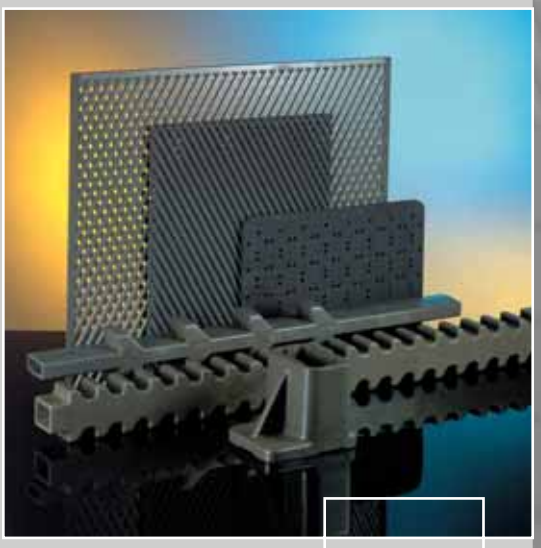
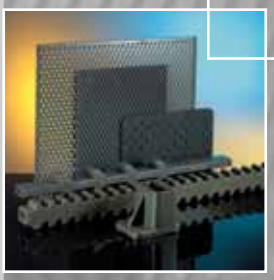
High Performance Products

for

Technical Ceramics





SAINT-GOBAIN

CERAMICS

The requirements of Technical Ceramics are very complex. By successfully using high performance materials from Saint-Gobain Ceramics integrated ceramic systems can be developed for each application field.

Saint-Gobain Ceramics means:

- Creativity
- Know-how
- Service
- Quality
- Innovation
- Research & Development

Improve your profits by using our experience and expertise.









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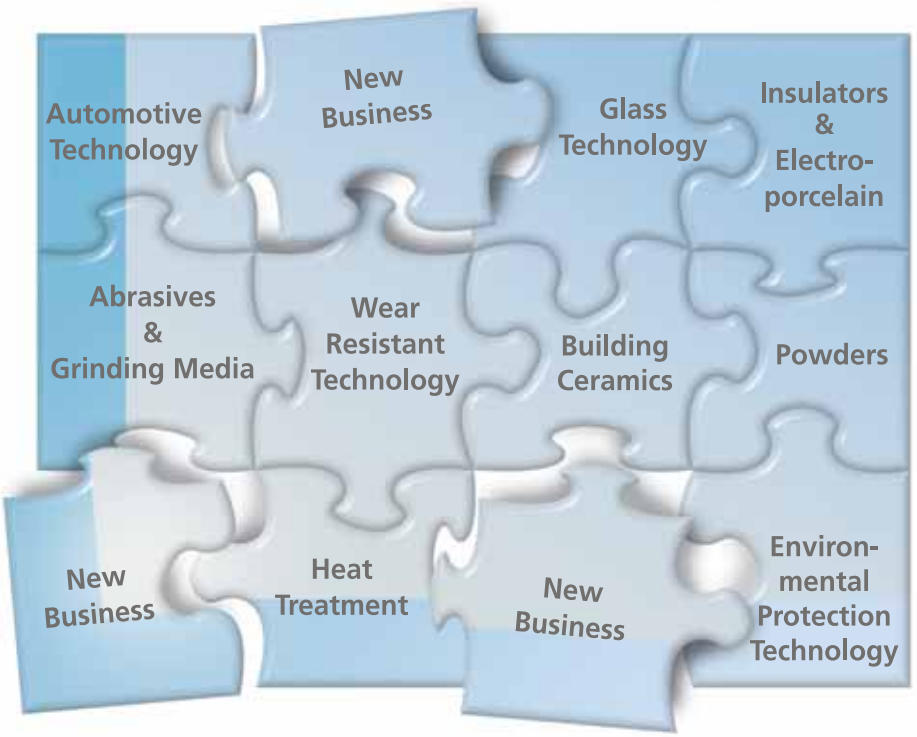
High Performance Materials

High performance materials are destined for the wide ranging and innovative applications in the field of Technical Ceramics. Saint-Gobain Ceramics develops products which fulfill the existing requirements in accordance with lighter, thinner and mechanical superior materials. These high performance products have positive effects on the firing process and offer additional benefits like increasing capacity, faster cycle time, higher service life and reduced reworking costs to the customer.



