Morgan Advanced Materials

HALDENWANGER

→ Materials

Contents

High temperature usage

Due to their specific chemical nature, ceramic materials may be used in high (> 1200°C) and very high temperature conditions (> 1500°C). In some cases, the usage of ceramic materials is the only viable choice, especially as compared with metallic materials.

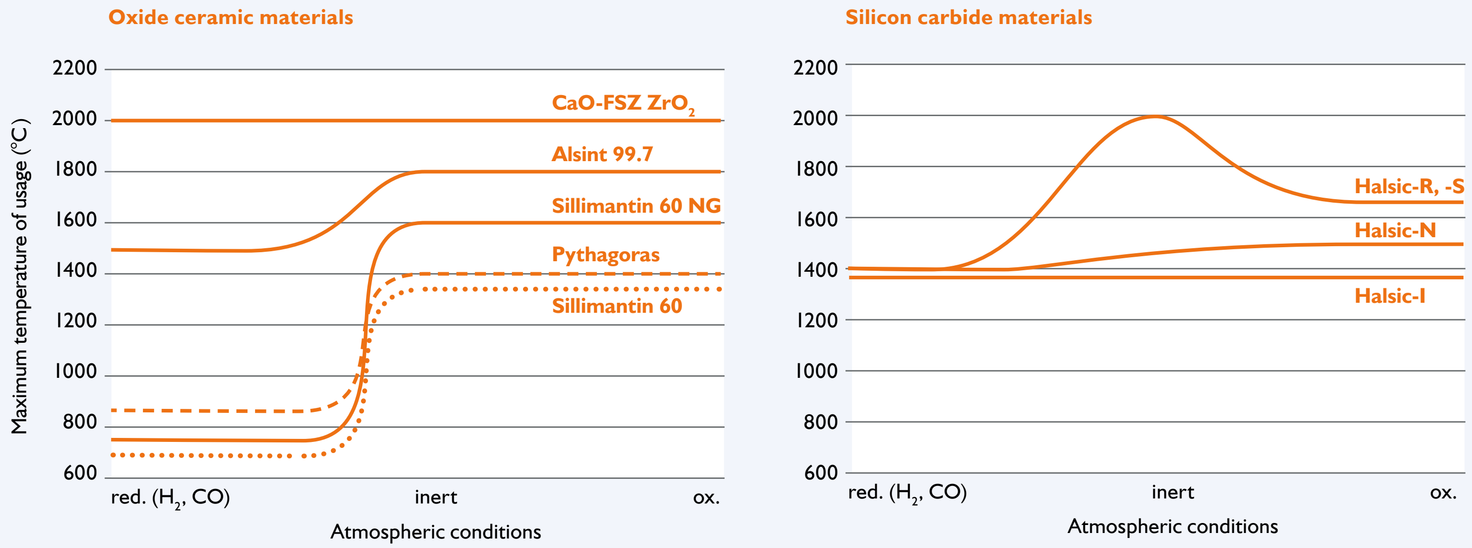
For choosing the best ceramic material, at least the following aspects should be taken into account:

- Maximum peak and dwell temperatures
- Atmospheric conditions in the vicinity of the ceramic part
- Mechanic loading of the part at high temperature

