Installation and Operating Instructions

Vacuum pumps

WY 4500 C

Ateliers Busch S.A.
Zone industrielle
2906 Chevenez
Switzerland

0870565696 / 170707 / Original instructions / Subject to change without notice
Table of Contents

Introduction ................................................................. 2
Product description ....................................................... 3
Use ................................................................................. 3
Principle of operation ..................................................... 3
Cooling ............................................................................. 4
On/Off switch ................................................................... 4
Safety ............................................................................... 4
Intended use ..................................................................... 4
Safety notes ....................................................................... 4
Sound Emissions ............................................................. 4
Transport .......................................................................... 4
Transport in Packaging ..................................................... 4
Transport without packaging ............................................. 4
Storage .............................................................................. 5
Short-term Storage ........................................................ 5
Removal of the pump ...................................................... 5
Conservation .................................................................... 5
Commissioning after conservation .................................... 5
Installation and Commissioning ......................................... 5
Installation Prerequisites .................................................. 5
Local installation ............................................................ 5
Suction Connection ........................................................ 6
Discharge connection ...................................................... 6
Electrical connection/ Controls ........................................ 6
Installation ........................................................................ 7
Fitting .............................................................................. 7
Electrical connection ...................................................... 7
Electrical motor connection (15 kW) ............................... 7
Adjustment values for the temperature sensor ............... 8
Connecting Lines/ Pipes .................................................. 8
Filling up with Oil ........................................................... 8
Saving the operating parameters ..................................... 8
Recommendations on operation ....................................... 8
Application ....................................................................... 8
Cooling water .................................................................... 9
Limitations of use .......................................................... 9
Maintenance ..................................................................... 9
Maintenance Schedule ...................................................... 9
Weekly ............................................................................. 9
Monthly ........................................................................... 9
Yearly .............................................................................. 9
Every 16000 Operating hours, at the latest after 4 years .... 9
Checking the oil ............................................................... 9
Checking the oil level at the gears and bearing housings ... 9
Checking the colour of the oil ......................................... 10
Life Span of the oil at the gears and the bearings .......... 10
Oil Change ....................................................................... 10
Draining used oil from the gears and the bearings .......... 10
Checking the magnetic plug from the rear lubrication circuit of the rotor bearing .............................................. 10
Filling in fresh oil for the gears and the bearings .......... 11
Overhaul ......................................................................... 11
Removal from Service ...................................................... 11
Temporary Removal from Service .................................... 11
Recommissioning ........................................................... 11
Dismantling and Disposal ................................................ 12
Exploded drawing ............................................................ 13
Spare parts ...................................................................... 14
Gasket kit ........................................................................ 14
Full service kit .................................................................. 14
Oil .................................................................................. 15
Oil type ............................................................................ 15
Technical Data ................................................................. 16
Troubleshooting ............................................................... 17
EU-Declaration of Conformity ........................................... 21

Introduction

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

These operating instructions contain information on
– product description,
– security,
– 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 must be read and understood. If anything remains to be clarified please contact your Busch representative!

Keep these operating instructions and, if applicable, other relevant operating instructions available and accessible on site.
Product description

Use

The roots pumps are designed for applications in the semiconductor industry under Clean Room conditions. The WY 4500 C roots pumps can only be used as backing pumps in conjunction with other (primary) pumps in vacuum systems. They can be used to draw gases and mixtures of gases.

Make sure that the system complies with the appropriate national and international safety regulations and that all safety instructions are followed when drawing toxic, inflammable and/or explosive gases.

These pumps are not designed for the drawing of explosive mixtures. Before using the vacuum pump for drawing aggressive gases, you must imperatively contact your local Busch Agency.

Do not use the pump for other processes without a general overhaul. Gases or products could have remained inside the pump.

The Roots vacuum pumps are usually used as backing pumps in conjunction with other types of vacuum pumps in vacuum systems.

Conveying media with a higher density than air leads to an increased thermal and mechanical load on the vacuum pump and is permissible only after consultation with a Busch company.

Max. allowed temperature of the drawn gases:
See “Oil, Ambient temperature range”

Make sure that the oil level in both housings is in the target circle of the oil sight glasses after the vacuum pump has been switched off.

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

Max. permissible number of startings per hour: 6.

The vacuum pump is thermally suitable for continuous operation.

The vacuum pump is capable of holding end pressure.

Principle of operation

The Roots vacuum pumps operate according to the approved principle of the Roots type machine. Operation is both simple and effective.

Two rotors with identical profiles rotate in opposite directions within a casing. As they rotate, gas is drawn into the space between each rotor and the casing where it is trapped and pushed out at the discharge through the rotation of the lobes. This action is repeated twice for each revolution of each rotor and therefore four times for each revolution of the drive shaft. There is no mechanical contact between rotors and cylinder, therefore no oil lubrication in the process chamber is required.

The drive motor of the roots pump is a water-cooled motor.
Cooling

**CAUTION**
Operating the motor without water cooling will destroy the motor.

Water must be neutral and clean. It must fulfill the following conditions:
- Temperature of water: 10-15°C at inlet
- Quantity of cooling water: 4 l/min.

