

V-PAD Pipe Surface Thermocouples for Fuelling Plants Model TC59-V

WIKA Data Sheet TE 65.59

Applications

- Chemical industry
- Superheated steam applications
- Refineries
- Heating furnaces and high-performance boilers
- Heat exchanger

Special Features

- Application ranges from 0 ... +1200 °C
- Flexible sheathed cable, mineral-insulated internal leads
- High mechanical strength, shock resistant



V-PAD Pipe Surface Thermocouple, Model TC59-V

Description

The patented WIKA V-PAD enables the surface temperature of a pipe within a combustion furnace to be measured accurately.

The name V-PAD is derived from the shape of the sensor. It is V-shaped and enables a welded connection to be made between the sensor and the pipe.

In the V-PAD, the flexible part of the sensor is a mineral-insulated cable (sheathed cable). It consists of a metal outer sheath, which contains the insulated internal leads, compressed within a high-density ceramic composition. The internal leads are made from thermo material. The material of the outer sheath can be selected to match the application.

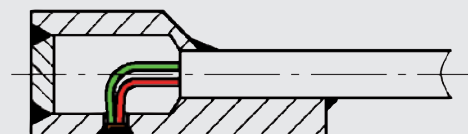
At one end of the sheathed cable, the internal leads are welded together. For the versions with a non-insulated (grounded) measuring point, the sheath is welded to the thermocouple. At the other end of the sheathed cable the ends of the leads are connected and the sheathed cable is hermetically sealed using a sealing compound.

The lead ends form the platform for the electrical connection. Cables, plug-in connectors or connector sockets can be connected to them.

Sensor design

The pipe surface thermocouple is supplied with a non-insulated measuring point (grounded).

Only in this way it is possible to ensure that the temperature-sensitive measuring point is positioned as close as possible to the pipe surface. By welding the V-PAD, the measuring point is, thus, a part of the pipe surface and provides the most-accurate measurement results.



Sensor

Type	Recommended max. temperature
K (NiCr-Ni)	1200 °C
N (NiCrSi-NiSi)	1200 °C

Sensor limiting error

A cold junction temperature of 0 °C is taken as the basis for the definition of the sensor limiting error of thermocouples.

When using a compensating cable or thermocouple cable, an additional measuring error must be considered.

Type K

Class	Temperature range	Limiting error
DIN EN 60 584 part 2		
1	-40 °C ... +375 °C	± 1.5 °C
1	+375 °C ... +1000 °C	± 0.0040 • t ¹⁾
2	-40 °C ... +333 °C	± 2.5 °C
2	+333 °C ... +1200 °C	± 0.0075 • t ¹⁾
ISA (ANSI) MC96.1-1982		
Standard	0 °C ... +750 °C	± 2.2 °C or ²⁾ ± 0.75 %
Special	0 °C ... +750 °C	± 1.1 °C or ²⁾ ± 0.4 %

Type N

Class	Temperature range	Limiting error
DIN EN 60 584 part 2		
1	-40 °C ... +375 °C	± 1.5 °C
1	+375 °C ... +1000 °C	± 0.0040 • t ¹⁾
2	-40 °C ... +333 °C	± 2.5 °C
2	+333 °C ... +1200 °C	± 0.0075 • t ¹⁾

1) | t | is the value of the temperature in °C without consideration of the sign
2) Whichever is larger.

Limiting error with selected temperatures in °C for thermocouples type K and type N

Temperature (ITS 90) °C	Limiting error DIN EN 60 584 Teil 2 Class 1 °C	Class 2 °C
0	± 1.5	± 2.50
100	± 1.5	± 2.50
200	± 1.5	± 2.50
300	± 1.5	± 2.50
400	± 1.6	± 3.00
500	± 2.0	± 3.75
600	± 2.4	± 4.50
700	± 2.8	± 5.25
800	± 3.2	± 6.00
900	± 3.6	± 6.75
1000	± 4.0	± 7.50
1100	-	± 8.25
1200	-	± 9.00

Other thermocouples on request

Mechanical design

Through its special design the V-PAD sensor offers a high accuracy and a fast response characteristic. The measurement accuracy can be further increased by an additional, optimised insulating screen.

