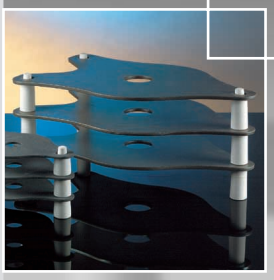
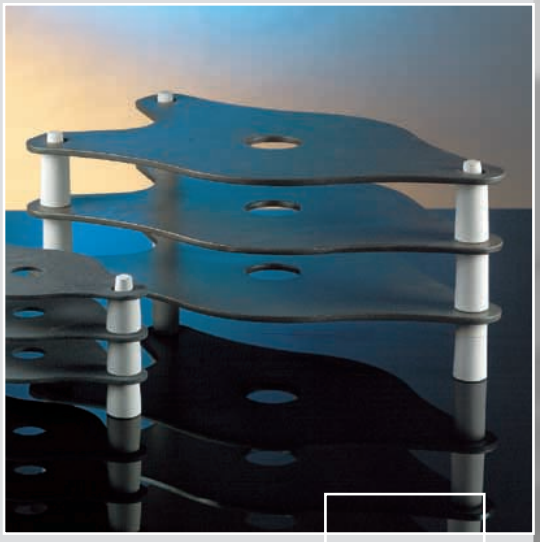
Ceramic Systems

for the
Dinnerware Industry

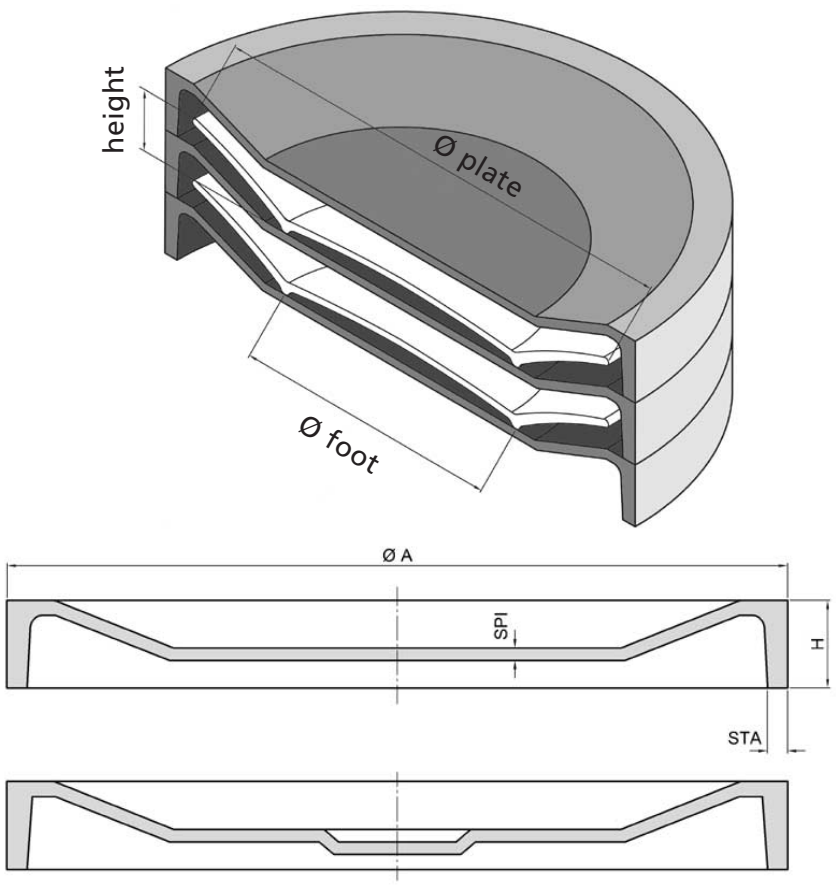




SAINT-GOBAIN
CERAMICS

Saggars for tunnel kilns

For more than 50 years, tunnel kilns have been advancing in the dinnerware industry. Consequently the demand for lighter and economically better kiln furniture arose. The birth of the saggar was announced. Through the development of saggars produced from silicon carbide, the firing of flatware in this application field was revolutionized. The various shapes available as **round** or **oval, flat** or **recessed** with **open** or **closed rims** facilitate the optimum suitability for the product and the firing conditions. Saggars are supplied **with** or **without coatings.**



Material	Outer-diameter A (mm)	to 240	244 to 316	320 to 356	360 to 368	to 400
AnnaCarbid® 42	SPI (mm)	5.0	6.0	7.0	8.0	-
AnnaCarbid® 82/02	SPI (mm)	-	5.0	5.5	6.0	7.0

Typical materials for saggars include: AnnaCarbid® 42 and AnnaCarbid® 82, oxide bonded SiC-materials; Crystar® 2000, recrystallized SiC; and AnnaSicon® RTH nitride bonded silicon carbide. Cast saggars have extremely thin walls (5 - 6 mm) resulting in low **firing mass** and **excellent flatness**. Due to the **high thermal conductivity** and **excellent thermal shock properties** cast SiC is ideal for fast firing kilns.

