



Hexoloy® Silicon Carbide  
Noralide® Silicon Nitride  
Ceramic Materials

# High Performance Mechanical Seals



Refineries



Mixers



Nuclear Power Plants



Refrigeration compressors



## Hexoloy® SiC – Your Mechanical Seal Face Material Solution

Saint-Gobain Ceramics offers a family of Hexoloy® sintered alpha silicon carbide grades, providing high performance seal face materials that have proven successful in such diverse applications as automotive water pumps, chemical processing, refining, mining, pulp and paper processing, mixers, and refrigeration.

**No other commercially available seal material offers the performance package Hexoloy SiC provides.**

The advantages of Hexoloy SiC include:

- As the hardest commercially available seal face material, it provides wear resistant, long service life.
- Its universal corrosion resistance offers a seal face material with unlimited application potential.
- Low friction and high strength characteristics result in superior high PV performance.
- It has high thermal conductivity for excellent thermal shock resistance.
- Net shape manufacturing capabilities eliminate costly machining operations.
- Hexoloy SP's unique spherical pore based lubrication delivers excellent hard face vs. hard face performance.
- The material's low density (one-fifth of tungsten carbide) results in low power consumption in high speed applications.



Mechanical seal faces

Whether the application involves exposure to corrosive environments, abrasives, high temperatures and pressures, or high speeds, Hexoloy sintered alpha silicon carbide will outperform other hard face materials including fine-grained, reaction bonded SiC and tungsten carbide.



Your application – where hardness, strength or resistance to heat, corrosion or wear is required

# There's a Hexoloy® SiC Material for your application

## Hexoloy SA Silicon Carbide

Hexoloy SA SiC is a pressureless, sintered form of alpha silicon carbide, with a density greater than 98 percent theoretical. It has a very fine grain structure (less than 10µm) for excellent wear resistance and contains no free silicon, which makes it highly chemically resistant in both oxidizing and reducing environments. The combination of fine grain structure and universal corrosion resistance results in a hard face material with excellent performance in a wide range of applications.

- Hexoloy SA outperforms tungsten carbide, aluminum oxide and reaction bonded SiC in all chemical environments.

## Hexoloy SP Silicon Carbide

Hexoloy SP SiC is a sintered alpha silicon carbide material designed specifically for optimum performance in sliding contact applications such as pump seal faces. This material improves upon the exceptional corrosion and erosion resisting properties of Hexoloy SA SiC through the addition of unique spherical pores. These discrete, evenly dispersed pores act as fluid or lubricant reservoirs helping to promote the retention of a fluid film at the interface of sliding component surfaces. (Reference Hexoloy SP SiC performance charts)

- Hexoloy SP outperforms hard face materials in the critical areas of friction and wear against a typical carbon mating face.
- Hexoloy SP provides the optimal solution for severe applications requiring hard on hard seal face combinations (SP vs. SP).

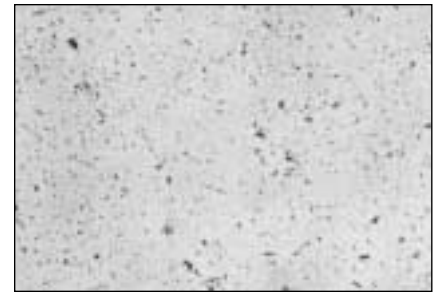
## Corrosion Test Results in Liquids

Test Environment*		Corrosive Weight Loss (mg/cm² yr)**			
Conc. Reagent	Temp.	Hexoloy® SA/SP (No Free Si)	Reaction Bonded SiC (12% Si)	Tungsten Carbide (6% Co)	Aluminum Oxide (99%)
(Wt%)	(°C)				
98% H <sub>2</sub> SO <sub>4</sub>	100	1.8	55.0	>1000	65.0
50% NaOH	100	2.5	>1000	5.0	75.0
53% HF	25	<0.2	7.9	8.0	20.0
85% H <sub>3</sub> PO <sub>4</sub>	100	<0.2	8.8	55.0	>1000
70% HNO <sub>3</sub>	100	<0.2	0.5	>1000	7.0
45% KOH	100	<0.2	>1000	3.0	60.0
25% HCl	70	<0.2	0.9	85.0	72.0
10% HF plus 57% HNO <sub>3</sub>	25	<0.2	>1000	>1000	16.0

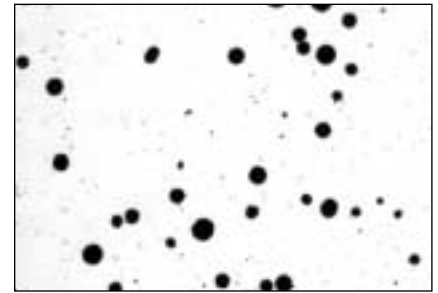
\* Test Time: 125 to 300 hours of submersive testing, continuously stirred.

