VACUUM SOLUTIONS

R5

Oil-Lubricated Rotary Vane Vacuum Pumps
RA 0520 A, RA 0600 A ECOTORQUE

Instruction Manual

Get technical data, instruction manuals, service kits

VACUUM APP

0870242264 | -0003_en-US | Original instructions

3/25/2024

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 in accordance with the 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.

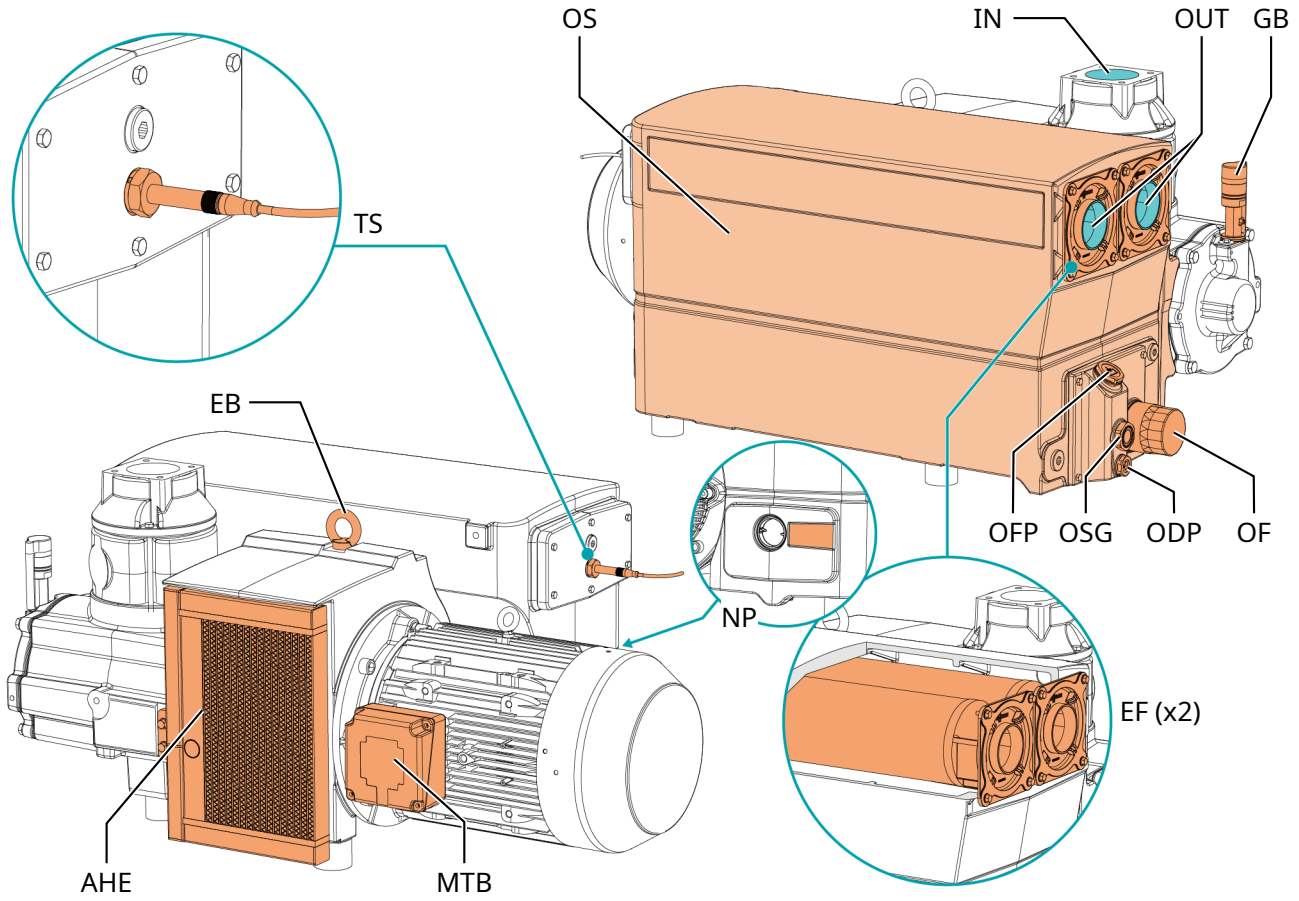
NOTICE

... 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	EB	Eye bolt
EF	Exhaust filter	GB	Gas ballast valve
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 “Gas”

NOTE

Technical term.

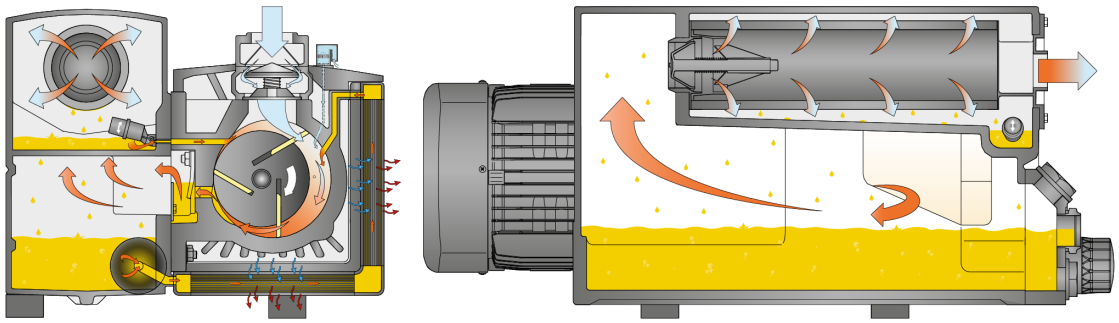
In this instruction manual, we consider that the term ‘machine’ refers to the ‘vacuum pump’.

NOTE

Illustrations.

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

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 damage to the machine!

Risk of damage 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, non-ignitable 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 installations. For outdoor installations, consult your Busch representative for special precautions.

The machine is capable of maintaining ultimate pressure, see Technical Data.

The machine is suitable for continuous operation.

Permitted environmental conditions, see Technical Data.

2.3 Start Controls

The machine comes without start controls. The control of the machine is to be provided in the course of installation.

The machine can be equipped with a starter unit or a variable speed drive.

2.4 Accessories

- Refer to the following table to find out which accessory is standard or optional on R5 RA 0520 A and R5 RA 0600 A ECOTORQUE:

Accessory	R5 RA 0520 A	R5 RA 0600 A ECOTORQUE
Temperature switch "Gas"	Standard	Standard
Gas ballast valve	Standard	Standard
Inlet filter	Optional	Optional
Temperature switch "Oil"	Optional	Optional
Resistance thermometer “Oil”	Optional	Optional
Level switch	Optional	Optional
Exhaust pressure transmitter	Optional	Optional
Inlet pressure transmitter	Optional	Standard
ECOTORQUE Variable Speed Drive (VSD)	Optional	Standard

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, see *Wiring Diagram Temperature Switch "Gas"* [➔ 23].

2.4.2 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 machine.

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

2.4.3 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.

The clamped design makes it easy to adjust the position to the installation and the o-ring sealing guaranties the tightness.

2.4.4 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* [➔ 40].

2.4.5 Resistance Thermometer “Oil”

The resistance thermometer monitors the oil temperature of the machine.

Depending on the oil type, warning and trip signals must be set, see *Oil* [➔ 40].

2.4.6 Level Switch

The level switch monitors the oil level.

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

2.4.7 Exhaust Pressure Transmitter

The pressure transmitter monitors the pressure in the oil separator.

The machine must be stopped when the gas reaches a certain pressure, see *Wiring Diagram Exhaust Pressure Transmitter (Optional)* [➔ 24].

2.4.8 Inlet Pressure Transmitter

The inlet pressure transmitter monitors the pressure at the inlet of the machine.

This allows the ECOTORQUE Variable Speed Drive to control the pump in pressure control mode, see *Wiring Diagram Inlet Pressure Transmitter (Optional)* [➔ 25].