High performance silicon carbide (SiC) material properties:

- Mechanical strength
- Temperature stability
- Wear resistance
- Chemical resistance
- Excellent thermal conductivity
- Very high thermal shock resistance
- Outstanding oxidation resistance
- Low thermal expansion

AUTOMOTIVE TECHNOLOGY

Catalytic converters
Diesel particle filters (DPF)
Electronic control devices
Lambda sensors
Spark plugs

Batts
Ground batts
Multi-lug systems
Pusher batts
Rollers
Square saggers
Stable substructures

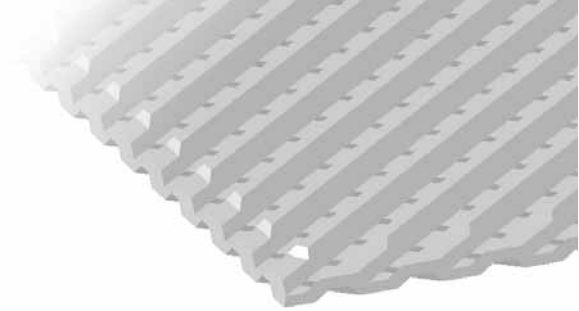
Advancer®
AnnaMullit®
AnnaSicon® RT/RTH
Crystar® 2000/3000
Hexoloy®

Automotive Technology

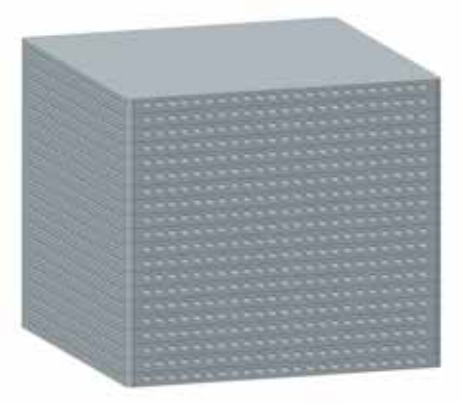
Innovative ceramic systems are often used in the modern automotive market, because of temperature stability and strength. For producing spark plugs, lambda sensors, catalytic converters, antilock braking systems, electronic stability programs and diesel particle filters in the required quality and precision, kiln furniture from high performance materials are absolutely necessary because of their benefits.

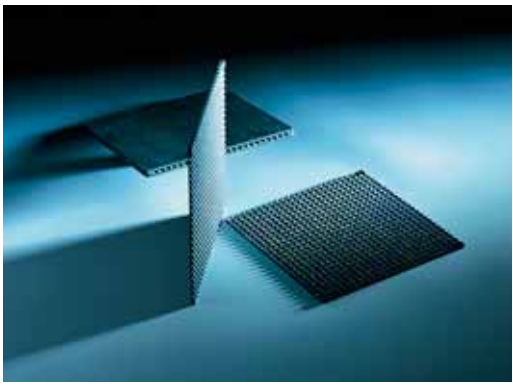
Benefits of Saint-Gobain Ceramics products:

- Excellent thermal conductivity
- Shape stability and strength
- Outstanding thermal shock resistance
- Defined flatness and surface finish

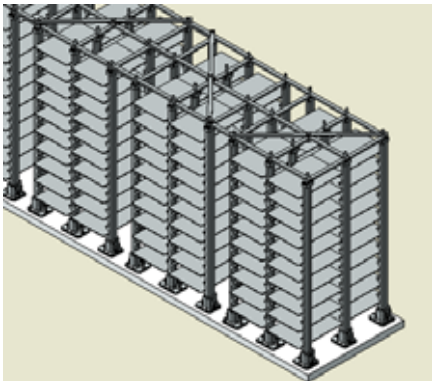


Crystar® 2000 and Crystar® 3000 batts for firing electronic control devices

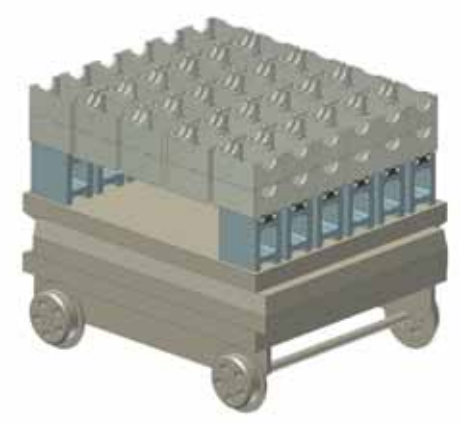




Advancer® Lo-Mass® systems for firing catalytic converters and diesel particle filters



