

OPERATING INSTRUCTIONS FOR THERMO-SENSORS (S**) FOR HAZARDOUS APPLICATION



Rev. D - 07/2024

1. General and Safety Instructions

These operating instructions contain important information about using the device correctly.

This product must be installed, put into operation, operated, maintained, and taken out of the operation only by technically trained or authorized personnel. When installing and operating thermos-sensors (S**), attention should be paid to the corresponding national safety regulations and to the relative country regulations concerning the Ex-application.

These operating instructions form an integral part of the device and must always be accessible to the relevant staff.

2. Disclaimer

Ashcroft Instruments GmbH accepts no liability in case of improper use, damage or modification to the device or failure to observe these instructions. To be sure that the device is suitable for your corresponding application, please get in touch with your direct sales contact for any questions.

Ashcroft Instruments GmbH shall not be responsible for the consequences of any application or installation not compliant to the regulations or recommendations for explosive environments as defined in the relevant local, national, regional, or international standards and regulations.

3. Intended use

- ✓ Thermo-sensor (S**) is used to convert the temperature at the measuring point into electrical signal or in digital data.
- ✓ Please refer to the relevant datasheet and agreed specifications for information about the temperature sensor.

4. Product Identification

Standard label



Example: ATEX certification label



The adhesive labels contain at least the following information:

- ✓ Model
- ✓ Number and type of sensing element
- ✓ Accuracy class
- ✓ Standards for the sensing element
- ✓ Serial Number
- ✓ Manufacturing date
- ✓ Certification number
- ✓ Transmitter model if applicable
- ✓ Explosion protection specific marking
- ✓ Ambient temperature
- ✓ Safety related maximum values
- ✓ Output signal for models with transmitter

Adhesive label (non-metallic part) surface respects the limits to avoid a build-up of electrostatic charge, according to IEC 60079-0 - 7.4.2 b) and derivative 60079-0 standards.

4.1. ATEX certification

Explosion protection	Marking	ATEX Certificate N°
Flameproof enclosure for Zone 1 and 2	CE 2813 Ex II 2 G Ex d IIC T6 Gb	LCIE 02 ATEX 6138X
Intrinsic Safety for Zone 0, 1 and 2	CE 2813 Ex II 1 G Ex ia IIC T4 / T5 / T6 Ga	LCIE 02 ATEX 6139X
Intrinsic Safety for Zone 1 and 2	CE 2813 Ex II 2 G Ex ib IIC T4 / T5 / T6 Gb	LCIE 02 ATEX 6139X
Increased safety for Zone 1 and 2	CE 2813 Ex II 2 G Ex e IIC T6 Gb	LCIE 01 ATEX 6032X
Increased safety for Zone 1, 2, 21 and 22 (S81 special conception only)	CE 2813 Ex II 2 GD Ex e IIC T6 to T3 Gb, Ex tb IIC T85°C to T150°C Db	LCIE 18 ATEX 3015X

4.2. IECEx and INMETRO certification

Explosion protection	Marking	IECEx Certificate N°	INMETRO Certificate N°
Flameproof enclosure for Zone 1 and 2	Ex db IIC T6 Gb	IECEx LCIE 13.0050X	INMETRO TÜV 19.1836 X
Intrinsic Safety for Zone 0, 1 and 2 for Zone 1 and 2	Ex ia IIC T4 / T5 / T6 Ga Ex ia IIB T4 / T5 / T6 Ga Ex ib IIC T4 / T5 / T6 Gb Ex ib IIB T4 / T5 / T6 Gb	IECEx LCIE 13.0023X	INMETRO TÜV 19.1837 X

4.3. CCC certification

Explosion protection	Marking	CCC Certificate N°
Intrinsic Safety for Zone 0, 1 and 2	Ex ia IIC T4 / T5 / T6 Ga	2021322315003986

4.4. Warning marking

For Ex d and Ex e protection, a special warning is marked on sensor: "WARNING – DO NOT OPEN WHEN ENERGIZED".

5. Mounting

- ✓ The device must only be installed by specialist personnel who have read and understood these operating instructions. Follow the national standards and safety regulations during the assembly and installation of the device.
- ✓ Before any installation, always check the technical data relative to the corresponding equipment supplied. Always mount according to ATEX 2014/34/EC directive, EN/IEC 60079-14 prescriptions (and its derivative standards).
- ✓ In the case of additional components such as electrical cable, enclosure, cable gland, compression fitting, or other equipment, the components used must have the same Ex-zone certificate as certified by the instrument itself.
- ✓ The device must only be installed on systems when they are not pressurized or connected to a power supply.

