BRITISH STANDARD

BS EN
50446:2006

Straight thermocouple assembly with metal or ceramic protection tube and accessories

The European Standard EN 50446:2006 has the status of a British Standard

ICS 17.200.20

BSI
British Standards

National foreword

This British Standard was published by BSI. It is the UK implementation of EN 50446:2006. It supersedes BS EN 50112:1996 and BS EN 50113:1996, which are withdrawn.

The UK participation in its preparation was entrusted by Technical Committee GEL/65, Measurement and control, to Subcommittee GEL/65/2, Elements of systems.

A list of organizations represented on GEL/65/2 can be obtained on request to its secretary.

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

Compliance with a British Standard cannot confer immunity from legal obligations.

This British Standard was published under the authority of the Standards Policy and Strategy Committee on 30 November 2006

ISBN 0 580 49631 7

Amendments issued since publication

Amd. No.	Date	Comments

EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

EN 50446

October 2006

ICS 17.200.20

Supersedes EN 50112:1994 and EN 50113:1994

English version

Straight thermocouple assembly with metal or ceramic protection tube and accessories

Thermomètres à thermocouple droits avec tube de protection métallique ou en céramique, et accessoires

Gerade Thermoelemente mit Metall- oder Keramik-Schutzrohr und Zubehör

This European Standard was approved by CENELEC on 2006-09-01. CENELEC members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration.

Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the Central Secretariat or to any CENELEC member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CENELEC member into its own language and notified to the Central Secretariat has the same status as the official versions.

CENELEC members are the national electrotechnical committees of Austria, Belgium, Cyprus, the Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, the Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland and the United Kingdom.

CENELEC

European Committee for Electrotechnical Standardization
Comité Européen de Normalisation Electrotechnique
Europäisches Komitee für Elektrotechnische Normung

Central Secretariat: rue de Stassart 35, B - 1050 Brussels

Ref. No. EN 50446:2006 E

Foreword

This European Standard was prepared by the CENELEC BTWG 109-2, Straight thermocouple thermometers.

The text of the draft was submitted to the formal vote and was approved by CENELEC as EN 50446 on 2006-09-01.

This European Standard supersedes EN 50112:1994 and EN 50113:1994.

The following dates were fixed:

– latest date by which the EN has to be implemented at national level by publication of an identical national standard or by endorsement	(dop)	2007-09-01
– latest date by which the national standards conflicting with the EN have to be withdrawn	(dow)	2009-09-01

Contents

Page

1 Scope **4**
2 Normative references **4**
3 Thermocouples, dimensions and description **4**
4 Straight thermocouples with metal protection tube **5**
5 Straight thermocouples with ceramic protection tube **6**
6 Metal protection tubes, dimensions and description **8**
7 Ceramic protection tubes, dimensions and description **9**
8 Lock rings **10**
9 Connection heads **11**
10 Stop flanges and counter flanges **12**
11 Threaded bushings **13**
Annex A (informative) **Remarks on the selection and operation of protection tubes** **14**
Figure 1 – Metal protection tubes form A and C 8
Figure 2 – Ceramic protection tube 9
Figure 3 – Lock ring 10
Figure 4 – Illustration of connection heads 11
Figure 5 – Illustration of stop flanges and counter flanges 12
Figure 6 – Illustration of a threaded bushing 13
Figure A.1 – Illustration of a counter flange 17
Figure A.2 – Mounting of the stop flange on a weld-on thread plate. Thermocouples forms AM / AMK / BM / BMK. Preferred type of mounting for metal surfaces 17
Figure A.3 – Mounting of the stop flange on a weld-on thread plate. Thermocouple forms AK / AKK / BK / BKK. Preferred type of mounting for meta surfaces 17
Figure A.4 – Mounting of the stop flange on a thread plate welded to the process pipe. Preferred type of mounting for non-metal surfaces. Suitable for all thermocouple forms 17
Figure A.5 – Mounting of the stop flange on a counter flange welded to the process pipe. Preferred type of mounting for non-metal surfaces, gas-tight mounting is possible. Suitable for all thermocouple forms 17
Table 1 – Types and dimensions, metal protection tube 5
Table 2 – Types and dimensions, ceramic protection tube 6
Table 3 – Ident letters for metal protection tubes 7
Table 4 – Ident letters for ceramic protection tubes 7
Table 5 – Ident letters for thermocouples 7
Table 6 – Dimensions and permitted deviations for metal protection tubes 8
Table 7 – Dimensions and additional data for ceramic protection tubes 9
Table 8 – Dimensions of lock rings 10
Table 9 – Dimensions of connection heads 11
Table 10 – Dimensions of stop flanges and counter flanges 12
Table 11 – Data of threaded bushings 13
Table A.1 – Resistance of metal protection tubes when in contact with gases 14
Table A.2 – Materials for operation in gases 14
Table A.3 – Materials for operation in melting plants 15
Table A.4 – Operating conditions and materials 15
Table A.5 – Materials for special applications 16

1 Scope

This standard applies to straight thermocouples for the nominal pressure level PN 1, which are made of standardized components (connection head, protection tube and thermocouple(s)).

Details regarding the operational areas of the thermocouples and the use of protection tubes are part of this standard.

