Instruction Manual

COBRA

Dry Screw Vacuum Pumps
NC 0100 B, NC 0200 B, NC 0300 B
(water-cooled version)
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1 Safety

Prior to handling the machine, this instruction manual should be read and understood. If anything needs to be clarified, please contact your Busch representative.

Read this manual carefully before use and keep for future reference.

This instruction manual remains valid as long as the customer does not change anything on the product.

The machine is intended for industrial use. It must be handled only by technically trained personnel.

Always wear appropriate personal protective equipment in accordance with the local regulations.

The machine has been designed and manufactured according to state-of-the-art methods. Nevertheless, residual risks may remain. 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.

ℹ️ NOTE

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

<table>
<thead>
<tr>
<th>CD</th>
<th>Condensate drain</th>
<th>CLD</th>
<th>Cooling liquid drain plug</th>
</tr>
</thead>
<tbody>
<tr>
<td>CLF</td>
<td>Cooling liquid fill plug</td>
<td>CLP</td>
<td>Cooling liquid pump</td>
</tr>
<tr>
<td>CWD</td>
<td>Cooling water drain plug</td>
<td>CWI</td>
<td>Cooling water inlet</td>
</tr>
<tr>
<td>CWO</td>
<td>Cooling water outlet</td>
<td>CWP</td>
<td>Cooling water pump</td>
</tr>
<tr>
<td>EB</td>
<td>Eye bolt</td>
<td>EV</td>
<td>Expansion vessel</td>
</tr>
<tr>
<td>GB</td>
<td>Gas ballast valve</td>
<td>IN</td>
<td>Suction connection</td>
</tr>
<tr>
<td>MP</td>
<td>Magnetic plug</td>
<td>MTB</td>
<td>Motor terminal box</td>
</tr>
<tr>
<td>NP</td>
<td>Nameplate</td>
<td>ODP</td>
<td>Oil drain plug</td>
</tr>
<tr>
<td>OFP</td>
<td>Oil fill plug</td>
<td>OSG</td>
<td>Oil sight glass</td>
</tr>
<tr>
<td>OUT</td>
<td>Discharge connection</td>
<td>PHE</td>
<td>Plate heat exchanger</td>
</tr>
<tr>
<td>PMR</td>
<td>Plug for manual rotation of rotors</td>
<td>SI</td>
<td>Silencer</td>
</tr>
<tr>
<td>SV</td>
<td>Safety valve</td>
<td>TM</td>
<td>Thermometer</td>
</tr>
<tr>
<td>TS</td>
<td>Temperature switch</td>
<td>TV</td>
<td>Thermostatic valve</td>
</tr>
</tbody>
</table>
NOTE
Technical term.
In this instruction manual, we consider that the term ‘machine’ refers to the ‘vacuum pump’.

2.1 Operating Principle
Water-cooled version with direct cooling:

Water-cooled version with plate heat exchanger (optional):

The machine works on the one-stage, twin-screw pump principle.
Two screw rotors are rotating inside the cylinder. The pumped medium is trapped between the cylinder and screw chambers, compressed, and transported to the gas outlet. During the compression process, the two screw rotors do not come into contact with each other nor with the cylinder. There is no need for a lubrication or an operating fluid in the compression chamber.

2.2 Application
The machine is intended for the suction of air and other dry, non-aggressive, non-toxic and non-explosive gases.
Conveying of other media leads to an increased thermal and/or mechanical load on the machine and is permissible only after a consultation with Busch.
The machine is intended for the placement in a non-potentially explosive environment.
The machine is capable of maintaining ultimate pressure, see Technical Data [► 37].
The machine is suitable for continuous operation.
Permitted environmental conditions, see Technical Data [► 37].

2.3 Start Controls
The machine comes without start controls. The control of the machine is to be provided in the course of installation.
The machine can be optionally equipped with a starter unit or a variable-frequency drive.
2.4 Water Cooling Variants

2.4.1 Direct Cooling
The machine is cooled by a cooling water circuit in the cylinder cover and cylinder. The cooling water pump (CWP) allows a recirculating flow in the cooling water chamber. The thermostatic valve (TV) allows a temperature regulation of the machine by regulating the cooling water flow. The adjustment of thermostatic valve from position 1 (cool position) to the position 5 (hot position) alters the cooling water temperature and must correspond to the application requirements.

**NOTE**
Busch recommendations for the thermostatic valve adjustment:
- The position 1 (cold position) is mainly intended for applications with a risk of polymerization.
- The position 5 (hot position) is mainly intended for applications with a risk of condensation.

2.4.2 Plate Heat Exchanger (Optional)
The machine is cooled by a cooling liquid circuit in the cylinder cover and cylinder. The cooling liquid is cooled by a plate heat exchanger (PHE) which must be connected to the water main. The cooling liquid pump (CLP) allows a recirculating flow in the cooling liquid chamber.

2.5 Standard Features

2.5.1 Temperature Switch
The temperature switch monitors the operating temperature of the machine. The machine must be stopped when the temperature switch trips (106 °C).

