# Hexoloy® SA Silicon Carbide

## Technical Data

Hexoloy® SA SiC is produced by pressureless sintering submicron silicon carbide powder. The sintering process results in a self-bonded, fine grain (less than 10µm) SiC product which is extremely hard, lightweight and low in porosity. The material can be formed into complex shapes with greater than 98% theoretical density. Hexoloy® SA SiC is highly resistant to corrosion, erosion, sliding wear, high temperature and thermal shock.

### Corrosion Resistance

The corrosion resistance of Hexoloy® SA SiC permits superior performance in environments of hot gasses and liquids including strong acids and bases, even at extremely high temperatures. The results (below) indicate that by comparison Hexoloy® SA SiC outperforms tungsten carbide and aluminum oxide in all chemical categories.

The ability of Hexoloy® SA SiC to resist corrosion along with its excellent surface finish characteristics makes it ideally suited to applications involving heat exchangers, mechanical seal faces, valves, bearings and other mineral and chemical processing equipment components.

### Corrosion Test Results in Liquids

| Test Environment* | | Corrosive Weight Loss ($mg/cm^2yr$)** | | | |
|---|---|---|---|---|---|
| Conc. Reagent (Wt%) | Temp. (°C) | Hexoloy® SA (No Free Si) | Reaction Bonded SiC (12% Si) | Tungsten Carbide (6% Co) | Aluminum Oxide (99%) |
| 98% $H_2SO_4$ | 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% $H_3PO_4$ | 100 | <0.2 | 8.8 | 55.0 | >1000 |
| 70% $HNO_3$ | 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% $HNO_3$ | 25 | <0.2 | >1000 | >1000 | 16.0 |

*__Test Time:__ 125 to 300 hours of submersive testing, continuously stirred.

**__Corrosion Weight Loss Guide:__

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

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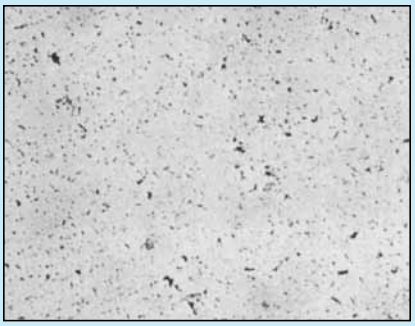
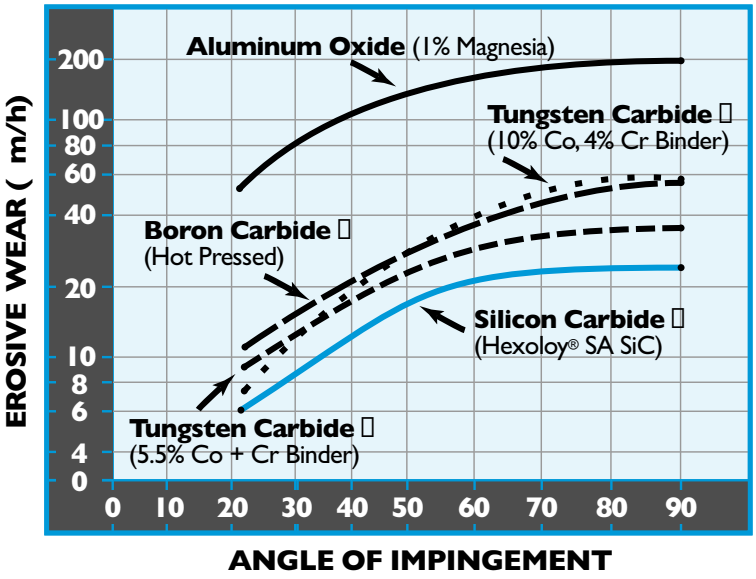


Photomicrograph of Hexoloy® SA Silicon Carbide (200x).

## Erosion Resistance




Erosion resistance is usually associated with high hardness, i.e. high percent theoretical density and reduction of second phase content. Hexoloy® SA SiC is 50% harder than tungsten carbide and ten times harder than conventional stainless steel. This extreme hardness combined with high purity and fine microstructure makes Hexoloy® SA SiC particularly resistant to wear and erosion under mechanically abrasive conditions. The results depicted in the graph are from a test run in accordance with ASTG 76. It clearly demonstrates the superiority of Hexoloy® SA SiC, especially at higher impingement angles.

Hexoloy® SA SiC's excellent erosion and wear resistant properties make it ideally suited for sand blast and spray nozzles, abrasion resistant linings and mechanical seal and bearing surfaces.

## High Temperature Properties

The single phase composition of Hexoloy® SA SiC enables it to reliably perform in air at temperatures in excess of 1900˚C (3450˚F).

Where dimensional changes at high temperature are a concern, Hexoloy® SA SiC has a consistently low coefficient of thermal expansion. This feature allows design flexibility for shrink fit or leak-tight joint applications.

Oxidation resistance is also important for certain high temperature applications. Hexoloy® SA SiC, due to its high purity and high density, is more stable in long-term applications because it is more oxidation resistant. A protective coating of $SiO_2$ is formed on the surface of SiC which slows the oxidation process.

