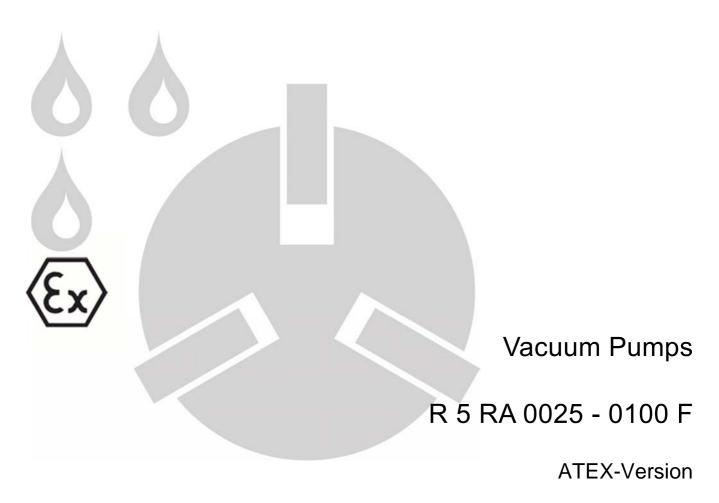


Installation and Operating Instructions



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Preface

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

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

These operating instructions contain information for

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

of the vacuum pump.

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

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

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

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



Illustration shows RA 0040 F, RA 0025 - 0100 F are similar

- a Directional arrow
- b Terminal box
- c Eye bolt
- d Suction connection
- e Inlet air filter
- f Connection for equipotential bonding, inlet air filter
- g Gas discharge
- h Gas ballast
- i Axial flow fan
- i Oil filter
- k Nameplate, vacuum pump
- Oil separator
- m Float valve with oil return line (version with float valve and oil return line only)
- n Oil fill plug
- Sight glass
- p Oil drain plug
- q Temperature measurement system

Product Description

Use

The vacuum pump is intended for

the suction

of

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

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

Conveying media with a lower or higher density than air leads to an in- creased 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 ("ATEX 2014") the vacuum pump is made for the intended use in potentially explosive areas according to the data given on the nameplate of the vacuum pump and on the data given on the nameplate of the drive motor.

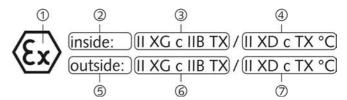
This requires a separate consideration of the conveyed gas/air or dust/air mixtures on the one side and the environment of the vacuum pump on the other. On the nameplate of the vacuum pump the classification with regard to the conveyed gas/air or dust/air mixtures is marked with an "inside", while the classification with regard to the environment is marked with an "outside". The classification of the motor always refers to the environment.

In case Busch delivered the vacuum pump without drive motor or a re-placement 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.

Depending on the version the approval is valid only together with certain standard or optional components, or is limited by the use of certain optional components, as described below and in the chapter Operational Options / Use of Optionally Available Equipment (\rightarrow page 4).

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



- 1 = Execution according to directive 2014/34/EU
- ② **inside** = in this line classification for explosive atmosphere inside the vacuum pump
- ③ II 2G c IIB TX = in the process gas explosive atmosphere consisting of a mixture with air of flammable substances in the form of gas likely to occur in normal operation occasionally; temperature monitoring is required (resistance thermometer and temperature-transmitter in standard scope of delivery);
- ④ II 2D c TX ℃ = in the process gas explosive atmosphere in the form of a cloud of combustible dust in air to occur in normal operation, the use of the special ATEX-inlet air filter (with equipotential bonding) is required; temperature monitoring is required (resistance thermometer and temperature-transmitter in standard scope of delivery)

II 3D c TX ℃ = in the process gas explosive atmosphere in the form of a cloud of combustible dust in air not likely to occur in normal operation but, if it does occur, will persist for a short period only; the use of the special ATEX-inlet air filter (with equipotential bonding) is required;

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- ⑤ **outside** = in this line classification for explosive atmosphere in the environment of the vacuum pump
- (i) II 2G c IIB TX = in the environment explosive atmosphere consisting of a mixture with air of flammable substances in the form of gas, vapour or mist likely to occur in normal operation occasionally; temperature monitoring is required (resistance thermometer and temperature-transmitter in standard scope of delivery); sufficiently qualified ATEX-drive motor is required;

In case the vacuum pump is equipped with a gas ballast (optional) water vapour within the gas flow can be tolerated within certain limits (→ page 12: Conveying Condensable Vapours). The conveyance of other vapours shall be agreed upon with Busch.

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

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

The vacuum pump is thermally suitable for continuous operation (observe the notes with regard to the oil recirculation:

→ page 5: Oil Circulation; → page 12: Oil Return).

The vacuum pump is ultimate pressure proof.

The approval for use in potentially explosive atmospheres is valid for the vacuum pump together with the 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

Version with temperature monitoring:

The safety concept is based on the prevention of hot oil mist and hot surfaces through a temperature sensor in the vicinity of the stage gas outlet (=zone of highest temperature) together with various other measures to prevent sparks. The temperature sensor must be integrated into the system control such that operation of the vacuum pump will safely be inhibited if the temperature 130 $\ensuremath{\mathbb{C}}$ is exceeded.

Operational Options / Use of Optionally Available Equipment

Operation with varying speed, i.e. with a frequency inverter is permit- ted, 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 with- out 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 per- mitted (observe the safety note hereafter!).



WARNING

By means of the gas ballast the process gas gets mixed with a dry ballast gas, usually ambient air, with the mixing ratio depending on the current working pressure of the vacuum pump.

For certain process gases the mixing with air increases the explosion risk because of the oxygen contained herein.

So the ballast gas must be considered when the zone inside the vacuum pump is being established.

If the mixing of process gas and ambient air created a zone 0 in- side the vacuum pump, ambient air would not be allowed to be used as ballast gas. In this case an inert dry gas must be used as ballast gas.

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

Operation with an ATEX-pressure switch (optional) in order to monitor the condition of the exhaust filter(s) is permitted.

Principle of Operation

The vacuum pump works on the claw principle.

The vacuum pump works on the rotating vane principle.

A circular rotor is positioned centrically 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 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, sliding in slots in the rotor, separate the space between the rotor and the cylinder into chambers. At any time gas is sucked in and at almost any time ejected. Therefore the vacuum pump works almost pulsation free.

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

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

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

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

Through the gas ballast (h, 440) a small amount of ambient air is sucked into the pump chamber and compressed together with the process gas. This counteracts the accumulation of condensates from the process gas inside the vacuum pump

(→ page 12: Conveying Condensable Vapours).

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

Gas ballast version with ball valve:

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

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

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Oil Circulation

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

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 (I) 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 (I) as oil mist. Oil that separates before the exhaust filters (120) accumulates at the bot- tom of the bottom chamber of the oil separator (I).

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

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

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

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

Version with oil return valve:

At continuous operation this would cause the entire supply of oil to ac-cumulate at the bottom of the upper chamber, expel oil droplets through the gas discharge/pressure connection and let the vacuum pump run dry. Therefore the vacuum pump must be shut down at the latest after 10 hours of continuous operation, depending on the operating conditions even after a shorter period, for at least approx. 15 minutes (→ page 11: Operation Notes). After turning off the vacuum pump the pressure difference between the inside and the out-side of the exhaust filter(s) (120) collapses, hence the two chambers of the oil separator assume an equal pressure level, the oil return valve between the two chambers opens and the accumulated oil in the upper chamber can run down to the bottom chamber.

Cooling

The vacuum pump is cooled by

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

Start Controls

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

Safety

Intended Use

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

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

The allowed media and operational limits (→ page 3: Product Description) and the installation prerequisites (→ page 7: 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

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

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 47: Technical Data.

Transport

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

Transport in Packaging

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

Transport without Packaging

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

Remove the inflated cushions from the box

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

♦ Remove the corrugated cardboard from the box

In case the vacuum pump is laid in foam:

• Remove the foam

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

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

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

Remove the tightening straps





CAUTION

Do not walk, stand or work under suspended loads.

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

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

Remove the stud bolts from the rubber feet



CAUTION

Tilting a vacuum pump that is already filled with oil can cause large quantities of oil to ingress into the cylinder.

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

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

Prior to every transport make sure that the oil is drained

Storage

Short-term Storage

Version with gas ballast with ball-valve:

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

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

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

Conservation

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

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

Version with gas ballast with ball-valve:

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

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

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

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

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

For commissioning after conservation:

Make sure that all remains of adhesive tape are removed from the ports

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 Commission the vacuum pump as described in the chapter Installation and Commissioning (→ page 7)

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 de- signer of the machinery into which the vacuum pump is to be incorporated; → page 27: 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 in order to warrant a sufficient cooling there will be a clearance of minimum 20 cm between the vacuum pump and nearby walls
- Make sure that no heat sensitive parts (plastics, wood, cardboard, paper, electronics) will touch the surface of the vacuum pump





CAUTION

The vacuum pump is not absolutely gas tight. With closed cooling air circuits this could lead to potentially explosive mixtures of gases in the environment of the vacuum pump.

Risk of explosion!

The installation space or location must be vented such that **no** potentially explosive mixtures of gases will occur in the environment vacuum pump. Closed cooling air circuits are not permitted.

 Make sure that the installation space or location is vented such that a sufficient cooling of the vacuum pump is warranted





CAUTION

During operation the surface of the vacuum pump may reach temperatures of more than 70 $^{\circ}$ 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 (o, 83) will remain easily accessible

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

- Make sure that the drain port (p, 95), the oil filter (j, 100) and the filling port (n, 88) will remain easily accessible
- Make sure that enough space will remain for the removal and the reinsertion of the exhaust filters (120)

Suction Connection



CAUTION

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
 (d) of the vacuum pump

Version for the conveyance of explosive atmospheres consisting of a mixture with air of flammable substances in the form of gas:

 Make sure that the pipe is made from electrically conductive material and equipped with an equipotential bonding connection (execution according to EN 60079-14 or equivalent national or local regulations)

Version for the conveyance of explosive atmospheres in the form of a cloud of combustible dust in air:

- Make sure that the pipe is made from electrically conductive material and equipped with an equipotential bonding connection (execution according to EN 61241-14 or equivalent national or local regulations)
- 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 (d) 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, 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.





WARNING

In case the vacuum pump is intended to convey potentially explosive gases/gas mixtures

(→ page 3: Product Description):

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.



CAUTION

The discharged gas contains small quantities of vacuum oil.

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

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

 Make sure that the discharge line fits to the gas discharge (p) of the vacuum pump

Version for the conveyance of explosive atmospheres consisting of a mixture with air of flammable substances in the form of gas:

- Make sure that the pipe is made from electrically conductive material and equipped with an equipotential bonding connection (execution according to EN 60079-14 or equivalent national or local regulations)
- 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





WARNING

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

Static discharge can cause explosion of potentially existing oil mist.

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

Electrical Connection / Controls

Version with ATEX-drive motor:

- 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 27: 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

Version with temperature monitoring:

 Execute the interfaces for the temperature measurement system in the system control according to the safety concept (→ page 4: Safety Concept) and according to the instructions of the manufacturer (→ page 28: Equipment Documentation Measurement and Safety Instrumentation)

Version with ATEX-inlet air filter:

 Make sure that an earth point is available for connection to the equipotential bonding rail or the ATEX-inlet air filter resp.

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 7) 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.

Version with ATEX-drive motor:

Connect the drive motor according to the installation instructions for the drive motor (separate leaflet)

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Version with non-ATEX-drive motor:

 Connect the drive motor according to the installation instructions given below



CAUTION

The connection schemes given below are typical. Depending on the specific order or for certain markets deviating connection schemes may apply.

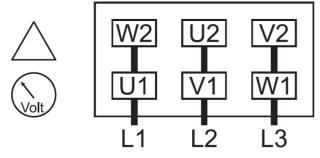
Risk of damage to the drive motor!

The inside of the terminal box shall be checked for drive motor connection instructions/schemes.

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

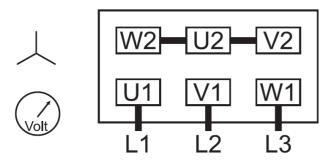
Connection Scheme Three-Phase Motor

Delta connection (low voltage):

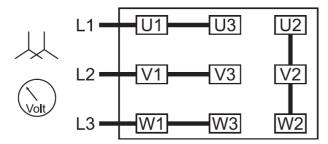


Star connection (high voltage):

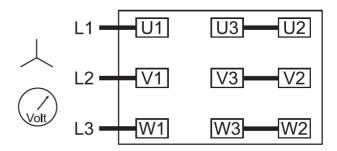
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Double star connection, multi-voltage motor with 9 terminals (low voltage):



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







CAUTION

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

Risk of explosion!

