

Instruction Manual

R 5

Oil-Lubricated Rotary Vane Vacuum Pumps

RA 1000 B, RA 1600 B

RC 1000 B, RC 1600 B

US version



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1 Safety

Before installing and operating the vacuum pump, this instruction manual should be read and understood. If anything needs to be clarified please contact your Busch representative.

Read 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 vacuum pump 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 vacuum pump has been designed and manufactured according to state-of-the-art methods. Nevertheless, residual risks may remain. This instruction manual highlights potential hazards where appropriate. Safety notes and warning messages are tagged with one of the keywords DANGER, WARNING, CAUTION, NOTICE and NOTE as follows:

DANGER

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

WARNING

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

CAUTION

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

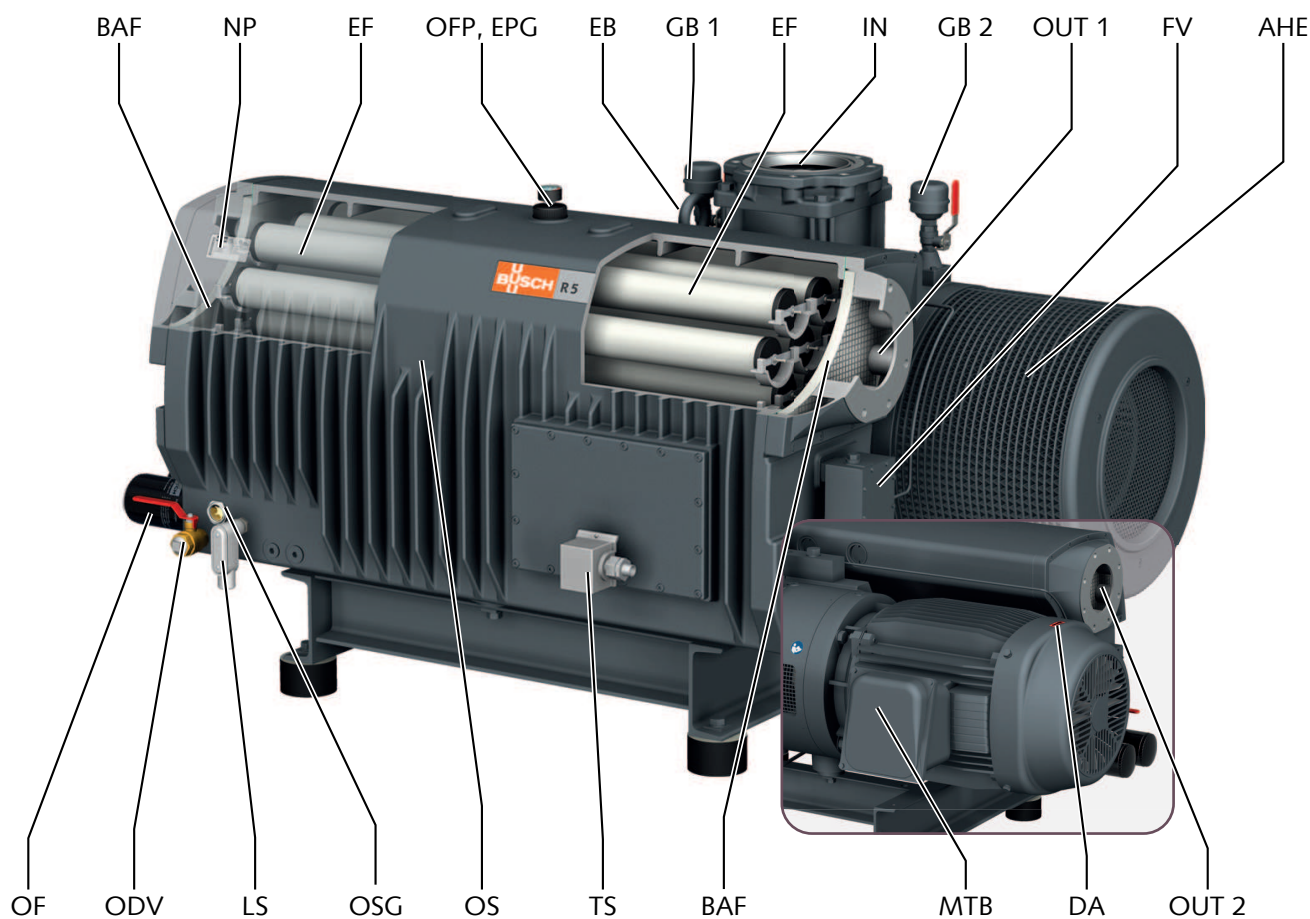
NOTICE

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

NOTE

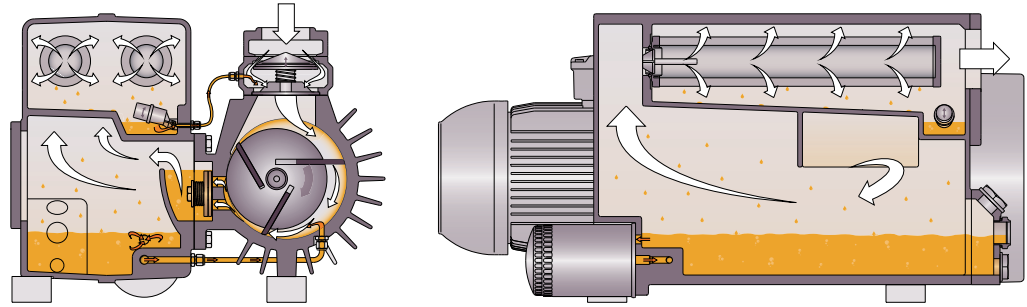
... indicates helpful tips and recommendations, as well as information for efficient and trouble-free operation.

2 Product Description



IN	Suction connection	MTB	Motor terminal box
OUT	Discharge connection	DA	Directional arrow
OFF	Oil fill plug	EF	Exhaust filter
EPG	Exhaust pressure gauge	NP	Nameplate
ODV	Oil drain valve	OSG	Oil sight glass
OF	Oil filter	OS	Oil separator
EB	Eye bolt	GB	Gas ballast valve (standard on RA)
BAF	Baffle filter	AHE	Air-oil heat exchanger
FV	Float valve (RA version only)	LS	Level switch
TS	Temperature switch		

2.1 Operating Principle



The vacuum pump 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 Application

The vacuum pump is intended for the suction of air and other dry, non-aggressive, non-toxic and non-explosive gases.

Conveying of other media leads to an increased thermal and/or mechanical load on the vacuum pump and is permissible only after a consultation with Busch.

The vacuum pump is intended for the placement in a non-hazardous environment.

The vacuum pump is capable of maintaining ultimate pressure.

The vacuum pump is suitable for continuous operation.

For permitted environmental conditions see Technical Data [► 29].

2.3 Start Controls

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

The vacuum pump can be optionally equipped with a starter unit.

2.4 Features, Accessories, Options

2.4.1 Exhaust Pressure Gauge (feature)

The exhaust pressure gauge (EPG) indicates the status of the exhaust filters. Exhaust filters must be changed when the dial is in the red field.

2.4.2 Temperature Switch (feature)

The temperature switch (TS) monitors the gas temperature in the oil separator of the vacuum pump.

The vacuum pump must be stopped when the gas temperature reaches 240 °F.

2.4.3 Inlet Filter (accessory)

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

2.4.4 Level Switch (accessory)

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

2.4.5 Gas Ballast Valve (option)

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

The gas ballast valve has an influence on the ultimate pressure of the vacuum pump, see Technical Data [► 29].

2.4.6 Right-Angle Oil Adapter (option)

The right-angle oil adapter mounts between the oil separator and the oil filter so the oil filter can be replaced without needing to change the oil.

3 Transport



WARNING

Suspended load.

Risk of severe injury!

