



Installation and Operating Instructions



Vacuum Pumps

Enivac RE 0016 B / RE 0040 B / RE 0063 B



Busch Produktions GmbH
Schauinslandstr. 1
79689 Maulburg
Germany

Table of Contents

Preface	2
Product Description	3
Use	3
Safety Concept	3
Operational Options / Use of Optionally Available Equipment	4
Principle of Operation	4
Oil Circulation	4
Cooling	4
Start Controls	5
Safety	5
Intended Use	5
Safety Notes	5
Emission of Oil Mist	5
Noise Emission	5
Transport	5
Transport in Packaging	5
Transport without Packaging	5
Storage	6
Short-term Storage	6
Conservation	6
Installation and Commissioning	6
Installation Prerequisites	6
Mounting Position and Space	6
Suction Connection	7
Gas Discharge	7
Electrical Connection / Controls	7
Installation	8
Mounting	8
Connecting Electrically	8
Connecting Lines/Pipes	8
Filling Oil	8
Checking the Function of the Measurement and Safety Instrumentation	9
Recording of Operational Parameters	9
Operation Notes	10
Use	10
Conveying Condensable Vapours	10
Maintenance	11
Maintenance Schedule	11
Daily:	11
Weekly:	11
Monthly:	11
Every 6 Months:	11
Every Year:	12
Every 500 – 2000 Operating Hours:	12
Alle 16000 Betriebsstunden, spätestens nach 4 Jahren:	12
Checking the Oil	12
Checking the Level	12
Topping up Oil	12
Checking the Colour of the Oil	12
Oil Life	12
Oil Change	13
Draining Used Oil	13
Flushing the Vacuum Pump	13
Filling in Fresh Oil	13
Exhaust Filter	13
Check during Operation	13
Assessment	13
Change of the Exhaust Filter	14
Removing the Exhaust Filter	14
Inserting the Exhaust Filter	14
Checking the Function of the Measurement and Safety Instrumentation	14
Overhaul	15
Removal from Service	15
Temporary Removal from Service	15
Recommissioning	15
Dismantling and Disposal	15
Troubleshooting	16
Spare Parts	22
Spare Parts Lists	22
Accessories	22
Oil	23
EC-Declaration of Conformity	24
EC-Type Examination Certificate PTB 03 ATEX 4043 X	26
Equipment Documentation Measurement and Safety	32
Instrumentation	32
Overview	32
Temperature Switch	32
Pressure Switch/Indicator	32
Level Switch (u) (Optional)	33

Flow Chart Safety Tests	34
Connection Examples Precont S in Ex-areas	35
Excerpt from Installation and Operating Instructions BA0811	36
Precont S10	36
Excerpt from Operating- / Assembly Instructions of the BoWex-coupling	45
Technical Data	47
Busch - All over the World in Industry	48

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.

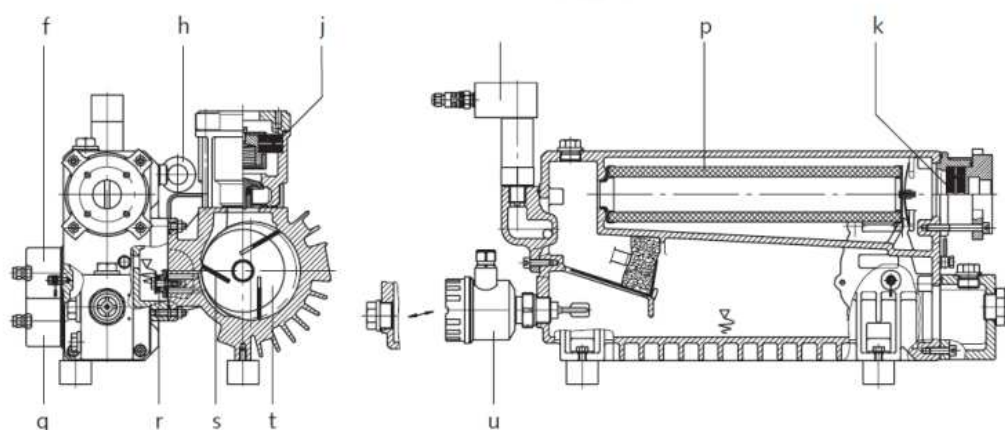


Illustration shows RE0040 B.
RE 0016 B and RE 0063 B are similar

- a Pressure switch/indicator
- b Terminal box
- c Oil fill plugs
- d Nameplate, vacuum pump
- e Oil separator
- f Temperature switch
- g Earth connection
- h Eye bolt
- i Suction connection
- j Flame arrestor with slip stream interruption
- k Flame arrestor
- l Gas discharge
- m Axial fan
- n Oil sight glass
- o Oil drain plug
- p Exhaust filter
- q 2nd temperature switch for frost protection operation (optional)
- r Exhaust valve
- s Vanes
- t Rotor
- u Level switch (optional)

Product Description

Use

The vacuum pump is intended for

- the suction
- of
- explosionsfähigen trockenen, nicht aggressiven und nicht giftigen Gasgemischen gemäß Baumusterprüfbescheinigung

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 "Technical Data"

According to the directive 2014/34/EU the vacuum pump is made for the intended use in potentially explosive areas.

According to this directive the vacuum pump is inside a category 1 device (suitable for connection to tubings the inside of which is classified as zone 0). Outside the vacuum pump is approved as category 2 device (for use in zone 1).

According to the EC-Type Examination Certificate issued by the German "Physikalisch-Technische Bundesanstalt" (PTB) the vacuum pump may be used for the conveyance of explosive atmospheres consisting of a mixture with air of flammable substances in the form of gas, provided that the material belongs to the temperature classes T1 to T4 according to EN 13463-1 and to the explosion groups IIA to IIB3 according to E. Brandes, W. Möller "Sicherheitstechnische Kenngrößen, Band 1: Brennbare Flüssigkeiten und Gase", ISBN 3-89701-745-8 (or equivalent source).

The vacuum pump is suitable for placement in an environment where potentially explosive gas/air mixtures of flammable material with temperature class T1 to T3 or T4 (depending on the classification of the drive motor) are likely to occur in normal operation occasionally (zone 1).

In case Busch delivered the vacuum pump without drive motor or a replacement motor is to be mounted or for economic reasons the vacuum pump was equipped with a simpler motor, the following must be observed:

In case the classifications of the vacuum pump and of the drive motor are different the inferior classification is relevant. This means also that the vacuum pump is suitable for the placement in a potentially explosive environment only if both the vacuum pump, the coupling and the drive motor are approved to the required extent for use in potentially explosive areas.

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.

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

The vacuum pump is ultimate pressure proof.

The approval for use in potentially explosive atmospheres is valid for the vacuum pump together with the described measurement and safety equipment. 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.

Safety Concept

The safety concept for the vacuum pumps Enivac RE 0016 B / RE 0040 B / RE 0063 B for use in potentially explosive atmosphere

as a category 1 device (inside) and category 2 device (outside) is based on two safety principles being independent from each other:

1. Avoidance of ignition caused by an electric or non-electric ignition source inside or outside the vacuum pump.

In order to avoid an ignition inside as well as outside the vacuum pump a sight glass (n) (optionally a level switch (u)) and two different electric switches are used, all of which must be checked for allowed operating parameters prior to start and continuously during operation. In case of an illegal operating parameter the vacuum pump must not start or must be shut down immediately respectively (→ page 32: Flow Chart Safety Tests).

Electrical equipment with ATEX-approval is being used (where applicable).

- Version without level switch (u): The sight glass (n) must be read every day prior to the start of the vacuum pump, in case of continuous operation again in intervals of max. 24 hours.
- Version with level switch (u) (optional): The level switch must safely inhibit the operation of the vacuum pump if the level is below minimum.
- The pressure switch/indicator (a) gives a warning at switching point S1 (550 hPag (=mbarg)) and must safely shut down the vacuum pump at switching point S2 (600 hPag (=mbarg)). The digital display gives an indication to the operator about the degree of soiling and therefore necessary maintenance of the exhaust filter or the discharge/pressure side flame arrestor.
- The temperature switch must safely inhibit the operation of the vacuum pump if the temperature limit (120 °C) is exceeded.

2. Avoidance of hazards to persons and goods from the effects of an explosion that might happen inside the vacuum pump despite the mentioned safety precautions.

- Pressure proof design of the vacuum pump, capable of resisting a pressure up to 18 barg without bursting.
- The suction connection and the gas discharge feature flame arrestors (j) (k), preventing flashbacks into the suction side and discharge side of the system.
- Flame arrestor (j) on the suction side of the vacuum pump with slip-stream interruption.

Operational Options / Use of Optionally Available Equipment

Operation with varying speed, i.e. with a frequency inverter is permitted, provided that the drive motor is approved for frequency inverter operation. The minimum speed shall not drop below 700 rpm. The maximum speed is the one for which the drive motor is intended without frequency inverter operation (i.e. the frequency inverter must **not** be used to increase the speed), but no more than 1800 rpm.

The system control must be designed such that no speed outside the permissible range can be set.

Operation with gas ballast, e.g. in order to avoid condensates, is permitted.

The return of separated oil from the oil separator into the suction connection (required for continuous operation at intake pressures higher than 300 hPa/mbar abs; standard for RE 0016 B, optional for RE 0040 B and RE 0063 B) is permitted.

Operation with an additional temperature switch (optional for RE 0040 B and RE 0063 B) which starts the vacuum pump, if the oil sump temperature falls below 0 °C, is permitted.

Operation with an ATEX-level switch (u) (optional) in order to monitor the oil level is permitted.

Operation with a nickel-plated oil separator (optional) (e) is permitted.

Principle of Operation

The vacuum pump works on the rotating vane principle.

A circular rotor (t) 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 (t) 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 (s), 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 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 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 with a sinter metal filter.

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

Oil Circulation

The vacuum pump requires oil to seal the gaps, to lubricate the vanes (s) 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 (e).

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 (e) 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 (e) as oil mist. Oil that separates before the exhaust filter (p) accumulates at the bottom of the bottom chamber of the oil separator (e).

Oil that is separated by the exhaust filter (p) accumulates at the bottom of the upper chamber of the oil separator (e).

The flow resistance of the exhaust filters (p) 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 oil return line to the suction connection:

Therefore the oil that accumulates in the upper chamber is sucked through the oil return line right to the suction connection.

Version with oil return line to the B-cover:

Therefore the oil that accumulates in the upper chamber is sucked through the oil return line right to the cylinder chamber.

Cooling

The vacuum pump/ compressor is cooled by

- radiation of heat from the surface of the vacuum pump incl. oil separator (e)
- the air flow from the fan wheel of the drive motor

- the process gas
- the air flow from the fan wheel (m) on the shaft of the vacuum pump

(fan wheel on the shaft of the vacuum pump only for RE 0040 B and RE 0063 B)

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 2014/34/EU 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 45: 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 packed 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 is in faultless condition (replace a damaged, e.g. bent eyebolt with a new one)
- Make sure that the eyebolt is fully screwed in and tightened by hand
- Attach lifting gear securely to the eyebolt 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 operating fluid can cause large quantities of operating fluid to ingress into the cylinder.

Starting the vacuum pump with excessive quantities of operating fluid in the cylinder immediately will break the vanes (s) and ruin the vacuum pump.

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

- Prior to every transport make sure that the operating fluid is drained

Storage

Short-term Storage

Version with gas ballast with ball-valve:

- ♦ Close the sinter metal filter of the gas ballast device 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 without ball-valve, with sinter metal filter:

- ♦ Close the sinter metal filter of the gas ballast device 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 packaging,

- 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 24: 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 "Technical Data"
- 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 the base for placement / mounting base is even
- Make sure that in order to warrant a sufficient cooling there will be a clearance of minimum 0.1 m 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



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) will remain easily accessible

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

- ♦ Make sure that the drain port (o) and the filling port (c) will remain easily accessible
- Make sure that enough space will remain for the removal and the reinsertion of the exhaust filter (p)

Suction Connection



Intruding foreign objects or liquids can destroy the vacuum pump

In case the inlet gas can contain dust or other foreign solid particles:

- ♦ Make sure that a suitable filter (5 micron or less) is installed upstream the vacuum pump
- ♦ Make sure that the filter is sufficiently ATEX-qualified (electrically conductive, with equipotential bonding etc.; also for non-combustible dusts!)
- Make sure that the suction line fits to the suction connection (i) 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 (i) 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.



The vacuum pump is intended to convey potentially explosive gases/gas mixtures.

Risk of explosion in the discharge area!

The process gas/gas mixture must be disposed of such that no potentially explosive gas mixtures can accumulate in the discharge area.



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 (l) 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 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



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 installation instructions for the ATEX-drive motor (separate leaflet) are available
- Observe the instructions given in the installation instructions manual for the ATEX-drive motor
- 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 24: 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
- Execute the interfaces for the switches for
 - pressure inside the oil separator
 - temperature inside the oil separator
 - level monitoring (level switch (u); optional)
 in the system control according to the safety concept (→ page 3: Safety Concept) and according to the Equipment Documentation Measurement and Safety Instrumentation (→ page 30)
- Make sure that an earth point is available for connection to the earthing connection of the vacuum pump

Electrical circuits in zone 1 (outside) shall be executed intrinsically safe in protection class ib acc. to EN 60079-11.

All signal lines shall be executed with shielded cables according to EN 60079-14 or EN 61241-14 or the equivalent national or local regulations.

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.

- Connect the drive motor according to the installation instructions for the drive motor (separate leaflet)
- Electrically connect the drive motor
- Connect the protective earth conductor



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 (clockwise rotating field).

Version with three-phase motor:

- ♦ Determine the intended direction of rotation with the arrow (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



WARNING

The proper integration of measurement and safety equipment into the system control is decisive for the explosion safety of the vacuum pump.

Risk of explosion!

The vacuum pump may be operated in areas with potentially explosive atmosphere only with completely installed and checked measurement and safety equipment.

- Connect the switches for
 - temperature inside the oil separator
 - pressure inside the oil separator
 - level monitoring (optional)
 to the system control (→ page 30: Equipment Documentation Measurement and Safety Instrumentation)
- After connecting the cable to the temperature switch make sure that the gasket is inserted between the front and the rear part of the housing, the housing is firmly closed and the grommet is tightened
- Connect the earthing connection of the vacuum pump 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

Note: During the functional check of the measurement and safety instrumentation in the course of the test run with inert gas it is necessary to throttle the gas discharge, which will require the discharge line to be disconnected from the vacuum pump

- Connect the discharge line

Installation without discharge line:

- ♦ Make sure that the gas discharge (I) 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 23: Oil).

- Keep approx. 1.0 litre (RE 0016 B) or 2.0 litres (RE 0040 B / RE 0063 B) oil acc. to the table Oil (→ page 23) ready

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

Version with level switch (u):

- ◆ Make sure that the level switch (u) reports "low level!"
- ◆ Switch on the vacuum pump
- ◆ Make sure that the vacuum pump does **not** start!



CAUTION

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

Oil may be filled through the filling port (c) 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 (c) is ejected.

Remove the filling plug (c) only if the vacuum pump is stopped.

