

# Thermocouple straight version per DIN 50446

## For high-temperature measurements

### TC80 model series

WIKA data sheet TE 65.80



for further approvals  
see page 12

#### Applications

- Blast furnaces, hot blast stoves
- Annealing and heat treatment processes
- Waste, biomass and hazardous waste incineration
- Large heating plants, heat generation, power engineering, reactors
- Glass, porcelain and ceramic industry, cement and brick production

#### Special features

- Application ranges up to max. +1,700 °C / +3,100 °F (DIN EN 50446 / ASTM E230)
- Protection tube from heat-resistant steel or ceramic, also with ceramic inner tube
- Support tube from different steels
- Gas-tight process connection
- Coatings (option)

#### Description

Thermocouples of the TC80 model series have been developed to measure extremely high temperatures. These high-temperature thermocouples comply with DIN EN 50446. The thermocouple wires of the thermocouple which is built into the protection tube, are fed into either capillary bores in ceramic insulation tubes or into capillary bores in insulation rods. A protection tube, mostly from highly heat-resistant metal or high temperature ceramic, with or without additional inner tube, protects the thermocouple from the process medium as well as from mechanical and chemical damage.

A wide selection of process connections, e.g. stop flanges, threaded bushings and solid welded flanges enable direct mounting into the process. For particularly critical



**Straight thermocouples of the TC80 model series**

applications, there are designs with inert gas or compressed air flushing or with a pressure-tight sealing. Of course, extremely robust protection tube designs may also be used.

Optionally, a transmitter can be built in. Among the advantages of a built-in transmitter is an increased reliability of the signal transmission. Lower-cost copper cable can then be used, in place of specific thermocouple and compensating cables, between the transmitter and the control room. A cold junction is integrated into all WIKA transmitters.

# Sensor

## Sensor types

Type	Tolerance value	Class	Temperature range
<b>K N</b>	IEC 60584-1	1	-40 ... +1,000 °C
		2	-40 ... +1,200 °C
	ASTM E230	Special	0 ... +1,260 °C
		Standard	0 ... +1,260 °C
<b>J</b>	IEC 60584-1	1	-40 ... +750 °C
		2	-40 ... +750 °C
	ASTM E230	Special	0 ... +760 °C
		Standard	0 ... +760 °C
<b>E</b>	IEC 60584-1	1	-40 ... +800 °C
		2	-40 ... +900 °C
	ASTM E230	Special	0 ... +870 °C
		Standard	0 ... +870 °C
<b>R S</b>	IEC 60584-1	1	0 ... +1,600 °C
		2	0 ... +1,600 °C
	ASTM E230	Special	0 ... +1,480 °C
		Standard	0 ... +1,480 °C
<b>B</b>	IEC 60584-1	2	+600 ... +1,700 °C
		3	+600 ... +1,700 °C
	ASTM E230	Special	-
		Standard	+870 ... +1,700 °C

### Tolerance value

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

For detailed specifications for thermocouples, see Technical information IN 00.23 at [www.wika.com](http://www.wika.com).

Listed models are available both as single or dual thermocouples. The thermocouple will be delivered with an insulated measuring point, unless explicitly specified otherwise.

The application range of these thermometers is limited both by the permissible max. temperature of the thermocouple and by the max. temperature of the protection tube material.

The long-term stability of precious-metal thermocouples rises with increasing thermo-wire diameter. The type S, R and B sensors are available with thermo-wire diameters of Ø 0.35 mm or Ø 0.5 mm.

# Versions

Depending on the form of the connection head and the material group of the thermowell, the variety of designs is subdivided into the following main models as per DIN EN 50446: AM, AMK, BM, BMK, AK, AKK, BK

### 1. Position

A = Connection head, Form A

B = Connection head, Form B

### 2. Position

M = Metal protection tube

C = Ceramic protection tube

### 3. Position

C = Ceramic inner tube

no 3rd character means: without inner tube

### Versions with metal protection tube

Depending on the material, the upper operating temperature of metal protection tubes can be up to 1,200 °C.

Generally, a base metal thermocouple is used as a sensor (types K, J and N).

### Versions with ceramic protection tube

Depending on the ceramic used, the upper operating temperature limit of ceramic protection tubes can be up to 1,600 °C, with higher temperatures on request. Generally, a precious metal thermocouple is used as a sensor (types R, S and B).

For the measurement of temperatures above 1,200 °C, only precious-metal thermocouples can be used as sensor.

With precious-metal thermocouples, however, there is a risk of "poisoning" by contamination. This risk rises with increasing temperatures. Therefore, at temperatures above 1,200 °C, gas-tight ceramics should be used, preferably high-purity C 799 (see "Remarks on the selection and operation of protection tubes").

The process connection is designed to be gas-tight up to 1 bar. With toxic or safety-critical process gases or special installation situations, it is recommended to take further constructive measures in addition to the standard features, in order to avoid any leakage of the medium to the outside via the connection head, in the event of a protection tube fracture (e.g. pressure-sealed feed-through in the connection head).

