

TIMKEN®

**CERAMIC BEARINGS
EXTENDED LIFE. REDUCED
WEAR. SMART ALTERNATIVES.**



Timken Super Precision

A TIMKEN COMPANY SUBSIDIARY

THE TRANSFORMATION OF AN AGE-OLD COMPOUND

For thousands of years, civilization has relied on ceramics - thanks to their heat- and corrosion-resistant nature - for everything from dishes to machine operations. Today, ceramics have evolved into advanced industrial components.

By integrating ceramic balls and metallic races, including 440C, 52100, M50, BG42 and beryllium copper races, we have significantly reduced bearing wear and lubrication breakdown in high-speed components, such as dental hand pieces and turbine engines.

Engineered ceramics are high technology products manufactured with advanced processing equipment for critical applications. Some of these materials have been specially developed to withstand the high cyclic stresses and localized wear seen in bearings. Bearings have been attractive applications for engineered ceramics because these materials are abrasive-resistant, heat resistant and can sustain large compressive loads, even at high temperatures.

More than 20 years of research and testing prove that ceramic bearings:

- ▶ Maintain longer, more reliable performance;
- ▶ Reduce noise and vibration;
- ▶ Retain stiffness;
- ▶ Operate at lower temperatures; and
- ▶ Require less lubrication.

Timken® ceramic bearings reduce wear and extend life.



Bearings have been attractive applications for engineered ceramics because of these materials' overall superior quality.

CERAMIC'S COMPETITIVE ADVANTAGES

Timken engineers have developed hundreds of ceramic designs. We continue to focus on solutions that incorporate the silicon nitride (Si_3N_4) family of ceramic compounds, known for their low-density, hardness, elasticity, tensile strength and other benefits.

Silicon nitride's density is 40 percent of traditional bearing steels. Because force is directly proportional to mass, the lower-density silicon nitride significantly reduces the centrifugal forces of the balls on the outer ring. This enhances operations in high-speed applications where outer race contact loads may hinder performance.

Bearing life is directly related to hardness, the most critical mechanical property of a bearing material. With an impressive Rockwell C 78 hardness - twice as hard as many bearing steels - silicon nitride improves wear resistance, minimizing the damaging effects of repetitive surface contacts.

In high-speed applications, bearings must withstand extremely high temperatures. Timken ceramic bearings operate precisely at temperatures up to 1,800°F for extended periods, compared to short-term maximum temperatures of 1,000°F for the best high-temperature bearing steels.

In hybrid ceramic bearings, the surface asperities of steel races and ceramic rolling elements do not micro-weld, preventing or slowing

failure caused by adhesive wear, fretting wear and/or lubricant breakdown.

Three other silicon nitride characteristics enhance bearing performance in some applications, such as corrosive or electrical environments: It is virtually chemically inert, it is non-magnetic and it does not conduct electricity.

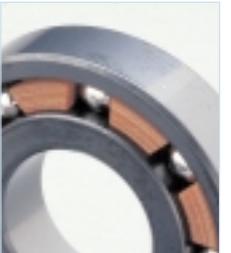
INCORPORATING CERAMIC HYBRIDS INTO YOUR APPLICATIONS

In applications where heat, friction, speed, adhesive wear and marginal lubrication are factors, Timken hybrid bearings may perform significantly better than steel bearings. Our hybrid bearings currently operate in:

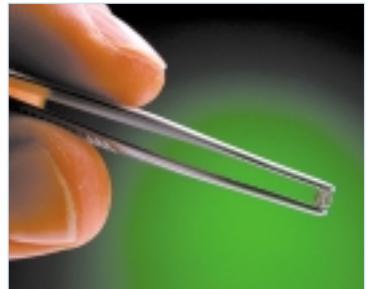
- ▶ Gimbals;
- ▶ Aircraft accessories;
- ▶ Medical hand pieces;
- ▶ Can-seaming machinery; and
- ▶ Food-processing equipment.

Hybrid bearings in turbo molecular pumps reduce noise, vibration, and operating temperatures, as well as increase life, and allow for operation under marginal lubrication conditions. The cooler operation of the ceramic hybrid permits the use of grease in place of oil previously used in conventional all steel bearings.

In corrosive atmospheres - including pumps, meters and semiconductor applications -



The lower-density silicon nitride significantly reduces the centrifugal forces of the balls on the outer ring.



Ceramic bearings continue to grow in popularity. Timken ceramic bearing customers report enhanced performance, reliability and bearing life with our designs.

continuing to develop solutions

understanding the elements



ceramic bearings resist chemical deterioration. They are ideal for critical tidal flow meters, where they withstand operation in seawater's hard-particulate and corrosive environment. Ceramic is the material of choice for the semiconductor industry because of its compatibility with wafer processing environments. Timken Super Precision engineers can provide customer-focused bearing recommendations for challenging your application.

TIMKEN: YOUR CERAMIC BEARING RESOURCE



Ceramic bearings continue to grow in popularity. Timken ceramic bearing customers report enhanced performance, reliability and bearing life with our designs.

Currently, we offer ceramic hybrids utilizing 1mm to 1/4-inch ball diameters. Most Timken Super Precision standard bearings may be ordered with ceramic balls in combination with 440C and 52100 steel rings.

Timken manufactures select sizes of full ceramic ball bearings from 0.1875-inch up to a 1-inch outside diameters.

As your bearing resource, Timken Super Precision, a subsidiary of The Timken Company, will deliver unparalleled engineering expertise in the ceramic arena, where our engineers will analyze your equipment, processes and maintenance routines to recommend the best solutions. Timken Super Precision delivers the best products, services and technical support available.

PRODUCTS:

- Super-Precision Ball Bearings
- Miniature Bearings
- Integral Bearings
- Precision Rotary Assemblies

HYBRID SIZE RANGE:

- Miniature and Instrument Bearings: .059" OD to 1.25" OD
- Thin Section Bearings: .625" OD to 6.0" OD
- Torque Tube Bearings: Up to 3.875" OD

TYPICAL APPLICATIONS:

- Aircraft Accessory, Valve, Transmission and Gearbox
- Gas Turbine Engine Mainshaft
- Gimbals
- Semiconductor Handling
- Food Processing
- Dental Handpiece Turbines
- Sensitive Instruments

BENEFITS:

- Ability to withstand high temperatures
- Extended fatigue life
- Corrosion Resistance
- Reduced lubrication requirements
- Twice as hard as bearing steels
- High speed capabilities
- Lightweight compared to steel



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