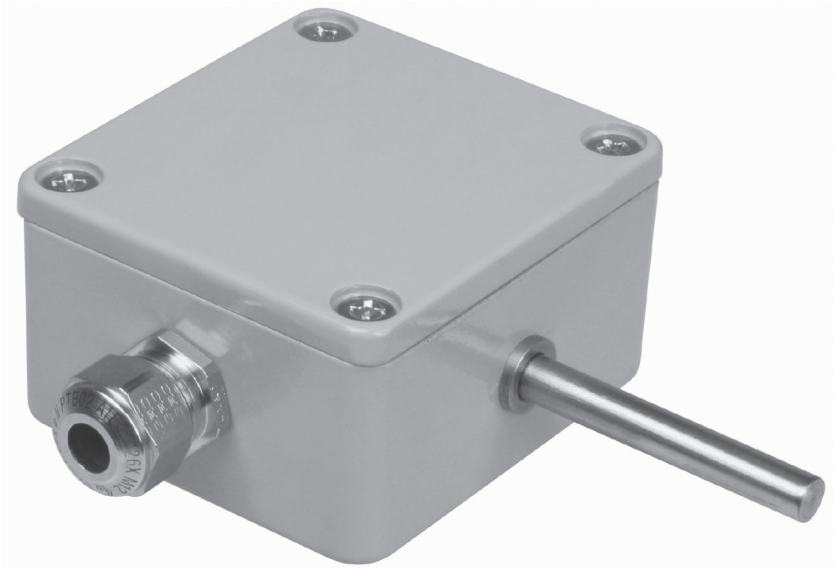
Intrinsically Safe Temperature Sensors for HVAC Applications

PN-EN 60079-0, PN-EN 60079-11, PN-EN 60079-26

II 2 G **II 3 G**
II 2 D **II 3 D**

Hazardous Areas - Ex ia



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1. Notes of safety.

Intrinsically safe temperature sensors are designed to use in hazardous location both gas and dust atmospheres. If used incorrectly it is possible that application – related danger may arise.

Intrinsically safe sensors may be installed, connected, commissioned, operated and maintained by qualified and authorized person only, under strict observance of these application manual, any relevant standards, legal requirements, and where appropriate, the certificate.

2. Application.

Temperature sensors are designed for temperature measurement in the industrial installations for measurement, signalization, monitoring, remote controlling in a range of industry branches, where hazardous areas of gas and dust occours.

Destination to the ATEX Directive

	Ex	II	1	G	D
non mining industry					
category of apparatus					
for gas hazardous areas					
for dust hazardous areas					

Hazardous areas		Category to ATEX
Explosion atmosphere of gases, vaporous mists	Zone 0	1G
	Zone 1	1G, 2G
	Zone 2	1G, 2G, 3G
Dust explosion atmosphere	Zone 20	1D
	Zone 21	1D, 2D
	Zone 22	1D, 2D, 3D

Kind of explosion protection for gases, vaporous and mist:

	Ex	ia	IIC	T1	Gb
electrical devices explosion protected to EC standard					
type of explosion protection: intrinsically safe					
gas group					
temperature class					
EPL type of protection					

Kind of explosion protection for dusts:

	Ex	ia	IIIC	T85°C	Da
electrical devices explosion protected to EC standard					
type of explosion protection: intrinsically safe					
dust group					
max surface temperature					
EPL type of protection					

Table 1. Temperature sensors marking:

Temperature sensor	...	TOPZ-842Exi	–	...	–	...	–	...	–	...	–	...	–	...
Without transmitter With transmitter	no designation AP													
Immersion length L [mm]			100*											
RTD type					Pt100*									
RTD class							A, B*							
RTD wire connection									2, 3, 4					
Transmitter type											HRFX*			
Temperature range												(0 ÷ 50) °C*		