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

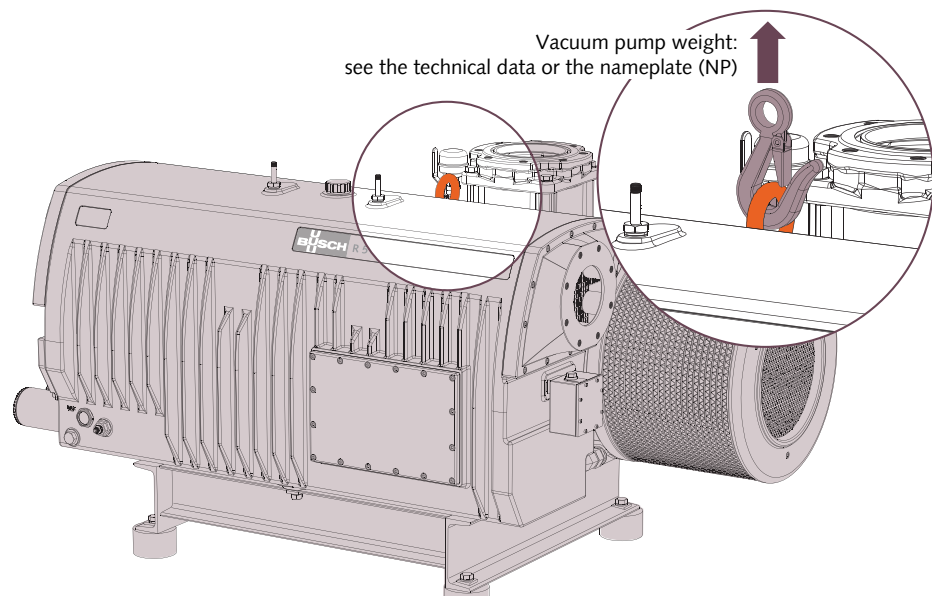


NOTICE

In case the vacuum pump is already filled with oil.

Tilting a vacuum pump that is already filled with oil can cause large quantities of oil to ingress into the cylinder. Starting the vacuum pump with excessive quantities of oil in the cylinder will immediately break the vanes and ruin the vacuum pump!

- Drain the oil prior to every transport or always transport the vacuum pump horizontally.
- Make sure that the eyebolt (EB) is in faultless condition, fully screwed in and tightened by hand.



The vacuum pump appearance may differ from the illustration

WARNING

Motor eye bolt.

Risk of severe injury!

- Do not lift the vacuum pump using the eye bolt fitted to the motor. Only lift the vacuum pump as previously shown.
- Check the vacuum pump for transport damage.

If the vacuum pump is secured to a shipping base:

- Remove the vacuum pump from the shipping base.

4 Storage

- Seal the suction and discharge connections with adhesive tape or reuse provided caps.

Version with water-oil heat exchanger:

- Make sure that the cooling water has been completely drained, see Decommissioning [► 22].

If storage for more than 3 months is scheduled:

- Wrap the vacuum pump in a corrosion inhibiting film.
- Store the vacuum pump indoors, dry, dust free and if possible in original packaging preferably at temperatures between 32 ... 104 °F.

5 Installation

5.1 Installation Conditions

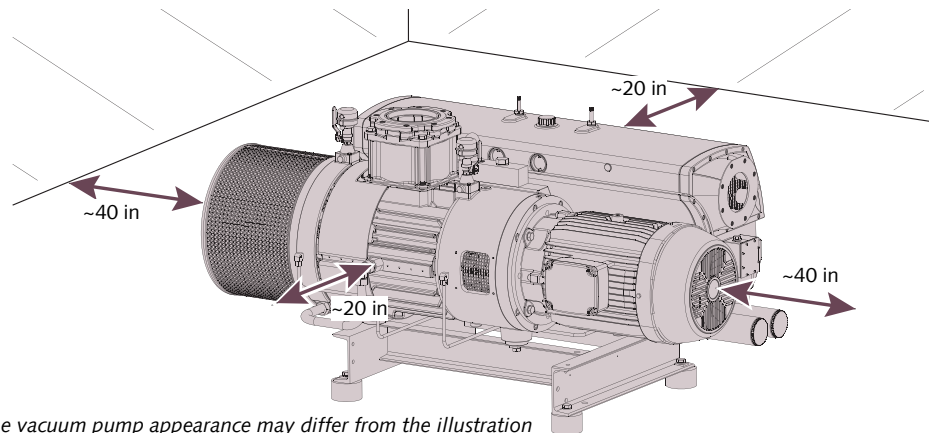
! NOTICE

Do not use the machine outside of the permitted installation conditions.

Risk of premature failure!

Loss of efficiency!

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



The vacuum pump appearance may differ from the illustration

- Make sure that the environment of the vacuum pump is not potentially explosive.
- Make sure that the ambient conditions comply with the Technical Data [► 29].
- Make sure that the environmental conditions comply with the protection class of the motor.
- Make sure that the installation space or location is vented such that sufficient cooling of the vacuum pump 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 vacuum pump is level within 1° in any direction.
- Check the oil level, see Oil Level Inspection [► 18].
- 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).

If the vacuum pump is installed at an altitude greater than 3300 feet above sea level:

- Contact your Busch representative, the motor should be derated or the ambient temperature limited.

If the vacuum pump 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 vacuum pump will be inhibited if the safety limit values are exceeded, see Electrical Connection [► 13].

5.2 Connecting Lines / Pipes

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

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

5.2.1 Suction Connection

WARNING

Unprotected suction connection.

Risk of severe injury!

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

NOTICE

Foreign objects or liquids.

Risk of damage to the vacuum pump!

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

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

Connection size:

- ANSI 6" – 150 lb

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

If the vacuum pump 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.
- Do not use the anti-suck-back valve as a system check valve.

NOTICE

Do not fill oil through the vacuum pump inlet.

Risk of damage to the vacuum pump!

Starting the vacuum pump with excessive quantities of oil in the cylinder will break the vanes.

- Only fill oil through the oil fill plug (OFP).

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.

Connection size:

- ANSI 4" – 150 lb

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

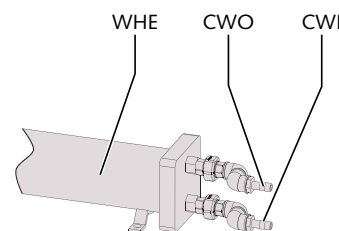
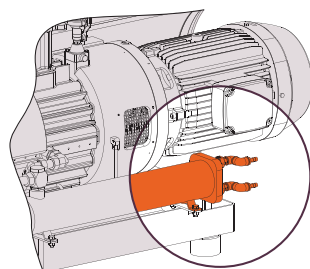
- Make sure that the discharged gas will flow without obstruction. Do not shut off or throttle the discharge line or use it as a pressurised air source.

Unless the pumped gas is discharged to the environment right at the vacuum pump :

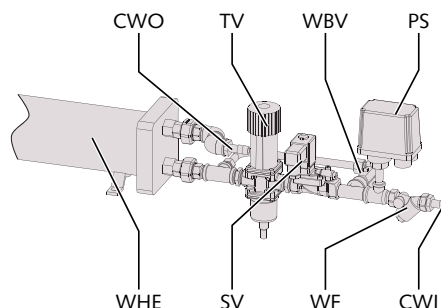
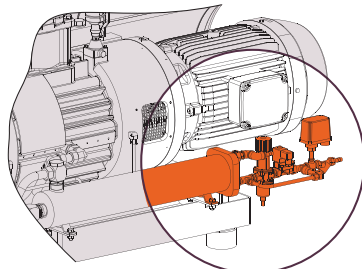
- Make sure that the discharge line either slopes away from the vacuum pump or provide a liquid separator or a drip leg with a drain valve, so that no liquids can flow back into the vacuum pump.
- Make sure to not exceed the maximum allowable back pressure, see Technical Data [▶ 29].

5.2.3 Cooling Water Connection (Optional)

Water-oil heat exchanger without inlet accessories



Water-oil heat exchanger with inlet accessories



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

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

The factory default adjustment of the thermostatic valve (TV) is set in position 2 (approx. 167°F oil temperature).

