Installation and Maintenance Instructions

Screw Vacuum Pumps

COBRA NS 0600 C

Direct cooling water system with heat exchanger and thermostatic valve

Ateliers Busch S.A.
Zone industrielle
2906 Chevenez
Switzerland

0870565684/ Subject to change without notice
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## Introduction

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

These operating instructions contain information for
- product description,
- security,
- transport,
- storage,
- installation and commissioning,
- maintenance,
- overhaul,
- troubleshooting

of the vacuum pump.

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

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

Keep these operating instructions and, if applicable, other pertinent operating instructions available on site.
Direct cooling water system with heat exchanger and thermostatic valve

IN Inlet
OUT Discharge
CWI 1 Cooling water inlet (motor)
CWO 1 Cooling water outlet (motor)
CWI 2 Cooling water inlet (heat exchanger + cylinder)
CWO 2 Cooling water outlet (heat exchanger + cylinder)
OFP Oil filler plug
OSG 1 Oil sight glass
OSG 2 Oil sight glass
ODP Oil drain plug
MP, ODP 1 Oil drain magnetic plug
ODP 2 Oil drain plug
MP, ODP 3 Oil drain magnetic plug
SV Safety valve
CLF Cooling liquid filler plug
CLP Cooling liquid pump
CLV Cooling liquid purge plug
CLD Cooling liquid drain ball valve
PMR Unblocking screw for rotors
TS 1 Temperature switch, 120°C
TS 2 Temperature switch, 140°C
TS 3 Temperature switch, 100°C
TR Temperature regulator, 55°C
FSA Cooling water flow switch
HE Heat exchanger

CWI 1 Cooling water inlet (motor)
CWO 1 Cooling water outlet (motor)
CWI 2 Cooling water inlet (heat exchanger + cylinder)
CWO 2 Cooling water outlet (heat exchanger + cylinder)
FSA Cooling water flow switch
TS 1 Temperature switch, oil temperature 120°C
TS 2 Temperature switch, oil temperature 140°C
TS 3 Temperature switch, cooling liquid temperature 100°C
TS 4 Temperature switch Motor, 155°C
PSA Overpressure sensor
TSA Temperature sensor PT100 (optional)
OSG 1 Oil sight glass
OSG 2 Oil sight glass
CLP Glycol circulating pump
PGI Process gas inlet
PGO Process gas outlet
TR Temperature regulator, 55°C
HE Heat exchanger
The vacuum pump is cooled by

- the filling of cooling liquid (mix of water and glycol) inside the water chambers 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 cooling liquid is cooled by a plate heat exchanger which must be connected up to the water main. The cooling circuit is equipped with a temperature regulator fitted upstream of the plate heat exchanger. When the cooling liquid temperature exceeds 55 °C, the temperature regulator TR opens (mechanical opening) and allows the cooling liquid to get into the heat exchanger. The flow of the cooling water is controlled by a flow switch FSA. If the flow is under 1 l/min during a minimum time of 30 seconds, then the pump stops.
- A temperature sensor (kiixon) TS 4 can be used to control the temperature of the motor. The relief valve prevents excessively high pressure in the cooling liquid chambers of cylinder, relief pressure: 6 bar.
- A direct cooling water in the motor: The cooling water flow must be set at a minimum of 4 l/min.
- A direct cooling water in the heat exchanger (HE). The cooling water flow must be set at a minimum of 4 l/min. The direct water cooling circuit stabilises the temperature of the cooling liquid.

NOTE: Before vacuum pump first startup, control the oil level and the cooling level. In the event of absence of one or the other of these lubricants, please carry out the filling (please refer to the various chapter 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.

Process diagram

Sealing systems

The COBRA NS vacuum pumps are equipped with labyrinth seals on the motor side (A-side) and inlet side (B-side) as standard.

Operational Options/ Use of Available Accessories

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

A silencer or sound absorber (accessory) at the outlet of the pump reduces the noise of the pump and collects any condensates.

A temperature switch TS 3 allows the monitoring of the cooling liquid temperature in the cylinder. When the temperature exceeds 100°C, the pump must stop.

A resistance thermometer PT 100 TSA (option) allows the monitoring of the cooling liquid temperature. When the temperature exceeds 100°C, the pump must be switched off.

A nitrogen supply system fitted to the base frame allows the supply of nitrogen to a number of different points on the vacuum pump. The system allows to adjust pressure and volume flow separately. This gas can be used in a number of different ways:
A purge gas system fitted to the inlet flange allows to flush the vacuum pump after use or during operation. This system consists of a solenoid valve which enables to open and close the purge circuit. The filtered gas is fed directly into the inlet flange.

Barrier gas for the labyrinth seals or the oil-lubricated single mechanical seal: this option seals off the process gases and the gear oil. The nitrogen is fed into the intermediary chambers.

Dilution gas: this option prevents the formation of condensates or dilutes them, depending on the application. The nitrogen is fed directly into the cylinder of the vacuum pump.

**On/ Off switch**

The vacuum pump is delivered without on/ off switch. The control of the vacuum pump must be provided in the course of the installation.

**Safety**

**Intended use**

**DEFINITION:** For the purpose of correct understanding, the “handling” of the vacuum pump implies the transport, storage, installation, commissioning, the influence on operating conditions, maintenance, troubleshooting and overhaul of the vacuum pump.

The vacuum pump is intended for industrial use. It should only be handled by qualified staff.

The different applications for use and operational limits of the vacuum pump as laid out in the “Product Description” and the “Installation Prerequisites” of the vacuum pump must be observed both by the manufacturer of the machinery into which the vacuum pump is to be incorporated and by the end user.

The need for personal safety regulations depends mainly on the application the pump will be used in. The end user must provide the operators with all necessary means and tools and must inform his personnel about any dangers emanating from the processed products.

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 observed and respected.

It is vital that these installation and maintenance instructions are read and understood before the vacuum pump is used. If you have any doubts, please contact your local Busch representative.

**Safety information**

The vacuum pump has been designed and manufactured in accordance with the latest technical and safety standards. Nevertheless, residual risks may remain.

A lot of safety information is mentioned in these Installation and Operating Instructions as well as on the pump. The safety instructions must be observed. The safety information can quickly be detected through key words like DANGER, WARNING and CAUTION and is defined as follows:

**DANGER**

Disregard of this safety note will always lead to accidents with potentially fatal injuries and serious damages.

**WARNING**

Disregard of this safety note may lead to accidents with potentially fatal injuries and serious damages.

**CAUTION**

Disregard of this safety note will always lead to accidents with minor injuries and damages to property.

**Noise emission**

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

**Safety area**

Before any maintenance action, ensure a safety perimeter of at least 1 [m] around the pump.

**Stopping procedure for maintenance**

- Stop the vacuum pump
- Switch off power supply (the vacuum pump must be fully disconnected from any power supply)
- Disconnect water connections (inlet first, then outlet)
- Put up label or warning board “Maintenance in progress” on or next to the pump.

**Start-up procedure after maintenance**

- Remove label or warning board “Maintenance in progress”
- Check cooling liquid and oil levels according to the chapters “Checking the oil level” and “Checking the cooling liquid level”
● Switch on power supply (the vacuum pump must be connected to the power supply)
● Connect the water connections (outlet first, then inlet)
● Check that the “Installation prerequisites” are observed
● Start the vacuum pump

Transport
The COBRA NS vacuum pumps are tested and checked in our factory before careful packing. Check the packaging for transport damage when the goods arrive. The pump can withstand temperatures between -20°C and +55°C during transport.

Transportation of packaged pump
Packed on a pallet, the vacuum pump can be transported with a forklift.