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

- Remove the filling plug (c)
- Fill in approx. 1.0 litre (RE 0016 B) or 2.0 litres (RE 0040 B / RE 0063 B) of oil
- Make sure that the level is between the MIN and the MAX-markings of the sight glass (n)

Version with level switch (u):

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

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 (i) with a piece of rubber mat
- Let the vacuum pump run for a few minutes

Version with level switch (u):

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

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

In case the level switch (u) 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

Checking the Function of the Measurement and Safety Instrumentation



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 pre-

- Make sure that the vacuum pump aspirates inert gases and that there are no potentially explosive atmospheres in the environment
- Disconnect the discharge line from the vacuum pump
- Connect a throttle valve to the gas discharge (l)
- Switch on the vacuum pump
- Interrupt the electrical circuit of the temperature switch by pulling a connector from the temperature switch
- Make sure that an alarm is released in the system control and the vacuum pump is shut down automatically
- Push the connector back on the temperature switch
- Make sure that the alarm persists
- Make sure that the vacuum pump does not start self-acting
- Switch on the vacuum pump again
- Throttle the gas discharge until the display on the pressure switch/indicator (a) shows 550 hPag (=mbarg)
- Make sure that a warning is released in the system control
- Relieve the throttling of the gas discharge
- Make sure that the warning persists
- Throttle the gas discharge further until the display on the pressure switch/indicator (a) shows 600 hPag (=mbarg)
- Make sure that an alarm is released in the system control, the vacuum pump is shut down automatically and remains shut down
- Remove the throttle valve and connect the discharge line
- Make sure that on the temperature switch the gasket is inserted between the housing cover and the housing bottom, firmly close the housing and tighten the cable gland

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
- Read the display on the pressure switch/indicator (a) 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

- explosionsfähigen trockenen, nicht aggressiven und nicht giftigen Gasgemischen gemäß Baumusterprüfbescheinigung

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 "Technical Data"

According to the directive 2014/34/EU the vacuum pump is made for the intended use in potentially explosive areas.

According to this directive the vacuum pump is inside a category 1 device (suitable for connection to tubings the inside of which is classified as zone 0). Outside the vacuum pump is approved as category 2 device (for use in zone 1).

According to the EC-Type Examination Certificate issued by the German "Physikalisch-Technische Bundesanstalt" (PTB) the vacuum pump may be used for the conveyance of explosive atmospheres consisting of a mixture with air of flammable substances in the form of gas, provided that the material belongs to the temperature classes T1 to T4 according to EN 13463-1 and to the explosion groups IIA to IIB3 according to E. Brandes, W. Möller "Sicherheitstechnische Kenngrößen, Band 1: Brennbare Flüssigkeiten und Gase", ISBN 3-89701-745-8 (or equivalent source).

The vacuum pump is suitable for placement in an environment where potentially explosive gas/air mixtures of flammable material with temperature class T1 to T3 or T4 (depending on the classification of the drive motor) are likely to occur in normal operation occasionally (zone 1).

In case Busch delivered the vacuum pump without drive motor or a replacement motor is to be mounted or for economic reasons the vacuum pump was equipped with a simpler motor, the following must be observed:

In case the classifications of the vacuum pump and of the drive motor are different the inferior classification is relevant. This means also that the vacuum pump is suitable for the placement in a potentially explosive environment only if both the vacuum pump, the coupling and the drive motor are approved to the required extent for use in potentially explosive areas.

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.

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

The vacuum pump is ultimate pressure proof.

The approval for use in potentially explosive atmospheres is valid for the vacuum pump together with the described measurement and safety equipment. 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

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.

- 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

Installation and Commissioning

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.

Daily:

Version without level switch (u):

- ◆ Check the level and the colour of the oil (→ page 12: Checking the Oil)

Weekly:

Version with level switch (u):

- ◆ Check the level and the colour of the oil (→ page 12: Checking the Oil)

- Check that the filling plug (c) and the drain plug (o) 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 filter → page 13: Exhaust Filter)
- Make sure that the vacuum pump is shut down and locked against inadvertent start up

In case an inlet air filter is installed:

- ◆ Check the inlet air filter, if necessary replace

In case of operation in a dusty environment:

- ◆ Clean as described under → page 11: 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

Version with BoWex-coupling:

- ◆ Undo the screws of the drive motor
- ◆ Remove the drive motor
- ◆ Check the coupling element for wear (→ page 43: Excerpt from Operating- / Assembly Instructions of the BoWex-coupling)
- ◆ Mount the drive motor on the vacuum pump



WARNING

The proper assembly of flame arrestors is essential for their safe function.

Risk of explosion in case of faulty assembly!

Flame arrestors must only be serviced by personnel that have received specific training for this purpose either by Busch or by the manufacturer of the flame arrestors.

- Service the flame arrestors (j) (k) – in case of discolouration or deformation consult Busch or the manufacturer of the flame arrestor in any case
- Check the electrical connection
- Make sure that the electrical connection of the temperature monitoring is undamaged
- Make sure that the electrical connection of the pressure monitoring is undamaged

Version with level switch (u):

- ◆ Make sure that the electrical connection of the level switch is undamaged
- Make sure that the earth cable (cable between earth connection of the vacuum pump and earth point) is undamaged (resistance check)

Every Year:

- Make sure that the vacuum pump is shut down and locked against inadvertent start up
- Replace the exhaust filter (p) (→ page 13: Exhaust Filter)

Version with Sure-Flex-coupling:

- ◆ Undo the screws of the drive motor
- ◆ Remove the drive motor
- ◆ Check the coupling element for wear, replace if necessary
- ◆ Mount the drive motor on the vacuum pump

In case an inlet air filter is installed:

- ◆ Replace the inlet air filter

In case an inlet screen is installed:

- ◆ Check the inlet screen, clean if necessary

Version with gas ballast with sinter metal filter:

- ◆ Clean the sinter metal filter (compressed air)
- Check the function of the measurement and safety instrumentation (→ page 14: Functional Check of the Measurement and Safety Instrumentation)

Every 500 – 2000 Operating Hours:

(→ page 12: Oil Life):

- Change the oil (→ page 13: Oil Change)

Alle 16000 Betriebsstunden, spätestens nach 4 Jahren:

- 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 (e)
- Read the level on the sight glass (n)

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

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

- ◆ Top up oil (→ page 12: 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:

- ◆ Clean the sinter metal filter (compressed air)

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 16: Troubleshooting).

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



CAUTION

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

Oil may be filled through the filling port (c) 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 (c) is ejected.

Remove the filling plug (c) only if the vacuum pump is stopped.

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

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

Version with level switch (u):

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

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 13: Oil Change).

In case of burnt oil:

- ◆ Check the function of the temperature monitoring (→ page 14: Functional Check of the Measurement and Safety Instrumentation)

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

- ◆ Clean the sinter metal filter (compressed air)

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 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 16: 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 oil 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 Change

**DANGER**

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

Danger to health during the changing of contaminated oil.

Danger to the environment.

Personal protective equipment must be worn during the changing of contaminated oil.

Contaminated oil is 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)
- Remove the drain plug (o) and drain the oil

When the oil stream dwindles:

- Reinsert the drain plug (u)
- If applicable, bridge the level switch (u)
- 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) again and drain the remaining oil
- Make sure that the seal ring is inserted into the drain plug (o) and undamaged, replace if necessary
- Firmly reinsert the drain plug (o) 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
- Create 1 litre (RE 0016 B) or 2 litres (RE 0040 B / RE 0063 B) flushing agent from 50 percent oil and 50 percent paraffin or diesel fuel/fuel oil
- Make sure that the drain plug (o) is firmly inserted
- Remove the filling plug (c)

- Fill in the flushing agent
- Firmly reinsert the filling plug (c)
- 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.

Filling in Fresh Oil

- Keep 1 litre (RE 0016 B) or 2 litres (RE 0040 B / RE 0063 B) oil acc. to the table Oil (→ page 23) ready

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

Version with level switch (n):

- ♦ Make sure that the level switch (u) reports "low level"
- ♦ Switch on the vacuum pump
- ♦ Make sure that the vacuum pump does **n o t** start!
- Make sure that the drain plug (o) is firmly inserted

**CAUTION**

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

Oil may be filled through the filling port (c) only.

- Remove the filling plug (c)
- Fill in approx. 1 litre (RE 0016 B) or 2 litres (RE 0040 B / RE 0063 B) of oil
- Make sure that the level is between the MIN and the MAX-markings of the sight glass (n)

Version with level switch (u):

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

Exhaust Filter

Check during Operation

- Remove the suction line from the suction connection (i) (unrestricted suction!)
- Check that the reading on the display of the pressure switch/indicator (a) is close to the value recorded at the end of the installation
- Reconnect the suction line to the suction connection (i)
- Check that the discharged gas is free from oil

Assessment

If the pressure switch/indicator (a) indicates a higher pressure than usual, then the exhaust filter (p) is clogged and must be replaced.

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

If the pressure switch/indicator (a) indicates a lower pressure than usual, then the exhaust filter (p) is broken through and must be replaced.

If the discharged gas contains oil, the exhaust filter (p) can either be clogged or broken through and, if applicable, must be replaced.



WARNING

The proper assembly of flame arrestors is essential for their safe function.

Risk of explosion in case of faulty assembly!

Flame arrestors must only be serviced by personnel that have received specific training for this purpose either by Busch or by the manufacturer of the flame arrestors.

If the pressure switch/indicator (a) continues to read a higher pressure than usual after the replacement of the exhaust filter, the flame arrestor (k) on the discharge/pressure side can be soiled:

- ◆ Service the flame arrestors (j) (k) – in case of discolouration or deformation consult Busch or the manufacturer of the flame arrestor in any case

Change of the Exhaust Filter



DANGER

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

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

Danger to the environment.

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

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



CAUTION

The filter spring 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.

Removing the Exhaust Filter

- 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 (k) from the oil separator (e)
- Loosen the screw in the centre of the exhaust filter retaining spring, but do not remove it at this time
- Press the exhaust filter retaining spring out of the indent and rotate it
- Remove the exhaust filter retaining spring from the oil separator (e)

- Pull the exhaust filter (p) out of the oil separator (e)

Inserting the Exhaust Filter

- Make sure that the new exhaust filter (p) is equipped with a new o-ring
- Insert the exhaust filter (p) such that its port is properly seated in its receptacle in the oil separator (e)
- Make sure that the tip of the screw in the centre of the exhaust filter retaining spring protrudes the retaining spring by about 2 – 5 revolutions
- Insert the exhaust filter retaining spring such that its ends are secured in their receptacles in the oil separator (e) by the protrusions and that the tip of the screw snaps into the indent of the exhaust filter (p)
- Tighten the screw in the exhaust filter retaining spring such that the screw head touches the spring steel sheet
- Make sure that the seal under the exhaust cover (k) is clean and undamaged, if necessary replace with a new seal
- Mount the exhaust cover (k) together with the seal and hex head screws on the oil separator (e)
- If necessary connect the discharge line

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

Checking the Function of the Measurement and Safety Instrumentation



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 pre-

- Make sure that the vacuum pump aspirates inert gases and that there are no potentially explosive atmospheres in the environment
- Disconnect the discharge line from the vacuum pump
- Connect a throttle valve to the gas discharge (l)
- Switch on the vacuum pump
- Interrupt the electrical circuit of the temperature switch by pulling a connector from the temperature switch
- Make sure that an alarm is released in the system control and the vacuum pump is shut down automatically
- Push the connector back on the temperature switch
- Make sure that the alarm persists
- Make sure that the vacuum pump does not start self-acting
- Switch on the vacuum pump again
- Throttle the gas discharge until the display on the pressure switch/indicator (a) shows 550 hPag (=mbarg)
- Make sure that a warning is released in the system control
- Relieve the throttling of the gas discharge
- Make sure that the warning persists

- Throttle the gas discharge further until the display on the pressure switch/indicator (a) shows 600 hPag (=mbarg)
- Make sure that an alarm is released in the system control, the vacuum pump is shut down automatically and remains shut down
- Remove the throttle valve and connect the discharge line
- Make sure that on the temperature switch the gasket is inserted between the housing cover and the housing bottom, firmly close the housing and tighten the cable gland

Overhaul



DANGER

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 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 (s) 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)
- ♦ 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 11: 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 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 and exhaust filters must be disposed of separately in compliance with applicable regulations.



CAUTION

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



CAUTION

The filter spring 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 filter (p) (→ page 13: Exhaust Filter)
- Drain the oil
- 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 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 11: Maintenance)
	No or not enough oil in the reservoir	Top up oil (→ page 11: Maintenance)
	The exhaust filter (p) is partially clogged	Replace the exhaust filter (p) (→ page 11: Maintenance)
	One or more flame arrestors (j) (k) are partially clogged	Warning: Risk of explosion in case of faulty assembly! Flame arrestors must only be serviced by personnel that have received specific training for this purpose either by Busch or by the manufacturer of the flame arrestors. Clean the flame arrestors (j) (k)
	In case a screen is installed in the suction connection (i): The screen in the suction connection (i) is partially clogged	Clean the screen If cleaning is required too frequently install a filter upstream

	In case a filter is installed on the suction connection (i): The filter on the suction connection (i) is partially clogged	Clean or replace the inlet air filter, 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 and the valve as required and reassemble
	The oil tubing is defective or leaking The oil return line is broken	Repair the oil tubing (Busch service)
	A shaft seal is leaking	Replace the shaft seal ring (Busch service)
	An/The exhaust valve (p) is not properly seated or stuck in partially open position	Disassemble and reassemble the exhaust valve(s) (p) (Busch service)
	A vane (s) is blocked in the rotor or otherwise damaged	Free the vanes (s) or replace with new ones (Busch service)
	The radial clearance between the rotor (t) 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)
	Version with oil return line to the suction connection: The oil return line starts in an area vented to atmospheric pressure. Particularly on small model pumps, a fairly large amount of air is sucked through the oil return line, which may prevent the ultimate pressure from reaching 20 mbar abs. In order to exclude this possible cause: squirt oil through the gas discharge (l) into the oil return line. While oil is being sucked in, the ultimate pressure is not affected by the air normally sucked through the oil return line.	
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
There is an indication on the control panel / in the control room that the switching point S1 or the switching point S2 have been reached at the pressure switch/indicator (a)	Excessive pressure in the oil separator, possible causes: the exhaust filter (p) is partially clogged, throttling of the discharge line, the flame arrestor (k) on the discharge side is partially clogged	Replace the exhaust filter (p) (→ page 11: Maintenance) Check the discharge line for throttling Warning: Risk of explosion in case of faulty assembly! Flame arrestors must only be serviced by personnel that have received specific training for this purpose either by Busch or by the manufacturer of the flame arrestors. Clean the flame arrestor (k) on the pressure/discharge side
There is an indication on the control panel / in the control room that the oil level has dropped below the minimum level The vacuum pump is shut down	Oil level too low	Top up oil
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 8 Installation)
	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 When the vacuum pump was restarted too much oil was enclosed between the vanes (s) Oil could not be compressed and thus broke a vane (s)	Repair the vacuum pump (Busch service) 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
	After shutting down the vacuum pump condensate ran into the pump chamber When the vacuum pump was restarted too much condensate was enclosed between the vanes (s) Condensate could not be compressed and thus broke a vane (s)	Repair the vacuum pump (Busch service) Make sure no condensate will enter the vacuum pump, if necessary provide a drip leg and a drain cock Drain condensate regularly
The drive motor is running, but the vacuum pump stands still	The coupling between the drive motor and the vacuum pump is defective	Replace the coupling element (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)

The vacuum pump starts, but labours or runs noisily or rattles The drive motor draws a too high current (compare with initial value after commissioning)	Loose connection(s) in the drive motor terminal box Version with three-phase-motor: Not all drive motor coils are properly connected The drive motor operates on two phases only	Check the proper connection of the wires against the connection diagram Tighten or replace loose connections
	Version with three-phase-motor: The vacuum pump runs in the wrong direction	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	Use the proper quantity of one of the recommended oils (→ page 23: Oil, Oil change: → page 11: Maintenance)
	No oil change over extended period of time	Perform oil change incl. flushing (→ page 11: Maintenance)
	The exhaust filter (p) is clogged and appears black from burnt oil	Flush the vacuum pump Replace the exhaust filter (p) Fill in new oil (→ page 11: Maintenance) In case the oil life is too short: use oil with better heat resistance (→ page 23: Oil) or retrofit cooling
	Foreign objects in the vacuum pump Broken vanes (s) Stuck bearings	Repair the vacuum pump (Busch service)
The vacuum pump runs very noisily	Defective bearings	Repair the vacuum pump (Busch service)
	Worn coupling element	Replace the coupling element (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)
	Stuck vanes (s)	Repair the vacuum pump (Busch service) Use only recommended oils (→ page 23: Oil) and change more frequently
There is an indication on the control panel / in the control room that the temperature monitoring has tripped (permissible temperature at the outlet of the stage has been exceeded) The vacuum pump is shut down	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 filter (p) is partially clogged	Replace the exhaust filter (p)
	Not enough oil in the reservoir	Top up oil