* as agreed

3. Installation.

A. On Zones 1, 21, 2, 22

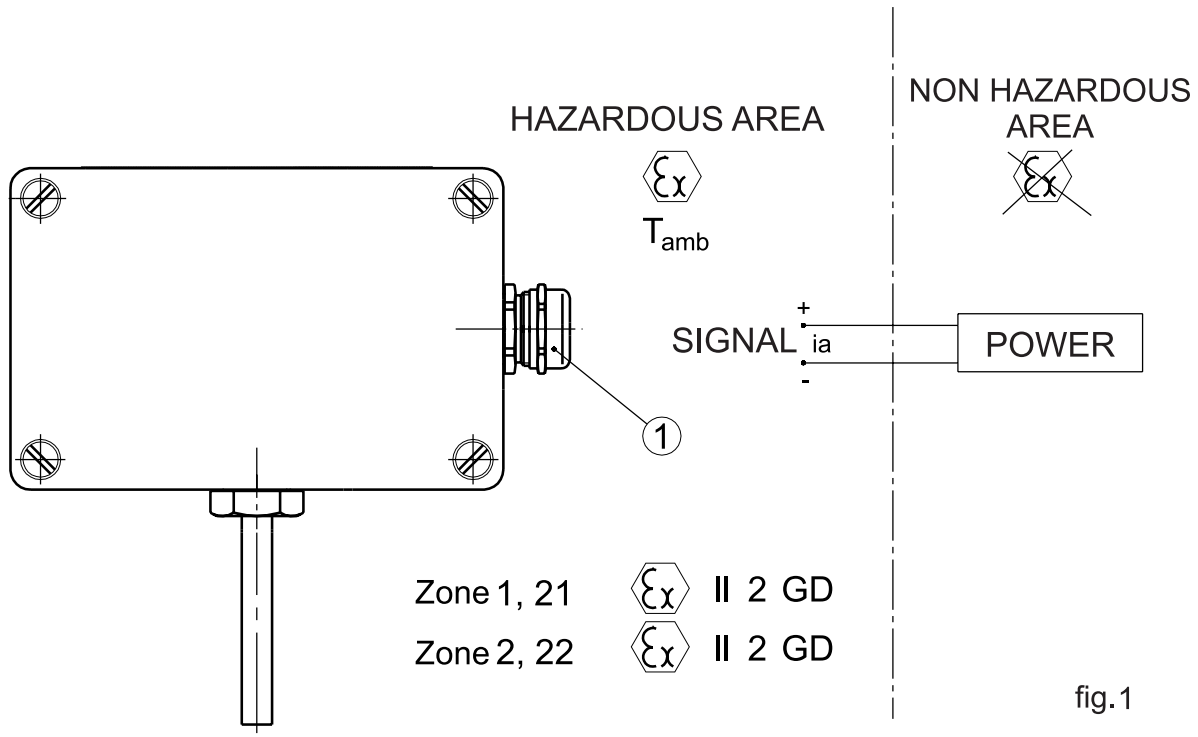


fig.1

1. Cable glands ATEX Ex eb IIC, Ex ta IIIC suitable dor cable diameter. IP min 65

4. Electrical connection to the intrinsically safe circuit.

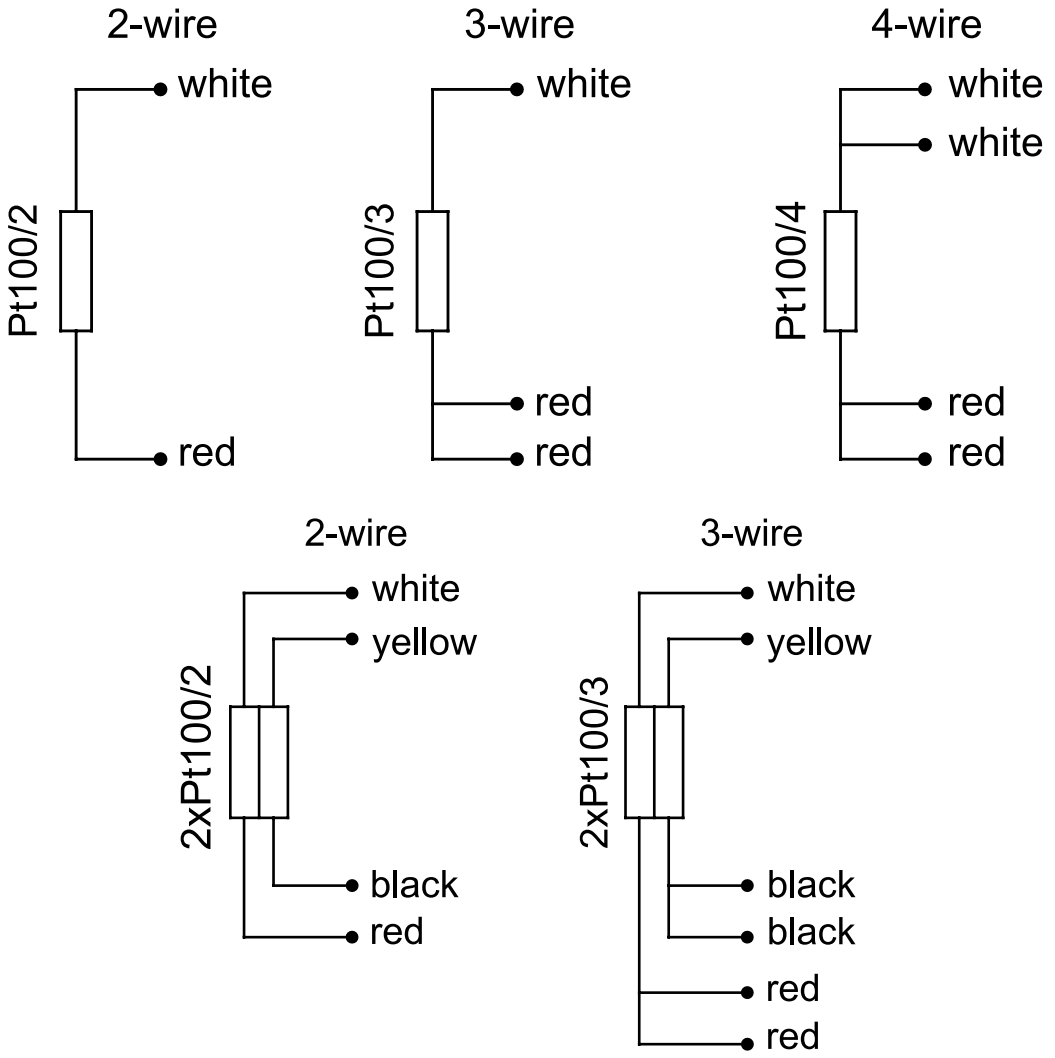
A) Connection of sensors without transmitter

a) Supply and signal connection

Sensor to connect to intrinsically safe circuit by cable according to poject of elctrical installation. The cable parameters C_L, L_L and L_i/R_i must be teken under consideration during accounting intrinsically safe circuit.

Maximal supply voltage: U_i = 45 V
Maximal current: I_i = 26 mA
Maximal strenght: P_i = 150 mW

RTD connection Diagram



All bellow transmitters are circuit galvanic

Parameter		FlexTop 2211	FlexTop 2221	FlexTop 2231	IPAQ-HX	956555dTRANS T01	956556dTRANS T01
Output signal		4÷20 mA	4÷20 mA	4÷20 mA	4÷20 mA	4÷20 mA	4÷20 mA
Supply voltage		6,5÷30 VDC	8÷30 VDC	9÷17,5 VDC	8÷30 VDC	8÷30 VDC	10÷30 VDC
Burden resistance [Kohm]		R_{obc}=(U-8 V)/22 mA	R_{obc}=(U-12 V)/23 mA	–	R_{obc}=(U-8 V)/22 mA	R_{obc}=(U-8 V)/0.022 A	R_{obc}=(U-8 V)/22 mA
Max internal voltage U_i		30 VDC	T 30 VDC	17,5 VDC	30 VDC	30 VDC	30 VDC
Max internal current I_i		100 mA	100 mA	215 mA	100 mA	100 mA	100 mA
Max internal power P_i		0,75 W	0,75 W	2 W	900 mW	750 mW	750 mW
