VACUUM SOLUTIONS

R5

Oil-Lubricated Rotary Vane Vacuum Pumps
RA 1000 B, RA 1600 B
RC 1000 B, RC 1600 B

Instruction Manual

Get technical data, instruction manuals, service kits

VACUUM APP

0870569784 | -0008_en-US | Original instructions

8/13/2022

Table of Contents

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, as described in the following chapters and in accordance with the chapter *Intended Use* [➔ 6]. This instruction manual highlights potential hazards where appropriate. Safety notes and warning messages are tagged with one of the keywords DANGER, WARNING, CAUTION, NOTICE and NOTE as follows:

DANGER

... indicates an imminent dangerous situation that will result in death or serious injuries if not prevented.

WARNING

... indicates a potentially dangerous situation that could result in death or serious injuries.

CAUTION

... indicates a potentially dangerous situation that could result in minor injuries.

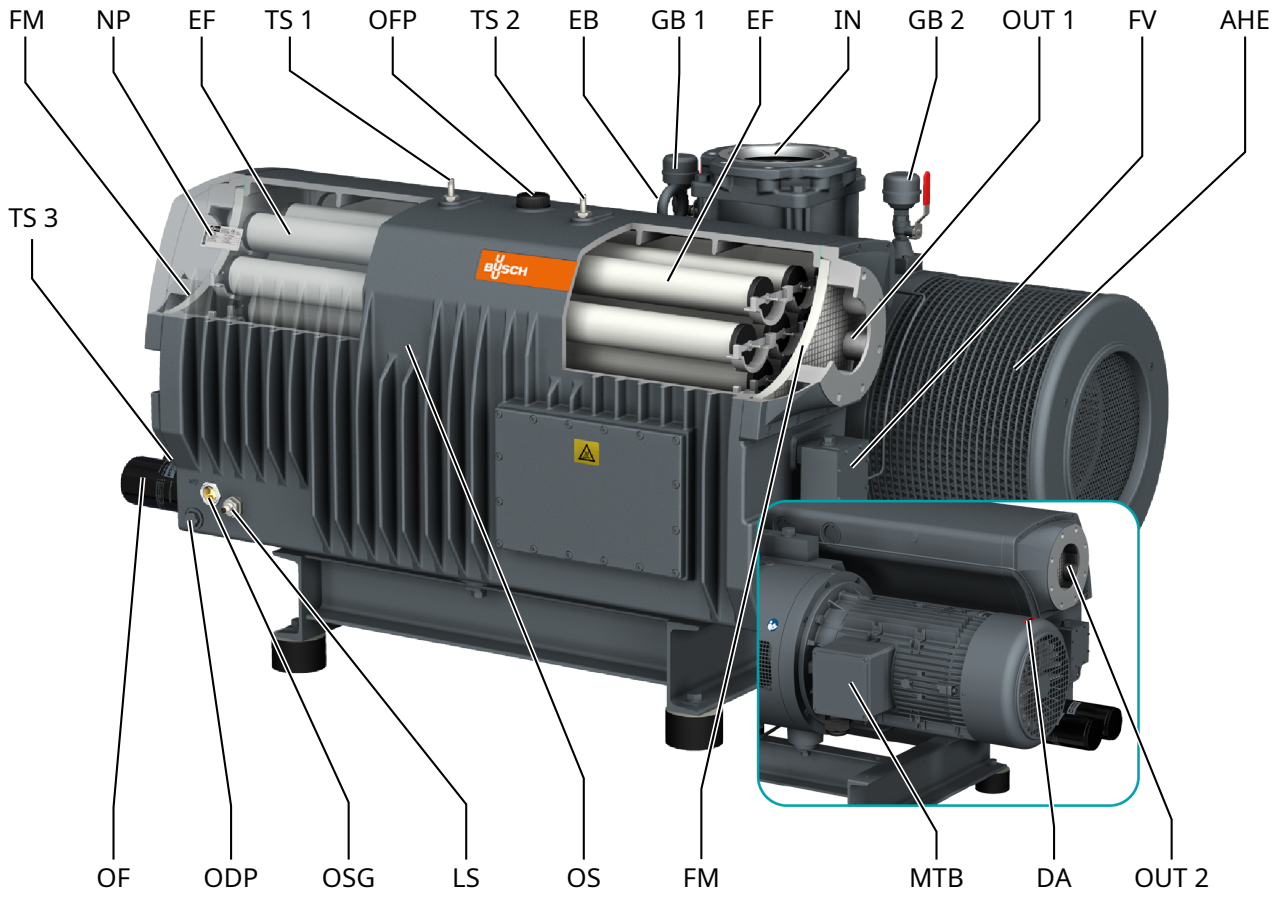
NOTICE

... indicates a potentially dangerous situation that could result in damage to property.

NOTE

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

2 Product Description



Description			
IN	Suction connection (Inlet)	OUT	Discharge connection (Outlet)
AHE	Air-oil heat exchanger	DA	Directional arrow
EB	Eye bolt	EF	Exhaust filter
FM	Filter material	FV	Float valve (on RA version only)
GB	Gas ballast valve	LS	Level switch
MTB	Motor terminal box	NP	Nameplate
ODP	Oil drain plug	OF	Oil filter
OFP	Oil fill plug	OS	Oil separator
OSG	Oil sight glass	TS	Temperature switch

NOTE

Technical term.

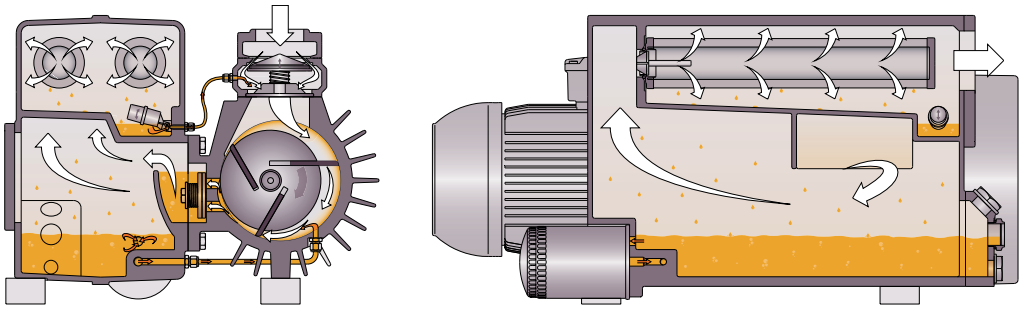
In this instruction manual, we consider that the term ‘machine’ refers to the ‘vacuum pump’.

NOTE

Illustrations

In this instruction manual the illustrations may differ from the machine appearance.

2.1 Operating Principle



The machine works on the rotary vane principle.

The oil seals the gaps, lubricates the vanes and takes away compression heat.

The oil filter cleans the circulating oil.

Exhaust filters separate the oil from the discharged gas.

2.2 Intended Use

WARNING

In case of foreseeable misuse outside the intended use of the machine.

Risk of injuries!

Risk of damages to the machine!

Risk of damages to the environment!

- Make sure to follow all instructions described in this manual.

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 designed for indoor installation, in case of outdoor installation, ask your Busch representative in order to take specific precautions.

The machine is capable of maintaining ultimate pressure, see *Technical Data* [➔ 38].

The machine is suitable for continuous operation.

Permitted environmental conditions, see *Technical Data* [➔ 38].

2.3 Start Controls

NOTE

To start the machine, Busch recommends the installation of starter devices such as soft-starters or variable speed drives.

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 speed drive.

2.4 Standard Accessories

2.4.1 Temperature Switch "Gas"

The temperature switch “Gas” monitors the gas temperature of the machine.

The machine must be stopped when the gas reaches 110 °C.

2.4.2 Level Switch

The level switch monitors the oil level.

The machine must be stopped when the oil level is too low.

2.4.3 Temperature Switch "Oil"

The temperature switch monitors the oil temperature of the machine.

It has two switch points.

Depending on the oil type, the machine must be stopped when the oil reaches a certain temperature, see *Oil* [➔ 39].

2.5 Optional Accessories

2.5.1 Gas Ballast Valve

The gas ballast valve mixes the process gas with a limited quantity of ambient air to counteract the condensation of vapor inside the vacuum pump.

The gas ballast valve has an influence on the ultimate pressure of the machine, see *Technical Data* [➔ 38].

2.5.2 Inlet Filter

The inlet filter protects the machine against dust and other solids in the process gas. The inlet filter is available with a paper or polyester cartridge.

2.5.3 Water-oil Heat Exchanger

In case of unfavorable ambient conditions a water-oil heat exchanger can be provided.

See *Cooling Water Connection (Optional)* [➔ 14].

2.5.4 Resistance Thermometer

The resistance thermometer monitors the oil temperature of the machine.

Depending on the oil type, warning and trip signals must be set, see *Oil* [➔ 39].

2.5.5 Pressure Switch

The pressure switch monitors the pressure in the oil separator.