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

2.5.3 Sealing Systems
The machine is equipped with labyrinth seals on the motor side and suction side. Other sealing systems are optionally available, see Mechanical Seals [► 8] or PTFE Shaft Seals [► 8]. Sealing systems prevent the process gas going to the bearings chambers. Depending on the application, the sealing systems efficiency can be improved with a barrier gas system, see Barrier Gas System [► 8].
2.6 Optional Accessories

2.6.1 Gas Ballast Valve
The gas ballast valve mixes the process gas with a limited quantity of ambient air to counteract the condensation of vapour inside the machine.

The gas ballast valve has an influence on the ultimate pressure of the machine, see Technical Data [37].

2.6.2 Silencer
A silencer at the discharge connection (OUT) can be provided to reduce the exhaust gas noise.
A non-return flap can be optionally added to the silencer.

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

2.6.4 Mechanical Seals
The sealing systems can be equipped with mechanical seals. The following variants are possible:
– Oil lubricated single mechanical seals on the motor side and labyrinth seals on the suction side.
– Oil lubricated single mechanical seals on the motor side and suction side.
– Gas lubricated double mechanical seals on the motor side and oil lubricated single mechanical seals on suction side.

2.6.5 PTFE Shaft Seals
The sealing systems on the motor side can also be equipped with PTFE shaft seals.

2.6.6 Nitrogen Panel
The nitrogen panel fitted to the base frame allows the supply of nitrogen to a number of different points on the machine.
Each device consists of a pressure regulator and a flow meter to adjust pressure and volume flow separately.
The following devices are available:
– The barrier gas system for sealing systems on motor side. This device is equipped with a flow switch integrated to the flow meter to switch off the machine if the nitrogen volume flow drops below the minimum set flow value.
– The dilution gas ballast prevents the formation of condensates or dilutes them, depending on the application. The nitrogen is fed into the cylinder.
– The purge gas system fitted at the inlet flange allows to flush the machine after use or during operation. The nitrogen is fed into the inlet flange.

2.6.7 Pressure Switch (Barrier Gas)
The pressure switch monitors the barrier gas pressure. It is only available if the machine has been equipped with gas lubricated double mechanical seals.
The machine must be stopped if the barrier gas pressure is below 2.5 bar, see Wiring Diagram Pressure Switch (Optional) [23].
3 Transport

**WARNING**

Suspended load.

Risk of severe injury!

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

**NOTICE**

In case the machine is already filled with oil.

Tilting a machine that is already filled with oil can cause large quantities of oil to ingress into the cylinder.

- Drain the oil prior to every transport or always horizontally transport the machine.

- Make sure that the eyebolt (EB) is in faultless condition, fully screwed in and tightened by hand.

---

**WARNING**

Lifting the machine using the motor eye bolt.

Risk of severe injury!

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

- Check the machine for transport damage.

If the machine is secured to a base plate:

- Remove the machine from the base plate.
4 Storage

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

If the machine is to be stored for more than 3 months:
- Wrap the machine in a corrosion inhibiting film.
- Store the machine indoors, dry, dust free and if possible in original packaging preferably at temperatures between 5 ... 55 °C.

5 Installation

5.1 Installation Conditions

![NOTICE]

Use of the machine outside of the permitted installation conditions.

**Risk of premature failure!**

**Loss of efficiency!**

- Take care that the installation conditions are fully complied with.

- Make sure that the environment of the machine is not potentially explosive.
- Make sure that the ambient conditions comply with the Technical Data [37].
- Make sure that the environmental conditions comply with the protection class of the motor and the electrical instruments.
- Make sure that the installation space or location is vented such that sufficient cooling of the machine is provided.
- Make sure that cooling air inlets and outlets of the motor fan are not covered or obstructed and that the cooling air flow is not affected adversely in any other way.
- Make sure that the oil sight glass (OSG) remains easily visible.
- Make sure that enough space remains for maintenance work.
- Make sure that the machine is placed or mounted horizontally, a maximum of 1° in any direction is acceptable.
- Check the oil level, see Oil Level Inspection [27].

If the machine is equipped with a plate heat exchanger (PHE):
- Check the cooling liquid level, see Cooling Liquid Level Inspection [28].
- Make sure that the cooling water complies with the requirements, see Cooling Water Connection [12].

If the machine is installed at an altitude greater than 1000 meters above sea level:
- Contact your Busch representative, the motor should be derated or the ambient temperature limited.
5.2 Connecting Lines / Pipes

- Remove all protective caps before installation.
- Make sure that the connection lines cause no stress on the machine's connection; if necessary use flexible joints.
- Make sure that the line size of the connection lines over the entire length is at least as large as the connections of the machine.

In case of very long connection lines it is advisable to use larger line sizes in order to avoid a loss of efficiency. Seek advice from your Busch representative.

5.2.1 Suction Connection

**WARNING**

Unprotected suction connection.

**Risk of severe injury!**

- Do not put hand or fingers in the suction connection.

**NOTICE**

Ingress of foreign objects or liquids.

**Risk of damage to the machine!**

If the inlet gas contains dust or other foreign solid particles:

- Install a suitable filter (5 micron or less) upstream from the machine.