To ensure the flow rate regulation of the cooling water, we recommend to fit a regulating valve at the cooling water inlet. The Roots WY 4500 C has cooling systems in both cylinder covers (cooling coils). These cooling systems are separated from each other. A recirculating water-cooling system into the outlet flange enables a stable temperature of the oil and the bearings.

Cooling water connection:
The cooling water connection can be made with flexible hoses or water pipes (Connection: 1/4”). The water outlet must be without pressure.

**Initial filling-up with cooling water:**
- Remove the safety caps from the connections. Connect up the two hoses at the water inlet.
- Fill in water until water flows out at the outlet.
- Connect up the two hoses at the water outlet.

**Sound Emissions**
Refer to the table “Technical Properties” for the permissible sound levels in free field conditions according to EN ISO 2151.

**CAUTION**
The vacuum pump emits sounds of high intensity.
Risk of hearing damage!
Users spending a longer period of time in the vicinity of a non-insulated vacuum pump must wear suitable hearing protection.

**Transport**
Roots vacuum pumps undergo a rigorous operating test in the factory and are packed carefully to avoid transport damage. The inlet and outlet flange are sealed with plugs so that no dirt can enter the pump during transport. These covers must be removed before connecting up the pump.

Please check packaging for transport damage on delivery.

The pump can be lifted from the packaging with suitable lifting gear using the lifting brackets on the pump.

The packaging materials must be disposed of in accordance with applicable environmental protection regulations, or re-used. These operating instructions are part of the delivery packaging consignment.

Pumps are generally shipped without oil.
Operating the vacuum pump without oil will destroy the pump!

**Transport in Packaging**
Packed on a pallet the vacuum pump can be transported with a forklift.

**Transport without packaging**
In case the vacuum pump is bolted to a pallet or a base plate:

- Remove the fixing bolts between the vacuum pump and the pallet/base plate

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

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

- Attach lifting gear to a crane hook equipped with a safety latch
- Lift the vacuum pump with a crane hook

In case the vacuum pump was bolted to a pallet:

- Remove the stud bolts from the rubber feet

Safety
CAUTION

Starting the vacuum pump with excessive quantities of oil in the cylinder will immediately break the lobes and destroy the vacuum pump.

Once the vacuum pump is filled with oil it must not be lifted anymore.

Prior to every transport make sure that the oil has been drained (unless recommended otherwise)

Storage

Short-term Storage

- Make sure that the suction connection/ gas inlet and the discharge connection/ gas outlet are closed (fit the provided plugs)

- Store the vacuum pump
  - if possible in its original packaging,
  - indoors,
  - dry,
  - dust free
  - vibration free

Switching off and conservation of the pump

Removal of the pump

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.

Conservation

In case of adverse ambient conditions (e.g. aggressive atmosphere, frequent temperature changes) the vacuum pump must be preserved after one week using a conservation agent inside the cylinder. In case of favourable ambient conditions, the pump must be preserved using a conservation agent inside the cylinder if the pump is to be stored for more than 3 months.

CAUTION

Using the pump with the gas discharge connection closed will damage the vacuum pump.

Make sure that the gas discharge connection is open.

CAUTION

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

Risk of burns!

Do not touch the hot housing.

- Electrically connect the vacuum pump (see “Installation and Commissioning, Installation, Connect Electrically”)
- Let the vacuum pump run for at least half an hour
- Switch off the vacuum pump
- Drain the conservation oil (see “Maintenance, Oil Change, Draining Used Oil”)
- Make sure that all openings are firmly closed; seal all openings that are not closed with PTFE-tape, gaskets or o-rings, with adhesive tape.
- Wrap the vacuum pump in VCI film

NOTE: VCI stands for “Volatile Corrosion Inhibitor”. VCI-products (film, paper, cardboard, foam) evaporate a substance that condenses in molecular thickness on the packed good and by its electrochemical properties effectively suppresses corrosion on metallic surfaces. However, VCI-products may attack the surfaces of plastics and elastomers. Seek advice from your local packaging dealer! VCI packaging ensures good protection against corrosion for a few years, even in the most extreme of conditions such as see transport and prolonged storage.

- Store the vacuum pump
  - if possible in its original packaging,
  - indoors,
  - dry,
  - dust free and
  - vibration free

Repeat the conservation process after 12 months of standstill.

Commissioning after conservation

- Make sure that all gaskets, plugs or adhesive tape are removed from the openings
- Make sure that the oil level at the gears and bearings is in the target circle of the oil sight glasses
- Commission the vacuum pump as described in the 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 adjoining system components!

Risk of injury!

The installation prerequisites must be complied with.

- Make sure that the integration of the vacuum pump is carried out in such a way that the essential safety requirements of the Machine Directive 2006/42/EC are complied with (regarding the responsibility of the designer of the machinery into which the vacuum pump is to be incorporated; see also the note in the EU-Declaration of Conformity)

Local installation

- Make sure that the vacuum pump is switched off and cannot accidentally be switched on again

- Make sure that the following ambient conditions are adhered to:
  - Ambient temperature : see “Oil”
  - Ambient pressure: atmospheric

- Make sure that the environmental conditions comply with the protection class of the drive motor (according to the nameplate)
- Make sure that the vacuum pump is placed on or fastened to a horizontal surface
- Make sure that the vacuum pump is level and even
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 0.5 m away from any wall to ensure sufficient cooling.

