



ALF SENSOR SPÓŁKA JAWNA



INSTRUCTION MANUAL

Version 2.0

Pt100 Resistor Thermometers

Type_ TOP - Exd - PKG-230

Type_ TOP - Exd - PF-231...

Type_ TOP - Exd - PKGz-236

Type_ TOP - Exd - PKG / PF -238

NiCr - NiAl(K) and Fe – CuNi(J) Thermocouples

Type_ TER - Exd - PKG-232..

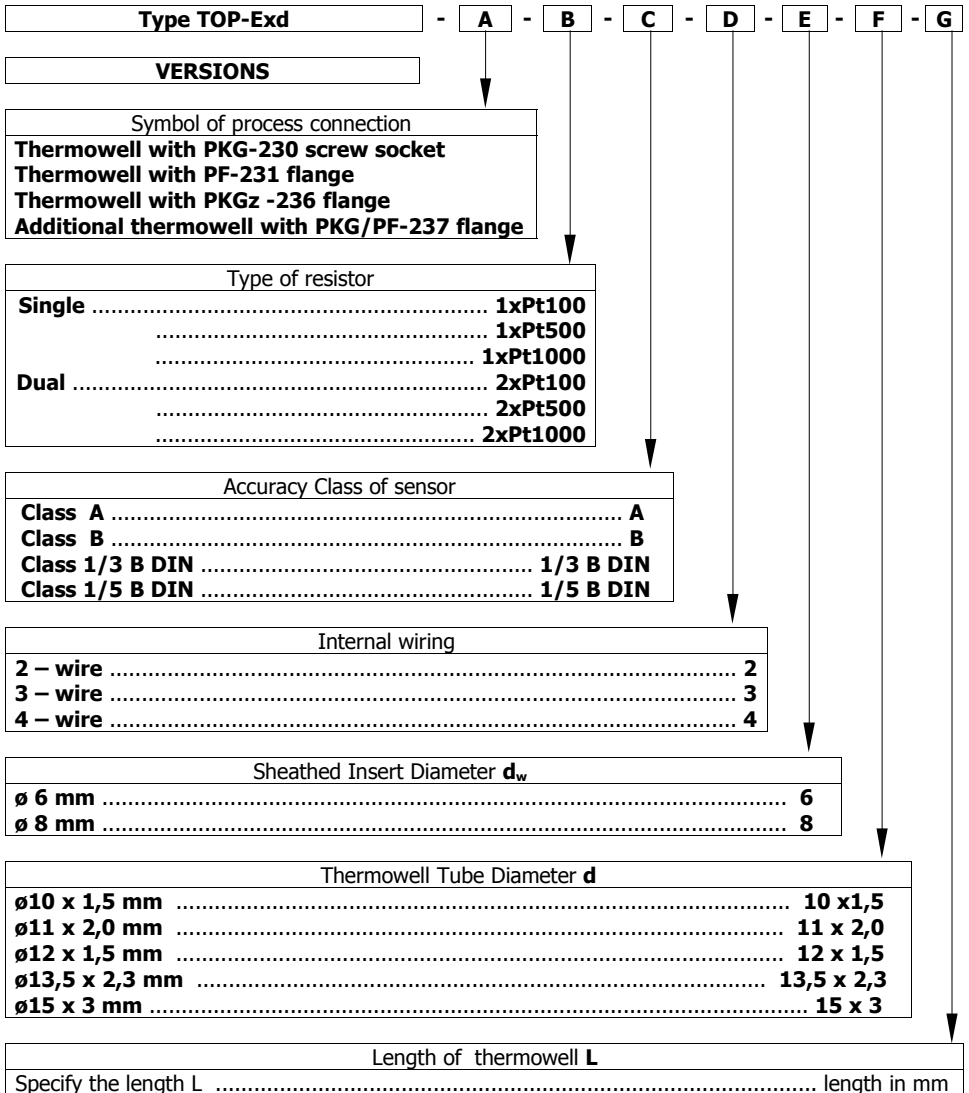
Type_ TER - Exd - PF-233...

Type_ TER - Exd - PKGz-237...

Type_ TER - Exd - PKG / PF -239...

1. Flame-proof Versions

1.1 Resistor Thermometers



Type TOP-Exd (cont.) - **H** - **I** - **K**

VERSIONS (cont.)