AnnaMullit® square saggers and Hexoloy® high-strength substructure for firing spark plugs



ENVIRONMENTAL PROTECTION TECHNOLOGY

Flue gas desulphurization plants
Power stations

Concentric nozzles
Helix nozzles
Spiral nozzles
Tangential nozzles

Silit® SKG

Environmental Protection Technology

The protection of our environment requires precise product performance and forward-thinking technologies. Due to the excellent resistance to acids, particularly H_2SO_4 or HCL, Silit® SKG spray nozzles are used in current environment protection systems. Silit® SKG spiral nozzles are used for glue gas desulphurization in power stations.

Benefits of Saint-Gobain Ceramics spray nozzles:

- Hardness similar to diamond
- Outstanding chemical resistance
- Excellent wear resistance

Chemical stability of Silit® SKG

Legend:
1 = resistant
2 = limited resistance
3 = very limited resistance

RT = Room Temperature
BP = Boiling Point

Medium		Temperature	Resistance
HCl	20 %	RT / BP	1 / 1
HCl	37 %	RT	1
HNO_3	20 %	RT / BP	1 / 1
HNO_3	100 %	RT	1
H_2SO_4	95 %	RT / BP	1 / 1
Oleum with 10 % free SO_2		RT	1
HF	20 %	RT	3
HF	40 %	RT	3
H_3PO_4	85 %	RT / BP	2 / 2
H_2CrO_4	20 %	RT / BP	1 / 1
NaCl	10 %		
NaCl	30 %	RT / BP	1 / 1
KCl	10 %		
KCl	30 %	RT / BP	1 / 1
$KMnO_4$	10 %	RT / BP	1 / 1
NaOH	10 %	RT / BP	2 / 3
NaOH	30 %	RT / BP	3 / 3
KOH	10 %	RT / BP	2 / 3
KOH	30 %	RT / BP	3 / 3
Sn Melting		300 °C	1 - 2
Pb Melting		450 °C	1 - 2
Zn Melting		550 °C	1 - 2
Al Melting			2 - 3
Cu Melting			3
Ni Melting			3
Fe Melting			3
NH_4OH		RT / BP	2 / 2

Spray nozzles made from Silit® SKG

Emission of flue gas

User specified spiral nozzles

Spiral nozzles in use

Results:

- Clean air
- Reduce acid rain
- Plaster as a recycled product

WEAR RESISTANT TECHNOLOGY

Furnace construction
Metal forming
Plant construction
Pump technology
Wear resistant technology

Batts
Diverse single components
One-piece linings
Rail and shelf systems
Supports

Crystar® 2000/3000
Hexoloy®
Silit® SKD

Wear Resistant Technology

Wear is the mechanical attack of a subject on a solid substance. In addition to wear effects caused by abrasion and erosion, further losses can be attributed to chemical corrosion of industrial equipment. Each year industry suffers high costs due to wear, maintenance operations and production losses.

Benefits of Saint-Gobain Ceramics products:

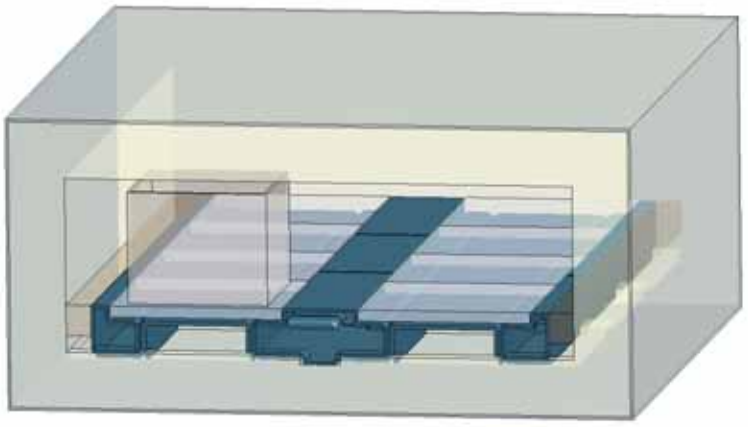
- Longer service life
- Increased productivity
- Improved production safety
- Improved quality and yield
- Outstanding chemical resistance
- Excellent wear resistance