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

- Version with three-phase motor:
- Determine the intended direction of rotation with the arrow
- Bump the drive motor
- Watch the fan wheel of the drive motor and determine the direction of rotation just before the fan wheel stops

If the rotation must be changed:

 Switch any two of the drive motor wires (three-phase motor)





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.

Version with temperature monitoring:

 Connect the temperature measurement system (part of standard scope of delivery) to the system control

Version with ATEX-inlet air filter, without equipotential bonding rail:

 Connect the housing of the inlet air filter to the earth point with an earth cable

Connecting Lines/Pipes

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

- Connect the suction line
- Connect the discharge line

Installation without discharge line:

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

Filling Oil

In case the vacuum pump was treated with conservation oil:

Drain the remainders of conservation oil



CAUTION

The vacuum pump is shipped without oil.

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

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

The vacuum pump is delivered without oil (oil specification → page 26: Oil).

 Keep approx.. 1.0 litre(s) (RA 0025/0040 F) or 2.0 litre(s) (RA 0063/0100 F) resp. oil acc. to the table Oil (→ page 26) ready

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

Version with level switch:

Make sure that the level switch reports "low level"



CAUTION

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

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



CAUTION

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

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

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

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

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

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

Version with level switch:

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

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

Switch on the vacuum pump

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

♦ Close the shut-off valve

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

 Cover the suction connection (d) with a piece of rubber mat Let the vacuum pump run for a few minutes

Version with level switch:

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

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

In case the level switch has reported low level:

◆ Top-up oil

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

Open the shut-off valve

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

 Remove the piece of rubber mat and connect the suction line

Checking the Function of the Measurement and Safety Instrumentation

(version with temperature monitoring only)



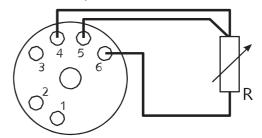


WARNING

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.
- Make sure that the vacuum pump aspirates inert gases and that there are no potentially explosive atmospheres in the environment
- Open the lid of the temperature measurement system (q)
- Disconnect the white cable from pins 4 and 5 and disconnect the red cable from the pin 6 of the temperature transmitter
- In order to simulate the resistance thermometer Pt100 set a variable ohmic resistance to approx. 100 Ω
- Connect the variable ohmic resistance with 3 identical cables to the pins 4, 5 and 6 of the temperature transmitter as shown in the sketch (the cable connected to pin 5 compensates the cable resistance)

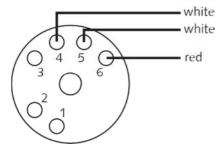


- Switch on the vacuum pump
- Increase the ohmic resistance to 150 Ω (equivalent to 130.5 \mathbb{C})
- Make sure that an alarm is released in the system control and the vacuum pump is shut down automatically
- Decrease the ohmic resistance to a value less than 150 Ω
- Make sure that the alarm persists

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- Make sure that the vacuum pump does not start self-acting
- Switch on the vacuum pump again
- Interrupt the ohmic resistance
- Make sure that a fault indication is released in the system control and the vacuum pump is shut down automatically
- · Reconnect the variable ohmic resistance
- Switch on the vacuum pump again
- Short circuit the variable ohmic resistance
- Make sure that a fault indication is released in the system control and the vacuum pump is shut down automatically
- Remove the short circuit
- Remove the variable ohmic resistance
- Reconnect the resistance thermometer Pt100 to the temperature transmitter (white cables to pins 4 and 5, red cable to pin 6, → sketch)



 Firmly close the temperature measurement system (q) with the lid

In case the mounting of the temperature measurement system (q) in the oil separator (I) has loosened:

- Open the lid of the temperature measurement system (q)
- Disconnect the supply voltage cables from the pins 1 and 2 of the temperature transmitter
- Undo the temperature
- Thoroughly clean the threads on the temperature measurement system (q) and on the oil separator (I) (oil and grease free)
- Make sure that the counter nut is screwed onto the temperature measurement system (q)
- Apply thread locker medium strength (e.g. LOCTITE 243) on the thread
- Screw the temperature measurement system (q) into the oil separator (l)
- Orientate the temperature measurement system (q) and tighten the counter nut
- Reconnect the supply voltage cables to the pins 1 (positive pole) and 2 (negative pole) of the temperature transmitter
- Firmly close the temperature measurement system (q) with the lid

Recording of Operational Parameters

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

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

Version with exhaust filter pressure gauge:

 Read the scale of the exhaust filter pressure gauge and record it as reference for future maintenance and troubleshooting work (→ page 15: Checks during Operation)

Operating Notes

Use





WARNING

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

In case of disregard risk of explosion!

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





WARNING

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

Risk of explosion!

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

The vacuum pump is intended for

the suction

of

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

Conveying media with a lower or higher density than air leads to an in- creased 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 ("ATEX 2014") the vacuum pump is made for the intended use in potentially explosive areas according to the data given on the nameplate of the vacuum pump and on the data given on the nameplate of the drive motor.

This requires a separate consideration of the conveyed gas/air or dust/air mixtures on the one side and the environment of the vacuum pump on the other. On the nameplate of the vacuum pump the classification with regard to the conveyed gas/air or dust/air mixtures is marked with an "inside", while the classification with regard to the environment is marked with an "outside". The classification of the motor always refers to the environment.

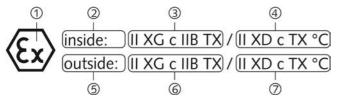
In case Busch delivered the vacuum pump without drive motor or a re- placement motor is to be mounted or for economic reasons the vacuum pump was equipped with a simpler motor, the following must be observed:

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.

Depending on the version the approval is valid only together with certain standard or optional components, or is limited by the use of certain optional components, as described below and in the chapter Operational Options / Use of Optionally Available Equipment (\rightarrow page 4).

The classification on the vacuum pump is to be read as follows (inter- pretations of equipment categories and zones for information only; the relevant laws, directives and standards are literally binding; for temper- ature classes and explosion groups

see E. Brandes, W. Möller "Sicherheitstechnische Kenngrößen, Band 1: Brennbare Flüssigkeiten und Gase", ISBN 3-89701-745-8 (or equivalent source)):



- 1 = Execution according to directive 2014/34/EU
- ② **inside** = in this line classification for explosive atmosphere inside the vacuum pump
- ③ II 2G c IIB TX = in the process gas explosive atmosphere consisting of a mixture with air of flammable substances in the form of gas likely to occur in normal operation occasionally; temperature monitoring is required (resistance thermometer and temperature-transmitter in standard scope of delivery);
- ④ II 2D c TX ℃ = in the process gas explosive atmosphere in the form of a cloud of combustible dust in air to occur in normal operation, the use of the special ATEX-inlet air filter (with equipotential bonding) is required; temperature monitoring is required (resistance thermometer and temperature-transmitter in standard scope of delivery)
- II 3D c TX ℃ = in the process gas explosive atmosphere in the form of a cloud of combustible dust in air not likely to occur in normal operation but, if it does occur, will persist for a short period only; the use of the special ATEX-inlet air filter (with equipotential bonding) is required;
- ⑤ **outside** = in this line classification for explosive atmosphere in the environment of the vacuum pump
- (i) II 2G c IIB TX = in the environment explosive atmosphere consisting of a mixture with air of flammable substances in the form of gas, vapour or mist likely to occur in normal operation occasionally; temperature monitoring is required (resistance thermometer and temperature-transmitter in standard scope of delivery); sufficiently qualified ATEX-drive motor is required;

In case the vacuum pump is equipped with a gas ballast (optional) water vapour within the gas flow can be tolerated within certain limits (→ page 12: Conveying Condensable Vapours). The conveyance of other vapours shall be agreed upon with Busch.

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

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

The vacuum pump is thermally suitable for continuous operation (observe the notes with regard to the oil recirculation:

→ page 5: Oil Circulation; → page 12: Oil Return).

The vacuum pump is ultimate pressure proof.

The approval for use in potentially explosive atmospheres is valid for the vacuum pump together with the 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 $\mbox{\it C}.$

Risk of hurns!

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 vacuum pump emits noise of high intensity in a narrow band.

Risk of damage to the hearing.

Persons staying in the vicinity of a non noise insulated vacuum pump over extended periods shall wear ear protection.

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

Oil Return

Only for version with oil return valve:

During operation oil accumulates at the bottom of the upper chamber of the oil separator (I), which cannot flow down into the bottom chamber, as long as the vacuum pump runs (for detailed description: → page 5: Oil Circulation).

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

Conveying Condensable Vapours



CAUTION

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

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

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

Version with gas ballast with ball-valve:

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

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At process start:

• Open the shut-off valve in the suction line

At the process end:

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

Maintenance





WARNING

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

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









DANGER

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

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

Danger to the environment.

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

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





CAUTION

During operation the surface of the vacuum pump may reach temperatures of more than 70 $\mbox{\it C}.$

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 pro- cess material, can make it necessary to shorten the maintenance intervals significantly.

Version without level switch:

 Prior to start-up check the level and the colour of the oil (→page 14: Checking the Oil)

Weekly

Version with level switch (optional):

- Check the level and the colour of the oil (→page 14: Checking the Oil)
- Check that the filling plug (n, 88) and the drain plug (p, 95) are firmly seated
- Check the vacuum pump for oil leaks in case of leaks immediately remove the vacuum pump from service and have it repaired (Busch service)

Monthly

- Check the function of the exhaust filters (120)
 (→page 15: Exhaust Filters)
- Make sure that the vacuum pump is shut down and locked against inadvertent start up

In case an inlet air filter (e) is installed:

• Check the inlet air filter (e), if necessary replace

In case of operation in a dusty environment:

♦ Clean as described under → page 13: 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 45: Excerpt from Operating- / Assembly Instructions of the BoWex-coupling)
- Replace the coupling if necessary (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 must be mounted by the Busch service only)
- ♦ Mount the drive motor on the vacuum pump

Version with temperature monitoring:

- Check the electrical connection
- Make sure that the electrical connection of the temperature monitoring is undamaged

Version with ATEX-inlet air filter (with equipotential bonding):

 Make sure that the earthing cable on the inlet air filter housing is undamaged (resistance check)

Every Year:

- Make sure that the vacuum pump is shut down and locked against inadvertent start up
- Replace the exhaust filters (120) (→page 15: Exhaust Filters)

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

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Mount the drive motor on the vacuum pump

In case an inlet air filter (e) is installed:

- Replace the inlet air filter (e)
- Check the inlet screen (261), clean if necessary

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

- Clean the sinter metal filter (compressed air)
- Check the function of the measurement and safety instrumentation (→page 16: Functional Check of the Measurement and Safety Instrumentation)

Every 500 - 2000 Operating Hours

(→ page 14: Oil Life):

Change the oil and the oil filter (j, 100)
 (→ page 14: Oil and Oil Filter Change)

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

Check the float valve (m, 200)
 (→ page 15: Checking the Float Valve)

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

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

Checking the Oil

Checking the Level

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

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

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

Top up oil (→ page 14: 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 12)

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 19: Troubleshooting).

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



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CAUTION

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

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



CAUTION

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

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

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

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

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

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

Version with level switch:

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

Checking the Colour of the Oil

Note: The oil should be light, either transparent, a little foamy or a little tarnished. A milky discolouration that does not vanish after sedation of the oil indicates contamination with foreign material. Oil that is either contaminated with foreign material or burnt must be changed (→page 14: Oil and Oil Filter Change).

In case of burnt oil:

 Check the function of the temperature monitoring
 (→ page 16: 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 $^{\circ}$ C are ideal. Under these conditions the oil and the oil filter (j, 100) shall be changed every 500 to 2000 operating hours or after half a year.

Under very unfavourable operating conditions the oil life can be less than 500 operating hours. Extremely short life time indicate malfunctions (→page 19: 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.

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Oil and Oil Filter Change











DANGER

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

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

Danger to the environment.

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

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

Draining Used Oil

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

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

When the oil stream dwindles:

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

Flushing the Vacuum Pump





WARNING

Degraded oil can choke pipes and coolers.

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

Risk of explosion due to overheating.

