Full ceramic bearings and ceramic material selection guide

Zro2 (zirconia) versus Si3N4 (silicon nitride) - a guide to selecting the correct ceramic bearing material

Full ceramic bearings, not to be confused with hybrid ceramic bearings (steel rings & ceramic balls), have many advantages but given their high cost its very important to be sure that they will suit your specific application. To help you choose the right bearing, we explain what full ceramic bearings can and can't do and give some tips on how to choose the right ceramic material.

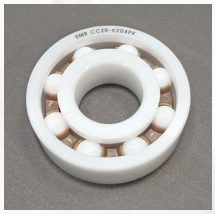
Our full ceramic ball bearings can be supplied with rings and balls made from zirconia (ZrO2) or silicon nitride (Si3N4). They are available as full complement (no cage) or with a cage made from PEEK or PTFE. Full ceramic bearings are for medium load and medium speed applications. It is not possible to achieve the inner and outer ring roundness that is found with precision steel bearings so full ceramic bearings have lower speed ratings. They also have lower load ratings than steel bearings. Ceramic materials are much harder than steel but this also means they are more brittle, particularly silicon nitride. This reduces their load ratings.

One benefit of full ceramic bearings is that they are highly corrosion resistant to seawater and most chemicals, including acids and alkalis. They are found in the chemical industry, food and beverage industry, marine applications, chlorine systems, film processing equipment and fuel handling equipment to name just a few areas of use. Full ceramic bearings have excellent low temperature performance which is why they can be found in cryogenic applications. They can also withstand extremely high temperatures so they are often used in furnace applications. As they are non-magnetic, they are suitable for motors used in MRI scanners, magnetometers, semi-conductor manufacturing equipment or any application in which the bearings may be exposed to a strong magnetic field. These bearings are also non-conductive.

Full ceramic bearings are much more expensive than steel bearings which is why they are normally used in more hostile environments. It may be the case that the efficiency savings from using full ceramic bearings are too negligible to make them worth the added cost. We'd be delighted to advise you on the best options as long as we have some basic information on your application (load, speed, temperature, environment etc.). You can download technical drawings on all of our products from the relevant product pages which can be accessed from the "SMB product range" page here:
http://www.smbbearings.com/products/smb-product-range.html

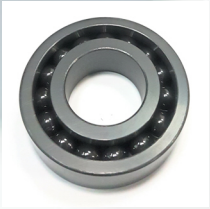
For help in choosing the best ceramic bearing material for your application, please take a look at the comparison chart below which highlights the advantages and disadvantages of the two ceramic bearing types we keep in stock.

ZrO2 / zirconia (CCZR)



- ☺ resistant to acids & alkalis
- ☺ resistant to water, salt water
- ☺ suitable for 400°C if full complement
- ☺ non-magnetic and electrically insulating
- ☺ light - approximately 70% of the weight of steel bearings
- ☺ higher fracture toughness so can withstand small shock loads
- ☺ thermal expansion very similar to steel so no problems with inner/outer ring fits if shafts or housings are steel
- ☹ can degrade after time if used with hot water or steam
- ☹ not suitable for low noise applications

Si3n4 / silicon nitride (CCSI)



- ☺ resistant to acids & alkalis
- ☺ resistant to water, salt water
- ☺ suitable for 800°C if full complement
- ☺ non-magnetic and electrically insulating
- ☺ very light - approx 45% of the weight of steel bearings
- 😐 more expensive than zirconia
- 😐 very low thermal expansion so pay attention to changes in inner/outer ring fits if shafts or housings are not Si3N4
- ☹ not suitable for shock loads
- ☹ not suitable for low noise applications

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