Transport in unpacked state
The vacuum pump is bolted to a pallet or a base plate:
   ◆ Remove the bolts between the vacuum pump and the pallet or base plate

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

WARNING
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 centre 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 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

In case the vacuum pump was bolted to a pallet with fixing bolts:
   ◆ Unscrew the fixing bolts in the base frame

Starting-up of the vacuum pump after storage
● Please ensure that all protective agents such as gaskets, plugs or adhesive tapes that were used for the protection of the pump, are removed.
● Commission the vacuum pump as described in chapter “Installation and Commissioning”

NOTE: VCI is the abbreviation for “volatile corrosion inhibitor”. The VCI molecule is an organic corrosion inhibitor in the vapour phase. Integrated in various carriers such as film, cardboard, paper, foam, liquid and powder, it protects parts against corrosion as a result of its action in vapour phase. However, VCI packaging can attack plastic 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 harshest conditions: overseas shipment, extended storage before use.

Starting-up of the vacuum pump after storage
● Make sure that the inlet/ discharge connections are closed (leave the provided plugs in the pump)
● Store the vacuum pump
   – if possible in its original packaging,
   – indoors,
   – dry,
   – in a dust free room and
   – free from vibrations

Storage

Short-term Storage

● Make sure that the inlet/ discharge connections are closed (leave the provided plugs in the pump)
● Store the vacuum pump
   – if possible in its original packaging,
   – indoors,
   – dry,
   – in a dust free room and
   – free from vibrations

Removal from storage
Before starting up 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.

Consevation
In case of adverse ambient conditions (e.g. aggressive atmosphere, frequent temperature changes) conserve the vacuum pump immediately.
In case of favourable ambient conditions conserve the vacuum pump if a storage of more than 3 months is anticipated.

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

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● Wrap the vacuum pump in VCI film
● Store the vacuum pump
   – if possible in its original packaging,
   – indoors,
   – dry,
   – in a dust free and
   – vibration free area

Storage

Short-term Storage

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● Store the vacuum pump
   – if possible in its original packaging,
   – indoors,
   – dry,
   – in a dust free and
   – vibration free area

Starting-up of the vacuum pump after storage

● Please ensure that all protective agents such as gaskets, plugs or adhesive tapes that were used for the protection of the pump, are removed.
● Commission the vacuum pump as described in chapter “Installation and Commissioning”
Installation and Commissioning

Installation prerequisites

**CAUTION**
In case of non-compliance with the installation prerequisites, particularly in case of insufficient cooling:
- Risk of damage or destruction of the vacuum pump and its components!
- Risk of personal injury!

The installation prerequisites must be complied with.

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

- Make sure that the installation site or assembly area is ventilated in such a way that adequate cooling of the vacuum pump is assured.

**WARNING**
Local regulations regarding the motors and electric control elements must be observed when installing the pump in potentially explosive environments. Before start-up, make sure that all safety measures have been followed.

Local installation

- Make sure that the environment of the vacuum pump is not potentially explosive.
- Make sure that the following ambient conditions are adhered to:
  - Ambient temperature: 5 - 50 °C
  - Ambient pressure: atmospheric
  - Humidity: max. 95%, non-condensing
- Make sure that the cooling water fulfills the following requirements:
  - Temperature: 5 - 30 °C
  - Water pressure: 1,5 - 5 bar (relative)
  - Required pressure differential across supply and return: ≥ 1,5 bar
  - Flowrate:
    - Motor: ≥ 4 l/min
    - Heat exchanger (HE): ≥ 4 l/min
    - Total water flow: ≥ 8 l/min
- To reduce the maintenance effort and to achieve a long product lifetime we recommend the following cooling water quality:
  - Hardness: < 5° dH (degrees German hardness)
  - < 9° fH (degrees French hardness)
  - < 1.25° e (degrees English hardness)
  - < 90 mg/kg CaCO3 (American hardness)
  - Properties: Clean & clear
  - pH value: 7 - 9
  - Particle size: < 200 μm
  - Chloride: < 100 mg/l
  - Free chlorine: < 0.3 mg/l
  - Materials in contact with the cooling water: Stainless steel, copper
- Make sure that the environment conditions correspond to the protection class of the motor (according to motor nameplate)
- Make sure that the vacuum pump is fastened to prevent inadvertent movement
- Make sure that the vacuum pump is level to a maximum of 1° in any direction

- Make sure that the vacuum pump cannot inadvertently or intentionally be used as a support for heavy objects
- Make sure that the vacuum pump cannot be hit by falling objects
- Make sure that the vacuum pump is at least 1 m away from any wall
- Make sure that the vacuum pump is easily accessible and that the selected installation site fulfills the requirements for assembly/dismantling
- Make sure that no temperature-sensitive part (such as plastic, wood, cardboard, paper, electronic parts) come into direct contact with the hot surfaces of the vacuum pump
- Make sure that the installation site or assembly area is ventilated in such a way that adequate cooling of the vacuum pump is assured.

**CAUTION**
During operation the surface of the vacuum pump may exceed temperatures of 70° C.

- Risk of burns!

- Make sure that the vacuum pump cannot be touched inadvertently during operation, provide a guard if necessary
- Make sure that the oil sight glasses (OSG 1 and OSG 2) will remain easily accessible

If the oil change is meant to be performed on site:
- Make sure that the oil drain plugs as well as the oil filler plugs, are easily accessible.

Suction Connection

**CAUTION**
Do not put hands into the inlet aperture.

- Risk of body damage!

- Make sure that the protection that prevents the ingress of foreign matter during transport, has been removed before connecting up the vacuum pump to the piping.

**CAUTION**
The ingress of foreign objects or liquids can destroy the vacuum pump.

In case the inlet gases can contain dust or other foreign solid particles:
- Make sure that a suitable filter or protection screen is installed at the inlet of the vacuum pump
- Make sure that the nominal diameter of the inlet line is at least equal to the diameter of the inlet flange to prevent a drop in the performance of the vacuum pump in the case of a smaller cross-section.
- Make sure that the vacuum pump is connected with leak proof lines.

**CAUTION**
Once the inlet line has been connected up, make sure that the system does not leak. Leakage of dangerous substances must be prevented!

- Make sure that the inlet line is equipped with a shut-off device upstream of the inlet flange, so that the flow of drawn gases can be stopped
- Make sure that the inlet line does not exercise any pressure on the inlet flange. Use bellows if necessary.
- The inlet flange has the following dimension:
In case of long inlet lines the pipe diameter should be larger than the inlet flange to prevent a drop in the performance of the vacuum pump. If you have any doubts, contact your Busch representative.

**Discharge connection**

- **CAUTION**
  Do not put hands into the outlet aperture.
  Risk of body damage!

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

- Make sure that the protection, that was fitted to prevent the ingress of particles during transport, has been removed before the vacuum pump is connected up to the vacuum pipe.
- Make sure that the nominal diameter of the discharge line corresponds at least to the diameter of the exhaust flange of the vacuum pump in order to prevent a drop in the performance of the vacuum pump, in case of use of a smaller cross-section.

- **CAUTION**
  When the discharge piping has been connected up, make sure that the system does not leak. Leakage of dangerous substances must be prevented!

- Make sure that the discharge line is fitted in such a way so as to prevent any liquids or condensates to re-enter the vacuum pump (siphon, discharge line sloping away from the pump).
- Make sure that the discharge line does not exercise any load onto the exhaust flange. Mount bellows if necessary.
- The outlet flange has the following dimension:
  - DN 100 ISO-K

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

A silencer (optional accessory) can be fitted to the pump discharge to avoid pulsation and sound transmission into the exhaust line.

**Cooling water connections**

The cooling water is generally connected up with a flexible hose.

The cooling water outlet must be unpressurised.

Connection diameter:
- cooling water inlet: G ½
- cooling water outlet: G ½

**Motor cooling water connections**

The motor cooling water is generally connected up with a tight hose to the electrical motor.