### \*\*Corrosion Weight Loss Guide:

- >1000 mg/cm² yr Completely destroyed within days
- 100 to 999 mg/cm² yr Not recommended for service greater than a month
- 50 to 100 mg/cm² yr Not recommended for service greater than one year
- 10 to 49 mg/cm² yr Caution recommended, based on the specific application
- 0.3 to 9.9 mg/cm² yr Recommended for long term service
- <.2 mg/cm² yr Recommended for long term service: no corrosion, other than as a result of surface cleaning was evidenced.



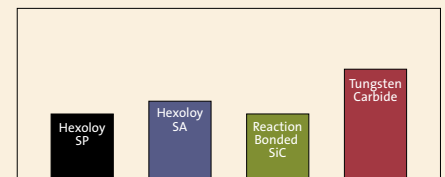
Photomicrograph of Hexoloy SA SiC (200x)



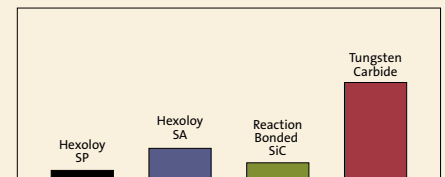
This photomicrograph shows the typical appearance of Hexoloy SP pores (50x).

## Hexoloy SP SiC Performance

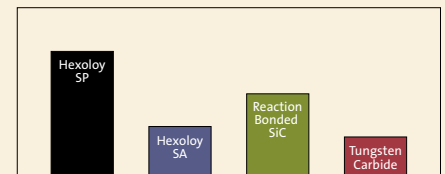
Relative Coefficient of Friction vs. Carbon



Relative Wear of Carbon Mating Face



Relative PV Limit Self-Mated



## Compare Hexoloy® SiC to Other Common Seal Face Materials

Testing shows that Hexoloy SiC outperforms other common seal face materials in properties such as hardness, thermal conductivity and specific strength.

**Some examples of how Hexoloy SiC solves application requirements.**

**Automotive Water Pumps** – Because of greater resistance to both wear and thermal shock, Hexoloy SiC has replaced aluminum oxide as the material of choice for automotive water pump seal faces, one of the most challenging hard-on-hard applications. Over 20 million units are sold annually to meet the demands of U.S. and European automakers.

**Chemical Processing** – Hexoloy SiC provides a universal solution for many applications in the chemical processing industry where corrosion resistance and high temperature resistance are critical in such demanding environments.

**Oil Refineries** – Hexoloy SP is the ideal solution for oil refinery applications where limited lubrication situations occur. Hexoloy SP provides exceptional low friction properties while retaining universal corrosion resistance.

**Industrial Applications** – Net shape moldable Hexoloy SiC offers a high performance, cost-effective seal face solution for high volume general purpose industrial pump seals.

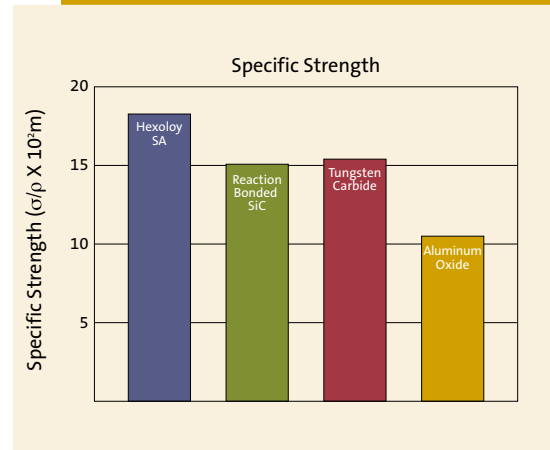
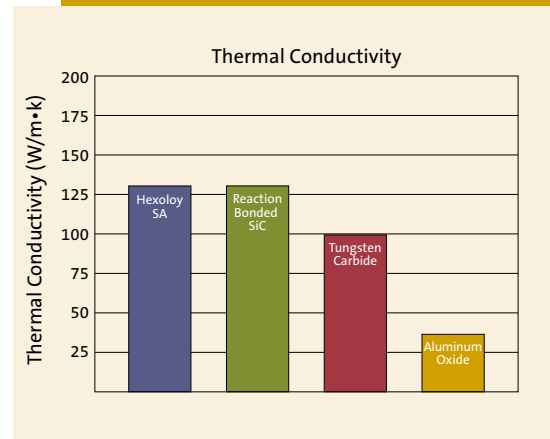
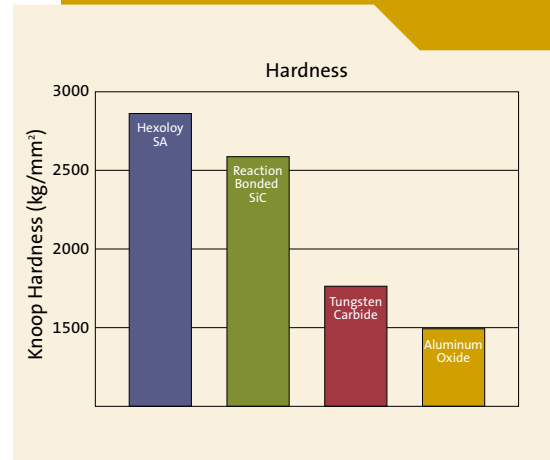
**Special Applications** – Hexoloy SiC can be applied in critical seal face applications such as high speed compressors and nuclear reactor cooling water pumps.