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

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

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

5.2.2 Discharge Connection

Connection size:
At the machine discharge connection:
- Ø85 / 8 x M8

At the extra flange discharge connection (Optional):
- DN40 PN16, EN 1092-1 for NC 0100 B
- DN50 PN16, EN 1092-1 for NC 0200 B and NC 0300 B

At the silencer (SI) discharge connection (Optional):
- DN40 PN16, EN 1092-1 for NC 0100 B
- DN50 PN16, EN 1092-1 for NC 0200 B and NC 0300 B

- Make sure that the discharged gas will flow without obstruction. Do not shut off or throttle the discharge line or use it as a pressurised air source.
- Make sure that the counter pressure (also termed back pressure) at the discharge connection (OUT) does not exceed the maximum allowable discharge pressure, see Technical Data [► 37].
5.2.3 Cooling Water Connection

Water-cooled version with direct cooling:

Water-cooled version with plate heat exchanger (optional):

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

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

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

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Units</th>
<th>Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supply capacity</td>
<td>l/min</td>
<td>2 ... 4</td>
</tr>
<tr>
<td>Water pressure</td>
<td>bar</td>
<td>3 ... 6 (direct cooling)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1 ... 6 (plate heat exchanger)</td>
</tr>
<tr>
<td>Supply temperature</td>
<td>°C</td>
<td>+10 ... +25</td>
</tr>
<tr>
<td>Required pressure differential across supply and return</td>
<td>bar</td>
<td>≥ 3 (direct cooling)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>&gt; 0.5 (plate heat exchanger)</td>
</tr>
</tbody>
</table>
To reduce the maintenance effort and ensure a long product lifetime we recommend the following cooling water quality:

<table>
<thead>
<tr>
<th>Property</th>
<th>Unit</th>
<th>Requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hardness</td>
<td>mg/l (ppm)</td>
<td>&lt; 90</td>
</tr>
<tr>
<td>Properties</td>
<td></td>
<td>Clean &amp; clear</td>
</tr>
<tr>
<td>PH value</td>
<td></td>
<td>7 ... 8</td>
</tr>
<tr>
<td>Particle size</td>
<td>µm</td>
<td>&lt; 200</td>
</tr>
<tr>
<td>Chloride</td>
<td>mg/l</td>
<td>&lt; 100</td>
</tr>
<tr>
<td>Electrical conductivity</td>
<td>µS/cm</td>
<td>≤ 100</td>
</tr>
<tr>
<td>Free chloride</td>
<td>mg/l</td>
<td>&lt; 0.3</td>
</tr>
<tr>
<td>Materials in contact with the cooling water</td>
<td></td>
<td>Stainless steel, copper and cast iron</td>
</tr>
</tbody>
</table>

**NOTE**

Water hardness unit conversion.

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

### 5.2.4 Barrier Gas System Connection (Optional)

With nitrogen panel

- Connect the barrier gas connection (BGC) to the gas supply.
- Connection size: 
  - G1/4, ISO 228-1
- Electrically connect the flow switch (FS) of the flow meter, see Wiring Diagram Flow Switch [► 22].
  - If a pressure switch being installed:
    - Electrically connect the pressure switch, see Wiring Diagram Pressure Switch (Optional) [► 23].
**Installation**

- Make sure that the gas complies with the following requirements:

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gas type</td>
<td>Dry nitrogen</td>
</tr>
<tr>
<td>Gas temperature</td>
<td>°C</td>
</tr>
<tr>
<td>Maximum gas pressure</td>
<td>bar</td>
</tr>
<tr>
<td>Recommended pressure setting at the pressure regulating valve (PRV)</td>
<td>bar</td>
</tr>
<tr>
<td>Filtration</td>
<td>µm</td>
</tr>
<tr>
<td>Recommended flow rate for labyrinth seals, oil lubricated single mechanical seals and PTFE shaft seals</td>
<td>SLM*</td>
</tr>
<tr>
<td>Recommended flow rate for gas lubricated double mechanical seals</td>
<td>SLM*</td>
</tr>
</tbody>
</table>

*standard litre per minute*

---

**5.2.5 Dilution Gas System Connection (Optional)**

- Connect the dilution gas connection (DGC) to the gas supply.
  - Connection size: G1/4, ISO 228-1
- Electrically connect the solenoid valve (MV), see Wiring Diagram Solenoid Valve [► 22].
- Make sure that the gas complies with the following requirements:

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gas type</td>
<td>Dry nitrogen</td>
</tr>
<tr>
<td>Gas temperature</td>
<td>°C</td>
</tr>
<tr>
<td>Maximum gas pressure</td>
<td>bar</td>
</tr>
<tr>
<td>Recommended pressure setting at the pressure regulating valve (PRV)</td>
<td>bar</td>
</tr>
<tr>
<td>Filtration</td>
<td>µm</td>
</tr>
<tr>
<td>Recommended flow rate</td>
<td>SLM*</td>
</tr>
</tbody>
</table>

*standard litre per minute*
5.2.6 Purge Gas System Connection (Optional)

- Connect the purge gas connection to the gas supply.
  - Connection size: G1/4, ISO 228-1
- Electrically connect the solenoid valve (MV), see Wiring Diagram Solenoid Valve [► 22].
- Make sure that the gas complies with the following requirements:

<table>
<thead>
<tr>
<th>Gas type</th>
<th>Dry nitrogen</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gas temperature</td>
<td>°C</td>
</tr>
<tr>
<td>Maximum gas pressure</td>
<td>bar</td>
</tr>
<tr>
<td>Recommended pressure setting at</td>
<td>bar</td>
</tr>
<tr>
<td>the pressure regulating valve</td>
<td></td>
</tr>
<tr>
<td>(PRV)</td>
<td></td>
</tr>
<tr>
<td>Filtration</td>
<td>µm</td>
</tr>
<tr>
<td>Recommended flow rate</td>
<td>SLM*</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* standard litre per minute
5.3 Filling Oil

**NOTICE**

Use of an inappropriate oil.