## Model overview and dimensions

### Dimensions for standard versions in mm

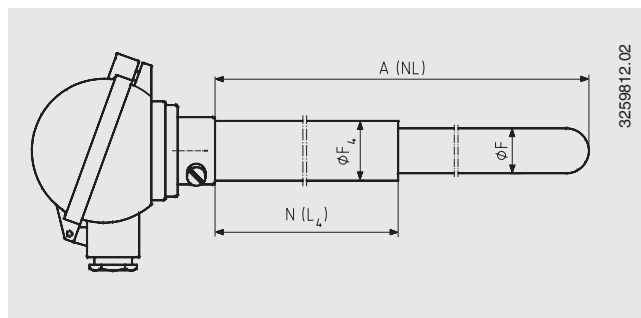
#### Version AK per DIN EN 50446

- Connection head form A
- Ceramic protection tube
- Metallic support tube

Dimensions for versions with protection tube  $\varnothing \geq 26$  mm

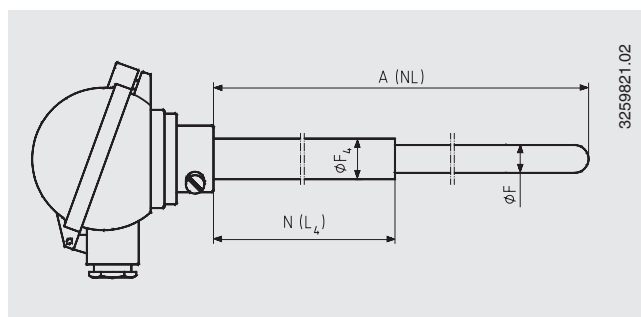
A	Nominal length	500, 710, 1,000, 1,400, 2,000 <sup>1)</sup>
$\varnothing F$	Protection tube outer $\varnothing$	26 (SIC, C 530)
N	Support tube length	200 (standard)
$\varnothing F_4$	Support tube $\varnothing$	32

1) These nominal lengths (and greater lengths) with inserted precious-metal thermocouples are not suitable for installation at right angles.



Dimensions for versions with protection tube  $\varnothing < 26$  mm

A	Nominal length	500, 710, 1,000 or 1,400
$\varnothing F$	Protection tube outer $\varnothing$	15, 16 (C 610)
N	Support tube length	150 (standard)
$\varnothing F_4$	Support tube $\varnothing$	22



#### Version AKK per DIN EN 50446

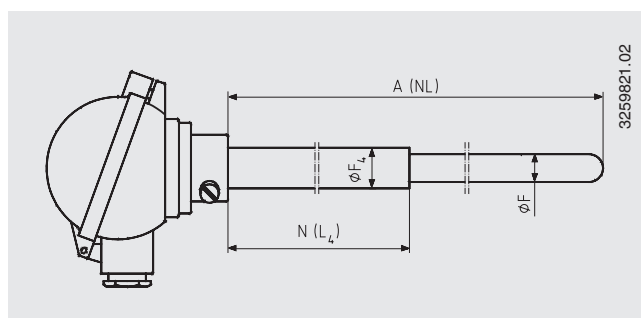
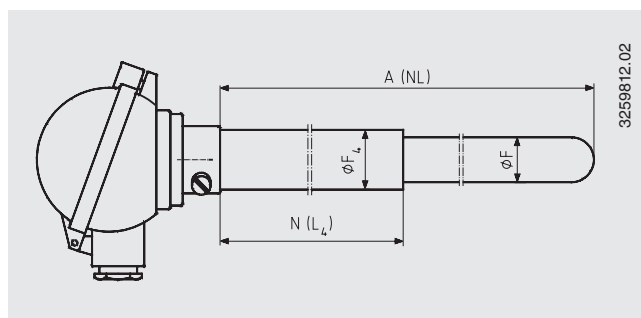
- Connection head form A
- Ceramic protection tube
- Metallic support tube
- Ceramic inner tube

Dimensions for versions with protection tube  $\varnothing \geq 26$  mm

A	Nominal length	500, 710, 1,000 or 1,400
$\varnothing F$	Protection tube outer $\varnothing$	26 (SIC, C 530)
N	Support tube length	200 (standard)
$\varnothing F_4$	Support tube $\varnothing$	32

Dimensions for versions with protection tube  $\varnothing < 26$  mm

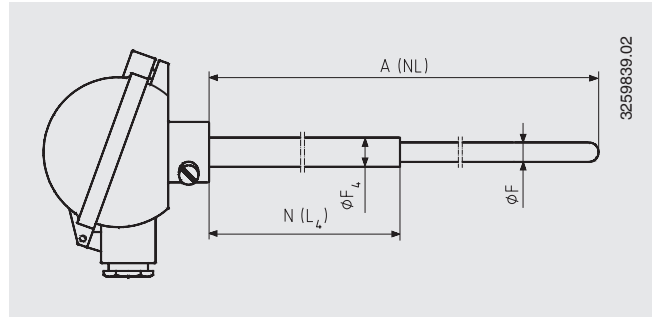
A	Nominal length	500, 710, 1,000 or 1,400
$\varnothing F$	Protection tube outer $\varnothing$	15, 16 (C 610)
N	Support tube length	150
$\varnothing F_4$	Support tube $\varnothing$	22



### Version BK per DIN EN 50446

- Connection head form B
- Ceramic protection tube
- Metallic support tube

A Nominal length 355, 500, 710, 1,000  
 ØF Protection tube outer Ø 10  
 N Support tube length 80  
 ØF<sub>4</sub> Support tube Ø 15

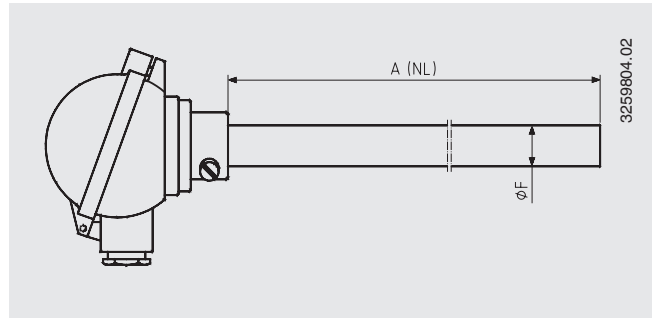


### Version AM / AMK per DIN EN 50446

- Connection head form A
- Metal protection tube
- Ceramic inner tube (AMK)

A Nominal length 500, 710, 1,000, 1,400, 2,000<sup>1)</sup>  
 ØF Protection tube outer Ø 22 (24, 26)

1) These nominal lengths (and greater lengths) with inserted precious-metal thermocouples are not suitable for installation at right angles.

