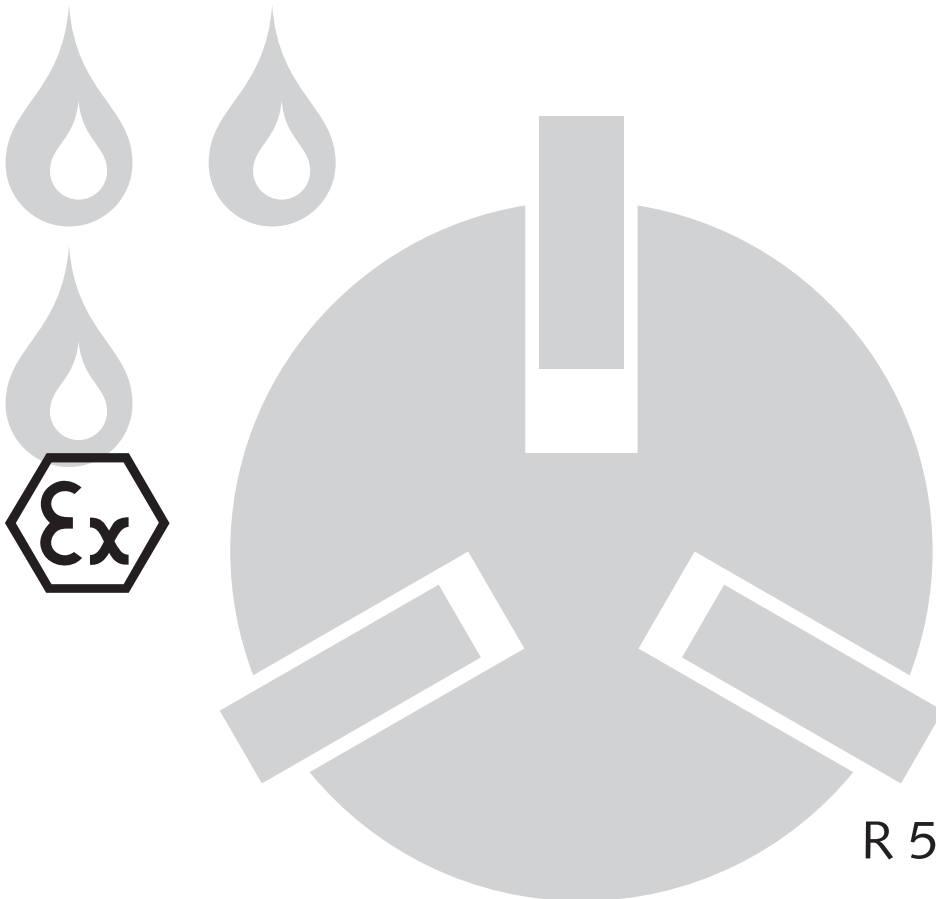




Installation and Operating Instructions



Vacuum Pumps

R 5 RA 0025 - 0100 F

ATEX-Version Cat. 3(i) D



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Preface

Congratulations on your purchase of the Busch vacuum pump. With watchful observation of the field's requirements, innovation and steady development Busch delivers modern vacuum and pressure solutions worldwide.

These operating instructions contain information for

- product description,
- safety,
- transport,
- storage,
- installation and commissioning,
- maintenance,
- overhaul,
- troubleshooting and
- spare parts

of the vacuum pump.

The ATEX-drive motor is subject to a separate instruction manual.

For the purpose of these instructions, "handling" the vacuum pump means the transport, storage, installation, commissioning, influence on operating conditions, maintenance, troubleshooting and overhaul of the vacuum pump.

Prior to handling the vacuum pump these operating instructions shall be read and understood. If anything remains to be clarified please contact your Busch representative!

Keep these operating instructions and, if applicable, other pertinent operating instructions available on site.

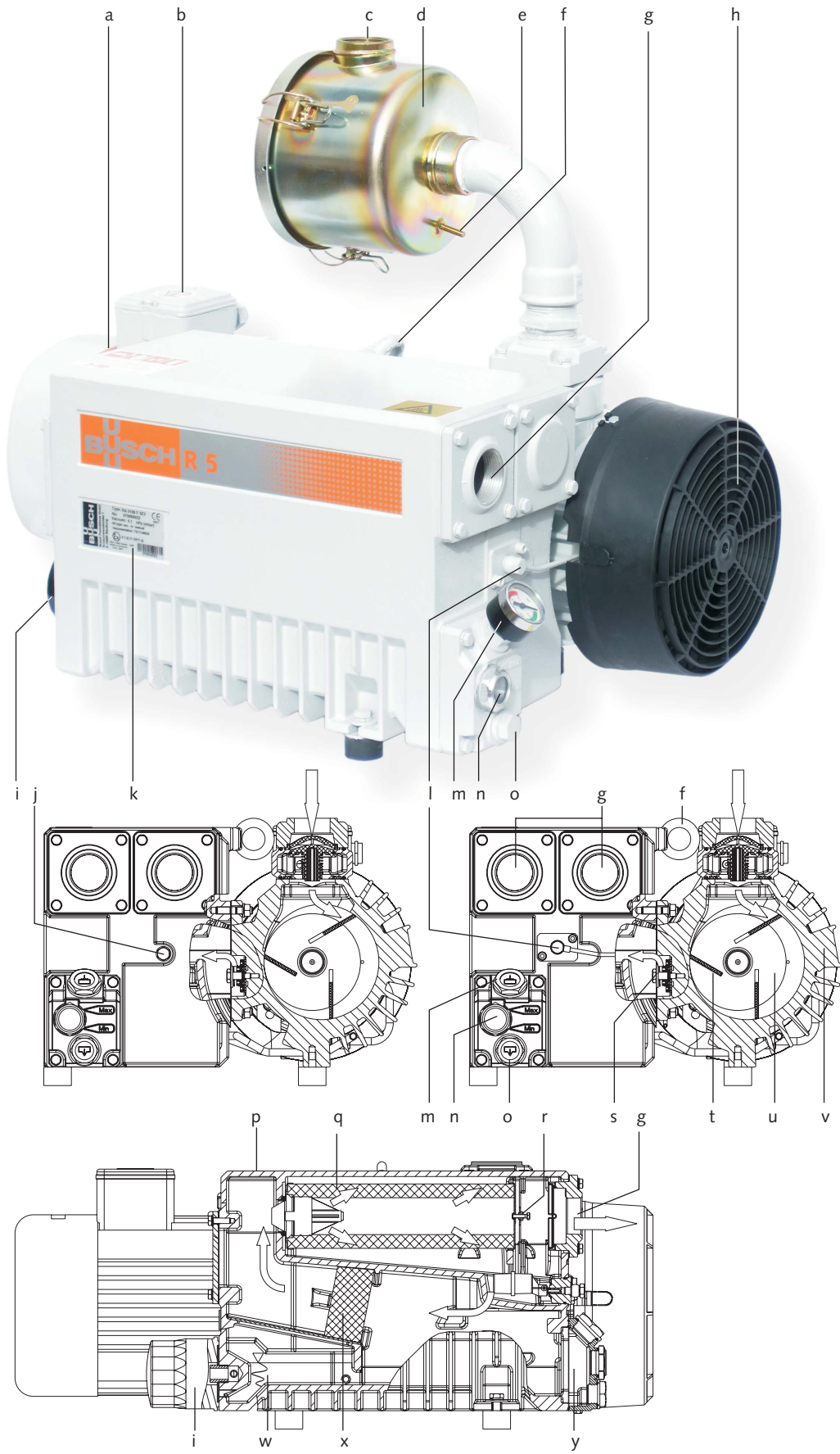


Illustration shows RA 0100 F,
RA 0025 - 0100 F are similar

- a Directional arrow
- b Terminal box
- c Suction connection
- d Inlet air filter
- e Connection for equipotential bonding, inlet air filter
- f Eye bolt
- g Gas discharge
- h Axial flow fan
- i Oil filter
- j Oil return valve (version with oil return valve only)
- k Nameplate, vacuum pump
- l Float valve with oil return line (version with float valve and oil return line only)
- m Oil fill plug / Oil fill plug with filter pressure gauge (optional)
- n Oil sight glass
- o Oil drain plug
- p Oil separator
- q Exhaust filter
- r Filter spring
- s Exhaust valve
- t Vane
- u Rotor
- v Cylinder
- w Oil sump
- x Demister
- y Service cover

Product Description

Use

The vacuum pump is intended for

- the suction

of

- mixtures of dry non-aggressive and non-toxic gases and/or dust according to the identification on the nameplate of the vacuum pump (explanation see below)

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

Permissible temperature range of the inlet gas: see "Oil", "Ambient temperature range"

The classification on the vacuum pump is to be read as follows (interpretations of equipment categories and zones for information only; the relevant laws, directives and standards are literally binding; for temperature classes and explosion groups see E. Brandes, W. Möller "Sicherheitstechnische Kenngrößen, Band 1: Brennbare Flüssigkeiten und Gase", ISBN 3-89701-745-8 (or equivalent source)):

II 3(i) D 125°C (i)

Group II, for non-mining applications, in the process gas explosive atmosphere in the form of a cloud of combustible dust in air not likely to occur in normal operation but, if it does occur, will persist for a short period only (equipment category 3, for zone 22);

maximum permissible surface temperature for the dust/air mixture in the process gas greater equal 125 °C (acc. to EN 50281-2-1 or IEC 61241-2-1 resp.).

Not for explosive atmospheres consisting of mixtures with air of flammable substances in the form of gas.

Not for potentially explosive atmospheres in the environment.

The use of the supplied inlet air filter with equipotential bonding including the pertinent filter cartridge with equipotential bonding is required.

In case the vacuum pump is equipped with a gas ballast (optional) water vapour within the gas flow can be tolerated within certain limits (→ page 10: Conveying Condensable Vapours). The conveyance of other vapours shall be agreed upon with Busch.