	Oil burnt from overheating	Flush the vacuum pump Replace the exhaust filter (p) Fill in new oil (→ page 11: Maintenance) In case the oil life is too short: use oil with better heat resistance (→ page 23: 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	The exhaust filter (p) is not properly seated	Check the proper position of the exhaust filter (p), if necessary insert properly (→ page 11: Maintenance)
	The o-ring is missing or damaged	Add or replace resp. the o-ring (→ page 11: Maintenance)
	The exhaust filter (p) shows cracks	Replace the exhaust filter (p) (→ page 11: Maintenance)
	The exhaust filter (p) is clogged with foreign matter Note: The saturation of the exhaust filter with oil is no fault and does not impair the function of the exhaust filter! Oil dropping down from the exhaust filter is returned to the oil circulation.	Replace the exhaust filter (p) (→ page 11: Maintenance)
	The oil return line is clogged or broken	Repair the oil tubing (Busch service)
The oil is black	Oil change intervals are too long The oil was overheated	Flush the vacuum pump Replace the exhaust filter (p) Fill in new oil (→ page 11: Maintenance) In case the oil life is too short: use oil with better heat resistance (→ page 23: Oil) or retrofit cooling
The oil is watery and coloured white	The vacuum pump aspirated water or significant amounts of humidity Version with gas ballast: The filter of the gas ballast is clogged	Flush the vacuum pump Replace the exhaust filter (p) Fill in new oil (→ page 11: Maintenance) In case the oil life is too short: use oil with better heat resistance (→ page 23: Oil) or retrofit cooling Version with gas ballast with sinter metal filter: Clean the sinter metal filter of the gas ballast (compressed air)
The oil is resinous and/or sticky	Improper oil type, perhaps in confusion Topping up of incompatible oil	Flush the vacuum pump Replace the exhaust filter (p) Fill in new oil (→ page 11: Maintenance) Make sure the proper oil is used for changing and topping up

The oil foams	Mixing of incompatible oils	Flush the vacuum pump Replace the exhaust filter (p) Fill in new oil (→ page 11: Maintenance) Make sure the proper oil is used for changing and topping up
---------------	-----------------------------	---

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.

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

Busch (UK) Ltd.
Hortonwood 30-35
Telford
Shropshire
TF1 7YB
Tel: 01952 677 432
Fax: 01952 677 423

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

Busch Ireland Ltd.
A10-11 Howth Junction Business Centre
Kilbarrack, Dublin 5
Tel: +353 (0)1 8321466
Fax: +353 (0)1 8321470

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

Busch Inc.
516-B Viking Drive
Virginia Beach, VA 23452
Tel: 1-800-USA-PUMP (872-7867)

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

Busch Vacuum Technics Inc.
1740, Boulevard Lionel Bertrand
Boisbriand (Montréal)
Québec J7H 1N7
Tel: 450 435 6899
Fax: 450 430 5132

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

Busch Australia Pty. Ltd.
30 Lakeside Drive
Broadmeadows, Vic. 3047
Tel: (03) 93 55 06 00
Fax: (03) 93 55 06 99

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

Busch New Zealand Ltd.
Unit D, Arrenway Drive
Albany, Auckland 1311
P O Box 302696
North Harbour, Auckland 1330
Tel: 0-9-414 7782
Fax: 0-9-414 7783

Find the list of Busch companies all over the world (by the time of the publication of these installation and operating instructions) on → page 46 (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.
-	Exhaust filter with o-ring (RE 0016 B)	1	0532 141 263
-	Exhaust filter with o-ring (RE 0040 B / RE 0063 B)	1	0532 141 269
-	Oil fill plug (RE 0016 B)	1	0416 138 045

-	Oil fill plug (RE 0040 B / RE 0063 B)	2	0416 138 045
-	O-ring for oil fill plug (RE 0016 B, standard version)	1	0486 000 633
-	O-ring for oil fill plug (RE 0016 B, PTFE version)	1	0486 123 685
-	O-ring for oil fill plug (RE 0040 B / RE 0063 B, standard version)	2	0486 000 633
-	O-ring for oil fill plug (RE 0040 B / RE 0063 B, PTFE version)	2	0486 123 685
-	Oil drain plug (RE 0016 B)	1	0415 000 074
-	Oil drain plug (RE 0040 B / RE 0063 B)	1	0416 000 130
-	O-ring for oil drain plug (RE 0040 B / RE 0063 B, standard version)	1	0486 000 504
-	O-ring for oil drain plug (RE 0040 B / RE 0063 B, PTFE version)	1	0486 123 695
-	Flame arrestor (gas discharge, RE 0016 B)	1	0543 134 468
-	Flame arrestor (gas discharge, RE 0040 B / RE 0063 B)	1	0534 144 189
-	Flame arrestor with slip stream interruption (suction connection, RE 0016 B)	1	0534 134 469
-	Flame arrestor with slip stream interruption (suction connection, RE 0040 B / RE 0063 B)	1	0534 144 186
-	Coupling (for the connection of the pressure switch/indicator)	1	0680 135 293

Spare Parts Lists

Spare Parts List	Description	Part no.
Service kit (RE 0016 B)	Exhaust filter, o-ring for exhaust filter, o-ring for oil fill plug, oil fill plug, o-ring for oil drain plug, seal ring for oil drain plug, oil drain plug, o-ring for exhaust cover	on request
Wartungssatz (RE 0040 B / RE 0063 B)	Exhaust filter, o-ring for exhaust filter, o-rings for oil fill plugs, oil fill plugs, o-ring for oil drain plug, seal ring for oil drain plug, oil drain plug, o-ring for exhaust cover	on request

Accessories

Accessories	Part no.
Oil return line to suction connection (RE 0040/0063 B)	0946 124 018
Gas ballast, complete (RE 0016 B)	0916 101 562
Gas ballast, complete (RE 0040 B / RE 0063 B)	0916 128 516
Level switch	0652 125 885

Oil

Denomination	VM 100	VE 101	VSL 100
ISO-VG	100	100	100
Base	Mineral oil	Diester	PAO
Density [g/cm³]	0.888	0.96	0.84
Ambient temperature area [°C]	12 ... 30	0 ... 40	0 ... 40
Kinematic viscosity at 40 °C [mm²/s]	110	95	96
Kinematic viscosity at bei 100 °C [mm²/s]	11.5	9.5	13
Flashpoint [°C]	260	255	240
Pourpoint [°C]	-15	-30	-50
Part no. 1 l packaging	0831 000 060	0831 000 099	0831 122 573
Part no. 5 l packaging	0831 000 059	0831 000 100	0831 122 572
Remark			Food applications (NSF H1)
Filling quantity, approx. [l]	RE 0016 B: 1 RE 0040 B / RE 0063 B: 2		

EC-Declaration of Conformity

Note: This Declaration of Conformity and the CE-mark affixed to the nameplate are valid for the machine within the Busch scope of delivery. This Declaration of Conformity is issued under the sole responsibility of the manufacturer.
When this machine is integrated into a superordinate machinery the manufacturer of the superordinate machinery (this can be the operating company, too) must conduct the conformity assessment process for the superordinate machine or plant, issue the Declaration of Conformity for it and affix the CE-mark.

We

Busch Produktions GmbH
Schauinslandstr. 1
79689 Maulburg
Germany

Declare that the vacuum pumps **RE 'ATEX' 0016, 0040, 0063 B**

Type Examination Certificate PTB 03 ATEX 4043 X

Audit: CE 0637

with a serial number from **D1601...** to **D1752...**

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

- 'Machinery' 2006/42/EC
- 'ATEX Directive' 94/9/EC (up to 19th April 2016) or 2014/34/EU (from 20th April 2016)
for use in potentially explosive areas according to classification written on the machine nameplate
- '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 for design –Risk assessment and risk reduction
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 immunity standards. Immunity for industrial environments
EN 61000-6-4: 2007 + A1: 2011	Electromagnetic compatibility (EMC) - Generic immunity 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
EN ISO 13463-1: 2009	Non-electrical equipment for potentially explosive atmospheres - Part 1: Basic methodology and requirements
EN ISO 1127-1: 2011	Explosive atmospheres - Explosion prevention and protection - Part 1: Basic concepts and methodology

Manufacturer



Dr.-Ing. Karl Busch
General Director

Person authorized to compile
the technical file

Andrej Riwe
Technical writer

Maulburg, 04.04.2016



(1) **EC-TYPE-EXAMINATION CERTIFICATE**
(Translation)

(2) Equipment and Protective Systems Intended for Use in
Potentially Explosive Atmospheres - **Directive 94/9/EC**

(3) EC-type-examination Certificate Number:

PTB 03 ATEX 4043 X



- (4) Equipment: Vacuum pump Typ Enivac RE 0016 B, RE 0040 B, RE 0063 B
- (5) Manufacturer: Vakuumpumpen und Systeme Busch Produktions GmbH
- (6) Address: Schauinslandstraße 1, D-79689 Maulburg
- (7) This equipment and any acceptable variation thereto are specified in the schedule to this certificate and the documents therein referred to.
- (8) The Physikalisch-Technische Bundesanstalt, notified body No. 0102 in accordance with Article 9 of the Council Directive 94/9/EC of 23 March 1994, certifies that this equipment has been found to comply with the Essential Health and Safety Requirements relating to the design and construction of equipment and protective systems intended for use in potentially explosive atmospheres, given in Annex II to the Directive.
- The examination and test results are recorded in the confidential report PTB Ex 03-43068.
- (9) Compliance with the Essential Health and Safety Requirements has been assured by compliance with:
- EN 13463-1 EN 12874 EN 50014**
EN 50020
- (10) If the sign "X" is placed after the certificate number, it indicates that the equipment is subject to special conditions for safe use specified in the schedule to this certificate.
- (11) This EC-type-examination Certificate relates only to the design, examination and tests of the specified equipment in accordance to the Directive 94/9/EC. Further requirements of the Directive apply to the manufacturing process and supply of this equipment. These are not covered by this certificate.
- (12) The marking of the equipment shall include the following:



II 1/2 G IIB3 T4

Zertifizierungsstelle Explosionsschutz
By order:

Braunschweig, 2003-10-23

Dr. H. Förster
Regierungsdirektor



sheet 1/3

EC-type-examination Certificates without signature and official stamp shall not be valid. The certificates may be circulated only without alteration. Extracts or alterations are subject to approval by the Physikalisch-Technische Bundesanstalt. In case of dispute, the German text shall prevail.

Physikalisch-Technische Bundesanstalt • Bundesallee 100 • D-38116 Braunschweig

SCHEDULE

(13)

(14) **EC-TYPE-EXAMINATION CERTIFICATE PTB 03 ATEX 4043 X**

(15) Description of equipment

Vacuum pumps type Enivac RE 0016 B, RE 0040 B and RE 0063 B work on the rotating vane principle. A circular rotor is positioned centrally on the shaft of the vacuum pump. The rotor 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, gliding in slots in the rotor, separate the space between the rotor and the cylinder into chambers. During the first half of a revolution the free volume increases and vanishes to almost zero during the second half of a revolution. This causes the conveyed gas to be sucked in, compressed and ejected. The pumps are lubricated with oil, which seals the gap between the sliding vanes and the cylinder while also providing a lubricating film between the vanes and the cylinder.

Vacuum pumps type Enivac RE 0016 B, RE 0040 B and RE 0063 B feature one flame arrester each on the suction side and on the pressure side. The crimped ribbon type flame arrester elements inside the flame arrester consist of one crimped and one flat ribbon each made of stainless steel. The ribbons, each 10 mm wide and 0.15 mm thick are spirally wound in tight layers. This forms passages of triangular shape, which pass vapour-air mixtures, but shall prevent the transmission of flames. Two flame arrester elements are used in each flame arrester. The triangle heights of the ribbons are 0.5 mm on the suction side and 0.3 mm on the pressure side.

The vacuum pumps can optionally be fitted with an explosion-proof oil sump heater.

Several monitoring devices shall make sure that

1. the oil level will not drop below the minimum level,
2. impermissibly high temperatures inside the pump as well as at gas outlet connection will not occur and
3. impermissibly high pressure inside the oil separator and inside the flame arrester on the pressure side will not occur.

The design, materials and dimensions are specified in drawings, part lists and data sheets as listed in the test report PTB EX 03-43068.

Requirements for explosion protection

Interior of inlet and outlet pipe: requirements according to category 1

Vacuum pump environment: requirements according to category 2

(16) Test report PTB Ex Ex 03-43068 (consisting of 10 pages, 126 drawings, 21 parts lists, 17 drawings and parts lists of the flame arresters, installation and operating instructions, hazard analysis and risk assessment, list of variety of types, 5 test reports, data sheets and test protocols with calibration data)

sheet 2/3

EC-type-examination Certificates without signature and official stamp shall not be valid. The certificates may be circulated only without alteration. Extracts or alterations are subject to approval by the Physikalisch-Technische Bundesanstalt. In case of dispute, the German text shall prevail.

Physikalisch-Technische Bundesanstalt • Bundesallee 100 • D-38116 Braunschweig

SCHEDULE TO EC-TYPE-EXAMINATION CERTIFICATE PTB 03 ATEX 4043 X

Result: the type complies with the requirements of directive 94/9/EC for equipment group II, (subdivision IIA and IIB according to EN 50014), temperature class T4 according to EN 50014 and – as specified under (15) in the requirements for explosion protection – category 1 in one part and category 2 in the other part.

(17) Special conditions for safe use

- The housing of the vacuum pumps type Enivac RE 0016 B, RE 0040 B and RE 0063 B shall be tested for leak tightness and strength with a static pressure of 15 bar.
- For the operation of the vacuum pumps type Enivac RE 0016 B, RE 0040 B and RE 0063 B all mounted devices, components and parts (coupling, drive motor etc.) shall be suitable for the respective zone. This includes that the requirements according to equipment group II (subdivision IIA, IIB), category 2G, temperature class T4 (according to EN 50014) are complied with.
- The drive motor must not exceed the allowed power and speed as specified in the operating instructions of the pump.
- Prior to commissioning of the pump a comprehensive equipotential bonding of the entire system shall be applied in accordance with EN 50014:2000, chapter 15 and other applicable EN-, IEC- and ISO-standards.
- The operator shall observe the temperature limits for the oil, the ambient temperature and the conveyed gas and the pressure values on the suction and the pressure side as stipulated in the operating instructions.
- The operator is allowed to commission the pump only when the monitoring devices (as mentioned in the operating instructions) have been properly installed and the prescribed switching conditions have been implemented into the controls.
- Only oils as mentioned in the operating instruction or equivalent oils are allowed to be used.
- The oil separator may alternatively be nickel-plated.
- The optionally available oil sump heater must comply with the requirements acc. to equipment group II (subdivision IIA, IIB), category 2G, temperature class T4 (according to EN 50014).
- The temperature switch may only be operated in an intrinsically safe electrical circuit according to EN 50020, annex A.
- The vacuum pumps may alternatively be fitted with a gas ballast.

