Operating instructions for pressure gauges with electrical contact device,

Introduction

These operating instructions refer to installation, commissioning, servicing and adjustment. Statutory regulations, valid standards, additional technical details in the relevant data sheet, details of the type plate and any additional certificates are to be observed along with these operating instructions.

Safety instructions

- Installation, operation and maintenance of the instrument may be executed by authorized personnel, only, using suitable equipment.
- Warning: If the instrument is used incorrectly it is possible that serious injuries or damage can occur.
- Pressure gauges that are mechanically defective can cause injuries or give rise to process faults. Suitable precautions should be taken to avoid this.
- Separate regulations apply to service with hazardous media such as oxygen, acetylene, combustible substances, toxic substances and to service in refrigeration plant, compressors and the like.
- Prior to the disassembly of the pressure gauge the impulse ducts between the pressure gauge and the process have to be locked and relieved from pressure.
- The standard nominal pressure rating and the permissible operating temperature of the gasket should be observed for all process connections.
- De-installed pressure gauges can contain dangerous media residues. Adequate safety precautions must be taken when de-installing or transporting these instruments.
- Electrical equipment in hazardous areas should only be installed and commissioned by competent personnel. Modifications to devices and connections destroy the operating safety, the ex-proofing and the guarantee. The limit values detailed in the certificate of conformity are to be observed.

Transportation and storage

Store and transport pressure gauges under dry, clean condition and, where possible, in their original packaging. Avoid shock and vibrations.

Permissible storage temperature:	-40...+70°C
with case filling:	-20...+60 °C.

Mounting and operation

- Before mounting the instrument ensure that pressure range, overpressure resistance, media compatibility, thermostability and pressure port are suitable for the process at hand.
- Safety pattern gauges per EN 837-1 S1 and S3 must be mounted so that the blow-out device can be freely pushed off to the rear. Appropriate wall cut-outs are to be provided for wall-mounted devices.
- Pressure gauges are designed for self-supporting installation arrangements. An additional measuring instrument support should be fitted if the measuring line is not stable enough.
- Where possible, pressure gauges should be connected to the pressure measurement point by using an intermediate shut-off valve.
- Vibrations and pulsating measured media can significantly affect the service life of measuring elements. The following counter measures are common: vibration: liquid damping.
  Pulsating measured medium: Upstream connection of a flow restrictor and liquid damping.
- For steam measurements, siphons must be connected upstream of the device. Care should be taken during comissioning that enough condensate is available to prevent steam entering into the device.
- Measuring devices for water or steam pressure are to be mounted so that they are protected against frost. If this is not possible, diaphragm seals are to be connected in series with the devices. The same applies to media which, because they are aggressive or may cause blockage, should not enter the measuring element.
- If the measured media contain solids which could cause build-up of deposits in the devices, suitable filters together with the necessary controls should be connected in line.
- Instruments that should not have any oil or grease residues in the pressure element assembly are marked with the graphic symbol “oil can“ on the scale. Pressure gauges for oxygen operation are marked on scale with the graphic symbol “oil can“ and with the word “oxygen”. See recommendations of EN 837-2 for selection and installation.
- Pressure gauges are calibrated for vertical mounting. Any other mounting position is indicated by the position mark on the dial face.
- Not the housing, but the flange neck provided for this purpose is to be used for tightening and loosening. Open measuring flanges should not be distorted by excessively tightening the flange bolts, in order to avoid zero-point errors.
- Gaskets must be chosen that are suited to the process connection and resistant to the measured medium. Seal cylindrical screw threads by fitting a sealing washer to the front face of the gasket. Seal taper screw threads by screwing tight; typically a gasket material is applied to the male thread. Make sure that the set of gaskets you use are correct and in perfect condition when mounting the instrument; non-matching gaskets can cause faults.
- After mounting, the casing on pressure gauges with liquid filling and a nominal range ≤ 10 bar is to be aerated through the prescribed fitting device (atmospheric pressure compensation, see figure).

Before placing in operation move red air valve to limit stop !