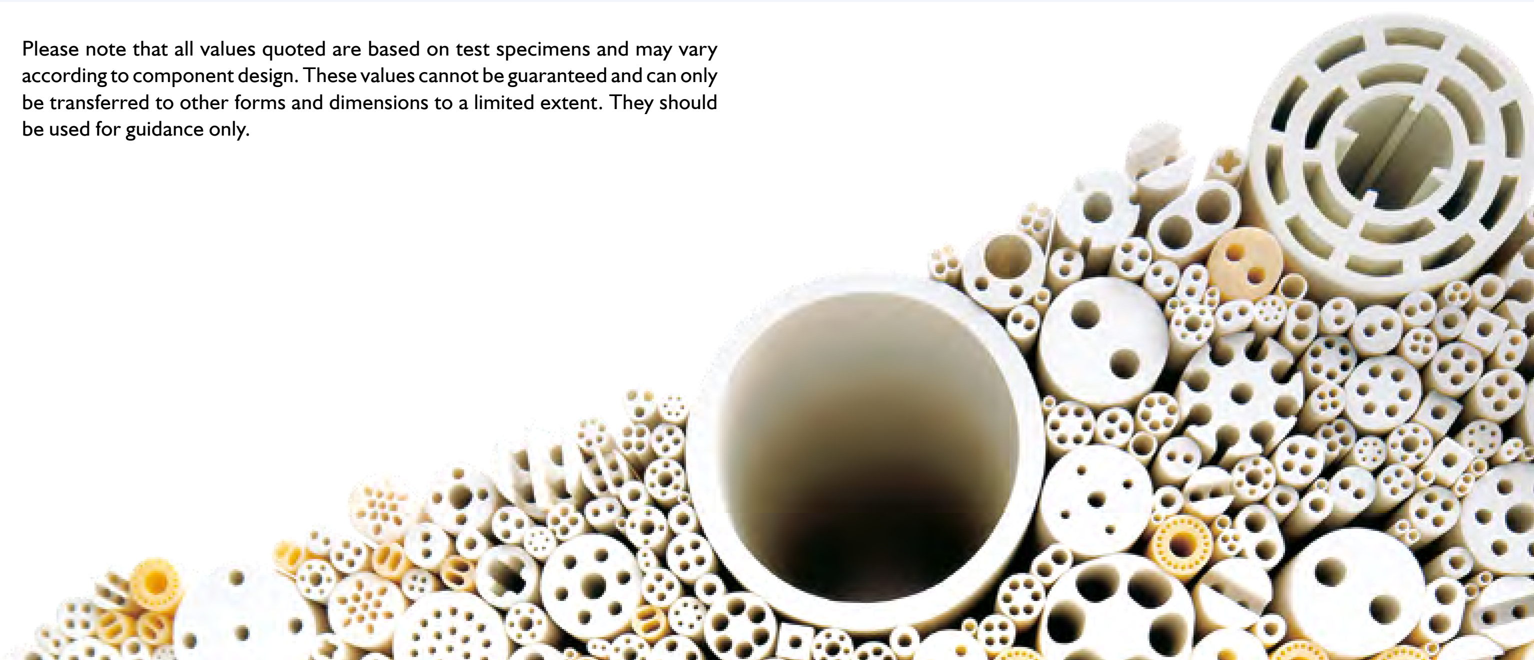
Parts to be used at high temperature usually are not designed for maximum strength at room temperature. Rather, creep deformation behaviour due to mechanical loads as well as corrosive attack by atmospheric constituents are the relevant properties.

At any rate, Morgan Advanced Materials Haldenwanger provides technical expertise for any specific enquiries, to facilitate the choice of the best ceramic material. For an initial estimate of all viable candidates however, the two stability diagrams shown in this brochure (see below) may be used.

Maximum operating temperatures
for the different atmospheres given for oxide ceramic and silicon carbide materials



Please note that all values quoted are based on test specimens and may vary according to component design. These values cannot be guaranteed and can only be transferred to other forms and dimensions to a limited extent. They should be used for guidance only.



Aluminium oxides

Material	Description	Properties and applications
Alsint 99.7	High-purity, gas-tight aluminium oxide	• Material type C799 according to DIN EN 60672-3 • Aluminium oxide content ≥ 99.7% • Working temperature up to 1800°C • Very high dielectric strength • High mechanical strength • Excellent refractoriness • High corrosion resistance • Versatile material for demanding thermal, chemical and mechanical applications (e.g., in furnace construction and temperature measurement) • Standard geometries: tubes, solid rods, protection tubes, capillary tubes, plates, crucibles, saggars, insulators; customised dimensions upon request
Alsint PG	High-purity, fine grained aluminium oxide for special high temperature applications	• Aluminium oxide content ≥ 99.8% • Working temperature up to 1800°C • Improved refractoriness and corrosion resistance • Material for protection tubes for extreme high temperature applications • Order-related production in defined diameters and lengths; availability upon request
Alsint 96	Aluminium oxide for wear applications	• Aluminium oxide content ≥ 96% • Working temperature up to 1400°C • Wear resistant ceramic for use in mechanical engineering applications • Order-related production for customer-specific geometries
Alsint 99.5	High-purity, porous aluminium oxide for high-temperature applications	• Aluminium oxide content ≥ 99.5% • Working temperature up to 1700°C • Very good thermal shock resistance • Standard geometries: kiln furniture, tubes, crucibles, saggars and plates
SKA 100FF **SKA 200FF**	High-purity, porous aluminium oxide for filtration applications	• Aluminium oxide content ≥ 99.7% • Working temperature up to 500°C • Tubes for use in filtration applications and manifold tubes
HalFoam Alumina	Ceramic foam for high temperature thermal insulation	• Aluminium oxide content ≥ 98.5% • Working temperature up to 1700°C • Fibre-free, non-dusting insulation material • High mechanical strength • High corrosion resistance • Order-based production for customised dimensions; availability upon request