The manufacturer of the rotating vane vacuum pump Enivac RE 0016 B, RE 0040 B and RE 0063 B is required to transmit the above conditions to the user in a suitable form, and the user is required to duly fulfill and observe them.

(18) Essential health and safety requirements

Zertifizierungsstelle Explosionsschutz
By order:

Braunschweig, 2003-10-23



Dr. H. Förster
Regierungsdirektor



sheet 3/3

EC-type-examination Certificates without signature and official stamp shall not be valid. The certificates may be circulated only without alteration. Extracts or alterations are subject to approval by the Physikalisch-Technische Bundesanstalt. In case of dispute, the German text shall prevail.

Physikalisch-Technische Bundesanstalt • Bundesallee 100 • D-38116 Braunschweig

2nd SUPPLEMENT

according to Directive 94/9/EC Annex III.6

to EC-TYPE-EXAMINATION CERTIFICATE PTB 03 ATEX 4043 X

(Translation)

Equipment: Vacuum pump, types Enivac RE 0016B, RE 0040B, RE 0063B

Marking:  II 1/2 G IIB3 T4 and  II 1/2 G IIA T4

Manufacturer: Vacuum pumps and systems
Busch Produktions GmbH

Address: Schauinslandstraße 1
79689 Maulburg, Germany

Description of supplements and modifications

The vacuum pumps, types Enivac RE 0016 B, RE 0040 B and RE 0063 B, have been modified in a number of respects.

The vacuum pumps, types Enivac RE 0040 B and RE 0063 B, are alternatively to be equipped with RMG-Gaselan flame arrestors.

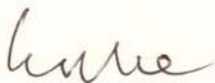
The vacuum pumps, types Enivac RE 0040 B and RE 0063 B, are alternatively to be equipped with RMG-Gaselan flame arrestors with a different height of the triangular gap to be able to convey potentially-explosive explosion-group IIA mixtures.

Test report: PTB Ex 07-47013

Result: The structural modifications do not affect the explosion protection features of types Enivac RE 0016B, RE 0040B, RE 0063B vacuum pumps. The relationship between explosion group and height of triangular gap of the flame arrestor used must be observed. The Special Conditions specified in (17) remain unaffected.

Zertifizierungsstelle Explosionsschutz

By order:



Dr. H. Bothe
Direktor und Professor



Braunschweig, 14 August 2007

Sheet 1/1

EC-type-examination Certificates without signature and official stamp shall not be valid. The certificates may be circulated only without alteration. Extracts or alterations are subject to approval by the Physikalisch-Technische Bundesanstalt. In case of dispute, the German text shall prevail.

Physikalisch-Technische Bundesanstalt • Bundesallee 100 • 38116 Braunschweig, Germany

3. SUPPLEMENT

according to Directive 94/9/EC Annex III.6

to EC-TYPE-EXAMINATION CERTIFICATE PTB 03 ATEX 4043 X

(Translation)

Equipment: Vacuum pump, type Enivac RE 0016 B, RE 0040 B, RE 0063 B

Marking:  II 1/2 G c IIB3 T4 and II 1/2 G C IIA T4

Manufacturer: Busch Produktions GmbH

Address: Schauinslandstraße 1, 79689 Maulburg, Germany

Description of supplements and modifications

The assessment for the Enivac RE 0016 B, RE 0040 B and RE 0063 B vacuum pumps has been adapted to the current status of standards.

The gas ballast can also be operated when an external gas supply system is connected.

Applied standards

EN 13463-1, EN 13463-5, EN 16852

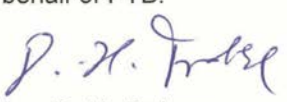
Test report: PTB Ex 13-43008

Result:

The modifications that have been made do not affect the safety against explosion of the Enivac RE 0016B, RE 0040 B and RE 0063 B vacuum pumps. The Special Conditions mentioned in No. 17 of EC Type Examination Certificate PTB 03 ATEX 4043 X remain unaffected.

Zertifizierungssektor Explosionsschutz
On behalf of PTB:

Braunschweig, August 19, 2013


Dr.-Ing. D.-H. Frobese
Oberregierungsrat



Sheet 1/1

EC-type-examination Certificates without signature and official stamp shall not be valid. The certificates may be circulated only without alteration. Extracts or alterations are subject to approval by the Physikalisch-Technische Bundesanstalt. In case of dispute, the German text shall prevail.

Physikalisch-Technische Bundesanstalt • Bundesallee 100 • 38116 Braunschweig • GERMANY

Equipment Documentation Measurement and Safety Instrumentation

Overview

Temperature Switch

Type	2010206-R28-120 05 J ð TR 105+-5 03EN15S040-M5X6	
Marking	03EN A 120°C * VDE T150 (* = code for date of manufacture)	
Interface	Connection for two cable shoes 6.3 x 0.8 mm Cable gland for cable diameter 3.5 ... 7 mm	
Arrangement of contacts	 Opening at temperature rise (i.e. excessive temperature interrupts the electrical circuit)	
Switching points	Open: 120 °C ± 5 K Close: 105 °C ± 5 K	
Transition resistance	< 30 mΩ	
Nominal temperature range	-20 ... +150 °C	
Nominal current/ Nominal voltage (these data refer to the capabilities of the switch alone, they constitute no limit values for intrinsically safe circuits!)	Nominal voltage	250 V AC 125 V AC 30 V AC
	Nominal current at cos φ = 1,0	250 V AC 10A/16A 125 V AC 15A 30 V DC 5 A
	Nominal current at cos φ = 0,75	250 V AC 10 A 125 V AC 13,5 A 30 V DC 4 A
More installation notes: The temperature switch is intended for use in an intrinsically safe circuit acc. to EN 60079-11, annex A, i.e. for connection to an isolation switch amplifier (e.g. Pepperl+Fuchs KF__-SR2-Ex1.W; not in the Busch scope of delivery). The temperature switch is a simple apparatus in terms of EN 60079-11. The limit values for intrinsically safe circuits shall be established acc. to EN 60079-11, annex A for the explosion group IIB. Interruption of the electrical circuit must automatically shut down the vacuum pump. Closing of the electrical circuit after cooling down of the temperature switch must not start the vacuum pump self-acting. The restart of the vacuum pump is permitted only by action from the operating personnel after remedy of the cause of the excessive temperature. For the functional check in the course of the test run of the vacuum pump with inert gas interrupt the electrical circuit by pulling a connector from the temperature switch. Make sure that an alarm is released in the system control and the vacuum pump is shut down automatically. Push the pulled connector back on the temperature switch. Make sure that the alarm persists and the vacuum pump remains shut down. After reconnection of the cable to the temperature switch make sure that the gasket is inserted between the housing cover and the housing bottom, the housing is firmly closed and the cable gland is tightened.		

Pressure Switch/Indicator

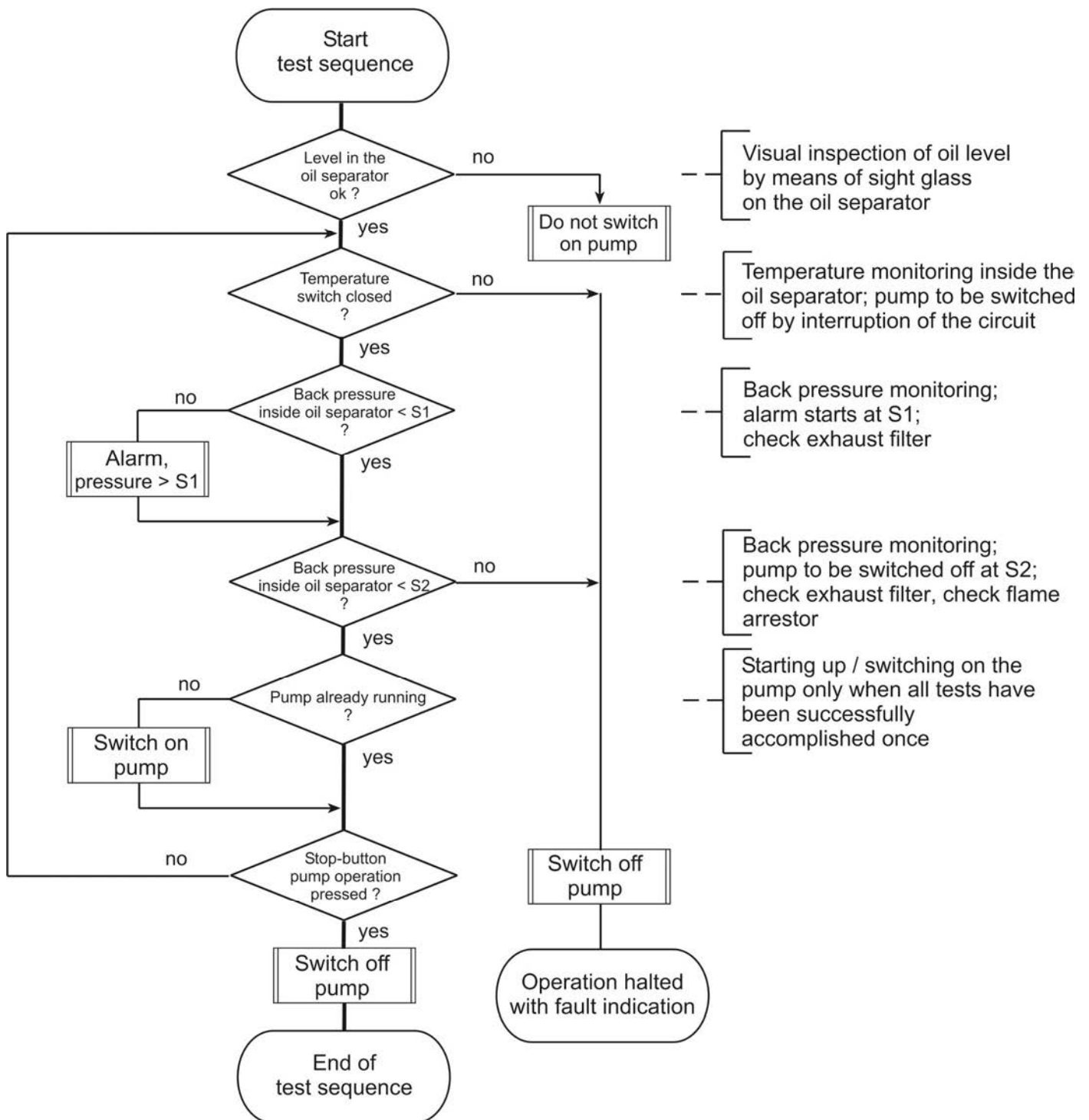
Type/Marking	ExS10-0AVA0811R2SB or ExS10-0AVA0811R2SB2
Brief description: The device is fed with a voltage between 14.5 and 45 V DC (between 14.5 and 27.3 V DC in intrinsically safe circuits). The positive pole of the supply is connected to pin 1, the negative pole to pin 3. Depending on the pressure signal the current between pin 3 and the negative pole of the supply varies between 4 mA (corresponding to 0 hPa (=mbarg)) and 20 mA (corresponding to 1600 hPa (=mbarg)). 1600 hPa are not reached in practice, though, as the vacuum pump must be shut down at 600 hPa (corresponding to 10 mA). Under normal operating conditions the voltage between the pins 4 and 3 is the supply voltage minus 2 V. The LED S1 is lit. When the switching point S1 is reached the voltage falls to zero and the LED S1 goes out. Under normal operating conditions the voltage between the pins 2 and 3 is the supply voltage minus 2 V. The LED S2 is lit. When the switching point S2 is reached the voltage falls to zero and the LED S2 goes out.	
	→ excerpt from Installation and Operating Instructions BA0811 (→ pages 37 ff.)
Interface	A mating coupling is in the scope of delivery. Cable connection with screw clamps max. 0.75 mm².
Upon delivery the pressure switch/indicator is set as listed below. Version ExS10-0AVA0811R2SB: The parameters are programmed as «customer specific adjustments». Restoration in case of inadvertent misadjustment → page 42 of these Installation and Operating Instructions. Version ExS10-0AVA0811R2SB2: The parameters are programmed into the firmware as «factory values». Restoration in case of inadvertent misadjustment → page 42 of these Installation and Operating Instructions → «Factory reset - read the factory values».	
Lower pressure signal with signal applied (liquid adjustment)	not to be set
Zero signal without applied signal (dry adjustment)	0.000
Upper pressure signal with signal applied (liquid adjustment)	not to be set
Span signal without applied signal (dry adjustment)	1.600
Decimal places	dp0 (corresponds to indication 8888., i.e. indication in hPa (mbar))
Zero scaling	0000
Endpoint-scaling	1600
Damping	6 (corresponds to 2 seconds delay)
Limit value switch point 1	0550
Hysteresis switch point 1	0015
Operating mode switch point 1	n.c. (quiescent principle)
Function switch point 1	norF

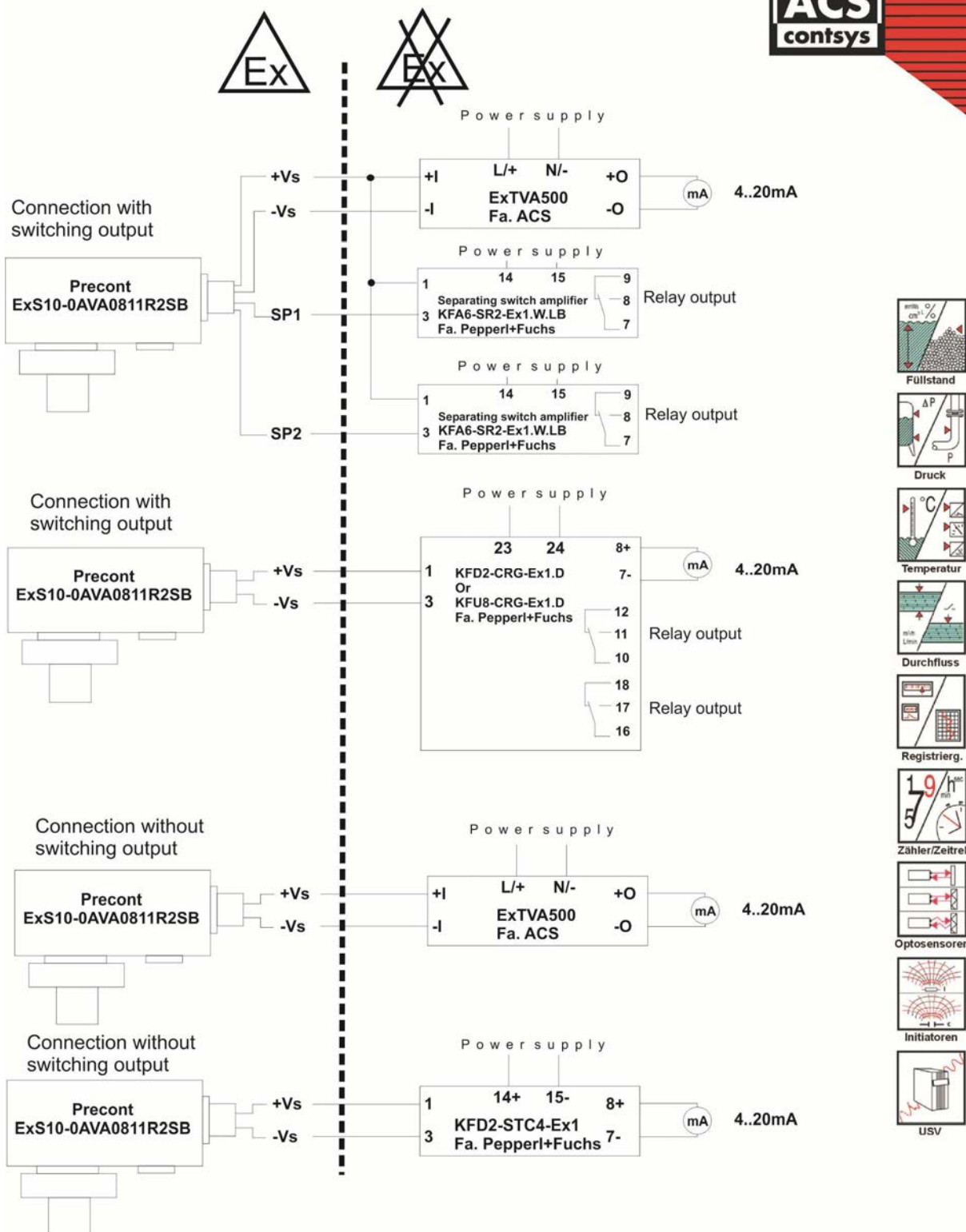
Limit value switch point 2	0600
Hysteresis switch point 2	0015
Operating mode switch point 2	n.c. (quiescent principle)
Fast adjustment	oFF
Behaviour of signal output	oFF
More installation notes: Observe the excerpt from Installation and Operating Instructions BA0710 (→ page37 ff.); the complete documentation is available from www.acs-controlsystem.de. A matching coupling for the connection of a cable to the pressure switch/indicator (a) is included in the scope of delivery of the vacuum pump. The direct connection of switching relays to the pins 2 and 4 can cause the current on pin 1 to exceed the limit for intrinsically safe circuits. In order not to exceed the allowed current either only the 4 ... 20 mA signal is to be evaluated with a suitable transmitter supply (e.g. Pepperl+Fuchs KF__-CRG-Ex1.D; not in the Busch scope of delivery), set to the switch points 9.5 and 10 mA, corresponding to 550 and 600 hPag (=mbarg), or isolation switch amplifiers (e.g. Pepperl+Fuchs KF__-SR2-Ex1.W; not in the Busch scope of delivery) are to be switched between the pins 1, 2 and 4 of the pressure switch/indicator (a) on the one side and the switching relays on the other. Alternatively the evaluation of the 4 ... 20 mA signal, after isolation by means of a suitable transmitter supply (e.g. ACS <->ExTVA500, Pepperl+Fuchs KFD2-STC4-Ex1) can be performed by a non-Ex-system control or SPS respectively. → Page36, Connection Examples Precont S in Ex-areas. The pressure switch/indicator (a) is to be integrated into the system control such that 550 hPag (=mbarg) will release a warning, which must be acknowledged by the operating personnel. 600 hPag (=mbarg) must automatically shut down the vacuum pump. The restart of the vacuum pump is permitted only by action from the operating personnel after remedy of the cause of the excessive pressure. For the functional check in the course of the test run of the vacuum pump with inert gas throttle the gas discharge until the display on the pressure switch/indicator (a) reads 550 hPa. Make sure that a warning is released in the system control. Relieve the throttling of the gas discharge, so that the indicated pressure drops below 550 hPa. Make sure that the warning persists. Throttle the gas discharge further until the display on the pressure switch/indicator (a) reads 600 hPa. Make sure that an alarm is released in the system control, the vacuum pump is shut down automatically and remains shut down.	