Version with float valve (I, 200) and oil return line:

The vacuum pump is thermally suitable for continuous operation (100 percent duty).

Version with oil return valve:

The vacuum pump is thermally suitable for continuous operation (observe the notes with regard to the oil recirculation: → page 4: Oil Circulation; → page 10: Oil Return).

The vacuum pump is ultimate pressure proof.

The approval for use in potentially explosive atmospheres is valid for the vacuum pump together with the supplied inlet air filter. The approval is void if the system is altered or if the scheduled maintenance is not complied with. Maintenance must be performed by specifically instructed personnel only.

Principle of Operation

The vacuum pump works on the rotating vane principle.

A circular rotor (u) is positioned centrally on the shaft of the vacuum pump. The shaft of the vacuum pump is driven by the drive motor shaft by means of a flexible coupling.

The rotor (u) rotates in an also circular, fixed cylinder, the centreline of which is offset from the centreline of the rotor such that the rotor and the inner wall of the cylinder almost touch along a line. Vanes (t), sliding in slots in the rotor, separate the space between the rotor and the cylinder into chambers. At any time gas is sucked in and at almost any time ejected. Therefore the vacuum pump works almost pulsation free.

In order to avoid the suction of dust, the vacuum pump is equipped with an air filter (d) on the suction connection.

In order to avoid the suction of solids, the vacuum pump is equipped with a screen (261) in the suction connection.

In order to avoid reverse rotation after switching off, the vacuum pump is equipped with a non-return valve.

Note: This valve shall not be used as a non-return valve or shut-off valve to the vacuum system and is no reliable means to prevent suction of oil into the vacuum system while the vacuum pump is shut down.

In case the vacuum pump is equipped with a gas ballast (optional):

Through the gas ballast (440) a small amount of ambient air is sucked into the pump chamber and compressed together with the process gas.

This counteracts the accumulation of condensates from the process gas inside the vacuum pump (→ page 10: Conveying Condensable Vapours).

The gas ballast line is equipped either with a paper filter or with a sinter metal filter.

Gas ballast version with ball valve:

The gas ballast line can be closed partially or completely by means of a ball valve.

In order to improve the operating characteristics the outlet of the pump chamber is equipped with a spring loaded valve (s).

Oil Circulation

The vacuum pump requires oil to seal the gaps, to lubricate the vanes (t) and to carry away compression heat.

The oil reservoir is located on the pressure side of the vacuum pump (i.e. high pressure) at the bottom of the bottom chamber of the oil separator (p).

The feed openings are located on the suction side of the vacuum pump (i.e. low pressure).

Forced by the pressure difference between pressure side and suction side oil is being drawn from the oil separator (p) through the oil supply lines and injected on the suction side.

Together with the sucked gas the injected oil gets conveyed through the vacuum pump and ejected into the oil separator (p) as oil mist. Oil that separates before the exhaust filters (q, 120) accumulates at the bottom of the bottom chamber of the oil separator (p).

Oil that is separated by the exhaust filters (q, 120) accumulates at the bottom of the upper chamber of the oil separator (p).

The flow resistance of the exhaust filters (q, 120) causes the inside of the exhaust filters (which is connected to the bottom chamber of the oil separator) to be on a higher pressure level than the outside of the exhaust filters (i.e. the upper chamber of the oil separator). Because of the higher pressure in the bottom chamber it is not possible to let oil that drips off the exhaust filters simply flow down to the bottom chamber.

Version with float valve and oil return line to the suction connection (I, 200):

Therefore the oil that accumulates in the upper chamber is sucked through the float valve (I, 200) and the oil return line (I) to the suction connection.

Version with oil return valve:

At continuous operation this would cause the entire supply of oil to accumulate at the bottom of the upper chamber, expel oil droplets through the gas discharge/pressure connection and let the vacuum pump run dry. Therefore the vacuum pump must be shut down at the latest after 10 hours of continuous operation, depending on the operating conditions even after a shorter period, for at least approx. 15 minutes (→ page 9: Operation Notes). After turning off the vacuum pump the pressure difference between the inside and the outside of the exhaust filter(s) (q, 120) collapses, hence the two chambers of the oil separator assume an equal pressure level, the oil return valve between the two chambers opens and the accumulated oil in the upper chamber can run down to the bottom chamber.

Cooling

The vacuum pump is cooled by

- radiation of heat from the surface of the vacuum pump incl. oil separator (p)
- the air flow from the fan wheel of the drive motor
- the process gas
- the air flow from the fan wheel (h) on the shaft of the vacuum pump

Start Controls

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

Safety

Intended Use

Definition: For the purpose of these instructions, "handling" the vacuum pump means the transport, storage, installation, commissioning, influence on operating conditions, maintenance, troubleshooting and overhaul of the vacuum pump.

The vacuum pump is intended for industrial use. It shall be handled only by qualified personnel.

The allowed media and operational limits (→ page 3: Product Description) and the installation prerequisites (→ page 6: Installation Prerequisites) of the vacuum pump shall be observed both by the manufacturer of the machinery into which the vacuum pump is to be incorporated and by the operator.

In particular the intended use in potentially explosive areas, i.e. either inside the vacuum pump or in its adjacency potentially explosive atmosphere can occur, requires that the vacuum pump is equipped accordingly and carries the Ex-mark and that the associated documentation acc. to the directive 94/9/EC is available.

The maintenance instructions shall be observed.

Prior to handling the vacuum pump these installation and operating instructions shall be read and understood. If anything remains to be clarified please contact your Busch representative!

Safety Notes

The vacuum pump has been designed and manufactured according to state-of-the-art methods. Nevertheless, residual risks may remain. These operating instructions highlight potential hazards where appropriate. Safety notes are tagged with one of the keywords DANGER, WARNING and CAUTION as follows:



DANGER

Disregard of this safety note will always lead to accidents with fatal or serious injuries.



WARNING

Disregard of this safety note may lead to accidents with fatal or serious injuries.



CAUTION

Disregard of this safety note may lead to accidents with minor injuries or property damage.

Emission of Oil Mist

The oil in the process gas is separated to the greatest possible extent, but not perfectly.



CAUTION

The gas conveyed by the vacuum pump contains remainders of oil.

Aspiration of process gas over extended periods can be harmful.

The room into which the process gas is discharged must be sufficiently vented.

Note: The possibly sensible smell is not caused by droplets of oil, though, but either by gaseous process components or by readily volatile and thus gaseous components of the oil (particularly additives).

Noise Emission

For the sound pressure level in free field according to EN ISO 2151 → page 23: Technical Data.

Transport

Note: Also a vacuum pump, that is not topped up with oil contains residues of oil (from the test run). Always transport and store the vacuum pump in upright position. Do not put the vacuum pump on its side nor put it upside down.

Transport in Packaging

Packed on a pallet the vacuum pump is to be transported with a forklift.

Transport without Packaging

In case the vacuum pump is packed in a cardboard box with inflated cushions:

- ◆ Remove the inflated cushions from the box

In case the vacuum pump is in a cardboard box cushioned with rolled corrugated cardboard:

- ◆ Remove the corrugated cardboard from the box

In case the vacuum pump is laid in foam:

- ◆ Remove the foam

In case the vacuum pump is bolted to a pallet or a base plate:

- ◆ Remove the bolting between the vacuum pump and the pallet/base plate

In case the vacuum pump is fastened to the pallet by means of tightening straps:

- ◆ Remove the tightening straps



CAUTION

Do not walk, stand or work under suspended loads.

- Make sure that the eyebolt (f) is in faultless condition (replace a damaged, e.g. bent eyebolt with a new one)
- Make sure that the eyebolt (f) is fully screwed in and tightened by hand
- Attach lifting gear securely to the eyebolt (f) on the oil separator
- Attach the lifting gear to a crane hook with safety latch
- Lift the vacuum pump with a crane

In case the vacuum pump was bolted to a pallet or a base plate:

- ◆ Remove the stud bolts from the rubber feet



CAUTION

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 (t) and ruin the vacuum pump.

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

- Prior to every transport make sure that the oil is drained

Storage

Short-term Storage

Version with gas ballast with ball-valve:

- ◆ Make sure that the ball-valve of the gas ballast device (440) is closed

Version with gas ballast without ball-valve, with sinter metal filter:

- ◆ Close the sinter metal filter of the gas ballast device (440) with adhesive tape

Version with gas ballast without ball-valve, with paper filter:

- ◆ Close the paper filter of the gas ballast device (440) with adhesive tape
- Make sure that the suction connection and the gas discharge are closed (leave the provided plugs in)
- Store the vacuum pump
 - if possible in original packaging,
 - indoors,
 - dry,
 - dust free and
 - vibration free

Conservation

In case of adverse ambient conditions (e.g. aggressive atmosphere, frequent temperature changes) conserve the vacuum pump immediately. In case of favourable ambient conditions conserve the vacuum pump if a storage of more than 3 months is scheduled.

During the test run in the factory the inside of the vacuum pump was completely wetted with oil. Under normal conditions a treatment with conservation oil is therefore not required. In case it is advisable to treat the vacuum pump with conservation oil because of very adverse storage conditions, seek advice from your Busch representative!

Version with gas ballast with ball-valve:

- ◆ Make sure that the ball-valve of the gas ballast (440) is closed

Version with gas ballast without ball-valve, with sinter metal filter:

- ◆ Close the sinter metal filter of the gas ballast (440) with adhesive tape

Version with gas ballast without ball-valve, with paper filter:

- ◆ Close the paper filter of the gas ballast (440) with adhesive tape
- Make sure that all ports are firmly closed; seal all ports that are not sealed with PTFE-tape, gaskets or o-rings with adhesive tape

Note: VCI stands for "volatile corrosion inhibitor". VCI-products (film, paper, cardboard, foam) evaporate a substance that condenses in molecular thickness on the packed good and by its electro-chemical properties effectively suppresses corrosion on metallic surfaces. However, VCI-products may attack the surfaces of plastics and elastomers. Seek advice from your local packaging dealer! Busch uses CORTEC VCI 126 R film for the overseas packaging of large equipment.