High performance materials for fast firing technology

Our constructions combined with your fast-fire kiln can help your company reduce costs.
New developments in this application field aim towards automatic loading and unloading of fired products and kiln furniture. Requirements for the realisation of this are fine and light kiln furniture, for better handling during the setting and desetting procedure. This produces requirements for high quality and high performance materials with corresponding customised constructions.

Advantages of SiC fast firing systems:

- Weight reduction through light and fine constructions
- Automatic loading and unloading
- Higher flexibility
- Increased capacity
- Reduced porcelain rejects
- Lower maintenance costs
- Higher service life
- High profitability and efficiency
- Extremely short firing cycle times

Kiln furniture for the fast firing of dinnerware

Our SiC kiln furniture for the dinnerware market is produced through different manufacturing processes according to the conditions of the application. It is possible to make complicated hollow parts through a slip-casting process. Special extrusion machines enable us to maintain tight dimensions of construction components, such as supports, beams and rollers.

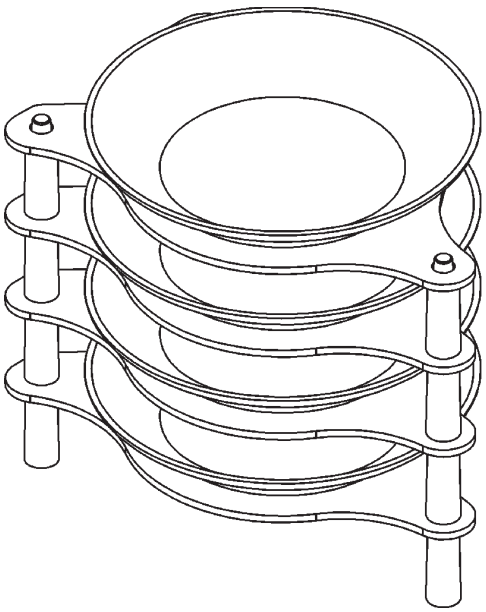
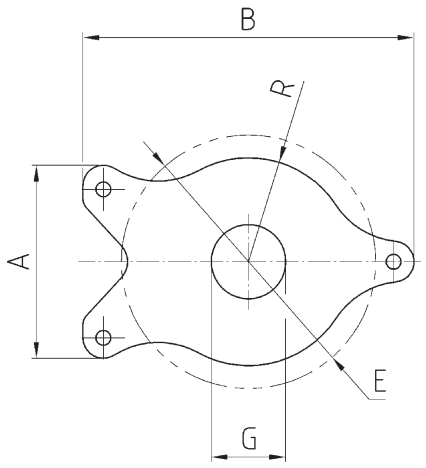


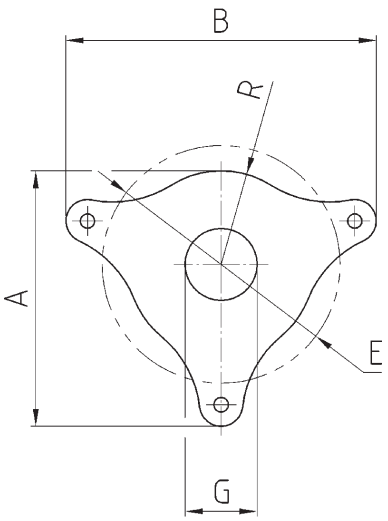
Plate-setters for firing dinnerware

Due to the high-valued properties of our plate-setters in performance and to the excellent flexibility of design, these products are essential for the latest technology of fast firing. The extremely light-weight construction systems for plate-setters were developed to perfect the requirements of an automatic loading system for dinnerware.

Plate-setter TSY and TS
Size E = suitable size according to the diameter of the unfired plate.