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

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

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

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

- Connect the cooling water connections (CWI / CWO) to the water supply.
- If necessary, electrically connect the pressure switch (PS).
- If necessary, electrically connect the solenoid valve (MV).
- Make sure that the cooling water complies with the following requirements:

Min. supply capacity	US gallon per minute	2.11
Water pressure	PSI	29 - 87
Supply temperature	°F	+41 - +95
Required pressure differential across supply and return	PSI	≥ 14.5

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

Hardness	Grain per US gallon	< 5.26
Properties	Clean & clear	
PH value		7.0 – 8.0
Particle size	µm	< 200
Chloride	lb/gal (US)	< 8.3e-4
Electrical conductivity	µS/cm	≤ 100
Free chloride	lb/gal (US)	<2.5e-6
Materials in contact with the cooling water	Stainless steel, copper and cast iron	

5.3 Filling Oil

WARNING

The vacuum pump is underfilled with oil.

Risk of fire!

- Insufficient oil quantity in the vacuum pump has the potential, under certain conditions, to lead to self-ignition of the remaining oil in the vacuum pump.

NOTICE

Do not fill oil through the vacuum pump inlet.

Risk of damage to the vacuum pump!

Starting the vacuum pump with excessive quantities of oil in the cylinder will break the vanes.

- Only fill oil through the oil fill plug (OFP).

NOTICE

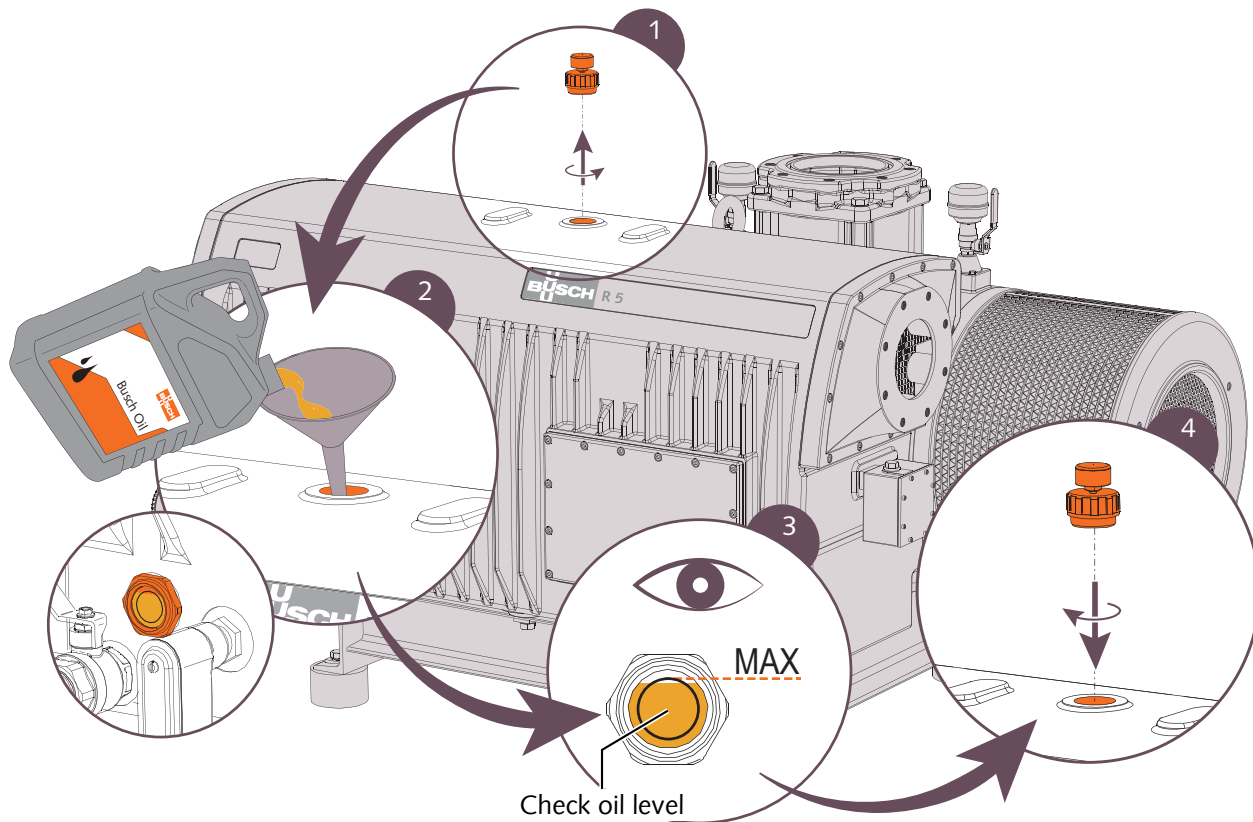
Do not use inappropriate oil.

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 [▶ 29] and Oil [▶ 29].



5.4 Electrical Connection

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-frequency drive or a soft starter unit, is allowed as long as the motor is admitted and the permitted motor speed range is neither underrun nor exceeded (see Technical Data [▶ 29]).

Seek advice from your Busch representative.

- Make sure that the motor is connected according to local electrical codes.
- Make sure that the power supply for the motor is compatible with the data on the nameplate of the motor.
- The power supply must be routed through a fused switch to protect the motor against electrical or mechanical overloads.
- The motor starter has to be set consistent with the motor current listed on the motor nameplate.
- Make sure that the motor of the vacuum pump will not be affected by electric or electromagnetic disturbance from the mains; if necessary seek advice from Busch.

- Ensure the electrical connection is properly grounded.
- Electrically connect the motor.
- Electrically connect the temperature switch (TS) so that the vacuum pump stops when the exhaust temperature reaches 240 °F.

If the vacuum pump is equipped with a level switch:

- Electrically connect the level switch so that the vacuum pump stops when the oil level is too low.

NOTICE

Incorrect connection.

Risk of damage to the motor!

- Check the inside of the terminal box for motor connection instructions/diagrams.

WARNING

Exhaust temperature switch is not connected.

Risk of severe injury!

Risk of damage to the vacuum pump!

- The vacuum pump comes with an exhaust temperature switch. Wire this switch into the starter control circuit so that when the set point is reached, power is shut off to the pump.

5.4.1 Wiring Diagram Three-Phase Motor

The wiring diagram for the electrical connection is located in the terminal box or on the nameplate of the motor.

If the pump is supplied with a motor starter, it is preset at the factory in accordance with the supplied motor. For other voltage requirements, contact the factory for motor and/or starter information.

NOTE

See the motor manufacturer's manual for start-up maintenance of the motor.

NOTICE

Incorrect direction of rotation.

Risk of damage to the vacuum pump!

- Operation in the wrong direction of rotation can damage the vacuum pump in a short time! Prior to starting-up make sure that the vacuum pump is operated in the right direction.
- Determine the intended direction of rotation from the arrow on the motor.
- Jog the motor briefly.
- Watch the fan of the motor and determine the direction of rotation just before the fan stops.

If the rotation of the motor must be changed:

- Switch any two of the motor phase wires.

6 Commissioning

NOTICE

The vacuum pump is shipped without oil.

Operation without oil will damage the vacuum pump in a short time!

- Prior to commissioning, the vacuum pump must be filled with oil, see Filling Oil [▶ 12].

CAUTION

During operation the surface of the vacuum pump may reach temperatures of more than 158°F.

Risk of burns!

- Avoid contact with the vacuum pump during and directly after operation.



CAUTION

Vacuum pump may be loud.

Risk of damage to hearing!

If people are present in the vicinity of a non-acoustically-insulated vacuum pump over extended periods:

- Make sure that ear protection is being used.
- Make sure that the installation conditions (see Installation Conditions [▶ 8]) are being followed.