The machine must be stopped when the gas reaches a certain pressure, see *Wiring Diagram Pressure Switch (Optional)* [➔ 23].

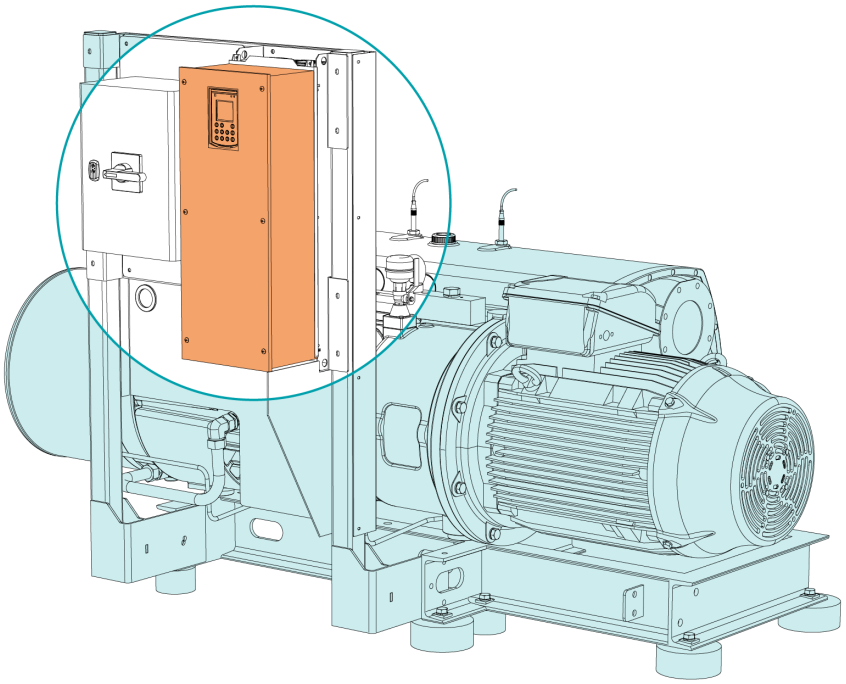
2.5.6 Pressure Transmitter

The pressure transmitter monitors the pressure in the oil separator.

Warning and trip signals must be set, see Wiring Diagram Pressure Transmitter (Optional).

2.5.7 Variable Speed Drive

The machine can optionally be equipped with a Variable Speed Drive (VSD). A variable speed drive increases the pumping speed of the machine and saves energy. For more information contact your Busch representative.



3 Transport

WARNING

Suspended load.

Risk of severe injury!

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

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 shown.

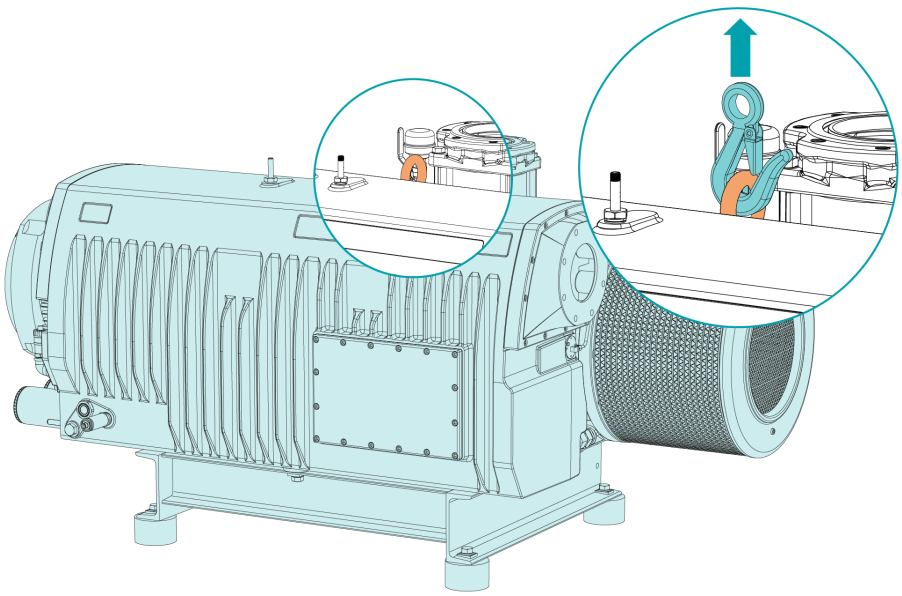
NOTICE

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. Starting the machine with excessive quantities of oil in the cylinder will immediately break the vanes and ruin the machine!

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

- To find out the weight of the machine, refer to the chapter *Technical Data* [➔ 38] or the nameplate (NP).
- Make sure that the eye bolt(s) (EB) is/are in faultless condition, fully screwed in and tightened by hand.



- 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.

Version with water-oil heat exchanger:

- Make sure that the cooling water has been completely drained, see *Decommissioning* [➔ 34].

If the machine is equipped with a variable speed drive:

NOTICE

Long storage time.

Risk of damage to the machine!

- Due to a long storage time the capacitors of the variable speed drive can lose efficiency because of electrochemical processes. In the worst case, it can lead to a short-circuit and therefore to a damage to the variable speed drive of the machine.
- Connect the machine every 18 months for 60 minutes to the mains.

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 0 ... 40 °C.

5 Installation

5.1 Installation Conditions

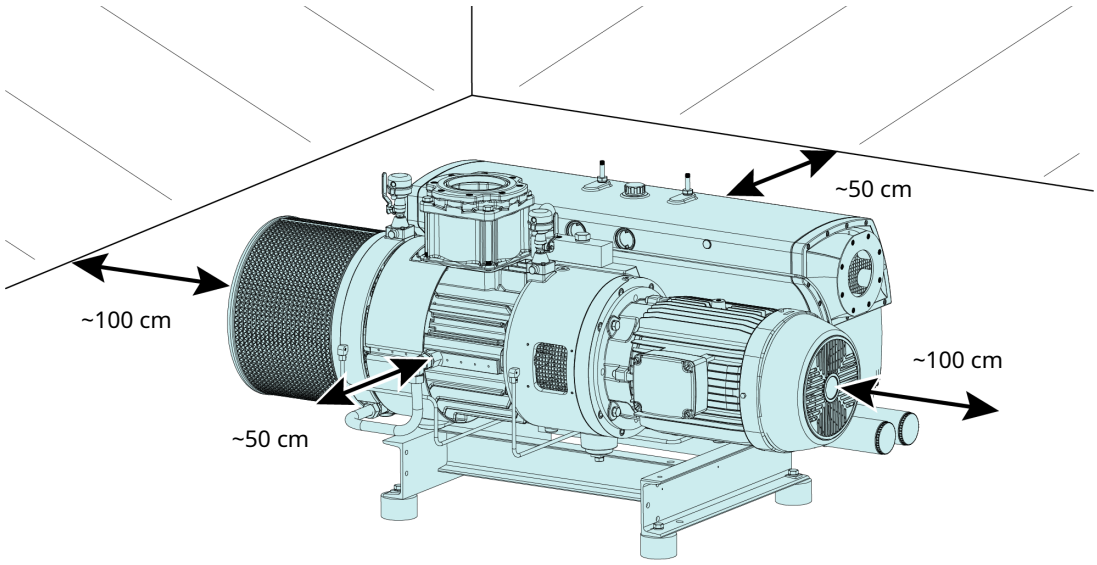
NOTICE

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* [➔ 38].
- Make sure that the environmental conditions comply with the protection class of the motor and the electrical elements.
- Make sure that the installation space or location is protected from weather and lightning.
- 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 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* [➔ 29].
- Make sure that all provided covers, guards, hoods, etc. are mounted.

Version with water-oil heat exchanger:

- Make sure that the cooling water complies with the requirements, see *Cooling Water Connection (Optional)* [➔ 14].

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.

If the machine is equipped with monitoring devices or sensors:

- Make sure that the monitoring devices are correctly connected and integrated into a control system such that operation of the machine will be inhibited if the safety limit values are exceeded, see *Electrical Connection of the Monitoring Devices* [➔ 22].

5.2 Connecting Lines / Pipes

- Remove all protective covers 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 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(s):

– DN150 PN16, EN 1092-1

Depending on the specific configuration ordered, other connection dimensions may apply.

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

- Busch recommends the installation of an isolation valve in order to prevent the oil from flowing back to the vacuum system.

5.2.2 Discharge Connection

CAUTION

The discharge gas contains small quantities of oil.

Risk to health!

If air is discharged into rooms where persons are present:

- Make sure that sufficient ventilation is provided.

NOTICE

Discharge gas flow obstructed.

Risk of damage to the machine!

- Make sure that the discharged gas will flow without obstruction. Do not shut off or throttle the discharge line or use it as a pressurized air source.

