals of the filler cap are not damaged and that they sit properly. Replace if necessary.
- Stop fill in.
- Screw on the cooling liquid filler cap (CLF) again.
- If liquid has run on to the outside surfaces of the vacuum pump, wipe it off.

7.3.3 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 filling plug of cooling liquid (CLF).
- Unscrew purge cap (CLV 1) on cylinder upper plate.
- Unscrew purge cap (CLV 2) 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 filling plug of cooling liquid (CLF).
- 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 1) on cylinder upper plate.
- Unscrew again purge cap (CLV 2) 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 on the drain plug again.
- Dispose of the used cooling liquid according to applicable environmental protection regulations.

7.3.4 New Cooling Liquid Filling

- Prepare the quantity of cooling liquid needed (see "*Cooling Liquid Type/ Quantity* [→ 69]").



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 (CLV 1) on cylinder upper plate.
- Unscrew purge cap (CLV 2) on cylinder endplate B-side.
- Unscrew the filler cap (CLF) for the cooling liquid.
- Fill in by filler hole until cooling liquid flows by purge cap (CLV 2) of cylinder endplate B-side.
- Stop fill in.
- Close the purge cap (CLV 2) on cylinder endplate B-side.
- Fill in again by filler hole until cooling liquid flows by purge cap (CLV 1) of cylinder upper plate.
- Close the purge cap (CLV 1) on cylinder upper plate.
- Make sure that the seals of the filler cap (CLF) are not damaged and that they sit properly. Replace them if necessary.

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

- Close the shut-off device.

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

- Place a rubber plate on the suction flange.
- Let the vacuum pump run for maximum 5 minutes.
- Stop the vacuum pump and wait for a few minutes.
- Check that the filling level is just under the cylinder upper plate.

In case the cooling liquid level is below the required level:

- Fill in more cooling liquid.

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

- Open the shut-off device.

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

- Remove the rubber plate from the inlet flange and connect the inlet line to the inlet flange.
- Wipe cooling liquid that may have run on outside surfaces of vacuum pump.
- Start the vacuum pump.

7.4 Additional Checking

Subject	Checking
Cooling Water	<ul style="list-style-type: none"> • Check the cooling water flow. <p>If the flow drops, check for leaks:</p> <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. <p>If the flow drops, check for leaks:</p> <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. <p>An increased intensity is an indication for a fault (see “<i>Troubleshooting</i> [→ 66]”).</p>
Silencer (Accessory)	<ul style="list-style-type: none"> • Make sure that the condensate does not collect at the exhaust of the vacuum system . • 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.



CAUTION



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

There could still be residues of contamination.

8 Overhaul



CAUTION

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

Danger of explosion!

- If requirements are not met, the vacuum system 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

Incorrect assembly.

Risk of premature failure!

Loss of efficiency!

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

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

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

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

9 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.



CAUTION

Hot liquids.

Risk of burns!

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

9.1 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.

9.2 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 system by following the procedure described in "*Installation and Commissioning* [→ 69]".

9.3 Dismantling and Disposal



DANGER



In case the vacuum system 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 system.

Danger to health during dismantling of the vacuum system.

Danger to the environment.

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

Prior to shipping, the vacuum system 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 system.



CAUTION

Only authorized personnel may carry out dismantling work on the vacuum system. Before work begins, the operator of the vacuum system 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 system 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 system.



CAUTION



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

- Dispose of the vacuum system 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.

10 Spare Parts



NOTICE

Use of non-Busch genuine spare parts.

Risk of premature failure!

Loss of efficiency!

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

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

For Busch genuine spare parts:

- Contact your Busch representative.

11 Troubleshooting



DANGER

Live wires.

Risk of electrical shock!

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



CAUTION

Hot surface.

Risk of burns!

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



CAUTION

Hot liquids.

Risk of burns!

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

Problem	Possible Cause	Remedy
The machine does not start.	The motor is not supplied with the correct voltage.	<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 vapors.
	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 at the inlet connection.	Suction or exhaust 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, contact your Busch representative.

12 Oil Type/ Quantity

12.1 Oil Type

Make sure that the oil type corresponds to specifications:

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

Oil suitability

- **Oil YLC 250 B:** Mandatory oil for specific applications.



CAUTION

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

12.2 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 0600 C	0,8	0,8
Quantity (l)	Motor side (A)	Gear side (B)
WY 075	6.0	6.5

13 Cooling Liquid Type/ Quantity

13.1 Cooling Liquid Type

Make sure that the Cooling Liquid type corresponds to specifications:

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

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

For more information, contact your manufacturer representative.

13.2 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 0600 C
Cooling liquid quantity (Liter)	approx. 26 liters
Cooling liquid type	Glycol (Ethylene), Art. No. 2000 241 757, CLA 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.

14 Technical Data

DS 9161 B		
Nominal pumping speed	m ³ /h (50 Hz / 60 Hz)	6220
	ACFM (50 Hz / 60 Hz)	3625.2
Ultimate pressure	TORR hPa (mbar)	0.00075 0.001
Nominal motor rating backing pump	kW (60 Hz)	15
Nominal motor rating vacuum booster	kW (60 Hz)	20
Power consumption at ultimate pressure	kW (MB: 60 Hz)	13
Power consumption at ultimate pressure / idle mode	kW (MB: 30 Hz)	11
Nominal motor speed backing pump	min ⁻¹ (50 Hz / 60 Hz)	3000 / 3600
Nominal motor speed vacuum booster with variable speed drive	min ⁻¹ (50 Hz / 60 Hz)	3000 / 3600
Sound pressure level (ISO 2151), KpA = 3 dB *	dB(A) (50 Hz / 60 Hz)	< 75 / < 75
Ambient temperature range	°C	0 ... 40
	°F	32 ... 104
Maximum allowable counter pressure at exhaust connection	hPa (mbar)	200
Water consumption (motors cooling)	l/min	min. 14
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	1875

* With silencer at exhaust.



CAUTION

There are two pump versions with different mechanical gears depending on the operating / present electrical frequency (50 or 60 Hz). The pump speed (rpm) depends on the frequency.

Take care to choose the right pump version (regarding voltage and frequency).

It depends usually on operating site (example: Europe = 400V/50Hz).

Usual worldwide Voltages and Frequencies in SEMICON INDUSTRIES:

Country	Voltages and Frequencies
Europe	400 V @ 50 Hz
China	400 V @ 50 Hz
Taiwan	208 V @ 60 Hz
Korea	208 V @ 60 Hz
USA	208 V or 460 V @ 60 Hz

15 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 9161 B

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

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

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

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

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

Busch Dienste GmbH
Schauinslandstr. 1
DE-79689 Maulburg

Icheon-si, 19.12.2023



Jeihong Kim

General Manager

Busch Manufacturing Korea, Ltd

16 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 9161 B

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

- Supply of Machinery (Safety) Regulations 2008
- Electromagnetic Compatibility Regulations 2016
- Restriction of the use of certain hazardous substances in Electrical and Electronic Equipment Regulations 2012

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

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

Legal person authorized to compile the technical file and importer in the UK (if the manufacturer is not located in the UK): **Busch (UK) Ltd**
30 Hortonwood
Telford - UK

Icheon-si, 19.12.2023



Jaihong Kim

General Manager

Busch Manufacturing Korea, Ltd

Notes

A large grid of dots for taking notes, consisting of 20 columns and 30 rows of small, evenly spaced dots.

BUSCH GROUP

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



● Busch Group companies

▲ Busch Group production sites

● Busch Group service centers

■ Busch Group local representatives

www.buschvacuum.com

www.pfeiffer-vacuum.com