2.4.9 ECOTORQUE Variable Speed Drive

The machine can be equipped with an ECOTORQUE Variable Speed Drive (VSD). An ECOTORQUE 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.

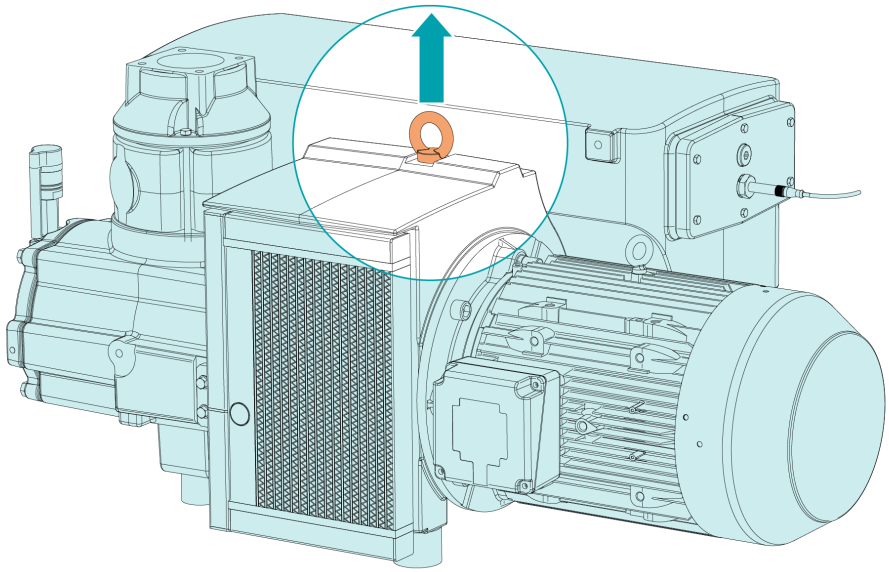
NOTICE

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 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 hermetically all apertures with the caps provided with the machine, or with adhesive tape if the caps are no longer available.
- Store the machine indoors, in a dry place, away from dust and vibrations and if possible, in original packaging, preferably at temperatures between 0 ... 40 °C.

If the machine is to be stored for more than 3 months:

- Carefully drain all the oil from the machine.
- Add, via the suction connection (IN) and per small quantities, 3 liters of conservation oil, BUSCH part no. 0831 570 966 (5-liter packaging).
- Remove the motor protective cover and turn the fan by hand a few turns in the direction indicated by the arrow on the motor, to ensure that oil is correctly applied to all surfaces of the pump stage.
- Seal hermetically all apertures with the caps provided with the machine, or with adhesive tape if the caps are no longer available.
- Wrap the machine in a VCI (Vapor Corrosion Inhibitor) film.
- Store the machine indoors, in a dry place, away from dust and vibrations and if possible, in original packaging, preferably at temperatures between 0 ... 40 °C.
- Every 6 months, remove the motor protective cover and turn the fan by hand a quarter turn in the direction indicated by the arrow on the motor, to ensure that the static load of the rotor does not remain constantly applied to the same location on the bearings and shaft sleeves.
- Repeat the procedure of conservation after 12 months of immobilization.

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.

When putting the machine back into service after storage:

- Carefully drain the conservation oil.
- Rinse the machine completely.
- Change the oil filter(s) before filling the machine with oil.

5 Installation

5.1 Installation Conditions

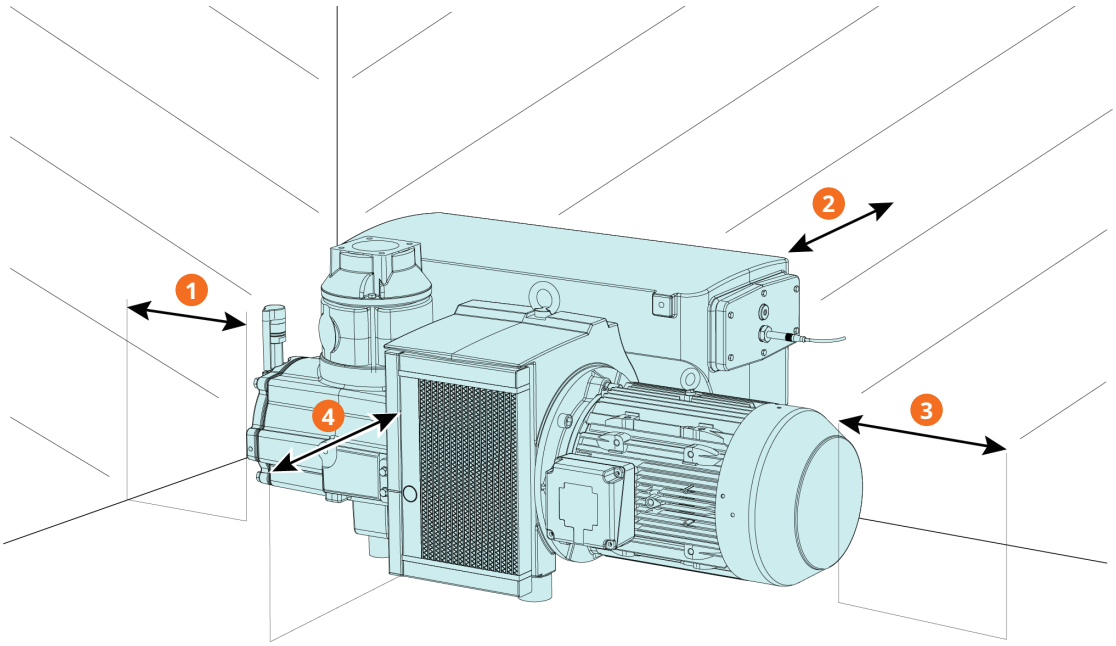
NOTICE

Use of the machine outside of the permitted installation conditions.

Risk of premature failure!

Loss of efficiency!

- Make sure that the installation conditions are fully respected.



Description			
1	Min. 70 cm	2	~10 cm
3	~50 cm	4	~50 cm

- Make sure that the environment of the machine is not potentially explosive.
- Make sure that the ambient conditions comply with the Technical Data.
- 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 deviation of 1° in any direction is acceptable.
  - Even 0.5° in longitudinal direction, in case of a level switch is being used in.

- Check the oil level, see *Oil Level Inspection* [➔ 29].
- Make sure that all provided covers, guards, hoods, etc. are mounted.

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* [➔ 23].

5.2 Connecting Lines / Pipes

- Remove all protective covers before installation.
- Make sure that the connection lines cause no stress on the connections of the machine. Therefore, we recommend installing flexible lines on the suction and discharge connections.
- Make sure that the diameter 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 recommended to use larger diameters to avoid a loss of efficiency. In this case, please contact 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.

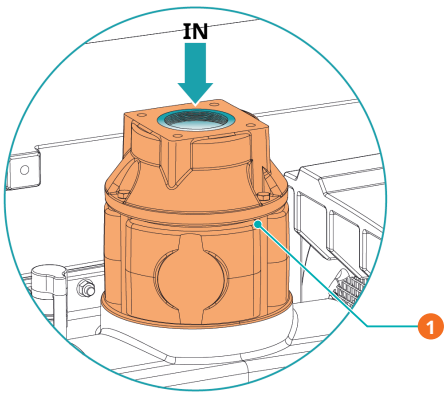
NOTICE

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.



Description			
1	Suction connection with vertical inlet flange		

Connection size(s):

– G3”

– 3” NPT

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.

- Make sure that the connection lines cause no stress on the connections of the machine. Therefore, we recommend installing flexible lines on the suction and discharge connections.

