Morgan Advanced Materials

HALDENWANGER

→ Ceramic tubes

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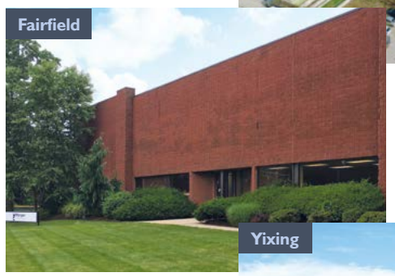
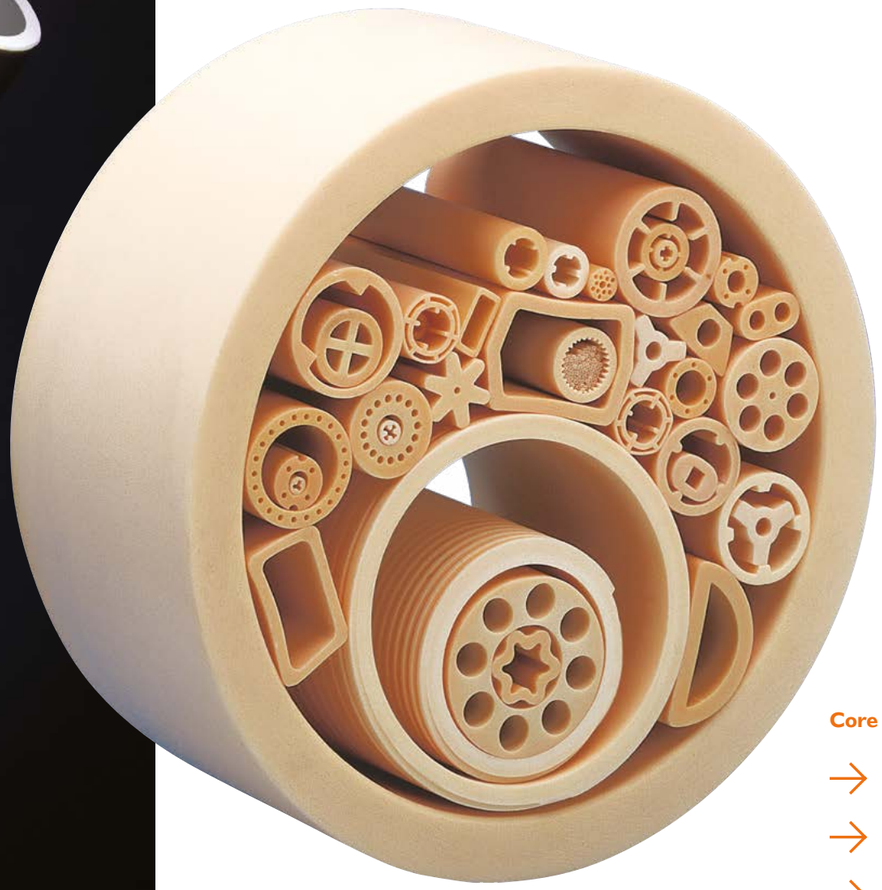
Our company

Since its foundation, Morgan Advanced Materials Haldenwanger developed into a leading global producer of high-tech ceramics. We offer you a comprehensive product range of oxide and non-oxide materials, primarily for use in demanding thermal, chemical and mechanical applications. By virtue of our extensive ceramic expertise, we are able to act not only as your supplier but also as a reliable partner in finding solutions to any technical challenges you may face.

The Haldenwanger Group employs more than 400 people at three locations: Waldkaraiburg, Fairfield and Yixing. The British parent company Morgan Advanced Materials employs approx. 7,400 people at over 75 locations worldwide.





Our extensive range of tubes
Stable processes require customised components. Our comprehensive range of tubes provides optimal solutions for applications up to 2000°C, whether in aggressive media or under high thermal shock. We offer a total of 15 oxide and carbide materials in numerous designs, including Alsint 99.7 (C 799), Pythagoras (C 610) and Sillimantin 60 (C 530), in accordance with DIN EN 60672. Use our wide Haldenwanger range to optimise your processes.