Make sure that no temperature-sensitive components (plastics, wood, cardboard, paper, electronics) come into direct contact with the hot surface 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 guaranteed.

**CAUTION**

During operation the surface of the vacuum pump can 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, 220/222) remain easily accessible.

If the oil change is meant to be performed on site:
- Make sure that the oil drain plugs (ODP, 252/262 or 610) and the oil filler plugs (OFP, 250/260) remain easily accessible.

Configuration of the pump:
- Vertical gas flow

Vertical gas flow has the advantage of self-cleaning of the cylinder during operation.

### Suction Connection

**CAUTION**

Do not put hands into the inlet aperture.

Risk of body damage!

**CAUTION**

The ingress of foreign particles or liquids can destroy the vacuum pump.

In case the inlet gas contains dust or other foreign solid particles:
- Make sure that a suitable filter is installed upstream of the vacuum pump.
- Make sure that the suction line fits the suction flange / gas inlet of the vacuum pump.
- Make sure that the vacuum pump is switched off and cannot accidentally be switched on again.

When using pipes:
- Make sure that the pipe does not exercise any pressure on the vacuum pump’s connection, use bellows if necessary.

If two or more vacuum pumps work on the same suction line, if the volume of the vacuum system is large enough to draw back oil after having been switched off, or if the vacuum must be maintained after switching off the vacuum pump:
- Provide a manual or automatic operated valve (non-return valve) in the suction line (the installed non-return valve inside the suction connection is not meant to be used for this purpose!)

If the vacuum pump is intended to be used for the drawing of gases that contain limited quantities of condensable vapour:
- Provide a shut-off valve, a drain line and a drain tap in the suction line, so that condensates can be drained from the suction line.
- Make sure that the suction line does not contain foreign matter, e.g. welding slag.

### Discharge connection

**CAUTION**

Do not put hands into the outlet aperture.

Risk of body damage!

- Make sure that the discharge line fits the gas discharge of the vacuum pump.

When using pipes:
- Make sure that the pipe does not exercise any pressure on the discharge connection, use bellows if necessary.
- Make sure that the discharge line’s diameter over its entire length is at least as large as the diameter of the gas discharge of the vacuum pump.

In case of very long discharge lines, it is advisable to use a larger diameter piping in order to avoid a loss in efficiency and an overload on the vacuum pump. For advice please contact your local Busch representative.

- Make sure that the discharge line either slopes away downwards from the vacuum pump or provide a liquid separator or a drain line with a drain tap, so that no liquids can be drawn back into the vacuum pump.

**WARNING**

Discharge lines made from non-conducting material can build up electrostatic charge.

Electrostatic discharge can lead to explosion of potentially present oil mist.

The discharge line must be made of conducting material or provisions must be made against electrostatic discharge.

### Electrical connection/ Controls

- Make sure that the regulations acc. to the EMC-Directive 2004/108/EC as well as the EN-standards, electrical and occupational safety directives and the local or national regulations, respectively, are complied with (this is in the responsibility of the designer of the machinery into which the vacuum pump is to be incorporated; see also the note in the EU-Declaration of Conformity).
- Make sure that the power supply is compatible with the specification 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 disturbance from the mains; if necessary contact the Busch service for advice.

In case of mobile installation:
- Make sure that the vacuum pump is switched off and cannot accidentally be switched on again.
- If the Roots blower is used in a vacuum system where a vacuum pump is connected upstream, the vacuum pump can only be started up after the primary pump has gone into operation.
Installation

Fitting

- Make sure that the “Installation Prerequisites” are complied with
- Fit or mount 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 regulations.

**CAUTION**

The wiring diagrams given below are typical. Depending on specific purchase orders or certain markets different wiring diagrams may apply.

Risk of damage to the drive motor!
The inside of the terminal box must be checked for correct drive motor wiring diagrams/instructions.

- Electrically connect the drive motor (120)
- Connect the earth

Electrical motor connection (15 kW)

**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):

Thermoswitch connection:

**CAUTION**

Operation in the wrong direction of rotation can destroy the vacuum pump within a very short period of time.

Risk of explosion of the drive motor!

Prior to starting-up make sure that the vacuum pump is to be operated in the right direction.

- Make sure that the vacuum pump is switched off and cannot accidentally be switched on again
- Determine rotation sense of the motor by using a measure tool or by placing a rubber plate on the inlet.
- Press the on/ off switch briefly
- Make sure that the vacuum pump draws in

If the direction of rotation has to be changed:
  - Exchange two of the three feeder leads
Adjustment values for the temperature sensor

The temperature of the oil is monitored by a temperature sensor TSA which is fitted to the cover on the B-side. Depending on the temperature of the oil, first a warning is emitted, then the pump will eventually be switched off when the temperature of the oil has reached the corresponding temperature values.

<table>
<thead>
<tr>
<th>Oil</th>
<th>TSA</th>
</tr>
</thead>
<tbody>
<tr>
<td>YLC 250 B</td>
<td>80°C</td>
</tr>
</tbody>
</table>

Connecting Lines/ Pipes

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

- Connect the suction line
- Connect the discharge line
- Make sure that cooling air inlets and outlets are not covered or obstructed and that the cooling air flow is not affected adversely in any other way

Filling up with Oil

The gears and the bearings are oil-lubricated.

