



ALF-SENSOR SPÓŁKA JAWNA

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INSTRUCTION MANUAL

Version 1.1

18.06.2009

RESISTANCE THERMOMETERS AND THERMOCUPLES WITH CONNECTION HEAD increased safety execution

Typ TOP-PD-03-.../Exe	Typ TER-PD-07-.../Exe
Typ TOP-PKG-04-.../Exe	Typ TER-PKG-08-.../Exe
Typ TOP-PKG-05-.../Exe	Typ TER-PF-09-.../Exe
Typ TOP-PF-06-.../Exe	Typ TER-P-10-.../Exe
Typ TOP-W-12-.../Exe	Typ TER-W-11-.../Exe
Typ TOP-Pm-26-.../Exe	Typ TER-P-44-.../Exe
Typ TOP-PKGm-27-.../Exe	Typ TER-PD-54-.../Exe
Typ TOP-PGm-28-.../Exe	Typ TER-PF-60-.../Exe
Typ TOP-PF/DN-55-.../Exe	Typ TER-PKG-64-.../Exe
Typ TOP-PD-71-.../Exe	Typ TER-PKG-78-.../Exe
Typ TOP-PKG-79-.../Exe	Typ TER-PKG-79-.../Exe
Typ TOP-PD-86-.../Exe	Typ TER-PF-97-.../Exe
Typ TOP-SpPKG-88-.../Exe	Typ TER-PKG-99-.../Exe
Typ TOP-PKG-141-.../Exe	Typ TER-Pdm-142-.../Exe
Typ TOP-PKG-158-.../Exe	Typ TER-PKG-143-.../Exe
Typ TOP-PKG-181-.../Exe	Typ TER-PKG-157-.../Exe
Typ TOP-PKG-193-.../Exe	
Typ TOP-PF-194-.../Exe	



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1. Options of increased safety execution

TOP – A – B – C – D – E – F – G – H – I – K – L /Exe

A: Symbol of process connection according to catalog card

PD – 03, PKG – 04, PKG – 05, PF – 06, W -12,
PF– 55, PD – 71, PD – 86, PKG – 79, PKG – 158, PF – 55

B: Type of measuring inserts: WP – OP – 01, WP – OP – 01 ds1,
WP – OP – 01 – SG

C: Type of

Single: 1xPt100, 1xPt500; Double 2xPt100, 2xPt500, 2xPt1000

D:

E: Internal wire configuration

2 – wire	2p
3 – wire	3p
4 – wire	4p

F: Diameter of protection tube d mm (diameter of measuring insert sheath D mm)

6, 8, 9, 10, 11, 12, 15, 18, 1/2", 1", 1 1/2", 2" and grater

G: Protection tube length L

Specify protection tube length L In mm according to order

H: Protection tube material – sheath:

- for 0 zone steel <10 % Mg, Al, Ti, Zr or <7,5% altogether Mg, Ti, Zr
- for 1 zone steel <6% Mg

1.4301, 1.4305, 1.4404, 1.4571, 1.4841, 1.7335, 1.7380, INCONEL, HASTELLOY, TYTAN, DUPLEX, i inne

I: Type of process connection

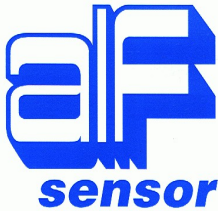
- For threaded fitting - M10, M12, M12x1, M14x1.5, M16x1.5, M18x1.5, M20x1.5, M24x1.5, M27x2, M33x3, G1/4, G1/2, G3/4, G1, 1/4NPT, 1/2NPT, 3/4NPT
- For flange – according to order (specify flange specification)

K: Type of connection head according to catalog card – material: aluminium cast <6 % Mg: protection rating IP67

Insulation intervals and clamps according to PN-EN 60079-11:2007 (U)
XE – DANA, XE – DANAW, XE – DANAF, XE – DANAFW, XD-AD, XE-BE, XE-BED, XE-BEDF,
XE-BEwin, XE-BEDwin, XE-BEDFwin, BEG, BAEG

L: Type of transmitter

Without transmitter, with terminal block0

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e-mail: biuro@alf-sensor.com.plName of the product: thermocouples with connection head.
TER – A – B – C – D – E – F – G – H – I – K – L /Exe**A:** Symbol of process connection according to catalog cardPD – 07, PKG – 08, PF – 09, P – 10, W – 11, PD – 54, PD – 54 – skin,
PKG/PF – 64, PKG – 78, PKG – 78 – skin, PKG – 79, PD – 157**B:** Type of measuring inserts: WP – TE – 02, WP – TE – 02 ds1,
WP – TE – 02 – SG**C:** Type of thermoelement

1xK, 1xJ, 1xS, 1xB, 2xK, 2xJ, 1xT, 2xT and others

D: Accuracy class of sensor: 1, 2**E:** Diameter of protection tube d mm

6, 8, 9, 10, 11, 12, 15, 18, 20, 22, 30, ½", 1½", 2" and grater

F: Protection tube length L

Specify protection tube length..... L in mm

G: Protection tube material – sheath:

- for 0 zone steel <10 % Mg, Al, Ti, Zr or <7,5% altogether Mg, Ti, Zr
- for 1 zone steel <6% Mg

1.4301, 1.4305, 1.4571, 1.4841, 15HM, 10H2M, KANTHAL, INCONEL, TYTAN, DUPLEX, HASTELLOY
and others**H:** Type of process connection

- For threaded fitting - M10, M12, M12x1, M14x1.5, M16x1.5, M18x1.5, M20x1.5, M24x1.5, M27x2, M33x3, G1/4, G1/2, G3/4, G1, 1/4NPT, 1/2NPT, 3/4NPT i inne
- For flange – according to order (specify flange specification)

I: Type of connection head according to catalog card – material: aluminum cast <6 % Mg: protection rating IP67XE – DANA, XE – DANAW, XE – DANAF, XE – DANAFW, XD-AD, XE-BE, XE-BED, XE-BEDF,
XE-BEwin, XE-BEDwin, XE-BEDFwin, BEG, BAEG**K:** Type of jointInsulatedO
GroundedU**L:** Type of transmitter