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):

– G3” (with optional exhaust flange)

– 3” NPT (with optional exhaust flange)

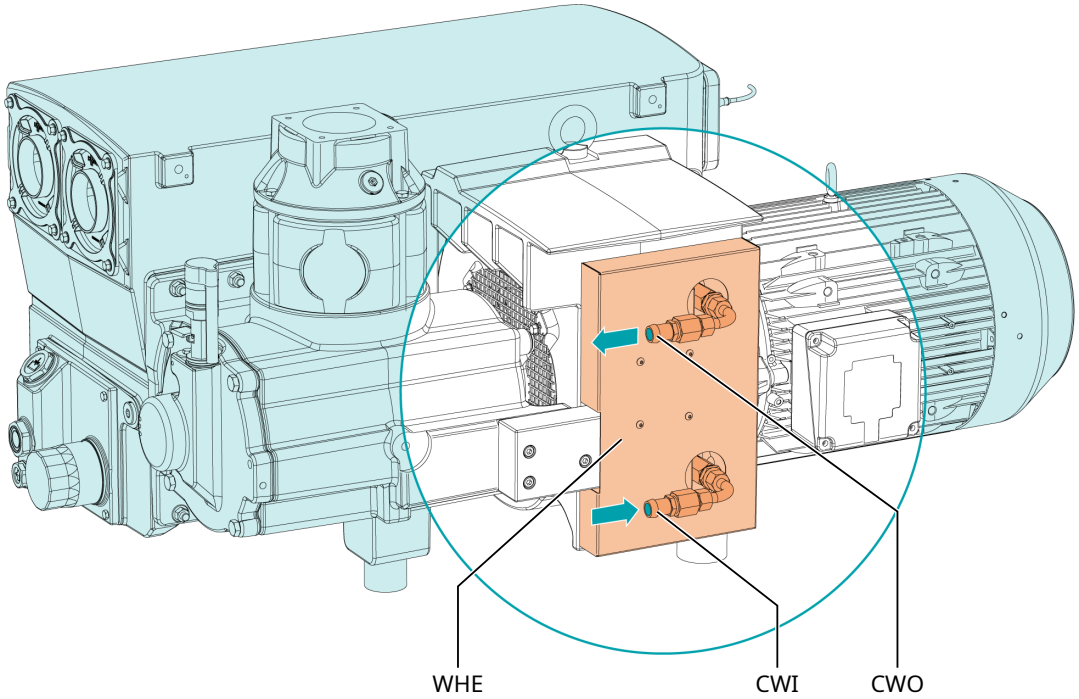
Unless the aspirated air is discharged to the environment right at the machine.

- 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.

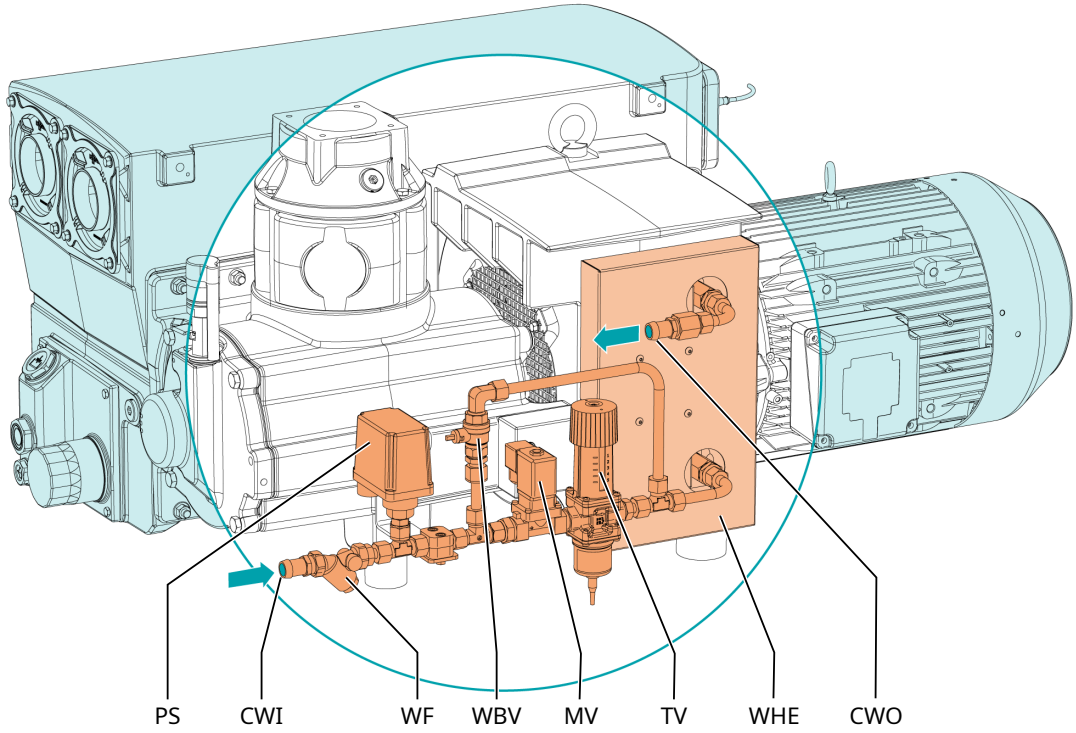
- Make sure that the connection lines cause no stress on the connections of the machine. Therefore, we recommend installing flexible lines on the suction and discharge connections.

5.2.3 Cooling Water Connection (Optional)

Water-oil heat exchanger without inlet accessories



Water-oil heat exchanger with inlet accessories



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

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

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

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

- 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)* [➔ 25].
- If necessary, electrically connect the solenoid valve (MV).
- Make sure that the cooling water complies with the following requirements:

Min. supply capacity	l/min	5
Water pressure	bar (g)	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

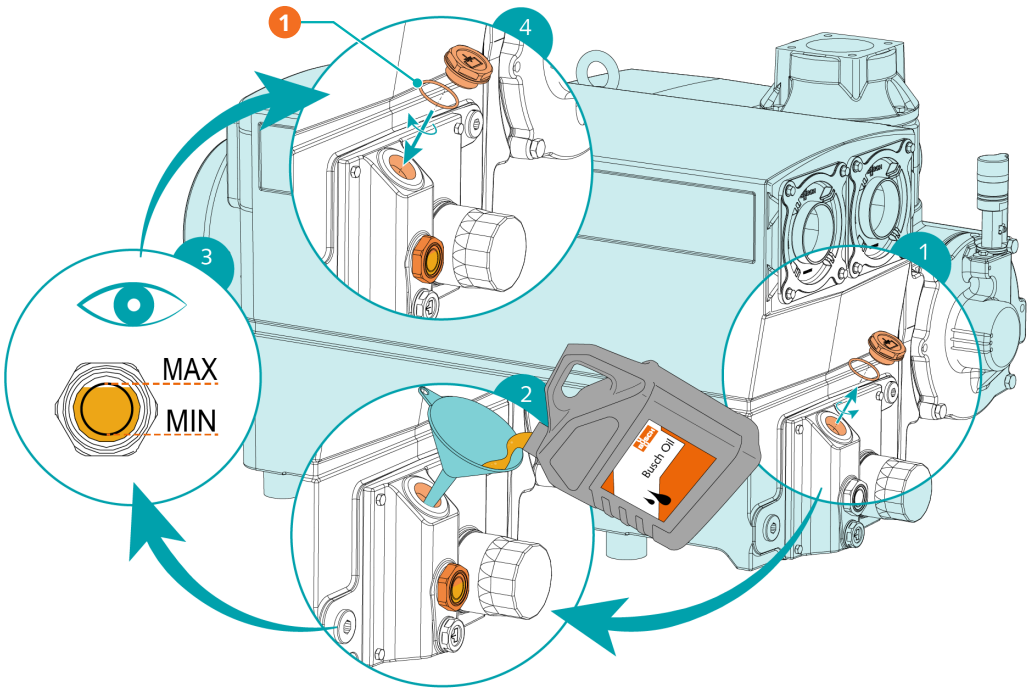
Use of an inappropriate oil.

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 and *Oil* [➔ 40].