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

- · Make sure that all the used oil is drained
- Make sure that the used oil filter (j, 100) is still in place
- Create 1.0 litre(s) (RA 0025/0040 F) or 2.0 litre(s)
 (RA 0063/0100 F) resp. flushing agent from 50 percent oil and 50 percent paraffin or diesel fuel/fuel oil
- Make sure that the drain plug (p, 95) is firmly inserted
- Remove the filling plug (n, 88)

- Fill in the flushing agent
- Firmly reinsert the filling plug (n, 88)
- Close the suction line
- Run the vacuum pump for at least half an hour
- Drain the flushing agent and dispose of it in compliance with applicable regulations

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

Checking Float Valve

(version with float valve and oil return line only)

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

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

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

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

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

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

Replacing the Oil Filter

- Make sure that the oil is drained
- Remove the oil filter (j, 100)
- Apply a drop of fresh oil on the seal ring of the new oil filter (j, 100)
- Mount the new oil filter (j, 100) and tighten it by hand
- Dispose of the used oil filter in compliance with applicable regulations

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Filling in Fresh Oil

 Keep 1.0 litre(s) (RA 0025/0040 F) or 2.0 litre(s) (RA 0063/0100 F) resp. oil acc. to the table Oil (→ page 26) ready

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

Version with level switch:

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



CAUTION

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

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

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

Version with level switch:

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

Exhaust Filter

Check during Operation

Busch recommends the use of a filter pressure gauge (available as accessory, → page 24: Accessories). Without filter pressure gauge the filter resistance shall be assessed on the basis of the drive motor current drawn.

Version with exhaust filter pressure gauge:

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

Version without filter pressure gauge:

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

Version with oil return valve:

Note: The discharged gas will also contain oil if the vacuum pump is operated without interruption for too long a period (→ page 11: Operation Notes).

Check that the discharged gas is free from oil

Assessment

lf

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

or

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

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

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

lf

the filter pressure gauge indicates a lower pressure than usual,

or

the drive motor draws less current than usual,

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

If the discharged gas contains oil,

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

Change of the Exhaust Filters











DANGER

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

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

Danger to the environment.

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

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





CAUTION

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

Risk of eye injury.

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

Removing the Exhaust Filters

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

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Inserting the Exhaust Filters

- Make sure that the new exhaust filters (120) are equipped with new o-rings
- Insert the exhaust filters (120) such that their ports are properly seated in their receptacles in the oil separator (I)
- Make sure that the tips of the screws in the centre of the exhaust filter retaining springs (125) protrude the retaining springs by about 2 - 5 revolutions
- Insert the exhaust filter retaining springs (125) such that their ends are secured in their receptacles in the oil separator (I) by the protrusions and that the tips of the screws snap into the indent of the exhaust filters (120)
- Tighten the screws in the exhaust filter retaining springs (125) such that the screw heads touch the spring steel sheets
- Make sure that the seal (141) under the exhaust cover (g) is clean and undamaged, if necessary replace with a new seal (141)
- Mount the exhaust cover (g) together with the seal (141) and hex head screws on the oil separator (I)
- If necessary connect the discharge line

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

Functional Check of the Measurement and Safety Instrumentation

(version with temperature monitoring only)



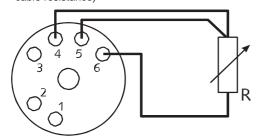


WARNING

Risk of electrical shock, risk of damage to equipment.

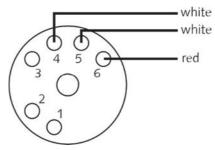
Electrical installation work must only be executed by qualified personnel that knows and observes the following regulations:

- 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.
- Make sure that the vacuum pump aspirates inert gases and that there are no potentially explosive atmospheres in the environment
- Open the lid of the temperature measurement system (q)
- Disconnect the white cables from the pins 4 and 5 and disconnect the red cable from the pin 6 of the temperature transmitter
- In order to simulate the resistance thermometer Pt100 set a variable ohmic resistance to approx. 100 Ω
- Connect the variable ohmic resistance with 3 identical cables to the pins 4, 5 and 6 of the temperature transmitter as shown in the sketch (the cable connected to pin 5 compensates the cable resistance)



• Switch on the vacuum pump

- Increase the ohmic resistance to 150 Ω equivalent to 130.5 ℃)
- Make sure that an alarm is released in the system control and the vacuum pump is shut down automatically
- Decrease the ohmic resistance to a value less than 150 Ω
- Make sure that the alarm persists
- Make sure that the vacuum pump does not start self-acting
- Switch on the vacuum pump again
- Interrupt the ohmic resistance
- Make sure that a fault indication is released in the system control and the vacuum pump is shut down automatically
- Reconnect the variable ohmic resistance
- Switch on the vacuum pump again
- Short circuit the variable ohmic resistance
- Make sure that a fault indication is released in the system control and the vacuum pump is shut down automatically
- · Remove the short circuit
- Remove the variable ohmic resistance
- Reconnect the resistance thermometer Pt100 to the temperature transmitter (white cables to pins 4 and 5, red cable to pin 6,→ sketch)



 Firmly close the temperature measurement system (q) with the lid

In case the mounting of the temperature measurement system (q) in the oil separator (I) has loosened:

- Open the lid of the temperature measurement system (q)
- Disconnect the supply voltage cables from the pins 1 and 2 of the temperature transmitter
- Undo the temperature measurement system (q) from the oil separator (l)
- Thoroughly clean the threads on the temperature measurement system (q) and on the oil separator (I) (oil and grease free)
- Make sure that the counter nut is screwed onto the temperature measurement system (q)
- Apply threadlocker medium strength (e.g. LOCTITE 243) on the thread
- ♦ Screw the temperature measurement system (q) into the oil separator (I)
- Orientate the temperature measurement system (q) and tighten the counter nut
- Reconnect the supply voltage cables to the pins 1 (positive pole) and 2 (negative pole) of the temperature transmitter
- Firmly close the temperature measurement system (q) with the lid

Overhaul





WARNING

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

Risk of explosion!

Approval for operation will be void!

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











DANGER

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

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

Danger to health during dismantling of the vacuum pump. Danger to the environment.

Prior to shipping the vacuum pump shall be decontaminated as good as possible and the contamination status shall be stated in a "Declaration of Contamination" (form downloadable from www.buschvacuum.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 disconnecting pipes/lines make sure that all pipes/lines are vented to atmospheric pressure

Recommissioning



CAUTION

Vanes can stick after a long period of standstill.

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

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

After longer periods of standstill:

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

If deposits could have gathered in the vacuum pump:

- Flush the vacuum pump (→ page 13: Maintenance)
- Observe the chapter Installation and Commissioning (→ page 7)

Dismantling and Disposal











DANGER

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

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

Danger to health during dismantling of the vacuum pump. Danger to the environment.

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

The vacuum pump must be decontaminated prior to disposal.

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

- Remove the exhaust filters (120) (→ page 15: Exhaust Filters)
- Drain the oil
- Remove the oil filter (j, 100)
- Make sure that materials and components to be treated as special waste have been separated from the vacuum pump
- Make sure that the vacuum pump is not contaminated with harmful foreign material

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

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

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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 corresponding national accident prevention regulation.





CAUTION

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

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)	The vacuum system or suction line is not leak-tight	Check the hose or pipe connections for possible leak
Evacuation of the system takes too long		
	Conteminated oil (the most sommer source)	Change the oil
	Contaminated oil (the most common cause)	(→ page 13: Maintenance)
	No annual annuals all in the annuals	Top up oil
	No or not enough oil in the reservoir	(→ page 13: Maintenance)
	The exhaust filters (120) are partially clogged	Replace the exhaust filters (120) (→ page 13: Maintenance)
	The oil filter (j, 100) is clogged (the oil flows through the bypass only, the oil does not get filtered any more)	Replace the oil filter (j, 100) (→ page 13: Maintenance)
	The second (OCA) is the second in a (1)	Clean the screen (261)
	The screen (261) in the suction connection (d) is partially clogged	If cleaning is required too frequently install a filter upstream
	In case a filter (e) is installed on the suction connection (d):	Clean or replace the inlet air filter (e),
	The filter (e) on the suction connection (d) is partially clogged	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

1	<u></u>	I
	The valve disk of the inlet non-return valve is stuck in closed or partially open position	Disassemble the inlet, clean the screen (261) and the valve as required and reassemble
	The oil tubing is defective or leaking The oil return line (m) is broken	Repair the oil tubing (Busch service)
	Version with float valve (m, 200) and oil return line	Make the float valve (m, 200) movable, replace if necessary (→ page 15: Checking the
	The float valve (m, 200) is stuck in open position	Float Valve)
	A shaft seal is leaking	Replace the shaft seal ring (Busch service)
	An/The exhaust valve is not properly seated or stuck in partially open position	Disassemble and reassemble the exhaust valve(s) (Busch service)
	A vane is blocked in the rotor or otherwise damaged	Free the vanes or replace with new ones (Busch service)
	The radial clearance between the rotor and the cylinder is no longer adequate	Readjust the vacuum pump (Busch service)
	Process components evaporating under vacuum	
The gas conveyed by the vacuum pump	Readily volatile and thus gaseous components of the oil, e.g. additives, particularly right after an oil change.	Check the process, if applicable
smells displeasing	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.	Use a different type of oil, if applicable
The vacuum pump does not start	The drive motor is not supplied with the correct voltage or is overloaded	Supply the drive motor with the correct voltage
	The drive motor starter overload protection is too small or trip level is too low	Compare the trip level of the drive motor starter overload protection with the data on the nameplate, correct if necessary
	One of the fuses has blown	Check the fuses
	Version with alternating current motor: The drive motor capacitor is defective	Repair the drive (Busch service)
	The connection cable is too small or too long causing a voltage drop at the vacuum pump	Use sufficiently dimensioned cable
		Make sure the drive motor is disconnected from the power supply
	The vacuum pump or the drive motor is	Remove the fan cover
	blocked	Try to turn the drive motor with the vacuum pump by hand
		If the vacuum pump is blocked:
		Repair the vacuum pump (Busch service)
		Replace the drive motor (Busch service) (in order not to compromise the explosion
	The drive motor is defective	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)
		Repair the vacuum pump (Busch service)
The vacuum pump is blocked	Solid foreign matter has entered the vacuum pump	Make sure the suction line is equipped with a screen
		If necessary additionally provide a filter

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	Corrosion in the vacuum pump from remaining condensate	Repair the vacuum pump (Busch service) Check the process Observe the chapter Conveying Condensable Vapours (→ page 12) Repair the vacuum pump (Busch service)
	Version with three-phase motor: The vacuum pump was run in the wrong direction	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 Oil could not be compressed and thus broke a vane	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	Repair the vacuum pump (Busch service)
	When the vacuum pump was restarted too much condensate was enclosed between the vanes	Make sure no condensate will enter the vacuum pump, if necessary provide a drip leg and a drain cock
	Condensate could not be compressed and thus broke a vane	Drain condensate regularly
		Replace the coupling element
The drive motor is running, but the vacuum pump stands still	The coupling between the drive motor and the vacuum pump is defective	(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	Loose connection(s) in the drive motor terminal box	Check the proper connection of the wires
noisily or rattles The drive motor draws a too high current (compare with initial value after commissioning)	Version with three-phase-motor:	against the connection diagram
	Not all drive motor coils are properly connected	(particularly on motors with six coils) Tighten or replace loose connections
	The drive motor operates on two phases only	
	Version with three-phase motor: The vacuum pump runs in the wrong direction	Verification and rectification → page 7: Installation and Commissioning
	Standstill over several weeks or months	Let the vacuum pump run warm with inlet closed
		Use the proper quantity of one of the recommended oils
	Improper oil quantity, unsuitable oil type	(→ page 26: Oil change: → page 13: Maintenance)
	No oil change over extended period of time	Perform oil change incl. flushing and oil filter replacement
		(→ page 13: Maintenance)
		Flush the vacuum pump Replace the oil filter (j, 100) Replace the exhaust filters (120)
	The exhaust filters (120) are clogged and appear black from burnt oil	Fill in new oil
		(→ page 13: Maintenance)
		In case the oil life is too short: use oil with better heat resistance (→ page 26: Oil) or retrofit cooling

	Foreign objects in the vacuum pump Broken vanes	Repair the vacuum pump (Busch service)
	Stuck bearings	
The vacuum pump runs very noisily	Defective bearings	Repair the vacuum pump (Busch service)
		Replace the coupling element
	Worn 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)
		Replace the coupling element
	Worn 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)
		Repair the vacuum pump (Busch service)
	Stuck vanes	Use only approved oils (→ page 26: Oil) and change more frequently
There is an indication on the control panel / in the control room that the temperature		Make sure that the cooling of the vacuum pump is not impended by dust/dirt
monitoring has tripped (permissible temperature at the outlet of the stage has	Insufficient air ventilation	Clean the fan cowlings, the fan wheels, the ventilation grilles and the cooling fins
been exceeded) The vacuum pump is shut down		Install the vacuum pump in a narrow space only if sufficient ventilation is ensured
	Ambient temperature too high	Observe the permitted ambient temperatures
	Temperature of the inlet gas too high	Observe the permitted temperatures for the inlet gas
	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
		Top up oil
	Not enough oil in the reservoir	Top up oil
		Flush the vacuum pump Replace the oil filter (j, 100) Replace the exhaust filters (120) Fill in new oil
	Oil burnt from overheating	(→ page 13: Maintenance)
		In case the oil life is too short: use oil with better heat resistance (→ page 26: 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

