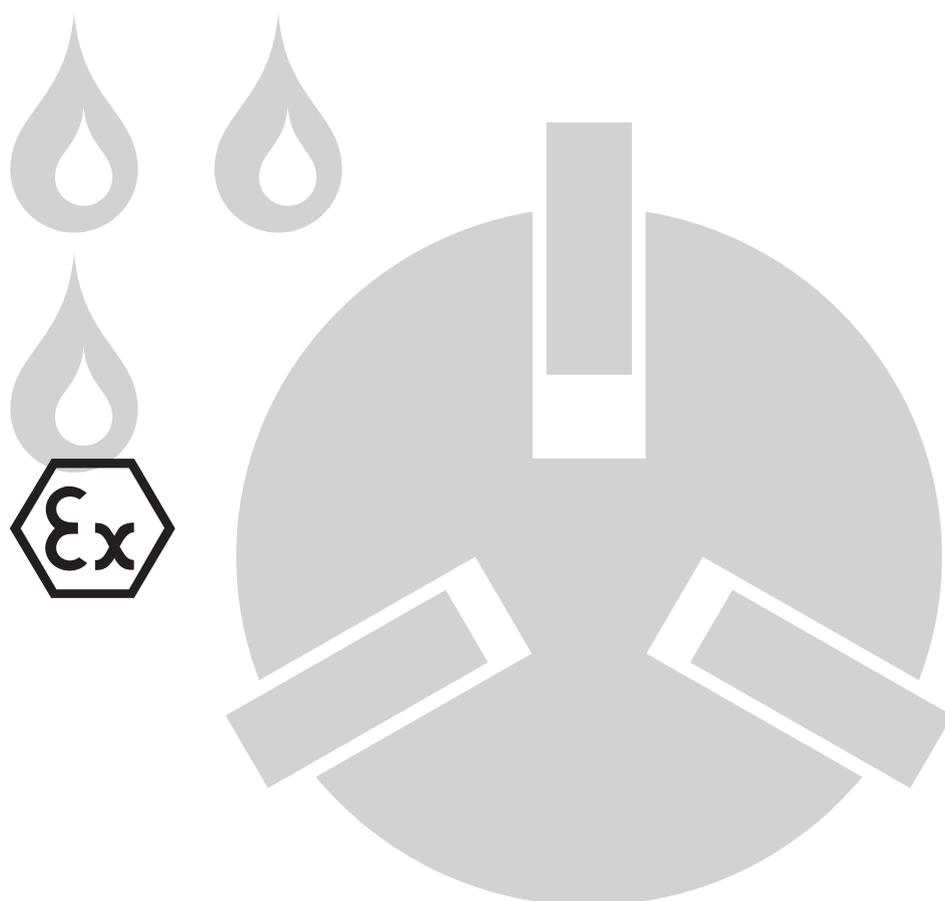


## Installation and Operating Instructions



Vacuum Pumps

RA/RC 0016 C

ATEX-Version Cat. 2 G



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# Preface

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

These operating instructions contain information for

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

of the vacuum pump.

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

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

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

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

## Equipment Documentation Measurement and Safety Instrumentation

Overview . . . . .	23
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## Busch – All over the World in Industry . . . . . 43



- a Directional arrow
- b Temperature measurement system
- c Oil drain plug
- d Terminal box
- e Oil fill plug
- f Oil sight glass
- g Nameplate
- h Gas discharge
- i Suction connection

## Product Description

### Use

The vacuum pump is intended for

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

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

Permissible temperature range of the inlet gas: see "Technical Data"

**According to the directive 94/9/EC ("ATEX 95") 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.**

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

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

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 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)):

#### **II 2 G IIB3 T4**

Group II, for non-mining applications, in the process gas and in the environment explosive atmosphere consisting of a mixture with air of flammable substances in the form of gas (in the environment also vapour or mist) likely to occur in normal operation occasionally (equipment category 2, for zone 1), for gases explosion group IIB3, temperature class T4. Not for potentially explosive dust/air atmospheres. Temperature monitoring is required (resistance thermometer and temperature-transmitter in standard scope of delivery).

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

Version with oil return line to the suction connection (RC 0016 C):

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

Version with oil return valve (RA 0016 C):

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

The vacuum pump is ultimate pressure proof.

**The approval for use in potentially explosive atmospheres is valid for the vacuum pump together with the described measurement and safety equipment. The approval is void if the system is altered or if the scheduled maintenance is not complied with. Maintenance must be performed by specifically instructed personnel only.**

## Safety Concept

The safety concept 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). 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 °C is exceeded.

## Operational Options / Use of Optionally Available Equipment

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

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

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

The return of separated oil from the oil separator into the suction connection (optional for version RA; required for continuous operation at intake pressures higher than 300 hPa/mbar abs) is permitted.

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 rotating vane principle.

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

The rotor 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 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 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 in-

side the vacuum pump (→ page 10: Conveying Condensable Vapours).

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

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

## 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 (e).

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

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

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

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

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 oil return line to the suction connection (RC 0016 C):

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

Version with oil return valve (RA 0016 C):

At continuous operation this would cause the entire supply of oil to accumulate at the bottom of the upper chamber, expel oil droplets through the gas discharge/pressure connection and let the vacuum pump run dry. Therefore the vacuum pump must be shut down at the latest after 10 hours of continuous operation, depending on the operating conditions even after a shorter period, for at least approx. 10 minutes (→ page 9: Operation Notes). After turning off the vacuum pump the pressure difference between the inside and the outside of the exhaust filter(s) (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 (e)
- the air flow from the fan wheel of the drive motor
- the process gas

## Start Controls

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

# Safety

## Intended Use

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

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

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

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

The maintenance instructions shall be observed.

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

## Safety Notes

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



### DANGER

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



### WARNING

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



### CAUTION

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

## Emission of Oil Mist

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



### CAUTION

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

Aspiration of process gas over extended periods can be harmful.

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

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

## Noise Emission

For the sound pressure level in free field according to EN ISO 2151 → page 42: 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

Vacuum pumps individually packed in cardboard boxes can be carried by hand.

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

Version without handle:

- ◆ Grasp the vacuum pump with both hands

Version with handle:

- ◆ Carry the vacuum pump using the handle



### 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 without ball-valve, with sinter metal filter:

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

## Conservation

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

During the test run in the factory the inside of the vacuum pump was completely wetted with oil. Under normal conditions a treatment with conservation oil is therefore not required. In case it is advisable to treat

the vacuum pump with conservation oil because of very adverse storage conditions, seek advice from your Busch representative!

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

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

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

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

For commissioning after conservation:

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

## Installation and Commissioning

### Installation Prerequisites



CAUTION

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

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

Risk of injury!

The installation prerequisites must be complied with.

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

### Mounting Position and Space

- Make sure that the following ambient conditions will be complied with:
  - ambient temperature: see "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
- Make sure that the installation space or location is vented such that a sufficient cooling of the vacuum pump is warranted



CAUTION

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

Risk of burns!

- Make sure that the vacuum pump will not be touched inadvertently during operation, provide a guard if appropriate
  - Make sure that the sight glass (j, 83) will remain easily accessible
- If the oil change is meant to be performed on location:
- ◆ Make sure that the drain port (i, 95) and the filling port (d, 88) will remain easily accessible
  - Make sure that enough space will remain for the removal and the reinsertion of the exhaust filter (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 (h) of the vacuum pump
- Make sure that the pipe will cause no stress on the vacuum pump's connection, if necessary use an expansion joint
- Make sure that the line size of the suction line over the entire length is at least as large as the suction connection (h) of the vacuum pump

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

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

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

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

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

- ◆ Provide a shut-off valve, a drip-leg and a drain cock in the suction line, so that condensates can be drained from the suction line

- Make sure that the suction line does not contain foreign objects, e.g. welding scales

## Gas Discharge

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



**WARNING**

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

Risk of explosion in the discharge area!

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



**CAUTION**

The discharged gas contains small quantities of vacuum oil.

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

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

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

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

- Make sure that the discharge line either slopes away from the vacuum pump or provide a liquid separator or a drip leg with a drain cock, so that no liquids can back up into the vacuum pump



**WARNING**

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

Static discharge can cause explosion of potentially existing oil mist.

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

## Electrical Connection / Controls

- Make sure that 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 22: note in the EC-Declaration of Conformity).
- Make sure that the power supply for the drive motor is compatible with the data on the nameplate of the drive motor
- Make sure that an overload protection according to EN 60204-1 is provided for the drive motor

- Make sure that the drive of the vacuum pump will not be affected by electric or electromagnetic disturbance from the mains; if necessary seek advice from the Busch service

In case of mobile installation:

- ◆ Provide the electrical connection with grommets that serve as strain-relief
- 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 23: Equipment Documentation Measurement and Safety Instrumentation)

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

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

## Installation

### Mounting

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

### Connecting Electrically



**WARNING**

Risk of electrical shock, risk of damage to equipment.

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

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

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



**CAUTION**

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

Risk of explosion!

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

Version with three-phase motor:

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

If the rotation must be changed:

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



## WARNING

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

Risk of explosion!

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

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

## Connecting Lines/Pipes

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

- ◆ Connect the suction line

- Connect the discharge line

Installation without discharge line:

- ◆ Make sure that the gas discharge (g) is open

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

## Filling Oil

In case the vacuum pump was treated with conservation oil:

- ◆ Drain the remainders of conservation oil



## CAUTION

The vacuum pump is shipped without oil.

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

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

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

- Keep approx. 0.4 litres oil acc. to the table Oil (→ page 21) ready

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



## CAUTION

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

Oil may be filled through the filling port (d, 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 (d, 88) is ejected.

