VACUUM SOLUTIONS

Part of the BUSCH GROUP

R5

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

Instruction Manual

SERVICE
AND SPARE PARTS, INSTRUCTION MANUALS ...
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VACUUM APP

CE UK CA

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1 Safety

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

Read this instruction 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.

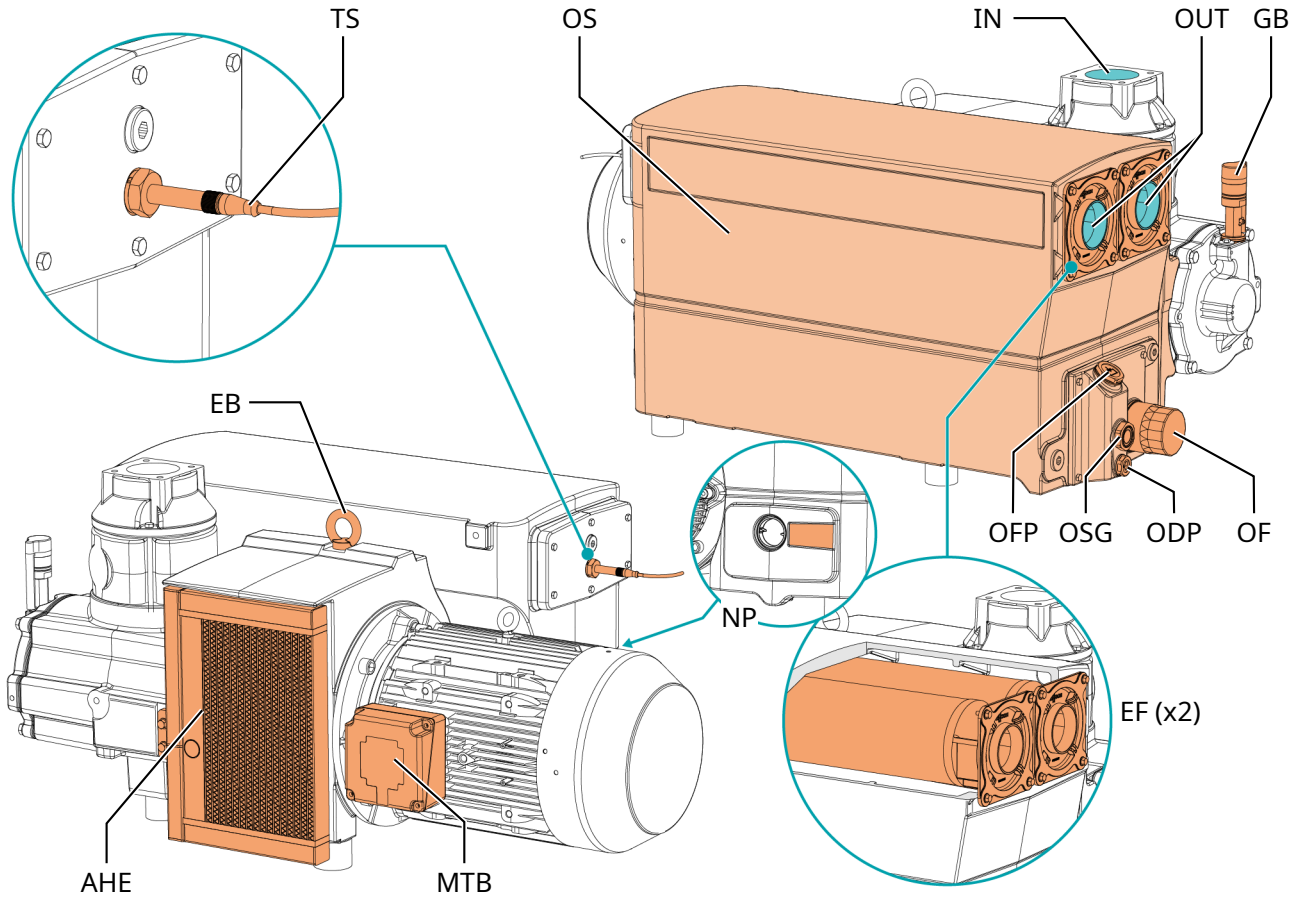
NOTICE

... 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	Inlet connection	OUT	Exhaust connection
AHE	Air-oil heat exchanger	EB	Eye bolt
EF	Exhaust filter	GB	Gas-ballast valve
MTB	Motor terminal box	NP	Name plate
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.

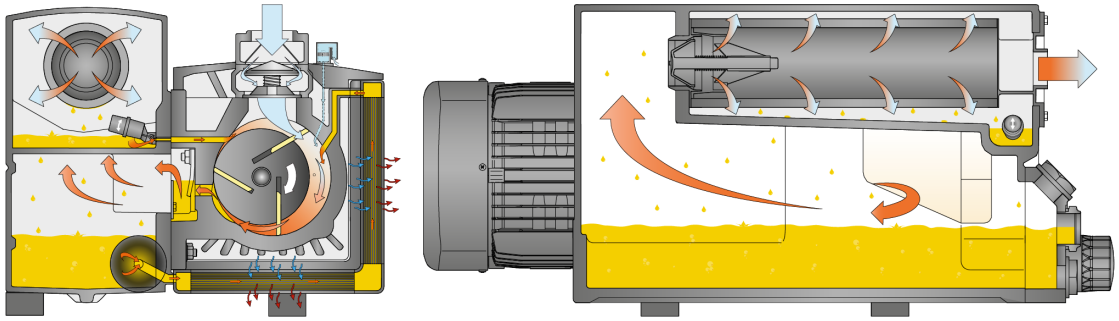
In this instruction manual, the illustrations may differ from the appearance of the machine.

NOTE

Product origin.

The serial number on the name plate (NP) determines the manufacturing plant.

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 exhaust 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 the manufacturer.

The machine is intended for placement in a potentially non-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* [➔ 42].

The machine is suitable for continuous operation.

Permitted environmental conditions, see *Technical Data* [➔ 42].

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"* [➔ 24].

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* [➔ 42].

2.4.3 Gas-Ballast Valve Options

- **Large gas-ballast valve.** It increases the flow rate of the standard gas-ballast valve to handle a high vapor load and/or increase process gas dilution.
- **Solenoid “On/Off” valve.** It allows the flow of the gas-ballast valve to be interrupted by an external electrical signal.

2.4.4 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.

2.4.5 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.

- For more information, see *Oil* [➔ 44].

2.4.6 Resistance Thermometer “Oil”

The resistance thermometer monitors the oil temperature of the machine.

Depending on the type of oil, warning and trip signals must be set, see chapter Oil.

2.4.7 Level Switch

The level switch monitors the oil level.

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

2.4.8 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)* [➔ 25].

2.4.9 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)* [➔ 26].

2.4.10 ECOTORQUE Variable Speed Drive

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

The ECOTORQUE Variable Speed Drive (VSD) regulates the pumping speed of the machine and saves energy. For more information contact your Busch representative.

3 Transport and Handling

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.

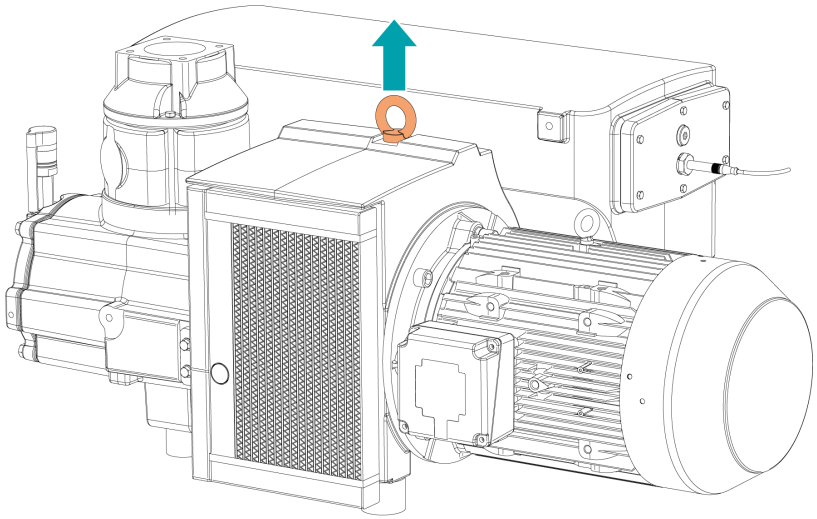
NOTICE

If the machine is already filled with oil.