Sheathed cable

The sheathed cable is flexible. The minimum bending radius is 5-times the sheath diameter.

Sheath diameter

- 6.0 mm
- 8.0 mm

Other sheath diameters on request

It is recommended that as thick a sheathed cable as possible is used, since it will have better mechanical and electrical characteristics.

V-PAD sheath materials

- Ni-alloy 2.4816 (Inconel 600)
 - up to 1200 °C (air)
 - standard material for applications which require specific corrosion resistance properties under exposure to high temperatures, resistant to induced stress corrosion cracking and pitting in media containing chloride
 - highly resistant to halogens, chlorine, hydrogen chloride
 - problematic applications in sulphurous fuels
- Steels
 - up to 850 °C (air)
 - good corrosion resistance with aggressive media as well as steam and flue gases in chemical media

V-PAD & MI sheath material	Resistance in sulphurous ambient	maximum temperature
2.4665 (Hastelloy X®)	medium	1150 °C
2.4816 (Inconel 600®)	low	1150 °C
1.4841 (310 SS)	medium	1150 °C
1.4749 (446 SS)	high	1150 °C
Pyrosil D®	high	1200 °C
Haynes HR 160®	very high	1250 °C
1.4401 (316 SS)	medium	850 °C

Other sheath materials on request

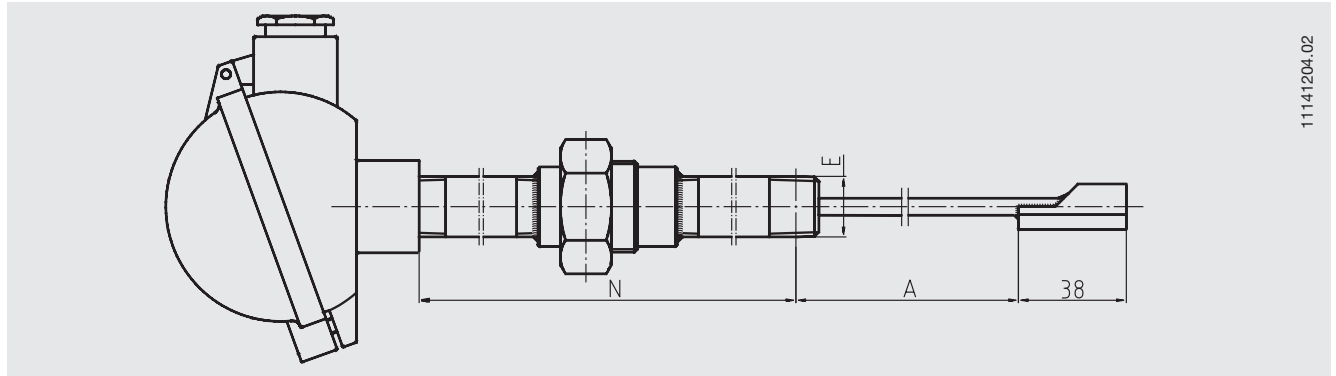
Design and electrical connection

Depending on their electrical connection, V-PAD thermocouples are divided into the following designs:

- Design with connection head
- Design with compression fitting on sheathed cable and leads
- Design with compression fitting on the sheathed cable and extension cable

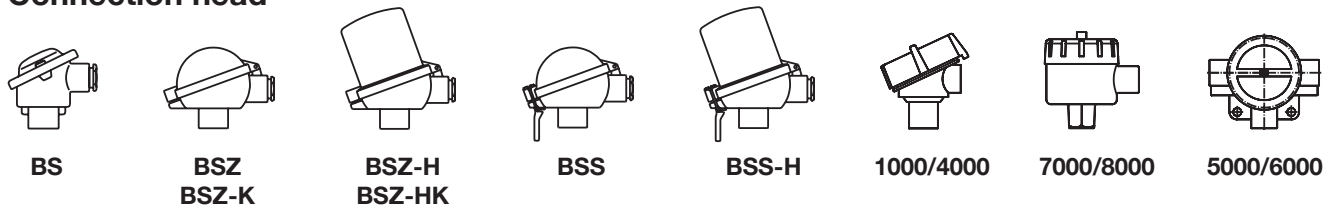
Design with connection head

V-PAD with connection head, neck-tube with multipart fitting (optional) and sheathed cable



The sealing from the process occurs within the neck tube.