In case the pump has been preserved with conservation oil:

- Drain any remaining conservation liquids

**CAUTION**

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

Prior to commissioning the vacuum pump, make sure that oil is filled in.

The vacuum pump can be delivered with or without oil.

**In case the pump is delivered filled with oil, the oil used is PFPE oil.**

Dispose of the used oil according to applicable environmental protection regulations.

**NOTE** The quantity of oil given in these operating instructions serves as a guideline only. Check the oil level with the help of the oil sight glasses (OSG, 220/222) on the vacuum pump.

**CAUTION**

In case the vacuum pump has been treated with conservation oil:

Synthetic oils (except for oils based on poly-olefin) are incompatible with mineral oils and conservation oils.

Risk of foam building leading to the destruction of the vacuum pump.

**CAUTION**

Oil may only be filled in through oil filler holes (OFP, 250/260)

Remove oil filler plugs (OFP, 250/260) only if the vacuum pump and the primary pump are at a complete standstill.

The vacuum pump must only be operated with the oil filler plugs (OFP, 250/260) firmly tightened up.

- Remove oil filler plugs (OFP, 250/260)
- Fill in the relevant quantity of oil as detailed in the table “Oil Quantity”

**CAUTION**

In case of disrespect of the above, risk of damage or destruction of the vacuum pump and adjacent system components!

- Make sure that the oil level at the gears and bearings is in the target circle of the oil sight glasses

**CAUTION**

- Make sure that the seals of the filler plugs (OFP, 250/260) are not damaged and positioned correctly. Replace seals if damaged.
- Refit the oil filler plugs (OFP, 250/260)
- 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 suction flange (IN) with a rubber mat
- Let the vacuum pump run for a few minutes
- Switch off the vacuum pump and wait for a few minutes
- Make sure that the oil level at the gears and bearings is in the target circle of the oil sight glasses
- Make sure that the vacuum pump is switched off and cannot accidentally be switched on again.
- 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 mat from suction flange and connect the suction line

**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 save it as reference value for all future maintenance and repair work

**Recommendations on operation**

**Application**

The vacuum pump has been designed for use in the semiconductor industry under clean room conditions. The roots pumps can only be used in conjunction with primary pumps in vacuum systems. They can be used to draw gases and mixtures of gases.

The end user must make sure that the system complies with national and international safety regulations and that all safety measures are followed, when drawing toxic, inflammable and/ or explosive gases.

Max. permissible number of startings per hour: 6.

These pumps are not suitable for the drawing of explosive mixture. Before using the vacuum pump with aggressive gases, imperatively contact your local Busch Agency.

Do not use the pump for another process without general overhaul, as gases or products can remain inside the pump.
Make sure that the system is leak-tight and that there is no leakage of dangerous substances. If in doubt on drawn process-related liquids, we recommend the installation of a separator.

Drawing substances with a higher density than air leads to an increased thermal and mechanical load on the vacuum pump and is permissible only after consultation with Busch.

Max. allowed temperature of the drawn gas:
See “Oil, Ambient temperature range”

Dispose of the used oil according to applicable environmental protection regulations.

The vacuum pump is thermally suitable for continuous operation.

The pumping of other vapours must be previously approved by the Busch Company.

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

Risk of burns!
The vacuum pump must be protected against contact during operation, provide a guard if necessary.

CAUTION
The vacuum pump emits sound of high intensity.
Risk of hearing damage.

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

- Make sure that the vacuum pump and the primary pump are switched off and cannot accidentally be switched on again.
- Make sure that protective devices will not be disconnected
- Make sure that cooling air inlets and outlets are not covered or obstructed and that the cooling air flow can circulate without obstruction
- Make sure that the “Installation Prerequisites” (see “Installation Prerequisites and Commissioning”) are followed, particularly follow those instructions that ensure sufficient cooling

Cooling water
To drain the cooling water, the hoses have to be removed and the cooling water system blown through with compressed air, until all the water has been completely removed.
Advice: When there is danger of frost, the cooling water must be fully drained at a standstill of the pump, as described above.

Limitations of use
\( \Delta P \) = differential pressure between the outlet and the inlet of the vacuum pump. See table “Technical Characteristics”. Do not exceed the values given in the table.

Maintenance
For all maintenance work, the vacuum pump or the vacuum system must be switched off and it must be ensured that it cannot accidentally be switched on again.

Any dismantling of the pump must be executed by qualified personnel only. Before dismantling, the end user of the vacuum pump must fill in a “Certificate about Absence of Danger” which will inform about possible risks and dangers and corresponding measures. Without this document duly filled in and signed by an authorised person, the pump cannot be dismantled.

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

Risk of burns!
- Prior to any work that requires touching the vacuum pump, let the vacuum pump cool down
When draining the oil:
  - Let the vacuum pump cool down for no more than 20 minutes
  - Prior to disconnecting the inlet or discharge lines, make sure that these pipes/lines have been vented to atmospheric pressure

Maintenance Schedule
NOTE: The maintenance intervals depend very much on the individual operating conditions. The intervals given below must be considered as starting values which should be shortened or extended as appropriate. Particularly heavy duty operation, e.g. high dust loads in the environment or in the process gases, other contaminations or ingress of process material, can make it necessary to shorten the maintenance intervals significantly.