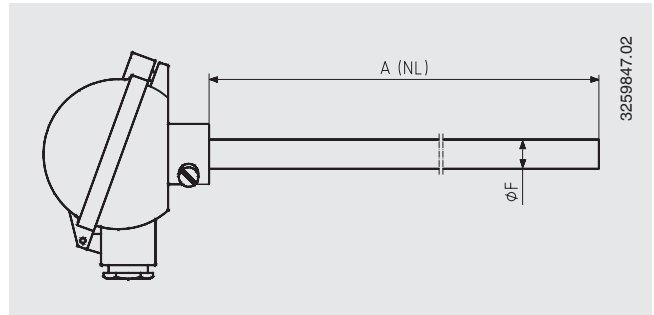


### Version BM / BMK per DIN EN 50446

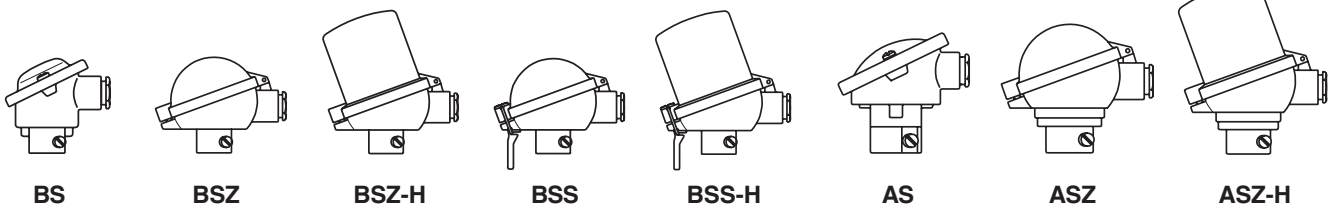
- Connection head form B
- Metal protection tube
- Ceramic inner tube (BMK)

A Nominal length 355, 500, 710, 1,000, 1,400<sup>2)</sup>  
 ØF Protection tube outer Ø 15

2) Only version BM



## Connection head



Model	Material	Cable outlet	Ingress protection	Cap	Surface
BS	Aluminium	M20 x 1.5 <sup>1)</sup>	IP53	Cap with 2 screws	Blue, lacquered <sup>2)</sup>
BSZ	Aluminium	M20 x 1.5 <sup>1)</sup>	IP53	Hinged cover with cylinder head screw	Blue, lacquered <sup>2)</sup>
BSZ-H	Aluminium	M20 x 1.5 <sup>1)</sup>	IP53	Hinged cover with cylinder head screw	Blue, lacquered <sup>2)</sup>
BSS	Aluminium	M20 x 1.5 <sup>1)</sup>	IP53	Hinged cover with clip	Blue, lacquered <sup>2)</sup>
BSS-H	Aluminium	M20 x 1.5 <sup>1)</sup>	IP53	Hinged cover with clip	Blue, lacquered <sup>2)</sup>
AS	Aluminium	M20 x 1.5 <sup>1)</sup>	IP53	Cap with 2 screws	Blue, lacquered <sup>2)</sup>
ASZ	Aluminium	M20 x 1.5 <sup>1)</sup>	IP53	Hinged cover with cylinder head screw	Blue, lacquered <sup>2)</sup>
ASZ-H	Aluminium	M20 x 1.5 <sup>1)</sup>	IP53	Hinged cover with cylinder head screw	Blue, lacquered <sup>2)</sup>

Designs with IP65 ingress protection on request

1) Standard  
 2) RAL 5022

## Transmitter (option)

The transmitter can be mounted directly into the thermometer. Attention must be paid to the permissible ambient temperature of the transmitter in accordance with the data sheet. With a direct connection of the thermocouple to the transmitter - due to the heat transfer of the thermo wires - the risk of an unacceptably high heating of the transmitter terminals increases. The thermocouple can also be indirectly connected to the transmitter using a short piece of thin compensating cable between terminal block and transmitter.

Hence, the resulting mounting in the cap of the connection head requires a connection head with a high cap: ASZ-H head for AK, AM, AMK and AKK versions and BSZ-H or BSS-H head for BM, BMK and BK versions.

Connection head	Transmitter model		
	T32	T91	T53
BS	-	-	-
BSZ	-	-	-
BSZ-H	●	●	●
BSS	-	-	-
BSS-H	●	●	●
AS	-	-	-
ASZ	-	-	-
ASZ-H	●	●	●

● Mounted within the cap of the connection head

- Mounting not possible

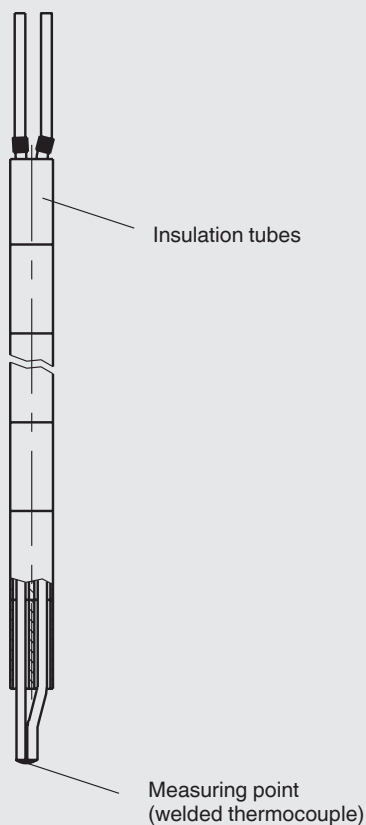
Model	Description	Data sheet
T32	Digital transmitter, HART® protocol	TE 32.04
T53	Digital transmitter FOUNDATION™ Fieldbus and PROFIBUS® PA	TE 53.01
T91	Analogue transmitter, fixed measuring range	TE 91.01