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The vacuum pump fumes or expels oil drop- lets through the gas discharge The oil level drops An exhaust filter (120) is not proper		Check the proper position of the exhaust filters (120), if necessary insert properly (→ page 13: Maintenance)
	An o-ring is missing or damaged	Add or replace resp. the o-ring (→ page 13: Maintenance)
	An exhaust filter (120) shows cracks	Replace the exhaust filter (120) (→ page 13: Maintenance)
	The exhaust filters (120) are clogged with foreign matter	
	Note: The saturation of the exhaust filters with oil is no fault and does not impair the function of the exhaust filters! Oil dropping down from the exhaust filters is returned to the oil circulation.	Replace the exhaust filters (120) (→ page 13: Maintenance)
	Version with oil return valve:	Regularly shut down the vacuum pump for
	In case the vacuum pump runs for more than 10 hours without interruption, oil can collect in the upper chamber of the oil separator (I) to an extent that it gets expelled together with the discharged gas	short periods of time. Check that the oil return valve functions properly and lets oil run from the upper into the bottom chamber of the oil separator (I) as soon as the vacuum pump is shut down (→ page 5: Oil Circulation)
	Version with oil return valve:	
	The oil return valve does not work properly or is clogged (proper function is when blowing into the valve it should close, when vacuum is applied, the valve should open; CAUTION: do not let your mouth get in direct contact with the oil return valve, do not inhale through the oil return valve!)	Clean or replace the oil return valve
	Version with float valve (m, 200) and oil return line: The float valve (m, 200) is stuck in closed position	Make the float valve (m, 200) movable, replace if necessary (→ page 15: Checking the Float Valve)
	The oil return line (m) 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 oil filter (j, 100) Replace the exhaust filters (120) Fill in new oil (→ page 13: Maintenance) In case the oil life is too short: use oil with
		better heat resistance (→ page 26: Oil) or retrofit cooling
		Flush the vacuum pump Replace the oil filter (j, 100) Replace the exhaust filters (120) Fill in new oil
The oil is watery and coloured white	The vacuum pump aspirated water or	(→ page 13: Maintenance)
	significant amounts of humidity Version with gas ballast: The filter of the gas ballast is clogged	Modify the operational mode (→ page 12: Operating Notes Conveying Condensable Vapours)
		Version with gas ballast (h, 440) with sinter metal filter:
		Clean the sinter metal filter (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 oil filter (j, 100) Replace the exhaust filters (120) Fill in new oil (→ page 13: 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 oil filter (j, 100) Replace the exhaust filters (120) Fill in new oil (→ page 13: Maintenance) Make sure the proper oil is used for topping up

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Spare Parts

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

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

This parts list applies to a typical configuration of the vacuum pump RA 0025 - 0100 F ATEX-versions. Depending on the specific order deviating parts data may apply.

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

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Find the list of Busch companies all over the world (by the time of the publication of these installation and operating instructions) on → page 48 (rear cover page).

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

Pos.	Part	Qty	Part no.
83	Sight glass	1	0583 521 760
84	O-ring for sight glas	1	0486 000 633
88	Plug	1	0416 138 045
89	O-ring for plug	1	0486 000 633
95	Plug with seal ring	1	0415 000 074
100	Oil filter	1	0531 000 002
120	Exhaust filter with o-ring (RA 0025/0040 F)	1	0532 141 266
120	Exhaust filter with o-ring (RA 0063/0100 F)	2	0532 141 267
125	Filter spring (RA 0025/0040 F)	1	0947 000 720
125	Filter spring (RA 0063/0100 F)	2	0947 000 720
141	Gasket (RA 0025/0040 F)	1	0480 000 112
141	Gasket (RA 0063/0100 F)	2	0480 000 112
200	Float valve, complete	1	0947 138 417
261	Screen	1	0534 000 018
440	Gas ballast, complete, with sinter metall filter (optional, RA 0025/0040 F)	1	0916 142 105
440	Gas ballast, adjustable, complete, with sinter metall filter and ball valve (optional, RA 0025/0040 F)	1	0916 142 106
440	Gasballast, komplett, mit Sintermetallfilter (optional, RA 0063/0100 F)	1	0916 154 155
440	Gas ballast, adjustable, complete, with sinter metall filter and ball valve (optional, RA 0063/0100 F)	1	0916 142 108
_	Paper cartridge for air filter, ATEX Cat. 2D	1	_
_	Polyester cartridge for air filter, ATEX Cat. 2D	1	0532 147 871
_	Paper cartridge for air filter, ATEX Cat. 2G and Cat. 3D	1	0532 134 778
_	Polyester cartridge for air filter, ATEX Cat. 2G and Cat. 3D	1	0532 137 988

Accessories

Accessories	Description	Part no.
Inlet air filter	ATEX Cat. 2D, inlet-side, with paper cartridge, to separate solids	_
Inlet air filter	ATEX Cat. 2D, inlet-side, with polyester cartridge, to separate solids	_
Inlet air filter	ATEX Cat. 2G and Cat. 3D, inlet-side, vertical, with paper cartridge, to separate solids	0945 139 207
Inlet air filter	ATEX Cat. 2G and Cat. 3D, inlet-side, horizontal, with paper cartridge, to separate solids	0945 139 208
Inlet air filter	ATEXKat. 2G und Kat. 3D, inlet-side, vertical, with polyester cartridge, to separate solids	0945 141 829
Inlet air filter	ATEX Cat. 2G and Cat. 3D, inlet-side, horizontal, with polyester cartridge, to separate solids	0945 141 830
Filter pressure gauge	for easy checking of the degree of clogging of the exhaust filter	0946 000 100
Gas ballast, complete	for the conveying of condensable vapours, with sinter metal filter (RA 0025/0040 F)	0916 142 105
Gas ballast, adjustable, complete	for the conveying of condensable vapours, with sinter metal filter and ball valve (RA 0025/0040 F)	0916 142 106
Gas ballast, complete	for the conveying of condensable vapours, with sinter metal filter (RA 0063/0100 F)	0916 154 155
Gas ballast, adjustable, complete	for the conveying of condensable vapours, with sinter metal filter and ball valve (RA 0063/0100 F)	0916 142 108

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 range [℃]	12 30	0 40	0 40
Kinematic viscosity at 40 ℃ [mm²/s]	110	95	96
Kinematic viscosity at 100 ℃ [mm²/s]	11.5	9.5	13
Flashpoint [℃]	260	255	240
Pourpoint [℃]	–15	-30	-50
Part number 1 I packaging	0831 000 060	0831 000 099	0831 122 573
Part number 5 I packaging	0831 000 059	0831 000 100	0831 122 572
Remark			Food applications (NSF H1)
Filling quantity, approx. [I]		RA 0025/0040 F: 1.0 RA 0063/0100	

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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 RA 'ATEX' 0025 - 0100 F

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

Documentation No.: T611139599

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

Person authorized to compile the technical file

Dr.-Ing. Karl Busch General Director Andrej Riwe Technical writer

Maulburg, 04.04.2016

RA 0025 - 0100 F ATEX-Version

Equipment Documentation Measurement and Safety Instrumentation

Overview

	Temperature measurement system, consisting of:
Type/Marking	Resistance thermometer Pt-100: PTX-12BynS5WM-0140-0015
	Temperature transmitter: Ex KTM CA0

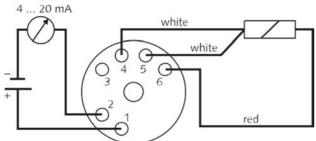
Brief description:

Resistance thermometer with integrated temperature

 $transmitter \ Temperature \ resistor \ with \ 3-wire \ connection.$

Temperature transmitter with 2-wire electronics for signal 4 \dots 20 mA.

Connection of supply voltage to pins 1 (positive pole) and 2 (negative pole).



Technical data	→ Installation and Operating Instructions BA0509 and BA1210 (→ pages 29 ff.)			
Interface	2 clamps for cross section max. 1.75 mm². Cable gland for cable diameter 3 7 mm			
Supply voltage (Ex)	8.5 27.3 V			
Temperatures - currents				
	Temperature	Current		
Sensor short circuit	-	3.55 mA		
Lower measurement range limit	0 C	4 mA		
Shutdown temperature	130 ℃	17.867 mA		
Upper measurement range limit	150 ℃	20 mA		
Sensor breakage	-	21.7 mA		

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Safety notes

Installation

Application

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Technical data

Order code

Maintenance

Repair

Application

The passive head transmitter Transcont KTM is used, to linearize Pt100 temperature signals in the range from 1—100°C to 400°C with a measuring span between 20°C kelvin and 70°C kelvin and 10°C convert it into an electrical standard signals 4...20nA resp. 0...10°C, also in explosive hazardous areas.

The voltage signal of the P1100 is monitored continuously. At wire break resp. wire short circuit a fail information is generated at the 4...20 mA resp. 0...10V output signal.

Whire break the output signal rises up to 21,7 mA resp. 10,85 V, at wire short circuit the output signal fails to 3.55mA resp. 0V.

At a short circuit between terminas 4 and 5 the device will operate in 2-wire-connection.

In the version type AS, with 2-wire-technology with signal 4...20 mA, an optional, per potentiometer freely adjustable, overload and short circuit protected PNP switching output in working current principle is integrated.



Head transmitter - passive Transcont KTM

for conversion and adjustment of a Pt100 temperature signal Input signal Pt100 in 2- or 3-wire-technology

— Zero value - 100°C...+100°C

• Messuring ange 30k...700k

• 12 standard measuring ranges or adjustment by specification

Output signals

Direct current 4...20mA

Direct voltage 0...10V

NP switching output

ATEX II 1 G Ex ia IIC T4 Certification for the use in explosion hazardous areas High accuracy

Installation in connection head style B acc. to DIN 43729

ACS-CONTROL-SYSTEM





know how mit system

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ACS contsys

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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.

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. 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 meets the legal requirements of all relevant EC directives. C 6 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 (EN60079-14, VDE0165), 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 = -20... +60 °C T_a = -40... +85 °C T_a = -40... +85 °C || 2(1) G Ex ib ||C T4 II 1 G Ex ia IIC T4

The devices are conceived for measuring of temperatures in explosive hazardous areas. The measured medium may also be combustible gases, vapors, liquids and dusts.

A warming marking points out to the safety measures, that must be applied because of the electrostatic charging to the plastic housing in operation and especially in the case of manternance activities.

avoid inclion no dry cleaning no assembling in pneumatic conveying stream avoid inclion

Installation

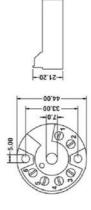
The device can be installed into a connection head style B acc. to DIN 43729 or into a field installation housing

For the installation of the device proceed like follows:

- Feed the sensor inset cables through the central hole in the head transmitter Place the installation springs onto the screws Feed the installation screws through the holes in the head transmitter and the holes in the sensor inset. Fix
 - both screws using the circlips. Position the head transmitter in the connection head in such a way so that the power supply input terminals

 - (terninal 1 and 2) are towards the cable entry gland.
 Fix the head transmitter and sensor inset into the connection head.
 Attention: In order to avoid damaging the head transmitter do not over tighten the installation screws.

The devices must be installed wheather and stroke protected, ideally at places without direct solar radiation. This is especially important in warm climatic regions.



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Lauterbacksts.77 - 84307 Eggenfelden - Germany Rei: +49 8721/ 9668-30 ACS-CONTROL-SYSTEM info@accontropsren dis-neuron-neuronal processing info@accontropsren dis-neuron-neuronal processing in the processing in

RA 0025 - 0100 F ATEX-Version

ACS

Transcont KTM

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.

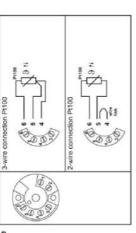
Measuring input and signal output are not galvanically isolated from each other.

Connection of the Pt100 - measuring input

measurement error. Using resp. connecting a Pt100 in 3-wire-connection it is possible to completely eliminate Because the measured Pt100 voltage signal is very small, the resistance of the leads can cause an error source that may not be neglected. The constant feed current also produces a the resistance of the leads a voltage drop and according to the requirements of the measurement it must be tried to neutralize this The resistance lemperature sensor Pt100 is connected to the head transmitter in 2- or 3-wire-connection

the influence of the lead resistance. If a Pt100 in 2-wire-connection is used, the measuring error, that is generated by the lead resistance, will result in the case of a signal increasement.