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

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

- Remove the filling plug (d, 88)

- Fill in approx. 0.4 litres of oil
- Make sure that the level is between the MIN and the MAX-markings of the sight glass (j, 83)
- Make sure that the seal ring (89) is inserted into the filling plug (d, 88) and undamaged, replace if necessary
- Firmly reinsert the filling plug (d, 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 (h) with a piece of rubber mat

- Let the vacuum pump run for a few minutes

- Shut down the vacuum pump and wait a few minutes

- Check that the level is between the MIN and the MAX-markings of the sight glass (j, 83)

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

- ◆ Top-up oil

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

- ◆ Open the shut-off valve

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

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

## Checking the Function of the Measurement and Safety Instrumentation



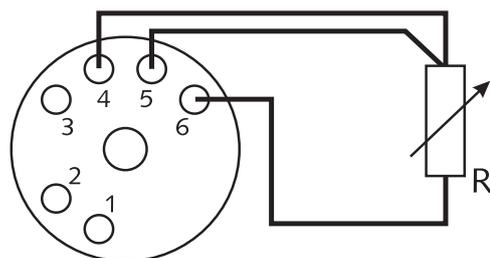
## WARNING

Risk of electrical shock, risk of damage to equipment.

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

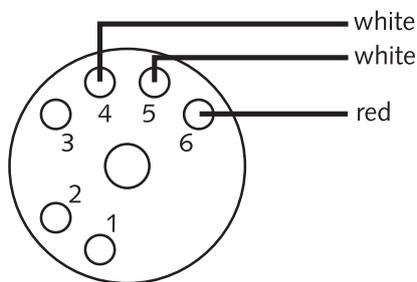
- IEC 364 or CENELEC HD 384 or DIN VDE 0100, respectively,
- IEC-Report 664 or DIN VDE 0110,
- BGV A2 (VBG 4) or corresponding national accident prevention regulation.

- 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
- 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 °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
- 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 with the lid
- In case the mounting of the temperature measurement system in the oil separator (e) has loosened:
- ◆ Open the lid of the temperature measurement system
  - ◆ Disconnect the supply voltage cables from the pins 1 and 2 of the temperature transmitter
  - ◆ Undo the temperature measurement system from the oil separator (e)
  - ◆ Thoroughly clean the threads on the temperature measurement system and on the oil separator (e) (oil and grease free)
  - ◆ Make sure that the counter nut is screwed onto the temperature measurement system
  - ◆ Apply threadlocker medium strength (e.g. LOCTITE 243) on the thread
  - ◆ Screw the temperature measurement system into the oil separator (e)
  - ◆ Orientate the temperature measurement system 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 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

## Operation Notes

### Use



**WARNING**

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

**In case of disregard risk of explosion!**

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



**WARNING**

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

**Risk of explosion!**

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

The vacuum pump is intended for

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

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

Permissible temperature range of the inlet gas: see “Technical Data”

**According to the directive 94/9/EC (“ATEX 95”) 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.**

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

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

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

⊕ II 2 G IIB3 T4

Group II, for non-mining applications, in the process gas and in the environment explosive atmosphere consisting of a mixture with air of flammable substances in the form of gas (in the environment also vapour or mist) likely to occur in normal operation occasionally (equipment category 2, for zone 1), for gases explosion group IIB3, temperature class T4. Not for potentially explosive dust/air atmospheres. Temperature monitoring is required (resistance thermometer and temperature-transmitter in standard scope of delivery).

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

Version with oil return line to the suction connection (RC 0016 C):

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

Version with oil return valve (RA 0016 C):

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

The vacuum pump is ultimate pressure proof.

**The approval for use in potentially explosive atmospheres is valid for the vacuum pump together with the described measurement and safety equipment. The approval is void if the system is altered or if the scheduled maintenance is not complied with. Maintenance must be performed by specifically instructed personnel only.**



CAUTION

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

Risk of burns!

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



CAUTION

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

Aspiration of process gas over extended periods can be harmful.

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

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

## Oil Return

Only for version with oil return valve (RA 0016 C):

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

At the latest after 10 hours of continuous operation, in case of high pressure difference between suction side and pressure side after a shorter period, the vacuum pump must be shut down for at least 10 minutes, so that the oil can run down from the upper chamber of the oil separator (e) 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.

- Close the shut-off valve in the suction line
- Operate the vacuum pump with the suction line shut off for approx. half an hour, so that the operating temperature rises to approx. 75 °C

At process start:

- Open the shut-off valve in the suction line

At the process end:

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

## Maintenance



WARNING

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

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



DANGER

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

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

**Danger to the environment.**

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

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



CAUTION

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

Risk of burns!

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

## Maintenance Schedule

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

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

**Daily:**

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

## Weekly:

- Check that the filling plug (d, 88) and the drain plug (i, 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 filter (120) (→ page 12: Exhaust Filter)
- Make sure that the vacuum pump is shut down and locked against inadvertent start up

In case an inlet air filter is installed:

- ◆ Check the inlet air filter, if necessary replace

In case of operation in a dusty environment:

- ◆ Clean as described under → page 11: Every 6 Months:

## Every 6 Months:

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

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

- Clean the fan cowling, the fan wheel, the ventilation grille and the cooling fins
- Check the electrical connection
- Make sure that the electrical connection of the temperature monitoring is undamaged

## Every Year:

- Make sure that the vacuum pump is shut down and locked against inadvertent start up
- Replace the exhaust filter (120) (→ page 12: Exhaust Filter)

In case an inlet air filter is installed:

- ◆ Replace the inlet air filter

- Check the inlet screen, clean if necessary

Version with gas ballast with sinter metal filter:

- ◆ Clean the sinter metal filter (compressed air)

- Check the function of the measurement and safety instrumentation (→ page 13: Functional Check of the Measurement and Safety Instrumentation)

## Every 500 - 2000 Operating Hours:

(→ page 11: Oil Life):

- Change the oil (→ page 12: Oil Change)

## 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 (e)
- Read the level on the sight glass (j, 83)

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

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

In case the level exceeds the MAX-marking:

- ◆ Excessive dilution with condensates - change the oil and check the process

- ◆ If appropriate retrofit a gas ballast (Busch Service) and observe the chapter Conveying Condensable Vapours (→ page 10)

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

- ◆ Clean the sinter metal filter (compressed air)

## Topping up Oil

**Note:** Under normal conditions there should be no need to top up oil during the recommended oil change intervals. A significant level drop indicates a malfunction (→ page 16: Troubleshooting).

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



### CAUTION

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

Oil may be filled through the filling port (d, 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 (d, 88) is ejected.

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

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

- Make sure that the vacuum pump is shut down and locked against inadvertent start up
- Remove the filling plug (d, 88)
- Top up oil until the level reaches the middle of the sight glass (j, 83)
- Make sure that the seal ring (89) is inserted into the filling plug (d, 88) and undamaged, replace if necessary
- Firmly reinsert the filling plug (d, 88) together with the seal ring (89)

## Checking the Colour of the Oil

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

In case of burnt oil:

- ◆ Check the function of the temperature monitoring (→ page 13: Functional Check of the Measurement and Safety Instrumentation)

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

- ◆ Clean the sinter metal filter (compressed air)

## Oil Life

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

Under very unfavourable operating conditions the oil life can be less than 500 operating hours. Extremely short life times indicate malfunctions (→ page 16: Troubleshooting) or unsuitable operating conditions, though.

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

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

## Oil Change



**DANGER**

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

**Danger to health during the changing of contaminated oil.**

**Danger to the environment.**

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

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

## Draining Used Oil

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

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

When the oil stream dwindles:

- Reinsert the drain plug (i, 95)
- 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 (i, 95) again and drain the remaining oil
- Make sure that the seal ring (96) is inserted into the drain plug (i, 95) and undamaged, replace if necessary
- Firmly reinsert the drain plug (i, 95) together with the seal ring (96)
- Dispose of the used oil in compliance with applicable regulations

## Flushing the Vacuum Pump



**WARNING**

**Degraded oil can choke pipes and coolers.**

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

**Risk of explosion due to overheating.**

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

- Make sure that all the used oil is drained
- Create 0.4 litres flushing agent from 50 percent oil and 50 percent paraffin or diesel fuel/fuel oil
- Make sure that the drain plug (i, 95) is firmly inserted
- Remove the filling plug (d, 88)
- Fill in the flushing agent

- Firmly reinsert the filling plug (d, 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.

## Filling in Fresh Oil

- Keep 0.4 litres oil acc. to the table Oil (→ page 21) ready

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

- Make sure that the drain plug (i, 95) is firmly inserted



**CAUTION**

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

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

- Remove the filling plug (d, 88)
- Fill in approx. 0.4 litres of oil
- Make sure that the level is between the MIN and the MAX-markings of the sight glass (j, 83)
- Make sure that the seal ring (89) is inserted into the filling plug (d, 88) and undamaged, replace if necessary
- Firmly reinsert the filling plug (d, 88) together with the seal ring (89)

## Exhaust Filter

### Checks during Operation

- 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 (RA 0016 C):

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

- Check that the discharged gas is free from oil

### Assessment

If

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

then the exhaust filter (120) is clogged and must be replaced.

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

If

the drive motor draws less current than usual,

then the exhaust filter (120) is broken through and must be replaced.

If the discharged gas contains oil,

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

## Change of the Exhaust Filter



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

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

Danger to the environment.

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

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



The filter spring (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 Filter

- Make sure that the vacuum pump is shut down and locked against inadvertent start up
- Prior to disconnecting pipes/lines make sure that the connected pipes/lines are vented to atmospheric pressure
- Remove the discharge line, if necessary
- Remove the exhaust cover (g) from the oil separator (e)
- Loosen the screw in the centre of the exhaust filter retaining spring (125), but do not remove it at this time
- Press the exhaust filter retaining spring (125) out of the indent and rotate it
- Remove the exhaust filter retaining spring (125) from the oil separator (e)
- Pull the exhaust filter (120) out of the oil separator (e)

### Inserting the Exhaust Filter

- Make sure that the new exhaust filter (120) is equipped with a new o-ring
- Insert the exhaust filter (120) such that its port is properly seated in its receptacle in the oil separator (e)
- Make sure that the tip of the screw in the centre of the exhaust filter retaining spring (125) protrudes the retaining spring by about 2 - 5 revolutions
- Insert the exhaust filter retaining spring (125) such that its ends are secured in their receptacles in the oil separator (e) by the protrusions and that the tip of the screw snaps into the indent of the exhaust filter (120)
- Tighten the screw in the exhaust filter retaining spring (125) such that the screw head touches the spring steel sheet
- 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 (e)
- If necessary connect the discharge line

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

## Functional Check of the Measurement and Safety Instrumentation

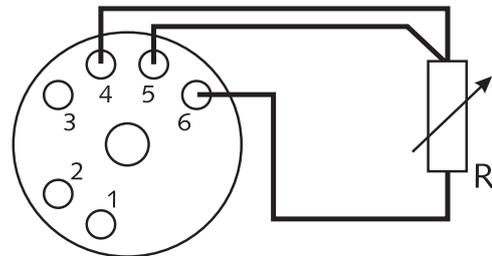


Risk of electrical shock, risk of damage to equipment.

