



## PRODUCT MANUAL

### FOR DESIGNS WITH CONVERTER A MANUAL IS ENCLOSED TO THE RELEVANT CONVERTER

# Thermoelectric rod temperature sensor Ex d with metal protective tube without converter or with converter type line 350 type 352

and **dust-tight closure** pursuant to ČSN EN 50281-1-1:

Ex II 1/2 GD Ex d IIC T1+T6 T=T media

(explanation of designation refer to figure 1)

### APPLICATION

- For remote measurement of temperature of gases, for which the properties of the material of the protective tube are suitable (e.g. in furnaces)
- For explosive environment pursuant to ČSN EN 60079-10 (ČSN EN 61241-10)
  - o Protective tube of the sensor may be installed into zone 0(20), zone 1(21) or zone 2(22)
  - o Other parts of the sensor (screw-joint, connecting head) may be located in zone 1(21) or zone 2(22)
  - o In case of application of the converter Ex ia or in case of connection into Ex ia circuit, the sensor may be used in zone 0 (20)
- As a complete set with control or diagnostic systems for process monitoring
- Design with converter to convert the signal of the thermoelectric sensor to unified output signal 4 to 20 mA or digital signal (converter with HART protocol)

The sensors are rated products pursuant to the Act No. 22/1997 and Compliance Certificate **EC-352000** is issued for them.

### DESCRIPTION

The sensor consists of a replaceable measuring insert with a flange and a ceramic terminal board or installed two-wire converter (insulated or un-insulated, also in design Ex i) and protective armature consisting of a head and a protective tube. The head with a measuring insert and outlet form the fixed closure Ex d. It is provided with a screwing lid and cable outlet for connecting wiring. The cable outlet (pursuant to the required cable diameter) forms optional accessories of the sensor. The terminal board (of the converter) of the sensor is accessible after unscrewing the lid of the head, which shall be fixed after tightening with a screw against spontaneous release. On the head, the sensor is provided with an external terminal for connection of the grounding wire or wire for mutual interconnection.

The sensor with converter is supplied from an external source. The installed converter is pre-set to the required range at the sensor manufacturer.

To measure temperature, a defined change of thermoelectric voltage of the sensor in dependence on the change of temperature of the measured environment is used.

### TECHNICAL DATA

The sensor dimensions are based on DIN 43772 and original ČSN 25 8301. The sensor is designed pursuant to ČSN EN 61140 ed.2 as an electrical equipment of protection class III for the application in networks with category of overvoltage in installation II and pollution grade 2 pursuant to ČSN EN 61010-1; the follow-up (evaluation) device shall comply with Article 6.3 of the said standard.

**Measuring range:** -70 to 450 °C

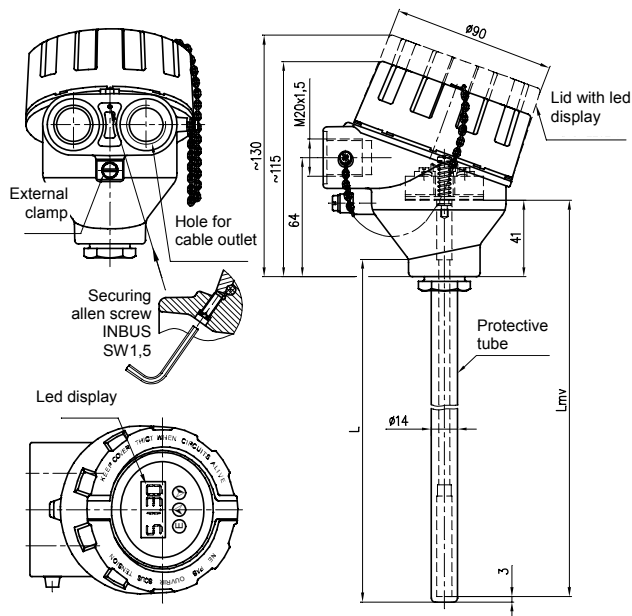
The upper limit of the measuring range is limited by resistance of the material of the used protective tube; however, it may not exceed 450°C.

If it is ensured by a suitable way of installation that the surface temperature of a part of the sensor located in the explosive area does not exceed the temperature of the required temperature class (T1+T6), the upper limit of the measuring range may be even higher (max. 1100°C for thermocouple K, max. 800°C for thermocouple J).

Examples of installation - refer to Figure 2.

Measuring range of the sensor with converter is established by the range of the selected converter.

