Installation and Operating Instructions

Compressors
Mink MM 1202, 1252, 1322 AP

gas tight, temperature monitored

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Preface

Congratulations on your purchase of the Busch compressor. 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 compressor.

For the purpose of these instructions, “handling” the compressor means the transport, storage, installation, commissioning, influence on operating conditions, maintenance, troubleshooting and overhaul of the compressor.

Prior to handling the compressor 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.
Product Description

Use

The compressor is intended for

- the compression
  of
  - air and other dry, non-aggressive, non-toxic and non-explosive gases

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

Max. allowed temperature of the inlet gas: 40 °C

The compressor is equipped with pressure relief lines between the pump stage and the gas inlet (c). The pressure relief lines and shaft seal rings safeguard that no process gases will escape into the environment of the compressor.

The proper function of the compressor requires ambient pressure ±200* hPa (=mbar) to be present at the gas inlet (c) at any operating point.

*a*unless specified otherwise on the nameplate of the compressor

Standard-version:

The gas shall be free from vapours that would condensate under the temperature and pressure conditions inside the compressor.

Version “Aqua”:

The compressor features the corrosion protection coating CPC and is capable of conveying water vapour (page 9: Conveying Condensable Vapours). Conveyance of other vapours shall be agreed upon with Busch. Conveyance of water or other liquids in liquid phase increases the power consumption and shall therefore be avoided (risk of drive overload).

The compressor is intended for the placement in a non-potentially explosive environment.

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

Max. permissible number of startings per hour: 12

The maximum allowed pressure on the pressure connection (q) is 0.4 ... 2.0 barg (the nameplate of the compressor indicates the valid
By means of process control and/or pressure relief valves it must be made sure that the maximum allowed pressure will not be exceeded.

The safety valve (o) on the compressor protects the compressor against overload only. It is no pressure limiting device in terms of EN 1012-1 for the pressure system. It is not designed for frequent use and must therefore not be used as a system pressure regulating valve.

Note: The safety valve (o) routes compressed product gas back to the gas inlet (c). This will increase the gas inlet temperature. In case of continuous operation of the safety valve the temperature monitoring will therefore shut down the compressor.

The temperature measurement system must be integrated into the system control such that operation of the compressor will safely be inhibited if the shutdown temperature (see nameplate) is exceeded.

**Principle of Operation**

The compressor works on the claw principle.

The components are dimensioned such, that on the one hand there is never contact between the two claws or between a claw and the cylinder, on the other hand the gaps are small enough to keep the clearance loss between the chambers low.

In order to avoid the suction of solids, the compressor is equipped with a screen in the gas inlet.

In order to avoid reverse rotation after switching off, the compressor is equipped with a non-return valve (u).

The compressor compresses the inlet gas absolutely oil-free. A lubrication of the pump chamber is neither necessary nor allowed.

**Cooling**

The compressor is cooled by

- radiation of heat from the surface of the compressor
- the air flow from the fan wheel of the drive motor
- the process gas
- the air flow from the fan wheel on the shaft of the compressor

**Start Controls**

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

**Safety**

**Intended Use**

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

The compressor 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 5: Installation Prerequisites) of the compressor shall be observed both by the manufacturer of the machinery into which the compressor is to be incorporated and by the operator.

The maintenance instructions shall be observed.

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

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**Safety Notes**

The compressor 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](image1)

**DANGER**

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

![WARNING](image2)

**WARNING**

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

![CAUTION](image3)

**CAUTION**

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

**Noise Emission**

For the sound pressure level in free field according to EN ISO 2151 (page 36: Technical Data).

![CAUTION](image4)

**CAUTION**

The compressor emits noise of high intensity in a narrow band. Risk of damage to the hearing.

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

**Transport**

**Transport in Packaging**
Packed on a pallet the compressor is to be transported with a forklift.

**Transport without Packaging**

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

- Remove the inflated cushions from the box

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

- Remove the corrugated cardboard from the box

In case the compressor is laid in foam:

- Remove the foam

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

- Remove the bolting between the compressor and the pallet/base plate

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

- Remove the tightening straps

![CAUTION](image5)

**CAUTION**

Do not walk, stand or work under suspended loads.

- Make sure that the eyebolts are in faultless condition (replace damaged, e.g. bent eyebolts with a new ones)
- Make sure that the eyebolts are fully screwed in and tightened by hand
● Attach lifting gear securely to the eyebolts on the synchronising gear (h, 615) and on the drive motor
In case the drive motor comes without an eyebolt or the eyebolt on the drive motor is located at an unfavourable position:
  ◆ Loop a belt/rope with suitable length and strength around the flange of the drive motor
● Attach the lifting gear to a crane hook with safety latch
● Lift the compressor with a crane
In case the compressor was bolted to a pallet or a base plate:
  ◆ Remove the stud bolts from the rubber feet

Storage
Short-term Storage
● Make sure that the gas inlet and the pressure connection are closed (leave the provided plugs in)
● Store the compressor
  – 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 compressor immediately. In case of favourable ambient conditions conserve the compressor if a storage of more than 3 months is scheduled.
● 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 compressor in VCI film
● Store the compressor
  – 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 compressor as described in the chapter Installation and Commissioning (➔ page 5)

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 compressor and adjoining plant components!
Risk of injury!
The installation prerequisites must be complied with.
● Make sure that the integration of the compressor 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 compressor is to be incorporated, ➔ page 17: note in the EC-Declaration of Conformity)

Mounting Position and Space
● Make sure that the environment of the compressor is not potentially explosive
● Make sure that the following ambient conditions will be complied with:
  – ambient temperature: 0 ... 40 °C
  – 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 compressor will be placed or mounted horizontally
● Make sure that the base for placement / mounting base is even
● Make sure that in order to warrant a sufficient cooling there will be a clearance of minimum 1 m between the compressor and nearby walls
● Make sure that no heat sensitive parts (plastics, wood, cardboard, paper, electronics) will touch the surface of the compressor
● Make sure that the installation space or location is vented such that a sufficient cooling of the compressor is warranted

CAUTION
The compressor is not absolutely gas tight.
Risk of damage to health!

Make sure that the installation space or location is vented such that in case of conveying media which are dangerous to health no impermissible accumulation of conveyed media in the environment of the compressor will occur.
● Make sure that the installation space or location is vented such that even in the case of an impaired gas tightness of the compressor (e.g. due to illegal pressures at the gas inlet, worn shaft seal rings or clogged pressure relief lines) no impermissible accumulation of process gas in the environment of the compressor will occur. Closed cooling air circuits are not permitted.