Connection scheme



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Transcont KTM

Electrical connection

Connection of the power supply voltage / signal output

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.

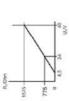
The voltage applied to the terminal contacts may not exceed 40 V at the variants A0 / AS resp. 35 V at the variant B0, to avoid damage of the electronic. All connections are polarity protected.

A load e.g. the measuring shunt of an evaluation device, in series with a temperature head transmitter of the variant A0 / AS with 4...20 mA current signal in 2-wire-technology reduces the supply voltage available at the head transmitter. This 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 max = (V_{Sact.} - 8,5V) / 20mA with V_{Sact.} = applying supply voltage.

The following graph shows the characteristics for the resistor values at 24 V and 40 V.



For inauguration it is suggested, to deactivate all connected control devices, to avoid unwanted control

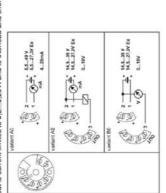
Inductive loads at the pnp switching output, e.g. relays or contactors may only be used with a free-wheeling diode or a RC protection circuit to avoid high voltage peaks.

semiconductor switch contactless and by this bounce-free. At an activated switching state a positive signal near supply voltage is feed 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 imited to 0,2...0,25 A and is overload and short circuit protected. The load at the PNP switching output will be connected to the terminal +terminal of the supply voltage by a

Connection scheme



Maintenance

The device is free of maintenance.

Due to it's construction, the device can not be repaired. When sending back the device for check, add a note with the description of the error and the application.

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Ex 8,5...27,3 V DC 8,5..40 V DC 8,5..40 V DC 14,5..35 V DC Reverse polarity protected Variant A0 Variant AS Variant B0 Permitted supply voltage

Auxiliary power supply

Technical data

2-wire-technology 4...20 mA < 22 mA PNP switching outputs no load 3-wire-technology 0...10 V < 10 mA 2 Vpp condition: within the permitted supply voltage range

Supply current:

Ripple voltage:

3- / 2-wire-connection, temperature linear, meas. current 2 x 0,5mA ± 0,2mA -100°C...+600°C, dependent on settings resp. configuration ≤ 15 \ per wire Temperature resistor Pt100:

Signal output 4...20 mA

Error monitoring input:

Direct current:

Measuring signal range:

Signal input

Wire resistance:

Linear characteristic from 3,55 mA ... 20,7 mA, 2-wire-technology Output signal 20,7 mA at wire break
Output signal 3,55 mA at short circuit terminals 4/6 resp. 5/6
Measurement in 2-wire-connection at short circuit terminals 4/5 R_L max = (V_{S act.} - 8,5) / 20mA

Signal output 0...10 V

Minimum delay time:

Permitted load:

Direct voltage: Error monitoring input:

Minimum delay time:

Permitted load:

Linear characteristic from \leq 0.01 V ... 10,35 V, 3-wire-technology Output signal 10,85 V at wire break Output signal ≤ 0,01 V at short circuit terminats 4/6 resp. 5/6 Measurement in 2-wire-connection at short circuit terminats 4/5 R_L ≥ 2500 Ω, equals 4 mA at signal 10 V, current limited

PNP switching to +Vs / normally open NO – working current principle Adjustment by multi-turn potentiometer PNP switching output

current limited, short circuit protected output load ≤ 3000 Ω resp. ≥ 4,5 mA ≤ 250 mA, min. 200 mA
≤ 700 µs Vour ≥ +Vs - 1,5 V > 100.000.000 < 2 ms Switching cycles: Output voltage: Output current: Rise up time: Delay time:

Measuring accuracy

±0,1 K / year or 0,05% / year < 0,02% / 100Ω < 0,2K or 0,1% S 0,05% / 10K Influence of supply voltage (5) 12) 13); < 0,02% / 10V %80'0 ≥ Characteristic deviation 3) 5) 8) 12). Temperature deviation 28 t2. Influence of output load 13). Long term drift 2) 6) 12); Accuracy 2) 8

higher value is valid

nigher value is valid

Refering to nominal measuring span resp. full scale (FS) Nonlinearity + Hysteresis + Reproducibility At limit value adjustment At reference conditions
Higher values for special measuring range
Of the nominal output signal end value 20mA/10V Lauterbachstr.57 - 84307 Eggenfelden - Germany Talle 1:+49 8711 9668-0 - Fax - 49 8711 9688-30 know how mit system info@accontropscent.

0870155907 / 150220



Translation

EC-TYPE EXAMINATION CERTIFICATE

E

Equipment and protective systems intended for use in potentially explosive atmospheres - Directive 94/9/EC (2)

EC-Type Examination Certificate Number (3)

TÜV 02 ATEX 1924 X

ACS CONTROL SYSTEM GmbH

Manufacturer: Equipment

(5)

Address:

8

Temperature Head Transmitter type ExKTM A0

This equipment or protective system and any acceptable variation thereto are specified in D-84307 Eggenfelden

the schedule to this certificate and the documents therein referred to.

1994 (94/9/EC), certifies that this equipment or protective system 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 TÜV NORD CERT GmbH & Co. KG, TÜV CERT-Certification Body, notified body number N° 0032 in accordance with Article 9 of the Council Directive of the EC of March 23, (8)

The examination and test results are recorded in the confidential report N° 02YEX187208.

Compliance with the Essential Health and Safety Requirements has been assured by (6)

EN 50 014: 1997

(10)

EN 50 020: 1994

EN 50284: 1999

If the sign "X" is placed after the certificate number, it indicates that the equipment or protective system is subject to special conditions for safe use specified in the schedule to this certificate. 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. (11)

The marking of the equipment or protective system must include the following: (12)

II 1 G resp. II 2(1) G EEx ia IIC T4 or II 2 G EEx ib IIC T4

TÜV NORD CERT GmbH & Co. KG

Am TÚV 1 D-30519 Hannover Tel: 0511 986-1470 Fax: 0511 986-2555

Proud

Head of the Certification Body

This certificate may only be reproduced without any change, schedule included. Excerpts or changes shall be allowed by the TÜV NORD CERT GmbH & Co. KG

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2010110146

SCHEDULE

13)



(14) EC-TYPE EXAMINATION CERTIFICATE Nº TÜV 02 ATEX 1924 X

Description of equipment (15)

The Temperature Head Transmitter type ExKTM_A0 is used for the determination of temperatures of a connected 2-wire- or 3-wire-Pt100-resistance. The temperature signal will be converted into a 4 ... 20 mA signal

taken from the following table

The permitted ambient temperatures in the range of the Temperature Head Transmitter (T_a) in dependence on the device category and the category of the intrinsically safe circuits have to be

Та		-40°C +85°C	:
Category of the intrinsically safe circuits	ía	įs.	Q
Device category		2(1)	2

in explosion hazardous areas which require apparatus of category 1 only process pressures of 0,8 bar to 1,1 bar are permitted

Electrical data

Supply and signal circuit (Terminals 1 and 2)

in type of protection Intrinsic Safety EEx is IIC resp. EEx ib IIC

only for the connection of a certified intrinsically safe circuit

는王 effective internal capacitance: 4 effective internal inductance: 110 = 140 mA = 0.9 W

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Schedule EC-Type Examination Certificate N° TÜV 02 ATEX 1924 X

2 mH in type of protection Intrinsic Safety EEx ia IIC
resp. EEx ib IIC
only for the connection of a Pr100 sensor
Uo = 5.9 V
Io = 35 mA
R = 756 D
Po = 163 mW
Characteristic line: trapezoidal 8 1 mH 2 maximum external inductance maximum external capacitance EEx ia/ib

(16) Test documents are listed in the test report No.: 02YEX187208.

7.6 µF

1.7 µF

(17) Special conditions for safe use

- At the chargeable plastic parts of the Temperature Head Transmitter type ExKTM_A0
 there is a danger of ignition by electrostatic discharge for apparatus of category 1. The
 operator has to ascertain the suitability of this apparatus for his use.
- The Temperature Head Transmitter type ExKTM_A0 has to be installed in such a way that a degree of protection of min. IP20 according to IEC 529 is reached.

(18) Essential Health and Safety Requirements

no additional ones

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Sensor circuit (Terminals 4, 5, 6)

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in gases, vapors, liquids and dust Resistance Thermometer Measurement of temperatures

PTX

Technical manual 01.14

Main features

Process temperature from -200°C to 600 °C

Wide variety of process connections, optionally with coating Long term stable temperature sensor platinum Pt100 - IEC 60751

- 2-, 3,- or 4-wire-connection Double type in 2-wire-connection for redundancy
 - Accuracy classes AA, A or B function

Exchangeable measuring insert

- Certification for the use in explosion hazardous areas
 ATEX II 1 G Ex la IIC T6...T1 Ga
 ATEX II 1 D Ex la IIIC Tx°C Da

Short response time

Integrated temperature head transmitter

• 2-wire with current signal 4...20 mA – fix adjusted

• 2-wire with current signal 4...20 mA –
programmable

• Profibus PA®

ACS-CONTROL-SYSTEM

knowledge and systems Your partner for measuring technology and automation

You have purchased a high-grade and modern measuring device of ACS-CONTROL-SYSTEM GmbH. We want to give thanks for your purchase and for your confidence to us. The actual technical manual includes instructions for installation, electrical connection and inauguration, as well as the technical data of the device.

Modifications, that answer the purpose of the technical progress, are reserved by ACS-CONTROL-SYSTEM GmbH without prior notice.

If a question occurs, that can't be answered by the listed informations, please call on our technicians team in Eggenfelden Tel: +49 8721/ 9668-0 or info@acs-controlsystem.de

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ACS-CONTROL-SYSTEM 6mb Hitlauterbachstr. 57 ID-84307 Eggenfelden I www.acs-controlsystem.de linfo@acs-controlsystem.de N

page 34 0870155907 / 150220 The use of a long-term stable platinum temperature sensor – Pt100 – allows a precise measurement of temperatures in nearly all fields of industry, especially at hygienic applications.

Function

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Supply voltage Connection scheme

Special safety notes 6

Safety notes...

 Installation Installation place 9
Process and environmental temperature 10
Installation notes 10

The device is used for temperature measurement by recording the ohmic resistance of a resistance temperature sensor Pt.100.

2888

Dimension drawings......
Terminal enclosure

Process connection Neck tube

Order Code . .

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Repair 14

Technical Data Measuring accuracy 15
Process conditions 16
Environmental conditions 16
Materials process wetted 17

Materials not process wetted 17

The device consists of a changeable measuring insert in a protection tube, the process connection, optionally a neck tube and a terminal enclosure.

The protection tube is fixed at the process connection. Process connection and terminal enclosure can be separated from each other by a neck tube. A temperature head transmitter or a terminal socket can be mounted on the measuring insert. By using a neck tube of a corresponding length between the respective process connection and the connection housing at high medium temperatures if can be additived that the temperature in the area of the connection housing does not exceed the permitted environmental temperatures.

The protection tube of the resistance thermometer is the junction point with the applied medium and is in direct contact with it. The terminal enclosure is used for the connection of the temperature sensor resp. sensors PLIOD with an evaluation electronic and is suitable for the installation of head transmitters.

Inside the resistance thermometer the changeable measuring insert is installed. This measuring insert is the real temperature sensor. In the installed state the tip of the measuring insert is pushed against the lower end of the protection thus and pit has notimal heat transfer is guaranteed. In the tip of the measuring insert the temperature sensor resp. the two temperature sensor P\$100

The resistance temperature sensor Pt100, dependent on the requirements for accuracy up to class AA, ensures a precise and long-term stable temperature measurement. At the side of the terminal enclosure optionally a temperature head transmitter or a terminal socket is

Basics Pt100

of the material platinum (element symbol Pt), whose resistance value is ideally 100Ω at a temperature of 0°C.

This results according to the norm EN/IEC 60751 in the expression "Pt10°C.

The resistance value increases at higher temperatures corresponding to a resistor material characteristic coefficient and decreases correspondingly at lower temperatures. The temperature measuring sensor of resistance thermometers Pt100 consists of an electrical resistor

For industrial thermometers acc. to the standard EN/IEC 60751, the ideal resistance values of a resistor Pt100 can be calculated according to the following equation: Temperature range from $T = -200^{\circ}C...0^{\circ}C$

The proposator rate $(1.5 \times 10^{-3} \times 10^{-3}$

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Different specification accuracy sorting's are available for temperature resistors Pt100. The accuracy classes define at first the maximum permitted temperature deviation against 0°C, when the accuracy classes define at first the aresistance of 1000. The temperature resistor Pt10 has a resistance of 1000. Secondary the maximum permitted temperature deviation from the calculated value at an arbitrary.

esistance value different from 1000 is determined.