Internal capacitance L_i		15 mH	T 15 mH	10 mH	~ 0 mH	~ 0	~ 0
Internal induktance C_i		5 nF	T 5 nF	2 nF	~ 0 nF	~ 0	~ 0
Circuit galvanic izolation	U	30 VDC	T 30 VDC	20 VDC	1500 VAC / 1 min	3,75 kV / 50 Hz	3,75 kV / 50 Hz
	I	0,1 A	T 0,1 A	100 mA	–	–	–
	P	0,75 W	T 0,75 W	0,75 W	–	–	–
Temperature class for Ex II 1 G	T1...T6	-40 < T_{amb} < 50°C	-40 < T_{amb} < 50°C	-40 < T_{amb} < 50°C	-40 < T_{amb} < 50°C	-20 < T_{amb} < 40°C	-20 < T_{amb} < 40°C
	T1...T5	-40 < T_{amb} < 85°C	-40 < T_{amb} < 85°C	-40 < T_{amb} < 85°C	-40 < T_{amb} < 65°C	-20 < T_{amb} < 50°C	-20 < T_{amb} < 50°C
	T1...T4	–	–	–	-40 < T_{amb} < 85°C	-20 < T_{amb} < 60°C	-20 < T_{amb} < 60°C
Temperature class for Ex II 2 G Ex II 3 G	T1...T6	–	–	–	–	-40 < T_{amb} < 55°C	-40 < T_{amb} < 55°C
	T1...T5	–	–	–	–	-40 < T_{amb} < 70°C	-40 < T_{amb} < 70°C
	T1...T4	–	–	–	–	-40 < T_{amb} < 85°C	-40 < T_{amb} < 85°C
Communication way			Hart HCF	Profibus PA ver. 3.0 DPV 1	–	–	Hart
Explosion protection concept		Intrinsically safe Ex ia IIC T5/T6 ⟨Ex⟩ II 1G	Intrinsically safe Ex ia IIC T5/T6 ⟨Ex⟩ II 1G	Intrinsically safe Ex ia IIC T5/T6 ⟨Ex⟩ II 1G	Intrinsically safe Ex ia IIC T5/T6 ⟨Ex⟩ II 1G	Intrinsically safe Ex ia IIC T5/T6 ⟨Ex⟩ II 1G	Intrinsically safe Ex ia IIC T5/T6 ⟨Ex⟩ II 1G
ATEX Certificate		TÜV 07 ATEX 347151X	TÜV 07 ATEX 347151X	TÜV 07 ATEX 347152X	Demko 02 ATEX 132033X	ZELM 99 ATEX 0018X	PTB 01 ATEX 2124