Without transmitter, with terminal block.....0



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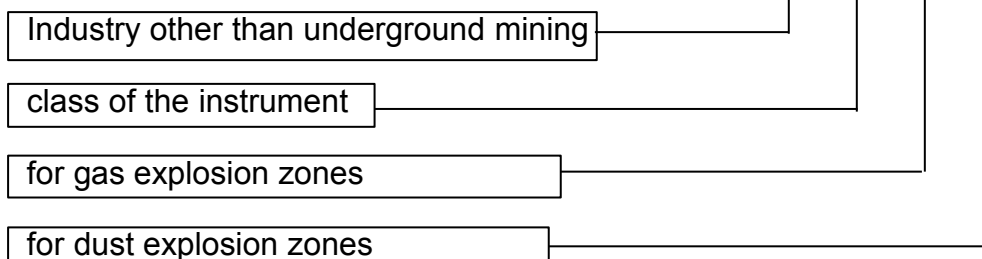
2. Application

Resistance thermometers and thermocouples has been designed for temperature measurement. Their measuring inserts are sectional and between measuring end and tube there is a thermal and electrical separation, which reduce temperature transfer from measuring end to the tube.

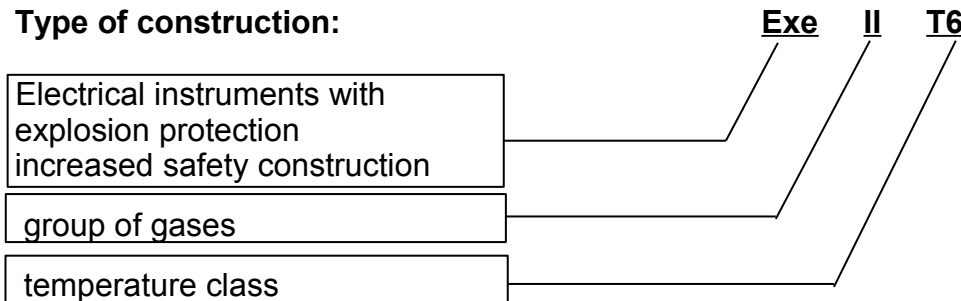
Resistance thermometers TOP-.../Exe and thermocouples TER-.../Exe have the following designation:

II 2 GD, Exe II T6

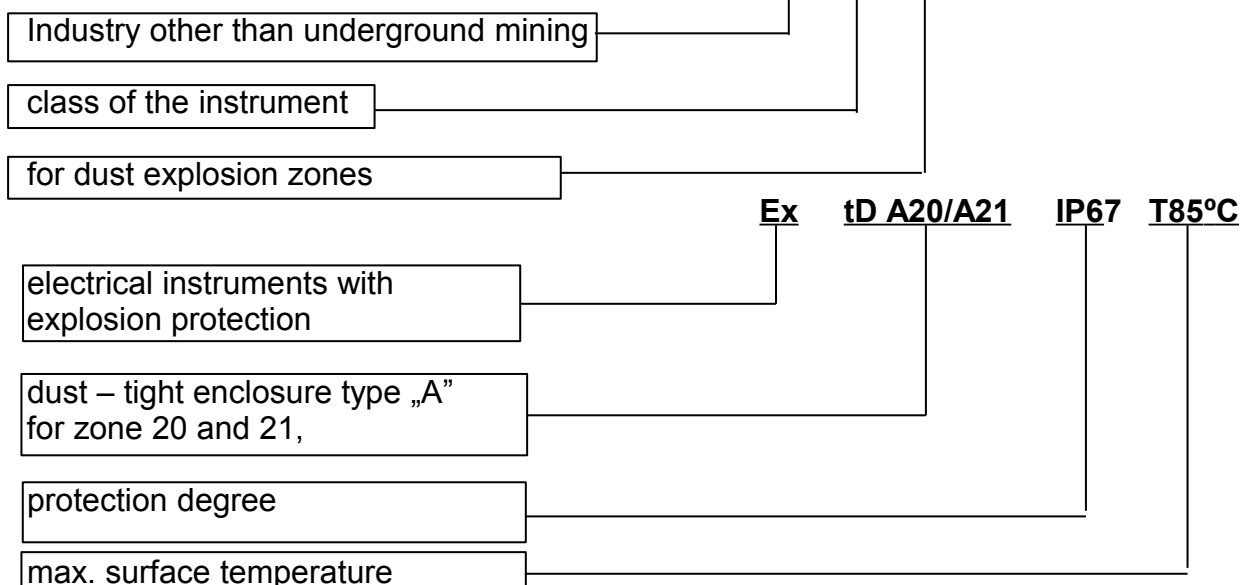
Application according to the directive ATEX II 2 G D

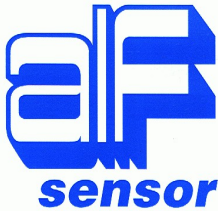


Type of construction:



Application according to the directive ATEX II 1/2 D





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Allowable installation zones:

No	Zone	Marking
1	Zone 1	 II 2 G, Exe II T6
	Zone 21	 II 1/2 D, Ex tD A20/A21 IP67 T85°C
2	Zone 0	 II 2 G, Exe II T6 ;  II 1/2 D, Ex tD A20/A21 IP67 T85°C
	Zone 20	In zone "0" measuring insert should be protected by casting with wall 1mm thick.

Sensor and connection head can be installed in zone 1 (21) or in zone 2 (22). Flange or threaded fitting mounted on protection tube is a boundary between zones. Thread of connection fitting should be secured against self unscrew. Inside the protection tube only measuring insert of improved execution can be installed.

3. Operating and ambient temperature

Sensor technical specification

Operating temperature range.....from -40°C to +80°C
Including threaded fitting temperature due to tightening O-ring.....to max. +80°C

Type of sensor

- Resistance thermometer - thin-film resistor Pt100 Cl.B, A, 1/3B.....for 1xPt100
 - double thin-film resistor Pt100 Cl.B, A, 1/3 Bfor 2xPt100
 - double ceramic resistor Pt 100.....for 2xPt100
 - characteristicacc. EN-PN 60751
 - configuration for 1xPt100..... 3 or 4 wire
 - configuration 2xPt100.....2x3 wire
- Thermocouple type of thermoelement e.g. 1xNiCr-Ni(K) lub Fe-CuNi(J)single thermocouple
 - Two thermoelements e.g. 2xNiCr-Ni(2xK) lub 2xFe-CuNi(2xJ).....double thermocouple
 - Characteristic..... acc. PN-EN 60584-1

After sensors installation in explosion zones in order to do temperature measurement of medium T, servicing personnel should assure through measurement, that temperature of parts of thermometer or thermocouple, which contact with the medium, do not exceed its temperature class.