Tilting a machine already filled with oil can cause a large amount of oil to ingress into the cylinder. Starting the machine with excessive oil in the cylinder will immediately break the vanes and render it unusable!

- Drain the oil before each transport or always transport the machine horizontally.

- To find out the weight of the machine, refer to the chapter *Technical Data* [➔ 42] or the name plate (NP).
- Make sure that the eye bolt(s) (EB) is/are in faultless condition, fully screwed in and tightened by hand.



- Check that the machine has not been damaged during transport.

If the machine is mounted and secured on a transport support (pallet):

- Remove the machine from the transport support before installation.

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 inlet connection (IN) and per small quantities, 3 liters of conservation oil, BUSCH article number 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 film (Vapor Corrosion Inhibitor).
- 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* [➔ 37].

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.

If the machine is equipped with a variable speed drive:

NOTICE

Long storage time (over 12 months).

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.

5 Installation

5.1 Installation Conditions

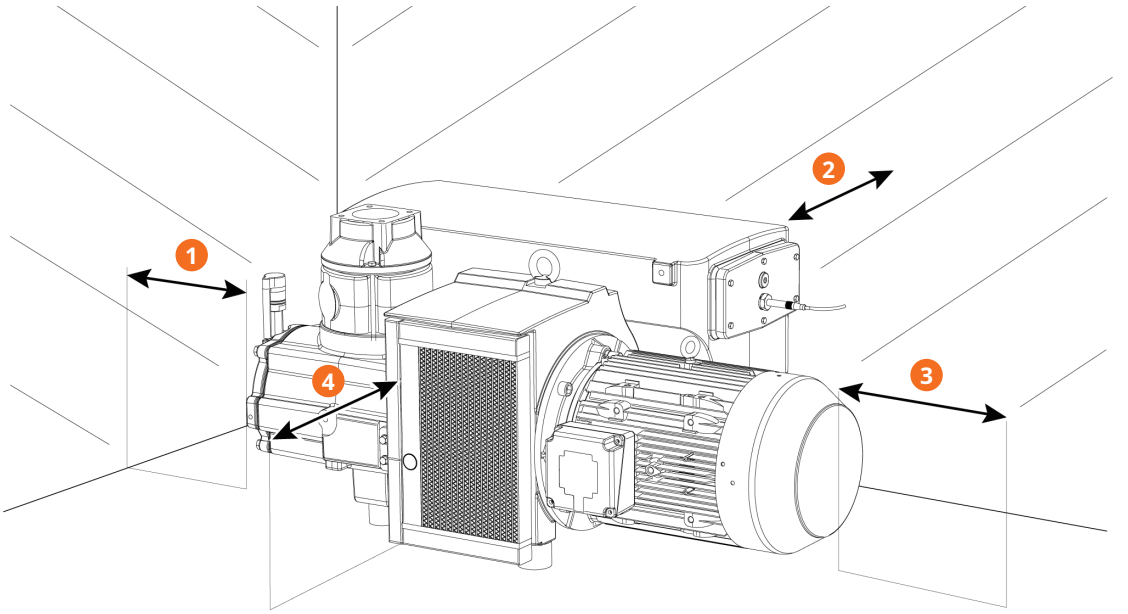
NOTICE

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* [➔ 42].
- 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.
  - If a level switch is installed on the machine, the maximum permitted deviation in longitudinal direction is 0.5°, to avoid false alarms.

- Check the oil level, see *Oil Level Inspection* [➔ 31].
- 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 manufacturer representative, the motor must 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 so that machine operation is inhibited if safety limit values are exceeded. For more information, refer to chapter *Electrical Connection of the Monitoring Devices* [➔ 24].

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 at the inlet and exhaust connections.
- Make sure that the diameter of the connecting lines over the entire length is at least as large as the connections of the machine.

In case of long connecting lines:

- Use larger diameters to avoid a loss of efficiency.
- Contact your manufacturer representative for more information.

5.2.1 Inlet Connection

WARNING

Unprotected inlet connection.

Risk of severe injury!

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

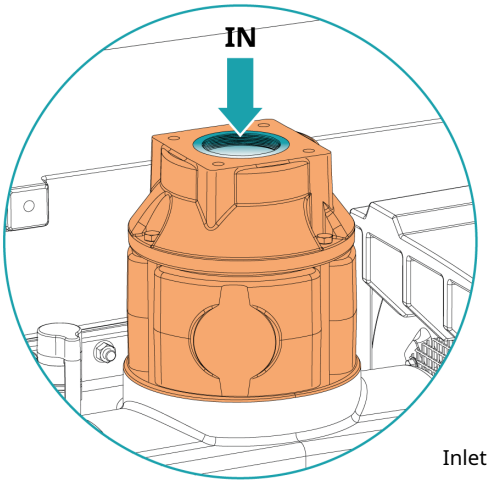
NOTICE

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) at the inlet of the machine.



Inlet 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 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 at the inlet and exhaust connections.

5.2.2 Exhaust Connection

CAUTION

Exhaust gas contains small amounts of oil.

Risk to health!

If air is released into rooms occupied by people:

- Make sure that adequate ventilation is provided.

NOTICE

Exhaust gas flow obstructed.

Risk of damage to the machine !

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

Connection size(s):

- G3” (with optional exhaust flange)
- 3” NPT (with optional exhaust flange)

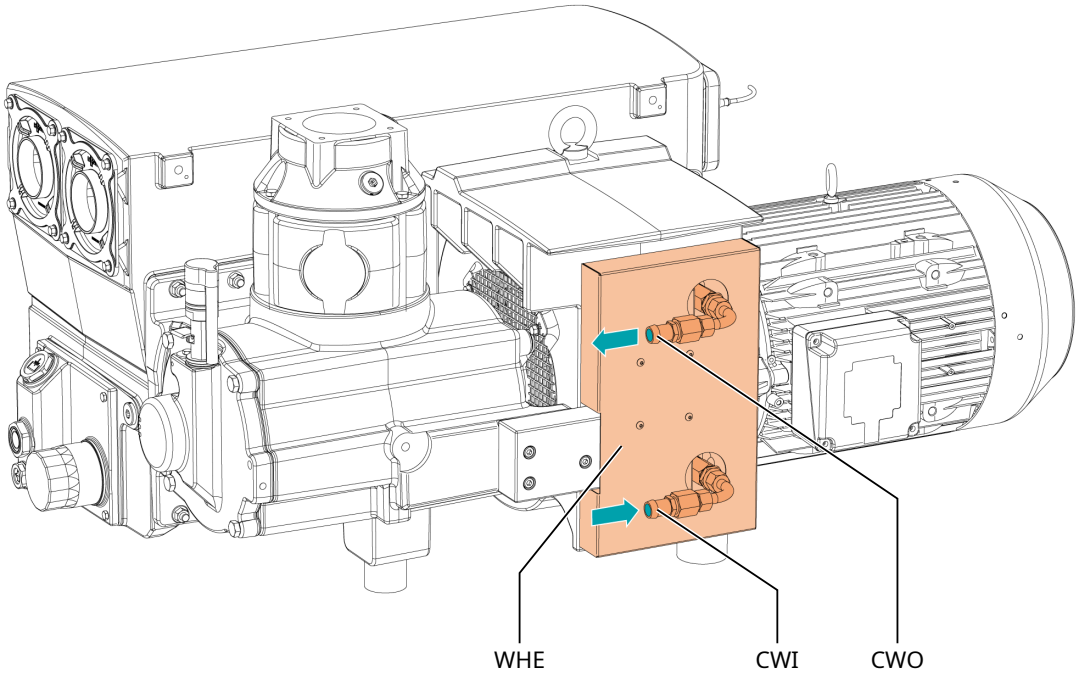
Unless the air drawn in is directly released into the environment right at the machine:

- Make sure that the exhaust line slopes away from the machine. In the opposite case, provide a liquid separator or a siphon with a drain cock, to prevent liquids from flowing back into the machine.