Core competencies of Morgan Advanced Materials:

- **Application Engineering**
- **Materials Science**
- **Customer Focus**

Oxide ceramics – standard tubes

Alsint 99.7	Pythagoras	Sillimantin 60	Sillimantin KS
High-purity, gas-tight aluminium oxide	Gas-tight aluminium silicate	Porous aluminium silicate	Supporting tubes for heating elements
Material type C 799 acc. to DIN EN 60672-3	Material type C 610 acc. to DIN EN 60672-3	Material type C 530 acc. to DIN EN 60672-3	
Aluminium oxide content > 99.7%	Aluminium oxide content 56–58%	Aluminium oxide content 72–74%	Aluminium oxide content 70–72%
Working temperature up to 1800°C	Working temperature up to 1400°C	Working temperature up to 1350°C	Working temperature up to 1350°C
Outer Ø x Inner Ø	Outer Ø x Inner Ø	Outer Ø x Inner Ø	Outer Ø x Inner Ø
0.8 x 0.3	–	–	15 x 7
1.3 x 0.7	1.3 x 0.7	–	20 x 12
1.6 x 1	1.6 x 1	–	20 x 15
1.8 x 1.2	1.8 x 1.2	–	25 x 18
2 x 1	2 x 1	–	30 x 20
2.7 x 1.7	2.7 x 1.7	–	35 x 25
3 x 2	3 x 2	–	40 x 30
4 x 2	4 x 2	–	45 x 35
5 x 2	5 x 2	–	50 x 40
6 x 4	6 x 4	–	55 x 45
8 x 5	8 x 5	–	
9 x 6	9 x 6	–	
9.6 x 6.4	9.6 x 6.4	–	
10 x 6	10 x 7	10 x 7	
12 x 8	12 x 8	12 x 8	
12.7 x 8.9	12.7 x 8.9	12.7 x 8.9	
14 x 10	14 x 10	14 x 10	
15 x 10	15 x 10	15 x 10	
17 x 12	17 x 12	17 x 12	
20 x 15	20 x 15	20 x 15	
24 x 18	24 x 19	24 x 19	
25 x 20	26 x 18	26 x 18	
30 x 23	30 x 23	30 x 23	
35 x 27	35 x 27	35 x 27	
40 x 32	40 x 32	40 x 32	
50 x 40	50 x 40	50 x 40	
60 x 50	60 x 50	60 x 50	
65 x 56	65 x 56	65 x 56	
70 x 60	70 x 60	70 x 60	
75 x 65	75 x 65	75 x 65	
80 x 70	80 x 70	80 x 70	
85 x 75	85 x 75	85 x 75	
90 x 80	90 x 80	90 x 80	
100 x 85	100 x 85	100 x 85	
110 x 95	110 x 95	110 x 95	
120 x 100	120 x 100	120 x 100	
Further dimensions upon request			Further lengths upon request
Max. manufacturable outer Ø ca. 410	Max. manufacturable outer Ø ca. 300	Max. manufacturable outer Ø ca. 330	Production only in defined diameters
Max. length 4,000, depending on the outer Ø	Max. length 3,500, depending on the outer Ø	Max. length 4,000, depending on the outer Ø	Standardlängen bis 1,600

All dimensions in mm.

Silicon carbides – standard tubes

Halsic-R/-RX	Halsic-N	Halsic-I	SiC mullite-bonded
Recrystallised silicon carbide (RSiC)	Nitride-bonded silicon carbide (NSiC)	Silicon-filtrated, reaction-bonded silicon carbide (SiSiC)	Mullite-bonded silicon carbide
porous	porous	vacuum-tight	porous
Working temperature up to 1600°C oxidising, up to 2000°C under inert gas	Working temperature up to 1400°C	Working temperature up to 1350°C	Working temperature up to 1350°C
Outer Ø x Inner Ø	Outer Ø x Inner Ø	Outer Ø x Inner Ø	Outer Ø x Inner Ø
15 x 5	15 x 5	15 x 5	16 x 10
20 x 10	20 x 10	20 x 10	20 x 12
22 x 12	22 x 12	22 x 12	23 x 17
25 x 15	25 x 15	25 x 15	26 x 18
30 x 20	30 x 20	30 x 20	30 x 22
32 x 22	32 x 22	32 x 22	35 x 28
34 x 24	34 x 24	34 x 24	40 x 32
35 x 25	35 x 25	35 x 25	45 x 35
40 x 30	40 x 30	40 x 30	50 x 40
45 x 35	45 x 35	45 x 35	60 x 50
50 x 38	50 x 38	50 x 38	65 x 55
60 x 46	60 x 46	60 x 46	70 x 60
70 x 56	70 x 56	70 x 56	80 x 70
75 x 61	75 x 61	75 x 61	95 x 80
80 x 66	80 x 66	80 x 66	115 x 95
			120 x 100
Further dimensions upon request			
Max. manufacturable outer Ø up to approx. 250	Max. manufacturable outer Ø up to approx. 250	Max. manufacturable outer Ø up to approx. 80	
Max. length 3,500, depending on the outer Ø		Max. length 3,200, depending on the outer Ø	

All dimensions in mm.