Technical data of transmitter used exchangeable in the sensors

B) Connection of sensor without transmitter

! Sensor to connect to intrinsically safe circuit by cable according to project of electrical installation. The cable parameters C_L, L_L and L_i/R_i must be taken under consideration during accounting intrinsically safe circuit.

! Each transmitter's data sheet includes diagrams. It is attached with sensor documentation.

! The transmitter must be supplied via intrinsically supply unit direct or via Zener barrier.

! The transmitter without galvanic isolator must be supplied by intrinsically safe supply unit via Zener barrier placed outside hazardous areas.

5. Temperature class of the sensor – gas potential explosive atmosphere G.

Temperature class of the apparatus determine its the hottest surface, which can appear during normal operation, it means temperature measurement of the process in the measuring range.

Because sensor manufacturer is not able foreseen actually operation condition of the sensor, on the data sheets and certificate was declared temperature class responding top temperature declared measuring range regardless influence of ambient T_{amb} and self-heating Te temperature.
Actually maximum surface temperature and responding temperature class of sensor working on the object can be lower than declared by sensor producer in accordance to Table 1. in the standard EN 60079-0.
The hottest sensor surface can be surface of electronic transmitter, connection heads or surfaces around sensing element (RTD, TC).

If process temperature T_p is lower than ambient temperature T_{amb} the hottest surface of the sensor will be surface of transmitter / connection head.

$$\mathbf{T_p < T_{amb}}$$

Sensors without transmitters

Sensor type	Measuring range	Range of temperature	Ambient temperature T_{amb}	The hottest surface in the most disadvantageous conditions T_s
Category ⟨Ex⟩ II 2 G, ⟨Ex⟩ II 3 G				
TOPZ-842Exi	-40÷85°C	T6	-40÷60°C	enclosure Fig. 1.

Sensors with transmitters

Sensor type	Measuring range	Range of temperature class	Ambient temperature T_{amb}	The hottest surface in te most disadvantageous conditions T_s
Category ⟨Ex⟩II 2 G, ⟨Ex⟩II 3 G				
APTOPZ-842Exi	-40÷T_{amb}	T6...T4 depending on the class temperature transmitter	-40÷60°C	enclosure Fig. 1.

T_{amb} for temperature class for type of used transmitter - see Table page 5 with the technical data of used transmitters in the sensors.

! Designer of the installation is responsible for such sensor type choosing and way his installation so as to after sensor installation during extremal working conditions temperature of the hottest surface will be lower than temperature of class temperature for surrounding gas, mist, vaporous type.