Connection size(s):

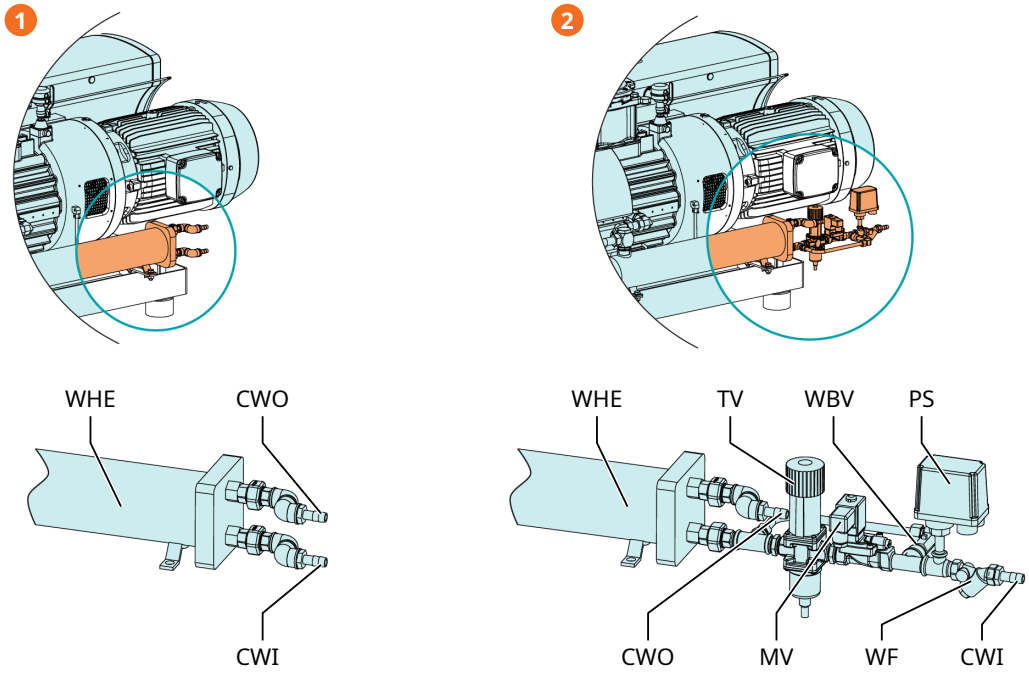
– DN125 PN16, EN 1092-1

Depending on the specific configuration ordered, other connection dimensions may apply.

Unless the aspirated air is discharged to the environment right at the machine:

- Make sure that the discharge line either slopes away from the machine or provide a liquid separator or a siphon with a drain cock, so that no liquids can flow back into the machine.

5.2.3 Cooling Water Connection (Optional)



Description			
1	Water-oil heat exchanger without inlet accessories	2	Water-oil heat exchanger with inlet accessories

Description			
CWI	Cooling water inlet	PS	Pressure switch
CWO	Cooling water outlet	WBV	Water bypass valve
WHE	Water-oil heat exchanger	WF	Water filter
TV	Thermostatic valve	MV	Solenoid valve

The thermostatic valve (TV) is used to control the water flow in order to keep a stable vacuum pump temperature.

The factory default adjustment of the thermostatic valve (TV) is set in position 2 (approx. 75°C oil temperature).

The pressure switch (PS) is used to monitor the presence of water at the cooling system of the vacuum pump.

When the pressure switch detects a pressure lower than 2 bar, the vacuum pump must be stopped.

The water bypass valve (WBV) is used at the first vacuum pump start-up. At that moment it should be open (approx. 90 seconds) to prime the water heat exchanger, afterwards it should be closed.

The solenoid valve (MV) is used to stop the cooling water circulation when the vacuum pump is not running.

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

Connection size:

– 19 mm hose (CWI / CWO)

- If necessary, electrically connect the pressure switch (PS), see Wiring Diagram Pressure Switch of Water-oil Heat Exchanger (Optional).
- If necessary, electrically connect the solenoid valve (MV).
- Make sure that the cooling water complies with the following requirements:

Min. supply capacity	l/min	8
Water pressure	bar	2 ... 6
Supply temperature	°C	+5 ... +35
Required pressure differential across supply and return	bar	≥ 1

- To reduce the maintenance effort and ensure a long product lifetime we recommend the following cooling water quality:

Hardness	mg/l (ppm)	< 90
Properties	Clean & clear	
PH value		7 ... 8
Particle size	µm	< 200
Chloride	mg/l	< 100
Electrical conductivity	µS/cm	≤ 100
Free chloride	mg/l	< 0.3
Materials in contact with the cooling water	Stainless steel, copper and cast iron	

NOTE

Water hardness unit conversion.

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

5.3 Filling Oil

NOTICE

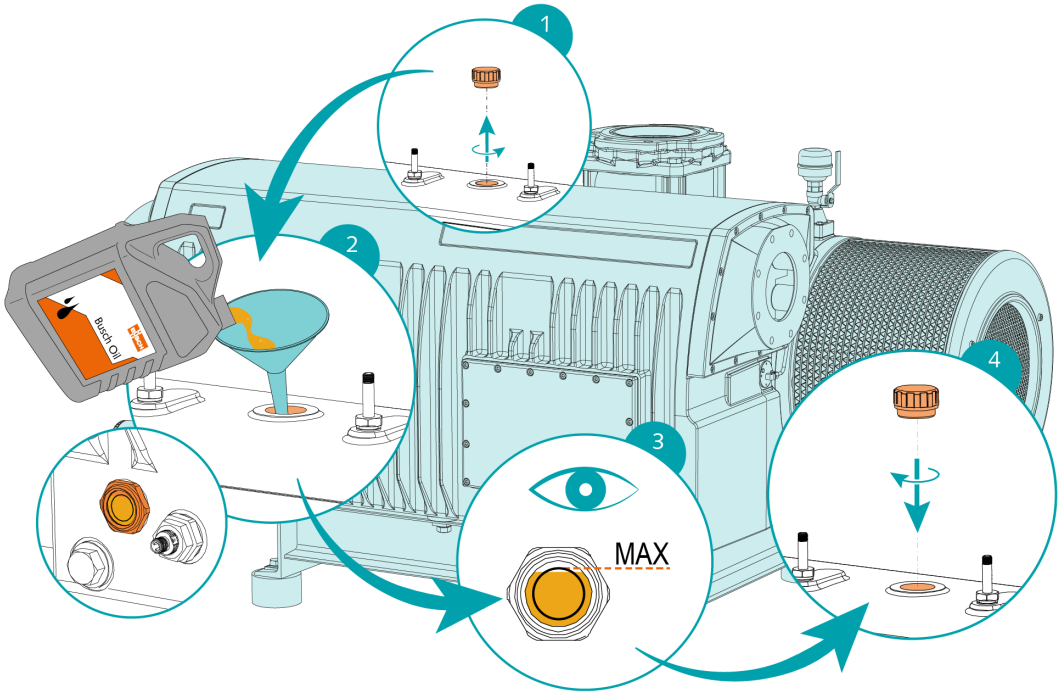
Use of an inappropriate oil.

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* [➔ 38] and *Oil* [➔ 39].

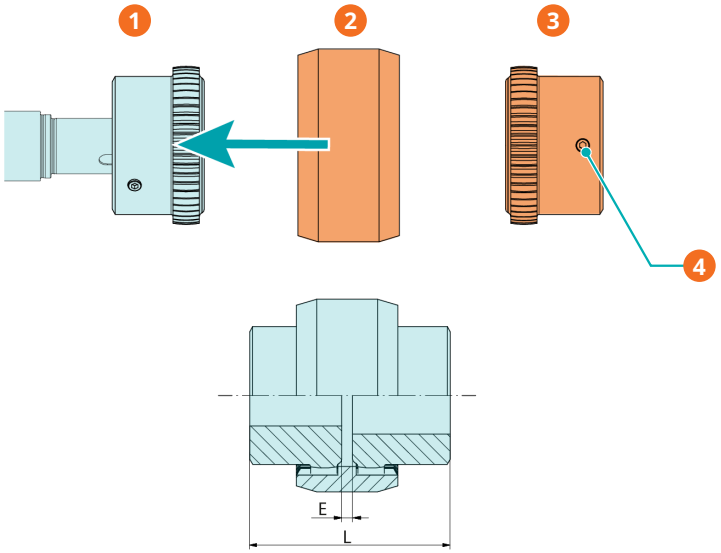


5.4 Fitting the Coupling

NOTE

Radial screw.

For trouble-free operation, use thread locking glue to secure the radial screw.



Description			
1	Coupling hub (machine side)	2	Coupling sleeve
3	Coupling hub (motor side)	4	Radial screw / max. admissible torque: 17Nm

Machine type	Coupling size	Value “E” (mm)	Value “L” (mm)
RA/RC 1000 B	BoWex® I-80	6	186
	POLY PKZ 17	4	144
	POLY PKZ 20	4	164
RA/RC 1600 B	BoWex® I-80	6	186
	POLY PKZ 20	4	164

In case of a machine delivery without motor:

- Fit the second coupling hub on the motor shaft (separately delivered).
- Axially adjust the sleeve in such a way until value "E" (or “L”) 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 sleeve.