**Fixed closure** pursuant to ČSN EN 60079-0 and ČSN EN 60079-1



L nominal length  
L<sub>mv</sub> measuring insert length

**Electric strength** pursuant to ČSN EN 61010-1 Article 6.8.4: 500 V eff

(only measuring insert without converter or design with insulated converter)

**Electric insulation resistance** pursuant to ČSN EN 61515: min. 1000 M $\Omega$ , at ambient temperature 20 $\pm$ 15°C and max. 80% relative humidity

**Power supply of converter:**

DC 24 V from source SELV, e.g. INAP 16 and INAP 901

**Other data of the converter:** refer to the enclosed manual  
**Ingress protection** pursuant to ČSN EN 60529: IP 68

**Operation position:**

discretionary, the outlet shall not be situated upwards

**Type of operation:** continuous

**Sensor weight:**

nominal length L	350 mm approx. 1.06 kg
	500 mm approx. 1.20 kg
	710 mm approx. 1.38 kg
	800 mm approx. 1.46 kg
	1000 mm approx. 1.64 kg
	1400 mm approx. 1.99 kg
	1600 mm approx. 2.17 kg
	2000 mm approx. 2.52 kg

**Used materials:**

protective tube	steel 1.4845.nebo 1.4541
head	aluminium alloy painted with blue epoxy paint
stem tube of the measuring insert	steel 1.4541
internal wiring	Cu
head terminals of the terminal board	brass with Ni surface
sensor connecting element	stainless steel

**OPERATION CONDITIONS**

The environment is defined by the group of parameters and their severity grades IE 36 pursuant to ČSN EN 60721-3-3 and the following operation conditions.

**Ambient temperature for head and outlet of the sensor:**

-40 °C ≤ Ta ≤ 70 °C

for design with converter pursuant to the type of the converter (refer to the enclosed manual of the converter)

**Maximum surface temperature of the sensor:**

it complies with the maximum temperature of the measured medium

**Maximum surface temperature** for equipment operating in the environment with a threat of explosion of gases, steam and mist pursuant to ČSN EN 60079-0 and temperature class of the sensor are determined in dependency on the temperature of measured medium pursuant to the following table:

Temperature class	Maximum surface temperature	Maximum temperature of measured medium
T6	85°C	85°C
T5	100°C	100°C
T4	135°C	135°C
T3	200°C	200°C
T2	300°C	300°C
T1	450°C	450°C

**Maximum permitted surface temperature** for the equipment operating in the environment with a threat of explosion of dust pursuant to ČSN EN 61241-14:

a) Temperature limitation due to occurrence of stirred dust:

$$T_{max} = 2/3 T_{ci}$$

where  $T_{ci}$  is the temperature of ignition of stirred dust

b) Temperature limitation due to occurrence of layers of dust to 5mm thickness:  $T_{max} = T_{5mm} - 75 °C$

where  $T_{5mm}$  is the temperature of ignition of dust layer 5mm thick

c) Dust layers over 5 mm – refer to ČSN EN 61241-14

**Maximum permitted surface temperature is defined by the lower value of the values specified above.**



**WARNING**



The user shall guarantee that the maximum surface temperature of any part of the sensor does not exceed the temperatures of ignition of any gas, steam or dust, which can occur, due to external thermal effects.

**Vibrations:**

Nominal length L[mm]	350 to 1000	1400 to 2000
Frequency range [Hz]	10 to 55	
Drift amplitude $s_a$ [mm]	0.15	0.075
Acceleration amplitude $a_a$ [m.s <sup>-2</sup> ]	19.6	9.8

**Relative ambient humidity:**

10 to 100 % with condensation, with upper limit of water content 29 g H<sub>2</sub>O/kg of dry air

**Atmospheric pressure:** 70 to 106 kPa

**Maximum speed of flow of gas medium:** 2 m/s

**METROLOGICAL DATA**

**Probe:** measuring thermocouple **J** (Fe-CuNi) or **K** (NiCr-NiAl) pursuant to ČSN EN 60584-1 Ø 6, tolerance class 2 or 1 pursuant to ČSN IEC 584-2 single or double with insulated measuring connection

**Output signal**

of the analogue converter (linear with thermoelectric voltage): 4 to 20 mA

of the programmable converter (linear with measured temperature): 4 to 20 mA (+ digital for HART protocol)

**Calibration depth of immersion of the measuring insert of the sensor**

for temperature points within range -70 to 250°C: 200 mm (min. 160 mm)


for temperature points over 250°C: 300 mm (min. 260 mm)

The distance of flange of the measuring insert from the level of medium in the calibration bath shall be at least 40 mm at temperatures to 250°C and min. 70 mm at temperatures above 250°C.