CAUTION
During operation the surface of the compressor may reach temperatures of more than 70 °C.
Risk of burns!
Gas Inlet

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 compressor
- Make sure that the suction line fits to the gas inlet (c) of the compressor
- Make sure that the gas will be sucked through a vacuum-tight flexible hose or a pipe

In case of using a pipe:
- Make sure that the pipe will cause no stress on the compressor’s connection, if necessary use an expansion joint
- Make sure that ambient pressure ±200* hPa (=mbar) will be present at the gas inlet (c) at any operating point
- 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
- Provide a valve for the unthrottled suction of ambient air (ambient air valve) between the shut-off valve and the compressor (in order to dry the compressor after process end)
- Make sure that the anti-pulsation chamber is equipped with a condensate drain cock (m) (optional, if the condensate drain cock is missing contact the Busch service)
- Make sure that the suction line does not contain foreign objects, e.g. welding scales

Pressure Connection
- Make sure that the pressure line fits to the pressure connection (q) of the compressor
- Make sure that the pressure connection is connected to a pressure-tight flexible hose or a pipe
- Make sure that the pressure line is designed for 2.0 barg and 250 °C

In case of using a pipe:
- Make sure that the pipe will cause no stress on the compressor’s connection, if necessary use an expansion joint
- Make sure that the line size of the pressure line over the entire length is at least as large as the pressure connection (q) of the compressor

In case the length of the pressure 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 compressor. Seek advice from your Busch representative!
- Make sure that the pressure line either slopes away from the compressor or provide a liquid separator or a drip leg with a drain cock, so that no liquids can back up into the compressor

Electrical Connection / Controls
- Make sure that the stipulations acc. to the EMC-Directive 2004/108/EC and Low-Voltage-Directive 2006/95/EC as well as the EN-standards, electrical and occupational safety directives and the local or national regulations, respectively, are complied with (this is the responsibility of the designer of the machinery into which the compressor is to be incorporated, page 17: 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 compressor 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 instructions of the manufacturer (page 18: Equipment Documentation Measurement and Safety Instrumentation); applicable shutdown temperature nameplate of the compressor

Installation

Mounting a NEMA-Motor with BoWex-Coupling

For certain markets the compressor is available without motor, but with a NEMA-adaptor flange and a BoWex-coupling.

- Remove the NEMA-adaptor flange (I) from the compressor
- Pull the elastomer part (V) together with the hub (III) off the shaft of the compressor
- Mount the NEMA-adaptor flange (I) on the motor (the bolts (II) are not part of the Busch scope of delivery)
- Undo the cylinder screws (VI) and remove the elastomer part (V) from the hub (III)
- Make sure that the parallel key is inserted into the motor shaft
- Push the hub (III) onto the motor shaft such that the mounting face of the hub (III) will be located 16a1 mm before the mounting face of the NEMA-adaptor flange (I) (sketch)
- Fasten the hub (III) on the motor shaft using the set screw (IV)
- Apply thread locking agent on the threads of the cylinder screws (VI)
- Mount the elastomer part (V) on the hub (III) with the cylinder screws (VI) and tighten the cylinder screws with 14 Nm
- Mount the motor on the compressor

Mounting
- Make sure that the installation prerequisites (page 5) are complied with
- Set down or mount the compressor at its location

Checking Synchronising Gear Oil

The compressor is delivered with oil filled synchronising gear. The level shall be slightly above the middle of the sight glass (e).
Check on the sight glass (e) that the proper amount of oil is filled.

Connecting Electrically

**WARNING**

Risk of electrical shock, risk of damage to equipment.

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

**CAUTION**

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

Risk of damage to the drive motor!

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

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

Delta connection (low voltage):

![Diagram of Delta connection](image)

Star connection (high voltage):

![Diagram of Star connection](image)

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

![Diagram of Double star connection](image)

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

![Diagram of Star connection](image)

**CAUTION**

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

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

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

If the rotation must be changed:
  - Switch any two of the drive motor wires

**WARNING**

The proper integration of measurement and safety equipment into the system control is decisive for the operational reliability of the compressor.

The compressor may be commissioned 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

- Connect the suction line
- Connect the pressure line
- 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

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.

- Open the lid of the temperature measurement system (f)
- Disconnect the white cable from pin 1, the first red cable from pin 2 and the second red cable from pin 3
- 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 1, 2 and 3 of the temperature transmitter as shown in the sketch (the cable connected to pin 2 compensates the cable resistance).

Switch on the compressor
Increase the ohmic resistance to the resistance at shutdown temperature according to the Equipment Documentation Measurement and Safety Instrumentation (page 18)
Make sure that an alarm is released in the system control and the compressor is shut down automatically
Decrease the ohmic resistance to a value less than the shutdown point
Make sure that the alarm persists
Make sure that the compressor does not start self-acting
Switch on the compressor again
Interrupt the ohmic resistance
Make sure that a fault indication is released in the system control and the compressor is shut down automatically
Reconnect the variable ohmic resistance
Switch on the compressor again
Short circuit the variable ohmic resistance
Make sure that a fault indication is released in the system control and the compressor is shut down automatically
Remove the short circuit
Remove the variable ohmic resistance
Reconnect the resistance thermometer Pt100 to the temperature transmitter (white cable to pin 1, first red cable to pin 2, second red cable to pin 3, sketch)
Firmly close the temperature measurement system (f) with the lid

Recording of Operational Parameters
As soon as the compressor 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

The compressor is designed for operation under the conditions described below.

In case of disregard risk of damage or destruction of the compressor and adjoining plant components!

Risk of injury!
The compressor must only be operated under the conditions described below.

The compressor is intended for
- the compression of
- air and other dry, non-aggressive, non-toxic and non-explosive gases
Conveying media with a lower or higher density than air leads to an increased thermal and/or mechanical load on the compressor and is permissible only after prior consultation with Busch.
Max. allowed temperature of the inlet gas: 40 °C
The compressor is equipped with pressure relief lines between the pump stage and the gas inlet (c). The pressure relief lines and shaft sealings safeguard that no process gases will escape into the environment of the compressor.
The proper function of the compressor requires ambient pressure $p_{200} \geq 101325$ ( = mbar) to be present at the gas inlet (c) at any operating point.
*unless specified otherwise on the nameplate of the compressor
Standard-version:
The gas shall be free from vapours that would condensate under the temperature and pressure conditions inside the compressor.
Version “Aqua”:
The compressor features the corrosion protection coating CPC and is capable of conveying water vapour (page 9: Conveying Condensable Vapours). Conveyance of other vapours shall be agreed upon with Busch. Conveyance of water or other liquids in liquid phase increases the power consumption and shall therefore be avoided (risk of drive overload).
The compressor is intended for the placement in a non-potentially explosive environment.
The compressor is thermally suitable for continuous operation (100 percent duty).
Max. permissible number of startings per hour: 12
The maximum allowed pressure on the pressure connection (q) is 0.4 ... 2.0 bar (the nameplate of the compressor indicates the valid pressure). By means of process control and/or pressure relief valves it must be made sure that the maximum allowed pressure will not be exceeded.
The safety valve (o) on the compressor protects the compressor against overload only. It is no pressure limiting device in terms of EN 1012-1 for the pressure system. It is not designed for frequent use and must therefore not be used as a system pressure regulating valve.

Note: The safety valve (o) routes compressed product gas back to the gas inlet (c). This will increase the gas inlet temperature. In case of continuous operation of the safety valve the temperature monitoring will therefore shut down the compressor.
The temperature sensor must be integrated into the system control such that operation of the compressor will safely be inhibited if the shutdown temperature (see nameplate) is exceeded.
CAUTION

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

Risk of burns!

The compressor 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 compressor emits noise of high intensity in a narrow band.

Risk of damage to the hearing.

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

- Make sure that all provided covers, guards, hoods etc. remain mounted
- Make sure that protective devices will not be disabled
- Make sure that cooling air inlets and outlets will not be covered or obstructed and that the cooling air flow will not be affected adversely in any other way
- Make sure that the installation prerequisites (page 5: Installation Prerequisites) are complied with and will remain complied with, particularly that a sufficient cooling will be ensured

Conveying Condensable Vapours

Version “Aqua”:

CAUTION

Due to the corrosion protection coating CPC the compressor is capable of conveying water vapour.

Very humid process gases and/or adverse operating cycles can lead to residual condensates, though, which cause corrosion.

If this is the case, it is necessary to counteract residual condensates by warming up the compressor, conveyance of ambient air after process end and regular draining of the anti-pulsation chamber (m).