- Connection diameter: G ½

**Nitrogen system connections (option)**

The connection of the nitrogen system is generally done using flexible hoses (diameter ¼”)

Connection diameter:
- G ¼, ISO 228-1

**Electrical connection/ Checks**

- Make sure that the requirements according to EMC-Directive 2014/30/EU as well as the current EN-standards, electrical and occupational safety directives and the local or national regulations respectively, are complied with (this is the responsibility of the designer of the machinery into which the vacuum pump is to be incorporated; see also the corresponding comments in the EU Declaration of Conformity).
- Make sure that the power supply is compatible with the data on the nameplate of the drive motor.
- Make sure that an overload protection according to EN 60204-1 is provided for the drive motor.
- Make sure that the drive of the vacuum pump will not be affected by electric or electromagnetic interference; if unsure please seek advice from your Busch representative.

**Cooling liquid temperature control**

The cooling liquid temperature in the cylinder is monitored by a temperature switch TS 3 that is mounted in the lower cylinder cover.

The electrical wiring of the temperature switch has to be done in order that the vacuum pump stops when the temperature switch trips (break contact).

<table>
<thead>
<tr>
<th>Designation</th>
<th>Set value [°C]</th>
</tr>
</thead>
<tbody>
<tr>
<td>TS 3</td>
<td>100</td>
</tr>
</tbody>
</table>

**Technical data**

<table>
<thead>
<tr>
<th>Technical data</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Set value</td>
<td>100 °C ± 7 °C</td>
</tr>
<tr>
<td>Switching cycles</td>
<td>10'000</td>
</tr>
<tr>
<td>AC current (\cos\varphi = 1)</td>
<td>2,5 A / 250 VAC</td>
</tr>
<tr>
<td>AC current (\cos\varphi = 0,6)</td>
<td>1,6 A / 250 VAC</td>
</tr>
<tr>
<td>DC current</td>
<td>1,6 A / 24 VDC</td>
</tr>
<tr>
<td>DC current</td>
<td>1,25 A / 48 VDC</td>
</tr>
<tr>
<td>Resistance contact max.</td>
<td>50 mΩ</td>
</tr>
<tr>
<td>Bounce time contact max.</td>
<td>1 ms</td>
</tr>
<tr>
<td>High voltage max.</td>
<td>2 kV</td>
</tr>
<tr>
<td>Cable operating temperature max.</td>
<td>motionless -30°C … +80°C</td>
</tr>
<tr>
<td>Cable operating temperature max.</td>
<td>motionless -5°C … +70°C</td>
</tr>
</tbody>
</table>

**Electrical wiring**
Resistance thermometer PT 100 (option)
Resistance thermometer PT 100 instead of temperature switch.

Monitoring the barrier gas volume flow (option)
A flow meter with contact fitted to the control panel of the nitrogen system enables the monitoring of the gas volume flow which is fed into the intermediary chambers.

The flow meter must be connected in such a way that the vacuum pump switches off when the volume flow drops below the min. set flow value.

- Set value: 3.5 Nl/ min

Solenoid valve (option)
Opening/ closing of the nitrogen barrier gas circuit
A solenoid valve connected to the barrier gas circuit enables to control the opening/ closing of the nitrogen barrier gas circuit.

The nitrogen barrier gas circuit depends on the application and is defined by the end user of the vacuum pump.

Opening/ closing the nitrogen purge gas circuit
A solenoid valve, connected to the inlet flange, enables to control the opening/ closing of the nitrogen purge gas circuit.

The nitrogen purge gas circuit depends on the application and is defined by the end user of the vacuum pump.

Opening/ closing the nitrogen dilution gas circuit
A solenoid valve connected to the dilution gas circuit enables to control the opening/ closing of the nitrogen dilution gas circuit.

The dilution gas circuit depends on the application and is defined by the end user of the vacuum pump.

Installation
Fitting
- Make sure that the “Installation Prerequisites” are complied with
- Fit or install the vacuum pump at its final location

Electrical connection

WARNING
Risk of electrical shock, risk of damage to equipment.

Electrical installation work must only be executed by qualified personnel that knows and observes the following regulations:
- IEC 364 or CENELEC HD 384 or DIN VDE 0100, respectively,
- IEC-Report 664 or DIN VDE 0110,
- BGV A2 (VBG 4) or corresponding national accident prevention regulation.

CAUTION
The connection schemes given below are typical. Specific orders or deviating connection schemes for certain markets may apply.

Risk of damage to the drive motor!

Please check drive motor connections inside the terminal box and refer to the drive motor connection instructions.

WARNING
The operating rotational speed of the drive motor must correspond to the pump’s nameplate value. Do not exceed the mentioned rotational speed.

\[ n_{\text{max}} = 3000 \, \text{min}^{-1} \Rightarrow 50 \text{Hz} \ \pm/\pm \ 2\% \]

\[ n_{\text{max}} = 3600 \, \text{min}^{-1} \Rightarrow 60 \text{Hz} \ \pm/\pm \ 2\% \]

Risk of damage to the vacuum pump!

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).

Three phase motor connection

Star-star connection (Low voltage):
Star connection (High voltage):

Thermo switch connection

CAUTION
Operation of the pump in the wrong direction of rotation, even for a short period of time, can destroy the vacuum pump.
Risk of damage of the drive motor!

Prior to starting-up of the vacuum pump, please ensure that the vacuum pump is connected up correctly.

- Determine the direction of rotation by using a pressure measure tool or by placing a rubber plate on the inlet
- Press the on/ off switch and hold briefly
- Make sure that the pump draws in
If the direction has to be changed:
  - Switch around any two of the drive motor wires in the terminal box

Connecting up of lines/ pipes
- Connect the suction line
- Connect the discharge line
- Make sure that all provided covers, guards, hoods etc. are fitted

Filling up with oil
The COBRA NS vacuum pumps are always delivered without oil (see chapter “Oil Type” for information on recommended oils).
- Prepare the quantity of oil specified in the table “Oil quantity”
- Refer to the pump nameplate to identify the correct oil type used for this pump
- Only use the oil type specified on the pump nameplate

NOTE: The quantity of oil specified in the operating instructions is of informative nature only. Check the oil level with the help of the various oil sight glasses (OSG 1 and OSG 2) on the vacuum pump.
- Unscrew the oil filler plugs
- Fill in oil
- Make sure that the filling level is in the target circle of the oil sight glasses (OSG 1 and OSG 2)

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
- Switch on the vacuum pump

In case the suction line is equipped with a shut-off valve:
  - Close the shut-off valve

In case the suction line is not equipped with a shut-off valve:
  - Cover the inlet connection with a rubber plate
  - Let the vacuum pump run for a few minutes
  - Switch off the vacuum pump and wait for a few minutes
  - Check that the filling level is in the target circle of the oil sight glasses (OSG 1 and OSG 2)

If the oil level is below the target circle of the oil sight glasses:
  - Top-up with oil

In case the suction line is equipped with a shut-off valve:
  - Open the shut-off valve

In case the suction line is not equipped with a shut-off valve:
  - Remove the rubber plate from the suction flange and connect the suction line to the suction flange
  - Before any transport, make sure that the oil has been drained out of the vacuum pump.

CAUTION
Once filled with oil, the vacuum pump should not be lifted or moved anymore.
Filling in cooling liquid

The COBRA NS vacuum pumps are always delivered without cooling liquid (see chapter “Cooling liquid types ” for information on the recommended cooling liquids).

- Prepare the quantity of cooling liquid as specified in the table “Cooling liquid quantity”

**NOTE:** The quantity of cooling liquid specified in the installation handbook is of informative nature only. Follow the procedure of filling the cooling liquid.