Weekly
- Check the oil level (see “Checking the oil”)

Monthly:
- Make sure that the vacuum pump and the primary pump are switched off and cannot be accidentally be switched on again
- Check the vacuum pump for oil leaks - in case of leaks have the vacuum pump repaired (Busch service)

In case of operation in a dusty environment:
  - Make sure that the working area is free from dust and dirt, clean if necessary (see “Every 6 Months”)
  - Make sure that the oil level at the gears and bearings is in the target circle of the oil sight glasses

Yearly:
- Make sure that the oil level at the gears and bearings is in the target circle of the oil sight glasses

Every 16,000 Operating hours, at the latest after 4 years
- Have a major overhaul done on the vacuum pump (Busch service)

Checking the oil
Checking the oil level at the gears and bearing housings
- Make sure that the vacuum pump and the primary pump are switched off and cannot accidentally be switched on again
- Read the level on the oil sight glasses (OSG, 220/222)

In case the level has dropped below the target circle:
  - Top up with oil (see “Topping up Oil”)
In case the level is above the target circle:
  - Change the oil (see “Change the oil”)
Make sure that the oil level at the gears and bearings is in the target circle of the oil sight glasses.

Dispose of the used oil in compliance with applicable environmental protection regulations.

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

CAUTION
Make sure that the vacuum pump is switched off and cannot accidentally be switched on again

Please fill in the oil after removing the oil filler plugs on the cylinder covers.

- Remove oil filler plugs (OFP, 250/260)
- Top up with oil until the oil level is in the target circle of the oil sight glasses
- Make sure that the oil level at the gears and bearings is in the target circle of the oil sight glasses
- Refit the oil filler plugs (OFP, 250/260)
- Make sure that the oil filler plugs have been correctly fitted after filling in the oil, so that no air can enter the pump. Too high an oil level must be avoided as well as this could lead to overheating of the gears

Checking the colour of the oil

NOTE: The oil should have a light colour and can be transparent, a little foamy or a little clouded. A milky discolouration that does not vanish after the oil has been left to rest indicates contamination with foreign material. Darkly coloured oil has either been contaminated with foreign material or burnt and must be changed (see “Oil Change”).

CAUTION
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.

Life span of the oil at the gears and the bearings

The oil life depends very much on the operating conditions. A clean and dry air stream and operating temperatures below 100°C are ideal. Under these conditions the oil and the oil filter must be changed every 5000 operating hours, latest after 6 months.

Under very unfavourable operating conditions the oil life can be less than 500 operating hours. Extremely short life times indicate

Oil Change

Draining used oil from the gears and the bearings

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

- 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 is vented to atmospheric pressure
- Put a drain tray underneath the oil drain plugs (ODP, 252/262 or 610)
- Remove the oil drain plugs (ODP, 252/262 or 610)
- Drain the oil
When the oil flow has stopped:
Make sure that all the used oil is drained
- Carefully unscrew and take off the magnetic plugs (MP 1, 590, MP 2, 592)
- Check that no metal swarf sticks to the magnet of the drain plug, clean or change it if necessary
- Make sure that the seals of the oil drain plugs are not damaged and fits correctly. Replace seal if damaged
- Refit the oil drain plugs (ODP, 252/262 or 610)
- Make sure that the seals of the oil drain plugs are not damaged and fits correctly. Replace seal if damaged
- Refit the magnetic plugs
- Dispose of the used oil in compliance with applicable regulations

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

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

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

CAUTION
Never unscrew and remove the magnetic plug (MP 3, 536) 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

Maintenance
Page 10
Carefully unscrew and take off the magnetic plug (MP 3, 536), 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 3, 536)

**CAUTION**
It is recommended that the magnetic plug (MP 3, 536) is replaced at every oil change due to wear and tear of the seal.

### Filling in fresh oil for the gears and the bearings

- Prepare the necessary oil quantity (see table “Oil quantity”)

**NOTE:** The quantity given in these operating instructions serves as a guideline only. Check the oil level with the help of the oil sight glasses (OSG, 220/222) on the vacuum pump.

- Make sure that oil drain plugs (ODP, 252/262 or 610) have been correctly fitted and are tight.

- Makes sure that the magnetic plugs (MP 1, 590, MP 2, 592) have been fitted and tightened up correctly.

**CAUTION**
Oil may be filled through oil filler holes (OFP, 250/260) only.

- Remove oil filler plugs (OFP, 250/260)

- Top up with oil until the oil level is in the target circle of the oil sight glasses

**CAUTION**

- Make sure that the seals of the filler plugs (OFP, 250/260) are not damaged and positioned correctly. Replace seals if damaged.

- Refit the oil filler plugs (OFP, 250/260)

---

**Overhaul**

**CAUTION**
In order to achieve the highest degree of efficiency and a long life span, the vacuum pump has been assembled and adjusted in accordance with precisely defined tolerances.

This adjustment will be lost during dismantling of the vacuum pump.

It is therefore highly recommended that any dismantling of the vacuum pump going beyond the scope of description in this manual should be carried out by specially trained Busch service personnel only.