Connection heads as well as stop flanges and threaded bushings for the mounting of the thermocouples are also part of this standard. Special designs are to be agreed upon between manufacturer and user.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

EN 50113 *Measurement, control, regulation - Electrical temperature sensors – Isolating tubes for thermocouples*

EN 60529 *Degrees of protection provided by enclosures (IP code)* (IEC 60529)

EN 60584-1 *Thermocouples - Part 1: Reference tables* (IEC 60584-1)

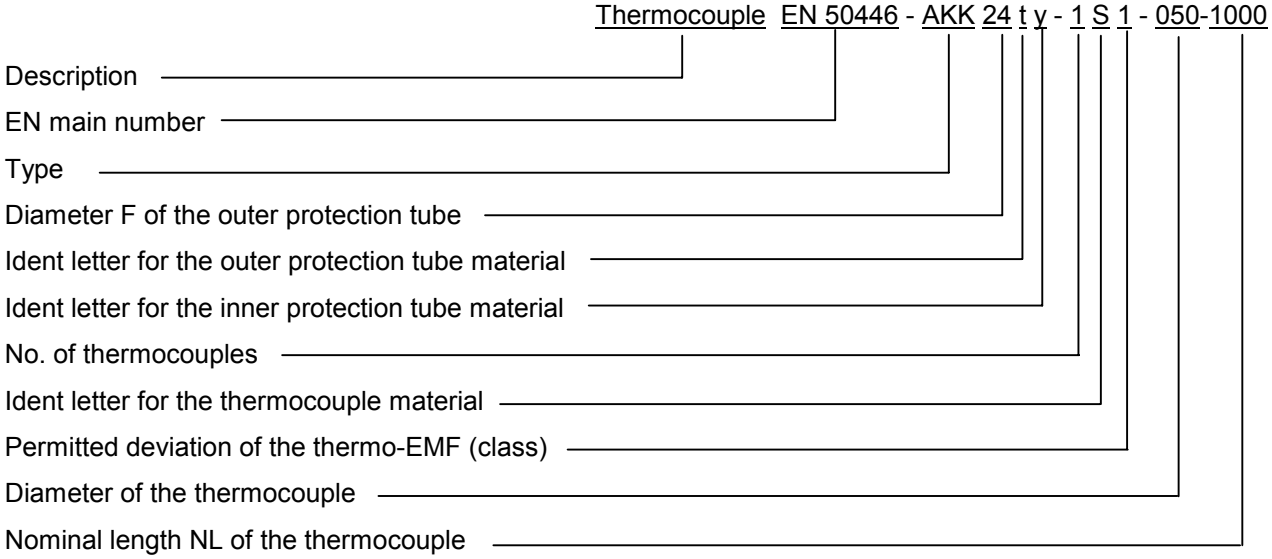
EN 60672-1 *Ceramic and glass insulating materials - Part 1: Definitions and classification* (IEC 60672-1)

EN 22768-1 *General tolerances - Part 1: Tolerances for linear and angular dimensions without individual tolerance indications* (ISO 2768-1)

ISO 2944 *Fluid power systems and components - Nominal pressures*

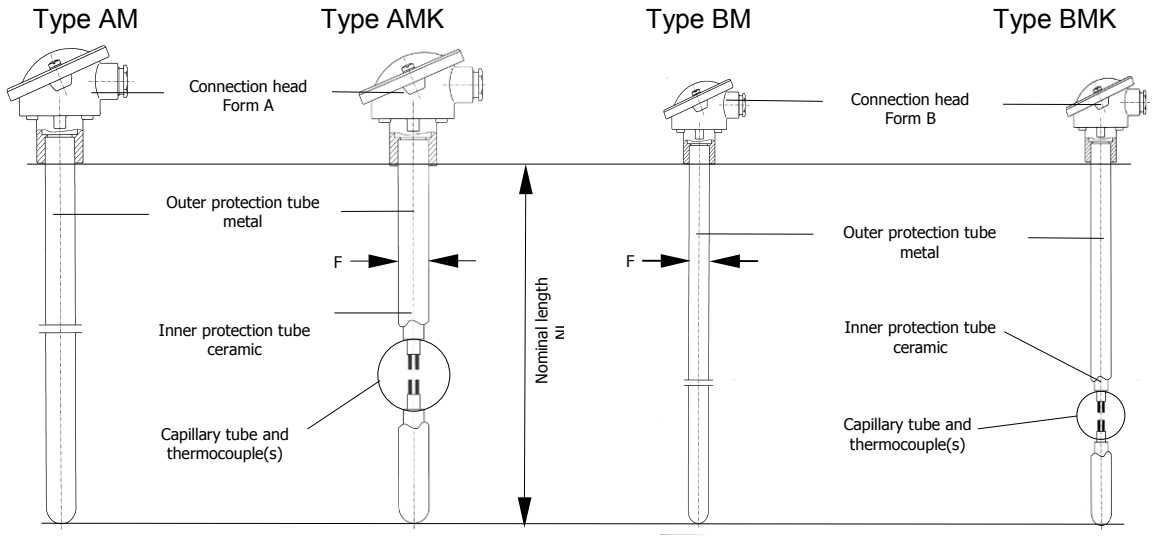
3 Thermocouples, dimensions and description

All dimensions in this standard are given in mm. If not stated differently the general tolerances according to EN 22768-1 apply. The thermocouples do not have to conform to the illustration, only the indicated dimensions must be adhered to.