- Remove the cooling liquid filler plug (CLP) on cylinder upper plate
- Open the cooling liquid purge plug (CLV) on cylinder upper plate
- Fill in cooling liquid by filler hole until the cooling liquid flows of the cooling purge plug (CLV) on cylinder upper plate
- Close the cooling liquid purge plug (CLV) on cylinder upper plate
- Fit the cooling liquid filler plug (CLP) on cylinder upper plate
- If there is any spillage on the surface of the vacuum pump, wipe it up
- Start the vacuum pump

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
- Open the cooling liquid purge plug (CLV) on cylinder upper plate
- 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 suction flange and connect the suction line to the suction flange

Checking the cooling water temperature

As standard, the vacuum pump is delivered without water temperature control device. Regularly check the temperature of the cooling water. Too high a temperature of the cooling water will not make it possible to regulate the temperature of the cooling liquid.

Checking the cooling water flow (option)

As option, the flow of the cooling water is checked by the flowmeter FSA. 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 3 l/min.

Purge gas supply for barrier gas and dilution gas

The pump has connections available to add a barrier gas system and a dilution gas system. These systems are typically equipped with pressure regulators and solenoid valves. Disfunctions of these components must not cause dangerous overpressure conditions inside the vacuum pump or in connected pipework. If required pressure monitoring or relief valves should be foreseen.

### Table: Cooling Liquid Specifications

<table>
<thead>
<tr>
<th>Gas type (depends on process)</th>
<th>Barrier gas</th>
<th>Dilution gas</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gas temperature</td>
<td>0 - 60°C</td>
<td></td>
</tr>
<tr>
<td>Filtration</td>
<td>≤ 50 μm</td>
<td></td>
</tr>
<tr>
<td>Maximum permissible flow rate</td>
<td>30 SLM</td>
<td>200 SLM</td>
</tr>
<tr>
<td>Recommended flow rate</td>
<td>8 SLM</td>
<td>depends on process</td>
</tr>
</tbody>
</table>

**Saving the operating parameters**

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

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

**Recommendations on operation**

**Application**

**WARNING**

The vacuum pump is designed for operation under the conditions described below.

In case of disrespect of the above, risk of damage or destruction of the vacuum pump!

The vacuum pump must only be operated under the conditions described below.

The COBRA NS 600 C vacuum pumps have been designed for use in industrial applications and similar industries.

They can be used to draw gases and gas mixtures.

Maximum permissible inlet pressure: atmospheric pressure

Make sure that the maximal counter pressure at the discharge of 0,2 bar is never exceeded. If there is the risk of obstruction of exhaust lines, a permanent discharge pressure monitoring is recommended.

**WARNING**

When using toxic, inflammable and/ or explosive gases, make sure that the system corresponds 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 enter the vacuum pump. In case of process errors, the pump can draw in a certain amount of liquids. If the pump has drawn in liquid, a short drying run will be necessary at the end of the process and, in case a silencer (accessory) is mounted at the outlet:

- Drain the silencer (accessory)

Condensables should be drained out of the silencer continuously.

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

Max. permissible number of startings per hour: 6.

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

During operation the surface of the vacuum pump can exceed temperatures of 70°C.

Risk of burns!

The vacuum pump must be protected against contact during operation. If touching the pump is unavoidable, wait until the surface temperature has cooled down or wear protective gloves.

CAUTION

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

Risk of hearing damage.

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

CAUTION

The COBRA NS vacuum pumps are always delivered without oil.

Operation without oil will destroy the vacuum pump within a short period of time.

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

CAUTION

The COBRA NS vacuum pumps are always delivered without cooling liquid.

Operation without cooling liquid will destroy the vacuum pump within a short period of time.

- Make sure that all provided covers, guards, hoods etc. remain fitted
- Make sure that protective devices will not be disconnected
- Make sure that there is no leakage in the system, the escape of dangerous substances must be avoided
- Make sure that the “Installation Prerequisites” are complied with and will remain so, and ensure that adequate cooling is guaranteed

If the pump is shut down for a longer period of time:

To avoid obstruction of the pumping mechanism and to avoid adhesion of process materials on the screw rotors, dilution gas can be injected (optional accessory)

CAUTION

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

- Drain the cooling water
  - Open the cooling liquid purge plug (CLV)
  - Open the cooling liquid drain ball valve (CLD)
  - Drain the cooling liquid completely
  - Refit the cooling liquid drain plug again
  - Close the cooling liquid purge ball valve
  - Collect the cooling liquid and re-use it or dispose of it according to local or national regulations
- Disconnect the cooling water inlet/ outlet connections

- Drain the cooling water
- Disconnect the cooling water inlet/ outlet connections

CAUTION

If necessary, drain the cooling water with the help of compressed air in order to prevent any risk of frost or corrosion

NOTE: When the pump has not been in operation for a few days or when a sticky substance has been drawn, it is possible that the two rotor screws of the COBRA NS vacuum pump stick to each other.

Switching the vacuum pump on/off

First start-up of the system

- Make sure that the “Installation Prerequisites” are followed

If the system is equipped with a solenoid valve on the cooling water circuit:
  - Open the solenoid valve
  - Open the cooling water supply

If the vacuum pump is equipped with a barrier gas system:
  - Open the solenoid valve
  - Open the nitrogen supply
  - Adjust the barrier gas pressure

If the vacuum pump is equipped with a purge gas system:
  - Open the solenoid valve
  - Open the nitrogen supply
  - Adjust the pressure and volume flow for the purge gas

If the vacuum pump is equipped with a dilution gas system:
  - Open the solenoid valve
  - Open the nitrogen supply
  - Adjust the pressure and volume flow for the dilution gas
  - Start the vacuum pump

If the vacuum pump is equipped with a solenoid valve at the inlet:
  - Open the solenoid valve

If the vacuum pump is equipped with a shut-off valve at the inlet:
  - Open the shut-off valve

Switching off the system

If the vacuum pump is equipped with a solenoid valve at the inlet:
  - Close the solenoid valve

If the vacuum pump is equipped with a shut-off valve at the inlet:
  - Close the shut-off valve

If the vacuum pump is equipped with a purge gas system:
  - Open the solenoid valve on the flushing device
  - Flush the vacuum pump for 20 - 40 minutes
  - Close the solenoid valve on the flushing device

- Switch off the vacuum pump
- Close the cooling water supply

If the vacuum pump is equipped with a solenoid valve on the cooling water circuit:
  - Close the solenoid valve

If the vacuum pump is equipped with a barrier gas, purge or dilution gas system:
  - Close the nitrogen supply
  - Close the solenoid valve(s)
  - The system must be disconnected from the power supply

Installation and Commissioning
Page 12
"Stopping procedure for maintenance": Switched on again. Follow the shutdown procedure in the section pump has been fully switched off and that it cannot accidentally be switched on again. Make sure that the vacuum pump has been switched off and that it cannot accidentally be switched on again.

Before disconnecting the different connections, make sure that the inlet and exhaust lines of the vacuum pump have been brought to atmospheric pressure.

When the maintenance work has been finished, follow the procedure “Start-up procedure after maintenance”: - Remove the label or warning board “Maintenance in progress” - Check the cooling liquid and oil levels according to chapters “Checking the oil level” and “Checking the cooling liquid level” - Connect the pump up to the power supply - Reconnect the cooling water connections (outlet first, then inlet) - Make sure that the “Installation Prerequisites” are followed - Start the pump

Maintenance program
NOTE: The maintenance intervals depend on the individual operating conditions. The intervals given below should be considered as initial guidelines which should be shortened or extended as appropriate. In particularly heavy duty operation such as high dust loads in the environment or in the process gas, it can become necessary to shorten the maintenance intervals significantly.