- Electrical installation should only be carried out by competent personel in accordance with statutory safety regulations.
- The instrument can only be protected against electromagnetic interference (EMC) when the conditions for screening, earthing, wiring and potential isolation are met during installation.
- The instrument requires no maintenance.

Zero-point correction

Small measuring errors or deviations cause by difference in level between pressure gauge and point of measurement can be corrected on measuring devices with micro control position pointers, by turning the adjusting screw on the pointer hub. Similarly, displacement of the zero point caused by use and long service life can be checked from time to time and corrected if necessary.

CE marking

The CE marking on the instruments certifies compliance with valid EU directives for bringing products to market within the European Union. The following directives are met:

ATEX 94/9/EG, EMC 2004/108/EG, PED 97/23/EC, LVD 2006/95/EG

ATEX 94/9/EG: Electrical equipment in hazardous areas should only be installed and commissioned by competent personnel. Modifications to devices and connections destroy the operating safety, the ex-proofing and the guarantee.
EMC 2004/108/EG: The instrument can only be protected against electromagnetic interference (EMC) when the conditions for screening, earthing, wiring and potential isolation are met during installation.
PED 97/23/EC: Pressure gauges are pressure accessories in line with the Pressure Equipment Directive. The CE marking is granted after classification in the relevant categories. Unmarked instruments satisfy the Pressure Equipment Directive and are manufactured in accordance with "sound engineering practice".
LVD 2006/95/EG: The directive covers electrical equipment with a voltage at input or output terminals between 50 and 1000 volts for alternating current (AC) or between 75 and 1500 volts for direct current (DC).

Applied standards (among others)

EN 837-1	Bourdon tube pressure gauges. Dimensions, metrology, requirements and testing
EN 837-2	Selection and installation recommendations for pressure gauges
EN 837-3	Diaphragm and capsule pressure gauges. Dimensions, metrology, requirements and testing
DIN 16085	Control pressure gauges
DIN EN 60947-5-6	Low voltage systems (NAMUR)

Adjusting of contacts

To adjust the contact, the adjusting lock must be pressed down with a separate adjusting key until the lock lever riveted to the core of the lock touches the adjustment pin affixed to the set pointer. The key is turned laterally to adjust the set pointers over the entire range of the scale. In its pressed position, the lock lever should not touch the contact itself.
The contacts can be adjusted over the complete indicating range.
However, we recommend to set the switching points between 10 % and 90 % of the measuring span to ensure safety and switching accuracy.
The operation of a switching point outside the indicating range is not allowed.

Switch function and terminal connection

Switch function, terminal connections and directions of effect are realized according to DIN 16085.

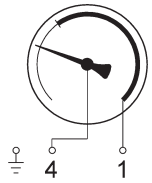
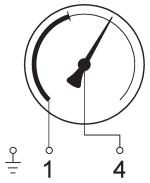
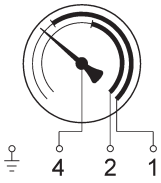
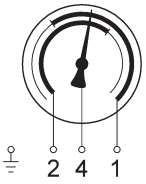
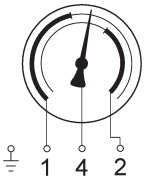
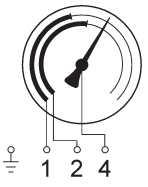
switchwing element	switch function: slow acting contact magnetic snap contact	switch function: inductive contact device	direction of effect
makers	makes contact	makes contact; control current on	increasing pressure
			decreasing pressure
breakers	breaks contact	breaks contact; control current off	increasing pressure
			decreasing pressure
change over contact	makes or breaks contact	not applicable	increasing pressure
			decreasing pressure