Sensor electrical specification:

- **Thermoelements** - output clamps (terminal block, cable):
U₀=3 [V]; I_i=10 [mA]; L_i=0,3 [mH/m]; C_i=0,25 [nF/m]
- **Thermometric resistors** - output clamps (terminal block, cable):
U_i< 10 [V]; I_i< 10 [mA]; P_i< 100 [mW]; L_i< 400 [μH]; C_i< 6 [pF]

4. Standards.

Sensors fulfil requirements of:

- PN-EN 60079 – 0: 2006
- PN-EN 60079 – 7: 2007
- PN-EN 61241 – 0: 2007
- PN-EN 61241 – 1: 2005

5. Principle of operation

The measuring elements of the resistance thermometers are resistors 1xPt100 single, 2xPt100 double or elements of different resistance e.g. Pt500 or Pt1000 having characteristic complying to EN 60751 class B, A, 1/3B and thermocouple with hot junction having characteristic complying to PN - EN 60584.

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 measurement instrument, temperature recorder or controller.

6. Design.

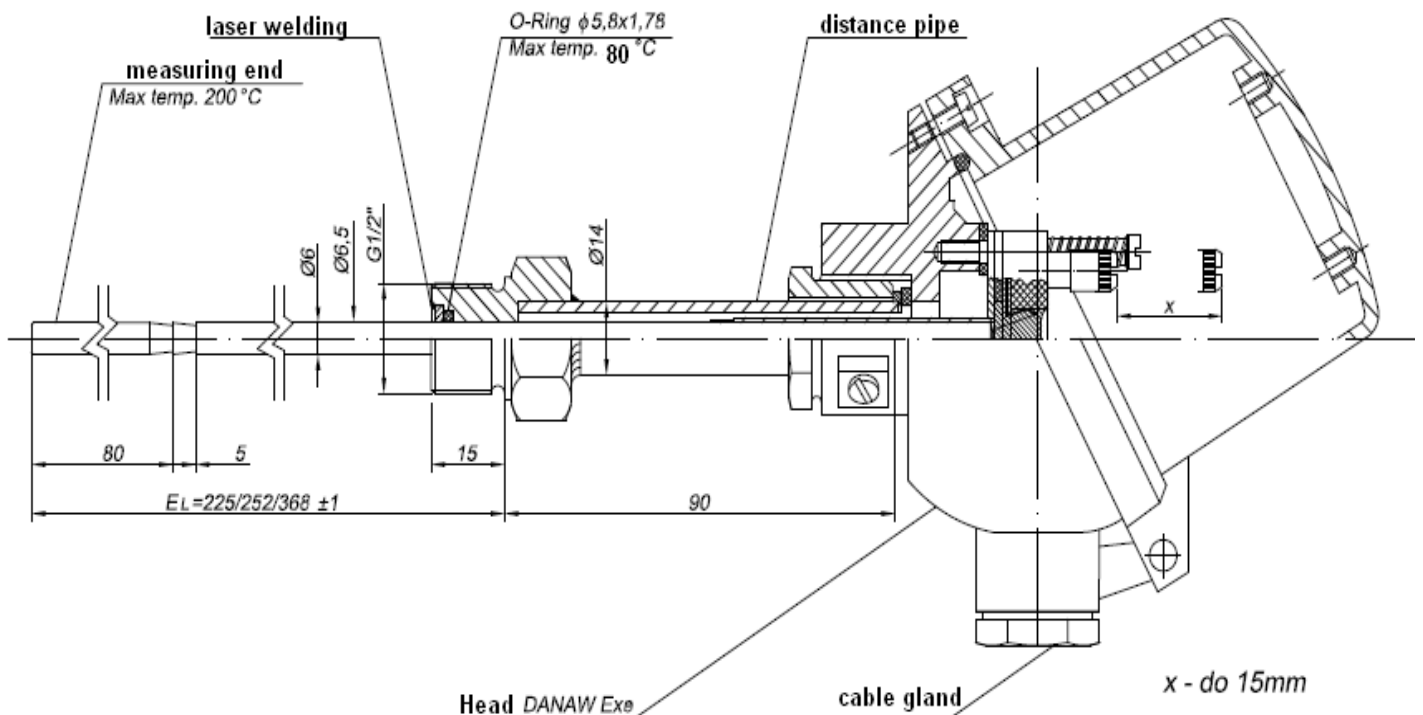
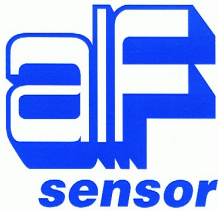


Fig. 1

TOP-PKG-79-Exe
TER-PKG-79-Exe



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Design according to the drawing No 1.

External protection – it is a body of bearing or its oil container

Immersion length of sensor.....	L = as per Client request
Diameter of insert.....	Ø 6 mm
Material of hot end and tube.....	1.4571
Material of thermal and electrical separation tube	Teflon (FEP- max. temp. to +250°C)
Distance tube..... Ø 14 mm.....	made of material1.4571
Threaded fitting.....	G1/2", M20x1,5. ½"NPT or the other
Leak-stopping o-ring inside threaded fitting	made of material NBR (resistant to +80°C)
Connection head....for Exe execution.....	type DANAW (IP67)
Cable gland M20x1,5.....	comply with requirements of Exe acc. ATEX