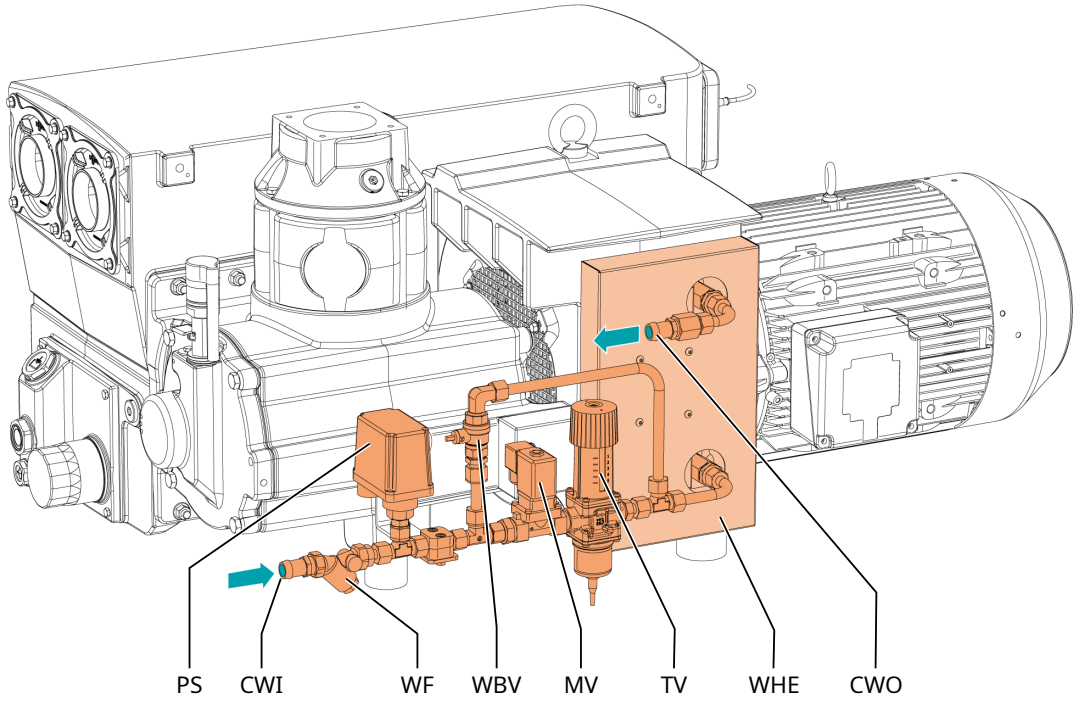
- Make sure that the connection lines cause no stress on the connections of the machine. Therefore, we recommend installing flexible lines at the inlet and exhaust connections.

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.

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

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

Connection size(s):

  - 19 mm hose (CWI / CWO)
- If necessary, electrically connect the pressure switch (PS):
  - See *Wiring Diagram Pressure Switch of Water-Oil Heat Exchanger (Optional)* [➔ 26].
- If necessary, electrically connect the solenoid valve (MV).
- Make sure that the cooling water complies with the following requirements:

Minimum 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

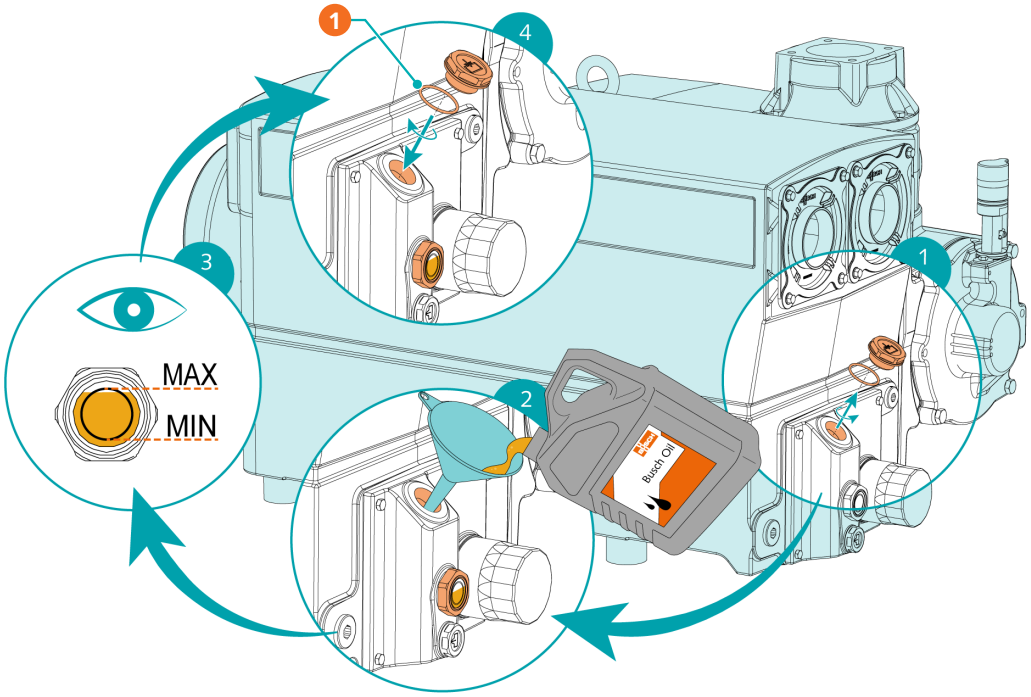
Use of inappropriate oil.

Risk of premature failure!

Loss of efficiency!

- Use only a type of oil previously approved and recommended by the manufacturer.

- For information on oil type and filling capacities, see the *Technical Data* [➔ 42] and *Oil* [➔ 44] chapters.



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

5.4 Fitting the Coupling

NOTICE

Coupling hub / radial fan assembly (Motor side).

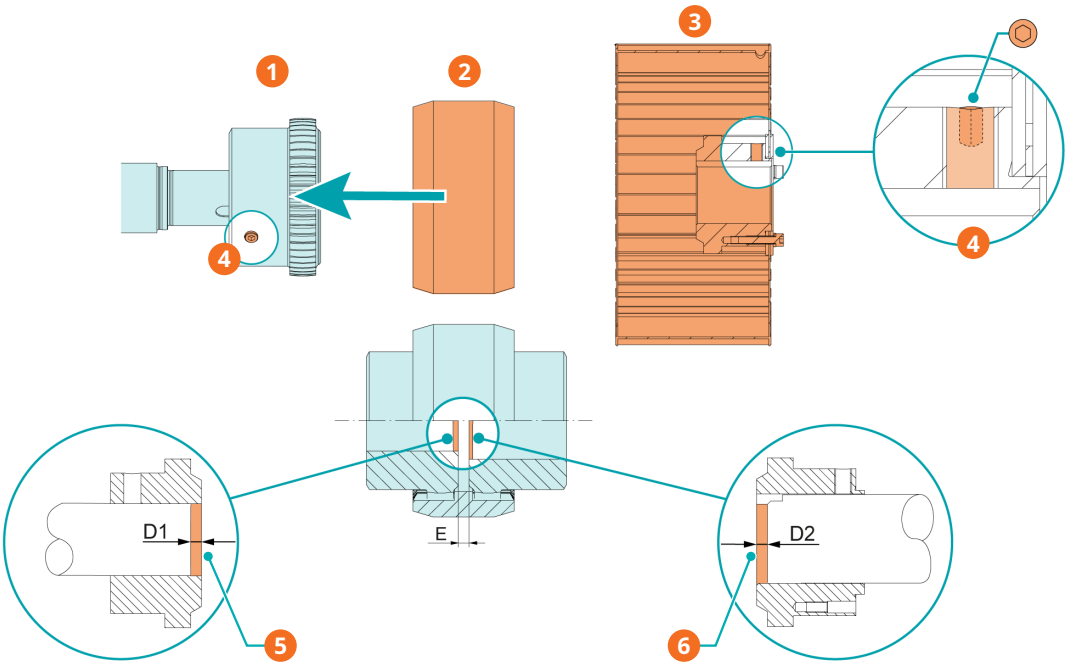
The coupling hub and radial fan assembly on the motor side is balanced and must not be disassembled.