Description			
1	1x O-ring, see "Service kit" (chapter Spare Parts)		

5.4 Fitting the Coupling

NOTICE

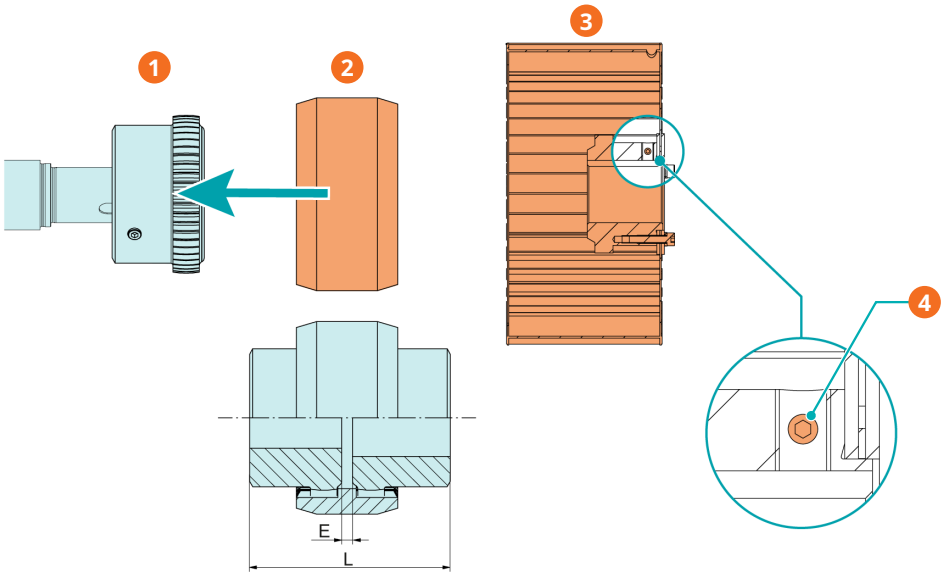
Coupling hub / radial fan assembly (Motor side).

The coupling hub and radial fan assembly on the motor side is balanced and must not be disassembled.

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 + radial fan assembly (Motor side)	4	Radial screw / max. admissible torque: 17 Nm

Machine type	Coupling size	Value “E” (mm)	Value “L” (mm)
RA 0520 A	BoWex® M-65	4	114
RA 0600 A ECOTORQUE			

NOTE

Use the appropriate tools to adjust the position of the coupling hub on the machine shaft, and the coupling hub/radial fan assembly on the motor side.

Contact your Busch representative to order the appropriate tools.

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

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 in accordance with EN 60204-1 must be provided by the customers on their installation(s).
- 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 electromagnetic 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* [➔ 41] or *UK Declaration of Conformity* [➔ 42]).

6.1 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 a defective insulation.
  - 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.
- 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.

6.2 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

The operation with variable speed, i.e. with a variable speed drive or a soft starter unit, is allowed as long as the motor is capable and the permitted motor speed range is respected (see Technical Data).

Contact your Busch representative for further advice and information.

- 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 a defective insulation.
  - 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.

6.3 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 a defective insulation.
  - 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.
- Electrically connect the Variable Speed Drive (VSD).

NOTICE

The admissible motor speed exceeds the recommendation.

Risk of damage to the machine!

- Check the admissible motor speed range, see Technical Data.

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!

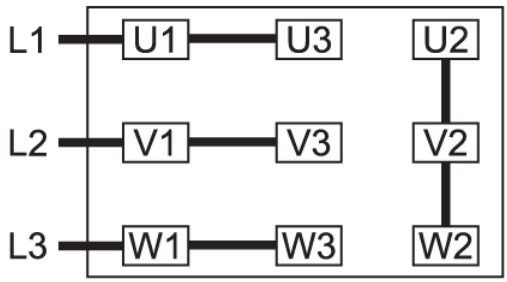
- Operation in the wrong direction of rotation can destroy the machine in a short time! Prior to start-up, ensure that the machine is operated in the right direction.

- Determine the intended direction of rotation with the arrow (stuck on or cast).
- Jog the motor briefly.

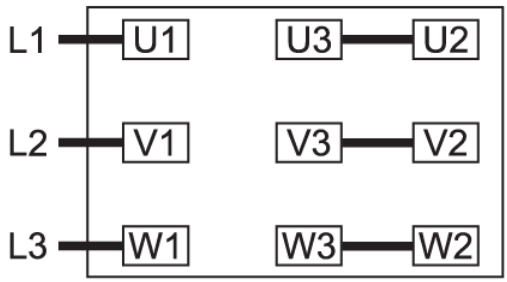
If the rotation of the motor must be changed:

- Switch any two of the motor phase wires.

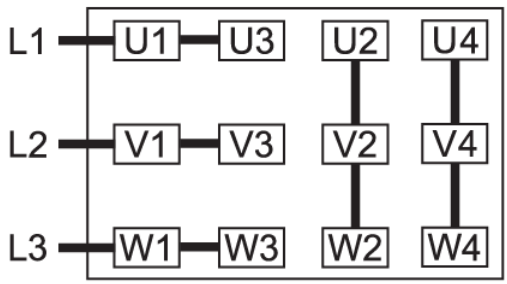
Double star connection, multi-voltage motor with 9 pins (low voltage):



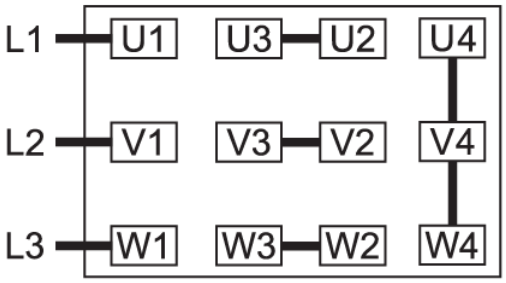
Star connection, multi-voltage motor with 9 pins (high voltage):



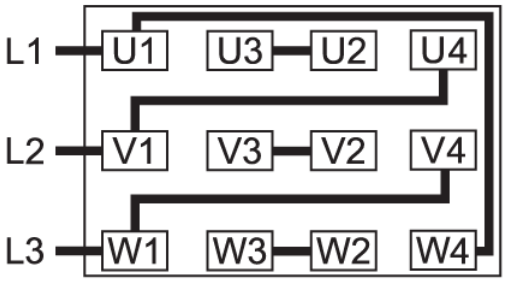
Double star connection, multi-voltage motor with 12 pins (low voltage):



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



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



6.5 Electrical Connection of the Monitoring Devices

WARNING

The electrical connection of the monitoring devices fitted as standard on the machine (not optional) is mandatory to ensure the safety of the machine and the users.

NOTE

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"

NOTE

Already connected to the ECOTORQUE variable speed drive of the R5 RA 0600 A ECOTORQUE.

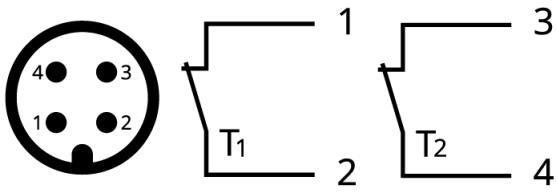
- No wiring required on ECOTORQUE machines.

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

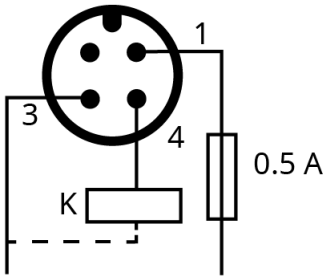
6.5.2 Wiring Diagram Level Switch (Optional)

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.

6.5.3 Wiring Diagram Temperature Switch "Oil" (Optional)

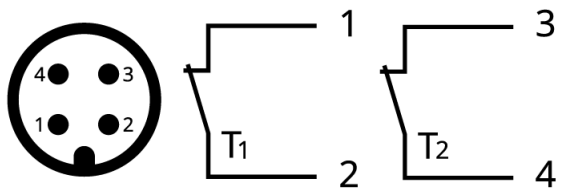
Part no.: 0651 566 632

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*

* The switch point value depends on the oil type, see chapter *Oil* [➔ 40].