Weekly:
- Check the oil level and the colour (see “Checking the Oil”) - Check the vacuum pump for oil leaks - in case of leaks, have the vacuum pump repaired (Busch service)

Monthly:
- Make sure that the vacuum pump has been switched off and that it cannot accidentally be switched on again - Check the level of the cooling liquid (see “Checking the Cooling liquid”) - Check the cooling water (see “Checking the cooling water”) - Check the electrical connections - Carry out a visual inspection of the vacuum pump - Check the vacuum pump for cooling liquid leaks - in case of leaks, have the vacuum pump repaired (Busch service) - Check the vacuum pump for cooling water leaks - in case of leaks, have the vacuum pump repaired (Busch service)

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

If the inlet is equipped with a mesh screen:
- Check the mesh screen at the inlet and clean it if necessary - Check the correct operation of the measurement and safety equipment - Check the seals and replace them if necessary - Drain the cooling liquid (see “Draining the cooling liquid”) - Perform a vacuum leak test measurement on the pump - Check the inlet and discharge lines and clean or replace them if necessary

Maintenance

WARNING
In case the vacuum pump has conveyed gases that have been contaminated with harmful foreign material which are harmful to health, the oil and the condensates will also be contaminated with harmful foreign material. These foreign materials can infiltrate the pores, recesses and other internal spaces of the vacuum pump. Danger to health during dismantling of the vacuum pump. Danger to the environment.

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

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

CAUTION
Only authorised 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.

CAUTION
Before any maintenance work is started, a safety perimeter of at least 1 [m] around the machine must be set up.

CAUTION
During operation the surface of the vacuum pump may reach temperatures in excess of 70 °C.

Risk of burns!

Before starting any maintenance work, make sure that the vacuum pump has been fully switched off and that it cannot accidentally be switched on again. Follow the shutdown procedure in the section “Stopping procedure for maintenance”:
- Stop the vacuum pump
- Switch off the power supply (the vacuum pump must be fully disconnected from the power supply)
- Disconnect the cooling water connections (inlet first, then outlet)
- Put up label or warning board “Maintenance in progress” on or next to the pump

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

Danger of burns!

- Make sure that the oil circuit and the cooling liquid circuit have been drained before moving the vacuum pump
- Do not use strong solvents for cleaning of labels and stickers on the pump
- Make sure that any cleaning materials used to clean the vacuum pumps have been disposed of according to local and national regulations

Weekly:
- Check the oil level and the colour (see “Checking the Oil”) - Check the vacuum pump for oil leaks - in case of leaks, have the vacuum pump repaired (Busch service)

Monthly:
- Make sure that the vacuum pump has been switched off and that it cannot accidentally be switched on again - Check the level of the cooling liquid (see “Checking the Cooling liquid”) - Check the cooling water (see “Checking the cooling water”) - Check the electrical connections - Carry out a visual inspection of the vacuum pump - Check the vacuum pump for cooling liquid leaks - in case of leaks, have the vacuum pump repaired (Busch service) - Check the vacuum pump for cooling water leaks - in case of leaks, have the vacuum pump repaired (Busch service)

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

If the inlet is equipped with a mesh screen:
- Check the mesh screen at the inlet and clean it if necessary - Check the correct operation of the measurement and safety equipment - Check the seals and replace them if necessary - Drain the cooling liquid (see “Draining the cooling liquid”) - Perform a vacuum leak test measurement on the pump - Check the inlet and discharge lines and clean or replace them if necessary

Maintenance program
NOTE: The maintenance intervals depend on the individual operating conditions. The intervals given below should be considered as initial guidelines which should be shortened or extended as appropriate. In particularly heavy duty operation such as high dust loads in the environment or in the process gas, it can become necessary to shorten the maintenance intervals significantly.

Weekly:
- Check the oil level and the colour (see “Checking the Oil”) - Check the vacuum pump for oil leaks - in case of leaks, have the vacuum pump repaired (Busch service)

Monthly:
- Make sure that the vacuum pump has been switched off and that it cannot accidentally be switched on again - Check the level of the cooling liquid (see “Checking the Cooling liquid”) - Check the cooling water (see “Checking the cooling water”) - Check the electrical connections - Carry out a visual inspection of the vacuum pump - Check the vacuum pump for cooling liquid leaks - in case of leaks, have the vacuum pump repaired (Busch service) - Check the vacuum pump for cooling water leaks - in case of leaks, have the vacuum pump repaired (Busch service)

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

If the inlet is equipped with a mesh screen:
- Check the mesh screen at the inlet and clean it if necessary - Check the correct operation of the measurement and safety equipment - Check the seals and replace them if necessary - Drain the cooling liquid (see “Draining the cooling liquid”) - Perform a vacuum leak test measurement on the pump - Check the inlet and discharge lines and clean or replace them if necessary

Maintenance

Page 13
Every 16'000 operating hours, at the latest after 4 Years:

- Oil change (see “Oil change”)
- Have a major overhaul done on the vacuum pump (Busch service)

Stopping procedure for maintenance

- Stop the vacuum pump
- Switch off the power supply (the vacuum pump must be disconnected from the power supply)
- Disconnect the cooling water connections (inlet first, then outlet)
- Put up label or warning board “Maintenance in progress” on or next to the pump.

Start-up after maintenance

- Remove label or warning board “Maintenance in progress”
- Check the cooling liquid and oil levels according to the chapters “Checking the oil level” and “Checking the cooling liquid level”
- Connect the pump up to the power supply
- Reconnect the cooling water connections (outlet first, then inlet)
- Make sure that the “Necessary installation instructions” are followed
- Start the vacuum pump

Checking the oil

Checking the oil level

- Make sure that the vacuum pump is switched off and cannot accidentally be switched on again
- Check the oil level on the different oil sight glasses

If the oil level is lower than the target circle of the oil sight glass:

- Top up with oil (see “Topping up Oil”)

If the oil level is higher than the target circle of the oil sight glass:

- Check the evacuation of the condensates.
- Drain the oil (see “Change the oil”)

Oil level, pump not operating

- To check the oil level during operation of the pump, please use the following guidelines:

50 Hz operation, \( n_{\text{max}} = 3000 \text{ min}^{-1} \)
60 Hz operation, \( n_{\text{max}} = 3600 \text{ min}^{-1} \)
according to nameplate,
 oil sight glass inlet side (OSG1)

Minimum oil level, Pump operating

During operation, oil level must not be more than 3 mm under the oil level target circle of oil sight glass!

60 Hz operation, \( n_{\text{max}} = 3600 \text{ min}^{-1} \)
according to nameplate,
 oil sight glass motor side (OSG2)

Minimum oil level, Pump operating

During operation, oil level must not be more than 5 mm under the oil level target circle of oil sight glass!

50 Hz operation, \( n_{\text{max}} = 3000 \text{ min}^{-1} \)
according to nameplate,
 oil sight glass motor side (OSG2)

Minimum oil level, Pump operating

During operation, oil level must not be more than 10 mm under the oil level target circle of oil sight glass!
Topping up with oil

NOTE: Under normal conditions there should be no need to top up with oil in-between the recommended oil change intervals. A significant drop in the oil level indicates a malfunction (see “Troubleshooting”).

CAUTION
Fill in oil only through the oil filler holes.

CAUTION
Risk of injury (burns) with open oil filler orifice.
Risk of injury in case of badly screwed-in plugs.
Remove the oil filler plugs only when the vacuum pump is stopped.
The vacuum pump must only be operated when the oil filler plugs are firmly tightened up and do not leak.

- Make sure that the vacuum pump is switched off and cannot accidentally be switched on again
- Remove the oil filler plugs
- Top up with oil and fill up to the upper level of the target circle of the oil sight glasses (OSG 1 and OSG 2)
- Make sure that the oil level is in the target circle of the oil sight glasses (OSG 1 and OSG 2)

Oil level, pump not operating

![Image of oil sight glasses]

- Make sure that the seals of the oil filler plugs are not damaged and replace plugs if necessary
- Refit the oil filler plugs and tighten up

Checking the colour of the oil

- Check oil type according to nameplate
Busch oil YLC 250 B: The oil must be clear and transparent. A permanent milky colour is an indication for contamination by foreign bodies. A dark colour is an indication for oil that has been chemically altered or contaminated by foreign bodies.

