CHAMPION BEARING, INC.

Ceramic Ball Bearing Performance Tests

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A New Ball Bearing

INTRODUCTION:

Want to save a *million barrels of petroleum a day by simply changing to a more efficient ball bearing in machinery? Sounds too good to be true, but it's possible with new materials available today.

Tribology – The science of friction and wear.

If we look at the surface finish of a metal ball or race very closely, peaks and valleys appear over these surfaces. It is the job of fluid lubricants to fill-in these valleys with an incompressible fluid such as oil and grease, to prevent peaks on a ball from contacting peaks on a race. If contact occurs, the area of contact is so small that a pressure of over 1 million pounds per square inch occurs with a small force on the ball or race. This pressure causes cold welding between the ball and race which is easily broken by the inertia of the system but causes heat. This condition, if allowed to repeat itself, causes failure of the fluid lubricant which heats up further and eventually causes failure of the bearing.

Ceramics (silicon nitride or zirconia) overcome this problem by eliminating cold welding. Ceramic balls can't weld to ceramic races. Ceramic bearings with ceramic balls and races do not require oil or grease.

These concepts when applied to the ceramic ball bearing result in:

1. Longer life.
2. Reduction in energy consumption.
3. Ability to operate in extreme environment and temperatures.

TESTING - Comparison tests were made between several all-metal bearings. They were tested and compared to a Teflon sealed (non contact) bearing with Teflon retainer, zirconia race and silicon nitride balls i.e. an all ceramic bearing. The attached photo shows the test figure which was taken up to 5000 rpm with an external drive which was disengaged. Time and rpm were recorded with a digital cameral. Bearings tested were ¼ in. I.D x 5/8 in. O.D; ABEC 1. Each bearing was tested using the same apparatus and procedure.

Bearing #1

CR4LL; zirconia races, S13N4 balls, Teflon retainer and labyrinth seals (see Sketch Page 2 of patent pending).

Bearing #2

SR42RS; stainless steel races and balls, rubber seals, ribbon retainer, 30% fill SRI grease.

Bearing #3

Hybrid with S13N4 balls, stainless races, crown steel retainer, Champion Dry Film Lubricant, No seals or shields.

Bearing #4

All stainless except slug retainer, 1/16 in. dia. balls, shielded.

Bearing #5

The same as #2 except shields.

The angular deceleration is the slope of the speed vs. time graph. The rotational inertia of the flywheel was calculated from dimensions and masses of the system to be 2750 grams-square centimeters. Torque and power loss are readily calculated from these quantities. A graph of torque vs. rpm was constructed (see graph 2). A graph of power vs. rpm was then constructed (see graph 3). At 3000 rpm the ceramic bearing saved 1.25 watts of power. If this is an average bearing running 8 Hours/Day, 7 Days/Week, 52 Weeks/Year, there would be a savings of 1.3 millions barrels of oil/day This is based on a Federal Trade Commission Report stating there are 600 million bearings in use in the United States.

As a real life test the same SR4 (1/4 in. I.D. x 5/8 in. O.D.) size bearings were installed in several electric motors.** Replacement of stock bearings with ceramic resulted in a drop in current draw of 10-12%.

Further tests of larger diameter ball bearings are in progress and results are available at www.championballbearings.com or through our e-mail at hybridbearings@aol.com.
DC motor, P.N. 537A133 (30.3 D.C. volts)

SUMMARY of RESULTS –

Ball bearings consisting of ceramic rings, ceramic balls and Teflon retainer offer tremendous energy savings.
(See attached graphs 1-3 and chart 1)

CONCLUSION

A popular misconception is that by adding grease or oil to a ball bearing it will go faster when in reality the opposite is true. It will slow it down. Why? To put it simply, "kinematic viscosity."

Mechanical engineers are continually bombarded with data on various types of oil and grease lubricants for use in a variety of machines and of course, ball bearings. All this data is superfluous with respect to ceramic ball bearings. No metal-to-metal contact means no oil or grease. Ceramics are lighter than steel with a lower coefficient of friction and little thermal expansion. Ceramics mean higher speeds, hardness, durability and they never rust; ceramics are resistant to acids, alkali and salt. **Champion** offers three types of ceramics, alumina, silicon nitride and zirconia, in both races and balls. Retainers and seals can be Teflon, peek or steel. (All sizes are available/See our web site.)

***Data and assumptions are as follows:**

1 Barrel of Oil= 5,800,000 BTU.

The "average" ball bearing is ¼ in. I.D. x 5/8 in. O,D.

The "average" ball bearing is used 8 Hours/Day, 7 Days/Week, 52 Weeks/Year.

**DC motor P.N. 537A133 (30.3 D.C. volts).

¼ in. x 5/8 in. Ball Bearing

1. **Ceramic**
   Zirconia races, S13N4 balls, Teflon retainer, Labyrinth non-contact seals.

2. **SR42RS**
   440C races, ribbon retainer, BUNA N rubble seals, 30% fill SRI grease.
   8 in. x 3/32 in. Dia. Stainless Steel balls.

3. **Hybrid**
   S13N4, 8 in. x 3/32 in. dia. Ceramic, 440c races and retainer, no lubricant.
   Champion coated (T-7) races, crown retainer. Open – no seals or shields.

4. **Small ball**
   440c stainless steel, slug retainers 15 x 1mm, metal shields, light oil

5. **SR4ZZ**
   Same as #2 except metal shields.

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