**Temperature response time** pursuant to ČSN IEC 751 in whirling water (characteristic value):

0.5	75 s
0.9	90 s

**CERTIFICATION**

- Non-explosiveness  II 1/2 GD Ex d IIC T1+T6 T=T media  
EC Type Examination Certificate pursuant to the Decree of the Government 23/2003 Coll. FTZÚ 06 ATEX ???X
- Non-explosiveness Ex i, EC Type Examination Certificate pursuant to the Decree of the Government 23/2003 Coll., (pursuant to the type of the converter)

**DESIGNATION:**

**Data on label of head**

- Trademark of the manufacturer
- Made in Czech Republic
- Type of the thermoelectric sensor / tolerance class
- Measuring range or adjustable range of the converter
- Product ordering number
- Ingress protection
- Manufacturing number
- Output signal 4 to 20 mA (design with converter)
- Ambient temperature  $-40\text{ }^{\circ}\text{C} \leq T_a \leq 70\text{ }^{\circ}\text{C}$
- Designation of non-explosiveness:  
 Ⓢ II 1/2 GD Ex d IIC T1+T6 T=T media  
 and EC Type Examination Certificate number
- Designation of non-explosiveness and EC Type Examination Certificate number (for design with converter Ex i)
- CE mark 1026
- CE mark with identification number of notified person (for design with converter Ex i)

**Data on label of measuring insert**

- Trademark
- Type of probe / tolerance class
- Manufacturing number

**Data on converter label**

- Type of probe
- Adjustable temperature range

**DELIVERY**

Unless agreed otherwise with the customer, each delivery includes

- Delivery note
- Sensor pursuant to the purchase order
- Allen key 1.5 mm
- As accessories to sensors, a suitable cable outlet can be delivered; it shall be ordered separately pursuant to the catalogue of accessories, type 991. An instruction sheet is delivered with each cable outlet
- Accessories to be ordered separately:  
 connecting flange or weld-on piece with threaded ring
- Optional accessories to sensor with programmable converter

- o Configuration (parameterization) programme pursuant to the required converter
- o Communication modem (for serial port RS 232C) pursuant to the required converter
- Accompanying technical documentation in Czech
  - o Product quality and completeness certificate, which also serves as the warranty certificate
  - o EC Compliance Certificate
  - o Calibration sheet (for uncertified calibrated design)
  - o Product manual

If it is established in the purchase contract or agreed otherwise, the following documentation can be also delivered with the product

- Copy of the Inspection Certificate 3.1 for material of protective tube and stem tube with the casting number
- Copy of EC Type Examination Certificate pursuant to the Decree of the Government 23/2003 Coll. for fixed closure
- Copy of EC Type Examination Certificate pursuant to the Decree of the Government 23/2003 Coll. for design with converter Ex i

**PACKING**

Both sensors and accessories are delivered in a packing ensuring resistance to the impact of thermal effects and mechanical effects pursuant to controlled packing regulations.

**TRANSPORT**

The sensors may be transported on conditions corresponding to the set of combinations of classes IE 21 pursuant to ČSN EN 60721-3-2 (i.e. by airplanes and trucks, in premises that are ventilated and protected against atmospheric effects).

**STORAGE**

The sensors may be stored on conditions corresponding to the set of combinations of classes IE 11/1K3 pursuant to ČSN EN 60721-3-1 (i.e. in places with temperature from  $-5\text{ }^{\circ}\text{C}$  to  $45\text{ }^{\circ}\text{C}$  and humidity from 5 to 95%, without a special threat of an attack with biological agents, with vibrations of small significance and not situated close to sources of dust and sand).