NOTE

Radial screws.

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

5.4.1 BoWex Coupling



Description			
1	Coupling hub (machine side)	2	Coupling sleeve
3	Coupling hub + radial fan assembly (motor side)	4	Radial screws / Tightening torque: 17 Nm
5	Value "D1": see table below	6	Value "D2": see table below

Machine type	Coupling size	Value “E” (mm)
RA 0520 A	BoWex® M65	4
RA 0600 A ECOTORQUE		

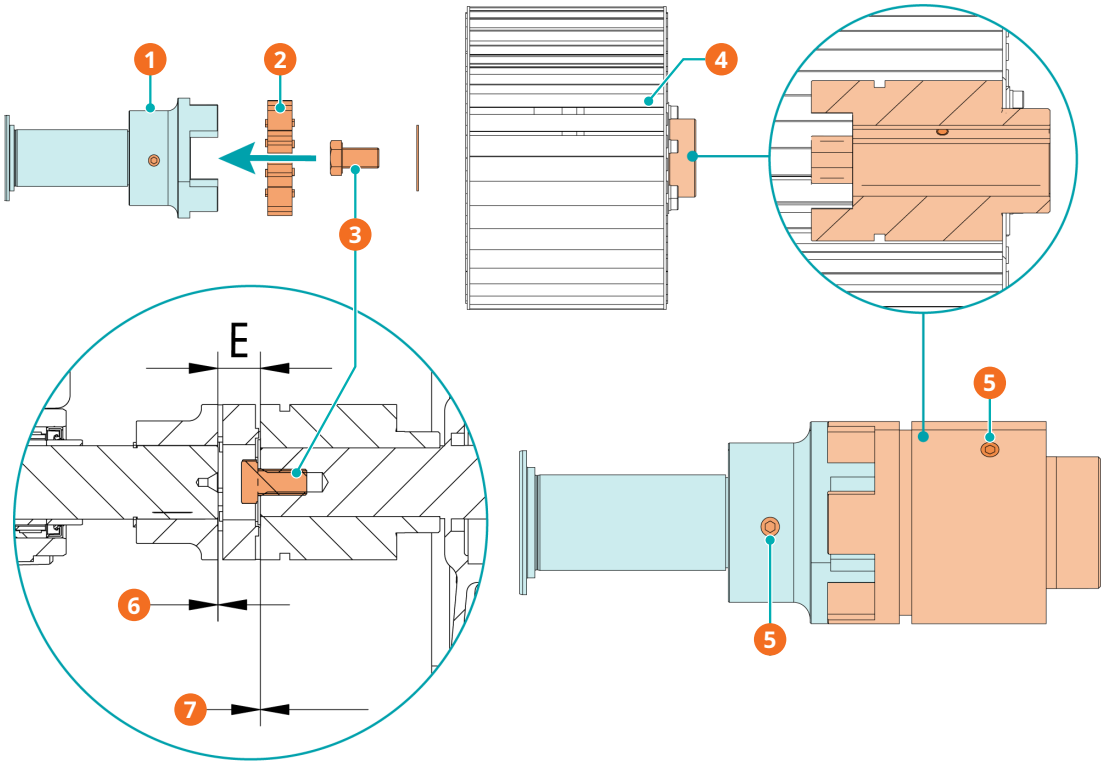
Clearance “E” between the two coupling hubs is obtained by adjusting the position of each coupling hub relatively to the end face of the rotor shaft on which it is mounted.

Machine type	Motor type	Value “D1” (mm)	Value “D2” (mm)
RA 0520 A	IEC	15	0
RA 0600 A ECOTORQUE			

For more information on coupling, visit *www.ktr.com* and download the BoWex® Coupling Instruction Manual.

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

5.4.2 TRASCO Coupling



Description			
1	Coupling hub (machine side)	2	Coupling spider
3	Axial screw / Tightening torque: 70 Nm	4	Coupling hub + radial fan assembly (motor side)
5	Radial screws / Tightening torque: 17 Nm	6	Value "D1": see table below
7	Value "D2": see table below		

Machine type	Coupling size	Value “E” (mm)
RA 0520 A	D42	26
RA 0600 A ECOTORQUE		

Clearance “E” between the two coupling hubs is obtained by adjusting the position of each coupling hub relatively to the end face of the rotor shaft on which it is mounted.

Machine type	Motor type	Value “D1” (mm)	Value “D2” (mm)
RA 0520 A	IEC	0	0
	NEMA	0	11
RA 0600 A ECOTORQUE	IEC	0	0

6 Electrical Connection

DANGER

Live wires.

Risk of electrical shock!

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

INSTALLATION(S) CURRENT PROTECTION:

DANGER

Missing current protection.

Risk of electrical shock!

- Provide current protection in accordance with EN 60204-1 on your 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, contact your Busch representative for more information.
- 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* [➔ 45] or *UK Declaration of Conformity* [➔ 46]).

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 name plate 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 below are examples only. See inside the control box for connection instructions and 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* [➔ 42]).

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 name plate 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 below are examples only. See inside the terminal box for motor connection instructions and 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 before starting any work.

- Make sure that the power supply for the drive is compatible with the data on the name plate 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* [➔ 42].

NOTICE

Incorrect connection.

Risk of damage to the variable speed drive!

- The wiring diagrams below are examples only. Refer to the connection instructions and diagrams of the variable speed drive.

6.4 Wiring Diagram Three-Phase Motor

NOTICE

Incorrect direction of rotation.

Risk of damage to the machine!

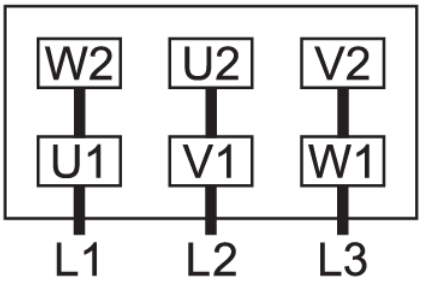
- Operation in the wrong direction of rotation can destroy the machine in a short time! Prior to start-up, ensure that the machine is operated in the right direction.

- 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.

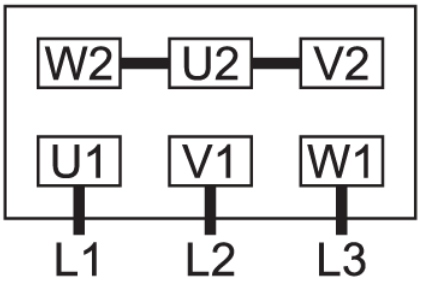
If the rotation of the motor must be changed:

- Switch any two of the motor phase wires.