Version with water-oil heat exchanger:

- Open the water supply.
- If the cooling water inlet is equipped with a water bypass valve (WBV), open it for approx. 90 seconds before the first machine start-up.
- Make sure that cooling water requirements are fully complied with, see Cooling Water Connection (Optional).
- Switch on the vacuum pump .
- Minimum time between starts and maximum number of starts per hour are dependent upon the motor and coupling type used. Please consult the factory for recommendations.
- Make sure that the operating conditions are complied with, see Technical Data [▶ 29].
- After few minutes of operation, check the oil level and top up if necessary. See Oil Level Inspection [▶ 18].

As soon as the vacuum pump is operating under normal operating conditions:

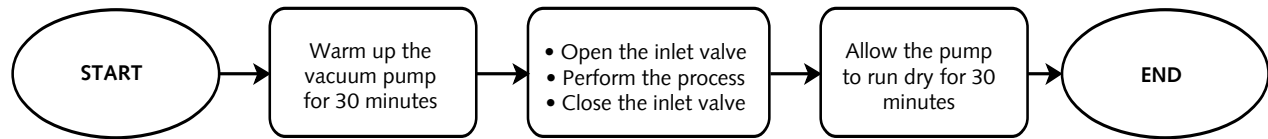
- Measure the motor current and record it as reference for future maintenance and troubleshooting work.

6.1 Conveying Condensable Vapours

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

If condensable vapours are to be conveyed:

Warm the pump up for 30 minutes before exposing it to the process, and allow it to run dry for 30 minutes before turning it off. Make sure to run the pump with the gas ballast open.



Note:

- Make sure to run the pump with the gas ballast open

7 Maintenance



WARNING

Vacuum pumps contaminated with hazardous material.

Risk of poisoning!

Risk of infection!

If the vacuum pump is contaminated with hazardous material:

- Wear appropriate personal protective equipment.

CAUTION

Hot surface.

Risk of burns!

- Prior to touching the vacuum pump, let the vacuum pump cool down.

NOTICE

Using inappropriate cleaners.

Risk of removing safety stickers and protective paint!

- Do not use incompatible solvents to clean the machine out.

NOTICE

Failing to properly maintain the machine.

Risk of premature failure!

Loss of efficiency!

- Respect the maintenance intervals or ask your Busch representative for service.
- Shut down the vacuum pump and lock against inadvertent start up.
- Vent the connected lines to atmospheric pressure.

Version with water-oil heat exchanger:

- Turn off the water supply.

If necessary:

- Disconnect all connections.

7.1 Maintenance Schedule

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

Maintenance work	Interval	
	Normal application	Harsh application
<ul style="list-style-type: none"> • Check the oil level, see Oil Level Inspection [► 18]. 	Daily	
<ul style="list-style-type: none"> • Check the vacuum pump for oil leaks - in case of leaks have the machine repaired (contact Busch). • Drain drip legs on inlet and exhaust piping <p>In case of an inlet filter being installed:</p> <ul style="list-style-type: none"> • Check the inlet filter cartridge, replace if necessary. 	Monthly	
<ul style="list-style-type: none"> • Change the oil filter* (OF). • Check the oil*, change it if necessary. 	Max. after 2000 hours, at the latest after 6 months	
<ul style="list-style-type: none"> • Change the oil and the oil filter (OF). 	Max. after 4000 hours, at the latest after 1 year	
<ul style="list-style-type: none"> • Change the exhaust filters (EF). 	Every 4000 hours, at the latest after 1 year	Every 2000 hours, at the latest after 6 months
<ul style="list-style-type: none"> • Clean the vacuum pump from dust and dirt. <p>In case of a gas ballast valve (GB) being installed:</p> <ul style="list-style-type: none"> • Clean the gas ballast valve. <p>If the vacuum pump is equipped with an air-oil heat exchanger (AHE):</p> <ul style="list-style-type: none"> • Check and/or clean the air-oil heat exchanger. <p>If the vacuum pump is equipped with a water cooling system:</p> <ul style="list-style-type: none"> • Check and/or clean the water cooling system. 	Every 6 months	
<ul style="list-style-type: none"> • 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

7.2 Oil Level Inspection

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



- Fill up if necessary, see Oil Filling [▶ 12].

7.3 Oil and Oil Filter Change

⚠ CAUTION

Filling oil while the vacuum pump is running.

Risk of burns! Hot gasses may escape through the oil fill port.

- Only perform oil filling when the vacuum pump is stopped.

ⓘ NOTICE

Do not use inappropriate oil.

Risk of premature failure!

Loss of efficiency!

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

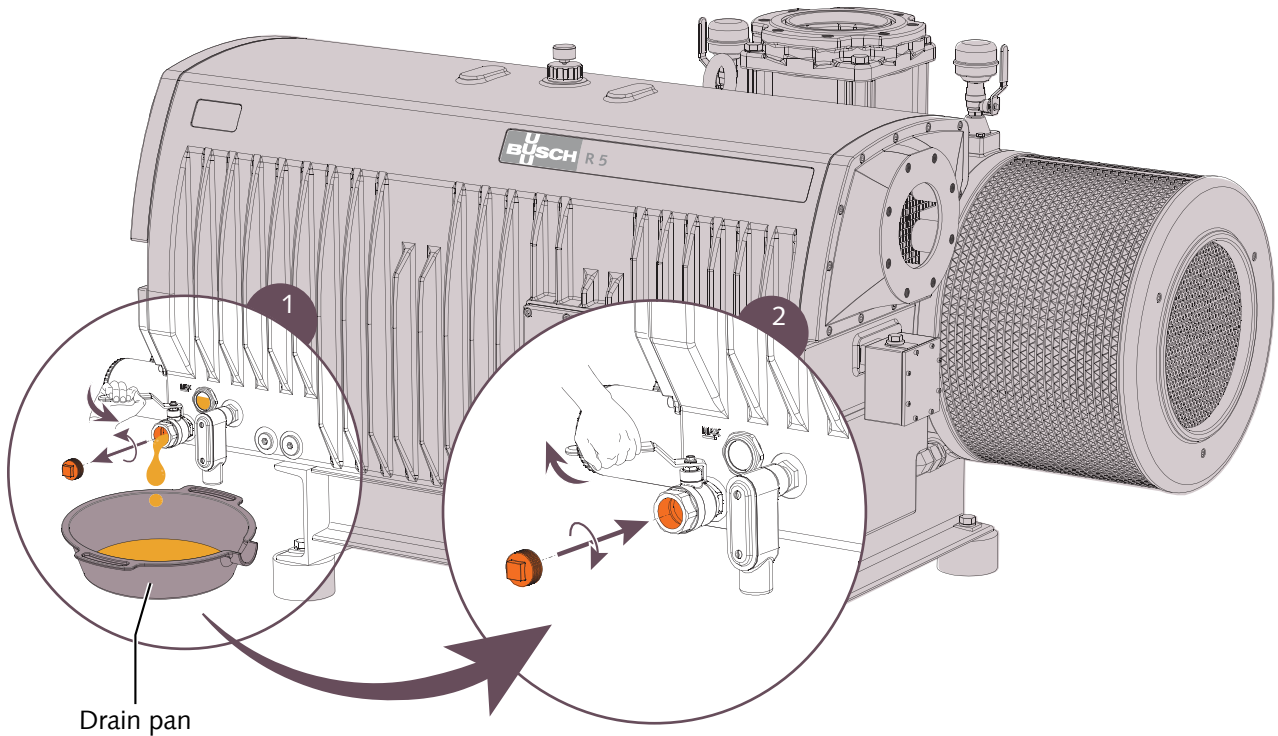
ⓘ NOTICE

Do not fill oil through the vacuum pump inlet.