- Close the shut-off valve in the suction line
- Warm up the compressor for approx. 10 minutes
  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
  - Open the ambient air valve
  - Operate the compressor for another approx. 10 minutes
  - Close the ambient air valve

CAUTION

During operation of the compressor the anti-pulsation chamber is under pressure.

Risk of injury when the condensate drain cock is opened!

Drain condensate only when the compressor is shut down and the pressure connection (q) is vented to atmospheric pressure.

- Regularly drain condensate from the anti-pulsation chamber (m)

DANGER

In case the compressor 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 compressor may reach temperatures of more than 70 °C.

Risk of burns!

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 shall be considered as starting values which should be shortened or extended as appropriate. 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.

Monthly:

- Make sure that the compressor 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 9: Every 6 Months:

Every 3 Months:

- Make sure that the compressor is shut down
- Check the level of the synchronising gear oil
  The level shall be slightly above the middle of the sight glass (e).
  The level of the synchronising gear should stay constant over the lifetime of the oil. If the level does fall, the gear is leaky and the compressor requires repair (Busch service).

Every 6 Months:

- Make sure that the housing is free from dust and dirt, clean if necessary
- Make sure that the compressor is shut down and locked against inadvertent start up
- Remove the acoustic enclosure

Note: Make sure that the foam mats do not get soaked with water

- Clean the fan cowlings, fan wheels, the ventilation grilles and cooling fins
- Mount the acoustic enclosure
- Make sure that the electrical connection of the temperature monitoring is undamaged
Every Year:
- Make sure that the compressor is shut down and locked against inadvertent start up
  In case an inlet air filter is installed:
  - Replace the inlet air filter
- Check the inlet screen, clean if necessary
- Check the function of the measurement and safety instrumentation (page 11: Functional Check of the Measurement and Safety Instrumentation)

Every 5000 Operating Hours, At the Latest after 2 Years:
In case of higher requirements in terms of gas tightness:
  - Replace the shaft seal rings (Busch service)

Every 10000 Operating Hours, At the Latest after 2 Years:

Every 20000 Operating Hours, At the Latest after 6 Years:
- Have a major overhaul on the compressor (Busch service)
**Functional Check 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.

- Open the lid of the temperature measurement system (f)
- Disconnect the white cable from pin 1, the first red cable from pin 2 and the second red cable from pin 3
- 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 1, 2 and 3 of the temperature transmitter as shown in the sketch (the cable connected to pin 2 compensates the cable resistance)
- Switch on the compressor
- Increase the ohmic resistance to the resistance at shutdown temperature according to the Equipment Documentation Measurement and Safety Instrumentation (page 18)
- Make sure that an alarm is released in the system control and the compressor is shut down automatically
- Decrease the ohmic resistance to a value less than the shutdown point
- Make sure that the alarm persists
- Make sure that the compressor does not start self-acting
- Switch on the compressor again
- Interrupt the ohmic resistance
- Make sure that a fault indication is released in the system control and the compressor is shut down automatically
- Reconnect the variable ohmic resistance
- Switch on the compressor again
- Short circuit the variable ohmic resistance
- Make sure that a fault indication is released in the system control and the compressor is shut down automatically
- Remove the short circuit
- Remove the variable ohmic resistance

- Reconnect the resistance thermometer Pt100 to the temperature transmitter (white cable to pin 1, first red cable to pin 2, second red cable to pin 3, sketch)
- Firmly close the temperature measurement system (f) with the lid

**Overhaul**

**CAUTION**
In order to achieve best efficiency and a long life the compressor was assembled and adjusted with precisely defined tolerances. This adjustment will be lost during dismantling of the compressor.

It is therefore strictly recommended that any dismantling of the compressor that is beyond of what is described in this manual shall be done by Busch service.

**DANGER**
In case the compressor conveyed gas that was contaminated with foreign materials which are dangerous to health, harmful material can reside in pores, gaps and internal spaces of the compressor.

Danger to health during dismantling of the compressor.

Danger to the environment.

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

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

**Removal from Service**

**Temporary Removal from Service**
- Prior to disconnecting pipes/lines make sure that all pipes/lines are vented to atmospheric pressure

**Recommissioning**
- Observe the chapter Installation and Commissioning (page 5)
Dismantling and Disposal

DANGER

In case the compressor conveyed gas that was contaminated with foreign materials which are dangerous to health, harmful material can reside in pores, gaps and internal spaces of the compressor.

Danger to health during dismantling of the compressor.

Danger to the environment.

During dismantling of the compressor personal protective equipment must be worn.

The compressor must be decontaminated prior to disposal.

- Drain the oil
- Make sure that materials and components to be treated as special waste have been separated from the compressor
- Make sure that the compressor 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 compressor involve no risk.

- Dispose of the used oil in compliance with applicable regulations
- Dispose of the compressor as scrap metal
## Troubleshooting

### 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 compressor may reach temperatures of more than 70 °C.

Risk of burns!