**Your Applications** – Contact Saint-Gobain Ceramics engineers to assist you in the design of a seal face solution for your seal needs.

**Hexoloy SiC the way you need it.**

Saint-Gobain Ceramics, Structural Ceramics Group, supplies both Hexoloy SA and Hexoloy SP as:

- Finished components
- Unfinished tubes and machined blanks
- Pressed near net shape blanks
- High volume pressed net shape components
- Complex, highly machined parts



## Material Properties – Typical Values

Property	Units	Hexoloy SA SiC	Hexoloy SP SiC	Hexoloy Enhanced®SA	Noralide® NBD-200 Si <sub>3</sub> N <sub>4</sub>
Composition*	–	SiC	SiC	SSiC	Si•N
Grain Size	µm	4-10	4-10	4-10	<2
Density	g/cm <sup>3</sup>	3.10	3.04	3.13	3.18
Hardness (Knoop 0.1 kg load)	kg/mm <sup>2</sup>	2800	2800	2800	N/A
Hardness (Vickers 10 kg load)	GPa	N/A	N/A	N/A	16
Flexural Strength 4 pt @ RT**	MPa x10 <sup>3</sup> lb/in <sup>2</sup>	380 55	240 35	428 62	800 –
Compressive Strength @ RT	MPa x10 <sup>3</sup> lb/in <sup>2</sup>	3900 560	N/A	3900 560	3500 –
Modulus of Elasticity @RT	GPa x10 <sup>6</sup> lb/in <sup>2</sup>	410 59	400 58	410 59	320 –
Weibull Modulus (2 parameters)		8	19	12	N/A
Poisson Ratio		0.14	0.14	0.14	N/A
Fracture Toughness @ RT Double Torsion & SENB	MPa x m <sup>1/2</sup> x10 <sup>3</sup> lb/in <sup>2</sup> x in <sup>1/2</sup>	4.60 4.20	4.3 3.9	4.60 4.20	– –
Fracture Toughness @ RT Indentation	MPa x m <sup>1/2</sup>	–	–	–	4.1
Coefficient of Thermal Expansion RT to 700°C	x10 <sup>-6</sup> mm/mmK x10 <sup>-6</sup> in/in °F	4.02 2.20	4.2 2.3	4.02 2.20	2.9*** –
Maximum Service Temp. Air	°C °F	1900 3450	1900 3450	1900 3450	N/A
Mean Specific Heat @ RT	J/gmK	0.67	0.59	0.67	N/A
Thermal Conductivity @ RT	W/mK Btu/ft h °F	125.6 72.6	110 64	125.6 72.6	N/A
@ 100°C	W/mK Btu/ft h °F	N/A N/A	N/A	N/A	29
@ 200°C	W/mK Btu/ft h °F	102.6 59.3	N/A	102.6 59.3	N/A
@ 400°C	W/mK Btu/ft h °F	77.5 44.8	N/A	77.5 44.8	N/A
Permeability @ RT to 1000°C		Impervious to gases over 31 MPa			
Electrical Resistivity @ RT**** @ 1000°C	ohm-cm ohm-cm	10 <sup>2</sup> -10 <sup>8</sup> 0.01-0.2	N/A	10 <sup>2</sup> -10 <sup>8</sup> 0.01-0.2	>10 <sup>12</sup>
Emissivity		0.9	0.9	0.9	N/A
Pore Volume Fraction	%	N/A	4.0-6.0	N/A	N/A
Pore Size (Typical)	µm	N/A	50	N/A	N/A

\*Composition code: Si = free silicon metal;  
C = free graphite; SiC = silicon carbide;  
N = nitrogen; Si<sub>3</sub>N<sub>4</sub> = silicon nitride

\*\*\*RT to 1000°C

\*\*\*\*Dependent upon dopants in Hexoloy® SA  
SiC which will decrease electrical resistivity

\*\*Test Bar Size: 3 x 4 x 45 mm  
(0.118" x 0.157" x 1.772")



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#### **Your Source for Cost-Effective Hexoloy SiC...Worldwide.**

Saint-Gobain Ceramics offers vast resources to meet your needs for silicon carbide products. With representation in Asia by Norton KK (a Saint-Gobain company) and locations in Europe, Australia and South America, we can deliver your solution when you need it, where need you need it, in virtually every corner of the world.

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