

Thermocouple for civil nuclear applications Model TCN, with IEEE conformity

WIKA data sheet TE 75.03

IEC/IEEE 60780-323:2016

Applications

- Reactor building
- Peripherals
- Heating, ventilation, air-conditioning
- Accident-proof applications
- Temperature measurement of primary, secondary and tertiary circuits and also temperature monitoring in cooling pools

Special features

- Measuring range from $-40 \dots +1,000 \text{ }^{\circ}\text{C}$ [$-40 \dots +1,832 \text{ }^{\circ}\text{F}$]
- Mounting in all standard thermowell designs possible
- Spring-loaded measuring insert
- Thermocouple type K



Description

Thermometers for use in nuclear power plants comprise:

- Thermocouple type K
- Thermowell / Protection tube
- Accessories

The model TCN thermocouple can be combined with a large number of thermowell / protection tube designs. Operation without thermowell / protection tube is only recommended in certain applications.

Example-thermocouple type K

Cable couplings are available as accessories.

A wide variety of possibilities for the combination of insertion length, neck length, thermowell / protection tube, plug connections etc. are available to be able to offer suitable thermocouples for any application.

Specifications

Construction and functionality of the combined sensor

The combined sensor consists of a resistance thermometer and two thermocouples. The resistance thermometer is used for directly measuring the current temperature. The two thermocouples have their measuring points at different positions inside the sensor tip and are connected electrically against each other. The thermocouples thus only give a differential signal between the two measuring points. Since one of the two measuring points can heat up faster than the other, the gradient of the temperature change can be measured by this measuring signal. The response time of the gradient measurement is much shorter than the actual temperature measurement. Combined sensors are therefore intended for installation in the primary cooling circuit to determine the current coolant temperature on the one hand, and rapid temperature changes of the coolant on the other hand.


Qualification

The current qualification is based on IEC/IEEE 60780-323:2016. Depending on plant specification, an extended qualification evaluation is required. This can be made on the basis of KTA, RCC or project-specific.

→ Plant-specific qualifications on request

Overview of versions	
Model	Description
TCN-Iz	Immersed, with and without thermowell / protection tube (I = immersed)
TCN-Az	Room air sensor (A = ambient)
TCN-Sz	Surface probe (S = surface); for versions, see model TC50, data sheet TE 65.50
TCN-Pz	Resistance thermometer for cooling ponds and similar applications (P = pool)
TCN-Gz	Combined sensor (G = gradient)

Basic information	
Output signal	-1.6 ... +42 mV
BDBA (Beyond Design Basis Accident), qualified	
ΔT	Max. 209 °C; max. 9.8 bar (g) saturated steam: 184 h
Short time ΔT	Max. 250 °C, 1 h
Radiation resistance	To: 1,850 kGy

Measuring element	
Type of measuring element	Type K, class 1 or 2 per IEC 60584-1
Measurement principle	Thermocouple
Connection method	
Single thermocouple	
Validity limits of the class accuracy in accordance with IEC 60584-1	
Class 2 ± (2.5 or 0.0075 x t) ¹⁾	-40 ... 1,200 °C [-40 ... +2,192 °F]
Class 1 ± (1.5 or 0.004 x t) ¹⁾	-40 ... 1,000 °C [-40 ... +1,832 °F]

1) |t| is the numerical value of the temperature in °C without consideration of the sign

The table shows the temperature ranges listed in the respective standards, in which the tolerance values (class accuracies) are valid. The actual operating temperature of the thermometer is limited both by the maximum permissible operating temperature and the diameter of the thermocouple and the sheathed cable, as well as by the maximum permissible working temperature of the sheath material.

For the tolerance value of thermocouples, a cold junction temperature of 0 °C [32 °F] has been taken as the basis.

→ For detailed specifications for thermocouples, see IEC 60584-1 and technical information IN 00.23 at www.wika.com.

Operating conditions	
Accident conditions (qualified)	
ΔT	Max. 195 °C; 5.4 bar (g) saturated steam: 24 h
Radiation resistance	to 850 kGy
Vibration resistance 10 ... 35 Hz	Constant deflection 0.35 mm
Vibration resistance 15 ... 500 Hz	0.3 g (max. reaction acceleration measured at the instrument, peak value up to 41 g)
Throughput speed	1 oct./min, 10 cycles
Vibration resistance 0 ... 3 Hz	Constant deflection
Vibration resistance 3 ... 100 Hz	Max. 35 g
Boric acid resistance	24 h at 60 ... 150 °C, concentration 6,200 ppm
Operational radiation	≤ 250 kGy (gamma equivalent)
Humidity	100%, r. h. (condensation permissible)

Further details on operating conditions			
Connector	TCN-yH	TCN-yA	TCN-yC
Description	Harting (HAN7D...)	TS connector LOCA	Connector LOCA + SA
IP ingress protection	IP65 (IP67 possible without radiation)	IP68	IP68
IEEE rating	N1E Harsch	1E	1E + SA
Qualified lifetime	12 years at 45 °C ambient temperature	55 years at 45 °C ambient temperature	55 years at 45 °C ambient temperature
Maximum radiation during normal operation	100 kGy TID - "Total Integrated Dose"	250 kGy TID - "Total Integrated Dose"	250 kGy TID - "Total Integrated Dose"
Maximum radiation during accident	-	600 kGy (TID: 850 kGy)	600 kGy (TID: 850 kGy)
LOCA test conditions	-	max. 195 °C, 5.4 bar (g), 24 h	1 h at 250 °C; 5 h at 207 °C
Accidental radiation after LOCA	-	-	1,000 kGy (TID: 1,850 kGy)
Humidity	90 % r. h. (condensation permissible)	100 % r. h. (condensation permissible)	100 % r. h. (condensation permissible)
Ambient and storage temperature	-40 ... +80 °C [-40 ... +176 °F]	-40 ... +80 °C [-40 ... +176 °F]	-40 ... +80 °C [-40 ... +176 °F]

Examples of response time

Measuring tip Ø 3 mm [0.12 in]	Ungrounded	Grounded
Thermometer version		
Sensor	Type K	
Diameter	3 mm [0.12 in]	
Probe length	150 ... 1,100 mm [5.91 ... 43.31 in] → Other probe lengths on request	
Material	Stainless steel 1.4571	
Response time in seconds (±10 %)		
$t_{0.5}$	2.56	0.42
$t_{0.63}$	3.19	0.55
$t_{0.9}$	5.96	1.32

Fundamentals of the measurements

- VDI/VDE directive 3522 part 1: Dynamic behaviour of contact thermometers / Principles and characteristic values
- VDI/VDE directive 3522 part 2 Dynamic behaviour of contact thermometers / Experimental determination of time percentage values
- IEC 60584-1

Medium: water

Response times of the thermocouple in other dimensions, configurations or materials result in different response times.

Approvals

Logo	Description	Region
CE	EU declaration of conformity	European Union
	RoHS directive	
UK CA	UKCA	United Kingdom
	Restriction of Hazardous Substances (RoHS) regulations	

→ For approvals and certificates, see website

Certificates

Certificates	Measurement accuracy	Material certificate ¹⁾
2.2 test report	x	x
3.1 inspection certificate	x	x
DAkkS calibration certificate	x	-

1) For selected components

Accessories and spare parts

Model	Description	Order number
Cable couplings	Mounting type depending on cable / customer specification	Customer-specific

Ordering information

To order the described product the order number is sufficient.

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