The Haldenwanger-variety

Our extensive range of tubes enables us to offer a ceramic solution for every application. The tables list a small selection of typical dimensions of standard materials oxide ceramics and silicon carbides. All tubes are available with dimensions: both ends open, one end closed, both ends open with flange, one end closed with flange. Further dimensions upon request.

Standard tubes for temperature monitoring

We are your specialist for technical ceramics – especially for use at high temperatures. Through our extensive product portfolio of oxide and non-oxide materials, we offer you the best ceramic solution. The listed dimensions show a small selection of our standard protection tubes, further dimensions or maximum lengths upon request.

Alsint 99.7	Pythagoras	Sillimantin 60
High-purity, gas-tight aluminium oxide	Gas-tight aluminium silicate	Porous aluminium silicate
Material type C 799 acc. to DIN EN 60672-3	Material type C 610 acc. to DIN EN 60672-3	Material type C 530 acc. to DIN EN 60672-3
Aluminium oxide content > 99.7%	Aluminium oxide content 56–58 %	Aluminium oxide content 72–74 %
Working temperature up to 1800°C	Working temperature up to 1400°C	Working temperature up to 1350°C
Outer Ø x Inner Ø	Outer Ø x Inner Ø	Outer Ø x Inner Ø
4 x 2	4 x 2	12 x 8
5 x 3	5 x 3	15 x 10
6 x 4	6 x 4	16 x 12
8 x 5	8 x 5	17 x 13
9 x 6	9 x 6	20 x 15
9.6 x 6.4	9.6 x 6.4	22 x 17
10 x 6	10 x 7	26 x 18
12 x 8	12 x 8	
15 x 10	15 x 11	
16 x 12	16 x 12	
17 x 12	17 x 13	
20 x 15	20 x 15	
22 x 17	22 x 17	
24 x 18	24 x 19	
Non-binding guide value ID tolerance for standard lengths acc. to DIN 40680		

Halsic-R/-RX	Halsic-N	Halsic-I
Recrystallised silicon carbide (RSiC)	Nitride-bonded silicon carbide (NSiC)	Silicon-filtrated, reaction-bonded silicon carbide (SiSiC)
porous	porous	vacuum-tight
Working temperature up to 1600°C oxidising, up to 2000°C under inert gas	Working temperature up to 1400°C	Working temperature up to 1350°C
Outer Ø x Inner Ø	Outer Ø x Inner Ø	Outer Ø x Inner Ø
20 x 10	16 x 8	20 x 10
22 x 12	22 x 12	22 x 12
25 x 15	28 x 16	25 x 15
30 x 20 (15)		26 x 18
35 x 25	with groove if desired	28 x 18
40 x 30		30 x 20
45 x 35		35 x 25
50 x 38		40 x 30
Non-binding guide value ID tolerance for standard lengths +3/-0		Non-binding guide value ID tolerance for standard lengths +2/-1

All dimensions in mm.

Special material

Alsint PG

Alsint PG only recently developed is a high-purity, fine-grained aluminium oxide for special applications in the high temperature range. The use of expecially selected high-purity raw materials and the smart microstructure design result in an increased service life of the protection tubes.

Alsint PG is characterised by the following properties:

- High corrosion resistance to chemical attacks
- High imperviousness in gaseous atmospheres
- Low creep tendency at high temperatures
- High purity
- High strength

Availability and feasibility upon request. We align production campaigns exclusively on the basis of orders for defined diameters and lengths.

Physical properties	Unit	Value
Material group acc. to type DIN EN 60672	–	C 799
Al_2O_3 content	%	> 99.8
Bulk density	$\frac{g}{cm^3}$	> 3.90
Flexural strength at 20°C	MPa	350
Young's modulus	GPa	300–380
Thermal expansion at 20–1000°C	$\frac{1}{10^6\ K}$	8–9
Thermal conductivity at 200°C	$\frac{W}{m\ K}$	25
Maximal approximate temperature for load bearing elements	°C	1800

Please note that all the values quoted are based on test specimens and may vary according to component design. These values are not guaranteed in any way and should only be treated as indicative values. They should be used for guidance only and for no other purpose.

Why Alsint tubes from Haldenwanger?