## Design of thermocouple

### Base-metal thermocouple types K, N, J

Thermo wire:  $\varnothing$  1 mm or  $\varnothing$  3 mm

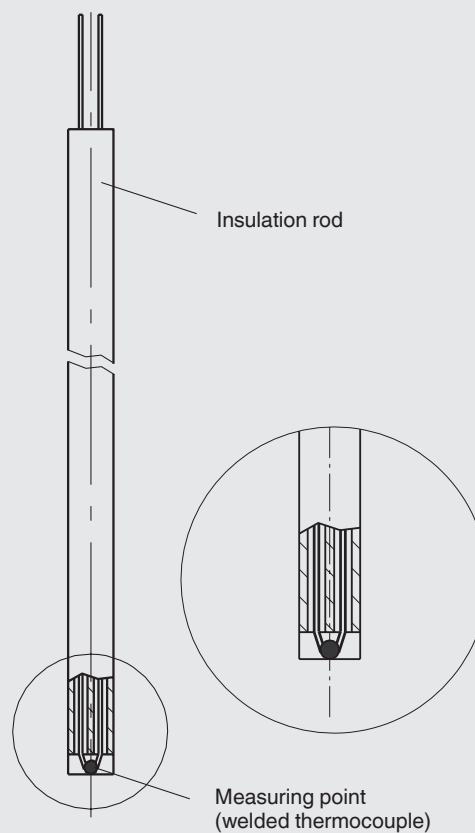
Insulation: Insulation tubes, ceramic C 610



### Precious-metal thermocouple types S, R, B

Thermo wire:  $\varnothing$  0.35 mm or  $\varnothing$  0.5 mm

Insulation: Insulation rod, ceramic C 799



## AM, AMK, BM and BMK versions

### Metal protection tube

The protection tube is manufactured from tube per DIN EN 50446 Form A (dished) or Form C (flat). Both versions should be considered to be technically equivalent. The selection of the base form is the responsibility of the manufacturer.

With enamelled metal protection tubes, the bottom is always dished. The protection tube is pressed into the connection head and clamped.

In addition, we offer the possibility of a head screwed onto the protection tube. This enables IP65 protection to be achieved. An adjustable process connection is clamped onto the protection tube, thus allowing a variable insertion length.

Standard nominal lengths per DIN EN 50446 are preferable.

### Standard nominal lengths

A = 500, 710, 1,000, 1,400, 2,000 mm

Others on request

### Materials for metal protection tubes

See "Remarks on the selection and operation of protection tubes"

### Inner tube (option)

At high temperatures, metal protection tubes can become porous or scaled.

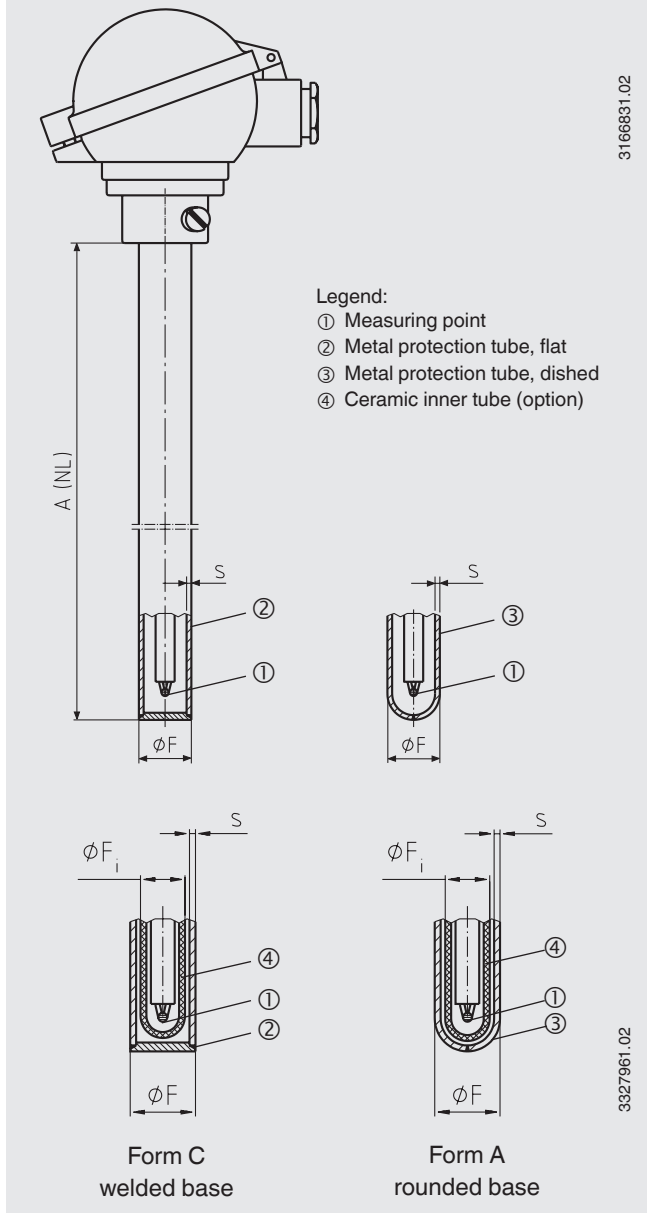
An inner tube from gas-tight ceramic protects the thermocouple from aggressive gases. As a result, on the one side, changes in the thermoelectric properties of the thermocouple are avoided, and on the other side, an increase in the service life of the thermometer is achieved.