Conventional lining with rectangular or hexagonal wear resistant batts

Silit® SKD one-piece lining

Diverse products made of Silit® SKD and Hexoloy® for wear resistance

Crystar® 2000 and Crystar® 3000 Lo-Mass® system for firing wear resistant products



Silit® SKD rail and shelf system

BUILDING CERAMICS

Chimney flues
Clay bricks
Floor tiles
Roof tiles
Split tiles
Stoneware pipes

Batts
Beams
Bricks
Extrusion dies
Heavy load constructions
H-saggers
Monolithic support systems
Rollers
Supports

Advancer®
Alfrax®
Alundum®
AnnaCarbid® 94
AnnaCorit® 50/60
AnnaSicon® 25
AnnaSicon® RT
Mullfrax®
Silit® SK/SKD

Building Ceramics

For the production of roof tiles, wall bricks, split tiles, and floor tiles, the use of high performance materials offer the following advantages:

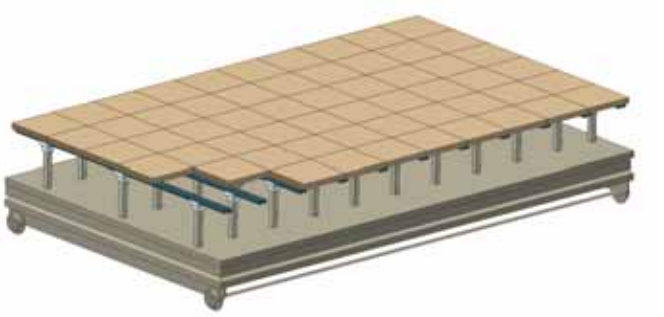
Advantages of Saint-Gobain Ceramics products:

- Reduced energy consumption
- Optimum rate of capacity utilization
- High flexibility
- Excellent product quality
- Very good creep resisance
- Outstanding shape stability

Silit® SK rollers for firing floor tiles

Heavy-load constructions made of AnnaSicon® 25 for hang firing of rollers

Silit® SK stable substructures for firing wall bricks and split tiles



Monolithic support system for realization single level superstructures

Beams out of Silit® SK and AnnaSicon® RT for firing roof tiles

INSULATORS & ELECTROPORCELAIN

Capacitors
Electrically insulated devices
Ferrites
High-voltage insulators
Low-voltage insulators
Substrates
Varistors

Beams
Collar batts
Batts
Rollers
Heavy load constructions
Square saggers
Supports

Advancer®
Alundum®
AnnaCarbid® 42/94
AnnaMullit® 83/86/88
AnnaSicon® 25
Crystar® 2000/3000
Silit® SK