Level Switch (u) (Optional)

Type/Marking	FTL50-GGR2AA6G4A
Interface	Electronic insert FEL 56: for separate switching unit (isolation switch amplifier not in the Busch scope of delivery); Signal transmission L-H edge 0.6...1.0 / 2.1...2.8 mA to EN 60947 (NAMUR) along two-wire cabling
Human interface	2 switches for fail-safe mode and density change, green LED flashes to indicate power on, red LED to indicate switching status, flashes on damage by corrosion on sensor or with defective electronics
More installation notes: Installation and operation acc. to operating instructions of the level switch (separate leaflet); the complete documentation is available from www.endress.com.	

Flow Chart Safety Tests





ACS-CONTROL-SYSTEM GmbH

Lauterbachstraße 57
Tel. (08721) 9668-0
Fax. (08721) 966830

84307 Eggenfelden
Email: info@acs-controlsystem.de
Internet: www.acs-controlsystem.de



Technical manual

BA 0811



Pressure

Precont S

Pressure transmitter

for continuous measuring and surveillance of pressures
in gases, vapors, liquids and dusts

Pressure ranges 0...0,1 bar to 0...1000 bar / -0,1...0/+0,1 bar / -1...0/+1 bar
Ceramic or metallic membrane with various process connections
Suitable for wide process temperature range from - 40 °C to +370 °C
Various usability, especially for hygienic applications
ATEX II 1/2 G Ex ia IIC T4 resp. ATEX II 1/2 D Ex iaD 20/21 T60°C/T102°C
Certification for the use in explosion hazardous areas
Excellent accuracy up to 0,1%

Programmable evaluation electronic with high brightness LED-display

- in 2-wire-technology with current signal 4...20 mA or
- in 3-wire-technology with voltage signal 0...10 V
- with two PNP switching outputs

ACS

controls

ACS-CONTROL-SYSTEM

know how mit system

Lauterbachstr. 57 – 84307 Eggenfelden – Germany
Tel: +49 8721/9668-0 – Fax: +49 8721/9668-30
info@acs-controlsystem.de – www.acs-controlsystem.de

Index

Application description 3

Function 3

Variant differences 4

Available pressure ranges – permissible overload resp. burst pressure 5

Safety notes 6

Safety notes 6

Installation 7

Maintenance 7

Repair 7

Electrical connection 8 / 9 / 10

Operation and display elements / function modes 11

Function description 12

° Analogue output / PNP – switching output / damping / function scheme 12 / 13

° Adjustment menu 14

Technical data 15 / 16 / 17 / 18

Dimension drawings Precont S10 19

Order code overview Precont S10 20

Dimension drawings Precont S20 21

Order code overview Precont S20 22

Dimension drawings Precont S30 23

Order code overview Precont S30 24

Dimension drawings Precont S40 25

Order code overview Precont S40 26

Dimension drawings Precont S70 27

Order code overview Precont S70 28

Precont S

Application description

The devices of the series **Precont S** with integrated digital evaluation electronic are compact pressure transmitter for continuous measuring and surveillance of pressures from -1 up to 1000 bar within gases, vapors, liquids and dusts within closed container or pipelines, also in explosive hazardous areas, at process temperatures from -40°C to +370°C.

The use of a capacitive measuring sensor with ceramic membrane or of a strain gauge with metallic membrane, by use of various, also front flush process connections resp. process diaphragm seals, allows the use in nearly all fields of industry, especially also in hygienic applications.

Function

The device is used for pressure measurement.

Characteristics of the ceramic measuring membrane – Precont S10 / S40 / S70

The system pressure is applied to the ceramic membrane and causes there a variation of the capacity at the back side of the membrane.

A pressure transmitting liquid is not used.

The ceramic membrane offers excellent characteristics like highest pressure and pressure blow strength up to forty times the nominal pressure, vacuum resistance, very high resistance against chemicals, corrosion and abrasion as well as very good insensitivity against temperature shocks, highest accuracy and reproducibility, good long term stability and a very low temperature influence.

Characteristics of the metallic measuring membrane – Precont S20 / S30 / S70

The system pressure is applied to the metallic membrane and causes there a deflection of the strain gauge at the back side of the membrane.

A pressure transmitting liquid is only used at pressure ranges lower than 0...25 bar.

The metallic membrane offers excellent characteristics like high pressure and pressure blow strength up to six times the nominal pressure, vacuum resistance, good reproducibility and hysteresis and also good long term stability and a low temperature influence.

Characteristics of the process diaphragm seal – Precont S70

The system pressure is applied to the metallic membrane of the process diaphragm seal and is transmitted by a pressure transmitting liquid to the respective ceramic or metallic measuring membrane that is placed behind. This leads among others to an extension of the permissible medium temperature up to +370°C and to an essential increase of the temperature stability of the device.

Signal processing

The pressure dependent variation of capacity resp. the variation of the strain gauge output voltage is recorded in high resolution by a processor, adjusted acc. to the settings and converted in high resolution into an output signal of 4...20mA or 0...10V.

According to the resp. settings the PNP switching outputs are driven.

The switching state of the two PNP switching output are indicated by each an LED.

By 3 keys and the four digit LED display all settings for the display, the analogue output as well as the PNP switching outputs can be set resp. adjusted.

A transmitter fast adjustment per key combinations is also possible.



Safety notes

Each person that is engaged with inauguration and operation of this device, must have read and understood this technical manual and especially the safety notes.

Installation, electrical connection, inauguration and operation of the device must be made by a qualified employee according to the informations in this technical manual and the relevant standards and rules.

The device may only be used within the permitted operation limits that are listed in this technical manual. Every use besides these limits as agreed can lead to serious dangers.

The materials of the device must be chosen resp. checked for suitability to the respective application requirements (contacting substances, process temperature). An unsuitable material can lead to damage, abnormal behavior or destruction of the device and to the resulting dangers.

The device may not used as sole device for prevention of dangerous conditions in machines and plants.

This device meets article 3 (3) of the EC directive 97/23/EC (pressure equipment device directive) and is designed and produced in good engineer practice.

The device meets the legal requirements of all relevant EC directives. **CE 0158**

Safety notes for electrical operating supplies for explosive hazardous areas

If a device is installed and operated in explosive hazardous areas, the general Ex construction standards (EN/IEC 60079-14, EN/IEC 61241-14, VDE 0165), this safety notes and the enclosed EC conformity certificate incl. supplements must be observed.

The installation of explosive hazardous systems must be carried out principally by specialist staff.

The device meets the classification

	T _a Medium	T _a Housing
II 1/2 G Ex ia IIC T4	-20...+60 °C	-20...+85 °C
II 1/2 D Ex iaD 20/21 T60°C / T102°C (T57°C)	-20...+60 °C	-20...+85 °C (+40 °C)
II 2 G Ex ib IIC T4	-20...+85 °C	-20...+85 °C
II 2 D Ex ibD 21 T102°C	-20...+85 °C	-20...+85 °C
II 2 G Ex ib IIC T4	-20...+125 °C	-20...+50 °C
II 2 D Ex ibD 21 T125°C	-20...+125 °C	-20...+50 °C

The highest surface temperature is determined inside the housing at complete fill up, that means thermal isolation. The power at the sensor is negligible.

The devices are conceived for measuring of pressures in explosive hazardous areas.

The measured medium may also be combustible gases, vapors, liquids and dusts.

The permitted operating temperatures and pressures are type and variant dependent and can be found in this technical manual.

For applications, which require devices of category 1/2 or category 1, the process pressure and temperature range of the medium has to be between 0,8 bar and 1,1 bar and between -20 °C and 60 °C.

The permissible maximum values for U_i, I and P_i are equal for variants A/B/C/D/E/F/G/H. To this there must be paid especially attention in the case of combining more intrinsically safe circuits at the variants with voltage output 0...10V (variants E/F/G/H) and at the variants with PNP switching outputs (variants A/E). The rules for combination of intrinsically safe circuits must be applied.

The PA terminal inside the connection housing resp. the process connection must be connected to the potential compensation of the explosive hazardous area.

At variants of the devices with chargeable plastic parts (e.g. cable resp. connection housing), a warning marking points out to the safety measures, that must be applied because of the electrostatic charging in operation and especially in the case of maintenance activities.

avoid friction - no dry cleaning - no assembling in pneumatic conveying stream

Installation

- The installation of the device at a position, where high pressure pulses can occur, should be avoided. Adjustment and function control can be made easier, if the device is mounted behind a stop fitting.
- The installation of the device should be made if possible at temperature calmed places to get a reliable measuring result. Large temperature steps, e.g. at filling of a hot liquid into a cold system, can produce a short-time higher measuring signal deviation at the variant with ceramic measuring membrane. At a large amplification of the measuring signal this deviation will be also amplified accordingly. The deviation will be completely neutralized after the adaptation of the measuring membrane of the pressure transmitter to the temperature.
- At a step from +20°C ... +80°C this neutralization can take up to 3 minutes.
- The use of a process diaphragm seal can cause an essential improvement.
- The installation position has influence on the measuring result of the kind of a zero value shift because of the deadweight of the measuring membrane and a possible pressure transmitting liquid. This deviation can be eliminated by an offset adjustment. Zero and end value must be shifted by the same amount.
- Drive the system pressure free prior installation resp. deinstallation of the sensor.
- The tightening of the process connection with screw-in thread may only be done at the hexagon by a suitable spanner.
- The maximum permitted torque strength is 50 Nm.
- The screw in of the process connection by using the connection housing is not permitted.
- The housing can be rotated every time, also at operation, by 330°.
- Avoid the pollution of the pressure compensation vent. The hindrance of the pressure compensation can lead to faulty measuring results.
- The correct function of the device within the specific technical data can only be guaranteed, if the permitted temperature in the area of the connection housing (see technical data) will not be exceeded.
- This can be achieved by the using of the temperature decoupler, a process diaphragm seal (variant S70) or also by isolation of the medium carrying part of the plant or by other constructive measures to reduce the transferring of an extreme temperature to the connection housing.
- A process diaphragm seal (variant S70) together with the measuring transmitter forms a closed, calibrated system, that is filled by openings in the process diaphragm seal and in the measuring system of the measuring transmitter. These openings are sealed and may not be opened.

Maintenance

- The device is free of maintenance.
- Special substances can lead to solid coatings on the membrane.
- Such depositions can lead to faulty measurement results of the device.
- In the case of coat forming liquids the membrane must be regularly cleaned e.g. with clear water.
- Don't use sharp tools or aggressive chemicals for cleaning.

Repair

- A repair may only be carried out by the manufacturer.
- If the device must be sent back for repair, the following informations must be enclosed:
 - An exact description of the application.
 - The chemical and physical characteristics of the product.
 - A short description of the occurred error.
- Before returning the device for repair, the following measures must be proceeded:
 - All stick product residues must be removed. This is especially important, if the product is unhealthy, e.g. caustic, toxic, carcinogenic, radioactive etc.
 - A returning must be refrained, if it is not possible by 100% to remove the unhealthy product completely, because e.g. it is penetrate into cracks or is diffused through plastic.

Electrical connection

- The electrical connection of the device must be carried out according to the respective country specific standards. Incorrect installation or adjustment could cause applicationally conditioned risks.
- Use only twisted shielded signal and measurement wires and install these wires separated from power leading wires. Connect the cable shield only at one side to earth. Ideally at the installation place of the device. The metallic parts of the device with connection housing plug - type S resp. cable - type K are electrically connected with the earthing connection screw. At the variant with connection housing terminal box - type A all metallic parts are connected with terminal 1 - PE/shield.
- The device must be grounded, e.g. by the earth terminal screw or by the process connection.
- At the housing variant with terminal box, the terminals for wire cross-section from 0.5...2.5mm², for the connection of a cable are placed below the electronic module. This is plugged and can be pushed easily. After the connection of the cable, the module must be correctly inserted again.
- The cable gland is suitable for cable diameter from 4.5 to 10 mm.
- After the installation of the cable the cable gland must be firmly screwed to ensure the tightness of the connection housing. The same is valid for the screw cap of the housing.
- The voltage applied to the terminal contacts may not exceed 45 V to avoid damage of the electronic. All connections are polarity protected.
- The minimum resp. maximum supply voltage depends on the respective variant:

Variant	not Ex	Ex
type A/B/E/F/G/H	14.5...45V DC	14.5...30V DC
type C/D	10.5...45V DC	10.5...30V DC

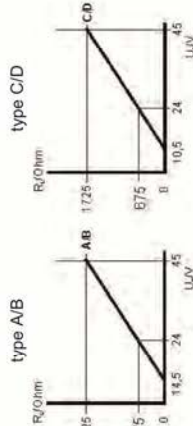
A load, e.g. the measuring shunt of an evaluation device, in series with a sensor of the variant A/B/C/D with 4...20 mA current signal in 2-wire-technology reduces the supply voltage available at the sensor. Dependent on version resp. minimum supply voltage, it results in a maximum value for this resistor, where a correct function is still possible.