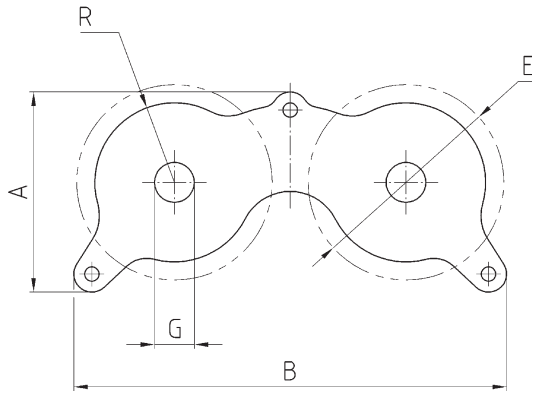
Type	A (mm)	B (mm)	E max. plate Ø (mm)	G (mm)	R (mm)
TSY 150	140	245	150	30 50	70
TSY 175	160	270	175	30 60	80
TSY 215	180	310	215	30 80	90
TSY 250	192	350	250	30 85	96
TSY 270	192	370	270	43 85	100
TSY 290	208	390	290	50 100	110
TSY 310	220	415	310	50 100	120
TSY 340	260	445	340	50 100	140
TSY 360	280	465	360	50 100	150

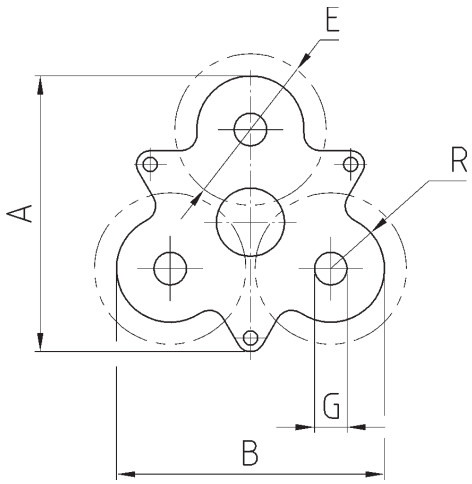


Type	A (mm)	B (mm)	E max. plate Ø (mm)	G (mm)	R (mm)
TS 150	210	250	150	30 50	80
TS 215	250	315	215	30 80	90
TS 240	260	337	240	45 85	87
TS 250	275	345	250	30 85	96
TS 270	285	375	270	43 85	100
TS 290	315	405	290	50 100	110
TS 310	355	430	310	50 100	130
TS 340	370	460	340	50 100	140

Multi plate-setter DTS, TTS and QTS
for 2, 3 and also 4 plates. Size E = suitable size according to the diameter of the unfired plate.

Type	A (mm)	B (mm)	E max. plate Ø (mm)	G (mm)	R (mm)
DTS 170	185	424	170	40	65
DTS 190	197	457	190	45	70,5
DTS 215	217	500	215	45	75
DTS 230	227	525	230	50	80
DTS 250	242	558	250	55	92,5
DTS 270	256	591	270	55	95
DTS 280	266	608	280	55	97,5
DTS 295	277	598	295	55	110
DTS 310	289	627	310	60	120
DTS 340	335	730	340	60	125
DTS 360	352	764	360	80	130





Type	A (mm)	B (mm)	E max. plate Ø (mm)	G (mm)	R (mm)
TTS 170	320	320	170	30	65
TTS 190	345	348	190	40	70
TTS 225	385	411	225	45	80
TTS 240	410	440	240	50	90
TTS 280	455	494	280	55	100
TTS 295	484	526	295	55	105
TTS 325	524	569	325	60	115
TTS 340	547	595	340	60	120

Type	A (mm)	B (mm)	E max. plate Ø (mm)	G (mm)	R (mm)
QTS 190	400	400	190	50	80
QTS 215	430	430	215	55	85
QTS 230	450	450	230	70	90
QTS 280	530	530	280	80	105
QTS 295	555	555	295	80	110
QTS 330	620	620	330	80	125