### Materials for inner tube 1)

- Ceramic C 610 gas-tight  
up to 1,500 °C, not resistant to alkali vapours
- Ceramic C 799 gas-tight, high-purity  
up to 1,600 °C, however only partially resistant to changes in temperature, not resistant to alkali vapours

1) see "Remarks on the selection and operation of protection tubes"

## Protection tube design



Dimensions in mm for protection tube and inner tube

Version	Metal protection tube		Ceramic inner tube
	External Ø	Wall thickness	External Ø
	Ø F	s	Ø Fi
AM	22	2	15
BM	15	2	10

## AKK, AK and BK versions

### Ceramic protection tube

Ceramic protection tubes are made from high-fired aluminium oxide ceramics, the tip is closed and hemispherical. Due to the low mechanical strength, a metal support tube is used to fix the process connection to the thermocouple.

The ceramic protection tube is cemented into the support tube using a fireproof ceramic compound. The support tube is inserted into the connection head and clamped.

Standard nominal lengths per DIN EN 50446 are preferable.

### Standard nominal lengths

A = 355, 500, 710, 1,000, 1,400, 2,000 mm

Others on request

### Materials for ceramic protection tubes 1)

- Ceramic C 530 not gas-tight, fine-pored highly resistant to changes in temperature, usable up to 1,600 °C, not attacked by gases  
Used as outer protection tube in combination with gas-tight inner protection tube
  - Ceramic C 610 gas-tight usable up to 1,500 °C, not resistant to alkali vapours
  - Ceramic C 799 gas-tight, high-purity usable up to 1,600 °C, however, only partially resistant to changes in temperature, not resistant to alkali vapours
- Other materials on request

### Inner tube (optional, only for version AKK)

If the outer protection tube of version AKK is selected from C 530 non gas-tight ceramic, then it should be combined with a gas-tight inner tube. This protects the thermocouple from aggressive gases.

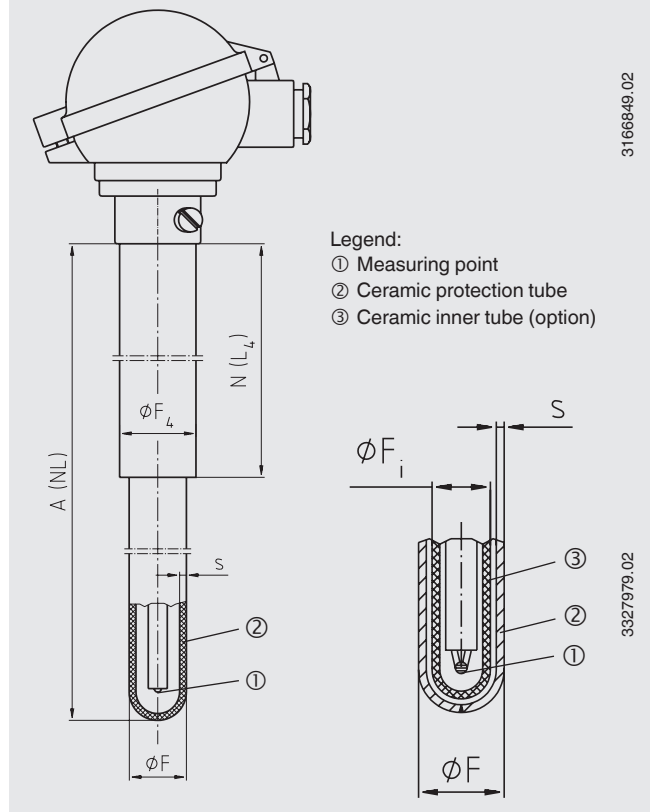
As a result, on the one side, changes in the thermoelectric properties of the thermocouple are avoided, and on the other side, an increase in the service life of the thermometer is achieved.

### Materials for inner tube 1)

- Ceramic C 610 gas-tight up to 1,500 °C, not resistant to alkali vapours
- Ceramic C 799 gas-tight, high-purity up to 1,600 °C, however, only partially resistant to changes in temperature, not resistant to alkali vapours

1) see "Remarks on the selection and operation of protection tubes"

### Protection tube design



3166849.02

3327979.02

Dimensions in mm for protection tube and inner tube

Ceramic protection tube		Ceramic inner tube
External $\phi$	Wall thickness	External $\phi$
$\phi F$	s	$\phi F_i$
26	2 - 4	15, 16
15, 16	2	10

### Support tube

Material: carbon steel, stainless steel

Other materials on request

Dimensions in mm for support tube

Version	External $\phi$	Length
	$\phi F_4$	$N (L_4)$
AK	32	200
	22	150
AKK	32	200
	22	150
BK	15	150

## AM, AMK, BM and BMK versions

### Enamelled protection tube

When using enamelled protection tubes, a threaded bushing should be used to prevent the enamel layer from being damaged.

### Not gas-tight

A stop flange is sufficient; a mating flange is not needed. The stop flange is adjustable on the protection tube and is secured using a clamp. Therefore, the insertion length of the thermometer is variable and can be easily adjusted at the mounting point.

### Gas-tight up to 1 bar <sup>1)</sup>

A threaded bushing or a combination of stop flange/mating flange is needed.