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

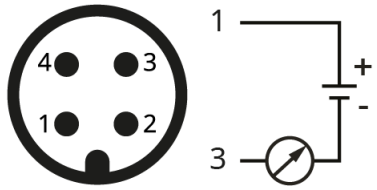
6.5.4 Wiring Diagram Resistance Thermometer (Optional)

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* [➔ 40]



1 = Brown; 3 = Blue

6.5.5 Wiring Diagram Exhaust Pressure Transmitter (Optional)

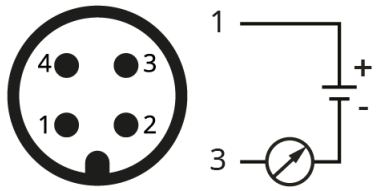
Part no.: 0653 567 425

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)

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



1 = Brown; 3 = Blue

6.5.6 Wiring Diagram Inlet Pressure Transmitter (Optional)

NOTE

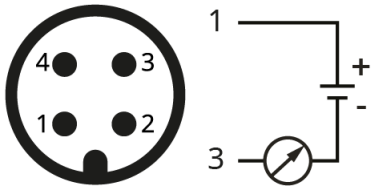
Already connected to the ECOTORQUE variable speed drive of the R5 RA 0600 A ECOTORQUE.

- No wiring required on ECOTORQUE machines.

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

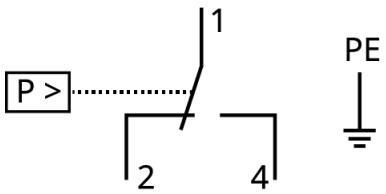
6.5.7 Wiring Diagram Pressure Switch of Water-oil Heat Exchanger (Optional)

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

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 people are present in the vicinity of a machine that is not insulated from noise for extended periods of time:

- Make sure to wear hearing protection.

NOTICE

The machine can be shipped without oil.

Operation without oil will ruin the machine in short time!

- Prior to commissioning, the machine must be filled with oil, see *Filling Oil* [➔ 16].

- Make sure that the *Installation Conditions* [➔ 11] are met.
- Start 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.

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

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

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*
- Warm up the machine for 30 minutes
- Open the isolation valve* and perform the process
- Close the isolation valve*
- Wait 30 minutes

END

* Not included in the scope of delivery.

8 Maintenance

DANGER

Live wires.

Risk of electrical shock!

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

WARNING

The machine is contaminated with hazardous material.

Risk of poisoning!

Risk of infection!

If the machine is contaminated with hazardous material:

- Wear appropriate personal protective equipment.

CAUTION

Hot surface.

Risk of burns!

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

If necessary:

- Disconnect all connections.

If the machine is equipped with a variable speed drive:

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.

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 individually shortened or extended as appropriate.

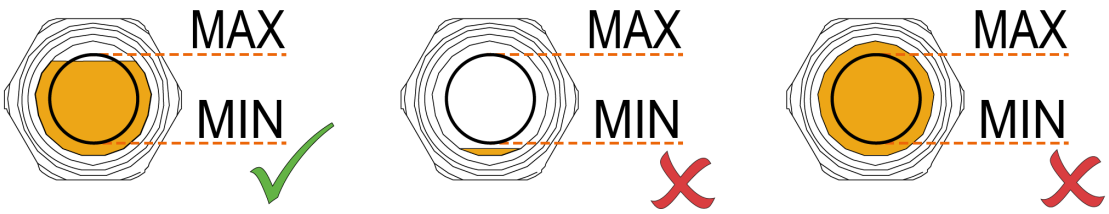
Particularly harsh applications or heavy duty operation, such as high dust loads in the environment or in the process gas, other contamination or ingress of process material, can make it necessary to shorten the maintenance intervals significantly.

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). If an inlet filter is installed: • Check the inlet filter cartridge, replace if necessary.	Monthly	
• Change the oil*, the oil filter* (OF) and the exhaust filter (EF). • **Harsh applications**: Open the service cover to check/clean the oil sump of the oil separator (OS). • Clean the machine and air heat exchanger from dust and dirt (see *Air Heat Exchanger Cleaning* [➔ 32]). • Clean the gas ballast valve (GB).	Max. after 4000 hours or after 1 year	Max. after 2000 hours or after 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* [➔ 16].

8.3 Oil and Oil Filter Change

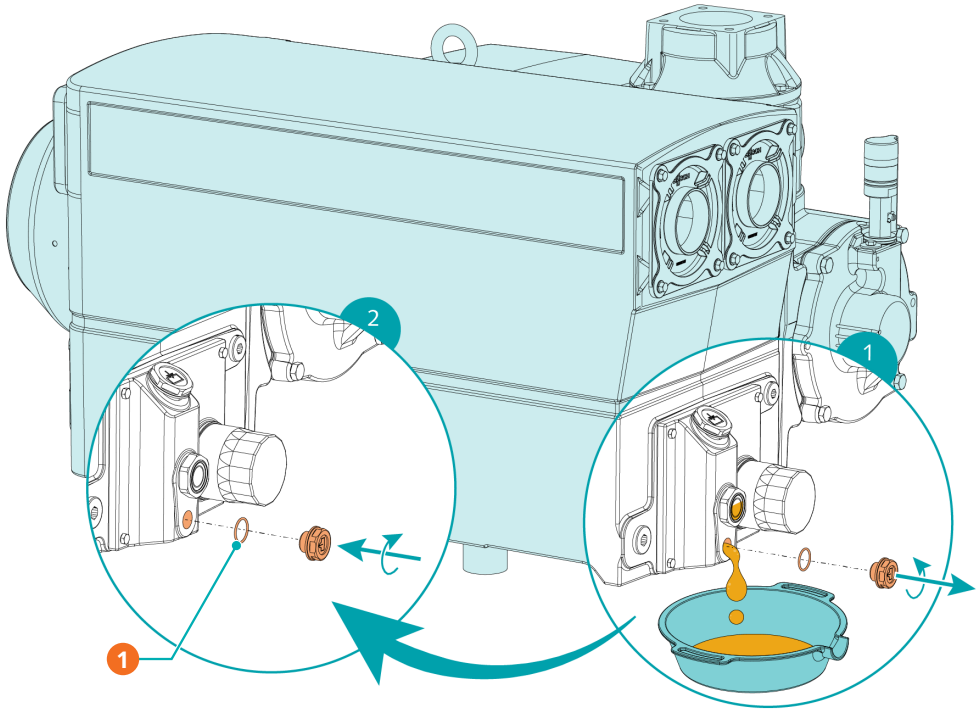
NOTICE

Use of an inappropriate oil.

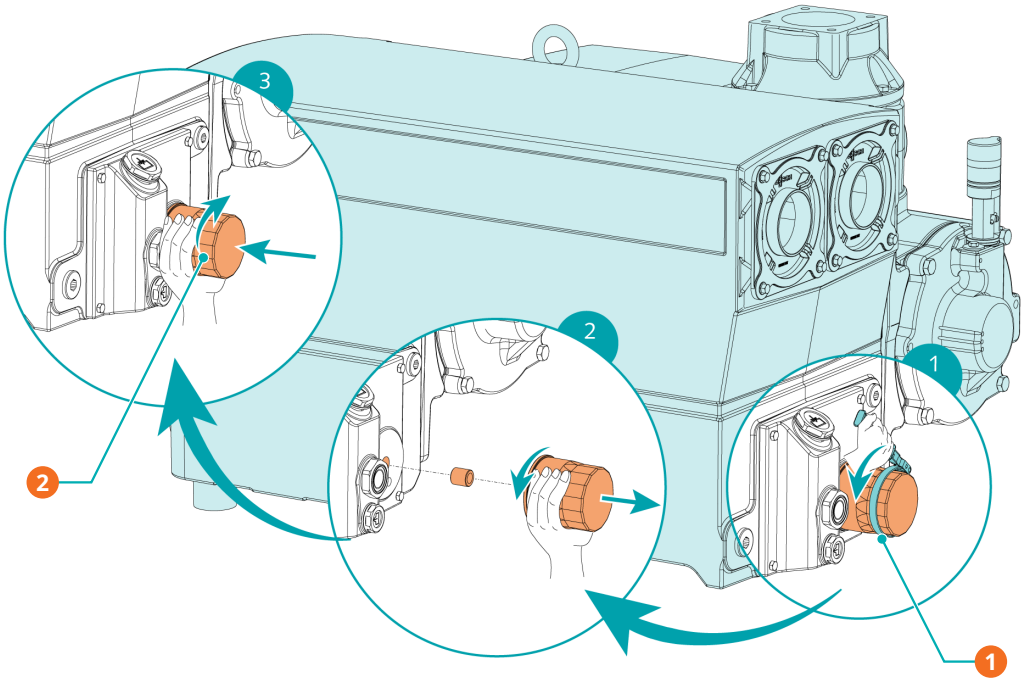
Risk of premature failure!