**DESIGN OF TEMPERATURE SENSORS Ex d WITH METAL PROTECTIVE TUBE, TYPE 352**

SPECIFICATION				ORDERING NUMBER																		
				352	x	0	x	0	x	x	x	/xxxxxxx	/xxx									
Nominal length L [mm]	350	Length of measuring insert L <sub>mv</sub> [mm]	375	1																		
	500		525	2																		
	710		735	3																		
	800		825	4																		
	1000		1025	5																		
	1400		1425	6																		
	1600		1625	7																		
	2000		2025	8																		
	Other (max. 3000 *)			9																		
Protective tube material	1.4845				1																	
	1.4541 *)				2																	
	Other *)				9																	
Head of sensor with thread for outlet (Ex d)	M20x1.5								1													
	1/2-14NPT *)								2													
Thermocouple	K										K											
	J										J											
Accuracy class	1 *)												1									
	2												2									
Design of measuring ends of thermocouple pursuant to figure 3	Single thermocouple, insulated end																	/JI				
	Double thermocouple, independent end																	/DU				
Converter type		Galvanic separation	Ex	Range [°C]																		
Analogue linear output signal with thermoelectric voltage	APAQ-HCF			Adjustable range														/HCF				
	APAQ-HCFX *)		•																/HCFX			
Programmable linear output signal with temperature	TK	•		Programmable range														/TK				
	TK-ex *)	•	•															/TKX				
	IPAQ-H	•																/IPAQH				

	IPAQ-HX *)	•	•							/IPAQHX
	MINIPAQ-H									/MINIPAQ
Programmable with HART protocol linear output signal with temperature	TK-H	•								/TKH
	TK-H-ex *)	•	•							/TKHX
	MESO-H	•								/MESOH
	MESO-HX *)	•	•							/MESOHX
	644 H NA	•								/644HNA
	644 H I1 *)	•	•							/644HI1X
<b>LED display in loop 4-20mA (only with converter)</b>										
LED display *)										/LD
LED display-ex (only pro converter Ex) *)										/LDX

**standard design**

\*) only as a special request after an agreement with the manufacturer

**ACCESSORIES - to be ordered separately**

SPECIFICATION		ORDERING NUMBER
Connecting flange		991 UP 14
Weld-on piece with threaded ring	Material: carbon steel	991 NVP6 D14 13
	Material: corrosion-resistance steel	991 NVP6 D14 72

**ORDERING TEMPERATURE SENSORS**

The purchase order shall specify

- Name
- Product ordering number
- Measuring range
- If calibration is required and in what temperature points
- If a connecting flange or a weld-on piece with threaded ring is required
- If the delivery of the outlet for the output cable is required as accessories to the sensor pursuant to the type 991
- If optional accessories to the sensor with programmable converter are required
- Other (special) requirements
- Number of pieces

Behind the ordering number specified pursuant to the above mentioned table, the customer shall identify the required range of measured temperature (i.e. lower and upper temperature limits in °C) and, as the case may be, other non-standard required parameters for converter configuration (e.g. indication of sensor tripping, dampening, required designation - tagging etc.).

**PURCHASE ORDER EXAMPLE**

**Standard design:**

Resistance temperature sensor Ex d with metal protective tube without converter  
352 201 01K2/JI – 6 pcs  
range -70 to 450°C

**Special request:**

Resistance temperature sensor Ex d with metal protective tube with converter  
334 901 01J2/HCF – 6 pcs  
nominal length L = 380 mm, range 0 to 300°C

**ORDERING ACCESSORIES**

The purchase order shall specify:

- Name
- Product ordering number
- Number of pieces

**PURCHASE ORDER EXAMPLE**

**Standard design:**

Connecting flange  
991 UP 14 - 5 pcs

**OUTLET ORDERING**

The purchase order shall specify

- Name
- Ordered outlets
- Number of pieces

**ORDERING NUMBER OF OUTLETS, type 991**

Outlet M 20 x 1.5 (with clamp against cable pull-out)

for cable Ø 4 8.5mm VM 408  
for cable Ø 6 12mm VM 612  
for cable Ø 8.5 16mm VM 816

(the set consists of the outlet itself, cable clamp and sealing under outlet 20x24)

Outlet 1/2–14NPT (with clamp against cable pull-out)

for cable Ø 4 8.5mm VK 408  
for cable Ø 6 12mm VK 612  
for cable Ø 8.5 15.5mm VK 815

(the set consists of the outlet itself and the cable clamp)


**CALIBRATION**

It is realized pursuant to TPM 3322-94 and in compliance with ČSN EN 584, usually in three temperature points evenly distributed within the operation range of the sensor or in the points according to the requirement of the customer. Calibration sheets with measured data are issued for calibrated sensors.