Material properties

	Property	Unit	Alsint 99.7	Alsint PG	Alsint 96	Alsint 99.5	SKA 100FF	SKA 200FF	HalFoam Alumina
GENERAL	Type according to EN 60672	–	C 799	C 799	–	–	–	–	–
	Main components	%	≥ 99.7 Al_2O_3	≥ 99.8 Al_2O_3	≥ 96 Al_2O_3	≥ 99.5 Al_2O_3	≥ 99.7 Al_2O_3	≥ 99.7 Al_2O_3	≥ 98.5 Al_2O_3
	Bulk density	$\frac{g}{cm^3}$	3.75–3.94	3.90–3.94	3.6–3.7	3.50–3.65	2.5–2.7	2.7–2.9	0.6
	Water absorption capacity	%	0	0	0	1.5–3.0	12–13	8–10	–
	Porosity	Vol.-%	vacuum tight	vacuum tight	–	8–12	32–37	27–32	80
	Diameter or pores, average	µm	–	–	–	1.5–3.0	0.2–0.5	0.2–0.5	150–250
MECHANICAL	Medium Flexural strength at: 20°C 700°C 1300°C	MPa	300 – –	350 – –	200–260 – –	80–120 – –	30–50 – –	50–70 – –	3.5 – –
	Young's modulus at 20°C	GPa	300–380	300–380	–	–	–	–	–
THERMAL	Linear coefficient of thermal expansion at 20–1000°C	$\frac{1}{10^6 K}$	8–9	8–9	7.5–8.5	–	–	–	–
	Thermal conductivity: 200°C 1200°C 1600°C	$\frac{W}{m K}$	25 – –	25 – –	25 – –	25 – –	– – –	– – –	– 0.47 0.71
	Specific heat capacity at: 20–100°C 1000°C	$\frac{J}{kg K}$	– –	– –	– –	– –	– –	– –	– 1200
	T_{max} depends on the area of application, but is max.	°C	1800	1800	1400	1700	–	–	1700
	Thermal shock resistance	–	good	–	–	good	–	–	–
ELECTRIC	Dielectric strength according to IEC 672-2	$\frac{kV}{mm}$	17	–	–	–	–	–	–
	Resistivity at DC voltage 20°C	Ω cm	10^{14}	–	–	–	–	–	–
	Feasibility/Availability								

The physical and chemical values specified above have been determined acc. to standard DIN-EN 60672 and are applicable for the standard test specimens described in this norm. Given the material-specific properties of ceramic materials these values may not be applied directly to components deviating from the norm in size and shape. The values specified above do not constitute warranted properties as defined by law.

= upon request

Aluminium Silicates

Material	Description	Properties and applications
Pythagoras	Gas-tight aluminium silicate	• Material type C610 according to DIN EN 60672-3 • Working temperature up to 1400°C • High dielectric strength • Good corrosion resistance • Versatile material for demanding thermal, chemical and mechanical applications (e.g., in furnace construction and temperature measurement) • Standard geometries: tubes, solid rods, protection tubes, capillary tubes; customised dimensions upon request
Pythagoras 1800Z ?	Gas-tight aluminium silicate for high-temperature applications	• Material type C620 according to DIN EN 60672-3 • Working temperature up to 1600°C • High mechanical strength • Thin-walled tubes for excellent thermal shock resistance • Tubes > 40 mm outside diameter for use as radiant tubes • Availability upon request
Sillimantin KS	Supporting tubes for heating elements	• Working temperature up to 1350°C • No reaction with metallic heating elements • Production in defined diameters and lengths
Sillimantin 60	Porous aluminium silicate	• Material type C530 according to DIN EN 60672-3 • Working temperature up to 1350°C • Excellent thermal shock resistance • Versatile material for demanding thermal and mechanical applications (e.g., in furnace construction and temperature measurement) • Standard geometries: tubes, profiles, heating plates, bushings, spacers, customised dimensions upon request
Sillimantin 60 NG	Porous aluminium silicate for high-temperature applications	• Working temperature up to 1650°C • High mechanical strength with good thermal shock resistance • Standard geometries: tubes, protection tubes
Sillimantin 80	Porous aluminium silicate	• Working temperature up to 1350°C • Very high thermal shock resistance • Versatile material for demanding thermal and mechanical applications (e.g., in furnace construction and chemical process technology) • Standard geometries: Crucibles, saggars, bushings and plates; customised dimensions upon request
FG50 ?	Mullite bonded, porous corundum material for filtration applications	• Working temperature up to 1400°C • Tubes and crucibles for use in filtration applications • Availability upon request