	၁့၀	Lt1°C
Deviation Pt100 class AA	+/- 0,10 K	+/- (0,10 K + 0,0017 K * [t])
Deviation Pt100 class A	+/- 0,15 K	+/- (0,15 K + 0,002 K * [t])
Deviation Pt100 class B	+/- 0,30 K	+/- (0,30 K + 0,005 K * [t])
Deviation PTX	depends on accuracy	depends on accuracy class Pt100 and installation situation

[t] without sign, in K

Measurement methods – measurement error. For capturing the resistor value of the Pt100 commonly a constant current in the range from 0,1mA to 6mA is used. This current produces at the resistor a processible voltage drop.

The used constant current however causes due to the self-heating through the current flow in the resistor Pt100 an increasing of the temperature that distort the measuring result. By this the constant current should be logically kept as low as possible. Contrary a too low current also can cause problems because on the one hand the susceptibility against electromagnetic interferences increases and on the other hand the measured voltage signal decreases and this leads to higher requirements to the evaluation electronic.

Because the measured voltage signal is very small, the resistance of the PLIO0 leads can cause an error source that may not be neglected. The constant current pootuces in the resistance of the leads a voltage drop and according to the requirements of the measurement it is must be theta to neutralize this.

measurement error. Using a Pt100 in 3-wire or 4-wire connection-technique it is possible to completely eliminate the influence of the lead resistance, if a suitable evaluation electronic is connected.

tesponse time

It the temperature sensor is applied to a temperature variation, a defined time goes by until the sensor has taken over this new temperature. This time depends on the style of the thermometer and the environmental conditions like e.g. flow speed, medium, etc.

The values for the response times can be found in the chapter "technical data"

The values refers to measurement in water with 0,4 m/s, temperature step 23 to 33°C acc. to EN/IEC 60751. The response times for other medias can be determined by using the thermal exchange constant acc.

to VDI/VDE 3522

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 compatibility with the respective application requirements (corracting materials, process temperature). An unsuitable material can lead to damage, abnormal behavior or destruction of the device and to the resulting damaers.

The sensors may not be used as sole device for prevention of dangerous conditions in machines and This measuring 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.

Using the device in a manner that does not fall within the scope of its intended use, disregarding this instruction, using under-qualified personnel, or making unauthorized alterations releases the manufacturer from liability for any resulting damage. This renders the manufacturer's warranty null

Special safety notes

Electrical operating supplies for explosive hazardous areas

If a device is installed and operated in explosive hazardous areas, the general Ex construction standards (ENJTE CO099-14, VDE 0195), these safety notes and the endosed EC conformity certificate incl. supplements must be observed. For installed head transmitters also those technical instructions, safety notes and the 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:

II 1 D Ex ia IIIC Tx°C Da	II 1/2 D Ex Ib IIIC Tx°C Da/Db	II 2 D Ex ib IIIC Tx°C Db
II 1 G Ex la IIC T6T1 Ga	II 1/2 G Ex ib IIC T6T1 Ga/Gb	11 2 G Ex ib IIC T6T1 Gb

The temperatures Tx°C can be found in the tables of the EC conformity certificate.

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 The devices are conceived for measurement of temperatures in explosive hazardous areas. found in this technical manual.

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For applications, which require devices of category 1/2 or category 1, the process pressure and temperature range of the media has to be between 0.8 bar to 1,1 bar and -20 °C to 60 °C. If the thermometer is operated beyond these atmospheric conditions, this approval can be used as a guide. Additional tests for the special application conditions are recommend.

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Installation

The correct function of the device within the specific technical data can only be guaranteed, if the permitted process and environmental temperatures (see chapter "Technical data") will not be exceeded.

Material terminal enclosure	Environmental temperature Explosive-free area	temperature free area	Environmental temperature gas-explosive-area	temperature sive-area	Environmental temperat dust-explosive-area	Environmental temperature dust-explosive-area
	Without transmitter	With transmitter KTM	Without	With transmitter ExkTM - A0	Without	With transmitter ExkTMA0
Steel / Aluminium	-40°C+130°C40°C+85°C	-40°C+85°C	-20°C+1,00°C cat. 1 -20+60°C	-20°C+85°C cat. 1 +60°C cat. 1 / T6	-20°C+80°C cat. 1 -20+60°C	-20°C+80°C cat. 1 +60°C
POM	-25°C+100°C -25°C+85°C	-25°C+85°C	-20°C+1/00°C cat. 1 -20+60°C	-20°C.,+85°C cat. 1 +60°C cat. 1 / T6	inadmissible	inadmissible
8	-15°C+100°C -15°C+85°C	-15°C+85°C	-15°C+100°C cat. 1 -15+60°C	-15°C+85°C Kat 1 +60°C cat 1 / 76	inadmissible	inadmissible

A bullt-in temperature head transmitter must be certified for II G Ex ia IIC T6...T1 Ga resp. II D Ex ia IIIC TX°C Da. For the use in zone 1 resp. 21 the certification II G Ex ib IIC T6...T1 resp. II D Ex ib IIIC TX°C Da is also sufficient. The installation of a temperature head transmitter with lower temperature class resp. maximum surface temperature and use maximum surface. temperature of the whole device.

aluminum type 4 are permitted. In explosion hazardous areas with dust-air-atmosphere the coating of the process connection resp. the

protection tube is not permitted.

In explosion hazardous areas with dust-air-atmosphere only the terminal enclosure in steel or

For specifying the permitted environmental temperature in the area of the terminal enclosure when using a temperature head transmitter that is built into the terminal enclosure the permitted renvironmental temperature of the transmitter must also be observed.

The maximum permitted supply voltage of the device PTX is 30V. The installation of a temperature head transmitter with a lower maximum permitted supply voltage than 30V reduces the maximum permitted supply voltage to those values. For the use in explosion hazardous areas with dust-air-atmosphere only the temperature head transmitter EXFM-. A0 or another therefore specially proded device is permitted. The maximum surface temperature of the built-in temperature head transmitter Ex-KTM-. A0 is 15K higher than the environmental temperature of the temperature head transmitter. This results e.g. in TTS at $\frac{1}{2} = 40^{\circ}$ C. The Sta $\frac{1}{2} = 60^{\circ}$ C and T95 at $\frac{1}{2} = 80^{\circ}$ C in the area of the temperature head transmitter.

For PROFIBUS* transmitter, where the electrical output values towards measuring insert are defined, the determined input values for U, I and V, the ard electrical in the EC conformity certificate may be exceeded, if the safety specifications for the installation and the application of the PROFIBUS* devices are observed (see also the safety instructions of the used PROFIBUS* transmitter).

If the thermometer is mounted in the separation wall to the hazardous area that requires devices of adappory 1, the process connections have to be designed in such a way, that they are sufficiently tight according to EMJEC 60079-26 section 4.6.

Using a terminal enclosure in aluminum there is a danger of ignition by sparks caused by impact or

Operational conditioned friction or pushes with device parts in iron/steel are not permissible. The operator has to ascertain the suitability of this device for his application.

At variants of the devices with chargeable plastic parts, a waming marking points out to the safety measures, that must be applied because of the electrostatic charging in operation and especially in the case of immitten

- no assembling in pneumatic conveying stream dry cleaning 2

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Installation place

The choice of the place of installation of the sensor and the length of the sensor tube are of considerable importance for the quality and the reliability of the measuring results.

If the sensor isn't installed deeply enough, an error in the measured temperature can occur because of the different process flow temperature at the pipeline wall and the heat transfer along the sensor tube.

The appearance of the error should not be ignored if a considerable difference between process

temperature and environmental temperature exists.

Thus it is suggested to use an installation length of at least 80...100 mm.

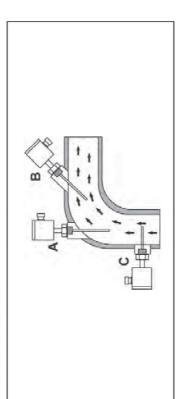
The shorter the installation length, the greater is the deviation against the real medium temperature caused by the heat transfer.

- The following general recommendations can be applied as approximately guideline:

 In liquids, the sensor tube length should be 5...6 times greater than the diameter of the sensor tube plus the sensitive length of 50 mm.
- In steam, air and gases, the sensor tube length should be 10...15 times greater than the diameter of the sensor tube plus the sensitive length of 50 mm.

In pipelines with small diameter the tip of the sensor tube should reach the axis line, that means the middle of the pipeline, and if possible additionally a little more.

An additional solution for optimizing the measurement quality of small formatted pipelines could be the installation of the sensor tube diagonal to the pipeline longitudinal axis or the installation of the sensor tube in the pipeline arc. By isolating the external parts of the sensor, the effect caused by too low installation depth, can be



- A) In the pipe arc against the flow direction
 B) In small pipes diagonal against the flow direction
 C) Vertical to the flow direction

At a horizontal installation, especially in hygienic applications, the probe should be installed with a decline against the horizontal of minimum 3° , to ensure a self-emptying.

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Process and environmental temperature

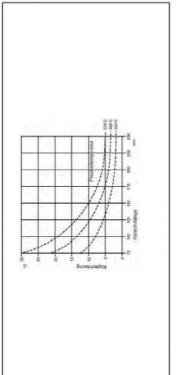
At high process temperatures a heat transfer to the terminal enclosure can be reduced by isolation of the medium carrying part of the plant or by the use of a neck tube.

Neck tube

The neck tube is used to decouple the temperatures between medium and the terminal enclosure in order to reduce the temperature at the terminal enclosure.

By using a neck tube at extreme process temperatures it can be achieved, that the permitted environmental temperature range in the area of the terminal enclosure will not be exceeded.

The length of the needed neck tube depends on the height of the process temperature and the respective installation situation.



Installation notes

Drive the system pressure free prior installation resp. deinstallation of the sensor. Be also sure that no medium is flowing in the system. At extreme system or medium temperatures there could exist sentous dangers. The screw-in of the thread process connection by using the terminal enclosure is not permitted. The bightening of the thread process connection may only be done at the hexagon by a suitable spanner and with the maximum permitted torque strength.

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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.

Potential equalization - earthing
The device must be grounded.
The earthing can be carried out by the metallic process connection.

Connection cable
Use only shielded signal and measurement wires and install these wires separated from power leading
wires.
The cable shield of a connected cable must be grounded.

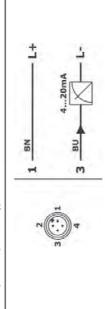
Supply voltageThe voltage applied to the terminal contacts may not exceed the maximum permitted supply voltage to ensure the compliance with the intrinsically safety.
The maximum permitted supply voltage is:

30V _{2C}	27,3Vpc	30V _{2C}	17,5V
Without head transmitter	Head transmitter ExKTMA0 – type M	Head transmitter UTN500-B - type X	Head transmitter PTN601-B type T

Further detailed informations to the temperature head transmitters can be found in the technical instructions, safety notes and EC conformity certificate.

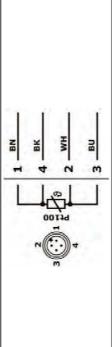
Connection scheme Connection type loose wires - type D

1x Pt100 / 2-wire / sensor type 1



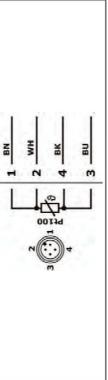
Conductor color: WH = white, RD = red

1x Pt100 / 3-wire / sensor type 2



Conductor color: WH = white, RD = red

1x Pt100 / 4-wire / sensor type 3



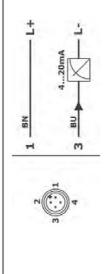
Conductor color: WH = white, RD = red

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1

2x Pt100 / 2-wire / sensor type 4



Conductor color: WH = white, RD = red, BK = black, YE = yellow

Connection type terminal socket – type K / L See color assignment connection type loose wires – type D

Connection type head transmitter – type M / X / T Head transmitter EXTN-_A0 – type M • P100 / 2- resp. 3-Wire • Output 4..20MA / 2-Wire • Fix adjusted

Head transmitter UTN-500-B – type X • Pt100 / 2 - resp. 3- resp. 4-wire • Output 4...20mA / 2-wire • Adjustable per software

Head transmitter PTN601-B - type T Pt100 / 2- resp. 3- resp. 4-wire Output PROFIBUS-PA* / 2-wire Adjustable per software

See technical manual head transmitter

Operation

An operation provided by user is not designated.

Maintenance

The device is free of maintenance.