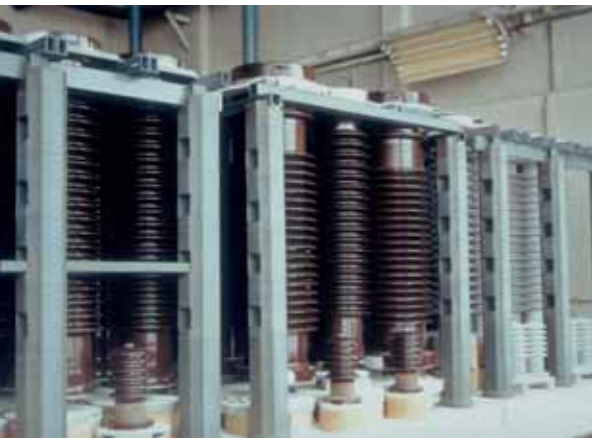
Insulators & Electroporcelain

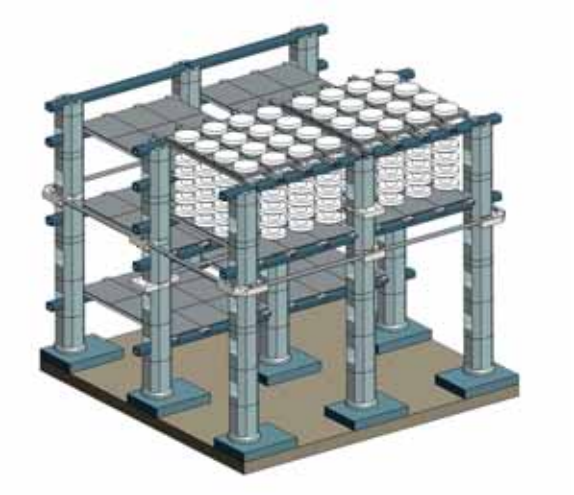
Saint-Gobain provides kiln furniture for the firing of ferrites, capacitors, substrates, insulators, varistors, capacitors and several other electronical components.

Benefits of Saint-Gobain Ceramics products:

- High stability and strength
- Excellent thermal shock resistance
- Outstanding thermal conductivity
- High productivity
- Excellent oxidation resistance

Heavy-load construction out of AnnaSicon® 25 for hang firing of insulators

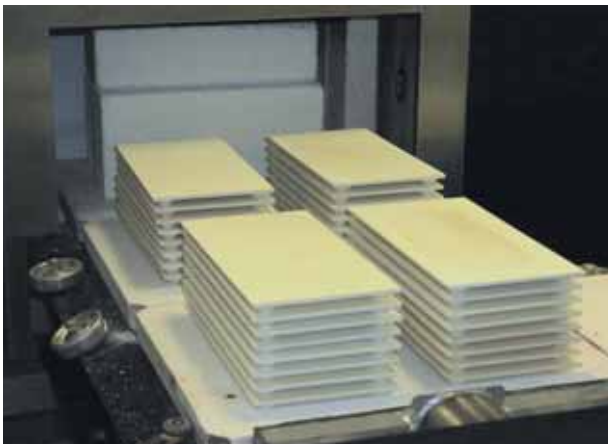




Square saggers made of AnnaCarbid® for firing electronical components

Batts with covers made of Crystar® 2000 for sintering bulk solids

Batts out of silicon carbide and mullite for firing electronic devices



Construction for firing electronic components consisting of AnnaMullit® 83 square saggers and batts made of Advancer®

AnnaMullit® 86 batts for firing ferrites

ABRASIVES & GRINDING MEDIA

Grinding balls
Grinding wheels

Batts
Beams
Pusher batts
Square saggers
Supports
Triangle batts

Advancer®
AnnaCarbid® 42/94
AnnaMullit® 83/88
AnnaSicon® 25
AnnaSicon® RTH
Crystar® 2000
Crystolon®
Cryston®

Abrasives & Grinding Media

For the production of grinding wheels and grinding balls Saint-Gobain Ceramics provides complete constructions as well as firing saggers and frames.

Benefits of Saint-Gobain Ceramics products:

- High shape stability and creep resistance
- Very good thermal conductivity
- Excellent thermal shock resistance
- High oxidation resistance

Constructions for firing grinding wheels

Kiln furniture for sintering grinding media

POWDERS

Coloured pigments
Phosphorous powders

Hearth plates
Pusher batts
Saggers
Square saggers

AnnaSicon® 25
AnnaSicon® RTH
Crystar® 2000
Silit® SKD

Powders

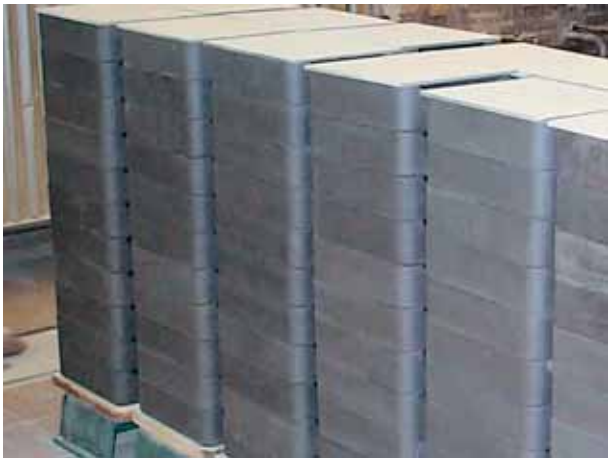
Silicon carbide saggers and bowls for the firing, sintering, heat treating and analysis of pulverized materials, e.g. phosphorous and fluorescent powders. The often neutral chemical reaction and the thermal shock resistance of silicon carbide allows extremely high temperature profiles, which will be fulfilled by another material in addition with a long service life.