For further coupling information, go to *www.ktr.com* and download the instruction manual of the BoWex® or POLY PKZ coupling.

BoWex®

English	German	French
Instruction Manual - English	*Instruction Manual - German*	*Instruction Manual - French*

POLY PKZ

English	German	French
Instruction Manual - English	*Instruction Manual - German*	*Instruction Manual - French*

6 Electrical Connection

DANGER

Live wires.

Risk of electrical shock.

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

CURRENT PROTECTION OF THE CUSTOMER INSTALLATION:

DANGER

Missing current protection.

Risk of electrical shock.

- Current protection according to EN 60204-1 must be insured by the customer on its installation.
- The electrical installation must comply with the applicable national and international standards.

NOTICE

Electromagnetic compatibility.

- Make sure that the motor of the machine will not be affected by electric or electro- magnetic disturbance from the mains, if necessary seek advice from Busch.
- Make sure that the EMC of the machine is compliant with the requirements of your supply network system, if necessary provide further interference suppression (EMC of the machine, see *EU Declaration of Conformity* [➔ 40] or *UK Declaration of Conformity* [➔ 41]).

6.1 Machine delivered without Control Box or Variable Speed Drive (VSD)

DANGER

Live wires.

Risk of electrical shock.

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

NOTE

It is recommended that the machine is started either by a soft starter unit or by a variable speed drive. Supplying power directly to the motor of the machine may reduce the lifetime of the coupling. When using a soft starter unit or a variable speed drive, make sure that the permitted motor speed range is respected (see *Technical Data* [➔ 38]).

Seek advice from your Busch representative.

- Make sure that the power supply for the motor is compatible with the data on the nameplate of the motor.
- If the machine is equipped with a power connector, install a residual current protective device to protect persons in case of isolation default.
  - Busch recommends installing a type B residual protective device suitable for the electrical installation.
- Provide a lockable disconnect switch or an emergency stop switch on the power line so that the machine is completely secured in case of an emergency situation.
- 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.
  - Busch recommends installing a D-curve circuit breaker.
- Connect the protective earth conductor.
- Electrically connect the motor.

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.

6.2 Machine delivered with a Control Box (Option)

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 control box.
- If the machine is equipped with a power connector, install a residual current protective device to protect persons in case of isolation default.
  - Busch recommends installing a type B residual protective device suitable for the electrical installation.
- If the control box is not equipped with a lockable disconnect switch, provide it on the power line so that the machine is completely secured during maintenance tasks.
- Provide an overload protection according to EN 60204-1.
  - Busch recommends installing a D-curve circuit breaker.
  - In case of a soft start, Busch recommends installing a C-curve circuit breaker.
- Connect the protective earth conductor.
- Electrically connect the control box.

NOTICE

Incorrect connection.

Risk of damage to the control box and motor!

- The wiring diagrams given below are typical. Check the inside of the control box for connection instructions/diagrams.

6.3 Machine delivered with a Variable Speed Drive (Option)

DANGER

Live wires. Carry out any work on the variable speed drive and motor.

Risk of electrical shock!

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

DANGER

Maintenance work without disconnecting the variable speed drive.

Risk of electrical shock.

- Disconnect and isolate the variable speed drive before attempting any work on it.
  High voltages are present at the terminals and within the variable speed drive for up to 10 minutes after disconnection of the electrical supply.
- Always ensure by using a suitable multimeter that no voltage is present on any drive power terminals prior to commencing any work.

- Make sure that the power supply for the drive is compatible with the data on the nameplate of the variable speed drive.
- If the machine is equipped with a power connector, install a residual current protective device to protect persons in case of isolation default.
  - Busch recommends installing a type B residual protective device suitable for the electrical installation.
- If the variable speed drive is not equipped with a lockable disconnect switch, provide it on the power line so that the machine is completely secured during maintenance tasks.
- Provide an overload protection according to EN 60204-1.
  - Busch recommends installing a C-curve circuit breaker.
- Connect the protective earth conductor.

NOTICE

The admissible motor speed exceeds the recommendation.

Risk of damage to the machine!

- Check the admissible motor speed range, see *Technical Data* [➔ 38].

NOTICE

Incorrect connection.

Risk of damage to the variable speed drive!

- The wiring diagrams given below are typical. Check the connection instructions/diagrams.

6.4 Wiring Diagram Three-Phase Motor

NOTICE

Incorrect direction of rotation.

Risk of damage to the machine!

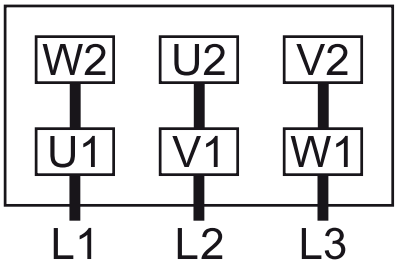
- Operation in the wrong direction of rotation can destroy the machine in a short time! Prior to start-up, ensure that the machine is operated in the right direction.

- Determine the intended direction of rotation with the arrow (stuck on or cast).
- Jog the motor briefly.
- Watch the fan wheel of the motor and determine the direction of rotation just before the fan wheel stops.

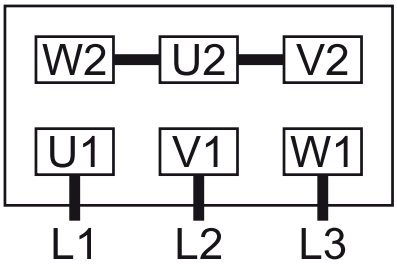
If the rotation of the motor must be changed:

- Switch any two of the motor phase wires.

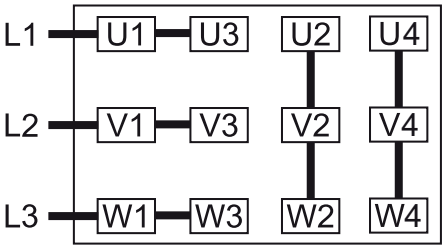
Delta connection (low voltage):



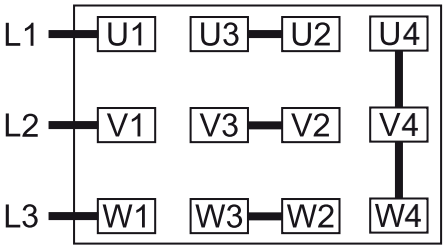
Star connection (high voltage):



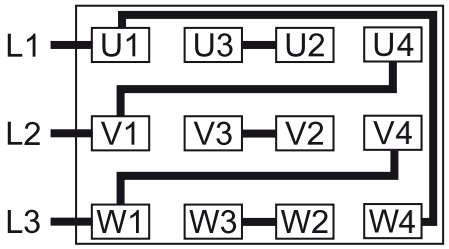
Double star connection, multi-voltage motor with 12 pins (low voltage):



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



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



6.5 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.

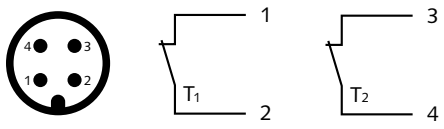
6.5.1 Wiring Diagram Temperature Switch "Gas"

Part no.: 0651 566 632

Connector: M12x1, 4-pin

Electrical data:
U = ≤ 250 V AC/DC (50/60 Hz) ; I = ≤ 1 A

Switch point: T_1 pin 1 + 2 = 110 °C



1 = Brown ; 2 = White ;
3 = Blue ; 4 = Black

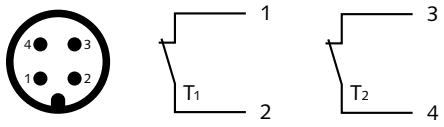
6.5.2 Wiring Diagram Temperature Switch "Oil"

Part no.: 0651 566 632

Connector: M12x1, 4-pin

Electrical data:
U = ≤ 250 V AC/DC (50/60 Hz) ; I = ≤ 1 A

Switch point:
T_1 pin 1 + 2 = 110 °C*
T_2 pin 3 + 4 = 130 °C*



1 = Brown ; 2 = White ;
3 = Blue ; 4 = Black

* *The switch point value depends on the oil type, see Oil* [➔ 39].

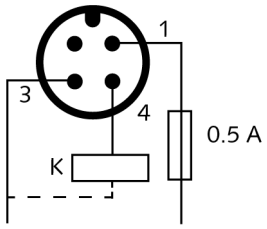
6.5.3 Wiring Diagram Level Switch

Part no.: 0652 567 576

Connector: M12x1, 4-pin

Electrical data:
U = 10 – 30 V DC
I consumption : <15 mA
I output max : 150 mA

Switch point:
Pin 1 = low level



1 = Brown: Supply +24V DC
3 = Blue: Supply 0V DC
4 = Black: Signal low level

NOTE:
For this device, the recommended time delay to prevent nuisance alarms can be up to 240 seconds.