Connection head

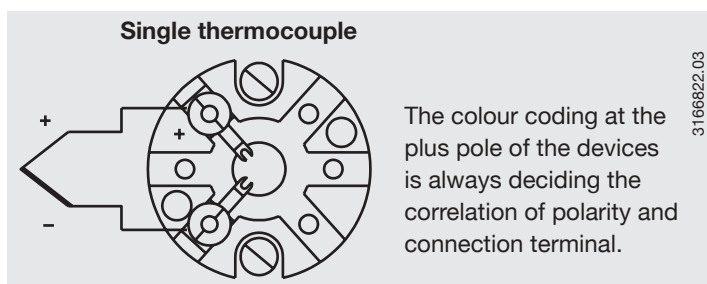


Model	Material	Cable entry	Ingress protection	Cap	Surface finish
BS	Aluminium	M20 x 1.5	IP 65	Cap with 2 screws	blue, painted
BSZ	Aluminium	M20 x 1.5	IP 65	Flap cap with screw	blue, painted
BSZ-K	Plastic	M20 x 1.5	IP 65	Flap cap with screw	plastic
BSZ-H	Aluminium	M20 x 1.5	IP 65	Flap cap with screw	blue, painted
BSZ-HK	Plastic	M20 x 1.5	IP 65	Flap cap with screw	plastic
BSS	Aluminium	M20 x 1.5	IP 65	Flap cap with clip	blue, painted
BSS-H	Aluminium	M20 x 1.5	IP 65	Flap cap with clip	blue, painted
1000	Aluminium	½ NPT	IP 65	Screw cover	blue, painted
1000	Stainless steel	½ NPT	IP 65	Screw cover	blank
8000	Aluminium	M20 x 1.5	IP 65	Screw cover	blue, painted
8000	Stainless steel	½ NPT	IP 65	Screw cover	blank
DIH50 5000/6000	Aluminium	3 x M20 x 1.5	IP 65	Screw cover with window and LCD indicator DIH50	blue, painted window
DIH10/ BSZ-H	Aluminium	M20 x 1.5	IP 65	Flap cap with screw and LED indicator DIH10	blue, painted with display

1) Standard others on request

2) RAL5022, polyester paint saltwater-proof

Electrical connection



Transmitter (option)

A transmitter can be mounted directly into the connection head.

The following installation variants are thus possible:

Connection head	Transmitter Model		
	T12	T32	T53
BS	-	-	○
BSZ/BSZ-K	○	○	○
BSZ-H/BSZ-HK	●	●	●
BSS	○	○	○
BSS-H	●	●	●
1000/4000	○	○	○
7000/8000	○	○	○
DIH50	○	○	-
DIH10	○	○	-

- Mounted instead of terminal block
- Mounted within the cap of the connection head
- Mounting not possible

Model	Description	Explosion protection	Data sheet
T12	Digital transmitter, PC-configurable	optional	TE 12.03
T32	Digital transmitter, HART protocol	optional	TE 32.03 + TE 32.04
T53	Digital transmitter FOUNDATION Fieldbus and PROFIBUS PA	standard	TE 53.01

Connection head with digital indicator (option)

DIH50

As an optional alternative to the standard connection head the thermometer may be equipped with the digital indicator DIH50.

For operation a 4 ... 20 mA transmitter is necessary, which is mounted into the case. When using a HART transmitter, e.g. Model T32, the measuring range and indication range of the transmitter and indicator can be configured together.



Fig. Connection head with digital indicator, Model DIH50

DIH50-F

The DIH50-F can be used as an enclosure for wall mounting. Thus, it is possible to fit a digital indicator to designs without a connection head. For operation a 4 ... 20 mA transmitter is necessary, which is mounted into the case. When using a HART transmitter, e.g. Model T32, the measuring range and indication range of the transmitter and indicator can be configured together.

For the DIH50-F an optional pipe mounting set is available.