Pressure Gauge&Temperature Gauge

with electrical contact serie

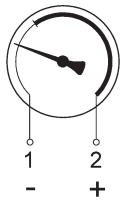
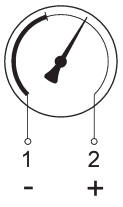
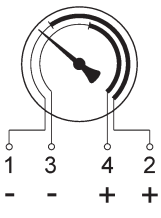
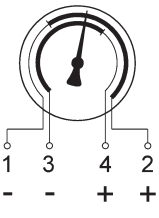
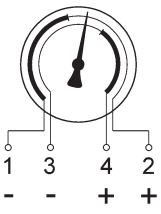
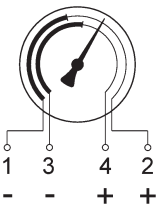
Magnetic snap-action contact type 821

1, 2 or 3 electrical adjustable contacts
Voltage max 250 VAC, maximum load 30W, 50 VA
Contact material silver-nickel alloy(80/20) Hysteresis 2-4% of full scale range
Option extra also Gold-silver or Platinum-Iridium

1 contact		2 contacts			
821.1	**821.2**	**821.11**	**821.12**	**821.21**	**821.22**
					
1 x max	**1 x min**	**2 x max**	**min - max**	**max - min**	**2 x min**
contact makes by rising pressure	contact breaks by rising pressure	contact makes by rising pressure	contact breaks by falling and rising	contact makes by falling and rising	contact breaks by rising pressure

Inductive contact type 831

1, 2 or 3 electrical adjustable contacts
The inductive contact is well suited to servere operating conditions, such as extremely swift changes or when an explosion safe design is necessary.The contacts are completely protected from touch and the hysteresis is less than 0,5%

1 contact		2 contacts				3
831.1	**831.2**	**831.11**	**831.12**	**831.21**	**831.22**	**831.xxx**
						Special option
1 x max	**1 x min**	**2 x max**	**min - max**	**max - min**	**2 x min**	
contact makes by rising pressure	contact breaks by rising pressure	contact makes by rising pressure	contact breaks by falling and rising	contact makes by falling and rising	contact breaks by rising pressure	

Touch contacts

The magnetic snap contact is a mechanical contact for switching capacities up to 30 W 50 VA max. Contact making will be delayed and or advanced in relation to the movement of the actual value pointer.
To close the circuit, the contact pin of the movable contact arm is attracted in a jump by the permanent magnet fastened to the supporting arm shortly before the set value has been reached. Due to the retention force of the magnet, magnetic snap contacts are more resistant against shock and vibration. The switching safety is increased by the increased contact pressure.
When the circuit is opened, the magnet keeps the contact arm in its place until the restoring force of the measuring element exceeds the magnetic force, and the contact opens in a jump. This sudden way of switching reduces the formation of a light arc between the contact pins and in this way allows for an increased switching performance.

Connection characteristic data for touch contacts

hysteresis error:	2 up to 5 % of meas. span (hysteresis) according to DIN 16085
switching accuracy:	1.5 of accuracy class (setting accuracy per DIN 16085)
contact setting range:	can be adjusted across the entire scale range (adjustment made with contact lock)
ambient temperature:	-25 up to +70°C
contact material:	silver-nickel 10µ gold plating, standard

Recommended contact load under resistive and inductive load and operation in air

voltage per DIN IEC 60038		slow acting contact			magnetic snap contact		
		resistive load		inductive load	resistive load		inductive load
DC	AC	DC	AC	cos φ > 0,7	DC	AC	cos φ > 0.7
220 V	230 V	40 mA	45 mA	25 mA	100 mA	120 mA	65 mA
110 V	110 V	80 mA	90 mA	45 mA	200 mA	240 mA	130 mA
48 V	48 V	120 mA	170 mA	70 mA	300 mA	450 mA	200 mA
24 V	24 V	200 mA	350 mA	100 mA	400 mA	600 mA	250 mA

The switching current should not be lower than 20 mA for 24 V DC.

Limit values for the contact load under resistive load and operation in air

		slow acting contact	magnetic snap contact
rated insulation voltage U_i		60 < U_i ≤ 250 V	60 < U_i ≤ 250 V
rated operation voltage U_{eff} max.		250 V	250 V
rated current:	- make rating	0.7 A	1.0 A
	- break reating	0.7 A	1.0 A
	- continous load	0.6 A	0.6 A
switching capacity		10 W 18 VA	30 W 50 VA

Limit values for current, voltage and output should not be exceeded.