- Wrap the vacuum pump in VCI film
- Store the vacuum pump
 - if possible in original packing,
 - indoors,
 - dry,
 - dust free and
 - vibration free.

For commissioning after conservation:

- Make sure that all remains of adhesive tape are removed from the ports
- Commission the vacuum pump as described in the chapter Installation and Commissioning (→ page 6)

Installation and Commissioning

Installation Prerequisites



CAUTION

In case of non-compliance with the installation prerequisites, particularly in case of insufficient cooling:

Risk of damage or destruction of the vacuum pump and adjoining plant components!

Risk of injury!

The installation prerequisites must be complied with.

- Make sure that the integration of the vacuum pump is carried out such that the essential safety requirements of the Machine Directive 2006/42/EC are complied with (in the responsibility of the designer of the machinery into which the vacuum pump is to be incorporated; → page 22: note in the EC-Declaration of Conformity)

Mounting Position and Space

- Make sure that the following ambient conditions will be complied with:
 - ambient temperature: see "Oil"
 - If the vacuum pump is installed in a colder environment than allowed with the oil used:
 - ◆ Fit the vacuum pump with a temperature switch and control the vacuum pump such that it will start automatically when the oil sump temperature falls below the allowed temperature
 - ambient pressure: atmospheric
- Make sure that the environmental conditions comply with the protection class of the drive motor (according to the nameplate)
- Make sure that the vacuum pump can neither inadvertently nor intentionally be stepped on and cannot be used as a support for heavy objects
- Make sure that the vacuum pump cannot be hit by falling objects
- Make sure that the vacuum pump will be placed or mounted horizontally
- Make sure that in order to warrant a sufficient cooling there will be a clearance of minimum 20 cm between the vacuum pump and nearby walls
- Make sure that no heat sensitive parts (plastics, wood, cardboard, paper, electronics) will touch the surface of the vacuum pump
- Make sure that the installation space or location is vented such that a sufficient cooling of the vacuum pump is warranted



CAUTION

During operation the surface of the vacuum pump may reach temperatures of more than 70 °C.

Risk of burns!

- Make sure that the vacuum pump will not be touched inadvertently during operation, provide a guard if appropriate
- Make sure that the sight glass (n, 83) will remain easily accessible

If the oil change is meant to be performed on location:

- ◆ Make sure that the drain port (o, 95), the oil filter (i, 100) and the filling port (m, 88) will remain easily accessible
- Make sure that enough space will remain for the removal and the reinsertion of the exhaust filters (q, 120)

Suction Connection



CAUTION

Intruding foreign objects or liquids can destroy the vacuum pump.

- Make sure that the suction line will be connected via the supplied inlet air filter (with equipotential bonding)
- Make sure that the suction line fits to the suction connection (c) of the vacuum pump
- Make sure that the pipe will cause no stress on the vacuum pump's connection, if necessary use an expansion joint
- Make sure that the line size of the suction line over the entire length is at least as large as the suction connection (c) of the vacuum pump

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

If two or more vacuum pumps work on the same suction line, if the volume of the vacuum system is large enough to suck back oil or if the vacuum shall be maintained after switching off the vacuum pump:

- ◆ Provide a manual or automatic operated valve (= non-return valve) in the suction line

(the standard non-return valve that is installed inside the suction connection is not meant to be used for this purpose!)

If the vacuum pump is planned to be used for the suction of gas that contains limited quantities of condensable vapour:

- ◆ Provide a shut-off valve, a drip-leg and a drain cock in the suction line, so that condensates can be drained from the suction line
- Make sure that the suction line does not contain foreign objects, e.g. welding scales

Gas Discharge

The discharged gas must flow without obstruction. It is not permitted to shut off or throttle the discharge line or to use it as a pressurised air source.



CAUTION

The discharged gas contains small quantities of vacuum oil.

Staying in vacuum oil contaminated air bears a risk of damage to health.

If air is discharged into rooms where persons stay, sufficient ventilation must be provided for.

- Make sure that the discharge line fits to the gas discharge (g) of the vacuum pump
- Make sure that the pipe will cause no stress on the vacuum pump's connection, if necessary use an expansion joint
- Make sure that the line size of the discharge line over the entire length is at least as large as the gas discharge (g) of the vacuum pump

In case the length of the discharge line exceeds 2 m it is prudent to use larger line sizes in order to avoid a loss of efficiency and an overload of the vacuum pump. Seek advice from your Busch representative!

- 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 cock, so that no liquids can back up into the vacuum pump



WARNING

Discharge lines made from non-conductive material can build up static charge.

Static discharge can cause explosion of potentially existing oil mist.

The discharge line must be made of conductive material or provisions must be made against static discharge.

Electrical Connection / Controls

- Make sure that the stipulations acc. to the EMC-Directive 2004/108/EC and Low-Voltage-Directive 2006/95/EC as well as the EN-standards, electrical and occupational safety directives and the local or national regulations, respectively, are complied with (this is the responsibility of the designer of the machinery into which the vacuum pump is to be incorporated; → page 22: note in the EC-Declaration of Conformity).
- Make sure that the power supply for the drive motor is compatible with the data on the nameplate of the drive motor
- Make sure that an overload protection according to EN 60204-1 is provided for the drive motor
- Make sure that the drive of the vacuum pump will not be affected by electric or electromagnetic disturbance from the mains; if necessary seek advice from the Busch service

In case of mobile installation:

- ◆ Provide the electrical connection with grommets that serve as strain-relief
- Make sure that an earth point is available for connection to the inlet air filter

Electrical circuits in zone 1 (outside) shall be executed intrinsically safe in protection class *ib* acc. to EN 50020:2002.

Installation

Mounting

- Make sure that the Installation Prerequisites (→ page 6) are complied with
- Set down or mount the vacuum pump at its location

Connecting Electrically



WARNING

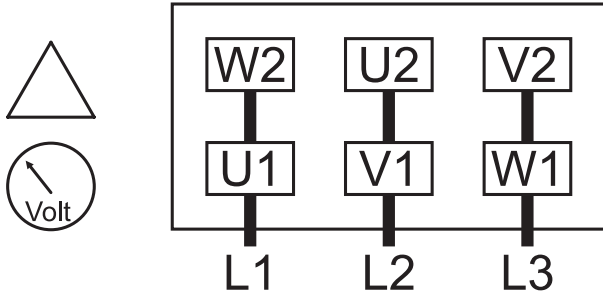
Risk of electrical shock, risk of damage to equipment.

Electrical installation work must only be executed by qualified personnel that knows and observes the following regulations:
- IEC 364 or CENELEC HD 384 or DIN VDE 0100, respectively,
- IEC-Report 664 or DIN VDE 0110,
- BGV A2 (VBG 4) or corresponding national accident prevention regulation.

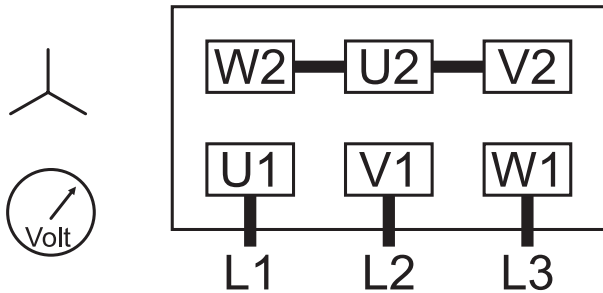
- Electrically connect the drive motor
- Connect the protective earth conductor

Connection Scheme Three-Phase Motor

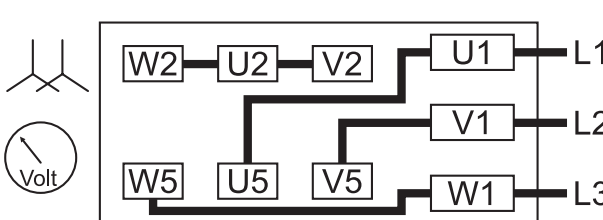
Delta connection (low voltage):



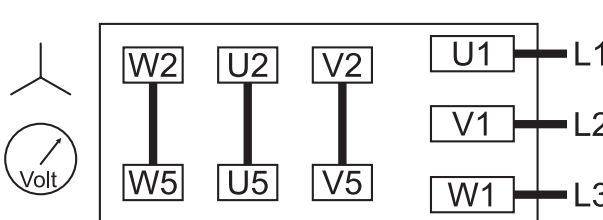
Star connection (high voltage):



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



Star connection, multi-voltage motor (high voltage):



CAUTION

Operation in the wrong direction of rotation can destroy the vacuum pump in short time.

Risk of explosion!

Prior to starting-up it must be made sure that the vacuum pump is operated in the proper direction.

Version with three-phase motor:

- ◆ Determine the intended direction of rotation with the arrow (a) (stuck on or cast)
- ◆ "Bump" the drive motor
- ◆ Watch the fan wheel of the drive motor and determine the direction of rotation just before the fan wheel stops

If the rotation must be changed:

- ◆ Switch any two of the drive motor wires (three-phase motor)
- Connect the housing of the inlet air filter to the earth point with an earth cable

Connecting Lines/Pipes

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

- ◆ Connect the suction line
- Connect the discharge line

Installation without discharge line:

- ◆ Make sure that the gas discharge (g) is open
- Make sure that all provided covers, guards, hoods etc. are mounted
- Make sure that cooling air inlets and outlets are not covered or obstructed and that the cooling air flow is not affected adversely in any other way

Filling Oil

In case the vacuum pump was treated with conservation oil:

- ◆ Drain the remainders of conservation oil



CAUTION

The vacuum pump is shipped without oil.