The maximum load at signal current 20mA can be calculated by the equation:

$$R_L \text{ max} = (V_{S \text{ act}} - V_{S \text{ min}}) / 20\text{mA}$$

with $V_{S \text{ act}}$ = applying supply voltage and $V_{S \text{ min}}$ = minimum supply voltage.

The following graph shows the characteristics for the resistor values at 24 V and 45 V.



Inductive loads at the pnp switching outputs, e.g. relays or contactors may only be used with a free-wheeling diode or a RC protection circuit to avoid high voltage peaks.

The load at the PNP switching output will be connected to the terminal +terminal of the supply voltage by a semiconductor switch contactless and by this bounce-free. At an activated switching state a positive signal near supply voltage is fed to the output.

At deactivated switching state and at failure of supply voltage the semiconductor switch is shut off.

The PNP switching output is current limited to 0.2...0.25 A and is overload and short circuit protected.

Precont S

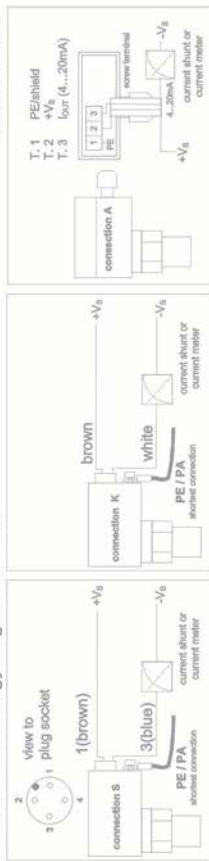
Assignment

connection type S
plug M12x1

connection type K
cable

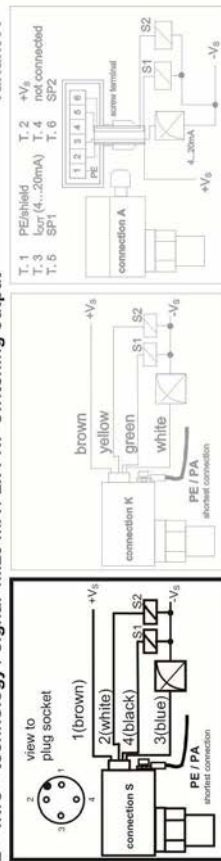
connection type A
terminal box

2 – wire – technology / signal 4...20 mA



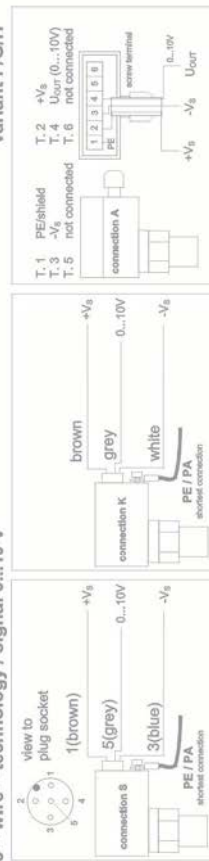
variant B/C/D

2 – wire – technology / signal 4...20 mA / 2x PNP switching output



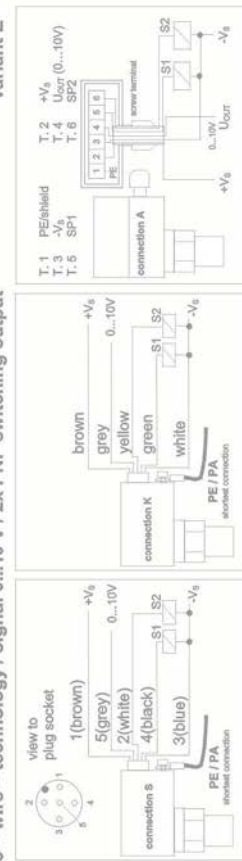
variant A

3 – wire – technology / signal 0...10 V



variant F/G/H

3 – wire – technology / signal 0...10 V / 2x PNP switching output

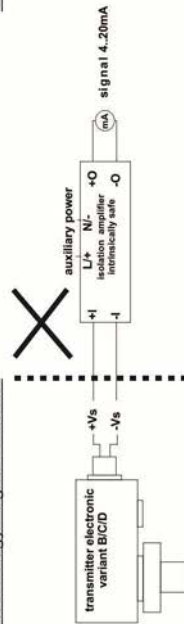


variant E

Precont S

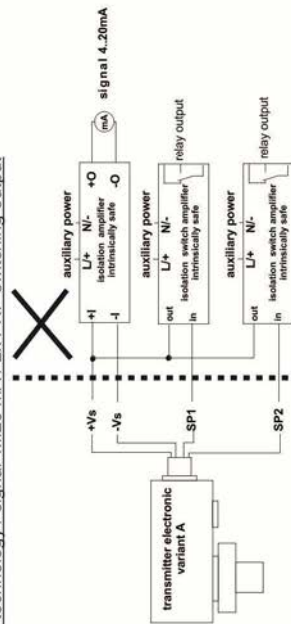
Electrical connection in an explosion hazardous area

2 – wire – technology / signal 4...20 mA



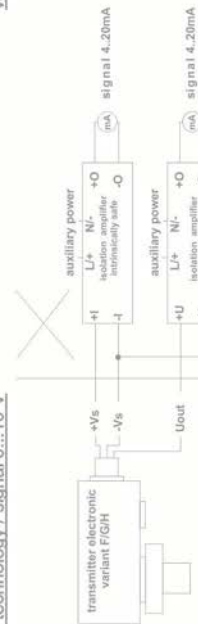
variant B/C/D

2 – wire – technology / signal 4...20 mA / 2x PNP switching output



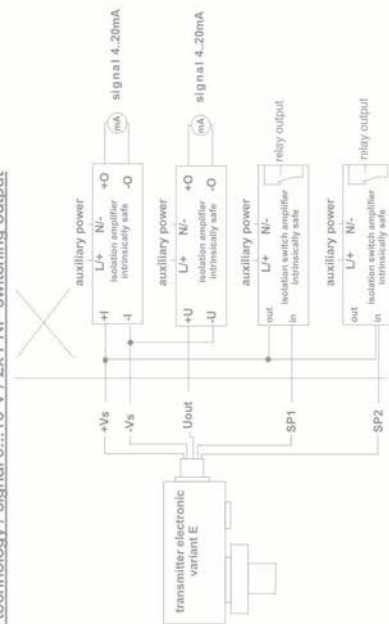
variant A

3 – wire – technology / signal 0...10 V



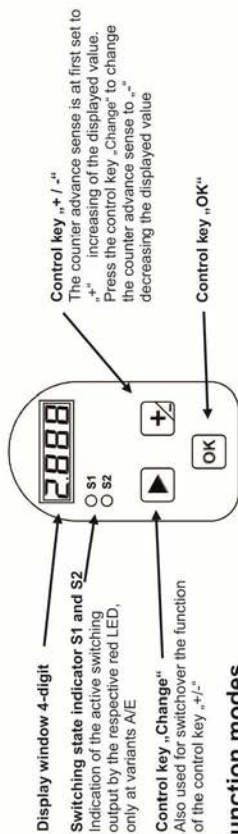
variant F/G/H

3 – wire – technology / signal 0...10 V / 2x PNP switching output



variant E

Operation and display elements



Function modes

run mode

The pressure transmitter records the applied system pressure and proceeds the chosen functions according to the set parameter. The measuring value is displayed in the display window.

The analogue output and the switching outputs are driven. A switched-on switching output is signaled by the come on of the respective red switching condition light-emitting diode.

The exceeding of the frame specifications, abnormal behavior conditions or also device malfunctions are displayed by the display values EEEEResp. -EEE

By pushing the control key „+/-“ the software version will be displayed

Programming mode

To access to the adjustment menu push the control key „OK“ and enter the **password 3009**.

Fast adjustment mode

By pushing of key combinations in the run mode the transmitter can be operated without using the adjustment menu.

Zero value adjustment with applied pressure signal:

Short pushing the key's „Change“ and „OK“ in succession and hold approx. 6 seconds.

The output signal 4mA / 0V is generated that can be varied by „+/-“ resp. „Change“ and „+/-“.

By pushing the key „OK“, the current pressure value is captured as lower pressure reference value, assigned to the previously adjusted output signal and the changed settings are stored loss protected (duration approx. 3 s). A jump back to the run mode is carried out.

End value adjustment with applied pressure signal:

Short pushing the key's „+/-“ and „OK“ in succession and hold approx. 6 seconds.

The output signal 20mA / 10V is generated that can be varied by „+/-“ resp. „Change“ and „+/-“.

By pushing the key „OK“, the current pressure value is captured as upper pressure reference value, assigned to the previously adjusted output signal and the changed settings are stored loss protected (duration approx. 3 s). A jump back to the run mode is carried out.

Damping adjustment:

Short pushing the key's „Change“ and „+/-“ in succession and hold approx. 6 seconds.

The damping value can now be varied. This value can be varied arbitrary by „+/-“ resp. „Change“ and „+/-“ from 0 to 60 seconds in 10 steps of each 0.6 seconds, at variants C / G from 0 to 6 seconds in 10 steps of each 0.6 seconds. By pushing the key „OK“, the value is captured and stored loss protected.

A jump back to the run mode is carried out.

Reset to factory values:

At devices of variants C / G, a reset to factory values will be carried out by pushing the key „OK“ for approx. 5 seconds at a restart after removing the supply voltage. All customer specific adjustment values will be lost.

Attention:

If the lower pressure reference value (zero) is adjusted higher than the upper pressure reference value (span), the output signal falls **below** 3.8mA resp. to 0V. The display shows EEEEResp. as long as the key „OK“ is pushed. A readjustment has to be done correctly (zero < span).

Function description

Analogue output

The pressure signal is transmitted to the analogue output, in which the adjusted pressure zero value equals an output current of 4 mA resp. an output voltage of 0 V and the adjusted pressure end value equals an output current of 20 mA resp. an output voltage of 10 V.

At an adjustment by Zero resp. the pressure zero value resp. the pressure end value and thus the zero value (4 mA / 0 V) resp. the end value (20 mA / 10 V) of the analogue output can be shifted.

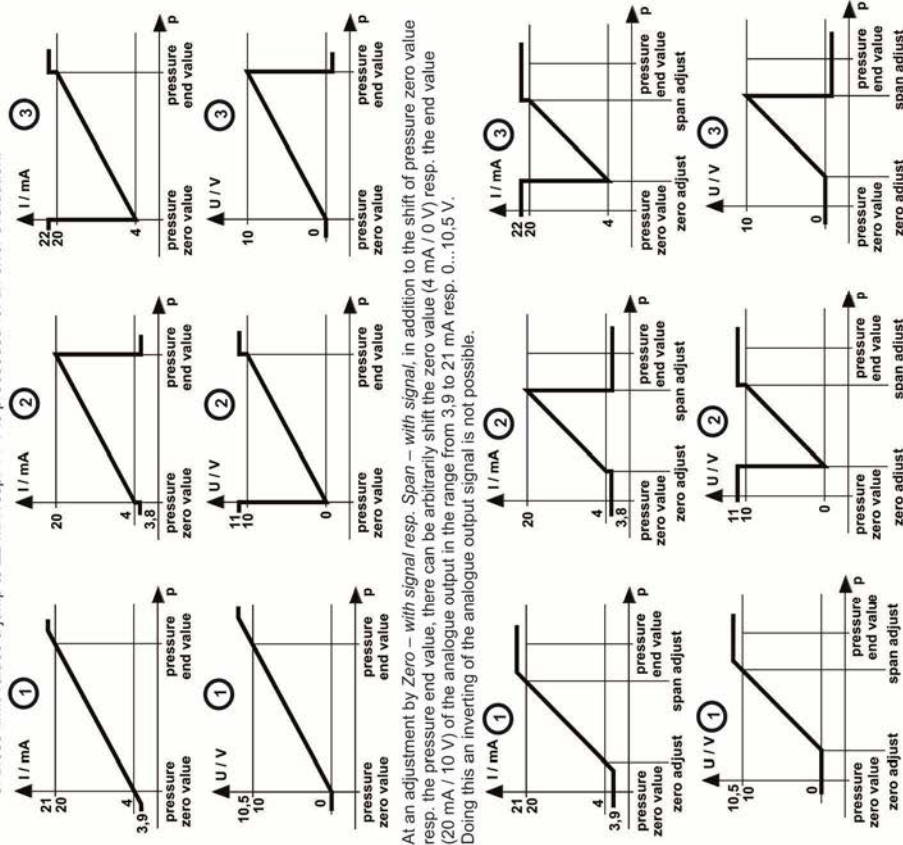
The output signal behaves depending on the set mode in three different possibilities:

① Linear signal transmission in the range from 3.9 mA to 21 mA resp. 0 V to 10.5 V.

The limit values are kept at exceeding or under-run.

② Linear signal transmission in the range from 4 mA to 20 mA resp. 0 V to 10 V. At exceeding or under-run of these limit values a jump to 3.8 mA resp. 0 V is proceeded for an error evaluation.

③ Linear signal transmission in the range from 4 mA to 20 mA resp. 0 V to 10 V. At exceeding or under-run of these limit values a jump to 22 mA resp. 11 V is proceeded for an error evaluation.



At an adjustment by Zero – with signal resp. Span – with signal, in addition to the shift of pressure zero value resp. the pressure end value, there can be arbitrarily shift the zero value (4 mA / 0 V) resp. the end value (20 mA / 10 V) of the analogue output in the range from 3.9 to 21 mA resp. 0...10.5 V.

Doing this an inverting of the analogue output signal is not possible.

PNP – switching output

The switching function realizes a stable switching condition, independent from system conditioned pressure fluctuations around the adjusted set point.

It can also be used for realizing a pressure controlled two-position control.

The switching range is determined separately by the switch point – SP- and hysteresis – HyS- for the respective switching output.

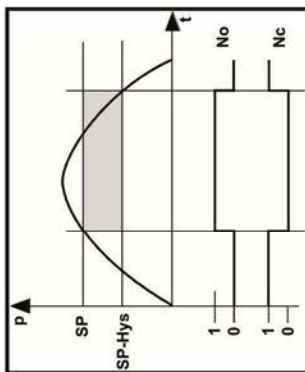
For the switch point as well as for the hysteresis an arbitrary value referring to the display scaling can be input. The switch back point result from switch point deducting hysteresis, as equation $SP - Hys$.

There is no default minimum value for hysteresis, that means the distance between switch resp. switch back point.

The working principle can be set separately for each switching output to:

open-circuit principle resp. no normally open or to closed-circuit principle resp. nc normally closed

The switching output S1 can be also used for error indication function alternatively to the limit value function. Doing this a switching action happens, if the output signal becomes higher than 20mA/10V resp. lower than 4mA/0V.



Damping

The damping influences the reaction speed of display, output signal and switching output at a change of the pressure.

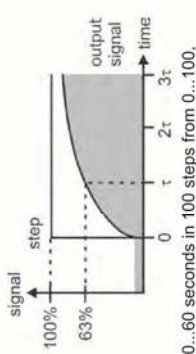
The behaviour of display and output signal follows an exponential characteristic with the damping time constant t . Within the time period t the output signal increases respectively by 63% of the existing deviation.

With 99,3%, the end value is nearly achieved after $5t$. At the variants A / B / E / F the damping can be adjusted from 0...60 seconds in 100 steps from 0...100, whereby one step equals 0,6 seconds.