5.1. Installation safety information

When installing the device outdoors or in another damp environment, note the following points:

- ✓ The ingress protection classes given in the datasheet only apply in combination with a suitable, correctly installed cable gland associated to the appropriate cable cross-section, with suitable thermowell, and adhere to the tightening torques for all threaded connections. Special design can be provided to ensure special ingress protection class without thermowell.
- ✓ Make sure that liquid does not accumulate on any seal surfaces near cable or inset entry.
- ✓ Install the sensor head where it is protected from direct sunlight. Otherwise, the maximum ambient temperature permitted risks being exceeded.
- ✓ The ambient temperature range defined for connection head is given in table below for the appropriate case. It is the responsibility of the installer to ensure that the external heating or cooling source (if available) does not affect the temperature classification of the equipment.

Models	Temperature for classification	Ambient temperature range for			
		Ex d	Ex i	Ex e	Ex e / Ex tb
Without transmitter	T6	-20°C to +60°C ⁽¹⁾	-55°C to +55°C	-55°C to +60°C	-20°C to +60°C
	T5	-20°C to +60°C ⁽¹⁾	-55°C to +70°C	-55°C to +60°C	-20°C to +60°C
	T4	-20°C to +60°C ⁽¹⁾	-55°C to +90°C	-55°C to +60°C	-20°C to +60°C
With transmitter	T6	-20°C to +60°C ⁽¹⁾	Refer to label on	Not allowed	Not allowed
	T5	-20°C to +60°C ⁽¹⁾	thermo-sensor		
	T4	-20°C to +60°C ⁽¹⁾	head ⁽²⁾		

⁽¹⁾ Extended ambient temperature range are available with special head, in any case refer to label or certificate.

⁽²⁾ Ambient temperature range shall be inside limit ranges defined in the case without transmitter and in transmitter certificate.

- ✓ For Ex d / i / e insets, measuring temperature range shall be limited per table below:

TC type	Temperature limit range	RTD Type	Temperature limit range
K, N, E	- 200 °C to 500 °C	Pt 100	- 200 °C to 500 °C
J	- 40 °C to 500 °C	Pt 1000	- 40 °C to 400 °C

For higher temperatures, please inform manufacturer.

5.2. Mechanical Installation

- ✓ Before installation, make sure that the measuring point are clean and undamaged.
- ✓ List of instructions to ensure the optimum installation:
 - Place the probe into media or thermowell. To avoid measurement errors due to heat conduction and radiation, the following minimum immersion lengths are recommended:

Inset	in liquid (water)		in gas/vapor		Inset	in liquid (water)		in gas/vapor	
	RTD Ø 3 mm	TC Ø 3 mm	RTD Ø 6 mm	TC Ø 6 mm		RTD Ø 6 mm	TC Ø 6 mm	RTD Ø 6 mm	TC Ø 6 mm
	45 mm	55 mm	60 mm	75 mm		60 mm	75 mm	60 mm	75 mm
	15 mm	25 mm	30 mm	50 mm		30 mm	50 mm	30 mm	50 mm

- Position the head to avoid vibration source applied on it, eventually fix it if needed.
- If applicable, screw extension or process connection (see table below) to thermowell or installation.

Example of available standard connection threads of enclosure

¼" NPT to 3" NPT	PG7 to PG48	¼" R to 3" R
M16 to M50	¼" G to 32" G	¼" NPSM to 32" NPSM

- After electrical installation, screw cable gland to ensure hermeticity.
- ✓ For Ex d, all screwed parts must be engaged by at least 5 threads.

5.3. Electrical Installation

- ✓ Connect the device according to the electrical connection standards or identification of measurement circuits on terminal block and/or marking plate:
 - RTD: color coding, according to IEC 60751.
 - TC: type of thermocouple is identified by color code for thermocouples according to IEC 60584-3 or ANSI/ASTM E230/E230M depending on the order. So please refer to the purchase order.
- ✓ Preferably use a shielded multi-wire cable.
- ✓ For Ex i and Ex e, the device must be earthed on connection head (provided with a screw terminal for connecting to ground) or on cable shield for S80/S81.
- ✓ Internal resistances of conductors inside inset are approx. 0.28 Ω/m for insets Ø 3 mm and approx. 0.07 Ω/m for insets Ø 6 mm (indicative values for temperatures +15 to +35°C).
- ✓ The use of cable terminals with safety device for required cable section for wiring the Ex e execution is imperative.

5.4. SI parameters for Ex i and Electrical parameters for Ex e

- ✓ For Ex i, thermo-sensor (S**) must be combined with certified intrinsically safe equipment and this combination must be compatible with intrinsic safety rules. The maximum values of voltage, current and power may not be exceeded for any combination of electrical circuits.
- ✓ For Ex i, Intrinsic Safety barrier is required to limit electrical energy delivering in the Hazardous area and shall be selected or configured to respect maximum electrical property defined in the table below. For Ex e, table below indicates maximum connection values in the sensor circuit to be safe with electric connection creepage distances. For measurement accuracy, lowered values are recommended.

