The Nilcra® range of Silicon Nitrides

MORGAN TECHNICAL CERAMICS

Silicon Nitride solutions for severe service wear and corrosion applications

Contents

At Morgan we design and manufacture Advanced Ceramic Components from a portfolio of cutting edge materials.

We offer a wide range of technical ceramic materials, in-depth materials expertise and vast applications experience in diverse markets.

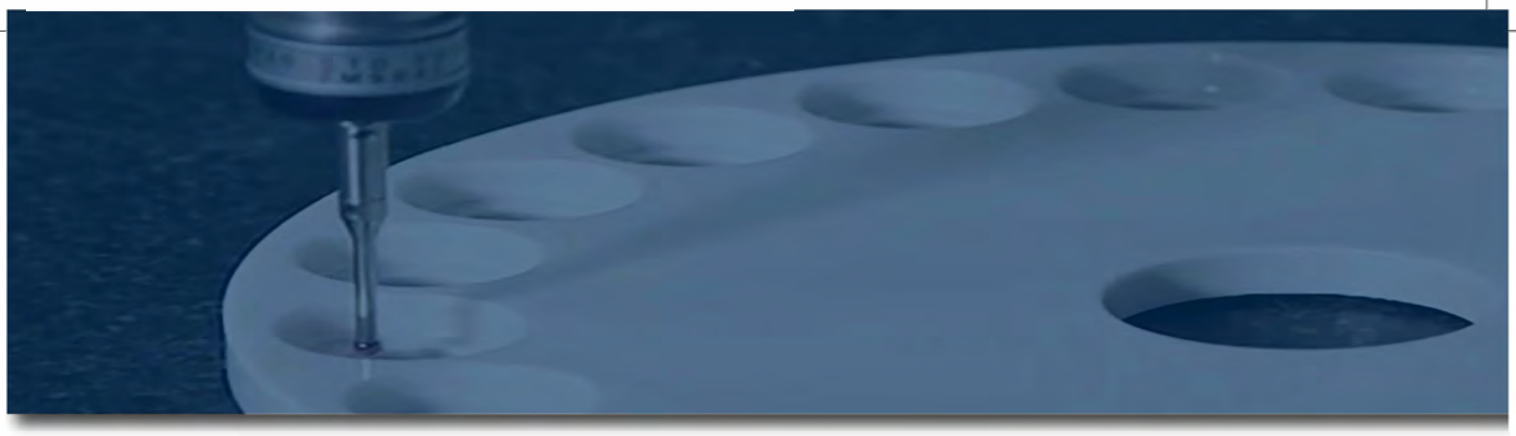
Our materials, coupled with our outstanding capability for the manufacture of complex components, help our customers to extend the life of their equipment and reduce downtime even in the most demanding applications.

Our team of experienced technical specialists and design engineers will work with you to develop solutions that meet your specific requirements.

This is how we have consistently delivered innovation to industry, helping our customers to reduce costs and improve the performance of their products and processes.

We offer world-class design expertise and specialist manufacturing capabilities. We work in partnership with our customers to develop competitive tailored solutions to meet their needs.

Our team of experienced technical specialists and design engineers will work with you to develop solutions that meet your specific requirements



Nilcra® Silicon Nitride

Silicon Nitride is a unique technical ceramic, available in three distinct grades:

Nilcra® SSN E	**Sintered Silicon Nitride**
Nilcra® SSN HP/HIP	**Silicon Nitride Hot Pressed/HIP'ed**
Nilcra® RBSN	**Reaction Bonded Silicon Nitride**

Each of the grades features their own unique properties in terms of high temperature mechanical strength, outstanding thermal shock resistance and chemical corrosion resistance.

Nilcra® SSN E is suitable for a range of applications:

- Severe duty valve trims and pumps
- HF weld rolls for steel and aluminium tube production
- Materials handling
- Semiconductor applications
- Precision balls and bearings

Nilcra® SSN E

This exceptionally reliable, hard-wearing and nonporous silicon nitride is a high strength ceramic designed for applications demanding high durability, toughness, corrosion, and wear resistance even at very high temperatures (up to 1000°C/1832°F). Additionally, its low coefficient of thermal expansion, combined with high strength and toughness, provides excellent thermal shock resistance outperforming most other ceramic materials when used in demanding high temperature conditions. Nilcra® SSN E is a sintered silicon nitride based ceramic material containing interlocking grains of beta phase silicon nitride contributing to outstanding durability and performance.