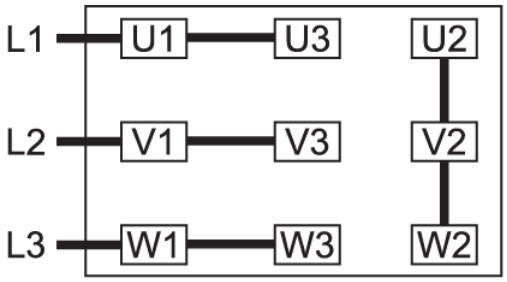
Delta connection (low voltage):



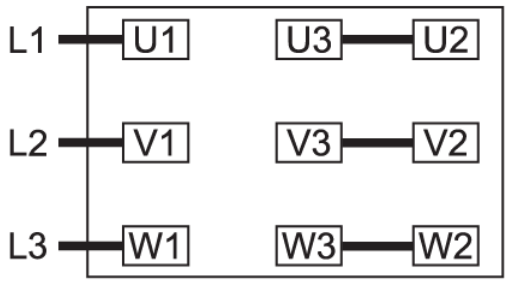
Star connection (high voltage):



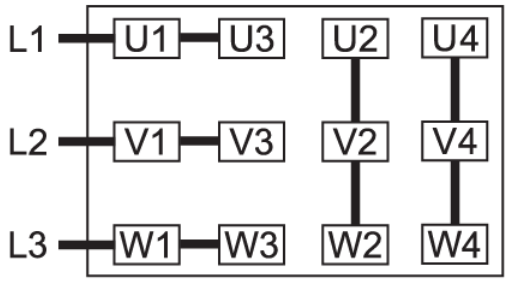
Double star connection, multi-voltage motor with 9 pins (low voltage):



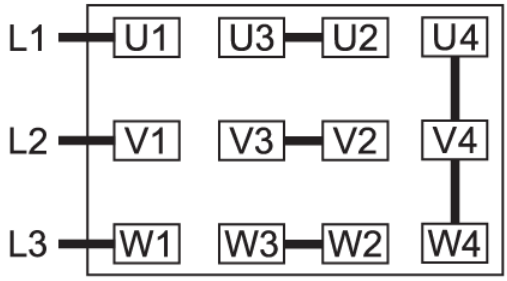
Star connection, multi-voltage motor with 9 pins (high voltage):



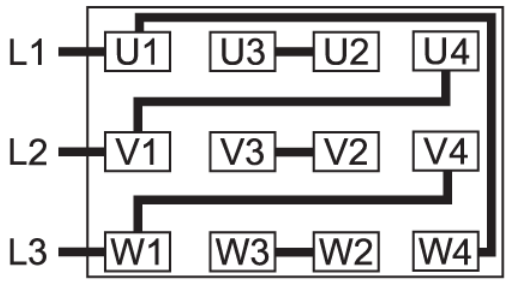
Double star connection, multi-voltage motor with 12 pins (low voltage):



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.

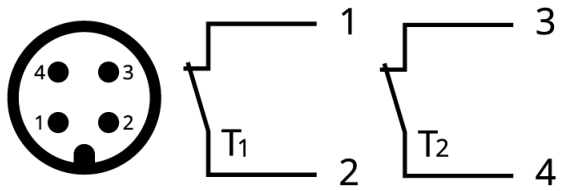
- No wiring required on ECOTORQUE machines.

Article number: 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

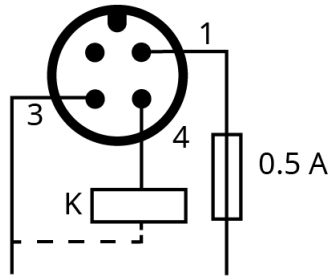
6.5.2 Wiring Diagram Level Switch (Optional)

Article number: 0652 567 576

Connector: M12x1, 4-pin

Electrical data: U = 10 ... 30 VDC; 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)

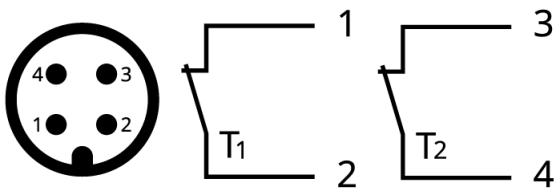
Article number: 0651 566 632

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.



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

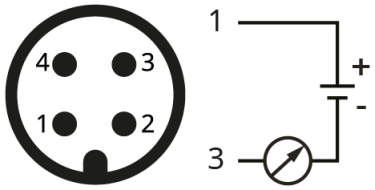
6.5.4 Wiring Diagram Resistance Thermometer (Optional)

Article number: 0651 566 842

Connector: M12x1, 4-pin

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

Warning / trip signals: see chapter Oil



1 = Brown; 3 = Blue

6.5.5 Wiring Diagram Exhaust Pressure Transmitter (Optional)

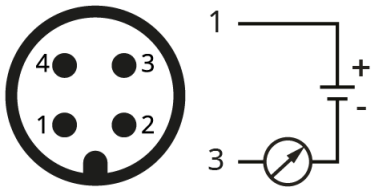
Article number: 0653 567 425

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

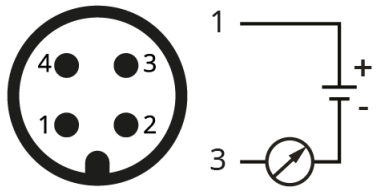
Already connected to the ECOTORQUE Variable Speed Drive.

- No wiring required on ECOTORQUE machines.

Article number: 0653 233 987

Connector: M12x1, 4-pin

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



1 = Brown; 3 = Blue

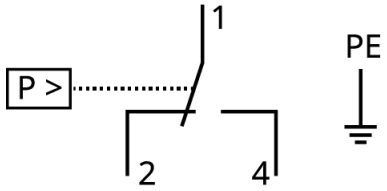
6.5.7 Wiring Diagram Pressure Switch of Water-Oil Heat Exchanger (Optional)

Article number: 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

In operation, the surface of the machine may reach temperatures over 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 is normally shipped without oil.

Operation without oil will ruin the machine in short time!

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

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

Version with water-oil heat exchanger:

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

- 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* [➔ 42].

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

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

7.1 Conveying Condensable Vapors

CAUTION

In operation, the surface of the inlet and exhaust connections may reach temperatures over 70°C.

Risk of burns!

- Avoid contact with these surfaces during and directly after operation.

CAUTION

Venting the machine.

The discharged gases and/or liquids may reach temperatures above 70°C!

Risk of burns!

- Avoid direct contact with the flow of gases and/or liquids.

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

If condensable vapors are to be conveyed:

START

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

** When the machine is equipped with a gas-ballast valve

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

Hot liquids.

Risk of burns!

- Before draining liquids, 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.

- Stop the machine and lock it to prevent accidental start-up.
- Vent the connected lines to atmospheric pressure.

Version with water-oil heat exchanger:

- Close the water supply.

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 before starting 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 for normal application	Interval for harsh application
• Check the oil level, see *Oil Level Inspection* [➔ 31].	Daily	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, clean or replace if necessary.	Monthly	Monthly

Maintenance work	Interval for normal application	Interval for harsh application
• 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* [➔ 35]). • Clean the gas-ballast valve (GB).	Max. after 4000 hours or after 1 year	Max. after 2000 hours or after 6 months
• Check the electrical connections and the monitoring devices.	Every year	Every year
• Contact Busch for an inspection. If necessary, overhaul the machine.	Every 5 years	Every 5 years

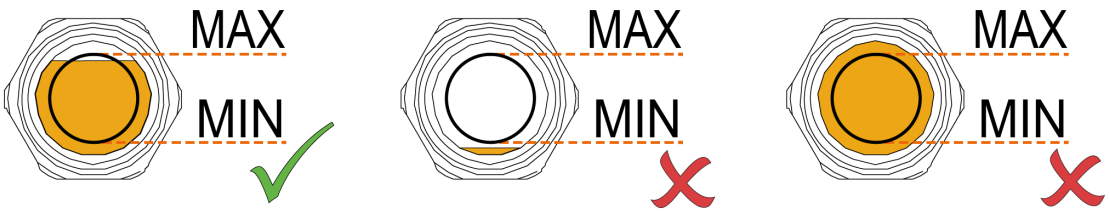
Motor Bearings

• Regrease motor bearings (if the motor requires periodic re-greasing)	Refer to the motor name plate for interval and grease type.

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

8.2 Oil Level Inspection

- Stop the machine.
- Wait 1 minute.
- Check the oil level.



- Fill up if necessary, see *Filling Oil* [➔ 16].