Material properties

	Material	Unit	Pythagoras	Pythagoras 1800Z	Sillimantin KS	Sillimantin 60	Sillimantin 60 NG	Sillimantin 80	FG50
GENERAL	Type according to EN 60672	–	C 610	C 620	–	C 530	–	–	–
	Main components	%	56–58 Al_2O_3 38–40 SiO_2	76–78 Al_2O_3 20–22 SiO_2	70–72 Al_2O_3 25–27 SiO_2	72–74 Al_2O_3 24–26 SiO_2	73–75 Al_2O_3 22–24 SiO_2	84–85 Al_2O_3 14 SiO_2	> 87 Al_2O_3 > 10 SiO_2
	Bulk density	$\frac{g}{cm^3}$	2.6	3.0	2.5–2.6	2.45	2.75–2.85	2.55–2.65	2.4–2.5
	Water absorption capacity	%	0	0	6	9	1–3	8.5–10.5	10–14
	Porosity	Vol.-%	vacuum tight	vacuum tight	15–18	17–20	3–9	24–28	25–33
	Diameter or pores, average	µm	–	–	0.5–1.3	0.8–1.3	3.5–5.5	0.8–1.3	20–26
MECHANICAL	Medium Flexural strength at: 20°C 700°C 1300°C	MPa	120 – –	150 – –	45–60 – –	45 – –	60 – –	30–40 – –	– – –
	Young's modulus at 20°C	GPa	100	150	60	60	100	–	–
THERMAL	Linear coefficient of thermal expansion at 20–1000°C	$\frac{1}{10^6\,K}$	6	6	5.7	5.7	5.8	6.3	–
	Thermal conductivity: 200°C 1000°C 1700°C	$\frac{W}{m\,K}$	2 – –	6 – –	1.4 – –	1.4 – –	– – –	– – –	– – –
	Specific heat capacity at: 20–100°C 1000°C	$\frac{J}{kg\,K}$	– –	– –	800 –	800 –	900 –	– –	– –
	T_{max} depends on the area of application, but is max.	°C	1400	1600	1350	1350	1650	1350	1400
	Thermal shock resistance	–	good	excellent	excellent	excellent	good	good	–
ELECTRIC	Dielectric strength according to IEC 672-2	$\frac{kV}{mm}$	17	17	–	–	–	–	–
	Resistivity at DC voltage 20°C	Ω cm	10^{13}	10^{13}	–	–	–	–	–
	Feasibility/Availability			?					?

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? = upon request

Silicon carbides

Material	Description	Properties and applications
Halsic-R	Recrystallized silicon carbide (RSiC)	• Working temperature up to 1600°C (oxidising), up to 2000°C (inert atmosphere) • High thermal shock resistance • High corrosion resistance • Standard applications: kiln furniture for high temperature applications as well as tubes for temperature measurement in the gas phase • Standard geometries: plates, beams, supports, tubes, protection tubes, rollers, saggars, crucibles, burner nozzles; customised dimensions upon request
Halsic-RX	Chemically modified recrystallized silicon carbide ($RSiC_{dot}$)	• Working temperature up to 1650°C (oxidising) • Very good oxidation resistance • Standard applications: kiln furniture for the porcelain industry as well as heavy duty beams for high temperature applications • Standard geometries: plates and beams
Halsic-N	Nitride bonded silicon carbide (NSiC)	• Working temperature up to 1450°C • High mechanical strength • Very good oxidation resistance • Standard applications: kiln furniture and tubes for temperature measurement in non-ferrous metal melts • Standard geometries: plates, beams, supports, protection tubes; customised dimensions upon request
Halsic-I	Silicon-filtrated, reaction-bonded silicon carbide (SiSiC)	• Working temperature up to 1350°C • Very good thermal shock resistance • Very good corrosion resistance • Standard applications: heavy-duty beams as well as tubes for temperature measurement in the gas phase • Standard geometries: beams, tubes and protection tubes
Halsic-S	Pressureless sintered, dense silicon carbide (SSiC)	• Working temperature up to 1600°C (oxidising), up to 2000°C (inert atmosphere) • Very high mechanical strength • Very high thermal shock resistance • Very high corrosion resistance • Standard applications: kiln furniture and tubes for temperature measurement in applications with extreme conditions • Standard geometries: beams, tubes and protection tubes • Availability upon request
SiC mullite bonded	Mullite bonded silicon carbide	• Working temperature up to 1300°C • Good thermal shock resistance • Standard applications: tubes for temperature measurements in the gas phase • Standard geometries: tubes and protection tubes in defined diameters and lengths