Thermowell Material	
Tube made of 1.4404 steel.....	1.4404
Tube made of 1.4301 steel	1.4301
Tube made of 1.4305 steel	1.4305
Tube made of 1.4541 steel	1.4541
Tube made of 1.4571 steel	1.4571
Tube made of 1.7335 (15 HM) steel.....	15 HM
Tube made of 1.7380 (10H2M) steel...	10H2M
Tube made of Hastelloy C 22 Alloy ..	Hastelloy
Tube made of INCONELL steel	INCONELL

Process Connection Type	
<i>Screw socket:</i>	
thread M12 x 1,5	M12x1,5
thread M14 x 1,5	M14x1,5
thread M16 x 1,5	M16x1,5
thread M18 x 1,5	M18x1,5
thread M20 x 1,5	M20x1,5
thread M24 x 1,5	M24x1,5
thread M27 x 2	M27x2
thread G1/2	G1/2
thread G3/4	G3/4
thread G1	G1
thread 1/2 „NPT”	1/2 „NPT”
thread 3/4 „NPT”	3/4 „NPT”
thread 1 „NPT”	1 „NPT”
<i>Flange – according to the customer's design</i>	
Flange acc. EN 1092	EN 1092
Flange acc. ANSI B 16-5	ANSI 16-5
Flange acc. PN-ISO 7001.5	PN-ISO 7001.5
Flange acc. DIN	DIN

Measurement Transmitter Type	
Without transmitter, with terminal block	
Type APAQ–HRFX	APAQ-HRFX
Type IPAQ–HX	IPAQ-HX
Type MESO–HX	MESO-HX
Model STT 25	STT 25
Model 144 H	144 H
Model 248	248
Other transmitters with the ATEX certificate specify type	

1.2 Thermocouples

Type TER-Exd	A	B	C	D	E	F	G
VERSIONS							
Process Connection Symbol							
Thermowell with PKG-232 socket screw Thermowell with PF-233 flange Add. thermowell with PKGz-238 socket screw Add. thermowell with PKG/PF-239 flange							
Measuring Insert Type							
WP-TE-J/K-02-Exd							
Measurement Element Type							
Single – 1x Fe-CuNi 1xJ 1x NiCr-NiAl 1xK Dual – 2x Fe-CuNi 2xJ 2x NiCr-NiAl 2xK							
Accuracy Class of sensor							
Class 1 1							
Class 2 2							
Diameter of the sheathed insert d_w							
ø 6 mm 6							
ø 8 mm 8							
Thermowell Tube Diameter d_r							
ø10 x 1,5 mm 10x1,5							
ø11 x 2,0 mm 11x2,0							
ø12 x 1,5 mm 12x1,5							
ø13,5 x 2,3 mm 13,5x2,3							
ø15 x 3 mm 15x3							
Length of thermowell L							
Specify the length L in mmlength in mm							

Type TER-Exd (cont.) - H - I - K

VERSIONS (cont.)

Thermowell material	
Tube made of 1.4404 steel.....	1.4404
Tube made of 1.4301 steel	1.4301
Tube made of 1.4305 steel	1.4305
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Tube made of 1.4571 steel	1.4571
Tube made of 1.7335 (15 HM) steel.....	15 HM
Tube made of 1.7380 (10H2M) steel...	10H2M
Tube made of Hastelloy C 22 Alloy ..	Hastelloy
Tube made of INCONELL steel	INCONELL


Process Connection Type	
Socket screw:	
thread M12 x 1,5	M12x1,5
thread M14 x 1,5	M14x1,5
thread M16 x 1,5	M16x1,5
thread M18 x 1,5	M18x1,5
thread M20 x 1,5	M20x1,5
thread M24 x 1,5	M24x1,5
thread M27 x 2	M27x2
thread G1/2	G1/2
thread G3/4	G3/4
thread G1	G1
thread 1/2 „NPT”	1/2 „NPT”
thread 3/4 „NPT”	3/4 „NPT”
thread 1 „NPT”	1 „NPT”
Flange – according to the customer's design	
Flange acc.. EN 1092	EN 1092
Flange acc.. ANSI B 16-5	ANSI 16-5
Flange acc. PN-ISO 7001.5	PN-ISO 7001.5


Measurement Transmitter Type	
Without transmitter, with terminal block	
Type IPAQ–HX	IPAQ-HX
Type MESO–HX	MESO-HX
Model STT 25	STT 25
Model 144 H	144 H
Model 248	248
Other transmitters with the ATEX certificate specify type	

2. Application

TOP – Exd Pt100 type resistor thermometers — and TOP - Exd thermocouples... have got flame-proof enclosure composed of two chambers: head chamber (XD – AD type) and measurement insert thermowell chamber. TOP - Exd... resistor thermometer , TER - Exd... thermocouple designated as:

 II 2 GD , Exd IIC T6 – for operation with the non-intrinsic safety circuit.

 II 1/2 G , Exd ia / ib IIA / IIB / IIC T6 / T5 – for operation with the intrinsic safety circuit .