Operation without oil will ruin the vacuum pump in short time.

Prior to commissioning it must be made positively sure that oil is filled in.

The vacuum pump is delivered without oil (oil specification → page 21: Oil).

- Keep approx. 1.0 litre(s) (RA 0025/0040 F) or 2.0 litre(s) (RA 0063/0100 F) resp. oil acc. to the table Oil (→ page 21) ready

Note: The amount given in these operating instructions is a guide. The sight glass (n, 83) indicates the actual amount to be filled in.

Version with level switch:

- ◆ Make sure that the level switch reports "low level"



CAUTION

Filling oil through the suction connection (c) will result in breakage of the vanes (t) and destruction of the vacuum pump.

Oil may be filled through the filling port (m, 88) only.



CAUTION

During operation the oil separator is filled with hot, pressurised oil mist.

Risk of injury from hot oil mist with open filling port.

Risk of injury if a loosely inserted filling plug (m, 88) is ejected.

Remove the filling plug (m, 88) only if the vacuum pump is stopped.

The vacuum pump must only be operated with the filling plug (m, 88) firmly inserted.

- Remove the filling plug (m, 88)
- Fill in approx. 1.0 litre(s) (RA 0025/0040 F) or 2.0 litre(s) (RA 0063/0100 F) resp. of oil
- Make sure that the level is between the MIN and the MAX-markings of the sight glass (n, 83)

Version with level switch:

- ◆ Make sure the level switch reports correct level
- Make sure that the seal ring (89) is inserted into the filling plug (m, 88) and undamaged, replace if necessary

- Firmly reinsert the filling plug (m, 88) together with the seal ring (89)

Note: Starting the vacuum pump with cold oil is made easier when at this very moment the suction line is neither closed nor covered with a rubber mat.

- Switch on the vacuum pump

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

- ◆ Close the shut-off valve

In case the suction line is not equipped with a shut-off valve:

- ◆ Cover the suction connection (c) with a piece of rubber mat

- Let the vacuum pump run for a few minutes

Version with level switch:

- ◆ Check that the level switch reports correct level
- Shut down the vacuum pump and wait a few minutes
- Shut down the vacuum pump
- Check that the level is between the MIN and the MAX-markings of the sight glass (n, 83)

In case the level has dropped below the MIN-marking:

In case the level switch has reported low level:

- ◆ Top-up oil

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

- ◆ Open the shut-off valve

In case the suction line is not equipped with a shut-off valve:

- ◆ Remove the piece of rubber mat and connect the suction line

Recording of Operational Parameters

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

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

Version with exhaust filter pressure gauge:

- ◆ Read the scale of the exhaust filter pressure gauge and record it as reference for future maintenance and troubleshooting work (→ page 13: Checks during Operation)

Operation Notes

Use



WARNING

The vacuum pump is designed for operation under the conditions described below.

In case of disregard risk of explosion!

The vacuum pump must only be operated under the conditions described below.



WARNING

Operating a faulty vacuum pump puts the explosion safety at risk.

Risk of explosion!

The vacuum pump must only be operated in faultless condition. A faulty vacuum pump must immediately be removed from service.

The vacuum pump is intended for

– the suction

of

- mixtures of dry non-aggressive and non-toxic gases and/or dust according to the identification on the nameplate of the vacuum pump (explanation see below)

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

Permissible temperature range of the inlet gas: see “Oil”, “Ambient temperature range”

The classification on the vacuum pump is to be read as follows (interpretations of equipment categories and zones for information only; the relevant laws, directives and standards are literally binding; for temperature classes and explosion groups see E. Brandes, W. Möller “Sicherheitstechnische Kenngrößen, Band 1: Brennbare Flüssigkeiten und Gase”, ISBN 3-89701-745-8 (or equivalent source)):

⊕ II 3(i) D 125°C (i)

Group II, for non-mining applications, in the process gas explosive atmosphere in the form of a cloud of combustible dust in air not likely to occur in normal operation but, if it does occur, will persist for a short period only (equipment category 3, for zone 22);

maximum permissible surface temperature for the dust/air mixture in the process gas greater equal 125 °C (acc. to EN 50281-2-1 or IEC 61241-2-1 resp.).

Not for explosive atmospheres consisting of mixtures with air of flammable substances in the form of gas.

Not for potentially explosive atmospheres in the environment.

The use of the supplied inlet air filter with equipotential bonding including the pertinent filter cartridge with equipotential bonding is required.

In case the vacuum pump is equipped with a gas ballast (optional) water vapour within the gas flow can be tolerated within certain limits (→ page 10: Conveying Condensable Vapours). The conveyance of other vapours shall be agreed upon with Busch.

Version with float valve (l, 200) and oil return line:

The vacuum pump is thermally suitable for continuous operation (100 percent duty).

Version with oil return valve:

The vacuum pump is thermally suitable for continuous operation (observe the notes with regard to the oil recirculation: → page 4: Oil Circulation; → page 10: Oil Return).

The vacuum pump is ultimate pressure proof.

The approval for use in potentially explosive atmospheres is valid for the vacuum pump together with the supplied inlet air filter. The approval is void if the system is altered or if the scheduled maintenance is not complied with. Maintenance must be performed by specifically instructed personnel only.



CAUTION

During operation the surface of the vacuum pump may reach temperatures of more than 70 °C.

Risk of burns!

The vacuum pump shall be protected against contact during operation, it shall cool down prior to a required contact or heat protection gloves shall be worn.



CAUTION

The gas conveyed by the vacuum pump contains remainders of oil.

Aspiration of process gas over extended periods can be harmful.

The room into which the process gas is discharged must be sufficiently vented.

- Make sure that all provided covers, guards, hoods etc. remain mounted

- Make sure that protective devices will not be disabled
- Make sure that cooling air inlets and outlets will not be covered or obstructed and that the cooling air flow will not be affected adversely in any other way
- Make sure that the installation prerequisites (→ page 6: Installation Prerequisites) are complied with and will remain complied with, particularly that a sufficient cooling will be ensured

Oil Return

Only for version with oil return valve:

During operation oil accumulates at the bottom of the upper chamber of the oil separator (p), which cannot flow down into the bottom chamber, as long as the vacuum pump runs (for detailed description: → page 4: Oil Circulation).

At the latest after 10 hours of continuous operation, in case of high pressure difference between suction side and pressure side after a shorter period, the vacuum pump must be shut down for at least 15 minutes, so that the oil can run down from the upper chamber of the oil separator (p) into the bottom chamber. **Note:** This is a good time to check the temperature, the level and the colour of the oil.

Conveying Condensable Vapours



CAUTION

Residual condensates dilute the oil, deteriorate its lubricating properties and can cause a seizure of the rotor.

Apply a suitable operating method to make sure that no condensates remain in the vacuum pump.

In order to use the vacuum pump for the conveyance of condensable vapours, the vacuum pump must be equipped with a shut-off valve in the suction line and with a gas ballast.

Version with gas ballast with ball-valve:

- ◆ Make sure that the gas ballast valve is open and will remain open during operation
- Close the shut-off valve in the suction line
- Operate the vacuum pump with the suction line shut off for approx. half an hour, so that the operating temperature rises to approx. 75 °C

At process start:

- Open the shut-off valve in the suction line

At the process end:

- Close the shut-off valve in the suction line
- Operate the vacuum pump for another approx. half an hour

Maintenance



WARNING

The approval of the vacuum pump for use in potentially explosive areas remains valid only if the maintenance is conducted regularly according to the maintenance schedule below and genuine spare parts and consumables, approved for use in potentially explosive areas by Busch, are used exclusively.

Maintenance work must be executed by qualified personnel, specially instructed in the maintenance of this type of vacuum pump by Busch.



DANGER

In case the vacuum pump conveyed gas that was contaminated with foreign materials which are dangerous to health, harmful material can reside in filters.

Danger to health during inspection, cleaning or replacement of filters.

Danger to the environment.

Personal protective equipment must be worn during the handling of contaminated filters.

Contaminated filters are special waste and must be disposed of separately in compliance with applicable regulations.



CAUTION

During operation the surface of the vacuum pump may reach temperatures of more than 70 °C.

Risk of burns!

- Prior to action that requires touching of the vacuum pump, let the vacuum pump cool down, however, if the oil is to be drained, for no more than 20 minutes (the oil shall still be warm when being drained)
- Prior to disconnecting connections make sure that the connected pipes/lines are vented to atmospheric pressure

Maintenance Schedule

Note: The maintenance intervals depend very much on the individual operating conditions. The intervals given below are upper limits that must not be exceeded.

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

Version without level switch:

- Prior to start-up check the level and the colour of the oil (→ page 11: Checking the Oil)

Weekly:

Version with level switch (optional):

- ◆ Check the level and the colour of the oil (→ page 11: Checking the Oil)
- Check that the filling plug (m, 88) and the drain plug (o, 95) are firmly seated
- Check the vacuum pump for oil leaks - in case of leaks immediately remove the vacuum pump from service and have it repaired (Busch service)

Monthly:

- Check the function of the exhaust filters (q, 120) (→ page 13: Exhaust Filters)
- Make sure that the vacuum pump is shut down and locked against inadvertent start up
- Check the inlet air filter (d), if necessary replace

In case of operation in a dusty environment:

- ◆ Clean as described under → page 10: Every 6 Months:

Every 6 Months:

- Make sure that the housing is free from dust and dirt, clean if necessary
- Make sure that the vacuum pump is shut down and locked against inadvertent start up

Note: Any kind of deposit on the vacuum pump compromises the explosion safety of the vacuum pump.