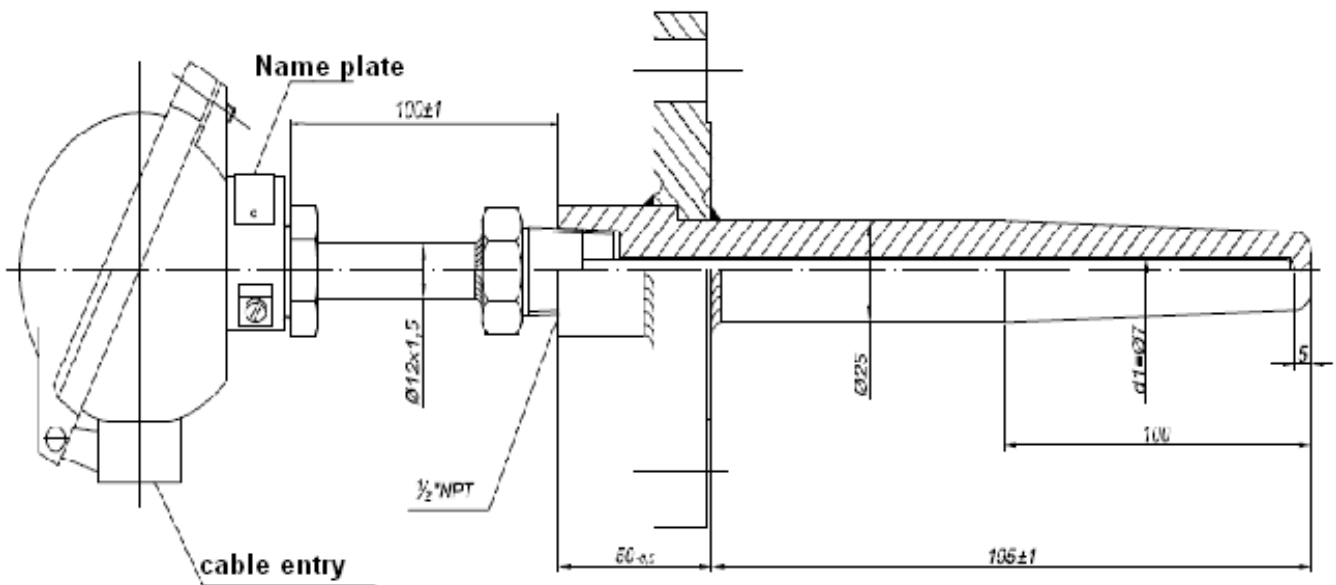
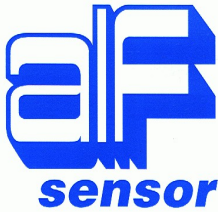


Fig. 2
TOP-PKG-78-Exe
TER-PKG-78-Exe

Design according to the drawing No 2.

External protection – only with protection sheath

Immersion length of sensor.....	L = as per Client request
Diameter of insert.....	Ø 6 mm
Material of hot end and tube.....	1.4571
Material of thermal and electrical separation tube	Teflon (FEP- max. temp. to +250°C)
Distance tube..... Ø 14 mm.....	made of material1.4571
Threaded fitting.....	G1/2", M20x1,5. ½"NPT or the other
Connection head....for Exe execution.....	type DANA (IP67)
Cable gland M20x1,5.....	comply with requirements of Exe acc. ATEX (IP67)



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6.1 Connection head of increased safety execution Exe.