*Risk of premature failure!*

*Loss of efficiency!*

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

For oil type and oil capacity see Technical Data [⇒ 37] and Oil [⇒ 37].

Oil filling at the motor side
When the oil filling is achieved:

- Write down the oil change date on the sticker.

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

- Order it from your Busch representative.
5.4 Filling Cooling Liquid

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

For cooling liquid type and cooling liquid capacity see Technical Data [37] and Cooling Liquid [37].

5.5 Liquid Flushing Device Installation (Optional)
• Electrically connect the solenoid valve (MV), see Wiring Diagram Solenoid Valve [► 22].
• Electrically connect the two level switches (LS), see Wiring Diagram Level Switch [► 23].
• Fill the flushing liquid vessel (FLV) with a process compatible flushing liquid.

5.6 Fitting the Coupling

<table>
<thead>
<tr>
<th>Machine type</th>
<th>Coupling size</th>
<th>Value &quot;E&quot; (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>NC 0100 B</td>
<td>ROTEX® 38</td>
<td>24</td>
</tr>
<tr>
<td>NC 0200 B</td>
<td></td>
<td></td>
</tr>
<tr>
<td>NC 0300 B</td>
<td>ROTEX® 42</td>
<td>26</td>
</tr>
</tbody>
</table>

In case of a machine delivery without motor:
• Fit the second coupling hub on the motor shaft (separately delivered).
• Axially adjust the hub in such a way until value "E" is reached.
• When the coupling adjustment is done, lock the coupling hub by tightening the radial screw.
• Mount the motor on the machine by including the coupling spider.

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

**DANGER**

Live wires.

**Risk of electrical shock.**

- Electrical installation work must only be executed by qualified personnel.
- Make sure that the power supply for the motor is compatible with the data on the nameplate of the motor.
- The electrical installation must comply with applicable national and international standards.
- Provide a lockable disconnect switch on the power line so that the machine is completely secured during maintenance tasks.
- Provide an overload protection according to EN 60204-1 for the motor.
- Make sure that the motor of the machine will not be affected by electric or electromagnetic disturbance from the mains; if necessary seek advice from Busch.
- Connect the protective earth conductor.
- Electrically connect the motor.

**NOTICE**

The admissible motor nominal speed exceeds the recommendation.

**Risk of damage to the machine!**

- Check the admissible motor nominal speed \(n_{\text{max}}\) on the nameplate of the machine (NP).
- Make sure to comply with it.
- Consult the Technical Data [37] to get more information.

**NOTICE**

The motor frequency is below 20 Hz. (even 25 Hz with gas lubricated double mechanical seals)

**Risk of damage to the machine!**

- The motor nominal speed must always be higher than 1200 min\(^{-1}\) (20 Hz).
- The motor nominal speed must always be higher than 1500 min\(^{-1}\) (25 Hz), if the machine is equipped with gas lubricated double mechanical seals.

**NOTICE**

Incorrect connection.

**Risk of damage to the motor!**

- The wiring diagrams given below are typical. Check the inside of the terminal box for motor connection instructions/diagrams.
5.7.1 Wiring Diagram Three-Phase Motor (Pump Drive)

Delta connection (low voltage):

Star connection (high voltage):

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

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

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

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

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

**NOTICE**

Incorrect direction of rotation.

Risk of damage to the machine!

- Operation in the wrong direction of rotation can destroy the machine in a short time!

Prior to start-up, ensure that the machine is operated in the right direction.
The intended rotation direction of the motor is defined by the illustration below:

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

If the rotation of the motor must be changed:
- Switch any two of the motor phase wires.

### 5.7.2 Wiring Diagram Solenoid Valve (Optional)

**Part no.:** 0654 000 092  
**U =** 24 VDC ; **P\textsubscript{max} =** 8 W  
**Contact:** Normally closed

### 5.8 Electrical Connection of the Monitoring Devices

#### NOTE

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

#### 5.8.1 Wiring Diagram Temperature Switch

**Part no.:** 0651 555 985  
**U =** 6 … 30 VDC ; **I =** 10 … 100 mA  
**Contact:** Normally closed  
**Switch point:** \( T_{\text{trip}} = 106 \ ^\circ \text{C} \)

1 = White ; 2 = Brown

#### 5.8.2 Wiring Diagram Flow Switch (Optional)

**Part no.:** RC15-14-N3 (ref. Pepperl+Fuchs)  
**U =** 5 … 25 V ; **I =** 1 … 3 mA

Switching element function: NAMUR, bistable

For labyrinth seals, oil lubricated single mechanical seals and PTFE shaft seals:  
**Contact:** Normally open  
**Switch point:** 1.5 SLM \( \Rightarrow \) min. volume flow

For gas lubricated double mechanical seals:  
**Contact:** Normally closed  
**Switch point:** 1 SLM \( \Rightarrow \) max. volume flow
5.8.3 Wiring Diagram Pressure Switch (Optional)