Material properties

	Property	Unit	Halsic-R	Halsic-RX	Halsic-N	Halsic-I	Halsic-S	SiC mullite bonded
GENERAL	Main components	%	99 SiC	99 SiC	70 SiC 25 Si_3N_4 5 Oxide	85–90 SiC 10–15 Si	99 SiC	70–90 SiC
	Bulk density	$\frac{g}{cm^3}$	2.7	2.7	2.8	3.0–3.1	3.1	2.2–2.5
	Water absorption capacity	%	–	–	–	0	0	–
	Porosity	Vol.-%	10–15	10–15	8–15	vacuum tight	vacuum tight	–
MECHANICAL	Medium Flexural strength at: 20°C 700°C 1300°C	MPa	80–100 – 90–110	80–100 – 90–110	160 – –	240–280 – 250–300	350–400 – 370–420	30 – –
	Young's modulus at 20°C	GPa	280	280	250	370	420	–
THERMAL	Linear coefficient of thermal expansion at 20–1000°C	$\frac{1}{10^6\ K}$	4.5	4.5	4.2	4.3–4.5	5.0	5.0
	Thermal conductivity: 200°C 1000°C 1700°C	$\frac{W}{m\ K}$	100 25 –	100 25 –	100 20 –	100 30 –	125 30 –	– – –
	T_{max} depends on the area of application, but is max.	°C	1600 (ox.) 2000 (red.)	1650 (ox.)	1450	1350	1600 (ox.) 2000 (red.)	1300
	Thermal shock resistance	–	excellent	excellent	good	good	excellent	excellent
Feasibility/Availability								

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= upon request

Fused silica – Zirconium oxides – Spinel

Material	Description	Properties and applications
Fused Silica	Porous roller material based on fused silica	• Silica content (amorphous) ≥ 99.7% • Working temperature up to 1000°C • Excellent thermal shock resistance • Standard applications: rollers for heat treatment of glass and steel • Standard geometries: solid, hollow and profiled rollers, with end caps upon request; customised dimensions and HalCoat Si_3N_4 coatings are also available
HalFoam Fused Silica	Ceramic foam for thermal insulation	• Silica content (amorphous) ≥ 95% • Working temperature up to 1000°C continuous operating temperature up to 850°C • Fibre-free, non-dusting insulation material • Order-based production for customised structural components; availability upon request
ZrO_2 Mgo-PSZ	Magnesia partially stabilised zirconia	• Working temperature up to 500°C • Very high bending strength and abrasion resistance • Wear resistant ceramic for use in mechanical engineering applications • Order-based production for customised dimensions; availability upon request
ZrO_2 CaO-FSZ	Calcia fully stabilised zirconia	• Working temperature up to 2000°C • Excellent corrosion resistance • Components for extreme high-temperature applications in temperature measurement or for laboratory applications • Standard geometries: crucibles and tubes; availability upon request
HalDur C800	Composite material made of partially stabilised zirconia and alumina	• Working temperature up to 1400°C • Excellent bending strength and abrasion resistance • Good thermal shock resistance • Wear resistant ceramic for use in mechanical engineering applications • Availability upon request
MgO-Spinel	Fine ceramic magnesium aluminate spinel	• Working temperature up to 1700°C • Excellent corrosion resistance • Kiln furniture and crucibles for extreme high temperature applications with corrosion attack by alkali metals • Availability upon request

Material properties

	Property	Unit	Fused Silica	HalFoam Fused Silica	ZrO_2 Mgo-PSZ	ZrO_2 CaO-FSZ	HalDur C800	MgO-Spinel
GENERAL	Main components	%	99.7 SiO_2	95 SiO_2	95.5 ZrO_2 + HfO_2 3.5 MgO	94 ZrO_2 + HfO_2 5 CaO	62–63 ZrO_2 + HfO_2 24 + 25 Al_2O_3	≥ 67.5 Al_2O_3 ≥ 31.5 MgO
	Bulk density	$\frac{g}{cm^3}$	1.92–2.00	0.85	5.6–5.8	5.4–5.7	5.2–5.5	≥ 3.5
	Water absorption capacity	%	4–6	–	0	0	0	0
	Porosity	Vol.-%	10–14	70	vacuum tight	vacuum tight	vacuum tight	vacuum tight
	Diameter or pores, average	µm	0.2	150–200	–	–	–	–
MECHANICAL	Medium flexural strength at: 20°C 700°C 1300°C	MPa	30–40 45–60 –	1.5 – –	500–700 – –	200 – –	750–850 – –	150 – –
	Young's modulus at 20°C	GPa	30–40	–	–	–	240	280
THERMAL	Linear coefficient of thermal expansion at 20 – 1000°C	$\frac{1}{10^6 K}$	0.5	2.3 (20–800°C)	10	10	10.2	8–9
	Thermal conductivity: 200°C 600°C 1000°C	$\frac{W}{m K}$	– – –	– 0.40 0.48	– – –	– – –	12–14 – –	12–14 – –
	T_{max} depends on the area of application, but is max.	°C	1000	1000	500	2000	1400	1700
	Thermal shock resistance	–	excellent	excellent	–	–	good	good
	Feasibility/Availability							