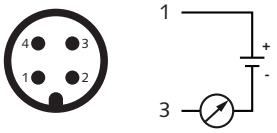
6.5.4 Wiring Diagram Resistance Thermometer (Optional)

Part no.: 0651 566 842

Connector: M12x1, 4-pin

Electrical data:
U = 10 ... 35 VDC
4 ... 20 mA ► 0 ... 150 °C

Warning / trip signals: see *Oil* [➔ 39].



1 = Brown ; 3 = Blue

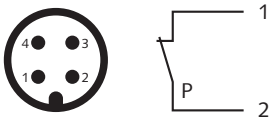
6.5.5 Wiring Diagram Pressure Switch (Optional)

Part no.: 0653 566 736

Connector: M12x1, 4-pin

Electrical data:
U = ≤ 250 V AC/DC (50/60 Hz) ; I = ≤ 4 A

Switch point:
P pin 1 + 2 = 0.6 bar (overpressure)



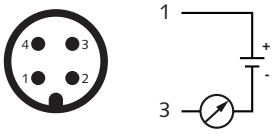
1 = Brown ; 2 = White

6.5.6 Wiring Diagram Inlet Pressure Transmitter (Optional)

Part no.: 0653 233 987

Connector: M12x1, 4-pin

Electrical data:
U = 7 ... 33 VDC
4 ... 20 mA ► 0 ... 1 bar (abs.)



1 = Brown ; 3 = Blue

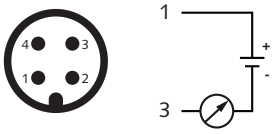
6.5.7 Wiring Diagram Exhaust Pressure Transmitter (Optional)

Part no.: 0653 567 425

Connector: M12x1, 4-pin

Electrical data:
U = 10 ... 35 VDC
4 ... 20 mA ► 0 ... 1.6 bar (abs.)

Warning signal:
$P_{warning}$ = 0.4 bar (overpressure)



1 = Brown ; 3 = Blue

Trip signal:
P_{trip} = 0.6 bar (overpressure)

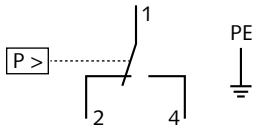
6.5.8 Wiring Diagram Pressure Switch of Water-oil Heat Exchanger (Optional)

Part no.: 0653 000 002

Electrical data:
U = 230 VAC ; I = 1 A
U = 24 ... 100 VDC ; I = 0.5 ... 2 A

Contact: Normally open

Switch point:
P_{trip} = 2 bar (relative) ► min. admissible pressure



7 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* [➔ 15].

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* [➔ 11]) are met.

Version with water-oil heat exchanger:

  - Turn on the water supply.
  - If the cooling water inlet is equipped with a water bypass valve (WBV), open it for approx. 90 seconds before the first machine start-up.
  - Make sure that cooling water requirements are fully complied with, see *Cooling Water Connection (Optional)* [➔ 14].

- Switch on the machine.
- Make sure that the maximum permissible number of starts does not exceed 12 starts per hour. Those starts should be spread within the hour.
- Make sure that the operating conditions comply with the *Technical Data* [➔ 38].
- After a few minutes of operation, check the oil level and top up if necessary.

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

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

7.1 Conveying Condensable Vapors

Water vapor within the gas flow is tolerated within certain limits. The conveyance of other vapors shall be agreed upon with Busch.

If condensable vapors are to be conveyed:

START

- Close the isolation valve* and open the gas ballast valve** (GB)
- Warm up the machine

- Wait 30 minutes
- Open the isolation valve* and perform the process
- Close the isolation valve*
- Wait 30 minutes
- Close the gas ballast valve** (GB)

END

** not included in the scope of delivery*

*** may be considered as optional on certain products*

8 Maintenance

DANGER

Live wires.

Risk of electrical shock.

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

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.

CAUTION

Failing to properly maintain the machine.

Risk of injuries!

Risk of premature failure and loss of efficiency!

- Maintenance work must only be executed by qualified personnel.
- Respect the maintenance intervals or ask your Busch representative for service.

NOTICE

Using inappropriate cleaners.

Risk of removing safety stickers and protective paint!

- Do not use incompatible solvents to clean the machine.

- Shut down the machine and lock against inadvertent start up.
- Vent the connected lines to atmospheric pressure.

Version with water-oil heat exchanger:

- Turn off the water supply.

If necessary:

- Disconnect all connections.

If the machine is equipped with a variable speed drive:

DANGER

Maintenance work without disconnecting the variable speed drive.

Risk of electrical shock.

- Disconnect and isolate the variable speed drive before attempting any work on it.
  High voltages are present at the terminals and within the variable speed drive for up to 10 minutes after disconnection of the electrical supply.
- Always ensure by using a suitable multimeter that no voltage is present on any drive power terminals prior to commencing any work.

DANGER

Live wires. Carry out any work on the variable speed drive and motor.

Risk of electrical shock!

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

8.1 Maintenance Schedule

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

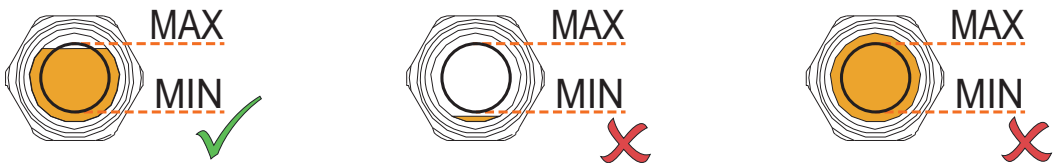
Maintenance work	Interval	
	Normal application	Harsh application
• Check the oil level, see *Oil Level Inspection* [➔ 29].	Daily	
• Check the machine for oil leaks - in case of leaks have the machine repaired (contact Busch). In case of an inlet filter being installed: • Check the inlet filter cartridge, replace if necessary.	Monthly	
• Change the oil*, the oil filter* (OF) and the exhaust filters (EF).	Max. after 4000 hours, at the latest after 1 year	Max. after 2000 hours, at the latest after 6 months
• Clean the vacuum pump from dust and dirt. In case of a gas ballast valve (GB) being installed: • Clean the gas ballast valve. If the vacuum pump is equipped with an air-oil heat exchanger (AHE): • Check and/or clean the air-oil heat exchanger. If the vacuum pump is equipped with a water cooling system: • Check and/or clean the water cooling system.	Every 6 months	

• Contact Busch for an inspection. If required, overhaul the machine.	Every 5 years

* Service interval for synthetic oil, shorten the interval when using mineral oil, contact Busch Service

8.2 Oil Level Inspection

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



- Fill up if necessary, see *Oil Filling* [➔ 15].

8.3 Oil and Oil Filter Change

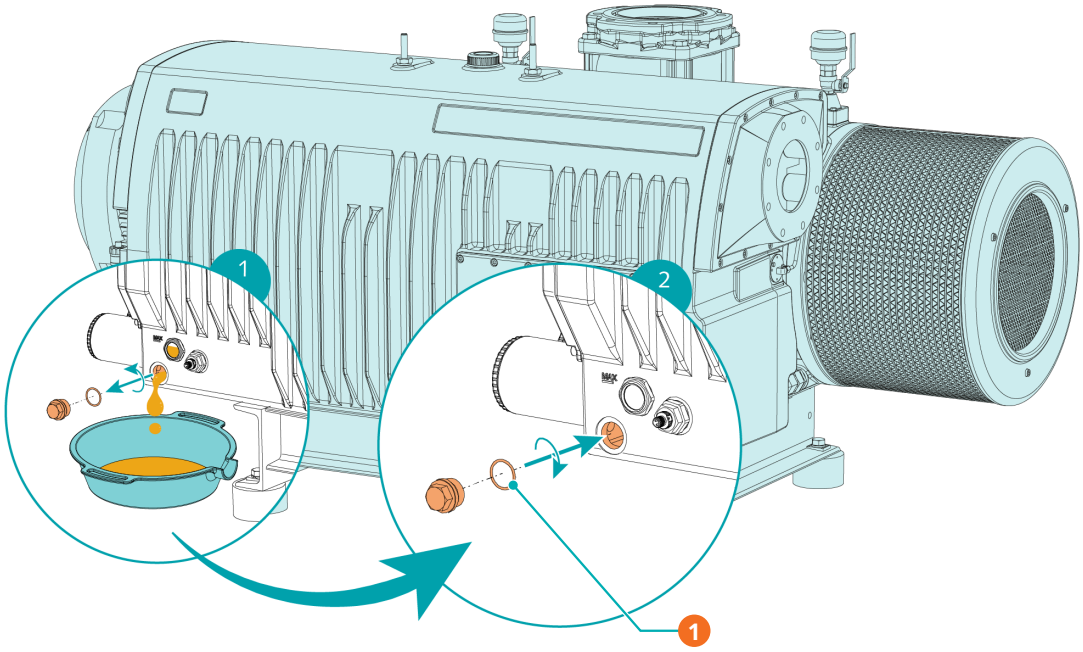
NOTICE

Use of an inappropriate oil.