 II 1/2 D , Ex tD A20/A21 IP66 T85°C

3. Operating and ambient temperature

Sensor designed for measurement of temperature:

- ◆ from – 40°C to + 600 ° C – TOP - Exd...type
- ◆ from – 40°C to + 1200 ° C – TER - Exd...type

The maximum ambient temperature of a head with terminal block:









- ◆ from – 50°C to +150°C – with VQM (silicon) „o-ring”

The maximum ambient temperature of a head with transmitter:

- ◆ from – 50°C to +85°C – with VQM (silicon) „o-ring”
- ◆ from – 25°C to +200°C – with VR 1 „o-ring” (fluoroelastometer)

After installation of sensors in potentially explosive area for measurement of temperature of medium according to p. 9 of the Instruction Manual, operator should assure, through the measurement, whether temperature of components of the thermometer or thermocouple remaining in contact with explosive mixture, does not exceed a temperature of its class.

4. The zones where resistor thermometers and thermocouples are allowed to be used

Item	Zone	Marking
01.	Zone 0, Zone 20	 II 1/2 G ,Exd ia/ib IA/IIB/IIC T6/T5  II 1/2 D, Ex tD A20/A21 IP66 T85°C
02.	Zone 1, Zone 21	 II 1/2 G , Exd ia/ib IIA/IIB/IIC T6/T5 ,  II 2 G , Exd IIC T6  II 1/2 D, Ex tD A20/A21 IP66 T85°C
03.	Zone 2, Zone 22	 II 2 G , Exd ia/ib IIA/IIB/IIC T6/T5,  II 2 G ,Exd IIC T 6  II 2 D, Ex tD A20/A21 IP66 T85°C

Thermowell (thermowell unit) can be situated in Zone 0 or Zone 20 solely. The head can be situated in Zone 1 (Zone 21) or Zone 2 (Zone 22) solely . The flange or socket screw is the limit between zones. Thread of a socket screw must be secured against self-unscrewing with e.g. glue (BERNER). Measurement insert operating in intrinsically safe circuit of the „ia” or „ib” category can be situated inside of flame-proof thermowell solely.

5. Standards

Sensors meet the requirements of:

**EN 60079-0:2006, EN 60079-1:2008, EN 60079-26:2007,
EN 61241-0:2007 , EN 61241-1:2005.**

6. Principle of Operation

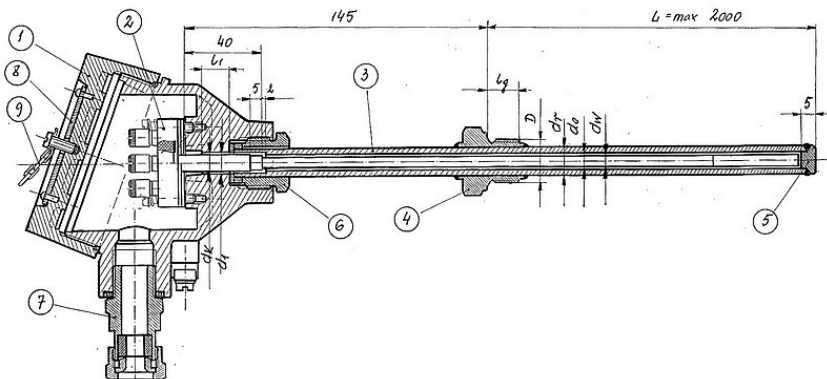
The measuring elements of the resistor thermometer are the 1xPt100 single or 2xPt100 dual resistor having characteristics complying to EN 60751 Class B, A, 1/3 B, and thermocouple with hot junction having characteristics complying to PN - EN 60584.

In the sensor, resistors having another value of resistance e.g. Pt500, or Pt1000 can be installed too.

Influenced by changes of the ambient temperature under control, resistance of measurement sensor resistor changes in accordance with its characteristics, or the thermocouple electromotive force.

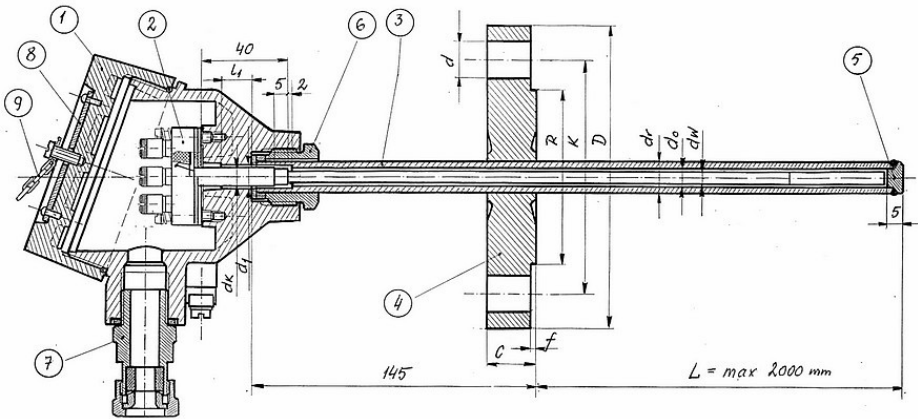
Temperature measurement, recording or control is performed with use of a device mated with the sensor, such as 2-wire transmitter (with signal 4...20mA), measurement instrument, temperature recorder or controller;