Benefits of Saint-Gobain Ceramics products:

- High stability and strength
- Excellent thermal conductivity
- Very good chemical resistance
- Outstanding thermal shock resistance

Bowls and saggers made of Silit® SKD and AnnaSicon® RTH

Stackable square saggers with lids made of Silit® SKD



GLASS TECHNOLOGY

Flat glass
Flat screens
Glass ceramic cooktops

Annealing constructions
Rollers

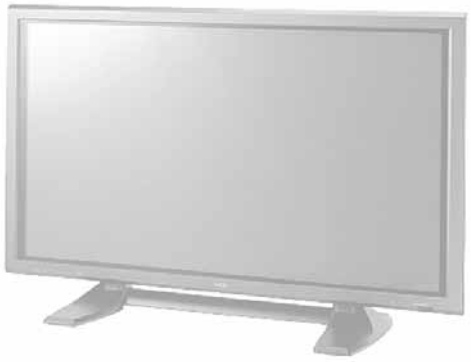
Advancer®
Alundum®
AnnaSicon® RT/RTH
Hexoloy®
Silit® SK

Glass Technology

Large roller kilns are used for the horizontal tempering of large glass plates for flat screens or glass ceramic cooktops. In the high temperature zone these roller kilns are predominantly equipped with black silicon carbide rollers.

Benefits of Saint-Gobain Ceramics products:

- Slight bending over the whole temperature range
- Outstanding temperature stability
- Excellent thermal conductivity
- High strength and shape stability



Silicon carbide rollers for horizontal tempering of glass plates

Silicon carbide multiple construction for vertical tempering of glass plates

HEAT TREATMENT

Heat treatment
Surface refinement

Batts
Beams
Bricks
Hearth plates
Muffles
Muffle systems

Alundum®
Crystar® 2000
Crystolon®
Cryston®
Hexoloy®
Silit® SK/SKD

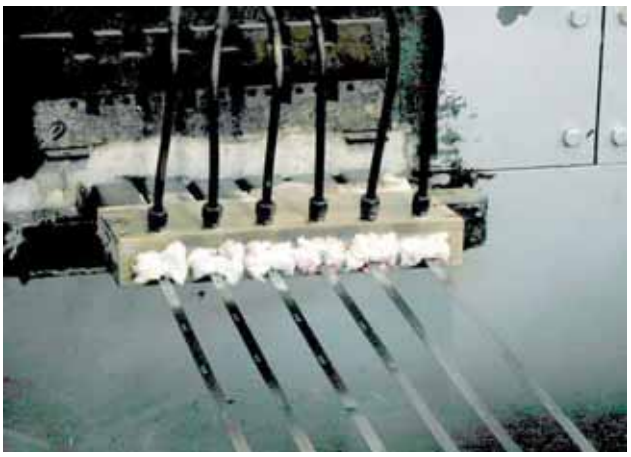
Heat Treatment

Heat treatment processes are frequently running in mesh belt kilns in atmosphere. Here SiC high performance materials are convincing by the use of muffle channels as well as kiln furniture for hardening razor blades or carpet knives.

Benefits of Saint-Gobain Ceramics products:

- Very good temperature stability up to max. application temperature
- Excellent chemical resistance
- Outstanding strength

Silit® SKD ceramic muffle system for the heat treatment of razor blades



Silit® SK one-piece muffle beam for the heat treatment of carpet cutters

Material Properties

Products from Saint-Gobain Ceramics are manufactured out of multitude refractory raw materials. However main part is silicon carbide (SiC), predominantly made from one of the hardest of all raw materials existing on the ceramic market. The specific chemical composition, purity and ceramic structure of this material fulfill all the conditions for an all-round industrial application.