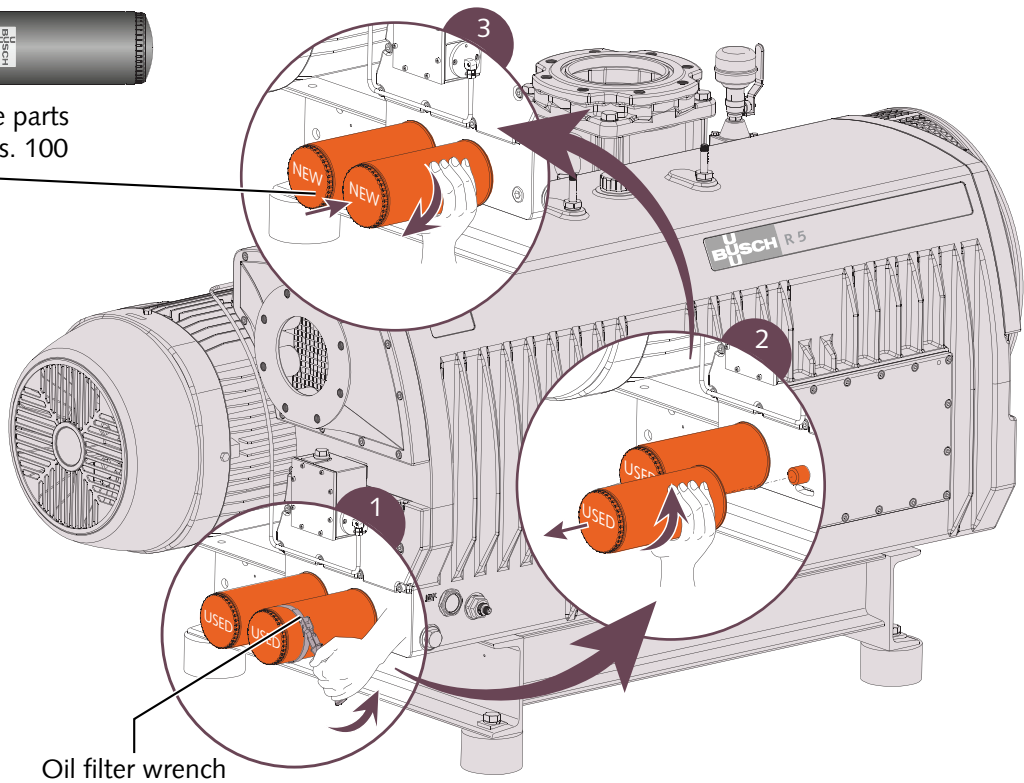
Risk of damage to the vacuum pump!

Starting the vacuum pump with excessive quantities of oil in the cylinder will break the vanes.

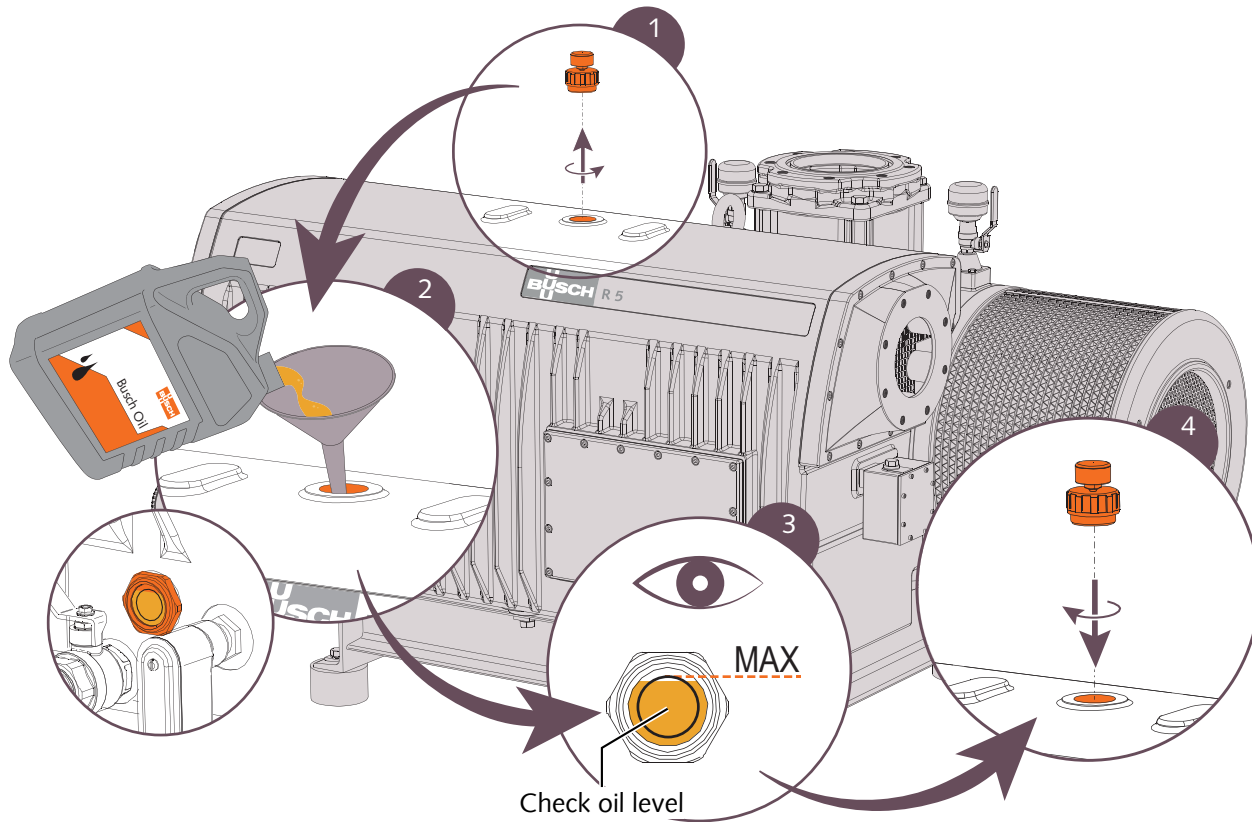
- Only fill oil through the oil fill plug (OFP).



Busch genuine spare parts
2x oil filter (OF), pos. 100



For oil type and oil capacity see Technical Data [▶ 29] and Oil [▶ 29].



⚠ CAUTION

Oil fill plug not tight enough.

Failure to secure oil fill plug could cause bodily injury if the plug is blown out.

- When replacing the oil, fully tighten the oil fill plug.

⚠ WARNING

The vacuum pump is underfilled with oil.

Risk of fire!

- Insufficient oil quantity in the vacuum pump has the potential, under certain conditions, to lead to self-ignition of the remaining oil in the vacuum pump.