WARNING
Dark coloured oil may indicate a hazardous pump condition which could cause personal injury.

If dark oil similar to the example shown is observed, you have to contact the Busch Customer Service without delay.

Oil change

WARNING
In case the vacuum pump has conveyed gases that have been contaminated with harmful foreign materials, the oil will also be contaminated.

Danger to health during the change of contaminated oil.
Danger to the environment.
Wear protective equipment during the change of contaminated oil.
Contaminated oil is hazardous waste and must be disposed of separately in compliance with applicable regulations.

Draining used oil

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

- Make sure that the vacuum pump is switched off and cannot accidentally be switched on again
- Make sure that the vacuum pump is vented to atmospheric pressure
- Put a drain tray underneath the oil drain plugs (ODP)
- Remove the oil drain plugs (ODP)
- Carefully remove the drain plugs
- Drain the oil
- Because of wear and tear on the seals replace the current drain plugs with new ones

When the oil flow has stopped:

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

---

**CAUTION**

Never unscrew and remove the magnetic plug (MP, ODP 3) when the vacuum pump is operating.

- Make sure that the vacuum pump and the primary pump are switched off and cannot accidentally be switched on again
- Make sure that the vacuum pump has been vented to atmospheric pressure
- Make sure that all the oil has been drained
- Carefully unscrew and take off the magnetic plug (MP, ODP 3), which is situated on the rear lubrication circuit of the motor bearing
- Make sure there is no metallic swarf on the magnetic part of the magnetic plug, clean off as necessary
- Refit the magnetic plug (MP, ODP 3)

---

**CAUTION**

It is recommended that the magnetic plug (MP, ODP 3) is replaced at every oil change due to wear and tear of the seal.

---

### Checking the magnetic plug from the rear lubrication circuit of the motor bearing

**Warning:** 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 operating instructions 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 oil drain plugs have been fitted properly and that they do not leak

---

**CAUTION**

Only fill in oil through the oil filler orifices.

- Remove the oil filler plugs
- Fill in oil until it reaches the upper level of the target circle of the oil sight glasses (OSG 1 and OSG 2)
- Make sure that the oil level is in the target circle of the oil sight glasses (OSG 1 and OSG 2)

---

#### Filling in new oil

- Prepare the quantity of oil needed (see “Oil type/ quantity”)

---

#### Checking the cooling liquid

- Make sure that the vacuum pump is switched off and cannot accidentally be switched on again
- Check the level of the cooling liquid
- Open the cooling liquid purge plug (CLV) on cylinder upper plate
  - The filling level must be just under the cylinder upper plate
- If the level is below:
  - Top up with cooling liquid (see “Refilling cooling liquid”)

---

#### Top up with cooling liquid

**Note:** Under normal conditions there should be no need to top up with cooling liquid in-between the recommended change intervals. A significant drop in the cooling liquid level indicates a malfunction (see “Troubleshooting”).

- Make sure that the vacuum pump is switched off and cannot accidentally be switched on again
- Remove the cooling liquid filler plug (CLP) on the cylinder
- Open the cooling liquid purge plug (CLV) on cylinder upper plate
- Fill in cooling liquid by filler hole until the cooling liquid flows of the cooling purge plug (CLV) on cylinder upper plate
- Close the cooling liquid purge plug (CLV) on cylinder upper plate
- Fit the cooling liquid filler plug (CLP) on cylinder upper plate
- Make sure that the seal rings of the cooling liquid filler plug (CLP) and cooling liquid purge plug (CLV) are not damaged, replace plugs if necessary
- If there is any spillage on the surface of the vacuum pump, wipe it up

---

### Last oil change

- — / — / —

**Note:** The quantity of oil specified in the operating instructions is of informative nature only. Check the oil level with the help of the various oil sight glasses on the vacuum pump.

**Note:** The quantity of oil specified in the operating instructions is of informative nature only. Check the oil level with the help of the various oil sight glasses on the vacuum pump.

**Note:** The quantity of oil specified in the operating instructions is of informative nature only. Check the oil level with the help of the various oil sight glasses on the vacuum pump.

**Reference:**

- Oil type see nameplate
- Change interval see instruction manual

---

**Note:** Make sure that the seals of the oil filler plugs are not damaged and replace plugs if necessary

**Note:** Make sure that the oil filler plugs are not damaged and replace plugs if necessary

**Note:** Make sure that the oil filler plugs are not damaged and replace plugs if necessary
Draining the cooling liquid
- Make sure that the vacuum pump is switched off and cannot accidentally be switched on again
- Make sure that the vacuum pump is vented to atmospheric pressure
- Put a drain tray underneath the cooling liquid drain ball valve (CLD)
- Remove the cooling liquid purge plug (CLV)
- Open the cooling liquid drain ball valve (CLD)
- Drain the cooling liquid
- Refit the cooling liquid purge plug (CLV) and tighten up
- Close the cooling liquid purge ball valve
- Start the vacuum pump and let it run for about 5 seconds
- Make sure that the vacuum pump is switched off and cannot accidentally be switched on again
- Remove the cooling liquid purge plug (CLV) on cylinder upper plate again
- Open the cooling liquid drain ball valve (CLD) again
- Drain any remaining cooling liquid
- Make sure that the seals of the cooling liquid purge plugs are not damaged, replace plugs if necessary
- Refit the cooling liquid purge plugs again and tighten up
- Close the cooling liquid drain ball valve
- Collect the cooling liquid and re-use it or dispose of it according to local or national regulations

Filling up with new cooling liquid
- Prepare the quantity of cooling liquid needed (see "Cooling liquid type/ quantity")

NOTE: The quantity of cooling liquid specified in the operating instructions is of informative nature only.
- Remove the cooling liquid filler plug (CLP) on cylinder upper plate
- Open the cooling liquid purge plug (CLV) on cylinder upper plate
- Fill in cooling liquid by filler hole until the cooling liquid flows of the cooling purge plug (CLV) on cylinder upper plate
- Close the cooling liquid purge plug (CLV) on cylinder upper plate
- Fit the cooling liquid filler plug (CLP) on cylinder upper plate
- If there is any spillage on the surface of the vacuum pump, wipe it up
- Start the vacuum pump

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
- Open the cooling liquid purge plug (CLV) on cylinder upper plate
- 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

Checking the cooling water
Checking the cooling water temperature
- Check regularly the cooling water temperature
  - Make sure that the specifications of the cooling water are followed

Checking the current consumption
- Check the current of the motor
An increased current indicates a fault (see “Troubleshooting”)

Checking the silencer (accessory)
- Make sure that the condensates do not collect at the outlet of the vacuum pump
- Drain the condensates via the drain provided and collect them in a container
- Dispose of the condensates in compliance with applicable environmental protection regulations
- Check regularly the silencer and clean it if necessary

Filling up with new cooling liquid
- Prepare the quantity of cooling liquid needed (see "Cooling liquid type/ quantity")

NOTE: The quantity of cooling liquid specified in the operating instructions is of informative nature only.
- Remove the cooling liquid filler plug (CLP) on cylinder upper plate
- Open the cooling liquid purge plug (CLV) on cylinder upper plate
- Fill in cooling liquid by filler hole until the cooling liquid flows of the cooling purge plug (CLV) on cylinder upper plate
- Close the cooling liquid purge plug (CLV) on cylinder upper plate
- Fit the cooling liquid filler plug (CLP) on cylinder upper plate
- If there is any spillage on the surface of the vacuum pump, wipe it up
- Start the vacuum pump

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
- Open the cooling liquid purge plug (CLV) on cylinder upper plate
- 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

Overhaul

CAUTION
Improper maintenance work on the vacuum pump can damage it.
Risk of explosion!
Non-adherence to the procedure will cancel approval for start-up of the pump!