Typical material properties	Unit	AnnaCorit®		AnnaMullit®				Mullfrax®	Alundum®	Alfrax®
		50	60	70	83	86	88	202		B201
Al_2O_3-content	%	37	58	75	86	75,5	82	89	91.3	88.4
Max. service temperature [2]	°C	1280	1350	1550	1500	1450	1750	1750	1750	1815
Bulk density	kg/dm³	1.9	2.1	2.5	2.6	2.4	2.75	2.8	2.9	1.7
Open porosity	%	27	26	21	23	22.5	16	19	20	54
Hot bending strenght (at 1400 °C)	N/mm²	13[3]	13[3]	10	11	7	10	4.5	-	-
Thermal expansion (20 °C….1100 °C)	$K^{-1}\cdot10^{-6}$	2.9	2.9	5.5	6.0	5.3	5.3	6.0	-	7.3

Typical material properties	Unit	AnnaCarbid®		AnnaSicon®	Crystolon®	Cryston®
		42	94	25	CN192	CN159
SiC-content [1]	%	40	>90	75	88	80
Max. service temperature [2]	°C	1430	1500	1550	1500	1550
Bulk density	kg/dm³	2.5	2.5	2.6	2.6	2.6
Open porosity	%	20	18	18	18	15
Hot bending strenght (at 1400 °C)	N/mm²	10	20	40	20	55
Thermal expansion (20 °C….1100 °C)	$K^{-1}\cdot10^{-6}$	5.0	5.0	4.5	5.8	5.0

Typical material properties		Unit	Silit®			AnnaSicon®		Advancer®	Crystar®		Hexoloy®
			SK	SKG	SKD	RT	RTH		2000	3000	SA
SiC-content		%	81	81	88	66	66	68	>99	>99	~99
Max. service temperature[2]		°C	1350	1320	1380	1200	1550	1550	1600	1600	1750
Bulk density		kg/dm³	3.0	3.0	3.05	2.8	2.8	2.8	2.7	2.7	3.07
Open porosity		Vol %	0	0	0	<1	<1	<1	15	15	0,6
Modulus of rupture	20 °C	MPa	260	320	250	160	160	160	80	80	380
	1400 °C	MPa	260[3]	320[3]	250[3]	180[3]	180	180	90	90	370
Modulus of elasticity	20 °C	GPa	300	380	360	235	235	250	240	240	350
Thermal conductivity	1000 °C	W/(m·K)	40	35	35	20	20	20	25	25	30
Thermal expansion (20 °C…1100 °C)		$K^{-1}\cdot10^{-6}$	4.5	4.1	4.1	4.4	4.4	4.4	4.8	4.8	4.0

1) in the mixture 2) dependant on the corresponding operation 3) measured at T=1200 °C

The excellent deformation resistance of our SiC products in the different fields of Technical Ceramics leads to an even higher quality of customer's end product. Its high thermal conductivity, combined with its extraordinary thermal shock resistance properties, allow excellent results. These advantages, coupled with the long service life of our SiC products, guarantee a high profitability.

Quality Assurance and Quality Control

In order to meet customer requirements at Saint-Gobain Ceramics, all of the single production steps are supervised and continuously improved. All products are checked carefully before shipment. The strong demands on quality and environmental protection are based on our management system, which fulfill the requirements of DIN EN ISO 9001 and DIN EN 14001.

Quality Control:

- Measurement of roller deflection
- Measurement of the maximum bending
- Strength and load capacity testing and control
- Control of tightness
- Checking of flatness and parallelism
- Determination of gas permeability
- Product dimensions meet blueprint specifications

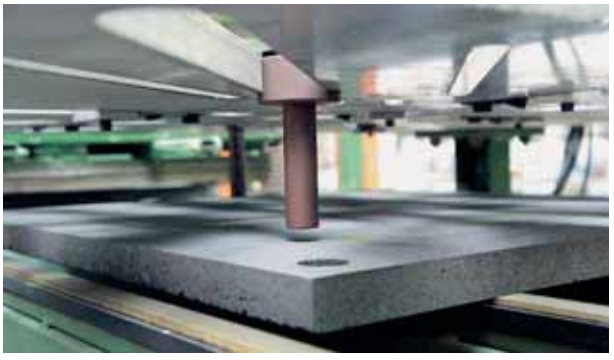
In coordination with our customer corresponding certificates and inspection sheets will be drawn up and shipped with the goods.