7. Design

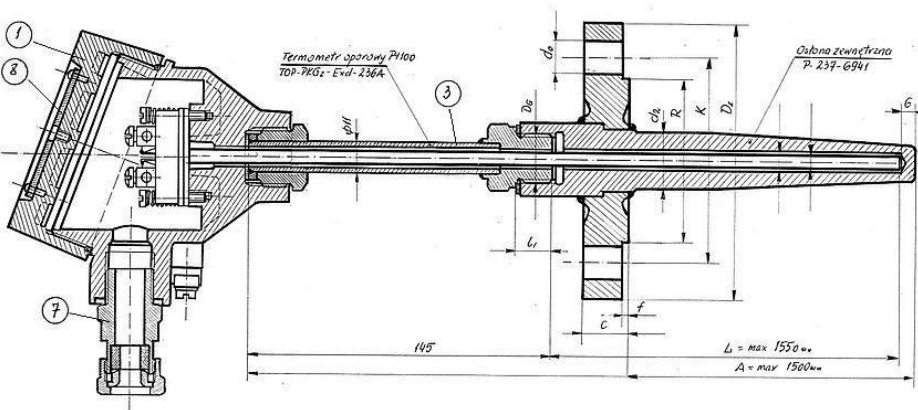


TOP-Exd-PKG- 230-...

TER-Exd-PKG-232-...

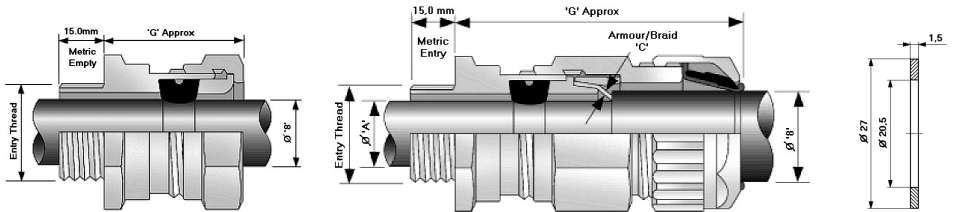


TOP-Exd-PF -231-...
TER-Exd-PF -233-...



TOP-Exd-PKGz-236A-... (without thermowell)
TOP-Exd-PKG/PF-237-...
TER-Exd-PKGz-238A-... (without thermowell)
TER-Exd-PKG/PF-239-..

7.2 Cable entries



There are two types of cable entries used in the heads, depending on type of connection cable and the outside diameter of cable.

- 501/421 Type of the cable entry from HAWKE International Co, for not armoured cables and sheathed (but with some limitations i.e. there where braiding and the outer sheath enter to inside of the head, and the end of armour is protected with e.g. shrinkable sleeve). Operating temperature from -60°C to $+100^{\circ}\text{C}$ for Zone 1, Zone 21, Zone 2, Zone 22 for gas groups IIA, IIB, IIC, IP68 protection rating. Certificate of conformity BASS 01 ATEX 2070 X ; Ex II 2 GD. Exd IIC.
- 501/453 Type cable entry from HAWKE International Co. for armoured cables and sheathed, wire armoured, with braiding or steel tape.
 - Operating temperature from -60°C to $+100^{\circ}\text{C}$ for Zone 1, Zone 21, Zone 2, Zone 22 for gas groups IIA, IIB, IIC, IP66 to IP68 protection rating . Certificate of conformity BASS 01 ATEX 2072 X ; Ex II 2 GD . Exd IIC
 - Other cable entries Exd II C with the ATEX Ex II 2 GD certificate , IP66 protection rating, operating temperature from -40°C to $+100^{\circ}\text{C}$.

7.3 Connection of the Pt100 resistance thermometer and thermocouple.

Resistance thermometers and thermocouples can operate with secondary devices (measurement instruments, temperature controllers or transmitters with the output signal 4...20 mA) .