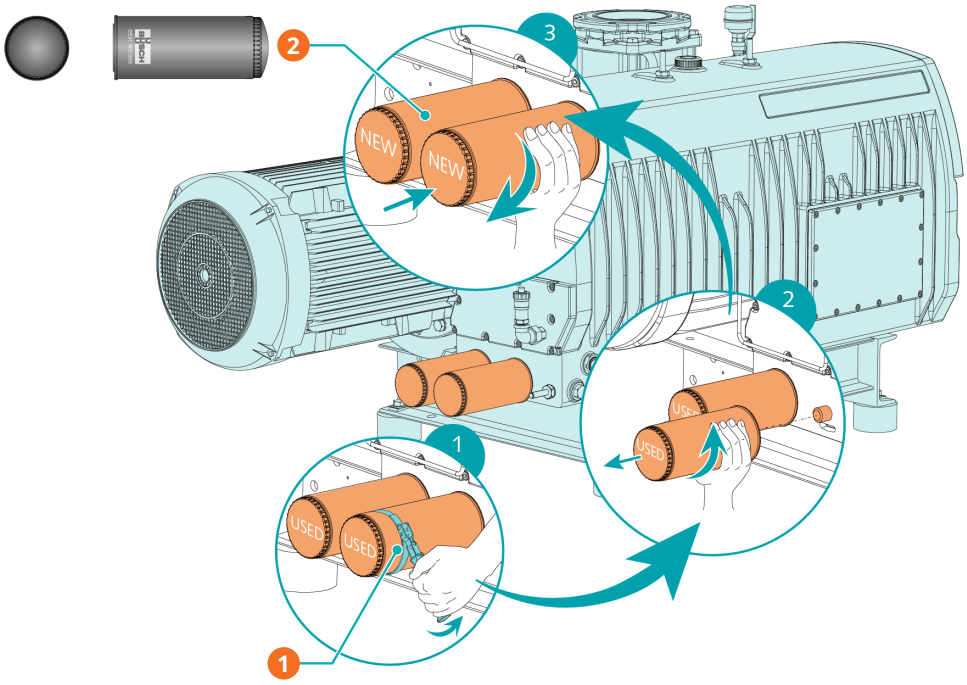
Risk of premature failure!

Loss of efficiency!

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

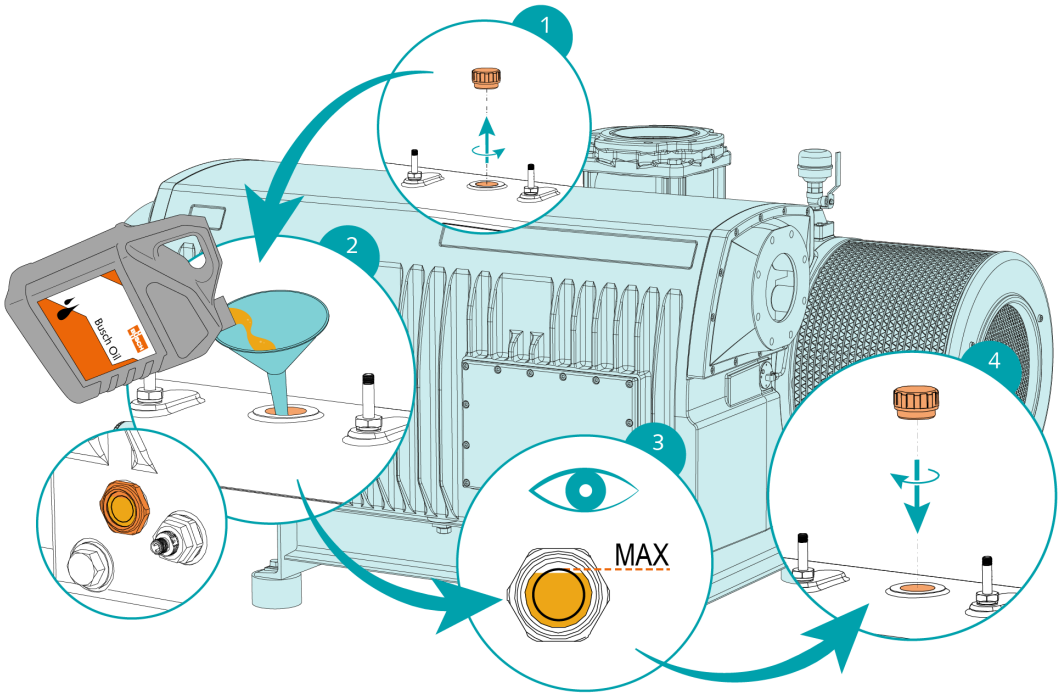


Description			
1	1x seal - Part no. 0482 509 012		

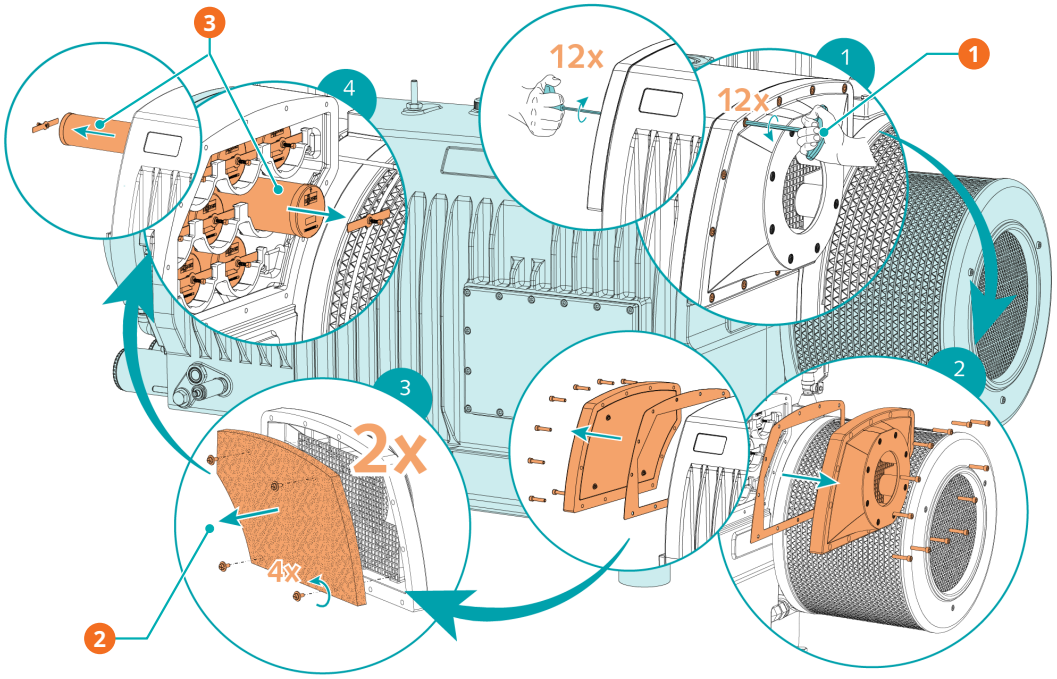


Description			
1	Oil filter wrench	2	2x oil filter (OF) - Part No. 0531 000 005 (Busch genuine spare part)

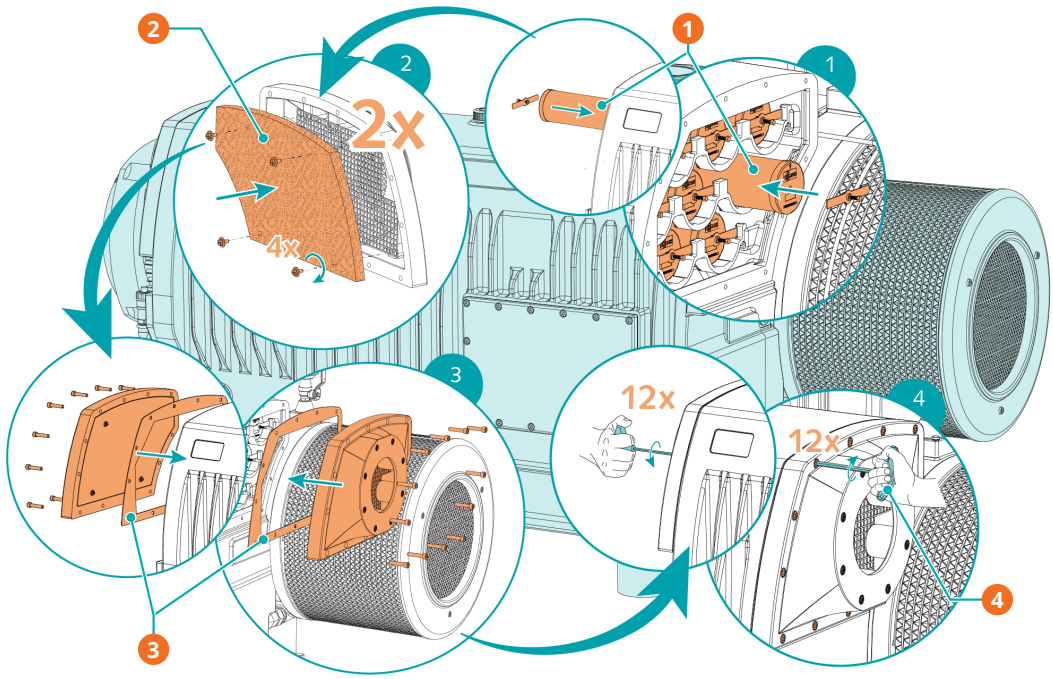
For oil type and oil capacity see *Technical Data* [➔ 38] and *Oil* [➔ 39].