Any dismantling of the vacuum pump beyond of what is described in this manual must be done by specially trained Busch service staff only.

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

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

Danger to health when the vacuum pump is dismantled.
Danger to the environment.

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

Busch service will only accept vacuum pumps that come with a completely filled in and legally binding signed form.

Overhaul
Removal from service

Temporary removal from service

Prior to disconnecting inlet and outlet pipes as well as cooling water pipes, make sure that all piping is vented to atmospheric pressure.

Recommissioning

**CAUTION**

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

- Make sure that all gaskets, plugs or adhesive tapes have been removed.
- Start the vacuum pump as described in the chapter “Installation and Commissioning”

Dismantling and Disposal of the vacuum pump

**DANGER**

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

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

Danger to health during dismantling of the vacuum pump.

Danger to the environment.

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

The vacuum pump must be decontaminated prior to disposal.

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

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

When the vacuum pump comes to the end of its life:

- it must be decontaminated

**CAUTION**

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

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

- drain the oil
  - dispose of the used oil in compliance with applicable environmental regulations
- drain the cooling liquid
  - dispose of the cooling liquid in compliance with applicable environmental regulations
- dismantle the vacuum pump

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

- dispose of the vacuum pump as scrap metal
- dispose of the different components of the pump in compliance with applicable regulations
WARNING
Risk of electrical shock, risk of damage to equipment.

Electrical installation work must only be executed by qualified personnel that knows and observes the following regulations:
- IEC 364 or CENELEC HD 384 or DIN VDE 0100, respectively,
- IEC-Report 664 or DIN VDE 0110,
- BGV A2 (VBG 4) or equivalent national accident prevention regulation.

CAUTION
During operation the surface of the vacuum pump may reach temperatures of more than 70 °C.
Risk of burns!
Let the vacuum pump cool down prior to a required contact or wear heat protection gloves.

<table>
<thead>
<tr>
<th>Problem</th>
<th>Possible Cause</th>
<th>Remedy</th>
</tr>
</thead>
<tbody>
<tr>
<td>The vacuum pump does not reach the usual pressure</td>
<td>The vacuum system or suction line is not leak-tight</td>
<td>Check the hose or pipe connections for possible leak</td>
</tr>
<tr>
<td>Evacuation of the system takes too long</td>
<td>In case a mesh screen is installed on the suction connection: The mesh screen on the suction connection is partly clogged</td>
<td>Clean the mesh screen If cleaning is required too frequently install a filter upstream</td>
</tr>
<tr>
<td></td>
<td>In case an inlet filter is installed on the suction connection: The filter on the suction connection is partly clogged</td>
<td>Clean or replace the inlet filter, respectively</td>
</tr>
<tr>
<td></td>
<td>Partial clogging in the suction, discharge or pressure line</td>
<td>Remove the clogging</td>
</tr>
<tr>
<td></td>
<td>Long suction, discharge or pressure line with too small diameter</td>
<td>Use larger diameter</td>
</tr>
<tr>
<td></td>
<td>Internal parts worn or damaged</td>
<td>Repair the vacuum pump (Busch service)</td>
</tr>
<tr>
<td>The vacuum pump does not start</td>
<td>The drive motor is not supplied with the correct voltage or is overloaded</td>
<td>Supply the drive motor with the correct voltage</td>
</tr>
<tr>
<td></td>
<td>The drive motor starter overload protection is too small or trip level is too low</td>
<td>Compare the trip level of the drive motor starter overload protection with the data on the nameplate Correct if necessary In case of high ambient temperature: Set the trip level of the drive motor starter overload protection 5 percent above the nominal drive motor current</td>
</tr>
<tr>
<td></td>
<td>One of the fuses has blown</td>
<td>Check the fuses</td>
</tr>
<tr>
<td></td>
<td>The connection cable is too small or too long causing a voltage drop at the vacuum pump</td>
<td>Use sufficiently dimensioned cable</td>
</tr>
<tr>
<td></td>
<td>The drive motor is defective</td>
<td>Replace the drive motor (Busch service)</td>
</tr>
<tr>
<td>The vacuum pump is blocked</td>
<td>Solid foreign matter has entered the vacuum pump</td>
<td>Repair the vacuum pump (Busch service) Make sure the suction line is equipped with a mesh screen If necessary additionally provide a filter</td>
</tr>
<tr>
<td>Issue</td>
<td>Solution</td>
<td></td>
</tr>
<tr>
<td>----------------------------------------------------------------------</td>
<td>--------------------------------------------------------------------------</td>
<td></td>
</tr>
<tr>
<td>Corrosion in the vacuum pump from remaining condensate</td>
<td>Repair the vacuum pump (Busch service)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Check the process</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Observe the chapter “Installation and Commissioning, Operating Notes”</td>
<td></td>
</tr>
<tr>
<td>The vacuum pump was run in the wrong direction</td>
<td>Repair the vacuum pump (Busch service)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>When connecting the vacuum pump make sure the vacuum pump will run in the correct direction (see “Installation”)</td>
<td></td>
</tr>
<tr>
<td>Condensate ran into the vacuum pump</td>
<td>Repair the vacuum pump (Busch service)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Make sure no condensate will enter the vacuum pump, if necessary provide a drip leg and a drain cock</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Drain condensate regularly</td>
<td></td>
</tr>
<tr>
<td>The circulating pump is blocked</td>
<td>Remove the circulating pump, clean if necessary</td>
<td></td>
</tr>
<tr>
<td>The vacuum pump starts, but labours or runs noisily or rattles (compare with initial value after commissioning)</td>
<td>Connections in the drive motor terminal box are defective</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Not all drive motor coils are properly connected</td>
<td></td>
</tr>
<tr>
<td></td>
<td>The drive motor operates on two phases only</td>
<td></td>
</tr>
<tr>
<td>The vacuum pump runs in the wrong direction</td>
<td>Verification and rectification see “Installation and Commissioning”, correct if necessary</td>
<td></td>
</tr>
<tr>
<td>Standstill over several weeks or months</td>
<td>Let the vacuum pump run warm with inlet closed</td>
<td></td>
</tr>
<tr>
<td>Improper oil quantity, unsuitable oil type</td>
<td>Use the proper quantity of one of the recommended oils (see “Oil”, oil change see “Maintenance”)</td>
<td></td>
</tr>
<tr>
<td>No oil change over extended period of time</td>
<td>Perform oil change incl. flushing (see “Maintenance”)</td>
<td></td>
</tr>
<tr>
<td>Foreign objects in the vacuum pump</td>
<td>Repair the vacuum pump (Busch service)</td>
<td></td>
</tr>
<tr>
<td>The vacuum pump runs very noisily</td>
<td>Defective bearings</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Repair the vacuum pump (Busch service)</td>
<td></td>
</tr>
<tr>
<td>The vacuum pump runs very hot (the oil sump temperature shall not exceed 100 °C)</td>
<td>Cooling water flow too low</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Check the cooling water circuit and adjust the flow if necessary</td>
<td></td>
</tr>
<tr>
<td>Ambient temperature too high</td>
<td>Observe the permitted ambient temperatures</td>
<td></td>
</tr>
<tr>
<td>Temperature of the inlet gas too high</td>
<td>Observe the permitted temperatures for the inlet gas</td>
<td></td>
</tr>
<tr>
<td>Oil level too low</td>
<td>Top up oil</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Check the oil filler plugs</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Check the mechanical seals (option)</td>
<td></td>
</tr>
<tr>
<td>Mains frequency or voltage outside tolerance range</td>
<td>Provide a more stable power supply</td>
<td></td>
</tr>
<tr>
<td>In case a mesh screen is installed on the suction connection:</td>
<td>Clean the mesh screen</td>
<td></td>
</tr>
<tr>
<td></td>
<td>If cleaning is required too frequently install a filter upstream</td>
<td></td>
</tr>
<tr>
<td>The mesh screen on the suction connection is partially clogged</td>
<td></td>
<td></td>
</tr>
<tr>
<td>In case an inlet air filter is installed on the suction connection:</td>
<td>Clean or replace the filter</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>The filter on the suction connection is partially clogged</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Partial clogging in the suction or discharge line</td>
<td>Remove the clogging</td>
<td></td>
</tr>
<tr>
<td>Long suction, discharge or pressure line with too small diameter</td>
<td>Use larger diameter</td>
<td></td>
</tr>
<tr>
<td>Cooling water too low</td>
<td>Quick coupler for cooling water dislocated</td>
<td>Connect the quick couple</td>
</tr>
<tr>
<td>-----------------------</td>
<td>------------------------------------------</td>
<td>--------------------------</td>
</tr>
<tr>
<td></td>
<td>Water supply pressure too low</td>
<td>Apply proper pressure</td>
</tr>
<tr>
<td></td>
<td>Cooling water piping obstructed</td>
<td>Clean/ replace piping</td>
</tr>
<tr>
<td></td>
<td>Leakage of cooling water piping</td>
<td>Replace seals</td>
</tr>
</tbody>
</table>
## Oil type/ quantity