4 Straight thermocouples with metal protection tube

Table 1 – Types and dimensions, metal protection tube



Code for straight thermocouples			AM	AMK	BM	BMK
Connection head		Form	A		B	
Protection tube F x s [a]	Metal outer protection tubes		22 x 2		15 x 2	
			24 x 3		–	
			26 x 4		–	
	Ceramic inner protection tubes	C 610	–	15(16) x 2	–	10 x 1,5
		C 799	–	15 x 2,5	–	10 x 2

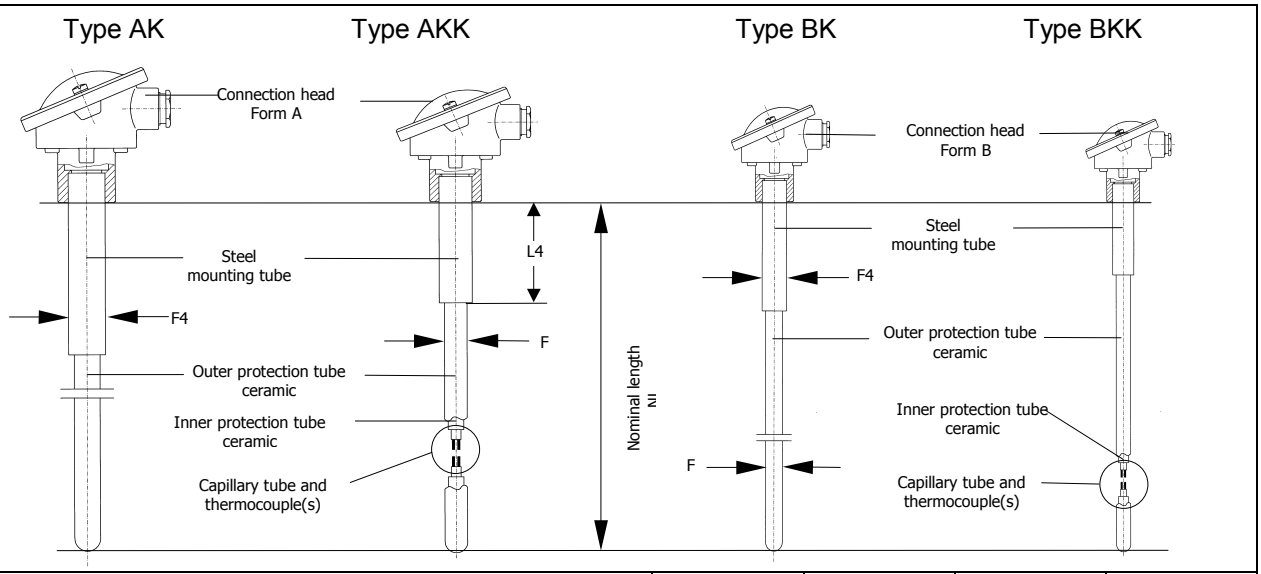
1 TC=1 thermocouple 2 TC=2 thermocouples Thermocouple acc. to EN 60584-1 Capillary tubes acc. to EN 50113	Ident letter	Diam.								
	E, J, K, N *)	3,0	1 TC	2 TC	1 TC	2 TC	–	–	–	–
	E, J, K, N *)	2,5	1 TC	2 TC	1 TC	2 TC	–	–	–	–
	E, J, K, N *)	1,38	1 TC	2 TC	1 TC	2 TC	1 TC	2 TC	1 TC	2 TC
	E, J, K, N *)	1,0	1 TC	2 TC	1 TC	2 TC	1 TC	2 TC	1 TC	2 TC
	*) Thermocouple(s) preferably form A or B acc. to EN 50113.									
	R, S, B **)	0,5; 0,35	–	–	1 TC	2 TC	–	–	1 TC	2 TC
	**) Thermocouple(s) preferably form C or D acc. to EN 50113.									

Nominal length NL NOTE Depending on diameter, nominal length and design an additional support must be provided by the user in the case of horizontal mounting.			
	–	355	
	500	500	
	710	710	
	1 000	1 000	
	1 400	1 400	–
	2 000 [b]	–	–

[a] s = wall thickness of the protection tube.
[b] This nominal length with built-in precious-metal thermocouple is not suitable for vertical mounting.

5 Straight thermocouples with ceramic protection tube

Table 2 – Types and dimensions, ceramic protection tube



Code for straight thermocouples			AK	AKK	BK	BKK
Connection head		Form	A		B	
Mounting tube, type of steel at the discretion of the manufacturer		F_4 x s / L_4	32 x 2 / 200	22 x 2 / 150	15 x 2 / 80	
Protection tube F x s [a]	Ceramic outer protection tubes	C 530	26 x 4	–	–	
		C 610	24 x 2,5	15(16) x 2	10 x 1,5	
		C 799	24 x 3	15 x 2,5 [f]	10 x 2 [f]	
	Ceramic inner protection tubes Types AKK and BKK only	C 610	15(16) x 2	10 x 1,5	–	–
		C 799	15 x 2,5	10 x 2	–	6 x 1

	Ident letter	Diam.								
1 TC=1 thermocouple 2 TC=2 thermocouples Thermocouple acc. to EN 60584-1 Capillary tubes acc. to EN 50113	K, N *)	3,0	1 TC	2TC [d]	1TC [d]	2TC [d]	–	–	–	–
	K, N *)	2,5	1 TC	2 TC	1 TC	2TC [e]	–	–	–	–
	K, N *)	1,38	1 TC	2 TC	1 TC	2 TC	1 TC	2 TC	–	–
	K, N *)	1,0	1 TC	2 TC	1 TC	2 TC	1 TC	2 TC	–	–
	*) Thermocouple(s) preferably form A or B acc. to EN 50113.									
	R, S, B **)	0,5; 0,35	– [g]	– [g]	1 TC	2 TC	– [g]	– [g]	1 TC	2TC [c]
	**) Thermocouple(s) preferably form C or D acc. to EN 50113.									