Part no.: 0653 518 304

Contact: Normally closed

U = 250 VAC ; I = 6 A
U = 12 … 220 VDC ; I = 6 … 0.25 A

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

5.8.4 Wiring Diagram Level Switch (Optional)

Part no.: 0652 556 531

Connector: M12x1, 4-pin

< 6 mW at I < 1 mA;
< 38 mW at I = 3.5 mA

Switching element function: NAMUR

Contact: Normally closed

Switch point:
$L_{\text{warning}} = LS1 \blacktriangleright$ pin 1 + 4 $\blacktriangleright$ low level “warning”
$L_{\text{trip}} = LS2 \blacktriangleright$ pin 1 + 4 $\blacktriangleright$ low level “stop flushing”

6 Commissioning

⚠️ NOTICE

The machine can be shipped without oil.

Operation without oil will ruin the machine in short time!

• Prior to commissioning, the machine must be filled with oil, see Filling Oil [► 16].

⚠️ NOTICE

Lubricating a dry running machine (compression chamber).

Risk of damage to the machine!

• Do not lubricate the compression chamber of the machine with oil or grease.

⚠️ CAUTION

During operation the surface of the machine may reach temperatures of more than 70°C.

Risk of burns!

• Avoid contact with the machine during and directly after operation.
CAUTION

Noise of running machine.

Risk of damage to hearing!

If persons are present in the vicinity of a non noise insulated machine over extended periods:

- Make sure that ear protection is being used.

- Make sure that the installation conditions (see Installation Conditions [► 10]) are met.

- Turn on the water supply.

- Adjust the thermostatic valve position according to the process requirements.

If the machine is equipped with a barrier gas system:

- Turn on the barrier gas supply.

- Adjust the barrier gas pressure and volume flow.

- Switch on the machine.

- Make sure that the maximum permissible number of starts does not exceed 6 starts per hour. Those starts should be spread within the hour.

- Make sure that the operating conditions comply with the Technical Data [► 37].

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

- After a few minutes of operation, perform a Cooling Liquid Level Inspection [► 28].

- After a few minutes of operation, perform an Oil Level Inspection [► 27].

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

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

### 6.1 Conveying Condensable Vapours

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

If condensable vapours are to be conveyed:

1. **Start**
   - Open the gas ballast valve* or the dilution gas system* (solenoid valve)

2. **Warm up the machine**
   - 30 minutes

3. **Process**
   - Open the inlet valve
   - Perform the process
   - Close the inlet valve
   - 30 minutes

4. **End**
   - Close the gas ballast valve* or the dilution gas system*

* optional accessories

- Continuously drain condensate from the condensate drain plug (CD) of the silencer (SI) (Optional).
### 6.2 Liquid Flushing Procedure

If after the application process a liquid flushing is required:

1. **START**
2. Reduce the motor speed to 10 Hz* with the inlet valve closed
3. Open the liquid flushing device (solenoid valve)
4. Adapt the flushing liquid flow according to the application requirements
5. The flushing duration depends on the application
6. Close the liquid flushing device

* minimum admissible frequency

**NOTE:** With gas lubricated double mechanical seals, the minimum admissible frequency is 25 Hz.

### 6.3 Gas Purging Procedure

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

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

1. **START**
2. Close the inlet valve
3. Open the purge gas (solenoid valve)
4. The flushing duration depends on the application
5. Close the purge gas

**NOTE:** Min. 200 seconds to render the machine inert
7 Maintenance

⚠️ WARNING
Machines contaminated with hazardous material.
Risk of poisoning!
Risk of infection!
If the machine is contaminated with hazardous material:
• Wear appropriate personal protective equipment.

⚠️ CAUTION
Hot surface.
Risk of burns!
• Prior to any action requiring touching the machine, let the machine cool down first.

⚠️ NOTICE
Using inappropriate cleaners.
Risk of removing safety stickers and protective paint!
• Do not use incompatible solvents to clean the machine.

⚠️ CAUTION
Failing to properly maintain the machine.
Risk of injuries!
Risk of premature failure and loss of efficiency!
• Respect the maintenance intervals or ask your Busch representative for service.
• Shut down the machine and lock against inadvertent start up.
• Turn off the water supply.
If the machine is equipped with a barrier gas system:
• Close the barrier gas supply.
• Vent the connected lines to atmospheric pressure.
If necessary:
• Disconnect all connections.
7.1 Maintenance Schedule

The maintenance intervals depend very much on the individual operating conditions. The intervals given below are desired to be considered as starting values which should be shortened or extended as appropriate. Particularly harsh applications or heavy duty operation, such as high dust loads in the environment or in the process gas, other contamination or ingress of process material, can make it necessary to shorten the maintenance intervals significantly.