Fig. Field housing with digital indicator, Model DIH50-F

DIH10

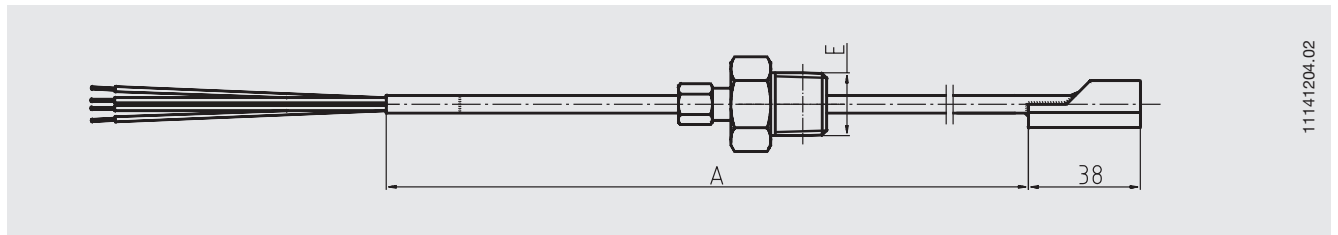
As an optional alternative to the standard connection head the thermometer may be equipped with the digital indicator DIH10. The connection head used in this case is similar to the head model BSZ-H.

For operation a 4 ... 20 mA transmitter is necessary, which is mounted to the measuring insert. The scale range of the indicator is configured manual identical to the measuring range of the transmitter.



Fig. Connection head with digital indicator, Model DIH10

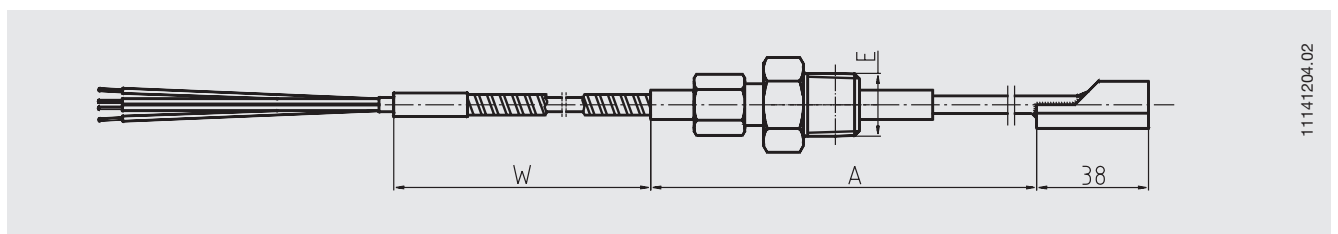
Design with compression fitting on sheathed cable and leads



This design with cable ends is intended for installation in the enclosures available. The flexible sheath is extended from the enclosure and is run to the measuring point.

- Cable length 100 mm, other lengths on request
- Thermo wire Ø 0.22 mm
- Compensating cable type depending on the sensor type, PTFE insulated
- The sealing from the process is performed by the compression fitting. It can be supplied in all common thread sizes e.g. G 1/2 , 1/2 NPT, 3/4 NPT)

Design with compression fitting on sheathed cable and extension cable



- Cable length to customer specifications
- Compensating cable, leads 0.22 mm², compensating cable type depending on the sensor type
- Number of leads depends on the number of sensors, lead ends bare
- Insulation (material / ambient temperature max.):
 - PVC 105 °C
 - Silikon 200 °C
 - PTFE 250 °C
 - fibreglass 400 °C
- Other versions on request
- The sealing from the process is performed by the compression fitting. It can be supplied in all common thread sizes (e.g. G 1/2 , 1/2 NPT, 3/4 NPT)