Minimum values for the contact load under resistive load in air

	slow acting contact		magnet snap contact	
rated operation voltage U_{eff} min.	24 V		24 V	
switching capacity (DC AC)	0.4 W	0.4 VA	0.4 W	0.4 VA

The use of contact protection relays is recommended in order to provide the greatest switching reliability possible, to prevent contact interruptions and to increase the breaking capacity. The service life of the contacts is considerably increased, because 99% of the time the contacts are opened and closed in a voltage-free state. This switching amplifier should definitely be used in measuring devices with liquid filling.

Limit values for the contact load under resistive and inductive load and operation in liquid filling (oil)

	slow acting contact	magnetic snap contact		
rated operation voltage U_{eff} max:	slow acting contacts are generally unsuitable for devices with liquid filling	(AC) 230 V ~	(AC) 110 V ~	(AC) 48 V ~
rated current:		90 mA	90 mA	90 mA
switching capacity (AC):		20 VA	10 VA	4.3 VA

Maximum values for current (90 mA) and output (20 VA) should also not be exceeded with low operating voltages. This means that 24 V AC operating voltage is too low to assure secure switching in liquid filling. We recommend the use of contact protection relays for DC voltages.

Connection characteristic data for explosion protection

Contact devices for use in zones 1 and 2 considered as simple electrical equipment as per IEC / DIN EN 60079-11 for connection to intrinsically safe circuits Ex IIC T6 only and with following max. values:
U ≤ 24 V DC I ≤ 30 mA P ≤ 0.7 W
Intrinsically safe circuits must not be connected or branched. The operation at switching contacts with change-over function is not allowed. Exception: The change-over contact is only applied as breaker or maker, according to EN 60079-14.

Operation with liquid filling

As the liquid filling (in general oil) is non conducting, an insulating layer is formed between the contact pins which must be overcome by the applied voltage. The light arc which is formed between the pins will burn the oil and turn it cloudy.
In principle, direct voltages should only be used with small currents (20 mA), as direct voltage causes a standing light arc. High currents must also be avoided with alternating voltages, because these would burn the oil. Moreover, a high alternating voltage (e.g. 230 V) may be required to overcome the insulating layer. Tests have shown that at 230 V, only currents up to 90 mA will be operative, equalling a capacity of up to 20 VA. Depending on the thickness of the oil layer between the pins, a voltage of 24 V may be too small.
To avoid cloudy oil and to improve the switching safety, we recommend our „pulse controlled contact protection relays“ type PG1210A1 (see catalogue group M7).
The service life of the limit value switches is considerably extended by the use of our multifunctional relays, because the pulse and pause ratio will open and close the contacts at an almost voltage free level (99%). In addition, the relays have a certain time response which almost completely excludes fluttering effects.

Inductive contact devices

The electrical distance sensors (proximity sensors) acc. to EN 50227 or NAMUR respectively, used in inductive contacts are simple two wire DC switches merely containing the transistor oscillator.
We use proximity sensors type N which are also called slot sensors due to the slot design. The electromagnetic field is concentrated between two axially opposed coils. The switch operates when the aluminium control vane moved by the actual value pointer enters into the space or slot between the two coils. The signal is transmitted without a time lag analogous to the movement of the actual value pointer.
If no material is present around the slot, the oscillator will vibrate. In this condition, the impedance of the whole system is very low (approx. 1 kΩ). The coil system is attenuated as soon as the control vane enters into the air gap, the oscillator stops vibrating and the impedance of the whole system becomes relatively high (approx. 7 kΩ).
Current consumption : ≥ 3 mA (active face uncovered)
≤ 1 mA (active face covered)
The difference in the current consumption of vibrating and non vibrating oscillators is used to drive a switching amplifier which turns the input signal into a binary output signal. This is why the switching operation of inductive contacts is not only governed by the slot proximity sensor, but also by the switching amplifier.