Loss of efficiency!

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

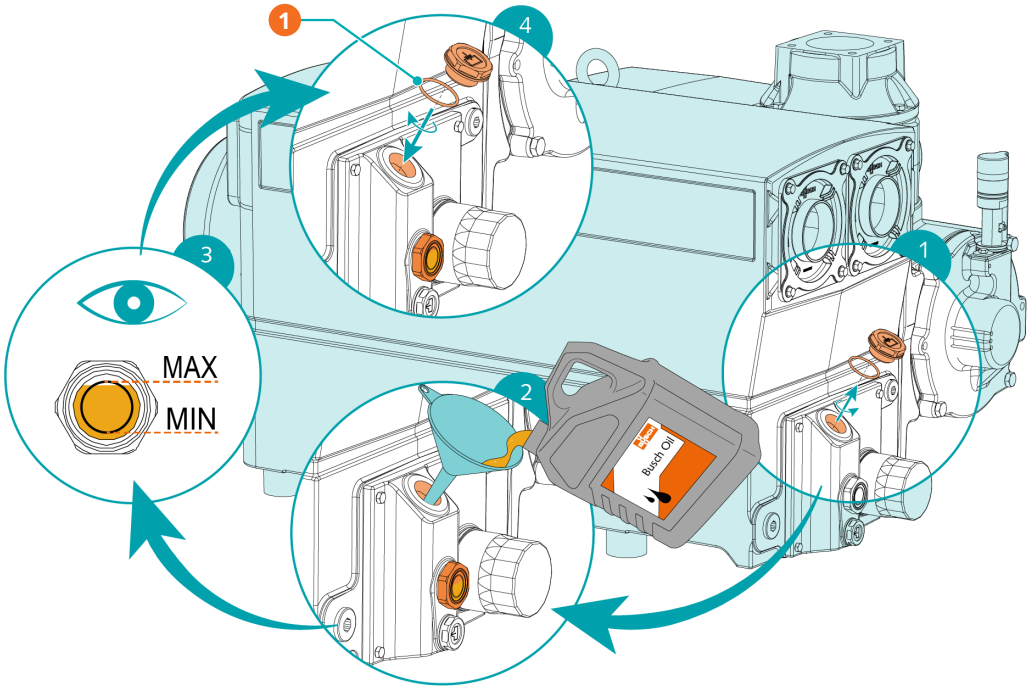


Description			
1	1x O-ring, see "Service kit" (chapter Spare Parts)		



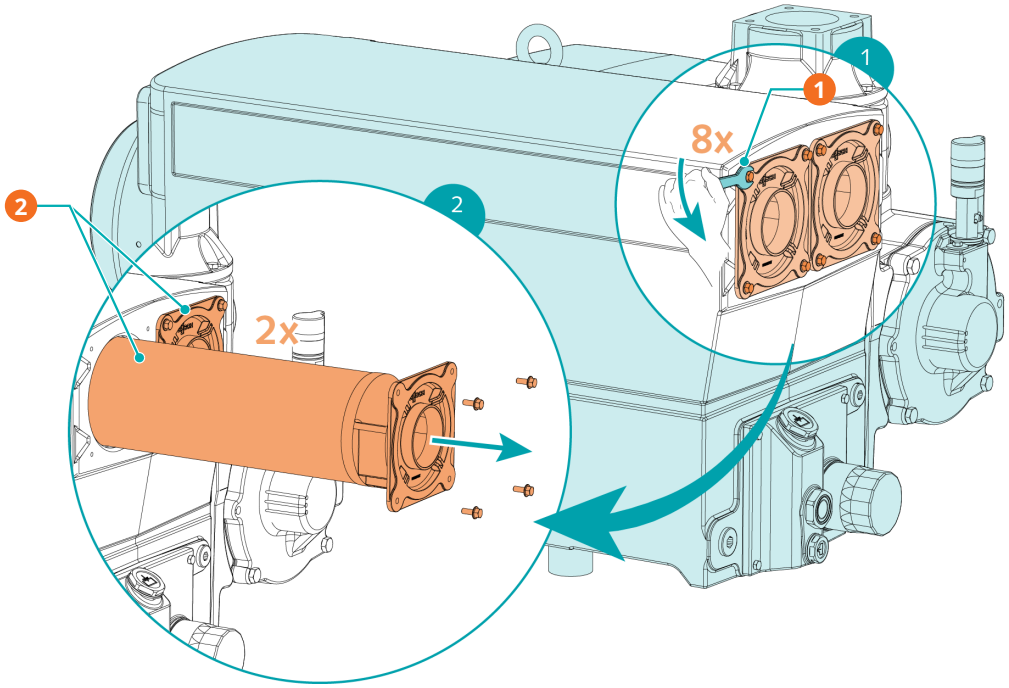
Description			
1	Remove the used oil filter with an oil filter wrench	2	1x oil filter (OF), see "Service kit" (chapter Spare Parts - Busch genuine spare part)

For oil type and oil capacity see Technical Data and *Oil* [➔ 40].

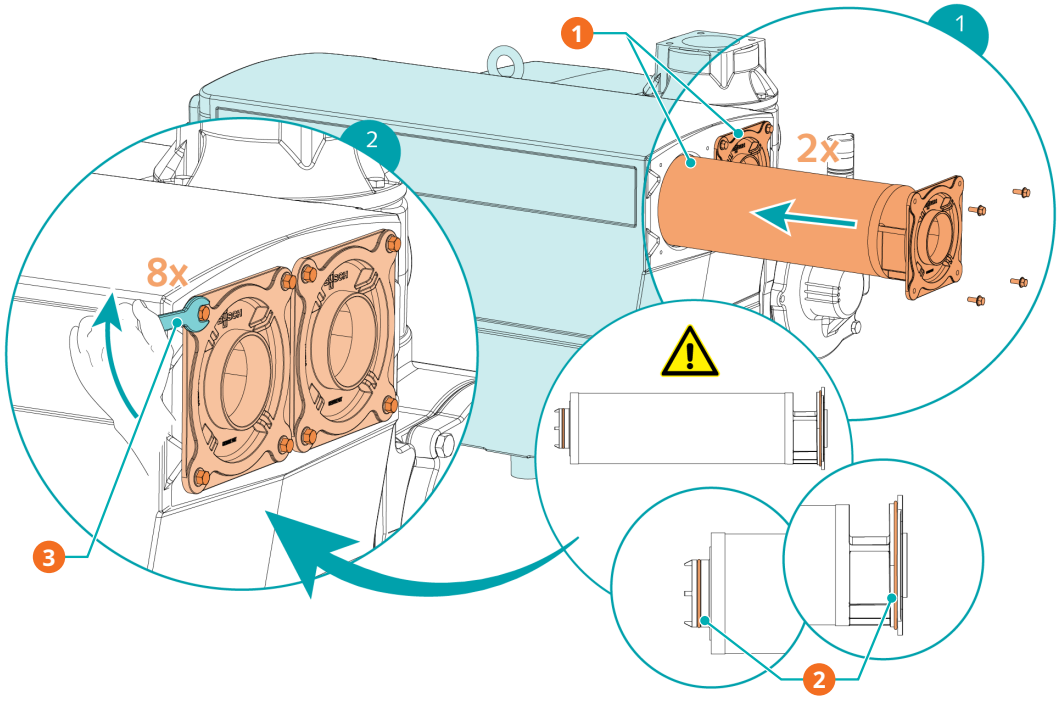


Description			
1	1x O-ring, see "Service kit" (chapter Spare Parts)		