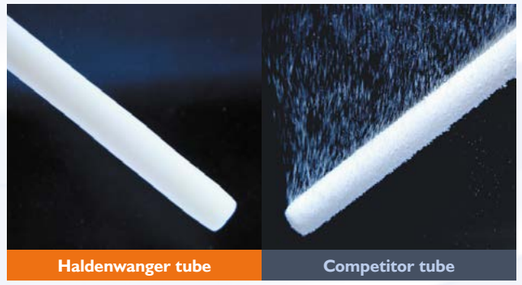
Long service life

Due to its high aluminium oxide content, Alsint 99.7 demonstrates very good chemical resistance in corrosive atmospheres. Even after the thermocouple has been used for years at high temperatures, the noble metal wires are still well protected from contamination and embrittlement. The long-term availability of the temperature sensor is unparalleled.

The positive material properties also ensure the long-term and accurate stability of the voltage reading between the thermocouple wires, essential to precise, reproducible temperature measurement.

Our ceramic tubes are all 'Made in Germany'. Every one of our protecting tubes undergoes standardised leak-tightness checks. These can reliably detect leakage rates of up to 10–2 cm^3/min (corresponding to a bubble of ø 3 mm after 100 seconds of testing).

The images below show a gas-tight Haldenwanger tube compared with a gas-permeable tube following long-term use in a leaktightness test.

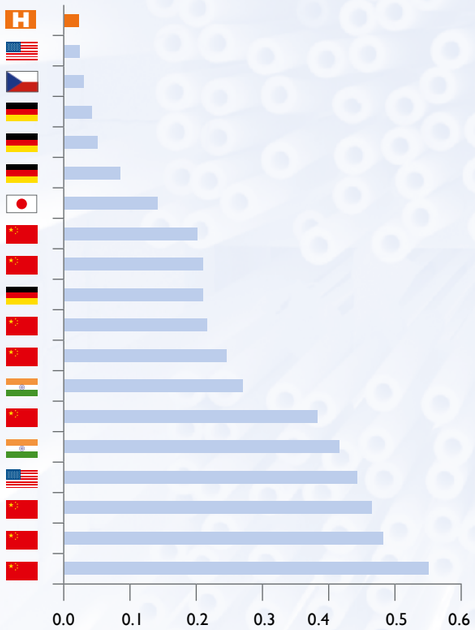


High dimensional accuracy

The extrusion method ensures even wall thickness and high tube concentricity, facilitating a combined protecting tube and insulating profi e. Casting, an alternative production method, generates uneven wall thickness, which leads to thermal stresses in use. Production-related ovality and differences in wall thickness mean the insulating profi le does not fit precisely within the protecting tube. With extrusion, you can be sure of getting the same tolerances within each batch, but also across different deliveries covering various production timeframes.

Our tubes stand out thanks to the reproducible dimensional accuracy facilitated by the extrusion method and the associated reliability with which the protecting tube and insulating profile can be assembled.

Using benchmarking analysis, the dimensional stability of Haldenwanger protecting tubes is compared with that of other tube manufacturers below. Pores resulting from the casting method do not arise in extrusion moulding. The properties of a Haldenwanger extruded tube include dimensional accuracy, gas tightness, electrical insulation and dielectric strength.



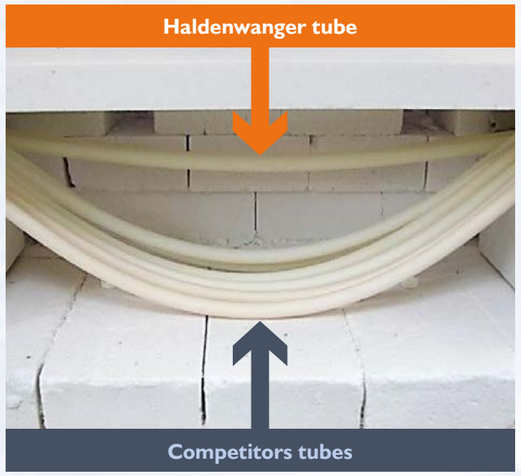
Dimensional stability std. dev. (mm)

Excellent high temperature properties

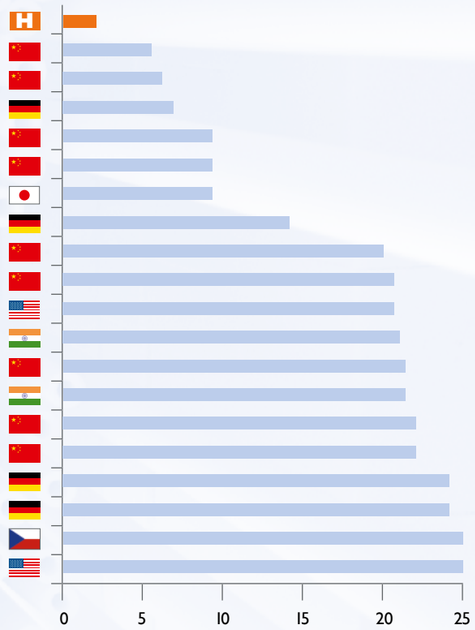
Alsint 99.7 in particular boasts excellent resistance to high temperatures and refractoriness, while the smart microstructure design produces less creep deformation. In the case of tubes used for temperature measurement, we achieve this through our individual firing process with higher temperatures and a longer dwell time.