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

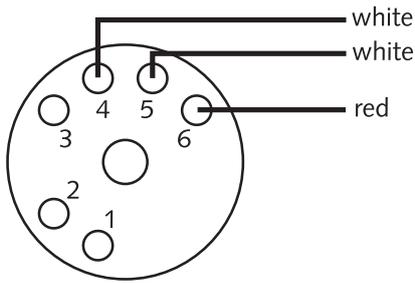
- IEC 364 or CENELEC HD 384 or DIN VDE 0100, respectively,
- IEC-Report 664 or DIN VDE 0110,
- BGV A2 (VBG 4) or corresponding national accident prevention regulation.

- 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
- 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  $\Omega$
- 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  $\Omega$  (equivalent to 130.5  $^{\circ}\text{C}$ )
- 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  $\Omega$
- 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 with the lid  
In case the mounting of the temperature measurement system in the oil separator (e) has loosened:

- ◆ Open the lid of the temperature measurement system
- ◆ Disconnect the supply voltage cables from the pins 1 and 2 of the temperature transmitter
- ◆ Undo the temperature measurement system from the oil separator (e)
- ◆ Thoroughly clean the threads on the temperature measurement system and on the oil separator (e) (oil and grease free)
- ◆ Make sure that the counter nut is screwed onto the temperature measurement system
- ◆ Apply threadlocker medium strength (e.g. LOCTITE 243) on the thread
- ◆ Screw the temperature measurement system into the oil separator (e)
- ◆ Orientate the temperature measurement system 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 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.**



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

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

Danger to health during dismantling of the vacuum pump.

Danger to the environment.

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

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

## Removal from Service

### Temporary Removal from Service

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

### Recommissioning



**CAUTION**

Vanes can stick after a long period of standstill.

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

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

After longer periods of standstill:

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

If deposits could have gathered in the vacuum pump:

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

## Dismantling and Disposal



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

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

Danger to health during dismantling of the vacuum pump.

Danger to the environment.

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

The vacuum pump must be decontaminated prior to disposal.

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



CAUTION

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



CAUTION

The filter spring (125) can fly out of the exhaust port during removal.

Risk of eye injury.

Eye protection goggles must be worn while handling filter springs.

- Remove the exhaust filter (120) (→ page 12: Exhaust Filter)
- Drain the oil
- Make sure that materials and components to be treated as special waste have been separated from the vacuum pump
- Make sure that the vacuum pump is not contaminated with harmful foreign material

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

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

# Troubleshooting



**WARNING**

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

The vacuum pump must only be operated in faultless condition.

Risk of explosion in case of operation of faulty equipment!

A faulty vacuum pump must immediately be removed from service.

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



**WARNING**

Risk of electrical shock, risk of damage to equipment.

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

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



**CAUTION**

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

Risk of burns!

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

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

	An/The exhaust valve 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)
	Internal parts are worn or damaged	Repair the vacuum pump (Busch service)
	Version with oil return line to the suction connection (RC 0016 C): The oil return line starts in an area vented to atmospheric pressure. Particularly on small model pumps, a fairly large amount of air is sucked through the oil return line, which may prevent the ultimate pressure from reaching 20 bar abs. In order to exclude this possible cause: squirt oil through the gas discharge (g)	
The gas conveyed by the vacuum pump smells displeasing	Process components evaporating under vacuum Readily volatile and thus gaseous components of the oil, e.g. additives, particularly right after an oil change. <b>Note:</b> This is no indication of a malfunction of the oil separator. The oil separator is able to retain droplets of oil, however no gaseous components of it.	Check the process, if applicable Use a different type of oil, if applicable
The vacuum pump does not start	The drive motor is not supplied with the correct voltage or is overloaded	Supply the drive motor with the correct voltage
	The drive motor starter overload protection is too small or trip level is too low	Compare the trip level of the drive motor starter overload protection with the data on the nameplate, correct if necessary
	One of the fuses has blown	Check the fuses
	Version with alternating current motor: The drive motor capacitor is defective	Repair the drive (Busch service)
	The connection cable is too small or too long causing a voltage drop at the vacuum pump	Use sufficiently dimensioned cable
	The vacuum pump or the drive motor is blocked	Make sure the drive motor is disconnected from the power supply Remove the fan cover Try to turn the drive motor with the vacuum pump by hand If the vacuum pump is blocked: Repair the vacuum pump (Busch service)
	The drive motor is defective	Replace the drive motor (Busch service) (in order not to compromise the explosion safety of the vacuum pump the coupling must be adjusted and measured according to a precisely defined procedure; therefore the motor must be mounted by the Busch service only)
The vacuum pump is blocked	Solid foreign matter has entered the vacuum pump	Repair the vacuum pump (Busch service) Make sure the suction line is equipped with a screen If necessary additionally provide a filter
	Corrosion in the vacuum pump from remaining condensate	Repair the vacuum pump (Busch service) Check the process Observe the chapter Conveying Condensable Vapours (→ page 10)

	<p>Version with three-phase motor: The vacuum pump was run in the wrong direction</p>	<p>Repair the vacuum pump (Busch service) When connecting the vacuum pump make sure the vacuum pump will run in the correct direction (→ page 7: Installation)</p>
	<p>After shutting down the vacuum pump the vacuum system exerted underpressure onto the pump chamber which sucked back excessive oil from the oil separator into the pump chamber When the vacuum pump was restarted too much oil was enclosed between the vanes Oil could not be compressed and thus broke a vane</p>	<p>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</p>
	<p>After shutting down the vacuum pump condensate ran into the pump chamber When the vacuum pump was restarted too much condensate was enclosed between the vanes Condensate could not be compressed and thus broke a vane</p>	<p>Repair the vacuum pump (Busch service) Make sure no condensate will enter the vacuum pump, if necessary provide a drip leg and a drain cock Drain condensate regularly</p>
<p>The drive motor is running, but the vacuum pump stands still</p>	<p>The coupling between the drive motor and the vacuum pump is defective</p>	<p>Replace the coupling element (in order not to compromise the explosion safety of the vacuum pump the coupling must be adjusted and measured according to a precisely defined procedure; therefore the coupling element must be replaced by the Busch service only)</p>
<p>The vacuum pump starts, but labours or runs noisily or rattles The drive motor draws a too high current (compare with initial value after commissioning)</p>	<p>Loose connection(s) in the drive motor terminal box Version with three-phase-motor: Not all drive motor coils are properly connected The drive motor operates on two phases only</p>	<p>Check the proper connection of the wires against the connection diagram Tighten or replace loose connections</p>
	<p>Version with three-phase motor: The vacuum pump runs in the wrong direction</p>	<p>Verification and rectification → page 6: Installation and Commissioning</p>
	<p>Standstill over several weeks or months</p>	<p>Let the vacuum pump run warm with inlet closed</p>
	<p>Improper oil quantity, unsuitable oil type</p>	<p>Use the proper quantity of one of the recommended oils (→ page 21: Oil change: → page 10: Maintenance)</p>
	<p>No oil change over extended period of time</p>	<p>Perform oil change incl. flushing (→ page 10: Maintenance)</p>
	<p>The exhaust filter (120) is clogged and appears black from burnt oil</p>	<p>Flush the vacuum pump Replace the exhaust filter (120) Fill in new oil (→ page 10: Maintenance) In case the oil life is too short: use oil with better heat resistance (→ page 21: Oil) or retrofit cooling</p>
	<p>Foreign objects in the vacuum pump Broken vanes Stuck bearings</p>	<p>Repair the vacuum pump (Busch service)</p>
<p>The vacuum pump runs very noisily</p>	<p>Defective bearings</p>	<p>Repair the vacuum pump (Busch service)</p>

	Worn coupling element	Replace the coupling element (in order not to compromise the explosion safety of the vacuum pump the coupling must be adjusted and measured according to a precisely defined procedure. Therefore the coupling element must be replaced by Busch service only)
	Stuck vanes	Repair the vacuum pump (Busch service) Use only approved oils (→ page 21: Oil) and change more frequently
There is an indication on the control panel / in the control room that the temperature monitoring has tripped (permissible temperature at the outlet of the stage has been exceeded) The vacuum pump is shut down	Insufficient air ventilation	Make sure that the cooling of the vacuum pump is not impeded by dust/dirt Clean the fan cowling, the fan wheel, the ventilation grille and the cooling fins Install the vacuum pump in a narrow space only if sufficient ventilation is ensured On a vacuum pump with oil-cooler: clean the intermediate spaces of the finned tube
	Ambient temperature too high	Observe the permitted ambient temperatures
	Temperature of the inlet gas too high	Observe the permitted temperatures for the inlet gas
	The exhaust filter (120) is partially clogged	Replace the exhaust filter (120)
	Not enough oil in the reservoir	Top up oil
	Oil burnt from overheating	Flush the vacuum pump Replace the exhaust filter (120) Fill in new oil (→ page 10: Maintenance) In case the oil life is too short: use oil with better heat resistance (→ page 21: Oil) or retrofit cooling
	Mains frequency or voltage outside tolerance range	Provide a more stable power supply
	Partial clogging of filters or screens Partial clogging in the suction, discharge or pressure line	Remove the clogging
	Long suction, discharge or pressure line with too small diameter	Use larger diameter
	The vacuum pump fumes or expels oil droplets through the gas discharge The oil level drops	The exhaust filter (120) is not properly seated
The o-ring is missing or damaged		Add or replace resp. the o-ring (→ page 10: Maintenance)
The exhaust filter (120) shows cracks		Replace the exhaust filter (120) (→ page 10: Maintenance)
The exhaust filter (120) is clogged with foreign matter <b>Note:</b> The saturation of the exhaust filter with oil is no fault and does not impair the function of the exhaust filter! Oil dropping down from the exhaust filter is returned to the oil circulation.		Replace the exhaust filter (120) (→ page 10: Maintenance)
Version with oil return valve (RA 0016 C): In case the vacuum pump runs for more than 10 hours without interruption, oil can collect in the upper chamber of the oil separator (e) to an extent that it gets expelled together with the discharged gas		Regularly shut down the vacuum pump for short periods of time. Check that the oil return valve functions properly and lets oil run from the upper into the bottom chamber of the oil separator (e) as soon as the vacuum pump is shut down (→ page 4: Oil Circulation)

