Application Guide for Ceramic Components Used in Domestic & Industrial Pumps

Shafts, Seals & Bearings

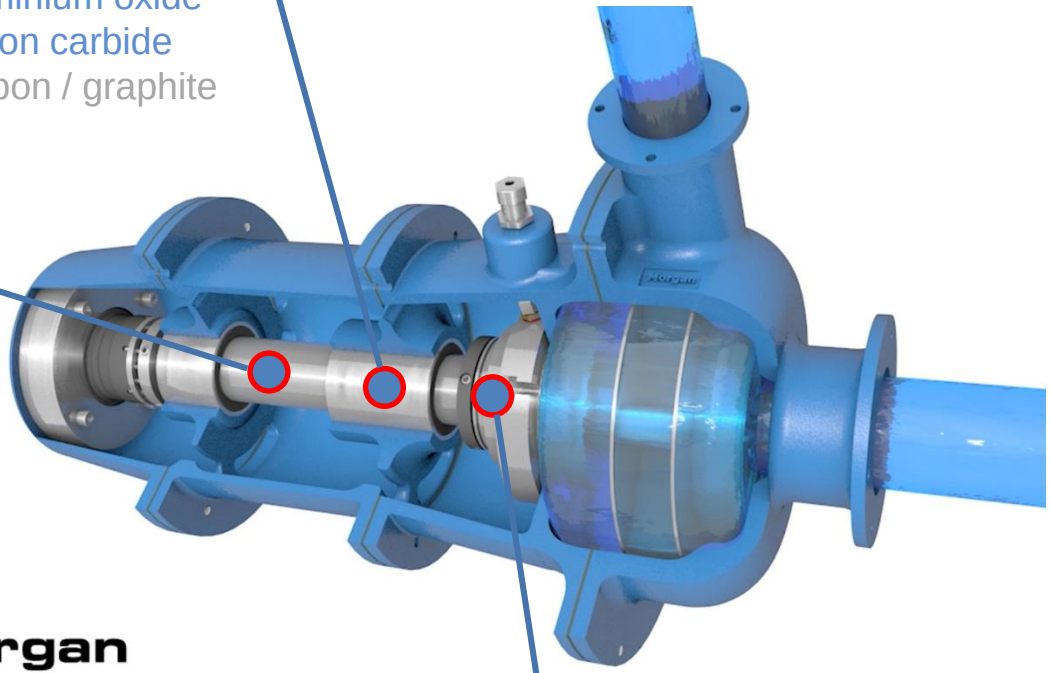
Overview – Morgan Seals & Bearings

Bearing

- Aluminium oxide
- Silicon carbide
- Carbon / graphite

Ceramic shaft

- Aluminium oxide



Mechanical seal face

- Silicon carbide
- Aluminium oxide
- Carbon / graphite
- PTFE

* Carbon/graphite/PTFE products are manufactured in a Morgan S&B site in Italy.

Precision Ceramic Shafts for Circulating Pumps

Materials	Applications	Morgan's USPs	Price
Aluminium oxide • **Hilox 961**	- Circulating water pumps - Heating pumps - Industrial high pressure pumps - Hybrid car cooling pumps - Digital motors	- High volume capability - Press-to-size in complex shapes to customer requirements - Precision dimension tolerances - Consistent, high level quality control - Superior dimension stability - Low coefficient of friction - High flexural strength - Excellent wear resistance over lime scales - Corrosion resistance	Low to Medium

<u>Key advantages over conventional, stainless steel shafts:</u>

- High energy efficiency;
- Minimised pump noise (shaft/bearing clearances <= 30 µm);
- Maintenance free operation for pump life in excess of 15 years;
- Corrosion resistance in the most demanding environments.

Mechanical Seal Faces – Application Focused Material Selections and Key Advantages

Key advantages:

- Leak proof;
- High energy efficiency;
- Minimised pump noise;
- Excellent wear resistance;
- Mating options with other Morgan seal products;
- Superior corrosion resistance.