- Clean the fan cowlings, fan wheels, the ventilation grilles and cooling fins
- Check the electrical connection
- Make sure that the earth cable on the inlet air filter housing is undamaged (resistance check)

Every Year:

- Make sure that the vacuum pump is shut down and locked against inadvertent start up
- Replace the exhaust filters (q, 120) (→ page 13: Exhaust Filters)
- Replace the inlet air filter (d)
- Check the inlet screen (261), clean if necessary

Note: As there is an inlet air filter upstream the inlet screen, the inlet screen should not show soiling. A soiled inlet screen indicates that the filter is either broken through or improperly inserted.



WARNING

A soiled screen indicates the improper function of the filter. The pump chamber contains material that can compromise the explosion safety of the vacuum pump.

Risk of explosion!

If the inlet screen is soiled, the vacuum pump must be cleaned by Busch service.

Version with gas ballast (440) with sinter metal filter:

- ◆ Clean the sinter metal filter (compressed air)

Version with gas ballast (440) with paper filter:

- ◆ Replace the filter

Every 500 - 2000 Operating Hours:

(→ page 11: Oil Life):

- Change the oil and the oil filter (i, 100) (→ page 12: Oil and Oil Filter Change)

Version with float valve (l, 200) and oil return line

- ◆ Check the float valve (l, 200) (→ page 12: Checking the Float Valve)

Every 16000 Operating Hours, At the Latest after 4 Years:

- Have a major overhaul on the vacuum pump (Busch service)

Checking the Oil

Checking the Level

- Make sure that the vacuum pump is shut down and the oil has collected at the bottom of the oil separator (p)
- Read the level on the sight glass (n, 83)

In case the level has dropped underneath the MIN-marking:

In case the level switch (optional) has reported low level:

- ◆ Top up oil (→ page 11: Topping up Oil)

In case the level exceeds the MAX-marking:

- ◆ Excessive dilution with condensates - change the oil and check the process
- ◆ If appropriate retrofit a gas ballast (Busch Service) and observe the chapter Conveying Condensable Vapours (→ page 10)

In case the level exceeds the MAX-marking despite proper use of the gas ballast:

Version with gas ballast (440) with sinter metal filter:

- ◆ Clean the sinter metal filter (compressed air)

Version with gas ballast (440) with paper filter:

- ◆ Replace the filter

Topping up Oil

Note: Under normal conditions there should be no need to top up oil during the recommended oil change intervals. A significant level drop indicates a malfunction (→ page 15: Troubleshooting).

Note: During operation the exhaust filters get saturated with oil. It is therefore normal that the oil level will drop slightly after replacement of the exhaust filters.



CAUTION

Filling oil through the suction connection (c) will result in breakage of the vanes (t) and destruction of the vacuum pump.

Oil may be filled through the filling port (m, 88) only.



CAUTION

During operation the oil separator is filled with hot, pressurised oil mist.

Risk of injury from hot oil mist with open filling port.

Risk of injury if a loosely inserted filling plug (m, 88) is ejected.

Remove the filling plug (m, 88) only if the vacuum pump is stopped.

The vacuum pump must only be operated with the filling plug (m, 88) firmly inserted.

- Make sure that the vacuum pump is shut down and locked against inadvertent start up
- Remove the filling plug (m, 88)
- Top up oil until the level reaches the middle of the sight glass (n, 83)

Version with level switch:

- ◆ Make sure the level switch reports correct level
- Make sure that the seal ring (89) is inserted into the filling plug (m, 88) and undamaged, replace if necessary
- Firmly reinsert the filling plug (m, 88) together with the seal ring (89)

Checking the Colour of the Oil

Note: The oil should be light, either transparent, a little foamy or a little tarnished. A milky discolouration that does not vanish after sedation of the oil indicates contamination with foreign material. Oil that is either contaminated with foreign material or burnt must be changed (→ page 12: Oil and Oil Filter Change).

In case the oil appears to be contaminated with water or other condensates despite proper use of the gas ballast:

Version with gas ballast (440) with sinter metal filter:

- ◆ Clean the sinter metal filter (compressed air)

Version with gas ballast (440) with paper filter:

- ◆ Replace the filter

Oil Life


The oil life depends very much on the operating conditions. A clean and dry air stream and operating temperatures below 100 °C are ideal. Under these conditions the oil and the oil filter (i, 100) shall be changed every 500 to 2000 operating hours or after half a year.

Under very unfavourable operating conditions the oil life can be less than 500 operating hours. Extremely short life times indicate malfunctions (→ page 15: Troubleshooting) or unsuitable operating conditions, though.

Choosing a synthetic oil instead of a mineral oil can extend the oil life. To select the oil best suited for your process please contact your Busch representative.

If there is no experience available with regard to the oil life under the prevailing operation conditions, it is recommended to have an oil analysis carried out every 500 operating hours and establish the change interval accordingly.

Oil and Oil Filter Change



DANGER

In case the vacuum pump conveyed gas that was contaminated with harmful foreign material the oil and the oil filter will be contaminated with harmful material.

Danger to health during the changing of contaminated oil and oil filters.

Danger to the environment.

Wear personal protective equipment during the changing of contaminated oil and oil filters.

Contaminated oil and oil filters are special waste and must be disposed of separately in compliance with applicable regulations.

Draining Used Oil


Note: After switching off the vacuum pump at normal operating temperature wait no more than 20 minutes before the oil is drained (the oil shall still be warm when being drained).

- Make sure that the vacuum pump is shut down and locked against inadvertent start up
- Make sure that the vacuum pump is vented to atmospheric pressure
- Put a drain tray underneath the drain port (o, 95)
- Remove the drain plug (o, 95) and drain the oil

When the oil stream dwindles:

- Reinsert the drain plug (o, 95)
- If applicable, bridge the level switch
- Switch the vacuum pump on for a few seconds
- Make sure that the vacuum pump is shut down and locked against inadvertent start up
- Remove the drain plug (o, 95) again and drain the remaining oil
- Make sure that the seal ring is inserted into the drain plug (o, 95) and undamaged, if necessary replace the drain plug (o, 95)
- Firmly reinsert the drain plug (o, 95) together with the seal ring
- Dispose of the used oil in compliance with applicable regulations

Flushing the Vacuum Pump



WARNING

Degraded oil can choke pipes and coolers.

Risk of damage to the vacuum pump due to insufficient lubrication.

Risk of explosion due to overheating.

If there is a suspicion that deposits have gathered inside the vacuum pump the vacuum pump shall be flushed.

- Make sure that all the used oil is drained
- Make sure that the used oil filter (i, 100) is still in place

- Create 1.0 litre(s) (RA 0025/0040 F) or 2.0 litre(s) (RA 0063/0100 F) resp. flushing agent from 50 percent oil and 50 percent paraffin or diesel fuel/fuel oil
- Make sure that the drain plug (o, 95) is firmly inserted
- Remove the filling plug (m, 88)
- Fill in the flushing agent
- Firmly reinsert the filling plug (m, 88)
- Close the suction line
- Run the vacuum pump for at least half an hour
- Drain the flushing agent and dispose of it in compliance with applicable regulations

Note: Due to the use of paraffin and even more in case of using diesel fuel/fuel oil, an unpleasant odour can occur after recommissioning. If this is a problem, diesel fuel/fuel oil should be avoided and the vacuum pump be run at idle in a suitable place until the unpleasant odour vanishes.

Checking the Float Valve

(version with float valve and oil return line only)

Note: It is essential that the float valve (l, 200) works properly, so that the vacuum pump will achieve the intended ultimate pressure and no oil will be expelled out of the gas discharge (g).

- Make sure that the vacuum pump is shut down and locked against inadvertent start up
- Prior to disconnecting pipes/lines make sure that the connected pipes/lines are vented to atmospheric pressure
- Remove the discharge line, if necessary
- Remove the exhaust cover (g) above the float valve (l, 200)
- Remove the oil from the floater chamber with the aid of a suction hose or a wash bottle
- Undo the screws and remove the fan cover (h)

Note: While undoing the banjo fitting of the oil return line (l) a small amount of oil will leak out: keep a cleaning rag ready. Be careful not to lose the sealing rings of the banjo fitting.

- Undo the banjo fitting of the oil return line (l) from the oil separator (p) and bend the oil return line a little bit aside
- Undo the two screws of the flange of the float valve (l, 200) and pull the float valve out of the oil separator (p)
- Check the cleanliness and function of the float valve (l, 200), blow out with compressed air, if necessary
- Make sure that the o-ring on the flange of the float valve (l, 200) is in place and undamaged, replace with a new o-ring, if necessary
- Insert the float valve (l, 200) in the proper orientation into the oil separator (p) and fasten it with two screws and lock washers
- Connect the banjo fitting of the oil return line (l) to the oil separator (p) with the hollow-core screw and two seal rings
- Fasten the fan cover (h) to the vacuum pump with the screws

Only if the exhaust filters (q, 120) are **not** meant to be changed, too:

- ◆ Make sure that the seal (141) under the exhaust cover (g) is clean and undamaged, if necessary replace with a new seal (141)
- ◆ Mount the exhaust cover (g) together with the seal (141), hex head screws and lock washers on the oil separator (p)
- ◆ If necessary connect the discharge line

Replacing the Oil Filter

- Make sure that the oil is drained
- Remove the oil filter (i, 100)
- Apply a drop of fresh oil on the seal ring of the new oil filter (i, 100)
- Mount the new oil filter (i, 100) and tighten it by hand

- Dispose of the used oil filter in compliance with applicable regulations

Filling in Fresh Oil

- Keep 1.0 litre(s) (RA 0025/0040 F) or 2.0 litre(s) (RA 0063/0100 F) resp. oil acc. to the table Oil (→ page 21) ready

Note: The amount given in these operating instructions is a guide. The sight glass (n, 83) indicates the actual amount to be filled in.

Version with level switch:

- ◆ Make sure that the level switch reports "low level"
- Make sure that the drain plug (o, 95) is firmly inserted



CAUTION

Filling oil through the suction connection (c) will result in breakage of the vanes (t) and destruction of the vacuum pump.