	<p>Version with oil return valve (RA 0016 C):</p> <p>The oil return valve does not work properly or is clogged (proper function is when blowing into the valve it should close, when vacuum is applied, the valve should open; CAUTION: do not let your mouth get in direct contact with the oil return valve, do not inhale through the oil return valve!)</p>	Clean or replace the oil return valve
	The oil return line is clogged or broken	Repair the oil tubing (Busch service)
The oil is black	<p>Oil change intervals are too long</p> <p>The oil was overheated</p>	<p>Flush the vacuum pump</p> <p>Replace the exhaust filter (120)</p> <p>Fill in new oil</p> <p>(→ page 10: Maintenance)</p> <p>In case the oil life is too short: use oil with better heat resistance (→ page 21: Oil) or retrofit cooling</p>
The oil is watery and coloured white	<p>The vacuum pump aspirated water or significant amounts of humidity</p> <p>Version with gas ballast:</p> <p>The filter of the gas ballast is clogged</p>	<p>Flush the vacuum pump</p> <p>Replace the exhaust filter (120)</p> <p>Fill in new oil</p> <p>(→ page 10: Maintenance)</p> <p>Modify the operational mode (→ page 10: Operating Notes → Conveying Condensable Vapours)</p> <p>Version with gas ballast with sinter metal filter:</p> <p>Clean the sinter metal filter (compressed air)</p>
The oil is resinous and/or sticky	<p>Improper oil type, perhaps in confusion</p> <p>Topping up of incompatible oil</p>	<p>Flush the vacuum pump</p> <p>Replace the exhaust filter (120)</p> <p>Fill in new oil</p> <p>(→ page 10: Maintenance)</p> <p>Make sure the proper oil is used for changing and topping up</p>
The oil foams	Mixing of incompatible oils	<p>Flush the vacuum pump</p> <p>Replace the exhaust filter (120)</p> <p>Fill in new oil</p> <p>(→ page 10: Maintenance)</p> <p>Make sure the proper oil is used for topping up</p>

## Spare Parts

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

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

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

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

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

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

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

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

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

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

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

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

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

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

Find the list of Busch companies all over the world (by the time of the publication of these installation and operating instructions) on → page 43 (rear cover page).

Find the up-to-date list of Busch companies and agencies all over the world on the internet at [www.busch-vacuum.com](http://www.busch-vacuum.com).

Pos.	Part	Qty	Part no.
83	Sight glass with seal ring	1	0583 521 760
84	O-ring for sight glas	1	0486 000 633
88	Plug	1	0416 000 105
89	O-ring	1	0486 000 633
95	Plug	1	0416 000 130
96	O-ring	1	0486 000 504
120	Exhaust filter with o-ring	1	0532 141 264

125	Filter spring	1	0947 000 719
141	Gasket	1	0480 000 103

## Oil

Denomination	VM 068	VSL 068
ISO-VG	68	68
Base	Mineral oil	PAO
Density [g/cm <sup>3</sup> ]	0.884	0.83
Ambient temperature range [°C]	5 ... 30	5 ... 40
Kinematic viscosity at 40 °C [mm <sup>2</sup> /s]	68	68
Kinematic viscosity at 100 °C [mm <sup>2</sup> /s]	8.5	10
Flashpoint [°C]	235	240
Pourpoint [°C]	-15	-55
Part no. 1 l packaging	0831 102 492	0831 131 846
Part no. 5 l packaging	0831 102 493	0831 131 847
Remark		Food applications (NSF H1)
Filling quantity, approx. [l]	0.4	

# EC-Declaration of Conformity

**Note:** This Declaration of Conformity and the **CE**-mark affixed to the nameplate are valid for the vacuum pump within the Busch-scope of delivery. When this vacuum pump is integrated into a superordinate machinery the manufacturer of the superordinate machinery (this can be the operating company, too) must conduct the conformity assessment process acc. to the Directive Machinery 2006/42/EC for the superordinate machine, issue the Declaration of Conformity for it and affix the **CE**-mark.

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

We

**Busch Produktions GmbH**  
**Schauinslandstr. 1**  
**79689 Maulburg**  
**Germany**

declare that vacuum pumps **RA/RC 0016 C ATEX-Version Cat. 2 G**

documentation no.: T611139599

audit: **CE**0637

in accordance with the European Directives:

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

have been designed and manufactured to the following specifications:

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

Manufacturer   <b>Dr.-Ing. Karl Busch</b> General director	Person authorised to compile the technical file   <b>Andrej Riwe</b> Technical writer
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# Equipment Documentation Measurement and Safety Instrumentation

## Overview

Type/Marking	Temperature measurement system, consisting of: Resistance thermometer Pt-100: PTX-12BynS5WM-0065-0015 or PTX-12BynS5WM-0140-0015 (depending on the design of the oil separator) Temperature transmitter: Ex KTM CAO	
<p>Brief description:</p> <p>Resistance thermometer with integrated temperature transmitter</p> <p>Temperature resistor with 3-wire connection.</p> <p>Temperature transmitter with 2-wire electronics for signal 4 ... 20 mA.</p> <p>Connection of supply voltage to pins 1 (positive pole) and 2 (negative pole).</p>		
<p>The diagram illustrates a 4...20 mA current loop. On the left, a power source (battery) is connected to pins 1 and 2 of a 6-pin terminal block. Pin 1 is the positive pole and pin 2 is the negative pole. The current flows from pin 1 through a resistor to pin 2. On the right, a transmitter is connected to pins 3 and 6. The transmitter is connected to a sensor (resistance thermometer) which is connected to pins 4, 5, and 6. The sensor has a 3-wire connection. The wires are labeled 'white' and 'red'. The current flows from pin 4 through the sensor to pin 5, and from pin 5 through the sensor to pin 6. The transmitter is connected to pins 3 and 6, and the current flows from pin 6 through the transmitter to pin 3, and from pin 3 through the transmitter to pin 6.</p>		
Technical data	→ Installation and Operating Instructions BA0207 and BA0404 (→ pages 24 ff.)	
Interface	2 clamps for cross section max. 1.75 mm <sup>2</sup> . 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 °C	17.867 mA
Upper measurement range limit	150 °C	20 mA
Sensor breakage	-	21.7 mA

# Temperature head transmitter

for 2-wire or 3-wire resistor PT-100, fix adjusted measurement range  
2-wire electronic 4...20 mA with PNP-switching output or 3-wire electronic 0...10V

KTM



BA0207

Installation and operating instructions

Page 1 of 2

- + fix adjusted measurement range
- + temperature measurement range  $-100^{\circ}\text{C}$  to  $+600^{\circ}\text{C}$
- + 2-wire-electronic with signal 4...20mA  
with free adjustable PNP-switching output
- + 3-wire-electronic with signal 0...10V
- + 12 different standard measurement ranges or  
adjustment by customer specification
- + for 2- or 3-wire-PT100
- + failure signal at sensor breakage or short circuit
- + polarity protected
- + Ex approval ATEX
- + connection head (form B) or field housing
- + everlasting screws
- + maintenance free



## Application:

The temperature head transmitter, for connection to an temperature dependent resistance PT-100 is a temperature converter for measuring and monitoring temperatures in a range from  $-100^{\circ}\text{C}$  to  $+600^{\circ}\text{C}$  with a measurement span between 20 Kelvin and 700 Kelvin.

Because of the implemented PNP-switching output in the 2-wire device (4...20 mA), separate evaluation devices are not necessary in many cases.

## Function:

The temperature head transmitter KTM can be installed in a connection head (form B) or in a field housing.

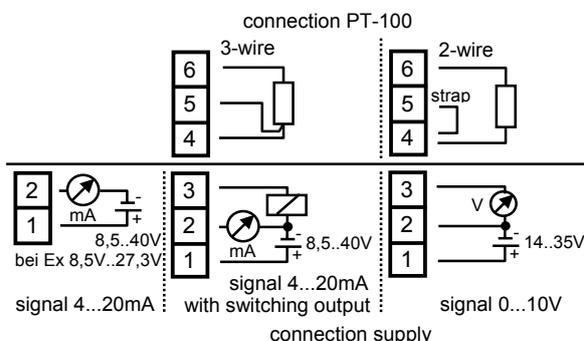
A constant current from an integrated current source is impressed about a 2- or 3-wire PT-100 resistance that is installed in a sensor

This current leads to an voltage drop about the PT-100, that becomes higher or lower, dependent on the measured medium temperature.

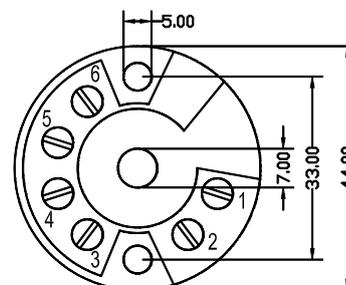
The produced resistance proportional voltage signal is measured by the transmitter and is then linearized and converted into an constant current signal 4...20mA or a constant voltage signal 0...10V. The measured voltage signal of the PT-100 is supervised and in the case of sensor breakage a failure information is produced on to the 4...20mA or 0...10V output signal. The output signal rises in that case to 21,7 mA or 10,85 V. At a sensor short circuit the signal goes to 3,55 mA resp. 0 V.

In the temperature head transmitter in 2-wire-technic with 4...20 mA, an overload and short circuit protected PNP-switching output in working current principle is integrated, that can be freely adjusted by an multi-turn potentiometer.