**INSTALLATION AND CONNECTION  
SENSOR INSTALLATION**

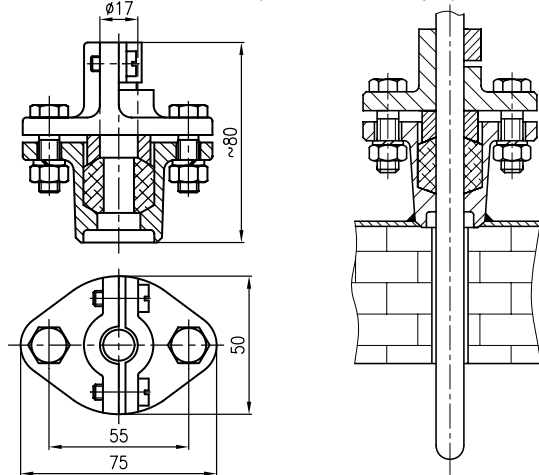
The sensors are installed by means of a connecting flange or by means of a weld-on with threaded ring.

**WARNING**

**Distance of the fixed closure**  II 1/2 GD Ex d IIC from close structures or between the suspensions shall be at least 40 mm.

**INSTALLATION OF FLANGES**

Weld bottom part of the flange onto the wall of the technological equipment. After releasing two screws M6x14, you can move the sensor in the connecting flange, whereby the required immersion of the sensor can be adjusted.

**CONNECTING FLANGE** (installation example)

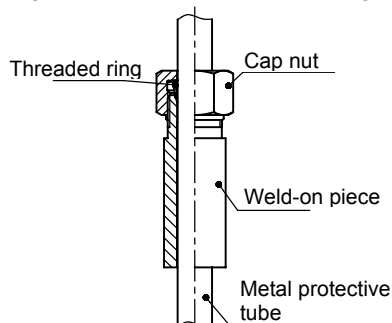
**INSTALLATION OF THE WELD-ON PIECE WITH THREADED RING** shall be realized pursuant to the instruction label as follows:


- 1) Uninstall the complete weld-on piece by unscrewing the cap nut
- 2) Weld the weld-on piece itself (after possible shortening) onto the wall of the piping or another technological equipment
- 3) On the metal protective tube of the rod temperature sensor, put the cap nut, thrust ring and threaded ring in the said order,
- 4) Slide the temperature sensor with put-on components pursuant to point 3 into the prepared weld-on piece and only tighten it adequately after the definitive selection of immersion (recommended torque is 60 to 70 Nm).

**WARNING**

**Length of the immersion part of the sensor cannot be changed; the sensor can only be uninstalled!**

With respect to maintaining metrological properties and the longest possible service life, it is not recommended to install the sensors in places with high turbulence of the medium, which is caused e.g. by a rapid transition from a small diameter of the piping to a larger one (when failing to comply with the required shape and dimensions of diffuser behind the flow meter), etc. Recommended distance of the temperature sensor from the installation flange of the flow meter is min. 1 m.

**WELD-ON PIECE WITH THREADED RING****INSTALLATION OF CABLE OUTLET**

To secure the fixed closure, only the certified cable outlet  II 2 GD Ex d IIC with ingress protection IP 68 shall be used (refer to accessories 991 or another similar outlet). It shall be tightened in the sensor head in the prescribed way.

Torque of outlet body:

- |    |                                    |           |
|----|------------------------------------|-----------|
| a) | for outlet with thread 1/2 - 14NPT | 25 – 30Nm |
| b) | for outlet with thread M20x1.5     | 30 – 35Nm |

Installation of the cable in the outlet, its sealing and securing against pull-out shall be realized pursuant to the instruction sheet of the outlet supplier.

**WARNING**

**Do not use other sealing rings in the outlet than the original ones delivered by the manufacturer. Do not change artificially the outer diameter of the cable e.g. by winding it around with electrical insulating tapes.**

**ELECTRICAL CONNECTION**

The electrical connection may be only realized by qualified workers pursuant to § 5 of the Decree 50/1978 Coll.

**The sensor installation in conditions with explosive gaseous atmosphere shall comply with the requirements of ČSN EN 60079-14 ed. 2.**

**The sensor installation in conditions with flammable dust shall comply with the requirements of ČSN EN 61241-14.**

The terminal board of the sensor (converter) is accessible after unscrewing the lid of the head.

Connect the evaluation devices to the sensor with a cable with double insulation, internal wires with Cu core (sensor with converter) or compensation wiring (sensor without converter) 0.5 to 1.5 mm<sup>2</sup>. Seal the cable in the outlet by prescribed tightening of the closing nut pursuant to the instruction sheet of the outlet. Then secure it with a clamp against pull-out.