Nilcra® RBSN

Nilcra® RBSN has notable high temperature strength, creep resistance and oxidation resistance, but with relatively lower mechanical properties than SSN E due to the 20% porosity levels. Additionally, RBSN's low thermal expansion coefficient provides superior thermal shock resistance, compared with most ceramic materials. The manufacturing process of RBSN has only a small volume change allowing net shape forming, offering a cost advantage to other grades of SiN. RBSN can be utilised in many applications, including molten metal handling, thermocouple sheaths, welding jigs, fixtures and nozzles.

Our range of Nilcra® Silicon Nitride includes:

Most reliable ceramic properties

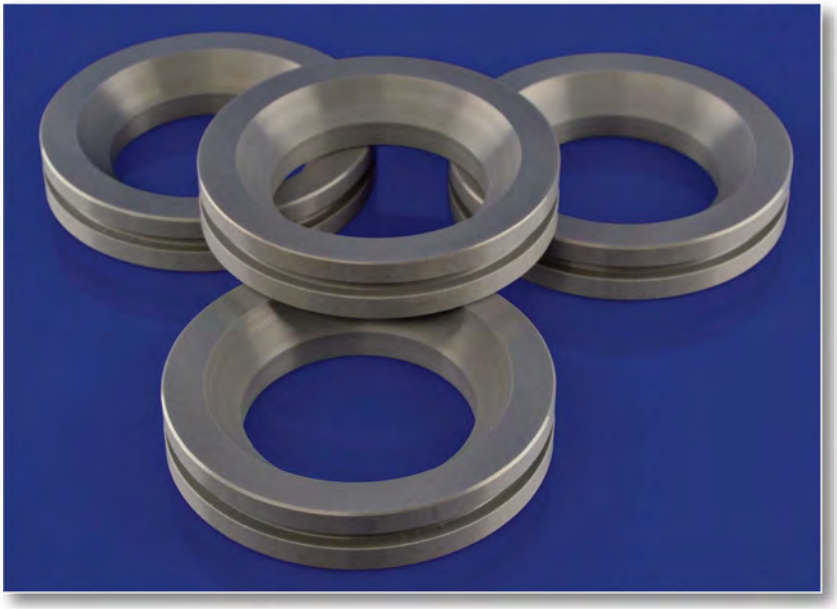
Morgan's range of advanced silicon nitrides are amongst the strongest and most durable ceramic materials available. Our products provide reliability, outstanding service and performance.

- **Nilcra®** SSN E **Sintered Silicon Nitride**
  Maximum strength and toughness grade ideal for severe wear applications such as in valves, weld rolls, bearing and automotive applications.
- **Nilcra®** SSN HP/HIP **Silicon Nitride Hot Pressed/HIP'ed**
  High purity and low porosity grade ideal for semiconductor applications.
- **Nilcra®** RBSN **Reaction Bonded Silicon Nitride**
  High temperature, low creep and strong material resistant to oxidation and corrosion.

Nilcra® SINTERED SILICON NITRIDE — SSN E

Nilcra® SILICON NITRIDE — SSN HP/HIP

Nilcra® SILICON NITRIDE — RBSN



Industries served include:

- Severe service valves and pumps
- Mineral processing
- Scientific instrumentation
- Metal forming
- Wire drawing
- Materials handling
- Power stations

Tube welding roll products

Nilcra® SSN E is an advanced Engineering grade of sintered silicon nitride (Si_3N_4) designed for applications demanding high strength, toughness and wear resistance. We use this material to make high performance welding rolls and guides for High Frequency - Electric Resistance Welding (HF-ERW) in continuous steel and aluminium tube production.

Our welding rolls and guides are made using Nilcra® SSN E, a tough solid ceramic material - not a coating that can peel off and cause damage - that maintains strength and hardness even at high temperatures, making it highly resistant to wear, deformation, galling and corrosion. Nilcra® SSN E has a low coefficient of friction and even abrasive materials have minimal effect on its surface.

Nilcra® SSN E is ideal for use in ERW applications because it is non-conductive and is unaffected by the HF electric field that operates in close proximity to the rolls.