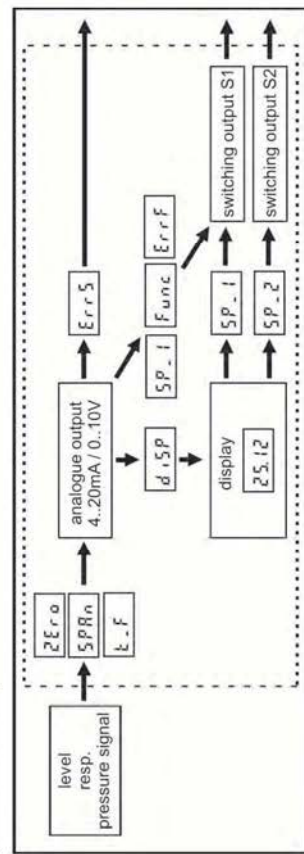
The set time (value x 0,6 seconds) equals 5 t.

At the variants type C and G the damping can be adjusted from 0...6 seconds in 10 steps from 0...10, whereby one step equals 0,6 seconds.

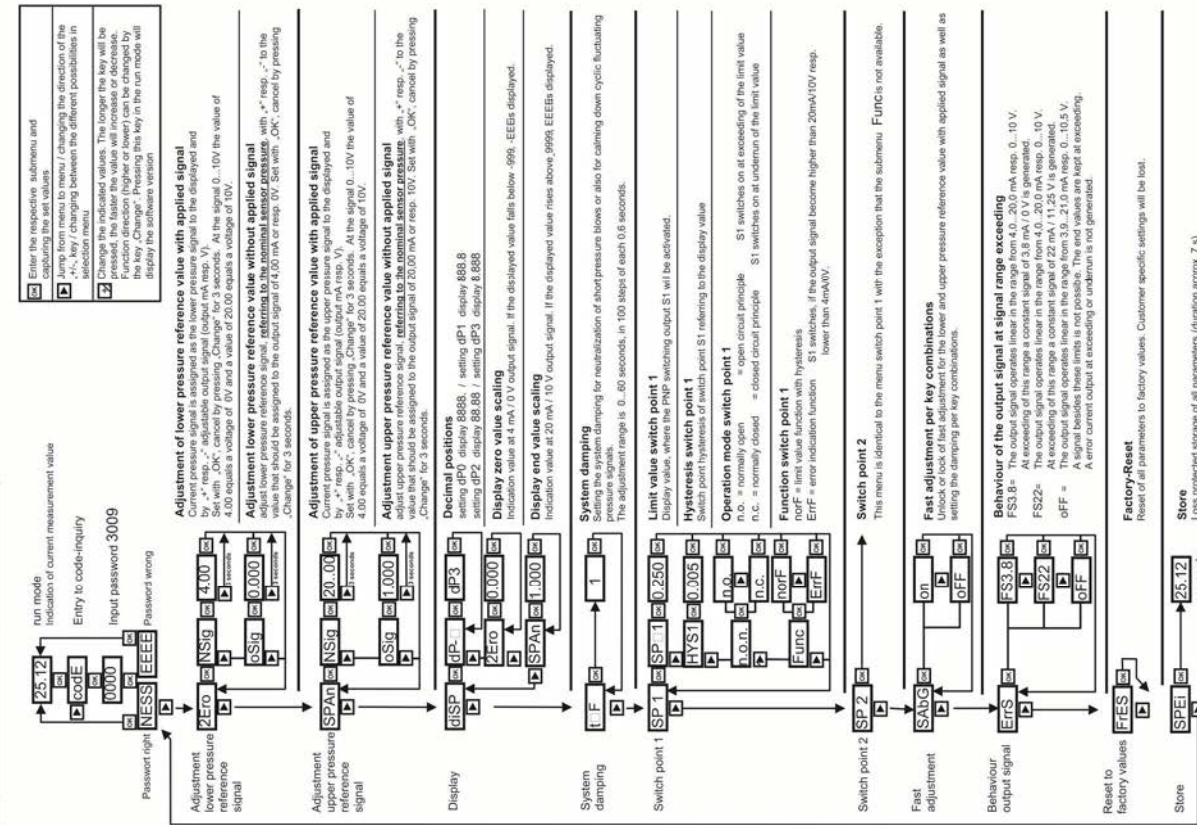
The set time (value x 0,6 seconds) equals 5 t.



Function scheme



Adjustment menu – password 3009



Precont S

Technical data

Auxiliary supply

Permitted supply voltage:

reverse polarity protected
Variant A/B/E/F/G/H 14,5...45 V DC Ex 14,5...30 V DC
10,5...45 V DC Ex 10,5...30 V DC

Ripple voltage:

2 V_{pp} condition: within the permitted supply voltage range

Supply current:

2-wire 4...20 mA 22 mA PNP switching outputs no load
3-wire 0...10 V 10 mA PNP switching outputs no load

Analogue output 4...20 mA

Signal range:

linear characteristic from 3,9 mA resp. 21 mA, error 3,8 mA / 22 mA
inverted output characteristic 20...4 mA only possible by manufacturer
R_L max = (V_S act. - V_S min) / 20mA V_S min = 10,5 / 12,5 / 14,5 / 16,5 V

Permitted load:

1 mA

Resolution:

310 ms (typ. 260 ms)
0,02% FS²⁾ / 10V

Minimum delay time:

at set system damping 0

Influence of supply voltage:

at set system damping 0

Analogue output 0...10 V

Signal range:

linear characteristic from 0,07...10,5 V, error 0,07 V / 11,25 V
inverted output characteristic 10...0 V only possible by manufacturer
R_L 2000 Ω, equals 5 mA at signal 10 V, current limited

Permitted load:

0,5 mV
310 ms (typ. 260 ms)
0,02% FS²⁾ / 10V

Resolution:

at set system damping 0

Minimum delay time:

at set system damping 0

Influence of supply voltage:

at set system damping 0

PNP switching output

Function:

PNP switching to +Vs
V_{OUT} +Vs - 2 V

Output voltage:

250 mA, min. 200 mA
700 ms

Rise up time:

current limited, short circuit protected
output load 3000 W resp. 4,5 mA

Delay time:

at set system damping 0

Switching cycles:

330 ms (typ. 280 ms)
100.000.000

²⁾ Referring to nominal measuring span resp. full scale (FS)

Precont S

Measuring accuracy

Characteristic deviation ^{3) 5) 6) 12)}:

Membrane ceramic

0,1% / 0,2% FS²⁾

Membrane metallic

0,5% FS²⁾

Membrane metallic

1,0% FS²⁾ at pressure range 0,0...1 / 0,25 bar

Membrane ceramic

0,1% / 0,2% FS²⁾

Membrane metallic

0,3% FS²⁾

Membrane metallic

0,6% FS²⁾ at pressure range 0,0...1 / 0,25 bar

Membrane ceramic

negligible

Membrane metallic

0,1% FS²⁾

Membrane ceramic

0,1% FS²⁾ / year not cumulative

Membrane metallic

0,15% FS²⁾ / year not cumulative

Membrane ceramic

T_k⁴⁾ Zero 0,10% FS²⁾ / 10 K

Membrane metallic

max. 0,75 % FS²⁾ (-20...+80°C)

Membrane ceramic

T_k⁴⁾ Span 0,10% FS²⁾ / 10 K

Membrane metallic

max. 0,5 % FS²⁾ (-20...+80°C)

Membrane ceramic

max. 0,8 % FS²⁾ (-20...+80°C) 0,0,4 bar

Membrane metallic

besides -20...+80°C with factor 2 for T_k

Membrane ceramic

T_k⁴⁾ Zero 0,20% FS²⁾ / 10 K

Membrane metallic

0,20% FS²⁾ / 10 K

Membrane ceramic

max. 1,0 % FS²⁾ (-20...+80°C)

Membrane metallic

besides -40...+100°C with factor 2 for T_k

Membrane ceramic

T_k⁴⁾ Zero 0,20% FS²⁾ / 10 K

Membrane metallic

Range 0...0,4 bar 0,25% FS²⁾ / 10 K

Membrane ceramic

Range 0...0,25 bar 0,4% FS²⁾ / 10 K

Membrane metallic

Range 0...0,1 bar 1,0% FS²⁾ / 10 K

Membrane ceramic

T_k⁴⁾ Span 0,20% FS²⁾ / 10 K

Membrane metallic

besides 0...+80°C with factor 2 for T_k

Precont S70

A change in temperature produces a change of the volume of the pressure transmitting liquid and thus results in an additional zero value shift, whose amount depends on the style of the process diaphragm seal. The influence of the temperature can be minimized by a process diaphragm seal with a wider membrane diameter.

Mounting position

Maximum deviation ¹⁰⁾:

Precont S10 / S40

0,18 mbar

Precont S20 / S30

Process connection G 1/4" / G 1/2" 4 mbar

Precont S70

Process connection G 1" 10 mbar

At versions with process diaphragm seal the deadweight of the membrane

and of the pressure transmitting liquid produces an additional zero value shift, whose amount depends on the style of the process diaphragm seal.

²⁾ Referring to nominal measuring span resp. full scale (FS)³⁾ Nonlinearity + Hysteresis + Reproducibility⁴⁾ T_k = Temperature coefficient⁵⁾ Limit value adjustment⁶⁾ Specification valid, if adjusted measuring range = nominal measuring range, i.e. for TD⁷⁾ = 1⁷⁾ At TD⁷⁾ = 1 (adjusted measuring range = nominal measuring range)⁸⁾ Specification at adjusted measuring range = specification at nominal measuring range x TD⁷⁾⁹⁾ Turn-Down TD = nominal measuring range (FS²⁾ / adjusted measuring range¹⁰⁾ Device rotated by 180°, process connection upside.¹²⁾ Higher values for special measuring range

Precont S

Materials

Membrane:
(medium contact)

Precont S10 / S40 Ceramic Al₂O₃ 96% resp. 99.9%
Precont S20 front flush Steel 1.4571 (AISI 316Ti)
40 bar
< 40 bar Steel 1.4571 (AISI 316Ti)
Precont S30 Steel 1.4542 (AISI 630) / 1.4534
Precont S70 Steel 1.4435 (AISI 316L)
Steel 1.4404 (AISI 316L)
Precont S10 / S40 Steel 1.4404 (AISI 316L) /
Steel 1.4571 (AISI 316Ti)
Precont S20 Steel 1.4571 (AISI 316Ti)
Precont S30 Steel 1.4435 (AISI 316L)
Precont S70 Steel 1.4404 / 1.4435 (AISI 316L)
CrNi-steel

Process connection:
(medium contact)

Temperature decoupler:
(medium contact)

Connection housing:
CrNi-steel / PBT polybutyleneterephthalat / PP – polypropylene /
POM – polyoxymethylene (Delrin)

Display window:

PC – polycarbonate (Makrolon)

Device plug M12x1: Socket CrNi-steel, insert PUR, contacts gold-plated

Connection cable:

PE – polyethylene

Cable gland:

Housing PA – polyamide, gasket CR / NBR

Pressure compens. element:

Housing PA – polyamide, membrane ePTFE

Membrane keyboard:

PES – polyester

Gaskets:

medium contact

FPM – fluorelastomere (Viton)
EPDM – ethylene-propylene-dienmonomere
CR – chloroprene-rubber (Neopren)
FFKM – perfluorelastomere (Kalrez)
NBR – nitril-butadien-rubber
FPM – fluorelastomere (Viton)
Silicone

others

Precont S

Environmental conditions

Environmental temperature:

– 40°C...+85°C, limitation at Ex variants

additional limitations by material	Environmental temperature range
Connection housing PBT	-25...+85 °C
Connection housing PP	-10...+85 °C
Connection cable PE	-40...+70 °C

Process temperatures:

– 40°C...+100°C, limitation at Ex variants

Limitations by variant	Process temperature range
Temperature decoupler at S10 / S40	-40...+125 °C
Precont S30	-20...+150 °C
Precont S70	-10...+100 °C
Temperature decoupler B at S70	-10...+200 °C
Temperature decoupler C at S70	-20...+275 °C
Capillary tube at S70	-40...+370 °C
additional limitations by material	Process temperature range
Gasket FPM	-25...+140 °C
Gasket EPDM	-40...+130 °C
Gasket CR	-40...+120 °C
Gasket FFKM	-25...+140 °C
Gasket NBR	-30...+110 °C

depends on variant, maximum – 1 bar ...1000 bar

depends on measuring range, see table overload pressure / burst pressure

0 mbar_{abs}

Ceramic membrane –0.1...0 bar resp. 0...0.1 bar 700mbar_{abs}
(at S40 process connection 8 / R 0 mbar_{abs})

Ceramic membrane –0.1...+0.1 bar resp. 0...0.2 bar 500mbar_{abs}
(at S40 process connection 8 / R 0mbar_{abs})

Precont S20 Synthetic oil ranges 0...25 bar

Precont S30 Synthetic oil FDA listed

Precont S70 Food oil / Silicone oil / high temperature oil

depends on variant

50 Nm at process connections with screw-in thread
IP67 EN/IEC 60592 IP65 at Ex variant

4K4H EN/IEC 60721-3

4 g 5 - 100 Hz

emission EN/IEC 61326-1 operation device class B
immunity EN/IEC 61326-1 industrial range

EN/IEC 60770-1 T = 15...35 °C, relative humidity 45...75 %, environmental air pressure 860...1060 kPa

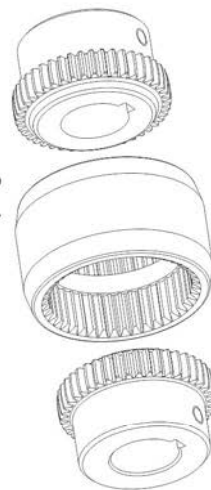
KTR KTR Kupplungstechnik GmbH D-48407 Rheine	BoWex® Operating-/Assembly Instructions	KTR-N sheet: 40110 EN 12 of 19 edition: 9
--	---	---

5 Enclosure A
Hints and Instructions Regarding the Use in  Hazardous Areas

5.2 Control Intervals for Couplings in Hazardous Areas

explosion group	control intervals
3G 3D	For couplings which are classified in category 3G or 3D the operating and assembly instructions that are usual for standard operation apply. During the standard operation which has to be subject to the analysis of danger of ignition the couplings are free from any ignition source. Merely the temperature increase produced by proper heating and depending on the coupling type has to be considered: for BoWex®: T = 30 K (standard sleeve „light“) for BoWex®: T = 20 K (conductive sleeve „black“)
II 2GD c IIB T4, T5, T6	A checking of the circumferential backlash and a visual check of the flexible sleeve must be effected after 3,000 operating hours for the first time, after 6 months at the latest. Except for centered, stiff connecting flanges (e. g. bellhousings). If you note an unconsiderable or no wear at the sleeve after this first inspection, the further inspections can be effected, in case of the same operating parameters, respectively after 6,000 operating hours or after 18 months at the latest. If you note a considerable wear during the first inspection, so that a change of the sleeve would be recommended, please find out the cause according to the table „Breakdowns“, as far as possible. The maintenance intervals must be adjusted according to the changed operating parameters.
II 2GD c IIC T4, T5, T6	A checking of the circumferential backlash and a visual check of the flexible sleeve must be effected after 2,000 operating hours for the first time, after 3 months at the latest. Except for centered, stiff connecting flanges (e. g. bellhousings). If you note an unconsiderable or no wear at the sleeve after this first inspection, the further inspections can be effected, in case of the same operating parameters, respectively after 4,000 operating hours or after 12 months at the latest. If you note a considerable wear during the first inspection, so that a change of the sleeve would be recommended, please find out the cause according to the table „Breakdowns“, as far as possible. The maintenance intervals must be adjusted according to the changed operating parameters.

BoWex® coupling



picture 12: BoWex® coupling

Here the backlash between the hub and the nylon toothing must be checked by a torsional backlash, separately from the drive and the driven end.
The friction / wear may only be X_{max} of the original toothing strength before the nylon sleeves must be exchanged.
When reaching the torsional backlash $\cdot S_{max}$, the nylon sleeve must be exchanged immediately, irrespective of the inspection intervals.