### Oil type

- Make sure that the oil type corresponds to the specification:
- Refer to the pump nameplate to identify the correct oil type used for this pump

### Denomination

<table>
<thead>
<tr>
<th>Denomination</th>
<th>Busch YLC 250 B</th>
</tr>
</thead>
<tbody>
<tr>
<td>Base</td>
<td>Perfluorinated polyether</td>
</tr>
<tr>
<td>Specific gravity (20°C [g/cm3])</td>
<td>1,90</td>
</tr>
<tr>
<td>Kinematic viscosity at 20 °C [cSt]</td>
<td>270</td>
</tr>
<tr>
<td>Viscosity index (20°C)</td>
<td>113</td>
</tr>
<tr>
<td>Decomposition temperature [°C]</td>
<td>&gt; 290</td>
</tr>
<tr>
<td>Pourpoint [°C]</td>
<td>-35</td>
</tr>
<tr>
<td>Part no. 0.5 litre packaging</td>
<td>0831 000 054</td>
</tr>
<tr>
<td>Part no. 2.5 litres packaging</td>
<td>0831 514 524</td>
</tr>
<tr>
<td>Colour</td>
<td>Clear, colourless</td>
</tr>
</tbody>
</table>

### WARNING

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

### 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.

<table>
<thead>
<tr>
<th>Quantity [Liter]</th>
<th>COBRA NS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Motor side (A)</td>
</tr>
<tr>
<td>NS 600 C</td>
<td>0,8</td>
</tr>
</tbody>
</table>
Cooling liquid type/ quantity

Cooling liquid type

- Make sure that the cooling liquid type corresponds to specifications:

<table>
<thead>
<tr>
<th>Specifications</th>
<th>Zitrec M-25 (ready-to-use)</th>
</tr>
</thead>
<tbody>
<tr>
<td>25 litres can</td>
<td>5 litres can</td>
</tr>
<tr>
<td>part no. 0831 563 468</td>
<td>part no. 0831 563 469</td>
</tr>
</tbody>
</table>

Cooling liquid quantity

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

<table>
<thead>
<tr>
<th>Quantity</th>
<th>Zitrec M-25 (already mixed ready-to-use)</th>
</tr>
</thead>
<tbody>
<tr>
<td>NS 0600 C</td>
<td>approx. 30 litres</td>
</tr>
</tbody>
</table>

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 pump and to respect this proportion.
## Technical data

<table>
<thead>
<tr>
<th>Technical data</th>
<th>NS 0600 C</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nominal suction capacity</td>
<td>m³/h (cfm)</td>
</tr>
<tr>
<td>Ultimate pressure</td>
<td>Torr mbar/ hPa</td>
</tr>
<tr>
<td>Nominal motor rating</td>
<td>kW</td>
</tr>
<tr>
<td>Motor voltage and current rating</td>
<td>50 Hz</td>
</tr>
<tr>
<td></td>
<td>50 Hz</td>
</tr>
<tr>
<td></td>
<td>60 Hz</td>
</tr>
<tr>
<td></td>
<td>60 Hz</td>
</tr>
<tr>
<td>Motor speed</td>
<td>50 Hz</td>
</tr>
<tr>
<td></td>
<td>60 Hz</td>
</tr>
<tr>
<td>Maximal allowed operational speed</td>
<td>Refer to pump nameplate</td>
</tr>
<tr>
<td>Noise level (EN ISO 2151)</td>
<td>50 Hz</td>
</tr>
<tr>
<td></td>
<td>60 Hz</td>
</tr>
<tr>
<td>Ambient temperature</td>
<td>°C (°F)</td>
</tr>
<tr>
<td>Maximal counter pressure at the discharge side</td>
<td>bar</td>
</tr>
<tr>
<td>Maximum permissible inlet pressure</td>
<td>Atmospheric pressure</td>
</tr>
<tr>
<td>Leak rate</td>
<td>mbar*l/s</td>
</tr>
<tr>
<td>Cooling water requirement</td>
<td>l/ min</td>
</tr>
<tr>
<td>Cooling water pressure</td>
<td>bar</td>
</tr>
<tr>
<td>Cooling water temperature</td>
<td>°C (°F)</td>
</tr>
<tr>
<td>Nitrogen requirement</td>
<td>approx.</td>
</tr>
<tr>
<td>Nitrogen overpressure</td>
<td>bar</td>
</tr>
<tr>
<td>Weight</td>
<td>approx.</td>
</tr>
</tbody>
</table>
EU-Declaration of Conformity

This Declaration of Conformity and the CE-mark 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-mark.

The manufacturer: Ateliers Busch S.A.
Zone Industrielle
CH-2906 Chevenez

declare that the machine(s) NS 0600 C has (have) been manufactured in accordance with the European Directives:

- “Machinery” 2006/42/EC
- “Electromagnetic Compatibility” 2014/30/EU
- “RoHS 2” 2011/65/EU, 2017/2102, restriction of the use of certain hazardous substances in electrical and electronic equipment

and following the standards:

<table>
<thead>
<tr>
<th>Standard</th>
<th>Title of the standard</th>
</tr>
</thead>
<tbody>
<tr>
<td>EN ISO 12100:2010</td>
<td>Safety of machinery - Basic concepts, general principles of design</td>
</tr>
<tr>
<td>EN ISO 13857:2008</td>
<td>Safety of machinery - Safety distances to prevent hazard zones being reached by the upper and lower limbs</td>
</tr>
<tr>
<td>EN 1012-1:2010</td>
<td>Compressors and vacuum pumps - Safety requirements - Part 1 and 2</td>
</tr>
<tr>
<td>EN ISO 2151:2008</td>
<td>Acoustics - Noise test code for compressors and vacuum pumps - Engineering method (grade 2)</td>
</tr>
<tr>
<td>EN 60204-1:2006</td>
<td>Safety of machinery - Electrical equipment of machines - Part 1: General requirements</td>
</tr>
<tr>
<td>EN 61000-6-2:2005</td>
<td>Electromagnetic compatibility (EMC) – Generic standards. Immunity for industrial environments; Part 1 and 3</td>
</tr>
<tr>
<td>EN ISO 13849-1:2015 (1)</td>
<td>Safety of machinery - Safety-related parts of control systems - Part 1: General principles for design and 2</td>
</tr>
</tbody>
</table>

Person authorised to compile the technical file: Gerd Rohweder
Busch Dienste GmbH
Schauinslandstr. 1
DE-79689 Maulburg

Chevenez, 08.10.2018

Christian Hoffmann, General Director

(1) In case control systems are integrated.