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

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<td></td>
<td>Long suction, discharge or pressure line with too small diameter</td>
<td>Use larger diameter</td>
</tr>
<tr>
<td></td>
<td>The valve disk of the inlet non-return valve is stuck in closed or partially open position</td>
<td>Disassemble the inlet, clean the screen and the valve (u) as required and reassemble</td>
</tr>
<tr>
<td></td>
<td>Internal parts are worn or damaged</td>
<td>Repair the compressor (Busch service)</td>
</tr>
<tr>
<td>The compressor does not start</td>
<td>The drive motor is not supplied with the correct voltage or is overloaded</td>
<td>Supply the drive motor with the correct voltage</td>
</tr>
<tr>
<td></td>
<td>The drive motor starter overload protection is too small or trip level is too low</td>
<td>Compare the trip level of the drive motor starter overload protection with the data on the nameplate, correct if necessary In case of high ambient temperature: set the trip level of the drive motor starter overload protection 5 percent above the nominal drive motor current</td>
</tr>
<tr>
<td></td>
<td>One of the fuses has blown</td>
<td>Check the fuses</td>
</tr>
<tr>
<td></td>
<td>The connection cable is too small or too long causing a voltage drop at the compressor</td>
<td>Use sufficiently dimensioned cable</td>
</tr>
<tr>
<td>Condition</td>
<td>Possible Cause</td>
<td>Action</td>
</tr>
<tr>
<td>----------------------------------------------</td>
<td>---------------------------------------</td>
<td>------------------------------------------------------------------------</td>
</tr>
<tr>
<td>The compressor or the drive motor is blocked</td>
<td>Make sure the drive motor is discon-</td>
<td>Remove the fan cover</td>
</tr>
<tr>
<td></td>
<td>nected from the power supply</td>
<td>Try to turn the drive motor with the compressor by hand</td>
</tr>
<tr>
<td></td>
<td></td>
<td>If the unit is still frozen: remove the drive motor and check the</td>
</tr>
<tr>
<td></td>
<td></td>
<td>compressor and the compressor separately</td>
</tr>
<tr>
<td></td>
<td></td>
<td>If the compressor is blocked:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Repair the compressor (Busch service)</td>
</tr>
<tr>
<td>The drive motor is defective</td>
<td>Replace the drive motor (Busch service)</td>
<td>(the proper function of the fan wheel requires the precise adjustment</td>
</tr>
<tr>
<td></td>
<td></td>
<td>of the coupling on the motor shaft and on the pump shaft; therefor</td>
</tr>
<tr>
<td></td>
<td></td>
<td>e the motor can be mounted by the Busch service only)</td>
</tr>
<tr>
<td>The compressor is blocked</td>
<td>Repair the compressor (Busch service)</td>
<td>Make sure the suction line is equipped with a screen</td>
</tr>
<tr>
<td></td>
<td></td>
<td>If necessary additionally provide a filter</td>
</tr>
<tr>
<td>Solid foreign matter has entered the</td>
<td>Repair the compressor (Busch service)</td>
<td>Check the process</td>
</tr>
<tr>
<td>compressor</td>
<td></td>
<td>Observe the chapter Conveying Condensable Vapours (page 9)</td>
</tr>
<tr>
<td>Corrosion in the compressor from remaining</td>
<td>Repair the compressor (Busch service)</td>
<td>Check the process</td>
</tr>
<tr>
<td>condensate</td>
<td></td>
<td>Observe the chapter Conveying Condensable Vapours (page 9)</td>
</tr>
<tr>
<td>The compressor was run in the wrong direc-</td>
<td>Repair the compressor (Busch service)</td>
<td>When connecting the compressor make sure the compressor will run in</td>
</tr>
<tr>
<td>tion</td>
<td></td>
<td>the correct direction (page 6: Installation)</td>
</tr>
<tr>
<td>The drive motor is running, but the</td>
<td>Replace the coupling element</td>
<td>(the proper function of the fan wheel requires the precise adjustment</td>
</tr>
<tr>
<td>compressor stands still</td>
<td></td>
<td>of the coupling on the motor shaft and on the pump shaft; therefor</td>
</tr>
<tr>
<td></td>
<td></td>
<td>e the coupling element can be replaced by the Busch service only)</td>
</tr>
<tr>
<td>The compressor starts, but labours or runs</td>
<td>Check the proper connection of the</td>
<td>Tighten or replace loose connections</td>
</tr>
<tr>
<td>noisily or rattles</td>
<td>wires against the connection diagram</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(particularly on motors with six coils)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Not all drive motor coils are properly</td>
<td></td>
</tr>
<tr>
<td></td>
<td>connected</td>
<td></td>
</tr>
<tr>
<td></td>
<td>The drive motor operates on two phases</td>
<td></td>
</tr>
<tr>
<td>The compressor runs in the wrong direction</td>
<td>Verification and rectification (page 5: Installation and Commissioning)</td>
<td></td>
</tr>
<tr>
<td>Foreign objects in the compressor</td>
<td>Repair the compressor (Busch service)</td>
<td></td>
</tr>
<tr>
<td>Stuck bearings</td>
<td></td>
<td></td>
</tr>
<tr>
<td>The compressor runs very noisily</td>
<td>Repair the compressor (Busch service)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Repair the compressor (Busch service)</td>
<td></td>
</tr>
<tr>
<td>Defective bearings</td>
<td>Replace the coupling element</td>
<td></td>
</tr>
<tr>
<td>Worn coupling element</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low oil level in the synchronising gear</td>
<td>The synchronising gear is leaky</td>
<td></td>
</tr>
<tr>
<td>Synchronising gear damaged due to operation</td>
<td>Repair the compressor (Busch service)</td>
<td></td>
</tr>
<tr>
<td>with low oil level</td>
<td></td>
<td></td>
</tr>
<tr>
<td>The compressor runs very hot</td>
<td>Make sure that the cooling of the</td>
<td>Install the compressor in a narrow space only if sufficient ventilation</td>
</tr>
<tr>
<td></td>
<td>compressor is not impeded by dust/dirt</td>
<td>is ensured</td>
</tr>
<tr>
<td></td>
<td>Clean the fan cowlings, the fan wheels,</td>
<td></td>
</tr>
<tr>
<td></td>
<td>the ventilation grilles and the cooling</td>
<td></td>
</tr>
<tr>
<td></td>
<td>fins</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Observe the permitted ambient</td>
<td></td>
</tr>
<tr>
<td></td>
<td>temperatures</td>
<td></td>
</tr>
<tr>
<td>Issue</td>
<td>Solution</td>
<td></td>
</tr>
<tr>
<td>----------------------------------------------------------------------</td>
<td>--------------------------------------------------------------------------</td>
<td></td>
</tr>
<tr>
<td>Temperature of the inlet gas too high</td>
<td>Observe the permitted temperatures for the inlet gas</td>
<td></td>
</tr>
<tr>
<td>Insufficient gas transfer</td>
<td>Provide a pressure relief valve</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Check the process conditions</td>
<td></td>
</tr>
<tr>
<td>Mains frequency or voltage outside tolerance range</td>
<td>Provide a more stable power supply</td>
<td></td>
</tr>
<tr>
<td>In case a pressure relief valve/regulating system is installed:</td>
<td>Adjust, repair or replace, respectively</td>
<td></td>
</tr>
<tr>
<td>The pressure relief valve/regulating system is misadjusted or defective</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Partial clogging of filters or screens</td>
<td>Remove the clogging</td>
<td></td>
</tr>
<tr>
<td>Partial clogging in the suction, discharge or pressure line</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Long suction, discharge or pressure line with too small diameter</td>
<td>Use larger diameter</td>
<td></td>
</tr>
</tbody>
</table>
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 compressor. This will allow Busch service to check if the compressor is compatible with a modified or improved part.

The exclusive use of genuine spare parts and consumables is a prerequisite for the proper function of the compressor and for the granting of warranty, guarantee or goodwill.

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 37 (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.

<table>
<thead>
<tr>
<th>Pos.</th>
<th>Part</th>
<th>Qty</th>
<th>Part no.</th>
</tr>
</thead>
<tbody>
<tr>
<td>---</td>
<td>Safety valve (quote in your order also the ultimate working pressure of the compressor)</td>
<td>1</td>
<td>on request</td>
</tr>
</tbody>
</table>
EC-Declaration of Conformity

Note: This Declaration of Conformity and the CE-mark affixed to the nameplate are valid for the compressor within the Busch-scope of delivery. When this compressor 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 compressors without a drive may only be used a drive with a written consent of Busch.

We
Busch Produktions GmbH
Schaunilandsstr. 1
79689 Maulburg
Germany

declare that compressors MM 1202, 1252, 1322 AP gas tight, temperature monitored
in accordance with the European Directives:

- “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,

have been designed and manufactured to the following specifications:

<table>
<thead>
<tr>
<th>Standard</th>
<th>Title of the Standard</th>
</tr>
</thead>
<tbody>
<tr>
<td>EN ISO 12100-1</td>
<td>Safety of machinery - Basic concepts, general principles of design - Part 1 and 2</td>
</tr>
<tr>
<td>EN ISO 12100-2</td>
<td>Safety of machinery - Safety distances to prevent hazard zones being reached by the upper and lower limbs</td>
</tr>
<tr>
<td>EN 1012-1</td>
<td>Compressors and vacuum pumps - Safety requirements - Part 1 and 2</td>
</tr>
<tr>
<td>EN 1012-2</td>
<td>Compressors and vacuum pumps - Safety requirements - Part 1 and 2</td>
</tr>
<tr>
<td>EN ISO 2151</td>
<td>Acoustics - Noise test code for compressors and vacuum pumps - Engineering method (grade 2)</td>
</tr>
<tr>
<td>EN 60204-1</td>
<td>Safety of machinery - Electrical equipment of machines - Part 1: General requirements</td>
</tr>
<tr>
<td>EN 61000-6-1</td>
<td>Electromagnetic compatibility (EMC) - Generic immunity standards</td>
</tr>
<tr>
<td>EN 61000-6-3</td>
<td>Electromagnetic compatibility (EMC) - Generic emission standards</td>
</tr>
<tr>
<td>EN 61000-6-4</td>
<td>Electromagnetic compatibility (EMC) - Generic emission standards</td>
</tr>
</tbody>
</table>

Manufacturer
Dr.-Ing. Karl Busch
General director

Person authorised to compile the technical file
Andrej Riwe
Technical writer
**Version with Resistance Thermometer, without Transmitter**

In case the transmitter is furnished by the system supplier or operator.