8.4 Exhaust Filter Change



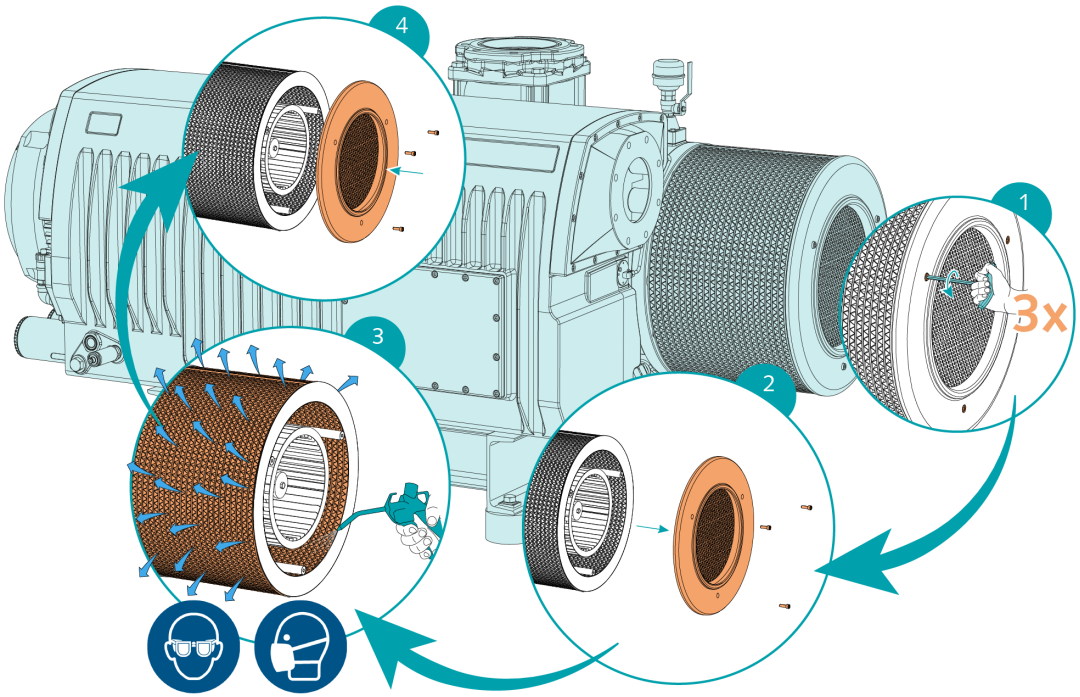
Description			
1	6 mm hex key	2	Extract filter material (FM)
3	16x (2x8) exhaust filter (EF)		



Description			
1	16x (2x8) exhaust filter (EF) - Part No. 0532 140 160 (Busch genuine spare part)	2	Filter material (FM) - 1x Part No. 0537 000 042 + 1x Part No. 0537 000 043
3	2x flat gasket - Part No. 0480 000 131	4	6 mm hex key / max. admissible torque: 21Nm

8.5 Air Heat Exchanger Cleaning

- Use compressed air and wear protective eyewear and mask.



9 Overhaul

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.

NOTICE

Improper assembly.

Risk of premature failure!

Loss of efficiency!

- Any dismantling of the machine that goes beyond anything that is described in this manual should be done by Busch authorized technicians.

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

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

Busch will only accept machines that come with a completely filled in and legally binding signed ‘Declaration of Contamination’ (form downloadable from *www.buschvacuum.com*).

10 Decommissioning

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.

- Shut down the machine and lock against inadvertent start up.
- Disconnect the power supply.
- Vent the connected lines to atmospheric pressure.

Version with water-oil heat exchanger:

- Turn off the water supply.
- Disconnect the water supply.
- Open the water bypass valve (WBV).
- Blow through the water cooling inlet with compressed air.

- Disconnect all connections.

If the machine is going to be stored:

- See *Storage* [➔ 10].

10.1 Dismantling and Disposal

- Drain and collect the oil.
- Make sure that no oil drips onto the floor.
- Remove the exhaust filters.
- Remove the oil filter.
- Separate special waste from the machine.
- Dispose of special waste in compliance with applicable regulations.
- Dispose of the machine as scrap metal.

11 Spare Parts

NOTICE

Use of non-Busch genuine spare parts.

Risk of premature failure!

Loss of efficiency!

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

Spare parts kit	Description	Part no.
Service kit	Includes all the necessary parts for maintenance.	0992 000 010

If other parts are required:

- Contact your Busch representative.

12 Troubleshooting

DANGER

Live wires.

Risk of electrical shock.

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

DANGER

Live wires. Carry out any work on the variable speed drive and motor.

Risk of electrical shock!

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

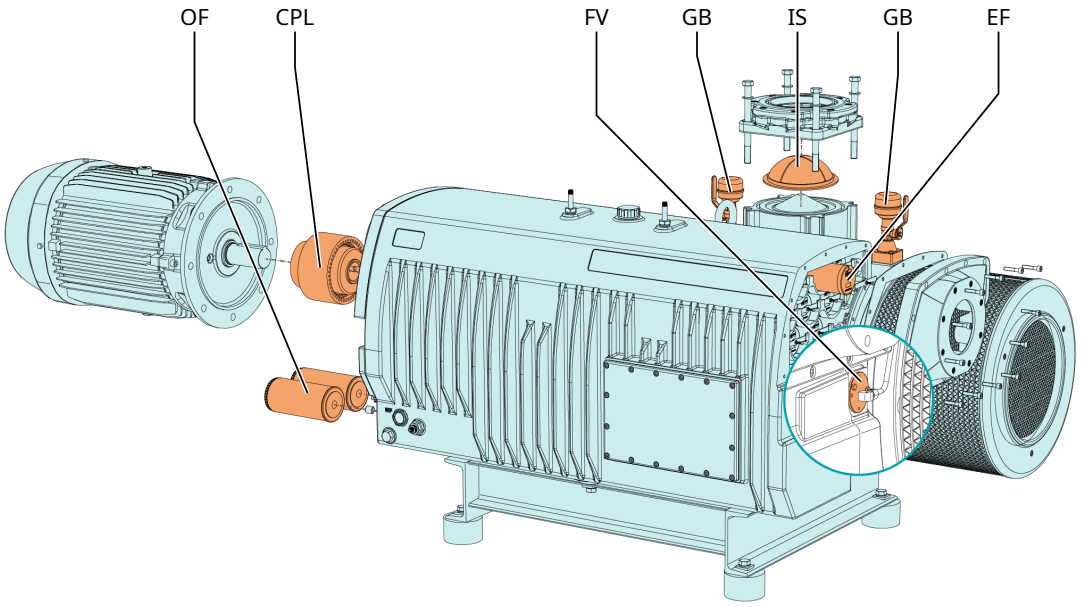
CAUTION

Hot surface.

Risk of burns!

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

Illustration showing parts that may be involved during troubleshooting:



(the machine appearance may differ from the illustration)

Problem	Possible Cause	Remedy
The machine does not start.	The motor is not supplied with the correct voltage.	• Check the power supply.
	The motor is defective.	• Replace the motor.
	The coupling (CPL) is defective.	• Replace the coupling (CPL).