Nominal length NL NOTE Depending on diameter, nominal length and design an additional support is to be provided by the user in the case of horizontal mounting.					
	–		355		
	500		500		
	710		710	–	
	1 000		1 000	–	
	1 400		–	–	
	2 000 [b]	–	–	–	

[a] s = wall thickness of the support resp. the protection tube.
[b] This nominal length with built-in precious-metal thermocouple is not suitable for vertical mounting.
[c] Only thermocouples with 0,35 mm diam. can be installed.
[d] Thermocouple(s) cannot be installed in ceramic protection tubes 15(16) x 2 and 15 x 2,5.
[e] Thermocouples cannot be installed in ceramic inner protection tubes 10 x 2.
[f] Ceramic inner protection tube is not possible.
[g] Design without inner protection tube is not recommended.

Table 3 – Ident letters for metal protection tubes [1)]

Ident. letter	Brief description	Material No.
H	St 35.8	1.0305
D	X 10 CrAl 24	1.4762
Q	X 15 CrNiSi 2520	1.4841
F	X 18 Cr Ni 28	1.4749
U	X 10 NiCrAlTi 3220 [a]	1.4876

[a] Detailed material specifications as well as the available diameters and lengths are to be agreed upon between manufacturer and user.

Table 4 – Ident letters for ceramic protection tubes

Ident. letter	Material
T	C 530
U	C 610
Y	C 799
X	SiC re-crystallized, porous [a, b]
Z	SiC reaction-bonded, gas-tight [a, b]

[a] Detailed material specifications as well as the available diameters and lengths are to be agreed upon between manufacturer and user.

[b] For deviating dimensions see Table 6 and footnotes.

Table 5 – Ident letters for thermocouples

Ident. letter	Thermocouple EN 60584-1
E	NiCr – CuNi
J	Fe – CuNi
K	NiCr – Ni
N	NiCrSi – NiSi
S	Pt 10 % Rh – Pt
R	Pt 13 % Rh – Pt
B	Pt 30 % Rh – Pt 6 % Rh

[1)] Coatings on metal protection tubes are to be agreed upon between manufacturer and user.

6 Metal protection tubes, dimensions and description

Form A
Protection tube, round bottom

Form C
Protection tube, weld-in bottom

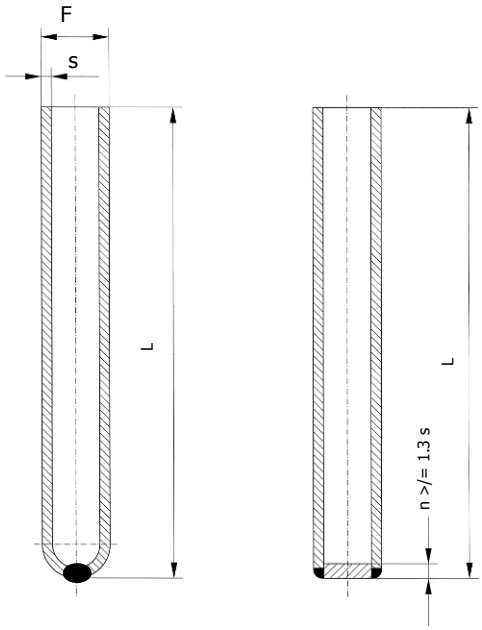


Figure 1 – Metal protection tubes form A and C

EXAMPLE: Protection tube - A 22 x 1 020 – 1.4841 or – Q:

The example gives a description of a metal protection tube Form A with diameter F = 22 mm and protection tube length L = 1 020 mm, made from material no. 1.4841 (Ident letter Q acc. to Table 3).

Table 6 – Dimensions and permitted deviations for metal protection tubes

Form	Diameter F $^{+0,2}_{-0,1}$	Wall thickness S ± 0,1	For straight thermocouples with nominal length NL					
			355	500	710	1 000	1 400	2 000
			Protection tube length L Permitted deviation +3/-0				Protection tube length L Permitted deviation +5/-0	
A / C	15	2	370	515	725	1 015	1 415	-
	22	2	-	520	730	1 020	1 420	2 020
	24	3	-	520	730	1 020	1 420	2 020
	26	4	-	520	730	1 020	1 420	2 020

Protection tubes forms A and C are technically equivalent.

Coatings on metal protection tubes are to be agreed upon between manufacturer and user; please observe the changing diameters in this case.

7 Ceramic protection tubes, dimensions and description

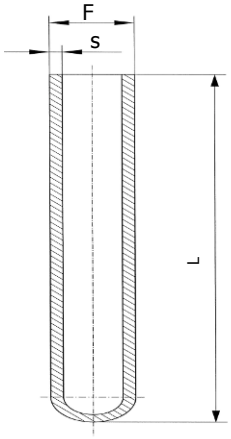


Figure 2 – Ceramic protection tube

EXAMPLE: Protection tube – 15 x 1030 – C 799:

The example gives a description of a ceramic protection tube with diameter F = 15 mm and protection tube length L = 1030 mm, made of ceramic insulating material C 799.
EN 60672-1 applies regarding further details on design, demands and tests.