<table>
<thead>
<tr>
<th>Scope of delivery</th>
<th>Resistance thermometer with connecting cable</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type/Marking</td>
<td>&gt;2008-01: TR730-H-R3B-##-GT60100#15002-Z#</td>
</tr>
<tr>
<td>Documentation</td>
<td>Operating instructions for resistance thermo-</td>
</tr>
<tr>
<td></td>
<td>meters and thermocouples (11208287 10/2006 GB/D; on the following pages)</td>
</tr>
</tbody>
</table>

**Version with Resistance Thermometer and Transmitter**

Standard scope of delivery

<table>
<thead>
<tr>
<th>Scope of delivery</th>
<th>Thermometer system, consisting of:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Resistance thermometer with connecting cable, transmitter, junction box</td>
</tr>
<tr>
<td>Type/Marking</td>
<td>Resistance thermometer:</td>
</tr>
<tr>
<td></td>
<td>&gt;2008-01: TR730-H-R3B-##-GT60100#15002-Z#</td>
</tr>
<tr>
<td></td>
<td>Transmitter: T24.10.2P2-ZF</td>
</tr>
<tr>
<td></td>
<td>Junction box: 1506003</td>
</tr>
</tbody>
</table>

**Operational Notes:**
- Connection of supply voltage to pins + (positive pole) and - (negative pole).
- After connection of the cables to the switchboard/system control make sure that the housing is firmly closed and the cable glands are tightened.

**Temperatures - currents (presets)**

<table>
<thead>
<tr>
<th>Temperature</th>
<th>Resistance</th>
<th>Current</th>
</tr>
</thead>
<tbody>
<tr>
<td>Under measurement range (= sensor short circuit)</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Lower measurement limit</td>
<td>-20 °C</td>
<td>92.160 Ω</td>
</tr>
<tr>
<td>Shutdown temperatures (applicable shutdown temperature see nameplate of the compressor)</td>
<td>125 °C</td>
<td>147.944 Ω</td>
</tr>
<tr>
<td></td>
<td>130 °C</td>
<td>149.824 Ω</td>
</tr>
<tr>
<td></td>
<td>150 °C</td>
<td>157.315 Ω</td>
</tr>
<tr>
<td></td>
<td>160 °C</td>
<td>161.043 Ω</td>
</tr>
<tr>
<td></td>
<td>165 °C</td>
<td>162.903 Ω</td>
</tr>
<tr>
<td></td>
<td>170 °C</td>
<td>164.760 Ω</td>
</tr>
<tr>
<td></td>
<td>190 °C</td>
<td>172.158 Ω</td>
</tr>
<tr>
<td></td>
<td>220 °C</td>
<td>183.168 Ω</td>
</tr>
<tr>
<td></td>
<td>225 °C</td>
<td>184.993 Ω</td>
</tr>
<tr>
<td></td>
<td>230 °C</td>
<td>186.815 Ω</td>
</tr>
<tr>
<td></td>
<td>240 °C</td>
<td>190.451 Ω</td>
</tr>
<tr>
<td></td>
<td>250 °C</td>
<td>194.074 Ω</td>
</tr>
<tr>
<td></td>
<td>270 °C</td>
<td>201.287 Ω</td>
</tr>
<tr>
<td></td>
<td>280 °C</td>
<td>204.876 Ω</td>
</tr>
<tr>
<td></td>
<td>290 °C</td>
<td>208.453 Ω</td>
</tr>
<tr>
<td></td>
<td>300 °C</td>
<td>212.019 Ω</td>
</tr>
<tr>
<td></td>
<td>310 °C</td>
<td>215.573 Ω</td>
</tr>
<tr>
<td></td>
<td>340 °C</td>
<td>226.166 Ω</td>
</tr>
<tr>
<td></td>
<td>350 °C</td>
<td>229.673 Ω</td>
</tr>
<tr>
<td>Upper measurement range limit</td>
<td>350 °C</td>
<td>229.673 Ω</td>
</tr>
<tr>
<td>Sensor breakage</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

**MM 1202, 1252, 1322 AP gas tight, temperature monitored**
Resistance thermometers and thermocouples

Widerstandsthermometer und Thermoelemente

Contents

1. Safety instructions 4
2. Mounting 4
3. Special wiring advice 5
4. Storage 5
5. Maintenance and servicing / cleaning 5
6. Cable connections 5
7. Electrical connections 6
8. Notes 10
1. Safety instructions / 2. Mounting

1. Sicherheitshinweise

When mounting, starting and operating these instruments it is important to observe the respective national safety precautions and regulations in effect (e.g. VDE 100). Please ensure the correct selection of instruments/thermowells with regard to the maximum pressure and temperature (e.g. table of contact ratings in DIN 43 772).

- Serious injuries and/or damage can occur should the relevant regulations not be observed.
- Only qualified persons authorised by the plant manager are permitted to install and service these instruments.

2. Mounting

The thermometer should be mounted in such a way that the permissible operating temperature (ambient, medium) is not exceeded, in terms of ambient and medium temperature, but also with respect to convected and radiant heat.

The plant must always be free from pressure before disconnecting the thermometer!

Electrical connection must be carried out in accordance with the sensor connections/pin assignments shown in the diagrams that follow.

3. Special wiring advice ...

3. Special wiring advice

- Damage to cables and wires, as well as connection points must be avoided
- Flying leads with bare ends must be covered by an end splice (cable preparation)
- Both the internal capacitance and inductance must be considered

4. Storage

Measuring instruments should be protected against humidity and dust.

5. Maintenance and servicing / cleaning

The instruments require no maintenance or servicing.

Repairs must only be carried out by the manufacturer.

Remainder of the pressure medium in dismounted pressure gauges may be hazardous or toxic. This should be considered when handling and storing the removed pressure gauges.

6. Cable connections

In practice, when assembling the cable gland with certain cables and leads, the protection class might not be met if deviations from the original standard’s test conditions are too great (e.g. cable is not circular, cable is twisted, cable is too flexible, i.e. not enough cross-sectional or longitudinal stiffness, cable with a different surface roughness, etc.).
6. Cable connections / 7. Electrical connections

Requirements for meeting protection class

- Only use cable glands within their indicated clamping range (cable diameter suitable for the cable gland)
- Do not use the lower clamping range with very soft cable types
- Only use circular cross-section cables (if necessary, slightly oval in cross-section)
- Repeated opening/closing is possible; however only if necessary as it might have a detrimental effect on the protection class
- For cable with a pronounced cold-flow behaviour the screw connection must be fully tightened

Note: The protection class is not valid with armoured cables (stainless-steel sheathed).