## Electrical connection



## Dimensions (in mm)



housing height: 21 mm

ACS-CONTROL-SYSTEM GmbH  
Lauterbachstraße 57 – 84307 Eggenfelden  
Tel: +49 8721/9668-0 – Fax: +49 8721/9668-30  
[info@acs-controlsystem.de](mailto:info@acs-controlsystem.de) – [www.acs-controlsystem.de](http://www.acs-controlsystem.de)

Seite 1 von 2

**ACS-CONTROL-SYSTEM**  
know how mit system



# Temperature head transmitter

for 2-wire or 3-wire resistor PT-100, fix adjusted measurement range  
2-wire electronic 4...20 mA with PNP-switching output or 3-wire electronic 0...10V

KTM



**Electrical data:**

Standard measurement ranges: 0...+50°C, 0...+100°C, 0...+150°C, 0...+200°C, 0...+250°C, 0...300°C, 0...+400°C, 0...+500°C, 0...+600°C, -40...+60°C, -50...+100°C, -100...+50°C, or adjustment by customer specification in the range of -100...+600°C with an measurement span from 20 to 700 Kelvin

Output variants \_A0 or \_AS: 4...20mA → temperatur linear from 3,55...20,7 mA, at sensor breakage 21,7 mA, at sensor short circuit 3,55 mA permitted load see scheme

Output variant \_B0: 0...10 V → temperature linear from 0 V...10,35 V, at sensor breakage 10,85 V, at sensor short circuit 0 V permitted load ≥ 2500 Ω at 10 V, equals 4 mA, current limited

Permitted supply voltage: variants \_A0 or \_AS → +8,5 V to 40 V DC (max. 50 V DC), polarity protected variant \_B0 → +14 V to 35 V DC, polarity protected

Ripple voltage: ≤ 2 V<sub>pp</sub> (condition: within the permitted supply voltage range), f<sub>max</sub> = 1 kHz

Temperature deviation: ≤ 0,1% / 10 K of nominal measurement range

Characteristic deviation: ≤ 0,1% of nominal measurement range

Calibration deviation: ≤ 0,1% of nominal measurement range

Long term drift: ≤ 0,05% / year of nominal measurement range

Influence of supply voltage: ≤ 0,02% / 10 V of nominal measurement range

Influence of load: ≤ 0,02% / 100 Ω of nominal measurement range

Delay time output: ≤ 2 ms

Connectable sensor: PT-100 in 2- or 3-wire connection

PT-100 wire resistance: max. 15 Ω each wire

EMC specifications: emission appropriate EN 50081-1 imission appropriate EN 50082-2

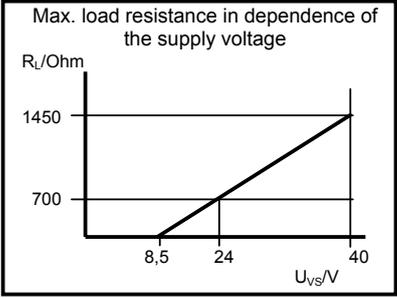
**Switching output:** (variant \_AS) PNP-switching to +V<sub>s</sub>, V<sub>OUT</sub> ≥ +V<sub>s</sub> - 1,5 V

Output current: ≥ 200 mA, current limited, short circuit protected

Rising time: < 700 μs with R<sub>L</sub> < 3 kΩ or I<sub>L</sub> > 4,5 mA

Adjustment: by multi-turn-potentiometer

Function: working current principle (n.o.)



**Mechanical data:**

Protection: IP00 / IP66 if installed in connection head housing or field housing with corresponding protection

Material connection head housing: PC

Connection clamps: line cross cut max. 1,75 mm<sup>2</sup>, screws everlasting

Weight: 40 g

Operation temperature: -40°C...+85°C

Storage temperature: -40°C...+100°C

Dewing: permitted

**Assembly, electrical installation and inauguration, maintenance:**

Assembly, electrical installation, inauguration, operation and maintenance of the device must be carried out by an qualified employee. The electrical installation of the device must be carried out according to the respective country specific standards. An incorrect assembly or adjustment could cause applicationally conditioned risks. The device is maintenance free. The voltage applied to the clamps may not exceed 50 V at devices of the variants \_A0 or \_AS and 35 V at devices of the variants \_B0 to avoid damage of the electronic. All connections are polarity protected. Use only shielded signal and measurement wires and install these wires separated from power leading wires. Connect the shield only at one side to earth, ideally at the installation place of the device. If inductive loads, e.g. relays are connected to the PNP output, an RC protection circuit must be used to avoid high voltage peaks, because they could influence the properly function of the device

**Safety notes:**

If a device of the variant Ex KTM\_A0 is installed and operated in a hazardous area, the general Ex construction standards (EN60079-14, VDE0165), this safety notes and the enclosed EC conformity certificate must be observed. The assembly of an Ex system must be carried out principally by specialist staff. The devices meets **II 1 G EEx ia IIC T4** T<sub>a</sub> = -20°C...+60°C, **pressure from 0,8 bar to 1,1 bar (atmospherically conditions) or II 2 (1) G EEx ia IIC T4 or II 2 G EEx ib IIC T4** T<sub>a</sub> = -40°C...+85°C U<sub>i</sub> = 27,3 V / I<sub>i</sub> = 140 mA / P<sub>i</sub> = 0,9 W

The devices are conceived for measurement of temperatures in hazardous areas. The measured medium may also be combustible liquids, gases, fogs or steams. A warning marking points out to the dangers through electrostatic charging of the plastic housing and to the safety measures, that must be applied because of this dangers in operation mode and especially in the case of maintenance activities. avoid friction don't clean dry don't assemble in pneumatic conveying stream

**Approval:**  
KTM standard  
Ex KTM II 1 G EEx ia IIC T4 for Ex-Zone 0 appropriate ATEX100a (only available for variant Ex KTM \_A0)

**Measurement temperature range:**

A	range	0°C to +50,0°C	J	range	0°C to +500,0°C
B	range	0°C to +100,0°C	L	range	0°C to +600,0°C
C	range	0°C to +150,0°C	Q	range	-40°C to +60,0°C
E	range	0°C to +200,0°C	O	range	-50°C to +100,0°C
F	range	0°C to +250,0°C	N	range	-100°C to +50,0°C
G	range	0°C to +300,0°C	Y	adjustment by customer specification (note range!!!)	
H	range	0°C to +400,0°C			

**Transmitter electronic:**

A0	4...20 mA	2-wire-electronic
AS	4...20 mA	2-wire-electronic with PNP-switching output
B0	0...10 V	3-wire-electronic

CE 0032



Translation

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

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



(3) EC-Type Examination Certificate Number

**TÜV 02 ATEX 1924 X**

(4) Equipment: Temperature Head Transmitter type ExKTM\_A0

(5) Manufacturer: ACS CONTROL SYSTEM GmbH

(6) Address: Lauterbachstraße 57  
D-84307 Eggenfelden

(7) This equipment or protective system and any acceptable variation thereto are specified in the schedule to this certificate and the documents therein referred to.

(8) 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, 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 examination and test results are recorded in the confidential report N° 02YEX187208.

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

**EN 50 014: 1997**

**EN 50 020: 1994**

**EN 50284: 1999**

(10) 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.

(11) This EC-type examination certificate relates only to the design, examination and tests of the specified equipment in accordance to the Directive 94/9/EC. Further requirements of the Directive apply to the manufacturing process and supply of this equipment. These are not covered by this certificate.

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



**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  
TÜV CERT-Certification Body  
Am TÜV 1  
D-30519 Hannover  
Tel.: 0511 986-1470  
Fax: 0511 986-2555

Hanover, 2002-09-30

Head of the  
Certification Body



**TÜV NORD CERT**

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TÜV CERT A4 04.02 10.000 L6

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(13)

## SCHEDULE

(14) **EC-TYPE EXAMINATION CERTIFICATE N° TÜV 02 ATEX 1924 X**

(15) Description of equipment

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.

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 taken from the following table:

Device category	Category of the intrinsically safe circuits	$T_a$
1	ia	-20°C ... +60°C
2(1)	ia	-40°C ... +85°C
2	ib	-40°C ... +85°C

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 ia IIC  
resp. EEx ib IIC  
only for the connection of a certified intrinsically safe circuit  
Maximum values:  
 $U_i = 27.3 \text{ V}$   
 $I_i = 140 \text{ mA}$   
 $P_i = 0.9 \text{ W}$   
effective internal capacitance: 4 nF  
effective internal inductance: 110  $\mu\text{H}$



Sensor circuit ..... in type of protection Intrinsic Safety EEx ia IIC  
(Terminals 4, 5, 6) resp. EEx ib IIC

only for the connection of a Pt100 sensor

Maximum values:

$U_o = 5.9 \text{ V}$

$I_o = 35 \text{ mA}$

$R = 756 \text{ } \Omega$

$P_o = 163 \text{ mW}$

Characteristic line: trapezoidal

EEx ia/ib	IIC	IIB
maximum external inductance	1 mH	2 mH
maximum external capacitance	1.7 $\mu$ F	7.6 $\mu$ F

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

(17) Special conditions for safe use

1. 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.
2. 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

# Resistance thermometer Pt-100

with and without neck tube, with changeable measuring insert  
with terminals or built in Pt-100 transmitter Pt-100

PTX 

BA0404

Installation and operating instructions

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- + Various process connections
- + Length of sensor and neck tube is freely selectable
- + Surface roughness  $R_a < 0,8\mu\text{m}$
- + Reduced protection tube tip for faster reaction time
- + Connection housing in steel, aluminum or plastic POM or PP
- + Protection type IP 67
- + Changeable measuring insert
- + Accuracy classes A, B, 1/3 DIN B or 1/5 DIN B
- + Measurement range standard  $-50^\circ\text{C}...+400^\circ\text{C}$   
or extended  $-200^\circ\text{C}...+600^\circ\text{C}$
- + Single Pt-100 with 2-, 3- or 4-wire-connection
- + Dual Pt-100 with 2-wire-connection  
for redundancy measurement
- + Clamp socket or built in Pt-100-transmitter
- + Certification ATEX II 1 G D EEx ia T6...T1



## Application:

The resistance thermometer PTX is used for measurement of temperatures in all areas, where explosive gas / air or dust / air atmospheres can occur.