The diagrams below explain the link between our highly purified Al_2O_3 content, specially developed grain structure and resulting resistance to high temperatures in a comparison with that of other tube manufacturers. This results in a long service life in high-temperature applications.

The practical test at a temperature of 1750°C and with an exposure time of five hours emphasises the quality on offer from Haldenwanger (see photo on the right).



Proportion of Al_2O_3 (wt %)



Deflection (%), length 640 mm

Alsint 99.7 insulation rods

2 bore rods	O Ø x B Ø
	1.2 x 0.3
	2.0 x 0.5
	2.5 x 0.7
	3.0 x 0.8
	3.5 x 1.2
	4.0 x 1.2
	4.5 x 1.2
	5.0 x 1.0
	5.5 x 1.2
	6.0 x 1.8
	8.0 x 2.0
	8.5 x 2.5

4 bore rods	O Ø x B Ø
	1.6 x 0.4
	2.0 x 0.5
	2.7 x 0.8
	3.0 x 0.8
	4.0 x 1.0
	4.0 x 1.2
	4.5 x 1.2
	5.0 x 1.0
	5.5 x 1.2
	6.0 x 1.8
	8.5 x 1.5
	10.2 x 2.7

2 bore rods	Width / Height x B Ø
oval	2.0 / 1.5 x 0.7
	2.3 / 1.4 x 0.7
	2.5 / 1.5 x 0.8
	3.0 / 2.0 x 0.7
	4.0 / 2.8 x 1.0
	4.5 / 2.8 x 1.2
	5.0 / 3.0 x 1.5
	7.5 / 5.0 x 2.2

5 bore rods	O Ø x IB Ø / B Ø
with centre bore and 4 smaller bores	3.0 x 0.9 / 0.3
	5.0 x 2.3 / 0.7
	6.0 x 3.0 / 0.8
	7.0 x 3.3 / 1.0
	8.5 x 4.0 / 0.8
	8.5 x 4.0 / 1.0
	8.5 x 4.4 / 1.2
	9.0 x 3.2 / 1.15

6 bore rods	O Ø x B Ø
	4.0 x 0.75
	4.4 x 1.0
	5.1 x 1.1
	6.0 x 1.2
	6.4 x 1.0
	8.0 x 1.2

10 bore rods	O Ø x B Ø
	5.5 x 0.8
	5.7 x 0.65
	6.0 x 0.75
	6.4 x 1.0
	7.0 x 1.1
	8.0 x 0.7

Insulation rods made of Alsint 99.7 type C 799 or Pythagoras type C 610 are used to insulate inserted thermal wires. In accordance with DIN 43725, Pythagoras insulation rods can be heated to temperatures up to 1500°C. For higher temperatures, we recommend Alsint 99.7 insulation rods.

Our extensive range of tubes enables us to offer a ceramic solution for every application. Please refer to the tables for a small selection of typical dimensions of standard insulation rods. Further dimensions upon request.

Pythagoras insulation rods

2 bore rods	O Ø x B Ø
	1.8 x 0.6
	2.0 x 0.6
	2.6 x 0.8
	3.0 x 0.8
	3.5 x 1.2
	4.0 x 1.2
	4.5 x 1.2
	5.0 x 1.5
	5.5 x 1.2
	6.0 x 1.8
	8.0 x 2.8
	8.5 x 2.5

4 bore rods	O Ø x B Ø
	1.7 x 0.4
	2.2 x 0.6
	2.7 x 0.8
	3.0 x 0.8
	3.5 x 1.0
	4.0 x 1.2
	4.5 x 1.2
	5.0 x 1.2
	5.5 x 1.2
	6.0 x 1.8
	8.5 x 1.5
	12.0 x 3.5

2 bore rods	Width / Height x B Ø
oval	2.3 / 1.4 x 0.7
	3.0 / 2.0 x 0.7
	4.0 / 2.7 x 1.0
	4.4 / 3.1 x 1.7
	4.6 / 3.3 x 1.5
	7.5 / 5.0 x 2.2

5 bore rods	O Ø x IB Ø / B Ø
with centre bore and 4 smaller bores	2.8 x 0.9 / 0.5
	4.5 x 1.2 / 0.75
	6.0 x 3.5 / 0.6
	8.5 x 4.0 / 1.0
	8.5 x 4.0 / 1.2
	9.0 x 4.0 / 1.1

6 bore rods	O Ø x B Ø
	4.0 x 0.75
	4.5 x 1.0
	5.1 x 1.1
	6.0 x 1.1
	6.0 x 1.5
	7.5 x 1.2

10 bore rods	O Ø x B Ø
	5.0 x 0.4
	5.2 x 0.8
	5.4 x 0.65
	5.6 x 0.75
	6.5 x 1.1
	7.5 x 0.7

O Ø = Outer diameter
B Ø = Bore diameter
CB Ø = Centre bore diameter
All dimensions in mm.