8.3 Oil and Oil Filter Change

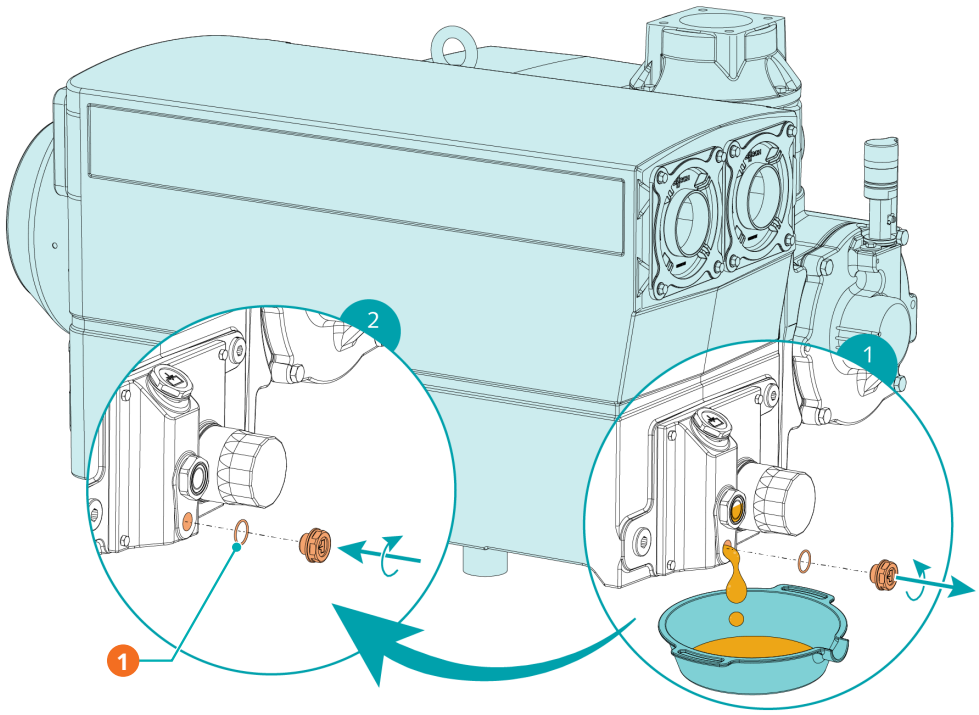
NOTICE

Use of inappropriate oil.

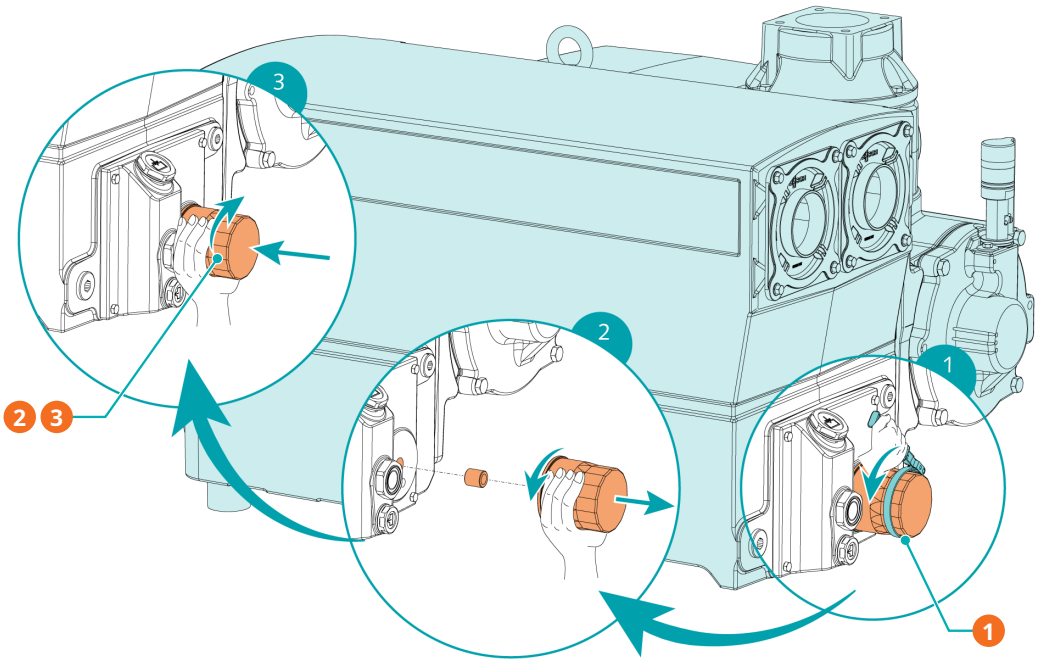
Risk of premature failure!

Loss of efficiency!

- Use only a type of oil previously approved and recommended by the manufacturer.

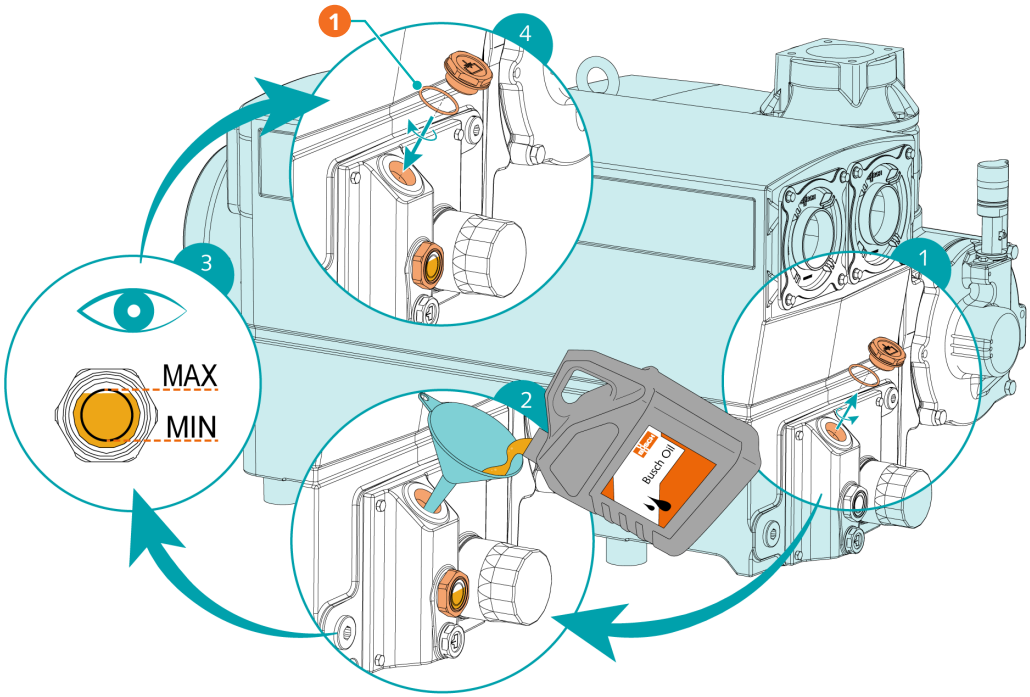


Description			
1	1x O-ring, see "Service kit" (chapter Spare Parts)		