Use of Nilcra® SSN E rolls and guides improves the surface finish of the tube and reduces scrap rates. Manufacturers benefit from reduced down time, better process efficiency and higher yields. Investment in tooling inventories can be correspondingly scaled down too. Unlike steel rolls, Nilcra® SSN E rolls do not draw power from the ERW equipment, so they stay cooler, which enhances the bearing life and reduces energy consumption.

For more information on our advanced ceramic welding rolls and guides for Electric Resistance Welding (ERW) applications in continuous tube production, contact us today.

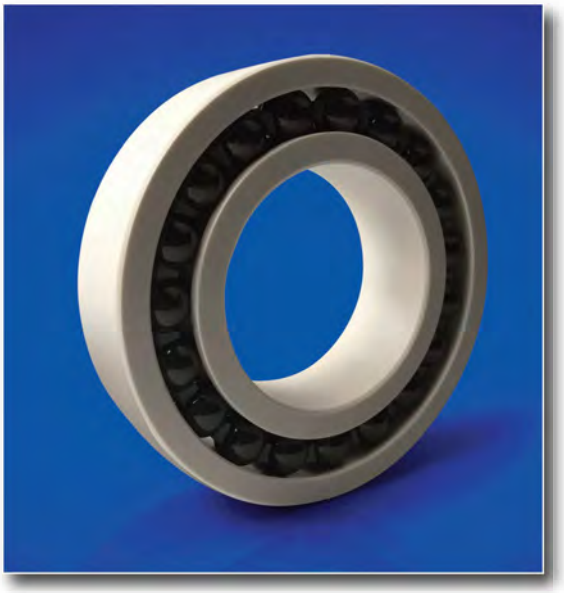
Precision balls and bearings

Morgan has the technology to produce extremely accurate and large precision balls in solid ceramic. Additionally, using our advanced manufacturing techniques, features such as extended stems and complex geometries are also possible upon request.

We use our tough, high strength range of ceramic materials, including Nilcra® SSN E and Nilcra® Zirconia to make high performance balls for corrosive and abrasive environments in demanding severe service conditions.

When required, a sphericity, <5µm can be achieved on a 120 mm diameter sphere. Surface finishes down to Ra 0.08 are also possible.

Whether it's a check valve, unidirectional bearing, ball hinge, bearing pad or a precision instrument, ceramics can make a huge difference to performance and longevity.



Bearing industry

In comparison to other ceramics Nilcra® SSN E has high strength, toughness, and resistance to chemical and thermal extremes offering significant benefits in applications such as all-ceramic or hybrid steel-ceramic rolling contact bearings by reducing rolling friction, fatigue and wear.

Specifications

- **Size:**
  Up to 200 mm diameter, fully dense
- **Ceramic Material:**
  Nilcra® Zirconia and Nilcra® SiAlON
- **Accuracy:**
  Sphericity <5µm
- **Surface finish:**
  Ra <0.08

Nilcra® products are frequently used to replace conventional metal alloys, hardened steels and tungsten carbides that suffer from wear and corrosion

Semiconductor applications

Within the semiconductor industry Nilcra® SSN HP/HIP ceramic components are indispensable due to their excellent thermal and mechanical properties. Their high toughness and excellent thermal conductivity being critical for applications in extreme conditions.

For over 60 years, the Morgan Technical Ceramics business has been the premium supplier of custom ceramic components for chemical, electrical, mechanical, and vacuum applications.

We serve Semiconductor industry customers around the world. Parts are manufactured from our selected Silicon Nitride/Nilcra® SSN HP/HIP grades and manufactured to customer defined designs and specifications.

Semiconductor applications:

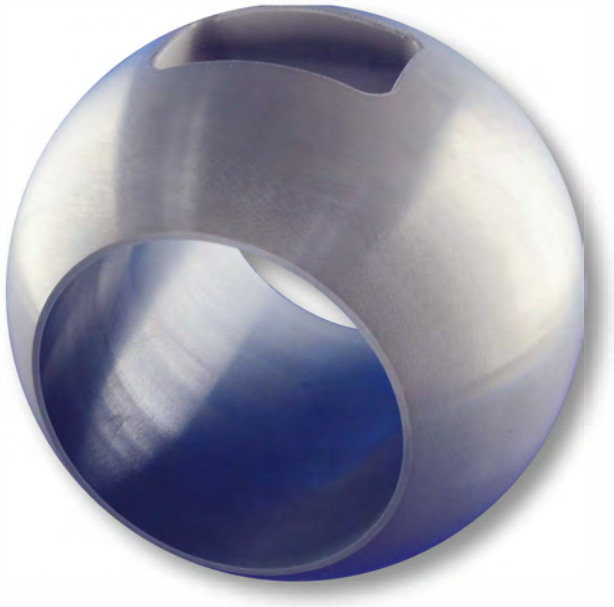
- **Wafer Manufacturing; Pad Dresser**
- **Device Manufacturing Route; Plasma Proof Ring**
- **Structural components for LCD and Lithography equipment**
- **Custom made parts for Furnace and Chamber assemblies**