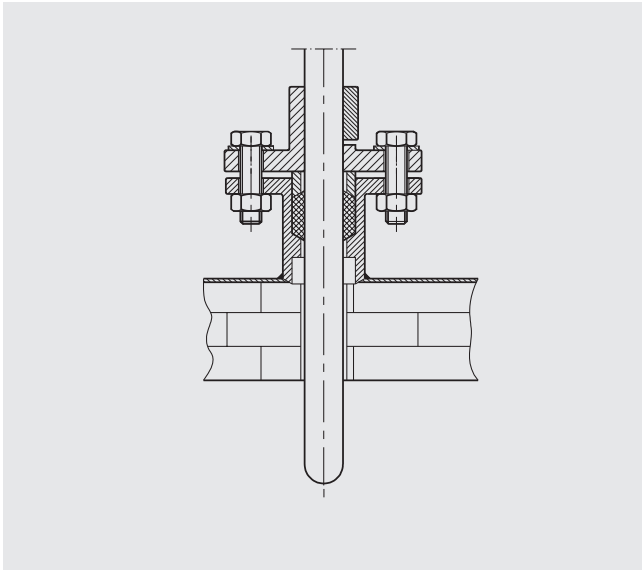
#### Threaded bushing:

This is secured onto the metal protection tube using a clamp. Once loosened, adjustment along the protection tube is possible. The insertion length of the thermometer is variable and can be easily adjusted at the mounting point.

#### Stop flange/mating flange:

Sealing is made via a stuffing box between mating flange and protection tube. It is secured using a clamp between the stop flange and protection tube.

The insertion length of the thermometer is variable.



## AKK, AK and BK versions

### Not gas-tight

A stop flange is sufficient; a mating flange is not needed. The stop flange is adjustable on the support tube and is secured using a clamp.

Therefore, the insertion length within the limit of the support tube length is variable and can be easily adjusted at the mounting point.

### Gas-tight up to 1 bar <sup>1)</sup>

A threaded bushing or a combination of stop flange/mating flange is needed.

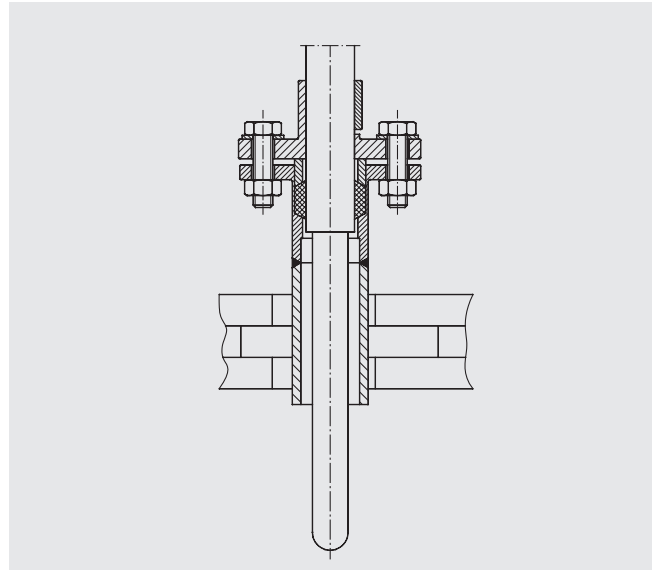
#### Threaded bushing:

This is secured onto the support tube using a clamp. Once loosened, adjustment along the support tube is possible. Therefore, the insertion length of the thermometer within the limit of the support tube length is variable and can be easily adjusted at the mounting point.

#### Stop flange/mating flange:

It is sealed and secured using a clamp between mating flange and metal support tube.

<sup>1)</sup> see "Remarks on the selection and operation of protection tubes"



## Installation notes for ceramic protection tubes

The C 799 ceramic material is only partially resistant to changes in temperature. A temperature shock can therefore easily result in stress cracks and consequently in damage to the ceramic protection tube. For this reason, thermometers with protection tubes of C 799 ceramic must be pre-heated before installation, and then slowly inserted into the process.

Depending on the ambient and process temperatures present, this procedure is also recommended for the other ceramic materials.

In addition to the protection from thermal stress, ceramic protection tubes must also be protected from mechanical stress. Such damaging stress conditions are caused by bending forces acting in a horizontal installation position. Thus, with horizontal installation (and dependent upon diameter, nominal length and design), additional support should be provided by the customer.

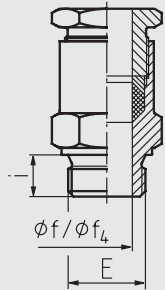
**The note regarding the problems caused by bending forces also applies, in principle, to metal protection tubes.**



## Process connection

### Threaded bushing

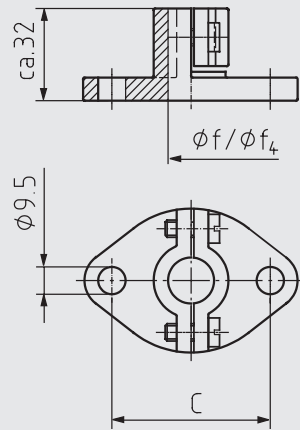
adjustable,  
gas-tight up to 1 bar  
Sealing: asbestos-free,  
up to max. 300 °C,  
higher temperatures  
on request