6. Maximal permissible surface temperature of the sensor - dust explosive atmosphere D.

Maximal surface temperature of the sensor can be reached during operation in extreme conditions. Because tightness of the sensor is IP6X (dusttight enclosure) dust must not ingress inside and this concerns outside surface of the sensor.
If process temperature T_p is higher than ambient temperature Tamb sensor surfaces will be wormed by process temperature T_p, ambient temperature Tamb and self-heating T_e.

Maximum surface temperature of the sensor having contact with explosive dust mixture must not excced ⅔ self-inflamination temperature of dust cloud or 75K lower from self-ignition temperature of dust layer thickness up to 5mm (EN 60079-0).

Example of maximum surface temperature of hot parts of the sensor for choosen type of dusts

Dust	Self-inflamination temp. °C layer cloud		Minimum inflamation energy (cloud) [mJ]	Minimum explosion concentration (cloud) [g/m³]	$T_{smax}=T_{smin}$-75K	T_{smax}=2/3 T_{cL}
	T_{smax}	T_{Cl}				
Agricultural dust						
Cellulose	270	480	80	55	195	300
Cocoa	240	510	100	75	165	320
Corn strach	-	380	30	40	-	253
Cork	210	460	35	35	135	306
Dextrin						
Flour/wheat	44	440	60	50	365	293
Malt	250	400	35	55	175	266
Milk powder	250	490	50	50	125	326
Peanuts (husks)	200	460	50	45	135	306
Rice	450	510	100	85	375	340
Soya (flour)	340	550	100	60	265	366
Starch (wheat)	380	400	25	25	305	266
Unprocessed cotton	520	-	100	190	445	-
Wheat (bulk)	220	500	60	65	145	333
Wood/pine (sawdust)	260	470	40	35	185	313
Sugar	400	370	30	45	325	246

Carbonated materials						
Acetylsalicylic acid (aspirin)	fond	660	25	50	-	440
Adipic acid	-	550	60	35	-	366
2,2'-Axobis (isobutyronitrile)	350	430	25	15	275	286
1.4 benzenediamin	430	380	15	20	355	253
Benzoic acid	fond	620	20	30	-	413
Biphenyl	-	630	20	15	-	420
Biphenol A	-	570	15	20	-	380
Diallyl phtalate	-	480	20	30	-	320
Dicumyl peroxide	180	560	30	45	105	373
Dimethyl isophthalate	-	580	15	25	-	386
2.6-Di-tert-butyl-4-cresol	-	470	20	20	-	313
Fumaric acid	-	520	35	85	-	346
Hexamethyleneteramine	-	410	10	15	-	273
Hydraxyethylcellulose	-	410	40	25	-	273
Mannitol	-	460	40	65	-	306
Pentaerythritol	-	450	10	30	-	300
Phenyl-B-naphthylamine	-	680	25	25	-	453
Phtalic anhydride	-	650	15	15	-	433
Soap	500	640	120	83	425	426
Sulphur	220	190	15	35	145	126
Terephthalic	-	680	20	50	-	453
Zinc stearate	fond	510	10	20	-	340
Vitamin B1 nitrate	-	360	60	35	-	240
Vitamin C (ascorbic acid)	280	460	60	70	205	306
Chemicals						
Asphalt	550	510	40	35	475	340
Bituminous coal	180	610	30	50	105	406
Carbon black	900	no inflammation	-	-	825	-
Charcoal	180	530	20	140	19105	353
Coal (anthracite)	-	730	100	65	-	486
Graphite	580	no inflammation	-	-	505	-
Liguite	200	450	30	30	125	300
Referemce coal (Pittsburgh)	170	610	60	55	95	406
Smoke black	-	730	-	-	-	486
Tar	-	630	25	45	-	420