Materials, Capabilities and Services:

- Controlled microstructures
- Very high purity, consistency, and uniformity
- Low particle generation materials
- High tolerance ceramic machining
- Complete documentation and traceability
- CAD/EDI and engineering design support

Valve components

Nilcra® SSN E is an advanced Engineering grade of sintered silicon nitride (Si_3N_4) designed for applications demanding high strength, toughness and wear resistance.



We use this ceramic to make high performance wear components for corrosive and abrasive fluid in demanding processing environments, such as, chemical processing, paper and pulp manufacturing, and oil and gas extraction and refining. Our product range includes options for ball valves, rotary and linear control valves.

Nilcra® SSN E ceramic provides an exceptionally reliable, high performance option, where other conventional materials, such as, metals and plastics tend to fail. The very high hardness of the material offers excellent resistance to cavitation, a major problem for process control valves.

If you are working in challenging processing environments and would like to know more about our Nilcra® SSN E wear parts, please contact us today.

Used for critical duties in high value processing environments, Nilcra® SSN E valve components offer processors the potential for substantial savings in downtime and valve repair costs. As a result, processors and their equipment suppliers are increasingly demanding it for use in aggressive chemical slurry environments, such as, sour oil, bitumen, bleached wood pulp, sulphur dioxide, concentrated sodium hydroxide, and concentrated sulphuric or hydrochloric acids.

If you are working with valves in a challenging processing environment and would like to know more about our Nilcra® valve components, please contact us today.

Valve component applications:

- **Chemical processing**
- **Paper and pulp manufacturing**
- **Oil and gas extraction and refining**

Wear parts for solids handling

We use this ceramic to make high performance wear components for corrosive and abrasive fluid in demanding processing environments, such as, chemical processing, paper and pulp manufacturing, and oil and gas extraction and refining. Our product range includes:

- **Wear sleeves**
- **Hydrocyclones**
- **Guides and spigot liners**

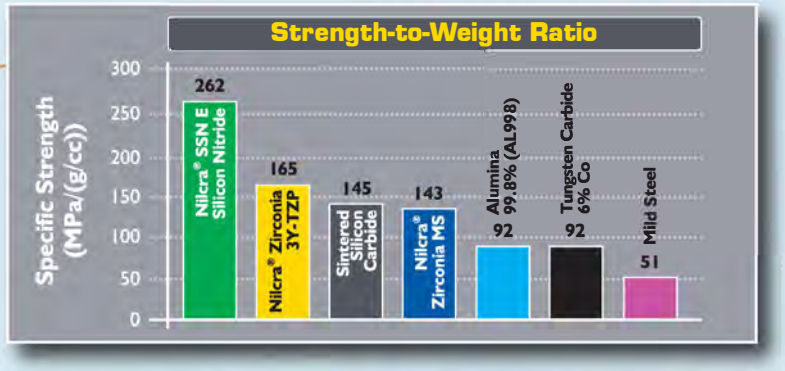
Nilcra® products provide a reliable, high performance option where other materials tend to fail, even in the most challenging process applications