Oil may be filled through the filling port (m, 88) only.

- Remove the filling plug (m, 88)
- Fill in approx. 1.0 litre(s) (RA 0025/0040 F) or 2.0 litre(s) (RA 0063/0100 F) resp. of oil
- Make sure that the level is between the MIN and the MAX-markings of the sight glass (n, 83)

Version with level switch:

- ◆ Make sure the level switch reports correct level
- Make sure that the seal ring (89) is inserted into the filling plug (m, 88) and undamaged, replace if necessary
- Firmly reinsert the filling plug (m, 88) together with the seal ring (89)

Exhaust Filters

Checks during Operation

Busch recommends the use of a filter pressure gauge (available as accessory, → page 20: Accessories). Without filter pressure gauge the filter resistance shall be assessed on the basis of the drive motor current drawn.

Version with exhaust filter pressure gauge:

- ◆ Remove the suction line from the suction connection (c) (unrestricted suction!)
- ◆ Make sure that the vacuum pump is running
- ◆ Check that the reading on the filter pressure gauge is in the green field
- ◆ Reconnect the suction line to the suction connection (c)

Version without filter pressure gauge:

- ◆ Make sure that the vacuum pump is running
- ◆ Check that the drive motor current drawn is in the usual range

Version with oil return valve:

Note: The discharged gas will also contain oil if the vacuum pump is operated without interruption for too long a period (→ page 9: Operation Notes).

- Check that the discharged gas is free from oil

Assessment

If

the reading on the filter pressure gauge is in the red field,

or

the drive motor draws too much current and/or the pump flow rate has dropped,

then the exhaust filters (q, 120) are clogged and must be replaced.

Note: Exhaust filters cannot be cleaned successfully. Clogged exhaust filters must be replaced with new ones.

If

the filter pressure gauge indicates a lower pressure than usual, or

the drive motor draws less current than usual,

then one exhaust filter (q, 120) is broken through, the exhaust filters must be replaced.

If the discharged gas contains oil,

the exhaust filters (q, 120) can either be clogged or broken through and, if applicable, must be replaced.

Change of the Exhaust Filters



DANGER

In case the vacuum pump conveyed gas that was contaminated with harmful foreign material the exhaust filters will be contaminated with harmful material.

Danger to health during the changing of the contaminated exhaust filters.

Danger to the environment.

Wear personal protective equipment during the changing of the contaminated exhaust filters.

Used exhaust filters are special waste and must be disposed of separately in compliance with applicable regulations.



CAUTION

The filter springs (r, 125) can fly out of the exhaust port during removal or insertion.

Risk of eye injury.

Eye protection goggles must be worn while handling filter springs (r, 125).

Removing the Exhaust Filters

- Make sure that the vacuum pump is shut down and locked against inadvertent start up
- Prior to disconnecting pipes/lines make sure that the connected pipes/lines are vented to atmospheric pressure
- Remove the discharge line, if necessary
- Remove the exhaust cover (g) from the oil separator (p)
- Loosen the screws in the centre of the exhaust filter retaining springs (r, 125), but do not remove them
- Press the exhaust filter retaining springs (r, 125) out of the indents and rotate them
- Remove the exhaust filter retaining springs (r, 125) from the oil separator (p)
- Pull the exhaust filters (q, 120) out of the oil separator (p)

Inserting the Exhaust Filters

- Make sure that the new exhaust filters (q, 120) are equipped with new o-rings
- Insert the exhaust filters (q, 120) such that their ports are properly seated in their receptacles in the oil separator (p)
- Make sure that the tips of the screws in the centre of the exhaust filter retaining springs (r, 125) protrude the retaining springs by about 2 - 5 revolutions
- Insert the exhaust filter retaining springs (r, 125) such that their ends are secured in their receptacles in the oil separator (p) by the

protrusions and that the tips of the screws snap into the indent of the exhaust filters (q, 120)

- Tighten the screws in the exhaust filter retaining springs (r, 125) such that the screw heads touch the spring steel sheets
- Make sure that the seal (141) under the exhaust cover (g) is clean and undamaged, if necessary replace with a new seal (141)
- Mount the exhaust cover (g) together with the seal (141), hex head screws and lock washers on the oil separator (p)
- If necessary connect the discharge line

Note: During operation the exhaust filters get saturated with oil. It is therefore normal that the oil level will drop slightly after replacement of the exhaust filters.

Overhaul



WARNING

Improper work on the vacuum pump puts the operating safety at risk.

Risk of explosion!

Approval for operation will be void!

Any dismantling of the vacuum pump that is beyond of what is described in this manual must be done by specially trained Busch service personnel only.



DANGER

In case the vacuum pump conveyed gas that was contaminated with harmful foreign material the oil, the oil filter and the exhaust filter(s) will be contaminated with harmful material.

Harmful material can reside in pores, gaps and internal spaces of the vacuum pump.

Danger to health during dismantling of the vacuum pump.

Danger to the environment.

Prior to shipping the vacuum pump shall be decontaminated as good as possible and the contamination status shall be stated in a "Declaration of Contamination" (form downloadable from www.busch-vacuum.com).

Busch service will only accept vacuum pumps that come with a completely filled in and legally binding signed "Declaration of Contamination" (form downloadable from www.busch-vacuum.com).

Removal from Service

Temporary Removal from Service

- Prior to disconnecting pipes/lines make sure that all pipes/lines are vented to atmospheric pressure

Recommissioning



CAUTION

Vanes (t) can stick after a long period of standstill.

Risk of vane breakage if the vacuum pump is started with the drive motor.

After longer periods of standstill the vacuum pump shall be turned by hand.

After longer periods of standstill:

- ◆ Make sure that the vacuum pump is locked against inadvertent start up
- ◆ Remove the cover around the fan of the drive motor
- ◆ Slowly rotate the fan wheel by hand several revolutions in the intended direction of rotation (see stuck on or cast arrow (a))
- ◆ Mount the cover around the fan wheel of the drive motor

If deposits could have gathered in the vacuum pump:

- ◆ Flush the vacuum pump (→ page 10: Maintenance)
- Observe the chapter Installation and Commissioning (→ page 6)

Dismantling and Disposal



DANGER

In case the vacuum pump conveyed gas that was contaminated with harmful foreign material the oil, the oil filter and the exhaust filter(s) will be contaminated with harmful material.

Harmful material can reside in pores, gaps and internal spaces of the vacuum pump.

Danger to health during dismantling of the vacuum pump.

Danger to the environment.

During dismantling of the vacuum pump personal protective equipment must be worn.

The vacuum pump must be decontaminated prior to disposal.

Oil, oil filters and exhaust filters must be disposed of separately in compliance with applicable regulations.



CAUTION

Used oil, used exhaust filters and used oil filters are special waste and must be disposed of in compliance with applicable regulations.



CAUTION

The filter springs (r, 125) can fly out of the exhaust port during removal.

Risk of eye injury.

Eye protection goggles must be worn while handling filter springs.

- Remove the exhaust filters (q, 120) (→ page 13: Exhaust Filters)
- Drain the oil
- Remove the oil filter (i, 100)
- Make sure that materials and components to be treated as special waste have been separated from the vacuum pump
- Make sure that the vacuum pump is not contaminated with harmful foreign material

According to the best knowledge at the time of printing of this manual the materials used for the manufacture of the vacuum pump involve no risk.

- Dispose of the used oil in compliance with applicable regulations
- Dispose of special waste in compliance with applicable regulations
- Dispose of the vacuum pump as scrap metal

Troubleshooting



WARNING

Vacuum pump/ Compressor/ Vacuum and pressure pump/ Blower for use in potentially explosive atmospheres.

The vacuum pump must only be operated in faultless condition.

Risk of explosion in case of operation of faulty equipment!

A faulty vacuum pump must immediately be removed from service.

In case of faults the cause of which cannot be determined the Busch service must be contacted.



WARNING

Risk of electrical shock, risk of damage to equipment.

Electrical installation work must only be executed by qualified personnel that knows and observes the following regulations:

- IEC 364 or CENELEC HD 384 or DIN VDE 0100, respectively,
- IEC-Report 664 or DIN VDE 0110,
- BGV A2 (VBG 4) or equivalent national accident prevention regulation.



CAUTION

During operation the surface of the vacuum pump may reach temperatures of more than 70 °C.

Risk of burns!

Let the vacuum pump cool down prior to a required contact or wear heat protection gloves.