<table>
<thead>
<tr>
<th>Interval</th>
<th>Maintenance work</th>
</tr>
</thead>
<tbody>
<tr>
<td>Monthly</td>
<td>• Check the oil level, see Oil Level Inspection [☞ 27].</td>
</tr>
<tr>
<td></td>
<td>If the machine is equipped with a plate heat exchanger (PHE):</td>
</tr>
<tr>
<td></td>
<td>• Check the cooling liquid level, see Cooling Liquid Level Inspection [☞ 28].</td>
</tr>
<tr>
<td></td>
<td>• Check the machine for oil leaks - in case of leaks have the machine repaired (contact Busch).</td>
</tr>
<tr>
<td>Yearly</td>
<td>• Carry out a visual inspection and clean the machine from dust and dirt.</td>
</tr>
<tr>
<td></td>
<td>• Check the electrical connections and the monitoring devices.</td>
</tr>
<tr>
<td>Yearly</td>
<td>• Check the filter of the gas ballast valve (GB), clean it if necessary.</td>
</tr>
<tr>
<td>In case of those accessories</td>
<td>• Check the silence (SI) and clean it if necessary.</td>
</tr>
<tr>
<td>being installed.</td>
<td></td>
</tr>
<tr>
<td>Every 5000 hours, at the latest</td>
<td>• Change the oil of the gear and bearing housings (both sides), see Oil Change [☞ 29].</td>
</tr>
<tr>
<td>after 1 year</td>
<td>• Clean the magnetic plugs (MP).</td>
</tr>
<tr>
<td>Every 16000 hours, at the latest</td>
<td>• Have a major overhaul on the machine (contact Busch).</td>
</tr>
<tr>
<td>after 4 years</td>
<td></td>
</tr>
</tbody>
</table>

7.2 Oil Level Inspection

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

Oil sight glass on suction side

![Oil sight glass on suction side](image)

Oil sight glass on motor side

![Oil sight glass on motor side](image)

- Fill up if necessary, see Oil Filling [☞ 16].
### 7.3 Cooling Liquid Level Inspection

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

- Shut down the machine.

**For NC 0100 B:**

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

**For NC 0200 – 0300 B:**

- Check cooling liquid level.

- Fill up if necessary, see Filling Cooling Liquid [► 18].
7.4 Oil Change

⚠️ NOTICE
Use of an inappropriate oil.
Risk of premature failure!
Loss of efficiency!
• Only use an oil type which has previously been approved and recommended by Busch.

Oil draining at the motor side

1. Drain pan
2. Cleaning cloth
3. Magnetic plug

[Diagram showing oil drainage process]
Oil draining at the suction side

- Cleaning cloth
- Drain pan
- Magnetic plug

For oil type and oil capacity see Technical Data [► 37] and Oil [► 37].

Oil filling at the motor side

- Check oil level
- MAX
- MIN

Busch Oil
When the oil filling is achieved:

- Write down the oil change date on the sticker.

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

- Order it from your Busch representative.
7.5 Cooling Liquid Change

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

For cooling liquid type and cooling liquid capacity see Technical Data [► 37] and Cooling Liquid [► 37].
8 Overhaul

**NOTICE**

Improper assembly.

**Risk of premature failure!**

**Loss of efficiency!**

- It is highly recommended that any dismantling of the machine that goes beyond anything that is described in this manual should be done through Busch.

**WARNING**

Machines contaminated with hazardous material.

**Risk of poisoning!**

**Risk of infection!**

If the machine is contaminated with hazardous material:

- Wear appropriate personal protective equipment.

In case of the machine having conveyed gas that was contaminated with foreign materials which are dangerous to health:

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

Busch will only accept machines that come with a completely filled in and legally binding signed ‘Declaration of Contamination’.

(Form downloadable from www.buschvacuum.com)

9 Decommissioning

- Shut down the machine and lock against inadvertent start up.
- Turn off the water supply.

If the machine is equipped with a barrier gas system:

- Close the barrier gas supply.
- Vent the connected lines to atmospheric pressure.
- Drain the cooling water from the two cooling water drain plugs (CWD).
- Disconnect all connections.

If the machine is going to be stored:

- See Storage [► 10].

9.1 Dismantling and Disposal

- Drain the oil.

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

- Drain the cooling liquid.
- Separate special waste from the machine.
- Dispose of special waste in compliance with applicable regulations.
- Dispose of the machine as scrap metal.
10 Spare Parts

**NOTICE**

Use of non-Busch genuine spare parts.

Risk of premature failure!

Loss of efficiency!

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

There is no standard spare parts kits available for this product, if you require Busch genuine parts:

- Contact your Busch representative for the detailed spare parts list.
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!**

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

<table>
<thead>
<tr>
<th>Problem</th>
<th>Possible Cause</th>
<th>Remedy</th>
</tr>
</thead>
<tbody>
<tr>
<td>The machine does not start.</td>
<td>The motor is not supplied with the correct voltage.</td>
<td>• Check the power supply.</td>
</tr>
<tr>
<td>The machine does not reach the usual pressure on the suction connection.</td>
<td>Suction or discharge lines too long or section diameter too small.</td>
<td>• Use larger diameter or shorter lines. • Seek advice from your local Busch representative.</td>
</tr>
<tr>
<td></td>
<td>Process deposits on the pumping components</td>
<td>• Flush the machine.</td>
</tr>
<tr>
<td></td>
<td>The machine runs in the wrong direction.</td>
<td>• Check the direction of rotation, see Wiring Diagram Three-Phase Motor.</td>
</tr>
<tr>
<td></td>
<td>Internal parts are worn or damaged.</td>
<td>• Repair the machine (contact Busch).</td>
</tr>
<tr>
<td></td>
<td>The rotors are jammed or seized.</td>
<td>• Turn the screw rotors manually from the rotor access plug (PMR). • Repair the machine (contact Busch).</td>
</tr>
<tr>
<td></td>
<td>Solid foreign matter has entered the machine.</td>
<td>• Remove the solid foreign matter or repair the machine (contact Busch). • Install an inlet filter if necessary.</td>
</tr>
<tr>
<td></td>
<td>A temperature sensor has reached the switch point.</td>
<td>• Let the machine cool down. • See problem “The machine runs too hot”.</td>
</tr>
<tr>
<td></td>
<td>Corrosion in the machine from remaining condensate.</td>
<td>• Repair the machine. • Check the process and follow the recommendation in case of Conveying Condensable Vapours [⇒ 24].</td>
</tr>
<tr>
<td></td>
<td>The motor is defective.</td>
<td>• Replace the motor.</td>
</tr>
</tbody>
</table>
The machine runs very noisily.