Problem	Possible Cause	Remedy
The machine does not reach the usual pressure on the suction connection.	Oil level too low.	• Top up oil.
	The inlet screen (IS) is partially clogged.	• Clean the inlet screen (IS).
	The inlet filter cartridge (optional) is partially clogged.	• Replace the inlet filter cartridge.
	Internal parts are worn or damaged.	• Repair the machine (contact Busch).
The machine runs very noisily.	Worn coupling (CPL).	• Replace the coupling (CPL).
	Stuck vanes.	• Repair the machine (contact Busch).
	Defective bearings.	• Repair the machine (contact Busch).
The machine runs too hot.	Insufficient cooling.	• Remove dust and dirt from the machine. • Check the cooling fan.
	Ambient temperature too high.	• Observe the permitted ambient temperature.
	Oil level too low.	• Top up oil.
	The exhaust filters (EF) are partially clogged.	• Replace the exhaust filters (EF).
The machine fumes or expels oil droplets through the gas discharge.	The exhaust filters (EF) are partially clogged.	• Replace the exhaust filters (EF).
	An exhaust filter (EF) with o-ring is not fitted properly.	• Ensure the correct position of the exhaust filters (EF) and the o-rings.
	The float valve (FV) does not work properly.	• Check the float valve and the oil return line, repair if necessary (contact Busch).
Abnormal oil consumption.	Oil leaks.	• Replace seals (contact Busch).
	The float valve (FV) does not work properly.	• Check float valve and the oil return line, repair it if necessary (contact Busch).
	The machine runs at atmospheric pressure for a long period.	• Make sure that the machine operates under vacuum.
The oil is black.	Oil change intervals are too long.	• Flush the machine (contact Busch).
	The inlet filter (optional) is defective.	• Replace the inlet filter.
	The machine runs too hot.	• See problem "The machine runs too hot".
The oil is emulsified.	The machine sucked in liquids or significant amounts of vapor.	• Flush the machine (contact Busch). • Clean the filter of the gas ballast valve (GB). • Modify the operational mode (see *Conveying Condensable Vapors* [➔ 25]).

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

13 Technical Data

		RA 1000 B RC 1000 B	RA 1600 B RC 1600 B
Nominal pumping speed (50Hz / 60Hz)	m^3/h	1000 / 1200	1600 / 1800
Ultimate pressure (without gas ballast valve)	hPa (mbar) abs.	RA version: 0.3 ... 0.5 ► see nameplate (NP) RC version: 20.0	
Ultimate pressure (with gas ballast valve)	hPa (mbar) abs.	RA version: 0.5 ... 1.0 RC version: 20.0	
Nominal motor speed (50Hz / 60Hz)	min^{-1}	1000 / 1200	
Permitted motor speed range	min^{-1}	700 ... 1200	
Nominal motor rating (50Hz / 60Hz)	kW	22.0 / 30.0	30.0 / 37.0
Power consumption at 100 mbar (50Hz / 60Hz)	kW	17.3 / 22.4	26.8 / 33.0
Power consumption at ultimate pressure (50Hz / 60Hz)	kW	9.3 / 12.1	13.8 / 17.9
Noise level (ISO 2151) (50Hz / 60Hz)	dB(A)	78 / 80	80 / 82
Water vapor tolerance max. (with gas ballast valve) (50Hz / 60Hz)	hPa (mbar)	40 / 40	
Water vapor capacity (with gas ballast valve) (50Hz / 60Hz)	kg / h	29 / 45	31 / 45
Max. allowable pressure in the oil mist separator	hPa (mbar) abs.	1600	
Max. allowable gas inlet temperature	°C	≤50 hPa (mbar) abs. ► 150	
		>50 hPa (mbar) abs. ► 80	
Ambient temperature range	°C	5 ... 40	
Ambient pressure		Atmospheric pressure	
Oil capacity	l	First filling: 35.0	
		Oil change: 30.0	
Weight approx. (50Hz / 60Hz)	kg	1000 / 1060	1300 / 1350

14 Oil

	VM 100	VSC 100	VSB 100
ISO-VG	100	100	100
Oil type	Mineral oil	Synthetic oil	Synthetic oil
Part number 1 L packaging	0831 000 060	0831 168 356	0831 168 351
Part number 5 L packaging	0831 000 059	0831 168 357	0831 168 352
Part number 10 L packaging	-	0831 210 162	-
Part number 20 L packaging	0831 166 905	0831 168 359	0831 168 353
Warning signal Oil temperature [°C]	90	110	110
Switch point / Trip signal Oil temperature [°C]	110	130	130

In case of unfavorable ambient temperature, other oil viscosities may be used. Please consult your Busch representative for more details.

To know which oil has been filled in the machine, please refer to the nameplate (NP).

15 EU Declaration of Conformity

This Declaration of Conformity and the CE-markings affixed to the nameplate are valid for the machine within the Busch scope of delivery. This Declaration of Conformity is issued under the sole responsibility of the manufacturer.

When this machine is integrated into a superordinate machinery the manufacturer of the superordinate machinery (this can be the operating company, too) must conduct the conformity assessment process for the superordinate machine or plant, issue the Declaration of Conformity for it and affix the CE-marking.

The manufacturer

Ateliers Busch S.A.
Zone Industrielle
CH-2906 Chevenez

declares that the machine: R5 RA 1000 B; R5 RC 1000 B; R5 RA 1600 B; R5 RC 1600 B

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

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

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

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

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

Busch Dienste GmbH
Schauinslandstr. 1
DE-79689 Maulburg

Chevenez, 25.01.2022

Christian Hoffmann, General Director

16 UK Declaration of Conformity

This Declaration of Conformity and the UKCA-markings affixed to the nameplate are valid for the machine within the Busch scope of delivery. This Declaration of Conformity is issued under the sole responsibility of the manufacturer.

When this machine is integrated into a superordinate machinery the manufacturer of the superordinate machinery (this can be the operating company, too) must conduct the conformity assessment process for the superordinate machine or plant, issue the Declaration of Conformity for it and affix the UKCA-marking.

The manufacturer

Ateliers Busch S.A.
Zone Industrielle
CH-2906 Chevenez

declares that the machine: R5 RA 1000 B; R5 RC 1000 B; R5 RA 1600 B; R5 RC 1600 B

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

- Supply of Machinery (Safety) Regulations 2008
- Electromagnetic Compatibility Regulations 2016
- Restriction of the use of certain hazardous substances in Electrical and Electronic Equipment Regulations 2021

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

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

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

Busch (UK) Ltd
30 Hortonwood
Telford - UK

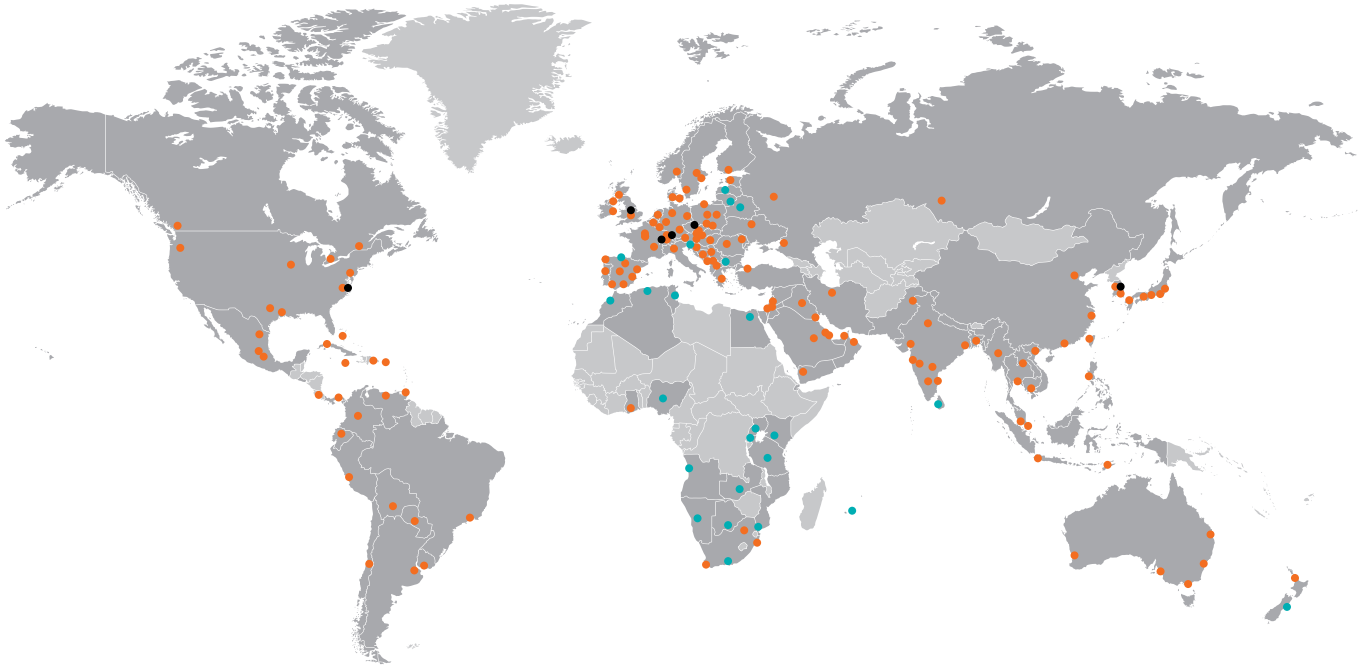
Chevenez, 25.01.2022

Christian Hoffmann, General Director

Notes

Busch
Vacuum Solutions

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



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

www.buschvacuum.com

0870569784 | -0008_en-US