Connection characteristic data for initiators per DIN EN 60947-5-6 (NAMUR):
nominal voltage: 8 V= (Ri ≈ 1KΩ)
operating voltage: 5 - 25 V
current consumption: > 3 mA (active face uncovered)
switching accuracy: approx. 0.5% of full scale value
contact setting range: can be adjusted across the entire scale range (adjustment made with contact lock)
ambient temperature: -25° to +100°C, SJ2-SN: -40 to +100°C, SJ3.5-SN: -50 to +100°C

Connection characteristic data and limit values for Explosion protection

PTB 99 ATEX 2219 X			Ex-valves for initiator										type of connected circuit as per type examination certificate
connection to intrinsically safe circuits Ex ia IIC/IIB or Ex ib IIC/IIB with:			SJ2 - N (DN 100)					SJ3,5 - N (DN 160)					
			C_i	L_i	Tu at T4	Tu at T5	Tu at T6	C_i	L_i	Tu at T4	Tu at T5	Tu at T6	
U_i = 16 V	I_i = 25 mA	P_i = 34 mW	30nF	100µH	100 °C	88 °C	73 °C	50nF	250µH	100 °C	88 °C	73 °C	1
U_i = 16 V	I_i = 25 mA	P_i = 64 mW	30nF	100µH	100 °C	82 °C	67 °C	50nF	250µH	100 °C	81 °C	66 °C	2
U_i = 16 V	I_i = 52 mA	P_i = 169 mW	30nF	100µH	78 °C	60 °C	45 °C	50nF	250µH	89 °C	60 °C	45 °C	3
U_i = 16 V	I_i = 76 mA	P_i = 242 mW	30nF	100µH	57 °C	45 °C	30 °C	50nF	250µH	74 °C	45 °C	30 °C	4

PTB 00 ATEX 2049 X			Ex-valves for initiator										type of connected circuit as per type examination certificate
connection to intrinsically safe circuits Ex ia IIC/IIB or EEx ib IIC/IIB with:			SJ2 - SN, SJ2 - S1N (DN 100)					SJ3,5 - SN, SJ3,5 - S1N (DN 160)					
			C_i	L_i	Tu at T4	Tu at T5	Tu at T6	C_i	L_i	Tu at T4	Tu at T5	Tu at T6	
U_i = 16 V	I_i = 25 mA	P_i = 34 mW	30nF	100µH	100 °C	88 °C	73 °C	30nF	100µH	100 °C	88 °C	73 °C	1
U_i = 16 V	I_i = 25 mA	P_i = 64 mW	30nF	100µH	100 °C	81 °C	66 °C	30nF	100µH	100 °C	81 °C	66 °C	2
U_i = 16 V	I_i = 52 mA	P_i = 169 mW	30nF	100µH	78 °C	60 °C	45 °C	30nF	100µH	89 °C	60 °C	45 °C	3
U_i = 16 V	I_i = 76 mA	P_i = 242 mW	30nF	100µH	57 °C	45 °C	30 °C	30nF	100µH	74 °C	45 °C	30 °C	4

The allowed electrical connection data and allowed ambient temperatures (Tu) for ex-operation should not be exceeded. Please refer to product category M7 for suitable switching amplifiers and isolation switch amplifiers for ex-areas.

Additional requirements relating to type BN4xxx pressure switches and type BP4xxx pressure limiters

The evaluation unit and downstream control current circuit are not part of our scope of supply.
The following evaluation units conform to the requirements of the Association of Technical Inspection Agencies (VdTÜV) Fact Sheet No. 100.

Pepperl+Fuchs, switching amplifier:
- Typ KHA6-SH-Ex1, PTB 00 ATEX 2043
- Typ KFD2-SH-Ex1, PTB 00 ATEX 2042

The use of alternative evaluation units is within the responsibility of the operator.
The operator is also responsible for the control current circuit and the locking switch required with pressure limiters, that comply with the Association of Technical Inspection Agencies (VdTÜV) Fact Sheet No. 100.