KTR KTR Kupplungstechnik GmbH D-48407 Rheine	BoWex® Operating-/Assembly Instructions	KTR-N sheet: 40110 EN 13 of 19 edition: 9
--	---	---

5 Enclosure A
Hints and Instructions Regarding the Use in  Hazardous Areas

5.3 Checking of Torsional Backlash

CAUTION!
To check the torsional backlash the turned off drive aggregate must be secured against unintended turning on.

Drive end

- Turn the hub in opposite direction to the directiof drive.



CAUTION!
Here the sleeve may not be axially displaced from its wear position.

- Mark sleeve and hub (see picture 13).
- Turn the hub in the direction of drive and measutbe torsional backlash $\cdot S_{max}$.
- When reaching the torsional backlash S_{max} the nylon sleeve must be exchanged.

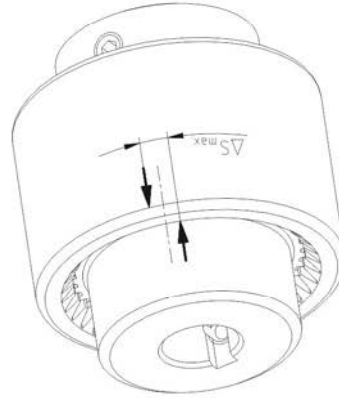
Driven end

- Turn the hub in the direction of drive.



CAUTION!
Here the sleeve may not be axially displaced from its wear position.

- Mark sleeve and hub (see picture 13).
- Turn the hub in opposite direction to the directiof drive and measure the torsional backlash $\cdot S_{max}$.
- When reaching the torsional backlash S_{max} the nylon sleeve must be exchanged.



picture 13: marking of the sleeve and the hub

Schutzvermerk ISO 16016 beachten.	Gezeichnet: 06.04.10 Pz/Hk Geprüft: 09.04.10 Pz	Ersatz für KTR-N vom 27 Ersetzt durch:
--------------------------------------	--	--

KTR KTR Kupplungstechnik GmbH D-48407 Rheine	BoWex® Operating-/Assembly Instructions	KTR-N sheet: 40110 EN 14 of 19 edition: 9
--	---	--

5 Enclosure A

Hints and Instructions Regarding the Use in Hazardous Areas

5.4 Approximate Values of Wear

If the torsional backlash is $\cdot S_{max}$ [mm] / friction $\cdot X_{max}$ [mm], the nylon sleeves must be exchanged.
 The reaching of the exchange values depends on the operating conditions and the existing operating parameters.

 **CAUTION!**
 In order to ensure a long lifetime of the coupling and to avoid dangers regarding the use in hazardous areas, the shaft ends must be accurately aligned.
 Please absolutely observe the displacement figures indicated (see tables 5 and 6). If the figures are exceeded, the coupling is damaged.



Table 7:

BoWex® size	limits of wear each hub		BoWex® size	limits of wear each hub	
	friction X_{max} [mm]	torsional backlash $\cdot S_{max}$ [mm]		friction X_{max} [mm]	torsional backlash $\cdot S_{max}$ [mm]
14	0,8	1,3	45	1,0	1,8
19	0,8	1,4	48	1,0	1,8
24	1,0	1,5	65	1,4	2,5
28	1,0	1,6	80	1,6	2,7
32	1,0	1,7	100	1,8	3,1
38	1,0	1,7	125	2,0	3,5
42	1,0	1,7			

5.5 Permissible Coupling Materials in the Hazardous Area

explosion group	permitted coupling materials / size
IIB	BoWex M14 to M65 with sleeve material PA (light)
IIC	BoWex M14 to M19 with sleeve material PA (light) BoWex M14 to M65 with sleeve material PA12CF15 (black)

In the Explosion Groups **IIB** and **IIC** the following materials may be combined:
 steel
 stainless steel

Schutzvermerk ISO 16016 beachten.	Gezeichnet: 06.04.10 Pz/HK Geprüft: 09.04.10 Pz	Ersatz für KTR-N vom 27 Ersetzt durch:
--------------------------------------	--	--

Technical Data

For motor connection parameters see nameplate

General Technical Data			RE 0016 B	RE 0040 B	RE 0063 B
Nominal suction capacity	m³/h	50 Hz	13	40	63
		60 Hz	15	48	75
Ultimate pressure	hPa abs. (mbar abs.)	with oil return line to B-cover	-	0,5	
		with oil return line to suction connection	20		
Motor nominal rating	kW	50 Hz	0.37	1.5	2.2
		60 Hz	0.55	2.2	2.2
Max. allowed nominal motor rating	kW	50 Hz	0.37	1.5	2.2
		60 Hz	0.55	2.2	3.0
Motor nominal speed	min ⁻¹	50 Hz	1500		
		60 Hz	1800		
Sound pressure level (DIN EN ISO 2151)	db(A)	50 Hz	60	63	64
		60 Hz	63	66	68
Ambient temperature / temperature of inlet gas	°C	with oil Busch VE 101	0 ... 40		
		with oil Busch VSL 100	0 ... 40		
		with oil Busch VM 100	12 ... 30		
Oil quantity	l		1	2	
Weight	kg		~39	~87	~91
Explosion protection data					
Category w.r.t. process gas (i)			1		
Category w.r.t. environment (o)			2		
Explosion group			IIB3		
Temperature class w.r.t. process gas (i)			T4		
Temperature class w.r.t. environment (o)			T4*		
Temperature switch switching point	°C		120		
Pressure switch switching point S1	hPag (mbarg)		550		
Pressure switch switching point S2	hPag (mbarg)		600		

* only if also the drive motor is approved for temperature class T4, else downgrading of the entire vacuum pump to the temperature class of the drive motor

Argentina

Busch Argentina S.R.L.
Santo Domingo 3076
C1293AGN-Capital Federal
Buenos Aires
Tel: +54 11 4302 8183
Fax: +54 11 4301 0896
e-mail: info@busch-vacuum.com.ar

Australia

Busch Australia Pty. Ltd.
30 Lakeside Drive
Broadmeadows, Vic. 3047
Tel: +61 3 93 55 06 00
Fax: +61 3 93 55 06 99
e-mail: sales@busch.com.au

Austria

Busch Austria GmbH
Industriepark Nord
2100 Korneuburg
Tel: +43 2262 / 756 65-0
Fax: +43 2262 / 756 65-20
e-mail: busch@busch.at

Belgium

Busch N.V. Kruinstraat 7
9160 Lokeren
Tel: +32 9 / 348 47 22
Fax: +32 9 / 348 65 35
e-mail: info@busch.be

Brazil

Busch do Brasil Ltda.
Rod. Edgard Máximo Zambotto, Km 64
13240-000 Jarinu-SP
Tel: +55 11-4016 1400/5277
Fax: +55 11-4016 5399
e-mail: vendas@buschdobrasil.com.br

Canada

Busch Vacuum Technics Inc.
1740, Lionel Bertrand
Boisbriand, Québec J7H 1N7
Tel: +1 450 435 6899
Fax: +1 450 430 5132
e-mail: info@busch.ca

Chile

Busch Chile S.A.
Calle El Roble N° 375-G
Lampa - Santiago
Tel: +56 2 3765136
Fax: +56 2 7387092
e-mail: info@busch.cl

China

Busch Vacuum (Shanghai) Co., Ltd
No.5, Lane 195 Xipu Road
Songjiang Industrial Estate East New Zone
Shanghai 201611 PRC
Tel: +86 (0)21 67600800
Fax: +86 (0)21 67600700
e-mail: busch@busch-china.com

Czech Republic

Busch Vakuum s.r.o.
Pražákova 10
619 00 Brno-Horní Heršpice
Tel: +420 543 42 48 55
Fax: +420 543 42 48 56
e-mail: info@buschpumps.cz

Denmark

Busch Vakuumtechnik A/S Parallevej
11
8680 Ry
Tel: +45 87 88 07 77
Fax: +45 87 88 07 88
e-mail: info@busch.dk

Finland

Busch Vakuumtechnik Oy
Sinikellontie 4
01300 Vantaa
Tel: +358 9 774 60 60
Fax: +358 9 774 60 666
e-mail: info@busch.fi

France

Busch France S.A.S.
16, Rue du Bois Chaland
91090 Lisses
Tel: +33 16989 8989
Fax: +33 16989 8958
e-mail: busch@busch.fr

Germany

Dr.-Ing. K. Busch GmbH
Schauinslandstr. 1
79689 Maulburg
Tel: +49 76 22 6 81-0
Fax: +49 76 22 6 81-194
e-mail: info@busch.de

Dr.-Ing. K. Busch GmbH
Niederlassung Nord
Ernst-Abbe-Str. 1-3
25451 Quickborn
Tel: +49 41 06 7 99 67-0
Fax: +49 41 06 7 99 67-77

Dr.-Ing. K. Busch GmbH
Niederlassung West
Nordring 35
64807 Dieburg
Tel: +49 60 71 92 82-0
Fax: +49 60 71 14 71

Dr.-Ing. K. Busch GmbH
Außenstelle Neuenrade
Breslauer Str. 36
58809 Neuenrade
Tel: +49 23 92 50 29 92
Fax: +49 23 92 50 72 11

Dr.-Ing. K. Busch GmbH
Niederlassung Süd-Ost
Gewerbstraße 3
90579 Langenzenn
Tel: +49 91 01 90 25-0
Fax: +49 91 01 90 25-25

Dr.-Ing. K. Busch GmbH
Außenstelle Zella-Mehlis
Am Rain 11
98544 Zella-Mehlis
Tel: +49 36 82 46 92 71
Fax: +49 36 82 46 92 73

Dr.-Ing. K. Busch GmbH
Außenstelle Meitingen-Ostendorf
Grünteweg 8
86405 Meitingen-Ostendorf
Tel: +49 82 71 426-341
Fax: +49 82 71 426-342

Hungary

Busch Vacuum Kft.
Bentonit u. 8
1225 Budapest
Tel: +36 1 207 6135
Fax: +36 1 207 6136
e-mail: busch@busch-vacuum.hu

India

Busch Vacuum India Pvt Ltd.
Plot No. 110, Sector 7
PCNTDA, Bhosari
Pune 411026
Tel: +91 206410 2886
Fax: +91 202711 2838
e-mail: sales@buschindia.com

Ireland

Busch Ireland Ltd.
A10-11 Howth Junction Business Centre
Kilbarrack, Dublin 5
Tel: +353 1 832 1466
Fax: +353 1 832 1470
e-mail: sales@busch.ie

Israel

Busch Israel Ltd.
1 Mevo Sivan Street
Qiryat Gat 82022, Israel
Tel: +972 (0)8 6810485
Fax: +972 (0)8 6810486
e-mail: service_sales@busch.co.il

Italy

Busch Italia S.r.l.
Via Ettore Majorana, 16
20054 Nova Milanese
Tel: +39 0362 370 91
Fax: +39 0362 370 999
e-mail: info@busch.it

Japan

Nippon Busch K.K.
1-23-33, Megumigaoka
Hiratsuka City, Kanagawa
Japan 259-1220
Tel: +81 463-50-4000
Fax: +81 463-50-4004
e-mail: info@busch.co.jp

Korea

Busch Korea Ltd.
248-2, Ichi-ri, Majang-Myun,
Icheon-si, Kyunggi-Do
Tel: +82 31 321 8114
Fax: +82 31 321 8877
e-mail: busch@buschkorea.co.kr

Malaysia

Busch Malaysia Sdn Bhd.
4&6, Jalan Taboh 33/22, Seksyen 33
Shah Alam Technology Park
40400 Shah Alam
Selangor Darul Ehsan
Tel: +60 3 5122 2128
Fax: +60 3 5122 2108
e-mail: busch@busch.com.my

Mexico

Busch Vacuum Mexico S. de R.L. de C.V.
Tlaquepaque 4865, Los Altos
Monterrey, Nuevo Leon
Mexico 64370
Tel: +52 81 8311-1385
Fax: +52 81 8311-1386
e-mail: info@busch.com.mx

Netherlands

Busch B.V. Pompmolenlaan 2
3447 GK Woerden
Tel: +31 348-462300
Fax: +31 348-422939
e-mail: info@busch.nl

New Zealand

Busch New Zealand Ltd.
Unit D, 41 Arrenway Drive
Albany, Auckland 1330
Tel: +64 9 414 7782
Fax: +64 9 414 7783
e-mail: sales@busch.co.nz

Norway

Busch Vakuumteknikk AS
Hestehagen 2
1440 Drøbak
Tel: +47 64 98 98 50
Fax: +47 64 93 66 21
e-mail: busch@busch.no

Poland

Busch Polska Sp. z o.o.
Ul. Chopina 27
87-800 Wrocawek
Tel: +48 54 2315400
Fax: +48 54 2327076
e-mail: busch@busch.com.pl

Portugal

Busch Ibérica S.A., Sucursal em Portugal
Zona Industrial Norte, Fracção B, Armazém 2
3750-753 Raso de Travassô - Agueda
Aveiro, Portugal
Tel: +351 234 648 070
Fax: +351 234 648 068
e-mail: geral@buschib.pt

Russia

Busch Vacuum Russia OOO
Kotlyakovskaya str., 6/9
115201 Moscow
Tel: +7 495 6486726
Fax: +7 495 6486724
e-mail: info@busch.ru

Singapore

Busch Vacuum Singapore Pte Ltd
20 Shaw Road
Unit 01-03 Ching Shine Building
Singapore 367956
Tel: +65 6488 0866
Fax: +65 6288 0877
e-mail: busch@busch.com.sg

South Africa

Busch Vacuum South Africa (Pty) Ltd.
Denver
Johannesburg
Tel: +27 11 856 0650/6
Fax: +27 11 856 0625
e-mail: joe.jagger@busch.co.za

Spain

Busch Ibérica S.A.
Pol. Ind. Coll de la Manyà
C/ Jaume Ferran, 6-8
08403 Granollers
Tel: +34 93 861 61 60
Fax: +34 93 840 91 56
e-mail: busch@buschib.es

Sweden

Busch Vakuumteknik AB
Bråta Industriområde
435 33 Mölnlycke
Tel: +46 31-338 00 80
Fax: +46 31-338 00 89
e-mail: info@busch.se

Switzerland

Busch AG Waldweg 22
4312 Magden
Tel: +41 61 / 845 90 90
Fax: +41 61 / 845 90 99
e-mail: info@buschag.ch

Taiwan

Busch Taiwan Corporation
1F. No. 69, Sec. 3, Beishen Road
Shenkeng Township,
Taipei County 222
Tel: +886 2 2662 0775
Fax: +886 2 2662 0796
e-mail: info@busch.com.tw

Thailand

Busch Vacuum (Thailand) Co., Ltd.
888/30 Moo19, Soi Yingcharoen,
Bangplee-Tamru Road,
Bangplee-Yai, Bangplee,
Samutprakarn 10540
Tel: +66 2-382-5428
Fax: +66 2-382-5429
e-mail: info@busch.co.th

Turkey

VAKUTEK
Emlak Kredi Ishani No: 179
34672 Üsküdar-Istanbul
Tel: +90 216 310 0573
Fax: +90 216 343 5126
e-mail: vakutek@ttnet.net.tr

United Kingdom

Busch (UK) Ltd
2 Hortonwood 30
Telford Shropshire TF1 7YB
Tel: +44 1952 677 432
Fax: +44 1952 677 423
e-mail: sales@busch.co.uk

USA

Busch LLC
516-B Viking Drive
Virginia Beach, VA 23452
Tel: +1 757 463-7800
Fax: +1 757 463 7407
e-mail: marketing@buschusa.com