DIN measurements

Designs

Unglased
Admissible tolerance of the wall thickness is in compliance with DIN 40680 Part 1, degree of accuracy: coarse. Admisible deflection is in compliance with DIN 40680 Part 2, degree of accuracy: fine, with the following specifications: A straight rod, diameter 0.8 x (d1–2s), must be able to be inserted to the bottom of the sheath tube. The rounded bottom of the sheath tube informly becomes the cylindrical section of the sheath tube.

Requirements

Thermal shock resistance
No visible damage after test implementation.

Dimensional stability
Original straightness after test implementation.

Gas-tightness
No air is released during testing: only valid for the sheath tubes labelled gas-tight in table.

Tests

Thermal shock resistance
The sheath tube is inserted with the closed end into a 40 mm internal diameter tube furnace at a constant rate (table). The furnance is heated to the maximum permissible continuous temperature of the sheath tube. The sheath tube must not come in contact with the tube furnace, therefore a vertical setup of the tube furnace is recommended. After a minimum of 20 minutes holding time, the sheath tube is removed at the same rate and is hung freely in order to cool in calm air.

Dimensional stability
The sheath tube is horizontally clamped into the tube furnace used for thermal shock resistance testing and is then heated to the maximum permissible continuous temperature. This procedure lasts for 30 minutes.

Gas-tightness
The sheath tube is exposed to an inner overpressure of 2 bar, and then submersed in water for one minute.

Note
The tests should be conducted in the abovementioned order. The termal shock resistance tests and dimensional stability tests can be conducted simultaneously when the tube furnace is setup horizontally.

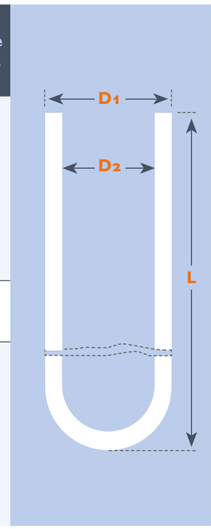
Guidelines for the selection of sheath tube materials according to DIN 43724, paragraph 7:

- **Type C 610**
  Alkali- and hydrofluric acid-free gases up to 1500°C
- **Type C 799**
  Contact with alkali vapours up to 1500°C
- **Type C 530**
  Gases of all kinds, if inner tubes are gas-tight, up to 1600°C
- **Type C 799**
  Melting glasses up to 1500°C

Not general specifications; reference values only)

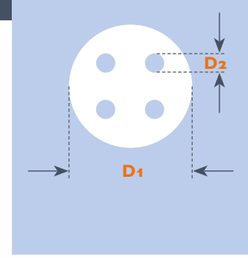
Ceramic sheath tubes according to DIN 43724 EN 50446

DIN EN 60672	D1 Outer Ø	D2 Inner Ø	L Length	Insertion rate cm/min	Termal shock resistance	Perme-ability	Max. permissible continuous temp.
C 610	10	7	200, 270, 375, 530, 740, 1,030	100	medium to good	gas-tight	1400°C
	15	11	530, 740, 1,030, 1,430, 2,030	50			
	24	19	530, 740, 1,030, 1,430	1			
C 530	26	18	530, 740, 1,030, 1,430	1	very good	porous	1350°C
C 799	10	6	200, 270, 375, 530	100	medium	gas-tight	1600°C
	15	10	530, 740, 1,030	50			
	24	18	530, 740, 1,030, 1,430	1			