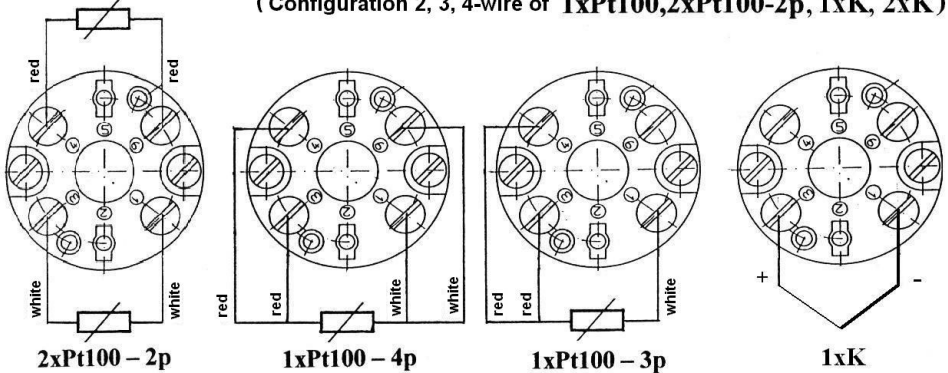
The electrical parameters of sensors :

Ci < 280pF : Li < 15µH : Ui < 10 V , Ii < 10 mA , Pi < 0,5 W

Depending on a connection system of the single or dual resistor , the connection should be done as follows:

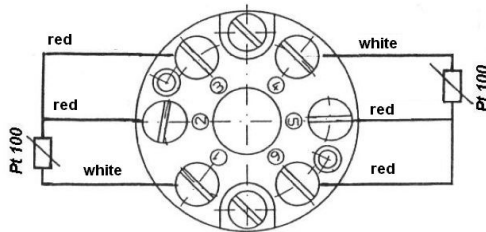
- for resistor thermometer with measurement insert with a terminal block having 4 terminals for 1xPt100 resistors in 2-, 3- and 4- wiring system and 2xPt100 resistor in 2 x 2 wiring system.
- for thermocouple with 4 terminals

Configuration 4-wire terminal block
(Configuration 2, 3, 4-wire of 1xPt100,2xPt100-2p, 1xK, 2xK)



- for resistor thermometer with measuring insert with the 6-terminals terminal block for 2xPt100 resistors in 2x3 wiring system.

Connection system with 6 terminals block



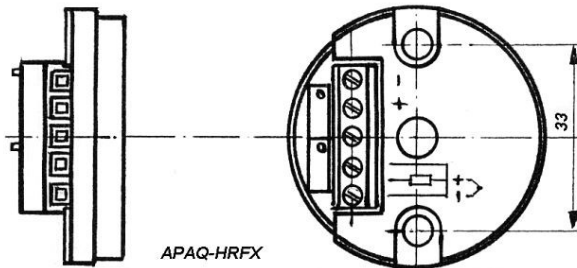
7.4 Head mounted transmitter

2-wire transmitter with the output signal 4...20 mA can be mounted in the sensor head in place of a terminal block. On the transmitter input Pt100 resistor or thermocouple are connected. Transmitters of the following types can be used e.g.:

- APAQ-HRFX transmitter for the Pt100 basic one solely, without possibility of changing the range at the site – DEMCO 03 ATEX 135011X Ex II 1 G , Ex ia II B T4/T5/T6,
- Intelligent IPAQ - HX transmitter, configured with PC, with the galvanic isolation 1500 VAC – DEMCO 02 ATEX 132033 Ex II 1 G , Ex ia IIC T4/T5/T6,
- MESO - HX SMART type transmitter, configured from the HART communicator or PC, with the galvanic isolation 1500 VAC, HART protocol .DEMCO 03 ATEX 134077 Ex II 1 G , Ex ia II CT6.
- other transmitters with the ATEX Ex II 1 G . Ex ia IIC T6

7.5 Connection of lines of the transmitter output signal outer loop

Connection is performed by connecting of the positive end of a power pack to terminal block of transmitter designated with the "+" sign, and of the negative end of a power pack to terminal block designated with the "-" sign.



8. Warranty

Manufacturer provides 12 month warranty for the temperature sensors on condition, that the product is used strictly in accordance with the requirements of Instruction Manual.

9. Storage and transportation

Temperature sensors should be stored in closed rooms at temperature from + 5°C to +50°C and humidity maximum 80%.

10. Mounting

Generally taking all temperature sensors can be mounted in any operating position. Depending on the thermowell type, the places where measurement is to be performed as well as type of medium, the following guidelines should be consider:

10.1 Temperature sensors should be mounted (if possible) in easy to access places, where the maintenance, as well as changing of measurement insert is facilitated and unrestricted.

10.2 Thermometers of a bigger length (particularly at high temperatures) should be mounted in vertical position, to avoid bending them under their own weight.

10.3 Mounting of thermometers in pipeline should be done this way, that temperature resistor, or thermocouple junction is in the pipeline axis.