This concerns application fields of chemical and energy industry as well as many other general application areas of industry.

## Function:

The resistance thermometer PTX can be mounted into pipes, containers or other facility parts by using various process connections.

The protection tube of the resistance thermometer is the junction point to the measured medium.

By using a neck tube with the corresponding length at high medium temperatures, the temperature in the area of the connection housing can be kept in the range of the permitted environmental temperature.

For highly vibration loaded operation areas a neck tube with a greater outside diameter can be used.

The connection housing is used for the connection of the temperature measuring resistances Pt-100 to an evaluation electronic and is suitable for building-in of a head transmitter that is constructed for form B.

Inside the resistance thermometer the measuring insert is placed. This measuring insert represents the real temperature sensor. In the built-in condition the tip of the measuring insert is pressed against the end of the protection tube and guarantees by that the optimum heat transfer.

Inside the measuring insert tip the one or two temperature measuring resistors Pt-100 are integrated.

At the end of the measuring insert tube a mounting plate is fixed, by which the measuring insert can be fastened inside the device or on that an optional transmitter or terminal socket is or can be fixed.

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# Resistance thermometer Pt-100

with and without neck tube, with changeable measuring insert  
with terminals or built in Pt-100 transmitter Pt-100



BA0404

Installation and operating instructions

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## Common basics for thermometer with resistor Pt-100

The temperature measuring sensor of resistance thermometers Pt-100 consists of an electrical resistor in the material platinum (element symbol Pt), whose resistance value is ideally 100Ω at a temperature of 0°C.

This results according to the norm DIN EN 60751 in the expression „Pt-100“.

The resistance value increases at higher temperatures corresponding to a resistor material characteristic coefficient and decreases correspondingly at lower temperatures.

For industrial thermometers that meets the standard DIN EN 60751, the ideal resistance values of a resistor Pt-100 can be calculated according to the following equation:

### Temperature range from T = -200°C...0°C

$$R_T = 1000 \times [1 + (3.90802 \times 10^{-3} \times T) - (0.5802 \times 10^{-6} \times T^2) - (4.27350 \times 10^{-12} \times (T - 100) \times T^3)]$$

### Temperature range from T = 0°C...+600°C

$$R_T = 1000 \times [1 + (3.90802 \times 10^{-3} \times T) - (0.5802 \times 10^{-6} \times T^2)]$$

In the equation the term  $R_T$  describes the resistance in Ω of an ideal Pt-100 at the temperature T in °C

### Measurement accuracy - tolerances

Different committed accuracy sortings are available for temperature resistors Pt-100.

The accuracy sortings defines at first the maximum permitted temperature deviation against 0°C, when the temperature resistor Pt-100 shows a resistance of 100Ω.

At second in addition the maximum permitted temperature deviation from the calculated value at an arbitrary from 100Ω varying resistance value is determined.

Class A →	0°C - deviation:	+/- 0,15 Kelvin
	end point deviation:	+/- (0,15 Kelvin + 0,002 Kelvin per Kelvin ΔT against 0°C)
Class B →	0°C - deviation:	+/- 0,30 Kelvin
	end point deviation:	+/- (0,30 Kelvin + 0,005 Kelvin per Kelvin ΔT against 0°C)
Class 1/3 DIN B →	0°C - deviation:	+/- 0,10 Kelvin
	end point deviation:	+/- (0,10 Kelvin + 0,005 Kelvin per Kelvin ΔT against 0°C)
Class 1/5 DIN B →	0°C - deviation:	+/- 0,06 Kelvin
	end point deviation:	+/- (0,06 Kelvin + 0,005 Kelvin per Kelvin ΔT against 0°C)

### Measurement methods – measurement error

For capturing the resistor value of the Pt-100 usually a constant current in the range from 0,1mA to 6mA is impressed. This current produces a voltage drop over the resistor, that can be measured by an evaluation electronic.

The impressed constant current however causes because of the self-heating through the current flow in the resistor Pt-100 an increasing of the temperature that distort the measurement result. 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 em-irradiation 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 Pt-100 leads can cause an error source that may not be neglected. The constant current produces in the resistance of the leads a voltage drop and according to the requirements of the measurement it must be tried to neutralize this measurement error. Using a Pt-100 in 3-wire or 4-wire technique it is possible to eliminate the influence of the lead resistance, if a suitable evaluation electronic is connected.

### Measurement range

The measurement range of the temperature that should be recorded depends very much on the construction of the device. This concerns the construction of the resistor Pt-100 as well as the used isolation material of the leads.

For standard applications mostly Pt-100 resistors in thin-film-technique are used.

Those measurement range is limited to temperatures from -50°C to +400°C.

For higher measurement range requirements usually wire-wound Pt-100 resistors are used.

Those measurement range is limited to temperatures from -200°C to +600°C.

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# Resistance thermometer Pt-100

with and without neck tube, with changeable measuring insert  
with terminals or built in Pt-100 transmitter Pt-100



BA0404

Installation and operating instructions

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## Construction of the resistance thermometer PTX

The resistance thermometer **PTX** consists on a measuring insert with a protection tube and a connection housing. The protection tube is fixed at the process connection. Process connection and connection housing can be separated from each other by a neck tube. At the measuring insert a temperature transmitter or a connection socket can be mounted.

### Protection tube

the protection tube is the separation point between medium and measuring insert.

Outside diameter: 8 mm, 10 mm, 12 mm, others on inquiry  
Reduced tip: diameter 8 mm, length 40 mm (only for protection tube with diameter 10 mm or 12 mm)  
Material: steel 1.4571, wall thickness  $\geq 1$  mm, other materials on inquiry  
Length: free selectable  
Surface quality: surface roughness  $R_a < 0,8\mu\text{m}$

### Process connection

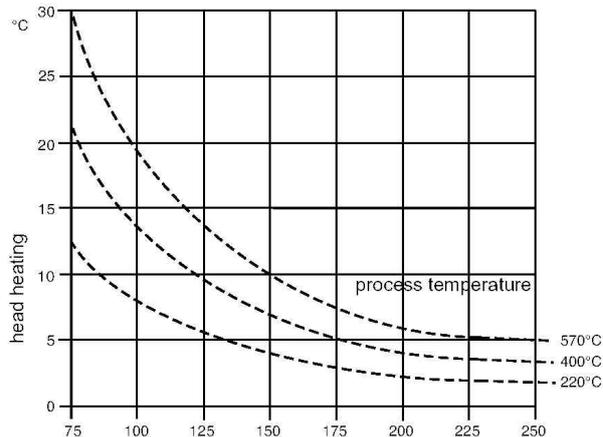
the process connection facilitates the connection of the resistance thermometer Pt-100 to the facility part, that contains the medium that should be measured.

Variants: screw in thread G 1/2" or G 1", DIN-flange DN 25 or DN 50, without process connection  
others on inquiry  
Material: steel 1.4404, other materials on inquiry

### Neck tube

the neck tube is used to decouple the temperatures between medium and connection housing in order to reduce the temperature at the connection housing.

Outside diameter: 10 mm, on inquiry also 16 mm (at strong vibrations of the application system)  
Length: free selectable



The length of the neck tube can affect the temperature inside the connection housing (see scheme beside). This temperature must be kept inside the permitted environmental temperature of the connection housing. For specifying the permitted environmental temperature in the area of the connection housing when using a transmitter that is built into the connection housing the permitted environmental temperature of the transmitter must also be observed.

For the available standard ACS transmitter (Ex KTM\_A0 resp. UTN-500 resp. PTN-600) this temperature is between -40...+85°C. The graphic besides is only a approximately guide, because the real heating of the connection housing depends on various additionally factors (e.g. pipe isolation, position, neck tube thickness, etc.).

### Connection housing

the connection housing connects the temperature measurement resistor resp. resistors Pt-100 with a post-connected evaluation electronic.

Material: steel 1.4404, lacquered aluminum, plastic POM or PP, others on inquiry  
In areas with explosive dust / air – mixtures only the connection housings steel or lacquered aluminum are permitted.

Protection type: IP67 (connection sensor to connection housing / connection housing / cable gland)  
Connection cable: The built-in cable gland is suitable for the installation of cables with a diameter between 3 and 7 mm.

Interior: suitable for the installation of connection sockets or transmitters that are suitable for installing into housings of form B according to DIN 43729.

Environmental temperature: material steel and lacquered aluminum → -40°C...+130°C  
material POM → -25°C...+100°C  
material PP → -15°C...+100°C

### Measuring insert

the measuring insert represents the real temperature sensor. The sensor element Pt-100 is placed in the tip of the measuring insert.

Material: steel 1.4571  
Outside diameter: 5 mm  
Length: is determined by protection tube length, process connection and neck tube length  
Dielectric strength: Pt-100 against measuring insert tube resp. Pt-100 against Pt-100:  $\geq 500$  V ac  
Sensor element: thin-film - Pt-100 or wire-wound Pt-100  
2-wire- resp. 3-wire- resp. 4-wire-connection  
single or dual Pt-100 (dual Pt-100 only as thin-film resp. with 2-wire-connection)

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# Resistance thermometer Pt-100

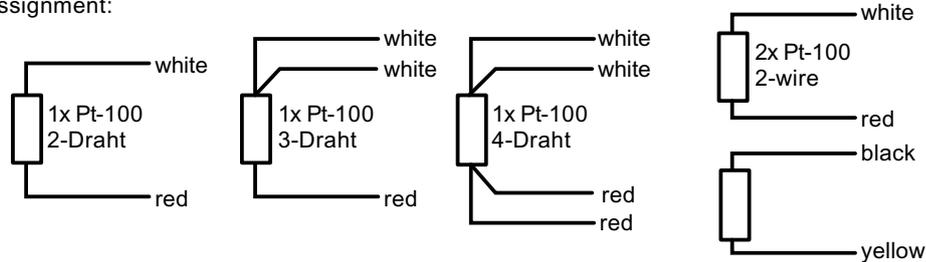
with and without neck tube, with changeable measuring insert  
with terminals or built in Pt-100 transmitter Pt-100



## Electrical connection of the resistance thermometer PTX

The resistance thermometer PTX can be equipped with various connection variants.