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= upon request

Chemical resistance of high purity aluminium oxides

Among others, Alsint 99.7, DIN EN 60672, part 3, type C 799 with 99.7% Al_2O_3 content

Agent	Chemical formula	up to % conc.	up to °C temp
Alum	$KAl(SO_4)_2$	10	20
Aluminium chloride	$AlCl_3$	25	100
Aluminium sulphate	$Al_2(SO_4)_3$	80 57	boiling 120
Ammonium hydroxide	NH_3	25 concentrated	boiling 100
Ammonium bromide	NH_4Br	10	20
Ammonium carbonate	$(NH_4)_2CO_3$	30 saturated	80 100
Ammonium chloride	NH_4Cl	50 50 saturated	20 boiling boiling
Ammonium fluoride	NH_4F	20	80
Ammonium nitrate	NH_4NO_3	50 50	20 boiling
Ammonium sulphate	$(NH_4)_2SO_4$	100	boiling
Arsenic acid	H_3AsO_4	100	20
Barium chloride	$BaCl_2$	20	100
Barium hydroxide	$Ba(OH)_2$	saturated	boiling
Bisulfit waste liquor, calcium bisulfite	$Ca(HSO_3)_2$	100	20
Cyanide	HCN	100	20
Boric acid	H_3BO_3	50	boiling
Bromine	Br	dry	boiling
Potassium bisulphate	$Ca(HSO_4)_2$	–	20
Calcium hypochloride	$Ca(OCl)_2$	20	20
Calcium nitrate	$Ca(NO_3)_2$	–	20
Calcium sulphate	$CaSO_4$	10	boiling
Chlorine	Cl	dry	50
Chlorsulfonic acid	HSO_3Cl	–	boiling
Chromic acid	H_2CrO_4	50 50	20 boiling
Iron (II) chloride	$FeCl_2$	30 10 saturated	100 boiling 20
Iron (III) chloride	$FeCl_3$	50 50	50 boiling

Agent	Chemical formula	up to % conc.	up to °C temp
Iron nitrate	$Fe(NO_3)_3$	100	20
Iron (II) sulphate	$FeSO_4 7H_2O$	100	boiling
Iron (III) sulphate	$Fe_2(SO_4)_3$	30	50
Hydrofluoric acid	HF	40 40 50	20 50 20
Potassium chloride	KCl	30 saturated	boiling 100
Potassium cyanide	KCN	10	20
Potassium hydroxide	KOH	50 50	20 boiling
Potassium hypochlorite	KClO	120 g/l	150
Potassium nitrate	KNO_3	saturated	boiling
Potassium perchlorate	$KClO_4$	75	20
Potassium permanganate	$KMnO_4$	80	boiling
Potassium sulphate	K_2SO_4	20	50
Silicofluoric acid	H_2SiF_6	30	25
Aqua regia	$HCL + HNO_3$	30	20
Copper (II) chloride	$CuCi_2$	saturated	boiling
Copper sulphate	$CuSO_4$	all	boiling
Magnesium chloride	$MgCl_2$	40	boiling
Magnesium sulphate	$MgSO_4$	50 saturated	boiling 50
Manganese chloride	$MnCl_2$	50	100
Manganese sulphate	$MnSO_4$	all	20
Seawater	–	–	20
Sodium bisulphate	$NaHSO_4$	saturated	boiling
Sodium carbonate	Na_2CO_3	saturated 50	boiling boiling
Sodium chlorate	$NaClO_3$	5	boiling
Sodium chloride	NaCl	pure	boiling
Sodium chlorite	$NaClO_2$	5 10	boiling 20
Sodium hydroxide (caustic soda)	NaOH	35 50 70	boiling 20 boiling
Sodium hydrogen carbonate	$NaHCO_3$	all	boiling