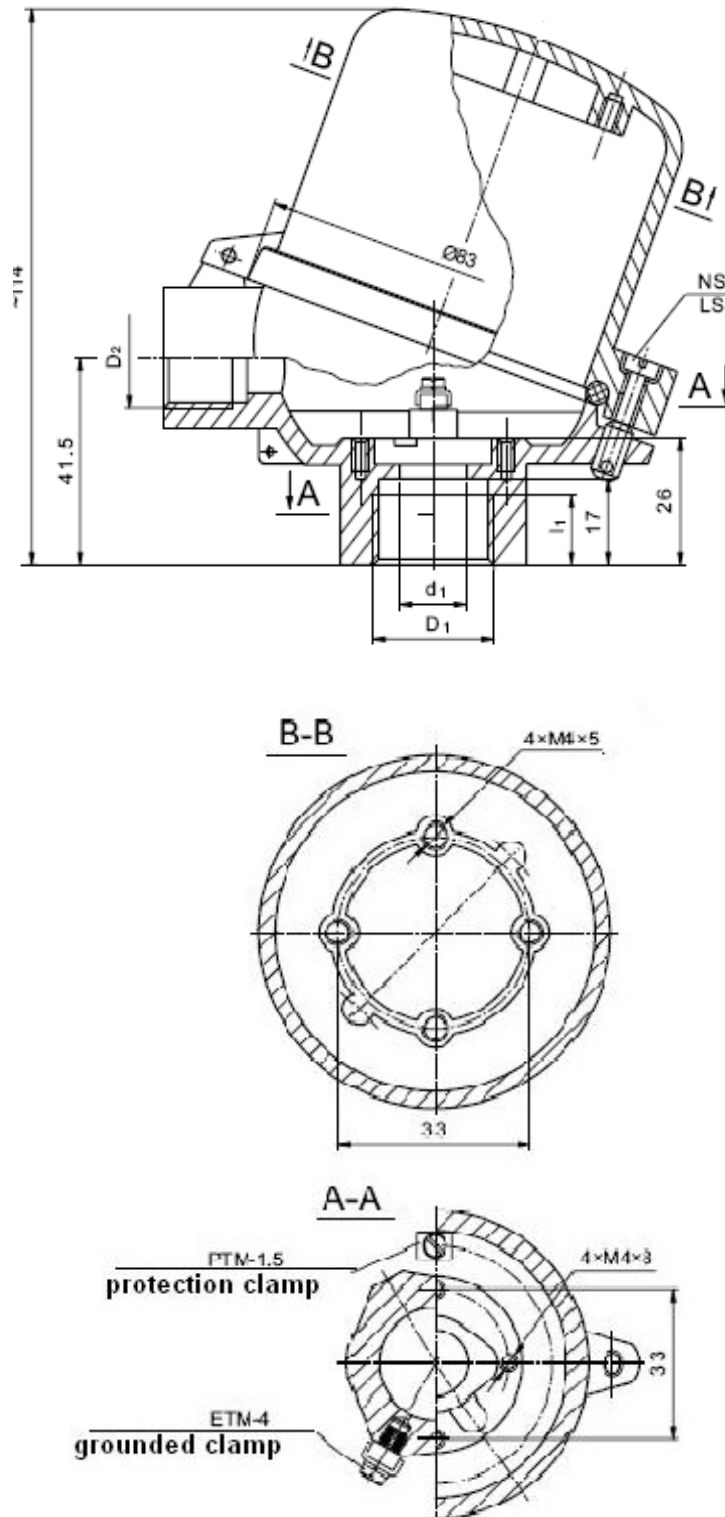


Fig. 3
Connection head of increased safety execution type XE-DANAW



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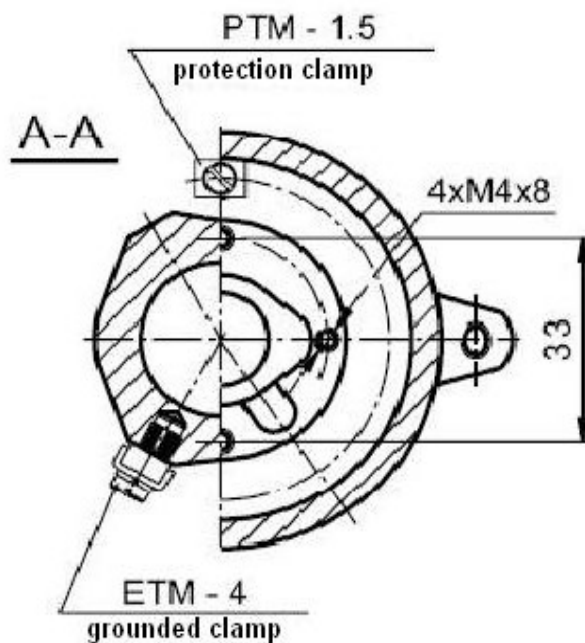
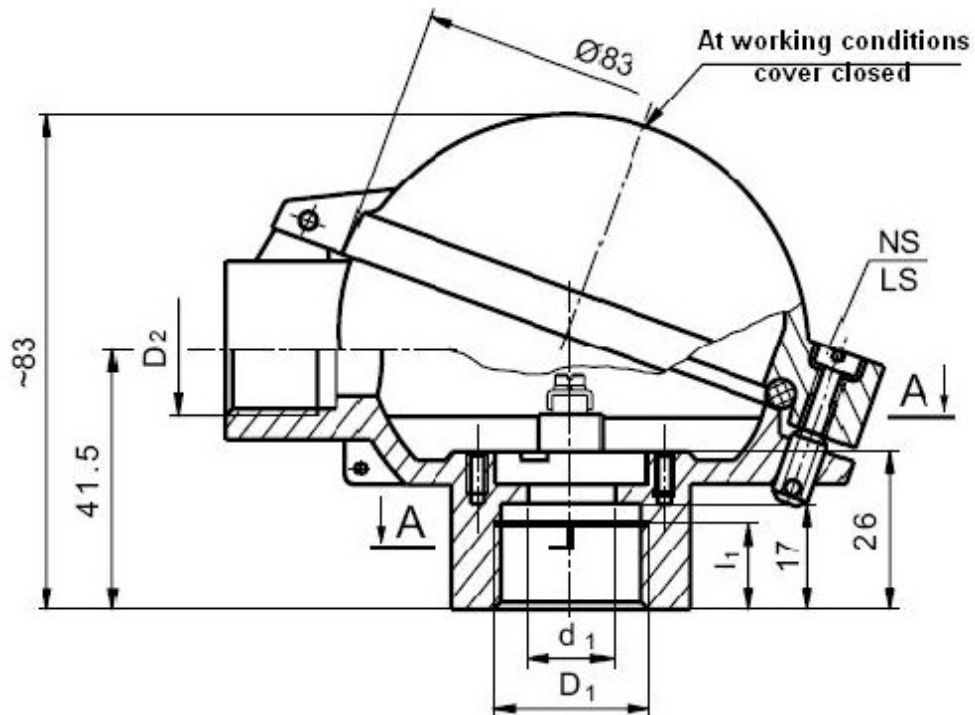


Fig. 4
Connection head of increased safety execution type XE-DANA



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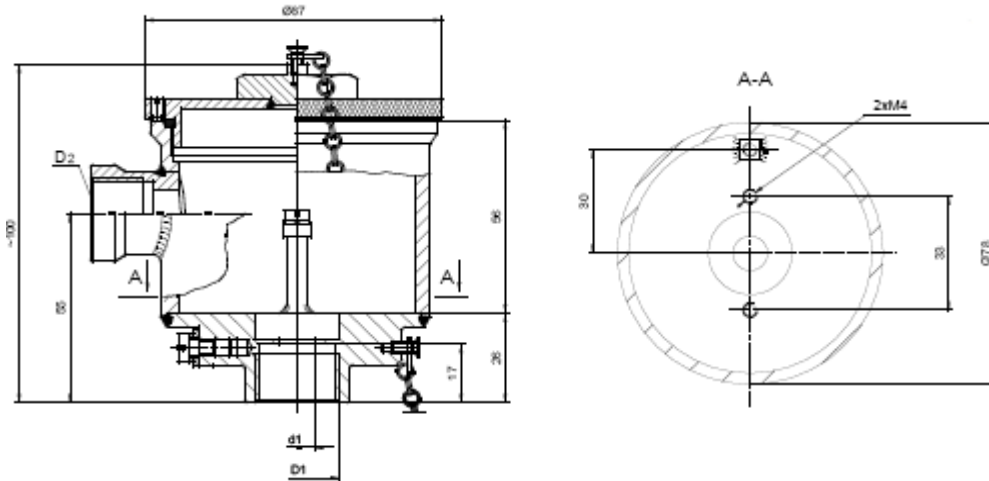



Fig. 5 XE- BE connection heads

The connection heads of increased safety execution type XE-BE have certificate FTZU 06 ATEX 0254U ;  II 2 GD, Exe tD II. Heads are made of aluminum alloy. Operation temperature of heads is between $-40^{\circ}\text{C} < T < 80^{\circ}\text{C}$. The head has been equipped in three elements of increased safety:

4. Cover of the head is secured by blocking screw, which secures against unscrew it by mistake or by not appointed people.
5. cable entry in order to ensure protection rating IP67, one can only and exclusively cable entries of increased safety Exe execution, adjusted to type and diameter of cable.
6. Inlet of replaceable insert with thread G1/2", M20x1,5. 1/2"NPT or other, one can secure by using leak-stopping washer, which ensures protection rating IP67 minimum.

The assurance of requirements for the increased safety execution demands absolute application of above points.

