A BARDEN

Precision Bulletin

Emerson Bearing
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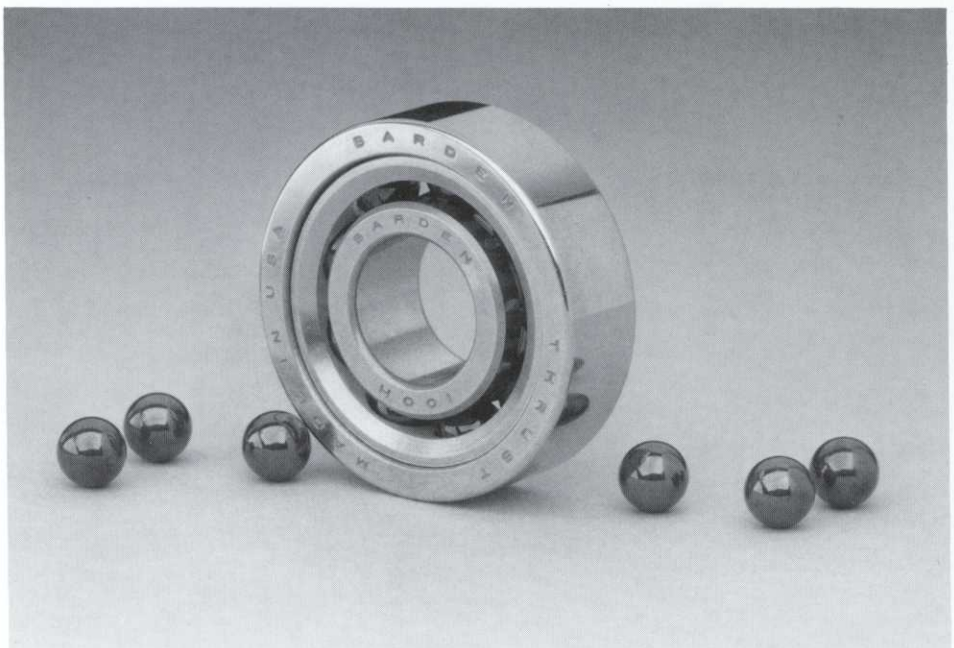

CERAMICS FOR USE IN BALL BEARINGS

Because of their material properties, ceramics have been under investigation over the past several years for use as a bearing material. Of all the ceramic materials tested, silicon nitride shows the most promise for rolling element bearing applications. Silicon nitride's material properties, and their influence on bearing performance, are as follows:

- **High Hot Strength.** High compressive and flexural strength over a wide temperature range. Lends itself for use to 2200°F. Tensile strength is generally poor.
- **Low Density.** Specific density of 3.2 compared to 7.8 for steel. At high bearing operating speeds (greater than 1.2 x 10^6 dN), the bearing balls have a centrifugal force which may exceed the external loads on the bearing. The low density of ceramics can reduce this load considerably.
- **High Hardness.** While bearing steel is in the RC 58-64 hardness range, silicon nitride has a hardness of RC 75 to 80 and offers excellent wear resistance.
- **Coefficient of Friction.** Silicon nitride has a coefficient of friction which is significantly lower, especially under marginal lubrication conditions. It also exhibits better resistance to scuffing and seizing than bearing steel.
- **Corrosion Resistance.** Silicon nitride is unaffected by most common corrosive agents and is well-suited for use in hot corrosive atmospheres, or where lubricants have been known to attack conventional bearing steels.
- **Long Fatigue Life.** Recent improvements in purity and grain structure have given silicon nitride a high stress fatigue life equal to, or better than, that of bearing steels. Some tests have shown life 3 to 5 times that of M-50 steel.
- **Elastic Modulus.** Silicon nitride has an elastic modulus of 45 x 10^6 psi - some 50% higher than that of conventional bearing steel. This increased stiffness results in bearings with lower yield rates (in./lb.).
- **Low Coefficient of Thermal Expansion.** This property has made it difficult to mount a ceramic bearing on a steel shaft (which expands 3 times faster than ceramic). The steel shaft may crack a ceramic bearing ring due to the thermally induced tension stresses created in the ceramic ring.

Barden has taken the lead in working with our customers in applications which lend themselves to the advantages of ceramics. To date, the most promising use is with bearings using ceramic balls only. Mounting difficulties and manufacturing intricacies, with their associated high costs, have slowed acceptance and potential usage of the all-ceramic bearing.

Hybrid bearings (steel rings, ceramic balls) are being evaluated in several applications. These applications range from small high-speed turbines to larger grease lubricated machine tool spindles. To date, results look promising for:

- Higher speedability, with grease or oil lubrication;
- Longer life on grease lubricated bearings;
- Lower bearing torque - both average and hash;
- Non-repetitive runout due to ball geometry is extremely low;
- Quiet running;
- Increased bearing stiffness.

If your application can benefit from these parameters, contact your Barden Sales or Application Engineer. They can help evaluate the potential of ceramics in your product. Our extensive experience in bearing design and application, coupled with the finest manufactured steel rings and premium, 100% radiographically inspected silicon nitride balls, will help unleash the finest performance possible from your design.

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