7. Electrical connections

Thermocouples with terminal block

Simplex thermocouple  Duplex thermocouple

The colour coding at the plus pole of the device is always deciding the correlation of polarity and connection terminal.
7. Electrical connections

Resistance thermometers with cable connection or male connector

<table>
<thead>
<tr>
<th>Cable</th>
<th>Lemosa connector, (male) on cable</th>
<th>Binder male connector, fitted to cable</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 x Pt100</td>
<td>2 wire</td>
<td><img src="image1" alt="Diagram" /></td>
</tr>
<tr>
<td>1 x Pt100</td>
<td>3 wire</td>
<td><img src="image3" alt="Diagram" /></td>
</tr>
<tr>
<td>1 x Pt100</td>
<td>4 wire</td>
<td><img src="image5" alt="Diagram" /></td>
</tr>
<tr>
<td>2 x Pt100</td>
<td>2 wire</td>
<td><img src="image7" alt="Diagram" /></td>
</tr>
<tr>
<td>2 x Pt100</td>
<td>3 wire</td>
<td><img src="image9" alt="Diagram" /></td>
</tr>
</tbody>
</table>

Thermocouples with cable connection or male connector

<table>
<thead>
<tr>
<th>Cable</th>
<th>Lemosa connector, (male) on cable</th>
<th>Binder connector, (threaded plug connection)</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image11" alt="Diagram" /></td>
<td><img src="image12" alt="Diagram" /></td>
<td><img src="image13" alt="Diagram" /></td>
</tr>
</tbody>
</table>

Simplex thermocouple

Duplex thermocouple

Thermo connector Positive and negative terminal are marked. Two miniature size thermo connectors are used with duplex thermocouples.

Colour code of cable

<table>
<thead>
<tr>
<th>Type of sensor</th>
<th>Standard</th>
<th>Positive terminal</th>
<th>Negative terminal</th>
</tr>
</thead>
<tbody>
<tr>
<td>K</td>
<td>DIN EN 60 584</td>
<td>green</td>
<td>white</td>
</tr>
<tr>
<td>J</td>
<td>DIN EN 60 584</td>
<td>black</td>
<td>white</td>
</tr>
<tr>
<td>E</td>
<td>DIN EN 60 584</td>
<td>violet</td>
<td>white</td>
</tr>
<tr>
<td>T</td>
<td>DIN EN 60 584</td>
<td>brown</td>
<td>white</td>
</tr>
<tr>
<td>N</td>
<td>DIN EN 60 584</td>
<td>pink</td>
<td>white</td>
</tr>
</tbody>
</table>
8. Notes

For equipment to be used in hazardous areas, see the appropriate operating instructions.

Models TR221 / TR223 and TR225 / TR227 have their own, individual operating instructions.
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15. FM installation drawing 23
16. Declaration of conformity 24

---

### Temperature Transmitter Model T24.10

- **GB**

### Temperatur-Transmitter Typ T24.10

- **D**

---

**Operating Instructions**

Betriebsanleitung

---

**Temperatur - Transmitter Typ T24.10**
1. General information / 2. Safety instructions

1. General information

WIKA temperature transmitters are carefully designed and manufactured using state-of-the-art technology. Every component undergoes strict quality inspection before assembly and each instrument is fully tested prior to shipment.

Note

Please inspect the equipment for possible damage during transportation. Should there be any obvious damage, please inform the transport company and WIKA without delay.

The following installation and operating instructions have been compiled by us with great care but it is not feasible to take all possible applications into consideration.

If questions remain regarding a specific application, you can obtain further information (data sheets, instructions, etc.) via our Internet address (www.wika.de / www.wika.com / download) or contact WIKA for additional technical support. (see section 13, Service)

2. Safety instructions

When mounting, starting and operating these transmitters it is important to observe the respective national safety precautions and regulations in effect (e.g. VDE 100).

Serious injuries and/or damage can occur should the relevant regulations not be observed. Only qualified persons authorised by the plant manager are permitted to install and service these transmitters.

When working on the terminals of the T24.10 while the process is running it is recommended to take appropriate measures to avoid any electrostatic discharge, because discharges may result in temporary falsifications of the measured value. When mounting a T24.10 transmitter into a field case separately from the temperature sensor (transmitter mounted outside of the connection head of a thermometer) it is recommended to use connection cables with shielding between sensor and transmitter and to connect the shielding to earth on one side.

If the instrument should become damaged or unsafe for operation, it should be removed from service and marked to prevent it from being used again accidentally.

We draw your attention to the following which must be observed for transmitters with Ex protection:

1. Observe the applicable regulations for the use of Ex-class instruments (e.g.: EN 50 014, EN 50 020, EN 50 021, EN 50 284).
2. Observe the notes for mounting and operating in hazardous area described in section 6.
3. It is forbidden to use a transmitter that is damaged externally.
4. Repairs may be performed by the manufacturer only. The instrument must not be interfered with or changed in any way.
5. During configuration the transmitter, the programming unit PU348 and PC must not be located in the hazardous area

3. Intended use

The instrument is a universal, configurable transmitter for resistance thermometers (RTD) and resistance and calibration sources. The transmitter meets the requirements on

- explosion protection (depending on the version)
- signalling at the analogue output according to NAMUR recommendation NE 43

Before initial operation check the suitability for the intended application.

WIKA Operating instructions temperature transmitter Model T24.10
3. Intended use

3.1 Functional description

The analogue temperature transmitter serves for the conversion of a resistance value into a proportional current signal (4-20 mA). The analogue signal is transmitted to a series-connected logic unit, e.g. an SPS or an alarm contact, where it is monitored for upper deviations from a maximum value or lower deviations from a minimum value. For failure monitoring the logic unit has to be capable of recognising HI alarms (> 21 mA) as well as LO alarms (< 3.6 mA). The electrical components of the transmitter are arranged in a plastic case and completely encapsulated. Due to the internal analogue signal processing these transmitters can also be used in multiplexed systems. The transmitters described in these operating instructions feature an internal conductive connection between the sensor input and the analogue output. There must not be any conductive connection (e.g. via earth) between the connected sensor and the analogue output!

3.2 Ambient conditions

<table>
<thead>
<tr>
<th>T24.10***</th>
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</tr>
</thead>
<tbody>
<tr>
<td>Ambient/ storage temperature</td>
<td>-40 ... +85 °C</td>
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<td>Standard range:</td>
<td>-40 ... +105 °C 1)</td>
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<tr>
<td>Extended range:</td>
<td>Cx (-40 ... +85 °C, 5 % to 95 % rel. air humidity)</td>
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<td>DIN EN 60 654-1</td>
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<td>Climate class:</td>
<td>max. permissible humidity</td>
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<tr>
<td>100 % relative humidity (unlimited with insulated sensor connection wires), moisture condensation permissible DIN IEC 68-2-30 Var. 2</td>
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<tr>
<td>Vibration</td>
<td>10 ... 2000 Hz 10 g DIN IEC 68-2-6</td>
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<td>Shock</td>
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<td>Salt mist</td>
<td>DIN IEC 68-2-11</td>
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<td>Case ingress protection IP 66 / IP 67 IEC 529 / EN 60 529</td>
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<tr>
<td>Terminals ingress prot.</td>
<td>IP 00 IEC 529 / EN 60 529</td>
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</tbody>
</table>

1) without explosion protection

For further technical details please refer to WIKA data sheet TE 24.01

4. Mounting

4.1 Mounting on the measuring insert

Mount the transmitter on the circular plate of the measuring insert using two countersunk head M3 screws per DIN EN ISO 2009. Appropriate threaded inserts have been press-fitted in the underside of the case. Assuming the countersinking is carried out correctly, the permissible screw length can be calculated as follows:

\[ l_{\text{max}} = s + 4 \text{ mm} \]

with

\[ l_{\text{max}} \] Length of screw in mm
\[ s \] Thickness of circular plate in mm

Check the screw length before affixing the transmitter to the measuring insert: stick the screw in the circular plate and verify additional length of 4 mm!