Problem	Possible Cause	Remedy
The vacuum pump does not reach the usual pressure The drive motor draws a too high current (compare with initial value after commissioning) Evacuation of the system takes too long	The vacuum system or suction line is not leak-tight	Check the hose or pipe connections for possible leak
	Contaminated oil (the most common cause)	Change the oil (→ page 10: Maintenance)
	No or not enough oil in the reservoir	Top up oil (→ page 10: Maintenance)
	The exhaust filters (q, 120) are partially clogged	Replace the exhaust filters (q, 120) (→ page 10: Maintenance)
	The oil filter (i, 100) is clogged (the oil flows through the bypass only, the oil does not get filtered any more)	Replace the oil filter (i, 100) (→ page 10: Maintenance)
	The screen (261) in the suction connection (c) is partially clogged	Clean the screen (261) If cleaning is required too frequently install a filter upstream
	The filter (d) on the suction connection (c) is partially clogged	Clean or replace the inlet air filter (d), respectively
	Partial clogging in the suction, discharge or pressure line	Remove the clogging
	Long suction, discharge or pressure line with too small diameter	Use larger diameter
	The valve disk of the inlet non-return valve is stuck in closed or partially open position	Disassemble the inlet, clean the screen (261) and the valve as required and reassemble
The oil tubing is defective or leaking The oil return line (l) is broken	Repair the oil tubing (Busch service)	

	Version with float valve (l, 200) and oil return line The float valve (l, 200) is stuck in open position	Make the float valve (l, 200) movable, replace if necessary (→ page 12: Checking the Float Valve)
	A shaft seal is leaking	Replace the shaft seal ring (Busch service)
	An/The exhaust valve (s) is not properly seated or stuck in partially open position	Disassemble and reassemble the exhaust valve(s) (s) (Busch service)
	A vane (t) is blocked in the rotor or otherwise damaged	Free the vanes (t) or replace with new ones (Busch service)
	The radial clearance between the rotor (u) and the cylinder is no longer adequate	Readjust the vacuum pump (Busch service)
	Internal parts are worn or damaged	Repair the vacuum pump (Busch service)
The gas conveyed by the vacuum pump smells displeasing	Process components evaporating under vacuum Readily volatile and thus gaseous components of the oil, e.g. additives, particularly right after an oil change. Note: This is no indication of a malfunction of the oil separator. The oil separator is able to retain droplets of oil, however no gaseous components of it.	Check the process, if applicable Use a different type of oil, if applicable
The vacuum pump does not start	The drive motor is not supplied with the correct voltage or is overloaded	Supply the drive motor with the correct voltage
	The drive motor starter overload protection is too small or trip level is too low	Compare the trip level of the drive motor starter overload protection with the data on the nameplate, correct if necessary
	One of the fuses has blown	Check the fuses
	Version with alternating current motor: The drive motor capacitor is defective	Repair the drive (Busch service)
	The connection cable is too small or too long causing a voltage drop at the vacuum pump	Use sufficiently dimensioned cable
	The vacuum pump or the drive motor is blocked	Make sure the drive motor is disconnected from the power supply Remove the fan cover Try to turn the drive motor with the vacuum pump by hand If the vacuum pump is blocked: Repair the vacuum pump (Busch service)
	The drive motor is defective	Replace the drive motor (Busch service) (in order not to compromise the explosion safety of the vacuum pump the coupling must be adjusted and measured according to a precisely defined procedure; therefore the motor must be mounted by the Busch service only)
The vacuum pump is blocked	Solid foreign matter has entered the vacuum pump	Repair the vacuum pump (Busch service) Make sure the suction line is equipped with a screen If necessary additionally provide a filter
	Corrosion in the vacuum pump from remaining condensate	Repair the vacuum pump (Busch service) Check the process Observe the chapter Conveying Condensable Vapours (→ page 10)
	Version with three-phase motor: The vacuum pump was run in the wrong direction	Repair the vacuum pump (Busch service) When connecting the vacuum pump make sure the vacuum pump will run in the correct direction (→ page 7: Installation)

	<p>After shutting down the vacuum pump the vacuum system exerted underpressure onto the pump chamber which sucked back excessive oil from the oil separator into the pump chamber</p> <p>When the vacuum pump was restarted too much oil was enclosed between the vanes (t)</p> <p>Oil could not be compressed and thus broke a vane (t)</p>	<p>Repair the vacuum pump (Busch service)</p> <p>Make sure the vacuum system will not exert underpressure onto the shut-down vacuum pump, if necessary provide an additional shut-off valve or non-return valve</p>
	<p>After shutting down the vacuum pump condensate ran into the pump chamber</p> <p>When the vacuum pump was restarted too much condensate was enclosed between the vanes (t)</p> <p>Condensate could not be compressed and thus broke a vane (t)</p>	<p>Repair the vacuum pump (Busch service)</p> <p>Make sure no condensate will enter the vacuum pump, if necessary provide a drip leg and a drain cock</p> <p>Drain condensate regularly</p>
The drive motor is running, but the vacuum pump stands still	The coupling between the drive motor and the vacuum pump is defective	<p>Replace the coupling element</p> <p>(in order not to compromise the explosion safety of the vacuum pump the coupling must be adjusted and measured according to a precisely defined procedure; therefore the coupling element must be replaced by the Busch service only)</p>
<p>The vacuum pump starts, but labours or runs noisily or rattles</p> <p>The drive motor draws a too high current (compare with initial value after commissioning)</p>	<p>Loose connection(s) in the drive motor terminal box</p> <p>Version with three-phase-motor:</p> <p>Not all drive motor coils are properly connected</p> <p>The drive motor operates on two phases only</p>	<p>Check the proper connection of the wires against the connection diagram (particularly on motors with six coils)</p> <p>Tighten or replace loose connections</p>
	<p>Version with three-phase motor:</p> <p>The vacuum pump runs in the wrong direction</p>	Verification and rectification → page 6: Installation and Commissioning
	Standstill over several weeks or months	Let the vacuum pump run warm with inlet closed
	Improper oil quantity, unsuitable oil type	<p>Use the proper quantity of one of the recommended oils</p> <p>(→ page 21: Oil change: → page 10: Maintenance)</p>
	No oil change over extended period of time	<p>Perform oil change incl. flushing and oil filter replacement</p> <p>(→ page 10: Maintenance)</p>
	The exhaust filters (q, 120) are clogged and appear black from burnt oil	<p>Flush the vacuum pump</p> <p>Replace the oil filter (i, 100)</p> <p>Replace the exhaust filters (q, 120)</p> <p>Fill in new oil</p> <p>(→ page 10: Maintenance)</p> <p>In case the oil life is too short: use oil with better heat resistance (→ page 21: Oil) or retrofit cooling</p>
	<p>Foreign objects in the vacuum pump</p> <p>Broken vanes (t)</p> <p>Stuck bearings</p>	Repair the vacuum pump (Busch service)
The vacuum pump runs very noisily	Defective bearings	Repair the vacuum pump (Busch service)
	Worn coupling element	<p>Replace the coupling element</p> <p>(in order not to compromise the explosion safety of the vacuum pump the coupling must be adjusted and measured according to a precisely defined procedure. Therefore the coupling element must be replaced by Busch service only)</p>

	Stuck vanes (t)	Repair the vacuum pump (Busch service) Use only approved oils (→ page 21: Oil) and change more frequently
The vacuum pump runs very hot	Insufficient air ventilation	Make sure that the cooling of the vacuum pump is not impeded by dust/dirt Clean the fan cowlings, the fan wheels, the ventilation grilles and the cooling fins Install the vacuum pump in a narrow space only if sufficient ventilation is ensured On a vacuum pump with oil-cooler: clean the intermediate spaces of the finned tube
	Ambient temperature too high	Observe the permitted ambient temperatures
	Temperature of the inlet gas too high	Observe the permitted temperatures for the inlet gas
	The exhaust filters (q, 120) are partially clogged	Replace the exhaust filters (q, 120)
	The oil filter (i, 100) is clogged (the oil flows through the bypass only, the oil does not get filtered any more)	Replace the oil filter (i, 100) (→ page 10: Maintenance)
	Not enough oil in the reservoir	Top up oil
	Oil burnt from overheating	Flush the vacuum pump Replace the oil filter (i, 100) Replace the exhaust filters (q, 120) Fill in new oil (→ page 10: Maintenance) In case the oil life is too short: use oil with better heat resistance (→ page 21: Oil) or retrofit cooling
	Mains frequency or voltage outside tolerance range	Provide a more stable power supply
	Partial clogging of filters or screens Partial clogging in the suction, discharge or pressure line	Remove the clogging
Long suction, discharge or pressure line with too small diameter	Use larger diameter	
The vacuum pump fumes or expels oil droplets through the gas discharge The oil level drops	An exhaust filter (q, 120) is not properly seated	Check the proper position of the exhaust filters (q, 120), if necessary insert properly (→ page 10: Maintenance)
	An o-ring is missing or damaged	Add or replace resp. the o-ring (→ page 10: Maintenance)
	An exhaust filter (q, 120) shows cracks	Replace the exhaust filter (q, 120) (→ page 10: Maintenance)
	The exhaust filters (q, 120) are clogged with foreign matter Note: The saturation of the exhaust filters with oil is no fault and does not impair the function of the exhaust filters! Oil dropping down from the exhaust filters is returned to the oil circulation.	Replace the exhaust filters (q, 120) (→ page 10: Maintenance)
	Version with oil return valve: In case the vacuum pump runs for more than 10 hours without interruption, oil can collect in the upper chamber of the oil separator (p) to an extent that it gets expelled together with the discharged gas	Regularly shut down the vacuum pump for short periods of time. Check that the oil return valve functions properly and lets oil run from the upper into the bottom chamber of the oil separator (p) as soon as the vacuum pump is shut down (→ page 4: Oil Circulation)

	<p>Version with oil return valve:</p> <p>The oil return valve does not work properly or is clogged (proper function is when blowing into the valve it should close, when vacuum is applied, the valve should open; CAUTION: do not let your mouth get in direct contact with the oil return valve, do not inhale through the oil return valve!)</p>	Clean or replace the oil return valve
	<p>Version with float valve (l, 200) and oil return line:</p> <p>The float valve (l, 200) is stuck in closed position</p>	Make the float valve (l, 200) movable, replace if necessary (→ page 12: Checking the Float Valve)
	The oil return line (l) is clogged or broken	Repair the oil tubing (Busch service)
The oil is black	<p>Oil change intervals are too long</p> <p>The oil was overheated</p>	<p>Flush the vacuum pump</p> <p>Replace the oil filter (i, 100)</p> <p>Replace the exhaust filters (q, 120)</p> <p>Fill in new oil</p> <p>(→ page 10: Maintenance)</p> <p>In case the oil life is too short: use oil with better heat resistance (→ page 21: Oil) or retrofit cooling</p>
The oil is watery and coloured white	<p>The vacuum pump aspirated water or significant amounts of humidity</p> <p>Version with gas ballast:</p> <p>The filter of the gas ballast is clogged</p>	<p>Flush the vacuum pump</p> <p>Replace the oil filter (i, 100)</p> <p>Replace the exhaust filters (q, 120)</p> <p>Fill in new oil</p> <p>(→ page 10: Maintenance)</p> <p>Modify the operational mode (→ page 10: Operating Notes → Conveying Condensable Vapours)</p> <p>Version with gas ballast (440) with sinter metal filter:</p> <p>Clean the sinter metal filter (compressed air)</p> <p>Version with gas ballast (440) with paper filter:</p> <p>Replace the filter</p>
The oil is resinous and/or sticky	<p>Improper oil type, perhaps in confusion</p> <p>Topping up of incompatible oil</p>	<p>Flush the vacuum pump</p> <p>Replace the oil filter (i, 100)</p> <p>Replace the exhaust filters (q, 120)</p> <p>Fill in new oil</p> <p>(→ page 10: Maintenance)</p> <p>Make sure the proper oil is used for changing and topping up</p>
The oil foams	Mixing of incompatible oils	<p>Flush the vacuum pump</p> <p>Replace the oil filter (i, 100)</p> <p>Replace the exhaust filters (q, 120)</p> <p>Fill in new oil</p> <p>(→ page 10: Maintenance)</p> <p>Make sure the proper oil is used for topping up</p>

Spare Parts

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

The approval of the vacuum pump for use in potentially explosive areas remains valid only if genuine spare parts and consumables, which are approved for use in potentially explosive areas by Busch, are used exclusively.