	Ex i without transmitter	Ex i with transmitter	Ex e Ex e/Ex tb
Max. Voltage Power Supply	$U_i \leq 30V$	Refer to	$U_n \leq 30 V$
Max. Current Input	$I_i \leq 100 \text{ mA}$	transmitter	$I_n \leq 100 \text{ mA}$
Max. Input Power	$P_i \leq 0.75 \text{ W}$	datasheet or label	$P_n \leq 0.75 \text{ W}$
Max. internal capacitance	$C_i: 280 \text{ pF/m}$	on thermo-sensor	N/A
Max. internal inductance	$L_i: 15 \text{ μH/m}$	head	N/A

- ✓ For the probes having a diameter between 0.5mm and 1.6mm, the power supply shall be isolated from earth with galvanic barrier.

6. Precision classes

- ✓ RTD according to IEC 60751.
- ✓ TC according to IEC 60584-1 or ANSI/ASTM E230/E230M. For temperatures between -130°C and -40°C, the tolerances may exceed those for class 3.

7. Commissioning

- ✓ Before operating the device for the first time, check whether the device has been installed properly.
- ✓ The device may only be operated by qualified personnel who have read and understood the operating instructions.
- ✓ The device may only be operated within the specifications. See the technical datasheet or the agreed specifications.

8. Service and Repairs

8.1. Maintenance

Thermo-sensors (S**) are maintenance-free and if used in accordance with the specifications, are fault free.

8.2. Recalibration

The cycle for recalibration depends on the application conditions configuration.

8.3. Return

Before returning a device for recalibration or repair, it must be thoroughly cleaned and securely packaged. For faulty devices, please get in touch with your direct sales :customer.service@ashcroft.com and describe the fault in the Ashcroft Instruments GmbH return form.

If your device has been into contact with harmful substances, you must state this on the Ashcroft Instruments GmbH declaration of decontamination returns form.

If you return a device without mentioning contact with harmful substances and our repair department suspects that this is the case, the device will not be repaired until the facts have been established.

9.1. For all protection mode

9. Special conditions for safe use

- ✓ When temperature probes are integrated in an ATEX safety apparatus in charge of limitation of explosion hazards, the safety apparatus must be assessed according to EN 50495 requirements.
- ✓ Temperature probes must be replaced after 10 years of use.
- ✓ Use of product in low vibration environment.

9.2. Ex d according to IEC 60079-1 and derivative standards

- ✓ In function of the operating ambient temperature, the apparatus can be only equipped with the following connecting heads:

Connecting head	Certification	Operating ambient temperature
FPL: TTE1xx	IECEX INE 14.0005U, Issue No:1	-55°C to +75°C
FPL: TTE2xx, TTE3xx, TTE6xx, TTE7xx	CESI 08 ATEX 029U IECEX CES 14.0006U, Issue No:1	-55°C to +60°C
LIMATHERM: XD-A**	FTZU 03 ATEX 0074U IECEX FTZU 14.0003U, Issue No:3	-50°C to +60°C
CO.SI.ME: GUB-SF-S-GUB...F IME: 1080, 1088	CEC 11 ATEX 072 Sira 09 ATEX 1023U	-20°C to +60°C -40°C to +60°C

- ✓ The calorific transfer of sensor shall not transmit, in any case a heating above 80°C including ambient temperature, to all sensor part directly in contact with explosive atmosphere.
- ✓ It is the responsibility of the manufacturer or end user to ensure that external source of heating or cooling (if present) does not impact the temperature classification of the equipment.
- ✓ For higher max ambient temperatures see table below (only for the version with head TTE1XX / IECEx CES 14.0005U and GUB / IECEx INE 11.0019U):

Surface temperature class / Process temperature	T6 / 400 °C	T6 / 700 °C	T5 / 700 °C
<i>Ambient Temperature</i>	-55 °C to +75 °C	-55 °C to +65 °C	-55 °C to +75 °C

- ✓ The equipment must be associated to a certified Ex d cable gland.