Table 7 – Dimensions and additional data for ceramic protection tubes

F [a]	s min.	For straight thermocouples types AK, AKK, BK and BKK Nominal length NL 355	500	710	1 000	1 400	2 000	Protection tube material	Tempe-rature shock resistance	Tightness [c]	Permitted permanent tempe-rature °C [b]
		Protection tube length L Permitted deviation +/ -3				+/ -5					
10	1,5	375	520	730	1 020	–	–	C 610	medium to good	gas-tight	1 500
15/16	2	–	530	740	1 030	1 430	–				
24	2,5	–	530	740	1 030	1 430	2 030				
10	2	375	520	730	1 020	–	–	C 799	medium	gas-tight	1 600
15/16	2,5	–	530	740	1 030	1 430	–				
24	3	–	530	740	1 030	1 430	2 030				
26	4	–	–	740	1 030	1 430	2 030	C 530	very good	porous	1 500
20 [e]	5	–	530	740	1 030	1 430	–	SiSiC [d] Re-crystallized	very good	porous	1 600
22 [f]	5	–	530	740	1 030	1 430	2 030				
25 [f]	5	–	530	740	1 030	1 430	2 030				
20 [f]	3,5	–	530	740	1 030	1 430	–	RSiC [d] Reaction-bonded	very good	gas-tight	1 350
22 [f]	3,5	–	530	740	1 030	1 430	2 030				
25 [g]	3,5	–	530	740	1 030	1 430	2 030				

[a] F must be maintained with a permitted deviation of ± 0,5 mm over a length of 20 mm from the open end.
[b] Precious-metal thermocouples are predominantly used for measuring temperatures above 1 000 °C. When installed in thermocouples and capillary tubes made from the above indicated ceramic insulation materials, it has to be taken into account that in a reducing atmosphere the thermocouples may be affected. Of particular influence and reducing the admissible permanent temperature are silicon and heavy metals.
[c] At temperatures above approx. 1 000 °C gas tightness can no longer be assumed.
[d] When using precious-metal thermocouples the installation of an inner protection tube made of C 799 is strongly recommended.
[e] Type AKK: inner protection tube 6 x 1.
[f] Type AKK: inner protection tube 10 x 2.
[g] Type AKK: inner protection tube 15 x 2,5.

8 Lock rings

Lock rings are used to fasten ceramic inner protection tube inside the connection head.

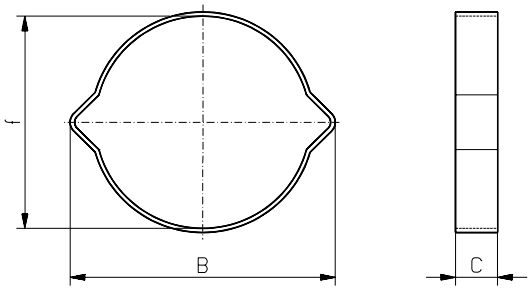


Figure 3 – Lock ring

Table 8 – Dimensions of lock rings

For protection tube diam. F	f + 0,5/+1	B [a]	C [a]
5 … 7	7,3	11	6,5
9 … 11	11,3	17	6,5
13 … 15	15,3	21	7
15 … 18	18,3	25	8
22 … 25	25,3	32	10
25 … 28	28,3	36	10
31 … 34	34,3	42	10
[a] For information only, dimensions are at the discretion of the manufacturer.			

The lock rings do not have to conform to the illustration, the indicated dimensions are recommendations. Type of material and coating is at the discretion of the manufacturer.

The lock ring is applied by squeezing the bulges in. Make sure that it fits tightly around the inner protection tube as – in the case of vertical mounting – it has to carry the whole weight of the inner protection tube. It is recommended to ensure the secure fit of the lock ring.