Metallic dust						
Aluminium flakes (*)	400÷900	600÷700	10÷100	40÷60	325÷825	400÷466
Aluminium powder (*)	490÷700	550÷800	15÷160	40÷140	415÷625	366÷533
Antimony	350	415	1900	420	255	276
Cadmium	250	570	4000	-	250	380
Copper	-	900	-	-	-	600
Electrolytic chromium	400	580	40	230	325	386
Ferro-silicon (88% Si)	-	860	400	425	-	573
Ferro-titanum	400	37	80	140	325	246
Ground aluminium (*)	460÷900	550÷700	50÷120	45÷120	389÷600	475÷466
Ground magnesium	430	560	40	30	355	373
Iron pentacarbomyl	310	320	20	105	235	213
Iron reduced with hydrogen	290	320	80	120	215	213
Magnesium aluminium (Dow metal)	480	430	80	20	405	286
Manganese	240	460	305	125	165	306
Pulverised lead	270	710	-	-	195	473
Silicon	950	80	96	160	21	520
Thorium	280	270	5	75	205	180
Thorium (hydride)	20	260	3	80	-55	173
Tin	430	630	80	190	355	420
Titanium	510	330	25	45	435	220
Titanium (hydride)	540	480	60	70	465	320
Uranium	100	20	45	60	25	13
Uranium (hydride)	20	20	5	60	-55	13
Vandanium	490	500	60	220	415	333
Zinc	540	690	960	460	465	460
Zirconium	300	350	120	45	225	233
Zirconium (hydride	270	350	60	85	195	233

Plastics, rubber						
A.B.S. (Acryloitrile Butadiene Styrene)	-	480	20	25		320
Carboxymethylcellulose	310	460	140	60		306
Cellulose acetate	-	420	15	40		280
Coumarin - indene resin	-	550	10	15		366
Ethylcellulose	350	370	10	25		246
Flameproof polyurethane foam	390	550	flame in presence of hot surface			366
Formic melamine-aldehyde resin	-	810	320	85	-	540
Formic phebol-aldehyde resin	-	580	15	25	-	386
Ground alkyl resin	270	500	120	155	195	333
Ground formic urea-aldehyde resin	-	460	80	85	-	306
Ground polystyrene	-	560	40	15	-	373
Methylcellulose	340	360	-	30	265	240
Methyl polymethacrylate	-	480	20	30	-	320
Non-flameproof polyurethane foam	440	510	20	30	365	340
Nylon (hexamethylene polyadipamied)	430	500	20	30	355	333
(*) Depending on size grading and manufacture process						
Petroleum resin (Blown asphalt)	500	510	25	25	425	340
Phenol-2-furaldehyde resin	-	530	10	25	-	353
Polyarcylonitrile	460	500	20	25	385	333
Polybutyral vinylique	-	390	10	20	-	
Polycarbonate	-	710	25	25	-	473
Polyester (styrene-glass fiber)	360	440	flame in presence of hot surface		285	293
Polyethylene	380	450	30	20	305	300

Polyformaldehyde	-	440	20	35	-	293
Polypropylene	-	420	30	20	-	280
Poly-2-propylene-1-d	-	510	20	35	-	340
Poly-2-propylene-1-d+glass fiber	-	540	1600	345	-	360
Polystyrene (latex)	500	500	15	20	425	333
Polytetrafluoroethylene	570	670			495	446
Polyvinvyl chloride	400	660			325	440
Pure epoxy resin	-	540	15	20	-	360
Rubber containing chlorine	290	940	flame in presence of hot surface		215	626
Shellac	-	390	10	15	145	260
Sodium resinate	220	350	60	40	-	233
Styrene-acrylonitrile copolymer	-	500	30	35	415	333
Styrene-acrylonitrile maleic copolymer	490	470	20	30	-	313
Styrene-butadiene copolymer	-	440	35	25	-	293
Synthetic rubber (33% of sulphur)	-	320	30	30	-	213
Unprocessed rubber)	-	350	50	25	-	233
Vinyl polyacetate	-	550	160	40	-	366
Vinyl polyacetochloride	-	690	no information	-	-	460
Viscose (rayon)	250	520	240	55	175	346

In case other type of dusts has not been mentioned in the above table T_{smax} shall be evaluated on the base relevant standards and scores of testing.