<table>
<thead>
<tr>
<th>Troubleshooting Item</th>
<th>Cause</th>
<th>Solution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wrong oil quantity or unsuitable oil type.</td>
<td>• Use one of the recommended oils in the correct quantity, see Oil [37].</td>
<td></td>
</tr>
<tr>
<td>Defective gears, bearings or coupling element.</td>
<td>• Repair machine (contact Busch).</td>
<td></td>
</tr>
</tbody>
</table>

The machine runs too hot.

<table>
<thead>
<tr>
<th>Troubleshooting Item</th>
<th>Cause</th>
<th>Solution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Insufficient cooling.</td>
<td>• Make sure to comply with the cooling water requirements, see Cooling Water Connection [12].</td>
<td></td>
</tr>
<tr>
<td>Ambient temperature too high.</td>
<td>• Observe the permitted ambient temperature, see Technical Data [37].</td>
<td></td>
</tr>
<tr>
<td>Temperature of the process gases at the inlet too high.</td>
<td>• Observe the permitted gas inlet temperature, see Technical Data [37].</td>
<td></td>
</tr>
<tr>
<td>The cooling water pump is defective.</td>
<td>• Repair the machine.</td>
<td></td>
</tr>
<tr>
<td>Oil level too low.</td>
<td>• Top up oil.</td>
<td></td>
</tr>
</tbody>
</table>

The oil is black.

<table>
<thead>
<tr>
<th>Troubleshooting Item</th>
<th>Cause</th>
<th>Solution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oil change intervals are too long.</td>
<td>• Drain the oil and fill in new oil, see Oil Change [29].</td>
<td></td>
</tr>
<tr>
<td>The machine runs too hot.</td>
<td>• See problem &quot;The machine runs too hot&quot;.</td>
<td></td>
</tr>
</tbody>
</table>

For the solution of problems not mentioned in the troubleshooting chart contact your Busch representative.
12 Technical Data

<table>
<thead>
<tr>
<th></th>
<th>NC 0100 B</th>
<th>NC 0200 B</th>
<th>NC 0300 B</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pumping speed (50Hz / 60Hz)</td>
<td>m³/h</td>
<td>110 / 130</td>
<td>220 / 265</td>
</tr>
<tr>
<td>Ultimate pressure with standard coating “NC xxxx xxx” (50Hz / 60Hz)</td>
<td>hPa (mbar) abs.</td>
<td>≤0.05 / ≤0.01</td>
<td></td>
</tr>
<tr>
<td>Ultimate pressure with special coating “NE xxxx xxx” or NT xxxx xxx” (50Hz / 60Hz)</td>
<td>hPa (mbar) abs.</td>
<td>≤0.5 / ≤0.1</td>
<td></td>
</tr>
<tr>
<td>Nominal motor rating (50Hz / 60Hz)</td>
<td>kW</td>
<td>3.5 / 4.8</td>
<td>6 / 7.6</td>
</tr>
<tr>
<td>Nominal motor speed (50Hz / 60Hz)</td>
<td>min⁻¹</td>
<td>3000 / 3600</td>
<td></td>
</tr>
<tr>
<td>Noise level (EN ISO 2151) (50Hz / 60Hz)</td>
<td>dB(A)</td>
<td>≤70 / ≤74</td>
<td>≤71 / ≤76</td>
</tr>
<tr>
<td>Ambient temperature range</td>
<td>°C</td>
<td>5 ... 50</td>
<td></td>
</tr>
<tr>
<td>Max. allowable counter pressure at the discharge</td>
<td>hPa (mbar)</td>
<td>200</td>
<td></td>
</tr>
<tr>
<td>Max. allowable gas inlet temperature</td>
<td>°C</td>
<td>≤50 hPa (mbar)</td>
<td>≥200</td>
</tr>
<tr>
<td>Relative humidity</td>
<td>at 30 °C</td>
<td>90%</td>
<td></td>
</tr>
<tr>
<td>Ambient pressure</td>
<td></td>
<td>Atmospheric pressure</td>
<td></td>
</tr>
<tr>
<td>Cooling water requirements</td>
<td></td>
<td>See Cooling Water Connection [► 12]</td>
<td></td>
</tr>
<tr>
<td>Oil capacity - motor side</td>
<td>l</td>
<td>1.1</td>
<td></td>
</tr>
<tr>
<td>Oil capacity - suction side</td>
<td>l</td>
<td>0.45</td>
<td></td>
</tr>
<tr>
<td>Cooling liquid capacity approx. (with plate heat exchanger only)</td>
<td>l</td>
<td>4</td>
<td>5.5</td>
</tr>
<tr>
<td>Weight approx.</td>
<td>kg</td>
<td>300</td>
<td>350</td>
</tr>
</tbody>
</table>

13 Cooling Liquid

<table>
<thead>
<tr>
<th>Zitrec M-25 (ready-to-use)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Part number 5 L packaging</td>
</tr>
<tr>
<td>Part number 25 L packaging</td>
</tr>
</tbody>
</table>

The cooling liquid Zitrec M-25 is ready-to-use and does not require additional water. For further information, consult the website www.arteco-coolants.com.