9 Connection heads

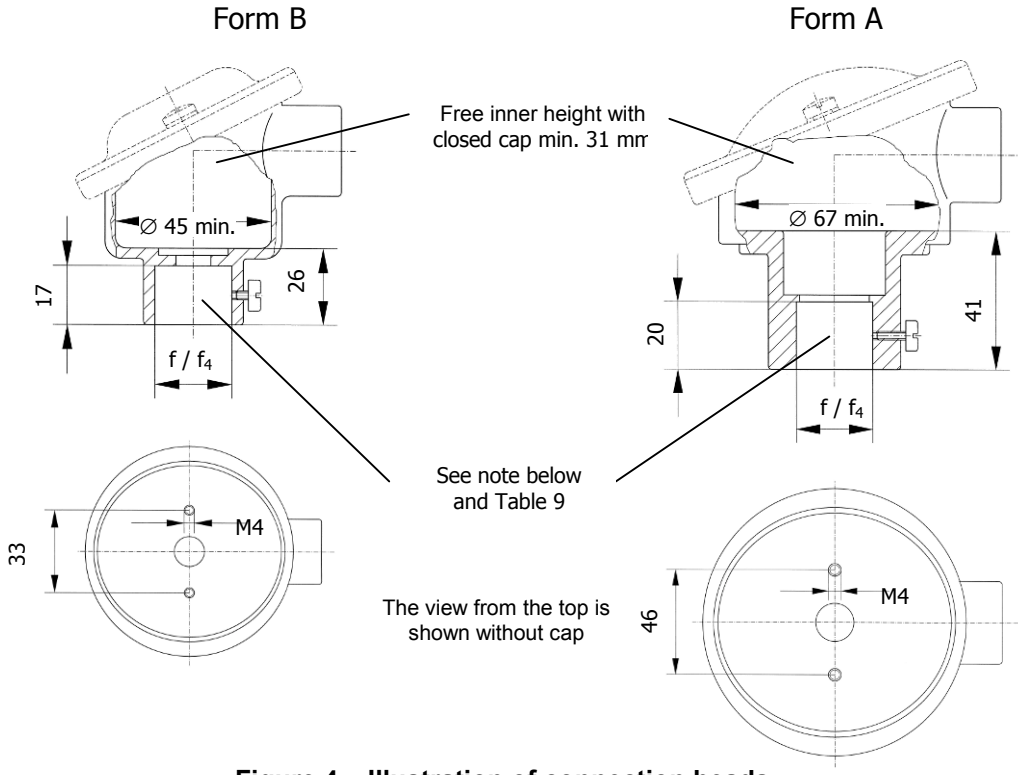


Figure 4 – Illustration of connection heads

It is not mandatory that connection heads comply with the illustrations above, however the specified dimensions shall be adhered to. The outer form and all details, which do not negatively affect the universal applicability, are at the discretion of the manufacturer. Minimum values are given regarding the space requirements of the connection heads. Also the type of cap (screwed, threaded, hinged or bayonet lock) are at the discretion of the manufacturer. For vertical mounting a minimum protection classification of IP 54 according to EN 60529 shall be ensured. The illustration above shows a typical cable inlet.

NOTE For other types of instruments or applications, connection heads may also have a thread instead of a plain bore. In that case the fixing screws are obsolete. The standard thread is M 24 x 1,5, but other threads are possible.

Table 9 – Dimensions of connection heads

Form	Nominal size	f / f_4	For installation with
A	22	22,8	mounting tubes or protection tubes with 22 mm diam.
	24	24,8	protection tubes with 24 mm diam.
	26	26,5	protection tubes with 26 mm diam.
	32	32,5	mounting tubes with 32 mm diam.
B	15	15,8	mounting tubes or protection tubes with 15 mm diam.
Form	**Nominal size**	**Thread e [a]**	**Remarks**
A	----	M 24 x 1,5	for protection tubes with Kopfhalteverschraubung
		G ½ " B	for protection tubes with even thread
		G ¾ " B	
		½ " NPT F	for protection tubes with conical thread
		¾" NPT F	
B	----	M 24 x 1,5	for protection tubes with Kopfhalteverschraubung
		G ½ " B	for protection tubes with even thread
		½ " NPT F	for protection tubes with conical thread
[a] Other threads are possible and are to be agreed upon between manufacturer and user.			

Material: At the discretion of the manufacturer or as agreed upon, e.g. cast iron, stainless steel, aluminum or plastics.

10 Stop flanges and counter flanges

It is not mandatory that the stop flanges as well as the corresponding counter flanges comply with the illustrations above, however the specified dimensions shall be adhered to. Special designs are to be agreed upon between manufacturer and user.

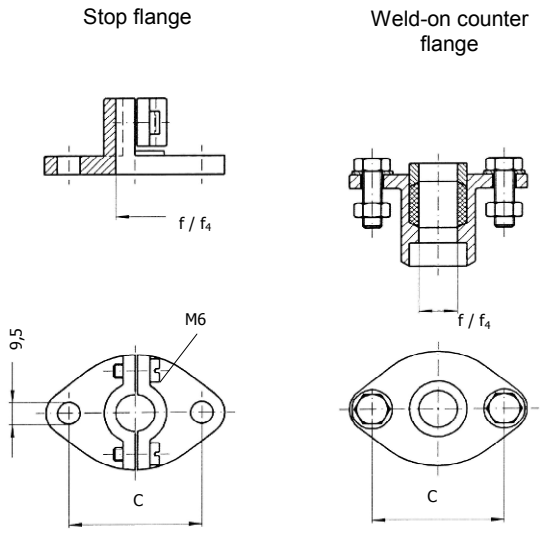


Figure 5 – Illustration of stop flanges and counter flanges

Table 10 – Dimensions of stop flanges and counter flanges

Nominal size for F / F_4 protection tube/ mounting tube	C
15	55
22	70
24	
26	
32	

Material: at the discretion of the manufacturer, e. g. GtW-35 (stop flange) and 1.0401 (counter flange).

See A.6.1 for additional information regarding the counter flange.

11 Threaded bushings

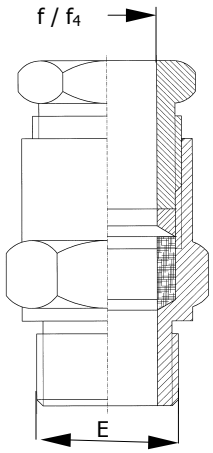


Figure 6 – Illustration of a threaded bushing

Table 11 – Data of threaded bushings

Protection or mounting tube diameter	F / f_4 + 0,5	Process connection thread E	Process connection thread E	Process connection thread E
10	10,5	M 20 x 1,5	G ¾	½ " NPT
15	15,5	M 27	G ¾ / G 1	¾ " NPT
22	22,5	--- [a]	G 1	1 " NPT
24	24,5	--- [a]	G 1 ¼	1 ¼ " NPT
26	26,5	--- [a]	G 1 ¼	1 ¼ " NPT
32	32,5	--- [a]	G 1 ¼ / G 1 ½	1 ¼ " / 1 ½ " NPT
[a] Metric threads for process connection are available. Thread sizes are to be agreed upon between manufacturer and user.				

The threaded bushings do not have to correspond to the illustration, only the indicated dimensions must be adhered to. The outer form and all details, which do not negatively affect their universal applicability, are at the discretion of the manufacturer.

Material: At the discretion of the manufacturer or as agreed upon, e.g. galvanically plated steel, stainless steel.

If not specified differently the sealing consists of ceramic or glass fiber rope. Depending on the application other sealing materials can be agreed upon between manufacturer and user.