Agent	Chemical formula	up to % conc.	up to °C temp
Sodium hypochloride	NaClO	10 g Cl/l	20
Sodium nitrate	$NaNO_3$	–	100
Sodium nitrite	$NaNO_2$	–	100
Sodium peroxide	Na_2O	10	boiling
Sodium sulfate	Na_2SO_4	saturated	boiling
Sodium sulfide	Na_2S	50 saturated	boiling boiling
Sodium sulfite	Na_2SO_3	50	boiling
Sodium thiosulfite	$Na_2S_2O_3$	25	boiling
Nickel chloride	$NiCl_2$	30 80	boiling 100
Nickel nitrate	$Ni(NO_3)_2$	–	20
Nickel sulfate	$NiSO_4$	–	80
Phosphoric acid	H_3PO_4	1 45 80 90 concentrated	135 boiling boiling boiling 20
Mercury	Hg	– –	50 boiling
Nitric acid	HNO_3	65 65 70 100	20 boiling 100 boiling
Hydrochloric acid	HCl	35	boiling
Sulfurous acid	H_2SO_3	saturated	20
Sulfuric	H_2SO_4	60 60 96 96	boiling 77 20 boiling
Sodium chloride solution	–	saturated	boiling
Zinc (II) chloride	$ZnCl_2$	60	boiling
Tin (V) chloride	$SnCl_2$, $SnCl_4$	all	150

The behaviour of our dense Alsint materials when exposed to various chemicals is described in the table of properties. We recommend the use of our very pure, dense alumina ceramic Alsint 99.7. The temperature limits and the concentrations – up to which no attack takes place – are also quoted. Values can vary, though, for different concentrations and temperatures.

Agent: gases	Atmosphere	Resistant up to °C
Oxygen	oxidising	2000
Hydrogen	reducing	1600
N, F, He, Ne, Ar, Kr, Xe, Rn	vacuum	1800

Agent: elements, metal alloys	Atmosphere	Resistant up to °C
Al	–	750
B	–	1100
C	vacuum	1100
Si	vacuum/inert	1200
Mg and Ca	reducing	750
K	–	restricted
V, Ni, Ta	–	1450
Ta	vacuum	1350
Cl, Se. Te, Mo, W	inert	1500
U	–	1500
Bi, Fe, Co, Mn, Ni, Pb, Sb and Zn	Oxides of these metals usually act corrosively	
High purity alumina oxide ceramic is also attacked by Lithium		

Agent: melts and slags	Reaction	Resistant up to °C
Alkali chlorides	–	750
Alkali sulphates	–	750
Alkali nitrates	–	750
CaC_2 and TiC	reducing from	1100
SiC	–	1600
Hybrides (Ca-Hybride)	reducing from	300
Metallurgical melts	–	different
Molten glass (free of phosphoric and boric acid)	molten sodium pyrosulfate attacks	melting point of the glass

All resistant with the exception of:

= sufficiently resistant (orange)

= not resistant (red)

Tolerances according to DIN 40680

Diameter and deflection tolerances without grinding according to DIN 40680

Nominal Ø or length		Accuracy (admissible tolerances) coarse	medium
	above 4	± 0.4	± 0.15
above 4	up to 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	1000	± 20.0	± 10.00
1000		± 0.02 · d	± 0.01 · d

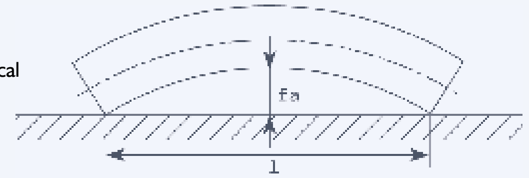
All specifications in mm, please contact us for stricter tolerances.

Nominal length		Accuracy (admissible deflection fa) coarse	medium
	above 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	1000	9.5	5.00
1000		1.5 + 0.8% · l	0.50% · l

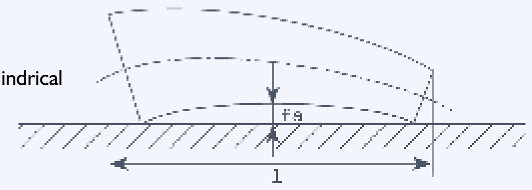
Manufacturing process	Accuracy coarse	medium
Cast, turned, extruded for parts with an envelope size of 30 mm and higher	●	
Extruded for parts with an envelope size up to 30 mm, non-metered pressed, metered semi-moist pressed, metered dry pressed, white machined		●