Materials	Applications	Morgan's USPs	Price
Silicon carbide (SiC) • **PS5000** • **PGS3** • **Porous**	- Circulating water pumps - Heating pumps - Chemical pumps - Cooling pumps - Cosmetics handling pumps - Automotive cooling pumps - Hygiene pumps (food, beverage, drug, etc.)	- High volume capability - Press-to-size in complex shapes to customer requirements - Precision dimension tolerances - Consistent, high level quality control - Excellent pressure-velocity performances - Dry running capability - Low thermal expansion coefficient - Superior corrosion resistance - Outstanding thermal shock resistance	Medium
Aluminium oxide • **Hilox 882** • **Hilox 961** • **Hilox 991**	- Centrifugal pumps - Water pumps - Blood pumps for plasma apheresis	- Excellent mating seal with carbon/graphite - Good corrosion resistance - High stiffness	Low to medium

Mating of Silicon Carbide Seal Faces – Applications and Key Considerations

Mating options	Silicon carbide (SiC)	Aluminium oxide	Carbon / graphite
Silicon carbide (SiC)	- Hot water (PGS3) - Light & heavy duty water (PGS3) - Highly corrosive (PS5000) - Highly abrasive (PS5000, PGS3) - Viscous (PGS3, PS5000, porous) - Cosmetics (porous) - Food, beverage, drug (PS5000, porous) - Coolant (PS5000, porous) - Automotive (PGS3, porous, PS5000)	- Automotive water pumps - Agricultural waste water - Printing & dyeing - Pharmaceutical - Sewage pump	- Pulp & paper - Abrasive - Automotive

Primary considerations when selecting mating seals:

- **Wear performance**: determined by the hardness and surface roughness of material, as well as operating conditions. Mating of Morgan's seals (SiC, alumina and carbon/graphite) offers optimised wear performance to our customers;
- **Operating condition**: corrosiveness, temperature, viscosity, etc. of the fluid and its contents, i.e. a mixture of fluid and abrasive particulates (sand, scale, etc.);
- **Pump design**: expected service life, expected energy efficiency rating, leak proof feature, etc.;
- **Physical properties of mating seals**: hardness, abrasion resistance, thermal conductivity, coefficient of thermal expansion, coefficient of friction, etc.

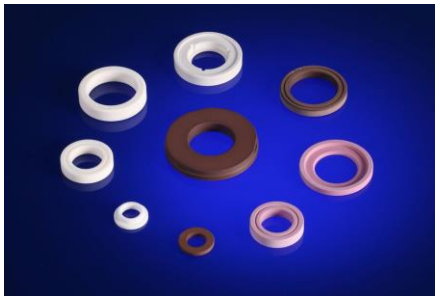
Precision Alumina & SiC Bearings for Domestic & Industrial Pumps

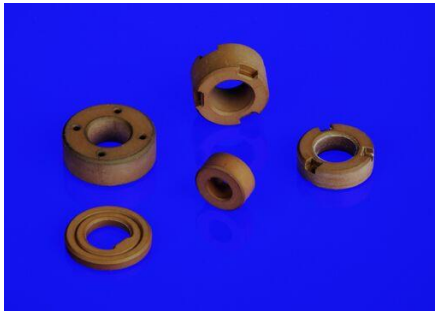
Key advantages:

- High energy efficiency;
- Minimised pump noise;
- Excellent wear resistance;
- Superior corrosion resistance.

Materials	Applications	Morgan's USPs	Price
Silicon carbide (SiC) • **PS5000** • **PGS3** • **Porous**	- Circulating water pumps - Heating pumps - Chemical pumps - Cooling pumps - Cosmetics handling pumps - Automotive EWP pumps - Hygiene pumps (food, beverage, drug, etc.) - Hermetically sealed pumps	- High volume capability - Press-to-size - Precision grinding to achieve dimension tolerances - Consistent, high level quality control - Excellent abrasion resistance - Low coefficient of friction - High strength - Low thermal expansion coefficient - Superior corrosion resistance - Outstanding thermal shock resistance	Medium
Aluminium oxide • **Hilox 961**	- Centrifugal pumps - Domestic & industrial water pumps - Heavy duty pumps	- High strength - Good wear resistance - Good corrosion resistance - High stiffness	Low to medium