10.4 When mounting thermometers with weld-in thermowells, thermometer should be unscrewed from the thermowell for the welding operation, while inside of the thermowell should be protected against dirt e.g. with a plug.

10.5 To reduce meaningfully an error of the sensor immersed in medium, in particularly the error resulting from temperature distribution, e.g. in the pipeline:

- Use sensor of such a length, that the immersed length is bigger than the length of the sensor above the pipeline. It can be done e.g. by a slant mounting of a bigger length sensor.
- A part of thermowell protruding above the pipeline should be provided with thermal insulation,
- When measuring temperature in pipelines with a low flow velocity, to increase the flow velocity necking should be used.

10.6 When mounting explosion-proof sensor, the thermal conduction of the thermowell as well as ambient temperature "Ta" should be taken into consideration, to make provision for a suitable temperature class of the temperature sensor.

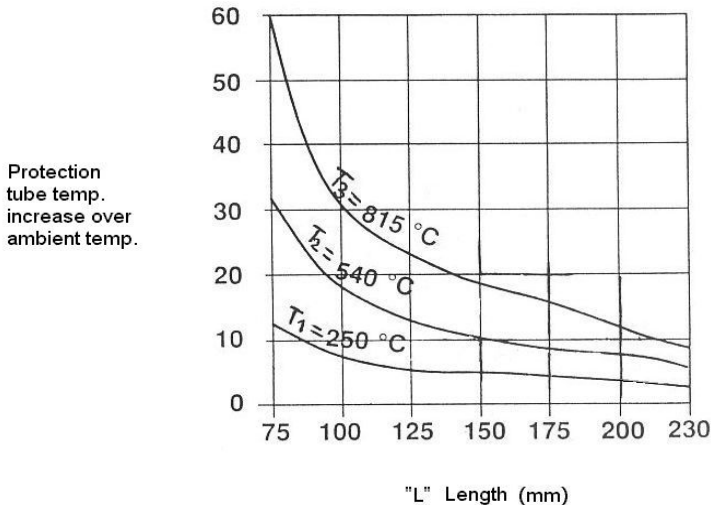


Figure 8

or the test installation Fig. 8 represents buildup of the sensor thermowell temperature above the ambient temperature "Ta" depending on its length "L" in the compartment $75 \text{ mm} < "L" < 230 \text{ mm}$ for different temperatures "T" of the measured medium . In the test installation measurements for $T1 = 250^{\circ}\text{C}$; $T2 = 540^{\circ}\text{C}$; $T3 = 815^{\circ}\text{C}$ were performed. It has been assumed that for $"L" = 0$, the thermowell has got the measured medium temperature "T".

Example:

The ambient temperature $T_a = 40^{\circ}\text{C}$. The measured medium temperature $T = 540^{\circ}\text{C}$. The Temperature Class of the sensor should be T6. We calculate the maximum admissible increase of temperature of the ambient:

- Temperature Class $T6=85^{\circ}\text{C}$
- The ambient temperature $T_a=40^{\circ}\text{C}$
- $(T6 - T_a) = 85-40=45^{\circ}\text{C}$

From the Fig. No 8 for $"L"=90 \text{ mm}$: temperature of the thermowell will grow 22°C above the ambient temperature. We assume, that $"L"=100\text{mm}$, what will assure a safe increase of the thermowell temperature. Therefore, when we measure e.g. temperature of medium in the pipeline, this should have thermal insulation of minimum thickness 100 mm. If we measure the temperature sensor with head mounted transmitter, the range should be matched to the ambient temperature T_a for a given temperature class, which is specified in the attached ATEX certificate of transmitter.

E.g. IPAQ – HX Type transmitter, has the following temperature classes:

- T4 $-40^{\circ}\text{C} < T_a < 85^{\circ}\text{C}$
- T5 $-40^{\circ}\text{C} < T_a < 65^{\circ}\text{C}$
- T6 $-40^{\circ}\text{C} < T_a < 50^{\circ}\text{C}$

Additional thermowells must comply with the requirements of standards PN-EN 50018, PN-EN 50284; threaded fitting must be secured with glue against self-unscrewing.

Mounting of the sensors in explosion risk area should be done in compliance with the operation rules for the explosion-proof devices to EN 60079-14. Electrical devices in explosion risk areas. Selection, installing, maintenance and repair of electrical devices intended to use in explosion risk areas.

10.7 Temperature limitations in the presence of flammable dusts.

The maximum temperature of a temperature sensor surface should not cross two thirds of the ignition temperature of dust mixture with air given in $^{\circ}\text{C}$.