! In case the explosive atmosphere is above the sensor mounting point, and the process temperature $\mathbf{T_p > T_{amb}}$, the maximum surface temperature Tmax will occur on parts of the sensor just behind the separation wall of the process

$T_{Smax} < \min(⅔\ T_{Cl};\ T_{5mm} – 75K)$ for particular dust type

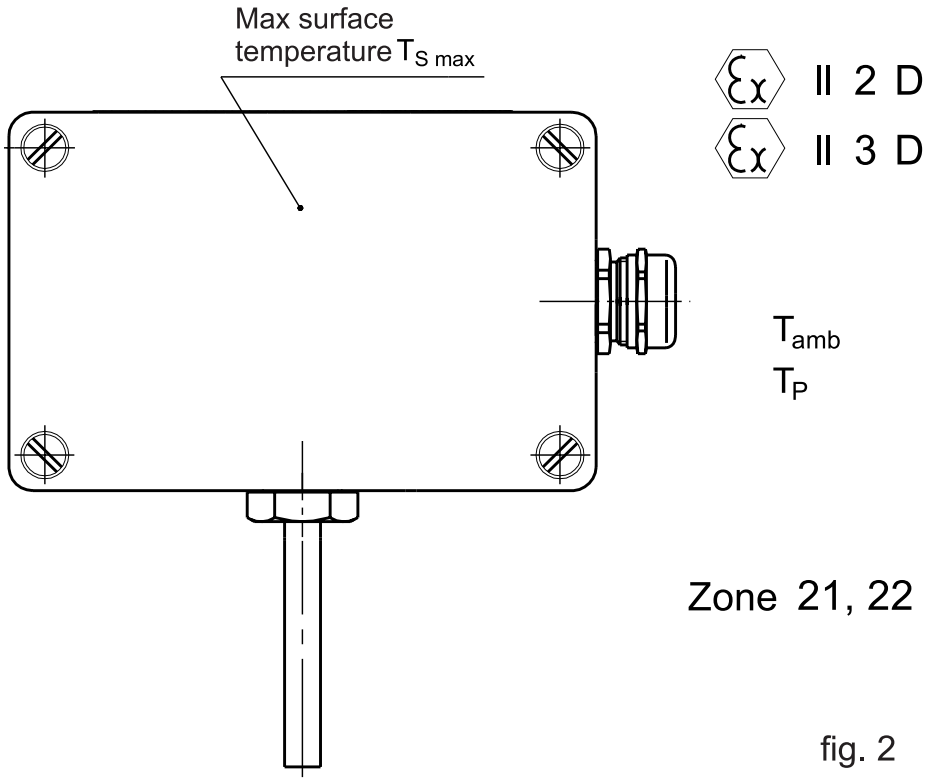


fig. 2

! Designer of the installation is responsible for such sensor choosing and way his installation so as to after sensor installation during extremal working conditions, temperature the hottest surface will not be higher than ⅔ of dust cloud self inflamination temperature T_{Cl} or dust layer self-inflamination temperature T_5mm – 75K.

Other cases of using sensor and adequate conditions are given by standard EN 60079-0.

7. Environmental conditions.

- Ambient temperature depend on sensor type acc. to Table page 6,7.
- Humidity max 80%,
- Sensors are destined to use indoor and outdoor location.

8. Tightness. IP degree.

Ordered in Limatherm Sensor, sensor can be equipped with appropriate cable gland:
- for sensor intended for use in potentially gas G explosive atmospheres Ex eb IIC approved, or standard design
- for sensor intended for use in potencially dust D explosive Ex ta IIIC approved.

All cable glands are pointed out by Limatherm Sensor, so as to include foreseen to use cable diameter.

In case ordering a sensor without cable gland, fitter is obliged to mount certified cable gland for destination of sensor (G or D atmospheres).

All parts of the sensors are assembled using tightening moment which ensure comply declared IP degree rating. During sensor installation on the object, after electrical connection to the intrinsically safe circuit shall:

• standard cable glands

using wrench (AF = 24 mm or other appropriate) tighten the press cup of cable gland so as to seal ring closely pressed the cable. Check by hand possibility of draw out cable from cable gland. In case of cable moving use the wrench once more. Tightening moment max 6 Nm.

• ATEX approved cable glands

Handling shall be done in accordance with gland producer's manual

• Using screwdriver tighten by hand cover screw. Tightening moment max 2,2 Nm.

! Tightening with appropriate moment of cable gland press cup and cover screw is especially important in the sensor intended for use in potential dust D explosive atmospheres. Housing tightness rating IP6X is the base way to ensure dust explosion protection.

! Do not open connection head cover of the sensor marked II Ex ia IIIC during operation in the presence dust cloud or when dust is stored on the connection head.

9. Documents.

To the each sensor is enclosed:

- Application manual for sensor,
- Application manual for cable gland ATEX approved,
- Warranty,
- Declaration of conformity.