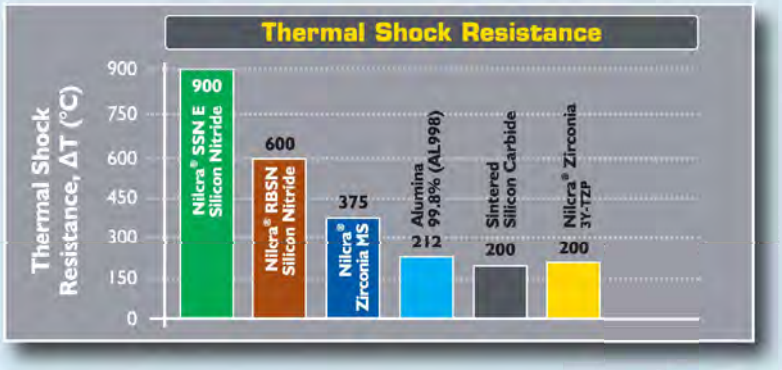
Nilcra® material properties

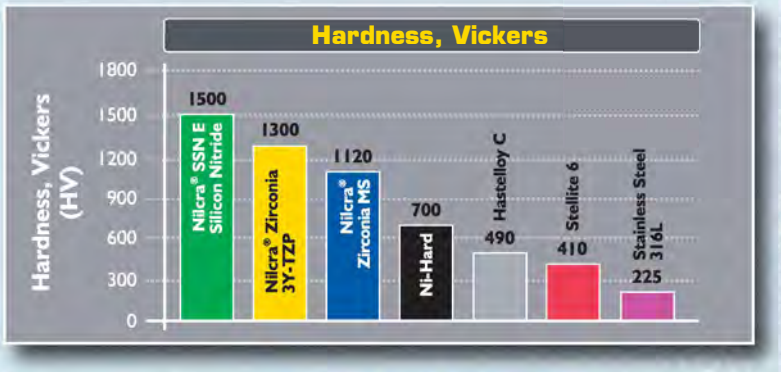
Properties	Units	Nilcra® SSN E Sintered Silicon Nitride	Nilcra® SSN HP/HIP Hot Pressed/HIP'ed Silicon Nitride	Nilcra® RBSN Reaction Bonded Silicon Nitride
Density	g/cm^3	3.24	3.26	2.4
Porosity	%	<0.1	<0.05	20
Fracture Toughness	$MPa\sqrt{m}$	8	6	3
Flexural Strength	MPa	850	925	190
Weibull Modulus	-	10	10	-
Compressive Strength	MPa	3500	3000	550
Hardness, Vickers	$HV_{0.3}$ kg/mm^2	1500	1560	1100
Modulus of Elasticity	GPa	290	320	170
Electrical Resistivity	Ohm.cm	$>10^{12}$	$>10^{12}$	$>10^{10}$
Thermal Conductivity	W/m.K	28	24	16
Coefficient Thermal Expansion	$x\ 10^{-6}/°C$	3.0	3.2	3.0
Specific Heat Capacity	J/g.K	0.65	0.66	1.1
Thermal Shock Resistance, ΔT	°C	900	725	600
Maximum Use Temperature	°C	1200	1200	1150
Colour	-	Black / Grey	Grey	Grey
Typical Applications		Severe Wear, Bearings, Automotive	Semiconductor Processing	Molten Aluminium Processing

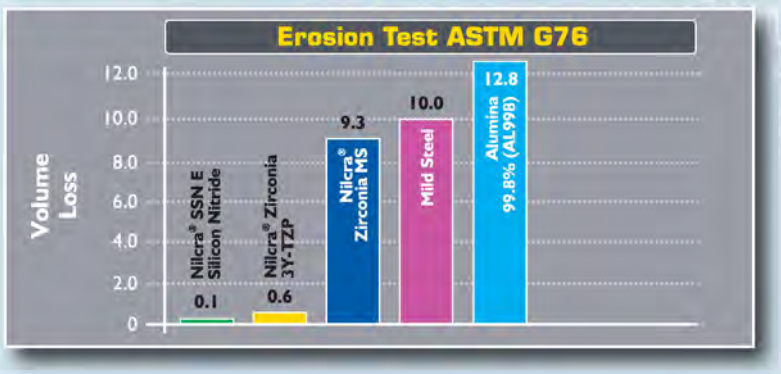
All values quoted are based on test pieces and may vary according to component design.
These values are typical and should be treated as indicative and for guidance only.

Nilcra® Zirconia MS Grade	Nilcra® Zirconia 3Y-TZP Grade
5.74	6.05
<1.0	<0.1
12	10
820	1000
>30	20
1990	2300
1120	1300
205	205
$>10^{11}$	$>10^{11}$
3.08	3.0
10.2	9.0
0.47	0.5
375	200
800	800
White	White
Severe Wear & Corrosion	Can Tooling, Cutting Blades









Deal direct with the manufacturer