This parts list applies to a typical configuration of the vacuum pump RA 0025 - 0100 F ATEX-Version Cat. 3(i) D. Depending on the specific order deviating parts data may apply.

Your point of contact for service and spare parts in the United Kingdom:

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Your point of contact for service and spare parts in the USA:

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Your point of contact for service and spare parts in Canada:

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Your point of contact for service and spare parts in New Zealand:

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Find the list of Busch companies all over the world (by the time of the publication of these installation and operating instructions) on → page 24 (rear cover page).

Find the up-to-date list of Busch companies and agencies all over the world on the internet at www.busch-vacuum.com.

Pos.	Part	Qty	Part no.
83	Sight glass	1	0583 000 001
84	Seal ring for sight glass	1	0480 000 271
88	Plug	1	0710 000 009
89	O-ring for plug	1	0486 000 590

95	Plug with seal ring	1	0415 000 074
100	Oil filter	1	0531 000 002
120	Exhaust filter with o-ring (RA 0025/0040 F)	1	0532 140 156
120	Exhaust filter with o-ring (RA 0063/0100 F)	2	0532 140 157
125	Filter spring (RA 0025/0040 F)	1	0947 000 720
125	Filter spring (RA 0063/0100 F)	2	0947 000 720
141	Gasket (RA 0025/0040 F)	1	0480 000 112
141	Gasket (RA 0063/0100 F)	2	0480 000 112
200	Float valve, complete	1	0947 138 417
261	Screen	1	0534 000 018
440	Gas ballast, complete, with sinter metall filter (optional, RA 0025/0040 F)	1	0916 142 105
440	Gas ballast, adjustable, complete, with sinter metall filter and ball valve (optional, RA 0025/0040 F)	1	0916 142 106
440	Gas ballast, complete, with paper filter (optional, RA 0063/0100 F)	1	0916 142 107
440	Gas ballast, adjustable, complete, with sinter metall filter and ball valve (optional, RA 0063/0100 F)	1	0916 142 108
—	Paper cartridge for air filter, ATEX (optional)	1	0532 134 778
—	Polyester cartridge for air filter, ATEX (optional)	1	0532 137 988

Accessories

Accessories	Description	Part no.
Filter pressure gauge	for easy checking of the degree of clogging of the exhaust filter	0946 000 100
Gas ballast, complete	for the conveying of condensable vapours, with sinter metal filter (RA 0025/0040 F)	0916 142 105
Gas ballast, adjustable, complete	for the conveying of condensable vapours, with sinter metal filter and ball valve (RA 0025/0040 F)	0916 142 106
Gas ballast, complete	for the conveying of condensable vapours, with paper filter (RA 0063/0100 F)	0916 142 107
Gas ballast, adjustable, complete	for the conveying of condensable vapours, with sinter metal filter and ball valve (RA 0063/0100 F)	0916 142 108
Motor safety switch	adjustment range: 1.6 – 2.4 A, 3 Ph.	0985 000 248
Motor safety switch	adjustment range: 2.4 – 4.0 A, 3 Ph.	0985 000 249
Motor safety switch	adjustment range: 4.0 – 6.0 A, 3 Ph.	0985 104 496
Motor safety switch	adjustment range: 6.0 – 10.0 A, 3 Ph.	0985 104 497
Motor safety switch	adjustment range: 10.0 – 16.0 A, 3 Ph.	0985 104 498
Motor safety switch	adjustment range: 10.0 – 16.0 A, 1 Ph.	0985 101 152

Oil

Denomination	VM 032	VM 068	VM 100	VE 101	VMH 100	VSL 032	VSL 068	VSL 100
ISO-VG	32	68	100	100	100	32	68	100
Base	Mineral oil	Mineral oil	Mineral oil	Diester	Mineral oil	PAO	PAO	PAO
Density [g/cm ³]	0.872	0.884	0.888	0.96	0.87	0.83	0.83	0.84
Ambient temperature range [°C]	0 ... 10	5 ... 20	12 ... 30	12 ... 40	12 ... 30	-5 ... 10	5 ... 20	10 ... 40
Kinematic viscosity at 40 °C [mm ² /s]	30	68	110	95	94	32	68	96
Kinematic viscosity at 100 °C [mm ² /s]	5	8.5	11.5	9.5	—	6	10	13
Flashpoint [°C]	225	235	260	255	264	240	240	240
Pourpoint [°C]	-15	-15	-15	-30	-15	-60	-55	-50
Part no. 1 l packaging	0831 000 086	0831 102 492	0831 000 060	0831 000 099	0831 133 403	0831 122 575	0831 131 846	0831 122 573
Part no. 5 l packaging	0831 000 087	0831 102 493	0831 000 059	0831 000 100	—	0831 131 845	0831 131 847	0831 122 572
Remark	Standard oil for non-demanding applications	Standard oil for non-demanding applications	Standard oil for non-demanding applications	For thermally and chemically demanding applications	For ultimate pressure critical applications	Food applications (NSF H1)	Food applications (NSF H1)	Food applications (NSF H1)
Filling quantity, approx. [l]	RA 0025/0040 F: 1.0 RA 0063/0100 F: 2.0							

EC-Declaration of Conformity

Note: This Declaration of Conformity and the **CE**-mark affixed to the nameplate are valid for the vacuum pump within the Busch-scope of delivery. 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 acc. to the Directive Machinery 2006/42/EC for the superordinate machine, issue the Declaration of Conformity for it and affix the **CE**-mark.

For maintenance of this Declaration of Conformity of vacuum pumps without a drive may only be used a drive with a written consent of Busch.

We

Busch Produktions GmbH
Schauinslandstr. 1
79689 Maulburg
Germany

declare that vacuum pumps **RA 0025 - 0100 F ATEX-Version Cat. 3(i) D**

documentation no.: T611139599

audit: **CE**0637

in accordance with the European Directives:

- "ATEX" 94/9/EC for use in potentially explosive areas acc. to the nameplate,
- "Machinery" 2006/42/EC,
- "Electrical Equipment Designed for Use within Certain Voltage Limits" (so called "Low Voltage") 2006/95/EC,
- "Electromagnetic Compatibility" 2004/108/EC,
- "Restriction of the use of certain hazardous substances in electrical and electronic equipment" ("RoHS") 2002/95/EC

have been designed and manufactured to the following specifications:

Standard	Title of the Standard
Harmonised Standards	
EN ISO 12100-1 EN ISO 12100-2	Safety of machinery - Basic concepts, general principles of design - Part 1 and 2
EN ISO 13857	Safety of machinery - Safety distances to prevent hazard zones being reached by the upper and lower limbs
EN 1012-1 EN 1012-2	Compressors and vacuum pumps - Safety requirements - Part 1 and 2
EN ISO 2151	Acoustics - Noise test code for compressors and vacuum pumps - Engineering method (grade 2)
EN 60204-1	Safety of machinery - Electrical equipment of machines - Part 1: General requirements
EN 61000-6-1 EN 61000-6-2	Electromagnetic compatibility (EMC) - Generic immunity standards
EN 61000-6-3 EN 61000-6-4	Electromagnetic compatibility (EMC) - Generic emission standards
EN 60079-10 EN 60079-14	Electrical apparatus for explosive gas atmospheres - Part 10 and 14
EN 13463-1	Non-electrical equipment for potentially explosive atmospheres - Part 1: Basic methodology and requirements
EN 1127-1	Explosives atmospheres - Explosion prevention and protection - Part 1: Basic concepts and methodology

<p>Manufacturer</p>  <p>Dr.-Ing. Karl Busch General director</p>	<p>Person authorised to compile the technical file</p>  <p>Andrej Riwe Technical writer</p>
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Technical Data

For motor connection parameters see nameplate

			RA 0025 F	RA 0040 F	RA 0063 F	RA 0100 F
Nominal suction capacity	m ³ /h	50 Hz	25	40	63	100
		60 Hz	30	48	76	120
Suction capacity at 1 mbar	m ³ /h	50 Hz	23	35	40	60
		60 Hz	27	41	45	65
Ultimate pressure	hPa abs. (mbar abs)		0.1			
Nominal motor rating	kW	50 Hz	1.1	1.5	1.5	3.0
		60 Hz	1.1	1.5	2.2	3.0
Nominal speed	min ⁻¹	50 Hz	1500			
		60 Hz	1800			
Sound pressure level (EN ISO 2151)	db(A)	50 Hz	62	64	64	65
		60 Hz	64	67	66	68
Ambient temperature/ temperature of inlet gas	° C		0 ... 40			
Oil quantity	l		1		2	
Weight	kg		~36	~40	~54	~72

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