6.2. Cable entries

In the heads one can use the following cable entries, depending on type of connection cable:

- Type of the cable entry Pflitsch – U59 (U55). Operating temperature from -40°C to $+135^{\circ}\text{C}$ for Zone 1, 21, 2, 22 for gas groups II, IP68 protection rating. Certificate PTB 02 ATEX 1115 X ; Ex II 2 GD. Exe II. Diameter of the cable from 4 to 32 mm.
- Type of the cable entry Skintop® K- and Skintop® M- for armored and screened, armored by wire, braid or steel tape. Safety degree must be IP67 minimum. Operating temperature from -40°C to $+80^{\circ}\text{C}$. Diameter of the cable from 4 to 32 mm. Atest DMT 03 ATEX E044X; Ex II 2 G Exe II.
- The other cable entries Exe IIC with certificate ATEX Ex II 2 GD, pressure rating IP67 minimum. Operating temperature from -40°C to $+80^{\circ}\text{C}$.

6.3. Measuring inserts

The measuring insert is sectional and made of bottomed end necked from the other side. For necking part, PTFE tube made of Teflon FEP (resistant to $+250^{\circ}$) has been installed. On this part, metal tube $\varnothing 6$ mm has been installed and necked, to make non-separable joint.

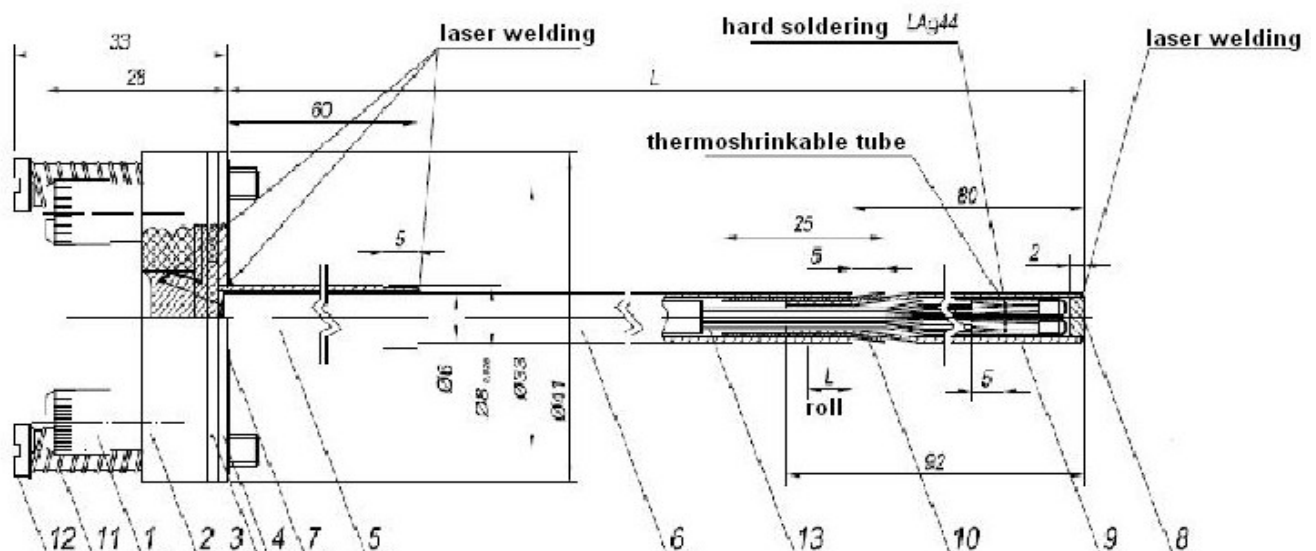


Fig. 6
Construction of measuring insert



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Insulation tube of FEP, placed between hot end, has two major functions:

- a) acts as a thermal barrier between hot end operating in temperature to +200°C and the tube Ø 6 mm, which is placed in distance tube with threaded fitting G1/2" (or the other), where O-Ring from material NBR is installed (resistant to temp. to + 80°C maximum). This construction prevent high temperature transfer to O-Ring.
- b) acts as electrical separation between measuring hot end and rest of the sensor.
The measuring insert is tested for electrical resistance:
 - the resistance of insulation through teflon tube should not be lower than 100 MOhm, by testing of voltage 500V during 1 minute.
 - insulation test with 500 V DC between end of wire and steel sheath, insulation should not be lower than 1,5 MΩ/km (e.g. For 3 m it should be 500MΩ)

There are following elements inside the hot end:

1. One thin film resistor Pt100 (for 1xPt100) connected to terminal block using wire of diameter 0,22mm² in teflon insulation of 3 or 4 wire configuration.
2. Two thin film resistors or double ceramic resistor Pt100 (for 2xPt100) connected to 2 x 3 wire configuration.
3. One thermocouple NiCr-Ni(K) or Fe-CuNi(J) for single thermocouple, made of thermocouple wires KX or JX in teflon insulation, connected to terminal block.
4. Two thermocouples 2xNiCr-Ni(2xK) or 2xFe-CuNi(2xJ) for double thermocouple.

Pt100 resistors, their connection points and thermocouple joint, are secured by teflon thermo-shrinking element, which secures the sensor.

The whole insert – resistors, thermoelements and wires are backfilled by oxide Al₂O₃ in order to provide insulation protection, by flange, protected by epoxide resin – Araldit.

There are holding down, prolonged length springs, mounted on the flange, which ensure possibility of moving hot end of the insert by 15mm maximum.

The measuring insert is mounted in a head, to which distance tube of Ø 14 mm with treaded fitting is installed. Inside the threaded fitting leak-protecting O-ring, of material NBR, operating to 110°C, is mounted. This O-ring protects the distance tube and the head from oil, which is used to smear the bearing.