The maximum temperature of the temperature sensor surface, determined with the method to EN 50281-1 chapter 10, should not cross the value lower by 75 K from the minimum temperature of ignition of layer of a given dust having the thickness from 5 mm to 50 mm. If the layer of dust can built-up on the sensor, having the thickness from 5 mm to 50 mm, then the maximum admissible temperature of the surface should be lowered adequately according to Fig.1 p.6.2.2 of PN-EN 50281-1-1-2.

10.8. Examples of thermometers and thermocouples mounting.

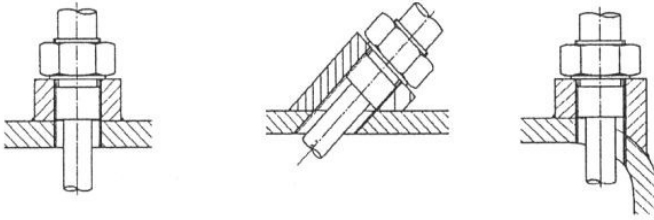


Fig.1 Example of the TOP-PKG type thermometers mounting

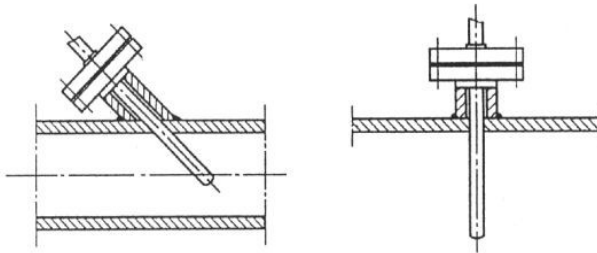


Fig.2 Example of TOP-PF type thermometers mounting

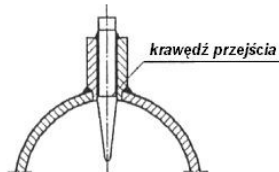


Fig. 3 The transition edge should be moved back slightly to inside of the hole

10.9 Insertion of wires through the cable entry to a terminal block or to transmitter

- The wire should be connected terminals of a terminal block or transmitter according to the data of p. **6.3** and **6.5** of the Instruction Manual.
- Preparation of a wire as well as the way of pushing it through the cable entry, depending on the wire type, as well as the way of protection of braid and armour, should be done in accordance with the rules given in the Attachments No 1 and 2.

11. Maintenance

If the thermometers or thermocouples are operated in accordance with the conditions in the Data Sheet, additional maintenance has not been required. In case of any doubts, that these means have not been adequate, first of all the measuring insert should be checked, keeping the top of thermometer or thermocouple in a known temperature, measure resistance or voltage, and compare the indicated value with the data to EN 60751 or PN - EN 60584.

When checking a transmitter decade resistor should be connected with 3-wire line to the input terminals, and the resistance referred to the beginning and end of the measuring range should be set in compliance with the a.m. standard, and then the output signals compared, that should be 4 mA and 20 mA accordingly.

12. Final remarks

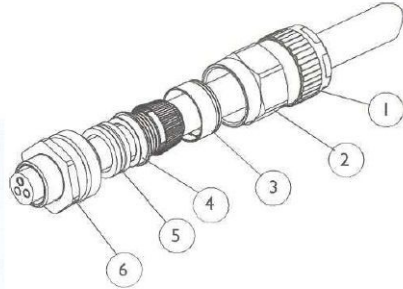
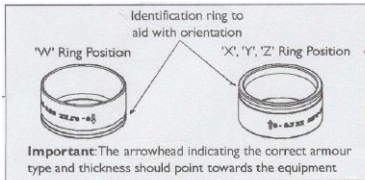
In case of any troubles in starting or operation of a Pt100 resistor thermometer or thermocouple, our company will provide you with technical information or advices related to the encountered problems.

ATTACHMENT 1

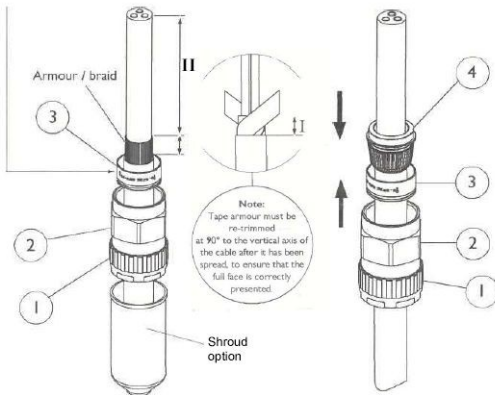
Mounting instruction for cable entry Type 501/453/RAC Certification BASEFA Nr.BAS 01 ATEX 2072X

Operating temperature from -60°C to +80°C, IP 65

1. Backnut
2. Middle Nut
3. Reversible Armour Clamping Ring (RAC)
4. Armour Spigot
5. Inner Seal
6. Entry (with captive deluge seal), if required



Cable Preparation



A

Strip Cable to suit equipment as shown above and expose the armour / braid 'J'.