Dimensional inspection

Measurement of the maximum deflection

Inspection of strength sustaining components with load

Proximity measurement of flatness at planar components



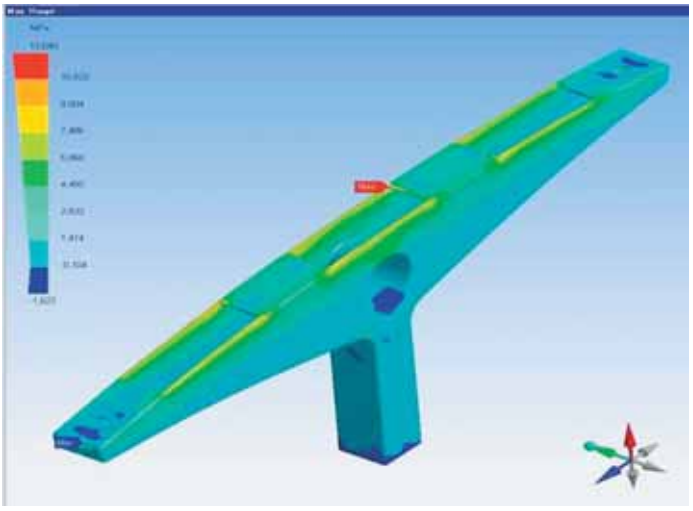
Saint-Gobain Ceramics strives for innovation and leadership in the fast-paced and ever-advancing field of technical ceramics.

Laser test equipment for rollers (Deflection/Bending)

Numeric controlled measuring device for complex components

Simulation of stress distribution of a monolithic supporting system made of Silit® SKD

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.



Standard Dimensions

Feasible dimensions and tolerances of SILIT® SK beams and profiles*				
Dimensions		Tolerance X mm	Wall thickness s mm	Max. Length mm
Height H ± X mm	Width B ± X mm			± 2
20	20	± 1.0	6.0	1500
25	25	± 1.0	6.0	2000
30	20	± 1.0	6.0	2000
30	30	± 1.0	6.0	2000
35	35	± 1.0	6.0	2000
40	20	± 1.0	6.0	2000
40	30	± 1.0	6.0	3000
40	40	± 1.0	6.0	3500
50	30	± 1.0	6.0	3000
50	40	± 1.0	6.3	3500
50	50	± 1.0	6.3	3500
50.8	44.5	± 1.0	6.3	2700
60	40	± 1.0	6.8	3500
60	50	± 1.2	6.8	3500
60	60	± 1.2	7.3	3500
70	50	± 1.4	7.5	2500
76,2	38.1	± 1.4	7.5	2500
80	40	± 1.4	8.0	2500
80	60	± 1.4	8.5	2500
80	80	± 1.4	9.0	2500

Feasible dimensions and tolerances of Advancer® beams and profiles*			
Dimensions		Wall thickness s +3/-0 mm	Max. Length L ± 2 mm
Height H ± 1.5 mm	Width B ± 1.5 mm		
20	20	4	1300
30	20	5	2000
30	30	5	2000
40	20	5	2000
40	30	5	2000
40	40	6	2800
50	30	6	2500
50	40	6	2800
50	50	6	2800
60	40	6	2800
60	50	6	3200
60	60	6	3200
70	40	6	2800
70	50	6	3200
70	60	6	3200
80	50	6	3200
80	60	7	3000
80	80	7	3000
90	50	7	2500
100	60	7	2500
110	50	7	2500
110	60	7	2500

*Technical data, right of modification reserved

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SAINT-GOBAIN
CERAMICS

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Saint-Gobain IndustrieKeramik Rödental
is a global business, integrated in the Compagnie de Saint-Gobain, Paris, France. Compagnie de Saint-Gobain is an international business group located in 46 countries. The company is one of the 100 largest industrial companies in the world and has a leading position in all its strategic business areas.

Saint-Gobain IndustrieKeramik Rödental
has more than 100 years of experience in the production of high performance materials and is world-wide respected in all well-known business fields with all its brand names.

Saint-Gobain IndustrieKeramik Rödental
has a strong customer-service orientation and operating philosophy. We pride ourselves on our ability to partner with our customer and to provide high performance materials.