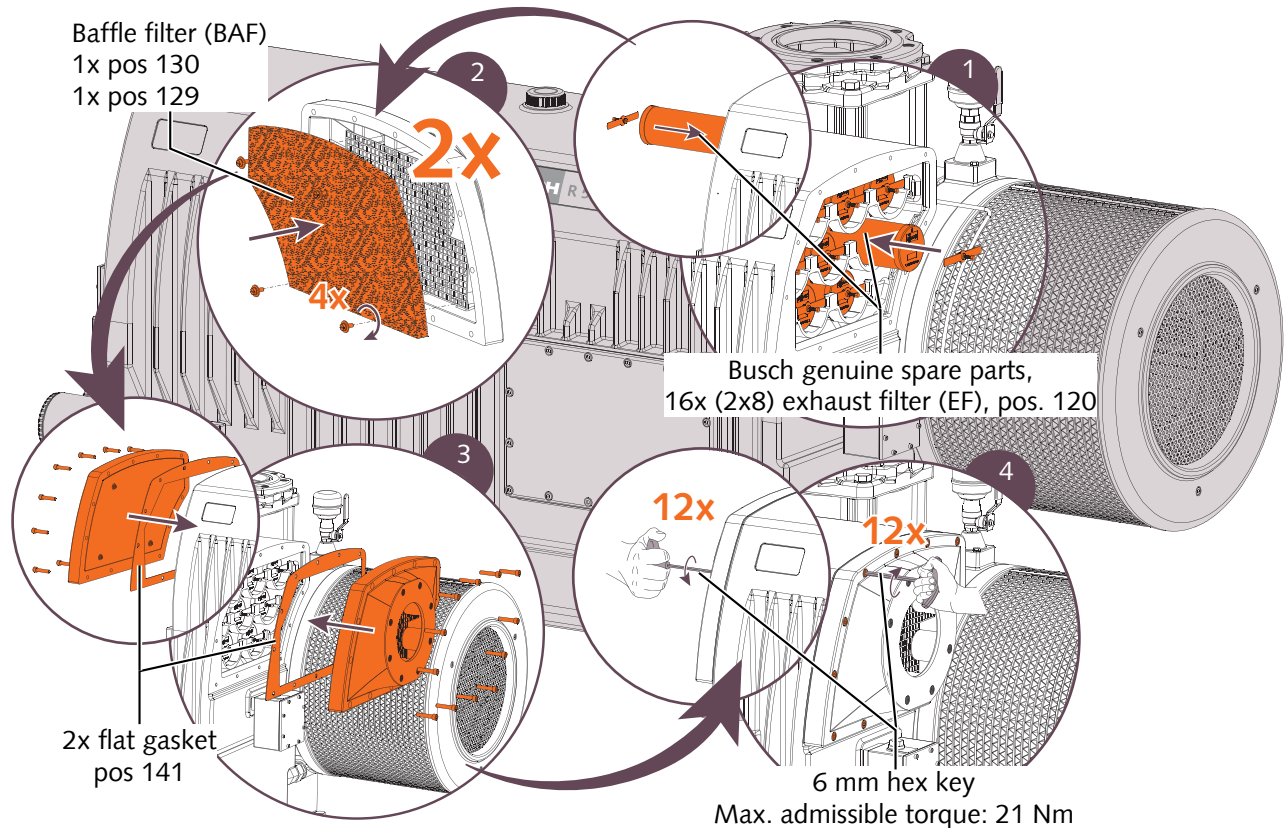
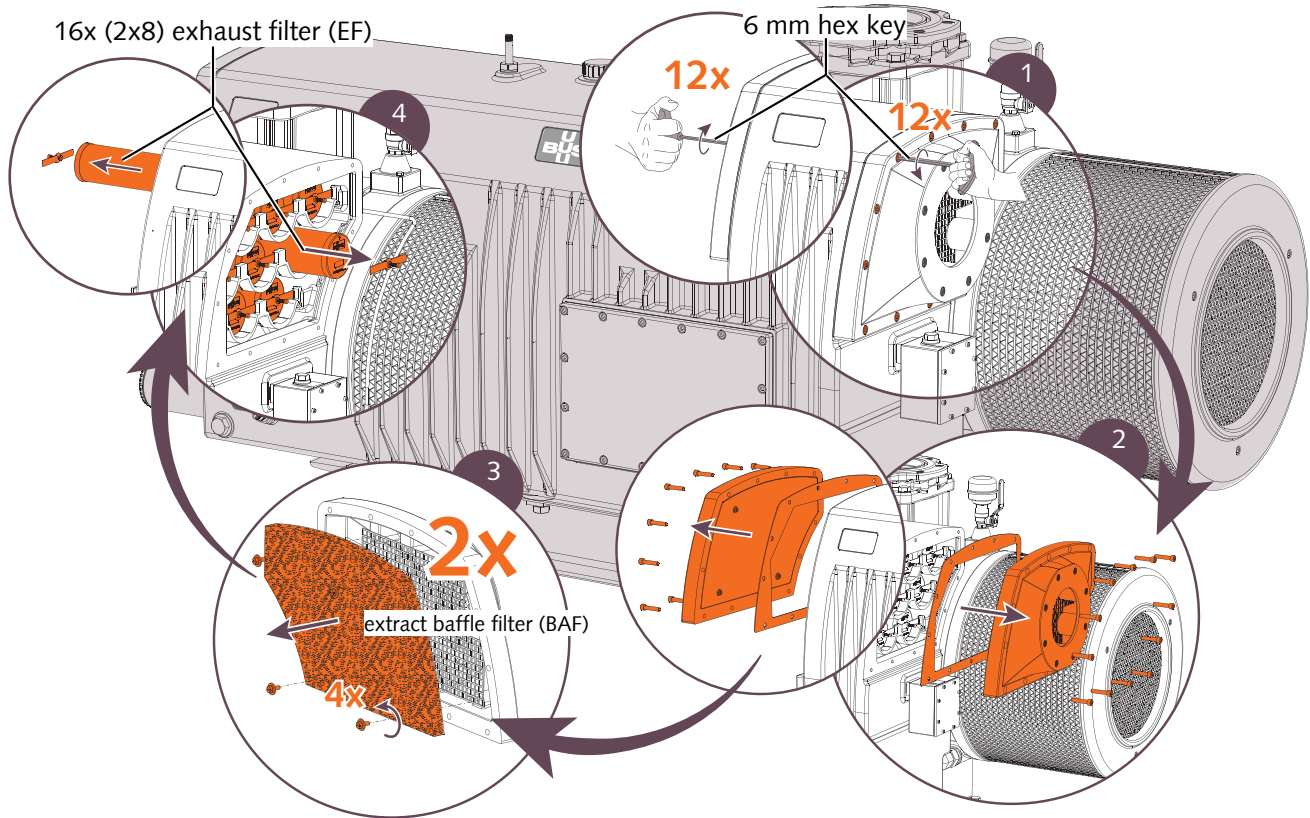
⚠ WARNING

Degraded oil build up in oil lines.

Risk of fire!

- When changing the oil, it may be necessary to flush the vacuum pump to remove any build-up of degraded oil from the sumps, oil lines, radiators, etc., to ensure proper oil flow through the pump. Reduced oil flow, especially through radiators and cooling coils, can cause mechanical damage or extreme overheating, which could cause the oil vapors to ignite.

7.4 Exhaust Filter Change



CAUTION

Installing or removing exhaust filter spring retainers

Risk of flying parts.

- Wear safety glasses when installing or removing spring retainers for the exhaust filters. The retainers can, if not secured correctly, slip off and fly out of the exhaust box.

8 Overhaul

NOTICE

Improper assembly.

Risk of premature failure!

Loss of efficiency!

- It is highly recommended that any dismantling of the vacuum pump beyond what is described in this manual should be done through Busch.



WARNING

Vacuum pumps contaminated with hazardous material.

Risk of poisoning!

Risk of infection!

If the vacuum pump is contaminated with hazardous material:

- Wear appropriate personal protective equipment.

If the vacuum pump conveyed gas that was contaminated with foreign materials which are dangerous to health:

- Decontaminate the vacuum pump as well as possible and state the contamination status in a 'Declaration of Contamination'.

Busch will only accept vacuum pumps that come with a complete filled in and legally binding signed 'Declaration of Contamination'.

9 Decommissioning

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

Version with water-oil heat exchanger:

- Turn off the water supply.
- Disconnect the water supply.
- Open the water bypass valve (WBV).
- Clean the cooling water inlet with compressed air.
- Disconnect all connections.

If the vacuum pump is going to be stored:

- See Storage [► 7].

9.1 Dismantling and Disposal

- Drain the oil.
- Remove the exhaust filters.
- Remove the oil filter.
- Separate special waste from the vacuum pump.
- Dispose of special waste in compliance with applicable regulations.
- Dispose of the vacuum pump as scrap metal.

10 Spare Parts

NOTICE

Use of non-Busch genuine spare parts.

Risk of premature failure!

Loss of efficiency!

- The exclusive use of Busch genuine spare parts and consumables is recommended for the proper function of the vacuum pump and for granting of warranty.
- Contact your Busch representative if you need any spare parts.

11 Troubleshooting

DANGER

Live wires.

Risk of electrical shock.