**CAUTION**
Risk for the operating safety after improper work on the vacuum pump.

Risk of explosion!
Approval for operation of the pump will be void!

Any dismantling of the vacuum pump going beyond the scope of what is described in this manual must be carried out by specially trained Busch service personnel only.

**WARNING**

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.

---

**Removal from Service**

**Temporary Removal from Service**

- Prior to disconnecting the inlet and discharge lines, as well as the water piping to and from the motor, make sure that all pipes have been vented to atmospheric pressure.

**Recommissioning**

After longer periods of standstill:

- Make sure that the vacuum pump and the primary pump are switched off and cannot accidentally be switched on again.

- Follow the instructions in chapter “Installation and Commissioning”
Dismantling and Disposal

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.

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.

- Drain the oil
  - Dispose of the used oil in compliance with applicable regulations
- Make sure that all materials and components that must be treated as special waste have been removed from the vacuum pump
- Make sure that the vacuum pump is not contaminated with any harmful foreign material

Based on what is known at the time of print of this manual, the materials used for the manufacturing of the vacuum pump involve no risk.

- Please dispose of used parts and fluids in accordance with local applicable environmental laws and regulations
- Dispose of the vacuum pump as scrap metal
Exploded drawing
Spare parts

NOTE: When ordering spare parts or accessories acc. to the table below please always quote the type and the serial no. of the vacuum pump (on the nameplate of the pump). This will allow Busch service technicians to check if the vacuum pump is compatible with a modified or improved part.

The exclusive use of genuine spare parts and consumables is a prerequisite for the proper function of the vacuum pump and for the granting of warranty, guarantee or goodwill.

This parts list applies to a standard configuration of the vacuum pump. Specific pump configuration parts lists can be supplied upon request.

Gasket kit

The gasket kits contain all the seals to be changed during service work on a vacuum pump.

<table>
<thead>
<tr>
<th>Partnumber: 0990 565 406</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pos.</td>
</tr>
<tr>
<td>9</td>
</tr>
<tr>
<td>73</td>
</tr>
<tr>
<td>221</td>
</tr>
<tr>
<td>223</td>
</tr>
<tr>
<td>241</td>
</tr>
<tr>
<td>243</td>
</tr>
<tr>
<td>245</td>
</tr>
<tr>
<td>247</td>
</tr>
<tr>
<td>256</td>
</tr>
<tr>
<td>384</td>
</tr>
<tr>
<td>523</td>
</tr>
<tr>
<td>556</td>
</tr>
<tr>
<td>603</td>
</tr>
<tr>
<td>611</td>
</tr>
</tbody>
</table>

Full service kit

These full service kits contain all relevant gasket kits as well as the wear and tear parts that need to be changed.

<table>
<thead>
<tr>
<th>Partnumber: 0994 565 407</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pos.</td>
</tr>
<tr>
<td>4</td>
</tr>
<tr>
<td>14</td>
</tr>
<tr>
<td>15</td>
</tr>
<tr>
<td>19</td>
</tr>
<tr>
<td>22</td>
</tr>
<tr>
<td>25</td>
</tr>
<tr>
<td>101</td>
</tr>
<tr>
<td>250</td>
</tr>
<tr>
<td>252</td>
</tr>
<tr>
<td>260</td>
</tr>
<tr>
<td>262</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>520</td>
</tr>
<tr>
<td>522</td>
</tr>
<tr>
<td></td>
</tr>
</tbody>
</table>
Oil

Oil type

CAUTION

It is possible that the vacuum pump was tested with a different type of oil to the type you will be using for your application. Vacuum pumps that have been tested with a special oil, are labelled with specific stickers ("Special oil") affixed on the B-side cover (inlet side) as well as on the A-side cover (motor-side). If the oil type is not compatible, all parts that have come into contact with the oil must be cleaned. Make sure that the bearings are lubricated prior to reassembly.

- Make sure that the oil type corresponds to specifications:
  - Busch YLC 250 B, n° art. 0831 000 054 (0,5 l = 1 kg)

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 of oil [l]</th>
<th>Motor side</th>
<th>Gear side</th>
</tr>
</thead>
<tbody>
<tr>
<td>WY 4500 C</td>
<td>2,2</td>
<td>1,8</td>
</tr>
</tbody>
</table>
## Technical Data

<table>
<thead>
<tr>
<th>Technical Properties</th>
<th>WY 4500 C</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nominal displacement</td>
<td></td>
</tr>
<tr>
<td>50 Hz m³/h</td>
<td>4500</td>
</tr>
<tr>
<td>60 Hz m³/h</td>
<td>5400</td>
</tr>
<tr>
<td>Max. differential pressure (according to DIN 28426)</td>
<td></td>
</tr>
<tr>
<td>50 Hz hPa (mbar)</td>
<td>30</td>
</tr>
<tr>
<td>60 Hz hPa (mbar)</td>
<td>30</td>
</tr>
<tr>
<td>Nominal motor rating</td>
<td></td>
</tr>
<tr>
<td>50 Hz kW</td>
<td>15</td>
</tr>
<tr>
<td>60 Hz kW</td>
<td>15</td>
</tr>
<tr>
<td>Nominal motor speed</td>
<td></td>
</tr>
<tr>
<td>50 Hz min⁻¹</td>
<td>3000</td>
</tr>
<tr>
<td>60 Hz min⁻¹</td>
<td>3600</td>
</tr>
<tr>
<td>Weight approx.</td>
<td></td>
</tr>
<tr>
<td>kg</td>
<td>600</td>
</tr>
</tbody>
</table>
## Troubleshooting

### WARNING

Risk of electrical shock, risk of damage to equipment.