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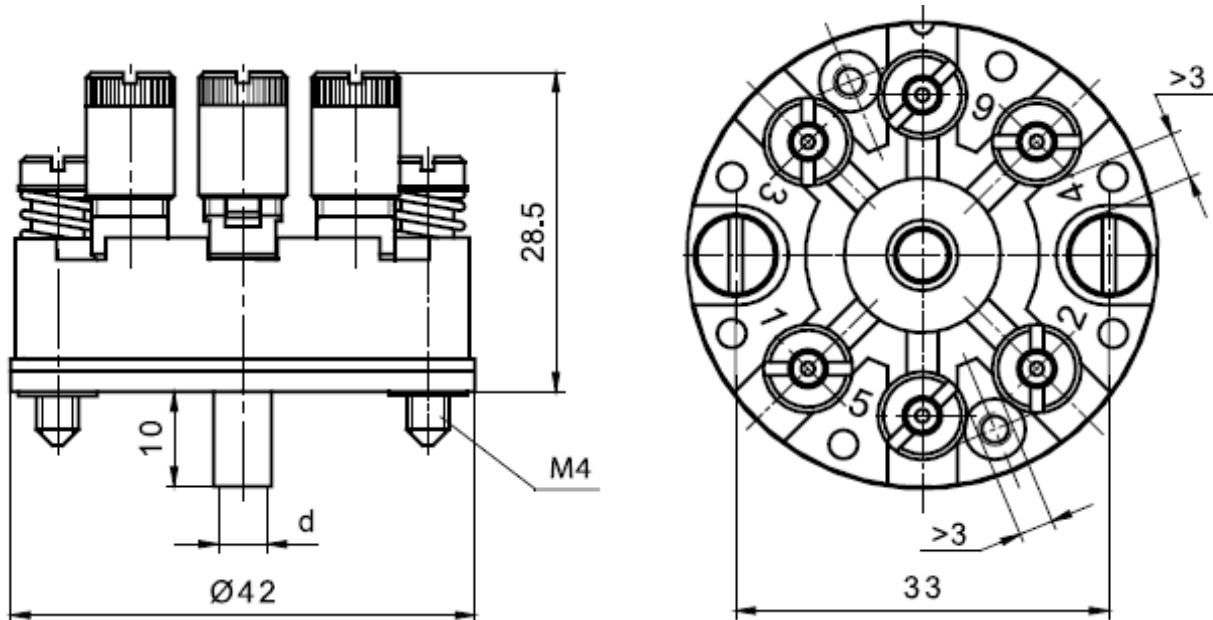


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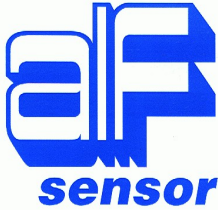
6.4. Terminal blocks of insert



Wires of the measuring insert are connected to soldering ends by using laser. After temperature sensor wires welding operation, the terminal block is heated to 200°C, and then connections are poured by epoxide resin "Araldit", which protects against overvoltages and ensures a surface insulation. All this fulfills Exe requirements (acc. PN-EN 60079-7). Terminal block clamps allow connection of wires up to 2,5 mm² diameter. There is permitted only one clamp connection to one measuring wire.

Used terminal blocks fulfill the requirements of increased safety regulations according to the certificate **04 ATEX 0003U** and by following construction:

- provides appropriate contact, without damage of the wires, which could reduce their functionality,
- the construction which makes impossible to slip off the wires during installation and exploitation,
- secure contacts against self-loosening.



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7. Mounting

Mounting of the sensor

- Before mounting the sensor, to the head one should screw a cable gland, which fulfills above requirements.
- After installing an oil-proof gasket onto the threaded fitting, one can screw the sensor to a place, where temperature measurement is planned.

All temperature sensors can be mounted in all required working positions. Depending on the type of external protection tube, the site of measurement, or medium of measurement, one should obey the following rules:

- 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.
- Thermometers of a bigger length L (particularly at high temperatures) should be mounted in vertical position, to avoid bending them under their own weight.
- Mounting of thermometers in pipeline should be done this way, that temperature resistor, or thermocouple junction is in the pipeline axis.
- By temperature measurement of bearings, the sensor should be screwed so as, measuring insert move deeper into the distance tube and touch bearing track it will cause that the measuring insert will move into the distance tube and into the head (maximum 15mm).
- The temperature sensors type TOP-PKG-79, TER-PKG-79 and TOP-PKG-158 used for temperature measurement of water and oil must be equipped in protection sheath.
- 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.



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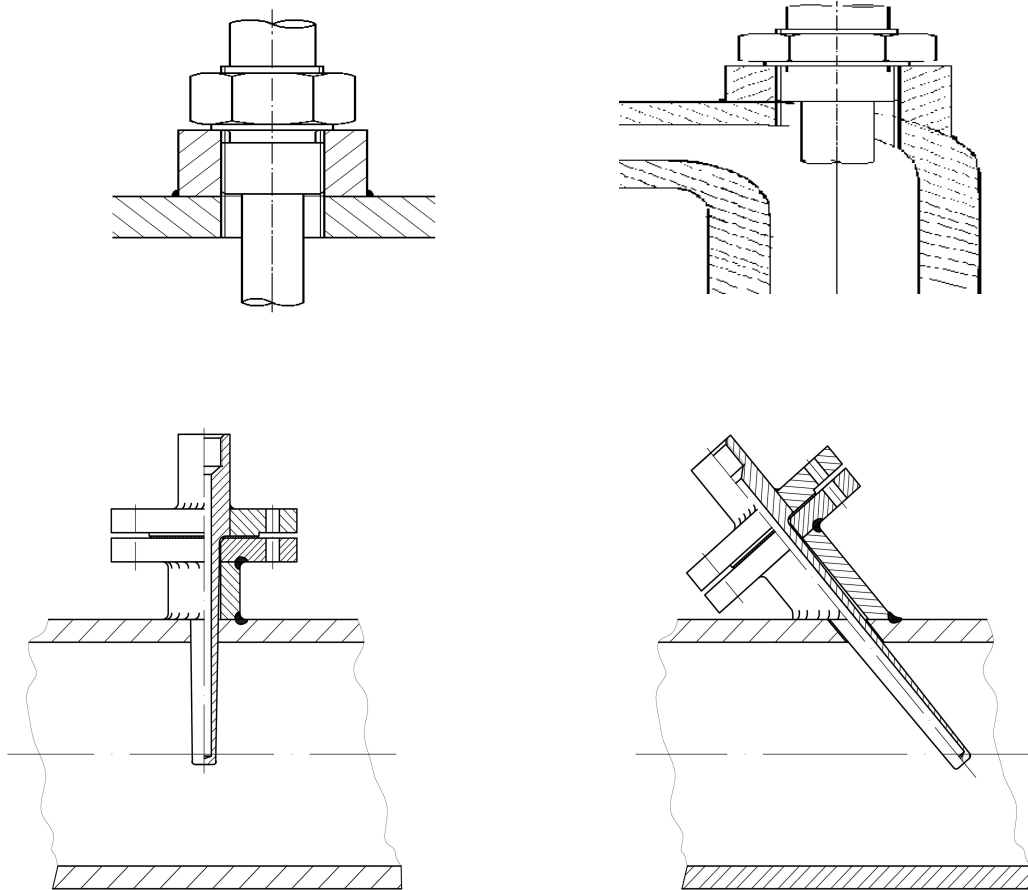