**WARNING**

**Do not use independent wires without jacket for electrical connection. To ensure the ingress protection grade in the outlet, the connecting cable shall have circular cross-section. Temperature resistance of the cable shall comply with the ambient temperature! Its permanent temperature resistance to at least 70°C is required.**



The cable insulation shall have chemical and mechanical resistance in compliance with the conditions, in which the cable will be installed. It is recommended supporting the cable along its length between the sensor and the follow-up device. In the environment with interfering signals, use shielded cable in the power supply circuit. Shielding may be only grounded (earthed) in one point. The cable should not be placed together with power cables.

In case of the sensor with HART protocol converter, the maximum length of wiring is defined by the arrangement of wires of the connecting cable. The total length of wiring may be up to 1500 m. It requires a twisted two-wire with shared shielding with the cross section of the core min. 0.5 mm<sup>2</sup>. Recommended HART communicator, model 275, is connected to the supply loop of the converter pursuant to Figure 3. To achieve reliable communication, resistor 250 shall be introduced in the circuit of the output loop.

**WARNING**

**Programmable converter may not be connected to a computer or a HART communicator if the converter is located in explosive environment.**



**WARNING for sensor with converter Ex i**  
**Ex i parameters shall be complied with pursuant to the enclosed converter manual.**



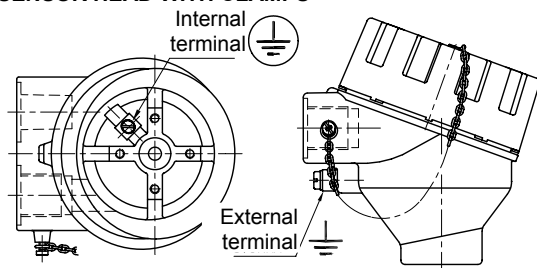
**To ensure safety, an intrinsic safe source shall be always used pursuant to the converter manual, e.g. INAP 901 ordering number 901 000 101.**

**Surface temperature of the converter may not exceed maximum surface temperature for that particular temperature class.**

For the installations in dangerous areas, mutual connection is required (bringing to the same potential). To achieve it, terminals on the sensor head can be achieved.

The sensor need not be connected to the system of mutual connection independently if it is installed firmly and has metal interconnection with the structural parts or the piping, which is connected to the system of mutual connection.

#### SENSOR HEAD WITH CLAMPS



#### Maximum cross-section of wire for connection to external and internal terminals:

Internal terminal: stranded wire 1.5 mm<sup>2</sup>, full wire 2.5 mm<sup>2</sup>

External terminal: stranded wire 4.0 mm<sup>2</sup>, full wire 6.0 mm<sup>2</sup>

If stranded wires are used for the interconnection, they shall be protected against fraying with pressing hollow.

#### CLOSING HEAD OF FIXED CLOSURE Ex d

After electrical connection of the sensor, the lid of the head shall be fully tightened by hand, then released slightly to ensure matching with the closest groove against the securing screw and fixed by this screw against releasing. If the lid of the sensor is not tightened and secured with the above mentioned screw, the sensor does not comply with the requirements of fixed closure Ex d.



#### WARNING:

**Power supply of the sensor may not be connected before closing the fixed closure!**



#### COMMISSIONING

After the sensor installation, including closing the fixed closure, and connection of the follow-up (evaluation) device to the supply voltage (and the settlement period of the converter), the equipment is prepared for operation.

#### OPERATION AND MAINTENANCE

The sensor does not require any operation and maintenance.



#### WARNING



**Any intervention into the sensor and its structure will result in a change of properties and can result in an explosion!**

#### SENSOR UNINSTALLATION



#### WARNING



**Warning: Temperature sensor is in design Ex and must be disconnected from the power supply source before opening the lid of the head and releasing the cable outlet in the explosive environment!**

Release the securing screw of the lid with ALLEN key 1.5 mm (a part of accessories). The terminal board of the sensor (converter) is accessible after unscrewing the lid of the head. Measuring insert of the sensor can be replaced and is uninstalled from the head after disconnecting the cable by releasing two screws.

Before a complete uninstallation of the sensor, the wire for mutual interconnection shall be released from the external terminal on the sensor.

Disconnect the connecting cable from the terminal board, then release it from the clamp on the outlet and from the closing nut of the outlet. After releasing the screws on the connecting flange (unscrewing the nut on the weld-on piece with threaded rings), remove the sensor.

#### SPARE PARTS

Spare parts shall be delivered by the manufacturer.

Relevant measuring inserts can be ordered pursuant to the offered price list of spare parts.