8.4 Exhaust Filter Change



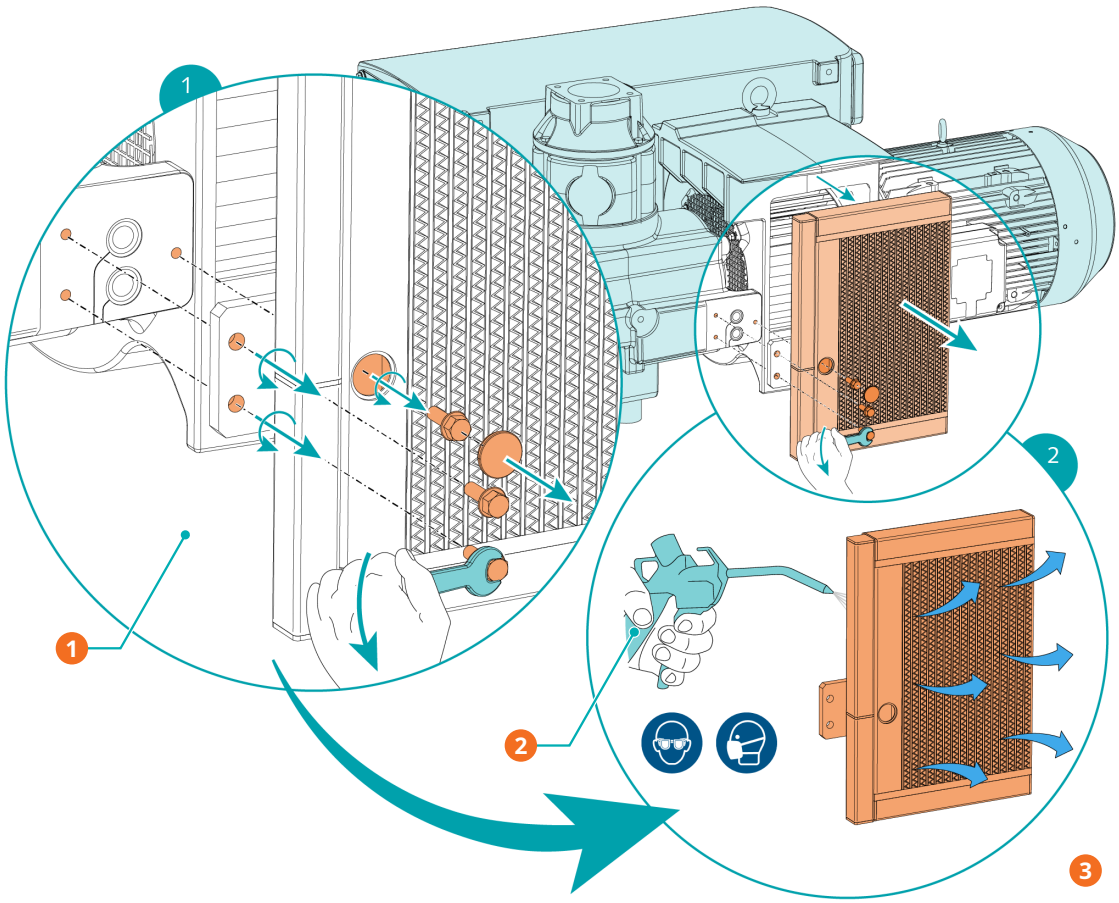
Description			
1	10 mm wrench	2	2x exhaust filter (EF)



Description			
1	2x exhaust filter (EF), see "Service kit" (chapter Spare Parts - Busch genuine spare part)	2	Check 2x O-ring on both exhaust filters
3	10 mm wrench / max. admissible torque: 4Nm		

8.5 Air Heat Exchanger Cleaning

- Make sure that the machine is oil drained before cleaning the air heat exchanger (see *Oil and Oil Filter Change* [➔ 29]).
- Run the machine without oil and at atmospheric pressure for a maximum of 1 minute to drain the radiator.
- Make sure to protect the open hydraulic connections to avoid contamination.



Description			
1	In addition to the screws, 3x O-rings (not illustrated), see "Service kit" (chapter Spare Parts)	2	Use compressed air and wear protective eyewear and mask
3	After cleaning, reassemble the exchanger with 3 new O-rings and the 3 screws tightened with a 13 mm wrench / max. admissible torque: 20Nm		

9 Overhaul

WARNING

The machine is contaminated with hazardous material.

Risk of poisoning!

Risk of infection!

If the machine is contaminated with hazardous material:

- Wear appropriate personal protective equipment.

NOTICE

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.

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

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

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

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!

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

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

If the machine is 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 parts necessary for maintenance	0992 242 247

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.

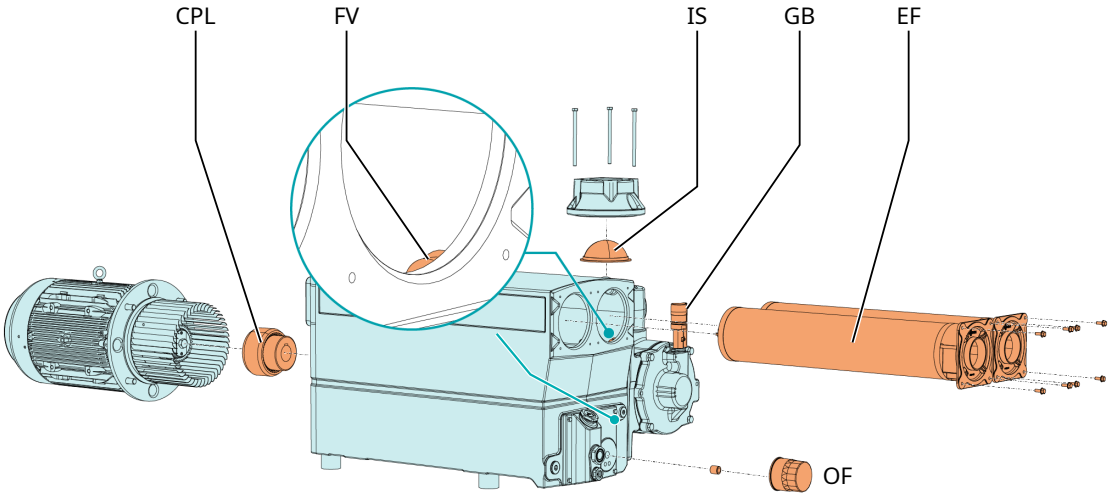
CAUTION

Hot surface.

Risk of burns!

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

Illustration showing parts that may be involved during troubleshooting:



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).
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 Vapours).
The power consumption of the machine has increased.	The exhaust filters (EF) are partially clogged.	• Replace the exhaust filters (EF).
	Oil level too high.	• Drain the oil overfill to correct the oil level.

For resolution of problems not listed in the troubleshooting table, please contact your Busch representative.