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 adhesive product residues must be removed. This is especially important, if the product is unhealthlig, e.g. caustic, toxic, carcinope

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Technical Data

Process conditions

Process temperature

Output Signal Pt100

Function	Pt100
Supply current	≤ 0,16 mA
Step response time T _{savo}	Diameter sensor tip Ø8mm
	T ₅₀ ≤ 18 s / T ₅₀ ≤ 55 s
	Diameter sensor tip Ø10mm
	T _{s0} ≤ 28 s / T _{s0} ≤ 90 s
	Diameter sensor tip @12mm
	T _{co} ≤ 38 s / T _{co} ≤ 125 s
Isolation voltage	≥ 500 V ₂
	Pt100 to Pt100 / Pt100 to metallic parts

Limitation by category / temperature class/ electrical power, see EC conformity certificate

Accuracy class type B / A / C

-50°C...+400°C

Accuracy class type S

-200°C...+600°C

Permitted process temperature without neck tube
Environmental temperature temperature
Up to +150°C

Up to +40°C

Up to +60°C

Up to +60°C

H120°C

H120°C

H120°C

H100°C

Measuring accuracy

Reference conditions	EN/IEC 60770-1 resp. EN/IEC 61003-1
	T = 25 °C, relative humidity 4575 %, environmental air
	pressure 3601060 kPa
Installation position	Vertical, process connection bottom side
Warm-up time	≥ 600 s

Measurand error	Accuracy class B - type B	
	T= -50400°C	≤ ±(0,3K +0,005 * T)
	Accuracy class A - type A	
	T= -50250°C	≤ ±(0,15K +0,002 * ⊤)
	T= 250400°C	≤ ±(0,3K +0,005 * T)
	Accuracy class AA - type C	
	T= 0100°C	≤ ±(0,1K +0,0017 * T)
	T= -500°C / 100250°C	≤ ±(0,15K +0,002 * ⊤)
	T= 250400°C	≤ ±(0,3K +0,005 * T)
	Type S - Accuracy class B	
	T= -200600°C	≤ ±(0,3K +0,005 * T)
	Type S - Accuracy class A	
	T= -200600°C	≤ ±(0,15K +0,002 * ⊤)
	Type S - Accuracy class AA	
	T= -50250°C	≤ ±(0,1K +0,0017 * T)
	T= -500°C / 250600°C	≤ ±(0,15K +0,002 * T)
	T = Numerical value of temperature in °C, no leading sign	erature in °C, no leading sign

Environmental conditions

depending on process connection

≤ 60 bar Limitation

Process pressure

The permitted environmental temperature range results from the combination of standard range and limitation, whereby the range is defined by the narrowest limitation.

Environmental temperature	-40°C+130°C	
	Limitation by material	
	Terminal enclosure type B - PP	-15+100°C
	Terminal enclosure type 2 - POM	-25+100°C
	Limitation by type certificate	
	Certificate type 1 – ATEX II 1 G	-20+100°C
	Certificate type 2 – ATEX II 1 D	-20+80°C
	Limitation by application	
	Category 1	-20+60°C
	Limitation by head transmitter	
	EXKTM / UTN-500 / PTN-601	-40+85°C
	ExKTM category 1 / temperature class T6	-20+49°C
	UTN-500 temperature class T4	-40+85°C
	UTN-500 temperature class T5	-40+70°C
	UTN-500 temperature class T6	-40+55°C
	PTN-501 temperature class T4	-20+85°C
	PTN-501 category 1 / temperature class T5	-20+50°C
	PTN-601 category 2 / temperature class T5	-40+65°C
	PTN-601 category 1 / temperature class T6	-20+40°C
	PTN-501 category 2 / temperature class T6	-40+50°C
Protection	IP67 (EN/IEC 60529)	
Shock classification	3 g [10 - 500 Hz] (EN/IEC 60068-2-6)	
Vibration classification	3 g [10 - 500 Hz] (EN/IEC 60068-2-6)	
EM compatibility	Operation device class B / Industrial range (EN/IEC 61326)	N/IEC 61326)
Weight	Depends on variant	

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Materials - process wetted

Protection tube	Steel 1.4404 (AISI 316L) / 1.4571 (AISI 316Ti) Wall thickness > 1 mm
Process connection	Steel 1.4404 (AISI 316L) / 1.4571 (AISI 316TI)
Surface quality	Ra < 0,8µm
Surface coating	E-CTFE – ethylene-chlorotrifluorethylene (Halar*) / others

Materials - not process wetted

Neck tube	CrNi-steel
Terminal enclosure	CrNi-steel / Aluminium lacquered / PP – polypropylene /
	POM – polyoxymethylene (Delrin*)
Electrical connection part	Cable gland
	CrNi-steel / PA - polyamide
	Gasket
	CR / NBR
Gaskets	FPM – fluorelastomere (Viton*) / Silicone



EC TYPE-EXAMINATION CERTIFICATE

3

- Equipment or protective system intended for use in potentially explosive atmospheres - Directive 94/9/EC (2)
- EC-Type Examination Certificate Number

(3)

TÜV 04 ATEX 2430 X

Resistance thermometer type PTX ACS CONTROL SYSTEM GmbH

Manufacturer: Equipment:

(6) (4)

D-84307 Eggenfelden Lauterbachstraße 57

This equipment or protective system and any acceptable variation thereto is specified in the

(94/9/EC), certifies that this equipment or protective system has been found to comply with the and protective systems intended for use in potentially explosive atmospheres given in Annex II The TÜV NORD CERT GmbH & Co. KG, TÜV CERT-Certification Body, notified body number Nº 0032 in accordance with Article 9 of the Council Directive of the EC of March 23, 1994 Essential Health and Safety Requirements relating to the design and construction of equipment schedule to this certificate and the documents therein referred to. to the Directive. 0 (8)

The examination and test results are recorded in the confidential report N° 04YEX551171.

Compliance with the Essential Health and Safety Requirements has been assured by compliance with (6)

EN 50281-1-1:1998 EN 50284:1999 EN 50020:2002 EN 50014:1997+A1+A2

If the sign "X" is placed after the certificate number, it indicates that the equipment or protective system is subject to special conditions for safe use specified in the schedule to this certificate. (10)

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. (11)

The marking of the equipment or protective system must include the following: (12)

II 1 GD EEx ia IIC Tx°C IP65 resp. II 1/2 GD EEx ib IIC Tx°C IP65 resp. II 2 GD EEx ib IIC Tx °C IP65 (3)

Hanover, 2004-04-02

TÜV NORD CERT GmbH & Co. KG TÜV CERT-Certification Body Am TÜV 1 D-30519 Hannover Tel.: 0511 986-1470 Fax: 0511 986-2555

TÜV NORD CERT

TÜY CERT A4 10,02 10,000 L6 Certification Body

Head of the

This certificate may only be reproduced without any change, schedule included. Excerpts or changes shall be allowed by the TÜV NORD CERT GmbH & Co. KG

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SCHEDULE

(13)

(14) EC-TYPE EXAMINATION CERTIFICATE N° TÜV 04 ATEX 2430 X

Description of equipment (12)

The Resistance thermometer type PTX is used for the temperature measurement of gases,

vapours, liquids or dusts in vessels and pipes.

The Resistance thermometer type PTX consists of a measuring insert with one or two Pt100 sensors (embedded in aluminium oxid powder), a protective tube (wall thickness ≥ 1mm) and a housing (with connecting wires, terminals or built in separately certified transmitter). For temperature decoupling a neck tube may be necessary.

The Resistance thermometer type PTX may be operated according to the thermical/electrical

Electrical data

Sensor supply without built in transmitter:

in type of protection "Intrinsic safety" EEx ia IIC resp. EEx ib IIC Sum of the maximum values: $U_{i} = 30$ Sensor circuit Pt100

The effective internal capacitances and inductances are negligibly small. = 0.9

Sensor supply with built in suitably certified Transmitter (e. g. Ex-KTM-_ A0, UTN-500-B_ PTN-600-B

in type of protection "Intrinsic safety" EEx ia IIC

Signal circuit transmitter

EEx ib IIC

only for connection to a certified intrinsically safe circuit maximum values; mA = 140 $U_1 = 30$

The effective internal capacitances and inductances have to be taken from the regarding EC Type Examination = 0.9

 $P_{\rm max}$ (see tables) is the maximum value of the power converted in the sensor circuits (Pt100) (Pmax = Pi resp. the value according the EC Type Examination Certificate of the transmitter).



Schedule EC-Type Examination Certificate Nº TÜV 04 ATEX 2430 X

Table 3

Ambient temperature range

MW

mW -26 -14

mW

mW

mW

mW

mW

mW

max, permissible process temperature on the protective tube [°C] at power P_{max}

Marking			max. per	max, permissible process temperature on the protective tube [°C] at power P _{max}	rocess fer tive tube er Pmax	nperature [°C]	124		Ambient temperature
at level of protection ib	50 mW	100 Wm	163 mW	200 m/W	500 mW	650 mW	750 mW	900 Wm	range
II 2 GD EEx ib IIC T80 °C IP65 resp. II 2 G EEx ib IIC T6	74	88	09	99	20	2	-10	-28	
II 2 GD EEx ib IIC T95 °C IP65 resp. II 2 G EEx ib IIC T5	88	83	75	71	32	17	20	+	
II 2 GD EEx ib IIC T130 °C IP65 resp. II 2 G EEx ib IIC T4	124	118	110	106	70	52	40	22	see manual
II 2 GD EEx ib IIC T195 °C IP65 resp. II 2 G EEx ib IIC T3	189	183	175	171	135	117	105	87	
II 2 GD EEx ib IIC T290 °C IP65 resp. II 2 G EEx ib IIC T2	284	278	270	266	230	212	200	182	
II 2 GD EEx ib IIC T440 °C IP65 resp. II 2 G EEx ib IIC T1	434	428	420	416	380	362	350	332	

-20°C ... 60 °C housing made of POM: -15°C ... +60°C

 resp. II 1 G EEx ia IIC T4 II 1 GD EEx ia IIC T195 °C IP65 resp. II 1 G EEx ia IIC T3

resp. II 1 G EEx ia IIC T2 II 1 GD EEx ia IIC T440 °C IP65 resp. II 1 G EEx ia IIC T1

Table 2 Marking

II 1 GD EEx ia IIC T290 °C IP65

-32

ņ

II 1 GD EEx ia IIC T95 °C C IP65 resp. II 1 G EEx ia IIC T5 II 1 GD EEx ia IIC T130 °C IP65

II 1 GD EEx ia IIC T80 °C IP65 resp. II 1 G EEx ia IIC T6

at level of protection ia

Table 1 Marking The temperature measurements were carried out without dust layer (see EN 50 281-1-1, 10.5).

(16) Test documents are listed in the test report No. 04YEX551171.

Ambient temperat range

MW

MW

mW

mW

11 WW

mW

38 WW

00 m № 50

II 1/2 GD EEx ib IIC T80 °C IP65

at level of protection ib

max, permissible process temperature on the protective tube [°C] at power P_{max}

;

11.2 G EEX Ib IIC 76
11.12 GD EEX Ib IIC 76
11.12 GD EEX Ib IIC 75
11.12 GD EEX Ib IC 75
11.12 GD EEX Ib IC 73
11.12 GD EEX Ib IC 73
11.12 GD EEX Ib IC 74

see manual

-16

resp. II 1/2 G EEx ib IIC T3

-29 resp. II 1/2 G EEx ib IIC T2 II 1/2 GD EEx ib IIC T440 °C IP65 resp. II 1/2 G EEx ib IIC T1 II 1/2 GD EEx ib IIC T290 °C IP65



Schedule EC-Type Examination Certificate No TÜV 04 ATEX 2430 X

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60.11.50 AB

80.11.50 AB



Schedule EC-Type Examination Certificate Nº TŪV 04 ATEX 2430 X

(17) Special conditions for safe use

- The thermometer is not marked with the permissible medium temperature and ambient temperature. The appropriate designations have to be taken from this certificate resp. from the manual.
- At the housing made of plastic there is a danger of ignition by electrostatic discharges.The operator has to ascertain the suitability of this equipment for his use.
- At the housing made of aluminium there is a danger of ignition by sparks caused by impact or friction. The operator has to ascertain the suitability of this equipment for his
- It has to be ensured, that the permissible ambient temperature range of the built in transmitters is observed (e.g., by thermical isolation and/or an appropriate length of the neck tube). Restrictions by the temperature class and the category of the built in transmitters have to be observed (see manual).
- If mounted in the partition wall to the hazardous area for category 1 apparatus, the process connections have to be designed in such a way, that they are sufficiently tight according to EN 50284 section 4.5.
- For applications, which require category 1/2 apparatus or category 1 apparatus, the process pressure and temperature range of the media has to be between 0.8 bar and 1.1 bar and conditions, this approval serves as a guide. Additional tests for the special application between -20 °C and 60 °C. If the thermometer is operated beyond these atmospheric
- The permissible operating pressures and temperatures have to be taken from the manual if no explosion hazardous gas mixtures exist.