Fig. 6 Example of thermometers mounting TOP-PKG.../Exe and TER-PKG.../Exe

- the sensor is properly installed, it can be connected.
- In order to connect the sensor, one should unscrew the bolt of head cover and then lift the cover, to get access to clamps.
- For connection, one can use cable of diameter up to 2,5 mm². End of cable should be insulated in the section of 10mm, and protect a sleeve associated to the clamp.
- After above operations, one can connect the sensor, in accordance with connection diagram, shown on the insert drawings LA-9788 and LA9787.
- After connection, one should tighten gland on the cable, protecting it from pulling out.

8. Technical acceptance

The approval and authorization for operations by Quality Control Department of manufacturer is done basing on technical conditions of acceptance, which are grounded on following standards:

PN-EN 60751; PN-EN 60079-0; PN-EN 60079-7; PN-EN 61241-0; PN-EN 61241-1



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NIP: 677-10-20-794

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9. Cooperative instruments

Sensors can cooperate with any instruments, adjusted to work with particular thermometric resistor. For resistance thermometers, any instrument should be adapted to cooperate with current signal 4-20 mA, PROFIBUS or FIELDBUS signals.

10. Spare parts

Permissible for usage are only original parts, supplied by manufacturer Alf-Sensor company. Accompanied instruments should be ordered by the manufacturer as well.

11. Equipment

Standard equipment of thermometer consists of:

- ✓ Instruction manual
- ✓ Warranty card
- ✓ ATEX Certificate (for increased safety executions)
- ✓ Declaration of conformity (for increased safety executions)

12. 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. Contract of product delivery incorporates 12 month warranty including mistakes in the project of ALF-SENSOR origin or production of the product. Condition of considering the claim, is pointing causes of the claim, before the goods are returned to manufacturer. More detailed information you can find in general terms of sale and delivery positioned on web side of Alf-Sensor company.

13. Storage and transportation

Temperature sensors should be stored in closed rooms at temperature from + 5°C to +50°C and humidity maximum 80%. Transport of sensors should be done by covered carriage.



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14. Temperature class

The temperature class of the sensor defines the hottest surface, which can be obtained during process temperature measurement, in defined measuring range.

If the process temperature T is lower than ambient temperature T_a , the hottest surface will be by the head with transmitter. While the process temperature T is higher than ambient temperature T_a , therefore sensor surface will be heated by the process and the hottest part will be the sensor thermowell. In this case process maximum temp. T can be higher than temperature for its temperature class for particular explosive mixture, under condition that transfer and radiant heat from process temperature T do not heat any surface of the sensor, in explosion zone, above ignition temperature of this explosive mixture.

Designer of installation is responsible for particular sensor selection and its mounting, which after installation on the process, and during extreme working conditions, makes all sensor surfaces to be of lower temperature than temperature of temperature class for particular substance (gas, mist, stream)

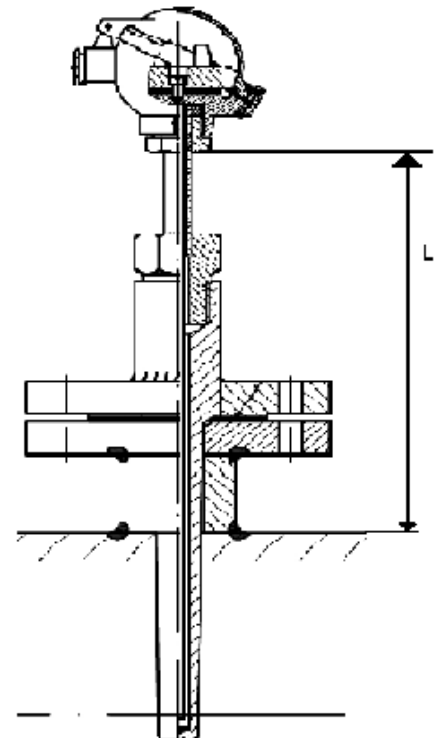
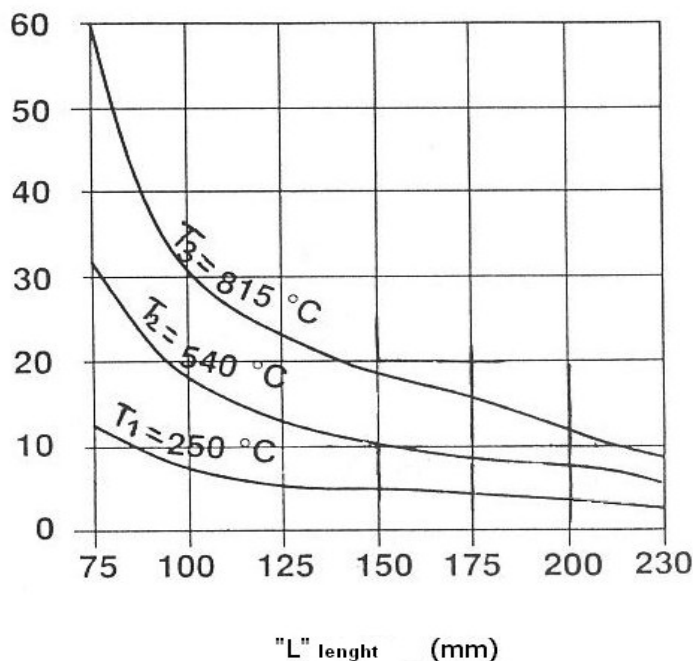


Fig. 7 Sensor's thermowell temperature increase in the function of its length L



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15. 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 °C.

The maximum temperature of the temperature sensor surface, determined with the method to EN 61241-0, should not cross the value lower by 75 K from the minimum temperature of ignition of layer of a given dust having the thickness of 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 PN-EN 61241-1.

16. 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.

17. 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.



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	Nazwisko i imię	Data	Podpis
Wykonał	R. Skrzyński	18.06.2009	
Zatwierdził	J. Mikołajczyk	18.06.2009	