**Material:**  
Carbon steel or 1.4571  
stainless steel

### Stop flange per DIN EN 50446

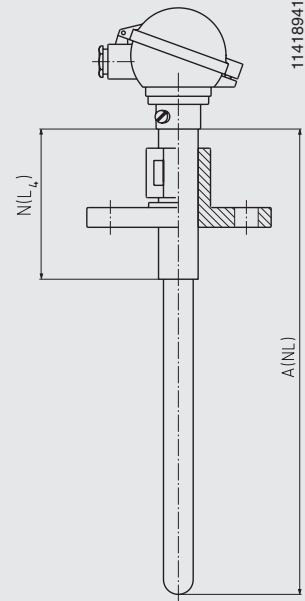
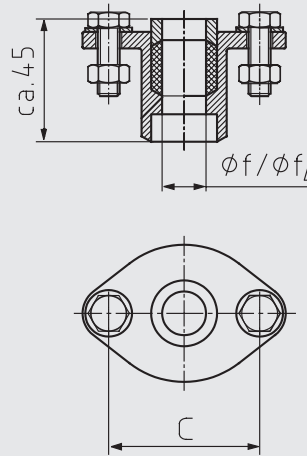
adjustable



**Material:**  
Carbon steel or malleable cast iron,  
others on request

### A mating flange can only be used in conjunction with a stop flange

adjustable,  
gas-tight up to 1 bar  
Sealing: asbestos-free



### Selectable threaded bushings

Version	Protection tube	Dimensions in mm		Process connection
	External Ø	Ø f/f <sub>4</sub>	i min.	E
AM AMK	22	22,5	20	G 1, 1 NPT, G 1½
BM BMK	15	15,5	20	G ½, G ¾, G 1, 1 ½ NPT, M20 x 1.5, M27 x 2

Other threads on request

### Selectable threaded bushings

Version	Protection tube	Dimensions in mm		Process connection
	External Ø	Ø f/f <sub>4</sub>	i min.	E
AK	32	32.5	30	G 1¼
	22	22.5	20	G 1, 1 NPT
BK	15	15.5	20	G ½, G ¾, G 1

Other threads on request

### Selectable stop flanges

Version	Protection tube	Dimensions in mm	
	External Ø	Ø f/f <sub>4</sub>	C (hole centre spacing)
AM AMK	22	22.5	70
BM BMK	15	15.5	55

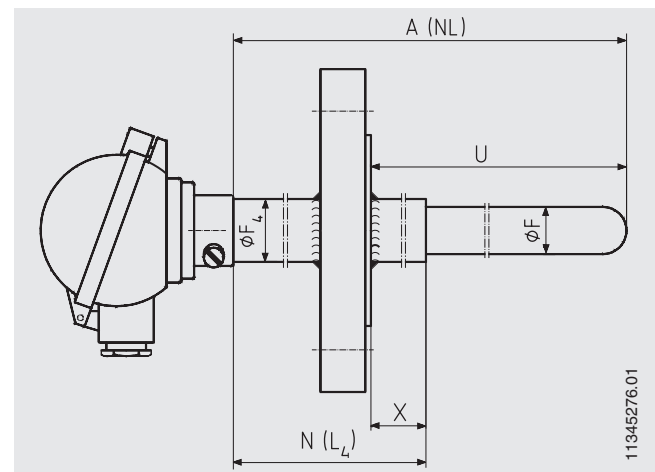
### Selectable stop flanges

Version	Protection tube	Dimensions in mm	
	External Ø	Ø f/f <sub>4</sub>	C (hole centre spacing)
AK	32	32.5	70
	22	22.5	70
BK	15	15.5	55

### TC80 with fixed-welded flange connection

Flanges can be specified in various nominal sizes, pressure ratings and materials.

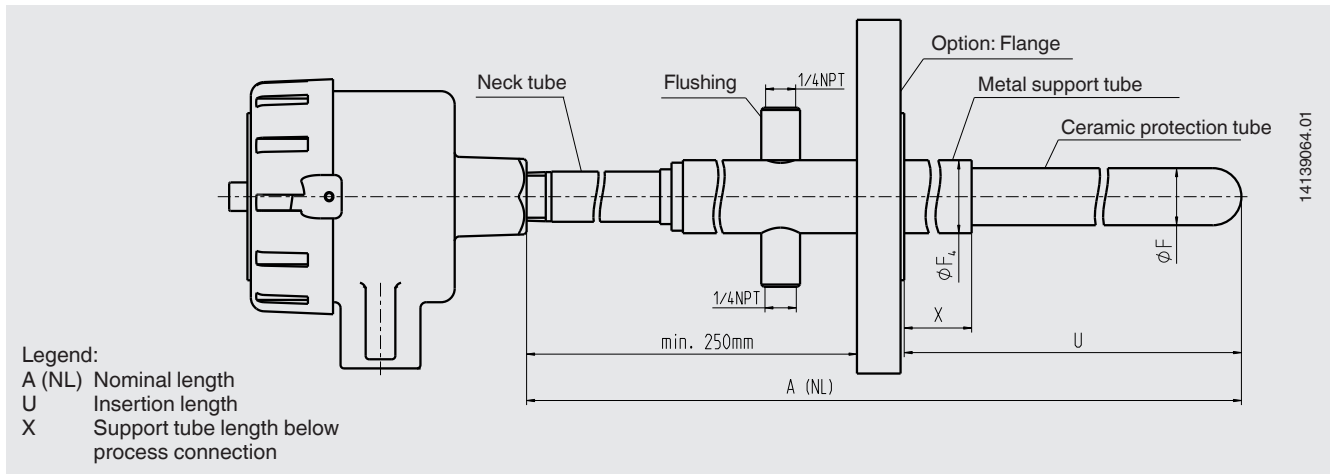
As standard, the flange is welded, using a double fillet weld, to the metallic extension neck or to the metallic exterior protection tube.



### Custom designs

In addition, for particularly unusual or critical applications, we offer high-temperature thermocouples in special versions. These versions can be made with pressure-tight versions, inert gas or compressed air purging, flange cooling.