9.3. Ex i according to IEC 60079-11 and derivative standards

- ✓ The intrinsically safe apparatus shall only be connected to associated intrinsically safe apparatus certified for the intended use. This association shall comply with the requirements of the IEC 60079-25 standard.
- ✓ The maximum permitted probe length is 200m except for the equipment fitted with the transmitter 248 from Rosemount for which the maximum permitted probe length is 85m.
- ✓ For equipment constructed with aluminium alloy enclosure, it must be installed in such a manner as to eliminate the risk of sparks caused by friction or impact.
- ✓ Follow special conditions for safe use relevant of the transmitters' certificate and associated instruction manual.
- ✓ The connection of electrical cable must be performed in an enclosure according to IEC 60079-0 standard (with a minimum protection degree of IP20). For models supplied without connection head, it is under the responsibility of the installation manufacturer or the end user to ensure IP20 enclosure for electrical connection.
- ✓ Ambient temperature range: refer to the certificate for the details.
- ✓ Temperature classification concerns only head connection. It is the responsibility of the installation manufacturer or end user to ensure that the external source of heating or cooling (if available) doesn't impact the temperature classification of the equipment.
- ✓ For the probes having a diameter between 0.5mm and 1.6mm, the power supply shall be isolated from earth with galvanic barrier.

9.4. Ex e according to IEC 60079-7 and derivative standards

- ✓ The certified connecting head used must have an operating ambient temperature from -55°C to +60°C.
- ✓ The calorific transfer of sensor shall not transmit, in any case a heating above 80°C including ambient temperature, to all sensor part directly in contact with explosive atmosphere.
- ✓ The equipment must be associated with a connection box, junction block and cable glands Ex e certified.
- ✓ The connection of the electric cable must be carried out in an enclosure conforming to EN 60079-0 (with a minimum protection degree of IP54).
- ✓ For the probes with a diameter ≤ 1.6mm, the power supply shall be isolated from earth with galvanic barrier.

9.5. Ex e/Ex tb for S81 special conception according to EN 60079-7 and EN 60079-31

- ✓ The calorific transfer of sensor shall not transmit, in any case a heating above 80°C including ambient temperature, to all sensor part directly in contact with explosive atmosphere.
- ✓ The connection box must not be used in areas that are affected by high charge producing processes, mechanical friction and separation processes, electron emission (e.g. near electrostatic coating equipment), and pneumatically conveyed dust.
- ✓ The cable entries, type Progress MS****EX (size M8, M12), shall be mechanically protected to high impact energy according to clause 26.4.2 of EN 60079-0 standard and shall be equipped with the specific gaskets intended for use with non-threaded holes.

10. EU Declaration of Conformity

The device supplied complies with the legal requirements. The relevant directives and harmonized standards are listed in the EU Declaration of Conformity applicable to the product. You can find the EU Declarations of Conformity by the relevant product at www.ashcroft.eu.

11. Technical information for execution SIL2 sensor type S** and temperature transmitters

When the execution is SIL2, the probability of fault has been evaluated for a lifetime of 10 years, it must be replaced after 10 years. Hardware failure tolerance is HFT=0.

<i>convert the temperature at the measuring point into electrical signal or in digital data.</i>			
Summary of IEC 61508- Clauses 7.4.2 and 7.4.4		Sxx Thermo-sensor	
		RTD Type	Thermocouple Type
Architectural constraints & Type of product A/B		HFT = 0 TYPE A	HFT = 0 TYPE A
Safe Failure Fraction (SFF)		80 %	90 %
Random hardware failures: [h ⁻¹]	λ_{DU}	3.81E- 07	9.0E-07
	λ_{SU}	9.50E-08	1. 0E-07
Random hardware failures: [h ⁻¹]	λ_{SD}	0.00E- 00	0.00E- 00
	λ_{SU}	0.00E- 00	0.00E- 00
Diagnostic coverage (DC)		80%	90%
PFD @ PTI = 8760 Hrs. MTTR = 8 Hrs.		4.16E-04	4.39E-04
Probability of Dangerous failure (High Demand - PFH) [h ⁻¹]		9.5E-08	1.00E-07
Hardware safety integrity compliance		Route 1 H	Route 1 H
Systematic safety integrity compliance		Not assessed	Not assessed
Systematic Capability (SC1, SC2, SC3, SC4)		Not assessed	Not assessed
Hardware safety integrity achieved		SIL 2	SIL 2

12. Applicable standards

Standard	Title
EN/IEC 60079-0	Explosive atmospheres - Part 0: Equipment - General requirements
EN/IEC 60079-1	Explosive atmospheres - Part 1: Equipment protection by flameproof enclosures "d"
EN/IEC 60079-11	Explosive atmospheres - Part 11: Equipment protection by intrinsic safety "i"
EN/IEC 60079-7	Explosive atmospheres - Part 7: Equipment protection by increased safety "e"
EN/IEC 60079-31	Explosive atmospheres - Part 31: Equipment dust ignition protection by enclosure "t"
GB/T 3836.1	Explosive atmospheres -- Part 1: Equipment -- General requirements
GB/T 3836.4	Explosive atmospheres -- Part 4: Equipment protection by intrinsic safety "i"