Electrical installation work must only be carried out by qualified personnel that know and observe 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 regulations.

### CAUTION

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

Risk of burns!

Do not touch the hot surfaces of the vacuum pump or wear heat protection gloves.

Please contact your local Busch representative if you have any doubts or questions

<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 working pressure</td>
<td>The vacuum system or suction line are not leak-tight</td>
<td>Check piping, hoses or pipe connections for possible leaks</td>
</tr>
<tr>
<td>The current consumption of the motor is too high (compared with the initial value after commissioning)</td>
<td>Jammed lobes</td>
<td>Inspection of the lobes</td>
</tr>
<tr>
<td></td>
<td>Defective bearings</td>
<td>Have the vacuum pump repaired (Busch service)</td>
</tr>
<tr>
<td>Reaching operational pressure takes too long</td>
<td>In case an inlet filter is installed on the suction side: The filter on the suction flange is partially clogged</td>
<td>Clean or change the filter</td>
</tr>
<tr>
<td></td>
<td>Partial clogging or blockage in suction or discharge lines</td>
<td>Remove foreign particles</td>
</tr>
<tr>
<td></td>
<td>Suction or discharge lines too long, or too small (diameter)</td>
<td>Use larger diameter lines</td>
</tr>
<tr>
<td></td>
<td>Internal parts worn or damaged</td>
<td>Have the vacuum pump repaired (Busch service)</td>
</tr>
<tr>
<td></td>
<td>The vacuum pump runs in the wrong direction</td>
<td>Check rotation of the driving motor. See “Installation and Commissioning”, change if necessary</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 trip switch protection is too weak or trip level is too low</td>
<td>Compare the technical data of drive motor trip switch with the data on the nameplate of the motor. Correct if necessary</td>
</tr>
<tr>
<td></td>
<td></td>
<td>In case of high ambient temperature: Set the trip level of the drive motor trip switch 5% 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 long or too small causing a voltage drop at the vacuum pump</td>
<td>Use adequately dimensioned cable</td>
</tr>
<tr>
<td>The vacuum pump or the drive motor is jammed or seized</td>
<td>The drive motor is defective</td>
<td></td>
</tr>
<tr>
<td>-------------------------------------------------------</td>
<td>-----------------------------</td>
<td></td>
</tr>
<tr>
<td>Make sure that the drive motor is disconnected from the power supply</td>
<td>Change the drive motor (Busch service)</td>
<td></td>
</tr>
<tr>
<td>Remove the fan cover</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Try to turn the fan by hand</td>
<td></td>
<td></td>
</tr>
<tr>
<td>If the unit vacuum pump/ drive motor is still jammed:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Remove the drive motor and check the drive motor and the vacuum pump separately</td>
<td></td>
<td></td>
</tr>
<tr>
<td>If the vacuum pump is jammed:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Have the vacuum pump repaired (Busch service)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>The vacuum pump is jammed or seized</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Solid foreign matter has entered the vacuum pump</td>
<td></td>
</tr>
<tr>
<td>Have the vacuum pump repaired (Busch service)</td>
<td></td>
</tr>
<tr>
<td>Make sure the suction line is equipped with a mesh screen</td>
<td></td>
</tr>
<tr>
<td>If necessary fit a mesh screen at the inlet</td>
<td></td>
</tr>
<tr>
<td>Corrosion in the vacuum pump from remaining condensates</td>
<td></td>
</tr>
<tr>
<td>Have the vacuum pump repaired (Busch service)</td>
<td></td>
</tr>
<tr>
<td>Check the process</td>
<td></td>
</tr>
<tr>
<td>Follow the instructions in chapter “Installation and Commissioning, Operating Notes”</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>The vacuum pump starts, but labours or runs noisily or rattles</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>The drive motor draws too high a current (compare with initial value after commissioning)</td>
<td></td>
</tr>
<tr>
<td>Connection(s) in the drive motor terminal box are defective</td>
<td></td>
</tr>
<tr>
<td>Check the proper connection of the wires against the wiring diagram</td>
<td></td>
</tr>
<tr>
<td>Tighten or change the connections</td>
<td></td>
</tr>
<tr>
<td>The motor winding is defective</td>
<td></td>
</tr>
<tr>
<td>Wrong oil quantity, unsuitable oil type</td>
<td></td>
</tr>
<tr>
<td>Use one of the recommended oils in the correct quantity (see “Oil”, Oil change see “Maintenance”)</td>
<td></td>
</tr>
<tr>
<td>Foreign particles in the vacuum pump</td>
<td></td>
</tr>
<tr>
<td>Seized bearings</td>
<td></td>
</tr>
<tr>