Do not exceed the maximum permissible screw length! The transmitter will be damaged if the screws are screwed further than 4 mm into the bottom of the transmitter.

WIKA Operating instructions temperature transmitter Model T24.10
4. Mounting / 5. Electrical connections

4.2 Mounting in connection head

Insert the measuring insert with the mounted transmitter in the protective sheath and affix in the connecting head using screws in pressure springs.

5. Electrical connections

5.1 General

For any work on the transmitters (e.g. assembly / disassembly) it is recommended to take measures, which prevent electrostatic discharge to the terminals.

Recommended tools for terminal screws:
Pozidriv screw driver size 2 (ISO 8764).
max. tightening torque 0.4 Nm

5.2 Power supply / 4 ... 20 mA-loop

The T24 is a temperature transmitter in 2-wire design. Depending on the version, it can be supplied with different types of power supply. Connect the plus pole of the power supply to the terminal marked with \(\oplus\), the minus pole to the power supply marked with \(\ominus\). In the case of flexible leads we recommend the use of crimped connector sleeves.

The T24 temperature transmitter requires a minimum terminal voltage of 10 V DC. The load must not be too high, because otherwise the terminal voltage at the transmitter will be too low in the case of relatively high currents.

The following diagram shows the maximum permissible load in dependence on the supply voltage.

Load diagram

5.3 Connect sensor

It is possible to connect an RTD resistance thermometer (e.g. to DIN EN 60 751 or similar) in a 2- or 3-wire connection method. Configure the input of the transmitter in accordance with the actual method of connection.
5. Electrical connections / 6. Notes for mounting ...

connection used. Otherwise you will not fully exploit the possibilities of connection lead compensation and, as a result, possibly cause additional measuring errors (see section 9. Configuration).

If 2 wire connecting method is used: Set a jumper between the input terminals ② and ③. Otherwise the transmitter signals a sensor burnout and sets the output signal < 3.6 mA or > 21.0 mA, dependent on configuration.

6. Notes for mounting and operating in hazardous areas (Europe)

Use only such transmitters in a hazardous area that have the corresponding approval for this hazardous area. The approval is noted on the product label.

6.1 Type overview of the European approvals

<table>
<thead>
<tr>
<th>Head mounting</th>
<th>Explosion protection</th>
<th>Approval No.</th>
<th>Type of Ignition protection</th>
</tr>
</thead>
<tbody>
<tr>
<td>T24.10.**2</td>
<td>II 1G EEx ia IIB/IIC T4/T5/T6</td>
<td>DMT 02 ATEX E 025 X</td>
<td>intrinsically safe equipment</td>
</tr>
<tr>
<td>T24.10.**9</td>
<td>II 3G EEx nL/nA IIC T4/T5/T6 X</td>
<td>energy-limited equipment and non-incendive equipment</td>
<td></td>
</tr>
</tbody>
</table>

6.2 Special conditions for safe use

T24.10.**2: Transmitters in a hazardous area are supplied only with associated intrinsically safe apparatus that are approved for this hazardous area. These transmitters must be mounted in a case that must at least correspond to ingress protection IP 20 according to EN 60 529 / IEC 529.

6. Notes for mounting and operating in hazardous areas

T24.10.**2 for category II 1G/IIC in addition: The surface of the case is not conductive. The temperature transmitter must be mounted in a way that electrostatic charges will not occur. This is ensured e.g. by mounting the transmitter into an electrically conductive connection head.

T24.10.**9 (Use as energy-limited equipment II 3G EEx nL): The supply current circuit must fulfil the requirements for ignition protection type II 3G EEx nL energy-limited (EN 50 021). These transmitters must be mounted in a case that must at least correspond to following ingress protection IP 54 according to EN 60 529 / IEC 529.

T24.10.**9 (Use as non-incendive equipment II 3G EEx nA): Disconnection of power supply is forbidden inside the hazardous area. When connecting or disconnecting the terminals ensure the power supply is disconnected outside the hazardous area. These transmitters must be mounted in a case that must at least correspond to ingress protection IP 54 according to EN 60 529 / IEC 529.

When using in circuits with the safety class nA (non-incendive) the permissible connected loads have been exceeded for a short term1), the use of these transmitters in circuits with the safety class EEx nL (energy-limited) is not permissible any more.

1) When the transmitters are used in circuits with the safety class nA, it is permissible to exceed the maximum supply voltage by up to 40% for a short term.

Operation in Zone 0: The temperature transmitter may only be operated in areas that require apparatus of category 1 when following atmospheric conditions exist:
Temperature: -20 °C ... +60 °C  Pressure: 0.8 bar ... 1.1 bar

Operation in Zone 1 und Zone 2:
According to the temperature class, these transmitters may be used only in the following ambient temperature ranges.
6. Notes for mounting and operating in hazardous areas

Ambient temperature range

| Model T24.10.**2               | T4: - 50 °C  Ta + 85 °C | T5: - 50 °C  Ta + 75 °C | T6: - 50 °C  Ta + 60 °C |
| Model T24.10.**9               | T4: - 50 °C  Ta + 85 °C | T5: - 50 °C  Ta + 65 °C | T6: - 50 °C  Ta + 50 °C |

6.3 Safety-engineering values

6.3.1 Power supply / 4 ... 20 mA-loop
The following safety-relevant maximum values must not be exceeded:

| Model T24.10.**2 | Voltage:  $U_i = DC \ 30 \ V$ | Current:  $I_i = 120 \ mA$ | Power:  $P_i = 800 \ mW$ |
| Model T24.10.**9 | Voltage:  $U_i = DC \ 36 \ V$ |

Following have an outward effect at the connection terminals $\oplus$ und $\ominus$ of the transmitter:
- effective internal capacitance  $C_i = 6.2 \ nF$
- effective internal inductance  $L_i = 110 \ \mu H$

6.3.2 Sensor (terminal 1 to 3)
The connected sensor must not warm up inadmissably according to the temperature class of the respective hazardous area for the following values for voltage, current and power:

| Model T24.10.**2 | Voltage during operation:  $U_0 = DC \ 6.4 \ V$ | Current:  $I_0 = 42.6 \ mA$ | Power:  $P_0 = 37.1 \ mW$ |
| Model T24.10.**9 | Voltage during operation:  $U_0 = DC \ 5.4 \ V$ | Current:  $I_0 = 0.5 \ mA$ |

The sum of the values of the connected sensor and the connection line must not exceed the following values for the maximum permissible capacitance and inductance:

| Mod. T24.10.**2 | Sensor + Cine < $C_O$  | $C_O = 500 \ \mu F$ | Sensor + Line < $L_O$  | $L_O = 50 \ \mu H$ |
| Mod. T24.10.**2 | Sensor + Cine < $C_O$  | $C_O = 20 \ \mu F$ | Sensor + Line < $L_O$  | $L_O = 10 \ \mu H$ |
| Mod. T24.10.**9 | Sensor + Cine < $C_O$  | $C_O = 200 \ \mu F$ | Sensor + Line < $L_O$  | $L_O = 1000 \ \mu H$ |
7. Further ... approvals / 8. Notes ... shipbuilding industry

7. Further country-specific approvals

<table>
<thead>
<tr>
<th>Version</th>
<th>Explosion protection</th>
<th>Approval No.</th>
<th>Approval</th>
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<tbody>
<tr>
<td>T24.10.**6</td>
<td>intrinsically safe</td>
<td>CSA 1248412</td>
<td>CSA International</td>
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<tr>
<td>T24.10.**6</td>
<td>intrinsically safe</td>
<td>FM 301588B</td>
<td>FM Approvals</td>
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<td>T24.10.**2</td>
<td>II 1G Ex ia IIB/IC T4/T5/T6</td>
<td>2003EC02CP027-X</td>
<td>INMETRO</td>
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<tr>
<td>T24.10.***</td>
<td>Ex ia IIB/IC T4--T6</td>
<td>DE.C.32.001.A. No. 15279</td>
<td>GOSSTANDARD</td>
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<td>Ex ia IIB/IC T4--T6</td>
<td>GYJ04426X</td>
<td>NEPSI</td>
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</table>

For relevant data for instrument versions T24.10.**6 (CSA) and T24.10.008 (FM) see the enclosed installation drawing (section 15. FM).