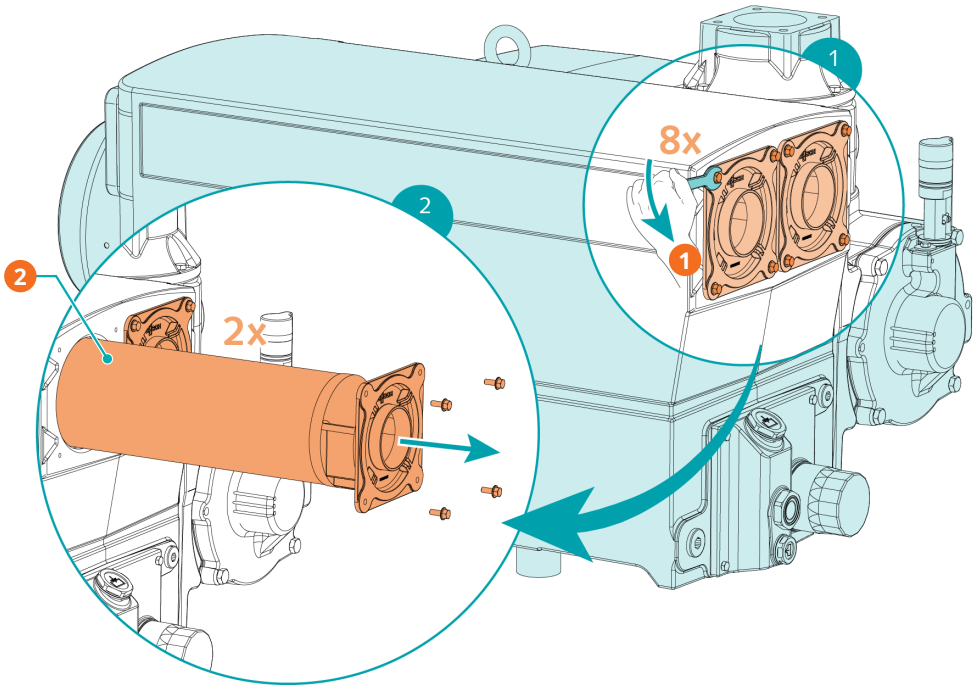
Description			
1	Remove the used oil filter with an oil filter wrench	2	1x oil filter (OF), see "Service kit" (chapter Spare Parts - Busch genuine spare part)
3	Contact followed by a tightening torque of 10 Nm or 3/4 of a turn		

- For information on oil type and filling capacities, see the *Technical Data* [➔ 42] and *Oil* [➔ 44] chapters.

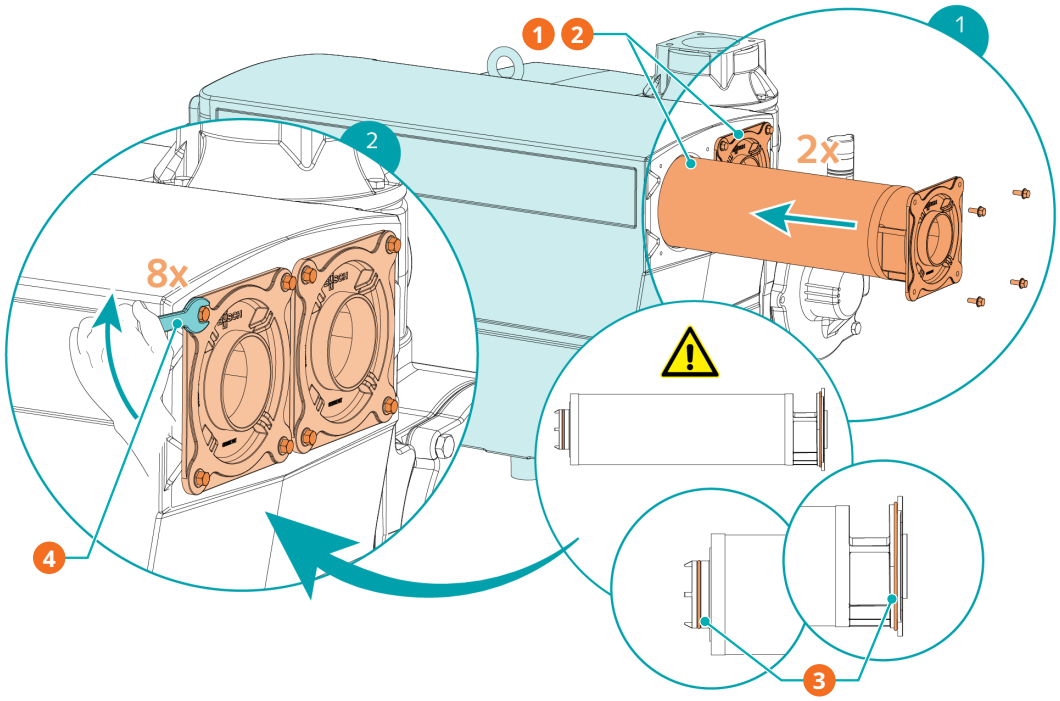


Description			
1	1x O-ring, see "Service kit" (chapter Spare Parts)		

8.4 Exhaust Filter Change



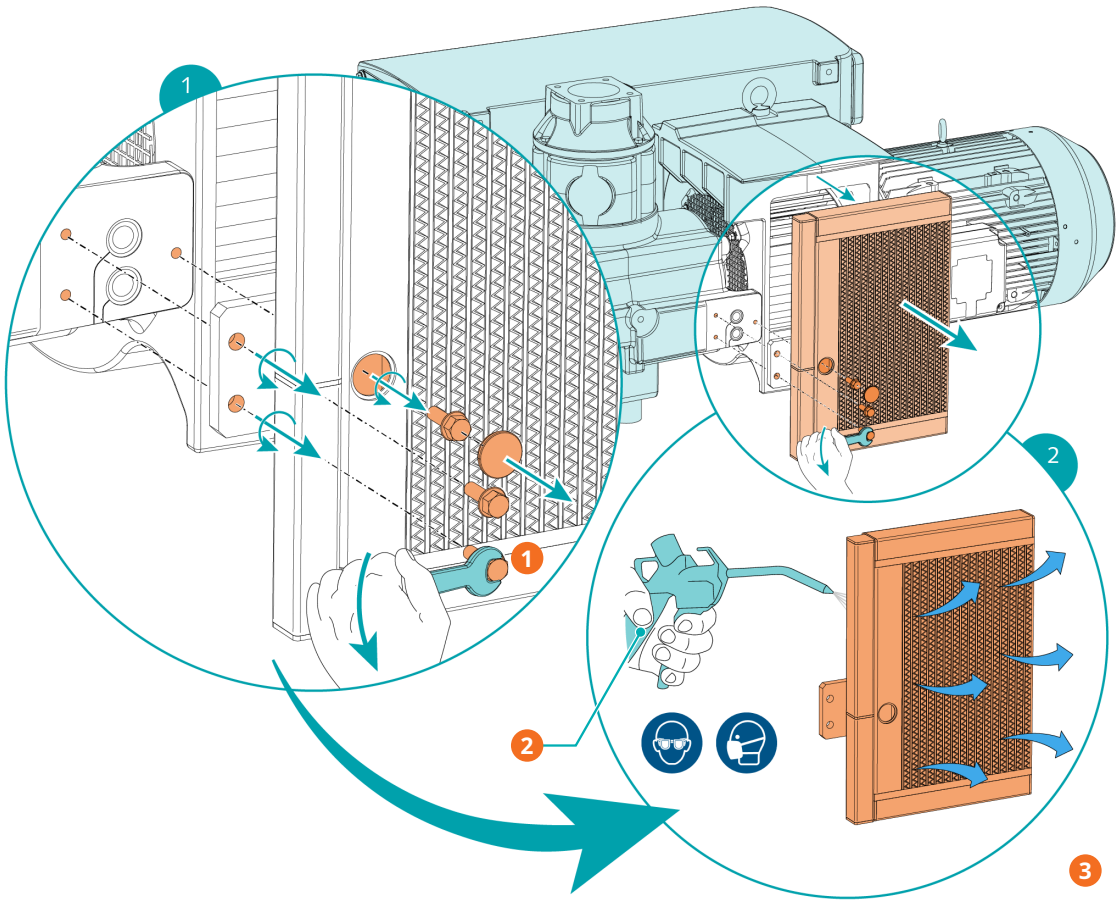
Description			
1	10 mm wrench	2	2x exhaust filter (EF)



Description			
1	2x exhaust filter (EF), see "Service kit" (chapter Spare Parts - Busch genuine spare part)	2	Install the filter the right way up, with the Busch logo facing upwards
3	Make sure both O-rings are in place before refitting each exhaust filter	4	Use a 10 mm wrench to tighten the 4 screws / Tightening 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* [➔ 31]).
- 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	13 mm wrench (Note: 3x O-rings (not shown) in addition to the three screws)	2	Use compressed air and wear protective eyewear and mask
3	After cleaning, reassemble the exchanger with 3 new O-rings (see "Service kit" in chapter Spare Parts) and the 3 screws / Tightening 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

Incorrect assembly.