#### WARRANTY

Pursuant to § 429 of the Commercial Code and the provisions of § 620 (2) of the Civil Code, the manufacturer warrants for technical and operation parameters of the product specified in the manual. The warranty period is 24 months from the receiving of the product by the customer, unless established otherwise in the contract. Rejection of defects shall be enforced in writing at the manufacturer within the warranty period. The rejecting side shall identify the product name, ordering and manufacturing numbers, date of issue and number of the delivery note, clear description of the occurring defect and the subject of the claim. If the rejecting side is invited to send the device for repair, it shall do so in the original package of the manufacturer and/or in another package ensuring safe transport.

The warranty shall not apply to defects caused by unauthorized intervention into the device, its forced mechanical damage or failure to comply with operation conditions of the product and the product manual.

#### REPAIRS

The sensors shall be repaired by the manufacturer. They shall be sent for repair in the original or equal package without accessories.

#### DISABLING AND LIQUIDATION

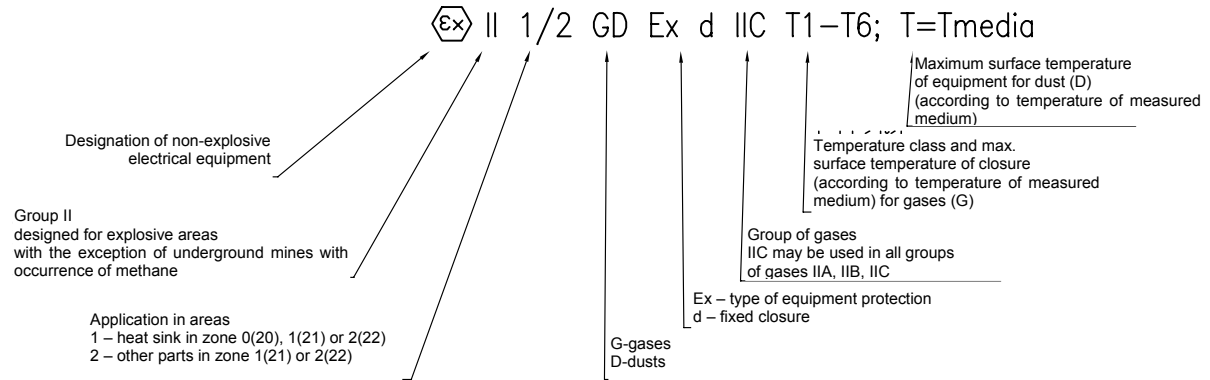
They shall be realized in compliance with the Waste Act 106/2005 Coll.

The product and its package do not include any parts that could impact the environment.

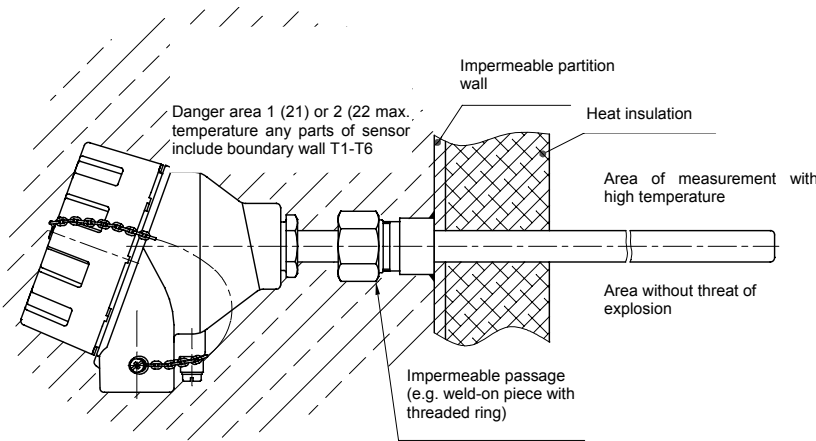
The products that are withdrawn from operation, including their packages (with the exception of products marked as electrical equipment for the purposes of return withdrawal and separate salvage of electrical waste), may be disposed of to sorted or unsorted waste pursuant to the type of waste.

The manufacturer realizes free return withdrawal of marked electrical equipment (from 13.8.2005) from the consumer and points out the danger connected with their illegal disposal. The package of the sensor can be recycled completely. Metal parts of the products are recycled, non-recyclable plastic materials and electrical waste shall be disposed of in compliance with the aforesaid Act.