8. Notes for application of T24 in the shipbuilding industry

The transmitters model T24.10.xxx-Gx are approved and certified for applications in the environment category D, F, H, EMC1 by Germanischer Lloyd. Please note the details in the approval certificate No. 47 183 - 03 HH.
9. Configuration

Input, measuring range, signalling and diverse parameters can be configured, see data sheet TE 24.01. The transmitters are delivered with a basic configuration (Pt100, 3-wire, 0 ... +150 °C, downscale) or configured according to customer’s specifications within the given configuration possibilities. With the later case, input and measuring range is given in clear text on the product label. The initial value of the measuring range is between -200 °C and +200 °C (T23.10.2Px) or between -150 °C and +150 °C (T24.10.1Px). The possible end of the measuring range is dependent on the respective initial value of the range. For possible combinations of initial value of measuring range / end of measuring range see the diagram shown on the following page. For the purpose of clarity this dependency is represented in 50 °C steps in this diagram, but intermediate values are also configurable. Amendments to configuration should be noted on the product label with a waterproof fibre tipped pen.

For the configuration of the T24 a simulation of the input value is not required. A sensor simulation is only required for the functional test.

9.1 Configuration via the PC

For the configuration of the transmitter configuration software WIKA_TT and the programming unit PU348 is additionally required. Therefore WIKA offers an optional configuration set for the T24 (order no.: 3634842), consisting of the following components:

- Configuration software WIKA_TT (suitable for Windows 3.xx / 95 / 98 / 2000 / ME / XP / NT 4.0):
- free of charge download from the Homepage www.wika.de

WIKA Operating instructions temperature transmitter Model T24.10
10. Connection of the programming unit PU348

- Transmitter, programming unit and PC must be used outside the hazardous area during configuration.
- Yellow and green are connected only if configuration of the T24 is to be made when the transmitter is on-line.
- When configuring in the workshop, an external power supply is not required as the programming unit provides the power.
- Tighten the screws of the terminal connections to avoid communication errors.

10. Connection of the ... / 11. T24 configuration software

Wiring according to the picture above. It is absolutely necessary that there is a contact between the positive pole of the transmitter and the red crimp as well as the negative pole of the transmitter and the black crimp. The connection of the green and yellow crimp is only necessary if the measuring signal (4-20 mA) is supposed to be further conducted to a connected evaluation system.

In order to perform a configuration it is necessary to disconnect the wiring of the transmitter to a connected evaluation system (positive and negative pole), which may already be in place.

11. T24 configuration software WIKA_TT

For installation please follow the instructions of the installation routine. Configuration software WIKA_TT: free of charge download from the Homepage www.wika.de

11.1 Start of the software

You can start the WIKA_TT software by double-clicking on the WIKA_TT Icon

11.2 Connection

Via the menu item "Device"/"Load from device" a connection to a T24 is established. The configuration data of the connected T24 are displayed.

You now have access to all operation-relevant functions and parameters as:

- Sensor type and connection
- Measuring range and temperature unit
- Error signalling in the case of a sensor burnout
- Tag of test point (Instrument information)
- Write protection and diagnostic functions
11. T24 configuration software WIKA_TT

The software can only establish one single connection at the same time.
Do not interrupt the connection to the transmitter during this process, otherwise data cannot be read correctly.

The initial value of measuring range is configurable between -200 °C and +200 °C (T24.10.2Px) resp. -150 °C ... +150 °C (T24.10.1Px).
(see diagram page 17).
The configuration software checks the desired measuring range.
Only permissible values are accepted. Intermediate values are configurable, the smallest step is 0.1 °C.

Furthermore under the "process adaption" category adaptations to the process can be carried out, if required. The "Report" category supports the printout of a configuration protocol.

After changing the configuration data please remember to store the data in the device. By pushing the F1 key you can call up the extended help file, which assists you during the configuration and explains the terms used.

Should you require further configuration information, please refer to our internet address (www.wika.de / www.wika.com / download) for additional details (data sheets/notes etc.) or contact WIKA for additional technical support (see section 13, Service).

12. Troubleshooting

Fault-Tree

- Current loop disconnected
- Transmitter not connected
- Wrong polarity of the supply voltage
- Wrong transmitter configuration
- Process temperature out of range
- Sensor Burnout
- Process temperature out of range
- Sensor burnout or short circuit
- Wrong sensor connection
- Clamps interchanged
- Jumper is missing (2-wire connection P100)
- 4 mA < I < 20 mA but wrong values
- Wrong transmitter configuration
- Output current I is unstable and changes within seconds
- Electromagnetic Interferences
- Capacitive or inductive Coupling over the loop
- Output current I is okay at low values, but too low at higher temperatures
- Loop resistance too high
- Ground-Loop

WIKA Operating instructions temperature transmitter Model T24.10
12. Troubleshooting

Should any problems occur, please return the transmitter to the manufacturer with a short description of the problem, the ambient conditions and the period of operation until the problem occurred.

13. Maintenance

The temperature transmitters described here are absolutely maintenance-free. The electronics are completely encapsulated and incorporate no components which could be repaired or replaced.

14. Disposal

Dispose of instrument components and packaging materials in accordance with the respective waste treatment and disposal regulations of the region or country to which the instrument is supplied.

Service

Further information and contacts:

(+49) 93 72/132-0
or www.wika.de
17. Declaration of conformity

EC Declaration of Conformity
Document No.: 6004306

We declare that the C E marked products

Models:
   T24.10.xxx

Beschreibung:
Analogue temperature transmitter, PC configurable, head mounting

according to the valid data-sheet TE 24.01

are in conformity with the essential requirements of the directives and standards:

1) 89/336/EEC (EMC)

2) 94/9/EC (ATEX) 1)
   T24.10.xP2
   EN 50020:1994
   EN 50284:1999

1) EC-type-examination certificate DMT 02 ATEX E 025 X of EXAM
   BBG Prüf- und Zertifizier GmbH, Bochum (reg. no. 0158),

3) 94/9/EC (ATEX)
   T24.10.009
   EN 50021:1999
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<th>Frequency (Hz)</th>
<th>Ultimate working pressure*</th>
<th>Nominal motor rating**</th>
<th>Nominal speed (min⁻¹)</th>
<th>Volume flow (m³/h)</th>
<th>Sound pressure level (EN ISO 2151) with silencer, measured at +0.7 bar g (db(A))</th>
<th>Weight (kg)</th>
<th>Ambient temperature range (°C)</th>
<th>Ambient pressure (bar)</th>
<th>Synchronising gear oil qty (l)</th>
<th>Synchronising gear oil filled ex-works</th>
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*valid ultimate working pressure see nameplate

*may vary depending on specific order