The maximum operation temperature is 400 °C. Higher temperatures can be agreed upon between manufacturer and user.

Example for the description of a threaded bushing for a protection tube F = 24 mm diameter and thread G 1¼:

Threaded bushing – 24 – G 1¼ or briefly GM – 24 – G 1¼

Annex A
(informative)

Remarks on the selection and operation of protection tubes

A.1 Resistance of metal protection tubes when in contact with gases

Table A.1 – Resistance of metal protection tubes when in contact with gases

Material No.	Usable in air up to °C	Resistance against			
		Sulfurous gases		Nitrogenous low-oxygen gases	Carburization
		oxidizing	reducing		
1.0305	550	low	low	medium	low
1.4571	800	low	low	medium	medium
1.4762	1 200	very high	high	low	medium
1.4749	1 150	very high	high	low	medium
1.4841	1 150	very low	very low	high	low
1.4876	1 100	low	low	high	very high

A.2 Information for operation in gases

Table A.2 – Materials for operation in gases

Application	Material No.
Tempering Furnaces	1.0305
Annealing or tempering ovens with sulfurous and carbonaceous gases	1.4762 1.4749
Chemically aggressive vapors, except hydrochloric acid, sulphur-dioxide vapors	1.4571
Ovens with nitrogenous low-oxygen gases	1.4841

A.3 Information for operation in melting plants

Table A.3 – Materials for operation in melting plants

Application		Material No.
Aluminum	up to 700 °C	1.4841
Magnesium, magnesium-containing aluminum		1.1003
Babbitt metal	up to 600 °C	1.0305
Lead	up to 700 °C	1.0305 1.4841 2.4867
Zinc	up to 480 °C up to 600 °C	1.0305 1.4749 1.4762 1.1003
Tin	up to 650 °C	1.0305
Copper	up to 1 250 °C	1.4762
Copper-zinc alloy	up to 900 °C	1.4841

A.4 Remarks on the selection and operation of ceramic protection tubes

Table A.4 – Operating conditions and materials

Typical operational conditions	For temperatures up to °C	Material
Contact with gases of all kinds, if gas-tight ceramic inner protection tubes are used (Table 7)	1 500 1 500 (1 600) 1 600 (1 800)	C 530 C 610 C 799
Contact with alkaline vapors (glass melting furnaces and ceramic kilns)	1 500	C 799
Glass melting furnaces	1 500	C 799 with Pt-cover
Waste and special waste incineration	1 600	SiC re-crystallized
Fluidized bed combustion	1 350	SiC reaction-bonded

A.5 Remarks on the selection of protection tubes for special applications

Table A.5 – Materials for special applications

Material	Maximum operation temperature °C	Characteristics/Applications	Remarks
Titanium	600	Quenching baths	
Pure iron	900	Saltpeter, chloride, cyanide-containing salt baths	
Steel, enameled	600	Molten zinc	
1.4749	1 100	Molten lead and tin	
1.4772	1 250	Molten copper and brass	
1.4821	1 350	Saltpeter, chloride, cyanide-containing salt baths	
Cast iron (GG 22))	700	Molten babbitt metal, aluminum, zinc	
GG22 with ceramic coating	800	Molten aluminum, zinc	
Chromium-aluminum oxide Cr Al_2O_3 77/23	1 200	Gas-tight, oxidation- and temperature-shock resistant, copper, tin, zinc, magnesium, lead melting plants, cement furnaces, SO_2 -, SO_{3-} -gas, H_2SO_4 -acid	Not for aluminum and glass melting plants, salt baths
Molybdenum-disilized $MoSi_2$	1 700	Abrasion-resistant, shock-resistant, highly temperature shock-resistant, surface-glazed, chemically resistant, waste incineration, fluidized bed combustion	Brittle at low temperatures, above approx. 1 400 °C viscid
Aluminum - oxide Al_2O_3 99,7 %, fine - grained	1 950	Finer than C 799, highest purity, strength and gas-tightness at high temperatures, hydrofluoric-acid, alkaline, metal-oxide vapors, molten glass	Medium temperature shock-resistance
Aluminum - oxide Al_2O_3 99,7 %, porous	1 950	Porous, temperature shock-resistant, high strength at high temperatures, waste incineration, fluidized bed combustion	
Silicon-carbide SiC, re-crystallized	1 600	Porous, highly mechanically resistant, highly temperature-shock resistant , < 0,1 % free silicon. Suitable under inert gas/vacuum up to 2 000 °C.	Not suitable for molten aluminum and copper
Silicon-carbide SiC, reaction-bonded	1 350	Gas-tight, highly mechanically resistant, high thermal conductivity, 8-12 % free silicon. High breaking strength at high temperatures.	Not suitable for molten Al, Cu, Ni, Fe; medium temperature shock resistivity
Silicon-nitride Si_3N_4	1 000	Temperature shock-resistant, no wetting in molten aluminum or brass	Shock-sensitive
Silicon-nitride/ aluminum-oxide Si_3N_4+Al_2O_3	1 300	Temperature shock-resistant, molten copper and aluminum	
Graphite	1 250	Oxygen-free molten copper, brass and aluminum	Heavy oxidation when in contact with air
Aluminum - titanate Al_2TiO_5	1 100	Gas-tight, molten aluminum	Shock-sensitive; not temperature shock-resistant
Sapphire (Al_2O_3)	1 800	Mono-crystalline aluminum-oxide, gas-tight, special waste incineration, semiconductor industry	Highly shock- and scratch-sensitive

All recommendations in Clauses A.1 to A.6 are given without liability and do not constitute binding and/or guaranteed characteristics, as even minimal variations of process parameters can lead to significant effects regarding reliability. They must therefore always be checked in detail regarding each particular application.