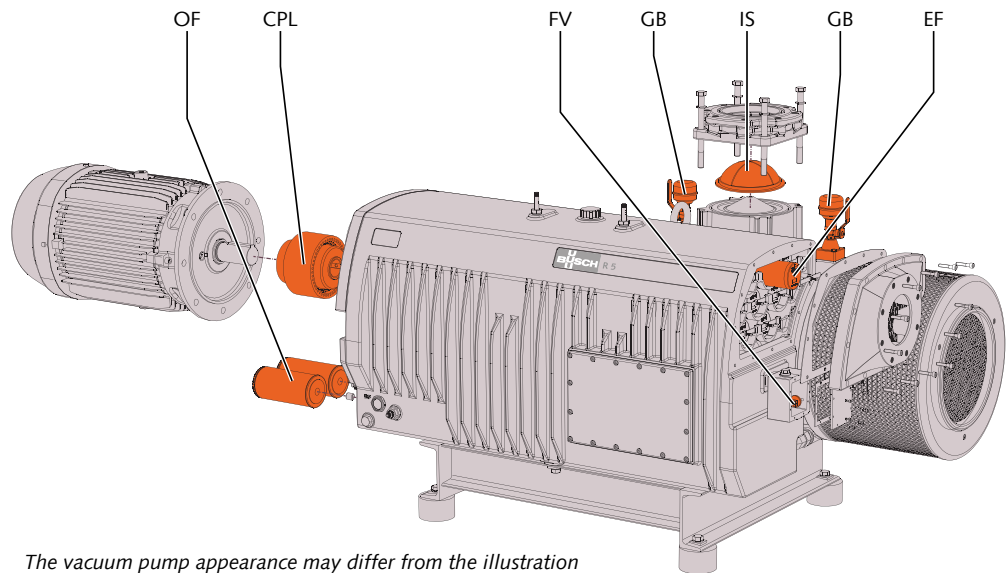
- Electrical installation work must only be executed by qualified personnel.

CAUTION

Hot surface.

Risk of burns!

- Prior to touching the vacuum pump, let the vacuum pump cool down.



The vacuum pump appearance may differ from the illustration

Problem	Possible Cause	Remedy
The vacuum pump does not start.	The motor is not supplied with the correct voltage.	<ul style="list-style-type: none"> • Check the power supply.
	The motor starter overload settings are too low or trip level is too low.	<ul style="list-style-type: none"> • Check overload settings in motor starter for size and set according to motor nameplate data.
	A fuse is blown.	<ul style="list-style-type: none"> • Check the fuses, replace if necessary.
	Connection wiring is too small or runs are too long causing too great a voltage drop.	<ul style="list-style-type: none"> • Use proper wire size.
	Pump or motor is seized.	<ul style="list-style-type: none"> • Remove fan cover and try to turn the pump and motor by hand. If frozen, remove motor from pump and check motor and pump separately. If pump is frozen, contact Busch service.
	The motor is defective.	<ul style="list-style-type: none"> • Replace the motor.
	The coupling (CPL) is defective.	<ul style="list-style-type: none"> • Replace the coupling (CPL).

The vacuum pump starts, but labors and draws a very high current.	Vacuum pump runs in the wrong direction	<ul style="list-style-type: none"> • Swap any two motor leads
	Vacuum pump is overfilled with oil or wrong kind of oil is used	<ul style="list-style-type: none"> • Correct the oil level and quantity per Technical Data Table [▶ 29].
	Exhaust filters in exhaust chamber are clogged and appear to be burned black with pump oil	<ul style="list-style-type: none"> • Replace exhaust filters. Maintain proper oil condition and oil level, and use only Busch recommended vacuum oil.
	The exhaust filter is clogged due to process material	<ul style="list-style-type: none"> • Contact Busch for process recommendations
	Loose connection in motor terminal box; not all motor coils are properly connected. Motor operates on two phases only.	<ul style="list-style-type: none"> • Check motor wiring diagram for proper hookup, especially on motors with six internal motor windings. Tighten and/or replace loose connections.
	Vanes broken	<ul style="list-style-type: none"> • Contact Busch service.
	Seized bearing	<ul style="list-style-type: none"> • Contact Busch service.
	Foreign object in pump	<ul style="list-style-type: none"> • Remove foreign object

The vacuum pump does not reach the usual pressure on the suction connection.	Oil is contaminated.	<ul style="list-style-type: none"> • Change oil (see Oil and Oil Filter Change [▶ 18]).
	Leakage in suction line.	<ul style="list-style-type: none"> • Check the piping for leaks.
	The inlet screen (IS) is partially clogged.	<ul style="list-style-type: none"> • Clean the inlet screen (IS).
	Oil level too low.	<ul style="list-style-type: none"> • Top up oil.
	The oil filter (OF) is dirty or clogged.	<ul style="list-style-type: none"> • Change the oil and replace the oil filter (see Oil and Oil Filter Change [▶ 18]).
	The anti-suck back valve is stuck in the closed or partially open position due to contamination.	<ul style="list-style-type: none"> • Disassemble anti-suck back valve and screen. Clean as required.
	The oil tubing is plugged or leaking.	<ul style="list-style-type: none"> • Replace or clean tubing. Check and retighten oil tubing fittings (contact Busch service).
	The shaft seal is leaking.	<ul style="list-style-type: none"> • Contact Busch service.
	Vanes are blocked in the rotor or they are damaged.	<ul style="list-style-type: none"> • Contact Busch service.
	The radial clearance between the rotor and the cylinder is no longer correct.	<ul style="list-style-type: none"> • Contact Busch service.
	The exhaust valve is not properly seated or it is partially stuck open (RA models only).	<ul style="list-style-type: none"> • Contact Busch service.
	The inlet filter cartridge (optional) is partially clogged.	<ul style="list-style-type: none"> • Replace the inlet filter cartridge.
	Internal parts are worn or damaged.	<ul style="list-style-type: none"> • Contact Busch service.
	The vacuum pump runs very noisily.	Worn coupling (CPL).
Stuck vanes.		<ul style="list-style-type: none"> • Contact Busch service.
Defective bearings.		<ul style="list-style-type: none"> • Contact Busch service.
The vacuum pump runs too hot.	Insufficient cooling.	<ul style="list-style-type: none"> • Remove dust and dirt from the exterior of the vacuum pump . • Check the cooling fan.
	Ambient temperature too high.	<ul style="list-style-type: none"> • Observe the permitted ambient temperature.
	Oil filter (OF) is clogged.	<ul style="list-style-type: none"> • Change the oil and oil filter (see Oil and Oil Filter Change [▶ 18]).
	Oil change intervals are too long.	<ul style="list-style-type: none"> • Flush the vacuum pump (contact Busch service).
	Oil level too low.	<ul style="list-style-type: none"> • Top up oil.
	The exhaust filters (EF) are partially clogged.	<ul style="list-style-type: none"> • Replace the exhaust filters (EF).

Pump is seized	Pump was operated without oil; pump was operated for an extended period of time in the wrong direction.	<ul style="list-style-type: none"> • Contact Busch service.
	Liquid carryover into the cylinder broke vanes while the pump was running	<ul style="list-style-type: none"> • Contact Busch service. Install liquid separator on the inlet of the vacuum pump.
	Pump was overfilled with oil in oil reservoir.	<ul style="list-style-type: none"> • Contact Busch service. Follow Oil and Oil Filter Change [▶ 18] procedure and do not overfill.
	A second vacuum pump or a vacuum receiver is connected to the inlet of the pump.	<ul style="list-style-type: none"> • Contact Busch service. Install a non-return valve on the inlet of each vacuum pump.
The Oil Filter (OF) does not get warm within 2-5 minutes when cold pump is started.	Oil filter is clogged	<ul style="list-style-type: none"> • Change oil and oil filter (see Oil and Oil Filter Change [▶ 18]).
	Wrong oil filter is installed.	<ul style="list-style-type: none"> • Use only Busch approved oil filter.
	Oil lines are clogged	<ul style="list-style-type: none"> • Clean oil lines; flush oil cooler (contact Busch service).
	Motor has failed	<ul style="list-style-type: none"> • Service or replace motor (contact Busch service).
The vacuum pump fumes or expels oil droplets through the gas discharge.	The exhaust filters (EF) are partially clogged.	<ul style="list-style-type: none"> • Replace the exhaust filters (EF).
	An exhaust filter (EF) with o-ring is not fitted properly.	<ul style="list-style-type: none"> • Ensure the correct position of the exhaust filters (EF) and the o-rings.
	The float valve (FV) does not work properly.	<ul style="list-style-type: none"> • Check the float valve and oil piping for correct operation (contact Busch service).
	Oil return line is clogged.	<ul style="list-style-type: none"> • Clean or replace clogged line. Check that oil is being drawn out of the exhaust filter area while the vacuum pump is operating.
The oil is black.	Oil change intervals are too long.	<ul style="list-style-type: none"> • Flush the vacuum pump (contact Busch).
	The inlet filter (optional) is defective.	<ul style="list-style-type: none"> • Replace the inlet filter.
	The vacuum pump runs too hot.	<ul style="list-style-type: none"> • See problem "The vacuum pump runs too hot".