13 Technical Data

		RA 0520 A
Nominal pumping speed (50 / 60 Hz)	m^3/h	430 / 520
	ACFM	254 / 306
Ultimate pressure (Gas-ballast valve closed)	hPa (mbar) abs.	0.1
	TORR	0.075
Ultimate pressure (Gas-ballast valve open)	hPa (mbar) abs.	0.5
	TORR	0.375
Nominal motor speed (50 / 60 Hz)	min^{-1}	1000 / 1200
	RPM	
Permitted motor speed range	min^{-1}	1000 ... 1200
	RPM	
Nominal motor rating (50 / 60 Hz)	kW	11.0 / 12.5
	HP	15.0
Power consumption at 100 mbar / 75 TORR (50 / 60 Hz)	kW	7.3 / 9.0
	HP	9.8 / 12.0
Power consumption at ultimate pressure (50 / 60 Hz)	kW	3.3 / 3.9
	HP	4.5 / 5.3
Sound pressure level (ISO 2151) KpA = 3 dB (50 / 60 Hz)	dB(A)	74 / 76
Water vapor tolerance max. with gas ballast valve (50 / 60 Hz)	hPa (mbar) abs.	15.0 / 21.0
	TORR	11.0 / 16.0
Water vapor capacity with gas ballast valve (50 / 60 Hz)	kg/h	21.0 / 77.0
	lbs/h	46.0 / 169.0
Maximum allowable pressure in the oil mist separator	hPa (mbar) abs.	1600
	TORR	1200
Maximum allowable gas inlet temperature according to the inlet pressure	°C	≤ 50 hPa (mbar) abs. : 150
	°F	≤ 37.5 TORR : 302
	°C	> 50 hPa (mbar) abs. : 80
	°F	> 37.5 TORR : 176
Ambient temperature	°C	5 ... 40
	°F	41 ... 104
Ambient pressure		Atmospheric pressure
Oil capacity	l	11
	qts.	11.6
Weight approx.	kg	420
	Lbs.	930

		RA 0600 A ECOTORQUE
Nominal pumping speed (40 – 70 Hz)	m^3/h	330 – 600
	ACFM	194 – 353
Ultimate pressure (Gas-ballast valve closed)	hPa (mbar) abs.	0.1
	TORR	0.075
Ultimate pressure (Gas-ballast valve open)	hPa (mbar) abs.	0.5
	TORR	0.375
Permitted motor speed range	min^{-1}	800 ... 1400
	RPM	
Nominal motor rating	kW	18.5
	HP	25.0
Power consumption at 100 mbar / 75 TORR (40 – 70 Hz)	kW	6.2 – 10.7
	HP	8.3 – 14.3
Power consumption at ultimate pressure (40 – 70 Hz)	kW	2.6 – 5.2
	HP	3.5 – 7.0
Sound pressure level (ISO 2151) KpA = 3 dB (40 – 70 Hz)	dB(A)	70 – 77
Water vapor tolerance max. with gas ballast valve (40 – 70 Hz)	hPa (mbar) abs.	10.0 – 45.0
	TORR	7.5 – 34.0
Water vapor capacity with gas ballast valve (40 – 70 Hz)	kg/h	8.0 – 90.0
	lbs/h	17.0 – 200.0
Maximum allowable pressure in the oil mist separator	hPa (mbar) abs.	1600
	TORR	1200
Maximum allowable gas inlet temperature according to the inlet pressure	°C	≤ 50 hPa (mbar) abs. : 150
	°F	≤ 37.5 TORR : 302
	°C	> 50 hPa (mbar) abs. : 80
	°F	> 37.5 TORR : 176
Ambient temperature	°C	5 ... 40
	°F	41 ... 104
Ambient pressure		Atmospheric pressure
Oil capacity	l	11
	qts.	11.6
Weight approx.	kg	525
	Lbs.	1160

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 find out which oil needs to be filled into the machine, please refer to the nameplate (NP).

Oil suitability

- **Oil VM 100**: Standard oil for operating temperatures <90°C.
- **Oil VSB 100**: Suitable for food applications (H1); heavy duty cycle operation.
  - Compliant with kosher and halal standards.
- **Oil VSC 100**: Suitable for harsh applications.

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 is determined by the serial number:

Serial number starts with **CHM1...**

Ateliers Busch S.A.
Zone industrielle
2906 Chevenez
Switzerland

Serial number starts with **USM1...**

Busch Manufacturing LLC
516 Viking Drive
Virginia Beach, VA 23452
USA

declares that the machine: R5 RA 0520 A; R5 RA 0600 A ECOTORQUE

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

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

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

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, 01.11.2023

Christian Hoffmann

General Manager

Ateliers Busch S.A.

Virginia Beach, 01.11.2023

Dalip Kapoor

Chief Counsel, Legal & Compliance Officer

Busch Manufacturing LLC

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 is determined by the serial number:

Serial number starts with **CHM1...**

Ateliers Busch S.A.
Zone industrielle
2906 Chevenez
Switzerland

Serial number starts with **USM1...**

Busch Manufacturing LLC
516 Viking Drive
Virginia Beach, VA 23452
USA

declares that the machine: R5 RA 0520 A; R5 RA 0600 A ECOTORQUE

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

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

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

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, 01.11.2023

Christian Hoffmann

General Manager

Ateliers Busch S.A.

Virginia Beach, 01.11.2023

Dalip Kapoor

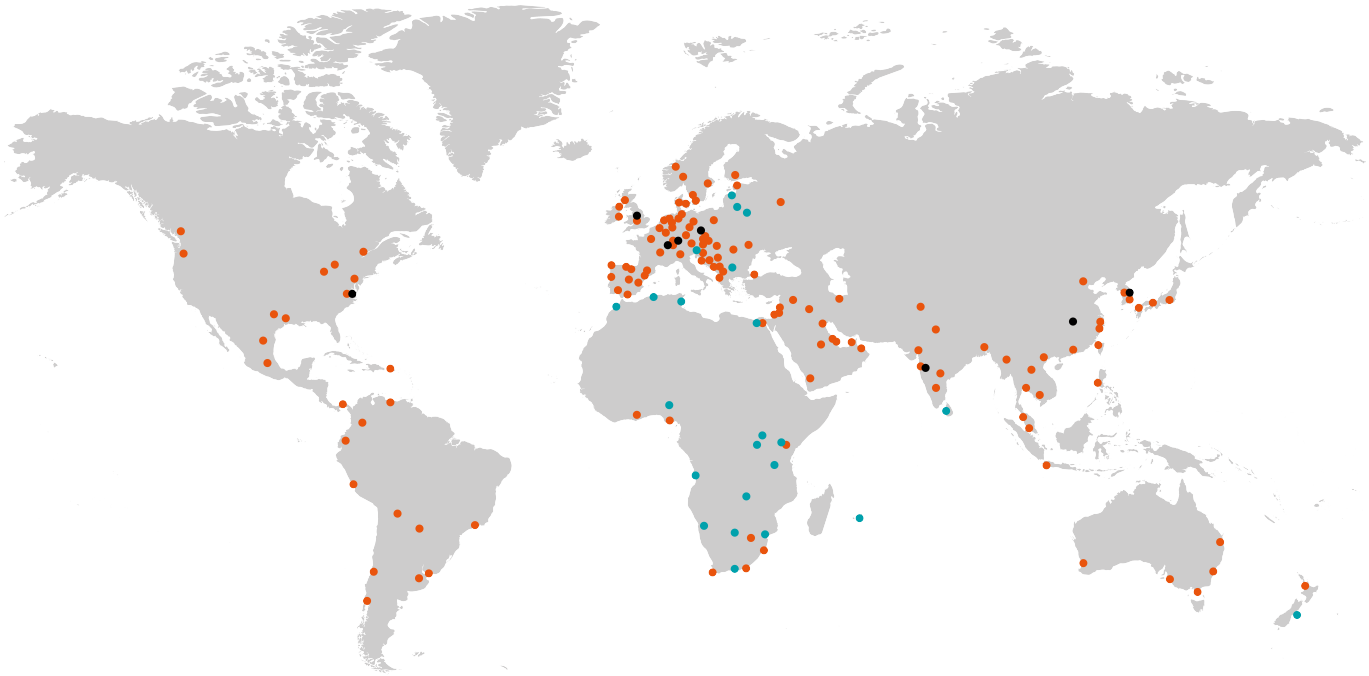
Chief Counsel, Legal & Compliance Officer

Busch Manufacturing LLC

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.



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

www.buschvacuum.com

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