<td>Have the vacuum pump repaired (Busch service)</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>The vacuum pump is very noisy</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Defective bearings</td>
<td></td>
</tr>
<tr>
<td>Have the vacuum pump repaired (Busch service)</td>
<td></td>
</tr>
<tr>
<td>Worn coupling element</td>
<td></td>
</tr>
<tr>
<td>Replace the coupling elements</td>
<td></td>
</tr>
<tr>
<td>Defective gears</td>
<td></td>
</tr>
<tr>
<td>Have the vacuum pump repaired (Busch service)</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Noise at the sealings</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Insufficient lubrication</td>
<td></td>
</tr>
<tr>
<td>Check oil levels and top up with oil</td>
<td></td>
</tr>
<tr>
<td>Worn sealing (wear parts)</td>
<td></td>
</tr>
<tr>
<td>Change sealing</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>The vacuum pump is very hot (the temperature of the drained oil must not exceed 90°C)</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Cooling water flow is too low</td>
<td></td>
</tr>
<tr>
<td>Check the cooling water circuit and adjust the flow if necessary</td>
<td></td>
</tr>
<tr>
<td>Ambient temperature too high</td>
<td></td>
</tr>
<tr>
<td>Keep within the permitted ambient temperature range</td>
<td></td>
</tr>
<tr>
<td>Temperature of the gases at inlet too high</td>
<td></td>
</tr>
<tr>
<td>Keep within the permitted temperature range for the gases at inlet</td>
<td></td>
</tr>
<tr>
<td>Mains frequency or voltage outside tolerance range</td>
<td></td>
</tr>
<tr>
<td>Provide a more stable power supply</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>The oil is black</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Oil change intervals are too long</td>
<td></td>
</tr>
<tr>
<td>The oil has overheated</td>
<td></td>
</tr>
<tr>
<td>Drain the oil</td>
<td></td>
</tr>
<tr>
<td>Fill in new oil (see “Maintenance”)</td>
<td></td>
</tr>
<tr>
<td>In case the oil life is too short: use oil with better heat resistance (see “Oil”) or fit additional cooling</td>
<td></td>
</tr>
<tr>
<td>Troubleshooting Scenarios</td>
<td>Potential Causes</td>
</tr>
<tr>
<td>-------------------------------------------</td>
<td>-------------------------------------------------------</td>
</tr>
<tr>
<td><strong>The rotors do not turn, and cannot be turned either way by hand:</strong></td>
<td>Failure of the motor</td>
</tr>
<tr>
<td></td>
<td>Rotors are jammed, stuck or seized</td>
</tr>
<tr>
<td></td>
<td>Foreign substances in the pump</td>
</tr>
<tr>
<td><strong>Abnormal sounds or vibrations:</strong></td>
<td>Excessive wear of bearings</td>
</tr>
<tr>
<td><strong>STOP BLOWER IMMEDIATELY!!</strong></td>
<td>Too little gear oil in the pump, or oil in the pump is worn</td>
</tr>
<tr>
<td></td>
<td>Resonance of piping</td>
</tr>
<tr>
<td></td>
<td><strong>Abnormal increase of discharge pressure</strong></td>
</tr>
<tr>
<td></td>
<td>Leakage</td>
</tr>
<tr>
<td></td>
<td>Synchronising the rotors</td>
</tr>
<tr>
<td></td>
<td>Foreign particles in the gear housing</td>
</tr>
<tr>
<td></td>
<td>Failure of non-return valve</td>
</tr>
<tr>
<td><strong>Abnormal heat</strong></td>
<td>Abnormal increase of discharge pressure</td>
</tr>
<tr>
<td></td>
<td>Rotational speed of blower and/ or motor too low (when using a frequency converter)</td>
</tr>
<tr>
<td></td>
<td>Too much gear oil in the housing</td>
</tr>
<tr>
<td></td>
<td>Ambient temperature too high</td>
</tr>
<tr>
<td></td>
<td>Blockage of the suction inlet or filter</td>
</tr>
<tr>
<td></td>
<td>Excessive wear of rotors and consequently increase of rotor tolerances</td>
</tr>
<tr>
<td></td>
<td><strong>Abnormal increase of discharge pressure</strong></td>
</tr>
<tr>
<td></td>
<td>Blockage of discharge pipe</td>
</tr>
<tr>
<td></td>
<td>Blockage of system piping</td>
</tr>
<tr>
<td></td>
<td>Primary pump failure</td>
</tr>
<tr>
<td><strong>Oil leaks</strong></td>
<td>Too much oil in the pump</td>
</tr>
<tr>
<td></td>
<td>Worn or broken mechanical seals (oil-lubricated single mechanical seals) do not apply to WY pumps</td>
</tr>
<tr>
<td></td>
<td>Ambient conditions and vacuum combined with pressure operation and high dP</td>
</tr>
<tr>
<td></td>
<td>Pump has been tilted or is not level</td>
</tr>
<tr>
<td><strong>Oil level in the seal housing fluctuates abnormally (Applies to pumps equipped with a drop oiler)</strong></td>
<td>Worn or broken mechanical seals</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) WY 4500 C
with a serial number from C1701... to C1852...
has (have) been manufactured in accordance with the European Directives:

- "Machinery" 2006/42/EC
- "Electromagnetic Compatibility" 2014/30/EU
- "RoHS" 2011/65/EU, 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</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, 16.03.2016

Christian Hoffmann, General Director

(1) In case control systems are integrated.