The oil is emulsified.	The vacuum pump sucked in liquids or significant amounts of vapour.	<ul style="list-style-type: none">• Flush the vacuum pump (contact Busch).• Clean the filter of the gas ballast valve (GB).• Modify the operational mode (see Conveying Condensable Vapours [▶ 15]).
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For the solution of problems not mentioned in the troubleshooting chart contact your Busch representative.

12 Technical Data

		RA 1000 B RC 1000 B	RA 1600 B RC 1600 B
Nominal pumping speed	ACFM	710	1060
Ultimate pressure (without gas ballast valve)	Torr abs.	For RA version: 0.225 ... 0.375 ► see nameplate (NP) For RC version: 15	
Ultimate pressure (with gas ballast valve)	Torr abs.	For RA version: 0.375 ... 0.75 For RC version: 15	
Nominal motor speed	RPM	1200	
Nominal motor speed range	RPM	800 ... 1200	
Nominal motor rating	hp	40.0	50.0
Motor rating at 75 Torr	hp	30.0	44.2
Motor rating at ultimate pressure	hp	16.2	24.0
Noise level (EN ISO 2151)	dB(A)	82	83
Water vapour tolerance max. (with gas ballast valve)	Torr	22.5	
Water vapour capacity (with gas bal- last valve)	kg / h	19	27
Operating temperature	°F	176	
Max. allowable back pressure	PSI	3	
Max. allowable gas inlet temperature	°F	≤37.5 Torr ► 300	
		>37.5 Torr ► 175	
Ambient temperature range	°F	See Oil [► 29]	
Ambient pressure		Atmospheric pressure	
Oil capacity	Qts.	42	44
Weight approx.	Lbs.	2151	2833
Exhaust temperature switch setpoint.	°F	250	260

13 Oil

	R-530	R-590	R-570
ISO-VG	100	100	100
Oil type	Mineral oil	Synthetic oil	Synthetic oil
Ambient temperature range [°F]	41 - 86	41 - 104	41 - 104

14 EU Declaration of Conformity

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

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

The manufacturer

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



declare that the vacuum pump(s): **R 5 RA/RC 1000 B; RA/RC 1600 B**

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

- 'Machinery' 2006/42/EC
- 'Electromagnetic Compatibility' 2014/30/EU
- 'RoHS' 2011/65/EU, restriction of the use of certain hazardous substances in electrical and electronic equipment

and following the standards.

Standard	Title of the Standard
EN ISO 12100:2010	Safety of machinery - Basic concepts, general principles of design
EN ISO 13857:2008	Safety of machinery - Safety distances to prevent hazard zones being reached by the upper and lower limbs
EN 1012-1:2010 EN 1012-2:1996 + A1:2009	Compressors and vacuum pumps - Safety requirements - Part 1 and Part 2
EN ISO 2151:2008	Acoustics - Noise test code for compressors and vacuum pumps - Engineering method (grade 2)
EN 60204-1:2006	Safety of machinery - Electrical equipment of machines - Part 1: General requirements
EN 61000-6-2:2005	Electromagnetic compatibility (EMC) - Generic standards. Immunity for industrial environments
EN 61000-6-4:2007 + A1:2011	Electromagnetic compatibility (EMC) - Generic standards. Emission standard for industrial environments
EN ISO 13849-1:2015 ⁽¹⁾	Safety of machinery - Safety-related parts of control systems - Part 1: General principles for design

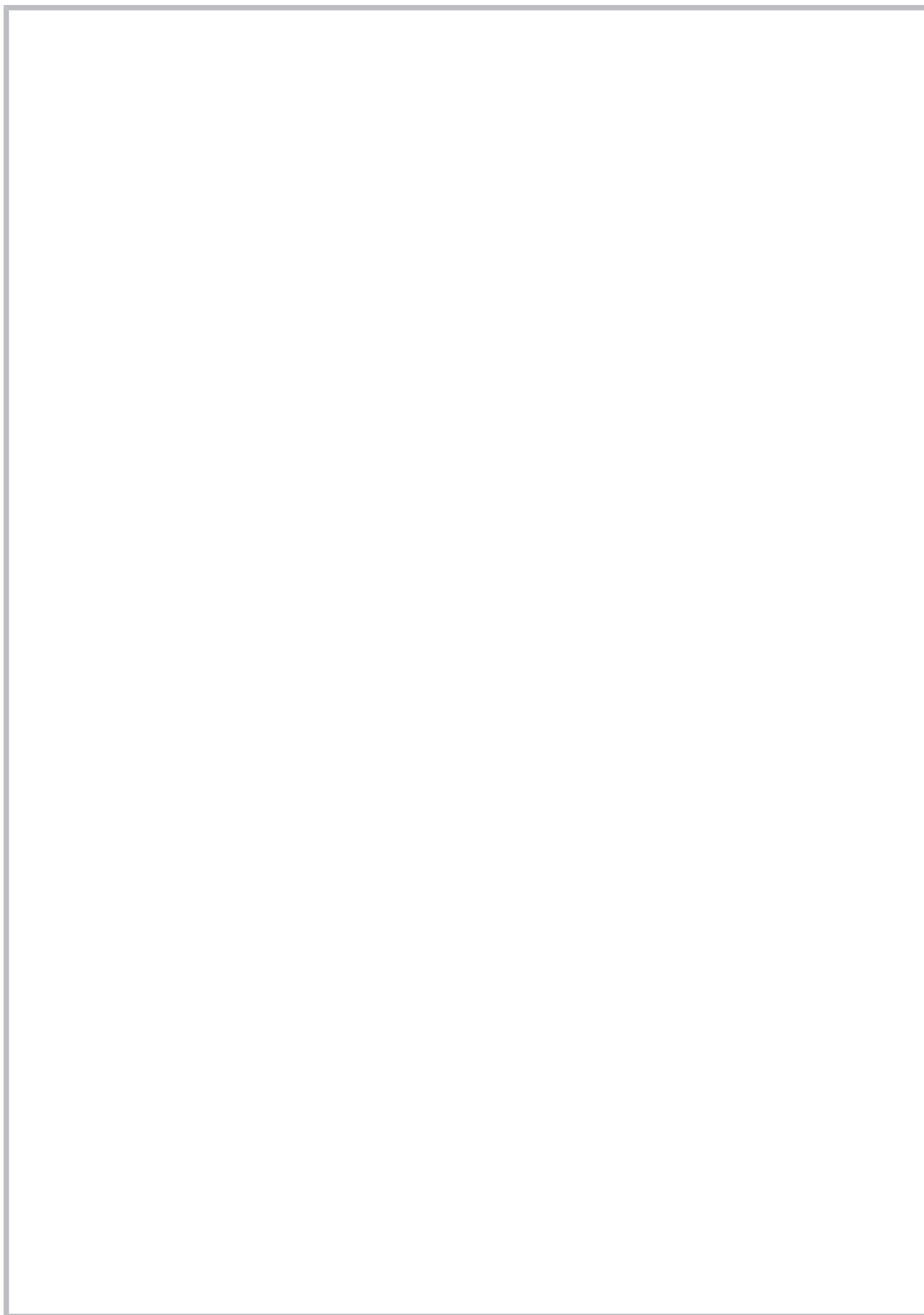
Person authorised to compile the technical file:

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Chevenez, 11.01.2018

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⁽¹⁾ In case control systems are integrated.



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