- Loose wires, for connection of own transmitters for housings form B according to DIN 43729 with the following color assignment:



- Connection socket, for connection of external transmitter (e.g. Ex WTA-100-G0), see color assignment above.
- Installed transmitter, that captures the resistance of the temperature dependent Pt-100 sensor element and conditions it for further processing. The two transmitter Ex KTM-\_A0 resp. UTN-500-B \_\_\_S produces a standard current signal of 4...20 mA in two-wire-technique. The transmitter Ex KTM-\_A0 is a fix set 2-/3-wire- Pt-100 transmitter, where the desired measurement range is set by factory and can not be changed by the user. At the 2-/3-/4-wire- transmitter UTN-500-B \_\_\_S however the user can set the measurement range using a PC and the setup program GM-500 by himself. The 2-/3-/4-wire- transmitter PTN-600-B \_\_\_S is a device with Profibus-PA® - interface, for supply and digital communication by Profibus-PA®. Additionally supplementary informations for the mentioned transmitter can be found in the corresponding installation and operating instructions, safety notes and EC conformity certificates.

## Accessories – sliding sleeve

**Sliding sleeves with press ring in steel 1.4571, resistant to pressure up to 20 bar**

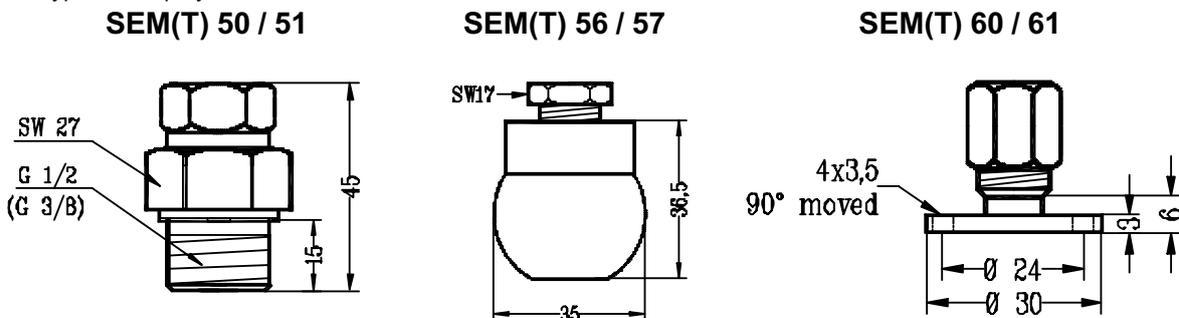
Type	Process connection
SEM-50	G 1/2" for sensor diameter 8 mm
SEM-51	G 1/2" for sensor diameter 10 mm
SEM-56	ball weld sleeve for sensor diameter 8 mm
SEM-57	ball weld sleeve for sensor diameter 10 mm
SEM-60	screw sleeve for sensor diameter 8 mm
SEM-61	screw sleeve for sensor diameter 10 mm

other types on inquiry

**Sliding sleeves with press ring in PTFE (Teflon), adjustable, not pressure tight**

Type	Process connection
SEMT-50	G 1/2" for sensor diameter 8 mm
SEMT-51	G 1/2" for sensor diameter 10 mm
SEMT-56	ball weld sleeve for sensor diameter 8 mm
SEMT-57	ball weld sleeve for sensor diameter 10 mm
SEMT-60	screw sleeve for sensor diameter 8 mm
SEMT-61	screw sleeve for sensor diameter 10 mm

other types on inquiry



# Resistance thermometer Pt-100

with and without neck tube, with changeable measuring insert  
with terminals or built in Pt-100 transmitter Pt-100



BA0404

Installation and operating instructions

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## Assembly, electrical installation and inauguration, maintenance:

Assembly, electrical installation, inauguration, operation and maintenance of the device must be carried out by a qualified employee. The electrical installation of the device must be carried out according to the respective country specific standards. An incorrect assembly or adjustment could cause applicationally conditioned risks. The device is maintenance free.

The materials for protection tube, process connection, neck tube and connection housing must be selected corresponding to the respective operating conditions (medium, temperature). An unsuitable material can cause damage, abnormal behaviour or destruction of the device and from that it can lead to resulting danger.

Use only shielded signal and measurement wires and install these wires separated from power leading wires. Connect the shield only at one side to earth.

After connecting the cable the cable gland and the connection housing cover must be fixed screwed on to achieve the tightness IP67 of the housing.

The device meets the legal requirements of all relevant EC-guidelines. 0032



## Safety notes:

If a device is installed and operated in a hazardous area, the general Ex construction standards (EN60079-14, VDE0165), this safety notes and the enclosed EC conformity certificate must be observed. The installation and operation instructions, safety notes and EC conformity certificate of a built-in transmitter must also be observed. The assembly of an Ex system must be carried out principally by specialist staff.

Classification: **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 or**  
**II 1 G EEx ia IIC T6...T1 resp. II 1/2 G EEx ib IIC T6...T1 resp. II 2 G EEx ib IIC T6...T1**

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

The devices are conceived for measurement of temperatures in explosive endangered areas, that requires devices of category 1. The measured medium may also be combustible liquids, gases, fogs, steams or dusts.

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

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 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 guide. Additional tests for the special application conditions are recommend.

In areas with explosive dust-air-atmosphere that requires devices of category 1/2 or category 2 the permitted environmental temperature in the area of the connection housing in steel or aluminum is between -20°C...+80°C.

In areas with explosive gas-air-atmosphere the permitted environmental temperature in the area of the connection housing in steel, aluminum or POM is between -20°C...+100°C, resp. in the area of the connection housing in PP -15°C...+100°C. For specifying the permitted environmental temperature in the area of the connection housing when using a transmitter that is built into the connection housing the permitted environmental temperature of the transmitter must also be observed.

In explosive endangered areas dust-air-atmosphere only the connection housing in steel or aluminum are permitted

A built-in transmitter must be certified for EEx ia IIC T4 or T5 or T6. For applications in zone 1 resp. 21 the certification EEx ib IIC T4 or T5 or T6 is also sufficient. The installation of a transmitter with lower temperature class reduces the temperature class of the whole device.

For the application in explosive endangered areas with dust-air-atmosphere only the transmitter ExKTM-\_A0 or another therefore specially proofed device is permitted. The maximum surface temperature of the built-in transmitter Ex-KTM-\_A0 is around 15K higher than the environmental temperature of the transmitter.

This results e.g. in T55 at T<sub>a</sub> = 40°C, T75 at T<sub>a</sub> = 60°C and T95 at T<sub>a</sub> = 80°C in the area of the transmitter ExKTM-\_A0.

For PROFIBUS® transmitter, where the electrical output values in direction measuring insert are defined, the determined input values for U<sub>i</sub>, I<sub>i</sub> and P<sub>i</sub>, that are described 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 mounted in the partition wall to the hazardous area that requires devices of category 1, the process connections have to be designed in such a way, that they are sufficiently tight according to EN 50284 section 4.5.

At the connection housing in aluminum there is a danger of ignition by sparks caused by impact or friction. The operator has to ascertain the suitability of this device for his use.

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

avoid friction

no dry cleaning

no assembling in pneumatic conveying stream

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# Resistance thermometer Pt-100

with and without neck tube, with changeable measuring insert  
with terminals or built in Pt-100 transmitter Pt-100



**Certificate**

- 1 ATEX II 1 G EEx ia IIC T6...T1                      for Ex-zone 0
- 2 ATEX II 1 G D EEx ia IIC T6...T1 T85°C...450°C                      for Ex-zone 0 resp. 20    for transmitter → only Ex KTM\_A0

**Sensor type**

- 1 1x Pt-100                      2-wire-connection
- 2 1x Pt-100                      3-wire-connection
- 3 1x Pt-100                      4-wire-connection
- 4 2x Pt-100                      2-wire-connection

**Accuracy class**

- B Class B                      -50°C...+400°C
- A Class A                      -50°C...+400°C
- C 1/3 DIN B                      -50°C...+400°C
- D 1/5 DIN B                      -50°C...+400°C
- S special variant                      (e.g. high temperature variant -200...+600°C, not for 2x Pt-100)

**Process connection**

- 1 G 1/2"                      screw in thread
- 2 G 1"                      screw in thread
- E DN 25                      flange
- F DN 50                      flange
- 0 without connection for sliding sleeve
- S special variant

**Material / sensor diameter → process side**

- N steel 1.4571 / 8mm
- L steel 1.4571 / 10mm
- W steel 1.4571 / 12mm
- A steel 1.4571 / 10mm, reduced tip 8mm, length 40mm
- B steel 1.4571 / 12mm, reduced tip 8mm, length 40mm
- S special variant

**Neck tube**                      diameter 10mm; for strong vibrations also 16mm → note especially

- A without neck tube
- B with neck tube, L=100mm                      not for process connection „without connection“
- S with neck tube, L free selectable in mm                      not for process connection „without connection“

**Connection housing**

- B form large, PP                      -25...+100°C    not for ATEX II 1 G D EEx
- 2 form large, POM (delrin)                      -15...+100°C    not for ATEX II 1 G D EEx
- 4 form large, aluminum                      -40...+130°C
- 5 form large, steel 1.4404                      -40...+130°C
- S special variant

**Measuring insert**

- W changeable measuring insert

**Connection type**

- K connection socket                      -40...+85°C when using an transmitter
- M transmitter Ex KTM\_A0                      4...20mA, fix set    → note measurement range
- X transmitter Ex UTN-500                      4...20mA, free programmable
- T transmitter Ex PTN-600                      Profibus-PA
- D loose wires                      for self installation of transmitters
- S special variant