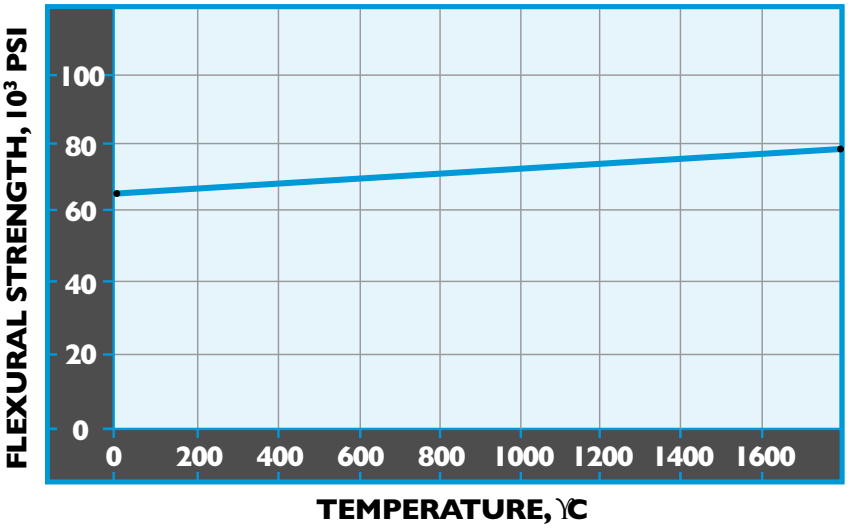
Hexoloy® SA SiC wear liners.

### Thermal Shock

Because of its high thermal conductivity and low coefficient of thermal expansion, it is very resistant to thermal shock and will survive rapid thermal cycling as compared to other refractory materials.

Typical thermal applications include thermocouple protection tubes, kiln beams, burner components and other furnace and high temperature applications.

### Flexural Strength




Hexoloy® SA SiC exhibits excellent strength at room temperature and maintains that strength even at elevated temperatures as depicted above due to its single phase fine grain structure.

### Designing with Hexoloy® SA SiC

Hexoloy® SA SiC's compressive strength is 10 times greater than its tensile strength. This is an important consideration when designing with ceramics due to an inability to yield and relieve stresses like metals when placed in tension. Care should be taken to chamfer or radius all edges.

### If you'd like to know more...

For more information about Hexoloy® Silicon Carbide products, or to discuss your specific application, contact us. Our engineers will work with you to analyze your particular requirements and determine the most cost effective solution.

## Hexoloy® SA SiC Typical Physical Properties

| Property | Units | Typical Value |
|---|---|---|
| **Composition*** | – | SiC |
| **Grain Size** | µm | 4-10 |
| **Density** | $g/cm^3$ | 3.10 |
| **Hardness (Knoop)**** | $kg/mm^2$ | 2800 |
| **Flexural Strength 4 pt @ RT***** | MPa<br>$x10^3$ $lb/in^2$ | 380<br>55 |
| **Flexural Strength 3 pt @ RT***** | MPa<br>$x10^3$ $lb/in^2$ | 550<br>80 |
| **Compressive Strength @ RT** | MPa<br>$x10^3$ $lb/in^2$ | 3900<br>560 |
| **Modulus of Elasticity @ RT** | GPa<br>$x10^6$ $lb/in^2$ | 430<br>62 |
| **Weibull Modulus** (2 parameter) | | 10 |
| **Poisson Ratio** | | 0.14 |
| **Fracture Toughness @ RT**<br>**Double Torsion & SENB** | MPa x $m^{1/2}$<br>$x10^3$ $lb/in^2$ x $in^{1/2}$ | 4.60<br>4.20 |
| **Coefficient of Thermal Expansion**<br>**RT to 700˚C** | $x10^{-6}$ mm/mmK<br>$x10^{-6}$ in/in ˚F | 4.02<br>2.20 |
| **Maximum Service Temp.**<br>**Air** | ˚C<br>˚F | 1900<br>3450 |
| **Mean Specific Heat @ RT** | J/gmK | 0.67 |
| **Thermal Conductivity @ RT**<br>**@ 200˚C**<br>**@ 400˚C** | W/mK<br>Btu/ft h ˚F<br>W/mK<br>Btu/ft h ˚F<br>W/m˚K<br>Btu/ft h ˚F | 125.6<br>72.6<br>102.6<br>59.3<br>77.5<br>44.8 |
| **Permeability @ RT to 1000˚C** | Impervious to gases over 31 MPa | |
| **Electrical Resistivity @ RT****<br>**@ 1000˚C** | ohm-cm<br>ohm-cm | $10^2$-$10^8$<br>0.01-0.2 |
| **Emissivity** | | 0.9 |

*__Composition code:__ Si = free silicon metal; C = free graphite; SiC = silicon carbide

**Knoop 0.1 kg load

***__Test Bar Size:__ 3 x 4 x 45 mm (0.118" x 0.157" x 1.772")

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

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