Deflection of a formed part

cylindrical



non-cylindrical



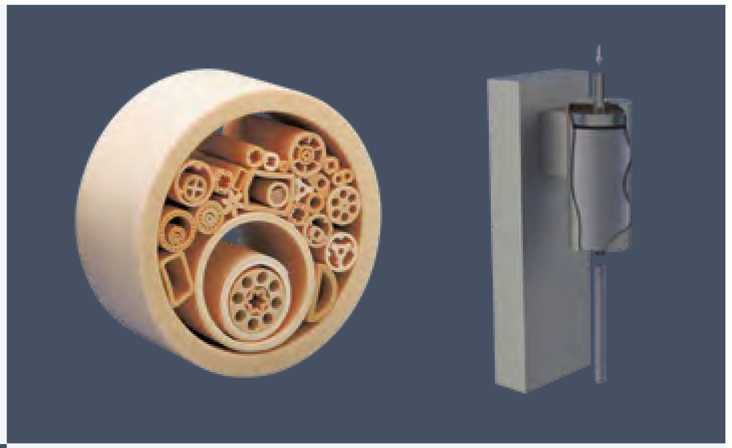
Manufacturing process	Accuracy coarse		medium	
DIN EN 60672, Type	C 610	C 799	C 610	C 799
Casted	●	●		
Turned	●			
Extruded envelope size 30 mm and higher	●	●		
Extruded envelope size up to 30 mm			●	●

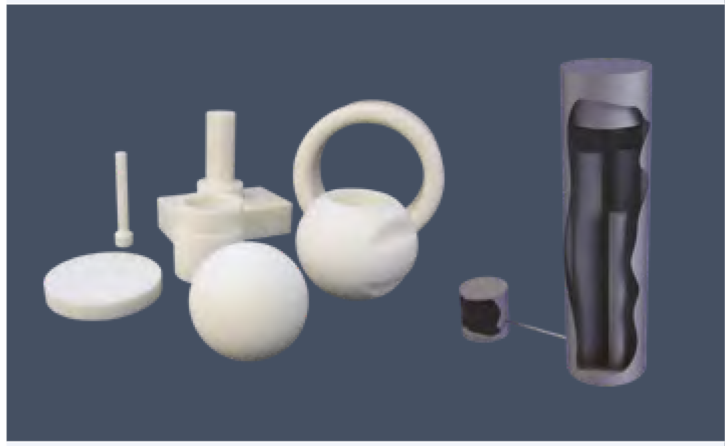
The values for accuracy in the column under the heading 'coarse' are not applicable to the first manufacturing. Special agreements are required.
● Customary manufacturing process

Our ceramic shaping variants

Extrusion

This is a very economical method for shaping elongated bodies, even with profiles or several bores in the direction of flow. Dimensional tolerances according to DIN 40680 can be maintained. Closer tolerances may be obtained by grinding the fired part.



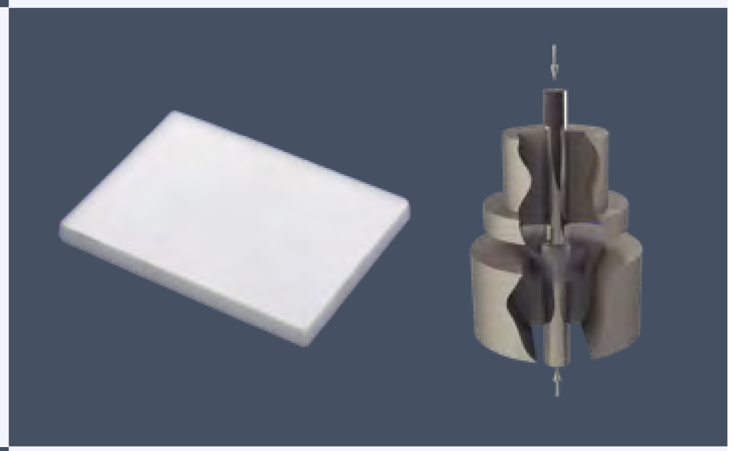


Isostatic pressing

This method is used for the production of small or large items from Alsint 99.7. The isostatically pressed blank, whether tubular, square, triangular, circular or irregular, is machined in an unfired condition. Practically any geometry can be machined, including undercuts, conical bores and other shapes, from ceramic. Dimensional tolerances according to DIN 40680 are maintained. Closer tolerances can be achieved by grinding after firing.

Dry pressing

This process is suitable for large quantities at reasonable prices. The geometry of the parts should not be too complicated. Ideally, the height should be only a fraction of the diameter. Varying elevation within the part can be produced. Bores, grooves and recesses must be in the direction of pressing. Undercuts cannot be pressed. Dimensional tolerances are according to DIN 40680. Closer tolerances can be obtained by grinding after firing.



Slip casting

For the manufacture of simple hollow bodies such as crucibles, dishes or trays, the wall thickness must be exactly the same. Dimensional tolerances are according to DIN 40680. Apart from our laboratory ware, closed end tubes made of Silicon Carbide and Fused Silica Rollers are produced by the slip casting method.

Morgan
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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.**

Morgan Advanced Materials Haldenwanger GmbH
Teplitzer Str. 27
84478 Waldkraiburg, Germany
+49 (0)8638 60 04-0
info@haldenwanger.de

morgantechnicalceramics.com