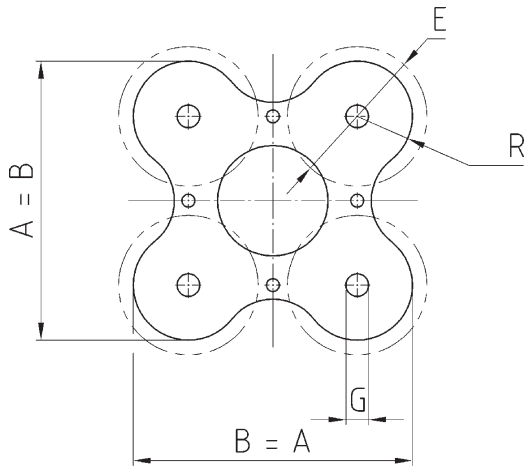
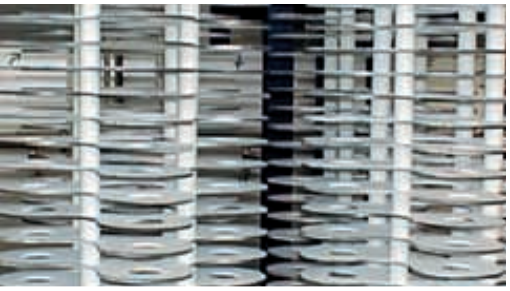
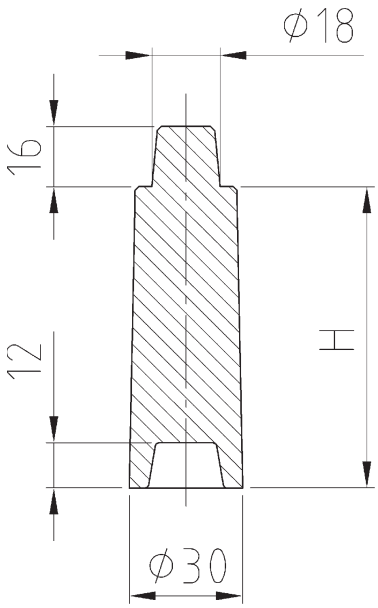


Plate-setter supports TSS in AnnaMullit® 70 for various heights in combination with the respective plate-setters

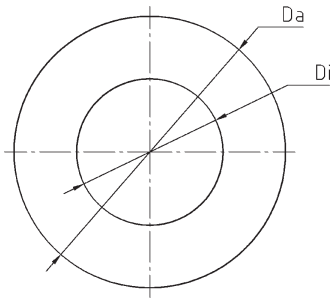


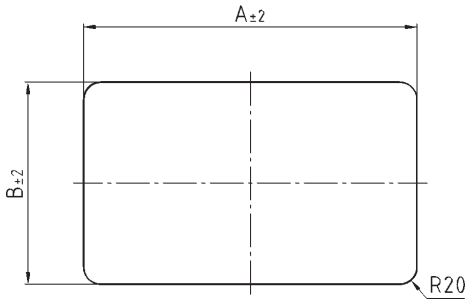


Type	H (mm)
TSS 30	30
TSS 35	35
TSS 40	40
TSS 50	50
TSS 60	60
TSS 70	70
TSS 80	80
TSS 90	90
TSS 110	110

Discs and batts for glost firing

Discs and batts are very thin, available in **square** or **rectangular**, **round** or **oval** shapes; **flat** or **recessed** forms, **with** or **without rims** and **with reinforced edges**. The setting surface of up to 5000 cm² allows an extremely high setting density in combination with a very low kiln furniture weight.





Product	Da (mm)	Di (mm)	A (mm)	B (mm)	d (mm)
Disc	150 - 350	0 - 50	-	-	5 - 12
Batt	-	-	100 - 800	100 - 600	5 - 12

Base batts for biscuit and glost firing

Our nitride bonded Anna-Sicon® 25 and oxide bonded AnnaCarbid® 94 are well-known silicon carbide materials for base batts. Both materials impress with their excellent strength in this application. Base batts for shuttle kilns can be manufactured **with holes, locating nibs** or **coated.**

Product	A (mm)	B (mm)	d (mm)
Base batt	300 - 800	300 - 600	15 - 30

Profiles - Beams - Support Posts for biscuit and glost firing

The use of load-bearing construction components in dinnerware firing systems requires careful and accurate calculations. We are always at your disposal to make these calculations and to ensure the proper cross-section for profiles, beams and supports.We work with all major kiln OEM´s to create new, innovative solutions in close co-operation.