'I' = 20mm for cable gland sizes Os to

'I' = 25mm for cable gland sizes C/ to F
'II' = to suit equipment.

If required, fit shroud.

Cable Gland Preparation

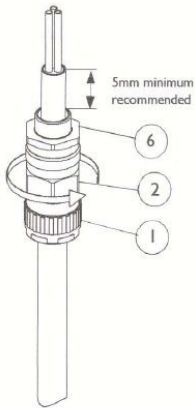
B

Push the cable through the armour spigot ④. Spread armour/ braid over the armour spigot ④ until the end of the armour / braid is up against the shoulder of the armour cone. Position the armour clamping ring ③.

C

Remove the inner seal ⑤ from the entry ⑥. Race the entry ⑥ over the armour spigot ④. Move the sub-assembly ② and ③ up to meet the entry ⑥.

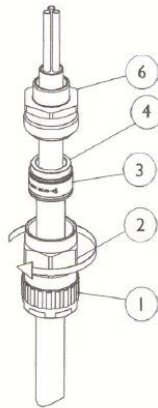
Note: If the equipment has a threaded entry, it may be advisable to screw the entry component into the equipment to prevent twisting of the cable after step D



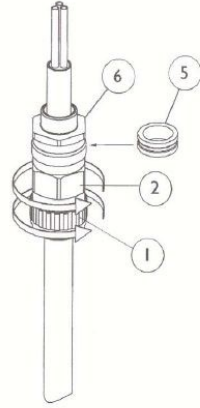
Unless already screwed into the equipment hold the entry ⑥ in position with a spanner / wrench to prevent rotation. Hand tighten the middle nut ② to the entry ⑥ and turn a further 1/2 to 3/4 of a turn with a spanner / wrench.

IMPORTANT: Support the cable to prevent it from twisting.

To ease wiring inside the enclosure, it may be beneficial to strip the inner sheath of the cable as shown above.



Unscrew the middle nut ② and visually inspect that the armour / braid has been successfully clamped between the armour spigot ④ and the armour damping ring ⑤. If armour / braid not clamped, repeat assembly.



Remove entry ⑥ and refit inner seal ⑤, replace entry ⑥ and re-assemble middle nut ② onto the entry component ⑥. Tighten up the middle nut ② using a wrench / spanner until resistance is felt between the seal and cable, then turn the middle nut through a further half a full turn to complete the inner seal.

Tighten the backnut ① to form a seal around the cable, then tighten a further full turn using a wrench / spanner. Ensure that the middle nut ② does not rotate when tightening the backnut ①. Ensure that the deluge seal is pulled down into position, if fitted.

Locate the shroud over the cable gland, if applicable.

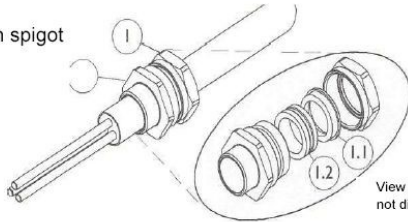
Note: Cable acceptance sizes are marked on the clamping ring and backnut

ATTACHMENT 2

Mounting instruction for cable entry Type 501/421/RAC
Certification BASEFA Nr.BAS 01 ATEX 2070X

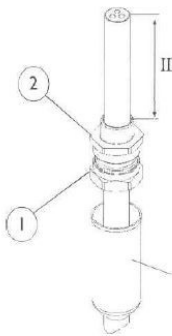
Operating temperature from -60°C to $+100^{\circ}\text{C}$, IP 65

1. Backnut
- 1.1 Compression spigot
2. Seal
3. Entry



View for clarity only, do not disassemble © & ©.

Cable Preparation

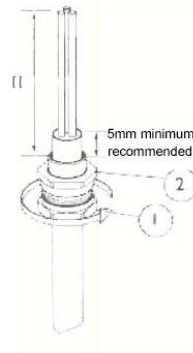


A

Allow sufficient length of cable, II, to suit equipment. If required, fit shroud. Pass cable through the cable gland as shown above.

Note : If the equipment has a threaded entry, it may be advisable to screw the cable gland into the equipment to prevent twisting of the cable after Step B

Cable Gland Preparation



B

Unless already screwed into the equipment, hold the entry © in position with a spanner/ wrench to prevent rotation and tighten the backnut © using a wrench/spanner until resistance is felt between the seal and cable. Then turn the back nut through a further half a full turn to complete the inner seal. Locate the shroud over the cable gland, if applicable.

To ease wiring inside the equipment it may be beneficial to strip the outer sheath of the cable as shown above.

IMPORTANT:SUPPORT THE CABLE TO PREVENT IT FROM TWISTING.