14 Oil

<table>
<thead>
<tr>
<th>VE 101</th>
</tr>
</thead>
<tbody>
<tr>
<td>ISO-VG</td>
</tr>
<tr>
<td>Part number 1 L packaging</td>
</tr>
<tr>
<td>Part number 5 L packaging</td>
</tr>
</tbody>
</table>
# 15 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

declares that the machine(s): **COBRA NC/NT/NX 0100 B; NC/NX 0200 B; NC/NT/NX 0300 B**

has (have) been manufactured in accordance with the European Directives:

- 'Machinery' 2006/42/EC
- 'Electromagnetic Compatibility' 2014/30/EU

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 Part 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 61000-6-2:2005</td>
<td>Electromagnetic compatibility (EMC) - Generic standards. Immunity for industrial environments</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</td>
</tr>
</tbody>
</table>

(1) In case control systems are integrated.

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

Chevenez, 10.10.2018

Christian Hoffmann, General director

For ATEX certified machines, the directive and standards are mentioned in the EU Declaration of Conformity of the ATEX documentation provided with the product.
<table>
<thead>
<tr>
<th>Country</th>
<th>Website</th>
<th>Email</th>
</tr>
</thead>
<tbody>
<tr>
<td>Argentina</td>
<td><a href="http://www.buschvacuum.com/ar">www.buschvacuum.com/ar</a></td>
<td><a href="mailto:info@busch.com.ar">info@busch.com.ar</a></td>
</tr>
<tr>
<td>Australia</td>
<td><a href="http://www.buschvacuum.com/au">www.buschvacuum.com/au</a></td>
<td><a href="mailto:sales@busch.com.au">sales@busch.com.au</a></td>
</tr>
<tr>
<td>Austria</td>
<td><a href="http://www.buschvacuum.com/at">www.buschvacuum.com/at</a></td>
<td><a href="mailto:busch@busch.at">busch@busch.at</a></td>
</tr>
<tr>
<td>Bangladesh</td>
<td><a href="http://www.buschvacuum.com/bd">www.buschvacuum.com/bd</a></td>
<td><a href="mailto:sales@busch.com.bd">sales@busch.com.bd</a></td>
</tr>
<tr>
<td>Belgium</td>
<td><a href="http://www.buschvacuum.com/be">www.buschvacuum.com/be</a></td>
<td><a href="mailto:info@busch.be">info@busch.be</a></td>
</tr>
<tr>
<td>Brazil</td>
<td><a href="http://www.buschvacuum.com/br">www.buschvacuum.com/br</a></td>
<td><a href="mailto:sales@buschdobrasil.com.br">sales@buschdobrasil.com.br</a></td>
</tr>
<tr>
<td>Canada</td>
<td><a href="http://www.buschvacuum.com/ca">www.buschvacuum.com/ca</a></td>
<td><a href="mailto:info@busch.ca">info@busch.ca</a></td>
</tr>
<tr>
<td>Chile</td>
<td><a href="http://www.buschvacuum.com/cl">www.buschvacuum.com/cl</a></td>
<td><a href="mailto:info@busch.cl">info@busch.cl</a></td>
</tr>
<tr>
<td>China</td>
<td><a href="http://www.buschvacuum.com/cn/zh">www.buschvacuum.com/cn/zh</a></td>
<td><a href="mailto:info@busch-china.com">info@busch-china.com</a></td>
</tr>
<tr>
<td>Colombia</td>
<td><a href="http://www.buschvacuum.com/co">www.buschvacuum.com/co</a></td>
<td><a href="mailto:info@buschvacuum.co">info@buschvacuum.co</a></td>
</tr>
<tr>
<td>Czech Republic</td>
<td><a href="http://www.buschvacuum.com/cz">www.buschvacuum.com/cz</a></td>
<td><a href="mailto:info@buschvacuum.cz">info@buschvacuum.cz</a></td>
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<tr>
<td>Denmark</td>
<td><a href="http://www.buschvacuum.com/dk">www.buschvacuum.com/dk</a></td>
<td><a href="mailto:info@busch.dk">info@busch.dk</a></td>
</tr>
<tr>
<td>Finland</td>
<td><a href="http://www.buschvacuum.com/fi">www.buschvacuum.com/fi</a></td>
<td><a href="mailto:info@busch.fi">info@busch.fi</a></td>
</tr>
<tr>
<td>France</td>
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<td><a href="mailto:busch@busch.fr">busch@busch.fr</a></td>
</tr>
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<td><a href="mailto:info@busch.de">info@busch.de</a></td>
</tr>
<tr>
<td>Hungary</td>
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