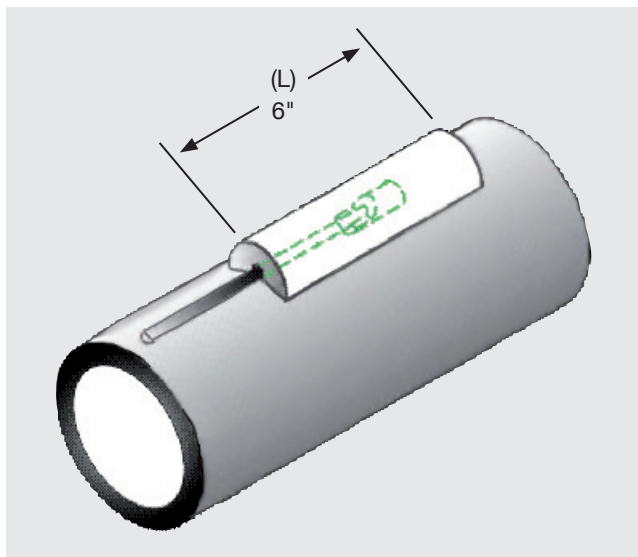
Colour coding of the connecting leads (Form B and C)

Sensor	Standard	Outer sheath colour	Positive	Negative
K	DIN EN 60 584-3	green	green	white
N	DIN EN 60 584-3	pink	pink	white

Heat shield (option)

In contrast to most other surface measurements, with applications in combustion plants the temperature outside of the pipe is higher than that inside it. The heat is mostly generated by an open flame and, therefore, high gas velocities and a high thermal radiation density prevail. Since the V-PAD sensor protrudes from the flush pipe surface, it is heated more intensively than the pipe itself, due to both radiation and convection. This may lead to a positive measuring error, i.e. the measurement shows too high a temperature. To reduce this distortion, which is dependant upon the operating conditions, the V-PAD can be supplied with an additional heat shield.

However, the shield must be designed, in terms of material as well as layout, to match precisely the pipe being measured. This means that the external diameter of the pipe MUST be specified.



Installation

It is recommended that the mineral-insulated cable is placed in the radiation shadow for the measurement. To fix the cable, you can order fastening brackets that, ideally, should be manufactured from the same material as the pipe. To compensate for thermal expansion, the MI cable should be laid in one, or several, loops.

Upon customer request, the mineral-insulated cable can be bent in advance to prepare it for installation.

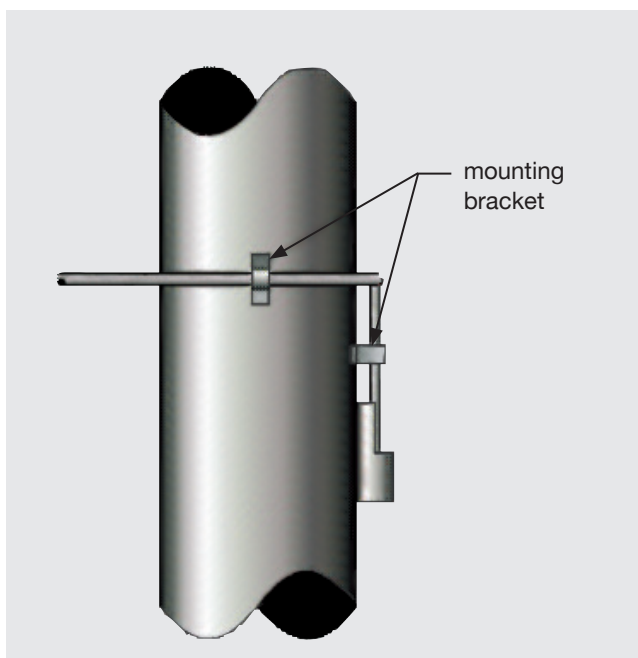
Explosion protection

An intrinsically-safe design of the V-PAD sensor is technically possible but is not recommended.

The final inspection of an intrinsically-safe thermocouple demands a 500 V insulation test. A grounded thermocouple cannot pass this test.

For an insulated thermocouple, the measuring point would be no longer on the pipe surface but several millimetres away from it. This would cause a considerable measuring error.

In most cases, an ATEX-conformant version would not make sense, since these are usually operated in combustion plants and ATEX is not defined for a temperature class higher than T1 (450 °C).



Mounting bracket

Mineral-insulated cable Ø	S-Number	Material
Ø 6 ... 8 mm	11051841	Inconel 600
Ø 10 mm	11197634	Inconel 600

Modifications may take place and materials specified may be replaced by others without prior notice. Specifications and dimensions given in this leaflet represent the state of engineering at the time of printing.



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