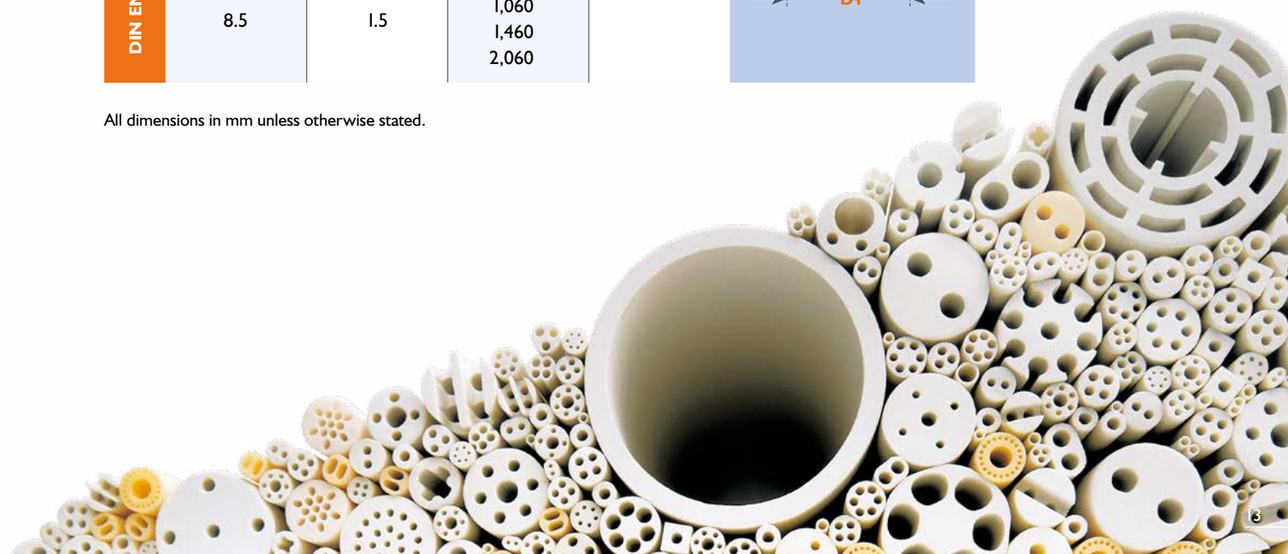


Insulation rods according to DIN 43725 EN 50446

DIN EN 60672 Type C 610 or C 799	D1 Outer Ø	D2 Bore Ø	Length	For wire Ø
	5.5	1.2	205 275 380 560 770	≤ 0.8
	8.5	1.5	1,060 1,460 2,060	



All dimensions in mm unless otherwise stated.



Tolerances according to DIN 40680

Diameter and deflection tolerances without grinding according to DIN 40680

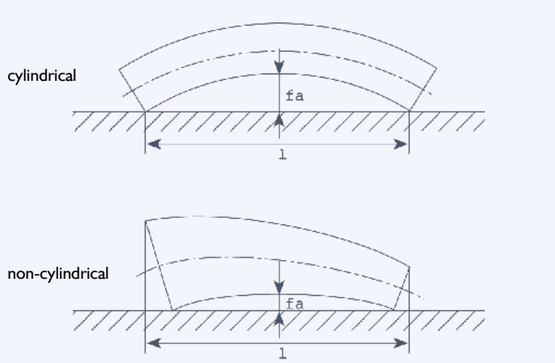
Nominal Ø or length		Accuracy (admissible tolerances) coarse	Accuracy (admissible tolerances) medium
	up to 4	± 0.4	± 0.15
above 4	6	± 0.6	± 0.20
6	8	± 0.7	± 0.25
8	10	± 0.8	± 0.30
10	13	± 1.0	± 0.35
13	16	± 1.2	± 0.40
16	20	± 1.2	± 0.45
20	25	± 1.5	± 0.50
25	30	± 1.5	± 0.55
30	35	± 2.0	± 0.60
35	40	± 2.0	± 0.65
40	45	± 2.0	± 0.70
45	50	± 2.5	± 0.80
50	55	± 2.5	± 0.90
55	60	± 2.5	± 1.00
60	70	± 3.0	± 1.20
70	80	± 3.5	± 1.40
80	90	± 4.0	± 1.60
90	100	± 4.5	± 1.80
100	110	± 5.0	± 2.00
110	125	± 5.5	± 2.20
125	140	± 6.0	± 2.50
140	155	± 6.5	± 2.80
155	170	± 7.0	± 3.00
170	185	± 7.5	± 3.40
185	200	± 8.0	± 3.80
200	250	± 9.0	± 4.20
250	300	± 10.0	± 4.60
300	350	± 11.0	± 5.00
350	400	± 12.0	± 5.50
400	450	± 13.0	± 6.10
450	500	± 14.0	± 6.80
500	600	± 15.0	± 7.60
600	700	± 16.0	± 8.30
700	800	± 17.5	± 9.00
800	900	± 19.0	± 9.50
900	1,000	± 20.0	± 10.00
1,000		± 0.02 · d	± 0.01 · d

All specifications in mm, please contact us for stricter tolerances.

