

the challenge continues...

MARGINAL LUBRICATION

Many times bearings are required to operate under marginal or non-lubricated conditions. Ball and raceway surfaces are not separated by a complete film of lubrication. The asperities or peaks of each surface contact under high-localized stress and temperature. Asperities weld and break during bearing operation forming wear particles. Wear debris decreases life and can contaminate the environment surrounding the bearing. In ceramic hybrid bearings the asperities of the steel races and silicon nitride balls do not weld, thus preventing or slowing generation of debris. Titanium carbide coated stainless steel balls offer the same benefits, but are recommended for use in marginally lubricated applications only. The use of silicon nitride or titanium carbide coated balls results in a longer and cleaner running bearing.

HYBRID BEARINGS FOR MARGINAL LUBRICATION		
Ring material	Ball material	Part number prefix
440C SST	Silicon Nitride	U
52100 STL		E
440C SST	Titanium carbide	T
52100 STL	coated stainless steel	D

THE BEST SOLUTION

Our capabilities go beyond just bearings. We can offer complete assemblies which mate super precision bearings with components manufactured to extremely tight tolerances. This results in higher yields and lower cost to you. It can help minimize your vendor base as well. Integral assemblies can be designed to minimize tolerance stack-up where high system accuracy is required.

Our experienced engineers will work with you to select the appropriate materials and design. Timken Super Precision can provide the best solution for your extreme environment application.

APPLICATIONS:

- ▶ X-ray tubes
- ▶ Hot valves
- ▶ Space mechanisms
- ▶ Semiconductor equipment
- ▶ Flow meters
- ▶ Can seaming

BENEFITS:

- ▶ Higher speed
- ▶ Longer Life
- ▶ Corrosion resistant
- ▶ Reduce wear
- ▶ Non-magnetic
- ▶ Low Conductivity
- ▶ Vacuum compatible
- ▶ High temperature
- ▶ Enhanced performance
- ▶ Reduced weight
- ▶ Bearing cleanliness



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Ideas in Motion

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TIMKEN

WORLDWIDE LEADER IN BEARINGS AND STEEL

TIMKEN®

EXTREME ENVIRONMENTS



Timken Super Precision

A TIMKEN COMPANY SUBSIDIARY



WORLD LEADER STATUS

Excellence in the design and manufacture of super precision bearings has earned Timken Super Precision, a Timken Company subsidiary, world leader status in the production of precision bearings and bearing related products.

Founded in 1941 as a manufacturer of miniature precision and instrument ball bearings, Timken Super Precision has grown to serve the complexities of many different markets by utilizing the best technologies and materials to provide customers with product solutions that perform in the most extreme environments:

- ▶ Vacuum
- ▶ High Temperature
- ▶ Non-Magnetic
- ▶ Corrosion Resistance
- ▶ Marginal Lubrication

Timken Super Precision has earned world leader status in the production of precision bearings and bearing-related products for extreme environments, through our excellence in design and manufacture.

more than just bearings

VACUUM COMPATIBLE MATERIALS			
Rings	Balls	Retainer	Lubrication
- 440C SST	- 440C SST	- Stainless steel	- Vacuum compatible oils and greases
- M-62 high speed tool steel	- Silicon Nitride	- PTFE	- Dry film lubricants
	- Titanium carbide coated stainless steel	- Phenolic	- Solid film lubricants
		- Porous Polyimide	
		- Solid Polyimide	
		- Filled PTFE	

VACUUM

Timken Super Precision products have been used by the space industry for many years. Precision designed actuators, drive motors and gimbal systems are but a few examples of the applications. The ability to meet the critical requirements of these applications is a result of Timken Super Precision's knowledge and resources in vacuum environments.

440C stainless steel is the most widely accepted bearing material for use in vacuum applications. Standard stainless steel rings can be matched with balls of the same material, silicon nitride or titanium carbide coated stainless steel. A variety of retainer styles and materials are available including: stainless steel, PTFE, phenolic, porous polyimide, solid polyimide and filled PTFE. Timken Super Precision stocks a number of vacuum compatible oils and greases. All lubrication is performed in a controlled "clean room" environment to prevent contamination. In applications where conventional "wet" lubricants are not appropriate, dry film lubricants can be applied. These include molybdenum disulfide and tungsten disulfide.

In some situations more specialized design solutions are required. Such is the case with bearing assemblies used in medical x-ray tubes. These assemblies are subjected to the combined conditions of a vacuum environment, high temperature and high speed. Powdered metal M-62 high-speed tool steel is used for the bearing material. Silver and lead are used as solid film lubricants. These bearings are typically full ball complement (no ball separator). Due to the temperature extremes, the design must be thermally

meeting the most critical expectations

compensating to prevent excessive looseness or preload. Timken Super Precision engineers can assist with design of these bearings.

HIGH TEMPERATURE

With standard heat treatment, bearings of 440C have a minimum hardness of HRC 58 and can operate at temperatures of up to 350°F. In applications where the normal operating temperature exceeds this limit, 440C will decrease in hardness, lowering the bearing's load capacity and theoretical life. These cases require selection of an alternate material.

HIGH TEMPERATURE MATERIALS	
Material	Max operating temperature
440C SST	350°F
BG-42®	600°F
M-50	600°F
M-62	1000°F
UNS R30605	1200°F*
Silicon nitride	1500°F

*UNS R30605 hardness is below that of other materials listed

Materials such as BG-42®, M-50 tool steel, M-62 tool steel, UNS R30605 Cobalt-Nickel-Chromium-Tungsten alloy and silicon nitride offer excellent hot hardness and load capacity at elevated temperatures. All will maintain dimensional stability at elevated operating temperatures as well. Retainers manufactured from stainless steel, aluminum bronze, silicon iron bronze and special plastics can be used. Careful selection of bearing lubrication must be made in these extreme temperature applications.

NON-MAGNETIC

In applications where bearings must operate in a magnetic field, non-magnetic materials are desirable. Beryllium copper is a precipitation hardening alloy

NON-MAGNETIC MATERIALS		
Rings	Balls	Retainer
-Beryllium Copper	-Beryllium Copper	-Beryllium Copper
-Silicon Nitride	-Silicon Nitride	-Nylon 6/6
		-Phenolic
		-PTFE

of 2% beryllium in copper. Since the hardness is well below that of other bearing materials, bearings made from this material have limited load capacity. Load ratings are typically 20% that of conventional steel bearings. Silicon nitride is also an acceptable non-magnetic material option. It offers high hardness and excellent wear resistance.

CORROSION RESISTANCE

440C stainless steel offers superior corrosion resistance over 52100 steel. While its corrosion resistance is adequate for most applications, more extreme environments such as seawater and corrosive chemicals or gases require alternate materials. In these situations, materials with high corrosion resistance such as 17-4 PH, Silicon Nitride or UNS N10276 nickel-molybdenum-chromium alloy are required for the rings and balls. Both 17-4 and UNS N10276 have hardness limitations. Care should be taken in selecting a bearing with the appropriate load capacity. Available retainer materials include PTFE, PEEK, 300 series stainless steel and Nylon 6/6. Timken engineers can assist with selection of the most appropriate materials for applications where corrosion resistance is a concern.

CORROSION RESISTANT MATERIALS		
Rings	Balls	Retainer
-17-4 PH	-17-4 PH	-PTFE
-Silicon Nitride	-Silicon Nitride	-PEEK
-UNS N10276		-300 series stainless steel
		-Nylon 6/6