It is recommended to contact the manufacturer in the case of special applications.

A.6 Remarks regarding the mounting of straight thermocouples

A.6.1 Counter flanges and stop flanges as per Clause 10

Design, dimensions and description see Clause 10 of this standard. The used sealing is asbestos-free. When properly mounted a gas-tightness can be assumed up to a pressure of approximately 1 bar.

Special designs are to be agreed upon between manufacturer and user.

Material: at the discretion of the manufacturer. In many cases 1.0401 (C15) is used.

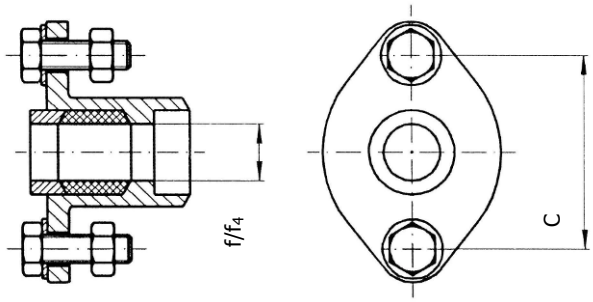


Figure A.1 – Illustration of a counter flange

A.6.2 Examples for the vertical mounting of straight thermocouples

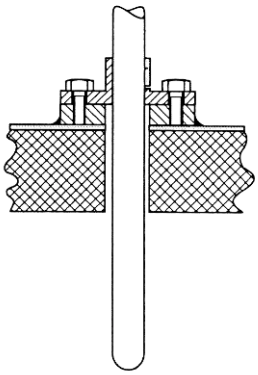


Figure A.2 - Mounting of the stop flange on a weld-on thread plate. Thermocouple forms AM / AMK / BM / BMK. Preferred type of mounting for metal surfaces.

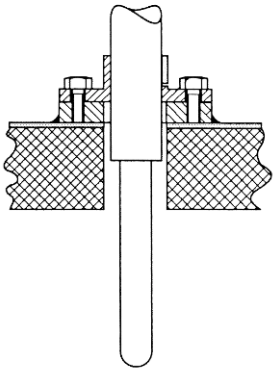


Figure A.3 - Mounting of the stop flange on a weld-on thread plate. Thermocouple forms AK / AKK / BK / BKK. Preferred type of mounting for meta surfaces.

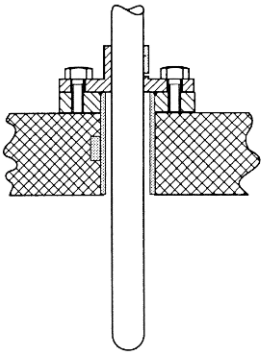


Figure A.4 - Mounting of the stop flange on a thread plate welded to the process pipe. Preferred type of mounting for non-metal surfaces. Suitable for all thermocouple forms

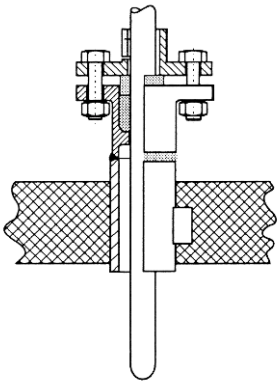


Figure A-5 - Mounting of the stop flange on a counter flange welded to the process pipe. Preferred type of mounting for non-metal surfaces, gas-tight mounting is possible. Suitable for all thermocouple forms

BSI — British Standards Institution

BSI is the independent national body responsible for preparing British Standards. It presents the UK view on standards in Europe and at the international level. It is incorporated by Royal Charter.

Revisions

British Standards are updated by amendment or revision. Users of British Standards should make sure that they possess the latest amendments or editions.

It is the constant aim of BSI to improve the quality of our products and services. We would be grateful if anyone finding an inaccuracy or ambiguity while using this British Standard would inform the Secretary of the technical committee responsible, the identity of which can be found on the inside front cover. Tel: +44 (0)20 8996 9000. Fax: +44 (0)20 8996 7400.

BSI offers members an individual updating service called PLUS which ensures that subscribers automatically receive the latest editions of standards.

Buying standards

Orders for all BSI, international and foreign standards publications should be addressed to Customer Services. Tel: +44 (0)20 8996 9001. Fax: +44 (0)20 8996 7001. Email: orders@bsi-global.com. Standards are also available from the BSI website at http://www.bsi-global.com.

In response to orders for international standards, it is BSI policy to supply the BSI implementation of those that have been published as British Standards, unless otherwise requested.

Information on standards

BSI provides a wide range of information on national, European and international standards through its Library and its Technical Help to Exporters Service. Various BSI electronic information services are also available which give details on all its products and services. Contact the Information Centre. Tel: +44 (0)20 8996 7111. Fax: +44 (0)20 8996 7048. Email: info@bsi-global.com.

Subscribing members of BSI are kept up to date with standards developments and receive substantial discounts on the purchase price of standards. For details of these and other benefits contact Membership Administration. Tel: +44 (0)20 8996 7002. Fax: +44 (0)20 8996 7001. Email: membership@bsi-global.com.

Information regarding online access to British Standards via British Standards Online can be found at http://www.bsi-global.com/bsonline.

Further information about BSI is available on the BSI website at http://www.bsi-global.com.

Copyright

BSI
389 Chiswick High Road
London
W4 4AL