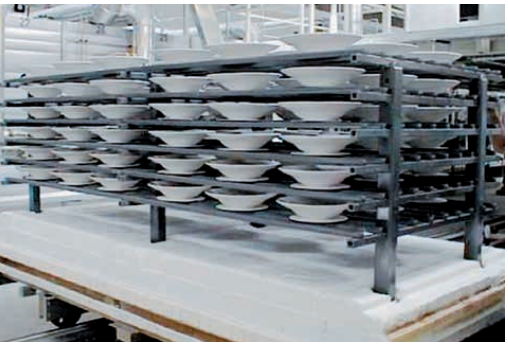
Typical construction components for biscuit and glost firing include:

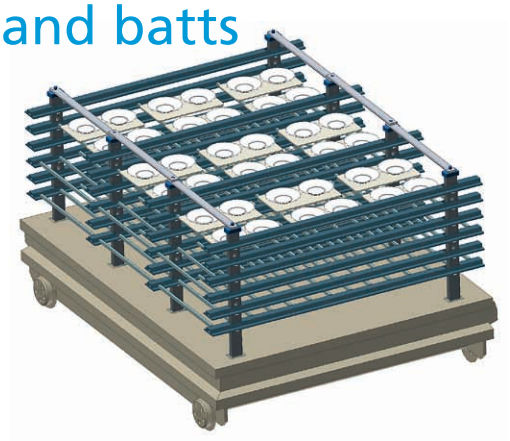
- Multi-lug posts
- Supports with windows
- Profiles
- T-profiles
- T- supports
- H-profiles
- Supporting beams

Typical constructions for firing dinnerware

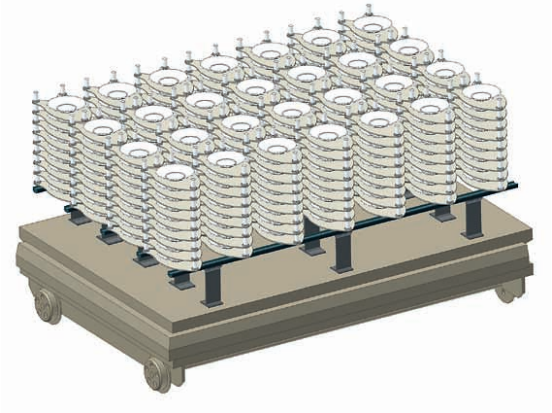
Fast firing systems are designed for one or more levels and feature low mass with high flexibility. The high mechanical strength of SiC components enables the construction of tall, slim systems. Complex support systems, such as multi-lug or supports with windows, offer very tight setting arrangements, according to the multi-lug and window pitch. The batts are not fixed and therefore can be inserted and removed automatically by appropriate handling systems. With other construction types it is possible to move the entire setting stack.