Risk of premature failure!

Loss of efficiency!

- Any disassembly of the machine beyond that described in this manual must be carried out by technicians approved by Busch.

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’.

The manufacturer 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.

CAUTION

Hot liquids.

Risk of burns!

- Before draining liquids, let the machine cool down first.

- Stop the machine and lock it to prevent accidental start-up.
- Disconnect the power supply.
- Vent the connected lines to atmospheric pressure.

Version with water-oil heat exchanger:

- Close 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 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!

- Use only Busch genuine spare parts, consumables and supplies to ensure correct operation of the machine and to validate the warranty.

Spare part	Description	Article number
Service kit	Includes all parts to perform maintenance work	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.

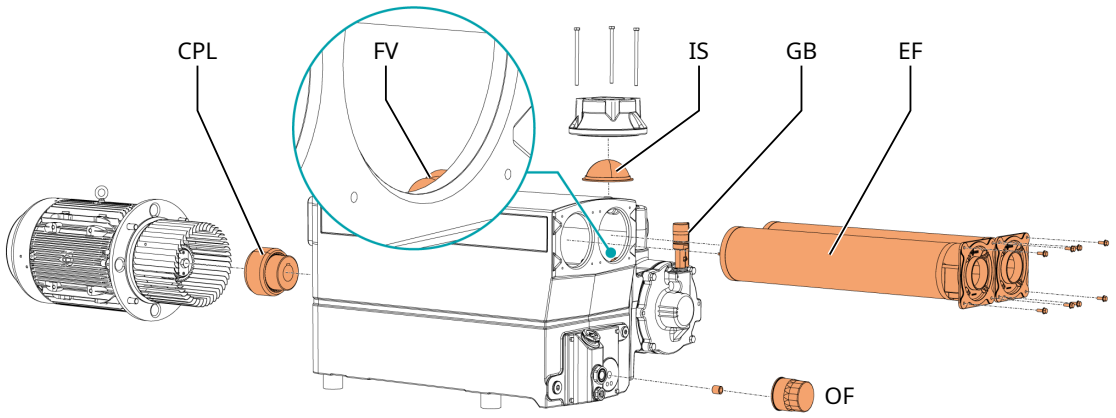
CAUTION

Hot liquids.

Risk of burns!

- Before draining liquids, let the machine 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 (contact Busch).
	The coupling (CPL) is defective.	• Replace the coupling (CPL) (contact Busch).
The machine does not reach the usual pressure at the inlet connection.	The oil level is too low.	• Top up oil, see *Filling Oil* [➔ 16].
	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 exhaust gases.	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".

Problem	Possible Cause	Remedy
The oil is emulsified.	The machine has sucked in liquids or large amounts of steam/vapor.	• Flush the machine (contact Busch). • Clean the filter of the gas-ballast valve (GB). • Change the operating mode (see chapter *Conveying Condensable Vapors* [➔ 28]).
The power consumption of the machine has increased.	The exhaust filters (EF) are partially clogged.	• Replace the exhaust filters (EF).
	The oil level is too high.	• Drain excess oil to correct the oil level.
	Oil change intervals are too long.	• Flush the machine (Contact Busch).

For resolution of problems not listed in the troubleshooting table, 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 with closed gas-ballast valve	hPa (mbar) abs.	0.1
	Torr	0.075
Ultimate pressure with open gas-ballast valve	hPa (mbar) abs.	0.5
	Torr	0.375
Nominal motor speed (50/60 Hz)	min^{-1}	1000 / 1200
	rpm	
Permitted motor speed	min^{-1}	1000 ... 1200
	rpm	
Nominal motor rating (50/60 Hz)	kW	11.0 / 12.5
	hp (60 Hz)	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)	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. (standard configuration)	kg	420
	lbs.	930

		RA 0600 A ECOTORQUE
Nominal pumping speed (40-70 Hz)	m^3/h	330 – 600
	ACFM	194 – 353
Ultimate pressure with closed gas-ballast valve	hPa (mbar) abs.	0.1
	Torr	0.075
Ultimate pressure with open gas-ballast valve	hPa (mbar) abs.	0.5
	Torr	0.375
Nominal motor speed (40-70 Hz)	min^{-1}	800 – 1400
	rpm	
Permitted motor speed	min^{-1}	800 ... 1400
	rpm	
Nominal motor rating (40-70 Hz)	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)	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. (standard configuration)	kg	525
	lbs.	1160

14 Oil

Name	ISO-VG	Oil type	1 L packing	5 L packing	10 L packing	20 L packing
VM 100	100	Mineral	0831 000 060	0831 000 059	-	0831 166 905
VSB 100	100	Synthetic	0831 168 351	0831 168 352	-	0831 168 353
VSC 100	100	Synthetic	0831 168 356	0831 168 357	-	0831 168 359

Oil monitoring	Warning signal Oil temperature [°C]	Switch point / Trip signal Oil temperature [°C]
VM 100	90	110
VSB 100	110	130
VSC 100	110	130

In case of unfavorable ambient temperature, other oil viscosities can be used.

- For more information, contact your Busch representative.

To find out which oil needs to be filled into the machine, refer to the name plate (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 name plate 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: vacuum pump R5 RA 0520 A; R5 RA 0600 A ECOTORQUE

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

- 'Machinery Directive' 2006/42/EC, if the serial number is less than or equal to XXX126999999
- 'Machinery Regulation' (EU) 2023/1230, if the serial number is greater than or equal to XXX127000000
- '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:

Standard	Title of the Standard
EN ISO 12100 : 2010	Safety of machinery - Basic concepts, general principles of design
EN 1012-2 : 1996 + A1 : 2009	Vacuum pumps - Safety requirements - Part 2
EN 60204-1 : 2018	Safety of machinery - Electrical equipment of machines - Part 1: General requirements
EN ISO 13857 : 2019	Safety of machinery - Safety distances to prevent hazard zones being reached by the upper and lower limbs
EN ISO 2151 : 2008	Acoustics - Noise test code for compressors and vacuum pumps - Engineering method (grade 2)
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, 2025.01.05

Christian Hoffmann
General Manager
Ateliers Busch S.A.

Virginia Beach, 2025.01.05

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 name plate 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: vacuum pump 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:

Standard	Title of the Standard
EN ISO 12100 : 2010	Safety of machinery - Basic concepts, general principles of design
EN 1012-2 : 1996 + A1 : 2009	Vacuum pumps - Safety requirements - Part 2
EN 60204-1 : 2018	Safety of machinery - Electrical equipment of machines - Part 1: General requirements
EN ISO 13857 : 2019	Safety of machinery - Safety distances to prevent hazard zones being reached by the upper and lower limbs
EN ISO 2151 : 2008	Acoustics - Noise test code for compressors and vacuum pumps - Engineering method (grade 2)
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, 2025.01.05

Christian Hoffmann
General Manager
Ateliers Busch S.A.

Virginia Beach, 2025.01.05

Dalip Kapoor
Chief Counsel, Legal & Compliance Officer
Busch Manufacturing LLC

Notes

BUSCH GROUP

The Busch Group is one of the world's largest manufacturers of vacuum pumps, vacuum systems, blowers, compressors and gas abatement systems. Under its umbrella, the group houses two well-known brands: Busch Vacuum Solutions and Pfeiffer Vacuum+Fab Solutions. Together, they offer solutions to a wide range of industries. A global network of highly competent local teams in 44 countries ensures that expert, tailor-made support is always available near you. Wherever you are. Whatever your business.

- Busch Group companies
- Busch Group production sites
- Busch Group service centers
- Busch Group local representatives

www.buschvacuum.com

www.pfeiffer-vacuum.com

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