Nominal length		Accuracy (admissible deflection fa) coarse	Accuracy (admissible deflection fa) medium
	up to 30	1.7	0.15
above 30	40	1.8	0.20
40	50	1.9	0.25
50	60	2.0	0.30
60	70	2.1	0.35
70	80	2.1	0.40
80	90	2.2	0.45
90	100	2.3	0.50
100	110	2.4	0.55
110	125	2.5	0.65
125	140	2.6	0.70
140	155	2.7	0.80
155	170	2.9	0.85
170	185	3.0	0.90
185	200	3.1	1.00
200	250	3.5	1.25
250	300	3.9	1.50
300	350	4.3	1.75
350	400	4.7	2.00
400	450	5.1	2.25
450	500	5.5	2.50
500	600	6.3	3.00
600	700	7.1	3.50
700	800	7.9	4.00
800	900	8.7	4.50
900	1,000	9.5	5.00
1,000		1.5 + 0.8% · l	0.50% · l

Manufacturing process	Accuracy coarse	Accuracy medium
Cast, turned, extruded for parts with an envelope size of 30 mm and higher	●	
Extruded for parts with an envelope size up to 30 mm, non-metered pressed, metered semi-moist pressed, metered dry pressed, white machined		●

Deflection of a formed part



Manufacturing process	Accuracy coarse		Accuracy medium	
DIN EN 60672, type	C 610	C 799	C 610	C 799
Casted	●	●		
Turned	●			
Extruded envelope size 30 mm and higher	●	●		
Extruded envelope size up to 30 mm			●	●

The values for accuracy in the column under the heading 'coarse' are not applicable to the first manufacturing. Special agreements are required.
● Customary manufacturing process

WH-1500 refractory cement

Handling instructions

→ Getting prepared

Visual appearance of the two glue components

WH-1500 Part A component typically comes as a loose powder, whilst WH-1500 Part B component is a low viscosity liquid. If one or the other should show a different appearance (e.g., due to exceeding the "best-before" date or due to keeping under inappropriate storage conditions), this may be an indicator that the typical performance of the glue may be impaired.

Preparation of the surfaces

In order to achieve the optimum gluing result, all kinds of fatty, oily, dusty, and any other residues need to be completely removed from the surface areas of the two joining parts. This may be achieved by using highly volatile organic solvents, such as acetone, if necessary, in combination with a mechanic surface treatment, e.g. brushing. Depending on the kind of surface contamination, ceramics parts may additionally be subjected to a thermal treatment at a temperature of approx. 1000°C.

→ Joining

Mixing of the two components

Mixing of the two constituent components, WH-1500 Part A and WH-1500 Part B, shall be conducted according to the consistency required for the application ahead. The table shows typical mixing ratios for various applications. Common working (hardening) times are in the range of 10–40 minutes.

Joining and hardening

Apply a thin layer of WH-1500 on each of the surface areas of the two parts to be joined. In the case of porous materials, applying a primary layer of WH-1500 Part B component onto the surface may reduce the uptake behavior of the surfaces.

WH-1500 has a hydraulic binding behavior. Depending on the joining gap between the two parts, the cement should be dried for 24–48 hours at room temperature. Gaps between two parts typically ought to be in the range of between 0.3–1.5 mm. Complete drying of the parts is obtained by subjecting them to an additional heat treatment at 50–100°C.

In a mix of the two components with a higher content of WH-1500 Part A, heat treatment at 1200 to 1500°C in air will help enhance the mechanic strength of the joint.

Remark

When metals such as aluminium, tin, zink, and copper, are joined a passivation of the metal surface takes place.

Ratio of the two cement components A : B	Typical areas of application
1.2 : 1	Small joining gaps between the two parts Dense as well as porous materials Various materials (ceramics/metals) Long working time (retarded hardening)
2.4 : 1	Large joining gap between the two parts Porous materials Short working time (fast hardening)

Remark

When mixing or working with WH-1500 refractory cement, working safe is of paramount importance. The WH-1500 refractory cement is not classified as dangerous material, however we recommend the use of safety glasses and gloves. For further information please refer to our safety data sheets.

Morgan
Advanced Materials

HALDENWANGER

Morgan Advanced Materials Haldenwanger has developed from its foundation in 1865 to become one of the world's leading manufacturers of high-tech ceramics. We offer you an extensive range of products made of oxide and non-oxide materials, which are primarily used in demanding thermal, chemical or even mechanical applications. Thanks to our wealth of expertise in ceramics, we serve you not only as a supplier, but also as a reliable partner in developing **solutions for your challenges.**

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