Fast firing system - Construction with beams and batts

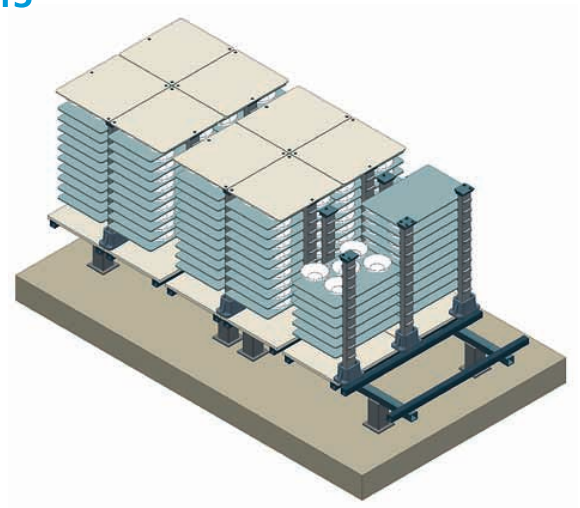




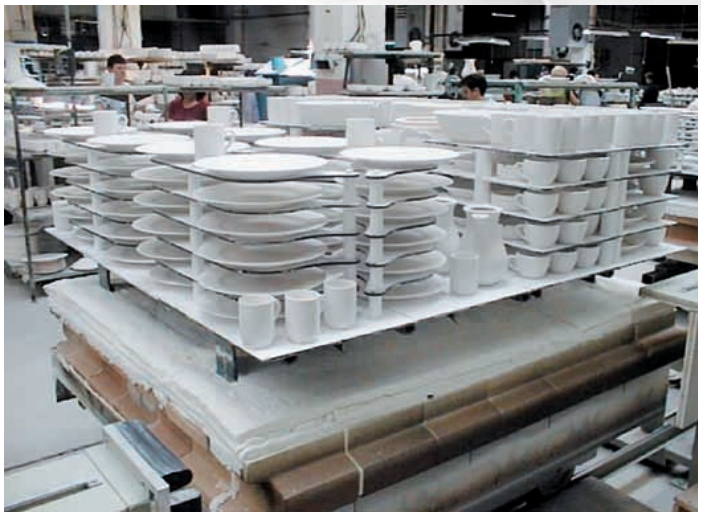
Fast firing system with plate-setters



Fast firing system for shuttle kilns

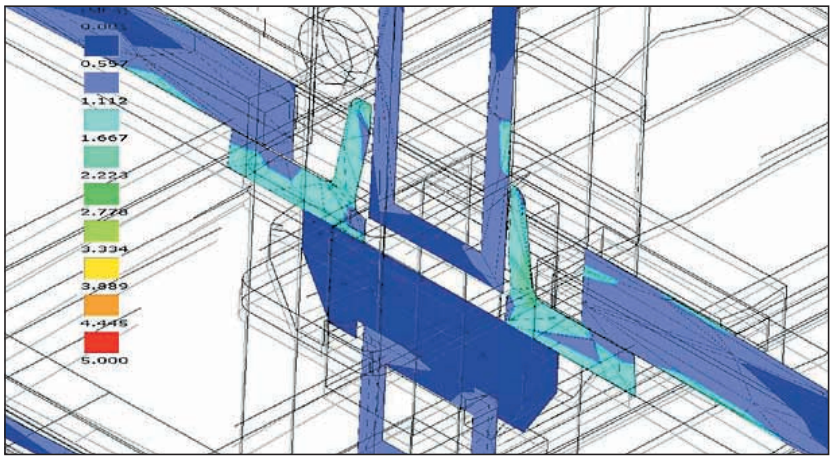


Systems for firing flat and hollow ware



Simulation of stress distribution

For the production of ceramic products, kiln furniture has to meet the current requirements in economical, ecological and even in ergonomic respects. Utilising the potential of modern ceramic materials development, combined with Computer Aided Design (CAD), special tailor-made high-temperature logistic systems have been developed for the firing process of any specific ceramic product. Close co-operation between user, kiln builder and producer of kiln furniture is therefore of great importance.



Material properties

Our materials are made from the hardest of all raw materials existing on the ceramic market - silicon carbide (SiC). The specific chemical composition, purity and ceramic structure of this material fulfil all the conditions for an all-round industrial application. We produce ceramic components made from oxide bonded SiC, R-SiC, N-SiC and SiSiC. The surface of all our ceramic products may be subjected to a treatment of glazing, polishing or grinding.

High performance SiC materials have the following advantages and characteristics:

- Excellent mechanical strength
- Excellent temperature stability
- Excellent chemical resistance
- Excellent thermal conductivity
- Excellent thermal shock resistance
- Excellent oxidation resistance
- Very good shape stability at high temperature

Material properties	Unit	AnnaCarbid® 42	AnnaCarbid® 82/02	AnnaCarbid® 94	AnnaSicon® 25	AnnaMullit® 70
SiC[1)]-content	%	40	70	> 90	75	-
Al_2O_3-content	%	45	-	-	-	75
Max. application temperature[2)]	°C	1430	1450	1500	1550	1550
Bulk density	kg/dm^3	2.5	2.5	2.5	2.6	2.5
Open porosity	Vol %	20	20	18	18	21
Hot bending strength 1400°C	N/mm^2	10	15	20	40	10
Thermal expansion (20°C...1100°C)	$K^{-1} * 10^{-6}$	5.0	5.0	5.0	4.5	5.5

1) in the mixture, 2) dependant on the corresponding operation conditions

Material properties		Unit	AnnaSicon® RT	Silit® SK	AnnaSicon® RTH	Advancer®	Crystar® 2000
SiC-content		%	66	81	66	68	> 99
Max. application temperature[1)]		°C	1200	1350	1550	1550	1600
Bulk density		kg/dm^3	2.8	3.0	2.8	2.8	2.7
Open porosity		Vol %	<1	0	<1	<1	15
Modulus of rupture	20°C	MPa	160	260	160	160	80
	1400°C	MPa	180	260[2)]	180	180	90
Modulus of elasticity	20°C	GPa	235	300	235	250	240
Thermal conductivity	1000°C	W/(m*K)	20	40	20	20	25
Thermal expansion	(20°C...1100°C)	$K^{-1}*10^{-6}$	4.4	4.5	4.4	4.4	4.8

1) dependant on the corresponding operation conditions, 2) measured at T=1200°C

The excellent deformation and contamination resistance of our SiC products lead to an even **higher quality of customer's end product**. Its high thermal conductivity, combined with its extraordinary thermal shock resistance properties, allow **shorter firing cycles**, especially in the dinnerware industry. These advantages, coupled with the long service life of our SiC products, guarantee a **high profitability**.

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