Volume Precision Manufacturing Capability





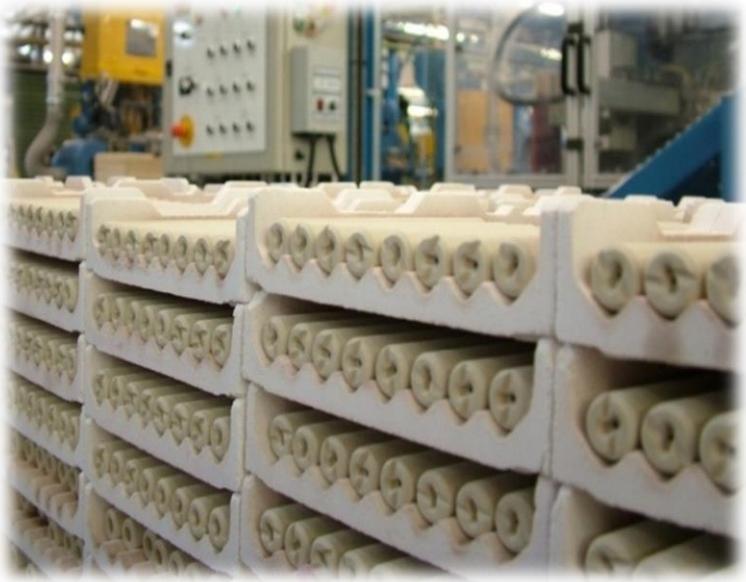
Ceramic shafts – Hilox 961

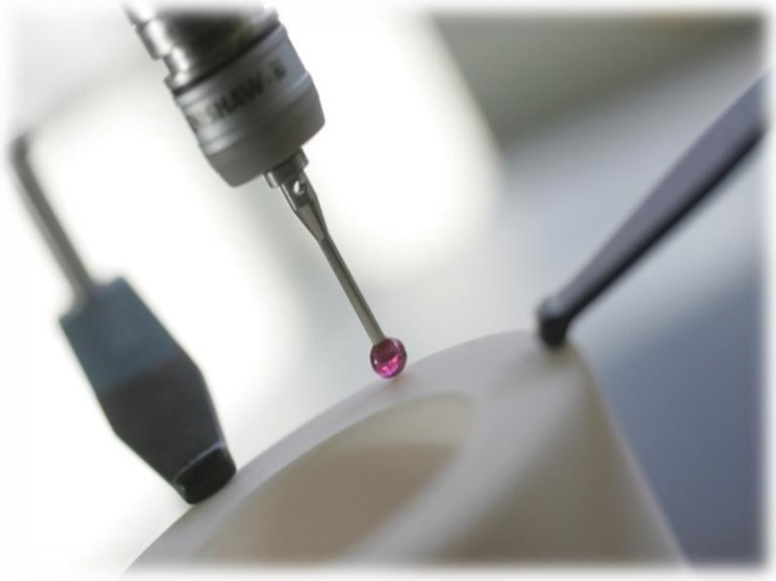
Dimension	Typical Size range (mm)	Tolerances as-fired(+/-)	Tolerances machined(+/-)
OD (D)	2 - 50	1%	0.005
Bore (d)	1 - 3	1%	
Length (L)	30 – 120	1%	0.3
End squareness	0.2 - 0.02	0.2	0.05max
Concentricity	0.2 - 0.02	0.2	0.03max
Roundness	0.1 - 0.002	0.1	0.002max
Surface (Ra)	0.1 – 1.5µm	1.5max	0.1max

Ceramic bearings

Dimension	Typical Size range (mm)	Tolerances as-fired(+/-)	Tolerances machined(+/-) Alumina	Tolerances machined(+/-) SiC
OD (D)	10 - 80	1%	0.005	0.01
Bore (d)	5 - 50	1%	0.005	0.01
Length (L)	5 – 50	1%	0.03	0.03
End Squareness	0.2 - 0.02	0.2	0.05max	0.05max
Parallelity	0.2 - 0.02	0.2	0.02max	0.05max
Roundness	0.1 - 0.002	0.1	0.002max	
Surface (Ra)	0.1 – 1.5µm	1.5max	0.1max	0.4max

Thank you





Contact us:

Dr. Yifei Zhang
Business Development Manager

Phone：+44 1299 872 217
Mobile：+44 7789 694 458
Email：Yifei.Zhang@morganplc.com
Morgan Advanced Materials
Morgan Drive, Stourport-on-Severn, Worcestershire DY13 8DW, United Kingdom

Chris Paine
Business Development Manager

Phone：+44 1299 872 235
Mobile：+44 7944 037 211
Email：Chris.Paine@morganplc.com
Morgan Advanced Materials
Morgan Drive, Stourport-on-Severn, Worcestershire DY13 8DW, United Kingdom