**Length L1 - sensor - in mm**

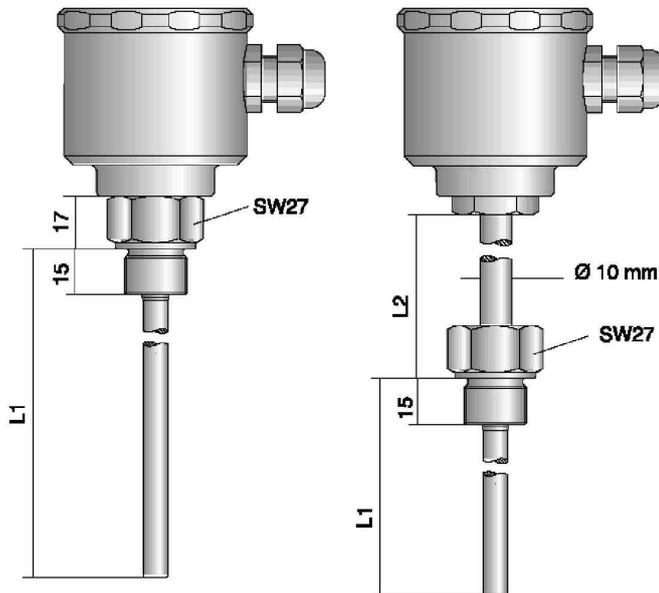
**Length L2 – neck tube - in mm**



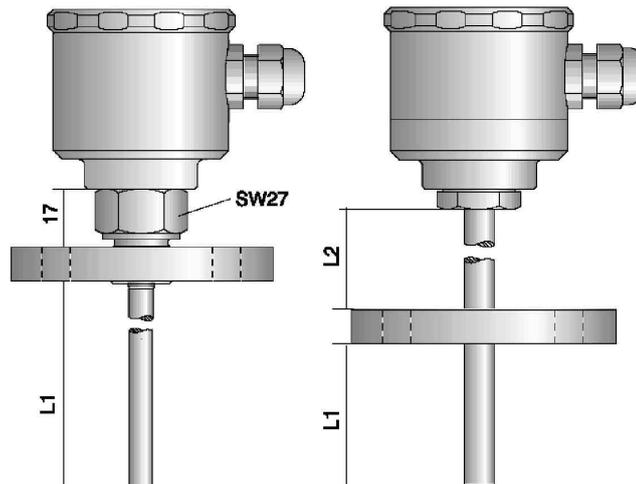
**Resistance thermometer Pt-100**  
 with and without neck tube, with changeable measuring insert  
 with terminals or built in Pt-100 transmitter Pt-100



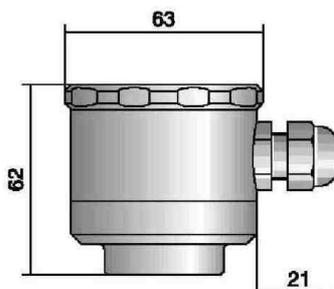
Process connection screw in thread G1/2" resp. 1"  
 without neck tube      with neck tube



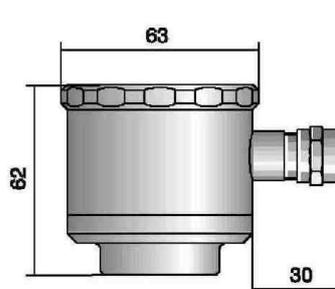
Process connection flange DN 25 resp. DN 50  
 without neck tube      with neck tube



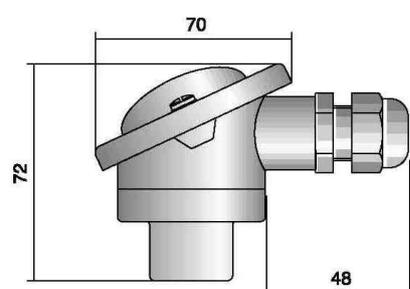
connection housing  
 POM, PP



connection housing  
 steel 1.4404



connection housing  
 aluminum





Translation

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

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



(3) EC-Type Examination Certificate Number

**TÜV 04 ATEX 2430 X**

(4) Equipment: Resistance thermometer type PTX

(5) Manufacturer: ACS CONTROL SYSTEM GmbH

(6) Address: Lauterbachstraße 57  
D-84307 Eggenfelden

(7) This equipment or protective system and any acceptable variation thereto is specified in the schedule to this certificate and the documents therein referred to.

(8) 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, 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 examination and test results are recorded in the confidential report N° 04YEX551171.

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

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

(10) 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.

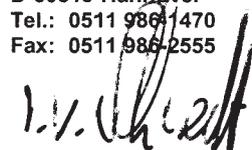
(11) This EC-type examination certificate relates only to the design, examination and tests of the specified equipment in accordance to the Directive 94/9/EC. Further requirements of the Directive apply to the manufacturing process and supply of this equipment. These are not covered by this certificate.

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

 **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**

TÜV NORD CERT GmbH & Co. KG  
TÜV CERT-Certification Body  
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D-30519 Hannover  
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Hanover, 2004-04-02

  
Head of the  
Certification Body



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(13)

## SCHEDULE

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

(15) Description of equipment

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  $\geq 1\text{mm}$ ) 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 thermal/electrical data and categories mentioned below.

### Electrical data

Sensor supply without built in transmitter:

Sensor circuit Pt100 ..... in type of protection „Intrinsic safety“ EEx ia IIC  
resp. EEx ib IIC

Sum of the maximum values:

$$U_i = 30 \text{ V}$$

$$P_i = 0,9 \text{ W}$$

The effective internal capacitances and inductances are negligibly small.

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

Signal circuit transmitter ..... in type of protection „Intrinsic safety“ EEx ia IIC  
resp. EEx ib IIC

only for connection to a certified intrinsically safe circuit  
maximum values:

$$U_i = 30 \text{ V}$$

$$I_i = 140 \text{ mA}$$

$$P_i = 0,9 \text{ W}$$

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

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

Table 1

Marking	max. permissible process temperature on the protective tube [°C] at power $P_{max}$								Ambient temperature range
	50 mW	100 mW	163 mW	200 mW	500 mW	650 mW	750 mW	900 mW	
at level of protection ia									
II 1 GD EEx ia IIC T80 °C IP65 resp. II 1 G EEx ia IIC T6	58	52	44	40	4	-14	-26	--	-20°C ... 60 °C housing made of POM: -15°C. ... +60°C
II 1 GD EEx ia IIC T95 °C C IP65 resp. II 1 G EEx ia IIC T5	70	64	56	52	16	-2	-14	-32	
II 1 GD EEx ia IIC T130 °C IP65 resp. II 1 G EEx ia IIC T4	98	92	84	80	44	26	14	-4	
II 1 GD EEx ia IIC T195 °C IP65 resp. II 1 G EEx ia IIC T3	150	144	136	132	96	78	66	48	
II 1 GD EEx ia IIC T290 °C IP65 resp. II 1 G EEx ia IIC T2	226	220	212	208	172	154	142	124	
II 1 GD EEx ia IIC T440 °C IP65 resp. II 1 G EEx ia IIC T1	346	340	332	328	292	274	262	244	

Table 2

Marking	max. permissible process temperature on the protective tube [°C] at power $P_{max}$								Ambient temperature range
	50 mW	100 mW	163 mW	200 mW	500 mW	650 mW	750 mW	900 mW	
at level of protection ib									
II 1/2 GD EEx ib IIC T80 °C IP65 resp. II 1/2 G EEx ib IIC T6	51	38	21	11	--	--	--	--	see manual
II 1/2 GD EEx ib IIC T95 °C IP65 resp. II 1/2 G EEx ib IIC T5	63	50	33	23	--	--	--	--	
II 1/2 GD EEx ib IIC T130 °C IP65 resp. II 1/2 G EEx ib IIC T4	91	78	61	51	-29	--	--	--	
II 1/2 GD EEx ib IIC T195 °C IP65 resp. II 1/2 G EEx ib IIC T3	143	130	113	103	24	-16	--	--	
II 1/2 GD EEx ib IIC T290 °C IP65 resp. II 1/2 G EEx ib IIC T2	219	206	189	179	100	60	33	-7	
II 1/2 GD EEx ib IIC T440 °C IP65 resp. II 1/2 G EEx ib IIC T1	339	326	309	299	220	180	153	114	

**Table 3**

Marking	max. permissible process temperature on the protective tube [°C] at power P <sub>max</sub>								Ambient temperature range
	50 mW	100 mW	163 mW	200 mW	500 mW	650 mW	750 mW	900 mW	
II 2 GD EEx ib IIC T80 °C IP65 resp. II 2 G EEx ib IIC T6	74	68	60	56	20	2	-10	-28	see manual
II 2 GD EEx ib IIC T95 °C IP65 resp. II 2 G EEx ib IIC T5	89	83	75	71	35	17	5	-13	
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	
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	

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.

(17) Special conditions for safe use

1. 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.
2. 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.
3. 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 use.
4. It has to be ensured, that the permissible ambient temperature range of the built in transmitters is observed (e. g. by thermal 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).
5. 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 .
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 guide. Additional tests for the special application conditions are recommend.
7. 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

# Technical Data

For motor connection parameters see nameplate

General technical data			RA/RC 0016 C
Nominal suction capacity	m <sup>3</sup> /h	50 Hz	16
		60 Hz	19
Ultimate pressure	hPa abs. (mbar abs)	RA 0016 C (with oil return valve)	0.5
		RC 0016 C (with oil return line to suction connection)	20
Nominal motor rating	kW	50 Hz	0.55
		60 Hz	0.75
Nominal speed	min <sup>-1</sup>	50 Hz	1500
		60 Hz	1800
Sound pressure level (EN ISO 2151)	db(A)	50 Hz	53
		60 Hz	55
Ambient temperature/ temperature of inlet gas	° C	with oil Busch VM 068	5 ... 30
		with oil Busch VSL 068	5 ... 40
Oil quantity	l		0.4
Weight	kg		~20
<b>Explosion protection data (version  II 2G IIB3 T4)</b>			
Category w.r.t. process gas (i)			2
Category w.r.t. environment (o)			2
Explosion group			IIB3
Temperature class w.r.t. process gas (i)			T4
Temperature class w.r.t. environment (o)			T4*
Shut-off temperature	° C		130
Current at shut-off temperature	mA		17.867

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