(18) Essential Health and Safety Requirements

no additional ones



1. SUPPLEMENT Translation

Resistance thermometer type PTX **TÜV 04 ATEX 2430 X** to Certificate No. Equipment:

ACS CONTROL SYSTEM GmbH Lauterbachstraße 57

Manufacturer

Address:

84307 Eggenfelden, Germany 8000555819 The resistance thermometer type PTX was tested according to the standards listed below.

2010-06-16

Order number:

Date of issue:

The changes refer to

die informtion in the table 1, the power to be taken into account for the sensor circuit Pt100 and

the "Special conditions for safe use"

Electrical data

Sensor supply without built-in transmitter

in type of protection "Intrinsic safety" Ex ia/fib IIC resp. Ex iaD/fibD Sensor circuit Pt100

Sum of the maximum values:

3 $U_1 = 30$ $P_1 = 0.9$

The effective internal capacitances and inductances are negligibly small.

only for connection to a certified intrinsically safe circuit in type of protection "Intrinsic safety" Ex ia/fib IIC resp. Ex iaD/fibD maximum values: Signal circuit transmitter

Sensor supply with built-in suitably certified Transmitter (e. g. Ex-KTM-_A0, UTN-500-B__S, PTN-600-B__S):

 $\begin{array}{lll} U_1 &= 30 & V \\ I_1 &= 140 & \text{mA} \\ P_1 &= 0.9 & W \\ \end{array}$ The effective internal capacitances and inductances have to be taken from the regarding EC Type Examination

The power P_{max} (see tables) is the maximum value of the power converted in the sensor circuits Certificate.

(Pt100) $P_{max} = P_{i}$, a power reduction by the transmitter is not allowed to be taken into account.

BA 02 11.03

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P17-F-016 08-06



1. Supplement to Certificate No. TÜV 04ATEX 2430 X

irking			max, peri	nissible p the protect at pow	max. permissible process temperature on the protective tube [*C] at power P _{max}	mperature [°C]			Ambient temperature
level of protection la	90 Mm	100 Wm	163 mW	200 mW	500 mW	650 mW	750 mW	900 MM	range
D Ex iaD 20 T80 °C resp. G Ex ia IIC T6	58	52	44	40	4	-14	-26	Œ	
D Ex iaD 20 T95 °C resp. G Ex ia IIC T5	70	54	56	52	16	-2	-14	-32	
D Ex iaD 20 T130 *C resp. G Ex ia IIC T4	86	92	84	80	44	26	14	4	a some did a
D Ex iaD 20 T195 °C resp. G Ex ia IIC T3	150	144	136	132	96	78	99	48	900
D Ex iaD 20 T290 °C resp. G Ex ia IIC T2	226	220	212	208	172	154	142	124	
D Ex iaD 20 T440 °C resp. G Ex ia IIC T1	346	340	332	328	292	274	262	244	

Table 2

4 000									
Marking			max perr	nissible p the protect at pow	max, permissible process temperature on the protective tube [°C] at power P _{max}	nperature "C]			Ambient temperature
at level of protection ib	50 Wm	100 Wm	163 mW	200 mW	500 mW	650 mW	750 mW	900 MM	range
II 1/2 D Ex ibD 20/21 T80 °C resp. II 1/2 G Ex ib IIC T6	51	38	21	=	1	1	ı	1	
II 1/2 D Ex ibD 20/21 T95 "C resp. II 1/2 G Ex ib IIC T5	63	20	33	23	t	t	t	t	
II 1/2 D Ex ibD 20/21 T130 °C resp. II 1/2 G Ex ib IIC T4	16	78	61	51	-29	ı	1	t.	
II 1/2 D Ex lbD 20/21 T195 °C resp. II 1/2 G Ex lb IIC T3	143	130	113	103	24	-16	1	1	see manual
II 1/2 D Ex ibD 20/21 T290 °C resp. II 1/2 G Ex ib IIC T2	219	206	189	179	100	09	33	1.	
II 1/2 D Ex ibD 20/21 T440 °C resp.	339	326	309	299	220	180	153	114	

Manufacture			max per	nissible p	max, permissible process temperature	nperature			
Marking			5	at pow	at power Pmax	5			Ambient temperature
at level of protection ib	50 Wm	100 Wm	163 mW	200 mW	500 mW	650 mW	750 mW	900 MM	afigur
II 2 D Ex ibD 21 T80 °C resp. II 2 G Ex ib IIC T6	74	68	09	98	20	2	-10	-28	
II 2 D Ex ibD 21 T95 °C resp. II 2 G Ex ib IIC T5	88	83	75	71.	35	17	5	-13	
II 2 D Ex lbD 21 T130 °C resp. II 2 G Ex lb IIC T4	124	118	110	106	70	25	40	22	see manual
II 2 D Ex lbD 21 T195 *C resp.	189	183	175	171	135	117	105	87	
II 2 D Ex ibD 21 T290 °C resp. II 2 G Ex ib IIC T2	284	278	270	286	230	212	200	182	
II 2 D Ex lbD 21 T440 °C resp. II 2 G Ex lb IIC T1	434	428	420	416	380	362	350	332	

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1. Supplement to Certificate No. TÜV 04ATEX 2430 X

TUN NORD

Al other details remain unchanged for this supplement

The equipment according to this supplement meets the requirements of these standards:

IEC 60079-26:2006 EN 60079-26:2007 EN 60079-11:2007 EN 61241-11:2006 IEC 60079-11:2006 IEC 61241-11:2005 IEC 60079-0:2004 EN 60079-0:2006 EN 61241-0:2006 IEC 61241-0:2004

(16) The test documents are listed in the test report No. 10 203 555819.

(17) Special conditions for safe use

 The thermometer is not marked with the permissible medium temperature and ambient temperature. The appropriate designations have to be taken from this certificate resp. from the manual

At the housing made of plastic there is a danger of ignition by electrostatic discharges. The operator has to ascertain the suitability of this equipment for his use.

At the housing made of aluminium there is a danger of ignition by sparks caused by impact or friction. Operational friction or impacts with equipment parts made of iron/steel is not permitted. The operator has to ascertain the suitability of this equipment for his use.

transmitters is observed (e. g. by thermal insulation and/or an appropriate length of the neck tube). Restrictions by the temperature class and the category of the built in It has to be ensured, that the permissible ambient temperature range of the built in transmitters have to be observed (see manual) If mounted in the partition wall to the hazardous area for category 1 apparatus, the process connections have to be designed in such a way, that they are sufficiently tight according to EN 60079-26 section 4.6.

For applications, which require category 1/2 apparatus or category 1 apparatus, the process pressure and temperature range of the media has to be between 0.8 bar and 1.1 bar and between -20 °C and 60 °C. If the thermometer is operated beyond these atmospheric conditions, this approval serves as a a guide. Additional tests for the special application conditions are recommend. 9

The permissible operating pressures and temperatures have to be taken from the manual if no explosion hazardous gas mixtures exist.

(18) Essential Health and Safety Requirements

no additional ones

TÜV NORD CERT GmbH, Langemarckstraße 20, 45141 Essen, accredited by the central office of the countries for safety enjgingering (ZLS), Ident. Nr. 0044, legal successor of the TÜV NORD CERT GmbH & Co. KG Ident. Nr. 0032

The head of the certification body

Hanover office, Am TÜV 1, 30519 Hanover, Tel.: +49 (0) 511 986-1455, Fax: +49 (0) 511 986-1590

Operating-/Assembly Instructions KTR Kupplungstechnik GmbH D-48407 Rheine

RA 0025 - 0100 F ATEX-Version

Hints and Instructions Regarding the Use in (Ex) Hazardous Areas

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40110 EN 13 of 19 KTR-N sheet:

Operating-/Assembly Instructions

KTR Kupplungstechnik GmbH

D-48407 Rheine

Hints and Instructions Regarding the Use in

5.3 Checking of Torsional Backlash

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

Drive end

instructions that are usual for standard operation apply. During the standard operation which has to be subject to the analysis of danger of fightion the couplings are free from any giantion source. Meetly the temperature increase produced by proper heating and

or couplings which are classified in category 3G or 3D the operating and assembly

control intervals

Hazardous Areas

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5.2 Control Intervals for Couplings in

explosion group

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Turn the hub in opposite direction to the direction of drive

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

Mark sleeve and hub (see picture 13).

Turn the hub in the direction of drive and measure the torsional backlash ΔS_{max}

When reaching the torsional backlash ΔS_{mix} the nylon sleeve must be exchanged.

Driven end

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 not a considerable ward uning the first inspection, so that a change of the steeve would be recommended, please find out the cause according to the table "Breakdowns", as

you note an unconsiderable or no wear at the sleeve after this first inspection, the furthe

checking of the circumferential backlash and a visual check of the flexible sleeve must effected affer 3,000 operating hours for the first time, after 6 months at the latest. Except for centered, stiff connecting flanges (e. g. bellhousings).

for BoWex*: AT = 20 K (conductive sleeve "black")

depending on the coupling type has to be considered: for BoWex*: $\Delta T = 30 \text{ K}$ (standard sleeve, light')

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 direction of drive and measure the torsional backlash ΔS_{max}

When reaching the torsional backlash ΔS_{mix} the nylon sleeve must be exchanged

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 duffly the first inspection, so that a change of the sleeve would be recommended, please find out the cause according to the table "Breakdowns", as

The maintenance intervals must be adjusted according to the changed operating parameters.

far as possible.

II 2GD c IIC T4, T5, T6

BoWex[®] coupling

If you note an unconsiderable or no wear at the sleeve after this first inspection, the further

A checking of the circumferential backlash and a visual check of the flexible sleeve must 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).

The maintenance intervals must be adjusted according to the changed operating parameters.

far as possible.

II 2GD c IIB T4, T5, T6



picture 13: marking of the sleeve and the hub

ammin

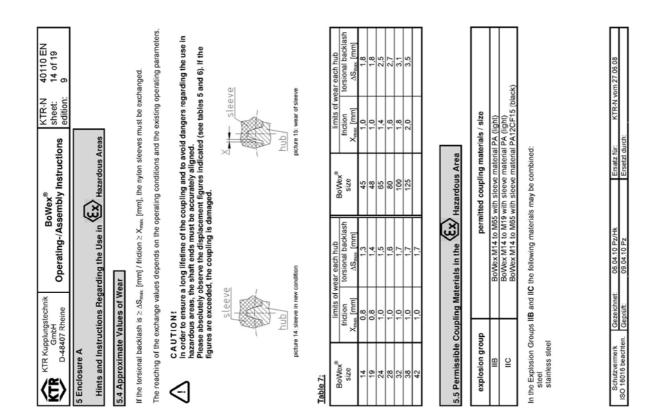
picture 12: BoWex[®] coupling

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 fiction wear may only be X_{max} of the original toothing strength before the nylon sleeves must be

When reaching the torsional backlash ΔS_{muc} , the nylon sleeve must be exchanged immediately, irrespective of the inspection intervals.

Schutzvermerk ISO 18016 beachten.

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Technichal Data

Ex-classification and motor connection parameters see nameplates

General technical data			RA 0025 F	RA 0040 F	RA 0063 F	RA0100 F
Nominal suction capacity	m³/h	50 Hz	25	40	63	100
		60 Hz	30	48	76	120
Suction capacity at 1 mbar	m³/h	50 Hz	23	35	40	60
		60 Hz	27	41	45	65
Ultimate pressure	hPa abs. (mbar abs)		0.1			
Nominal motor rating	kW	50 Hz	1.1	1.5	1.5	3.0
		60 Hz	1.1	1.5	2.2	3.0
Nominal speed	-1 min	50 Hz	1500			
		60 Hz	1800			
Sound pressure level (EN ISO 2151) db(A)		50 Hz	62	64	64	65
		60 Hz	64	67	66	68
A malais and design a graduate /	°C	with oil Busch VE 101	0 40 (RA 0100 F Agua: 0 30)			
Ambient temperature/ temperature of inlet gas		with oil Busch VSL 100	0 40 (RA 0100 F Agua: 0 30)			
		with oil Busch VM 100	12 30			
Oil quantity	1		1 2			
Weight	kg		~58	~64	~78	~91
Explosion protection data						
Shut-off temperature °C			130			
Current at shut-off temperature mA			17.867			

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