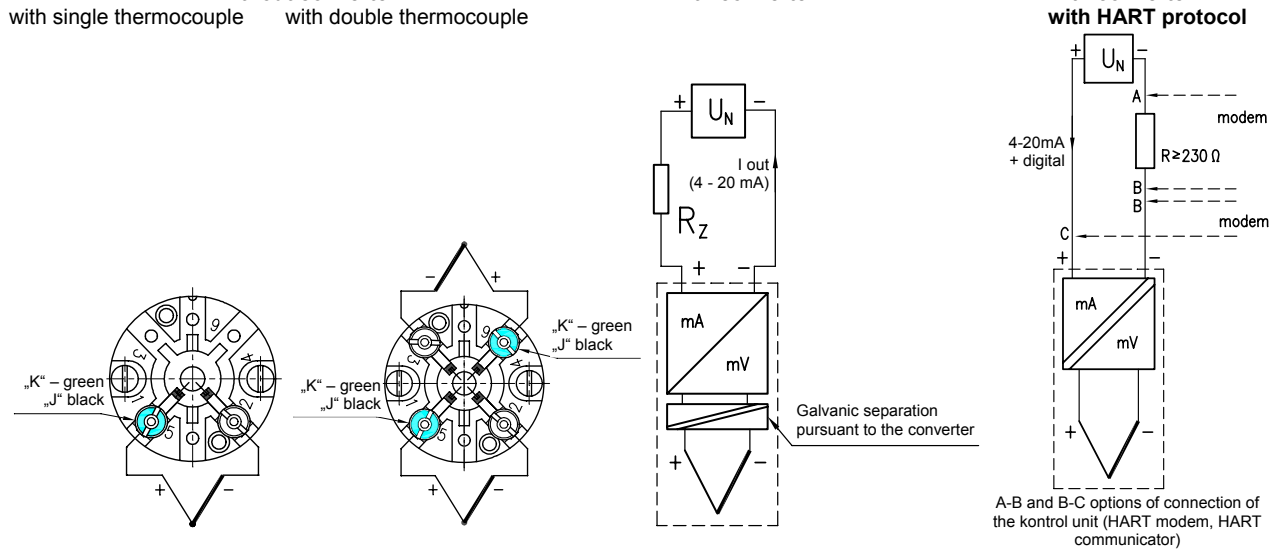
**FIGURE 1 - DESIGNATION OF NON-EXPLOSIVENESS**



**FIGURE 2 - EXAMPLES OF INSTALLATION OF TEMPERATURE SENSORS Ex d WITH METAL PROTECTIVE TUBE**  
(in case a higher upper limit of the range of measurement is required than the required temperature class)

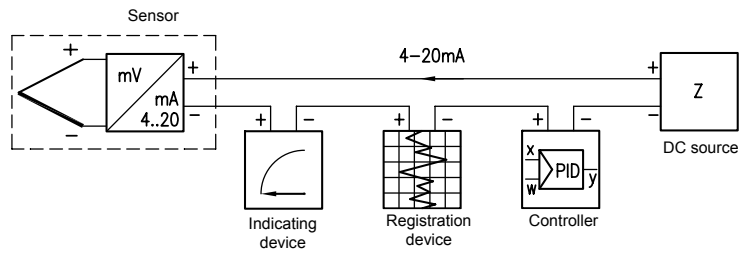


**FIGURE 3 - SCHEME OF CONNECTION OF TEMPERATURE SENSORS**  
without converter                      with converter



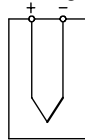


**FIGURE 4 - EXAMPLE OF OPERATION CONNECTION OF TEMPERATURE SENSOR WITH CONVERTER IN LOOP4 - 20 mA**



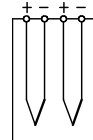
**FIGURE 5 - DESIGN OF MEASURING ENDS OF JACKETED THERMOCOUPLES (SCHEMATIC ILLUSTRATION)**

INSULATED END  
design I  
(standard pro simple design)



JI

INDEPENDENT END  
design U  
(standard pro double design)



DU

March 2006  
ZPA Nová Paka, a.s.



NOVÁ PAKA



ZPA Nová Paka, a. s.  
Pražská 470  
509 39 Nová Paka

tel.: spojovatel: 493 761 111  
fax: 493 721 194  
e-mail: obchod@zpanp.cz

www.zpanp.cz  
bankovní spojení: ČSOB Trutnov  
číslo účtu: 271 992 523/0300

IČO: 46 50 48 26  
DIČ: CZ46504826