Coated protection tubes for specific applications are also possible, as is platinum coating.



### Remarks on the selection and operation of protection tubes

Ceramic protection tubes should be considered to be gas-tight in accordance with the DIN EN 50446 standard. A diffusion of gas from the process into the sensor cannot be ruled out, particularly at high temperatures.

As a result of this, the resistance of the thermocouple material to the medium should be explicitly considered. The responsibility for the choice of materials for the safe function of the thermometer/protection tube within the plant/machinery is the responsibility of the customer/operator. WIKA can only offer recommendations which are based on our experience in similar applications.

The following table does not claim to be complete. All information is non-binding and does not represent guaranteed characteristics. They should be fully tested by the customer using the conditions of the respective application.

#### Resistance when in contact with gases

Material No.	AISI No.	Applicable in air up to °C	Resistance against sulphurous gases		nitrogenous, low-oxygen gases	Carburisation
			oxidising	reducing		
1.0305		550	low	slight	medium	slight
1.4571	316Ti	800	slight	slight	medium	medium
1.4762		1,200	very high	high	slight	medium
1.4749	446	1,150	very high	high	slight	medium
1.4841	310 / 314	1,150	very slight	very slight	high	slight
1.4876		1,100	low	low	high	very high

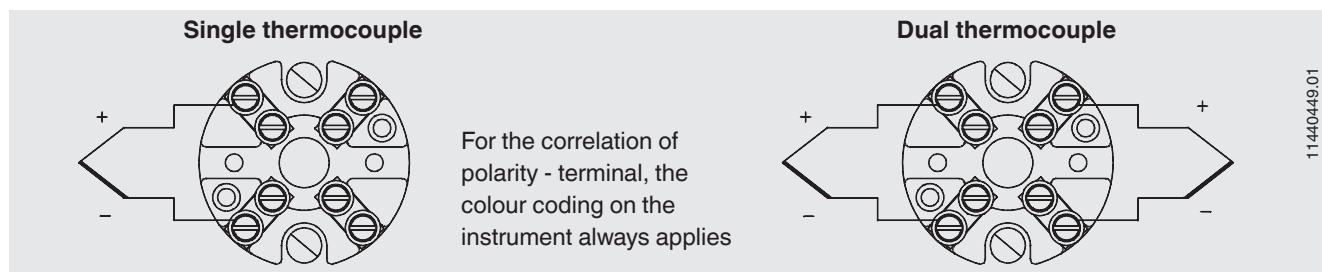
## Operation in gases

Material No.	Range of applications
1.0305 (St35.8)	Tempering furnaces for heat treatment plant, galvanising and tinning plant, carbon-dust-air mixture pipelines in steam power stations
1.0305 enamelled (St35.8 enamelled)	Flue-gas desulphurisation plants, babbitt metal, lead and tin smelters
1.4762 X 10 CrAlSi 25	Combustion exhaust gases, cement and ceramic furnaces, heat treatment plants, annealing furnaces
1.4749 X 18 CrNi 28	Flue gas ducts, annealing furnaces
Kanthal Super (molybdenum disilicide)	Glass and ceramic industries, coal liquification, refuse incinerators
1.4841 X 15 CrNiSi 25-21	Combustion chambers, industrial furnaces, petrochemical industry, cowper stoves, cyanide baths

## Operation in melting plant

Material No.	Range of applications	Temperature range
1.4841	Aluminium	up to 700 °C
1.1003	Magnesium (magnesium-containing aluminium)	
1.0305	Babbitt metal	up to 600 °C
1.0305	Lead	up to 700 °C
1.4841	Lead	up to 700 °C
2.4867	Lead	up to 700 °C
1.0305	Zinc	up to 480 °C
1.4749	Zinc	up to 480 °C
1.4762	Zinc	up to 480 °C
1.1003	Zinc	up to 600 °C
1.0305	Tin	up to 650 °C
1.4762	Copper	up to 1,250 °C
1.4841	Copper-zinc alloy	up to 900 °C

## Electrical connection









For the electrical connections of built-in temperature transmitters see the corresponding data sheets or operating instructions.

## Colour coding at the terminal block

Sensor Type	IEC 60584-1		ASTM E230	
	Positive	Negative	Positive	Negative
K	green	white	yellow	red
N	pink	white	orange	red
J	black	white	white	red
S	orange	white	black	red
R	orange	white	black	red
B	grey	white	grey	red

## Approvals

Logo	Description	Country
	<b>EU declaration of conformity</b> EMC directive <sup>1)</sup>	European Community
	<b>EAC (option)</b> Electromagnetic compatibility <sup>1)</sup>	Eurasian Economic Community
	<b>GOST (option)</b> Metrology, measurement technology	Russia
	<b>KazInMetr (option)</b> Metrology, measurement technology	Kazakhstan
-	<b>MTSCHS (option)</b> Permission for commissioning	Kazakhstan
	<b>BelGIM (option)</b> Metrology, measurement technology	Belarus
	<b>Uzstandard (option)</b> Metrology, measurement technology	Uzbekistan

1) Only for built-in transmitter

## Certificates (option)

Certification type	Measuring accuracy	Material certificate
2.2 test report	x	x
3.1 inspection certificate	x	-
DKD/DAkkS calibration certificate	x	-

The different certifications can be combined with each other.

Approvals and certificates, see website

## Ordering information

Model / Connection head / Connection head cable outlet / Terminal block, transmitter / Neck tube, neck tube material / Material and diameter of the external protection tube / Material and diameter of the internal protection tube / Process connection / Measuring element / Number of measuring elements / Tolerance value / Wire gauge of the elements / Length details / Certificates / Options

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